Aluminum Conductor Carbon Fiber Core Reinforced (ACCR), C^7-TP, Manufactured by Southwire

Test Material

This test evaluated the performance of a Suwanee sized Aluminum Conductor Carbon Fiber Core Reinforced (ACCR), C^7-TP, conductor. The Southwire ACCR C^7-TP conductor evaluated was comprised of twenty-two trapezoidal shaped aluminum zirconium (Al-Zr) conductive strands around seven carbon fiber composite strands produced by Celanese. The outer diameter of the Southwire ACCR C^7-TP conductor was 1.108-inches (28.14-mm) with a conductive area of 995-kcmil (504.17-mm^2). The rated breaking strength of the Southwire ACCR C^7-TP conductor was 41,400-lbf (184.2-kN).

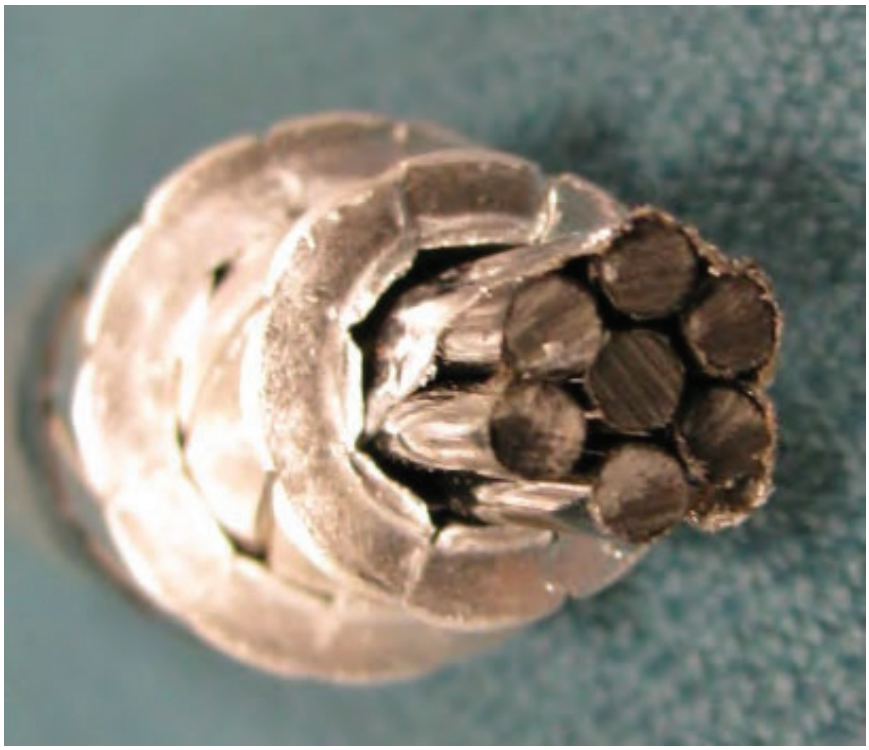

Figure 2-61. Southwire aluminum conductor carbon fiber core reinforced (ACCR), C^7-TP cross-section

Conductor Specific Test and Measurement Parameters

The test lines were initially tensioned to 25% RBS of the Southwire ACCR C^7-TP conductor and then re-tensioned to 25% RBS if the line tension dropped below 20% RBS at ambient temperature. The lines were heated to the manufacturer defined maximum continuous operating temperature of 180°C for two hours and then were passively cooled to near ambient temperature. Resistance measurements were taken every 150-300 cycles.

Results

Both Lines 2 & 3 were tensioned at 25% the initial RBS of the Southwire ACCR C^7-TP conductor, 11,500 lbs, at the beginning of the thermal mechanical cycles. During the initial cycles, both test lines saw an increase in the tension, then at approximately 100 cycles, the tension in both lines dropped below 25% RBS of the Southwire ACCR C^7-TP conductor and stayed in a narrow tension range during the 1500 cycles. Neither Line 2 nor Line 3 was re-tensioned during the thermal mechanical cycles.

Thermal Performance

Through the 1500 cycles, the connector temperature operated below the Southwire ACCR C^7-TP conductor temperature. On average, the interface temperatures, where the connector and conductor meet, ran 74°C less than the average Southwire ACCR C^7-TP conductor reference temperature. On average, the connectors at 25% of the body length from the end of the aluminum body measured 93°C less than the Southwire ACCR C^7-TP conductor reference temperature.

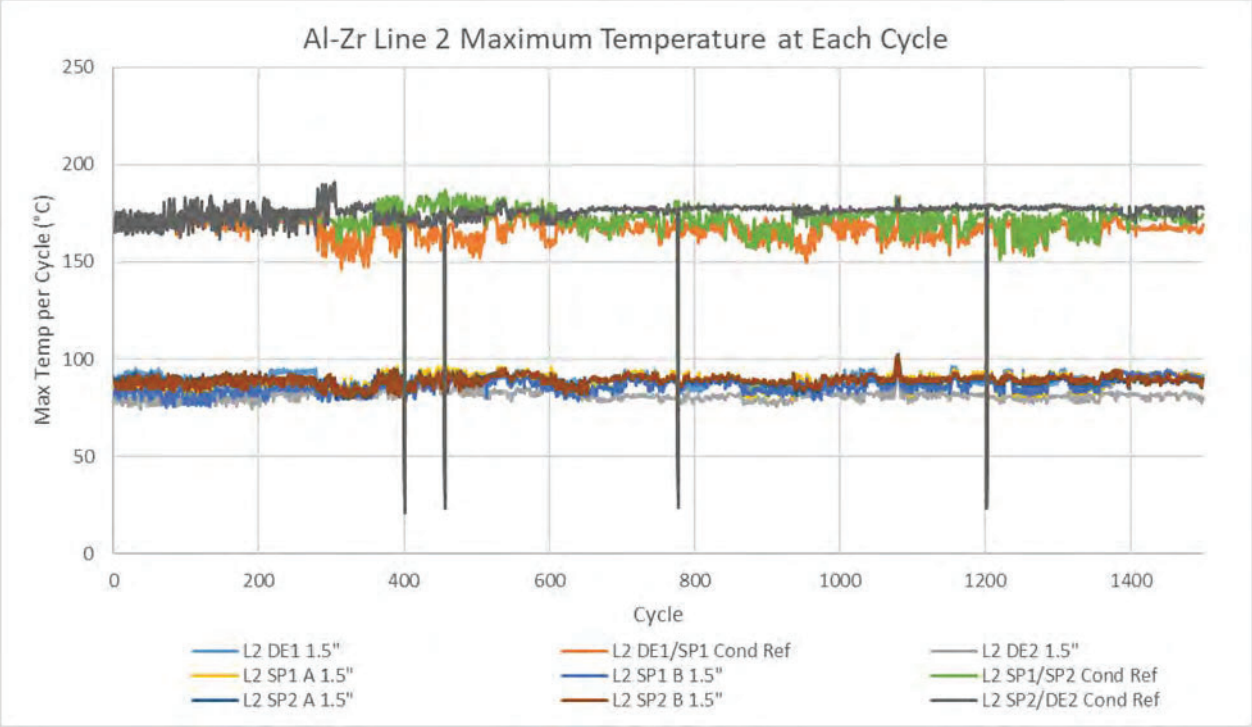

Figure 2-62. ACCR C^7-TP Line 2 maximum temperature at each cycle

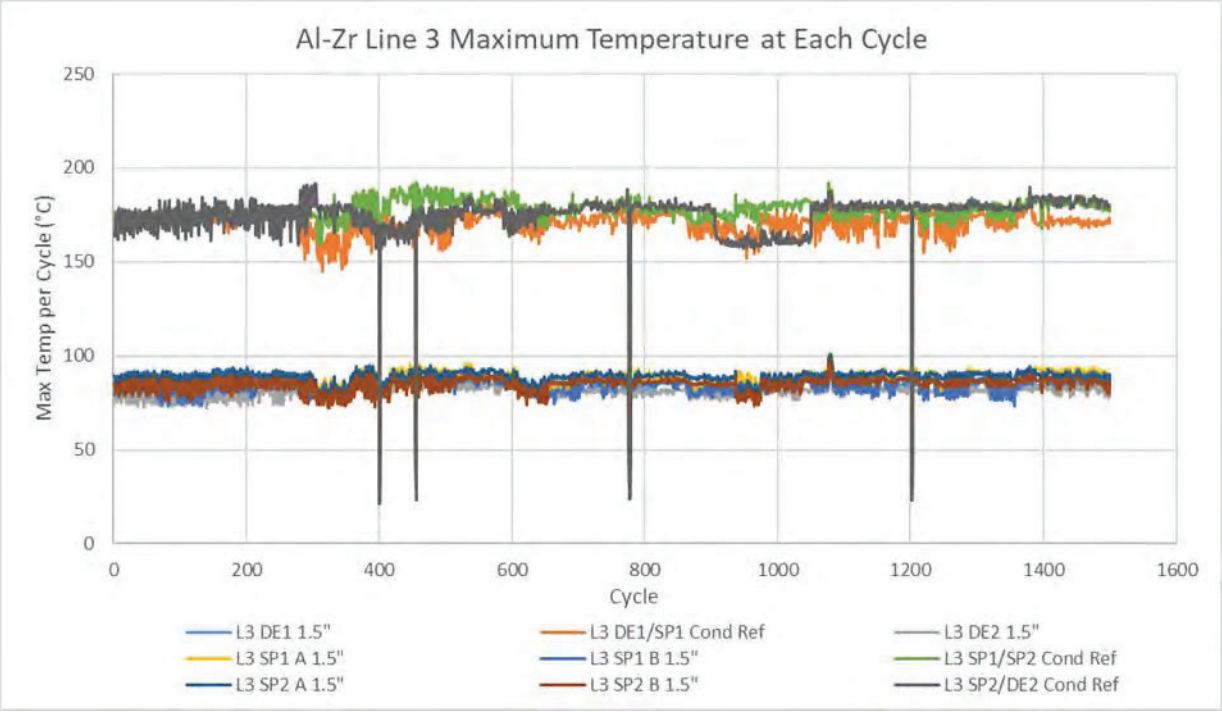

Figure 2-63. ACCR C[7]-TP Line 3 maximum temperature at each cycle

Electrical Performance

The resistance ratios, the connector resistance over the conductor resistance, for Line 2 and Line 3 stayed at or below 0.4, indicating healthy connectors.

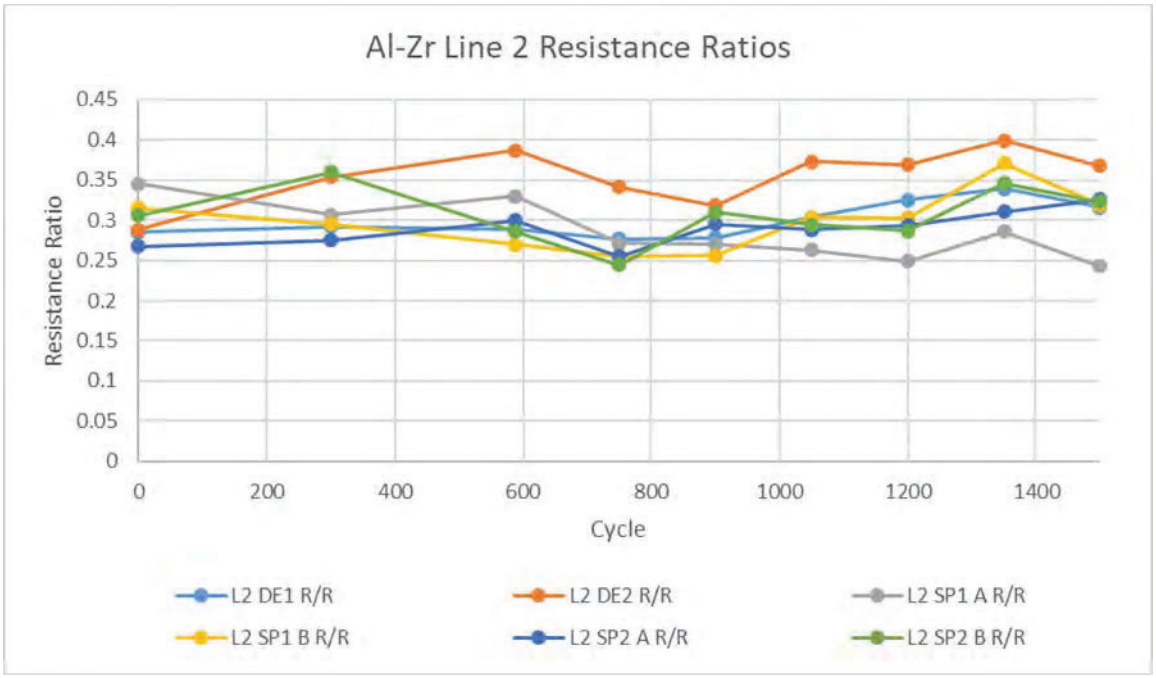

Figure 2-64. ACCR C[7]-TP Line 2 resistance ratios throughout thermal cycling process

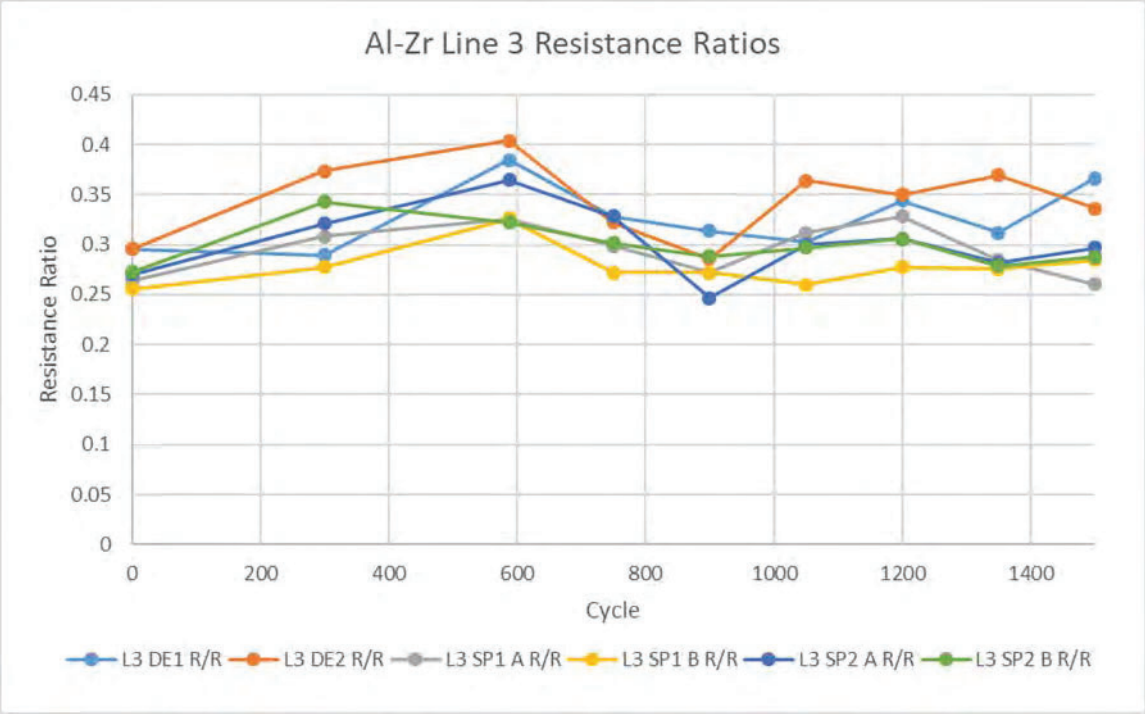

Figure 2-65. ACCR C^7-TP Line 3 resistance ratios throughout thermal cycling process

Mechanical Performance

At the beginning of the thermal mechanical testing, the RBS of the C^7 Aluminum-Zirconium ACCR conductor/connector systems was 46,000 lbs. During a separate qualification test that EPRI was performing, it was determined that this RBS was not conservative enough for the Southwire ACCR C^7-TP conductor/connector systems, and it was lowered to 41,400 lbs. All the aged Southwire ACCR C^7-TP conductor/connector samples and all the control samples failed the original acceptance criteria of 95% RBS of 46,00 lbs (43,700 lbs). With the adjustment of the RBS, only two of the aged splice samples and two control splice samples failed the new acceptance criteria of 39,300 lbs.

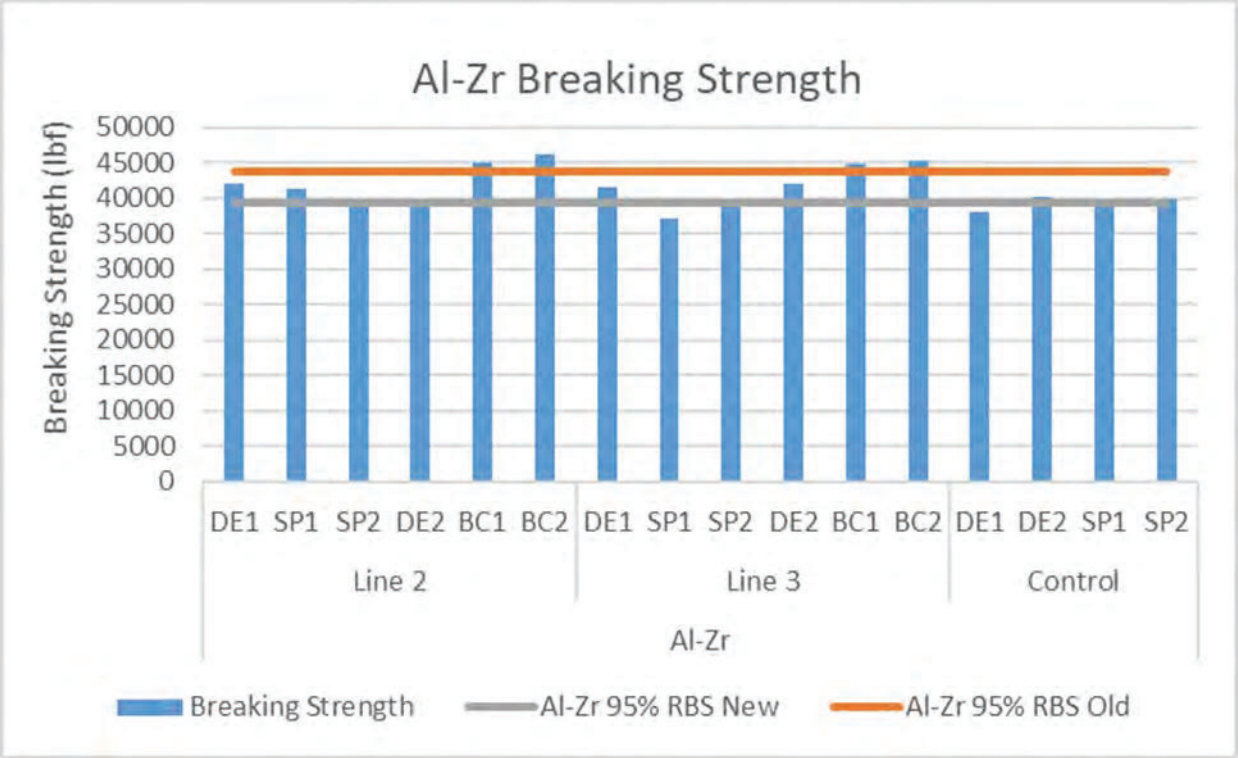

Figure 2-66. ACCR C[7]-TP breaking strength for conductor/connector samples

Table 2-7. Summary of ACCR C[7]-TP breaking strengths

Component	Breaking Strength
Line 2 Dead-end 1	42155
Line 2 Splice 1	41316
Line 2 Splice 2	39394
Line 2 Dead-end 2	40039
Line 2 Bare Conductor 1	45106
Line 2 Bare Conductor 2	46238
Line 3 Dead-end 1	41503
Line 3 Splice1	37204
Line 3 Splice 2	38959
Line 3 Dead-end 2	42117
Line 3 Bare Conductor 1	44812
Line 3 Bare Conductor 2	45433
Control Dead-end 1	38081

Control Dead-end 2	40229
Control Splice 1	39297
Control Splice 2	39873