Aluminum Strand UTS for TS Ruddy M3 8.5 1098.6 kcmil Conductor

NEETRAC Project: 24-151

Final Report

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National Electric Energy Testing, Research, and Applications Center

Requested by: Idaho National Labs (INL)

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1.0 BACKGROUND

Aluminum strand ultimate tensile strength (UTS) testing evaluates the tensile strength and elongation of the conductor's aluminum strands. Idaho National Labs (INL) requested that NEETRAC perform aluminum strand UTS testing on multiple advanced transmission line conductors. This report covers control strand UTS testing for the TS Ruddy M3 8.5 1098.6 kcmil overhead conductor. Testing was performed in compliance with ASTM B609.

2.0 TEST SAMPLES

Only one complete conductor section was used for this test. This section of TS conductor was destranded with the conductor core set aside, while the inner and outer aluminum layers of the conductor were separated. The 24 aluminum strands from this conductor section comprised the test samples. "I" and "O" were included in each sample name to indicate which layer the strands came from ("I" for inner and "O" for outer).

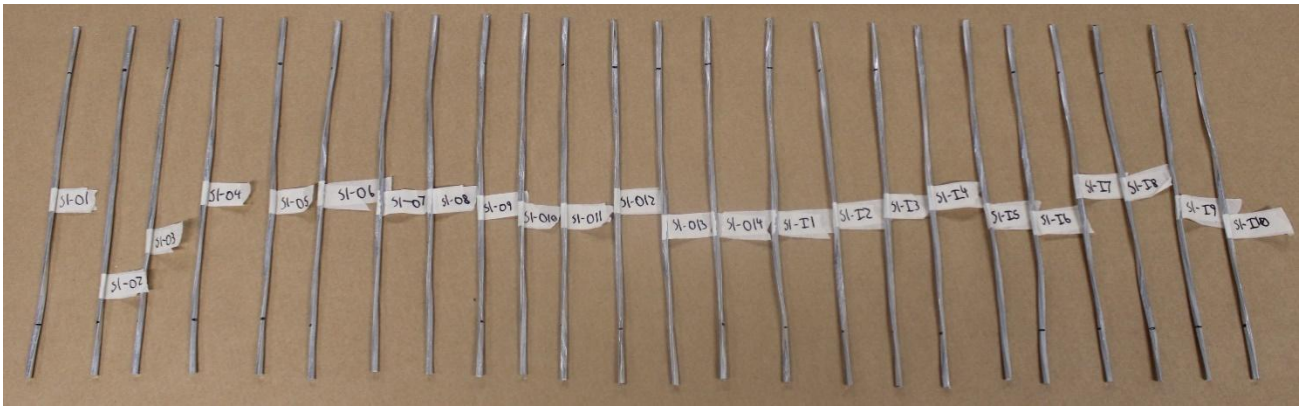

Figure 1: Test Samples Before UTS Testing

3.0 PROCEDURE

3.1 Area Calculations

After destranding, each sample was straightened and cut to a length of 24" with care given to make the cuts at a right angle to the sample's axis. It was at this length that precise length and weight measurements were taken. With each sample's length, weight, and density (the latter provided by ASTM 609), the cross-sectional area of each strand could be computed as follows:

$$Cross\ Sectional\ Area = Sample\ Mass/(Sample\ Length * ASTM\ B609\ Al\ Density)$$

3.2 UTS and Elongation

After the cross-sectional area was calculated for each sample, they were cut down to 14” and marked with a 10” gauge section. UTS testing was then performed in accordance with ASTM B609.

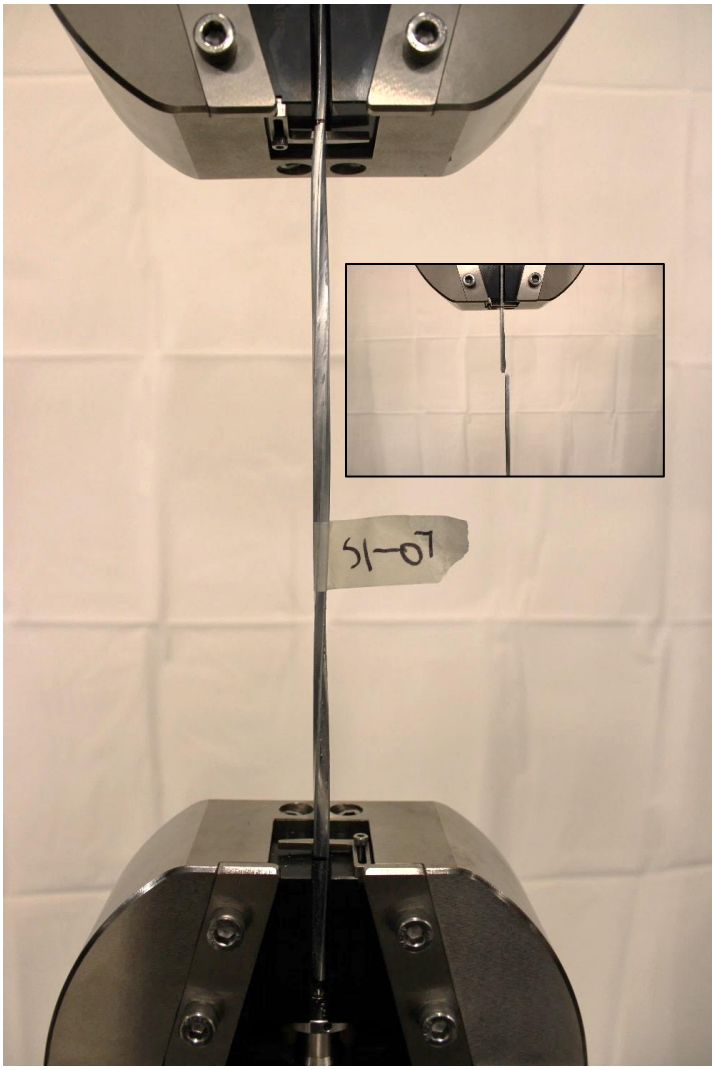

Figure 2: Sample mounted before testing. Inset: Typical ductile fracture.

4.0 RESULTS

ASTM B609 Table 3 states that O temper aluminum strands shall have a tensile strength between 8.5 ksi and 14.0 ksi. The tensile strength of each sample could be calculated using its breaking load and calculated cross sectional area. A summary of tensile strength results is shown in Figure 3. All samples met the requirement of ASTM B609.

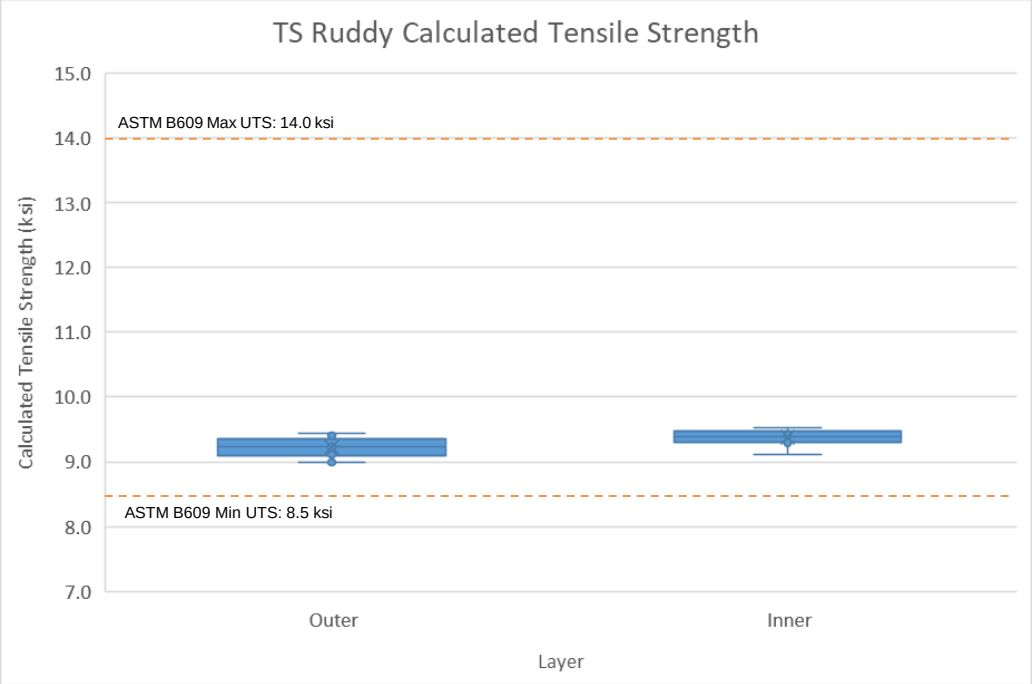

Figure 3: Tensile Strength Results for Both Al Layers

ASTM B609 does not provide criteria for sample elongation; however, elongation is presented in this report for reference only in Figure 4. O temper aluminum typically elongates 25% to 35%. Given the minor cold working that occurred during manufacturing (stranding) and straightening during destranding (at NEETRAC), the results are reasonable. Figure 5 shows a typical force-deflection curve that exhibits substantial elongation.

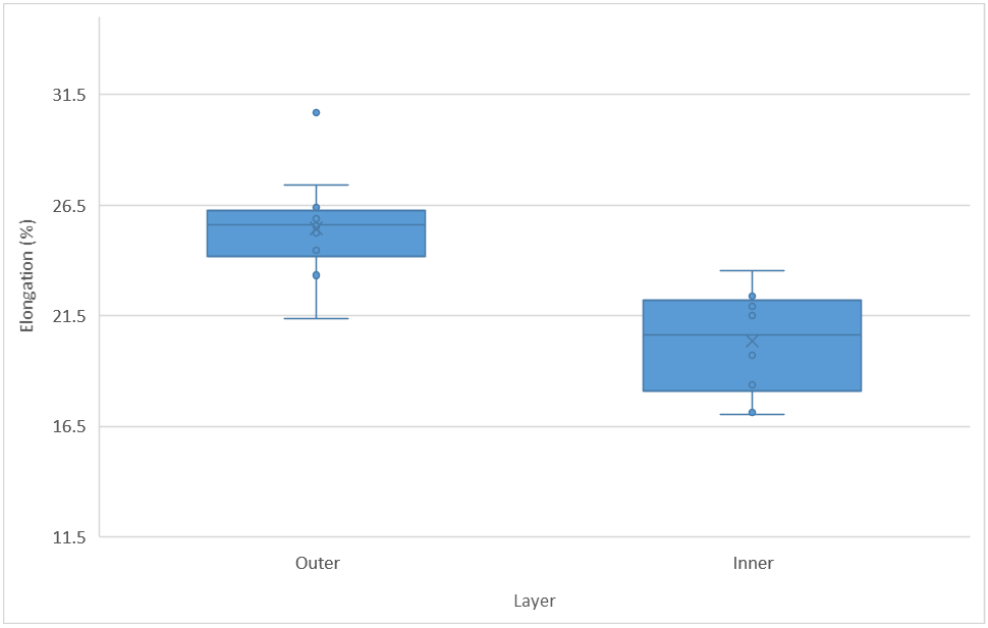

Figure 4: Percent Elongation Results for Both Al Layers

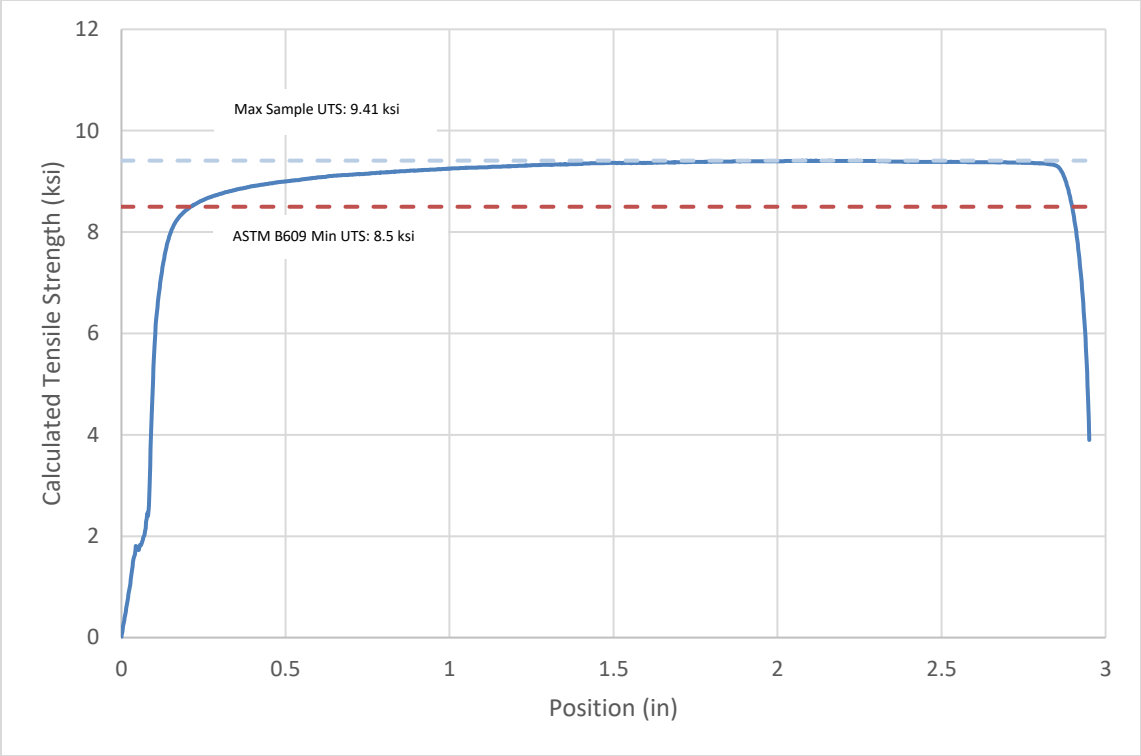

Figure 5: Sample S1-O4 Force-Deflection Curve, Typical of All Samples

5.0 EQUIPMENT

Tinius-Olsen UTM	CQ-0013
24” Digital Caliper	CQ-6733
Balance	CQ-7819

6.0 STANDARDS

ASTM B609/B609M Standard Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes