DC Resistance for Prysmian 1431 kcmil 39/19 Plover ACSS/TW/MA3/E3X Overhead Conductor

NEETRAC Project: 24-151

Final Report

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National Electric Energy Testing, Research, and Applications Center

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1.0 BACKGROUND

Idaho National Labs (INL) requested NEETRAC perform DC resistance tests on multiple advance transmission line conductors. This report is for Prysmian 1431 kcmil 39/19 Plover ACSS/TW/MA3/E3X overhead conductor.

DC resistance is easily measured by passing a known DC current through the conductor, and measuring the voltage drop over a defined length (4-wire measurement method). The DC resistance is defined as the ratio of the voltage to the current (V/I). Per industry practice, the measured DC resistance is corrected to a 20 °C reference temperature using industry standard resistance temperature coefficients.

2.0 TEST SAMPLE

A test sample was removed from a reel provided by the Electric Power Research Institute (EPRI) circa December 2025. The conductor is identified Prysmian 1431 kcmil 39/19 Plover ACSS/TW/MA3/E3X. Table 1 shows the resistance and ampacity values per the manufacturer.

Table 1 Prysmian "Plover" ACSS/TW/MA3/E3X Manufacturer's Specifications

Component Description	Property	Value[1]			Unit
		Min.	Nom.	Max.	
Core: MA3 Steel	Individual Wire Diameter	0.09570	0.09770	0.09970	in
High Strength Class A Zinc-5% Mischmetal Alloy Coated Steel	Diameter	--	0.4885	--	in
	Area	--	0.1424	--	in²
19 Wires	Weight (mass)[2]	--	484.4	--	lb/kft
ASTM B803 Latest Edition	Rated Breaking Strength[3]	32800	--	--	lb
Outer: 1350-O Aluminum	Equiv. Individual Wire Diameter	-	0.1916	-	in
Trapezoidal Shaped Annealed Aluminum	Area	1.101	1.124	1.146	in²
39 Wires	Weight (mass)[2]	--	1352	--	lb/kft
ASTM B609 Latest Edition	Rated Breaking Strength[3]	9180	--	--	lb
Overall: PLOVER/ACSS/TW/MA3/E3X	Diameter	1.324	1.337	1.350	in
Aluminum Conductor, Steel Supported (Trapezoidal)	Area	--	1.267	--	in²
ASTM B857 Latest Edition	Weight (mass)[2]	--	1838	--	lb/kft
E3X Conductor Coating	Rated Breaking Strength[3]	41900	--	--	lb
Electrical Properties[4]	dc Resistance at 20 °C[2]	--	0.0116	--	Ω/kft
	ac Resistance at 25 °C[2]	--	0.0124	--	Ω/kft
	ac Resistance at 75 °C[2]	--	0.0152	--	Ω/kft
	ac Resistance at 150 °C[2]	--	0.0192	--	Ω/kft
	ac Resistance at 250 °C[2]	--	0.0245	--	Ω/kft
	Inductive Reactance (XL)	--	0.0711	--	Ω/kft
	Capacitive Reactance (XC)	--	0.452	--	MΩ-kft
	Geometric Mean Radius (GMR)	--	0.0454	--	ft
Surface Properties[5]	Emissivity	--	0.9	--	--
	Absorptivity	--	0.2	--	--

3.0 PROCEDURE

A bolted clamp (see Figure 1) was applied at each end of the 25-ft sample before cutting the sample from the reel. This preserves the as-manufactured position and pre-stress of each strand and each layer. All strands, including the aluminum core sheath, were puddle-welded into an aluminum plate that ensures balanced current flow to each strand for a 4-wire DC resistance measurement.

Voltage terminals were applied inboard of the current terminals. Per industry practice, a length of #20 AWG solid copper wire is wrapped around the conductor and the ends twisted to form an electrical connection used as voltage terminals. The location of the voltage terminals defines the gage section over which the resistance is measured. The voltage leads from the digital low resistance ohmmeter (DLRO) are connected to the voltage terminals of the conductor sample. The distance between the copper terminals is measured using a metal tape to establish the gage section.

The DLRO employs a four-wire measurement method, where the current is applied at the equalizers located at each end of the sample, and the voltage is measured between the voltage terminals. Three readings were recorded with the current direction in a nominally positive polarity, and three measurements with the polarity reversed. No sensitivity to current direction was noted, and all readings were repeatable within the 0.0001 mΩ sensitivity of the DLRO. After each reading, the conductor temperature was measured to provide the temperature data to normalize the resistance value to the industry-standard 20 °C reference. Figure 1 shows the four-wire test used to measure DC resistance.

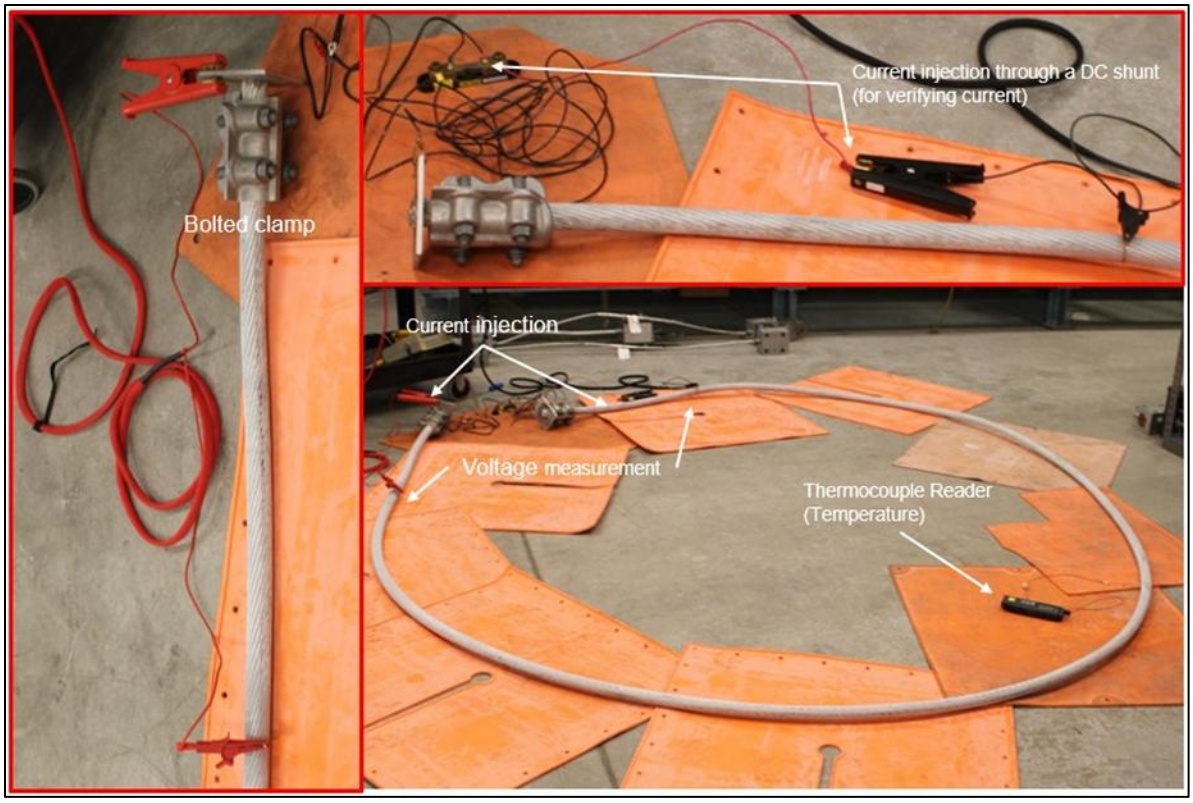

Figure 1 Four-wire measurement

4.0 RESULTS

Table 2 shows the DC resistance measurement taken, R-20 adjusted resistances using a coefficient of 0.00416 ohm/degree-C, and a comparison against the manufacturer's specification of 0.0116 ohm/1000 ft. The average of all measurements is 0.0116 ohm/1000 ft. and the manufacturer's specified resistance was higher than the 95% confidence interval upper bound for the data, as seen in Figure 2.

Table 2 Resistance Values and Conversions

Measured Resistance @ Temperature (mΩ)	Current (amps)	Current Direction	Cond Temperature (°C)	Resistance @ 20 °C (mΩ)	Test Section (ft)	DC Resistance Reading (Ω/1000ft)	Specification (Ω/1000ft)
0.0002779	10.00	(+)	22.3	0.0002753	23.74	0.0116	0.0116
0.0002776	10.00	(+)	22.6	0.0002746	23.74	0.0116	0.0116
0.0002773	10.00	(+)	22.3	0.0002747	23.74	0.0116	0.0116
0.0002776	10.00	(-)	22.3	0.0002750	23.74	0.0116	0.0116
0.0002773	10.00	(-)	22.3	0.0002747	23.74	0.0116	0.0116
0.0002773	10.00	(-)	22.3	0.0002747	23.74	0.0116	0.0116

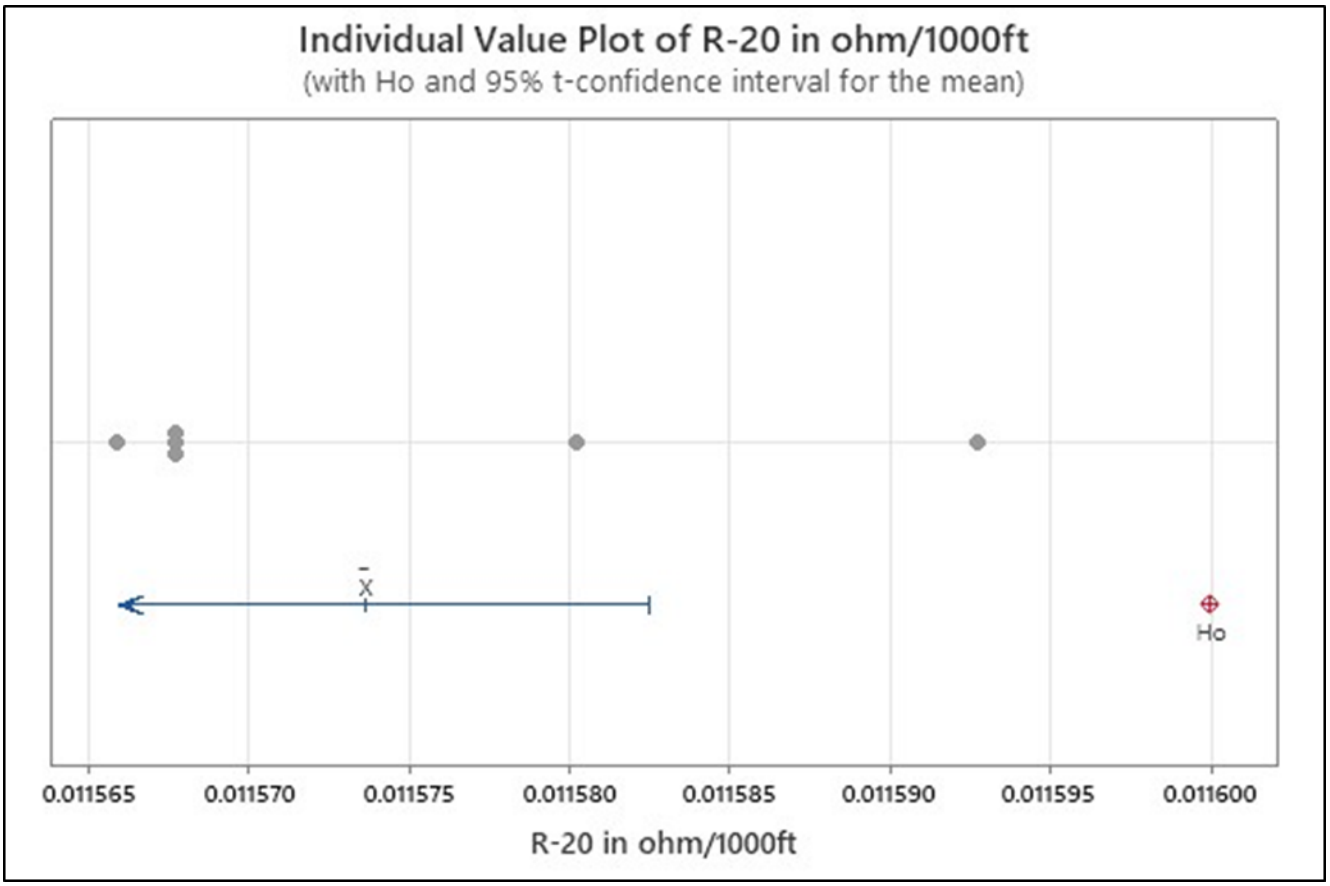

Figure 2 Individual Value Plot R-20

5.0 CONCLUSIONS

All six DC resistance measurements met the manufacture's provided specifications.

6.0 EQUIPMENT

VALHALLA Digital Low Resistance Ohmmeter, calibration control #CQ2209

Hewlett Packard 3468A Digital Multimeter, calibration control # CQ0106

OMEGA HH378 Thermocouple Reader, calibration control # CQ6766

Impro Calibration Reference Resistor, 499.478046 μΩ, calibration control number CN7844