

Sag Calculation Errors at High Temperatures

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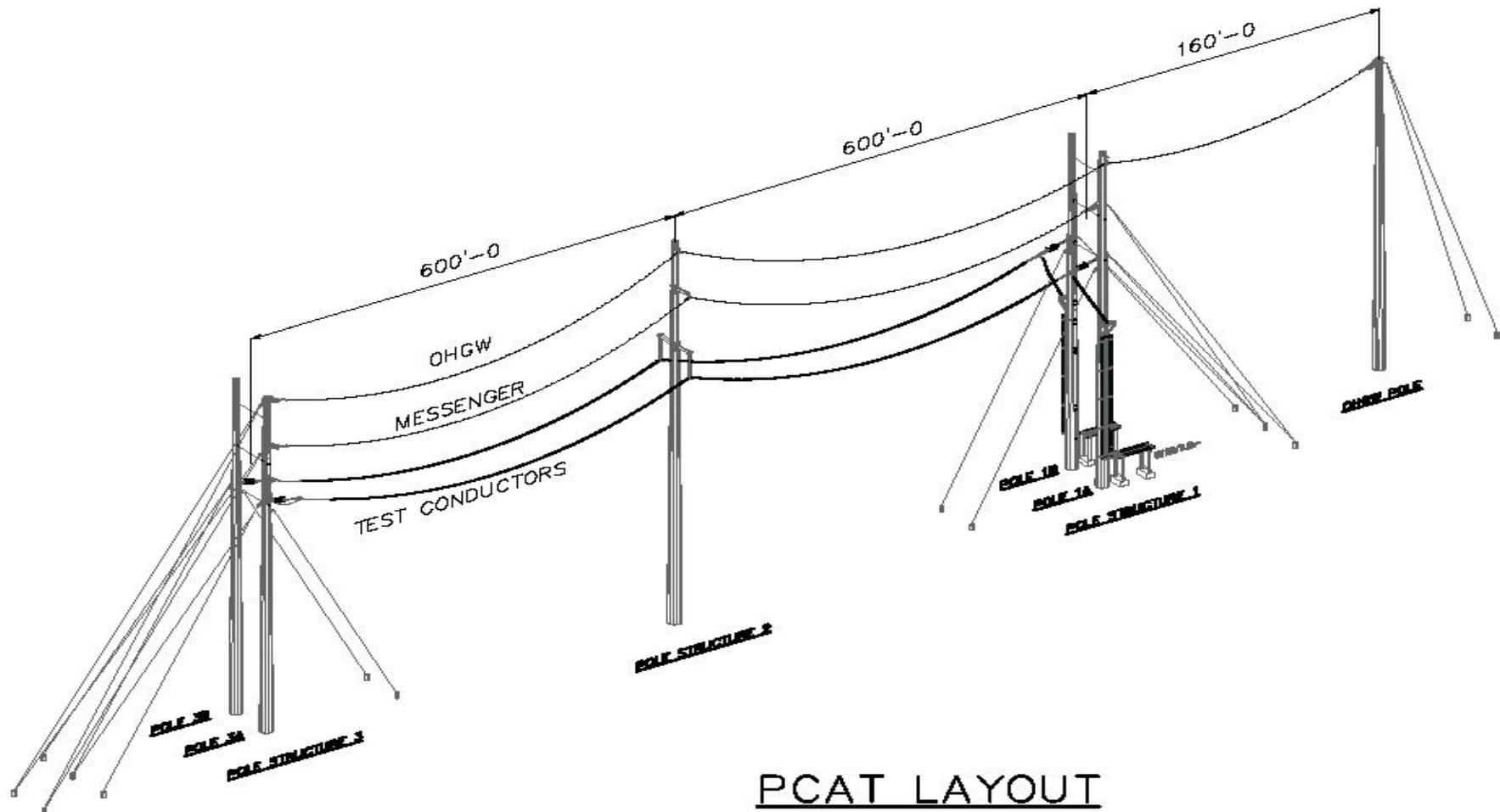
The Valley Group- a Nexans Company

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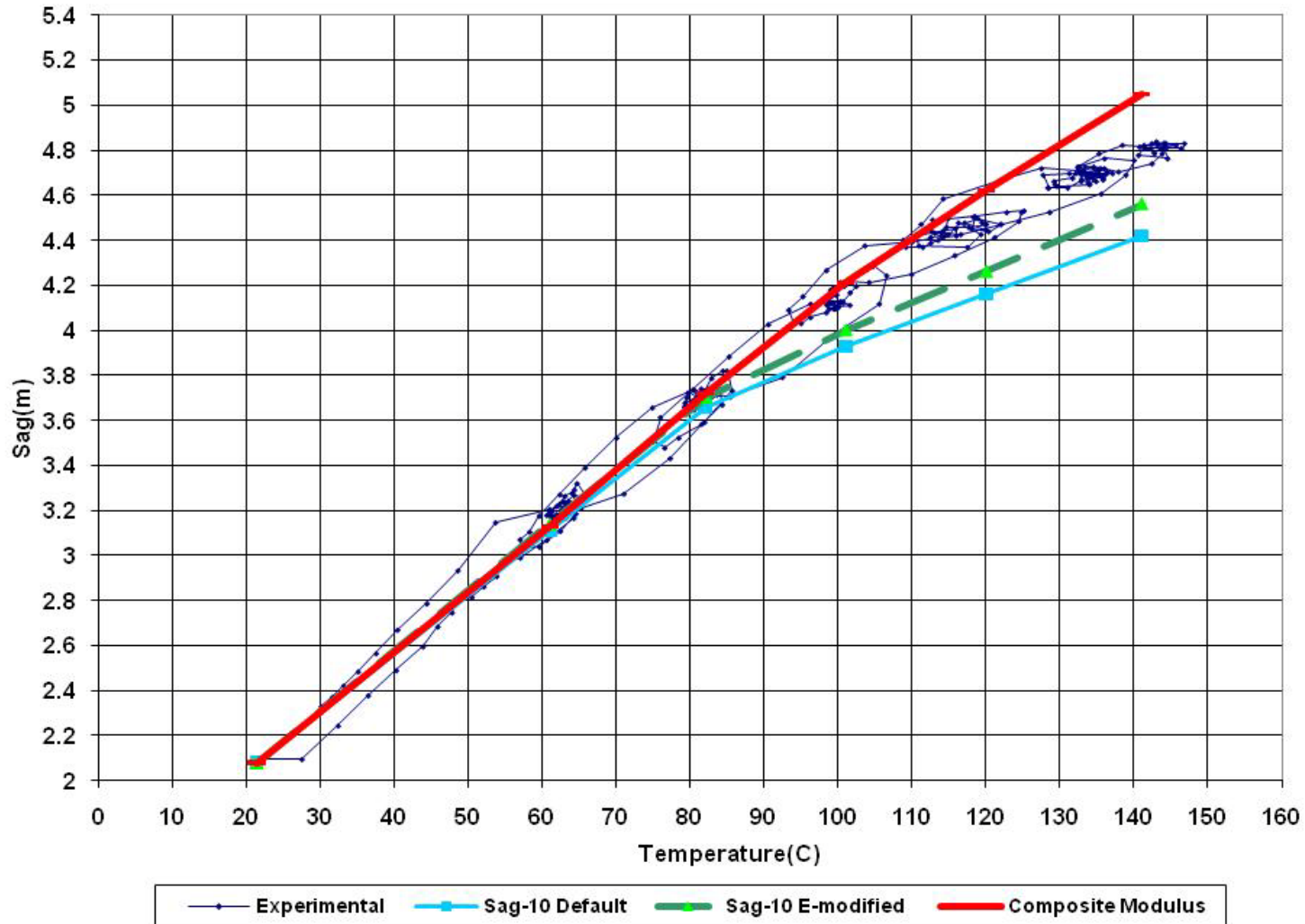
ORNL Test Line



PCAT LAYOUT

- **Drake conductor had been prestressed to eliminate creep during tests (38% of RBS overnight at 18 C)**
- **Final tension 31.6 kN (22.6% of RBS at 21 C)**
- **The average temperature of the line is measured with thermocouples at ends, midpoints and quarter-points of spans.**
- **In this test, temperature is increased in steps to 60, 80, 100, 120, 140 and 150 C and held at each level for 60 minutes, then reduced with same steps.**
- **Conductor tension and sags are measured at 5 minute intervals.**

ORNL - ACSR "DRAKE" Sag vs Temperature, 180m R.S. Port 1 - Roadside, June 18, 2010



Findings

- **Knee region is much higher than anticipated by graphic method and sag calculation programs based on it (100-120 C vs. 75-80 C)**
- **Above knee region the sags appear to increase more than that calculated using properties of steel core only.**
- **This means that present line design programs are likely to underestimate high temperature ACSR sags, even if corrected with proper high temperature elastic modulus.**
- **Real-time rating methods based on temperature measurement only will also seriously underestimate actual high temperature sags.**
- **There is significant hysteresis; sags with increasing temperatures are less than sags with decreasing temperatures.**
- **Possible explanation could be gravity effects ignored by the graphic method and its derivatives; aluminum and steel components remain interlocked until the relative stress in the aluminum-steel interface exceeds the weight of aluminum times friction coefficient.**
- **More details later in a full report of tests.**