

15kV Cable Development Project Summary

August 19, 2026
NSRP Meeting, Schweitzer Engineering Laboratories (SEL)



Marmon Aerospace
& Defense Group

A Berkshire Hathaway Company



15kV Cable Development Project Plan



Marmon Aerospace
& Defense Group

Goal: Design, build and test 1C 400MCM shielded and jacketed cable rated to 15kV

Key attributes:

- In accordance with MIL-DTL-24643D general requirements
- Circuit integrity using gas flame testing
- Zero Halogen Materials
- Waterblocked
- Flexible to withstand typical installation practices and routings

Scope:

- Design, Manufacture, and Test.
- Thermoset insulation types XL-EPR and Silicone Rubber to be evaluated
- Test and evaluate:
 - 3-hour circuit integrity (Gas Flame Test)
 - Partial Discharge
 - Waterblocking
 - Perform Scope of M24643/86 (5kV) test requirements

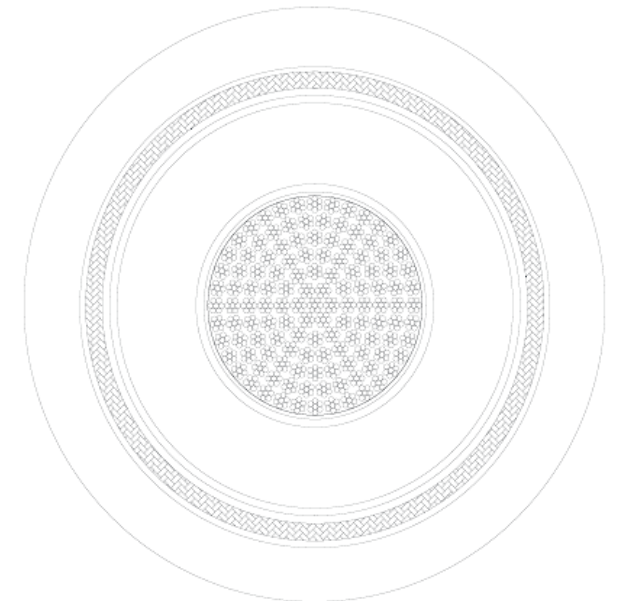
15kV Cable Development Project



Marmon Aerospace
& Defense Group

Routing:

- Conductor mfg using 7-strand blocked conductor components, ASTM Class I (24 AWG)
- Semiconductive Tape directly over the conductor
- Extruded Insulation over the Semi-con
- Mold cure or HAV crosslinking
- Silicone-fiberglass and additional semi-conductive tapes
- Braided Shield
- Polyester Tapewrap (substituted Mica-Fiberglass*)
- LSZH XLPO jacket
- Mold cure crosslinking
- Test, test, test



*Mica-Fiberglass tape provides increased flame resistance

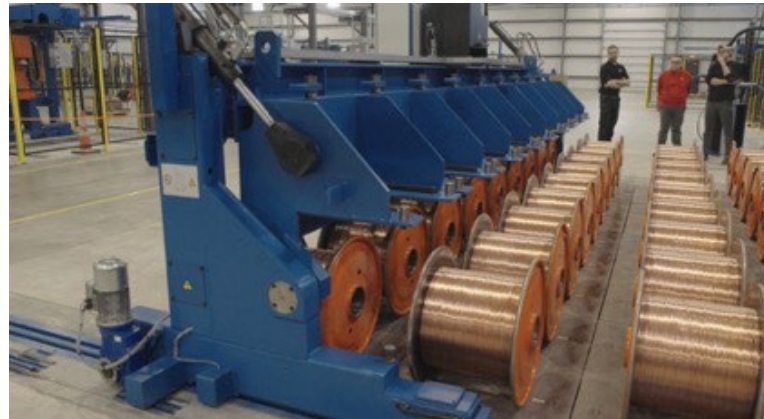
15kV Cable Development Project



Marmon Aerospace
& Defense Group

Conductor:

- Most significant contributor to cable flexibility
- Manufacture with 7 strands X 127 groups equals 889 total strands
- Water-blocked strands
- Results:
 - Much improved flexibility vs. standard 127 strand
 - Excellent water-blocking
 - Slightly higher conductor resistance (DCR)
Tradeoff between DCR and Diameter



15kV Cable Development Project

Manufacturing / Design / Testing Issues / Items of Interest

- Novel approach using 7-strand conductor components presented no processing issues
- Semiconductive tape leaked acrylic component when wrapped / heated
- Overheating of power source for Gas Flame test at SWRI resulted in 33-minute test / 5-minute cool-down cycles but did not affect the outcome of testing
- Several partial discharge testing issues occurred which were overcome



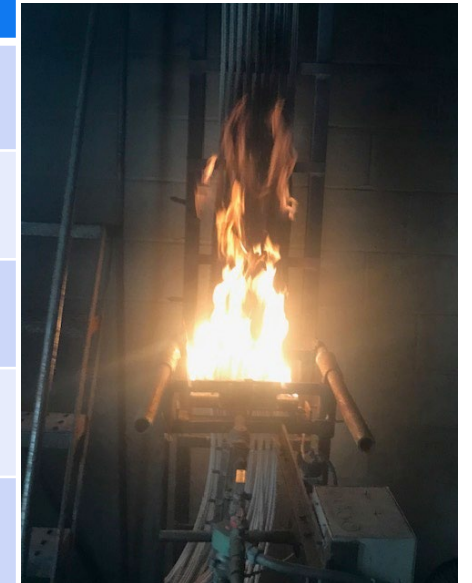
15kV Cable Development Project



Marmon Aerospace
& Defense Group

Physical / Electrical Test Results – Conductor and Primary Insulation

Test	DN Spec Requirement	/86 (5kV) Requirement	Actual Result	Comments
Conductor Resistance (DCR)	0.0273 Ω /kft	0.0273 Ω /kft	0.0292 Ω /kft	6.5% Higher than target
Conductor Diameter	0.810"	0.750"	0.786"	5.8% larger than standard 127 strand
Conductor Water-Blocking	N/A	N/A	0.050 in ³	Almost zero leakage through the conductor
Insulation Wall Thickness	0.175" Min. Average	0.175" Min Avg 0.158" Min.	0.215" Nom. 0.185" Min.	slightly larger than min avg and min point
Insulation Diameter	1.180"	N/A	1.185"	Right on target



All other basic electricals / visual and dimensional tests were acceptable or exceeded existing specifications

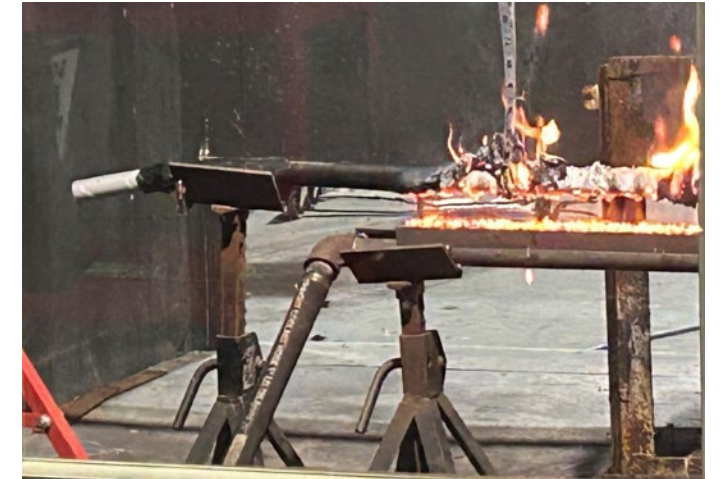
15kV Cable Development Project



Marmon Aerospace
& Defense Group

Cable Performance Test Results

Test	/86 (5kV) Requirement	Actual Result	Comments
Cable Water-Blocking	27 in ³	2 in ³	One sample failed due to conductor to tape leak path
Gas Flame Test	3-hr at rated voltage	EPR Pass / Silicone Fail	EPR sample passed easily, particular grade of silicone did not do well
Flame Propagation	UL 1685	Pass	Both samples easily passed, substituted MG tape for Mylar
Partial Discharge (Corona)	5pC max at 15kV RMS	5pC at 7kV	Attributed to taped semiconductor, extruded semiconductor expected to perform much better



All other Group A, B, C and qualification tests meet or exceed existing specifications

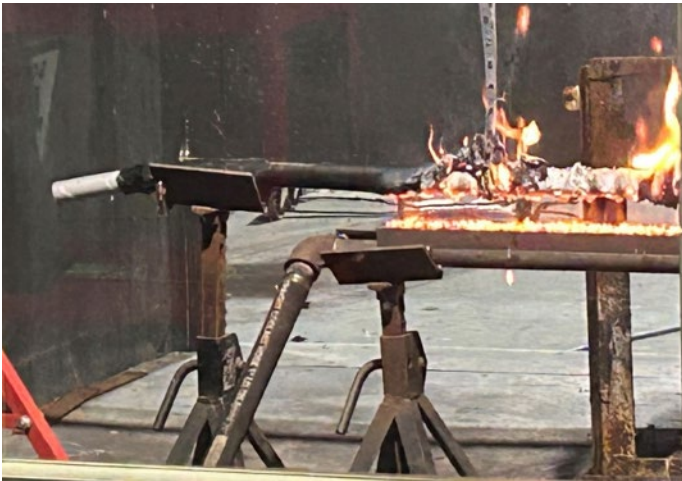
15kV Cable Development Project



Marmon Aerospace
& Defense Group

Circuit Integrity Testing at SWRI

- Silicone Rubber and EPR samples both tested
- Silicone Rubber performed surprisingly poorly while EPR sample performed extremely well



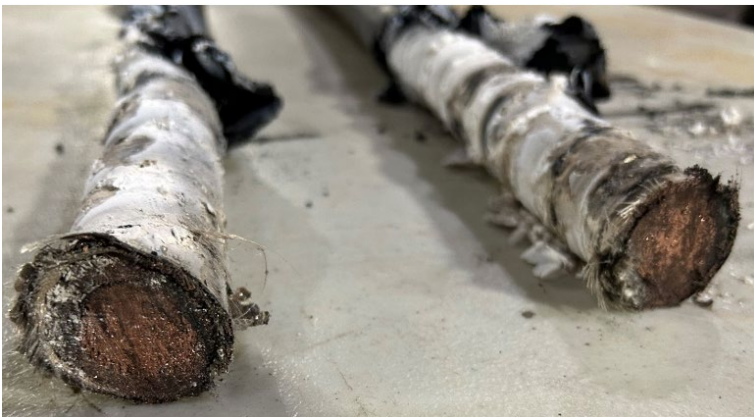
15kV Cable Development Project



Marmon Aerospace
& Defense Group

Conclusions / Lessons Learned

- 15kV and other large NAVSEA specified cables can meet waterblocking standards with fine strand, increasing flexibility and ease of installation
- Finely stranded conductors can meet existing diameter specs OR conductor resistance, but not both
- Semiconductive tape directly over conductor results in partial discharge extinction at low unacceptable voltage
- EPR insulated cables in this case outperformed silicone rubber insulated cable in circuit integrity / gas flame tests and met existing 3-hr tests along with flame propagation



15kV Cable Development Project

Recommendations for further Development

- Continue 15kV development using extruded XL EPR as primary insulation layer
- Decision to be made on conductor type used:
 - Diameter / Resistance /Flexibility concerns to be decided upon
- Produce and test new sample with extruded semiconductive layer to improve partial discharge results
- Produce and test 3-conductor 400MCM 15kV cable
- After testing above, draft new M24643 slant sheet for 1 and 3-conductor 15kV cables (/87?)



Marmon Aerospace
& Defense Group

Thank You!