15kV Cable Development Project Update

August 13, 2025
NSRP Meeting
Manchester, NH

Marmon Aerospace & Defense Group
A Berkshire Hathaway Company

15kV Cable Development Project Plan

Marmon Aerospace & Defense Group

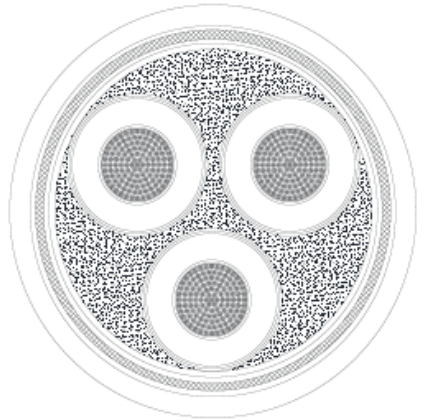
Goal: Design, build and test 3C 400MCM cable rated to 15kV

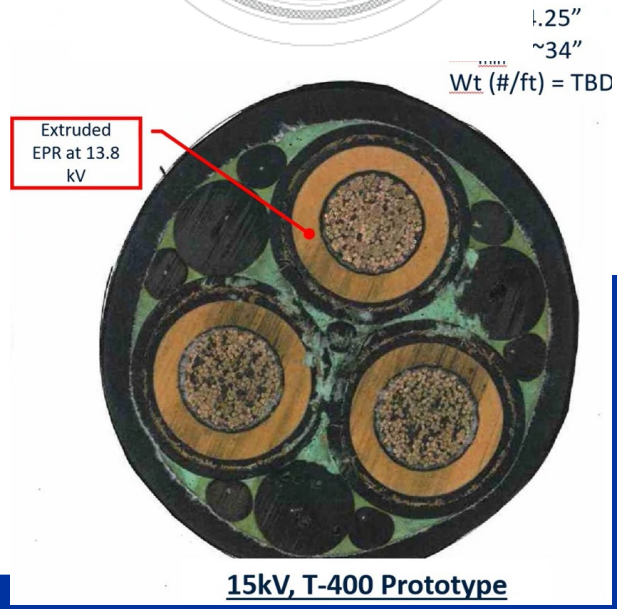
Key attributes:
- In accordance with MIL-DTL-24643D general requirements
- Circuit integrity using gas flame testing
- Zero Halogen Materials
- Waterblocked
- Flexible to withstand typical installation practices and routings

Milestones:

Phase 1 – Development of single conductor insulated 15kV primary wire
- Design, mfr, test

Phase 2 – Development of 3-conductor 15kV cable using above primary wire
- Design, mfr, test





15kV, T-400 Prototype

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Phase 1

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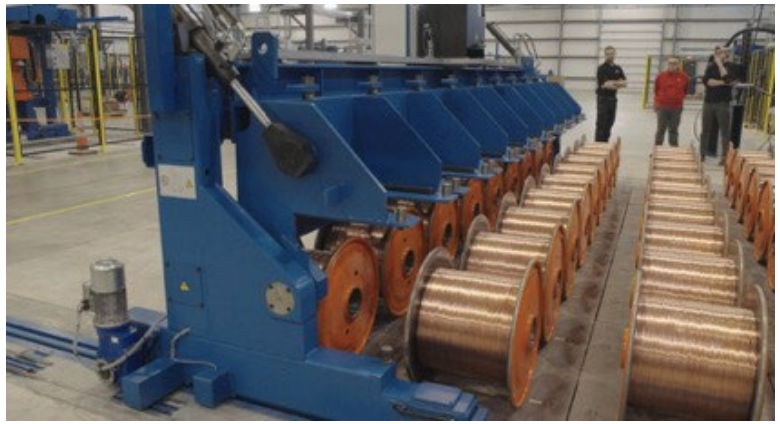
Conductor:

- Most significant contributor to cable flexibility
- Options limited to equipment capabilities
- Waterblocked constructions are limited to 127 components / strands
- Planning to use 127 components consisting of 7 strand lightly waterblocked subcomponents (24 AWG ASTM Class I)
- Rationale: Much higher flexibility and improved waterblocking than currently used non-waterblocked 127 strand rope construction



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Phase 1

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Primary Insulation Options and Key Performance Characteristics

Material	LSZH	Flexibility	Type of Ash	Fire & CI performance	Voltage Resistance
Polyethylene	Yes	Poor	Conductive	Poor	Excellent
XL EPR	Yes	Medium	Conductive	Fair	Excellent
Silicone	Yes	Flexible	Non-conductive	Very Good	Fair
Silicone/Glass Tape	Yes	Medium	Non-conductive	Outstanding	Poor

- XL EPR and Silicone Rubber are best candidates, but EPR must be enhanced to meet circuit integrity gas flame requirements
- 2 Configurations for mfr and test:
  - **1. XLEPR insulation enhanced with additional layer of silicone-glass tape**
  - **2. Silicone rubber insulation with outer layer of silicone-glass tape**
- **Rationale –**
- Silicone glass tape may enhance the fire performance of the primary EPR insulation while providing better electrical properties than silicone rubber.
- If the EPR/SG sample is not capable of withstanding the flame test, the fallback is a complete silicone rubber solution
- If both configurations fail to meet performance requirements, there is a more complex solution

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Phase 1

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Test Schedule for Primary Wires

Primary wires for testing will have a braided shield applied to better approximate finished cable performance

- Physicals
- Gas flame (Circuit Integrity)
- Flame Propagation / Smoke Index
- Watertightness
- Voltage withstand (tested against braided shield)
- Partial Discharge Corona

Gas flame testing is currently planned at SWRI

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Phase 2

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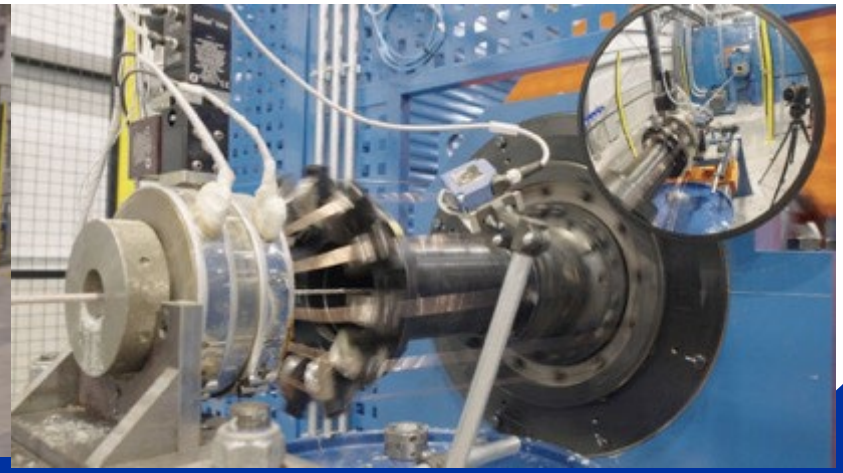
Utilizing the best performing primary wire configuration:

- **Cabling** operation will be performed on our new state-of-the-art planetary in Hooksett
- Shielding considerations:
- **Shielding**– Individual shields or Overall shield, or both
- Additional shielding usually performs better in flame tests
- We will start with an overall shield and optimize if needed. Using fine strand for enhancing flexibility
- **Rationale –**
- Silicone glass tape may enhance the fire performance of the primary EPR insulation while providing better electrical properties than silicone rubber.
- If the EPR/SG sample is not capable of withstanding the flame test, the fallback is a complete silicone rubber solution
- If both configurations fail to meet performance requirements, there is a more complex solution
- **Jacket –** Planning to use XLPO tried-and-proven jacket material. Various grades are more flexible than others



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Phase 2

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Test Schedule for Finished Cable

Test schedule repeated as with primary wires,

- Physicals
- Gas flame (Circuit Integrity)
- Flame Propagation / Smoke Index
- Watertightness
- Voltage withstand (tested against braided shield)
- Partial Discharge Corona

In addition, all test parameters in M24643/86 (with voltage adjustment) will be performed

Samples for installers will be provided to ensure the cables will be flexible enough to be pulled and routed in typical shipboard installations

Main Challenges

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- Gas Flame Testing
- Flexibility
- Waterblocking
- Cost of Development
- Development cycle and timing

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Thank You!