Electric Utility - *Em*Powr® *Fill* LF – Lead-Free Filled EAM Insulation
Frequently Asked Questions

Q: What is *Em*Powr®?

A: *Em*Powr® is General Cable's trade name for its medium-voltage underground and shielded power cables for 5 kV – 46 kV primary distribution lines.

Q: What is *Em*Powr® *Fill*?

A *Em*Powr® *Fill* is our trade name for a filled Ethylene Propylene Rubber (EPR) insulation formulated for high operating temperature applications.

Q: What is *Em*Powr® *Fill* LF?

A *Em*Powr® *Fill* LF is a lead-free EAM insulated cable formulated for high operating temperatures with demonstrated flexibility characteristics superior to traditional filled insulated cables for easier cable handling during installation that help reduce costs.

Q: What is the advantage of using General Cable lead-free EAM insulation over traditional EPR insulation stabilized with lead?

A: General Cable lead-free EAM insulation is formulated with an elastomer which uses the traditional ethylene backbone of an EPR formulation, but with a longer side chain. This results in an insulation that retains the inherent features and benefits of an EPR compound, but the increased side chain lengths in General Cable EAM compound improves flexibility, trainability, reduces spring-back and thus provides ease of installation.

Q What does the EAM insulation designation stand for?

A Ethylene alkene copolymer (EAM) is the ASTM nomenclature (E-Ethylene, A-Alkene and M-repeating CH_2 unit of saturated polymer backbone) for copolymers consisting of ethylene and an alkene co-monomer. ANSI/ICEA S-94-649 and S-97-682 allow alternate EAM insulating materials meeting the same physical and electrical requirements of XLPE, TRXLPE, and EPR. EAM materials are initially identified in a footnote under Table 4-1 in ANSI/ICEA S-94-649 and S-97-682, and further explained in Appendix I and Appendix H respectively. EAM materials have been listed since 1996.

After more than a decade of extensive research and development programs with EAM formulations, General Cable is at the forefront in offering lead-free energy cable products. General Cable has applied emerging technologies that allow for the removal of lead from filled insulation medium-voltage energy cables, while maintaining or exceeding the aging performance, electrical stability and flexibility of our

traditional EmPowr® Fill EPR medium-voltage cable. Over ten years of comprehensive testing has proven that this new, lead-free technology, in combination with EAM, will offer trouble-free service life, while providing complete compatibility with existing infrastructures.

Q: Why is General Cable removing lead from Ethylene Propylene Rubber (EPR) medium-voltage insulation?

A: General Cable is committed to reducing our environmental footprint in the manufacture and supply of cable and assemblies; the reduction of hazardous materials, including lead, is one of our goals. As compounding technology has improved over time, General Cable's compound development team has worked diligently to develop a proprietary medium-voltage, lead-free EAM formula that meets or exceeds all industry standard requirements, delivering not only the performance you demand, but also reducing the overall impact to the environment.

Separately, several pieces of legislation, including RoHS, California Proposition 65 and REACH all restrict the use of lead. The EPA is not currently restricting lead content in medium-voltage EPR insulation as it is below the threshold limit; however, with the continued worldwide focus on environmental impact and sustainability, it's likely those limits will be reduced in the future.

Q: Why was a lead stabilizer required in traditional Ethylene Propylene Rubber (EPR) filled insulations?

A: A lead stabilizer is used in filled EPR insulation formulations (in levels below the EPA threshold) to provide electrical stability in wet conditions, offering better moisture stability and lower dielectric loss. Traditional EPR insulation compounds have always been able to pass the leachable lead content protocol per EPA 40 CFR, Part 261, and not considered toxic waste.

Q: Will the lead-free EAM insulation affect the wet electrical performance?

A: Innovative lead-free EAM insulation ensures electrical performance over the life of the cable, even in extreme conditions. Under accelerated wet (AWTT) and dry electrical testing, lead-free EAM medium-voltage cables exhibits excellent results—displaying high ac breakdown retention and thermal stability even under high voltage and temperature. Test data is available upon request.

Q: What color is the lead-free EAM compound?

A: General Cable's lead-free EAM is white in color. The red/pink shade commonly associated with medium-voltage filled EPR insulation is due in part to the addition of red lead oxide as a stabilizer. Without the red lead oxide additive, the compound takes on its "natural" color, which in this case is white. Please be advised that there may be other white filled rubber insulation compounds that utilize lead-based stabilizers, so the white color does not, in itself, guarantee a lead-free compound.

Q: Are there any compatibility issues between lead-free EAM and leaded EPR cables?

A: No. General Cable lead-free EAM insulated cables can be spliced into circuits with existing leaded EPR cables or vice versa. The two insulation types are 100% interchangeable. Additionally, General Cable lead-free EAM insulated cables can be used with the same lubricants, lugs, terminations, and splices as the traditional leaded EPR cable designs. No changes to work methods or cable accessories are required.

Q: Are General Cable lead-free EAM medium-voltage products fully qualified to AEIC CS8 and ANSI/ICEA S-94-649 or ANSI/ICEA S-97-682?

A: Yes. General Cable completed all applicable production and qualification tests of AEIC CS8 and ANSI/ICEA S-94-649 or ANSI/ICEA S-97-682 in 2007. These tests include, but are not limited to, the Core Material Qualification Tests (HVTT, Hot Impulse, Load Cycle, AWTT, etc.); the Dry-Electrical Test for Class III insulation (MV-105); the Dissipation Factor Characterization Test; and the Thermomechanical Qualification Test at 140 °C. The compound is also UL Listed as Type MV-105 per UL File # E90501.

Q: Should I continue to allow EPR (leaded) insulation in my specification?

A: As mentioned previously, the current leaded EPR compounds are not currently considered hazardous waste and will likely be supplied in the cable industry for many years to come. However, with no electrical or physical performance differences associated with using the lead-free insulated products, specifying cables with lead-free EAM insulation promotes environmental sustainability.

Q: With many years of experience with leaded EPR, should I be concerned with the long-term performance of lead-free EAM?

A: General Cable has performed all applicable long-term physical and electrical testing as required by ICEA, AEIC, and UL. Notably, the lead-free EAM has undergone an accelerated water treeing test (AWTT), which measures electrical performance in water, under voltage for a 360-day period to validate long-term electrical stability and breakdown strength. Long-term wet aging performance was also demonstrated by the accelerated cable life test (ACLT). In both the AWTT and ACLT testing, lead-free EAM insulation has performed equally or better than leaded EPR insulation. Additionally, General Cable has completed field installation trials and validation in network with a major utility partner.

Q: How does the dielectric losses (dissipation factor) of lead-free EAM compare with other MV insulations?

A: General Cable lead-free EAM is a semi-crystalline filled insulation material. Its dissipation factor and the resulting dielectric losses would be comparable to other existing semi-crystalline filled EPR insulations available in the market. That said, the dielectric losses in General Cable lead-free EAM are significantly lower than the losses in other commercial amorphous filled EPR insulations, but higher than the losses in TRXLPE insulations.

Q: Will lead-free EAM cable's insulation shield removal be comparable to leaded EPR cables?

A: Yes. There is no discernable difference. The expected insulation shield adhesion would be in the range of 7 to 13 lbf at room temperature on MV cables using General Cable lead-free EAM insulation.

Q: Is the new lead-free EAM cable more expensive than current leaded EPR cable?

A: No. General Cable's development team has worked tirelessly to produce a lead-free EAM compound that delivers exceptional physical and electrical characteristics, all without increasing the cost of the compound or the final product.

Q: Can I still purchase leaded EPR from General Cable?

A: Yes. General Cable can still provide all designs using our current leaded EPR insulation on a make to order basis. However, please note, that General Cable's standard offering for medium-voltage utility cables using a filled insulation will be lead-free EAM. Should you require a leaded EPR insulation for any utility medium-voltage product, please contact your local General Cable Sales Representative.

Q: Is lead-free EAM insulation available from other cable manufacturers?

A: While we believe that other manufacturers have commercially available lead-free EPR insulated cable for sale, only General Cable has commercially available cable built with lead-free EAM insulation. Our specific lead-free EAM insulation material formulation is proprietary to General Cable and is produced in-house using buss-kneader continuous mixing process and clean material handling systems. As mentioned previously, alternate EAM insulating materials are recognized by ANSI/ICEA S-94-649 and ANSI/ICEA S-97-682 and can be developed and commercialized by other cable manufacturers.

Q: How long has this material been qualified and in field applications?

A: General Cable completed the development and full qualification to AEIC CS8, ANSI/ICEA S-94-649 and ANSI/ICEA S-97-682 in 2007. The product was first trialed in the field in 2010. Following a series of field evaluations, the product has been fully adopted for regular use and field installations since 2013.