White Paper WP-11284 Effective November 2022

BUSSMANN SERIES

Plastic enclosures: Suitable for outdoor electrical applications?

Debunking common misconceptions about thermoplastic electrical enclosures

Abstract

Plastic components and enclosures have been used in outdoor electrical applications for many years. Despite common misconceptions, plastics provide multiple advantages over traditional metal enclosures, including improved dielectric properties, impact resistance and aesthetics.

There are preconceived concerns about the ability of plastics to perform reliably in the harsh environmental conditions found in outdoor applications. This paper will address these apprehensions by examining the intended use of the NORYL™ family of modified polyphenylene ether (PPE) plastics and the suitability of this material for use in outdoor electrical enclosure applications.

What is NORYL PPE plastic?

The NORYL family of modified PPE resins is a polymer consisting of amorphous blends of PPO™ resin (polyphenylene ether) and polystyrene. This material combines the inherent benefits of PPO resin (affordable, high heat resistance, good electrical properties, excellent hydrolytic stability) with excellent dimensional stability, good processability and low specific gravity.

NORYL PPE also offers low moisture absorption and excellent hydrolysis resistance and can be made flame retardant. Additionally, this family of PPE resins is designed to provide a good balance of mechanical and chemical properties, and to be suitable for a wide variety of applications.

Common commercial use cases for PPE resins include components in printers and copiers, electrical devices like connectors and circuit breakers, and in vending machines and water softeners.

History of PPE in electrical applications

According to global safety science organization UL®, PPE plastic was first introduced as polyphenylene oxide (PPO) by the General Electric Co. in the United States and by AKU in Holland in 1965. As we've seen across the electrical industry, technological innovation moves at an incredibly rapid pace. The same has occurred with PPE plastics and enclosure technology.

Due to its inherent corrosion-resistant properties, modern PPE plastic is currently utilized as an enclosure material for many different industrial and electrical applications, including:

- Alternative energy: Protecting sensitive electronic devices from the environment in solar and wind applications
- Water treatment: Shielding electronics from environmental conditions typical in wastewater treatment plants, commercial and industrial sprinkler systems and more
- Marine and marina: Safeguarding electrical equipment and components from corrosive saltwater and sunlight
- Harsh and hazardous areas: Protecting motor starters, controls and junction boxes from extreme environmental conditions that cause corrosion

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PPE plastic enclosures for outdoor AC disconnects

Although PPE plastic enclosures can be found across industrial environments, the focus of this paper will be the use of PPE plastics for outdoor air-conditioning disconnects.

The National Electrical Code® (NEC)® Article 440 requires a disconnecting means within sight of, and readily accessible from, air-conditioning or refrigerating equipment. These devices are commonly referred to as air-conditioning disconnects (HVAC disconnects), pullouts or air-conditioning switches. HVAC disconnects are also suitable for any other application where a local disconnect is required, such as heat pumps, water heaters, hot tubs and many others.

Traditionally, HVAC disconnects were constructed with NEMA® 3R metallic enclosures in adherence to UL 50E standards to provide a quality weatherproof enclosure resistant to rain, ice and snow. However, PPE plastic enclosures can be used in outdoor HVAC disconnect applications and they deliver on a variety of benefits compared to the traditional metal enclosure approach.

Six key benefits of PPE plastic enclosures for AC disconnects

1. Impact resistance

   Plastic products need to be tested by a third party to ensure that they meet a very specific set of regulatory safety and quality standards. NORYL PPE plastics are tested to UL 746C, which outlines the evaluation process for polymeric materials used in electrical equipment.

   This test includes:

   - Subjection to steel ball impact at –31 °F and at room temperature per UL 746C
   - Subjected to the 100 lbf crushing test per UL 746C
   - Subjected to mold stress-relief distortion test per UL 746C in an oven at 158 °F for 7 hours

2. Corrosion resistance

   Chemical resistance and corrosion resistance are among the greatest advantages of plastics as compared to metals. Because the impact of corrosive compounds resulting from water, salt, acids and bases is minimal with PPE material, it is incredibly suitable for coastal, marine and harsh environmental applications.

   Beyond natural resistance to the impact of corrosion, PPE plastics support effective maintenance in the long term simply because a plastic enclosure is far less likely than its metal counterpart to jam, stick or fail to open because of rust or corrosion—and can be maintained harmlessly with many different cleaning agents.

   Further, the enclosure never has to be painted to withstand corrosive environments or harsh climatic conditions. They can be installed and used right out of the box in places where a metal enclosure would need to be epoxy coated.

3. Fire protection and grounding

   The NORYL PPE resin SE1X used in HVAC disconnect enclosure applications is flame retardant to comply with a broad range of environmental standards, including UL 94 V-1.

4. Ultraviolet (UV) resistance and environmental protection

   The NORYL PPE plastics used for HVAC disconnects are tested to comply with UL 746C with a f1 rating. This means the material has met both UV and water immersion requirements. UV exposure is performed by using either a twin-enclosed carbon weatherometer for 720 hours or a xenon-arc weatherometer for 1000 hours. Water immersion testing is performed for 7 days at 70 °C.

   The material is tested before and after exposure for flammability, mechanical impact and mechanical strength. Materials whose properties are not significantly degraded in any of these areas are considered to have passed and are suitable for outdoor use.

5. Ease of modification

   Compared to traditional metal enclosures, PPE plastic enclosures are much easier and safer to machine. Due to their inherent structure, PPE plastics do not leave potentially dangerous edges that must be machined or painted prior to handling. Plus, when drilling mounting holes to meet the needs of unique installation locations, no special tools are required and the risk of exposure to dust particles containing metallic compounds is mitigated to enhance personal safety.

6. Aesthetics

   The NORYL class of PPE plastics used for HVAC disconnects can be molded in several different colors or pantones as the manufacturer specifies. Further, the enclosure can be painted without any form of pretreatment due to the plastic's favorable paint adhesion to match the appearance of nearly any application, which is especially desirable in the common residential application of HVAC disconnects.

Table 1. The capabilities of PPE plastic enclosures

Feature	NORYL SE1X resin	NEMA 3R metallic
Impact resistant	✓	✓
Corrosion resistant	✓	
UV resistant	✓	✓
Ingress protection	✓	✓
Paint adhesion	✓	

Reviewing the value of PPE plastics for outdoor electrical enclosures

Many electrical professionals have concerns regarding the ability of plastic enclosures to perform reliably in outdoor applications such as HVAC disconnects.

However, as illustrated in this paper and **Table 1** above, manufacturers that utilize the correct compound of PPE plastics (such as NORYL PPE resin SE1X) are able to produce enclosures with the same features of traditional metal enclosures including:

- Impact resistance
- UV resistance
- Ingress protection

Plastics also provide many advantages that go beyond what metal enclosures are capable of, including improved corrosion resistance, simplified field modification and favorable paint adhesion.

Plastic enclosures: Suitable for outdoor electrical applications?

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Printed in USA
Publication No. 11283
September 2022

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