Polycarbonate Enclosures 101: A Guide for Specifiers

When many in our industry think about electrical enclosures, they think of traditional materials such as carbon steel or stainless steel. That's understandable as these materials continue to dominate the market. When non-metallics are considered, the material that most are familiar with is molded fiberglass. Molded fiberglass enclosures (FRP) dominate the non-metallic segment of the enclosure market. The material that seems to be least understood is really the latest entry into the electrical enclosure market, and that material is polycarbonate (PC).

The use of polycarbonate resins in electrical enclosure applications is a relatively recent occurrence. Like so many products in the electrical industry, steel was the original material of choice. In the very early 1900's with the invention of Bakelite, the basic material for the FRP enclosure industry was introduced to the marketplace. Then, in the 1950's, GE and Bayer concurrently developed polycarbonate resin, and in the 1960's the new resins (*Lexan* for GE and *Makrolon* for Bayer) began finding their way into the marketplace. Due to its exceptional impact strength, machinability, formability, and UV stability, polycarbonate-based products are widely used in many automotive, aircraft, industrial, and electrical applications. You may be reading this magazine through the polycarbonate lenses in your glasses. You might want to burn a copy of this onto a polycarbonate CD, or call a colleague on your polycarbonate-housed cell phone.

Unfortunately, there is some confusion in the marketplace about polycarbonates in electrical enclosure applications. The objective here is to outline the capabilities of polycarbonate enclosures, providing a basis for enclosure specifiers to better understand how and when PC might be the right choice for a given application.

UV Stability: The Ability to Use Outdoors

The area of greatest confusion is in the suitability of polycarbonate enclosures for outdoor application. The fact is that most PC enclosures are very well suited for outdoor use. While some PC compounds are not UV protected, others are, and you have to check the technical data put forth by the manufacturer, supported by Underwriters Laboratories testing and certification.

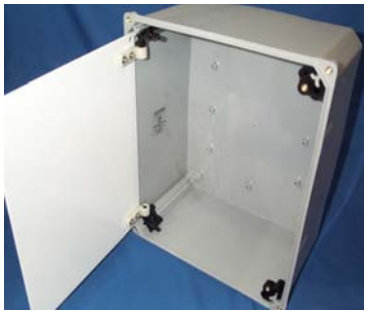
The capability of an enclosure to withstand exposure to the elements, including sunlight, water exposure, and immersion are quantified and tested by Underwriters Laboratories, again under UL 746C. At UL, the enclosures are exposed to 720 hours of twin-enclosed carbon or 1,000 hours of xenon-arc weatherometer conditioning, water exposure and water immersion for seven days at 70 degrees C. The enclosures are then tested for flammability, mechanical impact, and mechanical strength.

If the enclosures meet the UL standards for these criteria, the enclosure earns the "F1" rating, designating that the enclosure has met UL standards after UV, water exposure, and water immersion, and is suitable for outdoor use. Most PC enclosures hold the "F1" rating.

To earn an "F2" rating, the enclosure is subjected to at least one of the designated exposures (UV, Water Exposure, or Water Immersion). In this case, the enclosure is deemed suitable for outdoor use with limitations defined by UL. Those limitations are typically described in the technical data provided by the manufacturer. For example, manufacturers of FRP enclosures recommend painting the enclosure to provide better UV protection and avoid surface erosion.

Impact Resistance: The Ability to Survive Handling and Abuse

The ability to withstand impacts, such as a hit from a wrench, or a thrown rock or ball, is critical to the successful protective life of an enclosure. Impact resistance also has an effect on potential shipping damage. Higher impact resistance values tested under UL 746C translate into less field breakage, less shipping damage, and lower overall cost of use. Polycarbonate is far and away the superior non-metallic material in this area.



The measuring stick for impact resistance is UL 746C and is quantified as inch pounds of impact using a falling steel ball. Polycarbonate enclosures exhibit an impact resistance of 500- to 900-inch pounds. This compares to FRP at just over 200-inch pounds. Both values meet UL standards, but the difference favoring polycarbonate is dramatic. That's typically why you see polycarbonates in applications like cell phones and MP3 players, where the risk of dropping is high.

Machinability: The Ability to Cut a Hole

Given that virtually all electrical enclosures have holes cut into them at one point or another, the ability to safely and easily machine the enclosure is vital. All non-metallics can be machined using CNC technology, or hole saws, drills, and in some cases hydraulic punches. The polycarbonate advantage is the elimination of any need to protect workers from the airborne fibers inherent with FRP enclosures. With polycarbonates, those fibers simply do not exist.

Formability: The Ability to Add Features

With thermo-plastic injection molding technology as is used with polycarbonates, the manufacturer has the ability to take advantage of several design opportunities not available with other traditional materials. For example, features like mounting rails or bosses can be molded as an integral part of the enclosure. Also, covers can be molded using clear grades of polycarbonate, eliminating the requirement for mechanically installed windows.

Other features like non-metallic hinging systems (that allow removal and replacement of covers by eliminating metallic hinge pins and steel piano hinges) are available using polycarbonate construction.

A traditional limitation of thermo-plastic enclosures, including polycarbonate, is lack of availability in larger sizes. Much of this is due to the relatively high cost of injection molding tooling. However, polycarbonate enclosures are now being fabricated using sheets of material, effectively eliminating this limitation. This is a new application of polycarbonate, and is made possible through the development of machining and welding techniques. By forming and welding, PC enclosures can now be built in virtually any length, width, or depth, much like a steel enclosure.

Chemical Resistance: The Ability to Survive Chemical Exposure

The requirement for the enclosure specifier to understand and choose an enclosure solution based on anticipated chemical exposure is critical. All materials, ranging from steel to fiberglass to polycarbonate to aluminum have certain chemicals that attack them and others that do not cause problems. It is always best to thoroughly review chemical resistance data tables provided by the manufacturer to properly specify an enclosure material, and not rely on broad generalizations regarding material appropriateness.

As the relative new-comer to the electrical enclosure market, polycarbonate enclosures offer a wide array of benefits to the specifier. Contrary to what some would have you believe, polycarbonate enclosures are a superior choice in outdoor applications. High impact strength relative to other non-metallics provides a key to long enclosure life. Molded-in features can contribute to overall lower cost of use.

As always, when choosing a protection system for your electrical components, an evaluation of alternatives based on objective analysis is required. Be sure to check for UL certification for appropriateness for you application, and also be sure to evaluate and compare the written technical data provided by the manufacturer. Using an approach like this will ensure that the right product is chosen, and the desired result is achieved.

You can learn more about Integra and its full line of high-quality polycarbonate enclosures at www.integraenclosures.com.