

NON-METALLIC ENCLOSURES IN OUTDOOR ENVIRONMENTS

Enclosures house electronic controls and electrical systems in indoor and outdoor applications, protecting sensitive components from extreme environments and hazards such as water, chemicals, extreme temperatures, dust and dirt.

NON-METALLICS OVERVIEW

Non-metallic materials withstand many conditions that traditional steel enclosures cannot. Providing excellent corrosion and chemical resistance, non-metallics offer rugged durability—even withstanding rough handling—and long operational life. These benefits make non-metallic enclosures an increasingly popular choice for outdoor applications. However, ultraviolet (UV) radiation is a concern, because it causes the enclosure surface to degrade which can negatively affect aesthetics but does not affect functional life. For optimal performance and longevity, painting or gel-coating fiberglass, or using unfilled materials such as polyester or polycarbonate will help combat UV degradation, including fiberbloom.



FIBERGLASS: THE MOST POPULAR NON-METALLIC

A thermoset polyester material reinforced with glass fibers, fiberglass is the most popular non-metallic material used in the industry, offering a cost-effective alternative to stainless steel for corrosive environments. Composed of a high-performing, engineered composite resin, fiberglass enclosures are typically formed in one of two ways. The first method, compression molding, utilizes a material known as SMC—a long-glass-fiber pigmented polyester resin. These long fibers provide ultimate strength and, when formulated with UV inhibitors and aluminum trihydrate, they provide resistance to material degradation and achieve the UL 94 5V flame rating—the highest performance requirement for a UL 508 enclosure. These precision-designed molds provide extremely good part uniformity and material consistency.

The second method, the hand lay-up or spray-up process, also utilizes molds that provide part uniformity and material consistency. This material also achieves the UL 94 5V rating. The heavy, unfilled pigmented outer gel coat layer delivers exceptional protection and is available in numerous colors.



Enclosures used in outdoor environments must withstand various harsh elements, including UV radiation. Non-metallic materials provide a solution for many outdoor applications.



Fiberglass, the most popular non-metallic enclosure material, offers a cost-effective alternative to stainless steel for corrosive environments, as well as high impact strength and rigidity, and a superior working temperature range.

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Fiberglass enclosures can be painted or gel coated to provide additional protection against fiberbloom.

Injection compression, pultrusion and resin transfer molding, RTM, are other fiberglass molding processes. Injection compression is used for molding components such as hinges, latches or handles. The pultrusion process is used to produce structural components including wireway. The RTM process is used when a Class A gel finish is required on both the interior and exterior of a component. The inside and outside of the component is encapsulated in a gel coat which provides exceptional protection against UV and moisture and has an extremely high resistance to acids, alkyls and organic solvents.

Fiberglass offers high impact strength and rigidity, a superior working temperature range of -31 to 300 F, with excellent dimensional stability, dielectric strength, and high overall moisture and chemical resistance. Fiberglass is frequently specified for indoor and outdoor applications in plating facilities, and pulp, petrochemical and sewage processing plants.

FIBERBLOOM: LOSS OF GLOSS AND COLOR

While fiberglass enclosures provide many benefits, UV—in combination with wind, dirt and rain—will eventually erode an enclosure's surface causing it to become rough and porous. As the resin-rich surface is worn, glass fibers are exposed. This is fiberbloom. Fiberbloom does not affect an enclosure's functionality or its ability to protect components, but it does affect its aesthetics.

This surface erosion, which reduces gloss and increases roughness—also increases surface area, resulting in additional UV absorption. This phenomenon occurs throughout nature and cannot be prevented. Protective coatings can, however, decrease the surface degradation rate.



Prolonged UV exposure can cause fiberbloom on fiberglass enclosures, a form of surface degradation that results in loss of color and gloss.



PROTECTIVE COATINGS

Applying a glossy, light colored surface coating increases surface reflectivity, decreasing UV absorption. The glossy surface also reduces roughness, minimizing dirt collection points that increase UV absorption. Applying paint to resin-rich fiberglass surfaces before they begin to degrade provides additional protection layers or thickness. Four mils of primer and paint over the 4 mils of surface resin is standard and increases a fiberglass enclosure's protection level 200 percent. Painting an enclosure white reduces the solar heat load by nearly 200 percent. And while more expensive than painting, applying a 12 to 15 mil white gel coat provides the optimum level of protection by making fiberglass enclosures more resistant to UV and providing an ideal solution for wet environments.

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POLYESTER (HYBRID POLYCARBONATE/POLYESTER BLENDS)

The use of hybrid polycarbonate/polyester blends for non-metallic enclosures is a relatively new option. While it is not as widely available as other non-metallic materials, it offers a wide range of benefits at a moderate price, providing a practical alternative to traditional non-metallic enclosures. The thermoplastic material is processed using injection molding and delivers high impact resistance, excellent electrical properties, and superior chemical and moisture resistance.



Hybrid PC polyester blend enclosures offer a wide range of benefits, including excellent impact resistance. Since they do not contain glass, these enclosures are not susceptible to fiberbloom.

Polyester contains no glass, so unlike fiberglass, it is not susceptible to fiberbloom. While alternative solutions, including paint, gel coating and other surface treatments such as UV absorbers provide a degree of protection, polyester does not degrade over time, providing continuous UV protection.

Polyester provides excellent impact resistance. The glass in fiberglass gives rigidity to the material, but this differs from strength. While fiberglass alternatives eventually break under extreme pressure, polyester absorbs the pressure and doesn't shatter. Polyester is also less susceptible to scratches and abrasion than fiberglass and performs well in extreme temperatures. In a Pentair Technical Products' UL lab test, a polyester enclosure was frozen at -31 F and met both the UL and CSA drop tests, which require an enclosure to withstand being struck by a heavy falling object without breaking.

Since polyester is flame retardant, it will not ignite when in contact with fire. It delivers excellent corrosion and chemical resistance, withstanding the highest range of solvents, alkalis and acids without failure. Polyester is suitable for many industries including food, petroleum, chemical and wastewater processing, pulp and paper, outdoor monitoring, and virtually any indoor or outdoor industry exposed to corrosive environments or chemical agents.

Polyester produces almost no dust and can be easily drilled and punched for holes and cutouts, even in the field. Since it doesn't contain glass, it causes less wear on tools and doesn't create the skin irritation associated with loose glass particles.

Since fiberglass is a thermoset material, the composition cannot be changed. Once it has fulfilled its purpose, it ends up in a landfill. On the other hand, polyester, which is a thermal-molded material, can be changed and reused. It is recyclable. It also takes less energy to recycle polyester than many alternative materials, making it an eco-friendly enclosure material choice that is widely accepted worldwide.

POLYCARBONATE

Polycarbonate—a high-performance engineered thermoplastic resin that is processed by injection molding or sheet extrusion—is another popular non-metallic material option. Polycarbonate exhibits high impact resistance, a wide range of temperature limits, high dimensional stability and good electrical properties. Plus, clear polycarbonate has very high transparency. Fire-retardant grades and silicone-coated grades are available to improve scratch, harsh chemical and UV exposure resistance. Glass fiber-reinforced grades provide increased stiffness and higher service temperatures. Polycarbonate is well suited to many indoor and outdoor applications, with the exception of environments that contain strong alkalis or organic solvents, unless silicone-coated as mentioned above.

Most polycarbonate enclosures provide a Type 4X rating at a low to moderate price. Like hybrid PBT/PC (polyester polycarbonate blends), polycarbonate does discolor and experiences low level surface deterioration. However, it does not experience fiberbloom, because it does not contain glass.



Polycarbonate enclosures offer many of the same benefits as hybrid PC polyester blend enclosures and also do not experience fiberbloom.

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CONCLUSION

While enclosures protect electrical and electronic components from harsh outdoor environments, they are exposed to UV radiation along with other harmful elements. A wide range of enclosures is available, including non-metallic material options, and should be carefully selected according to an application's specific requirements.

Feature	Fiberglass	Polyester	Polycarbonate
UV performance	Excellent	Excellent	Good
Chemical resistance*	Excellent	Excellent	Fair
Impact strength	Good	Excellent	Excellent
Rigidity	Very rigid	Flexible/tough	Flexible/tough
Temperature range	-31 to 266°F (-35 to 130°C)	-40 to 248°F (-40 to 120°C)	-31 to 180°F (-35 to 82°C)
Weight (12" x 12" x 6")	11 lbs.	5 lbs.	4.1 lbs.
Flammability	Self extinguishing	Self extinguishing	Self extinguishing
Water absorption resistance	Good	Excellent	Fair
Recyclable	No	Yes	Yes
Ease of adding cutouts	Dusty can be drilled	Low dust can be drilled/punched	Low dust can be drilled/punched

