How to select the right enclosure material

Size is normally the first and the most dominant criterion when looking for the right enclosure for a specific application. Enclosure performance, i.e. material performance, is usually the second property considered.The following list of benefits and drawbacks indicates the basic differences between the various FIBOX enclosure materials.

Polycarbonate (PC)

Standard polycarbonate (PC)

Benefits:
- Very high impact resistance
- Available in transparent form
- Easy machining with normal tools
- High IP rating
- Excellent surface finish
- Wide operating temperature range
- Self-extinguishing flammability
- Good resistance to chemical attack
- Light weight
- Good UV resistance
- Excellent insulating properties
- Cost-effective material for harsh environments

Drawbacks:
- No EMC shielding

Acrylnitrile-butadiene-styrene (ABS)

Benefits:
- Easy machining with normal tools
- Easy coloring through pigmentation
- Low weight
- Good resistance to chemical attack
- Excellent insulating properties

Drawbacks:
- Slightly lower impact resistance compared with PC
- Slightly lower operating temperature range compared with PC
- Slightly lower UV resistance compared with PC.
- Not available in transparent form
- No EMC shielding

Aluminum (AL)

Benefits:
- Good resistance to chemical attack (painted)
- High impact resistance
- Wide operating temperature range
- Electrically conductive
- EMC shielding.
- Good heat sink properties
- Rigid construction

Drawbacks:
- More expensive than PC
- Heavier than PC and ABS
- Machining with special tools only

Fiberglass (GRP)

Benefits:
- Excellent record of resistance to corrosion and chemical attack
- Good impact resistance
- Rigid construction
- Good weather resistance
- Wide operating temperature range
- Fire resistant
- Good insulating properties

Drawbacks:
- More expensive than PC
- Cannot be machined using standard tools
- No EMC shielding
- Heavier than other plastic enclosures

Comparison of materials

The following table provides a general indication of the properties of various materials. For more detailed information on material performance in your specific application environment, please consult your local FIBOX representative.

	PC	ABS	GRP[2)]	AL [1)]	PA6 [3)]
Outdoor use	▪▪▪▪	▪	▪▪▪▪▪	▪▪▪▪	▪▪▪▪
Indoor use	▪▪▪▪▪	▪▪▪▪▪	▪▪▪▪▪	▪▪▪▪▪	▪▪▪▪▪
Cost	▪▪▪	▪▪▪▪▪	▪	▪	▪▪
Light weight	▪▪▪▪▪	▪▪▪▪▪	▪▪▪	▪	▪▪▪▪▪
High rigidity	▪▪▪	▪	▪▪▪▪	▪▪▪▪▪	▪▪▪
Impact resistance	▪▪▪▪▪	▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪
Chemical resistance					
Salt water environments	▪▪▪▪▪	▪▪	▪▪▪▪▪	▪▪▪▪[1)]	▪▪▪▪▪
Neutral salts	▪▪▪▪▪	▪▪▪▪	▪▪▪▪▪	▪▪▪▪[1)]	▪▪▪▪
Acids, low concentrations	▪▪▪▪▪	▪▪▪▪	▪▪▪▪▪	▪▪	▪▪▪▪
Acids, high concentrations	▪▪▪	▪	▪▪▪	▪	▪
Alkalis, low concentrations	▪▪▪	▪▪▪▪▪	▪▪▪▪	▪	▪▪
Alkalis, high concentrations	▪	▪▪▪▪	▪▪▪▪	▪	▪
Petroleum	▪▪▪	▪	▪▪▪▪▪	▪▪▪▪▪	▪▪▪▪
Hydraulic oil	▪▪▪▪▪	▪▪▪▪▪	▪▪▪▪▪	▪▪▪▪▪	▪▪▪▪▪
Alcohols	▪▪▪▪	▪▪▪	▪▪▪▪	▪▪▪▪▪	▪▪▪▪
Solvents	▪	▪	▪▪▪▪▪	▪▪▪▪▪	
Cooling fluids	▪▪▪	▪▪▪▪▪	▪▪▪▪▪	▪▪▪	

▪▪▪▪▪ = Excellent

▪ = Poor

[1)] Polyester powder coated AlSi cast aluminum

[2)] Glass fiber reinforced polyester (fiberglass)

[3)] Polyamide (nylon)

Data subject to change without notice.

FIBOX enclosure gaskets offer the best protection

The gasket seals the enclosure cover to the body, playing a critical role in establishing the enclosure's performance rating. The reliability of the NEMA/IP rating depends upon the properties of the gasket material. Key performance factors of a gasket are its compression set and chemical resistance. Compression set is the amount of residual displacement after the compressing load has been removed. Chemical resistance varies with material and there is no single compound that is resistant to all chemicals.

PUR (Polyurethane) is the gasket of choice in general-purpose applications, and are often called molded in place because they are produced by a continuous foam injection process without joints. Fibox enclosures feature a gasket groove that shapes the PUR gasket and assures a reliable ingress rating. PUR gaskets have a very low permanent compression set, and their mechanical properties remain stable in a -50° to +130° C temperature range. PUR gaskets resist oils, fats, and acids, but don't withstand strong alkalis.

EPDM gaskets have a very low permanent compression set, and can work in a temperature range of -50° to +120° C. In addition, ozone, oxygen and UV have little effect on these gaskets, which makes them suitable for outdoor applications. EPDM gaskets tolerate water, salt fluids, steam, alcohol, glycol, weak acids and alkalis, but are not resistant to many oils or hydrocarbon-based solvents.

TPE is a gasket material that is injection molded concurrently with the molding of the enclosure. Denoted as 2 component molding, this process produces a perfectly formed gasket without the process control variations of PUR technology. TPE molding technology is now featured on a number of Fibox products.

Neoprene has good mechanical properties and offers a low permanent compression set. Its temperature range is -40° to +100° C, and it has excellent resistance to UV, ozone and oxygen. In addition, neoprene gaskets resist oils, fats, hydrocarbons and alcohols. Silicone gaskets have an exceptionally wide temperature range of -60° to +170° C. They are primarily used in extremely cold or hot environments. Silicone resists alcohols and ketones, but strong acids and strong alkalis have dissolving effects on the material.

Fibox enclosures come equipped, as standard, with the optimum gasket material. However, in some cases the gasket may be changed to alter the performance of the enclosure. Keep in mind that the enclosure and gasket must withstand the same chemicals. When considering a change in gasket material, always consult the factory.

Property	Unit	TPE	PUR	EPDM	Neoprene	Silicone
Temperature range	°C	-40 - +120	-50 - +130	-50 - +120	-40 - +100	-60 - +170
Tensile strength	Mpa	5	0,4	13,0	8,0	9,4
Elongation at break	%	700	110	300	250	540
Hardness	Shore A	30	12	65	66	52
Density	g/cm3	1,13	0,33	1,12	1,6	1,15
Compression set	%	17	5	20	35	14

Table 1: Gasket materials: physical properties comparison

Chemical Performance	TPE	PUR	EPDM	Neoprene	Silicone
Neutral salts	▪▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪▪
Acids, low concentrations	▪▪▪▪	▪▪▪	▪▪▪▪	▪▪▪	▪▪▪
Acids, high concentrations	▪▪▪	▪	▪▪▪	▪	▪
Alkalis, low concentrations	▪▪▪▪	▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪
Alkalis, high concentrations	▪▪▪	▪	▪▪▪▪	▪▪▪	▪
Petroleums	▪	▪	▪	▪▪▪	▪
Hydraulic oils	▪	▪▪▪▪	▪	▪▪▪	▪
Alcohols	▪▪	▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪▪
Cooling fluids	▪▪▪	▪▪▪	▪▪▪▪	▪▪▪	▪▪▪▪

Table 2: Gasket materials: chemical resistance comparison

PUR = polyurethane
TPE = thermoplastic elastomer
EPDM = ethylene – propylene – diene – monomer