

# Guide for selecting the right FIBOX enclosure

Enclosure family												
Property	ARCA	MNX	PICCOLO		EURO-NORD		ALU	SOLID		EK	CAB	CARD-MASTER
Material	PC	PC	PC	ABS	PC	GRP	AL	PC	ABS	PC	PC	PC
Pages	13 - 26	27 - 54	55 - 62		63 - 96		97 - 122	123 - 132		133 - 146	147 - 154	155 - 162
Number of versions	120	168	22	22	87	12	31	48	48	97	28	26
Size min (in) Size min (mm)	6x6x4 152x152x102	3.9x3.9x1.4 100x100x35	4.3x3.1x2.6 110x80x65		2x1.8x1.3 50x52x40		2x1.8x1.3 50x45x32	7.4x7.4x5.1 188x188x130		7.5x7.5x5.1 190x190x130	5.9x5.9x4.3 150x150x110	6.5x6.3x3.5 160x166x78
Size max (in) Size max (mm)	18x16x10 406x356x203	14.2x10x6 360x255x150	9.1x5.5x4.9 230x140x125		23.6x12.2x7.1 360x400x151		23.6x12.2x7.1 310x600x180	22x14.9x7.1 558x378x180		29.9x22x9.8 760x560x250	23.6x15.7x8.7 600x400x220	15.4x12.4x6.3 316x363x156
NEMA Type ratings	4, 4X, 6, 6P, 12 and 13	1, 4, 4X and 6	1, 4, 4X, 6, 12 and 13		1, 4, 4X, 12 and 13		1, 4, 4X, 12 or 13	1, 3, 3S, 4, 4X, 6, 6P and 12		1, 3, 3S, 4, 4X, 6, 6P and 12	1, 4, 4X, 12 and 13	1, 4X and 12K
IP rating	IP 66/67	IP 66/67	IP 66/67	IP 66/67	IP 66/67	IP 66/67	IP 66/67	IP 66/67	IP 66/67	IP 66/67	IP 65	IP 65
IK rating	IK 09	IK 08	IK 08	IK 07	IK 08	IK 08	IK 08	IK 08	IK 08	IK 08	IK 08	IK 08/07
Electronics enclosures	■	■	■	■	■	■	■	■	■	■		
Industrial enclosures	■	■	■	■	■	■	■	■	■	■	■	■
Instrumentation enclosures	■	■	■	■	■	■	■				■	■
Modular enclosures										■		
Outdoor enclosures	■	■	■		■	■	■	■		■	■	■
Power distribution enclosures										■		
Terminal enclosures	■		■	■	■	■	■	■	■			
UL- enclosures	■	■	■		■		■	■		■	■	■
Wall mounting cabinets	■							■	■	■	■	

PC = polycarbonate  
 ABS = acrylnitrile-butadiene-styrene  
 AL = aluminum  
 GRP = glass fiber reinforced polyester (fiberglass)

# FIBOX customizing services

## FIBOX machining services

To increase the range and flexibility of our enclosure solutions, Fibox has developed a comprehensive range of services, permitting cost effective customization for specific applications. The two most important of these are machining services and customized tooling.

Our sophisticated CNC machinery can supply enclosures with holes, cutouts and openings. This solution is best suited for small to medium volumes of enclosures. Fibox knowledge of enclosure materials ensures that the machining method is compatible with the chosen enclosure material.

Prior to machining a production run, product specification and drawings need to be prepared. Either the customer or Fibox can create these drawings. Enclosure specifications and technical data are available at [www.fiboxusa.com](http://www.fiboxusa.com). CAD support 2D-drawings are available in IGES, DWG and DXF formats and 3D-models in IGES and Parasolid formats adaptable to your design system requirements.



## Assembly services

Many enclosure solutions utilize Fibox accessories to improve the functionality of the enclosure system. Fibox can provide assembly services and install accessories specified by the end user, allowing delivery of "ready to use" mechanical packaging assemblies, saving labor costs and speeding up the manufacturing process. The Fibox accessory program includes a large number of items ranging from hinges and latches, cable glands and wiring accessories, to inspection windows and ventilators.



## Customized tooling

For large volume OEM requirements, it is often possible to customize the molding of a standard product to meet the OEM's specific needs. Provided the mold is a sophisticated multiple slide mold, any enclosure side may be customized without requiring an entirely new mold. It is important that the OEM consult with Fibox early in their design process to determine what, if any, mold change restrictions exist. Altering an existing Fibox mold can be a very cost effective alternative to creating a custom mold. In essence, you lease our high volume, standard product mold with minimal initial tooling cost. This can shorten product development times and permit customizing even those products with projected short life cycles. Your new product reaches the market sooner.



## Colored plastic enclosures

Fibox offers custom molding of standard enclosures in customer specified colors. Standard color specifications are based upon the RAL system, however custom color matching is possible. The type of plastic has significant impact on color match, color consistency and cost. Please consult your Fibox representative for guidance. Custom color molding becomes economical in volumes over 1000 pieces, but lower volumes are also possible. Cost adders are based upon increased raw material costs, plus the cost to prepare molds prior to production and then clean the molds and injection machines after production. These mold preparation costs are highly volume dependent.



## Painted enclosures

Painting enclosures is recommended for plastic enclosures when volumes do not justify custom molding. Critical color matching, if required, is also easier to accomplish with paint. Paint type is dependent upon the choice of enclosure material. Please consult your Fibox representative for guidance.



## EMC - plastic enclosures

Plastic enclosures can be prepared to provide EMC shielding. Various methods are available, but painting the internal surface with Cu paint is the preferred method. This coating, combined with a conductive gasket material such as CHO-SEAL 1350, can provide significant shielding levels. Proper selection of materials is very application specific. Please consult your Fibox representative for guidance.



## Printed enclosures

Silk screen printing is recommended for enclosure batches of less than 1000 pieces. This method is mainly suitable for flat surfaces, and can be used for large areas. Tampo printing is the best solution for volumes greater than 1000 pieces. It is suitable for printing on both flat and curved surfaces of limited size. Tampo printing is also ideal for tight spots like the inside surface of the enclosure.



## FIBOX quality creates customer advantage

Fibox has developed a sophisticated quality system to assure our customers of the reliability and consistency of our products and our service. All aspects of our operations, from design and development through to production and product delivery, are documented to ensure superior performance. Performance you can rely on.

Fibox is an ISO 9001 certified manufacturer and was awarded its certificate by Bureau Veritas Quality International in 1992. This approval covers specifications defined by ISO 9001:2008.



### The FIBOX QUALITY system

The Fibox quality system applies not only to product quality and safety, but availability of product, accuracy of shipments, technical support and customer service. The continued success of this program is assured by regular internal and independent external audits.

## NEMA/UL classification of protection

The National Electrical Manufacturers Association (NEMA) is a US Manufacturers Organization which actively promotes standardized product specifications for electrical apparatus.

NEMA performance criteria and test methods are used by Underwriters Laboratories as guidelines for investigation and listing of electrical enclosures.

### NEMA
























Approximate IP equivalents in parentheses

<b>1</b>	Indoor use primarily to provide a degree of protection against contact with the enclosed equipment and against a limited amount of falling dirt. (IP30)
<b>2</b>	Indoor use to provide a degree of protection against limited amounts of falling water and dirt. (IP31)
<b>3</b>	Outdoor use to provide a degree of protection against wind blown dust, rain, and sleet; undamaged by the formation of ice on the enclosure. (IP64)
<b>3R</b>	Outdoor use to provide a degree of protection against falling rain and sleet; undamaged by the formation of ice on the enclosure. (IP32)
<b>3S</b>	Outdoor use to provide a degree of protection against windblown dust, rain and sleet; external mechanisms remain operable while ice laden.
<b>4</b>	Indoor or outdoor use to provide a degree of protection against splashing water, windblown dust and rain, hose directed water; undamaged by the formation of ice on the enclosure. (IP66)
<b>4X</b>	Indoor or outdoor use to provide a degree of protection against splashing water, windblown dust and rain, hose directed water; undamaged by the formation of ice on the enclosure, resists corrosion. (IP66)
<b>6</b>	Indoor or outdoor use to provide a degree of protection against the entry of water during temporary submersion at a limited depth; undamaged by the formation of ice on the enclosure.
<b>6P</b>	Indoor and outdoor use to provide a degree of protection against the entry of water during prolonged submersion at a limited depth.
<b>11</b>	Indoor use to provide by oil immersion a degree of protection of the enclosed equipment against the corrosive effects of corrosive liquids and gases.
<b>12, 12K</b>	Indoor use to provide a degree of protection against dust, falling dirt and dripping non-corrosive liquids. (IP65)
<b>13</b>	Indoor use to provide a degree of protection against dust and spraying of water, oil and non-corrosive coolants. (IP65)

# The IP and IK classifications

The ingress protection class of enclosures is expressed in the form of IP classification, a two digit coding which is shown below. We have tested our enclosures according to EN 60529. The standard requires the second digit to be tested separately from class 6 upwards for each level of class, thus the double marking IP 66 / IP 67 indicates that the actual tests have been made for both levels.

The new European standard for empty enclosures, EN 62208 includes the IK impact test. This test is described in EN 50102, and as Fibox enclosures are tested to EN 62208, the data for impact resistance is available.

FIRST DIGIT Protection against solid objects		SECOND DIGIT Protection against liquids		IK CODE Protection against mechanical impacts	
IP	TEST	IP	TEST	IK	TEST
0	 no protection	0	 no protection	00	 no protection
1	 protected against solid objects over 50 mm (hands)	1	 protected against vertically falling drops of water	01-05	 impact < 1 joule
2	 protected against solid objects over 12 mm (fingers)	2	 protected against direct sprays of water up to 15° from the vertical	06	 500 g 20 cm impact 1 joule
3	 protected against solid objects over 2,5 mm (tools+ small wires)	3	 protected against sprays to 60° from the vertical	07	 500 g 40 cm impact 2 joule
4	 protected against solid objects over 1 mm (tools+ small wires)	4	 protected against water sprayed from all directions - limited ingress permitted	08	 1,7 kg 29,5 cm impact 5 joule
5	 protected against dust - limited ingress permitted (no harmful deposit)	5	 protected against low pressure jets of water from all directions - limited ingress permitted	09	 5 kg 20 cm impact 10 joule
6	 totally protected against dust	6	 protected against strong jets of water e.g. for use on shipdecks - limited ingress permitted	10	 5 kg 40 cm impact 20 joule
		7	 15 cm protected against the effects of immersion between 15 cm and 1 m		
		8	 1 m protected against long periods of immersion under pressure		

# 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 <sup>2)</sup>	AL <sup>1)</sup>	PA6 <sup>3)</sup>
Outdoor use	• • • • •	•	• • • • •	• • • • •	• • • • •
Indoor use	• • • • •	• • • • •	• • • • •	• • • • •	• • • • •
Cost	• • •	• • • • •	•	•	• •
Light weight	• • • • •	• • • • •	• • •	•	• • • • •
High rigidity	• • •	•	• • • • •	• • • • •	• • •
Impact resistance	• • • • •	• • •	• • • • •	• • • • •	• • •
Chemical resistance					
Salt water environments	• • • • •	• •	• • • • •	• • • • • <sup>1)</sup>	• • • • •
Neutral salts	• • • • •	• • • • •	• • • • •	• • • • • <sup>1)</sup>	• • • • •
Acids, low concentrations	• • • • •	• • • • •	• • • • •	• •	• • • • •
Acids, high concentrations	• • •	•	• • •	•	•
Alkalis, low concentrations	• • •	• • • • •	• • • • •	•	• •
Alkalis, high concentrations	•	• • • • •	• • • • •	•	•
Petroleum	• • •	•	• • • • •	• • • • •	• • • • •
Hydraulic oil	• • • • •	• • • • •	• • • • •	• • • • •	• • • • •
Alcohols	• • • • •	• • •	• • • • •	• • • • •	• • • • •
Solvents	•	•	• • • • •	• • • • •	• • • • •
Cooling fluids	• • •	• • • • •	• • • • •	• • •	• • •

- • • • • = Excellent
- = Poor

<sup>1)</sup> Polyester powder coated AISi cast aluminum

<sup>2)</sup> Glass fiber reinforced polyester (fiberglass)

<sup>3)</sup> 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