Plastics

A plastic is a material that can be formed and shaped into finished articles using heat (thermoformed). It has a molecular structure that consists of very long chains of polymers formed by the interaction of many molecules (monomers) or molecular pairs.

A distinction is made between thermoplastics and thermosettings.

Thermoplastics

Made by injection of the molten plastic into a cool mold.

Parts formed from thermoplastics can be repeatedly softened by an increase of temperature. Most thermoplastics are soluble in a suitable organic solvent.

Thermosettings

Made by forming the plastic objects in a hot mold.

Once formed, it becomes substantially infusible and also insoluble because of the crosslinked molecular structure.

Thus products from materials made using thermosettings do not melt upon heating and are practically insoluble to most commercial solvents.

Some softening under the effect of commercial solvents is however possible.

Advantages of Non-Metallic

Double insulation ensures perfect safety against direct and indirect contact.

Enclosure does not need to be grounded.

Unlike metals, plastics are **non-corrosive**.

The enclosures are homogenous, thus they do **not require any maintenance** even when scratched, as only more of the same material will be exposed.

Due to their **light weight**, non-metallic enclosures can be very easily handled and installed.

Special features

Polyester

A thermoset derived from unsaturated polyester resins reinforced with glass fibers. Readily worked with common tools such as drills, punches and saws. Polyester enclosures are ideally suited for outdoor installations and use in hot, humid and/or chemically aggressive environments.

Polycarbonate

A bisphelon A based thermoplastic. It meets the highest mechanical requirements. Its resistance to most chemical vapors is good and it is used in a corrosive environment. Outdoor exposure may cause yellowing.

Technical data of plastics

Properties	Standards
Mechanical	
Impact strength	ISO 179
Notched impact strength	ISO 179
Flexural strength	ISO 178
Tensile strength	ISO 3268
Electrical	
Tracking resistance	IEC 112
Surface resistivity	IEC 93
Special resistivity	IEC 93
Dielectric strength	IEC 243
Physical	
Deflection temperature	ISO 75/A
Vicat softening point	ISO 306/B50
Temperature resistance	continuous
Color fastness	ISO R879
Tropicalization and resistance to mold and fungus growth	IEC 68-2-3
Water absorption	ISO 62/1 96h
Density	ISO R1183
Flame resistance	
Limit oxygen index	ISO 4589
Flammability	UL 94 (3mm)
Hot wire resistance	IEC 695-2-1
Toxicity of fumes	ISO 4615
Chemical resistance	
a. Resistance to splashes and vapors	
Acids 10%	(any concentration
Bases 10%	that is not harmful to
Salts	mankind)
Organic solvents	
Oils and fats	
Combustibles	
b. Longlasting contact (not harmful to people)	
Acids 10%	
Bases 10%	
Mineral oils and combustibles	

Unit	FRP	Polycarbonate	Polycarbonate glassfiber reinforced	PPO	PA6	PVC (2.5% humidity)
kJ/m^2	55	no rupture	50	40	40	25
kJ/m^2	55	30-50	15	15	25	20
MPa	150	no rupture	160-170	no rupture	no rupture	no rupture
MPa	50-60	65-70	100	37	60	65
V/50dr	KC600	KC200	KC175	KC175	KC600	KC600
Comparative fig.	12	15	15	>12	12	15
cm	10^{12}	10^{16}	10^{16}	10^{14}	10^{12}	10^{13}
kV/mm	18	35	39	16	34	30
°C	>250	135	145	95	60	50
°C	-	145-150	160-165	109	210-220	70
°C	-50 to +150	-50 to +130	-50 to +130	-50 to +100	-40 to +100	-20 to +60
Blue wool scale	7-8	4	4	4	8	4
-	no degradation	no degradation	no degradation	no degradation	no degradation	no degradation
mg	45	10	10	7	320	5
kg/dm^3	1.75	1.2	1.33	1.1	1.14	1.38 to 1.40
% 0_2	26	24.3	34.4	27.5	23	43 to 47
	94HB	94 V2	94 V1	94 V1	94 V2	94 V0
°C	960	850	960	960	650	960
% Cl	halogen-free	halogen-free	halogen-free	halogen-free	halogen-free	halogens
	good resistance	good resistance (1)	good resistance (1)	good resistance (1)		
					fair resistance	good resistance
					good resistance	good resistance
					good resistance	good resistance
					good resistance	fair resistance
					good resistance	good resistance
					good resistance	good resistance
	limited	fair resistance	fair resistance	fair resistance	excellent chemical	good resistance
	not recommended	no degradation	no degradation	fair resistance	resistance except to	good resistance
	resist	fair resistance	fair resistance	fair resistance	effect of acids and phenols	good resistance

(1) except to organic and aromatic hydrocarbons

Chemical resistance for hot compression-molded fiberglass reinforced polyester (FRP) enclosures

SALTS

Ammonium sulfate	+
Potassium ammonia sulfate	+
Ammonium bichromate 20%	0
Ammonium carbonate 10%	0
Ammonium chloride	+
Ammonium nitrate	0
Ammonium sulfate 10%	+
Ammonium acetate	-
Aniline sulfate	+
Carbonate of barium	-
Chloride of barium	+
Calcium chloride, saturated sol.	+
Calcium hypochlorite	0
Calcium sulfate	+
Copper (II) chloride	+
Copper (III) sulfate	+
Iron (III) chloride	+
Iron (III) nitrate	+
Iron (III) sulfate	+
Iron (II) chloride	+
Iron (II) sulfate	+
Magnesium chloride	+
Magnesium sulfate	+
Mercuric (II) chloride	+
Nickel chloride	+
Nickel nitrate	+
Nickel sulfate	+
Potassium carbonate	0
Potassium chloride	+
Potassium nitrate	+
Potassium sulfate	+
Nitrate of silver	+
Sodium acetate	+
Sodium bicarbonate 10%	+
Sodium carbonate 10%	0
Sodium chloride	+
Sodium hypochlorite 5%	0
Sodium nitrate	+
Zinc chloride	+
Sulfate of zinc	+

OTHER AGENTS AND MEDIA

Ethylene glycol solution of 0 to 100%	+
Glycerine	+
Chlordioxide (bleaching agent)	-
Saturated chlorinated water	+
Formaldehyde 10 to 40%	+
Hydrogen peroxide 5 to 10%	+
Normal water	+
Distilled water	+
Sea-water	+
Phenol	0

Above based on total immersion tests and are thus extremely conservative.
In most applications, fiberglass reinforced polyester offers the best all around performance in corrosive environments. The only reagent likely to cause severe problems is hydrofluoric acid. If likely to be encountered, refer anticipated concentration to Vynckier Enclosure Systems.

List of conventional symbols

+ = resistant
0 = resistance limited
- = non resistant

ACIDS

Acetic acid	+
Benzoic acid	+
Boric acid	+
Chromic acid 30%	-
Citric acid	+
Formic acid 25%	0
Hydrochloric acid 10%	+
Conc. hydrochloric acid	0
Lactic acid 1%	+
Nitric acid 5%	0
Nitric acid 50%	-
Concentrated nitric acid	-
Phosphoric acid 25%	0
Phosphoric acid 50%	-
Sulfuric acid 25%	+
Sulfuric acid 50%	-
Tartaric acid	+
Oxalic acid, saturated solution	+

BASES

Ammonia 5%	0
Ammonia 25%	0
Barium hydroxide 10%	-
Calcium hydroxide	-
Hydroxide of sodium 5%	0
Hydroxide of sodium 20%	-

OILS AND GREASES

Fatty acids	+
Oleic acid	+
Stearic acid	+
Lubricating oil	+

ORGANIC SOLVENTS

Acetone	-
Amyl alcohol	0
Methanol	0
Ethyl alcohol	0
Benzene	0
Butyl acetate	-
Carbon bisulphide	-
Carbon tetrachloride	+
Gasoline	+
Petroleum	+
Naphta	+
Perchlorethylene	0
Toluol	0
Ethyl acetate	0
Dichlorethylene	0
Ether	0

Chemical resistance for polycarbonate covers

ACIDS

Acetic anhydride	-
Acetic acid (low concentration)	+
Hydrobromid acid	+
Hydrochloric acid 10%	+
Concentrated hydrochloric acid	+
Chromic acid	+
Citric acid	+
Hydrofluoric acid 20%	+
Phosphoric acid 86%	+
Carbonic acid	+
Lactic acid 20%	+
Oxalic acid	+
Nitric acid <10%	+
Nitric acid 25%	+
Concentrated nitric acid	-
Sulfuric acid <50%	+
Sulfuric acid 70%	-
Sulfuric acid 95%	-

BASES

Ammonia	-
Sodium hydroxide (strongly diluted)	-
Sodium hydroxide (diluted)	-
Sodium hydroxide (concentrated)	-

SALTS

Aluminum chloride	+
Ammonium chloride	+
Ferric chloride	+
Ferrous chloride	+
Ferric sulfate	+
Ferrous sulfate	+
Copper salt	+
Solution of sodium carbonate	+
Sodium phosphate	+
Sodium hypo-chlorite 0.5%	+
Sodium nitrate	+
Sodium sulfide	-
Calcium chloride	+

ORGANIC SOLVENTS

Acetone	-
Alcohols	+
Aliphatic hydrocarbons	-
Amyl acetate	-
Aromatic solvents	-
Carbon disulfide	-
Carbon tetrachloride	-
Trichlorethylene	-

OILS AND GREASES

Minerals oils	+
Vegetable oils	+
Fatty acids >C6	+

OTHER CHEMICALS

Aniline	-
Phenol	-
Formaldehyde 40%	+
Sea water	+
Hydrogen peroxide 3%	+
Chlorine water solution	-

ALCOHOLS

Does not resist: methyl alcohol, benzylalcohol, furfurylalcohol, amylalcohol

Chemical Resistance for PPO (polyphenylene oxyde)

	Temperature (°C)	
Ethanol	20	+
Benzol	20	-
Soldium chloride	80	+
Acetic acid 10%	80	+
Dichlorethylene	20	-
Ammonia	80	+
Sodium hydroxyde	80	+
Oleic acid	20	+
Hydrochloric acid 10%	80	+
Hydrochloric acid 37%	20	+
	80	-
Sulfuric acid 10%	80	+
Toluol	20	-

Resistance To Weathering

Regardless of the product range or the manufacturer, it is known that hot compression-molded FRP is subject to erosion when used. Due to the combined action of rain, wind and UV rays the polyester matrix is only superficially eroded and glass fibers become apparent, the depth of the erosion is only 7 µm.

This slight erosion is unavoidable unless a surface coating (eg. varnish) is applied (which brings with it additional problems such as adhesion). It is important to note that any erosion is very superficial and has no effect on the physical characteristics of polyester (electrical, mechanical or chemical).

Vynckier fiberglass enclosures have been successfully used outdoors since 1958 and tests on field samples support laboratory results.

Painting of Fiberglass Enclosures

Because of the presence of mold release agents, painting of hot molded fiberglass generally requires surface preparation prior to painting.

To ensure a good bond, the following points are important:

- adequate surface cleaning or preparation
- use of an appropriate primer. This is recommended, but satisfactory results can be obtained without it.

The surface preparation can be one of several ways:

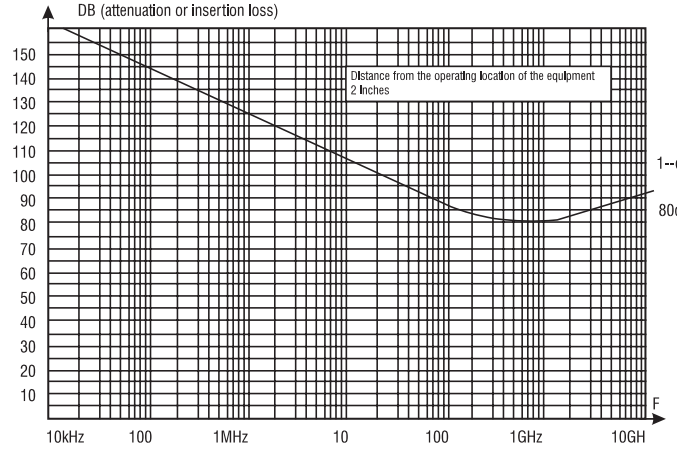
- roughening of the surface with an abrasive such as pumice or waterproof carborundum paper. This ensures good adhesion but the operation can be time consuming.
- degreasing the surface with an organic solvent such as trichlorethylene. This by itself, however, is not the preferred method as attention is required to prevent the evaporating solvent from leaving mold release residue which could interfere with a good bond.
- degreasing and cleaning with alcohol. This normally gives satisfactory results.
- degreasing with a water solution of alkaline or caustic salts such as sodium carbonate or trisodium phosphate. The solution can also contain a detergent or other domestic cleaning products.
- industrial solvents: aromatic hydrocarbon eg. benzene, toluene, xylene, butyl acetate, glycol acetate

After cleaning the product must be carefully rinsed and dried.

Once the surface has been prepared, an appropriate primer and top coat, based on polyurethane or epoxy, should give satisfactory results. Recommendations for use of a specific paint should be obtained by reference to the paint manufacturer.

Attention should be taken to ensure appropriate ventilation is utilized and manufacturers recommendations are followed to prevent any toxic effects of any chemicals used in this process.

Typical (representative) attenuation or insertion loss curve



SPECIFICATION:
We provide coating capable of an atteunation level of 60 to 65 db at 2 mils of thicknes per ASTM ES 7-38.
The gasket is a continuously extruded silicon elastomer

EMI-RFI Protection

Foreward

Electromagnetic pulses (EMPS) may adversely affect electronic and other control systems. These disturbances may be such that they cause erratic operation, component failure or a reduction in component life. This electromagnetic energy, called EMI, has become an added pollutant in the radio spectrum.

Vynckier can provide EMI-RFI shielded enclosures which give effective protection against electromagnetic and radio frequency interference, hence the designation EMI-RFI.

Application

The EMI-RFI enclosures have been especially designed to overcome the problems frequently arising from power supplies featuring non-sinusoidal input current waveforms, such as those produced by energising and deenergising transformers and regulators, the on and off switching of digital electronic controls, etc.

The EMI-RFI enclosure is made of insulating molding material, suitable for installation outdoors or indoors, that serves a double duty:

— it attenuates the radiation of enclosed EMI generating appliances from getting OUT and
— it guards sensitive equipment from breakdowns and destruction due to EMI radiation getting IN.

Specification:

Vynckier procedures for coating are providing an attenuation level of 60 to 65 db at 2 mils of thickness per ASTM ES 7-83.
The gasket is a continuously extruded silicone elastomer fill with silver-plated inert particles.

Hazardous Gases or Vapors

The chart below shows the differences in the way specific gases or vapors are designated.

Gas	Explosive Group (NEC)	Explosive Group (IEC)	Comment
Acetylene	A	IIC	Acetylene is IIC
Hydrogen	B	IIB	Hydrogen is IIC
Ethylene	C		Ethylene is IIB
Propane	D	IIA	Propane is IIA

These global products consist of flameproof components with increased safety terminals which are enclosed in non-metallic housings.

1)	IEC Term Flameproof	NEC Term Explosion-proof	IEC Symbol "d"	IEC Suitability Zone 1, 2

Description: Sources of ignition are contained within enclosures which can contain an internal explosion without igniting the surrounding atmosphere.

2)	IEC Term Increased Safety	NEC Term NA	IEC Symbol "e"	IEC Suitability Zone 1,2

Description: Additional measures are taken to prevent excessive heat, arcs, or sparks from occurring in equipment where this does not normally occur, i.e., terminals.

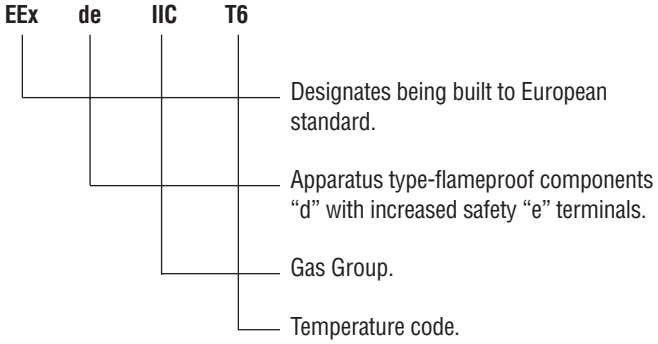
Classification of Maximum Surface Temperatures

The IEC has a system of "T" codes which are used to designate the maximum operating temperatures on the surface of the hazardous location equipment.

Maximum Degrees °C	IEC/NEC "T" Code
450	T1
300	T2
200	T3
135	T4
100	T5
85	T6

Product Marking

In addition to traditional NEC product markings for NEC hazardous location suitability, these products also carry CENELEC markings. A breakdown of the symbols is shown below.



NEMA Ratings/IP Codes

NEMA ratings are standards which define the hazardous or hostile environments which may face a particular electrical installation. Under IEC publication 529, the degree of protection required for a given enclosure is defined as IP (Ingress Protection) codes. IP codes are two digit numerals which can be derived from the following chart.

Ingress Protection (IP) Codes

First Numeral	Protection against Solid Bodies	Symbol description
	0	No protection
	1	Objects greater than 2.0"
	2	Objects than .47"
	3	Objects greater than .10"
	4	Objects greater than .04"
	5	Dust protected
	6	Dust tight

Second Numeral	Protection against liquid	Symbol description
	0	No protection
	1	Vertically dripping water
	2	75° to 90° angled dripping water
	3	Sprayed water
	4	Splashed water
	5	Waterjets (Hose)
	6	Heavy seas
	7	Effects of immersion
	8	Indefinite immersion

Example: IP65

Hazardous areas under CENELEC European Norms

Zone 0 = Zone in which an explosive gas/air mixture is continuously present or present for long periods.
Zone 1 = Zone in which an explosive gas/air mixture is likely to occur in normal operation.
Zone 2 = Zone in which an explosive gas/air mixture is not likely to occur in normal operation and if does, will only last for a short period.

EXPLANATION OF CERTIFICATE SYMBOLS

The following tables can be used as practical quick guides.

The different EX protection types specified are:

Protection type	Symbol	Test Standard
Increased safety	e	EN 50019
Non-sparking	n	
Flameproof	d	EN 50018
Intrinsically safe	i	EN 50020
Special protection	s	
Encapsulation	m	EN 50028
Oil immersion	o	EN 50015
Pressurisation	p	EN 50016
Sand or powder filled	q	EN 50017