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 bisphenol 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

<table>
<thead>
<tr>
<th>Properties</th>
<th>Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact strength</td>
<td>ISO 179</td>
</tr>
<tr>
<td>Notched impact strength</td>
<td>ISO 179</td>
</tr>
<tr>
<td>Flexural strength</td>
<td>ISO 178</td>
</tr>
<tr>
<td>Tensile strength</td>
<td>ISO 3268</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Properties</th>
<th>Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tracking resistance</td>
<td>IEC 112</td>
</tr>
<tr>
<td>Surface resistivity</td>
<td>IEC 93</td>
</tr>
<tr>
<td>Special resistivity</td>
<td>IEC 93</td>
</tr>
<tr>
<td>Dielectric strength</td>
<td>IEC 243</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Properties</th>
<th>Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection temperature</td>
<td>ISO 75/A</td>
</tr>
<tr>
<td>Vicat softening point</td>
<td>ISO 306/B50</td>
</tr>
<tr>
<td>Temperature resistance</td>
<td>continuous</td>
</tr>
<tr>
<td>Color fastness</td>
<td>ISO R879</td>
</tr>
<tr>
<td>Tropicalization and resistance to mold</td>
<td>IEC 68-2-3</td>
</tr>
<tr>
<td>and fungus growth</td>
<td></td>
</tr>
<tr>
<td>Water absorption</td>
<td>ISO 62/1 96h</td>
</tr>
<tr>
<td>Density</td>
<td>ISO R1183</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Properties</th>
<th>Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit oxygen index</td>
<td>ISO 4589</td>
</tr>
<tr>
<td>Flammability</td>
<td>UL 94 (3mm)</td>
</tr>
<tr>
<td>Hot wire resistance</td>
<td>IEC 695-2-1</td>
</tr>
<tr>
<td>Toxicity of fumes</td>
<td>ISO 4615</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Properties</th>
<th>Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance to splashes and vapors (any concentration that is not harmful to mankind)</td>
<td></td>
</tr>
<tr>
<td>Acids 10%</td>
<td></td>
</tr>
<tr>
<td>Bases 10%</td>
<td></td>
</tr>
<tr>
<td>Salts</td>
<td></td>
</tr>
<tr>
<td>Organic solvents</td>
<td></td>
</tr>
<tr>
<td>Oils and fats</td>
<td></td>
</tr>
<tr>
<td>Combustibles</td>
<td></td>
</tr>
<tr>
<td>Longlasting contact (not harmful to people)</td>
<td></td>
</tr>
<tr>
<td>Acids 10%</td>
<td></td>
</tr>
<tr>
<td>Bases 10%</td>
<td></td>
</tr>
<tr>
<td>Mineral oils and combustibles</td>
<td></td>
</tr>
<tr>
<td>Unit</td>
<td>FRP</td>
</tr>
<tr>
<td>--------------</td>
<td>-----</td>
</tr>
<tr>
<td>kJ/m²</td>
<td>55</td>
</tr>
<tr>
<td>kJ/m²</td>
<td>55</td>
</tr>
<tr>
<td>MPa</td>
<td>150</td>
</tr>
<tr>
<td>MPa</td>
<td>50-60</td>
</tr>
<tr>
<td>V/50dr</td>
<td>KC600</td>
</tr>
<tr>
<td>cm</td>
<td>10¹²</td>
</tr>
<tr>
<td>kV/mm</td>
<td>18</td>
</tr>
<tr>
<td>°C</td>
<td>&gt;250</td>
</tr>
<tr>
<td>°C</td>
<td>-</td>
</tr>
<tr>
<td>°C</td>
<td>-50 to +150</td>
</tr>
<tr>
<td>Blue wool scale</td>
<td>7-8</td>
</tr>
<tr>
<td>mg</td>
<td>45</td>
</tr>
<tr>
<td>kg/dm³</td>
<td>1.75</td>
</tr>
<tr>
<td>% O₂</td>
<td>26</td>
</tr>
<tr>
<td>°C</td>
<td>94HB</td>
</tr>
<tr>
<td>% Cl</td>
<td>halogen-free</td>
</tr>
</tbody>
</table>

- good resistance
- fair resistance
- limited resist
- excellent chemical resistance except to effect of acids and phenols

(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%
- Ammonium carbonate 10%
- 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 (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%
- Sodium chloride +
- Sodium hypochlorite 5%
- Sodium nitrate +
- Zinc chloride +
- Sulfate of zinc +

### OTHER AGENTS AND MEDIA
- Ethylene glycol solution of 0 to 100% +
- Glycerine +
- Chlor dioxide (bleaching agent) -
- Saturated chlorinated water +
- Formaldehyde 10 to 40% +
- Hydrogen peroxide 5 to 10% +
- Normal water +
- Distilled water +
- Sea-water +
- Phenol 0

### 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 +
- Perchloroethylene 0
- Toluol 0
- Ethyl acetate 0
- Dichloroethylene 0
- Ether 0

## Chemical resistance for polycarbonate covers

### ACIDS
- Acetic anhydride -
- Acetic acid (low concentration) +
- Hydrobromic 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 carbonate +
- Sodium hypo-chlorite 0.5% +
- Sodium nitrate +
- Sodium sulfide +
- Calcium chloride +

### ORGANIC SOLVENTS
- Acetone -
- Alcohols +
- Aliphatic hydrocarbons -
- Amyl acetate -
- Aromatic solvents -
- Carbon disulphide -
- Carbon tetrachloride -
- Trichloroethylene -

### OILS AND GREASES
- Minerals oils +
- Vegetable oils +
- Fatty acids >G6 +

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

### ALCOHOLS
- Does not resist: methyl alcohol, benzylalcohol, furfurylalcohol, amylalcohol

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.


### Chemical Resistance for PPO (polyphenylene oxide)

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Residue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol 20</td>
<td>+</td>
</tr>
<tr>
<td>Benzol 20</td>
<td>-</td>
</tr>
<tr>
<td>Sodium chloride 80</td>
<td>+</td>
</tr>
<tr>
<td>Acetic acid 10%</td>
<td>+</td>
</tr>
<tr>
<td>Dichloroethylene 20</td>
<td>+</td>
</tr>
<tr>
<td>Ammonia 80</td>
<td>+</td>
</tr>
<tr>
<td>Sodium hydroxide 80</td>
<td>+</td>
</tr>
<tr>
<td>Oleic acid</td>
<td>+</td>
</tr>
<tr>
<td>Hydrochloric acid 20</td>
<td>+</td>
</tr>
<tr>
<td>Hydrochloric acid 37%</td>
<td>-</td>
</tr>
<tr>
<td>Sulfuric acid 10%</td>
<td>+</td>
</tr>
<tr>
<td>Toluol 20</td>
<td>-</td>
</tr>
</tbody>
</table>

### 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 (e.g., 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 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 trichloroethylene. 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 such as benzene, toluene, xylene, butyl acetate, glycol acetate.

### EMI-RFI Protection

**Foreword**

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.
- It guards sensitive equipment from breakdowns and destruction due to EMI radiation getting IN.

**Specification**

We provide coating capable of 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.

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

<table>
<thead>
<tr>
<th>Gas</th>
<th>Explosive Group (NEC)</th>
<th>Explosive Group (IEC)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetylene</td>
<td>A</td>
<td>IIC</td>
<td>Acetylene is IIC</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>B</td>
<td>IIC</td>
<td>Hydrogen is IIC</td>
</tr>
<tr>
<td>Ethylene</td>
<td>C</td>
<td>IIB</td>
<td>Ethylene is IIB</td>
</tr>
<tr>
<td>Propane</td>
<td>D</td>
<td>IIA</td>
<td>Propane is IIA</td>
</tr>
</tbody>
</table>

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

1) **IEC Term** NEC Term IEC Symbol IEC Suitability
   **Description:** Sources of ignition are contained within enclosures which can contain an internal explosion without igniting the surrounding atmosphere.
   **Flameproof** Expansion-proof **“d”** Zone 1, 2

2) **IEC Term** NEC Term IEC Symbol IEC Suitability
   **Increased NA** **“e”** 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.

<table>
<thead>
<tr>
<th>Maximum Degrees °C</th>
<th>IEC/NEC “T” Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>450</td>
<td>T1</td>
</tr>
<tr>
<td>300</td>
<td>T2</td>
</tr>
<tr>
<td>200</td>
<td>T3</td>
</tr>
<tr>
<td>135</td>
<td>T4</td>
</tr>
<tr>
<td>100</td>
<td>T5</td>
</tr>
<tr>
<td>85</td>
<td>T6</td>
</tr>
</tbody>
</table>

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.

EXPLANATION OF CERTIFICATE SYMBOLS
The following tables can be used as practical quick guides.

**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**

<table>
<thead>
<tr>
<th>First Numeral</th>
<th>Protection against Solid Bodies</th>
<th>Symbol description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No protection</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Objects greater than 2.0&quot;</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Objects than .47&quot;</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Objects greater than .10&quot;</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Objects greater than .04&quot;</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Dust protected</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Dust tight</td>
<td></td>
</tr>
</tbody>
</table>

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

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.

**NEX de IIC T6**
**Designates being built to European standard.**

Apparatus type-flameproof components “d” with increased safety “e” terminals.

Gas Group.

Temperature code.