



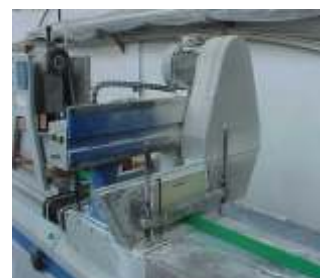
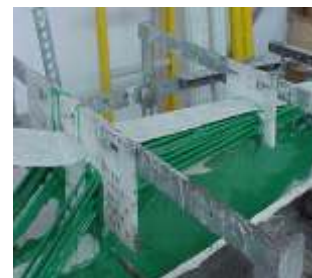


The pultruded profiles are high performance products, manufactured in a continuous process called pultrusion. Pultrusion is a continuous manufactory process of plastic reinforced with glassfiber profiles. Involves the fiber incorporation, such as glassfiber, carbon or aramid (Kevlar®), on a variety of high performance resins, polyester is the most used, but depending on the profile applicability, it may be used vinilester, acrylic or epoxy resins.

In this process, fibers are dragged thru a resin bath and guided to a hot spinner. This spinner has the profile geometry we wish to manufacture.

The composite fiber/resin polymerization occurs inside the spinner. A traction system pulls the profile till the saw to cut the profile with the measure we wish. The fiber content may vary 40% to 80%, depending on the profile applicability.

Engineers, Architects and Designers are constantly looking for ways to improve our products. The goods selection is the critical part of this process. The pultruded composites have multiple advantages over the traditional materials, such as steel and aluminum and the search is growing.





Properties and Benefits

- △ Maintenance free.
- △ Excellent resistance to corrosion, acids and several chemical products.
- △ Light and flexible, around 1/4 of the steel weight and 2/3 of the aluminum weight.
- △ High relation resistance/weight.
- △ Electrical and thermal isolation, non-conductor under extreme temperatures.
- △ Non – magnetic.
- △ Dimensional stability, low thermo expansion coefficient. Intense heat and cold resistant.
- △ Color, pigments are added to obtain the wanted color. The matrix is entirely the same color, which allows camouflaging the scratches.
- △ Profiles processing, these materials are easily cut, drilled, glued, riveted or screwed with conventional equipment.
- △ Excellent behavior to fatigue and fluency.
- △ Transparent to radio frequency transmission.
- △ The almost infinity of possible sections, means a high level of design freedom and choice of properties like resistance, weight, color and flexibility.
- △ The manufactory process nature guaranties reproducibility and does not brings limitations to the profile length.
- △ Good mechanical vibrations absorber.



Electrical

- △ Cable trays
- △ Cable mats
- △ Isolating ladders
- △ Armors
- △ Electric transformers
- △ Stays
- △ Non - magnetic structures
- △ Light poles
- △ Electric transport poles
- △ Tool cables



Transports

- △ Profiles for trucks
- △ Tows
- △ Plummets to signing plaques
- △ Container structures
- △ Shock absorber bars



Construction / anticorrosive

- △ Building structures
- △ Handrails
- △ Walkways
- △ Cold chambers armors
- △ Ladders
- △ Protection barriers
- △ Peasant bridges



Leisure and sports

- △ Vaulting
- △ Garden benches
- △ Fences
- △ Flag masts



Pultruded profiles are profiles made of plastic with resin, usually thermosetting, reinforced with fiber, this fiber may be glassfiber, carbon fiber or aramid fiber. These profiles possess high specific mechanic and chemical resistance, because of that they're applied in places with corrosion problems, to avoid frequent maintenance actions.

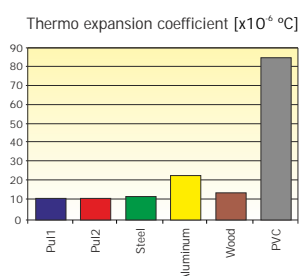
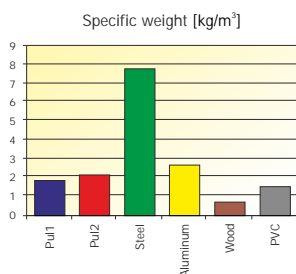
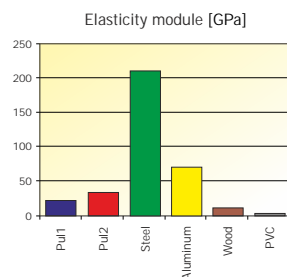
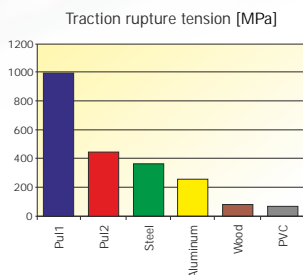
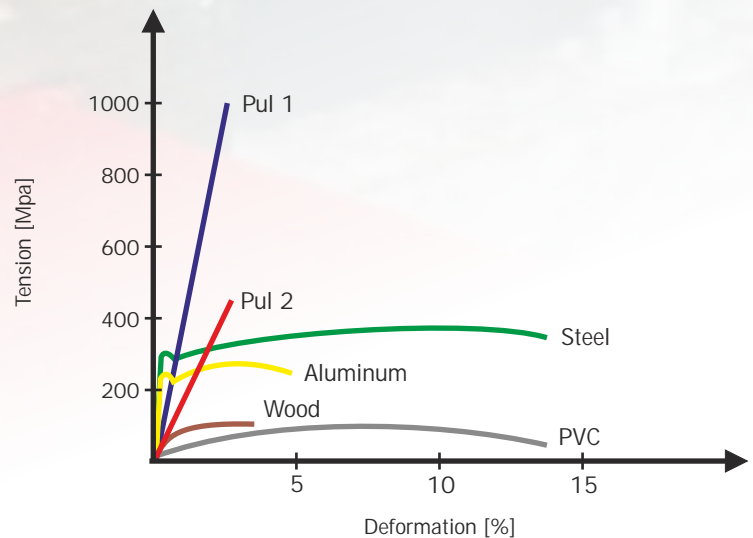
Mechanical properties vary with the resin and reinforcement used, the polyester glassfiber reinforced profiles are the most usual.



Properties and comparison

Pul 1 - Pultruded profile with unidirectional glassfiber reinforcement only.

Pul 2 - Pultruded profile with unidirectional reinforcement and glassfiber cloth.



Properties	Norm	Units	Medium value
Density	ASTM D 792/UNI 7092	g/cm ₃	1.8
Inorganic substance content	ISO 1172	%	60
Water absorption	ASTM D 570/ISO 62	%	0.15
Barcol hardness	ASTM D 2583	—	50
Resistance to Charpy impact	ASTM D 256/UNI 6062	KJ/m ₂	230
Thermal expansion coefficient ⁽¹⁾	ASTM D 696/UNI 6061	1/°C	11x10 ⁻⁶
Thermal expansion coefficient ⁽¹⁾	ASTM D 638/UNI 5819		
Elasticity module	"	GPa	32
Resistance	"	MPa	450
Elongation to rupture	"	%	1.5
Properties to flexion ⁽¹⁾	ASTM D 790/UNI 7219		
Elasticity module	"	GPa	23
Resistance	"	MPa	450
Section module	—	GPa	28
Properties to compression ⁽¹⁾	ASTM D 695/UNI 4279		
Elasticity module	"	GPa	23
Resistance	"	MPa	350

⁽¹⁾ The indicated values refer to the profile longitudinal direction.

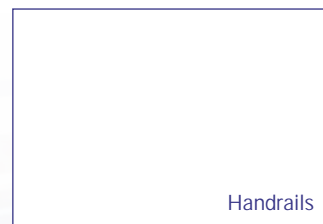


The pultruded profile handrails are applied in industrial, commercial and domestic structures. It's resistance to corrosion allied to its low weight is the main characteristic. These handrails may be applied with monochromatic or polychromatic coloration; the pultruded profile guard may be pre-manufactured or easily assembled on the site. The guard is conceived in a way that is maintenance free for years.

The handrail's configuration is infinite, being able to combine a large variety of profiles and other materials.

Its fixation may be made laterally, with the application of bushings or screws, preferentially stainless steel; or vertically using an accessory, a foot, which has to be stainless steel or a corrosion resistant material as well and maintenance free.

There's the possibility to put doors in these handrails, the doors may have the same configuration of the handrails.



Handrails





Stairs

The pultruded profile stairs are characterized by its resistance to corrosion, lightness and easy assembly. These stairs are pre-manufactured and applied without heavy elevation means. Its lightness is one of the reasons that allows its application in places where is impossible to reach with elevation machinery.

Made of pultruded profiles and GRP grating, united by stainless steel screws, allows a very long time of maintenance absence.

The pultruded profile stairs can only be manufactured in straight fragments. The stairs that follow curved walls are manufactured in straight segments so that they can follow the curves.

To stairs that must have a circular form, the GRP materials manufactory process is different; this situation applies to winding staircases. The steps for these stairs are manufactured by a different process. Each step is a single piece and they're engaged into a central column.



Walkways

The GRP (glassfiber reinforced plastics) walkways are made of pultruded profiles and its floor of GRP grating or safety floor. These walkways are the ideal choice to places with corrosion problems. The materials lightness makes the assembly work a lot easier, with no elevation means required. Around 4 times lighter than steel, these materials can be loaded with low human resources.





The pultruded profile ladders are characterized by its chemical resistance and absence of maintenance. These may be attached or removable. The attached vertical ladders are applied in the chemical industry, sanitation, water treatment stations, etc.

Its innocuousness in contact with water, allows its use in human water-supply systems. The attached vertical ladders may be supplied with back protection when necessary.

The back protection, also made of the same materials may have superior, frontal or side, right or left exit.

In what concerns the superior ladder exit, both ladder and back protection go till the superior ladder top. In these the way out has no support to help the exit.

In frontal exit ladders, is added a segment without steps above the level of the ladders to provide support to the superior exit and entrance of the ladder. In this case there's two supporting plummets. In these ladders the back protection goes till the supporting plummets height.

On side exit ladders, the ladder is longer; enough to allow the support on lateral exit and the back protection that goes till the ladder limit is interrupted on the exit side.

It may be assembled resting intermedium landings with pultruded profiles and GRP grating or safety floor.

The pultruded profile removable ladders main application is the electrical industry. Theirs electrical isolation is ensured by the pultruded profile plummets, the steps may be aluminum or pultruded profiles.





Grating

The GRP moulded grating, composed by glassfiber strings and thermosetting resin, is the ideal pavement for many applications. Chemically resistant and lighter than metallic gratings, this kind of material is a good choice to industrial, urban and domestic installations, with no need of maintenance.

This grating is manufactured in panels with a high resistance mesh that allows cutting in the application site, minimizing this way the waste. After cut or indentation is not required any additional treatment.

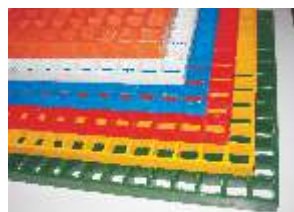
Moulded into one piece, the concave upper side makes it anti-slipping. In situations of superior demands it may be applied a fine grain anti-slipping layer.

The square mesh grating is the one with better resistance and major profits as well. It has square mesh with bars of equal sections in both ways, which allows its application without the need of continuous support.



Moulded grating advantages

- △ Corrosion resistant
- △ High resistance
- △ Impact resistant
- △ Fire resistant
- △ Non-electric conductor
- △ Non-magnetic
- △ Anti-slipping
- △ Anti-sparks
- △ Maintenance free
- △ Light and easy to install
- △ Manufactured in the desired color



Resin types

Depending on the final application requisitions, may be used the following types of resin:

Type	Characteristics	Application
OF	Orthophthalic polyester resin	Slightly corrosive environments
IF	Isophthalic polyester resin	Industrial and chemical, where corrosion resistance is important
VF	Vinilester resin	Industrial and chemical, where corrosion resistance needs to be very big
PF	Phenolic resin	High resistance to fire and low smoke emissions

All types of grating posses class 1 to flames propagation coefficient of 25 or less, according to the tunnel test norm ASTM E-84.

The PF type has a flames propagation coefficient of 5 and smoke density coefficient of 5, according to the norm ASTM E-84.

There's the possibility of specific requisitions under consultation.



Safety floor

A variant of this grating is the safety floor. It is composed by superficially covered grating. On its surface may be applied an anti-slipping layer.

The GRP safety floors may be applied in a stanching way.





Structures

Just like the traditional material structures, the pultruded structures can support large cargos.

Its lightness and absence of maintenance, even in chemically aggressive environments are important factors when choosing these materials.

The pultruded profile structures may be glued, screwed or the combination of both methods.

The flexibility of these materials has been a good option for areas where the earthquake risk is higher.

The choice of these materials in the rehabilitation of old houses is rising, mainly because of its lightness, easy handling and maintenance free. These materials may be manufactured with fire resistance and/or may be painted with fire resistant paint.



Fences

The application of glassfiber reinforced plastic fences is ideal for applications where's needed corrosion resistance, absence of maintenance, easy assemble and where's required radio transparency, such as radars and airports.





The GRP (glassfiber reinforced plastic) coverings are designed and manufactured according to the application demanding. The glassfiber and polyester or vinilester matrix, are particularly used on corrosive environments or in situations where's required absence of maintenance. Some typical applications are the chemical industry, water treatment stations and commercial structures with saline environments. These coverings may be self bearers or placed over pultruded profile structures. It is possible the assembly of a man entrance or chimneys.

The glassfiber reinforced plastics (GRP) manufactured pieces, are manufactured using essentially two elements, glassfiber (reinforcement) which is resin impregnated (plastic matrix). Depending on the desired chemical resistance, it may be used several types of resin. The most usual are polyester, which may be orthophthalic for solutions where's not needed considerable chemical resistance; isophthalic where is desirable considerable chemical resistance and vinilester where's wanted high chemical resistance.

The search of application of glassfiber reinforced plastics (GRP) on coverings or façades have been rising, due to its characteristics, mainly because of the maintenance absence, low weight, easy handling, esthetics, etc.

These kinds of pieces may be manufactured with lots of finishing types, brick imitation, granite, rustic, wood, military camouflage, among others. The coloration is given by a gel coat layer, which is just a painting on the mold before its manufactory and it stays perfectly glued to the piece and guaranties a long life with high resistance to weather and also ultraviolet rays. It is also possible the incorporation of additives with ultraviolet resistance to the resin.

The GRP pieces may be opaque or translucent; in translucent pieces it's not possible to do more than 3mm, because they may not be translucent anymore. In case of pieces for coverings, these may be self bearers, where the assembly the traditional rafters is no longer needed. These solutions may be applied on metallic, pultruded or betony structure building, and its assembly time is significantly low in comparison to the traditional solutions.

To each situation is studied a solution and developed a new product according to the needs. When the thickness of the obtained solution is higher than 3 or 5mm, we must use sandwich type structures. In this case it's used a light nucleus in between the laminated layers without increasing significantly the structure weight, and consequently increasing the pieces resistance. The nucleus may be polyurethane or honeycombs, among others.





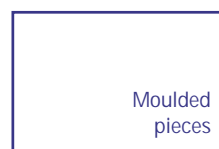
ALTO has a set of manufactory processes of FRP (fiber reinforced plastics). Depending on the series to manufacture, and also the wanted mechanical properties it is chosen the most economic process.

After the solution choice is necessary the mould execution. To the mould's manufactory is made a model that may be metallic, wood, polyurethane, etc, above which the mould is manufactured. This is also manufactured in GRP, which allows having low mould costs. Depending on the quantity of pieces to manufacture, the manufacturing process may be one of the followings:

Hand lay-up – for small series, usually under 50 units. The piece is manufactured over a mould applying glassfiber layers and manually impregnated with resin.

VARTM – for series over 50 units. The piece is manufactured by putting dried glassfiber, where's injected low pressure resin and it is vacuum assisted. This process allows obtaining both sides of the pieces regular and with good finishing.

Infusion – for small series but with high mechanical properties. Identical to the VARTM process where the counter-mould is replaced by a flexible membrane. In this case it is applied maximum depression, squeezing the resin, guaranteeing a high concentration of glassfiber. In this case the consumable materials quantity for the manufactory of the piece is very high, consequently the price is higher. This process is used on the manufactory of technical pieces, standing out the manufactory of airplane wings, where the glassfiber may be replaced by carbon fiber.



Moulded pieces



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