



## FRP and Pultrusion

As the wiki's report Fibre-reinforced plastic (FRP) (also fibre-reinforced polymer) are composite materials made of a polymer matrix reinforced with fibres. The fibres are usually fibreglass, carbon, or aramid, while the polymer is usually an epoxy, vinylester or polyester thermosetting plastic. FRPs are commonly used in the aerospace, automotive, marine, and construction industries.

The FRP is also called GRP(Glass fiber Reinforced Plastic). The main technique to made FRP products contains pultrusion, pulwinding, filament winding, molded, mandrel wrapping and Hand Lay-up. Because those techniques has their own features, for different products, there is a most resonable technique to made it according to the qauality and cost.

(Unicomposite's main products by different technique:

Pultrusion: fiberglass rod, tube, channel and other structure profiles with steady profiles, fiberglass windows profile, fiberglass sail battens, decking, panel, grating, column, lighting pole, cross arm, carbon fiber rod, carbon fiber tube

Pulwinding: rod, tube, taper pole, thin wall pipe, high pressure pipe, power pole, heavy load corss arm,

Molded : composite sheet, carbint, gratings, samll accessories, rebar

Mandrel wrapping: tubes, conical poles, telescopic pole, cabon fiber shaft

Hand lay-up: large garbage can, garden flowerpot, and other parts )

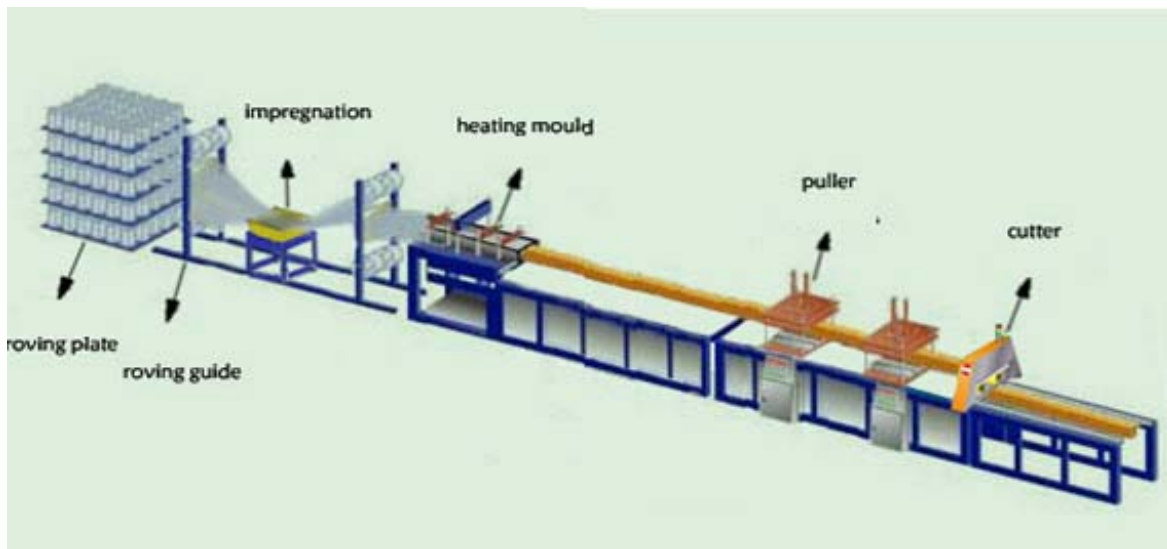
The technique used most widely is the pultrusion. Pultrusion is a continuous process of manufacturing of composite materials with constant cross-section whereby reinforced fibers are pulled through a resin, possibly followed by a separate preforming system, and into a heated die, where the resin undergoes polymerization. Many resin types may be used in pultrusion including polyester, polyurethane, vinylester and epoxy.

But the technology isn't limited to thermosetting resins. More recently, pultrusion has also been successfully used with thermoplastic matrices such as polybutylene terephthalate (PBT) either by powder impregnation of the glass fiber or by surrounding it with sheet material of the thermoplastic matrix which is then molten



## The advantages of FRP products

- Light Weight
- High Strength
- Durable and Long Service Span.
- Corrosion Resistant.
- Lasting Performance
- Excellent Structural Properties
- Environmentally Safe
- Electrical and Thermal Insulation
- Dimensional Stability



### Process of pultrusion

For most application, the material used is polyester and fiberglass. Also the carbon fiber is used for the application which needs more stiffer and strength.

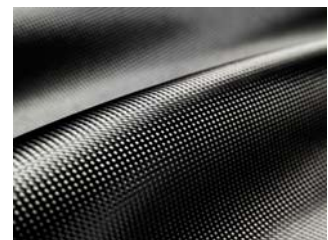
Material: resin, fiberglass roving, fiberglass mat, carbon fiber roving, carbon fiber mesh.



**Fiberglass Roving**



**Fiberglass Mat**



**Carbon Fiber Cloth**

## Question and Answer about pultrusion (from pultruder.org)

Can GRP profiles be recycled?	GRP profiles are fully recycleable. There are recycling concepts for particle and energy usage available. A real advantage is the fact that no halogen or heavy metal is included which does not require special treatment.
Can GRP profiles be welded?	no
Can GRP profiles be glued?	GRP profiles may be glued. Typically single stage or multi stage glues will be used.
Can GRP profiles be bolted?	GRP profiles can be bolted with metallic or non-metallic bolts
Which colours can be realized?	Polyesters (UP) based GRP profiles are available without restrictions in colouring. Transparent colouring is generally not available.
Can GRP profiles be melted?	GRP profiles are not meltable. They offer a high temperature resistance.
What are the ingredients of GRP profiles?	GRP profiles are containing - beneath the corresponding resin (thermoset or thermoplastic)- glass fibres, carbon fibres or other fibres. They can contain flame retardants (e.g. ATH), UV stabilizers and special fillers.
Do GRP profiles show creepage?	GRP profiles in direct comparison to thermoplastics are only showing very little creepage (cold flow) which is why the material is extremely well positioned for engineering appliances.
Against which media are GRP profiles resistant?	GRP profiles are very resistant against many organic and anorganic solvents. The chemical resistance depends on the matrix resin
Can GRP profiles be coated or metal-plated?	There are special GRP profiles available to metal-plating and other coatings.
Comparison thermoplastic / thermoset matrix for GRP profiles	Thermoset matrices form opposite to thermoplastic matrices 3-dimensional network during moulding. This is the reason for their excellent temperature stability and very high thermo-mechanical properties.
Do GRP profiles contain any heavy metals or halogens?	GRP profiles do neither contain heavy metals nor halogens.
Are varying wall-thicknesses possible?	No, not within the same part.
Do recesses or shrinkholes appear?	Shrinkholes or recesses do not appear, if processing is done correctly.
What shrinkages do appear?	GRP profiles usually do show very little shrinkage and post-shrinkage. Depending on the used fillers and resins you may experience shrinkages from zero to less than one per cent .
Are GRP profiles prepared for coding or marking?	GRP profiles may be laser-marked. Furthermore you may code the product by ink-jet printing or chip technology (Laser or Needles).
Which techniques for joining are available?	Glueing      Bolting

How is production of samples done?	See the chapter "What is pultrusion?" at this web site
Can GRP profiles processed?	Yes, by the following methods: Grinding Drilling Turning Milling Sawing Water jet cutting Laser Blasting
Can inserts be integrated?	Not during the manufacturing process
Can screws be driven directly into GRP profiles?	There are special screws available which allow direct screwing even into GRP profiles. The design of the screw holes has to be precisely adapted to the type of material. In particular the very little cold-flow of GRP profiles is giving high preference on these materials for direct screwing. These screw-fit is not designed for reversible usage.
Can thermoset parts be connected with rivets?	Yes
Do GRP profiles require special mould tools?	See the chapter "moulds" at this website ("What is pultrusion")
What part weights can be realized?	from 10 grs. up to serveral kilograms.
Are tapers required?	Usually tapers of 1-2 degrees are sufficient.
Are technologies for simulation available?	Mold-Flow-Simulation is used already. It is based on 3-dimensional layout and allows calculation of network-creation.
How is deflashing done on GRP profiles?	There is no need for deflashing
Can GRP profiles be adapted to specific conditions of usage (e.g. temperature)?	Yes. It depends on the matrix resin
What temperatures can GRP profiles withstand?	short time up to 250 ° C (depending on the matrix resin) long term ~ 120 ° C These data have to be checked and confirmed by application and cannot be taken as a general condition.
Can thermoset-parts be cleaned?	Cleaning with water and cleaning inhibits Solvents (to be checked and confirmed before usage)
Do reinforcing fibres show up after chipping (brush effect)?	Usually any kind of chipping does cut the fibres completely. If any, the brush-building effect of fibres is much less than on thermoplastics.
How are GRP profiles tested?	For standardized methods see chapter „standardisation“ at this website ("What is pultrusion")