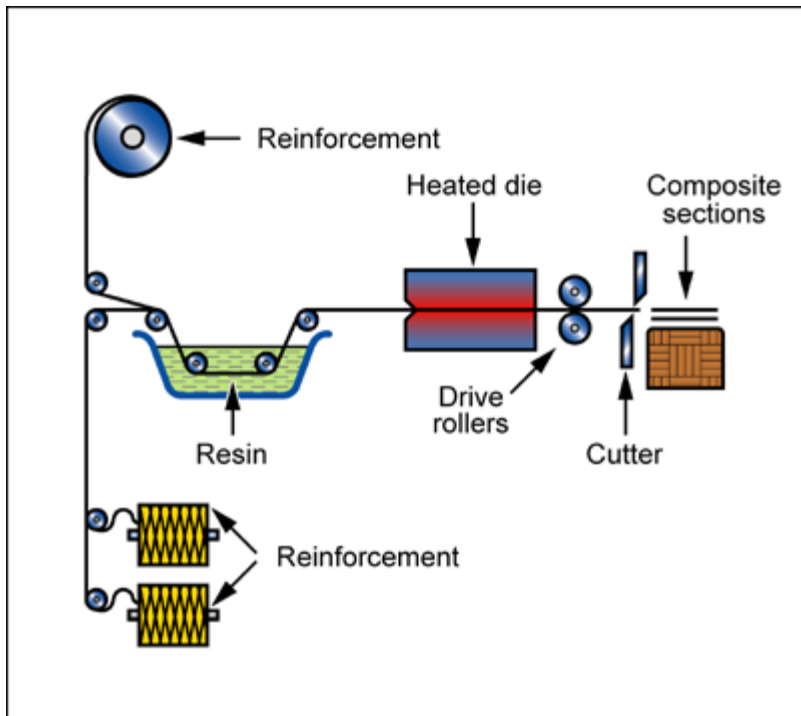


## Description

### Process schematic



### Figure caption

Pultrusion. The pultruded section is drawn through the heated die by the drive

### The process

In PULTRUSION, resin-impregnated fibers or fabrics are pulled through a series of hardened steel forming dies. The last die is heated to cure the resin, producing a rigid composite section. The profile is determined by the die cross-section; solid or hollow circular, rectangular, square sections, and channel and I-sections, are all possible. The speed of travel through the die is determined by the viscosity, thickness and curing of the resin. The section produced is either cut into discrete lengths after the puller system or wound onto a drum.

## Material compatibility

Composites

✓

## Shape

Circular prismatic

✓

Non-circular prismatic

✓

Flat sheet

✓

Dished sheet

✗

Solid 3-D

✓

Hollow 3-D

✗

## Economic compatibility

Relative tooling cost

medium

Relative equipment cost

high

Labor intensity	low
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### Physical and quality attributes

Mass range	0.1	-	200	kg
Range of section thickness	3	-	15	mm
Tolerance	0.25	-	1	mm
Roughness	0.3	-	1.6	μm
Surface roughness (A=v. smooth)	A			

### Process characteristics

Primary shaping processes	✓
Continuous	✓

### Cost model and defaults

Capital cost	8.2e4	-	3.28e5	USD
Material utilization fraction	0.85	-	0.97	
Tooling cost	3.28e3	-	4.92e4	USD

### Supporting information

#### Design guidelines

Pultrusion makes continuous prismatic shapes of constant cross section and thin walls. Pultruded sections of glass or carbon reinforced polyester and epoxy are available as standard products.

#### Technical notes

Liquid polyester and epoxy are the most usual resin systems, but prepreg - epoxy can be pultruded. Reinforcement is typically glass (60-75%), carbon or aramid in the form of continuous roving. The production rate depends on thickness, shape complexity and the curing time of the resin.

#### Typical uses

A range of cross-sections such as rods, tubes, channels, boxes, I-beams and angles are available as standard. They are used for applications such as corrosion resistant walkways, handrails, cable support systems, bridges, ladders and waste management systems.

#### The economics

The costs are greater than for hand lay-up or spray-up but with the compensation of higher quality.

#### The environment

Glass dust causes irritation, resin fumes are a hazard and therefore a good extraction system is required.

### Links

MaterialUniverse

Reference