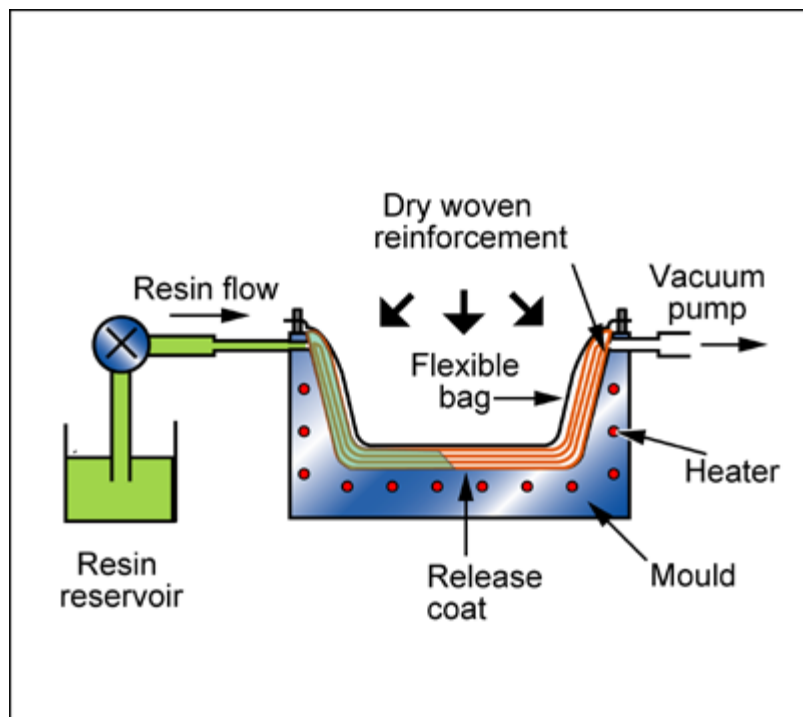


## Description

### Process schematic



### Figure caption

VARTM: the resin is pulled into the dry layup by vacuum.

### The process

VACUUM ASSISTED RESIN TRANSFER MOLDING (VARTM) is a low-cost tooling way of manufacturing large complex shapes of composite materials. Reinforcement is placed in the mold in the form of layers of dry, woven fabric. This is covered by a peel ply and the whole lot is vacuum bagged. Resin is released and sucked into the bag by the vacuum, flowing through and impregnating the fabric, which is then cured.

### Tradenames

VARTM, SCRIMP (Seeman composite resin infusion molding process), RIFT (resin infusion under flexible tooling) VARI (vacuum assisted resin injection), VRTM (vacuum resin transfer molding) RIRM (resin injection re-circulation molding), VIMP (vacuum injection molding process).

## Material compatibility

Composites



## Shape

Flat sheet



Dished sheet



## Economic compatibility

Relative tooling cost

low

Relative equipment cost

medium

Labor intensity	medium		
Economic batch size (units)	10	-	500

### Physical and quality attributes

Mass range	1.1	-	1.32e3	lb
Range of section thickness	39.4	-	787	mil
Tolerance	11.8	-	39.4	mil
Roughness	0.0394	-	0.0945	mil
Surface roughness (A=v. smooth)	A			

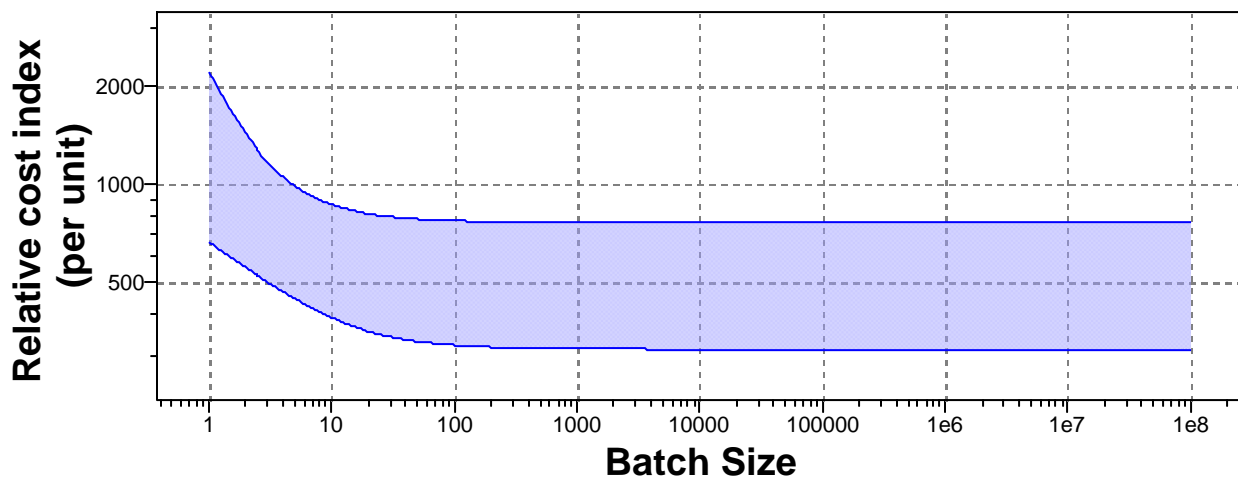
### Process characteristics

Primary shaping processes	✓
Discrete	✓

### Cost model and defaults

Relative cost index (per unit)	314	-	765
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Parameters: Material Cost = 3.63USD/lb, Component Mass = 2.2lb, Batch Size = 1e3, Overhead Rate = 150USD/hr, Discount Rate = 5%, Capital Write-off Time = 5yrs, Load Factor = 0.5



Material Cost=3.63USD/lb, Component Mass=2.2lb, Overhead Rate=150USD/hr, Capital Write-off Time=5yrs, Load Factor=0.5, Discount Rate=5%

Capital cost	820	-	1.64e4	USD
Material utilization fraction	0.85	-	0.95	
Production rate (units)	0.2	-	0.5	/hr
Tooling cost	164	-	1.64e3	USD
Tool life (units)	200	-	500	

### Supporting information

#### Design guidelines

Both simple and complex shapes can be molded. Ribs, bosses and foam inserts are all practical, but undercuts present difficulties.

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**Technical notes**

Most common resin systems can be used; the commonest are epoxies, phenolics, polyesters and vinyl-esters. Reinforcement takes the form of woven fabrics of glass, carbon or other fibers. Polymeric foam cores allow sandwich-like structures to be molded.

**Typical uses**

VARTM and its variants are used to mold small yacht hulls and for boat building, train and truck body

**The economics**

Dies can be expensive. Laser or water-jet cutting can be cheaper than blanking for small batch sizes. Explosive forming competes with stretching for large components and small batch sizes.

**The environment**

The total enclosure of the process gives good environmental control of solvent vapor. The process is an exceptionally clean one.

**Links**

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MaterialUniverse

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Reference

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