

Description

Process schematic

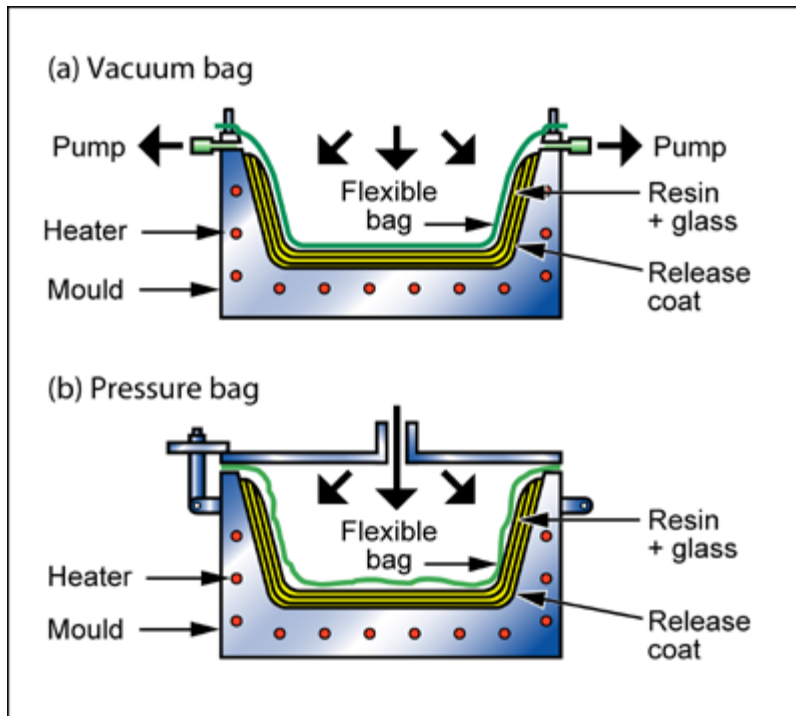


Figure caption

Vacuum-bag and pressure-bag molding (figure following T.H. Meister)

The process

In VACUUM/PRESSURE BAG MOLDING reinforcement is layed-up on the mold and resin is applied by conventional hand or spray lay-up techniques. The laminate is then sealed beneath a rubber membrane and the air pumped. Atmospheric pressure or a pumped pressure applies a uniform compression across its surface. The single-part mold, made of epoxy, GRFP or metal, is relatively cheap. The use of vacuum or pressure bags gives high quality, dense products.

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)

1 - 1e3

Physical and quality attributes

Mass range	1.76	-	4.41e3	lb
Range of section thickness	78.7	-	236	mil
Tolerance	31.5	-	47.2	mil
Roughness	* 0.0197	-	0.126	mil
Surface roughness (A=v. smooth)	A			

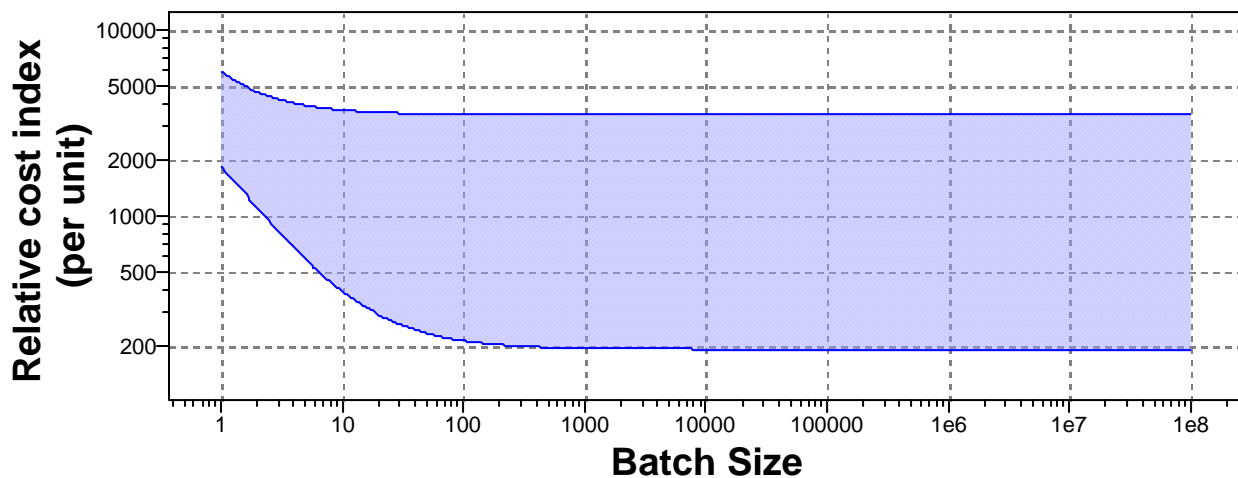
Process characteristics

Primary shaping processes	✓
Discrete	✓
Prototyping	✓

Cost model and defaults

Relative cost index (per unit)	194	-	3.49e3
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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	3.28e4	-	8.2e5	USD
Material utilization fraction	0.85	-	0.95	
Production rate (units)	0.05	-	1	/hr
Tooling cost	820	-	3.28e3	USD
Tool life (units)	100	-	1e3	

Supporting information

Design guidelines

Both processes are limited to simple shapes with high surface area-to-thickness ratio. Ribs and bosses possible but undercuts, inserts and foam panels should be avoided.

Technical notes

Liquid resins based on polyesters or epoxies are commonly used. Prepreg epoxy and polyester SMC can also be molded by these processes. Reinforcement is typically glass (25-60%), carbon or aramid.

Typical uses

Aircraft sections, and interior panels, radomes and structural sections of high-performance

The economics

The cost of sheet forming operations depends largely on tooling costs. Dedicated tools and dies are usually expensive, and require large batch sizes to make them economic. Processes with low cost tooling, such as spinning, are best suited to small batch sizes, because they are labor intensive.

The environment

Although the vacuum bag does reduce the number of volatiles emitted during cure, they can still be hazardous. Disposal of bagging can be environmentally harmful.

Links

MaterialUniverse

Reference