

Simple Vacuum Assisted Composite Techniques

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Why Vacuum Bag?

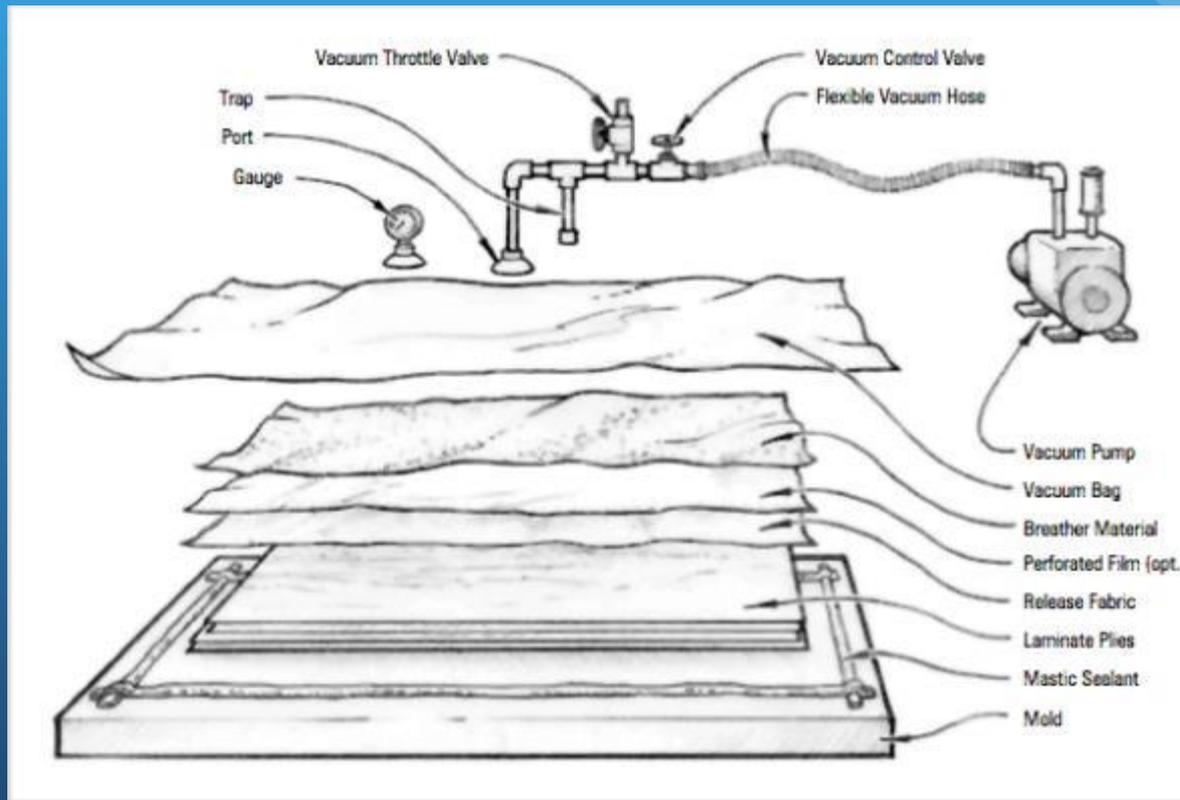
- Provides 1 atmosphere (14.7 psi) of pressure distribution
 - Equivalent of 18 stacked concrete blocks

14 psi Distributed Force



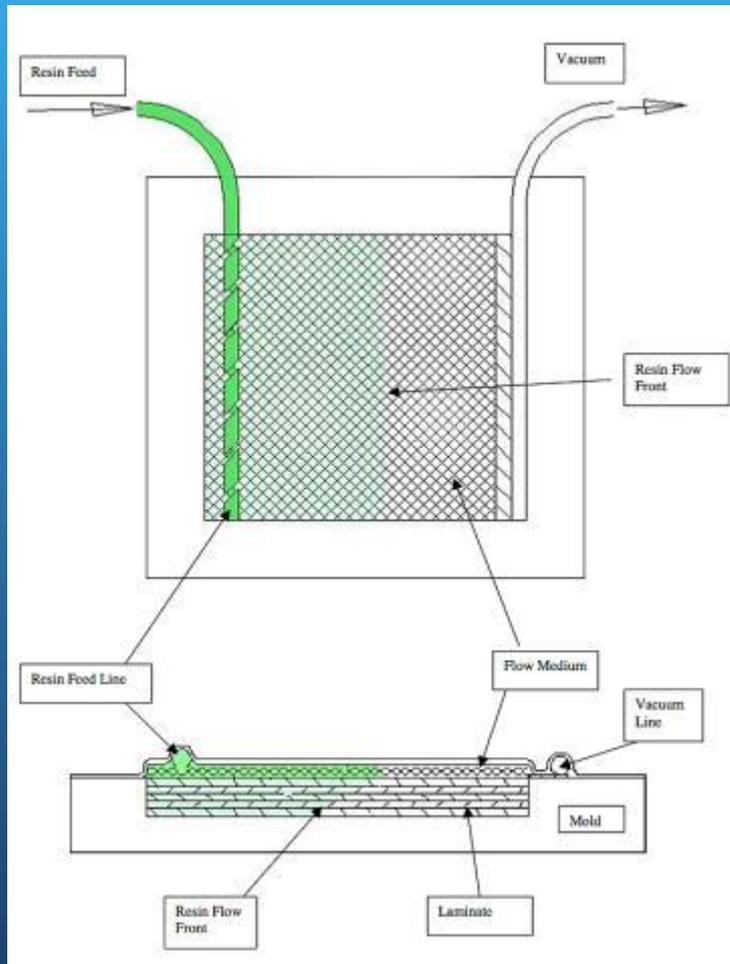
Wet Bagging System

- Typical components of a vacuum bagging system (courtesy Gougeon Bros. Inc.)



- Vacuum assisted system would have a resin source opposite of the vacuum source (TYP)

Vacuum Assisted Resin Transfer

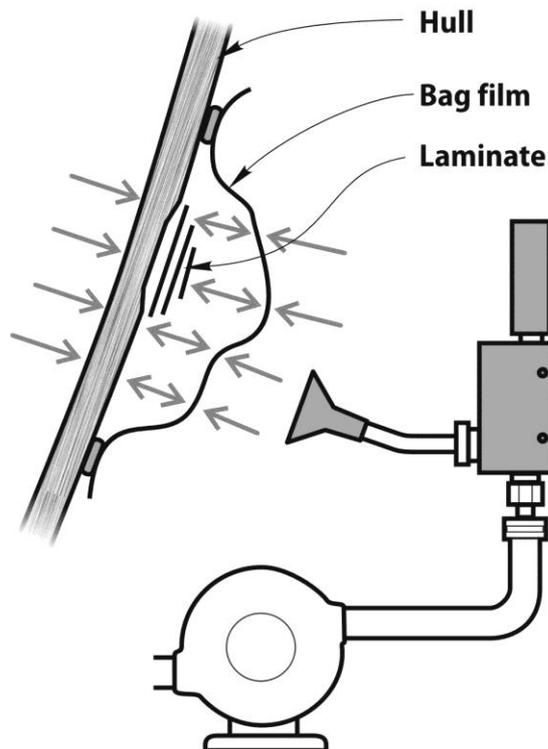


Very basic layout of the process.
The supporting equipment for this procedure is not shown here.

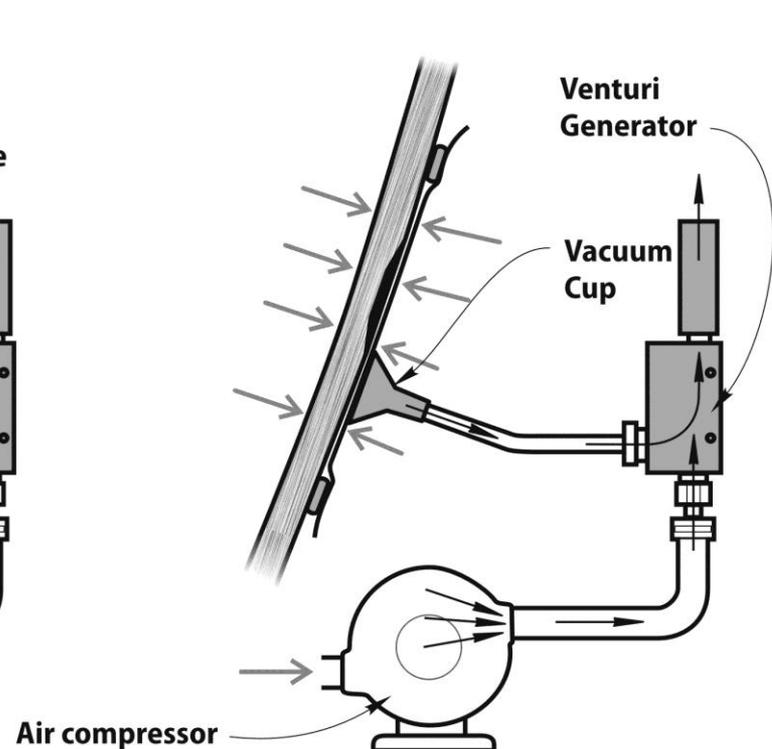
Vacuum Physics

- The action of a vacuum bagging system (courtesy Gougeon Bros. Inc.)

Atmospheric pressure outside and inside of envelope



Atmospheric pressure outside envelope, reduced pressure inside envelope



Tools of the Trade

- Vacuum Pump
 - More is better. Purchase a pump that is a little more than needed
 - Some pumps do not draw a full 28" Hg so make sure to study the SPECS
- Venturi Blocks
 - PRO: reasonable price
 - CON: work well but need a lot of compressor & compressor runs constantly
- Vacuum Gage & Hose
 - Low priced gage can be purchased at the local auto parts retailer or Sears
 - Polypro tubing may be purchased at local home improvement center

Tools of the Trade Cont.

- Vacuum Bag
 - Don't use plastic film from local retail sources, purchase good quality film
 - Vacuum leaks are frustrating to chase and poor quality film will be too porous
 - Handle the bag carefully as little pin holes caused by inadvertent damage (folding, wrinkling, scissors, blades, pointing things on table) are tough to locate once in place
- Tacky Tape
 - I recommend either **Schnee-Morehead** or **General Sealants**
- **Water Based Mold Releases:**
 - Zyvox, Tannis Layman, 706.698.4405, ext 23
 - Use the right one or tacky tape won't seal to surface

Tools of the Trade Cont.

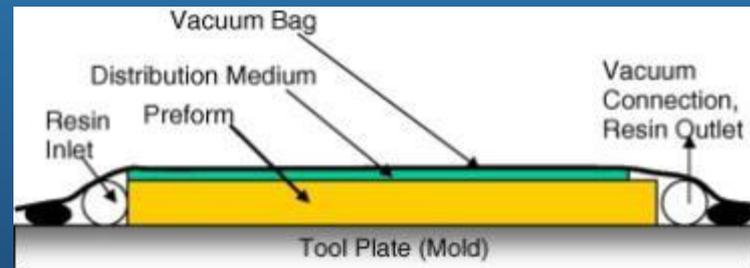
- Air Weave (wet bagging)
- P3 Perforated Film (wet bagging)
- Peel Ply (both processes)
 - Use heat scoured polyester, medium weave (AIRTECH Release Ply-F is ideal)
- Distribution Media (aka shade cloth for VARTM)
- Nylon Tubing & Fittings (both processes)
- Teflon Tape
- Flashbreaker Tape or good masking tape (both processes)

Wet Bag Process

- Down Hand Lamination of laminate stack
- Peel Ply as first layer over laminate
- Tacky Tape now applied to perimeter after pulling protective tape (do not remove paper vehicle yet)
- Vacuum lines are placed and taped to hold temporarily
- P3 Film as second layer
- Air Weave Layer as third layer
- Vacuum bag is placed after paper is removed from tacky tape
- Apply vacuum checking for leaks. Do not exceed 12" Hg at his time. The biggest risk is sucking the laminate dry until resin gels

Vacuum Assisted Resin Transfer Molding

- Tacky Tape (do not remove the paper vehicle at this time)
- Dry Fabric Stack set in place
- Vacuum Gage (not really required)
- Vacuum Lines set in place and taped to hold temporarily
- Peel Ply placed
- Distribution Media
- Vacuum Bag
- Resin Pot



Surface Treatment by Zyvac. Inc.

✓ CLEAN

Remove all contaminates from the mold surface

It is essential to start with a clean surface - dirt, oils and debris prevent bonding to the surface of the mold and may cause defects in the finished part surface

✓ SEAL

Eliminate mechanical bonding of the part and provide a durable base for the release agent

Mold sealing is the most important step – by sealing the mold both chemical and mechanical bonds can be formed at the mold-to-sealer interface (six coats required on epoxy face molds)

✓ RELEASE

Select the appropriate release agent and follow through with proper application

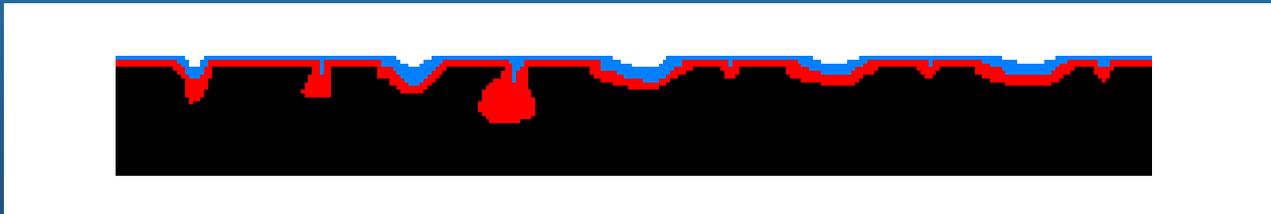
The function of the release agent is to provide the appropriate amount of horizontal slip while maintaining an effective vertical release

Surface Treatment Cont.

Mold release treated surface without sealer



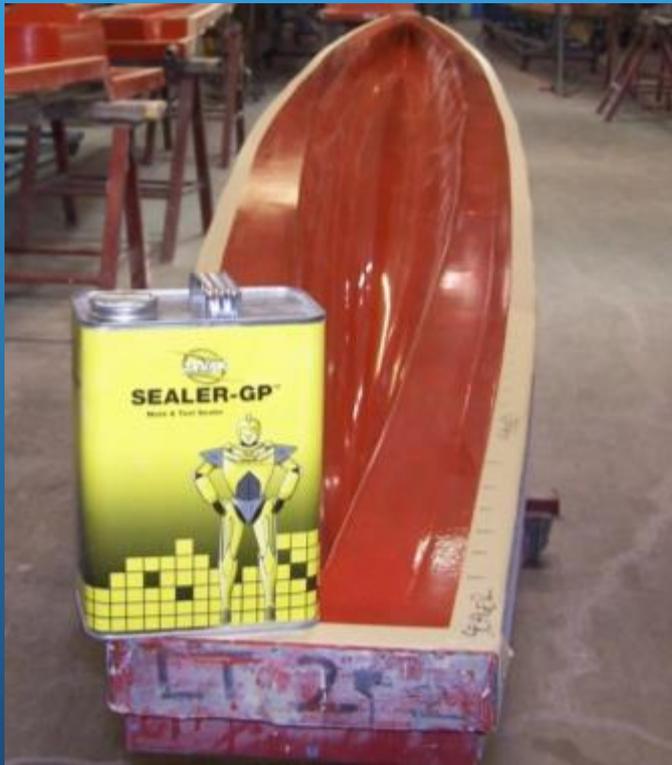
Mold release treated surface with sealer



Courtesy of Zyvax, Inc.

Surface Treatment Cont.

Sealing Application



Courtesy of Zyvax, Inc.

Surface Treatment Cont.

Release Agent Application

“Less is More” Philosophy:

Semi-permanent release agents work best when applied very thin and sparingly on the mold surface.

- Heavy application of the release agent can contribute to build up on the mold surface.
- Extremely heavy applications and/or improper cure of the release agent prior to molding can cause the release polymer to work like an adhesive and cause localized sticking.
- Sticking a part will ruin your part, mold and day!

Courtesy of Zyvax, Inc.

Sample Part

Epoxy Face Plaster Mold



Wet Loading Fabric



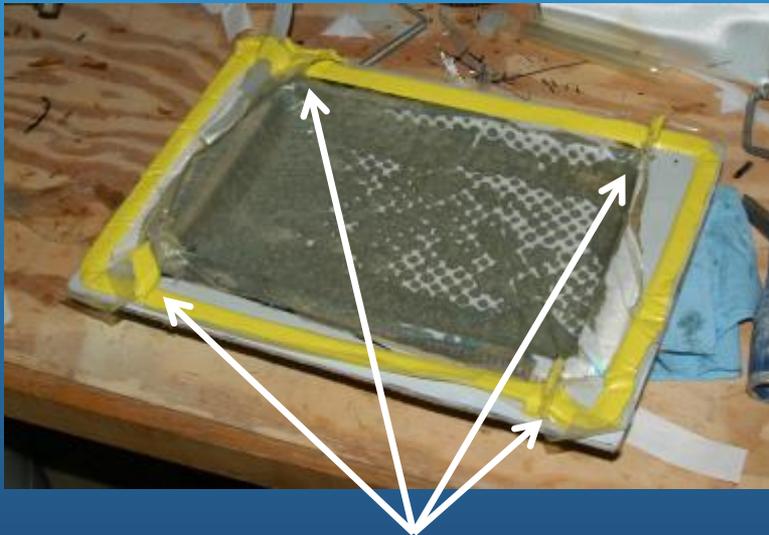
Peel Ply



P3 Perforated Film

Sample Part Cont.

Air Weave



Note the Darts in the bag. This helps the bag contour in the radii to prevent bridging.



Vacuum Bag in Action

Quick & Simple Oven

- Made of insulating board purchased from home improvement store
- Tape together with Al foil tape
- Use heat gun as source for the heat and air circulation
- Use simple digital temperature controller
- Can build up to very large sizes if one can deliver enough heat

Quick & Simple Oven Cont.



No No's

- Rags (read bond breaker)
 - Cloth rags are not used no matter how often they are washed or washed with
 - Preferred are the Scott Blue Shop or the Multi-Ply, Reinforced Nylon Fiber Utility Towel
- Fabric Handling - not handle with bare hands
- Shop heating - I do not recommend kerosene heat as it puts contaminants in the air and so on the surface of your work
- Diluents in resin - some have used alcohols to thin out epoxy resin - DON'T! Keep your resins at temperatures in the 80's or 90's. Use a heat box if you have to (wooden box with light bulb & thermostat).
- Open Fabric storage - keep your fabric in a bag to be free of dust and moisture: preserves sizing
- Open Resin storage - epoxies last a long time when stored cool & dry
- Solvent wiping / cleaning - many like to clean with acetone or MEK; these are potential bond breakers. I recommend isopropyl alcohol as it does not have any recycled adds due to the medical requirements. Try to get 92%.
- Additives (fumed silica aka cabosil, micro-balloons, flox) - cabosil at less than 2% for thixing and balloons or flox as required. Cabosil has no strength. Additives are introduced after resin & hardener is thoroughly mixed

Sources List

- Vacuum techniques manual (.pdf):
<http://www.westsystem.com/ss/how-to-publications-2>
 - Scroll down until you see the vacuum techniques manual
- Vacuum pumps: Combined Fluid Products Co., Cathy, 847.540.0054 (combinedfluidproducts.com)
- Processing Supplies:
 - Northern Composites: nfgsales.com
 - Freeman Supply: freemansupply.com
 - Coast-line International: coastlinedistributors.com
 - AIRTECH: airtechonline.com, Gregg Brown, gbrown@airtechintl.com
 - Resins: ProSet Epoxies, Joe Parker, parker@prosetepoxy.com (prosetepoxy.com)
- Mold Release: Zyxax, Tannis Layman, 706.698.4405, ext 23

Sources List Cont.

- Reinforced Nylon Fiber Utility Towel: Grangers Part# 5LG 76 1000/PK or Item # 5LG97 150/PK
- Teflon Tape: CS Hyde Company, 1" wide Skived PTFE Part# 15-2A, 2" wide Skived PTFE Part# 15-2A (cshyde.com)
- Airtech Flashbreaker Tape - Airtech (airtechonline.com) or Freeman Supply (freemansupply.com)
- Vacuum Bag Tape - General Sealants (generalsealants.com). Yellow AT-200Y is preferred.
- Scissors: Kretzer Finny 74525 10.0" - Extra Heavy Duty, Industrial Scissors (on the web ~\$40) or John A. Eberly, Inc. Textile and Sewing Scissors and Shears Professional Cutlery Industrial Tools and Supplies, Box 8047 Syracuse NY 13217, 800-532-3759

Sources List Cont.

- Wheel Cutters: Olfa Rotary Cutter sold at many fabric stores
- Fiberglass Rollers: E S Manufacturing, St Petersburg, FL (esmfg.com)
- Tongue Depressors: non-sterile - any local medical supply
- Epoxy Tooling Gel: ProSet M1019/224 or PTM&W PT 1105A & B
- Ultracal 30: Freeman Supply, (freemansupply.com)