PROCESS-MEASUREMENT & ANALYTICS | DATA SHEET

VacBag – Vacuum Bagging Composite Kit

User Manual

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1 Introduction

1.1 What is vacuum bagging?

Vacuum bagging (or vacuum bag laminating) is a clamping method that uses atmospheric pressure to hold the adhesive or resin-coated components of a lamination in place until the adhesive cures. (When discussing composites, “resin” generally refers to the resin system—mixed or cured resin and hardener—rather than unmixed 105 epoxy resin.) Modern room-temperature-cure adhesives have helped to make vacuum bag laminating techniques available to the average builder by eliminating the need for much of the sophisticated and expensive equipment required for laminating vacuum bagging permits the laminating of a veneers to synthetic fibers and core materials.

1.2 Theory

Vacuum bagging uses atmospheric pressure as a clamp to hold laminate plies together. The laminate is sealed within an airtight envelope. The envelope may be an airtight mold on one side and an airtight bag on the other. When the bag is sealed to the mold, pressure on the outside and inside of this envelope is equal to atmospheric Pressure: approximately 29 inches of mercury (Hg), or 14.7 psi. As a vacuum pump evacuates air from the inside of the envelope, air pressure inside of the envelope is reduced while air pressure outside of the envelope remains at 14.7 psi. Atmospheric pressure forces the sides of the envelope and everything within the envelope together, putting equal and even pressure over the surface of the envelope.

The pressure differential between the inside and outside of the envelope determines the amount of clamping force on the laminate. Theoretically, the maximum possible pressure that can be exerted on the laminate, if it were possible to achieve a perfect vacuum and remove all of the air from the envelope, is one atmosphere, or 14.7 psi. A realistic pressure differential (clamping pressure) will be 12–25 inches of mercury (6–12.5 psi).

Figure 1-1 *A typical vacuum bagging lay-up before and after vacuum is applied.*

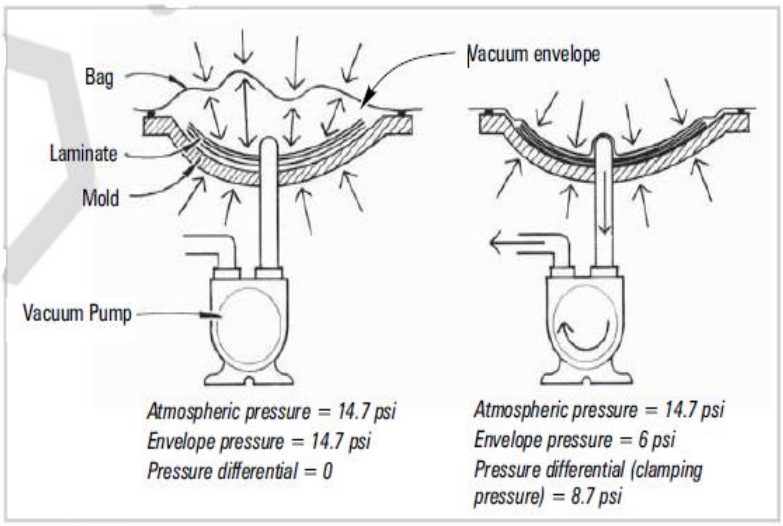


Figure 1 *A typical vacuum bagging lay-up before and after vacuum is applied.*

1.3 Advantages of vacuum bagging

Vacuum bagging offers many advantages over conventional clamping or stapling techniques. As with other laminating methods, different materials can be incorporated into the laminate. Materials can be selected specifically to match the structural requirements of the component rather than the limitations of the clamping method.

Even clamping pressure

Mechanical clamping or stapling applies pressure only to concentrated areas and can damage fragile core materials in one area while not providing enough pressure for a good bond

Vacuum bagging, on the other hand, delivers firm, evenly distributed pressure over the entire surface regardless of the type or quantity of material being laminated. This allows a wider range and combination of materials as well as a superior bond between the materials.

Control of resin content
Vacuum bagging also gives you the means to control excess adhesive in the laminate, resulting in higher fiber-to-resin ratios. This translates into higher strength-to-weight ratios and cost advantages for the builder

Custom shapes
Another big advantage of vacuum bagging is in the simplicity and variety of the molds used. Keep in mind that the atmosphere is not only pushing down on the top of the envelope, but it is also pushing up equally on the bottom of the envelope or mold. Since atmospheric pressure provides equal and even clamping pressure to the back of the mold, the mold only has to be strong enough to hold the laminate in its desired shape until the epoxy has cured. Therefore, most molds can be relatively light weight and easy to build.

Efficient laminating
Because all of the materials in the laminate are wet out and laid up at the same time, vacuum bagging allows you to complete the laminating process in one efficient operation.

.1.4 Using vacuum bagging technology

This manual is designed to give you the basics of vacuum bagging. Before producing a finished composite part, you should also have an understanding of composite materials and engineering involved in designing composite structures. Experimenting is essential to understanding and a valuable part of the design process. Composite construction is the ideal medium for experimentation, even on a small scale. Composite construction and vacuum bag laminating are rapidly expanding technologies. The information in this manual is sure to be surpassed by the development of new composite materials and the refinement of vacuum bagging techniques. We hope this manual gives you the tools not only to expand your building capabilities, but also to explore the technology and improve on these techniques.

2. Vacuum Bagging Equipment

The vacuum bagging system consists of the airtight clamping envelope and a method for removing air from the envelope until the epoxy adhesive cures. This section discusses the components of this system *(Figure 2),* which include both specialized equipment and commonly available materials.

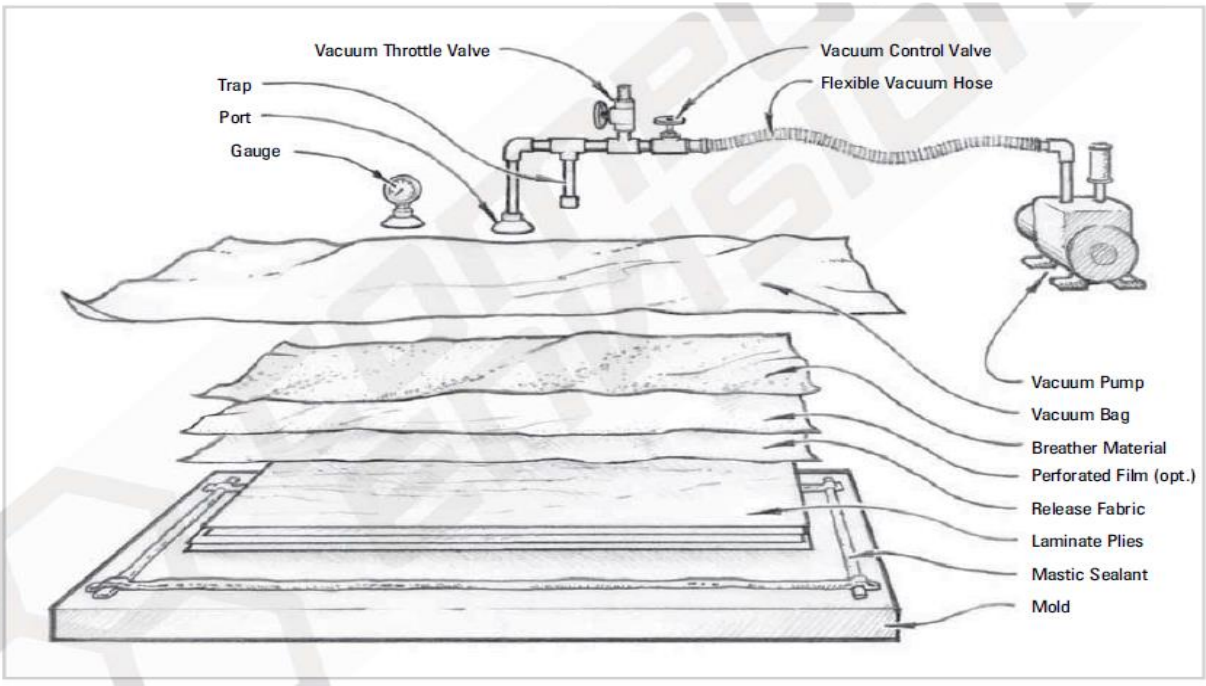


FIG 2: ILLUSTRATION OF VACUUM BAGGING TECHNIQUE

2.1 Vacuum pumps

The heart of a vacuum system is the vacuum pump. Powered vacuum pumps are mechanically similar to air compressors, but work in reverse so that air is drawn from the closed system and exhausted to the atmosphere. Vacuum pumps are designated by their vacuum pressure potential or “Hg maximum” (Hg is the chemical symbol for mercury), their displacement in cubic feet per minute (CFM) and the horsepower required to drive the pump.

2.2 Vacuum bagging materials

Release fabric
is a smooth woven fabric that will not bond to epoxy. It is used to separate the breather and the laminate. Excess epoxy can wick through the release fabric and be peeled off the laminate after the laminate cures. It will leave a smooth textured surface that, in most cases, can be bonded to without additional preparation. Surfaces that will subject to highly-loaded bonds should be sanded. it. It is not recommended for post cure temperatures over 120°F (49°C). A variety of release materials are produced specifically for vacuum bagging operations. They may be known as release fabric, peel ply or release film. Many are designed for use at higher temperatures or to control the amount of resin that can pass through them.

Perforated film

A perforated plastic film may be used in conjunction with the release fabric. This film helps hold the resin in the laminate when high vacuum pressure is used with slow curing resin systems or thin laminates. Perforated films are available in a variety of hole sizes and patterns depending on the clamping pressure, and the resin’s open time and viscosity.

Breather material

A breather (or bleeder) cloth allows air from all parts of the envelope to be drawn to a port or manifold by providing a slight air space between the bag and the laminate.it is wide lightweight polyester blanket that provides air passage within the vacuum envelope and absorbs excess epoxy. A variety of other materials can be used such as mosquito screen, burlap, fiberglass cloth or a bubble type swimming pool .

Vacuum bag

The vacuum bag, in most cases, forms half of the airtight envelope around the laminate. If you plan to use vacuum pressure of less than 5 psi (10 hg) at room temperatures, 6-mil polyethylene plastic can be used for the bag. Clear plastic is preferable to an opaque material to allow easy inspection of the laminate as it cures. For higher pressure and temperature applications, specially manufactured vacuum bag material should be used

The plumbing system & sealant tapes

The plumbing system provides an airtight passage from the vacuum envelope to the vacuum pump, allowing the pump to remove air from and reduce air pressure in the envelope. A basic system consists of flexible hose or rigid pipe, a trap, and a port that connects the pipe to the envelope. Amore versatile system includes a control valve and a vacuum throttle valve that allow you to control the envelope vacuum pressure at the envelope. A system is Often split to provide several ports on large laminations, or may include some type of manifold within the envelope to help channel air to a single port. A variety of pipe or tubing canbe used for plumbing as long as it is airtight and resists collapsing under vacuum.

A **vacuum port /Suction flange:** connects the exhaust tubing to the vacuum bag. It can be designed specifically for the purpose or built from commonly available materials. One of the simplest ports is a hollow suction cup that sits over a small slit in the vacuum bag. Cups designed for use with car top carriers can be easily adapted by drilling through the center of the cup.

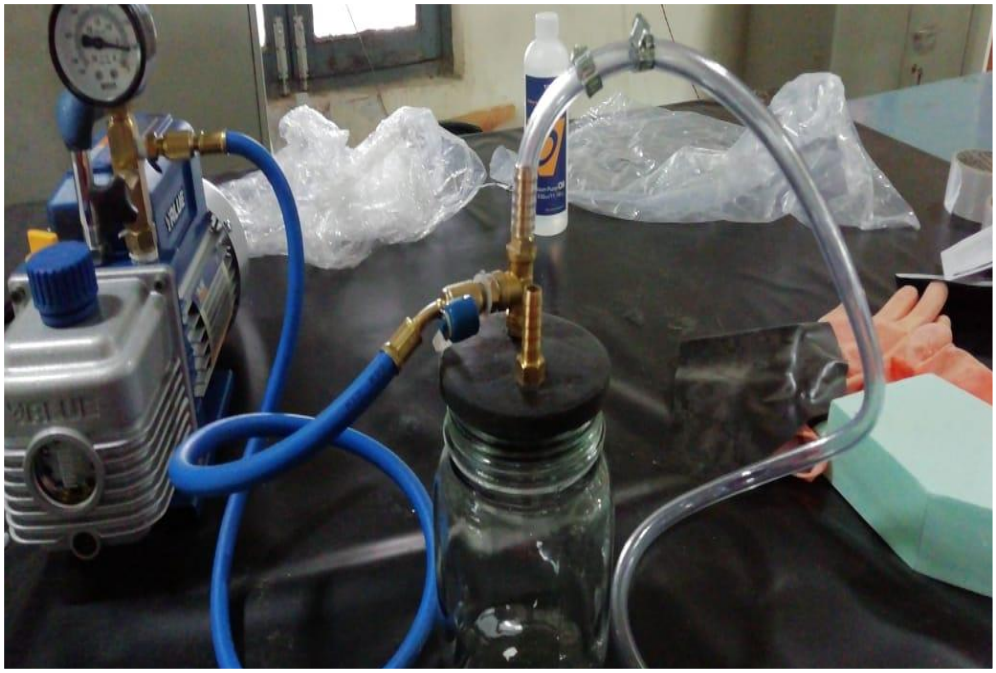
A **control valve** should be incorporated into the vacuum line to allow you to control the volume of airflow at the envelope. The control valve affects the rate of air removal, but not the vacuum pressure. Valves should be placed close to the envelope.

A **trap** should be incorporated into the line as close as possible to the envelope. The trap collects any excess adhesive that gets sucked into the line before it reaches the valves or pump and prevents a buildup of adhesive in the line.

A **vacuum gauge** is necessary to monitor the vacuum level/clamping force during the cure time of the laminate. Most gauges read in inches of mercury from zero (one atmosphere) to 30 (inches Hg below one atmosphere). The reading of negative pressure inside the bag equals the net pressure of the atmosphere pressing on the outside of the bag. To approximate this reading in pounds per square inch (psi), simply divide the reading by two.

3. Kit Connection method:

1) Check the oil level in the pump to produce a stable Pressure
2) Adjust the pressure range using control valve and adjust according in the gauge
3) Connect the hose pipe from vacuum pump to Resin catch pot inlet (to capture excessive flow of resin or dust material in the process to prevent reach over the pump
4) From the trap outlet end you can connect the silicone flexible tubing to the suction flange
5) The suction flange is connected and covered and seal to the mould



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