

Graco dispensing equipment for wind turbine blade manufacturing

Weighing in at 6 or 7 tons, and measuring 35 to 40 meters (115 to 131 feet), manufacturing a standard size wind blade requires a large amount of material. Construction materials must be lightweight, long lasting, and structurally strong enough to stand up to high wind gusts and extreme weather conditions. Composite materials – made up of a reinforcing material such as fiberglass, and a matrix material, usually a resin solution – provide the strength and characteristics required for a wind blade.

Wind blades are typically made of fiberglass-reinforced epoxy or polyester

Throughout a wind blade, materials of construction can include resins, gel coats, adhesives, polyurethanes, structural foams, prepreg fabrics, fiber-reinforced epoxy or polyester. However, composites (resins and fiberglass reinforcements) are the primary materials in the outer shell of a wind blade.

A wind turbine blade is usually manufactured by forming two half shells in an aerodynamically engineered pair of molds, then bonding the two halves together with adhesive.

Graco's broad line of fluid handling equipment and dispensing solutions handle most of the materials required for wind blade manufacturing.

Composites processing methods

Blades can be manufactured with a number of processes including hand lay-up, vacuum infusion and prepreg molding.

Hand lay-up, open mold process

Wind turbine blades are often fabricated by **hand lay-up**: cutting sheets of fiberglass cloth to fit the mold, laying the pieces into the mold, infusing resins to the fiber, and letting it cure.

Vacuum resin infusion

Currently, vacuum resin infusion is probably the most dominant processing method for manufacturing wind turbine blades. The [Graco VRM Metering System](#) is a resin metering system for [vacuum infusion processes](#). It provides controlled resin output for varying demand throughout the infusion process, and offers real time flow rate and ratio verification. Heated by autoclave for curing (pressure and heat) or an oven (a form of RTM)

Resin transfer molding

During the vacuum-assisted [resin transfer molding](#) (RTM) process, fiber reinforcements are placed into a mold, formed into shape, and resins are then applied to the fibers. [GlasCraft RTM Systems](#), designed for low-pressure injection of polyester and vinyl ester resins, are available in a range of configurations for traditional resin transfer molding processes, light RTM, vacuum infusion, and closed cavity bag molding.

Blade bonding

Epoxy is usually used for blade [bonding](#), or gluing blade halves together. The [Graco VPM Metering System](#) delivers up to 25 kg (55 lb) of adhesive paste per minute, making it a top choice for manufacturers of wind blades who need to keep up with productivity demands.

Structural foam core

Inside the outer shells of a wind blade are structural cores made from balsa wood or rigid foam. Rigid foam is manufactured by [reaction injection molding](#) (RIM), where isocyanate and polyol are mixed by high-pressure impingement, then injected into a mold. Inside the mold, a chemical reaction occurs, and the foam expands to fill the mold. The [Graco HFR Metering System](#) is a compact, affordable RIM solution that offers repeatable, accurate polyurethane processing.



Gelcoating

Some wind blade producers spray a [gelcoat](#) layer on the inner mold surface to produce a smooth, consistent blade surface. The [GlasCraft Gelcoat System](#) is a gelcoat spray system for production or repair applications. It dispenses polyester and vinyl ester based coatings, and offers infinite adjustment of catalyst ratio, with no tools required.

Molds and tooling paste

Tooling paste is often used to create a fine, smooth surface on the face of the mold tool. The Graco VPM Metering System can dispense up to 25 kg (55 lb) of high-viscosity tooling paste per minute. After it has cured, the paste is milled and finished to specification.

Blade repair

Wind and nature take a toll on wind blades. Lightning strikes, violent winds, damage from birds, UV degradation from the sun, and deterioration from extreme hot and cold temperatures can crack and damage blades. Depending on the extent of the damage, the blades can either be repaired while they are still mounted to the wind tower, or individual blades can be removed and lowered to the ground for on-site repair. [Graco PR70 Two-Component Dispensing System](#) is a portable dispensing system for blade repair applications. It offers two-component dispensing of low- to high-viscosity materials without solvent flush and disposal.