

## Fiberglass Industry Terms Glossary

### A

#### **ACCELERATOR**

An additive to polyester resin that reacts with catalyst to speed up polymerization. This additive is required in room temperature cured resins. See PROMOTER.

Accelerator - A material which, when mixed with a catalyzed resin, will speed up the chemical reaction between the catalyst and the resin. Also known as promoter

#### **ACOUSTIC EMISSION (AE)**

In composites, a sound generated by defects within the laminate, such as plastic deformation, crack initiation or crack growth.

#### **ACETONE**

A ketone group solvent that is used to dissolve polyester resins. Used to a large extent for clean up of tools in fiberglass operations.

#### **ADDITIVE**

Any number of materials used to modify the properties of polymer resins. Categories of additives include reagents, fillers, viscosity modifiers, pigments and others.

#### **ALLIGATORING**

A visible cosmetic defect in the exposed gel coat which looks like wrinkled or alligator skin.

#### **ANTIMONY TRIOXIDE**

Fire retardant additive for use with resins.

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### B

#### **BAG MOLDING**

See "Vacuum" and "Pressure" or "The use of an elastic or woven material to apply atmospheric force to a laminate." See VACUUM and PRESSURE.



## **BARCOL HARDNESS**

A measure of surface hardness made with a Barcol Impressor instrument in accordance with ASTM D-2583. The hardness value can be used as an indication of the degree of cure of FRP laminates.

## **BARCOL HARDNESS**

A hardness value obtained by measuring the resistance to penetration of a sharp steel point under a spring load. The instrument, called a Barcol Impressor, gives a direct reading on a 0-100 scale. The hardness value is often used as a measure of the degree of cure of the plastic.

## **BARRIER CREAM**

A cream used to protect the skin from contact with resins.

## **BENZOYL PEROXIDE (BPO)**

One of two generally used initiators for curing polyester resin. BPO is used with aniline accelerators or where heat is used to cure the resin. See MEKP.

## **BI-DIRECTIONAL**

Reinforcing fibers that are arranged in two directions, usually at right angles

## **BI-DIRECTIONAL LAMINATE**

A reinforced plastic laminate with the fibers oriented in various directions in the plane of the laminate: a cross laminate. See also unidirectional laminate.

## **BINDER**

A resin soluble adhesive that secures the random fibers in chopped strand mat or continuous strand roving.

.Binder - The agent applied to glass mat to bond the fibers prior to laminating or molding.

## **BISPHENOL A FUMARATE**

A condensation product formed by reaction of two (bis) molecules of phenol with acetone (A) used as a component in one type of traditional corrosion resistant FRP resin

## **BLISTER**

A flaw either between layers of laminate or between the gel coat film and laminate.

Blister - An undesirable rounded elevation of the surface of a plastic whose boundaries may be more or less sharply defined. The blister may contain process fluid.

## **BOND STRENGTH**



The amount of adhesion between bonded surfaces; a measure of the stress required to separate a layer of material from the base to which it is bonded. See also peel strength.

Bond Strength - The amount of adhesion between bonded surfaces; a measure of the stress required to separate a layer of material from the base to which it is bonded. See also peel strength.

### **BROMINE**

A fire retardant (halogen) which is used to reduce or eliminate a resin's tendency to burn. Often used in conjunction with chemicals such as antimony trioxide and pentoxide to achieve a maximum Class 1 fire retardancy rating and often used in ducting systems.

### **BUTT WRAP JOINT**

A secondary laminate wrapped around two or more components in an edge-to-edge configuration used to join them together.

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## **C**

### **CASTING**

The process of pouring a mixture of resin, fillers and/or fibers into a mold as opposed to building up layers through lamination. This technique produces different physical properties from laminating.

### **CATALYST**

Technically considered an initiator, catalyst is the colloquial name given to the substance added to the resin or gel coat in controlled quantities to initiate the cure.

Catalyst - A substance which changes the rate of a chemical reaction without itself undergoing permanent change in its composition; a substance which markedly speeds up the cure of a compound when added in minor quantities compared to the amounts of primary reactants (hardener, initiator or curing agent).

### **CAULK**

An elastic material used to protect joints or connections from external elements, particularly moisture.

### **CAVITY**

The space between a male and female mold set in which the part is formed. Sometimes used to refer to a female mold.

### **CENTIPOISE**

A unit of measure used to describe the viscosity of a liquid. The centipoise of a resin is measured with a Brookfield Viscometer for most polyester resin applications.



## **CHALKING**

A surface phenomenon indicating degradation of a cosmetic surface. Chalking is a powdery film which appears lighter than the original color.

## **CHOPPED STRAND MAT**

A fiberglass reinforcement consisting short strands of fiber arranged in a random pattern and held together with a binder. Mat is generally used in rolls consisting of 3/4 oz/ft<sup>2</sup> material to 2 oz/ft<sup>2</sup> material.

## **CHOP**

get definition from CLM

## **CLOTH**

A fiberglass reinforcement made by weaving strands of glass fiber yarns. Cloth is available in various weights measured in ounces per square yard or Kg/m<sup>2</sup>

## **CLOSED-MOLDING**

A molding process that uses two matched molds. This method of molding reinforced plastic provides a finished inside and outside surface. More expensive than open mold tooling.

## **COMPOSITE**

A chemical or mechanical bonding of dissimilar materials such as glass fiber and polyester resin, whose cumulative properties are superior to the individual materials.

Composite - An homogenous material created by the synthetic assembly of two or more materials (selected reinforcing elements and compatible matrix resin) to obtain specific characteristics and properties.

## **COMPRESSION MOLD**

A closed mold, usually of steel, used to form a composite under heat and pressure

## **COMPRESSIVE MODULUS**

A mechanical property description which measures the compression of a sample at a specified load. Described in ASTM D-695.

## **COMPRESSIVE STRENGTH**

The stress a given material can withstand when compressed.

## **CONNECTION**

Where two panels are attached to each other or a panel is attached to the building.



## **CONTACT MOLDING**

Refers to the use of a single or open mold onto which layers of polymer and reinforcement materials can be applied. Contact molding is characterized by one finished cosmetic side.

## **CONTACT MOLDING**

A process for molding reinforced plastics in which reinforcement materials, such as mat and woven roving saturated with resin, are applied to a mold. The cure is either at room temperature using a catalyst-promoter system or by heat in an oven with no additional pressure.

## **CONTINUOUS FILAMENT STRAND**

An individual rod of glass with small diameter, flexibility and great or indefinite strength. Also when referring to gun roving, is a collection of string like glass fiber or yarn, which is fed through a chopper gun in the spray up process.

## **CONTINUOUS STRAND ROVING**

A bundle of glass filaments which are fed through a chopper gun in the spray up process.

## **CONTINUOUS LAMINATING**

A process for forming panels and sheeting in which fabric or mat is passed through a resin bath, brought together between covering sheets, and passed through a heating zone for cure. Squeeze rolls control thickness and resin content as the various plies are brought together.

## **CORE**

A low density material used between two FRP skins. Examples of core materials are end-grain balsa wood, urethane foam, PVC foam and various honeycomb materials.

## **CRAZING**

Cracking of gel coat or resin due to stress.

## **CREEP**

The change in dimension of a plastic under load over a period of time, not including the initial elastic deformation.

## **CROSS-LINKING**

The chemical bonding of molecules which in polymers occurs in the curing transition from a liquid to a solid.

## **CROSSLINK**



The formation of a three-dimensional polymer by means of inter-chain reactions resulting in changes in physical properties

## **CURE**

The completion of the cross-linking process during which a composite develops its full strength. To change the properties of a resin by chemical reaction, which may be condensation or addition

## **CURE TIME**

Time between introduction of catalyst or initiator to a polymer and final cure.

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# **D**

## **DEAD LOAD**

Permanent or constant loads (weight) on the FRP structure.

## **DELAMINATION**

The separation of composite layers from each other.

To split a laminated plastic material along the plane of its layers. Physical separation or loss of bond between laminate plies.

## **DENSITY**

A comparison of weight per volume, measured in pounds per cubic foot.

## **DEW POINT**

That temperature at which the weight of steam associated with a certain weight of dry air is adequate to saturate that weight of air. When air at less than 100% relative humidity is cooled to the temperature at which it becomes saturated, the air has reached the minimum temperature to which it can be cooled without precipitation of the moisture (dew).

## **DIELECTRIC STRENGTH**

The value of a material as an electrical insulator or the resistance to the flow of electric current.

## **DIFFERENTIAL SCANNING CALORIMETRY (DSC)**

DSC is used to determine the glass transition temperature and the degree of cure of an FRP laminate by measuring the heat flow into and out of a sample as the material which is heated at a constant heating rate under a nitrogen purged atmosphere. The degree of cure may be determined by repeated heating of a sample beyond the glass transition temperature. If the laminate was undercured, the glass transition temperature will continue to increase.



## **DIMENSIONAL STABILITY**

A description of the change in size of an object during the molding process or in varying temperature conditions or under various loads.

## **DISCONTINUITY STRESS**

Additional stress produced where abrupt changes in geometry, materials and/or loading occur in an FRP laminate

## **DISTORTION**

A change in shape form that which is intended. It is symptomatic of laminating difficulties, curing problems, tooling problems or resin shrinkage.

## **DRAFT**

The angle of the vertical components of a mold which allow removal of the part.

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# **E**

## **E-GLASS**

Originally formulated for use in electric circuitry, E-glass is the most common glass formulation used in fiberglass reinforcements. "E" Glass - A borosilicate glass; the type most used for glass fibers for reinforced plastics; suitable for electrical laminates because of its high resistivity.

## **ECR GLASS**

A corrosion-grade glass exhibiting corrosion resistant properties superior to "E" glass. Superior resistance to acids and alkalis is obtained through the application of special treatments and sizings to "E" fibers.

## **ELASTIC DEFORMATIONS**

That part of the total strain in a stressed body which disappears upon removal of the stress; opposed to plastic deformation.

## **ELONGATION DEFORMATION**

Caused by stretching; the fractional increase in length of a material stressed in tension. When expressed as a percentage of the original gage length, it is called percentage elongation.

## **ELONGATION**

Standard measure for the amount a sample can stretch as a percentage of original length before it fails or breaks. Elongation Deformation - Caused by stretching; the fractional increase in length of a material stressed in tension. When expressed as a percentage of the original gage length, it is called percentage elongation.



## **ENCAPSULATING**

Completely surrounding an object with resin or a fiber resin composite.

## **EPOXY RESIN**

A polymer resin characterized by epoxide molecule groups. Epoxies generally have higher physical properties than polyester resins. They are also more costly and difficult to process and less able to endure exposure to sunlight. Plastics based on resins made by the reaction of epoxides or oxiranes with other materials such as amines, alcohols, phenols, carboxylic acids, acid anhydrides and unsaturated compounds.

## **EXOTHERMIC HEAT**

Internally developed heat accompanying a chemical reaction, such as might be created when curing a thermosetting resin.

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# **F**

## **FABRICATOR**

Manufacturer of reinforced plastic products.

## **FEMALE MOLD**

A concave mold used to precisely define the convex surface of a molded part.

## **FIBER**

Reinforcement material which is a major component in a composite matrix.

## **FIBERGLASS**

Glass which has been extruded into extremely fine filaments. These filaments vary in diameter, and are measured in microns. Glass filaments are treated with special binders and processed similar to textile fibers. These fibers come in many forms such as roving, woven roving, mat and continuous strands.

## **FILAMENT**

A single thread-like fiber of extruded glass. Typically microns in diameter.

## **FILAMENT WINDING**

A process which involves winding a resin-saturated strand of glass filament around a rotating mandrel. A process for fabrication of a composite structure in which continuous reinforcements, either previously



impregnated with a matrix material or impregnated during the winding, are placed over a rotating and removable form or mandrel in a previously prescribed way to meet certain stress conditions.

### **FINITE ELEMENT ANALYSIS (FEA)**

A method of analysis used in situations that are difficult to model by standard engineering techniques. The finite element method operates on the assumption that any continuous function over a global domain can be approximated by a series of functions operating over a finite number of small sub-domains. The series of functions are piecewise, continuous and will approach the exact solution as the number of subdomains approaches infinity.

### **FILLERS**

Usually inert organic or inorganic materials which are added to plastics, resins or gel coats to vary the properties, extend volume, or lower the cost of the article being produced. A relatively inert material added to a plastic mixture to reduce cost, to modify mechanical properties, to provide thixotropy, to serve as a base for color effects or to improve the surface texture.

### **FIRE RETARDANTS**

Compounds mixed with the resin to reduce flammability.

### **FISH EYE**

The effect of surface contamination which causes a circular separation of a paint or gel coat.

### **FLAME RETARDANT RESIN**

A polyester resin which has been specifically formulated to reduce the flame spread and/or smoke generation characteristics.

### **FLAMMABILITY**

A measure of how fast a material will burn under controlled conditions. ASTM D-635/UL E-84 tests.

### **FLANGE**

An extension around the perimeter of a mold or part for the purpose of demolding, stiffening or connecting two components.

### **FLASH POINT**

The lowest temperature at which a substance gives off enough vapors to form a flammable mixture.

### **FLEXURAL MODULUS**

ASTM D-790. An engineering measurement which determines how much a sample will bend when a given load is applied.



## **FOAM**

A lightweight, cellular plastic material containing gas-filled voids. Typical foams include urethane, PVC and polyester.

## **FOAM-IN-PLACE**

The process of creating a foam by the combination of two liquid polymers. See IN-SITU.

## **FRP**

Fiber Reinforced Plastics, also known as GFRP (Glass Fiber Reinforced Plastic), GRP (Glass Reinforced Plastic) and RP (Reinforced Plastic). Fiberglass Reinforced Plastic (FRP) - A general term covering any type of plastic reinforced cloth, mat, strands or any other form of fibrous glass.

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# **G**

## **GEL**

The irreversible point at which a polymer changes from a liquid to a semi-solid. Sometimes called the "B" stage.

## **GEL-COAT**

A surface coat of a specialized polyester resin, either colored or clear, providing a cosmetic enhancement and weatherability to a fiberglass laminate.

## **GEL TIME**

The length of time from catalyzation to gel or "B" stage. That interval of time in connection with the use of synthetic thermosetting resins, extending from the introduction of a catalyst into a liquid adhesive system until the interval of gel formation.

## **GELATION**

The formation of a gel.

## **GLASS REINFORCEMENT**

An inorganic product of fusion in the form of a filament which has cooled to a rigid condition without crystallizing. Glass filaments are combined, cut, woven or matted into many types of reinforcements.

## **GOOD SIDE**



The side of a molding in contact with a mold surface.

## **GREEN**

Resin which has not completely cured and is still rather soft and rubbery.

## **GRP**

Glass reinforced plastics. Generally based on polyester resin. See FIBERGLASS, FRP.

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# **H**

## **HALOGENATED RESIN**

A resin combined with chlorine or bromine to increase fire retardancy. See also Bromine.

## **HAND LAY UP**

The process of manually building up layers of fiberglass and resin using hand rollers, brushes and spray equipment. The process of placing and working successive plies of reinforcing material or resin-impregnated reinforcement in position on a mold by hand.

## **HEAT DISTORTION POINT**

The temperature at which the strength of a material begins to degrade. The temperature at which a standard test bar deflects under a stated load.

## **HELIX ANGLE**

The angle at which continuous filaments are placed relative to the longitudinal mandrel axis in the filament winding process.

## **HOOP STRESS**

The circumferential stress in a material of cylindrical form subjected to internal or external pressure.

## **HYDROSTATIC LOAD**

Loading produced by a fluid head.

## **HET-ACID RESIN**

Polyester resin with exceptional fire qualities.

## **HONEYCOMB CORE**

Strips of paper, plastic, metal, etc., joined together to form a honeycomb pattern. Used as a lightweight core in sandwich moldings.



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# I

## **IGNITION LOSS**

The difference in weight before and after burning; as with glass, the burning off of the binder or size. Used to determine the amount and types of glass reinforcement present.

## **ISOTROPIC LAMINATE**

One in which the strength properties are equal in all directions, such as contact-molded laminates or metals.

## **IMPREGNATE**

To saturate with resin. The most common application is saturating fiberglass with a catalyzed resin.

## **INHIBITOR**

An additive to polyester resin or styrene used to slow the chemical reaction which leads to curing.

## **INHIBITOR**

A substance which retards a chemical reaction; used in certain types of monomers and resins to prolong storage life.

## **INSERT**

A piece of material put into a laminate during or before molding to serve a definite purpose.

## **INTUMESCENT**

A fire-retardant technology which causes an otherwise flammable material to foam, forming an insulating barrier when exposed to heat.

## **IN-SITU**

In the position which it will finally occupy, e.g. molding or forming foam.

## **ISOPHTHALIC**

A polyester resin based on isophthalic acid, generally higher in properties than a general purpose or orthostatic polyester resin.

## **ISOTROPIC**

The description of equal strength properties in all orientations. Isotropic composites are usually achieved by random fiber orientation.



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## J

### **JACKSTRAWING**

A visual effect of glass fiber turning white in a cured laminate. This may not affect the strength of a laminate, but could be an indication of air entrapment or water contamination.

### **JIG**

Any fixture for holding parts in position, while joining them together or to maintain their shape.

### **JOINT**

A line or distinction formed when two panels are connected. Also referred to as a seam.

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## L

### **LAMINANT**

The product of lamination. A composite consisting of a layer or layers of thermoset polymer and fiber reinforcement.

### **LAMINATE**

To place into a mold a series of layers of polymer and reinforcement. The act of applying FRP materials to a mold. To lay up. To unite sheets of material by bonding material usually with pressure and heat. A product made by bonding.

### **LAMINATION**

Applying layers of glass and resin to a mold. Also used to describe a single ply of laminate.

### **LAYER**

A single ply of lay up or laminate.

### **LAY UP**

The act of building up successive layers of polymer and reinforcement. Layers of catalyzed resin and fiberglass or other reinforcements are applied to a mold in order to make a part.



### **LINER (CORROSION LINER)**

The continuous, usually flexible reinforced resin barrier on the inside surface of the FRP laminate used to protect the laminate from chemical attack or to prevent leakage under stress.

### **LIVE LOAD**

Pressure, vacuum, thermal or other variable loads that may be applied to a structure.

### **LOW-PRESSURE LAMINATES**

Laminated molded and cured using pressures from 400 psi down to and including the pressure obtained by mere contact of the plies.

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## **M**

### **MALE MOLD**

A convex mold where the concave surface of the part is precisely defined by the mold surface.

### **MANDREL**

The mold around which resin-impregnated glass is wound or placed by hand to form pipes, tubes, vessels or irregularly shaped components. See also filament winding.

### **MASTER**

A full scale representation of the intended part, usually retained as a reference and the part from which production molds are made.

### **MAT**

A fibrous material consisting of randomly-oriented chopped or swirled filaments loosely held together with a binder. See CHOPPED STRAND MAT.

### **MATCHED DIE MOLDING**

Technique for producing long runs of identical parts with two finished sides.

### **MATCHED MOLDS**

Two or more tools arranged in a set as a male and female mold. Normally used in a press.

### **MATRIX**

The liquid component of a composite or laminate. - The resin in which the glass reinforcements are distributed.



### **MEK PEROXIDE (MEKP)**

One of two initiators is often referred to as catalyst and used to initiate polymerization of a resin. Methyl Ethyl Ketone Peroxide. (See BENZOYL PEROXIDE).

### **MEK SOLVENT**

Methyl Ethyl Ketone; a colorless, flammable liquid sometimes used in clean up procedures.

### **MICROBALLOONS**

Microscopic bubbles of glass, ceramic or phenolic, used as a filler or to create syntactic foam or putty mixtures.

### **MIL (MIL THICKNESS)**

The unit used in measuring film thickness. One mil equals one thousandth of an inch. (1 mil = .001 ").

### **MILLED FIBERS**

Glass fiber processed by a hammer mill into lengths of 1/32" to 1/8". Commonly used as a reinforcement in polyester putty.

### **MODULUS OF ELASTICITY**

An engineering term used to describe a material's ability to bend without losing its ability to return to its original physical properties. The ratio of the stress or load applied to the strain or deformation produced in a material that is elastically deformed.

### **MOLD**

The tool used to fabricate the desired part shape. Also used to describe the process of making a part in a mold.

### **MOLDING**

The process of using a mold to form a part.

### **MOLD RELEASE**

A wax or polymer compound that is applied to the mold surface which acts as a barrier between the mold and the part, thus preventing the part from bonding to the mold.

### **MONOMER**

One of the constituents of polyester resin. A simple molecule which is capable of reacting with like or unlike molecules to form a polymer; the smallest repeating structure of a polymer.



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## N

### **NPG GEL COAT**

Neopentyl glycol gel coat has enhanced weatherability compared to non-NPG gel coat.

### **NON-AIR-INHIBITED RESIN**

A resin in which the surface cure will not be inhibited or stopped by the presence of air.

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## O

### **ORANGE PEEL**

A gel coated or painted finish which is not smooth and is patterned similar to an orange's skin.

### **ORTHOPHTHALIC RESIN ORTHO**

A polyester resin based on orthophthalic acid, also known as a general purpose resin (GP).

### **OPEN MOLDING**

Single mold into (or onto) which the fiberglass is shaped and formed. Provides a finished and dimensionally accurate surface upon which the lay-up can be executed. Gel coat is usually sprayed first on the prepared surface of the mold with the reinforcement materials applied on top of the gel coat.

### **ORTHOTROPIC**

Having three mutually perpendicular planes of elastic symmetry; usually with differing properties, typically filament-wound laminates.

### **OUTSIDE DIAMETER**

The outside diameter of a pipe or any cylinder is the distance from one outside edge of the pipe to the opposite outside edge, measuring straight across the face of the pipe or across a cross-section that runs perpendicular to the pipe's long axis.

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# P

## **PARTING AGENT**

See MOLD RELEASE and PVA.

## **PARTING LINE**

The location on a molded product between different segments of the mold used to produce the product.

## **PATTERN**

The initial model for making fiberglass molds. See PLUG.

## **PEEL STRENGTH**

Bond strength, in pounds per inch of width, obtained by peeling the layer. See bond strength.

## **PENETRANT**

Process fluids that have penetrated the FRP liner or structural wall. PH A measure of the acidity or alkalinity of a process fluid.

## **PERMEABILITY**

The passage or diffusion of a gas, vapor, liquid or solid through a barrier without physically or chemically affecting it.

## **PLASTIC DEFORMATION**

Change in dimensions of an object under load that is not recovered when the load is removed; opposed to elastic deformation. PLY An individual layer of reinforcement within a total laminate composed of several such layers.

## **PIGMENT**

A colorant added to gel coat or resin.

## **PIGMENT SEPARATION**

Occurs when the pigment is not thoroughly mixed into the gel coat during formulation or the gel coat is improperly mixed prior to use. It is characterized by a nonhomogeneous surface color.

## **PINHOLES**

Small holes on the exposed gel coated surface. They are about the diameter of common pins and may be easily counted.

## **PLASTICS**

Organic chemical compounds called polymers which can be formulated to produce a wide range of properties.



## **PLUG**

A composite industry name for a pattern or model. Plugs - A plug is basically an exact finished part or the exact shape and size you want your final fiberglass product to be. The plug is the male part that we pull a female mold from. When we lay-up fiberglass in a mold, the part has to be able to be pulled from the mold - so every angle must be obtuse (at least a degree or two) or else the part wouldn't lift out of the mold. If your existing parts or plugs don't have an angle to them, we'll either need to rebuild them with angles or add a bit to your current part to achieve the desired angle. Overall, this usually won't change the look of your part but it's a critical step to making fiberglass pieces.

## **POLYESTER (unsaturated)**

The product of an acid-glycol reaction commonly blended with a monomer to create a polymer resin. In its thermosetting form it is the most common resin used in the FRP industry.

## **POLYESTER**

Thermosetting resins, produced by dissolving unsaturated, generally linear, alkyd resins in a vinyl-type active monomer such as styrene, methyl styrene and diallyl phthalate. The resins are usually furnished in solution form, but powdered solids are also available.

## **POLYMER**

A chain molecule composed of many identical groups, commonly found in plastics. A high molecular weight organic compound, natural or synthetic, whose structure can be represented by a repeated small unit. Some polymers are elastomers while others are plastics. When two or more monomers are involved, the product is called a copolymer.

## **POLYMERIZATION**

The chemical bonding of polymer molecules during the curing reaction.

## **POLYVINYL ALCOHOL (PVA)**

A parting film applied to a mold for part releasing.

## **POROSITY**

Entrapped gas bubbles or voids in a gel coat film.

## **POST-CURE**

To cure by application of heat after the chemical exothermic reaction has subsided. Additional elevated temperature cure, usually without pressure, to improve final properties and/or complete the cure. In certain resins, complete cure and ultimate mechanical properties are attained only by exposure of the cured resin to higher temperatures than those of curing.

## **POT LIFE**



The time during which the catalyzed resin remains liquid or "workable." See GEL TIME.

### **PREMIX**

Reinforcing material mixed with resin, and usually with pigment, filler and catalyst, before placing in the mold.

### **PREPREG**

Reinforcing material impregnated with resin prior to the molding process and cured by the application of heat.

### **PRESSURE BAG**

A membrane which conforms to the inside of a laminate laid up on a mold. The membrane or bag is then inflated applying pressure which consolidates and densifies the laminate.

### **PRINT THROUGH**

A distortion in the surface of a part which allows the pattern of the core or fiberglass reinforcement to be visible through the surface. Also known as print out, telegraphing or read through.

### **PROMOTER**

A reagent which speeds resin cure. See ACCELERATOR. - A chemical, itself a weak catalyst. See Accelerator.

### **PUTTY**

A thickened mixture of resin made by adding fillers, thixotropes and reinforcing fibers.

### **PVA**

See POLYVINYL ALCOHOL.

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## **R**

### **REINFORCED MOLDING COMPOUND**

Compound consisting of a polymer and a reinforcement fiber or filler supplied by raw material producer in the form of ready-to-use materials.

### **REINFORCEMENT**

A fiber which when encapsulated in a polymer resin matrix forms a composite or fiberglass laminate. Also refers to a structural member designed to stiffen a molded part.



## **RELEASE AGENT**

A compound used to reduce surface tension or adhesion between a mold and a part.

## **RESIN**

A liquid polymer which when catalyzed cures to a solid state. A class of organic products, either natural or synthetic in origin, generally having high molecular weights. Most uncured resins used in open molding are liquids. Resins are generally used to surround and hold fibers. When catalyzed, the resin cures going through a polymerization process transforming the liquid resin into a solid. The cured resin and fiber reinforcement create a composite material with mechanical properties that exceed those of the individual components.

## **RESIN TEARING**

Separation of pigments in a gel coat affecting cosmetic appearance.

## **ROVING**

A collection of bundles of continuous filaments in untwisted strands. Used in the spray-up (chopping) process. The term "ROVING" is used to designate a collection of bundles of continuous filaments either as untwisted strands or as twisted yarns. Glass rovings are predominantly used in filament winding.

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# **S**

## **SANDWICH CONSTRUCTION**

A laminate with two composite skins separated by, but bonded to, a structural core material. Used to create stiff, lightweight structures.

## **SEAM**

A line or distinction formed when two panels are connected. Also referred to as a Joint.

## **SELF EXTINGUISHING**

Ceases to burn when the source of flame is removed.

## **SELF-TAPPING SCREWS**

Hardened screws which cut their own thread as they are set.

## **SHEAR**

An engineering term referring to forces applied normally to the surface of a given material. The movement between plies of a laminate is referred to as interlaminar shear. An action or stress resulting from applied



forces which causes or tends to cause two contiguous parts of a body to slide relative to each other in a direction parallel to their plane of contact. In interlaminar shear, the plane of contact is composed of resin only.

### **SHELF LIFE**

The allowable storage time before a product must be used.

### **SHIPLAP**

Method of joining two panels together by means of one panel having a recessed shelf to receive the other panel on top of it leaving a flush surface.

### **SKIN**

A thin fiberglass layer over a mold to protect it from damage.

### **SKIN COAT**

The first layer of laminate next to the gel coat, generally, one ply of chopped strand mat.

### **SPECIFIC GRAVITY**

The ratio between the density of a given substance and the density of water.

### **SPLIT MOLD**

An open mold made in two or more pieces.

### **SPRAY UP**

The process of spraying glass fibers, resin and catalyst simultaneously into a mold using a chopper gun.

### **STYRENE MONOMER**

A component of polyester resin that provides crosslinking sites and reduces the polyester to a workable viscosity.

### **SURFACE MAT**

A lightweight tissue (10-30 mils thick) of glass or synthetic fiber used to provide a resin-rich surface. See VEIL.

### **SURFACTANT**

Chemicals used to modify or change the surface of a layer of resin or polymer. Usually used to form a film on a curing resin, producing a tack-free surface.



## **SYNTACTIC FOAM**

A foam made by mixing microspheres with a resin.

## **SAFETY FACTOR**

The ratio of ultimate stress to allowable stress, or some similar ratio of units expressing this intent.

## **SHEAR**

An action or stress resulting from applied forces which causes or tends to cause two contiguous parts of a body to slide relative to each other in a direction parallel to their plane of contact. In interlaminar shear, the plane of contact is composed of resin only.

## **SIZE OR SIZING**

A treatment consisting of starch, gelatin, oil, wax or other suitable ingredient which is applied to fibers at the time of formation to protect the surface and aid the process of handling and fabrication, or to control the fiber characteristics. The treatment contains ingredients which provide surface lubricity and binding action but, unlike a finish, contains no coupling agent.

## **STEADY STATE**

Stable operating or other load conditions that do not change with time.

## **STIFFNESS**

The relationship of load and deformation; a term often used when the relationship of stress to strain does not conform to the definition of Young's modulus. See also modulus of elasticity.

## **STRAIN**

The elongation per unit length of a material.

## **STRESS CORROSION**

Preferential attack of areas under stress in a corrosive environment, where this factor alone would not have caused corrosion.

## **STRESS RELAXATION**

Stress relaxation occurs when the stresses in the structure decrease while the deformation is held constant. Under this condition, the FRP laminate will assume a permanently deformed shape after mechanical and thermal loads are removed.

## **STRUCTURAL LAMINATES**

That portion of a total laminate that is designed to take the imposed equipment loads. Normally does not include the sacrificial portion of the corrosion barrier or liner.

## **STYRENE**

Unsaturated hydrocarbon used in plastics. In polyester resin it serves as a solvent and as a co-reactant in the polymerization process that occurs during curing.

## **SURVIVAL**



A term used to describe a safety factor between 1.0 and 2.0. Equipment may be designed for "survival" when subjected to infrequent or unlikely upset conditions of short duration.

### **SYNTHETIC FIBER**

Fiber made of materials other than glass, such as polyester.

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## **T**

### **TACK**

Surface stickiness.

### **TACK FREE**

A surface which is not sticky after cure.

### **TAPE**

A narrow width reinforcing fabric or mat.

### **TENSILE LOAD**

A load applied away from and to opposite ends of a given sample.

### **TENSILE ELONGATION**

An engineering term referring to the amount of stretch a sample experiences during tensile strain. ASTM D-638.

### **TENSILE STRENGTH**

A measurement of the tensile load a sample can withstand. ASTM D-638.

### **THERMAL COEFFICIENT OF EXPANSION**

Measures dimensional change of a material when heated or cooled. Measured in inches per inch per degree.

### **THERMAL CONDUCTIVITY**

Measures the transfer of heat through a material.

### **THERMAL GRADIENT**



The change in temperature through the FRP laminate from the interior to the exterior of the equipment. The change in temperature per unit of wall thickness

### **THERMOPLASTICS**

A group of plastic materials that become elastic or melt when heated, and return to their rigid state at room temperature. Examples are PVC, ABS, polystyrene, polycarbonates, nylon, etc. Capable of being repeatedly softened by increase of temperature and hardened by decrease in temperature.

### **THERMOSETS**

Materials that undergo a chemical crosslinking reaction going from liquid to solid or semi-solid. This reaction is irreversible. Typical thermosets are polyesters, acrylics, epoxies, and phenolics. A plastic which, when cured by application of heat or chemical means, changes into a substantially infusible and insoluble material.

### **THIXOTROPIC**

A term describing the rheology (or characteristics) of a liquid that resists flowing or drainage during application. Concerning materials that are "gel-like" at rest but that are fluid when agitated. Materials having high static shear strength and low dynamic shear strength at the same time.

### **THIXOTROPIC INDEX (T.I.)**

A measure of thixotropy using a Brookfield Viscometer. The low speed viscosity divided by the high speed viscosity.

### **TOOLING GEL COAT**

A gel coat formulated for mold surfaces.

### **TRANSLUCENT**

Permits a percentage of light to pass but not optically clear like window glass.

### **TRANSIENT LOADS**

Temporary loads of limited duration.

### **TRANSVERSE CRACK**

A crack occurring in the resin matrix at right angles to the direction of the reinforcements.

### **TRIM**

The act of removing the excess fiberglass from a part after it is cured. Usually accomplished with a razor blade knife, diamond blade saw or grinder.



# U

## **UNDERCUT**

An area of a part or mold that No changes. has an acute angle between two surfaces. If a part has an undercut a split mold is necessary.

## **UNIDIRECTIONAL**

Strength lying mainly in one direction. A glass reinforcement in which the fiber is oriented in one direction.

## **UV STABILIZER**

A chemical compound which improves resistance to degradation from ultraviolet radiation.

## **ULTIMATE TENSILE STRENGTH**

The ultimate or final stress sustained by a laminate under tension loading; the stress at the moment of rupture.

## **UNIDIRECTIONAL LAMINATE**

A reinforced plastic laminate in which substantially all of the fibers are oriented in the same direction.

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# V

## **VACUUM BAG MOLDING**

Process for eliminating voids and forcing out entrapped air and excess resin from layups by drawing a vacuum from a plastic film which blankets a laminate.

## **VISCOSITY**

The liquid properties of a material. Resistance to flow.

## **VOID FREE**

A molding containing no entrapped air cavities, blisters, or voids.

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# W

## **WATER ABSORPTION**



The amount of water which a laminate will absorb.

## **WAX**

A compound used as a release agent. See RELEASE AGENT.

## **WETTING-OUT**

The action of saturating a glass fabric with resin. Also a measure of the speed with which a fabric soaks up resin.

## **WARP**

The yarn running lengthwise in a woven fabric.

## **WEFT**

The transverse threads or fibers in a woven fabric; those fibers running perpendicular to the warp.

## **WEEPING**

A slow passage of process fluid through an FRP laminate that can occur when a leak path is established by extensive cracking.

## **WET-OUT**

Saturating reinforcing material (glass fiber) with resin. The rate or speed of saturation is a key factor in effective and profitable molding.

## **WOVEN ROVING**

A heavy glass fiber fabric made by the weaving of roving and used as the primary structural material in the laminate.

## **WOVEN ROVING FABRIC**

Heavy fabrics woven from continuous filament in roving form. Usually in weights between 18-30 oz. per square yard.

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# **Y**

## **YARN**

Twisted strands of roving, used to weave textile reinforcements.

## **YIELD POINT**

The first stress in a material, less than the maximum attainable stress, at which an increase in strain occurs without an increase in stress.

