CANZ GLOSSARY OF TERMS

- A -

ACCELERATOR – An additive to polyester and VE resins that speeds up the cure and is usually used in conjunction with a promoter. Also known as a co-promoter.

ACETONE – In the context of FRP, primarily useful as a cleaning solvent for removal of uncured resin from applicator equipment and clothing. ***Very Flammable Liquid***.

ADHESIVE – A bonding substance that creates a molecular attraction, holding two surfaces together.

ADHESIVE FAILURE – Failure in an adhesive joint that occurs between the adhesive material and the adherend, contrast with Cohesive Failure.

ADDITIVE – Any number of materials used to modify the properties of polymer resins. Categories of additives include reagents, fillers, viscosity modifiers, pigments, UV absorbers, flame retardant materials, waxes, promoters etc.

AIR DRY – To cure at room temperature with addition of catalyst but without assistance of heat and pressure.

AIR-INHIBITED RESIN – Resin which cures with a tacky surface (air inhibits its surface cure).

ALLIGATORING – Wrinkling of gel coat film resembling alligator hide; caused by poor cure at time of contact with styrene from a subsequent or preceding coat.

ANTIMONY TRIOXIDE – Additive used to provide special flammability characteristics to a polyester.

ARAMID – Aromatic polyamide used to make high strength fibres, commonly known as Dupont Kevlar™

ARCING – Spray method which should normally be avoided as it consists of directing spray passes by gun rotation at the wrist (arcing), as opposed to conventional stroke from shoulder, keeping fan pattern perpendicular to mould.

AREAL WEIGHT – Weight of a fibre reinforcement per unit area (width times length) of tape or fabric.

ARRIS – Is the sharp edge formed by the intersection of two surfaces.

AUTOCLAVE MOLDING – Moulding technique in which an entire composite assembly is placed in an autoclave (or closed vessel with pressure/heat capability) at 50 to 10 psi pressure to consolidate the laminate by removing entrapped air and volatiles.

AUTO-IGNITION TEMPERATURE – Lowest temperature required to initiate or cause self sustained combustion in absence of a spark or a flame.

- B -

BAG MOLDING – Technique in which composite material is placed in rigid mould and covered with flexible bag. Pressure is applied by vacuum, autoclave, press, or by inflating the bag.

BALANCED – Laminate design term used with aligned-fibre composites to indicate that each ply oriented at plus theta degrees is matched by a ply at minus theta degrees. When plus theta is zero degrees, minus theta is 90 degrees. See related Symmetric.

Laminate can be balanced and not be symmetric.

BARCOL HARDNESS – A measure of surface hardness made with a Barcol Impressor instrument in accordance with ASTM D-2583. The harness value can be used as an indication of the degree of cure of a gel coat or laminate.

BARCOL IMPRESSOR – Instrument invented by Walter Colman during WWII to measure hardness of soft metals; manufactured by Barber-Colman Company. Two types are commonly used in the FRP industry. Model 934 is used to check ultimate cure; Model 935 is used for initial readings prior to

BATCH (OR LOT) – Identity for all material produced during one operation possessing identical characteristics throughout.

BENZOYL PEROXIDE (BPO) – Catalyst used in conjunction with aniline accelerators or where heat is used as an accelerator.

BI-DIRECTIONAL – Arrangement of reinforcing fibre strands in which half the strands are laid at right angles to the other half; a directional pattern that provides maximum product strength to those two directions.

BINDER – Bonding resin applied to glass fibres to hold them in position in a broadgoods textile structure. During lamination, this resin is dissolved by the styrene in polyester resin, and, if unsaturated, can become part of the final polymer network.

BINDERLESS CHOPPED STRAND MAT – Textile material consisting of short glass fibres held together with polymer fibre cross-stitch; resembles chopped strand mat without the binder. Also called Stitched Chopped Strand Mat.

BLEEDING – Result of softening of backside of gel coat (typically by laminating resin or post applied gel coat) which causes pigments (colour) to reflow.

BLEED OUT – Excess liquid resin appearing at the surface, primarily occurring during filament winding or from an RTM mould tube.

BLEEDER PLY – Layer of porous material placed in a vacuum bag to absorb excess resin and allow air and gas to escape.

BLISTER – A void formed within a composite that may be the result of either trapping air in a laminate, or chemical action within the laminate.

BOND – The joining of materials by chemical or mechanical means.

BRACE – Integral structural element used to stiffen or strengthen mould skin.

BREAKOUT – Separation or breakage of fibres when edges of a composite part are drilled or cut.

BRIDGING – Condition that occurs when textile or sheet material does not conform to inside edge or radius on mould or laminate surface and does not come into contact with the laminate below.

BUCKLING – Failure mode usually characterised by fibre deflection rather than breaking.

BULK MOLDING COMPOUND (BMC) – Premixed blend of thermosetting resin, reinforcements, catalysts, and fillers for use in closed moulding process. Similar to sheet moulding compound (SMC) but mechanical qualities are not as good, and it is less expensive.

- C -

CAD – Computer-aided design.

CAM – Computer-aided manufacturing.

CARBON (OR GRAPHITE) FIBER – Reinforcing fibre known for its light weight, high strength, and high stiffness.

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

CATALYST – In a scientific sense, the substance that promotes or controls the curing of compound without being consumed in the reaction (initiator). Within the composites industry, free radial initiators such as MEKP are often referred to as “catalysts”. Such usage is scientifically inaccurate since initiator is consumed during usage.

CATALYST INJECTION – Used with spray equipment to catalyse polyester at spray gun, therefore eliminating the need to clean system within gel time of polyester. Internal mix guns require a solvent flush for cleaning gun head.

CATALYST (PEROXIDE) – In FRO terms, substance added to resin or gel coat in controlled quantities to make it gel and cure. Catalyst is reduced by accelerator, creating free radicals, which in turn initiate polymerization.

CAVITY – Space between matched moulds (pressure moulds) in which laminate is formed. Also, a term for a female mould.

CENTIPOISES – (CPS) A unit of measure used to describe the viscosity of a liquid. Viscosity is measured with a Brookfield Viscometer for most polyester resin applications. At 21 °C water is one cps.

CHALKING – A surface phenomenon indicating degradation of a cosmetic surface. Chalking is a powdery film that appears lighter than the original colour.

CHAMFER – An angle or type of bevel at the junction of two surfaces internal or external.

CHOPPED STRAND MAT – A fibreglass reinforcement consisting of short strands of fibre arranged in a random pattern and held together with a binder. Mat is generally used in rolls consisting of 225 – 600gm/m2 material.

CLOSED MOULDING – Fabrication process in which composite part is produced in a mould cavity formed by the joining of two or more tool pieces.

CLOTH – A fibreglass reinforcement made by weaving strands of glass fibre yarns. Cloth is available in various weights measured in ounces per square yard or grams/m².

CNC – Computer Numerical Control, typically used to machine composites, plugs and templates usually 3 or 5 axes.

COBALT – Used as an accelerator for methyl ethyl ketone peroxide catalyzed polyesters.

COEFFICIENT OF THERMAL EXPANSION (CTE) – Material’s fractional change in dimension for given unit change of temperature.

COHESION – Tendency of single substance to adhere to itself. Also, force holding single substance together.

COHESIVE FAILURE – Failure of adhesive joint that occurs either within adhesive material or within one or both adherends.

COMPOSITE – A material made of distinct components. For example, a reinforcing fibre in a resin matrix where

the combined properties are superior to the individual materials.

COMPRESSION MOLD – Mould that is open when material is introduced and that shapes material by heat and by the pressure of closing.

COMPRESSION MOLDING – See "Closed moulding".

COMPRESSIVE STRENGTH – Resistance to crushing or buckling force; maximum compressive load specimen sustains divided by its original cross-sectional area.

CONSOLIDATION – Processing step that compresses fibre and matrix to remove excess resin, reduce voids and achieve particular density.

CONTACT MOULDING – Refers to the use of a single or open mould onto which resin and reinforcement materials can be applied. Contact moulding is characterised by one finished cosmetic side.

CONTAMINANT – Impurity or foreign substance that affects one or more properties of composite material.

CONTINUOUS FILAMENT STRAND – A fibre bundle composed of many glass filaments. Also, when referring to gun roving, a collection of string like glass fibre or yard, 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.

COPOLYMER – Large chemical chain composed of two or more dissimilar groups.

CORD, REINFORCING – Loosely twisted cord made up from rovings and designed for incorporation in mouldings where edge reinforcement and high strength ribs are necessary.

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.

CORE CRUSH – Compression damage to core.

CORE ORIENTATION – On honeycomb core, used to line up ribbon direction, thickness of cell depth, cell size, and transverse direction.

CORNER – Geometric feature characterised as point where three edges come together, as in a box corner. Can be either inside corner or outside corner.

COSMIC STABILITY – Capability of substance or part to maintain appearance with respect to surface smoothness, colour, gloss, or other visual appearance characteristics.

COVE – Fillet of adhesive used to smooth out a transition between two adjoining surfaces.

CRAZING – Cracking of the resin due to internal stress.

CREEL – Device used to hold required number of roving spools or other supply packages of reinforcement in desired position for unwinding.

CREEP – Over time, dimensional change in material under physical load (beyond initial elastic deformation).

CROSS-LAMINATED – Laminated so some layers are oriented at right angles to remaining layers with respect to grain or strongest direction in tension.

CROSS-LINKING – The chemical bonding of molecules which in polymerisation occurs in the curing transition from a liquid to a thermoset solid.

CURE – The completion of the cross-linking process during which a composite develops its full strength.

CURING AGENT – An initiator or catalyst that initiates polymerisation when added to a resin. For epoxies these are known as hardeners.

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

- D -

DELAMINATE - Separation of layers due to failure of adhesion or cohesion of one component to others. Also includes separation of layers of fabric from core structure. May be associated with bridging, drilling, and trimming.

DELAMINATION – Laminate defect that occurs due to mechanical or thermal stress and is characterised by separation between laminae.

DEMOLD – To remove a part from a tool or a tool from an intermediate model.

DENSITY – A comparison of weight per volume, measured in pounds per cubic foot, grams per litre or pounds per gallon.

DESIGN ALLOWABLE – Limiting – value for material property that can be used to design structural or mechanical system to specified level of success with 95 per cent statistical confidence.

DIAMOND SAW BLADE – Diamond encrusted abrasive cutting saw blade to cut composites. Used in angle electric or air powered grinders.

DIBUTYL PHTHALATE – Lubricant for spray equipment.

DIELECTRIC STRENGTH – Non conductor of electricity; ability of material to resist flow of an electrical current.

DIETHYLANILINE (DEA) – Accelerator used in conjunction with BPO catalyst, or as co-promoter for cobalt/MEKP systems.

DILUENT – Diluting (reducing or thinning) agent.

DIMENSIONAL STABILITY – Capability of substance or part to maintain its shape when subjected to varying forces, moments, degrees of temperature and moisture, or other stress.

DIMETHYLANILINE (DMA) – Accelerator used in conjunction with BPO catalyst; more effective than DEA.

DIMPLES – Small sunken dots in gel coat surface, generally caused by foreign particle, air void, or catalyst droplets in gel coat or laminate.

DISPERSION – Homogeneous mixture of suspended solid particles in liquid medium.

DISTORTION – A change in shape from that which is intended. Wavy gel coat surface reflection often found in conjunction with print-through. Commonly caused by a problem in laminating system.

DOUBLER – Extra layers of reinforcement for added stiffness or strength where fasteners or other abrupt load transfers occur.

DRAFT ANGLE- Mould or mandrel's taper or angle for ease of part removal (minimum of 3 degrees is recommended).

DRAPE – Ability of fabric (or prepreg) to conform to shape of contoured surface.

DRAINAGE – Leaking, sagging and puddling of laminating resin from reinforcement.

DRY SPOT – Laminate defect that occurs during moulding process and is characterised by dry, unwet fibres that have never been encapsulated by matrix material.

DUPLICATION MOLD – A mould made by casting over or duplicating another article.

DWELL – Hold in temperature change during a laminate cure cycle.

- E -

EDGE – Geometric feature characterised as line formed where two panels on different planes come together. When angle between two panels is between zero and 180 degrees, edge is inside. When angle is between 180 and 360 degrees, edge is outside.

E-GLASS – Originally formulated for use in electric circuitry, e-glass is the most common glass formulation used in fibreglass reinforcements.
ELASTICITY – Capacity of materials to recover original size and shape after deformation.

ELASTOMER – Material that substantially recovers original shape and size at room temperature after removal of deforming force.

ELONGATION – Standard measure for the amount a sample can stretch as percentage of original length before it fails or breaks.

ENCAPSULATING – Completely surrounding an object with resin or a fibre resin composite.

EPOXY RESIN – A polymer resin characterised by epoxide molecule groups.

EXOTHERMIC HEAT – Internally developed heat accompanying a chemical reaction, such as might be created when a thermoset resin is cross linking.

EXTENDERS – Low cost materials used to dilute or extend higher-cost resins without excessive reduction in properties.

- F -

FABRIC, NONWOVEN – Material formed from fibres or yarns without interlacing, (e.g.: stitched nonwoven broad goods),

FABRIC, WOVEN – Material constructed of interlaced yarns, fibres, or filaments.

FABRICATION – Process of making composite part or tool.

FADING – Degradation of colour in gel coat or coatings.

FATIGUE – Failure of material's mechanical properties caused by repeated stress over time.

FATIGUE STRENGTH – Maximum cyclical stress withstood for given number of cycles before material fails.

FELT – Fibrous material made up of interlocking fibres by mechanical or chemical action, pressure or heat. Felts may be made of cotton, glass or other fibres.

FEMALE – Archaic term formerly used to describe concave surface or inside edge or feature.

FIBRE – Individual rod of sufficiently small diameter to be flexible, having known or approximate limit of length.

FIBRE BLOOMING – Fibre and resin are eroded by weathering or sandpaper at different rates. Resins erode before fibre. As a result, fibre

rich surface, when sanded, often has fibres protruding; called fibre blooming.

FIBRE CONTENT – Amount of fibre in a composite compared to the amount of resin and/or filler.

FIBRE GLASS – Glass that 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 fibres. These fibres come in many forms such as roving, woven roving, mat and continuous strands.

FIBRE ORIENTATION – The direction of fibre alignment in a laminate. Chopped strand mat has isotropic (all directions) orientation. Knitted ad woven fabrics can have two or more orientations such as 0 deg/90 deg or +45 deg/-45 deg.

FIBRE PRINT – Cosmetic defect, visible on exterior gel coat surface that resembles fibre bundle and reflects architecture of glass reinforcement bundle at or near part surface.

FIBRE REINFORCED PLASTICS (FRP) – General term for composite material or part that consists of plastic matrix containing reinforcing fibres such as glass or carbon having greater strength or stiffness than plastic. FRP is most often used to denote glass fibre-reinforced plastics. “Advanced composite” usually indicates high-performance aramid or carbon fibre-reinforced plastics.

FIBREGLASS – Fibers similar to wool or cotton fibres but made from glass; sometimes called fibrous glass. Glass fibre forms include cloth, yarn, mat, milled fibres, chopped strands, roving, woven roving.

FILAMENT – Single, thread-like fibre or number of these fibres drawn together. Variety of fibre characterised by extreme length, which permits its use in yarn with little or no twist and usually without spinning operation required for fibres.

FILAMENT WINDING – Process for production of high strength, lightweight products in which tape, roving or single strands are fed from creel through bath of resin (or fed dry using pre-impregnated roving) and wound on suitably designed mandrel. Wound mandrel can be cured at room temperature or in oven.

FILLERS – Relatively inert organic or inorganic materials which are added to resins or gel coats for special flow characteristics, to extend volume, and to low cost of article being produced.

FINISH – Surface treatment applied to fibres or filaments after they are fabricated into strands, yarn or woven fabrics to allow resins to flow freely around and adhere to them.

FIRE RETARDANTS – Compounds mixed with the resin to reduce flammability.

FIRE POINT – Lowest temperature at which liquid in open container will give off enough vapours to continue to burn once ignited. Fire point generally is only slightly higher than flash point.

FIRE RETARDANTS – Compounds mixed with the resin to reduce flammability.,

FISHEYES – Circular separation in gel coat film generally caused by contamination such as silicone, oil, dust, water, freshly waxed mould, or low gel coat viscosity.

FLAME RETARDANT RESIN – A polyester resin that 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-894 tests.

FLANGE – An extension around the perimeter of a mould or part for the purposes of demoulding, stiffening, or connecting two components; or for containing over spray.

FLASH POINT – Lowest temperature at which substance emits enough vapours to form flammable or ignitable mixture with air near the surface of the substance being tested.

FLEXURAL MODULUS – Ratio, within elastic limit, of applied stress in test sample in flexure to corresponding strain in outermost fibres of sample. ASTM D-790

FLEXURAL STRENGTH – Strength of material (in bending) expressed as stress of bent test sample at instant of failure; usually expressed in force per unit area.

FLOCOTE, FLOWCOTE, FLOWCOAT – A waxed surface coat of specialized resin, usually pigmented, applied to a fibreglass laminate to offer a self-cleaning surface as well as having some weatherability and water resistance.

FLOODING – High delivery rate from spray gun; in pigmented systems, difference in colour between surface and bulk of film.

FLOW METER – Instrument designed to measure flow of liquid.

FOAM – A lightweight, cellular plastic material containing gas-filled voids.

FOAM-IN-PLACE – The process of creating a foam by the combination of two liquid polymers. See In-Situ

FRACTURE – Rupture of surface of laminate due to external or internal forces; may or may not result in complete separation.

FREE RADICALS – Highly reactive molecular fragments capable of initiating chemical reactions, such as polymerization of polyester resins.

FRIABLE – Term used to describe material that, when dry, can be crumbled, pulverised, or reduced to powder by hand pressure.

FRP – Fibre Reinforced Polymers, with evolution of new fibrous materials, GRP (or GRFP) becomes Glass Reinforced Polymers term.

FUMED SILICA (Trade names: Aerosil, Cabosil) – Thickening agent used in polyesters to increase flow or sag resistance qualities, especially on vertical surfaces.

- G -

GEL – Partial cure stage in plastics resins of a viscous, jelly-like state where liquid material starts to transform into solid.

GEL COAT – A surface coat of specialised polyester resin, either coloured or clear, providing a cosmetic enhancement and weatherability to a fibreglass laminate.

GEL TIME – The length of time from catalyzation to gel or “B” stage.

GELATION – The formation of a gel.

GLASS TRANSITION – Reversible change in an amorphous polymer between a viscous or rubbery condition and a hard, relatively brittle one.

GLASS TRANSITION TEMPERATURE (Tg) – Approximate temperature above which increased molecular mobility causes a material to become rubbery rather than brittle. The measure value of Tg can vary, depending on the test method. (A widely accepted method is Differential Scanning Colorimeter – DSC.)

GLUE FILM – Adhesive film used for bonding in prepreg manufacturing.

GRP – Glass reinforced plastics. Generally based on polyester resin. See fibreglass or FRP.

- H -

HAND LAY UP – The process of manually building up layers of fibreglass, with roll stock reinforcements and resin, using hand rollers, brushes and spray equipment.

HAP – Acronym for Hazardous Air Pollutants. Over 180 chemicals identified by Congress in 1990 Clean Air Act, Section 112. In this law, Congress mandated EPA to control emissions of these chemicals. EPA has endeavoured to do this through a series of MACT standards (see (MACT").

HARDENER – Substance that reacts with epoxy resin to promote or control curing action.

HEAT – Term used colloquially to indicate any temperature above ambient (room) temperature, to which part or material is or will be subjected.

HEAT-ACID RESIN – Polyester resin with exceptional fire qualities based chloridic acid.

HEAT- ONVERTIBLE RESIN – Thermosetting resin convertible by heat to an infusible and insoluble mass.

HEAT-DISTORTION TEMPERATURE (HDT) – Temperature at which test bar deflects a certain amount under specified load (e.g.: temperature at which material softens).

HEAT-PRESSURE LAMINATES – Laminates moulded and cured at pressures not lower than 1000 psi.

HELICAL – Ply laid onto mandrel at an angle, often 45° (degree) angle.

HERMETIC – Completely sealed, airtight.

HONEYCOMB – Manufactured product of sheet metal or resin-impregnated sheet (paper, fibrous glass, etc.) that has been formed into hexagonal shaped cells. Used as core material for sandwich construction.

HOOP – Ply laid onto mandrel at a 90 ° (degree) angle.

HOOP STRESS – Circumferential stress in cylindrically shaped part as a result of internal or external pressure.

HYBRID COMPOSITE – Composite with two or more types of reinforcing fibres. Also refers to composite prepared from a polymer which uses more than one type of chemistry, such as XYCON™ polyester/polyurethane hybrid material.

HYBRID RESIN – Resin with two or more types of chemistries combined.

HYDROPHOBIC – Moisture resistant capability, moisture repelling.

HYGROSCOPIC – Moisture absorbing capability.

- I -

IMPREGNATE – To saturate with resin. The most common application is saturating fibreglass with a catalyzed resin.

INHIBITOR – A substance designed to slow down or prevent chemical reaction; chemical additive that slows or delays cure cycle.

INJECTION MOLDING – Method of forming plastic to desired shape by forcibly injecting polymer into a mould.

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

INTEGRAL HEATING – System in which heating elements are built into a tool, forming part of the tool and usually eliminating the need for oven or autoclave as a heat source.

INTERFACE – Surface between two materials in glass fibres, (e.g.: area at which glass and sizing meet). In laminate, area at which reinforcement and laminating resin meet.

INTERLAMINAR – Existing or occurring between two or more adjacent laminae.

INTERLAMINAR SHEAR – Shearing force that produces displacement between two laminae along plane of their interface.

IN SITU – In original position. In filament winding, used to indicate mandrel that remains in place after winding, as opposed to mandrel that is removed after winding.

INTUMESCENCE – A coating technology that causes the material to swell when exposed to heat, forming an insulating barrier to resist fire.

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

ISOTROPIC – The description of equal strength properties in all orientation. Isotropic composites are usually achieved by random fibre orientation.

- J -

JACKSTRAWING – Prominence of fibreglass pattern having turned white in the laminate because glass has separated from resin due to excessive exothermic heat; usually associated with thick, resin rich laminates. Cosmetic problem only.

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.

- K -

KEVLAR™ - Strong, lightweight aramid fibre trademarked by Dupont; used as reinforcement fibre.

- L -

LAMINA – One layer of laminate; can be chopped fibre reinforced plastic layer, textile reinforced plastic layer, or core material, etc. Plural is laminae.

LAMINATE (Noun) – Layers of a composite consisting of a resin and a reinforcement, bonded together to form a single structure.

LAMINATE (Verb) – The act of processing resin and reinforcement into a bonded structure. Saturating glass reinforcement and rolling out air voids is to laminate.

LAMINATED PLASTICS – Material consisting of superimposed layers of synthetic materials that have been bonded together, usually by mans of heat and pressure, to form a single piece.

LAMINATING ROLLER – Used for the consolidation and air removal in open moulding lamination.

LAMINATION – Layering on of layers of reinforcing materials and resin, much like build-up of plywood. Several layers of material bonded together.

LAYER – A single ply of lay up or laminate.

LAYUP – The act of building up successive layers of polymer and

reinforcement. Layers of catalysed resin and fibreglass or other reinforcements are applied to a mould in order to make a part. Layup is sometimes used as a term for the work piece itself.

LOW-PRESSURE LAMINATES – Laminates moulded and cured in range of pressures from 400 psi down to and including pressure obtained by mere contact of plies.

LOW PROFILE – Resin compounds formulated for low, zero, or negative shrinkage during moulding.

- M -

MACROSCOPIC – Large enough to be visible at magnification of 60x or less.

MACT – Acronym for Maximum Achievable Control Technology Standards established by the EOA in response to the 1990 Clean Air Act, Section 112. These standards set forth regulations for reduced emissions of Hazardous Air Pollutants (see 'HAP').

MALE – Archaic term formerly used to describe convex surface or outside edge or feature.

MANDREL – Elongated mould around which resin-impregnated fibre, tape or filaments are wound to form structural shapes or tubes.

MASS – Quantity of matter contained in a specific body. In reference to polyesters, mass is measured in terms of weight and/or volume.
MASTER (Plug) – A full scale representation of the intended part, usually retained as a reference and the part from which production moulds are made.

MACHED-METAL MOLDING/MATCHED-DIE MOLDING – Method of closed moulding in which reinforced plastics are moulded between two close-fitting metal moulds mounted in hydraulic press. Generally considered most economical mass production method for manufacturing FRP parts in large volumes.

MATRIX – Material in which fibre reinforcements of composite system is imbedded. Thermoplastic and thermoset resin systems can be used, as well as metal and ceramic.

MEK PEROXIDE (MEKP) – Abbreviation for methyl ethyl ketone peroxide; free radical source commonly used as initiator for polyesters in FRP industry.

MEK (SOLVENT) – Abbreviation for methyl ethyl ketone; colourless flammable liquid commonly used in spray gun clean-up procedures. Good for cleaning Epoxy Resins.

MICRO CRACKING – Cracks formed in composites when thermal stresses locally exceed strength of matrix.

MICROSCOPIC – Small enough to require magnification much greater than 10x to be visible.

MILS – Unit used in measuring film thickness and diameter of fibre strands, glass, wire, etc., (one mil = .001 inch).

MILLED FIBRES – Carbon or glass used for making fibre-filled putty or C strands hammer-milled into short fibre lengths of 1/32 inch, 1/16-inch, 1/8 inch and ¼ inch.

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.

MOISTURE ABSORPTION – Pick-up of water vapour from air by a material. Relates only to vapour withdrawn from air by a material; must be distinguished from water absorption,

which is a gain in weight due to take-up of water by immersion.

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

MOLDING – The process of using a mould to form a part.

MOLD RELEASE – A wax or polymer compound that is applied to the mould surfaces acts as a barrier between the mould and the part, thus preventing the part from bonding to the mould.

MONOLITHIC – Solid laminate comprised of one material.

MONOMER – A constituent of polyester or vinyl ester resin. Styrene monomer is most commonly used.

MSDS – Material Safety Data Sheet

- N -

NANOMETER – Abbreviated (nm) and equal to one millimicron or one billionth of meter, used to measure wavelengths of light.

NETSHAPE – A fabricated part that comes out of the mould and does not require cutting, trimming or machining

NON-DESTRUCTIVE INSPECTION (NDI) – Determining material or part characteristics without permanently altering test subject. Non-destructive testing (NDT) and non-destructive evaluation (NDE) widely considered synonymous with NDI.

NPG™ - Registered trademark (of Eastman Chemical Company) for neopentyl glycol.

NON-AIR INHIBITED RESIN - Resin, cure of which will not be inhibited or stopped by presence of air, possibly due to surfacing agent added to exclude air from resin surface.

NON-VOLATILE MATERIAL – Material remaining after heating to condition short of decomposition.

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

- O -

ONE-OFF – Fabrication process in which single part is fabricated.

ORIFICE – An opening, generally referred to regarding spray tip size.

ORANGE PEEL – A gel coated or painted finish that is not smooth and is patterned similar to an orange's skin.

ORTHOPHTHALIC OR ORTHO RESIN – A polyester resin based on orthophthalic acid, also known as a general-purpose resin (GP).

ORIGINAL EQUIPMENT MANUFACTURER (OEM) – Companies that design and build products bearing their name.

OUT-GASSING – Release of solvents, volatiles, gasses and moisture from composite parts under vacuum.

- P -

PARALLEL-LAMINATED – Laminated so all layers of material are oriented approximately parallel with respect to the grain or strongest direction in tension. Also called unidirectional. This pattern allows the highest loading of reinforcement but gives maximum strength in only one direction.

PART CONSOLIDATION – Process of composites fabrication in which multiple discrete parts are designed and fabricated together into a single part, thus reducing the number of fabricated parts and the need to join those parts together.

PARTING AGENT – See Mould Release and PVA

PATTERN – General term for master model that is usually constructed from single material or material type. Pattern is generally not durable and suitable for producing only one (or small number) of moulds. Sometimes used interchangeably with Plug.

PEEL PLY – A removable non-stick fabric applied to a lay-up surface that is removed from the cured laminate prior to bonding operations in order to leave clean, resin-rich surface ready for bonding. -

PEEL STRENGTH – Strength of adhesive bond obtained by stress that is applied "in a peeling mode".

PEROXIDES – Category of compounds containing unstable O-O (or O-OH) Group: Oxygen to Oxygen atoms; used as initiators.

PHENOLIC RESIN – Thermosetting resin produced by condensation of aromatic alcohol with aldehyde, particularly phenol with formaldehyde.

PIGMENT – ingredient used to impart colour, as in gel coats.

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 characterised by a non-homogeneous surface colour.

PINHOLES – Small air bubbles in gel coat film, few enough to count. Generally larger in size than porosity.

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

PLUG – General term for master model that is usually hand-crafted from a variety of materials. Plug is generally not durable; suitable for producing only one (or a small number) of moulds. Sometimes used interchangeably with "Pattern".

PLY – A single layer within a laminate.

PLY SCHEDULE – Layup of individual plies or layers to build laminate (FRP). Plies may be arranged (scheduled) in alternating fibre orientation to produce multi-directional strength part (see "Fibre Architecture").

POLYESTER (Unsaturated) – Resin formed by reaction between dibasic acids and dihydroxy alcohols, one of which must be unsaturated (typically maleic anhydride) to permit cross-linking.

POLYMER – Large chemical chain composed of many repeating groups such as polystyrene.

POLYMERISATION – Chemical reaction of linking molecules or chains of molecules.

POLYVINYL ALCOHOL (PVA) – A parting film applied to a mould for part releasing. Water-soluble.

POROSITY – Small air bubbles in composite or gel coat film; too numerous to count. Generally small in size than pinholes.

POSTCURE – Exposure of cured resin to higher temperatures than during moulding; necessary in certain resins to attain complete cure and ultimate mechanical properties.

POT LIFE – The time during which the catalyzed resin remains liquid or "workable". See Gel Time.

PPE – Personal Protective Equipment such as gloves, respirator, safety glasses etc.

PREFORM – Pre-shaped fibrous reinforcement formed by distribution of

chopped fibres by air, water flotation, or vacuum over surface of perforated screen to approximate contour and thickness desired in finished part. Also, compact pill of compressed premixed materials.

PREFORM MAT – Fibre reinforced mat shaped like mould in which it will be used. Eliminates need for overlapping corners in moulding.

PREHEATING – Heating of compound prior to moulding or casting in order to facilitate operation, reduce moulding cycle, or remove volatiles.

PREMIX – Mixture of resin, pigment, filler, and catalyst for moulding.

PREPREG – Resin-impregnated cloth, mat or filaments in flat form that can be stored for later use. Resin often partially cured to tack-free state called "B-staging". Additives can be added to obtain specific end-use properties and improve processing, storage, and handling characteristics.

PRE-RELEASE – The premature release of the gel coat or laminate from the mould. Pe-release causes **cosmetic** or dimensional problems.

PRESSURE BAG – A membrane that conforms to the inside of a laminate laid-up on a mould. The membrane or bag is then inflated by applying pressure that consolidates and densifies the laminate.

PRINT THROUGH – A distortion in the surface of a part that allows the pattern of the core or fibreglass reinforcement to be visible through the surface. Also known as print out, telegraphing or read through.

PRODUCTION MOLD – durable, robust mould used to produce hundreds or thousands of part copies. Laminated production moulds are best manufactured from laminated master moulds.

PROFILE – Surface contour of part viewed from edge or cross section. When describing cosmetic features, profile is the roughness of surface on a scale large enough to affect visual appearance but small enough to be insignificant with respect to dimensional functionality. Low profile corresponds to exceptionally smooth surface; high profile corresponds to a surface with greater roughness.

PROMOTOR – An additive to speed up the cure. This additive is required for room temperature resin cure. See Accelerator.

PROTOTYPE – Process of creating test part not intended for commercial release that establishes design, material, and fabrication parameters for new product. May require multiple iterations (repetitions) to arrive at final/commercial part design.

PULTRUSION – Automated continuous process for manufacturing composite rods, tubes and structural shapes having constant cross section. Roving and other reinforcements saturated with resin and continuously pulled through a heated die, where part is formed and cured. Cured part then automatically cut to length.

PTE (TEFLON) – Used as mould release material. Typically supplied with an adhesive backer and as a film.

PUTTY – A thickened mixture of resin made by adding fillers, fumed silica (thixotropes) and reinforcing fibres.

- R -

RAMPING – Gradual programmed increase/decrease in temperature or pressure to control cure or cooling of composite parts.

REINFORCED MOLDING COMPOUND – Compound consisting of a polymer and a reinforcement fibre or filler supplied by raw material

producer in the form of ready-to-use materials.

REINFORCEMENT – Strong, relatively inert material moulded into plastics to improve strength, stiffness, and impact resistance. Usually fibres of glass, carbon, boron mineral, synthetic polymer, ceramic, textile, sisal, cotton, etc., in woven or non-woven form.

RELEASE AGENT – a compound used to reduce surface tension or adhesion between a mould and apart. See mould release.

RELEASE FILM – A non-stick film layer that does not bond to the composite during cure.

RESIN – A liquid polymer that when catalyzed cures to a solid state.

RESIN INFUSION – To draw or force resin into dry reinforcement already in mould cavity.

RESIN PRESSURE HEAD – RTM process feature; state of pressure across apart from injection point to vent point; driving force that causes rein to flow through and saturate fibre pack.

RESIN RICH – Localised area filled with excess resin as compared to consistent resin/fibre ratio.

RESIN STARVED – Localised area lacking sufficient resin for fibre wetout.

RESIN TEARING – Separation of vehicle from pigments/fillers in gel coat film, usually seen as black wavy lines.

RESIN TRANSFER MOLDING (RTM) – moulding process in which catalysed resin is pumped into two-sided, matched mould where fibrous reinforcement has been placed. Mould and/or resin may or may not be heated.

RIBBON DIRECTION – On honeycomb core, direction in which honeycomb can be separated; direction of one continuous ribbon.

ROVING – Collection of bundles of continuous filaments either as untwisted strands or as twisted yarns. For filament winding, generally wound as bands or tapes with as little twist as possible.

- S -

SAGS/RUNS – Sag: Slumping of gel coat or resin film. Run: Running of gel coat film or laminating resin.

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

SDS – Safety Data Sheet.

SEALANT – Applied to joint in paste or liquid from that which hardens in place to form a seal.

SECONDARY BONDING – Joining together by adhesive bonding of two or more previously cured parts, or subsequent lamination onto earlier cured laminate surface.

SELF EXTINGUISHING – Ceases to burn when the source of flame is removed.

SET – To convert resin into fixed or hardened state by chemical or physical action, such as condensation, polymerization, vulcanization, or gelation.

S-GLASS – Magnesia/alumina/silicate glass reinforcement designed to provide remarkably high tensile strength. Commonly used in high-performance parts. Has high compressive strength.

SHEAR – Stress resulting from applied forces. Caused by two contiguous parts of body sliding, relative to each other, in direction parallel to their plane of contact. In cross shear, plane of contact is composed of resin and glass fibres. In interlaminar shear (ILS), plane of contact is composed of resin only. In liquids, force and movement of components or layers against each other.

SHEET MOLDING COMPOUND (SMC) – Ready-to-mould, glass-fibre-reinforced, thickened polyester material primarily used in closed moulding. Similar to bulk moulding compound (BMC) but with improved mechanical properties.

SHELF LIFE – Length of time uncatalyzed polyester remains workable while stored in tightly sealed container; also referenced as “storage life”.

SHIP LAP – 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.

SHOT – One complete cycle on injection moulding machine. Shot weight is measured compound delivered to completely fill mould in injection or transfer moulding.

SILICONE BAG – Not necessarily a bag but a shaped blanket made of silicone used in the RTM and LTRM manufacture as the B mould.

SISAL – White fibre produced from leaves of agave plant. Used as reinforcing filler, in short chopped lengths, to impart moderate impact resistance.

SIZING – Water-soluble solution of chemical additives used to coat filaments; additives protect filaments from water absorption and abrasion. They also lubricate filaments and reduce static electricity (see chapter on “Open moulding”).

SKIN LAMINATE – Thin, glass laminate applied directly against gel coat to provide durability by eliminating entrapped air, and good cosmetic quality by isolating gel coat from subsequent laminate shrinkage due to exotherm heat.

SLAVE PUMP – Small, specifically sized pump driven by master gel coat or resin pump to deliver catalyst in ratio of one to three per cent.

SOLVENT – Liquid used to dissolve and clean materials.

SPEC – Specification of properties, characteristics, or requirements; a particular material or part must have to be accept able to potential user of material or part.

SPECIFIC GRAVITY – Ratio of weight of any volume of substance to weight of equal volume of some substance taken as standard unit; usually water for solids and liquids, and air or hydrogen for gasses.

SPLIT MOLD – An open mould made in two or more pieces.

SPRAYUP – Process in which glass fibres, resin and catalyst are simultaneously deposited in mould. Typically, a slight dimensional change in the cured laminate once released from the mould. It can also be caused by reinforcement imbalance as well as the laminate having areas where the resin content is in excess. Glass roving is fed through chopper and ejected into resin stream directed at mould. Catalyst and accelerated resin may be sprayed from one or two guns., Glass resin mix is then rolled by hand before curing.

SPRAY TACK – A spray adhesive used in closed mould applications to temporarily hold dry laminate and

consumables in place prior to the resin being applied.

SPRING BACK – Slight dimensional change in the cured laminate once released from the mould. Can also be caused by reinforcement imbalance as well as the laminate having areas where the resin content is in excess.

STABILIZER – Additive for polymers which aids maintenance of certain properties.

STAR CRAZING – A crack in the gel coat often looking like a spider web caused by an impact to the part.

STIFFNESS – Structural property that describes relationship between forces and moments applied to and stretching and bending deflections experienced by any item.

STRAIN – Deformation resulting from stress.

STRANDS – Primary bundle of continuous filaments combined into single compact unit without twist.

STRESS- Internal resistance to change in size or shape, expressed in force per unit area.

STRESS CORROSION – Preferential attack of areas under stress in corrosive environment, where such an environment alone would not have caused corrosion.

STRESS CRACK – External or internal cracks in composite caused by tensile stresses; cracking may be present internally, externally or in combination.

STYRENE MONOMER – Unsaturated aromatic hydrocarbon, used in plastics. In polyester, a reactive diluent.

SUBSTRATE – Material on which adhesive-containing substance is spread for any purpose, (e.g.: bonding o coating).

SURFACE PROFILE – Cosmetic quality of surface (see “Profile”).

SURFACING AGENT – Material (commonly paraffin wax) that allows surface of polyesters to cure; limits adhesion of another coat of resin if first is thoroughly cured. May be removed by sanding or rubbing with steel wool.

SURFACING VEIL – Used with other reinforcing mats and fabrics to enhance quality of surface finish. Designed to block out fibre patterns of underlying reinforcements; also called “surfacing mat”.

SYMMETRIC – Laminate design term used with composites to indicate that laminate is symmetric about the lane, midway through its thickness.

- T -

TACK – Stickiness.

TACK CLOTH – Slightly tacky cloth used to help create a dust free surface.

TACK FREE – A surface that is not sticky after cure.

TAPE – A narrow width reinforcing fabric or mat.

TAPER - See Draft Angle

TBPB – Abbreviation for tertiary-butyl perbenzoate used as catalyst in high speed, heated cures of polyester resin systems.

TBPO – Abbreviation for tertiary-butyl peroctoate used as catalyst in high speed, heated cures of polyester resin systems.

TENSILE LOAD - A pulling load applied 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 – Maximum stress sustained by composite specimen before it fails in tension test. ASTM D-638.

TEXTILE – Any type of sheet material made from fibres that are woven, knitted, knotted, stitched, or bonded together.

TDS – Technical Data Sheet

THERMAL COEFFICIENT OF EXPANSION – Measures dimensional change.

THERMAL CONDUCTIVITY – Ability to transfer heat.

THERMAL SHOCK – Temperature changes Rapidly, causing large thermal stresses.

THERMAL STRESS – Occurs when change in temperature causes materials to expand and contract at different rates. Can form within and between layers of laminate as well as between laminate and steel frame.

THERMAL STRESS CRACKING – Crazing or cracking of some thermoset or thermoplastic resins from over-exposure to elevated temperatures or cyclic temperature variations.

THERMOCOUPLE – Assembly used to sense and record temperature.

THERMOPLASTICS – Polymers that can be repeatedly softened when heated, hardened when cooled. Thermoplastics such as polymers and copolymers of acrylics, PET, polycarbonates, nylons, fluorocarbons, and styrene are fast becoming important engineering materials.

THERMOSETS – Materials that will undergo or have undergone chemical reaction, leading to relatively infusible state. Typical materials are aminos (melamine and urea), unsaturated polyesters, alkyds, epoxies and phenolics; not reformable.

THIXOTROPIC – Condition in which material possesses resistance to flow until it is agitated (mixed, pumped, or sprayed).

THIXOTROPIC INDEX (TI) – Indication of sag resistance determined by dividing low shear viscosity by high shear viscosity.

TOOL – Mould, either one or two-sided, and either open or closed, in or upon which composite material is placed to make part, also “mould”.

TOOLING GEL COAT RESIN – Special polyesters designed for mould making.

TOUGHNESS – Measure of ability of material to absorb energy.

TOW – An untwisted bundle of continuous filaments. Reference to spread or flat tow carbon fibre.

TRANSFER MEDIUM – Used to assist resin flow during resin infusion.

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

- U -

UNDERCUT – An area of a part or mould that has acute angle between two surfaces. If a part has an undercut, a split mould is necessary.

UNDIRECTIONAL – Refers to fibres oriented in the same direction, such as unidirectional fabric, tape, or laminate; often called UD.

UPPER MOLD TYPE – RTM process feature that describes materials and construction used for mating mould.

- V -

VACUUM-ASSISTED RESIN TRANSFER MOLDING (VAR-TM) – Infusion process where vacuum draws resin into one-sided mould; cover, either rigid or flexible, is placed over top to form vacuum-tight seal.

VACUUM BAG MOLDING – moulding process for minimising emissions voids and maximising reinforcement content, forcing out entrapped air and excess resin from layups, by drawing vacuum into flexible film draped over part. Also considered “Resin Infusion”. Vacuum may be drawn after resin entry.

VACUUM INFUSION PROCESSING – A process where the reinforcement is laid-up in the mould dry, then vacuum bagged and the resin is pulled into the mould at lower than atmospheric pressure.

VAPOR BARRIER – Material through which water vapour will not pass readily or at all.

VEIL – Tissue of fibres which drapes and wets easily; of value to provide resin-rich barrier to corrosion or glass print, as in surfacing veil.

VISCOSITY – Fluid’s resistance to flow.

VOIDS – Laminate defect that occurs during moulding process; characterised by lack of resin material (entrapped air, un-wetted fibres).
VOID FREE – A laminate containing no entrapped air cavities, blisters, or voids.

VOLATILE MATERIAL – Material vaporizing under specific conditions short of decomposition; non-volatile material remains.

VOLATILE ORGANIC COMPOUNDS (VOC) – Carbon containing chemical compounds (e.g.: solvents or liquids) that evaporate readily at ambient or process temperatures. Environmental, safety and health regulations often limit exposure to these compounds, so low VOC content is preferable.

- W -

WARP – Yarns running lengthwise and perpendicular to the narrow edge of woven fabric.

WARPAGE – Dimensional distortion in composite part.

WATER ABSORPTION – The amount of water that a laminate will absorb.

WATER JET – High pressure water stream used for cutting polymer composite parts.

WAX – Mould release agent or surfacing agent.

WEAVE – Pattern by which fabric is formed from interlacing yarns. In plain weave, warp and fill fibres alternate to make both fabric faces identical. In satin weave, pattern produces satin appearance with warp roving crossing over several fill rovings and under next one (e.g.: eight-harness satin would have warp roving over seven fill rovings and under eighth).

WEAVE PRINT – Extreme form of fibre print resembling architecture of woven or stitched glass ply just below or near gel coat surface.

WEFT – Yarns running perpendicular to the warp in a woven fabric; also called “woof”.

WET-OUT – The action of saturating a glass fabric with resin. Also, a measure of the speed that a fabric soaks up resin.

WET LAYUP – Application of liquid resin to dry reinforcement in the mould.

WET WINDING – Filament winding wherein fibre strands are impregnated with resin immediately before they contact mandrel.

WETTING AGENT – Surface-active agent that promotes wetting by decreasing cohesion within liquid.

WHISKER – Short single crystal fibre or filament used as reinforcement in matrix.

WIND ANGLE – Measure in degrees between direction parallel to filaments and established reference.

WINDING PATTERN – Regularly recurring pattern of filament path in filament winding after certain number of mandrel revolutions.

WIRE MESH – Fine wire screen used to increase electrical conductivity. Typically used to dissipate electrical charge from lightning or electromagnetic interference.

WITNESS MARK – Defect in gel coat surface profile that corresponds to some feature, either in underlying laminate or on/in moulding surface; sometimes called mark-off.

WOVEN ROVING FABRIC – Heavy fabrics woven from continuous filaments n roving form. They drape well, are quickly impregnated, are intermediate in price between mats and yarn cloths, and contribute to higher glass content.

WOVEN TAPE – Tape of various thicknesses woven from continuous filament yarns.

WRINKLE – Imperfection in surface of laminate that appears to be a crease in one of the outer layers; occurs in vacuum-bag moulding when bag is improperly placed.

- X -

X-AXIS - Axis in plane of laminate used as zero reference.

- Y -

YARN – Twisted strands of roving, used to weave textile reinforcements.

Y-AXIS – Axis in plane of the laminate perpendicular to the x-axis.

- Z -

Z-AXIS – Perpendicular to the XY plane. The thickness or height of a laminate.