

Glossary - Terms Encountered in the Polyurethane Industry

Abrasion: Wear due to friction.
ABS: (Acrylonitrile-Butadiene-Styrene) A thermoplastic used in injection moulding.
Acoustic Flexible Foam: Flexible polyurethane foam designed to attenuate (dampen) sound.
Additive: A substance that is added to a resin, usually in relatively small amounts, to alter its properties. Examples are catalysts, fire retardants, stabilisers, pigments and blowing agents.
Adhesive: A material capable of bonding one surface to another identical, similar or dissimilar surface.
Aerosol: Ultrafine droplets of a liquid suspended in a gas.
Air Entrainment: A condition where air is dispersed in liquid polyurethane.
Air Injection: A method employed to improve the quality of mix of a polyurethane foam by injecting small amounts of air into the mixing chamber of a low pressure polyurethane dispensing machine.
Air Traps: Voids in moulded polyurethane parts caused by encapsulation of air pockets during the mould filling process. These voids have smooth, shiny surfaces.
Aliphatic: A class of organic compounds containing straight, branched or cyclic chain arrangements of carbon atoms.
Amine: A class of compounds used as catalysts or curatives in polyurethane foam and elastomer reactions. Amines are characterized by having N, NH or NH ₂ groups in the molecule.
Annealing: The process of heating and cooling metals and some plastics to reduce brittleness and/or improve strength.
Anti-Static Polyurethane Foam: polyurethane foam that contains electrically conductive materials to prevent static electricity build-up or promote static discharge. Flexible types are used primarily in packaging applications, such as for electronic components.
Aramid: Name given to "Kevlar" a fibre reinforcing cloth which has superior impact and tensile strength properties, often used with carbon to produce a hybrid cloth.
Aromatic: A class of organic compounds containing a resonant, unsaturated ring of carbon atoms. Included are benzene, naphthalene, anthracene, and their derivatives.
Ball Rebound: A test procedure used to measure the surface resilience of flexible polyurethane foam and polyurethane elastomers. The test involves dropping a steel ball of known mass from a predetermined height onto a sample of the polyurethane. The rebound height attained by the steel ball, expressed as a percentage of the original drop height, is the ball rebound resilience value.
Barrier Coating: Also known as an "in-mould coating". A coating that is spray applied to the mould surface before pouring of foam or elastomer occurs. The coating is a means of producing a moulded surface having specific properties such as UV stability, a water proof nature or a means of hiding minor moulding flaws.
Blanketing: The process of creating an inert atmosphere to prevent unwanted chemical reactions from occurring.
Bleeding: Migration to the surface of a polyurethane cast, of plasticizer, waxes or similar materials to form a film or beads.
Block Foam: Low, medium or high density polyurethane foam blocks produced in large reinforced rectangular mould boxes (typically 2.4 x 1.2 x 1.0 metres in size).
Bloom: A discoloration or change in appearance of the surface of a polyurethane product caused by the migration of a liquid or solid to the surface.

Blowing: The process of foaming polyurethane.
Blowing agent: A substance incorporated in a mixture for the purpose of producing foam. Polyurethane foam can be produced using a physical blowing agent, or a chemical blowing agent.
- Physical blowing agents are gaseous or low boiling point liquids, which form finely dispersed bubbles in the reacting liquid polyurethane. Heat generated by the reacting polyurethane expands the blowing agent bubbles, creating foam.
- Chemical blowing agents are substances added to a polyurethane that undergo a chemical reaction which releases gas bubbles. The most commonly used reaction is that between water and the diisocyanate. This reaction produces carbon dioxide gas bubbles, forming foamed polyurethane.
Calibration: The process of accurately setting the component mix ratio on a polyurethane dispensing machine. Involves dispensing timed "shots" of polyol and isocyanate from the metering ports of the mix head, into weighing cups. The dispensed weight of each component is adjusted until the required mix ratio is achieved. At this point the mix head is said to be calibrated.
Calorie: The amount of heat required to raise the temperature of one gram of water one degree Celsius.
Capillary Action: The movement of liquid within a material against gravity as a result of surface tension.
CAS Number: A number assigned by the Chemical Abstract Service which is a unique identifier for each chemical.
Cast: Also referred to as "the moulding". A replica produced by filling a mould with a casting compound, such as polyurethane, and allowing it to react and harden inside the impression, taking on the shape and surface details of the original specimen.
Casting: The process of producing a cast by pouring uncured liquid polyurethane into open moulds.
Catalyst: Classically, a substance that accelerates a chemical reaction when added to the reactants in a minor amount, and that is not consumed in the reaction. Today, the term catalysts tends to include substances added to the reacts in minor amounts, that accelerate the reaction but are also consumed in the reaction.
Cell Size: The average diameter of the cells in the final polyurethane foam product measured in microns.
CFC: (Chlorofluorocarbon) Any of various halocarbon compounds consisting of carbon, hydrogen, chlorine, and fluorine, once used widely as foam blowing agents, aerosol propellants and refrigerants. Chlorofluorocarbons are believed to cause depletion of the atmospheric ozone layer, and have been banned from widespread use in the developed world since the mid 1990s, in accordance with the requirements of the Montreal Protocol.
Chain extenders: Low molecular weight molecules which usually react with diisocyanates. They form rigid, crystalline hard segments in the polyurethane and lengthen the main urethane chain by end-to-end attachment.
Chalking: Formation of a powdery surface on an elastomer, coating or binder due to degradation of the surface by UV exposure, weathering or other destructive environments. Chalking may be detected by rubbing the surface with the fingertip
Checking: Shallow cracks on the surface of an elastomer or coating generally caused by the destructive action of severe environmental conditions.
Chute lining: Highly abrasion resistant elastomeric polyurethane lining applied to a chute to protect the metal chute from abrasion wear.
Clamping Pressure: The mechanical force required to clamp a mould closed during the foam moulding process.

Closed Pour: The process in moulded foam production in which the mould lid is closed and locked and the foaming mixture is introduced through one or more special ports in the lid of the mould.
Coefficient of Thermal Expansion: The rate at which a material expands per degree of temperature.
C of A: (Certificate of Analysis) Documentation of analytical test results for a chemical or chemical system.
Cold Collapse: Moulding defects on moulded foam parts usually caused by low mould temperature. Typically, the defects appear as localised subsurface voids covered by a thin skin of polyurethane material.
Cold Cure: Casting process for the production of elastomers, in which the elastomer is mixed, dispensed and cured at or near room (ambient) temperature.
Cold Moulding: Moulding process for the production of high-resiliency foam in which the foam is mixed, dispensed and cured at or near room (ambient) temperature.
Collapse: The rapid loss of height in a foam as it reaches its end of rise or expansion. Often caused by insufficient "green strength" development resulting from low component or mould temperatures or insufficient catalysis.
Combustion Modified Foam: Flexible polyurethane foams manufactured by using specialised fire retardant additives that reduce the ease of ignition of the foam.
Component: In polyurethanes, refers to the liquid Part A Polyol and Part B Isocyanate materials which, when mixed together, react to form a polyurethane. To add confusion, in North America the polyol component is referred to as Part B, while the isocyanate is Part A.
Compression Force Deflection: A measure of a foams load bearing ability.
Compression Set: A measure of permanent deformation remaining in an elastomer or flexible foam after a deforming force is removed. For most applications, a low degree of compression set is desirable.
Compressive strength: A measure of a materials resistance to a crushing load.
Conduction: Transmission of energy (heat /sound) through a material or from one material to another by direct contact. Materials with low rates of thermal or acoustic conductive transfer make good heat or sound insulators.
Convection: Transmission of energy (heat /sound) from one place to another by movement of a fluid such as air or water.
Core Density: A value of foam density when sampled without skin or compressed sections, at or near the centre of the foamed item.
Cracking: A sharp break or fissure in the surface of an elastomer or coating generally caused by excessive strain.
Crater: A small, shallow surface imperfection.
Crazing: Slight microscopic or visible breaks in the surface of a material. The break should be called a "crack" if the underlying surface is visible.
Cream Time: In polyurethane foams, the interval of time between mixing together the polyol and diisocyanate and the first definite appearance of foam expansion.
Creep: Compressive deformation occurring over time in both cured and uncured polyurethane, resulting from the application of a constant load or stress.
Cross-linking: Formation of chemical bonds or bridges between separate polymer chains, resulting in a three dimensional polymer network.
Crude MDI: (Polymeric MDI) A type of diisocyanate resulting from the polymerisation of MDI. The

product is relatively unrefined and can contain molecules having a range of molecular weights and structures. It tends to produce polyurethanes having a rigid, cross-linked structure making it suitable for use in rigid polyurethane foams. Because it is relatively unrefined, it also has a lower cost than most other MDI based diisocyanates.

Crushing: Usually a mechanical or vacuum-assisted procedure employed to open the closed cells of a flexible, high-resilience slab stock or moulded foam.

Curative: Materials that react with an isocyanate prepolymer to produce the final elastomer.

Cycle time: The amount of time required to complete a moulding cycle including mould preparation, insert loading (when applicable), release agent application, mixing and dispensing of components, reaction and demoulding.

Dangerous Goods: A classification system for chemicals which describes the safety issues associated with its transportation, storage, handling and emergency procedures.

Dead Foam: Foam that has a low resiliency and only slowly regains its original shape after deformation.

Deaeration: Also known as degassing or vacuuming - removing air from a liquid material.

Demould: The process of removing a specimen or cast from a mould.

Demould time: The time period between dispensing the liquid polyurethane components into the mould and removing the moulded article without causing permanent distortion.

Density: A measure of mass per unit volume of a substance, expressed in units such as kilograms per cubic.

Dew Point: The temperature of a surface at a given ambient temperature and relative humidity at which condensation of moisture will occur.

Dielectric strength: The measure of polyurethane's ability as an insulating compound to resist the passage of a disruptive discharge produced by an electric potential.

Diisocyanate: A chemical compound, usually organic, containing two reactive isocyanate groups. Isocyanate groups are chemical species that react with other chemical species containing "active" hydrogen atoms such as alcohols or amines. Isocyanate groups consist of a nitrogen atom bonded to a carbon atom bonded to an oxygen atom, $-N=C=O$. Often abbreviated to isocyanate or iso in the polyurethane industry.

Durometer: A test instrument used to measure the hardness of a cured elastomer. The Shore scale is commonly used to rate the hardness of an elastomer.

Durometer Hardness: A measure of the hardness of a material. Low durometer hardness (Duro) indicates soft materials. Polyurethane durometer hardness is normally measured by any of three Shore scales:

- 1) Shore 00 - for very soft materials, such as flesh
- 2) Shore A - for average hardness, such as rubber, or
- 3) Shore D - for very hard materials, such as ebony.

Elastomer: A material that at room temperature can be stretched (elongated) repeatedly to at least twice its original length and, immediately upon release of the stress returns with force to approximately its original length. This definition distinguishes elastomers from plastics, which typically have low elongation and recovery properties.

Elongation: A measure of the ability of material to stretch without breaking. Usually expressed as a percentage of length that is the maximum stretch of the material before breaking.

Endothermic: A chemical reaction which absorbs heat from the environment around it.

Epoxy: Synthetic resin compounds, usually thermosetting, which are capable of forming tight cross-linked polymer structures characterized by toughness, strong adhesion and high corrosion and

chemical resistance. Used for making casts, coatings and high-strength adhesives.
Exothermic: A chemical reaction which generates heat and releases the heat to the environment around it.
Filler: A compound added to a polyurethane to:
1) Alter its density without significantly affecting its properties
2) Reduce the cost of the polyurethane
3) Act as a heat sink and reduce the exotherm generated by the polyurethane
4) Enhance specific properties of the polyurethane.
Flame Spread: Standard test for determining relative combustibility. The flame spread of a tested material is traditionally rated relative to red oak (flame spread = 100).
Flame retardant: An added substance which inhibits the initiation and/or spread of flame and/or amount of smoke generated during combustion.
Flammability: Relative ability of a material to support combustion as expressed by its flash point.
Flammable Limits: The concentration of flammable vapour in air, oxygen, or other oxidant that will propagate flame upon contact when provided with a source of ignition. The lower explosive limit (LEL) is the concentration below which a flame will not propagate; the upper explosive limit (UEL) is the concentration above which a flame will not propagate. A change in temperature or pressure may vary the flammable limits.
Flash: A thin, film like remnant of the casting process, which is attached to the cast, and represents a cast of the void of the part-line left between two mould halves.
Flash Point: The lowest temperature at which a flammable liquid will give off enough vapour at or near its surface to form an ignitable mixture with air.
Flexible Polyurethane Foam: Flexible polyurethane foams are produced by reacting a diisocyanate with a high molecular weight polyol. Carbon dioxide is the principal blowing agent used to create flexible foam. The carbon dioxide can be produced by the reaction between an excess of diisocyanate with water, or can be added as liquid carbon dioxide.
Flexural Modulus: The ratio, within the elastic limit, of the applied stress on a test specimen in flexure to the corresponding strain of the specimen.
Flexural Strength: The maximum stress required to be applied to the centre of a test specimen (a bar shaped test specimen that is positioned on two supports, one either side of the load) required to crack or break the specimen.
Fogging: The emission of volatile, migrating components of a polymer over time, which form a thin, white often greasy film on automotive windscreens and interiors. Usually caused by the use of "old technology" flexible polyurethane systems and other plasticised polymers such as some PVCs, vinyls etc.
Friable: A term used to indicate the crumbling, flaking, or powdering of a foam when the surface is rubbed.
Free Isocyanate: A measure of the free, unreacted diisocyanate monomer present in an isocyanate prepolymer. Low free isocyanate prepolymers are desirable as they contain very low levels of volatile isocyanate, making them inherently safer for the end user.
Frothing: A method of producing polyurethane foam using gaseous blowing agents. Gases such as HCFC 22, HFC 134a, carbon dioxide or nitrogen are introduced into the foam components, under pressure, before or during mixing. As the mixture is dispensed from the mix head into a mould or cavity, it undergoes a pressure drop to atmospheric pressure. The blowing agent gas expands rapidly, creating a viscous "shaving cream" like frothed foam. Foam expansion continues, forcing itself through the cavity, until it fills. The high froth viscosity can result in poor foam flow and the formation of voids. Careful design of tooling and dispense machinery is required to minimise

this negative effect.

Functionality: The number of reactive groups in a molecule.

Gate: a point at which the polyurethane material is injected into a closed mould.

Gel Coat: A thin layer of resin that is applied to the surfaces of a mould without any reinforcing material. A gel coat is necessary so that reinforcing materials present in the rest of the cast, such as fibreglass, won't show through to the surface of the cast and obscure the natural features of the specimen.

Gel Time: For polyurethanes, the interval of time between mixing together the polyol and diisocyanate or prepolymer and curative, and the formation of a non-flowing, semi-solid, jelly like system.

Glass Transition Temperature (T_g): A reversible change that occurs when plastic is heated to a certain temperature range, characterized by a rather sudden transition from a hard, glassy, or brittle condition to a flexible or elastomeric condition.

Glycolysis: A process developed to recycle polyurethane foam waste. Polyurethane scrap is ground or chopped and then reacted with aliphatic glycols at high temperature. The reaction breaks down the polyurethane to a mixed glycosate-polyol. This is then recovered and can be used as a major polyol component in a new polyurethane foam formulation, often without further purification.

Green Strength: The rate of development of initial strength properties of polyurethane, soon after reaction completion. Rapid green strength development is desirable in moulding operations, as it allows early removal of the moulded part from the mould, decreasing moulding cycle times and increasing productivity of the moulding operation.

Halogen: The common elements of fluorine, chlorine, bromine and iodine.

Hard Segment: One of the two phases which make up a polyurethane. The hard segment is composed of polyisocyanates and chain extenders. The hard segment controls many of the polyurethane properties such as tensile tear strength, hardness, compression set, abrasion/erosion resistance and thermal stability.

Hazardous Goods: A classification for chemicals which describes the Workplace Health & Safety issues associated with its handling by end users, as described by Worksafe Australia.

HC: (Hydrocarbon) Organic compounds containing carbon and hydrogen. Generally, they are highly flammable liquids. Hydrocarbons are used as solvents in many coating and adhesive systems. Some types such as cyclopentane or isopentane are used as blowing agents in rigid polyurethane foams. However, their high flammability limits their use to applications where the foam manufacturing process can be completely isolated in an expensive, flame proof environment.

HCFC: (Hydrochlorofluorocarbons) are compounds containing carbon, hydrogen, chlorine and fluorine. They are used as foam blowing agents, aerosol propellants and refrigerants, and have shorter atmospheric lifetimes than CFCs, delivering less reactive chlorine to the stratosphere where the "ozone layer" is found. HCFCs are believed to cause reduced depletion of the atmospheric ozone layer, and are being phased out of widespread use in the developed world, in accordance with the requirements of the Montreal Protocol.

HDI: An abbreviation for hexamethylene diisocyanate.

HDPE: (High Density Polyethylene) A thermoplastic commonly used in injection moulding.

Heat build up: The temperature rise within an elastomer due to hysteresis. In many end use applications, an elastomer can be subjected to repeated cycles of deformation-relaxation. As this occurs, friction between the elastomer molecules generates heat. As elastomers have relatively poor thermal conductivity, the heat generated builds up over time, progressively increasing the internal temperature of the elastomer. If the temperature increases over 70°C, the elastomer physical properties can begin to reduce. Design of the elastomer part can play an important role in minimizing the effects of heat build up.

Heat loss: Heat that is lost from a building through air leakage, conduction and radiation. To

maintain a steady interior temperature, heat losses must be offset by a combination of heat gains and heat contributed by a heating system.

HFC: (Hydrofluorocarbons) are compounds containing carbon, hydrogen and fluorine. They are used as foam blowing agents, aerosol propellants and refrigerants. They contain no reactive chlorine and therefore cause no depletion of the atmospheric ozone layer. HFCs are believed to be Greenhouse gases and can contribute to global warming. However, they are currently the most efficient non-ozone depleting foam blowing agents available. In many thermal insulating applications, usage of HFC blown foams can reduce the electrical energy consumption requirements (and consequently reduce Greenhouse gas generation by power stations) of refrigerators, freezers, hot water services and insulated buildings; so much so that the Greenhouse gas contribution of the HFCs used can become negligible.

HFO: (Hydrofluoroolefin) are compounds containing carbon, hydrogen and fluorine. They are used as foam blowing agents, aerosol propellants and refrigerants. They contain no reactive chlorine and therefore cause no depletion of the atmospheric ozone layer. Unlike HFCs & HCFCs, HFOs are not Greenhouse gases and do not contribute to global warming. They are currently the most efficient non-ozone depleting, non-global warming foam blowing agents available. In many thermal insulating applications, usage of HFO blown foams can reduce the electrical energy consumption requirements (and consequently reduce Greenhouse gas generation by power stations) of refrigerators, freezers, hot water services and insulated buildings.

High Resilience (HR) Foam: A variety of polyurethane foam produced using a blend of specialised polyols, diisocyanates and additives. These components help add support, comfort, and resilience or bounce. High resilience foams have a high support factor and greater surface resilience than conventional foams.

HMDI: An abbreviation for hydrogenated diphenylmethane-4,4'-diisocyanate.

Homogeneous: A term describing the uniform composition of a material. It can be used to describe complete and thorough mixing of a polyurethane, or uniform physical properties throughout a cured polyurethane.

Hot Cure: Casting process for the production of high performance elastomers, in which the elastomer is mixed, dispensed and cured at elevated temperature.

Hot Moulding: A flexible moulded foam production process in which high oven temperatures are used to drive the curing reaction in foams made from relatively low-reactivity polyols and TDI.

Hydrolysis: The effect experienced particularly by polyester based polyurethanes, where prolonged contact with water or water based liquids causes breakdown and failure of the polyurethane.

Hydrophilic: Water soluble or water attracting molecules or systems that strongly interact with water.

Hydrophobic: Water insoluble or water repelling molecules or systems that strongly resist interaction with water.

Hydroxyl group: The combined oxygen and hydrogen radical (-OH) which forms the reactive group in polyols.

Hysteresis: The ability of polyurethane to absorb and dissipate energy due to successive deformation and relaxation. A measurement of the area between the deformation and relaxation stress-strain curves. Hysteresis values may provide a good indication of overall polyurethane durability.

Impingement: A method of machine mixing of polyurethane, in which streams of polyol and isocyanate are forced toward one another at high velocity, producing very thorough instantaneous mixing of the two streams. The process occurs in a high pressure mix head.

Incineration: A form of polyurethane waste recycling where the waste is clean incinerated at high temperature and the large quantity of energy liberated is collected, stored or used to operate other processes.

Inert Gas: A gas that exhibits great stability and extremely low reaction rates under normal

temperature and pressure conditions. Examples are nitrogen, argon and helium. Nitrogen is commonly used in polyurethane processing as a nitrogen “blanket” to protect the polyol and isocyanate components from atmospheric moisture or oxygen.

Injection Point: The point on a mould or panel injection jig at which polyurethane is introduced into the cavity. The location of the injection point can be critical for obtaining correct cavity filling and high quality moulded components.

In-mould Coating: Also known as a “barrier coating”. A coating that is spray applied to the mould surface before pouring of foam or elastomer occurs. The coating is a means of producing a moulded surface having specific properties such as UV stability, a water proof nature or a means of hiding minor moulding flaws.

Inorganic Substance: Substances that do not contain carbon in their chemical structure.

Insulation (Thermal): Materials with low thermal conductivity characteristics that are used to slow the transfer of heat.

Insulation (Acoustic): Materials with low acoustical conductivity characteristics that are used to reduce the transfer of sound.

Integral Skin Foam: A type of moulded polyurethane foam having a cellular, low density core surrounded by a dense, tough outer skin, which are moulded from one polyurethane system in one moulding process.

IPDI: An abbreviation for isophorone diisocyanate.

Isocyanate: See Diisocyanate.

Isocyanate Decontaminant: A liquid material consisting of 90% water, 8% concentrated ammonia and 2% detergent, used to neutralise isocyanate spills and decontaminate used isocyanate drums before disposal.

Isocyanurate: Also known as polyisocyanurate, abbreviated as PIR. A family of rigid polyurethane foams developed specifically as insulation materials having superior flame retardant properties. While PIR foams do still burn, they are designed to rapidly form a protective char which helps prevent further combustion of the underlying foam, minimising its contribution in a fire.

Knit Line: A visible line seen in a moulded polyurethane part that indicates where two flows of reacting polyurethane have come together and joined. Often caused by flow turbulence, incorrect injection point placement, or poor polyurethane flow. Depending on the severity, the knit line can be a weak point in the moulding that may cause future delamination, structural failure or poor dimensional stability.

K-Value: (Thermal Conductivity) A measure of performance of a material as a thermal insulator, typically expressed as the amount of heat that flows through the material in a given time, per degree of temperature difference across the material. Expressed as W/mK.

Latex: A solvent based moulding elastomer which is applied as a liquid solution of pre-vulcanized rubber particles. Normally applied to a mould or “tool” as a thin film. As the solvent evaporates, the rubber particles bond into a solid layer. Film thickness can be increased by building up successive layers of latex, until the desired film thickness is achieved.

LDPE: (Low Density Polyethylene) A thermoplastic commonly used in injection moulding.

Lead-Lag: A term describing the late delivery of either the polyol or isocyanate component into the mixing head of a polyurethane dispensing machine. This miss timed delivery causes off ratio polyurethane production at the beginning of the shot. The problem normally indicates a mechanical or maintenance problem in the dispensing machine. The majority of lead-lags will produce a polyol lead, indicating that a isocyanate side one-way return valve (or similar) may be sticking due to a build up of isocyanate residue over time. It can also indicate an isocyanate piston seal is worn and bleeding pressure.

Master Cast: A flawless cast, which is set aside to take the place of the specimen, should it need to be moulded in the future.

Master Pattern: A flawless pattern similar in function to a master cast. The pattern preserves the detail of the mould, as well as the detail of the specimen. There is one master pattern for each side of a mould. Therefore, a two sided mould would have two master patterns.

MDI: An abbreviation for diphenylmethane-4,4'-diisocyanate.

Microbubbles: A large concentration of fine bubbles occurring on the upper side of a cast. Occurs only when the casting compound has not been completely de-aired.

Micron: Abbreviation for micrometer. One-millionth of a meter.

Mixing Head: The device that mixes two or more component streams before dispensing the mixed polyurethane onto the mould or production surface.

MW: Abbreviation for Molecular Weight. The sum of the atomic weights of all the atoms that constitute a molecule.

MOCA: (MBCA) Trade name for methylene bischloroaniline, which is a widely used curing agent for hot cure polyurethane elastomers. There are ongoing debates about health risks associated with its use, as it is a suspected carcinogen. Responsible manufacturers and processors have moved away from its use, opting for alternative curatives which offer similar properties and lower safety risk. Processors who continue to use MOCA must observe and follow correct safety precautions and requirements, as described in the Material Safety Data Sheets for the product.

Molecule: A group of atoms held together by chemical forces. Each type of molecule is composed of a specific arrangement of atoms. It is the smallest quantity of matter which can exist by itself and retain the properties of the original substance.

Monomer: The smallest repeating structure of a polymer. Usually a relatively simple compound containing carbon, which can react with itself or with other molecules or compounds to form a polymer.

Mould: A manufactured cavity which preserves a negative impression of a specimen which can be filled with a foam or casting compound to produce a specimen replica. Can be a manufactured from a variety of materials depending on the production requirements, such as steel, aluminium, polyurethane, epoxy, FRP, silicone rubber or latex. It can be manufactured in "one piece" or in multiple interlocking pieces. Multi piece moulds are used when the cast has a complex shape or undercuts which would make demoulding from a one piece mould difficult or impossible.

Moulded Density: A measure of the overall density of a moulded component, including any higher density skins formed at the moulded surface.

Moulded Foam: A cellular foam product having the shape of the mould cavity in which it was produced.

Moulding: Also referred to as "the cast". A replica produced by filling a mould with a casting compound, such as polyurethane, and allowing it to react and harden inside the impression, taking on the shape and surface details of the original specimen.

Mould Packing: Also known as over packing. The commonly used practice of purposely adding more material to the mould than is actually required to just fill it. The extra material serves to accommodate slight changes in material temperatures, mould temperatures, and pour patterns. In foam moulding it is also a way to ensure that the foam expands and fills all areas of the mould, displacing air voids and producing an even foam density throughout the entire moulded component. This improves the appearance and physical properties of the material without changing the foam formulation.

Mould Release Agent: A lubricant that prevents the cast from adhering to the mould.

MSDS: (Material Safety Data Sheet) A document required by law to be supplied to a user of a hazardous product, to assist the user in safe use and handling of the hazardous product.

NCO: Chemical representation of the isocyanate group, the reactive group of an isocyanate molecule. Also can be a measure of the amount of reactive isocyanate groups present on a diisocyanate or isocyanate prepolymer molecule. Normally expressed as a percentage.

NDI: The abbreviation for naphthalene diisocyanate.

Nucleation: In polyurethane foams, the process of introducing small quantities of a finely dispersed gas (or sometimes a solid) into the foam during mixing. The gas bubbles act as sites that encourage foam blowing agents to generate their own micro fine bubbles. The result is a polyurethane foam having a very fine cell structure, which ensures optimal optimal foam physical properties.

NVH Foam: (Noise-Vibration-Harshness) A type of flexible polyurethane foam developed to absorb and combat the effects of noise and vibration in automotive, marine, aero-space and building construction applications.

Open Cell Structure: The permeable structure in flexible foam in which most of the cell walls in the foam have been ruptured, allowing gases or liquids to readily pass through the foam.

Open Pour: The process of filling a mould by pouring polyurethane foam directly onto the lower surface of an opened mould. After pouring, the mould is then closed and the mould filled by the rising foam. The process allows optimal positioning of the polyurethane, ensuring good mould filling and high quality moulded components.

Over Pack: Also known as mould packing. The commonly used practice of purposely adding more material to the mould than is actually required to just fill it. The extra material serves to accommodate slight changes in material temperatures, mould temperatures, and pour patterns. In foam moulding it is also a way to ensure that the foam expands and fills all areas of the mould, displacing air voids and producing an even foam density throughout the entire moulded component. This improves the appearance and physical properties of the material without changing the foam formulation.

Pantone: World wide recognised colour chart to identify all shade variations.

Part Line: The surface at which the various pieces of a mould come together when re-assembled. The part lines of a mould determine the flash lines of the casts produced from that mould.

Percentage Elongation: The percentage increase in length of a specimen when stretched, at the instant before rupture occurs.

Permeability: The rate of transmission of a gas, vapour or liquid through a material of unit area & thickness.

PFC: (Perfluorocarbon) are compounds containing only carbon and fluorine atoms, such as carbon tetrafluoride and hexafluoroethane. They are used as solvents and foam blowing agents. They contain no reactive chlorine and therefore cause no depletion of the atmospheric ozone layer. PFCs are believed to be Greenhouse gases and can contribute to global warming.

pH: Value taken to represent the acidity or alkalinity of an aqueous solution. Pure water is the standard used in arriving at pH values and it has a pH of seven. A pH that is less than seven is called acidic. Likewise, a pH greater than seven is called alkaline.

Pigment: A powdered or liquid substance used in resins that imparts colouration to the cured item. Can be organic or inorganic.

Pinhole: Minute holes in a dry film which form during application and drying of a coating.

Plasticiser: A material that is added to a polymer to separate and lubricate its molecular chains, allowing them to slide over one another more freely. This results in a reduction of the polymer glass transition temperature, which reduces the polymer stiffness and can improve its processability.

Polyester Polyol: A chemical building block used to produce polyurethane foams, elastomers, coatings and prepolymers. The polyester provides good solvent resistance and good mechanical properties in the final polyurethane. Some polyesters are used to enhance flame retardant properties of polyurethane foams.

Polyether: A chemical building block used to produce polyurethane foams, elastomers, coatings and prepolymers. The polyether provides good resilience, hydrolytic stability, mechanical properties and cost advantages.

Polyisocyanurate: Abbreviated as PIR. A family of rigid polyurethane foams developed specifically as insulation materials having superior flame retardant properties. While PIR foams do still burn, they are designed to rapidly form a protective char which helps prevent further combustion of the underlying foam, minimising its contribution in a fire.

Polymer: A natural or synthetic substance made of giant molecules formed by the repeated union of simple molecules (monomers). A copolymer contains more than one type of monomeric unit.

Polyol: An organic compound having more than one hydroxyl (-OH) group per molecule. The term includes monomeric and polymeric compounds containing hydroxyl groups such as polyethers, glycols, glycerol, and polyesters, used as reactants in polyurethane foam, elastomers, coatings and prepolymers.

Polyurethane: Abbreviated as PUR. A large family of polymers with widely ranging properties and uses, all containing urethane linkages, based on the reaction of an organic diisocyanate with compounds containing a hydroxyl group.

They have been dubbed the "erector set" of the plastics industry due to the great variety of polyurethanes available. They may be thermosetting or thermoplastic, rigid and hard or flexible and soft, solid or cellular, and the properties of any of these types may be varied within wide limits to suit the desired application.

Post-curing: The process of forming an uncured thermosetting resin article, then completing the curing after the article has been removed from its forming mould, usually by subjecting it to elevated temperature for a specified period of time.

Pot Life (Working Time): The period during which a reacting polyurethane remains suitable for its intended use.

Pour Pattern: A term usually applying to open mould dispensing of polyurethane foam into shallow or complex moulds. The polyurethane can be dispensed in a continuous stream over the mould surface in a way which ensures the foam will flow and fill all regions of the mould, after mould closing.

PPDI: An abbreviation for paraphenylene diisocyanate.

PP: (Polypropylene) A thermoplastic commonly used in injection moulding.

Ppb: (Parts per billion) One particle of an "impurity" in 1,000,000,000 particles.

Ppm: (Parts per million) One particle of an "impurity" in 1,000,000 particles.

Prepolymer: A reacted but not completely polymerised chemical intermediate manufactured by reacting polyols with diisocyanates. Generally, the product contains residual, unreacted isocyanate groups which can be further reacted with polyols, diamine curatives or water to produce the final polymer.

Pre-Preg: A glass/carbon cloth which is pre-impregnated with resin where the cure is initiated using external heat.

Print Through: The effect seen on the surface of a gel coat, which is a result of the weave used in the backing reinforcing structure being forced through the gel coat. Can be caused by shrinkage of excess resin used in the laminating process, early application of the backing reinforcement before the gel coat has cured sufficiently, or the use of too thin a layer of gel coat.

Processability: The degree of ease with which a polyurethane is processed.

PS: (Polystyrene) A thermoplastic commonly used in injection moulding.

PU: An abbreviation for polyurethane.

Purging: Process of expelling an unwanted gas or vapour from a system through the introduction of a different gas or vapour until all traces of unwanted gas or vapour have been removed.

Pyrolysis & Hydrogenation: A method of recycling and converting polyurethane waste (and other plastics) into a variety of valuable petrochemical feedstocks through reaction with hydrogen at high

temperature and pressure.

Rebonded Foam: A recycling process for scrap flexible polyurethane foam, where the scrap foam is shredded into small pieces, coated in a polyurethane binder and then low pressure moulded into sheet, blocks or shapes. A common use for this process is the production of carpet underlay.

Registration: The active alignment of the various pieces of a mould by tabs or locator pins, so that no portion of the mould will stray from the position it was in when it was initially formed around a specimen.

Relative Humidity: The ratio expressed as a percentage of the amount of moisture air actually contains to the maximum amount it could contain at that temperature.

Resilience: The degree to which a body can resume its original shape after removal of a deforming stress.

Resin Infusion: A process where a reacting liquid polymer mix is drawn into a mould cavity containing a glass or carbon fibre reinforcing carbon weave using vacuum. The polymer infuses through the fibres and cures resulting in a reinforced composite part.

Rigid Polyurethane Foam: Abbreviated to rigid PUF. A family of cellular plastics formed by reacting a specially formulated blend of polyols, diisocyanates and additives. During the polyol-isocyanate reaction, certain chemical and/or physical reactions occur, resulting in the formation of polyurethane foam. Rigid PUF typically have a highly cross linked structure, giving them high strength and rigidity.

RIM: Abbreviation for Reaction Injection Moulding. The RIM process involves the rapid metering, and mixing of polyurethane reaction ingredients, followed by their injection into a mould. It allows the rapid production of moulded polyurethane components.

Rise Time: In polyurethane foams, the interval of time between mixing together the polyol and diisocyanate and the point where foam expansion ceases.

R-Value: A unit of measurement of a materials resistance to heat flow through a material. It is expressed as m^2K/W .

Scorch: A yellow or brown discoloration of polyurethane foam, particularly in the core. Scorching is caused by oxidation and excessive heat created during the exothermic reaction.

Sealants: A liquid, paste, coating, or tape that fills holes, joints or gaps between mating surfaces, stopping leakage of gas, liquids or solids.

Self skinning: See Integral Skin Foam.

Semi-Rigid Polyurethane Foam: A PU foam having properties somewhere between flexible and rigid. These materials often show a degree of flexibility and will normally recover most of their original dimensions after being compressed. They provide properties of impact absorption and dissipation, making them particularly suitable for automotive interior crash pad applications.

Shiners: Light reflected from intact cell walls, noticeable on the cut surfaces of polyurethane foam. A large number of shiners, or shiny spots, indicates foam having many closed cells.

Shore Hardness (Indentation Hardness): The hardness of a material as determined by either the size of an indentation made by an indenting tool under a fixed load, or the load necessary to produce penetration of the indenter to a pre-determined depth. To measure the Shore hardness of a material, a Shore testing instrument is used which is comprised of spring-loaded indenter point projecting through a hole in a presser foot and a device to indicate the distance the point projects beyond the face of the foot. The scale readings range from 0 (for 0.100 penetration) to 100 (for zero penetration). A Shore "A" instrument employs a "blunt" indenter point and is used to measure the hardness of soft, rubber like elastomers. The Shore "D" instrument employs a "sharp" point and is used to measure the hardness of rigid, ebony like elastomers.

Shot: The accurate dispensing of a pre-calculated quantity of mixed polyurethane from a polyurethane dispensing machine. The shot can be expressed in seconds or by weight of polyurethane dispensed.

Shrinkage: A measure of a material's reduction in size after setting or curing. Usually expressed as a dimensionless ratio of the amount of shrinkage over a unit length. Dimensionally stable materials have shrinkages very close, or equal, to 0.

Silicone Rubber: A two-component synthetic rubber capable of curing at room temperature by chemical means into a solid elastomer. Commonly used as a mould making compound where a soft, pliable mould is required. Silicone rubbers offer advantages of very low hardness, high flexibility and self releasing properties, but have the disadvantages of high cost, high viscosity and low strength, which limit their application and longevity.

Slabstock: Rigid or flexible polyurethane foam made in the form of a continuous or discontinuous block, usually of approximately rectangular cross-section.

Soft Segments: One of the two phases which make up a polyurethane. The soft segment is composed of long chain polyether or polyester polyols. The soft segment controls many of the polyurethane properties such as tensile and tear strength, hydrolysis and chemical resistance, glass transition temperature & flexibility.

Sprue: The opening, or hole, through which the casting medium is poured into some moulds. The term also refers to the waste material which hardens in the opening and often adheres to the cast. Alternately, the term can also apply to the piece of material which the mould maker originally places on the specimen to form the opening in the mould.

Stereolithography: A process where a low power laser is used to cure a thin film of photosensitive polymer.

Strain: A measure of how much as material extends or compresses when a force is applied to the material.

Stress: A measure of force applied to a material.

Struts: The structural members of a foam material. These roughly triangular features contain most of the solid polymer and form the cell shape.

System: The two (or more) polyol and isocyanate components which, when mixed together, react to form a polyurethane or polyisocyanurate polymer.

Taber Wear Index: The ability of a material to withstand mechanical action such as rubbing, scraping or abrasion, that tends to progressively remove material from its surface. Usually expressed in milligrams loss per number of cycles per a given load.

Tack Free Time: In open moulded polyurethane foams, the interval of time between mixing together the polyol and diisocyanate and the point where the foam surface has cured sufficiently that its surface is no longer "sticky".

Tare: To ensure that a balance or scale weighs in at zero. For instance, you may wish to tare the balance with an empty container on it so that the scale will only display the weight of the container's contents.

TDI: An abbreviation for toluene diisocyanate.

Tear Strength: A measure of the resistance of elastomer or flexible foam to tear. Normally expressed in N/mm (Newtons per mm).

Tensile Modulus: The ratio of stress to corresponding strain below the proportional limit of the material. Normally expressed in MPa (megapascals).

Tensile Strength: The stress per unit area required to stretch a specimen, at a specified rate, until it fails. Normally expressed in kPa (kilopascals) or N/mm² (Newtons per mm²).

Thermoforming: The process of forming a thermoplastic sheet into a three-dimensional shape by clamping the sheet in a frame, heating it to render it soft and pliable, then applying differential pressure to make the sheet conform to the shape of a mould or die positioned below the frame.

Thermal Barrier: A material applied over foam insulation designed to slow the temperature rise of

the foam during a fire situation and delay its involvement in the fire.
Thermal Bridge: A thermally conductive material which penetrates or bypasses an insulation system; such as a metal fastener or stud.
Thermal Conductivity (K): A measure of a materials ability to conduct heat flow. See K-Value.
Thermal Resistance (R): A measure of a material's resistance to heat flow. See R-Value.
Thermal Shock: A building materials reaction to rapid changes in temperature.
Thermography: A building energy diagnostic technique using an infrared camera for locating areas of temperature differential in a building.
Thermoplastic: A resin or plastic compound that can be repeatedly softened by heating and hardened by cooling. Examples of thermoplastics are: acetal, acrylic, chlorinated polyether, fluorocarbons, polyamides (nylons), polycarbonate, polyethylene, polypropylene, polystyrene, some types of polyurethanes, and vinyl resins.
Thermoset: A resin or plastic compound that in its final state is substantially infusible and insoluble. They can not be repeatedly softened by heating and hardened by cooling. Examples of thermosets are: epoxy, phenol-formaldehyde, some types of polyester, some types of polyurethane and urea-formaldehyde resins.
Thixotropy: A flow characteristic of certain fluids where a decrease in viscosity of the fluid occurs when it is stirred at a constant or increasing rate of shear. When the stirring or shearing is discontinued, the apparent viscosity of the fluid gradually increases back to the original value. Changes in both directions are dependent on time as well as shear.
TMXDI: An abbreviation for meta-tetramethylxylylene diisocyanate.
Toxic: A substance that has the ability to produce injurious or lethal effects through its chemical interaction with the body.
Trimerisation: A molecule formed by the union of three molecules of a monomer. In polyurethanes, the term refers to the reaction of three diisocyanate molecules to form an isocyanurate trimer. This reaction is utilised in polyurethanes to impart specific properties of improved temperature resistance or decreased combustibility to the polyurethane. These types of modified polyurethanes are generally known as polyisocyanurate (PIR) polymers.
Triol: A polyol containing three reactive hydroxyl groups.
Turbulence: Used to describe an erratic, tumbling flow of polyurethane foam or elastomer through a mould or cavity during filling. Usually caused by poor mould design, incorrect location of the polyurethane injection point, obstructions in the mould or cavity or poor polyurethane flow properties of the polyurethane formulation.
UHMWPE: (Ultra High Molecular Weight Polyethylene) A specialised thermoplastic used in injection moulding.
Undercut: A part of a mould, cast, or specimen which deviates from a sloping or vertical surface and turns back onto itself.
Underfill: A term describing an inadequate degree of mould filling. Poor mould filling can be caused by a "short shot" where insufficient polyurethane was added to the mould. It can also be caused by low mould temperature or low component temperatures.
U-Value: Overall thermal conductance. U value is equal to the inverse of the sum of the R-values in a system ($U = 1 / R \text{ total}$).
UV Stabilizers: Additives incorporated into a polymer which prevent or slow the degradation of the polymers caused by exposure to light.
Vapour Pressure: The pressure exerted by the vapour above a liquid when the two are in equilibrium. The value depends on the substance and the temperature of the system.

Vaporization: The process of changing from a liquid to a gaseous state.

Venting: In polyurethane moulding, the process of the displacement air from the mould cavity as the cavity is filled by polyurethane. Venting normally occurs through small holes or seams in the mould located at strategic positions around the mould to ensure that all air is vented. When the mould is completely air free and polyurethane filled, a small amount of polyurethane also vents, further ensuring a complete air free filling of the mould.

Viscosity: The thickness of a substance and its resistance to flow. The higher the viscosity number, the thicker the substance. The ratio of shearing stress to rate of shear.

VOC: (Volatile Organic Compound) Any compound containing carbon and hydrogen or containing carbon and hydrogen in combination with other elements, which is volatile or readily vapourises.

Volatility: The quality of having a high vapour pressure at ordinary temperatures.

Wetting: The process by which a liquid spreads over a solid surface.

Windows: The thin membranes formed between cell struts in foams. Windows may be present (a closed-cell foam) or absent (an open-cell foam) depending on the particular foam chemistry used.