Myrdal Orthopedic Technologies

Technical O&P Solutions

Material Terminology Glossary
(Specific to Orthotics & Prosthetics)

090311

MATERIAL PROPERTIES

MECHANICAL (M)

Tensile Strength, Elongation at Break, Flexural Modulus, Rockwell Hardness, Izod impact Strength, Dynatup Impact Strength

OTHER

PHYSICAL (P)

Specific Gravity, Water Absorption, Melting Point, Shrinkage

OTHER

GENERAL (G)

Color, Odor,

OTHER

ELECTRICAL (E)

Volume Resistivity, ohm-cm 73 F, Surface Resistivity ohm, Dielectric Constant, Dielectric Strength, Dissipation Factor

OTHER

THERMAL (T)

Brittleness Temperature, Vicat Softening Point, Flammability Rating, Glass Transition Temperature, Heat Deflection Temperature, Thermal Conductivity, Specific Heat, Coefficient of Thermal Expansion

OTHER

CHEMICAL (C)

OTHER

OPTICAL (O)

Refractive Index, Transmittance %, Haze %, Gloss
OTHER

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Term	Definition / Interpretation
Addition-cure	Moldmaking products are characterized by extremely low shrinkage during curing as well as high temperature stability. These materials are therefore appropriate if a high dimensional accuracy is required of the replica. Addition-cure silicone elastomers are susceptible to cure inhibition when in contact with certain materials and chemicals such as amines, sulfur and organic tin salt containing products and substrates.
Aliphatic	**Requires definition/interpretation**
Alloy	A homogenous mixture of two or more metals made up of distinct components or elements.
Aluminum	
Anistropic	Reference to composite reinforced fibers that exhibit different properties when measured along different axis and are respondent to the direction of force.
Annealing	1. To heat (glass or metal) and slowly cool it to toughen and reduce brittleness. 2. To temper.
ASTM	American Society for Testing and Materials. This organization establishes test methods that are accepted as standards for the specific conditions a material must perform under. The following are some examples, please realize there is a multitude of test methods used and the ASTM for specific testing identifies them all.
ASTM Test Methods	The melt index test indicates relative flowability of plastic resins in the melt form. Used by processors for quality control check to make sure that the resin furnished meets specifications. A significant change in the flow rate of a resin after processing is often an indication of improper processing. The capillary rheometer test measures the rheological (flowability) characteristics of thermoplastics at temperature

and shear conditions common to processing equipment. Similar to a melt index test, but measures flowability over a broader shear stress and shear rate range. Commonly calculated values are shear stress, shear rate and viscosity.

Tensile properties are often considered the most important single indication of strength in a material.

Compressive properties are obtained by mounting a compression tool in a testing machine that applies load at a constant rate of movement. The compressive strength of a material is calculated as the stress required to rupture or deform the specimen a given percentage of its height.
The compressive strength of plastics is of limited design value, since plastic products (except foams) seldom fail from compressive loading alone.
This strength test is however useful for determining different grades of material as well as along with other property data the overall strength of different kinds of material. In the case of a material that fails in compression by a shattering fracture, the compressive strength has a very definite value.

Flexural Properties are obtained by placing the specimen on two supports. A load is applied in the center at a specified rate and the load at failure is used to calculate flexural strength.

Notched Izod impact testing indicates the energy required to break notched specimens under standard conditions. Using a controlled pendulum system that records the energy required to break the notched surface of the material being tested. While the test can be useful for comparing types and grades of plastics results should not be considered a reliable indication of overall toughness or impact strength. Some materials are notch sensitive resulting in the need for a reverse notch test that allows un-notched impact strength measurement.
The notched Izod may indicate the need for avoiding sharp corners in parts made of these materials. For example, nylons and acetals that are among the toughest materials register relatively low values on the notched Izod test.

	Tensile impact test provides advantages over the notched Izod test: the notch-sensitivity factor is eliminated, and energy is not used in pushing aside the broken portion of the specimen. Again pendulum records the energy required to break the specimen but the actual weight of the broken portion of the material is removed at impact.
Atom	A unit of matter, the smallest unit of an element, having all the characteristics of that element and consisting of a dense, positively charged nucleus surrounded by a system of electrons.
Brittleness	Opposite of toughness, there is usually no evidence of plasticity prior to failure.
Brittleness Temperature	Requires Definition / Interpretation
Calendering	This is a process that forms continuous plastic sheets by forcing hot thermoplastic resin between heated rollers called calenders. Series of secondary calenders further thins the plastic sheets.
Carbon	A non-metallic chemical element found esp. in all organic compounds; diamond and graphite are pure carbon.
Carbonaceous	Man made fibers. Created using heat
Case Harden	The process of forming a hard surface on a material leaving the material below the surface uninterrupted. Used for high wear surfaces on materials that take a surface load but require the main structure to have flexural, torsional and ductile characteristics.
Catalyst	A substance serving as the agent in the speeding up or sometimes slowing down of a chemical reaction by adding a substance which itself is not changed thereby.
Catastrophic Failure	This term is used to refer to a material breakdown that happens quickly and with little prior signs of failure. This is a term none of us ever want to experience but must be aware of the capability of any material to fail.

Centipoise	Reference to viscosity measurement scale.
Chem./Solvent Resistance	Requires definition/interpretation
Coefficient	A number used as a multiplier in measuring a specific property of a material.
Coefficient of Friction	This is the number used to recognize a material's resistance to friction. Friction is identified as the resistance to motion of surfaces that touch. The basic Law of Friction says that the force needed to overcome friction is proportional to the total perpendicular force pressing one surface against the other. When a weight of a box being pulled across the floor is doubled the force needed to pull it must also be doubled. The ratio between the weight being moved and the force pressing the solid faces together is called the Coefficient of Friction. The Coefficient of Friction equals the force needed to move an object divided by the force pressing the surfaces together. The Coefficient of Friction depends on the types of surfaces moving against each other. Suppose a force of 30 N is needed to pull a block weighing 80 kg. The Coefficient of Friction equals 30/80 or 0.375. The Coefficient of Friction for wood sliding on wood is between 0.25 and 0.5. Metal has a Coefficient of Friction of between 0.15 and 0.2. All force due to rolling friction is about 1/100th as much as that due to sliding friction. The Coefficient of Friction for iron rolled on oiled wood would be much less than 0.018. The friction depends more on the viscosity of the liquid than the types of surfaces.

Cold Flow	Reference to a materials ability to migrate due to various forces applied at room temperature. Maximum and minimum atmospheric temperatures can affect the degree of flow depending on the material. Old window glass that is optically distorted is a good example of a materials cold flow characteristic.
Color	Useful color wheels are available to establish basic color mixing. J. Itten has a wheel used to determine which colors to mix to achieve a variety of custom colors.
Co-monomer	**Requires definition**
Compcore	A brand name sheet material made of directional carbon fibers impregnated with thermoplastic to allow bonding to formed thermoplastic O&P devices. See Poly Car C.
Condensation-cure	This term refers to a curing process of removing water from a raw material to result in a hardening of the material. The chemical reaction involved displaces water molecules in the mixture. High tear strength and elasticity characterize mold-making products. Together with a very good flowability, this allows detailed reproduction of complex originals with deep undercuts, without harming the original. Often one- or two-part molds are sufficient. The multitude of possible combinations with curing agents and additives allows customizing products for different purposes.
Composite Material	Substance that is made up of a combination of two or more different materials. A composite material can provide superior and unique mechanical and physical properties because it combines the most desirable properties of its constituents while suppressing their least desirable properties. For example, a glass-fiber reinforced plastic combines the high strength of thin glass fibers with the ductility and chemical resistance of plastic; the brittleness that the glass fibers have when isolated

	is not a characteristic of the composite. The opportunity to develop superior products for aerospace, automotive, and recreational applications has sustained the interest in advanced composites. Currently composites are being considered on a broader basis—for applications that include civil engineering structures such as bridges and freeway pillar reinforcement; and for biomedical products, such as prosthetic devices.
Compound	A substance consisting of atoms or ions of two or more different elements in definite proportions, usually having properties unlike those of its constituent elements
Compression Strength	This property is the maximum load in lbs., which a 1" square piece of material will support without fracturing. Some materials are very resistant to fracturing. Therefor an understanding of the term yield point is required and can be used to assist as a comparison between different materials.
Compression Modulus	A multiplier used in a formula to determine a material's compression strength. This modulus is adjusted to accommodate a comparison under pre-determined conditions.
Co-Polyester (PETG)	Used for check sockets in Orthotics & Prosthetics. Rigid, clear thermoplastic. Vivak.
Copolymer	A polymer that is made up of more than one monomer unit. A copolymer has each of its comonomers in every chain. There are a number of different types of copolymers which describe the nature of the arrangement of the comonomers within the polymer chain. For the two monomer units A and B we can have:

block	...AAAAAABBBBBB...
alternating	...ABABABABAB...
statistical (or random)	...ABAAABBABBAABBB...

Copper Belt Rivet	Term used to describe a wide headed copper rivet. Commonly used to attach leatherwork to an orthopedic structural element. Often used to attach stirrups to footwear and thicker material attachment requirements. Available in various gauges and lengths, steel core and or nickel coated rivets are available.

Coefficient of lineal thermal expansion:	
	The ratio of change in length per degree centigrade compared to the base length at zero degrees centigrade. The unit of measurement is centimeter per centimeter per degree centigrade (cm/cm/°C). This measurement means that for every centimeter of base length, the length will change X centimeters for every change of one degree centigrade.
Corrosion inhibition	Corrosion can be defined as the unwanted production of a salt from a metal. Adding acid or oxygen are good ways to do this. The main ways of slowing corrosion down (inhibition) are by providing an impermeable coating to stop the chemical reaction from occurring in the first place, or by providing a more easily attacked metal which will be consumed first (a 'sacrificial anode')
Corrosion resistance	The ability of a material to not be chemically degraded in its working environment.
Demold Time	This is the manufacturer's recommended period of time the material should be left on or in a mold before being removed.
Density	Provides a comparison of the relative weights of materials. The ratio of mass to unit volume expressed in grams/cm3 for solids and liquids and grams/liter in gases (density = mass/volume).
Denier	**Requires Definition / Interpretation – Thread Count per square inch?**
Dielectric Constant	**Requires Definition / Interpretation**
Dielectric Strength	**Requires Definition / Interpretation**
Ductility	The ability of a material to be stretched and or compressed without fracture.
Durometer	Technically, this term refers to the hardness of a material and ranges from a skin soft 0A to a harder than a car tire 95A. There are different scales used to determine a materials

	hardness that we should be aware of. Please take some time to research them.
Elasticity	The ability of a material to recover its original shape after deformation.
Element	A substance composed of atoms having an identical number of protons in each nucleus and not reducible to a simpler substance.
Elongation at break	This term, which is always associated with tensile strength, is the increase in original length at fracture, expressed as a percentage. Standard tests are applied to a 1" x 1" x 1' piece of material. If the material being tested were stretched to a length of 3" before breaking, the elongation at break would be 200%. Elongation recorded at the moment of rupture of the specimen, often expressed as a percentage of the original length.
Embrittlement	**Requires Definition / Interpretation**
Epoxy Resin	Resins, which may be of widely different structures but are characterized by the presence of the epoxy group. (The epoxy or epoxide group is usually present as a glycidyl ether, glycidylamine, or as part of an aliphatic ring system. (The aromatic type epoxy resins are normally used in composites. Epoxy (EP) resins are named for the epoxide groups (cycl-CH_2OCH; *cycl* or *cyclic* refers to the triangle formed by this group) that terminate the molecules. The oxygen along epoxy's carbon chain and the epoxide groups at the ends of the carbon chain give epoxy resins some useful properties. Epoxies are tough, extremely weather-resistant, and do not shrink as they cure (dry). Epoxies cross-link when a catalyzing agent (hardener) is added, forming a three-dimensional molecular network. Because of their outstanding bonding strength, epoxy resins are used to make coatings, adhesives, and composite laminates. Epoxy has important applications in the aerospace industry. All composite aircraft are made of epoxy. Epoxy is used to make the wing skins for the F-18 and F-22 fighters, as well as the horizontal stabilizer for the F-16 fighter and the B-1 bomber. In addition, almost 20 percent of the Harrier jet's total weight is composed of reinforcements bound with an epoxy

	matrix. Because of epoxy's chemical resistance and excellent electrical insulation properties, electrical parts such as relays, coils, and transformers are insulated with epoxy.
Epoxy Plastics	Plastics based on resins made by the reaction of epoxides or oxiranes with other materials such as amines, alcohol, phenols, carboxylic acids, acid anhydrides and unsaturated compounds.
EVA	Ethyl Vynal Acetate. Available in a wide variety of durometers commonly used for padding, liners and shoe raises. Commonly used for foot bed liners, shoe modifications, orthotic liners, prosthetic liners, and as a flexible thermoplastic resin additive. This materials characteristics are widely responsible for our ability to thermoform and adjust the materials shape and or form.
Extrusion	A process normally used with a compound. The compound is forced through a die, producing a profiled shape.
Failing Dart Impact Strength	**Requires definition**
Fatigue Resistance	The ability of a material to withstand cyclic loading with limited failure.
Ferrous	Of, containing, or derived from iron (a metallic chemical element, the most common of all metals)
Fiber	1. A threadlike structure that combines with others to form animal or vegetable tissue. 2. Any substance that can be separated into threadlike parts for weaving 3. Texture 4. Character or nature 5. Roughage

Flex Life (MIT cycles)	**Requires Definition / Interpretation**	
Flame Rating	**Requires Definition / Interpretation**	
Gardner Impact Strength	**in-lbs 73 F, -40 F**	
Glass	A Glass	Used when resistance to acids is required
	C Glass	Chemical resistant
	D Glass	Dielectric Glass – low density used for electronic applications.
	E Glass	Electrical Glass - constitutes the majority of glass textile production.
	L Glass	Lead Glass used for x-ray protective clothing
	S Glass	Stiffer and stronger fibers by 20% often used in structural composites in the aerospace industry.
Glass Transition Temperature		
	The temperature where the molecules of a polymeric solid can begin to move relative to one another, giving a substance that behaves like a rubber, rather than a brittle glass. Alternatively, you can think of it as the temperature where the molecules of a polymeric solid can no longer move relative to one another, giving a substance that behaves like glass, rather than a rubber that can be stretched without breaking. It all depends on which way you are going...	
Graphite	Crystalline form of carbon used in pencils, as lubricant, and formed into man made fibers etc.	
Heat of Fusion	**Requires Definition / Interpretation**	
HDPE	(*high-density polyethylene*): The structure is similar to PVC except that there is no chlorine (C1) associated with the molecule. The tight structure makes it very dense.	

	HDPE has a density that ranges from 0.94 to 0.97 g/cm3 (0.62 to 0.64 oz/cu in). Its molecules have an extremely long carbon backbone with no side groups. As a result, these molecules align into more compact arrangements, accounting for the higher density of HDPE. HDPE is stiffer, stronger, and less translucent than low-density polyethylene. (See Polyethylene)
HMW	Commonly referred to in the O&P industry as sub-ortholene. This is a High Molecular Weight compression set thermoplastic that is commonly used for AFOs, bi-valved spinal applications, foot orthotics and wrist / hand applications. It can also be used for triceps cuffs in upper extremity prosthetic applications.
Instruction	(ˈstrukˈshən) 1 an instructing; education 2 something taught 3 [pl.] orders or directions
Isotropic	**Requires definition / interpretation**
IZOD Impact Strength	Notched Izod impact testing indicates the energy required to break notched specimens under standard conditions. (See ASTM Tests)
Kevlar	Reinforced plastics, called composites, are plastics strengthened with fibers, strands, cloth, or other materials. Thermosetting epoxy and polyester resins are commonly used as the polymer matrix (binding material) in reinforced plastics. Due to a combination of strength and affordability, glass fibers, which are woven into the product, are the most common reinforcing material. Organic synthetic fibers such as aramid (an aromatic polyamide with the commercial name Kevlar) offer greater strength and stiffness than glass fibers, but these synthetic fibers are considerably more expensive.

The Properties of KEVLAR®

KEVLAR® is one of the most important manmade organic fibers ever developed. Because of its unique combination of properties, KEVLAR® is used today in a wide variety of industrial applications. KEVLAR® para-aramid fiber possesses a remarkable combination of properties that has led to its adoption in a variety of end-uses since its commercial introduction in the early 1970's.

Fibers of KEVLAR® consist of long molecular chains produced from poly-paraphenylene terephthalamide. The chains are highly oriented with strong interchain bonding which result in a unique combination of properties.

General Features of KEVLAR®:

- High Tensile Strength at Low Weight
- Low Elongation to Break High Modulus (Structural Rigidity)
- Low Electrical Conductivity
- High Chemical Resistance
- Low Thermal Shrinkage
- High Toughness (Work-To-Break)
- Excellent Dimensional Stability
- High Cut Resistance
- Flame Resistant, Self-Extinguishing

(**Kevlar**$^{(R)}$) Aromatic polyamide fibers characterized by excellent flame-resistance, high-temperature, and electrical properties. Aramid fibers are used to achieve high-strength, high-modulus reinforcement in plastic composites.

Laminating

This term refers to the process of binding layers of materials together in a plastic matrix. It is important that the results desired are considered and compatible fibers and matrix are selected for the intended application. In custom orthotic and prosthetic applications this is a common practice.

Latex

This is a natural rubber extracted from rubber trees found mainly in Southeast Asia. The raw rubber is often processed

	with ammonia and water, which makes it usable for many applications. It is a one component system that is ready to use right out of the container. Latex has high elasticity and abrasion characteristics. The milky sap of certain plants that coagulates on exposure to air. The main disadvantage of latex is its shrinkage percentage. It can be as high as 20%, which makes it somewhat undesirable for exact replication and or fabrication in O & P applications.
LDPE	(*Low Density Polyethylene*): This structure is similar to high-density polyethylene except that it is a less rigid and less dense form of the molecule. See polyethylene.
Limiting Oxygen Index	Requires Definition / Interpretation
LOCTITE	Brand name cynacrolate / adhesive. Available in assorted strength and formulation. Used, as a thread locker to assure fasteners will not loosen. Sets (cures) in the absence of air.
Low Temperature	**Requires Definition / Interpretation**
Matrix	
MEK Solvent	Abbreviation for Methyl Ethyl Ketone; a colorless, flammable liquid commonly used in degreasing and cleaning procedures. Read MSDS. USE WITH CAUTION
MEK Peroxide	Abbreviation for Methyl Ethyl Ketone Peroxide; a strong oxidizing agent (free radical source) commonly used as the catalyst for polyesters in the FRP industry.
Microballoons	Microscopic bubbles of glass, ceramic or Phenolic used as a filler or to create syntactic foam or putty mixtures.

Melting Point	The temperature at which a solid becomes liquid at standard atmospheric pressure.
Mix Ratio	This term refers to the quantities, weights and or volume ratios when mixed will obtain the results required. It is very important that we follow the manufacturer's instructions. They are there to be read twice before using.
Mixed Viscosity	This term is self-explanatory. What happens when we mix water and molasses? The mixed viscosity (assuming equal portions of each material) would be approximately 50,000 CPS
Mohs Scale	Devised by German mineralogist Friedrich Mohs, this scale rates the hardness of abrasives and other materials on a scale of one to ten. When referring to abrasives, diamond is the hardest known substance and is rated as a 10. Talc, one of the softest minerals has a rating of 1.
Mold Release	Parting agent, which prevents sticking to a mold. No one mold release agent is best for all applications. Molding temperature, compatibility with the article to be released, intricacy of the mold, strength of the part to be removed, necessity for post-finishing, end use of the molded part, (toxicity, FDA regulations, etc.) and economics all are important factors in making the right decision.
Molecular Weight	Molecules are too small to put on a scale, but if you put 6.022×10^{23} of them (60 220 000 000 000 000 000 000 000, Avogadro's Number) of them on a scale, they will weigh about 2 g (if they are Hydrogen molecules, H_2), 128 g (if they are butyl acrylate molecules, $C_7O_2H_{12}$) or 10 tonnes (if they are typical molecules of poly(acrylamide)). This number is their 'molecular weight'.
Monomer	**A substance composed of molecules capable of reacting with like or unlike molecules to form polymers.** Any small molecule that can undergo a reaction in which it is incorporated into a large molecule containing many similar units. Common monomers are vinyl acetate, styrene, butadiene

	and vinyl chloride. (It is appropriate to consider hydrocarbons as polymers of methylene!)
Non Ferrous	Of or containing no iron.
Nucleus	The positively charged central mass of an atom about which the orbital electrons revolve. The nucleus is composed of nucleons, that is, protons and neutrons, and its mass accounts for nearly the entire mass of the atom.
Permeability	Oxygen @ 25 C, ccmil/100 sq in day Transmission Rate, Water vapor Transition ccmil/100 sq in day 25C 38 C
PETG	See Co-polyester
Phenolic	Phenolic (phenol-formaldehyde) resins, first commercially available in 1910, were some of the first polymers made. Today phenolics are some of the most widely produced thermosetting plastics. They are produced by reacting phenol (C_6H_5OH) with formaldehyde (HCOH). Phenolic plastics are hard, strong, inexpensive to produce, and they possess excellent electrical resistance. Phenolic resins cure (cross-link) when heat and pressure are applied during the molding process. Phenolic resin-impregnated paper or cloth can be laminated into numerous products.
Polymer	A substance composed of molecules characterized by the repetition (neglecting ends, branch junctions, and other minor irregularities) of one or more types of monomeric units* *Definition taken from ANST/ASTM Standard D883, Plastics
Polymerisation	The process in which many small molecules (molecular weight ~100) are joined together to form a few, much larger molecules (molecular weight 10 000 - 10 000 000). The two ways in which this happens are chain-growth and step-growth polymerisation.

Platinum cure	Introduction of the element of platinum to cure the material being processed. Commonly found in higher quality silicone components.
Plasticity	The ability of a material to be formed to a new shape without fracture and retain that shape after load removal.
Plastisizer	A compound added to a polymer to make it softer and more flexible. These are usually small molecules with dangling bits that can disrupt the packing of polymer chains.
Polypropylene	Polypropylene is polymerized from the organic compound propylene (CH_3-CH==CH_2) and has a methyl group (-CH_3) branching off of every other carbon along the molecular backbone. Because the most common form of polypropylene has the methyl groups all on one side of the carbon backbone, polypropylene molecules tend to be highly aligned and compact, giving this thermoplastic the properties of durability and chemical resistance. Many polypropylene products, such as rope, fiber, luggage, carpet, and packaging film, are formed by injection molding. Polypropylene is widely used in O&P applications. Its most prevalent application occurs in lower extremity orthotics where high strength combined with its flexural capabilities is desired. Because this material is notch sensitive it is important that its edges are finished smoothly. Flame finishing is not recommended as it will case harden the finished edge and make it more susceptible to failure. Take the time to finish edges of this material in graduating abrasive grits and it will perform well in flexural applications.
Polyesters	Thermosetting resins produced by dissolving unsaturated, generally linear, alkyd resins in a vinyl-type active monomer such as styrene, methyl styrene, and diallyl phthalate. Cure is effected through vinyl polymerization using peroxide catalysts and promoters, or heat, to accelerate the reaction. The resins are usually furnished in solution form, but powdered solids are also available.

Polyethylene (PE)	resins are milky white, translucent substances derived from ethylene (CH_2==CH_2). Polyethylene, with the chemical formula -CH_2-CH_2-]$_n$ (where *n* denotes that the chemical formula inside the brackets repeats itself to form the plastic molecule) is made in low- and high-density forms. Low-density polyethylene (LDPE) has a density ranging from 0.91 to 0.93 g/cm3 (0.60 to 0.61 oz/cu in). The molecules of LDPE have a carbon backbone with side groups of four to six carbon atoms attached randomly along the main backbone. LDPE is the most widely used of all plastics, because it is inexpensive, flexible, extremely tough, and chemical-resistant. High-density polyethylene (HDPE) has a density that ranges from 0.94 to 0.97 g/cm3 (0.62 to 0.64 oz/cu in). Its molecules have an extremely long carbon backbone with no side groups. As a result, these molecules align into more compact arrangements, accounting for the higher density of HDPE. HDPE is stiffer, stronger, and less translucent than low-density polyethylene. HDPE is formed into grocery bags, car fuel tanks, packaging, and piping.
Polyurethane	Rubbers are two component systems (base plus curative; A+B) that cover a wide variety of applications at a relatively low cost. They are pourable, brushable, sprayable and easily laminated into custom orthopedic appliances. They can be easy to use with no scale required. They are available in a wide durometer range for specific custom orthopedic requirements. Polyurethane has good abrasion resistance and poor release properties. Certain procedures must be considered when applying polyurethane in O & P applications. Polyurethane is moisture sensitive in its raw form and can exhibit a short shelf life if exposed to high moisture and or radical temperature changes. Products are available to address this characteristic and their use is recommended. Any of various resins used in tough chemical-resistant coatings adhesives and foams. Most types of polyurethane resin cross-link and become thermosetting plastics. However, some polyurethane resins

	have a linear molecular arrangement that does not cross-link, resulting in thermoplastics. Thermosetting polyurethane molecules cross-link into a single giant molecule. Thermosetting polyurethane is widely used in various forms, including soft and hard foams. Soft, open-celled polyurethane foams are used to make foam blanks which are shaped in endo-skeletal prosthetic finishes. Hard polyurethane foams are used for structure and cosmetics when applying and exo skeletal finish in prosthetics.
PPT	**Requires Interpretation**
Poron	**Requires Interpretation**
Pot Life	This term is common to two part liquid mixtures that result in a monogamous material. It is the amount of time a person has to mix and apply the material being used. The length of time that a catalyzed resin system retains a viscosity low enough to be used in processing.
Poly Car C	This material is a combination of directional carbon fibers that have been etched and impregnated with thermoplastic. This allows the sheet material to be heated and bonded to polypropylene while being formed. While this material offers excellent rigidity control its final shape and fiber direction can distort your original design shape. Caution should be used to assure this characteristic does not effect your desired results. Experiment with different directional lay-ups to assure your desired design results. Knowing how the shapes and fiber orientation used affects your final product can enhance or deteriorate your final product requirements.
Polyesters	Thermosetting resins produced by dissolving unsaturated, generally linear, alkyd resins in a vinyl-type active monomer such as styrene, methyl styrene, and diallyl phthalate. Cure is effected through vinyl polymerization using peroxide catalysts and promoters, or heat, to accelerate the reaction. The resins are usually furnished in solution form, but powdered solids are also available.

Polysulfide	These rubbers are two component systems and are commonly used in higher temperature casting procedures. They are commonly softer and longer lasting than other materials. They are offensive in odor and may stain plaster.
Prepreg	Ready-to-mold material in sheet form, which may be cloth, mat, man made fibers or paper impregnated with resin and stored for use. The resin is partially cured to a "B" stage and supplied to the fabricator who lays up the finished shape and completes the cure with heat and pressure.
Pressure Forming	Compressed air is used to drive hot thermoplastic into cavities and depressions of a concave or female mold.
Primer	This term refers to a substance that is designed to improve adhesion to a materials surface. These substances are specialized for the materials they designed for and can assist adhesion between similar and / or dissimilar materials. Cleaning or abrading a materials surface could be referred to as priming (preparing) the surface for adhesion to the original material's surface.
Promoter	A material which, when mixed with a catalyzed resin, will speedup the chemical reaction between the catalyst and resin; either in polymerizing of resins or vulcanization of rubbers. Also known as "accelerator".
Proton	A stable positively charged sub atomic particle found in all atomic nuclei.
Polyvinyl Alcohol (PVA)	A liquid water-soluble release agent. Often used in sheet or bag form when applied in orthotics & prosthetics. Liquid PVA is commercially available or can be made by placing sheet material in water and allowing it to breakdown into a liquid solution.

Reaction Injection Molding	(RIM) In this process, liquid thermosetting resin is combined with a curing agent (a chemical that causes the polymer molecules to cross-link) and injected into a mold. Most products made by reaction injection molding are made from polyurethane.
Release Agent Release	**Requires Definition / Interpretation – See Mold**
Resin	While this term applies to a variety of materials it usually indicates a material that requires a catalyst, promotor and or temperature to allow it to cure. It is commonly used for the liquid plastics as opposed to liquid rubber.
Refractive Index	**Requires Definition / Interpretation**
Research	Finding out stuff. Finding out stuff that has never been found out before is the most exciting kind of research. The more stuff you have found out, the more power you have to do good things, and bad things. The country that finds out the most stuff wins. Also, it takes money to find out stuff, especially stuff that has never been found out before.
Rockwell scale	This hardness scale is used to best represent a comparison of material (often metal) that have been modified from their original composition to acquire the characteristics desired from the material being modified. Rockwell hardness is not an index of wear qualities or abrasion resistance; it is more a measure of a material's resistance to indentation.
Shear Strength	A property of the amount of strain required (commonly measured as lbs. per square inch; PSI) to distort or rupture the particular material. A predetermined size and thickness (a standard 1" x 1" x 1") of material is placed under a cross sectional strain which is recorded as the amount required to distort or rupture the material being tested.
Shear Modulus	**Requires definition**

Shore A scale	This hardness scale is used to best represent a comparison of softer rubber like materials
Shore D scale	This hardness scale is used to best represent a comparison of harder plastic like materials.
Shrinkage	**Requires Definition / Interpretation**
Silicone	Silicone rubbers are two component systems (base plus curative; A + B) and are available in a hardness range of very soft to medium. Silicones can be cured with either a platinum catalyst or a tin catalyst. Silicones are pourable, brushable, sprayable and easily laminated into custom orthopedic appliances. They can be easy to use but are more mixing ratio specific than polyurethane and require an accurate scale. They are also available in a wide durometer range for specific custom orthopedic requirements. Pigments specific to silicone are recommended, assuring silicone pigment compatibility is critical if pigmentation is implemented. There are a variety of techniques used when pigmenting. Other silicone characteristics are as follows: Higher viscosity – adjustable to a certain degree. Cure sensitive to certain substances such as latex, sulfur and clay. Special products are available to address this disadvantage. Degassing and or pressure casting is recommended to reduce air in a final product. Tin catalyst silicones are subject to a higher shrinkage percentage than platinum cure silicones. While the percentage is nominal it can be crucial when reproducing and or fabricating exact pieces. Their library life is also shorter than the platinum cure silicone available.

	Silicones exhibit very good chemical resistance as well as high temperature resistance. While they are generally higher in cost their specific characteristics are desirable for a multitude of O & P applications. In general silicones offer good electrical properties and chemical resistance; repel water; have a high degree of lubricity, and are weather-resistant. Properties are relatively stable over a wide temperature range.
Specific Gravity	The ratio of the weight of any volume of a substance to the weight of an equal volume of another substance taken as standard at a constant or stated temperature. Solids and liquids are usually compared with water, and air or hydrogen for gases.
Spectralon	**Requires interpretation/definition**
Spectra-Carb	A brand name woven stockingette made of spectralon & carbon fibers. Used for laminating strong, lightweight lay-ups. Grey in color, provides a structural matrix that allows a small degree of torsional capability of the material dependant upon the resin being applied.
Speedy Rivet	A two-part (Post & Cap, usually hollow bodied) fastener commonly used for attaching straps in O&P applications. Available in nickel, brass coated steel. Styles and sizes vary from manufacturer to manufacturer.
Strain	A material's reaction to a stress
Strength	The ability to withstand load, to resist an applied force without failure.
Stress	The reference to the force being applied
Stress Relieved	This term is used to indicate that a specific process was used to align the molecules of a material in their most efficient configuration.
Substance	a. that which has mass and occupies space; matter b. A material of a particular kind or constitution.

Surlyn	Requires Definition / Interpretation – Thermoplastic available in limited stiffness, considered the predecessor to PETG (Co-Polyester) used for diagnostic check sockets.
Taber Abrasion Resistance	This is a measurement of the milligram weight loss of a material per 1000 cycles using ASTM test method D1044
Tensile Strength	The word tensile means, "to pull apart". Tensile strength is the resistance of material to being pulled apart and is expressed in lbs. per square inch. The maximum tensile load per unit area of original cross section, within the gage boundaries, sustained by the specimen during a tension test. It is expressed as PSI. Tensile load is interpreted to mean the maximum tensile load sustained by the specimen during the test, whether or not this coincides with the tensile load at the moment of rupture.
Tenacity	The term generally used in yarn manufacture and textile engineering to denote the strength of a yarn or of a filament of a given size. Numerically it is the grams of breaking force per denier unit of yarn or filament size; grams per denier, gpd. The yarn is usually pulled at the rate of 12 inches per minute. Tenacity equals breaking strength (grams) divided by denier.
Tensile Modulus	When a bar is pulled in tension, it has to get longer. The tensile modulus is used to calculate how much longer it will get when a certain load is applied to it. Units are normally millions of pounds per square inch. (10 6 PSI) - Giga Pascals (gPa). Higher numbers indicate materials, which will not elongate as much as others when they are being compared under equal tensile loading conditions.
Tensile Impact Strength	**Requires Definition / Interpretation**
Terpolymer	**Requires Definition / Interpretation**
Thermal Conductivity	This property is known as the K factor. It is a measure of the transfer of heat by conduction. It tells how much heat is transferred from one side of a plate to the other side. It is measured as BTUs per hour per unit area (square feet) for a thickness of one inch and temperature difference of one degree.

Thermodynamic	The word 'thermodynamic' comes from roots that mean 'heat' and 'motion'. In a chemical reaction where chemical bonds rearrange to give more stable products, the energy that was stored in the bonds will be released as heat. In many chemical reactions where there are a number of possible products, one will be the most stable (give the greatest release of heat) - this will be the thermodynamic product. This might not be the product that is actually formed, since another possible product might be formed more rapidly - the kinetic product.
Thermoforming	This is a term used to describe several techniques for making products from plastic sheets. In a vacuum forming process, hot thermoplastic sheets are draped over a mold. Removing air from between the mold and the plastic creates a vacuum that draws the plastic to the surface of the mold.
Thermoset	A polymer that, when heated ('thermo') does not become soft and deformable. This is usually because it is crosslinked, and the molecules comprising it cannot move past one another unless chemical bonds are actually broken - which leads to the decomposition of the polymer. Phenol-formaldehyde resin is an example.
Thermosets	Reference to the make up of monomers that when formulated in a liquid state solidifies by chemical reaction. Because of the chemical reaction the material is often not adjustable once the mixture has set.
Thermoplastics	Reference to the make up of monomers that when formulated in a liquid state solidifies by cooling. In particular the materials capability to be remelted repeatedly. A polymer that, when heated ('thermo') becomes soft and deformable ('plastic'). Examples are poly (styrene) and poly(ethylene)...
Tin Cure	**Requires Definition / Interpretation**
Toughness	The ability of a material to withstand sudden or shock loading forces without fracture.

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TPE	Thermoplastic Elastomer
Trichloroethylene	Non Flammable Solvent, cleaner, degreaser. Read MSDS, USE WITH CAUTION.
UMHW	(Ultra High Molecular Weight – Reference to Polyethylene)
Upper Service temp. (20,000h)	Requires Definition / Interpretation
Viscosity	This term indicates how well a material does or does not flow and is measured in centipoise (CPS). Water has a viscosity of 1 CPS and flows easily. Molasses has a viscosity of 100,000 CPS and is very thick resulting in a much slower flow rate.
Viscosity Midpoint	The reference preceding indicates an equal mix of the liquids being combined.
Vivak	See Co-Polyester
Vulcanize	To improve strength, resiliency, and texture of (for example with sulfur or other additives under heat and pressure.
Volume Resistivity (ohm/sq.)	The property of a material to resist electric conductivity
Yield Point	There are various types of yield points ─ compressive, tensile, flexural and torsional. The term simply represents the point at which material under compression, tension. Etc. will no longer return to its original dimensions after removal of the stress applied.
Young's Modulus	This is the fundamental material property governing deflection under load. It is also recognized as the elastic modulus, E. It is defined as the tensile stress required to produce 100% strain. The ratio of tensile stress to tensile strain below the proportional limit.
Viscosity	This term indicates how well a material does or does not flow and is measured in centipoise (CPS). Water has a viscosity of

	1 CPS and flows easily. Molasses has a viscosity of 100,000 CPS and is very thick resulting in a much slower flow rate.
Viscosity Midpoint	The reference preceding indicates an equal mix of the liquids being combined.

Water Absorption, 24h **Requires Definition / Interpretation**

Information resources accessed for information and program support:

http://www.kcpc.usyd.edu.au/discovery/glossary-all.html

http://www.steelforge.com/infoservices/infoservices.asp

http://www.boltscience.com/pages/glossary.htm

http://www.polarware.com/resource.html

http://www.alloytech.com/mmsonline/glossary/step1.asp

http://www.principalmetals.com/glossary/step1.asp

http://www.gadwall.com/internet/techreferences.html

http://ntsrv2000.educ.ualberta.ca/nethowto/examples/edit435/d_snider/links.htm

http://www.tosaythankyou.com/Reference.htm

http://environmentalchemistry.com/yogi/chemistry/dictionary/

http://users.telenet.be/educypedia/sitemap.htm

http://www.msue.msu.edu/msue/imp/mod02/master02.html

http://www.homoexcelsior.com/

http://www.titaniumservices.com/tsdata/glossary.htm

www.modernplastics.com

www.renewmaterials.com

3M Canada

Canadian Standards Association

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Andrew St. Hillarie

Richard Alsip

Modern Plastics

Industry catalogues

Webster's New World Dictionary

Julie Myrdal

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