



## Rubber Definitions

ASTM – ASTM designation for a copolymers from an acrylate and a small amount of cross linking monomer. (Examples, Hycar 4021,4051,4054 elastomers.)

ABRASION RESISTANCE – The resistance of a material to loss of surface particles due to frictional forces.

ABRASION RESISTANCE INDEX – A measure of the abrasion resistance of a vulcanized rubber part relative to that of a standard under the same conditions.

ACCELERATED AGING – A method in which an attempt is made to produce and measure the effects of natural or in-use aging in a short period of time. (Example, 72 hours at 100C (212F) in air test tube.)

ACCELERATOR – A chemical used in small amounts to speed up curing or vulcanization of elastomeric compounds. (Example, tetramethyl thiuram monosulfide, 0.5 parts.)

ACRYLATE RUBBER – General term used to describe a class of elastomers based on acrylate esters. (Examples, Hycar 4021, 4051, 4054.) See ACM above.

ACRYLIC RUBBER – See Acrylate Rubber above, which is the preferred usage.

ACRYLONITRILE – A chemical  $\text{CH}_2\text{CHCN}$ , also known as vinyl cyanide, manufactured from propylene and copolymerized with butadiene to produce butadiene/acrylonitrile elastomers. (Examples, Hycar 1041,1032.)

ACTIVATOR – A chemical used in elastomer compounding in small quantities to increase the effectiveness of an accelerator. (Example, stearic acid.)

ADHESION – The state in which two surfaces are held together by interfacial forces which may consist of molecular forces or interlocking action, or both.

ADHESION FAILURE – The separation of two materials at the surface interface rather than within one of the materials itself.

ADHESIVE – A substance capable of holding materials together by surface attachment.

ADHESIVE – CONTACT - An adhesive that is apparently dry to the touch but which will adhere to itself upon contact.

ADHESIVE – HEAT ACTIVATED – A dry adhesive film that is rendered tacky or fluid by application of heat or heat and pressure.

ADHESIVE – SOLVENT ACTIVATED – A dry adhesive film that is rendered tacky just prior to use by application of a solvent.



## Rubber Definitions

**AGE RESISTANCE** – The resistance to deterioration by oxygen, heat, light, and ozone or combinations thereof during storage or use.

**AGING** –

1. An irreversible change in material properties after exposure to an environment for an interval of time.
2. Exposing materials to a specified environment for an interval of time.

**AGING, AIR OVEN** – Exposing materials to the action of circulating air in an oven at elevated temperature for a specified period of time. A more severe test than air test tube aging.

**AGING, AIR TEST TUBE** – Exposing materials to the action of static air within a closed test tube inserted in an oven. Less severe than air oven aging, but more reproducible, as it prevents transfer of volatiles from one set of samples to another.

**AIR CHECKS** – The surface markings or depressions due to trapping air between the product being cured and the mold or press surface.

**AIR-CURING** – Curing or vulcanization in air at room or elevated temperatures. Normally at atmospheric pressure.

**AMBIENT TEMPERATURE** – The temperature of the atmosphere or medium surrounding the object under consideration.

**ANILINE POINT** – The minimum equilibrium solution temperature for equal volumes of aniline and the liquid in question. The lower the aniline point, the more severe the swelling effect upon nitrile elastomers.

**ANTIOXIDANT** – Same as Age Register, a chemical used to retard deterioration specifically caused by oxygen. (Example, Age-Rite, Resin D)

**ANTIOZONANT** – A chemical compounding material used specifically to retard deterioration caused by ozone. (Example, Antozite II)

**ANTISTATIC AGENTS** – Chemicals which when added to a rubber compound will help dissipate the buildup of electron charges, thereby eliminating a spark or shock risk.

**ASH** – The residue of mineral matter left when a material is subjected to high heat and all organic material is burned away.

**AUTOCLAVE** – A pressure vessel used for the curing or vulcanization of rubber parts by means of steam under pressure.

**B**

**BR** – Butadiene rubber; contains various levels of cis-polybutadiene. ASTM designation.



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**BACK RINDING** - A distortion of a rubber part at the mold parting line, usually in the form of a ragged or torn indentation. This is normally caused by curing before all flow in the mold has taken place.

**BANBURY** – See Internal Mixer.

**BATCH** – Product of one mixing operation in an intermittent process.

**BEAD** – The annular structure of wire, fabric and rubber compound as part of a tire that holds the tire to the rim of the wheel.

**BENCH MARK** – Marks of known distance apart applied to a test specimen and used to measure elongation.

**BLACK** – Carbon black, which see, or the color.

**BLANK** – Piece of mixed compound of suitable size and shape for placing in a mold.

**BLEEDING** – Surface exudation of a liquid or solid material from a vulcanized rubber part due to a partial or complete incompatibility (insolubility).

**BLISTER** – A cavity or sac deforming the surface of material usually due to expansion of an entrapped gas.

**BLOOM** – A change in the surface appearance of a product caused by the migration of a solid (or liquid) material to the surface due to incompatibility.

**BLOW** – The volume expansion during the forming of sponge rubber expressed either in percent or a ratio.

**BLOWING AGENT** – A chemical added to a rubber compound to produce gas by chemical or thermal action in the manufacturing of hollow or sponge articles.

**BOND** – The union of materials by use of adhesives, usually used in relation to parts vulcanized after attaching.

**BONDING AGENT** – See Adhesive.

**BOOT** – A bellows type covering to exclude dust, dirt, moisture, etc., from a flexible joint.

**BRITTLE POINT** – The highest temperature at which a cured rubber part will fracture under sudden impact and specified test conditions.

**BULK DENSITY** – The density of loose material (powder, cubes, etc.) expressed as a ration of weight to volume (lbs. /ft. cubed or grams/cm cubed).

**BUMPING** – A procedure in molding rubber parts where pressure to the press ram is alternately applied and released to aid in the venting of trapped air and gases from the mold.



## Rubber Definitions

BUNA-N – Original German designation for co-polymers of acrylonitrile and butadiene.

BUNA-S – Original German designation for co-polymers of styrene and butadiene.

BUTADIENE – A hydrocarbon, gaseous at room temperature of composition  $CH_2CHCH_2$ . Derived from butanes or as by-product in production of ethylene. It is the major constituent in copolymers with styrene and acrylonitrile and is polymerized by itself to form polybutadiene.

BUTT SPLICE – A joint made before or after vulcanization in a rubber part by placing the two pieces to be joined edge to edge.

BUTYL RUBBER – ASTM designation IIR, for isobutylene-isoprene rubber. Butyl rubber is the common name for such materials.

C

CM – ASTM designation for Chlorinated Polyethylene.

CO – ASTM designation for Epichlorohydrin Homopolymer (Hydrin 100 elastomers)

CR – ASTM designation for Chloroprene Rubber (neoprene)

CSM – ASTM designation for Chloro Sulfonyl Polyethylene (Hypalon\*)

CALENDER – A precision machine equipped with three or more heavy, internally heated or cooled rolls, revolving in opposite directions, which is used for the highly accurate continuous sheeting or plying up of rubber compounds, and fractioning or coating of fabric with rubber compounds.

CARBON BLACK – Elemental carbon in finely divided form used to reinforce elastomeric compounds. It may be produced by several processes, each imparting different properties to the carbon black, these are channel black, furnace black and thermal black.

CARBON BLACK MASTERBATCH – A mixture of an elastomer with a high content of carbon black. It may be produced by mill or Banbury mixing the black into the rubber or adding the black to a synthetic rubber latex such as SBR followed by coagulation, washing and drying of the mixture.

CAST – To form a part by filling a mold cavity with a liquid resin or rubber and then curing to a solid at room temperature or with heat, but generally without pressure.

CAVITY – A hollowed out area of a mold, forming the outer surface of the molded part. Molds may be single or multi-cavity.

CELL – A single, small open space surrounded partially or completely by walls (as in sponge).

CELLULAR MATERIAL – A generic term for materials containing many cells, either open or closed, dispersed throughout the mass.



## Rubber Definitions

**CELSIUS** – A temperature scale in which 0C is the freezing point and 100C is the boiling point of water (formerly called centigrade).

**CEMENT (Rubber)** – A dispersion or solution of any elastomer or compound in a volatile solvent for use as an adhesive or coating.

**CHALKING** – The formation of a powdery residue on the surface of a material resulting from degradation.

**CHECKING** – Short, shallow cracks on the surface of a rubber product, resulting from damaging action by environmental conditions.

**CHLOROPRENE – 2** – Chloro, 1, 3 butadiene,  $\text{CH}_2\text{CC}(\text{Cl})\text{CH}=\text{CH}_2$ , monomer for neoprene rubber.

**CHLOROSULFONATED POLYETHYLENE** - An elastomeric material sold as Hypalon\*.

**COEFFICIENT OF EXPANSION** – The fractional change in dimension of a material for a unit change in temperature.

**COEFFICIENT OF FRICTION** – Between rubber and dry surfaces, is the ratio of the force required to move one surface over the other to the force pressing the two surfaces together.

**COLD BEND** – A test in which a sample of wire or cable is wound around a mandrel of a specified size within a cold chamber, at a specified temperature for a given number of turns at a given rate of speed. The sample is removed and examined for defects or deterioration in the materials of construction.

**COLD FLOW** –

1. Continual dimensional change that follows initial instantaneous deformation in non-rigid material under static load (creep).
2. Dimensional change of unvulcanized rubber or compound under gravitational force at or below room temperature.

**COMPATIBILITY** – The ability of different materials to blend and form a homogeneous system.

**COMPOSITE** – A homogeneous material created by the synthetic assembly of two or more materials (selected filler or reinforcing elements and compatible matrix binder) to obtain specific characteristics and properties.

**COMPOUND** – An intimate mixture of a polymer(s) with all the ingredients necessary for the finished article. Sometimes called stock.

**COMPOUNDING MATERIAL** – A substance used as part of a rubber mix.

**COMPRESSION MOLDING** – A molding process in which the blank of rubber compound is placed directly in the mold cavity and compressed to shape by closure of the mold.



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**COMPRESSION SET** – The residual deformation of material after removal of the compressive stress. Generally obtained after stress was applied for a given length of time at a specified temperature.

**CONTINUOUS VULCANIZATION** – A process where the vulcanization of a rubber compound takes place in a continuous manner such as by drawing a hose or coated wire through a jacketed tube which may be 200 ft. long and under internal steam pressure of 1.4 MPa (200 psi). Or also by passing through a liquid salt or bead bath at 204C (400F) at atmospheric pressure.

**COPOLYMER** – A polymer formed from two or more types of monomers.

**CRACKING** –

1. A sharp break or fissure in the surface of rubber articles that develops on exposure to light, heat, ozone or repeated bending or stretching.

2. The treatment of raw rubber by passing it through moving corrugated rolls.

**CRAZING** – A surface effect on rubber or plastic articles characterized by many minute cracks.

**CREEP** – The deformation in either vulcanized or unvulcanized rubber under stress that occurs with lapse of time after the immediate deformation.

**CROSS LINKING** – When chemical bonds set up between molecular chains, the material is said to be cross linked. Once cross linked, materials cannot be reprocessed. A form of curing.

**CROSSHEAD EXTRUDER** – An extruder so constructed that the axis of the emerging product is a right angle to the axis of the extruder screw, commonly used for applying the cover to braided or spiraled hose or covering wire conductors.

**CRUDE RUBBER** – Refers to raw natural rubber.

**CRUSH TEST** – A specification test employed for O-ring hydraulic packings in which the ring, in twisted condition, is subjected to a severe compressive load.

**CRYSTALLINITY** – Orientation of the disorder long chain molecules of a polymer into repeating patterns. Degree of crystallinity effects stiffness, hardness, low temperature flexibility and heat resistance.

**CURE** – Similar to cross linking and vulcanization, except that vulcanization refers specifically to sulfur cross linking, while cure covers all types (sulfur, peroxide, radiation, etc.).

**CURING AGENT** – A chemical which will cause cross linking to occur.

**CYCLE** – One complete operation of a molding press from closing time to closing time.

**D**

**DAMPING** – A material's ability to absorb energy to reduce vibration.



## Rubber Definitions

**DEFLASHING** – Various processes to remove flash (mold overflow materials) from a finished part.

**DELAMINATION** – Separation or splitting, either between plies in laminated goods or occasionally within the homogeneous part itself.

**DeMATTIA FLEX TEST** – This laboratory test to determine the flexible life of a material. It measures the rate of formation of cracks in a standard molded test bar.

**DENSITY** – The mass (weight) per unit volume of material. (Lbs/cubic foot or grams/cubic centimeter)

**DISPERSION** –

1. The act of causing particles of matter to separate and become evenly distributed throughout a medium.
  2. A system of matter in which finely divided particles of one or more phases (components) are uniformly scattered throughout another phase or medium (a plastisol).
- DRUM CURE** – A method of curing in which the product is wrapped around a drum and vulcanized in hot air or open steam.

**DUMBBELL** – A standard, flat strip specimen shaped like a dumbbell that is used in many physical tests.

**DUROMETER** – An instrument for measuring the hardness of rubber and plastics. “A” Durometer is used for flexible materials and the “D” for rigids.

**DUROMETER HARDNESS** – An arbitrary numbering scale that indicates the resistance to indentation of the indenter point of the Durometer. High values indicate harder materials. The value may be taken immediately, (highest point) or after a very short specified time.

**DYNAMIC PROPERTIES** – Mechanical properties exhibited under repeated cyclic deformations.

**E**

**EPDM** – ASTM abbreviation for a terpolymer of ethylene, propylene, and a diene with the residual unsaturated portion of the diene in the side chain.

**EPM** – ASTM abbreviation for copolymers of ethylene and propylene.

**EBONITE** – A term for hard rubber, made by vulcanization of rubber with high levels (greater than 30 parts) of sulfur, where the high hardness is due to the action of the sulfur.

**ELASTIC LIMIT** – The maximum extent to which a material may be deformed and yet return to its original dimensions after removal of the deforming force.

**ELASTICITY** – The property of matter by virtue of which it tends to return to its original size and shape after removal of the stress which caused the deformation.



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**ELASTOMER** – A polymeric material which, at room temperature, is capable of recovering substantially in shape and size after removal of a deforming force. This generally refers to a synthetic polymer as opposed to rubber which preferably indicates the natural products.

**ELONGATION** – Extension produced by tensile stress, usually expressed as a percent of original unit length.

**ELONGATION, ULTIMATE** – The elongation at time of rupture.

**EMBOSSING** – The production of a design in relief on a rubber surface by molds or by engraved rolls.

**EMBRITTEMENT** - A rubber compound becoming brittle during low or high temperature exposure or as a result of aging.

**ENDOTHERMIC** – A chemical reaction that absorbs heat energy.

**EXOTHERMIC** – A chemical reaction in which heat energy is liberated.

**EXTENDER** –

1. An inert material added to a compound to increase volume and lower cost.
2. An organic material used to augment, or replace part of, the polymer in a compound.

**EXTRACTION** – The process of removing one or more components of a homogeneous mixture by treating the mixture with a liquid (solvent) in which the components to be removed are soluble but not the mixture as a whole.

**EXTRUDER** – A machine with a driven screw for continuous forming of rubber by forcing through a die.

**EXUDATION** – Delayed phase separation of incompatible material, also called bleeding, blooming, spewing, or sweating.

**F**

**FKM** – ASTM designation for fluoro elastomers.

**FADE-O-METER** – An apparatus for accelerated light aging and light fastness testing of sample of vulcanized rubber and plastic specimens under the action of artificial light from an electric arc between two carbons.

**FILLER** – A solid compounding material which may be added, usually in finely divided form, in relatively large proportions, to a polymer. Generally to reduce cost or modify properties.

**FILLER, INERT** – A filler added for cost or processing reasons that have little affect on physical properties.

**FLASH** – The excess material attached to the surface of a molded article at the mold parting line. Mold overflow.





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**FLEX CRACKING** – A cracking condition of the surface of rubber articles such as tires and footwear, resulting from constantly repeated bending or flexing of the part.

**FLOW MARKS, LINES OR CRACKS** – Variants by degree, with cracks the most severe of surface imperfections caused by imperfect flow of the uncured compound during forming.

**FOAM RUBBER** – Cellular rubber formed by whipping latex to a froth and then vulcanizing.

**FORMULATION** – Kinds and proportions of ingredients for a mix, together with the method of incorporation. Also called recipe.

**FREE SULFUR** – That portion of the sulfur originally present in the compound which did not react during vulcanization.

**FRICTIONING** – Process of impregnating woven fabric with rubber using a calender whose rolls rotate at different surface speeds.

### G

**GR-S** – Obsolete description of styrene-butadiene rubber. Current ASTM designation is SBR.

**GAGE** – Refers to a dimension, generally thickness of a product, as measured by a gage of some type.

**GARVEY DIE EXTRUSION TEST** – A procedure for rating the extrusion characteristics of a rubber compound by extruding under prescribed conditions through a die of prescribed contour and dimensions. Named after its inventor, Benjamin Garvey.

**GEHMAN FREEZE TEST** – An apparatus for measuring the relative stiffening of rubber specimens at low temperatures by measuring the resistance to twisting at specified temperatures.

**GLASS TRANSITION POINT** – Temperature at which a material loses its glasslike properties and becomes a semi-liquid.

**GRAIN** – The unidirectional orientation of rubber or filler particles occurring during processing (extrusion, milling, calendering) resulting in anisotropy of a rubber vulcanizate.

**GREEN STOCK** – Raw, unvulcanized compound.

**GREEN STRENGTH** –

1. The resistance to deformation of a rubber stock in the uncured state.

2. Uncured adhesion between plied or spliced surfaces.

**GUAYULE RUBBER** – A form of natural rubber obtained from the guayule shrub. It is soft and highly resinous. There is currently little commercial use.



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**GUM STOCK OR COMPOUND** – A rubber compound containing only those ingredients necessary for vulcanization and small amounts of other ingredients such as process aids, colors and antioxidants. It contains no filler, reinforcing agents or plasticizers.

**GUTTA-PERCHA** – A form of rubber obtained from trees in a manner similar to Hevea (natural) rubber. It differs in that it is highly transpolyisoprene like balata as compared to natural (Hevea) rubber which is cis-polyisoprene. Its commercial usage is generally limited to underwater cable.

**H**

**HALOGEN** – Class of elements containing Chlorine, Bromine, Iodine and Fluorine.

**HALOGENATION** – The reaction of a halogen element with an organic compound by direct addition or by substitution for a hydrogen atom.

**HARD RUBBER** – See Ebonite. In ground form as “dust,” it is used as a filler in other hard rubber articles as a process aid and to reduce the possibility of thermal generated in the vulcanization of hard rubber (high sulfur) parts.

**HARDNESS** – The measured resistance to indentation of a material.

**HEAT AGING** – When specimens of vulcanized rubber are given accelerated aging in air or oxygen at elevated temperatures and in some cases, pressure for specified periods of time. The deterioration is generally noted as a percent change from originally measured properties.

**HEAT BUILD UP** – The generation of heat due to hysteresis when rubber is rapidly or continually deformed.

**HEAT EMBRITTLEMENT** – The hardening of a vulcanized rubber compound when aged at elevated temperatures in air, accompanied by increased modulus and decreased tensile and elongation. Characteristics of diene containing polymers.

**HEAT HISTORY** – The accumulated amount of heat a stock has been subjected to during processing operations, usually after incorporation of the vulcanizing agents. Since vulcanization takes place at elevated temperatures, incipient cure or scorch can take place if heat history has been excessive.

**HERTZ, Hz** – Unit of frequency equal to one cycle per second.

**HOMOPOLYMER** – A polymer consisting of molecules containing a single type of unit (i.e., based on only one monomer).

**HOT MELT ADHESIVE** – A thermoplastic adhesive compound, usually solid at room temperature which becomes fluid on heating for use.

**HYDROCARBON** – An organic chemical compound containing only the elements carbon and hydrogen. Aliphatic hydrocarbons are straight chain compounds and aromatic hydrocarbons are based on the



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cyclic or benzene ring. They may be gaseous, (methane, ethylene, butadiene) liquid (hexane, benzene) or solid (natural rubber, naphthalene, cis-polybutadiene).

**HYSTERESIS** – The heat generated by rapid deformation of a vulcanized rubber part. It is the difference between the energy of the deforming stress and the energy of the recovery cycle.

I

**I.D. OR ID** – Abbreviation for inside diameter.

**IIR** – ASTM designation for isobutene-isoprene rubber, or “butyl” rubber.

**IMPACT STRENGTH** – Measure of the toughness of a material, as the energy required to break a specimen with a single blow.

**IMPREGNATE** – To force material into all the openings of a fabric.

**INCOMPATIBILITY** – Inability of material to form a homogeneous system.

**INERT** – A material that has little tendency to reinforce or have any other effect upon the properties of vulcanizates.

**INHIBITOR** – A chemical that is added to a system to slow down or prevent the rate of reaction, as in a monomer to prevent its premature polymerization.

**INJECTION MOLDING** – Molding operation wherein a rubber compound is heated in the barrel of an extruder and injected into the mold cavity while in a fluid state. The extruder may be screw or plunger type.

**INORGANIC CHEMICALS** – Chemicals whose composition is based on atoms other than carbon (salt, clay, silica, caustic, hydrochloric acid, etc.).

**INSERT** – A foreign object, generally of metal, molded into a rubber part for a definite purpose.

**INTERNAL MIXER** – An enclosed mixing machine of high power for rubber or other suitable material, inside of which are two counter-rotating heavy mixing rotors with small clearance between themselves and the enclosing walls. The mixing chamber is jacketed and may be heated or cooled, as may be the rotor.

**ISOPRENE** –  $(\text{CH}_2\text{C}(\text{CH}_3) = \text{CH} = \text{CH}_2)$ , a liquid hydrocarbon, the fundamental repeating unit in natural rubber and the monomer from which IR, (or polyisoprene) is produced.

**IZOD IMPACT TEST** – A test procedure to determine the impact toughness of a rigid material. It consists of a notched specimen supported as a cantilever which is struck by a pendulum blow.

K



## Rubber Definitions

**KNIT LINES OR MARKS** – Imperfections in a vulcanized part where material did not flow together properly during molding. Also called poor knitting.

**KNOTS** – Lumps which appear in a stretched rubber part, generally due to poor dispersion of a curative, such as sulfur.

L

**LIM** – Liquid injection molding. A molding process in which one or more liquid materials are injected into a mold held at room or elevated temperatures catalyzed to cure in a very short period of time. RIM, reaction injection molding, is a special case referring to catalyzed liquid urethanes reacting in the mold at room temperature. also called LRM, or liquid reaction molding.

**LAMINATE** -

1.To unite sheets of material together with heat and pressure. May be done on a press or a calender.  
2.A product made by such a process.

**LATEX** – An aqueous colloidal emulsion of rubber, natural or synthetic or certain plastics. It refers to the emulsion obtained from the tree or plant or produced by emulsion polymerization.

**LATEX CEMENT** – An adhesive cement made from latex by compounding with suitably prepared curing agents, fillers and tackifiers.

**LEAD PRESS CURE** – A process for curing hose where the uncured hose is covered with lead in an extruding machine, cured in steam and the lead stripped off. The lead covering acts as a mold during vulcanization.

**LIGHT AGING** – Deterioration of compounds when exposed to light (direct or indirect, natural or man-made).

**LOADING** – The kind and quantity of fillers mixed with rubber.

**LOT** –

1.A mass of material or collection of articles of similar composition and characteristics.

2.An amount of material produced at one time and of uniform composition.

**LOW TEMPERATURE FLEXIBILITY** – The ability of a rubber product to be flexed, bent or bowed at specified low temperatures without loss of serviceability.

**LOW TEMPERATURE RETRACTION** – Behavior of a compound when tested in T-50 test. It is designed to evaluate the crystallizing tendency of cured compounds at low temperatures. The specimen is elongated, frozen to an inelastic state, and released while allowing the temperature to rise at a uniform rate. The length of the specimen is measured at regular temperature intervals while it is retracting.

**LUBRICANTS** – Internal (mixed into the compound) to reduce tendency to stick to processing equipment or to lower heat build up on flexing. External (sprayed on) to reduce tendency to stick to a mold.



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M

**MANDREL** – A hollow or solid metal pole used as a form for producing lengths of tubing, hose, or for tubes later cut on a lathe into gaskets.

**MARCHING MODULUS** – A curing characteristic of a compound where the modulus never quite levels off but keeps increasing with cure time.

**MASTERBATCH** – A homogeneous mixture of rubber and one or more materials in high proportions for use as a raw material in the final mixing of the compound. Masterbatches are used to improve dispersion of reinforcing agents, improve breakdown of the rubber, lower the heat history of a compound or facilitate the weighing or dispersion of small amounts of additives.

**MASTICATE** – To break down rubber, particularly natural, by working it on a mill or in an internal mixer.

**MATRIX** –

1. Mold or form in which anything is cast or shaped.

2. Continuous medium in which discrete particles are dispersed, as chopped fiberglass in polyester resin.

**MECHANICAL PROPERTIES** – Physical properties of a material associated with reaction to various applied forces, as in tensile strength, compression set, DeMatia Flex, etc.

**MECHANICAL RUBBER GOODS** – A general term covering rubber goods manufactured for use in engineering and industrial applications, covering belting, hose, gaskets, rolls, milking inflations, etc.

**MICROMETER** – An instrument by which highly accurate minute measurements of length, depth, or thickness may be made.

**MICRON** – A unit of length equal to .0001 cm or 10,000 angstrom units. Now replaced by micrometer.

**MIGRATION** – The movement of materials within a rubber product to the surface, from an area of high concentration to one of low concentration, or into another material to which it is laminated.

**MILL** – A machine used for the mechanical mixing or working of rubber consisting of two adjacent, heavy, hardened-steel, counter-rotating horizontal rolls. Generally they revolve at slightly different speeds. Mill rolls are hollow and may be heated or cooled as needed.

**MILL SHRINKAGE** – The amount of shrinkage, expressed in percent, of a polymer or compound after being subjected to a specified amount of mill breakdown. A square of known dimension is cut from the band on the mill using a metal template and the dimension in mill direction measured after a specified period of time and compared to the original template dimension.

**MODULUS** – In the testing of rubber, it is the force in lbs./in. squared or pascals of initial cross-sectional area necessary to produce a given percentage of elongation.

**MODULUS OF ELASTICITY** – Ratio of stress to strain within the elastic range. Same as Young's modulus, which see.



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**MOLD LUBRICATION** – Lubricants, usually insoluble in rubber, sprayed or brushed on the face of a mold to facilitate removal of the article from the mold after cure. Soaps and silicones are most widely used.

**MOLD SHRINKAGE** – The difference in dimensions, expressed in inches per inch, between a molding and the mold cavity in which it was molded, both the mold and the molding being at room temperature when measured.

**MONOMER** – A small molecule which is capable of reacting with similar or other molecules to form large chain-like molecules called polymers.

**MOONEY SCORCH** – A procedure for determining the cure characteristics of a compound using the Mooney Viscometer, generally at specified elevated temperatures. The values versus time are recorded or plotted and the time values reported when the viscosity values have increased 5 and 30 points above the minimum.

**N**

**NBR** – ASTM designation for copolymers of acrylonitrile ( $\text{CH}_2=\text{CHCN}$ ) and butadiene ( $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$ ). Often called nitrile rubber or Buna N.

**NBS** – National Bureau of Standards

**NMR** – Nuclear magnetic resonance. A type of radio frequency or microwave spectroscopy, based on the magnetic field generated by the spinning of the electrically charged nucleus of certain atoms. This is used for qualitative and quantitative analysis and the following of chemical rates of reaction.

**NR** – ASTM designation for natural rubber.

**NATURAL RUBBER** – Rubber formed in a living plant or tree, usually referring to Hevea Brasiliensis.

**NECKING** – The localized reduction in cross section that may occur in a material under tensile stress.

**NEOPRENE** – Originally the trade name, now the generic name of polymers and co-polymers based on chloroprene ( $\text{CH}_2=\text{CCl}-\text{CH}=\text{CH}_2$ ).

**NERVE** – The elastic resistance of raw rubber or compounds to permanent deformation during processing.

**NITRILE RUBBER** – Copolymers of acrylonitrile and butadiene. Same as NBR or Buna-N. Co-polymers may vary in acrylo content from 10% to 50% and in viscosity from Mooney 25 to 125. “Hycar” is the trademark for BFGoodrich chemical Division nitrile elastomers.

**NON-FILL** – A molded part incompletely formed due to the fact that the compound did not flow sufficiently to fill the mold entirely.



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**NON-STAINING** – An accelerator, antioxidant or similar substance that will not discolor other goods placed next to the rubber in which it is used. Sometimes used as well to describe non-discoloring in white or colored goods.

**O**

**O.D. AND OD** – Abbreviation for Outside Diameter.

**OS & D HOSE** – Abbreviation for oil suction and discharge service hose.

**ODORANT** – An aromatic substance for masking the odor of vulcanized compounds.

**OIL BLACK MASTERBATCH** – A rubber (generally SBR) masterbatch containing petroleum oil and carbon black, both added to the SBR latex prior to coagulation.

**OIL MASTERBATCH** – Similar to oil black masterbatch but without the carbon black. The addition of the oil as a process aid allows the use of much higher molecular weight, tougher, SBR than could be normally processed, providing improved physical properties, such as abrasion resistance, at lower cost.

**OIL RESISTANCE** – The ability to withstand swelling and deterioration by a specified oily liquid for a specified time and temperature.

**OLEFIN** – A family of unsaturated aliphatic hydrocarbons having the general formula  $C_nH_{2n}$ . They contain one or more double bonds and hence, are chemically reactive. They are named after the corresponding paraffins by adding “-ene” or “ylene” to the stem. (Example: butadiene, from butane, having two (-di-) sets of double bonds.)

**OPEN CELL** – A condition of cellular or sponge rubber where the cell walls are not continuous but interconnect, rendering the sponge breathable and able to soak up fluids.

**OPEN STEAM CURE** – A method of vulcanization in which the steam comes in direct contact with the product being vulcanized, generally in an autoclave.

**OPTIMUM CURE** – The time and temperature of cure necessary to develop the desired combination of properties. Several laboratory procedures are available to help determine this point.

**ORANGE PEEL** – The description of a surface appearance of a cured part when stretched. Generally a result of poor dispersion of the filler or of incomplete breakdown of the rubber.

**ORGANIC** – Refers to chemical structure based on the carbon atom, natural and synthetic.

**ORGANOSOL** – A suspension of a finely divided polymer (PVC) in a plasticizer together with a volatile organic liquid.

**O-RING** – An elastomeric seal of homogeneous composition molded in one piece to the configuration of a torus (ring) with circular cross-section.



## Rubber Definitions

OVEN-AGING TEST – See Aging, Air Oven.

OVERCURE – A state of vulcanization beyond the optimum, often resulting in a decline in certain physical properties.

OVERFLOW – See Flash.

OXIDATION – The reaction of oxygen with a rubber product, usually accompanied by a change in feel, appearance of surface or change, usually adverse, in physical properties.

OXYGEN BOMB – A pressure resisting apparatus used in an aging test in which rubber is deteriorated in hot compressed oxygen.

OZONE (O<sub>3</sub>) – An allotropic form of oxygen. A gas with characteristic odor which is a powerful oxidizing agent. It is present in the atmosphere at low levels and causes cracking in certain types of elastomeric compounds.

### P

pH – The measure, on a logarithmic scale of 1 to 14, of the relative acidity or alkalinity of an aqueous solution. Neutral pH (pure water) is 7. Hydrochloric acid would be approximately 1 and sodium hydroxide approximately 13.

phr – Abbreviation for parts per hundred of rubber, used for indicating the proportions of ingredients in a rubber compound.

PMQ – ASTM designation for silicone rubbers having both methyl and phenyl substituent groups on the polymer chain. All similar designations ending in Q denote silicone rubbers.

PACKING, MECHANICAL – A deformable material used to prevent or control the passage of matter between surfaces which move in relation to each other. (Example: the packing around the hydraulic ram of a press.)

PALE CREPE – The highest grade of unsmoked plantation rubber.

PARAFFINS – A class of aliphatic hydrocarbons characterized by saturated carbon chains. They vary from gases (Methane) to waxy solids.

PASTE –

1. An adhesive composition having a characteristic plastic-type consistency.

2. Description of a PVC resin dispersion in plasticizer, a plastisol.

PEPTIZER – A chemical used in small proportions added to a rubber compound to accelerate by chemical action the breakdown and softening of rubber under the influence of mechanical action or heat, or both.

PERFORMANCE TEST – See Service Test.





## Rubber Definitions

**PERMANENT SET** – The amount by which an elastic material fails to return to its original form after deformation.

**PEROXIDE** – A compound containing a bivalent -O-O- group in the molecule. They are strong oxidizing agents and are very reactive. (Examples: benzoyl peroxide, dicumyl peroxide.) Used in polymerization reactions and for cross-linking agents.

**PHASE** – A physically homogeneous, mechanically separable portion of a material system.

**PHENOLIC** – A synthetic resin produced by the condensation of an aromatic phenol with an aldehyde, particularly phenol with formaldehyde.

**PIGMENT** –

1. Properly, a dry colored powder used for coloring paint, rubber or other mediums.

2. Sometimes, incorrectly, used to include all fillers and reinforcing agents as well as colors.

**PLANTATION RUBBER** – Crude natural rubber obtained from cultivated rubber trees as opposed to wild or uncultivated trees.

**PLASTIC FLOW, OR DEFORMATION** - The deformation of a plastic material beyond the point of recovery, accompanied by continuing deformation with no further increase in stress.

**PLASTICITY** – The tendency of a material to remain deformed after reduction of the deforming stress to or below its yield stress.

**PLASTICIZER** – A substance incorporated into a material to increase its workability, flexibility or distensibility.

**PLASTISOL** – A suspension of a finely divided polymer (such as PVC) in a plasticizer.

**PLASTOMETER** – An instrument for measuring the plasticity of a material.

**PLATEAU EFFECT** – The maintenance of the properties of a rubber composition over a broad range of vulcanization times.

**PLATEN** – The flat steel or cast iron part of a press that applies heat and pressure to a mold.

**PLY** – One layer in a laminated structure.

**PLY ADHESION** – The force required to separate two adjoining plies in a rubber product.

**POLYBLEND** – A term used to describe colloidal blends of compatible polymers such as PVC and nitrile rubber. At one time, a BFGoodrich registered trademark.

**POLYBUTADIENE** – Various polymers formed by the chemical combination of monomers having either the same or different chemical composition.



## Rubber Definitions

**POLYMER** – A macromolecular material formed by the chemical combination of monomers having either the same or different chemical composition.

**POLYMER CHAIN** – The chain of elements that form the basis of the structure of a polymer. The elements may be all carbon atoms, carbon and oxygen, silicone, nitrogen, etc.

**POLYMERIZATION** – A chemical reaction in which the molecules of a monomer are linked together to form large molecules whose molecular mass is a multiple of the original substance. When two or more different monomers are involved, the process is called copolymerization. Polymerization may be via emulsion (SBR, nitrile), ionic (butyl), solution (EPDM, cis-polyisoprene), suspension or bulk (PVC) processes.

**POST CURE** – Heat or radiation treatment, or both, to which a cured or partially cured thermosetting plastic or rubber composition is subjected to increase the state of cure or enhance the level of one or more properties.

**POUND-VOLUME** – A concept used to calculate the volume cost of a rubber compound as compared to its weight cost. The cost per pound times the specific gravity of the material or compound equals the pound-volume cost.

**PRECURE** –

1. Premature vulcanization taking place during the process prior to vulcanization. Similar to scorch.
2. Vulcanization taking place in the latex state.

**PREFORM** – The preshaped, uncured material placed in a mold for vulcanization. Preshaping is done to facilitate mold flow, control weight accuracy, etc.

**PREPOLYMERS** – As used in polyurethane production, a reaction intermediate of a polyol with an isocyanate, in which either component is in considerable excess of the other. It is capable of further reaction after processing.

**PRESS CURE** – Vulcanization in a mold in a press.

**PRIMER** – A coating applied to the surface of a material, prior to the application of an adhesive to improve the performance of the bond.

**PROCESSABILITY** – The relative ease with which raw or compound rubber can be handled in rubber machinery.

**PROOFED GOODS** – Fabrics that have been coated with rubber by spreading rubber solution or dough on the surface.

**PURE GUM STOCK** – See gum stock.

R



## Rubber Definitions

**RHC** – The Rubber Hydrocarbon Content of a rubber, reclaim or compound. Natural rubber is 92-95% hydrocarbon.

**RATE OF CURE** – The relative time required to reach a predetermined state of vulcanization under specified conditions.

**RAW RUBBER** – Unprocessed, vulcanizable elastomer, normally implying the natural product.

**REBOUND TEST** – A method of determining the resilient properties of vulcanized rubber, by measuring the rebound of a steel ball or pendulum falling from a definite height onto a rubber sample.

**RECLAIM** – Reclaimed rubber, resulting from the treatment of scrap vulcanized rubber in various operations. Reclaim is generally used as an extender or processing aid in natural and SBR compounds rather than by itself. It contains all the constituents of the original rubber scrap (elastomer, carbon black, filler, antioxidants, plasticizers, sulfur, etc.) and runs approximately 50% rubber hydrocarbon.

**RECOVERY** – The degree to which a rubber product returns to its normal dimensions after being distorted.

**REINFORCEMENT** – The stiffening effect of solids, such as carbon black, on unvulcanized elastomer mixtures and the enhancement of the physical properties of the vulcanized compound, such as tensile, elongation, modulus, abrasion resistance, tear, etc.

**RESILIENCE** – The ratio of energy output to energy input in a rapid (or instantaneous) full recovery of a deformed specimen.

**RETARDER** – A material used to reduce the tendency of a rubber compound to vulcanize prematurely. Same as scorch inhibitor.

**REVERSION** –

1. A deterioration of physical properties that may occur upon excessive vulcanization of some elastomers, evidence by a drop in hardness and tensile strength, and an increase in elongation.
2. A similar change in properties after air aging at elevated temperatures. Natural rubber, butyl, polysulfides and epichlorohydrin polymers exhibit this effect. Most others will harden and suffer loss of elongation on hot air aging.

**REX HARDNESS** – The hardness of a rubber compound as determined by the Rex gage. It has the same values as Durometer hardness.

**ROTATIONAL MOLDING OR CASTING** - A procedure used to make hollow articles from liquid polymers or dispersion; may be thermoplastic or thermoset. The material is charged into a hollow mold capable of being rotated in one or more planes. The heated mold fuses the plastic or cures the reactive liquid polymer after the rotation has caused it to cover all surfaces.

**RUBBER** – An elastomer, generally implying natural rubber, but used loosely to mean any elastomer, vulcanized and unvulcanized. By definition, a material that is capable of recovering from large



## Rubber Definitions

deformations quickly and forcibly and can be, or already is, modified to a state in which it is essentially insoluble (but may swell) in boiling solvent, such as benzene, methyl ethyl ketone and ethanol-toluene azeotrope.

**RUBBER LATEX** – A colloidal aqueous emulsion of an elastomer. The state of natural rubber as it comes from the tree, or as a result of emulsion polymerization for synthetic rubbers.

S

**SI** – Abbreviation for International System of Units. (See ASTM E380.)

**SCORCH** – Premature vulcanization of a rubber compound, generally due to excessive heat history.

**SCREW** – Rotating member with a helical groove to propel rubber through the barrel of an extruder.

**SERVICE TEST** – A test in which the product is evaluated under actual service conditions.

**SET** – Deformation remaining after complete release of the force producing the deformation.

**SET UP** – When a stock is said to be “set up,” it has scorched, and vulcanization has started. It can no longer be processed smoothly.

**SHEET MOLDING COMPOUND** – “SMC” is a compression molding material consisting of glass fibers in a thickened polyester resin, possibly modified with liquid nitrile polymers for increased fracture resistance.

**SHELF AGING** – The natural deterioration of rubber articles kept in storage or “on the shelf” under normal atmospheric conditions. This slow deterioration is due primarily to oxygen and ozone attack.

**SHELF LIFE** – An expression describing the time an unvulcanized stock can be stored without losing any of its processing or curing properties.

**SHORE HARDNESS** – See Durometer Hardness.

**SILICONE RUBBER** – A rubber prepared by the action of moisture on dimethyl dichloro silane and other halosilanes. They are characterized by serviceability at very low and very high temperatures.

**SINK MARK** – A depression in the surface of a part caused by:

- 1.the collapse of blister or bubble, or
- 2.internal shrinkage in injection molded parts, or
- 3.shrinkage over rubber area in rigid sheet plastics.

**SKIM COAT** – A layer compound laid on a fabric but not forced into the weave. May be spread or calendered.

**SKIN** –



## Rubber Definitions

1. A dense layer on the surface of cellular material.

2. An overcured layer on the surface of a molded rubber part.

SOAPSTONE – A soft powder or stone, basically hydrated magnesium silicate, having a soapy feel, used to dust the surface of unvulcanized rubber compounds to keep them from sticking together. Similar to talc.

SPECIFIC GRAVITY – The ratio of the mass of a unit volume of a material to that of the same volume of water at a specified temperature. Specific Gravity is: grams/cc of material (1) grams /cc of water or pounds/ft<sup>3</sup> of material (62.4) pounds/ft<sup>3</sup> of water.

SPECIFIC VOLUME – The reciprocal (1/Sp. Grav.) of specific gravity. Also expressed as the ratio between the volume of one pound of water and the volume of one pound of material.

SPRUE –

1. The primary feed channel that runs from the outer face of an injection or transfer mold to the mold gate in a single cavity mold or to runners in a multiple cavity mold.

2. The piece of material formed or partially cured in the primary feed channel.

SPRUE MARK – A mark, usually elevated, left on the surface of an injection or transfer molded part, after removal of the sprue.

STABILIZER – A chemical used to prevent or retard degradation of rubber polymer by heat, light or atmospheric exposure.

STATE OF CURE – The cure condition of a vulcanizate relative to that at which optimum physical properties are obtained.

STEAM CURE (Open) – A method of vulcanizing rubber parts by exposing them directly to steam in a vulcanizer.

STOCK – A term for unvulcanized, mixed rubber compound.

STRAIN – Deformation resulting from a stress.

STRESS – Force per unit or original cross sectional area that is applied to a part of specimen.

STRESS RELAXATION – The time dependent decrease in stress for a specimen at constant strain.

SUBSTRATE – A material upon the surface of which an adhesive is spread for any purpose, such as bonding or coating.

SUN CHECKING – Surface deterioration in the form of cracks, checks, or crazing caused by exposure to direct or indirect sunlight.

T



## Rubber Definitions

**TGA** – Thermogravimetric Analysis. A test procedure used to determine the thermal stability or composition of a material. Two modes are possible; determining the change of weight of a specimen while changing temperature at a given rate or the change of weight of a specimen with time at a fixed temperature.

**TR TEST** – A method for evaluating the low temperature characteristics of a vulcanized part by measuring the temperature at which retraction over the range of 10 to 70% of original elongation occurs. The test is generally employed to determine the susceptibility of a rubber to crystallize. The specimen is stretched at room temperature, cooled to very low temperature, released and warmed at a uniform rate.

**TACK** – The property of a polymer or compound that causes two layers to stick together on application of mild pressure. Tacky polymers or compounds do not necessarily stick to other surfaces.

**TENSILE STRENGTH** – The maximum tensile stress applied during stretching of a specimen to rupture.

**TERPOLYMER** – A copolymer made from three different monomers.

**THERMOPLASTIC** – Capable of being repeatedly softened by increase of temperature and hardened by decrease in temperature.

**THERMOSETTING** – Capable of being changed into a substantially infusible or insoluble product when cured under application of heat or chemical means.

**TOLERANCE** – The amount by which a property of a material or object can vary from a specified value and still be acceptable.

**TORSILASTIC SPRING** – A cylindrical rubber spring consisting of an inner shaft, an outer shell, and a solid layer of rubber of substantial thickness between, and adhered to the shaft and shell.

**TRANSFER MOLDING** – A process for forming and vulcanizing rubber articles by forcing a predetermined quantity of compound into a closed heated cavity from a heated chamber integral with the mold.

**TRAPPED AIR** – The air that is enclosed in a product or between a mold surface and a product during vulcanization.

**TUMBLING** – A finishing process for removing flash from a molded part by placing in a rotating barrel with or without the added finishing material such as shells, dry ice, etc.

### U

**ULTRA ACCELERATOR** – A generic term for a class of vulcanization accelerators that are very active and are generally used in very small quantities (less than 1 part).

**ULTRAVIOLET LIGHT** – A form of energy occupying a position in the spectrum of sunlight beyond the violet, and having wavelengths of less than .4m. which is the limit of visible light. Ultraviolet rays are



## Rubber Definitions

very active chemically, exhibit bactericidal action, and cause many substances to fluoresce. Their action accelerates deterioration of rubber parts exposed to them and can initiate polymerization.

**UNSATURATION** – A chemical condition occurring in carbon compounds when the full combining power of two adjacent atoms is not satisfied by other elements, resulting in double or triple bonds. These bonds are available for reaction with sulfur (vulcanization) and are susceptible to scission (breakage) or cross linking on exposure to heat or light resulting in deterioration of properties.

### V

**VISCOSITY** – The resistance of a material to flow either by gravity or under stress.

**VOLUME COST** – Costs calculated on the basis of unit volume rather than unit weight. (See Pound Volume.)

**VULCANIZATE** – Preferably used to denote the product of vulcanization, without reference to shape or form.

**VULCANIZATION** –

1. An irreversible process during which a rubber compound, through a change in its chemical structure (cross-linking), becomes less plastic and more elastic. It becomes more resistant to swelling by organic liquids. Elastic properties are conserved, improved, or extended over a greater range of temperature.
2. It often refers to the reaction of rubber specifically with sulfur, while “curing” covers other methods of cross-linking. Both terms are often used interchangeably.

**VULCANIZING AGENT** – Any material that can produce in rubber the change in physical properties known as vulcanization, such as sulfur, peroxides, polysulfides, quinones, etc.

### W

**WEATHERING** – The surface deterioration of a rubber article during outdoor exposure.

**WRAPPED CURE** – A vulcanizing process using a tensioned wrapper (usually fabric tape) to apply external pressure.

### Y

**YERZLEY RESILIENCE** – Resilience as measured on a Yerzley oscillograph, determined by dividing the vertical height of the rebound of the first cycle of the oscillating system by the preceding vertical height of fall.

**YIELD POINT** – The first stress in a material less than a maximum attainable stress at which an increase in strain (elongation) can occur without an increase in stress.

**YOUNG'S MODULUS** – The ratio of normal stress to corresponding strain for tensile or compressive stresses below the proportional limit of the material.