
Glossary of Plastic Injection Molding Terms

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A

Abrasion Resistance: The ability of a substance to withstand mechanical actions, such as rubbing, scraping, or erosion, which tend to progressively remove material from its surface.

Acceptable Runner/Cavity Ratio: Runner systems designed for high pressure drops to minimize material usage and increase frictional heating in the runner.

Additive: A substance compounded into a resin to enhance or improve certain characteristics.

Adhesive Assembly: The process of joining two or more plastic parts by means of an adhesive.

Air Entrapment: Air is trapped in the mold cavity during the filling of the cavity and leaves a void in the part.

Aging: The process of, or the results of, exposure of plastics to natural or artificial environmental conditions for a prolonged period of time.

Alloy: A term used in the plastics industry to denote blends of polymers or copolymers with other polymers or elastomers, e.g., ABS/polycarbonate.

Ambient Temperature: The temperature of a medium surrounding an object. The term is often used to denote prevailing room temperature.

Amorphous: Devoid of crystallinity or stratification. Most plastics are amorphous at processing temperatures. Amorphous materials have a greater resistance to stress cracking, warping, and shrinkage due to their random molecular structure.

Annealing: A process that relieves internal stresses of molded plastic articles by heating the part to a predetermined temperature, maintaining this temperature for a predetermined length of time, and slowly cooling the part.

ANSI: Abbreviation for American National Standards Institute.

Antioxidant: Additive used to reduce degradation from oxygen attack at normal or elevated temperatures. Sources such as heat, age, chemicals, and/or stress may accelerate oxygen attack.

Antiozonants: These additives are used to prevent the negative effects of ozone on the resin materials.

Antistatic Agent: Additive used to improve the electrical conductivity of the plastic part so that any charge can readily go to ground and not remain in the part.

Application: The act of applying or putting to use. What the molded plastic article will be in its final form.



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The computer console on the right has aged badly, becoming warped and discolored.

Artificially Balanced Runner System: A runner system that is balanced by adjusting the pressure drop of a long, large-diameter runner against a short, small-diameter runner. Because the pressure drop over the small-diameter runner will be much more affected by heat loss than the pressure drop of the large-diameter runner, an artificially balanced runner system will work with a set range of molding conditions. The width of this range of molding conditions determines the stability of the molding.

Ash Content: The solid residue remaining after a substance has been incinerated or heated to a temperature sufficient to drive off all combustible or volatile substances.

Aspect Ratio: Ratio of total flow length to average wall thickness.

ASTM: Abbreviation for the American Society for Testing and Materials.

B

Back Pressure: Resistance of the molten plastic material to forward flow. In molding, back pressure increases the temperature of the melt and contributes to better mixing of colors and homogeneity of the material. However, as back pressure increases, so does cycle time.

Backflow: Molten resin flows back out of the mold, returning to the runners.

Backing Plate: A plate used as a support for the mold cavity block, guide pins, bushings, etc.

Balanced Runner: A runner system designed to place all cavities at the same distance from the sprue.

Barrel: The section of a molding machine that contains the feed screw, as well as the section where resin heating and mixing occurs.

Black Specks: A specific kind of inclusion/contamination often associated with heat-degraded materials.

Blister: An imperfection on the surface of a plastic article caused by a pocket of air or gas beneath the surface.

Bloom: An undesirable cloudy effect or whitish powdery deposit on the surface of a plastic article or to the surrounding environment caused by the exudation of an ingredient such as a lubricant, stabilizer pigment, plasticizer, or other non-bonded component.

Blowing & Foaming Agents: Additives for plastics or rubbers that generate inert gases within the resin matrix when heated. The resulting part will have a cellular structure.

Blushing: The tendency of a plastic article to turn white or chalky in areas that are highly stressed.

Boss: A raised feature of a molded part designed to add strength, facilitate alignment during assembly or for attachment to another part.

Branching: The modification of the molecular structure of a polymer derived from the growth of a new polymer chain from an active site on an established chain, in a direction different from that of the original chain.

Breakdown Voltage: The voltage that an insulating material can withstand before dielectric breakdown occurs.

Brittle Temperature: A measure for judging the relative merits of materials for low temperature flexing or impact - i.e., the temperature at which materials rupture by impact under specified conditions.

Broken Mold Marks: Part surface defects caused by mold damage.

Bubbles: Air or gas pockets that have formed in the material of the component. Bubbles may vary in size.

Burned: Showing evidence of excessive heating during processing or use of a plastic, as evidenced by blistering, discoloration, distortion or destruction of the surface.

Burn Mark: A patch or streak of brown or black material on the component caused by air or gases that have not been properly vented from the mold and have caused the material to overheat and burn.

C

Cavity: A depression, or a set of matching depressions, in a plastics-forming mold which forms the outer surfaces of the molded articles.

Chopped Strand: A type of fiber reinforcement consisting of strands of individual glass fibers which have been chopped into short pieces.

Clamp: The part of an injection molding machine incorporating the platens that provides the force necessary to hold the mold closed during injection of the molten resin and open the mold to eject the molded part.

Clamping Area: The largest rated molding area an injection press can hold closed under full molding pressure.

Clamping Force: The force applied to the mold to keep it closed, in opposition to the fluid pressure of the compressed molding material within the mold cavity and the runner system.

Clamping Plate: A plate fitted to a mold and used to fasten the mold to a platen.

Clamping Pressure: The pressure applied to the mold to keep it closed during the molding cycle.

Clarifiers: Additive used in resins to improve transparency or translucency.

Closed-Loop Control: System for monitoring and automatically adjusting injection molding process conditions such as temperature, pressure and time. The automatic changes keep part production within preset tolerances.

Coefficient of Thermal Expansion (CTE): The change in length of a material per unit change in temperature, per unit of length.

Co-Injection: Simultaneous or near simultaneous injection of multiple materials.

Cold Flow Lines: Imperfections within the part wall due to thickening or solidification of resin prior to full cavity fill.

Cold-Runner Mold: A mold in which the runners are cooled and ejected with the part. Each machine cycle produces a plastic part and a runner. Compare *Hot-Runner Mold*.

Color Concentrate: A plastic compound which contains a high percentage of pigment, to be blended in appropriate amounts with the base resin so that the correct final color is achieved.

Colorant: See *Color Concentrate*.

Contamination: Parts that have foreign material embedded in them.

Composite: A structural, non-homogenous material consisting of a combination of materials. Typically, one material is a strengthening agent, and the other is a thermoset or thermoplastic resin.

Compound: A mixture of resin(s) and additives usually formed in a separate machine downstream from the primary reactor.

Compounding: The process required to mix polymer(s) with all the additives that are necessary to provide the end user with a finished grade with suitable properties.

Compressive Strength: The ability of a material to sustain a force in a direction opposite to tension.

Conditioning: Subjecting a material or product to a standard environmental and/or non-standard stress state prior to further processing, testing or use.

Constant Pressure Gradient: pressure drop per unit of length. The constant pressure gradient principle says that the most efficient filling pattern is the result of a constant pressure gradient along the flow path.

Continuous Service Temperature: The highest temperature at which a material can perform reliably in a long-term application, as defined by the manufacturer.

Controlled Frictional Heating: Heating with runners designed to deliver a higher melt temperature to the cavity. This results in lower stress levels in the part without causing material degradation due to long exposure to elevated temperatures in the barrel.

Cooling Channels: Channels located within the body of a mold through which a cooling medium is circulated to control the mold surface temperature.

Cooling Time: The time required for the plastic to solidify to allow part ejection without distortion. This time depends on the material and its cross section, the thermal conductivity of the tool, and other mold and part design factors.

Copolymer: A unique new polymer resulting from the chemical reaction of two different monomers. Compare *Homopolymer*.

Core: A protrusion, or set of matching protrusions, in a plastics forming mold which forms the inner surfaces of the molded articles.

Corona Treatment: Impingement of AC power on a component to bombard with free radicals, thus improving the ability of the component to bond to a surface.

Corrosion Resistance: A broad term applying to the ability of plastics to resist degradation in many environments, usually from oxidation.

Corrosion Resistance: A broad term applying to the ability of plastics to resist many environments.

Coupling Agents: Materials that are used to form a chemical bridge between the resin and an additive, such as glass fiber or mineral fiber. The fiber acts as an interface, enhancing bonding.

Crack/Splits/Chips: A physical separation or tearing of the part.

Crazing: Defect in plastic articles characterized by distinct surface cracks or white regions. These are the result of stresses within the plastic in an area that is stretched beyond its yield point, exceeding the tensile strength of the plastic.

Creep: Deformation of the plastic. A plastic subjected to a load for a period of time tends to deform more than it would from the same load released immediately after application, and the degree of this deformation is dependent on the load duration.

Cross-Linking: The formation of chemical links between the molecular chains in polymers. This process can be achieved by chemical reaction, vulcanization, or electron bombardment.

Crystal: A homogeneous solid having an orderly and repetitive three-dimensional arrangement of atoms.

Crystallinity: The molecular structure in some resins attributed to the existence of solid crystals with a definite geometric form. Such structures are characterized by uniformity and compactness.

Cure: The process of changing the properties of a polymer to make it more stable and usable. . This is accomplished by the use of heat, radiation, or reaction with chemical additives.

Cure Time: Time in the molding cycle during which the thermoplastic material becomes rigid enough to withstand ejection.

Custom Molder: A firm specializing in the molding of items or components to the specifications of another firm, which handles the sale of distribution of the items, or incorporates the custom molded items into one of its own products.

Cycle Time: The time required by an injection molding system to mold a part and return to its original position/state.

Cycle: Complete, repeating sequence of operations for injection molding a part.

D

Damping: Dissipating energy to absorb shock and reducing the impact of vibration on a mold.

Deflection Temperature: The temperature at which a specimen deflects to a set point under a defined load.

Degassing: The momentary opening and closing of a mold during the early stages of the cycle to permit the escape of air or gas from the heated compound.

Degradation: A deleterious change in the chemical structure, physical properties or appearance of a plastic caused by exposure to heat, light, oxygen, weathering or other external influence.

Delamination: The separation of the surface of a finished part. Strata or fish-scale-type appearance may be visible where the layers are separated.

Dimensional Variation: Fluctuation in part size due to differences in cavity steel in multi-cavity molds or a combination of one of the following: pressure gradients, improper measuring techniques, different amounts of material in the mold, degree of crystallinity, cooling rate, amount of molecular chain orientation, and/or fiber orientation.

Density: Mass per unit volume of a substance.

Design Review: A review of a blueprint of an application, to be molded in a plastic material, with recommendations given for design, material, processing, and tooling.

Diaphragm Gate: A type of gate used in symmetrical cavity filling to reduce weld-line formations and improve filling rates.

Dielectric Strength: See *Breakdown Voltage*.

Differential Cooling: Occurs when one area of the part cools at a different rate from another area, or when the mold surfaces have different temperatures. Warping can result from differential cooling.

Dimensional Stability: Retention of the precise shape of the part.

Direct Gate: A sprue that feeds directly into the mold cavity.

Discoloration: Any change from the designated color of the material or component.

Distortion: Visual or physical anomalies such as cracks, pulls, pushing, or twisting of the part.

Dispersion Aids: Flow alteration components placed at the entry point of an additive to aid in mixing or dispersing actions of a compounding process.

Dominant Flow Path: At the juncture of two confronting flows, the dominant flow will reverse the direction of the other flow.

Dose: The amount of material used to load a mold at one time or during one cycle.

Draft: A slight taper in a mold wall designed to facilitate removal of the molded object from the mold.

Drag Marks: A form of deep scratch or scratches on the surface of the component, usually caused by the ejection of the part.

Drooling: Leaking of molten resin from the nozzle or nozzle sprue bushing area while the mold is filled or shot.



A durometer provides a uniform method of measuring the hardness of plastic polymers, elastomers and rubbers.

Drying: Removing moisture from the resin pellets by exposure to a particular temperature for a period of time. All hygroscopic materials must be dried prior to molding.

Durometer: An instrument used for measuring the hardness of a material.

Dwell: A pause in the applied pressure to a mold during the injection cycle just before the mold is completely closed. The dwell allows any gases to escape from the molding material.

E

Edge Gate: The entrance to the part from the runner located on the parting line.

Ejection Pin Marks: A residual mark on the part caused by the profile of the ejection pin.

Ejection Pin: A rod, pin or sleeve that pushes a molded part off a core or out of a mold cavity.

Ejector Pad: Area where the ejector site is either heightened or raised above the surface of the component.

Ejector Return Pins: Projections that push the ejector assembly back as the mold closes.

Ejector Rod: A bar that actuates the ejector assembly when the mold opens.

Elastic Memory: The tendency of certain plastics to revert to a previously existing shape or dimension.

Elasticity: The ability of a material to quickly recover its original dimensions after removal of a load that has caused deformation.

Elastomer: A rubber-like material which, at room temperature, can be stretched repeatedly to at least twice its original length and, upon immediate release of the stress, which returns with force to its approximate original length.

Element: a triangle defined by at least three nodes, creating the basis for the finite element analysis.

Elongation, Break: The increase in distance between two gauge marks at the break point divided by the original distance between the marks. A zero value in the field indicates that it measured less than one.

Elongation, Yield: The increase in distance between two gauge marks at a yield point divided by the original distance between the marks. A zero value indicates that the increase was less than one.

Engineering Plastics: A broad term covering plastics, with or without fillers or reinforcements, which have improved mechanical, chemical and thermal properties over commodity grades of resins.

Extender: A filler material added to a plastic compound used to reduce the amount of resin required per unit value.

Extrudate: The product or material delivered from an extruder, for example, film, pipe profiles.

Extrusion: The process of forming continuous shapes by forcing a molten plastic material through a die.

F

Fabricating: The manufacture of plastic products by appropriate operations. This includes plastics formed into molded parts, rods, tubes, sheeting, extrusion and other forms by methods including punching, cutting, drilling, tapping, fastening or by using other mechanical devices.

Family Mold: A mold that produces non-identical parts simultaneously from multiple cavities.

Fan Gate: A gate used to help reduce stress concentrations in the gate area by spreading the opening over a wider area. Use of this type of gate usually results in less warping of parts.

Fatigue Strength: The maximum cyclic stress a material can withstand for a given number of cycles before failure occurs.

Fill Pattern: The contours the melt takes sequentially as it fills the cavity.

Fill Pressure: The pressure required to fill the cavity.

Fill Time: The time required to fill the cavity or mold.

Fill: The packing of the cavity or cavities of the mold as required to give one or more complete parts that are free of flash and voids.

Filler: A relatively inert substance added to a plastic compound to reduce its cost and/or to improve physical properties, particularly hardness, stiffness and impact strength.

Fines: In the classification of powdered or granular materials (such as molding compounds) according to particle size, fines are the portion of the material composed of particles smaller than a specified size.

Finish: The surface texture and appearance of a finished article.

Finite Element Analysis: The solution of simultaneous equations for each element with resulting pressure, temperature and elapsed time at each node.

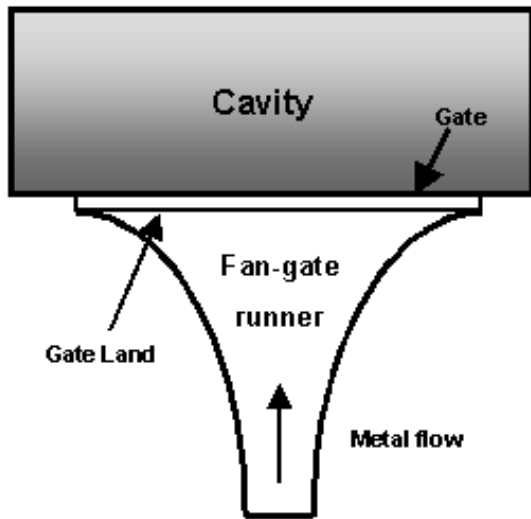
Flame Retardant: Resistant to combustion. A flame-retardant plastic is considered to be one that will not continue to burn or glow after the source of ignition has been removed.

Flash: Any excess material that is formed with, and attached to, the component along a seam or mold parting line.

Flash Gate: Wide gate extending from a runner which runs parallel to an edge of a molded part along the parting line of a mold.

Flexural Modulus: The ratio, within the elastic limit, of the applied stress on a test specimen in flexure to the corresponding strain in the outermost elements of the specimen.

Flexural Strength, Yield: The measure of resistance of the material to fracture during bending.



The fan gate helps prevent warping of parts by reducing stress concentrations in the gate area.

Flexural Strength: The maximum stress in the outer fiber at the moment of crack or break. In the case of plastics, this value is usually higher than the tensile strength.

Flow Balancing: Modification of a flow path, particularly runner sections, so that all flow paths within a mold fill in equal time with equal pressure.

Flow Leader: Local increase in thickness to encourage flow in a particular direction.

Flow Marks: Wavy surface appearances on a molded part caused by improper flow of the melt into the mold.

Flow Pattern: See *Fill Pattern*.

Flow Rate: The volume of material passing a fixed point per unit of time.

Foaming Agent: Any substance which, alone or in combination with other substances, is capable of producing a cellular structure in a plastic mass.

Fracture: The separation of a body, usually characterized as either brittle or ductile.

Freeze Off: Reduction of a material's temperature to the point that the material blocks an area it would fill if it were hotter.

Frictional Heating: Heat generated by the friction of the chains of molecules slipping past each other or over a surface.

G

Gate: The channel through which the molten resin flows from the runner into the cavity.

Gate Area: The gate dimension parallel to the direction of melt flow.

Gate Blush: A blemish or disturbance in the gate area of an injection molded article.

Gate Trim: Remnant of plastic left over when a component is cut from the runner or sprue, usually to be cut flush with the edge of the component.

Glass Fibers: A family of reinforcing materials for reinforced plastics based on single filaments of glass.

Glass Transition: Change in an amorphous polymer from viscous to hard and relatively brittle.

Gloss: The shininess of a surface. A too high or too low level of gloss on the surface of a part might be considered a defect.

H

Hardness: The resistance of a material to compression, indentation and scratching.

Haze: The cloudy appearance of a material caused by light scattered from within the specimen or from its surfaces.

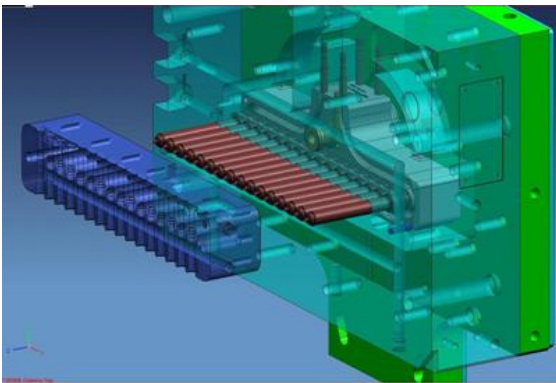
Heat Stabilizers: Additives that increase the ability of a material to withstand the negative effects of heat exposure. Heat stabilizers are used to increase the overall service temperature of the material.

Hesitation Effect: An effect that typically occurs in parts with varying thicknesses. The flow moves preferentially into a thicker area causing an adjacent thin area to freeze off while the thicker area fills. Gates should be positioned as far as possible from where the flow divides into thick and thin flow paths.

Homopolymer: Plastic that results from the polymerization of a single monomer. Compare *Copolymer*.

Hopper Dryers: Auxiliary equipment that removes moisture from resin pellets.

Hopper Loader: Auxiliary equipment for automatically loading resin pellets into machine hopper.



A hot-runner mold is insulated and kept hot in order to produce parts without scrap.

Hot-Runner Mold: A mold in which the runners are insulated from the chilled cavities and are kept hot. Hot-runner molds make parts that have no scrap.

Hygroscopic: Describes a material that readily absorbs moisture.

Impact Modifier: Additive used to enhance a material's ability to withstand the force of impact.

Impact Resistance: The resistance of plastic articles to fracture under stresses applied at high speeds.

Impact Strength: The ability of a material to withstand shock loading.

Injection: See *Fill Time*.

Injection Molding Pressure: The pressure applied to the cross-sectional area of the molding cylinder.

Injection Molding: The method of forming objects from granular or powdered plastics, most often thermoplastics, in which the material is fed from a hopper into a heated chamber, in which it is softened. A ram or screw then forces the material into a mold. Pressure is maintained until the mass has hardened sufficiently for removal from the mold.

Injection Pressure: The pressure on the face of the injection screw or ram when injecting material into the mold, usually expressed in PSI.

Injection Rate: The maximum rate of displacement of the injection screw (cubic in/sec) when the injection molding machine is operating at maximum injection pressure.

Insert Molding: The process of molding plastic around preformed metal inserts.

Insert: A removable part of the mold imparting increased resistance to wear, heat transferability, or changeable part shape to that area of the mold.

Insulated Runner: See *Hot-Runner Mold*.

Isobar: A line of equal pressure. Any point along an isobar sees the same cavity pressure as any other point along the same isobar.

Isotherm: A measure of impact strength determined by the difference in energy of a swinging pendulum before and after it breaks a notched specimen held vertically as a cantilever beam.

Izod Impact Strength: Test to determine impact strength of a sample by holding a sample bar at one end and breaking it by striking. The sample specimen can be either notched or un-notched.

Izod, Notched, LT: The energy required to break specimens in which there is a v-notch to create an initial stress point but measured at low temperature (minus 40°C)..

Izod, Notched, RT: The energy required to break specimens in which there is a v-notch to create an initial stress point.

Injection Blow Molding: Blow molding process by which the plastic parison to be blown is formed by injection molding.

J

Jetting: The turbulent flow of plastic from an undersized gate or where a thin section rapidly becomes thicker, as opposed to laminar flow.

Jig: A tool for holding parts of an assembly during the manufacturing process.

K

K-Factor: A term sometimes used for thermal insulation value or coefficient of thermal conductivity.

Knit Lines: A line or lines formed by the flow fronts of melted material coming together. Knit lines may cause weakening or breaking of the component.

Knockout Pin: See *Ejector Pin*.

L

Land: See *Gate Area*.

Land Area: The surfaces of a mold that make contact with each other when the mold is closed.

Laminar Flow: Occurs when a fluid flows in parallel layers, with no disruption between the layers. In fluid dynamics, laminar flow is characterized by high momentum, diffusion, low momentum convection, pressure and velocity independent from time. Compare *Turbulent Flow*.

Light, UV Stabilizers & Absorbers: These additives increase the ability of the material to withstand the negative effects of light and UV exposure, thus increasing the service life of the material.

Linear Mold Shrinkage: The difference between the size of the part and the size of the mold cavity. Values given are often the average of a range.

Linear Thermal Expansion: The fractional change in length of a material for a unit change in temperature.

Liquid Injection Molding (LIM): The process that involves an integrated system for proportioning, mixing, and dispensing two component liquid resin formulations and directly injecting the resultant mix into a mold which is clamped under pressure.

Low Temperature Flexibility: The ability of a plastic to be bent without fracture at reduced temperatures.

Lubricant: Internal lubricants, without affecting the fusion properties of a compound, promotes resin flow. External lubricants promote release from metals which aids in the smooth flow of melt over die surfaces.

M

Machine Shot Capacity: Refers to the maximum volume of thermoplastic resin which can be displaced or injected by the injection ram in a single stroke.

Mar Resistance: The resistance of glossy plastic surfaces to abrasive action.

Master batch: A concentration of a substance (an additive, pigment, filler, etc.) in a base polymer.

Material Safety Data Sheets: Documentation regarding the toxicity or other hazards associated with contact with some substances. The manufacturer of the plastic prepares these data sheets.

Mechanical Properties: Properties of plastics such as abrasion resistance, creep, ductility, friction resistance, elasticity hardness, impact resistance, stiffness and strength.

Melt Flow Rate: A measure of the molten viscosity of a polymer determined by the weight of polymer extruded through an orifice under specified conditions of pressure and temperature. Particular conditions are dependent upon the type of polymer being tested.

Melt Flow: Rate of extrusion of molten resin through a die of specified length and diameter. The conditions of the test (e.g., temperature and load) should be given. Frequently, however, the manufacturer's data lists only the value, not the condition as well.

Melt Index: The amount of a thermoplastic resin, measured in grams, which can be forced through a specified orifice within ten minutes when subjected to a specified force. (ASTM D-1238)

Melt Strength: The strength of the plastic while in the molten state. This is a pertinent factor in extrusion, blow molding and drawing of molten resin from a die.

Memory: The tendency of a plastic article to revert in dimension to a size previously existing at some stage in its manufacture.

Metallizing: Any processes for coating plastics with metal.

Migration: See *Bloom*.

Mineral Reinforcements: Inorganic substances used as fillers for plastics. Some common examples are: clay, mica, and talc.

Minimum Specifications: The minimum values, usually of mechanical properties, that a compound must be approved by Quality Assurance prior to shipment.

Modulus: Derived from the Latin word meaning “small measure”, modulus is the ratio of stress to strain in the linear region of the s-e curve.

Modulus in Compression: The ratio of compressive stress to strain within elastic limits of the material.

Modulus in Flexure: The ratio of the flexure stress to strain, within the elastic limits of the material.

Modulus in Shear: The ratio of shear stress to strain within the elastic limits of the material.

Modulus of Elasticity: The ratio of stress to corresponding strain below the proportional limit of a material in tensile testing.

Modulus of Resilience: The energy that can be absorbed per unit volume without creating a permanent distortion.

Moisture Absorption: The pick-up of moisture from the environment by a material.

Mold (n): A hollow form or matrix into which a plastic material is placed, which imparts to the material its final shape as a finished article.

Mold (v): To impart shape to a plastic mass by means of a confining cavity or matrix.

Mold Changer: An automated device for removing one mold from a machine and replacing it with another mold.

Mold Core Pin: A pin used to produce a hold in an injection molded plastic part.

Mold Frame: A series of steel plates which contain mold components, including cavities, cores, runner system, cooling system, ejection system.

Mold Release Problems: Excess use of mold release may leave parts oily and weaken the material.

Mold Release Agent: A lubricant used to coat the surface of an injection mold to enhance ejection of the molded article or prevent it from sticking to the tool.

Mold Temperature: The temperature at which the mold is maintained. Often the most important benefit of raising mold temperature is that it allows a slower injection rate without the plastic getting too cold.

Moldability: The characteristics of being easy to mold without rupturing or developing flaws due to movement of the polymer during gelation.

Molding Cycle: The period of time occupied by the complete sequence of operations on a molding press required for the production of one set of molded articles.

Molding Defects: Problems that occur individually or in combination, that render a part unacceptable. Typical problems include material delaminating, streaks or flow marks, contamination, sink marks, flash, short shots, dimensional problems, warping or twisting.

Molding Pressure: The pressure applied to the ram of an injection machine or press to force the softened plastic completely to fill the mold cavities.

Molding Sensitivity: The variability of the pressure to fill the cavity and temperature of the melt at the part as influenced by changes in injection time and barrel melt temperature.

Molding Window: The range of molding conditions under which a part can be successfully molded.

Mold-Temperature-Control Unit: Auxiliary equipment used to control mold temperature. Some units can both heat and cool the mold. Others, called chillers, only cool the mold.

Molecular Weight: The sum of the atomic weights of all atoms in a molecule. Especially in plastics, an average molecular weight is reported.

Molecule: The smallest unit quantity of matter that can exist by itself and retain all the properties of the original substance.

Monomer: A relatively simple molecular structure, usually containing carbon and of low molecular weight, which can react to form a polymer by combination with itself or with other molecules and energy.

Moving Platen: The platen of an injection molding machine that is moved by a hydraulic ram or mechanical toggle. Also called the B-side. Compare *Stationary Platen*.

Multi-Cavity Mold: A mold that produces more than one identical part with each cycle.

Multidirectional Flow: Flow direction changes during filling resulting in orientation in different directions which can cause flow marks, stresses and warping.

Multi-Shot Molding: The injection of two or three materials, in sequence, into a single mold during a single molding cycle. The injection molding machine is equipped with two or three plasticators.

N

Naturally Balanced Runner System: A retainer plate in the mold with a depressed area for cavity blocks.

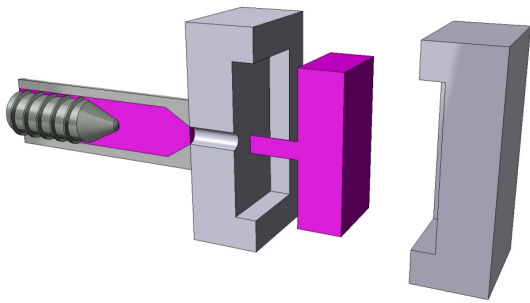
Nest Plate: An additive used to improve the electrical conductivity of the plastic part so that any charge can readily go to ground and not remain in the part.

Non-Fill: Failure to completely fill the mold or cavities of the mold. Edges may appear melted.

Non-Return Valve: Screw tip that allows for material to flow in one direction, closes to prevent back flow, and injects material into the mold.

Notch Sensitivity: The extent to which the sensitivity of a material to fracture is increased by the presence of a surface notch or sudden change in cross-section.

Nozzle: The orifice-containing end of the heating barrel that connects the injection unit to the mold through a platen.



The moving platen, or B-side, of an injection molding machine is moved by a hydraulic ram or mechanical toggle on a hydraulic or electric molding machine.

Nucleating Agent: Additive used in a polymer to increase crystallization rate by providing additional sites for crystal growth (e.g. talc). This results in faster cycle time.

O

Odorants & Deodorants: Odorants are used to add odor to materials, usually for safety reasons; deodorants are used to mask other odors.

Opaque: Not able to transmit light.

Operation, Automatic: A machine operating automatically will perform a complete cycle of programmed molding functions repetitively and stop only in the event of a malfunction on the part of the machine or mold, or when manually interrupted.

Operation, Semiautomatic: Machine operation during which the machine completes a cycle of programmed molding functions automatically and then stops. An operator must manually start another cycle.

Orange Peel: A surface finish on a molded part that is rough and splotchy, usually caused by moisture in the mold cavity, or by poor heat transfer properties in the resin.

Orientation: The arrangement of the molecules of the melt. If the molecules are oriented, they are aligned with each other; if non-oriented, they are not aligned. In general, oriented material shrinks more than non-oriented material.

Orifice: An opening in the part.

Over Molding: A process in which a mold cavity is partially filled with one plastic, and then a second shot is injected to encapsulate the first shot.

Overpack: Over-filling of a particular area of the part. Melt will fill the easiest flow path first and will continue to pack this area while material reaches the other areas. This is a cause of warping created by unbalanced flow.

Oxygen Index: A flammability test based on the principle that a certain volumetric concentration of oxygen is necessary to maintain combustion of a specimen after it has been ignited.

P

Packing: The filling of the mold cavity or cavities as completely as possible without causing undue stress on the molds or causing flash to appear on the finished parts. Over- or under-packing results in less than optimum fill.

Part Picker: An auxiliary unit usually mounted on fixed platen, which reaches into the open mold to grab parts and remove them prior to the next molding cycle. The device can also perform secondary functions such as inspection, degating, or precise placement of parts on a conveyor.

Partially-Balanced Runner System: Composed of both naturally and artificially balanced runners.

Parting Line: Mark on the part indicating where the two halves of the mold met in closing.

Parting Line Mismatch: Misalignment between cavity impressions that cross a parting line.

Peeling: An open blister in the part.

Pellets: Tablets or granules of uniform size, consisting of resins or mixtures of resins with compounding additives, which have been prepared for molding operations by extrusion and chopping into short segments.

Photodegradation: Degradation of plastics due to the action of light.

Pigment: See *Color Concentrate*.

Pinpoint Gate: A restricted gate of 0.030 in. or less in diameter, this gate is common on hot-runner molds.

Piston: The forward motion of the screw in the plasticator barrel that forces the melt into the mold cavity.

Pit: An imperfection or small crater in the surface of the plastic.

Plastic Deformation: A change in dimensions of an object under load that is not recovered when the load is removed.

Plastic: A material that contains as an essential ingredient one or more organic polymeric substances of large molecular weight, is solid in its finished state, and, at some stage in its manufacture or processing into finished articles, can be shaped by flow.

Plasticity: The ability of a material to withstand continuous and permanent deformation by stresses exceeding the yield value of the material without rupture.

Plasticize: To render a material softer, more flexible and/or more moldable by the addition of a plasticizer.

Plasticizer: A substance or material incorporated in a material (usually a plastic or an elastomer) to increase its flexibility, workability or extensibility.

Platens: The mounting plates of a press on which the mold halves are attached.

Plate-Out: An objectionable coating gradually formed on metal surfaces of molds during processing of plastics due to extraction and deposition of some ingredient, such as pigment, lubricant, stabilizer or plasticizer.

Plots: Graphical representations of the results of analysis.

Poisson's Ratio: The constant relating to the changes in dimensions that occur when a material is stretched. This ratio is obtained by dividing the change in width per unit length by the change in length per unit length.

Polymer Structure: A general term referring to the relative positions, arrangement in space, and freedom of motion of atoms in a polymer molecule.

Polymer: High-molecular-weight organic compound, natural or synthetic, whose structure can be represented by a repeated small unit, the *mer*, e.g., polyethylene, rubber, cellulose. If two or more monomers are involved, a copolymer is obtained.

Polymerization: A chemical reaction in which the molecules of a simple substance (monomer) are linked together to form large molecules whose molecular weight is a multiple of that of the monomer.

Preform: A plastic pre-shaped part produced by injection molding systems in the first step of a two-stage injection molding and blow molding process used to produce bottles or containers. The preform is subsequently re-heated and stretch blown through a blow molding process into the final container shape.

Pressure: The injection molding pressure applied to the injection screw to force the melt from the barrel into the mold (psi or Mpa).

Pressure Pads: Reinforcements of hardened steel distributed around the dead areas in the faces of a mold to help the land absorb the final pressure of closing without collapsing.

Processing Aids: Additives specifically used to improve the injection process.

Proportional Limit: The greatest stress that a material can withstand without deviation from proportionality of stress and strain (Hooke's Law).

Prototype Tool: A preliminary mold upon which the final mold will be based.

Pulled Gate: Area where the part was connected to the sprue or runner that has been drawn out or stretched from the surface.

Purging: In extrusion or injection molding, the cleaning of one color or type of material from the machine by forcing it out with the new color or material to be used in subsequent production, or with another compatible purging material.

Pyrometer: An electrical thermometer for measuring and recording temperatures.

Q

Qualification Test: Test conducted by a procuring plant to determine conformation of materials to specifications or other requirements.

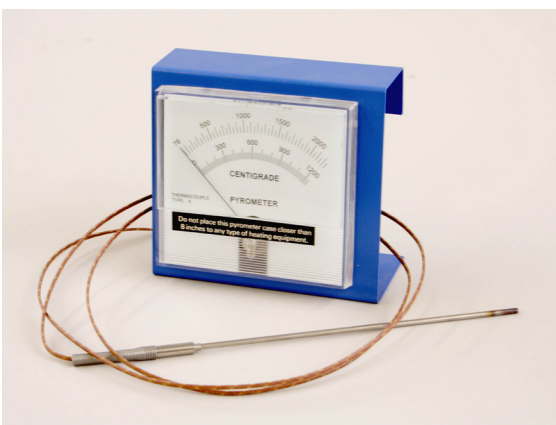
Quality Assurance Test: A test in a program conducted to determine the quality level.

Quality Auditing: Evaluation of the existence and adequacy of the QA program to ensure that the manufacturer's operations are within compliance.

R

Raised Ejector Site: See *Ejector Pad*.

Ram: See *Piston*.



A pyrometer is a type of thermometer that is used to measure high temperatures. Temperature is a critical variable in the injection molding process.

Reaction Injection Molding (RIM): A process that involves the high pressure impingement mixing of two or more reactive liquid components and injecting into a closed mold at low pressure.

Reagent Resistance: The ability of a plastic to withstand exposure to chemicals.

Recovery Time: The length of time for the screw to rotate, create a shot, and return to its original position.

Regrind: Waste material such as sprues, runners, excess parison material and reject parts from injection molding, blow molding and extrusion, which has been reclaimed by shredding or granulating. Regrind is usually mixed with virgin compound at a predetermined percentage for remolding.

Reinforced Plastic: A plastic composition in which fibrous reinforcements are imbedded, with strength properties greatly superior to those of the base resin.

Resin, Synthetic: The term is used to designate any polymer that is a basic material for plastics.

Return Pins: See *Ejector Return Pins*.

Restricted Gate: A very small orifice between runner and cavity in an injection mold. When the part is ejected, this gate readily breaks free of the runner system. Generally, the part drops through one chute and the runner system through another chute that leads to a granulator and scrap reclaim system.

Recessed Gate: A gate that is designed below the adjoining surfaces

Retainer Plate: The plate on which demountable pieces, such as mold cavities, ejector pins, guide pins and bushings are mounted during molding.

Retractable Cores: Projections used to core a hole in a direction other than the line of closing of a mold when molding parts in cavities not perpendicular to the direction in which the part is ejected from the mold. The cores are automatically pulled from the mold prior to the mold opening and reinserted when the mold closes again and prior to injection.

Rib: A reinforcing member of a molded part.

Ring Gate: Used on some cylindrical shapes, this gate encircles the core to permit the melt to first move around the core before filling the cavity.

Robot: See *Part Picker*.

Rockwell Hardness: A measure of the surface hardness of a material. A value derived from the increase in depth of an impression as the load of a steel indenter is increased from a fixed minimum value to a higher value and then returned to the minimum value. The values are quoted with a letter prefix corresponding to a scale relating to a given combination of load and indenter.

Runner: In an injection mold, the feed channel, usually of circular cross-section, that connects the sprue with the cavity gate. The term is also used for the plastic piece formed in this channel.

Runner Balancing: Developing a runner system which delivers the required amount of melt to each cavity with the correct pressure to finish filling all the cavities simultaneously at the correct temperature for the part.

Runner Design: Using the runner as a flow-control device (positioning the gate and using the size of the runner to control the filling pattern within the cavity) in addition to getting the melt into the cavity.

Runner System: In injection molding, this term is sometimes used for the entire resin feeding system, including sprues, runners and gates.

Runnerless Mold: See *Hot-Runner Mold*.

S

Scrap: Any output of a mold that is not usable as the primary product.

Screw Travel: The distance the screw travels forward when filling the mold cavity.

Shear Rate: The rate at which a layer of melt slides over the layer below. Shear rate is velocity-related rather than force-related.

Shear Strength: The maximum load required to shear the specimen in such a manner that the moving portion has completely cleared the stationary portion. Sheets are distinguished from films in the plastics industry according only to their thickness. In general, sheets have thicknesses greater than .040 in.

Shear Stress: The shearing force divided by the area. It is always a maximum at the outside of the flow channel. As it is force-related, it depends on the viscosity of the material, which in turn depends on the material and molding conditions. The maximum allowable stress level is usually taken as 1% of the tensile strength of the material. High shear stress is unimportant at gates, and in sprues and runners.

Short Shot: See *Non-Fill*.

Shot Capacity: Generally based on polystyrene, this is the maximum weight of plastic that can be displaced or injected by a single injection stroke. This capacity is generally expressed as ounces of polystyrene.

Shot: The amount of material fed into the mold for each cycle of a complete molding operation.

Shrinkage Allowance: The dimensional allowance which must be made in molds to compensate for shrinkage of the plastic compound on cooling.

Shrinkage: Contraction upon cooling of all or areas of the part. Shrinkage occurs less in disorientated material and more across chains of molecules than along their lengths. Lower pack areas have lower areas of orientation and shrinkage.

Side-Draw Pins: See *Retractable Cores*.

Sink Mark: An indentation on the surface of the part that results from a significant local change in wall section. The mark will occur in the thicker area.

Skin: A relatively dense layer at the surface of the material.

Slide: Projection in the mold used to form the geometry of the part, which is not in the direction of the closing of the mold and must be withdrawn before the part can be ejected.

Slip Agent: Additive used to provide lubrication during and immediately following processing of plastics.

Solvents: Substances with the ability to dissolve other substances.

Specific Gravity: The ratio of the density of a material as compared to the density of water at standard atmospheric pressure (1 ATM) and room temperature (73 degrees F).

Specific Volume: The volume of a unit of weight of a material; the reciprocal of density.

Spiral Flow: Test performed by injection molding a sample into a spiral mold and used to compare the processability of different resins.

Splay Marks: Scan or surface defects on molded part caused by abnormal racing of the melt in the mold.

Split-Ring Mold: A mold in which a split cavity block is assembled in a channel to permit the forming of undercuts in a molded piece. These parts are ejected from the mold and then separated from the piece.

Sprue Bushing: A hardened-steel insert in the mold that accepts the nozzle and provides an opening for transferring the melt.

Sprue Gate: A passageway through which melt flows from the nozzle to the mold cavity.

Sprue Lock: The portion of resin retained in the cold-slug well by an undercut. This lock is used to pull the sprue out of the bushing as the mold opens. The sprue lock itself is pushed out of the mold by an ejector pin.

Sprue: The feed opening provided in injection molding between the nozzle and cavity or runner system.

Stabilizer: An agent used in compounding some plastics to assist in maintaining the physical and chemical properties of the compounded materials at suitable values throughout the processing and service life of the material and/or the molded parts.

Stack Molds: Two or more molds of a similar type that are positioned one behind the other to allow for additional parts to be manufactured during a cycle.

Stationary Platen: The large front plate of an injection molding press to which the front plate of the mold is secured. This platen does not move during normal operation. Also called the A-side. Compare *Moving Platen*.

Stiffness: The capacity of a material to resist elastic displacement under stress.

Strain: In tensile testing, the ratio of the elongation to the gage length of the test specimen, that is, the change in length per unit of original length.

Stress Concentrators: Abrupt changes in geometry of the part, which serve as the focus of high stresses. The designer can devise various means to relieve the abruptness of the geometric changes and thus reduce the stresses.

Stress Relaxation: The decay of stress at a constant strain.

Stress: The force producing or tending to produce deformation in a body measured by the force applied per unit area.

Stress-Crack: External or internal cracks in a plastic caused when tensile stresses are less than the short-time mechanical strength. The development of such cracks is frequently accelerated by the environment to which the plastic is exposed. There are three types of stress cracking: 1) *Thermal stress cracking* is caused by prolonged exposure of the part to elevated temperatures or sunlight. 2) *Physical stress cracking* occurs between crystalline and amorphous portions of the part when the part is under an internally or externally induced strain. 3) *Chemical stress cracking* occurs when a liquid or gas permeates the part's surface. All three types of stress cracking have the same end result: the splitting or fracturing of the molding.

Stress-Strain Curve: The curve plotting the applied stress on a test specimen versus the corresponding strain. Stress can be applied through shear, compression, flexure, or tension.

Striations: Marks evident on the molded-part surfaces that indicate melt flow directions or impingement.

Strings: See *Pulled Gate*.

Stripper Plate: A plate that strips a molded piece from core pins or force plugs. The stripper plate is set into operation by the opening of the mold.

Structural Foam Molding: The process of molding thermoplastic articles with a cellular core and integral solid skins in a single operation.

Subgate: Entrance to the part from the runner located below the parting line. On ejection the part breaks away from the subgate.

Suck-Back: Condition that occurs when the pressure on the sprue is not held long enough for the melt to cool before the screw returns. Some of the melt in the cavities or runner system may expand back into the nozzle and cause sink marks on the finished part.

Surface Pins: See *Ejector Return Pins*.

T

Tab Gate: A small removable tab about the same thickness as the molded item, but usually perpendicular to the part for easy removal.

Tackifiers: Additives used to enhance the adhesiveness or bonding ability of a material.

Tensile Modulus See *Modulus of Elasticity*.

Tensile Strength, Break: The maximum stress that a material can withstand without breaking when subjected to a stretching load.

Tensile Strength, Yield: The maximum stress that a material can withstand without yielding when subjected to a stretching load.

Tensile Strength: The maximum tensile stress sustained by the specimen during a tension test

Thermal Conductivity: Ability of a material to conduct heat.

Thermal Degradation: Deterioration of the material by heat, characterized by molecular scission.

Thermal Shut-Off: The freezing of a material, causing blockage.

Thermoelasticity: Rubber-like elasticity exhibited by a rigid plastic, resulting from an increase in temperature.

Thermoplastic Elastomers: The family of polymers that resemble elastomers in that they can be repeatedly stretched without distortion of the unstressed part shape, but that are true thermoplastics and thus do not require curing.

Thermoplastic: Material that will repeatedly soften when heated and harden when cooled.

Tie-Bar Spacing: The space between the horizontal tie-bars on an injection molding machine. Basically, this measurement limits the size of molds that can be placed between the tie-bars and into the molding machine.

Time Scan: Effects of mold and melt temperature and injection time changes on pressure, stress and temperature at the end of flow.

Toggle: A type of clamping mechanism that exerts pressure by applying force on a knee joint. A toggle is used to close and exert pressure on a mold in a press.

Tonnage: The measure by which injection molding machines are typically categorized, representing the clamping force of the machine.

Tool: In injection molding, the term sometimes used to describe the mold.

Transfer Molding: A process of forming articles by fusing a plastic material in a chamber then forcing the whole mass into a hot mold to solidify.

Transition Temperature: The temperature at which a polymer undergoes a change in condition. One condition is viscous or rubbery, and the other condition is hard and relatively brittle.

Tunnel Gate: See *Submarine Gate*.

Turbulent Flow: Movement of a fluid in which sub-currents in the fluid display irregular patterns while the overall flow moves in one direction. Turbulent flow is common in non-viscous fluids moving at high velocities. Compare *Laminar Flow*.

U

UL Temperature Index: The maximum temperature below which a material maintains its electrical and mechanical integrity over a reasonable period.

Ultimate Elongation: In a tensile test, the elongation at rupture.

Ultimate Strength: The maximum unit stress a material will withstand when subjected to an applied load in a compression, tension, flexural, or shear test.

Undercut: A protuberance or indentation in a part that impedes withdrawal from a two-piece rigid mold.

Underflow: The dominant flow of two confronting flows, over the other. The lesser flow reverses direction, giving poor surface appearance and structural strength. Underflow should be avoided by positioning gates so that the flow fronts meet at the end of filling.

Unidirectional Flow Pattern: Plastic flowing in one direction with a straight flow front throughout filling.

Uniform Cooling Time: Maintenance of the same cooling time throughout the part to avoid warping.

V

Valve Gating: A type of gate where a pin is held in the gate or channel by spring tension. As the injection stroke moves forward, this gate compresses the plastic in the runner. When this pressure build-up is sufficient to overcome the spring tension, the pin is then pushed back (pulled), and the fast decompression of the melt fills the cavity at extremely high speed.

Vent: A shallow channel or opening cut in the cavity to allow air or gases to escape as the melt fills the cavity.

Vented Barrel: Special barrel unit with a vent port over the compression section of the screw to permit escape of gases prior to injecting melt into mold. Often used when molding moisture-sensitive resins.

Vertical Flash Ring: The clearance between the force plug and the vertical wall of the cavity in a positive or semi-positive mold. The ring of excess melt that escapes from the cavity into this clearance space.

Vicat Softening Point: The temperature at which a flat-ended needle will penetrate a specimen under a specific load using a uniform rate of increase in temperature.

Virgin Material: Any plastic compound or resin that has not been subjected to use or processing other than that required for its original manufacture.

Viscoelasticity: The property possessed by all plastics to some degree that dictates that plastics have solid-like characteristics such as elasticity, strength and form-stability, as well as liquid-like characteristics, such as flow. These characteristics depend on time, temperature, and rate and amount of loading.

Viscosity: Resistance to flow of a liquid.

Void: An unfilled space within a solid material.

W

Warpage: Distortion caused by non-uniform internal stresses.

Water Absorption: The amount of water absorbed by a plastic article when immersed in water for a stipulated period of time. All plastics will absorb moisture to some extent.

Weld Line: Where melted material flows together during molding to form a visible line or lines on a finished part that may cause weakening or breaking of the component.

Wisps: Similar to stringing but smaller in size. These also might occur as slight flashing when the mold is over-packed or forced open slightly. Mold-parting-line wear or misalignment can also cause wisps.

Y

Yellowness Index: A measure of the color on the yellow scale.

Yield Point: In tensile testing, the first point on the stress-strain curve at which an increase in strain occurs without an increase in stress.

Yield Strength: The stress at which a material exhibits a specified limiting deviation from the proportionality of stress to strain.

Young's Modulus: The ratio of tensile stress to tensile strain below the proportional limit.

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