

Plastics

Plastic is a commercial name for a group of materials that while being processed, can be pushed or formed into almost any desired shape and then retain that shape. Plastics can be cast, molded, or pressed into an unlimited variety of shapes. They are one of the most used materials on a volume basis in industrial and commercial life. Plastics are on par with metals, wood, and ceramics and are essential to the needs of virtually the entire spectrum of business. Plastics, properly applied, will perform functions at a cost that other materials cannot match.

Most plastics can be classified as either thermoplastic or thermosetting materials. Thermoplastic materials can be formed into desired shapes under heat and pressure and become solids on cooling. If they are subjected to the same conditions of heat and pressure, they can be reprocessed into new shapes. Thermosetting materials are like concrete, once processed and shaped, they cannot be reshaped. Today, the vast majority of plastics are thermoplastics.

Plastics are made up of polymers. Polymeric materials are characterized by long chains of repeated molecule units known as "mers". These long chains intertwine to form the bulk of the plastic. The ways in which the chains intertwine determine the plastic's macroscopic properties. Typically, the polymer chain orientations are random and give the plastic an *amorphous* structure. Amorphous plastics have good impact strength and toughness. Examples include acrylonitrile-butadiene-styrene (ABS), styrene-acrylonitrile copolymer (SAN), polyvinyl chloride (PVC), polycarbonate (PC), and polystyrene (PS).

If instead the polymer chains take an orderly, densely packed arrangement, the plastic is said to be crystalline. Crystalline plastics share many properties with crystals, and typically will have lower elongation and flexibility than amorphous plastics, and better chemical resistance. Examples of crystalline plastics include acetal, polyamide (PA; nylon), polyethylene (PE), polypropylene (PP), polyester (PET, PBT), and polyphenylene sulfide (PPS). Advances in chemistry have made the distinction between crystalline and amorphous less clear, since some materials like nylon are formulated both as a crystalline material and as an amorphous material.

Thermoplastics and Thermosets

Material name	Abbreviation	Trade names	Description	Applications
Acetal	POM	Celcon, Delrin, Hostaform, Lucel	Strong, rigid, excellent fatigue resistance, excellent creep resistance, chemical resistance, moisture resistance, naturally opaque white, low/medium cost	Bearings, cams, gears, handles, plumbing components, rollers, rotors, slide guides, valves
Acrylic	PMMA	Diakon, Oroglas, Lucite, Plexiglas	Rigid, brittle, scratch resistant, transparent, optical clarity, low/medium cost	Display stands, knobs, lenses, light housings, panels, reflectors, signs, shelves, trays
Acrylonitrile Butadiene Styrene	ABS	Cycolac, Magnum, Novodur, Terluran	Strong, flexible, low mold shrinkage (tight tolerances), chemical resistance, electroplating capability, naturally opaque, low/medium cost	Automotive (consoles, panels, trim, vents), boxes, gauges, housings, inhalors, toys
Cellulose Acetate	CA	Dexel, Cellidor, Setilithe	Tough, transparent, high cost	Handles, eyeglass frames
Polyamide 6 (Nylon)	PA6	Akulon, Ultramid, Grilon	High strength, fatigue resistance, chemical resistance, low creep, low friction, almost opaque/white, medium/high cost	Bearings, bushings, gears, rollers, wheels
Polyamide 6/6 (Nylon)	PA6/6	Kopa, Zytel, Radilon	High strength, fatigue resistance, chemical resistance, low creep, low friction, almost opaque/white, medium/high cost	Handles, levers, small housings, zip ties
Polyamide 11+12	PA11+12	Rilsan,	High strength, fatigue resistance,	Air filters, eyeglass

(Nylon)		Grilamid	chemical resistance, low creep, low friction, almost opaque to clear, very high cost	frames, safety masks
Polycarbonate	PC	Calibre, Lexan, Makrolon	Very tough, temperature resistance, dimensional stability, transparent, high cost	Automotive (panels, lenses, consoles), bottles, containers, housings, light covers, reflectors, safety helmets and shields
Polyester - Thermoplastic	PBT, PET	Celanex, Crastin, Lupox, Rynite, Valox	Rigid, heat resistance, chemical resistance, medium/high cost	Automotive (filters, handles, pumps), bearings, cams, electrical components (connectors, sensors), gears, housings, rollers, switches, valves
Polyether Sulphone	PES	Victrex, Udel	Tough, very high chemical resistance, clear, very high cost	Valves
Polyetheretherketone	PEEK		Strong, thermal stability, chemical resistance, abrasion resistance, low moisture absorption	Aircraft components, electrical connectors, pump impellers, seals
Polyetherimide	PEI	Ultem	Heat resistance, flame resistance, transparent (amber color)	Electrical components (connectors, boards, switches), covers, shields, surgical tools
Polyethylene - Low Density	LDPE	Alkathene, Escorene, Novex	Lightweight, tough and flexible, excellent chemical resistance, natural waxy appearance, low cost	Kitchenware, housings, covers, and containers
Polyethylene - High Density	HDPE	Eraclene, Hostalen, Stamylan	Tough and stiff, excellent chemical resistance, natural waxy appearance, low cost	Chair seats, housings, covers, and containers
Polyphenylene Oxide	PPO	Noryl, Thermocomp, Vamporan	Tough, heat resistance, flame resistance, dimensional stability, low water absorption, electroplating capability, high cost	Automotive (housings, panels), electrical components, housings, plumbing components
Polyphenylene Sulphide	PPS	Ryton, Fortron	Very high strength, heat resistance, brown, very high cost	Bearings, covers, fuel system components, guides, switches, and shields
Polypropylene	PP	Novolen, Appryl, Escorene	Lightweight, heat resistance, high chemical resistance, scratch resistance, natural waxy appearance, tough and stiff, low cost.	Automotive (bumpers, covers, trim), bottles, caps, crates, handles, housings
Polystyrene - General purpose	GPPS	Lacqrene, Styron, Solarene	Brittle, transparent, low cost	Cosmetics packaging, pens
Polystyrene - High impact	HIPS	Polystyrol, Kostil, Polystar	Impact strength, rigidity, toughness, dimensional stability, naturally translucent, low cost	Electronic housings, food containers, toys
Polyvinyl Chloride - Plasticised	PVC	Welvic, Varlan	Tough, flexible, flame resistance, transparent or opaque, low cost	Electrical insulation, housewares, medical tubing, shoe soles, toys
Polyvinyl Chloride -	UPVC	Polycol,	Tough, flexible, flame resistance,	Outdoor applications

Rigid		Trosiplast	transparent or opaque, low cost	(drains, fittings, gutters)
Styrene Acrylonitrile	SAN	Luran, Arpylene, Starex	Stiff, brittle, chemical resistance, heat resistance, hydrolytically stable, transparent, low cost	Housewares, knobs, syringes
Thermoplastic Elastomer/Rubber	TPE/R	Hytrel, Santoprene, Sarlink	Tough, flexible, high cost	Bushings, electrical components, seals, washers