Plastic Material

- Acrylic or Polymethyl Methacrylate (PMMA)
- Polycarbonate (PC)
- Polyethylene (PE)
- Polypropylene (PP)
- Polyethylene Terephthalate (PETE or PET)
- Polyvinyl Chloride (PVC)
- Acrylonitrile-Butadiene-Styrene (ABS)
- Polystyrene (PS)
- Low-density polyethylene (LDPE)
- High-Density Polyethylene (HDPE)
- Nylon/polyamide/silk-like thermoplastic
- Delrin Polyoxymethylene
- Polytetrafluoroethylene (PTFE)

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Acrylic or Polymethyl Methacrylate (PMMA)

- it is a transparent thermoplastic.

- PMMA is also known as acrylic, acrylic glass, as well as by the trade names and brands Crylux, Alfaplas, Plexiglas, Acrylite, Lucite, and Perspex.

- PMMA is a highly versatile thermoplastic resin noted for being a strong, lightweight, and cost-effective alternative for many applications where glass might otherwise be used. However, this weather-resistant material also happens to be biocompatible, leading to its use in a wide range of medical devices as well.

- Used for - Polymethyl methacrylate (PMMA) is commonly used for prosthetic dental applications, including the fabrication of artificial teeth, denture bases, dentures, obturators, orthodontic retainers, temporary or provisional crowns, and for the repair of dental prostheses.

Chemical formula	$(C_5O_2H_8)_n$
Molar mass	Varies
Density	1.18 g/cm3[1]
Melting point	160 °C (320 °F; 433 K)[4]
Magnetic susceptibility (χ)	−9.06×10−6 (SI, 22 °C)[2]
Refractive index (nD)	1.4905 at 589.3 nm[3]

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Polycarbonate (PC)

Polycarbonate also known as PC resin, is a type of engineering plastic, which is a generic term for plastics that are specially designed for enhanced strength, temperature resistance, and other mechanical properties

Used for - Compact discs, riot shields, vandal proof glazing, baby feeding bottles, electrical components, safety helmets and headlamp lenses are all typical applications for PC.

Physical properties	
Density (ρ)	1.20–1.22 g/cm3
Abbe number (V)	34
Refractive index (n)	1.584–1.586
Flammability	HB-V2
Limiting oxygen index	25–29%
Water absorption—Equilibrium (ASTM)	0.16–0.35%
Water absorption—over 24 hours	0.10%
Radiation resistance	Fair
Ultraviolet (1–380 nm) resistance	Fair

Mechanical properties	
Young's modulus (E)	2.0–2.4 GPa
Tensile strength (σt)	55–75 MPa
Elongation (ε) at break	80–150%
Compressive strength (σc)	>80 MPa
Poisson's ratio (ν)	0.37
Hardness—Rockwell	M70
Izod impact strength	600–850 J/m
Notch test	20–35 kJ/m2
Abrasive resistance ASTM D1044	10–15 mg/1000 cycles
Coefficient of friction (μ)	0.31
Speed of sound	2270 m/s

Gas permeation at 20 °C	
Nitrogen	10–25 cm3·mm/(m2·day·Bar)
Oxygen	70–130 cm3·mm/(m2·day·Bar)
Carbon dioxide	400–800 cm3·mm/(m2·day·Bar)
Water vapour	1–2 g·mm/(m2·day) @ 85%–0% RH gradient

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Thermal properties	
Glass transition temperature (Tg)	147 °C (297 °F)
Heat deflection temperature	0.45 MPa: 140 °C (284 °F)
Temperature	1.8 MPa: 128–138 °C (262–280 °F)
Vicat softening point at 50 N	145–150 °C (293–302 °F)[1]
Upper working temperature	115–130 °C (239–266 °F)
Lower working temperature	−40 °C (−40 °F)[2]
Thermal conductivity (k) at 23 °C	0.19–0.22 W/(m·K)
Thermal diffusivity (a) at 25 °C	0.144 mm^2/s[3]
Linear thermal expansion coefficient (α)	65–70 × 10−6/K
Specific heat capacity (c)	1.2–1.3 kJ/(kg·K)

Electrical properties	
Dielectric constant (εr) at 1 MHz	2.9
Permittivity (ε)	2.568 × 10−11 F/m
Relative permeability (μr) at 1 MHz	0.866(2)
Permeability (μ) at 1 MHz	1.089(2) μN/A2
Dissipation factor at 1 MHz	0.01
Surface resistivity	1015 Ω/sq
Volume resistivity (ρ)	1012–1014 Ω·m

Chemical resistance	
Acids—concentrated	Poor
Acids—dilute	Good
Alcohols	Good
Alkalis	Good-Poor
Aromatic hydrocarbons	Poor
Greases and oils	Good-fair
Halogenated hydrocarbons	Good-poor
Halogens	Poor
Ketones	Poor

Polyethylene (PE)

Polyethylene, also known as polythene or polyethene, is one of the most commonly used plastics in the world. Polyethylene usually have a linear structure and are known to be addition polymers. The primary application of these synthetic polymers is in packaging.

Classification

- Ultra-high-molecular-weight polyethylene (UHMWPE)
- Ultra-low-molecular-weight polyethylene (ULMWPE or PE-WAX)
- High-molecular-weight polyethylene (HMWPE)
- High-density polyethylene (HDPE)
- High-density cross-linked polyethylene (HDXLPE)
- Cross-linked polyethylene (PEX or XLPE)
- Medium-density polyethylene (MDPE)
- Linear low-density polyethylene (LLDPE)
- Low-density polyethylene (LDPE)
- Very-low-density polyethylene (VLDPE)
- Chlorinated polyethylene (CPE)

Use - It is the most widely used plastic in the world, being made into products ranging from clear food wraps and shopping bags to detergent bottles and automobile fuel tanks. It can also be slit or spun into synthetic fibers or modified to take on the elastic properties of rubber.

Properties	
Chemical formula	(C2H4)n
Density	0.88–0.96 g/cm3[2]
Melting point	115–135 °C (239–275 °F; 388–408 K)[2]
Solubility in water	Not soluble
log P	1.02620[3]
Magnetic susceptibility (χ)	−9.67×10−6 (HDPE, SI, 22 °C)[4]

Polypropylene (PP)

Polypropylene, a synthetic resin built up by the polymerization of propylene. One of the important family of polyolefin resins, polypropylene is molded or extruded into many plastic products in which toughness, flexibility, light weight, and heat resistance are required.

Polypropylene is a plastic that's used to make everything from rugs to sour cream containers. It's generally considered to be one of the safer plastics. The fda has approved its use as a food container material, and there are no known cancer-causing effects associated with polypropylene.

The density of pp is between 0.895 and 0.93 g/cm^3

polypropylene is recyclable and has the number "5" as its resin identification code:[63]
symbol resin code 5 

Use - range from plastic packaging, plastic parts for machinery and equipment and even fibres and textiles.

Properties	
Chemical formula	(c3h6)n
Density	0.855 g/cm3, amorphous
	0.946 g/cm3, crystalline
Melting point	130 to 171 °c (266 to 340 °f; 403 to 444 k)

Polyethylene Terephthalate (PETE or PET)

Polyethylene terephthalate (PET or PETE), a strong, stiff synthetic fiber and resin and a member of the polyester family of polymers. PET is spun into fibers for permanent-press fabrics and blow-molded into disposable beverage bottles. PET is produced by the polymerization of ethylene glycol and terephthalic acid.

Use - in fibers for clothing, containers for liquids and foods, and thermoforming for manufacturing, and in combination with glass fiber ...

Properties	
Chemical formula	$(C_{10}H_8O_4)_n$[1]
Molar mass	10–50 kg/mol, varies
Density	1.38 g/cm3, 20 °C[2]
	1.370 g/cm3,[1] amorphous
	1.455 g/cm3,[1] single crystal
Melting point	> 250 °C (482 °F; 523 K)[2] 260 °C[1]
Boiling point	> 350 °C (662 °F; 623 K) (decomposes)
Solubility in water	Practically insoluble[2]
log P	0.94540[3]
Thermal conductivity	0.15[4] to 0.24 W/(m·K)[1]
Refractive index (nD)	1.57–1.58,[4] 1.5750[1]

Polyvinyl Chloride (PVC)

Polyvinyl chloride is the world's third-most widely produced synthetic polymer of plastic (after polyethylene and polypropylene).

PVC contains dangerous chemical additives including phthalates, lead, cadmium, and/or organotin, which can be toxic to your child's health.

PVC has excellent electrical insulation properties, making it ideal for cabling applications. Its good impact strength and weatherproof attributes make it ideal for construction products.

Application - PVC is a versatile material that offers many possible applications, these include; window frames, drainage pipes, water service pipes, medical devices, blood storage bags, cable and wire insulation, resilient flooring, roofing membranes, stationary, automotive interiors, and seat coverings, fashion and footwear, packaging, cling film, credit cards, vinyl records, synthetic leather, and other coated fabrics.

Properties	
Tensile Strength	2.60 N/mm²
Notched Impact Strength	2.0 - 45 Kj/m²
Thermal Coefficient of expansion	80 x 10-6
Max Cont Use Temp	60 °C
Density	1.38 g/cm3

Resistance to Chemicals	
Dilute Acid	Very Good
Dilute Alkalis	Very Good
Oils and Greases	Good (variable)
Aliphatic Hydrocarbons	Very Good
Aromatic Hydrocarbons	Poor
Halogenated Hydrocarbons	Moderate (variable)
Alcohols	Good (variable)

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Acrylonitrile-Butadiene-Styrene (ABS)

Acrylonitrile Butadiene Styrene (ABS) is an impact-resistant engineering thermoplastic. It is an amorphous polymer. It is made of three monomers: acrylonitrile, butadiene, and styrene. It is a preferred choice for structural applications due to its physical properties.

- **High rigidity, good weldability, and insulating properties**
- **Good impact resistance, even at low temperatures**
- **Good abrasion and strain resistance**
- **High dimensional stability (Mechanically strong and stable over time)**
- **High surface brightness and excellent surface aspect**

Use - is a common thermoplastic used to make light, rigid, molded products such as pipe, automotive body parts, wheel covers, enclosures, and protective headgear

Physical properties	
Density (ρ)	0.9–1.53 g/cm3; median, 1.07 g/cm3
Flammability	1
Temperate	-20°c to 80°c

Thermal properties	
Thermal conductivity (k)	0.1 W/(m·K)
Solubility in water	Insoluble in water
Linear thermal expansion coefficient (α)	12×10−5 K−1

Chemical resistance	
Acids—concentrated	Good
Acids—dilute	Excellent
Alcohols	Poor
Aldehydes	Poor
Alkalis	Excellent
Aromatic hydrocarbons	Poor
Esters	Poor
Halogenated hydrocarbons	Poor
Ketones	Poor

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Polystyrene (PS)

Polystyrene (PS) plastic is a naturally transparent thermoplastic that is available as both a typical solid plastic as well in the form of a rigid foam material. PS plastic is commonly used in a variety of consumer product applications and is also particularly useful for commercial packaging.

Use - Polystyrene is used in applications from appliances to medical products to automotive parts. Appliances use polystyrene foam as insulation, while its rigid form is used for housings and casings. Electronics also use this material's rigid form for housings and casings.

Physical properties	
Chemical formula	(C8H8)n
Density	0.96–1.05 g/cm3
Melting point	240 °C (464 °F; 513 K)[4]
Boiling point	430 °C (806 °F; 703 K) and depolymerizes
Solubility in water	Insoluble
Solubility	Soluble in benzene, carbon disulfide, chlorinated aliphatic hydrocarbons, chloroform, cyclohexanone, dioxane, ethyl acetate, ethylbenzene, MEK, NMP, THF[1]
Thermal conductivity	0.033 W/(m·K) (foam, ρ 0.05 g/cm3)[2]
Refractive index (nD)	1.6; dielectric constant 2.6 (1 kHz – 1 GHz)[3]

Low-density polyethylene (LDPE)

LDPE is a soft, flexible, lightweight plastic material. LDPE is noted for its low-temperature flexibility, toughness, and corrosion resistance. It is not suited for applications where stiffness, high-temperature resistance, and structural strength are required. It is often used for orthotics and prosthetics. LDPE has good chemical and impact resistance and is easy to fabricate and form.

Use for manufacturing various containers, dispensing and squeezing bottles, tubing, plastic parts of computer components, molded laboratory equipment, and many caps and closures.

Physical properties	
Chemical formula	$(CH_2\text{-}CH_2)_n$
Density	0.917 - 0.930 g/cm3
Melting point	102-113 °c
Water Vapor Transmission	0.260-24.0 (g/m2/day)
Hardness, Shore D	42.0-56.0
Max Cont. Use Temp	65 °C
Tensile Strength	0.20 - 0.40 N/mm²
Thermal Coefficient of expansion	100 - 220 x 10-6

Resistance to chemicals	
Dilute Acid	very good
Dilute Alkalis	very good
Oils and Greases	moderate variable
Aliphatic Hydrocarbons	poor
Aromatic Hydrocarbons	poor
Halogenated Hydrocarbons	poor
Alcohols	very good

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High-Density Polyethylene (HDPE)

HDPE is a hydrocarbon polymer prepared from ethylene/petroleum by a catalytic process. It is a kind of thermoplastic which is famous for its tensile strength. Its unique properties can stand high temperatures.

HDPE plastic is resistant to strong acids and bases, reducing agents, and gentle oxidants, which makes it ideal for helping to create cleaner public spaces and more durable infrastructures.

High-density polyethylene or polyethylene high-density is a thermoplastic polymer produced from the monomer ethylene. It is sometimes called "alkathene" or "polythene.

The Advantages of HDPE Include

- Affordable
- High-Quality
- Operate and Harsh Temperatures
- Non-Leaching
- UV Resistant
- Resistant to most Chemicals
- Stiff Material
- Amazing Durability
- Highly Versatile

The Disadvantages of HDPE Include

- Poor Weathering
- Highly Flammable
- Sensitive to Stress Cracking
- Not Biodegradable
- Can't Be Composted
- Not Resistant to Oxidizing Acids
- Not Resistant to Chlorinated Hydrocarbons
- High Thermal Expansion
- Poor Temperature Capability

The Top Uses for HDPE Include

- Shampoo Bottles
- Toys
- Chemical Containers
- Pipe Systems
- Milk Jugs
- Recycling Bins
- Grocery Bags
- Cereal Box Liners
- Flower Pots

Physical properties	
chemical formula	(C2H2)n
Density	940 kg/m3
Melting point	130.8 °C.
Temperature of crystallization	111.9 °C.
Latent heat of fusion	178.6 kJ/kg.
Thermal conductivity	0.44 W/m.°C. at °C.
Specific heat capacity	1330 to 2400 J/kg-K
Specific heat (solid)	1.9 kJ/kg. °C.
Crystallinity	60%

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Nylon

Nylon is a generic designation for a family of synthetic polymers composed of polyamides. Nylon is a silk-like thermoplastic, generally made from petroleum, that can be melt-processed into fibers, films, or shapes. Nylon polymers can be mixed with a wide variety of additives to achieve many property variations.

Types of Nylon

Nylon 6 – It was developed by Paul Schlack. It is formed by ring-opening polymerization.

Nylon 510 – It is obtained from sebacic and pentamethylene diamine acid.

Nylon 1,6 – It is produced from dinitriles with the help of acid catalysis.

Nylon 66 – Wallace Carothers patented nylon 66 with the use of amide.

Uses of Nylon

- **Clothing – Shirts, Foundation garments, lingerie, raincoats, underwear, swimwear and cycle wear.**
- **Industrial uses – Conveyer and seat belts, parachutes, airbags, nets and ropes, tarpaulins, thread, and tents.**
- **It is used to make a fishnet.**
- **It is used as plastic in manufacturing machine parts**

Use for a variety of applications, including clothing, reinforcement in rubber material like car tires, for use as a rope or thread, and for many injections molded parts for vehicles and mechanical equipment.

Physical properties	
Density	1.15 g/cm3
Electrical conductivity (σ)	10−12 S/m
Thermal conductivity	0.25 W/(m·K)
Melting point	190–350 °C

Delrin Polyoxymethylene

Delrin, also known as Polyoxymethylene (POM), is a high-performance acetal resin with several desirable physical and mechanical properties. This highly crystalline engineered thermoplastic is widely regarded for its durability, stiffness, and exceptional dimensional stability.

Use - to make bearings, bushings, gears, fittings, sliding and guiding parts, rollers, conveyor systems, scraper blades, and various electrical insulator parts.

- High strength, rigidity, and toughness
- Good impact strength, even at low temperatures
- Low moisture absorption (at saturation 0.8%)
- Outstanding wear resistance and sliding properties
- Excellent machinability
- Good creep resistance
- High dimensional stability
- Good resistance to hydrolysis (up to ~60 °C)
- Excellent resilience/recovery elasticity.

Physical properties	
Chemical formula	(CH2O)n
Molar mass	Variable
Appearance	Colorless solid
Density	1.41–1.42 g/cm3[1]
Melting point	165 °C (329 °F)[2]
Electrical resistivity	14×1015 Ω·cm[2]
Magnetic susceptibility (χ)	−9.36×10−6 (SI, at 22 °C) [3]
Hardness	86 shore

Polytetrafluoroethylene (PTFE)

Polytetrafluoroethylene (PTFE) is a fluoropolymer and is commonly known by its trade name, Teflon®. Unique properties of PTFE include nonreactivity, hydrophobicity, a low coefficient of friction, and good insulating properties. It is most commonly used as a nonstick coating for cookware.

Properties

- Very high working temperatures
- Non-stick characteristic
- Low friction surface
- Very high resistance to chemicals and solvents
- Very high electrical resistance
- Resistance to weather, UV light and corrosion
- Inert, non-toxic and bio-compatible.

Advantages

- Best price: performance ratio
- Continuous working temperature of +260°C - This is the highest working temperature for any fluoroplastic
- Resistance to nearly all chemicals
- Low friction surface - Even a gecko would slip on PTFE
- Very high electrical resistance
- Translucent color (when the correct raw polymer grade is chosen).

PTFE can be used to make different products, from gaskets to vessel linings and chemical tanks. PTFE is also widely used in high-temperature applications, from fire-critical applications to terminal insulation on heating elements and jet engines, UV lamps, and external aircraft fittings.

Physical properties	
Chemical formula	(C2F4)n
Density	2200 kg/m3
Melting point	327 °C
Electrical resistivity	1018 Ω·cm[a]
Thermal conductivity	0.25 W/(m·K)