PHYSICAL PROPERTIES OF SELECTED POLYMERS

The physical properties of polymers are important parameters in determining their behavior and performance in a wide range of applications. This table lists some examples of general representative physical properties (including mechanical properties) of representative polymeric compounds. For glass transition temperatures of selected polymers, see pages 13-10 through 13-16 in this section. Some of the properties in this table are defined as follows:

The **heat deflection temperature** (HDT), or heat distortion temperature, is the temperature at which a polymer or plastic sample deforms under a specified load (normally either 0.455 MPa or 1.82 MPa).

The **crystalline melting point** is the temperature (or temperature range) at which a crystalline solid changes its state from solid to liquid. Although the phrase would suggest a specific temperature, most crystalline compounds actually melt over a range of a few degrees or less.

The **coefficient of linear thermal expansion** is the fractional change in length per °C change in temperature at constant pressure.

The **compressive strength** of a material is the maximum uniaxial compressive stress (compressive force per unit area) reached when the material fails completely on being subjected to a load that pushes it together.

The **tensile strength** is a measure of the ability of a material to withstand pulling stresses. It is defined as the stress (stretching force per unit area) required to break a specimen. Polymers are approximately 20 % stronger in compression than in tension.

The **flexural strength**, or cross-breaking strength, of a material is a measure of the bending strength or stiffness of a specimen expressed as the stress required to break a specimen by exerting a torque on it.

The **impact strength** is a measure of the energy needed to break a sample. The term toughness is sometimes used to describe the impact strength of a material. The notched izod impact test is a single point test that measures the resistance of a material to impact from a swinging pendulum. Izod impact is defined as the kinetic energy needed to initiate fracture and continue the fracture until the specimen is broken. Izod specimens are notched to prevent deformation of the specimen upon impact. This test can be used as a quick and easy quality control check to determine if a material meets specific impact properties or to compare materials for general toughness.

The **ultimate elongation** is a measure of how far a material will stretch before breaking, expressed as a percentage of its original length.

The properties of the following polymers are presented in this table:

PET	poly(ethylene terephthalate)
PBT	poly(butylene terephthalate)
PC	polycarbonate
Nylon 6,6	poly(iminoadipoyliminohexamethylene)
Nylon 6	poly[imino(1-oxohexamethylene)]
PPO	poly(phenylene ether)
POM	polyoxymethylene
LDPE	low-density polyethylene
HDPE	high-density polyethylene
UHMWPE	ultrahigh molecular weight polyethylene
iPP	isotactic polypropylene
ABS	copolymer of acrylonitrile, butadiene, and styrene (extrusion grade)
PTFE	polytetrafluoroethylene, Teflon
PCTFE	polymonochlorotrifluoroethylene
PVDF	poly(vinylidene fluoride)
PVF	poly(vinyl fluoride)
PVC (rigid)	poly(vinyl chloride)
PVC (plasterized)	poly(vinyl chloride)
PMMA	poly(methyl methacrylate)

The assistance of Charles E. Carraher, Jr. in providing these data is gratefully acknowledged.

Reference

Carraher, Jr., C. E., *Seymour/Carraher's Polymer Chemistry*, 7th Ed., CRC Press, Taylor & Francis Group, Boca Raton, FL, 2008.

	PET	PBT	PC	Nylon 6,6	Nylon 6	PPO
Heat deflection temperature at 1820 kPa (°C)	100	65	130	75	80	100
Maximum resistance to continuous heat (°C)	100	60	115	120	125	80
Crystalline melting point (°C)	—	—	225	265	225	215
Coefficient of linear expansion (10^{-5}/°C)	6.5	7.0	6.8	8.0	8.0	5.0
Compressive strength (kPa)	8.6×10^4	7.5×10^4	8.6×10^4	1×10^5	9.7×10^4	9.6×10^4
Flexural strength (kPa)	1.1×10^5	9.6×10^4	9.3×10^4	1×10^5	9.7×10^4	8.9×10^4
Impact strength (Izod: cm N/cm of notch)	26	53	530	80	160	270
Tensile strength (kPa)	6.2×10^4	5.5×10^4	7.2×10^4	8.3×10^4	6.2×10^4	5.5×10^4
Ultimate elongation (%)	100	100	110	30	—	50
Density (g cm^{-3})	1.35	1.35	1.2	1.2	1.15	1.1

	POM	LDPE	HDPE	UHMWPE	iPP	ABS
Heat deflection temperature at 1820 kPa (°C)	125	40	50	85	55	90
Maximum resistance to continuous heat (°C)	100	40	80	80	100	90
Crystalline melting point (°C)	180	—	—	—	—	—
Coefficient of linear expansion (10^{-5}/°C)	10.0	10	12	12	9	9.5
Compressive strength (kPa)	1.1×10^5	—	3×10^4	—	—	4.8×10^4
Flexural strength (kPa)	9.7×10^4	—	—	—	5×10^4	6.2×10^4
Impact strength (Izod: cm N/cm of notch)	80	No break	30	No break	27	320
Tensile strength (kPa)	6.9×10^4	5×10^3	2×10^4	6×10^4	3.5×10^4	3.4×10^4
Ultimate elongation (%)	30	—	—	—	100	60
Density (g cm^{-3})	1.4	0.91	0.96	0.93	0.90	1.0

	PTFE	PCTFE	PVDF	PVF	Rigid PVC	Plasticized PVC	PMMA
Heat deflection temperature at 1820 kPa (°C)	100	100	80	90	75	—	95
Maximum resistance to continuous heat (°C)	250	200	150	125	60	35	75
Crystalline melting point (°C)	—	—	—	—	170	—	—
Coefficient of linear expansion (10^{-5}/°C)	10	14	8.5	10	6	12	7.0
Compressive strength (kPa)	2.7×10^4	3.8×10^4	—	—	6.8×10^4	6×10^3	1×10^5
Flexural strength (kPa)	—	6×10^4	—	—	9×10^4	—	9.6×10^4
Impact strength (Izod: cm N/cm of notch)	160	130	—	—	27	—	21
Tensile strength (kPa)	2.4×10^4	3.4×10^4	5.5×10^4	—	4.4×10^4	1×10^4	6.5×10^4
Ultimate elongation (%)	200	100	200	—	50	200	4
Density (g cm^{-3})	2.16	2.1	1.76	1.4	1.4	1.3	1.2