

	Densità [g/cm ³]	Resistenza [MPa]	Rigidezza [MPa]	σ/ρ	E/ρ	Costo/peso [\$/kg]	Costo/volume [\$/m ³]
Acetale	1.42	69	3600	49	2535	3.89	5520
Nylon 6/6	1.14	83	2900	73	2544	5.21	5940
Policarbonato	1.20	62	2340	52	1950	4.55	5460
LDPE	0.92	14	140	15	152	0.85	780
Polipropilene	0.90	35	1400	39	1556	0.87	780
HIPS	1.06	28	1400	26	1321	1.30	1380
Poliestere vetro	2.00	158	15700	79	7850	3.45	6900
Epoxy vetro	1.90	300	25000	158	13158	9.47	18000
Poliimmide vetro	2.00	345	27000	173	13500	17.34	34680
Fenolica vetro	1.80	100	21000	56	11667	1.90	3420
Al 2024-T4	2.70	280	70000	104	25926	1.60	4320
Ghisa	7.00	138	83000	20	11857	0.65	4560
Acciaio dolce	7.70	400	200000	52	25974	0.76	5820
Acciaio speciale	7.70	1950	207000	253	26883	1.73	13320
Abete	0.52	50	10500	96	20192	1.15	600

Confronto Nylon – leghe leggere

Table 1.3

Comparison between die casting alloys and nylons

Points for comparison	Die casting alloys	Nylon
Cost of raw material/tonne	Low	High
Cost of mould	High	Can be lower – no higher
Speed of component production	Slower than injection moulding of nylon	Lower component production costs
Accuracy of component	Good	Good
Post moulding operations	Finishing – painting. Paint chips off easily	Finishing – not required – painting not required. Compounded colour retention permanent.
Surface hardness	Low – scratches easily	Much higher. Scratch resistant.
Rigidity	Good to brittleness	Glass reinforced grades as good or better
Elongation	Low	GR grades comparable unfilled grades excellent
Toughness (flexibility)	Low	GR grades comparable unfilled grades excellent
Impact	Low	All grades good
Notch sensitivity	Low	Low
Young's modulus (E)	Consistent	Varies with load
General mechanical properties	Similar to GR grades of 66 nylon	Higher compressive strength
Heat conductivity	High	Low
Electrical insulation	Low	High
Weight	High	Low
Component assembly	Snap fits difficult	Very good

Calcolo indici scelta materiali

$$I_1 = \frac{E}{\rho} \quad I_3 = \frac{E^{\frac{1}{2}}}{\rho} \quad I_5 = \frac{E^{\frac{1}{3}}}{\rho}$$

$$I_2 = \frac{\sigma_f}{\rho} \quad I_4 = \frac{\sigma_f^{\frac{2}{3}}}{\rho} \quad I_6 = \frac{\sigma_f^{\frac{1}{2}}}{\rho}$$

	Densità [g/cm ³]	Modulo [MPa]	Resistenza [MPa]	$I_1 \times 1000$	I_2	I_3	I_4	I_5	I_6
Acciaio	7.8	210000	600	26.9	76.9	58.8	9.1	7.6	3.1
Al 2024	2.8	70000	100	25.0	35.7	94.5	7.7	14.7	3.6
PP H	0.9	1300	35	1.4	38.9	40.1	11.9	12.1	6.6
PP H30	1.1	6000	70	5.5	63.6	70.4	15.4	16.5	7.6

PERIODIC TABLE OF THE ELEMENTS

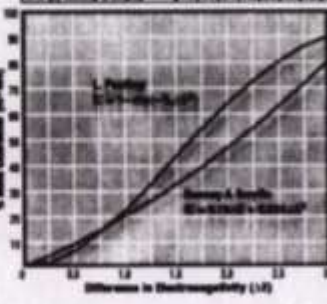
▼ Elementary Subatomic Particles

Electron	Proton	Neutron	Photon	Neutrino
Symbol	e	p	n	ν
Rest mass (kg)	$9.1093897 \times 10^{-31}$	$1.6726216 \times 10^{-27}$	$1.6749273 \times 10^{-27}$	0
Relative atomic mass (dalton)	$5.48579909 \times 10^{-4}$	$1.007276467 \times 10^{-3}$	$1.008664915 \times 10^{-3}$	0
Particle-antiparticle mass ratio	1	1000.5058449	1000.5058449	0
Particle-photon mass ratio	$1.8361197(17) \times 10^{-6}$	1	1.8361197(17)	0
Particle-neutrino mass ratio	$1.8361197(17) \times 10^{-6}$	0.000001	1	0
Specific charge (C/kg)	$-1.759874619 \times 10^{11}$	$9.578583619 \times 10^{17}$	0	0
Ratio (e)	-1.6×10^{-19}	1.6×10^{-19}	1.6×10^{-19}	0
Spin quantum number	1/2	1/2	1/2	1/2
Compton wavelength (m)	$2.426310241 \times 10^{-12}$	$1.321410003 \times 10^{-15}$	$1.321410003 \times 10^{-15}$	—
Bohr magneton (J/T)	$9.27401007(43) \times 10^{-24}$	$1.4010803547 \times 10^{-18}$	$0.0002041886 \times 10^{-18}$	0
In Bohr magneton (J/T)	1.001193245(18)	$1.500000000 \times 10^{-4}$	$1.001193245 \times 10^{-4}$	0
In nuclear magneton (J/T)	1836.152673(43)	1.836152673(43)	1.836152673(43)	0

Elementary particles are the fundamental constituents of matter and energy. The electron (e⁻) is a subatomic particle which has the same mass as an antiparticle, the positron (e⁺). The other particles are not their own antiparticles. The rest mass of a particle can also be expressed as a percentage ratio to the rest mass of a proton. The spin quantum number (s) is a quantum number that describes the intrinsic angular momentum of a particle. The spin quantum number (s) is a quantum number that describes the intrinsic angular momentum of a particle. The spin quantum number (s) is a quantum number that describes the intrinsic angular momentum of a particle.

▼ % Ionic Character of a Single Chemical Bond

Electronegativity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Pauling	0.7	1.0	1.3	1.6	1.9	2.2	2.5	2.8	3.0	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0
Allred	0.8	1.1	1.4	1.7	2.0	2.3	2.6	2.9	3.1	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.0
Mulliken	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.2	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.0	4.0



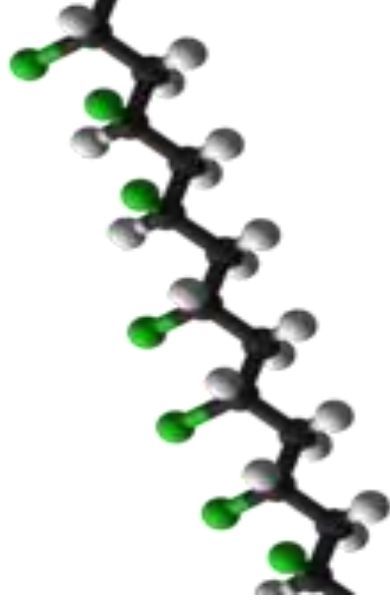
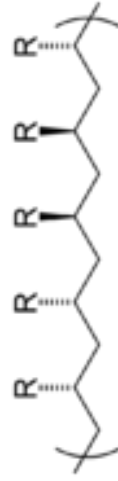
Percent ionic character describes the value of a bond. Bonds having 50% or greater ionic character are generally termed ionic; bonds with less than 50% ionic character are termed covalent. Pauling's equation may be modified by inserting a bond length in order to adjust better agreement between experimental and calculated values. Transition from ionic to covalent bonding is usually accompanied by a reduction in molecular conductivity, melting point and boiling point.

1 IA 1 H 1.00794 1.008 1.009 1.010 1.011 1.012 Hydrogen	2 IIA 3 Li 6.941 6.942 6.943 6.944 6.945 Lithium	4 Be 9.012182 9.012 9.013 9.014 9.015 Beryllium	5 VA 6 B 10.811 10.811 10.812 10.813 10.814 Boron	6 VIA 7 C 12.011 12.011 12.012 12.013 12.014 Carbon	7 VIIA 8 N 14.007 14.007 14.008 14.009 14.010 Nitrogen	8 VIIIA 9 O 15.999 15.999 16.000 16.001 16.002 Oxygen	9 VIIIA 10 F 18.998 18.998 19.000 19.001 19.002 Fluorine	10 VIIIA 11 Ne 20.180 20.180 20.181 20.182 20.183 Neon									
11 Na 22.990 22.990 22.991 22.992 22.993 Sodium	12 Mg 24.305 24.305 24.306 24.307 24.308 Magnesium	13 Al 26.982 26.982 26.983 26.984 26.985 Aluminum	14 Si 28.086 28.086 28.087 28.088 28.089 Silicon	15 P 30.974 30.974 30.975 30.976 30.977 Phosphorus	16 S 32.065 32.065 32.066 32.067 32.068 Sulfur	17 Cl 35.453 35.453 35.454 35.455 35.456 Chlorine	18 Ar 39.948 39.948 39.949 39.950 39.951 Argon										
19 K 39.098 39.098 39.099 39.100 39.101 Potassium	20 Ca 40.078 40.078 40.079 40.080 40.081 Calcium	21 Sc 44.956 44.956 44.957 44.958 44.959 Scandium	22 Ti 47.88 47.88 47.89 47.90 47.91 Titanium	23 V 50.942 50.942 50.943 50.944 50.945 Vanadium	24 Cr 52.00 52.00 52.01 52.02 52.03 Chromium	25 Mn 54.938 54.938 54.939 54.940 54.941 Manganese	26 Fe 55.847 55.847 55.848 55.849 55.850 Iron	27 Co 58.933 58.933 58.934 58.935 58.936 Cobalt	28 Ni 58.693 58.693 58.694 58.695 58.696 Nickel	29 Cu 63.546 63.546 63.547 63.548 63.549 Copper	30 Zn 65.38 65.38 65.39 65.40 65.41 Zinc	31 Ga 69.723 69.723 69.724 69.725 69.726 Gallium	32 Ge 72.64 72.64 72.65 72.66 72.67 Germanium	33 As 74.922 74.922 74.923 74.924 74.925 Arsenic	34 Se 78.96 78.96 78.97 78.98 78.99 Selenium	35 Br 79.904 79.904 79.905 79.906 79.907 Bromine	36 Kr 83.80 83.80 83.81 83.82 83.83 Krypton
37 Rb 85.468 85.468 85.469 85.470 85.471 Rubidium	38 Sr 87.62 87.62 87.63 87.64 87.65 Strontium	39 Y 88.906 88.906 88.907 88.908 88.909 Yttrium	40 Zr 91.224 91.224 91.225 91.226 91.227 Zirconium	41 Nb 92.906 92.906 92.907 92.908 92.909 Niobium	42 Mo 95.94 95.94 95.95 95.96 95.97 Molybdenum	43 Tc 98.906 98.906 98.907 98.908 98.909 Technetium	44 Ru 101.07 101.07 101.08 101.09 101.10 Ruthenium	45 Rh 101.07 101.07 101.08 101.09 101.10 Rhodium	46 Pd 106.42 106.42 106.43 106.44 106.45 Palladium	47 Ag 107.868 107.868 107.869 107.870 107.871 Silver	48 Cd 112.411 112.411 112.412 112.413 112.414 Cadmium	49 In 114.818 114.818 114.819 114.820 114.821 Indium	50 Sn 118.710 118.710 118.711 118.712 118.713 Tin	51 Sb 121.757 121.757 121.758 121.759 121.760 Antimony	52 Te 127.60 127.60 127.61 127.62 127.63 Tellurium	53 I 126.905 126.905 126.906 126.907 126.908 Iodine	54 Xe 131.29 131.29 131.30 131.31 131.32 Xenon
55 Cs 132.905 132.905 132.906 132.907 132.908 Cesium	56 Ba 137.327 137.327 137.328 137.329 137.330 Barium	57 La 138.905 138.905 138.906 138.907 138.908 Lanthanum	58 Ce 140.12 140.12 140.13 140.14 140.15 Cerium	59 Pr 140.908 140.908 140.909 140.910 140.911 Praseodymium	60 Nd 144.24 144.24 144.25 144.26 144.27 Neodymium	61 Pm 144.9127 144.9127 144.9128 144.9129 144.9130 Promethium	62 Sm 150.36 150.36 150.37 150.38 150.39 Samarium	63 Eu 151.964 151.964 151.965 151.966 151.967 Europium	64 Gd 157.25 157.25 157.26 157.27 157.28 Gadolinium	65 Tb 158.92534 158.92534 158.92535 158.92536 158.92537 Terbium	66 Dy 162.50 162.50 162.51 162.52 162.53 Dysprosium	67 Ho 164.93032 164.93032 164.93033 164.93034 164.93035 Holmium	68 Er 167.26 167.26 167.27 167.28 167.29 Erbium	69 Tm 168.93421 168.93421 168.93422 168.93423 168.93424 Thulium	70 Yb 173.054 173.054 173.055 173.056 173.057 Ytterbium	71 Lu 174.967 174.967 174.968 174.969 174.970 Lutetium	
87 Fr 223.0281 223.0281 223.0282 223.0283 223.0284 Francium	88 Ra 226.0254 226.0254 226.0255 226.0256 226.0257 Radium	89 Ac 227.02871 227.02871 227.02872 227.02873 227.02874 Actinium	Unq 261.101 261.101 261.102 261.103 261.104 Unquadium	Unp 288.101 288.101 288.102 288.103 288.104 Unpentium	Unh 315.101 315.101 315.102 315.103 315.104 Unhexium	Uns 342.101 342.101 342.102 342.103 342.104 Unseptium	Uno 369.101 369.101 369.102 369.103 369.104 Unoctium	Uue 396.101 396.101 396.102 396.103 396.104 Unnonium	Uun 423.101 423.101 423.102 423.103 423.104 Undecium								

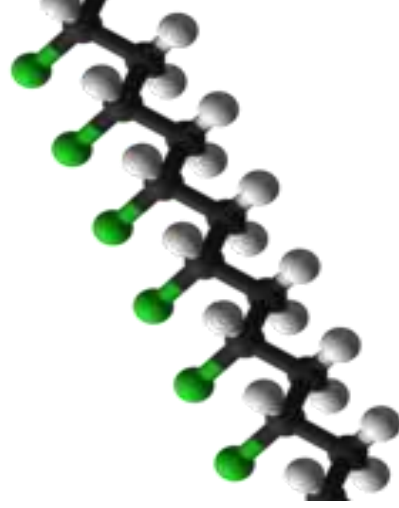
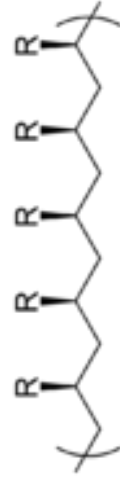
Atomic Weight 1 (relative mass of ¹² C = 12)	74.076
Melting Point, °C	1539
Boiling Point, °C	2471
Density, g/cm ³ (at 20°C, 1 atm)	7.47
Electronegativity ¹	1.55
First Ionization Potential ² , eV	7.43

58 Ce 140.12 140.12 140.13 140.14 140.15 Cerium	59 Pr 140.908 140.908 140.909 140.910 140.911 Praseodymium	60 Nd 144.24 144.24 144.25 144.26 144.27 Neodymium	61 Pm 144.9127 144.9127 144.9128 144.9129 144.9130 Promethium	62 Sm 150.36 150.36 150.37 150.38 150.39 Samarium	63 Eu 151.964 151.964 151.965 151.966 151.967 Europium	64 Gd 157.25 157.25 157.26 157.27 157.28 Gadolinium	65 Tb 158.92534 158.92534 158.92535 158.92536 158.92537 Terbium	66 Dy 162.50 162.50 162.51 162.52 162.53 Dysprosium	67 Ho 164.93032 164.93032 164.93033 164.93034 164.93035 Holmium	68 Er 167.26 167.26 167.27 167.28 167.29 Erbium	69 Tm 168.93421 168.93421 168.93422 168.93423 168.93424 Thulium	70 Yb 173.054 173.054 173.055 173.056 173.057 Ytterbium	71 Lu 174.967 174.967 174.968 174.969 174.970 Lutetium
90 Th 232.0377 232.0377 232.0378 232.0379 232.0380 Thorium	91 Pa 231.03626 231.03626 231.03627 231.03628 231.03629 Protactinium	92 U 238.02891 238.02891 238.02892 238.02893 238.02894 Uranium	93 Np 237.04817 237.04817 237.04818 237.04819 237.04820 Neptunium	94 Pu 244.06422 244.06422 244.06423 244.06424 244.06425 Plutonium	95 Am 243.06138 243.06138 243.06139 243.06140 243.06141 Americium	96 Cm 247.07125 247.07125 247.07126 247.07127 247.07128 Curium	97 Bk 247.07125 247.07125 247.07126 247.07127 247.07128 Berkelium	98 Cf 251.0825 251.0825 251.0826 251.0827 251.0828 Californium	99 Es 252.0830 252.0830 252.0831 252.0832 252.0833 Einsteinium	100 Fm 257.0834 257.0834 257.0835 257.0836 257.0837 Fermium	101 Md 258.1038 258.1038 258.1039 258.1040 258.1041 Mendelevium	102 No 259.1038 259.1038 259.1039 259.1040 259.1041 Nobelium	103 Lr 260.1038 260.1038 260.1039 260.1040 260.1041 Lawrencium

Polimero atattico



Polimero isotattico



Polimero sindiotattico

