

Properties of insulating and sheathing materials

Material Properties	PVC Polyvinyl-chloride (insulation)	PVC Polyvinyl-chloride (sheath)	LDPE Polyethylene (low density)	HDPE Polyethylene (High density)	XLPE Polyethylene (cross linked)	PP Polypropylene	PA Polyamide	PTFE Polytetrafluoroethylene	FEP Polytetrafluoroethylene-polypropylene	PVDF Polyvinylidene-fluoride	ETFE Ethylene-tetrafluoroethylene-copolymer	PCTFE Polychlorotrifluoroethylene
Abbreviation according to VDE	Y	Y	2Y	2Y	2Y	9Y	4Y	5Y	6Y	10Y	7Y	-
Monomeric unit	$\text{-CH}_2\text{-CH-}$ Cl	$\text{-CH}_2\text{-CH-}$ Cl	$\text{-CH}_2\text{-CH}_2\text{-}$	$\text{-CH}_2\text{-CH}_2\text{-}$	$\text{-CH-CH}_2\text{-}$ $\text{-CH-CH}_2\text{-}$	$\text{-CH}_2\text{-CH-}$ CH ₃	$\text{-NH-(CH}_2\text{)-NH-}$ $\text{-CO-(CH}_2\text{)-CO-}$	$\text{-CF}_2\text{-CF}_2\text{-}$	$\text{-(CF}_2\text{-CF}_2\text{)-}$ $\text{-(CF}_2\text{-CF)-}$ CF ₃	$\text{-CH}_2\text{-CF}_2\text{-}$	$\text{-CH}_2\text{-CH}_2\text{-}$ $\text{-CF}_2\text{-CF}_2\text{-}$	$\text{-CH}_2\text{-CF-}$ Cl
Elongation at break [% 200°C (68°F)]	150-350	150-350	200-600	400-800	180-450	400-700	100-300	250-400	250-350	200-300	100-300	300-350
Tensile strength [N/mm ² , 20° (68°F)]	10-25	10-25	8-14	20-30	10-20	30-38	45-180	20-40	19-21	40-45	45	10-20
Specific gravity [g/cm ³]	1.2-1.4	1.2-1.55	0.918-0.935	0.935-0.97	0.915-0.97	0.91	1.13-1.15	2.15-2.20	2.1-2.2	1.77	1.7	2.1
Operating temperature range [°C (°F)] <	-40/+105 (-40/+221)	-40/+105 (-40/+221)	-80/+80 (-112/+176)	-80/+90 (-112/+194)	-50/+90 (-112/+176)	-40/+90 (-40/+194)	-55/+90 (-67/+194)	-100/+260 (-148/+500)	-100/+205 (-148/+401)	-30/+150 (-22/+302)	-100/+150 (-148/+302)	-100/+250 (-148/+482)
Loss factor [50Hz, 20°C (68°F)]	0.04-0.16	-	2.10 ⁻⁴ - 7.10 ⁻⁴	2.10 ⁻⁴ - 7.40 ⁻⁴	3.10 ⁻³ - 4.10 ⁻²	2.10 ⁻⁴ - 7.10 ⁻⁴	0.02-0.03	2.10 ⁻⁴	2.10 ⁻⁴	0.04	4.10 ⁻³	0.02
Dielectric constant [50Hz, 20°C (68°F)]	4.4-8.0	-	2.3	2.35	2.2-2.6	2.3	3-6	2.1	2.1	8-9	2.6	2.7
Volume resistivity [ohm x cm, 20°C (68°F)]	10 ¹¹ - 10 ¹⁴	-	>10 ¹⁶	>10 ¹⁶	>10 ¹⁶	>10 ¹⁶	>10 ¹⁴	>10 ¹⁸	>10 ¹⁸	>10 ¹⁵	>10 ¹⁶	>10 ¹⁸
Oxygen index (LOI) [% ASTM 2863]	25-28	23-26	17	17	17-19	17	17	95	95	44	30	95
Abrasion resistance >	3	3	3	3	3	3	1	4	4	3	4	3
Flammability fl	se	se	if	if	if	if	if	nif	nif	nif	nif	nif
Radiation resistance [J/kg = 10 ² rad]	10 ⁸	10 ⁸	10 ⁷	10 ⁷	10 ⁷	10 ⁶	10 ⁷	10 ⁵	10 ⁵	10 ⁶	10 ⁶	10 ⁶
General properties	All properties depend on the plasticiser and filler content and are adjustable to meet a wide range. Good weather resistance		Good electrical properties low water-uptake	Properties comparable with LDPE, less flexible	Because of crosslinking suitable for higher thermal load than PE	Higher stress-cracking resistance than PE less flexible	Higher water-uptake, poor electrical properties in relation to polyolefins	Excellent chemical and thermal properties processing of the material is difficult	Good ozone and weather resistance	Good ozone and weather resistance	Good ozone and weather resistance	Good ozone and weather resistance
Chemical resistance	Good resistance to water and aqueous salt solutions, acids and alkalis; moderate resistance to organic solvents and oils, resistance to different chemical media can be ameliorated by special additives.		Excellent resistance against water, inorganic salts, acids and alkalis. Good resistance to organic solvents.				Resistance to organic solvents, low resistance against acids and alkalis.	Excellent chemical resistance.		Good resistance to most chemicals.		Good resistance, swelling possible in organic solvents.
Some trade names	-	-	DYLAN LUOPEN DOW-PE	HI-FAX SUPER/ DYLAN DOW-PE	-	ESCON OLEFIL POLY-PRO	NYPEL ZYPEL	TEFLON HALON	TEFLON	KYNAR DAFLOR	TEFZEL	KEL-F PLASKON

All particulars in this table are given as approximate values

1 = excellent
2 = good
3 = fair
4 = poor

if = inflammable
nif = not inflammable
se = self extinguishing

The stipulated maximum operating temperature may be exceeded for a short period.

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ECTFE Ethylene-chlorotrifluoroethylene-copolymer	PI Polyimide	PUR Polyurethane	PS Polystyrene	NR Natural rubber	SBR Styrene-butadiene rubber	IIR Butyl-rubber	CR Polychloroprene rubber	CSP Chlorosulphonated polyethylene	SiR Silicone rubber	EPR Ethylene-propylene-terpolymer	EVA Ethylene-vinylacetate-copolymer	Material Properties
-	8Y	11Y	3Y	G	G	3G	5G	6G	2G	3G	4G	Abbreviation according to VDE
$-(CH_2-CH_2)-$ $-(CH_2-CH)-$ Cl	-	-	$-CH_2-CH_2-$ Ph Ph=Phenyl	$-CH_2-CH=CH_2-$ CH ₃	$CH_2-CH_2-CH-CH_2-$ CH ₂ $-(CH-CH_2)-$ Ph	-	$-CH_2-C-CH-CH_2-$ Cl	$-(CH_2-CH_2)-$ $-(CH_2-CH)-$ S O ₂ Cl	R -O-Si R	-	-	Monomeric unit
200	71-115	10-650	< 4	250-700	250-700	250-700	250-700	200-400	300-800	300-400	250-750	Elongation at break [% 200°C (68°F)]
50	180	30-60	45-65	5-25	5-30	45-10	5.20	7-40	5-13	45-10	10-20	Tensile strength [N/mm², 20° (68°F)]
1.69	1.42	1.05-1.3	1.05	1.4-1.6	1.4-1.6	1.3-1.6	1.4-1.6	1.3-1.5	1.3	1.3	0.92-0.95	Specific gravity [g/cm³]
-100/+145 (-148/+293)	-100/+275 (-148/+527)	-60/+90 (-76/+194)	-20/+100 (-4/+212)	-30/+60 (-22/+140)	-30/+60 (-22/+140)	-60/+100 (-76/+212)	-40/+80 (-40/+176)	-30/+100 (-22/+212)	-60/+180 (-76/+356)	-40/+90 (-40/+194)	-40/+110 (-40/+230)	Operating temperature range [°C (°F)] <
10 ⁻³	3.10 ⁻³	0.015-0.048	10 ⁻⁴	0.03	0.015	3-10 ⁻⁴	0.035	0.056	10 ⁻⁴	5.10 ⁻³	3.10 ⁻³ - 2.10 ⁻²	Loss factor [50Hz, 20°C (68°F)]
2.3	3.8	4-8	2.5	3.5-5	3.9	2.3	10 - 20	5 - 7	2.9-3.5	3.2	2.5-3.2	Dielectric constant [50Hz, 20°C (68°F)]
> 10 ⁻⁵	10 ⁻⁷	10 ⁻⁷ - 10 ⁻⁴	10 ⁸	10 ⁻²	10 ⁻²	10 ⁻⁴	10 ⁻³	10 ⁻⁴	10 ⁻⁵	10 ⁻⁶	10 ⁻³ - 10 ⁻⁵	Volume resistivity [ohm x cm, 20°C (68°F)]
60	-	20-22	19-22	20-25	20-25	20-25	38	35	30	20-25	25	Oxygen index (LOI) [% ASTM 2863]
3-4	1	1	2	2	2	3	2	1	4	3	3	Abrasion resistance >
nif	se	if	if	if	if	if	se	se	se	if	if	Flammability fi
10 ⁶	10 ⁸	10 ⁹	10 ⁹	10 ⁷	10 ⁷	10 ⁷	10 ⁸	10 ⁸	10 ⁷	10 ⁷	10 ⁷	Radiation resistance [J/kg = 10² rad]
Good ozone and water resistance	Poor weather resistance	Excellent abrasion resistance good flexibility and oil resistance	Good electrical properties	Excellent tear resistance poor ozone and weather resistance good cold-flexibility	Good cold-flexibility poor ozone- and weather resistance	Good ageing properties and cold flexibility	Good ozone and weather resistance	Excellent ozone resistance poor tear resistance good oil resistance	Excellent ozone resistance excellent cold flexibility	Excellent ageing properties as well as ozone and weather resistance	Very good ozone and weather resistance poor cold-flexibility	General properties
Good resistance to most chemicals	Moderate resistance to most chemicals	Poor resistance to acids, alkalis and no resistance to organic solvents	Good resistance to water, acids, alkalis and salts no resistance to certain solvents	Good resistance to water, acids, alkalis and salts no resistance to certain solvents	Very good resistance to water and aqueous solutions of inorganic salts, acids and alkalis	Very good resistance to acids, alkalis and salts	Very good resistance to acids, alkalis and solvents	Very good resistance to acids, alkalis and solvents	Poor resistance to acids, alkalis and solvents	Good resistance to acids and alkalis, less to solvents and oils	Good resistance to acids and alkalis, reduced resistance to oils and solvents	Chemical resistance
HALAR	KAPTON	ROYLAR TEXIN	DYLENE STYRON	-	FLOSBRENE AMPERIPOL POLYSAR S	HYCAR- BUTYL ENJAY- BUTYL	NEOPRENE	HYPALON	KE RUBBER	NORDEL EPCAR	LEVAP- RENE	Some trade names

The materials listed in these tables partly concern the mixture of products. e.g. soft PVC or rubber. A number of characteristics depend on the specification of the compound. Because of this fact, only a partial range of values or maximum can be indicated for the materials concerned. With reference to admissible temperature ranges, particularly the upper operating temperatures, consideration should be given to the the methods of testing applied by other national standards organisations which may show differing results.