Attachment-3 List of properties

1.Plastics

Plastic type			Regulated materials								ECHA alternative candidates				
			Polytetrafluoroethylene	Fluorinated-ethylene-propylene	Perfluoroalkoxy alkane	Polychlorotrifluoroethylene	Ethylene tetrafluoroethylene	Ethylenechlorotrifluoro-ethylene	Polyvinylidene fluoride	Polyvinyl fluoride	Poly phenylene sulfide	Poly ether ether ketone	Polyamide 66	modified-Polyphenyleneether	Polybutylene terephthalate
			PTFE	FEP	PFA	PCTFE	ETFE	ECTFE	PVDF	PVF	PPS	PEEK	PA66	m-PPE	PBT
Formability	Formability	-	△	◎	◎	◎	◎	◎	◎	◎	△	×	-	-	-
	Compression molding temperature℃	-	–	319 - 399	329 - 371	238 - 254	–	–	204 - 288	–	-	-	-	240 - 270	–
	Injection molding temperature℃	-	–	329 - 404	371 - 427	227 - 316	–	–	232 - 288	–	-	-	280-300	220 - 350	220-270
	Mold shrinkage rate %	-	–	3 .0 - 6 .0	2-3	1 .0 - 1 .5	–	–	3	–	-	-	0.8-1.5	0.5 - 0.7	1.5-2.0
Physical properties	Specific gravity	D792	2 .13 - 2 .20	2 .12 - 2 .17	2 .15 - 2 .17	2 .10 - 2 .20	1 .73 - 1 .74	1 .68 - 1 .69	1 .75 - 1 .78	1 .33	1 .34	1	1.07-1.09	1.04 - 1.09	1.30-1.38
	Water absorption rate % (24 h -3 .18mm thickness)	D570	0 .01	0 .01	0 .01	0 .01	0 .03	0 .01	0 .03	–	0 .02	0	1.0-1.3	0.06 - 0.12	0.08-0.09
Mechanical properties	Tensile strength MPa	D638/651	20 - 35	20 - 35	20 - 30	31 - 41	38 - 42	41 - 48	30 - 70	82	81	105	48-67	66	57
	Elongation %	D638	200 - 400	300 - 350	200 - 400	80 - 250	300 - 400	200 - 300	200 - 370	140	8	22	55-200	60	50-300
	Tensile modulus of elasticity MPa	D638	–	–	–	–	–	–	–	–	-	-	-	2,500 - 2,600	1,900-3,000
	Compressive strength MPa	D638	10-15	15 - 20	14 - 19	31 - 51	40 - 50	35 - 40	32 - 74	–	-	-	-	113	59-100
	Flexural strength MPa	D638	–	–	–	–	–	–	–	–	132	174	59	66 - 96	82-115
	Impact strength(Izod/notch))J/m	D638	150 - 160	didn't break	didn't break	135 - 145	didn't break	didn't break	160 - 375	–	4	6	907-1014	267	37-53
	Hardness (Rockwell)	D785	R20	R50	R50	R80	R50	R50	R93 - 116	–	-	M99	R100 (dry), R107, 113	R118 - 120	M68-78
Thermal properties	Coefficient of thermal expansion 10^{-5}/℃	D696	10	12	9	6	6	8	16	–	2 .4/2 .9	4	-	3.3 - 7.7	6.0-9.5
	Continuous heat resistance temperature ℃	-	260	260	200	120	150	150	150	100	-	-	-	-	-
	Melting point ℃	D2117	327	310	260	220	270	245	151 - 178	203	278	343	260	-	224
	Deflection temperature under load (1 .81MPa) ℃	D648	55	47	50	90	74	77	100	–	＞ 260	156	66-68	107 - 149	50-85
Electrical properties	Volume resistance Ω ·㎝ (50% , RH23℃)	D257	＞ 10^{18}	＞ 10^{18}	＞ 10^{18}	＞ 10^{18}	＞ 10^{17}	＞ 10^{15}	＞ 10^{15}	＞ 10^{13}	1 × 10^{14}	5 × 10^{16}	10^{11}-10^{14}	＞ 10^{17}	10^{15}-10^{16}
	Dielectric breakdown strength Short-time	D149	19	20	22	22	16	20	11	–	30	-	-	20 - 28	17-22
	Permittivity 10^3Hz(10^6Hz)	D150	2 .1	2 .1	2 .1	2 .6	2 .6	2 .6	8 .4	8 .4	3 .5	3	-	2.6	(3.1-3.3)
	Arc resistance sec	D495	＞ 300	＞ 300	＞ 300	＞ 300	75	18	60	–	-	-	130-140	75	75-192
Other	Burning rate mm/min	D635	V-0	V-0	V-0	V-0	V-0	V-0	V-0	–	V-0	V-0	Self-extinguishing	Self-extinguishing	–
chemical property	Effects of weak acids	D543	◎	◎	◎	◎	◎	◎	○	△	○	◎	△	◎	△
	Effect of strong acid	D543	◎	◎	◎	◎	◎	◎	○	△	△	△	×	○	×
	Effects of weak alkali	D543	◎	◎	◎	◎	◎	◎	○	○	○	◎	△	◎	△
	Effect of strong alkali	D543	◎	◎	◎	◎	◎	◎	○	○	△	◎	×	○	×
	Organic solvent resistance	D543	◎	◎	◎	○	◎	◎	△	△	○	○	Dissolved in phenol/formic acid	Swells or dissolves in aromatic and chlorinated hydrocarbons	Swells in polar solvents

Plastic type			ECHA alternative candidate				
			Polyvinyl chloride		High density polyethylene	Low density polyethylene	Polypropylene
			PVC Hard	PVC Soft	HDPE	LDPE	P P
Formability	Formability	-	△- ○	○	◎	◎	◎
	Compression molding temperature℃	-	141 - 204	141 - 177	149 - 232	135 - 177	171 - 232
	Injection molding temperature℃	-	149 - 204	160 - 195	149 - 316	149 - 371	199 - 304
	Mold shrinkage rate %	-	0 .1 - 0 .5	1-5	2-5	1 .5 - 5 .0	1 - 2 .5
Physical properties	Specific gravity	D792	1 .35 - 1 .45	1 .16 - 1 .35	0 .94 - 0 .97	0 .91 - 0 .93	0 .90 - 0 .91
	Water absorption rate % (24 h -3 .18mm 厚)	D570	0 .07 - 0 .40	0 .15 - 0 .75	< 0 .01	< 0 .015	< 0 .01
Mechanical properties	Tensile strength K g /㎝^{2}	D 638/651	350 - 630	105 - 630	220 - 390	70 - 160	300 - 390
	Elongation %	D 638	2 - 40	200 - 450	15 - 100	90 - 800	200 - 700
	Tensile modulus of elasticity 10^4kg/㎝	D 638	2 .5 - 4 .2	-	0 .42 - 1 .1	0 .11 - 0 .25	1 .1 - 1 .4
	Compressive strength K g /㎝^{2}	D 695	560 - 910	63 - 120	230	-	420 - 560
	Flexural strength K g /㎝^{2}	D 790	700 - 1130	-	70	-	420 - 560
	Impact strength(Izod/notch))J/m	D 256	2 .2 - 109	-	8 .2 - 10 .9	didn't break	3 .3 - 33
	Hardness (Rockwell)	D 785	70 - 90 (Shore D)	50 - 100 (Shore A)	60 - 70 (Shore D)	41 - 46 (Shore D)	R 85 - 110
Thermal properties	Coefficient of thermal expansion 10^{-5}/℃	D 696	5 - 18 .5	7-25	11-13	16 - 18	6 - 8 .5
	Continuous heat resistance temperature ℃	-	66 - 79	66 - 79	121	82 - 100	107 - 150
	Heat deformation temperature ℃ (18 .5Kg/㎝2)	D 648	54 - 74	-	43 - 54	32 - 40	52 - 60
Electrical properties	Volume resistance Ω ·㎝ (50% , RH23℃)	D 257	＞ 10^{16}	10^{11} - 10^{15}	＞ 10^{16}	＞ 10^{16}	＞ 10^{16}
	Dielectric breakdown strength Short-time	D 149	16 .7 - 51 .1	11 .8 - 39 .3	17 .7 - 19 .7	18 .1 - 27 . 5	19 .7 - 26
	Permittivity 10^3～	D 150	3 - 3 .3	4-8	2 .3 - 2 .35	2 .25 - 2 .35	2 .2 - 2 .3
	Arc resistance sec	D 495	60 - 80	-	-	135 - 160	185
Other	Burning rate (flame resistance)	D 635	Self-extinguishing	Slow self-extinguishing	Very slow	Very slow	Slow
chemical property	Effects of weak acids	D 543	◎	◎	◎	○	◎
	Effect of strong acid	D 543	△-◎	△-◎	△	△	△
	Effects of weak alkali	D 543	◎	◎	◎	○	◎
	Effect of strong alkali	D 543	◎	◎	◎	○	◎
	Organic solvent resistance	D 543	Swelling or soluble in ketones, esters, swelling in aromatics.	Swelling or soluble in ketones, esters, swelling in aromatics.	Withstand (80°C or less)	Withstand (80°C or less)	Withstand (80°C or less)

2.Elastomers

Elastomer type			Regulated materials	ECHA alternative candidate			
			Fluoro rubber(Viton) FKM、FPM	Nitrile rubber NBR	Ethylene/Propylene Rubber EPM、EP EPDM	Acrylic rubber ACM、ANM	Silicone rubber Si、Q VMQ、SR
Mechanical properties	Specific gravity of pure rubber	D 297	1.80-1.82	1.00-1.20	0.86-0.87	1.09-1.10	0.95-0.98
	JIS hardness range possible	K 6301	50-90	15-100	30-90	40-90	30-90
	Tensile strength (k g / c m²)	K 6301	70-200	50-250	50-200	70-120	40-100
	Elongation %	K 6301	100-500	100-800	100-800	100-600	50-500
	Rebound resilience	K 6301	△	○	○	△	◎
	tear strength	—	○	○	△	△	△-×
	Compression set	K 6301	○	◎	○	×	◎
	Wear resistance	D 394	◎	◎	○	○	△-×
	Flex-crack resistance	—	○	○	○	○	○-×
physical properties	Heat resistance (maximum specified temperature ℃)	—	300	130	150	180	280
	Cold resistance (brittleness temperature °C)	D 746	−10-−50	−10-−20	−40-−60	0-−30	−70-−120
	Aging resistance	K 6301	◎	○	◎	◎	◎
	Ozone resistance	—	◎	×	◎	◎	◎
	Light (weather) resistance	D 518	◎	○	◎	◎	◎
	Flame resistance	—	◎	△-×	×	△-×	○-×
	Gas permeability (cc･cm/cm²･sec･atm)	—	1	0.3-3.5	15	10	400
	Radiation resistance	—	○-△	○-×	○	○-×	◎-△
Electrical properties	Volume resistivity (Ω/ c m、2 5 ℃)	D 257	1015-1018	109-1010	1012-1015	108-1010	1011-1015
	Breakdown voltage (V/mil,Short time)	D 149	450-600	500	1000-1500	—	500-1100
	Permittivity 6 0 ∝	D 150	2.0-2.5	15-20	3.1-3.4	—	3.2-10.0
Oil and chemical resistance	Gasoline/light oil	K 6301	◎	◎	×	◎	△-×
	Benzene/Toluene	K 6301	◎	△-×	△	×	△-×
	Trichlene	—	○	×	×	×	○-×
	Alcohol	K 6301	◎	◎	◎	×	◎
	Ether	—	×-△	×-△	○	×	×-△
	Ketone (M E K)	—	×	×	◎	×	○
	Ethyl acetate	—	×	×-△	◎	×	△-◎
	Water	—	◎	◎	◎	△	○
	Organic acid	—	×	×-△	×	×	○
	High concentration inorganic acid	—	◎	○	○	△	△
	low concentration inorganic acid	—	◎	○	◎	○	○
	High concentration alkali	—	×	○	◎	△	◎
	Low concentration alkali	—	△	○	◎	○	◎