

Physical Properties of Quadrant TIVAR® Materials

PHYSICAL PROPERTIES OF THE QUADRANT [U]HMW-PE STOCK SHAPES [INDICATIVE VALUES]

	TEST METHODS	UNITS	TIVAR® 1000	TIVAR® 1000 antistatic	TIVAR® ECO (19)
Colour	-		natural [white] green/black/colours	black	green
Average molar mass (average molecular weight) (1)	-	10 ⁶ g/mol	5	5	≥ 4.5
Density	ISO 1183-1	g/cm ³	0.93	0.935	0.94
Water absorption at saturation in water of 23°C (2)	-	%	0.01	0.02	0.02
Thermal Properties (3)					
Melting temperature (DSC, 10°C/min)	ISO 11357-1/-3	°C	135	135	135
Thermal conductivity at 23°C	-	W/(K.m)	0.40	0.40	0.40
Average coeff. of linear therm. exp. between 23 and 100°C	-	m/(m.K)	200 x 10 ⁻⁶	200 x 10 ⁻⁶	200 x 10 ⁻⁶
Temperature of deflection under load :					
- method A: 1.8 MPa	ISO 75-1/-2	°C	42	42	42
Vicat softening temperature - VST/B50	ISO 306	°C	80	80	80
Max. allowable service temperature in air:					
- for short periods (4)	-	°C	120	120	120
- continuously : for 20,000 h (5)	-	°C	80	80	80
Min. service temperature (6)	-	°C	-200 (7)	-150	-150
Flammability (8):					
- "Oxygen Index"	ISO 4589-1/-2	%	< 20	< 20	< 20
- according to UL 94 (6 mm thickness)	-	-	HB	HB	HB
Mechanical Properties at 23°C (9)					
Tension test (10):					
- tensile stress at yield (11)	ISO 527-1/-2	MPa	19	20	20
- tensile strain at yield (11)	ISO 527-1/-2	%	15	15	15
- nominal tensile strain at break (11)	ISO 527-1/-2	%	> 50	> 50	> 50
- tensile modulus of elasticity (12)	ISO 527-1/-2	MPa	750	790	775
Compression test (13):					
- compressive stress at 1 / 2 / 5% nominal strain (12)	ISO 604	MPa	6.5/10.5/17	7/11/17.5	7/11/17.5
Flexure test (14)					
- flexural strength	ISO 178	MPa	17	18	18
Charpy impact strength - unnotched (15)	ISO 179-1/1eU	kJ/m ²	no break	no break	no break
Charpy impact strength - notched	ISO 179-1/1eA	kJ/m ²	115P	110P	90P
Charpy impact strength - Notched (double 14° notch) (16)	ISO 11542-2	kJ/m ²	170	140	100
Ball indentation hardness (17)	ISO 2039-1	N/mm ²	33	34	34
Shore hardness D (15 s) (17)	ISO 868	-	60	61	60
Relative weight loss during a wear test in "sand/water-slurry"; TIVAR 1000 = 100	ISO 15527	-	100	105	200
Electrical Properties at 23 °C					
Electric strength (18)	IEC 60243-1	kV/mm	45	-	-
Volume resistivity	IEC 60093	Ohm.cm	> 10 ¹⁴	-	-
Surface resistivity	IEC 60093	Ohm	> 10 ¹²	< 10 ⁸	-
Relative permittivity ϵ_r :					
- at 100 Hz	IEC 60250	-	2.1	-	-
- at 1 MHz	IEC 60250	-	3.0	-	-
Dielectric dissipation factor tan δ :					
- at 100 Hz	IEC 60250	-	0.0004	-	-
- at 1 MHz	IEC 60250	-	0.0010	-	-
Comparative tracking index (CTI)	IEC 60112	-	600	-	-

Note: 1 g/cm³ = 1,000 kg/m³; 1 MPa = 1 N/mm²; 1 kV/mm = 1 MV/m.

Legend:

- (1) These are the average molar masses of the UHMW-PE resins [irrespective of any additives] used for the manufacture of the materials. They are calculated by means of the Margolies-equation $M = 5.37 \times 10^4 \times [\eta]^{1.69}$, with $[\eta]$ being the intrinsic viscosity [Stadinger index] derived from a viscosity measurement according to ISO 1628-3:2001, using decahydronaphtalene as a solvent [concentration of 0.0002 g/cm³].
- (2) Measured on 1 mm thick test specimens.
- (3) The figures given for these properties are for the most part derived from raw material supplier data and other publications.
- (4) Only for short time exposure [a few hours] in applications where no or only a very low load is applied to the material.
- (5) Temperature resistance over a period of 20,000 hours. After this period of time, there is a decrease in tensile strength - measured at 23° C - of about 50% as compared with the original value. The temperature values given here are thus based on the thermal-oxidative degradation which takes place and causes a reduction in properties. Note, however, that the maximum allowable service temperature depends in many cases essentially on the duration and the magnitude of the mechanical stresses to which the material is subjected.
- (6) Impact strength decreasing with decreasing temperature, the minimum allowable service temperature is practically mainly determined by the extent to which the material is subjected to impact. The values given here are based on unfavourable impact conditions and may consequently not be considered as being the absolute practical limits.
- (7) Because of its outstanding toughness, this material withstands even the temperature of liquid helium [-269° C] at which it still maintains a useful impact resistance without shattering.
- (8) These estimated ratings, derived from raw material supplier data and other publications, are not intended to reflect hazards presented by the materials under actual fire conditions. There are no 'UL File Numbers' available for the UHMW-PE stock shapes.
- (9) The figures given for these properties are average values of tests run on test specimens machined out of 30 mm thick plates.
- (10) Test specimens: Type 1 B