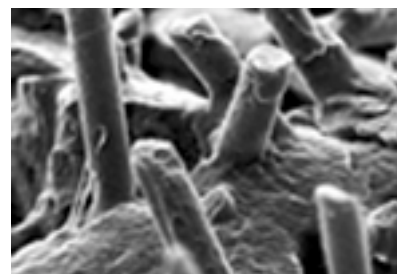


E, R and D glass properties

Technical data sheet



Glass composition (weight %)

Composition	E (glass)	R (glass)	D (glass)
Silica SiO ₂	53 to 57	58 to 60	72 - 75
Alumina AL ₂ O ₃	12 to 15	23.5 to 25.5	-
Calcium Oxide CaO + Magnesium Oxide MgO	22 to 26	14 to 17	-
Boron Oxide B ₂ O ₃	5 to 8	-	up to 23
F ₂	0 to 0.6	-	-
Na ₂ O + K ₂ O	< 1	-	< 4
Fe ₂ O ₃	= 0.5	-	-
Miscellaneous	-	<2	< 1

Physical properties

Properties	Unit	E glass	R glass	D glass
Density	g/cm ₃	2.60	2.53	2.14
Hardness (<i>Vickers 50 g - 15 s</i>)	-	5.6	6.2	-
Sound velocity	m/s	5680	5940	-

Mechanical properties

Properties	Unit	E glass	R glass	D glass
Virgin filament tensile test	MPa	3400	4400	2500
	ksi	493	638	363
Impregnated strand tensile test (<i>calculated on fiber cross section</i>)	MPa	2400	3400	1700
	ksi	348	493	246
Tensile modulus	GPa	73	86	55
	msi	10.5	12.5	8
Tenacity (<i>sized yarns</i>)	cN/Text	Min. 50		
Elongation at break for sized yarns according to binder system	%	2.2 - 2.5		
Elastic recovery	%	100	100	100

Resistance to water according DGC method – DIN 1211

Fiber type	E glass	R glass	D glass
DGG result	7 mg	5 mg	40 mg

Electrical properties

Properties	Unit	E glass	R glass	D glass
Dielectric constant at 1MHz	-	6.4	6	3.8
Dielectric constant at 1 GHz		6.13		4
Loss angle at 1 MHz	-	0.0018 to 0.0039	0.0019	0.0005
Loss angle at 1 GHz		0.0039		0.0026
Volume resistivity	Ohm.cm	10^{14} to 10^{15}		
Surface resistivity	Ohm.cm	10^{13} to 10^{14}		
Electrical rigidity	kV/mm	8-12		

Thermal properties

Properties	Unit	E glass	R glass	D glass
Softening point (Littleton)	°C	840	986	769
Strain point	°C	617	736	
Linear coefficient of thermal expansion	m/m/°C	$5.3 \cdot 10^{-6}$	$4.0 \cdot 10^{-6}$	$3.0 \cdot 10^{-6}$
Specific heat	J/g. °K	0.764 @ 20°C 0.958 @ 200°C	0.732 @ 20°C 0.983 @ 200°C	
Coefficient of thermal conductivity	W/m.°K	1.0	1.0	0.8

Thermal resistance of R and E glass virgin filament (after ageing during 24 hours)

Temperature °C	Residual strength (%)	
	E glass	R glass
- 200	100	100
200	98	100
300	82	91
400	65	77
500	46	61
600	14	45
700	-	27

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