SCHOTT

Specification Physical and chemical properties	**PCP** **RD 50®**

RD 50®

Radiation shielding glass RD 50® protects against X-rays and gamma rays in the medical and technical field. In research works it also provides necessary safety screening.

RD 50® is an extra dense flint glass. Its protective effect is based on its high content of heavy metallic oxides of nearly 70 per cent by weight. The lead oxide content alone is more than 65 per cent by weight. Therefore, a density of above 5.05 g/cm³ is reached, so that relatively small thicknesses fulfil all legal safety regulations. Radiation shielding glass RD 50® meets the requirements of DIN EN 61331-2. The protective capacity of a radiation shielding glass for X-rays is indicated by the attenuation equivalent, either in relation of lead thickness to glass thickness in per cent or in mm Pb.

The subsequent properties are based primarily upon the measuring results of the very latest standards and measuring methods, which are defined in corresponding "Measuring and Test Procedures".
We retain the right to change the data in keeping with the latest technical standards.
Non-toleranced numerical values are reference values of an average production quality.

Values marked with ◊ do not apply to the type of glass or no values are available.

Requirements deviating from these specifications must be defined in writing in a **customer agreement**.

Specification

Physical and chemical properties

PCP
RD 50®

1.	**Optical properties**		
1.1	**Refractive index**	n_D	1.79
1.2	**Transmittance data**		
1.2.1	**Spectral transmittance τ (λ)**		
1.2.1.1	**τ (λ) - curve**		
	Plot of spectral transmittance τ (λ) for d = 5.0 mm, d = 10.0 mm, d = 20.0 mm (λ = 340 nm to 800 nm)		see annex
1.2.1.2	**τ (λ) - individual values in % (d = 10 mm)**		
	τ at λ = 550 nm	τ_{550}	85
1.2.1.3	**Edge wavelength (d = 5.0 mm)**		
	Edge wavelength $\lambda_{c\ (\tau = 0.46)}$ in nm		397
1.2.2	**Luminous transmittance τ_v as a function of thickness**		

Thickness in mm	τ_{vD65} in %	τ_{vA} in %
5.0	85	85
10.0	84	84.5
20.0	82.5	83

2.	**Thermal properties**		
2.1	**Viscosities and corresponding temperatures**		

Designation	Viscosity lg η in dPas	Temperature ϑ in °C
Strain point	14.5	444
Annealing point	13.0	467
Softening point	7.6	603
Forming temperature	6.0	673
Forming temperature	5.0	729
Forming temperature	4.0	800

2.2	**Transformation temperature *Tg* in °C**	467
2.3	**Coefficient of thermal expansion α**	
2.3.1	**Coefficient of mean linear thermal expansion α(20 °C;300 °C) in 10^{-6} K^{-1}** (Static measurement)	7.4
2.4	**Fuseability**	disregarded
2.5	**Mean specific heat capacity c_p(20 °C to 100 °C) in J/(g · K)**	0.39
2.6	**Thermal conductivity λ in W/ (m·K) for 50 °C**	0.62

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3.	**Mechanical properties**	
3.1	**Density ρ in g/cm³** (Condition as supplied)	≥ 5.05
3.2	**Stress optical coefficient *C* in 1.02 · 10^{-12} m²/N**	0.78
3.3	**Breaking strength**	disregarded
3.4	**Young´s modulus *E* in kN/mm²**	56.6
3.5	**Poisson´s ratio μ**	0.245
3.6	**Torsion modulus *G* in kN/mm²**	22.7
3.7	**Knoop hardness *HK* 0.1/20**	360
4.	**Chemical properties**	
4.1	**Hydrolytic resistance acc. to DIN ISO 719**	
	Hydrolytic class	HGB 1
	Equivalent of alkali (Na_2O) per gram of glass grains in µg/g	24
4.2	**Acid resistance acc. to DIN 12 116**	
	Acid class	◊
	Half surface weight loss after 6 hours in mg/dm²	◊
4.3	**Alkali resistance acc. to DIN ISO 695**	
	Class	A 3
	Surface weight loss after 3 hours in mg/dm²	510
4.4	**Hazardous Substances**	
	EC-directive 2002/95/EC (RoHS-directive)	on request
5.	**Electrical properties**	disregarded

Specification

Physical and chemical properties

PCP
RD 50®

6. Other properties

6.1 Attenuation equivalent for lead in % of glass thickness for different types of radiation

6.1.1 X - radiation quality

Nominal thickness in cm	0.55**	0.7**	0.9**	1.05**	1.2	1.4**	1.9**	2.3**
Thickness min. to thickness max. in mm	4.0 to 5.5	5.0 to 7.0	7.0 to 9.0	8.5 to 10.5	10.0 to 12.0	11.5 to 14.0	16.0 to 19.0	20.0 to 23.0
Tube voltage in kV								
76	31.1	31.2	31.3	30.9	30.8	30.2	◊	◊
80	31.2	31.2	31.2	31.1	31.2	31.2	◊	◊
100	30.6	30.6	30.8	31.0	31.3	31.5	31.5	31.5
110*	30.0	30.0	30.2	30.3	30.5	30.6	30.6	30.6
150	30.0	30.1	30.3	30.5	30.8	30.9	30.9	30.9
200	29.2	29.2	29.2	29.1	29.1	29.1	29.3	29.1
250	28.7	28.7	28.7	28.8	28.9	29.0	29.5	29.5
300	29.2	29.3	29.4	29.6	29.6	29.8	30.2	30.6
350*	29.7	29.8	30.0	30.2	30.3	30.4	30.9	31.3
400	30.3	30.5	30.8	30.9	31.1	31.3	31.7	32.1
450*	30.7	30.9	31.2	31.4	31.6	31.8	32.3	32.7
500*	30.9	31.2	31.6	31.8	32.0	32.2	32.7	33.2
550*	31.4	31.7	32.1	32.3	32.6	32.8	33.3	33.7
600*	31.7	32.0	32.5	32.7	33.0	33.2	33.7	34.2
650*	31.9	32.2	32.8	33.1	33.3	33.6	34.1	34.6
750*	32.4	32.7	33.3	33.7	34.0	34.2	34.8	35.2
1000*	33.5	33.9	34.6	34.9	35.3	35.5	36.1	36.5

* tube voltage not enclosed in DIN EN 61331-1

** nominal thickness not enclosed in DIN EN 61331-2

Measuring and Test Procedures

TÜV NORD EnSys Hannover GmbH & Co. KG (23.06.2009)	on request

VX 0050/1e

Specification

Physical and chemical properties

PCP
RD 50®

6.1.2 **Radionuclide**

Thickness min. to thickness max. in mm	4.0 to 5.5	5.0 to 7.0	7.0 to 9.0	8.5 to 10.5	10.0 to 12.0	11.5 to 14.0	16.0 to 19.0	20.0 to 23.0
Nuclide								
^{11}C	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2
^{13}N	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2
^{15}O	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2
^{18}F	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2
^{22}Na	40.8	41.1	41.5	41.5	41.5	41.4	41.0	40.6
^{58}Co	40.9	40.7	40.5	40.4	40.3	40.3	40.1	39.9
^{59}Fe	44.7	44.7	44.6	44.5	44.4	44.3	44.2	44.2
^{60}Co	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5
^{68}Ga	37.6	37.5	37.4	37.4	37.3	37.3	37.2	37.1
^{82}Rb	38.1	38.0	37.9	37.8	37.7	37.7	37.5	37.5
^{99}Mo	38.5	44.1	45.9	45.5	44.8	44.2	42.9	42.2
$^{99}Tc^{m}$	29.4	29.2	29.1	29.0	29.0	28.9	28.7	28.6
^{123}I	30.2	31.2	32.6	34.7	37.7	38.8	39.2	39.8
^{125}I	--*	--*	--*	--*	--*	--*	--*	--*
^{131}I	34.1	34.1	33.9	33.8	33.7	33.5	33.0	32.6
^{137}Cs	40.1	39.8	39.4	39.3	39.2	39.1	38.9	38.8
^{192}Ir	30.3	32.1	33.8	34.4	34.7	34.9	34.7	34.3

* For the radionuclide ^{125}I we have not been able to calculate a lead equivalent within the preset calculating time, because the glass shields the radiation too good.

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VX 0050/1e

Specification

Physical and chemical properties

PCP
RD 50®

6.1.3 **Monoenergetic photon radiation**

Thickness min. to thickness max. in mm	4.0 to 5.5	5.0 to 7.0	7.0 to 9.0	8.5 to 10.5	10.0 to 12.0	11.5 to 14.0	16.0 to 19.0	20.0 to 23.0
Energy in MeV								
0.5	36.9	36.9	37.0	37.0	37.0	37.0	37.0	37.0
0.75	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9
1	43.0	43.0	43.0	43.0	43.0	43.0	43.1	43.1
1.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5
2.5	43.4	43.4	43.4	43.4	43.4	43.4	43.5	43.5
5	39.2	39.3	39.3	39.4	39.4	39.4	39.4	39.5
7.5	37.3	37.4	37.5	37.5	37.6	37.6	37.7	37.8
9	37.2	37.2	37.4	37.4	37.5	37.5	37.7	37.8

Measuring and Test Procedures

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7. **Annex** (diagrams, curves)

VX 0050/1e

Specification

Physical and chemical properties

PCP

RD 50®