Specification

Physical and chemical properties

PCP
D 0991

S 3

D 0991

Colour:	clear
Application:	Special glass for moulds, in particular suitable for a rapid chemical toughening without problems.

Fuseability

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**.

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1. Optical properties

1.1 Refractive indices (20 °C)

Pretreatment of samples
[x] Condition as supplied
[ ] annealed at 40 °C/h

n_g	1.5343
$n_{F'}$	1.5298
n_F	1.5293
n_e	1.5251
n_d	1.5229
n_D	1.5228
$n_{C'}$	1.5205
n_C	1.5201

1.1.1 Abbe value

ν_e	56.5
ν_d	56.7

1.2 Transmittance data

1.2.1 Fuseability

1.2.1.1 $\tau(\lambda)$ - curve

Plot of spectral transmittance $\tau(\lambda)$ for d = 2.0 mm (λ = 300 nm to 1500 nm): see annex

1.2.1.2 $\tau(\lambda)$ - individual values in % (d = 2.0 mm)

$\tau(\lambda)_{max}$ for the λ - range 280 nm to 315 nm	49
$\tau(\lambda)_{max}$ for the λ - range 315 nm to 350 nm	88
τ_{380}	90
$\tau(\lambda)_{min}$ for the λ - range 500 nm to 650 nm	◊

1.2.1.3 Edge wavelength (d = 2.0 mm)

Edge wavelength $\lambda_{c\ (\tau = 0.46)}$ in nm	314

1.2.2 Luminous transmittance τ_v

1.2.2.1 Luminous transmittance τ_{vD65} in % at nominal thickness

d = 2.0 mm *** nominal transmittance**: 91.7*

Luminous transmittance as a function of thickness

Thickness in mm	1.4	2.0	3.0	4.0	5.0	6.0
τ_{vD65} in %	91.7	91.7	91.7	91.7	91.6	91.5
τ_{vA} in %	91.7	91.7	91.7	91.7	91.6	91.5
τ_{vC} in %	91.7	91.7	91.7	91.7	91.6	91.5

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1.2.2.2	**Scale number / Filter category**		
	N for mean thickness *d* = mm (τ_{vD65} = %)		◊
	N for mean thickness *d* = mm (τ_{vD65} = %)		◊
	filter category for nominal transmittance τ_{vD65} = 91.7 %		0
1.2.3	**Special transmittance values in % (*d* = 2.0 mm)**		
1.2.3.1	**UV - transmittance**		
		τ_{UVA}	82.2
		τ_{SUV}	◊
		τ_{SUVA}	77.2
		τ_{SUVB}	31.6
1.2.3.2	**IR - transmittance**	τ_{SIR}	92
1.2.3.3	**Solar blue - light transmittance**	τ_{sb}	◊
1.3	**Colour**		
1.3.1	**Fuseability**		
	The visual evaluation of the admissible colour differences is to be made by using internal reference samples in transmission mode towards an from the backside illuminated opal screen with uniform luminance. Sample thickness *d* in mm for the visual colour comparison		90
1.3.2	**Colorimetry**		
	Chromaticity coordinates	x_{10}	0.314
			0.332
	Chromaticity coordinates (colour locus) are referred to the Standard Illuminant D_{65} according to CIE 10°-observer for the nominal transmittance τ_{vD65} = 91.7 % (refer to 1.2.2.1)		
1.3.3	**Signal light recognition**		
	Relative visual attenuation coefficient (quotient) *Q*	Q_{blue}	1.00
	for signal light recognition referred to the	Q_{green}	1.00
	nominal transmittance τ_{vD65} = 91.7 %	Q_{yellow}	1.00
	(refer to 1.2.2.1)	Q_{red}	1.00
1.3.4	**Yellowness index (*d* = 10 mm)**		
		Y_i	1.0

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2. Thermal properties

2.1 Viscosities and corresponding temperatures

Designation	Viscosity lg η in dPas	Temperature ϑ in °C
Strain point	14.5	523
Annealing point	13.0	556
Softening point	7.6	754
Forming temperature	6.0	862
Forming temperature	5.0	953
Forming temperature	4.0	1072

2.2	**Transformation temperature *Tg* in °C**	551
2.3	**Coefficient of mean linear thermal expansion α(20 °C;300 °C) in 10^{-6} K^{-1}** (Static measurement)	9.7
2.4	**Fuseability**	◊
2.5	**Mean specific heat capacity c_p(20 °C to 100 °C) in J/(g · K)**	◊

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3.	**Mechanical properties**	
3.1	**Density ρ in g/cm³**	2.61
3.2	**Stress optical coefficient C in 1.02 · 10^{-12} m²/N**	3.30
3.3	**Breaking strength**	
	A higher mechanical strength can be realized by chemical toughening according to the ion exchange procedure (refer to annex 3.3.1) or by thermal toughening.	
3.3.1	**Chemical toughening**	
	Processing temperature ϑ in °C	440
	Processing time t in h	4
	Compressive stress Ds as birefringence in nm/cm	10750
	Penetration depth Nz up to neutral zone in µm	61
	Fuseability	see annex
3.3.2	**Thermal toughening**	
	Recommended minimum thickness d in mm for toughened safety glass lenses without corrective effect as per ball drop test (DIN EN 168)	2.5
3.4	**Young´s modulus E in kN/mm²**	69
3.5	**Poisson´s ratio μ**	0.227
3.6	**Torsion modulus G in kN/mm²**	28
3.7	**Knoop hardness HK 0.1/20**	500

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4. Chemical properties

4.1 Hydrolytic resistance acc. to DIN ISO 719

Hydrolytic class	HGB 3
Equivalent of alkali (Na_2O) per gram of glass grains in µg/g	84

4.2 Acid resistance acc. to DIN 12 116

Acid class	S 4
Half surface weight loss after 6 hours in mg/dm²	22,5

4.3 Alkali resistance acc. to DIN ISO 695

Class	A 3
Surface weight loss after 3 hours in mg/dm²	315

4.4 Hazardous Substances

EC-directive 2002/95/EC (RoHS-directive)	on request

5. Electrical properties

disregard

6. Other properties

disregard

7. Annex (diagrams, curves)

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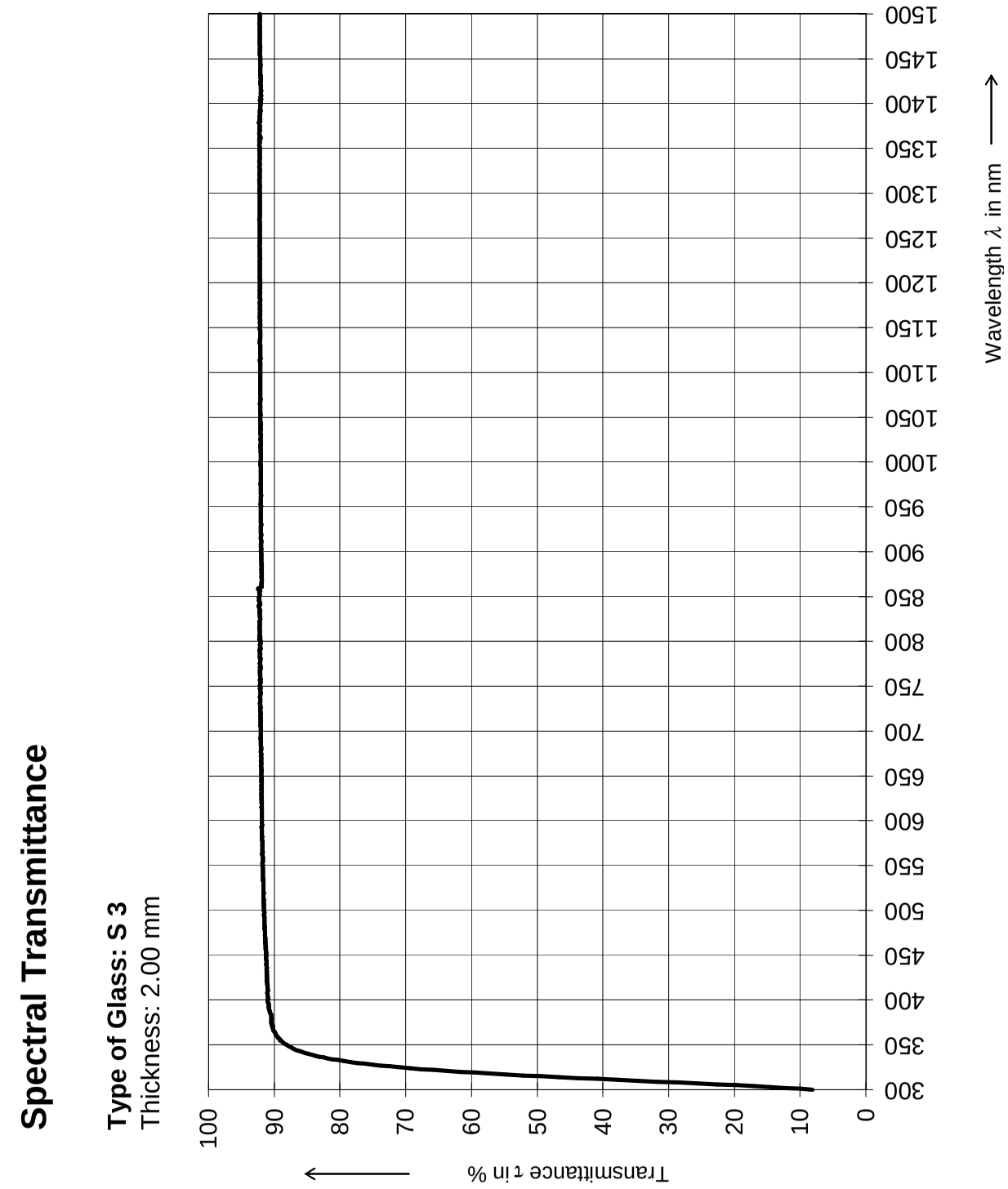

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Chemical toughening parameter

Glass and chemical toughening parameters		
Transformation temperature	°C	551
Glass thickness	mm	2
Processing time	h	4
Processing temperature	°C	440
Salt bath (* weight percentages)	KNO_3 in % *	99.5
	SiO_2 x H_2O in % *	0.5

Chemical toughening results *		
Penetration depth	µm	61
Birefringence	nm/cm	10750

* measured across at a sample piece ground down to 0.3 mm ± 0.05 mm

Ball drop test acc. FDA	% failed	passed
Ball drop test acc. DIN	% failed	passed