

Specification	PCP
Physical and chemical properties	D 6526 / D 6626

PHOTOSOLAR SUPERBROWN
PHOTOSOLAR B SUPERBROWN

D 6526
D 6626 (Bifocal)

Colour: brown

Application: Glass sensitive to light
for corrective lenses and
sun glare filter;
luminous transmittance range
89 % (τ_0) / 27 % (τ_1) or
filter categories 0 / 2 respectively
and UV - absorption

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 \diamond 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		PCP	
Physical and chemical properties		D 6526 / D 6626	
1. Optical properties			
1.1 Refractive indices (20 °C)			
Pretreatment of samples		n_g	1.5342
[x] Condition as supplied (D 6526)		$n_{F'}$	1.5298
[x] annealed at 40 °C/h for bifocal (D 6626) *± 0.0003		n_F	1.5293
		n_e	1.5251 ± 0.001*
		n_d	1.5229
		n_D	1.5228
		$n_{C'}$	1.5205
		n_C	1.5201
1.1.1 Abbe value			
		v_e	56.7 ± 0.6
		v_d	56.9
1.2 Transmittance data			
1.2.1 Spectral transmittance $\tau(\lambda)$			
1.2.1.1 $\tau(\lambda)$ - curve			
Plot of spectral transmittance $\tau(\lambda)$ for the light state $\tau_{0'}$ and dark state $\tau_{15'}$			see annex
1.2.1.2 $\tau(\lambda)$ - individual values in % (d = 2.0 mm)			
		$\tau_{0'}$	$\tau_{15'}$
	$\tau(\lambda)_{\max}$ for the λ - range 280 nm to 315 nm	< 0.001	< 0.001
	$\tau(\lambda)_{\max}$ for the λ - range 315 nm to 350 nm	3	1.4
	τ_{380}	24	6.5
	$\tau(\lambda)_{\min}$ for the λ - range 500 nm to 650 nm	80	21
1.2.1.3 Edge wavelength (d = 2.0 mm)			
Edge wavelength λ_c ($\tau = 0.46$) in nm for $\tau_{0'}$			395

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1.2.2	Luminous transmittance τ_v								
1.2.2.1	Luminous transmittance τ_{vD65} or τ_{vA} in % respectively under standard conditions ($d = 2.0$ mm)								
	Light state τ_{vD65}	$\tau_{0'} (\tau_0)$	89 ± 1						
	Dark state	$\tau_{15'} (\tau_1)$	27 ± 2						
		$\tau_{R5'}$	-						
	Regeneration τ_{vA}	$\tau_{R10'}$	75 ± 2						
		$\tau_{R30'}$	81 ± 2						
	Darkening-fading curve for 23 °C	see annex							
	Luminous transmittance τ_{vD65} in % in relationship to the thickness	$\tau_{0'} (\tau_0)$	$\tau_{15'} (\tau_1)$						
	Thickness in mm	2.0	27						
		3.0	22						
		4.0	19						
	Diagram for $\tau_{15'}$	see annex							
1.2.2.2	Scale number / Filter category ($d = 2.0$ mm)								
	Scale number	5 - 1.1 < 2.5							
		$\tau_{0'} (\tau_0)$	$\tau_{15'} (\tau_1)$						
	Filter category	0	2						
1.2.2.3	Luminous transmittance dark state $\tau_{15'}$ in % in relationship to the sample temperature ϑ in °C ($d = 2.0$ mm)								
	ϑ	-	-	τ_w	τ_1	τ_s	-		
		-10	-5	5	23	35	50		
	$\tau_{15'}$	◇	◇	17	27	43	64		
1.2.2.4	Luminous transmittance dark state $\tau_{15'}$ in % in relationship to the illuminance E in klx ($d = 2.0$ mm)								
	E	τ_1	-	-	τ_a	-	-		
		50	30	20	15	10	5		
	$\tau_{15'}$	27	33	38	43	50	60		
1.2.2.5	Luminous transmittance dark state $\tau_{15'}$ in % in relationship to the variation the excitation spectrum in dependance of the edge wavelength λ_c of a sharp cut filter in nm ($d = 2.0$ mm)								
	λ_c	328	353	369	389	410	433	448	468
	$\tau_{15'}$	26.5	29	31.5	37	48.5	70	76	83
	Diagram	see annex							

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1.2.3	Special transmittance values in % ($d = 2.0$ mm)		
1.2.3.1	UV - transmittance for τ_{15}		
		τ_{UVA}	2.0
		τ_{SUV}	0.9
		τ_{SUVA}	1.3
		τ_{SUVB}	< 0.05
1.2.3.2	IR - transmittance	τ_{SIR}	$\geq \tau_{vD65}$
1.2.3.3	Solar blue - light transmittance	τ_{sb}	18.7
1.3	Colour		
1.3.1	Visual evaluation		
	The visual evaluation is made on the basis of a simultaneous comparison with internal limit samples.		
1.3.2	Colorimetry		
	Chromaticity coordinates	A x_{10}	0.363 ₁
		y_{10}	0.352 ₈
	Chromaticity coordinates (colour locus) are referred to the Standard Illuminant D ₆₅ according to CIE 10°-observer	B x_{10}	0.368 ₀
	for τ_{15} (τ_1) - for the time being they are only reference values	y_{10}	0.351 ₃
	($d = 2.0$ mm) in view of the relative calibration possibility	C x_{10}	0.371 ₂
	In case of verification, the measured values may additionally deviate by the measuring uncertainty of the used measuring devices.	y_{10}	0.356 ₅
	part of chromaticity coordinates	D x_{10}	0.366 ₃
		y_{10}	0.358 ₁
			see annex
1.3.3	Signal light recognition		
	Relative visual attenuation coefficient (quotient) Q	Q_{blue}	0.93
	for signal light recognition for τ_{15} (τ_1) ($d = 2.0$ mm)	Q_{green}	0.90
		Q_{yellow}	1.16
		Q_{red}	1.37
1.3.4	Yellowness index ($d = 10$ mm)		
		Y_i	◇

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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	482
Annealing point	13.0	508
Softening point	7.6	673
Forming temperature	6.0	766
Forming temperature	5.0	848
Forming temperature	4.0	957
2.2 Transformation temperature T_g in °C		504
2.3 Coefficient of mean linear thermal expansion $\alpha(20\text{ °C};300\text{ °C})$ in 10^{-6} K^{-1} (Static measurement)		6.5
2.4 Fuseability		
Stress-free fusing with lower segments from Barberini GmbH, listed in the margin is possible with a maximum birefringence of 70 nm/cm measured 0.5 mm from the fusing area in the major blank.		V 512 V 513 V 514
2.5 Mean specific heat capacity $c_p(20\text{ °C to }100\text{ °C})$ in J/(g · K)		◇

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3.	Mechanical properties	
3.1	Density ρ in g/cm ³	2.41
3.2	Stress optical coefficient C in $1.02 \cdot 10^{-12}$ m ² /N	3.60
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). This toughening method may cause slight transmittance - and colourchanges.	
3.3.1	Chemical toughening	
	Processing temperature ϑ in °C	390
	Processing time t in h	16
	Compressive stress D_s as birefringence in nm/cm	4050
	Penetration depth N_z up to neutral zone in μm	62
	Further information	see annex
3.4	Young's modulus E in kN/mm ²	70
3.5	Poisson's ratio μ	0.223
3.6	Torsion modulus G in kN/mm ²	29
3.7	Knoop hardness HK 0.1/20	◇

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4.	Chemical properties		
4.1	Hydrolytic resistance acc. to DIN ISO 719		
	Hydrolytic class	HGB 3	
	Equivalent of alkali (Na ₂ O) per gram of glass grains in µg/g	105	
4.2	Acid resistance acc. to DIN 12 116		
	Acid class	S 4	
	Half surface weight loss after 6 hours in mg/dm ²	200	
4.3	Alkali resistance acc. to DIN ISO 695		
	Class	A 3	
	Surface weight loss after 3 hours in mg/dm ²	350	
4.4	Hazardous Substances		
	EC-directive 2002/95/EC (RoHS-directive)		on request
5.	Electrical properties		disregarded
6.	Other properties		
6.1	Anti-reflection processes		
	Luminous transmittance dark state τ_{15} for $d = 2.0$ mm in relationship of the additional heat treatment		
	temperature/time	τ_{15} in %	
	additional heat treatment	275 °C/30'	27
	Additional heat treatment		
	The sample is put on a kaolin plate (room temperature) and then placed in a box furnace, in which the treatment temperature is already existing. After the specified time, the sample and the kaolin plate are taken out and immediately put on a cold (room temperature) kaolin plate for rapid cooling.		
7.	Annex (diagrams, curves)		

Specification

Physical and chemical properties

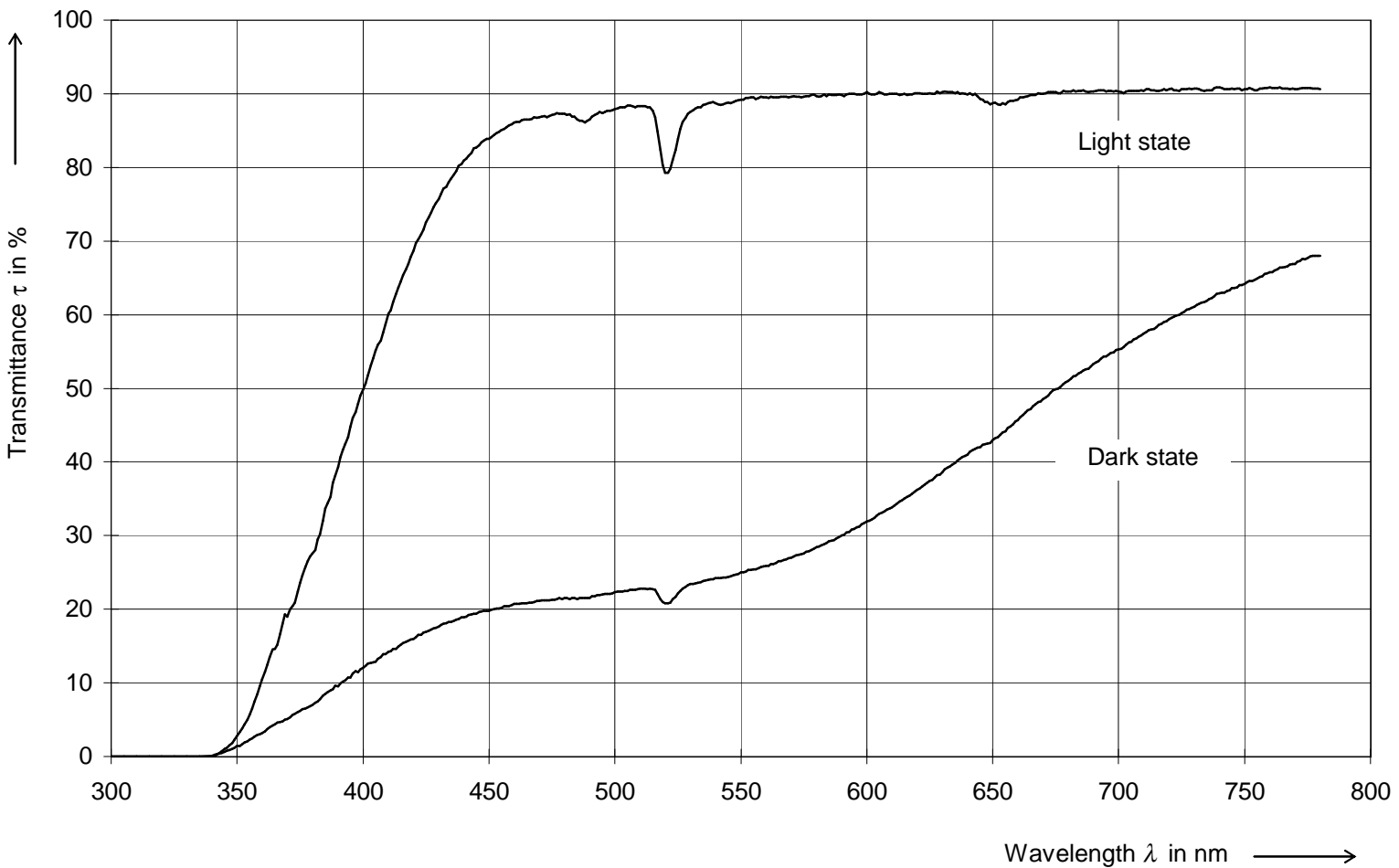
PCP

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Spectral Transmittance

Type of Glass: PHOTOSOLAR SUPERBROWN

Thickness: 2 mm

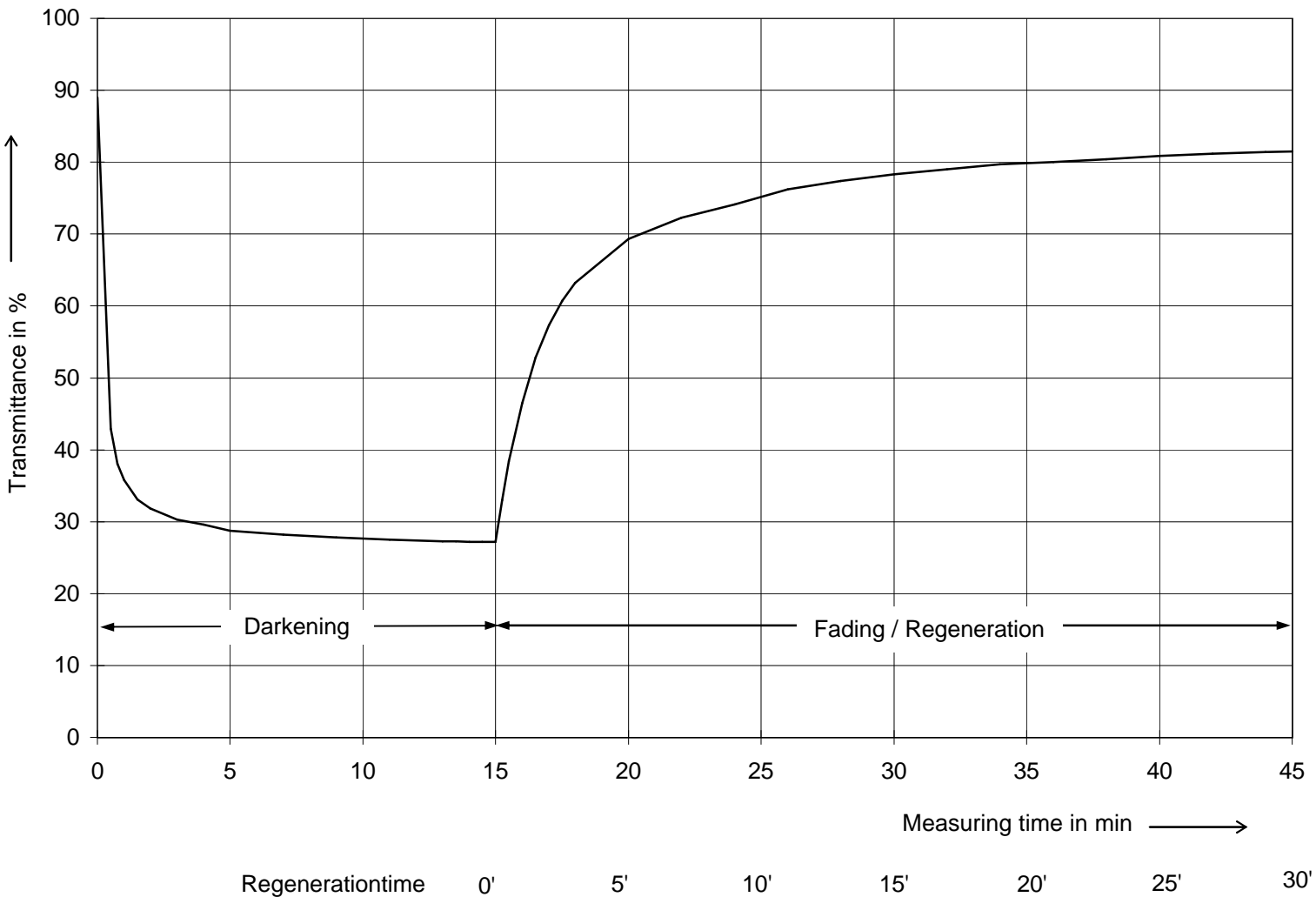


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Darkening - Fading - Curve

Type of Glass: PHOTOSOLAR SUPERBROWN
Thickness: 2 mm



Specification

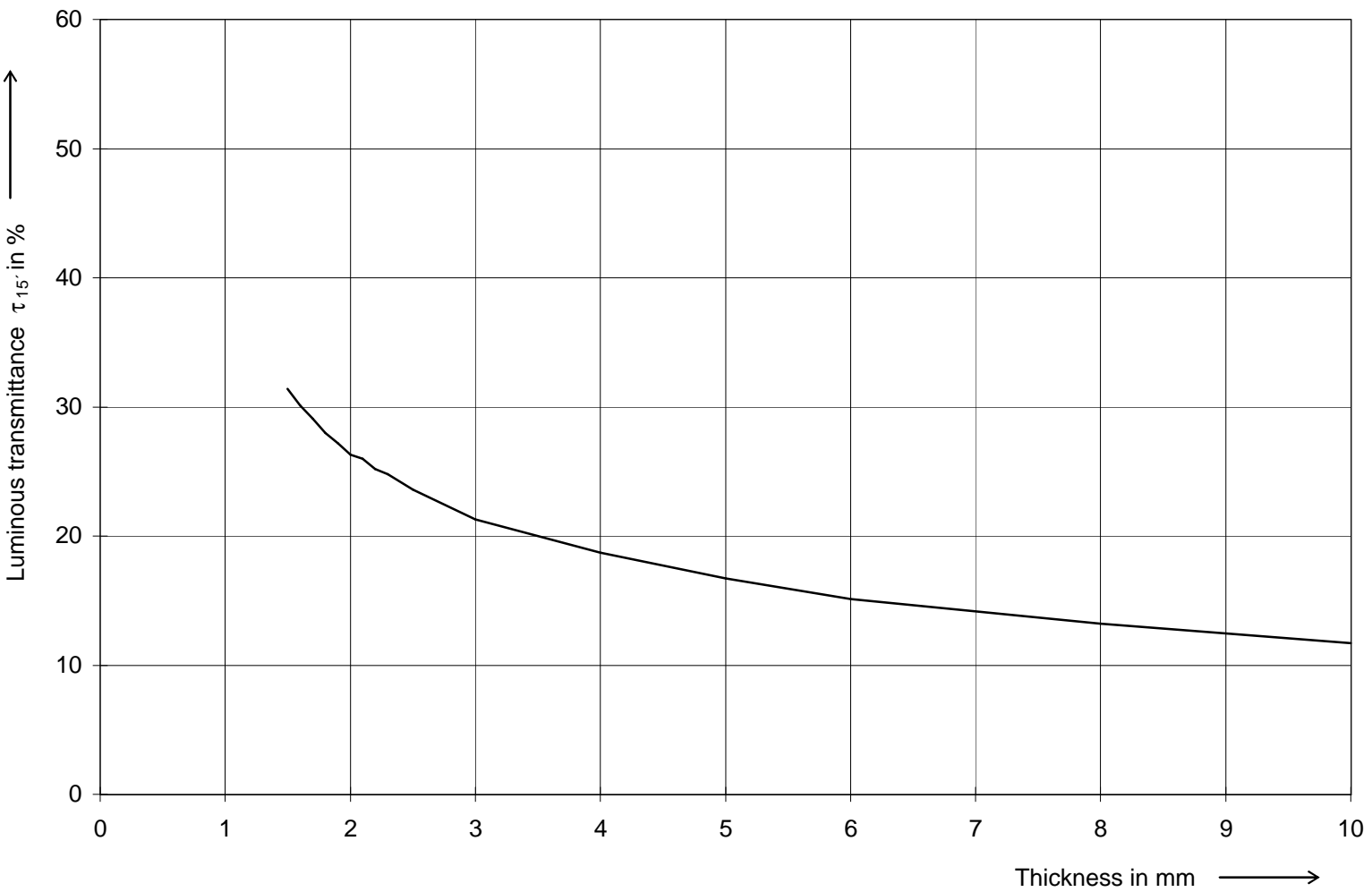
Physical and chemical properties

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Luminous transmittance dark state in relationship to the thickness

Type of Glass: PHOTOSOLAR SUPERBROWN



Specification

Physical and chemical properties

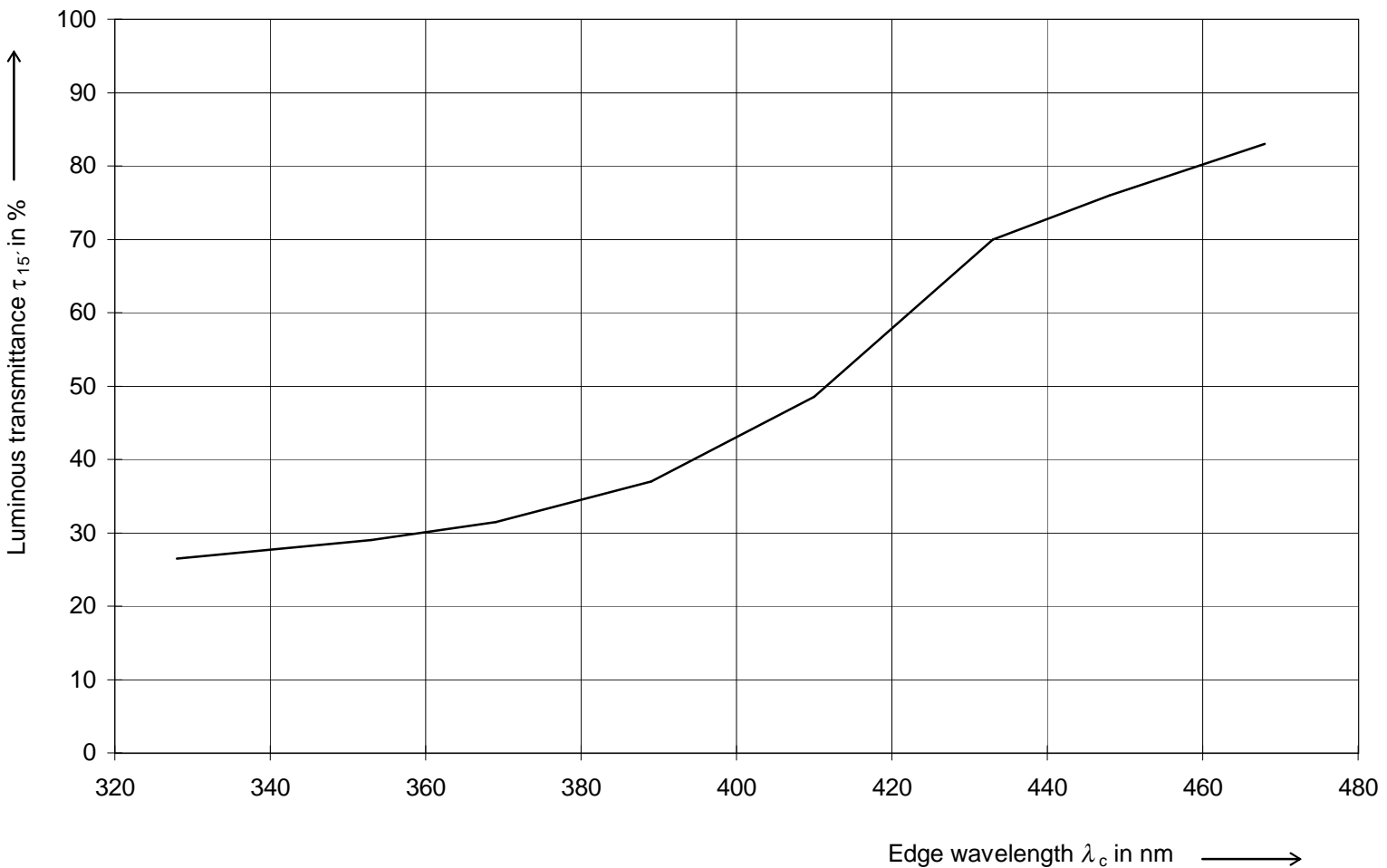
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Luminous transmittance dark state in relationship to the variation the excitation spektrum (sharp cut filter)

Type of Glass: PHOTOSOLAR SUPERBROWN

Thickness: 2 mm



Specification

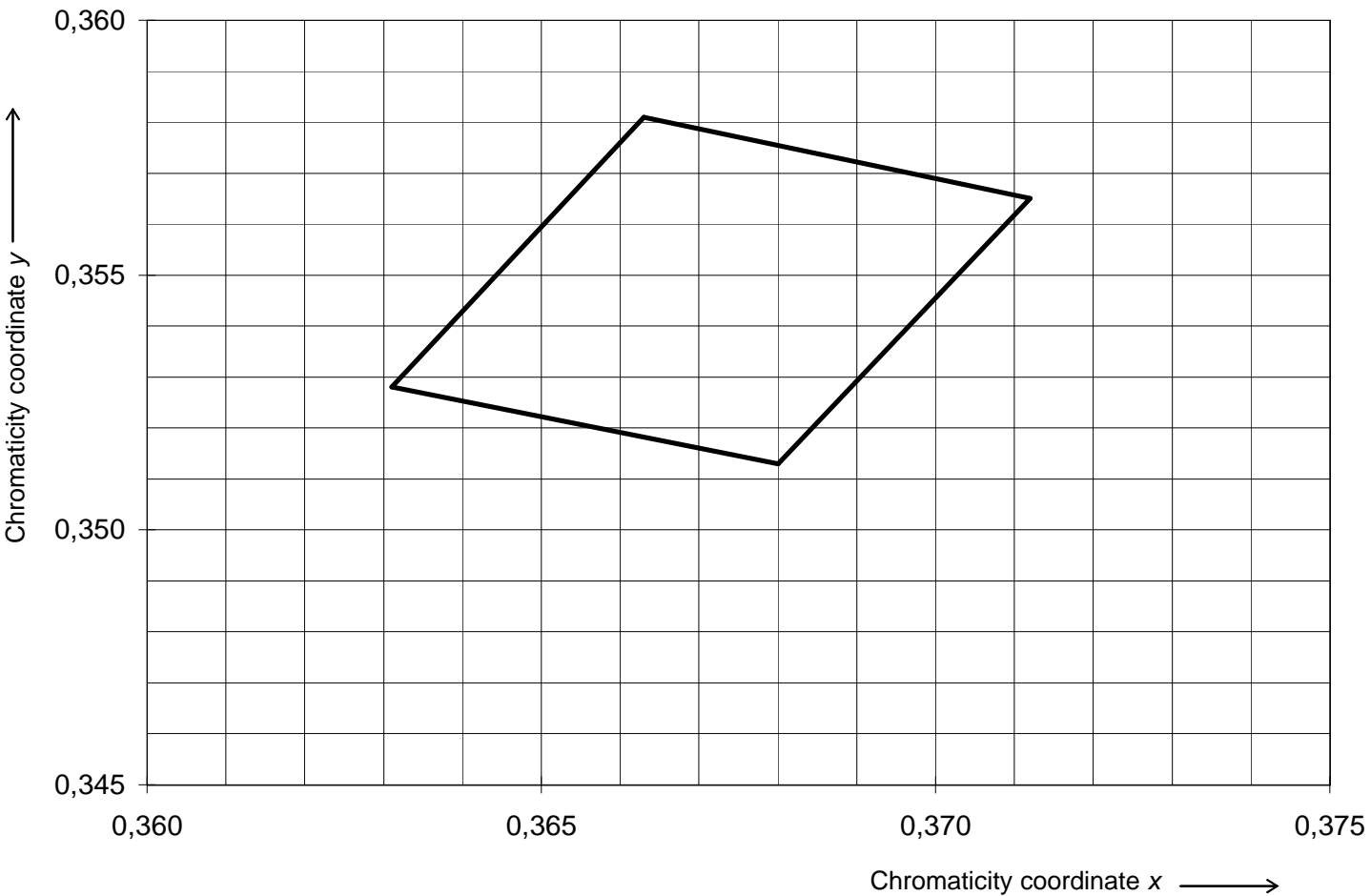
Physical and chemical properties

PCP

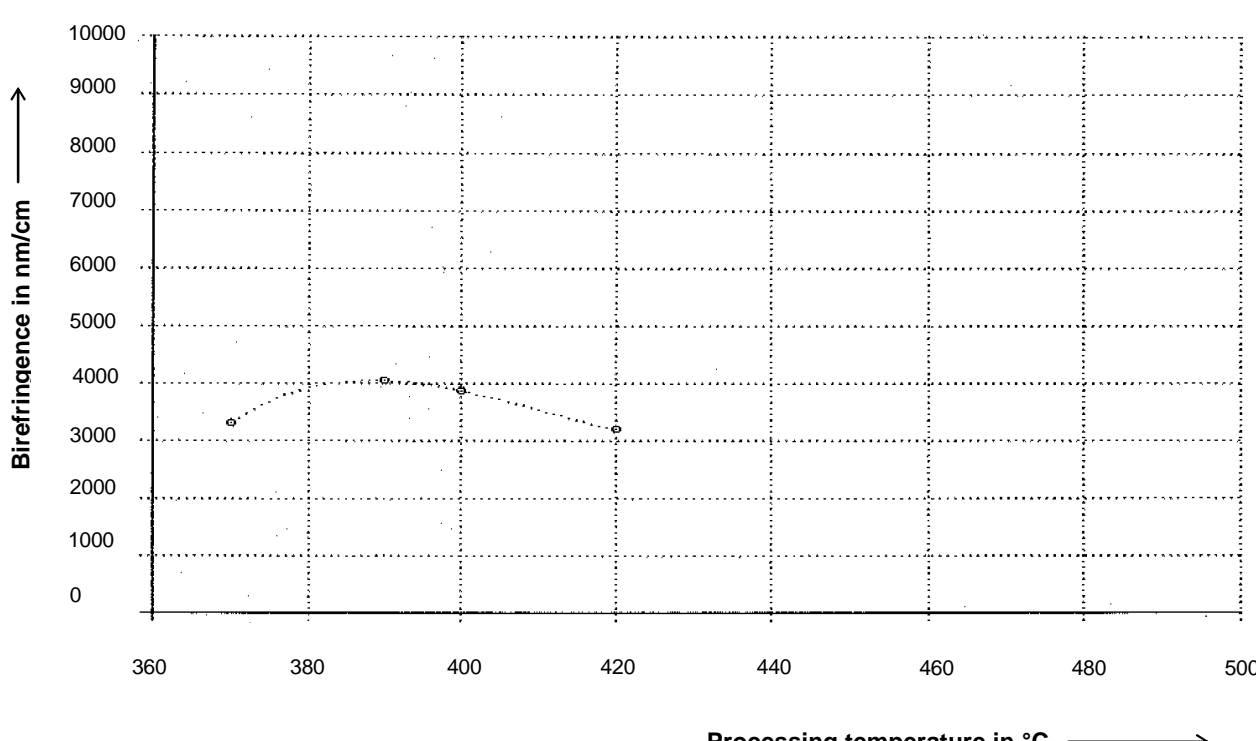
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Chromaticity Coordinates

Type of Glass: PHOTOSOLAR SUPERBROWN
Thickness: 2 mm



Annex 3.3.1

Specification		PCP											
Physical and chemical properties		D 6526 / D 6626											
Chemical toughening parameter													
Glass and chemical toughening parameters													
Transformation temperature	°C	504											
Glass thickness	mm	2											
Processing time	h	16											
Processing temperature	°C	390											
Salt bath (* weight percentages)	NaNO ₃ in % *	40.0											
	KNO ₃ in % *	59.5											
	SiO ₂ x H ₂ O in % *	0.5											
Chemical toughening results *													
Penetration depth	μm	62											
Birefringence	nm/cm	4050											
* 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	not carried out											
 <table border="1"> <caption>Birefringence vs Processing Temperature Data</caption> <thead> <tr> <th>Processing temperature (°C)</th> <th>Birefringence (nm/cm)</th> </tr> </thead> <tbody> <tr> <td>370</td> <td>3200</td> </tr> <tr> <td>390</td> <td>3900</td> </tr> <tr> <td>400</td> <td>3800</td> </tr> <tr> <td>420</td> <td>3100</td> </tr> </tbody> </table>				Processing temperature (°C)	Birefringence (nm/cm)	370	3200	390	3900	400	3800	420	3100
Processing temperature (°C)	Birefringence (nm/cm)												
370	3200												
390	3900												
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