

Specification Physical and chemical properties	PCP D 1420 1
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- p r o v i s i o n a l -

S 4020

D 1420 1

Colour: grey

Application: Neutral Crown Shade C
medium tinted sunglare filter
with IR- and UV-absorption
filter category 2 acc. to DIN EN 1836
(for $\tau_v < 18$ % filter category 3)

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 1420 1				
1. Optical properties						
1.1 Refractive indices (20 °C)						
Pretreatment of samples	n_g	1.5354				
[x] Condition as supplied	$n_{F'}$	1.5305				
[] annealed at 40 °C/h	n_F	1.5300				
	n_e	1.5255				
	n_d	1.5232				
	n_D	1.5231				
	$n_{C'}$	1.5207				
	n_C	1.5202				
1.1.1 Abbe value						
	v_e	53.7				
	v_D	53.9				
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 $d = 2.0$ mm ($\lambda = 300$ 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	< 0.01				
	$\tau(\lambda)_{\max}$ for the λ - range 315 nm to 350 nm	1.7				
	τ_{350}	1.7				
	τ_{380}	11.7				
	$\tau(\lambda)_{\min}$ for the λ - range 500 nm to 650 nm	16.3				
1.2.1.3 Edge wavelength ($d = 2.0$ mm)						
	Edge wavelength λ_c ($\tau = 0.46$) in nm	◇				
1.2.2 Luminous transmittance τ_v						
1.2.2.1 Luminous transmittance τ_{vC} in % at nominal thickness			20.0* ± 3.0			
$d = 2.0$ mm * nominal transmittance						
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 %	◇	20.0	◇	◇	◇	◇
τ_{vA} in %	◇	20.2	◇	◇	◇	◇
τ_{vC} in %	◇	20.0	◇	◇	◇	◇

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1.2.2.2	Scale number / Filter category		
	N for mean thickness $d = 1.8$ mm ($\tau_{vD65} = 22.8$ %)		6 - 2.5
	N for mean thickness $d = 2.6$ mm ($\tau_{vD65} = 12.6$ %)		6 - 3.1
	filter category for luminous transmittance $\tau_{vD65} = 20.0$ %		2
1.2.3	Special transmittance values in % ($d = 2.0$ mm)		
1.2.3.1	UV - transmittance		
		τ_{UVA}	4.2
		τ_{UVB}	< 0.05
		τ_{SUV}	1.9
		τ_{SUVA}	2.9
		τ_{SUVB}	< 0.05
	Mean $\tau(\lambda)$ for the λ - range 290 nm to 320 nm		max. 0.2
1.2.3.2	IR - transmittance	τ_{SIR}	9.0
1.2.3.3	Solar blue - light transmittance	τ_{sb}	18.6
1.3	Colour		
1.3.1	Visual evaluation		◇
1.3.2	Colorimetry		
	Chromaticity coordinates	A x	0.3206
		y	0.3307
	Chromaticity coordinates (colour locus) are referred to the Standard Illuminant C according CIE 2°-observer for $d = 2.0$ mm	B x	0.3226
		y	0.3287
		C x	0.3261
		y	0.3327
	In case of verification, the measured values may additionally deviate by the measuring uncertainty of the used measuring devices.	D x	0.3236
		y	0.3350
	part of chromaticity coordinates		see annex
1.3.3	Signal light recognition		
	Relative visual attenuation coefficient (quotient) Q for signal light recognition referred to the luminous transmittance $\tau_{vD65} = 20.0$ % (refer to 1.2.2.1)	Q_{blue}	0.94
		Q_{green}	0.98
		Q_{yellow}	1.03
		Q_{red}	0.98
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	496
Annealing point	13.0	532
Softening point	7.6	750
Forming temperature	6.0	868
Forming temperature	5.0	967
Forming temperature	4.0	1097
2.2 Transformation temperature T_g in °C		528
2.3 Coefficient of mean linear thermal expansion $\alpha(20\text{ °C};300\text{ °C})$ in 10^{-6} K^{-1} (Static measurement)		9.5
2.4 Fuseability		
Stress-free fusion with suitable Barberini GmbH lower segments is possible.		
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 (annealed at 40 °C/h)	2.60
3.2	Stress optical coefficient C in $1.02 \cdot 10^{-12}$ m ² /N	3.5
3.3	Breaking strength	
	<p>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. Both toughening methods may cause in slightly transmittance - and colourchange.</p>	
3.3.1	Chemical toughening	
	Processing temperature ϑ in °C	450
	Processing time t in h	16
	Compressive stress D_s as birefringence in nm/cm	7180
	Penetration depth N_z up to neutral zone in μm	86
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/mm ²	◇
3.5	Poisson´s ratio μ	◇
3.6	Torsion modulus G in kN/mm ²	◇
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 ₂ O) per gram of glass grains in µg/g	137
4.2	Acid resistance acc. to DIN 12 116	
	Acid class	S 2
	Half surface weight loss after 6 hours in mg/dm ²	1.11
4.3	Alkali resistance acc. to DIN ISO 695	
	Class	A 2
	Surface weight loss after 3 hours in mg/dm ²	120
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)	

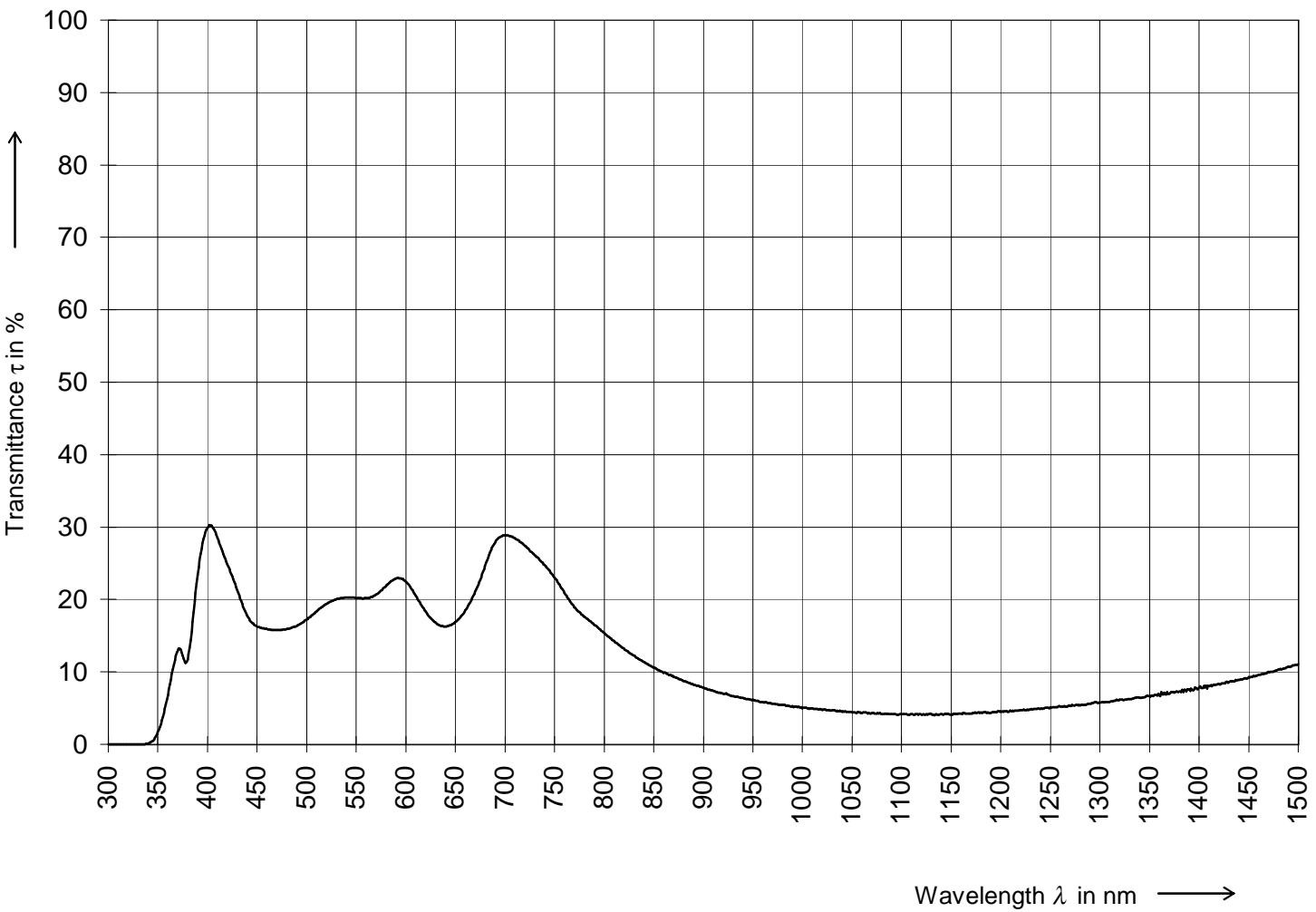
Specification

Physical and chemical properties

PCP
D 1420 1

Spectral Transmittance

Type of Glass: S 4020
Thickness: 2.00 mm



Annex 1.3.2

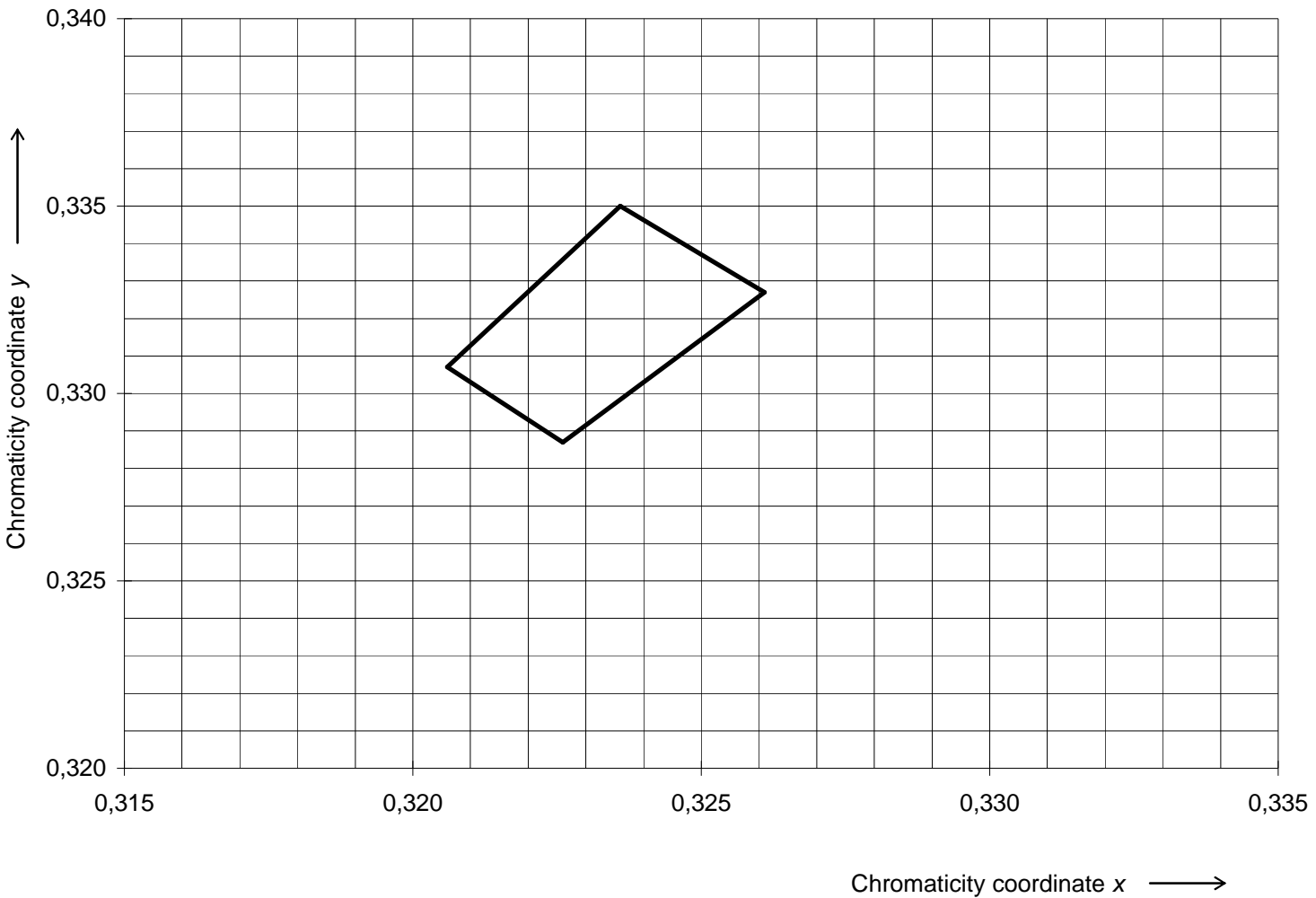
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Physical and chemical properties

PCP
D 1420 1

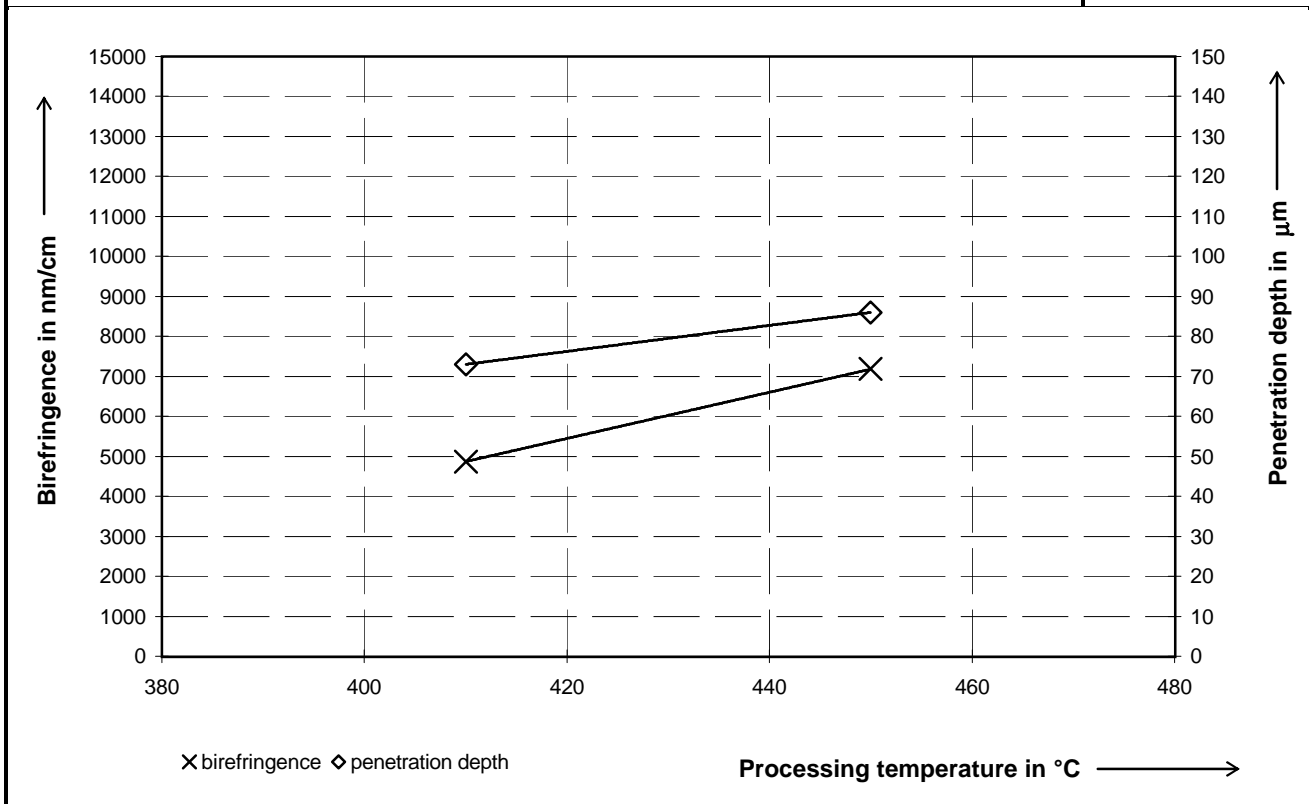
Chromaticity Coordinates

Type of Glass: S 4020
Thickness: 2.0 mm



Annex 3.3.1

Specification		PCP	
Physical and chemical properties		D 1420 1	
Chemical toughening parameter			
Glass and chemical toughening parameters			
Transformation temperature	°C	528	
Glass thickness	mm	2.0	
Processing time	h	16	
Processing temperature	°C	450	
Salt bath (* weight percentages)	KNO ₃ in % *	99.5	
	SiO ₂ x H ₂ O in % *	0.5	
Chemical toughening results *			
Penetration depth	µm	86	
Birefringence	nm/cm	7180	
* measured across at a sample piece ground down to 0.3 mm ± 0.05 mm			
Ball drop test acc. FDA	% failed	not carried out	
Ball drop test acc. DIN	% failed	not carried out	



Form 0050/1e