

Specification

Physical and chemical properties

PCP

D 1125

- provisional -

HC - PHOTOSOLAR GRAU

D 1125

Colour: grey

Application: High index glass sensitive to light
for corrective lenses and
sun glare filter;
luminous transmittance range
87% (τ_0) / 25% (τ_1) or
filter categories 0 / 2 respectively

The measured values of the paragraphs 1 - 1.2.3.2 and 2 - 4 have been taken
from HC-PHOTOSOLAR DUNKELBRAUN
Paragraph 1.3 come from PHOTOSOLAR SUPERGREY

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 D 1125	
Physical and chemical properties			
1. Optical properties			
1.1 Refractive indices (20 °C)			
Pretreatment of samples	n_g	1.6185	
[x] Condition as supplied	$n_{F'}$	1.6113	
[] annealed at 40 °C/h	n_F	1.6104	
	n_e	1.6040 ^{+0.0006} _{-0.001}	
	n_d	1.6007	
	n_D	1.6006	
	$n_{C'}$	1.5972	
	n_C	1.5965	
1.1.1 Abbe value			
	v_e	42.8	
	v_d	43.0	
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 $\tau_{15'}$		◇	
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	< 0.003	< 0.003
	$\tau(\lambda)_{\max}$ for the λ - range 315 nm to 350 nm	2.5	2
	τ_{380}	28	8
	$\tau(\lambda)_{\min}$ for the λ - range 500 nm to 650 nm	77	19
1.2.1.3 Edge wavelength ($d = 2.0$ mm)			
Edge wavelength λ_c ($\tau = 0.46$) in nm for $\tau_{0'}$		393	

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Physical and chemical properties								
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}	$\tau_{0'} (\tau_0)$	87					
	Dark state	$\tau_{15'} (\tau_1)$	25					
		$\tau_{R5'}$	-					
	Regeneration τ_{vA}	$\tau_{R10'}$	71					
		$\tau_{R30'}$	78					
	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	25					
		3.0	19					
		4.0	16.5					
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)							
		-	-	τ_w	τ_1	τ_s		
	ϑ	-10	-5	5	23	35		
	$\tau_{15'}$	◇	◇	16	25	39		
1.2.2.4	Luminous transmittance dark state $\tau_{15'}$ in % in relationship to the illuminance E in klx ($d = 2.0$ mm)							
		τ_1	-	-	τ_a	-		
	E	50	30	20	15	10		
	$\tau_{15'}$	25	31	37	42	47		
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	454
	$\tau_{15'}$	◇	◇	◇	◇	◇	◇	◇

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1.2.3	Special transmittance values in % ($d = 2.0$ mm)		
1.2.3.1	UV - transmittance for $\tau_{15'}$		
	τ_{UVA}	◇	
	τ_{SUV}	◇	
	τ_{SUVA}	◇	
	τ_{SUVB}	◇	
1.2.3.2	IR - transmittance	τ_{SIR}	$\geq \tau_{vD65}$
1.2.3.3	Solar blue - light transmittance	τ_{sb}	◇
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		
	colour locus as medium position	x_{10} y_{10}	0.325 0.336
	Chromaticity coordinates (colour locus) are referred to the Standard Illuminant D_{65} according to CIE 10°-observer for $\tau_{15'}$ (τ_1) - for the time being they are only reference values ($d = 2.0$ mm) in view of the relative calibration possibility		
1.3.3	Signal light recognition		
	Relative visual attenuation coefficient (quotient) Q for signal light recognition for $\tau_{15'}$ (τ_1) ($d = 2.0$ mm)	Q_{blue}	1.00
		Q_{green}	0.97
		Q_{yellow}	1.04
		Q_{red}	1.10
1.3.4	Yellowness index ($d = 10$ mm)		
		Y_i	◇

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Physical and chemical properties			
2. Thermal properties			
2.1 Viscosities and corresponding temperatures			
	Designation	Viscosity lg η in dPas	Temperature ϑ in °C
	Strain point	14.5	516
	Annealing point	13.0	541
	Softening point	7.6	692
	Forming temperature	6.0	772
	Forming temperature	5.0	838
	Forming temperature	4.0	923
2.2	Transformation temperature T_g in °C		539
2.3	Coefficient of mean linear thermal expansion $\alpha(20\text{ °C};300\text{ °C})$ in 10^{-6} K^{-1} (Static measurement)		6.0
2.4	Fuseability		◇
2.5	Mean specific heat capacity $c_p(20\text{ °C to }100\text{ °C})$ in $\text{J}/(\text{g} \cdot \text{K})$		◇

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Physical and chemical properties		
3.	Mechanical properties	
3.1	Density ρ in g/cm ³ (annealed at 40 °C/h)	2.74
3.2	Stress optical coefficient C in $1.02 \cdot 10^{-12}$ m ² /N	3.49
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	440
	Processing time t in h	16
	Compressive stress D_s as birefringence in nm/cm	2600
	Penetration depth N_z up to neutral zone in μm	51
	Further information	see annex
3.4	Young's modulus E in kN/mm ²	78
3.5	Poisson's ratio μ	0.229
3.6	Torsion modulus G in kN/mm ²	32
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 2
	Equivalent of alkali (Na ₂ O) per gram of glass grains in µg/g	42
4.2	Acid resistance acc. to DIN 12 116	
	Acid class	S 4
	Half surface weight loss after 6 hours in mg/dm ²	253
4.3	Alkali resistance acc. to DIN ISO 695	
	Class	A 2
	Surface weight loss after 3 hours in mg/dm ²	100
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	◇
7.	Annex (diagrams, curves)	

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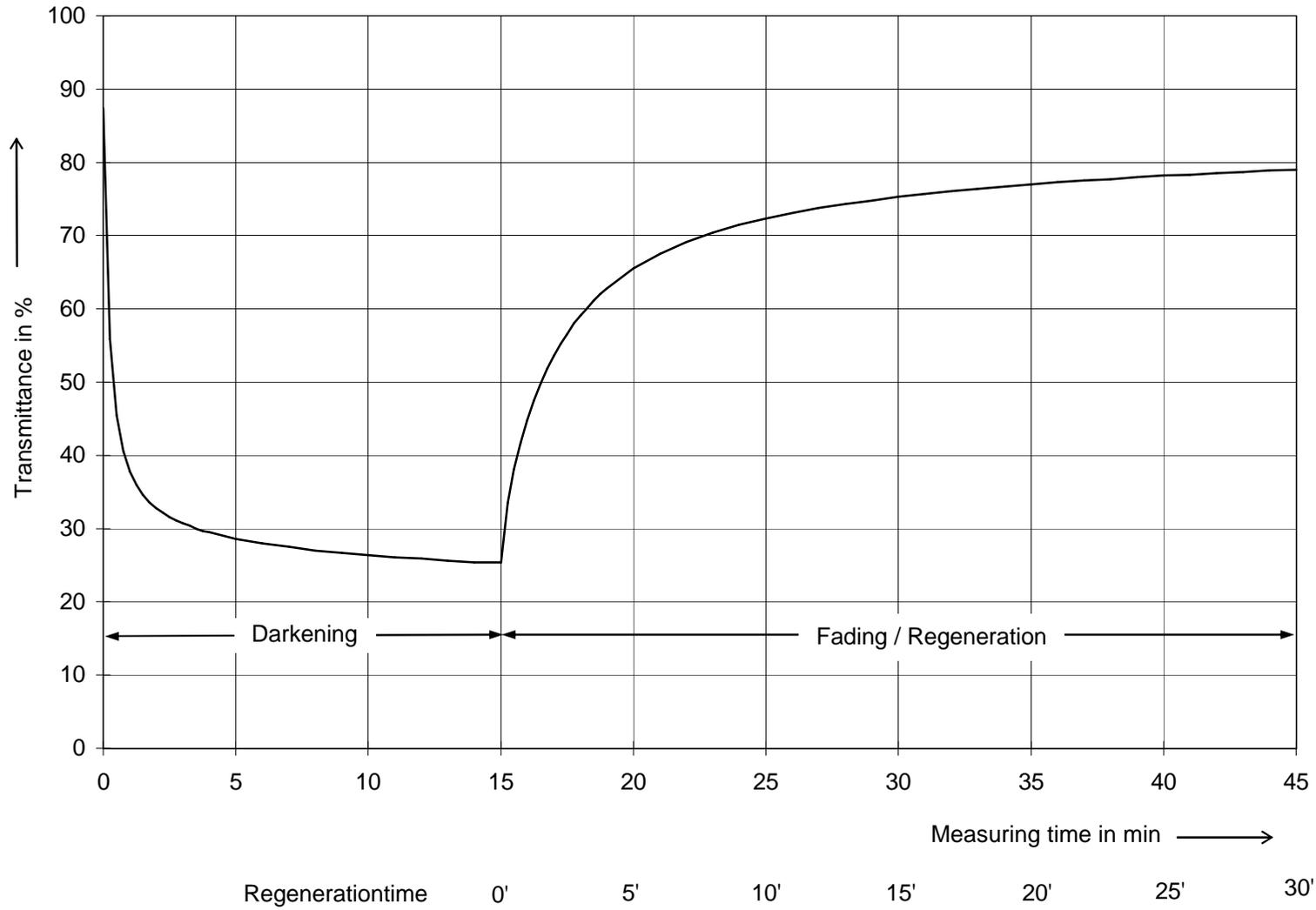
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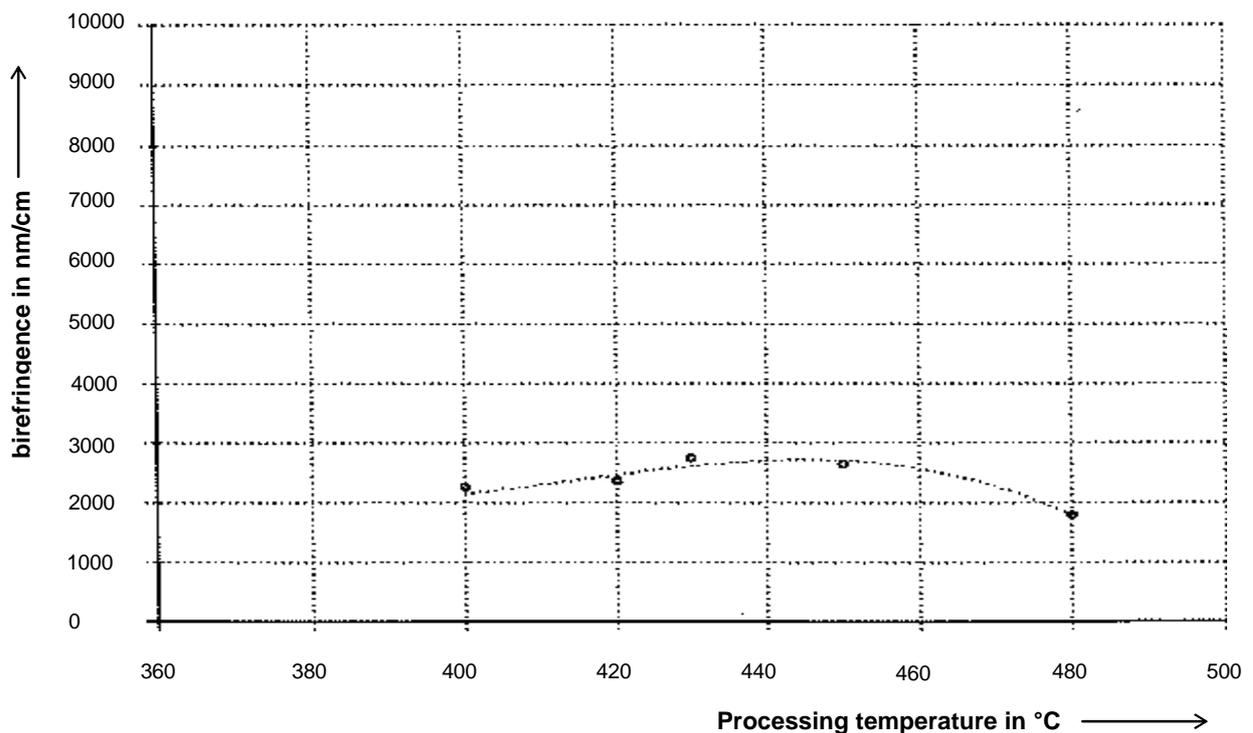
Darkening - Fading - Curve

Type of Glass: HC - PHOTOSOLAR GRAU
Thickness: 2 mm



Annex 3.3.1

Specification		PCP D 1125	
Physical and chemical properties			
Chemical toughening parameter			
Glass and chemical toughening parameters			
Transformation temperature	°C	539	
Glass thickness	mm	2	
Processing time	h	16	
Processing temperature	°C	440	
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	51	
Birefringence	nm/cm	2600	
* 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	



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