Specification

Physical and chemical properties

PCP
D 1616

Grau 1616 D 1616

Colour:	greyish-green
Application:	dark tinted sunglare filter with high UV- absorption filter category 3 acc. to DIN EN 1836 (for τ_v > 18 % filter category 2)

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	1.5355
$n_{F'}$	1.5304
n_F	1.5298
n_e	1.5251
n_d	1.5227
n_D	1.5226
$n_{C'}$	1.5201
n_C	1.5196

1.1.1 Abbe value

ν_e	50.7 ± 0.6
ν_d	50.9

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 (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	< 0.001
$\tau(\lambda)_{max}$ for the λ - range 315 nm to 350 nm	0.04
τ_{380}	3.0
$\tau(\lambda)_{min}$ for the λ - range 500 nm to 650 nm	10

1.2.1.3 Edge wavelength (d = 2.0 mm)

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

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: 16.0 * ± 2.5

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 %	27.0	16.0	6.8	◊	◊	◊
τ_{vA} in %	26.5	15.6	6.5	◊	◊	◊
τ_{vC} in %	27.0	16.0	6.8	◊	◊	◊

Form 0050/1e

Specification

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1.2.2.2	**Scale number / Filter category**		
	N for mean thickness *d* = 1.6 mm (τ_{vD65} = 22.8 %)		6 - 2.5
	N for mean thickness *d* = 2.3 mm (τ_{vD65} = 12.6 %)		6 - 3.1
	filter category for nominal transmittance τ_{vD65} = 16.0 %		3
1.2.3	**Special transmittance values in % (*d* = 2.0 mm)**		
1.2.3.1	**UV - transmittance**		
		τ_{UVA}	0.8
		τ_{SUV}	< 0.5
		τ_{SUVA}	< 1.0
		τ_{SUVB}	< 0.05
1.2.3.2	**IR - transmittance**	τ_{SIR}	2
1.2.3.3	**Solar blue - light transmittance**	τ_{sb}	13.9
1.3	**Colour**		
1.3.1	**Visual evaluation**		◊
1.3.2	**Colorimetry**		
	Chromaticity coordinates	A x_{10}	0.308_6
		y_{10}	0.355_4
	Chromaticity coordinates (colour locus) are referred to the	B x_{10}	0.314_6
	Standard Illuminant D_{65} according CIE 10°-observer	y_{10}	0.359_2
	for nominal thickness (d = 2,0mm)	C x_{10}	0.312_3
		y_{10}	0.362_6
	In case of verification, the measured values may additionally de-	D x_{10}	0.306_4
	viate by the measuring uncertainty of the used measuring devices.	y_{10}	0.358_8
	part of chromaticity coordinates		see annex
1.3.3	**Signal light recognition**		
	Relative visual attenuation coefficient (quotient) *Q*	Q_{blue}	1.00
	for signal light recognition for nominal thickness (d = 2,0mm)	Q_{green}	1.05
		Q_{yellow}	0.94
		Q_{red}	0.79
	This sunglare filter is acc. to DIN EN 172 and DIN EN 1836 "not suitable for driving and road use"		
1.3.4	**Yellowness index (*d* = 10 mm)**		
		Y_i	◊

Form 0050/1e

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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	453
Annealing point	13.0	483
Softening point	7.6	671
Forming temperature	6.0	780
Forming temperature	5.0	875
Forming temperature	4.0	1006

2.2	**Transformation temperature *Tg* in °C**	479
2.3	**Coefficient of mean linear thermal expansion α(20 °C;300 °C) in 10^{-6} K^{-1}** (Static measurement)	10.0
2.4	**Fuseability**	◊
2.5	**Mean specific heat capacity c_p(20 °C to 100 °C) in J/(g · K)**	◊

Form 0050/1e

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3.	**Mechanical properties**	
3.1	**Density ρ in g/cm³**	2.53
3.2	**Stress optical coefficient C in 1.02 · 10^{-12} m²/N**	3.13
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. Both toughening methods may cause slight transmittance - and colourchanges.	
3.3.1	**Chemical toughening**	
	Processing temperature ϑ in °C	360
	Processing time t in h	16
	Compressive stress Ds as birefringence in nm/cm	5200
	Penetration depth Nz up to neutral zone in µm	39
	Further information	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**	◊
3.5	**Poisson´s ratio μ**	◊
3.6	**Torsion modulus G in kN/mm²**	◊
3.7	**Knoop hardness HK 0.1/20**	462

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4. Chemical properties

4.1 Hydrolytic resistance acc. to DIN ISO 719

Hydrolytic class	HGB 4
Equivalent of alkali (Na_2O) per gram of glass grains in µg/g	343

4.2 Acid resistance acc. to DIN 12 116

Acid class	S 3
Half surface weight loss after 6 hours in mg/dm²	1.8

4.3 Alkali resistance acc. to DIN ISO 695

Class	A 3
Surface weight loss after 3 hours in mg/dm²	193

4.4 Hazardous Substances

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

5. Electrical properties — disregarded

6. Other properties — disregarded

7. Annex (diagrams, curves)

Form 0050/1e

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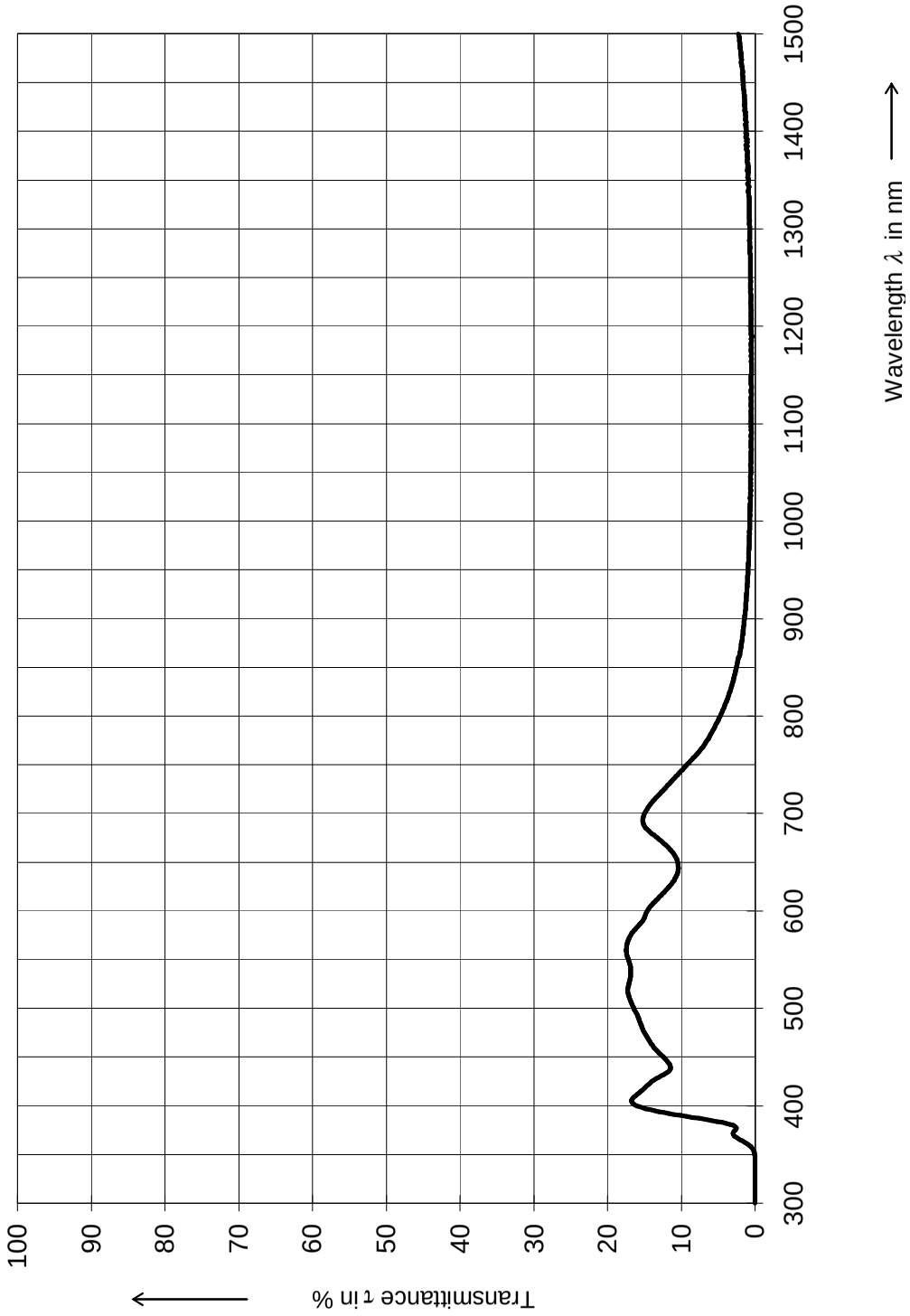
Spectral Transmittance

Type of Glass: Grau 1616
Thickness: 2.00 mm



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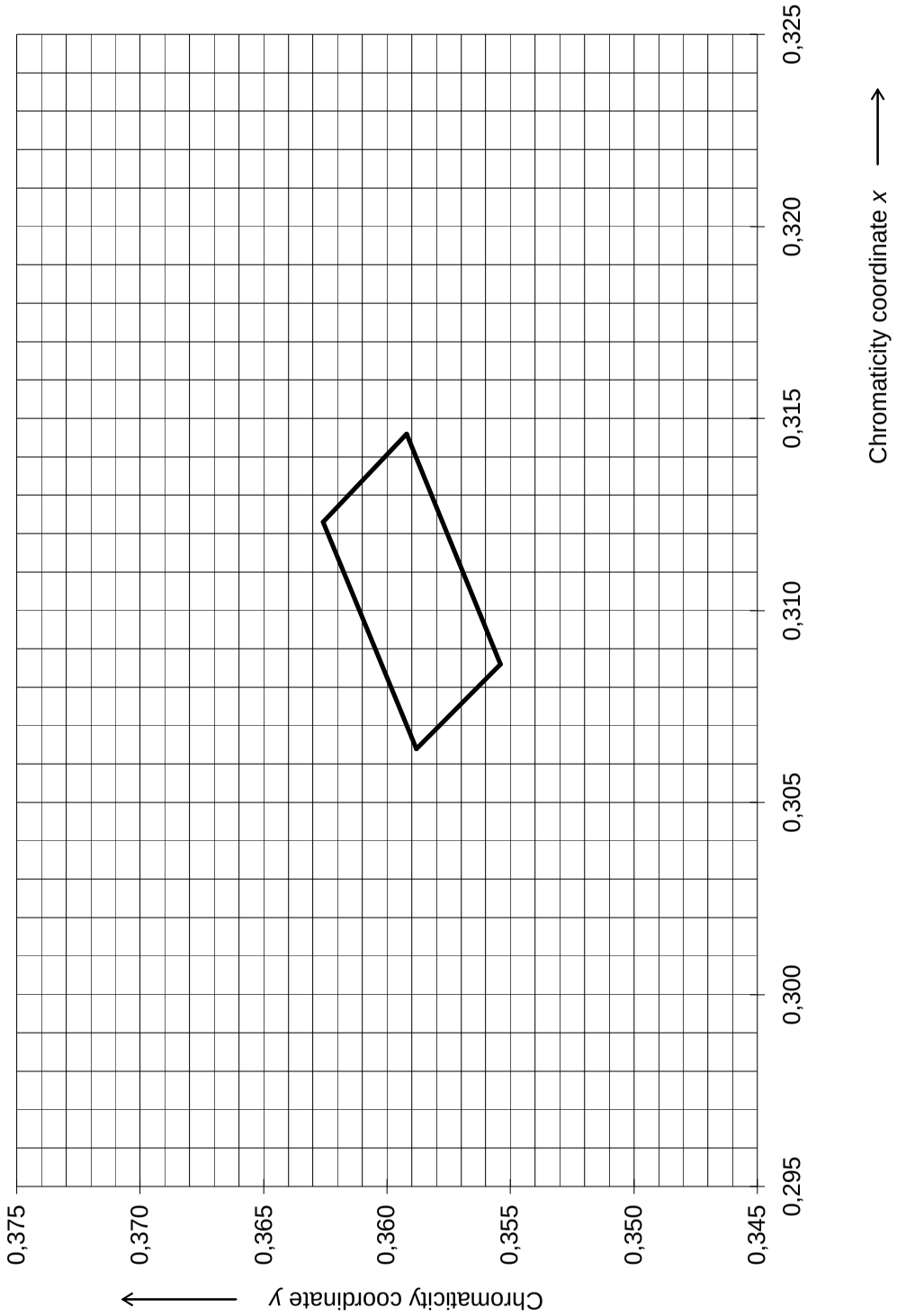
Chromaticity Coordinates

Type of Glass: Grau 1616
Thickness: 2.00 mm



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D 1616

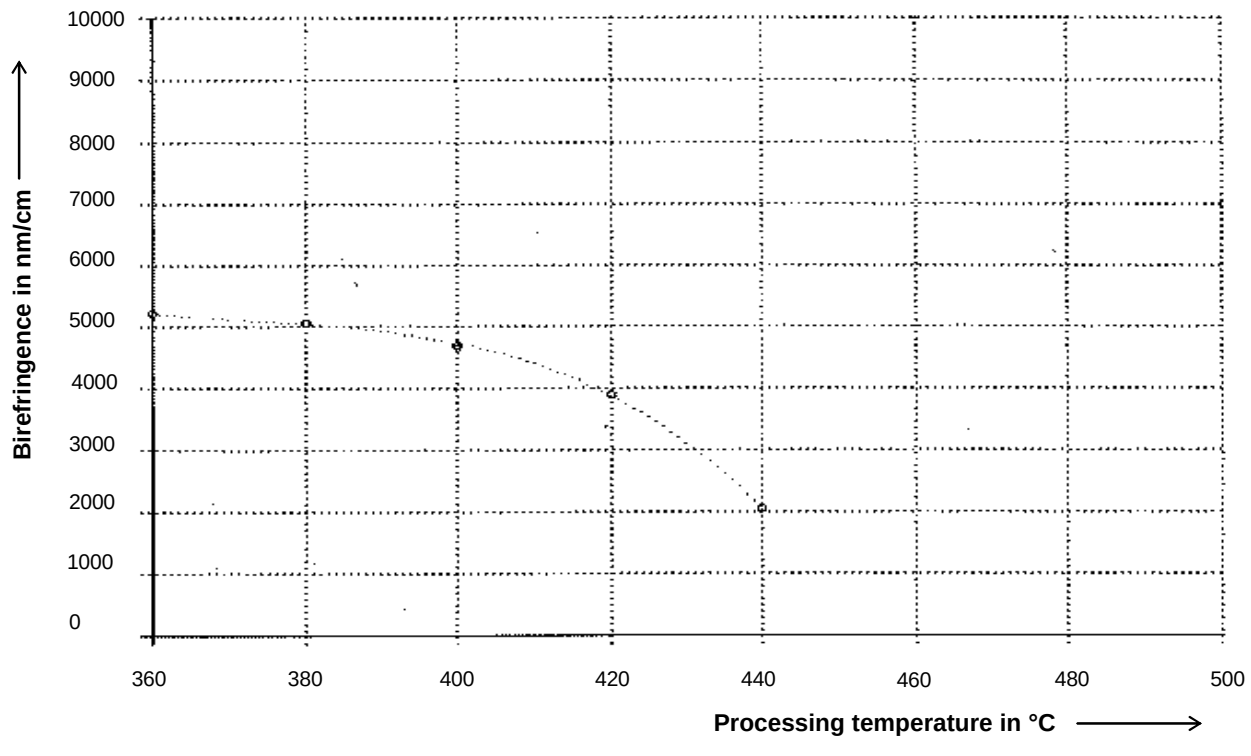
Chemical toughening parameter

Glass and chemical toughening parameters		
Transformation temperature	°C	479
Glass thickness	mm	2
Processing time	h	16
Processing temperature	°C	360
Salt bath (* weight percentages)	KNO_3 in % *	99.5
	SiO_2 x H_2O in % *	0.5

Chemical toughening results *		
Penetration depth	µm	39
Birefringence	nm/cm	5200

* 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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