

Femt* Line

Components Selection Guide

FEMTOLINE LASER OPTICS



See page

FEMTOLINE OPTICS	4.2–4.20
Laser Mirrors	4.2
Dual Line Laser Mirrors	4.4
Broadband Ultrafast Ti:Sapphire Laser Mirrors	4.5
Laser Harmonic Separators	4.6
Laser Output Couplers	4.7
Laser Rear Mirrors	4.8
Laser Beamsplitters	4.10
AR Coated Lens Kits	4.12
Thin Film Laser Polarizers	4.13
Zero Order Optically Contacted Plates	4.15
Zero Order-Air Spaced Plates	4.15
Zero Order Dual Wavelength Plates	4.16
Low Order Plates	4.16
Multiple Order Dual Wavelength Plates	4.17
Polarization Plane Rotators	4.17
Group Velocity Delay (GVD) Compensation Plates	4.18
Variable Attenuator for Femtosecond Linearly Polarized Laser Beam 990-0070, -0071	4.19



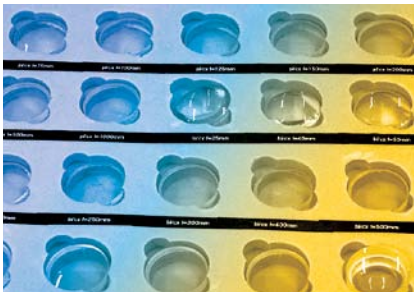
OPTICAL COMPONENTS CLEANING INSTRUCTIONS See page A.3

FEMTOLINE LASER AND NONLINEAR CRYSTALS



See page

FEMTOLINE CRYSTALS	4.21–4.28
Ti:Sapphire Laser Line and Harmonics	4.21
Thin BBO Crystals for SHG and THG of Ti:Sapphire Laser Wavelength	4.22
Third Harmonic Generation of Ti:Sapphire Laser Kits	4.25
Thin AgGaS ₂ Crystals for DFG → 2.5-1.3 μm	4.26
Yb:KGW and Yb:KYW Crystals Laser Lines and Harmonics	4.27
BBO and LBO Crystals for SHG of Yb:KGW/KYW Laser Frequency Conversion	4.28



FemtoLine Laser Optics

LASER MIRRORS

Laser mirrors for femtosecond applications are designed to have a broad operating wavelength range and linear phase versus frequency characteristics (*low reflectance group delay dispersion (GDD)*). The coating is a single layer dielectric and has no phase shift over the operating wavelength region.

High reflectivity mirrors always have higher reflection, broader operating region and lower pulse distortion for s-polarization than for p-polarization for the same dielectric coating. If possible use the mirrors with s-polarized beam.

Our standard mirrors are suitable for fundamental Ti:Sapphire and Yb:KGW or KYW lasers and their doubled, tripled or quadrupled frequencies.

SUBSTRATE

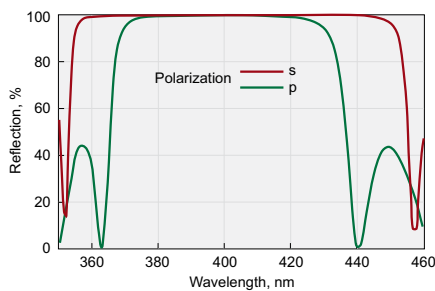
Material	UV grade fused silica or BK7 glass
S1 Surface Flatness	$\lambda/10$ at 633 nm
S1 Surface Quality	20–10 scratch & dig laser quality
S2 Surface Quality	Commercial polish
Diameter Tolerance	+0.00 mm -0.12 mm
Thickness Tolerance	± 0.25 mm
Wedge	< 3 min
Chamfer	0.3 mm at 45° typical

COATING

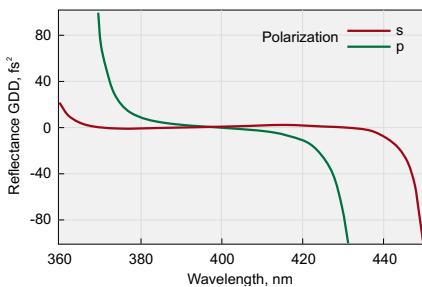
Technology	Electron beam multilayer dielectric
Adhesion and Durability	Per MIL-C-675A. Insoluble in lab solvents
Clear Aperture	Exceeds central 85% of diameter
Coating	Hard dielectric High Reflection R>99.5%
Angle of Incidence	45±3°
Designed for average polarization	$R=(R_s+R_p)/2$
Laser Damage Threshold	>100 mJ/cm ² , 50 fsec pulse, 800 nm typical
Coated Surface Flatness	$\lambda/10$ at 633 nm over clear aperture

Laser Line Wavelength

Substrate material: **BK7 grade A**



HR>99.5%@380-420 nm, AOI=45°



HRsp@380-420 GDD, AOI=45°

Diameter – 12.7 mm

Wavelength, nm	Thickness T, mm	R, % (s+p)/2	Catalogue number	Price, EUR
380-420	3.0	99.5	031-0400	57
500-530	3.0	99.5	031-0515	56
760-840	3.0	99.5	031-0800	61
1000-1060	3.0	99.5	031-1030	61

Diameter – 25.4 mm

Wavelength, nm	Thickness T, mm	R, % (s+p)/2	Catalogue number	Price, EUR
380-420	6.0	99.5	032-0400	89
500-530	6.0	99.5	032-0515	74
760-840	6.0	99.5	032-0800	85
1000-1060	6.0	99.5	032-1030	75

Diameter – 50.8 mm

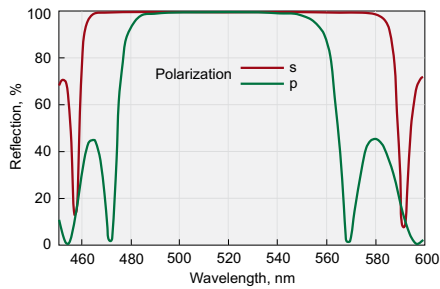
Wavelength, nm	Thickness T, mm	R, % (s+p)/2	Catalogue number	Price, EUR
380-420	8.0	99.5	035-0400	133
500-530	8.0	99.5	035-0515	110
760-840	8.0	99.5	035-0800	133
1000-1060	8.0	99.5	035-1030	110

Diameter – 76.2 mm

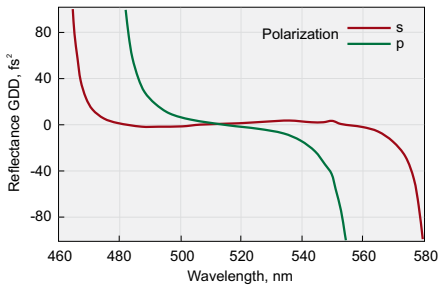
Wavelength, nm	Thickness T, mm	R, % (s+p)/2	Catalogue number	Price, EUR
380-420	12.7	99.5	037-0400	199
500-530	12.7	99.5	037-0515	185
760-840	12.7	99.5	037-0800	199
1000-1060	12.7	99.5	037-1030	185

Laser Line Wavelength

Substrate material: **UV Grade Fused Silica**



HR>99.5% @ 500-530 nm, AOI=45°



HRsp @ 500-530 GDD, AOI=45°

Diameter – 12.7 mm

Wavelength, nm	Thickness T, mm	R, % (s+p)/2	Catalogue number	Price, EUR
257-275	3.0	99.0	041-0266	81
333-353	3.0	99.5	041-0343	77
380-420	3.0	99.5	041-0400	75
500-530	3.0	99.5	041-0515	74
760-840	3.0	99.5	041-0800	75
1000-1060	3.0	99.5	041-1030	75

Diameter – 25.4 mm

Wavelength, nm	Thickness T, mm	R, % (s+p)/2	Catalogue number	Price, EUR
257-275	6.0	99.0	042-0266	111
333-353	6.0	99.5	042-0343	107
380-420	6.0	99.5	042-0400	101
500-530	6.0	99.5	042-0515	91
760-840	6.0	99.5	042-0800	97
1000-1060	6.0	99.5	042-1030	92

Diameter – 50.8 mm

Wavelength, nm	Thickness T, mm	R, % (s+p)/2	Catalogue number	Price, EUR
257-275	8.0	99.0	045-0266	207
333-353	8.0	99.5	045-0343	187
380-420	8.0	99.5	045-0400	181
500-530	8.0	99.5	045-0515	169
760-840	8.0	99.5	045-0800	181
1000-1060	8.0	99.5	045-1030	169

Diameter – 76.2 mm

Wavelength, nm	Thickness T, mm	R, % (s+p)/2	Catalogue number	Price, EUR
257-275	12.7	99.0	047-0266	290
333-353	12.7	99.5	047-0343	281
380-420	12.7	99.5	047-0400	272
500-530	12.7	99.5	047-0515	258
760-840	12.7	99.5	047-0800	272
1000-1060	12.7	99.5	047-1030	258

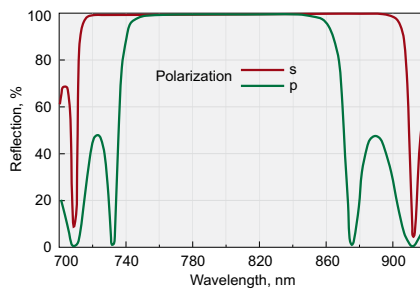
Recommended for high power laser applications operating in UV region.

Nd:YAG LaserLine

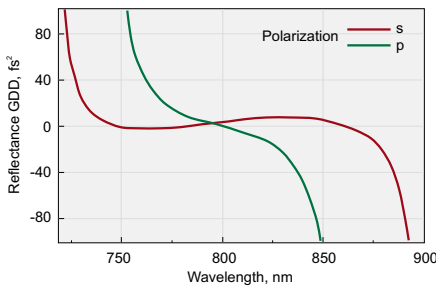
- For Nd:YAG laser applications we offer Laser Line and Dual Laser Line Mirrors
See page 3.3

HOUSING ACCESSORIES

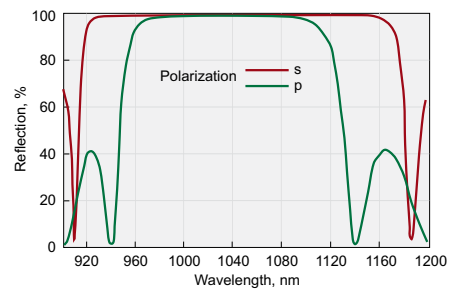
- Adapter for Mirror at 45°
840-0115
See page 7.72



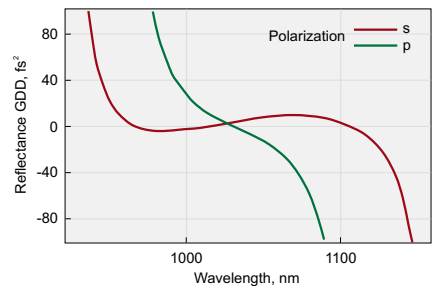
HR>99.5% @ 760-840 nm, AOI=45°



HRsp @ 760-840 GDD, AOI=45°



HR>99.5% @ 1000-1060 nm, AOI=45°



HRsp @ 1000-1060 GDD, AOI=45°

DUAL LINE LASER MIRRORS

SPECIFICATIONS

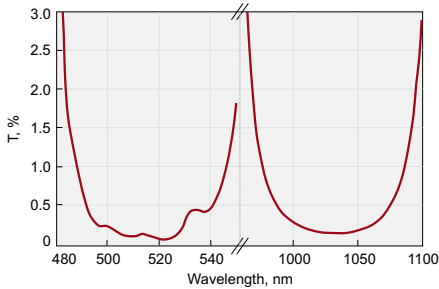
Coating	Hard dielectric High Reflection R>99.5%
Angle of Incidence	45±3°
Designed for average polarization	$R=(R_s+R_p)/2$
Laser Damage Threshold	>50 mJ/cm ² , 50 fsec pulse, 800 nm typical

SUBSTRATE

Material	Fused Silica or BK7 glass
S1 Surface Flatness	λ/10 at 633 nm
S1 Surface Quality	20–10 scratch & dig laser quality
S2 Surface Quality	Commercial polish
Diameter Tolerance	+0.00 mm -0.12 mm
Thickness Tolerance	±0.25 mm
Wedge	< 3 min
Chamfer	0.3 mm at 45° typical

Dual Laser Line Mirrors

Substrate material: **BK7 grade A**



HR>99.5% @ 500-530 nm+1000-1060 nm, AOI = 45°

Diameter – **12.7 mm**

Wavelength, nm	Thickness T, mm	R, % (s+p)/2	Catalogue number	Price, EUR
390-410+780-820	3.0	99.5	051-4080	85
500-530+1000-1060	3.0	99.5	051-5103	85

Diameter – **25.4 mm**

Wavelength, nm	Thickness T, mm	R, % (s+p)/2	Catalogue number	Price, EUR
390-410+780-820	6.0	99.5	052-4080	103
500-530+1000-1060	6.0	99.5	052-5103	103

Diameter – **50.8 mm**

Wavelength, nm	Thickness T, mm	R, % (s+p)/2	Catalogue number	Price, EUR
390-410+780-820	8.0	99.5	055-4080	151
500-530+1000-1060	8.0	99.5	055-5103	151

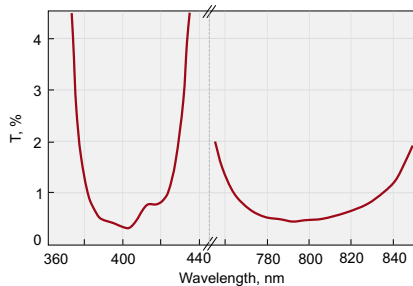
Diameter – **76.2 mm**

Wavelength, nm	Thickness T, mm	R, % (s+p)/2	Catalogue number	Price, EUR
390-410+780-820	12.7	99.5	057-4080	227
500-530+1000-1060	12.7	99.5	057-5103	227

Dual Laser Line Mirrors

Substrate material: **Fused Silica**

Recommended for high power laser applications operating in UV region.



HR>99% @ 400 nm + 800 nm, AOI = 45°

Diameter – **12.7 mm**

Wavelength, nm	Thickness T, mm	R, % (s+p)/2	Catalogue number	Price, EUR
390-410+780-820	3.0	99.5	061-4080	110
500-530+1000-1060	3.0	99.5	061-5103	110

Diameter – **25.4 mm**

Wavelength, nm	Thickness T, mm	R, % (s+p)/2	Catalogue number	Price, EUR
390-410+780-820	6.0	99.5	062-4080	128
500-530+1000-1060	6.0	99.5	062-5103	128

Diameter – **50.8 mm**

Wavelength, nm	Thickness T, mm	R, % (s+p)/2	Catalogue number	Price, EUR
390-410+780-820	8.0	99.5	065-4080	214
500-530+1000-1060	8.0	99.5	065-5103	214

Diameter – **76.2 mm**

Wavelength, nm	Thickness T, mm	R, % (s+p)/2	Catalogue number	Price, EUR
390-410+780-820	12.7	99.5	067-4080	321
500-530+1000-1060	12.7	99.5	067-5103	321

RELATED PRODUCTS

- Laser Line and Dual Laser Line Mirrors of other wavelengths

See page 1.8



BROADBAND ULTRAFAST Ti:Sapphire LASER MIRRORS

- High reflectivity and low group velocity dispersion in broad region centered at 800 nm

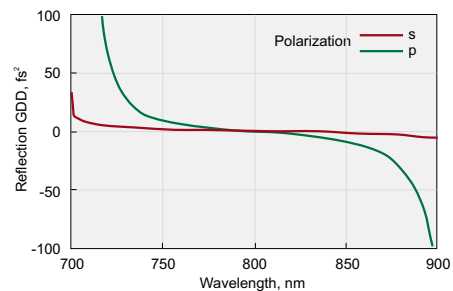
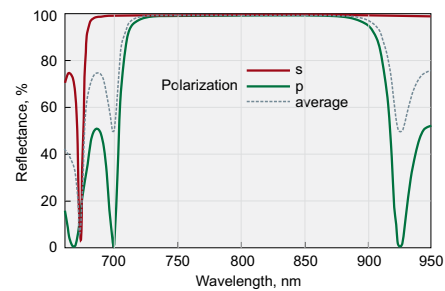
SPECIFICATIONS

Coating	Hard dielectric High Reflection R>99.5%
Angle of Incidence	45±3°
Designed for average polarization	$R=(R_s+R_p)/2$
Laser Damage Threshold	>50 mJ/cm ² , 50 fsec pulse, 800 nm typical

SUBSTRATE

Material	Fused Silica or BK7 glass
S1 Surface Flatness	$\lambda/10$ at 633 nm
S1 Surface Quality	20–10 scratch & dig laser quality
S2 Surface Quality	Commercial polish
Diameter Tolerance	+0.00 mm -0.12 mm
Thickness Tolerance	±0.25 mm
Wedge	< 3 min
Chamfer	0.3 mm at 45° typical

Material	Diameter, mm	Thickness T, mm	Wavelength, nm	R, % (s+p)/2	Price, EUR	
BK7						
FS						
071-7288	081-7288	12.7	3.0	720-880	99.0	86 / 111
072-7288	082-7288	25.4	6.0	720-880	99.0	104 / 129
074-7288	084-7288	38.1	8.0	720-880	99.0	127 / 170
075-7288	085-7288	50.8	8.0	720-880	99.0	147 / 210
077-7288	087-7288	76.2	12.7	720-880	99.0	215 / 317



HR>99% @720-880nm, AOI=45deg

LASER HARMONIC SEPARATORS

- Offered on Ø 0.5 or 1 inch FS substrates with surface flatness $\lambda/10$

Harmonic separators are dichroic beamsplitters that reflect one wavelength and transmit others. Reflectance is better than 99.5% for the wavelength of interest and transmittance is at least 90% for the rejected wavelengths. The rear surface of harmonic separators is antireflection coated.

If possible use shorter wavelength for reflection and longer wavelengths for transmission in order to have higher reflection/transmission coefficients.

SUBSTRATE

Material	Fused silica
S1 Surface Flatness	$\lambda/10$ typical at 633 nm
S1 Surface Quality	20–10 scratch & dig laser quality
S2 Surface Flatness	$\lambda/10$ typical at 633 nm
S2 Surface Quality	20–10 scratch & dig laser quality
Diameter Tolerance	+0.00 mm -0.12 mm
Thickness Tolerance	± 0.25 mm
Parallelism	< 30 arcsec
Chamfer	0.3 mm at 45° typical

COATING

Technology	Electron beam multilayer dielectric
Adhesion and Durability	Per MIL-C-675A. Insoluble in lab solvents
Clear Aperture	Exceeds central 85% of diameter
Coated Surface Flatness	$\lambda/10$ at 633 nm over clear aperture
Back side antireflection coated	AOI 45°, R<0.5% AOI 0°, R<0.25%
Laser Damage Threshold	>100 mJ/cm ² , 50 fsec pulse, 800 nm typical

Reflected wavelength, nm, R > 99.5%	Transmitted wavelength, nm	Transmission, %	AOI	Substrate material	Catalogue number		Price, EUR
					Ø12.7x3 mm	Ø25.4x3 mm	
257-275	780-820	>95	0	FS	041-2800	042-2800	145 / 175
257-275	780-820	>95	45	FS	041-2805	042-2805	145 / 175
257-275	390-410	>95	0	FS	041-2400	042-2400	145 / 175
257-275	390-410	>95	45	FS	041-2405	042-2405	145 / 175
257-275	400+800	>90	0	FS	041-2480	042-2480	145 / 175
257-275	400+800	>90	45	FS	041-2485	042-2485	145 / 175
390-410	780-820	>95	0	FS	041-4800	042-4800	145 / 175
390-410	780-820	>95	45	FS	041-4805	042-4805	145 / 175
800	400	>93	0	FS	041-8400	042-8400	140 / 170
800	400	>93	45	FS	041-8405	042-8405	140 / 170
333-353	1000-1060	>95	0	FS	041-3130	042-3130	135 / 165
333-353	1000-1060	>95	45	FS	041-3135	042-3135	135 / 165
333-353	500-530	>95	0	FS	041-3450	042-3450	135 / 165
333-353	500-530	>95	45	FS	041-3455	042-3455	135 / 165
333-353	515+1030	>90	0	FS	041-3530	042-3530	155 / 185
333-353	515+1030	>90	45	FS	041-3535	042-3535	155 / 185
500-530	1000-1060	>95	0	FS	041-5130	042-5130	135 / 165
500-530	1000-1060	>95	45	FS	041-5135	042-5135	135 / 165
1030	515	>93	0	FS	041-6510	042-6510	140 / 170
1030	515	>93	45	FS	041-6515	042-6515	140 / 170

HOUSING ACCESSORIES

- Adapter for Beamsplitter at 45°
840-0116
See page 7.72



- Kinematic Mirror and Beamsplitter Mount
840-0020
See page 7.54



RELATED PRODUCTS

- Laser Harmonic Separators
Nd:YAG LaserLine
See page 3.5

LASER OUTPUT COUPLERS

- **Low reflectance Group Delay Dispersion**

An output coupler is a partially reflecting dielectric mirror used in a laser cavity. It transmits a part of the circulating intracavity power for generating a useful output from the laser.

A low transmission output coupler leads to low laser threshold and possibly to poor laser efficiency if the losses due to output coupling do not dominate other parasitic losses in the laser cavity. The output coupler transmission is often chosen to maximize the output power, although its optimum value may be lower or higher if there are other design purposes (minimizing intracavity intensities or suppressing Q-switching instabilities in a passively mode-locked laser).

The standard substrates are parallel within 30 arcsec. If you need wedged substrates, please, choose from chapter Wedge Prisms (page 1.37).

SUBSTRATE

Material	Fused silica
S1 Surface Flatness	$\lambda/10$ typical at 633 nm
S1 Surface Quality	20–10 scratch & dig laser quality
S2 Surface Flatness	$\lambda/10$ typical at 633 nm
S2 Surface Quality	20–10 scratch & dig laser quality
Diameter Tolerance	+0.00 mm -0.12 mm
Thickness Tolerance	± 0.25 mm
Parallelism	30 arcsec
Chamfer	0.3 mm at 45° typical

COATING

Technology	Electron beam multilayer dielectric
Adhesion and Durability	Per MIL-C-675A. Insoluble in lab solvents
Clear Aperture	Exceeds central 85% of diameter
Angle of Incidence	0–8°
Parallelism	30 arcsec
Back side antireflection coated	R < 0.25%
Laser Damage Threshold	>100 mJ/cm ² , 50 fsec pulse, 800 nm typical

Wavelength, nm	Reflection, %	Transmission, %	Substrate material	Catalogue number		Price, EUR
				Ø12.7 x 3 mm	Ø25.4 x 6 mm	
1030	50±3	50±3	FS	041-0150	042-0150	105 / 125
1030	60±3	40±3	FS	041-0160	042-0160	105 / 125
1030	65±3	35±3	FS	041-0165	042-0165	105 / 125
1030	70±3	30±3	FS	041-0170	042-0170	105 / 125
1030	75±3	25±3	FS	041-0175	042-0175	105 / 125
1030	80±3	20±3	FS	041-0180	042-0180	105 / 125
1030	85±3	15±3	FS	041-0185	042-0185	105 / 125
1030	90±2	10±2	FS	041-0190	042-0190	112 / 132
1030	95±2	5±2	FS	041-0195	042-0195	112 / 132
1030	97±1	3±1	FS	041-0197	042-0197	119 / 139
1030	98±1	2±1	FS	041-0198	042-0198	119 / 139
1030	99.0±0.5	1.0±0.5	FS	041-0199	042-0199	126 / 146
800	50±3	50±3	FS	041-1150	042-1150	105 / 125
800	60±3	40±3	FS	041-1160	042-1160	105 / 125
800	65±3	35±3	FS	041-1165	042-1165	105 / 125
800	70±3	30±3	FS	041-1170	042-1170	105 / 125
800	75±3	25±3	FS	041-1175	042-1175	105 / 125
800	80±3	20±3	FS	041-1180	042-1180	105 / 125
800	85±3	15±3	FS	041-1185	042-1185	105 / 125
800	90±2	10±2	FS	041-1190	042-1190	112 / 132
800	95±2	5±2	FS	041-1195	042-1195	112 / 132
800	97±1	3±1	FS	041-1197	042-1197	119 / 139
800	98±1	2±1	FS	041-1198	042-1198	119 / 139
800	99.0±0.5	1.0±0.5	FS	041-1199	042-1199	126 / 146

HOUSING ACCESSORIES

- Kinematic Mirror and Beamsplitter Mount 840-0020
See page 7.54



LASER REAR MIRRORS

High reflectivity ($R > 99.8\%$) dielectric coatings with high laser damage threshold are applied on laser rear mirrors. FS substrates are recommended for high power laser applications.

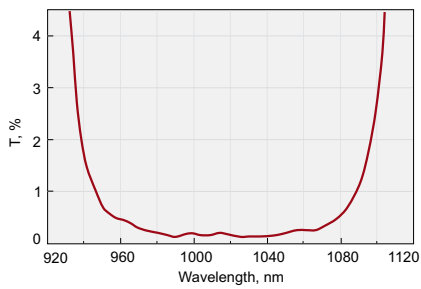
Back side can be AR coated to avoid back reflection from second surface on request.

SUBSTRATE

Material	Fused silica or BK7 glass
S1 Surface Flatness	$\lambda/10$ at 633 nm
S1 Surface Quality	20–10 scratch & dig laser quality
S2 Surface Quality	Commercial polish
Diameter Tolerance	+0.00 mm-0.12 mm
Thickness Tolerance	± 0.25
Chamfer	0.3 mm at 45° typical

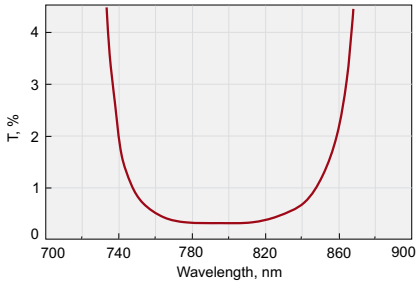
COATING

Technology	Electron beam multilayer dielectric
Adhesion and Durability	Per MIL-C-675A. Insoluble in lab solvents
Clear Aperture	Exceeds central 85% of diameter
Angle of Incidence	$0-8^\circ$ (normal)
Coating	Hard dielectric High Reflection $R > 99.8\%$
Laser Damage Threshold	> 100 mJ/cm ² , 50 fsec pulse, 800 nm typical



$HR > 99.8\%$ @ 1030 ± 30 nm, $AOI = 0^\circ$

Wavelength, nm	Substrate type	Radius, mm	Substrate material	Catalogue number $\varnothing 25.4 \times 6$ mm	Price, EUR
1030±30	Plano-plano	$-\infty$	BK7	012-8000	75
1030±30	Plano-concave	-50	BK7	012-8005	99
1030±30	Plano-concave	-100	BK7	012-8010	99
1030±30	Plano-concave	-150	BK7	012-8015	99
1030±30	Plano-concave	-200	BK7	012-8020	99
1030±30	Plano-concave	-250	BK7	012-8025	99
1030±30	Plano-concave	-500	BK7	012-8050	99
1030±30	Plano-concave	-1000	BK7	012-8100	99
1030±30	Plano-concave	-2000	BK7	012-8200	99
1030±30	Plano-concave	-2500	BK7	012-8250	99
1030±30	Plano-concave	-4000	BK7	012-8400	99
1030±30	Plano-concave	-5000	BK7	012-8500	99
1030±30	Plano-plano	$-\infty$	FS	022-8000	102
1030±30	Plano-concave	-50	FS	022-8005	119
1030±30	Plano-concave	-100	FS	022-8010	119
1030±30	Plano-concave	-150	FS	022-8015	119
1030±30	Plano-concave	-200	FS	022-8020	119
1030±30	Plano-concave	-250	FS	022-8025	119
1030±30	Plano-concave	-500	FS	022-8050	119
1030±30	Plano-concave	-1000	FS	022-8100	119
1030±30	Plano-concave	-2000	FS	022-8200	119
1030±30	Plano-concave	-2500	FS	022-8250	119
1030±30	Plano-concave	-4000	FS	022-8400	119
1030±30	Plano-concave	-5000	FS	022-8500	119
1030±30	Plano-convex	+100	BK7	012-9010	103
1030±30	Plano-convex	+200	BK7	012-9020	103
1030±30	Plano-convex	+500	BK7	012-9050	103
1030±30	Plano-convex	+1000	BK7	012-9100	103
1030±30	Plano-convex	+2000	BK7	012-9200	103
1030±30	Plano-convex	+4000	BK7	012-9400	103
1030±30	Plano-convex	+100	FS	022-9010	123
1030±30	Plano-convex	+200	FS	022-9020	123
1030±30	Plano-convex	+500	FS	022-9050	123
1030±30	Plano-convex	+1000	FS	022-9100	123
1030±30	Plano-convex	+2000	FS	022-9200	123
1030±30	Plano-convex	+4000	FS	022-9400	123



HR>99.8% @ 800±20 nm, AOI=0°

Wavelength, nm	Substrate type	Radius, mm	Substrate material	Catalogue number Ø25.4 x 6 mm	Price, EUR
800±20	Plano-plano	-∞	BK7	062-8000	75
800±20	Plano-concave	-50	BK7	062-8005	99
800±20	Plano-concave	-100	BK7	062-8010	99
800±20	Plano-concave	-150	BK7	062-8015	99
800±20	Plano-concave	-200	BK7	062-8020	99
800±20	Plano-concave	-250	BK7	062-8025	99
800±20	Plano-concave	-500	BK7	062-8050	99
800±20	Plano-concave	-1000	BK7	062-8100	99
800±20	Plano-concave	-2000	BK7	062-8200	99
800±20	Plano-concave	-2500	BK7	062-8250	99
800±20	Plano-concave	-4000	BK7	062-8400	99
800±20	Plano-concave	-5000	BK7	062-8500	99
800±20	Plano-plano	-∞	FS	082-8000	95
800±20	Plano-concave	-50	FS	082-8005	119
800±20	Plano-concave	-100	FS	082-8010	119
800±20	Plano-concave	-150	FS	082-8015	119
800±20	Plano-concave	-200	FS	082-8020	119
800±20	Plano-concave	-250	FS	082-8025	119
800±20	Plano-concave	-500	FS	082-8050	119
800±20	Plano-concave	-1000	FS	082-8100	119
800±20	Plano-concave	-2000	FS	082-8200	119
800±20	Plano-concave	-2500	FS	082-8250	119
800±20	Plano-concave	-4000	FS	082-8400	119
800±20	Plano-concave	-5000	FS	082-8500	119
800±20	Plano-convex	+100	BK7	062-9010	103
800±20	Plano-convex	+200	BK7	062-9020	103
800±20	Plano-convex	+500	BK7	062-9050	103
800±20	Plano-convex	+1000	BK7	062-9100	103
800±20	Plano-convex	+2000	BK7	062-9200	103
800±20	Plano-convex	+4000	BK7	062-9400	103
800±20	Plano-convex	+100	FS	082-9010	123
800±20	Plano-convex	+200	FS	082-9020	123
800±20	Plano-convex	+500	FS	082-9050	123
800±20	Plano-convex	+1000	FS	082-9100	123
800±20	Plano-convex	+2000	FS	082-9200	123
800±20	Plano-convex	+4000	FS	082-9400	123

Nd:YAG LaserLine

- Laser rear mirrors for Nd:YAG laser applications
See page 3.8

HOUSING ACCESSORIES

- Kinematic Mirror Mount 840-0010
See page 7.54



- Kinematic Mirror and Beamsplitter Mount 840-0020
See page 7.54



LASER BEAMSPLITTERS

Beamsplitter splits average polarized laser beam in two beams separated 90° from each other.

The standard substrate thickness is 3 mm. If you need thinner substrate, please, choose from chapter Precision Thin Round Windows (page 1.30).

Please contact us for wedged beamsplitters or choose wedged substrates from Wedge Prisms (page 1.37)

SUBSTRATE

Material	FS, UV FS
S1 Surface Flatness	$\lambda/10$ at 633 nm
S1 Surface Quality	20-10 scratch & dig laser quality
S2 Surface Flatness	$\lambda/10$ at 633 nm
S2 Surface Quality	20-10 scratch & dig laser quality
Diameter Tolerance	+0.00 mm-0.12 mm
Thickness Tolerance	± 0.25
Parallelism	30 arcsec
Chamfer	0.3 mm at 45° typical

COATING

Technology	Electron beam multilayer dielectric
Adhesion and Durability	Per MIL-C-675A. Insoluble in lab solvents
Clear Aperture	Exceeds central 85% of diameter
Angle of Incidence	45 \pm 3°
Back side antireflection coated	R<0.5%
Laser Damage Threshold	>100 mJ/cm ² , 50 fsec pulse, 800 nm typical

Designed for average polarization: $R=(R_s+R_p)/2$ and $T=(T_s+T_p)/2$

Wavelength, nm	Reflection, %	Transmission, %	Substrate material	Catalogue number		Price, EUR Ø12.7 / Ø25.4
				Ø12.7 x 3 mm	Ø25.4 x 3 mm	
1030	20±3	80±3	FS	031-7420	032-7420	105 / 125
1030	30±3	70±3	FS	031-7430	032-7430	105 / 125
1030	50±3	50±3	FS	031-7450	032-7450	105 / 125
1030	70±3	30±3	FS	031-7470	032-7470	105 / 125
1030	80±3	20±3	FS	031-7480	032-7480	105 / 125
515	20±3	80±3	FS	031-7520	032-7520	103 / 123
515	30±3	70±3	FS	031-7530	032-7530	103 / 123
515	50±3	50±3	FS	031-7550	032-7550	103 / 123
515	70±3	30±3	FS	031-7570	032-7570	103 / 123
515	80±3	20±3	FS	031-7580	032-7580	103 / 123
343	20±3	80±3	FS	031-7620	032-7620	110 / 140
343	30±3	70±3	FS	031-7630	032-7630	110 / 140
343	50±3	50±3	FS	031-7650	032-7650	110 / 140
343	70±3	30±3	FS	031-7670	032-7670	110 / 140
343	80±3	20±3	FS	031-7680	032-7680	110 / 140
800	20±3	80±3	FS	041-7720	042-7720	105 / 125
800	30±3	70±3	FS	041-7730	042-7730	105 / 125
800	50±3	50±3	FS	041-7750	042-7750	105 / 125
800	70±3	30±3	FS	041-7770	042-7770	105 / 125
800	80±3	20±3	FS	041-7780	042-7780	105 / 125
400	20±3	80±3	FS	041-7820	042-7820	103 / 123
400	30±3	70±3	FS	041-7830	042-7830	103 / 123
400	50±3	50±3	FS	041-7850	042-7850	103 / 123
400	70±3	30±3	FS	041-7870	042-7870	103 / 123
400	80±3	20±3	FS	041-7880	042-7880	103 / 123
266	20±3	80±3	UVFS	041-7920	042-7920	115 / 145
266	30±3	70±3	UVFS	041-7930	042-7930	115 / 145
266	50±3	50±3	UVFS	041-7950	042-7950	115 / 145
266	70±3	30±3	UVFS	041-7970	042-7970	115 / 145
266	80±3	20±3	UVFS	041-7980	042-7980	115 / 145

Designed for S- polarization

Wavelength, nm	Reflection, %	Transmission, %	Substrate material	Catalogue number		Price, EUR Ø12.7 / Ø25.4
				Ø12.7 x 3 mm	Ø25.4 x 3 mm	
1030	20±3	80±3	FS	031-7420S	032-7420S	105 / 125
1030	30±3	70±3	FS	031-7430S	032-7430S	105 / 125
1030	50±3	50±3	FS	031-7450S	032-7450S	105 / 125
1030	70±3	30±3	FS	031-7470S	032-7470S	105 / 125
1030	80±3	20±3	FS	031-7480S	032-7480S	105 / 125
515	20±3	80±3	FS	031-7520S	032-7520S	103 / 123
515	30±3	70±3	FS	031-7530S	032-7530S	103 / 123
515	50±3	50±3	FS	031-7550S	032-7550S	103 / 123
515	70±3	30±3	FS	031-7570S	032-7570S	103 / 123
515	80±3	20±3	FS	031-7580S	032-7580S	103 / 123

Wavelength, nm	Reflection, %	Transmission, %	Substrate material	Catalogue number		Price, EUR Ø12.7 / Ø25.4
				Ø12.7 x 3 mm	Ø25.4 x 3 mm	
343	20±3	80±3	FS	031-7620S	032-7620S	110 / 140
343	30±3	70±3	FS	031-7630S	032-7630S	110 / 140
343	50±3	50±3	FS	031-7650S	032-7650S	110 / 140
343	70±3	30±3	FS	031-7670S	032-7670S	110 / 140
343	80±3	20±3	FS	031-7680S	032-7680S	110 / 140
800	20±3	80±3	FS	041-7720S	042-7720S	105 / 125
800	30±3	70±3	FS	041-7730S	042-7730S	105 / 125
800	50±3	50±3	FS	041-7750S	042-7750S	105 / 125
800	70±3	30±3	FS	041-7770S	042-7770S	105 / 125
800	80±3	20±3	FS	041-7780S	042-7780S	105 / 125
400	20±3	80±3	FS	041-7820S	042-7820S	103 / 123
400	30±3	70±3	FS	041-7830S	042-7830S	103 / 123
400	50±3	50±3	FS	041-7850S	042-7850S	103 / 123
400	70±3	30±3	FS	041-7870S	042-7870S	103 / 123
400	80±3	20±3	FS	041-7880S	042-7880S	103 / 123
266	20±3	80±3	UVFS	041-7920S	042-7920S	115 / 145
266	30±3	70±3	UVFS	041-7930S	042-7930S	115 / 145
266	50±3	50±3	UVFS	041-7950S	042-7950S	115 / 145
266	70±3	30±3	UVFS	041-7970S	042-7970S	115 / 145
266	80±3	20±3	UVFS	041-7980S	042-7980S	115 / 145

Designed for P- polarization

Wavelength, nm	Reflection, %	Transmission, %	Substrate material	Catalogue number		Price, EUR Ø12.7 / Ø25.4
				Ø12.7 x 3 mm	Ø25.4 x 3 mm	
1030	20±3	80±3	FS	031-7420P	032-7420P	105 / 125
1030	30±3	70±3	FS	031-7430P	032-7430P	105 / 125
1030	50±3	50±3	FS	031-7450P	032-7450P	105 / 125
1030	70±3	30±3	FS	031-7470P	032-7470P	105 / 125
1030	80±3	20±3	FS	031-7480P	032-7480P	105 / 125
515	20±3	80±3	FS	031-7520P	032-7520P	103 / 123
515	30±3	70±3	FS	031-7530P	032-7530P	103 / 123
515	50±3	50±3	FS	031-7550P	032-7550P	103 / 123
515	70±3	30±3	FS	031-7570P	032-7570P	103 / 123
515	80±3	20±3	FS	031-7580P	032-7580P	103 / 123
343	20±3	80±3	FS	031-7620P	032-7620P	110 / 140
343	30±3	70±3	FS	031-7630P	032-7630P	110 / 140
343	50±3	50±3	FS	031-7650P	032-7650P	110 / 140
343	70±3	30±3	FS	031-7670P	032-7670P	110 / 140
343	80±3	20±3	FS	031-7680P	032-7680P	110 / 140
800	20±3	80±3	FS	041-7720P	042-7720P	105 / 125
800	30±3	70±3	FS	041-7730P	042-7730P	105 / 125
800	50±3	50±3	FS	041-7750P	042-7750P	105 / 125
800	70±3	30±3	FS	041-7770P	042-7770P	105 / 125
800	80±3	20±3	FS	041-7780P	042-7780P	105 / 125
400	20±3	80±3	FS	041-7820P	042-7820P	103 / 123
400	30±3	70±3	FS	041-7830P	042-7830P	103 / 123
400	50±3	50±3	FS	041-7850P	042-7850P	103 / 123
400	70±3	30±3	FS	041-7870P	042-7870P	103 / 123
400	80±3	20±3	FS	041-7880P	042-7880P	103 / 123
266	20±3	80±3	UVFS	041-7920P	042-7920P	115 / 145
266	30±3	70±3	UVFS	041-7930P	042-7930P	115 / 145
266	50±3	50±3	UVFS	041-7950P	042-7950P	115 / 145
266	70±3	30±3	UVFS	041-7970P	042-7970P	115 / 145
266	80±3	20±3	UVFS	041-7980P	042-7980P	115 / 145

RELATED PRODUCTS

- Laser Beamsplitters for Nd:YAG laser applications

See page 3.9

HOUSING ACCESSORIES

- Kinematic Mirror and Beamsplitter Mount
840-0030-02
See page 7.54



- Adapter for Beamsplitter at 45°
840-0116
See page 7.72



AR COATED LENS KITS

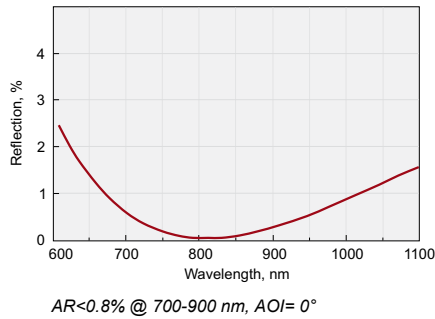
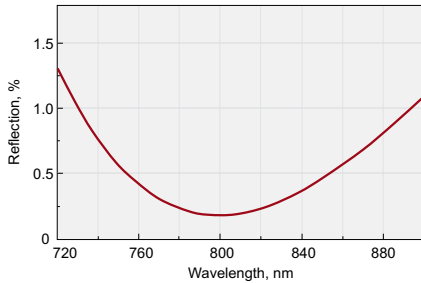
Lens kits consist of four basic types of lenses with various focal lengths. Focal lengths of plano-concave lenses range from -50 to -300 mm, biconcave lenses from -25 to -200. Plano-convex and biconvex lenses cover focal distances from 25 to 1000 mm. The lenses are 25.4 mm

diameter. Kits are available with laser line or broadband coatings. Lenses are placed in a hardwood box. Size of the box is 30×7×40 cm (W×H×D).

Lens kits are available from two kinds of substrate material: FS or UV FS. Lens kit includes 36 lenses.



Code	Material	Coating	Price, EUR
141-3235	FS	AR 1030	2650
142-3235	FS	AR 515	2650
143-3235	FS	AR 343	2770
144-1236	UV FS	AR 266	2960
148-3236	FS	AR 760-840, R<0.5 %	2650
149-3236	FS	AR 700-900, R<0.8%	2800



List of the lenses in lens kits

Code		Configuration	Dia*, mm	F, mm
UV FS	FS			
Plano-convex lenses (12 pcs.)				
110-1203	110-3203	pl/cx	25.4	30
110-1205	110-3205	pl/cx	25.4	50
110-1209	110-3209	pl/cx	25.4	75
110-1211	110-3211	pl/cx	25.4	100
110-1216	110-3216	pl/cx	25.4	125
110-1217	110-3217	pl/cx	25.4	150
110-1219	110-3219	pl/cx	25.4	200
110-1221	110-3221	pl/cx	25.4	250
110-1223	110-3223	pl/cx	25.4	300
110-1227	110-3227	pl/cx	25.4	400
110-1233	110-3233	pl/cx	25.4	500
110-1245	110-3245	pl/cx	25.4	1000
Biconvex lenses (12 pcs.)				
111-1204	111-3204	bi/cx	25.4	25
111-1207	111-3207	bi/cx	25.4	40
111-1210	111-3210	bi/cx	25.4	50
111-1214	111-3214	bi/cx	25.4	75
111-1218	111-3218	bi/cx	25.4	100
111-1222	111-3222	bi/cx	25.4	150
111-1226	111-3226	bi/cx	25.4	200
111-1230	111-3230	bi/cx	25.4	250
111-1234	111-3234	bi/cx	25.4	300
111-1238	111-3238	bi/cx	25.4	400
111-1240	111-3240	bi/cx	25.4	500
111-1260	111-3260	bi/cx	25.4	1000
Plano-concave lenses (6 pcs.)				
112-1205	112-3205	pl/cv	25.4	-50
112-1209	112-3209	pl/cv	25.4	-75
112-1211	112-3211	pl/cv	25.4	-100
112-1217	112-3217	pl/cv	25.4	-150
112-1219	112-3219	pl/cv	25.4	-200
112-1223	112-3223	pl/cv	25.4	-300
Biconcave lenses (6 pcs.)				
114-1204	114-3204	bi/cv	25.4	-25
114-1208	114-3208	bi/cv	25.4	-50
114-1212	114-3212	bi/cv	25.4	-75
114-1216	114-3216	bi/cv	25.4	-100
114-1220	114-3220	bi/cv	25.4	-150
114-1224	114-3224	bi/cv	25.4	-200

* Diameter tolerance: +0.0/-0.5 mm.

RELATED PRODUCTS

- Uncoated Lens Kits
See page 1.27
- AR coated lens kits Nd:YAG LaserLine
See page 3.12

HOUSING ACCESSORIES

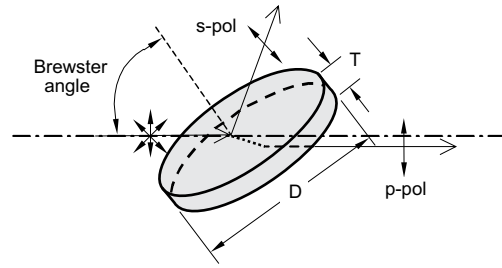
- Self-Centring Lens Mounts 830-0010
See page 7.44



THIN FILM LASER POLARIZERS

Thin Film Polarizers separate s- and p-polarization components. Thin Film Polarizers can be used as an alternative to Glan-Taylor laser polarizing prisms or cube polarizing beamsplitters due to high damage threshold reaching 100 mJ/cm², at 800 nm, 50 fsec.

Thin film polarizers are used in high energy lasers. They can be used for Yb:KYW/KGW or Ti:Sapphire laser fundamental wavelength and its harmonics or intracavity Q-switch hold-off polarizers. The most efficient way to use thin film laser polarizers is at Brewster angle – 56 ± 2° with minimal losses. Typical horizontal polarization ratio T_p/T_s is 200:1.

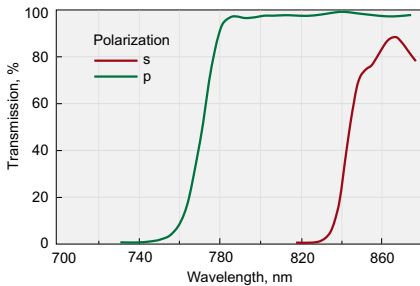


We provide Thin Film Laser Polarizers with T_p>99% per customer request.

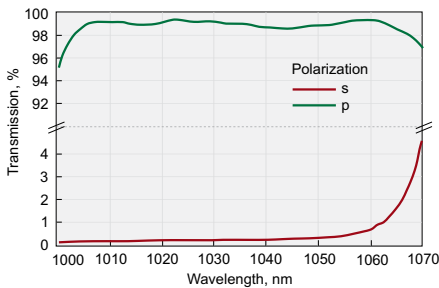
SPECIFICATIONS

Material	BK7, FS, UV FS
Surface quality	20–10 scratch & dig
Transmission efficiency	T _p >95%
Extinction ratio T _p /T _s	>200:1
Laser damage threshold	>100 mJ/cm ² , 50 fsec pulse, 800 nm typical

Material BK7



Transmission curve @ 780-820 nm, AOI=56°



Transmission curve @ 1010-1050 nm, R_s>99%, T_p>95%, AOI= 56°

Catalogue number	Diameter D, mm		Thickness T, mm	Wavelength, nm	Price, EUR
	Metric	English			
420-0114	12.5	12.7	3.0	515	97
420-0126	12.5	12.7	3.0	800	97
420-0136	12.5	12.7	3.0	780-820	145
420-0118	12.5	12.7	3.0	1030	94
420-0138	12.5	12.7	3.0	1010-1050	141
420-0244	25.0	25.4	3.0	515	115
420-0256	25.0	25.4	3.0	800	115
420-0266	25.0	25.4	3.0	780-820	172
420-0248	25.0	25.4	3.0	1030	110
420-0268	25.0	25.4	3.0	1010-1050	165
420-0514	50.0	50.8	6.0	515	185
420-0506	50.0	50.8	6.0	800	185
420-0526	50.0	50.8	6.0	780-820	278
420-0518	50.0	50.8	6.0	1030	185
420-0528	50.0	50.8	6.0	1010-1050	278

Catalogue number	Rectangular dimensions		Thickness T, mm	Wavelength, nm	Price, EUR
	Length, mm	Width, mm			
420-0274	28.6	14.3	3.0	515	127
420-0286	28.6	14.3	3.0	800	127
420-0296	28.6	14.3	3.0	780-820	190
420-0278	28.6	14.3	3.0	1030	125
420-0298	28.6	14.3	3.0	1010-1050	187

Material UV FS

Catalogue number	Diameter D, mm		Thickness T, mm	Wavelength, nm	Price, EUR
	Metric	English			
420-1112	12.5	12.7	3.0	343	149
420-1123	12.5	12.7	3.0	400	119
420-1114	12.5	12.7	3.0	515	119
420-1126	12.5	12.7	3.0	800	119
420-1136	12.5	12.7	3.0	780-820	178
420-1118	12.5	12.7	3.0	1030	115
420-1138	12.5	12.7	3.0	1010-1050	172
420-1242	25.0	25.4	3.0	343	165
420-1253	25.0	25.4	3.0	400	140
420-1244	25.0	25.4	3.0	515	140
420-1256	25.0	25.4	3.0	800	140
420-1266	25.0	25.4	3.0	780-820	210
420-1248	25.0	25.4	3.0	1030	135
420-1268	25.0	25.4	3.0	1010-1050	202

RELATED PRODUCTS

- Thin Film Laser Polarizers of other wavelengths
See page 1.44
- Thin Film Laser Polarizers for Nd:YAG laser applications
See page 3.14

Catalogue number	Diameter D, mm		Thickness T, mm	Wavelength, nm	Price, EUR
	Metric	English			
420-1512	50.0	50.8	6.0	343	315
420-1503	50.0	50.8	6.0	400	269
420-1514	50.0	50.8	6.0	515	269
420-1506	50.0	50.8	6.0	800	269
420-1526	50.0	50.8	6.0	780-820	404
420-1518	50.0	50.8	6.0	1030	263
420-1528	50.0	50.8	6.0	1010-1050	395

Catalogue number	Rectangular dimensions		Thickness T, mm	Wavelength, nm	Price, EUR
	Length, mm	Width, mm			
420-1272	28.6	14.3	3.0	343	255
420-1283	28.6	14.3	3.0	400	215
420-1274	28.6	14.3	3.0	515	215
420-1286	28.6	14.3	3.0	800	215
420-1296	28.6	14.3	3.0	780-820	322
420-1278	28.6	14.3	3.0	1030	210
420-1298	28.6	14.3	3.0	1010-1050	315

Material FS

Catalogue number	Diameter D, mm		Thickness T, mm	Wavelength, nm	Price, EUR
	Metric	English			
420-3112	12.5	12.7	3.0	343	143
420-3123	12.5	12.7	3.0	400	117
420-3114	12.5	12.7	3.0	515	117
420-3126	12.5	12.7	3.0	800	117
420-3136	12.5	12.7	3.0	780-820	175
420-3118	12.5	12.7	3.0	1030	113
420-3138	12.5	12.7	3.0	1010-1050	169
420-3242	25.0	25.4	3.0	343	159
420-3253	25.0	25.4	3.0	400	133
420-3244	25.0	25.4	3.0	515	133
420-3256	25.0	25.4	3.0	800	133
420-3266	25.0	25.4	3.0	780-820	199
420-3248	25.0	25.4	3.0	1030	130
420-3268	25.0	25.4	3.0	1010-1050	195
420-3512	50.0	50.8	6.0	343	300
420-3503	50.0	50.8	6.0	400	259
420-3514	50.0	50.8	6.0	515	259
420-3506	50.0	50.8	6.0	800	259
420-3526	50.0	50.8	6.0	780-820	389
420-3518	50.0	50.8	6.0	1030	251
420-3528	50.0	50.8	6.0	1010-1050	377

Material FS

Please contact us if you need thin film laser polarizers for other wavelengths or other types of substrates.

Catalogue number	Rectangular dimensions		Thickness T, mm	Wavelength, nm	Price, EUR
	Length, mm	Width, mm			
420-3272	28.6	14.3	3.0	343	247
420-3283	28.6	14.3	3.0	400	201
420-3274	28.6	14.3	3.0	515	201
420-3286	28.6	14.3	3.0	800	201
420-3296	28.6	14.3	3.0	780-820	301
420-3278	28.6	14.3	3.0	1030	195
420-3298	28.6	14.3	3.0	1010-1050	292

HOUSING ACCESSORIES

- Adapters for Polarizer at 56°
840-0117, 840-0118
See page 7.74



- Variable Attenuators for Linearly Polarized Laser Beam
990-0070
See page 4.19



QUARTZ RETARDATION PLATES

Quartz Retardation Plates are made of material enabling linear birefringence. These plates are made of high quality optical grade crystalline quartz, featuring high damage threshold. Retardation

plates rotate polarization's direction ($\lambda/2$) or convert linear into circular polarization or vice versa ($\lambda/4$). Quartz retardation plates are supplied mounted and AR coated.

ZERO ORDER OPTICALLY CONTACTED PLATES

- Easily aligned
- Temperature insensitive
- Moderately insensitive to wavelength

Zero order plates are comprised of two different plates cut parallel to their optical axis. This construction makes plates less dependent on temperature. The plates are polished to different thicknesses enabling one to achieve required retardation difference. These component plates have orthogonal optic axis directions, so that the roles of the ordinary and extraordinary rays are interchanged in passing from one plate to another. The thickness of the plate determines the phase shift between the ordinary and extraordinary beams for any specific wavelength.



SPECIFICATIONS

Material	Single crystal quartz
Optical axis	normal to facet on circumference of retarder
Clear aperture	Ø17 mm
Ring mount outer diameter	25.4 +0.0 -0.12 mm
Surface quality	20-40 scr/dig
Wavefront distortion	$\lambda/10$ @ 633 nm
Parallelism	< 10 arcsec
AR coating	R < 0.5%
Laser damage threshold	> 10 mJ/cm ² , 50 fsec pulse, 800 nm typical

RELATED PRODUCTS

- Zero Order Optically Contacted Plates of other wavelengths
See page 1.49
- Zero Order Optically Contacted Plates for Nd:YAG laser applications
See page 3.16

Center wavelength, nm	AR coating range, nm	Retardation $\lambda/2$		Retardation $\lambda/4$	
		Catalogue no.	Price, EUR	Catalogue no.	Price, EUR
1030	1000-1060	460-4208	245	460-4408	245
800	760-840	460-4215	245	460-4415	245
780	740-820	460-4220	245	460-4420	245
515	500-530	460-4232	245	460-4432	245
400	380-420	460-4235	245	460-4435	245
343	333-353	460-4241	270	460-4441	270
266	257-275	460-4245	280	460-4445	280
257	250-265	460-4246	280	460-4446	280

ZERO ORDER AIR-SPACED PLATES

- For high power laser applications



SPECIFICATIONS

Material	Single crystal quartz
Optical axis	normal to facet on circumference of retarder
Clear aperture	Ø17 mm
Ring mount outer diameter	25.4 +0.0 / -0.12 mm
Wavefront distortion	$\lambda/10$ @ 633 nm
Surface quality	20-10 scr/dig
Parallelism	< 10 arcsec
AR coating	R < 0.5%
Laser damage threshold	100 mJ/cm ² , 50 fsec pulse, 800 nm typical

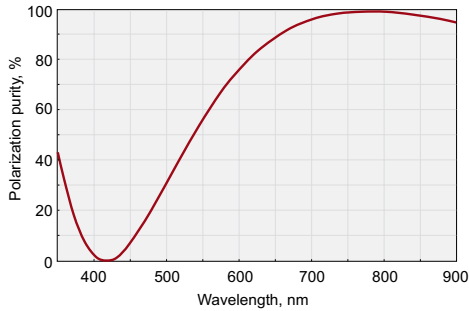
RELATED PRODUCTS

- Zero Order Air-Spaced Plates for Nd:YAG laser applications
See page 3.17

Center wavelength, nm	AR coating range, nm	Retardation $\lambda/2$		Retardation $\lambda/4$	
		Catalogue no.	Price, EUR	Catalogue no.	Price, EUR
1030	1000-1060	464-4208	310	464-4408	310
800	760-840	464-4215	310	464-4415	310
780	740-820	464-4220	310	464-4420	310
515	500-530	464-4232	310	464-4432	310
400	380-420	464-4235	310	464-4435	310
343	333-353	464-4241	335	464-4441	335
266	257-275	464-4245	345	464-4445	345
257	250-265	464-4246	345	464-4446	345

ZERO ORDER DUAL WAVELENGTH PLATES

When optical axis is turned by 45 degrees to input polarization, the waveplate rotates polarization of Ti:Sapphire laser fundamental (800 nm) by 90 degrees and the polarization of Ti:Sapphire second harmonic (400 nm) remains the same.



Polarization purity of zero order dual waveplate

SPECIFICATIONS

Material	Single crystal quartz
Optical axis	normal to facet on circumference of retarder
Clear aperture	Ø17 mm
Ring mount outer diameter	25.4 +0.0/-0.12 mm
Surface quality	20-10 scr/dig
Wavefront distortion	$\lambda/10$ @ 633 nm
Parallelism	<10 arcsec
AR coating	R<0.5%
Laser Damage Threshold:	
Optically Contacted (465-4211)	>10 mJ/cm ² , 50 fsec pulse, 800 nm typical
Air-Spaced (466-4211)	100 mJ/cm ² , 50 fsec pulse, 800 nm typical

Code	Description	AR coated	Price, EUR
465-4211	optically contacted; $\lambda/2@800$ nm + $\lambda@400$ nm	800+400 nm	345
466-4211	air-spaced; $\lambda/2@800$ nm + $\lambda@400$ nm	800+400 nm	410

LOW ORDER PLATES

- Thickness 0.15–0.35 mm
- Thinner than multiple order

Low order plates are less temperature sensitive and temperature dependent than multiple order plates. These plates are suitable for high and low power applications.

SPECIFICATIONS

Material	Single crystal quartz
Optical axis	normal to facet on circumference of retarder
Clear aperture	Ø17 mm
Ring mount outer diameter	25.4 +0.0/-0.12 mm
Surface quality	20–10 scr/dig
Wavefront distortion	$\lambda/10$ @ 633 nm
Parallelism	< 10 arcsec
AR coating	R < 0.5%
Laser damage threshold	100 mJ/cm ² , 50 fsec pulse, 800 nm typical

RELATED PRODUCTS

- Low Order Plates of other wavelengths
See page 1.52
- Low Order Plates for Nd:YAG laser applications
See page 3.17

Center wavelength, nm	AR coating range, nm	Retardation $\lambda/2$		Retardation $\lambda/4$	
		Catalogue no.	Price, EUR	Catalogue no.	Price, EUR
1030	1000-1060	461-4208	160	461-4408	160
800	760-840	461-4215	160	461-4415	160
780	740-820	461-4220	160	461-4420	160
515	500-530	461-4232	160	461-4432	160
400	380-420	461-4235	160	461-4435	160
343	333-353	461-4241	192	461-4441	192
266	257-275	461-4245	196	461-4445	196
257	250-265	461-4246	196	461-4446	196

MULTIPLE ORDER DUAL WAVELENGTH PLATES

SPECIFICATIONS

Material	Single crystal quartz
Optical axis	normal to facet on circumference of retarder
Wavefront distortion	$\lambda/10$ @ 633 nm
Clear aperture	$\varnothing 17$ mm of $\varnothing 20$ mm
Ring mount outer diameter	25.4 (or 25.0) +0.0/-0.12 mm
Surface quality	20-10 scratch & dig
Parallelism	< 10 arcsec
AR coating	R < 0.5%
Nominal thickness of waveplate	0.2-1.2 mm
Laser damage threshold	>100 mJ/cm ² , 50 fsec pulse, 800 nm typical

RELATED PRODUCTS

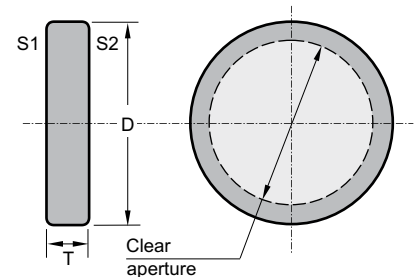
- Dual Wavelength Plates of other wavelengths
See page 1.53
- Dual Wavelength Plates for Nd:YAG laser applications
See page 3.18

Retardation and Wavelength	Catalogue number	Price, EUR
λ @ 800 nm + $\lambda/2$ @ 400 nm	463-4121	215
λ @ 800 nm + $\lambda/4$ @ 400 nm	463-4141	215
$\lambda/2$ @ 800 nm + λ @ 400 nm	463-4211	215
$\lambda/2$ @ 800 nm + $\lambda/2$ @ 400 nm	463-4221	215
$\lambda/2$ @ 800 nm + $\lambda/4$ @ 400 nm	463-4241	215
$\lambda/4$ @ 800 nm + λ @ 400 nm	463-4411	215
$\lambda/4$ @ 800 nm + $\lambda/2$ @ 400 nm	463-4421	215
$\lambda/4$ @ 800 nm + $\lambda/4$ @ 400 nm	463-4441	215

POLARIZATION PLANE ROTATORS

- Made of crystalline quartz
- Intended to rotate a beam polarization plane strictly to an appropriate angle using circular birefringent effect

Compared to a waveplate, a rotator has an intrinsic advantage, being independent of rotation around its own optical axis. It needs no adjustment, only to be installed normal to incident radiation. A polarization plane rotator is normally used for the specific wavelength. It is only slightly dependent on ambient temperature.



SPECIFICATIONS

Material	Single crystal quartz
Optical axis	Normal to faces S1, S2 of rotator
Clear aperture	$\varnothing 17$ mm
Ring mount outer diameter	25.4 +0.0/-0.12 mm
Surface quality	20-10 scr/dig
Wavefront distortion	$\lambda/10$ @ 633 nm
Parallelism	< 10 arcsec
AR coating	R < 0.5%
Laser damage threshold	100 mJ/cm ² , 50 fsec pulse, 800 nm typical

Catalogue number	Center wavelength, nm	Rotation angle of polarization plane, deg	AR coating range, nm	Price, EUR
470-4904	1030	45	1000-1060	215
470-4909	1030	90	1000-1060	215
470-4804	800	45	760-840	195
470-4809	800	90	760-840	195
470-4784	780	45	740-820	195
470-4789	780	90	740-820	195
470-4514	515	45	500-530	195
470-4519	515	90	500-530	195
470-4044	400	45	380-420	195
470-4049	400	90	380-420	195
470-4344	343	45	333-353	195
470-4349	343	90	333-353	195
470-4264	266	45	257-275	245
470-4269	266	90	257-275	245
470-4254	257	45	250-265	245
470-4259	257	90	250-265	245

RELATED PRODUCTS

- Polarization plane rotators of other wavelengths
See page 1.54
- Polarization plane rotators for Nd:YAG laser applications
See page 3.19

Polarization plane rotators for any wavelength from 200 to 2300 nm are available.

GROUP VELOCITY DELAY (GVD) COMPENSATION PLATES

new

Compensation plates are made of Calcite. Plates are available with different orientation for different Group Velocity Delay compensation – starting from tens of femtosecond up to tens of picosecond delay compensation.

Standard GVD compensation plates are adjusted for required compensation by angular tuning changing the angle of incidence. Suggested AOI is -5 to +5 deg, however they also can operate at larger AOI.

Standard plates are made of 14×14 mm aperture, clear aperture dia 12 mm and mounted in to 1" ring holder. The optical axis is at special orientation – non parallel to faces of plate.

AR coatings for custom wavelengths are also available.

SPECIFICATIONS

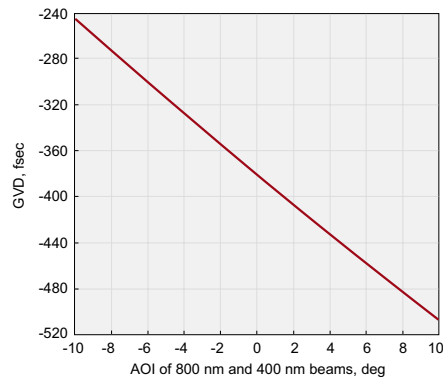
Material	Natural Calcite
Clear aperture	Ø12 mm
Ring mount outer diameter	25.4 +0.0/-0.12 mm
Surface quality	40-20 scr/dig
Wavefront distortion	$\lambda/4 @ 633 \text{ nm}$
Parallelism	<3 arc min
AR coating	R<0.5% 760-840 nm and R<1% at 380-420 nm

Standard Calcite plates for delay compensation between 800 nm ("o" polarization) and 400 nm ("e" polarization) pulses

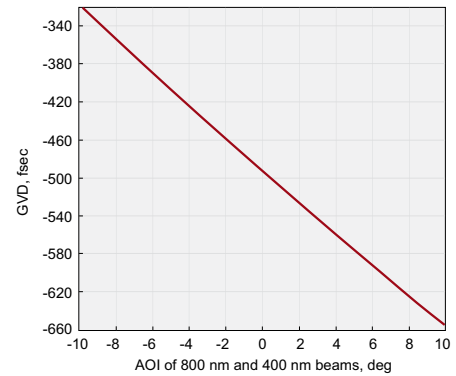
Code	GVD compensation range*	Coatings	Price, EUR
225-2110	310 – 450 fsec	BBAR @ 800+400 nm	470
225-2111	410 – 580 fsec	BBAR @ 800+400 nm	470
225-2112	500 – 710 fsec	BBAR @ 800+400 nm	470

*GVD compensation range at Angle Of Incidence from -5° to +5°.

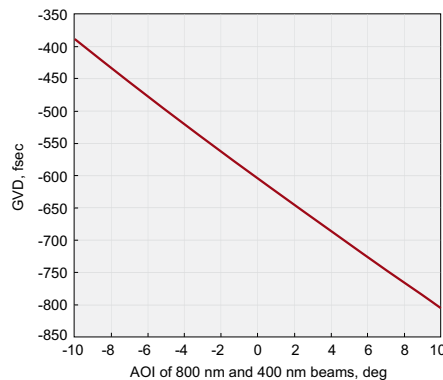
Alpha-BBO plates are available on request.



225-2110.



225-2111.



225-2112.

Group velocity delay between 800 nm and 400 nm pulses in special orientation calcite plates at different angle of incidence 400 nm pulse ("e" pol) is faster than 800 nm pulse ("o" pol).

RELATED PRODUCTS

- Third Harmonic Generation of Ti:Sapphire Laser Kits
See page 4.25
- Thin BBO Crystals for SHG and THG of Ti:Sapphire laser wavelengths
See pages 4.22
- Positioning Mount 840-0199 for Nonlinear Crystal Housing
See page 2.26

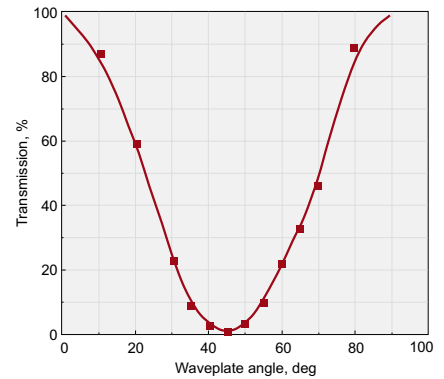
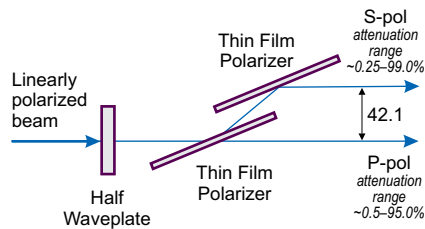
VARIABLE ATTENUATOR FOR FEMTOSECOND LINEARLY POLARIZED LASER BEAM 990-0070



This variable attenuator/beamsplitter consists of special design opto-mechanical Adapter and precision opto-mechanical Holder 840-0197. Two Thin Film Brewster type polarizers, which reflect s-polarized light while transmitting p-polarized light, are housed into Adapter. Quartz Half Waveplates are housed in rotating holder 840-0197

The intensity ratio of those two beams may be continuously varied without alteration of other beam parameters by rotating the waveplate. The intensity of either exit beam, or their intensity ratio,

can be controlled over a wide dynamic range. P-polarization could be selected for maximum transmission, or high-purity s-polarization could be reflected when maximum attenuation of the transmitted beam takes place. The holder 840-0197 allows to adjust Angle Of Incidence of the Thin Film Brewster type polarizers by $\pm 2^\circ$ and to get the maximum polarization contrast.



Note: Movable base 820-0090, Rod Holder 820-0050-02 and standard rod should be ordered separately.

- Divides laser beam into two parallel beams of manually adjustable intensity ratio
- Large dynamic range
- Negligible beam deviation
- High Optical damage threshold
- Weight – 0.35 kg

SPECIFICATIONS

Aperture diameter	17 mm
Damage threshold	>10 mJ/cm ² , 50 fs pulse at 800 nm, typical
for high power laser applications	>100 mJ/cm ² , 50 fs pulse at 800 nm, typical
Time dispersion	t<4 fs for 100 fs Ti:Sapphire laser pulses
Polarization Contrast (after 1st polarizer)	>1:200
Polarization Contrast (after 2nd polarizer)	>1:500

Catalogue number	Wavelength, nm	Price, EUR
990-0070-343	343	840
990-0070-400	400	740
990-0070-400B	390-410	890
990-0070-515	515	740
990-0070-515B	505-525	890
990-0070-800	800	740
990-0070-800B	780-820	890
990-0070-1030	1030	740
990-0070-1030B	1010-1050	890

Zero order optically contacted half waveplate is housed in rotating holder for high power femtosecond applications (Laser damage threshold: >10 mJ/cm², 50 fs pulse at 800 nm, typical).

For High Power Femtosecond Laser Applications

Catalogue number	Wavelength, nm	Price, EUR
990-0070-266H	266	1020
990-0070-343H	343	915
990-0070-400H	400	815
990-0070-400HB	390-410	965
990-0070-515H	515	815
990-0070-515HB	505-525	965
990-0070-800H	800	815
990-0070-800HB	780-820	965
990-0070-1030H	1030	815
990-0070-1030HB	1010-1050	965

Zero Order Air-Spaced half waveplate is housed in rotating holder for high power femtosecond applications (Laser damage threshold: >100 mJ/cm², 50 fs pulse at 800 nm, typical).

RELATED PRODUCTS

- Motorized Variable Attenuator for Linearly Polarized Laser Beam 990-0070M
See page 6.10
- Femtoline Thin Film Laser Polarizers
See page 4.13
- Femtoline Zero Order Optically Contacted/Air-Spaced Plates
See page 4.15
- Beam dumps 990-0800, 990-0820
See page 6.24

VARIABLE ATTENUATOR FOR FEMTOSECOND LINEARLY POLARIZED LASER BEAM 990-0071

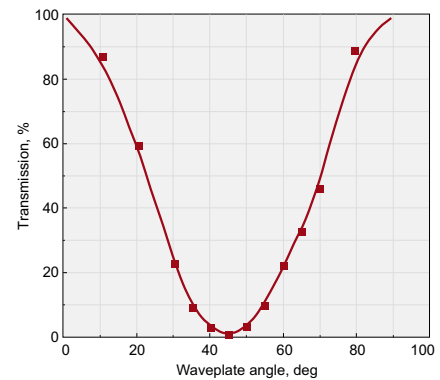
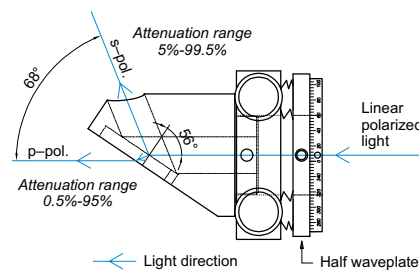


Note: Solid Base Height Extender 820-0210 and Standard Rod 820-0020-20 should be ordered separately

This variable attenuator/beamsplitter consists of special design opto-mechanical adapter for polarizer at 56° 840-0117A or 840-0118A and precision opto-mechanical holder 840-0197. Thin Film Brewster type polarizer, which reflect s-polarized light at 56° while transmitting p-polarized light, is housed into adapter for polarizer at 56°. Quartz Half Waveplates are housed in rotating holder 840-0197.

The intensity ratio of those two beams may be continuously varied without alteration of other beam parameters by rotating the waveplate. The intensity of

either exit beam, or their intensity ratio, can be controlled over a wide dynamic range. P-polarization could be selected for maximum transmission, or high-purity s-polarization could be reflected when maximum attenuation of the transmitted beam takes place. The holder 840-0197 allows to adjust Angle Of Incidence of the Thin Film Brewster type polarizer by $\pm 2^\circ$ and to get the maximum polarization contrast.



- Divides laser beam into separated by 68° angle two beams of manually adjustable intensity ratio
- Large dynamic range
- Negligible transmitted beam deviation
- High Optical damage threshold
- Weight – 0.25 kg

SPECIFICATIONS

Aperture diameter	10 mm
Damage threshold	>10 mJ/cm ² , 50 fs pulse at 800 nm, typical
for high power laser applications	>100 mJ/cm ² , 50 fs pulse, 800 nm typical
Time dispersion	t<4 fs for 100 fs Ti:Sapphire laser pulses
Polarization Contrast	>1:200

For Femtosecond Applications

Catalogue number	Wavelength, nm	Price, EUR
990-0071-343	343	600
990-0071-400	400	550
990-0071-400B	390-410	650
990-0071-515	515	550
990-0071-515B	505-525	650
990-0071-800	800	550
990-0071-800B	780-820	650
990-0071-1030	1030	550
990-0071-1030B	1010-1050	650

Zero order optically contacted half waveplate is housed in rotating holder 840-0197 (laser damage threshold: >10 mJ/cm², 50 fs pulse at 800 nm, typical).

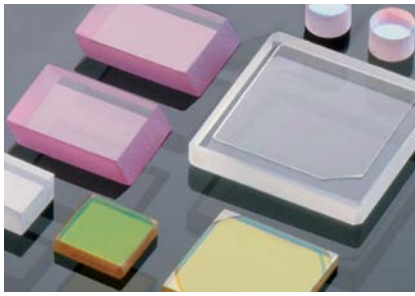
For High Power Femtosecond Laser Applications

Catalogue number	Wavelength, nm	Price, EUR
990-0071-266H	266	690
990-0071-343H	343	665
990-0071-400H	400	615
990-0071-400HB	390-410	715
990-0071-515H	515	615
990-0071-515HB	505-525	715
990-0071-800H	800	615
990-0071-800HB	780-820	715
990-0071-1030H	1030	615
990-0071-1030HB	1010-1050	715

Zero Order Air-Spaced half waveplate is housed in rotating holder 840-0197 (laser damage threshold: >100 mJ/cm², 50 fs pulse at 800 nm, typical).

RELATED PRODUCTS

- Motorized Variable Attenuator for Linearly Polarized Laser Beam 990-0071M
See page 6.12
- Femtoline Zero Order Optically Contacted / Air-Spaced Plates
See page 4.15
- Femtoline Thin Film Laser Polarizers
See page 4.13



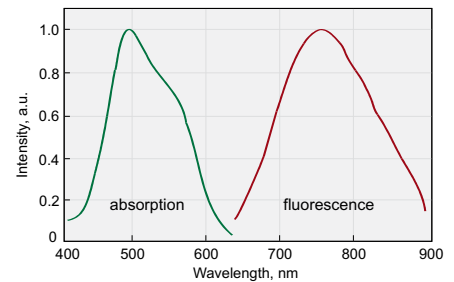
FemtoLine Laser Crystals

FEMTOLINE LASER OPTICS

TI:SAPPHIRE (Titanium Doped Sapphire – $Ti:Al_2O_3$) LASER LINE AND HARMONICS



Ti:Sapphire laser crystal is used as a gain medium for tunable lasers and femtosecond solid-state lasers. Lasers based on Ti:Sapphire crystal are mainly used to generate ultrashort – femtosecond pulses. The lasing band of Ti:Sapphire is 660-1050 nm, while common pump wavelength is frequency doubled Nd:YAG laser line at 532 nm or Argon Ion laser lines at 490-514 nm. The peak of emission in Ti:Sapphire is at 790-800 nm wavelength.



MATERIAL PHYSICAL AND LASER PROPERTIES

Chemical formula	$Ti^{3+}:Al_2O_3$
Crystal structure	Hexagonal
Lattice constants	$a=4.748, c=12.957$
Density	3.98 g/cm^3
Mohs hardness	9
Thermal conductivity	$0.11 \text{ cal}/(^{\circ}\text{C}\times\text{sec}\times\text{cm})$
Specific heat	0.10 cal/g
Melting point	$2050 \text{ }^{\circ}\text{C}$
Laser action	4-Level Vibronic
Fluorescence lifetime	$3.2 \text{ } \mu\text{sec}$ (T=300K)
Tuning range	660–1050 nm
Absorption range	400–600 nm
Emission peak	795 nm
Absorption peak	488 nm
Refractive index	1.76 @ 800 nm

STANDARD PRODUCT SPECIFICATIONS

Orientation	optical axis C normal to rod axis
Ti_2O_3 concentration	0.03–0.25 wt %
Figure of Merit	> 150
Size	up to 20 mm dia and up to 130 mm length
End configurations	flat/flat or Brewster/Brewster
End flatness	$\lambda/10$ @ 633 nm
Parallelism	10 arcsec
Surface finishing	10/5 scratch/dig
Wavefront distortion	$\lambda/4$ inch

Note: To inquire or order a finished Ti:Sa laser rod, please provide detailed specifications. Dopant concentration, size of crystal and end configuration are essential specifications.

Frequency Conversion of Ti:Sapphire laser wavelengths

Frequency doubling and tripling allow access to the green, blue and ultraviolet spectral regions. While the frequency conversion by Optical Parametric Generation offers wide tuning range in the near-infrared spectral region, it is often sufficient to tune the Ti:sapphire wavelength for tuning the OPO, rather

than tuning the OPO itself, e.g. by actively affecting the phase-matching conditions. Further wavelength extension to mid infrared range is possible by Difference Frequency Generation employing signal and idler wavelength pulses obtained from OPO.

Crystals selection for Ti:Sapphire laser frequency conversion

Thin BBO crystals for SHG @ 800 nm	→	350 – 450 nm range
Thin BBO crystals for THG @ 800 nm	→	230 – 300 nm range
Thin BBO crystals for OPG/OPA @ pump 800 nm	→	1050 – 2300 nm range
Thin BBO crystals for OPG/OPA @ pump 400 nm	→	480 – 2300 nm range
AgGaS ₂ crystals for DFG	→	2500-12000 nm range

FEMTOLINE LASER AND NONLINEAR CRYSTALS

THIN BBO CRYSTALS FOR SHG AND THG OF Ti:SAPPHIRE LASER WAVELENGTH



Free Standing BBO Crystals

The crystals down to 100 μm can be supplied as free standing crystals not attached to the support. However, ring mounts are highly recommended for safe handling of these thin crystals. Minimum aperture of free standing BBO is 5x5 mm, maximum aperture is 22x22 mm. The tolerance is $\pm 50 \mu\text{m}$ for crystals of thickness down to 300 μm and $\pm 20 \mu\text{m}$ for crystals of thickness down to 100 μm .

Optically contacted crystals

BBO crystals less than 100 μm thickness can be supplied optically contacted on UV Fused Silica substrate sizes 10x10x1 mm

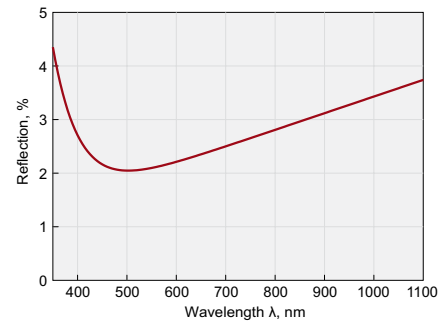
or 12x12x2 mm. Other sizes of substrates are also available on request. Minimum aperture of optically contacted BBO is 5x5 mm, maximum aperture is 10x10 mm. The tolerance of crystal thickness is +10/-5 microns.

Protective Coatings for BBO crystals

P-protective coating – is a single or two layer antireflection coating made at specified wavelength range. Typical reflection values are $R < 2\%$ in the mid range, $R < 4\%$ at the edges. P coating is highly recommended for ultrashort pulse applications and features low dispersion and very high laser damage threshold.

STANDARD SPECIFICATIONS OF ULTRATHIN BBO CRYSTALS

Flatness	$\lambda/8 @ 633 \text{ nm}$
Parallelism	$< 20 \text{ arcsec}$
Perpendicularity	$< 5 \text{ arcmin}$
Angle tolerance	$< 30 \text{ arcmin}$
Aperture tolerance	$\pm 0.1 \text{ mm}$
Surface quality	10/5 scratch & dig per MIL-O-13830A
Clear aperture	$> 90\%$ of full aperture



Typical P-coating for BBO SHG@800 nm application

EKSMA OPTICS recommends the following thickness BBO crystals depending on application and fundamental wavelength pulse duration, assuming it is spectrum limited Gaussian pulse.

Application	Pulse duration, fs	Thickness, mm
Type 1, SHG @ 800 nm $\Theta=29.2^\circ, \varphi=90^\circ$	10	0.05
	20	0.1
	50	0.2
	100	0.5
	200	1
Type 1, THG @ 800 nm $\Theta=44.3^\circ, \varphi=90^\circ$	10	0.01
	20	0.02
	50	0.05
	100	0.1
	200	0.2

BBO for SHG @ 800 nm

BBO crystal, Thickness = 0.05 mm*

Code	Aperture, mm	UV FS support size, mm	θ , deg	φ , deg	Coating	Price, EUR
BBO-600	6x6	10x10x2	29.2	90	P/P@400-800 nm	725
BBO-800	8x8	10x10x2	29.2	90	P/P@400-800 nm	760
BBO-1000	10x10	12x12x2	29.2	90	P/P@400-800 nm	850

* All BBO crystals of thickness less than 100 μ m are optically contacted onto UVFS support.

SHG BBO crystals, Thickness = 0.1 mm

Code	Aperture, mm	θ , deg	φ , deg	Coating	Price, EUR
BBO-601	6x6	29.2	90	P/P@400-800 nm	455
BBO-801	8x8	29.2	90	P/P@400-800 nm	660
BBO-1001	10x10	29.2	90	P/P@400-800 nm	675
BBO-1201	12x12	29.2	90	P/P@400-800 nm	960
BBO-1501	15x15	29.2	90	P/P@400-800 nm	1390
BBO-2001	20x20	29.2	90	P/P@400-800 nm	2640
BBO-2201	22x22	29.2	90	P/P@400-800 nm	3390

SHG BBO crystal, Thickness = 0.2 mm

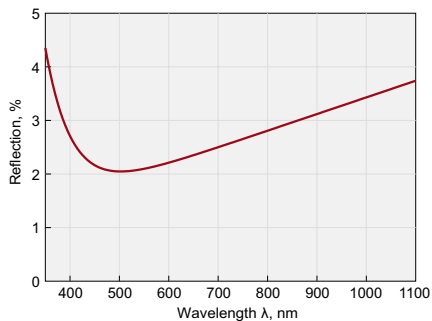
Code	Aperture, mm	θ , deg	φ , deg	Coating	Price, EUR
BBO-602	6x6	29.2	90	P/P@400-800 nm	455
BBO-802	8x8	29.2	90	P/P@400-800 nm	660
BBO-1002	10x10	29.2	90	P/P@400-800 nm	675
BBO-1202	12x12	29.2	90	P/P@400-800 nm	930
BBO-1502	15x15	29.2	90	P/P@400-800 nm	1360
BBO-2002	20x20	29.2	90	P/P@400-800 nm	2590
BBO-2202	22x22	29.2	90	P/P@400-800 nm	3340

SHG BBO crystal, Thickness = 0.5 mm

Code	Aperture, mm	θ , deg	φ , deg	Coating	Price, EUR
BBO-603	6x6	29.2	90	P/P@400-800 nm	360
BBO-803	8x8	29.2	90	P/P@400-800 nm	575
BBO-1003	10x10	29.2	90	P/P@400-800 nm	610
BBO-1203	12x12	29.2	90	P/P@400-800 nm	890
BBO-1503	15x15	29.2	90	P/P@400-800 nm	1305
BBO-2003	20x20	29.2	90	P/P@400-800 nm	2455
BBO-2203	22x22	29.2	90	P/P@400-800 nm	3150

SHG BBO crystal, Thickness = 1 mm

Code	Aperture, mm	θ , deg	φ , deg	Coating	Price, EUR
BBO-604	6x6	29.2	90	P/P@400-800 nm	260
BBO-804	8x8	29.2	90	P/P@400-800 nm	510
BBO-1004	10x10	29.2	90	P/P@400-800 nm	575
BBO-1204	12x12	29.2	90	P/P@400-800 nm	860
BBO-1504	15x15	29.2	90	P/P@400-800 nm	1250
BBO-2004	20x20	29.2	90	P/P@400-800 nm	2285
BBO-2204	22x22	29.2	90	P/P@400-800 nm	2930



P-protective coating curve of Type 1
($\theta=29.2^\circ$, $\varphi=90^\circ$) BBO crystal used for SHG@800 nm

SHG BBO crystal, Thickness = 2 mm

Code	Aperture, mm	θ , deg	φ , deg	Coating	Price, EUR
BBO-605	6x6	29.2	90	P/P@400-800 nm	260
BBO-805	8x8	29.2	90	P/P@400-800 nm	570
BBO-1005	10x10	29.2	90	P/P@400-800 nm	780
BBO-1205	12x12	29.2	90	P/P@400-800 nm	1150
BBO-1505	15x15	29.2	90	P/P@400-800 nm	1370
BBO-2005	20x20	29.2	90	P/P@400-800 nm	2720
BBO-2205	22x22	29.2	90	P/P@400-800 nm	3360

HOUSING ACCESSORIES

- Ring Holders for Nonlinear Crystals
See page 2.24



- Positioning Mount 840-0199 for Nonlinear Crystal Housing
See page 2.26



BBO for THG @ 800 nm

BBO crystal, Thickness = 0.01 mm*

Code	Aperture, mm	UV FS support size, mm	θ , deg	φ , deg	Coating	Price, EUR
BBO-606	6×6	10×10×2	44.3	90	P/P@400-800/266	795
BBO-806	8×8	10×10×2	44.3	90	P/P@400-800/266	830
BBO-1006	10×10	12×12×2	44.3	90	P/P@400-800/266	925

BBO crystal, Thickness = 0.02 mm*

Code	Aperture, mm	UV FS support size, mm	θ , deg	φ , deg	Coating	Price, EUR
BBO-607	6×6	10×10×2	44.3	90	P/P@400-800/266	790
BBO-807	8×8	10×10×2	44.3	90	P/P@400-800/266	820
BBO-1007	10×10	12×12×2	44.3	90	P/P@400-800/266	915

BBO crystal, Thickness = 0.05 mm*

Code	Aperture, mm	UV FS support size, mm	θ , deg	φ , deg	Coating	Price, EUR
BBO-608	6×6	10×10×2	44.3	90	P/P@400-800/266	725
BBO-808	8×8	10×10×2	44.3	90	P/P@400-800/266	760
BBO-1008	10×10	12×12×2	44.3	90	P/P@400-800/266	850

* All BBO crystals of thickness less than 100 μm are optically contacted onto UVFS support.

THG BBO crystal, Thickness = 0.2 mm

Code	Aperture, mm	θ , deg	φ , deg	Coating	Price, EUR
BBO-610	6×6	44.3	90	P/P@400-800/266	455
BBO-810	8×8	44.3	90	P/P@400-800/266	660
BBO-1010	10×10	44.3	90	P/P@400-800/266	675
BBO-1210	12×12	44.3	90	P/P@400-800/266	930
BBO-1510	15×15	44.3	90	P/P@400-800/266	1360
BBO-2010	20×20	44.3	90	P/P@400-800/266	2590
BBO-2210	22×22	44.3	90	P/P@400-800/266	3340

THG BBO crystal, Thickness = 0.1 mm

Code	Aperture, mm	θ , deg	φ , deg	Coating	Price, EUR
BBO-609	6×6	44.3	90	P/P@400-800/266	455
BBO-809	8×8	44.3	90	P/P@400-800/266	660
BBO-1009	10×10	44.3	90	P/P@400-800/266	675
BBO-1209	12×12	44.3	90	P/P@400-800/266	960
BBO-1509	15×15	44.3	90	P/P@400-800/266	1390
BBO-2009	20×20	44.3	90	P/P@400-800/266	2640
BBO-2209	22×22	44.3	90	P/P@400-800/266	3390

THG BBO crystal, Thickness = 1 mm

Code	Aperture, mm	θ , deg	φ , deg	Coating	Price, EUR
BBO-612	6×6	44.3	90	P/P@400-800/266	260
BBO-812	8×8	44.3	90	P/P@400-800/266	510
BBO-1012	10×10	44.3	90	P/P@400-800/266	575
BBO-1212	12×12	44.3	90	P/P@400-800/266	860
BBO-1512	15×15	44.3	90	P/P@400-800/266	1250
BBO-2012	20×20	44.3	90	P/P@400-800/266	2285
BBO-2212	22×22	44.3	90	P/P@400-800/266	2930

THG BBO crystal, Thickness = 0.5 mm

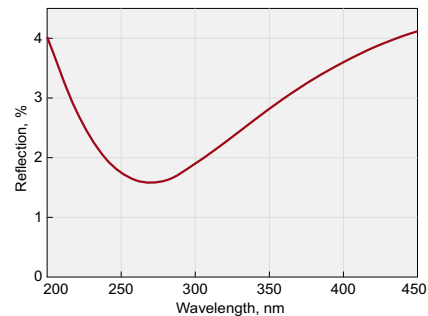
Code	Aperture, mm	θ , deg	φ , deg	Coating	Price, EUR
BBO-611	6×6	44.3	90	P/P@400-800/266	360
BBO-811	8×8	44.3	90	P/P@400-800/266	575
BBO-1011	10×10	44.3	90	P/P@400-800/266	610
BBO-1211	12×12	44.3	90	P/P@400-800/266	890
BBO-1511	15×15	44.3	90	P/P@400-800/266	1305
BBO-2011	20×20	44.3	90	P/P@400-800/266	2455
BBO-2211	22×22	44.3	90	P/P@400-800/266	3150

NOTE

For very high power (TW) laser systems LBO and KDP crystals can be supplied with Clear Apertures up to 35 mm and 60 mm diameters respectively.

HOUSING ACCESSORIES

- Ring Holders for Nonlinear Crystals
See page 2.24
- Positioning Mount 840-0199 for Nonlinear Crystal Housing
See page 2.26



P-protective coating curve of Type 1 ($\theta=44.3^\circ$, $\varphi=90^\circ$) BBO crystal's exit face used for THG@800 nm

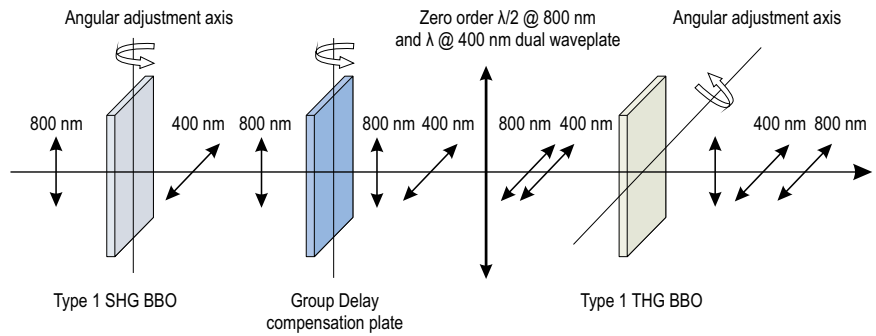
RELATED PRODUCTS

- Zero Order Dual Wavelength Plates
See page 4.16

THIRD HARMONIC GENERATION OF Ti:SAPPHIRE LASER KITS



Kits consist of set of components required for efficient third harmonic generation of femtosecond Ti:Sapphire laser. The scheme of the efficient third harmonic generation is presented on the right.



Complete standard kit includes:

- ▶ Type 1 SHG BBO crystal with 6x6 mm aperture, P-coated @ 400-800 nm,
- ▶ Type 1 THG BBO crystal with 6x6 mm aperture, P-coated @ 400-800/266 nm,
- ▶ Calcite plate for group delay compensation, AR coated @ 800+400 nm,
- ▶ Zero order dual waveplate, optically contacted, AR coated @ 800+400 nm (code 465-4211),
- ▶ All above four components are mounted in to 1 inch ring holders for convenient handling.

The thickness of SHG BBO crystal, THG BBO crystal and group delay compensation plate is different in each kit and is optimal for certain pulse duration of fundamental harmonic to avoid harmonic pulses broadening.

We offer four standard kits for different fundamental pulse duration:

Fundamental pulse duration	Kit code	Price, EUR
200 fsec	FK-800-200	1510
100 fsec	FK-800-100	1610
50 fsec	FK-800-050	1975
20 fsec	FK-800-020	2040

Non-standard kits with larger apertures of BBO crystals and thicknesses optimal for other pulse durations are available on request.

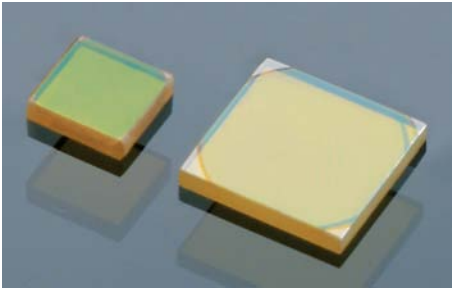


RELATED PRODUCTS

- Kinematic positioning mount 840-0199 for tilt and tip fine adjustment and 360° rotation
See page 2.26



THIN AgGaS₂ CRYSTALS FOR DFG → 2.5-1.3 μm



STANDARD SPECIFICATIONS

Flatness	λ/6 @ 633 nm
Parallelism	< 20 arcsec
Perpendicularity	< 10 arcmin
Angle tolerance	< 30 arcmin
Aperture tolerance	± 0.1 mm
Surface quality	10/5 scratch & dig per MIL-O-13830A
Clear aperture	>90% of full aperture

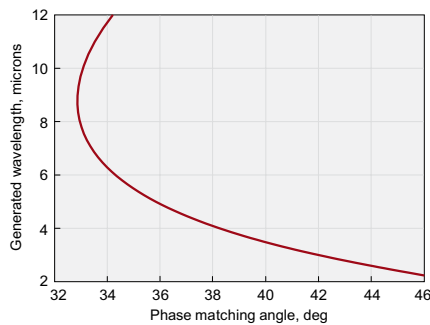
BBAR Coatings for AgGaS₂ crystals

BBAR coating – is multilayer dielectric antireflection coating made at specified wavelength range. Standard coating is designed to reduce reflection losses at input side at 1.1-2.6 micron range and output side at 2.6-11 micron range

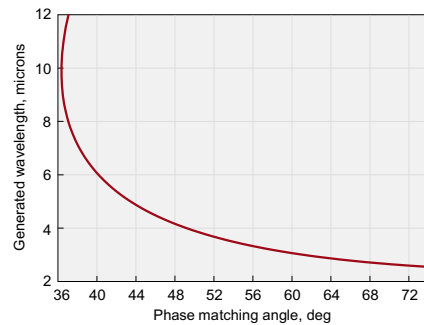
Typical reflection values are R<0.5% in the mid range, and up to reflection values of uncoated crystal at the edges of given ranges.

BBAR coating is designed to minimise dispersion of ultrashort pulses and also features high damage threshold.

AgGaS ₂	Size, mm			Orientation		Coating	Application	Price, EUR
	W	H	L	θ	φ			
AGS-401	5	5	1	39	45	BBAR/BBAR @ 1.1-2.6 / 2.6-11 μm	OPO @ 1.2-2.4 μm → 2.4-11 μm	575,-
AGS-402	6	6	2	50	0	BBAR/BBAR @ 1.1-2.6 / 2.6-11 μm	OPO @ 1.2-2.4 μm → 2.4-11 μm	645,-



Type 1 DFG (e-o=e) in AGS. DFG of signal and idler generated in BBO pumped at 800 nm



Type 2 DFG (e-o=e) in AGS. DFG of signal and idler generated in BBO pumped at 800 nm

HOUSING ACCESSORIES

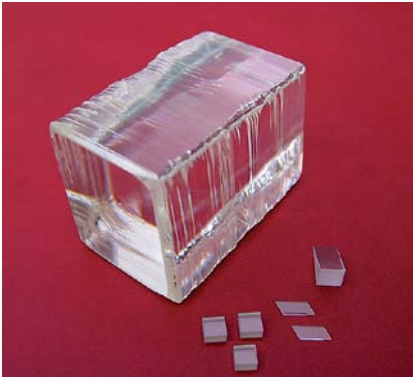
- Ring Holders for Nonlinear Crystals
See page 2.24



- Positioning Mount 840-0199 for Nonlinear Crystal Housing
See page 2.26



Yb:KGW AND Yb:KYW CRYSTALS LASER LINES AND HARMONICS



Yb:KGW and Yb:KYW crystals have broad emission bandwidths and are used as lasing materials to generate ultrashort (~100-200 fs) high power pulses. Direct pump of Yb:KGW/KYW crystals with laser diodes operating at 981 nm supports compact laser systems. Yb:KGW/KYW laser generates pulses at 1023-1060 nm wavelength range.

Also Yb:KGW and Yb:KYW can be used as ultrashort pulse amplifiers.

We believe that Yb:KGW and Yb:KYW are some of the best materials for high power thin disk lasers generating femtosecond pulses.

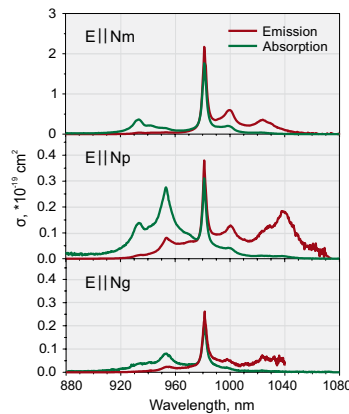
CUSTOM MANUFACTURING CAPABILITIES

- Various shapes (slabs, rods, cubes, disks)
- Different dopant levels
- Diversified coatings
- Attractive prices for introductory quantities to OEMs

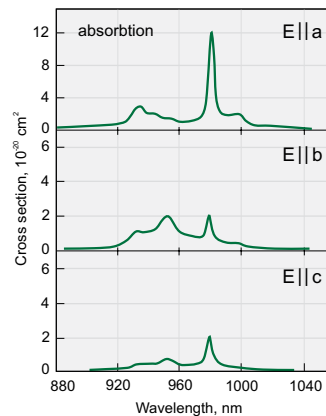
- High absorption coefficient at 981 nm
- High stimulated emission cross section
- Low laser threshold
- Extremely low quantum defect $\lambda_{\text{pump}} / \lambda_{\text{se}}$
- Broad polarized output at 1023–1060 nm
- High slope efficiency with diode pumping (~ 60%)
- High Yb doping concentration

PROPERTIES OF Yb:KGW AND Yb:KYW

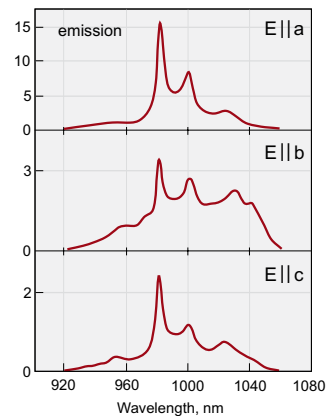
Name	Yb:KGW	Yb:KYW
Yb ³⁺ concentration	0.5–5%	0.5–100%
Crystal structure	monoclinic	monoclinic
Point group	C2/c	C2/c
Lattice parameters	a=8.095 Å, b=10.43 Å, c=7.588 Å, β=94.43°	a=8.05 Å, b=10.35 Å, c=7.54 Å, β=94°
Thermal expansion	$\alpha_a=4 \times 10^{-6} / ^\circ\text{C}$, $\alpha_b=3.6 \times 10^{-6} / ^\circ\text{C}$, $\alpha_c=8.5 \times 10^{-6}$	—
Thermal conductivity	$K_a=2.6 \text{ W/mK}$, $K_b=3.8 \text{ W/mK}$, $K_c=3.4 \text{ W/mK}$	—
Density	7.27 g/cm ³	6.61 g/cm ³
Mohs' hardness	4–5	4–5
Melting temperature	1075 °C	—
Transmission range	0.35–5.5 μm	0.35–5.5 μm
Refractive indices (λ=1.06 μm)	$n_g=2.037$, $n_p=1.986$, $n_m=2.033$	—
$\partial n / \partial t$	$0.4 \times 10^{-6} \text{ K}^{-1}$	$0.4 \times 10^{-6} \text{ K}^{-1}$
Laser wavelength	1023–1060 nm	1025–1058 nm
Fluorescence lifetime	0.3 ms	0.3 ms
Stimulated emission cross section (E a)	$2.6 \times 10^{-20} \text{ cm}^2$	$3 \times 10^{-20} \text{ cm}^2$
Absorption peak and bandwidth	$\alpha_a=26 \text{ cm}^{-1}$, λ=981 nm, Δλ=3.7 nm	$\alpha_a=40 \text{ cm}^{-1}$, λ=981 nm, Δλ=3.5 nm
Absorption cross section	$1.2 \times 10^{-19} \text{ cm}^2$	$1.33 \times 10^{-19} \text{ cm}^2$
Lasing threshold	35 mW	70 mW
Stark levels energy (in cm ⁻¹) of the ² F _{5/2} manifolds of Yb ³⁺ @ 77K	10682, 10471, 10188	10695, 10476, 10187
Stark levels energy (in cm ⁻¹) of the ² F _{7/2} manifolds of Yb ³⁺ @ 77K	535, 385, 163, 0	568, 407, 169, 0



Absorption and stimulated emission cross sections of Yb:KYW



Absorption and emission spectra of Yb(5%):KGW

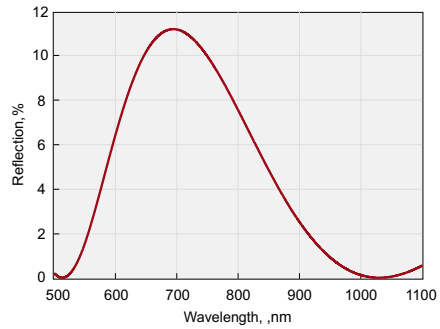


BBO AND LBO CRYSTALS FOR SHG OF Yb:KGW/KYW FREQUENCY CONVERSION

EKSMA OPTICS recommends the following thickness BBO and LBO crystals for Type 1 SHG at 1030 nm depending on fundamental wavelength pulse duration, assuming it is spectrum limited Gaussian pulse.

SHG@1030 nm	BBO crystal thickness	LBO crystal thickness
50 fs	0.5 mm	0.9 mm
100 fs	1 mm	1.9 mm
150 fs	1.5 mm	2.8 mm
200 fs	2 mm	3.7 mm

NOTE
LBO crystals can be supplied with Clear Aperture up to 35 mm diameter.



Typical AR@1030+515 nm coating for LBO or BBO SHG@1030 nm application

SHG LBO crystals

SHG LBO crystals, Type 1, Thickness = 0.9 mm

Code	Aperture, mm	θ , deg	ϕ , deg	Coating	Price, EUR
LBO-601	6×6	90	13.8	AR/AR@515+1030 nm	515
LBO-801	8×8	90	13.8	AR/AR@515+1030 nm	620
LBO-1001	10×10	90	13.8	AR/AR@515+1030 nm	650
LBO-1201	12×12	90	13.8	AR/AR@515+1030 nm	890
LBO-1501	15×15	90	13.8	AR/AR@515+1030 nm	1300
LBO-2001	20×20	90	13.8	AR/AR@515+1030 nm	2385
LBO-2201	22×22	90	13.8	AR/AR@515+1030 nm	3050

SHG LBO crystals, Type 1, Thickness = 1.9 mm

Code	Aperture, mm	θ , deg	ϕ , deg	Coating	Price, EUR
LBO-602	6×6	90	13.8	AR/AR@515+1030 nm	460
LBO-802	8×8	90	13.8	AR/AR@515+1030 nm	610
LBO-1002	10×10	90	13.8	AR/AR@515+1030 nm	815
LBO-1202	12×12	90	13.8	AR/AR@515+1030 nm	1190
LBO-1502	15×15	90	13.8	AR/AR@515+1030 nm	1405
LBO-2002	20×20	90	13.8	AR/AR@515+1030 nm	2750
LBO-2202	22×22	90	13.8	AR/AR@515+1030 nm	3395

SHG LBO crystals, Type 1, Thickness = 2.8 mm

Code	Aperture, mm	θ , deg	ϕ , deg	Coating	Price, EUR
LBO-603	6×6	90	13.8	AR/AR@515+1030 nm	545
LBO-803	8×8	90	13.8	AR/AR@515+1030 nm	790
LBO-1003	10×10	90	13.8	AR/AR@515+1030 nm	1035
LBO-1203	12×12	90	13.8	AR/AR@515+1030 nm	1405
LBO-1503	15×15	90	13.8	AR/AR@515+1030 nm	1535
LBO-2003	20×20	90	13.8	AR/AR@515+1030 nm	3180
LBO-2203	22×22	90	13.8	AR/AR@515+1030 nm	3935

SHG LBO crystals, Type 1, Thickness = 3.7 mm

Code	Aperture, mm	θ , deg	ϕ , deg	Coating	Price, EUR
LBO-604	6×6	90	13.8	AR/AR@515+1030 nm	465
LBO-804	8×8	90	13.8	AR/AR@515+1030 nm	660
LBO-1004	10×10	90	13.8	AR/AR@515+1030 nm	895
LBO-1204	12×12	90	13.8	AR/AR@515+1030 nm	1210
LBO-1504	15×15	90	13.8	AR/AR@515+1030 nm	1730
LBO-2004	20×20	90	13.8	AR/AR@515+1030 nm	2830
LBO-2204	22×22	90	13.8	AR/AR@515+1030 nm	3260

SHG BBO crystals

SHG BBO crystals, Type 1, Thickness = 0.5 mm

Code	Aperture, mm	θ , deg	ϕ , deg	Coating	Price, EUR
BBO-651	6×6	23.4	90	AR/AR@515+1030 nm	490
BBO-851	8×8	23.4	90	AR/AR@515+1030 nm	625
BBO-1051	10×10	23.4	90	AR/AR@515+1030 nm	650
BBO-1251	12×12	23.4	90	AR/AR@515+1030 nm	940
BBO-1551	15×15	23.4	90	AR/AR@515+1030 nm	1350
BBO-2051	20×20	23.4	90	AR/AR@515+1030 nm	2495
BBO-2251	22×22	23.4	90	AR/AR@515+1030 nm	3190

SHG BBO crystals, Type 1, Thickness = 1 mm

Code	Aperture, mm	θ , deg	ϕ , deg	Coating	Price, EUR
BBO-652	6×6	23.4	90	AR/AR@515+1030 nm	420
BBO-852	8×8	23.4	90	AR/AR@515+1030 nm	550
BBO-1052	10×10	23.4	90	AR/AR@515+1030 nm	610
BBO-1252	12×12	23.4	90	AR/AR@515+1030 nm	910
BBO-1552	15×15	23.4	90	AR/AR@515+1030 nm	1295
BBO-2052	20×20	23.4	90	AR/AR@515+1030 nm	2325
BBO-2252	22×22	23.4	90	AR/AR@515+1030 nm	2970

SHG BBO crystals, Type 1, Thickness = 1.5 mm

Code	Aperture, mm	θ , deg	ϕ , deg	Coating	Price, EUR
BBO-653	6×6	23.4	90	AR/AR@515+1030 nm	465
BBO-853	8×8	23.4	90	AR/AR@515+1030 nm	585
BBO-1053	10×10	23.4	90	AR/AR@515+1030 nm	695
BBO-1253	12×12	23.4	90	AR/AR@515+1030 nm	1050
BBO-1553	15×15	23.4	90	AR/AR@515+1030 nm	1365
BBO-2053	20×20	23.4	90	AR/AR@515+1030 nm	2465
BBO-2253	22×22	23.4	90	AR/AR@515+1030 nm	3155

SHG BBO crystals, Type 1, Thickness = 2 mm

Code	Aperture, mm	θ , deg	ϕ , deg	Coating	Price, EUR
BBO-654	6×6	23.4	90	AR/AR@515+1030 nm	470
BBO-854	8×8	23.4	90	AR/AR@515+1030 nm	615
BBO-1054	10×10	23.4	90	AR/AR@515+1030 nm	820
BBO-1254	12×12	23.4	90	AR/AR@515+1030 nm	1190
BBO-1554	15×15	23.4	90	AR/AR@515+1030 nm	1410
BBO-2054	20×20	23.4	90	AR/AR@515+1030 nm	2755
BBO-2254	22×22	23.4	90	AR/AR@515+1030 nm	3395