

Optics for CO₂-Laser

Tydex offers various optics for CO₂-lasers. Suitable materials for such application are Silicon, Zinc Selenide, Germanium, Gallium Arsenide and Potassium Chloride. Depending on a customer needs we propose the following parts:

MIRRORS

WINDOWS

LENSES

- Plano-convex lenses
- Meniscus lenses
- Cylindrical lenses
- Custom-made lenses

PARTIAL REFLECTORS

- Beamsplitters



For these parts various coatings, such as AR, BBAR, PR, HR are available.

MIRRORS



Optical components - mirrors are intended for the following applications:

- laser resonators;
- systems of transforming and focusing of laser's beam.

Silicon is effectively used as the substrates for production of CO₂ mirrors. Laser resonators can be formed in different designs but the cavity mirrors basically consist of a total reflector and an output coupler. The total reflectors are used as rear reflectors and fold mirrors and externally as beam benders in beam delivery systems.

We mainly offer plane, concave, and convex elements. Circular, rectangle, and ellipsoid configuration of the mirrors are realizable.

The reflectivity of such mirrors should be as high as possible for a laser wavelength. To meet above requirement Tydex provides some types of total reflecting coatings on the base of Au which allow to achieve more than 99.0% reflectance at 10.6 μm . Upon special inquiry above coatings can be optimized not only to provide high reflectance at 10.6 μm but to emphasize a definite wavelength at visible spectral range as well. Such coatings for the application discussed withstand power density to 1 kW/cm^2 in CW mode and energy density to 1 J/cm^2 for pulsed lasers.

Maximal available sizes of optical components are:

Si - 200 mm.



TYDEX[®]
J.S.C.O.

Domostroitelnaya str. 16, 194292 St.Petersburg, RUSSIA
Tel: 7-812-3346701, -3318702; Fax: 7-812-3346702
E-mail: tydex@tydex.ru, URL: <http://www.tydex.ru>

SILICON MIRRORS

Silicon is the most commonly used mirror substrate. Its advantages are low cost, good durability, and thermal stability. Low value of the coefficient of linear thermal expansion and its weak increasing with the temperature make Silicon key material for low power CO₂-lasers.



Specification:

Material	monocrystalline Cz-Si
Shape of the working surface	plane, spherical
Dimensional range (diagonal of optical part), mm	to 200
Clear aperture	> 90% of a size
Diameter (width & length) tolerances, mm	+0.0 / -0.1
Thickness tolerance, mm	+/- 0.1
Parallelism (concentricity) plano & radiused, arc. min.	<= 5
Surface quality, scr/dig:	
for parts to 3 inches	40/20
for larger parts	60/40
Surface figure (power-irregularity) @ 633 nm:	
plano, fringes	1 - 1/2
radiused	varies dependent upon radius
Coating type & Reflectivity* @ 10.6 μm, AOI = 0 deg:	
HR, protected Au, %	99.0
HR, enhanced Au, %	99.2
Damage threshold:	
CW mode, kW/cm ²	1
pulse mode, J/cm ²	1

* - upon special inquiry we can provide the reflectivity for VIS wavelengths as high as 85% while saving the above values for 10.6 μm wavelength.



TYDEX[®]
J.S.C.O.

Domostroitelnaya str. 16, 194292 St.Petersburg, RUSSIA
Tel: 7-812-3346701, -3318702; Fax: 7-812-3346702
E-mail: tydex@tydex.ru, URL: <http://www.tydex.ru>

WINDOWS

Windows are used in optical systems to separate the environment of one part of the system from another. For CO₂-lasers Tydex offers windows produced from

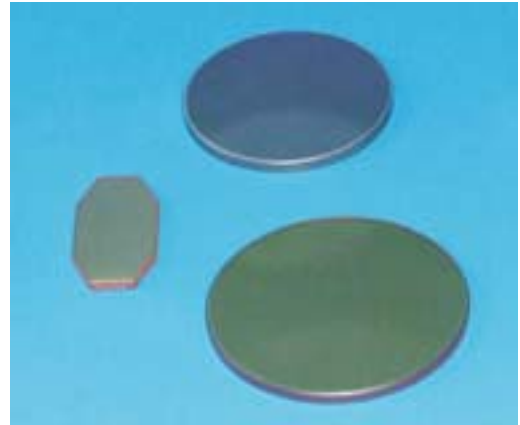
Germanium,
Zinc Selenide:

- AR coated windows,
- Uncoated windows,
- Combined coated windows,
- Brewster windows,

Gallium Arsenide.

Maximal available sizes of optical components are:

Ge - 250 mm,
ZnSe - 101.6 mm,
GaAs - 50.8 mm.



GERMANIUM WINDOWS

Specification:

Material	optical grade monocrystalline Ge
Clear aperture	> 90% of a size
Diameter (width & length) tolerances, mm	+0.0 / -0.1
Thickness tolerance, mm	+/- 0.1
Parallelism, arc. min.	<= 5
Surface quality, scr/dig:	
for parts to 3 in.	40/20
for parts to 8 in.	60/40
for larger parts	80/50
Surface figure (power-irregularity) @ 633 nm, fringes	1 - 1/2
Coating (residual reflectivity is specified per surface):	
AR/AR @ 10.6 μm, %	< 0.5
BBAR/BBAR @ 9-11 μm, %	2.0
Damage threshold	
CW mode, kW/cm ²	1



TYDEX[®]
J.S.C.O.

Domostroitelnaya str. 16, 194292 St.Petersburg, RUSSIA
Tel: 7-812-3346701, -3318702; Fax: 7-812-3346702
E-mail: tydex@tydex.ru, URL: <http://www.tydex.ru>

Optics for CO₂-Laser

AR COATED WINDOWS

Specification:

Material	CVD-ZnSe
Diameter tolerance, mm	+0.0 / -0.1
Thickness tolerance, mm	+/- 0.25
Parallelism, arc min	<= 3
Clear aperture	90% of diameter
Surface quality, scr/dig	40/20
Surface figure (power-irregularity)@ 633 nm, fringes	1 - 1/2
AR coating reflectivity per surface @ 10.6 μm, %	< 0.5

Maximal available dimensions: diameter - 101.6 mm. BBAR coatings are also available for NIR-MIR.

Standard sizes

Diameter		Thickness	
inches	mm	inches	mm
0.250	6.35	0.080	2.0
0.375	9.52	0.080	2.0
0.50	12.7	0.080	2.0
0.75	19.1	0.080	2.0
1.00	25.4	0.080	2.0
1.00	25.4	0.120	3.0
1.10	27.9	0.120	3.0
1.50	38.1	0.120	3.0
2.00	50.8	0.200	5.1
2.50	63.5	0.250	6.4
3.00	76.2	0.250	6.4

NOTE:

For other optical elements please fax or e-mail for price quotation and delivery



TYDEX[®]
J.S.C.O.

Domostroitelnaya str. 16, 194292 St.Petersburg, RUSSIA
Tel: 7-812-3346701, -3318702; Fax: 7-812-3346702
E-mail: tydex@tydex.ru, URL: <http://www.tydex.ru>

UNCOATED WINDOWS

Specification:

Material	CVD-ZnSe
Diameter tolerance, mm	+0.0 / -0.1
Thickness tolerance, mm	+/- 0.25
Parallelism, arc min	<= 3
Clear aperture	90% of diameter
Surface quality, scr/dig	40/20
Surface figure (power-irregularity)@ 633 nm, fringes	1 - 1/2

Standard sizes:

Diameter		Thickness	
inches	mm	inches	mm
0.250	6.35	0.080	2.0
0.375	9.52	0.080	2.0
0.50	12.7	0.080	2.0
0.75	19.1	0.080	2.0
1.00	25.4	0.080	2.0
1.00	25.4	0.120	3.0
1.10	27.9	0.120	3.0
1.50	38.1	0.120	3.0
2.00	50.8	0.200	5.1
2.50	63.5	0.250	6.4
3.00	76.2	0.250	6.4

NOTE:

For other optical elements please fax or e-mail for price quotation and delivery

ZnSe COMBINED COATED WINDOWS

For different applications and in particular for dental industry we produce ZnSe combiners allowing to achieve high transmission at working ("drilling") wavelength and reflect "pilot" beam to have enough illumination of an object under prosthetics procedure.

Custom-made sizes and specification are available.

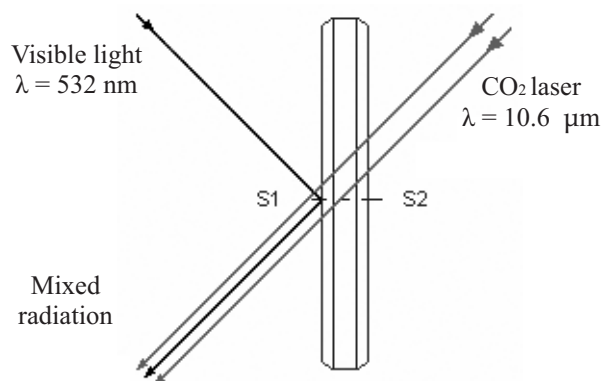


Fig. 1 Combined coated window.



TYDEX[®]
J.S.C.O.

Domostroitelnaya str. 16, 194292 St.Petersburg, RUSSIA
Tel: 7-812-3346701, -3318702; Fax: 7-812-3346702
E-mail: tydex@tydex.ru, URL: <http://www.tydex.ru>

Optics for CO₂-Laser

Specification:

Material	CVD-ZnSe, grade G1
Clear aperture	> 90% of diameter
Diameter tolerances, mm	+0.0 / -0.1
Thickness tolerance, mm	+/- 0.1
Parallelism, arc. min.	<= 5
Surface quality, scr/dig	40/20
Surface figure (power-irregularity) @ 633 nm, fringes	1 - 1/2
Coating:	combined, to meet the following parameters:
transmission @ 10.6 μm, AOI = 45 deg, %	>= 95.0
reflectance from one surface @ 532 nm, AOI = 45 deg, %	>= 80.0

BREWSTER WINDOWS

Specification:

Material	CVD-ZnSe
Width tolerance, mm	+0.0 / -0.1
Length tolerance, mm	+0.0 / -0.1
Thickness tolerance, mm	+/- 0.25
Parallelism, arc min	<= 3
Clear aperture	90% of length and width
Surface quality, scr/dig	40/20
Surface figure (power-irregularity) @ 633 nm, fringe	1 - 1/2
Brewster angle @ 10.6 μm, deg	67.4

Maximal available dimensions: diameter - 101.6 mm.

Standard sizes:

Width		Length		Thickness	
inches	mm	inches	mm	inches	mm
0.40	10.2	1.04	26.4	0.080	2.0
0.50	12.7	1.30	33.0	0.080	2.0
0.60	15.2	1.56	39.6	0.080	2.0
0.70	17.8	1.82	46.2	0.080	2.0
0.80	20.3	2.08	52.8	0.120	3.0
0.90	22.9	2.34	59.4	0.120	3.0
1.00	25.4	2.60	66.0	0.120	3.0
1.50	38.1	3.91	99.3	0.160	4.0

NOTE:

For other optical elements please fax or e-mail for price quotation and delivery



TYDEX[®]
J.S.C.O.

Domostroitelnaya str. 16, 194292 St.Petersburg, RUSSIA
Tel: 7-812-3346701, -3318702; Fax: 7-812-3346702
E-mail: tydex@tydex.ru, URL: <http://www.tydex.ru>

LENSES

The lens is the key optical component for CO₂-laser-based units. Due to its curved shape it allows to transform incident collimated beam into tiny-size area and thus concentrate the entire power of laser source in the shape of a spot.

Plano-convex lenses are the most economical transmissive focusing elements. Its prime advantage is the lower cost, whereas meniscus lenses can provide better performance, since they are specifically designed to minimize spherical aberration. The lenses of both designs can be effectively utilized for CO₂-laser-based heat treating, welding, cutting, drilling, and marking



Besides the plano-convex and meniscus lens shapes already mentioned, Tydex supplies biconvex and cylindrical lenses.

Custom-made lenses are also produced.

Zinc Selenide, Gallium Arsenide, and Potassium Chloride can be used for production of lenses.

Standard ZnSe and GaAs lenses are offered with both surfaces AR coating at 10.6 μm . KCl lenses are supplied uncoated.

Maximal available sizes of optical components are:

ZnSe - 101.6 mm,

GaAs - 50.8 mm,

KCl - 38.1 mm.



TYDEX[®]
J.S.C.O.

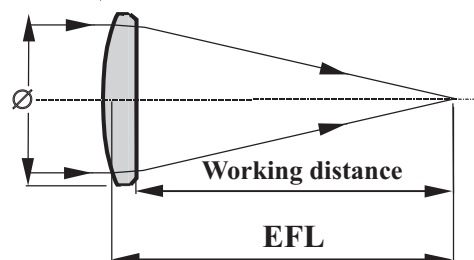
Domostroitelnaya str. 16, 194292 St.Petersburg, RUSSIA
Tel: 7-812-3346701, -3318702; Fax: 7-812-3346702
E-mail: tydex@tydex.ru, URL: <http://www.tydex.ru>

Optics for CO₂-Laser

PLANO-CONVEX LENSES

Specification:

Material	CVD-ZnSe, GaAs, KCl
Effective focal length (EFL) tolerance, %	+/- 2
Diameter tolerance, mm	+0.0 / -0.1
Thickness tolerance, mm	+/- 0.25
Edge thickness variation (ETV), mm	<= 0.05
Clear aperture	90% of diameter
Surface figure (power-irregularity) @ 633 nm:	
plano, fringes	1 - 1/2
radiused	depends on radius
Surface quality, scr/dig	40/20
AR coating reflectivity per surface @ 10.6 μm, %	< 0.5



BBAR coatings are also available for NIR-MIR.

Standard sizes

Diameter		EFL	
inches	mm	inches	mm
0.50	12.7	1.00	25.4
0.75	19.1	1.50	38.1
1.00	25.4	2.50	63.5
1.00	25.4	3.75	95.3
1.00	25.4	5.00	127.0
1.00	25.4	10.00	254.0
1.10	27.9	2.50	63.5
1.10	27.9	3.75	95.3
1.10	27.9	5.00	127.0
1.10	27.9	7.50	190.5
1.50	38.1	2.50	63.5
1.50	38.1	3.50	88.9
1.50	38.1	5.00	127.0
1.50	38.1	7.50	190.5
2.00	50.8	5.00	127.0
2.50	63.5	5.00	127.0
2.50	63.5	10.00	254.0
3.00	76.2	5.0	127.0
3.00	76.2	10.00	254.0

NOTE:

For other optical elements please fax or e-mail for price quotation and delivery



TYDEX[®]
J.S.C.O.

Domostroitelnaya str. 16, 194292 St.Petersburg, RUSSIA
Tel: 7-812-3346701, -3318702; Fax: 7-812-3346702
E-mail: tydex@tydex.ru, URL: <http://www.tydex.ru>

MENISCUS LENSES

Material	CVD-ZnSe, GaAs	
Effective focal length (EFL) tolerance, %	+/- 2	
Diameter tolerance, mm	+0.0 / -0.1	
Thickness tolerance, mm	+/- 0.25	
Edge thickness variation, mm	<= 0.05	
Clear aperture	90% of diameter	
Surface quality, scr/dig	40/20	
Surface figure (power-irregularity) @ 633 nm	varies dependent upon radius	
AR coating reflectivity per surface @ 10.6 μm, %	< 0.5	

BBAR coatings are also available for NIR-MIR.

Standard sizes

Diameter		EFL	
inches	mm	inches	mm
0.50	12.7	1.50	38.1
1.00	25.4	1.00	25.4
1.00	25.4	1.50	38.1
1.00	25.4	2.50	63.5
1.00	25.4	5.00	127.0
1.10	27.9	1.50	38.1
1.10	27.9	2.50	63.5
1.10	27.9	5.00	127.0
1.50	38.1	2.50	63.5
1.50	38.1	5.00	127.0
1.50	38.1	10.00	254.0
2.00	50.8	5.00	127.0
2.00	50.8	10.00	254.0
2.50	63.5	5.00	127.0
2.50	63.5	7.50	190.5
2.50	63.5	10.00	254.0
3.00	76.2	5.00	127.0
3.00	76.2	7.50	190.5
3.00	76.2	10.00	254.0

NOTE:

For other optical elements please fax or e-mail for price quotation and delivery



TYDEX[®]
J.S.C.O.

Domostroitelnaya str. 16, 194292 St.Petersburg, RUSSIA
Tel: 7-812-3346701, -3318702; Fax: 7-812-3346702
E-mail: tydex@tydex.ru, URL: <http://www.tydex.ru>

Optics for CO₂-Laser

CYLINDRICAL LENSES

Specification:

Material	CVD-ZnSe
Effective focal length tolerance, %	+/- 2
Diameter (width & length) tolerances, mm	+0.0 / -0.1
Thickness tolerance, mm	+/- 0.25
Edge thickness variation, mm	<= 0.05
Clear aperture	> 85% of a size
Surface figure (power-irregularity) @ 633 nm:	
plano, fringes	1 - 1/2
radiused	depends on radius
Surface quality, scr/dig	60/40
AR Coating reflectivity per surface @ 10.6 μm, %	< 0.5

BBAR coatings are also available for NIR-MIR.



TYDEX[®]
J.S.C.O.

Domostroitelnaya str. 16, 194292 St.Petersburg, RUSSIA
Tel: 7-812-3346701, -3318702; Fax: 7-812-3346702
E-mail: tydex@tydex.ru, URL: <http://www.tydex.ru>

CUSTOM-MADE LENSES

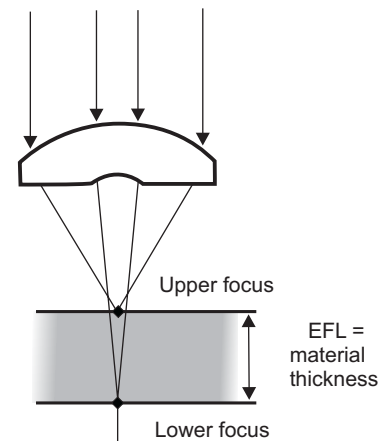
DUAL-FOCUS LENS

Dual-focus lenses (DFL) are a revolutionary new type of lens for CO₂ laser cutting.

DFL are intended to be used as a direct replacement for conventional lenses in some industrial laser systems and applications. The basic principal of the lenses coming from their title lies in existence of a couple of focal points. Complex design of these lenses allows to distribute an incident laser energy and deliver its calculated fraction into a secondary (lower) focus.

Especially designed to assist in a range of thick-section cutting jobs such lenses give the following advantages:

- processing of increased thicknesses at a given power,
- increased process speed,
- improved kerf quality,
- elimination of upper and lower surface dross,
- immediate cut-initiation,
- reduced assist-gas usage,
- improved process control.



Tydex proposed and have been using a novel approach in fabrication of DFL, which in particular did allow us to create DFL of cylindrical shape

A specification below presents standard product.
Custom-made sizes and specifications are available as well.
Non-standard lenses can be designed and proposed upon certain RFQ.

Specification:

Type of a part	cylindrical dual-focus lens
Material	CVD-ZnSe
Overall dimensions, mm	25.4 (+0/-0.25) x 25.4 (+0/-0.25)
Thickness, mm	4.0 (+0.5/-0.0)
Radii of curvature	the values depend on required combination of EFL
EFL tolerance @ 10.6 μm, %	+/- 2
Stripe width, mm	4 (+0.5/-0)
Surfaces quality, scr/dig	60/40
Surface figure, fringes	8
AR Coating reflectivity per surface @ 10.6 μm, %	< 0.5

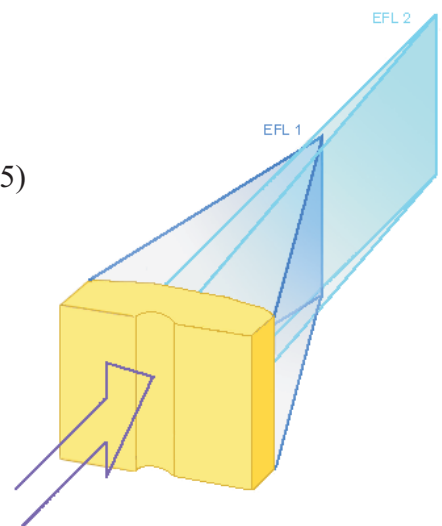


Fig. 2 Cylindrical DFL working principle.

Tydex supplies cylindrical DFL with the following EFL combinations:
127 & 254 mm and 169 & 254 mm.



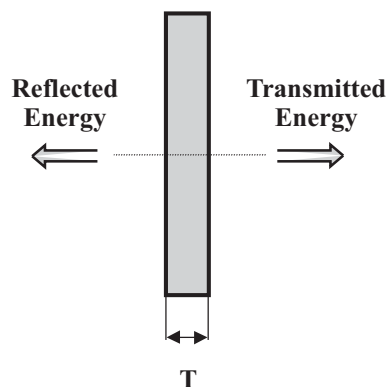
TYDEX[®]
J.S.C.O.

Domostroitel'naya str. 16, 194292 St.Petersburg, RUSSIA
Tel: 7-812-3346701, -3318702; Fax: 7-812-3346702
E-mail: tydex@tydex.ru, URL: <http://www.tydex.ru>

Optics for CO₂-Laser

PARTIAL REFLECTOR

The most common uses of partial reflectors are output couplers or beam attenuators. In these applications they are intended for use at (or close to) normal incidence. The standard coatings described here will perform to specification if used within 10° to 15° of normal incidence, depending upon the reflectivity.



Specification:

Material	CVD-ZnSe
Diameter tolerance, mm	+0.0 / -0.1
Thickness tolerance, mm	+0.1 / -0.2
Thickness (radiused) tolerance, mm	+/- 0.25
Parallelism, arc min:	
plano	<= 3
radiused, diameter < 1"	<= 10
radiused, diameter >= 1"	<= 5
Surface figure (power-irregularity) @ 633 nm:	
plano, fringes	1 - 1/2
radiused	depends on radius
Surface quality, scr/dig	40/20
Side 1: Reflectivity tolerance @ 10.6 μm:	
1% - 5%	+/- 0.5% x R
6% - 85%	+/- 5%
86% - 95%	+/- 2%
96% - 98%	+/- 1%
99% - 99.5%	+/- 0.2%
Side 2: AR Coating reflectivity per surface @ 10.6 μm	<= 0.5%
Maximal diameter - 50.8 mm.	

Standart size

Diameter		Thickness	
inches	mm	inches	mm
0.250	6.35	0.080	2.0
0.375	9.52	0.080	2.0
0.50	12.7	0.080	2.0
0.75	19.1	0.080	2.0
1.00	25.4	0.120	3.0
1.00	25.4	0.236	6.0
1.10	27.9	0.120	3.0
1.10	27.9	0.236	6.0
1.50	38.1	0.120	3.0
2.00	50.8	0.200	5.1
2.00	50.8	0.300	7.6

NOTE:

For other optical elements please fax or e-mail for price quotation and delivery

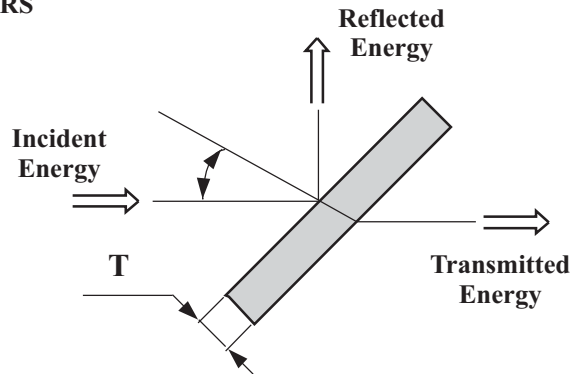


TYDEX[®]
J.S.C.O.

Domostroitelnaya str. 16, 194292 St.Petersburg, RUSSIA
Tel: 7-812-3346701, -3318702; Fax: 7-812-3346702
E-mail: tydex@tydex.ru, URL: <http://www.tydex.ru>

BEAM-SPLITTERS

Beamsplitters allow a certain percentage of incident energy to be reflected while transmitting the remainder. In most cases beamsplitters are angle, wavelength, and polarization sensitive.



Specification:

Material

Diameter tolerance, mm

Thickness tolerance, mm

Parallelism, arc min

Clear aperture

Surface quality, scr/dig

Surface figure (power-irregularity) @ 633 nm, fringes:

Side 1: Reflectivity tolerance @ 10.6 μm , % :

1% - 5%

6% - 85%

86% - 93%

94% - 99.5%

Side 2: AR coating reflectivity per surface @ 10.6 μm

Angle of incidence, deg

Maximal diameter - 50.8 mm.

Standard sizes:

CVD-ZnSe

+0.0 / -0.1

+/- 0.25

≤ 3

90% of diameter

40/20

1 - 1/2

+/- 0.5 x R

+/- 7

+/- 5

+/- 0.5

typically < 1%,

varies with polarisation and incidence angle

45

Diameter		Thickness	
inches	mm	inches	mm
0.375	9.52	0.080	2.0
0.50	12.7	0.080	2.0
0.75	19.1	0.080	2.0
1.00	25.4	0.080	2.0
1.00	25.4	0.120	3.0
1.10	27.9	0.120	3.0
1.50	38.1	0.120	3.0
2.00	50.8	0.200	5.1

NOTE:

For other optical elements please fax or e-mail for price quotation and delivery



TYDEX[®]
J.S.C.O.

Domostroitelnaya str. 16, 194292 St.Petersburg, RUSSIA
Tel: 7-812-3346701, -3318702; Fax: 7-812-3346702
E-mail: tydex@tydex.ru, URL: <http://www.tydex.ru>