



## Beam Expander

We manufacture a variety of laser beam expanders to suit most laser types, from small waveguide lasers up to multi-kilowatt industrial lasers. There is also a modular range for experimental and laboratory purposes.

The most common type of beam expander is derived from the Galilean telescope which usually has one negative input lens and one positive output lens, as shown in the following figure. The input lens presents a virtual beam focus at the output. For low expansion ratios (1.3-20×), the Galilean telescope is most often employed due to its simplicity, small package size, and low cost.

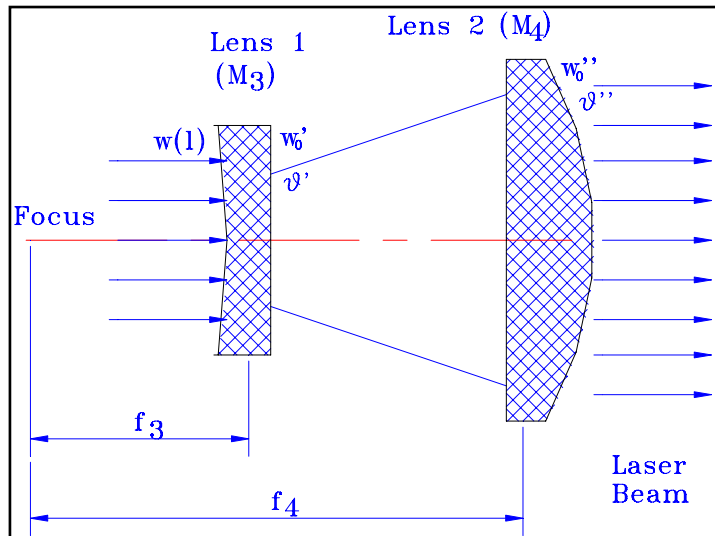
As shown in Figure 1, the lens  $M_3$  focuses the laser beam onto the front focus plane and the new beam waist  $\omega'_0$  and divergence angle  $\theta'$  can be represented as

$$\omega'_0 = \frac{f_3 \lambda}{\pi \omega(l)} \quad (1)$$

and

$$\theta' = \frac{2\lambda}{\pi \omega'_0} \quad (2)$$

$$\omega(l) = \omega_0 \sqrt{1 + \left( \frac{l\lambda}{\pi \omega_0^2} \right)^2} \quad (3)$$



where  $\omega(l)$  is the radius of the beam entering the lens  $M_3$ ,  $l$  is the distance between the lens  $M_3$  and the beam waist  $\omega_0$  from the laser generator, and  $f_3$  is the focal length of the lens  $M_3$ .

Since  $\omega'_0$  lies on the back focus plane of the lens  $M_4$  with a longer focal length,  $f_4$ , the Gaussian beam with a beam waist  $\omega'_0$  will be collimated by the beam expander. The collimation ratio of the beam expander for a Gaussian beam is as follows

$$T = \frac{\theta}{\theta''} = T_1 \sqrt{1 + \left( \frac{l\lambda}{\pi \omega_0^2} \right)^2} \quad (4)$$

where  $T_1 = f_4/f_3$ . The beam waist  $\omega''_0$  and divergence angle  $\theta''$  after the beam expander are

$$\omega''_0 = \frac{\lambda}{\pi \omega'_0} f_4 \quad (5)$$

and

$$\theta'' = \frac{\theta}{T} \quad (6)$$

Substituting Equation (1) into Equation (5), the following expression can be obtained

$$\omega''_0 = T_1 \omega(l) \quad (7)$$

From Equations (4)-(7), it is concluded that the beam expansion ratio and the collimation ratio for a Gaussian beam depend not only on the specifications of the beam expander, but also on the laser beam parameters as well as the positions of the optical lenses.

The function of a beam expander is to reduce the divergence angle of laser beams and thus make the focused beam diameter smaller.

The specifications of the lenses used in the beam expanders are

- Material: BK7 fine annealed, ZnSe or GaAs (depending on laser wavelength)
- Diameter:  $\pm 0.1$ mm
- Thickness:  $\pm 0.1$ mm
- Flatness:  $\lambda/4$
- Surface Quality: 60-40 scratch-dig
- Coating: HR dielectric coatings  $R > 99\%$



**Part number description: BEST-xxx-yy-z-M-T-AA**

BEST --- BEST series beam expanders

xxxx----- laser wavelength: 10.6 means 10.6um, 532 means 532nm, 633 means 633nm.

yy ----- expansion ratio in times

Z ----- lens material: Z means ZnSe; G means GaAs, none means optical glass.

L ----- beam expander shape, L means trumpet-shape, none means cylinder shape.

T ----- type: T means adjustable beam expander; none means fixed beam expander.

M ----- connection: M means screw connection; none means cylinder connection.

AA ----- special purpose.

Example: BEST-10.6-3GM: 10.6um fixed beam expander, 3x, GaAs material, cylinder, screw connection.

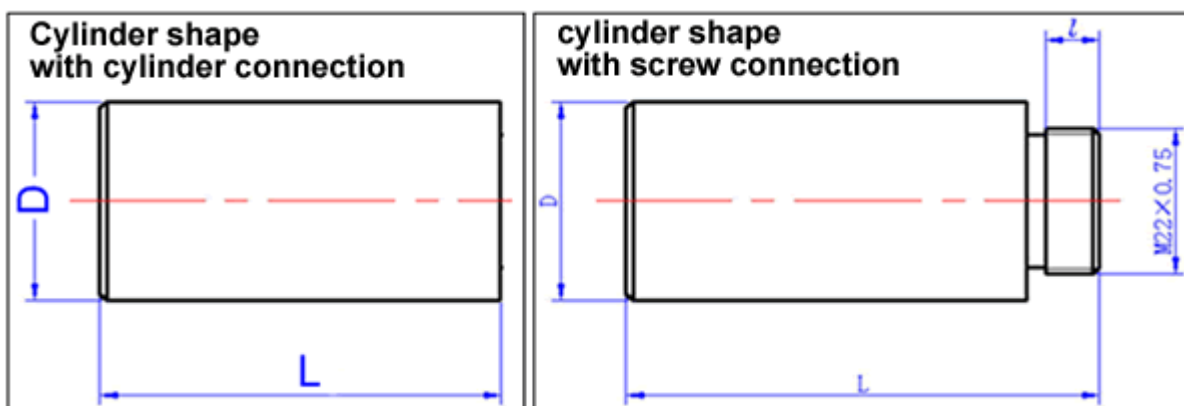
BEST-10.6-3.5Z: 10.6um fixed beam expander, 3.5x, ZnSe material, cylinder.

**1. CO<sub>2</sub> Laser Beam Expanders (10.6μm)**

There are 2 types of beam expander: fixed and adjustable beam expanders. For the fixed beam expanders, the spacing between the two lenses inside the beam expander is fixed, but the spacing between the two lenses inside the adjustable beam expanders is adjustable. The lens material is ZeSe, which allows the red light to go through the beam expander.

**(1) Fixed Beam Expanders:** there are 2 types of outlines: cylinder shape and trumpet shape. For each outline there are 2 types of connections: cylinder connection and screw connection.

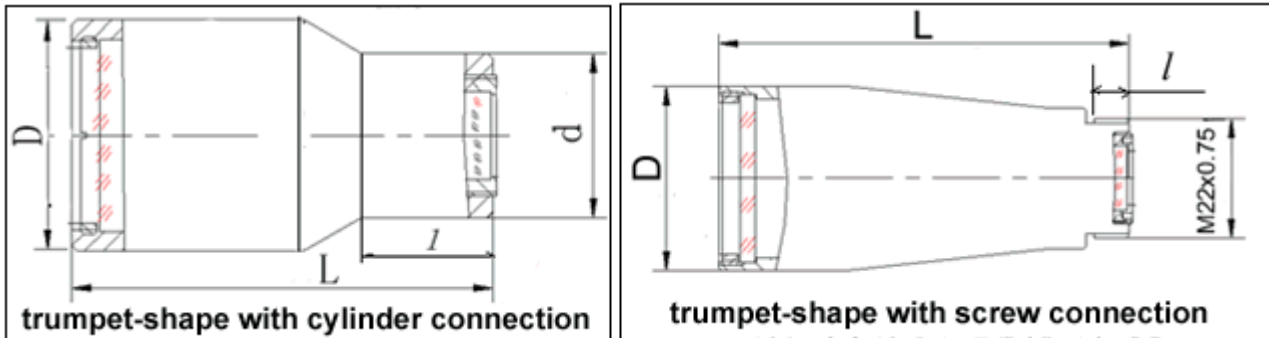
**Cylinder-shape fixed beam expander**



Model	Expansion ratio (times)	L (mm)	D (mm)	l (mm)	Input clear aperture (mm)	Output clear aperture (mm)	Connection (mm)
BEST-10.6-2Z	2	30	24		7	14	φ24
BEST-10.6-2ZM	2	30	24	6	7	14	M22x0.75

BEST-10.6-2.5Z	2.5	40	24		5.6	14	φ24
BEST-10.6-2.5ZM	2.5	40	24	6	5.6	14	M22x0.75
BEST-10.6-3Z	3	50	24		5.3	16	φ24
BEST-10.6-3ZM	3	50	24	6	5.3	16	M22x0.75
BEST-10.6-4Z	4	69.7	31		5.75	23	φ31
BEST-10.6-4ZM	4	69.7	31	6	5.75	23	M22x0.75
BEST-10.6-5Z	5	89.8	31		4.6	23	φ33
BEST-10.6-5ZM	5	89.8	31	6	4.6	23	M22x0.75

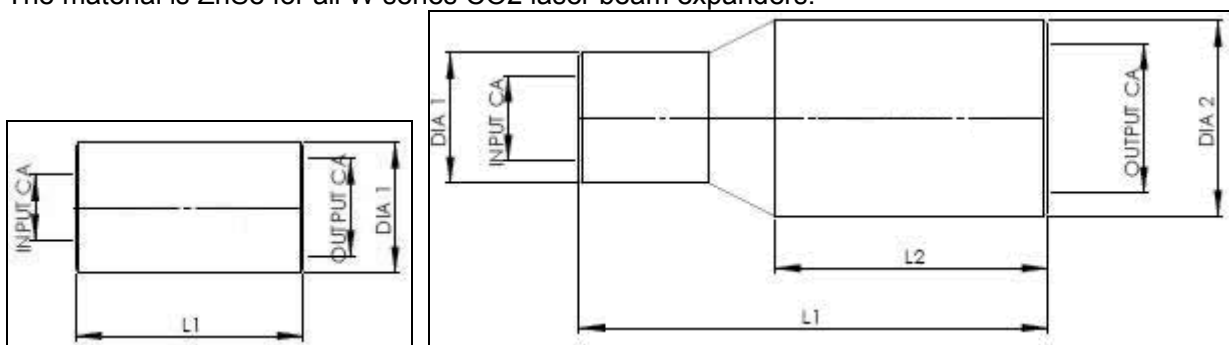
### Trumpet-shape fixed beam expander



Model	Expansion ratio (times)	L (mm)	D (mm)	l (mm)	Input clear aperture (mm)	Output clear aperture (mm)	Connection (mm)
BEST-10.6-2ZL	2	30	24	11.5	7	14	D24/d18
BEST-10.6-2ZLM	2	30	24	6	7	14	M22x0.75
BEST-10.6-2.5ZL	2.5	40	24	15.5	5.6	14	D24/d18
BEST-10.6-2.5ZLM	2.5	40	24	6	5.6	14	M22x0.75
BEST-10.6-3ZL	3	50	24	19	5.3	16	D24/d18
BEST-10.6-3ZLM	3	50	24	6	5.3	16	M22x0.75
BEST-10.6-4ZL	4	69.7	31	26.5	5.75	23	D31/d25
BEST-10.6-4ZLM	4	69.7	31	6	5.75	23	M22x0.75
BEST-10.6-5ZL	5	89.8	31	34	4.6	23	D33/d25
BEST-10.6-5ZLM	5	89.8	31	6	4.6	23	M22x0.75

### Fixed Beam Expander: - W Series

The material is ZnSe for all W series CO<sub>2</sub> laser beam expanders.

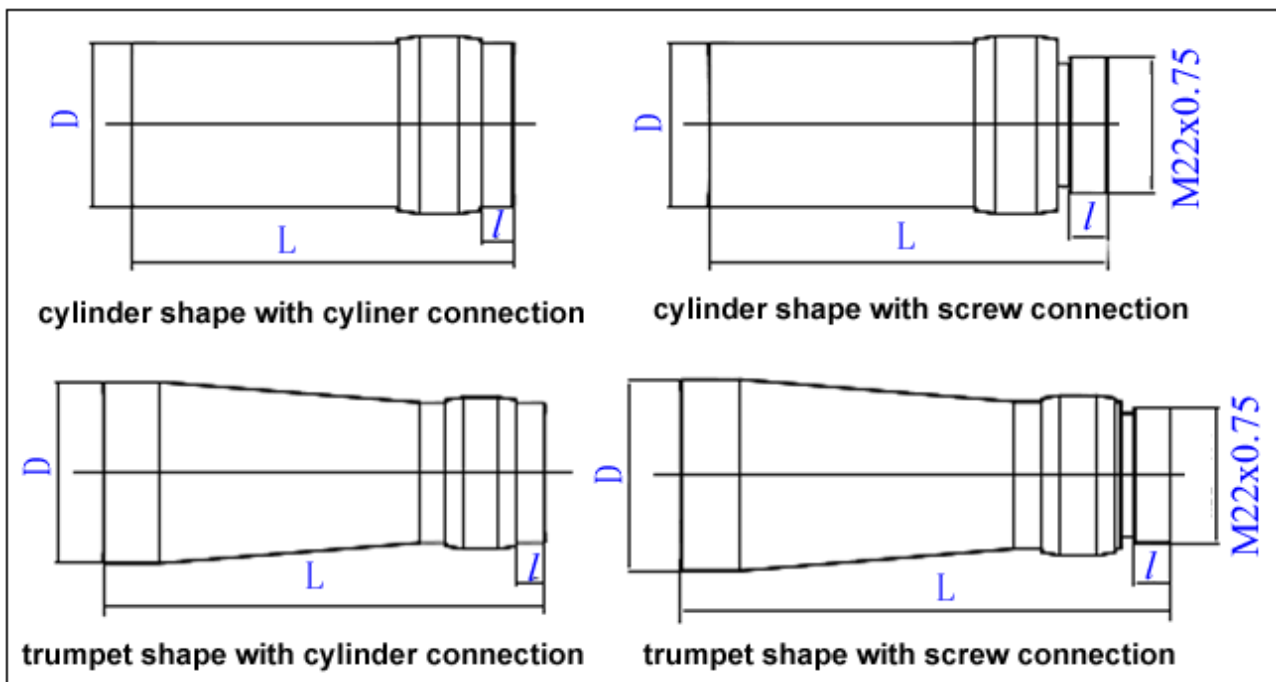


Part No.	Magnification	Input CA (mm)	Output CA (mm)	O.D Dia1 (mm)	O.D Dia2 (mm)	L1 (mm)	L2 (mm)
BEST-9.4-2X-W	2	16.5	23	M22X0.75	28	59	54
BEST-9.4-3X-W	3	10	20	28	28	61	51.5
BEST-9.4-5X-W	5	13	23	20	30	72	42
BEST-10.6-1.5-W	1.5	13	16	20	-	35	-
BEST-10.6-2-W	2	10	15	22	-	32.5	-
BEST-10.6-2A-W	2	15	17	22	-	35	-
BEST-10.6-2L-W	2	27	53	M44X1	63	72	47
BEST-10.6-2.5-W	2.5	12	20	27	-	54	-

BEST-10.6-3A-W	3	10	15	20	20	61	-
BEST-10.6-3B-W	3	12.5	20	20	28	59	29
BEST-10.6-3C-W	3	13	20	20	28	110	60
BEST-10.6-3X-W	3	11	16	20	20	59	-
BEST-10.6-3.3-W	3.3	10	15	21	21	67	-
BEST-10.6-4-W	4	10	20	20	28	67	46
BEST-10.6-4A-W	4	10	25	20	31	67	48
BEST-10.6-4C-W	4	12	23	20	30	135	90
BEST-10.6-5-W	5	12	23	20	30	72	47
BEST-10.6-5A-W	5	12	28	20	36	70	45
BEST-10.6-6A-W	6	10	28	20	36	75	55
BEST-10.6-8-W	8	13	26	20	36	120	75.1
BEST-10.6-8A-W	8	10	30	20	36	73	55.5

## (2) Adjustable Beam Expanders

These beam expanders are designed specially for large divergent laser beam. Changing the distance between two lenses inside the beam expander can decrease the beam divergence to obtain better collimation of the laser beam. If they are used for large-divergence laser beam, you may turn the inner body to increase the spacing of two lenses and then to obtain better collimation laser beam. The material is ZnSe and thus the red light can go through the beam expander.



### Cylinder-shape adjustable beam expanders

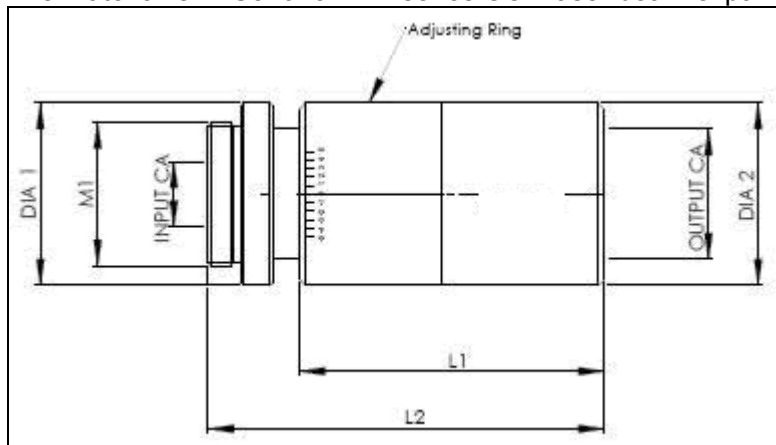
Model	Expansion ratio (times)	L (mm)	D (mm)	$l$ (mm)	Input clear aperture (mm)	Output clear aperture (mm)	Connection (mm)
BEST-10.6-2ZT	2	40	24	8	7	14	$\phi$ 24
BEST-10.6-2ZTM	2	46	24	6	7	14	M22x0.75
BEST-10.6-2.5ZT	2.5	50	24	8	5.6	14	$\phi$ 24
BEST-10.6-2.5ZTM	2.5	56	24	6	5.6	14	M22x0.75
BEST-10.6-3ZT	3	60	24	8	5.3	16	$\phi$ 24
BEST-10.6-3ZTM	3	66	24	6	5.3	16	M22x0.75
BEST-10.6-4ZT	4	75.7	31	8	5.75	23	$\phi$ 31
BEST-10.6-4ZTM	4	79.7	31	6	5.75	23	M22x0.75
BEST-10.6-5ZT	5	95.8	31	8	4.6	23	$\phi$ 33
BEST-10.6-5ZTM	5	99.8	31	6	4.6	23	M22x0.75

### Trumpet-shape adjustable beam expanders

Model	Expansion ratio (times)	L (mm)	D (mm)	$l$ (mm)	Input clear aperture (mm)	Output clear aperture (mm)	Connection (mm)
BEST-10.6-2ZTL	2	40	24	8	7	14	$\phi$ 24
BEST-10.6-2ZTLM	2	46	24	6	7	14	M22x0.75
BEST-10.6-2.5ZTL	2.5	50	24	8	5.6	14	$\phi$ 24
BEST-10.6-2.5ZTLM	2.5	56	24	6	5.6	14	M22x0.75
BEST-10.6-3ZTL	3	60	24	8	5.3	16	$\phi$ 24
BEST-10.6-3ZTLM	3	66	24	6	5.3	16	M22x0.75
BEST-10.6-4ZTL	4	75.7	31	8	5.75	23	$\phi$ 31
BEST-10.6-4ZTLM	4	79.7	31	6	5.75	23	M22x0.75
BEST-10.6-5ZTL	5	95.8	31	8	4.6	23	$\phi$ 33
BEST-10.6-5ZTLM	5	99.8	31	6	4.6	23	M22x0.75

### Adjustable Beam Expander: - TW Series

The material is ZnSe for all TW series CO<sub>2</sub> laser beam expanders.



Part No.	Magnification	Input CA (mm)	Output CA (mm)	M1	Dia1 (mm)	Dia2 (mm)	L1 (mm)	L2 (mm)
BEST-10.6-2Z-TW	2	10	15	M16x0.75	22	22	37	51
BEST-10.6-2Z1-TW	2	10	23	M22x0.75	32	32	38	48
BEST-10.6-2ZG-TW	2	10	15	M16x0.75	22	22	40	51
BEST-10.6-2Z3-TW	2	15	28	M22x0.75	36	36	33	48
BEST-10.6-2Z4-TW	2	10	15	M16x0.75	20	20	37	50
BEST-10.6-2.5Z-TW	2.5	10	16	M16x0.75	20	20	45	55.2
BEST-10.6-2.5Z1-TW	2.5	10	15	M16x0.75	20	20	25	34
BEST-10.6-2.5Z2-TW	2.5	10	20	M22x0.75	28	28	40.5	56
BEST-10.6-3X3T-TW	3	10	16	M16x0.75	-	20	28	37
BEST-10.6-3Z1-TW	3	10	16	M16x0.75	20	20	45	61
BEST-10.6-3Z2-TW	3	10	20	M22x0.75	28	28	47	61
BEST-10.6-3Z3-TW	3	10	16	M16x0.75	20	20	28	37
BEST-10.6-3Z4/1-TW	3	10	25	M22x0.75	32	32	43	60
BEST-10.6-3Z5-TW	3	15	35	M22x0.75	44	44	60	73
BEST-10.6-3Z6-TW	3	15	28	M22x0.75	36	36	51	60
BEST-10.6-3.75Z-TW	3.75	23	26	M33x0.5	36	36	48	64
BEST-10.6-4X-TW	4	11	17	-	M24x0.5	26	51.5	66
BEST-10.6-4Z-TW	4	10	16	M16x0.75	20	20	47	55
BEST-10.6-4Z1-TW	4	10	20	M22x0.75	28	28	55	71
BEST-10.6-4Z2-TW	4	15	28	M22x0.75	36	36	51	66
BEST-10.6-4Z3-TW	4	10	20	-	26	32	50	70
BEST-10.6-5Z-TW	5	10	16	M16x0.75	20	20	43	58
BEST-10.6-5Z1-TW	5	10	23	M22x0.75	30	30	56	71
BEST-10.6-6Z-TW	6	11	26	M22x0.75	32	32	62	76
BEST-10.6-6Z1-TW	6	10	35	M22x0.75	44	44	60	75

BEST-10.6-6Z2-TW	6	10	15	M16x0.75	20	20	45	60
BEST-10.6-8Z1-TW	8	10	33	M22x0.75	44	44	98	118
BEST-10.6-10Z1-TW	10	10	36	M22x0.75	44	44	98	118

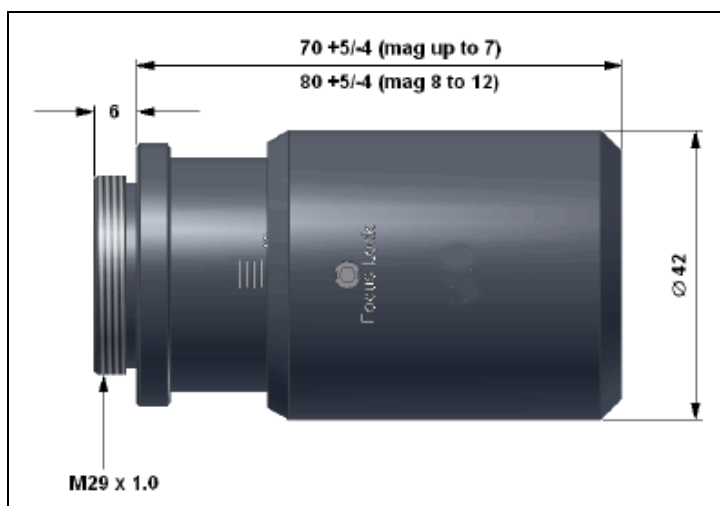
### (3) High-power CO2 Laser Beam Expanders

#### A: CBE Series Compact Beam Expanders

The high-power beam expander has a slide and lock focus setting. Normally this is set to infinity during manufacture. However, if a customer needs to adjust this to suit their system, the output should be coupled an adjustable pipe so this too can be adjusted to maintain an overall fixed length. Note that your input beam diameter should not exceed two-thirds of the input aperture. The output clear aperture is the same for all magnifications, 25mm. If your expanded beam diameter is 14.5mm to 22mm, the allowed input laser power can reach up to 500W. The input end has a M29 x 1.0 male thread and the output has the same female thread to take thread adaptors for coupling to other.



Part No.	Mag.	Input clear aperture	Max. input beam diameter
BEST-10.6-1.3ZTM-CBE	1.3	12.5mm	10mm
BEST-10.6-1.6ZTM-CBE	1.6	12.5mm	10mm
BEST-10.6-2ZTM-CBE	2	12.5mm	10mm
BEST-10.6-2.5ZTM-CBE	2.5	12.5mm	8mm
BEST-10.6-3ZTM-CBE	3	12.5mm	6mm
BEST-10.6-3.5ZTM-CBE	3.5	12.5mm	5mm
BEST-10.6-4ZTM-CBE	4	12.5mm	4.5mm
BEST-10.6-5ZTM-CBE	5	12.5mm	3.5mm
BEST-10.6-6ZTM-CBE	6	12.0mm	3.0mm
BEST-10.6-7ZTM-CBE	7	10.0mm	2.5mm
BEST-10.6-8ZTM-CBE	8	10.0mm	2.1mm
BEST-10.6-10ZTM-CBE	10	5.0mm	1.7mm
BEST-10.6-12ZTM-CBE	12	5.0mm	1.4mm



#### B: SBE Series Beam Expanders

The SBE series of beam expanders are designed for use with CO2 lasers of (relatively) small beam diameter, between the limits of around 2mm up to 12mm, and for power levels of up to 1kW CW. SBE units may be used to increase beam size, and reduce laser divergence accordingly. A wide range of magnifications is available to enable best performance to be obtained from the laser. The SBE series of beam expanders are of Galilean type, with two ZnSe lenses. The lenses are made from laser grade

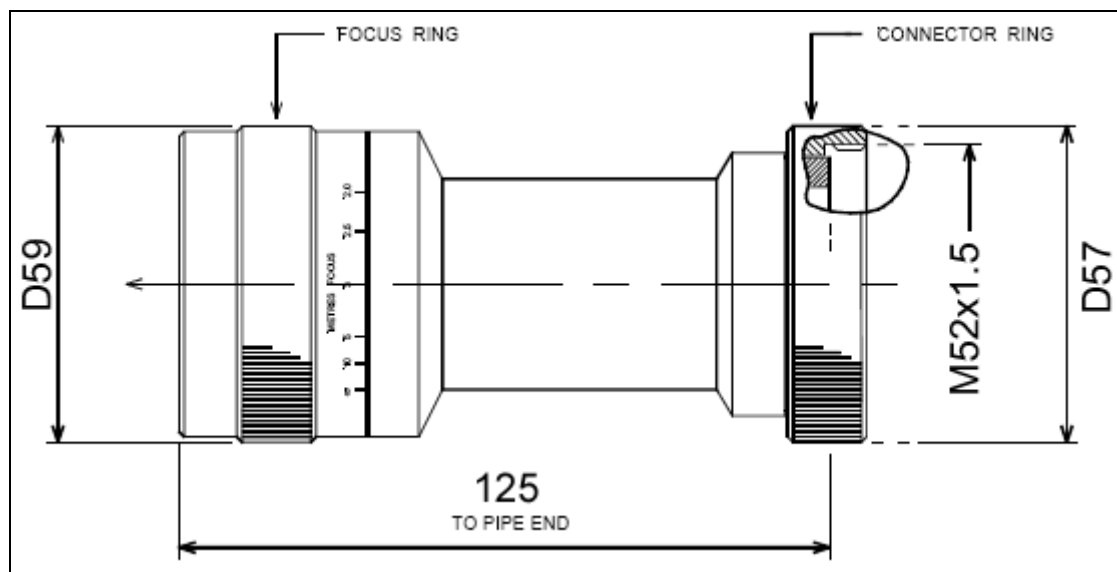


ZnSe and treated with ultra-low absorption anti-reflection coatings for 10.6µm. All models are externally identical.

The focus range is from -10 metres, through infinity, to +1.6 metres. It is factory calibrated from infinity to +2 metres focus range. Please note that the indicated focus is geometrical, and the actual downstream beam waist position will depend upon the parameters of the laser beam. The focus mechanism is of the actuated-slide type, and actuation of the focusing ring drives the output lens position in a linear, non-rotary sense. This mechanism reduces beam wander usually experienced with rotary focus mechanisms.

Model	Magnification	Input Clear Ap.	Output Clear Ap.
BEST-10.6-2ZTM-SBE	x2.0	12.50mm	25.4mm
BEST-10.6-2.5ZTM-SBE	x2.5	10.20mm	25.4mm
BEST-10.6-3ZTM-SBE	x3.0	8.33mm	25.4mm
BEST-10.6-4ZTM-SBE	x4.0	6.25mm	25.4mm
BEST-10.6-5ZTM-SBE	x5.0	5.00mm	25.4mm
BEST-10.6-6ZTM-SBE	x6.0	4.17mm	25.4mm
BEST-10.6-7ZTM-SBE	x7.0	3.57mm	25.4mm

The SBE series beam expanders can be used to reduce beam divergence and to help achieve very high energy densities from quite low laser power. For example, if used with a 10W Synrad laser, a model SBE/60 plus a TF25 focusing lens, would generate an energy density of around 20kW/mm<sup>2</sup> at the focus. Typical applications for the SBE series beam expanders with low power lasers include drilling holes in plastics, cutting paper and card, cutting man-made fibre material and rubber, and engraving decorative wooden plaques. In common with other beam expanders, the SBE series can provide a long-path of consistent beam quality. They may be used in conjunction with moderate power (several hundred watts) CO<sub>2</sub> lasers to enable large cutting bed applications, such as the processing of sail-cloth.



### C: BE25 Series Beam Expanders

The BE25 series of beam expanders is designed for use with CO<sub>2</sub> lasers of up to 2kW CW power. The units are water cooled and incorporate an actuated-slide focusing mechanism to reduce beam wander during focusing. By reducing beam divergence and allowing the user control over the ongoing beam characteristics, these industrial laser beam expanders can improve system Performance, especially in large moving-optics systems.

Technical specifications:

Type: Fully corrected Galilean type, with ZnSe lenses.

Construction: Aluminium alloy, black anodised. Lenses mounted using indium wire to aid heat transfer.

Cooling: Water (or air) cooled, via 8/6 size fittings.

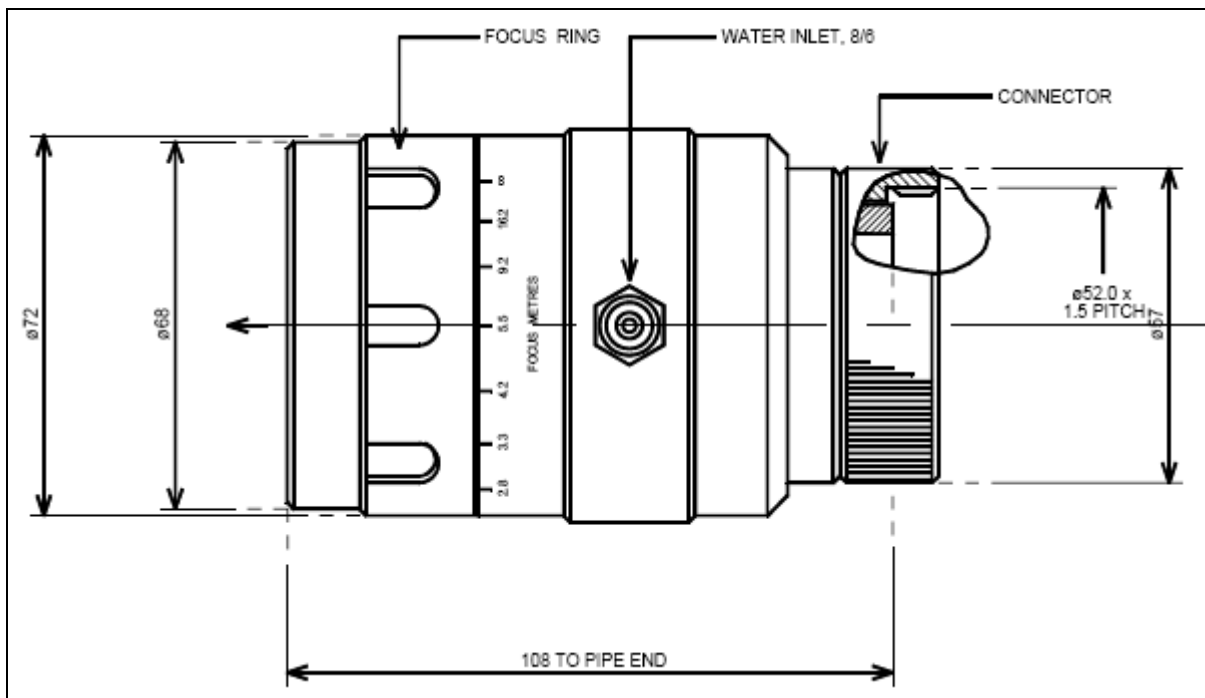


Focus range: From infinity down to 2.8 metres. Calibrated.  
 Beam wander during focusing: 2 minutes of arc over full range.  
 Output clear aperture: 35mm diameter.  
 Fitting: Via standard 52.0 dia x 1.5 pitch coupling ring.

Model	Magnification	Input Clear Aperture Dia.
BEST-10.6-1.33ZTM-BE25	x 1.33	25.0mm
BEST-10.6-1.5ZTM-BE25	x 1.50	23.2mm
BEST-10.6-1.66ZTM-BE25	x 1.66	21.1mm
BEST-10.6-1.75ZTM-BE25	x 1.75	20.0mm
BEST-10.6-2ZTM-BE25	x 2.00	17.5mm

The actuated-slide mechanism drives the output lens in a linear motion, reducing beam wander that can occur in rotary mechanisms. The geometrical focus setting is calibrated from 2.8m to infinity. Please note that the downstream beam waist position will depend upon the laser beam characteristics as well as the focus setting. Geometrical focus is calibrated for a plane wave input.

The specific applications for the BE25 series beam expanders are too numerous to list. In general, they are used by many system integrators in moving-optics cutting systems, long-bed anilox processing and a variety of systems where a controlled beam and increased focused energy density are desirable.



**D: BE38 Series Beam Expanders**

The BE38 series of beam expanders is designed for use with high power/large beam diameter CO2 lasers of up to 3kW power CW. These Galilean beam expanders use two ZnSe lens elements made from laser grade ZnSe and treated with ultra-low absorption anti-reflection coatings for maximum power handling capacity. BE38 series beam expanders use an actuated-slide focus mechanism to reduce beam wander during focusing. The units are water cooled. Use of these beam expanders can improve system performance by reduction of the beam far-field divergence and by providing control of the ongoing beam parameters.



Technical specifications:

Type : Fully corrected Galilean type, ZnSe lenses.

Construction : Aluminium alloy, black anodised. The lenses are mounted using indium wire to aid heat transfer.

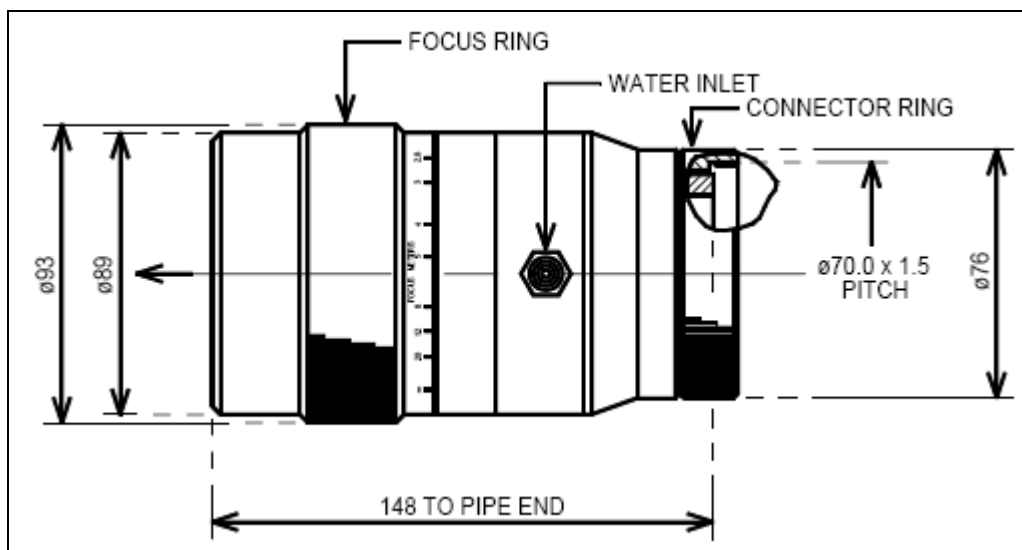
Cooling : Water cooled via 8/6 size fittings.



Focus range : From infinity down to 2.8 metres. Calibrated.  
 Output clear aperture : 57mm diameter.  
 Input clear aperture : 38mm diameter.  
 Fitting : Via 70.0mm x 1.5 pitch connector ring.  
 Beam wander during focusing : 2 arc minutes over full range.

Model	Magnification
BEST-10.6-1.15ZTM-BE38	x 1.15
BEST-10.6-1.25ZTM-BE38	x 1.25
BEST-10.6-1.33ZTM-BE38	x 1.33
BEST-10.6-1.5ZTM-BE38	x 1.50

The actuated-slide mechanism causes the output lens to be linearly repositioned when the focus control ring is rotated. This reduces the beam wander that can occur with rotary focus mechanisms. The geometrical focus position is calibrated from 2.8 metres to infinity. Please note that the downstream beam waist position will, in general, be different from the geometrical focus setting. The geometrical focus is calibrated for a plane wave input.



### E. Modular Beam Expanders

The modular series of CO<sub>2</sub> laser beam expanders provide a wide, versatile range of sizes and magnifications for laboratory and general industrial use with lasers of up to 1kW CW laser power. The range consists of a series of output sections, forming the main body of the beam expander, with output diameters from 25mm to 90mm. Input lens units plug into the main body to form the complete beam expander.

#### Technical specifications (all models):

Lenses: Laser grade ZnSe with ultra-low absorption anti-reflection coatings.

Bodies: Aluminium HE30, black anodised.

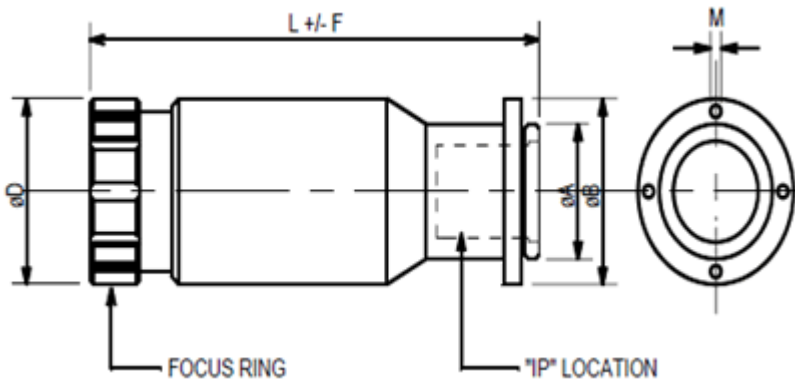
Output clear aperture: Defined by designation, eg "OP50" has 50mm clear aperture.

Input clear aperture: Defined by designation, eg "IP14" has 14mm clear aperture.

Magnification: Defined by designation, eg OP50 plus IP10 have, as a combination, a magnification of  $50/10 = \times 5$ .

Performance: Less than  $\lambda/20$  residual spherical aberration.





Model	A	B	D	F	L	M
OP25	40 dia. x 1 ISO	50	50	5	126	3.3 dia. on 45 PCD
OP35	40 dia. x 1 ISO	50	50	8	144	3.3 dia. on 45 PCD
OP50	45 dia. x 1 ISO	62	62	12	200	4.3 dia. on 54 PCD
OP70	45 dia. x 1 ISO	84	84	15	280	6.5 dia. on 70 PCD
OP90	45 dia. x 1 ISO	84	110	20	359	6.5 dia. on 70 PCD

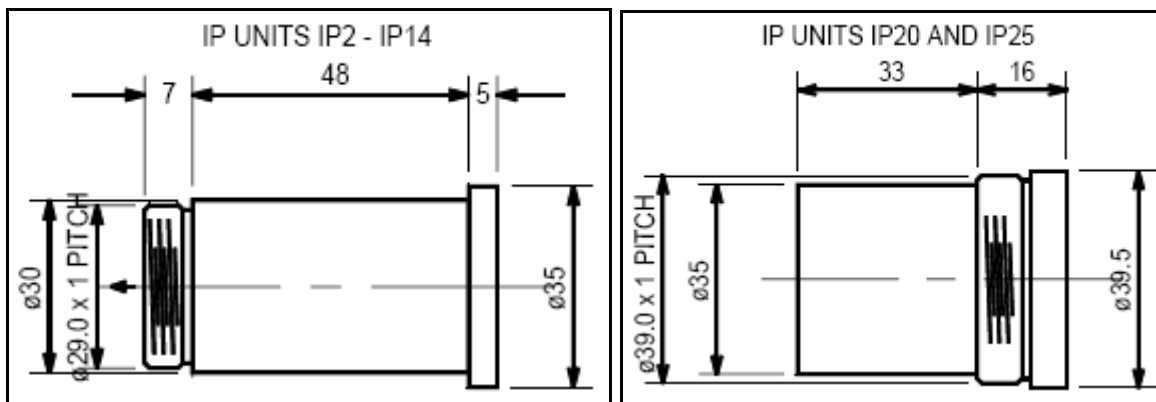
Remark: Lengths "L" stated at infinity focus

**Interchangeability**

The two larger 'IP' units designated IP20 and IP25 may only be used with OP70 or OP90 bodies. Otherwise, all IP units fit all OP units. In order to fit IP20/IP25 in to the OP70 /OP90 bodies an adaptor sleeve is removed.

**Input units**

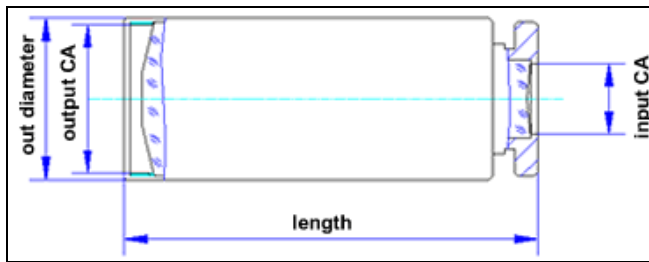
The size and shape of the 'plug-in' input units applies to IP designations from IP3.3 to IP14. The two larger input units IP20 and IP25 are shown in external view in the following figures. These may only be used with OP70 or OP90. Available models are given in the following table.



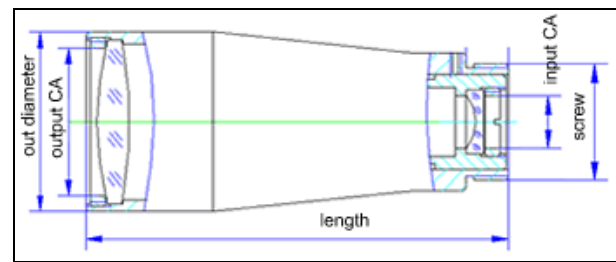
Model	Input aperture	Use with OP model
IP3.3	3.5mm	Any
IP5	5.0mm	Any
IP7	7.0mm	Any
IP8.75	8.8mm	Any
IP10	10.0mm	Any
IP14	14.0mm	Any
IP20	20.0mm	OP70, OP90 only
IP25	25.0mm	OP70, OP90 only

## 2. Nd:YAG Laser Beam Expanders (1064nm, 532nm & 355nm)

All the lenses are AR-coated and the damage threshold is >150MW/cm<sup>2</sup>



Cylinder shape, lenses' distance adjustable



Screw connection, lenses' distance adjustable

### 1064nm beam expanders

P/N	Wave-length (nm)	Expansion ratio (times)	Input clear aperture (mm)	Output clear aperture (mm)	Out diameter (mm)	length (mm)	connection (mm)
BEST-1064-1.5T	1064	1.5	10	21.6	25	20	φ25
BEST-1064-2M	1064	2	10	28	34	87	M22x0.75
BEST-1064-2.5T	1064	2.5	10	21.6	25	49.3	φ25
BEST-1064-2.5	1064	2.5	15	28	36	60	φ36
BEST-1064-2.5T-A	1064	2.5	15	28	36	63	φ36
BEST-1064-3M	1064	3	10	28	34	70.5	M22x0.75
BEST-1064-3M-2	1064	3	10	28	34	66.5	M22x0.75
BEST-1064-3	1064	3	15	32	42	77	φ30 or φ42
BEST-1064-3T	1064	3	15	32	42	80	φ30 or φ42
BEST-1064-4M	1064	4	10	28	34	76.5	M22x0.75
BEST-1064-4M-2	1064	4	10	28	34	62	M22x0.75
BEST-1064-4M-3	1064	4	10	28	34	72.5	M22x0.75
BEST-1064-4M-4	1064	4	10	28	34	58	M22x0.75
BEST-1064-4T	1064	4	11	21.6	25	64	φ25
BEST-1064-5M	1064	5	10	28	34	80	M22x0.75
BEST-1064-5M-2	1064	5	10	28	34	76.5	M22x0.75
BEST-1064-5T	1064	5	11	21.6	25	64	φ25
BEST-1064-6M	1064	6	10	28	34	81.5	M22x0.75
BEST-1064-6M-2	1064	6	10	28	34	83.5	M22x0.75
BEST-1064-6M-3	1064	6	10	28	39	95	M22x0.75
BEST-1064-6M-4	1064	6	12	34	42	80	M30x1
BEST-1064-6M-5	1064	6	10	46	53	90.5	M30x1
BEST-1064-6M-6	1064	6	10	28	39	95	M22x0.75 or φ39
BEST-1064-6T	1064	6	11	21.6	25	64	φ25
BEST-1064-8M	1064	8	10	28	34	87	M22x0.75
BEST-1064-8M-2	1064	8	10	46	53	90.5	M30x1
BEST-1064-10M	1064	10	11	28	36	87	M30x1
BEST-1064-10M-2	1064	10	10	28	34	90	M22x0.75
BEST-1064-15M	1064	15	11	34	40	102	M30x1
BEST-1064-20M	1064	20	11	34	40	102	M30x1

**532nm beam expanders**

P/N	Wave-length (nm)	Expansion ratio (times)	Input clear aperture (mm)	Output clear aperture (mm)	Out diameter (mm)	length (mm)	connection (mm)
BEST-532-1.5T	532	1.5	10	21.6	25	20	φ25
BEST-532-2M	532	2	10	28	34	87	M22x0.75
BEST-532-2.5T	532	2.5	10	21.6	25	49.3	φ25
BEST-532-2.5	532	2.5	15	28	36	60	φ36
BEST-532-2.5T-A	532	2.5	15	28	36	63	φ36
BEST-532-3M	532	3	10	28	34	70.5	M22x0.75
BEST-532-3M-2	532	3	10	28	34	66.5	M22x0.75
BEST-532-3	532	3	15	32	42	77	φ30 or φ42
BEST-532-3T	532	3	15	32	42	80	φ30 or φ42
BEST-532-4M	532	4	10	28	34	76.5	M22x0.75
BEST-532-4M-2	532	4	10	28	34	62	M22x0.75
BEST-532-4M-3	532	4	10	28	34	72.5	M22x0.75
BEST-532-4M-4	532	4	10	28	34	58	M22x0.75
BEST-532-4T	532	4	11	21.6	25	64	φ25
BEST-532-5M	532	5	10	28	34	80	M22x0.75
BEST-532-5M-2	532	5	10	28	34	76.5	M22x0.75
BEST-532-5T	532	5	11	21.6	25	64	φ25
BEST-532-6M	532	6	10	28	34	81.5	M22x0.75
BEST-532-6M-2	532	6	10	28	34	83.5	M22x0.75
BEST-532-6M-3	532	6	10	28	39	95	M22x0.75
BEST-532-6M-4	532	6	12	34	42	80	M30x1
BEST-532-6M-5	532	6	10	46	53	90.5	M30x1
BEST-532-6M-6	532	6	10	28	39	95	M22x0.75 or φ39
BEST-532-6T	532	6	11	21.6	25	64	φ25
BEST-532-8M	532	8	10	28	34	87	M22x0.75
BEST-532-8M-2	532	8	10	46	53	90.5	M30x1
BEST-532-10M	532	10	11	28	36	87	M30x1
BEST-532-10M-2	532	10	10	28	34	90	M22x0.75
BEST-532-15M	532	15	11	34	40	102	M30x1
BEST-532-20M	532	20	11	34	40	102	M30x1

**355nm beam expanders**

P/N	Wave-length (nm)	Expansion ratio (times)	Input clear aperture (mm)	Output clear aperture (mm)	Out diameter (mm)	length (mm)	connection (mm)
BEST-355-4T	355	4	11	21.6	25	64	φ25
BEST-355-6T	355	6	11	21.6	25	66	φ25
BEST-355-8T	355	8	11	21.6	25	68	φ25

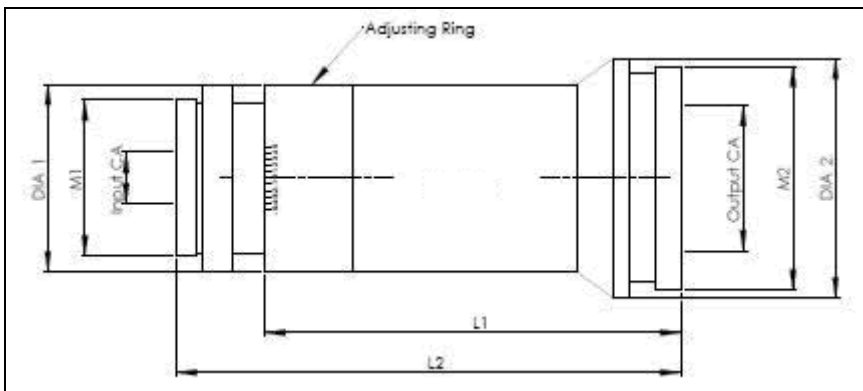
**3. HeNe Laser Beam Expanders (633nm)**

P/N	Expansion ratio (times)	Input clear aperture (mm)	Output clear aperture (mm)	Out diameter (mm)	length (mm)	connection (mm)
BEST-633-3	3	10	28	34	66.5	M22x0.75
BEST-633-55	5	10	28	34	76.5	M22x0.75
BEST-633-10	10	11	28	34	87	M30x1
BEST-633-20	20	8	78	89	173	M30x1

#### 4. 405nm - Adjusted Beam Expanders

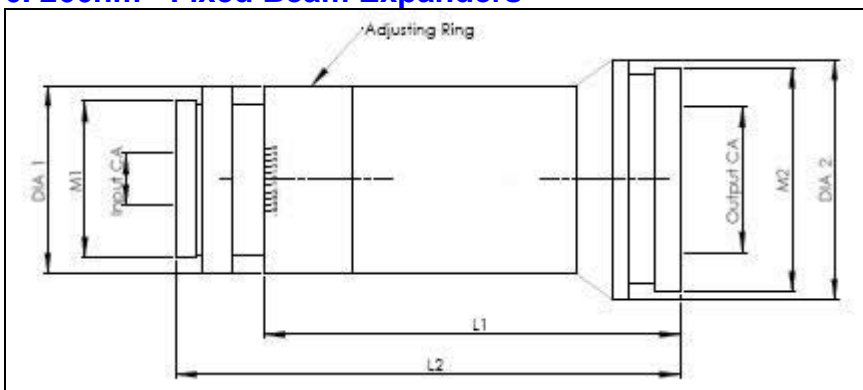
Part No.	Magnification	Input CA (mm)	Output CA (mm)	Dia1 (mm)	Dia2 (mm)	L1 (mm)	L2 (mm)
BEST-405-1.5X-W	1.5	6.0	30.0	-	46	85	-
BEST-405-2X-W	2	6.0	30.0	-	46	85	-
BEST-405-3X-W	3	6.0	30.0	-	46	85	-
BEST-405-5X-W	5	6.0	30.0	-	46	85	-
BEST-405-7X-W	7	4.2	30.0	-	46	85	-
BEST-405-10X-W	10	3.0	30.0	-	46	89	-
BEST-405-20X-W	20	1.5	30.0	-	46	95	-

#### 5. UV (355nm) - Adjustable Beam Expanders



Part No.	Magnification	Input CA (mm)	Output CA (mm)	M1	M2	L1(mm)	L2(mm)
BEST-355-1.5X-W	1.5	7.0	24.0	M30×1	M43x0.5	48.1	76.5
BEST-355-2X-W	2	7.0	24.0	M30×1	M43x0.5	47.2	75.6
BEST-355-3X-W	3	7.0	24.0	M30×1	M43x0.5	48.9	77.3
BEST-355-4X-W	4	8.0	28.0	M30×1	M43x0.5	48.9	75.0
BEST-355-5X-W	5	6.0	28.0	M30×1	M43x0.5	56.5	73.5
BEST-355-7X-W	7	8.0	28.0	M30×1	M43x0.5	73.13	88.13
BEST-355-10X-W	10	6.0	28.0	M30×1	M43x0.5	80.5	96.0
BEST-355-20X-W	20	6.0	28.0	M30×1	M43x0.5	81.3	97.0

#### 6. 266nm - Fixed Beam Expanders



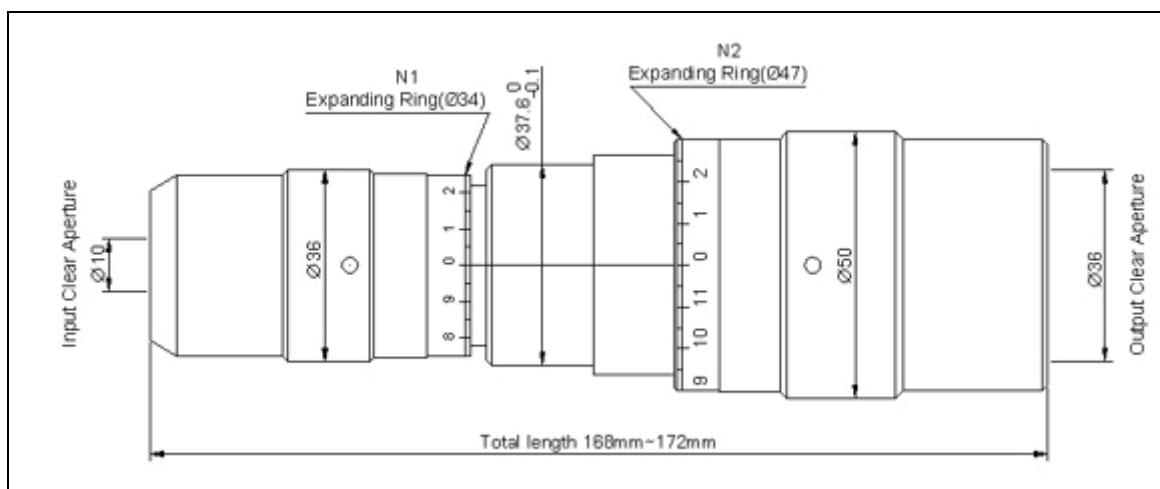
Part No.	Magnification	Input CA (mm)	Output CA (mm)	Dia1(mm)	Dia2(mm)	L2(mm)	L1(mm)
BEST-266-1.5X-W	1.5	8.0	24.0	30.0	30.0	46.2	63.7
BEST-266-2X-W	2	8.0	24.0	30.0	30.0	55.0	73.0
BEST-266-3X-W	3	6.0	30.0	37.6	46.0	71.0	85.0

BEST-266-5X-W	5	6.0	30.0	37.6	46.0	71.0	85.0
BEST-266-10X-W	10	3.0	30.0	37.6	46.0	74.0	88.0
BEST-266-20X-W	20	1.5	30.0	37.6	46.0	75.0	89.5

## 7. Zoom Beam Expanders for CO<sub>2</sub> Laser

### Specifications

- For collimation of CO<sub>2</sub> laser power < 1.5KW/cm<sup>2</sup>
- Variable magnifications 2X-8X
- Galilei Design
- Adjustable divergence



Part No.	Magnification	Input CA (mm)	Output CA (mm)	Length (mm)
BXZ-10.6-1-4X-W	1X-4X	18	48	135
BXZ-10.6-2-6X-W	2X-6X	16	96	205.78-212.37
BXZ-9.4-2-8X-W	2X-8X	10	36	168-172
BXZ-10.6-2-8X-W	2X-8X	10	36	168-172

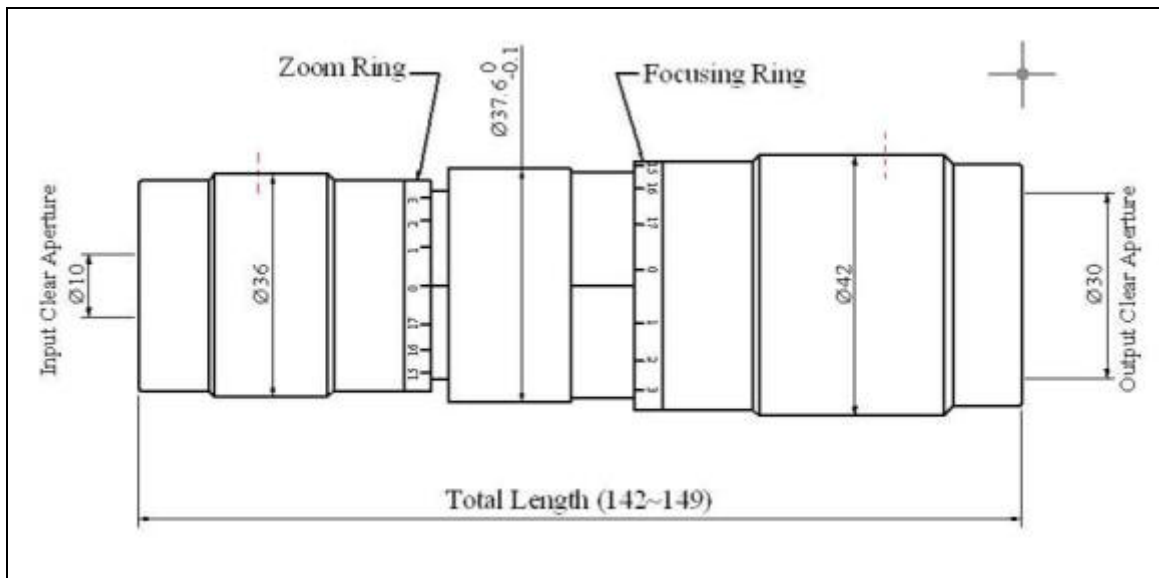
## 8. Zoom Beam Expander for Nd:YAG, Green & UV Lasers

We are proud to present our new product. It is specially designed to cater for the various variable magnification of 2x up to 8x. It consists of adjustable divergence. These beam expanders are primarily intended for Nd:YAG, Green & UV lasers. They offer diffraction-limited performance at 1064nm wavelength.

### Specifications

- For collimation of laser power < 500kw/cm<sup>2</sup>
- Variable magnifications 2x-8x
- Galilei Design
- Adjustable divergence





Part No.	Magnification	Input CA (mm)	Output CA (mm)	Length (mm)
BXZ-1064-1-3X-W	1x-3x	10	20	85.0
BXZ-1064-1-3X-A-W	1x-3x	20	38	118.0
BXZ-1064-2-8X-W	2x-8x	10	30	142-149
BXZ-1064-2-8X-A-W	2x-8x	13	60.67	162-169
BXZ-800-2-8X-W	2x-8x	10	30	142-149
BXZ-532-1-3X-W	1x-3x	10	20	85.0
BXZ-532-2-8X-W	2x-8x	10	30	131.1
BXZ-532-2-8X-A-W	2x-8x	11	60	190
BXZ-355-1-8X-W	1x-8x	10	30	85-200
BXZ-355-2-8X-W	2x-8x	10	30	142-149
BXZ-355-2-8X-A-W	2x-8x	11	60	183-192
BXZ-266-1-8X-W	1x-8x	10	30	162-200

## Zoom Beam Expanders

- Compact design
- 1-3X and 2-8X continuous zoom
- Variable focus

Designed primarily for Nd:YAG at 1064nm, 532nm and 355nm, these diffraction limited zoom beam expanders offer variable magnification of 1-3X and 2-8X with adjustable focus to correct for laser beam divergence. The zoom assembly features fine thread with smooth rotation. These beam expanders are designed and tested for high power laser applications at specified wavelength



### Zoom beam expander 2-8X, output clear aperture 60mm, 1064nm

Wavelength (nm)	1064
Expansion Power	2-8X
Input Clear Aperture CA (mm)	13.00
Output Clear Aperture CA (mm)	60.00
Length (mm)	162-169
Damage Threshold, CW (kW/cm <sup>2</sup> )	1000
Damage Threshold, Pulsed (J/cm <sup>2</sup> @ 20ns)	10.00

### Zoom beam expander 2-8X, output clear aperture 60mm, 532nm

Wavelength (nm)	532
Expansion Power	2-8X
Input Clear Aperture CA (mm)	11.00
Output Clear Aperture CA (mm)	60.00
Length (mm)	190.00
Damage Threshold, CW (kW/cm <sup>2</sup> )	500
Damage Threshold, Pulsed (J/cm <sup>2</sup> @ 20ns)	5.00



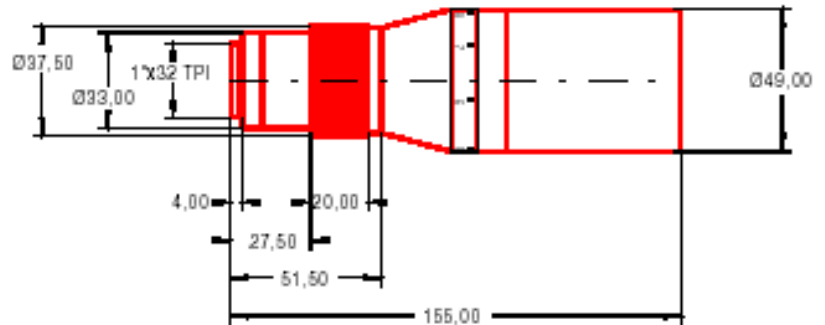
## ST Series Zoom/Variable Beam Expander

- for collimation of high power lasers
- variable magnification from 2x up to 8x
- reproduction of magnification
- high pointing stability <1mrad
- Galilean-design
- available with and without adjustable divergence
- UV beam expander made completely from quartz material
- max. exit pupil depending on the model  $\phi 30\text{mm}$  or  $\phi 50\text{mm}$



### Exit pupil $\phi 30\text{mm}$

Model	Wavelength
ST-S6ASS2074/126	YAG, 1064nm
ST-S6ASS2074/123	HeNe, 633nm
ST-S6ASS2074/121	Green YAG, 532nm

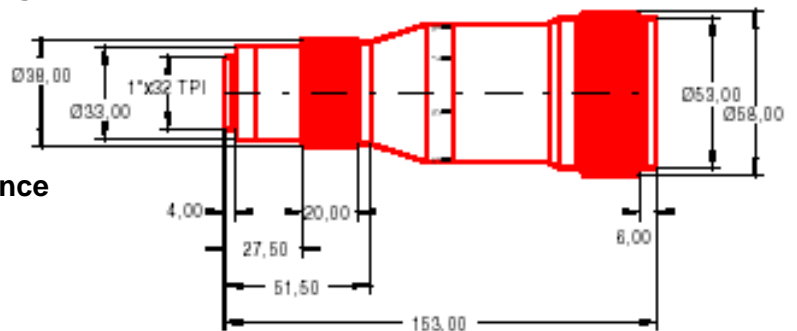


### Exit pupil $\phi 50\text{mm}$

Model	Wavelength
ST-S6ASS2073/126	YAG, 1064nm
ST-S6ASS2073/123	HeNe, 633nm
ST-S6ASS2073/121	Green YAG, 532nm

### Exit pupil $\phi 30\text{mm}$ with adjustable divergence

Model	Wavelength
ST-S6ASS2075/126	YAG, 1064nm
ST-S6ASS2075/123	HeNe, 633nm
ST-S6ASS2075/121	Green YAG, 532nm



### Exit pupil $\phi 50\text{mm}$ with adjustable divergence

Model	Wavelength
ST-S6ASS2076/126	YAG, 1064nm
ST-S6ASS2076/123	HeNe, 633nm
ST-S6ASS2076/121	Green YAG, 532nm

### Exit pupil $\phi 30\text{mm}$ with adjustable divergence for UV

Model	Wavelength
ST-S6ASS5075/075	tripled YAG, 355nm
ST-S6ASS5075/072	HeCd, 308nm
ST-S6ASS5075/119	4th YAG, 266nm

### Zoom-Beam Expander FUSED SILICA (1064nm)

Model	Magnification	Max exit (mm)	Length (mm)	Max outside (mm)	Material	Adjustable divergence	Motorised
ST-S6ASS5310/126	1x - 3x	20	85	47	Fused silica	√	--
ST-S6ASS5076/126	1x - 8x	30	162	58	Fused silica	√	--
ST-S6ASS3976/126	1x - 8x	30	200	160x71	Fused silica	√	√

max. beam- 6 mm respectively limited by the magnification factor

## VBE Series Zoom/Variable Beam Expanders

- Continuous variation of magnification 2x ... 8x possible
- Wavelengths 355 nm, 405 nm, 532 nm, 633/780/830 nm or 1064 nm
- Settings of zoom and focusing scales according to product specific graph
- Mounting in customer machine at surface [A]
- Consideration of convergence correction at maximum setting of movable lens elements



Order No.	Wavelength (nm)	Magnification factor	Max. entrance beam (mm)	Max. exit beam (mm)	Lens elements	Mounting diameter or thread (mm)
VBE4401-402-000-20	355	2 ... 8x variable	3.4*	31	4	37.6
VBE4401-380-000-20	405	2 ... 8x variable	6.0*	31	4	37.6
VBE4401-446-000-20	532	2 ... 8x variable	4.0*	31	4	37.6
VBE4401-257-000-20	532	2 ... 8x variable	8.0*	31	4	37.6
VBE4401-258-000-20	633/780/ 830	2 ... 8x variable	8.0*	31	4	37.6
VBE4401-359-000-20	1064	2 ... 8x variable	4.0*	31	4	37.6
VBE4401-256-000-20	1064	2 ... 8x variable	8.0*	31	4	37.6

\* Beyond defined zoom factors, the entrance beam is max. 31 mm / zoom factor.

Details can be found in the respective data sheet.

## Motorized Zoom Beam Expander

### Characteristics:

- variable expansion ratio from 1x to 8x with an entrance aperture of 3-6 mm
- wave front aberation better than  $\Lambda/8$
- zooming in steps of 0,05x
- direct input and output of zoom factor
- fine adjustment of collimation
- incremental and decremental adjustment of offset
- offset stored in EPROM
- powersafe by switching off the motor
- reset possible at any time
- fully programable via RS232
- remote control optional



### Technical Specifications:

- operating power 12V DC, stabilized
- current 1,0 A (with motors on) or 100 mA (with powersafe)
- interface RS232
- a RS422 interface is available optional
- lifetime > 100.000 cycles
- positioning time < 2 seconds

Model	Wavelength
ST-S6ASS2975/126	YAG 1064 nm
ST-S6ASS2975/123	He Ne 633 nm
ST-S6ASS2975/121	Green YAG 532 nm



## Motorzoom Adapter

### Characteristics:

- allows motorised controll of the zoom position of any zoom beamexpander
- fully programable via RS232
- quasi continuous adjustment of the zoom factor
- stand alone operation possible with optional available handheld unit

Motorzoom Adapter Article # ST-S6ASS3900



## Beam Expander Mount

Model: BEM-22x0.75

4D adjustable (4-axis adjustable)

Suitable for the beam expander with a screw of M22x0.75mm

