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THORLABS

BE052-A - September 28, 2022

Item # BE052-A was discontinued on September 28, 2022. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

VARIABLE OPTICAL BEAM EXPANDERS/REDUCERS, SLIDING LENS DESIGN

- 0.5X to 2X Continuously Variable Beam Expansion or Reduction
- Increase or Decrease Beam Size without Realigning the Setup
- 400 - 650 nm or 650 - 1050 nm AR-Coated Optics

BE052-B

SM2A21

Application Idea

BE052-B
Mounted in the
SM2A21 Mounting Adapter

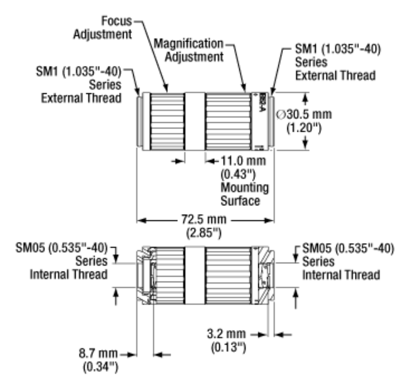
BE052-A

Hide Overview

OVERVIEW

Features

- Achromatic Design Minimizes Divergence of Multiwavelength Beams
- Sliding Lenses to Reduce Beam Walk
- Match Beam Sizes of Two Separate Beams
- Functions as a Zero Magnification Collimation Device
- Ø1.2" Mount and SM05/SM1 Lens Tube Compatible



Click to Expand

Thorlabs' 0.5X to 2X Galilean Variable Beam Expanders/Reducers allow the user to easily adjust the beam diameter without altering the alignment of the optical setup. The beam expander contains a fixed lens at the front followed by two movable lenses. The zoom is adjusted by turning the magnification ring (see the schematic to the right), which translates the position of the center lens. To adjust the collimation of the output beam, turn the focus ring, which translates the lens at the back end of the housing.

The input and output ends of the beam expander are equipped with both internal SM05 (0.535"-40) and external SM1 (1.035"-40) threading, which makes it easy to integrate these beam expanders into our entire line of optomechanical components. The threaded rings at either end of the beam expander do not rotate when turning the magnification or focus adjustment rings, allowing the user to adjust the beam expansion without disturbing any attached optics.

Click for Details
The external SM1 and internal SM05

The beam expander has a diameter of 1.2", which is identical to Thorlabs' SM1 Lens Tubes. An 11 mm wide ring, located between the focus and magnification adjustment rings, is provided for mounting the beam expander to a post via our SM1RC(/M) Lens Tube Slip Ring or SM1TC Lens Tube Clamp. Alternatively, the beam expander can be inserted into a 30 mm cage system using the CP36 Cage Plate.

threads on the beam expander to be used directly with both SM05 and SM1 Lens Tubes.

Alternatively, the SM2A21 adapter presented below can be used to convert the mounting ring outer diameter to 2", making it compatible with Thorlabs' SM2 Lens Tubes, 60 mm Cage Systems, and Ø2" optic mounts.

Thorlabs also offers variable magnification beam expanders that use a rotating lens to achieve expansions from 2X to 5X or 5X to 10X. Other beam expander options available are our UV fused silica, achromatic, and ZnSe fixed beam expanders, UV fused silica or achromatic zoom beam expanders, and reflective beam expanders. For more information on our extensive line of beam expanders, please see the *Beam Expanders* tab.

Hide Damage Thresholds

DAMAGE THRESHOLDS

Damage Threshold Data for Thorlabs' Variable Beam Expanders/Reducers

The specifications to the right are the measured data for Thorlabs' variable beam expanders/reducers.

Damage Threshold Specifications		
Item #	**Laser Type**	**Damage Threshold**
BE052-A	Pulsed[a]	0.5 J/cm² (532 nm, 10 ns pulse, 10 Hz, Ø5.66 mm)
	CW	600 W/cm (532 nm, Ø0.020 mm)
BE052-B	Pulsed[a]	5.0 J/cm² (810 nm, 10 ns pulse, 10 Hz, Ø0.155 mm)
	CW	9,000 W/cm (1064 nm, Ø0.025 mm)

- a. The power density of your beam should be calculated in terms of W/cm. For an explanation of why the linear power density provides the best metric for long pulse and CW sources, please see the "Continuous Wave and Long-Pulse Lasers" section below.

Laser Induced Damage Threshold Tutorial

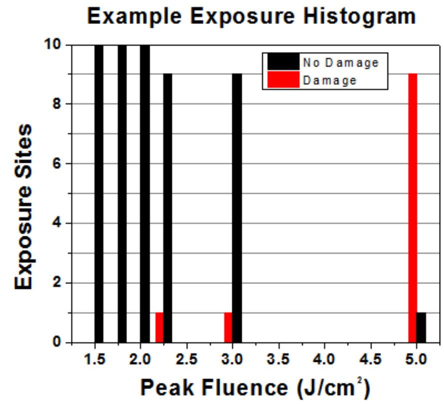
The following is a general overview of how laser induced damage thresholds are measured and how the values may be utilized in determining the appropriateness of an optic for a given application. When choosing optics, it is important to understand the Laser Induced Damage Threshold (LIDT) of the optics being used. The LIDT for an optic greatly depends on the type of laser you are using. Continuous wave (CW) lasers typically cause damage from thermal effects (absorption either in the coating or in the substrate). Pulsed lasers, on the other hand, often strip electrons from the lattice structure of an optic before causing thermal damage. Note that the guideline presented here assumes room temperature operation and optics in new condition (i.e., within scratch-dig spec, surface free of contamination, etc.). Because dust or other particles on the surface of an optic can cause damage at lower thresholds, we recommend keeping surfaces clean and free of debris. For more information on cleaning optics, please see our *Optics Cleaning* tutorial.

Testing Method

Thorlabs' LIDT testing is done in compliance with ISO/DIS 11254 and ISO 21254 specifications.

First, a low-power/energy beam is directed to the optic under test. The optic is exposed in 10 locations to this laser beam for 30 seconds (CW) or for a number of pulses (pulse repetition frequency specified). After exposure, the optic is examined by a microscope (~100X magnification) for any visible damage. The number of locations that are damaged at a particular power/energy level is recorded. Next, the power/energy is either increased or decreased and the optic is exposed at 10 new locations. This process is repeated until damage is observed. The damage threshold is then assigned to be the highest power/energy that the optic can withstand without causing damage. A histogram such as that below represents the testing of one BB1-E02 mirror.

The photograph above is a protected aluminum-coated mirror after LIDT testing. In this particular test, it handled 0.43 J/cm^2 (1064 nm, 10 ns pulse, 10 Hz, Ø1.000 mm) before damage.



Example Test Data			
Fluence	# of Tested Locations	Locations with Damage	Locations Without Damage
1.50 J/cm^2	10	0	10
1.75 J/cm^2	10	0	10
2.00 J/cm^2	10	0	10
2.25 J/cm^2	10	1	9
3.00 J/cm^2	10	1	9
5.00 J/cm^2	10	9	1

According to the test, the damage threshold of the mirror was 2.00 J/cm^2 (532 nm, 10 ns pulse, 10 Hz, Ø0.803 mm). Please keep in mind that these tests are performed on clean optics, as dirt and contamination can significantly lower the damage threshold of a component. While the test results are only representative of one coating run, Thorlabs specifies damage threshold values that account for coating variances.

Continuous Wave and Long-Pulse Lasers

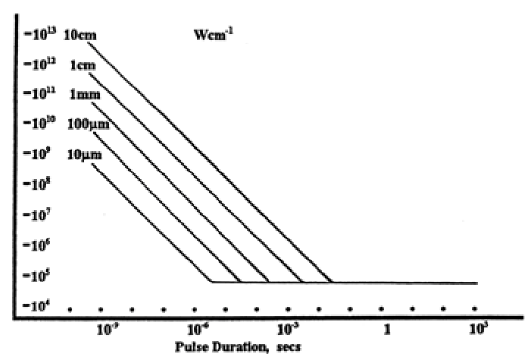
When an optic is damaged by a continuous wave (CW) laser, it is usually due to the melting of the surface as a result of absorbing the laser's energy or damage to the optical coating (antireflection) [1]. Pulsed lasers with pulse lengths longer than 1 µs can be treated as CW lasers for LIDT discussions.

When pulse lengths are between 1 ns and 1 µs, laser-induced damage can occur either because of absorption or a dielectric breakdown (therefore, a user must check both CW and pulsed LIDT). Absorption is either due to an intrinsic property of the optic or due to surface irregularities; thus LIDT values are only valid for optics meeting or exceeding the surface quality specifications given by a manufacturer. While many optics can handle high power CW lasers, cemented (e.g., achromatic doublets) or highly absorptive (e.g., ND filters) optics tend to have lower CW damage thresholds. These lower thresholds are due to absorption or scattering in the cement or metal coating.

Pulsed lasers with high pulse repetition frequencies (PRF) may behave similarly to CW beams. Unfortunately, this is highly dependent on factors such as absorption and thermal diffusivity, so there is no reliable method for determining when a high PRF laser will damage an optic due to thermal effects. For beams with a high PRF both the average and peak powers must be compared to the equivalent CW power. Additionally, for highly transparent materials, there is little to no drop in the LIDT with increasing PRF.

In order to use the specified CW damage threshold of an optic, it is necessary to know the following:

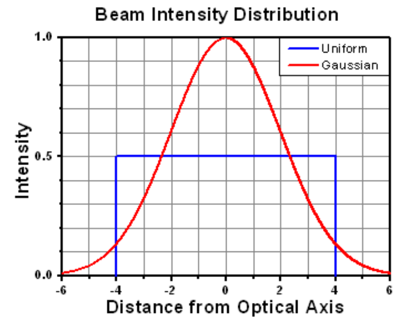
1. Wavelength of your laser
2. Beam diameter of your beam (1/e^2)
3. Approximate intensity profile of your beam (e.g., Gaussian)
4. Linear power density of your beam (total power divided by 1/e^2 beam diameter)



LIDT in linear power density vs. pulse length and spot size. For long pulses to CW, linear power density becomes a constant with spot size. This graph was obtained from [1].

Thorlabs expresses LIDT for CW lasers as a linear power density measured in W/cm. In this regime, the LIDT given as a linear power density can be applied to any beam diameter; one does not need to compute an adjusted LIDT to adjust for changes in spot size, as demonstrated by the graph to the right. Average linear power density can be calculated using the equation below.

$$Linear\ Power\ Density = \frac{Power}{Beam\ Diameter}$$



The calculation above assumes a uniform beam intensity profile. You must now consider hotspots in the beam or other non-uniform intensity profiles and roughly calculate a maximum power density. For reference, a Gaussian beam typically has a maximum power density that is twice that of the uniform beam (see lower right).

Now compare the maximum power density to that which is specified as the LIDT for the optic. If the optic was tested at a wavelength other than your operating wavelength, the damage threshold must be scaled appropriately. A good rule of thumb is that the damage threshold has a linear relationship with wavelength such that as you move to shorter wavelengths, the damage threshold decreases (i.e., a LIDT of 10 W/cm at 1310 nm scales to 5 W/cm at 655 nm):

$$Adjusted\ LIDT = LIDT\ Power\left(\frac{Your\ Wavelength}{LIDT\ Wavelength}\right)$$

While this rule of thumb provides a general trend, it is not a quantitative analysis of LIDT vs wavelength. In CW applications, for instance, damage scales more strongly with absorption in the coating and substrate, which does not necessarily scale well with wavelength. While the above procedure provides a good rule of thumb for LIDT values, please contact Tech Support if your wavelength is different from the specified LIDT wavelength. If your power density is less than the adjusted LIDT of the optic, then the optic should work for your application.

Please note that we have a buffer built in between the specified damage thresholds online and the tests which we have done, which accommodates variation between batches. Upon request, we can provide individual test information and a testing certificate. The damage analysis will be carried out on a similar optic (customer's optic will not be damaged). Testing may result in additional costs or lead times. Contact Tech Support for more information.

Pulsed Lasers

As previously stated, pulsed lasers typically induce a different type of damage to the optic than CW lasers. Pulsed lasers often do not heat the optic enough to damage it; instead, pulsed lasers produce strong electric fields capable of inducing dielectric breakdown in the material. Unfortunately, it can be very difficult to compare the LIDT specification of an optic to your laser. There are multiple regimes in which a pulsed laser can damage an optic and this is based on the laser's pulse length. The highlighted columns in the table below outline the relevant pulse lengths for our specified LIDT values.

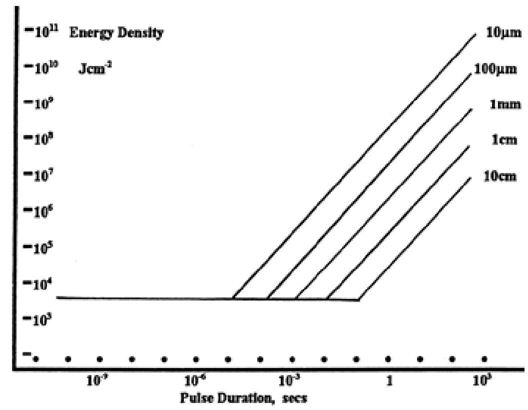
Pulses shorter than 10^{-9} s cannot be compared to our specified LIDT values with much reliability. In this ultra-short-pulse regime various mechanics, such as multiphoton-avalanche ionization, take over as the predominate damage mechanism [2]. In contrast, pulses between 10^{-7} s and 10^{-4} s may cause damage to an optic either because of dielectric breakdown or thermal effects. This means that both CW and pulsed damage thresholds must be compared to the laser beam to determine whether the optic is suitable for your application.

Pulse Duration	$t < 10^{-9}$ s	$10^{-9} < t < 10^{-7}$ s	$10^{-7} < t < 10^{-4}$ s	$t > 10^{-4}$ s
Damage Mechanism	Avalanche Ionization	Dielectric Breakdown	Dielectric Breakdown or Thermal	Thermal
Relevant Damage Specification	No Comparison (See Above)	Pulsed	Pulsed and CW	CW

When comparing an LIDT specified for a pulsed laser to your laser, it is essential to know the following:

1. Wavelength of your laser
2. Energy density of your beam (total energy divided by $1/e^2$ area)
3. Pulse length of your laser
4. Pulse repetition frequency (prf) of your laser
5. Beam diameter of your laser ($1/e^2$)
6. Approximate intensity profile of your beam (e.g., Gaussian)

The energy density of your beam should be calculated in terms of J/cm^2. The graph to the right shows why expressing the LIDT as an energy density provides the best metric for short pulse sources. In this regime, the LIDT given as an energy density can be applied to any beam diameter; one does not need to compute an adjusted LIDT to adjust for changes in spot size. This calculation assumes a uniform beam intensity profile. You must now adjust this energy density to account for hotspots or other nonuniform intensity profiles and roughly calculate a maximum energy density. For reference a Gaussian beam typically has a maximum energy density that is twice that of the $1/e^2$ beam.



LIDT in energy density vs. pulse length and spot size. For short pulses, energy density becomes a constant with spot size. This graph was obtained from [1].

Now compare the maximum energy density to that which is specified as the LIDT for the optic. If the optic was tested at a wavelength other than your operating wavelength, the damage threshold must be scaled appropriately [3]. A good rule of thumb is that the damage threshold has an inverse square root relationship with wavelength such that as you move to shorter wavelengths, the damage threshold decreases (i.e., a LIDT of 1 J/cm^2 at 1064 nm scales to 0.7 J/cm^2 at 532 nm):

$$Adjusted\ LIDT = LIDT\ Energy\sqrt{\frac{Your\ Wavelength}{LIDT\ Wavelength}}$$

You now have a wavelength-adjusted energy density, which you will use in the following step.

Beam diameter is also important to know when comparing damage thresholds. While the LIDT, when expressed in units of J/cm², scales independently of spot size; large beam sizes are more likely to illuminate a larger number of defects which can lead to greater variances in the LIDT [4]. For data presented here, a <1 mm beam size was used to measure the LIDT. For beams sizes greater than 5 mm, the LIDT (J/cm2) will not scale independently of beam diameter due to the larger size beam exposing more defects.

The pulse length must now be compensated for. The longer the pulse duration, the more energy the optic can handle. For pulse widths between 1 - 100 ns, an approximation is as follows:

$$Adjusted\ LIDT = LIDT\ Energy\sqrt{\frac{Your\ Pulse\ Length}{LIDT\ Pulse\ Length}}$$

Use this formula to calculate the Adjusted LIDT for an optic based on your pulse length. If your maximum energy density is less than this adjusted LIDT maximum energy density, then the optic should be suitable for your application. Keep in mind that this calculation is only used for pulses between 10^{-9} s and 10^{-7} s. For pulses between 10^{-7} s and 10^{-4} s, the CW LIDT must also be checked before deeming the optic appropriate for your application.

Please note that we have a buffer built in between the specified damage thresholds online and the tests which we have done, which accommodates variation between batches. Upon request, we can provide individual test information and a testing certificate. Contact Tech Support for more information.

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[1] R. M. Wood, Optics and Laser Tech. **29**, 517 (1998).
[2] Roger M. Wood, *Laser-Induced Damage of Optical Materials* (Institute of Physics Publishing, Philadelphia, PA, 2003).
[3] C. W. Carr *et al*., Phys. Rev. Lett. **91**, 127402 (2003).
[4] N. Bloembergen, Appl. Opt. **12**, 661 (1973).

Hide LIDT Calculations

LIDT CALCULATIONS

In order to illustrate the process of determining whether a given laser system will damage an optic, a number of example calculations of laser induced damage threshold are given below. For assistance with performing similar calculations, we provide a spreadsheet calculator that can be downloaded by clicking the button to the right. To use the calculator, enter the specified LIDT value of the optic under consideration and the relevant parameters of your laser system in the green boxes. The spreadsheet will then calculate a linear power density for CW and pulsed systems, as well as an energy density value for pulsed systems. These values are used to calculate adjusted, scaled LIDT values for the optics based on accepted scaling laws. This calculator assumes a Gaussian beam profile, so a correction factor must be introduced for other beam shapes (uniform, etc.). The LIDT scaling laws are determined from empirical relationships; their accuracy is not guaranteed. Remember that absorption by optics or coatings can significantly reduce LIDT in some spectral regions. These LIDT values are not valid for ultrashort pulses less than one nanosecond in duration.

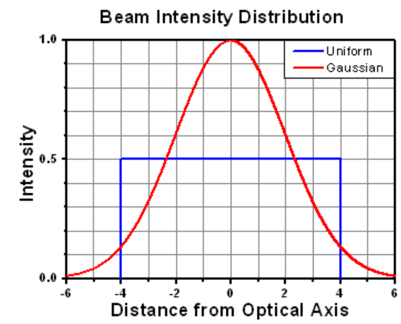
LIDT Calculator

CW Laser Example

Suppose that a CW laser system at 1319 nm produces a 0.5 W Gaussian beam that has a $1/e^2$ diameter of 10 mm. A naive calculation of the average linear power density of this beam would yield a value of 0.5 W/cm, given by the total power divided by the beam diameter:

$$\text{Linear Power Density} = \frac{\text{Power}}{\text{Beam Diameter}}$$

However, the maximum power density of a Gaussian beam is about twice the maximum power density of a uniform beam, as shown in the graph to the right. Therefore, a more accurate determination of the maximum linear power density of the system is 1 W/cm.



A Gaussian beam profile has about twice the maximum intensity of a uniform beam profile.

An AC127-030-C achromatic doublet lens has a specified CW LIDT of 350 W/cm, as tested at 1550 nm. CW damage threshold values typically scale directly with the wavelength of the laser source, so this yields an adjusted LIDT value:

$$\text{Adjusted LIDT} = \text{LIDT Power}\left(\frac{\text{Your Wavelength}}{\text{LIDT Wavelength}}\right)$$

The adjusted LIDT value of 350 W/cm x (1319 nm / 1550 nm) = 298 W/cm is significantly higher than the calculated maximum linear power density of the laser system, so it would be safe to use this doublet lens for this application.

Pulsed Nanosecond Laser Example: Scaling for Different Pulse Durations

Suppose that a pulsed Nd:YAG laser system is frequency tripled to produce a 10 Hz output, consisting of 2 ns output pulses at 355 nm, each with 1 J of energy, in a Gaussian beam with a 1.9 cm beam diameter ($1/e^2$). The average energy density of each pulse is found by dividing the pulse energy by the beam area:

$$\text{Energy Density} = \frac{\text{Pulse Energy}}{\text{Beam Area}}$$

As described above, the maximum energy density of a Gaussian beam is about twice the average energy density. So, the maximum energy density of this beam is ~0.7 J/cm^2.

The energy density of the beam can be compared to the LIDT values of 1 J/cm^2 and 3.5 J/cm^2 for a BB1-E01 broadband dielectric mirror and an NB1-K08 Nd:YAG laser line mirror, respectively. Both of these LIDT values, while measured at 355 nm, were determined with a 10 ns pulsed laser at 10 Hz. Therefore, an adjustment must be applied for the shorter pulse duration of the system under consideration. As described on the previous tab, LIDT values in the nanosecond pulse regime scale with the square root of the laser pulse duration:

$$\text{Adjusted LIDT} = \text{LIDT Energy}\sqrt{\frac{\text{Your Pulse Length}}{\text{LIDT Pulse Length}}}$$

This adjustment factor results in LIDT values of 0.45 J/cm^2 for the BB1-E01 broadband mirror and 1.6 J/cm^2 for the Nd:YAG laser line mirror, which are to be compared with the 0.7 J/cm^2 maximum energy density of the beam. While the broadband mirror would likely be damaged by the laser, the more specialized laser line mirror is appropriate for use with this system.

Pulsed Nanosecond Laser Example: Scaling for Different Wavelengths

Suppose that a pulsed laser system emits 10 ns pulses at 2.5 Hz, each with 100 mJ of energy at 1064 nm in a 16 mm diameter beam ($1/e^2$) that must be attenuated with a neutral density filter. For a Gaussian output, these specifications result in a maximum energy density of 0.1 J/cm^2. The damage threshold of an NDUV10A Ø25 mm, OD 1.0, reflective neutral density filter is 0.05 J/cm^2 for 10 ns pulses at 355 nm, while the damage threshold of the similar NE10A absorptive filter is 10 J/cm^2 for 10 ns pulses at 532 nm. As described on the previous tab, the LIDT value of an optic scales with the square root of the wavelength in the nanosecond pulse regime:

$$Adjusted\ LIDT = LIDT\ Energy\sqrt{\frac{Your\ Wavelength}{LIDT\ Wavelength}}$$

This scaling gives adjusted LIDT values of 0.08 J/cm^2 for the reflective filter and 14 J/cm^2 for the absorptive filter. In this case, the absorptive filter is the best choice in order to avoid optical damage.

Pulsed Microsecond Laser Example

Consider a laser system that produces 1 µs pulses, each containing 150 µJ of energy at a repetition rate of 50 kHz, resulting in a relatively high duty cycle of 5%. This system falls somewhere between the regimes of CW and pulsed laser induced damage, and could potentially damage an optic by mechanisms associated with either regime. As a result, both CW and pulsed LIDT values must be compared to the properties of the laser system to ensure safe operation.

If this relatively long-pulse laser emits a Gaussian 12.7 mm diameter beam ($1/e^2$) at 980 nm, then the resulting output has a linear power density of 5.9 W/cm and an energy density of 1.2×10^{-4} J/cm^2 per pulse. This can be compared to the LIDT values for a WPQ10E-980 polymer zero-order quarter-wave plate, which are 5 W/cm for CW radiation at 810 nm and 5 J/cm^2 for a 10 ns pulse at 810 nm. As before, the CW LIDT of the optic scales linearly with the laser wavelength, resulting in an adjusted CW value of 6 W/cm at 980 nm. On the other hand, the pulsed LIDT scales with the square root of the laser wavelength and the square root of the pulse duration, resulting in an adjusted value of 55 J/cm^2 for a 1 µs pulse at 980 nm. The pulsed LIDT of the optic is significantly greater than the energy density of the laser pulse, so individual pulses will not damage the wave plate. However, the large average linear power density of the laser system may cause thermal damage to the optic, much like a high-power CW beam.

Hide Beam Expanders

BEAM EXPANDERS

Thorlabs offers fixed and variable magnification beam expanders, as well as zoom beam expanders that do not need to be refocused when the magnification is adjusted since the collimation remains constant. The table below provides a direct comparison of the options we offer. Please contact Tech Support if you would like help choosing the best beam expander for your specific application.

Beam Expander Description	Fixed Magnification Laser Line, Sliding Lens	Fixed Magnification Achromatic, Sliding Lens	Fixed Magnification Mid-Infrared, Sliding Lens	Zoom, Sliding Lens	Zoom Achromatic, Sliding Lens
Expansions Available	2X, 3X, 5X, 10X, 20X[a]	2X, 3X, 5X, 10X, 15X, 20X	2X, 5X, 10X	0.5X - 2.5X, 1X - 4X	0.5X - 2.5X, 1X - 4X, 2X - 8X, 4X - 16X
AR Coating Range(s) (Item # Suffix)	240 - 360 nm (-UVB) 248 - 287 nm (-266) 325 - 380 nm (-355) 488 - 580 nm (-532) 960 - 1064 nm (-1064)	400 - 650 nm (-A) 650 - 1050 nm (-B) 1050 - 1650 nm (-C)	7 - 12 µm (-E3)	240 - 360 nm (UVB) 330 - 370 nm (3) 495 - 570 nm (2) 980 - 1130 nm (1)	400 - 650 nm (A) 650 - 1050 nm (B) 1050 - 1650 nm (C)
Mirror Coating (Range)	N/A				
Reflectance (per Surface)	R_{avg} < 0.2% (R_{Max} < 1.5% for -UVB)	R_{Max} < 0.5%	R_{avg} < 1.0%	R_{avg} < 0.2% (R_{Max} < 1.5% for UVB)	R_{Max} < 0.5%
Max Input Beam Diameter	2X: 8.5 mm 3X: 9.0 mm 5X: 4.3 mm 10X: 2.8 mm	2X: 8.5 mm 3X: 9.0 mm 5X: 5.0 mm 10X: 3.0 mm 15X: 2.5 mm	2X: 9.5 mm 5X: 6.7 mm 10X: 3.5 mm	0.5X - 2.5X: 10.9 to 8.0 mm 1X - 4X: 10.9 to 8.8 mm	0.5X - 2.5X: 10.9 to 8.0 mm 1X - 4X: 10.9 to 8.8 mm 2X - 8X: 6.0 to 4.4 mm

	20X: 2.0 mm	20X: 2.0 mm			4X - 16X: 6.0 to 2.7 mm
Wavefront Error	<λ/4 (Peak to Valley)				
Surface Quality	10-5 Scratch-Dig	20-10 Scratch-Dig	80-50 Scratch-Dig	10-5 Scratch-Dig	20-10 Scratch-Dig

- a. These 20X beam expanders are only available with V coatings for 355 nm, 532 nm, or 1064 nm.

Beam Expander Description	**Variable Magnification, Rotating Lens**	**Variable Magnification, Sliding Lens**	**Reflective Beam Expander Fixed Magnification**
Expansions Available	2X - 5X	0.5X - 2X	2X, 4X, 6X
AR Coating Range(s) (Item # Suffix)	400 - 650 nm (-A) 650 - 1050 nm (-B) 1050 - 1620 nm (-C)	400 - 650 nm (-A) 650 - 1050 nm (-B)	N/A
Mirror Coating (Range)	N/A		Protected Silver (450 nm - 20 µm)
Reflectance (per Surface)	$R_{avg} < 0.5\%$	$R_{avg} < 0.5\%$	$R_{avg} > 96\%$
Max Input Beam Diameter	2X - 5X: 4.0 mm	0.5X - 2X: 6.0 mm to 3.0 mm	3 mm
Wavefront Error	<λ/4		<λ/10[a] (RMS)
Surface Quality	20-10 Scratch-Dig		40-20 Scratch-Dig

- a. For a Ø1.5 mm Input Beam at 2X magnification, Ø1.0 mm Input Beam at 4X magnification, or Ø0.5 mm Input Beam at 6X magnification.

Hide 0.5X - 2X Variable Beam Reducer/Expander

0.5X - 2X Variable Beam Reducer/Expander

Item #		**BE052-A**	**BE052-B**
AR Coating Range		400 - 650 nm	650 - 1050 nm
Average Reflectance		<0.5% per Surface	
Transmission at Selected Laser Lines[a]		97% at 405 nm 97% at 488 nm 98% at 532 nm 98% at 633 nm	98% at 658 nm 97% at 780 nm 98% at 980 nm
Expansion		0.5X - 2X	
Max Input Beam Diameter ($1/e^2$)		Ø6.0 mm (0.5X), Ø3.0 mm (2X)	
Wavefront Error		<λ/4	
Input Aperture		Ø10.0 mm	
Surface Quality		20-10 Scratch-Dig	
Input and Output Threads		External: SM1 (1.035"-40) / Internal: SM05 (0.535"-40)	
Housing Dimensions		Ø30.5 mm x 72.5 mm (1.20" x 2.85")	
Damage Threshold	**Pulsed**	0.5 J/cm^2 (532 nm, 10 ns Pulse, 10 Hz, Ø5.66 mm)	5.0 J/cm^2 (810 nm, 10 ns Pulse, 10 Hz, Ø0.155 mm)
	CW[b]	600 W/cm (532 nm, Ø0.020 mm)	9,000 W/cm (1064 nm, Ø0.025 mm)
Lens Substrates		SF2/N-BK7, N-FK5	N-SF6/N-BAF10, N-FK5

- a. The data presented here is typical. Slight variations in performance data will occur from lot to lot. Please contact Technical Support with any questions regarding the use or reliability of this data.
- b. The power density of your beam should be calculated in terms of W/cm. For an explanation of why the linear power density provides the best metric for long pulse and CW sources, please see the "Continuous Wave and Long-Pulse Lasers" section on the *Damage Thresholds* tab.

Part Number	Description	Price	Availability
BE052-A	Variable Optical Beam Expander, 0.5X - 2X Zoom, AR Coated: 400 - 650 nm	$944.20	Lead Time
BE052-B	Variable Optical Beam Expander, 0.5X - 2X Zoom, AR Coated: 650 - 1050 nm	$944.20	Lead Time

Hide Mounting Accessories

Mounting Accessories

The mounting surfaces of Thorlabs' 0.5X to 2X Variable Magnification Beam Expanders share the same Ø1.2" diameter as our SM1-Threaded Lens Tubes. Several mounting options are provided for convenience in the table below.

Click for Details
The BE052-B beam expander is secured in the SM2A21 mounting adapter by a nylon-tipped setscrew and mounted in the LCP06 cage plate. The mounting adapter provides compatibility with 60 mm Cage Systems, Ø2" Optic Mounts, and SM2 Lens Tubes.

Item #	SM1RC(/M)	SM1TC	CP36	SM2A21
Photo (Click to Enlarge)				
Application	Slip Ring for Post Mounting Ø1.2" Housing	Clamp for Post Mounting Ø1.2" Housing	30 mm Cage Mounting for Ø1.2" Housing	Mount Beam Expander in Ø2" or SM2-Threaded Optic Mounts
Taps / Through Holes	8-32 (M4) Tap for Post Mounting	#8 (M4) Counterbore for Post Mounting	4 Through Holes for ER Cage Rods	-
Internal Bore	Ø1.2" Bore	Ø1.2" Bore	Ø1.2" Bore	Ø1.2" Bore
External Threads / Outer Diameter	-	-	-	0.16" Deep SM2 Threads and 0.31" Wide, Ø2" Smooth Surface

Part Number	Description	Price	Availability
SM1RC/M	Slip Ring for SM1 Lens Tubes and C-Mount Extension Tubes,M4 Tap	$27.02	Today
SM1TC	Clamp for SM1 Lens Tubes and C-Mount Extension Tubes	$49.20	Today
CP36	30 mm Cage Plate, Ø1.2" Double Bore for SM1 and C-Mount Lens Tubes	$23.75	Today
SM2A21	Externally SM2-Threaded Mounting Adapter with Ø1.20" (Ø30.5 mm) Bore and 2" Outer Diameter	$52.70	Today
SM1RC	Slip Ring for SM1 Lens Tubes and C-Mount Extension Tubes,8-32 Tap	$27.02	Today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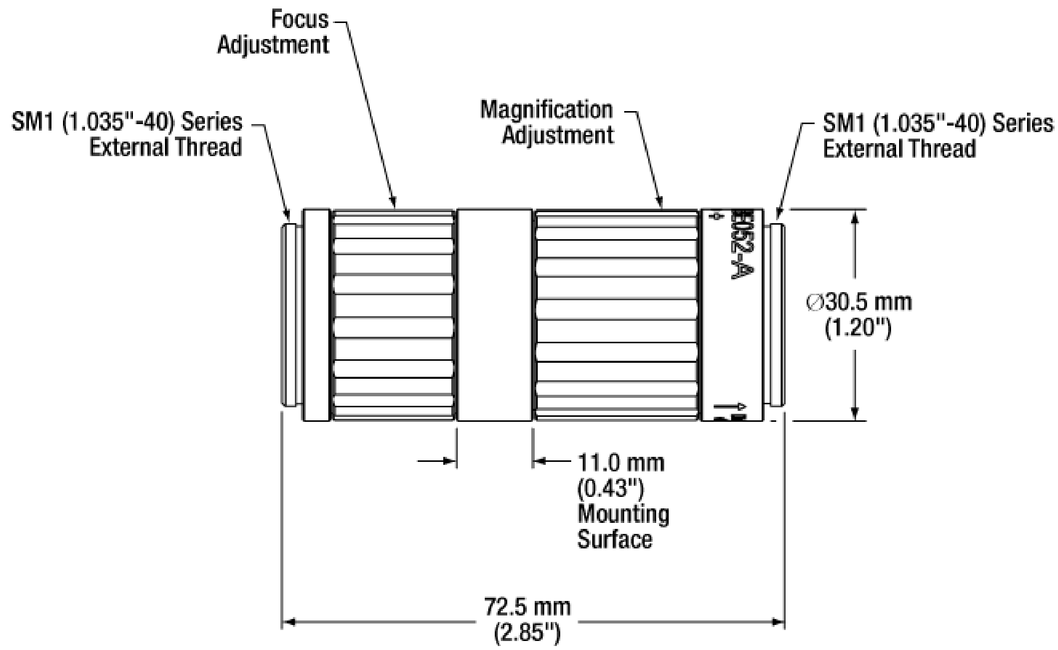
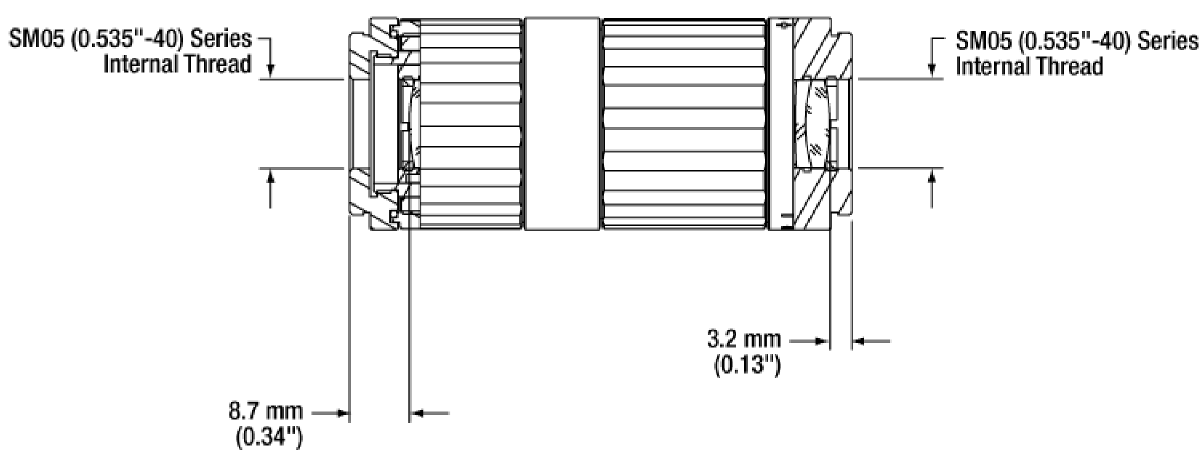
BE052-A


Focus Adjustment
SM1 (1.035"-40) Series External Thread
Magnification Adjustment
SM1 (1.035"-40) Series External Thread
Ø30.5 mm (1.20")
11.0 mm (0.43") Mounting Surface
72.5 mm (2.85")


SM05 (0.535"-40) Series Internal Thread
SM05 (0.535"-40) Series Internal Thread
3.2 mm (0.13")
8.7 mm (0.34")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