Sill OPTICS

LASER OPTICS

2025

太平貿易株式会社

LASER OPTICS

太平貿易株式会社 光学機器課 TEL 03-3270-4826 tokyo@taiheiboeki.co.jp

OUR HIGHLIGHTS 2025

Sill Optics sells customized lenses for CO_2 lasers. Scan lenses, beam expanders, focusing lenses and other customized optics for lasers with wavelengths above 9 µm can be calculated, designed, constructed, assembled and distributed thanks to our new materials (zinc selenide, zinc sulfide and germanium).

ZINC SELENIDE

Zinc selenide is particularly suitable for the design of high-performance lenses. This is mainly due to its high transmission (approx. 70 %) in the range of 550 nm to 20 µm and its low absorption. This means that little power remains in the lenses, which could otherwise lead to damage. The low hardness and therefore low mechanical strength as well as the toxicity of the dust during processing (due to the selenium content) are disadvantages of the material. However, due to its excellent optical properties, it is usually gladly accepted.

The 1-3x zoom beam expander S6EXZ9313-684 made of zinc selenide was developed for the use of high-power CO_2 lasers. For the first time, you can order a lens for lasers in the LWIR (long wave infrared) range from our catalog. Many other lenses can be requested as customized designs at any time.

GERMANIUM

Due to its high refractive power, germanium is particularly suitable for the color correction of lenses. Highly refractive materials are also advantageous for lenses that are only designed for one wavelength and therefore usually consist of one glass, as this saves single lens elements. The very high Knoop hardness of approx. 800 kg/mm^2 makes germanium insensitive to mechanical stress. Germanium is particularly suitable for low-power applications in the LWIR (long wave infrared) range. The medium transmission of 50 % between 1.8 µm and 18 µm and the high absorption make it less suitable in combination with high-power lasers. In addition, there is a strongly temperature-dependent refractive index, which leads to an enormous thermal focus shift.

The material is opaque in the visible range and therefore poses challenges during testing.

Nevertheless, it is often used for color-corrected applications in the low-power range due to its high refractive power and good machinability (non-toxic and hard).

OUR HIGHLIGHTS 2025

ZINC SULPHIDE

Zinc sulphide is a cost-effective alternative to zinc selenide. It is non-toxic during processing and slightly harder than zinc selenide, which makes it easier to manufacture lenses from this material. The high transmission of 70 % (clear grade) in the range of 500 nm to 12 µm makes the material interesting for medium power applications.

Zinc sulphide is less suitable for high-performance applications due to its higher absorption. In addition, the compound is not resistant to water, which causes problems for certain applications.

However, the temperature-stable refractive index and the low coefficient of thermal expansion ensure a low thermal color shift and suitability for use at high or strongly fluctuating temperatures. In addition, zinc sulphide as an alternative to zinc selenide allows a wider choice of glasses for the long-wave infrared range. This simplifies the color correction of lenses for this area of application.

NEW ZINC SELENIDE BEAM EXPANDERS FOR HIGH POWER LASERS

With the two zoom beam expanders S6EXZ9313-684 and S6EXZ9313-681, Sill Optics is launching lenses for CO_2 lasers with wavelengths of 9.3 µm and 10.6 µm as a standard product for the first time.

Both beam expanders are manually adjustable in an **expansion range from 1x to 3x**. All magnification levels in between can be set manually. As with all Sill Optics beam expanders, the divergence can also be set manually.

Both zoom beam expanders contain lenses made exclusively from **high-performance zinc selenide**. The material is characterized by very high transmission and low absorption for this spectrum. State-of-the-art coatings and a special optical design with particularly few individual lenses allow very high overall transmission through the lens. S6EXZ9313-684 and S6EXZ9313-681 are both suitable for usage with high-power lasers due to their material and optical design. A free entry aperture of 28.5 mm (mechanical limitation) can be widened to a maximum of 45 mm.

The difference between the two beam expanders lies in the correction for the wavelengths of 9.3 µm (S6EXZ9313-584) and 10.6 µm (S6EXZ9313-581). These are the two most common wavelengths for standard CO_2 lasers.

If you require a beam expander with other specifications (magnification, aperture, etc.) for your setup in the LWIR range (long wave infrared), you are welcome to contact us with your request at any time.

Since Sill Optics offers lenses made of materials for this range (zinc selenide, zinc sulphide, germanium), our engineers have experience in the design of such optics. In addition to beam expanders, this also applies to scan lenses, focusing optics and many other lenses. We design, manufacture and sell customer-specific prototypes and small series that are specially adapted to your requirements and wishes.

OUR HIGHLIGHTS 2025

MOTORIZED BEAM EXPANDER FOR HIGH-POWER LASERS

The success of the Sill Optics beam expanders made of high-quality fused silica and coatings over the past decades invited Sill Optics to start a new project, which resulted in the newly developed motorized beam expander S6EZM0940-574.

This new motorized beam expander S6EZM0940-574 features the identical optical design as the manually adjustable S6EXZ0940-574. By using the highest quality coatings and fused silica, Sill Optics also ensures that this new beam expander achieves a particularly high resistance, when used by modern high-power lasers. The beam diameter does not fall below the minimum value on all inside lens surfaces of the lens. As a result, the energy input even on the usually critical second lens is so low, even when using high-power lasers, that damage to the material and the coating is avoided.

While zoom beam expanders score with an adjustable range of the magnification factor, beam expanders with a fixed magnification are often interesting because of their suitability for extremely short-pulsed high-power lasers. The new high-power motorized beam expander S6EZM0940-574 combines both advantages as its manually adjustable counterpart.

In contrast to the S6EXZ0940-574, the inside lenses of the S6EZM0940-574 are moved motorized. This allows both the magnification factor in the range of 0.9x – 4x and the divergence to be set with high precision and fully automatically. Since no components are touched during the magnification and divergence setting and the lenses are positioned with an accuracy of up to 30 µm, a pointing error of ≤0.2 mrad can be realized.

Our wide range of products in the field of beam expanders is large and includes many different models. The spectrum ranges from compact or natural anodized beam expanders with fixed magnification to manual, partially motorized or fully motorized zoom beam expanders. If you need a specific magnification or have other special requirements that cannot be realized by our portfolio lenses, we are happy to adapt existing products to your needs or develop a customer-specific new design. Please feel free to contact us and experience the performance of our high-quality beam expanders.

CUSTOMIZED LASER OPTICS
BENEFIT FROM OUR EXPERTISE

OUR HIGHLIGHTS 2025

NEW LENSES FOR HIGH POWER LASERS

Sill Optics is expanding its laser range with a telecentric lens that combines two advantages: telecentricity and an extremely large scanning field.

Common LC display formats are usually very cheap. However, in some industries, such as aviation or modern trains, other formats are required. As a new development with special aspect ratios would be enormously expensive, especially for small and medium quantities, standard formats are preferred for cutting. In fact, this approach is possible without any loss of function, as LC displays consist of several individual components connected in series. If these are completed in advance, special formats can be produced cost-effectively by that.

Laser cutting is the method of choice for cutting the displays. It is particularly important that the cut is made perpendicular to the surface of the display. A minimal cutting depth results in minimal heat input so that neighbouring assemblies are not affected. In addition, a vertical cut is required to fit the extremely narrow space between the individual assemblies.

Telecentric f-theta lenses **enable a vertical beam incidence and therefore a vertical section in the entire working plane due to their low telecentric error**. This is most important for the field corners, where the input beam is deflected to the maximum by the upstream galvanometer scanner. Telecentric lenses are also characterized by a particularly homogeneous spot shape and size in the entire scan field area, especially when it comes to a diffraction-limited optical design.

Nevertheless, the advantages of telecentricity also come at a price, especially for applications which need a large scan field size. The scan field is mechanically limited by the diameter of the last lens. Therefore, the rear lenses of telecentric lenses must be significantly larger than those of non-telecentric versions to cover extended scan fields. The larger the scan field of the f-theta lens, the higher the maximum section length.

S4LFT3340-075 fulfils both criteria at a laser wavelength of 343 nm - 355 nm and has a low **telecentric error of less than 1° and a large scan field of 205 mm x 205 mm**. Due to its properties, the lens is particularly suitable for extremely fine cutting tasks such as cutting LC displays. Telecentric f-theta lenses are also available for other fields and wavelengths. Sill Optics also specializes in customized solutions for complicated applications with high quality requirements. This means that customized lens designs can be developed and manufactured. Existing designs can modified and adapted according to your wishes. Please contact us to find out more about the possibilities of our telecentric high-performance optics.

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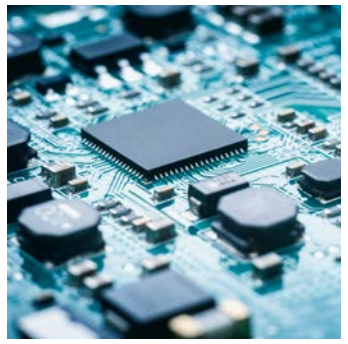
CUSTOMIZED LASER OPTICS

BENEFIT FROM OUR EXPERTISE

Sill Optics has been a trusted partner for customized laser optic solutions for years. Our specialties lie in many different areas of application and a wide variety of designs. Sill Optics also has many years of experience with various projects for customized optical designs and individual mechanical layouts.

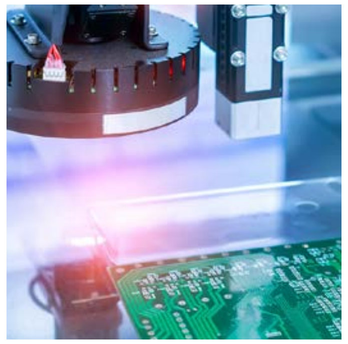
The close coordination between various internal departments, our large range of manufacturing capabilities and our high quality series production are the reasons why we are able to build your prototype in the shortest time possible.

In recent years, we have successfully completed more then 60% of laser optic orders as development projects based on individual inquiries and participation in public research projects. Most of these developments took part in the field of high-power solutions in solar systems, consumer electronics, eMobility or additive manufacturing applications for mechanical engineering processing.



SEMICONDUCTOR & DISPLAY MANUFACTURING

AUTOMOTIVE INDUSTRY, E.G. BATTERY PRODUCTION BODY WELDING ETC.



CONSUMER ELECTRONICS

SOLARCELL PRODUCTION

ADDITIVE MANUFACTURING

YOUR BENEFITS FROM A SILL OPTICS DEVELOPMENT

- development of specification sheet close to design and production possibilities
- direct contact to optical designer and project manager
- short distances between design, development and production
- prototypes at short notice
- high quality of series production
- quality assurance according to individual needs

YOUR BENEFITS FROM SILL OPTICS DEVELOPMENT

WHY SILL OPTICS?

- Development of specification sheets closely aligned with design and production capabilities
- Direct contact with optical designers and project managers
- Short distances between design, development and production
- Quick turnaround for prototypes
- High quality in series production
- Customized quality assurance based on individual needs

WHICH SPECIFICATIONS?

- Scan lens: laser data (wavelength, pulse duration, pulse energy, M²), scanner data (beam diameter, mirror distances, scanner type), Lens data (telecentricity, scan field size, spot diameter, focal length)
- Beam expander: wavelength, magnification (region), motorization, entrance beam diameter
- Focussing system: wavelength, focal length, spot diameter
- Trapped Ion lens: wavelengths, NA, vacuum window data (thickness, material, position), scan field

WHEN STARTING A PROJECT?

A typical starting point for a customized design, considering the overall benefit in terms of the price-performance ratio, is around 50-100 lenses per year. Sill Optics' production capacity is well-suited for up to 500 pieces per year.

However, the ideal number of lenses will vary depending on the size, number of elements, and complexity of the system. For highly complex designs with large elements, special glass types, high alignment demands and end test requirements, even as few as 5 pieces can be beneficial. Other designs may start with quantities of 20 or 50 pieces.

WORKFLOW THROUGH OUR CUSTOM DESIGN PROCESS

1. PROJECT DESCRIPTION AND SPECIFICATION
2. OPTICAL PREDESIGN AND FEASIBILITY ANALYSIS
3. QUOTE FOR DEVELOPMENT, TOOLING, PROTOTYPES AND SERIES CONDITIONS
4. PROTOTYPE AND TOOLING ORDER
5. PROTOTYPE PRODUCTION
6. PROTOTYPE FINAL TEST AND SHIPMENT

F-THETA LENSES
BENEFIT FROM OUR EXPERIENCE

Sill Optics has been manufacturing high-quality laser optics for almost 40 years. These lenses are specifically designed for laser material processing applications for industrial mechanical engineering.

They are specially designed for applications in CE, automotive, semiconductor, additive or solar cell manufacturing. In addition to medical and biotech applications (confocal microscopy, ophthalmology) and science and research. The design and the quality of the optical components play a key role in the lens performance.

GLASS OPTICS

PART NUMBER	FOCAL LENGTH [mm]	SCAN AREA [mm x mm]	FOCUS SIZE (1/e²) [µm]	MAX. BEAM-Ø [mm]	MAX. TELE-CENTRICITY ERROR [°]	WORKING DISTANCE [mm]	SP/USP*	ACHROMATIC
1000-1100 nm								
S4LFT7010-450	100	35 x 35	18.3	10	1.5	115.0	yes	yes
1064 nm								
S4LFT0080-126	80	39 x 39	6.5	25	3.8	79.4	no	no
S4LFT0163-126	163	107 x 107	26.4	12	15	181.2	no	no
S4LFT0253-126	254	160 x 160	35.2	14	16.7	284.9	no	no
S4LFT1254-126	254	160 x 160	41.4	12	14.9	306.5	no	no
S4LFT3254-126	254	115 x 115	16.6	30	8.5	297.0	no	no
S4LFT0350-126	350	212 x 212	56.3	12	16	412.2	no	no
S4LFT0420-126	420	242 x 242	27.7	30	14.8	480.9	no	no
S4LFT0508-126	508	325 x 325	55.6	20	16.3	651.4	no	no
S4LFT0635-126	635	370 x 370	51.3	25	16.3	732.8	no	no
532+1064 nm								
S4LFT1163-081	163	102 x 102	13.3 / 20.0	12	12.7	159.0	no	yes
S4LFT8254-081	254	180 x 180	16.6 / 33.0	15	19.7	211.6	no	yes
515-589 nm								
S4LFT7012-292	100	35 x 35	9.4	10	1.3	101.4	yes	yes
532 nm								
S4LFT5100-121	100	69 x 69	9.8	10	2.4	126.7	no	no
S4LFT0300-121	300	200 x 200	19.4	14	15.8	324.1	no	no

Besides our portfolio and customized optics, we also offer a variety of F-Theta lenses and Beam Expanders from our former portfolio with outstanding specifications upon request. This also includes lenses for different lens markets, applications and specifications.

- **MORE WAVELENGTHS**
- **MORE FOCAL LENGTHS**
- **MORE MAGNIFICATIONS**

*usable for SP=Short Pulse, USP=Ultra Short Pulse
In case of deviations from the portfolio and delivery times, please contact our Customer Care Team.

F-THETA LENSES
BENEFIT FROM OUR EXPERIENCE

FUSED SILICA OPTICS

PART NUMBER	FOCAL LENGTH [mm]	SCAN AREA [mm x mm]	FOCUS SIZE (1/e²) [µm]	MAX. BEAM-Ø [mm]	MAX. TELECEN-TRICITY ERROR [°]	WORKING DISTANCE [mm]	SP/USP*
1030-1080 nm							
S4LFT4147-328	48	7 x 7	6.3	15	2.1	61.1	yes
S4LFT4065-328	65	15 x 15	9.4	15	2	83.1	yes
S4LFT0710-328	100	60 x 60	39.1	5	11.5	120.7	yes
S4LFT4010-328	100	35 x 35	19.5	10	1.3	129.8	yes
S4LFT4127-328	125	50 x 50	13.6	15	1.5	157.6	yes
S4LFT0763-328	163	100 x 100	45.6	7	14.6	194.1	yes
S4LFT3162-328	163	90 x 90	21.2	15	5.6	201.5	yes
S4LFT3167-328	163	100 x 100	32.6	10	11.6	200.7	yes
S4LFT0725-328	254	140 x 140	61.5	8	16.2	282.8	yes
S4LFT3250-328	254	160 x 160	33.2	15	10.7	321.3	yes
S4LFT1330-328	330	215 x 215	33.3	20	23.5	203.4	yes
S4LFT1420-328	420	280 x 280	58.5	14	17.3	499.2	yes
S4LFT5430-328	430	250 x 250	30.0	30	11.6	538	yes
S4LFT1655-328	650	410 x 410	63.3	20	22.5	581.6	yes
S4LFT0910-328	910	500 x 500	65.8	30	16.2	1048.8	yes
515-532 nm							
S4LFT4148-292	48	6 x 6	3.2	15	1.8	60	yes
S4LFT4066-292	65	15 x 15	4.8	15	1.5	85.8	yes
S4LFT4010-292	100	35 x 35	9.8	10	1.5	130.2	yes
S4LFT4126-292	125	53 x 53	12	10	1.6	167	yes
S4LFT3161-292	163	90 x 90	15.4	10	4.8	219	yes
S4LFT4262-292	163	65 x 65	12.7	12	1.7	195.4	yes
S4LFT1330-292	330	212 x 212	24.3	14	20.3	279	yes
HIGHLIGHT S4LFT5650-292	650	410 x 410	31.8	20	22.7	569.9	yes
420-480 nm							
S4LFT4125-373	125	45 x 45	6.1	20	1.6	160.2	yes
S4LFT3170-373	168	75 x 75	7.6	20	3.2	228.3	yes
S4LFT3250-373	241	115 x 115	10	20	7.4	304.8	yes
S4LFT1330-373	330	180 x 180	10.7	20	11.1	268.2	yes
343-355 nm							
S4LFT4149-075	48	6 x 6	2.1	15	2.1	69.3	yes
S4LFT4067-075	65	15 x 15	3.1	15	1.8	81.7	yes
S4LFT4010-075	100	35 x 35	6.5	10	1.2	132	yes
S4LFT4125-075	125	53 x 53	8	10	1.1	156.9	yes
S4LFT3170-075	163	90 x 90	11.4	10	4.3	221.7	yes
S4LFT4262-075	163	65 x 65	10.5	10	2	193.7	yes
S4LFT1330-075	330	210 x 210	15.4	14	21	260.5	yes
HIGHLIGHT S4LFT3340-075	340	205 x 205	17.0	14	0.85	479.5	yes
257-266 nm							
S4LFT4068-199	65	20 x 20	2.5	15	1.3	85.6	yes
S4LFT3170-199	154	85 x 85	7.7	10	3.8	208.1	yes
S4LFT4263-199	163	70 x 70	9.2	10	2.6	218.4	yes

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BEAM EXPANDERS

BENEFIT FROM OUR EXPERIENCE

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They are specially designed for applications in CE, automotive, semiconductor, additive or solar cell manufacturing. In addition to medical and biotech applications (confocal microscopy, ophthalmology) and science and research. The design and the quality of the optical components play a key role in the lens performance.

Many of our Beam Expanders can also be used in reverse direction. Using a Beam Expander reverse may the result in increased divergence and possibly other disadvantages as the Beam Expanders are usually designed to magnify beams. Therefore, please feel free to contact our technical support if you have any questions.

ZOOM BEAM EXPANDERS

	PART NUMBER	MAGNIFICATION	CLEAR INPUT APERTURE [mm]	CLEAR OUTPUT APERTURE [mm]	LENGTH [mm]	THREAD
	9300-10600 nm					
HIGHLIGHT	S6EXZ9313-684	1-3x	28.5	45.0	150.0	M55x1
HIGHLIGHT	S6EXZ9313-681	1-3x	28.5	45.0	150.0	M55x1
	1030-1080 nm					
	S6EXZ5310-328	1-3x	10.5	20.0	85.2	C-Mount
	S6EXZ5311-328	1-3x	10.5	20.0	85.2	M30x1
	S6EXZ5076-328	1-8x	10.3	31.0	162.0	C-Mount
	515-532 nm					
	S6EXZ5310-292	1-3x	10.5	20.0	85.2	C-Mount
	S6EXZ5311-292	1-3x	10.5	20.0	85.2	M30x1
	S6EXZ5076-292	1-8x	10.3	31.0	162.0	C-Mount
	355 nm					
	S6EXZ5310-075	1-3x	10.5	20.0	85.2	C-Mount
	S6EXZ5311-075	1-3x	10.5	20.0	85.2	M30x1
	S6EXZ5075-075	1-8x	10.3	31.0	162.0	C-Mount
	343-355 nm					
	S6EXZ0940-574	0.9-4x	16.0	28.0	191.0	M30x1
	S6EXZ5310-574	1-3x	10.5	20.0	85.2	C-Mount
	S6EXZ5311-574	1-3x	10.5	20.0	85.2	M30x1
	S6EXZ5075-574	1-8x	10.3	31.0	162.0	C-Mount
	257-266 nm					
	S6EXZ5075-199	1-8x	10.3	31.0	162.0	C-Mount

MOTORIZED BEAM EXPANDER

	PART NUMBER	MAGNIFICATION	CLEAR INPUT APERTURE [mm]	CLEAR OUTPUT APERTURE [mm]	LENGTH [mm]	THREAD
	343-355 nm					
HIGHLIGHT	S6EZM0940-574	0.9-4x	12.0	28.0	200.0	M30x1

In case of deviations from the portfolio and delivery times, please contact our Customer Care Team.

BEAM EXPANDERS
BENEFIT FROM OUR EXPERIENCE

FIX MAGNIFICATION BEAM EXPANDERS

PART NUMBER	MAGNIFICATION	CLEAR INPUT APERTURE [mm]	CLEAR OUTPUT APERTURE [mm]	LENGTH [mm]	THREAD
1030-1080 nm					
S6EXK0005-328	0.5	12.0	12.0	44.7	M30x1
S6EXK0008-328	0.8	12.0	12.0	44.7	M30x1
S6EXK0010-328	1.0	12.0	14.0	44.7	M30x1
S6EXK0012-328	1.2	12.0	26.0	44.7	M30x1
S6EXK0015-328	1.5	12.0	26.0	44.7	M30x1
S6EXK0020-328	2.0	12.0	26.0	44.7	M30x1
S6EXK0025-328	2.5	11.0	26.0	44.7	M30x1
S6EXK0030-328	3.0	8.0	26.0	44.7	M30x1
S6EXK0035-328	3.5	8.0	20.0	44.7	M30x1
S6EXK0040-328	4.0	8.0	20.0	44.7	M30x1
515-532 nm					
S6EXK0005-292	0.5	12.0	12.0	44.7	M30x1
S6EXK0008-292	0.8	12.0	12.0	44.7	M30x1
S6EXK0010-292	1.0	12.0	14.0	44.7	M30x1
S6EXK0012-292	1.2	12.0	26.0	44.7	M30x1
S6EXK0015-292	1.5	12.0	26.0	44.7	M30x1
S6EXK0020-292	2.0	12.0	26.0	44.7	M30x1
S6EXK0025-292	2.5	11.0	26.0	44.7	M30x1
S6EXK0030-292	3.0	8.0	26.0	44.7	M30x1
S6EXK0035-292	3.5	8.0	20.0	44.7	M30x1
S6EXK0040-292	4.0	8.0	20.0	44.7	M30x1
355 nm					
S6EXK0008-075	0.8	12.0	12.0	44.7	M30x1
S6EXK0012-075	1.2	12.0	26.0	44.7	M30x1
S6EXK0015-075	1.5	12.0	26.0	44.7	M30x1
S6EXK0020-075	2.0	12.0	26.0	44.7	M30x1
S6EXK0025-075	2.5	11.0	26.0	44.7	M30x1
S6EXK0030-075	3.0	8.0	26.0	44.7	M30x1
S6EXK0035-075	3.5	8.0	20.0	44.7	M30x1
S6EXK0040-075	4.0	8.0	20.0	44.7	M30x1
343-355 nm					
S6EXK0008-574	0.8	12.0	12.0	44.7	M30x1
S6EXK0010-574	1.0	12.0	14.0	44.7	M30x1
S6EXK0012-574	1.2	12.0	26.0	44.7	M30x1
S6EXK0015-574	1.5	12.0	26.0	44.7	M30x1
S6EXK0020-574	2.0	12.0	26.0	44.7	M30x1
S6EXK0025-574	2.5	11.0	26.0	44.7	M30x1
S6EXK0030-574	3.0	8.0	26.0	44.7	M30x1
S6EXK0035-574	3.5	8.0	20.0	44.7	M30x1
S6EXK0040-574	4.0	8.0	20.0	44.7	M30x1

BEAM EXPANDERS

BENEFIT FROM OUR EXPERIENCE

FIX MAGNIFICATION BEAM EXPANDERS

PART NUMBER	MAGNIFICATION	CLEAR INPUT APERTURE [mm]	CLEAR OUTPUT APERTURE [mm]	LENGTH [mm]	THREAD
1030-1080 nm					
S6EXP0005-328	0.5	14.0	31.0	85.0	M30x1
S6EXP0008-328	0.8	14.0	20.0	85.0	M30x1
S6EXP0012-328	1.2	14.0	28.0	85.0	M30x1
S6EXP0015-328	1.5	8.0	31.0	85.0	M30x1
S6EXP0020-328	2.0	8.0	31.0	85.0	M30x1
S6EXP0025-328	2.5	8.0	31.0	85.0	M30x1
S6EXP0030-328	3.0	8.0	31.0	85.0	M30x1
S6EXP0040-328	4.0	8.0	31.0	85.0	M30x1
S6EXP0050-328	5.0	8.0	31.0	85.0	M30x1
515-532 nm					
S6EXP0005-292	0.5	14.0	31.0	85.0	M30x1
S6EXP0008-292	0.8	14.0	20.0	85.0	M30x1
S6EXP0015-292	1.5	8.0	31.0	85.0	M30x1
S6EXP0020-292	2.0	8.0	31.0	85.0	M30x1
S6EXP0025-292	2.5	8.0	31.0	85.0	M30x1
S6EXP0030-292	3.0	8.0	31.0	85.0	M30x1
S6EXP0040-292	4.0	8.0	31.0	85.0	M30x1
S6EXP0050-292	5.0	8.0	31.0	85.0	M30x1
355 nm					
S6EXP0015-075	1.5	8.0	31.0	85.0	M30x1
S6EXP0020-075	2.0	8.0	31.0	85.0	M30x1
S6EXP0025-075	2.5	8.0	31.0	85.0	M30x1
S6EXP0030-075	3.0	8.0	31.0	85.0	M30x1
S6EXP0040-075	4.0	8.0	31.0	85.0	M30x1
S6EXP0050-075	5.0	8.0	31.0	85.0	M30x1
343-355 nm					
S6EXP0015-574	1.5	8.0	31.0	85.0	M30x1
S6EXP0020-574	2.0	8.0	31.0	85.0	M30x1
S6EXP0025-574	2.5	8.0	31.0	85.0	M30x1
S6EXP0030-574	3.0	8.0	31.0	85.0	M30x1
S6EXP0040-574	4.0	8.0	31.0	85.0	M30x1
S6EXP0050-574	5.0	8.0	31.0	85.0	M30x1
257-266 nm					
S6EXP0015-199	1.5	8.0	31.0	85.0	M30x1
S6EXP0020-199	2.0	8.0	31.0	85.0	M30x1
S6EXP0030-199	3.0	8.0	31.0	85.0	M30x1
S6EXP0040-199	4.0	8.0	31.0	85.0	M30x1
S6EXP0050-199	5.0	8.0	31.0	85.0	M30x1

ASPHERES

BENEFIT FROM OUR CAPABILITIES

ASPHERES

The use of aspheric lenses in optical systems is increasing. Aspheric lenses enable an enhancement of resolution especially for optical systems with a high numerical aperture. The aspheric deviation of the high end series is smaller than 0.05 µm RMSi.

Aspheres offer the great advantage to accomplish monochromatic imaging tasks with one optical element where multiple lens elements would otherwise be needed. Main advantages of aspheres are less spherical aberrations, less weight, increased transmission and no internal ghosts.

PART NUMBER	FOCAL LENGTH [mm]	LENS-Ø [mm]	CENTER THICKNESS [mm]	WORKING DISTANCE [mm]
1064 nm				
S1ADX0220-328	20	25.0	13.2	13.3
S1ADX0230-328	30	30.0	16.0	20.9
S1ADX0240-328	40	30.0	15.0	31.3
S1ADX0250-328	50	30.0	13.7	42.1
S1ADX0260-328	60	30.0	11.3	53.5
S1ADX0370-328	72	38.1	11.0	63.6
S1ADX0380-328	80	38.1	12.0	73.1
S1ADX0310-328	100	38.1	11.0	93.7
S1ADX0312-328	120	38.1	10.3	114.0
S1ADX0316-328	150	30.0	9.6	144.4
S1ADX0320-328	200	38.1	8.9	194.8
S1ADX0325-328	250	38.1	8.9	245.2
S1ADX0330-328	300	30.0	9.0	294.7
S1ADX0540-328	400	52.0	8.0	395.2

Besides our portfolio and customized optics, we also offer a variety of F-Theta lenses and Beam Expanders from our former portfolio with outstanding specifications upon request. This also includes lenses for different lens markets, applications and specifications.

- **MORE WAVELENGTHS**
- **MORE FOCAL LENGTHS**
- **MORE MAGNIFICATIONS**

In case of deviations from the portfolio and delivery times, please contact our Customer Care Team.

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FOCUSING ELEMENTS
BENEFIT FROM OUR CAPABILITIES

LENS SYSTEMS
Multi-element lens systems minimize the imaging errors of single lenses and provide precision focusing for non-scanning applications.

MULTI-ELEMENT LENS SYSTEMS

PART NUMBER	FOCAL LENGTH [mm]	FOCUS SIZE 1/e² [µm]	HOUSING-Ø [mm]	LENGTH [mm]	WORKING DISTANCE [mm]
532 nm					
S6ASS2020-292	25	2.4	25.0	13.5	19.3
S6ASS2060-292	62	3.0	40.0	32.0	47.9
S6ASS5300-292	100	5.4	41.0	16.0	86.7
S6ASS6151-292	150	7.2	56.0	20.0	135.0
S6ASS6200-292	200	6.6	54.0	15.0	188.5
355 nm					
S6ASS2020-075	25	1.6	25.0	17.0	17.9
S6ASS2060-075	60	2.8	40.0	30.0	46.5
S6ASS5120-075	114	5.6	48.0	20.0	104.4
266 nm					
S6ASS2020-199	24	1.4	25.0	17.0	17.1
S6ASS2060-199	57	2.2	40.0	30.0	43.9
S6ASS5120-199	109	4.6	48.0	20.0	99.1

Besides our portfolio and customized optics, we also offer a variety of F-Theta lenses and Beam Expanders from our former portfolio with outstanding specifications upon request. This also includes lenses for different lens markets, applications and specifications.

- **MORE WAVELENGTHS**
- **MORE FOCAL LENGTHS**
- **MORE MAGNIFICATIONS**

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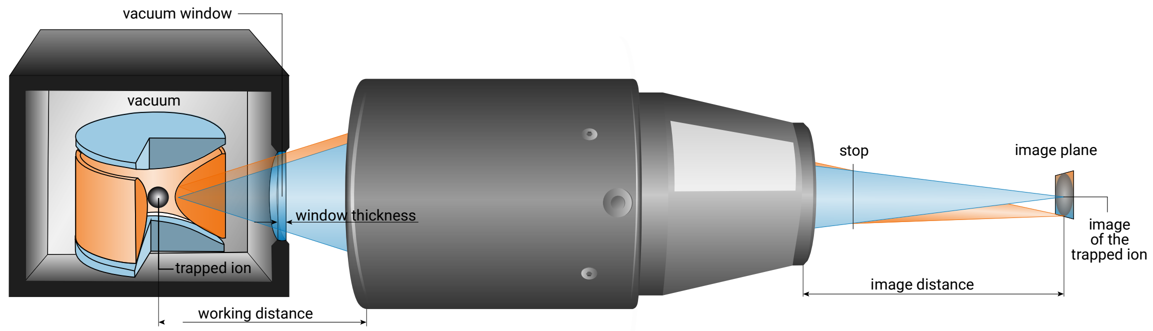
TRAPPED ION LENSES
BENEFIT FROM OUR CAPABILITIES

TRAPPED ION LENSES
Trapped (cold) ions are a research topic with increasing interest over the last few years because of their possibility to store Qubits (quantum bits) and the related use for quantum computers. To make the qubits usable under certain conditions, we must observe and study their behaviour in detailed experiments first.

Sill Optics has designed lenses both, for just observation and observation combined with laser focusing for these experiments. Those lenses are exceptional for their high NA and adjustment to specific wavelengths (UV to IR). As the vacuum cryostats differ in dimension (e.g. the window thickness) every lens has to be designed specifically for the existing conditions.

PART NUMBER	WAVE-LENGTH 1 [nm]	WAVE-LENGTH 2 [nm]	MATERIAL	FOCUS LENGTH [mm]	NA	MAX. FOV [mm]	MAGNIFI-CATION @ WAVE-LENGTH 1	MAGNIFI-CATION @ WAVE-LENGTH 2	THICK-NESS WINDOW	MATERIAL WINDOW	WORKING DISTANCE [mm]
S6ASS2243-126	1064	-	optical glass	40.5	0.4	0.71	infinity	-	6.0	fused silica	50.7
S6ASS2242-081	590	1064	optical glass	40.0	0.4	0.71	infinity	infinity	6.0	fused silica	50.7
S6ASS2224	494	671	optical glass	22.0	0.5	0.08	infinity	infinity	-	-	11.6
S6ASS2255	422	-	fused silica	45.0	0.4	0.27	10.0	-	19.1	fused silica	63.4
S6ASS2256	422	-	fused silica	44.9	0.4	0.27	10.0	-	19.1	N-BK7	63.8
S6ASS2258	397	422	optical glass	44.8	0.4	0.28	10.0	10.0	19.1	N-BK7	62.3
S6ASS2258-006	397	422	optical glass	45.5	0.4	0.29	10.0	10.0	6.3	fused silica	60.5
S6ASS2241	395	729	optical glass	66.9	0.3	0.2	20.0	20.0	6.0	fused silica	55.7
S6ASS2241-045	395	729	optical glass	66.9	0.3	0.19	20.0	20.0	6.0	fused silica	55.7
S6ASS2341	370	-	optical glass	82.1	0.2	0.2	6.0	-	6.0	fused silica	55.7
S6ASS2245	369	-	fused silica	40.0	0.4	0.35	infinity	-	8.0	fused silica	39.3
S6ASS2246	369	-	fused silica	41.2	0.4	0.36	infinity	-	4.3	fused silica	38.7
S6ASS2247	369	493	fused silica	50.1	0.2	0.95	8.0	78.0	2.0	sapphire	49.4
S6ASS2247-389	313	397	fused silica	49.0	0.2	0.95	8.2	79.0	2.0	sapphire	48.2
S6ASS2248	313	397	fused silica	49.0	0.3	0.27	15.0	145.0	3.0	fused silica	46.5



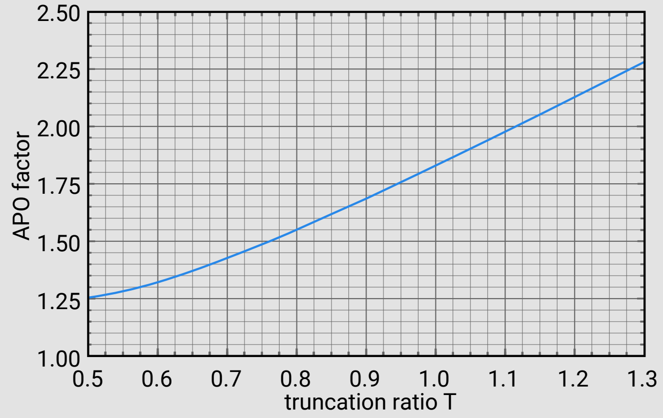
In case of deviations from the portfolio and delivery times, please contact our Customer Care Team.

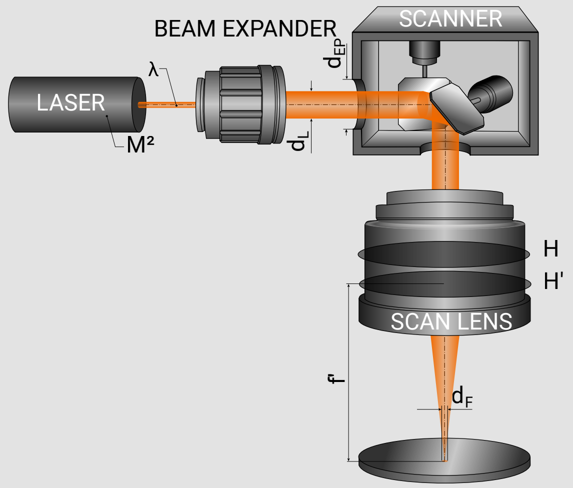
1. FOCUSSING LENSES

1.1 CALCULATION OF THE MINIMUM FOCAL DIAMETER

$$d_F = \frac{\lambda \cdot f' \cdot APO \cdot M^2}{d_L}$$

$$T = \frac{d_L}{d_{EP}}$$





d_F:	focal spot diameter
d_{EP}:	entrance pupil of the scanner
d_L:	entrance beam diameter (1/e²)
f':	focal length
λ:	wavelength
APO:	apodisation factor
M²:	diffraction value of the laser
T:	truncation ratio

1.2 CALCULATION OF THE RAYLEIGH LENGTH

$$z_R = \pi \cdot \left(\frac{d_F}{2}\right)^2 \cdot \frac{\left(APO/1.27\right)^2}{\lambda \cdot M^2}$$

zR: rayleigh length

1.3 CALCULATION OF THE FOCAL DIAMETER FOR FIBER IMAGING

$$d_F = M \cdot d_{fc} \approx \frac{f_2}{f_1} \cdot d_{fc}$$

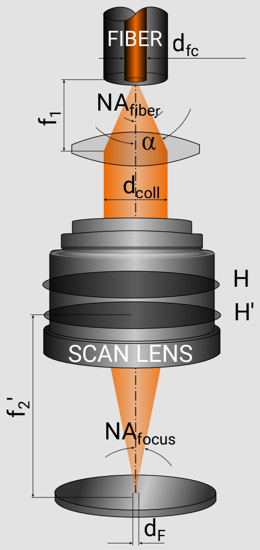
$$d_{coll} = 2 \cdot f_1 \cdot \tan(\alpha)$$

$$M = \frac{NA_{fiber}}{NA_{focus}}$$

$$\alpha = \sin^{-1}(NA_{fiber})$$

$$NA_{focus} = \sin\left[\tan^{-1}\left(\frac{d_{coll}/2}{f_2}\right)\right]$$

$$\alpha = \tan^{-1}\left(\frac{d_{coll}}{2 \cdot f_1}\right)$$



d_{fc}:	fiber core diameter
NA_{fiber}:	numerical aperture of the fiber
α:	half beam cone angle
M:	magnification by NA calculation
d_F:	focal spot diameter
f_1:	focal length of the collimating lens
f_2:	focal length of the focussing lens

2. LASER INDUCED DAMAGE THRESHOLD (LIDT)

2.1 ENERGY- AND POWER DENSITY

$$F\left[\frac{J}{cm^2}\right] = \frac{E[J]}{\frac{1}{4} \cdot (d_F[cm])^2 \cdot \pi}$$

$$I\left[\frac{W}{cm^2}\right] = \frac{P_{peak}[W]}{\frac{1}{4} \cdot (d_F[cm])^2 \cdot \pi}$$

F:	energy density / fluence
E:	pulse energy
F:	focal spot diameter
I:	power density / irradiance
P_{peak}:	peak power of the laser

2.2 ESTIMATE OF THE LIDT

$$\frac{E[J]}{\frac{1}{4} \cdot (d_F[cm])^2 \cdot \pi} \ll LIDT \approx \frac{\lambda}{\lambda_{spec}} \cdot \sqrt{\frac{\tau}{\tau_{spec}}} \cdot LIDT_{spec}$$

- E: pulse energy
- d_F: focal spot diameter
- λ: used wavelength
- λ_{spec}: specified wavelength
- τ: pulse duration of the used laser
- τ_{spec}: specified pulse duration
- LIDT: real LIDT
- $LIDT_{spec}$: specified LIDT

$$\frac{P_{peak}[W]}{\frac{1}{4} \cdot (d_F[cm])^2 \cdot \pi} \ll LIDT \approx \frac{\lambda}{\lambda_{spec}} \cdot \sqrt{\frac{\tau}{\tau_{spec}}} \cdot LIDT_{spec}$$

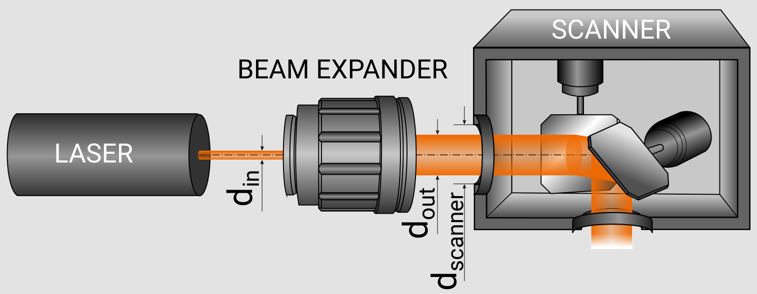
3. BEAM EXPANDERS

3.1 CALCULATION OF THE MAGNIFICATION

$$\beta' = \frac{d_{out}}{d_{in}}$$

$$\beta'_{max} = \frac{d_{scanner}}{d_{in}}$$

- β': magnification
- β'_{max}: maximum magnification
- d_{in}: entrance beam diameter
- d_{out}: outgoing beam diameter
- $d_{scanner}$: aperture of the scanner

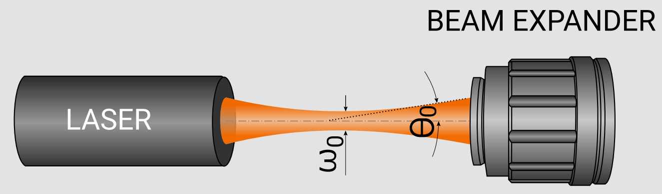


The outgoing beam diameter d_{out} is limited by the beam expander or by the aperture of the scanner.

3.2 DIVERGENCE ANGLE

$$\Theta_0 = \frac{\lambda}{\pi \cdot \omega_0/2} \rightarrow \Theta_0 \cdot \omega_0 = const$$

- Θ_0: divergence angle
- λ: wavelength
- ω_0: beam diameter at the waist



The higher the beam diameter the lower is the divergence!

NOTES
FOR YOUR INDIVIDUAL PROJECT

Field size (FOV, sensor size)

Camera specifications
(sensor dimensions, pixel size, resolution, camera thread, back flange distance, maximum chief ray angle, color)

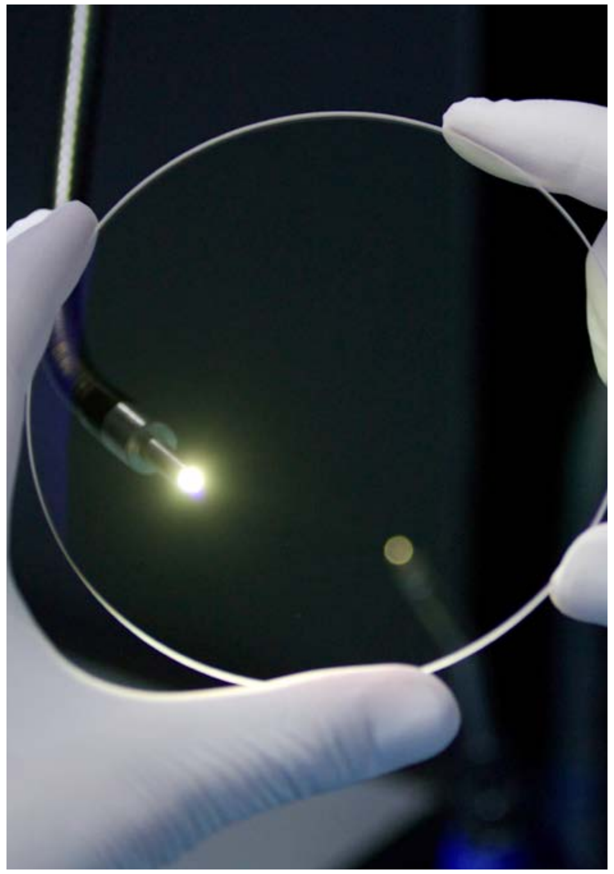
Aperture

Waveband
(UV, VIS, IR, bandwidth)

Space constraints
(total track, working distance, maximum length, maximum diameter, mounting)

Performance requirements
(Strehl ratio, MTF, edge spread function, distortion, color correction)

NOTES
FOR YOUR INDIVIDUAL PROJECT



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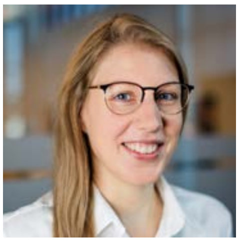

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