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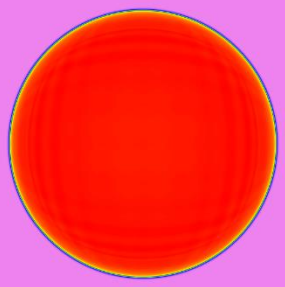


GTH-R
Large Round Top Hats

PRODUCT FEATURES

- Generation of round Top Hat profiles
- Top Hat sizes in the mm range
- Suitable from UV to IR
- Thin single optical element
- Easy integration in existing beam path

APPLICATIONS

- Selective laser ablation
- Surface finishing and cleaning
- Illumination
- Microscopy and spectroscopy

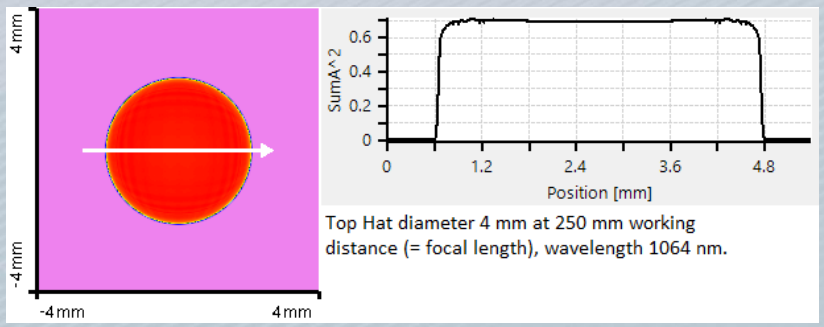
RELATED PRODUCT

Translation mount HSF01 for the alignment of the GTH-R in lateral (x, y) directions.

GTH-R beam shaper has a free-form surface which redistributes a Gaussian input beam profile into a round Top Hat profile. The beam shaper can be integrated into the beam path at nearly any position, even in front of or within a beam expander. You should only take into account that the beam diameter at the position of the shaper matches the design of the model.

Top Hat beam shapers GTH-R work together with nearly any focusing optic and scanning system. The Top Hat profile is generated in the focal plane of this focusing optic.
By varying the focal length, it is possible to scale the Top Hat size and working distance. Thus, the focal length of the focusing optic determines the Top Hat diameter which is typically in the range of 800 µm to 40 mm.
The combination with beam expanders/telescopes gives an additional option to scale the Top Hat size at a fixed focal length/working distance.
Integration of additional cylindrical optics also allows the generation of homogeneous elliptical profiles.

GTH-R beam shapers operate within a large wavelength range from UV to NIR. TOPAG offers the beam shapers with different standard AR/AR coatings. Broadband coatings @ UV (210 - 400 nm), VIS (400 - 700 nm) or IR (650 - 1100 nm), a dual line coating @ 505 -535 + 1010 - 1070 nm and a narrowband coating @ 337 - 357 nm. Also available are other AR/AR coatings on request.



Top Hat diameter 4 mm at 250 mm working distance (= focal length), wavelength 1064 nm.

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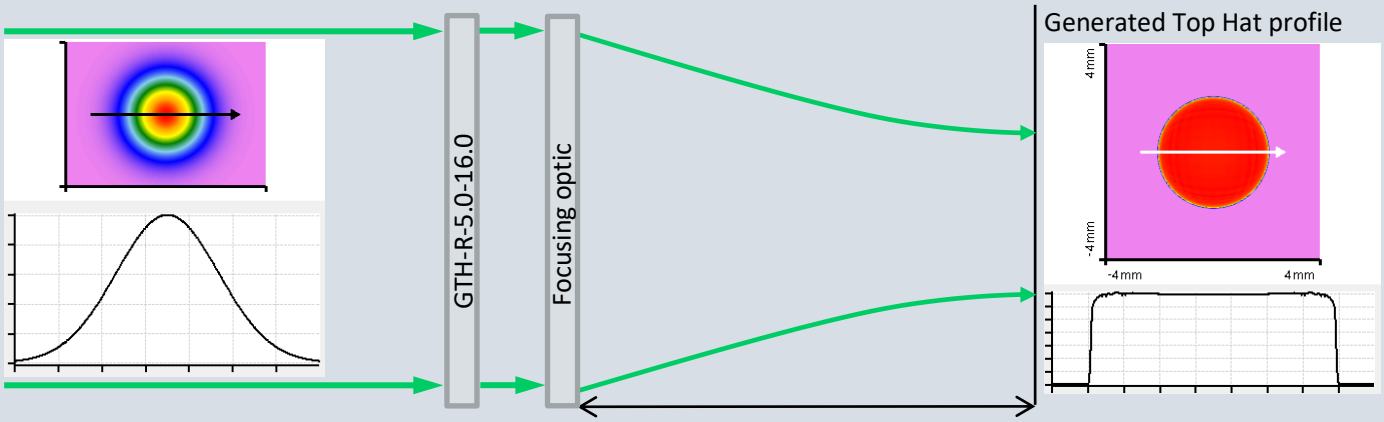
BASIC OPTICAL SETUP



Input beam diameter 5.0 mm, wavelength depends on AR coating type

Working distance wd = focal length f of focusing optics

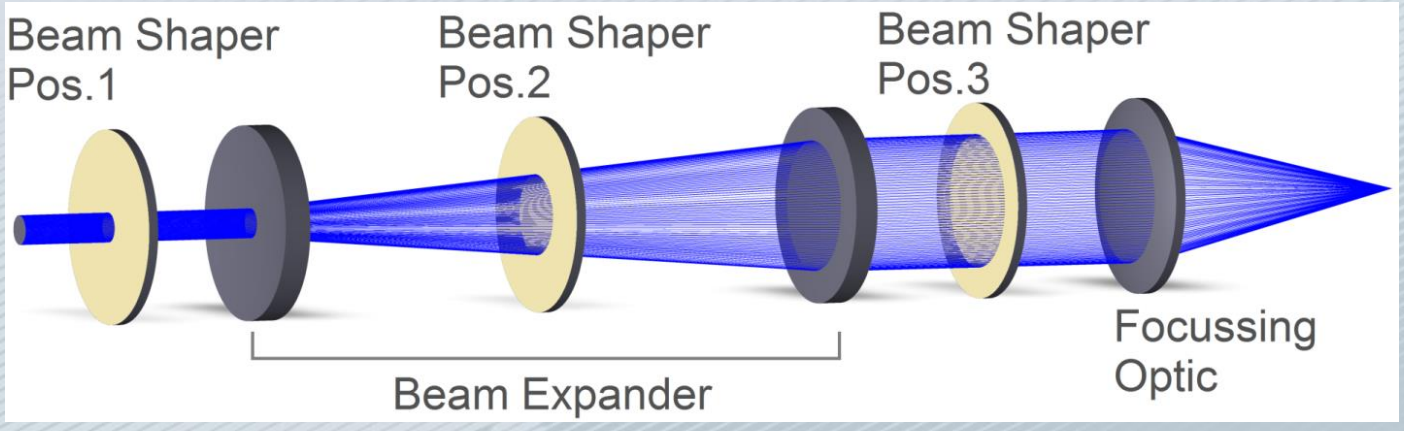
(example for model GTH-R-5.0-16.0)

GTH-R beam shaper in combination with any focusing optic and a collimated Gaussian beam delivers a homogeneous Top Hat profile. This Top Hat profile is generated in the focal plane of the focusing optic. The size of the generated Top Hat spot depends on the focal length f (= working distance) and size factor ϑ defined by the model.

$$Top\ Hat\ diameter_{Basic} = \frac{\vartheta \cdot f}{1000}$$

INTEGRATION – OPTICAL SETUPS WITH BEAM EXPANDER

In laser applications, optical setups match the laser beam diameter to the process. Typically, a beam expander is used to change the output beam diameter from laser. The GTH beam shaper can be integrated at different positions, before (pos. 1) or after (pos. 3) a beam expander. If the beam expander is not housed, the GTH can also be placed within (pos. 2) the two lenses of a Keplerian or Galilean telescope. GTH-R is designed for a fixed input beam diameter. Therefore, it is important that the optic is placed at the position into the beam path where the laser beam diameter matches the models design.



Pos. 1: GTH-R can be installed in front of a beam expander/telescope into the beam. Advantage of this option is scaling of the spot size in focal plane by changing the magnification of the beam expander. The diameter of the generated Top Hat depends on the focal length f of the focusing optic as well as on the magnification m of the beam expander (m = beam diameter behind / beam diameter in front of expander). The beam expander can also be used reverse to reduce

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the beam diameter and therefore to increase the Top Hat diameter. This is also shown in the following figure for magnifications m = 2 and m = 0.5 compared to the sizes generated with the basic optical setup.

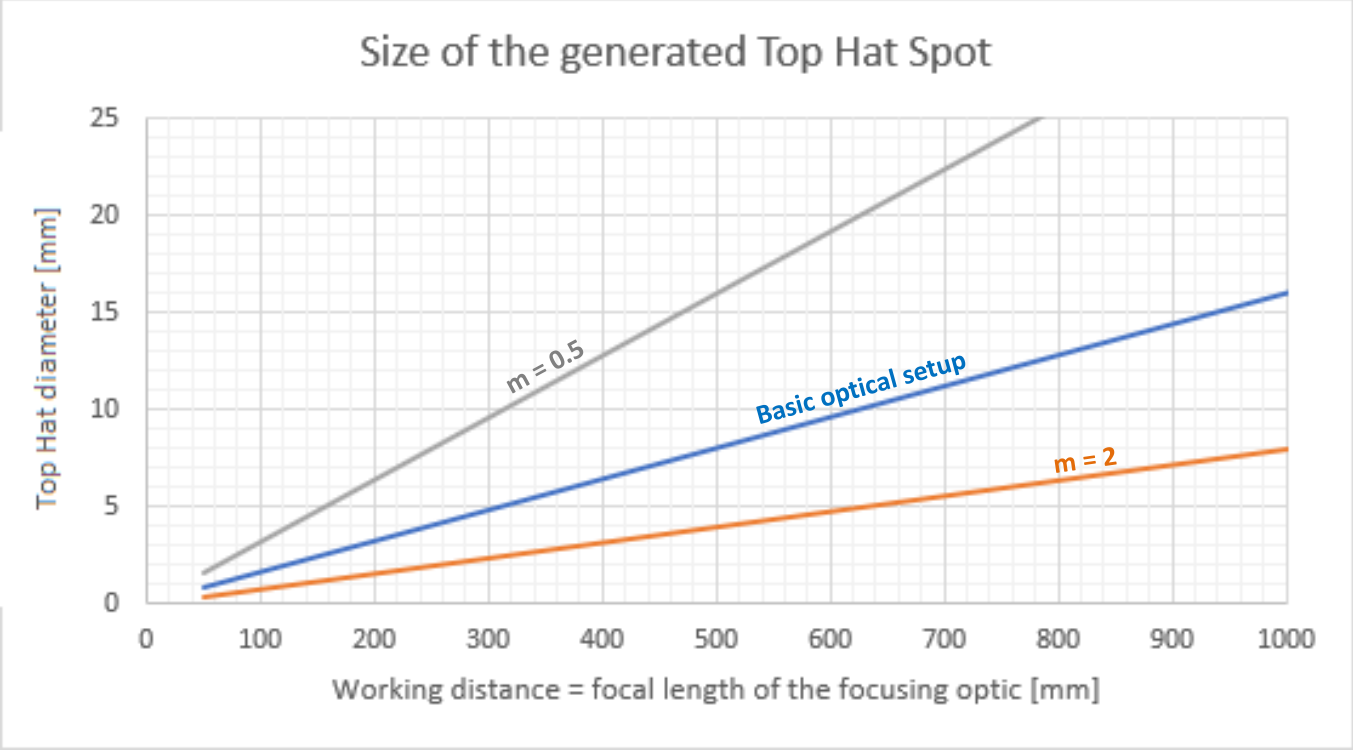
$$Top\ Hat\ diameter_{Pos\ 1} = \frac{\vartheta \cdot f}{m \cdot 1000}$$

Pos. 2: If the beam expander is not housed, it is also possible to place GTH-R between the telescope lenses. This position allows adjustment of the GTH-R position to match the effective beam diameter. In this case, the size of the generated Top Hat depends on the beam diameter d behind the beam expander, the design input beam diameter Ø of the shaper and the focal length f of the focusing optic.

$$Top\ Hat\ diameter_{Pos\ 2} = \frac{\vartheta \cdot f \cdot Ø}{d \cdot 1000}$$

Pos. 3: GTH-R can be placed behind the beam expander into the increased beam diameter. This setup is similar to the basic optical setup shown before.

TOP HAT SIZES



(example for model GTH-R-5.0-16.0)

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SPECIFICATIONS

SPOT GEOMETRY	
Top Hat width @FWHM	$\vartheta \times f/1000$ with ϑ of model and f = focal length, without additional beam expander
Efficiency	> 95% (depends on the coating type)
Homogeneity	about ± 5% (rel. to average intensity of the Top Hat plateau)

Available models		
Product code	Input beam diameter Ø	Size factor ϑ
GTH-R-3.0-5.0-AR	3.0 mm	5.0 mrad
GTH-R-5.0-16.0-AR	5.0 mm	16.0 mrad

REQUIREMENTS FOR THE USE OF GTH-R	
Input beam	single or multimode laser beam with Gaussian energy distribution
Input beam diameter	defined by model, ± 5% tolerance
Apertures within the optical setup	clear aperture along the whole beam path should be at least 2 x larger than beam diameter @ $1/e^2$

INTEGRATION OF GTH-R INTO THE BEAM PATH	
Alignment	alignment in lateral direction is necessary (translation). We recommend our mount HSF01.
Optical equipment	required: focusing optic to generate the Top Hat in the focal plane of this optic.
	useful: beam expander to firstly adjust the effective beam dia. to the design input beam dia. of GTH-R and secondly adjust the beam diameter to the desired spot size.
	helpful: beam profiler to check profiles while aligning.

SUBSTRATE SPECIFICATIONS		
Material	fused silica	
Dimension[1)]	dia. 1 inch x 3 mm	
Standard AR/AR coatings[2)]	AR coating type:	wavelengths range, transmission and laser damage threshold:
	343/355	337 - 357 nm; T > 99.6%; LDT 4 J/cm² @ 10 ns
	515/532+1030/1064	505 - 535 + 1010 - 1070 nm; T > 99.8%; LDT 10 J/cm² @ 10 ns
	UV	210 - 400 nm; T > 96%; LDT 1 J/cm² @ 10 ns
	VIS	400 - 700 nm; T > 98.2%; LDT 2 J/cm² @ 10 ns
	IR	650 - 1100 nm; T > 98.6%; LDT 3 J/cm² @ 10 ns

[1)] Other substrate dimensions on request
[2)] Other single line, dual line or broadband AR/AR coatings on requests