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THORLABS

PRECISION PINHOLES

- **Ideal for Building Spatial Filters**
- **Standard and High-Power Precision Pinholes**
- **Pinhole Diameters from 1 µm to 1 mm**
- **Mounted in Ø1" Disks**



P25C

Back View

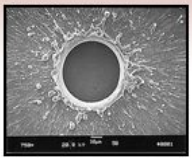


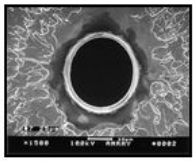
Front View



P5S

High-Power Pinhole





Standard Pinhole

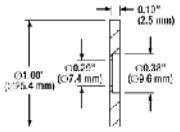


Application Idea

P1S Ø1 µm Pinhole Mounted in SM1ZM Zoom Housing and ST1XY-D XY Translator

OVERVIEW

These mounted precision pinholes are available with pinhole diameters from 1 µm to 1 mm. We also offer high-power versions with pinhole diameters from 10 µm to 50 µm. For many applications, such as holography, spatial intensity variations in the laser beam are unacceptable. Using these precision pinholes in conjunction with precision positioning and focusing equipment such as our KT310 Spatial Filter System creates a "noise" filter, effectively stripping variations in intensity out of a Gaussian beam. Please see the *Tutorial* tab for more information on spatial filters.



Click to Enlarge
Mounted Pinhole Dimensions

If you do not see what you need in our stocked offerings below, it is possible to special order precision pinholes that are fabricated from different substrate materials, have different pinhole sizes, incorporate multiple holes in one foil, or provide different pinhole configurations. Customized pinhole housings are also available. Please contact Tech Support to discuss your specific needs.

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TUTORIAL

Principles of Spatial Filters

For many applications, such as holography, spatial intensity variations in the laser beam are unacceptable. Our KT310 spatial filter system is ideal for producing a clean Gaussian beam.

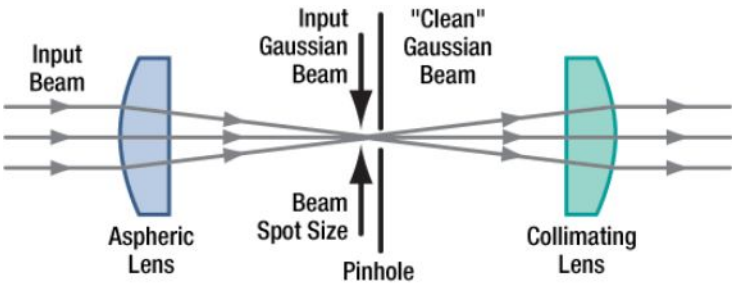


Figure 1: Spatial Filter System

The input Gaussian beam has spatially varying intensity "noise". When a beam is focused by an aspheric lens, the input beam is transformed into a central Gaussian spot (on the optical axis) and side fringes, which represent the unwanted "noise" (see Figure 2 below). The radial position of the side fringes is proportional to the spatial frequency of the "noise".

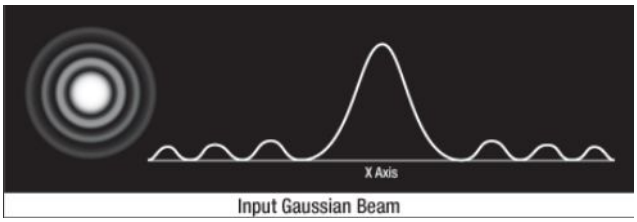


Figure 2

By centering a pinhole on a central Gaussian spot, the "clean" portion of the beam can pass while the "noise" fringes are blocked (see Figure 3 below).

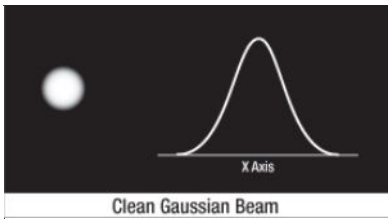


Figure 3

The diffraction-limited spot size at the 99% contour is given by:

$$D = \frac{\lambda f}{r}$$

where λ = wavelength, f =focal length and r = input beam radius at the $1/e^2$ point.

Choosing the Correct Optics and Pinhole for Your Spatial Filter System

The correct optics and pinhole for your application depend on the input wavelength, source beam diameter, and desired exit beam diameter.

For example, suppose that you are using a 650 nm diode laser source that has a diameter ($1/e^2$) of 1.2 mm and want your beam exiting the spatial filter system to be about 4.4 mm in diameter. Based on these parameters, the C560TME-B mounted aspheric lens would be an appropriate choice for the input side of spatial filter system because it is designed for use at 650 nm, and its clear aperture measures 5.1 mm, which is large enough to accommodate the entire diameter of the laser source.

The equation for diffraction limited spot size at the 99% contour is given above, and for this example, $\lambda = (650 \times 10^{-9}$ m), f = 13.86 mm for the C560TM-B, and r = 0.6 mm. Substitution yields

$$D = \frac{(650\ x\ 10^{-9}\ m)(13.86\ mm)}{0.6\ mm} \approx 15\ \mu m$$

Diffraction-Limited Spot Size (650 nm source, Ø1.2 mm beam)

The pinhole should be chosen so that it is approximately 30% larger than *D*. If the pinhole is too small, the beam will be clipped, but if it is too large, more than the TEM_{00} mode will get through the pinhole. Therefore, for this example, the pinhole should ideally be 19.5 microns. Hence, we would recommend the mounted pinhole P20S, which has a pinhole size of 20 µm. Parameters that can be changed to alter the beam waist diameter, and thus the pinhole size required, include changing the input beam diameter and focal length of focusing lens. Decreasing the input beam diameter will increase the beam waist diameter. Using a longer focal length focusing lens will also increase the beam waist diameter.

Finally, we need to choose the optic on the output side of the spatial filter so that the collimated beam's diameter is the desired 4.4 mm. To determine the correct focal length for the lens, consider the following diagram in Figure 4, which is not drawn to scale. From the triangle on the left-hand side, the angle is determined to be approximately 2.48^{o}. Using this same angle for the triangle on the right-hand side, the focal length for the plano-convex lens should be approximately 50 mm.

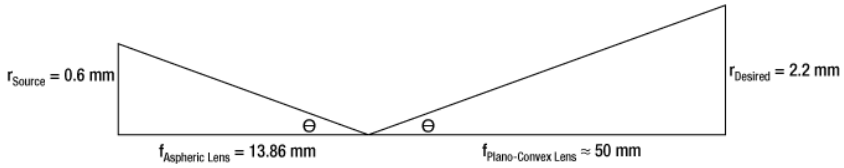


Figure 4: Beam Expansion Example

For this focal length, we recommend the LA1131-B plano-convex lens [with *f* = 50 mm at the design wavelength (λ = 633 nm), this is still a good approximation for *f* at the source wavelength (λ = 650 nm)].

Note: The beam expansion equals the focal length of the output side divided by the focal length of the input side.

For optimal performance, a large-diameter aspheric lens can be used in place of a plano-convex lens if the necessary focal length on the output side is 20 mm (see AL2520-A, AL2520-B, AL2520-C). These lenses are 25 mm in diameter and can be held in place using the supplied SM1RR Retaining Ring.

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Precision Pinholes



- Pinhole Diameters from 1 µm to 1 mm
- Fabricated from Stainless Steel (5 µm to 1 mm Pinholes) or Beryllium Copper (1 µm and 2 µm Pinholes)
- Aluminum Housing with 1" Outer Diameter



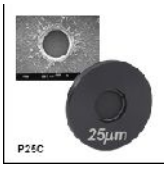
Click to Enlarge
Rear of Mounted Pinhole

These mounted precision pinholes are available with pinhole diameters from 1 µm to 1 mm. Pinholes with diameters from 5 µm to 1 mm are made of 12.7 µm thick stainless steel with a black oxide coating. The 1 and 2 µm diameter pinholes are made of nickel-plated beryllium copper (2.54 - 10.16 µm thick). Each pinhole is mounted in a Ø1" aluminum disk that is engraved with the diameter of the pinhole. The aluminum disks are 0.10" (2.5 mm) thick.

Pinhole Diameter	Diameter Tolerance	Pinhole Material
1 µm	+0.5/-0.0 µm	Beryllium Copper, 2.54 - 10.16 µm (0.0001" - 0.0004") Thick
2 µm	±0.5 µm	
5 and 10 µm	±1 µm	Stainless Steel, 12.7 µm (0.0005") Thick
15 µm	±1.5 µm	
20, 25, and 30 µm	±2 µm	
40, 50, and 75 µm	±3 µm	
100 µm	±4 µm	
150 and 200 µm	±6 µm	
300 µm	±8 µm	
400 µm - 1 mm	±10 µm	

Part Number	Description	Price	Availability
P1S	Customer Inspired!Ø1" Mounted Precision Pinhole, 1 +0.5/-0 µm Pinhole Diameter	$118.00	Today
P2S	Customer Inspired!Ø1" Mounted Precision Pinhole, 2 ± 0.5 µm Pinhole Diameter	$118.00	Today
P5S	Ø1" Mounted Precision Pinhole, 5 ± 1 µm Pinhole Diameter	$73.00	Today
P10S	Ø1" Mounted Precision Pinhole, 10 ± 1 µm Pinhole Diameter	$73.00	Today
P15S	Ø1" Mounted Precision Pinhole, 15 ± 1.5 µm Pinhole Diameter	$73.00	Today
P20S	Ø1" Mounted Precision Pinhole, 20 ± 2 µm Pinhole Diameter	$66.00	Today
P25S	Ø1" Mounted Precision Pinhole, 25 ± 2 µm Pinhole Diameter	$66.00	Today
P30S	Ø1" Mounted Precision Pinhole, 30 ± 2 µm Pinhole Diameter	$66.00	Today
P40S	Customer Inspired!Ø1" Mounted Precision Pinhole, 40 ± 3 µm Pinhole Diameter	$66.00	Today
P50S	Ø1" Mounted Precision Pinhole, 50 ± 3 µm Pinhole Diameter	$66.00	Today
P75S	Ø1" Mounted Precision Pinhole, 75 ± 3 µm Pinhole Diameter	$66.00	Today
P100S	Ø1" Mounted Precision Pinhole, 100 ± 4 µm Pinhole Diameter	$66.00	Today
P150S	Ø1" Mounted Precision Pinhole, 150 ± 6 µm Pinhole Diameter	$66.00	Today
P200S	Customer Inspired!Ø1" Mounted Precision Pinhole, 200 ± 6 µm Pinhole Diameter	$66.00	Today
P300S	Customer Inspired!Ø1" Mounted Precision Pinhole, 300 ± 8 µm Pinhole Diameter	$66.00	Today
P400S	Customer Inspired!Ø1" Mounted Precision Pinhole, 400 ± 10 µm Pinhole Diameter	$66.00	Today
P500S	Customer Inspired!Ø1" Mounted Precision Pinhole, 500 ± 10 µm Pinhole Diameter	$66.00	Today
P600S	Customer Inspired!Ø1" Mounted Precision Pinhole, 600 ± 10 µm Pinhole Diameter	$66.00	Today
P700S	Customer Inspired!Ø1" Mounted Precision Pinhole, 700 ± 10 µm Pinhole Diameter	$66.00	Today
P800S	Customer Inspired!Ø1" Mounted Precision Pinhole, 800 ± 10 µm Pinhole Diameter	$66.00	Today
P900S	Customer Inspired!Ø1" Mounted Precision Pinhole, 900 ± 10 µm Pinhole Diameter	$66.00	Today
P1000S	Customer Inspired!Ø1" Mounted Precision Pinhole, 1000 ± 10 µm Pinhole Diameter	$66.00	Today

High-Power Precision Pinholes



- Precision Copper Pinholes:
  - Gold-Plated One Side
  - Flat Poly Black (98% Emissivity) on the Reverse Side
- 25 µm Thickness at Aperture
- Aluminum Housing with 1" Outer Diameter
- High Damage Threshold:
  - 5 x 10^5 W/mm^2, 75 ns Pulse @ 700 nm
  - 1 x 10^6 W/mm^2, 10 ns Pulse @ 700 nm
  - 10 W/mm^2, CW @ 10.6 µm



Click to Enlarge
Gold Surface of High-Power Mounted Pinhole

Pinhole Diameter	Diameter Tolerance	Pinhole Thickness
10 µm	±1 µm	25 µm (0.001")
25 µm	±2 µm	
50 µm	±3 µm	

These high-power precision pinholes are designed to withstand high power densities, up to 10^4 W/mm^2 (10^6 W/cm^2) for CW lasers. These are designed to be used with the beam incident on the gold-plated side. We recommend aligning the pinhole at low power, increasing the laser to full power after ensuring good throughput.

Each pinhole is mounted in a Ø1" aluminum disk that is engraved with the diameter of the pinhole. The aluminum disks are 0.10" (2.5 mm) thick.

Part Number	Description	Price	Availability
P10C	Ø1" Mounted High-Power Precision Pinhole, 10 ± 1 µm Pinhole Diameter	$119.00	Today
P25C	Ø1" Mounted High-Power Precision Pinhole, 25 ± 2 µm Pinhole Diameter	$119.00	Today
P50C	Ø1" Mounted High-Power Precision Pinhole, 50 ± 3 µm Pinhole Diameter	$119.00	Today

Visit the *Precision Pinholes* page for pricing and availability information:

http://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=1400

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