



The diagram illustrates the Fourier transform relationship between spatial and frequency domains in microscopy. On the left, a microscope is shown emitting light rays that pass through various spatial patterns (top row) and are transformed into corresponding frequency patterns (bottom row).

- Top Row (Spatial Patterns):**
 - Concentric circles (representing a point source or a small aperture).
 - Four vertical bars (representing a grating or a series of slits).
 - A horizontal line (representing a slit or a narrow aperture).
 - A grid of circles (representing a periodic structure or a lattice).
 - A single vertical bar (representing a single slit or a narrow aperture).
 - A single circle (representing a single point source or a small aperture).
- Bottom Row (Frequency Patterns):**
 - A central bright spot with surrounding diffraction orders (representing the Fourier transform of a point source).
 - A spiral pattern (representing the Fourier transform of a grating).
 - A grid of circles (representing the Fourier transform of a periodic structure).
 - A single bright spot (representing the Fourier transform of a single slit).
 - A single bright spot (representing the Fourier transform of a single point source).

WEB SITE: <http://www.nationalaperture.com>



National Aperture, Inc.

PRECISION APERTURES

National Aperture, Inc. is the leading manufacturer of precision micro-apertures, including pinholes, slits, bar patterns and custom configurations.

Our specialty is micro-miniature pinholes and slits.

Standard pinholes range in size from 2 μ m to 1000 μ m and with larger sizes available. Standard slit widths range in size from 1.0 μ m to 200 μ m, with larger and custom sizes available.

High Power pinholes and slits are available as standard items.

All aperture edges are carefully fabricated employing proprietary computerized machining techniques. All finished components are rigidly quality controlled before shipping. Standards are traceable to NIST.

For special applications, we have provided a choice of options at an additional cost.

Some typical applications of our apertures include:

- Spatial filtering
- High power laser light control
- Gas/liquid flow control
- Spectrometry
- Fiber optics
- Astronomy

Basic types:

- Standard precision round apertures
- Standard precision air slit apertures
- High power precision round apertures
- High power precision air slit apertures
- Patterns on dielectric laser coatings

Materials:

Standard:

- Stainless Steel
- Copper
- Nickel Cobalt

Optional:

- Aluminum
- Nickel
- Brass
- Tantalum
- Tungsten
- Tungsten Copper
- Beryllium Copper
- Molybdenum
- Gold
- Titanium
- Platinum
- Custom material by request

General Quality Specifications:

Results may vary depending on type and thickness of material. See each Aperture page for Specifications.

Certifications:

Available on request at an additional charge.

Mounts:

See page 7

Pinhole Positioners:

See our:

MM-1 Micro-Mini stage

MM-3 Micro-Mini stage

Accessories Data Sheets pages 13 & 14

Delivery:

Standard Catalog items including Black one side (B-1) and Black two sides (B-2) option, available within 3 working days

Unlisted sizes available within 15 working days

precision round Standard

General Specifications:

Finish: Unblackened (see OPTIONS below)

Material: 300 Series Stainless Steel, Copper, and Nickel Cobalt

Diameter: 0.375 inch (9.53mm)

Centration: +/-0.003 inch (0.076mm)

Thickness: 0.0005 inch (12.7µm)

Catalog #	Size	Tolerance	Price
1 - 2.0 + HS	2.0µm	± 0.5µm	\$85.00
1 - 3.0 + HS	3.0µm	± 0.5µm	\$85.00
1 - 5.0	5.0µm	± 1µm	\$45.00
1 - 10	10µm	± 1µm	\$45.00
1 - 15	15µm	± 1.5µm	\$45.00
1 - 20	20µm	± 2µm	\$45.00
1 - 25	25µm	± 2µm	\$45.00
1 - 30	30µm	± 2µm	\$45.00
1 - 35	35µm	± 2µm	\$45.00
1 - 40	40µm	± 3µm	\$45.00
1 - 50	50µm	± 3µm	\$45.00
1 - 75	75µm	± 3µm	\$35.00
1 - 100	100µm	± 4µm	\$35.00
1 - 150	150µm	± 6µm	\$35.00
1 - 200	200µm	± 6µm	\$35.00
1 - 300	300µm	± 8µm	\$35.00
1 - 400	400µm	± 10µm	\$35.00
1 - 500	500µm	± 10µm	\$35.00
1 - 600	600µm	± 10µm	\$35.00
1 - 700	700µm	± 10µm	\$35.00
1 - 800	800µm	± 10µm	\$35.00
1 - 900	900µm	± 10µm	\$35.00
1 - 1000	1000µm	± 10µm	\$35.00
1 - "size"	above 1000µm		quote
Unlisted Size			quote
Setup charge for non-standard parts			\$125.00
Non-standard substrate or tolerance			quote

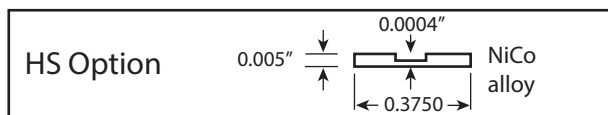
OPTIONS ADD'L CHARGE

B-1 Flat poly black one side, up to 90% emissivity in visible and near IR. Available on holes over 5µm. \$25.00

B-2 Oxide, dull black, both sides 85% emissivity in visible and near IR, both sides on 5.0µm and up \$25.00

HE High Emissivity; Flat black, both sides/one side 98% emissivity in visible and near IR on 5µm and up \$35.00

HS Heavy substrate \$30.00



CT Close Tolerance; half of listed tolerance, \$75.00

C Calibrated: Measurement Accuracy ± 0.5µm to 2µm \$35.00

M-(size) Mounted; See page 7 for Mounting selection and price

General Quality Standards for Round Apertures:

Roundness: Major Axis - Minor Axis, max.
0.5µm on holes 1-10µm
1.0µm on holes 10-50µm
2.0µm on holes 0µm and up

Line Edge Roughness: (average roughness Ra)
for **uncoated** or **B-2** substrates
Ra: 0.25µm on holes 1µm-10µm
Ra: 0.50µm on holes 10µm to 50µm
Ra: 1.50µm on holes over 50µm

Line Edge Roughness: (average roughness Ra)
for **B-1** or **HE** substrates
Ra: 0.75µm on holes 1µm-10µm
Ra: 1.0µm on holes 10µm to 50µm
Ra: 2.0µm on holes over 50µm

Ordering Information Example:
25µm round, black 2 sides, mounted on 25mm disc.
Cat no.: **1-25+B-2+M-25**

precision air slit

Standard

General Specifications:

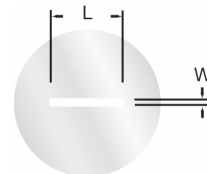
Finish: Unblackened (see OPTIONS below)

Material: 300 Series Stainless Steel, CopperI or NiCo

Diameter: 0.375 inch (9.53mm)

Centration: +/-0.003 inch (0.076mm)

Thickness: 0.0005 inch (12.7µm)



Catalog #	Slit Width (µm)	Tolerance	Length	Price
2 - 1 - 1 + HS	1.0µm	+0.5µm, -0µm	1 mm	\$312.00
2 - 2.5 - 3 + HS	2.5µm	+1µm, -0.5µm	3 mm	\$181.00
2 - 5 - 3	5µm	± 1µm	3 mm	\$70.00
2 - 10 - 3	10µm	± 1µm	3 mm	\$70.00
2 - 25 - 3	25µm	± 2µm	3 mm	\$60.00
2 - 50 - 3	50µm	± 2µm	3 mm	\$60.00
2 - 100 - 3	100µm	± 4µm	3 mm	\$60.00
2 - 150 - 3	150µm	± 4µm	3 mm	\$60.00
2 - 200 - 3	200µm	± 4µm	3 mm	\$60.00

Set-Up

For non-standard lengths up to 7.5mm:

\$125.00

Custom	Non-standard substrate or tolerance:	quote
--------	--------------------------------------	-------

OPTIONS

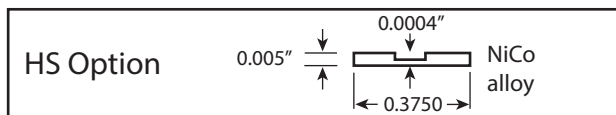
ADD'L CHARGE

B-1 Flat poly black one side, up to 90% emissivity in visible and near IR. Available on slits over 5µm. \$25.00

B-2 Oxide, dull black, both sides, 85% emissivity in visible and near IR on 5µm and up \$25.00

HE High Emissivity, Flat Black both sides/one side 98% emissivity in visible and near IR on 5µm and up

HS Heavy Substrate, \$30.00.



CT Close Tolerance; half of listed tolerance, \$95.00

C Calibrated; Measurement Accuracy ± 0.5µm to 2µm 55.00

M-(size) Mounted; See page 7 for Mounting selection and price

General Quality Standards for Slit Apertures:

Line Edge Roughness: (average roughness Ra)

for **uncoated** or **B-2** coated substrates

Ra: 0.25µm on slits 1µm-10µm

Ra: 0.50µm on slits 10µm to 50µm

Ra: 1.50µm on slits over 50µm

Line Edge Roughness: (average roughness Ra)

for **B-1** or **HE** coated substrates

Ra: 0.75µm on slits 1µm-10µm

Ra: 1.0µm on slits 10µm to 50µm

Ra: 2.0µm on over 50µm

Straightness: <1.5µm/mm

Ordering Information Example;

25µm air slit, 3mm long, black one side, calibrated.

Cat no.: 2-25-3+B-1+C

precision round

High Power

General Specifications:

Finish: Gold plated one side, flat poly black one side, up to 98% emissivity in visible and near IR.

(see OPTIONS below)

Material: Copper

Diameter: 0.375 inch (9.53mm)

Centration: 0.006 inch (0.1524mm)

Thickness: 0.001 inch (25µm)

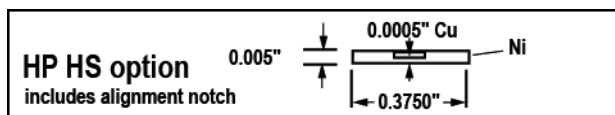
High Power

Catalog #	Size	Tolerance	Price
3 - 5	5µm	± 1µm	\$85.00
3 - 10	10µm	± 1µm	\$85.00
3 - 15	15µm	± 1.5µm	\$85.00
3 - 25	25µm	± 2µm	\$85.00
3 - 50	50µm	± 3µm	\$85.00
3 - 100	100µm	± 4µm	\$85.00
3 - 200	200µm	± 6µm	\$85.00
3 - "size"	>200µm and ≤7000µm		quote
Unlisted hole size for standard materials: Setup charge + price of nearest hole size			\$125.00
Non-standard substrate or tolerance			quote

OPTIONS

ADD'L COST

HS Heavy substrate \$95.00



G2 Gold plated both sides (unpainted) \$60.00

CT Close Tolerance; half of listed tolerance \$120.00

C Calibrated; Measurement Accuracy ± 0.5µm to 2µm \$60.00

M-(size) Mounted; See page 7 for Mounting selection and price

Power Resistance Examples:

0.5 to 1 megawatt/mm², 75 nanosecond duration, 700nm
1 to 2 megawatt/mm², 10 nanosecond duration, 700nm

Note: Because of numerous power density conditions, a test on 1 mil Cu in your direct operating environment is recommended.

General Quality Standards for Round Apertures:

Roundness: Major Axis - Minor Axis, max.

0.5µm on holes 1-10µm

1.0µm on holes 10-50µm

2.0µm on holes 0µm and up

Line Edge Roughness: (average roughness Ra)

for **uncoated** or **B-2** coated substrates

Ra: 0.25µm on holes 1µm-10µm

Ra: 0.50µm on holes 10µm to 50µm

Ra: 1.50µm on holes over 50µm

Line Edge Roughness: (average roughness Ra)

for **B-1** or **HE** coated substrates

Ra: 0.75µm on holes 1µm-10µm

Ra: 1.0µm on holes 10µm to 50µm

Ra: 2.0µm on holes over 50µm

Straightness: <1.5µm/mm

Ordering Information Example;

25µm air slit 3mm long (3-25), calibrated (C)

The part number would be **3-25-3+C**

precision air slit

High Power

General Specifications:

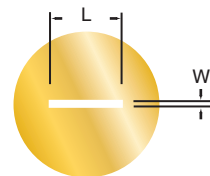
Finish: Gold plated one side, flat poly black one side, up to 98% emissivity in visible and near IR.
(see OPTIONS below)

Material: Copper

Diameter: 3/8 inch (0.375 inch maximum), 9.53mm

Centration: 0.006 inch (0.1524mm)

Thickness: 0.001 inch (25µm)



High Power

Catalog #	Tolerance	Slit Width (µm)	Length =	Price
4 - 5 - 3	± 1µm	5µm	3 mm	\$110.00
4 - 10 - 3	± 1µm	10µm	3 mm	\$110.00
4 - 25 - 3	± 2µm	25µm	3 mm	\$ 95.00
4 - 50 - 3	± 3µm	50µm	3 mm	\$ 95.00
4 - 100 - 3	± 4µm	100µm	3 mm	\$ 95.00
4 - 200 - 3	± 4µm	200µm	3 mm	\$ 95.00

Set-Up

For non-standard lengths up to 7.5mm: quote + setup shown

\$125.00 per size

Custom

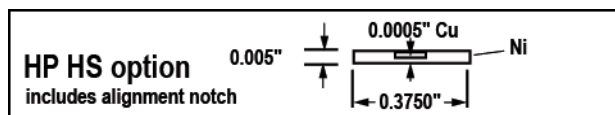
Non-standard substrate or tolerance:

quote

OPTIONS

ADD'L CHARGE

HS Heavy substrate, \$ 95.00



G2 Gold plated both sides (unpainted) \$ 60.00

CT Closer Tolerance; half of listed tolerance, \$120.00

C Calibrated; Measurement Accuracy ± 0.5µm to 2µm \$ 60.00

M-(size) Mounted; See page 7 for Mounting selection and price

Power Resistance Examples:

0.5 to 1 megawatt/mm², 75 nanosecond duration, 700nm
1 to 2 megawatt/mm², 10 nanosecond duration, 700nm

Note: Because of the numerous power density condition a test on
1 mil Cu in your direct operating environment is recommended.

General Quality Standards for Slit Apertures:

Line Edge Roughness: (average roughness Ra)

for **uncoated** or **B-2** coated substrates

Ra: 0.25µm on slits 1µm-10µm

Ra: 0.50µm on slits 10µm to 50µm

Ra: 1.50µm on slits over 50µm

Line Edge Roughness: (average roughness Ra)

for **B-1** or **HE** coated substrates

Ra: 0.75µm on slits 1µm-10µm

Ra: 1.0µm on slits 10µm to 50µm

Ra: 2.0µm on slits over 50µm

Straightness: <1.5µm/mm

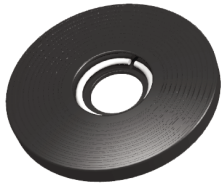
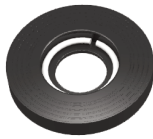

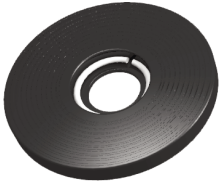

Ordering Information Example;

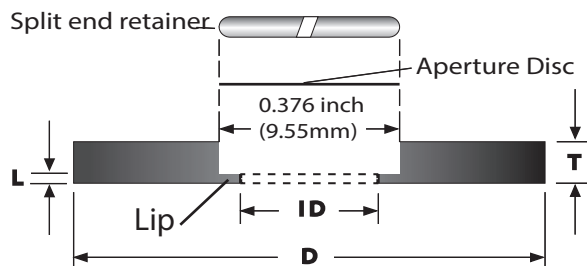
25µm air slit 3mm long (4-25), calibrated (C)

The part number would be **4-25-3+C**

Standard Aperture Mounts

Custom Mounts Available

	M-25 25mm diameter blackened aluminum mount (D)Diameter = 24.95mm (T)Thickness = 2.54mm (ID)Inner Diameter = 7.3mm (L)Lip = 0.63mm	\$35.00
	M-18 18mm diameter blackened aluminum mount (D)Diameter = 17.95mm (T)Thickness = 2.54mm (ID)Inner Diameter = 7.3mm (L)Lip = 0.63mm	\$35.00
	M-16 16mm diameter blackened aluminum mount (D)Diameter = 15.95mm (T)Thickness = 1.8mm (ID)Inner Diameter = 4.0mm (L)Lip = 0.46mm	\$35.00
	M-1 1.0 inch diameter blackened aluminum mount (D)Diameter = 0.998 inch (T)Thickness = 0.100 inch (ID)Inner Diameter = 0.290 inch (L)Lip = 0.025 inch	\$35.00
	M-0.5 0.5 inch diameter blackened aluminum mount (D)Diameter = 0.498 inch (T)Thickness = 0.055 inch (ID)Inner Diameter = 0.290 inch Lip = 0.018 inch	\$35.00



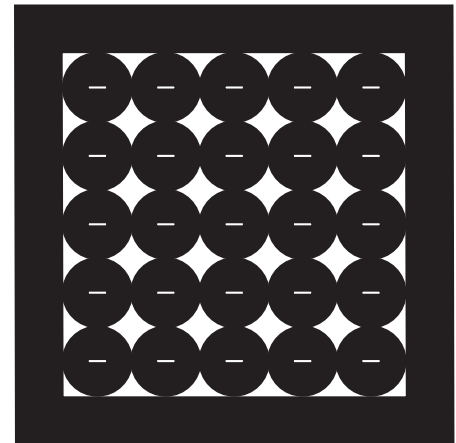
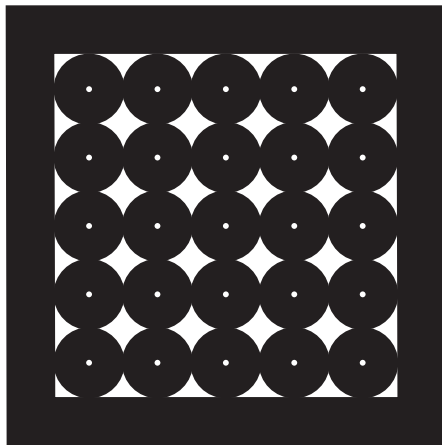
The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.

**High Quality
Palletized Precision APERTURES
For Volume Applications**

Pinholes



Slits



Custom and Stock Palletes

- Highly competitive on **pricing** and **quality** with Lithography and Etching
- **Volume** pricing on 500 pc. quantity and up
- Low NRE charges
- Features easily modifiable (post NRE)
- Highly competitive **delivery**
- Top quality feature interior **finish**

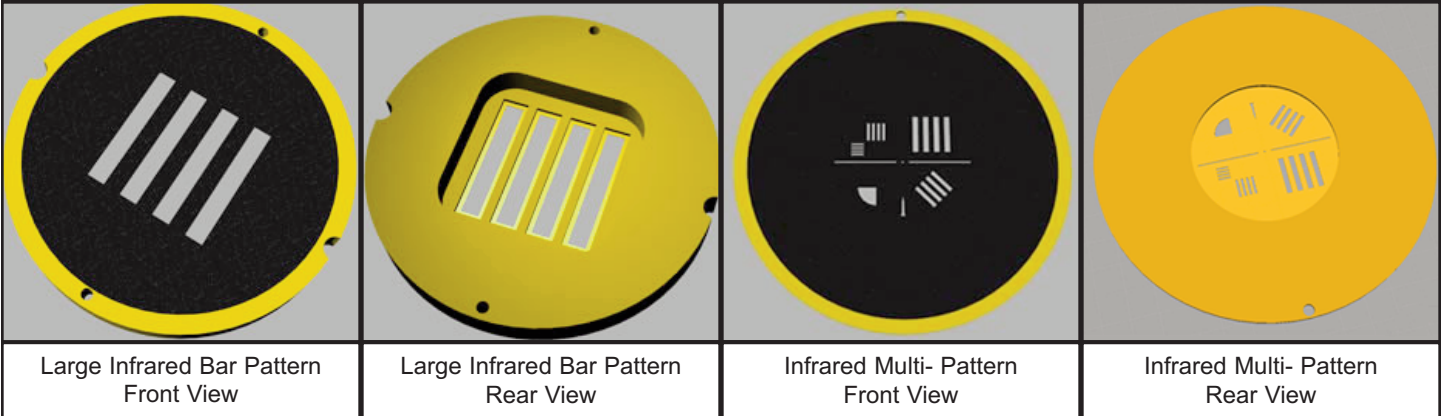
The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.



National Aperture, Inc.

Custom Patterns for Infrared Applications Made to Customer Specifications

Infrared



National Aperture, Inc. has been the leader in the military and industrial market for **precise, highly demanding** Infrared Apertures and Infrared Patterns requiring **high infrared emissivity**, in conjunction with **high reflectance**.

Competitive with:

- EDM
- Laser Machining
- Conventional Machining
- Micro-machining
- Etching
- Photo Lithography ...

Applications include:

- Infrared Calibration
- Infrared Resolution
- Infrared Imaging

Patterns include:

- 4 bar or other multi-bar
- Quarter round,
- Half round, etc.
- Cross target patterns
- Squares
- Slit and hole combinations
- Arrays, Random patterns, etc.

Standard Backer Option:

0.025-0.37 inch thick Aluminum, Brass or Copper

Available Coatings:

- Gold (bright or matte)
- Nextel™
- Aeroglaze™
- Poly black
- Krylon
- Textured Krylon
- Per customer request

Emissivity Data:

Available from 1μm to 16μm wavelength

Size Range:

- Slits and holes 10μm to >50mm
- Bar Patterns 17μm to >50mm

Edge Quality:

0.5μm to 1.75μm Ra (depending on requirements)

Standard Certifications:

Available down to +/- 2μm

The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.

National Aperture, Inc. • 10300 99th Way, Sebastian, FL 32958
(603) 893-7393 • (800) 360-4598 • FAX (603) 893-7857 • www.nationalaperture.com



National Aperture, Inc.

High Quality Spatial Filter APERTURES

FITS MOST STANDARD SPATIAL FILTERS

Specifications

Substrate:

Material: 300 Series Stainless Steel or NiCo

Substrate Diameter: 0.375 inch (9.53mm)

Thickness: 0.0005 inch (12.7µm)

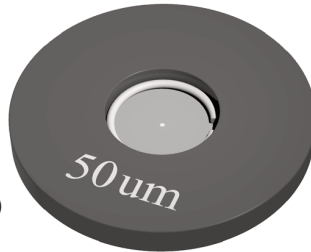
Finish: Black both sides

Mount:

Thickness: 0.1 inch

Diameter: 1 inch

Centration: 0.006 inch (0.1524mm)



Catalog #	Size (µm)	Tolerance	Price Ea. \$
SP-5	5.0µm	± 1µm	80.00
SP-10	10µm	± 1µm	80.00
SP-15	15µm	± 1.5µm	80.00
SP-25	25µm	± 2µm	80.00
SP-35	35µm	± 2µm	80.00
SP-50	50µm	± 3µm	80.00
SP-75	75µm	± 3µm	70.00
SP-100	100µm	± 4µm	70.00
SP-150	150µm	± 6µm	70.00
SP-200	200µm	± 6µm	70.00

SPATIAL FILTER HIGH POWER PINHOLES

Specifications

Substrate:

Material: Copper

Substrate Diameter: 0.375 inch (9.53mm)

Thickness: 0.001 inch (25.4µm)

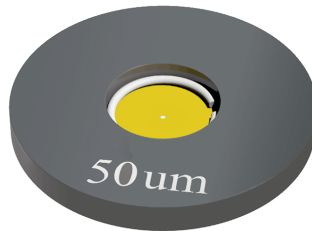
Finish: Black one side/
Gold one side

Mount:

Thickness: 0.1 inch

Diameter: 1 inch

Centration: 0.006 inch (1524mm)



Catalog #	Size (µm)	Tolerance	Price Ea. \$
SPHP-5	5.0µm	± 1µm	120.00
SPHP-10	10µm	± 1µm	120.00
SPHP-15	15µm	± 1.5µm	120.00
SPHP-50	50µm	± 3µm	120.00
SPHP-100	100µm	± 4µm	120.00
SPHP-150	150µm	± 6µm	120.00
SPHP-200	200µm	± 6µm	120.00

SPATIAL FILTERS FIXED SLITS

Specifications

Substrate:

Material: 300 Series Stainless Steel or NiCo

Substrate Diameter: 0.375 inch (9.53mm)

Thickness: 0.0005 inch (12.7µm)

Finish: Black both sides

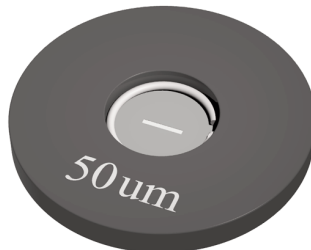
Slit Length: 3.0 mm

Mount:

Thickness: 0.1 inch

Diameter: 1 inch

Centration: 0.006 inch (1524mm)



Catalog #	Size (µm)	Tolerance	Price Ea. \$
SS-5	5.0µm	± 1µm	145.00
SS-10	10µm	± 1µm	145.00
SS-15	15µm	± 1.5µm	130.00
SS-25	25µm	± 2µm	130.00
SS-50	50µm	± 3µm	130.00
SS-100	100µm	± 4µm	130.00
SS-200	200µm	± 4µm	130.00

The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.

National Aperture, Inc. • 10300 99th Way, Sebastian, FL 32958
(603) 893-7393 • (800) 360-4598 • FAX (603) 893-7857 • www.nationalaperture.com

Apertures on Chrome/Aluminum/Gold Coated Glass First Surface Mirrors

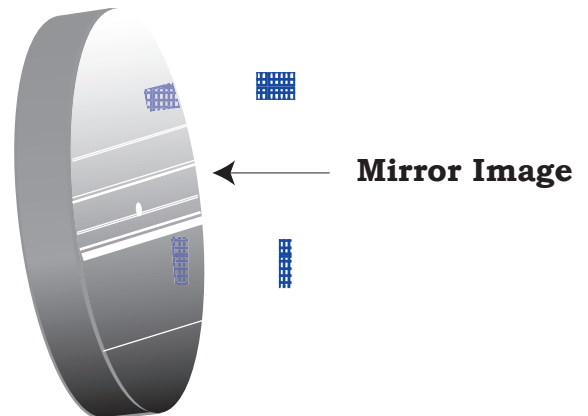
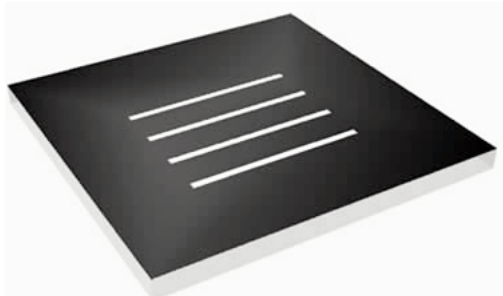
Custom Only

Low setup costs compared to conventional reticle artwork

Darkfield only

Patterns: small holes preferably less than 100 μ m and narrow slits, preferably less than 50 μ m wide, any length

Substrate: Commercial Quality, or other suitable first surface mirror, per customer choice



Typical materials:

- Stainless steel
- Brass
- Copper
- Aluminum
- Gold
- Nickel
- Tantalum
- Tungsten
- Molybdenum
- Titanium
- Platinum
- Nickel Cobalt,
•etc.

Suggested materials (unless otherwise required):

For best quality ;
Tungsten or Copper 0.001 inch thick or under.

Gas, Liquid, Material FLOW Oriented:

Leak test grade;

The emphasis normally on roundness is replaced by orifice area specification to improve cost effectiveness. To optimize quality, materials should be kept as thin as allowable. 302 stainless steel is suggested unless otherwise required.

Metered Flow;

Same as Leak Test above

Dies (wire polymer), Jets (liquid or gas);

Up to 0.010 inch (0.254mm) diameter x 0.010 inch (0.0245mm) deep

X-ray shielding, selective:

Typical materials are tantalum, tungsten and platinum

Special Micro Patterns:

Round, square, rectangular, slit, arc, hexagon, octagon, annular, etc. and combinations of patterns or arraysquote

Four-Bar Patterns:

Standard or 302 stainless steel 0.0005 in. x 0.375 in., or copper 0.001 in.

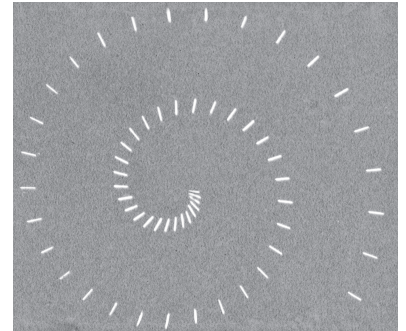
Up to 5mm square; not including applicable air slit optionsquote

Up to 0.750 in., any workable materialquote

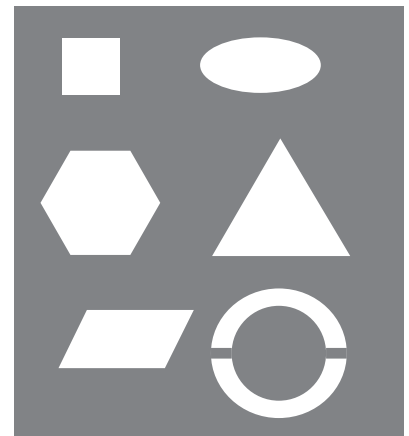
SEM photos:

per featurequote
per additional shot/anglequote
(Not to be used for calibration or measurement.)

Quality samples are available at minimal or no cost.



Spiral Slits



Shapes



Slits

Accessories

Model MM-1XY/PA

The pinhole (aperture) positioner is a composite of the MM-1 MicroMini™ stage and the PA-1 pinhole adapter.

Specifications:

Travel: 0.125 inch, X and Y

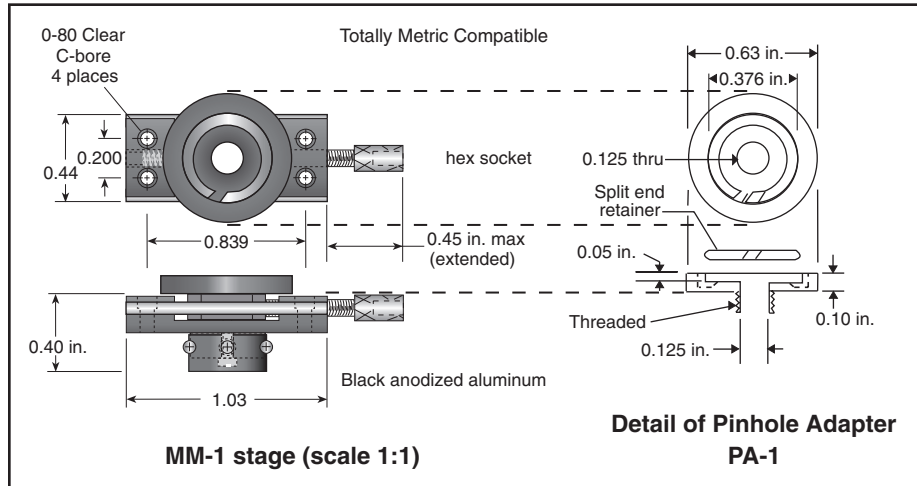
Screw Pitch: 80 TPI

Sensitivity: 0.5μm

Backlash: 0 (no ball bearings)

Wobble (max): 10 μrad

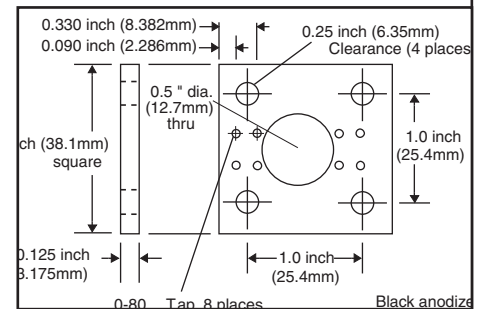
Weight: 8g



Accessories

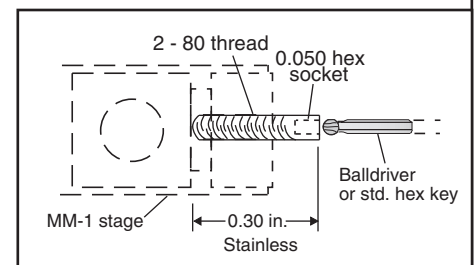
AP4-1 Adapter Plate

A multi-position mounting plate to interface with standard optical tables and accessories, or to stabilize free-standing stages.



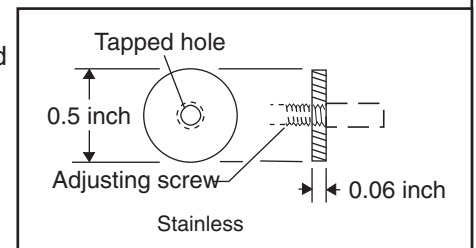
SS-1 Headless Adjusting Screw

This custom designed lead screw replaces the standard thumb screw. It provides full linear travel, while reducing the overall length of the stage by 0.4 inches.



TG-1 Thumb Grip

This knurled 1/2 in. diameter adjustment ring provides increased sensitivity. The TG-1 can be added to the standard MM-1 adjusting screw and may alternately be used as a locking nut.



The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.

Accessories

Model MM-3XY/PA

The pinhole (aperture) positioner is a composite of the MM-3 MicroMini™ stage and the PA-1 pinhole adapter.

Specifications:

Travel: 0.5 inch, X and Y

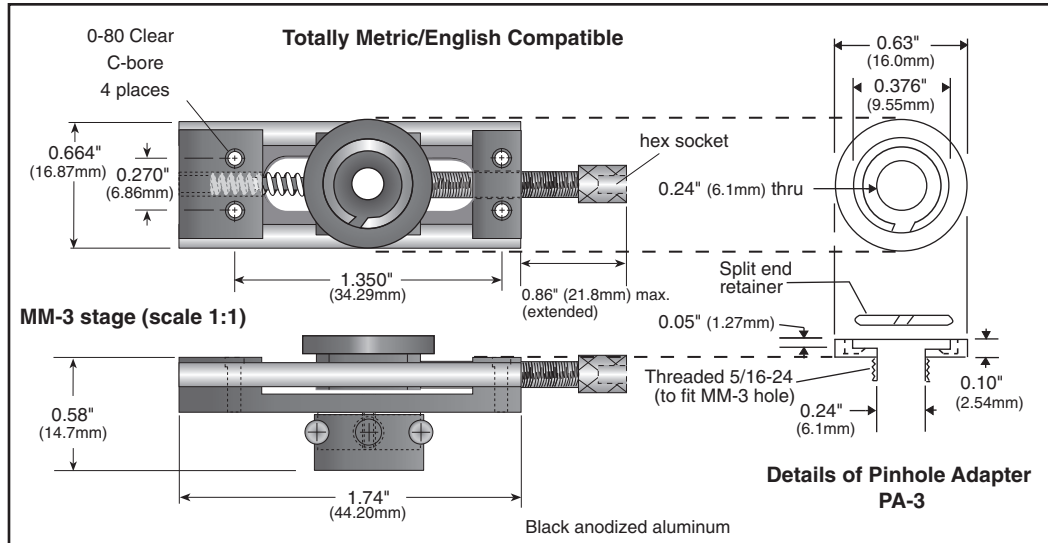
Screw Pitch: 80 TPI

Sensitivity: 0.5μm

Backlash: 0 (no ball bearings)

Wobble: 10 μrad

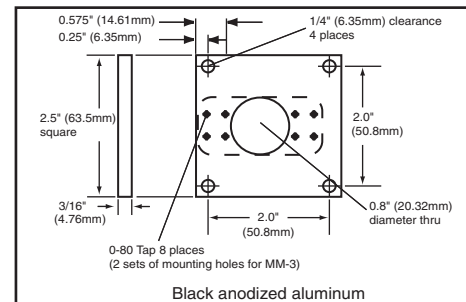
Weight: 35g



Accessories

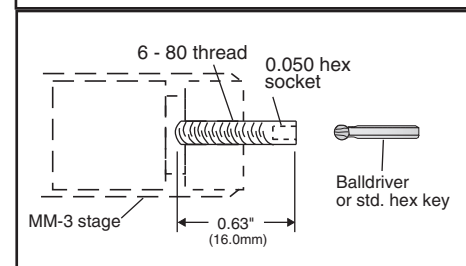
AP4-3 Adapter Plate

A multi-position mounting plate to interface with standard optical tables and accessories, or to stabilize free-standing stages.



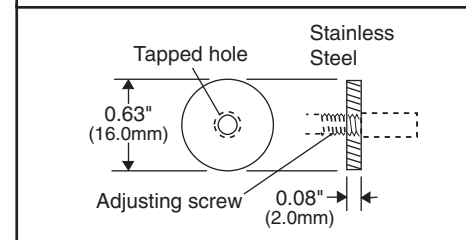
SS-3 Headless Adjusting Screw

This custom designed stainless lead screw replaces the standard thumb screw, and provides full linear travel while reducing the overall length of the stage by 0.5 inches.



TG-3 Thumb Grip

The knurled 5/8 inch diameter adjustment ring provides increased sensitivity. The TG-3 can be added to the standard MM-3 adjusting screw and may alternately be used as a locking nut.



The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.