



# High Voltage Piezo Actuators



Product range and technical data



|           |   |    |
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# Selecting a proper actuator

## Guideline:

The main pre-requisite for selecting suitable piezo components is the precise definition of the needed operation profile by the user!

Any supplier of piezo-mechanical components will highly appreciate precise specifications of the requested components beyond “the system shall do as much as possible”.

Putting definite numbers on the needed piezo-parameters is helpful to avoid over-sizing and mismatch. Poorly selected system components are ineffective and therefore expensive.

Please try to analyze the needs for operating your mechanics successfully according to the following:

A, what shift/stroke shall be achieved?

B, what force variation shall be generated by the piezo action?

C, what static preload is acting on the actuator from the beginning?

D, what is the desired maximum operation frequency?

E, what is the desired stroke at maximum frequency (D)?

F, what is the desired max. frequency at maximum stroke (see A)?

G, shortest achievable rise-/fall-time?

H, what external masses shall be attached to the actuator?

A, to C, allow an actuator selection for low dynamic operation according

D, to H, aims for the best match for the designated dynamic operation.

## Selecting the amplifier

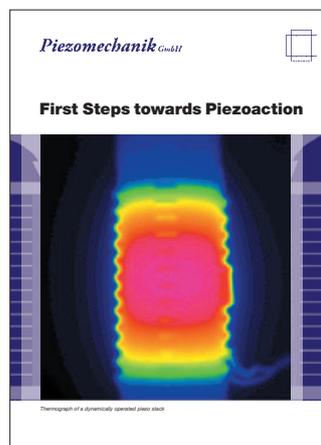
The above selection process results in a piezo-actuator of distinct voltage range and electrical capacitance. Only amplifiers with a matched voltage range should be considered for use.

Do not use amplifiers providing higher voltage!

The dynamic operation profile D, to H, defines the needed current levels ( $I_{\text{peak}}$  and  $I_{\text{average}}$ ).

When the power consumption of the actuator exceeds the Watt-range, self-heating of the piezo-ceramics can occur.

See brochure: First Steps towards Piezoaction



For details see brochure:  
“First Steps towards Piezoaction”

# General comments

## Low voltage stacks:

Co-fired multilayer actuators (CMA): also called “monolithic” stacks, involve no gluing, but a high temperature sintering of the complete ceramic electrode pile. Operating voltages are up to 200 V. Rectangular cross sections are typical due to the ease of cutting processes in production.

## High voltage stacks:

Composite structures made by the stacking of separately finished piezoceramic discs and metal electrode foils that are joined through the use of adhesives. Operating voltages ranging from 500 V thru 1000 V are typical. Cylindrical shapes are most common.

## Ring actuators:

A stack with center bore: made with rings instead of discs. This type of actuator is available in both low and high voltage form.

## Actuators with integral preload:

PIEZOMECHANIK offers all kinds of piezostacks in a cased version with internal preload. The standard preload shows forces of about 10 – 20% of the maximum load. This design covers a very wide range of applications. Preloaded actuators with casings are much more rugged than the bare ceramic stacks and are more likely to withstand “rough” handling and operation, or the impact of other environmental influences.

On request, PIEZOMECHANIK provides actuators with increased preload levels up to symmetrically acting push-pull arrangements with regard to the force balance.

## Dynamic operation:

The real operating frequency of a piezomechanical system is usually held far below the actuator’s resonance frequency

Ask for special low capacitance low voltage actuator’s PSt150hTc

For high dynamic applications

- To reduce power consumption
- To reduce self-heating

## Do not misinterpret catalogue data:

Not all operating specifications can be realized at the same time due to simple physical facts.

- Maximum displacement/shift/stroke and maximum force generation /max. blocking force cannot be generated at the same time, only either-or.
- The maximum actuator shifts (strokes) shown in data sheet are only valid under constant load conditions (no force variation!).
- Two values for stroke are stated in the data sheet  
A, for unipolar activation 0 V /+U<sub>max</sub>  
B, for semibipolar operation -U<sub>min</sub> /+U<sub>max</sub>  
The semi-bipolar operation increases the open-loop stroke of a stack by 20 – 30%.  
Any kind of stack actuator is suitable for semibipolar operation at room temperature.

## Example:

Piezostack PSt 1000/10/20

Unipolar operation 0 V/ +1000 V: stroke 20 μm

Semi-bipolar operation -200 V/+1000 V: stroke 27 μm  
with a PIEZOMECHANIK SVR 1000 amplifier

# 1. Stack type piezo actuators

## 1.1 High voltage stack actuators

### Bare stacks without casing

Configuration: discretely stacked elements  
Endfaces piezo ceramic, electrically insulated  
Potential free operation possible  
Surface coating  
General data: see brochure: "First Steps towards Piezoaction"



#### Stroke A/B:

PSt 500:           A:    -100 V thru +500 V  
                      B:    -0 V thru +500 V

**Max. force generation: for -100 V thru +500 V**

PSt 1000:          A:    -200 V thru +1000 V  
                      B:    -0 V thru +1000 V

**Max. force generation: for -200 V thru +1000 V**

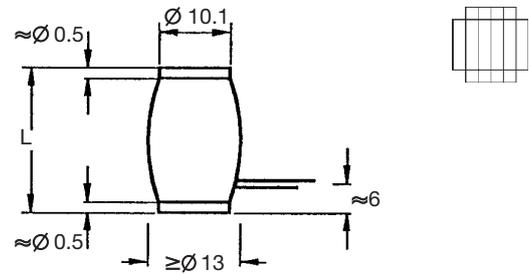
## PSt 500/10/... and PSt 1000/10/...

Maximum load: 5000 N

Maximum force generation: 4000 N

Open loop sensitivity for 5 mV amplifier noise at

PSt 500/10/5: approx. 0.05 Nanometer



| Type             | max. stroke | length<br>mm | el.<br>capacitance<br>nF | stiffness<br>N/ $\mu$ m | resonance<br>frequency<br>kHz |
|------------------|-------------|--------------|--------------------------|-------------------------|-------------------------------|
|                  | $\mu$ m     |              |                          |                         |                               |
| PSt 500/10/5     | 12/7        | 9            | 80                       | 260                     | 50                            |
| PSt 500/10/15    | 24/18       | 18           | 180                      | 130                     | 30                            |
| PSt 500/10/25    | 35/25       | 27           | 340                      | 90                      | 25                            |
| PSt 500/10/40    | 55/40       | 36           | 440                      | 55                      | 20                            |
| PSt 1000/10/5    | 12/7        | 9            | 20                       | 300                     | 60                            |
| PSt 1000/10/15   | 24/18       | 18           | 45                       | 150                     | 40                            |
| PSt 1000/10/25   | 35/25       | 27           | 85                       | 100                     | 30                            |
| PSt 1000/10/40   | 55/40       | 36           | 110                      | 75                      | 25                            |
| PSt 1000/10/60   | 80/60       | 54           | 170                      | 50                      | 20                            |
| PSt 1000/10/80   | 105/80      | 72           | 220                      | 35                      | 15                            |
| PSt 1000/10/>100 | >/100       | on request   |                          |                         |                               |

### Options:

Spherical endface **bS**, R = 5 mm

(order code e.g. PSt 500/10/25 bS)

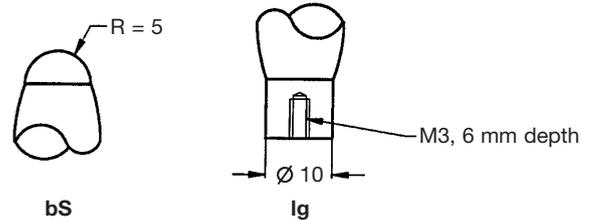
When not otherwise stated, the half sphere will be applied to the moving end.

Threaded piece for fix end (tapped hole M3): **lg**

Materials HP, HS/HT on request

Low temperature modification

UHV modification

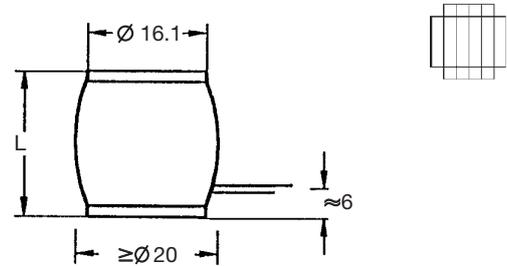


## PSt 1000/16/...

Maximum load: 15000 N

Maximum force generation: 12000 N

Open loop sensitivity for 10 mV amplifier noise at  
PSt 1000/16/5: approx. 0.05 Nanometer



| Type             | max. stroke<br>$\mu\text{m}$ | length<br>mm | el. capacitance<br>nF | stiffness<br>N/ $\mu\text{m}$ | resonance frequency<br>kHz |
|------------------|------------------------------|--------------|-----------------------|-------------------------------|----------------------------|
| PSt 1000/16/5    | 12/7                         | 9            | 60                    | 800                           | 60                         |
| PSt 1000/16/20   | 27/20                        | 18           | 150                   | 400                           | 40                         |
| PSt 1000/16/40   | 55/40                        | 36           | 360                   | 200                           | 25                         |
| PSt 1000/16/60   | 80/60                        | 54           | 540                   | 120                           | 20                         |
| PSt 1000/16/80   | 105/80                       | 72           | 720                   | 90                            | 15                         |
| PSt 1000/16/>100 | >/100                        | on request   |                       |                               |                            |

### Options:

End pieces for fixed and moving end on request

Materials HP, HS/HT on request

Low temperature modification

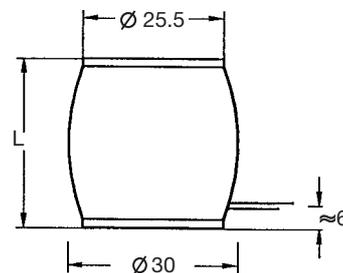
UHV modification

## PSt 1000/25/...

Maximum load: 35000 N

Maximum force generation: 25000 N

Open loop sensitivity for 10 mV amplifier noise at  
PSt 1000/25/5: approx. 0.05 Nanometer



| Type             | max. stroke<br>$\mu\text{m}$ | length<br>mm | el. capacitance<br>nF | stiffness<br>N/ $\mu\text{m}$ | resonance frequency<br>kHz |
|------------------|------------------------------|--------------|-----------------------|-------------------------------|----------------------------|
| PSt 1000/25/5    | 12/7                         | 9            | 140                   | 1800                          | 60                         |
| PSt 1000/25/20   | 27/20                        | 18           | 350                   | 900                           | 40                         |
| PSt 1000/25/40   | 55/40                        | 36           | 800                   | 450                           | 25                         |
| PSt 1000/25/60   | 80/60                        | 54           | 1250                  | 300                           | 20                         |
| PSt 1000/25/80   | 105/80                       | 72           | 1700                  | 200                           | 15                         |
| PSt 1000/25/>100 | >/100                        | on request   |                       |                               |                            |

### Options:

End pieces for fixed and moving end on request

Materials HP, HS/HT on request

Low temperature modification

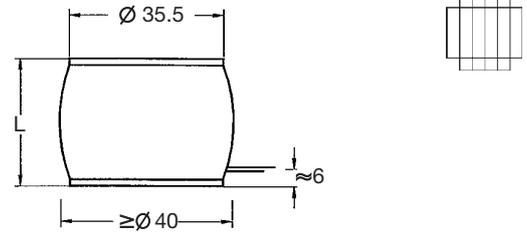
UHV modification

## PSt 1000/35/...

Maximum load: 70000 N

Maximum force generation: 50000 N

Open loop sensitivity for 10 mV amplifier noise at  
PSt 1000/35/5: approx. 0.05 Nanometer



| Type             | max. stroke<br>$\mu\text{m}$ | length<br>mm | el. capacitance<br>nF | stiffness<br>N/ $\mu\text{m}$ | resonance frequency<br>kHz |
|------------------|------------------------------|--------------|-----------------------|-------------------------------|----------------------------|
| PSt 1000/35/5    | 12/7                         | 9            | 300                   | 4000                          | 60                         |
| PSt 1000/35/20   | 27/20                        | 18           | 800                   | 2000                          | 40                         |
| PSt 1000/35/40   | 55/40                        | 36           | 1600                  | 1000                          | 25                         |
| PSt 1000/35/60   | 80/60                        | 54           | 2500                  | 600                           | 20                         |
| PSt 1000/35/80   | 105/80                       | 72           | 3300                  | 450                           | 15                         |
| PSt 1000/35/>100 | >100                         | on request   |                       |                               |                            |

### Options:

End pieces for fixed and moving end on request

Materials HP, HS/HT on request

Low temperature modification

UHV modification

## 1.2 High voltage stack actuators with casing and internal prestress



### Stroke A/B:

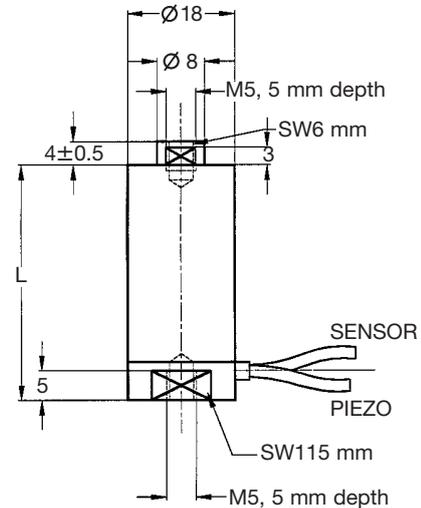
PSt 500:           A:    -100 V thru +500 V  
                       B:    -0 V thru +500 V

**Max. force generation: for -100 V thru +500 V**

PSt 1000:         A:    -200 V thru +1000 V  
                       B:    -0 V thru +1000 V

**Max. force generation: for -200 V thru +1000 V**

### PSt 500/10/...VS18 and PSt 1000/10/...VS18



General data: see brochure: "First Steps towards Piezoaction"

Prestress force = max. tensile force = 700 N

Maximum load: 5000 N

Maximum force generation: 4000 N

Open loop sensitivity at 5 mV amplifier noise for actuator PSt 500/10/5: approx. 0.05 Nanometer

| Type               | max. stroke | length | el. capacitance | stiffness | resonance frequency |
|--------------------|-------------|--------|-----------------|-----------|---------------------|
|                    | µm          | mm     | nF              | N/µm      | kHz                 |
| PSt 500/10/5 VS18  | 12/70       | 24     | 80              | 260       | 35                  |
| PSt 500/10/20 VS18 | 27/20       | 33     | 180             | 120       | 27                  |
| PSt 500/10/25 VS18 | 35/25       | 42     | 340             | 90        | 22                  |
| PSt 500/10/40 VS18 | 55/40       | 51     | 440             | 55        | 18                  |



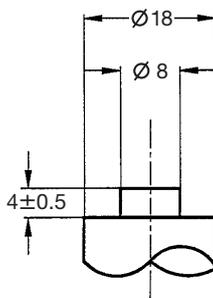
| Type                 | max. stroke<br>$\mu\text{m}$ | length<br>mm | el. capacitance<br>nF | stiffness<br>N/ $\mu\text{m}$ | resonance frequency<br>kHz |
|----------------------|------------------------------|--------------|-----------------------|-------------------------------|----------------------------|
| PSt 1000/10/5 VS18   | 12/7                         | 24           | 20                    | 300                           | 40                         |
| PSt 1000/10/20 VS18  | 27/20                        | 33           | 45                    | 150                           | 35                         |
| PSt 1000/10/25 VS18  | 35/25                        | 42           | 85                    | 100                           | 30                         |
| PSt 1000/10/40 VS18  | 55/40                        | 51           | 110                   | 75                            | 27                         |
| PSt 1000/10/60 VS18  | 80/60                        | 69           | 170                   | 50                            | 23                         |
| PSt 1000/10/80 VS18  | 105/80                       | 87           | 220                   | 35                            | 20                         |
| PSt 1000/10/100 VS18 | 130/100                      | 105          | 270                   | 30                            | 15                         |
| PSt 1000/10/125 VS18 | 160/125                      | 125          | 330                   | 25                            | 10                         |
| PSt 1000/10/150 VS18 | 200/150                      | 145          | 390                   | 17                            | 5                          |
| PSt 1000/10/200 VS18 | 260/200                      | 185          | 510                   | 10                            | 3                          |

#### Standard configuration:

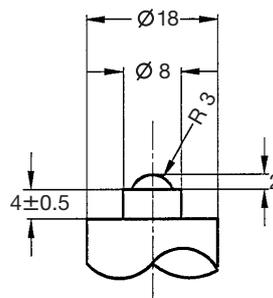
Coaxial cable RG 178, 1 m with connectors BNC or LEMO 0S250

#### Options:

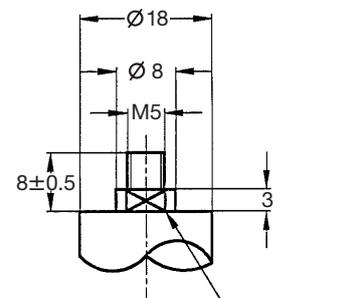
Piezomaterials HP, HS/HT  
 Thermostable modification for power applications  
 Low temperature modification  
 UHV modification  
 Position sensor  
 Negative polarity  
 Accessories: see section 3  
 Mechanical end pieces



pF



VbS



VAg

## PSt 1000/16/... VS 25



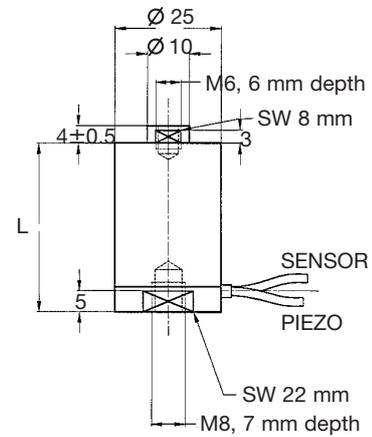
General data: see brochure: "First Steps towards Piezoaction"

Prestress force = max. tensile force = 1500 N

Maximum load: 15000 N

Maximum force generation: 12000 N

Open loop sensitivity at 10 mV amplifier noise for actuator PSt 1000/16/5 VS25: approx. 0.05 Nanometer



| Type                   | max. stroke<br>$\mu\text{m}$ | length<br>mm | el. capacitance<br>nF | stiffness<br>N/ $\mu\text{m}$ | resonance frequency<br>kHz |
|------------------------|------------------------------|--------------|-----------------------|-------------------------------|----------------------------|
| PSt 1000/16/5 VS25     | 12/7                         | 26           | 60                    | 800                           | 40                         |
| PSt 1000/16/20 VS25    | 27/20                        | 35           | 150                   | 400                           | 35                         |
| PSt 1000/16/40 VS25    | 55/40                        | 53           | 360                   | 200                           | 30                         |
| PSt 1000/16/60 VS25    | 80/60                        | 71           | 540                   | 120                           | 27                         |
| PSt 1000/16/80 VS25    | 105/80                       | 89           | 720                   | 90                            | 23                         |
| PSt 1000/16/100 VS25   | 130/100                      | 107          | 900                   | 75                            | 20                         |
| PSt 1000/16/125 VS25   | 160/125                      | 127          | 1100                  | 60                            | 15                         |
| PSt 1000/16/150 VS25   | 200/150                      | 147          | 1400                  | 50                            | 7                          |
| PSt 1000/16/200 VS25   | 260/200                      | 187          | 1900                  | 35                            | 4                          |
| PSt 1000/16/ >200 VS25 | > 200                        | on request   |                       |                               |                            |

### Standard configuration:

Coaxial cable RG 178, 1.5 m with connector LEMO 0S250

### Options:

Coaxial cable RG 316 for power applications

Piezomaterials HP, HS/HT

Thermostable modification for power applications

Low temperature modification

UHV modification

Position sensor

Negative polarity

Accessories: see chapter 3

Mechanical end pieces for moving end: on request

## PSt 1000/25/... VS35



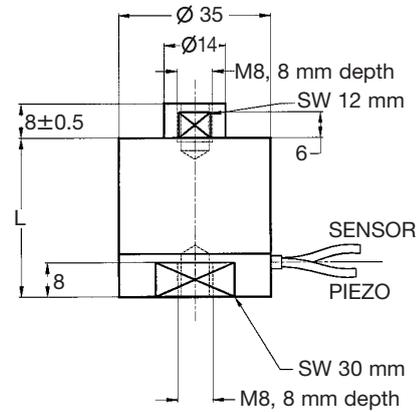
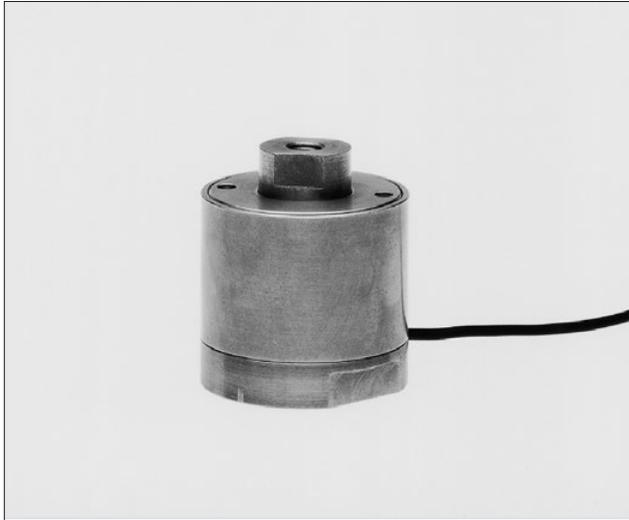
General data: see brochure: "First Steps towards Piezoaction"

Prestress force = max. tensile force = 4000 N

Maximum load: 35000 N

Maximum force generation: 25000 N

Open loop sensitivity for 10 mV amplifier noise for actuator PSt 1000/25/5 VS35: approx. 0.05 Nanometer



| Type                 | max. stroke<br>$\mu\text{m}$ | length<br>mm | el.<br>capacitance<br>nF | stiffness<br>N/ $\mu\text{m}$ | resonance<br>frequency<br>kHz |
|----------------------|------------------------------|--------------|--------------------------|-------------------------------|-------------------------------|
| PSt 1000/25/7 VS35   | 12/7                         | 33           | 140                      | 1800                          | 40                            |
| PSt 1000/25/20 VS35  | 27/20                        | 42           | 350                      | 900                           | 35                            |
| PSt 1000/25/40 VS35  | 55/40                        | 60           | 800                      | 450                           | 30                            |
| PSt 1000/25/60 VS35  | 80/60                        | 78           | 1250                     | 300                           | 27                            |
| PSt 1000/25/80 VS35  | 105/80                       | 96           | 1700                     | 200                           | 23                            |
| PSt 1000/25/100 VS35 | 130/100                      | 114          | 2150                     | 180                           | 20                            |
| PSt 1000/25/125 VS35 | 160/125                      | 134          | 2500                     | 150                           | 15                            |
| PSt 1000/25/150 VS35 | 200/150                      | 154          | 3100                     | 120                           | 7                             |
| PSt 1000/25/200 VS35 | 260/200                      | 194          | 3700                     | 90                            | 4                             |

### Standard configuration:

Coaxial cable RG 178, 1.5 m with connector LEMO 0S250

### Options:

Coaxial cable RG 316 for power applications

Piezomaterials HP, HS/HT

Thermostable modification for power applications

Low temperature modification

UHV modification

Position detection

Negative polarity

Accessories: see chapter 3

Mechanical end pieces for moving end: on request

## PSt 1000/35/... VS45



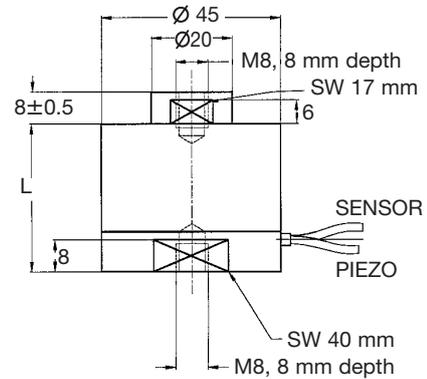
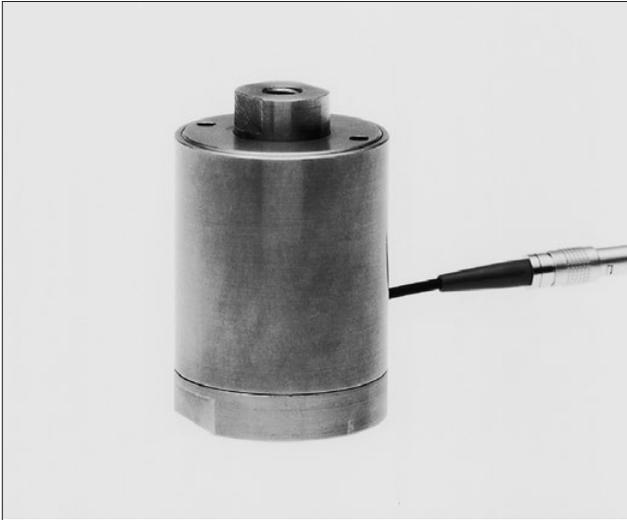
General data: see brochure: "First Steps towards Piezoaction"

Prestress force = max. tensile force = 6000 N

Maximum load: 70000 N

Maximum force generation: 50000 N

Open loop sensitivity at 10 mV amplifier noise for actuator PSt 1000/35/7 VS 45: approx. 0.05 Nanometer



| Type                 | max. stroke<br>μm | length<br>mm | el.<br>capacitance<br>nF | stiffness<br>N/μm | resonance<br>frequency<br>kHz |
|----------------------|-------------------|--------------|--------------------------|-------------------|-------------------------------|
| PSt 1000/35/7 VS45   | 12/70             | 33           | 300                      | 4000              | 37                            |
| PSt 1000/35/20 VS45  | 27/20             | 42           | 800                      | 2000              | 33                            |
| PSt 1000/35/40 VS45  | 55/40             | 60           | 1600                     | 1000              | 38                            |
| PSt 1000/35/60 VS45  | 80/60             | 78           | 2500                     | 600               | 25                            |
| PSt 1000/35/80 VS45  | 105/80            | 96           | 3300                     | 450               | 21                            |
| PSt 1000/35/100 VS45 | 130/100           | 114          | 4100                     | 350               | 18                            |
| PSt 1000/35/125 VS45 | 160/125           | 134          | 4900                     | 300               | 14                            |
| PSt 1000/35/150 VS45 | 200/150           | 154          | 5700                     | 220               | 7                             |
| PSt 1000/35/200 VS45 | 260/200           | 194          | 6500                     | 150               | 4                             |

### Standard configuration:

Coaxial cable RG 178, 1.5 m with connector LEMO OS250

### Options:

Coaxial cable RG 316 for power applications  
Piezomaterials HP, HS/HT  
Thermostable modification for power applications  
Low temperature modification  
UHV modification  
Position sensor  
Negative polarity  
Accessories: see chapter 3  
Mechanical end pieces for moving end: on request

### Stroke A/B:

PSt 500: A: -100 V thru +500 V  
B: -0 V thru +500 V

**Max. force generation: for -100 V thru +500 V**

PSt 1000: A: -200 V thru +1000 V  
B: -0 V thru +1000 V

**Max. force generation: for -200 V thru +1000 V**

## 2. Ring Actuators (stack type hollow cylinders)

### 2.1 High voltage ring actuators without casing

Technology: discrete stacking

Endfaces PZT ceramics

Endfaces completely electrically insulated, surface insulation coating

Wiring by 2 pigtailed

General data: see brochure: "First Steps towards Piezoaction"



#### Stroke A/B:

PSt 500            A:    -100 V thru +500 V  
                      B:        0 V thru +500 V

**Max. force generation: for -100 V thru +500 V**

PSt 1000           A:    -200 V thru +1000 V  
                      B:        0 V thru +1000 V

**Max. force generation: for -200 V thru +1000 V**

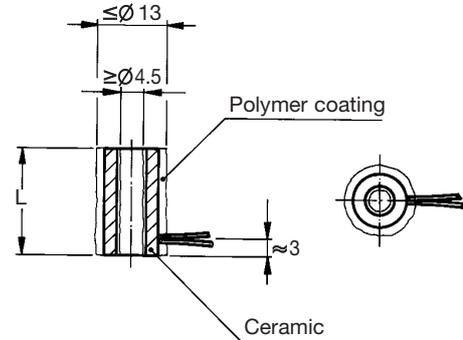


## HPSt 500/10-5/... und HPSt 1000/10-5/...

Maximum load: 3500 N

Maximum force generation: 2800 N

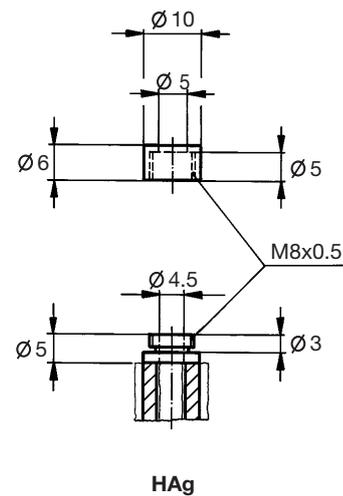
Open loop sensitivity for 5 mV amplifier noise for actuator HPSt 500/10-5/5: approx. 0.05 Nanometer



| Type              | max. stroke | length<br>mm | el.<br>capacitance<br>nF | stiffness<br>N/ $\mu$ m | resonance<br>frequency<br>kHz |
|-------------------|-------------|--------------|--------------------------|-------------------------|-------------------------------|
|                   | $\mu$ m     |              |                          |                         |                               |
| HPSt 500/10-5/5   | 12/7        | 9            | 65                       | 200                     | 40                            |
| HPSt 500/10-5/15  | 25/17       | 18           | 180                      | 100                     | 25                            |
| HPSt 500/10-5/25  | 35/25       | 27           | 260                      | 70                      | 20                            |
| HPSt 1000/10-5/5  | 13/8        | 9            | 15                       | 210                     | 50                            |
| HPSt 1000/10-5/15 | 25/17       | 18           | 40                       | 110                     | 35                            |
| HPSt 1000/10-5/25 | 35/25       | 27           | 65                       | 75                      | 25                            |
| HPSt 1000/10-5/40 | 55/40       | 36           | 90                       | 55                      | 20                            |
| HPSt 1000/10-5/60 | 80/60       | 54           | 140                      | 35                      | 15                            |

### Options:

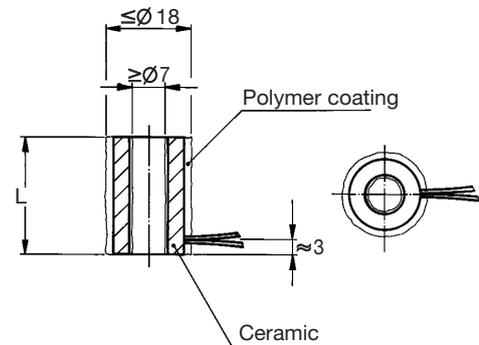
Threaded end pieces **HAg** (together with 1 screw cap)





## PSt 500/15-8/... und PSt 1000/15-8/...

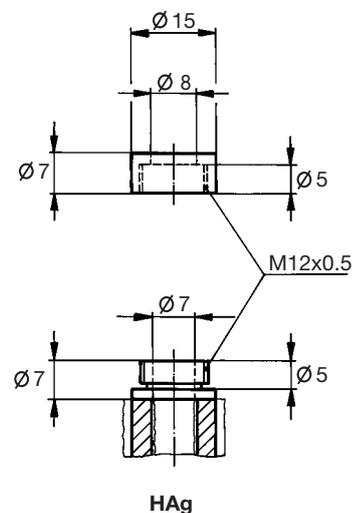
Maximum load: 9000 N  
 Maximum generation force: 5500 N  
 Open loop sensivity for 5 mV amplifier noise for actuator HPSt 500/15-8/5: approx. 0.05 Nanometer



| Type               | max. stroke   | length     | el. capacitance | stiffness        | resonance frequency |
|--------------------|---------------|------------|-----------------|------------------|---------------------|
|                    | $\mu\text{m}$ | mm         | nF              | N/ $\mu\text{m}$ | kHz                 |
| HPSt 500/15-8/5    | 12/7          | 9          | 140             | 550              | 40                  |
| HPSt 500/15-8/20   | 27/20         | 18         | 360             | 280              | 25                  |
| HPSt 500/15-8/25   | 35/25         | 27         | 520             | 180              | 20                  |
| HPSt 500/15-8/40   | 55/40         | 36         | 720             | 130              | 15                  |
| HPSt 500/15-8/60   | 80/60         | 54         | 1100            | 90               | 12                  |
| HPSt 500/15-8/80   | 105/80        | 72         | 1500            | 60               | 10                  |
| HPSt 500/15-8/L>80 | > /80         | on request |                 |                  |                     |
| HPSt 1000/15-8/5   | 12/7          | 9          | 35              | 600              | 50                  |
| HPSt 1000/15-8/20  | 27/20         | 18         | 90              | 300              | 35                  |
| HPSt 1000/15-8/25  | 35/25         | 27         | 130             | 200              | 25                  |
| HPSt 1000/15-8/40  | 55/40         | 36         | 180             | 150              | 20                  |
| HPSt 1000/15-8/60  | 80/60         | 54         | 270             | 100              | 15                  |
| HPSt 1000/15-8/80  | 105/80        | 72         | 360             | 70               | 12                  |
| HPSt 1000/15-8/>80 | > 80          | > 72       | on request      |                  |                     |

### Options:

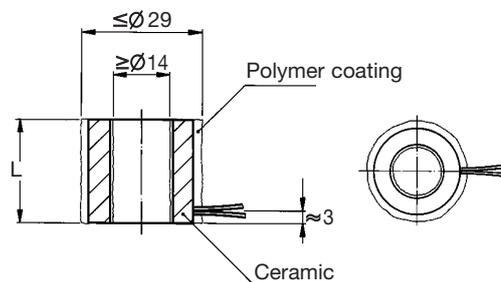
Threaded end pieces **HAg** (together with 1 screw cap)  
 Optics adaptor 0A 1/2" (see section 3)  
 Piezo ceramics: HP, HS/HT





## HPSt 1000/25-15/...

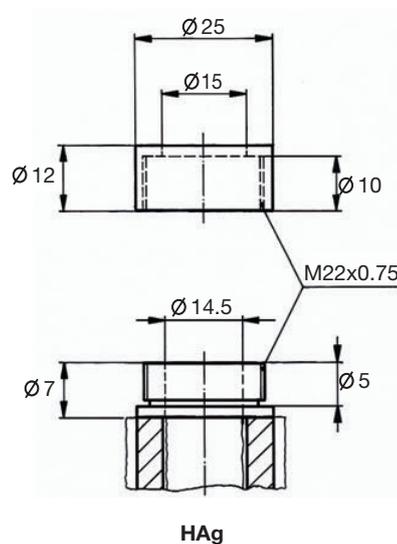
Maximum load: 22000 N  
 Maximum force generation: 13000 N  
 Open loop sensitivity for 10 mV amplifier noise for actuator HPSt 1000/25-15/5: approx. 0.05 Nanometer



| Type                 | max. stroke<br>$\mu\text{m}$ | length<br>mm | el. capacitance<br>nF | stiffness<br>N/ $\mu\text{m}$ | resonance frequency<br>kHz |
|----------------------|------------------------------|--------------|-----------------------|-------------------------------|----------------------------|
| HPSt 1000/25-15/5    | 12/7                         | 9            | 85                    | 1200                          | 50                         |
| HPSt 1000/25-15/20   | 27/20                        | 18           | 210                   | 600                           | 35                         |
| HPSt 1000/25-15/25   | 35/25                        | 27           | 310                   | 400                           | 25                         |
| HPSt 1000/25-15/40   | 55/40                        | 36           | 420                   | 300                           | 20                         |
| HPSt 1000/25-15/60   | 80/60                        | 54           | 650                   | 180                           | 15                         |
| HPSt 1000/25-15/80   | 105/80                       | 72           | 900                   | 130                           | 12                         |
| HPSt 1000/25-15/> 80 | > /80                        | > 72         | on request            |                               |                            |

### Options:

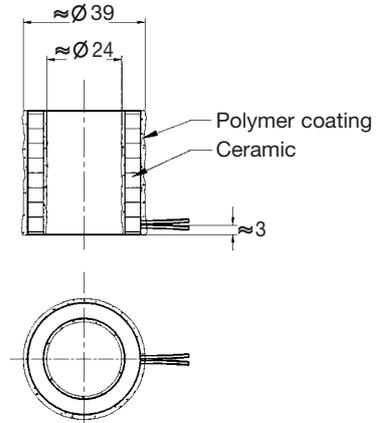
Threaded end pieces **HAg** (together with 1 screw cap)  
 Optics adaptor 0A 1" (see section 3)  
 Piezo ceramics: HP, HS/HT





## HPSt 1000/35-25/...

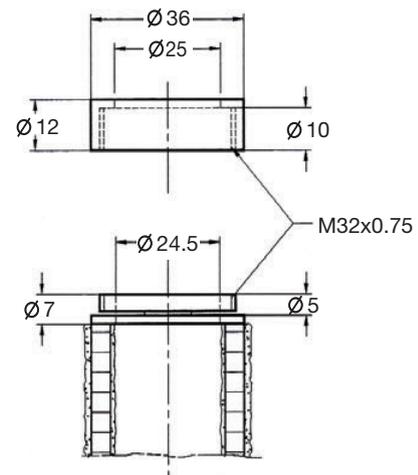
Maximum load: 35000 N  
 Maximum force generation: 20000 N  
 Open loop sensitivity for 10 mV amplifier noise for actuator HPSt 1000/35-25/5: approx. 0.05 Nanometer



| Type                 | max. stroke   | length | el. capacitance | stiffness        | resonance frequency |
|----------------------|---------------|--------|-----------------|------------------|---------------------|
|                      | $\mu\text{m}$ | mm     | nF              | N/ $\mu\text{m}$ | kHz                 |
| HPSt 1000/35-25/5    | 12/70         | 9      | 120             | 2000             | 50                  |
| HPSt 1000/35-25/20   | 27/20         | 18     | 300             | 1000             | 35                  |
| HPSt 1000/35-25/25   | 35/25         | 27     | 450             | 700              | 25                  |
| HPSt 1000/35-25/40   | 55/40         | 36     | 600             | 500              | 20                  |
| HPSt 1000/35-25/60   | 80/60         | 54     | 900             | 350              | 15                  |
| HPSt 1000/35-25/80   | 105/80        | 72     | 1300            | 250              | 12                  |
| HPSt 1000/35-35/100  | 130/100       | 90     | 1800            | 160              | 10                  |
| HPSt 1000/35-25/>100 | > /100        | > 90   | on request      |                  |                     |

### Options:

Threaded end pieces **HAg** (together with 1 screw cap)  
 Piezo ceramics HP, HS/HT



**HAg**

## 2.2 High voltage ring actuators, with internally prestressed casing VS



### HPSt 500/10-5/... VS18 and HPSt 1000/10-5/... VS18

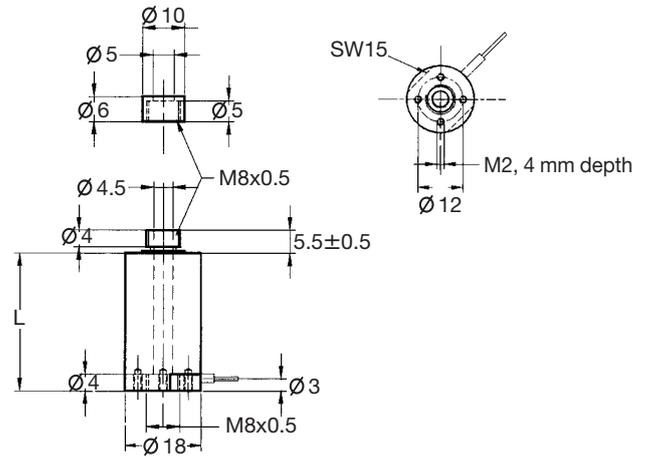
General data: see brochure: "First Steps towards Piezoaction"

Prestress force = max. tensile force = 200 N

Maximum load: 3500 N

Maximum force generation: 2800 N

Open loop sensitivity for 10 mV amplifier noise for actuator PSt 1000/10-5/7 VS18: approx. 0.05 Nanometer



| Type                   | max. stroke | length | el. capacitance | stiffness | resonance frequency |
|------------------------|-------------|--------|-----------------|-----------|---------------------|
|                        |             |        |                 |           |                     |
| HPSt 500/10-5/7 VS18   | 12/7        | 24     | 65              | 200       | 30                  |
| HPSt 500/10-5/20 VS18  | 27/20       | 33     | 180             | 100       | 25                  |
| HPSt 500/10-5/25 VS18  | 35/25       | 42     | 260             | 70        | 20                  |
| HPSt 1000/10-5/7 VS18  | 12/7        | 24     | 15              | 210       | 35                  |
| HPSt 1000/10-5/20 VS18 | 27/20       | 33     | 40              | 110       | 27                  |
| HPSt 1000/10-5/25 VS18 | 35/25       | 42     | 65              | 75        | 22                  |
| HPSt 1000/10-5/40 VS18 | 55/40       | 51     | 90              | 55        | 20                  |
| HPSt 1000/10-5/60 VS18 | 80/60       | 69     | 140             | 35        | 17                  |

#### Standard configuration:

Coaxial cable RG 178 length 1.5 m with connectors BNC or LEMO 0S250 1 screw cap for top

#### Options:

UHV compatibility

Low temperature application

Thermostable modification

Negative polarity

Piezo ceramics: HP, HS/HT

Adaptor rings AR: see section 3

## HPSt 500/15-8/... VS22 and HPSt 1000/15-8/... VS22



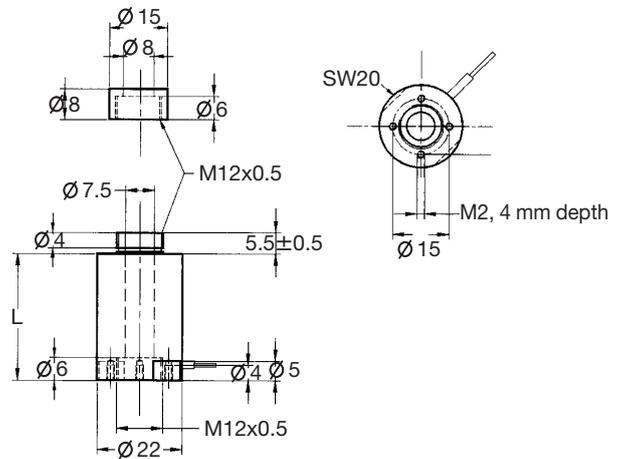
General data: see brochure: "First Steps towards Piezoaction"

Prestress force = max. tensile force = 400 N

Maximum load: 9000 N

Maximum force generation: 5500 N

Open loop sensitivity for 5 mV amplifier noise for actuator HPSt 500/15-8/7 VS22: approx. 0.05 Nanometer



| Type                    | max. stroke | length     | el. capacitance | stiffness | resonance frequency |
|-------------------------|-------------|------------|-----------------|-----------|---------------------|
|                         |             |            |                 |           |                     |
| HPSt 500/15-8/7 VS22    | 13/8        | 26         | 140             | 550       | 30                  |
| HPSt 500/15-8/20 VS22   | 27/20       | 35         | 360             | 280       | 25                  |
| HPSt 500/15-8/25 VS22   | 35/25       | 44         | 520             | 180       | 20                  |
| HPSt 500/15-8/40 VS22   | 55/40       | 53         | 720             | 130       | 15                  |
| HPSt 500/15-8/60 VS22   | 80/60       | 71         | 1100            | 90        | 12                  |
| HPSt 500/15-8/80 VS22   | 105/80      | 89         | 1500            | 60        | 10                  |
| HPSt 500/15-8/>80 VS22  | >/80        | on request |                 |           |                     |
| HPSt 1000/15-8/7 VS22   | 13/8        | 26         | 35              | 600       | 35                  |
| HPSt 1000/15-8/20 VS22  | 27/20       | 35         | 90              | 300       | 27                  |
| HPSt 1000/15-8/25 VS22  | 35/25       | 44         | 130             | 200       | 22                  |
| HPSt 1000/15-8/40 VS22  | 55/40       | 53         | 180             | 150       | 17                  |
| HPSt 1000/15-8/60 VS22  | 80/60       | 71         | 270             | 100       | 14                  |
| HPSt 1000/15-8/80 VS22  | 105/80      | 89         | 360             | 70        | 12                  |
| HPSt 1000/15-8/>80 VS22 | > /80       | on request |                 |           |                     |

### Standard configuration:

Coaxial cable RG 178 length 1.5 m with connectors BNC or LEMO 0S250

### Options:

UHV compatibility

Low temperature application

Thermostable modification

Negative polarity

Piezo ceramics: HP, HS/HT

Positions sensor

Optics adaptor 0A1/2": see section 3

Adaptor rings AR: see section 3

## HPSt 1000/25-15/... VS35



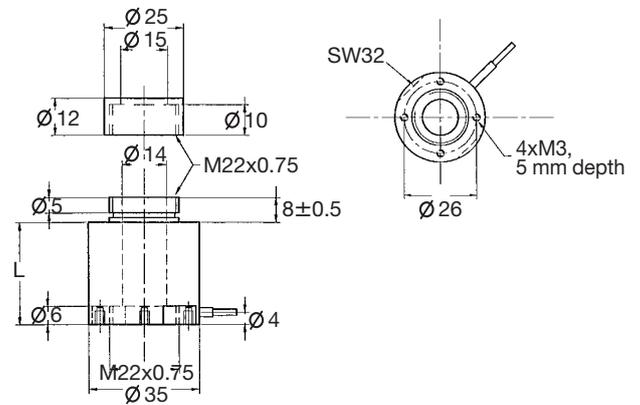
General data: see brochure: "First Steps towards Piezoaction"

Prestress force = max. tensile force = 2000 N

Maximum load: 22000 N

Maximum force generation: 13000 N

Open loop sensitivity for 10 mV amplifier noise for actuator PSSt 1000/25-15/7 VS35: approx. 0.05 Nanometer



| Type                     | max. stroke<br>µm | length<br>mm | el.<br>capacitance<br>nF | stiffness<br>N/µm | resonance<br>frequency<br>kHz |
|--------------------------|-------------------|--------------|--------------------------|-------------------|-------------------------------|
| HPSt 1000/25-15/7 VS35   | 13/8              | 26           | 85                       | 1200              | 40                            |
| HPSt 1000/25-15/20 VS35  | 27/20             | 35           | 210                      | 600               | 30                            |
| HPSt 1000/25-15/25 VS35  | 35/25             | 44           | 310                      | 400               | 25                            |
| HPSt 1000/25-15/40 VS35  | 55/40             | 53           | 420                      | 300               | 25                            |
| HPSt 1000/25-15/60 VS35  | 80/60             | 71           | 650                      | 180               | 20                            |
| HPSt 1000/25-15/80 VS35  | 105/80            | 89           | 900                      | 130               | 15                            |
| HPSt 1000/25-15/>80 VS35 | > / 80            | on request   |                          |                   |                               |

### Standard configuration:

Coaxial cable RG 178 length 1.5 m with connectors BNC or LEMO 0S250

### Options:

Coaxial cable RG 316 for power application

UHV compatibility

Low temperature application

Thermostable modification

Negative polarity

Piezo ceramics: HP, HS/HT

Position sensor

Optics adaptor 0A 1": see section 3

Adaptor rings AR: see section 3

## HPSt 1000/35-25/...VS45



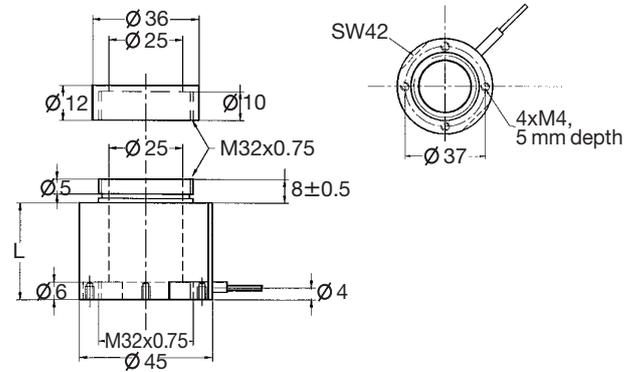
General data: see brochure: "First Steps towards Piezoaction"

Prestress force = max. tensile force = 3000 N

Maximum load: 35000 N

Maximum force generation: 20000 N

Open loop sensitivity for 10 mV amplifier noise for actuator HPSt 1000/35-25/7 VS45: approx. 0.05 Nanometer



| Type                      | max. stroke<br>$\mu\text{m}$ | length<br>mm | el.<br>capacitance<br>nF | stiffness<br>N/ $\mu\text{m}$ | resonance<br>frequency<br>kHz |
|---------------------------|------------------------------|--------------|--------------------------|-------------------------------|-------------------------------|
| HPSt 1000/35-25/7 VS45    | 12/70                        | 26           | 120                      | 2000                          | 40                            |
| HPSt 1000/35-25/20 VS45   | 27/20                        | 35           | 300                      | 1000                          | 30                            |
| HPSt 1000/35-25/25 VS45   | 35/25                        | 44           | 450                      | 700                           | 25                            |
| HPSt 1000/35-25/40 VS45   | 55/40                        | 53           | 600                      | 500                           | 20                            |
| HPSt 1000/35-35/60 VS45   | 80/60                        | 71           | 900                      | 350                           | 15                            |
| HPSt 1000/35-25/80 VS45   | 105/80                       | 89           | 1300                     | 250                           | 12                            |
| HPSt 1000/35-25/100 VS45  | 130/100                      | 107          | 1800                     | 160                           | 10                            |
| HPSt 1000/35-25/>100 VS45 | /> 100                       | on request   |                          |                               |                               |

### Standard configuration:

Coaxial cable RG 178 length 1.5 m with connectors BNC or LEMO 0S250

### Options:

Coaxial cable RG 316 for power applications

UHV compatibility

Low temperature modification

Thermostable modification

Position sensor

Negative polarity

Piezo ceramics: HP, HS/HT

## 3. Accessories

### 3.1 Electricals

**Supply coaxial cables:** one side connector, other side free for attaching piezocomponents such as bare stacks etc.

Cable type RG 178 (PTFE), thickness 1.8 mm:  
length 1.5 m

Connectors available: BNC, LEMO 0S250

Cable type RG 316 (PTFE), thickness 2.5 mm:  
length 1.5 m

for power applications

Connectors available: BNC, LEMO 0S250



**Extension cables:**

Connector system LEMO 0S250, length 2 m/4 m/6 m

Cable types RG 178 or RG 316 (see above)

**Connecting adaptors** for matching different connecting systems plug (from electronics)/Cable's connector LEMO 0S 250/BNC (this adaptor is used to match amplifiers with LEMO output to a component, having a BNC connector)

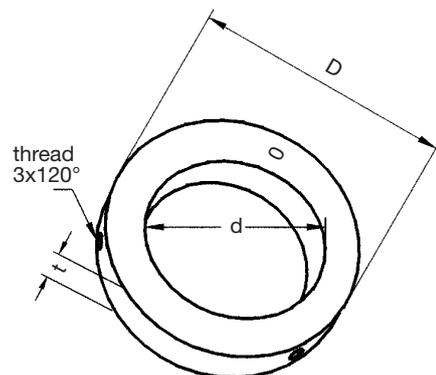
BNC/LEMO 0S250

BNC/LEMO 00250

### 3.2 Mechanics

**Adaptor rings**

The adaptor rings are normally used to match the diameter of actuators with casing to mirror mounts, defined for a distinct mirror's diameter. An often used combination are ring actuators (e.g. with casing VS22), which are adopted to 2" mirror mount system. The proper adaptor ring is an AR (51/22).



Designation AR X/Y X external diameter, Y internal diameter (corresponds to actuator's casing's diameter), T thickness of ring (all dimensions in mm)

|    |       |   |   |
|----|-------|---|---|
| AR | 25/10 | t | 5 |
| AR | 25/12 | t | 5 |
| AR | 25/18 | t | 5 |
| AR | 50/18 | t | 7 |
| AR | 50/20 | t | 7 |
| AR | 50/22 | t | 7 |
| AR | 50/25 | t | 7 |
| AR | 50/35 | t | 7 |

|    |       |   |   |
|----|-------|---|---|
| AR | 31/12 | t | 7 |
| AR | 31/22 | t | 7 |
| AR | 31/25 | t | 7 |
| AR | 51/18 | t | 7 |
| AR | 51/20 | t | 7 |
| AR | 51/22 | t | 7 |
| AR | 51/22 | t | 7 |
| AR | 51/35 | t | 7 |

### 3.3 Optic adaptor for ring actuators

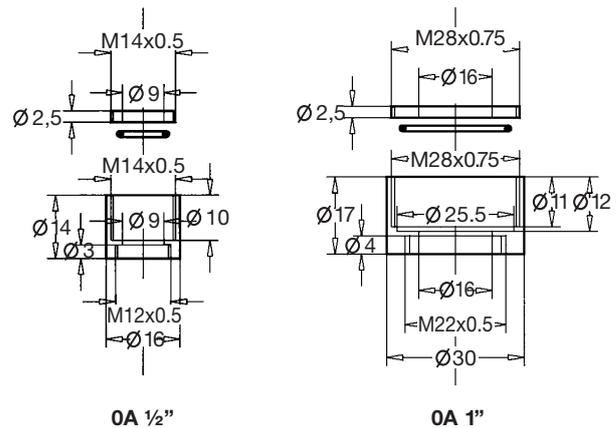
Ring actuators are often used within optical arrangements for precise adjustment of transmissive optical components e.g. within laser resonators or tunable etalons. The optic adaptors allow the simple mounting and changing of circular optics with the standard diameters 1/2" and 1".

#### Optic adaptor OA 1/2"

This element allows mounting of optics with diameter 1/2" up to a thickness of 8 mm. It can be simply attached using the M12x0.5 thread to all the corresponding ring actuators with a HA<sub>g</sub> M12x0.5 end piece (bare rings) such as the HPSt 150/14-10/..., HPSt 500/15-8/..., HPSt 1000/15-8/... or the equivalent cased types with a VS22 casing.

#### Optic adaptor OA 1"

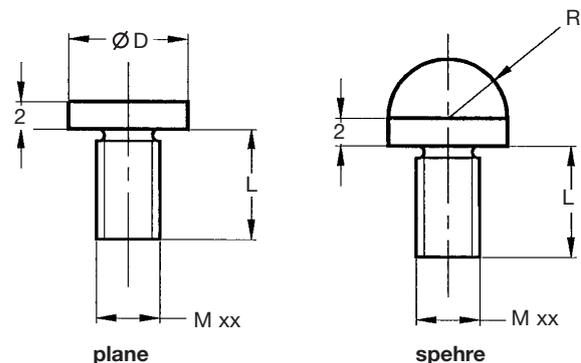
This element allows mounting of optics with diameter 1" up to a thickness of 8 mm. It can be simply attached using the M22x0.5 thread to all the corresponding ring actuators with a HA<sub>g</sub> M22x0.75 end piece (bare rings) such as the HPSt 150/25-15/... or the equivalent cased types with a VS35 casing.



### 3.4 Screw in front adaptor SE (For stacks with casings VS)

The adaptors have a threaded pin for simple attachment to the standard front pieces VS with tapped hole and provide a plane or spherical front to match the actuator for various uses. For example small mirrors can be glued onto the plane faces.

**Designation:** SE xx plane and SE x sphere, where xx represents the casing's diameter, where it is mounted to (e.g. 12 for VS 12).

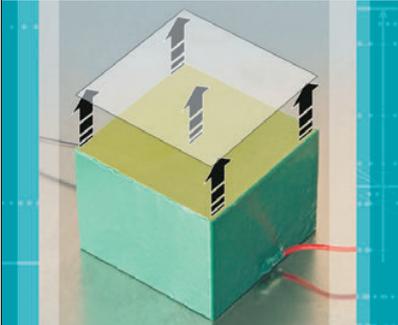


| Type    | Mx (mm) | D (mm) | L (mm) | R (mm) |
|---------|---------|--------|--------|--------|
| SE9     | 2.3     | 5      | 3      | 2.5    |
| SE10    | 3       | 6      | 3      | 2.5    |
| SE12    | 3       | 7      | 4      | 3.5    |
| SE15    | 4       | 8      | 4      | 3.5    |
| SE18/20 | 5       | 10     | 4      | 4      |

#### Magnetic front pieces

Based on the above described front adaptors, MA components with magnetic plane face are offered for VS10 and VS12 casings (designation MA10 / MA12). Small ferromagnetic components can be easily attached to the moving pin of stack actuators.

**Low voltage co-fired multilayer stacks, rings and chips for actuation**  
(without casing)



Low voltage actuators with casings, high voltage actuators    Check main catalogue

*Piezomechanik GmbH*

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