

PiezoMike Linear Actuator

MINIMUM DIMENSIONS, HIGH FORCES, STABLE POSITIONING



N-470

- Holding force >100 N
- Step size 30 nm
- Travel range 7.4 mm
- Compact design
- Feed force 22 N

Linear Actuator with PIShift Piezomotor

Linear screw-type actuator with PIShift piezo inertia drive for high-resolution and stable positioning. Open-loop operation

PIShift Piezomotors

Compact, cost-effective inertia drive (Stick-Slip). When at rest, the drive is self-locking and therefore requires no current and generates no heat. It holds the position with maximum force

Alignment of Mechanical and Optical Components

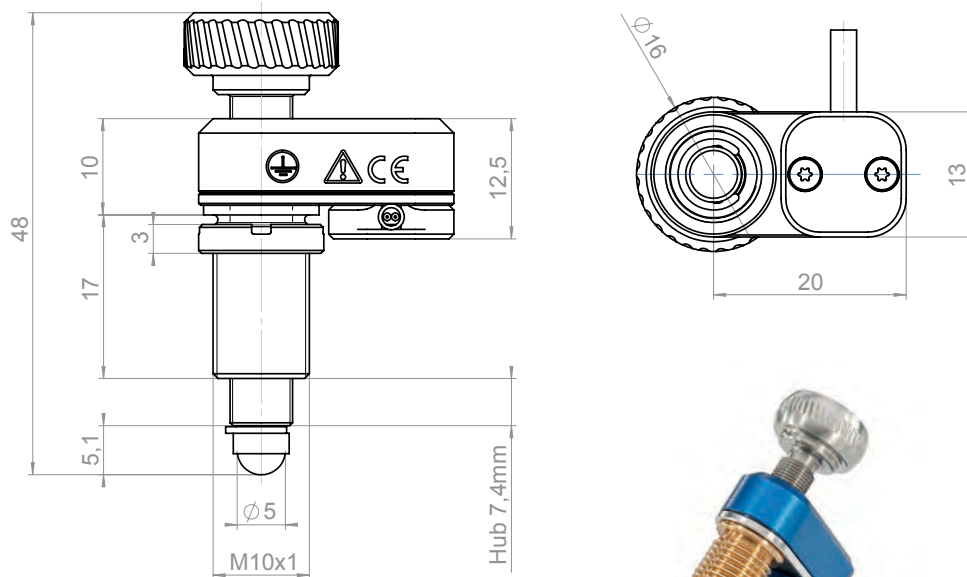
Stable alignment of optical paths. Long-term positioning stability: High stability in target position, reliable start-up even after longer downtimes. High holding force and resolution by combining piezo actuators with mechanical thread translation. Vacuum-compatible to 10^{-6} hPa



PiezoMike linear actuators replace manual micrometer screws in tip/tilt mirror mechanics

Preliminary data	N-470	Unit
Active axes	X	
Motion and positioning		
Travel range	7.4	mm
Max. step size in step mode	0.03	μm
Step frequency	2000	Hz
Max. velocity in full-step mode*	0.06	mm/s
Mechanical properties		
Stiffness in motion direction	15.5	N/ μm
Feed force (active)	22	N
Holding force (passive)	>100	N
Permissible lateral force	1	N
Drive properties		
Drive type	PIShift inertia drive	
Max. operating voltage	80	V
Max. power consumption	6.4	W
Miscellaneous		
Operating temperature range	10 to 40	$^{\circ}\text{C}$
Material	Screw: Stainless steel, Case: Aluminum	
Dimensions	16 mm x 28 mm x 48 mm	
Mass	80	g
Cable length	2	m
Connector	DIN 4-pin	
Recommended controller / driver	E-870 PIShift drive electronics	

* Short-term, depending on drive electronics.



N-470, dimensions in mm

Closed Loop PiezoMike Linear Actuator

With Position Sensor for Closed-Loop Operation



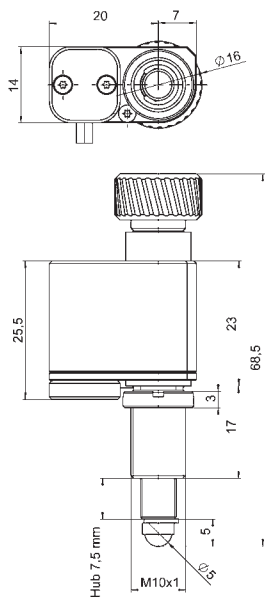
Integrated position sensor

An incremental encoder measures the motion performed relative to a freely definable reference position. In combination with the E-871 motion controller, the encoder resolution is up to <math><1\text{ nm}</math>

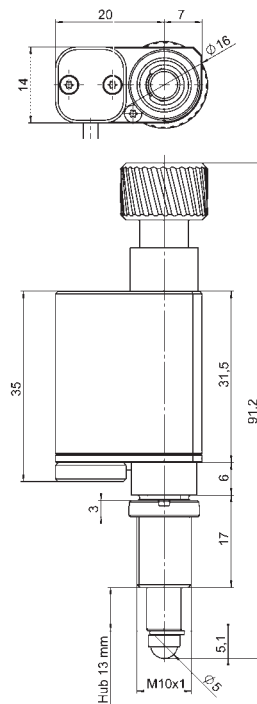
N-472

- High stability and holding force >100 N
- Self-locking at rest even when closed-loop control is switched off
- Travel range 7.5 mm and 13 mm
- Compact design with integrated incremental encoder
- Encoder resolution up to <math><1\text{ nm}</math>
- Feed force 22 N
- Lifetime >1,000,000,000 steps
- Versions with cable exit offset by 180°
- Nonmagnetic and vacuum-compatible operating principle

Preliminary Data	N-472.110; N-472.110Y / N-472.120; N-472.120Y	N-472.11V; N-472.11VY / N-472.12V; N-472.12VY	N-472.210; N-472.210Y / N-472.220; N-472.220Y	N-472.21V; N-472.21VY / N-472.22V; N-472.22VY	Unit
Active axis	X	X	X	X	
Mechanical interface	M10x1 mounting thread (N-472.110; N-472.110Y) 9.5 mm shank (N-472.120; N-472.120Y)	M10x1 mounting thread or 9.5 mm shank, vacuum-compatible to 10 ⁻⁶ hPa	M10x1 mounting thread (N-472.210; N-472.210Y) 9.5 mm shank (N-472.220; N-472.220Y)	M10x1 mounting thread or 9.5 mm shank, vacuum-compatible to 10 ⁻⁶ hPa	
Motion and positioning					
Travel range	7.5	7.5	13	13	mm
Integrated sensor	Incremental, optical	Incremental, optical	Incremental, optical	Incremental, optical	
Sensor signal	Analog, 1	Analog, 1	Analog, 1	Analog, 1	V _{pp}
Resolution	<1	<1	<1	<1	nm
Maximum velocity, open-loop	3.6	3.6	3.6	3.6	mm/min.
Recommended maximum velocity in continuous operation	2	2	2	2	mm/min.
Mechanical properties					
Holding force, de-energized	>100	>100	>100	>100	N
Feed force (active)	22	22	22	22	N
Drive properties					
Drive type	PIShift piezo inertia drive	PIShift piezo inertia drive	PIShift piezo inertia drive	PIShift piezo inertia drive	
Motor voltage	80	80	80	80	V _{pp}
Miscellaneous					
Operating temperature range	10 to 40	10 to 40	10 to 40	10 to 40	°C
Material	Screw: Stainless steel Case: Aluminum	Screw: Stainless steel Case: Aluminum	Screw: Stainless steel Case: Aluminum	Screw: Stainless steel Case: Aluminum	
Cable length	2	2	2	2	m
Connector	Actuator: Sub-D 15 (m)	Actuator: Sub-D 15 (m)	Actuator: Sub-D 15 (m)	Actuator: Sub-D 15 (m)	
Recommended controller / driver	E-871	E-871	E-871	E-871	



N-472.110, dimensions in mm,
Cable exit for N-472.XXXY versions offset by 180°



N-472.210, dimensions in mm,
Cable exit for N-472.XXXY versions offset by 180°



PiezoMike Linear Actuator

HIGH FORCES, STABLE POSITIONING, VACUUM-COMPATIBLE



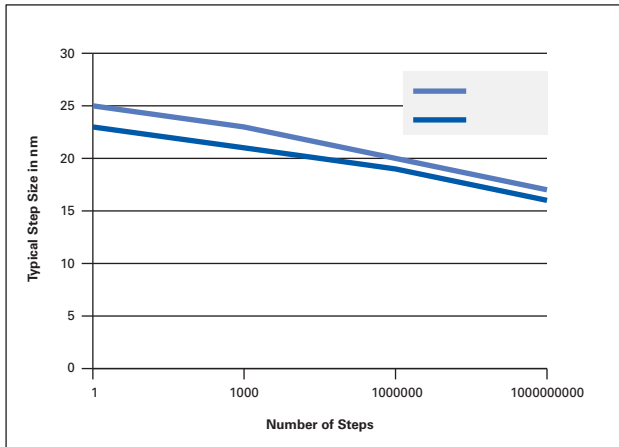
N-470.V/N-470.U

- Holding force >100 N
- Step size 20 nm
- Travel range 7.4 mm to 26 mm
- Compact design
- Feed force 22 N
- Lifetime >1.000.000.000 steps
- Mounting thread or shank
- Versions for 10^{-6} hPa and 10^{-9} hPa
- Versions with cable exit offset by 180°

	N-470.11V; N-470.11U/ N-470.12V; N-470.12U	N-470.21V; N-470.21U/ N-470.22V; N-470.22U	N-470.41V; N-470.41U/ N-470.42V; N-470.42U	Unit
Active axes	X M10 × 1 mm mounting thread (N-470.11V/.11U) 9.5 mm shank (N-470.12V/.12U)	X M10 × 1 mm mounting thread (N-470.21V/.21U) 9.5 mm shank (N-470.22V/.22U)	X M10 × 1 mm mounting thread (N-470.41V/.41U) 9.5 mm shank (N-470.42V/.42U)	
Vacuum Range	10^{-6} hPa (N-470.11V/.12V) 10^{-9} hPa (N-470.11U/.12U)	10^{-6} hPa (N-470.21V/.22V) 10^{-9} hPa (N-470.21U/.22U)	10^{-6} hPa (N-470.41V/.42V) 10^{-9} hPa (N-470.41U/.42U)	
Motion and positioning				
Travel range	7.5	13	26	mm
Max. step size	30	30	30	nm
Typical step size	20	20	20	nm
Max. step frequency	2000	2000	2000	Hz
Max. velocity in full-step mode	3	3	3	mm/minute
Typical velocity in full-step mode	2	2	2	mm/minute
Mechanical properties				
Stiffness in motion direction	15.5	15.5	15.5	N/ μ m
Feed force (active)	22	22	22	N
Holding force (passive)	>100	>100	>100	N
Permissible lateral force	1	1	1	N
Drive properties				
Drive type	PIShift piezomotor	PIShift piezomotor	PIShift piezomotor	
Max. operating voltage	80	80	80	V
Max. power consumption	6.4	6.4	6.4	W
Miscellaneous				
Operating temperature range	10 to 40	10 to 40	10 to 40	°C
Material	Screw: Stainless steel, Case: Aluminum	Screw: Stainless steel, Case: Aluminum	Screw: Stainless steel, Case: Aluminum	
Dimensions	14 mm × 28 mm × 48 mm	14 mm × 28 mm × 54 mm	14 mm × 28 mm × 68.5 mm	
Mass	80	85	95	g
Cable length / Connector	1 m in vacuum chamber, stranded wires; 2 m outside of vacuum chamber, stranded wires to Mini DIN 4-pin	1 m in vacuum chamber, stranded wires; 2 m outside of vacuum chamber, stranded wires to Mini DIN 4-pin	1 m in vacuum chamber, stranded wires; 2 m outside of vacuum chamber, stranded wires to Mini DIN 4-pin	
Recommended driver	E-870 PIShift drive electronics	E-870 PIShift drive electronics	E-870 PIShift drive electronics	

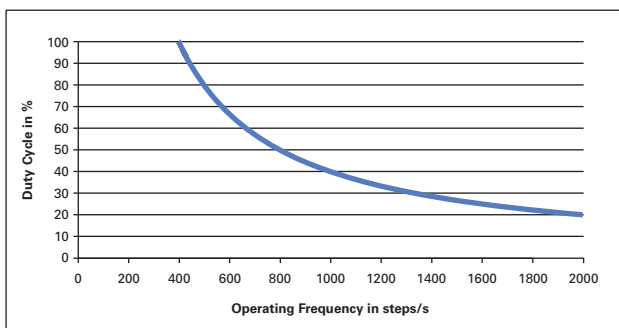
PiezoMike Precision Actuators: Operation and Lifetime

High Durability, Nanometer Resolution



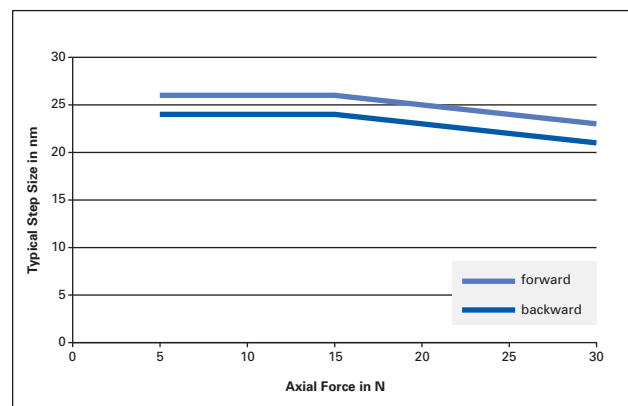
The step size of the PiezoMikes was measured during hundreds of millions of steps to determine the influence of wear. The following graph shows the step size in nanometers vs. the number of steps with and against an axial force of 22 N. Lifetime: The step size does not decrease below 70% of the initial step size (typically from 20 nm).

Frequency	Operation Time	Duty Cycle (max) / Waiting Time
2 kHz	60 (max. allowable)	20% / 4 minutes
2 kHz	10	20% / 40
1 kHz	110 (max. allowable)	40% / 165
1 kHz	10	40% / 15
400 Hz and slower	No limitation	No limitation



Recommendations for the duty cycle and operational frequency.

High frequency operation can create heat inside the piezoelectric actuator and the drive mechanics; the values are given for room temperature and standard air pressure of 1013 hPa.



The influence of the axial force on the typical step size is very low. Consequently the feed force is reliably high at velocities of typical 2 mm/minute.

