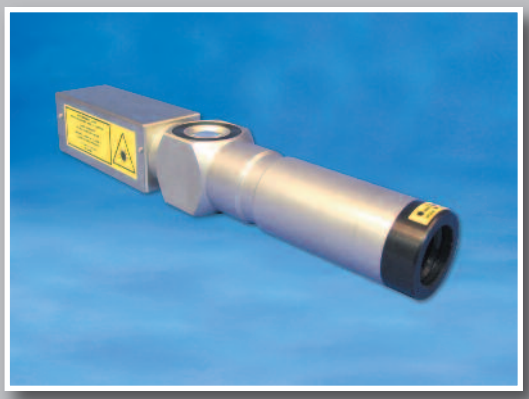
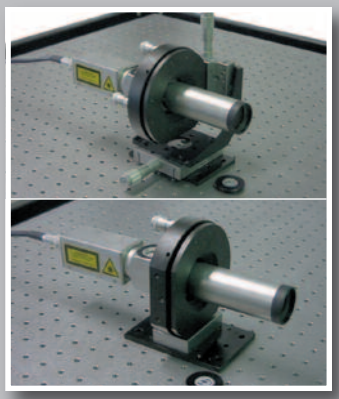
CONEX-LDS

Electronic Autocollimator for Metrology and Industrial Applications





For Motion, Think Newport™

Newport®
Experience | Solutions

Precision Measurement for Metrology and Industrial Applications

HIGH RESOLUTION AUTOCOLLIMATOR

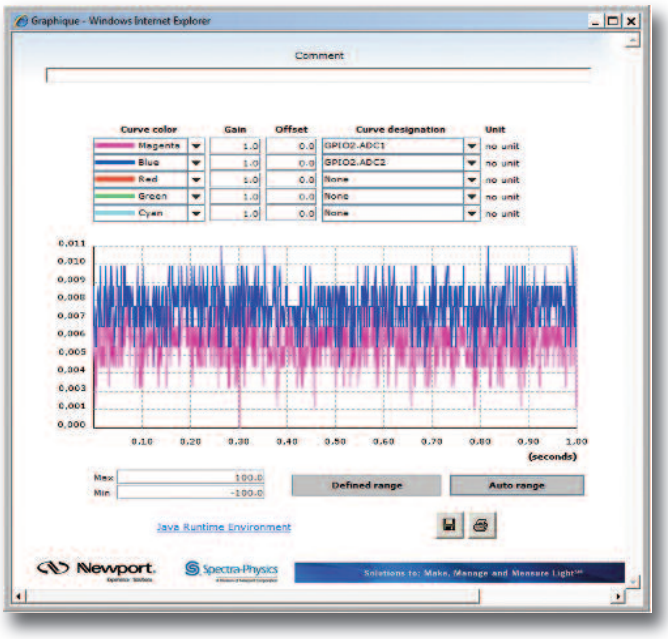
KEY FEATURES

- Compact and Portable Design
- 0.01 µrad Sensitivity
- Analog Outputs at 2 kHz Sampling Frequency Ideal for Vibration Measurements
- Easy Alignment with an Integrated, ±0.85° Field of View, Eyepiece and Mounting Accessories
- RS-422 interface for USB communication

The CONEX-LDS is a versatile electronic autocollimator traditionally used in non-contact alignment or measurement of angular variations. Using as much commercially available, but proven, optics and electronics technologies that simplified the design, the CONEX-LDS offers a high level of reliability for demanding metrology and industrial applications. With features like the integrated eyepiece and mounting accessories, the CONEX-LDS is easy to setup on site and on the production floor. The advantage of the CONEX-LDS is significant reduction in set-up time while still providing metrology-level features.

The light source is a visible red Laser diode, whose beam is perfectly collimated for use up to 5 m. The sensor is a dual axis analog silicon-based sensor chosen for its fast response time. With an RMS signal to noise ratio of 0.003 µrad/√Hz, the CONEX-LDS autocollimator is sensitive to even very small angular variations, enabling extremely accurate alignment procedures.

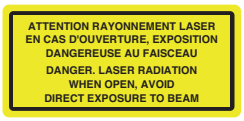
Sensor measurements are made at 5 kHz, which can be filtered (2nd order low pass filter) between 1 to 2000 Hz, for noise reduction.



The embedded controller supports RS-422 communication and can be connected to a computer through USB using the CONEX-USB-RS422 converter.

Analog outputs are included, with programmable gains and the instrument can be connected to a data logger, like the XPS Universal Motion controller which has data gathering capability.

DETAILS AND SPECIFICATIONS



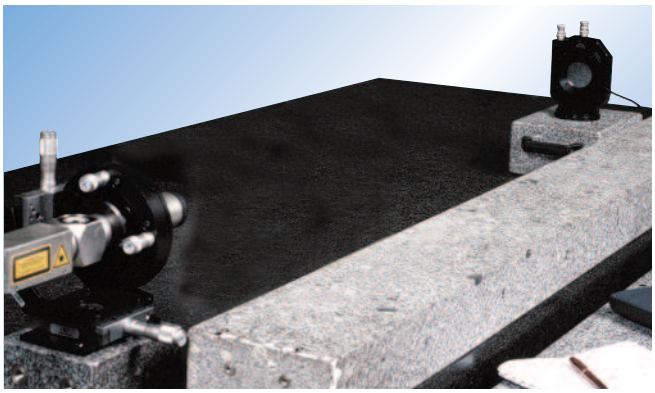
Complies with CFR 21 Subchapter J

RoHS Compliant CE

Sensitivity (µrad)	0.01
Accuracy (µrad)	±5 ±(0.02 x measurement) (±5 µrad around 0: [-250 µrad; +250 µrad]) (i.e. 2%)
Beam Diameter (mm)	22.5
Beam Divergence (µrad)	100
Beam Direction (µrad)	500
Equivalent Focal Length (mm)	250
Measuring Range (m)	5
Measurement Field (µrad)	±2000
Ocular Field - Eyepiece (mrad) ±15	(±0.85°)
Min. Reflectivity	2% reflectivity
Noise RMS (µrad/√Hz)	0.003 (at 100% reflectivity)
Weight (kg)	1.1
Communication Interface	RS-422 accessible through a USB to RS-422 converter or Ethernet to RS-422 converter (available soon)
Protocol	ASCII
16-Bit Analog Outputs	±5 V; adjustable filter and gain
Data Acquisition Frequency (Hz)	2000
2nd Order Low Pass Frequency	Adjustable from 1 to 2000 Hz
Source	Visible laser diode modulated at 5 kHz; circular polarized
Wavelength (nm)	670
Peak Power (mW)	<1 (Class II)
Operating Temperature Range (°C)	+15 to +25
Storage Temperature Range (°C)	-10 to +50
Power Supply	90/264 V, 50/60 Hz, 30 VA

Applications

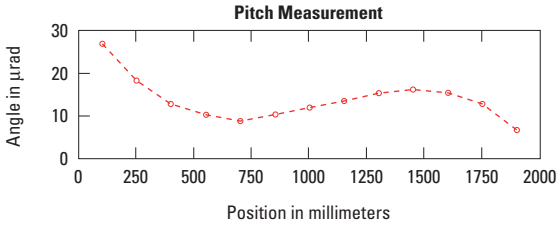
SURFACE FLATNESS

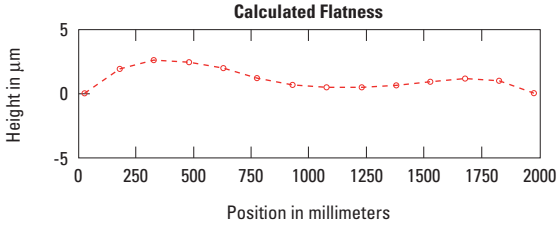


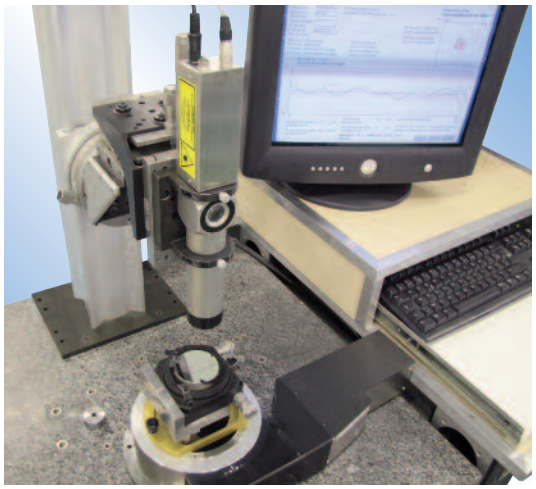
This is a classical application for autocollimators. To obtain flatness measurements, the autocollimator beam is reflected off a mirror. By indexing the mirror along the beam path at known distances, linear position vs. the pitch angle is obtained and is used to determine vertical displacement.

Flatness Measurement

- *Reflector*: Mirror on a 150 mm granite stand
- *Filter setting*: 1 Hz
- *Acquisition*: point to point



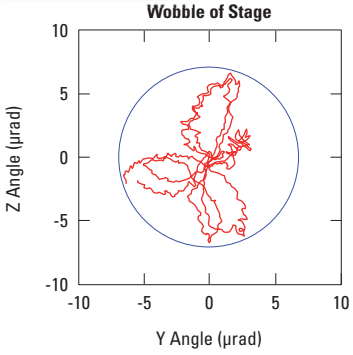




BEARING WOBBLE OR ECCENTRICITY MEASUREMENT

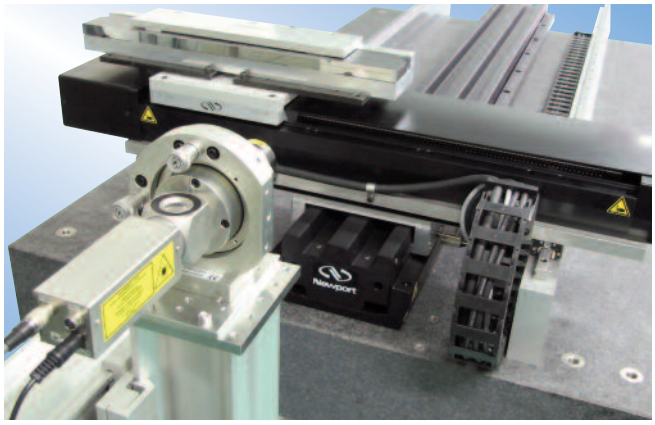
Wobble Measurement

- *Reflector*: λ/10 *flat mirror*
- *Filter setting*: 10 Hz
- *Dynamic acquisition at* 10 Hz *for* 2 *turns of the stage*



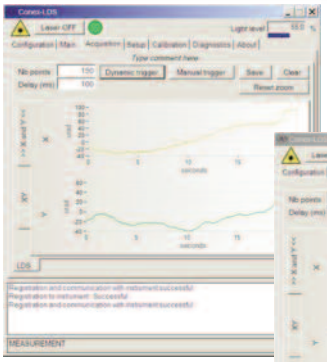
In manufacturing environments or metrology applications that utilize dividing heads or rotation stages with mechanical or air bearings, the CONEX-LDS is a very useful tool to verify the wobble of the bearings. In the manufacture of ball, thrust or air bearings, particularly those with large diameters, in-process or final verification of wobble specifications can be accomplished with the CONEX-LDS. In both cases, a simple mirror mounted perpendicular to the rotation axis with the CONEX-LDS beam coincident to it, will provide high precision measurements of wobble that will characterize the condition of the bearing. The results could indicate the need for maintenance, repair or rework. The graph on the right illustrates a typical result of a wobble test of a bearing. Using the same CONEX-LDS setup, but with a precision ball fixture rather than a mirror, it is possible to determine the axial eccentricity of a bearing.

PITCH AND YAW OR YAW AND ROLL MEASUREMENT



Pitch and Yaw Measurement

- *Reflector*: λ/4 *flat mirror*
- *Filter setting*: 10 Hz
- *Dynamic acquisition at* 10 Hz *while the stage is moving at* 10 *mm/s*

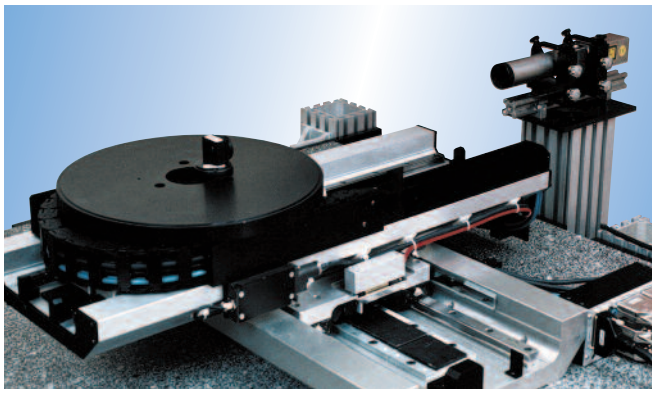


◀ *Upper axis yaw and roll measurement.*

Lower axis pitch and yaw measurement. ▶

Pitch and Yaw deviations during motion increase positioning errors due to the Abbe effect, especially at a longer distance between the sample and the feedback encoder. With the CONEX-LDS autocollimator, this type of error can be accurately identified and used to calculate true position. Pitch and yaw can be measured concurrently using a simple flat mirror. In addition, these angular measurements can be used to derive the flatness and straightness deviations of the linear bearing.

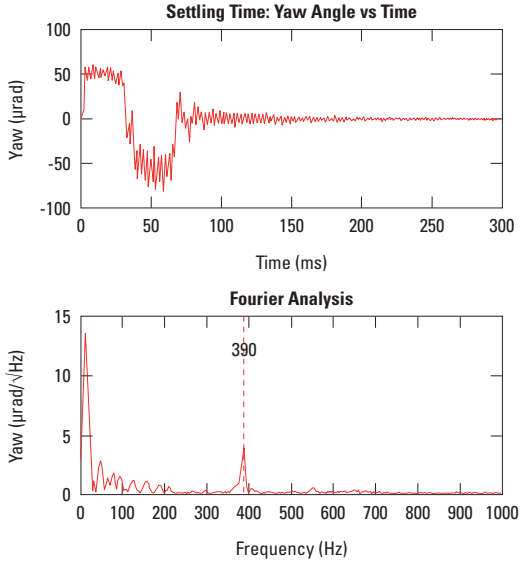
SETTLING TIME AND STAGE DAMPING



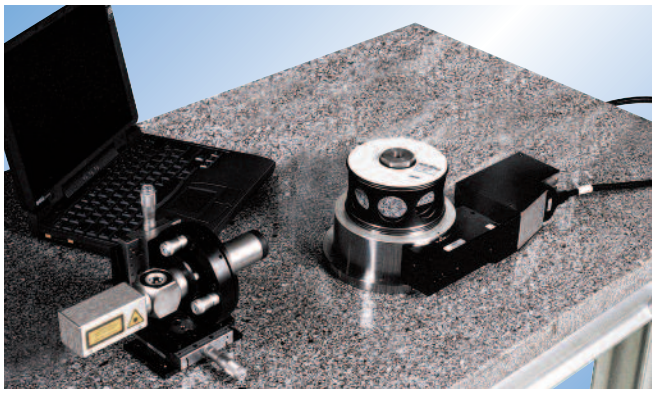
The time required for settling into a position is an important parameter in high-accuracy, high-throughput applications like semiconductor inspection. Fast settling times result in processes to be performed very quickly, thus increasing productivity. In this case the CONEX-LDS autocollimator is used to measure the angular displacement at all stage positions, according to the control parameters. The dynamic measurements reflect the stage performance at the given situation. Using Fourier analysis of the same data enables understanding of the stage's resonances.

Measurement During Displacement

- *Reflector*: λ/4 *flat mirror*
- *Filter setting*: 2000 Hz
- *Dynamic acquisition at* 2000 Hz *during displacement*



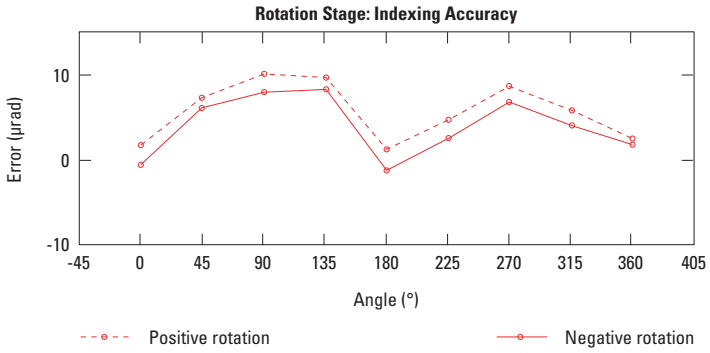
ROTATION STAGE ACCURACY



Rotation stage accuracy can be measured using a precisely calibrated multifaceted mirror. The CONEX-LDS autocollimator measures the angular difference between the stage rotation and index of the calibrated standard. Absolute accuracy is measured directly, taking the index error and hysteresis into account. The measurement accuracy is better than 1 µrad.

Indexation Measurement

- *Reflector*: 8-*facet mirror*
- *Filter setting*: 1 Hz
- *Acquisition*: *point to point*

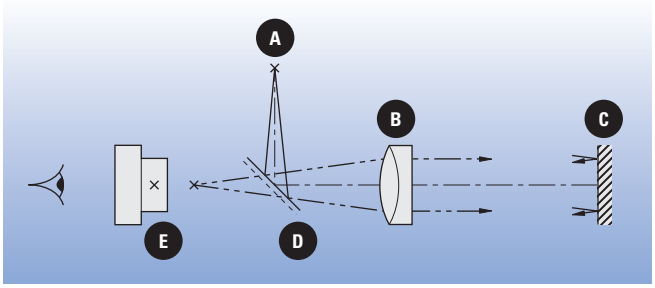


Principle of Operation

AUTOCOLLIMATION PRINCIPLES

A standard autocollimator uses a back illuminated cross light reticle A, located behind the focal plane of a collimating lens **B**.

The resulting image is projected to infinity and reflected back to the instrument from a plane reflecting mirror **C**.



The reflected image is focused on the back of the focal plane of the collimating lens (beamsplitter **D**). Most instruments use a measuring eyepiece **E** with a dark cross reticle to observe this autocollimated image.

If the reflected image becomes coincident with the incident beam, that the mirror is in autocollimating position.

For each angular movement of mirror **C**, a lateral displacement of the image is reflected on the back of the focal plane of the collimating lens.

If the value of the focal length of the collimating lens is "F", then the lateral displacement will be:

$$\Delta Y = F \times \tan(2\Delta\theta)$$

where $\Delta\theta$ is the angular displacement of the mirror.

This displacement can be measured by using the measuring eyepiece.

Autocollimation is a common method to check and align optical elements, such as laser cavities, Fabry-Perot, and is used in optical workshops to measure prism characteristics and angular deviations.

All these operations are typically done manually.

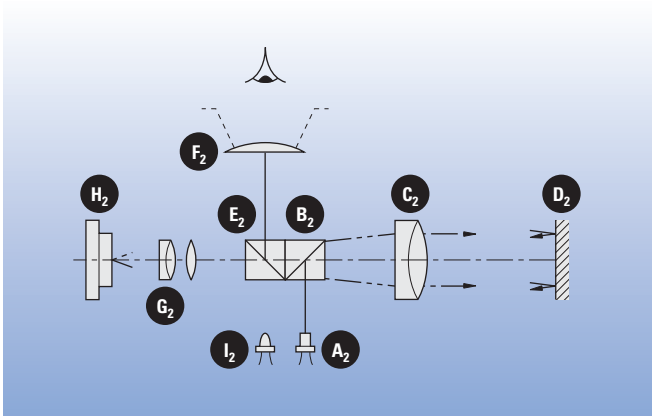
ELECTRONIC AUTOCOLLIMATOR

The advantage of the electronic autocollimator is the automation of angular measurements.

In the CONEX-LDS autocollimator, the basic principles are the same, but use different components:

- The source reticle is a Laser diode (1 mW; l = 670 nm).
- The measuring eyepiece is a position sensing device.

This position sensing device sends analog signals that are proportional to the position Vx and Vy of the reflected beam and are used to calculate the angular deviations $\Delta\theta x$ and $\Delta\theta y$.

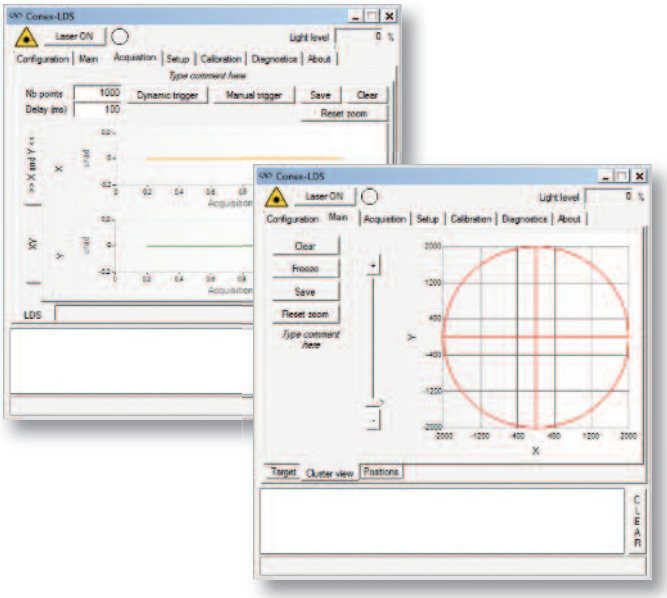


A2 Laser diode module
B2 Beamsplitter I
C2 Collimating lens
D2 Mirror
E2 Beamsplitter II
F2 Alignment eyepiece
G2 Magnifier
H2 Position sensing device
I2 Lighting LED (red)

A portion of the light from the diode is used for visual alignment, while a circle indicates the zone to start data recording.

Angular readings can be displayed using the supplied applet via USB. Alternatively, angular data can be obtained with a data logger. Note that the XPS Universal Motion Controller can be used to gather and store analog data.

Advantages



HIGH RESOLUTION

With an outstanding signal to noise ratio, the CONEX-LDS autocollimator is sensitive to extremely small angular variations, such as the angle produced by a 0.1 µm dust particle located beneath the end of a 1 m long bench.

FAST ACQUISITION

The CONEX-LDS autocollimator is equipped with an analog sensor which has been chosen for its fast response time. The architecture allows a sampling frequency of 2000 Hz. The advantage is not only the possibility of observing very rapid events, but also the ability to perform the maximum amount of acquisitions in a given period of time, less affected by noise.

The CONEX-LDS applet has an acquisition feature that is dedicated to Newport's XPS Motion Controller. A 3rd party logger can also be connected to the analog outputs.

SIMPLE TO SET-UP, EASY TO USE

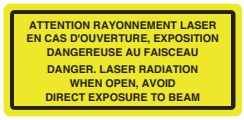
The intelligent design of the CONEX-LDS allows users to quickly set-up and obtain precise measurements. Alignment is easily performed by positioning the reflected visible beam in the integrated eyepiece of the CONEX-LDS. Precise measurements can be read immediately from the dedicated NStruct Applet or analog outputs. Compared to interferometers, the position sensing device provides absolute values, which are not lost if the beam is blocked during the measurement.

WITHIN EVERYONE'S REACH

You do not need to be an expert in instrumentation to obtain accurate measurements with the CONEX-LDS autocollimator, nor do you need to spend a fortune. Most operators can quickly learn how to use the CONEX-LDS to perform extremely accurate alignment operations, or simply to check the quality or movement of a structure, without wasting time and money.

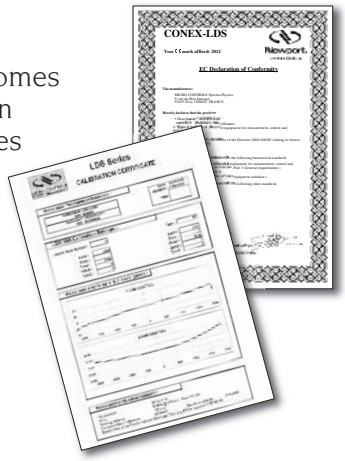
LASER SAFETY

The CONEX-LDS autocollimator is a Class II device, producing a laser emission that is less than 1 mW at a wavelength of 670 nm. This means that safety goggles are not required when using this instrument.



CALIBRATION & CE MARKING

Each autocollimator is individually tested and comes with a detailed calibration certificate. It also complies with applicable European directives and is delivered with a CE Certificate of Conformity.



Models & Accessories

ORDERING REFERENCES

Model	Description
CONEX-LDS	Electronic Autocollimator
CONEX-LDS-VER[1]	Verification Kit
CONEX-LDS-USB-422	USB/RS-422 Adapter
CONEX-LDS-CABLE20	20 m Cable
CONEX-LDS-PS	Power Supply

[1] The verification kit is a stand alone kit which includes a calibrated optical wedge fitted into a mechanical mount and all associated clamps and rod. The slide is delivered with a calibration certificate which provides the value of the angle of deviation which it produces on the autocollimator's beam. This kit allows user to verify that the CONEX-LDS is still within its calibration limits set in the factory. The applet will guide you through the verification process.

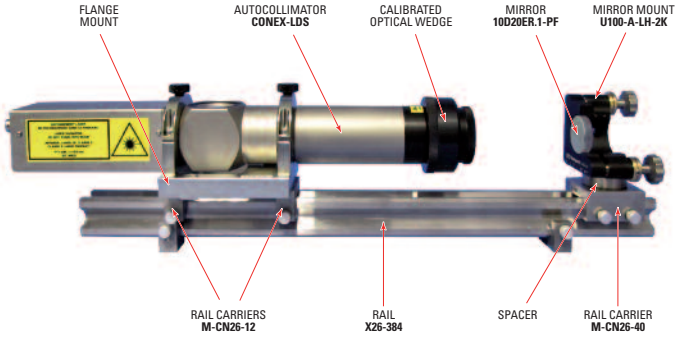
To achieve optimum, performance, use high quality Newport optics with the CONEX-LDS.

For metrology applications, we recommend using 50.8 mm (2") λ/10 mirrors. The SL51BD mirror mount provides the stability and adjustment sensitivity required for precise measurements.

For other high quality optics, optical mounts and assembly hardware visit www.newport.com

VERIFICATION KIT

The CONEX-LDS-VER verification kit includes a calibrated optical wedge fitted into a mechanical mount and all associated clamps and rods. The slide is delivered with a calibration certificate which provides the value of the angle of deviation which it produces on the autocollimator's beam.

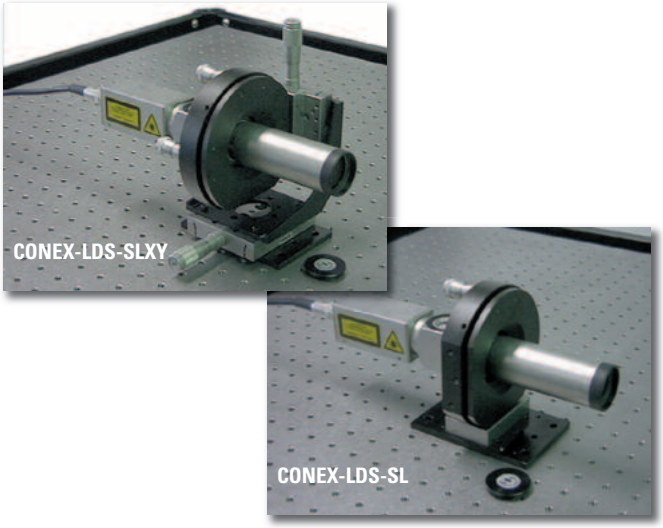


This kit enables the user to periodically verify the calibration verification of the CONEX-LDS autocollimator.

The measurement is performed in the middle of the range with a 0.5% level of uncertainty.

SET-UP

Various mounts are available to facilitate setting up the CONEX-LDS autocollimator. With two angular and two linear axes, the CONEX-LDS-SLXY is the most flexible mount. The CONEX-LDS-SL mount provides only two angular adjustments.

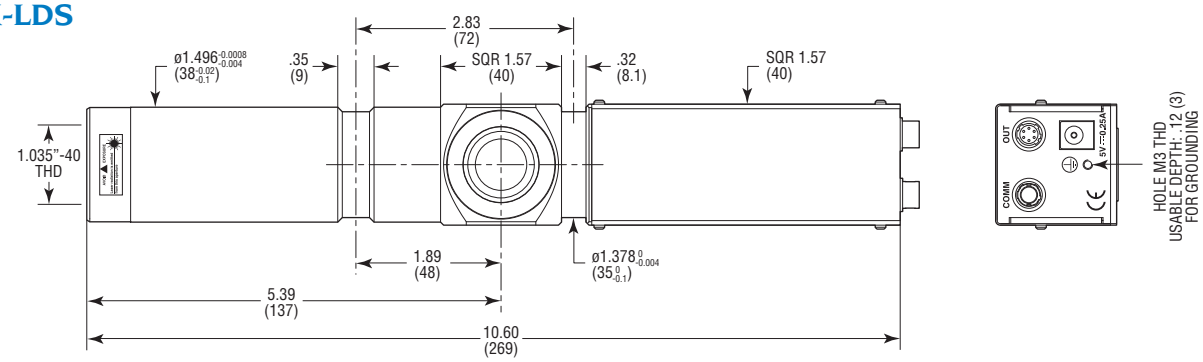


ORDERING REFERENCES

Model	Description	Axis Height (mm)	Angular Range (°)	Centering Travel (mm)
CONEX-LDS-SLXY	Precision Adjustable Four Axis Mount, XYθxqy	100	±2	±12.5
CONEX-LDS-SL	Precision Adjustable Two Axis Mount, θxθy	75	±2	–

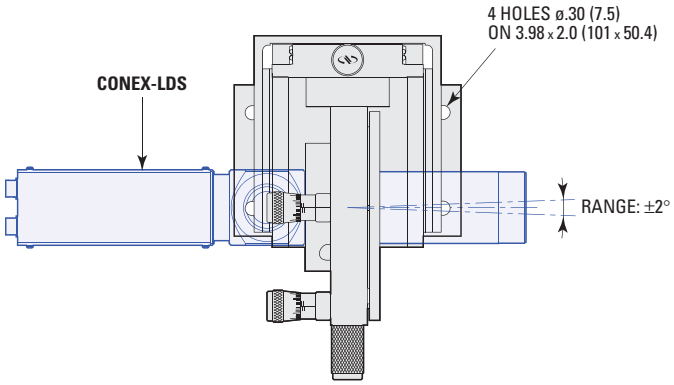
Dimensions

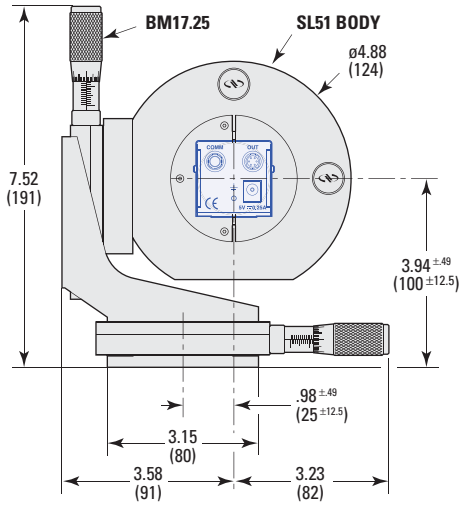
CONEX-LDS

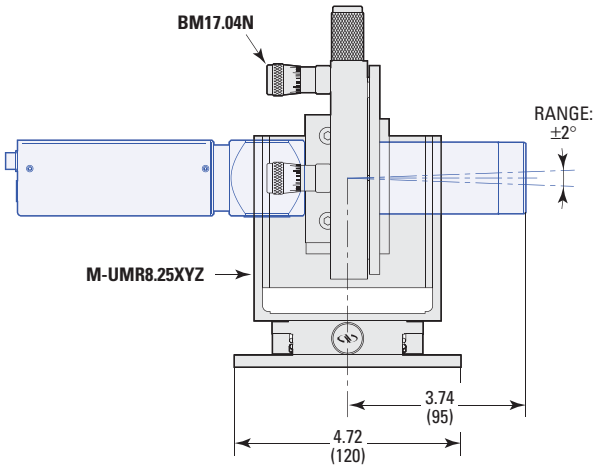


CONEX-LDS-SLXY

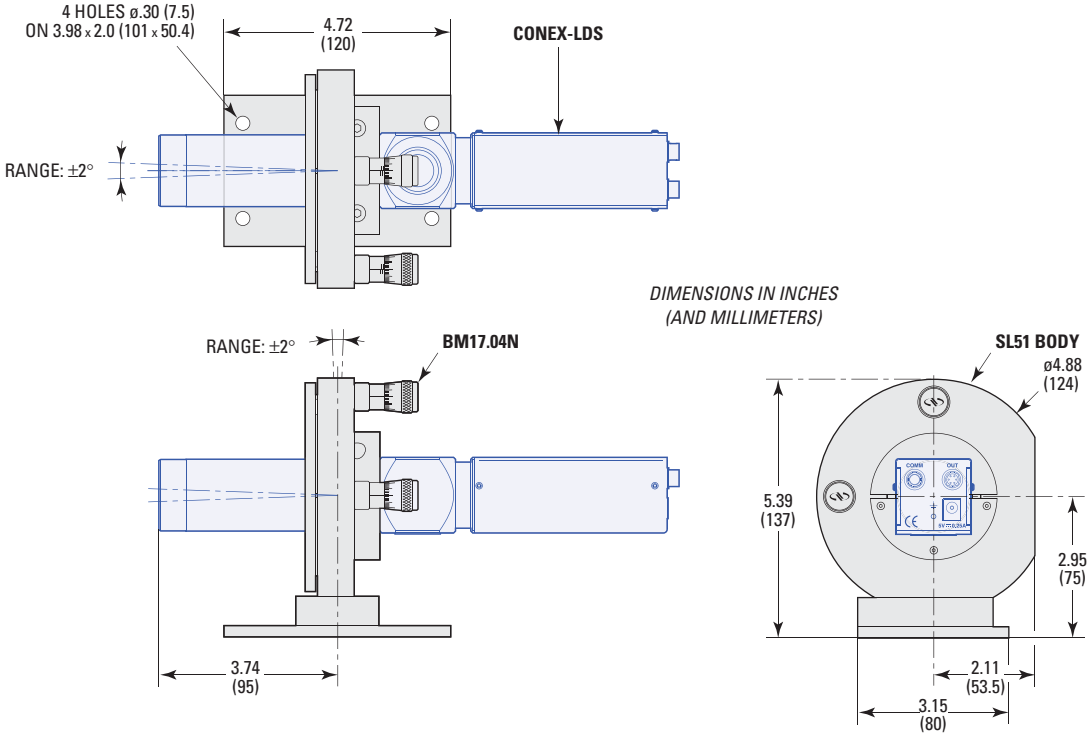
DIMENSIONS IN INCHES
(AND MILLIMETERS)





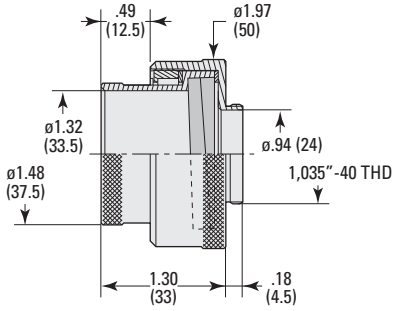


CONEX-LDS-SL



CONEX-LDS-VER

(Optical Wedge Shown)



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