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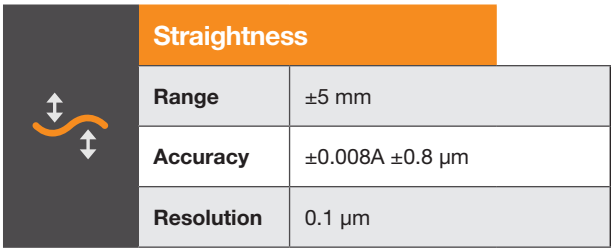
XK20 alignment laser measurement specifications explained

Introduction

In the examples that follow, we explain the factors that contribute to the published measurement specifications when using Renishaw's XK20 alignment laser system. A range of errors, including scale and residual, influence each measurement specification.

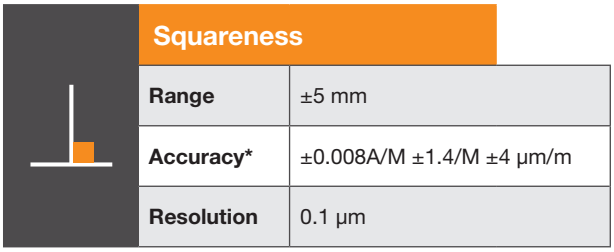
Measurement specification explained



Straightness	
Range	±5 mm
Accuracy	±0.008A ±0.8 µm
Resolution	0.1 µm

A = displayed straightness reading (µm)

- ±0.008A µm is the scale error of the position sensitive detector (PSD) in the M unit, where A is the displayed straightness reading.
- ±0.8 µm is the residual error associated with the PSD in the M unit, as well as the straightness of the beam emitted from the launch unit.

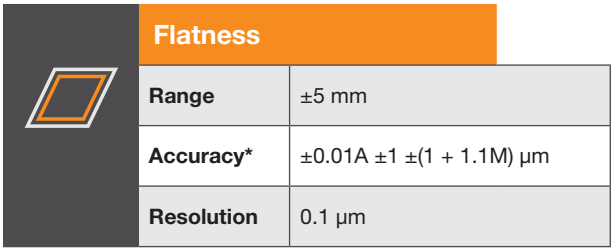


Squareness	
Range	±5 mm
Accuracy*	±0.008A/M ±1.4/M ±4 µm/m
Resolution	0.1 µm

* with squareness calibration factor

A = straightness reading of the furthest point (µm)
M = length of the (shortest) axis (m)

- ±0.008A/M µm/m is the scale error of the PSD in the M unit, where A is the displayed straightness reading, and the 1/M factor denotes that the uncertainty will decrease as the length of the (shortest) axis (M) increases.
- ±1.4/M µm/m is the residual error associated with the straightness of the beam emitted from the launch unit, where the 1/M factor denotes that the uncertainty will decrease as the length of the (shortest) axis (M) increases.
- ±4 µm/m is the residual error associated with the squareness of the pentaprism within the launch unit.



Flatness	
Range	±5 mm
Accuracy*	±0.01A ±1 ±(1 + 1.1M) µm
Resolution	0.1 µm

*over a 90° sweep

A = displayed straightness reading (µm)
M = distance to the furthest point (m)

- ±0.01A µm is the scale error of the PSD in the M unit, where A is the displayed straightness reading.
- ±1µm is the residual error associated with the PSD in the M unit, as well as the straightness of the beam emitted from the launch unit.
- ±(1 + 1.1M) µm is the laser plane flatness of the beam emitted from the launch unit, across a 90° sector.

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Parallelism	
Range	±5 mm
Accuracy (i)	±0.008A/M ±1.4/M ±2 µm/m*
Accuracy (ii)	±0.008A ±1.4 ±2M µm*
Resolution	0.1 µm

* laser to pentaprism distance >0.2 m

A = (largest) straightness reading (µm)
M = length of the axis (m)

(i) parallel angle
(ii) parallel straightness (point to point variation)

Parallelism angle

- ±0.008A/M µm/m is the scale error of the PSD in the M unit, where A is the displayed straightness reading, and the 1/M factor denotes that the uncertainty will decrease as the length of the axis (M) increases.
- ±1.4/M µm/m is the residual error associated with the straightness of the beam emitted from the launch unit, where the 1/M factor denotes that the uncertainty will decrease as the length of the axis increases.
- ±2 µm/m is the residual error associated with the alignment of the launch beam to the pentaprism.

Parallelism straightness

- ±0.008A µm is the scale error of the PSD in the M unit, where A is the displayed straightness reading.
- ±1.4 µm is the residual error associated with the straightness of the beam emitted from the launch unit.
- ±2M µm is the residual error associated with the alignment of the laser beam to the pentaprism, where M is the length of the axis.

Example of different measurement specifications

The straightness specification when measuring a deviation of A=10 µm:

±0.008*10 µm ±0.8 µm = ±0.80 µm

The parallelism angle specification between rails when measuring a deviation of A = 3 µm along a distance of M = 3 m, when pentaprism – launch separation is ≥0.2 m:

±0.008*(3 µm/3 m) ±1.4/3 m ±2 µm/m = ±2.05 µm/m

The squareness specification between rails when measuring a deviation of A = 8 µm deviation along a distance of M = 3 m:

±0.008*(8 µm/3 m) ±1.4/3 m ±4 µm/m = ±4.03 µm/m

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