Product XL-80 laser
Serial number 10R887
Date of calibration 3rd March 2021



Calibration certificate

Specification

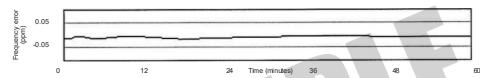
Vacuum wavelength

 $0.6329905770~\mu m~\pm 0.05~ppm$

Equivalent frequency

473612829.2 MHz

Measured values and uncertainties of calibration



Value (MHz) Results Value (ppm) Laser frequency: 473612824.9 -0 009 Laser frequency error: -4.3Stability (peak-to-peak): 5.1 0.011 Maximum laser frequency error: -6.9 -0.015 +5.9 ±0.01 Uncertainty of measurement (k=2):

Reference standards	Ref. no.	Lab	Certificate no.	Calibration date
Iodine stabilised HeNe laser	RUK27030	NPL	2017050069-LL03	24 th May 2017
Frequency counter	RUK25619	UKAS0152	U308558	20 th April 2020
Reference HeNe laser	XL-80 REF16	Renishaw	86H571-210223-00	23 rd February 2021
Test procedure	WI-10723			_

Laser measurement system accuracy: Based on this calibration, when this XL-80 is used with a Renishaw XC-80 and a Renishaw air temperature sensor (both within specification) the laser measurement system accuracy (k=2) in linear measurement mode will be within: ±0.5 ppm (see the system manual for details).

Authorised signature	Signatory	Position	Issue date
CM Hunt	Chris Hunt	General Manager	3 rd March 2021

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Renishaw plc

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L-9908-0888/04

Certificate number

10R887-210303-00

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Calibration notes

- Lasers (XM, XL, ML, HS and RLU) are calibrated by comparison to a reference HeNe laser using an
 optical beat frequency technique. Reference lasers are routinely calibrated against an iodine-stabilised
 HeNe laser supplied by the National Physical Laboratory (NPL), or by a national standards laboratory. All
 frequency measurements are taken over a 1 hour period.
- 2. Air pressure and relative humidity (RH) sensors are installed in a compensator (XC and RCU). The air pressure sensors are calibrated over 650 mbar to 1150 mbar range in a temperature controlled oven by direct comparison with a reference pressure meter. The RH sensors (where fitted) are certified by the manufacturer to be within specification. They are calibrated by comparison of the readings with those from a reference RH meter at a single applied humidity.
- Air and material temperature sensors (XC and RCU) are calibrated by direct comparison with transfer platinum resistance thermometers (PRTs) in a temperature controlled water bath over 0 °C to 40 °C (50 °C for material sensor). The transfer PRTs are routinely calibrated against reference PRTs.
- 4. Rotary axis calibrators (XR20) are calibrated using a HeNe laser angular interferometer.
- Ballbar transducers (QC20-W and QC10) are calibrated using a HeNe laser interferometer. The scale factor (QC10 only) is calculated and must be entered into the Renishaw application software prior to use.
- 6. Ballbar calibrators are calibrated by direct comparison with a reference ballbar calibrator (calibrated by a national standards laboratory) using a reference ballbar as a transfer standard. The measured values for the ballbar calibrator must be entered into the Renishaw application software prior to use.
- 7. Traceability. All the reference standards (listed overleaf) used in these calibrations are traceable either directly to major international metrology institutes who have signed the CIPM Mutual Recognition Agreement (e.g. NPL: UK; LNE: France; NIST: USA; PTB: Germany; NMIJ: Japan) or to a national accreditation body (e.g. UKAS: UK; A2LA: USA).
- 8. Environment. The equipment used for calibration is in a facility held between 15 °C and 25 °C.
- Uncertainty calculations. The uncertainty calculations have been carried out according to the European Co-operation for Accreditation document EA-4/02.
- Quality accreditation. All calibrations above are covered by Renishaw's ISO 9001 quality assurance system. The system is audited and certified by an accredited agency.
- 11. Re-calibration. Customers may wish to confirm that systems are performing within published specifications over time. If so, it is recommended that they should be periodically re-calibrated. Please note that compensators and temperature sensors are re-calibrated only at a single applied temperature, air pressure and humidity. Please refer to the appropriate system manual for further details.