

Product **XL-80 laser**  
Serial number **6EU676**  
Date of calibration **29th Aug 2024**

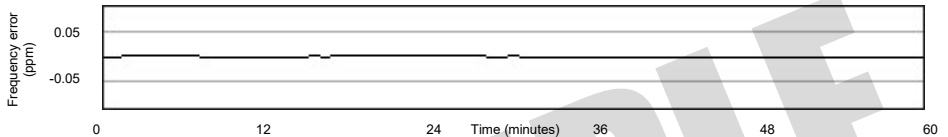
**RENISHAW**  
apply innovation™



# Calibration certificate

**Specification**      *Vacuum wavelength*      0.6329900000  $\mu\text{m}$   $\pm 0.05$  ppm  
*Equivalent frequency*      473613260.9 MHz

## Measured values and uncertainties of calibration



| Results                           | Value (MHz) | Value (ppm) |
|-----------------------------------|-------------|-------------|
| Laser frequency:                  | 473613261.9 | -           |
| Laser frequency error:            | 1.0         | 0.002       |
| Stability (peak-to-peak):         | 3.5         | 0.007       |
| Maximum laser frequency error:    | 2.7         | 0.006       |
| Uncertainty of measurement (k=2): | $\pm 5.9$   | $\pm 0.01$  |

| Reference standards          | Ref. no.    | Lab      | Certificate no.  | Calibration date |
|------------------------------|-------------|----------|------------------|------------------|
| Iodine stabilised HeNe laser | RUK27030    | NPL      | 2022080011-LL03  | 11th Aug 2022    |
| Frequency counter            | MTE/A164    | UKAS0152 | U388625          | 19th Mar 2024    |
| Reference HeNe laser         | XL-80 REF12 | Renishaw | 86H137-240809-00 | 9th Aug 2024     |
| Test procedure               | WI-10723    |          |                  |                  |

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

| Authorised signature | Signatory | Position                   | Issue date    |
|----------------------|-----------|----------------------------|---------------|
|                      | Dave Wall | Director & General Manager | 30th Aug 2024 |

**This certificate may not be reproduced other than in full, except with the prior written approval of:**

**Renishaw plc**  
Laser & Calibration Products Division  
Bath Road, Woodchester  
Stroud  
Gloucestershire  
GL5 5EY  
United Kingdom  
Tel +44 (0) 1453 524524

**Certificate number**  
**6EU676-240829-00**

L-9908-0888/04

# Calibration notes

- 1. 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.
- 3. 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.
- 5. Ballbar transducers (QC20 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.
- 9. Uncertainty calculations.** The uncertainty calculations have been carried out according to the European Co-operation for Accreditation document EA-4/02.
- 10. 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.