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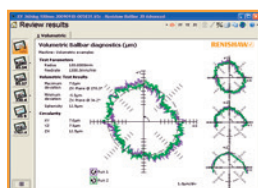
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QC20-W wireless ballbar system description and specifications



Hardware



Software



QC20-W ballbar and ballbar kit

QC20-W ballbar



The QC20-W ballbar contains a precision linear transducer of Renishaw's own design (patent applied for). It is used to measure variations in radius as the ballbar is rotated around a fixed point. This data is used to calculate overall measures of contouring performance (circularity, circular deviation) of CNC machine tools, in accordance with international standards such as ISO 230-4, ASME B5.54/57 and GB17421.4. System software also provides a detailed diagnosis of contributing individual error sources when analysed using Renishaw's unique diagnostic report format. Data is displayed graphically as well as in numeric format to support diagnosis.

Signal processing is carried out within the ballbar and data transmitted to a suitable PC using a Bluetooth® Class 2 module. A standard (non rechargeable) CR2 lithium battery is supplied with each unit. An LED status indicator built into the housing shows battery, communications and fault status.

Ballbar calibrator

A ballbar calibrator is supplied with all QC20-W kits and is used to calibrate the length of a ballbar. It is manufactured from a material which has a temperature expansion coefficient of almost zero.



When used with the calibrator, the QC20-W ballbar calculates absolute (rather than relative) errors for axis scaling and radial deviation values as required for ISO 230-4 and ASME B5.54/57 analyses.

In addition the ballbar software will automatically calculate a positional tolerance for the tested machine. (The positional tolerance value is an estimate of the planar, bi-directional positioning accuracy of the machine, within the area enclosed by the ballbar test, and under unloaded conditions.)

The calibrator can calibrate 100, 150 and 300 mm lengths. The small circle kit contains a 50 mm calibrator.

QC20-W ballbar kit

Kit contents

- QC20-W wireless ballbar (and one CR2 battery)
- Centre pivot
- Tool cup
- 50, 150 and 300 mm extension bars
- Ballbar calibrator
- Offset setting ball
- System software (including manuals)
- 'Getting started with QC20-W ballbar' DVD
- Machine validation cards
- Calibration certificates
- System carry case (the case includes cut-outs for the optional small circle and VTL adaptors)



Testing capability

The standard QC20-W ballbar kit includes a 100 mm long ballbar assembly and 50, 150 and 300 mm long extension bars. By assembling the ballbar with different combinations of extension bars it is possible to carry out ballbar tests with 100, 150, 250, 300, 400, 450, 550 or 600 mm radii. With additional extensions it is possible to perform tests up to 1350 mm.

The optional small circle kit allows tests with a 50 mm radius and testing can also be carried out on two-axis machines and lathes using optional accessories (page 6).

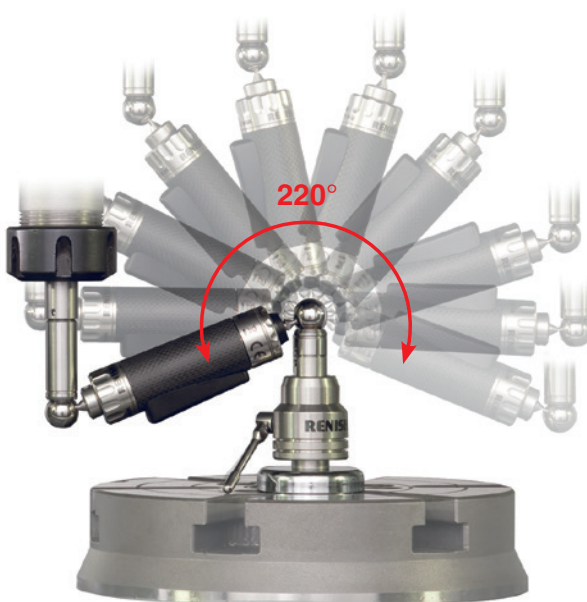
Partial arc testing

Redesigned ball mounts (including new centre pivot and tool cup extension) allow the QC20-W to carry out a 220° arc test in planes through the centre pivot axis. This means that you can carry out ballbar tests in three orthogonal planes without the need to reposition the centre pivot, so speeding up testing.



The results can also be used in the new “volumetric analysis” report function (see software section) with the assurance that all data has been gathered around the same reference point.

Partial arc testing also means simpler Z axis testing (no custom fixturing is required) and a reduced axis travel requirement, e.g. 100 mm less Z axis travel on a 150 mm radius test.



Partial arc tests of 100 mm and 150 mm radius can be carried out using the supplied centre pivot.



Certificates and recalibration

All QC20-W ballbars are delivered with a detailed calibration certificate; your guarantee of accuracy. This also gives full traceability details in accordance with ISO 17025 requirements. Machine shops can be an aggressive environment and accidents that affect the ballbar's performance can happen.

Periodic recalibration (typically 12 months) is therefore recommended to give you confidence that the ballbar is still measuring within specification (see website for further details). Renishaw's QC20-W calibration service includes inspection and testing of your ballbar, replacement of tool cups and balls, comparison against a laser reference standard, computation of a new scale factor, and issue of a certificate of accuracy and traceability.

System specification

Sensor resolution	0.1 μm	4 μin
Ballbar measurement accuracy*	$\pm (0.7 + 0.3\% L) \mu\text{m}$	$\pm (27.6 + 0.3\% L) \mu\text{in}$
Ballbar measuring range	$\pm 1.0 \text{ mm}$	$\pm 0.04 \text{ in}$
Sensor stroke	-1.25 mm to +1.75 mm	-0.05 in to +0.07 in
Maximum sample rate	1000 Hz	1000 Hz
Data transmission Bluetooth, Class 2	10 m typical	33 ft typical
Operating range	0 °C - 40 °C	32 °F - 104 °F
System case dimensions	395 x 300 x 105 mm	15.5 x 11.8 x 4.1 in
System case weight incl. kit contents	3.75 kg (approx)	8 lb 4 oz (approx)

* Also referred to as 'radial measurement variation'
Valid 15 °C - 25 °C (59 °F - 77 °F)

L = length over which error is measured
Specification if measuring 10 μm error on machine $\pm 0.73 \mu\text{m}$
Specification if measuring 100 μm error on machine $\pm 1.00 \mu\text{m}$

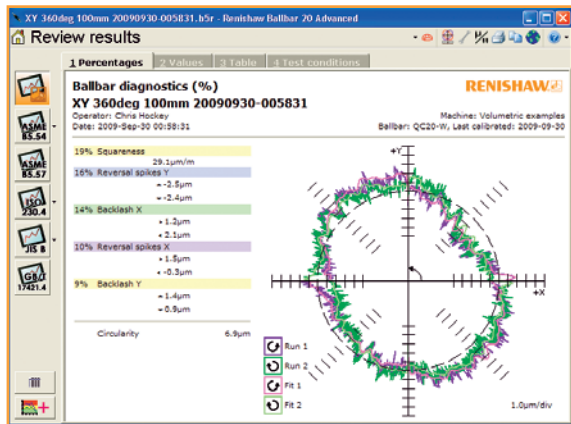
Measurement and diagnosis software

Ballbar 20 software

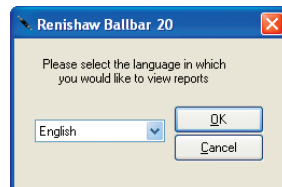
Just like the QC20-W ballbar, Ballbar 20 software is powerful and easy to use. The intuitive interface and step-by-step instructions mean you can be using the system in minutes.

Key features are:

- Easy to use interface (Windows XP, Windows Vista®, Windows 7 compatible)
- Live data capture
- Analysis and display of test data to all main standards
- Positional tolerance value calculation
- Comprehensive, integrated help manual
- Multilingual support*
- Powerful file and template administration utilities



Integrated manual

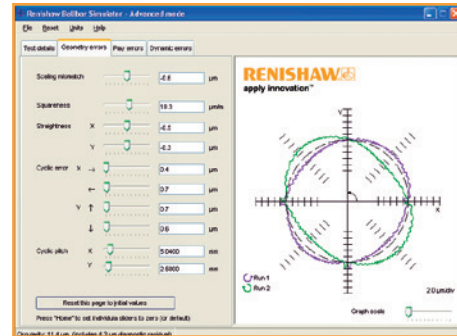


Multilingual support*

Analysis reports

Test data can be analysed and displayed in accordance with the latest ISO 230-4, JIS B 6190-4, B5.57, B5.54 and GB17421.4 standards. These reports give a value for a single overall indicator of machine positioning performance, e.g. circular deviation. The separate Renishaw analysis format uses unique maths algorithms to derive values for up to 15 contributory machine errors. It can even rank these according to their contribution to the overall positioning performance. In short it is a true 'expert' system that can deliver an in depth diagnosis of a machines errors; all from a single test. Renishaw analysis can even be used with 'partial arc' test data.

Ballbar plot simulator

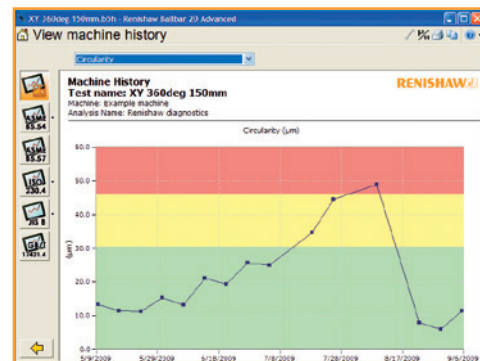


This is a powerful tool to aid decisions on corrective action or maintenance prediction. The simulator allows users to see their test results on screen and then to change various machine geometry, play and dynamic parameters to see "what if" results on the ballbar plot, circularity and positional tolerance values. The original test results are maintained separately and cannot be corrupted, no matter what scenarios are played out in the simulator.

Machine history

The machine history function allows you to build and review a test history for any specific machine. Just choose a test template and then select some or all of the tests in the machine folder.

Variations in the performance of your machine over time can be displayed graphically for any of the standard report parameter values e.g. circularity, squareness etc.

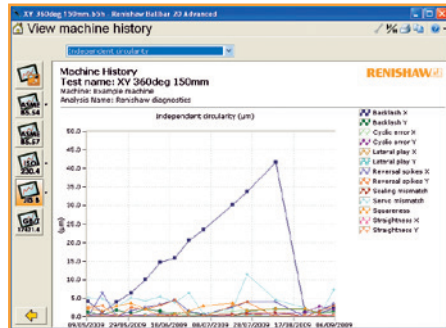


You can clearly see how your machine's performance has varied and can even "interrogate" individual plot points back to the original test report and polar graph.

In short, review a complete "medical record" for your machine!

The software also allows you to:

- Set individual warning and failure performance bands for each machine characteristic
- Get instant notification, during the ballbar test, if a machine's performance exceeds these tolerances

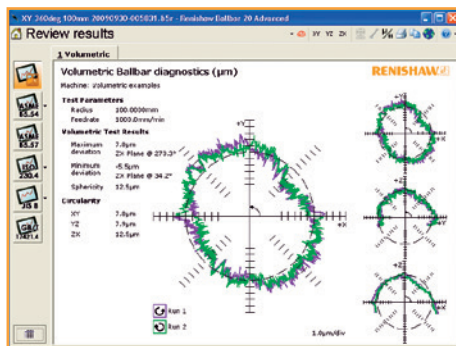


There's even a combined history plot which shows the independent circularity values for all parameters over time. This is a very useful "first stop" in reviewing the performance history of a machine and the relative importance of the errors that are present.

Machine history allows you to:

- Predict maintenance requirements in advance to reduce unscheduled downtime
- Compare performance before and after a crash to pinpoint corrective maintenance requirements
- Review the effects of maintenance and service adjustments as they are carried out
- Assess machine history to spot recurring problems, and the effectiveness of previous fixes

Volumetric analysis



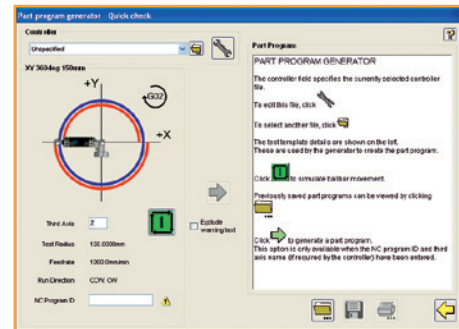
This is a new report option that allows the user to select three test files and then display a numeric "sphericity" result and the overall max and min circularity values. Graphical results are

given for each of the three planes together with their individual circularity results. This analysis option also shows individual test circularity results. The volumetric analysis is only available when viewing results in the 'Renishaw analysis' and is not supported in ISO, ASME and other standards' analyses.

To ensure the validity of the analysis the software carries out checks on data files, e.g. consistent machine name, feedrate, radius and that test planes are orthogonal, and will only display an analysis if these criteria are met.

Volumetric analysis will only work with data captured using BB20 software, although this can be used with QC10 (3 off 360° tests), or QC20-W (360° plus 2 off 220° tests).

Part program generator



This facility allows the automatic generation of a part program for the specific ballbar test. To create a part program, all the user has to do is define a ballbar test or select an existing test template, select a pre-defined CNC controller definition and then click the "generate" button.

The part program generated can be reviewed on-screen prior to printing or exporting to a removable storage device.

Ballbar 20 compatibility

Minimum computer requirements:

- Microsoft Windows® XP (SP2 or SP3) or Windows Vista®, Windows 7 compatible
- Minimum screen resolution 800 x 600 pixels
- CD-ROM drive (for software installation)
- Bluetooth enabled PC (Microsoft enumerator) or compatible Bluetooth-USB adaptor (ask Renishaw for current recommendations)

System accessories

Small circle accessory kit

The small circle accessory kit is used with the QC20-W ballbar to allow tests with a radius of 50 mm. This can be useful when testing machine axes with short axis travel, or to emphasise the effects of servo and dynamic errors on the machine (small circles require higher machine accelerations and decelerations).

The kit includes a 50 mm calibrator (and calibration certificate) and the small circle adaptor, which is supplied with an additional centre ball already fitted. The adaptor is a simple screw fitting to the main ballbar body. The adaptor is available separately for customers upgrading from QC10 to QC20-W who already have a small circle accessory kit.



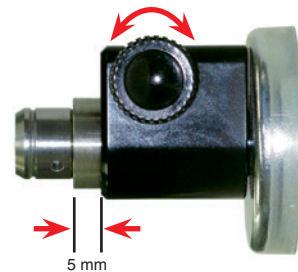
Contents of QC20-W small circle accessory kit

VTL adaptor

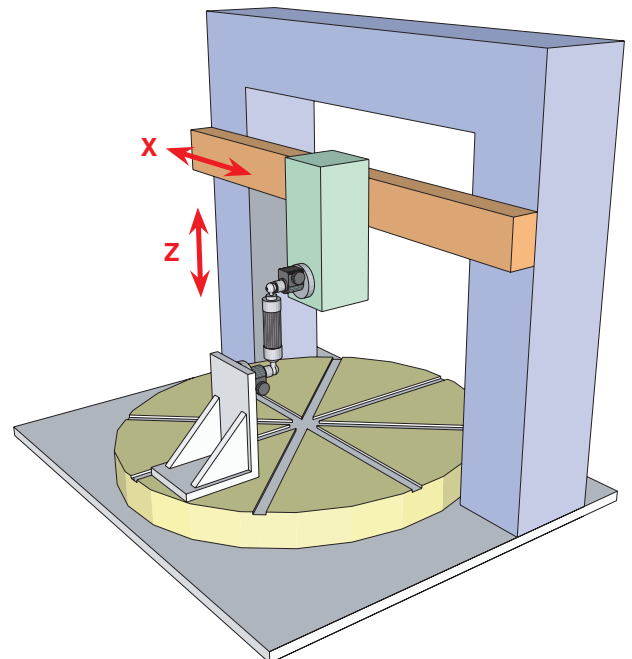
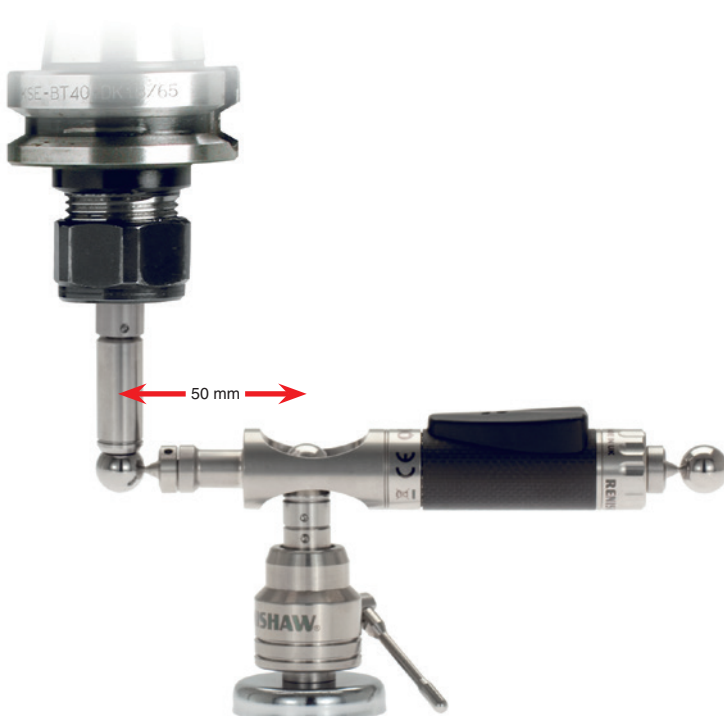
For 2-axis CNC applications the VTL adaptor is available (this replaces the “tool cup” in the standard set-up and restricts movement of the centre cup to a single axis only.) This enables typical 2-axis machines such as vertical turning lathes and laser cutting machines etc, to benefit from QC20-W ballbar diagnosis.

With the zero position coordinates set, the VTL accessory allows for one magnetic cup to be withdrawn (to allow it to be driven to the test start position using the free axes' motion) and then be pulled forward (to the third axis zero position) without introducing any offset error in the other two axes.

The schematic below shows a typical application on a VTL where the tool head always runs along the X axis on the centre-line of the rotary axis.



VTL adaptor restricts movement of the magnetic cup to 5 mm in one axis only.



Typical two-axis vertical turning lathe showing VTL adaptor on tool holder.

Lathe accessory kit

The lathe adaptor kit allows you to perform 360°, 100 mm radius ballbar tests on a lathe. The kit consists of an arm assembly for attachment to the lathe turret and a spindle bar for attachment in the lathe spindle. Both arm and spindle include magnetic cups in which to locate the ballbar; the one in the arm is equivalent to the tool cup in the normal kit set-up and the one in the spindle bar is equivalent to the pivot assembly/centre cup.

Note that to use this kit your lathe must have the following capabilities:

Axis clearance:	X-axis: 220 mm from centre-line Z-axis: 330 mm from chuck
Spindle diameter:	Ø25 mm (others will require additional magnetic base)
Tool holder:	accepts 20 mm or 25 mm tool shanks

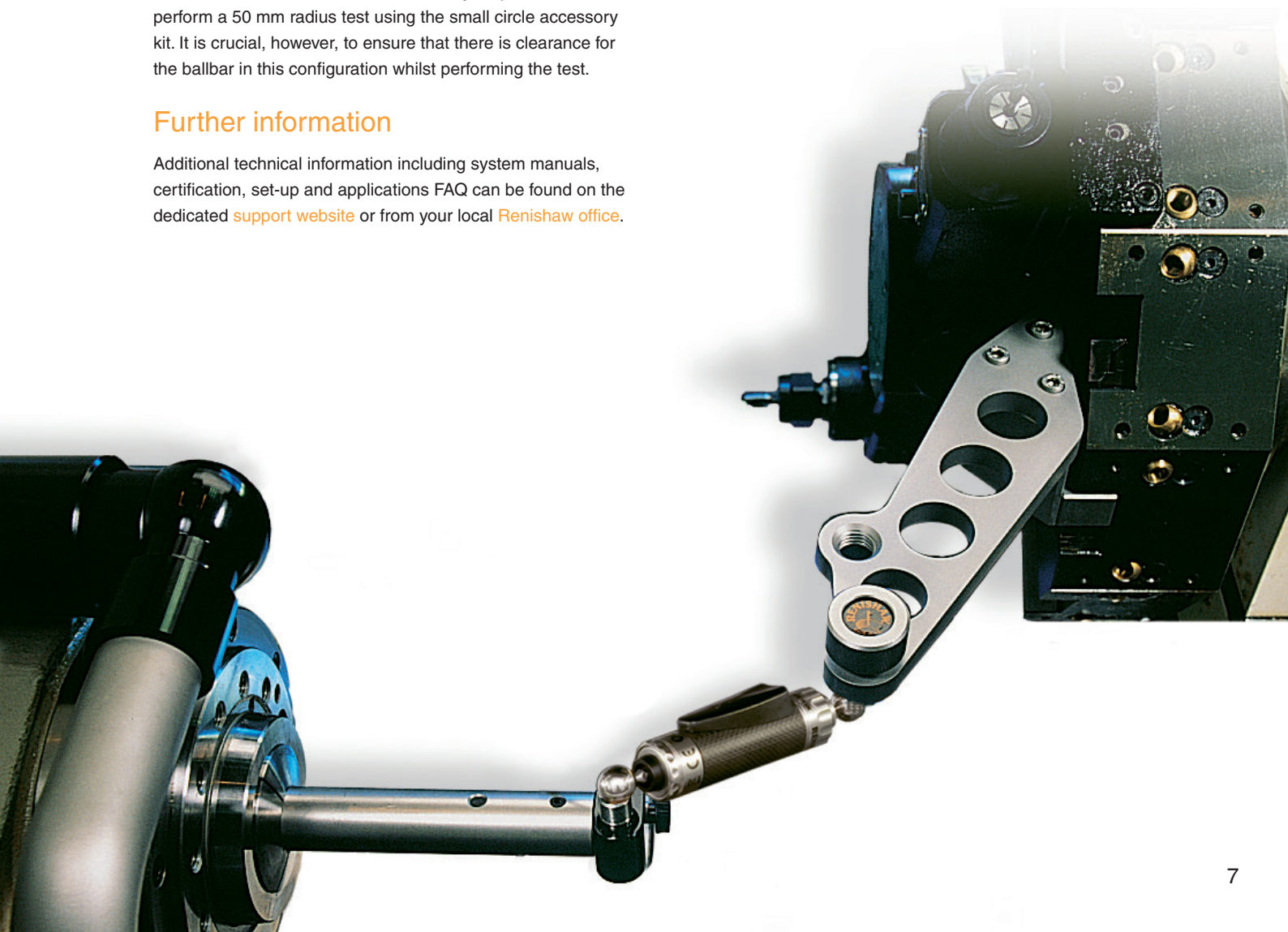
On lathes with restricted axis travel it may be possible to perform a 50 mm radius test using the small circle accessory kit. It is crucial, however, to ensure that there is clearance for the ballbar in this configuration whilst performing the test.

Further information

Additional technical information including system manuals, certification, set-up and applications FAQ can be found on the dedicated [support website](#) or from your local [Renishaw office](#).



Lathe adaptor kit



About Renishaw

Renishaw is an established world leader in engineering technologies, with a strong history of innovation in product development and manufacturing. Since its formation in 1973, the company has supplied leading-edge products that increase process productivity, improve product quality and deliver cost-effective automation solutions.

A worldwide network of subsidiary companies and distributors provides exceptional service and support for its customers.

Products include:

- Additive manufacturing, vacuum casting, and injection moulding technologies for design, prototyping, and production applications
- Advanced material technologies with a variety of applications in multiple fields
- Dental CAD/CAM scanning and milling systems and supply of dental structures
- Encoder systems for high accuracy linear, angle and rotary position feedback
- Fixturing for CMMs (co-ordinate measuring machines) and gauging systems
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- High speed laser measurement and surveying systems for use in extreme environments
- Laser and ballbar systems for performance measurement and calibration of machines
- Medical devices for neurosurgical applications
- Probe systems and software for job set-up, tool setting and inspection on CNC machine tools
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