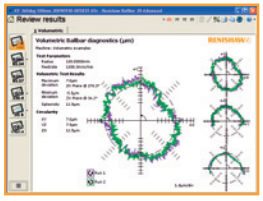
RENISHAW
apply innovation™

QC20-W wireless ballbar system description and specifications

Hardware



Software

Bluetooth®

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.

Zerodur® calibrator

A Zerodur® 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 Zerodur® 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 software will automatically calculate the positional tolerance of 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 Zerodur® calibrator can calibrate 100, 150 and 300 mm lengths. The small circle kit contains a 50 mm Zerodur® 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
- Zerodur® 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)

The *Bluetooth* word mark and logos are owned by Bluetooth SIG, Inc. and any use of such marks by Renishaw plc is under license.
Other trademarks and trade names are those of their respective owners.
Zerodur® is a registered name of Schott Glass Technologies.

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.

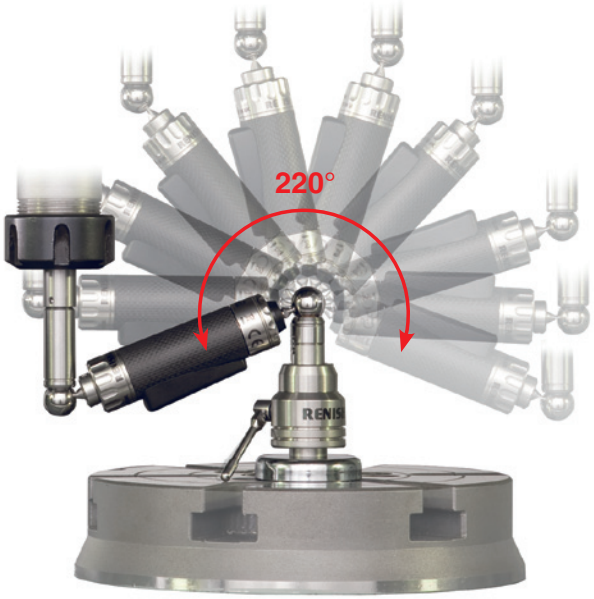
The optional small circle kit allows tests with a 50 mm radius and testing can also be carried out on two-axis machines and lathes using optional accessories *(page 6)*.

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 (at 20 °C / 68 °F)	±1.00 µm	±40 µin
Ballbar measuring range	±1.0 mm	±0.04 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)

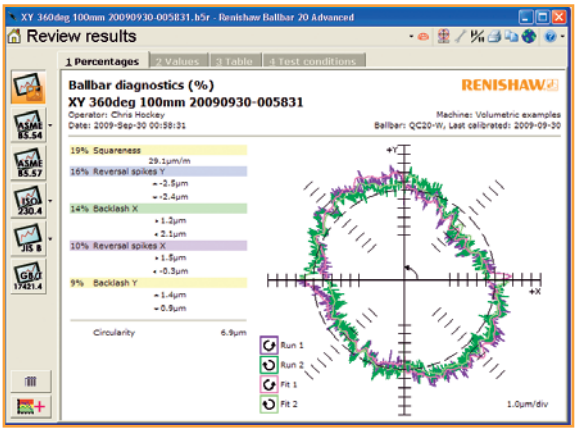
Measurement and diagnosis software

Ballbar 20 software

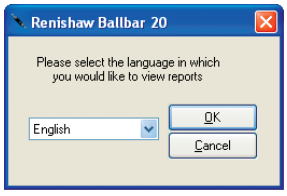
Just like the QC20-W ballbar, Ballbar 20 software is powerful and easy to use. The intuitive interface and step-by-step instructions mean you can be using the system in minutes.

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

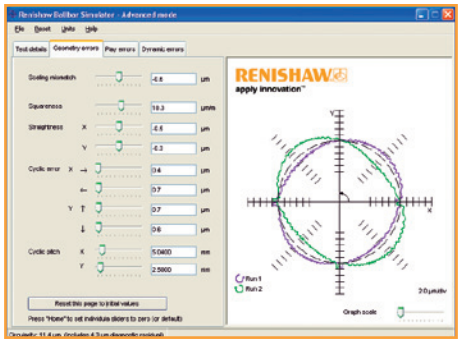


Multilingual support*

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

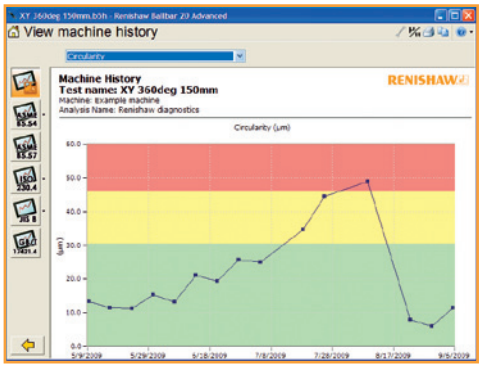


This is a powerful tool to aid decisions on corrective action or maintenance prediction. The simulator allows users to see their test results on screen and then to change various machine geometry, play and dynamic parameters to see "what if" results on the ballbar plot, circularity and positional tolerance 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.



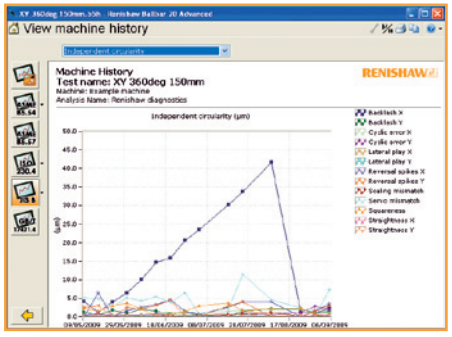
You can clearly see how your machine's performance has varied and can even "interrogate" individual plot points back to the original test report and polar graph.

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

* Ballbar 20 allows multi-language report generation as well as a choice of operating language.
Available in English, German, French, Italian, Spanish, Portuguese, Chinese, Japanese, Czech, Korean, Russian and Polish.

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

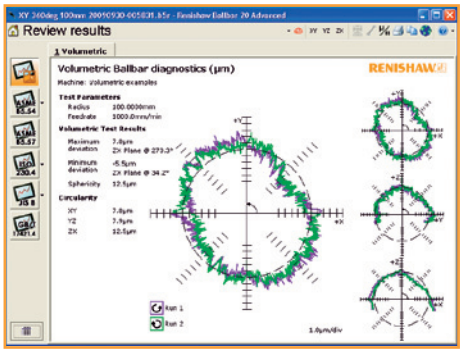


There's even a combined history plot which shows the independent circularity values for all parameters over time. This is a very useful "first stop" in reviewing the performance history of a machine and the relative importance of the errors that are present.

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

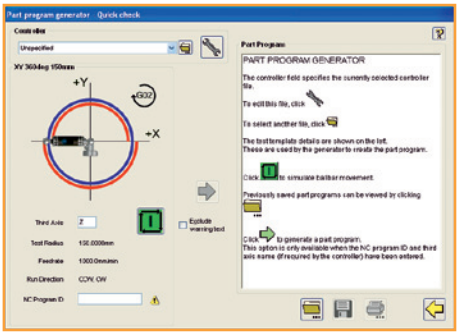


This is a new report option that allows the user to select three test files and then display a numeric "sphericity" result and the overall max and min circularity values. Graphical results are given for each of the three planes together with their individual circularity results. This analysis option 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 Zerodur® 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.

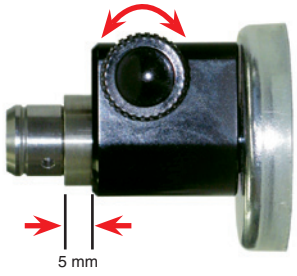
Contents of QC20-W small circle accessory kit

VTL adaptor

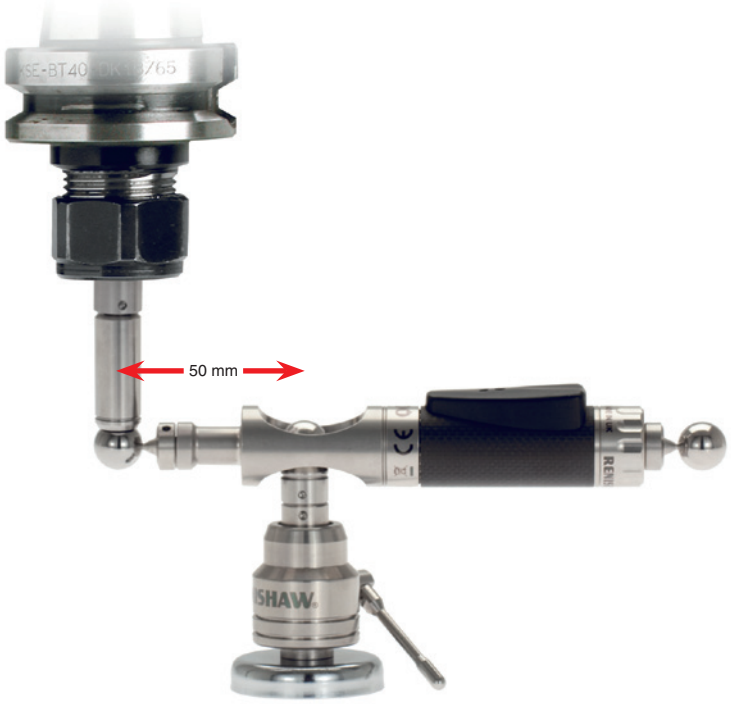
For 2-axis CNC applications the VTL adaptor is available (this replaces the “tool cup” in the standard set-up and restricts movement of the centre cup to a single axis only.) This enables typical 2-axis machines such as vertical turning lathes and laser cutting machines etc, to benefit from QC20-W ballbar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

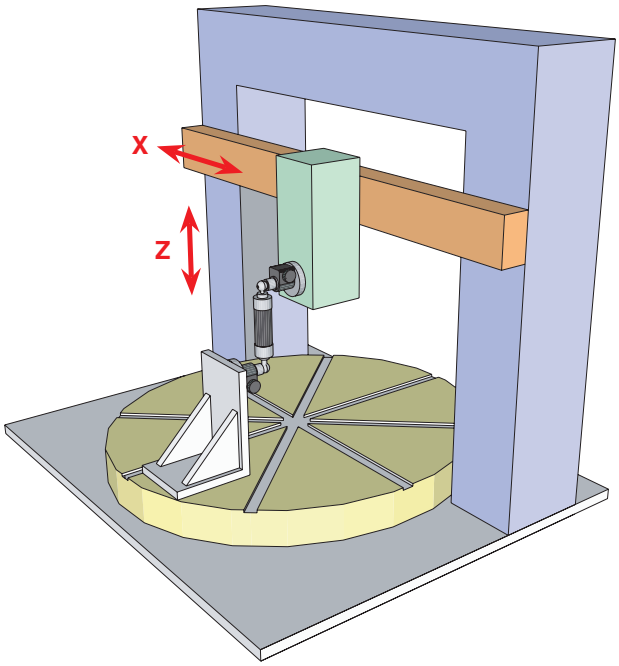
With the zero position coordinates set, the VTL accessory allows for one magnetic cup to be withdrawn (to allow it to be driven to the test start position using the free axes’ motion) and then be pulled forward (to the third axis zero position) without introducing any offset error in the other two axes.

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:

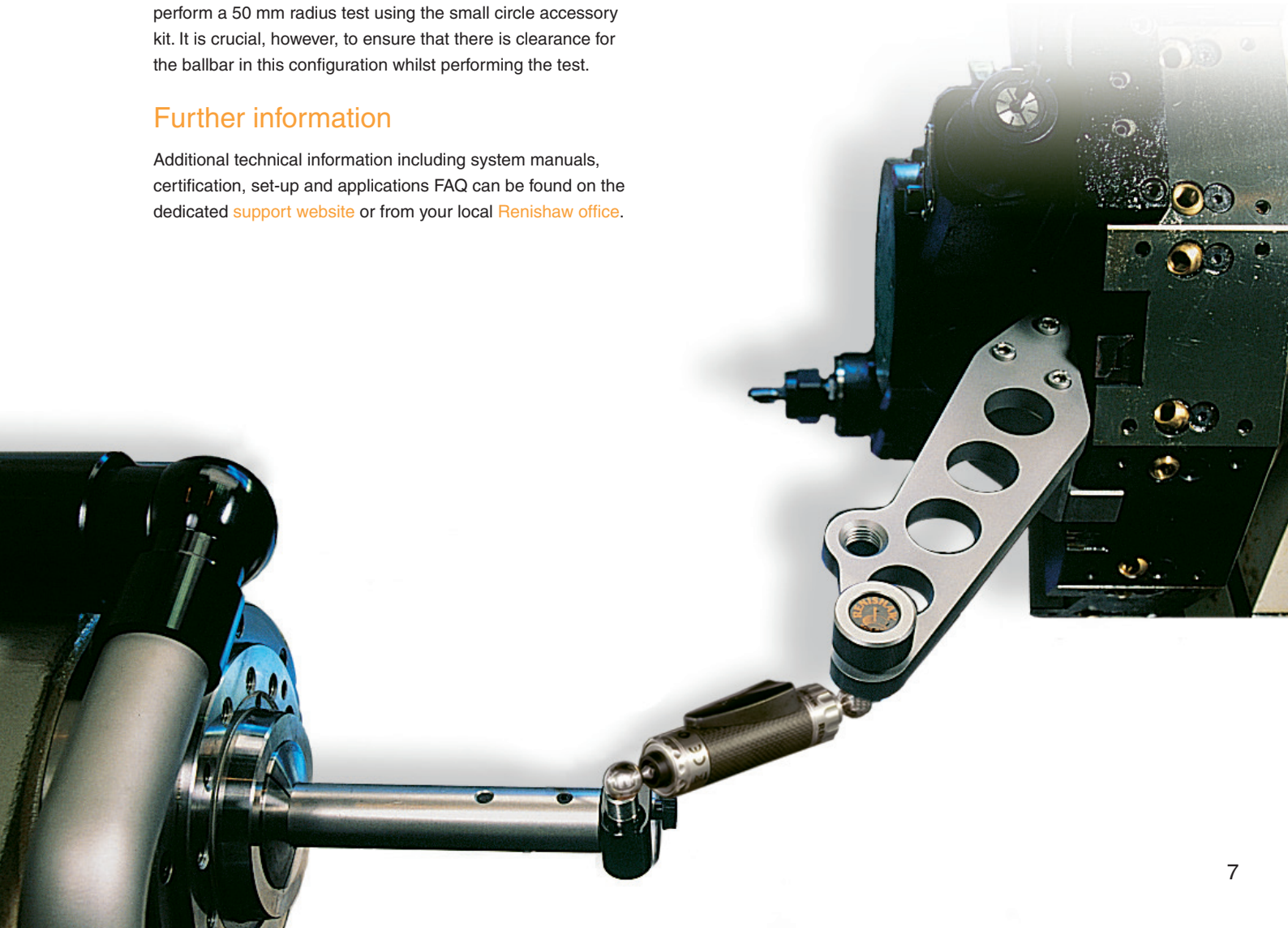
Axis clearance:	X-axis: 220 mm from centre-line Z-axis: 330 mm from chuck
Spindle diameter:	Ø25 mm (others will require additional magnetic base)
Tool holder:	accepts 20 mm or 25 mm tool shanks

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.

Lathe adaptor kit

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.



Renishaw plc

New Mills, Wotton-under-Edge,
Gloucestershire GL12 8JR
United Kingdom

T +44 (0) 1453 524524
F +44 (0) 1453 524901
E uk@renishaw.com

www.renishaw.com

RENISHAW
apply innovation™

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:

- **Dental CAD/CAM** scanning and milling systems
- **Encoder systems** for high accuracy linear, angle and rotary position feedback
- **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
- **Raman spectroscopy systems** for non-destructive material analysis
- **Sensor systems and software** for measurement on CMMs (co-ordinate measuring machines)
- **Styli** for CMM and machine tool probe applications

Renishaw worldwide

Australia
T +61 3 9521 0922
E australia@renishaw.com

Austria
T +43 2236 379790
E austria@renishaw.com

Brazil
T +55 11 4195 2866
E brazil@renishaw.com

Canada
T +1 905 828 0104
E canada@renishaw.com

The People's Republic of China
T +86 21 6180 6416
E china@renishaw.com

Czech Republic
T +420 548 216 553
E czech@renishaw.com

France
T +33 1 64 61 84 84
E france@renishaw.com

Germany
T +49 7127 9810
E germany@renishaw.com

Hong Kong
T +852 2753 0638
E hongkong@renishaw.com

Hungary
T +36 23 502 183
E hungary@renishaw.com

India
T +91 80 6623 6000
E india@renishaw.com

Indonesia
T +62 21 2550 2467
E indonesia@renishaw.com

Israel
T +972 4 953 6595
E israel@renishaw.com

Italy
T +39 011 966 10 52
E italy@renishaw.com

Japan
T +81 3 5366 5316
E japan@renishaw.com

Malaysia
T +60 3 5631 4420
E malaysia@renishaw.com

The Netherlands
T +31 76 543 11 00
E benelux@renishaw.com

Poland
T +48 22 577 11 80
E poland@renishaw.com

Russia
T +7 495 231 16 77
E russia@renishaw.com

Singapore
T +65 6897 5466
E singapore@renishaw.com

Slovenia
T +386 1 527 2100
E mail@rls.si

South Korea
T +82 2 2108 2830
E southkorea@renishaw.com

Spain
T +34 93 663 34 20
E spain@renishaw.com

Sweden
T +46 8 584 90 880
E sweden@renishaw.com

Switzerland
T +41 55 415 50 60
E switzerland@renishaw.com

Taiwan
T +886 4 2473 3177
E taiwan@renishaw.com

Thailand
T +66 2 746 9811
E thailand@renishaw.com

Turkey
T +90 216 380 92 40
E turkiye@renishaw.com

UK (Head Office)
T +44 1453 524524
E uk@renishaw.com

USA
T +1 847 286 9953
E usa@renishaw.com

For all other countries
T +44 1453 524524
E international@renishaw.com

©2010-2012 Renishaw plc. All rights reserved.
Specifications given in these pages are accurate to the best of our knowledge. Renishaw operates a policy of continual improvement and reserves the right to change product appearance and specification without notice.
RENISHAW® and the probe emblem used in the RENISHAW logo are registered trademarks of Renishaw plc in the UK and other countries.
apply innovation is a trademark of Renishaw plc.
Windows® and Vista® are registered trademarks of Microsoft Corporation in the United States and other countries.

Issued 0612 L-8014-1588-05-A