

ROUNDNESS MEASUREMENT

Bulletin No. 1750



**Mitutoyo Roundness Measurement Instruments—
For a complete range of applications from the
lab, to the shop or production floor.**

Mitutoyo

You define the task...

The advanced approach for measurement of rotationally symmetric workpieces.

For the production line, quality control room or laboratory, Mitutoyo's wide choice of product offers effective solutions for all your form measurement needs. From the easy-to-handle, compact instrument with dedicated processor and built-in printer to the high-precision, PC-controlled reference model, there is a Mitutoyo measurement solution for rotationally symmetric workpieces to suit practically every application.

This brochure presents an overview of Mitutoyo's range of form measurement instruments to help you choose the system that best meets your individual roundness measuring tasks. This brochure includes instrument specifications, configurations, additional equipment options and premium software solutions. Available upon request, individual product brochures provide detailed information on the form measurement instrument of your choice.

Whichever model you choose, Mitutoyo's form measuring machines empower you with the experience, competence and high performance of a world leader in measurement technology. And, as always, with Mitutoyo you can be assured of first-class, customer-friendly service.

FORM MEASUREMENT

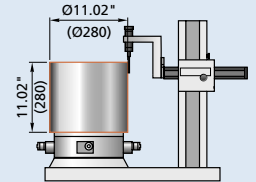


Whether off-the-shelf, or a custom-configured solution, Mitutoyo roundness measurement technology offers unmatched features with highest levels of accuracy.

Model	Description	Measuring range inch (mm)
-------	-------------	---------------------------

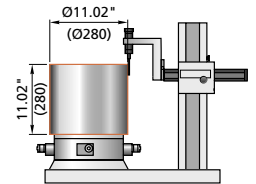
ROUNDTTEST RA-114

The compact, stand-alone solution for precise, effective and easy form-measurement in the production environment. The large, easy-to-read display shows measurement results at a glance.



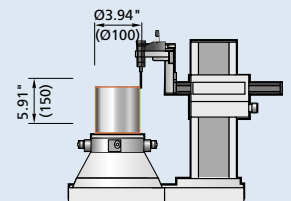
ROUNDTTEST RA-116

Easy-to-use, ergonomic, compact instrument equipped as the ROUNDTTEST RA-114 for use directly in production – plus the versatility of PC control and the power of the ROUNDPAK measuring and analysis software package.



ROUNDTTEST RA-1400 ROUNDTTEST RA-1500

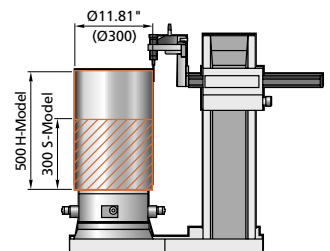
Compact PC-controlled desktop instrument for when the job demands high measurement precision. Ideal for testing small workpieces, e.g. in electronics and video technology. Large range of applications combined with high economic efficiency.



ROUNDTTEST RA-2100

ROUNDTTEST RA-2100 DS
ROUNDTTEST RA-2100 DH

Desktop models for ambitious, high-precision form measurement. Fast manual centering and levelling of workpiece on the Digital Adjustment Table (DAT).



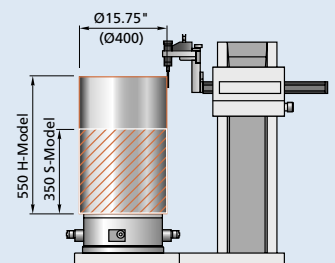
ROUNDTTEST RA-2100 AS
ROUNDTTEST RA-2100 AH

Desktop PC-controlled instrument focused on creating and running part programs for efficient use in production. Features automatic centering and levelling of workpiece.

ROUNDTTEST RA-H5000

ROUNDTTEST RA-H5000 AS
ROUNDTTEST RA-H5000 AH

High-performance floor-standing model with extremely fast and safe automatic workpiece centering and levelling system. Particularly suited to measuring the larger workpiece and running complex part programs.



Convenient, powerful and economical.

Highlights

- Stand-alone machine with in-built processor and display
- Simple manual alignment of workpiece
- Large centering range
- Built-in printer
- Extensive range of accessories



ROUNDTEST RA-114

- PC control versatility
- Measuring and analysis software package ROUNDPAK running under Windows® operating system
- Simple manual alignment of workpiece
- Large centering range
- Extensive range of accessories



ROUNDTEST RA-116

- PC control versatility
- Measuring and analysis software package ROUNDPAK running under Windows® operating system
- Large centering range
- Extensive range of accessories



ROUNDTEST RA-1400

ROUNDTEST RA-1500

- PC control versatility
- Measuring and analysis software package ROUNDPAK running under Windows® operating system
- Large automatic-centering range
- Extensive range of accessories



ROUNDTEST RA-2100

- PC control versatility
- Measuring and analysis software package ROUNDPAK running under Windows® operating system
- Large automatic-centering range
- Extensive range of accessories



ROUNDTEST RA-H5000

ROUNDTTEST RA-114

The practical solution.

The p

RA-114

rotational accuracy
($0.07 + 0.06H/100$) μm

RA-114

**A stand-alone instrument suitable for shop-floor jobs.
Convenient and cost-effective.**

- Simple and precise menu-controlled manual alignment of workpiece
- Compact and suitable for use on shop floor
- High price/performance ratio
- Easy measurement and evaluation plus print-out of measuring results
- Large, clear, built-in display
- Optimum measuring volume for instrument size
- Accepts workpieces up to $\varnothing 17.32$ " (440mm) diameter
- Turntable loading 20kgf maximum
- Measurable diameter 11.02" (280mm)
- Measuring range $\pm 1000\mu\text{m}$
- Measuring height for outside/inside diameters: 11.02" (280mm) maximum
- Measuring depth inside 3.94" (100mm) maximum (with standard stylus)
- Traverse of R axis 6.5" (165mm)
- Extensive accessory range
- PC link possible
- Air-bearing turntable for high precision, wear-free rotation
- Large centering range $\pm .12$ " ($\pm 3\text{mm}$)
- Large levelling range $\pm 1^\circ$
- Digimatic interface for statistical evaluation
- Interruption/notch exclusion function
- Extensive range of accessories



Result of roundness measurement



Part alignment

10 Analysis options

Roundness
Coaxiality
Concentricity
Radial runout
Axial runout
Perpendicularity to axis
Perpendicularity to plane
Wall thickness deviation
Flatness
Parallelism

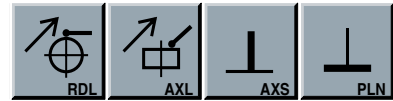


Roundness measurement outside, vertical



Roundness measurement outside, horizontal

A compact, desktop instrument – with a large display and available built-in printer or PC link – it's ideal for the shop or production floor.



Radial runout Axial runout Perpendicularity to axis Perpendicularity to plane



Wall thickness deviation Flatness Parallelism



Roundness Coaxiality Concentricity



Roundness measurement inside



Flatness measurement

ROUNDTTEST RA-116

Compact.

The c

RA-116

rotational accuracy
($0.07 + 0.06H/100$) μm

RA-116
PC control offers versatility.
Uncomplicated thanks to premium software.



Software ROUNDPAK: Main menu



Result menu: Concentricity



Result menu: Roundness

12 Analysis options

- Roundness
- Coaxiality
- Concentricity
- Radial runout
- Axial runout
- Perpendicularity to axis
- Perpendicularity to plane
- Wall thickness deviation
- Flatness
- Parallelism
- Performance spectrum
- Harmonic analysis

- PC control versatility
- Evaluation and output of measuring results via PC
- Measuring and analysis software package ROUNDPAK running under Windows® operating system
- Air-bearing turntable for high precision, wear-free rotation
- Simple and precise menu-controlled manual alignment of workpiece
- Compact and shop-floor usable
- High performance to cost ratio
- Easy measurement and evaluation as well as print-out of measuring results
- Optimum measuring volume
- Accepts workpieces up to $\varnothing 17.32$ " (440mm) diameter
- Turntable loading 20 kgf maximum
- Measurable diameter $\varnothing 11.02$ " (280mm)
- Measuring range $\pm 1000\mu\text{m}$
- Measuring height for outside/inside diameters: 11.02" (280mm) maximum
- Measuring depth inside 3.94" (100mm) maximum (with standard stylus)
- Traverse of R axis 6.5" (165mm)
- Extensive accessory range
- Large centering range ± 12 " ($\pm 3\text{mm}$)
- Large levelling range $\pm 1^\circ$
- Interruption/notch exclusion function
- Extensive range of accessories



Roundness measurement outside, vertical

Compact, PC-controlled desktop instruments
for shop or production floor.



Roundness measurement outside



Roundness measurement inside



Flatness measurement

ROUNDTTEST RA-1400/RA-1500

The perfectionist.

The

RA-1400/RA-1500

RA-1400/RA-1500

**Uncomplicated manual part centering and levelling.
High precision, wear-free turntable rotating on an
air bearing. For perfect results to meet your
high expectations.**

rotational accuracy
(0.07 + 0.06H/100) μ m

column straightness (Z axis)
0.15 μ m / 50 mm
0.3 μ m / 150 mm

20 Analysis options

Cylindricity*
Roundness
Concentricity
Coaxiality
Radial runout
Axial runout
Perpendicularity to axis
Perpendicularity to plane
Wall thickness deviation
Flatness
Parallelism
Total radial runout*
Straightness horizontal
Diameter
Radius deviation*
Conicity*
Performance spectrum
Harmonic analysis

*RA-1500 only

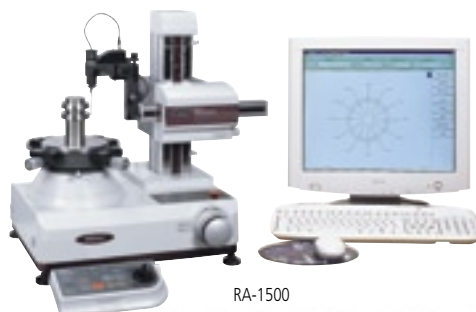
- Easy and fast measurement, evaluation and print-out of measuring results
- PC control versatility
- Measuring and analysis software package ROUNDPAK running under Windows® operating system
- Vertical spiral-trace-mode analysis supported
- Air-bearing turntable for high precision, wear-free rotation
- Fast, precise manual centering and levelling of workpiece on the Digital Adjustment Table (DAT)
- Enormous stability through FEM-aided design and high-stability ceramic components
- Large centering range ± 1 " (± 3 mm)
- Large levelling range $\pm 1^\circ$
- Optimum measuring volume
- Accepts workpieces up to $\varnothing 15.75$ " (400mm) diameter
- Turntable loading 10kgf maximum
- Measurable diameter 3.94" (100mm)
- Adjustable stylus force
- Stylus angle adjustable $\pm 45^\circ$
- Measuring range $\pm 400\mu$ m
- Measuring height for outside/inside diameters: 5.9" (150mm) maximum
- Traverse of R axis 2.95" (75mm)
- Measuring depth 3.54" (90mm) maximum
- Interruption/notch exclusion function
- Extensive range of accessories



Result menu : cylindricity, 3D view



Result menu : cylindricity, supervision



RA-1500



Roundness measurement outside, vertical

Compact desktop model for the most demanding cylindricity measurements.



RA-1400



RA-1500



Roundness measurement inside



Cylindricity measurement via vertical spiral trace (RA-1500)



Flatness measurement outside, horizontal

ROUNDTEST RA-2100

The versatile solution.

The v

RA-2100 DS/DH

rotational accuracy
(0.02 + 5H/10000) μm

column straightness (Z axis)
0.25 μm / 300 mm



Manual part alignment via digital micrometers

RA-2100 DS and RA-2100 DH
Fast, simple and precise manual part alignment thanks to the Digital Adjustment Table (DAT). Technology at its finest for users with high demands.

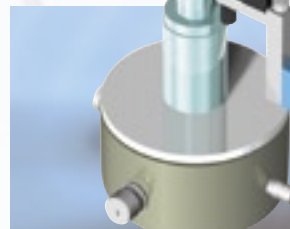
- Easy and fast measurement, evaluation and print-out of measuring results
- PC control versatility
- Measuring and analysis software package ROUNDPAK running under Windows® operating system
- Vertical and horizontal spiral-trace-mode analysis supported
- Air-bearing turntable for high precision, wear-free rotation
- Fast, precise manual centering and levelling of workpiece on the Digital Adjustment Table (DAT)
- Enormous stability through FEM-aided design and high-stability ceramic components
- Large centering range ± 0.19 " ($\pm 5\text{mm}$)
- Large levelling range $\pm 1^\circ$
- Optimum measuring volume
- Accepts workpieces up to $\varnothing 22.83$ " (580mm) diameter
- Turntable loading 30kgf maximum
- Turntable working diameter $\varnothing 7.87$ " (200mm)
- Measurable diameter 11.81" (300mm)
- Adjustable stylus force
- Stylus angle adjustable $\pm 45^\circ$
- Measuring range $\pm 400\mu\text{m}$
- Measuring height for outside/inside diameters: 11.81" (300mm) (RA-2100 DS) or 19.69" (500mm) (RA-2100 DH)
- Measuring depth 3.94" (100mm) maximum (with standard stylus)
- Traverse of R axis 6.89" (175mm)
- Rotation speed up to 10rpm
- Interruption/notch exclusion function
- Extensive range of accessories



Cylindricity measurement via vertical spiral trace



Flatness measurement via horizontal spiral trace



Automatic outside and inside measurement



Mitutoyo

Highly rigid desktop model with extended functionality. Available with manual or automatic workpiece centering and leveling.

RA-2100 AS/AH

RA-2100 AS and RA-2100 AH

The machine almost works by itself – reliable and fast automatic workpiece centering and levelling. Optimum features for demanding measuring tasks and automatic control of part programs.

Performance as RA-2100 DS/DH, plus:

- Fast, precise and automatic centering and levelling of workpiece
- Turntable working diameter $\varnothing 9.25''$ (235mm)
- Centering range $\pm 1''$ ($\pm 3\text{mm}$)

rotational accuracy
($0.02 + 5H/10000$) μm
column straightness (Z axis)
 $0.25 \mu\text{m} / 300 \text{mm}$



Automatic workpiece alignment via motorised micrometers



Result menu : cylindricity, supervision



Result menu: cylindricity, 3D view

20 Analysis options

Cylindricity	Parallelism
Roundness	Total radial runout
Concentricity	Total axial runout
Coaxiality	Straightness horizontal
Radial runout	Straightness vertical
Axial runout	Diameter
Perpendicularity to axis	Radius deviation
Perpendicularity to plane	Conicity
Wall thickness deviation	Performance spectrum
Flatness	Harmonic analysis

ROUNDTTEST RA-H5000

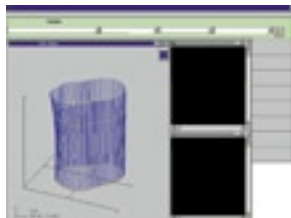
The perfect-in-form solution.

The per

RA-H5000

rotational accuracy
(0.02 + 0.04H/100) μm

column straightness (Z axis)
0.05 μm / 100 mm
0.3 μm / 350 mm
0.47 μm / 550 mm



Result menu: cylindricity, 3D view

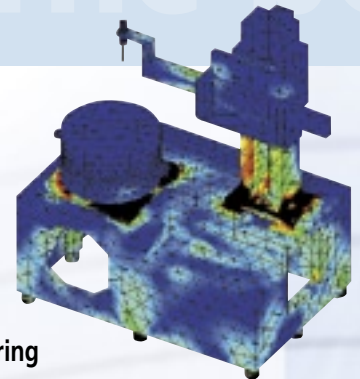
20 Analysis options

Cylindricity
Roundness
Concentricity
Coaxiality
Radial runout
Axial runout
Perpendicularity to axis
Perpendicularity to plane
Wall thickness deviation
Flatness
Parallelism
Total radial runout
Total axial runout
Straightness horizontal
Straightness vertical
Diameter
Radius deviation
Conicity
Performance spectrum
Harmonic analysis

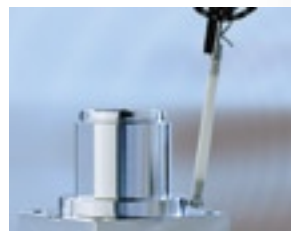
RA-H5000 AS and RA-H5000 AH

Top technology for 20 different measurements of form.
Attains the highest accuracy available at maximum measuring speed coupled with impressive versatility due to a wide range of well-matched accessories. For perfect-in-form results without the slightest compromise.

- Easy, fast measurement, evaluation and print-out of measuring results
- PC control versatility
- Measuring and analysis software package ROUNDPAK running under Windows® operating system
- Vertical and horizontal spiral-trace-mode analysis supported
- Air-bearing turntable for high precision, wear-free rotation
- Fast, precise and automatic centering and levelling of workpiece
- Enormous stability through FEM-aided design and high-stability ceramic components
- Optional accuracy compensation function removes the minute residual errors in rotation, straightness and conicity in a particular instrument for work demanding accuracy at the calibration-laboratory level
- Large centering range $\pm 2"$ ($\pm 5\text{mm}$)
- Large levelling range $\pm 1^\circ$
- Optimum measuring volume
- Accepts workpieces up to $\varnothing 26.77"$ (680mm) diameter
- Measurable diameter 15.75" (400mm)
- Adjustable stylus force
- Stylus angle adjustable $\pm 45^\circ$
- Measuring range $\pm 300\mu\text{m}$
- Measuring height for outside/inside diameters:
13.78" (350mm) (RA-H5000 AS) or 21.65" (550mm) (RA-H5000 AH)
- Traverse of R axis 8.86" (225mm)
- Measuring depth 3.94" (100mm) maximum (with standard stylus)
- Rotation speed up to 10rpm
- Interruption/notch exclusion function
- Extensive range of accessories



Stability and precision through FEM analysis



Cylindricity measurement



Roundness measurement outside, horizontal



Flatness measurement

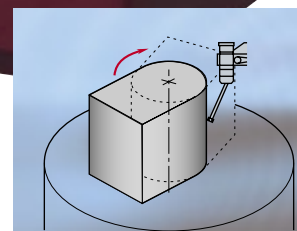
Extreme-accuracy models with advanced features for highest-performance measurement of rotationally symmetrical workpieces.



Cylindricity measurement via vertical spiral trace



Flatness measurement via horizontal spiral trace



Partial-circle measurement through precise turntable control

ROUNDPAK

Standard premium software.

Peak performance, flexibility and versatility personified. Form-measuring instruments ROUNDTTEST RA-116, RA-2100 and RA-5000 come equipped as standard with a control PC and the new Mitutoyo premium software package ROUNDPAK. Running under MS Windows® operating system, this premium software allows you to handle your individual measuring tasks as efficiently as possible by delivering flexibility, precision and speed.

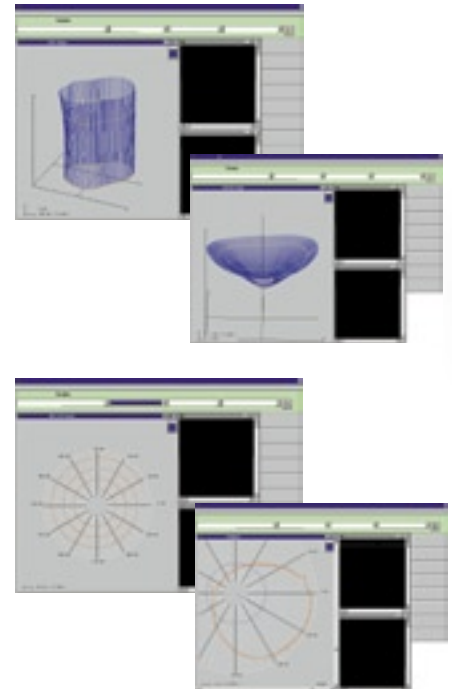
ROUNDPAK allows almost effortless preparation of your specific measuring programs, visualizes the entire measuring sequence and documents the results in impressively easy-to-view diagrams and 3D graphics.

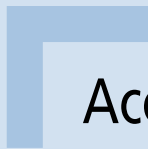
By storing and indexing the measurement and evaluation set-ups, you can compile your own structured library of workpiece measurement sequences. Several measurements can be integrated into the set-ups which can then be linked together to create complete measuring sequences. Up to 50 individual measurements with 3600 measuring points each can be defined within one measuring cycle.

ROUNDPAK provides three modes of measurement:

- Linear, vertical/horizontal
- Rotational
- Spiral*

*vertical (RA-1500, RA-2100 and RA-5000), horizontal (RA-2100 and RA-5000)





Accessories

Reference-origin gauge
for checking the turntable



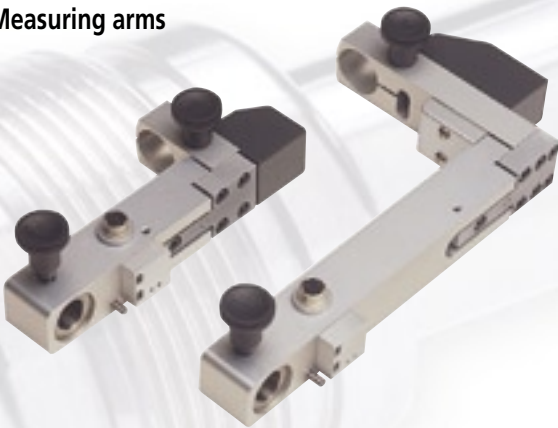
Centering chucks
for fast clamping
of workpieces



Calibration master
for dynamic probe calibration



Measuring arms



Interchangeable styli



For further detailed information, please
visit our website www.mitutoyo.co.uk



Types of analyses

Analyses with turntable rotation							
Analysis	Application	Result	RA-114	RA-116	RA-1500	RA-2100	RA-H5000
Straightness			●	●	●	●	●
Flatness (1 elements)			●	●	●	●	●
Flatness (n elements)			—	—	●	●	●
Perpendicularity to axis			●	●	●	●	●
Perpendicularity to plane			●	●	●	●	●
Concentricity			●	●	●	●	●
Coaxiality (axis – element)			●	●	●	●	●
Coaxiality (axis – axis)			—	●	●	●	●
Parallelism (1 elements)			●	●	●	●	●
Parallelism (n elements)			—	—	●	●	●
Wall thickness deviation (radial)			●	●	●	●	●
Wall thickness deviation (axial)			—	—	●	●	●
Cylindricity			—	—	●	●	●
Conicity			—	—	●	●	●
Axial runout			●	●	●	●	●
Radial runout			●	●	●	●	●
Total axial runout			—	—	●	●	●
Total radial runout			—	—	●	●	●
Diameter			—	—	●	●	●

Analyses

Analyses with linear scanning								
Analysis	Application	Result	RA-114	RA-116	RA-1500	RA-2100	RA-H5000	
Straightness (vertical)			—	—	●	●	●	
Straightness (horizontal)			—	—	●	●	●	
Conicity (vertical)			—	—	●	●	●	
Conicity (horizontal)			—	—	●	●	●	
Inclination (vertical)			—	—	●	●	●	
Inclination (horizontal)			—	—	●	●	●	
Cylindricity			—	—	●	●	●	
Perpendicularity to axis			—	—	●	●	●	
Coaxiality			—	—	●	●	●	
Parallelism (vertical)			—	—	●	●	●	
Parallelism (horizontal)			—	—	●	●	●	

Analyses with spiral scanning								
Cylindricity			—	—	●	●	●	
Flatness			—	—	●	●	●	
Coaxiality			—	—	●	●	●	
Perpendicularity to axis			—	—	●	●	●	
Perpendicularity to plane			—	—	●	●	●	
Total axial runout			—	—	●	●	●	
Total radial runout			—	—	●	●	●	

Additional overview brochures on Mitutoyo's contour and surface measuring systems and solutions are available upon request

SURFACE MEASURING INSTRUMENTS

A wide range extending from cost-effective and versatile hand-held portable instruments through to a high-precision desktop reference model. All equally suitable for measuring surface roughness and waviness either in the laboratory or on the production line.

CONTOUR MEASURING INSTRUMENTS

Profile contour measuring solutions for performance-oriented results. Whether you need a solution for portable applications or only for benchtop use, Mitutoyo has the right instrument for your solution.

COMBINATION OF CONTOUR AND SURFACE MEASUREMENT: FORMTRACER

The Formtracer series combines the technologies of surface and contour measurement in one single, space-saving system. This gives you the advantage of high-performance measurement in a package that takes up the bench space of just one machine. The optimum combination of efficiency and economy.

Note:

All our product details, in particular the illustrations, drawings, dimension and performance details and other technical specifications contained in this publication are to be considered approximate average values. To this extent, we reserve the right to make changes in design, technical data, dimensions and weight. Our specified standards, similar technical rules and technical specifications, descriptions and illustrations of the products are correct at the time of printing. The current version of our general terms and conditions also apply. Only offers which we have submitted can be considered to be definitive.

Coordinate Measuring Machines	_____
Vision Measuring Systems	_____
Surface, Form and Contour Measurement	_____
Optical Measuring	_____
Sensor Systems	_____
Hardness Measuring	_____
Digital Scale and DRO Systems	_____
Small Tool Instruments and Data Management	_____

Mitutoyo America Corporation

www.mitutoyo.com

Michigan
(734) 459-2810

Massachusetts
(978) 692-8765

Illinois
(630) 978-5385

Indiana
(317) 577-6070

California
(626) 961-9661

No. Carolina
(704) 875-8332

Mitutoyo

Precision is our Profession