Hardness Testers

Wilson® Instruments
An Instron® Company

Table of Contents

Introduction	4
What Type of Tester is Right for You?	5
Rockwell® Testers	6
What is Knoop/ Vickers testing?	12
Knoop/ Vickers Testers	13
Automatic Measuring Systems	18
Brinell Testers	20
Universal Testers	26
Portable and Mobile Testers	28
Custom Systems	31
Accessories	32
Services	33
Reference	
Application Guides	35
Conversion Charts	36
ASTM Standards	38
GR&R study	39

Introduction

Comprehensive Selection

Wilson® Instruments supplies a comprehensive range of hardness testers from Rockwell®, Microindentation and Brinell to complex production automation systems; including test blocks, accessories and fixtures. Wilson Instruments products are predominately used to determine the hardness of metals, alloys, small precision parts, wire and plastics ranging from the softest bearing materials to the hardest steels. Wilson hardness testers are used extensively in heat treat analysis and by the automotive, aerospace, steel and transportation equipment industries.

About Us

Wilson Instruments introduced the first Rockwell tester to the market over 80 years ago. The simplicity and robustness of the test invented by Stanley P. Rockwell revolutionized hardness testing. It was fast, accurate and allowed the part to be used after testing. Starting with the Rockwell tester, Wilson went on to develop the legendary Tukon™ range of Microindentation testers. These testers still are being used every day around the world to determine the hardness of countless parts and materials.

In 1993, Instron® Corporation purchased Wilson Instruments. Since then, Instron has spent millions of dollars in the development of new products using closed loop controls to revolutionize the performance of hardness testers. The results are the Rockwell 2000 and Tukon 2100 series of testers that are the best performing testers available today.

Today, our hardness product lines include Rockwell, Knoop/ Vickers, automatic computer controlled systems, Brinell, portable testers, Shore® durometers and a wide range of accessories.

If you have a hardness testing requirement, Wilson Instruments has a testing solution for you!

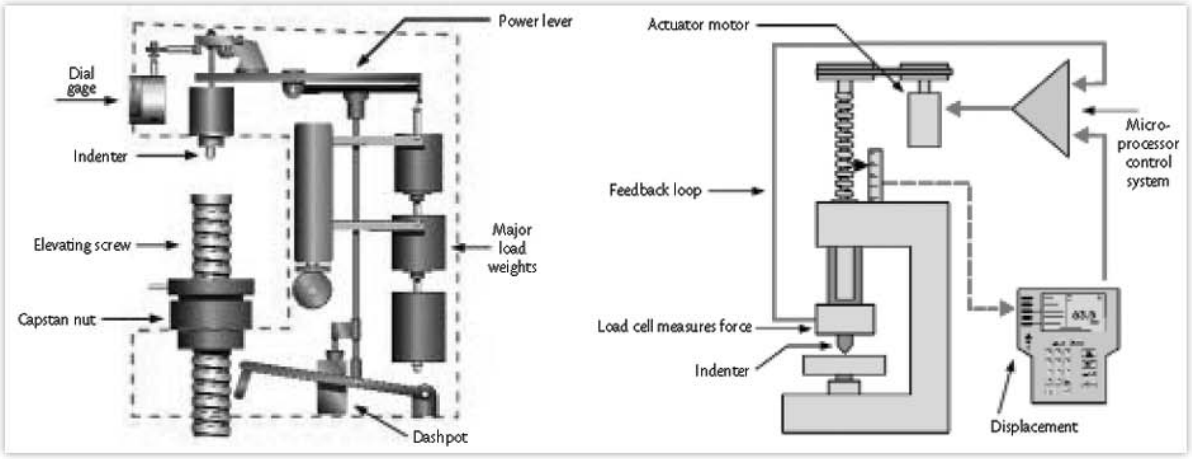
What Type of Hardness Tester is Right for You?

Closed-Loop or Deadweight

When choosing a hardness tester a number of factors are important to consider. One of the most important parameters in any hardness test is the means by which load application and load control are performed. Traditional hardness testers employ deadweight systems, a reliable and proven method, to apply and hold the test force. Deadweight, or open-loop, testers have been performing hardness indentations since the Rockwell® test was developed and are still a popular and efficient way to perform a hardness test. The deadweight system utilizes a series of incremental, stacked weights in conjunction with a lever and pivot point to apply a magnified test force at the indenter. Minor loads are applied by spring or small weight.

More recently, closed-loop hardness techniques have been developed as an alternative method of load application. Closed-loop testing, in the purest form, is a revolutionary technology that utilizes motor/ encoder control and a load cell or force transducer to apply and regulate the load. A closed-loop system can constantly monitor and adjust the applied force, virtually eliminating force errors and increasing tester accuracy and repeatability. Inherent in our closed-loop system is a simpler base design, devoid of the levers and deadweights of open-loop types. System repeatability and accuracy is further increased by the exclusive patented, in-line design of Wilson® Instruments hardness systems. Indenter, load cell and measurement system are aligned on a single test axis, eliminating mechanical linkages and levers. The resultant benefit is extremely precise hardness tests with unmatched repeatability.

Deadweight and closed-loop hardness testers



Typical deadweight system

Closed-loop system

Rockwell® Hardness Tester Series RB2000

Rockwell 2001 Twin Scale tester

GR&R certificate

Instron® Technology Guarantees Rockwell Results You Can Trust

The Rockwell 2000 series hardness tester uses a unique closed-loop electronic control system and load cell mounted directly on the indenter (U.S Patent No. 5,616,857) to eliminate errors. This ensures that preliminary and total forces are applied with unparalleled accuracy and repeatability, from day to day, operator to operator and tester to tester.

Highest Depth Measurement Accuracy for Precise Results

Rockwell hardness numbers are the result of measuring the depth of indentation into the material. Therefore, the accuracy and resolution of this measurement is critical in obtaining good results. The 2000 series uses optical linear measurement technology to achieve the highest level of depth measurement accuracy and resolution available. There are no mechanical linkages or sources of friction between this measuring device and the tested part. This is a major improvement over conventional dead-weight hardness testers.

No Elevating Screw Simplifies Test Operation and Accuracy

Traditional dead weight hardness testers use an elevating screw, which require a hole in the work surface supporting the tester and deflects under loading. This degrades the accuracy of the Rockwell test results. The 2000 series does not have an elevating screw, which improves displacement measuring accuracy and simplifies test operation.

Proof of Performance Included with Every Tester Shipped

Gauge Repeatabilty & Reproducibility (GR&R) is a method used to determine how much of a process tolerance is being used by variation in a specific machine and its operators (also known as equipment Variation and Appraiser Variation). If the variation is low, then the GR&R percentage will be low. Conversely, if the variation is high, the GR&R percentage will be high. We guarantee a GR&R of 5% or better with every 2000 series tester. The 2000 series delivers the lowest GR&R in the industry. A copy of the GR&R certificate is shipped with each tester for proof of superior performance.

Eronomic Design Significantly Improves Productivity

Ergonomic design makes the Rockwell 2000 Series hardness tester a marvel of simplicity and efficiency. Easier right from the start - the Rockwell 2000 series hardness tester can be operated while sitting or standing. A flexible fiber optic light source provides bright, pinpoint illumination of the test area. For faster operation, 'start', 'stop' and 'indenter' jog keys are ergonomically designed for operator efficiency. Jog speeds to position the indenter are up to 10 times quicker, so positioning for various size parts is faster than ever.

Fast, Two-step Operation

When using the 2000 series's simple menu system, the operator does not have to scroll through endless screen selections. Testing takes only two steps: (1) select a test scale; (2) push 'start' to initiate the test. Graphical icons and status messages provide time-saving information and test data is clearly displayed on the operator panel.

Load Cell Force Control Precision Load Application

The Series 2000 Rockwell tester features a unique, ASTM recognized, electronic closed loop control system design. Closed-loop testing utilizes motor/ encoder control and a force transducer to apply and regulate the test force. A closed-loop system can constantly monitor (500x/sec) and adjust the applied force, virtually eliminating force errors and increasing tester accuracy and repeatability. The resultant benefit is extremely precise hardness tests with unmatched repeatability on any scale.

Two-step operation

Indenter Snap Grip System™

PATENT PENDING

The Indenter Snap Grip system is an innovative device unique to the industry and found exclusively on the Rockwell 2000 series. For over 40 years, Wilson Rockwell testers used a spring ball detent known as the 'Gripsel' to hold the indenter in place. The new 'Snap Grip' has eliminated the Gripsel in favor of an internal self- aligning spring which firmly secures the indenter while assuring that the seat of the indenter is always aligned in the holder, insuring perpendicularity of the indenter and the test piece. With each point on the superficial scale equivalent to 0.000040 of an inch and each point on the regular scale equivalent to 0.000080 of an inch, elimination of error sources is paramount in assuring a precise and accurate test process.

Indenter 'snaps' into place and secured by self-aligning spring

ROCKWELL® HARDNESS TESTER SERIES RB2000

Rockwell 2000 with optional T-slot table testing engine component

The Wilson® Instruments Rockwell RB2000 series hardness testers provide the user with the advantage of selecting and ordering a configured system specific to your testing needs. The modular ordering system of the RB2000 provides complete flexibility in choosing instrument size, scales and components such as indenters, test blocks and anvils. The base model in size 1, 2 and 3 testers includes regular or superficial scale testing (choose one) as standard. Twin scale is an optional select. With a configured system you can choose and purchase only the items you need.

Series 2000 Features:

- ASTM compliant, closed-loop control - insures unmatched test accuracy and repeatability
- Guaranteed GR&R (Gage Repeatability and Reproducibility) of 5% or less
- Encoder based, high precision, optical displacement measurement system
- Intuitive, bright and crisp display/control panel
- New indenter snap grip eliminates traditional gripsel, provides increased repeatability by eliminating side loading of the indenter
- Logical menu drive system with soft keys and user friendly operation
- Large clear fluorescent back-lit display with status icons that indicate indenter type, scale, conversion, cylindrical correction and tolerances
- Meets or exceeds current versions of ASTM E 18, DIN, EN, ISO and other applicable national and international standards
- CE certified
- One-year warranty on material. One-year warranty on service labor with Wilson Instruments or Wilson Instruments authorized installation

Optional Accessories:

- Accessory kit options include diamond indenter and recommended blocks
- Wide range of anvils, fixtures and test tables
- Statistical Process Control (SPC) software
- Printers
- Enhanced operator panel provides:
  - Reports
  - Statistics
  - User programmable storage

Standard Accessories:

- 2.5 in (63 mm) flat anvil
- $^{1}/_{16}$ in carbide ball indenter with five extra carbide balls
- Comprehensive operators manual
- Dust cover
- Certificate of calibration

ROCKWELL® HARDNESS TESTER SERIES RB2000

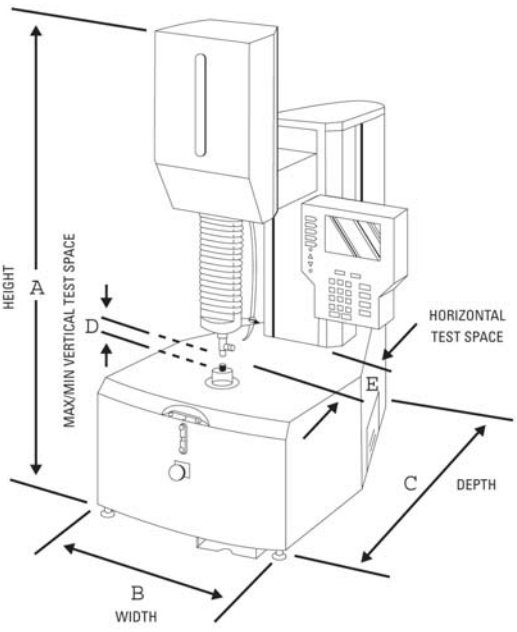
Technical Specifications

Model		(R) Regular Rockwell	(S) Superficial Rockwell	(T) Twin Rockwell Regular and Superficial
Model Numbers	6 in 10 in 14 in	2001R 2002R 2003R	2001S 2002S 2003S	2001T 2002T 2003T
Preliminary Load (kg)		10	3	3, 10
Total Load (kg)		60, 100, 150	15, 30, 45	15, 30, 45, 60, 100, 150
Test Scales		A, B, C, D, E, F, G, H, K, L, M, P, R, S, V	15N, 30N, 45N, 15T, 30T, 45T 15W, 30W, 45W, 15X, 30X, 45X, 15Y, 30Y, 45Y	A, B, C, D, E, F, G, H, K, L, M, P, R, S, V 15N, 30N, 45N, 15T, 30T, 45T 15W, 30W, 45W, 15X, 30X, 45X, 15Y, 30Y, 45Y
Vertical Capacity		Available in three sizes, 6 in (153 mm), 10 in (225 mm), 14 in (355 mm)		
Test Force Control		Closed-loop electronic load cell		
Standards Compliance/ Accuracy		All series 2000 Rockwell hardness testers meet or exceed worldwide standards including ASTM E 18, ASTM B 254, ISO 6508-1,2,3, DIN and JIS standards.		
Power Requirements		100, 120, 220 or 240 VAC ±10%, 47 Hz to 63 Hz single phase		

Physical Dimensions

Size	A	B	C	D (max)	D (min)	E	Weight
1	1029 mm (40.5 in)	343 mm (13.5 in)	590 mm (23.2 in)	153 mm (6.0 in)	0 mm (0.0 in)	216 mm (8.5 in)	100 kg (220 lb)
2	1232 mm (48.5 in)	343 mm (13.5 in)	590 mm (23.2 in)	255 mm (10.0 in)	0 mm (0.0 in)	216 mm (8.5 in)	107 kg (236 lb)
3	1341 mm (52.8 in)	554 mm (21.0 in)	590 mm (23.2 in)	355 mm (14.0 in)	203 mm (8.0 in)	216 mm (8.5 in)	111 kg (245 lb)

D max: Maximum test space between indenter tip and flat anvil; available accessories may increase or decrease test space. Wilson® Instrument series 2000 Rockwell hardness testers are available in three sizes (models 2001, 2002, 2003). Each model can be configured for regular scale Rockwell testing (R), superficial scale (S), or both (T). In addition, each series 2000 Rockwell hardness tester is supplied with a basic or optional enhanced operator panel. Customized configurations and fixtures are also available.



ROCKWELL® 500 SERIES

Analog and digital model 500 testers

The Wilson® Rockwell 500 tester series provides proven reliability and precision at an affordable price. This rugged and reliable design is the proven industry leader in its category and is the benchmark for cost efficient Rockwell hardness testing. Model 500 testers provide motorized application and removal of major loads while precisely controlling the rate of load application. This provides a completely uniform force application and smoother overall test process. Major load dead weights are carefully calibrated at the factory for uniformity from one instrument to another. The weights are enclosed in the aluminum frame and selected by means of a dial on the side of the unit. The operation of the 500 tester is as simple as choosing the desired scale, turning the load dial to the value appropriate to the scale and turning the capstan until the display indicates that the minor load has been reached (on digital models an integrated brake automatically stops the hand wheel). At that point, the tester operates automatically, applying and releasing the major load and displaying the test results. The Rockwell 524 and 504 tester series are manufactured at our Norwood, MA facility.

Analog Model Features:

- Color-coded analog display for fast, accurate reading
- Precision calibrated force system
- Motorized load application
- Dial load selection
- Thrust needle bearing capstan hand-wheel
- Conforms to current versions of ASTM E 18 and ISO 6508
- One-year warranty on parts, one-year warranty on parts and labor with Wilson Instruments or Wilson Instruments authorized installation

Digital Model Features:

- Easy-to-use digital display
- RS232 C serial data port for computer or printer interface
- Load selection error safeguard
- Automatic minor load set auto-brake system
- Automatic electronic scale conversion
- Microprocessor control of dwell and recovery time
- Thrust needle bearing capstan hand-wheel
- Conforms to current versions of ASTM E 18 and ISO 6508
- Plastics mode testing in accordance with ASTM D 785
- One-year warranty on parts, one-year warranty on parts and labor with Wilson Instruments or Wilson Instruments authorized installation

Technical Specifications

Model Number	524R	524S	524T	504R	504S	504T	500RA
Vertical Capacity	11 in (280 mm)	11 in (280 mm)	11 in (280 mm)	12 in (305 mm)	12 in (305 mm)	12 in (305 mm)	6.7 in (170 mm)
Throat Depth	6.2 in (158 mm)	6.2 in (158 mm)	6.2 in (158 mm)	6.2 in (158 mm)	6.2 in (158 mm)	6.2 in (158 mm)	6.5 in (165 mm)
Hardness Parameters	Rockwell regular scales	Rockwell superficial scales	Rockwell regular and superficial scales	Rockwell regular scales	Rockwell superficial scales	Rockwell regular and superficial scales	Rockwell regular and superficial scales
Standards Compliance/ Accuracy	Exceeds ASTM E 18-03 and EN-ISO 6508	Exceeds ASTM E 18-03 and EN-ISO 6508	Exceeds ASTM E 18-03 and EN-ISO 6508	Exceeds ASTM E 18-03 and EN-ISO 6508	Exceeds ASTM E 18-03 and EN-ISO 6508	Exceeds ASTM E 18-03 and EN-ISO 6508	Exceeds ASTM E 18-03 and EN-ISO 6508
Test Force Application Type	Single spring (minor load), deadweight stack (major load)	Single spring (minor load), deadweight stack (major load)	Dual calibrated springs (minor loads), deadweight stack (major load)	Single spring (minor load), deadweight stack (major load)	Single spring (minor load), deadweight stack (major load)	Dual calibrated springs (minor loads), deadweight stack (major load)	Weight (minor load), deadweight stack (major load)
Preliminary Test Force (Minor Load)	10 kgf (98.07 N)	3 kgf (29.4N)	3 kgf (29.4N) and 10 kgf (98.07 N)	10 kgf (98.07 N)	3 kgf (29.4N)	3 kgf (29.4N) and 10 kgf (98.07 N)	10 Kgf (98.07 N)
Total Test Force (Major Loads)	60 kgf (588.4 N), 100 kgf (980.7 N), 150 kgf (1471 N)	15 kg (147.1 N), 30 kg (294.2 N), 45 kg (441.3 N)	15 kg (147.1 N), 30 kg (294.2 N), 45 kg (441.3 N) 60 kgf (588.4 N), 100 kgf (980.7 N), 150 kgf (1471 N)	60 kgf (588.4 N), 100 kgf (980.7 N), 150 kgf (1471 N)	15 kg (147.1 N), 30 kg (294.2 N), 45 kg (441.3 N)	15 kg (147.1 N), 30 kg (294.2 N), 45 kg (441.3 N) 60 kgf (588.4 N), 100 kgf (980.7 N), 150 kgf (1471 N)	60 kgf (588.4 N), 100 kgf (980.7 N), 150 kgf (1471 N)
Readout	Digital panel	Digital panel	Digital panel	Analog color coded dial	Analog color coded dial	Analog color coded dial	Analog color coded dial
Test Cycle Type	Motorized (manual preload, auto trip, auto-brake)	Motorized (manual preload, auto trip, auto-brake)	Motorized (manual preload, auto trip, auto-brake)	Motorized (manual preload, manual trip)	Motorized (manual preload, manual trip)	Motorized (manual preload, manual trip)	Manual preload, Hydraulic dashpot
Data Output	RS232	RS232	RS232	N/A	N/A	N/A	N/A
Data Memory	9999 tests	9999 tests	9999 tests	N/A	N/A	N/A	N/A

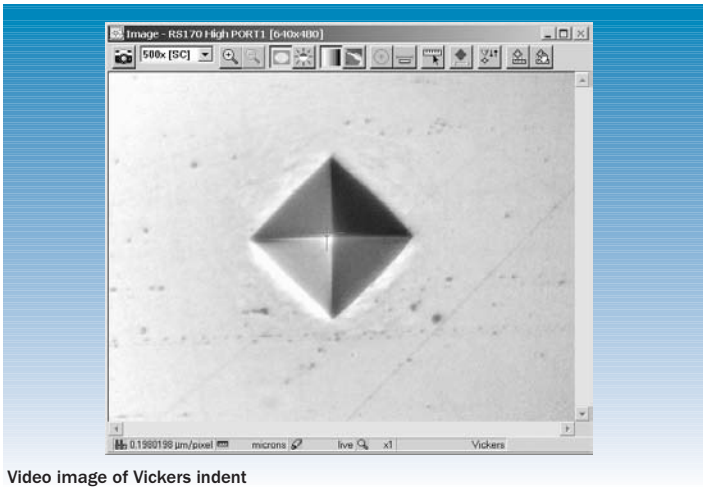
Standard Equipment:

- Dust cover
- Carbide $^{1}/_{16}$ in ball indenter with five extra balls
- Flat anvil: 2.5 in (63 mm)
- Operators manual

Optional Accessories:

- Accessory kit options include diamond indenter and recommended blocks
- Floor stand
- Anvils: standard, cylindron and gooseneck
- Vari-rest support

What is Knoop/ Vickers Testing?



Video image of Vickers indent


Microindentation testing of gear teeth


Sample mounted in UCLD for testing, using x-y stage with digital micrometers

Knoop and Vickers hardness scales are widely used for determining the hardness of a wide range of samples including small precision parts, thin material or wire, coatings, case depths and larger samples. The Knoop and Micro-Vickers scales are commonly referred to as microindentation scales because the indents are very small and must be measured using a high powered microscope. These scales have test forces from 1 g to 1000 g and are defined by ASTM test method E384. They are used for samples that are too small for other types of tests. The macro Vickers scale uses test forces from 1 kg to 100 kg and is defined by ASTM test method E92. Macro-Vickers tests are used for larger samples and the indents are measured using a low power microscope.

Vickers Scale

The Vickers hardness is calculated by dividing the applied force by the surface area of the indentation. A table allows determination of the Vickers number once the diagonals of the indentation have been measured. A Vickers indenter is a diamond ground to a square-based pyramid with a 136° angle between faces and leaves a square indentation with a diagonal length that is about 7 times the depth of the indentation. The Micro-Vickers test force range (10 gf to 1 kgf) is used for applications similar to the Knoop method. The Macro-Vickers test force range (1 kgf to 100 kgf) is generally used for larger specimens that could also be tested using Rockwell® or Brinell testers.

Knoop Scale

The Knoop hardness is calculated by dividing the applied force by the projected area of the indentation. A Knoop indenter is a diamond, ground to a elongated pyramidal form and produces an elongated indentation, with approximately a 7:1 ratio between the long and short diagonals and a 30:1 ratio between the length and depth of the indentation. The 172° 30' longitudinal angle and 130° 0' transverse angle of the pyramid shaped Knoop indenter allows accurate measurement of small force indentations. A table in ASTM E 384 provides the Knoop hardness value once the length of the indentation has been measured. The Knoop indenter is extremely useful in testing hard, brittle material like glass and coatings. Knoop testing uses 10 gf to 1000 gf test forces.

KNOOP/ VICKERS HARDNESS TESTER - TUKON™ 2100B

The Tukon 2100 tester is ideal for quality assurance, quality control, research and development and metallurgical departments. It can be used to monitor hardness during development, fabrication, heat treatment and the performance analysis of a variety of products and components.

Tukon 2100:

Precision. Consistency. Flexibility.

State-of-the-art sensors and closed-loop control technology combine to make the Tukon 2100 the most precise, consistent and accurate instrument for hardness testing. Unlike traditional microhardness testers which use dead weights and dashpots to apply indentation loads, the Tukon 2100 is built around precision force sensors and electromechanical drive systems to produce the most repeatable, error-free and accurate test results.

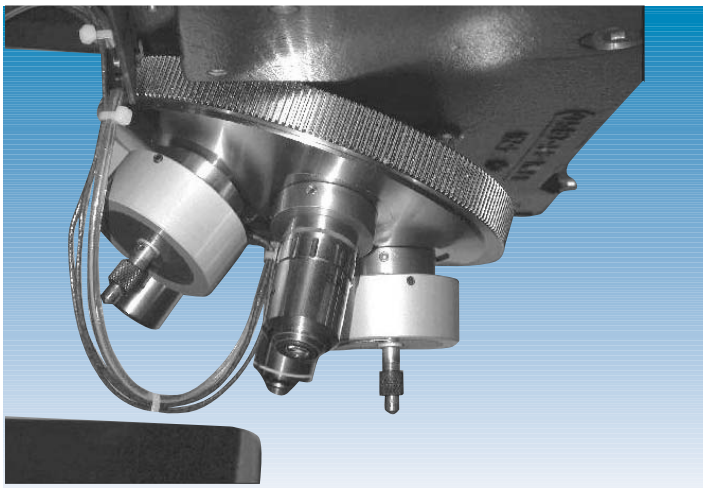
Freedom to Perform:

Configure Your Instrument and Test

The Tukon 2100 has a five position turret that can be custom configured to meet your individual requirements and budget. Start off with the Tukon 2100 base frame and then build your own tester by filling the five positions with additional load cells or objectives, or leave them empty and upgrade later. The Tukon 2100 is entirely modular and can be easily upgraded at your facility with most options. You will need:

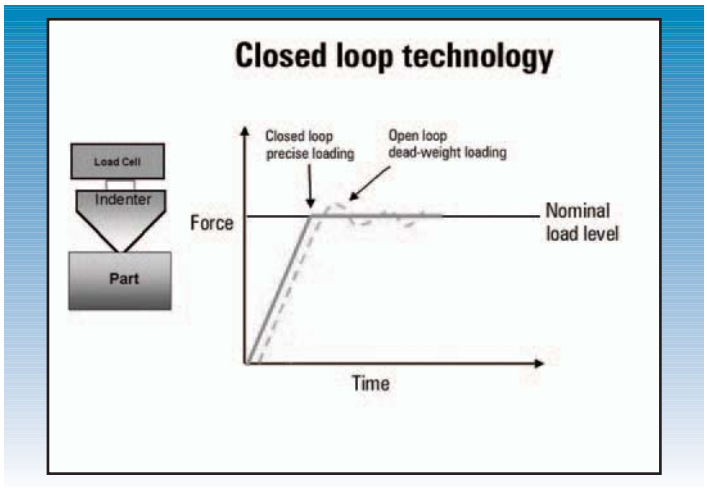
- At least one load cell package
- One objective (maximum four)
- A stage or anvil
- Indenters (Vickers, Knoop)
- Test blocks
- A measuring system

Wilson® model Tukon 2100B

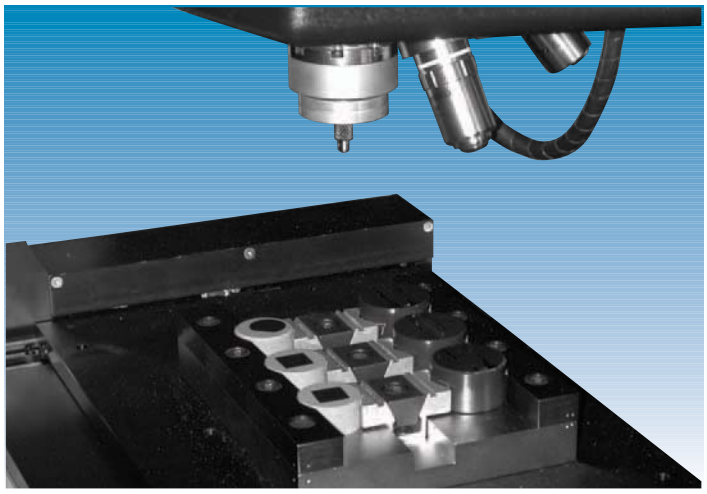


Unique five-station turret holds combination of indenters, objectives, and load cell options

KNOOP/ VICKERS HARDNESS TESTER - TUKON™ 2100B



Closed-loop vs. dead weight loading curves



Optional six-position multi-mount clamping fixture

Superior Test Control

Traditional hardness testing systems use 'open-loop' design, which lack the ability to measure and ensure that proper loading conditions have been achieved. The Tukon 2100 uses 'closed-loop' control technology to constantly measure and control the force applied to the sample. The dramatically improved accuracy and flexibility leads to a nearly unlimited selection of test loads and loading/ unloading rates for virtually any test condition imaginable.

Superior Accuracy

One of the many sources of inaccurate results is the improper application of the test force. Traditional systems have mechanical components that can wear over time, resulting in overshoot and higher than expected loads. The result is potentially, inaccurate hardness readings. The control system in the Tukon 2100 virtually eliminates overshoot through sophisticated algorithms that detect contact with the surface and anticipate the maximum desired test load.

Superior Repeatability

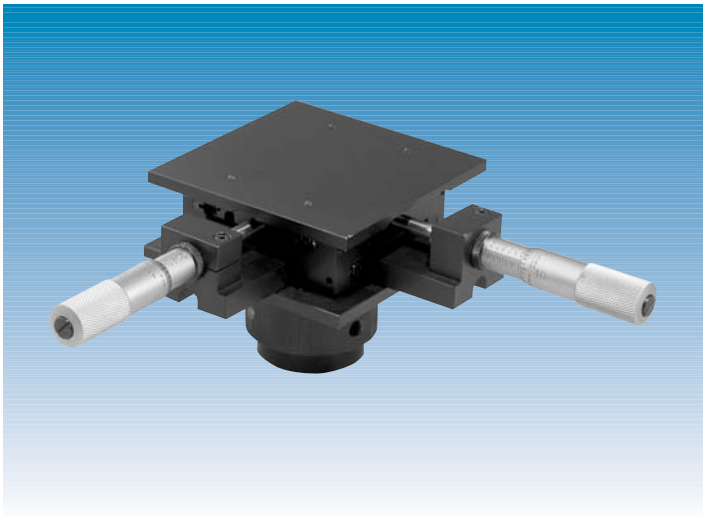
Accurate results depend on the ability to produce consistent, repeatable test conditions. The Tukon 2100 is in a class by itself in this category by virtue of the control it has over loading rate, dwell time and unloading rate.

Superior Productivity

Since the application and removal of the test loads are fully automatic, repeatability is excellent, testing time is reduced, and throughput is increased. As a result, costly and time consuming rework is eliminated. An optional multi-mount clamping fixture is also available for specialized applications to further increase the productivity and throughput of a Tukon 2100 microhardness test system. When used with Wilson®'s ATA™ system (refer to page 18), up to six mounts can be programmed to automatically indent and read individual hardness data in one continuous event. Utilizing its pre-set load and program features, the ATA system will automatically indent at designated surface locations. Once the indent operation is complete, the automated image analysis function performs indentation readings along the traverse of each of the mounted samples. As a result, operator time is reduced to the set up of blocks and the recall of pre-programmed indent and measurement patterns, eliminating time associated with manual operation, leading to greater testing efficiency and productivity.

KNOOP/ VICKERS HARDNESS TESTER - TUKON™ 2100B

Universal clamping and leveling device



X-Y mechanical stage

Technical Specifications

Test Force (Grams)	10 N load cell (10 gf to 1000 gf)
	500 N load cell (300 gf to 50 kgf)
Test Force Selection	Automatic
Test Force Accuracy	±1.5%<200 g, ±1%>200 g
User Panel	Soft key push button panel
Result Display	Length of diagonal, hardness, converted value, test force N, kg
Result Display Resolution	0.1 HK or HV
Test Control Panel	Turret position indicators and indicator lamps
	Start test, stop test, focus, fine focus, light intensity
Memory	1000 test results
Data Output	Adjustable bidirectional RS232C, I\O Port TTL
Hardness Conversion	Per ASTM E 140, ASTM A 370, DIN 50150
Statistics	Total test, highest hardness, lowest hardness, range, standard deviation, average
Loading Mechanism	Motorized closed-loop automatic loading and unloading
Loading Speed	Variable, user defined
Dwell Time	ASTM E 384 10 sec standard and variable 0.1 sec to 999 sec
Measuring Objectives	4X, 10X, 20X, 40X, 50X, 60X, 80X, 100x
Total Magnification	40X, 100X, 200X, 400X, 500X, 600X
	(Special Order - 800x, 1000x)
Measuring Microscope	Minimum graduation: 0.03 mm at 50X
Eyepiece	Dual line filar eyepiece with 10X magnification
Optical Functions	Field aperture, numerical aperture (variable)
Light Source	12 V 30 W halogen
Light Filter	Green, blue, grey and polarized
Stage (Optional)	Manual precision XY ball bearing stage, light or heavy load
Stage Dimensions	90 mm x 90 mm (3.5 in x 3.5 in)
Movement	25.4 mm (1 in) each axis
Movement Graduation	0.025 mm (0.001 in)
Vertical Capacity	108 mm (4.25 in)
Throat Depth	165 mm (6.5 in)
Jog Speed	500 mm per min
Turret	Five position, 288° rotating
	Mounting available for one indenter and four objectives or two indenters and three objectives
Operating Temperature	Range: +10 °C to +38 °C (+50 °F to +100 °F)
Humidity	10% to 90% non-condensing
Power Requirements	100 VAC, 120 VAC, 220 VAC, 240 VAC, 50/60 cycle single phase
Power	370 W
Dimensions	952 mm (37.5 in), 330 mm (13 in), 597 mm (23.5 in)
Weight	68 kg (150 lbs)

KNOOP/ VICKERS TESTER 401MVD AND 402MVD

Model 401MVD

Applications:

- Steels, non-ferrous metals, IC wafer
- Thin plastic, metallic foils, plating, coating, surface layers, laminated metals
- Effect of heat treatment and depths of carburized layer and flame hardened layer

Optional Accessories:

- 20x objective
- Digital stage micrometers
- 2 kg test load
- ATA system

The Series 400 Knoop/ Vickers testers are versatile, user-friendly, and provide an affordable, dependable solution for accurate Vickers and Knoop scale hardness testing. The 400 series is available with manual or automatic turrets and comes equipped with crisp optics that have a total magnification of 100x and 400x. The systems feature eight dial-selectable test forces ranging from 10 g to 1000 g. An optional 2000 g test force system is available. For easy sample mounting, models are equipped with a 100 mm x 100 mm precision XY stage with 25 mm movement in each direction.

Features:

- Model 401MVD manual turret operation
- Model 402MVD automatic turret operation
- Digital eyepiece with automatic encoder
- Automatic load control
- Statistics and conversions
- User-friendly operator panel
- Dual objectives
- XY stage with 0.01 mm resolution
- Optional AutoTest Assistant (ATA™) systems available
- Conforms to ASTM E 384 and ISO 6507

Standard Equipment:

- Knoop and Vickers indenter
- Objectives 10X, 40X
- Digital eyepiece 10X
- XY stage with micrometers
- Built-in printer
- RS232 data output
- Four adjustable feet
- Level gauge
- Dual calibrated Knoop/ Vickers test block
- Spare halogen lamp
- Fuse
- Operators manual
- CE certificate

MICROROCKWELL™ HARDNESS TESTER - SERIES 2001M

The 2001M MicroRockwell is a production level, microhardness load hardness tester. The combination of typical micro indentation test forces and precision and lab quality depth measurement system produces a repeatable, high speed, direct reading testing system. The MicroRockwell can double or triple test throughput and productivity, especially in high volume applications, by virtually eliminating the need for manual intervention. The instrument is ideal for thin metals or plated samples, where a regular Rockwell test is not appropriate due to small part size or light test load requirements. It's guaranteed to save time by reducing the need for surface preparation and eliminating costly and potential erroneous manual indentation measurement. The MicroRockwell is available in force ranges from 500 grams to 10 Kilograms (500 g and 1000 g major load or 5 Kg and 10 Kg major load).

Features:

- User selectable test forces of 500 and 1000 g (additional forces optional) in one test system allows use with a wide range of materials
- Tester can be easily integrated with automation systems for operator independent testing
- High speed, fully automatic testing cycle
- Closed-loop load control method with a load cell directly connected to the indenter
- Optical encoder depth measurement technology
- Uses standard Wilson® Rockwell®, Vickers, or Knoop test blocks
- Scales displayed in HRC, HRA, HRB, Vickers and Knoop

Standard Equipment:

- MicroRockwell indenter
- Hardness reference block
- Operator manual

Optional Accessories:

- Different configurations for integration with automation systems are available to satisfy your needs. Please contact our sales department for advice: 1-800-695-4273
- ATA™ automatic stage and software

Wilson MicroRockwell Model 2001M

Technical Specifications

Test Scales (Converted)	Vickers, Knoop, HRC, HRA, HRB, WMN
Test Cycle Time	15 sec
Preliminary Force	50 g, 100 g
Total Force	500 g, 1000 g
Weight	100 kg (220 lb)

Computerized Autotest Assistant™ (ATA) Systems

Vickers, Knoop and Rockwell® Testers

Wilson Instruments series T2100 Knoop/ Vickers tester with ATA premium fully automatic XY auto traversing system

Three Versions Available

1. **ATA Basic:**
   - PC-based video indent measuring system for Knoop and Vickers testers including Tukon™ 2100 and 400 Knoop/ Vickers
   - Automatic measurements using image analysis
   - Manual measurement capabilities
   - Automatic focus
   - High performance Dell® computer package
2. **ATA Rockwell:**
   - Series 2000 Rockwell and MicroRockwell™ testers
   - Perform fully automatic case depth and other traverses
   - High performance Dell computer package
   - Optional video system for test point definition
3. **ATA Premium:**
   - All features included in ATA basic
   - Knoop and Vickers testers
   - Fully automatic precision motorized stage with a variety of software tools to automate your time-consuming repetitive testing routines
   - Optional Wilson Instruments automatic turret to allow operator-free testing and measurements for a fully automatic system

Wilson® Instruments ATA computerized auto test systems are software-based measurement packages designed to increase productivity, accuracy and efficiency by automating the measurement and/ or the stage navigation process. If you are looking for a way to lower testing costs while maintaining strict compliance with ASTM standards, an ATA option can provide you with a system to meet your requirements.

Features:

- Auto-focus (Vickers and Knoop versions)
- Automatic image measurement with exclusive ATA image analysis (Vickers and Knoop versions)
- High resolution digital video camera
- Standard reporting capabilities
- Data export to Microsoft® Excel
- USB connecting cables
- Filar image measurement capability (Vickers/ Knoop versions)
- Conversions per ASTM E 140
- Pattern saving, recall and rotational abilities
- Up to 36 patterns per test run, unlimited total indents
- Return and re-measure capability (new measurement supercedes previous)
- Quick pattern set-up template
- Variable distance point plotting
- Tester software communication
- Save, print and export image
- Comprehensive results including graphing, statistics, individual values, case depth, effective case, and return and re-measure individual points ability
- Custom reporting capabilities
- Multiple size stages available
- Custom and multi-mount fixtures

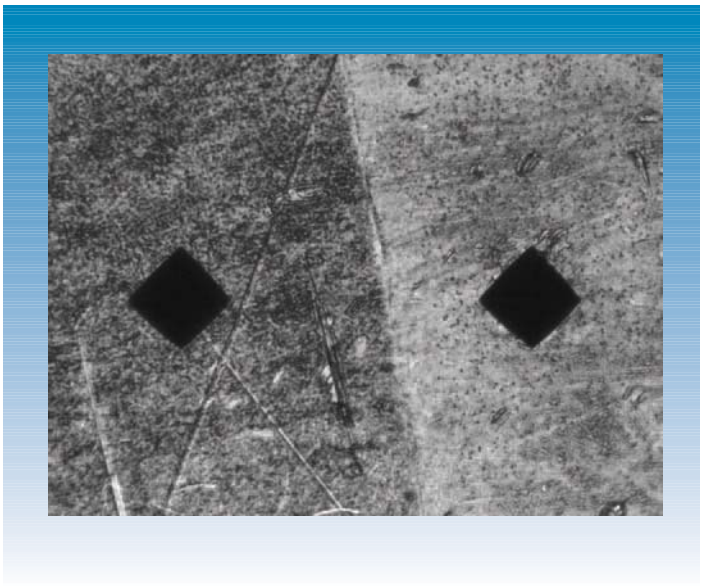
COMPUTERIZED AUTOTEST ASSISTANT™ (ATA) SYSTEMS

VICKERS, KNOOP AND ROCKWELL® TESTERS

Solutions for Microhardness Testing Challenges

Hardness testing of welded material is an excellent example of the challenges associated with micro hardness testing. A series of traversed hardness measurements across the weld, and most importantly in the Heat-Affected Zone (HAZ), can determine whether the weld is applied correctly and within specifications. Traditional testing techniques require manual stage traversing and manual indentation reading via a microscope system. The results obtained in this manner are subjective and dependent on each individual's interpretation; therefore the accuracy, consistency and reliability of the test data is questionable. Other disadvantages to this approach are the associated costs, extensive labor requirements and fatigue factor resulting from repetitive microscope work. Adding to the difficulties in weld analysis is the stark contrast between the HAZ and the surrounding areas. For years this minimized or negated the effectiveness of automatic indention reading packages, requiring time-consuming manual test procedures.

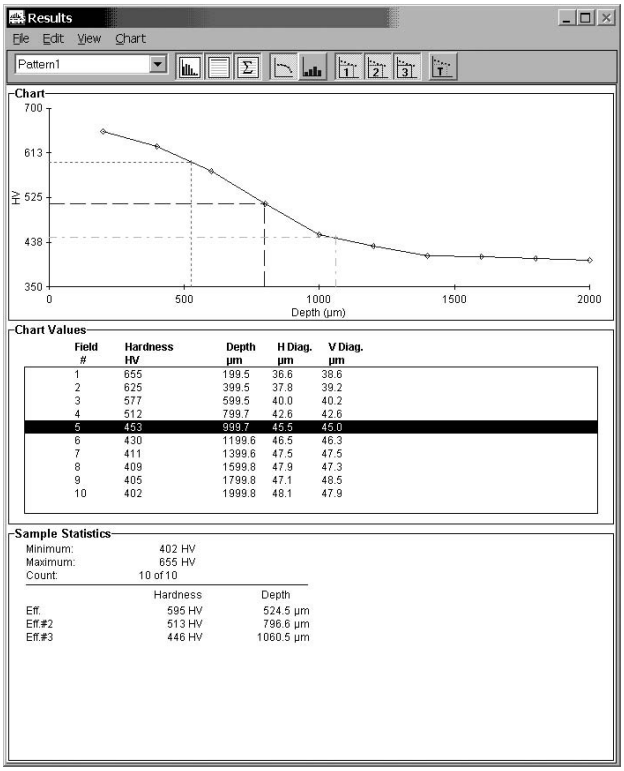
Recent advances in digital camera technology, application software and testing hardware have played a significant role in the emergence of image analysis as a viable tool in weld assessment. These advances are evident in a complete hands-off automated indentation and analysis system combined with the Tukon™ 2100B microhardness tester. Through use of a precision XY indexing stage, automation of the microhardness tester, high-resolution Sony® digital camera and a powerful software package, the results produced by the Tukon 2100B are guaranteed to be accurate, reliable and consistent.



Cross-section of welded tubing in the HAZ using a 500 g Vickers indent and automatic traverse system. The image is analyzed at 200x magnification utilizing automatic image analysis software.

Case Depth Analysis

ATA systems provide the ability to perform case depth and other forms of repetitive and high volume applications in a fully automated, hands-off process. Wilson Automatic case depth testing removes the time consuming, tedious and subjective processes associated with conventional manual case depth analysis and delivers quick, precise and comprehensive data in a fraction of the time. ATA software produces case depth graphs and data charts featuring individual results, effective case depth and statistics. Case depth analysis using ATA can be integrated with Rockwell or Knoop Vickers systems.



Typical case depth study report from ATA

Brinell Closed-Loop Hardness Tester (CLB3)

Closed-Loop Brinell system

The CLB3 is a unique Closed-Loop frame Brinell hardness testing system designed for accurate, repeatable testing on the Brinell scale. As an Instron® Company, Wilson® Instruments has been able to utilize the most advanced and widely used closed-loop technology to produce an extremely repeatable and accurate Brinell system. The system is designed and tested in compliance with ASTM Test Method E10, Standard Test Method for Brinell Hardness of Metallic Materials. The CLB3 has a capacity of 3000 kg and features a digital crosshead drive system, integrated digital closed-loop control and data acquisition electronics.

Features:

- Table mounted system, capacity 30 kN (3,000 kg, 6,750 lb)
- Digital cross-head drive system
- Integrated digital closed-loop control and data acquisition electronics
- Crosshead extension and load measurement channels
- Automatic recognition and calibration of transducers
- Pre-loaded ball-screw drive and crosshead guidance columns
- Load measurement accuracy: Meets or exceeds ASTM E 4, BS 1610, DIN 51221, ISO 7500/1, EN 10002-2, JIS B7721, JIS B773 and AFNOR A03-501 standards
- Model CLB3 compression load cell, Capacity: 30 kN (3,000 kg, 6,750 lb)
- Test control panel with functions keys
- CE certified
- Larger capacity models available upon request

Technical Specifications

Load Force	Four customer-defined, selectable loads 30 Kg - 3000 Kg
Horizontal Test Space	420 mm (16.5 in)
Crosshead (Vertical) Travel	1122 mm (44.2 in)
Crosshead Return Speed	600 mm/min (24 in/min)
Dwell Ttime	Static 1 sec to 999 sec
Force Accuracy	±0.5% of nominal Kgf load. Forces calibrated and verified with NIST traceable standards
Voltage	120 VAC

Standard Accessories:

- Carbide ball (specify size)
- Two Brinell test blocks, (specify range)
- Flat anvil 152 mm (6.0 in) diameter-hardened, chrome plated stainless steel

Optional Accessories:

- T-slot table
- Variety of anvils and mounting fixtures
- 20x and 40x Brinell microscopes
- Kingscan automatic Brinell microscope

Brinell Bench Model Hardness Testers

The benchtop Brinell line offers versatility and dependability in a convenient tabletop model. Incremental deadweight stack allows force options from 187.5 kg to 3000 kg and individually calibrated weights ensure high accuracy. Bench models are available in a motorized or a hydraulically-controlled manual version.

Model MJ

The motorized MJ deadweight Brinell hardness tester is designed for laboratories and shops that have low to medium rates of production and require the highest level of accuracy.

Features:

- Precalibrated deadweights
- Motorized automatic test cycle with indicator light
- Adjustable dwell 0 to 60 seconds
- Standard loads 500 kg, 1000 kg, 1500 kg, 2000 kg, 2500 kg, 3000 kg
- Low load model adds 187.5 kg, 250 kg, 750 kg weights
- Conforms to ASTM E 10

Model J

The model J is a manually operated deadweight Brinell tester. This model has the high accuracy of the MJ model but requires no external power source.

Features :

- Dashpot controlled load application
- Precalibrated deadweights
- Standard loads 500 kg, 1000 kg, 1500 kg, 2000 kg, 2500 kg, 3000 kg
- Low load model adds 187.5 kg, 250 kg, 750 kg weights
- Conforms to ASTM E 10

Wilson Brinell Model MJ

Standard Equipment for MJ and J Models:

- 10 mm tungsten carbide ball penetrator
- Spare 10 mm tungsten carbide ball
- 2½ in (65 mm) flat anvil
- Dust cover

Technical Specifications

Model	MJ	J
Catalog Number	900076100	900076500
Throat Depth	6 in (150 mm)	same as MJ
Vertical Capacity	9 in (230 mm)	same as MJ
Ram Stroke	⅛ in (3 mm)	same as MJ
Base Dimension (WxD)	15 in x 26 in (395 mm x 660 mm)	same as MJ
Overall Height	32 in (825 mm)	same as MJ
Operation	Motorized	Manual
Motor	115 v/ 60 Hz / 1 Ph (optional 220/ 50/1)	–

Brinell Floor Model Hardness Testers

Wilson Brinell Model K-10

Model K-10

The K-10 hydraulic Brinell hardness tester is a sturdy, durable, easy-to-use unit that is suitable for both laboratories or production testing applications. Brinell Floor models are used predominately in production environments that require repetitive testing of large, heavy parts.

Features:

- Load indicating gauge
- Automatic test cycle with adjustable dwell time
- Factory calibrated to one load (500 kgf to 3000 kgf)
- Optional selector for four pre-calibrated test loads
- Conforms to ASTM E 10

Standard Equipment:

- Foot switch
- 10 mm tungsten carbide ball penetrator
- Spare 10 mm tungsten carbide ball
- 2¼ in (57 mm) flat anvil

Brinell Floor Model Hardness Testers

Model AP

The Model AP hydraulic Brinell hardness tester is a heavy duty unit designed to make production testing of large parts easy, safe and convenient.

Features:

- Extended stroke
- Large testing capacity
- Heavy duty, hardened testing table
- Load indicating gauge
- Automatic test cycle with adjustable dwell time
- Factory calibrated to one load (500kgf to 3000 kgf)
- Optional selector for 4 precalibrated test loads
- Optional 24 in x 24 in (600 mm x 600 mm) testing table
- Conforms to ASTM E 10

Standard Equipment:

- Foot switch
- 10 mm tungsten carbide ball penetrator
- Spare 10 mm tungsten carbide ball
- 12 in (300 mm) ram extension
- 2¼ in (57 mm) flat anvil
- 12 in x 24 in (300 mm x 600 mm) testing table

Wilson Brinell Model AP shown with removable ram extension to test small parts

Model KDR-10 and AP-DR

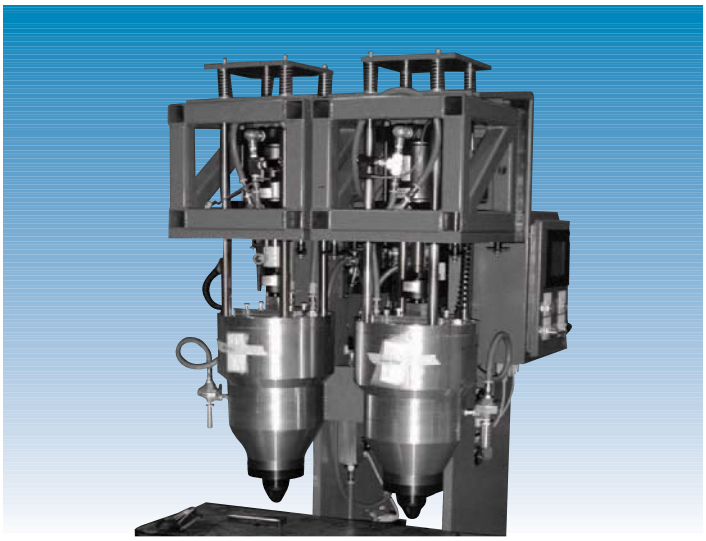
Wilson also offers K and AP models with a comparative reading feature. The KDR-10 and AP-DR models are ideal for Go/ No-Go testing large quantities of identical parts that are solid and have machined parallel surfaces. Both units are available in standard and low load versions.

Technical Specifications

Model	K	KDR	AP	APDR
Throat Depth	10 in (250 mm)	10 in (250 mm)	24 in (500mm)	24 in (500 mm)
Vertical Capacity	17 in (430mm)	14 in (360mm)	24 in (600 mm)	20 in (500 mm)
Base Dimension (WxD)	15 in x 20 in (380 mm x 740 mm)	15 in x 20 in (380 mm x 740 mm)	23 in x 40 in (580 mm x 1020 mm)	23 in x 40 in (580 mm x 1020 mm)
Overall Height	70 in (1780 mm)	70 in (1780 mm)	90 in (2290 mm)	90 in (2290 mm)
Operation	Motorized hydraulic	Motorized hydraulic	Motorized hydraulic	Motorized hydraulic
Motor	1 hp 115v/60Hz/1ph, optional 1 hp 220v/50hz/1ph			
Load Range	500 Kgf to 3000 Kgf (select one for single load option or four for four load option)			

Brinell Digital Production Models HP, CP and BP

Wilson Brinell Model BP



Custom-designed dual head production Brinell

Production Brinell systems offer an automated test method that provides both fast and accurate testing for high production applications. The Production Brinell test was developed by Wilson® Instruments as a unique method of automatically and accurately determining Brinell hardness. The Production Brinell test eliminates the costly and time consuming procedures associated with conventional Brinell testing. Available as a bench model or mounted on an optional floor stand, these models are easily adaptable to a variety of test applications with either manual or automatic sample handling. Special requirements typically require the design of a custom system by Instron®/ Wilson engineers.

Features:

- Low and high range heads available with standard single or optional dual loads
- A six second automatic testing cycle allows high production rates of up to 450 specimens per hour
- Hydraulic pre-clamping of the specimen prior to application of the test load to ensure that the specimen remains stationary
- Automatic determination of hardness values through the proven depth of indentation method
- Digital readout
- Three standard models available
- Standard RS-232 output

Technical Specifications

Specification	HP	BP	CP
Throat Depth	18 in (450 mm)	12 in (305 mm)	18 in (450 mm)
Vertical Capacity	24 in (600 mm)	16 in (404 mm)	35 in (900 mm)
Operation	Pneumatic/ hydraulic	Pneumatic hydraulic	Pneumatic/ hydraulic hydraulic
Load Range- Standard	1500 to 3000 kgf	1500 to 3000 kgf	1500 to 3000 kgf
Load Range- Low	250 to 1000 kgf		250 to 1000 kgf

Portable Brinell

King Portable Brinell hardness testers are lightweight, easy to maneuver and require only one operator, making them ideal for use as portable or bench units. Versatile enough to test virtually any size and shape of metal specimen, these Brinell testers are easy-to-use. The operator simply places the specimen between the anvil and the test head, cranks the test head down onto the specimen locking the tester in place, closes the pressure release valve and pulls the hydraulic lever until desired load is reached. The tester applies up to a 3000 kg load with a 10 mm ball. A by-pass valve is automatically activated at the calibrated load, eliminating the chance of overloading. The impression is then read and recorded by the operator using a Brinell microscope, such as the deep reading microscope or an automatic scan Brinell microscope. The King Portable Brinell meets ASTM E 110.

Features:

- Durable - rugged design withstands heavy usage
- Accurate - calibrated within 1% of load. Can be used for loads up to 3000 kg
- Versatile - can be used in virtually any position; right-side up, upside down or sideways
- Stainless steel test head - contains sealed hydraulic pump and reservoir. Fully compatible with optional frames
- Gear train with hand crank allows for easy, positive adjustment of vertical opening
- Pressure gauge for indication of load exerted by pump
- Alloy steel threaded posts

The King Portable Brinell tester comes standard with a 14 in (356 mm) vertical and 4 in (102 mm) horizontal capacity base frame. Also included is test head and gauge calibrated for test loads from 0 to 3000 kg.

King Portable Brinell hardness tester

Standard Equipment:

- 10 mm carbide ball
- Flat, dome and vee anvil
- Operators guide

Optional Accessories:

- 508 mm (20 in) vertical capacity frame with 102 mm (4 in) horizontal capacity
- 508 mm (20 in) vertical capacity frame with 152 mm (6 in) horizontal capacity
- 20x and 40x Brinell microscopes
- Kingscan automatic Brinell microscope

Universal Testing

Model 930 Dia-Testor

Universal Hardness, Dia-Testor 930:

- A comprehensive range of hardness testing procedures offered by one machine: Rockwell® Regular, Vickers, Brinell
- Closed-loop force control means force accuracy and efficiency
- User-friendly control panel for easy test setup and programming
- Digital control panel features include conversions, dwell timing, corrections and statistics
- RS232 serial interface
- Meets ISO hardness testing standards for test types
- Communication with the user in any of five languages (English, German, French, Italian and Swedish)

Universal Hardness, Dia-Testor™ 971:

- A comprehensive range of hardness testing procedures offered by one machine: Rockwell regular, Vickers, Brinell
- Closed-loop force control means extreme force accuracy and efficiency
- User-friendly control panel for easy test set-up and programming
- Digital control panel features include conversions, dwell timing, corrections and statistics
- RS232 Serial interface
- Meets ISO hardness testing standards for test types
- Communication with the user in any of five languages (English, German, French, Italian and Swedish)
- Available with optional motorized testing table
- 3000 kg capacity

Standard Equipment:

- Test table - flat, 80 mm diameter

Optional Accessories:

- Variety of anvils
- X-Y stage
- Additional objectives - 44x, 70x, 140x

Technical Specifications

Specification	Dia 930 universal tester	Dia 970 universal tester
Vertical Capacity	300 mm	700 mm
Throat Depth Hardness Parameters	150 mm Brinell, Vickers, Rockwell®	300 mm Brinell, Vickers, Rockwell
Standards Compliance/ Accuracy	DIN-EN-ISO 6506-6507-6508	DIN-EN-ISO 6506-6507-6508
Test Force Application Type	Closed-loop load control	Closed-loop load control
Vickers Procedures (HV)	2, 3, 5, 10, 20, 30, 50, 100	30, 50, 100
Brinell Procedures (HB)/ Forces	HB 1 – 2.5, 5, 10, 30 HB 2.5 – 6.25, 15.62, 31.25, 62.5, 187.5 HB 5 – 25, 62.5, 125, 250 HB 10 – 100, 250	25, 30, 31,25, 62,5, 100, 125, 187,5, 250, 500, 750, 1000, 1500, 3000
Rockwell Procedures (HR)	A, B, C, D, E, F, G, H, K, L, M, P, R, S, 15N, 30N, 45N, 15T, 30T, 45T, 15W, 30W, 45W, 15X, 30X, 45X, 15Y, 30Y, 45Y, 30 TM, HMR 5/25	A, B, C, D, E, F, G, H, K, L, M, P, R, S
Optics	Optics - High precision optics, screen diameter 135 mm	Optics - High precision optics, screen diameter 135 mm
Objectives	Optional 20x, 44x, 70x, magnification 140x standard	Optional 44x, 70x, 140x magnification 20x standard
Scale Resolution	Incremental scale / better than 1 micron	Incremental scale / better than 1 micron
Display	Integrated hardness calculator, determination of hardness values for all procedures, statistics functions, data transfer	Integrated hardness calculator, determination of hardness values for all procedures, statistics functions, data transfer
Data Output	RS232 serial interface (to printer or pc)	RS232 serial interface (to printer or pc)

Portable Rebound Testers M200A and M250A

Model M-250A handheld hardness tester with carrying case, test block and HP printer

Technical Specifications

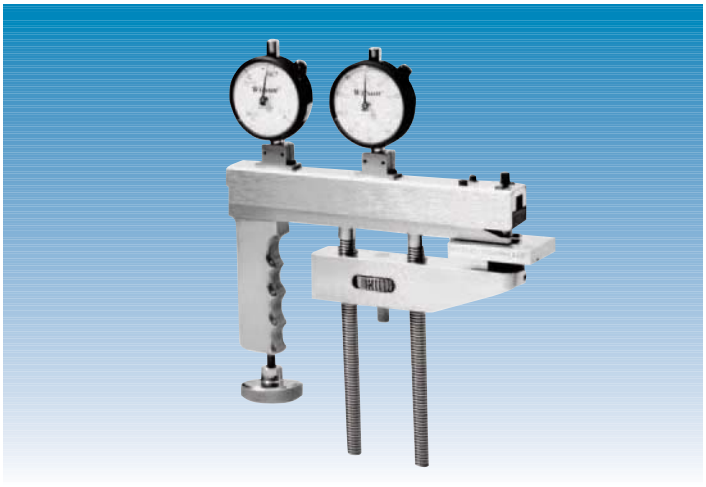
	M-200A	M-250A
Test Range	200-900 HL (Leeb value)	200-900 HL (Leeb value)
Scales	HL, HV, HB, HRB, HRC, HSD	HL, HV, HB, HRB, HRC, HSD
Accuracy	± 4 HL	± 4 HL
Results Storage	10	200
Printer	N/A	Standard
Sample Size	15 kg minimum	15 kg minimum
Battery Life	40 hr continuous (approx. 2,500 test results)	40 hr continuous (approx. 2,500 test results)

The M-200A and M-250A hardness testers operate on the Leeb principle of measuring both the impact velocity of a spring-loaded impact ball prior to contacting the test surface and the ball's rebound velocity after it has contacted the test surface. The small size and easy-to-use, one hand operation makes the M-200A and M-250A testers ideal for use on internal surfaces of casting or fabricated assemblies, or on large, cumbersome samples.

Features

- Easy-to-use, one-hand operation
- Large, easy to read LCD display
- Wireless design
- Stores up to 200 test results
- Direct readings in six hardness scales
- Conforms to ASTM A 956
- Tests in any direction

Handheld Testers M51 and M52



Model M51

Technical Specifications

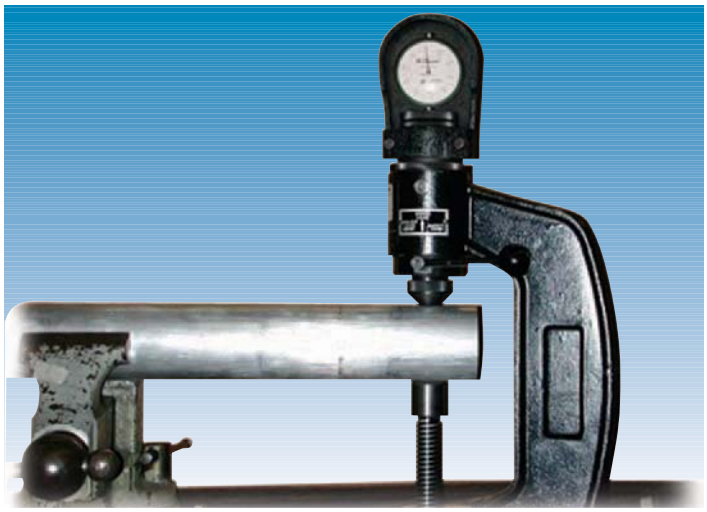
	M51	M52
Test forces	60, 100, 150 kg	60, 100, 150 kg
Scales	Regular Rockwell	Regular Rockwell
Vertical (Throat) Capacity	4.5 in (114 mm)	12 in (305 mm)
Horizontal (Throat Depth) Capacity	2.25 in (57 mm)	6 in (152 mm)
Display	Analog dial gauge	Analog dial gauge

The M51 and M52 portable handheld hardness testers are ideal for testing stacked sheets, rod and tubing on racks and in areas where clearance is limited. Regular scale test forces of 60, 100 and 150 kg can be applied. These handheld units are equipped with pistol grips for ease of operation and speed. Models are available in throat capacities up to 12 inches (304 mm) and throat depth up to 6 inches (152 mm).

Features:

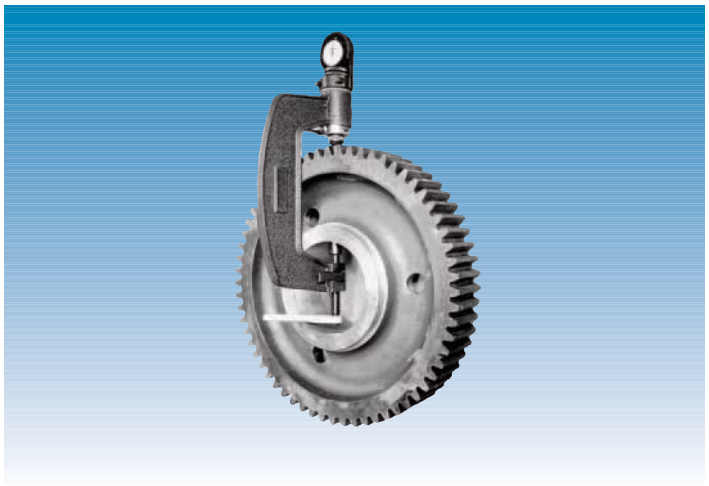
- Manual operation, analog display
- Ideal for areas with limited clearance
- Regular Rockwell scale testing
- Two sizes available
- Integral clamp mechanism

C-Frame Mobile Hardness Testers



Wilson® Instrument Model M-2 C-Frame Mobile hardness tester

Mobile hardness testers are useful for testing a large variety of parts, materials and components that do not lend themselves easily to bench testing. C-frame models, such as the Model M2, include lightweight cast alloy frames, threaded rod clamps and a standard test head with pre-loaded spring mechanisms. Cylinder type mobile testers are particularly useful in testing pipe and round stock. These testers employ a chain or steel band for clamping the workpiece. The M-8 magnet mobile tester is designed for testing large ferrous parts, such as engine blocks and other items of sufficient mass, to allow the tester's electromagnetic force to hold the instrument securely onto the workpiece. Both flat and cylindrical pieces can be tested with the magnetic mobile tester.



Wilson Instrument C-Frame testing gear teeth

Wilson Instruments Model M-7 cylinder type tester

C-Frame Mobile Hardness Testers

Technical Specifications

	M-0	MO-QC	M-1	M-2	M-3
Test Force Application	Manual/ clamping mechanism	Manual/ quick clamp release mechanism	Manual/ clamping mechanism	Manual/ clamping mechanism	Manual/ clamping mechanism
Test Forces	15 Kg (147.1 N), 30 Kg (294.2 N), 45 Kg (441.3 N) 60 Kgf (588.4 N), 100 Kgf (980.7 N), 150 Kgf (1471 N)	15 Kg (147.1 N), 30 Kg (294.2 N), 45 Kg (441.3 N) 60 Kgf (588.4 N), 100 Kgf (980.7 N), 150 Kgf (1471 N)	15 Kg (147.1 N), 30 Kg (294.2 N), 45 Kg (441.3 N) 60 Kgf (588.4 N), 100 Kgf (980.7 N), 150 Kgf (1471 N)	15 Kg (147.1 N), 30 Kg (294.2 N), 45 Kg (441.3 N) 60 Kgf (588.4 N), 100 Kgf (980.7 N), 150 Kgf (1471 N)	15 Kg (147.1 N), 30 Kg (294.2 N), 45 Kg (441.3 N) 60 Kgf (588.4 N), 100 Kgf (980.7 N), 150 Kgf (1471 N)
Scales	Regular or superficial	Regular or superficial	Regular or superficial	Regular or superficial	Regular or superficial
Vertical (Throat) Capacity	1.4 in (35 mm)	0.9 in (23 mm)	6.3 in (160 mm)	9.8 in (250 mm)	13.8 in (350 mm)
Horizontal (Throat Depth) Capacity	4.3 in (110 mm)	4.3 in (110 mm)	3.3 in (85 mm)	5.1 in (130 mm)	7.1 in (180 mm)
Minimum Sample Size	N/A	N/A	N/A	N/A	N/A
Display	Analog dial gauge	Analog dial gauge	Analog dial gauge	Analog dial gauge	Analog dial gauge

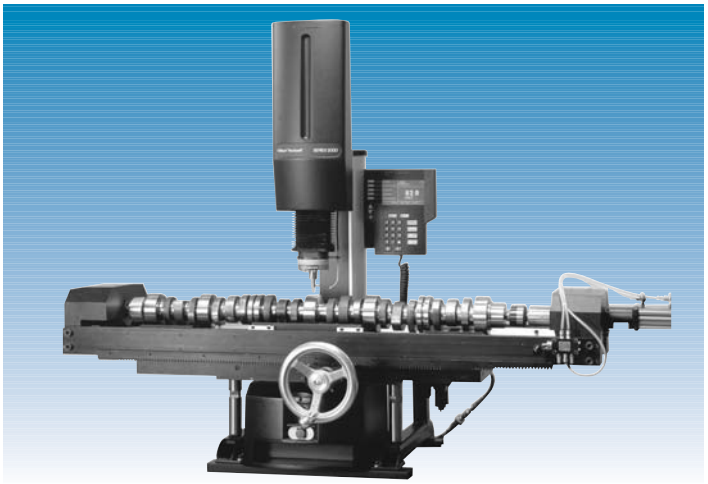
	M-4	M-6	M6-QC	M-7	M-8	M-9
Test Force Application	Manual/ clamping mechanism	Manual/ clamping mechanism	Manual/ quick clamp-release mechanism	Manual/ cylindrical/ take-up chain	Magnetic	Manual/ cylindrical/ take-up chain
Test Forces	15 Kg (147.1 N), 30 Kg (294.2 N), 45 Kg (441.3 N) 60 Kgf (588.4 N), 100 Kgf (980.7 N), 150 Kgf (1471 N)	15 Kg (147.1 N), 30 Kg (294.2 N), 45 Kg (441.3 N) 60 Kgf (588.4 N), 100 Kgf (980.7 N), 150 Kgf (1471 N)	15 Kg (147.1 N), 30 Kg (294.2 N), 45 Kg (441.3 N) 60 Kgf (588.4 N), 100 Kgf (980.7 N), 150 Kgf (1471 N)	15 Kg (147.1 N), 30 Kg (294.2 N), 45 Kg (441.3 N) 60 Kgf (588.4 N), 100 Kgf (980.7 N), 150 Kgf (1471 N)	15 Kg (147.1 N), 30 Kg (294.2 N), 45 Kg (441.3 N) 60 Kgf (588.4 N), 100 Kgf (980.7 N), 150 Kgf (1471 N)	15 Kg (147.1 N), 30 Kg (294.2 N), 45 Kg (441.3 N) 60 Kgf (588.4 N), 100 Kgf (980.7 N), 150 Kgf (1471 N)
Scales	Regular or superficial	Regular or superficial	Regular or superficial	Regular or superficial	Regular or superficial	Regular or superficial
Vertical (Throat) Capacity	13.8 in (350 mm)	1.4 in (35 mm)	0.9 in (23 mm)	N/A	N/A	N/A
Horizontal (Throat Depth) Capacity	13.8 in (350 mm)	8.6 in (220 mm)	8.6 in (220 mm	N/A	N/A	N/A
Minimum Sample Size	N/A	N/A	N/A	Round - 3 in (75 mm) dia.	Flat – 14 x 2.25 x .25 in Round – 1.5 in dia.	10 in (250 mm) dia.
Display	Analog dial gauge	Analog dial gauge	Analog dial gauge	Analog dial gauge	Analog dial gauge	Analog dial gauge

Custom Systems

For over 50 years, Wilson® Instruments has been the leading supplier of custom-designed solutions to a wide variety of special hardness testing application requirements. From simple modifications of support anvils and fixtures to full blown automatic systems, Wilson has the expertise to engineer the right solution. Our wide range of standard anvils and fixtures will handle most common testing needs. However, when a sample does not fit a standard accessory, our custom engineers can design a fixture to accommodate your special needs.

When your testing requirements go beyond the capabilities of standard hardness testers, our custom automation group can fill your needs. We have extensive experience designing and building modular robotically operated testers that can run 24/7, as well as inline production testers that can test 100% of your parts. Production rates can be tailored to suit your needs. Rockwell® testing rates can be as high as 3600 parts per hour and Brinell type systems can easily achieve rates of 300-400 parts per hour.

Whatever your needs are for customized products, Wilson Instruments has the capability and experience to fill them.



Specialized fixture to secure truck camshaft for Rockwell test

Modified Rockwell 2000 with Brinell test frame to accommodate testing of extremely large parts

Accessories

Wilson® Instruments offers a comprehensive selection of hardness accessories – from anvils and fixtures to test blocks. Wilson Instruments has everything you need to get the job done. If you have a special requirement, contact us and we will assist you with custom-designing a component to meet your testing requirements.

Test Blocks

Wilson Instruments test blocks set the standard for the industry and are made from the highest quality material to insure the most uniform and repeatable blocks available. A comprehensive variety of scales and blocks are available to meet the wide ranges and hardness scales associated with Rockwell®, Brinell, Knoop and Vickers testing. All Wilson Instruments test blocks are calibrated in the Wilson Hardness Calibration Laboratory in Norwood, MA. The Wilson lab is accredited to ISO/IEC 17025 by NVLAP® and the testers used in the calibration process undergo a stringent monitoring process using NIST traceable devices. Yamamoto test blocks are also supplied and calibrated by Wilson Instruments and are considered the premier test blocks in the industry. For the ultimate accuracy and performance in tester verification, calibration sets are available for most Rockwell scales.

Indenters

It is important to have an accurate indenter configuration for dependable hardness testing. Even a slight deviation in the form of flats, peaks or poor surface finish from the true contour, can result in inaccurate readings. For this reason, extreme care is taken in every step of manufacturing Brale® diamond indenters, which have been accepted as the industry standard for long life and reliable performance. All Rockwell brale, Knoop and Vickers indenters, and ball penetrators are calibrated to meet American and international standards at the Instron-Wilson Instruments Hardness Calibration Laboratory in Norwood, MA.

Anvils

Anvils ensure accurate test results by securing the specimen so that the test surface is always perpendicular to the indenter centerline during the application of the load force. A wide range of anvils are available with varying shapes and sizes. Irregular shaped pieces must be properly supported on specially designed fixtures if an accurate test is to be made. Custom anvils are available upon request.

Testing Fixtures

Testing fixtures are designed to accommodate a variety of specialized testing requirements for use on Wilson Instruments Rockwell, Brinell and Knoop/ Vickers testers.

Equitron jominy fixture

Miscellaneous

Other Wilson accessories include sturdy floor stands for securing your hardness tester, vibration isolation platforms, Brinell deep reading microscopes and various software packages for data collection.

Gear test fixture

Wilson® Instruments is committed to providing a superior range and level of support services to its customers. Wilson, the world's leading manufacturer of hardness testing equipment, has been in the forefront of manufacturing and servicing a comprehensive range of hardness testers for over 75 years. As an Instron® company, Wilson is part of an extensive global network of service engineers. Instron/ Wilson's factory-based calibration laboratory possesses capabilities normally found only in a National Standards Laboratory. Both the factory and field calibration services are accredited to ISO/IEC 17025 and 10012-1.

Services include:

- Calibration and verification
- Preventative maintenance
- On-site support
- Installation and relocation
- Web support
- Telephone support
- Application support and solutions
- On-site training

Calibration and Preventive Maintenance

Wilson Instruments offers an extensive range of calibration and verification services for hardness testing instruments and related equipment. Wilson's factory trained service engineers are uniquely qualified to not only perform accredited calibrations, but to also provide expert preventive maintenance, adjustments and repairs using parts from the factory that meet original equipment specs. This extends the life of your equipment and optimizes its accuracy and reliability. Instron actively participates in international standards organizations such as ASTM and ISO, so Wilson service engineers are kept up to date on the latest developments in hardness testing standards in addition to all developments affecting Wilson and Instron equipment.

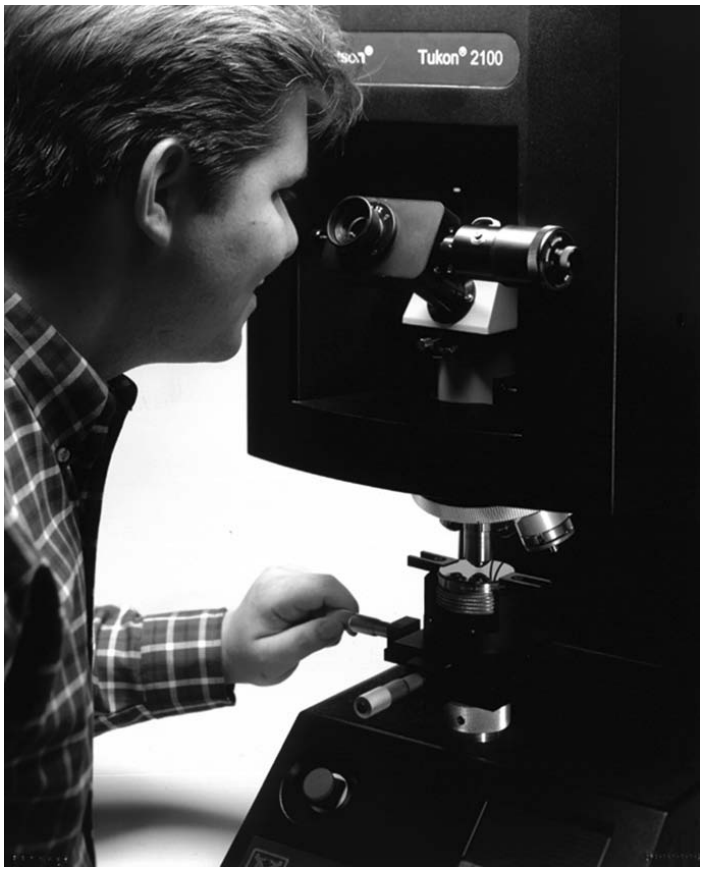
The factory-based hardness standards lab is unequalled by any other calibration supplier and provides the foundation of Wilson Rockwell test blocks. Accredited by NVLAP® (lab code 200301-0), an accrediting agency operated by NIST, it provides calibration sets for our customers, calibration sets for our service engineers that are superior to any sets commercially available, direct and indirect verification capabilities and standardized test blocks traceable to NIST. The lab has full capabilities for the calibration of all Wilson hardness instruments and meets or exceeds all relevant ASTM and ISO standards.


INSTRON

Verification Report


INSTRON

Services



Installation

Wilson® Instruments recommends installation of your hardness tester by a factory trained Instron®/ Wilson Service Engineer or Wilson authorized service representative. This service ensures smooth and fast start-up and efficient operation from the first day of installation. Installation by Wilson Instruments or a Wilson Instruments authorized service representative insures full service warranty on tester and components including parts and labor. Instron/ Wilson's Field Service Engineers are highly trained ISO 17025-accredited engineers who provide local services to install, repair and calibrate your equipment on site. Instron/ Wilson products are supported by the largest network of field service engineers in the material testing industry.

Training

Basic operator training is provided by your local Instron/ Wilson Field Service Engineer immediately following completion of the installation of your Wilson hardness tester. Training includes use of all safety features, calibration requirements and basic operational functions as well as the successful completion and acceptance of a customer test. Advanced on-site training courses are available upon purchase of an automatic measuring system (ATA™). Advanced ATA training provides the user with comprehensive knowledge of both the hardness instrument and ATA software features and abilities, and provides complete understanding of indentation pattern setup, design, reading and results manipulation.

Customized training courses tailored to meet your specific requirements are available upon request. Please consult with the factory or your local Instron/ Wilson service engineer.

Table 1: Regular Rockwell® Testing

Scale Symbol	Penetrator	Load in Kilograms - Force
A*	Brale®*	60
B	1/16 in ball	100
C	Brale	150
D	Brale	100
E	1/8 in ball	100
F	1/16 in ball	60
G	1/16 in ball	150
H	1/8 in ball	60
K	1/8 in ball	150
L	1/4 in ball	60
M	1/4 in ball	100
P	1/4 in ball	150
R	1/2 in ball	60
S	1/2 in ball	100
V	1/2 in ball	150

*Two scales - cabide and steel

In regular Rockwell testing the minor load is always 10 kgf (kilograms of force). The major load can be any of the following loads: 60, 100 or 150 kgf. A letter has been assigned for every possible combination of load and penetrator, as given in Table 1.

Table 2: Superficial Rockwell Testing

Scale Symbol	Penetrator	Load in Kilograms - Force
15 N	N Brale	15
30 N	N Brale	30
45 N	N Brale	45
15 T	1/16 in ball	15
30 T	1/16 in ball	30
45 T	1/16 in ball	45
15 W	1/8 in ball	15
30 W	1/8 in ball	30
45 W	1/8 in ball	45
15 X	1/4 in ball	15
30 X	1/4 in ball	30
45 X	1/4 in ball	45
15 Y	1/2 in ball	15
30 Y	1/2 in ball	30
45 Y	1/2 in ball	45

In superficial Rockwell testing the minor load is always 3 kgf. The major load can be one of the following loads: 15, 30 or 45 kgf. As with the regular scales, a scale designation has been assigned for every possible combination of load and penetrator as given in Table 2.

Table 3: Typical Scale Applications

Scale Symbol	Typical Applications of Scales
B	Copper alloys, soft steel aluminum alloys, mallable iron, etc.
C	Steel, hard cast irons, pearlitic malleable iron, titanium, deep casehardened steel and other materials harder than B 100
A	Cemented carbides, thin steel and shallow casehardened steel
D	Thin steel and medium casehardened steel and pearlitic malleable iron
E	Cast iron, aluminum and magnesium alloys, bearing metal
F	Annealed copper alloys, thin soft sheet metals
G	Phospor bronze, beryllium copper, malleable irons, upper limit G 92 to avoid possible flattening of ball
H	Aluminum, zinc lead
K, L, M, P, R, S, V	Bearing metals and other very soft or thin materials, including plastics (see ASTM 9785). Use smallest ball and heaviest load that do not give anvil effect.

Selecting the Proper Scale

ASTM Designation E 18 contains a listing of all regular Rockwell scales and typical materials for which these scales are applicable. This table provides an excellent starting point for choosing the correct scale, load and penetrator to be used for your test (Table 3).

Conversion Tables

HARDENED STEEL AND HARD ALLOYS

Rockwell*				Superficial			Vickers	Knoop	Brinell	Tensile Strength	Micro-ficial
C	A	D	G	15-N	30-N	45-N	HV	HK	HB	KSI	WMN
150 kg Brale*	60 kg Brale	100 kg Brale	150 kg 1/16" ball	15 kg N Brale	30 kg N Brale	45 kg N Brale	10 kg	500 gm and over	3000 kg 10 mm ball	1000 lbs/ sq in	1000 gm
80	92.0	86.5	▲	96.5	92.0	87.0	1865	–	▲	▲	–
79	91.5	85.5	⋮	96.3	91.5	86.5	1787	–	⋮	⋮	–
78	91.0	84.5	⋮	96.0	91.0	85.5	1710	–	⋮	⋮	–
77	90.5	84.0	⋮	95.8	90.5	84.5	1633	–	⋮	⋮	–
76	90.0	83.0	⋮	95.5	90.0	83.5	1556	–	⋮	⋮	–
75	89.5	82.5	⋮	95.3	89.0	82.5	1478	–	⋮	⋮	–
74	89.0	81.5	⋮	95.0	88.5	81.5	1400	–	NOTE 1	NOTE 2	–
73	88.5	81.0	⋮	94.8	88.0	80.5	1323	–	⋮	⋮	–
72	88.0	80.0	⋮	94.5	87.0	79.5	1245	–	⋮	⋮	–
71	87.0	79.5	⋮	94.3	86.5	78.5	1160	–	⋮	⋮	–
70	86.5	78.5	⋮	94.0	86.0	77.5	1076	972	⋮	⋮	953
69	86.0	78.0	⋮	93.5	85.0	76.5	1004	946	⋮	⋮	949
68	85.6	76.9	⋮	93.2	84.4	75.4	940	920	⋮	⋮	945
67	85.0	76.1	⋮	92.9	83.6	74.2	900	895	⋮	⋮	942
66	84.5	75.4	⋮	92.5	82.8	73.3	865	870	NA	⋮	938
65	83.9	74.5	⋮	92.2	81.9	72.0	832	846	739	⋮	934
64	83.4	73.8	⋮	91.8	81.1	71.0	800	822	722	⋮	930
63	82.8	73.0	⋮	91.4	80.1	69.9	772	799	706	⋮	926
62	82.3	72.2	⋮	91.1	79.3	68.8	746	776	688	⋮	922
61	81.8	71.5	⋮	90.7	78.4	67.7	720	754	670	⋮	917
60	81.2	70.7	⋮	90.2	77.5	66.6	697	732	654	NA	913
59	80.7	69.9	⋮	89.8	76.6	65.5	674	710	634	351	909
58	80.1	69.2	⋮	89.3	75.7	64.3	653	690	615	338	904
57	79.6	68.5	⋮	88.9	74.8	63.2	633	670	595	325	900
56	79.0	67.7	⋮	88.3	73.9	62.0	613	650	577	313	896
55	78.5	66.9	⋮	87.9	73.0	60.9	595	630	560	301	891
54	78.0	66.1	⋮	87.4	72.0	59.8	577	612	543	292	887
53	77.4	65.4	⋮	86.9	71.2	58.6	560	594	525	283	883
52	76.8	64.6	⋮	86.4	70.2	57.4	544	576	512	273	879
51	76.3	63.8	⋮	85.9	69.4	56.1	528	558	496	264	874
50	75.9	63.1	⋮	85.5	68.5	55.0	513	542	481	255	870
49	75.2	62.1	⋮	85.0	67.6	53.8	498	526	469	246	865
48	74.7	61.4	⋮	84.5	66.7	52.5	484	510	455	238	861
47	74.1	60.8	⋮	83.9	65.8	51.4	471	495	443	229	856
46	73.6	60.0	⋮	83.5	64.8	50.3	458	480	432	221	851
45	73.1	59.2	⋮	83.0	64.0	49.0	446	466	421	215	847
44	72.5	58.5	⋮	82.5	63.1	47.8	434	452	409	208	842
43	72.0	57.7	⋮	82.0	62.2	46.7	423	438	400	201	837
42	71.5	56.9	⋮	81.5	61.3	45.5	412	426	390	194	832
41	70.9	56.2	⋮	80.9	60.4	44.3	402	414	381	188	827
40	70.4	55.4	⋮	80.4	59.5	43.1	392	402	371	182	822
39	69.9	54.6	⋮	79.9	58.6	41.9	382	391	362	177	817
38	69.4	53.8	⋮	79.4	57.7	40.8	372	380	353	171	812
37	68.9	53.1	⋮	78.8	56.8	39.6	363	370	344	166	807
36	68.4	52.3	⋮	78.3	55.9	38.4	354	360	336	161	802
35	67.9	51.5	⋮	77.7	55.0	37.2	345	351	327	156	798
34	67.4	50.8	⋮	77.2	54.2	36.1	336	342	319	152	793
33	66.8	50.0	⋮	76.6	53.3	34.9	327	334	311	149	788
32	66.3	49.2	⋮	76.1	52.1	33.7	318	326	301	146	783
31	65.8	48.4	NA	75.6	51.3	32.5	310	318	294	141	778
30	65.3	47.7	92.0	75.0	50.4	31.3	302	311	286	138	773
29	64.6	47.0	91.0	74.5	49.5	30.1	294	304	279	135	768
28	64.3	46.1	90.0	73.9	48.6	28.9	286	297	271	131	762
27	63.8	45.2	89.0	73.3	47.7	27.8	279	290	264	128	757
26	63.3	44.6	88.0	72.8	46.8	26.7	272	284	258	125	751
25	62.8	43.8	87.0	72.2	45.9	25.5	266	278	253	123	746
24	62.4	43.1	86.0	71.6	45.0	24.3	260	272	247	119	741
23	62.0	42.1	84.5	71.0	44.0	23.1	254	266	243	117	736
22	61.5	41.6	83.5	70.5	43.2	22.0	248	261	237	115	730
21	61.0	40.9	82.5	69.9	42.3	20.7	243	256	231	112	725
20	60.5	40.1	81.0	69.4	41.5	19.6	238	251	226	110	720

HARDNESS VS MINIMUM THICKNESS CHART 55

Any greater thickness and hardness can be safely tested on indicated scale	Rockwell Superficial Hardness Scales			Rockwell Regular Hardness Scales		
	15N	30N	45N	A	D	C
	15 kgf	30 kgf	45 kgf	60 kgf	100 kgf	150 kgf
Thickness inches (mm)	N Brale Indenter			Brale Indenter		
.006 (0.15)	92	-	-	-	-	-
.008 (0.20)	90	-	-	-	-	-
.010 (0.25)	88	-	-	-	-	-
.012 (0.30)	83	82	77	-	-	-
.014 (0.36)	76	78.5	74	-	-	-
.016 (0.41)	68	74	72	86	-	-
.018 (0.46)	X	66	68	84	-	-
.020 (0.51)	X	57	63	82	77	-
.022 (0.56)	X	47	58	79	75	69
.024 (0.61)	X	X	51	76	72	67
.026 (0.66)	X	X	37	71	68	65
.028 (0.71)	X	X	20	67	63	62
.030 (0.76)	X	X	X	60	58	57
.032 (0.81)	X	X	X	X	51	52
.034 (0.86)	X	X	X	X	43	45
.036 (0.91)	X	X	X	X	X	37
.038 (0.96)	X	X	X	X	X	28
.040 (1.02)	X	X	X	X	X	20

Any greater thickness and hardness can be safely tested on indicated scale	Rockwell Superficial Hardness Scales			Rockwell Regular Hardness Scales		
	15-T	30-T	45-T	F	B	G
	15 kgf	30 kgf	45 kgf	60 kgf	100 kgf	150 kgf
Thickness inches (mm)	1/16 in Ball Indenter			1/16 in Ball Indenter		
.010 (0.25)	91	-	-	-	-	-
.012 (0.30)	86	-	-	-	-	-
.014 (0.36)	81	80	-	-	-	-
.016 (0.41)	75	72	71	-	-	-
.018 (0.46)	68	64	62	-	-	-
.020 (0.51)	X	55	53	-	-	-
.022 (0.56)	X	45	43	-	-	-
.024 (0.61)	X	34	31	98	94	94
.026 (0.66)	X	X	18	91	87	87
.028 (0.71)	X	X	4	85	80	76
.030 (0.76)	X	X	X	77	71	68
.032 (0.81)	X	X	X	69	62	59
.034 (0.86)	X	X	X	X	52	50
.036 (0.91)	X	X	X	X	40	42
.038 (0.96)	X	X	X	X	28	31
.040 (1.02)	X	X	X	X	X	22

Cylindrical Corrections

Values are consistent with ASTM E 18 tables 6, 7, 13 and 14.

Conversions

All values, except Wilson Microficial Numbers (WMN), are consistent with ASTM E 140. Tables 1 and 2 and ASTM A 370. Tables 3A and 3B, where applicable. WMN were developed by Wilson Instruments in the Wilson standards laboratory and are not derived from ASTM.

Hardness vs. Minimum Thickness

Values are consistent with ASTM E 18 tables 4, 5, 11 and 12 except for D and G scale values, which are obtained from Indentation Hardness Testing by Vincent E. Lysaght.

CYLINDRICAL CORRECTION CHART 53

Cylindrical work corrections to be added to observed Rockwell number for scales indicated

Scales C, D, A

Brale Diamond Indenter
Diameter of Specimen - inches (mm)

Observed Reading	1/8 (3.2)	1/4 (6.4)	3/8 (10)	1/2 (13)	5/8 (16)	3/4 (19)	7/8 (22)	1 (25)	1-1/4 (32)	1-1/2 (38)
90	NA	0.5	0	0	0	0	0	0	0	0
85		0.5	0.5	0.5	0	0	0	0	0	0
80		0.5	0.5	0.5	0.5	0.5	0	0	0	0
75		1.0	0.5	0.5	0.5	0.5	0.5	0	0	0
70		1.0	1.0	0.5	0.5	0.5	0.5	0.5	0	0
65		1.5	1.0	1.0	0.5	0.5	0.5	0.5	0	0
60		1.5	1.0	1.0	0.5	0.5	0.5	0.5	0	0
55		2.0	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0
50		2.5	2.0	1.5	1.0	1.0	0.5	0.5	0.5	0.5
45		3.0	2.0	1.5	1.0	1.0	1.0	0.5	0.5	0.5
40		3.5	2.5	2.0	1.5	1.0	1.0	1.0	0.5	0.5
35		4.0	3.0	2.0	1.5	1.5	1.0	1.0	0.5	0.5
30		5.0	3.5	2.5	2.0	1.5	1.5	1.0	1.0	0.5
25		5.5	4.0	3.0	2.5	2.0	1.5	1.0	1.0	1.0
20	▼	6.0	4.5	3.5	2.5	2.0	1.5	1.5	1.0	1.0

Scales B, F, G

1/16 in Ball Indenter
Diameter of Specimen - inches (mm)

Observed Reading	1/8 (3.2)	1/4 (6.4)	3/8 (10)	1/2 (13)	5/8 (16)	3/4 (19)	7/8 (22)	1 (25)	1-1/4 (32)	1-1/2 (38)
100	NA	3.5	2.5	1.5	1.5	1.0	1.0	0.5	NA	NA
90		4.0	3.0	2.0	1.5	1.5	1.5	1.0		
80		5.0	3.5	2.5	2.0	1.5	1.5	1.5		
70		6.0	4.0	3.0	2.5	2.0	2.0	1.5		
60		7.0	5.0	3.5	3.0	2.5	2.0	2.0		
50		8.0	5.5	4.0	3.5	3.0	2.5	2.0		
40		9.0	6.0	4.5	4.0	3.0	2.5	2.5		
30		10.0	6.5	5.0	4.5	3.5	3.0	2.5		
20		11.0	7.5	5.5	4.5	4.0	3.5	3.0		
10		12.0	8.0	6.0	5.0	4.0	3.5	3.0		
0	▼	12.5	8.5	6.5	5.5	4.5	3.5	3.0	▼	▼

Scales 15-N, 30-N, 45-N

N Brale Diamond Indenter
Diameter of Specimen - inches (mm)

Observed Reading	1/8 (3.2)	1/4 (6.4)	3/8 (10)	1/2 (13)	5/8 (16)	3/4 (19)	7/8 (22)	1 (25)	1-1/4 (32)	1-1/2 (38)
90	0	0	0	0	0	0	0	0	NA	NA
85	0.5	0.5	0.5	0.5	0	0	0	0		
80	1.0	0.5	0.5	0.5	0.5	0	0	0		
75	1.5	1.0	0.5	0.5	0.5	0.5	0	0		
70	2.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5		
65	2.5	1.5	1.0	0.5	0.5	0.5	0.5	0.5		
60	3.0	1.5	1.0	1.0	1.0	0.5	0.5	0.5		
55	3.5	2.0	1.5	1.0	1.0	0.5	0.5	0.5		
50	3.5	2.0	1.5	1.0	1.0	1.0	1.0	0.5		
45	4.0	2.0	1.5	1.0	1.0	1.0	1.0	1.0		
40	4.5	2.5	1.5	1.5	1.0	1.0	1.0	1.0		
35	5.0	2.5	2.0	1.5	1.0	1.0	1.0	1.0		
30	5.5	3.0	2.0	1.5	1.5	1.0	1.0	1.0		
25	5.5	3.0	2.0	1.5	1.5	1.5	1.5	1.0		
20	6.0	3.0	2.0	1.5	1.5	1.5	1.5	1.5	▼	▼

Scales 15-T, 30-T, 45-T

1/16 in Ball Indenter
Diameter of Specimen - inches (mm)

Observed Reading	1/8 (3.2)	1/4 (6.4)	3/8 (10)	1/2 (13)	5/8 (16)	3/4 (19)	7/8 (22)	1 (25)	1-1/4 (32)	1-1/2 (38)
90	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0.5	NA	NA
80	3.0	2.0	1.5	1.5	1.0	1.0	1.0	0.5		
70	5.0	3.5	2.5	2.0	1.5	1.0	1.0	1.0		
60	6.5	4.5	3.0	2.5	2.0	1.5	1.5	1.5		
50	8.5	5.5	4.0	3.0	2.5	2.0	2.0	1.5		
40	10.0	6.5	4.5	3.5	3.0	2.5	2.0	2.0		
30	11.5	7.5	5.0	3.5	3.5	2.5	2.0	2.0		
20	13.0	9.0	6.0	4.5	4.5	3.0	2.0	2.0	▼	▼

SOFT STEEL, GREY AND MALLEABLE CAST IRON AND MOST NON-FERROUS METALS

Rockwell							Superficial			Knoop	Brinell		Tensile Strength	Micro ficial
												10 mm Vickers 136°		
B	F	G	A	E	H	K	15-T	30-T	45-T	HK	HB	HB HV	KSI	WMN
100 kg 1/16" ball	60 kg 1/16" ball	150 kg 1/16" ball	60 kg Brale	100 kg 1/8" ball	60 kg 1/8" ball	150 kg 1/8" ball	15 kg 1/16" ball	30 kg 1/16" ball	45 kg 1/16" ball	500 gm and over	500 kg 10 mm ball	3000 kg 10 kg	1000lbs/ sq in	1000 gm
100	▲	82.5	61.5	▲	▲	▲	93.1	83.1	72.9	251	201	240	116	730
99		81.0	60.9				92.8	82.5	71.9	246	195	234	114	725
98		79.0	60.2				92.5	81.8	70.9	241	189	228	109	719
97		77.5	59.5				92.1	81.1	69.9	236	184	222	104	713
96		76.0	58.9				91.8	80.4	68.9	231	179	216	102	707
95		74.0	58.3				91.5	79.8	67.9	226	175	210	100	701
94		72.5	57.6				91.2	79.1	66.9	221	171	205	98	696
93		71.0	57.0			NA	90.8	78.4	65.9	216	167	200	94	690
92		69.0	56.4			100	90.5	77.8	64.8	211	163	195	92	684
91		67.5	55.8			99.5	90.2	77.1	63.8	206	160	190	90	679
90		66.0	55.2			98.5	89.9	76.4	62.8	201	157	185	89	674
89		64.0	54.6			98.0	89.5	75.8	61.8	196	154	180	88	668
88		62.5	54.0			97.0	89.2	75.1	60.8	192	151	176	86	662
87		61.0	53.4			96.5	88.9	74.4	59.8	188	148	172	84	656
86		59.0	52.8			95.5	88.6	73.8	58.8	184	145	169	83	651
85		57.5	52.3			94.5	88.2	73.1	57.8	180	142	165	82	646
84		56.0	51.7			94.0	87.9	72.4	56.8	176	140	162	81	640
83		54.0	51.1			93.0	87.6	71.8	55.8	173	137	159	80	634
82		52.5	50.6			92.0	87.3	71.1	54.8	170	135	156	77	629
81		51.0	50.0			91.0	86.9	70.4	53.8	167	133	153	73	624
80		49.0	49.5			90.5	86.6	69.7	52.8	164	130	150	72	618
79		47.5	48.9			89.5	86.3	69.1	51.8	161	128	147	70	612
78		46.0	48.4			88.5	86.0	68.4	50.8	158	126	144	69	607
77		44.0	47.9			88.0	85.6	67.7	49.8	155	124	141	68	602
76	NA	42.5	47.3			87.0	85.3	67.1	48.8	152	122	139	67	596
75	99.6	41.0	46.8			86.0	85.0	66.4	47.8	150	120	137	66	592
74	99.1	39.0	46.3			85.0	84.7	65.7	46.8	147	118	135	65	587
73	98.5	37.5	45.8			84.5	84.3	65.1	45.8	145	116	132	64	581
72	98.0	36.0	45.3	NA		83.5	84.0	64.4	44.8	143	114	130	63	576
71	97.4	34.5	44.8	100		82.5	83.7	63.7	43.8	141	112	127	62	571
70	96.8	32.5	44.3	99.5		81.5	83.4	63.1	42.8	139	110	125	61	566
69	96.2	31.0	43.8	99.0		81.0	83.0	62.4	41.8	137	109	123	60	561
68	95.6	29.5	43.3	98.0		80.0	82.7	61.7	40.8	135	107	121	59	556
67	95.1	28.0	42.8	97.5		79.0	82.4	61.0	39.8	133	106	119	58	551
66	94.5	26.5	42.3	97.0		78.0	82.1	60.4	38.7	131	104	117	57	546
65	93.9	25.0	41.8	96.0		77.5	81.8	59.7	37.7	129	102	116	56	542
64	93.4	23.5	41.4	95.5		76.5	81.4	59.0	36.7	127	101	114	NA	537
63	92.8	22.0	40.9	95.0		75.5	81.1	58.4	35.7	125	99	112		532
62	92.2	20.5	40.4	94.5		74.5	80.8	57.7	34.7	124	98	110		527
61	91.7	19.0	40.0	93.5		74.0	80.5	57.0	33.7	122	96	108		522
60	91.1	17.5	39.5	93.0		73.0	80.1	56.4	32.7	120	95	107		517
59	90.5	16.0	39.0	92.5		72.0	79.8	55.7	31.7	118	94	106		512
58	90.0	14.5	38.6	92.0		71.0	79.5	55.0	30.7	117	92	104		507
57	89.4	13.0	38.1	91.0		70.5	79.2	54.4	29.7	115	91	103		502
56	88.8	11.5	37.7	90.5		69.5	78.8	53.7	28.7	114	90	101		497
55	88.2	10.0	37.2	90.0		68.5	78.5	53.0	27.7	112	89	100		492
54	87.7	8.5	36.8	89.5		68.0	78.2	52.4	26.7	111	87	NA		487
53	87.1	7.0	36.3	89.0		67.0	77.9	51.7	25.7	110	86			482
52	86.5	5.5	35.9	88.0		66.0	77.5	51.0	24.7	109	85			477
51	86.0	4.0	35.5	87.5		65.0	77.2	50.3	23.7	108	84			472
50	85.4	2.5	35.0	87.0		64.5	76.9	49.7	22.7	107	83			468
49	84.8	NA	34.6	86.5		63.5	76.6	49.0	21.7	106	82			463
48	84.3		34.1	85.5		62.5	76.2	48.3	20.7	105	81			458
47	83.7		33.7	85.0		61.5	75.9	47.7	19.7	104	80			453
46	83.1		33.3	84.5		61.0	75.6	47.0	18.7	103	80			448
45	82.6		32.9	84.0		60.0	75.3	46.3	17.7	102	79			444
44	82.0		32.4	83.5		59.0	74.9	45.7	16.7	101	78			439
43	81.4		32.0	82.5		58.0	74.6	45.0	15.7	100	77			435
42	80.8		31.6	82.0		57.5	74.3	44.3	14.7	99	76			430
41	80.3		31.2	81.5		56.5	74.0	43.7	13.6	98	75			426
40	79.7		30.7	81.0		55.5	73.6	43.0	12.6	97	75			422
39	79.1		30.3	80.0		54.5	73.3	42.3	11.6	96	74			417
38	78.6		29.9	79.5		54.0	73.0	41.6	10.6	95	73			413
37	78.0		29.5	79.0	NA	53.0	72.7	41.0	9.6	94	72			409
36	77.4		29.1	78.5	100	52.0	72.3	40.3	8.6	93	72			404
35	76.9		28.7	78.0	99.5	51.5	72.0	39.6	7.6	92	71			401
34	76.3		28.2	77.0	99.0	50.5	71.7	39.0	6.6	91	70			396
33	75.7		27.8	76.5	98.0	49.5	71.4	38.3	5.6	90	69			392
32	75.2		27.4	76.0	98.5	48.5	71.0	37.6	4.6	89	69			388
31	74.6		27.0	75.5	98.0	48.0	70.7	37.0	3.6	88	68			384
30	74.0		26.6	75.0	97.8	47.0	70.4	36.3	2.6	87	67			380
29	73.5		26.0	74.0	97.5	46.0	70.0	35.6	1.0	87	66			376
28	73.0		25.5	73.5	97.0	45.0	69.3	34.5	NA	86	66			372
27	72.5		25.0	73.0	96.5	44.5	69.5	34.0		85	65			369
26	72.0		24.5	72.5	96.3	43.5	69.0	33.0		84	65			365
25	71.0		24.3	72.0	96.0	42.5	68.8	32.5		83	64			361
24	70.5		24.0	71.0	95.5	41.5	68.5	32.0		82	64			357
23	70.0		23.5	70.5	95.3	41.0	68.0	31.0		82	63			353
22	69.5		23.0	70.0	95.0	40.0	67.8	30.5		81	62			350
21	69.0		22.5	69.5	94.5	39.0	67.5	29.5		81	62			346
20	68.5		22.0	68.5	94.3	38.0	67.3	29.0		80	61			343
19	68.0		21.5	68.0	94.0	37.5	67.0	28.5		79	61			339
18	67.0		21.3	67.5	93.5	36.5	66.5	27.5		78	60			335
17	66.5		21.0	67.0	93.0	35.5	66.3	27.0		78	60			332
16	66.0		20.5	66.5	92.8	35.0	66.0	26.0		77	59			329
15	65.5		20.0	65.5	92.5	34.0	65.5	25.5		76	59			325
14	65.0		NA	65.0	92.0	33.0	65.3	25.0		75	59			322
13	64.5			64.5	91.8	32.0	65.0	24.0		75	58			318
12	64.0			64.0	91.5	31.5	64.5	23.5		74	58			314
11	63.5			63.5	91.0	30.5	64.3	23.0		73	57			311
10	63.0			62.5	90.5	29.5	64.0	22.0		72	57			308
9	62.0			62.0	90.3	29.0	63.8	21.5		71	57			304
8	61.5			61.5	90.0	28.0	63.5	20.5		71	56			300
7	61.0			61.0	89.5	27.0	63.0	20.0		70	56			297
6	60.5			60.5	89.3	26.0	62.8	19.5		69	55			293
5	60.0			60.0	89.0	25.5	62.5	18.5		69	55			289
4	59.5			59.0	88.5	24.5	62.0	18.0		69	55			286
3	59.0			58.5	88.0	23.5	61.8	17.0		68	54			283
2	58.0			58.0	87.8	23.0	61.5	16.5		68	54			279
1	57.5	▼	▼	57.5	87.5	22.0	61.0	16.0	▼	63	54	▼	▼	276
0	57.0			57.0	87.0	21.0	60.5	15.0		63	53		NOTE 2	272

ASTM Standards

List of ASTM Hardness Standards

The following is a list of the American Society for Testing and Materials' standards that reference hardness testing. These standards are copyrighted and can be purchased through the ASTM - refer to the contact information at the bottom of this page.

- E10 Standard Test Method for Brinell Hardness of Metallic Materials
- E18 Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
- E92 Standard Test Method for Vickers Hardness of Metallic Materials
- E103 Standard Test Method for Rapid Indentation Hardness Testing of Metallic Materials
- E110 Standard Test Method for Indentation Hardness of Metallic Materials by Portable Hardness Testers
- E140 Standard Hardness Conversion Tables for Metals E1842 Standard Test Method for Macro-Rockwell Hardness Testing of Metallic Materials
- E384 Standard Test Method for Microhardness of Materials
- E1842 Standard Test Method for Macro-Rockwell Hardness Testing of Metallic Materials
- A833 Standard Practice for Indentation Hardness of Metallic Materials by Comparison Hardness Testers
- A956 Standard Test Method for Equotip Hardness Testing of Steel Products
- B277 Standard Test Method for Hardness of Electrical Contact Materials
- B294 Standard Test Method for Hardness Testing of Cemented Carbides
- B578 Standard Test Method for Microhardness of Electroplated Coatings
- B647 Standard Test Method for Indentation Hardness of Aluminum Alloys by Means of a Webster Hardness Gage
- B648 Standard Test Method for Indentation Hardness of Aluminum Alloys by Means of a Barcol Impressor
- B721 Standard Test Method for Microhardness and Case Depth of Powder Metallurgy (P/M) Parts
- B724 Standard Test Method for Indentation Hardness of Aluminum Alloys by Means of a Newage Portable Non-Caliper-Type Instrument
- C661 Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer
- C730 Standard Test Method for Knoop Indentation Hardness of Glass
- C748 Standard Test Method for Rockwell Hardness of Fine-Grained Graphite Materials
- C849 Standard Test Method for Knoop Indentation Hardness of Ceramic Whitewares
- C886 Standard Test Method for Scleroscope Hardness Testing of Fine-Grained Carbon and Graphite Materials
- C1326 Standard Test Method for Knoop Indentation Hardness of Advanced Ceramics
- C1327 Standard Test Method for Vickers Indentation Hardness of Advanced Ceramics
- D785 Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials
- D1415 Standard Test Method for Rubber Property-International Hardness
- D1474 Standard Test Methods for Indentation Hardness of Organic Coatings
- D2240 Standard Test Method for Rubber Property-Durometer Hardness
- D2583 Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
- F1957 Standard Test Method for Composite Foam Hardness-Durometer Hardness

American Society for Testing and Materials
100 Barr Harbor Drive, West Conshohocken, PA 19428-2959
Phone: (610) 832-9585 Fax: (610) 832-9555
Website: www.astm.org

Rockwell® Series 2000 Tester Gauge Repeatability and Reproducibility Study

The Purpose -
GR and R's and Hardness Testing Instruments

The purpose of performing a Gauge Repeatability and Reproducibility (GR and R) study is to determine how much of the process tolerance is being used up by variation in the testing instrument (also referred to as equipment variation or repeatability) as well as between operators (also referred to as appraiser variation or reproducibility). When the combination of these sources Repeatability and Reproducibility (R and R) becomes a significant portion of the process tolerance, one cannot be sure whether they are measuring the hardness of a part or simply generating random numbers with the hardness instrument. The results are instrument type dependent. Hardness instruments with a GR and R between 10% and 30% are widely accepted in the hardness industry. Machines with a GR and R of greater than 30% should not be used for SPC.

The Calculation

The GR and R calculation is essentially the comparison of the combination of machine and operator variation with process tolerance. If the variation is low or the process tolerance wide by comparison, then the percantage of GR and R will also be low. Conversely, if the variation is high or the process tolerance narrow by comparison, the percentage of GR and R will be high.

Tolerance

The process tolerance aspect of the calculation is quite simple: it is plugged indirectly from the SPC X-bar chart or alternatively from the engineering specification for part's hardness (for example, a part calling for a hardness of 42 HRC to 48 HRC would have a total tolerance of 6-points). Note that the calculation of GR and R is only relevant in the context of process tolerance. Comparing machine and operator variation to a test block tolerance for example is not meaningful, as it says nothing about the machine's suitability to measure real parts. Test block tolerances are for insuring the accuracy of a machine, not its repeatability.

Variation

The calculations for variation can appear somewhat enigmatic, but all they are doing is converting average range values and operator differences into an approximation for six sigma (six times the standard deviation for all the data). Six sigma is the statistical description for a machine's total variation. Assuming the machine is varying in a normal manner, six sigma says that over 99% of all tests done on a given block (or set of ten blocks in the case of some types of GR and R) will fall within this region. It is also, in a sense, the uncertainty of the machine at that hardness level - meaning that for a given reading, the actual hardness value could be up to plus or minus three sigma away.

Operator	A					Min	Max
Sample #	1st	2nd	3rd	Range	Range Calcs		
1	64.18	64.14	64.16	0.04		64.14	64.18
2	64.38	64.41	64.38	0.03		64.38	64.41
3	64.13	64.14	64.14	0.01		64.13	64.14
4	64.32	64.35	64.37	0.05		64.32	64.37
5	64.28	64.24	64.23	0.05		64.23	64.28
6	64.34	64.36	64.32	0.04	Tolerance 6	64.32	64.36
7	64.25	64.27	64.22	0.05		64.22	64.27
8	64.06	64.10	64.06	0.04		64.06	64.10
9	64.17	64.15	64.14	0.03		64.14	64.17
10	64.17	64.15	64.16	0.02		64.15	64.17
Group Avgs				R= 0.04			
					Repeatability - equipment (machine) variation, %EV =		1.83

Corporate Headquarters
825 University Avenue
Norwood, MA 02062-2643 USA
Tel: +1 800 564 8378
+1 781 575 5000
Fax: +1 781 575 5725

www.instron.com

For information on Instron® products and services call your local worldwide sales, service and technical support offices:

USA
North America Sales and Service Center

Sales	Tel: +1 800 695 4273 +1 781 575 6000 Fax:+1 781 575 5770
Service and Technical Support	Tel: +1 800 473 7838

Canada

Toronto	Tel: +1 905 333 9123 +1 800 461 9123 Fax:+1 905 639 8683

www.wilsoninstruments.com

WB1230