Micro Vickers Hardness Testing Machines
HM-100

Refer to page M-3 for details.

CNC Rockwell Hardness Testing Machines
HR-600

Refer to page M-5 for details.

Rockwell Hardness Testing Machines
HR-430MS

Refer to page M-8 for details.

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HM-200
SERIES 810 — Micro Vickers Hardness Testing Machines

- The latest electromagnetic force motor used in the loading mechanism enables the test force to be freely selected.
- In addition to Vickers hardness testing, Knoop (HK)* and Fracture toughness (Kc) tests can also be performed.

* For Knoop hardness testing, Knoop indenter (optional) is required.

System A
(**HM-210A / 220A**)

SPECIFICATIONS

Model	HM-210			HM-220		
Display unit	metric	inch/mm	metric	metric	inch/mm	metric
Operation	Manual	Manual	System	Manual	Manual	System
Applicable standards	JIS B7725, ISO 6507-2					
Test force mN (gf)	98.07 to 9807 (10 to 1000)			0.4903 to 19610 (0.05 to 2000)		
Arbitrary test force	One setting can be saved, default is HV0.025					
External dimensions (WxDxH) (excluding protrusions and stage); Main unit mass	System **A**: Approx. 315x671x595 mm, 38.5 kg System **B**/**C**/**D**: Approx. 315x586x741 mm, 37.4 kg					
Power supply/ Power consumption	AC100 V to 240 V 50/60 Hz System **A**: 31 W System **B**/**C**/**D**: 30 W			AC100 V to 240 V 50/60 Hz System **A**: 44 W System **B**/**C**/**D**: 43 W		

System A (**HM-210A / 220A**)
All-in-one model with simple color touch-panel operation

System B (**HM-210B / 220B**)
A system equipped with automatic reading function with **AVPAK** software

System C (**HM-210C / 220C**)
In addition to the functions of System **B**, System **C** is equipped with an electric stage

System D (**HM-210D / 220D**)
In addition to the functions of System **B** and System **C**, System **D** is equipped with the auto focus function

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HM-100
SERIES 810 — Micro Vickers Hardness Testing Machines

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- The **HM-100** Series is an affordable line of microhardness testers able to work with very small test loads (from 98.07 mN, 10 gf, and upwards), which is perfect for evaluating the mechanical characteristics and controlling the quality of electric/ electronic components.

HM-103

SPECIFICATIONS

Model	HM-101*	HM-102	HM-103
Applicable standards	JIS B7725, ISO 6507-2		
Test force mN (gf)	98.07 to 9807 (10 to 1000)		
External dimensions (WxDxH)	Main unit: 380x600x590 mm, 42 kg		
	—	Control panel: 165x260x105 mm, 1.5 kg	
	—		TV monitor: 202x29.2x175.8 mm, 1.1 kg
Power supply/ Power consumption	AC 100 V±10% (AC 120 V, AC 220 V, AC 240 V according to the factory shipped setting)		
	60 VA or less		Approx. 90 VA or less

* Only the **HM-102** and **HM-103** models can be connected to the MeasurLink® measurement data network.

Refer to the Hardness Testing Machines Brochure (**E17001**) for more details.

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HV-100
SERIES 810 — Vickers Hardness Testing Machines

- Vickers hardness testers have a wide application in testing metals, especially small heat-treated parts, and are also suitable for making special-purpose tests such as carburized case hardness, maximum hardness of spot welds, high-temperature hardness, and fracture toughness of ceramic materials.
- In addition to Vickers hardness testing, Knoop (HK)*1/Brinell (HB)*2/Fracture toughness (Kc) tests can also be performed.

*1 For Knoop hardness testing, Knoop indenter (optional) is required.
*2 For Brinell hardness testing a Brinell indenter (optional) and additional weight are required.

System A (**HV-110A / 120A**)

SPECIFICATIONS

Model	HV-110			HV-120		
Display unit	metric	inch/mm	metric	metric	inch/mm	metric
Operation	Manual	Manual	System	Manual	Manual	System
Applicable standards	JIS B7725, ISO 6507-2					
Test force N(kgf)	9.807 to 490.3 (1 to 50)			2.942 to 294.2 (0.3 to 30)		
External dimensions (WxDxH) (excluding protrusions and stage)	System **A**: Approx. 307x696x781 mm System **B**/**C**/**D**: Approx. 307x627x875 mm					
Main unit mass	**HV-110**: 60 kg **HV-120**: 58 kg					
Power supply/ Power consumption	AC100 V to 240 V 50/60 Hz System **A**: 24 W System **B**/**C**/**D**: 22 W					

System A (**HM-110A / 120A**)
All-in-one model with simple color touch-panel operation

System B (**HM-110B / 120B**)
A system equipped with automatic reading function with **AVPAK** software

System C (**HM-110C / 120C**)
In addition to the functions of System **B**, System **C** is equipped with an electric stage

System D (**HM-110D / 120D**)
In addition to the functions of System **B** and System **C**, System **D** is equipped with the auto focus function

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Refer to the Hardness Testing Machines Brochure (**E17001**) for more details.

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HR-600
SERIES 810 — CNC Rockwell Hardness Testing Machines

- A workpiece that cannot be placed on a tester due to its large size can be placed on the stage of this product and tested as is. (Maximum loading mass 100 kg)
- The motorized stage makes automatic multi-point testing at multiple places and of multiple workpieces possible.
- Plastic hardness testing is also available in addition to Rockwell/Brinell tests on metal. Brinell and Vickers indentation hardness tests which do not require vision measurement can also be performed.
- The **HR-610A**/**620A** is operable with a touch panel display (some functions are operable with **AVPAK** software) and the **HR-620B** is operable with a touch panel display and **AVPAK** software.
- Automatic testing by moving in the X-, Y- and Z-axis directions for workpieces with uneven surfaces or steps is made possible by adding X-axis stage and **AVPAK** software to **HR-620B**, which is equipped with a motorized Y-axis stage as standard. Also, using **FORMEio** software makes possible easy communication with PLCs for automation purposes, such as control of handling devices and work cells.

Refer to the **HR-600** Series Brochure (**E17011**) for more details.

HR-610A
(Motorized X-axis stage is available)

HR-620B
(With a motorized Y-axis stage as standard and an optional motorized X-axis stage)

SPECIFICATIONS

Model		HR-610A		HR-620A		HR-620B
Display unit		metric	inch/mm	metric	inch/mm	—
Test methods/ Standard No.	Rockwell	JIS B7726:2017, ISO 6508-2:2015, ASTM E18-20				
	Brinell	JIS B7724:2017, ISO 6506-2:2017, ASTM E10-18				
	Plastic			ISO 2039-1:2001		
		JIS K 7202-2:2001, ISO 2039-2:1987, ASTM D785-08 [A&B]				
	Indentation Brinell hardness	VDI/VDE 2616				
	Indentation Vickers hardness			VDI/VDE 2616		
Initial test force N (kgf)	Rockwell	29.42 (3) 98.07 (10)				
	Plastic			9.807 (1)		
		98.07 (10)				
	Indentation Brinell hardness	98.07 (10) 490.3 (50)				
	Indentation Vickers hardness			9.807 (1)		
Test force N (kgf)	Rockwell	147.1 (15) 294.2 (30) 441.3 (45) 588.4 (60) 980.7 (100) 1471 (150)				
	Brinell	49.03 (5) to 1839 (187.5)		9.807 (1) to 2452 (250)		
	Plastic			49.03 (5) 132.4 (13.5) 358.0 (36.5) 962.1 (98.1)		
		588.4 (60) 980.7 (100) 1471 (150)				
	Indentation Brinell hardness	612.9 (62.5) 1839 (187.5)		612.9 (62.5) 1839 (187.5) 2452 (250)		
	Indentation Vickers hardness			294.2 (30) 490.4 (50)		
Power supply		AC100 to 200 V 50/60 Hz				
Mass		176 kg		181 kg		205 kg

Note 1: Plastic tests may not be supported depending on the plastic material.
Note 2: For Brinell hardness testing, an indenter (optional) and a measurement microscope are required. A measurement microscope should be prepared by customer.
Note 3: No indenter and hardness standard block is supplied with the unit. These items (conform to the applicable standard) must be purchased separately.

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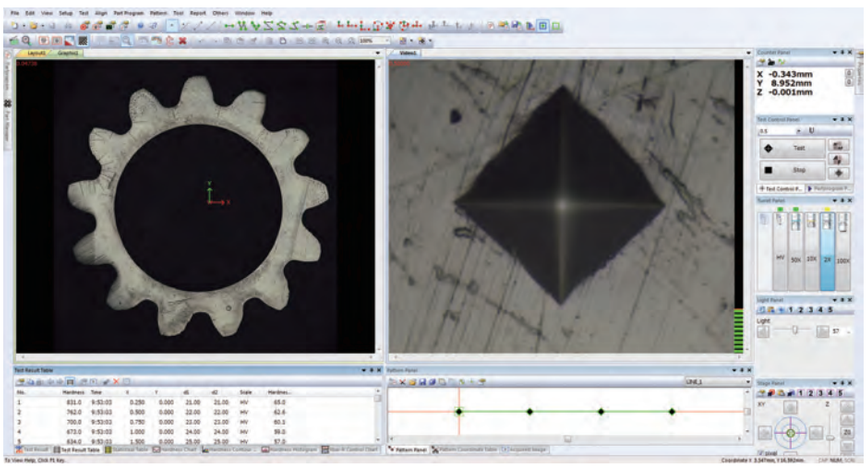
MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
HARDNESS

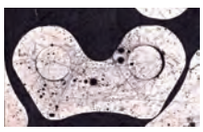
Software for Hardness testing AVPAK

- Enables capture of specimen images from a hardness testing machine, automatic measurement of indentations, and control of continuous automatic measurements based on a given pattern.



Function related to capture of specimen image and pattern setting of test position

Stitching (Only for **AVPAK-20**)
Takes images of an entire rectangular field from the moving stage then combines the images.
Note: Only for System **C**/**D** of **HM**/**HV**



Auto trace (Only for **AVPAK-20**)
Automatically traces the shape of the sample. Takes images as the stage moves along the outer contours of the specimen then combines the images.
Note: Only for System **C**/**D** of **HM**/**HV**

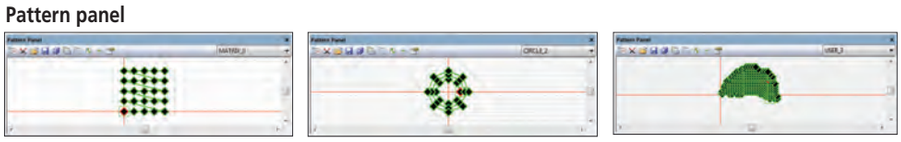
Contour detection (Only for **AVPAK-20**)
Detects the outline of the workpiece from combined images.

Various kinds of pattern setting
Performs time-consuming pattern setting with ease.

Pattern creation
This tool supports the creation of test patterns such as straight lines, zigzag lines, and teaching patterns.

Pattern pasting
This tool supports the pasting of created test patterns. It adjusts the origin, direction, etc., to paste a pattern.

Pattern panel



Handling of multiple specimens

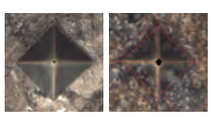
Part program and Parts Manager functions support testing of multiple and irregular specimens.

Multi-specimen testing
Executes different part programs for each irregular specimen.

Parts Manager
Executes a common part program for specimens having the same shape.

Reading of indentations

Improvement in image-processing performance has improved the indentation measurement function.



Note 1: Measurement accuracy varies according to conditions.
Note 2: Only for **HM**/**HV**

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HR-530
SERIES 810 — Rockwell Hardness Testing Machines

- Unique electronic control makes the **HR-530** Series of hardness testers extremely versatile by enabling Brinell hardness testing* as well as load-sequence hardness testing of plastics, plus Rockwell and Rockwell Superficial hardness testing.

  * For Brinell hardness testing, an indenter (optional) and a measurement microscope are required.

HR-530L

- This series can test the hardness of the inside wall of a ring, a test that is only possible using ordinary hardness testers by cutting the ring into pieces. (All models)
- The touch-panel display unit can be mounted on top of the tester, providing significant convenience if the machine installation space is restricted. (All models) Use the optional display mounting bracket to mount the unit.
- This series allows numeric display of statistical analysis results such as maximum and minimum values, mean value and graphic display of $\bar{X}$-R control charts and histograms required for hardness evaluation.

Refer to the **HR-530** Series Brochure (**E17009**) for more details.

SPECIFICATIONS

Model		HR-530		HR-530L	
Display unit		metric	inch/mm	metric	inch/mm
Applicable standards		JIS B7726, ISO 6508-2, ASTM E18-20			
Testable hardness		Rockwell hardness/Rockwell Superficial hardness/Brinell hardness/Indentation Brinell hardness/Plastics hardness			
Initial test force	N (kgf)	29.42 (3) 98.07 (10)			
Test force N (kgf)	Rockwell	588.4 (60) 980.7 (100) 1471 (150)			
	Rockwell Superficial	147.1 (15) 294.2 (30) 441.3 (45)			
	Brinell	61.29 (6.25) 98.07 (10) 153.2 (15.625) 245.2 (25) 294.2 (30) 306.5 (31.25) 612.9 (62.5) 980.7 (100) 1226 (125) 1839 (187.5)			
Power supply		AC100 to 240 V 50/60 kHz			
External dimensions	Main unit	250 (W)×667 (D)×621 (H) mm		300 (W)×667 (D)×766 (H) mm	
	Touch-panel display unit	191 (W)×147 (D)×71 (H) mm			
Mass		Main unit: 61 kg		Main unit: 70 kg	

Note 1: Plastic tests may not be supported depending on the plastic material.
Note 2: For Brinell hardness testing, an indenter (optional) and a measurement microscope are required. A measurement microscope should be prepared by customer.
Note 3: No indenter and hardness standard block is supplied with the unit. These items (conform to the applicable standard) must be purchased separately.

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HR-200/300/400
SERIES 810 — Rockwell Hardness Testing Machines

- A series of economical Rockwell hardness testing machines. The lineup consists of 4 models including a digital display type and an analog display type.

HR-210MR

HR-430MS

SPECIFICATIONS

Model		HR-210MR*	HR-430MR	HR-320MS	HR-430MS
Display		Analog	Digital	Digital	Digital
Applicable standards		JIS B7726:2017, ISO 6508-2:2015	JIS B7726:2017, ISO 6508-2:2015, ASTM E18-20		
Testable hardness		Rockwell hardness			
		—		Rockwell Superficial hardness	
Preliminary test force	N (kgf)	98.07 (10)		29.42 (3) 98.07 (10)	
Test force N (kgf)	Rockwell	588.4 (60) 980.7 (100) 1471 (150)			
	Superficial	—		147.1 (15) 294.2 (30) 441.3 (45)	
Power supply		AC100 to 240 V 50/60 Hz 1.8 A DC12 V-4.17 A			
External dimensions (excluding protrusions and stage)		214 (W)×512 (D)×780 (H) mm			
Mass		46 kg	50 kg	47 kg	50 kg

* Only the **HR-430MR**, **HR-320MS** and **HR-430MS** models can be connected to the MeasurLink® measurement data network.
Note 1: Plastic tests may not be supported depending on the plastic material.
Note 2: Brinell hardness tests can be performed by using the weight set for Brinell test, Brinell indenter and measuring microscope. A measurement microscope should be prepared by customer.
Note 3: No indenter and hardness standard block is supplied with the unit. These items (conform to the applicable standard) must be purchased separately.

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Refer to the Hardness Testing Machines Brochure (**E17001**) for more details.

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HARDMATIC HH-411
SERIES 810 — Rebound Type Portable Hardness Tester

- Excellent operability that performs hardness tests with the touch of a key and a compact body allows users to measure hardness in the field. This instrument is best suited for on-site hardness tests such as large molds, railroad track, and welded spots in structures.

SPECIFICATIONS

Order No.	810-299-10	810-299-11	810-298-10	810-298-11
Model	HH-411			
Hardness display range	Leeb hardness: 1 to 999 HL			
Display range* (This display range varies depending on the conversion table used.)	Vickers hardness: 43 to 950 HV Brinell hardness: 20 to 896 HB Rockwell hardness (C scale): 19.3 to 68.2 HRC Rockwell hardness (B scale): 13.5 to 101.7 HRB		Shore hardness: 30.1 to 99.5 HS (ASTM) 13.2 to 98.6 HS (JIS) Tensile strength: 499 to 1996 MPa	
Shore hardness (HS) conversion	VHS (JIS B7731)		HSD	
Detector	Impact hammer with integrated detector and carbide-ball tip (D type)			
Display unit	7-segment LCD			
Specimen requirements	Test points: At least 5 mm from specimen edges and at intervals of at least 3 mm Min. thickness: 5 mm; mass: 5 kg or more (However, specimens with a mass between 0.1 and 5 kg can be tested if fixed to a strong support.)			
Power supply	Alkaline AA battery 2 pcs. (battery life: 70 hours) or optional AC adapter	Optional AC adapter	Alkaline AA battery 2 pcs. (battery life: 70 hours) or optional AC adapter	Optional AC adapter
External dimensions/Mass	Detector: ø28×175 mm in length, 120 g Display (W×D×H): 70×35×110 mm, 200 g			

* For **HH-411**, display values are guaranteed based on Leeb hardness. Converted values are for reference only.

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Refer to the Hardness Testing Machines Brochure (**E17001**) for more details.

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HARDMATIC HH-300
SERIES 811 — Durometers for Sponge, Rubber, and Plastics

Compact type

811-329-10 HH-329
811-335-10 HH-335
811-337-10 HH-337

811-330-10 HH-330
811-336-10 HH-336
811-338-10 HH-338

Long type

811-331-10
HH-331

811-333-10
HH-333

811-332-10
HH-332

811-334-10
HH-334

- Hardness measurement by durometer is simply performed by holding the instrument against the surface of a specimen and reading the indicated value. This type of hardness tester is most widely used for hardness testing of sponge, rubber, plastics and other soft materials.

SPECIFICATIONS

Order No.		811-329-10	811-330-10	811-331-10	811-332-10	811-333-10	811-334-10
Model No.		HH-329	HH-330	HH-331	HH-332	HH-333	HH-334
Type		Compact		Long			
Display specification		Analog	Digital	Analog	Digital	Analog	Digital
Measurement target		Soft rubber, sponge, felt, hard film, winder		General rubber, soft plastic		Hard rubber, hard plastic, ebonite	
Category in standards		Type E		Type A		Type D	
Needle shape	Shaft diameter	ø5 mm		ø1.25 mm			
	Tip shape	Semi-sphere		Circular truncated cone		Cone	
	Tip angle	—		35°		30°	
	Tip diameter	—		ø0.79 mm		—	
	Tip curvature	—		—		0.1 mm	
Power supply		—	Button silver oxide battery SR44	—	Button silver oxide battery SR44	—	Button silver oxide battery SR44
External dimensions (W×D×H)		68×34×146 mm	59×40×147 mm	Analog long: 68×35×188 mm Digital long : 59×41×190 mm			
Mass		300 g	290 g	320 g	310 g	320 g	310 g

Order No.		811-335-10	811-335-11	811-336-10	811-336-11	811-337-10	811-337-11	811-338-10	811-338-11
Model No.		HH-335	HH-335-01	HH-336	HH-336-01	HH-337	HH-337-01	HH-338	HH-338-01
Type		Compact							
Display specification		Analog		Digital		Analog		Digital	
Measurement target		General rubber, soft plastic				Hard rubber, hard plastic, ebonite			
Category in standards		Type A				Type D			
Needle shape	Shaft diameter	ø1.25 mm							
	Tip shape	Circular truncated cone				Cone			
	Tip angle	35°				30°			
	Tip diameter	ø0.79 mm				—			
	Tip curvature	—				0.1 mm			
Power supply		—		Button silver oxide battery SR44		—		Button silver oxide battery SR44	
External dimensions (W×D×H)		Analog compact: 68×34×146 mm Digital compact : 59×40×147 mm							
Mass		300 g		290 g		300 g		290 g	

Optional Accessories for Dual-purpose Stand CTS Series

Order No.	811-019	811-012	811-013
Model	CTS-101	CTS-102	CTS-103
Applicable models	HH-331/332	HH-333/334/337/338/337-01/338-01	HH-335/336/335-01/336-01

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Quick Guide to Precision Measuring Instruments

Hardness Testing Machines

Methods of Hardness Measurement

(1) Vickers

Vickers hardness is a test method that has the widest application range, allowing hardness inspection with an arbitrary test force. This test has an extremely large number of application fields particularly for hardness tests conducted with a test force less than 9.807 N (1 kgf). As shown in the following formula, Vickers hardness is a value determined by dividing test force F (N) by contact area S (mm^2) between a specimen and an indenter, which is calculated from diagonal length d (mm, mean of two directional lengths) of an indentation formed by the indenter (a square pyramidal diamond , opposing face angle θ=136˚) in the specimen using a test force.

$$HV=k\frac{F}{S}=0.102\frac{F}{S}=0.102\frac{2F\sin\frac{\theta}{2}}{d^2}=0.1891\frac{F}{d^2} \qquad \begin{matrix}F: N\\ d: mm\end{matrix}$$

The error in the calculated Vickers hardness is given by the following formula. Here, Δd_1, Δd_2, and 'a' represent the measurement error that is due to the microscope, an error in reading an indentation, and the length of an edge line generated by opposing faces of an indenter tip, respectively. The unit of $\Delta\theta$ is degrees.

$$\frac{\Delta HV}{HV}\fallingdotseq-\frac{\Delta F}{F}-2\frac{\Delta d_1}{d}-2\frac{\Delta d_2}{d}-\frac{a^2}{d^2}-3.5\times10^{-3}\Delta\theta$$

(2) Knoop

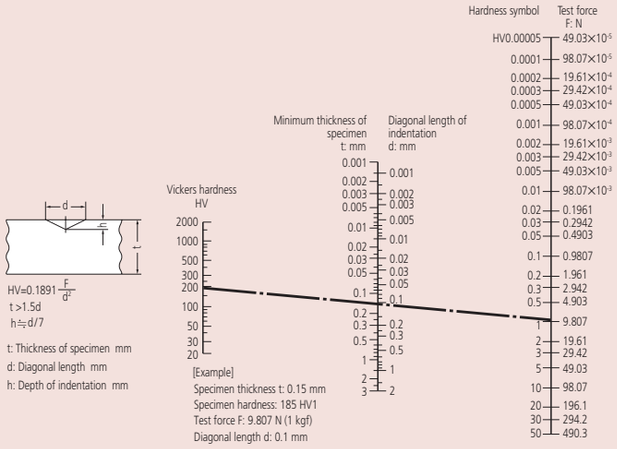
As shown in the following formula, Knoop hardness is a value obtained by dividing test force by the projected area A (mm^2) of an indentation, which is calculated from the longer diagonal length d (mm) of the indentation formed by pressing a rhomboidal diamond indenter (opposing edge angles of 172˚30' and 130˚) into a specimen with test force F applied. Knoop hardness can also be measured by replacing the Vickers indenter of a microhardness testing machine with a Knoop indenter.

$$HK=k\frac{F}{A}=0.102\frac{F}{A}=0.102\frac{F}{cd^2}=1.451\frac{F}{d^2} \qquad \begin{matrix}F: N\\ d: mm\end{matrix}$$

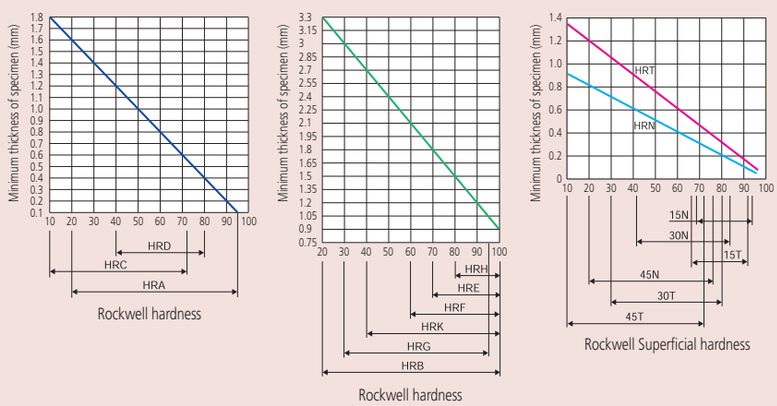
(3) Rockwell and Rockwell Superficial

To measure Rockwell or Rockwell Superficial hardness, first apply a preload force and then the test force to a specimen and return to the preload force using a diamond indenter (tip cone angle: 120˚, tip radius: 0.2 mm) or a sphere indenter (steel ball or carbide ball). This hardness value is obtained from the hardness formula expressed by the difference in indentation depth h (μm) between the preload and test forces. Rockwell uses a preload force of 98.07 N, and Rockwell Superficial 29.42 N. A specific symbol provided in combination with a type of indenter, test force, and hardness formula is known as a scale. Japanese Industrial Standards (JIS) define various scales of related hardness.

Relationship between Vickers Hardness and the Minimum Allowable Thickness of a Specimen



Relationship between Rockwell / Rockwell Superficial Hardness and the Minimum Thickness of a Specimen



Rockwell Hardness Scales

Scale	Indenter	Test force	Application
A	Diamond	588.4 N	Carbide, sheet steel
D		980.7 N	Case-hardened steel
C		1471 N	Steel (100 HRB or more to 70 HRC or less)
F	Sphere of 1.5875 mm diameter	588.4 N	Bearing metal, annealed copper
B		980.7 N	Brass
G		1471 N	Hard aluminum alloy, beryllium copper, phosphor bronze
H	Sphere of 3.175 mm diameter	588.4 N	Bearing metal, grinding wheel
E		980.7 N	Bearing metal
K		1471 N	Bearing metal
L	Sphere of 6.35 mm diameter	588.4 N	Plastic, lead
M		980.7 N	
P		1471 N	
R	Sphere of 12.7 mm diameter	588.4 N	Plastic
S		980.7 N	
V		1471 N	

Rockwell Superficial Hardness Scales

Scale	Indenter	Test force	Application
15-N	Diamond	147.1 N	Thin surface-hardened layer on steel such as carburized or nitrided
30-N		294.2 N	
45-N		441.3 N	
15-T	Sphere of 1.5875 mm diameter	147.1 N	Sheet of mild steel, brass, bronze, etc.
30-T		294.2 N	
45-T		441.3 N	
15-W	Sphere of 3.175 mm diameter	147.1 N	Plastic, zinc, bearing alloy
30-W		294.2 N	
45-W		441.3 N	
15-X	Sphere of 6.35 mm diameter	147.1 N	Plastic, zinc, bearing alloy
30-X		294.2 N	
45-X		441.3 N	
15-Y	Sphere of 12.7 mm diameter	147.1 N	Plastic, zinc, bearing alloy
30-Y		294.2 N	
45-Y		441.3 N	