

Hardness Testing Machines

Start quality control from the material — Mitutoyo's hardness testing machines can handle it

HM-200 SERIES 810 — Micro Vickers Hardness Testing Machines

MeasurLink[®] ENABLED
Data Management Software by Mitutoyo



System A
(HM-210A/220A)

- 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.

SPECIFICATIONS

Order No.	810-401	810-402	810-404	810-406	810-407	810-409
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 B 7725, 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: 315x671x595 mm, 38.5 kg System B/C/D: 315x586x741 mm, 37.4 kg					
Power supply (main unit)	AC100 V 50/60 Hz System A: 31 W System B/C/D: 30 W			AC100 V 50/60 Hz System A: 44 W System B/C/D: 43 W		

Note: 810-401, 810-402, 810-406, 810-407: System A

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

CAUTION: The AVPAK-20 software package is not for use within, or export to, the United States of America
The AVPAK-10 software package is for the United States of America

HM-100 SERIES 810 — Micro Vickers Hardness Testing Machines

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HM-103

- 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.

SPECIFICATIONS

Order No.	810-124-20*	810-125-20	810-959-20
Model	HM-101	HM-102	HM-103
Applicable standards	JIS B 7725, ISO 6507-2		
Test force mN (gf)	98.07 to 9807 (10 to 1000)		
External dimensions (WxDxH) (excluding protrusions and stage); Main unit mass	Main unit: 380x600x590 mm, 42 kg		
	Control panel: 165x235x125 mm, 1.5 kg		TV monitor: 202x29.2x175.8 mm, 1.17 kg
Power supply (main unit)	AC100 V 50/60 Hz		
	Less than 60 W		Less than 90 W

* Models which can be connected to the MeasurLink measurement data network system are only HM-102 and HM-103.

MeasurLink[®] ENABLED
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Products equipped with the measurement data output function can be connected to the measurement data network system MeasurLink[®] (refer to page A-25 for details).



An inspection certificate is supplied as standard. Refer to page U-9 for details.

MeasurLink[®] ENABLED
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Refer to the Hardness Testing Machines Brochure (E17001) for more details.



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HV-100 SERIES 810 — Vickers Hardness Testing Machines



System A
(HV-110A/120A)

- 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.

SPECIFICATIONS

Order No.	810-440	810-441	810-443	810-445	810-446	810-448
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 B 7725, 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: 307x696x781 mm System B/C/D: 307x627x875 mm					
Main unit mass	HV-110: Approx. 60 kg			HV-120: Approx. 58 kg		
Power supply (main unit)	AC100 V 50/60 Hz System A: 24 W System B/C/D: 22 W					

Note: 810-440, 810-445: System A, 810-443, 810-448: System B/C/D

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

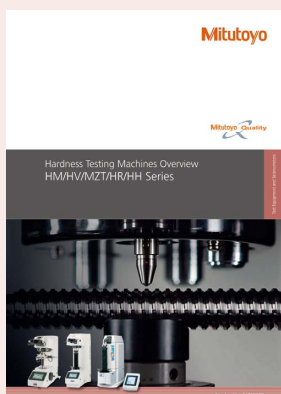
System C (HM-110C/120C)

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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HR-600 SERIES 810 — CNC Rockwell Hardness Testing Machines



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- 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.



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)



An online system to monitor the operational and mechanical statuses of measuring machines. This allows you to grasp the state of a process flow from the operational status of measuring machines within a production process.

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Products equipped with the measurement data output function can be connected to the measurement data network system MeasurLink® (refer to page A-25 for details).



An inspection certificate is supplied as standard. Refer to page U-9 for details.



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

SPECIFICATIONS

Order No.	810-512-21	810-512-23	810-522-21	810-522-23	810-527-21
Model	HR-610A		HR-620A		HR-620B
Display unit	metric	inch/mm	metric	inch/mm	—
Hardness testing methods*1	Rockwell	JIS B 7726:2017, ISO 6508-2:2015, ASTM E18-20			
	Brinell*2	JIS B 7724:2017, ISO 6506-2:2017, ASTM E10-18			
	Plastic	ISO 2039-1:2001			
	Indentation Brinell hardness	JIS K 7202-2:2001, ISO 2039-2:1987, ASTM D785-08 [A&B]			
Indentation Vickers hardness	VDI/VDE 2616				
Initial test force N (kgf)	Rockwell	29.42 (3) 98.07 (10)			
	Plastic	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)			
	Plastic	49.03 (5) 132.4 (13.5) 358.0 (36.5) 962.1 (98.1)			
	Indentation Brinell hardness	588.4 (60) 980.7 (100) 1471 (150)			
Indentation Vickers hardness	612.9 (62.5) 1839 (187.5) 2452 (250)				
Power supply	AC100 to 200 V 50/60 Hz				
Mass	176 kg		181 kg		205 kg

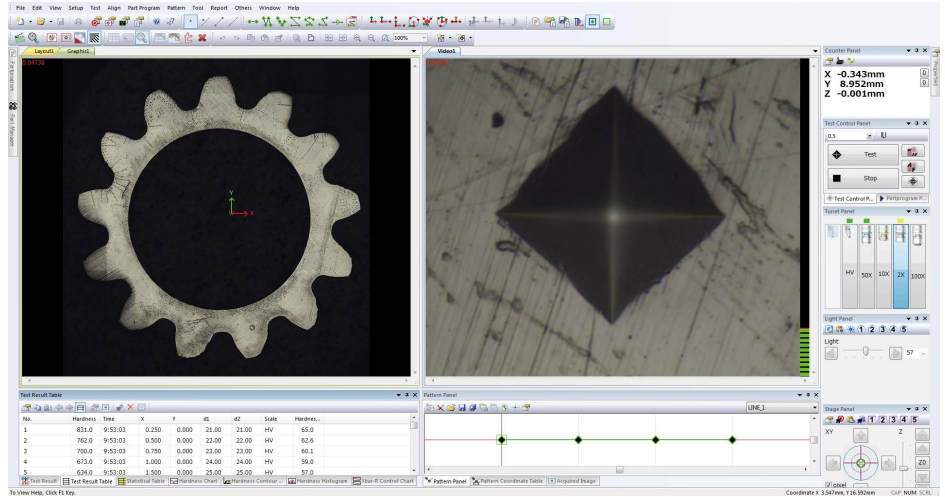
*1 Plastic testing may not be enabled depending on the material. For Brinell hardness, indentation Brinell hardness, and plastic hardness testing, other special accessories are required.

*2 For Brinell hardness testing, an indenter (optional) and a measurement microscope are required. Note: No indenter is supplied with the unit. Separately purchase an indenter that conforms to the applicable standard.

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Software for Hardness testing AVPAK

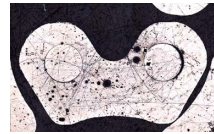
- Enables capture of specimen images from a hardness testing machine, automatic measurement of indentations, and control of continuous automatic measurements based on a given pattern.



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.



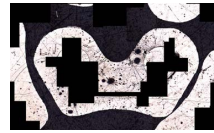
Various kinds of pattern setting

Performs time-consuming pattern setting with ease.



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.



Pattern creation

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



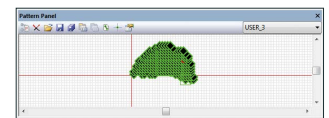
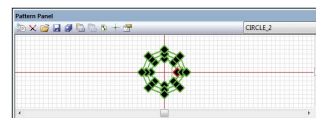
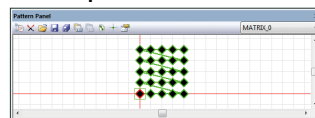
Pattern pasting

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

Contour detection (Only for AVPAK-20)

Detects the outline of the workpiece from combined images.

Pattern panel

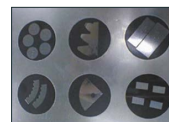


Handling of multiple specimens

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

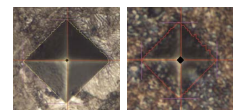
Executes a common part program for specimens having the same shape.



Reading of indentations

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

Note: Measurement accuracy varies according to conditions.



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HR-530 SERIES 810 — Rockwell Hardness Testing Machines

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- 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

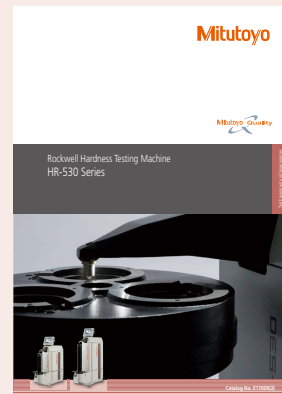
- This series can test the hardness of the inside wall of a ring, a test that is only possible using ordinary hardness testers by cutting the ring into pieces. (All models)
- The touch-panel display unit can be mounted on top of the tester, providing significant convenience if the machine installation 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.

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

SPECIFICATIONS

Order No.	810-233-21		810-233-23		810-333-21		810-333-23	
Model	HR-530				HR-530L			
Display unit	metric		inch/mm		metric		inch/mm	
Applicable standards	JIS B 7726:2017, ISO 6508-2:2015, ASTM E18-20							
Hardness testing methods	Rockwell/Rockwell Superficial/Brinell/Plastics hardness							
Initial test force	N (kgf)		29.42 (3)		98.07 (10)			
Test force	Rockwell		588.4 (60)		980.7 (100)		1471 (150)	
	Rockwell Superficial		147.1 (15)		294.2 (30)		441.3 (45)	
N (kgf)	Brinell		61.29 (6.25)		98.07 (10)		153.2 (15.625)	
			306.5 (31.25)		612.9 (62.5)		980.7 (100)	
Power supply			AC100/120/220/240 V		Auto-selection			
External dimensions (WxDxH)	Main unit		250x667x621 mm		300x667x766 mm			
	Touch-panel display unit		191x147x71 mm					
Mass			Main unit: Approx. 60 kg Display: Approx. 1.1 kg		Main unit: Approx. 69 kg Display: Approx. 1.1 kg			

Note 1: Plastic testing may not be enabled depending on the material.

Note 2: For Brinell hardness, indentation Brinell hardness, and plastic hardness testing, other special accessories are required.

Note 3: No indenter is supplied with the unit. Separately purchase an indenter that conforms to the applicable standard.



An inspection certificate is supplied as standard. Refer to page U-9 for details.

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

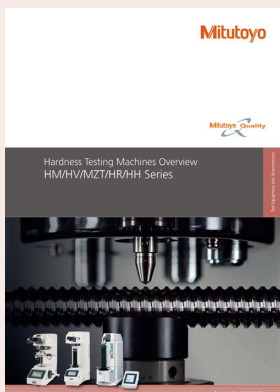


HR-430MS

SPECIFICATIONS

Order No.	810-191-11	810-193-21	810-192-21	810-194-21
Model	HR-210MR	HR-430MR	HR-320MS	HR-430MS
Display	Analog	Digital	Digital	Digital
Applicable standards	JIS B 7726:2017, ISO 6508-2:2015	JIS B 7726:2017, ISO 6508-2:2015, ASTM E18-20		
Supported hardnesses	Rockwell hardness			
	—		Rockwell Superficial hardness	
Preliminary test force N (kgf)	98.07 (10)		29.42 (3) 98.07 (10)	
Test force Rockwell N (kgf)	588.4 (60) 980.7 (100) 1471 (150)			
Test force Superficial N (kgf)	—		147.1 (15) 294.2 (30) 441.3 (45)	
External dimensions (WxDxH) (excluding protrusions and stage)	214×512×780 mm			
Main unit mass	46 kg	49 kg	47 kg	50 kg
Power supply	AC100 to 240 V 1.2 A (DC adapter DC12 V 3.5 A)			

Note: No indenter is supplied with the unit. Separately purchase an indenter that conforms to the applicable standard.



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

Hardness Testing Machines

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

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- 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	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 Tensile strength: 499 to 1999 MPa	
Shore hardness(HS) conversion	VHS (JIS B 7731)		HSD (ASTM E140)	
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): 70×110×35 mm, 200 g			

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

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

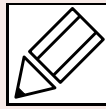
Order No.	811-329-10	811-330-10	811-331-10	811-332-10	811-333-10	811-334-10	811-335-10	811-336-10	811-337-10	811-338-10	
Model No.	HH-329*	HH-330	HH-331*	HH-332	HH-333*	HH-334	HH-335*	HH-336	HH-337*	HH-338	
Type	Compact		Long				Compact				
Display specification	Analog	Digital	Analog	Digital	Analog	Digital	Analog	Digital	Analog	Digital	
Measurement target	Soft rubber, sponge, felt, hard film, winder		General rubber, soft plastic		hard rubber, hard plastic, ebonite		General rubber, soft plastic		hard rubber, hard plastic, ebonite		
Classification by specification	Type E		Type A		Type D		Type A		Type D		
Needle shape	Shaft diameter		ø5 mm		ø1.25 mm						
	Tip shape		Semi-sphere		Circular truncated cone		Cone		Circular truncated cone		Cone
	Tip angle		—		35°		30°		35°		30°
	Tip diameter		—		ø0.79 mm		—		ø0.79 mm		—
	Tip curvature		—		—		0.1 mm		—		0.1 mm
Power supply	—	Button silver oxide battery SR44	—	Button silver oxide battery SR44	—	Button silver oxide battery SR44	—	Button silver oxide battery SR44	—	Button silver oxide battery SR44	
External dimensions (WxDxH)	68×34×146 mm	59×40×147 mm	Analog, long type : 68×35×188 mm Digital, compact type: 59×41×190 mm				Analog, long type : 68×34×146 mm Digital, compact type: 59×40×147 mm				
Mass	300 g	290 g	320 g	310 g	320 g	310 g	300 g	290 g	300 g	290 g	

* Models which can be connected to the MeasurLink measurement data network system are only Digital types.

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

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 (mm²) 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 $\theta=136^\circ$) in the specimen using a test force F (N). k is a constant ($1/g=1/9.80665$).

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

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.

$$\frac{\Delta HV}{HV} \approx \frac{\Delta F}{F} - 2 \frac{\Delta d_1}{d} - 2 \frac{\Delta d_2}{d} - \frac{a^2}{d^2} 3.5 \times 10^{-3} \Delta \theta$$

(2) Knoop

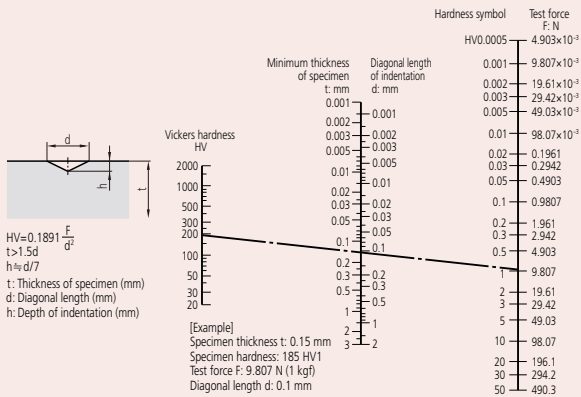
As shown in the following formula, Knoop hardness is a value obtained by dividing test force by the projected area A (mm²) of an indentation, which is calculated from the longer diagonal length d (mm) of the indentation formed by pressing a rhomboidal diamond indenter (opposing edge angles of $172^\circ 30'$ 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.

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

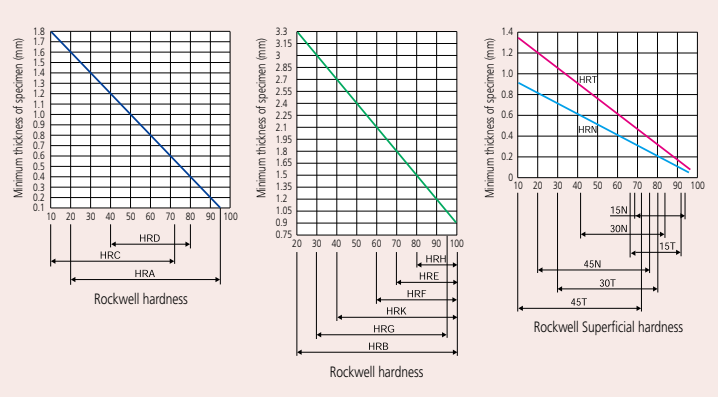
(3) Rockwell and Rockwell Superficial

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	
C		1471 N	
F	Sphere of 1.5875 mm diameter	588.4 N	Bearing metal, annealed copper
B		980.7 N	
G		1471 N	
H	Sphere of 3.175 mm diameter	588.4 N	Bearing metal, grinding wheel
E		980.7 N	
K		1471 N	
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	