Durometers for sponge, rubber, and plastic
Hardmatic HH-300 Series

The Hardmatic HH-300 Series includes a slim and easy-to-handle long type and a compact type that fits easily in your hand. Both types have 2 types of display specifications, analog and digital.

Long type

811-333-10,334-10
HH-333, 334
811-337-10,338-10
HH-337, 338

811-333-10,337-10
HH-334, 338

Compact type

811-331-10,332-10
HH-331, 332
811-335-10,336-10
HH-335, 336

811-329-10,330-10
HH-329, 330

HARD

SOFT

Plastics

Hard rubbers

811-019
CTS-101
811-332-10
HH-332

General types of rubber
Elastomers

811-013
CTS-103
811-336-10
HH-336

Hard sponges
Soft foams

DP-1VR

Measuring hardness just requires pressing the hardness tester against the specimen and reading the indicated value.

Various kinds of sample can be tested for hardness, from soft sponge to hard plastic. Also, various measurement locations on the specimen can be used, such as a flat surface, a hole, or the bottom of a groove. The 10 models of hardness testers in the HH-300 Series support various hardness measurement standards.

Long type HH-331, 332, 333, 334, 335-01, 337-01

The the long type has a slender cylindrical shape (ø24 x 85mm).
Due to this it can measure hardness at the bottom of grooves or holes as well as exposed surfaces. Also, hardness measurement can be performed while keeping your hands and face away from the specimen surface. This is essential when the surface temperature is high: for example immediately after molding.

Compact type HH-329, 330, 335, 336, 337, 338, 335-01, 336-01, 337-01, 338-01

The compact body fits snugly into your palm for ease of measurement.

Specifications

Order No.		811-329-10	811-330-10	811-331-10	811-332-10	811-333-10	811-334-10
Model		HH-329	HH-330	HH-331	HH-332	HH-333	HH-334
Type		Compact type		Long type			
Display specification		Analog	Digital	Analog	Digital	Analog	Digital
Measurement target		Soft rubber, sponge, felt, hard foam, winder		General rubber/soft plastic		Hard rubber/hard plastic/ebonite	
Category in standards		Type E		Type A		Type D	
Needle shape	Shaft diameter	—		ø1.25mm			
	Tip shape	Semi-sphere		Circular truncated cone		Cone	
	Tip angle	—		35°		30°	
	Tip diameter	ø5mm		ø0.79mm		—	
	Tip curvature	—		—		0.1	
Pressure surface shape		44×18mm		ø18mm			
Protrusion of needle from pressure surface		2.5mm		2.5mm			
Minimum graduation		1° (HH-329, 331, 333, 335, 337) 0.1° (HH-330, 332, 334, 336, 338)					
Loading device W_E, W_A, W_D, spring force (mN) H_E, H_A, H_D hardness		Coil spring method $W_E=550+75H_E$ (10 scale 1300mN, 90 scale 7300mN)		Coil spring method $W_A=550+75H_A$ (HA: 10 to 90) (10 scale 1300mN, 90 scale 7300mN)		Coil spring method $W_D=444.5H_D$ (HD: 20 to 90) (20° 8890mN, 90° 40005mN)	
Accuracy of spring force		±68.6mN		±68.6mN		±392.3mN	
Functions		Peak hold	Hold function Output function: Digimatic interface for printer Tolerance judgment Function lock	Peak hold	Hold function Output function: Digimatic interface for printer Tolerance judgment Function lock	Peak hold	Hold function Output function: Digimatic interface for printer Tolerance judgment Function lock
External dimensions (W×D×H)		68×34×146mm	59×40×147mm	Analog long 68×35×188mm Digital long 59×41×190mm			
Mass		300g	290g	320g	310g	320g	310g
Power supply		—	Button type silver oxide battery SR44	—	Button type silver oxide battery SR44	—	Button type silver oxide battery SR44

Hold function HH-330/332/334/336/338

Holds the display value at any time during measurement so that you can easily check the measurement result.

Peak hold function HH-329/331/333/335/337

The peak hold indicator attached to the analog display is very useful for peak value measurement.

Output zero set function HH-330/332/334/336/338

A Digimatic output interface is standard, so they can be connected to the DP-1VR (special accessory) and measurement system. By using the ZERO switch, which also serves as the power switch, you can correct any small shift of the zero position due to a quantization error.

Specifications

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	HH-335	HH-335-01	HH-336	HH-336-01	HH-337	HH-337-01	HH-338	HH-338-01
Type	Compact type							
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							
Needle shape Tip shape	Circular trancated cone				Cone			
Needle shape Tip angle	35°				30°			
Needle shape Tip diameter	ø0.79mm				—			
Needle shape Tip curvature	—				0.1mm			
Pressure surface shape	44×18mm	ø18mm	44×18mm	ø18mm	44×18mm	ø18mm	44×18mm	ø18mm
Protrusion of needle from pressure surface	2.5mm							
Minimum graduation	1° (HH-331, 333, 335, 337) 0.1° (HH-332, 334, 336, 338)							
Loading device W_A, W_D, spring force (mN) H_A, H_D hardness	Coil spring method $W_A=550+75H_A$ (HA: 10 to 90) (10 scale 1300mN, 90 scale 7300mN)				Coil spring method $W_D=444.5H_D$ (HD: 20 to 90) (20 scale 8890mN, 90 scale 40005mN)			
Accuracy of spring force	±68.6mN				±392.3mN			
Functions	Peak hold		Hold function Output function: Digimatic interface for printer Tolerance judgment Function lock		Peak hold		Hold function Output function: Digimatic interface for printer Tolerance judgment Function lock	
External dimensions (W×D×H)	Analog compact 68×34×146mm Digital compact 59×40×147mm							
Mass	300g		290g		300g		290g	
Power supply	—		Button type silver oxide battery SR44		—		Button type silver oxide battery SR44	

One unit for 3 applications

Optional accessories

Measurement/test dual purpose stand CTS Series (all models)

The CTS Series can be combined with the HH-300 Series for (1) hardness measurement, and (2) spring force testing of the HH-300 Series hardness tester main unit. (3) By connecting the attached weight directly to the hardness tester to perform hardness measurement results in better repeatability than can be obtained compared to hardness measurement made by directly pressing the hardness tester against the workpiece by hand. This measurement method with a weight directly connected to the hardness tester is useful for measuring the hardness of large samples for which the stand cannot be used, as well as hardness measurement in the field. The CTS Series includes 3 models for different hardness tester types. All 3 models can be used for (1), (2), and (3) above with one stand by adding a separately available accessory.

Specifications

Order No.		811-019	811-012	811-013
Model		CTS-101	CTS-102	CTS-103
Applicable model		HH-331, 332	HH-333, 334, 337, 338	HH-335, 336
Application	1.Fixed force hardness measurement			
	Measurement force	9.81N	49.05N	9.81N
	Weight used	(1)	(1)+(3)+(4)	(1)
	2.Manual fixed force hardness measurement			
	Measurement force	9.81N	49.05N	9.81N
	Weights used	(1)+(6)	(1)+(3)+(6)	(1)+(6)
	3.Loading test			
	Weight used	L:— / H:(1)	L:(1)+(5) / H:(3)	L:— / H:(1)+(2)
Weights	Weight application	(1)CTS-101, 102, 103 Measurement / testing (2)103 Measurement (3)CTS-102 Measurement / testing (4)CTS-102 Measurement (5)CTS-102 Measurement / testing (6)CTS-101, 102, 103 Measurement		
	Outside diameter (Unit: mm)	(1)ø64×23.5 (6)ø40×13	(1)ø64×23.5 (3)ø78×110 (4)ø20×25 (5)ø40×25 (6)ø40×13	(1)ø64×23.5 (2)ø20×19 (6)ø40×13
	Body mass	(1)580g (2)34.8g (3)3950g (4)50g (5)197.4g (6)130g		
Stand (overview)	External dimensions	ø148 x Height (Max.) 420mm		
	Up/down stroke	12mm		
	Maximum specimen thickness	Approx. 90mm		
	Specimen table dimension	ø90mm		
	Total mass	Approx. 9kg	Approx. 13kg	Approx. 9kg

Standard configuration

Item	Usage	Quantity	811-019 CTS-101	811-012 CTS-102	811-013 CTS-103
Main unit	—	1	✓	✓	✓
Tool set	—	1	✓	✓	✓
Weight (1)	Measurement / testing	1	✓	✓	✓
Weight (2)	Testing	1	—	—	✓
Weight (3)	Measurement / testing	1	—	✓	—
Weight (4)	Measurement / testing	1	—	✓	—
Weight (5)	Testing	1	—	✓	—
Weight (6)	Testing	2	✓	✓	✓
User's manual	—	1	✓	✓	✓
Warranty card	—	1	✓	✓	✓

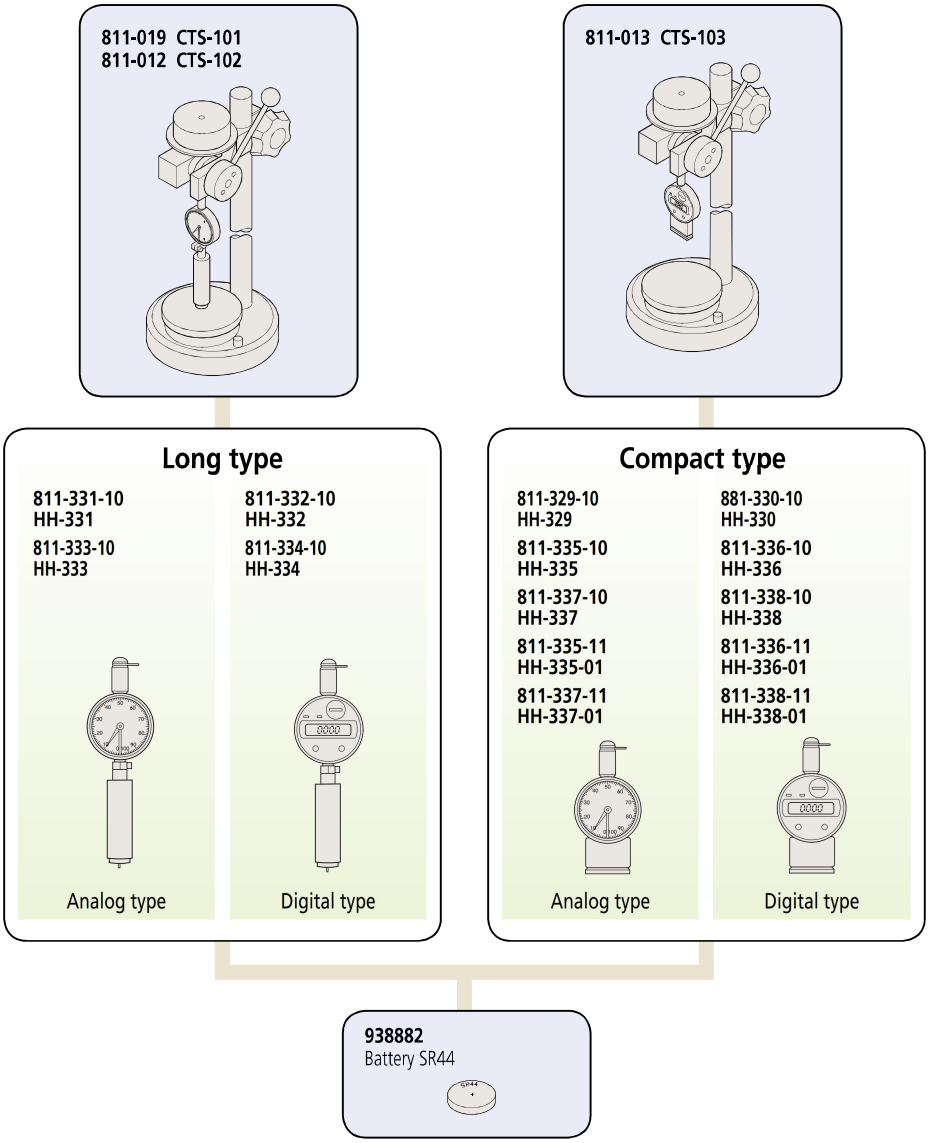
(1)Hardness measurement

(2)Spring force testing

(3)Direct application of weight

System configuration

The HH-300 Series can be used more effectively by combining them with various special accessories (sold separately).



Examples of hardness measurement performance in various standards

Standard	Designation	Description
JIS K 6253 ISO 7619	A45/15	Hardness measurement is performed with the Type A hardness tester. It indicates that a hardness measurement of 45 is obtained 15 seconds after starting the measurement.
	D70/10	Hardness measurement is performed with the Type D hardness tester. It indicates that a hardness measurement of 70 is obtained 10 seconds after starting the measurement.
JIS K 7215	HDA83	Hardness measurement is performed with the Type A hardness tester. It indicates that a hardness measurement of 83 is obtained.
	HDD56	Hardness measurement is performed with the Type D hardness tester. It indicates that a hardness measurement of 56 is obtained.
ASTM D 2240	A/45/15	Hardness measurement is performed with the Type A hardness tester. It indicates that a hardness measurement of 45 is obtained 15 seconds after starting the measurement.
	D/60/1	Hardness measurement is performed with the Type D hardness tester. It indicates that a hardness measurement of 60 is obtained 1 second after starting the measurement.
ISO 868	A/15:45	Hardness measurement is performed with the Type A hardness tester. It indicates that a hardness measurement of 45 is obtained 15 seconds after starting the measurement.
	D/1:60	Hardness measurement is performed with the Type D hardness tester. It indicates that a hardness measurement of 60 is obtained 1 second after starting the measurement.
DIN 53 505	75Shore A	Hardness measurement is performed with the Shore A hardness tester. It indicates that a hardness measurement of 75 is obtained.

Domestic and overseas standards

JIS K 6253-3	"Hardness testing methods for rubber, vulcanized or thermoplastic"
JIS K 7215	"Testing Methods for Durometer Hardness of Plastics"
JIS S 6050	"Plastics erasers"
ISO 7619	"Rubber-Determination of indentation hardness by means of pocket hardness meters"
ISO 68	"Plastics and ebonite-Determination of indentation hardness by means of a durometer (Shore hardness)"
ASTM D 2240	"Standard Test Method for Rubber property-Durometer Hardness"
DIN 53 505	"Testing of rubber and plastics; shore A and shore D hardness test"
SRIS 0101	"Physical testing methods for expanded rubber"

Hardness standard block (HH-331,332,335,336)

Hardness standard blocks (based on JIS K 7215/for Type D) are available as useful tools for a daily check of the hardness tester.
To order or for further details, contact the following:

Japanese Chemical Innovation Institute
High Polymer Test & Evaluation Center
2-11-17, Shinonome, Koto-ku, Tokyo 135-0062

Related information and materials

Hardness basics

"Hardness" is a convenient term used broadly in our daily language, but the concept is complicated. Experiencing hard and soft is easy, but it is difficult to express those actual qualities in simple terms. Hardness thus has broad meanings and refers to a measure closely related to one or a number of properties, including resistance to wear, resistance to scratching, elastic modulus, yield point, fracture strength, viscosity, brittleness, and ductility. Hardness testing is localized testing of a material and is therefore easier to perform than testing of other properties like tensile strength, proof stress, spring elastic limit, formability and abrasion resistance. Even after testing, it is often the case that the item can still be used as a product. Therefore testing hardness is often preferred as a practical alternative to testing other characteristics.

Hardness is not a physical quantity like length, time, mass or current, but an industrial quantity or comparison value like other mechanical properties.

The hardness of an object is a measure indicating the level of resistance when the object is subjected to deformation by another object

1. Overview of hardness

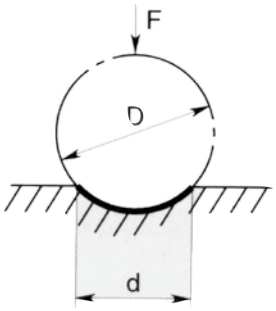
Testing methods used to characterize hardness as a numerical value employ diverse methods of applying deformation and resistance representation devised for, and defined by, each of those testing methods. The hardness testing methods used by industry today can be basically grouped as follows according to variations in standard materials, deformations to be used as the basis for measurement, and hardness calculation methods. Indentation testing methods are the most commonly applied. They involve applying a permanent deformation to the test surface and determining its hardness from the test force required to create the deformation and the size of the deformation.
Rebound hardness (or dynamic hardness) testing measures the behavior when a standard impactor is made to collide with the test surface, and scratch hardness testing measures the behavior when two materials are rubbed together. Portable hardness testing employs a different comparative measurement method for each type of material due to priority being placed on ease of operation and even magnetism and ultrasound are used.
Other typical examples of methods for common hardnesses include Mohs hardness and pencil hardness testing, which have been around for many years.

2. Hardness-related standards

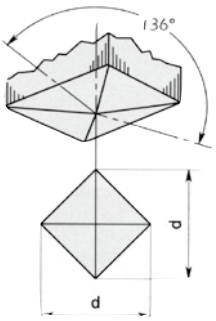
Japanese Industrial Standards (JIS) include a number of standards related to hardness. With the recent trend toward internationalization, JIS standards are being revised so they are consistent with ISO standards. The major categories can be grouped as follows.

- Test methods: Specifying the methods to be used for general hardness testing
- Verification of testing machines: Specifying the testing machines to be used for hardness testing
- Calibration of reference blocks: Specifying the methods of calibration of reference blocks to be used for verification of hardness testing machines
- Application-specific test methods: Specifying the hardness testing methods to be used for specific applications.

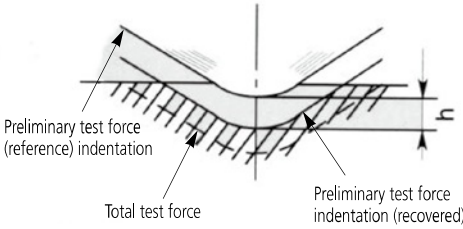
Brinell hardness testing



Vickers hardness testing



Rockwell hardness testing

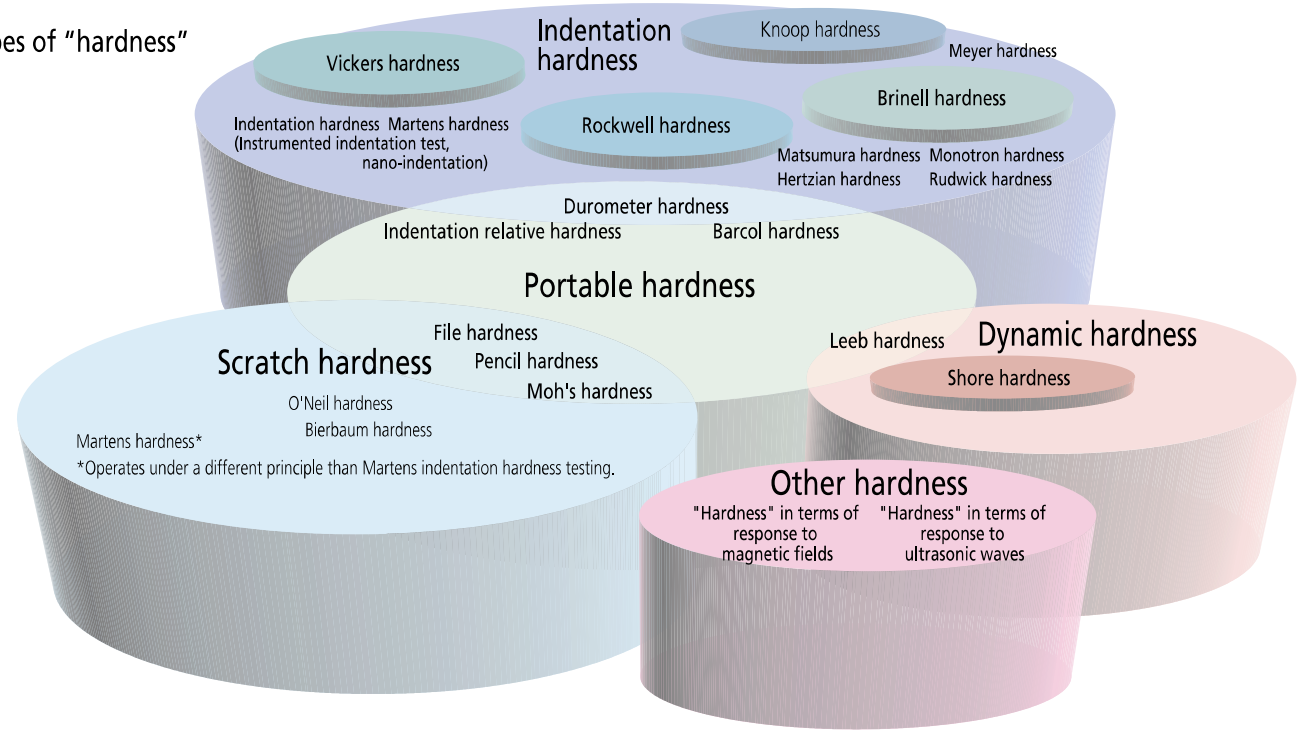


Indentation size for each type of hardness test

Hardness test	Test force	Indentation diameter (mm)	Indentation depth (mm)
Brinell hardness (HB)	29421N	5.5 to 3	1 to 0.5
Rockwell hardness (HRC)	1471N	1 to 0.5	0.06 to 0.015
Rockwell hardness (HRA)	588.4N	0.5 to 0.25	0.04 to 0.01
Rockwell Superficial hardness (HR)	147.1 to 441.3N	0.2 to 0.02	0.02 to 0.001
Vickers hardness (HV)	9.807 to 490.3N	0.7 to 0.05	0.1 to 0.01
	98.07 to 9807mN	0.2 to 0.005	0.03 to 0.001
Shore hardness (HS)		0.3 to 0.6	0.01 to 0.04

Hardness definitions and types

Types of "hardness"



Definition of hardness

(1) Brinell hardness

The Brinell hardness testing method was the first method invented for standardizing hardness, from which other hardness measuring methods have been derived.
Brinell hardness is the test force F divided by the contact area S (mm^2) between the spherical indenter and specimen calculated on the diameter d (mm) of the impression made when the indenter (a steel ball or cemented carbide ball with a diameter D mm) is pressed into the sample by the test force F and then removed. The symbol HBS is used when the indenter is a steel ball, or HBW when it is a cemented carbide ball. k is a constant (1/g = 1/9.80665 = 0.102).

$$HBW = k\frac{F}{S} = 0.102\frac{2F}{\pi D\left(D-\sqrt{D^2-d^2}\right)} \qquad \begin{matrix} F:N \\ D:mm \\ d:mm \end{matrix}$$

For the same loading condition (F/D^2), the Brinell hardness obtained is almost the same when different test forces are used for measurement. In many countries, measurement with small test forces is widespread as an application of this fact. Testing with a test force of 2451N or less can be conducted by using the test force weight and indenter for the Rockwell or Vickers hardness testing machine. For steel, F/D^2 is 30. For other softer materials, an appropriate value is selected from 15, 10, 5, 2.5, 1.25, and 1. In the JIS and ISO standards, the test force is 9.807 to 29420N, and the diameter of the spherical indenter is 1 to 10mm. An error of the Brinell hardness test is obtained by the following formula. $\triangle d^1$ indicates the error of the impression measuring device, $\triangle d^2$ the error in impression measurement.

$$\frac{\triangle HB}{HB} \fallingdotseq -\frac{\triangle F}{F} - (0.03\sim0.18)\frac{\triangle D}{D} - 2\frac{\triangle d_1}{d} - 2\frac{\triangle d_2}{d}$$

(2) Vickers hardness

Vickers hardness is the most versatile test method as it can be used with any test force. More specifically, there are many applications of microhardness below 9.807N.
Vickers hardness is the test force F divided by the area S (mm^2) of the indenter and sample calculated based on the diagonal length d (the average of 2 directions in mm) of the impression made when the pyramid-shaped diamond indentor (θ=136° between opposite faces) is pressed into the sample by the test force F(N) and then removed.

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

An error of the Vickers hardness test is obtained by the following formula. $\triangle d^1$ indicates the measuring error of the microscope, $\triangle d^2$ indicates the error in indentation measurement, "a" indicates the length of the edge line between two opposite faces at the tip of the indenter. $\triangle\theta$ is in degrees.

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

(3) Knoop hardness

Knoop hardness is the test force F divided by the projected area A (mm^2) of the impression calculated based on the longer diagonal length d (mm) of the indentation made when the pyramid-shaped diamond indenter with apical angles of 130° and 172°30' and rhomboid cross section is pressed into the specimen by the test force F and then removed. Knoop hardness can be measured by replacing the Vickers indenter of the microhardness testing machine with the Knoop indenter.

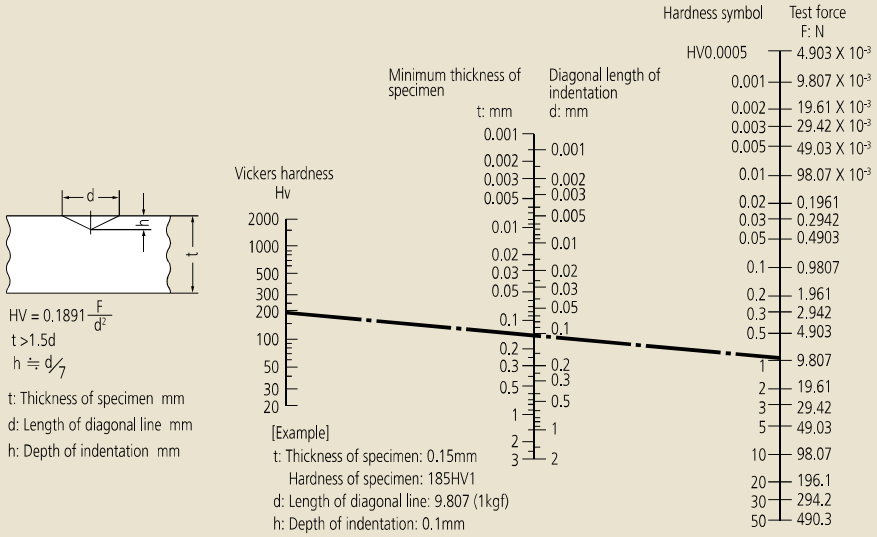
$$HK = k\frac{F}{A} = 0.102\frac{F}{A} = 0.102\frac{F}{cd^2} = 1.451\frac{F}{d^2} \qquad \begin{matrix} F:N \\ d:mm \end{matrix}$$

(4) Rockwell hardness and Rockwell Superficial hardness

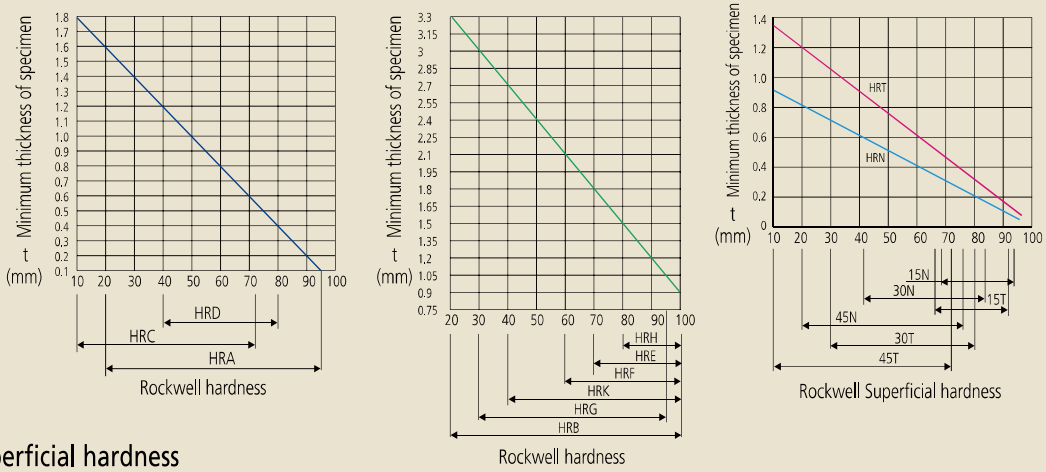
A conical diamond indenter with an angle of 120° and a tip radius of 0.2mm tip or spherical indenter (steel or cemented carbide) is used. The preliminary test force is applied first, the test force is applied, and then the preliminary test force is applied again. Rockwell hardness and Rockwell Superficial hardness can be obtained from the hardness calculation formula based on the difference in depths of impression h (μm) measured at the first and second application of the initial test force.
The hardness is called Rockwell hardness when the preliminary test force is 98.07N, or Rockwell Superficial hardness when it is 29.42N. Unique symbols are assigned to combinations of types of the indenter, test forces, and hardness calculation formula, which comprise a scale. JIS defines scales of hardness.

Relation diagram for specimen hardness and minimum thickness

Vickers



Rockwell
Rockwell Superficial hardness



Types of Rockwell hardness

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

Types of Rockwell Superficial hardness

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

Hardness conversion table

The table below enables conversion between hardness values for metals, which vary according to the particular standard.
For accurate results, please use values obtained with the respective testing machines as reference.

Steel

Vickers	Rockwell				Rockwell Superficial			Shore
HV	HRA	HRB	HRC	HRD	15N	30N	45N	HS
940	85.6	—	68.0	76.9	93.2	84.4	75.4	98.0
920	85.3	—	67.5	76.5	93.0	84.0	74.8	96.8
900	85.0	—	67.0	76.1	92.9	83.6	74.2	95.6
880	84.7	—	66.4	75.7	92.7	83.1	73.6	94.3
860	84.4	—	65.9	75.3	92.5	82.7	73.1	93.1
840	84.1	—	65.3	74.8	92.3	82.2	72.2	91.7
820	83.8	—	64.7	74.3	92.1	81.7	71.8	90.4
800	83.4	—	64.0	73.8	91.8	81.1	71.0	89.0
780	83.0	—	63.3	73.3	91.5	80.4	70.2	87.6
760	82.6	—	62.5	72.6	91.2	79.7	69.4	86.2
740	82.2	—	61.8	72.1	91.0	79.1	68.6	84.8
720	81.8	—	61.0	71.5	90.7	78.4	67.7	83.3
700	81.3	—	60.1	70.8	90.3	77.6	66.7	81.8
690	81.1	—	59.7	70.5	90.1	77.2	66.2	81.0
680	80.8	—	59.2	70.1	89.8	76.8	65.7	80.2
670	80.6	—	58.8	69.8	89.7	76.4	65.3	79.4
660	80.3	—	58.3	69.4	89.5	75.9	64.7	78.6
650	80.0	—	57.8	69.0	89.2	75.5	64.1	77.8
640	79.8	—	57.3	68.7	89.0	75.1	63.5	77.0
630	79.5	—	56.8	68.3	88.8	74.6	63.0	76.2
620	79.2	—	56.3	67.9	88.5	74.2	62.4	75.4
610	78.9	—	55.7	67.5	88.2	73.6	61.7	74.5
600	78.6	—	55.2	67.0	88.0	73.2	61.2	73.7
590	78.4	—	54.7	66.7	87.8	72.7	60.5	72.8
580	78.0	—	54.1	66.2	87.5	72.1	59.9	72.0
570	77.8	—	53.6	65.8	87.2	71.7	59.3	71.1
560	77.4	—	53.0	65.4	86.9	71.2	58.6	70.2
550	77.0	—	52.3	64.8	86.6	70.5	57.8	69.3
540	76.7	—	51.7	64.4	86.3	70.0	57.0	68.4
530	76.4	—	51.1	63.9	86.0	69.5	56.2	67.5
520	76.1	—	50.5	63.5	85.7	69.0	55.6	66.6
510	75.7	—	49.8	62.9	85.4	68.3	54.7	65.6
500	75.3	—	49.1	62.2	85.0	67.7	53.9	64.7
490	74.9	—	48.4	61.6	84.7	67.1	53.1	63.7
480	74.5	—	47.7	61.3	84.3	66.4	52.2	62.8
470	74.1	—	46.9	60.7	83.9	65.7	51.3	61.8
460	73.6	—	46.1	60.1	83.6	64.9	50.4	60.8
450	73.3	—	45.3	59.4	83.2	64.3	49.4	59.8
440	72.8	—	44.5	58.8	82.8	63.5	48.4	58.8
430	72.3	—	43.6	58.2	82.3	62.7	47.4	57.8
420	71.8	—	42.7	57.5	81.8	61.9	46.4	56.7
410	71.4	—	41.8	56.8	81.4	61.1	45.3	55.7
400	70.8	—	40.8	56.0	81.0	60.2	44.1	54.6
390	70.3	—	39.8	55.2	80.3	59.3	42.9	53.6
380	69.8	(110.0)	38.8	54.4	79.8	58.4	41.7	52.5
370	69.2	—	37.7	53.6	79.2	57.4	40.4	51.4
360	68.7	(109.0)	36.6	52.8	78.6	56.4	39.1	50.3
350	68.1	—	35.5	51.9	78.0	55.4	37.8	49.2
340	67.6	(108.0)	34.4	51.1	77.4	54.4	36.5	48.1
330	67.0	—	33.3	50.2	76.8	53.6	35.2	46.9
320	66.4	(107.0)	32.2	49.4	76.2	52.3	33.9	45.7
310	65.8	—	31.0	48.4	75.6	51.3	32.5	44.6
300	65.2	(105.5)	29.8	47.5	74.9	50.2	31.1	43.4
295	64.8	—	29.2	47.1	74.6	49.7	30.4	42.8
290	64.5	(104.5)	28.5	46.5	74.2	49.0	29.5	42.2
285	64.2	—	27.8	46.0	73.8	48.4	28.7	41.6
280	63.8	(103.5)	27.1	45.3	73.4	47.8	27.9	41.0
275	63.5	—	26.4	44.9	73.0	47.2	27.1	40.4
270	63.1	(102.0)	25.6	44.3	72.6	46.4	26.2	39.7
265	62.7	—	24.8	43.7	72.1	45.7	25.2	39.1
260	62.4	(101.0)	24.0	43.1	71.6	45.0	24.3	38.5
255	62.0	—	23.1	42.2	71.1	44.2	23.2	37.9
250	61.6	99.5	22.2	41.7	70.6	43.4	22.2	37.2
245	61.2	—	21.3	41.1	70.1	42.5	21.1	36.6
240	60.7	98.1	20.3	40.3	69.6	41.7	19.9	36.0
230	—	96.7	(18.0)	—	—	—	—	34.7
220	—	95.0	(15.7)	—	—	—	—	33.4
210	—	93.4	(13.4)	—	—	—	—	32.0
200	—	91.5	(11.0)	—	—	—	—	30.7
190	—	89.5	(8.5)	—	—	—	—	29.4
180	—	87.1	(6.0)	—	—	—	—	28.0
170	—	85.0	(3.0)	—	—	—	—	26.6
160	—	81.7	(0.0)	—	—	—	—	25.2
150	—	78.7	—	—	—	—	—	23.8
140	—	75.0	—	—	—	—	—	22.3
130	—	71.2	—	—	—	—	—	20.8
120	—	66.7	—	—	—	—	—	19.4
110	—	62.3	—	—	—	—	—	17.9
100	—	56.2	—	—	—	—	—	16.3

● This conversion table is compiled based on standard SAE J 417. ● Shore hardness follows JIS B 7731.

Brass

Vickers	Rockwell		Rockwell Superficial	
HV	HRV	HRF	30T	45T
196	93.5	110.0	77.5	66.0
194	—	109.5	—	65.5
192	93.0	—	77.0	65.0
190	92.5	109.0	76.5	64.5
188	92.0	—	—	64.0
186	91.5	108.5	76.0	63.5
184	91.0	—	75.5	63.0
182	90.5	108.0	—	62.5
180	90.0	107.5	75.0	62.0
178	89.0	—	74.5	61.5
176	88.5	107.0	—	61.0
174	88.0	—	74.0	60.5
172	87.5	106.5	73.5	60.0
170	87.0	—	—	59.5
168	86.0	106.0	73.0	59.0
166	85.5	—	72.5	58.5
164	85.0	105.5	72.0	58.0
162	84.0	105.0	—	57.5
160	83.5	—	71.5	56.5
158	83.0	104.5	71.0	56.0
156	82.0	104.0	70.5	55.5
154	81.5	103.5	70.0	54.5
152	80.5	103.0	—	54.0
150	80.0	—	69.5	53.5
148	79.0	102.5	69.0	53.0
146	78.0	102.0	68.5	52.5
144	77.5	101.5	68.0	51.5
142	77.0	101.0	67.5	51.0
140	76.0	100.5	67.0	50.0
138	75.0	100.0	66.5	49.0
136	74.5	99.5	66.0	48.0
134	73.5	99.0	65.5	47.5
132	73.0	98.5	65.0	46.5
130	72.0	98.0	64.5	45.5
128	71.0	97.5	63.5	45.0
126	70.0	97.0	63.0	44.0
124	69.0	96.5	62.5	43.0
122	68.0	96.0	62.0	42.0
120	67.0	95.5	61.0	41.0
118	66.0	95.0	60.5	40.0
116	65.0	94.5	60.0	39.0
114	64.0	94.0	59.5	38.0
112	63.0	93.0	58.5	37.0
110	62.0	92.6	58.0	35.5
108	61.0	92.0	57.0	34.5
106	59.5	91.2	56.0	33.0
104	58.0	90.5	55.0	32.0
102	57.0	89.8	54.5	30.5
100	56.0	89.0	53.5	29.5
98	54.0	88.0	52.5	28.0
96	53.0	87.2	51.5	26.5
94	51.0	86.3	50.5	24.5
92	49.5	85.4	49.0	23.0
90	47.5	84.4	48.0	21.0
88	46.0	83.5	47.0	19.0
86	44.0	82.3	45.5	17.0
84	42.0	81.2	44.0	14.5
82	40.0	80.0	43.0	12.5
80	37.5	78.6	41.0	10.0
78	35.0	77.4	39.5	7.5
76	32.5	76.0	38.0	4.5
74	30.0	74.8	36.0	1.0
72	27.5	73.2	34.0	—
70	24.5	71.8	32.0	—
68	21.5	70.0	30.0	—
66	18.5	68.5	28.0	—
64	15.5	66.8	25.5	—
62	12.5	65.0	23.0	—
60	10.0	63.0	20.5	—
58	—	61.0	18.0	—
56	—	58.8	15.0	—
54	—	56.5	12.0	—
52	—	53.5	—	—
50	—	50.5	—	—
49	—	49.0	—	—
48	—	47.0	—	—
47	—	45.0	—	—
46	—	43.0	—	—
45	—	40.0	—	—

● This conversion table is complied based on standard ASTM E140 TABLE 4.

Related information and materials

Related hardness standards

JIS	Name	Hardness used (scale)
A 1126-07	Method of test for content of soft particles in coarse aggregate by scratching	
B 7724-99	Brinell hardness test – Verification of testing machines	HB
B 7725-10	Vickers hardness test – Verification and calibration of testing machines	HV
B 7726-10	Rockwell hardness test – Verification and calibration of testing machines	HR
B 7727-00	Shore hardness test – Verification of testing machines	HS
B 7730-10	Rockwell hardness test – Calibration of standard blocks	HR
B 7731-00	Shore hardness test – Calibration of standard blocks	HS
B 7734-97	Knoop hardness test – Verification of testing machines	HV, HK
B 7735-10	Vickers hardness test – Calibration of standard blocks	HV
B 7736-99	Brinell hardness test – Calibration of standard blocks	HB
D 4421-96	Hardness test method for brake linings, pads and clutch facings of automobiles	HRM, HRR, BRS, HRV
G 0557-06	Methods of measuring case depth hardened by carburizing treatment for steel	HV
G 0558-07	Steels – Determination of depth of decarburization	HV, 15N, 30N
G 0559-08	Steel – Determination of case depth after flame hardening or induction hardening	HV, HRC
G 0561-11	Method of hardenability test for steel (End quenching method)	HV, HRC
G 0562-93	Method of measuring nitrided case depth for iron and steel	HV, HK
G 0563-93	Method of measuring surface hardness for nitrided iron and steel	HV, HK, HR15N, HS
H 0511-07	Titanium – Sponge titanium – Test methods for Brinell hardness	HB
K 6250-06	Rubber – General procedures for preparing and conditioning test pieces for physical test methods	A, D
K 6253-1-12	Rubber, vulcanized or thermoplastic – Determination of hardness – Part 1: General guidance	A, D
K 6253-3-12	Rubber, vulcanized or thermoplastic – Determination of hardness – Part 3: Durometer method	
K 6253-5-12	Rubber, vulcanized or thermoplastic – Determination of hardness – Part 5: Calibration and verification	
K 7060-95	Testing method for barcol hardness of glass fiber reinforced plastics	
K 7202-2-01	Plastics – Determination of hardness – Part 2: Rockwell hardness	HRR, HRL, HRM, HRE
K 7215-86	Testing Methods for Durometer Hardness of Plastics	HDA, HDD
R 1607-10	Testing methods for fracture toughness of fine ceramics at room temperature	Kc
S 6050-08	Plastics erasers	
Z 2101-09	Methods of test for woods	HB
Z 2243-08	Brinell hardness test – Test method	HB
Z 2244-09	Vickers hardness test – Test method	HV
Z 2245-11	Rockwell hardness test – Test method	HR
Z 2246-00	Shore hardness test – Test method	HS
Z 2251-09	Knoop hardness test – Test method	HV, HK
Z 2252-91	Test methods for Vickers hardness at elevated temperatures	HV
Z 3101-90	Testing Method of Maximum Hardness in Weld Heat - Affected Zone	HV
Z 3114-90	Method of Hardness Test for Deposited Metal	HV, HRB, HRC
Z 3115-73	Method of Taper Hardness Test in Weld Heat - Affected Zone	HV

Note: Standard numbers/names may be different due to revision of the standards.

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Coordinate Measuring Machines

Vision Measuring Systems

Form Measurement

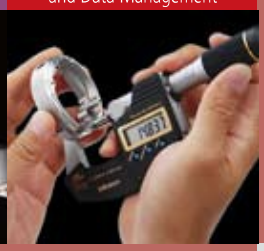
Optical Measuring

Sensor Systems

Test Equipment and Seismometers

Digital Scale and DRO Systems

Small Tool Instruments and Data Management



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