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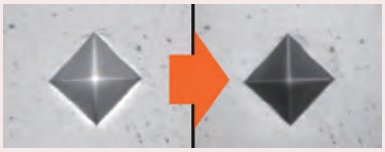
Micro-Vickers Hardness Testing Machines HM-210/220

Specifications

Test force generation	Electromagnetic
Load dwell time	0-999 sec (1 sec increment)
Load control	Automatic (load, dwell, unload)
Objective lens	4 units mountable
Power supply	100/120/220/240V AC, 50/60Hz
Indenter / Objective turret	Motor driven and manual operation
Data output	RS-232C, Digimatic, USB 2.0 interface
XY stage [mm]	**Stage sizes** : 100 x 100 mm / 130 x 130 mm **Travel range :** 25 x 25 mm / 50 x 50 mm **Resolution** : 0,001 mm
Working distance	50X = 2,5 mm
Mass	43 kg

Hardness Testing Machines brochure on request



Observation image of the indentation (50X)
Stray light reduction around the indentation

Power turret with 2 indenter mounts and 4 objective mounts

Series 810

This is a high performance hardness testing machine that uses advanced technology and is ideal for quality control.
The HM-210/220 offers you the following benefits:

- Its electromagnetic power generation system enables nonstop setup for testing force.
- A high performance optical system provides a visible indenter image.
- A long working distance greatly reduces the possibility of collision.
- You can use it for six objectives: 10X, 20X, 50X and 100X for measuring indentation images, and 2X and 5X for enabling wide-range measurement around indentations.
- LED lighting gives you an observation image in natural colour, with better contrast, as well as longer operation due to lower power consumption.
- You can set different kinds of conditions on a touch panel, and display test results for easy operation.
- Expak software gives you simple data collection 11AAC236
- Software AVPAK allows automatic measuring.
- It has low testing force **0.4903 x 10^{-3}N** (0.05gf) as well as standard force models.

HM-210A
HM-220A

HM-210B
HM-220B

Manual unit with Software AVPAK.

Model	HM-210A	HM-210B	HM-220A	HM-220B
No.	**810-400EU**	**810-403EU**	**810-405EU**	**810-408EU**
Control unit	Touch screen type	Software control type	Touch screen type	Software control type
Objective lens	10x 50x	10x 50x	10x 50x 100x	10x 50x 100x
Manual XY Stage unit	25x25 mm	25x25mm	25x25mm	25x25 mm
for Software AVPAK use only	-	AVPAK 11AAC064 and PC must be ordered separately to build complete auto-measuring unit	-	AVPAK 11AAC064 and PC must be ordered separately to build complete auto- measuring unit
Indentershaft units	1 unit with Vickers indenter installed	1 unit with Vickers indenter installed	1 unit with Vickers indenter installed	1 unit with Vickers indenter installed
TV Camera System	810-354D	-	810-354D	-

It is possible to choose from four ready to use models or to compile the machine set-up yourself by choosing up to four different objective lenses and 2 indentershaft units.

Objektiv	Vickers-Skala		
	HV 0,00005 - 0,02	HV 0,2 - 1	HV 1-2
2x	Use this objectives only for probe overview		
5x	Use this objectives only for probe overview		
10x			
20x			
50x			
100x			
10x objectiv for easy focus			
Use this table or first orientation			

Wide range of lenses available for different magnifications

Mitutoyo

Micro-Vickers Hardness Testing Machines HM-210/220

Manual or complete automatic measuring

Functions	System A	System B	System C	System D
				
Focusing	Manual	Manual	Manual	Auto
Testing action	Single point	Single point	Programmed multi-point	Programmed multi-point
Test-point positioning	Manual XY stage	Manual XY stage	Motorized XY stage	Motorized XY stage
Measuring ondentations	Measuring microscope	Automatic (AVPAK-20)	Automatic (AVPAK-20)	Automatic (AVPAK-20)
Camera (for observing and measuring indentations)	B/W 300.000 pixels	Color 3.000.000 pixels	Color 3.000.000 pixels	Color 3.000.000 pixels
Operating the main unit	Touch panel	PC (AVPAK-20)	PC (AVPAK-20)	PC (AVPAK-20)

Video camera unit 810-354
(Can be installed in the manual model main unit)
CCD camera and 8.4"/213,4mm TFT monitor Enables observation and measurement of indentations at high magnification thereby reducing operator error

AVPAK-20 software for automatic hardness testing systems
Software that supports control, testing, and report creation related to hardness testing Supports parameter setting and automatic measurement.

High-functionality PC and TFT monitor
Compatible with Windows® 7 Professional 32-bit
Supports a wide-screen TFT and provides improved operability.

Specifications Main Unit

Model name			HM-210A	HM-210B		
Main unit	HM-210 manual model main unit	810-401*		–	–	–
	HM-210 system model main unit	810-403*	–			
Hardness tester	Applicable standards		JIS B 7725 / ISO 6507-2			
	Test force		HV0.01 / HV0.02 / HV0.03 / HV0.05 / HV0.1 / HV0.2 / HV0.3 / HV0.5 / HV1 98.07x10⁻³ / 196.1x10⁻³ / 294.2x10⁻³ / 490.3x10⁻³ / 980.7x10⁻³ / 1.961 / 2.942 / 4.903 / 9.807 (10) / (20) / (20) / (50) / (100) / (200) / (300) / (500) / (1000)			
	Indenter approach speed		Fixed at 60 µm/s			
	Test force loading time		1- 99s Can be set in 1s increments.			
	Test force dwell time		0-999s Can be set in 1s increments.			
	Test force unloading time		1- 99s Can be set in 1s increments.			

Model name			HM-220A	HM-220B
Main unit	HM-220 manual model main unit	810-405		–
	HM-220 system model main unit	810-408	–	
Hardness tester	Applicable standards		JIS B 7725 / ISO 6507-2	
	Test force		HV0.00005 / HV0.0001 / HV0.0002 / HV0.0003 / HV0.0005 / HV0.001 / HV0.002 / HV0.003 / HV0.005 / HV0.01 0.4903x10⁻³ / 0.9807x10⁻³ / 1.961x10⁻³ / 2.942x10⁻³ / 4.903x10⁻³ / 9.807x10⁻³ / 19.61x10⁻³ / 29.42x10⁻³ / 49.03x10⁻³ / 98.07x10⁻³ (0.05) / (0.1) / (0.2) / (0.3) / (0.5) / (1) / (2) / (3) / (5) / (10) HV0.02 / HV0.03 / HV0.05 / HV0.1 / HV0.2 / HV0.3 / HV0.5 / HV1 / HV2 196.1x10⁻³ / 294.2x10⁻³ / 490.3x10⁻³ / 980.7x10⁻³ / 1.961 / 2.942 / 4.903 / 9.807 / 19.61 20 / (30) / (50) / (100) / (200) / (300) / (500) / (1000) / (2000)	
	Indenter approach speed		Variable between 2 and 60 µm/s Can be set in 1µm/s increments (only for 30 gf or smaller; Fixed at 60 µm/s for 31 gf or greater)	
	Test force loading time		1- 99s Can be set in 1s increments.	
	Test force dwell time		0-999s Can be set in 1s increments.	
	Test force unloading time		1- 99s Can be set in 1s increments.	

Mechanism	Loading device	Test force control	Electromagnetic (voice coil)	
		Test force switching	Can be selected from touch panel	
	Turret	Drive method	Motor drive	
		Operation method	Touch panel / Manual	AVPAK / Manual
		Number of turret ports	Indenter shaft unit: Up to two can be installed (including the standard Vickers indenter shaft unit already installed); Objective lens unit: Up to four can be installed (including the standard 50X objective lens already installed)	
Controller			Integrated touch panel (5.7"/**144,8mm** color LCD)	Data-processing software
	Display content	Indentation value	D1 D2, max. 5 digits each	
		Minimum display unit	For objective lenses of 50X or higher: 0.01 µm; For lower than 50X: 0.1 µm	
		Hardness value	Maximum of four digits, Minimum: 0.1 HV/HK, Fracture toughness value	
		Test condition	Indenter (HV/HK), test force, loading, dwell, and unloading times	
		Compensation	Cylinder, sphere, measurement	
		Pass/Fail determination	OK/±NG	
		Other	XY positional data, turret position display, statistical calculation	
		Language used	Japanese, English, German, French, Italian, Spanish	
	Calculation functions	Pass/Fail determination function	Determines whether or not the measured hardness is acceptable (OK/±NG) based on the upper and lower limits that have been set.	
		Function for guiding measurement condition setup	Enter the indenter, specimen thickness, and presumed hardness to calculate the maximum test force.	
		Compensation function	Cylindrical compensation, spherical compensation, measurement compensation	
		Statistical calculation function	Number of data units, maximum value, minimum value, average, range, upper limit, lower limit, number of passes, number of fails, ultra upper limit and ultra lower limit, standard deviation (n-1), standard deviation (n)	
External connection interface			For printer: Serial interface (compatible with the RS-232C standard); For Digimatic interface and data communication: USB 2.0	
		Maximum specimen dimensions	Maximum specimen depth: 160 mm, Maximum specimen height: 133 mm	
		Maximum load capacity	3kg	7kg / 3kg
Main unit	External dimensions (excluding protrusions and stage)		Approx. 315 (W) x 671 (D) 595 (H) mm	Approx. 315 (W) x 586 (D) 741 (H) mm
	Main unit mass		Approx. 43 kg	

Software (AVPAK-20) functions	System B	System C	System D
Tester and turret control functions			
Hardness conversion, compensation for curved surface, Pass/Fail determination, and statistical calculation			
Indentation reading and illumination control			
Contrast level meter			
Autofocusing	–	–	
Stage control, automated test execution and multispecimen testing	–		
Test pattern and coordinate system specification			
Wide-range image capture	–		
Simple operation			
Analysis and reports			

Micro-Vickers Hardness Testing Machines HM-210/220

Configuration

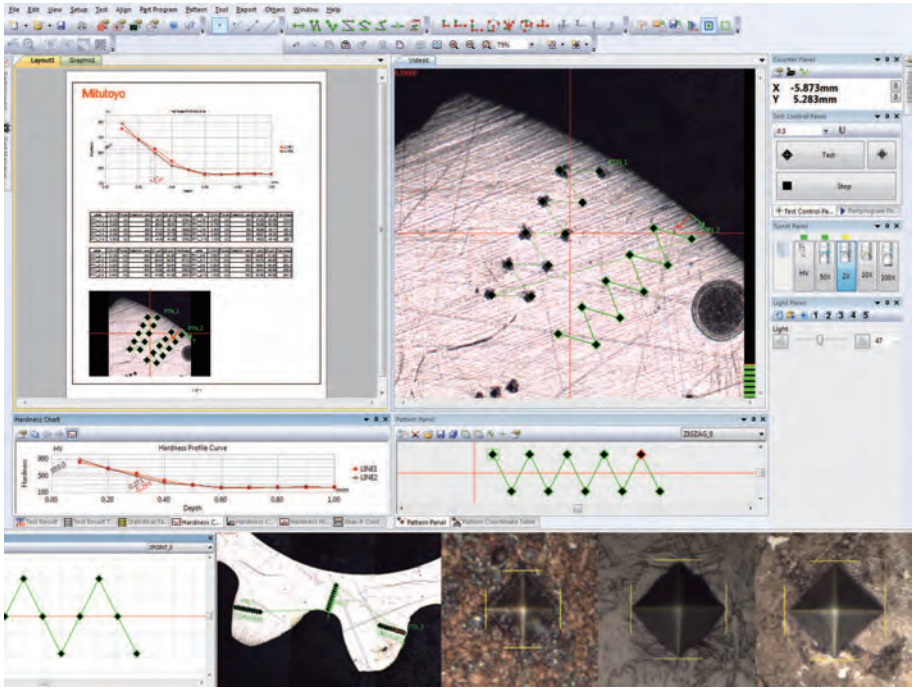
System configurations

Parameter	Code No.	Item name	System A	System B	System C	System D	Details	Notes
Main unit	810-400*	HM-210 manual model main unit	○		×		Standard test force, measuring microscope, with a 50X lens	
	810-405*	HM-220 manual model main unit	○		×		Low test force, measuring microscope, with a 50X lens	
	810-403*	HM-210 system model main unit	×		○		Standard test force, with a 50X lens	No measuring microscope, No touch panel
	810-408*	HM-220 system model main unit	×		○		Low test force, with a 50X lens	
Factory-installed options	11AAC104	Objective lens unit 2X	○				Objective lens, with lens holder	Up to three additional lenses can be selected (maximum of four lenses can be installed in the main unit)
	11AAC105	Objective lens unit 5X	○				Objective lens, with lens holder	
	11AAC106	Objective lens unit 10X	○				Objective lens, with lens holder	
	11AAC107	Objective lens unit 20X	○				Objective lens, with lens holder	
	11AAC108	Objective lens unit 100X	○				Objective lens, with lens holder	
	11AAC109	Indenter shaft unit for HM-210	○				With 19BAA061 knoop indenter	Double-indenter specification
	11AAC110	Indenter shaft unit for HM-220	○				With 19BAA062 knoop indenter	Double-indenter specification
	11AAC129	Measuring microscope (which can be added)	×		○			Cannot be used simultaneously with the VISION UNIT
	810-354*	Video camera unit	○		△		Monochrome 300,000-pixel camera, 8.4"/**213,4mm** TFT, with a stand	△: Installation requires a measuring microscope. Provided on a special order basis
Essential options	810-421*	Motorized XY stage unit 50X50	×		●			
	810-422*	Motorized XY stage unit 100X100						
	810-420	Manual XY stage unit 25X25	●		×			
	810-423	Manual XY stage unit 50X50						
	11AAC316	AVPAK-20	×		●			Selected according to the delivery destination
Others options	810-425	AT stage unit	×			●		
Special ccessories	810-016	Standard vise	○				Jaw opening: 51 mm	
	810-017	Special vise	○				Jaw opening: 100 mm	
	810-013	Thin plate specimen holder	△				Thickness: Max. 5 mm	△: System A and B only
	810-014	Slender specimen holder (horizontal)	△				Diameter: 0.4-3 mm	△: System A and B only
	810-015	Slender specimen holder (vertical)	○				Diameter: 0.4-4 mm	
	810-019	Specimen-tilting holder	△				Jaw opening: 37 mm, Tilting angle: ±15°, Rotating angle: ±25°	△: System A and B only
	810-020	Universal specimen holder	△				Thickness: Max. 30 mm	△: System A and B only
	810-018	Turntable	○				Minimum graduation: 1°	
	810-085	Adjustable thin-plate specimen holder	○				Thickness: Max. 3 mm, Width: Max. 56 mm	
	810-095	Rotatable tilting specimen holder	○				Height: Min. 20 mm, Width and diameter: 15-55 mm	
	810-870*	Specimen heater HST-250	○		△			△: Cannot be automatically read with AVPAK
	810-650-1	Resin-molded specimen holder Ø25.4	○				Ø25.4±0.5 mm Specimen height: 9-39 mm	
	810-650-2	Resin-molded specimen holder Ø30	○				Ø30±0.5 mm Specimen height: 9-39 mm	
	810-650-3	Resin-molded specimen holder Ø31.75	○				Ø31.75±0.5 mm Specimen height: 9-39 mm	
	810-650-4	Resin-molded specimen holder Ø38.1	○				Ø38.1±0.5 mm Specimen height: 9-39 mm	
	810-650-5	Resin-molded specimen holder Ø40	○				Ø40±0.5 mm Specimen height: 9-39 mm	
	19BAA061	Knoop indenter (for standard test force)	○					Can be selected to replace the Vickers indenter provided as a standard accessory.
	19BAA062	Knoop indenter (for low test force)	○					
	375-056	Objective micrometer	×		○		Scale graduation: 1 mm, Minimum graduation: 0.01 mm	For magnification calibration
Printers	02AGD600*	Model DPU-414 (with a connection cable)	○		×		Receipt printer	For 100V
	264-504*	Model DP-1VR	○		×		Digimatic mini-processor	
	936937	Connection cord	○		×		For DP-1VR 1 m	
	02AZD810D	U-WAVE-R	○		×			
	02AZD880D	U-WAVE-T	○		×		Buzzer type	
	02AZD790D	Dedicated connection cable for U-WAVE-T	○		×			
	06ADV380D	USB-ITN-D	○		×		Flat 10-pin	PC must be provided separately.
	11AAC236	EXPAK ver. 6	○		×		Data processing software	Requires Microsoft® Excel® 2010
Others	02ATE760	Table	○				1800 W x900 D x740 H	For testing machine and PC
	998923	System rack (vertical)	○					Only a PC can be mounted.
	810-641	Vibration isolator	○					Only the tester can be mounted.
	810-644	Wing for vibration isolator	○				For 810-641	Recommended if the video camera unit is to be attached
	11AAC146	Plate for preventing toppling						

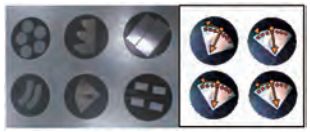
○: Selectable ●: One of each type must be selected from the choice offered ×: Cannot be selected △: Contact Mitutoyo Sales Dept. Note: A suffix replaces the * symbol.

Micro-Vickers Hardness Testing Machines HM-210/220

Software AVPAK-20 for system B,C and D



Screen layout for control, testing status, and result display can be changed freely.



Handling of multiple specimens
Part program and Part Manager function support testing of multiple and irregular specimens.
Multi-specimen testing
Executes different part programs for each iregular specimen.
Parts Manager
Executes a common part program for specimens having the same shape.

Pattern creation
This tool support 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.

Graphic view (of stored images)
For displaying the entire specimen and checking the pattern positioning The digital zoom function can be used to easily magnify and check the site being tested.

FUNCTIONS

Layout view
Photos from individual views, graphs, tables, etc., cab be laid out freely to help with report creation.

Stitching
Takes images of an entire rectangular field from the moving stage then combines the images.

Auto trace
Automatically traces the shape of the sample. Take images as the stage moves along the outer contours of the specimen then combines the images.

Navigation function
When the position is being moved during multi-point testing, this function guides the travel of the XY fine adjustment manual stage to the next position (System B)

Micro-Vickers Hardness Testing Machines HM-101/102/103/112/113

Series 810

This is a high performance hardness testing machine that uses advanced technology and is ideal for quality control.
The HM-101/102/103/112/113 offer you the following benefits:

- You can set the load time 1 second increments between 5 and 99 seconds (HM-112 / 113).
- Its measuring resolution of 0.01µm allows you to measure small indentations with high precision.
- Hardness tester according to DIN EN ISO 6507 and JIS B7725.
- Micro-Vickers hardness tester with Vickers test from HV 0.01 - HV 1.
- You can connect up to three objectives that can all be used for indent measurement (except HM-101).
- There is also a Knoop indenter which can be connected.
- It includes a manual lens system switch.
- Expak software gives you simple data collection 11AAC237 (not applicable for HM 101).

Specifications

Test force range	**98.07 / 245.2 / 490.3 / 980.7 / 1961 / 2942 / 4903 / 9807 mN**
Loading accuracy	1% (forces < 9.807 mN are ignored)
Load control	Automatic (load, dwell, unload)
XY stage [mm]	**Stage size** : 100 x 100 mm **Travel range** : 25 x 25 mm, with micrometer heads **Resolution** : HM-101 / 102 / 103 = 0,01 mm HM-112 / 113 = 0,001 mm
Graduation	0.01 mm
Max. specimen height	95 mm
Max. specimen depth	150 mm (from the centre of the indenter shaft)
Lens system	10X, 50X
Observation by	Micrometer eyepiece
Magnification	100X, 500X
Optical path	2-way (measurement / exposure)
Data output	RS-232C, Digimatic code (SPC) and Centronics
Power supply	100/120/220/240V AC, 50/60Hz
Dimensions (WxDxH)	410 x 600 x 590 mm
Mass	42 kg

Standard accessories

No.	Description
810-617	Objective 10X
810-619	Objective 50X
810-011	X-Y Stage 25x25mm (HM-101)
810-074	X-Y Stage 25x25mm (digital type (HM-112)
810-016	Vice, max. 45 groove width
19BAA058	For idenders and Hardness test blocks see chapter Hardness Test Blocks
19BAA109	Dust protection cover

Hardness testing block (700 HV0.3) and vickers idender are standard accessory.

Optional accessories

No.	Description	Price €
810-017	Vice, max. 100 groove width	1,174.00
810-018	Rotary table	1,030.00
810-019	Specimen tilting holder	1,936.00
810-013	Specimen (thin plate) holder	
810-014	Wire Holder horizontal for Ø0.3mm till Ø4mm	
810-015	Specimen (wire or ball) holder	299.00
810-020	Universal specimen holder	618.00
810-084	Rotary universal specimen holder up to 30mm	1,648.00
810-085	Adjustable specimen (thin plate) holder	1,494.00
810-012	50 x 50 travel XY stage	2,977.00
810-641	Vibration Isolator	
Objectives		
810-616	Objective 5X	335.00
810-618	Objective 20X	510.00
810-620	Objective 100X	3,131.00

HM-101
Economical manual type

HM-112
Digital display of measurement results and a statistical calculation function

Model	HM-101	HM-102	HM-103	HM-112	HM-113
No.	**810-124D**	**810-125D**	**810-959D**	**810-126D**	**810-969D**
Control unit	-	Membrane switch type	Membrane switch type	Touch-screen type	Touch-screen type
Load dwell time	5-30 sec	5-60 sec	5-60 sec	5-99 sec	5-99 sec
Video monitor	-	-	9" / **228,6mm** B&W	-	9" / **228,6mm** B&W
Indenter mounts	1	1	1	1	1
Objective mounts	1 (observation), 1 (measurement)	2 (measurement)	2 (measurement)	2 (measurement)	2 (measurement)
Resolution µm	0.2	0.1	0.1	0.1	0.1
Reading of hardness values	at Vickers table	Display	Display	via "Touch Screen"	via "Touch Screen"

Additional product description and accessories for Micro Vickers Hardness Testing HM-101 / 102 / 103 / 112 / 113
HM-101 Economical manual type **HM-102** Economical digital type **HM-103** The TV monitor removes fatigue in visual measurement, reducing measurement errors. **HM-112** Digital display of measurement results and a statistical calculation function. **HM-113** Reduce individual differences in visual measurement with the TV monitor. The statistical calculation function reduces operation time

Vickers Hardness Testing AVK-C0

Series 810

This a hardness testing machine that enables to make very precise measurements.
The Vickers Hardness Testing AVK-C0 offers you the following benefits:

- A range of test force from 49.03 N to 9.807 N is available, allowing you to measure various types of specimen.
- A measuring resolution of 1µm is provided so you can measure small indentations with precision.

810-160D

Model	AVK-CO
No.	**810-160D**
Test force range	**9.807 ; 49.03 ; 98.07 ; 196.1 ; 294.2 ; 490.3 N**
Indenter mounts	1
Objective mounts	1 (measurement)
Indenter / Objective turret	Manual operation

AVK-HF / 810-155
Vickers hardness testing at high temperatures.

Specifications

Resolution [µm]	1
Loading accuracy	±1%
Load control	Automatic (load, dwell, unload)
Load dwell time	5, 10, 15, 20, 30 seconds
Max. specimen depth	165 mm (from the centre of the indenter shaft)
Max. specimen height	205 mm
Optical path	Single way
Observation by	Micrometer eyepiece
Lens system	10X
Dimensions (WxDxH)	245 x 515 x 770 mm
Power supply	100/120/220/240V AC, 50/60Hz
Magnification	100X
Mass	45 kg

Identer Vickers, Hardness test block 720HV10, Splitlevel, Vickers table are standard accessories.

Standard accessories

No.	Description
810-039	Flat table Ø64
810-040	V-anvil ø40, 120°
810-041	V-anvil ø40, 90°
810-064	Objective 10X
19BAA110	Plastic cover
19BAA114	Power cord
19BAA134	Camera adapter

Hardness test block 700 HV, diamond indenter and split level are standard accessories.

Optional accessories

No.	Description	Price €
810-037	Round table Ø180	608.00
810-038	Round table Ø250	1,277.00
810-012	50 x 50 travel XY stage	2,977.00
810-640	Vibration damping stand	
Objectives		
810-063	Objective 5X	227.00
810-065	Objective 20X	500.00
810-066	Objective 40X	731.00
Vices		
810-016	Vice, max. 45 groove width	829.00
810-017	Vice, max. 100 groove width	1,174.00

Hardness Testing Machines brochure on request
See for Identers and hardness test blocks chapter Hardness Test Blocks

Vickers Hardness Testing HV-112/113/114/115

Series 810

This is a high precision hardness testing machine that you can use for a range of measurement tasks.
The Vickers Hardness Testing HV-112/113/114/115 offers you the following benefits:

- A wide range of test force from 1.961 N to 490.3 N allows you to measure various types of specimen.
- You can set the load dwell time in 1 second increments between 5 and 99 seconds.
- A measuring resolution of 1µm is provided so you can measure small indentations with precision.
- You can easily set different conditions and display test results on its touch panel.

Control unit

810-163D

LCD graphic display for:
o Indentation size (D1 and D2),
o Hardness value and scale,
o Number of measurement point
o Test conditions (HV/HK indenter type, test force, load dwell time),
o GO/±NG tolerance judgment,
o Cylindrical and spherical surface compensation and offset
• Remote control of power turret
• Conversion to other hardness scales
• Statistical processing
Expak software for simple data collection 11AAC237

Specifications

Loading accuracy	±1%
Load control	Automatic (load, dwell, unload)
Load dwell time	5-99 s (1 s increments)
Max. specimen height	210 mm
Max. specimen depth	170 mm (from the centre of the indenter shaft)
Observation by	Micrometer eyepiece
Magnification	100X, 200X
Lens system	10X, 20X
Optical path	Split two ways for video monitoring and photography
Resolution	0.1 µm
Data output	RS-232C, Digimatic code (SPC) and Centronics
Dimensions (WxDxH)	**Main unit :** 245 x 515 x 770 mm **Control unit :** 165 x 260 x 105 mm
Power supply	100/120/220/240V AC, 50/60Hz
Mass	50 kg

Standard accessories

No.	Description
19BAA110	Plastic cover
19BAA114	Power cord
810-039	Flat table Ø64
810-040	V-anvil ø40, 120°
810-041	V-anvil ø40, 90°
810-617	Objective 10X
810-618	Objective 20X
810-086	Digital microscope (for HV112-114)
19BAA445	Camera-Adapter for CCD-Camera

See for Identers and hardness test blocks chapter Hardness Test Blocks

Optional accessories

No.	Description	Price €
810-640	Vibration damping stand	
810-012	50 x 50 travel XY stage	2,977.00
810-037	Round table Ø180	608.00
810-038	Round table Ø250	1,277.00
HPHK	See for Identers and hardness test blocks chapter Hardness Test Blocks	474.00
HPHV	For identers and Hardness test blocks see chapter Hardness Test Blocks	397.00
Objectives		
810-616	Objective 5X	335.00
810-619	Objective 50X	809.00
Vices		
810-016	Vice, max. 45 groove width	829.00
810-017	Vice, max. 100 groove width	1,174.00

See for Identers and hardness test blocks chapter Hardness Test Blocks

Hardness Testing Machines brochure on request

Model	HV-112	HV-113	HV114	HV-115
No.	**810-163D**	**810-981D**	**810-165D**	**810-985D**
Test force range	**1.961 ; 2.942 ; 4.903 ; 9.807 ; 24.51 ; 49.03 ; 98.07 ; 196.1 N**	**1.961 ; 2.942 ; 4.903 ; 9.807 ; 24.51 ; 49.03 ; 98.07 ; 196.1 N**	**9.807 ; 19.61 ; 29.42 ; 49.03 ; 98.07 ; 196.1 ; 294.2 ; 490.3 N**	**9.807 ; 19.61 ; 29.42 ; 49.03 ; 98.07 ; 196.1 ; 294.2 ; 490.3 N**
Control unit	Touch screen type	-	-	-
Indenter / Objective turret	Motor driven	Motor driven	Motor driven	Motor driven
Indenter mounts	1	1	1	1
Objective mounts	2 (measurement)	2 (measurement)	2 (measurement)	2 (measurement)

		Test force	Indenter			Additional weight	Additional ball indenter
Hardness Scale	$0.102*F/D^2$	F [N]	D [mm]	810-163D-BN	810-165D-BN	Parts No.	Parts No.
HBW 1/30	30	294,2	1	not applicable	X		19BAA277
HBW 1/10	10	98,07	1	X	X		19BAA277
HBW 1/5	5	49,03	1	X	X		19BAA277
HBW 1/2,5	2,5	24,52	1	X	o	11AAA008	19BAA277
HBW 1/1	1	9,807	1	X	X		19BAA277
HBW 2.5/31.25	5	306,5	2,5	not applicable	o	11AAA007	19BAA279
HBW 2.5/15.625	2,5	153,2	2,5	o	o	11AAA009	19BAA279
HBW 2.5/6.25	1	61,29	2,5	o	o	11AAA007	19BAA279
HBW 5/25	1	245,2	5	o	o	11AAA008	19BAA280
X test can be performed without adding the weight							
o test can be performed with adding the weight							

Brinell Testing HV-112 / HV-114
Brinell ready machines 810-163D-BN and 810-165D-BN offer to perform Brinell testing with just adding ball indenter and, if necessary additional weights. Please contact our sales staff for details.

Mitutoyo

AT-400

Series 810

Auto-Reading Hardness Testing System with automatic XY stage

- The VLPAK2000 auto-reading measuring program automatically reads the lengths of the indentation's diagonals and converts the result to a hardness value, thereby reducing operator-dependent measurement error. Moreover, this program's automatic high-speed reading function requires only 0.3 seconds to determine hardness, which significantly improves work efficiency in hardness measurement.
- The movement pattern of the XY stage can be set to line, zigzag, matrix, circle, random or combination.
- The learn function allows part programs to be easily created.
- Measurement conditions, positional data and evaluation curves can be displayed on the monitor.

812-314-2D

Specifications

Automatic XY stage	**Movement range** 50.8 x 50.8 mm **Minimum pitch** 0,001 mm **External dimensions** 240 x 240 x 65 mm **Measurement pattern** Line, Staggered, 3-point staggered, Matrix, Circle / arc, Random pattern, Teaching pattern, Combination pattern. **Setting point count** Max. 1000 points
Auto-reading function	Refer to VLPAK2000 specifications

Model	AT-400 (Micro-Vickers hardness)	AT-400 (micro-duromètre)	AT-400 (Vickers hardness)
No.	**810-314-2D**	**810-314-2E**	**810-314-12D**
No. UK only	**810-314-2E**	-	**810-314-12E**
For use with	Micro-Vickers hardness models	-	Vickers hardness models

AAV-500

Series 810

Automatic Vickers Hardness Testing System

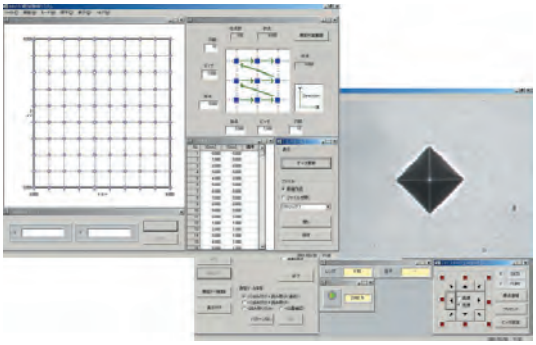
- This system can perform all operations required in the Vickers and Knoop hardness tests such as loading, turret indexing, focusing, indentation measurement, and measurement position movement in full automatic, so it is optimal for the labour-saving requirements of your test environment.
- An indentation-dimension automatic measuring time of 0.3 second is achieved (when a PC with recommended specifications is used), which dramatically improves operational efficiency.
- Measurement reproducibility of ±0.5% is achieved (for objective lens 50X, diagonal line 11 to 45 mm, and 500HV), which provides reliable and stable test results.
- All operations from test condition setting to test result analysis can be performed on a Windows PC. In addition, data processing for the test results can be performed by using spreadsheet software.
- The AAV-500 series reduces individual differences in indentation dimension measurement in the Vickers hardness test by adopting special image analysis technologies. In addition, improved precision and high speed have been realized with a measuring time of just 0.3 second.

Specifications

Automatic XY stage	**- Stage area** 130 x 130 mm **- Movement range** 50 x 50 mm **- Minimum step** 1 µm
Objective lens	10X, 20X
Measurable indentation size	40-400 / 20-100 µm
Manual measurement function	Measurement method with video line
Automatic indentation measurement	**- Measurement reproducibility** ±0.5% (0,1 µm) **- Measurement method** Quadratic curve regression **- Measuring time** 0.3 second **- Resolution** 0,1 µm
Software functions	**- Measurement pattern** Line, Staggered, 3-point staggered, Matrix, Circle / arc, Random **- Teaching measurement pattern setting** **- Hardness calculation function** **- Hardness conversion function** **- OK/NG judgement**
Analysis software functions	Device condition display, Measurement data display, Statistical calculation, Graph display
Standard accessories	Hardness testing machine, PC-AT drive, PC, Power Turret, XY automatic stage, Auto Focus (AF) stage, Control/Analysis software; Joystick box, Keyboard, Mouse.
Dimensions (WxDxH)	665 x 516 x 1000 mm

810-727D

Model	AAV-503	AAV-504
No.	**810-727D** **810-727E**	**810-728D** **810-728E**
Test force range	1.961 - 196.1N	9.807 - 490.3N
Test force switching	Manual	Manual
No. UK only	**810-727E**	**810-728E**



Micro Zone Test System MZT-500

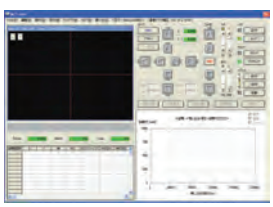
Series 810

These are exceptionally powerful tools that allows you evaluate the mechanical properties of ultra-small regions of ultra-fine specimens, for research, development and quality control. The MZT-500 Series offers the following benefits:

- They can evaluate mechanical properties that conventional hardness testing machines cannot measure, such as hardness of ultra-fine cross-sections, mechanical bonding properties and wear properties of carbon fibres, glass fibres, etc.
- CVD- and PVD-deposited or generated Films
- Ion-plated Films
- Semiconductor Technology
- Pharmacological Probes
- Biological Tissue
- Protective Coatings on Data Storage
- Decorative Coatings
- Wear Protective Coatings
- Optical Protective Coatings
- Automotive Probes
- The indentation factor can be obtained, which is related to the hardness value (partially) shown in Martens hardness test (ISO14577) and Young's modulus. Deformation characteristics in the load, dwell, and unload phases are also obtainable for use in determining properties of the specimen material.

810-813D

Model	MZT-500L	MZT-500P
No.	**810-813D**	**810-814D**
Automatic XY stage	-	●
Basic system	●	●
Data analysis / control device	●	●
Manual type XY stage	●	-



Specifications

Test force generation	Electrical
Test force range	**0.1-1000 mN**
Hardness test	(HV) Vickers and (HK) Knoop
Control resolution	0.916 µN
Loading speed	0.01-100 mN/s
Indentation depth measurement	**Range :** 0-20 µm **Resolution :** 0,1 nm
Indenter type	Bercovici triangular pyramid indenter
Sample surface observation method	**- Camera** 1/3"/ **8,5mm** B&W (410,000 pixels) **- Objective (monitor magnification)** 100X (2500X) **- Optional** 10X (250X) ; 40X (1000X)
Max. specimen depth	90 mm (from the centre of the indenter shaft)
Max. specimen height	90 mm
Test type	- Indentation test (with and without preload force) - Indentation depth setting test - Continuous indentation test - Repeated indentation test
Vibration isolation	The balance-lever vibration isolation mechanism reduces the effect of external vibrations on measurements.
XY stage [mm]	**Manual Type** : 25 x 25 **Automatic** : 50 x 50
Protection	Field-compatible form with cover for protection against dust and wind.

Micro Zone Test System MZT-500
Series 810
Additional product description and accessories for MZT-500

- The indentation factor can be obtained, which is related to the hardness value (partially) shown in Instrumented Indentation Test (ISO14577), also known as Martens or Universal Hardness and Young's modulus. Deformation characteristics in the load, dwell, and unload phases are also obtainable for use in determining properties of the specimen material.
- Hardness tests such as Vickers and Knoop hardness tests are supported.
- The balance lever vibration isolation mechanism reduces the effect of external vibrations on measurements.
- Indenter indentation depth can be measured up to a maximum of 20µm with a resolution of 0.1nm.
- Test forces between 0.1mN and 1000mN can be applied electromagnetically for evaluation of material properties in sub microscopic areas.
- Field-compatible form with cover for protection against dust and wind.

Rockwell HR-100/200/300/400

Series 963

These are five economical Rockwell hardness testing machines to suit practically every application you need.
The Rockwell HR-100/200/300/400 offers you the following benefits:

- The newly designed frame provides maximum clearance for positioning the work piece, all you need is a flat table for mounting these testing machines.
- They are very simple to operate: the analogue types HR-110/HR-210 use an automatic presetting dial gauge.
- HR-110MR does not require a power source, and is considered to be environmentally friendly.
- Digital models HR-430MR/MS use automatic steering wheel braking and load sequencing for easy handling.
- Digital models HR-320MS and HR-430MR/MS can use our Digimatic Mini-processor (DP-1VR) for printing results, and you can use an input tool (USB-ITN-E) to connect to a PC for data transfer, analysis and storage.
- You can perform Brinell hardness tests by using the following optional accessories: a Brinell indenter, a weight set and a measurement microscope.

Specifications

Standards	JIS B 7726, ISO 6508-2 (ASTM E18)
Height	Max. 180 (100 if cover is attached) mm
Measuring depth	Max. 165 mm (from the center of the endenter axis)
Functions	HR-320MS, HR-430MR, HR-430MS : GO/NG, Offset revision, Hardness conversion
Power supply	AC100-240V, 1.2A (HR-110MR : no power required)
Standard accessories	Diamond indenter for R and R/S, Steel ball indenter 1/16"/**1,587mm**, Flat anvil, large V-anvil, Hardness test blocks, AC adapter, cover, Accessory box, level.

Optional accessories

No.	Description	Price €
56AAK286B	Brinell load set weight HR-110MR, 210MR 62.5, 125, 187.5	247.00
56AAK287B	Brinell load set weight HR-320MS 31.25, 62.5, 125, 187.5	309.00
56AAK288B	Brinell load set weight HR-430MR 62.5, 125, 187.5	309.00
56AAK289B	Brinell load set weight HR-430MS 31.25, 62.5, 125, 187.5	247.00
56AAK541B	Brinell microscope 20x	1,298.00
810-038	Round table Ø250	1,277.00
Anvils		
810-037	Round table Ø180	608.00
810-030	Point anvil (diamond tipped for Rockwell Superficial)	2,328.00
810-027	Vari-rest	2,554.00
810-029	V-anvil length 400, groove width 50, 120°	2,091.00
810-026	Fine adjustment table for jominy test	3,657.00
810-028	Jack rest	2,554.00
810-040	V-anvil ø40, 120°	232.00
810-043	Point anvil (Ø12)	191.00
810-041	V-anvil ø40, 90°	232.00
810-044	Point anvil (Ø5,5)	191.00
810-042	V-anvil Ø10, 120°	191.00
810-048	Console table	1,864.00
Computer accessories		
264-504-5D	Digimatic Mini-Processor	445.00
06ADV380E	USB Input tool Direct cable (2 m)	100.00
937387	Digimatic cable (1 m)	47.00
965013	Digimatic cable (2 m)	57.50

19BAA072 for HR-xxxMR models only
19BAA073 for HR-xxxMS models only
For identers and Hardness test blocks see chapter Hardness Test Blocks

HR-110MR
Rockwell hardness testing machine
An environmentally friendly energy-saving model.
The basic operation is all manual, including weight-changing (total test force selection).

HR-210MR
Rockwell hardness testing machine
Manual weight changing (with total test force selected) and handling of preload force. Motor drive controls loading sequence.

HR-110MR and HR-210MR gauge

Model	HR-110MR	HR210MR	HR-320MS	HR-430MR	HR-430MS
No.	**963-210-20**	**963-220D**	**963-231D**	**963-240D**	**963-241D**
Hardness test	Rockwell	Rockwell	Rockwell Superficial	Rockwell	Rockwell Superficial
Display	Analog	Analog	Digital	Digital	Digital
Display unit	0,5 HR increments	0,5 HR increments	0,1 HR display	0,1 HR display	0,1 HR display
Preload force	Automatic presetting dial guage	Automatc presetting dial gauge	Loading navigator display	Automatic handle brake	Automatic handle brake
Preload force setting	-	-	Dial switching	-	Dial switching
Test force selection	Weight exchange	Weight exchange	Weight exchange	Dial switching	Dial switching
Test force application	Manual	Semi-automatic	Semi-Automatic	Automatic	Automatic
Data output	-	-	Digimatic (SPC), RS-232C	Digimatic (SPC), RS-232C	Digimatic (SPC), RS-232C
Dimensions (WxDxH) mm	296 x 512 x 780	235 x 512 x 780	235 x 516 x 780	235 x 516 x 780	235 x 516 x 780
Mass kg	49	47	47	50	50

Mitutoyo

Rockwell HR-100/200/300/400

Series 963

Additional product description and accessories for HR-100/200/300/400 Series

Optional accessories
For identers and Hardness test blocks see chapter Hardness Test Blocks

HR-320MS

Dual type (Rockwell / Rockwell Superficial) hardness testing machine
Manually handles test force and preload force selection.
Motor drive controls loading sequence.

HR-430MR

Rockwell hardness testing machine
Economy type, but supports dial switching, power steering and support of all test standards and is equipped with automatic brake handle auto start feature.
Motor drive controls loading sequence.

HR-430MS

Dual type (Rockwell / Rockwell Superficial) hardness testing machine
Economy type, but supports dial switching, power steering and support of all test standards and is equipped with automatic brake handle auto start feature.
Motor drive controls loading sequence.

Features preload force selection

Automatic steering wheel brake

SPC Digimatic and RS-232C interface

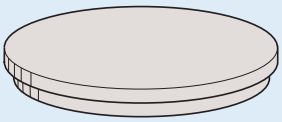
Rockwell HR-100/200/300/400

Series 963

Additional product description and accessories for HR-100/200/300/400 Series

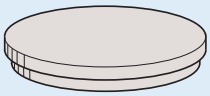
810-038
Round table OD Ø250 mm

For large probes
like profiles



810-037
Round table OD Ø180 mm

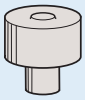
For large probes
like profiles



810-040
V-anvil (large)
(OD Ø40 mm, groove width 30 mm)
For shaft material (max Ø60 mm)

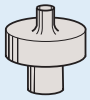
810-043
Spot anvil

(OD Ø12 mm)

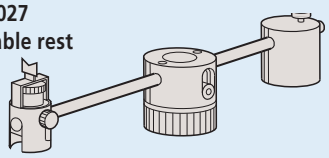


810-041
V-anvil (small)
(OD Ø 40 mm, groove width 6 mm)
For shaft material (max. Ø8.4 mm)

810-044
Spot anvil
(OD Ø5.5 mm)
For plate material



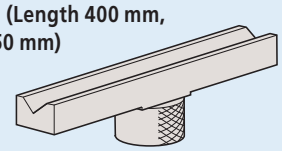
810-027
Variable rest



Test of long object probes (used together with anvil)

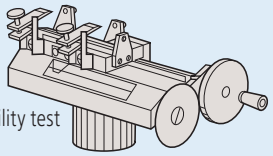
810-029
Special V-anvil (Length 400 mm, groove width 50 mm)

For shaft material
(max. Ø100 mm)



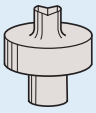
810-026
Micromovement table for Jominy test

JIS G 0561
Steel hardenability test



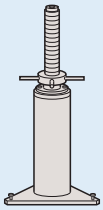
810-030
Diamond spot anvil
(OD Ø10 mm)
For plate material
Exclusive use for Rockwell superficial hardness test

810-042
Small V-anvil
(OD Ø10 mm)
For shaft material (max. Ø16 mm)

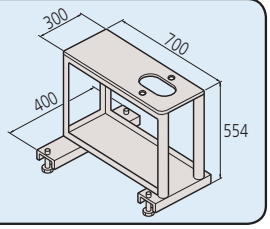


810-028
Jack rest

Testing of long object probes
(used together with anvil
or round table)



810-048
Mount for testing machine



264-504-5
Digimatic miniprocessor DP-1VR
Connecting cable not included (sold separately), please order separately. Connecting cable (1 m), part No. 937387

06ADV380E
USB input tool
Direct USB-ITN

Easy data input to PC

Mitutoyo

Wizhard Rockwell, Rockwell Superficial, Brinell Hardness Testers HR-500 Series

Series 810

These hardness testing machines give you high performance and improved productivity.
The Wizhard Rockwell, Rockwell Superficial, Brinell Hardness Testers HR-500 Series offers you the following benefits:

- Multiple test force generation for Rockwell, Rockwell Superficial and Brinell hardness.
- A dolphin-nose indenter arm gives you easy reach of interior surfaces (min. ø40mm / ø22mm, when using an optional diamond indenter) and exterior surfaces.
- Real-time electronic test force control gives you accurate loading, and completely eliminates load force overshoot.
- An indenter escape function allows you carry out continuous testing at a fixed table position, which eliminates instability caused by table retraction.
- Auto-stop table elevation and automatic preloading provide stable test force generation.
- EXPAK software for simple data collection 11AAC237

HR-521 / HR-522

HR-523

Model	HR-521	HR-522	HR-523
No.	**810-202D**	**810-203D**	**810-204D**
Control unit	Touch-screen type	Touch-screen type	Touch-screen type
Stage elevation	Manual (with automatic brake)	Power drive	Power drive
Table movement	Manual	Fully automatic	Fully automatic

Specifications

Preload force	29,42 N, 98,07 N
Test force	**Rockwell Superficial** 147.1 / 294.2 / 441.3 N **Rockwell** 588.4 / 980.7 / 1471 **Brinell** (1) 61.29 / 98.07 / 153.2 / 245.2 / 294.2 / 306.5 / 612.9 / 980.7 / 1226 / 1839 N (1) HR521 1839N only
Test force setting	By control unit
Load control	Automatic (load, dwell, unload)
Load dwell time	0-120 s (1 s increments)
Max. specimen height	205 mm (for standard flat anvil)
Max. specimen depth	150 mm (from the center of the indenter shaft)
Measurement Conversions to other hardness scales	HV, HK HRA, HRB, HRC, HRD, HRF, HRG, HR15T, HR30T, HR45T, HR15N, HR30N, HR45N, HS, HB, HBS, tensible strength
Statistics functions	Number of values, Max., Min., Average value, Range, Upper and lower limit, Standard deviation, Number of GO/NG evaluations, Storage of 1024 values, OFFSET, Hardness value, Test condition, Continuous measurement. X-R control card, Editing of 1024 values, Hardness conversion value, Statistical results, Cylindrical, spherical and multipoint correction.
Data output	RS-232C, Digimatic code (SPC) and Centronics
Dimensions (WxDxH)	**Main unit** 250 x 670 x 605 mm **Control unit** 165 x 260 x 105 mm
Power supply	100/120/220/240V AC, 50/60Hz
Optional Accessories	For a detailed list of standard and optional accessories, refer to the following page.
Mass	65 kg

Wizhard Rockwell, Rockwell Superficial, Brinell Hardness Testers HR-500 Series

Series 810

Additional product description and accessories for HR-500 series

Standard accessories

No.	Description
810-039	Flat table Ø64
810-040	V-anvil ø40, 120°
19BAA517	Dust protection cover

Hardness test blocks, Diamond indenter, steel balls and split level are standard accessories.

Optional accessories

No.	Description	Price €
11AAA001	EXPAK data processing program	
Anvils		
810-037	Round table Ø180	608.00
810-038	Round table Ø250	1,277.00
810-041	V-anvil ø40, 90°	232.00
810-042	V-anvil Ø10, 120°	191.00
810-029	V-anvil length 400, groove width 50, 120°	2,091.00
810-030	Point anvil (diamond tipped for Rockwell Superficial)	2,328.00
810-043	Point anvil (Ø12)	191.00
810-044	Point anvil (Ø5,5)	191.00
Computer accessories		
264-504-5D	Digimatic Mini-Processor	445.00
Fixed microscopes for Brinell testing		
19BAA161D	Microscope 20X	556.00
19BAA318D	Microscope 40X	605.00
19BAA319D	Microscope 100X	653.00
Indenters		
19BAA292	For idenders and Hardness test blocks see chapter Hardness Test Blocks	
19BAA072	For idenders and Hardness test blocks see chapter Hardness Test Blocks	

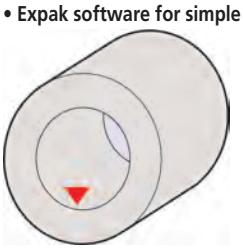
Additional accessories are available for Brinell hardness testing. Refer to the Hardness Testing Machines brochure.
For idenders and Hardness test blocks see chapter Hardness Test Blocks

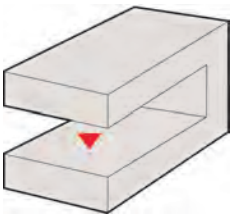
The dolphin-nose indenter arm

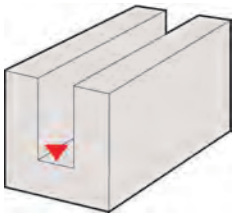
Hardness Testing Machines brochure on request

Control units

Touch-screen type
- **Touch-screen operation with a back-lit LCD graphic display.**
- **Remote selection of the test force linked to the hardness scale selection.**
- **Choice of message language in English, German, French, Spanish, Italian and Japanese for user-friendly operation.**
- **Cylindrical and spherical surface compensation.**
- **Data offset**
- **Conversion to other hardness scales.**
- **Powerful statistical processing with flexible data point editing and 1024 data memory.**
- **Measurement data editing**
- **OK/±NG tolerance judgement.**
- **Statistical processing, histogram and X-R chart**
- **Expak software for simple data collection 11AAC237**







Various shapes of specimen can be tested (a dolphin nose type indenter mechanism has been adopted). The dolphin-nose indenter mechanism allows internal measurement of pipe samples as well as the top surface of a flat sample.

Mitutoyo

Impact Type Hardness Testing Unit HARDMATIC HH-411

Series 810

This is a lightweight, digital-reading portable hardness testing instrument for metal workpieces. The Hardmatic HH-411 offers you the following benefits:

- It operates on the rebound hardness principle (standardised according to ASTM A 956).
- Measurement is conducted with hardness value L (Leeb-value) but you can convert to any desired hardness scale.
- The display automatically shows GO/±NO GO with the tolerance function set and selected.
- It has a memory function for 1800 measured values, and automatic measuring direction angle-compensation.
- Expak software gives you simple data collection 11AAC238

810-298

Sample application

Model	HH-411
No.	**810-298**
Price [€]	**5,356.00**
Accuracy	±12 HL (800 HL +/- 1.5%)
	Conversion range / Increment
Vickers	43-650 HV / 1 HV
Brinell	20-894 HB / 1 HB
Rockwell C	19.3-68.2 HRC / 0.1 HRC
Rockwell B	13.5-101.7 HRB / 0.1 HRB
Shore	13.2-99.3 HS / 0.1 HS
Tensile strength	499-1996 MPa / 1 MPa
Specimen Thickness	Min. 5 mm
Specimen Mass	5 kg or more
Dimensions Measuring/Display unit	ø28 x 175 mm / 70 x 110 x 35 mm
Display unit	7-segment LCD
Resolution	1-999 HL
Mass	320 g

UD-412 Detector
Use for inner walls of cylinders. The grip is short to allow positioning within a cylinder.

UD-413 Detector
Use for concave workpieces such as gear teeth, ball bearings, etc.

UD-414 Detector
Use for gear teeth, welded corners, etc.

Specifications

Impactor	Impact hammer with integrated carbide-ball tip, D type (ASTM A 956)
Functions	Auto angle compensation, Offset, OK/NG judgement, Hardness scale conversion, Data storage (1800 data entries), Statistical analysis (Average value, Max. value, Min. value, Dispersion), Auto sleep function, Impact counter display function
Power supply	Battery LR6 (2 pcs.) or AC adapter (optional)
Data output	RS-232C, SPC

Standard accessories

No.	Description
810-287	UD-411 impactor
19BAA457	Carbide ball indenter
19BAA451	Support ring ø22
19BAA450-01	Display unit
19BAA452	Support ring ø14 for HH-411
19BAA460	Cable detector for HH-411
19BAA258	Cleaning brush

Optional accessories

No.	Description	Price €
19BAA458	Impact device for type DL	541.00
06AEG302D	AC Adapter 9V, 500mA	66.50
11AAC238	EXPAK data processing	
Computer accessories		
264-504-5D	Digimatic Mini-Processor	445.00
937387	Digimatic cable (1 m)	47.00
19BAA263	RS-232C cable	206.00
Hardness test blocks (all blocks are 115 mm diameter, 33 mm thick, 3.7 kg mass)		
19BAA243	Hardness test block 880 HLD	1,210.00
19BAA244	Hardness test block 830 HLD	1,210.00
19BAA245	Hardness test block 730 HLD	1,210.00
19BAA246	Hardness test block 620 HLD	1,210.00
19BAA247	Hardness test block 520 HLD	1,210.00
Indenters		
810-288	UD-412 impactor	3,080.00
810-289	UD-413 impactor	3,142.00
810-290	UD-414 impactor	3,883.00
Support rings		
19BAA248	Cylinder support ring R10-20 (Types D/DC)	42.50
19BAA249	Hollow cylinder support ring R14-20 (Types D/DC)	42.50
19BAA250	Spherical support ring R10-27.5 (Types D/DC)	24.00
19BAA251	Support ring for hollow sphere R13.5-20 (Types D/DC)	24.00

Hardness Testing Machines brochure on request

Digital and Analogue Durometers HARDMATIC HH-300

Series 811

These compact digital/dial durometers can test a range of different materials and offer you the following benefits:

- You can use them for testing the hardness of the materials including natural rubber, neoprene, polyesters, PVC, leather, Thiokol, nitrite rubber, wax, vinyl, cellulose acetates, glass polystyrene, etc.
- Shore hardness „A“ and „D“.

Specifications

Resolution	**Dial models** : 1° **Digital models** : 0.5°
Setting standards pcs.	ASTM D 2240 ; ISO 868 ; ISO 7619 ; DIN 83 505 ; JIS K 6253 : JIS K 7215
Indenter diameter	ø1,25 (±0,15 mm)
Pressure foot	ø18 mm
Indenter protrusion	2,5 mm
Functions	**Digital models** : Data hold, Zero-setting, SPC output, ON/OFF **Dial models :** Maximum reading hand

Optional accessories

No.	Description	Price €
Auxiliary weights		
811-017	Auxiliary weights (Shore A)	
811-018	Auxiliary weights (Shore D)	
Computer accessories		
264-504-5D	Digimatic Mini-Processor	445.00
905693	Digimatic cable (1m)	30.00
905694	Digimatic cable (2 m)	36.00
Hardness testing block sets		
64AAA590	Test block set (rubber) Hardness 20, 40, 80 Shore D	252.00
64AAA964	Test block set (rubber) Hardness 30, 60, 90 Shore A	216.00
Measuring stands		
811-012	Measuring stand for 811-333 / 811-334	2,153.00
811-019	Measuring stand for 811-331 / 811-332	2,153.00
19BAA180	Chuckbar	

Measuring stand

- Workstage dimension : ø90 mm
- Max. specimen height : 90 mm

Testing stand applications
These stands are used to mount Durometers. They allow constant-pressure hardness measurement by ensuring that the Durometer presses vertically on the workpiece surface at all times.
• Anyone can perform repeatable hardness measurement due to fewer possibilities of human error and measurement variations.
• The supplied weights can be attached directly to a Durometer and allow constant-pressure hardness measurement of large samples for which a stand cannot be used.
• The supplied weights are used for calibrating the spring tension of Durometers

811-332

811-331

Model	HH-331	HH-332	HH-333	HH-334
No.	**811-331**	**811-332**	**811-333**	**811-334**
Price [€]	**560.00**	**1,025.00**	**560.00**	**1,025.00**
Type	Dial	Digital	Dial	Digital
Scale	0-100 Shore A	0-100 Shore A	0-100 Shore D	0-100 Shore D
Measuring range (inside)	10-90 Shore A	10-90 Shore A	20-90 Shore D	20-90 Shore D
Spring force mN	550 + 75 H (Hardness reading : 10-90)	550 + 75 H (Hardness reading : 10-90)	444.5 H (Hardness reading : 20-90)	444.5 H (hardness reading : 20-90)
Tip form	Cut cone	Cut cone	Cone	Cone
Tip angle	35° (±0.25°)	35° (±0.25°)	35° (±0.25°)	35° (±0.25°)
Tip radius	-	-	0.1 (±0.012 mm)	0.1 (±0.01 mm)
Tip diameter	ø0.79 mm (±0.01 mm)	ø0.79 mm (±0.01 mm)	-	-
Power supply	-	SR44 Battery	-	SR44 Battery
Dimensions (WxDxH)	56 x 33.5 x 144 mm	60 x 28.5 x 193 mm	56 x 33.5 x 186 mm	60 x 28.5 x 193 mm
Mass g	320	310	320	310

64AAA964

Mitutoyo

Digital and Analogue Durometers HARDMATIC HH-300

Series 811

These compact digital/dial durometers can test a range of different materials and offer you the following benefits:

- You can use them for testing the hardness of the materials including natural rubber, neoprene, polyesters, PVC, leather, Thiokol, nitrite rubber, wax, vinyl, cellulose acetates, glass polystyrene, etc.
- Shore hardness „A“ and „D“.

811-336-01

811-335-01

Compact digital model

Compact dial model

Model	HH-335	HH-336	HH-337	HH-338
No.	**811-335-01**	**811-336-01**	**811-337-01**	**811-338-01**
Price [€]	**560.00**	**1,025.00**	**560.00**	**1,025.00**
Type	Dial	Digital	Dial	Digital
Scale	0-100 Shore A	0-100 Shore A	0-100 Shore D	0-100 Shore D
Measuring range (inside)	10-90 Shore A	10-90 Shore A	20-90 Shore D	20-90 Shore D
Spring force mN	550 + 75 H (Hardness reading : 10-90)	550 + 75 H (Hardness reading : 10-90)	444.5 H (Hardness reading : 20-90)	444.5 H (Hardness reading : 20-90)
Tip form	Cut cone	Cut cone	Cone	Cone
Tip angle	35° (±0.25°)	35° (±0.25°)	30° (±0.5°)	30° (±0.5°)
Tip radius	-	-	0.1 (±0.01 mm)	0.1 (±0.01 mm)
Tip diameter	ø0.79 (±0.01 mm)	ø0.79 (±0.01 mm)	-	-
Power supply	-	SR44 Battery	-	SR44 Battery
Dimensions (WxDxH)	56 x 33.5 x 144 mm	60 x 28.5 x 151 mm	56 x 33.5 x 144 mm	60 x 28.5 x 151 mm
Mass g	300	290	300	290

64AAA964

Specifications

Resolution	**Dial models** : 1° **Digital models** : 0.5°
Setting standards pcs.	ASTM D 2240 ; ISO 868 ; ISO 7619 ; DIN 83 505 ; JIS K 6253 : JIS K 7215
Indenter diameter	ø1,25 (±0,15 mm)
Pressure foot	44 x 18 mm
Indenter protrusion	2,5 mm
Functions	**Digital models** : Data hold, Zero-setting, SPC output, ON/OFF **Dial models :** Peak retaining hand

Optional accessories

No.	Description	Price €
Auxiliary weights		
811-017	Auxiliary weights (Shore A)	
811-018	Auxiliary weights (Shore D)	
Computer accessories		
264-504-5D	Digimatic Mini-Processor	445.00
905693	Digimatic cable (1m)	30.00
905694	Digimatic cable (2 m)	36.00
Hardness testing block sets		
64AAA590	Test block set (rubber) Hardness 20, 40, 80 Shore D	252.00
64AAA964	Test block set (rubber) Hardness 30, 60, 90 Shore A	216.00
Measuring stands		
811-013	Measuring stand for 811-335-01 / 811-336-01	2,153.00
811-014	Measuring stand for 811-337-01 / 811-338-01	2,153.00
19BAA180	Chuckbar	

Measuring stand

- Workstage dimension : ø90 mm
- Max. specimen height : 90 mm

Hardness Testing Machines brochure on request

Hardness Test Blocks

Hardness Test Blocks

Today's hardness standards recommend, additional to annual calibration and verification, a daily control of the hardness testing machines. In order to document, calculate and present this for the hardness test blocks distributed by an external manufacturer, an Microsoft® Excel®-sheed has been created, in which calibration values, limiting deviation, repeatability of the hardness testing machine and the uncertainty of measurement of the hardness test block are integrated. The program may be downloaded and additional information may be obtained by taking to the following URL: http://www.mpanrw.de . After inserting MPA NRW number and calibration value, the download can be started by clicking on OK. There are also demo versions as examples available. The program shows in text form, whether the values predetermined by standard, are reached by the machine or not. The program offers two ways to determine the uncertainty of measurement. Firstly, without correction of error according to UNCERT proposal SMT of EU and secondly, with correction of error from nominal value.

How to order: select hardness scale (second column in table) and needed value. Then combine order number from first column with suffix above hardness value like in the following example. For 60HR45N hardness test block order BU107-11. All hardness test blocks are calibrated by German national institute MPA NRW and supplied with a DKD-certificate.

Brinell (triangle, 70x70x70x6mm 130 g) standard hardness value

No.	Description	01	02	03	05	06	07	08	09	10	11
BU0310-	HBW 2,5/31,25	100									
BU0311-	HBW 2,5/62,5	100	150	200							
BU0312-	HBW 2,5/187,5	100	150	200	250	300	350	400	450	500	600
BU0314-	HBW 2,5/15,625	(100)									

Brinell (triangle polished, 70x70x70x6mm 130 g standard hardness value hardness values in brackets are nonstandard values

No.	Description	01	03	05	06	07	08	09	10
BU0404-	HBW 1 / 5	(140)							
BU0405-	HBW 1 / 10	140	(240)						
BU0406-	HBW 1 / 30	140	240	300	350	400	450	540	620

Hardness Test Blocks Steel
Brinell (square, 100x100x16mm 1,3 kg) standard hardness valuesize 150x100x16mm 1,95 kg

No.	Description	02
BU201-	HBW 5/125	(150*)

Knoop (triangle polished, 35x35x35x6mm 30 g standard hardness value *hardness value 140 HK only available as macro size block (70x70x70x6mm 130 g)

No.	Description	02	04	06	07	08	09	10	11	12	14
BU0701-	HK 0,005	140*	240								
BU0702-	HK 0,01	140*	240								
BU0703-	HK 0,015	140*	240	300	350	400	450	540	620	720	
BU0705-	HK 0,025	140*	240	300	350	400	450	540	620	720	840
BU0707-	HK 0,05	140*	240	300	350	400	450	540	620	720	840
BU0708-	HK 0,1	140*	240	300	350	400	450	540	620	720	840
BU0709-	HK 0,2	140*	240	300	350	400	450	540	620	720	840
BU0710-	HK 0,3	140*	240	300	350	400	450	540	620	720	840
BU0711-	HK 0,5	140*	240	300	350	400	450	540	620	720	840
BU0712-	HK 1	140*	240	300	350	400	450	540	620	720	840
BU0713-	HK 2	140*	240	300	350	400	450	540	620	720	840

Hardness Test Blocks

Rockwell (square, 60x60x16mm 465 g) standard hardness value

No.	Description	01	02	03	04	05	06	07	08	09	10	11	12	13	14
BU101-	HRA		49	55	59,8	62,4	65	67,6	70,2	72,8	75,4	78,1	80,7	82	83,4
BU102-	HRB (S/W)	60	75	90	100										
BU103-	HRC				20	25	30	35	40	45	50	55	60	62/63	65
BU104-	HRF (S/W)	90	95		115										
BU105-	HR 15 N				67,7	70,5	73,4	76,2	79,1	81,9	84,7	87,5	89,9	90,8	91,3
BU106-	HR 30 N				41,2	45,6	50,1	54,6	59,1	63,9	68	72,1	76,8	79	81,2
BU107-	HR 45 N				19,7	25,4	31,2	37	42,8	48,5	54,3	60	65,7	68,5	71,4
BU108-	HR 15 T (S/W)	80	86,5	91	92,2										
BU109-	HR 30 T (S/W)	56,5	69,2	77,3	82										
BU110-	HR 45 T (S/W)	33,5	52,8	64,6	72,1										
BU115-	HRG (S/W)		62		81	87	94								
BU116-	HRE (S/W)	95													
BU117-	HRD				40	44	48	51	55	59	63	67	71	73	75
BU118-	HRK S/W)	76	97												

Vickers macro (traingle polished , 70 x 70 x 70 x 6 mm 130g) standard hardness

No.	Description	02	04	05	06	08	09	10	11	12	14
BU0601-	HV 1	140	240			400	450	540	620	720	840
BU0602-	HV 5	140	240		300	400	450	540	620	720	840
BU0603-	HV 20	140	240		300	400	450	540	620	720	840
BU0604-	HV 30	140	240		300	400	450	540	620	720	840
BU0605-	HV 50	140	240	300		400	450	540	620	720	840
BU0612-	HV 10	140	240		300	400	450	540	620	720	840
BU0613-	HV 3	140	240		300	400	450	540	620	720	840
BU0614-	HV 2	140	240		300	400	450	540	620	720	840

Vickers micro (triangle polished, 35x35x35x6mm 30 g) standard hardness value hardness values in brackets are nonstandard values, diagonal <20µm

No.	Description	04	06	07	08	09	10	11	12	14
BU0501-	HV 0,01	(240)								
BU0502-	HV 0,015	(240)	(300)							
BU0503-	HV 0,025	(240)	(300)							
BU0505-	HV 0,03	(300)	(300)	(350)	(400)	(450)				
BU0506-	HV 0,5	(240)	(300)	(350)	(400)	(450)	(540)	(620)	(720)	(840)
BU0507-	HV 0,1	240	300	(350)	(400)	(450)	(540)	(620)	(720)	(840)
BU0508-	HV 0,2	240	300	350	400	450	(540)	620	(720)	840
BU0510-	HV 0,3	240	300	350	400	450	540	620	720	840
BU0511-	HV 0,5	240	300	350	400	450	540	620	720	840
BU0512-	HV 1	240	300	350	400	450	540	620	720	840
BU0513-	HV 2	240	300	350	400	450	540	620	720	840
BU0514-	HV 3	240	300	350	400	450	540	620	720	840
BU0515-	HV 5	240	300	350	400	450	540	620	720	840
BU0516-	HV 10	240	300	350	400	450	540	620	720	840

Hardness Test Blocks

Hardness Test Blocks Aluminium

Brinell (150x100x16mm 650 g) standard hardness value

No.	Description	30	31	32
BU1707-	HBW 5/62,5	(60)	(80)	
BU1708-	HBW 5/125	60	80	100
BU1709-	HBW 5/250	60	80	100

Brinell (75x75x16mm 250 g) standard hardness value hardness values in brackets are nonstandard values

No.	Description	30	31	32
BU1803-	HBW 2,5/15,625	(60)	(80)	
BU1804-	HBW 2,5/31,25	60	80	100
BU1805-	HBW 2,5/62,5	60	80	100

Rockwell (75x75x16mm 250 g) standard hardness value

No.	Description	02	04	06	07	08	09	12	14
BU1601-	HRB (S/W				35		37	48	60
BU1602-	HRE (S/W)	36	67		37		85	49	92
BU1603-	HRF (S/W)	38	66		39		84	50	90
BU1604-	HRH (S/W)	40	93						
BU1605-	HRK (S/W)	41	36		42		61	52	72
BU1606-	HR 15 T (S/W)	43	66		44		76	53	80
BU1607-	HR 30 T (S/W)	45	27	46		48		54	56,5
BU1608-	HR 45 T (S/W)				47		20	55	33,5

Vickers (75x75x16mm 250 g) standard hardness value

No.	Description	30	31	32
BU1900-	HV 1	60	80	100
BU1901-	HV 2	60	80	100
BU1902-	HV 3	60	80	100
BU1903-	HV 5	60	80	100
BU1904-	HV 10	60	80	100
BU1905-	HV 20	60	80	100
BU1906-	HV 30	60	80	100
BU1907-	HV 50	60	80	100

Indenters

Brinell

No.	Ball Indenter	Ball only	Form	Machine type	Comment
19BAA162MPA		5,0mm	hardmetal	HR-100-200-300-400-500 Series Durotwin HV-100 Series	with DKD certificate
19BAA163MPA		10,0mm	hardmetal	HR-100-200-300-400-500 Series Durotwin HV-100 Series	with DKD certificate
19BAA277	1mm		with hardmetal ball	HR-100-200-300-400-500 Series Durotwin HV-100 Series	without certificate
19BAA279	2,5mm		with hardmetal ball	HR-100-200-300-400-500 Series Durotwin HV-100 Series	without certificate
19BAA280	5mm		with hardmetal ball	HR-100-200-300-400-500 Series Durotwin HV-100 Series	without certificate
19BAA281MPA		1,0mm	hardmetal	HR-100-200-300-400-500 Series Durotwin HV-100 Series	with DKD certificate
19BAA283MPA		2,5mm	hardmetal	HR-100-200-300-400-500 Series Durotwin HV-100 Series	with DKD certificate
19BAA284	10mm		with hardmetal ball	HR-100-200-300-400-500 Series Durotwin HV-100 Series	without certificate

All Mitutoyo indenters and hardmetal balls, marked with MPA, are calibrated by German national Institute MPA NRW and supplied with a DKD certifikate

Knoop

No.	Diamond Indenter	Form	Machine type
19BAA062MPA	HK 0,01	HM/MVK	HM-100 HM-200 MVK Series with DKD certificate
19BAA063MPA	HK 0,2	HV/AVK	HV-100 AVK Series with DKD certificate

All Mitutoyo indenters and hardmetal balls, marked with MPA, are calibrated by German national Institute MPA NRW and supplied with a DKD certifikate

Hardness Test Blocks

Rockwell

No.	Diamond Indenter	Ball Indenter	Ball only	Form	Machine type	Comment	Price [€]
19BAA072ASTM	Rockwell diamond			standard	all Mitutoyo Rockwell machines	ASTM E-18	
19BAA072MPA	Rockwell diamond			standard	all Mitutoyo Rockwell machines	with DKD certificate	**690.00**
19BAA072MPA10	Rockwell diamond			standard	all Mitutoyo Rockwell machines	extended measuring range down to 10HRC	
19BAA072MPAL	Rockwell diamond			slim 6mm wide	all Mitutoyo Rockwell machines	with DKD certificate	
19BAA073MPA	Rockwell diamond			standard	all Mitutoyo Rockwell machines	DIN EN ISO 6508-3	
19BAA292MPA	Rockwell diamond			short for Ø22mm	HR 500 Series	with DKD certificate	**747.00**
19BAA504		3,175 mm		with hardmetal ball	all Mitutoyo Rockwell machines	without certificate	
19BAA505		6,35 mm		with hardmetal ball	all Mitutoyo Rockwell machines	without certificate	
19BAA506		12,7 mm		with hardmetal ball	all Mitutoyo Rockwell machines	without certificate	
19BAA507MPA			1,5875 mm	hardmetal	all Mitutoyo Rockwell machines	with DKD certificate	
19BAA508MPA			3,175 mm	hardmetal	all Mitutoyo Rockwell machines	with DKD certificate	
19BAA509MPA			6,35 mm	hardmetal	all Mitutoyo Rockwell machines	with DKD certificate	
19BAA510MPA			12,70 mm	hardmetal	all Mitutoyo Rockwell machines	with DKD certificate	
19BAA515		1,5875 mm		with hardmetal ball	all Mitutoyo Rockwell machines	without certificate	

All Mitutoyo indenters and hardmetal balls, marked with MPA, are calibrated by German national Institute MPA NRW and supplied with a DKD certifikate

Vickers

No.	Diamond Indenter	Form	Machine type	Comment	Price [€]
19BAA059MPA	HV 0,01	HM/MVK	HM-100 HM-200 MVK Series	with DKD certificate	**762.00**
19BAA060MPA	HV 0,2	HV/AVK	HV-100 AVK Series	with DKD certificate	**577.00**

All Mitutoyo indenters and hardmetal balls, marked with MPA, are calibrated by German national Institute MPA NRW and supplied with a DKD certifikate

Quick Guide to Precision Measuring Instruments

Hardness Testing Machines

Hardness Test Methods and Guidelines for Selection of a Hardness Testing Machine

Material \ Test Method	Microhardness (Micro-Vickers)	Micro surface material characteristics	Vickers	Rockwell	Rockwell Superficial	Brinell	Shore	For sponge, rubber, and plastic	Rebound type portable
IC wafer	●	●							
Carbide, ceramics (cutting tool)		▲	●	●					
Steel (heat-treated material, raw material)	●	▲	●	●	●		●		●
Non-ferrous metal	●	▲	●	●	●				●
Plastic		▲		●				●	
Grinding stone				●					
Casting						●			
Sponge, rubber								●	
Form									
Thin metal sheet (safety razor, metal foil)	●	●	●		●				
Thin film, plating, painting, surface layer (nitrided layer)	●	●							
small parts, acicular parts (clock hand, sewing-machine needle)	●	▲							
Large specimen (structure)						●	●		●
Metallic material configuration (hardness for each phase of multilayer alloy)	●	●							
Plastic plate	▲	▲		●				●	
Sponge, rubber plate								●	
Application									
Strength or physical property of materials	●	●	●	●	●	●	●	●	▲
Heat treatment process	●		●	●	●		▲		▲
Carburized case depth	●		●						
Decarburized layer depth	●		●		●				
Flame or high-frequency hardening layer depth	●		●	●					
Hardenability test			●	●					
Maximum hardness of a welded spot			●						
Weld hardness			●	●					
High-temperature hardness (high-temperature characteristics, hot-workability)			●						
Fracture toughness (ceramics)	●		●						

Key: ● Well-suited ▲ Reasonably suited

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 **9.807N** (1kgf). 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 F (N). k is a constant ($1/g$=1/9.80665).

$$HV=k\frac{F}{S}=0.102\frac{F}{S}=0.102\frac{2F\sin\frac{\theta}{2}}{d^2}=0.1891\frac{F}{d^2}$$

F:N
d:mm

The error in the calculated Vickers hardness is given by the following formula. Here, Δd1, Δd2, 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.

$$\frac{\Delta HV}{HV}\fallingdotseq\frac{\Delta F}{F}-2\frac{\Delta d1}{d}-2\frac{\Delta d2}{d}-\frac{a^2}{d^2}\,3.5\times10^{-3}\Delta\theta$$

(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.

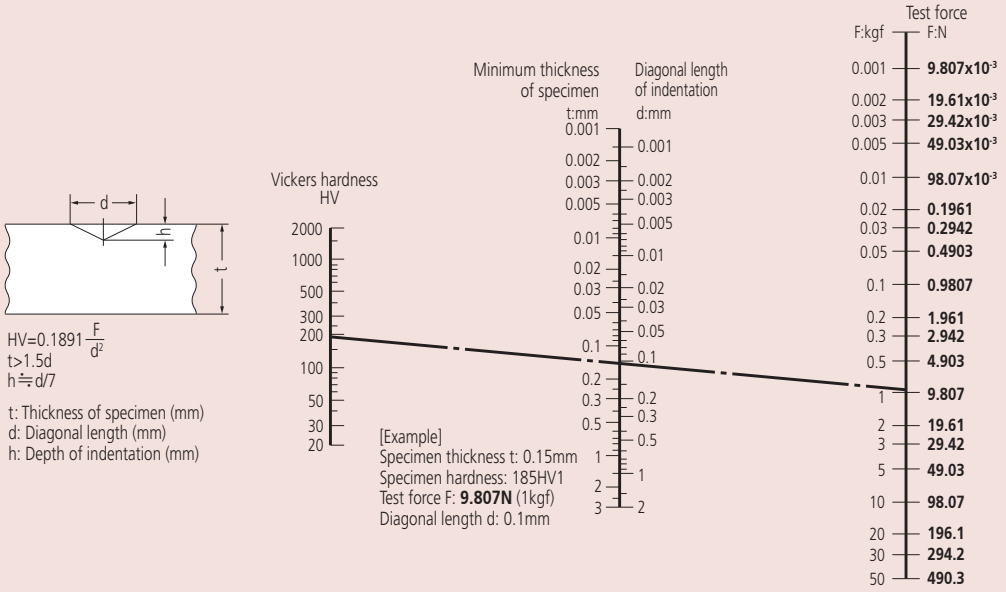
$$HK=k\frac{F}{A}=0.102\frac{F}{A}=0.102\frac{F}{cd^2}=1.451\frac{F}{d^2}$$

F:N
d:mm
c:Constant

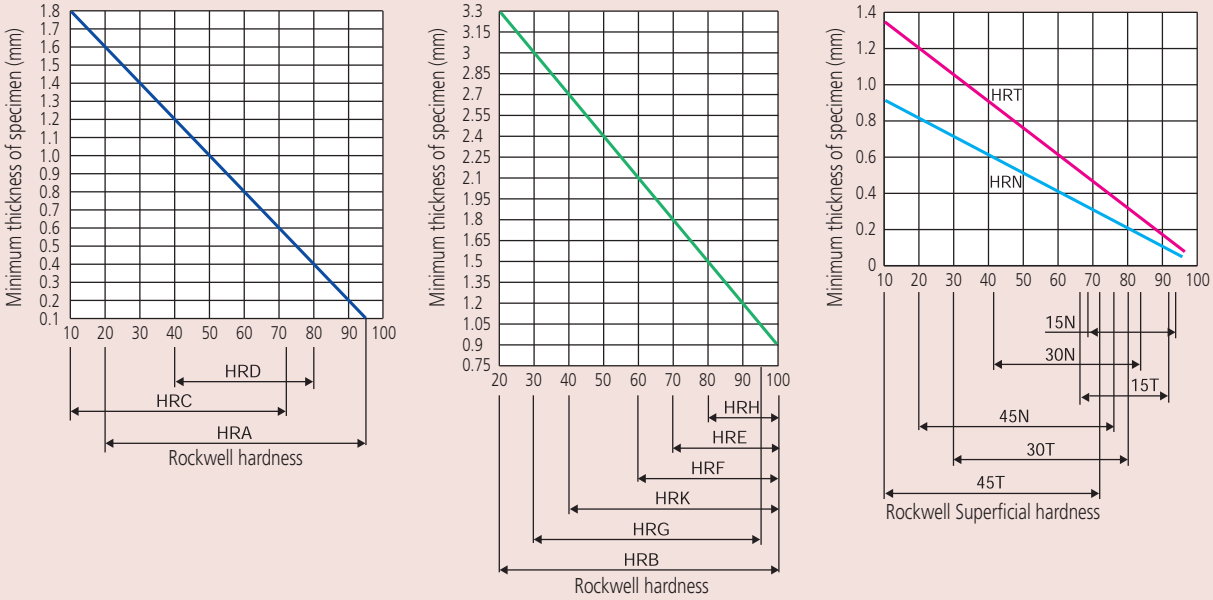
(3) Rockwell and Rockwell Superficial

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: 0.2mm) 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 98.07N, and Rockwell Superficial 29.42N. 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 Thickness of a Specimen



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



Rockwell Hardness Scales

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

Rockwell Superficial Hardness Scales

Scale	Indenter	Test force (N)	Application
15N	Diamond	147.1	Thin, hard layer on steel such as a carburized or nitrided layer
30N		294.2	
45N		441.3	
15T	Ball with a diameter of 1.5875mm	147.1	Thin metal sheet of soft steel, brass, bronze, etc.
30T		294.2	
45T		441.3	
15W	Ball with a diameter of 3.175mm	147.1	Plastic, zinc, bearing alloy
30W		294.2	
45W		441.3	
15X	Ball with a diameter of 6.35mm	147.1	Plastic, zinc, bearing alloy
30X		294.2	
45X		441.3	
15Y	Ball with a diameter of 12.7mm	147.1	Plastic, zinc, bearing alloy
30Y		294.2	
45Y		441.3	

Calibration Blocks: Test force Rockwell and Rockwell Superficial hardness

No.		Rockwell hardness			Rockwell Superficial hardness		
Preliminary test force	**N**	**98,07**			**29,42**		
	kgf	10			3		
Test force	**N**	**588,4**	**980,7**	**1471**	**147,1**	**294,2**	**441,3**
	kgf	60	100	150	15	30	45
Diamond indenter		A	D	C	15N	30N	45N
Inch ball / mm ball	Ø 1/16" / **1.5875 mm**	F	B	G	15T	30T	45T
	Ø 1/8" / **3.1750 mm**	H	E	K	15W	30W	45W
	Ø 1/4" / **6.3500 mm**	L	M	P	15X	30X	45X
	Ø 1/2" / **12.7000 mm**	R	S	V	15Y	30Y	45Y