

# K

## Test Equipment

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#### Test Equipment

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**Micro Hardness Testing Machines**



**Rockwell Hardness Testing Machines**



**Micro Zone Test System**



**Portable Hardness Testing Instruments**



Hardmatic HH-411



HM-210D/220D



HV110 Type B



HH-300 Durometers

# Lineup of Hardness Testing Machines

Hardness testing machines provide the simplest and most economical testing methods among many material testing machines, playing an important role in research activities, production activities, and commercial transactions. Mitutoyo offers a choice of standard hardness testing machines that are optimal for hard materials such as metals to soft materials such as plastic and rubber, as well as custom-designed testers such as in-line type automatic machines and labor-saving machines required on the shop floor.



## Technical Data

Test force range:

HM-210A: 9 steps + arbitrary test force

HM-220A: 19 steps + arbitrary test force

Load dwell time: 0 - 999s

Manual XY stage unit

Stage size: 100x100mm

Travel range: 25x25mm

with Digimatic in/mm micrometer heads

Resolution: 0.001mm

Max. specimen height: 133mm (Stage size: 25 x 25mm)

Max. specimen height: 121mm (Stage size: 50 x 50mm)

Max. specimen depth: 160mm (from the center of indenter)

Optical path: 4-port objectives switching system of

Infinity-correction optical system

Resolution: 0.01 $\mu$ m (When using objectives of X40 or more)

Data output: Serial interface (RS-232),

Digimatic interface, USB 2.0

Power supply: 39VA 100-125/220-240V AC, 50/60Hz

Dimensions: (W x D x H): 315x671x595mm

Mass: 43kg

## Optional Accessories (Factory-installed option)

**11AAC104:** Objective lens unit 2X

**11AAC105:** Objective lens unit 5X

**11AAC106:** Objective lens unit 10X

**11AAC107:** Objective lens unit 20X

**11AAC108:** Objective lens unit 100X

**11AAC129:** Measuring microscope (Digital ocular)

**11AAC109:** Knoop Indenter Assembly (HM-210 Series)

**11AAC110:** Knoop Indenter Assembly (HM-220 Series)

## Optional Accessories

**810-354A:** TV camera unit (8.4 inch LCD)

**19BAA058:** Diamond indenter for Vickers (HM210 Series standard test force)

**19BAA059:** Diamond indenter for Vickers (HM220 Series low test force)

**19BAA061:** Diamond indenter for Knoop (HM210 Series)

**19BAA062:** Diamond indenter for Knoop (HM220 Series)

**810-017:** Vise

**810-013:** Specimen (thin plate) holder

**810-014:** Specimen (wire) holder

**810-015:** Specimen (wire or ball) holder

**810-019:** Specimen tilting holder

**810-020:** Universal specimen holder

**810-018:** Rotary table

**810-084:** Rotatable universal specimen holder

**810-085:** Adjustable specimen (thin plate) holder

**810-095:** Rotatable specimen stage

**375-056:** Stage Micrometer (glass) Micro-scale

**810-650-1:** Resin mold specimen stage  $\phi$ 25.4

**810-650-2:** Resin mold specimen stage  $\phi$ 30

**810-650-3:** Resin mold specimen stage  $\phi$ 31.75

**810-650-4:** Resin mold specimen stage  $\phi$ 38.1

**810-650-5:** Resin mold specimen stage  $\phi$ 40

**02ATE760:** Table

**810-641:** Vibration Isolator

**810-870A:** Sample Heating Device HST-250

**810-420:** 25x25mm stage (metric only)

**810-423:** 50x50mm stage (metric only)

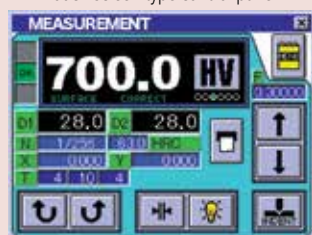
**810-424:** 1"x1" in/mm stage (standard)

**810-427:** 2"x2" in/mm stage



Power turret with up to 2 indenter mounts and 4 objective mounts (manual operation possible)

Touch-screen type control panel

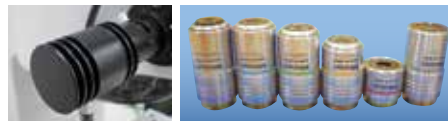


# HM-210 / 220 Type A

## SERIES 810 — Micro Vickers Hardness Testing Machines

### FEATURES

- The latest technology electromagnetic force motor used in the loading mechanism enables the test force to be freely selected (see test force specifications) over the wide range of 0.4903mN to 19610mN (0.05gf to 2 kgf). It is also possible to freely set load dwell times. Now your desire for absolute control over the indentation size in Vickers hardness testing can be satisfied. The HM-200 series always offers the test force most appropriate for the specimen material and shape.
- The long working distance objectives used enable a very comfortable working distance between the objective and the specimen surface. This, greatly reduces the possibility of collision between the specimen and the objective during focusing operations. (e.g. for 50X objectives: 1.1mm for conventional models, 2.5mm for HM-200 series)
- Newly-designed 'MH Plan' objectives are optimized for measuring indentation images. The lineup includes 6 types of long working distance objectives: 10X, 20X, 50X and 100X for measuring indentation images, and 2X and 5X for enabling wide-range measurement around indentations.
- LEDs, which have a longer life, produce less heat, consume less power and are more energy efficient than incandescent bulbs, are employed for the illumination system.
- The motorized turret allows for up to 4 objective lenses and 2 indenter assemblies to be mounted at the same time.



Observation image of the indentation (50X)



Stray light reduction around the indentation



HM-210A

### SPECIFICATIONS TYPE A Digital Hardness Tester

Model No.	HM-210 Type A	HM-210 Type A VK	HM-220 Type A	HM-220 Type A VK
<b>Part No.</b>	<b>64AAB305</b>	<b>64AAB306</b>	<b>64AAB307</b>	<b>64AAB308</b>
Main Unit No.	810-400	810-400	810-405	810-405
Fixed test force (mN)	98.07, 196.1, 294.2, 490.3, 980.7, 1961, 2942, 4903, 9807 (10gf-1000gf)		0.4903, 0.9807, 1.961, 2.942, 4.903, 9.807, 19.61, 29.42, 49.03, 98.07, 196.1, 294.2, 490.3, 980.7, 1961, 2942, 4903, 9807, 19610 (0.05 gf-2kgf)	
Arbitrary test force	$\leq$ 100 gf in 1 gram increments, $>$ 100gf in 10 gram increments		$<$ 1 gf in .1 gf increments, $\leq$ 100 gf in 1 gram increments, $>$ 100gf in 10 gram increments	
Test force control	Force generation by electromagnetic and automatic control (load, dwell, unload)			
Control unit	Color LCD Touch Screen			
Loading Rate	60 $\mu$ /sec		60 $\mu$ /sec	
Load Dwell Time	0-999 sec			
Indenter	Vickers	Vickers and Knoop	Vickers	Vickers and Knoop
Objective Lenses	10x, 50x	10x, 20x, 50x	10x, 50x, 100x	10x, 50x, 100x
Objective turret	Motor driven and manual operation			
Filar Eye Piece	Dual Line, 10X, .01 $\mu$ min			

### With TV camera unit 810-354A (selectable with HM-210A/220A)

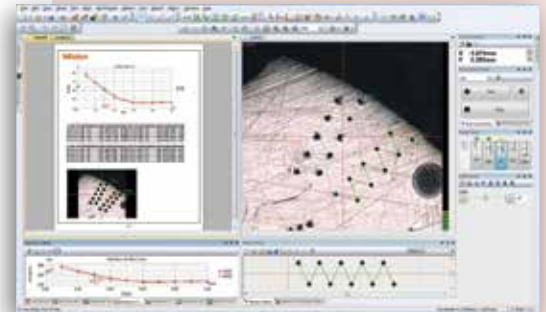
Measurement of indentation dimensions on a TV monitor reduces eye fatigue, which leads to improvement in operation efficiency in multi-point testing.





# HM-200 Series with AVPAK software

For semi and fully automatic Type B and D Systems



AVPAK Software



Indentation-reading example

## System B (HM-210B/220B)

System B is equipped with **AVPAK-10**, the software package that automatically measures the diagonal length of an indentation and calculates the corresponding hardness value. This means that measurement error caused by variation in operator interpretation is eliminated, so reducing costs.

Automatic measurement of indentation/ manual stage



## System D (HM-210D/220D)

In addition to the functions of System B, System D is equipped with the autofocus function. This function allows for automatic hardness testing, thereby increasing efficiency and reducing labor costs.

Automatic measurement of indentation / motorized XY stage / Autofocusing

## System D Technical Data

Motorized X-Y Stage	Travel Max	50 x 50 mm
	Travel Min	1μ
	Table Size	130 x 130mm
Motorized Focusing Stage	Speed Max	25mm/ sec
	Max Range	1.4mm
	Min Unit	.1μ
Joystick Controller Functions	Max Speed	1mm/ sec
	Functions	X and Y Lock out
	Axis	X, Y and Z (Focus)
	Speed Control	Adjustable H,M,L
	Tester Control	Indent, Turret Position
Other	Emergency Stop	

## SPECIFICATIONS

**TYPE B** PC Driven Test System    **TYPE D** PC Driven Test System with motorized stage and auto focus

Model No.	HM-210 Type B	HM-210 Type B V/K	HM-220 Type B	HM-220 Type B V/K
Part No.	64AAB323	64AAB324	64AAB325	64AAB326
Model No.	HM-210 Type D	HM-210 Type D V/K	HM-220 Type D	HM-220 Type D V/K
Part No.	64AAB380	64AAB381	64AAB382	64AAB383
Main Unit No.	810-403	810-403	810-408	810-408
Fixed test force (mN)	98.07, 196.1, 294.2, 490.3, 980.7, 1961, 2942, 4903, 9807 (10gf-1000gf)		0.4903, 0.9807, 1.961, 2.942, 4.903, 9.807, 19.61, 29.42, 49.03, 98.07, 196.1, 294.2, 490.3, 980.7, 1961, 2942, 4903, 9807, 19610 (0.05 gf-2kgf)	
Arbitrary test force	≤100 gf in 1 gram increments, > 100gf in 10 gram increments		< 1 gf in .1 gf increments, ≤100 gf in 1 gram increments, > 100gf in 10 gram increments	
Test force control	Force generation by electromagnetic and automatic control (load, dwell, unload)			
Control unit	None, By PC*			
Loading Rate	60 μ/ sec		60 μ/ sec	
Load Dwell Time	0-999 sec			
Indenter	Vickers	Vickers and Knoop	Vickers	Vickers and Knoop
Objective Lenses	10x, 50x	10x, 20x, 50x	10x, 50x, 100x	10x, 50x, 100x
Objective turret	Motor driven and manual operation			
Filar Eye Piece	None			
CCTV Camera	3 megapixel, 1/2"		3 megapixel, 1/2"	
Software	AV Pak		AV Pak	

\*Must use specified PC

# MZT-500

## SERIES 810 — Micro Zone Test System

### FEATURES

When it comes to evaluating mechanical properties of ultra-small regions of ultra-fine specimens, the MZT-500 Series models are exceptionally powerful tools in the fields of research and development and quality control. The MZT-500 can evaluate mechanical properties, which conventional

hardness testing machines for fine specimens cannot measure, such as various CVD and PVD-deposited or generated films, including ion-plated films; hardness of ultra-fine cross-sections; bonding mechanical properties; and mechanical wear properties of carbon fibers, glass fibers, whiskers, etc.

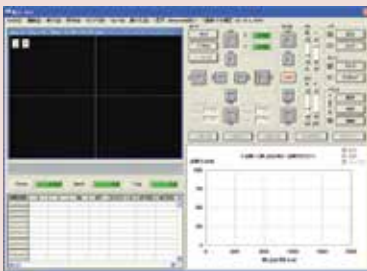
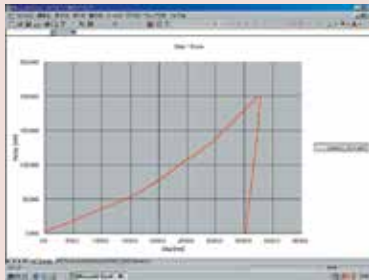
- Test data  
The indentation factor can be obtained, which is related to the hardness value (partially) shown in Martens hardness test (ISO14577) and Young's modulus. Deformation characteristics in the load, dwell, and unload phases are also obtainable for use in determining properties of the specimen material.
- 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 20 $\mu$ m with a resolution of 0.1nm.
- Test forces between 0.1mN and 1000mN can be applied electromagnetically for evaluation of material properties in submicroscopic areas.
- Field-compatible form with cover for protection against dust and wind.



### SPECIFICATIONS

Model No.	MZT-500L	MZT-500P
<b>Order No.</b>	<b>810-813A</b>	<b>810-814A</b>
Basic system	✓	✓
Data analysis / control device	✓	✓
Manual type XY stage (Travel range 25x25mm)	✓	—
Automatic XY stage (Travel range: 50x50mm)	—	✓

Test force loading device	Test force range: 0.1 to 1000mN
	Control resolution: 0.916 $\mu$ N
	Loading speed: 0.01 to 100mN/s
Indentation depth measurement	Range: 0 to 20 $\mu$ m
	Resolution: 0.1nm
Indenter	Type: Bercovich triangular pyramid indenter
Sample surface observation method	Camera: 1/3 inch black and white (410,000 pixels)
	Objective (monitor magnification): 100X (2500X), Optional: 10X (250X), 40X (1000X)
Specimen dimensions	Maximum height: 90mm
	Maximum depth: 90mm (From the center of the indenter axis)
Test type	Indentation test (with preliminary test force)
	Indentation test (without preliminary test force)
	Indentation depth setting test, continuous indentation test, repeated indentation test



# HV110 / HV120

## Series 810—Vickers Hardness Testing Machines – Type A

### FEATURES

- Heavy load Vickers testing machines feature motorized force selection from 1-50kgf or .3 to 30kgf. Fully adjustable long life LED illumination runs cool.
- A dual line filar eyepiece combines with a color touch screen LCD display to create accurate measurements with the touch of a button.
- The motorized turret can accommodate up to 3 long working distance objective lenses for an even wider range of materials and A wide variety of anvils and x-y stages are also available.



HV120 show with optional  
810-454A CCTV Camera

### SPECIFICATIONS

Model	HV110	HV120
Order No.	810-440A	810-445A
Test force	9.807N (1kgf), 19.61N (2kgf), 29.42N (3kgf), 49.03N (5kgf), 98.07N (10kgf), 196.1N (20kgf), 294.2N (30kgf), 490.3N (50kgf)	2.942N (0.3kgf), 4.903N (0.5kgf), 9.807N (1kgf), 24.51N (2.5kgf), 49.03N (5kgf), 98.07N (10kgf), 196.1N (20kgf), 294.2N (30kgf)
Supported Test Method	HV, HK, HB (Light Force*), Kc	
Test force selection	Motorized	
Loading accuracy	±1%	
Load control	60µ/s, 150µ/s Automatic (loading, duration, unloading)	
Load rate	5~999 sec.	
Objective lens	2X, 5X, 10X (standard), 20X, 50X, 100X	
Measuring microscope	10X Dual Line Filar	
Total magnification	20-1000X (100X Standard)	
Field of View	1,400µ (10X Lens) Type A	
Minimum reading	< 50x = 0.1µm, ≥50x = 0.01µm	
Display	Color LCD Touch Screen	
Scaled Conversion:	8 Types (ASTM, ISO, JIS, SAE and BS)	
Statistics:	N, Max., Min., Average, Range, High, Low, Good, Over, Under, SD(n-1), SD(n-1), SD(n) OK/NG Judgement,	
Curvature correction;	0.01 to 200.00mm	
Maximum Sample height	210mm Type A	
Maximum Sample depth	160mm	
Maximum Sample Weight	20 Kg Anvil, 10 Kg with x-y Stage	
Optical path	100% Eyetube or Camera	
Output	Rs232, SPC, USB2.0	
Power supply	120 Volt AC/ 60 Hz	
Dimensions Main Unit (WxDxH)	9.9" x 24.7" x 30.7" (252x627x781mm)	
Mass	110lbs. (50kg)	

\* Optional Test Forces May Be Required

### Optional Accessories

#### Lens:

- 11AAC712 OBJECTIVE LENS 2X
- 11AAC713 OBJECTIVE LENS 5X
- 11AAC714 OBJECTIVE LENS 20X
- 11AAC715 OBJECTIVE LENS 50X
- 11AAC716 OBJECTIVE LENS 100X

#### Stage

- 810-423 MANUAL STAGE 50X50
- 810-427 MANUAL STAGE 2" X 2" (In/mm)

- 959149 SPC cable (1m / 40")

#### Optical

- 11AAC711 "C" mount CAMERA ADAPTER
- 810-454A CCTV System

#### Indenters

- 19BAA060 DIAMOND INDENTER (VICKERS TYPE)
- 19BAA063 KNOOP DIAMOND INDENTER
- 19BAA281 CARBIDE-ALLOY BALL 1MM DIA.
- 19BAA277 CARBIDE-ALLOY INDENTER, 1MM DIA.
- 19BAA283 CARBIDE-ALLOY BALL, 2.5MM DIA.
- 19BAA279 CARBIDE-ALLOY INDENTER, 2.5MM DIA.

#### Additional Test Force

- 11AAC697 0.5 kg Brinell Weight
- 11AAC698 1.25 kg Brinell Weight
- 11AAC699 5.625 kg Brinell Weight
- 11AAC700 12.5 kg Brinell Weight

# HV110 / HV120

## Series 810—Vickers Hardness Testing Machines – Type B / D

### FEATURES

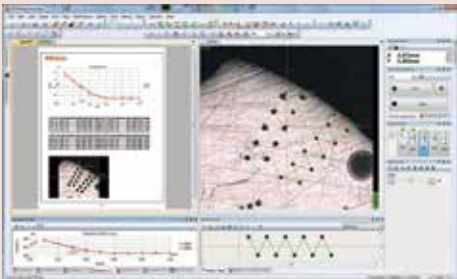
- The Type B HV110/ HV120 Vickers hardness testers add Computer control to make measurements even more repeatable.
- A high resolution 3 mega-pixel camera produces crisp images that are automatically measured in less than .3 seconds.
- Various software functions such as automatic light intensity, simple to use report generator and programming wizards make tedious and repetitive testing requirements more accurate than manual testing and eliminates common operator errors
- The Type D HV110 / 120 adds a motorized X-Y stage with up to 100mm x 100mm of travel for large samples. A motorized focusing platform is also utilized for a complete walk away system.



**Type B System**  
show with optional PC



**Type D System**  
show with optional PC



### SPECIFICATIONS

Model	HV110 Main Unit Only	HV120 Main Unit Only
<b>Order No.</b>	<b>810-443A</b>	<b>810-448A</b>
Test force	9.807N (1kgf), 19.61N (2kgf), 29.42N (3kgf), 49.03N (5kgf), 98.07N (10kgf), 196.1N (20kgf) 294.2N (30kgf), 490.3N (50kgf)	2.942N (0.3kgf), 4.903N (0.5kgf), 9.807N (1kgf), 24.51N (2.5kgf), 49.03N (5kgf), 98.07N (10kgf), 196.1N (20kgf) 294.2N (30kgf)
Supported Test Method	HV, HK, HB (Light Force**), Kc	
Measuring microscope	Optional	
Field of View w/ 10X Lens	590 x 443 µm	
Display	Via PC	
Curvature correction;	0.01 to 200.00mm	
Maximum Sample height	172mm Type B, 132mm Type D	
Maximum Sample depth	160mm	
Maximum Sample Weight	10 Kg Type B, 3 kg Type D	
Optical path	100% Eyetube or Camera	
Output	USB2.0	
Mass	110lbs. (50kg)	

\*Other Specifications as Type A Testers  
\*\* Optional Test Forces May Be Required

Basic Configuration	Type B	Type D
Main Unit	810-443A or 810-448A	810-443A or 810-448A
AVPak-10 Software	11AAC664	11AAC664
PC***	***	***
Automatic Focus Stage		810-465
Motorized X-Y Stage 50x50		810-461A
Motorized X-Y Stage 100x100		810-462A

\*\*\* PC Not Included

# Optional Accessories

## Micro-Vickers/Vickers Hardness Testing Machine

### Test Blocks

Order No.	Description	Load
64BAA173	Vickers 100HV Test Block	100gf
64BAA174	Vickers 200HV Test Block	100gf
64BAA175	Vickers 300HV Test Block	100gf
64BAA176	Vickers 400HV Test Block	100gf
64BAA177	Vickers 500HV Test Block	100gf
64BAA178	Vickers 600HV Test Block	100gf
64BAA179	Vickers 700HV Test Block	100gf
64BAA180	Vickers 800HV Test Block	100gf
64BAA181	Vickers 900HV Test Block	100gf
64BAA182	Vickers 100HV Test Block	500gf
64BAA183	Vickers 200HV Test Block	500gf
64BAA184	Vickers 300HV Test Block	500gf
64BAA185	Vickers 400HV Test Block	500gf
64BAA186	Vickers 500HV Test Block	500gf
64BAA187	Vickers 600HV Test Block	500gf
64BAA188	Vickers 700HV Test Block	500gf
64BAA189	Vickers 800HV Test Block	500gf
64BAA190	Vickers 900HV Test Block	500gf
64BAA191	Vickers 100HV Test Block	1000gf
64BAA192	Vickers 200HV Test Block	1000gf
64BAA193	Vickers 300HV Test Block	1000gf
64BAA194	Vickers 400HV Test Block	1000gf
64BAA195	Vickers 500HV Test Block	1000gf
64BAA196	Vickers 600HV Test Block	1000gf
64BAA197	Vickers 700HV Test Block	1000gf
64BAA198	Vickers 800HV Test Block	1000gf
64BAA199	Vickers 900HV Test Block	1000gf
64BAA200	Knoop 200HK Test Block	100gf
64BAA201	Knoop 300HK Test Block	100gf
64BAA202	Knoop 400HK Test Block	100gf
64BAA203	Knoop 500HK Test Block	100gf
64BAA204	Knoop 600HK Test Block	100gf
64BAA205	Knoop 700HK Test Block	100gf
64BAA206	Knoop 800HK Test Block	100gf
64BAA207	Knoop 250HK Test Block	500gf
64BAA208	Knoop 300HK Test Block	500gf
64BAA209	Knoop 400HK Test Block	500gf
64BAA210	Knoop 500HK Test Block	500gf
64BAA211	Knoop 600HK Test Block	500gf
64BAA212	Knoop 700HK Test Block	500gf
64BAA213	Knoop 800HK Test Block	500gf
64BAA214	Knoop 250HK Test Block	1000gf
64BAA215	Knoop 300HK Test Block	1000gf
64BAA216	Knoop 400HK Test Block	1000gf
64BAA217	Knoop 500HK Test Block	1000gf
64BAA218	Knoop 600HK Test Block	1000gf
64BAA219	Knoop 700HK Test Block	1000gf
64BAA220	Knoop 800HK Test Block	1000gf

\*other hardness ranges and test forces available

### Bulbs

Order No.	Description
513667	Bulb, 12v/50w, halogen double pin type, HM series with box style illuminators.
19BAA219	Bulb, 6v/2 0w, halogen double pin type, Later H series
19BAA095	Bulb, 6v/15w, halogen bayonet type, all E, G and early H series testers.

### Indenters

Order No.	Type	Model
19BAA061	Knoop Indenter	H, HM Standard Series
19BAA058	Vickers Indenter	H, HM Standard Series
19BAA062	Knoop Indenter	MVK-H2, H3, HM114, HM220
19BAA059	Vickers Indenter	MVK-H2, H3, HM114, HM220
19BAA060	Vickers Indenter	HV, AVK-C Series

### Universal Specimen Holder



Used to secure a specimen, that has a measuring surface that is hard to stabilize, perpendicular to the indenter axis.

810-020

### Mounted Specimen Vise



1.5" (39mm) Max Height

810-650-1

810-650-2

810-650-3

810-650-4

810-650-5

Diameter

1" 25.4mm

30mm

1.25" 31.75mm

1.5" 38.1mm

40mm

### 50x50mm travel stage



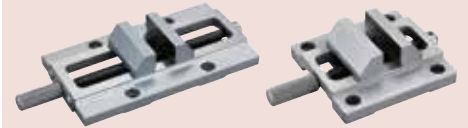
Manual XY Stage Unit 50 x 50

Manual XY Stage Unit 2"x 2"

810-423 Metric

810-427 Inch/Metric

### Clamping devices (Vises)



Vise

Max. opening: 3.94"(100mm)

810-017

Vise

Max. opening: 2"(51mm)

810-016

### Rotary Table



Rotary Table

810-018

### Round Tables



Dimensions: 8"(203mm)

810-037

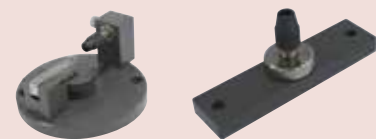
### Specimen (thin plate) Holder



Secures a plate with a thickness of .197"(5mm) or less, or foil-like specimens.

810-013

### Specimen (wire) Holder



Used to horizontally or vertically secure a wire or needle specimen that has a diameter of .126"(3.2mm) or less.

810-014-1 horizontal

810-015-1 vertical



# HR-521(L) / 523(L)

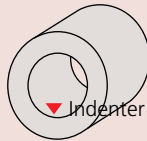
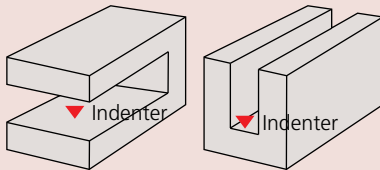
## SERIES 810 — Rockwell Type Hardness Testing Machines

### Technical Data

Preliminary test force:	29.42N, 98.07N
Test force	
Rockwell superficial:	147.1, 294.2, 441.3N
Rockwell:	588.4, 980.7, 1471N
Brinell*:	
Test force setting:	By control unit
Load control:	Automatic (loading, duration, unloading)
Load duration:	0s - 120s (1s increments)
Max. specimen height:	205mm (for standard flat anvil)
Max. specimen depth:	150mm (from the center of indenter shaft)
Stage elevation:	Manual or power drive
Control unit:	Sheet-switch type or touch screen type
Data output:	RS-232C, Digimatic code (SPC) and Centronics
Power supply:	120V AC, 50/60Hz
Dimensions (W x D x H)	
Main unit:	250 x 670 x 605mm
Control unit:	165 x 260 x 105mm

**Optional Accessories:** See page K-11, 12

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



### Function: 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.
- Measured data editing
- OK/±NG tolerance judgment.
- Statistical processing, histogram and X-R chart

### FEATURES

- Multiple test force generation for Rockwell, Rockwell Superficial and Brinell hardness.
- Dolphin-nose indenter arm for easy reach of interior (min.  $\varnothing 40\text{mm}/\varnothing 22\text{mm}^*$ ) and exterior surfaces.  
\*When using an optional diamond indenter (198AA292).
- Real time electronic test force control for accurate loading. This perfectly eliminates load force overshooting.
- Indenter escape function for continuous testing at fixed table position. This eliminates instability caused by the table retraction.
- Auto-stop elevation table and automatic preliminary test force loading to provide stable test force generation.



### SPECIFICATIONS

Model	HR-521	HR521L	HR-523	HR-523L
<b>Order No.</b>	<b>810-202-03A</b>	<b>810-205-03A</b>	<b>810-204-03A</b>	<b>810-207-03A</b>
Preliminary Test Force	29.42N (3kgf), 98.07N (10kgf)			
Test Force	Rockwell	588.4N (60kgf), 980.7N (100kgf), 1471N (150kgf)		
	Rockwell Superficial	147.1N (15kgf), 294.2N (30kgf), 441.3N (45kgf)		
	Brinell	1839N (187.5kgf) (for use with 2.5mm ball)		
Force Control	Automatic control (unloading/duration/unloading) with closed loop feed back			
Console/Display Unit	Touch screen operation with back-lit LCD graphic display			
Test Force Selection	By touch screen			
Table up/down drive	Manual (w/Auto-brake mechanism)	Power-Drive (for full-automatic measurement)		
Load Duration	0 to 120 sec. (1 sec. step)			
Maximum Specimen Height	8.1" (205mm)	15.5" (395mm)	8.1" (205mm)	15.5" (395mm)
Maximum Specimen Depth	5.9" (150mm)			
Display Indication Functions	Hardness value, Converted hardness value, Test conditions, OK/NG tolerance judgement, statistical processing result Rockwell/Rockwell superficial hardness testing. Continuous testing. Cylindrical/spherical surface compensation, data offset Hardness conversion (HV, HK, HRA/VC/D/FF/G/15T/30T/45T/15N/30N/45N, HS, HB, HBW, tensile strength) OK/±NG tolerance judgement, measured data editing, data memory (max 1024 data) SPC calculation (No. of data, max/min/mean values, range, upper/lower limit values, standard deviation, No. of passing/defective) Histogram, X-R chart			
Data Output	RS-232C, SPC, Centronics			
Dimensions (W x D x H)	9.84" x 26.38" x 23.82" (250 x 670 x 605mm)			
Mass	60kg			

# HR-210MR/320MS/430MR/430MS

## SERIES 963 — Rockwell Hardness Testing Machines

### FEATURES

- The new frame design allows the full 7.1" of specimen capacity without the need to cut a whole in the table.
- Simple to operate; the Dial Type HR210 features an automatic zero reset. The digital HR320 model uses a flashing bar graph to indicate when the initial test force has been reached.
- Automatic brake and automatic start function that prevents overloading and begins test cycle. The HR430 model also includes the dial a weight system for easier load selection.
- All models are complete with Flat and VEE anvils, diamond and 1/6" carbide ball indenters, 2 HRC and 1 HRBW Rockwell blocks (MR models)s or 3 Rockwell blocks and an HR30N and HR30TW for MS testers.



**HR-210MR**  
Rockwell hardness testing machine  
Motorized Loading  
Motor drive - Button start model



**HR-320MS**  
Rockwell/Rockwell Superficial hardness testing machine  
Motorized Loading  
Motor drive - Button start model



**HR-430MR**  
Rockwell hardness testing machine  
Motorized Loading  
Motor drive - Automatic start model



**HR-430MS**  
Rockwell/Rockwell Superficial hardness testing machine  
Motorized Loading  
Motor drive - Automatic start model

### Technical Data

Preliminary test force: 29.42N\*, 98.07N  
 Test force  
 Rockwell superficial\*: 147.1, 294.2, 441.3N  
 Rockwell: 588.4, 980.7, 1471N  
 Test force setting: By dial  
 Load control: Automatic (loading, duration, unloading)  
 Anvil: Flat (ø64mm)  
 Max. specimen height: 7.1" / 180mm  
 Max. specimen depth: 6.5" / 165mm (from the center of indenter shaft)  
 Stage elevation: Manual  
 Data output\*: RS-232C, Digimatic code (SPC)  
 Power supply: 120V AC, 50/60Hz

\*HR320-430 only

### SPECIFICATIONS

Order Number	963-220-10A	963-231-10A	963-240-10A	963-241-10A
Model	HR-210MR	HR-320MS	HR-430MR	HR-430MS
Test Scales	Rockwell	Rockwell and Rockwell Superficial	Rockwell	Rockwell and Rockwell Superficial
Standard	JIS B 7726 ISO 6508-2 ASTM E18-10			
Preliminary Test Force	98.07N (10kgf)	98.07N (10kgf), 29.42 (3kgf)	98.07N (10kgf)	98.07N (10kgf), 29.42 (3kgf)
Test Force Rockwell	588.4N (60kgf), 980.7N (100kgf), 1471N (150kgf)			
Test Force Superficial	—	147.1N (15kgf), 294.2N (30kgf), 441.3N (45kgf)	—	147.1N (15kgf), 294.2N (30kgf), 441.3N (45kgf)
Display	Dial	Matrix Backlight LCD		
Hardness Minimum Value	0.5 HR	0.1 HR		
Scale Conversions	—	HRC, HRB, HV, HBW, HS, Mpa plus offset, OK/NG		
Preliminary Test Force	Manual (with automatic zero set)	Manual (with Loading Navigator)	Manual (with automatic brake-start)	
Total Test Force Control	Automatic (loading, duration, unloading)			
Loading Method	Dead Weight			
Load Duration (Dwell)	Fixed (3s to 5.5s) or Manual	Adjustable (1s to 99s) or Manual		
Maximum Specimen Ht.	7.1" (180mm)			
Maximum Depth	6.5" (165mm)			
Data Output	—	RS-232C, SPC		
Power Supply	120V AC (±10%), 60Hz			
Dimensions (D x W x H)	20.15"(512mm) x 9.25"(235mm) x 30.7"(780mm)	20.6"(523mm) x 9.25"(235mm) x 30.7"(780mm)	20.6"(523mm) x 9.25"(235mm) x 30.7"(780mm)	20.6"(523mm) x 9.25"(235mm) x 30.7"(780mm)
Mass	100.53lb (45.6kg)	102.07lb (46.3kg)	108.69lb (49.3kg)	110.01lb (49.9kg)

# Optional Accessories

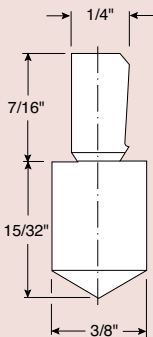
For Rockwell/Rockwell Superficial Type Hardness Testing machine



## Calibration Set

Order No.	Order No.
<b>64BAA241</b>	<b>64BAA242</b>
C Scale Set	B Scale Set
Test Blocks	Test Blocks
64BAA125	64BAA126
64BAA124	64BAA132
64BAA158	64BAA135
Indenter	Indenter
64BAA072	64BAA078
Order No.	Order No.
<b>64BAA243</b>	<b>64BAA244</b>
30N Scale Set	30T Scale Set
Test Blocks	Test Blocks
64BAA128	64BAA129
64BAA165	64BAA140
64BAA167	64BAA130
Indenter	Indenter
64BAA073	64BAA078

## Rockwell Type Diamond Indenters



Order No.	Scale
<b>64BAA072</b>	C
<b>64BAA073</b>	N
<b>64BAA086</b>	A
<b>64BAA071</b>	C & N

Order No.	Hardness
<b>64BAA159</b>	HRA81/86 Rockwell Test Block
<b>64BAA160</b>	HRA75/79 Rockwell Test Block
<b>64BAA161</b>	HRA70/73 Rockwell Test Block
<b>64BAA162</b>	HRA65/68 Rockwell Test Block
<b>64BAA163</b>	HRA60/62 Rockwell Test Block
<b>64BAA249</b>	HRBW95/100 Rockwell Test Block
<b>64BAA126</b>	HRBW90/95 Rockwell Test Block
<b>64BAA131</b>	HRBW80/85 Rockwell Test Block
<b>64BAA132</b>	HRBW70/75 Rockwell Test Block
<b>64BAA133</b>	HRBW60/65 Rockwell Test Block
<b>64BAA134</b>	HRBW50/55 Rockwell Test Block
<b>64BAA135</b>	HRBW40/45 Rockwell Test Block
<b>64BAA127</b>	HRBW30/35 Rockwell Test Block
<b>64BAA136</b>	HRBW20/25 Rockwell Test Block
<b>64BAA137</b>	HRBW10/15 Rockwell Test Block
<b>64BAA138</b>	HRBW0/5 Rockwell Test Block
<b>64BAA125</b>	HRC60/65 Rockwell Test Block
<b>64BAA157</b>	HRC50/55 Rockwell Test Block
<b>64BAA124</b>	HRC40/45 Rockwell Test Block
<b>64BAA123</b>	HRC30/35 Rockwell Test Block
<b>64BAA158</b>	HRC20/25 Rockwell Test Block

Order No.	Hardness
<b>64BAA129</b>	HR30T74/79 Rockwell Test Block
<b>64BAA139</b>	HR30T70/73 Rockwell Test Block
<b>64BAA140</b>	HR30T63/67 Rockwell Test Block
<b>64BAA141</b>	HR30T56/60 Rockwell Test Block
<b>64BAA142</b>	HR30T49/53 Rockwell Test Block
<b>64BAA130</b>	HR30T43/47 Rockwell Test Block
<b>64BAA143</b>	HR30T36/39 Rockwell Test Block
<b>64BAA144</b>	HR30T29/33 Rockwell Test Block
<b>64BAA145</b>	HR30T22/26 Rockwell Test Block
<b>64BAA146</b>	HR30T15/18 Rockwell Test Block
<b>64BAA147</b>	HR15T90/92 Rockwell Test Block
<b>64BAA148</b>	HR15T86/69 Rockwell Test Block
<b>64BAA149</b>	HR15T83/85 Rockwell Test Block
<b>64BAA150</b>	HR15T80/82 Rockwell Test Block
<b>64BAA151</b>	HR15T77/79 Rockwell Test Block
<b>64BAA152</b>	HR15T72/74 Rockwell Test Block
<b>64BAA153</b>	HR15T70/72 Rockwell Test Block
<b>64BAA154</b>	HR15T68/69 Rockwell Test Block
<b>64BAA155</b>	HR15T64/66 Rockwell Test Block
<b>64BAA156</b>	HR15T61/63 Rockwell Test Block

Order No.	Hardness
<b>64BAA222</b>	HR45N65/70 Rockwell Test Block
<b>64BAA223</b>	HR45N55/60 Rockwell Test Block
<b>64BAA224</b>	HR45N45/50 Rockwell Test Block
<b>64BAA225</b>	HR45N35/40 Rockwell Test Block
<b>64BAA226</b>	HR45N25/30 Rockwell Test Block
<b>64BAA128</b>	HR30N64/69 Rockwell Test Block
<b>64BAA164</b>	HR30N68/73 Rockwell Test Block
<b>64BAA165</b>	HR30N59/64 Rockwell Test Block
<b>64BAA166</b>	HR30N50/55 Rockwell Test Block
<b>64BAA167</b>	HR30N40/45 Rockwell Test Block
<b>64BAA168</b>	HR15N90/93 Rockwell Test Block
<b>64BAA169</b>	HR15N85/88 Rockwell Test Block
<b>64BAA170</b>	HR15N80/83 Rockwell Test Block
<b>64BAA171</b>	HR15N75/77 Rockwell Test Block
<b>64BAA172</b>	HR15N69/72 Rockwell Test Block

## Carbide Ball Indenters

Order No.	Description
<b>19BAA515</b>	1/16" Carbide ball indenter
<b>19BAA504</b>	1/8" Carbide ball indenter
<b>19BAA505</b>	1/4" Carbide ball indenter
<b>19BAA506</b>	1/2" Carbide ball indenter
<b>19BAA507</b>	1/16" Carbide ball (1pc.)
<b>19BAA508</b>	1/8" Carbide ball (1pc.)
<b>19BAA509</b>	1/4" Carbide ball (1pc.)
<b>19BAA510</b>	1/2" Carbide ball (1pc.)

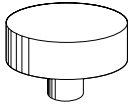
## Steel Ball Indenters

Order No.	Description
<b>64BAA074</b>	1/16" diameter steel ball indenter
<b>19BAA078</b>	1/16" diameter steel ball indenter (auto-discrimination type)
<b>64BAA075</b>	1/8" diameter steel ball indenter
<b>19BAA079</b>	1/8" diameter steel ball indenter (auto-discrimination type)
<b>64BAA076</b>	1/4" diameter steel ball indenter
<b>19BAA080</b>	1/4" diameter steel ball indenter (auto-discrimination type)
<b>64BAA077</b>	1/2" diameter steel ball indenter
<b>19BAA081</b>	1/2" diameter steel ball indenter (auto-discrimination type)
<b>64BAA082</b>	1/16" diameter spare steel ball (10 pcs)
<b>64BAA083</b>	1/8" diameter spare steel ball (10 pcs)
<b>64BAA084</b>	1/4" diameter spare steel ball (10 pcs)
<b>64BAA085</b>	1/2" diameter spare steel ball (10 pcs)

# Optional Accessories

For Rockwell/Rockwell Superficial Type Hardness Testing machine

## Flat anvil



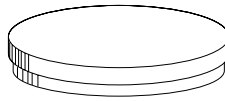
Diameter: 2.5" (64mm)

**810-039-7**

Diameter: 1.5" (38mm)

**810-039-8**

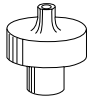
## Round Table



Diameter: 8" (203mm)

**810-037-7**

## Spot anvils



Diameter: .25" (6.4mm)

Height: .88" (22mm)

**810-044-7**



Diamond-tipped type for  
Rockwell superficial hardness measurement

**810-030-7**

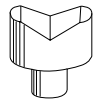
## V-anvils



Diameter: 1.5" (38mm)

Groove width: .38" (9.7mm)

**810-041-7**



Diameter: 1.5" (38mm)

Groove width: 1.5" (38mm)

**810-040-7**



Diameter: .38" (9.7mm)

Groove width: .38" (9.7mm)

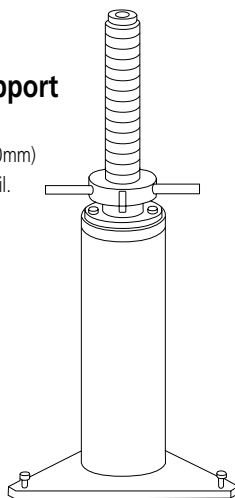
**810-042-7**

## Adjustable support

Adjustable height:  
13 to 18.5" (330 to 470mm)

Used to mount a V-anvil.

**810-028-7**



**264-504-5A**



**937386**



## Optional Accessories

**All tester Except HM 200:**

**06ADV580E:** USB input tool – Tester to PC

**937386:** Tester to DPI UR Printer

**HM 200 Type:**

**06ADV580D:** USB input tool – Tester to PC

**936937:** Tester to DPI UR Printer



# Hardmatic HH-411

## SERIES 810 — Impact Type Hardness Testing Unit

### Technical Data

Impactor:	Impact hammer with integrated detector and carbide-ball tip (D type: conforming to ASTM A 956)
Display unit:	7-segment LCD
Functions:	Auto angle compensation, Offset, OK/NG judgment, Hardness scale conversion Data storage (1800 data entries) Statistical analysis (Average, Maximum, Minimum, Dispersion) Auto sleep function Impact counter display function
Testable workpiece	
Thickness:	Minimum 5mm or more
Mass:	5kg or more in mass
Test points:	5mm or more from the edge of the sample, 3mm or more to each of the tested points.
Surface roughness:	Ra 10µm or less
Power supply:	Alkaline AA battery 2pcs or optional AC adapter (battery life: 70 hours)

### Standard Accessories

<b>19BAA265</b>	Test Block HLD800
<b>810-291</b>	Display Unit
<b>810-287</b>	Detector
<b>19BAA460</b>	Cable
	Battery AA (Alkaline) 2pcs.

### Optional Accessories

<b>264-504-5A:</b>	Digimatic Mini-Processor DP-1VR
<b>937387:</b>	Connecting cable for
<b>09EAA082:</b>	Printer paper (10 rolls/set)
<b>810-622A:</b>	Thermal printer DUP-414
<b>19BAA262:</b>	Thermal printer connecting cable
<b>19BAA157:</b>	Thermal printer paper
<b>19BAA238:</b>	RS-232C connecting cable for PC
<b>06AEG302JA:</b>	AC adapter of display unit
<b>19BAA243:</b>	Hardness test block (880HLD)
<b>19BAA244:</b>	Hardness test block (830HLD)
<b>19BAA245:</b>	Hardness test block (730HLD)
<b>19BAA246:</b>	Hardness test block (620HLD)
<b>19BAA247:</b>	Hardness test block (520HLD)
<b>19BAA248:</b>	Support ring for convex surface of cylinder (R10 - R20)
<b>19BAA249:</b>	Support ring for convex surface of cylinder (R14 - R20)
<b>19BAA250:</b>	Support ring for convex surface of sphere (R10 - R27.5)
<b>19BAA251:</b>	Support ring for concave surface of sphere (R13.5 - R20)
<b>19BAA457:</b>	Carbide ball for D, DC, D+15 type impactors
<b>19BAA458:</b>	Ball shaft for DL type impactor
<b>810-287:</b>	D type impactor UD-411
<b>810-288:</b>	DC type impactor UD-412
<b>810-289:</b>	D+15 type impactor UD-413
<b>810-290:</b>	DL type impactor UD-414

HH-411 is a rebound type portable hardness tester for metal with a compact body and high operability. It allows anyone to perform hardness testing easily at the touch of a key, so it can be used widely on various components in the field.



**810-298:** ASTM standard  
Including the display unit, D type impactor (810-287) and carbide ball (19BAA457).

### SPECIFICATIONS

Model	HH-411		
Order No.	810-298		
Hardness Range	L-Value (ASTM A956)		
Detector	Input device D (carbide ball)		
Display	<b>Hardness</b>	<b>Range</b>	<b>Resolution</b>
	HL	1-999 HL	1 HL
	HV	43-950 HV	1 HV
	HB	20-894 HB	1 HB
	HRC	19.3-68.2 HRC	0.1 HRC
	HRB	13.5 - 101.7 HRB	0.1 HRB
	HS	13.2 - 99.3 HS	0.1 HS
Functions	HTN	499 - 1996 Mpa	1 Mpa
	Conversions: HL, HV, HB, HRC, HRB, HS, HTN		
	Judgment: OK/NG		
	Offsetting Memory: 1,800 data		
Indentation Direction	Any direction		
Output	RS-232C, SPC		
Power supply	Alkaline AA Battery 2pcs.		
Dimensions	Detector: (Dia. X H) 1.10" x 6.89"		
	(28 x 175mm)		
	Display: (W x D x H) 2.76" x 4.33" x 1.38"		
Mass	(70 x 110 x 35mm)		
	Detector: .26lbs (120g) Display: .44lbs (200g)		

### Impactors (Optional accessories)

Various impactors can be connected to the display unit.



**810-288**  
Use for inner walls of cylinders. The grip is short to allow easy positioning within a cylinder.



**810-289**  
Use for concave workpieces such as gear teeth, ball bearing races, etc.



**810-290**  
Use for gear teeth, welded corners, etc.

# Hardmatic HH-300

## SERIES 811 — Durometers for Rubber and Plastics Hardness Testing

### FEATURES

Digital / Dial Durometers are suitable for testing the nature of the following materials — natural rubber, neoprene, polyesters, P.V.C., leather, nitrile rubber, wax, vinyl, cellulose acetates, glass polystyrene, etc.



Compact Digital  
Compact Dial

811-336-10  
811-335-10



Long Leg Digital  
Long Leg Dial

811-332-10  
811-331-10

### SPECIFICATIONS

Order No.	Digital	811-330-10	811-336-10	811-336-11	811-332-10	811-338-10	811-338-11	811-334-10
	Dial	811-329-10	811-335-10	811-335-11	811-331-10	811-337-10	811-337-11	811-333-10
Model No.	Digital	HH-330	HH-336	HH-336	HH-332	HH-338	HH-338	HH-334
	Dial	HH-329	HH-335	HH-335	HH-331	HH-337	HH-337	HH-333
Scale		Shore E	Shore A			Shore D		
Applications		Soft Rubber, Sponge, Felt, Hard Foam	Natural rubber, soft elastomers, etc.			Hard elastomers, plastics, hard rubber, ebonite, etc.		
Resolution		0.1 (digital) or 1 (dial)				0.1 (digital) or 1 (dial)		
Range		HA: 10 - 90				HD: 20 - 90		
Standards	ASTM D 2240	—	✓	✓	✓	✓	✓	✓
	ISO 868	—	✓	✓	✓	✓	✓	✓
	ISO 7619	—	✓	✓	✓	✓	✓	✓
	DIN 53 505	—	—	✓	—	—	✓	✓
	JIS K 6253	✓	✓	✓	✓	✓	✓	✓
	JIS K 7215	—	✓	✓	✓	✓	✓	✓
Pressure foot		44 x 18mm	44 x 18mm	ø18mm		44 x 18mm	ø18mm	
Spring force (mN)		WE=550+HE	WA=550+75HD (HA:Reading 10-90)			WD=444.5HD (HD:Reading 20-90)		
Indenter		Sphere (Tip diameter: 0.79mm)	Blunt taper (Tip diameter: 0.79mm)			Sharp point (Tip curvature: 0.1±0.01mm)		
Tip angle		—	35°±0.25°			30°±0.5°		
Indenter diameter		5mm	1.25mm					
Indenter protrusion		2.5mm						
Functions		Digital: Data hold, Zero -setting, SPC output, Power ON/OFF (Power supply: SR44 x 1pc.) Analog Durometer: Peak retaining hand						
Type		Compact	Compact		Long-leg	Compact		Long-leg
Dimensions (WxDxH)	Digital	60 x 28.5 x 151	60 x 28.5 x 151mm		60 x 28.5 x 193mm	60 x 28.5 x 151mm		60 x 28.5 x 193mm
	Dial	56 x 33.5 x 144mm	56 x 33.5 x 144mm		56 x 33.5 x 186mm	56 x 33.5 x 144mm		56 x 33.5 x 186mm
Mass	Digital	290g	290g		310g	290g		310g
	Dial	300g	300g		320g	300g		320g

### Technical Data

- Designed in accordance with the ASTM D 2240, ISO868, ISO 7619, DIN 53 505, JIS K 6253, and JIS K 7215 specifications.
- Units are available in both Shore A and Shore D scales, and will test a wide variety of applications.
- The Digital Durometer is provided with data hold function, permitting the operator to make an error-free reading on the LCD screen.
- The Dial Durometer is provided with a peak retaining hand for error-free reading.

### Testing stand applications

These stands are used to mount Durometers. They allow constant-pressure hardness measurement by pressing the Durometer vertically on a workpiece.

- 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.

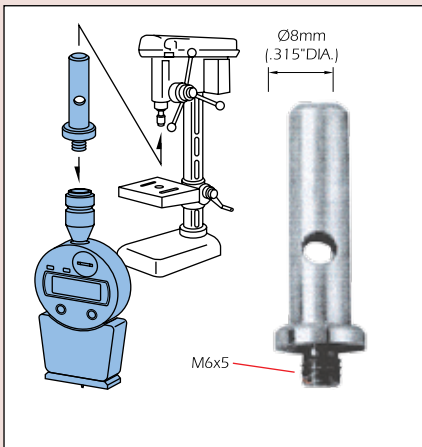


# Hardmatic HH-300

## Test Block Set

### Holding Bar

The holding bar is used to mount a Durometer on a drill press.



64AAA964



64AAA963



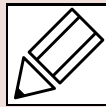
905693

811-332

Item No.	Description
64AAA964	Calibration Set (Shore A Scale) Test Block 30* DURO (Blue) Test Block 60* DURO (Yellow) Test Block 90* DURO (Gray) Mahogany Box
64AAA590	Calibration Set (Shore D Scale) Test Block 20* DURO (Blue) Test Block 40* DURO (Gray) Test Block 80* DURO (Black)
64AAA962	"A" Scale Durometer Stand
64AAA794	"A" Scale Durometer Stand with Air Damper
64AAA796	Combination "D" & "A" Scale Durometer Stand
64AAA963	O-Ring Fixture Set 1/16", 3/32", 1/8", 3/16" and 1/4" O-Ring cross sections
265-504-5A	Digimatic Miniprocessor with printer
905693	Connecting Cable 40" (1m) for Durometer and Digimatic Miniprocessor

\* Values shown are nominal only. Test Block Size 2" x 2" x 1/4"

# Quick Guide to Precision Measuring Instruments



## Hardness Testing Machines

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

Test Method	Micro Vickers	Micro surface material characteristics	Vickers	Rockwell	Rockwell Superficial	Durometer	Rebound type portable	Brinell	Shore
<b>Material</b>									
IC wafer	●	●							
Carbide, ceramics (cutting tool)		▲	●	●					
Steel (heat-treated material, raw material)	●	▲	●	●	●		●		●
Non-ferrous metal	●	▲	●	●	●		●		
Plastic		▲		●		●			
Grinding wheel				●					
Casting								●	
Sponge, rubber						●			
<b>Shape</b>									
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						●			
<b>Inspection, judgement</b>									
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  $S$  ( $\text{mm}^2$ ) 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  $\theta=136^\circ$ ) in the specimen using a test force  $F$  (N).  $k$  is a constant ( $1/g=1/9.80665$ ).

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

The error in the calculated Vickers hardness is given by the following formula. Here,  $\Delta d_1$ ,  $\Delta d_2$ , and 'a' represent the measurement error that is due to the microscope, an error in reading an indentation, and the length of an edge line generated by opposing faces of an indenter tip, respectively. The unit of  $\Delta \theta$  is degrees.

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

#### (2) Knoop

As shown in the following formula, Knoop hardness is a value obtained by dividing test force by the projected area  $A$  ( $\text{mm}^2$ ) 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  $172^\circ 30'$  and  $130^\circ$ ) into a specimen with test force  $F$  applied. Knoop hardness can also be measured by replacing the Vickers indenter of a microhardness testing machine with a Knoop indenter.

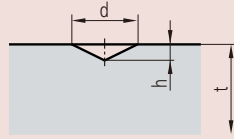
$$HK=k \frac{F}{A}=0.102 \frac{F}{A}=0.102 \frac{F}{cd^2}=1.451 \frac{F}{d^2} \quad \begin{matrix} F:\text{N} \\ d:\text{mm} \\ c:\text{Constant} \end{matrix}$$

#### (3) Rockwell and Rockwell Superficial

To measure Rockwell or Rockwell Superficial hardness, first apply a preload force and then the test force to a specimen and return to the preload force using a diamond indenter (tip cone angle:  $120^\circ$ , 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  $h$  ( $\mu\text{m}$ ) 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 Allowable Thickness of a Specimen



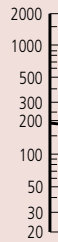
$$HV = 0.1891 \frac{F}{d^2}$$

$$t > 1.5d$$

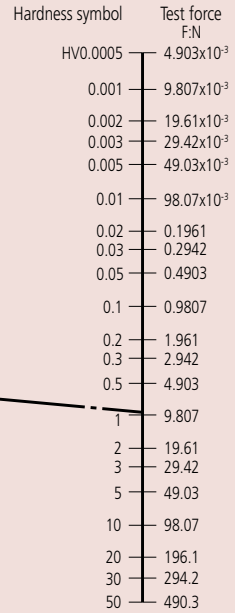
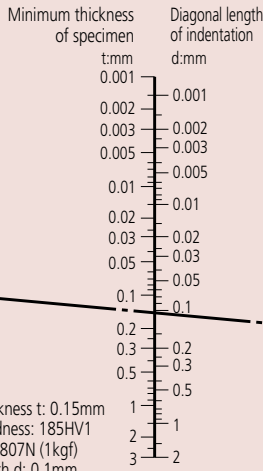
$$h = d/7$$

t: Thickness of specimen (mm)  
d: Diagonal length (mm)  
h: Depth of indentation (mm)

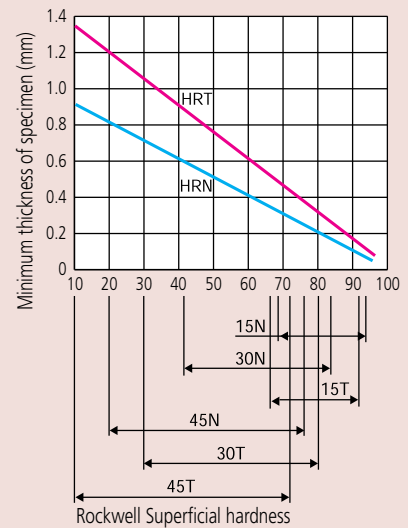
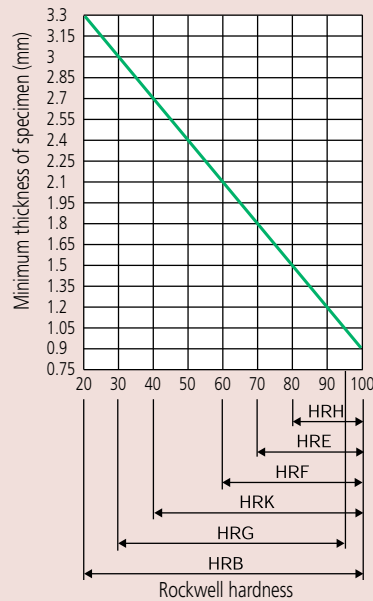
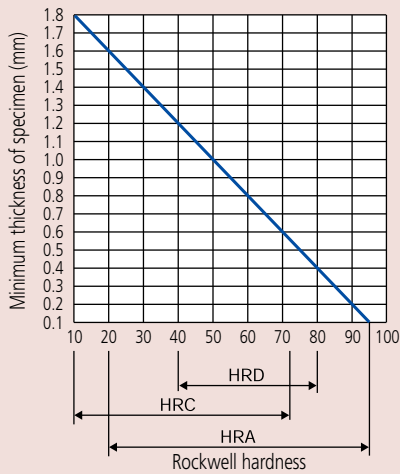
Vickers hardness HV



[Example]  
Specimen thickness t: 0.15mm  
Specimen hardness: 185HV1  
Test force F: 9.807N (1kgf)  
Diagonal length d: 0.1mm



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



### Rockwell Hardness Scales

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, grinding wheel
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	

### Rockwell Superficial Hardness Scales

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	

# Mitutoyo Quality



**People** – Quality starts with our people. Our team is comprised of the best and the brightest in the industry.



**Confidence** – Confidence you have each time you rely on a Mitutoyo product.

**Reliability** – Reliability of the product that you use many times every day.

**Accuracy** – Accuracy you need to preserve tight machining tolerances.



**Relationship** – Relationship you have formed with Mitutoyo staff and distributors

**Longevity** – Longevity of a tool or instrument that maintains factory specifications.



**Savings** – Savings that are realized by implementing metrology solutions that reduce production costs.



**Feel** – Feel of a caliper or micrometer that you have come to expect.

**Pride** – Pride you feel when you produce the best manufactured product possible.