Starrett®

Model No.3825 *Brinell Hardness Tester*

Optional Optical Scanner System
HT-5000

TECHNICAL SUPPORT: (201) 962-8352

Contents

1 General description

The Starrett 3825 Brinell hardness tester is mainly used for hardness determination for metallic materials such as cast iron, steel profiles, nonferrous metals and soft alloys, and also can be used for testing of hard plastics, bakelite and some other nonmetallic materials. This unit is suitable for use in factories, workshops, laboratories, universities and research institutes.

The tester follows guidelines:

- ISO6506 Metallic Materials-Brinell Hardness Test
- ASTM E-10 Test Method for Brinell Hardness of Metallic Materials

2 Key performance parameters

- Test **force**: 3000kgf (29400N), 1500Kgf (14700N), 1000Kgf (9800N), 750Kgf（7355N）, 500Kgf (4900N), 250Kgf (2452N), 187.5Kgf (1839N), 125Kgf (1226N), 100Kgf (980N), 62.5Kgf（612.9N)
- **Load dwell duration**: 2s～99s, can be set and stored
- **Tungsten Carbide Ball indenter:** 10mm, 5mm, 2.5mm
- **Measuring range:** 3.18HBW~658HBW
- **Magnification of the microscope:** 20X
- **Resolution capability of the microscope**: 0.005mm
- **Testing Capacity**: 230 mm in vertical, 140mm in horizontal
- **Dimensions**: 530mm×260mm×750mm
- **Net weight:** 110kg
- **Power supply**: single phase, AC, 110V, 50～60Hz, 4A

The power supply can be reset to 220V. Please contact the supplier to reset it according the local power supply.

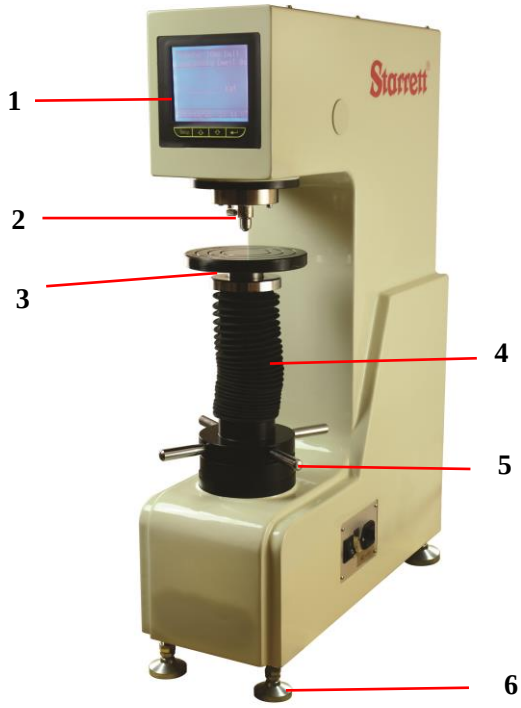
Optional Cabinet/Support Stand

3 Basic configuration and structure

3.1 Standard configuration

Base machine	1
Standard block 125-350HBW10/3000	1
Standard block 125-350HBW10/1000	1
Φ10mm Tungsten Carbide Ball indenter	1
Φ5mm Tungsten Carbide Ball indenter	1
Φ2.5mm Tungsten Carbide Ball indenter	1
Mounting screws for indenter	1
Screwdriver for indenter mounting	1
Flat anvil	1
“V ”shape anvil	1
20X microscope	1
Power supply wire	1
Dust cover	1

3.2 Structure schematic diagram



1) Screen/Keypad
2) Penetrator
3) Anvil
4) Elevation Screw/Cover
5) Handwheel
6) Leveling Feet

4 Installation and adjustment

4.1 Unpack the wood case, then remove the three M10 screws from the underside of the base. Lift the machine very carefully from the bottom. Remove the all accessories that are attached to the baseboard by the straps.

4.2 The machine should be mounted on a firm bench or table in a clean area, free from vibration or shock, recommended height is 800mm. A hole must be provided in the top of the bench to provide working clearance for the leadscrew referring figure 4.1.

4.3 Place the tester on the prepared bench, turn the hand wheel counter clockwise to lower the anvil, remove the anti vibration pad; then place a precision level with the accuracy of 0.2mm/m on the anvil, adjust the leveling feet of tester to make the machine level within 1mm/m, then lock the nuts on the leveling feet.

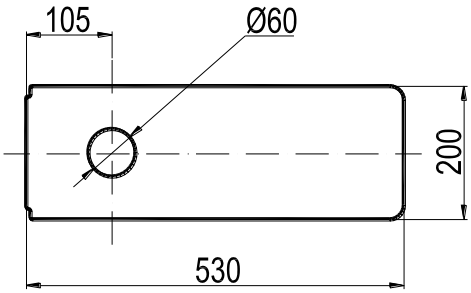


Figure 4.1

4.4 For installation, open the upper cover and back cover of tester, then remove all the packing materials. Inspect to make sure the blade should be correctly placed in the V groove as figure 4.2 showing.（This is done at the factory but may be out of adjustment due to transportation of machine.)

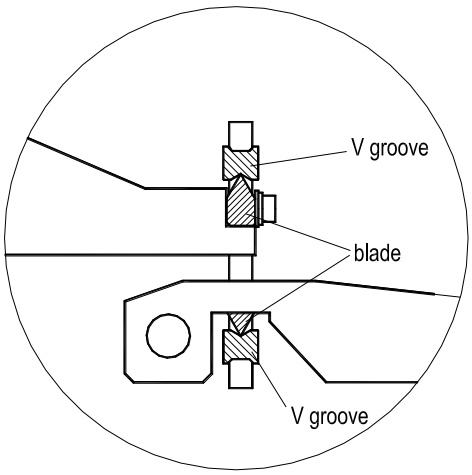


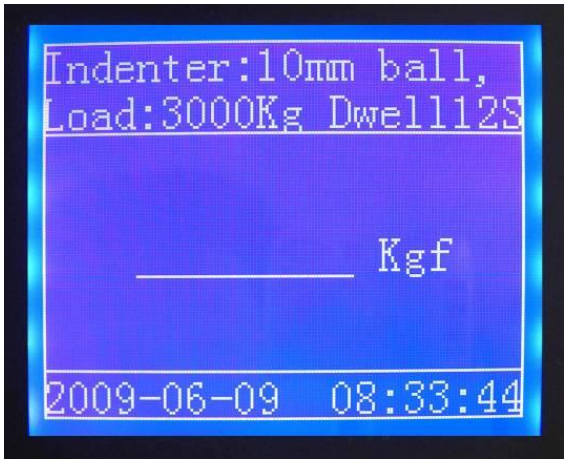
Figure 4.2

4.5 Reinstall the upper and back cover and connect the power supply wire.

5 Operating methods

5.1 Testing preparation

Switch on the machine and then the tester will automatically perform a self check. The relative information such as type, series number, software version will be displayed on screen. Tester will come to main menu after self-checking; current test parameters will be displayed on screen, and the status at the last test parameters will be automatically stored. Figure 5.1.1 is a typical status of

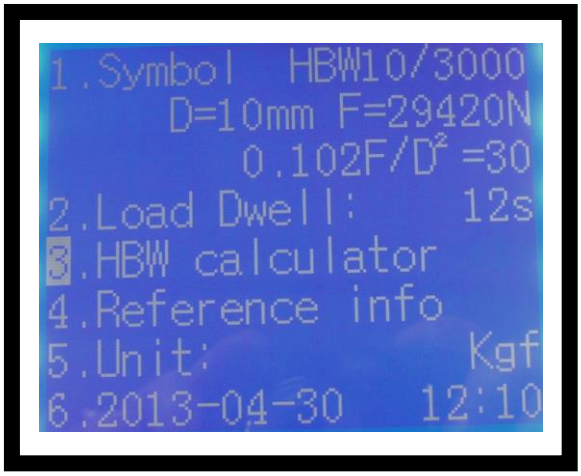


Brinell testing parameter; showing the testing load, indenter diameter, load dwell duration, as well as current time.

Figure 5.1.1

The proper indenter must be mounted in the machine according to the specific requirements of the hardness test. When installing indenter, make sure the installing surface clean and tightly fixed.
The test can be performed directly according to the procedure 5.3 if none of the parameters above is required to modify; following procedures should be observed if modification is necessary.

5.2 Test parameters setting



5.2.1

5.2.2

Press “**Setup**” key, figure 5.2.1 will be shown on the display, the parameter setting is ready.

5.2.1 Brinell hardness symbol

There are 12- Brinell weight loads that this machine is capable of setting. The appropriate parameters should be selected according the material and intended hardness value. The parameters are listed in Tab 5.1.

Press“⇧”or“⇩”key to move cursor to “1” in figure 5.2.1, press “ ↵ ” key ,then the cursor move to “HB10/3000”. Press “⇧”or“⇩”key at this time the optional 12 Brinell symbols in Tab5.1 will be appear in sequence. When the desired symbol appears, press “ ↵ ”to confirm. At this time test force will be changed automatically.

Press “**Setup**” key to return to figure 5.1.1；or press “⇧”or “⇩”key to reset the other parameters.

Tab 5.1 Brinell hardness parameters

	Hardness symbols	Indenter Diameter（mm）	Testing load, F		Indention （mm）	$0.102F/D^2$
			(in kgf）	(in N）		
1	HBW10/3000	10	3000	29420	2.4mm-6.0mm	30
2	HBW10/1500	10	1500	14710		15
3	HBW10/1000	10	1000	9807		10
4	HBW10/500	10	500	4903		5
5	HBW10/250	10	250	2452		2.5
6	HBW10/100	10	100	980.7		1
7	HBW5/750	5	750	7355	1.2mm-3.0mm	30
8	HBW5/250	5	250	2452		10
9	HBW5/125	5	125	1226		5
10	HBW5/62.5	5	62.5	612.9		2.5
11	HBW2.5/187.5	2.5	187.5	1839	0.6mm-1.5mm	30
12	HBW2.5/62.5	2.5	62.5	612.9		10

5.2.2 Load dwell setting

Load dwell refers to the duration of total test force.

Press “⇧”or“⇩”key to move cursor to “2” in figure 5.2.2, press “ ↵ ” key ,then the cursor move to “12S”. Press “⇧”or“⇩”key at this time to select the dwell time range from 2s～99s,then press “ ↵ ”to finish the setting.

Press “**Setup**” key to return to figure 5.1.1；or press “⇧”or“⇩”key to reset the other parameters.

5.2.3 Reference information

Press “⇧”or“⇩”key to move cursor to “4” in figure 5.2.2, press “ ↵ ” key ,then the figure 5.2.3, and 5.2.4 appear, which showing the directions for 0.102F/D^2 ratios should be selected according to the materials and the range of hardness value.

Figure 5.2.3

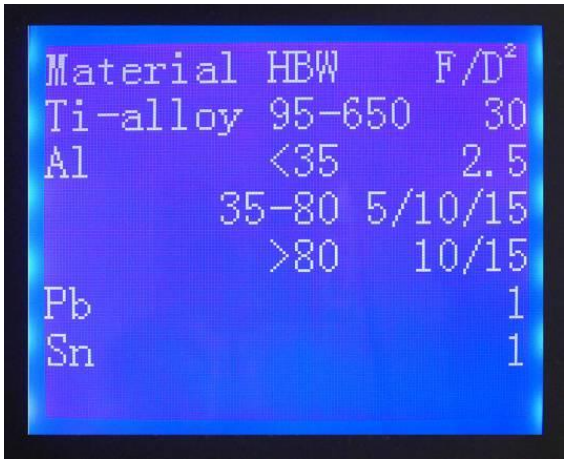


Figure 5.2.4

Press “**Setup**” key to return to figure 5.1.1；or press “⇧”or“⇩”key to reset the other parameters.

5.2.4 Time setting

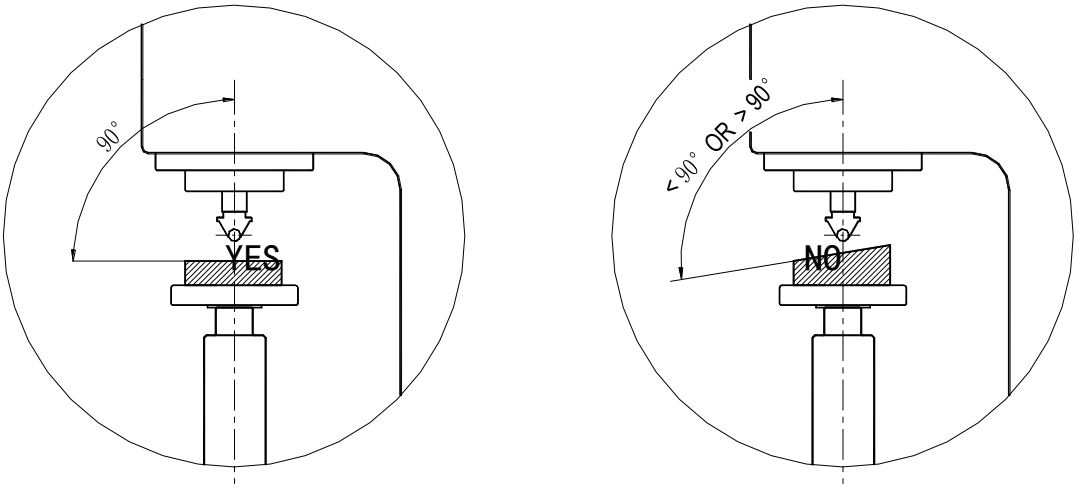
Press “⇧”or“⇩” key to move cursor to “6” in figure 5.2.1, press “ ↵ ” key, figure5.2.5 appears. Press “⇧”or“⇩”key to move cursor to “1” in figure 5.2.12, then press “ ↵ ” key, press “⇧”or“⇩” to select the year, and press “ ↵ ” key to confirm. The month, also the date, hour, minute and second can be reset in the same way.

Press “**Setup**” key to return to figure 5.1.1.

Figure 5.2.5

5.3 Testing

Caution：The sample must be place and supported in such a manner that the surface to be indented is in a plane perpendicular to the axis of the indenter and the line of the indenting force. Otherwise 3000kgf will bring a great divisive force in horizontal direction that may cause damage to the machine.



Place the sample to be tested on the anvil and rotate the hand wheel in clockwise to lift the anvil as figure 5.3.1, showing the anvil moving course. Rotate the hand wheel smoothly until the anvil in figure reaches the end position, buzzing warning will be given out, then the rotating should be stopped at right.

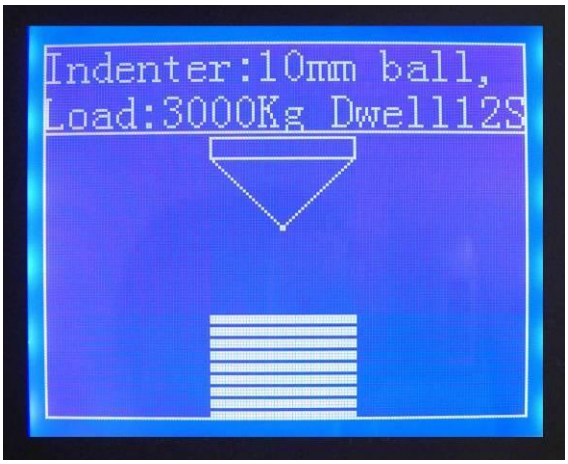


Figure 5.3.1

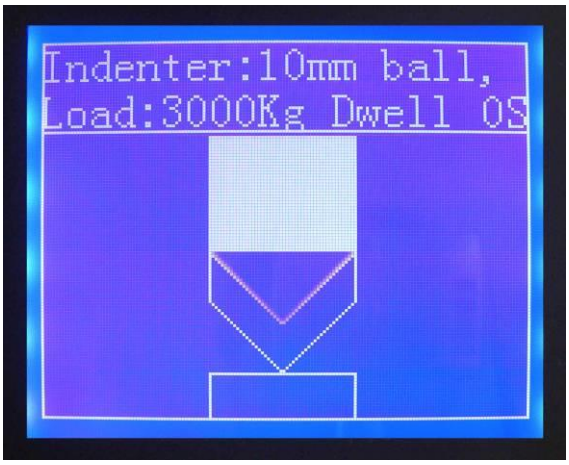


Figure 5.3.2

Then the testing cycle will be performed automatically as following: load application showing as figure 5.3.2, the load holding showing as figure 5.3.3 with dwell time counting down, finally unloading is performed immediately when the dwell time has finished.

After that, all the test results will be shown on the display as in figure 5.3.4.

Rotate the hand wheel in counter-clockwise to lower the anvil, and the screen returns to figure 5.1.1 for the next test.

Figure 5.3.3

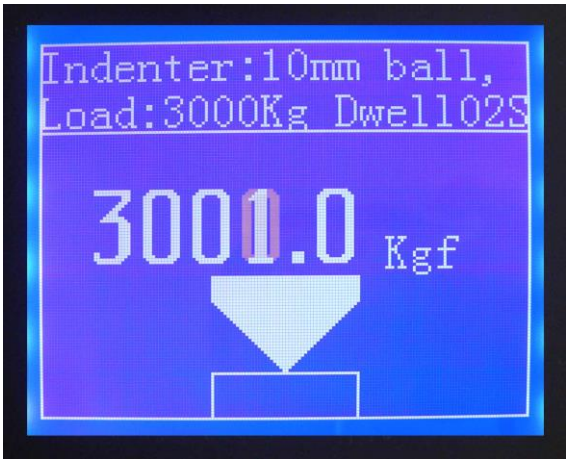


Figure 5.3.4

1. Use of Microscope for Readings Taking

1. 1 A scheme of the microscope's external structure (Fig. 8)

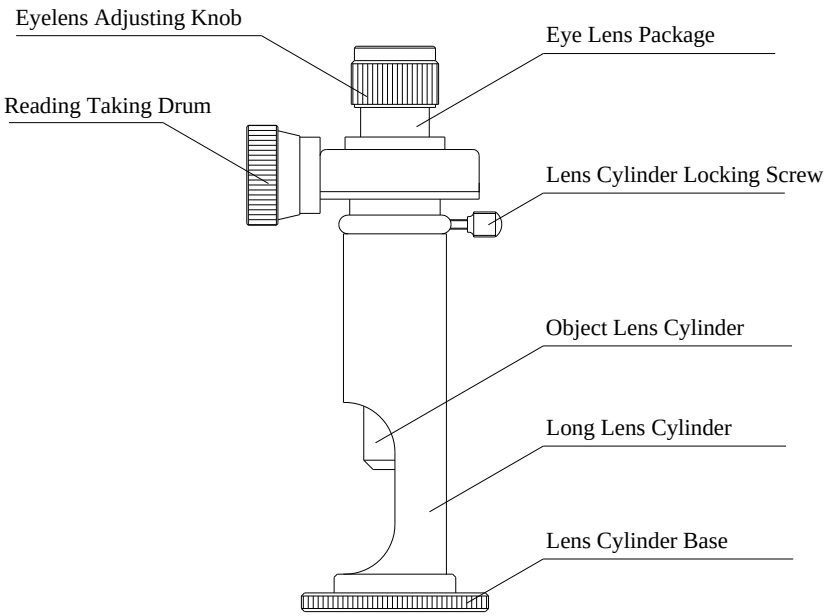


Fig 8

1. 2 **Application**

This microscope is designed to be used primarily for measurement of the indent formed in Brinell hardness test.

1. 3 **Technical Specification**

Eye lens scale span	Graduation range of eye lens scale	Minimum readable on the micro-measuring drum	Measurement accuracy
1 mm	8 mm	0.005 mm	0.005 mm

Amplification: x 20; diameter of the sight range: 9 mm; effective measurement range: 6 mm

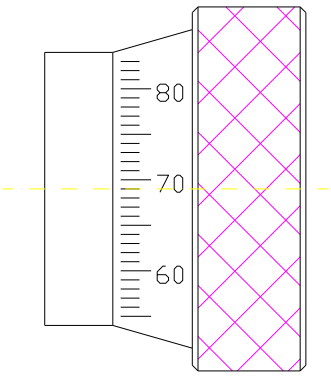
1. 4 **Operation instructions:**

1. 4. 1 Place the microscope on the standard block or specimen, using natural light or a lamp as illumination through the notch on the long lens cylinder. Both the numerals and graduation lines on the scale shall be clearly identifiable in the sight range. If the indent cannot be clearly defined, turn the eye lens knob to adjust the sight until it becomes clear. The microscope is calibrated at the factory to make possible that indents can be clearly defined.

1. 4. 2 Rotate the drum to take reading. Numerals from 0 – 90 and 100 graduation lines are printed on the drum with the scale span of 0.005 mm so that a complete turn of the drum equals to 0.5 mm. See Fig. 9 for details.

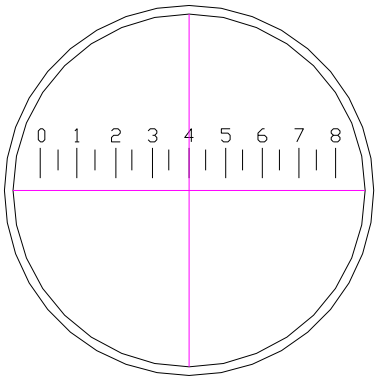
1. 4. 3 There are two graduation scales in the eye lens, one fixed and one mobile. Numerals from 0 – 8 are indicated on the fixed scale with span of 1 mm (see Fig. 10 for detail), while a black line is marked on the mobile scale for measurement.

1. 4. 4 When the drum starts to rotate, the mobile scale with black line moves simultaneously. By this time the indent can be measured in the following manner: at first move the black line to line up with one side of the indent and take the reading, then turn the drum and shift the line to the other side of the indent and take reading accordingly.



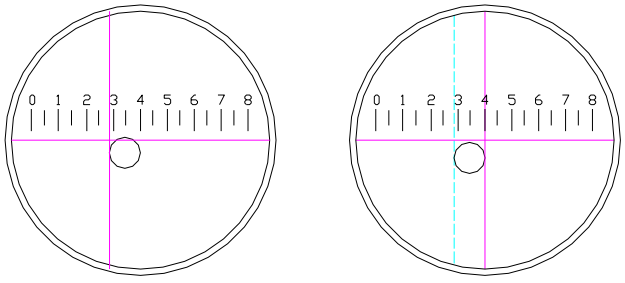
Reading Drum

Fig 9



Scheme of Graduation Lines on the Scale

Fig 10



Indent Measurement Example

Fig 11

Measure the diameter of the indention using the microscope in 2 directions perpendicular to each other. Remember the values and enter as shown below, marked as d1 and d2 on the digital display of the machine

Press “⇧”or“⇩” key to move cursor to “3” HBW Calculator in figure 5.2.1, then press “ ↵ ” key to confirm. Figure5.3.5 appears. Press “⇧”or“⇩”key to input the two diameters, d1 and d2. And press “ ↵ ” key to confirm. The Brinell hardness value will be calculated automatically.

Figure 5.3.5

5.4 Shut down

Remove the test force completely and switch off the power supply. Remove power cord when machine will not be in use for an extended period of time.

6 Maintenance

6.1 When the hardness tester is to be repositioned in another area of your facility, the indenter must be removed. If it is to be transported for a long distance, the original packaging must be restored.

6.2 When performing any adjustments and examining in the machine, the power supply must be turned off.

6.3 When installing or removing the indenter, the mounting surface should be clean and dry. The indenter should be removed carefully and placed back in its supplied case if not being used for an extended period of time.

6.4 The surface of anvil and standard hardness blocks should be clean without contamination, scratches or rust. When storing anvils or test blocks, they should be lightly coated with oil to prevent rusting.

6.5 Dustproof and corrosive medium prevention should be considered in daily operating environment. Rust prevention measures should be adopted in high humidity area.

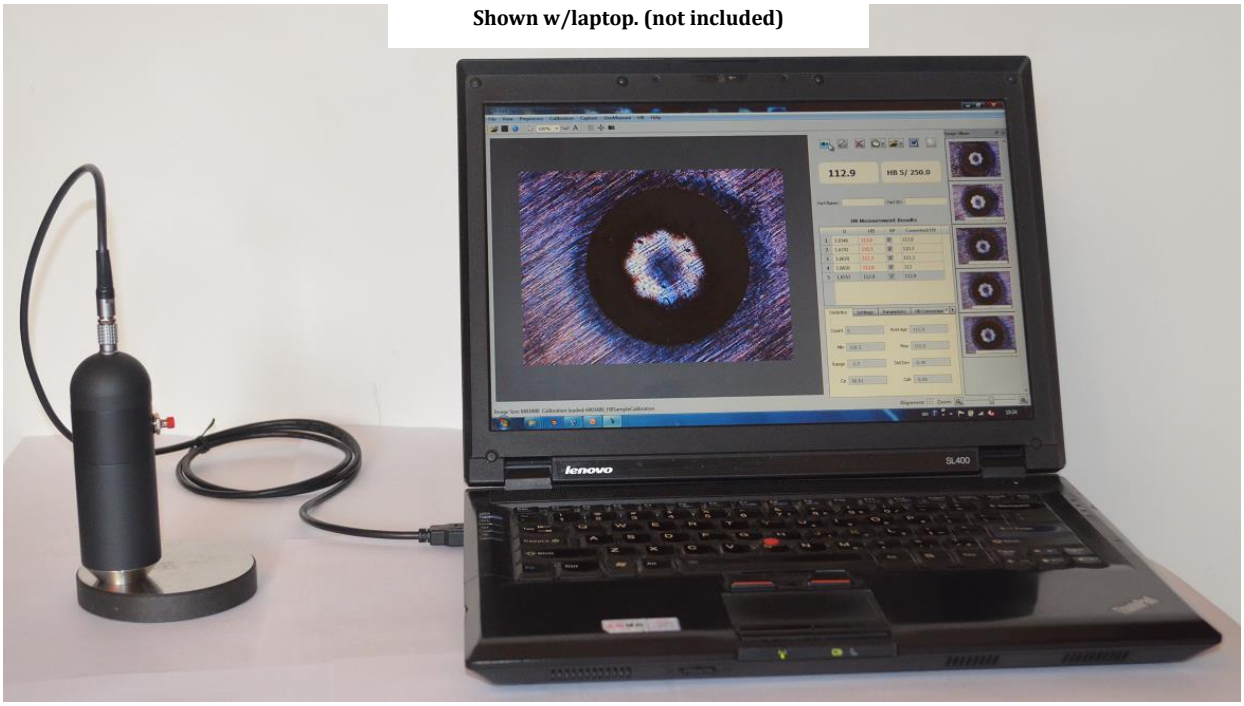
6.6 The leadscrew of the anvil should be lubricated periodically. Apply a few drops of light machine oil, then run the leadscrew up and down a few times to distribute the oil.

6.7 Please don’t disassemble or adjust any fixed parts. This will void your warranty. This should be done by a professional service person familiar with the machine.

HT-5000

Optional Brinell Hardness Indentation Auto-Measurement System

Shown w/laptop. (not included)



Features

1. **Friendly User Interface:** Automatic measurement with a key stroke or a click of a button; Test results can be manually generated or corrected with a single mouse drag move;
2. **High reliability:** Advanced image processing and analysis technologies in automatic measurement. Field proven under severe sample surface conditions;
3. **Single camera with four magnifications:** 1.3M pixel CMOS USB camera with two camera tubes with each tube height having two magnifications. Full measurement range is covered with four magnifications for better measurement accuracy. Specifically, tube 1 magnification #1 is suitable for indentation diameters 3~6mm, magnification #2 for 0.8~1.6mm, while tube 2 magnification #3 for 2~4mm, and magnification #4 for 1~2mm.

Main Functions

1. **Basic Functions:** Includes the basic functions of imaging system such as image capture, camera calibration, image processing, geometric measurement, document labeling, and album management;
2. **Automatic measurement:** Automatically or manually measures the indentation diameter and calculates the hardness HB value;
3. **HB2 (DIN 1605 standard) automatic measurement:** Automatically or manually measures the indentation diameters on the calibration sample and the test sample, and automatically interpolates the HB value for the test sample;
4. **Conversion and validation:** Converts HB to other hardness scales；Validates the test results with sample dimensions;
5. **Statistics:** Automatically updates the statistical values such as average, min and max, standard deviation,Cp and Cpk;
6. **Auto-alarm:** Automatically marks the out of spec measurements;
7. **Test report:** Automatically generates customizable WORD or EXCEL report.

Approximate Hardness Conversion Numbers for Non-Austenitic Steels (Rockwell C Hardness Range)[A]

		Brinell Hardness Number [C]			Rockwell		Superficial Rockwell Number			
Rockwell C 150kgf (HRC)	Vickers (HV)	10-mm Standard ball 3000kgf (HBS)	10-mm Carbide ball 3000kgf (HBW)	Knoop 500-gf and Over (HK)	A Scale 60 kgf (HRA)	D Scale 100kgf (HRD)	15-N Scale 15-kgf (HR15N)	30-N Scale 30-kgf (HR30N)	45-N Scale 45-kgf (HR45N)	Scleroscope Hardness[B]
68	940	...	...	920	85.6	76.9	93.2	84.4	75.4	97.3
67	900	...	...	895	85.0	76.1	92.9	83.6	74.2	95.0
66	865	...	...	870	84.5	75.4	92.5	82.8	73.3	92.7
65	832	...	(739)	846	83.9	74.5	92.2	81.9	72.0	90.6
64	800	...	(722)	822	83.4	73.8	91.8	81.1	71.0	88.5
63	772	...	(705)	799	82.8	73.0	91.4	80.1	69.9	86.5
62	746	...	(688)	776	82.3	72.2	91.1	79.3	68.8	84.5
61	720	...	(670)	754	81.8	71.5	90.7	78.4	67.7	82.6
60	697	...	(654)	732	81.2	70.7	90.2	77.5	66.6	80.8
59	674	...	634	710	80.7	69.9	89.8	76.6	65.5	79.0
58	653	...	615	690	80.1	69.2	89.3	75.7	64.3	77.3
57	633	...	595	670	79.6	68.5	88.9	74.8	63.2	75.6
56	613	...	577	650	79.0	67.7	88.3	73.9	62.0	74.0
55	595	...	560	630	78.5	66.9	87.9	73.0	60.9	72.4
54	577	...	543	612	78.0	66.1	87.4	72.0	59.8	70.9
53	560	...	525	594	77.4	65.4	86.9	71.2	58.6	69.4
52	544	(500)	512	576	76.8	64.6	86.4	70.2	57.4	67.9
51	528	(487)	496	558	76.3	63.8	85.9	69.4	56.1	66.5
50	513	(475)	481	542	75.9	63.1	85.5	68.5	55.0	65.1
49	498	(464)	469	526	75.2	62.1	85.0	67.6	53.8	63.7
48	484	451	455	510	74.7	61.4	84.5	66.7	52.5	62.4
47	471	442	443	495	74.1	60.8	83.9	65.8	51.4	61.1
46	458	432	432	480	73.6	60.0	83.5	64.8	50.3	59.8
45	446	421	421	466	73.1	59.2	83.0	64.0	49.0	58.5
44	434	409	409	452	72.5	58.5	82.5	63.1	47.8	57.3
43	423	400	400	438	72.0	57.7	82.0	62.2	46.7	56.1
42	412	390	390	426	71.5	56.9	81.5	61.3	45.5	54.9
41	402	381	381	414	70.9	56.2	80.9	60.4	44.3	53.7
40	392	371	371	402	70.4	55.4	80.4	59.5	43.1	52.6
39	382	362	362	391	69.9	54.6	79.9	58.6	41.9	51.5
38	372	353	353	380	69.4	53.8	79.4	57.7	40.8	50.4
37	363	344	344	370	68.9	53.1	78.8	56.8	39.6	49.3
36	354	336	336	360	68.4	52.3	78.3	55.9	38.4	48.2
35	345	327	327	351	67.9	51.5	77.7	55.0	37.2	47.1
34	336	319	319	342	67.4	50.8	77.2	54.2	36.1	46.1
33	327	311	311	334	66.8	50.0	76.6	53.3	34.9	45.1
32	318	301	301	326	66.3	49.2	76.1	52.1	33.7	44.1
31	310	294	294	318	65.8	48.4	75.6	51.3	32.5	43.1
30	302	286	286	311	65.3	47.7	75.0	50.4	31.3	42.2
29	294	279	279	304	64.8	47.0	74.5	49.5	30.1	41.3
28	286	271	271	297	64.3	46.1	73.9	48.6	28.9	40.4
27	279	264	264	290	63.8	45.2	73.3	47.7	27.8	39.5
26	272	258	258	284	63.3	44.6	72.8	46.8	26.7	38.7
25	266	253	253	278	62.8	43.8	72.2	45.9	25.5	37.8

Approximate Hardness Conversion Numbers for Non-Austenitic Steels (Rockwell B Hardness Range)[A]

				Rockwell		Superficial Rockwell Number		
Rockwell B 100kgf (HRB)	Vickers (HV)	10-mm Standard ball 3000kgf (HBS)	Knoop 500-gf and Over (HK)	A Scale 60 kgf (HRA)	F Scale 60kgf (HRF)	15-T Scale 15-kgf (HR15T)	30-T Scale 30-kgf (HR30T)	45-T Scale 45-kgf (HR45T)
100	240	240	251	61.5	...	93.1	83.1	72.9
99	234	234	246	60.9	...	92.8	82.5	71.9
98	228	228	241	60.2	...	92.5	81.8	70.9
97	222	222	236	59.5	...	92.1	81.1	69.9
96	216	216	231	58.9	...	91.8	80.4	68.9
95	210	210	226	58.3	...	91.5	79.8	67.9
94	205	205	221	57.6	...	91.2	79.1	66.9
93	200	200	216	57.0	...	90.8	78.4	65.9
92	195	195	211	56.4	...	90.5	77.8	64.8
91	190	190	206	55.8	...	90.2	77.1	63.8
90	185	185	201	55.2	...	89.9	76.4	62.8
89	180	180	196	54.6	...	89.5	75.8	61.8
88	176	176	192	54.0	...	89.2	75.1	60.8
87	172	172	188	53.4	...	88.9	74.4	59.8
86	169	169	184	52.8	...	88.6	73.8	58.8
85	165	165	180	52.3	...	88.2	73.1	57.8
84	162	162	176	51.7	...	87.9	72.4	56.8
83	159	159	173	51.1	...	87.6	71.8	55.8
82	156	156	170	50.6	...	87.3	71.1	54.8
81	153	153	167	50.0	...	86.9	70.4	53.8
80	150	150	164	49.5	...	86.6	69.7	52.8
79	147	147	161	48.9	...	86.3	69.1	51.8
78	144	144	158	48.4	...	86.0	68.4	50.8
77	141	141	155	47.9	...	85.6	67.7	49.8
76	139	139	152	47.3	...	85.3	67.1	48.8
75	137	137	150	46.8	99.6	85.0	66.4	47.8
74	135	135	147	46.3	99.1	84.7	65.7	46.8
73	132	132	145	45.8	98.5	84.3	65.1	45.8
72	130	130	143	45.3	98.0	84.0	64.4	44.8
71	127	127	141	44.8	97.4	83.7	63.7	43.8
70	125	125	139	44.3	96.8	83.4	63.1	42.8
69	123	123	137	43.8	96.2	83.0	62.4	41.8
68	121	121	135	43.3	95.6	82.7	61.7	40.8
67	119	119	131	42.8	95.1	82.4	61.0	39.8
66	117	117	129	42.3	94.5	82.1	60.4	38.7
65	116	116	127	41.8	93.9	81.8	59.7	37.7
64	114	114	125	40.9	93.4	81.4	59.0	36.7
63	112	112	124	40.4	92.8	81.1	58.4	35.7