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ELECTRONIC UNIVERSAL HARDNESS TESTER LB151AU

Lingua originale: Inglese

REV. 1 - 11/19

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CONTENTS

DESCRIPTION

1.Panel Shell

2.Dial Gauge

3.Fastening Screw of Indenter

4.Indenter

5.Testing Anvil

6.Up and Down Lead Screw

7.Load-Change Hand Wheel

8.Rotating Wheel

9.Emergency Stop

10.Control Button

11.Back Cover

12.Upper Cover

13.Power Socket

14.Power Switch

15. The Frame

1.1 TECHNICAL DATA

Rockwell Scales:	HRA, HRB, HRC, HRD, HRE, HRF, HRG, HRH, HRK, HRL, HRM, HRP, HRR, HRS, HRV
Preliminary Test Force:	10Kgf (98.07N) Permitted Error: ±2.0%
Test Force:	60Kgf (588.4N), 100Kgf (980.7N), 150Kgf (1471N) Permitted Error:±1.0%
Dwell Time:	Adjustable 1-60s
Hardness Indication:	5.2” Touch Screen, Resolution:640x480
Resolution:	0.1HR
Loading Control:	Auto Loading/Dwell/Unloading
Hardness Conversion:	HRC, HV, HBS, HBW, HK, HRA, HRD, HR15N, HR30N, HR45N, HS, HRF, HR15T, HR30T, HR45T,HRB
Conversion Standards:	ASTM, DIN
Language Option:	Chinese, English, German, Portuguese, Turkish, Czech, Korean
Correction Range:	-3.0HR to +3.0HR, Step 0.1HR
Data Memory:	2000 Single Measuring Result, Curve Analysis, Results Reviewing And Analysis
Data Output:	Optional Blue Tooth Mini Printer
Max. Height Of Specimen:	175 mm
Instrument Throat:	165 mm
Power supply:	AC220V/50Hz; AC110V/60Hz
Dimension (LxWxH):	546 x 182 x 755 mm
Packing Dimension:	620 x 460 x 870 mm
Gross/Net Weight:	120Kg / 90Kg
Execution Standard:	GB/T230.2, JJS Z2245, EN-ISO6508, ASTME-18

PRECAUTIONS

1. Carefully read the Operation Manual before you use the hardness tester and get to know thoroughly the operation procedure and the usage precautions so as to avoid the damages to the hardness tester and the safety accidents caused by the improper operation.
2. All the bands and the anti-shock tapes should be carefully removed before the hardness tester is installed and calibrated.
3. The single-phase 3-pin socket should be used for the power source of the hardness tester and the ground connecting cable should meet the safety requirements.
4. It is strictly prohibited to tamper with the installed position of all the electric component parts, switches, and sockets of the hardness tester without permission, otherwise it will cause accident.
5. It should not to turn the force knob or the Rotating Wheel during the loading and unloading operations and the dwell time of the test force.
6. Our company tries to improve the quality of the hardness testers and renew their structure. In case the contents in the Operation MANUAL are a bit different with the actual structure of the instrument, it is hoped and apologized for the fact that the further notice will not be given.

2. BRIEF INTRODUCTION

- Hardness is one of the important mechanic characteristics of the material while the hardness testing is an important method to judge the quality of the metal material or its component parts. The hardness of the metal is correspondent to its mechanic characteristics, and so its mechanic characteristics such as the strength, tiredness, wriggling and wearing out can be tested out approximately through its hardness testing.
- The Motorized Brinell Rockwell & Vickers Hardness Tester, a multi-functional hardness tester with Brinell, Rockwell &Vickers 3 kinds of testing methods and 7 steps testing force will meet the needs of many kinds of hardness measurement. The instrument is adopted automatic shifter to load, dwell and unload testing force, rotate the Load-Change Hand Wheel to change values of testing force, therefore the operation for this instrument is simple, easy and quickly. Beside set zero to the dial, there is no man made error for operation. The present instrument is with high sensitivity and stability, so as fit for usage in workshop and testing laboratory.

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3. INSTALLATION OF THE HARDNESS TESTER

3.1 The working condition of the hardness tester
3.1.1 Under the room temperature between 10~30°C;
3.1.2 The relative humidity in the test room shall not be over 65%;
3.1.3 In an environment free from vibration and shock; without corrosive in surroundings.

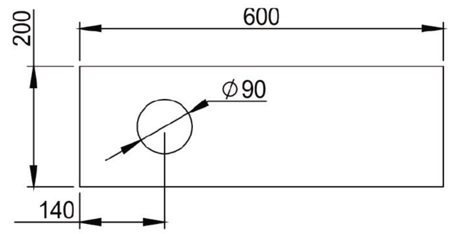

Fig.1

3.2 THE UNPACKING OF THE HARDNESS TESTER

3.2.1 Cut the belts on packing box, loosen off the screws at bottom of packing box, remove the upper body of packing box, and take out accessories kit.
3.2.2 Unscrew two (2) M10 outer hexagonal bolts under the bottom plate with a spanner, to separate the hardness tester from the bottom plate.
3.2.3 After unpacking, the hardness tester shall be placed on a stable working table horizontally, with horizontal deviation less than 1mm/m. A hole shall be drilled at an appropriate location on the working table (**see Fig.1)** to enable the Up and Down Lead Screw to operate properly. We suggest the height of working table should be about 500mm.

3.4 THE INSTALLATION OF THE WEIGHT GROUP (FIG.3)

3.4.1 During installation of weights, the instrument should be in the state without any test force.
3.4.2 The weights shall be placed on the hanging rod (17) tray one by one according to the sequence from the bottom to the top, and the test force shall be rotated to change the handwheel so that all weights can be reset to the normal position.

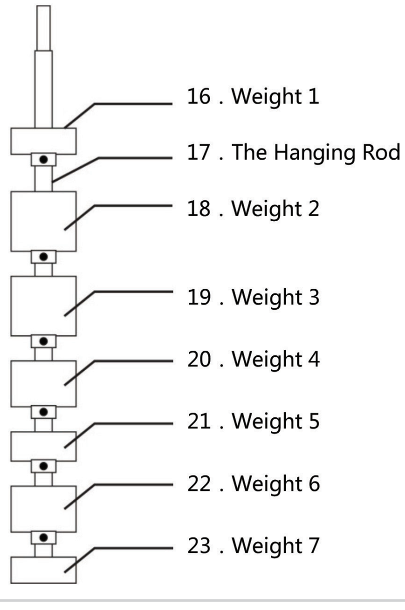

Fig. 3

3.5 THE CORRESPONDENCE RELATION AMONG HARDNESS SCALE--TEST FORCE--WEIGHTS IN WORKING STATUS (TABLE 1).

Table 1

Hardness Scale	Test Force	Graduated Value of Load-Changing Hand Wheel	Force on the Weight (Weight Code)
HV, HB	294.2 (30kg)	306.5	7
HB	306.5 (31.25kg)	306.5	7+1
HRA	588.4 (60kg)	588.4	7+1+6
HB	612.9 (62.5kg)	612.9	7+1+6+5
HV,HB,HRB	980.7 (100kg)	980.7	7+1+6+5+4
HRC	1471 (150kg)	1471	7+1+6+5+4+3
HB	1839 (187.5kg)	1839	7+1+6+5+4+3+2

3.6 INSTALLATION OF MEASURING MICROSCOPE

3.6.1 Take out the microscope body of the measuring microscope from the accessory box, install and fix it on the microscope frame on the left side of the main body.
Align the two locating pins and tighten them with screws.
3.6.2 Install the micrometer eyepiece. Tighten the screws.
3.6.3 Install 4x objective lens (10x objective lens is used for Vickers indentation measurement) and tighten it.
One or more adjusting washers may be installed between the objective lens and the connecting pipe, be careful not to remove them.
3.6.4 在Install the light tube on the objective lens, insert the power plug of the lamp into the jack on the side of the body and tighten the back cap.

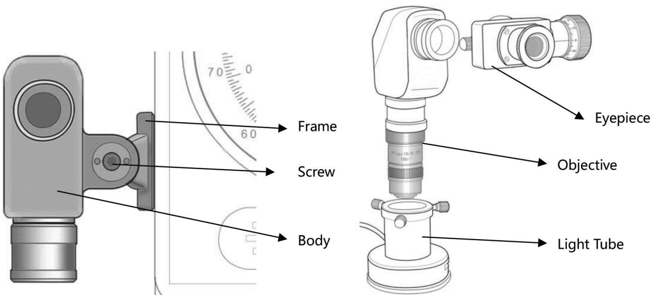

Fig4 Microscope Body Installation

3.7 ANVIL INSTALLATION

There are two types of 4 anvils for hardness tester. They are: flat anvil and V-shape installed in the middle hole of lifting lead screw, and flat anvil and V-shape anvil installed on the sliding test bench.
Installation of the middle hole of the lead screw: insert the handle of the anvil into the hole at the upper end of the lead screw.
Installation of sliding test stand: first slightly rotate and lower the lead screw protective cover. Insert the handle of the sliding test stand into the hole at the upper end of the lead screw, and screw the back cap onto the lead screw. Then install the test bench on the slider of the test bench. Readjust the height of the protective cover to fully cover the lifting lead screw.
To facilitate the horizontal adjustment of the hardness tester, a flat anvil can be installed in the lead screw hole first.

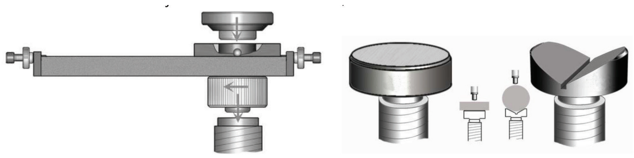
Fig5 Anvil Installation

3.8 HORIZONTAL ADJUSTMENT

Place the level gauge on the anvil, adjust the position and posture of the hardness tester, and adjust the levelness of the hardness tester within 1 / 1000 mm.

3.9 INDENTER INSTALLATION

There are five indenters in the standard of universal hardness tester, and the installation method is the same.
Wipe off the rust proof oil stain on the pressure head, insert it into the installation hole at the lower end of the pressure shaft, and use the set screw to tighten it.

4. ROCKWELL HARDNESS

4.1 The Technical Specifications of Rockwell Hardness

4.1.1 The Initial Test Force: 98.07N (10Kg)
4.1.2 The Total Test Force : 588.4N (60Kg), 980.7N (100Kg), 1471N(150Kg)
4.1.3 The Indenter: The Diamond Rockwell Indenter, The ф1.5875 mm Ball Indenter
4.1.4 The Tolerance of Rockwell Hardness Display Value **(Table 2)**

Table 2

Hardness Scale	Hardness Range of The Standard Testing Blocks	The Max. Tolerance of Display Value
HRA	20~≤75HRA	±2HRA
	>75~≤88HRA	±1.5HRA
HRB	20~≤45HRB	±4HRB
	>45~≤80HRB	±3HRB
	>80~≤100HRB	±2HRB
HRC	20~≤70HRC	±1.5HRC

4.2 DO ALL PREPARATION WORK BEFORE THE USE

Table 3

Scale	Indenter	Initial Test Force(N)	Total Test Force(N)	Applications
HRA	Diamond Indenter	98.07 (10kg)	588.4	Hard alloy, carbide, surface-quenched steel, carburized steel plate (sheet)
HRD			980.7	Steel sheet, surface-quenched steel
HRC			1471	Quenched steel, tempered steel, Hard cast iron
HRF	Ball Indenter φ1.5875mm (1/16 inch)		588.4	Cast iron, aluminum, magnesium alloy, bearing alloy, annealed copper alloy, mild steel sheet
HRB			980.7	Mild steel, aluminum alloy, copper alloy, malleable cast iron, annealed steel
HRG			1471	Phosphor bronze, beryllium bronze, malleable cast iron
HRH	Ball Indenter φ3.175mm (1/8 inch)		588.4	Aluminum, zinc, lead, etc
HRE			980.7	Bearing alloy, tin, hard plastic and other soft materials
HRK			1471	

There are 3 kinds of testing scale for Rockwell Hardness such as A, B & C.

4.2.1 The surface of the specimen should be smooth and clean without any feculence, oxidized peels and concaves, on the outstanding without processing signs.
4.2.2 The Min. thickness of the specimen should be 10 times superior to the depth of the indentation. After the test, the back of the specimen should not have any visible signs of deformation.
4.2.3 The specimen should be stably fixed on the working table. There should be no any movement of the specimen during the testing process and the test force should be loaded perpendicularly on the specimen.
4.2.4 When the specimen is columned in shape, the V-shaped testing table must be used. When testing HRC or HRA hardness value, the diameter of the specimen is smaller than 38 mm and when testing HRB hardness value, the diameter of specimen is smaller than 25 mm, the results of the test should be revised. The revised values are all positive numbers. **(Table 4).**

4.3 THE OPERATION PROCEDURE OF THE ROCKWELL HARDNESS TESTER

4.3.1 Connect the Power Socket (13) with power source, then turn on The Switch (14), nixie tube of the Touch Panel (10) will light.
4.3.2 According to hardness grade of the specimen, select Scale form Table 3. Turn the Load-Change Hand Wheel clockwise to confirm the total testing force.
4.3.3 Push the indenter (4) into the hole of main spindle closely against the supporting plane and make the caved plane of the indenter handle face to the screw. Fasten slightly the Fastening Screw for the Indenter (3), and then place the specimen on the Working Table (6).
4.3.4 Turn the Rotating Wheel (7) clockwise, lift the Up and Down Moving Shaft, enable the specimen slowly touch the indenter without any shock until the short pointer in dial indicator of the instrument move from black point to red point, at this time, the long pointer turn 3 cycles then indicate towards to position "C" vertically (When testing HRB hardness value, the long pointer indicate towards to position "B". When testing Brinell & Vickers hardness value, it is no necessary to set Zero). At this point, it has loaded initial Test Force 98.07N (10Kg), the

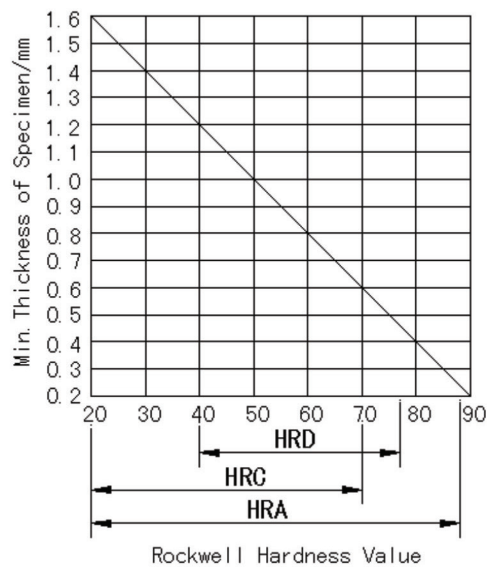

Fig. 3

offset of long pointer could not exceed 5 Rockwell hardness units, otherwise the Rotating Wheel shall turn anticlockwise and the position of specimen be changed for another repeat test.

4.3.5 Rotate the Dial (2) of the instrument to let long pointer indicate position “C”.

4.3.6 Press “START” key on the touch panel, the motor begin to work, the instrument load the test force automatically. When dwell time of total test force is up, the motor rotates to unload the test force automatically.

4.3.7 At this time, the data indicated by the long pointer in dial indicator of the instrument is the hardness value of the specimen tested (when testing HRB hardness for the specimen, the hardness value should be readout from the data in the inner ring of the dial).

4.3.8 The dwell time of total test force for Rockwell hardness measurement is 5 seconds. The dwell time can be adjusted by pressing up and down key on the touch plane.

4.3.9 Turn the Rotating Wheel in anticlockwise to let the Working Table go down, change testing position for other test and repeat above mentioned operation process.

4.3.10 The number of the point to be tested is not less than 5 (the first point in not include.) The number of the points to be tested may be reduced a bit for the specimen tested in a serial.

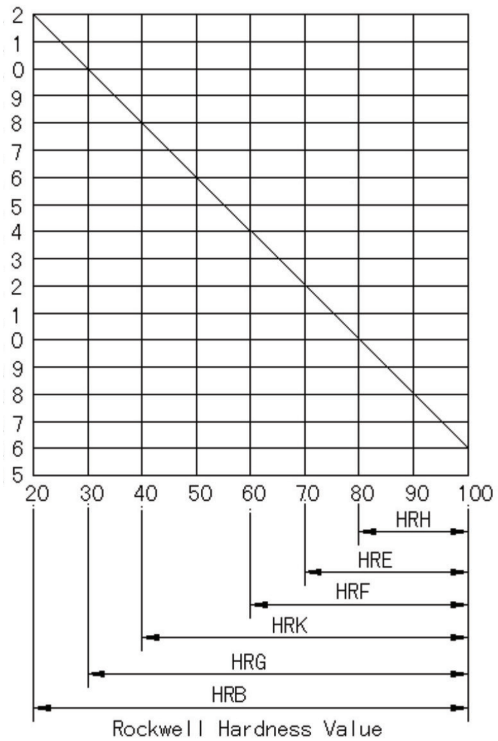

Fig 4

Table 4

Hardness value HR	Diameter (mm) of the Columned Specimens								
	6	10	13	16	19	22	25	32	38
	Modified Value (HR) of Rockwell Scales A, C & D								
20				2.5	2.0	1.5	1.5	1.0	1.0
25			3.0	2.5	2.0	1.5	1.0	1.0	1.0
30			2.5	2.0	1.5	1.5	1.0	1.0	0.5
35		3.0	2.0	1.5	1.5	1.0	1.0	0.5	0.5
40		2.5	2.0	1.5	1.0	1.0	1.0	0.5	0.5
45	3.0	2.0	1.5	1.0	1.0	1.0	0.5	0.5	0.5
50	2.5	2.0	1.5	1.0	1.0	0.5	0.5	0.5	0.5
55	2.0	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0
60	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0	0
65	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0	0
70	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0	0
75	1.0	0.5	0.5	0.5	0.5	0.5	0	0	0
80	0.5	0.5	0.5	0.5	0.5	0	0	0	0
85	0.5	0.5	0.5	0	0	0	0	0	0
90	0.5	0	0	0	0	0	0	0	0

Hardness Value (HR)	Diameter(mm)of the Columned Specimens						
	6	10	13	16	19	22	25
	Modified Value (HR) of Rockwell Scales B, F & G						
20				4.5	4.0	3.5	3.0
30			5.0	4.5	3.5	3.0	2.5
40			4.5	4.0	3.0	2.5	2.5
50			4.0	3.5	3.0	2.5	2.0
60		5.0	3.5	3.0	2.5	2.0	2.0
70		4.0	3.0	2.5	2.0	2.0	1.5
80	5.0	3.5	2.5	2.0	1.5	1.5	1.5
90	4.0	3.0	2.0	1.5	1.5	1.5	1.0
100	3.5	2.5	1.5	1.5	1.0	1.0	0.5

4.4 THE REGULATION OF DISPLAYED HARDNESS VALUE (Fig.5)

he precision of the displayed hardness value of the hardness tester is just calibrated before the instrument is turned out of the factory. If an error is caused due to the transportation, the operator may regulate it based on the understanding of the instrument structure and principle. The method is as follows: Remove the Upper Cover. If the displayed hardness value is in inferior to the hardness value of standard hardness block, withstand a screwdriver into the groove of the M4 Screw and unscrew the nut (25) a little. Rotate the Screw (26) clockwise to forward a bit (about rotate it half cycle, the hardness value is 1 degree higher), then calibrate the zero position (C position) for dial indicator, withstand the Screw Rod and fasten the nut. Do the test and display hardness value until the diaplayed hardness value stands in the tolerance range **(Table 1)**. If the displayed value is higher than the hardness value of the standard hardness block, rotate the Screw in the opposite direction. (There are screwdriver and spanner in the accessories kit.)

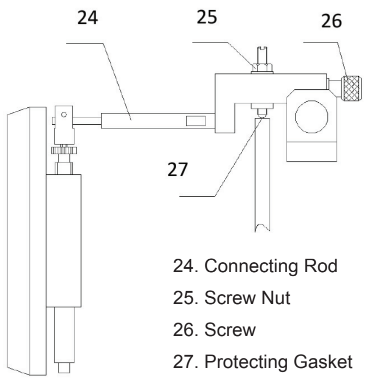

Fig. 5

5. BRINELL HARDNESS

5.1 The Technical Specification of Brinell Hardness Tester

5.1.1 Test Force: 306.5N(31.25Kg), 612.9N(62.5Kg), 1839N (187.5KG)
5.1.2 Ball Indenter: ф2.5 mm, ф5 mm
5.1.3 The Brinell Hardness Testing Range: 8HBW~650HBW

5.2 The Tolerance and Repetition of Displayed Value for Brinell Hardness Tester

Table 5

Hardness Range (HBW)	Tolerance of Displayed Value (%)	Repetition of Displayed Value (%)
≤125	±3	3
125≤HBW≤125	±2.5	2.5
≤225	±2	2

5.3 The test force should make the indentation diameter within the range of 0.25D < D < 0.6d: when d = 0.37d, the hardness value obtained is very accurate (d-indentation diameter, d-ball diameter).

5.4 Select 0.102F/D2 according to Table 6

Table 6

Material	Brinell Hardness	0.102F/D2
Steel	——	30
Cast iron	<140	10
	≥140	30
Copper & copper alloys	<35	5
	35~130	10
	>130	30
Light metals & their alloys	35	2.5
	35~80	5,10
		10
F—Test Force (N) D—Ball Diameter (mm)		

5.5 The corresponding relationship among the scale, indenter and test force (Table 7)

5.6 Preparation Before Use(Ref. 4.2.1, 4.2.2)

The minimum thickness of the test piece should be greater than 10 times the depth of the indentation. After the test, there shall be no visible deformation marks on the back of the test piece. (Table 8)

Table 7

Hardness Scale	Indenter D (mm)	Test Force F	$0.102F/D^2$
HBW 10/100	10	980.7N (100kg)	1
HBW 5/62.5	5	612.9N (62.5kg)	2.5
HBW 2.5/187.5	2.5	1839N (187.5kg)	30
HBW 2.5/62.5	2.5	612.9N (62.5kg)	10
HBW 2.5/31.25	2.5	306.5N (31.25kg)	5
HBW 1/30	1	294.2N (30kg)	30

Table 8

Indentation Average Dimameter (d)	Tested-piece Minimum Thickness			
	Ball Diameter(D)			
	D=1	D=2.5	D=5	D=10
0.4	0.33			
0.5	0.54			
0.6	0.8	0.29		
0.7		0.4		
0.8		0.53		
0.9		0.67		
1		0.83		
1.1		1.02		
1.2		1.23	0.58	
1.3		1.46	0.69	
1.4		1.72	0.8	
1.5		2	0.92	
1.6			1.05	
1.7			1.19	
1.8			1.34	
1.9			1.5	
2			1.67	
2.2			2.04	
2.4			2.46	1.17
2.6			2.92	1.38
2.8			3.43	1.6
3			4	1.84
3.2				2.1
3.4				2.38
3.6				2.68
3.8				3
4				3.34
4.2				3.7
4.4				4.08
4.6				4.48
4.8				4.91
5				5.36
5.2				5.83
5.4				6.33
5.6				6.86
5.8				7.42
6				8

5.7 Proper Use

5.7.1 Refer to 4.3.3-4.3.6 in Chapter 4 of Rockwell hardness (holding time of Brinell hardness test force; 10-15 seconds for ferrous metal, 30-35 seconds for non-ferrous metal, and 60 seconds for Brinell hardness value less than 35).

5.7.2 Alignment

Adjust the sliding test bench so that the indentation on the test piece is directly below the objective lens of the measuring microscope for observation and measurement. For a small number of tests, you can move the test piece and take

In the microscope field of view. During batch test, in order to save the time of indentation search, the stop screws at both ends of the sliding test bench can be used for adjustment so as to make the pressure.

The mark is directly in the visible position of the microscope field of view.

5.7.3 Focus

First, rotate the eyepiece on the micrometer eyepiece to the internal scribe line to achieve the clearest.

By rotating the lifting hand wheel, the up and down movement of the test piece driven by the lifting lead screw is adjusted to the most clear test surface or indentation of the test piece observed from the microscope.

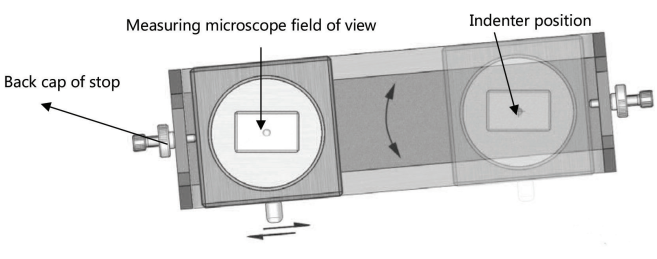

Fig 8 Sliding Test Bench Adjustment

5.7.4 Illumination Adjustment
The most suitable lighting effect is obtained by rotating or moving up and down the lamp barrel. Tighten the three knurled screws after adjustment. The brightness and color of the lighting light can be adjusted by two buttons on the side of the lighting barrel to achieve the most appropriate lighting effect.
5.7.5 Measurement and Reading of Indentation Size
Loosen the knurled screw on the eyepiece so that the eyepiece can rotate without falling. Rotate the micrometer eyepiece so that its measuring direction is consistent with the diameter or diagonal direction of the indentation.Align the edge (Brinell) or vertex (Vickers) of one side of the indentation with the zero line of the microscope. Rotate the percentile cylinder to move the index line to the other edge or vertex.
Read out the large number (mm) of the indentation size from the internal scribe and the decimal number (0.01mm for each small cell) from the scale of the cylinder. The sum of the two is the measurement size of the indentation.
Dividing the measured size of the indentation by the magnification of the objective lens used is the actual size of the indentation (indentation diameter or indentation diagonal length).
For example: when using 4x objective, it should be divided by 4; when using 10x objective, it should be divided by 10 Calculated hardness value: 300.9hv

6. VICKERS HARDNESS

6.1 Technical Specifications of Vickers Hardness

6.1.1 Test forces: 294.2N(30 Kg), 980.7N(100Kg)
6.1.2 Indenter: Vickers Diamond Indenter
6.1.3 Testing Range of Vickers Hardness: 40HV ~ 1000HV
6.1.4 The Tolerance and Repetition of Displayed Value for Vickers Hardness Teste **(Table 9)**
6.1.5 By means of 10X Objective for Vickers hardness testing, the amplification of measuring microscope is 150X.

6.2 Do all preparation work before do testing.

6.2.1 The surface of the specimen should be smooth and clean without any feculence, therefore to guarantee the length of diagonal of indentation could be measured accurately. The degree of surface finish should not less than 0.8
6.2.2 Put the specimen stably on the testing table, its touching surface should be clean. It is prohibited to move the specimen during measurement, and the test force should be loaded on the specimen keep vertically.
6.2.3 The Min. thickness of specimen or testing layer should not less than 1.5 times diagonal length of the indentation. After testing, the back of specimen should not have any visible signs of deformation.

6.3 Test Vickers Hardness

6.3.1 Refer to 5.7 of Brinell hardness for the operation sequence of Vickers hardness tester. It is mainly different from: For ferrous metals, the holding time of test force is 10-15 seconds, and for non-ferrous metals is 30 ± 2 seconds;
6.3.2 The measurement of the two diagonals of the indentation is carried out in two directions perpendicular to each other.
6.3.3 The ratio of the difference between the average value of hardness test and the hardness value of standard block to the hardness value of standard block is the indication error of hardness tester; the ratio of the maximum difference between hardness values and the average value is the indication repeatability of hardness tester. Indication error and repeatability shall be in accordance with **(Fig 9)**

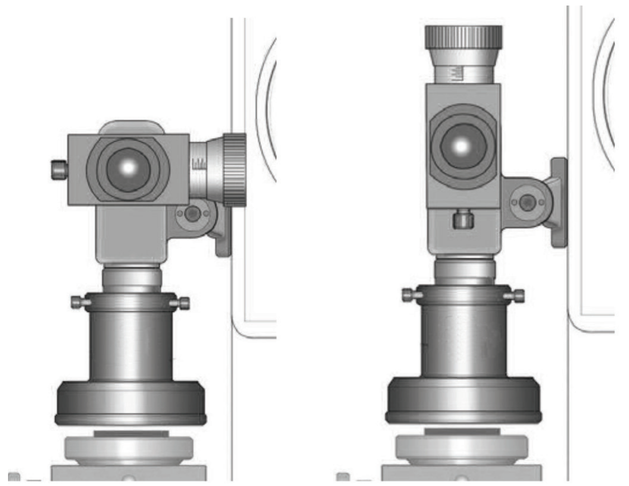

Fig9 Measurement in Two Vertical Directions

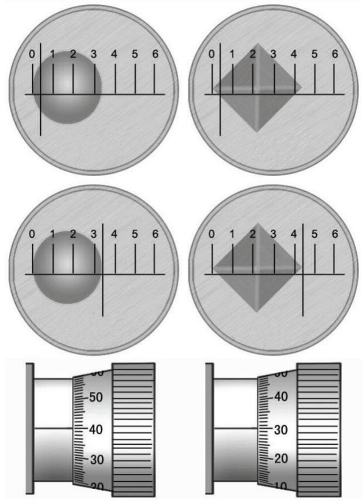

Fig10 measurement and calculation

At Fig 10
Brinell Hardness Test:
4X obejective lens, indenter Φ2.5, test force 187.5kg.
Indication 3.40mm
Indentation Diameter d=3.40/4=0.85=850μ m,
Hardness Value: 320.6HB

Vickers Hardness Tester:
10X objective lens, test force 30kg
Indication 4.30mm
Indentation Diameter d=4.30/10=0.43mm=430μ m,
Hardness Value:300.9HV

Table 9

Hardness Sign	Value of Hardness Block	Tolerance of Displayed Value	Value of Hardness Block	Repetition of Displayed Value
HV30 HV100	≤250HV	±3%	≤225HV	6%
	HV100	±2%	>225HV	4%

7. MAINTENANCE AND PRECAUTIONS

- The operator should observe the operation regulations and calibrate the instrument with the standard hardness block before and after the test. If the hardness tester is rarely used, the several tests should be carried out on the standard hardness block to make the hardness tester stable after start the instrument, and then carry out the necessary tests for specimen.
- The standard hardness block should be used only on the working plane with the distance of the two neighboring indentations and of the center of the indentations to their edges are not inferior to 3 mm. The life period of the standard hardness blocks is 2 years.
- During the transportation of the hardness tester, the hardness tester should be fixed with the Connecting Rod, with the weights and the Handing Rod discharged. Disconnect the power source before the weights and the Hanging Rod are taken out.
- Keep the hardness tester clean and cover it with anti-dust bag after the hardness tester is used, lubricate the hardness blocks and ball indenters with the rust protecting oil to avoid rust.
- Carry out periodic inspection of the hardness tester, at least once a year in order to assure the correct operation of the hardness tester.

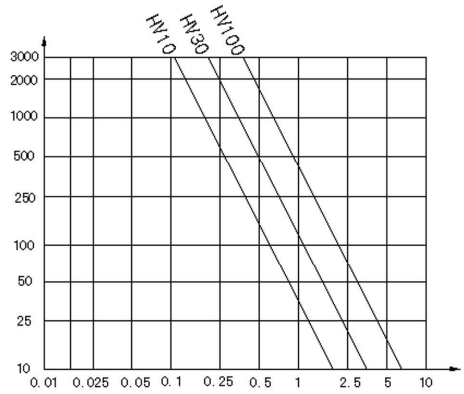

Fig 8

- The Treatment of the Common Malfunctions of the hardness tester
- When the hardness tester is in trouble state, it is advisable to get in touch with the relative units for the repair. The normal and common malfunctions should be dealt with by user's self. **(Table 10)**

Table 10

Phenomenon	Possible Causes	Method Used
When the tester is on ,the nixie tube is not light up	1 The power is blocked. 2 The fuse is broken.	1 Check the power cable. 2 Change the fuse.
The long pointer is offset, not point to "C" position	After regulate the display value of hardness, it causes the long pointer offsets.	Refer to figure 5, loosen the nut slightly, turn the M4 screw (26) slightly, align the dial with the "C" position, fix the screw and tighten the nut.
The Up and Down Moving Shaft road is blocked	The space between the screws is too small or they are blocked by the thread ends at dirt.	Remove the head and lifting screw protection cover, wipe the thread with a clean cloth, and then hold the wheel with both hands to pull the lifting screw up and down (sand paper friction screw is forbidden).
The deviation of the display hardness value is too large.	1 The indenter is damaged. 2 Weight installation sequence is reversed. 3 The instrument is not placed horizontally, and the weight rubs against the inner wall of the body. 4. The total test force or the indenter is wrongly chosen.	1 Change the diamond indenter or the ball indenter. 2 Install the weights according to Fig.3 3 Calibrate the hardness tester with a gradienter according to 3.8 in Chapter 3. 4 Select the tester force and the indenter according to the requirements
The indenter and the anvil are not well aligned	1. The table or positioning handle of the anvil is severely worn. 2. Displacement of lifting mechanism in use.	1. Change anvil. 2. Readjustment.

8 STORAGE/TRANSPORTATION ATTENTION

Storage should be far away from the vibration, corrosion, moisture, dust, also should be stored at a normal temperature and humidity. Please put in the original packing box before transportation to avoid any damage.

IX. APPENDIX: CONVERSION TABLES

TABLE 1 - Brinell's method metal value

$$HB = \frac{2*0.0102*F}{\pi D(D-\sqrt{D^2-d^2})}$$

Diameter steel sphere D (mm)		0.102 F/S2					Diameter steel sphere D (mm)		0.102 F/S2				
		30	10	5	2.5	1.25			30	10	5	2.5	1.25
		Test Force F,N (kgf)							Test Force F,N (kgf)				
5	2.5	1839 (187.5)	612.9 (62.5)	306.5 (31.25)	612.9 (62.5)	306.5 (31.25)	5	2.5	1839 (187.5)	612.9 (62.5)	306.5 (31.25)	612.9 (62.5)	306.5 (31.25)
Diameter impression d (mm)		Brinell hardness HBS (W)					Diameter impression d (mm)		Brinell hardness HBS (W)				
		D=2.5	D=2.5	D=2.5	D=5	D=5			D=2.5	D=2.5	D=2.5	D=5	D=5
1.445	0.7225	448	-	-	-	-	1.605	0.8025	361	120	60.1	30.1	15
1.450	0.7250	444	-	-	-	-	1.610	0.8050	359	120	59.8	29.9	14.9
1.455	0.7275	441	-	-	-	-	1.615	0.8075	356	119	59.4	29.7	14.8
1.460	0.7300	438	-	-	-	-	1.620	0.8100	354	118	59.0	29.5	14.8
1.465	0.7325	435	-	-	-	-	1.625	0.8125	352	117	58.6	29.3	14.7
1.470	0.7350	432	-	-	-	-	1.630	0.8150	350	117	58.3	29.1	14.6
1.475	0.7375	429	-	-	-	-	1.635	0.8175	347	116	57.9	29.0	14.5
1.480	0.7400	426	-	-	-	-	1.640	0.8200	345	115	57.5	28.8	14.4
1.485	0.7425	423	-	-	-	-	1.645	0.8225	343	114	57.2	28.6	14.3
1.490	0.7450	420	140	70.1	35.0	17.5	1.650	0.8250	341	114	56.8	28.4	14.2
1.495	0.7475	417	139	69.6	34.8	17.4	1.655	0.8275	339	113	56.5	28.2	14.1
1.500	0.7500	415	138	69.1	34.6	17.3	1.660	0.8300	337	112	56.1	28.1	14
1.505	0.7525	412	137	68.6	34.3	17.2	1.665	0.8325	335	112	55.8	27.9	13.9
1.510	0.7550	409	136	68.2	34.1	17.0	1.670	0.8350	333	111	55.4	27.7	13.9
1.515	0.7575	406	135	67.7	33.9	16.9	1.675	0.8375	331	110	55.1	27.5	13.8
1.520	0.7600	404	135	67.3	33.6	16.8	1.680	0.8400	329	110	54.8	27.4	13.7
1.525	0.7625	401	134	66.8	33.4	16.7	1.685	0.8425	326	109	54.4	27.2	13.6
1.530	0.7650	398	133	66.4	33.2	16.6	1.690	0.8450	325	108	54.1	27.0	13.5
1.535	0.7675	395	132	65.9	33.0	16.5	1.695	0.8475	323	108	53.8	26.9	13.4
1.540	0.7700	393	131	65.5	32.7	16.4	1.700	0.8500	321	107	53.4	26.7	13.4
1.545	0.7725	390	130	65.0	32.5	16.3	1.705	0.8525	319	106	53.1	26.6	13.3
1.550	0.7750	388	129	64.6	32.3	16.2	1.710	0.8550	317	106	52.8	26.4	13.2
1.555	0.7775	385	128	64.2	32.1	16.0	1.715	0.8575	315	105	52.5	26.2	13.1
1.560	0.7800	383	128	63.8	31.9	15.9	1.720	0.8600	313	104	52.2	26.1	13.0
1.565	0.7825	380	127	63.3	31.7	15.8	1.725	0.8625	311	104	51.9	25.9	13.0
1.570	0.7850	378	126	62.9	31.5	15.7	1.730	0.8650	309	103	51.6	25.8	12.9
1.575	0.7875	375	125	62.5	31.3	15.6	1.735	0.8675	308	102	51.3	25.6	12.8
1.580	0.7900	373	124	62.1	31.1	15.5	1.740	0.8700	306	102	50.9	25.5	12.7
1.585	0.7925	370	123	61.7	30.9	15.4	1.745	0.8725	304	101	50.6	25.3	12.7
1.590	0.7950	368	123	61.3	30.7	15.3	1.750	0.8750	302	101	50.3	25.2	12.6
1.595	0.7975	366	122	60.9	30.5	15.2	1.755	0.8775	300	100	50.1	25.0	12.5

Diameter steel sphere D (mm)		0.102 F/S2					Diameter steel sphere D (mm)		0.102 F/S2				
		30	10	5	2.5	1.25			30	10	5	2.5	1.25
		Test Force F,N (kgf)							Test Force F,N (kgf)				
5	2.5	1839	612.9	306.5	612.9	306.5	5	2.5	1839	612.9	306.5	612.9	306.5
		(187.5)	(62.5)	(31.25)	(62.5)	(31.25)			(187.5)	(62.5)	(31.25)	(62.5)	(31.25)
Diameter impression d (mm)		Brinell hardness HBS (W)					Diameter impression d (mm)		Brinell hardness HBS (W)				
		D=2.5	D=2.5	D=2.5	D=5	D=5			D=2.5	D=2.5	D=2.5	D=5	D=5
1.600	0.8000	363	121	60.5	30.3	15.1	1.760	0.8800	299	99.5	49.8	24.9	12.4
1.765	0.8825	297	98.9	49.5	24.7	12.4	1.955	0.9775	240	80.0	40.0	20.0	10.0
1.770	0.8850	295	98.3	49.2	24.6	12.3	1.960	0.9800	239	79.6	39.8	19.9	9.95
1.775	0.8875	293	97.8	48.9	24.4	12.2	1.965	0.9825	237	79	39.6	19.8	9.89
1.780	0.8900	292	97.2	48.6	24.3	12.2	1.970	0.9850	236	79	39.4	19.7	9.84
1.785	0.8925	290	96.6	48.3	24.2	12.1	1.975	0.9875	235	78	39.2	19.6	9.79
1.790	0.8950	288	96.1	48.0	24.0	12.0	1.980	0.9900	234	78	39.0	19.5	9.74
1.795	0.8975	287	95.5	47.8	23.9	11.9	1.985	0.9925	232	77	38.7	19.4	9.69
1.800	0.9000	285	95.0	47.5	23.7	11.9	1.990	0.9950	231	77	38.5	19.3	9.64
1.805	0.9025	283	94.4	47.2	23.6	11.8	1.995	0.9975	230	77	38.3	19.2	9.59
1.810	0.9050	282	93.9	47.0	23.5	11.7	2.000	10.000	229	76	38.1	19.1	9.54
1.815	0.9075	280	93.4	46.7	23.3	11.7	2.005	10.025	228	76	37.9	19.0	9.49
1.820	0.9100	279	92.8	46.4	23.2	11.6	2.010	10.050	226	75	37.7	18.9	9.44
1.825	0.9125	277	92.3	46.2	23.1	11.5	2.015	10.075	225	75	37.6	18.8	9.39
1.830	0.9150	275	91.8	45.9	22.9	11.5	2.020	10.100	224	74.7	37.4	18.7	9.34
1.835	0.9175	274	91.3	45.6	22.8	11.4	2.025	10.125	223	74.3	37.2	18.6	9.29
1.840	0.9200	272	90.7	45.4	22.7	11.3	2.030	10.150	222	73.9	37.0	18.5	9.24
1.845	0.9225	271	90.2	45.1	22.6	11.3	2.035	10.175	221	73.6	36.8	18.4	9.20
1.850	0.9250	269	89.7	44.9	22.4	11.2	2.040	10.200	220	73.2	36.6	18.3	9.15
1.855	0.9275	268	89.2	44.6	22.3	11.2	2.045	10.225	218	72.8	36.4	18.2	9.10
1.860	0.9300	266	88.7	44.4	22.2	11.1	2.050	10.250	217	72.4	36.2	18.1	9.06
1.865	0.9325	265	88.2	44.1	22.1	11.0	2.055	10.275	216	72.1	36.0	18.0	9.01
1.870	0.9350	263	87.7	43.9	21.9	11.0	2.060	10.300	215	71.7	35.9	17.9	8.96
1.875	0.9375	262	87.3	43.6	21.8	10.9	2.065	10.325	214	71.3	35.7	17.8	8.92
1.880	0.9400	260	86.8	43.4	21.7	10.8	2.070	10.350	213	71.0	35.5	17.7	8.87
1.885	0.9425	259	86.3	43.2	21.6	10.8	2.075	10.375	212	70.6	35.3	17.7	8.83
1.890	0.9450	258	85.8	42.9	21.5	10.7	2.080	10.400	211	70.3	35.1	17.6	8.78
1.895	0.9475	256	85.4	42.7	21.3	10.7	2.085	10.425	210	69.9	35.0	17.5	8.74
1.900	0.9500	255	84.9	42.5	21.2	10.6	2.090	10.450	209	69.6	34.8	17.4	8.70
1.905	0.9525	253	84.4	42.2	21.1	10.6	2.095	10.475	208	69.2	34.6	17.3	8.65
1.910	0.9550	252	84.0	42.0	21.0	10.5	2.100	10.500	207	68.9	34.4	17.2	8.61
1.915	0.9575	251	83.5	41.8	20.9	10.4	2.105	10.525	206	68.5	34.3	17.1	8.57
1.920	0.9600	249	83.1	41.5	20.8	10.4	2.110	10.550	205	68.2	34.1	17.0	8.52
1.925	0.9625	248	82.6	41.3	20.7	10.3	2.115	10.575	204	67.8	33.9	17.0	8.48
1.930	0.9650	247	82.2	41.1	20.5	10.3	2.120	10.600	203	67.5	33.8	16.9	8.44
1.935	0.9675	245	81.7	40.9	20.4	10.2	2.125	10.625	202	67.2	33.6	16.8	8.40
1.940	0.9700	244	81.3	40.6	20.3	10.2	2.130	10.650	201	66.8	33.4	16.7	8.36
1.945	0.9725	243	80.8	40.4	20.2	10.1	2.135	10.675	200	66.5	33.3	16.6	8.31
1.950	0.9750	241	80.4	40.2	20.1	10.1	2.140	10.700	199	66.2	33.1	16.5	8.27
2.145	10.725	198	65.9	32.9	16.5	8.23	2.335	11.675	165	55.0	27.5	13.8	6.88

EN

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DE

ES

RU

PL

Diameter steel sphere D (mm)		0.102 F/S2					Diameter steel sphere D (mm)		0.102 F/S2				
		30	10	5	2.5	1.25			30	10	5	2.5	1.25
		Test Force F,N (kgf)							Test Force F,N (kgf)				
5	2.5	1839 (187.5)	612.9 (62.5)	306.5 (31.25)	612.9 (62.5)	306.5 (31.25)	5	2.5	1839 (187.5)	612.9 (62.5)	306.5 (31.25)	612.9 (62.5)	306.5 (31.25)
Diameter impression d (mm)		Brinell hardness HBS (W)					Diameter impression d (mm)		Brinell hardness HBS (W)				
		D=2.5	D=2.5	D=2.5	D=5	D=5			D=2.5	D=2.5	D=2.5	D=5	D=5
2.150	10.750	197	65.5	32.8	16.4	8.19	2.340	11.700	164	54.8	27.4	13.7	6.85
2.155	10.775	196	65.2	32.6	16.3	8.15	2.345	11.725	164	54.5	27.3	13.6	6.82
2.160	10.800	195	64.9	32.5	16.2	8.11	2.350	11.750	163	54.3	27.1	13.6	6.78
2.165	10.825	194	64.6	32.3	16.1	8.07	2.355	11.775	162	54.0	27.0	13.5	6.75
2.170	10.850	193	64.3	32.1	16.1	8.03	2.360	11.800	161	53.8	26.9	13.4	6.72
2.175	10.875	192	64.0	32.0	16.0	8.00	2.365	11.825	161	53.5	26.8	13.4	6.69
2.180	10.900	191	63.6	31.8	15.9	7.96	2.370	11.850	160	53.3	26.7	13.3	6.66
2.185	10.925	190	63.3	31.7	15.8	7.92	2.375	11.875	159	53.1	26.5	13.3	6.63
2.190	10.950	189	63.0	31.5	15.8	7.88	2.380	11.900	158	52.8	26.4	13.2	6.60
2.195	10.975	188	62.7	31.4	15.7	7.84	2.385	11.925	158	52.6	26.3	13.1	6.57
2.200	11.000	187	62.4	31.2	15.6	7.80	2.390	11.950	157	52.3	26.2	13.1	6.54
2.205	11.025	186	62.1	31.1	15.5	7.77	2.395	11.975	156	52.1	26.1	13.0	6.52
2.210	11.050	186	61.8	30.9	15.5	7.73	2.400	12.000	156	51.9	25.9	13.0	6.49
2.215	11.075	185	61.5	30.8	15.4	7.69	2.405	12.025	155	51.7	25.8	12.9	6.46
2.220	11.100	184	61.2	30.6	15.3	7.66	2.410	12.050	154	51.4	25.7	12.9	6.43
2.225	11.125	183	61	30.5	15.2	7.62	2.415	12.075	154	51.2	25.6	12.8	6.40
2.230	11.150	182	61	30.3	15.2	7.58	2.420	12.100	153	51.0	25.5	12.7	6.37
2.235	11.175	181	60	30.2	15.1	7.55	2.425	12.125	152	50.7	25.4	12.7	6.34
2.240	11.200	180	60	30.1	15.0	7.51	2.430	12.150	152	50.5	25.3	12.6	6.32
2.245	11.225	179	60	29.9	15.0	7.48	2.435	12.175	151	50.3	25.2	12.6	6.29
2.250	11.250	179	60	29.8	14.9	7.44	2.440	12.200	150	50.1	25.0	12.5	6.26
2.255	11.275	178	59	29.6	14.8	7.41	2.445	12.225	150	49.9	24.9	12.5	6.23
2.260	11.300	177	59	29.5	14.7	7.37	2.450	12.250	149	49.6	24.8	12.4	6.21
2.265	11.325	176	59	29.4	14.7	7.34	2.455	12.275	148	49.4	24.7	12.4	6.18
2.270	11.350	175	58	29.2	14.6	7.30	2.460	12.300	148	49.2	24.6	12.3	6.15
2.275	11.375	174	58	29.1	14.5	7.27	2.465	12.325	147	49.0	24.5	12.2	6.13
2.280	11.400	174	57.9	28.9	14.5	7.24	2.470	12.350	146	48.8	24.4	12.2	6.10
2.285	11.425	173	57.6	28.8	14.4	7.20	2.475	12.375	146	48.6	24.3	12.1	6.07
2.290	11.450	172	57.3	28.7	14.3	7.17	2.480	12.400	145	48.4	24.2	12.1	6.05
2.295	11.475	171	57.1	28.5	14.3	7.14	2.485	12.425	144	48.1	24.1	12.0	6.02
2.300	11.500	170	56.8	28.4	14.2	7.10	2.490	12.450	144	47.9	24.0	12.0	5.99
2.305	11.525	170	56.6	28.3	14.1	7.07	2.495	12.475	143	47.7	23.9	11.9	5.97
2.310	11.550	169	56.3	28.2	14.1	7.04	2.500	12.500	143	47.5	23.8	11.9	5.94
2.315	11.575	168	56.0	28.0	14.0	7.01	2.505	12.525	142	47.3	23.7	11.8	5.92
2.320	11.600	167	55.8	27.9	13.9	6.97	2.510	12.550	141	47.1	23.6	11.8	5.89
2.325	11.625	167	55.5	27.8	13.9	6.94	2.515	12.575	141	46.9	23.5	11.7	5.87
2.330	11.650	166	55.3	27.6	13.8	6.91	2.520	12.600	140	46.7	23.4	11.7	5.84
2.525	12.625	140	46.5	23.3	11.6	5.82	2.715	13.575	119	39.7	19.9	9.93	4.97
2.530	12.650	139	46.3	23.2	11.6	5.79	2.720	13.600	119	39.6	19.8	9.89	4.95
2.535	12.675	138	46.1	23.1	11.5	5.77	2.725	13.625	118	39.4	19.7	9.85	4.93

Diameter steel sphere D (mm)		0.102 F/S2					Diameter steel sphere D (mm)		0.102 F/S2				
		30	10	5	2.5	1.25			30	10	5	2.5	1.25
		Test Force F,N (kgf)							Test Force F,N (kgf)				
5	2.5	1839 (187.5)	612.9 (62.5)	306.5 (31.25)	612.9 (62.5)	306.5 (31.25)	5	2.5	1839 (187.5)	612.9 (62.5)	306.5 (31.25)	612.9 (62.5)	306.5 (31.25)
Diameter impression d (mm)		Brinell hardness HBS (W)					Diameter impression d (mm)		Brinell hardness HBS (W)				
		D=2.5	D=2.5	D=2.5	D=5	D=5			D=2.5	D=2.5	D=2.5	D=5	D=5
2.540	12.700	138	45.9	23.0	11.5	5.74	2.730	13.650	118	39.3	19.6	9.81	4.91
2.545	12.725	137	45.7	22.9	11.4	5.72	2.735	13.675	117	39.1	19.6	9.77	4.89
2.550	12.750	137	45.5	22.8	11.4	5.69	2.740	13.700	117	38.9	19.5	9.74	4.87
2.555	12.775	136	45.3	22.7	11.3	5.67	2.745	13.725	116	38.8	19.4	9.70	4.85
2.560	12.800	135	45.2	22.6	11.3	5.65	2.750	13.750	116	38.6	19.3	9.66	4.83
2.565	12.825	135	45.0	22.5	11.2	5.62	2.755	13.775	115	38.5	19.2	9.62	4.81
2.570	12.850	134	44.8	22.4	11.2	5.60	2.760	13.800	115	38.3	19.2	9.58	4.79
2.575	12.875	134	44.6	22.3	11.1	5.57	2.765	13.825	115	38.2	19.1	9.54	4.77
2.580	12.900	133	44.4	22.2	11.1	5.55	2.770	13.850	114	38.0	19.0	9.51	4.75
2.585	12.925	133	44.2	22.1	11.1	5.53	2.775	13.875	114	37.9	18.9	9.47	4.73
2.590	12.950	132	44.0	22.0	11.0	5.50	2.780	13.900	113	37.7	18.9	9.43	4.72
2.595	12.975	132	43.8	21.9	11.0	5.48	2.785	13.925	113	37.6	18.8	9.39	4.70
2.600	13.000	131	43.7	21.8	10.9	5.46	2.790	13.950	112	37.4	18.7	9.36	4.68
2.605	13.025	130	43.5	21.7	10.9	5.44	2.795	13.975	112	37.3	18.6	9.32	4.66
2.610	13.050	130	43.3	21.7	10.8	5.41	2.800	14.000	111	37.1	18.6	9.28	4.64
2.615	13.075	129	43.1	21.6	10.8	5.39	2.805	14.025	111	37.0	18.5	9.25	4.62
2.620	13.100	129	42.9	21.5	10.7	5.37	2.810	14.050	111	36.8	18.4	9.21	4.61
2.625	13.125	128	42.8	21.4	10.7	5.35	2.815	14.075	110	36.7	18.3	9.17	4.59
2.630	13.150	128	42.6	21.3	10.6	5.32	2.820	14.100	110	36.5	18.3	9.14	4.57
2.635	13.175	127	42.4	21.2	10.6	5.30	2.825	14.125	109	36.4	18.2	9.10	4.55
2.640	13.200	127	42.2	21.1	10.6	5.28	2.830	14.150	109	36.3	18.1	9.07	4.53
2.645	13.225	126	42.1	21.0	10.5	5.26	2.835	14.175	108	36.1	18.1	9.03	4.52
2.650	13.250	126	41.9	20.9	10.5	5.24	2.840	14.200	108	36.0	18.0	9.00	4.50
2.655	13.275	125	41.7	20.9	10.4	5.22	2.845	14.225	108	35.8	17.9	8.96	4.48
2.660	13.300	125	41.6	20.8	10.4	5.19	2.850	14.250	107	35.7	17.9	8.93	4.46
2.665	13.325	124	41.4	20.7	10.3	5.17	2.855	14.275	107	35.6	17.8	8.89	4.45
2.670	13.350	124	41.2	20.6	10.3	5.15	2.860	14.300	106	35.4	17.7	8.86	4.43
2.675	13.375	123	41.0	20.5	10.3	5.13	2.865	14.325	106	35.3	17.6	8.82	4.41
2.680	13.400	123	40.9	20.4	10.2	5.11	2.870	14.350	105	35.2	17.6	8.79	4.39
2.685	13.425	122	40.7	20.4	10.2	5.09	2.875	14.375	105	35.0	17.5	8.75	4.38
2.690	13.450	122	40.5	20.3	10.1	5.07	2.880	14.400	105	34.9	17.4	8.72	4.36
2.695	13.475	121	40.4	20.2	10.1	5.05	2.885	14.425	104	34.7	17.4	8.69	4.34
2.700	13.500	121	40.2	20.1	10.1	5.03	2.890	14.450	104	34.6	17.3	8.65	4.33
2.705	13.525	120	40.1	20.0	10.0	5.01	2.895	14.475	103	34.5	17.2	8.62	4.31
2.710	13.550	120	39.9	19.9	10.0	4.99	2.900	14.500	103	34.3	17.2	8.59	4.29
2.905	14.525	103	34.2	17.1	8.55	4.28	2.955	14.775	99.5	32.9	16.5	8.23	4.12
2.910	14.550	102	34.1	17.0	8.52	4.26	2.960	14.800	98.5	32.8	16.4	8.20	4.10
2.915	14.575	102	34.0	17.0	8.49	4.25	2.965	14.825	98.1	32.7	16.3	8.17	4.09
2.920	14.600	101	33.8	16.9	8.46	4.23	2.970	14.850	97.7	32.6	16.3	8.14	4.07
2.925	14.625	101	33.7	16.9	8.42	4.21	2.975	14.875	97.3	32.4	16.2	8.11	4.06

Diameter steel sphere D (mm)		0.102 F/S2					Diameter steel sphere D (mm)		0.102 F/S2				
		30	10	5	2.5	1.25			30	10	5	2.5	1.25
		Test Force F,N (kgf)							Test Force F,N (kgf)				
5	2.5	1839 (187.5)	612.9 (62.5)	306.5 (31.25)	612.9 (62.5)	306.5 (31.25)	5	2.5	1839 (187.5)	612.9 (62.5)	306.5 (31.25)	612.9 (62.5)	306.5 (31.25)
Diameter impression d (mm)		Brinell hardness HBS (W)					Diameter impression d (mm)		Brinell hardness HBS (W)				
		D=2.5	D=2.5	D=2.5	D=5	D=5			D=2.5	D=2.5	D=2.5	D=5	D=5
2.930	14.650	101	33.6	16.8	8.39	4.20	2.980	14.900	97.0	32.3	16.2	8.08	4.04
2.935	14.675	100	33.4	16.7	8.36	4.18	2.985	14.925	96.6	32.2	16.1	8.05	4.03
2.940	14.700	100	33.3	16.7	8.33	4.17	2.990	14.950	96.3	32.1	16.0	8.02	4.01
2.945	14.725	100	33.2	16.6	8.30	4.15	2.995	14.975	95.9	32.0	16.0	7.99	4.00
2.950	14.750	99.9	33.1	16.5	8.27	4.13	3.000	15.000	95.5	31.8	15.9	7.96	3.98

TABLE 2 - Vicker’s method metal value

$$HV = \frac{0.102*1.854*F}{d^2}$$

Diagonal impression d (mm)	Test Force F N (kgf)		Diagonal impression d (mm)	Test Force F N (kgf)		Diagonal impression d (mm)	Test Force F N (kgf)	
	294.2 (30)	980.7 (100)		294.2 (30)	980.7 (100)		294.2 (30)	980.7 (100)
	Vickers Hardness HV			Vickers Hardness HV			Vickers Hardness HV	
	HV30	HV100		HV30	HV100		HV30	HV100
0.230	1052	-	0.306	594	-	0.382	381	-
0.232	1034	-	0.308	586	-	0.384	377	-
0.234	1016	-	0.310	579	-	0.386	373	-
0.236	999	-	0.312	572	-	0.388	370	-
0.238	982	-	0.314	564	-	0.390	366	-
0.240	966	-	0.316	557	-	0.392	362	-
0.242	950	-	0.318	550	-	0.394	358	-
0.244	934	-	0.320	543	-	0.396	355	-
0.246	919	-	0.322	537	-	0.398	351	-
0.248	905	-	0.324	530	-	0.400	348	-
0.250	890	-	0.326	524	-	0.402	344	-
0.252	876	-	0.328	517	-	0.404	341	-
0.254	862	-	0.330	511	-	0.406	338	-
0.256	849	-	0.332	505	-	0.408	334	-
0.258	836	-	0.334	499	-	0.410	331	-
0.260	823	-	0.336	493	-	0.412	328	-
0.262	810	-	0.338	487	-	0.414	325	-
0.264	798	-	0.340	481	-	0.416	321	-
0.266	786	-	0.342	476	-	0.418	318	-
0.268	775	-	0.344	470	-	0.420	315	-
0.270	763	-	0.346	465	-	0.422	312	-

Diagonal impression d (mm)	Test Force F N (kgf) 294.2 (30)	Test Force F N (kgf) 980.7 (100)	Diagonal impressione d (mm)	Test Force F N (kgf) 294.2 (30)	Test Force F N (kgf) 980.7 (100)	Diagonal impression d (mm)	Test Force F N (kgf) 294.2 (30)	Test Force F N (kgf) 980.7 (100)
	Vickers Hardness HV			Vickers Hardness HV			Vickers Hardness HV	
	HV30	HV100		HV30	HV100		HV30	HV100
0.272	752	-	0.348	459	-	0.424	309	-
0.274	741	-	0.350	454	-	0.426	307	-
0.276	730	-	0.352	449	-	0.428	304	-
0.278	720	-	0.354	444	-	0.430	301	1003
0.280	710	-	0.356	439	-	0.432	298	994
0.282	700	-	0.358	434	-	0.434	295	985
0.284	690	-	0.360	429	-	0.436	293	976
0.286	680	-	0.362	425	-	0.438	290	967
0.288	671	-	0.364	420	-	0.440	287	958
0.290	662	-	0.366	415	-	0.442	285	949
0.292	653	-	0.368	411	-	0.444	282	941
0.294	644	-	0.370	406	-	0.446	280	932
0.296	635	-	0.372	402	-	0.448	277	924
0.298	626	-	0.374	398	-	0.450	275	916
0.300	618	-	0.376	394	-	0.452	272	908
0.302	610	-	0.378	389	-	0.454	270	900
0.304	602	-	0.380	385	-	0.456	268	892
0.458	265	884	0.540	191	636	0.622	144	479
0.460	263	876	0.542	189	631	0.624	143	476
0.462	261	869	0.544	188	627	0.626	142	473
0.464	258	861	0.546	187	622	0.628	141	470
0.466	256	854	0.548	185	618	0.630	140	467
0.468	254	847	0.550	184	613	0.632	139	464
0.470	252	840	0.552	183	609	0.634	138	461
0.472	250	832	0.554	181	604	0.636	138	458
0.474	248	825	0.556	180	600	0.638	137	456
0.476	246	819	0.558	179	596	0.640	136	453
0.478	243	812	0.560	177	591	0.642	135	450
0.480	241	805	0.562	176	587	0.644	134	447
0.482	239	798	0.564	175	583	0.646	133	444
0.484	237	792	0.566	174	579	0.648	132	442
0.486	236	785	0.568	172	575	0.650	132	439
0.488	234	779	0.570	171	571	0.652	131	436
0.490	232	772	0.572	170	567	0.654	130	434
0.492	230	766	0.574	169	563	0.656	129	431
0.494	228	760	0.576	168	559	0.658	128	428
0.496	226	754	0.578	167	555	0.660	128	426
0.498	224	748	0.580	165	551	0.662	127	423
0.500	223	742	0.582	164	548	0.664	126	421
0.502	221	736	0.584	163	544	0.666	125	418
0.504	219	730	0.586	162	540	0.668	125	416
0.506	217	724	0.588	161	536	0.670	124	413
0.508	216	719	0.590	160	533	0.672	123	411

Diagonal impression d (mm)	Test Force F N (kgf)		Diagonal impression d (mm)	Test Force F N (kgf)		Diagonal impression d (mm)	Test Force F N (kgf)	
	294.2 (30)	980.7 (100)		294.2 (30)	980.7 (100)		294.2 (30)	980.7 (100)
	Vickers Hardness HV			Vickers Hardness HV			Vickers Hardness HV	
	HV30	HV100		HV30	HV100		HV30	HV100
0.510	214	713	0.592	159	529	0.674	122	408
0.512	212	707	0.594	158	526	0.676	122	406
0.514	211	702	0.596	157	522	0.678	121	403
0.516	209	697	0.598	156	519	0.680	120	401
0.518	207	691	0.600	155	515	0.682	120	399
0.520	206	686	0.602	154	512	0.684	119	396
0.522	204	681	0.604	153	508	0.686	118	394
0.524	203	675	0.606	151	505	0.688	118	392
0.526	201	670	0.608	151	502	0.690	117	390
0.528	200	665	0.610	150	498	0.692	116	387
0.530	198	660	0.612	149	495	0.694	116	385
0.532	197	655	0.614	148	492	0.696	115	383
0.534	195	650	0.616	147	489	0.698	114	381
0.536	194	646	0.618	146	486	0.700	114	378
0.538	192	641	0.620	145	482	0.702	113	376
0.704	112	374	0.786	90.1	300	0.868	73.8	246
0.706	112	372	0.788	89.6	299	0.870	73.5	245
0.708	111	370	0.790	89.1	297	0.872	73.2	244
0.710	110	368	0.792	88.7	296	0.874	72.8	243
0.712	110	366	0.794	88.2	294	0.876	72.5	242
0.714	109	364	0.796	87.8	293	0.878	72.2	241
0.716	109	362	0.798	87.4	291	0.880	71.8	239
0.718	108	360	0.800	86.9	290	0.882	71.5	238
0.720	107	358	0.802	86.5	288	0.884	71.2	237
0.722	107	356	0.804	86.1	287	0.886	70.9	236
0.724	106	354	0.806	85.6	285	0.888	70.6	235
0.726	106	352	0.808	85.2	284	0.890	70.2	234
0.728	105	350	0.810	84.8	283	0.892	69.9	233
0.730	104	348	0.812	84.4	281	0.894	69.6	232
0.732	104	346	0.814	84.0	280	0.896	69.3	231
0.734	103	344	0.816	83.6	279	0.898	69.0	230
0.736	103	342	0.818	83.1	277	0.900	68.7	229
0.738	102	341	0.820	82.7	276	0.902	68.4	228
0.740	102	339	0.822	82.3	274	0.904	68.1	227
0.742	101	337	0.824	81.9	273	0.906	67.8	226
0.744	101	335	0.826	81.5	272	0.908	67.5	225
0.746	100	333	0.828	81.2	271	0.910	67.2	224
0.748	99.4	331	0.830	80.8	269	0.912	66.9	223
0.750	98.9	330	0.832	80.4	268	0.914	66.6	222
0.752	98.4	328	0.834	80.0	267	0.916	66.3	221
0.754	97.9	326	0.836	79.6	265	0.918	66.0	220
0.756	97.3	324	0.838	79.2	264	0.920	65.7	219
0.758	96.8	323	0.840	78.8	263	0.922	65.4	218

Diagonal impression d (mm)	Test Force F N (kgf) 294.2 (30) Vickers Hardness HV HV30	Test Force F N (kgf) 980.7 (100) Vickers Hardness HV HV100	Diagonal impression d (mm)	Test Force F N (kgf) 294.2 (30) Vickers Hardness HV HV30	Test Force F N (kgf) 980.7 (100) Vickers Hardness HV HV100	Diagonal impression d (mm)	Test Force F N (kgf) 294.2 (30) Vickers Hardness HV HV30	Test Force F N (kgf) 980.7 (100) Vickers Hardness HV HV100
0.760	96.3	321	0.842	78.5	262	0.924	65.2	217
0.762	95.8	319	0.844	78.1	260	0.926	64.9	216
0.764	95.3	318	0.846	77.7	259	0.928	64.6	215
0.766	94.8	316	0.848	77.4	258	0.930	64.3	214
0.768	94.3	314	0.850	77.0	257	0.932	64.1	214
0.770	93.8	313	0.852	76.6	255	0.934	63.8	213
0.772	93.4	311	0.854	76.3	254	0.936	63.5	212
0.774	92.9	310	0.856	75.9	253	0.938	63.2	211
0.776	92.4	308	0.858	75.6	252	0.940	63.0	210
0.778	91.9	306	0.860	75.2	251	0.942	62.7	209
0.780	91.4	305	0.862	74.9	250	0.944	62.4	208
0.782	91.0	303	0.864	74.5	248	0.946	62.2	207
0.784	90.5	302	0.866	74.2	247	0.948	61.9	206
0.950	61.6	205	1.032	52.2	174	1.135	43.2	144
0.952	61.4	205	1.034	52.0	173	1.140	42.8	143
0.954	61.1	204	1.036	51.8	173	1.145	42.4	141
0.956	60.9	203	1.038	51.6	172	1.150	42.1	140
0.958	60.6	202	1.040	51.4	171	1.155	41.7	139
0.960	60.4	201	1.042	51.2	171	1.160	41.3	138
0.962	60.1	200	1.044	51.0	170	1.165	41.0	137
0.964	59.9	200	1.046	50.8	170	1.170	40.6	135
0.966	59.6	199	1.048	50.7	169	1.175	40.3	134
0.968	59.4	198	1.050	50.5	168	1.180	40.0	133
0.970	59.1	197	1.052	50.3	168	1.185	39.6	132
0.972	58.9	196	1.054	50.1	167	1.190	39.3	131
0.974	58.6	195	1.056	49.9	166	1.195	39.0	130
0.976	58.4	195	1.058	49.7	166	1.200	38.6	129
0.978	58.2	194	1.060	49.5	165	1.205	38.3	128
0.980	57.9	193	1.062	49.3	164	1.210	38.0	127
0.982	57.7	192	1.064	49.1	164	1.215	37.7	126
0.984	57.5	192	1.066	49.0	163	1.220	37.4	125
0.986	57.2	191	1.068	48.8	163	1.225	37.1	124
0.988	57.0	190	1.070	48.6	162	1.230	36.8	123
0.990	56.8	189	1.072	48.4	161	1.235	36.5	122
0.992	56.5	188	1.074	48.2	161	1.240	36.2	121
0.994	56.3	188	1.076	48.1	160	1.245	35.9	120
0.996	56.1	187	1.078	47.9	160	1.250	35.6	119
0.998	55.9	186	1.080	47.7	159	1.255	35.3	118
1.000	55.6	185	1.082	47.5	158	1.260	35.0	117
1.002	55.4	185	1.084	47.3	158	1.265	34.8	116
1.004	55.2	184	1.086	47.2	157	1.270	34.5	115
1.006	55.0	183	1.088	47.0	157	1.275	34.2	114
1.008	54.8	183	1.090	46.8	156	1.280	34.0	113

Diagonal impression d (mm)	Test Force F N (kgf) 294.2 (30)	Test Force F N (kgf) 980.7 (100)	Diagonal impression d (mm)	Test Force F N (kgf) 294.2 (30)	Test Force F N (kgf) 980.7 (100)	Diagonal impression d (mm)	Test Force F N (kgf) 294.2 (30)	Test Force F N (kgf) 980.7 (100)
	Vickers Hardness HV			Vickers Hardness HV			Vickers Hardness HV	
	HV30	HV100		HV30	HV100		HV30	HV100
1.010	54.5	182	1.092	46.7	156	1.285	33.7	112
1.012	54.3	181	1.094	46.5	155	1.290	33.4	111
1.014	54.1	180	1.096	46.3	154	1.295	33.2	111
1.016	53.9	180	1.098	46.1	154	1.300	32.9	110
1.018	53.7	179	1.100	46.0	153	1.305	32.7	109
1.020	53.5	178	1.105	45.6	152	1.310	32.4	108
1.022	53.3	178	1.110	45.2	151	1.315	32.2	107
1.024	53.1	177	1.115	44.8	149	1.320	31.9	106
1.026	52.9	176	1.120	44.4	148	1.325	31.7	106
1.028	52.6	175	1.125	44.0	147	1.330	31.5	105
1.030	52.4	175	1.130	43.6	145	1.335	31.2	104
1.340	31.0	103	1.545	23.3	77.7	1.750	18.2	60.6
1.345	30.8	103	1.550	23.2	77.2	1.755	18.1	60.2
1.350	30.5	102	1.555	23.0	76.7	1.760	18.0	59.9
1.355	30.3	101	1.560	22.9	76.2	1.765	17.9	59.5
1.360	30.1	100	1.565	22.7	75.7	1.770	17.8	59.2
1.365	29.9	99.5	1.570	22.6	75.2	1.775	17.7	58.9
1.370	29.6	98.8	1.575	22.4	74.8	1.780	17.6	58.5
1.375	29.4	98.1	1.580	22.3	74.3	1.785	17.5	58.2
1.380	29.2	97.4	1.585	22.1	73.8	1.790	17.4	57.9
1.385	29.0	96.7	1.590	22.0	73.4	1.795	17.3	57.6
1.390	28.8	96.0	1.595	21.9	72.9	1.800	17.2	57.2
1.395	28.6	95.3	1.600	21.7	72.4	1.805	17.1	56.9
1.400	28.4	94.6	1.605	21.6	72.0	1.810	17.0	56.6
1.405	28.2	93.9	1.610	21.5	71.5	1.815	16.9	56.3
1.410	28.0	93.3	1.615	21.3	71.1	1.820	16.8	56.0
1.415	27.8	92.6	1.620	21.2	70.7	1.825	16.7	55.7
1.420	27.6	92.0	1.625	21.1	70.2	1.830	16.6	55.4
1.425	27.4	91.3	1.630	20.9	69.8	1.835	16.5	55.1
1.430	27.2	90.7	1.635	20.8	69.4	1.840	16.4	54.8
1.435	27.0	90.1	1.640	20.7	69.0	1.845	16.3	54.5
1.440	26.8	89.4	1.645	20.6	68.5	1.850	16.3	54.2
1.445	26.6	88.8	1.650	20.4	68.1	1.855	16.2	53.9
1.450	26.5	88.2	1.655	20.3	67.7	1.860	16.1	53.6
1.455	26.3	87.6	1.660	20.2	67.3	1.865	16.0	53.3
1.460	26.1	87.0	1.665	20.1	66.9	1.870	15.9	53.0
1.465	25.9	86.4	1.670	19.9	66.5	1.875	15.8	52.8
1.470	25.7	85.8	1.675	19.8	66.1	1.880	15.7	52.5
1.475	25.6	85.2	1.680	19.7	65.7	1.885	15.7	52.2
1.480	25.4	84.7	1.685	19.6	65.3	1.890	15.6	51.9
1.485	25.2	84.1	1.690	19.5	64.9	1.895	15.5	51.6
1.490	25.1	83.5	1.695	19.4	64.6	1.900	15.4	51.4
1.495	24.9	83.0	1.700	19.3	64.2	1.905	15.3	51.1

Diagonal impression d (mm)	Test Force F N (kgf)		Diagonal impression d (mm)	Test Force F N (kgf)		Diagonal impression d (mm)	Test Force F N (kgf)	
	294.2 (30)	980.7 (100)		294.2 (30)	980.7 (100)		294.2 (30)	980.7 (100)
	Vickers Hardness HV			Vickers Hardness HV			Vickers Hardness HV	
	HV30	HV100		HV30	HV100		HV30	HV100
1.500	24.7	82.4	1.705	19.1	63.8	1.910	15.3	50.8
1.505	24.6	81.9	1.710	19.0	63.4	1.915	15.2	50.6
1.510	24.4	81.3	1.715	18.9	63.1	1.920	15.1	50.3
1.515	24.2	80.8	1.720	18.8	62.7	1.925	15.0	50.0
1.520	24.1	80.3	1.725	18.7	62.3	1.930	14.9	49.8
1.525	23.9	79.7	1.730	18.6	62.0	1.935	14.9	49.5
1.530	23.8	79.2	1.735	18.5	61.6	1.940	14.8	49.3
1.535	23.6	78.7	1.740	18.4	61.3	1.945	14.7	49.0
1.540	23.5	78.2	1.745	18.3	60.9	1.950	14.6	48.8
1.955	14.6	48.5	1.975	14.3	47.5	1.995	14.0	46.6
1.960	14.5	48.3	1.980	14.2	47.3	1.999	13.9	46.4
1.965	14.4	48.0	1.985	14.1	47.1			
1.970	14.3	47.8	1.990	14.0	46.8			

NOTE

NOTE

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