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HDT-PB350
HAMMER IMPACT BRINELL HARDNESS TESTER
OPERATION MANUAL

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Introduction

The HDT-PB350 hammer impact brinell hardness tester is designed following the Brinell hardness test method. The test force is controlled by a shear pin. After reading the diameter of the indention with the reading microscope, the Brinell hardness number can be obtained from the lookup table.

It is capable of testing from small to very large specimens. It is especially suitable for assemblies inconve-nient to be takento the lab and not allowed to be cut. The test can be completed in any dire-ction to test the hardness of upper, lower and lateral part of the specimen.

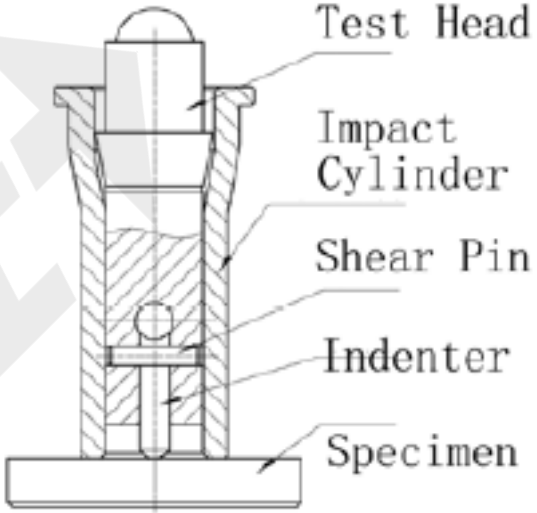
It can perform the testing by touching one side of the work piece. Its accuracy is much higher than any other type hammer impact tester.

According to the similarity principle of Brinell hardness testing, with testing force of 1580kg, indenter diameter of 7.26mm, then $F/D2^2$ =30. The test condition of the tester is equivalent to the standard Brinell hardness test .

The Portable Brinell Hardness Tester can be widely used to test the hardness of forgings, castings, steels, nonferrous metal and its alloy products, and to test the hardness of annealed, normalizing and temperedmechanical parts.

Compared to the rebound type hardness tester, the Brinell tester has many advantages such as higher precision, fewer factors affecting accuracy and lower requirement on the surface roughness. The test result meets the requirements of most drawings without conversion and is more widely accepted in the international business.

Principle and Structure



The principle of the instrument and inside structure of the test head are shown in picture above.

A shear pin is place in the horizontal hole on the test head. The indenter is pushed into the bottom hole and its top touches shear pin. The test head is placed into the impact cylinder.

When the test force is applied on top of the test head, the force is transmitted to the indenter through the shear pin which presses indenter against the specimen. As soon as the test force reaches 1580kg, the shear pin is cut into three segments by the cutting system comprising the test head and the indenter. The excessive force will not be transmitted to the indenter as it withdraws into bottom hole of the test head,and a round indentation will remain on the surface of the specimen. The indentationdiameter ismeasured with a reading microscope, and the Brinell hardness number can be obtained from the lookup table.

Technical Parameters

Measuring range	100~350HBW (with Ø7.26mm indenter, included) 350~650HBW (with Ø4mm indenter, optional)
Test force	1580kg
Accuracy	±5%HBW
Repeatability	±5%HBW
Measuring microscope	20X, graduation 0.01mm
Dimension	200×50×100mm
Weight	0.8kg

Operation

◆ Instructions for the hammer impact tester

1. Put a shear pin into the horizontal hole of the test head. Push the indenter into the bottom hole of the test head with the spherical surface out and make sure it contacts the shear pin.

2. Place the test head into impact cylinder.

3. Put the handle on the specimen. Put the impact cylinder into the handle, and make sure the bottom of the impact cylinder rest firmly on the specimen.

4. Use the flat side of a 1.5kg (3lb) hammer to apply a sharp blow on top of the test head. The shear pin must be broken at the first blow. If the pin is not broken, another blow must be applied in order to remove the pin, and the result must be ignored.

5. Take out the test head and remove the broken shear pin with the pin removal tool. Push the indenter outward off the hole of the shear pin. If the shear pin is not completely broken off, the test should be considered as invalid. Install a new shear pin and test again. Be sure to break off the shear pin completely.

6. The dynamic test with a bigger force may result in an elliptic indentation. The diameter of the indentation must be measured in at least two directions. Use the smallest diameter as the valid one to check Appendix A, B or C for the Brinell hardness value.

◆ Usage of the reading microscope

1. Look into the ocular with enough light and turn the barrel dial to make the vertical lens line aligned with the "0" scale of the horizontal line. Meanwhile the long scale mark should rest on "0" scale of the barrel dial.

2. Put the reading microscope on the test piece to locate the indentation in the center of the viewing field of the microscope. Move the microscope to make the vertical line tangential to the left edge of the indentation. Press the bottom of the reading microscope, turn the barrel dial to make the vertical line tangential to the right edge of the indentation.

3. Read the integral part (mm) of the indentation diameter from the horizontal scale mark, then read the 2-digit decimal part of the indentation diameter from the barrel dial.

4. When the vertical line is aligned with the "0" scale mark of the horizontal line, but the "0" scale mark of the barrel dial is not aligned with the long scale mark, it means the microscope is inaccurate. Adjustment should be made as following:
a. Make the vertical lens line aligned with the "0" scale mark of the horizontal line.
b. Unscrew the three screws on the barrel dial.
c. Make the “0” scale mark on the barrel dial exactly aligned with the long scale mark.
d. Fasten the three screws.

Verfication

The Brinell standard hardness block is used to calibrate the Brinell tester. The test result on the test block should be close to the hardness of testing pieces.

Impact on testing blocks by hardness tester and get indentation, measuring the average diameter value of indentation by microscope, then get the hardness value aftercheck appendix. The error of this tester is the difference between this value and the value of testing block.

Caution

1. When the hardness of specimen is greater than 400HB, the carbide indenter must be used.

2. Indenters are normal wear items and are not covered by the warranty. The carbide indenter is more brittle and more easily broken than the steel indenter.

3. To protect the specimen surface from the impact cylinder, a cardboard with a hole bigger than indenter can be placed between the impact cylinder and the specimen.

4. Wear safety goggles and gloves to prevent possible injury.

Factors Affecting On Accuracy

Specimen Surface

The surface of the specimen should be smooth and clean for the best accuracy. The rough surface makes the indentation edge blurry and affects the measurement of the indentation diameters which will increase the dispersity of the test result. The rough surface can also reduce the specimen's resistance against the pressing indenter which will result in a lower Brinell hardness value. Use a sand paper or polish machine to polish the part to be tested for better accuracy. If the oxide coating, decarbonization layer, dust or dirt remains on the specimen surface, the hardness testing will be invalid. Remove those things before testing.

Supporting of the specimen

Carefully clean the bearing surface of the specimen to ensure that the impurities or dirt like oxide coating, grease and dust can not be found between the back side of the specimen and the supporting anvil. Choose the proper anvil, proper testing surface and the bearing surface to ensure that the specimen is firmly supported without sliding or deformation when the test force is applied.

Impact Effect of Impact Test

The specimen may move under the test force when the hammer impact tester is being used which will affect the testing result.

When testing with the hammer impact hardness tester, loading and unloading of the test force is finished in an instant, and the dwell time of the greatest test force does not reach the set time of the ordinary Brinell hardness testing. This will affect the testing result.

As above-mentioned, the operator should regularly make comparison tests with the standard Brinell hardness testers in order to ensure the accuracy of the testing result.

Relationship between Brinell hardness and tensile strength

Brinell hardness test can reflect the average mechanical properties of a large region of the specimen, so there is a close relation between the Brinell hardness and other mechanical properties of materials, especially tensile strength.

The approximate conversion equation is:

$$\sigma_b = KHB$$

in this equation: σb is the tensile strength value in Mpa

K is a constant depending on the material

The tensile strength of materials can be obtained indirect by testing the Brinell hardness with its approximate value obtained by conversion, which is of great importance in practical production by both increasing work efficiency and saving material as well.

The conversion of hardness-tensile strength of some metallic materials is shown below:

Material	Brinell Hardness Value	Approximate Conversion
Steel	125～175	$\sigma_b \approx 3.43HB$ (MPa)
	＞175	$\sigma_b \approx 3.63HB$ (MPa)
Cast aluminum alloy		$\sigma_b \approx 2.6HB$ (MPa)
annealed brass, bronze		$\sigma_b \approx 5.5HB$ (MPa)
Brass, bronze after being cold-processed		$\sigma_b \approx 4.0HB$ (MPa)

Appendix A: Indentation—Brinell Hardness Table 1

Hammer Impact—Steel Ball Indenter ∮7.26mm—for Steel							
Diameter	HB	Diameter	HB	Diameter	HB	Diameter	HB
2.05	484.0	2.49	315.4	2.93	217.6	3.37	155.2
2.06	479.2	2.50	312.0	2.94	215.8	3.38	153.8
2.07	474.4	2.51	309.0	2.95	214.0	3.39	152.4
2.08	469.6	2.52	306.0	2.96	212.4	3.40	151.0
2.09	464.8	2.53	303.0	2.97	210.8	3.41	149.8
2.10	460.0	2.54	300.0	2.98	209.2	3.42	148.6
2.11	455.8	2.55	297.0	2.99	207.6	3.43	147.4
2.12	451.6	2.56	294.2	3.00	206.0	3.44	146.2
2.13	447.4	2.57	291.4	3.01	204.4	3.45	145.0
2.14	443.2	2.58	288.6	3.02	202.8	3.46	143.6
2.15	439.0	2.59	285.8	3.03	201.2	3.47	142.2
2.16	435.0	2.60	283.0	3.04	199.6	3.48	140.8
2.17	431.0	2.61	280.8	3.05	198.0	3.49	139.4
2.18	427.0	2.62	278.6	3.06	196.6	3.50	138.0
2.19	423.0	2.63	276.4	3.07	195.2	3.51	136.8
2.20	419.0	2.64	274.2	3.08	193.8	3.52	135.6
2.21	415.2	2.65	272.0	3.09	192.4	3.53	134.4
2.22	411.4	2.66	270.0	3.10	191.0	3.54	133.2
2.23	407.6	2.67	268.0	3.11	189.6	3.55	132.0
2.24	403.8	2.68	266.0	3.12	188.2	3.56	130.6
2.25	400.0	2.69	264.0	3.13	186.8	3.57	129.2
2.26	396.4	2.70	262.0	3.14	185.4	3.58	127.8
2.27	392.8	2.71	260.0	3.15	184.0	3.59	126.4
2.28	389.2	2.72	258.0	3.16	182.6	3.60	125.0
2.29	385.6	2.73	256.0	3.17	181.2	3.61	123.8
2.30	382.0	2.74	254.0	3.18	179.8	3.62	122.6
2.31	378.4	2.75	252.0	3.19	178.4	3.63	121.4
2.32	374.8	2.76	250.0	3.20	177.0	3.64	120.2
2.33	371.2	2.77	248.0	3.21	175.8	3.65	119.0
2.34	367.6	2.78	246.0	3.22	174.6	3.66	117.6
2.35	364.0	2.79	244.0	3.23	173.4	3.67	116.2
2.36	360.4	2.80	242.0	3.24	172.2	3.68	114.8
2.37	356.8	2.81	240.0	3.25	171.0	3.69	113.4
2.38	353.2	2.82	238.0	3.26	169.6	3.70	112.0
2.39	349.6	2.83	236.0	3.27	168.2	3.71	110.8
2.40	346.0	2.84	234.0	3.28	166.8	3.72	109.6
2.41	342.6	2.85	232.0	3.29	165.4	3.73	108.4
2.42	339.2	2.86	230.2	3.30	164.0	3.74	107.2
2.43	335.8	2.87	228.4	3.31	162.8	3.75	106.0
2.44	332.4	2.88	226.6	3.32	161.6	3.76	104.6
2.45	329.0	2.89	224.8	3.33	160.4	3.77	103.2
2.46	325.6	2.90	223.0	3.34	159.2	3.78	101.8
2.47	322.2	2.91	221.2	3.35	158.0	3.79	100.4
2.48	318.8	2.92	219.4	3.36	156.6	3.80	99.0

Appendix B: Indentation—Brinell Hardness Table 2

Hammer Impact—Steel Ball Indenter ϕ7.26mm—for Cast Iron							
Diameter	HB	Diameter	HB	Diameter	HB	Diameter	HB
2.50	308.0	2.84	237.8	3.18	186.4	3.52	150.0
2.51	305.8	2.85	236.0	3.19	185.2	3.53	149.0
2.52	303.6	2.86	234.4	3.20	184.0	3.54	148.0
2.53	301.4	2.87	232.8	3.21	182.8	3.55	147.0
2.54	299.2	2.88	231.2	3.22	181.6	3.56	146.0
2.55	297.0	2.89	229.6	3.23	180.4	3.57	145.0
2.56	294.6	2.90	228.0	3.24	179.2	3.58	144.0
2.57	292.2	2.91	226.4	3.25	178.0	3.59	143.0
2.58	289.8	2.92	224.8	3.26	176.8	3.60	142.0
2.59	287.4	2.93	223.2	3.27	175.6	3.61	141.2
2.60	285.0	2.94	221.6	3.28	174.4	3.62	140.4
2.61	282.8	2.95	220.0	3.29	173.2	3.63	139.6
2.62	280.6	2.96	218.4	3.30	172.0	3.64	138.8
2.63	278.4	2.97	216.8	3.31	171.0	3.65	138.0
2.64	276.2	2.98	215.2	3.32	170.0	3.66	137.2
2.65	274.0	2.99	213.6	3.33	169.0	3.67	136.4
2.66	272.0	3.00	212.0	3.34	168.0	3.68	135.6
2.67	270.0	3.01	210.4	3.35	167.0	3.69	134.8
2.68	268.0	3.02	208.8	3.36	166.0	3.70	134.0
2.69	266.0	3.03	207.2	3.37	165.0	3.71	133.2
2.70	264.0	3.04	205.6	3.38	164.0	3.72	132.4
2.71	262.0	3.05	204.0	3.39	163.0	3.73	131.6
2.72	260.0	3.06	202.6	3.40	162.0	3.74	130.8
2.73	258.0	3.07	201.2	3.41	161.0	3.75	130.0
2.74	256.0	3.08	199.8	3.42	160.0	3.76	129.2
2.75	254.0	3.09	198.4	3.43	159.0	3.77	128.4
2.76	252.2	3.10	197.0	3.44	158.0	3.78	127.6
2.77	250.4	3.11	195.6	3.45	157.0	3.79	126.8
2.78	248.6	3.12	194.2	3.46	156.0	3.80	126.0
2.79	246.8	3.13	192.8	3.47	155.0	3.81	125.2
2.80	245.0	3.14	191.4	3.48	154.0	3.82	124.4
2.81	243.2	3.15	190.0	3.49	153.0	3.83	123.6
2.82	241.4	3.16	188.8	3.50	152.0	3.84	122.8
2.83	239.6	3.17	187.6	3.51	151.0	3.85	122.0

Appendix C: Indentation—Brinell Hardness Table 3

Hammer Impact—Carbide Indenter ϕ4mm							
Diameter	HB	Diameter	HB	Diameter	HB	Diameter	HB
1.55	*742.0*	1.79	596.0	2.03	462.9	2.27	359.4
1.56		1.80	589.8	2.04	457.8	2.28	355.6
1.57		1.81	585.0	2.05	452.8	2.29	351.8
1.58		1.82	580.2	2.06	447.8	2.30	348.0
1.59		1.83	575.4	2.07	442.9	2.31	344.6
1.60	*708.0*	1.84	570.6	2.08	437.9	2.32	341.2
1.61		1.85	565.8	2.09	433.0	2.33	337.8
1.62		1.86	559.3	2.10	428.0	2.34	334.4
1.63		1.87	552.8	2.11	423.7	2.35	331.0
1.64		1.88	546.4	2.12	419.4	2.36	327.3
1.65	*673.0*	1.89	539.9	2.13	415.2	2.37	323.6
1.66		1.90	533.4	2.14	410.9	2.38	319.8
1.67		1.91	528.1	2.15	406.6	2.39	316.1
1.68		1.92	522.8	2.16	402.1	2.40	312.4
1.69		1.93	517.4	2.17	397.6	2.41	309.5
1.70	639.8	1.94	512.1	2.18	393.0	2.42	306.6
1.71	636.0	1.95	506.8	2.19	388.5	2.43	303.8
1.72	632.2	1.96	501.0	2.20	384.0	2.44	300.9
1.73	628.4	1.97	495.3	2.21	380.6	2.45	298.0
1.74	624.6	1.98	489.5	2.22	377.2	2.46	294.6
1.75	620.8	1.99	483.8	2.23	373.8	2.47	291.3
1.76	614.6	2.00	478.0	2.24	370.4	2.48	287.9
1.77	608.4	2.01	473.0	2.25	367.0	2.49	284.6
1.78	602.2	2.02	467.9	2.26	363.2	2.50	281.2