Detroit Testing Machine Co.

Model DTLC-3000

Operation Manual

DETROIT TESTING
MACHINE COMPANY

MODEL DTLC-3000

10 LOAD BRINELL HARDNESS TESTER

OPERATING INSTRUCTIONS

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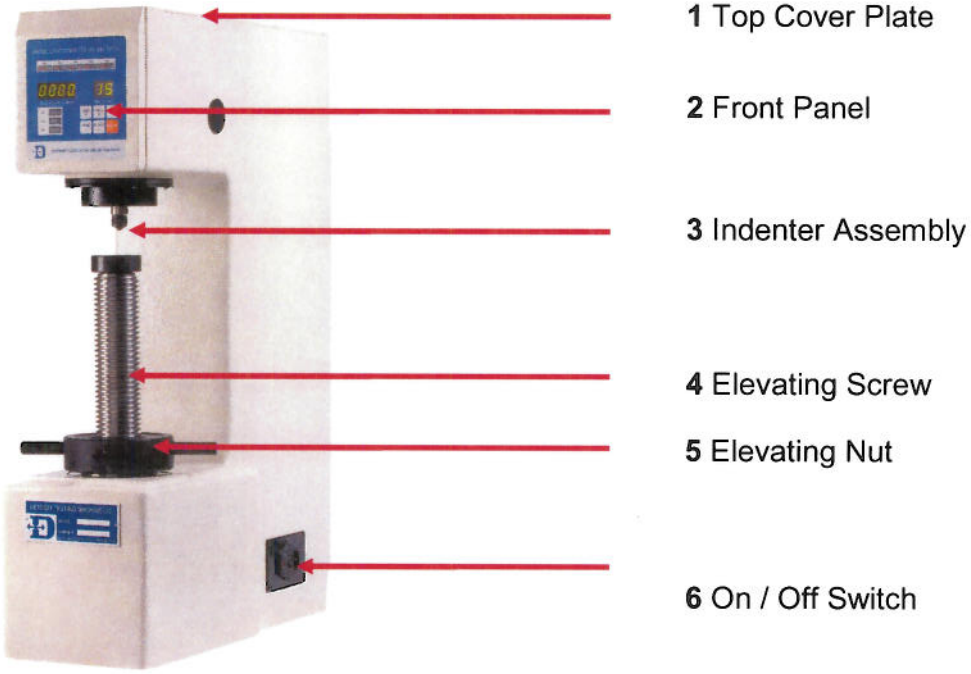


1 TOP COVER PLATE – For Access to Remove Packaging Material

2 FRONT PANEL – Operation Screen for Various Operations

3 INDENTER ASSEMBLY – Holds the Test Ball

4 ELEVATING SCREW – Used for Adjusting the Measuring Height of a Test Sample

5 ELEVATING NUT – Used to Lift the Test Specimen to the Indenter

6 ON / OFF SWITCH – Turns Machine Power On and Off

1. Introduction

Hardness is one if the mechanical properties of most importance in a material's performance, and the hardness test is an essential measure to determine the quality of a metallic material or a part made from the material. Hardness is the ability of a material to resist, under certain conditions, the pressure from another solid body which will not carry any residual deformation. The more the ability means the higher the hardness, and vise versa.

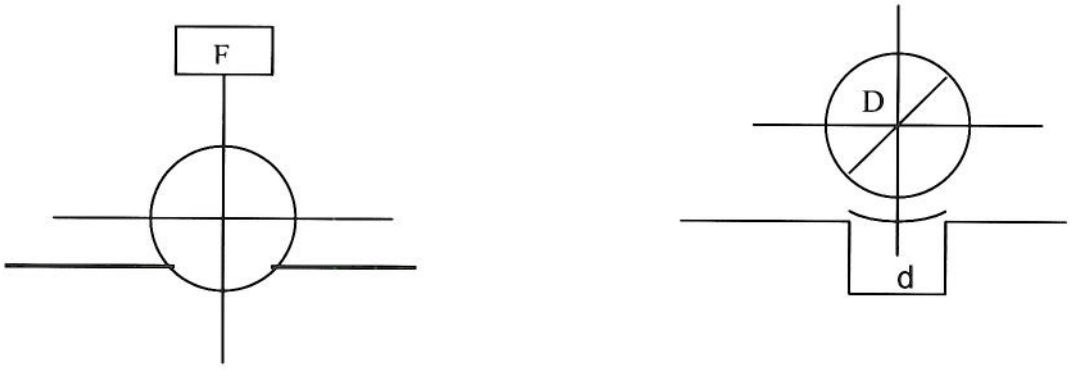
Brinell testing is mainly used in hardness determination for metallic materials such as cast iron, steel profiles, non-ferrous metals, and soft alloys. It can also be used for testing of hard plastics, bakelites, and some other non metallic materials. The apparatus is suitable for use in factories, workshops, laboratories, universities and colleges, and scientific research institutions.

Brinell hardness test uses a carbide ball of a certain diameter (10 mm supplied) to press on the substance surface to be tested with specified test force (Fig. 1). The test force is held for a specific time, and then moved. Next measure the impression diameter of the test piece with a reading microscope. Brinell harness number can be calculated from the mean diameter of the indentation using the following equation:

$$HBW = 0.102 \times \frac{2F}{\pi (D - \sqrt{D^2 - d^2})}$$

Where F is the test pressure by the steel ball on the specimen, N
D is the diameter of the steel ball, mm
d is the diameter of the indent, mm
0.102 is a specified coefficient

Figure 1



2. Main Technical Parameters

(1) Test Forces:

KG	Newton
62.5	612.5
187.5	1837.5
250	2450
500	4900
750	7350
1000	9800
1500	14700
2000	19600
2500	24500
3000	29400

(2) Hardness Test Range: 95.5 – 701 (@ 3000 Kgf)

(3) Indicating Value:

< 225 HBS (HBW), maximum error of indicating value ± 3 %, maximum allowed variation in indicating value 0.06H.

> 225 HBS (HBW), maximum error indicating value ± 3 %, maximum allowable variation in indicating value 0.03H.

(4) Maximum Height of specimen: 220mm (9.6 inches)

(5) Maximum Distance from Indenter Center to Machine Body: 135mm (5.2 inches)

(6) Power Voltage: 110 VAC (60 HZ)

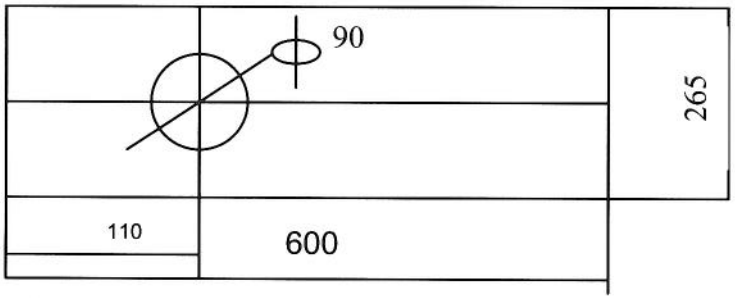
(7) Outer Dimensions: 753 X 550 X 236mm
30.5 x 21.5 x 9.6 inches

(10) Weight: 123 KG (350 Lbs.)

3. Installation of the Instrument

a. Operating Conditions of the Hardness Tester

- Hardness test should be performed with in 10 - 35° C range of room temperature, and should be controlled to within 23 ± 5° C for the test in high requirement of temperature.
- Clean surrounding
- No corrosive gas in the surroundings
- To be installed on a sturdy bench and leveled. Open a 90 mm (3 ½") hole on the bench for full capacity elevating screw.



b. Unpacking and Installation

Loosen the four nuts on the outer side packaging box and lift the outer box upward, then remove the two bolts under the bottom plate, and place the tester on a pre-leveled bench.

Remove the cushion block between lifting screw and indenter axes, apply a thin layer of machine oil for lubrication

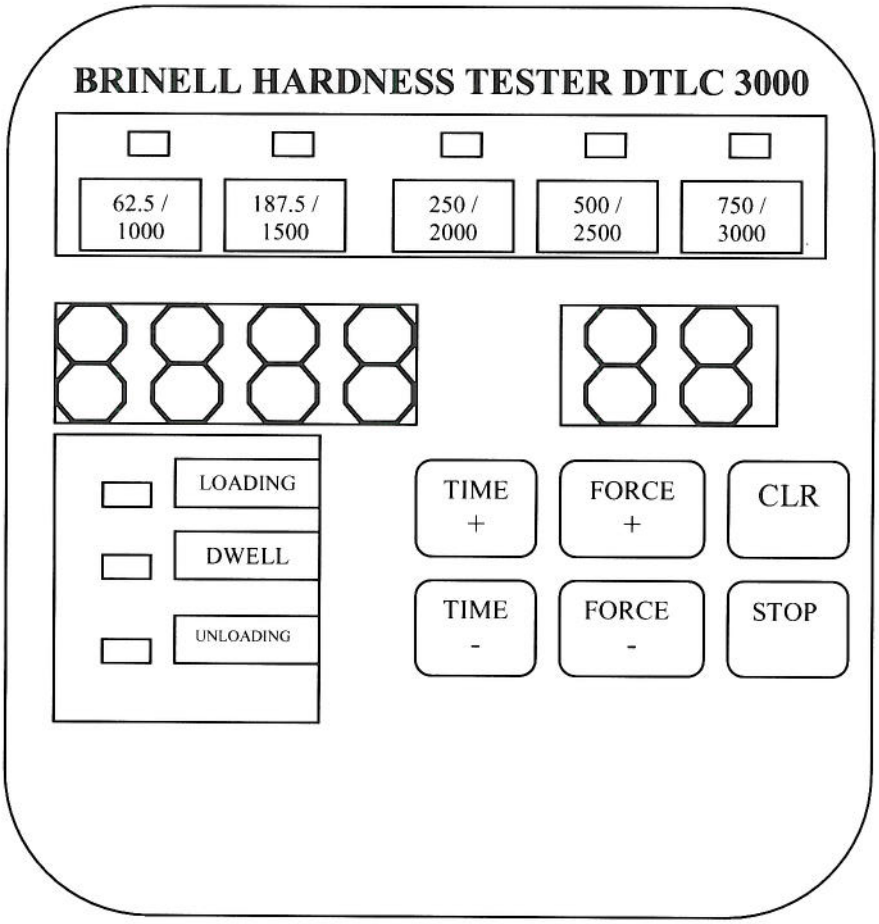
Open the top cover and remove the cushion foam blocks at both sides of the beam. Make an observation on the knife cushion support to see whether the knife falls properly in the notch. If the knife is out (this is seldom found only after a severe shake), push the beam down and place the knife into the correct position. Then replace the top cover.

Supply the power and turn the switch on. The hardness tester will enter operation mode automatically.

c. Introduction to Operating Panel Function

Panel function of the DLTC 3000 Brinell Hardness Tester includes 6 input keys and force value, holding load time plus unloading condition and force value range, LED 8-section numeric tube for output display and light diode display.

PANEL LAYOUT:



Main Technical Parameters

Panel Layout is shown in diagram on page 7

Brinell load display: in accordance with test requirement there are 10 tests, 62.5 Kgf – 3000 Kgf in total to light by selected load corresponding to emitting tube

Panel layout display:

62.5 Kgf	187.5 Kgf
250 Kgf	500 Kgf
750 Kgf	1000 Kgf
1500 Kgf	2000 Kgf
2500 Kgf	3000 Kgf

FORCE +	Press this key to increase load selection; maximum is up to 3000 Kgf.

FORCE -	Press this key to decrease load selection; minimum is down to 62.5 Kgf.

Panel Load value default setting is 750 Kgf.

(1) Display of Brinell test force graduation: In total 10 grades of test force (from 62.5 Kgf to 3000 Kgf) can be selected based on the test requirement. When a grade of load is selected, the corresponding LED will be lit; red light for loads up to 750 Kg, green light for 1000 Kg loads and up.

(2) Display of the applied force: It is to indicate the actual force value during the test (instantaneous value, in Kgf). When the red LED is lit, the value will be displayed from 62.5 – 750 Kg. When the green LED is lit, the value will be displayed from 1000 – 3000 Kg.

(3) Display of load keeping time period: By the end of loading period, the display will start to show the rest time for load dwelling. The time period can be set in 12 lengths ranging from 5 to 60 seconds, generally the length of 15 seconds will be used.

(4) Display of test status: Test will be carried out in three stages: a LOADING lamp will be lit during the loading period, a DWELL lamp lit during load dwelling period, and an UNLOADING lamp lit during unloading stage.

(5) Input keys: There are six input keys in total on the panel, two for time increment / decrement, another two fro force value increment / decrement, and the remaining two are stop key and clear key, respectively.

Every time a "+" or "-" key is depressed, a beeper will sound and once the maximum or minimum value is achieved, the beeper will sound longer to indicate it.

TIME +	Load dwelling time "+" key – the time period will be increased by 5 seconds every time it is depressed until the maximum of 60 seconds is achieved.
TIME -	Load dwelling time "-" key – the time period will be decreased by 5 seconds every time it is depressed until the minimum of 5 seconds is achieved.
FORCE +	Force value "+" key – the force value will be increased by one grade every time it is depressed until the maximum of 62.5 kgf is achieved.
FORCE -	Force value "-" key – the force value will be decreased by one grade every time it is depressed until the minimum of 62.5 kgf is achieved.
CLR	Clear key – when the load is totally removed (indenter is cleared off the specimen) While a small value is still shown, use this key to clear the display.
STOP	Stop key – press this to stop the test procedure during the operation and restore the original state of apparatus.

(4) Proper Use of Hardness Tester

a) Turn on power switch. Force value is at the 750 Kgf position and time is constantly set at 15 seconds. If you need to select other test force and load holding time, please refer to introduction to operation panel function. Place the test sample on operating stand. Turn elevating screw so that load rises slowly.

When load is equal to or greater than 90, the machine will emit electronic sound and at the same time loading pilot lamp LOADING lights up. Stop rotation of elevating screw, loading automatically goes on. When reaching your selected load, holding load starts, holding load DWELL lights up. Loading pilot lamp will go out, entering into counting backwards.

Until holding load time is complete, pilot lamp goes out, unloading automatically goes on, and at the same time unloading pilot lamp goes out, the lever will reset to the original position. Reverse elevating screw. Remove sample from anvil once test is complete.

b) Indenter installation: Install the indenter into the indenter holder, with flat side towards holding screw and tighten. Next, place anvil to be used on the elevating unit. Then install the test specimen directly on the anvil in a stable state to assure the specimen will not be moved or bent during the test. Rotate the hand wheel to lift the test piece slowly and make contact with the indenter

c) This tester utilizes a load cell feed back system. It can indicate they dynamic load change during the whole test process. The digital tubes for load display will continuously indicate the instantaneous force value. The force will be gradually reduced as the indenter is pressed onto the specimen, and the apparatus will automatically compensate the force once it is reduced to a pre-set minimum value, to keep the load always in a specified range.

d) Selection of load should keep impression diameter between 2.4 mm – 6.0 mm.

e) Minimum thickness of the test sample can be found in Table 1. The thickness of common test sample should not be 8 times less than the depth of impression. In order to inspect whether depth of impression is 8 times less than the thickness of test sample, value h can be also obtained from the following formula:

$$HB=F/(\pi Dh) \longrightarrow h=F/(\pi D \cdot HB)$$

In direct observation, if deformed trace appears on the back and edge of test sample, the test result is regarded as invalid. Test force again to reset.

f) Direction of load should be vertical to test plane. Load holding time of test Load: ferrous metal 10 – 15 seconds, non-ferrous metal 30 seconds, 60 seconds when Brinell is less than 35.

g) The distance of impression center away from the edge of test sample should not be less than 2.5 times of impression diameter. The distance of both adjacent impression centers should not be less than 4 times of average diameter of impression. When Brinell hardness is less than 35, the above distance should be 3 times and 6 times the average diameter of impression respectively.

h) Impression diameter should be measured in two directions, perpendicular (90 degrees) to each other, to take its arithmetic average value. The difference of two diameters of the impression should not exceed 2% of the smaller diameter.

i) Test Pieces should conform to the following guidelines:

a. Thickness: There shall be no bulge or other marking that shows the effects of the test force on the opposite side of the indentation. The thickness of the test samples should be at least ten times the depth of the indentation.

b. Width: The minimum width shall conform to the requirements for indentation spacing

c. Finish: The surface of the test sample should be filed, ground, machined or polished flat with an abrasive material so the edge of the indentation can be clearly defined to ensure the

accuracy of the measurement result.

Table 1

Diameter of Indentation, *d*	Minimum Specimen Thickness					
	10 mm Carbide Ball		5 mm Carbide Ball		2.5 mm Carbide Ball	
mm	mm	In.	mm	In.	mm	In.
0.2						
0.3						
0.4						
0.5						
0.6					0.4	0.014
0.7					0.5	0.020
0.8					0.7	0.026
0.9					0.8	0.033
1.0					1.0	0.041
1.1					1.3	0.050
1.2			0.7	0.029	1.5	0.060
1.3			0.9	0.034	1.8	0.072
1.4			1.0	0.039	2.1	0.084
1.5			1.2	0.045	2.5	0.098
1.6			1.3	0.052		
1.7			1.5	0.059		
1.8			1.7	0.066		
1.9			1.9	0.074		
2.0			2.1	0.082		
2.2			2.6	0.100		
2.4	1.5	0.058	3.1	0.121		
2.6	1.7	0.068	3.6	0.144		
2.8	2.0	0.079	4.3	0.169		
3.0	2.3	0.091	5.0	0.197		
3.2	2.6	0.104				
3.4	3.0	0.117				
3.6	3.4	0.132				
3.8	3.8	0.148				
4.0	4.2	0.164				
4.2	4.6	0.182				
4.4	5.1	0.201				
4.6	5.6	0.221				
4.8	6.1	0.242				
5.0	6.7	0.264				

j) Hardness tester has a multiple level of test loads. Each level of test loads should be selected and used in accordance with the nominal value specified in Table 2.

Table 2

Brinell Hardness Scale	Ball Diameter	Force – Diameter Ratio	Test force F N (Kgf)	Recommended Hardness Range HBW
HBW 10/3000	10	30	29420 (3000)	95.5 to 650
HBW 10/1500	10	15	14710 (1500)	47.7 to 327
HBW 10/1000	10	10	9807(1000)	31.8 to 218
HBW 10/500	10	5	4903 (500)	15.9 to 109
HBW 10/250	10	2.5	2452 (250)	7.96 to 54.5
HBW 5/750	5	30	7355 (750)	95.5 to 650
HBW 5/250	5	10	2452 (250)	31.8 to 218
HBW 2.5/187.5	2.5	30	1839 (187.5)	95.5 to 650

4. Maintenance of Hardness Tester

a) Elevating screw should be periodically cleaned and lubricated with oil.

b) After test is complete remove sample, turn off power source – when not in use.

c) When not in use, hardness tester should be covered with dust shield, preventing dust from entering into the interior of the machine.