Ex. No:
Date:

BRINELL HARDNESS TEST

AIM

To determine the hardness of the given specimen using Brinell hardness testing machine.

THEORY

Hardness represents the resistance of material to surface abrasion / scratching / cutting. Hardness is also an indication of strength. In all hardness tests, a pre-defined force is mechanically applied, through a indentor, on the test piece for a short interval of time. The indentor, which transmits the load to the test piece, varies in size and shape for different hardness testing machines. Indentors are made of hardened steel. In Brinell hardness testing, hardened steel balls are used as indentor. Diameter of the indentor and the applied force depend upon the material to be tested. For accurate results, the depth of indentation should be less than $1/8^{th}$ of the thickness of the test specimen.

EQUIPMENT'S REQUIRED

- Brinell hardness test machine (Specification: 500-3000 kgf)
- Ball indenter (10mm diameter)
- Microscope with light arrangement for measurement diameter of indentation

FORMULA USED

Brinell hardness number (BHN) = $$\frac{2P}{\pi D(D-\sqrt{D^2-d^2})}$$

where

P - applied load (kgf)

D - diameter of the steel ball (mm)

d - mean diameter of the indentation (mm)

PROCEDURE

1. Place the specimen on platform of the machine as shown in Fig 1.1.
2. Using the elevating screw, raise the platform and bring the specimen just in contact with the ball indenter.
3. Select the load to be applied according to the formula $10D^2$ for non-ferrous materials and $30D^2$ for ferrous material.
4. Apply the load for a minimum of 15 to 30 seconds.
5. Remove the load and measure the diameter of indentation (Fig 1.2) using the microscope.
6. Repeat the procedure three times on the specimen selecting different locations on the specimen.
7. Calculate the Brinell Hardness Number (BHN) using formula, shown above, and tabulate the average readings in table 1.

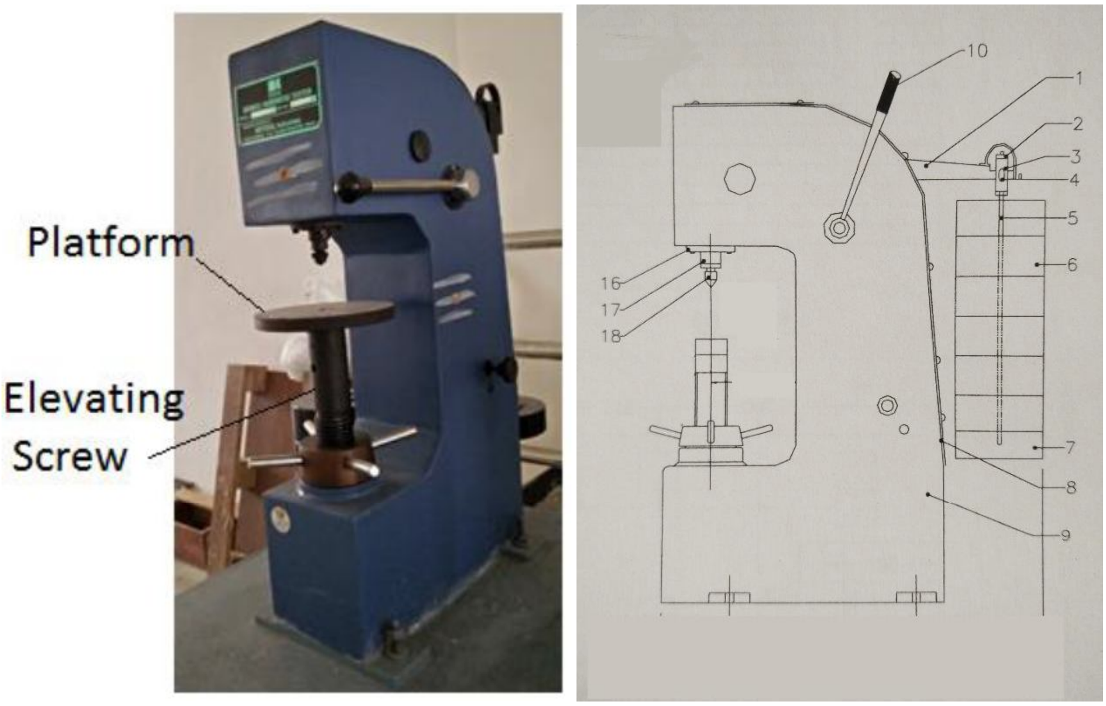

Figure 1.1 Brinell Hardness Tester

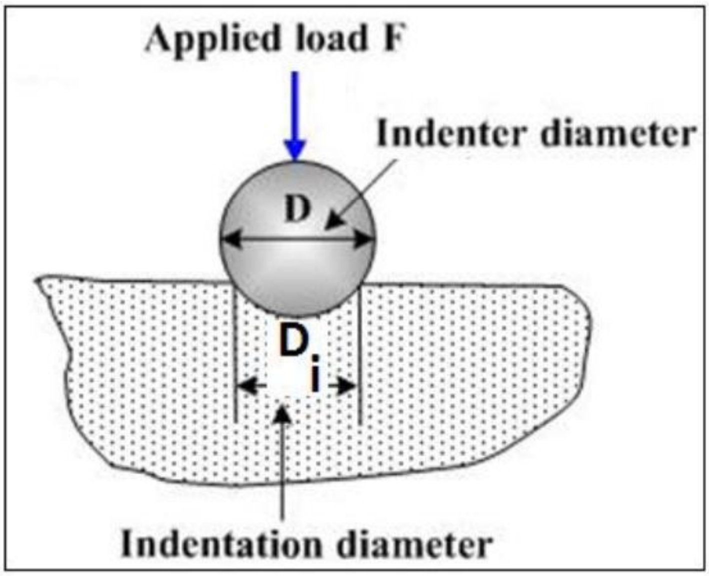

Fig 1.2 Indentation of ball

NOMENCLATURE

1. Main lever
2. Hanger
3. Hanger yee (male)
4. Hanger yee (Female)
5. Weight hanger
6. Weight
7. Bottom weight
8. Cover
9. Frame
10. Operating lever
16. Spindle bushing
17. Spindle
18. Ball holder

TABLE 1

Material	Load (kgf)	Diameter of indenter (mm)	Diameter of indentation (mm)				Brinell Hardness Number (BHN)
			1	2	3	Mean	

RESULTS

The Brinell hardness number of ………………..…………………..is………………..

The Brinell hardness number of ………………..…………………..is………………..

The Brinell hardness number of ………………..…………………..is………………..

The Brinell hardness number of ………………..…………………..is………………..

The Brinell hardness number of ………………..…………………..is………………..

INFERENCES:

Ex. No:

Date:

ROCKWELL HARDNESS TEST

AIM

To determine the hardness of the given specimen using Rockwell hardness testing machine.

THEORY

Hardness represents the resistance of material to surface abrasion / scratching / cutting. Hardness is also an indication of strength. In all hardness tests, a pre-defined force is mechanically applied, through a indentor, on the test piece for a short interval of time. The indentor, which transmits the load to the test piece, varies in size and shape for different hardness testing machines. Indentors are made of hardened steel / diamond. Rockwell hardness testing gives direct reading of hardness number on a dial provided on the machine. This testing is similar to Brinell hardness testing with differences only in diameter and material of the indentor and also applied force. The indentor has a diamond cone at the tip and applied force is 100 kgf for non-ferrous materials and 150 kgf for ferrous materials.

EQUIPMENT'S REQUIRED

- Rockwell hardness testing machine (Specification: 60,100,150 kgf)
- Diamond cone indenter with 120^o cone angle.

PROCEDURE

1. Place the specimen on platform of a machine as shown in Fig 2.1.
2. Using the elevating screw, raise the platform and bring the specimen just in contact with the diamond indenter.
3. Apply a minor load of 3 kgf, at which the pointer stands on the red dot marked on the small dial.
4. Now disengage the loading lever so that the pointer comes back to rest. Now engage the the selected load.
5. Note the position of the pointer on the corresponding scale ('B' or 'C'), which will indicates the specimen hardness.
6. Repeat the procedure three times at different locations on the specimen, note and tabulate the readings in table 1.

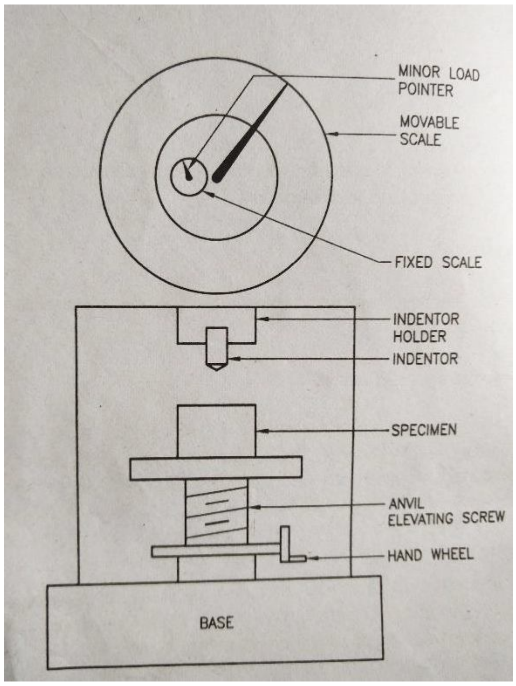

Figure 2.1 Rockwell Hardness Tester

TABLE 1

Specimens	Scale	Load (kgf)	Reading (HRC/HRB)			Mean (HRC / HRB)
			1	2	3	

RESULTS:

Rockwell hardness of ………………………………………………… is ………………………

Rockwell hardness of ………………………………………………… is ………………………

Rockwell hardness of ………………………………………………… is ………………………

Rockwell hardness of ………………………………………………… is ………………………

Rockwell hardness of ………………………………………………… is ………………………

INFERENCE:

Ex. No:
Date:

IMPACT TEST ON METAL SPECIMEN - CHARPY

AIM

To determine the impact strength and toughness of the given specimen using impact testing machine in Charpy mode.

THEORY

Machine elements like shock absorbers, impact hammers, and aircraft landing gears are subjected to impact (shock) loads. By shock we means large forces of short duration. The stress induced with such loading is much higher than gradually applied loads. Therefore, impact tests are performed to assess the capability of a particular material to absorb impact. The ability of a material to absorb impact is measured by (i) energy absorbed (ii) Impact strength, and (iii) toughness. Two types of impact tests are commonly performed, namely (i) Charpy test in which the specimen is kept as a 'simply supported beam', and (ii) Izod test in which the specimen is kept as a 'cantilever beam'. The specimens usually have a V-shaped notch of **45°** cut in the specimen and with the notch located on the 'tension side' of specimen during impact loading. The depth of notch is generally taken as **t/2** to **t/3**, where '**t**' is thickness of the specimen.

EQUIPMENT'S REQUIRED

- Impact testing machine in Charpy arrangement (Spec: 300 Joules)
- Vernier Caliper

FORMULA USED:

Energy absorbed = E_1-E_2 (J)
Impact Strength = (Energy absorbed / cross sectional area) (J/mm^2)
Toughness = (Energy absorbed / volume of specimen) (J/mm^3)

PROCEDURE:

1. Prepare the specimen as per Fig. 3.2.
2. Bring the pendulum weight to its top most position as shown in Fig. 3.1 and lock it in that position. Note down the initial reading from the dial
3. Place the given specimen for test, as per Fig. 3.3 and ensure that the notch is centrally located with respect to the centre line of hammer.
4. Release the pendulum and note the final reading.
5. The difference between the initial and final reading gives the actual energy required (Energy absorbed) to fracture the specimen.
6. Calculate the impact strength and toughness using the above formulae and tabulate in Table 1.

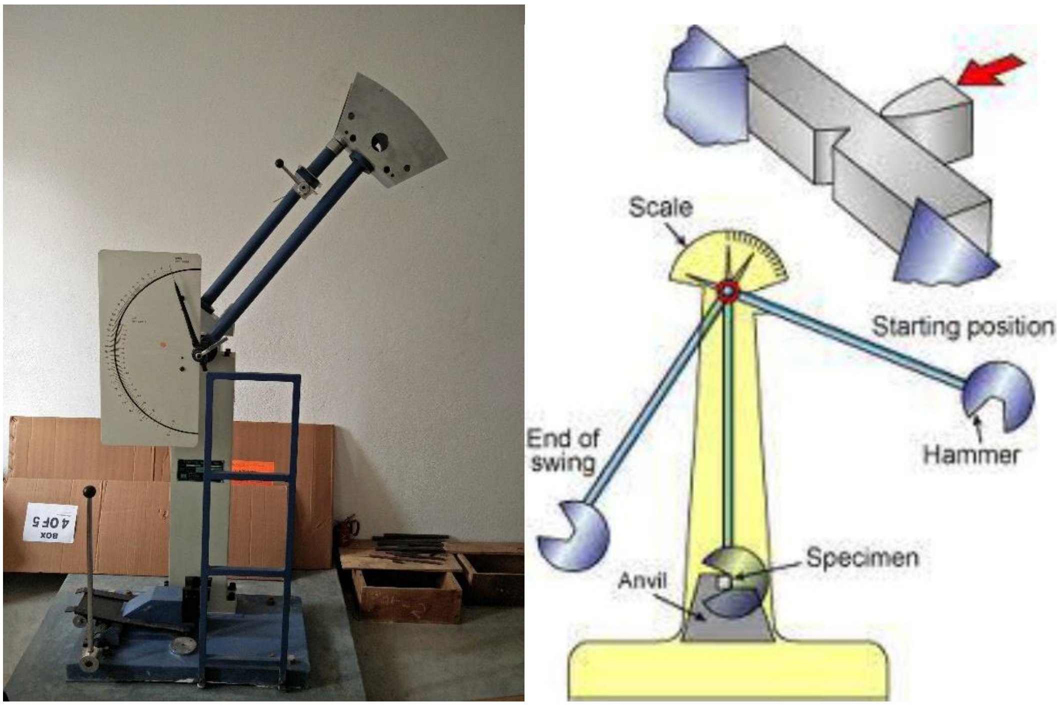

Fig 3.1 Impact test equipment

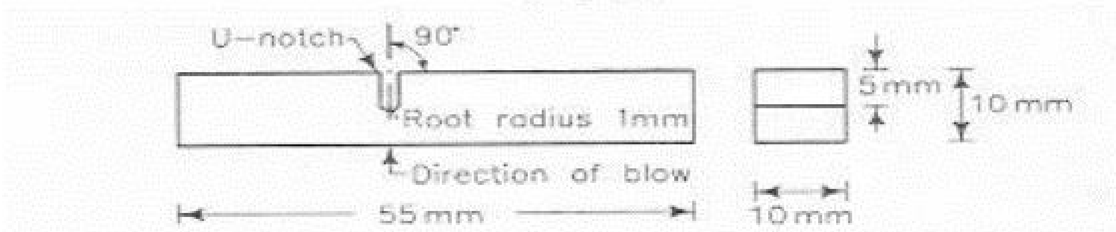

Fig 3.2 Charpy test specimen

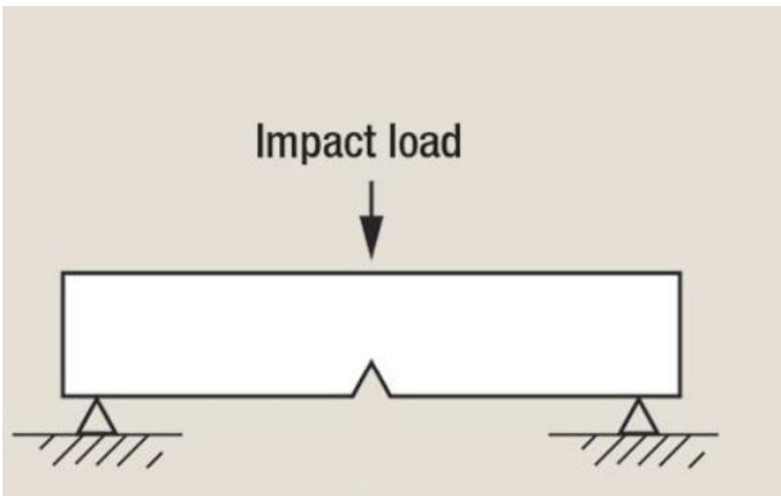

Fig 3.3 Specimen mounting for charpy test

OBSERVATION

Length of the specimen (L) = …………………mm

Breadth of the specimen (B) =…………………mm

Depth of the specimen (D) =…………………mm

Area of the specimen (A) = L x B = …………mm^2

Volume of the specimen (V) = L x B x D = ………….mm^3

TABLE 1

Specimen	Initial Energy E1, Joule	Residual Energy E2, Joule	Absorbed Energy (E1-E2) Joule	Impact Strength J/mm^2	Toughness J/mm^3

RESULTS:

The impact strength of given specimen = ………… Joule/mm^2

The toughness of given specimen = ………….. Joule/mm^3

INFERENCE:

Ex.No:
Date:

IMPACT TEST ON METAL SPECIMEN - IZOD

AIM

To determine the Impact strength and toughness of the given specimen using impact testing machine in izod mode.

THEORY

Machine elements like shock absorbers, impact hammers, and aircraft landing gears are subjected to impact (shock) loads. By shock we means large forces of short duration. The stress induced with such loading is much higher than gradually applied loads. Therefore, impact tests are performed to assess the capability of a particular material to absorb impact. The ability of a material to absorb impact is measured by (i) energy absorbed (ii) Impact strength, and (iii) toughness. Two types of impact tests are commonly performed, namely (i) Charpy test in which the specimen is kept as a 'simply supported beam', and (ii) Izod test in which the specimen is kept as a 'cantilever beam'. The specimens usually have a V-shaped notch of **45°** cut in the specimen and with the notch located on the 'tension side' of specimen during impact loading. The depth of notch is generally taken as **t/2** to **t/3**, where '**t**' is thickness of the specimen.

EQUIPMENT'S REQUIRED

- Impact testing machine in izod arrangement (Spec: 168 joules)
- Vernier Caliper

FORMULA USED

Energy absorbed = E_1-E_2 (J)
Impact Strength = Energy absorbed / cross sectional area (J/mm^2)
Toughness = Energy absorbed / volume of specimen (J/mm^3)

PROCEDURE:

1. Prepare the specimen as per Fig. 4.2.
2. Bring the pendulum weight to its top most position as shown in Fig. 4.1 and lock it in that position. Note down the initial reading from the dial
3. Place the given specimen for test, as per Fig. 4.2 and ensure that the notch is centrally located with respect to the centre line of hammer.
4. Release the pendulum and note the final reading.
5. The difference between the initial and final reading gives the actual energy required (Energy absorbed) to fracture the specimen.
6. Calculate the impact strength and toughness using the above formulae and tabulate in Table 1.

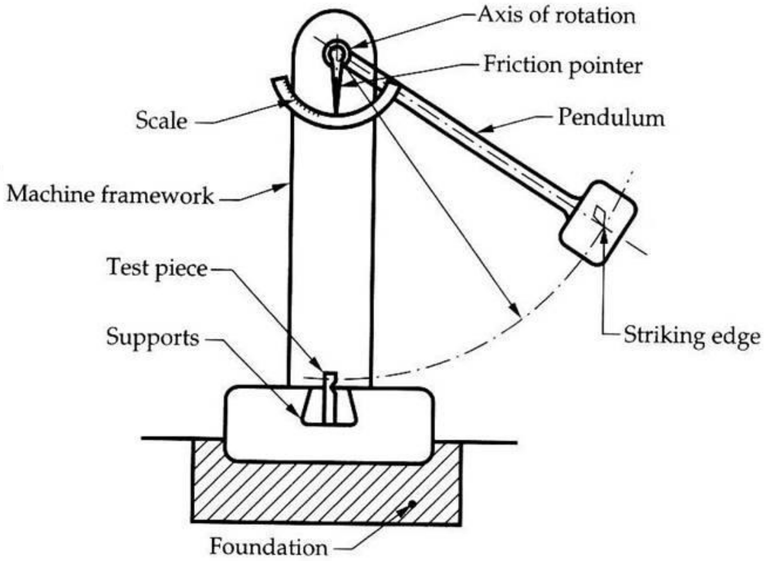

Fig 4.1 Impact test Izod mode

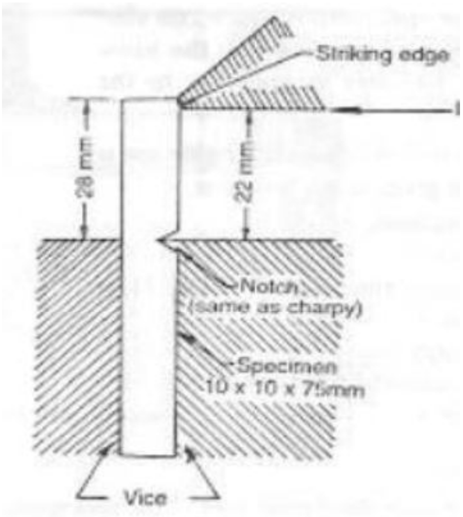

Fig 4.2 Specimen for izod test

OBSERVATION

Length of the specimen (L) = …………………mm

Breadth of the specimen (B) =…………………mm

Depth of the specimen (D) =…………………mm

Area of the specimen (A) = L x B = …………mm^2

Volume of the specimen (V) = L x B x D = ………….mm^3

TABLE 1

Specimen	Initial Energy E1, Joule	Residual Energy E2, Joule	Absorbed Energy (E1-E2) Joule	Impact Strength J/mm^2	Toughness J/mm^3

RESULTS:

The impact strength of given specimen = ………… joule/mm^2

The toughness of given specimen = ………….. Joule/mm^3

INFERENCE: