

LABORATORY MANUAL

STRENGTH OF MATERIALS LAB

ME-214-F

LIST OF EXPERIMENTS

S.No.	NAME OF EXPERIMENTS	PAGE No.	
		FROM	TO
1.	To study the Brinell hardness testing machine & perform the Brinell hardness test.		
2.	To study the Rockwell hardness testing machine & perform the Rockwell hardness test.		
3.	To study the Vickness hardness testing machine & perform the Vickers hardness test.		
4.	To study the Erichsen sheet metal testing machine & perform the Erichsen sheet metal test.		
5.	To study the Impact testing machine and perform the Impact tests (Izod & Charpy).		
6.	To study the Universal testing machine and perform the tensile test.		
7.	To perform compression & bending tests on UTM.		
8.	To perform the sheer test on UTM.		
9.	To study the torsion testing machine and perform the torsion test.		
10.	To draw shear Force, Bending Moment Diagrams for a simply Supported Beam under Point and distributed Loads.		
11.	To determine Mechanical Advantage and Efficiency of Single and Double Purchase Winch Crab.		
12.	To determine Mechanical Advantages and Efficiency of Worm and Worm Gear of Single, Double and Triple start.		
13.	To determine Mechanical Advantage, Efficiency of Simple and Compound Screw jack.		
14.	To find Moment of Inertia of a Fly Wheel.		

Note:

- 1. At least ten experiments are to be performed in the semester.**
 - 2. At least eight experiments should be performed from the above list.**
- Remaining two experiments may either be performed from the above list or designed & set by the concerned institute as per the scope of the syllabus.**

EXPERIMENT NO. – 01

AIM :- To study the Brinell Hardness testing machine and the Brinell hardness test.

APPARATUS: - Brinell Hardness testing machine, specimen of mild steel / cast iron/ non ferrous metals and Brinell microscope.

THEORY: - Hardness represents the resistance of material surface to abrasion, scratching and cutting, hardness after gives clear identification of strength. In all hardness testes, a define force is mechanically applied on the test piece for about 15 seconds. The indenter, which transmits the load to the test piece, varies in size and shape for different tstes. Common indenters are made of hardened steel or diamond.

In Brinell hardness testing, steel balls are used as indentor. Diameter of the indentor and the applied force depend upon the thickness of the test specimen, because for accurate results, depth of indentation should be less than $1/8^{\text{th}}$ of the thickness of the test pieces. According to the thickness of the test piece increase, the diameter of the indentor and force are changed.

SPECIFICATION OF HARDNESS TESTING OF HARDNESS TESTING M/C AND INDENTORS

A hardness test can be conducted on Brinell testing m/c, Rockwell hardness m/c or vicker testing m/c. the specimen may be a cylinder, cube, think or thin metallic sheet. A Brinell-cum-Rockwell hardness testing m/c along with the specimen is shown in figure. Its specification are as follows:

1. Ability to determine hardness upto 500BHN.
2. Diameter of ball (as indentor) used $D = 2.5\text{mm}, 5\text{mm}, 10\text{mm}$.
3. Maximum application load = 3000kgf.
4. Method of load application = Lever type
5. Capability of testing the lower hardness range = 1 BHN on application of $0.5D^2$ load.

PROCEDURE:-

1. Insert ball of dia 'D' in ball holder of the m/c.
2. Make the specimen surface clean by removing dust, dirt, oil and grease etc.
3. Make contact between the specimen surface and the ball by rotating the jack adjusting wheel.
4. Push the required button for loading.
5. Pull the load release level and wait for minimum 15 second. The load will automatically apply gradually.
6. Remove the specimen from support table and locate the indentation so made.
7. View the indentation through microscope and measure the diameter 'd' by micrometer fitted on microscope.
8. Repeat the entire operation, 3-times.

OBSERVATION AND CALCULATION : - Following observation are recorded from a test on steel specimen using a hardened steel ball as indenter.

Test piece material = -----

S.No.	Ball diameter 'D' in mm.	Load applied P in kgf.	Diameter of indentation 'd' (mm)	P/D ²	BHN

BHN = Load Applied (kgf.) / Spherical surface area indentation (in mm.)

$$2P/\pi D(D-\sqrt{D^2 - d^2})$$

PRECAUTIONS:-

1. The specimen should be clean properly.
2. Take reading more carefully and correct.
3. Place the specimen properly.
4. Jack adjusting wheel move slowly
5. After applying load remove the load.

RESULT:-

CONCLUSION:-

VIVA-QUESTIONS:-

- What is the limitation of Brinell hardness test and why ?
- Which is the hardest material ? and why ?
- Can we predict the tensile strength of a material if its hardness is known ?
- What is the unit of B.H.N?
- Which ball size is recommended for Brinell test?

EXPERIMENT NO. – 02

AIM : To study the Rockwell Hardness testing machine and perform the Rockwell hardness test.

APPARUTS :- Rockwell Hardness testing machine, specimen of mild steel or other material.

THEORY: - Hardness represents the resistance of material surface to abrasion, scratching and cutting, hardness after gives clear indication of strength. In all hardness tests, a define force is mechanically applied on the piece, varies in size and shape for different tests. Common indentors are made of hardened steel or diamond.

Rockwell hardness tester presents direct reading of hardness number on a dial provided with the m/c. principally this testing is similar to Brinell hardness testing. It differs only in diameter and material of the indenter and the applied force. Although there are many scales having different combinations of load and size of indenter but commonly 'C' scale is used and hardness is presented as HRC. Here the indenter has a diamond cone at the tip and applied force is of 150 kgf. Soft materials are often tested in 'B' scale with a 1.6mm dia. Steel indenter at 60kgf.

SPECIFICATION OF HARDNESS TESTING M/C AND INDENTORS:-

A hardness test can be conducted can be conducted on Brinell testing m/c, Rockwell hardness m/c or vicker testing m/c. the specimen may be a cylinder, cube, thick or thin metallic sheet. A Brinell-cum-Rocwell hardness testing m/c along with the specimen is shown in figure.

Various scales in Rockwell hardness test are given below:-

Scale	Type of indenter (Dimension)	Initial load (kgf)	Major load (kgf)	Pointer Position on dial	Kind of material
A	Cone, 120°	10	50	0	Much harder such as carburized steel, cemented carbides
B	Ball, 1.58mm	10	90	30	Soft steels, copper, aluminum, brass, grey cast iron.
C	Cone, 120°	10	140	0	Hard steels, Ti, W, Va, etc

PROCEDURE:-

1. Insert ball of dia. 'D' in ball holder of the m/c.
2. Make the specimen surface clean by removing dust, dirt, oil and grease etc.
3. Make contact between the specimen surface and the ball by rotating the jack adjusting wheel.
4. Push the required button for loading.
5. Pull the load release lever wait for minimum 15 second. The load will automatically apply gradually.
6. Remove the specimen from support table and locate the indentation so made.
7. Repeat the entire operation, 3-times.

OBSERVATION AND CALCULATION : -

Following observation are recorded are from a test on steel specimen using a hardened steel ball as indenter.

- Test piece material =-----
- HRA = $100 - (t/0.002)$
- HRB = $130 - (t/0.002)$

- $HRC = 100 - (t/0.002)$

PRECAUTIONS:-

- The specimen should be clean properly
- Take reading more carefully and