

2.2 HARDNESS TEST

1. HARDNESS

- ❖ The term 'hardness' is a structure-sensitive mechanical property of materials, primarily associated with the surface. If a material is uniform in composition and structure, the hardness measured on the surface layer will represent the hardness of the bulk of the material.
- ❖ The hardness is defined as the resistance of a material to permanent or plastic deformation of its surface, usually by indentation, under static or dynamic load.

2. CLASSIFICATION OF HARDNESS

- ❖ Depending on the manner in which the hardness test is conducted, hardness may be classified as follows
 - Indentation hardness
 - Rebound hardness
 - Scratch hardness
 - Wear or abrasion hardness
 - Cutting hardness

(a) Indentation hardness

- ❖ It is the resistance of a material to permanent indentation under static or dynamic load. The types indentation hardness test is given below,
 - ✓ Brinell
 - ✓ Meyer
 - ✓ Vickers (macro- and micro-hardness)
 - ✓ Rockwell (regular and superficial)
 - ✓ Knoop (micro hardness)
 - ✓ Nano hardness

(b) Rebound hardness

- ❖ It is the resistance offered by a material to strike and absorb energy for plastic deformation under impact loads, causing the hammer to rebound.
- ❖ Most common example is the 'Shore scleroscope hardness test' which measures the hardness in terms of the rebound height of the indenter. It is virtually an indentation test.

(c) Scratch hardness

- ❖ It is the resistance of a material to scratch by another material, for example Mohs scale of hardness which is discussed after.

(d) Wear or abrasion hardness

- ❖ It is the resistance of a material to abrasion and wear, when subjected to rotational or sliding motion, for example file hardness test.

(e) Cutting hardness

- ❖ It is the resistance of a material to various cutting or drilling operations. This hardness is a measure of machinability of materials.

3. MOHS SCALE

- ❖ Mohs scale of hardness is widely used in the field of mineralogy but rarely applied for the testing of metals and alloys; it is a qualitative ordinal scale characterizing scratch resistance of various minerals through the ability of harder material to scratch softer material.

Mohs scale	Material
1	Talc
2	Gypsum
3	Calcite
4	Fluorite
5	Apatite
6	Orthoclase feldspar
7	Quartz
8	Topaz
9	Corundum
10	Diamond

4. INDENTER

- ❖ Indenter is the tool of material which causes deformation or indentation on the surface of the specimen to be tested which must be harder than the test piece.
- ❖ The deformation mark or impression on the surface of the test piece is called indentation.

Indenter Type	Test
Hard metal ball	Brinell hardness test
Right pyramid with a square base	Vickers hardness test
Diamond or ball type	Rockwell hardness test

5. SELECTION CRITERIA OF HARDNESS TESTER

Main elements to consider before choosing a hardness tester

(a) Test load

- ❖ This is determined by the hardness of the material. Metals such as steel or alloys, for example, require test loads of up to 3,000 kgf, while soft metals require only 500 kgf. The higher the load, the higher the accuracy. It is important to note that the impression should not exceed 1/10 of the thickness of the sample.

(b) Hardness range

- ❖ It determines the material of the indenter. Over 650 HB/30 hardness, you should favor a diamond indenter. Below this value, steel or hard metal indenters are suitable.

(c) Accuracy level

- ❖ It depends on the surface to be measured (cleanliness, flat surface, static or dynamic system, etc).

(d) Adaptability of the device

- ❖ Its importance varies according to the shape and size of the samples to be tested.

6. BENEFITS OF HARDNESS TEST

- ❖ Easy
- ❖ Inexpensive
- ❖ Quick
- ❖ Non-destructive
- ❖ May be applied to the samples of various dimensions and shapes
- ❖ May be performed in-situ

