



جامعة المستقبيل
AL MUSTAQBAL UNIVERSITY

Class: `1st Stage
Subject: Engineering Materials

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Mechanical Testing

Hardness Testing

Hardness has already been defined as the resistance of a material to **indentation** or abrasion by another hard body (good hardness generally means that the material is resistant to scratching and wear). A **hard indenter** is pressed into the specimen by a standard load, and the magnitude of the **indentation** (either area or depth) is taken as a measure of hardness.

The Brinell Hardness Test

In this test, hardness is measured by pressing a hard steel, tungsten and cemented carbide ball (usually 10 mm in diameter) into the surface of the test piece, using a known load. It is important to choose the combination of **load** and **ball size** carefully so that the indentation is free from distortion and suitable for measurement. The relationship of the Brinell hardness [H_B] which is between load P (kg), the diameter D (mm) of the hardened ball indenter and the diameter d (mm) of the indentation on the surface is given by the expression:

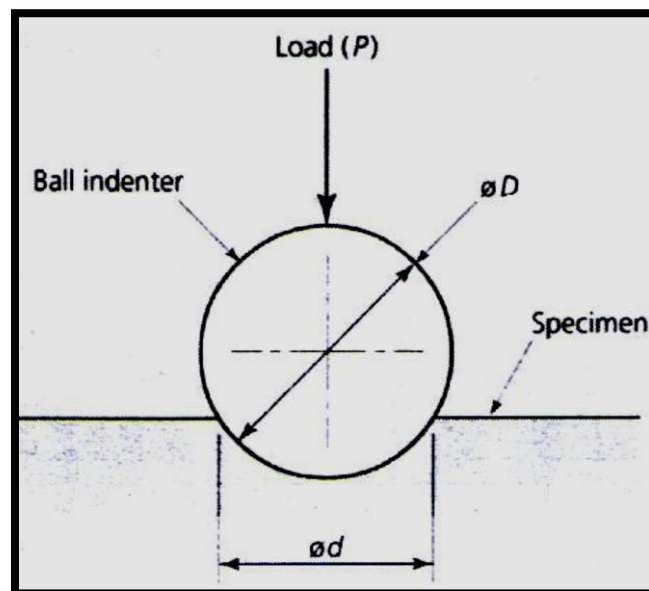


Figure1. Principle of the Brinell hardness test.



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The Vickers Hardness Test

This test is preferable to the Brinell test where hard materials are concerned, as it uses a diamond indenter. **Diamond** is the hardest material known - approximately **6000 H_B**. The diamond indenter is in the form of a square-based pyramid with an angle of **136°** between opposite faces.

Since only one type of indenter is used, the load has to be varied for different hardness ranges. Standard loads are **(5, 10, 20, 30, 50 and 100) kg**. It is necessary to state the load when specifying a Vickers hardness number. For example, if the hardness number is found to be **200** when using a **50 kg** load, then the hardness number is written as **H_V (50) = 200**.

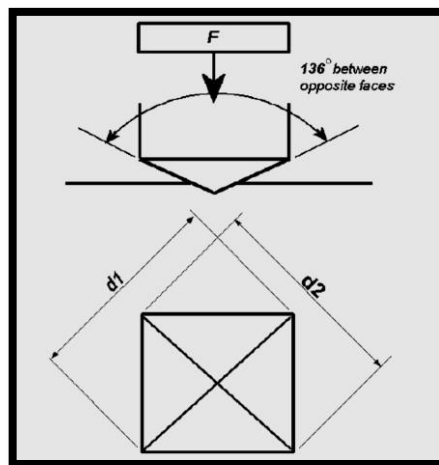


Figure 2. The Vickers hardness test method

The Rockwell Hardness Test

The Rockwell hardness test uses a small-diameter steel ball for soft materials and a diamond cone, or Brale, for harder materials. Therefore, it is widely used in industry as it is:

- 1.Quick and simple.
- 2.Direct reading.
- 3.Freedom from personal error (require no special skills).



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4.Ability to distinguish small hardness difference.

5.Small size of indentation, and

6.They are so simple to perform.

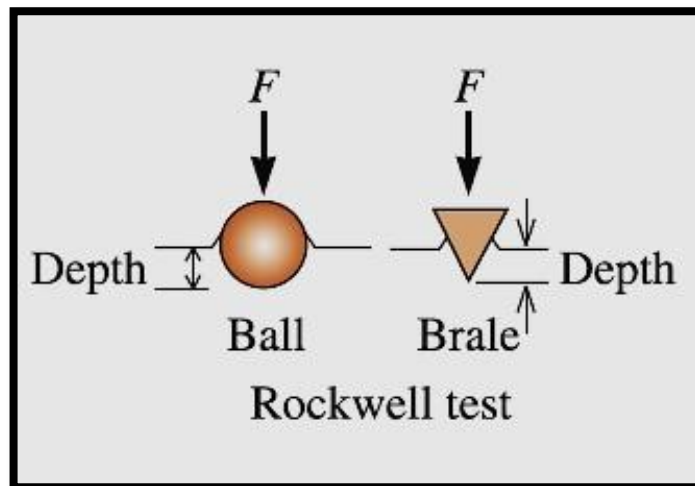


Figure 3. The Rockwell hardness test.