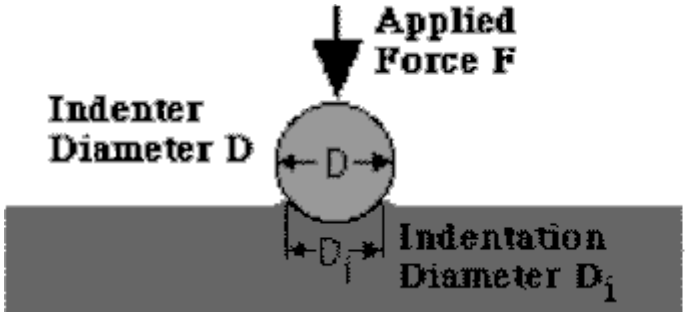
Zwick / Roell

Indentec
Hardness Testing

Indentec Hardness Testing Machines Limited, West Midlands, DY9 8HX

The Brinell Hardness Test

The Brinell hardness test method consists of indenting the test material with a tungsten carbide ball of either 1, 2.5, 5 or 10 mm diameter by applying a test force of between 1 and 3000 kgf. The full load is normally applied for 10 to 15 seconds in the case of iron and steel and for at least 30 seconds in the case of other metals. The diameter of the indentation left in the test material is measured. The Brinell harness number is calculated by dividing the load applied by the surface area of the indentation.



$$BHN = \frac{F}{\frac{\pi}{2} D \cdot (D - \sqrt{D^2 - D_i^2})}$$

The diameter of the impression is the average of two readings at right angles and the use of a Brinell hardness number table can simplify the determination of the Brinell hardness. Modern electronic testers offer inbuilt measuring systems with either manual or computer assisted automatic indentation measurement.

A well structured Brinell hardness number reveals the test conditions, for example
"75 HBW 10/500/30" which means that a Brinell Hardness of 75 was obtained using a 10mm diameter tungsten carbide ball with a 500 kgf test force for a period of 30 seconds.

When testing extremely hard metals the tungsten carbide ball indenter may not be suitable as the Brinell scale is limited to materials with hardness values of approximately 650 HBW. For such materials the Rockwell and Vickers tests are more suitable.

Compared to the other hardness test methods, the Brinell ball makes the deepest and widest indentation, so the test averages the hardness over a wider amount of material, which will more accurately account for multiple grain structures and any irregularities in the uniformity of the material. This method is the best for achieving the bulk or macro-hardness of a material, particularly those materials with heterogeneous structures.