



Metal Hardness Testing

[A comprehensive
Guide Book]

Hardness

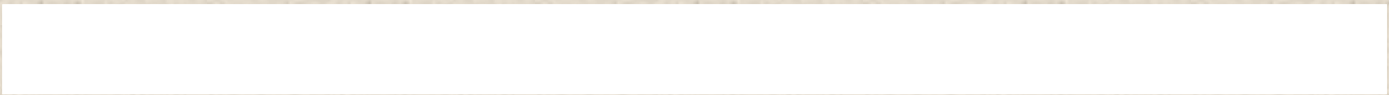
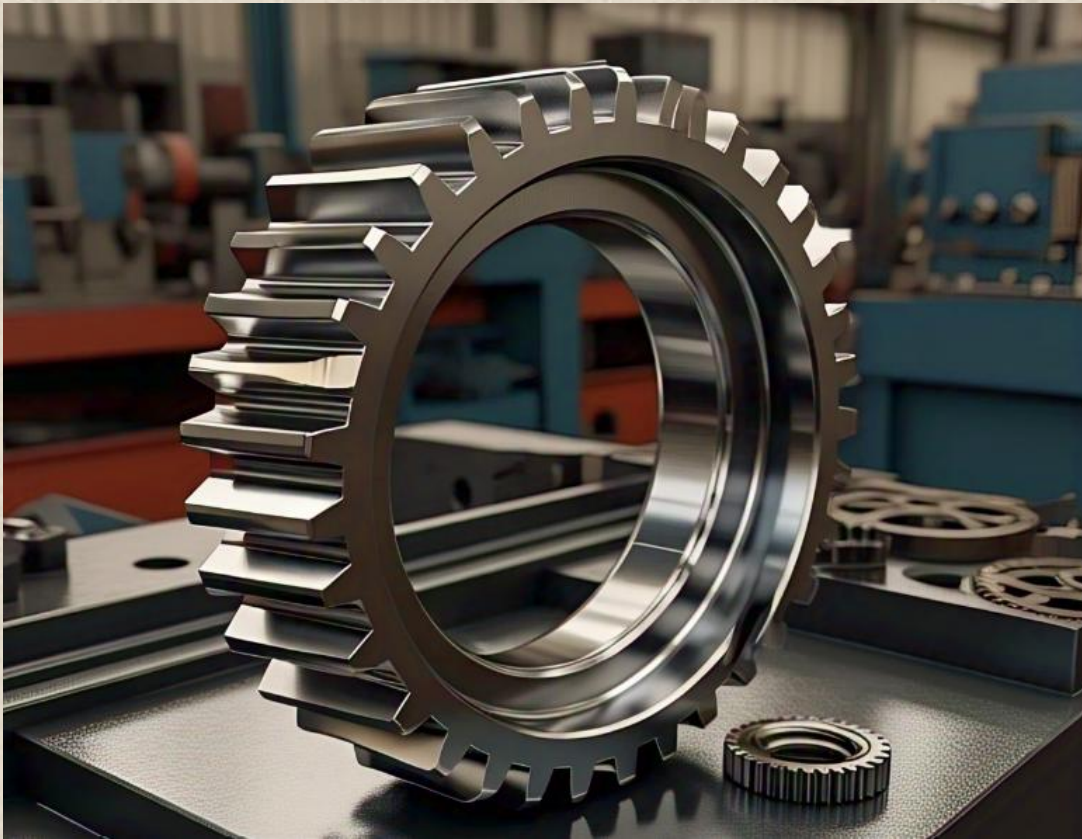
Resistance to
Deformation

[Measurement of
deformation of
material to a
compressive load]

Dependent on

- Ductility
- Elastic stiffness
- Plasticity
- Strain,
- Strength,
- Toughness,
- Viscosity
- Viscoelasticity

4 Types Of Measurement



4 Types Of Measurement

1. Scratch
2. Indentation
3. Wear
4. Rebound

Indentation

Hardness :

Most common
type of Hardness
in Laboratory

Intendation Hardness



Types of Indentation Hardness

1. Rockwell Hardness
2. Brinell Hardness
3. Vickers Hardness
4. Micro Vickers
5. Nano Hardness

1. Rockwell Hardness



1. Rockwell Hardness

- Uses a diamond or ball indenter
- Measures hardness by applying a minor load (10 kgf) and then a major load (60-150 kgf)
- Results are expressed in HRB (Rockwell B) or HRC (Rockwell C) scales
- Suitable for testing a wide range of metals, including steel, aluminum, and copper

2. Brinell Hardness



2. Brinell Hardness

- Uses a 10mm diameter steel ball indenter
- Measures hardness by applying a 3000 kgf load
- Results are expressed in HB (Brinell Hardness) scale
- Suitable for testing softer metals, such as copper, aluminum, and mild steel

3. Vickers Hardness



3. Vickers Hardness

- Uses a diamond pyramid indenter
- Measures hardness by applying a range of loads (0.5-100 kgf)
- Results are expressed in HV (Vickers Hardness) scale
- Suitable for testing a wide range of metals, including very hard materials like tungsten carbide

Key differences:

- Indenter shape and size: Rockwell (diamond or ball), Brinell (steel ball), Vickers (diamond pyramid)
- Load applied: Rockwell (minor & major loads), Brinell (fixed load), Vickers (range of loads)
- Hardness scale: Rockwell (HRB/HRC), Brinell (HB), Vickers (HV)
- Suitable materials: Rockwell (wide range), Brinell (softer metals), Vickers (wide range, including very hard materials)

Micro Vickers



Device used to measure hardness of small or thin materials, such as metals, alloys, and ceramics, at the microscale.

How does it work?

Micro Vickers

The tester uses a pyramid-shaped diamond indenter to apply a precise force to the material's surface. The resulting indentation is then measured using a microscope to determine the material's hardness.

The Micro Vickers hardness scale is similar to the Vickers hardness scale, but it's used for smaller indentation sizes. The scale ranges from HV0.01 to HV100, with higher values indicating greater hardness.

Advantages:

Micro Vickers

1. Small sample testing: Ideal for testing small or fragile samples, such as thin films, coatings, or microelectronic components.
2. High spatial resolution: Enables hardness measurements at specific locations or areas of interest.
3. Precise measurements: Provides reliable and accurate hardness measurements

4. Nano Hardness



Nano Hardness

Hardness measurement to Ultra micro and Nano Level

→ For thin Films , Surface treated Layers , Non metallic Materials , Plastics , Elastic recovery materials (Rubbers , elastomers etc.) where Conventional indentation cannot be used)

Nano Hardness

Evaluates hardness of a wide range of materials

Thin films

Plastics

Rubbers and elastomers

Metallic materials

Fibers

Brittle materials

Microscopic electronic components