

Mechanical Testing Methods Cheat Sheet

Stress, strain, tensile, hardness, fatigue, impact, creep

ENGINEERING
CHEAT SHEET

Key equations

Quantity	Equation	Notes
Engineering stress	$s_e = F / A_o$	Load over the initial area (Pa)
Engineering strain	$e = (l - l_o) / l_o$	Change in length over initial length
True stress	$\sigma = P / A$	Load over the instantaneous area
True strain	$\epsilon = \ln(l / l_o)$	Textbook form; the article's equation is an image
Five stresses	Tensile, compressive, shear, torsional, bending	Materials behave differently under each
Compression specimen	ASTM E9: 1.0 in dia × 2 in tall	Used for cast iron, ceramics, concrete
Hardness standards	Brinell ASTM E10, Rockwell ASTM E18, Vickers, Knoop	Compare only with the same indenter and geometry

Key takeaways

- Engineering stress uses the fixed initial area, so it is the more conservative curve and the one most often used.
- Tensile properties: yield strength, ultimate tensile strength, fracture strength; ductility from elongation.
- Brinell suits inhomogeneous metals like cast iron; it is not for very hard or very soft material, thin parts (thickness under 10× the indent depth), case-hardened surfaces or edges.
- Fatigue: S-N, cyclic stress-strain and fracture-mechanics tests. Steels show an endurance limit; aluminum alloys do not.
- Impact: Charpy (supported both ends) and Izod (cantilever) measure energy absorbed in a sudden load.
- Creep: time-dependent permanent deformation at constant stress; critical in exhaust, turbine blades and rocket motors.
- The article states the steel endurance limit as about 40% of yield. Many references quote about half of the ultimate strength, so check before design use.