

Impact Testing and Temperature Cheat Sheet

Charpy energy, hardness and the DBTT

ENGINEERING
CHEAT SHEET

Key equations

Quantity	Equation	Notes
Impact energy trend	Colder → lower energy, brittle	Warmer → higher energy, ductile
Hardness trend	Colder → harder; warmer → softer	Hardness and impact energy move inversely
DBTT	Temperature band where ductile turns brittle	Found from absorbed energy vs temperature (S-curve)
BCC metals (carbon steel)	Sharp DBTT	Pronounced loss of toughness when cold
FCC metals (aluminum, austenitic SS)	No sharp DBTT	Stay tougher across a wide range
Percent error	$(\text{published} - \text{experimental}) / \text{published} \times 100$	Textbook form used to compare hardness values

Key takeaways

- Specimens: Al-6061, Al-2024, Steel-1018, Steel-1095; Charpy on a Tinius Olsen machine, hardness on a Wilson Brinell tester.
- Conditioned at least 2 hours in a freezer or oven; one specimen per condition, so no means or standard deviations.
- Steel-1095 (0.9–1% carbon) had the smallest hardness change; Steel-1018 had the largest hardness error versus published (22.5%).
- Design use: a sacrificial part such as a woodruff key absorbs more energy when hot and may not break as designed; cold structures lose energy absorption.
- Calibrate the machine with no specimen (3 runs) and subtract that friction loss.
- The Rockwell C results were converted to Brinell B to compare all specimens on one scale.