



Material Property Chart Collection

Facilitator's Guide

Ansys Academic Development Team

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This guide supports the integration of 10 different material property charts in the classroom. These charts were all created with Ansys Granta EduPack™, a set of teaching resources to support materials education

Case Study Package Contents:

- Read Me Facilitator's Guide
- PDF documents for 10 charts

Age Range:

This collection of PDFs can be used at any age.

Prior/Supplemental Knowledge Required:

Explanation of the material properties plotted will be necessary; definitions can be found below (definitions taken from Ansys Granta EduPack 24R2).

Density (ρ)

Mass per unit volume. Units kg/m^3

Young's Modulus (E)

The slope of a stress-strain curve in the elastic region (see Figure to the right). Often considered to be the “stiffness” of a material, *i.e.* stiff materials have a high Young's modulus, while elastic materials have a lower Young's modulus. Units GPa

Yield Strength (σ_y)

The stress at which materials begin to plastically deform. The definition varies, but is considered a 0.2% offset for metals. Units MPa

Tensile Strength (σ_{ts})

The maximum engineering stress (applied load divided by the original specimen cross section) that a material can withstand before failure begins. Units MPa

Fracture Toughness (K_{1c})

Measures the resistance of a material to the propagation of a crack. Units $\text{MPa}\cdot\text{m}^{1/2}$

Mechanical Loss Coefficient (η)

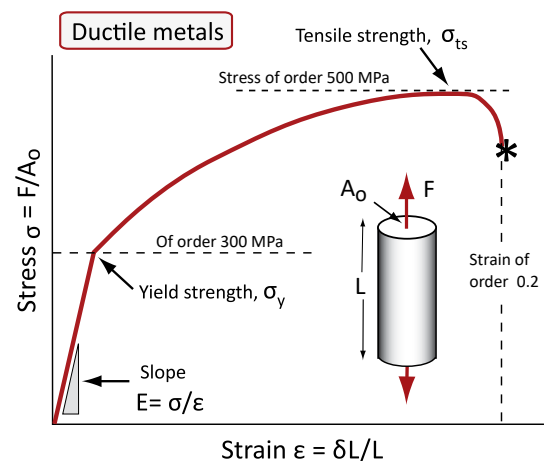
Also referred to as the damping coefficient, this measures the degree to which a material dissipates vibrational energy. Units - none.

Specific Modulus

Equal to the elastic modulus (Young's modulus) per mass density. Sometimes referred to as the stiffness to weight ratio. Equation= E/ρ . Units are $\text{GPa}/(\text{kg/m}^3)$.

Specific Strength

Equal to the yield strength per mass density. Equation= σ_y/ρ . Units are $\text{MPa}/(\text{kg/m}^3)$.



Sketch of a Stress-Strain curve result from a tensile test for a ductile metal. Young's modulus, yield strength, and tensile strength are shown here.

Thermal Conductivity (λ)

Rate at which heat is conducted through a solid at steady state. Units W/m·K.

Electrical Resistivity (ρ_e)

The material property that determines the resistance of a material. Equation is $\rho_e = (A/L) * R$ where A= cross sectional area, L=length of material, and R= electrical resistance (from Ohm's Law). Units Ωm .

Thermal Expansion Coefficient (α)

The thermal strain per degree of temperature change. Units K^{-1}

Example uses

These charts can be used to talk about materials, material properties, product design, and more.



Additional Ansys Resources:

Below are links to Ansys Educational Resources and Ansys Innovation Courses to support teaching around. They are ordered from most applicable (1) to least.

Ansys Education Resources:

1. [Materials Intelligence: the Card Game](#)
2. [The Materials Cube](#)
3. [Quick Materials Selection Projects](#)

Ansys Innovation Courses:

- [Materials Selection with Ashby Charts](#)
- [Intro to Material Performance](#)
- [Intro to Material Elasticity](#)

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Document Information

This instructor's guide is part of a set of teaching resources to help introduce students to materials and materials selection.

Ansyes Education Resources

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