PLASTICS > METALS

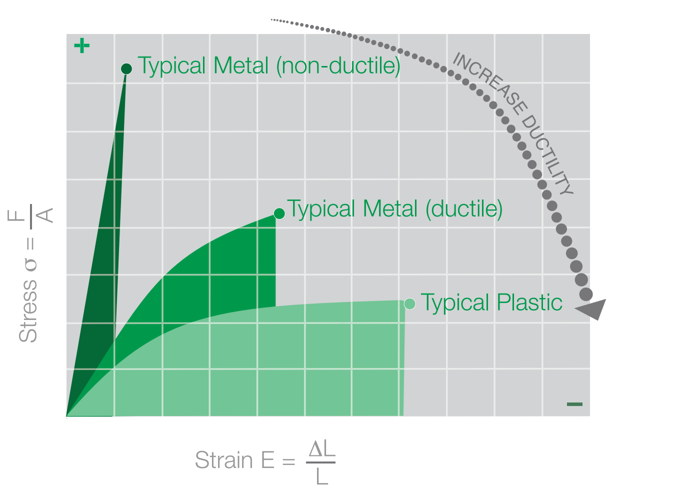
ELASTIC BEHAVIOR

The stress/strain behavior of a plastic differs from that of a metal in several respects, as can be seen in **Figure 3**.

- **The yield stress is lower**
- **The yield strain is higher**
- **The slope of the stress/strain curve may not be constant below the yield point**

The modulus as determined using standard tests is generally reported as the ratio of stress to strain at the origin of loading up to 0.2% strain. The effects of time, temperature and strain rate generally require consideration due to the viscoelasticity of plastics. Strains below 1% remain within the elastic limits of most engineering plastics and therefore allow analysis based upon the assumption that the material is linearly elastic, homogeneous, and isotropic. Another common practice is to design components so that the maximum working stress is 25% of the material's strength. This also minimizes plastics' time-dependent stress/strain behavior.

FIG 3 STRESS VS. STRAIN



IMPACT STRENGTH

Although a number of plastics are well suited for high impact applications, most parts made from rigid engineering plastics require minor design modifications. The relative notch sensitivity or impact resistance of plastics is commonly reported using Izod impact strength. Materials with higher Izod impact strengths are more impact resistant.

THERMAL PROPERTIES

Two important thermal properties for designing plastic components are:

TIPS

Sharp interior corners, thread roots and grooves should be broadly radiused (0.040" min.) to minimize the notch sensitivity of these materials.

- **Continuous Service Temperature**

The temperature above which significant and permanent degradation of the plastic occurs with long exposure.

- **Heat Deflection Temperature**

The softening temperature of a plastic as defined by the ASTM test method (D 648). It is commonly referred to as the maximum service temperature for a highly stressed, unconstrained component.

Note: The strength and stiffness of plastics can be significantly affected by relatively small changes in temperature. Dynamic Modulus Analysis (DMA) curves can be used to predict the effects of temperature change on a given material.

DIMENSIONAL STABILITY

Plastics expand and contract 10 times more than many metals. A material's dimensional stability is affected by temperature, moisture absorption and load. Assemblies, press fits, adhesive joints and machined tolerances must reflect these differences. Certain plastics such as nylons are hygroscopic – absorbing up to 7% water (by weight,when submerged). This can result in a dimensional change of up to 2%. Plastics' inherently lower modulus of elasticity can also contribute to dimensional change including part distortion during and after machining.