SELECTED SYMBOLS, FORMULAS AND CONVERSION FACTORS

Symbols

Symbol	Description	Preferred Units
F	Force	N
L	Length	mm, cm or m
A	Area	mm^2, cm^2 or m^2
s	Engineering stress	MPa
e	Engineering strain	-
F	True stress	MPa
,	True strain	-
t	Time	s

Conversion Factors

Description	Conversion Factors
Mass	1 kg = 2.207 lbs
Force	1 N = 10^6 dynes = 0.2248 lbf
Length	1 in = 25.4 mm = 2.54 cm = 2.54×10^{-2} m
Area	1 in^2 = 645.16 mm^2 = 6.4516 cm^2 = 6.4516×10^{-4} m^2
Stress, pressure	1 MPa = 1 MN/m^2 = 145 psi
Energy, work	1 J = 10^7 ergs = 6.242×10^{11} eV = 0.239 cal

Stress and Strain

	Nominal	True
Stress	$s = \dfrac{F}{A_0}$	$\sigma = \dfrac{F}{A}$
Strain	$e = \dfrac{\Delta L}{L_0}$	$\epsilon = \displaystyle\int_{L_0}^{L_f} \frac{dL}{L} = \ln\left(\frac{L_f}{L_0}\right)$
	$e = -\dfrac{\Delta A}{A_0}$	$\epsilon = \ln\left(\dfrac{A_o}{A_f}\right)$ (See note 1)
Strain Rate	$\dot{e} = \dfrac{de}{dt} = \dfrac{dL}{L_0 dt}$	$\dot{\epsilon} = \dfrac{d\epsilon}{dt}$

Note 1: Constant volume is assumed ($A_0 L_0 = A_f L_f$).

The true stress and strain can be written in terms of the nominal stress and strain, as long as the specimen has not started necking, by the equations

$$\sigma = s(e+1)$$

and

$$\epsilon = \ln(e+1)$$

Elastic Moduli

Modulus	Equation
Young's Modulus	$E, Y = \frac{d\sigma}{d\epsilon}$
Poisson's Ratio	$\nu = -\frac{\epsilon_x}{\epsilon_z}, \text{ For constant volume } \nu = 0.5$
Shear Modulus	$G = \frac{d\tau}{d\gamma} = Y\frac{1}{2(1+\nu)} = K\frac{3(1-2\nu)}{2(1+\nu)}$
Bulk Modulus	$K = \frac{d\sigma_{hyd}}{\frac{dV}{V}} = G\frac{2(1+\nu)}{3(1-2\nu)}$