Mechanical Behaviour of Materials

Chapter 16
Creep

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Introduction to creep

Creep : time-dependent plastic deformation at high temperature

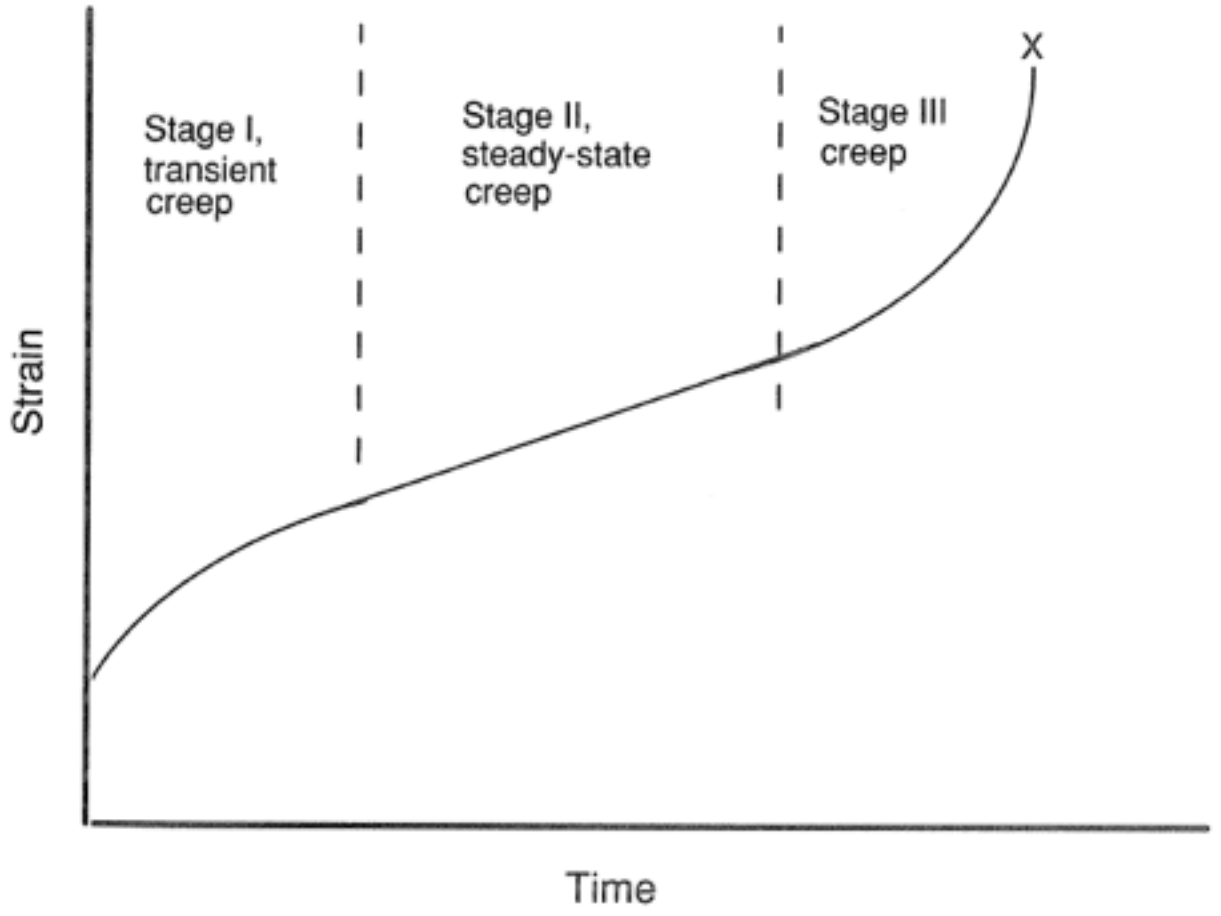
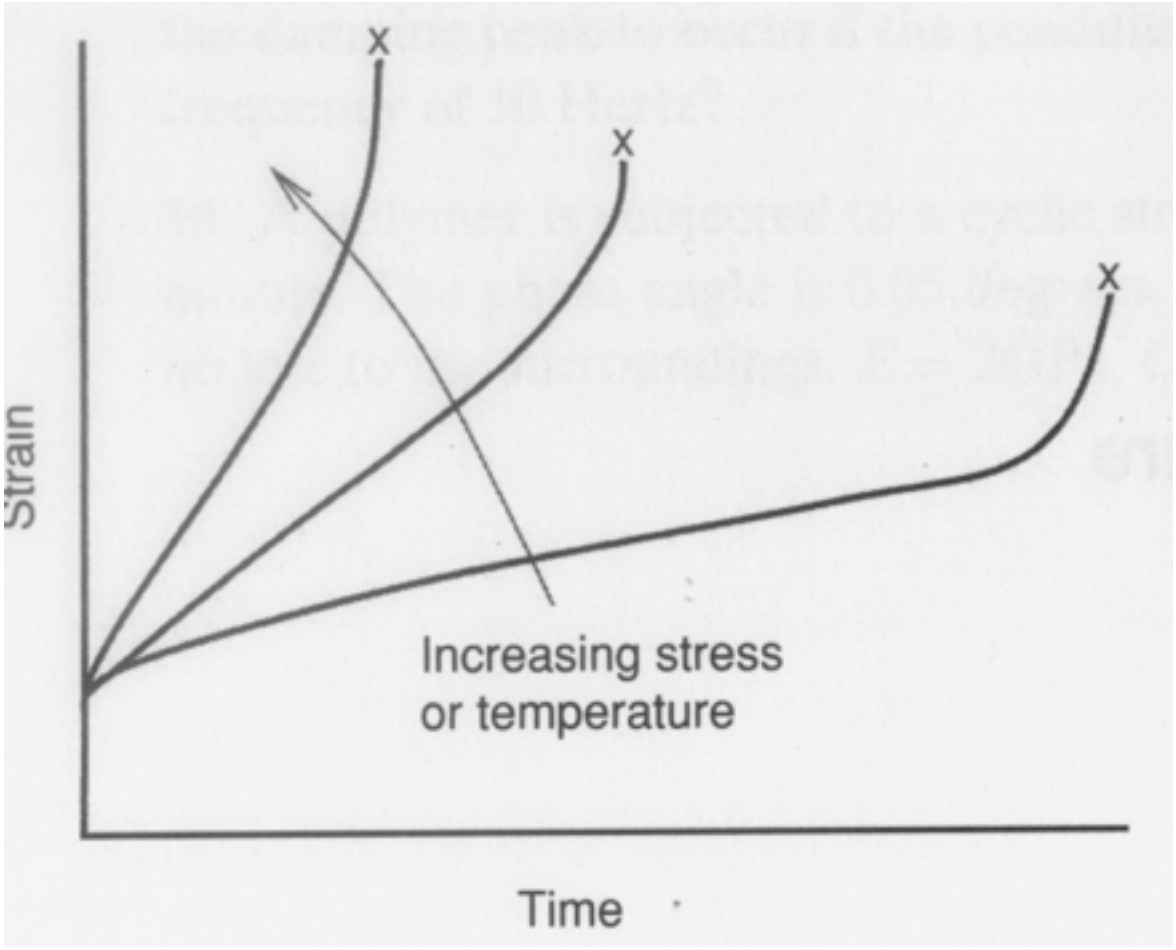
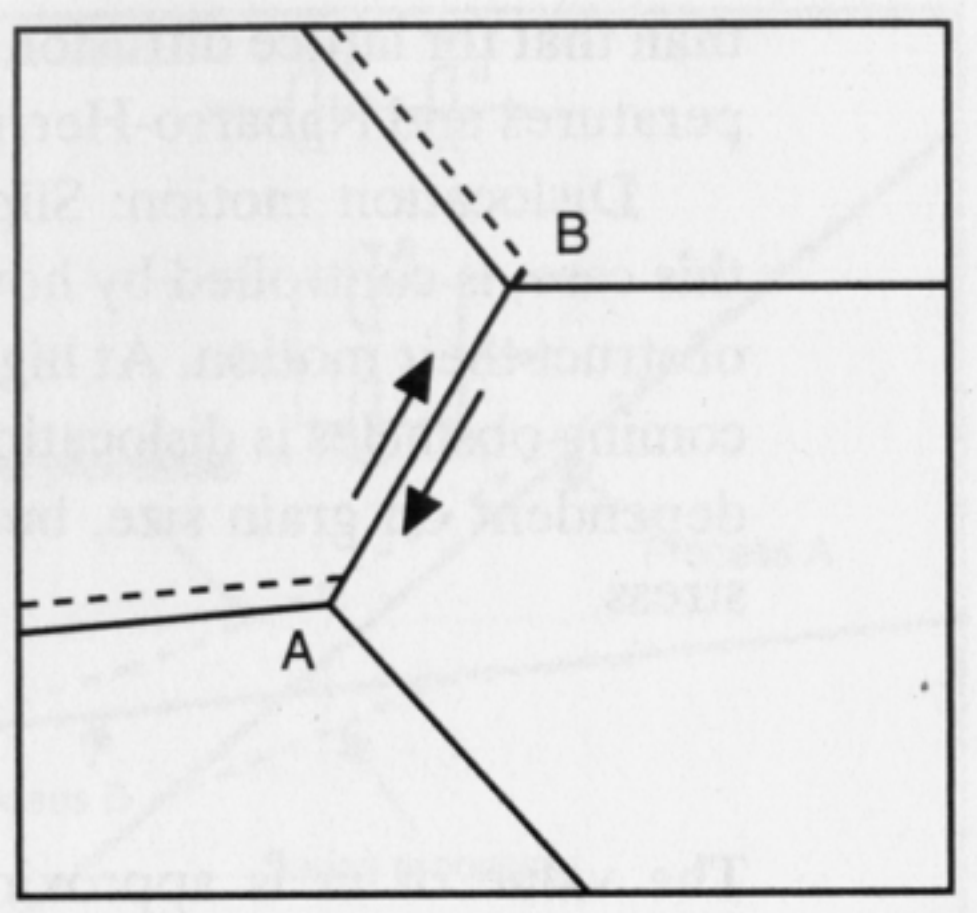


Figure 16.1. Typical creep curve showing three stages of creep.

Effect of temperature and stress on creep



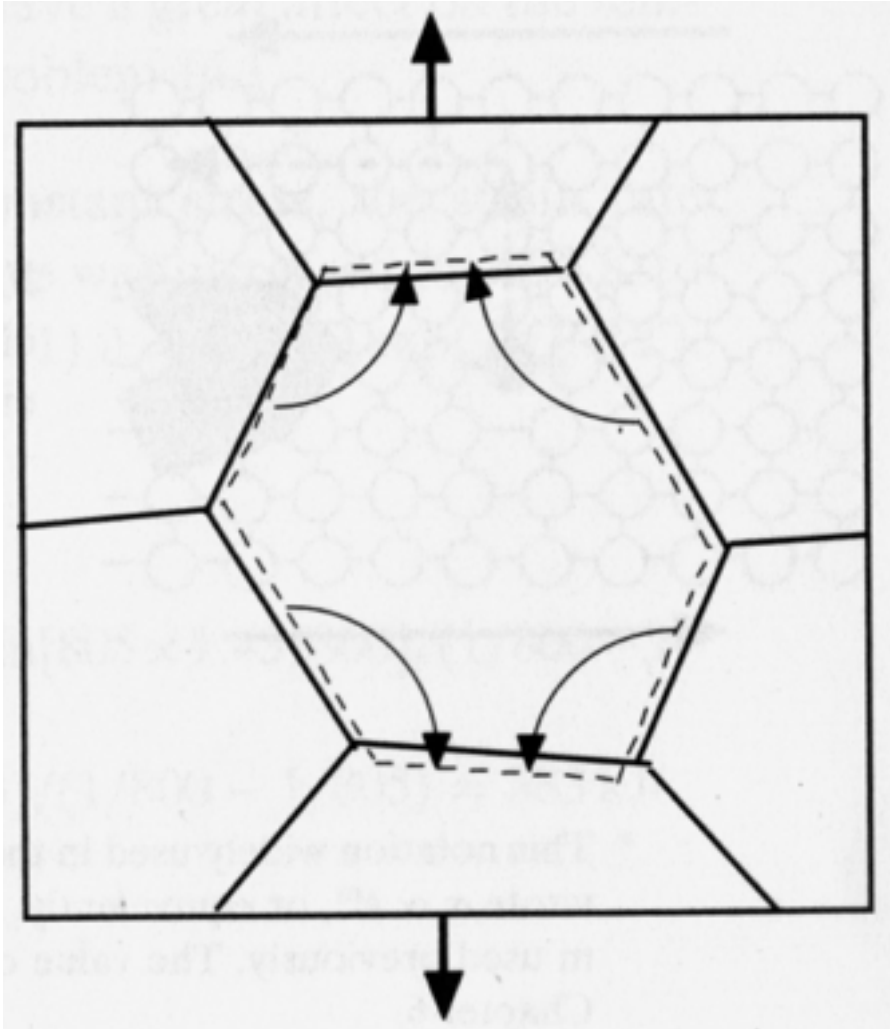
Creep mechanism: Nabarro-Herring creep



$$\dot{\varepsilon}_{N-H} = A_L \frac{\sigma}{d^2} D_L$$

The creep occurs by diffusion through the lattice

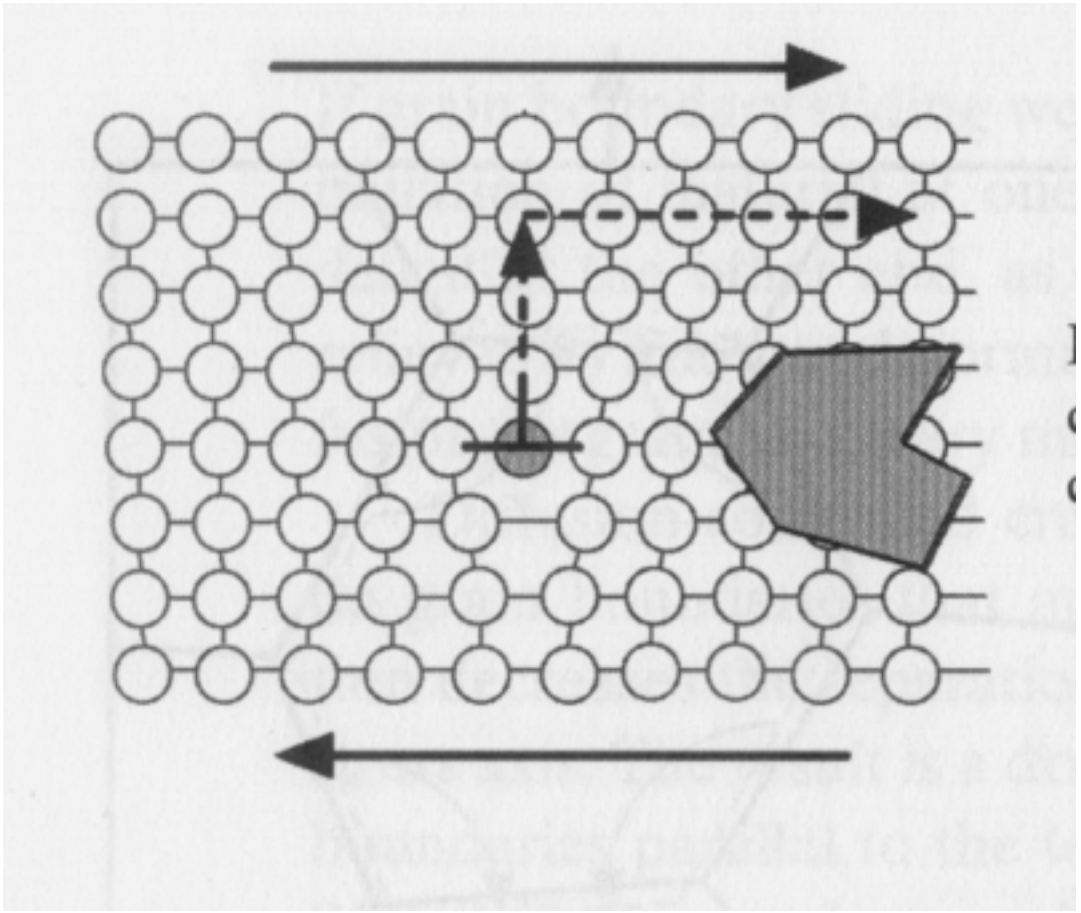
Creep mechanism: Coble creep



$$\dot{\varepsilon} = A_G \frac{\sigma}{d^3} D_{gb}$$

The creep occurs by diffusion along grain boundaries

Creep mechanism: dislocation movement



$$\dot{\varepsilon} = A_S \sigma^m$$

The creep occurs by diffusion along grain boundaries

Deformation Mechanism Maps

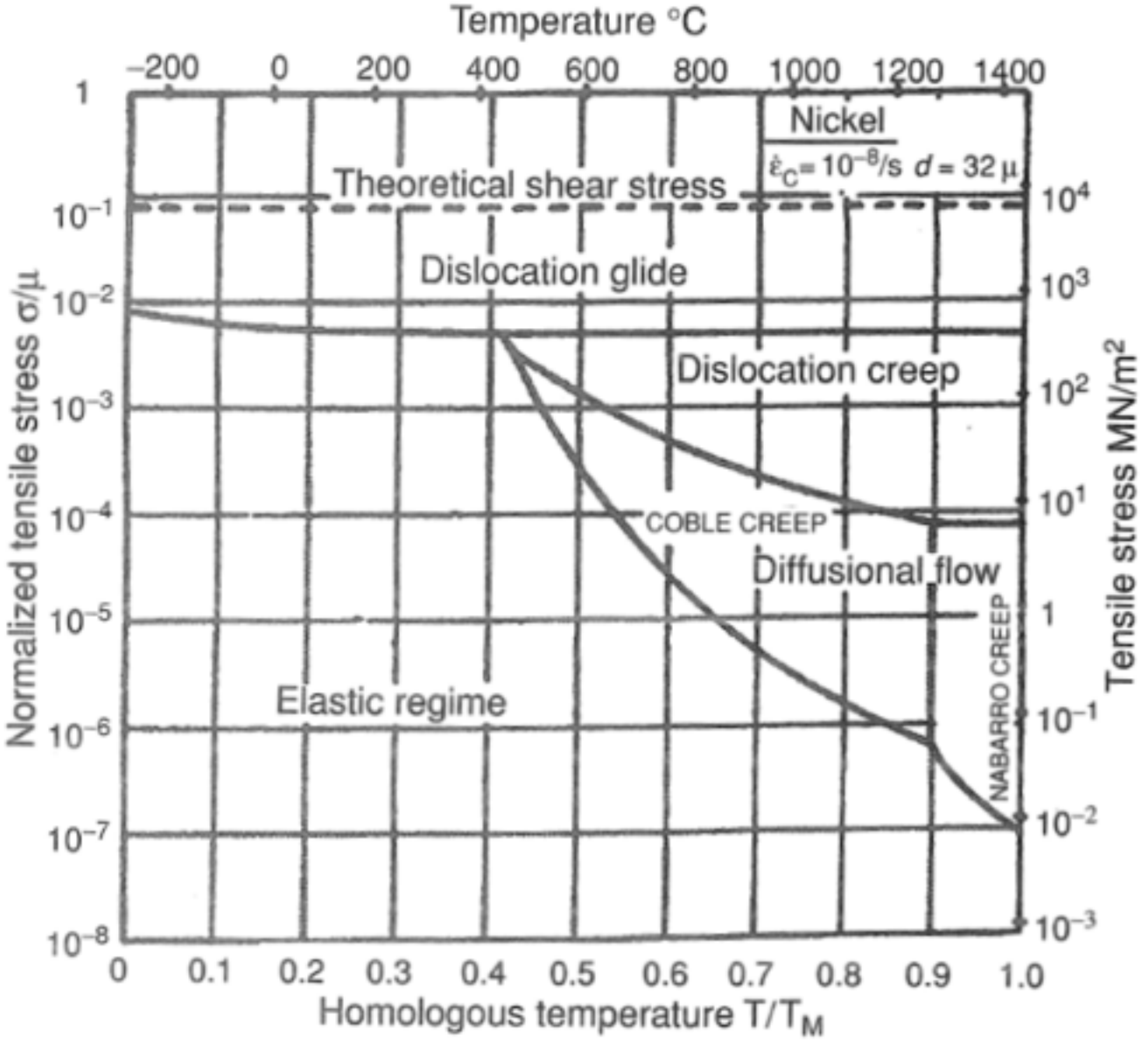


Figure 16.7. Deformation mechanism map for pure nickel with a grain size of $d = 32\ \mu$m. The strain rate is a function of stress and temperature. Different mechanisms are dominant in d regimes. Coble creep is controlled by grain boundary diffusion and Nabarro creep by lattice diffusion. From M. F. Ashby, *Acta Met.*, v. 20 (1972).

Alloys for high temperature applications

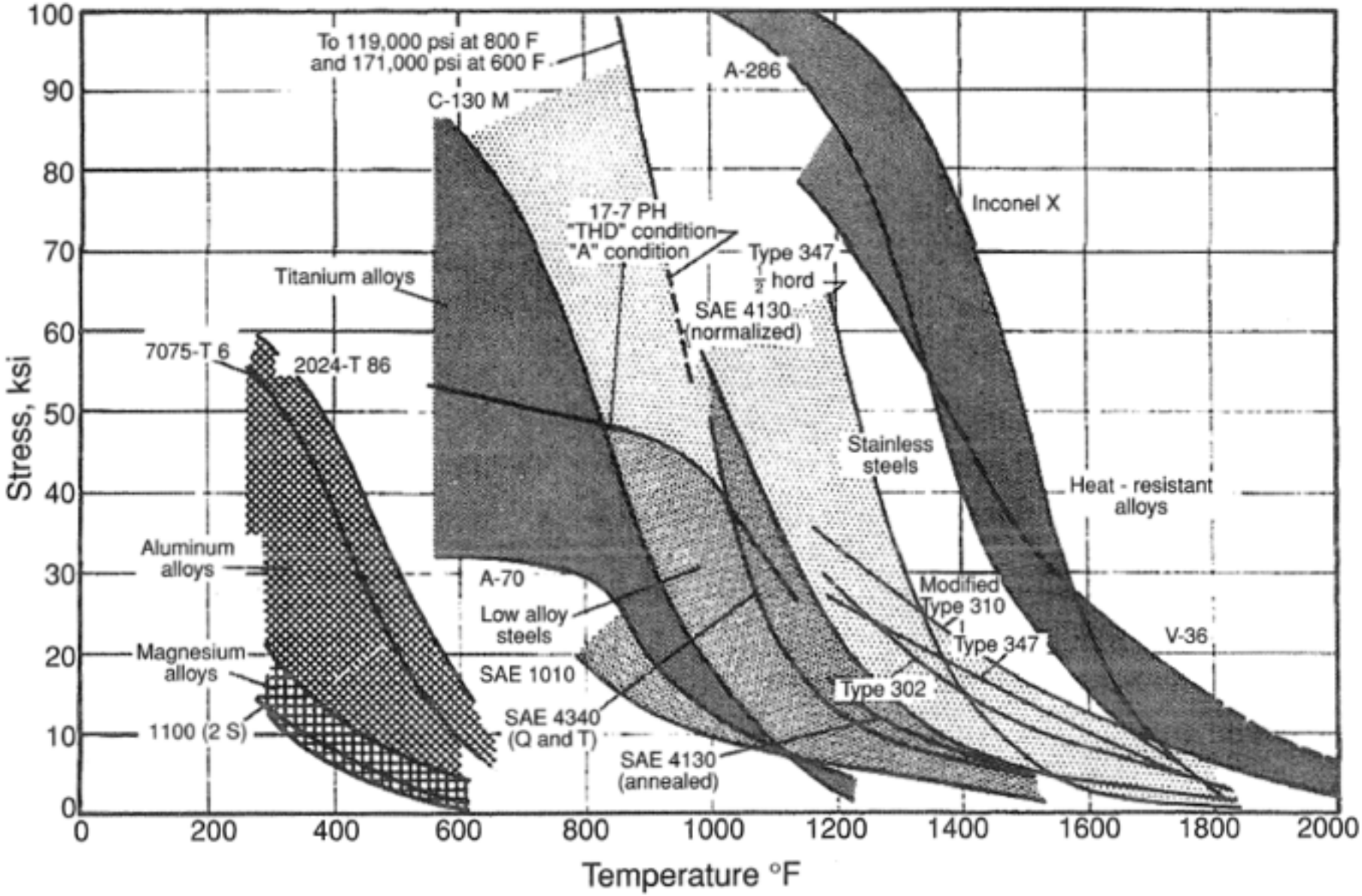


Figure 16.17. Strength of various alloys at high temperatures. From J. A. van Echo, *Short-Time High Temperature Testing*, ASM International (1958).