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Change of shear modulus and yield stress with pressure and temperature YEHUDA PARTOM, Retired — It is well known that the shear modulus (G) and yield stress (Y) of metals increase with pressure (P) and decrease with temperature (T). Steinberg, in his popular compendium of dynamic material properties, assumes for $Y/Y_0(P,T)=G/G_0(P,T)$ linear relations based on derivatives determined experimentally at ambient conditions. But recent tests of certain metals found, although with some scatter, that G(P) along the principal Hugoniot is higher than what follows from Steinberg's relations. Here we use a different approach to estimate $G/G_0(P,T)$. As a first approximation we let G(P,T) follow from assuming a constant Poisson (ν) ratio, which leads to $G/G_0 = K/K_0$, where K is the isentropic bulk modulus. With this assumption we compute the longitudinal sound speed of tantalum along its principal Hugoniot, and compare to recent measurements. There is slight disagreement, which we correct by assuming (second approximation) that Poisson's ratio increases with temperature to 0.5 at melting. We calibrate this increase to fit the data for tantalum along the Hugoniot, and get that $Y/Y_0 = G/G_0 = K/K_0[1+a(T-T_0)]$. As $K= \rho c^2$ is always available in a hydrocode run, so are G/G_0 and Y/Y_0.

Yehuda Partom
Retired

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