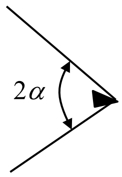
A projectile in flight carries with it a more or less conical-shaped shock front. From physical reasoning it appears that at great distances from the projectile this shock wave becomes truly conical and changes in velocity and density across the shock become vanishingly small.

Photographs of a bullet in flight show that at a great distance from the bullet the total included angle of the cone is 50.3°. The pressure and temperature of the undisturbed air are 14.62 psia and 73 °F, respectively. Calculate:

a. the velocity of the bullet, in ft/sec, and
b. the Mach number of the bullet relative to the undisturbed air.

SOLUTION:



2α	=	$50.3°$
p_{atm}	=	14.62 psia
T_{atm}	=	73 °F = 533 °R
γ_{air}	=	1.4
R_{air}	=	53.3 $(\text{ft}\cdot\text{lb}_f)/(\text{lb}_m\cdot°\text{R})$

$$\boxed{\sin\alpha = \frac{1}{\text{Ma}}} \Rightarrow \boxed{\text{Ma} = 2.35}$$

$$\text{Ma} = \frac{V}{c} = \frac{V}{\sqrt{\gamma RT}} \Rightarrow \boxed{V = \text{Ma}\sqrt{\gamma RT_{\text{atm}}}} \Rightarrow \boxed{V = 2660 \text{ ft/s}}$$