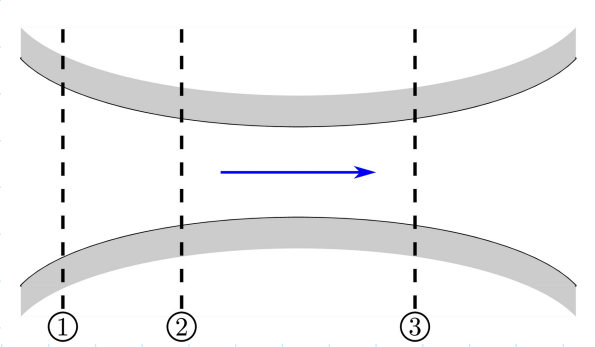
Problema 3

Monday, January 4, 2021 6:06 PM



$V_1 = 180\ m/s$

$P_1 = 500\ kPa$

$T_1 = 470\ K$

$A_1 = 0.05\ m^2$

$A_2 = A_3 = 0.036\ m^2$

a) calculen las condiciones de flujo en ②

$$Ma_1 = \frac{V_1}{c_1} = \frac{V_1}{\sqrt{kRT_1}} = 0.415$$ ← Subsónico

$$\frac{T_0}{T_1} = \left(1 + \frac{k-1}{2} Ma_1^2\right) \Rightarrow T_0 = 486.2\ K$$

$$\frac{P_0}{P_1} = \left(1 + \frac{k-1}{2} Ma_1^2\right)^{\frac{k}{(k-1)}} \Rightarrow P_0 = 563\ kPa$$

Área crítica:

$$\frac{A_1}{A^*} = \frac{(1+0.2Ma_1^2)^3}{1.728 Ma_1} = 1.544$$

$$A^* = 0.0323\ m^2$$

a) $A_2 = (1+0.2\ Ma_2^2)^3$

a) $\frac{A_2}{A^*} = \frac{(1+0.2\,Ma_2^2)^3}{1.728\,Ma_2}$

$\frac{A_2}{A^*} = \frac{0.036\,m^2}{0.0323\,m^2} = 1.115 = \frac{(1+0.2\,Ma_2^2)^3}{1.728\,Ma_2}$

$Ma_2 = 0.673$

↳ $\frac{T_0}{T_2} = 1.091 \rightarrow T_2 = 445.6\,K$

$\frac{p_0}{p_2} = 1.357 \rightarrow p_2 = 415.5\,kPa$

$V_2 = Ma_2 \cdot C = Ma_2 \sqrt{k \cdot R T_2}$

$\Rightarrow V_2 = 284.5\,m/s$

b) $\frac{A_3}{A^*} = \frac{(1+0.2\,Ma_3^2)^3}{1.728\,Ma_3}$

$\frac{0.036}{0.0323} = \frac{(1+0.2\,Ma_3^2)^3}{1.728\,Ma_3}$

$Ma_3 = 1.4$

$\frac{p_0}{p_3} = 3.1823 \Rightarrow p_3 = 1.769\,kPa$

$$\frac{T_0}{T_3} = 1.392 \rightarrow T_3 = 349.3\ K$$