FLUID MECHANICS FOR MECHANICAL ENGINEERING (ME 208F)

Section B:
Compressible Fluid Flows - I

Basic Equations for One-Dimensional Compressible Flow

✓Control Volume

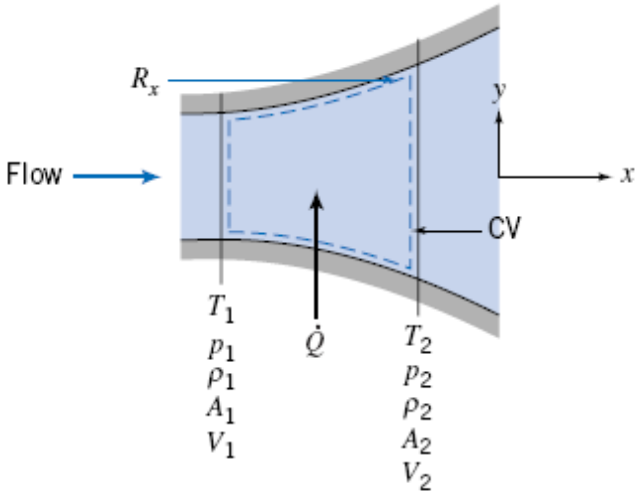

Fig. 13.1 Control volume for analysis of a general one-dimensional flow.

Basic Equations for One-Dimensional Compressible Flow

- ✓ **Continuity**

$$\rho_1 V_1 A_1 = \rho_2 V_2 A_2 = \rho V A = \dot{m} = \text{constant}$$

- ✓ **Momentum**

$$R_x + p_1 A_1 - p_2 A_2 = \dot{m} V_2 - \dot{m} V_1$$

Basic Equations for One-Dimensional Compressible Flow

- ✓ **First Law of Thermodynamics**

$$\frac{\delta Q}{dm} + h_1 + \frac{V_1^2}{2} = h_2 + \frac{V_2^2}{2}$$

- ✓ **Second Law of Thermodynamics**

$$\dot{m}(s_2 - s_1) \geq \int_{CS} \frac{1}{T}\left(\frac{\dot{Q}}{A}\right) dA$$

Basic Equations for One-Dimensional Compressible Flow

- ✓ **Equation of State**

$$p = \rho RT$$

- ✓ **Property Relations**

$$\Delta h = h_2 - h_1 = c_p \Delta T = c_p (T_2 - T_1)$$

$$\Delta s = s_2 - s_1 = c_p \ln \frac{T_2}{T_1} - R \ln \frac{p_2}{p_1}$$