MEASURES OF FLUID MASS AND WEIGHT

**Density**
Density is defined as *mass per unit volume*:

$$\rho = \frac{m}{V}$$

units: \([\rho] = \text{kg/m}^3\)

For a differential volume element of mass \(\delta m\) and volume \(\delta V\), density can be expressed as \(\rho = \frac{\delta m}{\delta V}\).

For an ideal gas: \(P = \rho RT\), where \(P\) is the absolute pressure, \(R\) is the gas constant, and \(T\) is the thermodynamic temperature.

**Specific Volume**
The specific volume is the reciprocal of density and is defined as *volume per unit mass*:

$$\alpha = \frac{1}{\rho}$$

units: \([\alpha] = \text{m}^3/\text{kg}\)

**Specific Weight**
The weight of a unit volume of substance is called specific weight and is expressed as:

$$\gamma = \rho g$$

units: \([\gamma] = \text{N/m}^3\)

where \(g\) is the gravitational acceleration.

**Specific Gravity**
The specific gravity is defined as the ratio of the density of a substance to the density of some standard substance at a specified temperature (usually water at 4°C, for which \(\rho_{\text{H}_2\text{O}} = 1000\) kg/m³):

$$SG = \frac{\rho}{\rho_{\text{H}_2\text{O}@4^\circ\text{C}}}$$

units: dimensionless