1 Fluid Description

$$\frac{\partial \rho}{\partial t} + \nabla \cdot (\rho \mathbf{v}) = 0 \tag{1}$$

$\partial \rho_e / \partial t + \nabla \cdot \mathbf{j} = 0$

$$\frac{\partial (\rho \mathbf{v})}{\partial t} + \nabla \cdot (\rho \mathbf{v} \otimes \mathbf{v}) = 0 \tag{2}$$

$\nabla \cdot (\rho \mathbf{v}) = \partial_i (\rho v_i) = v_i \partial_i \rho + \rho \partial v_i$

$$\frac{d\rho}{dt} = -\rho \nabla \cdot \mathbf{v} \tag{3}$$

$$\frac{d}{dt} \equiv \frac{\partial}{\partial t} + \mathbf{v} \cdot \nabla \tag{4}$$

$$\rho \frac{d\mathbf{v}}{dt} = -\nabla P \tag{5}$$

$$\frac{\partial (\rho \mathbf{v})}{\partial t} + \nabla \cdot (\rho \mathbf{v} \otimes \mathbf{v} + P \mathbb{I}) = 0 \tag{6}$$

$$e = \frac{1}{2} v^2 + u \tag{7}$$

$$P = \frac{\rho}{\mu m_{\mathrm{p}}} k_{\mathrm{B}} T \tag{8}$$

$$u = \frac{N}{2} \frac{k_{\mathrm{B}} T}{\mu m_{\mathrm{p}}} = \frac{1}{\gamma - 1} \frac{k_{\mathrm{B}} T}{\mu m_{\mathrm{p}}} \tag{9}$$

$P = (\gamma - 1) \rho u$

$$\frac{\partial (\rho e)}{\partial t} + \nabla \cdot [(\rho e + P) \mathbf{v}] = 0 \tag{10}$$