

Hypo-elasticity and Plasticity. II

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1. **Introduction.** In a previous paper by the present writer (1956) TRUESDELL's theory of hypo-elasticity (1955) was used to derive equations suitable for plastic flow of an incompressible work-hardening body. The present paper is concerned with the corresponding results for compressible bodies. In addition, the plastic flow of compressible bodies with zero work-hardening is discussed. In this case, by considering a simple special form of the general equations in the non-plastic region, we show that the yield criterion must then be of the von Mises type. Among the possible corresponding equations of plastic flow we find equations which are usually used in the theory of plasticity (HILL 1950, PRAGER & HODGE 1951), except that "rate of change of stress" is defined here to have the correct tensorial form. Work which is related to but different from that of the present paper has been published recently by THOMAS (1955).

2. **Notation.** We use a fixed system of general curvilinear coordinates x^i with corresponding metric tensors $g_{rs}(x)$, $g^{rs}(x)$. If v_i is the covariant velocity vector the rate of deformation tensor d_{ij} is defined by

$$d_{ij} = \frac{1}{2}(v_{i,i} + v_{j,i}), \quad (2.1)$$

where a comma denotes covariant differentiation. We denote the stress tensor by $2\mu s_{ij}$ where μ is one of the usual Lamé constants of classical elasticity. The stress deviator and the rate of strain deviator, denoted respectively by $2\mu t_{ij}$ and f_{ij} , are defined by the equations

$$t_i^i = s_i^i - \frac{1}{3}s_r^r \delta_i^i, \quad f_i^i = d_i^i - \frac{1}{3}d_r^r \delta_i^i, \quad (2.2)$$

and we see that

$$t_i^i = 0, \quad f_i^i = 0. \quad (2.3)$$

In formulating constitutive equations of the type

$$\text{rate of stress} = f(\text{stress, rate of deformation}), \quad (2.4)$$