Elevated temperatures and prestresses on evolving yield surfaces for modelling experimental data

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**Abstract**. Phillips and his collaborators obtained a series of experimental data from tubthin-walled specimens of aluminium alloy at room and at elevated temperatures. These data were beautifully executed in stress-controlled experiments, neatly recoded in various aspects and well known already for five decades; however, modelling these experimental data encountered tremendous difficulties. In this paper we evoked Lie groups and Lie algebras to devise closed-form solutions, facilitating our grasp of physical meaning obtained previously. Our axial-torsional model features an evolving cubic distortional yield hypersurface, which is articulated with two Mises hyperspheres, characteristic of internal symmetry of two elements of the projective proper orthochronous Poincare group in the plastic phase. Associated with each Mises hypersphere in stress space is a normality plastic flow rule of mixed-exp-AF, referring to a combined isotropic-kinematic rule of hardening-softening, which combines the isotropic exponential rule of degree 2 and the kinematic rule of Armstrong-Frederick.

**Keywords: elevated temperatures, modelling experimental data, flow elastoplasticity, Lie groups, closed-form solutions, cubic distortion yield surface, axial-torsional stress-controlled test.**