Material modelling of sheet metal by bi-axial experiments

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In Finite Element calculations the plastic material behaviour can be described with a yield criterion and a hardening rule. Commonly used yield criterions in sheet metal forming are based on uni-axial tensile tests. These criterions do not always describe the yield behaviour sufficiently accurate. Therefore Vegter [1] proposed a new yield criterion.
The Vegter yield criterion is based on measurements of multi-axial yield stress states: the pure shear state, the uni-axial state, the plane strain state and the equi-bi-axial state.

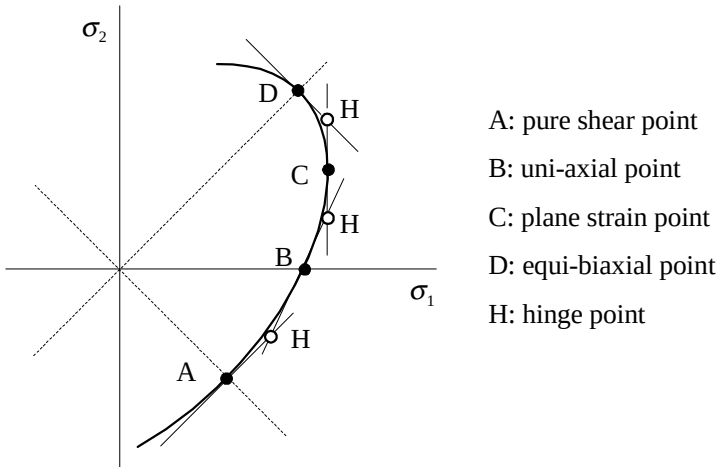

Figure 1: *The four reference points to construct the Vegter yield function*

To measure the multi-axial stress states a multi-axial test equipment has been designed. The test equipment is capable of imposing a shear deformation and a plane strain deformation, including combinations of both deformations. With the test equipment the part of the yield surface between the pure shear reference point and the plane strain point can be measured, see figure 1.
The Vegter yield function is validated on basic deep draw products and a complicated product, in which it provides realistic results.

Reference:

[1] H. Vegter, P. Drent, J. Huétink, 'A planar isotropic yield criterion based on mechanical testing at multi-axial stress states', Numiform'95, S. Shen et. al. (eds.), 1995