Investigation of ductile fracture in fine blanking processes and virtual prediction of scar formation by means of 3D ALE simulations

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ABSTRACT

Due to a rising part complexity, finite element simulations are nowadays standard in forming technology. For a realistic prediction of part quality in terms of fine blanking simulations, material modelling as well as meshing strategy reflect two challenges. The prediction of ductile fracture is needed in order to predict scar formation on the blanked surface. Additionally, the blanking edge geometry such as chamfer preparation and blanking clearance need to be mapped realistically, because minor changes of the micro-geometry can lead to significant scar formation.

As a reference for realistic simulations, a specially developed fine blanking tool covering the whole process window is shown in this paper. Changeable active elements enabling the variation of process parameters in order to estimate the process boundaries. Additionally a force measurement system is implemented, which measures all significant blanking forces for a comparison with simulations.

Common finite element codes need very small elements in order to create a realistic mesh for blanking simulations, which results in a high number of elements and therefore a high computation time. Due to this, a special ALE code with remeshing techniques was developed by Manopulo [1] and is used within this paper in order to simulate the mentioned fine blanking tool.

Several ductile fracture models including Oyanes criteria [2], a Lode parameter dependent model of Bai and Wierzbicki [3] and a stress limit model of Hora [4] have been calibrated by means of torsion tests and tensile tests with notched specimens for different stress triaxialities.

A comparison of the models for the prediction of scar formation in 3D ALE fine blanking simulations is given in order to give an overview of the applicability of the chosen models. Additionally, load path changes for different process parameters have been investigated in order to further understand scar formation in non-rotationally symmetric parts.

REFERENCES

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