Introduction

Fokker Aerostructures, a member of the Stork group, uses the stretch forming process to produce parts for aircraft skins, for example the leading edge of a wing.

The principle of this process is shown in Figure 1. Only one die (the stretch-block) is needed, which contains the shape of the part. The sheet, clamped with two gripper jaws, is formed around the stretch-block, when the grippers move along the given trajectories. Accurately shaped products can be obtained with minimal springback, when stretch deformation is added to the bending deformation of the sheet.

Objective

Fokker is interested in the optimisation of this process. Finite element models can be used for that purpose. Therefore a pilot study has been carried out to get an overview of the possibilities and difficulties encountered during the finite element simulation of stretch-forming.

FEM simulation

A saddle-shaped part has been chosen for the stretch forming simulations, because this type of product gives most problems in practice. The geometry of the stretch-block is shown in Figure 2. The aluminium AA2024 sheet (1130x1920x3.5mm) is formed in AQ-W condition. This process has been modelled with the FEM code DiekA [1]. The sheet is meshed with 2400 plate elements and an elasto-plastic material model has been used. The major strain distribution in the sheet after forming without heat treatments is shown in Figure 3. The formation of Lüders lines starts at strains larger than 4%, therefore the strains are much larger (34%) than allowed. In such cases heat treatments are used during the production. These heat treatments are added to the simulations, which decreases the strain per forming step. It is assumed that the material properties after a heat-treatment are equal to the initial properties.

Results and Future work

The results of this study [2] have been used for a project proposal [3]. Furthermore the strains in the product will be measured and used for the validation of the simulations.

References

[1] DiekA 6.1 manual, University of Twente, 2000