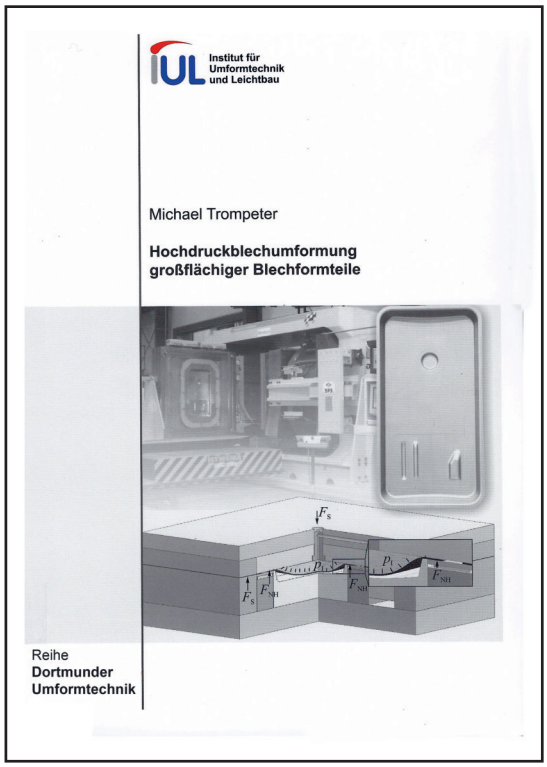
English version below

Institut für Umformtechnik und Leichtbau

Hochdruckblechumformung großflächiger Blechformteile

Michael Trompeter



Reihe Dortmunder Umformtechnik - Band 59

Shaker Verlag

ISBN: 978-3-8322-9080-1

Sprache: Deutsch

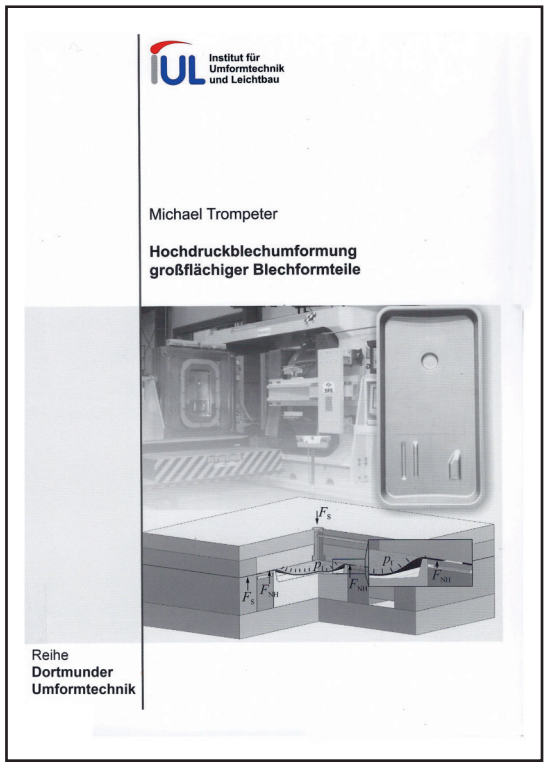
Zusammenfassung

This thesis presents a fundamental investigation on hydroforming of large-area panels with the focus on strain distribution, superposition of tension as well as contour accuracy and springback-induced shape deviations. For the experiments, a rectangular tool system was used which is based on a function sharing between locking and blankholder function. The integrated 10-point blankholder system can apply blankholder forces independently of the locking force which is required to lock the tool against the working media pressure. The tool system is operated in a 100 MN hydroform press with a maximum working medium pressure of 200 MPa. The working medium is supplied by a filling cylinder and a pressure intensifier which allows a volume-based process control by the measurement of the piston feeds of the cylinders. The investigation of the process behavior and achieved part properties is structured into the characteristic process stages (free form stage, form-based stage, calibration) of the hydroforming process course. During a free form stage, the strain distribution and the superposition of tension are affected by the geometrical and kinematical conditions in the blankholder area. The strain path in the part pole is strongly non-linear during the process course, and the strain path direction (from uniaxial to biaxial) depends on the blankholder load. During the form-based stage, tribological parameters are gaining influence on the process window and process limits. The use of adequate lubricants in combination with locally pulsing blankholder forces can widen the process window significantly. The investigation on a special springback phenomenon identified the bending/unbending of large part regions as cause of springback-induced shape deviations. According to this analysis, an induced bending moment can be a reason for springback in the flat part areas, if the tension during flattening is inadequate. In fact, an increase of the plastic strain in the part during the form-based stage is crucial for low geometrical deviations. For this purpose, special blankholder load profiles with stretching during the form-based stage were applied in the experiments, which led to low geometrical deviations of the hydroformed panels. During the last process stage, in which the geometry details are calibrated by high pressurization, the process window can be widened by a pre-distribution of sheet metal material using the 10-point blankholder system. The thesis closes with an exemplary discussion on measures for an increase of the process efficiency.

Institut für Umformtechnik und Leichtbau

Hydroforming of large-area panels

Michael Trompeter



Series: Dortmunder Umformtechnik - Volume 59

Shaker Verlag

ISBN: 978-3-8322-9080-1

Original language: German

Abstract

This thesis presents a fundamental investigation on hydroforming of large-area panels with the focus on strain distribution, superposition of tension as well as contour accuracy and springback-induced shape deviations. For the experiments, a rectangular tool system was used which is based on a function sharing between locking and blankholder function. The integrated 10-point blankholder system can apply blankholder forces independently of the locking force which is required to lock the tool against the working media pressure. The tool system is operated in a 100 MN hydroform press with a maximum working medium pressure of 200 MPa. The working medium is supplied by a filling cylinder and a pressure intensifier which allows a volume-based process control by the measurement of the piston feeds of the cylinders. The investigation of the process behavior and achieved part properties is structured into the characteristic process stages (free form stage, form-based stage, calibration) of the hydroforming process course. During a free form stage, the strain distribution and the superposition of tension are affected by the geometrical and kinematical conditions in the blankholder area. The strain path in the part pole is strongly non-linear during the process course, and the strain path direction (from uniaxial to biaxial) depends on the blankholder load. During the form-based stage, tribological parameters are gaining influence on the process window and process limits. The use of adequate lubricants in combination with locally pulsing blankholder forces can widen the process window significantly. The investigation on a special springback phenomenon identified the bending/unbending of large part regions as cause of springback-induced shape deviations. According to this analysis, an induced bending moment can be a reason for springback in the flat part areas, if the tension during flattening is inadequate. In fact, an increase of the plastic strain in the part during the form-based stage is crucial for low geometrical deviations. For this purpose, special blankholder load profiles with stretching during the form-based stage were applied in the experiments, which led to low geometrical deviations of the hydroformed panels. During the last process stage, in which the geometry details are calibrated by high pressurization, the process window can be widened by a pre-distribution of sheet metal material using the 10-point blankholder system. The thesis closes with an exemplary discussion on measures for an increase of the process efficiency.