

Experimental and numerical analysis of cold formed multi pin structures using a multi-acting tool design

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Intelligent material combinations for the production of multi-material systems as well as lightweight construction to save weight are becoming increasingly important in industrial applications. But the joining process of dissimilar materials, such as high-strength steel and aluminium as well as steel and continuous fiber-reinforced plastics (CFRT), which are often used in multi-material systems, poses challenges to established joining processes due to different mechanical properties and chemical incompatibilities and lead to a need for new, versatile joining technologies. In this context, joining with pin structures has proven to be a promising process for both metal/CFRT and metal/metal joints. The use of cold extruded pins made from the sheet metal plane is the subject of current research due to the added potential for weight saving and the advantage of process-induced work hardening. For the production of these pins and especially for multi-pin structures however, new tool concepts are needed. In the present work, a multi-acting tooling design is presented to produce a multi-pin array consisting of a 3x4 matrix by extrusion from the sheet metal plane. The tool allows the punches, the blank holder and the ejector to be controlled independently. This enables the blank holder pressure, which prevents the sheet from bulging and reduces the radial material flow during the process, to be controlled independently of the punch movement. The individual pins can be formed both simultaneously in one stroke and sequentially to control the formation of each pin individually. The numerical model utilised for designing the active parts of the tool is used to analyse the complex, resulting material flow and to gain insights into the pin forming. Furthermore, first experimental results of cold extruded multi-pin arrays are presented, to obtain a basic scientific understanding of the influence of the tool on the process in combination with the numerical results.

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