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Abstract
Flange height and lip thickness are limited to the drawing ratio of the sheet metal in the convectional hole flanging process. Necking or fracture tends to occur before the required flange height being achieved which is unfavorable for subsequent assembly operations. In order to improve the shortcoming of hole flanging, the current work adopts “flange extrusion” method by applying counter-pressure on the stripper to suppress the bottom of the cup-shaped workpiece. Multi-action tooling was adopted to obtain a robust punch and avoid buckling of the cup wall. The workpiece therefore can be further tapped, riveted or tight-fitted with other parts if the workpiece’s lip thickness is thick and flange height is large enough after the flange extrusion operation.

The current work applies FEM software DEFORM to simulate edge sizing and gear-shape forming. In edge sizing, outer chamfers of the drawn cup with and without pre-holes as well as inner chamfers of the hole flange are analyzed. Additionally, the simulation shows shafts with inner gear-shape can be extruded with the modified setup, while shafts with outer gear-shape would exhibit under-fill on the gear profiles. The under-fill can be avoided by increasing the chamfer radius of the die shoulder or by adding a plate, which is subject to counter-pressure, at the outlet of die cavity.

The current work also conducts tool design and trial-out on flanging extrusion with counter-pressure to attest the validity of its theory. The results show that substantial flanges can be extruded with a large diameter on zinc-plated steel and aluminum alloy sheets. However it is hard to extrude flanges with a small diameter on zinc-plated steel sheets. The die-set would deform elastically in flange extrusion with high extrusion ratio and high strength materials.
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