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Abstract
Wall thickness and flange height are restricted by the formation limit of metal blank during hole flanging operation. Wall thickness decreases and necking and/or fracture occur before the flange reaches the desired height in the process of drawing, and consequently lead the part unsuitable for subsequent assembly operations. Therefore, in the current work “extrusion” is employed in the hole flanging to obtain a high flange with even wall thickness. “Multi-action” is incorporated in the die design by holding the cup blank with a stripper plate and a movable-die. The punch and the movable-die then proceed together to avoid bucking at the rim of the metal blank.
An FEM software DEFORM 2-D is used in simulating the die design. The axis-symmetric mode is chosen in analyzing the design of the multi-action extrusion for hole flanging. The result shows under the application of counter-pressure on the stripper, the total extrusion load of the die set can be dramatically reduced. The magnitude of the counter-pressure has to be sufficient enough to cause the axial compressive stress to exceed the radial compressive stress at the forefront of the material flow approaching the flange, with the aim to suppress the dilation on the bottom of the cup-shaped workpiece and facilitate the forming of the flange. The greater the flange diameter, the less are the extrusion ratio and the forming load. The die trial-out also shows that flanges with larger diameter are easier to extrude. The bottom part of the workpiece also shows an increase in thickness from dilation, indicating the disk springs of the die set provide insufficient counter-pressure.
Therefore, by hole flanging with multi-action extrusion, the one-piece hole flanging part can achieve adequate height with even wall thickness. This die design concept can be broadly applied to forming axis-symmetric metal parts. Manufacturing cost can be lowered down because of the reduction of the process lead.
Advisory Committee Heng-Sheng Lin - advisor

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