

## Abstract

Dissimilar metal joints are widely used for the technical and economical reason in various industrial applications which involves lightweight design. To deal with all those challenges in conventional joining, advanced joining technology like electromagnetic crimping becomes prominent. Primarily, experiments were carried out to investigate the feasibility of (electromagnetic crimping) EM crimping of aluminum tube with steel rod using a single rectangular groove which includes the effects of discharge energies on the strength of a joint, radial displacement, and tube thickness reduction respectively. A numerical study was carried out initially to find a suitable coil dimension. A validated model was used to predict the effects of discharge energies on process parameters and to determine the best energy levels. For improving joint strength to support an axial load, a double rectangular groove was used. The numerical simulation is reasonably predicting mode of failure and process parameters. A significant effect of groove depth on the strength of the joint, groove filling, wrinkling, and tube thickness reduction was also studied. A practical design guideline that describes the effects of the width-to-depth ratio on the strength of a joint was proposed.

The effects of two field-shapers on the strength of a joint manufactured for torsional and axial load bearing were investigated experimentally. From this study, it can be concluded that a single stepped field-shaper is better than a tapered one regarding deformation uniformity in the joining zone and joint quality. Besides that, the joint strength of aluminum to steel rod with a knurled profile was found better compared to plain profile. Further, the effects of rectangular groove parameters on joint quality that can support both torsional and axial load simultaneously were investigated. A new technique in mechanical strength testing is introduced for the crimped sample which can resolve challenges faced so far in this regard. The optimum groove parameters predicted using response surface methodology (RSM) were found in a good agreement with actual measured parameters. Different modes of failure which signify joint quality were explored during mechanical strength tests. Finally, a guideline is proposed to design a rectangular groove to transfer maximum torsional and axial load simultaneously. The developed method has great importance to identify groove parameters which significantly affect the strength of a joint manufactured by EM crimping process. The results found in this study have vital significance in automotive and spaceframe structure industries practically use EM crimping as alternative joining techniques.