

Testing of magnetic pulse welded joints – destructive and non-destructive methods

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Abstract. Magnetic pulse welding is an innovative technology suitable for joining various similar and dissimilar tube and sheet metal materials including such material combinations, which are difficult to join by conventional, i.e. thermal welding methods due to significantly different melting points, extensive formation of intermetallic phases, etc. The process is based on a high-velocity impact instead of large melting of the joining partners. It is well known that the quality of the joint significantly depends on a variety of process parameters influencing this impact and that in case of proper parameter choice high quality can be achieved. In literature, high quality is frequently characterized by failure in the base material in destructive testing. However, up to now no standard testing process for magnetic pulse welded joints has been agreed on and therefore industrial implementation is severely complicated. Specifically investigations regarding non-destructive testing are rarely available. Therefore, the paper evaluates different destructive and non-destructive tests and characterization methods and with regard to their significance. Concerning sheet metal welding especially lap shear tests are taken into consideration, while for tubular joints the focus is put on leak tests. For both types of joints the investigations are complemented by metallographic analysis. Finally, Laser UltraSound (LUS) is presented as a new alternative for characterizing magnetic pulse welded joints. The technique is based on measuring laser ultrasound waves which are either transmitted through or reflected by the weld seam. As comparison of the results to those of the above mentioned slightly more established methods shows, LUS measurements absolutely allow qualitative and quantitative conclusions regarding the weld quality. Due to high automation potential, the method is a promising alternative for quality control in industrial manufacturing.