

“Evaluating techniques for joining piezo-electric elements on test structures for performing vibration-based measurement methods”

C. Gundlach¹, S. Meyer¹, C. Hopmann¹, K. Dilger¹, S. Hartwig¹

¹Technische Universität Braunschweig, Institute of Joining and Welding, Braunschweig,
Langer Kamp 8, 38106, Germany.

When performing vibration-based measurement techniques e.g. for Structural Health Monitoring, piezo-electric elements are often used as sensor and/or actuator part due to their durability. The connection between the piezo-electric element and the test structure plays a decisive role for the quality of the results obtained in the vibration-based measurement process. In addition to stable and mode-independent vibration transmission, further requirements such as reversibility or temperature resistance can be imposed depending on the application. In many preliminary studies, especially bonding by means of a two-component epoxy resin was practically and simulatively validated for a high amount of use cases. Nevertheless, the limited reversibility and the preparation time of the adhesion process can limit the flexibility of the vibration-based measurement method.

The aim of this work is to evaluate different joining technologies of piezo-electric elements on metal and polymer substrates with special respect to reversibility. Different techniques for joining piezo elements are collected considering previous work as well as newly developed approaches within the scope of the work. In the next step, frequency spectra of simple circular blanks are obtained using an EMI-setup from piezo elements joined to the blanks with the appropriate joining technique. Joining by means of a two-component epoxy is considered as the reference method. All joining techniques are evaluated especially based on degree of reversibility, transmission quality, effort for implementation and durability in comparison to the reference method. Finally, recommendations regarding the proper joining technique for different experimental conditions will be given based on the results.

Keywords: piezo-electric elements, non-destructive testing, joining techniques, vibration-based measurement, reversibility, plastic and metal substrates