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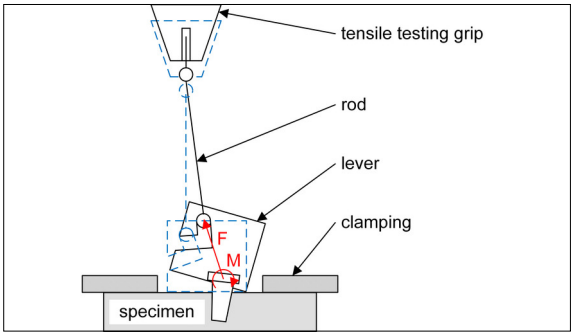
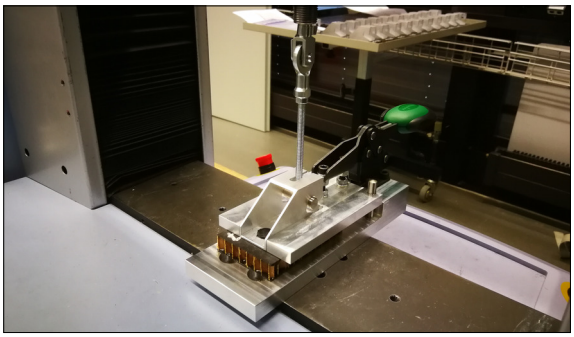
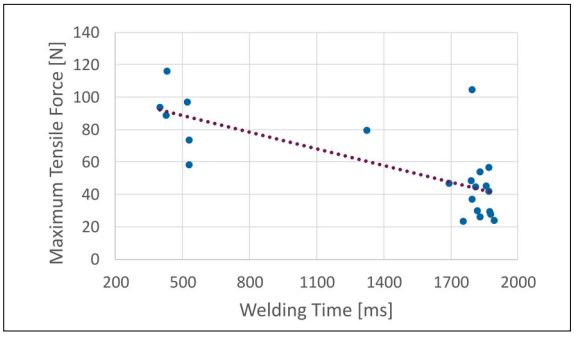
Effect of off-centered Load on a LiteWWeight™ Pin connecting a PU-foamed sandwich panel



Functionality of the developed test procedure.
Own presentment



Test rig assembled to the tensile testing machine.
Own presentment



Scatterplot of maximum tensile force versus welding time.
Own presentment

Initial Situation: The LiteWWeight™ Core technology is a novel joining technology developed by MultiMaterial-Welding AG, which allows efficient joining of functional components with sandwich panels containing PU foam by using a thermoplastic pin. During the ultrasonic welding process, the pin has been partially melted by initiating a high-frequency mechanical oscillation and forms an interlocking connection with the porous PU foam after solidification. The mechanical properties of the resulting connection are established by a standard pull-out test where the pin is subjected to a tensile force applied centrally on the pin. Although, the connections are often used for applications in which the connection must support off-centered loads, currently, there is no standard testing method available to evaluate the mechanical properties of the connection.

Objective: Two main objectives were defined in this project. First, a test rig was developed to measure the maximum off-centered tensile force with a main focus to reach reproducible results. Second, a Design of Experiments (DoE) was performed in order to find out which process parameter, i.e. ultrasonic welding parameter, has a statistically significant influence on the process. For this purpose, numerous welded connections have been carried out on the basis of planned and randomised experimental designs where welding parameters have been varied and the quality of the connection has been quantitatively evaluated in subsequent tensile tests.

Result: The main results of this project are the development of a test procedure for this type of ultrasonic welded connections under an off-centered load as well as the design and fabrication the appropriated test rig. The evaluation of mechanical results shows a wide process variation indicated by a coefficient of variation (CV) of approximately 50 per cent. In consequence, no statistically significant difference could be determined between the welded connections made with different sets of welding parameters. However, it has been observed that the connection strength and welding time behave in the opposite way as it can be observed in the scatter plot of maximum tensile force versus welding time.