Mechanical Behaviour of FSW Aluminium Tailored Blanks

Abstract. In this paper the mechanical behaviour of homogeneous and inhomogeneous FSW aluminium tailored blanks is analysed. The heterogeneity in mechanical properties, across the different weld zones, is discussed based on hardness testing results. Tensile and formability test results are also shown and the mechanical behaviour of the welds is discussed in relation to the base materials. Despite the fact that the hardness tests indicated very small differences in hardness, between the welds and the base materials, and the tensile test results also shown similarities in mechanical behaviour, the formability tests revealed additional difficulties in forming the welded sheets.

Friction Stir Welding (FSW)

Experimental Procedure
Friction Stir Welded Tailored Blanks were made on 1 mm thick plates of two aluminium alloys (AA 5182-H111 and AA 6016-T4). FSW was carried out with a 10 mm shoulder diameter tool with a threaded pin of 3 mm in diameter and 1 mm in length. The welding conditions were: 1800 rpm rotation speed (v), 160 mm/min travel speeds (v), 0.9–1 mm tool penetration and 2.5° tool angle. The welds were performed considering similar and dissimilar combinations of the two alloys. The samples extracted from the similar welds 5182-H111/5182-H111 and 6016-T4/6016-T4 were labelled as S55 and S66, respectively, and the dissimilar weld samples 5182-H111/6016-T4 as D56. Hardness measurements were performed transversely to the weld direction, for all the welds, using load values optimized according to the base material in study: 50g for the AA 5182-H111 alloy and 100 g for the AA 6016-T4 alloy.

Hardness tests
The hardness profile evolution across the welds for the S55, S66 and D56 samples. All the results were verified by performing, for each type of sample, hardness measurements in several positions along the welding directions.

Tensile tests
In order to characterize the mechanical behaviour of the tailored blanks, several weld samples extracted transverse to the weld direction were tested in tension. The reproducibility of the results was rather good out of three tests performed for each type of weld sample.

Formability tests
Deep-drawing tests were performed using circular blank specimens (with 200 mm diameter) from the two base materials and similar welded sheets.