

UNIVERSITI TEKNOLOGI MARA

**THE PERFORMANCE OF SMALL
WIRE SUBMERGED ARC
WELDING ON CARBON STEEL**

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Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science

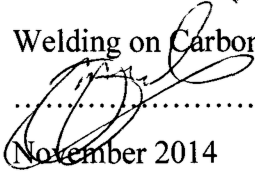
Faculty of Mechanical Engineering

November 2014

AUTHOR'S DECLARATION

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ABSTRACT

This research investigates the performance of small wire submerged arc welding (SAW) on carbon steel material. Small wire submerged arc welding is an innovation of conventional SAW using GMAW wire and machine. SAW can weld thin material and short length just like GMAW or FCAW. The correlation of welding parameters and bead geometry for 1G, 2F, and 3F positions have been identified by its trend-line equations. The trend-line equations enabled the precise prediction of weld bead geometry and welding parameter that will generate quality SAW welding. By incorporating these equations into a calculator, the predicted weld bead geometry and welding parameter can be displayed digitally. The maximum Mean Absolute Deviation (MAD) between the predicted geometry and the experimental results is 0.5mm, 95% of the deviation or error in predicted geometry when compared experimental welding is less than 1.0mm. This level of prediction accuracy is good for industry application. Three Welding Procedure Specification (WPS) tests were prepared, tested and qualified without trial and error. Successful qualification of WPS to AWS D1.1 for various positions and preparation of quality samples show that the SAW can be performed with small diameter wire consumable. The quality of weld metal deposit of small wire SAW was tested, evaluated to the quality requirement of AWS A5.18. The result of X-ray, tensile test, hardness and charpy impact results complied with the requirement of code. The fracture mechanics samples prepared to BS7448, to determine the criteria for planar crack propagation in the weld metal. The analysis of load versus CTOD (Crack Tip Opening Displacement) tests revealed the value of fracture toughness, K_{IC} , the equivalent to plane-strain fracture toughness, K_{IC} . If stress were lower than this critical value, the weld will not fail.

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