

# AN ANALYSIS OF MECHANICAL PROPERTIES OF ALUMINIUM WELDMENTS

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**ABSTRACT** - One of the main problems faced in the process of aluminum welding is a selection of the appropriate combination of inputs to achieve the required quality. In this paper work, different size of filler wire and current settings will be used to clarify the mechanical properties of the aluminum weldment. Total of specimens to be carried out are 40 types. Butt joint is selected as a joining for this experiment. It will divide into two types, V-groove and Straight groove. Tungsten Inert Gas (TIG) is used as a welding process in this experiment. All of the specimen will be tested using strength test. The result of the test was evaluated and compared to determine the appropriate settings for aluminum weldment. The result shows that the best parameter for V – groove joining is 3 mm with 100 ampere of current setting. For the S – groove, the best parameter joining is 1 mm of filler wire with 100 ampere of current setting where it gave a strong joint between two plat of aluminium.

**Keywords:** properties, weldments, V-groove, S-groove, strength test.

## 1. INTRODUCTION

Joining process is an important process to be applied in almost every operation that involves fabricating of product in manufacturing operations. Messler, (2004) stated that welding first evolved as an important technique for fabricating metals, Megat Mohd. Hazim<sup>2</sup>) as part of the copper and brass and then iron making processes, as well as a principal means of making products from these metals by joining small pieces into larger objects. In general, welding includes any process that causes materials to join through the attractive action of inter-atomic or inter molecular forces as opposed to purely macroscopic or even microscopic mechanical interlocking forces. Meanwhile, aluminium is a silvery white and ductile member of the boron group of chemical element. It has the symbol Al. Its atomic number is 13. It is not soluble in water under normal circumstances. Aluminum is the most abundant metal in the Earth's crust, and the third most abundant element therein, after oxygen and silicon. It makes up about 8% by weight of the Earth's solid surface. Aluminum is too reactive chemically to occur in nature as free metal. Instead, it is found combined in over 270 different minerals. The chief source of aluminum is bauxite ore.

### A. Problem statement

The characteristic of aluminum have an impact to this project. The selection of the process must be chosen wisely. The problems that will occur in this project are, the suitable current setting that will be used for aluminum. (80A, 100A) and the suitable filler wire diameter. (1mm, 3mm).

**B. Project Objective**

The objectives of the research are: i)To evaluate the mechanical properties by applying tensile test. ii)To study the suitable diameter of filler wire that can be applied for aluminum weldment. iii)To study the suitable impact of current that can be applied to aluminum weldment.

**C. Scope of Study**

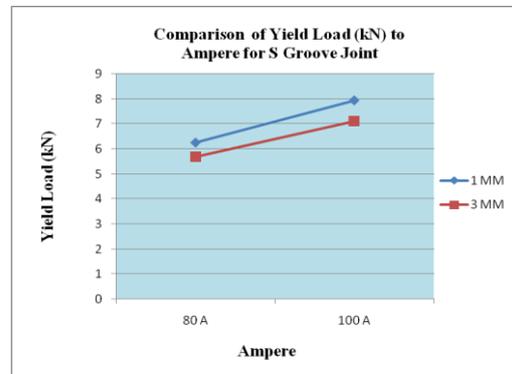
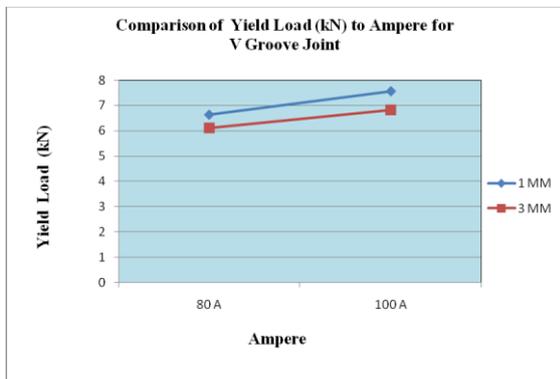
The research will be conducted within the following limits: i)Welding equipment: TIG welding. ii)Type of joint: Butt joint (straight and V-groove). iii) Base metal: Aluminum (Al)

**2. METHODOLOGY**

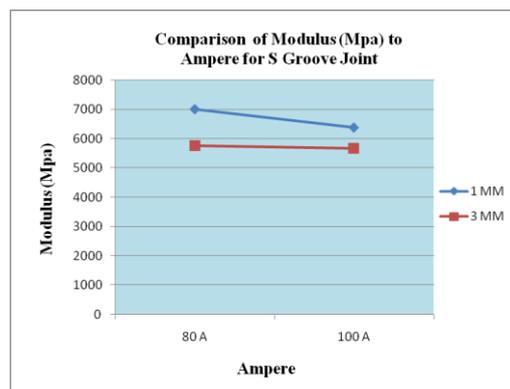
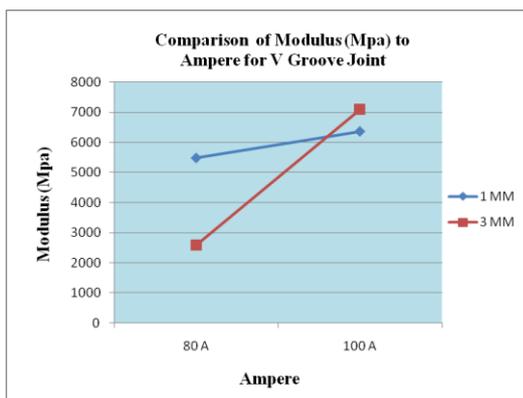
Experimental activity was conducted to obtain data in order to determine the mechanical properties of aluminum weldment. The first step is preparing the plate specimen. The specimen is cut into 50mm x 20mm. The welding activity will take place using TIG welding equipment. Testing specimen by applying strength test are the last step for this experiment. The parameters for the analysis will be discussed later. After deciding on the material (ANSI 6064) and select the appropriate parameter, the specimen will be cut into the desired size (50mm x 20mm).The cutting procedure will be conducted using Shearing Machine. Due to the accuracy in cutting, the machine will perform the cutting for all specimens (40 pieces of plate).Some of the specimen will undergo a 30 degree of V groove shape. The risk of melt through can be reduced and automatically can save cost. This will make the penetration of the weld metal be maximized and contributed to the strength of the weldment itself.

**3. RESULT AND DISCUSSION**

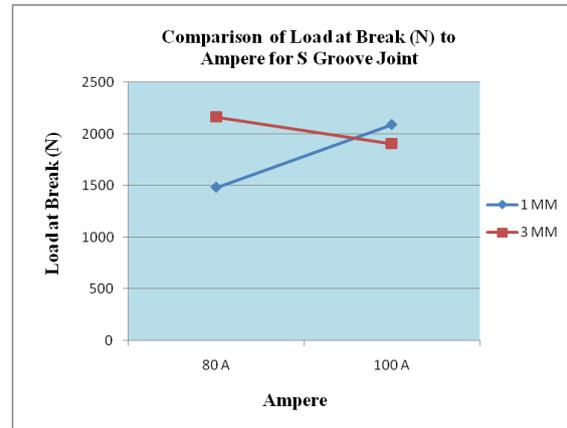
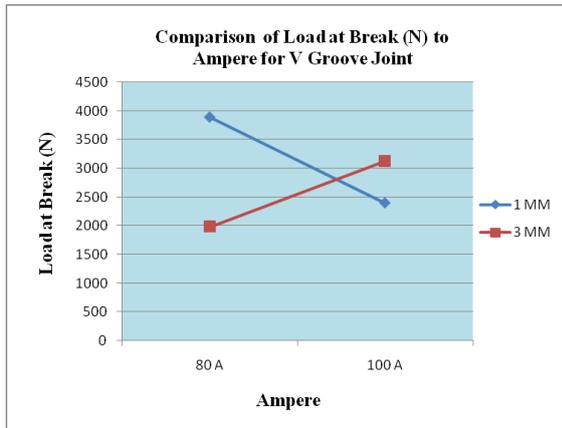
**A. Comparison of Yield Load**



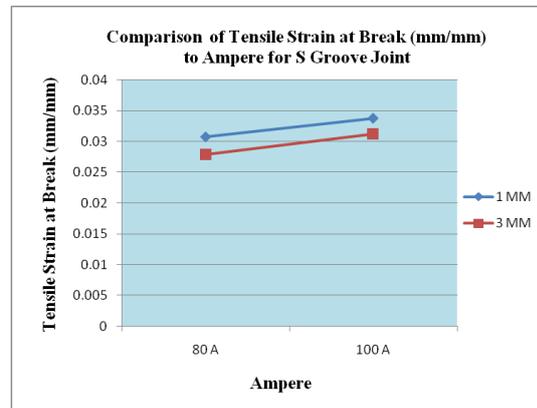
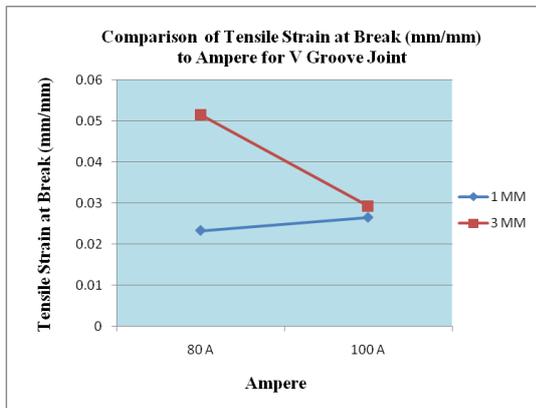
**B. Comparison of Modulus**



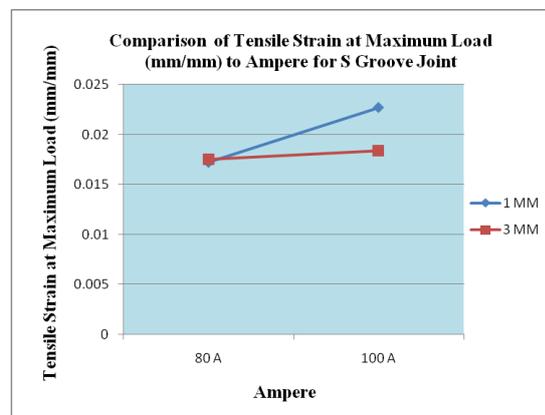
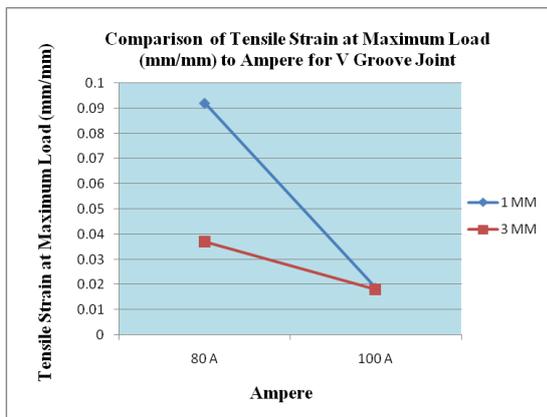
**C. Comparison of Load at Break**



**D. Comparison of Tensile Strain at Break**



**E. Comparison of Tensile Strain at Maximum Load**



From the entire graph, the parameter 3 mm of filler wire with 100 ampere is suitable for V groove joining because of the gap from V groove can be refill with the bigger diameter of filler wire. V groove joining is not suitable for the aluminium with the thickness of 5mm because aluminium easy to melt so the penetration is not stable while doing the welding process. For the best result, square groove is more preferable with the parameter of 1 mm of filler wire diameter with the 100 ampere current setting.

#### 4. CONCLUSION

This experiment has been done to study the mechanical properties of aluminum weldment. The experiment is done using TIG welding and used aluminum as a filler wire with variable diameter of filler wire and current setting. The totals of specimen are 40 pieces and were tested using tensile test. The analysis of mechanical properties has been done in this experiment. From the result experiment, the relationship between parameters and mechanical properties of aluminum weldment is determined. Through the mechanical properties analysis, the diameter of filler wire gives the main effect in this study. The increasing of the diameter will make the weldment joint stronger especially for v-groove joining. It is because of the space is huge and the biggest diameter of filler wire is needed. Actually, v-groove joining is not suitable for this experiment because of the thickness of the plate is low. The best parameter for V – groove was 3mm of filler wire with 100 ampere while for S – groove, the best parameter was 1 mm of filler wire with 100 ampere of current setting.

#### 5. RECOMMENDATION

Recommendation and suggestions for future works are included in section 5.2. This recommendation may contribute more confidence result and more research and development can be done on the project in the future. The recommendation is dividing in 3 parts which is workpiece, machine and technique.

- a) Workpiece  
The experiment could be carried with other dimension of the aluminium plate. The thickness of the aluminium should be change to above 5 mm in order to get best penetration and best joining in fabrication.
- b) TIG Machine  
The performance of TIG machine that provide in Mechanical Laboratory is not consistent. The setting for the machine sometimes will change automatically and it will cause the welding process not smooth. The machine should be change or repaired in order to get the better result in future.
- c) Technique  
Someone without any welding certificate supposed not to do the welding because they didn't have experience in any welding operation. Technician or other welder with certificate should do the welding process where the consistency will be gained.

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