

INVESTIGATION OF MECHANICAL PROPERTIES  
OF WELDED ALUMINIUM ALLOYS

ADDY FIRDAUS BIN OMAR

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**UNIVERSITI MALAYSIA PAHANG**  
**FACULTY OF MECHANICAL ENGINEERING**

I certify that the project entitled “Investigation of Mechanical Properties of Welded Aluminium Alloys” is written by Addy Firdaus Bin Omar . I have examined the final copy of this project and in my opinion; it is fully adequate in terms of scope and quality for the award of the degree of Bachelor of Engineering. I herewith recommend that it be accepted in partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering.

Dr. Noraini Mohd Razali

Examiner

Signature

### **SUPERVISOR'S DECLARATION**

I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering.

Signature :

Name : NUR AZHANI BINTI ABD RAZAK

Position : LECTURER OF FACULTY MECHANICAL ENGINEERING

Date :

### **STUDENT'S DECLARATION**

I hereby declare that the work in this project is my own except for quotations and summaries which have been acknowledged. The project has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature:

Name: ADDY FIRDAUS BIN OMAR

ID Number: MA08082

Date:

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## LIST OF ABBREVIATION

A	Amperes
AA	Aluminum Alloy
HAZ	Heat Affected Zone
HV	Hardness Value
MIG	Metal Inert Gas
N	Newton
TIG	Tungsten Inert Gas
UTS	Ultimate Tensile Strength

## **ABSTRACT**

This thesis will study about the current and the filler to the properties of the welding joint. The strength of the joint depends on the composition inside the weld zone. Welding process using filler gives the different value of strength compare to welding that does not use filler. In this study, tungsten inert gas (TIG) welding process applies by welding AA6061 aluminium alloys sheet. The welding process used by using the different value of current which is 30, 40, 50, 60 and 70A. Two types of filler material, ER4043 and ER4047 are the filler that used with same value of current. Hence, the mechanical properties were investigated when mechanical testing occurs such as tensile test and hardness test. Hardness value (HV) by using current 40A and filler type ER4047 give the value of 26.7 HV at the center of the weld zone, which is the highest value compare to others. Since hardness are directly proportional to the tensile strength, the value of ultimate tensile strength (UTS) by using 40A and filler type ER4047 give the value of 93.79520MPa. Hence, by using 40A and filler type ER4047 gives the strength of the joint compare to others.

## ABSTRAK

Kekuatan kimpalan bergantung kepada komposisi di dalam zon kimpal. Proses kimpalan menggunakan pengisi memberikan nilai kekuatan yang berbeza berbanding dengan kimpalan yang tidak menggunakan pengisi. Dalam kajian ini, proses kimpalan tungsten gas lengai (TIG) dikenakan pada kepingan AA6061 aluminium aloi. Proses kimpalan ini digunakan dengan mengubah nilai arus yang digunakan. Dua jenis bahan pengisi, ER4043 dan ER4047 adalah pengisi yang digunakan bagi setiap nilai arus dalam proses kimpalan. Oleh itu, sifat-sifat mekanikal disiasat seperti ujian tegangan dan ujian kekerasan pada zon kimpalan. Nilai kekerasan (HV) menggunakan arus 40A dan bahan pengisi ER4047 menunjukkan nilai 26.7 HV pada tengah-tengah zon kimpalan. Kekerasan sesuatu bahan adalah berkadar langsung dengan ketegangan bahan. Oleh itu, nilai UTS menggunakan 40A dan bahan pengisi ER4047 menunjukkan nilai 93.79520 MPa. Kekuatan kimpalan pada arus 40A dan bahan pengisi ER4047 menunjukan kekuatan kimpalan yg baik.

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 INTRODUCTION**

This chapter will discuss about background of the study, problem statement, objective of the project, and scope of the project.

#### **1.2 BACKGROUND OF STUDY**

Aluminium alloys widely used in the industry because of their attractive combination of properties such as high strength to weight ratio. (Sanjeev Kumar, 2010) During manufacturing of automotive and aerospace parts, welding of aluminium alloys 6xxx is frequently needed. Welding of aluminium is commonly performed by using metal inert gas welding or tungsten inert gas (TIG) welding. Gas metal arc welding offers the advantage of high deposition rate and high welding speed besides deeper penetration because of high heat input. However, excessive the heat input imposes to the problem such as melt through, distortion, especially when welding of thin aluminium sheets. Therefore, to produce high quality weldments, TIG welding is preferred than metal inert gas (MIG) welding. TIG welding process is one of the most well established processes which can not only weld all metals of industrial use but also produce the best quality welds among the arc welding process.(Rajesh Manti,2008) It produces very attractive welds, good profile, edge wetting and bright appearance. (Sanjeev Kumar, 2010) The good welding skills make the welding penetrate well. The good well profile and free defects are responsible for the improvement of the tensile properties. Due to the low hardness of fusion zone, this region is the weakest area in the tensile test and much easier to fracture (Chen,

2009). For the hardness value, the hardness is lower in the weld metal zone region compared to HAZ and base metal region irrespective of welding technique (Lakshminarayanan, 2009).

### **1.3 PROBLEM STATEMENT**

Aluminium alloys have been widely used in automotive, aerospace and manufacturing industry. Welding process is the major joining type in the industry. The poor strength of the joint caused the problem to the industry. The problem that occurs is an accident. The strength of the joint is the solution to solve the problem. The filler type and current is the method in the strength of welding joint.

### **1.4 OBJECTIVE**

- (i) To study the effect of current in TIG welding process to the mechanical properties of aluminium alloys.
- (ii) To study the effect of different filler materials to the mechanical properties of aluminium alloys.

### **1.5 SCOPE OF THE PROJECT**

- (i) TIG welding process of AA6061 aluminium alloys sheet.
- (ii) Current input 30, 40, 50, 60 and 70A in TIG welding process.
- (iii) ER4043 and ER4047 are the filler type use with different composition of material.
- (iv) Mechanical testing in this study are hardness test and tensile test.
- (v) Microstructure analysis for weld zone, heat affected zone and base metal using optical microscope.

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