JOINING PERFORMANCE OF ALUMINUM T6063 USING GTAW WELDING

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DECLARATION

I hereby, declared this thesis entitled “Joining Performance of Aluminum T6063 Parts Using TIG Welding” is the results of my own research except as cited in references.

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APPROVAL

This PSM submitted to the senate of UTeM and has been as partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Design). The members of the supervisory committee are as follow:

...........................................
(En Syahrul Azwan Bin Suandi)
(Official Stamp & Date)
This report was about to investigate “Joining Performance of Aluminum T6063 Parts Using TIG Welding”. This study was conducted by using several testing method. Aluminum was a very good conductor of heat. The heat was rapidly conducted away from the arc area and spread over the workpiece. Material preparation was the one of the most important in aluminum welding. This requires more consideration than it is often times given. Aluminum was very susceptible to contaminants which can cause considerable problems when welding. Aluminum was lightweight material and also resistant to corrosion. The material that use in this study was aluminum T6063 and the material thickness was 10mm. the material was provide from Nautical Line (M) Sdn Bhd. The composition for this type of aluminum was magnesium and silicon as the alloying elements. Contain additions of silicon and manganese up to 1,7 % and 1,2% respectively. It has generally good mechanical properties and was heat treatable and weldable. The mechanical properties of 6063 depend greatly on the temper, or heat treatment, of the material. Butt joint was the type of welding joining that use in this research. Butt joint was the general joining in welding and it was widely using. The specimens were prepare and welded by certified and skillful welder from Nautical Line (M) Sdn Bhd. The welding parameter the company welder uses which still in range of standard welding parameter. There were three type of testing method involved; impact test, hardness and Non destructive test. By completing this test; the obtained result which been brought out have been used for further analysis. From here, the result on performance of welding joining for aluminum using GTAW / TIG welding can be technically reveal.
ABSTRAK

DEDICATION

Specially dedicated to my beloved Father, My Mother and who are very concern, understanding, and patient and supporting me. Thanks for everything to my supervisor En Syahrul Azwan Bin Suandi for his constructive guidance, encouragement and patience in fulfilling our aspiration in completing this project. To All My Friends, I also would like to say thanks. The Work and Success will never be achieved without all of you.
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Rpm - Rotational Per Minute
kW - Kilowatt
Ø - Diameter
J - Joule
J/m² - Joule per Meter Square

LIST OF ABBREVIATIONS, AND SPECIALIZED NOMENCLATURE

GTAW - Gas Tungsten Arc Welding
TIG - Tungsten Inert Gas
GMAW - Gas Metal Arc Welding
MIG - Metal Inert Gas
UTeM - Universiti Teknikal Malaysia Melaka
DC - Direct Current
AC - Alternating Current
Al - Aluminum
HB - Hardness Brinell
HK - Hardness Knoop
UTS - Ultimate Tensile Strength
ASTM - American Standard of Testing Material
NDT - Non destructive Test
Ar - Argon
DOE - Design OF Experiment
ASME - American Society of Mechanical Engineering
GTA - Gas Tungsten Arc
HAZ - Heat Affected Zone

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CHAPTER 1
INTRODUCTION

1.1 BACKGROUND

In welding fabrication they have many type of welding process and type of welding joining. In the TIG (tungsten inert gas)/GTAW (gas tungsten arc welding) welding process, an essentially non-consumable tungsten electrode is used to provide an electric arc for welding. A sheath of inert gas surrounds the electrode, the arc, and the area to be welded. This gas shielding process prevents any oxidization of the weld and allows for the production of neat, clean welds.

TIG welding differs from MIG (metal inert gas)/GMAW (gas metal arc welding) welding in that the electrode is not consumed in the weld. In the MIG welding process the electrode is continuously melted and is added into the weld. In TIG welding, no metal is added unless a separate filler rod is used.

TIG welding can be performed with a large variety of metals. The two most commonly TIG welded metals are steel and aluminum. Steel is relatively easy to TIG weld and it is possible to produce very tight, neat welds. Aluminum takes a little more skill, and one should have at least a little bit of experience in welding steel before making the transition to aluminum. However, the basic technique is essentially the same and most people can make the jump to aluminum fairly easily.
1.2 PROBLEM STATEMENT

The Aluminum boat in Malaysia is still lacking in terms of the use of welding techniques as well as joining performance testing. The present research will describe the details information about welding performance of specifics parts in boat manufacturing. Previously, there is no standard testing to evaluate the stability of boat especially in materials effect of joined parts. Thus, the research will focus on the analysis of specific joining parts in terms of hardness, impact strength and metallurgy. The materials will be provided by the boat manufacturer, Nautical Line (M) Sdn. Bhd, Kedah and the testing evaluation will be held in UTeM.

1.3 OBJECTIVES

(a) Be able to analyze the characteristics of TIG (tungsten inert gas)/GTAW (gas tungsten arc welding) welding of Aluminum T6063 in terms of hardness, impacts, and microstructure.

(b) To be able to compare the welding performance GTAW (gas tungsten arc welding) between experimental and industrial practice.

1.4 SCOPE

(a) Details study on Aluminum T6063 in application for boat industries.

(b) Details study on material testing of joining products such as impact, hardness and microstructure.

(c) Welding practical to produce the required product.
2.1 DEFINITION OF WELDING

Welding is a fabrication process that joins the materials, usually metals or thermoplastics, by using type of welding machine that suitable with the type of material. This is often done by melting the workpieces and adding a filler material to form a pool of molten material that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. This is in contrast with soldering and brazing, which involve melting a lower-melting-point material between the workpieces to form a bond between them, without melting the workpieces.

The welding process best suited to joining two pieces of metal depends on the physical properties of the metals, the specific use to which they are applied, and the production facilities available. Welding processes are generally classified according to the sources of heat and pressure used. There are many type of joining process. All the type of joining process is using a different technique of welding. Welding is also use for replace the rivet process.
There have a many type of welding, but the basic welding is:-

i. Arc Welding
ii. MIG (Metal Inert Gas)Welding
iii. TIG (Tungsten Inert Gas)Welding

2.1.1 ARC WELDING

The term arc welding applies to a large and varied group of processes that use an electric arc as the source of heat to melt and join metals. In arc welding processes, the joining of metals, or weld, is produced by the extreme heat of an electric arc drawn between an electrode and the work piece, or between two electrodes. The formation of a joint between metals being arc welded may or may not require the use of pressure or filler metal. The arc is struck between the work piece and an electrode that is mechanically or manually moved along the joint, or that remains stationary while the work piece is roved underneath it.

The electrode will be either a consumable wire rod or a no consumable carbon or tungsten rod which carries the current and sustains the electric arc between its tip and the work piece. The electrode is specially prepared so that it not only conducts the current and sustains the arc. The electrode has the many type of size. All the size of electrode is related to the size of bead. The thickness of material is related to choose a suitable electrode in welding process.

Advantages of arc welding

- Portable
- Can be used in all environments
- Not as dependent on surface preparation
Arc welding equipment

- Welding machine
- Power supplies
- Power cable
- An electrode holder
- Electrode
- Face shield
2.1.2 GAS METAL ARC WELDING

Gas metal arc welding and formerly called metal inert-gas (MIG) welding, the weld area is shielded by an effectively inert atmosphere of argon, helium, carbon dioxide or various other gas mixture. The consumable bare wire is fed automatically through a nozzle into the weld arc. As an addition to the use of inert shielding gases, deoxidizers are usually present in the electrode metal itself in order to prevent oxidation of the molten weld puddle. Metal can be transferred by three methods in the GMAW process.

Figure 2.1.2 (a): GMAW / MIG Welding Set [www.wim.com.my]

Figure 2.1.2 (b): GMAW / MIG Schematic Welding Process

Table 2.1.2: GMAW / MIG Detail