TENSILE STRENGTH ANALYSIS OF V GROOVE BUTT WELD JOINT FOR ALUMINIUM ALLOYS AA 2025 & AA 7025

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ABSTRACT

In this research, the effect of groove angle on tensile strength of tungsten inert gas (TIG) welded AA2025 and AA7025 alloy weldments have been investigated. Now a days in shipping, aerospace and in process industry aluminium and its alloys are commonly used because of their valuable properties such as light weight, better corrosion resistance and weld ability. The current study aim is to Investigation of Strength of V Groove Butt Joint on mechanical properties of AA2025 and AA7025 for different groove angle and bevel heights keeping root opening, voltage and current constant. The specimens are prepared by using V groove butt weld joints. In this work gas Tungsten Inert Gas (TIG) welding process has been selected because TIG welding is the process of joining different materials with high quality in the presence of inert gas. Alternating current power source has been selected because of better cleaning action and due to alternating current the high heat concentration on the material can be avoided. Mechanical tests such as tensile test have been conducted to find tensile strength. The Tensile strength of the welded joint is tested by a universal tensile testing machine

Keyword— Gas Tungsten Arc Welding, Ultimate Tensile Strength, *V-Groove Butt Weld Joint, TIG Welding*.

INTRODUCTION

TIG welding is commonly used for welding aluminium and aluminium alloys. In this study aluminium alloy *2025 and 7025* is selected as the base material Welding is one of the most important and versatile means of fabrication available to industry. Welding is used to join hundreds of different commercial alloys in many different shapes. Actually, many products could not even be made without the use of welding, for example, guided missiles, nuclear power plants, jet aircraft, pressure vessels, chemical processing equipment, transportation vehicle and literally thousands of others. Many of the problems that are inherent to welding can be avoided by proper consideration of the particular characteristics and requirements of the process. Proper design of the joint is critical. Selection of the specific process requires an understanding of the large number of available options, the variety of possible joint configurations, and the numerous variables that must be specified for each operation. If the potential benefits of welding are to be obtained and harmful side effects are to be avoided, proper consideration should be given to the selection of the process and the design of the joint. Generally, the quality of a weld joint is strongly influenced by process parameters during the welding process. Groove angle was taken to analyze the mechanical properties and distortion in butt weld joints. In this paper detailed discussion is carried out on the Strength of Two Different Aluminium Alloy (AA 2025 & AA7025) With Varying Groove Angle(V & U) and Bevel Heights Keeping other parameter constant.

LITERATURE SURVEY

Literature survey of various works regarding welding of Aluminium alloy 2025 & 7025 is conducted. From the literature survey, process parameter that affects the weld strength is studied in detail. From the literature survey it is found that the parameters groove angle has significance importance regarding the strength of weld.

R.R.Balasubramanian et.al.(2015) studied and compared the mechanical properties of non-heat treatable aluminum alloy AA5083 and heat treatable Aluminum alloy AA7020 using TIG welding. Mechanical testing like tensile tests, impact test, bend and hardness test have been critically analyzed and the properties were summarized and correlating with microstructure and SEM fractographs and AA 5083 having better mechanical and metallurgical properties as compared to AA 7020 [1].

B.V.R.Ravikumar et.al. (2014) studied that different aluminum alloy like AA5083 and AA6082 welds are made with gas tungsten arc welding (GTAW) using AA 5356 filler wire with non-pulsed current and pulsed current at different pulse frequencies like 2 pulses/sec, 4 pulses/sec, and 6 pulses/sec using precision TIG 375 welding machine. different testing are taken out like non destructive testing (NDT) to study the porosity and surface cracks and also the mechanical properties like ultimate tensile strength, yield strength and % of elongation using GTAW with non-pulsed current and pulsed current at different pulse frequencies were studied then result of that is pulse current produces more tensile strength than non-pulse current [2].

G. Magudeeswaran et. al. (2014) studied the activated TIG (ATIG) welding process mainly focuses on increasing the depth of penetration. The major welding parameters, such as electrode gap, travel speed, current and voltage that control the aspect ratio of DSS joints. Hence in this study, the above parameters of ATIG welding for aspect ratio of ASTM/UNS S32205 DSS welds are optimized by using Taguchi orthogonal array (OA) experimental design and other statistical tools such as Analysis of Variance (ANOVA) and Pooled ANOVA techniques. The optimum process parameters are found to be 1 mm electrode gap, 130 mm/min travel speed, 140A current [3].

Baiju Sasidharan et al (2014) studied weld strength and microstructure of aluminum alloy AA2219, which possess low thermal characteristics and its Comparative study on Tensile and Micro structural characteristics of welded joints obtained from DCSP TIGW and FSW has been made. And result of this is that The Ultimate Tensile Strength (UTS) of DCSP TIG welded joint has been found 257.48MPa. The UTS for FSW resulted is 287.9MPa. Percentage elongation for FSW joint has also been found more than that of parent metal. Hence it is inferred that FSW techniques are more suited for the effective joining of alloys like AA2219 [4].

Arun Narayanan et al (2013) studied the best combination of welding parameters like welding current and gas flow rate in TIG welding of Aluminum alloy 5083. Various tests like Tensile test, Micro hardness, Macrostructure and Microstructure test conducted to study on the welded specimens. The test results shows that AA 5083 gives better results at 200A current and 15 l/min gas flow rate [5].

EXPERIMENTALMETHODOLOGIES

From the critical discussion on literature survey and gaps identified from the literature, the problem statement for the current paper is Investigation Of Strength Of V Groove Butt Joint By TIG Welding by using experimental method. In experimental methodology detail discussion is carried out, about material used, specimen preparation and welding geometry used.

2.1 Materials

The materials used for experimental setup are AA7025 and AA2025 Plates Having Diamensions 8x300x300 mm. The experimental work is to be carried out to investigate the strength analysis of V butt weld joint for different aluminum alloy using TIG welding method. Focus of this project work is to identify the strength of single V Groove butt welded joint by increasing the included angle up to 50^0. As included angle increases the contact area will also increases, therefore strength also increases.

Table 1: Mechanical properties of work material AA7025

Tensile Strength, min, (MPa)	572
Elongation, min (%),	11
Vickers Hardness (HV)	171

Table -Mechanical properties of work material AA2025

Tensile Strength, min, (MPa)	400
Elongation, min (%),	11
Vickers Hardness (HV)	138

Table - Specimens dimensions for V-Groove

Sr No.	Sample	Groove Angle (Degree)	Bevel Height (mm)	Material
1	V1	30^0	1	AA2025
2	V2	45^0	1.5	AA2025
3	V3	50^0	2	AA2025
4	V4	30^0	1	AA7025
5	V5	45^0	1.5	AA7025
6	V6	50^0	2	AA7025

2.2 TIG welding

TIG welding (Tungsten inert gas welding) is also called as gas Tungsten Arc Welding (GTAW) uses a non consumable electrode and a separate filler metal with an inert shielding gas. GTAW process welding set utilizes suitable power sources, a cylinder of Argon gas, welding torch having connections of cable for current supply, tubing for shielding gas supply and tubing water for cooling the torch. The shape of the torch is characteristic, having a cap at the back end to protect the rather long tungsten electrode against accidental breakage.

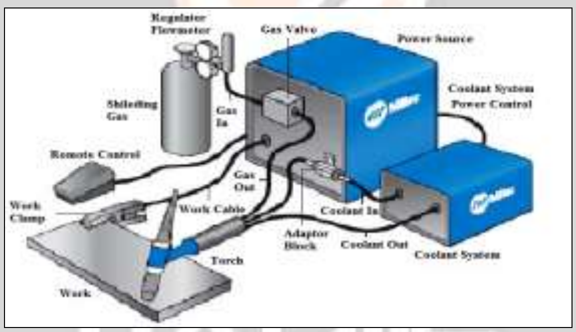


Fig-Tungsten Inert Gas Welding Process

3EXPERIMENTAL TESTING

3.1 Tensile test

This test is used to find the values of Ultimate tensile strength to carry out this test we have to prepare standard specimen as per (As per ASTM).

3.2 Specimen preparation

Longitudinal tension test specimens taken From Aluminium Plates conform to the requirements as to tensile properties. Tensile Test Specimen Prepared According to Following Standard

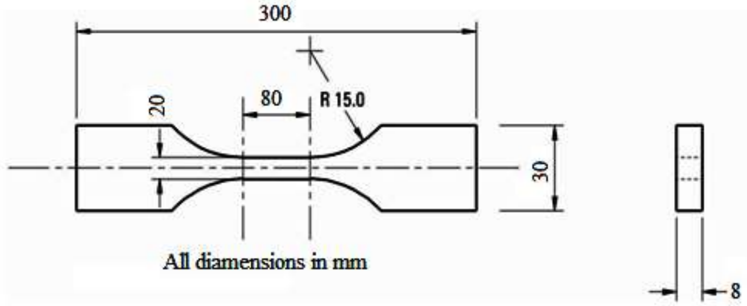


Fig.- Tensile test specimen (As per IS:1608-2005

3.3 Process setup for tensile test

The specimen is placed in the machine between the grips and an extensometer if required can automatically record the change in gauge length during the test. If an extensometer is not fitted, the machine itself can record the displacement between its cross heads on which the specimen is held. However, this method not only records the change in length of the specimen but also all other extending / elastic components of the testing machine and its drive systems including any slipping of the specimen in the grips. Once the machine is started it begins to apply an increasing load on specimen. Throughout the tests the control system and its associated software record the load and extension or compression of the specimen

Fig -Process setup for tensile test

Fig - Tensile test specimen Prepration

Fig-Standard Specimen Before Test

Fig-Standard Specimen After Test

Table Tensile test results of all specimens for AA2025

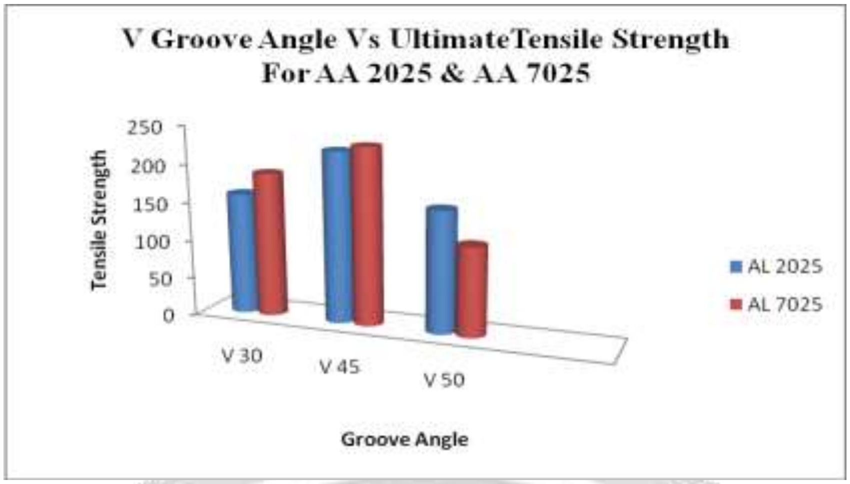
Sr.No.	**Sample Name**	**Groove Angle (Degree)**	**Bevel Height (mm)**	**Materials**	**UTS MPa**	**Failure location**
1	AA	0	0	AA2025	400	Unwelded
2	V1	30^0	1	AA2025	159.88	In weld
3	V2	45^0	1.5	AA2025	223.45	In weld
4	V3	50^0	2	AA2025	158.69	In weld

Table - Tensile test results of all specimens for AA7025

Sr.No.	**Sample Name**	**Groove Angle (Degree)**	**Bevel Height (mm)**	**Materials**	**UTS MPa**	**Failure location**
1	BB	0	0	AA7025	572	Unwelded
2	V4	30^0	1	AA7025	189.25	In weld
3	V5	45^0	1.5	AA7025	231.54	In weld
4	V6	50^0	2	AA7025	116.23	In weld

3.4 Discussion on results

The following graphs shows the effect of bevel height, groove angle and groove geometry on strength of butt weld joint.



Graph - Groove angle Vs ultimate tensile strength for V groove weld butt joint

From experimental data, for groove angle Vs ultimate tensile strength graph, it shows that, as the groove angle increases the ultimate tensile strength of single V-groove butt weld joint increase and at 45^0 we have maximum ultimate tensile strength. Also it isobserved that the strength of material AA7025 is more as compare to AA2025 at 45^0 V-groove geometry.

CONCLUSION

From the results of this present investigation and the discussion presented in the earlier chapters, the following conclusions are drawn.

1) From the experimental results we can say that the tensile strength increases with increase in groove angle. At 45^0 V-groove geometry we are having maximum strength. Both the materials show maximum strength at 45^0 groove angle.
2) From the above experimentation it is conclude that AA7025 is good in tensile as compare to AA2025.
3) From the above experimentation it is conclude that V groove geometry with groove angle 45^0 is suitable for both the materials.

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