

# International Journal of Innovative Research in Science, Engineering and Technology

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## Investigation of Crackability of Tig Welded Austenitic Stainless Steel Using Y Groove Test

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**ABSTRACT:** The purpose of the present study is to investigate cracks on welded area of austenitic stainless steel. Austenitic stainless steels are widely used in the application of aircraft engine parts, heat exchangers, furnace parts etc. It contains both chromium and nickel. Nickel and chromium aids stability of austenite over wide range of temperatures and high corrosion resistance respectively. TIG welding has mainly used for welding specimen with thickness of less than 6mm. In order to overcome this disadvantages of convectional TIG welding, Y-Groove test is done to monitor the Susceptibility in HAZ and then it is proved that these types are said to be good for studying susceptibility of parent metal.

### I. INTRODUCTION

SS 304 austenitic stainless steel is a widely used material for automotive, chemical, food processing industries and steam-power plant due to its excellent strength, ductility and corrosion resistance properties. Welding of SS 304 is in wide demand to make complex components. Tungsten inert gas (TIG) welding is an economical, robust and effective fabrication method for joining materials in almost every welding position and has the potential to produce good quality weld joint with excellent surface appearance. However, the low energy density of the arc in TIG welding process resulted in shallow penetration and wider melt width. It is well accepted that the enhancement of welding current or reduction of scan speed during the welding process improves the weld penetration depth. However, high welding current or low scan speed leads to expansion of weld width and grain coarsening in the weld zone. Study of Kumar and Shahi on TIG welding of AISI 304 stainless steel showed that grain coarsening in the weld zone significantly lower the mechanical property of weld joint, consequently, use of low heat input is recommended for better quality of weld joint.

### II. OBJECTIVES

The main objective of our project is to find the crackability of TIG welded austenitic stainless steel. Austenitic stainless steel SUS 304L has been widely used in aircraft industry, chemical processing (heat exchanger), food processing, Dairy industry (milk cans) and etc due to its excellent strength and scale resistance at high temperature and highest corrosion resistance. TIG welding has mainly used for welding specimen with thickness of less than 6mm. In order to overcome this disadvantages of convectional TIG welding In TIG welding shielding gas plays an important role. Composition of a shielding mixture in [1.5% H<sub>2</sub>-Ar, 5% H<sub>2</sub>-Ar] arc welding depends mostly on the kind of material to be welded. The selection of the shielding gas should be considered the chemical-Metallurgical processes between the gases and the molten pool that occur during welding. Y-Groove test is a self restraint test and is best suited for real time applications. Here critical preheat temperature (temperature at which crack doesn't occur) is obtained. Y-Groove test is done to monitor the susceptibility in HAZ. Specimens after testing were examined for cracking as per the standard. The fracture surface of the cracked specimens was examined under NDT. Non Destructive Testing is a wide group of analysis techniques used in science and technology industry to evaluate the properties of a material, component or system without causing damage.

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## III. EXPERIMENTAL SETUP

First of all the austenitic stainless steel is cut using AutoCAD software or by WEDM to have a proper regular cut. With the dimension of length 200mm, width 150mm and thickness 3mm again the 150mm width is sectioned to two equal halves i.e (75mm) The specimens (200x125) are prepared for butt welding with Y-edge preparation having 2mm root gap and a  $60^\circ$  groove angle. First symmetrical Anchor or constraining welds are made on both ends. This weld is the one giving the restraint to the test weld. So the anchor weld is made with the welding consumable whose Yield strength equal to the yield strength of the test material. The weld is deposited with the standard procedure as pre-heating ( $250^\circ\text{C}$ ). The austenitic stainless steel is joined using automatic TIG welding machine. Single pass, autogenous, bead on plate TIG welds were made along centre line of test specimens. A water cooled thoriated tungsten electrode rod with  $60^\circ$  degree angle. Argon was used as shield gas. Direct current with negatively charged electrode was used in all trials. The heat generated by the electric arc is used to melt and joint the base metal. Clean the surface with alcohol and let surface dry for 5 min. then Apply the liquid penetrant spray (red can) to the surface and brush for further penetration. Then, wait for 20 min. Wipe the surface with a clean textile and subsequently apply remover spray (blue can) to remove excess residues on the surface and wait for a few min. Apply the developer spray (yellow can) at a distance of about 30cm from the surface. As the penetrant is drawn out, it diffuses into the coating of the developer, forming indications of the surface discontinuities or flaws. With visible dye penetrants, surface defects are indicated by bleeding out of penetrant, which is normally of deep red colour, against white background. Hence inspection is obtained by 80 watts of day light fluorescent tube at 1 meter/100 watts tungsten filament lamp at 0.2 metres distance) should be provided.

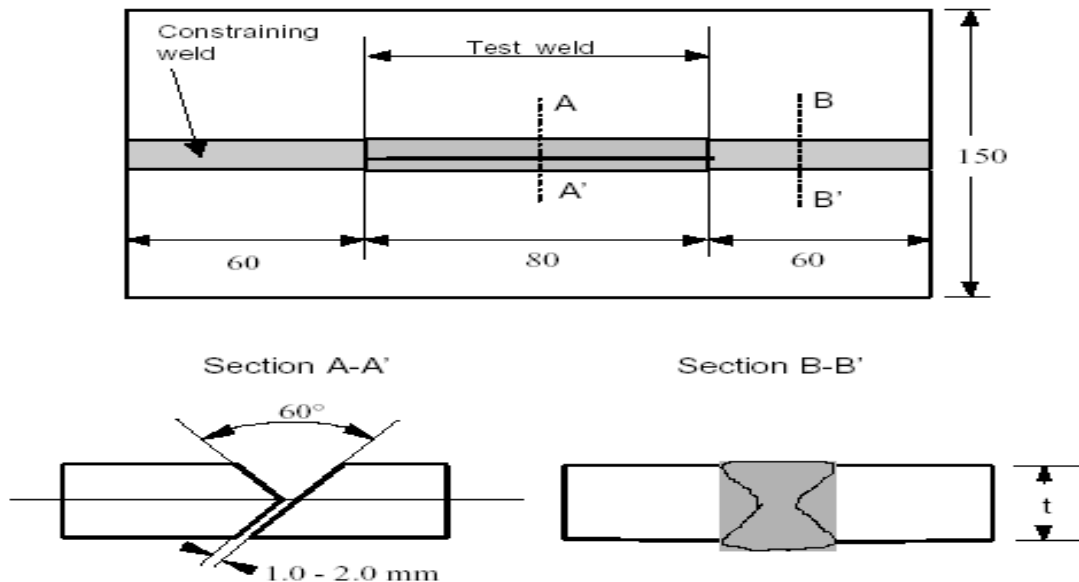


Fig: 1 schematic representation of inclined Y Groove

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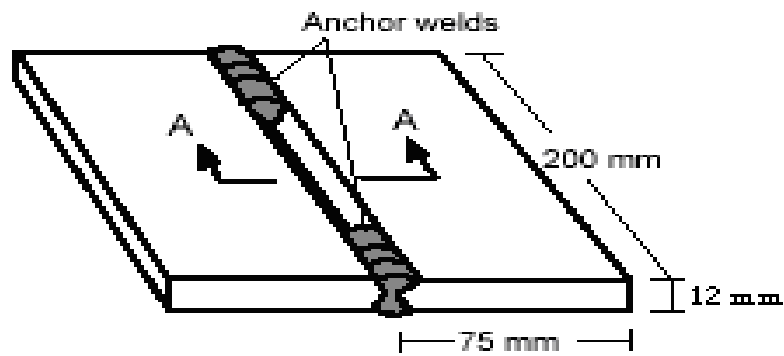


Fig: 1 welding



Fig: 2 red dye penetrant



Fig: 3 developer to check defect

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## IV. RESULT

TABLE SHOWING DEFECTS OF 304 MATERIAL

SPECIMEN NO.	amps	PREHEAT TEMPERATURE	FINDINGS
1	95	200	No defect
2	95	150	Surface finish not proper
3	95	100	No defect

Table :1

## V. CONCLUSION

In this present work AUSTENITIC STAINLESS STEELS 304 is taken as the base materials for joining to occur through TIG welding process. The TIG welding is resulted in inferior mechanical properties of the welds. A design of experiment technique, the penetrant test method has been used to identify the crack ability and TIG welding parameters (current, welding speed, gas flow rate) for the tensile strength of austenitic stainless steel.

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