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Study of welding procedure and study of friction stir welding using AA7005 as base metal and testing of welding

[1]Umar majid wani, research scholar, [2]Er. Rahul

Introduction : Welding is the most widely used fabrication technique, throughout industry, owing to its capability of providing cost-effective and high strength joints besides affording lighter weight through better utilization of materials and offering design flexibility, when used for joining of metals. Proper application of welding technology by the user makes the welds that are most suitable in virtually all kinds of service. Today's survival of the mankind has become so much dependent on welding that without welding it would extremely become difficult to build computers, aero planes, rockets, ships, submarines, nuclear reactors, home appliances, automobiles, pressure vessels, utility stations etc. Many other examples can be selected from technical literature to illustrate ways in which vast improvement and expansion has taken place in welding to meet a wide variety of demands by today's industry. The remarkable growth that has taken place in joining of all commercial metals and alloys shows that an impressive record of successful applications has been maintained by the welding industry, but, at the same time difficulties in obtaining sound welds have been encountered from time to time due to more than a few reasons.

Friction stir welding (FSW) was invented at The Welding Institute (TWI) of UK in 1991 as a solid-state joining technique, and it was initially applied to aluminum alloys [2,3]. This process is a derivative of the conventional friction welding in which the welding heat is generated from the tool shoulder and the workpiece. Since its invention in 1991, continuous attempts have been made by researchers to understand, use and improve this process.

Key words : welding, bse metal, aluminum FSW, etc.

Base metal:

The base metal used in friction stir welding is AA7005. This is a zinc and manganese base aluminum alloy. The composition of the base metal is as follows

Material composition

Element	Zinc	Manganese	Magnesium	Silicon	Tungsten	Iron	Aluminum
Percentage	4.81	0.42	1.05	0.22	0.012	0.30	rest

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Properties

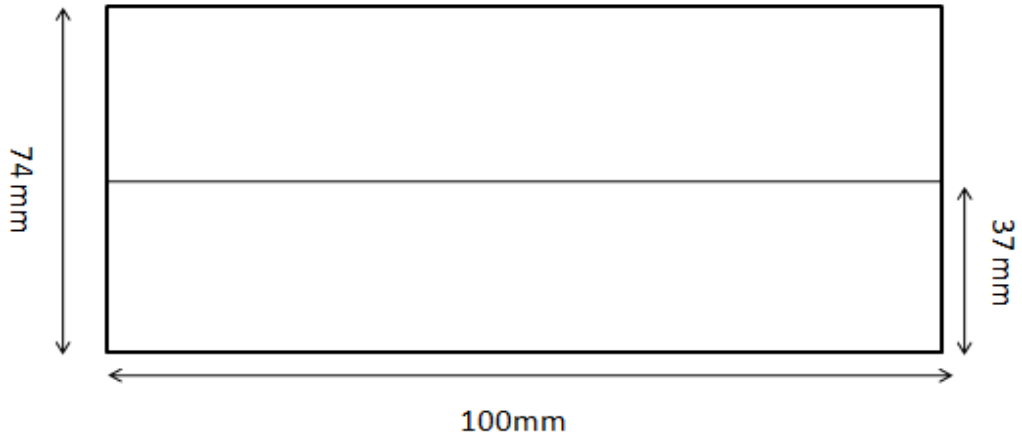
The different mechanical, thermal and electrical properties are shown in the Table 4.3

Material Properties

Density (1000 Kg/m^3)	2.6-2.8
Poisson ratio	0.33
Elastic modules (GPa)	70-80
Tensile strength (MPa)	180
Shear strength(MPa)	117
Fatigue strength(MPa)	140
Thermal conductivity(W/m-K)	166
Electrical resistivity($10^9\Omega$-m)	40

Preparation of base metal:

The material is cut from the sheet by a power press in required dimension. The length of the specimen is 100 mm, width is 37 mm and the thickness is of 5 mm.



Dimension view of the base plate

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welding parameter and their limit:

In present study, the three selected input parameters are the tool rotation speed, tool transverse speed and tool pin diameter. The ranges of these parameters have been selected after performing several trials on specimen as shown in Table 4.4. The selected parameters show good weld quality appearance after the welding.

Sr. n.	Welding parameter	Unit	Upper limit(+)	Lower limit(-)
1	Tool rotation speed	rpm	2000	1500
2	Tool transverse speed	mm/min	30	20
3	Tool pin diameter	mm	6	3

Testing:

Microhardness test:

After welding, transverse section of the weld beads were cut from the middle portion of the plates as specimens. These specimens were prepared by standard metallurgical polishing method ASTM E-384. Microhardness test carried out at R&D CENTRE LUDHIANA. The readings of Microhardness of the pieces were studied by the Vicker hardness machine, under the load 200gm with a dwell time of the 20 seconds. Readings were taken in advance side as well as in retreating side for comprehensive behavior of the nugget zone and thrmo mechanical effected zone and the base metal.

Impact testing:

The impact testing of the weldmetal is carried to accessing the energy stored before fracture. Charpy test is used for calculating the impact strength of the weldment. The dimension of the test specimen is shown in the Figure 4.6. The testing is done according to ASTM (E23-07A). Total

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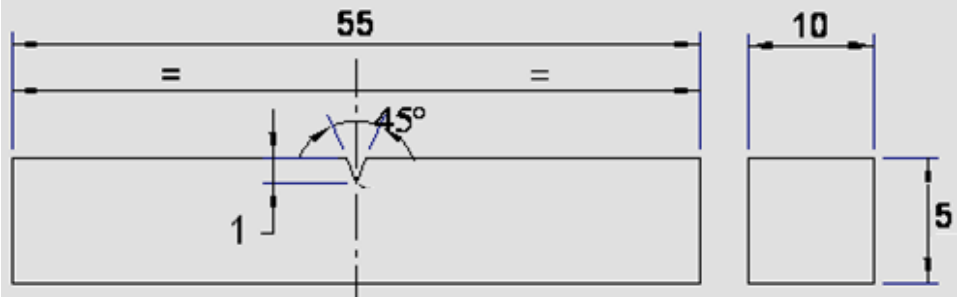
sixteen samples are prepared according to the design matrix with one repetition. The impact testing is done in strength of material lab at Galaxy Global Group of Institution, Ambala, Haryana..



Dimension view of the impact testing specimen.

Corrosion testing:

For conducting the corrosion test, the samples are cut in 2*2*0.5 cm dimension along the length of the weldment. The specimen are polish by 240, 400, 800, 1200, 1500 silicon carbide paper. The initial weigh of the specimen is noted. The corrosion test is done according the ASTM G110 in chemistry lab at Applied Science Department at SLIET Longowal. The samples are immersing in 0.98M of NaCL and .09M H_2O_2 for 100 hr. After the immersion, corroded surface is clean by using the silicon paper than, the specimen is washed with acetone and water. The final weight of the specimen is weighed after 1 hour. The difference of the weight will give the metal loss in corrosion.

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