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# Design and Fabrication of Friction Stir Welding Fixture with a New Approach

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## Keywor ds

Friction stir welding, Side plate, Stopper plate, Clamp.

## ABSTRACT

Friction stir welding is a relatively new solid-state joining technique which is widely adopted in different industry fields to join different metallic alloys that are hard to weld by conventional Fusion welding. FSW welding of material ( like aluminium stainless steel copper etc.) with good weld quality it is essential to manufacture specified fixture having accurate clamping capacity, heat resistance, compressive strength of base plate, flexibility in the welded plate dimension and easy to operate before and after FSW process. In this paper everything is calculated properly with complete design criteria to fulfill above mentions requirement.

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## Introduction

Friction stir welding invented by Thomas [1] in December 1991, is a solid state joining process in which constantly rotating , cylindrical shoulder tool transverse at constant rate along the joint between two clamped pieces of butted material. Frictional heat is generated between the tool and work pieces. This heat along with that produced by mechanical mixing and adiabatic shearing within the material causes the sired material to soften without melting, as the tool is move forward, a special profile on probe faces plasticized material to a rear where clamping force assist forged consolidation of the weld. There is increasing need to design light weight structure such as those in aircraft panels and vehicle body shells. Advanced joining technology is an integral part of manufacturing processes of light weight structures .Considering effort has been expended to develop essay operate fixture as well as welding process.

## **Fixture Design**

Fixture has an important role in FSW by stopping the joining material from going apart in plunging phase. In order to design fixture for our need few idea were generated and best design that can suit the objective of creating adjustable feature is selected based on the pugh method evaluation [2]. This method evaluated based on several criteria which will define its

suitability for overall project, as summarized in table. It is considering all the required flexibility of FSW welding. The main problem of FSW fixture, it should withstand high at high temperature itself and reduces the chances of distortion of welding material, welding plate should not shift during FSW welding from initial position, it means it can withstand complete side force.Fig1 (a) to (c)

Component of fixture

- 1. Base plate
- 2. Side plate
- 3.Stopper
- 4.clamp



Fig 1(a). Base plate (12x10 inches , hole dia. 10 mm )



Fig 1(b). Side plate (9x12 inches, 3 hole of 10mm dia and 2 counter hole of 12mm dia.)



Fig 1(c). complete disassembled with Stopper plate (5.5x1 inches, 2 counter hole of 10 mm dia.)

Material of fixture

EN 31 materials has been used for designing the base plate and side plates. It has better compressive strength as

Fixture Design Criteria				
Table 1				
Criteria	Description			
Design	Number of different component, number o			
complexity	non-symmetry and complex shape			
Functionality	The range of adjustable angle it can provide			
Practicality	Ease to be operated and used by end user,			
	time taking for preparing the fixture before			
	proceeding to fsw process.			
Strength	Maximum downward force of machine			
	spindle it can sustain during fsw			
Procurement	Expected price of material and its availability			
of material	in market.			
Workmanship	The capability of local machine, size			
	dimension tolerance and level of accuracy			
	needed.			

Table 2

Density	7.8 gm/cc			
Thermal conductivity	$466 \ W/mK$			
Melting point	1540 deg.			
Tensile strength	750 N/mm^2			
Yield strength	450 N/mm^2			
Elongation	30%			
Hardness	63 HRC			
Carbon	1.5%			

Table 3

SR. NO.	PROCESS
1	Edge preparation
2	Grinnding
F	Dimensioning
4	Drilling
5	Counter boring
6	Taping
7	Assembly

Table 4

NAME	FSW FIXTURE	
APPLICATION	Aluminum butt joint	
BASE PLATE	12" X10"X1"	
SIDE PLATE	9"X2.5"X1"	
STOPER	5.5"X1"X1"	
WEIGHT	20.8 kg	
MATERIAL	EN 31	
COLOUR	BLACK	
WORKPIECE DIMENSION	200X50X5 mm	
FASTNERS	8 LN SCREW 10mm diameter , 4 BOLT 12mm diameter	

Table 5

MAXIMUM T RANSVERS LOAD	156.3 KN by eight bolt
MAXIMUM AXAIL LOAD	26.58KN by t wo LN bolt
MAXIMUM	10"X5"X1"
DIMENSION OF	
SPESIMEN THAT CAN BE WELD	

### Table 6

Experiment	Experiment setu	р			
1.	2700 rpm and	feed	15.2 mm/min,		
	17mm/min, 20mn				
2.	3500 rpm and	feed	11.5mm/min,		
	15mm/min, 17mm/min				
3.	5400 rpm and fe	6.34mm/min,			
	20mm/min, 24 mi	m/min			

compare to mild steel. According to their properties it has been selected. Its properties are mention below. It is used is used in ball and roller bearing, punch and die. It has high wear resistance and surface loading. [Table 2.] & Fig.2 (a) to 2(c) **Properties Of En 31** 



Fig 2(a). Complete Fixture milling machine



Fig 2(b). complete fixture fixture on vertical



Fig 2 (c). Welded part

#### Process of fabrication Dimension

This fixture has quite compact dimension for bulky setup of friction stir welding.

## Capacities

It has very good strength and capacity for friction stir welding of aluminum plates. This fixture reduces all the problem of distortion high temperature problem and adjustability. It can wear 150 kilo Newton transverse load that is quit sufficient for aluminum and stainless steel plate for FSW.[Table 5]

## **Result and discussion**

Above this variable condition sound FSW found. There is no distortion occurs on weld material and no excess heat affected problem is set up during friction stir welding. This fixture is quite flexible, adjustable and easy to operate. It has been also observed that there is no sifting of aluminum plates during FSW welding. This material has sustainable vibration absorbing capacity so that at high rpm it can absorb some vibration due to tool rotation. It can weld up to 12 mm thick plates. It has very good axial load carrying capacity. Tensile strength of welded part is found to be 70 to 90 percent of base metal. it can be used for force temperature measurement. It is designed to make automatic clamping during FSW welding in future.[Table.6]

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## References

1. Thomas WM, Nicholas ED, Needham JC, Murch MG, Temple –smith P, Dawes CJ, Friction welding. International patent application number PCT/GB92/02203 and GB patent application number1925978.8; 1991

2. Pushp Kumar Baghel, Arshad Noor Siddiquee" Design and development of Fixture for Friction Stir Welding" Innovative Systems Design and Engineering, Vol 3, No.12, 2012 pp40-47.