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

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## ABSTRACT

*Friction Stir Welding is a new technique in which the non- consumable tool are used to performed the welding joint and heat produced due to the rotating tool over the surface of the work pieces. Friction stir welding is widely manufactured with specified fixture having good clamping capacity, compressive strength, heat resistance of the base plate, flexibility weld plate and easy to operate in FSW process. In this paper above mentioned fixture are calculated properly with complete dimensions and design criteria to fulfill requirements on certain parameters.*

**Keyword:** *Friction stir welding, Base plate, Clamping toggles, Stoppers, Clamp plate , Side plates, Fixture.*

## 1. INTRODUCTION

The friction stir welding (FSW) process developed by the Welding Institute (TWI) of UK in 1991 is a novel solid-state joining technology that has broad applications in joining aluminum alloys difficult to weld by conventional fusion processes [1]. Friction stir welding is a solid state joining process in which non-consumable cylindrical tool transverse along the joint between two clamped pieces of butted material. Heat is generated between the tool and work pieces due to the rotating tool and weld joint produced by mechanical mixing of the material causes to soften without melting, where clamping force assist forged consolidation of the weld. Friction stir welding are currently used in aerospace vehicle very large sheets due to their exceptional strength and stiffness-to-density ratios. Considering effort has been expended to develop essay operate fixture as well as welding process.

## 2. FIXTURE DESIGN

Fixture is playing an important role in FSW process. It is rigidly fixed on the machine table with help of different clamps during welding process. Plates may get separated due to the force arising during welding so fixture our need and best design. It is considering all the required flexibility of FSW welding. The main function of the fixture in FSW process to avoid the distortion and position of the work piece during the welding and also withstand complete side force and high temperature [2]. Production of a quality FSW Joint to needs a good selection of the appropriate fixture material for a specific application. Thus, it is has good tensile strength to withstand axial load during the FSW process [3]. It is considering all the required flexibility of FSW welding process. Fixture should withstand high temperature itself during FSW process and reduces the chances of distortion of welding joint, welding plate should not shift during FSW welding from initial position by using fixture as clamping device, it means it can withstand complete side force [4].

### Components of fixture

1. Base plates
2. Stoppers
3. Side plates
4. Clamping toggles
- 5-Top slider clammer

**Table 1. Fixture Design Criteria**

Criteria	Description
Design complexity	Different components, complex shape and non-symmetry
Practicality	Easy to be operated and time taking less
Strength	It can be high force withstand by FSW process
Functionality	More sliding adjustable
Material	Material easy available in the market
Finishing control	By machine and level of accuracy

**Table 2. Mechanical Properties of fixture base**

Tensile strength	745N/mm <sup>2</sup>
Yield strength	450N/mm <sup>2</sup>
Melting point	1750 C <sup>o</sup>
Density	7.8gm/cc
Hardness	63HRC
Carbon	1.5%
Thermal conductivity	465W/mK
Elongation	30%

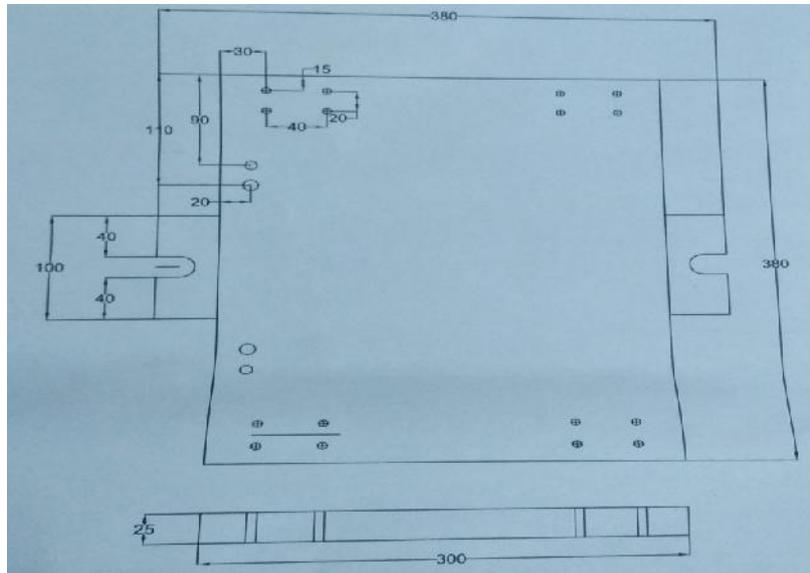
**Table.3. Preparation layout of fixture**

S.NO.	PROCEDURE
1	Edge preparation
2	Grinding
3	Marking as per drawing
4	Drilling
5	Counterering
6	Taping
7	Assembly

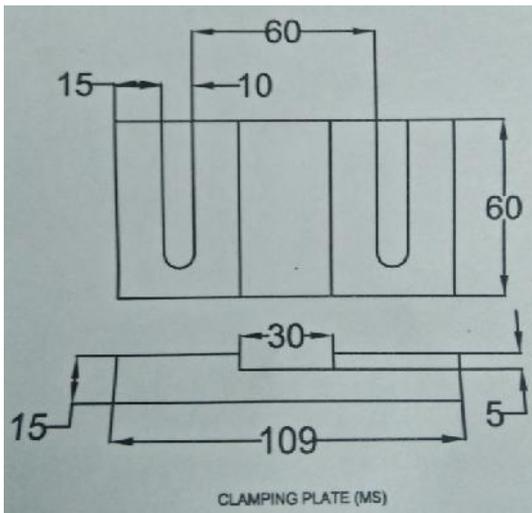
**Table.4. Fixture specifications**

S.NO.	Description	Size	Material	Quantity
1	Base Plate	380x300x25mm	En-8	1
2	Slid plate	110x60x15mm	Mild Steel	2
3	Support Plate	80x50x20mm	Mild Steel	4
4	Stopper	40x30x25mm	Mild Steel	2
5	Top slider	75x30x30mm	Mild Steel	2
6	Dowel Pin	8X35mm	Stainless Steel	2
7	Clamping Pieces	-----	-----	4

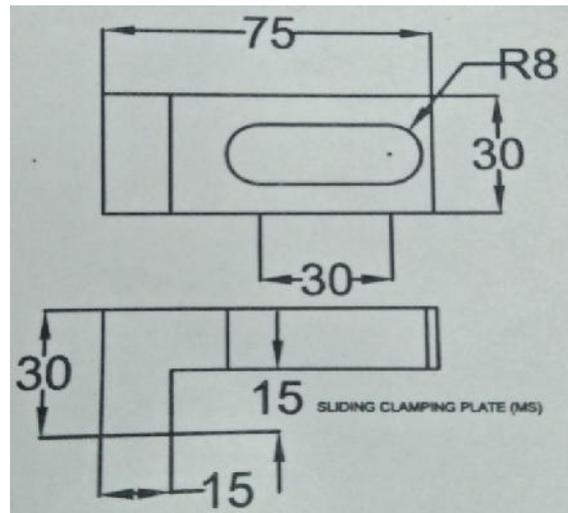
**3. PROCEDURE OF FIXTURE MANUFACTURING**



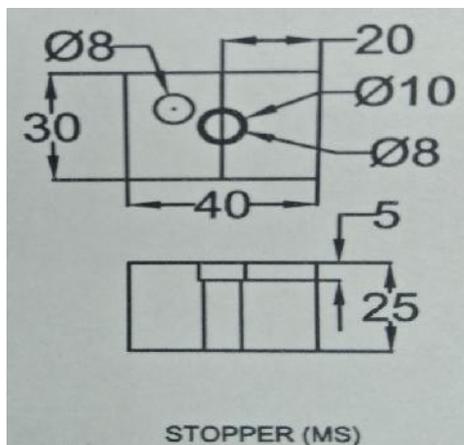
**Figure 1: Base plate**



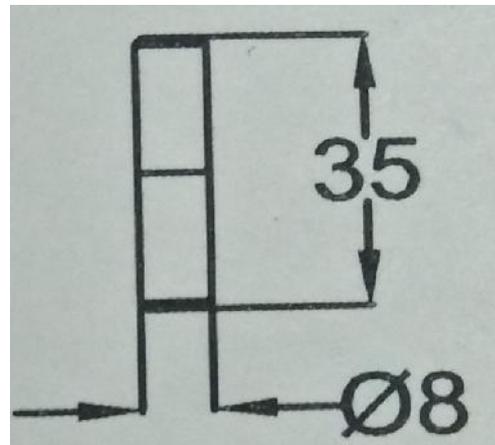
**Figure 2: Clamping Plate**

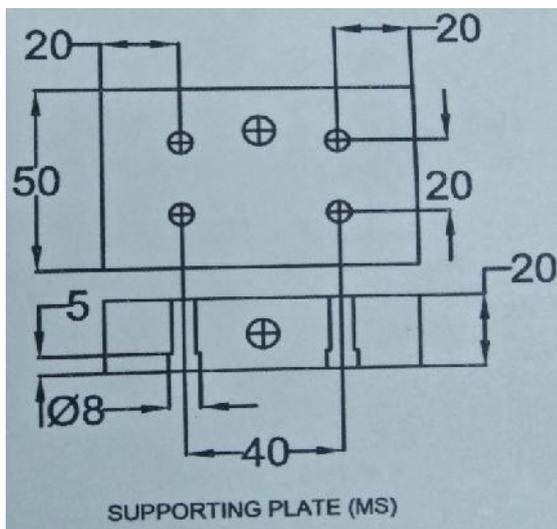


**Figure 3: Sliding Clamping Plate**



**Figure 4: Stopper**





**Figure 5: Supporting Plate**



**Figure 6: Assembled fixture**



**Figure 7: Fixture mount on milling machine for FSW**

#### **Dimension and size**

This fixture has better compact dimension and size for supporting bulky setup of friction stir welding.

#### **Capacities**

It has very good capacity strength for different material like aluminum plates and copper plates during the FSW process. This fixture reduces problem of distortion high temperature due to increased by FSW welding process. It can withstand 400N transverse load that is sufficient for stainless steel and aluminum plate for FSW process.

#### **4. RESULT AND DISCUSSION**

There is no distortion found in variable condition of FSW on weld material in set up during friction stir welding. This fixture has better strength and easy to operate. Clamping of fixture has a good holding power so

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we observed that there is no sifting of aluminum plates during friction stir welding process. It can weld up to 12 mm thick plates on this fixture. It has very good axial load carrying capacity. Designed fixture can be used in industries to performed the friction stir welding on the mass production bases because it has good tensile strength and flexibility strength.

## REFERENCES

- [1] Y.B. Tan , X.M. Wang , M. Ma , J.X. Zhang, W.C. Liua, R.D. Fu, S. Xiang A study on microstructure and mechanical properties of AA 3003aluminum alloy joints by underwater friction stir welding, *Materials Characterization*. 127 (2017). 41–52.
- [2] A. Nagamalleswara Rao a L. Srinivas Naik ,C. Srinivas, Evaluation and Impacts of Tool Profile and Rotational Speed on Mechanical Properties of Friction Stir Welded Copper 2200 Alloy, *Materials Today: Proceedings*. 4 (2017) 1225-1229.
- [3] Yahya Bozkurt, Zakaria Boumerzoug, Tool material effect on the friction stir butt welding of AA2124-T4 Alloy Matrix MMC, *Journal of Materials Technology*. 2017; xxx(x x):xxx–xxx, JMRTEC-246.
- [4] Rajnish Singh, Saadat Ali Rizvi and S.P Tewari, Design and Fabrication of Friction Stir Welding Fixture with a New Approach, *Elixir Mech. Engg.* 86. (2015) 34844-34846.
- [5] M. Sivashanmugam et. al., A review on friction stir welding for aluminium alloys, *Frontiers in Automobile and Mechanical Engineering* -2010, pp-216-221, 2010.
- [6] S. Arularasu, A. Jothilingam, Design and development of low cost friction stir welding machine, *IEEE-International Conference On Advances In Engineering, Science And Management (ICAESM -2012)*, Nagapattinam, Tamil Nadu, India, 30-31 March 2012.