International Journal of Engineering Sciences & Research Technology

(A Peer Reviewed Online Journal)
Impact Factor: 5.164

IJESRT

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[Naveen Raj* *et al.*, 7(12): December, 2018]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

DESIGN AND FABRICATION OF FRICTION STIR WELDING TOOLS

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DOI: 10.5281/zenodo.2526155

ABSTRACT

Friction stir welding is an automatic process falls under the category of solid state welding process. A non-consumable tool is used to generate frictional heat in the abutting surfaces. A shoulder and a pin are the important parts of the tool. This tool makes weld without conventional defects with good mechanical properties and is especially suited for defence applications. The tool shoulder produces a majority of the heating in thick work pieces. In this project the tools are designed in CATIA and fabricated by using the material H13 with the help of lathe machine, tool and cutter grinder. Four different tool pins are fabricated triangular pin tool, square pin tool, tapered cylindrical pin tool and straight cylindrical pin tool.

KEYWORDS: Abutting surfaces, H13, cutter grinder, triangular pin tool, tapered cylindrical pin tool, straight cylindrical pin tool

1. INTRODUCTION

Friction stir welding (FSW) is a solid-state joining process that uses a non-consumable tool to join two facing work pieces without melting the work piece material. Heat is generated by friction between the rotating tool and the work piece material, which leads to a softened region near the FSW tool. It is primarily used on wrought or extruded aluminum and particularly for structures which need very high weld strength. FSW is also found in modern shipbuilding, trains, and aerospace applications. Due to the benefits and potential advantages over processes such as arc welding, friction stir welding has sparked interest in many areas of industry that work with aluminium. FSW allows you to produce long lengths of welds in aluminium without the need to melt the base material. This eliminates the possibility of solidification cracking and provides important metallurgical benefits when compared to other, more conventional welding methods.

2. MATERIALS AND METHODS

Tool Material : Tool material selection depends on the tool material operational characteristics such as operational temperature, wear resistance and fracture roughness. H13Tool steel is a versatile chromium-molybdenum hot work steel that is widely used in hot tooling applications. The hot strength of H13 resists thermal fatigue cracking which occurs as a result of cyclic heating and cooling cycles in hot work tooling applications. Because of its excellent combination of high toughness and resistance to thermal fatigue cracking and also known as heat checking.H13 is used for more work tooling applications than any other steel.H-13 tool steel which is characterized by high harden ability and excellent toughness. The molybdenum and vanadium act as strengthening agents. The chromium content assists H- 13 to resist softening when used at high temperatures. H- 13 offer an excellent combination of shock and abrasion resistance. H-13 has good machinability, good weld ability, and good ductility.

COMPOSITION OF H13

Carbon	0.32 - 0.45
Chromium	4.75 - 5.5
Manganese	0.2 - 0.5
Molybdenum	1.1 - 1.75
Phosphorus	0.03 max
Silicon	0.8 - 1.2

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Impact Factor: 5.164
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Sulphur	0.03 max
Vanadium	0.8 - 1.2

CATIA DESIGNS OF THE FABRICATED TOOLS:

CATIA(computer aided three-dimensional interactive application) is a multi-platform software suite for computer-aided design (CAD), computer aided manufacturing (CAM), computer-aided engineering (CAE) and PLM , developed by the French company. **Dassault Systèmes.**

STRAIGHT CYLINDRICAL PIN TOOL:

Pin diameter (d) =6mm
Shoulder diameter (D) =18mm
Pin length (L) =5.7mm

TAPERED CYLINDRICAL PIN TOOL:

Pin diameter (d) =6mm
End pin diameter =4mm
Shoulder diameter (D) =18mm
Pin length (L) =5.7mm

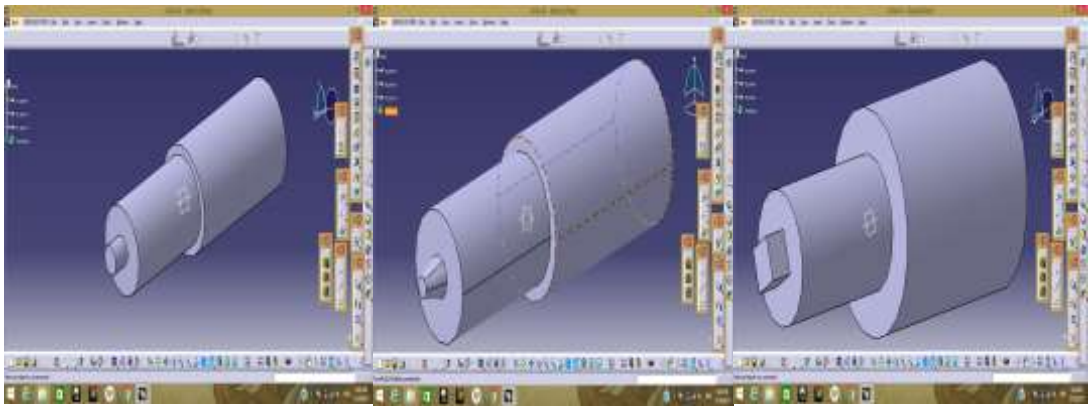
SQUARE PIN TOOL:

Pin diameter (d) =6mm
Pin length (L) =5.7mm
Shoulderdiameter(D) =18mm

TRIANGULAR PIN TOOL:

Pin diameter (d) =6mm
Pin length (L) =5.7mm
Shoulderdiameter(D) =18mm

Figure:



Straight cylindrical pin tool ***tapered cylindrical pin tool*** ***square pin tool***

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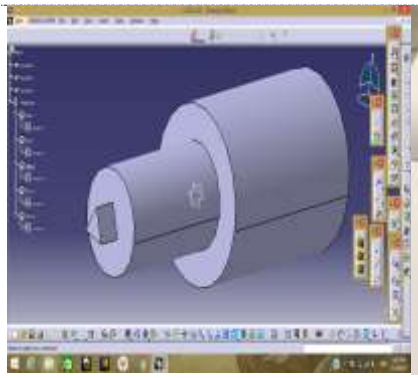

Triangular pin tool

Fabricated tools

3. RESULTS AND DISCUSSION

- Friction stir welding tools are used to join sheet and plate materials such as aluminum, copper and lead.
- Shipbuilding industry
- Aerospace industry
- Railway carriages

4. CONCLUSION

Four tools with different tool pin profiles are designed and fabricated. Square pin tool, tapered cylindrical pin tool, straight cylindrical pin tool and triangular pin tools are designed and fabricated.

5. ACKNOWLEDGEMENTS

I would like to express my heartfelt thanks to my institution VJIT, Hyderabad, which has created a great platform to attain profound technical skills in the field of Mechanical Engineering, thereby fulfilling my most cherished goal. I would like to convey my sincere thanks to **Dr.B.V.Reddi**, Guide and Professor in Mechanical Engineering, for his precious guidance, constant inspiration and kind co-operation at every step of this project work. I would like to convey my sincere thanks to Head of the Department, Mechanical Engineering, for his inspiration, and Successful completion of my project. I would also like to thank all of them who have helped me either directly or indirectly during the completion of the project tenure.

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Raj, C. N., Praveen, N., & Rao, S. N., Dr. (2018). DESIGN AND FABRICATION OF FRICTION STIR WELDING TOOLS. *INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY, 7*(12), 314-317.