ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering
(IJARMATE) Vol. IV, Issue VIII, August 2018

MODELING AND FABRICATION OF DIFFERENT TOOL PIN PROFILES AND MECHANICAL BEHAVIOUR OF FRICTION STIR WELDED AA6063

J.Ramesh[1],P.Karthikeyan[2],K.N.Karthick[3]

[1,2,3]Assistant Professor, Knowledge Institute of Technology,Tamilnadu,India

SM.Athishwaran[4],V.Dillip[5],Y.Harivenkatesh[6]

[4,5,6]Students,Dept of Mechanical Engineering,Knowledge Institute of Technology, Tamilnadu, India

Abstract

Aluminium alloy has gathered wide acceptance in the fabrication of light weight Structures requiring a high strength to weight ratio. Compared to the fusion welding processes that are routinely used for joining structural aluminium alloys, friction stir welding (FSW) process is an emerging solid state joining process in which the material that is being welded does not melt and recast. This process uses a non-consumable tool to generate frictional heat in the abutting surfaces. The welding parameters and tool pin profile play major roles in deciding the weld quality. In this investigation, an attempt has been made to understand the effect of tool pin profile. Five different tool pin profiles (straight cylindrical, tapered cylindrical, threaded cylindrical, triangular and square) have been used to fabricate the joints at different welding speeds. Investigate the mechanical properties of AA-6063 Aluminium alloy by using different tool pin profiles.

Keywords: AA-Aluminium Alloy, FSW-Friction Stir Welding, HCHCr-High Carbon High Chromium Steel,HRC-.Hardness

Introduction

Friction-stir welding (FSW) is a solid-state joining process (meaning the metal is not melted during the process) and is used for applications where the original metal characteristics must remain unchanged as far as possible. This process is primarily used on aluminium, and most often on large pieces which cannot be easily heat treated post weld to recover temper characteristics.In friction stir welding (FSW), a rotating cylindrical tool with a pin or probe at the bottom is plunged into a rigidly held work piece and traversed along the joint to be welded. Welding is achieved by plastic flow of frictionally heated material from ahead of the pin to behind it. Computer simulation

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering
(IJARMATE) Vol. IV, Issue VIII, August 2018

of FSW has suggested that the maximum temperature in the work piece, which exists at the pin/work piece interface, can reach the lower bound of the melting temperature range of the work pieceduring FSW of aluminum alloys, including Alloys 6061, 7030, and 7075.

1.TOOL PIN PROFILE

Five various FSW tools are designed by varying the tool pin profile. The configurations of the designed FSW.

1.1 Tools

1.Tool pin profiles of straight cylinder, threaded cylinder, square, tapered square, triangular without draft as in figure.

2. Tools having D/d ratios of 3.

Out of various tool materials like tool steel, high speed steel, high carbon high chromium steel (HCHCr), HCHCr steel is chosen as tool material because of its high strength, high hot hardness, easy to process, easily available and low cost. The FSW tools are manufactured using lathe and surface finishing for CNC Turning center and wire cut EDM (WEDM) machine. The tools are oil hardened to obtain a hardness of 60–62 HRC. Different tool pin profiles shown in fig 1.2

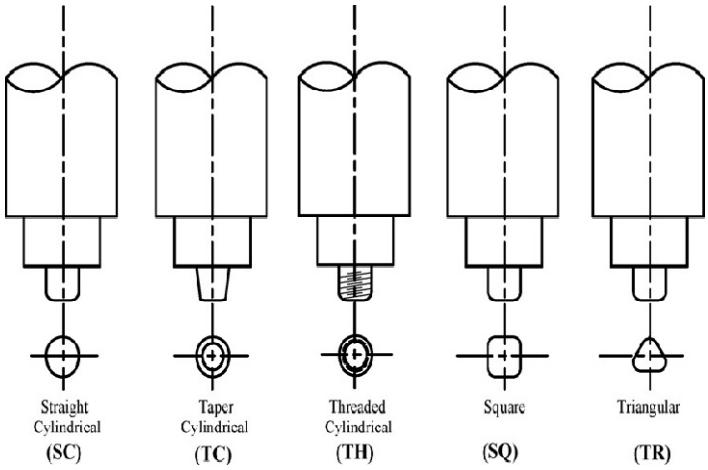
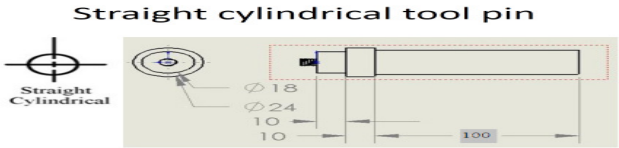


Figure 1.1 different tool pin profiles

Tool Pin Dimensions

1.2Straight Cylindrical Tool Pin

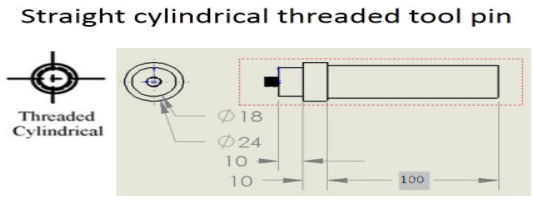


Shank length	100 mm
Shank diameter	22 mm
Shoulder length	15 mm
Shoulder	18 mm
Pin length	5.7 mm
Pin diameter	6 mm

Table 1.1 Straight Cylindrical Tool Pin dimensions

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering
(IJARMATE) Vol. IV, Issue VIII, August 2018

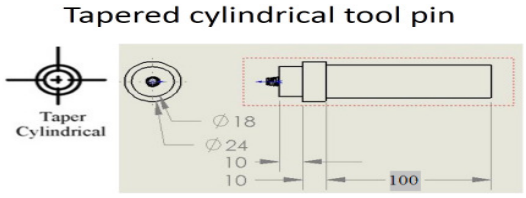
Threaded Cylindrical Tool pin



Shank length	100 mm
Shank diameter	22 mm
Shoulder length	15 mm
Shoulder	18 mm
Pin length	5.7 mm
Pin diameter	6 mm
Pitch	1mm

Table 1.2 Threaded Cylindrical Tool pin dimension

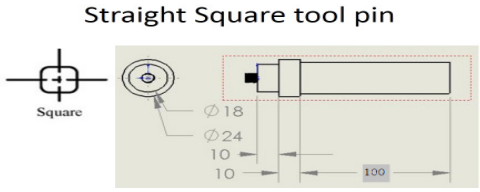
Taper Cylindrical Tool Pin



Shank length	100 mm
Shank diameter	22 mm
Shoulder length	15 mm
Shoulder	18 mm
Pin length	5.7 mm
Pin diameter	6 mm

Table 1.3 Tapered Cylindrical Tool Pin Dimensions

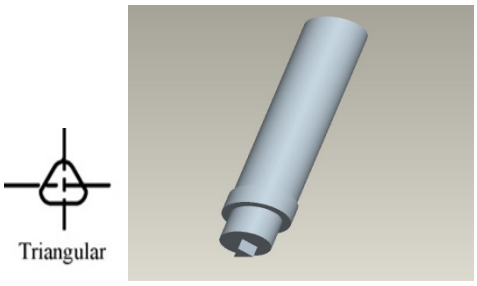
Square Tool Pin



Shank length	100 mm
Shank diameter	22 mm
Shoulder length	15 mm
Shoulder	18 mm
Pin length	5.7 mm
Pin diameter	6 mm

Table 1.4 Straight Square Tool Pin Dimensions

Straight Triangular tool pin



TOOL DIMENSIONS

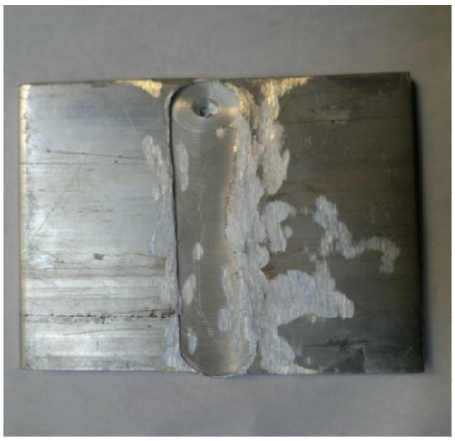
Straight Triangular tool pin

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering
(IJARMATE) Vol. IV, Issue VIII, August 2018

Shank length	100 mm
Shank diameter	22 mm
Shoulder length	15 mm
Shoulder	18 mm
Pin length	5.7 mm
Pin diameter	6 mm

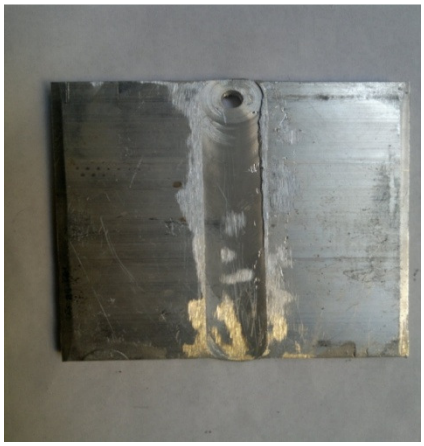
Table 1.5 Straight Triangular Tool Pin Dimensions

SQUARE

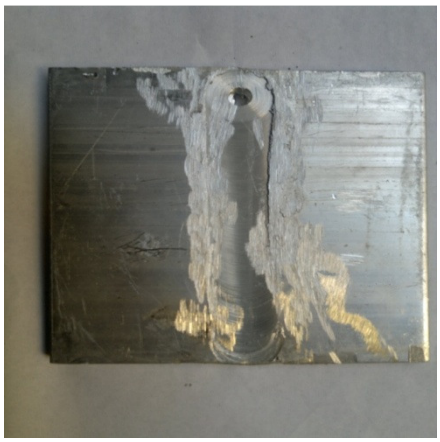


TAPER

WELDED MATERIAL



CIRCLE



THEARDED

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering
(IJARMATE) Vol. IV, Issue VIII, August 2018

TRIANGLE

S.NO	TYPES OF TOOL PROFILE USED	AT POINT 1	AT POINT 1	AT POINT 1
1	CIRCLE	12	9	8
2	SQUARE	10	9	7
3	TRIANGLE	10	6	8
4	THREADED	6	10	7
5	TAPER	7	11	9

S.NO	TYPES OF TOOL PROFILE USED	SPINDLE SPEED (RPM)	WELDING FEED (mm/min)	HARDNESS(Avg)
1	CIRCLE	1200	20	10
2	SQUARE	1200	20	9
3	TRIANGLE	1200	20	8
4	THREADED	1200	20	8
5	TAPER	1200	20	9

HARDNESS TESTING AND MICROSTRUCTURE

ROCKWELL HARDNESS TEST

In the Rockwell test the depth of the indenter penetration into the specimen surface is measured. The indenter may be either a hardened steel ball with diameter 1/16” with load of 100Kgf

BRINELL HARDNESS TEST

The Brinell hardness test method consists of indenting the test material with a 10 mm diameter hardened steel with load of 500Kgf.

ROCKWELL HARDNESS TESTING

BRINELL HARDNESS TESTING

S.NO.	TYPES OF TOOL PROFILE USED	AT POINT 1	AT POINT 1	AT POINT 1
1	CIRCLE	3.9	3.6	3.5
2	SQUARE	4.2	4.3	4.3
3	TRIANGLE	4.9	5.2	4.8
4	THREADED	4.5	4.0	4.4
5	TAPER	4.1	5.0	4.0

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering
(IJARMATE) Vol. IV, Issue VIII, August 2018

S.NO	TYPES OF TOOL PROFILE USED	SPINDLE SPEED (RPM)	WELDING FEED (mm/min)	HARDNESS(Avg)
1	CIRCLE	1200	20	45.45
2	SQUARE	1200	20	33.16
3	TRIANGLE	1200	20	34.65
4	THREADED	1200	20	32.81
5	TAPER	1200	20	31.83

MODEL CALCULATION

Applied load = 500 Kgf

Ball diameter =10mm

Diameter of impression =3.67mm

Brinell hardness number =P/A BHN

Surface area of impression (A)

$$= \frac{\pi D}{2} - \left[D - \sqrt{D^2 + d^2}\right.$$

$$= \frac{\pi \times 10}{2} - \left[10 - \sqrt{10^2 + 3.67^2}\right.$$

= 11 mm

Brinell hardness number = P/A

= 500/11

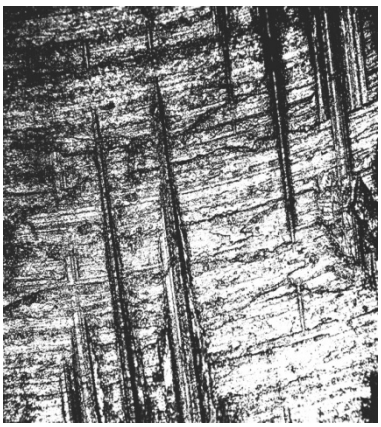
=45.45

BHN

MICROSTRUCTURE

- Unaffected material or parent metal
- Heat affected zone (HAZ)
- Thermo-mechanically affected zone (TMAZ)
- Weld Nugget

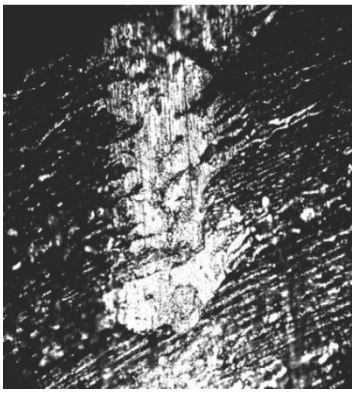
MICROSTRUCTURE



CIRCULAR

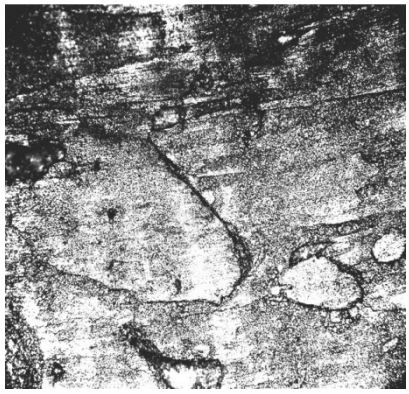
ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering
(IJARMATE) Vol. IV, Issue VIII, August 2018

SQUARE



TAPER

THREADED



TRIANGLE

TENSILE STRENGTH

- The resistance of a material to a force tending to tear it apart, measured as the maximum tension the material can withstand without tearing.
- Five different FSW material can be Tested by using UTM.

Ultimate Tensile Strength	100.92	97.22	90.02	78.14	74.44

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering
(IJARMATE) Vol. IV, Issue VIII, August 2018

Ex no	Tool Used	Spindle speed	Welding Feed(mm/min	Axial Load(kn)	Hardness BHN
1	CYLINDER	1200	20	6	45.45
2	STRAIGHT	1200	20	8	33.16
3	TAPERED	1200	20	10	34.65
4	THREADED	1200	20	8	32.81
5	SQUARE	1200	20	10	31.83

Conclusion

The different tool pin profile are made by using different tool pin profiles AA6063 weld can be done. The various tests are conducted to welded materials and the circular tool pin profile has been good result in all mechanical properties. I was conclude here by my various testing result the optimum tool pin profile is circular. It has high Tensile strength.