International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 3 March 2023, pp: 1696-1701 www.ijaem.net ISSN: 2395-5252

Experimental Trial of Friction stir scribed tool spot welding

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Date of Submission: 20-03-2023 Date of Acceptance: 30-03-2023

ABSTRACT
This work is about to new invented welding technique named friction stir scribed spot tool welding. which is about to joint aluminum material with the heat generated by the friction between the tool pin and workpiece material. this welding is performed on the milling machine with vertical tool. tool must be made from different material and can be harder than the tool material. By this welding technique we can joint small parts of aluminum and can be done in very less time required compared to all other welding technique. We can joint any kind of small part of the material.

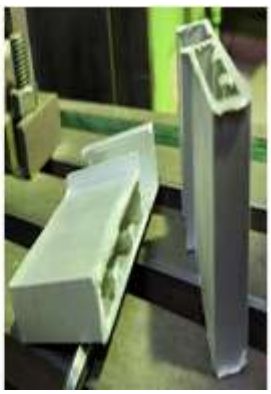
I. INTRODUCTION

This welding technique is for material joint by the friction generated between the workpiece material and tool pin. tool is constantly rotate after we on milling machine, after tool pin contact with the clamped workpiece, heat is generated between the workpiece and tool which is called as stir zone. When tool contact with the material, we can give feed rate and rpm to the tool, and it work similar just like sewing machine. Tool is made from EN31 as shape and size which can be undergoes fit into the tool holder of the milling machine.

II. MATERIAL AND EXPERIMENTAL DETAILS:

Tool and workpiece: FSSTSW works on the principle of friction welding, which required light weight material like aluminum, mild steel, stainless steel etc. it can be


En31 steel


He9 aluminum

Test report of Tool

Performed on the aluminum plates easily and help to joint two similar aluminum plates or blocks using these techniques. FSSTSW tool is made from the En31 steel because of their mechanical properties like hardness, toughness, ductility and chemical properties like corrosion resist. En31 is also used as first priority to made tool because of its more durable and hardness.

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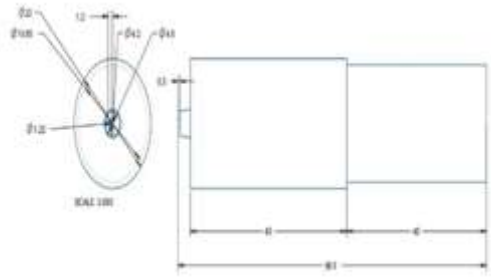
Test Certificate

Test report of Workpiece

Workpiece material should be light weight and can have low thickness around 0.5 to 2 mm is required for perform experiment easily. Due to light weight and harden material FSSTSW is easily performed on it.

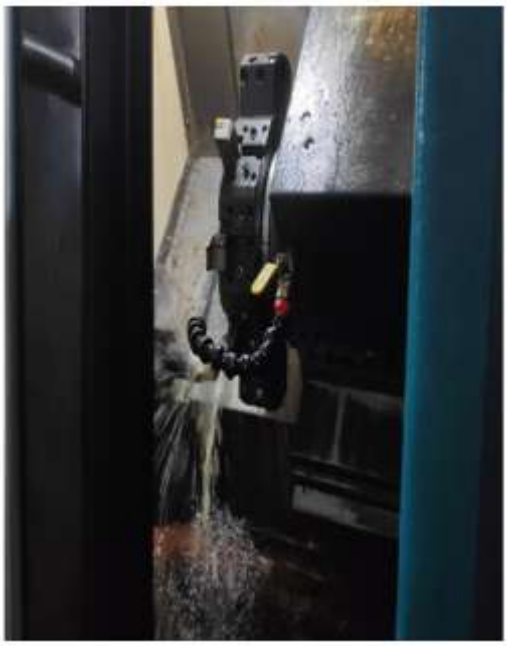
Tool design:



Tool design is required to made tool according to the size and shape of the collet of the milling machine. Tool can be easily fit in the collet to perform experiment. As shown in the figure tool pin is required at the end of tool to perform FSSTSW. Tool pin is help to generate such amount of heat using friction between the tool and workpiece and it transfer material from tool to the workpiece and helps joint the material.

Making of tool:

To required accurate shape and size is first priority to making the tool, using advanced technology we can get proper and accurate tool in short time with less error. CNC machine is used to making the tool of FSSTSW.in- Making Tool in CNC Machine conventional machine we can also produce the tool but it required more time and more effort and we get more error in those machines. So, using CNC machine is better option for making tool.it required less skill compared to conventional technique.



Hardening of Tool:

Hardening is the metallurgical metalworking process used to increase the hardness of the material. the hardness of the material is directly proportional to the uniaxial yield stress at the location of the imposed strain. A harder metal will have higher resistance to plastic deformation than less hard metal.in this process high temperature is given to the material and after heat treating it dip in the oil for the solidification and making it hard.

It used in machine cutting tools like drill, taps, lathe tools, milling tool. for avoiding plastic deformation and increasing hardness of the tool.

Machine setup: To perform the experiment is required milling machine (with vertical tool

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direction) because of the criteria of friction generation between thetool and workpiece. In machine setup, tool must be fit in the tool holder through the collet and workpiece should be fit in the fixture of the milling machine on the base as shown in the figure 2. Tool must be fit in the holder and workpiece cannot be moved in the fixture, it should resist all degree of freedom for perform the experiment without any error.

FSSTSW welding process:

After machine setup is done the next step is to perform the experiment by turning on the machine. Parameters are required to perform the experiment. Tool speed should be 1000 rpm and feed rate should be 63. (According to your workpiece material's thickness). As soon we start the machine tool will be rotate parallel to the workpiece just like drilling machine. Workpiece should be moved higher-lower by the lever of the milling machine. After contacting tool with the workpiece, it will create friction and start producing the heat. When the friction generates between them next step is to give feed rate to workpiece for tool can traverse along the axis of workpiece to the end of the surface. It will melt the pin of the tool which we created, and tool will joint the both aluminum blocks just like sewing.

As shown in picture, due to the friction, vapor is created due to the heat. And pin of the tool is start melting and it works as filler material, and joint the aluminum blocks in short time, this technique is the combination of the 'friction stir welding' and 'friction stir scribed welding'. We can joint material by not only continuous scribed welding but also it can joint by spot welding, so we can joint any single area of workpiece material and can be weldable very small area of the workpiece.

Result of experiment after FSSTSW

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ULR - TC509823022336F

Test Certificate

Page 1 of 1

Test Certificate No.	DMSPL-23-018716-1	Date of Issue:	16-03-2023
Customer Name:	M/s. Rutvik R.Solanki	Sample Received On:	15-03-2023
Customer Address:	A-4, Radhe Residency, Nava Naroda,Ahmedabad	Test Performed at:	DMSPL, Ahmedabad.

INFORMATION PROVIDED BY THE CUSTOMER

Stamped As	NIL	Sample Drawn By	customer
Nature of Sample	AL Piece		
Specification	AL ALLOY		

MECHANICAL | MECHANICAL PROPERTIES OF METALS

Test Name : Hardness Test

Test Method : ASTM E92:2017 | Dt. of Testing : 16-03-2023

Equipment : FIE VICKERS HARDNESS TESTER (DMSPL/07/09) Cal. Dt: 22-Jun-2022

Sample ID/Locaton	Hardness in HV1			Average
-	92	93	93	92.67

----------End of Report----------

V.H. KAKANI G.M.

Tested By H.K.VANIA / U.J.PATEL

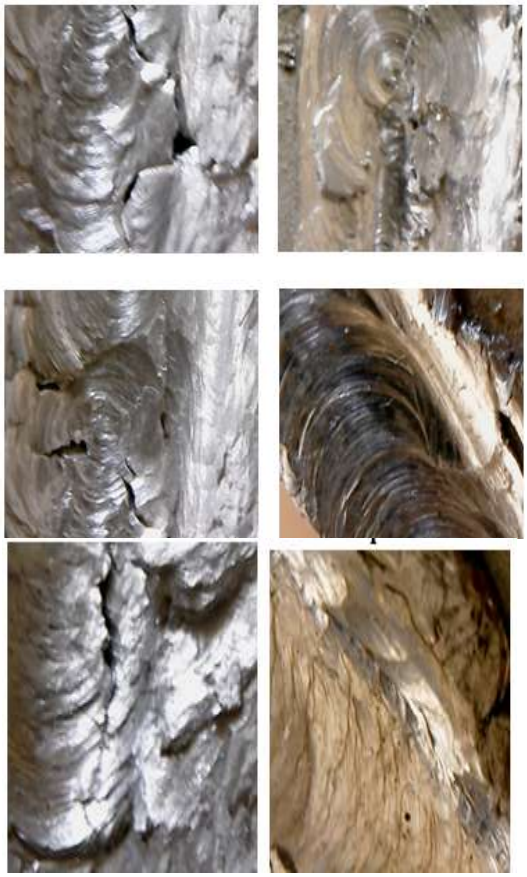
Reviewed & Authorized by

As shown in the pictures, FSSTSW technique is works to joint the similar material, lightweight aluminum plates in very less time without any error. And less skill required to perform the experiment, this can be good advantage of the welding techniques.

Hardness test of welded material (He9)

Hardness test of Tool (En31)

Microscopic view of experiment:



Pictures of different welding zone from 40x lens

III. RESULT AND DISCUSSION:

After taking multiple trials, we find out that this technique is very helpful for the limited size material. this experiment take less time to performed completely, as mentioned earlier, two similar material aluminum plates are joined by friction stir scribed tool spot welding in less time compared to previous techniques. This has also limitation of required good machine condition, and required same size tool that can be fit into the tool holder. Better thickness of material required changes in the speed and feed rate.

IV. FUTURE SCOPE:

The researchers can work on appropriate tool design can be made for such profile of aluminium.the researchers can work on appropriate fixture design can be made for such profile of aluminum.

The experimental studies can further be extended to various profiles straight as well curved.a robust and rigid machine can give good weld as it is also one of the limitations faced during attempting this experimental investigation.

V. CONCLUSION:

The aluminium sections are difficult profiles to friction stir weld. The observations show that the aluminum sections are hollow form inside, the reaction forces required to weld them are not enough.so there is necessity of providing internal support to the region of plate where weld is required.multiple experimental trials had been conducted to form weld. but as the profile gets distorted with each trial s well the plates are thin and hollow so it is found difficult to get the material fused in proper format. Though different attempts had been made. A result in small region the weld had been created successfully but it is not good enough to get tested and evaluated on conventional test basis, so macro structures had been captured and presented in study.

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