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Investigation of Bi-Directional 2 Passes Weld Distortion in AA7050-T7451 Thick Plate.

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Abstract: ***The metal joining processes have been evolved a lot. Various techniques have been introduced to observe and evaluate the in-depth study of various welding techniques. Friction stir welding process is one of the well accepted solid state joining process. This research paper represents attempts and experiments made to do 13 mm thick plate friction stir weld with the help of simple vertical milling machine. The experimental procedure followed was bi directional multi pass FSW. The distortion of plate is common phenomena in welding but evolution of distortion while conducting solid state welding process is also interesting observation. The distorted plate leads to failure of component considering loading cycles which are concerned with the weld plate. The distortion studies have been conducted using Vernier height gauge and plate clamping consideration with reference plate and slip gauge.***

Keywords: Welding distortion, FSW distortion, Aluminium plate distortion, plate deformation, bi-directional multi pass weld.

I. INTRODUCTION

The FSW –Friction stir welding methodology is well accepted in welding aluminium alloys. The welding of 7xxx series of aluminium alloy is considered critical. The procedures by which weld attempts succeed are more and one of them is friction stir welding process. Here the problem a welding personal face is welding of thick plate. Another issue relating to welding is plate distortion. Distortions are of many types. The major source of distortion is localised heat generation due to this the plate is getting heat profile within which eventually setup unbalance between residual stresses. This unbalance in residual stresses leads the plate towards distortion. The forms in which weld distortions can be observed are longitudinal shrinkage, transverse shrinkage, angular distortion, bowing and dishing, busking as well twisting. The plate selected for experimental investigation is 13 mm thick. Fixture have been developed to observe distortion behaviour in plate. Here the plate are clamped within a fixture and plate have been welded in 1st direction or face , now plate is flipped and again taking care of the nodal points weld is performed on 2nd direction or face. Here in case of bi-directional multi pass weld. The plate is firmly held within the fixture and then another pass is performed. The possibility of weld pass direction is also tough to decide. As the weld plat flipped the study points are changing their position. The FSW plate distortion study is required as the welding process is carrying plate inserted and moving heat source. Here experiments have been conducted on 9 plates for Bi-directional 2 pass welding of AA7050 T7451 plate. And distortion study have been conducted by using Vernier height gauge placing dial indicator on it with slip gauges placement to measure plate distortions.
Figure below shows bi directional multi pass welding procedural observations. Figure 1 represents bi directional welding physics.

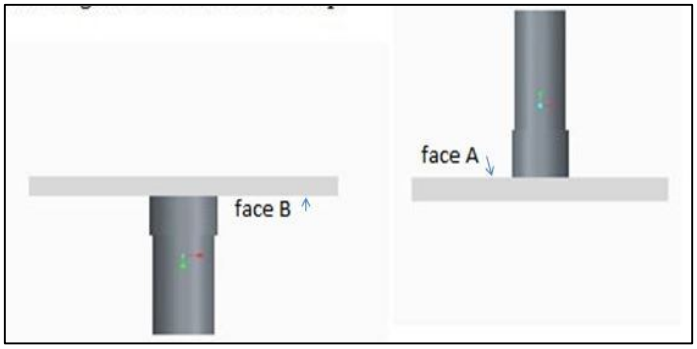


Figure 1Bidirectional welding phenomena.

Figure 2 and 3 represents the methodology to reproduce the physics by available resources as simple vertical milling machine, and fixture to hold the plate. Here manually the face change/ direction change have been done for each pass and witching of direction or face.

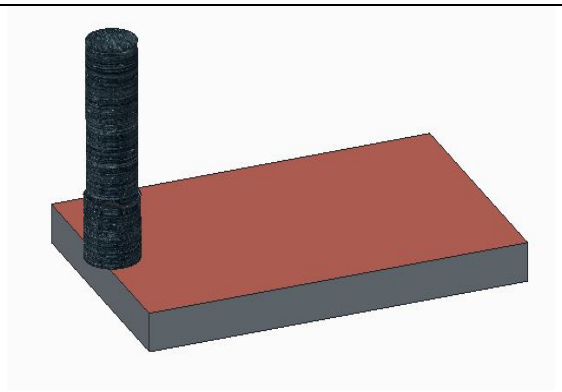


Figure 2 Direction 1 / Top face weld pass 1,2

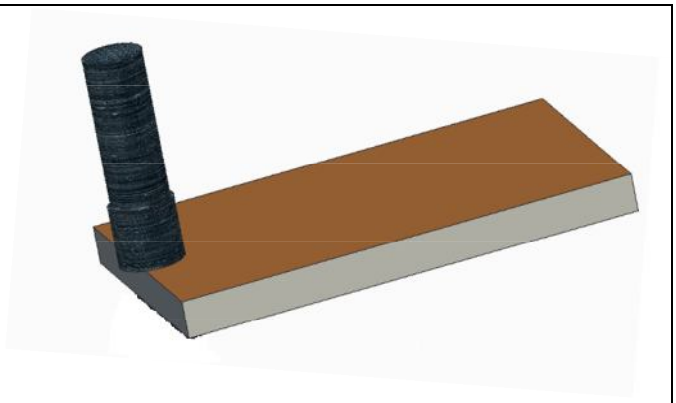


Figure 3 Direction 2 / Bottom face weld pass 1,2

II. LITERATURE REVIEW

There are literatures available for distortion study of ferrous and nonferrous materials are available. The FSW distortion study is observed in few literatures. The solid state joining processes are too much complex by its operational physics. The distortion behaviour in material welded with FSW can represent a good study.

Clinton T Canaday; Matthew A. moore; Wei Tang;A.P.Reynolds; Univresity of south kerolina,USA. "Through thickness property variation in a thick plate AA7050 friction stir weld joint" Pub: Elsevier, Journal: Material science and engineering, Year : 2013 ,Page no : 678-682 , have represented utilisation of effective parameters for conducting the experimentations and after the detailed study the outcomes were interesting. As they have achieved 60 to 180 HV hardness at various locations of weld. The temperature Vs. time plots have represented heating as well cooling cycle of material. Also some matullurgical investigations have been presented for detailed understanding.

Rebecca Brown; Wei tang; A.P. Reynolds, University of south kerolina, USA, Multipass friction stir welding in alloy 7050 T7451 : Effects on weld response variable and on weld properties "Pub: Elsevier, Journal: Material science and engineering, Year : 2009,Page no : 115-121. Have represented requirement of torque machine for the effective weld.the strength and hardness achieved by welds have been under consideration for detailed study. The crack initiation and failure criteria observations have also been conducted.

P.Upadhyay; A.P.Reynolds, Univresity of south kerolina, USA. "Effects of thermal boundary conditions in friction stir welded AA7050 T7 sheets" Pub: Elsevier Journal: Material science and engineering, Year: 2010, Page no: 1537-1543. The parameters which are utilised for study are material thickness, tool material selection, tool profile selection, spindle speed and weld speed selection. The output parameters which show effectiveness of result were taken under consideration.

j.Yan, A.P.Reynold, Univresity of south kerolina, USA. Effects of initial base metal temper on mechanical properties in AA7050 friction stir welds" Pub: MANEY (Institute of Materials, Minerals and mining) Journal: Science and technology of welding and joining,Year : 2009 ,Volume 14,Page no : 282-287. Have represented various studies on basis of forces carried by materials while conducting the experimentations. At lower speed higher forces are developed on material and at higher speeds lower forces have been developed. The forces developed during welding are also effecting the stir rate as well the hardness at various zones of weld and also it affects grain size of material.

Md. Reza E-Rabby,A.P.Reynold, Univresity of south kerolina, USA. Effect of tool pin thread forms on friction stir weldability of different aluminium alloy" Pub: Elsevier.Journal: Procedia engineering,Year : 2014,Volume 90,Page no : 637-642. The article or research paper refers to the development of specific properties of material at specific region for in depth study of parametrical 050. Tool material and spindle speed as well feed are having significant effect on measurable parameter.

III.EXPERIMENTAL

SETUPA simple vertical milling machine is selected to develop machine setup for FSW of 13 mm thick plate. The fixture to hold the plate is fastened with the carriage base T slots. The fixture is now charged with the raw material. The tool is assembled within the vertical spindle a 20mm collet is selected as per tool geometry developed. The whole setup is tested for its working. Now experimental data set is selected to be run on the machine with inventory of raw material.

Experimental data set.

This table suggests speed 1, 2, 3 (RPM) = 1000, 1400 & 2000.

Feed 1, 2, 3 (mm/minute) = 63, 80 and 100.

A. Assumptions

1) Machine base is rigid.

2) Machine operates on same RPM mentioned on its gearbox. Its feeds are constant.

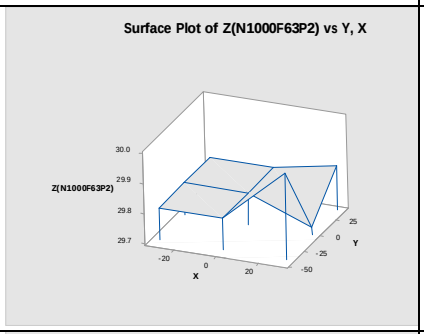
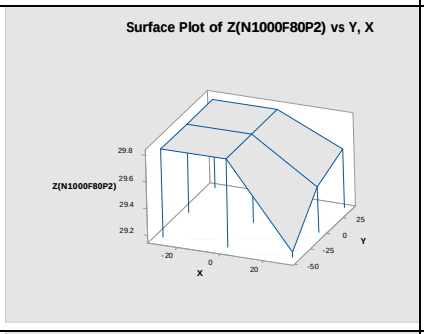
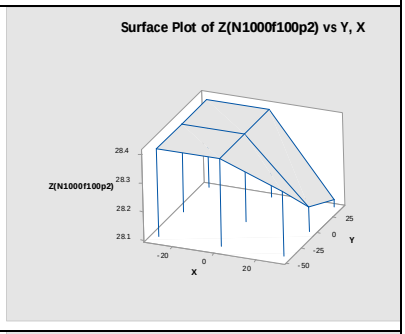
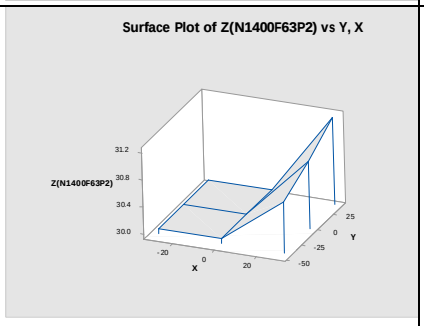
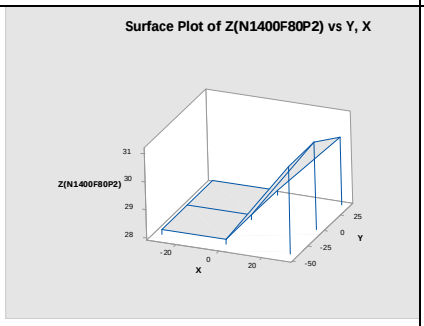
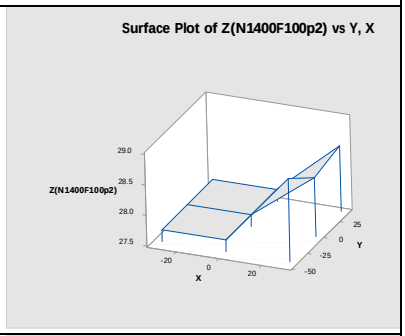
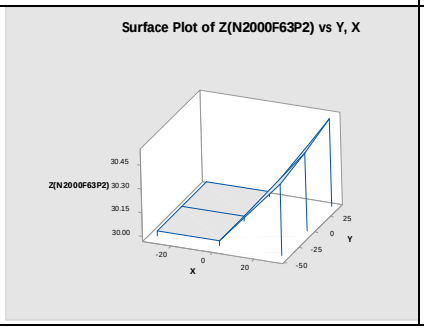
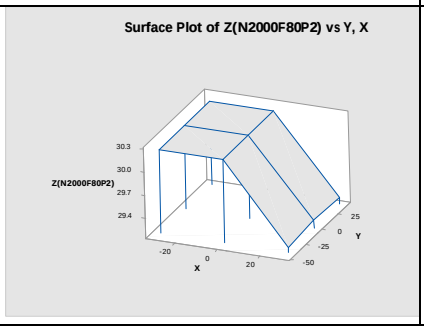
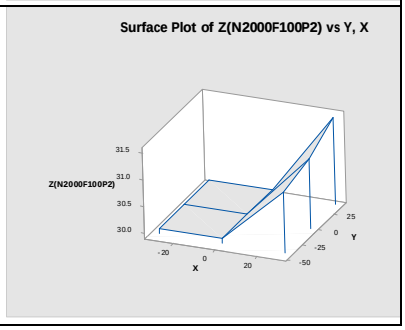
3) Machine do not define major vibration when experimentations have been carried.

4) Machine spindle and collet are rigid and do not deform when they are heated while conducting the experimentations.

	Feed (mm/minute)		
Speed (RPM)	63	80	100
1000	2 Pass	2 Pass	2 Pass
1400	2 Pass	2 Pass	2 Pass
2000	2 Pass	2 Pass	2 Pass

The distortion measurement have been conducted by Vernier height gauge with dial indicator and slip gauge mounting below the plate to hold it firmly on the surface flat.

IV. RESULTS AND DISCUSSION

No of pass 2	Feed (mm/minute)		
Speed (RPM)	63	80	100
1000			
1400			
2000			

The plots represents distortion in plates when 2 pass have been conducted on each direction or face. The plotted results show the behavior of plate distortion. The variables considered are Spindle speed or tool rotational speed, weld speed or feed. The assumptions considered are regarding its procedural requirements.

V. CONCLUSIONS

The work have been fulfilled the motto of conducting the experiments. The compilation of results have lead the work towards nice observations. The process investigations lead us to know the deformation behavior of plates when welded at specific speed and feed. When the bi directional 1 pass have been conducted the results are complicated to judge. The 2nd pass on both the directions or faces when conducted it have shown a trend which is followed. The results shown are following the same trend which have been achieved previously. The distortion behavior study concludes that, distortion in plate is following same trend so we are able to control the distortion in plate during FSW.

VI. ACKNOWLEDGMENT

The research work have been possible to conduct with the help of Department of Mechanical engineering, LDRP-Institute of technology and research, Kadi Sarva Vishwavidyalaya. The continuous guidance of Dr. G. D. Acharya, Principal, AITS, Rajkot have helped a lot to conduct the research work as well to technically observe the phenomena.

REFERENCES

[1] Clinton T Canaday;Matthew A. moore;Wei Tang; A.P.ReynoldsUnivresity of south kerolina,USA. “Through thickness property variation in a thick plate AA7050 friction stir weld joint” Pub: ElsevierJournal: Material science and engineeringYear : 2013 Page no : 678-682

[2] Bi- Directional FSW of 10 mm Thick AA6351 and Evaluation of impact Strength Null Hypothesis rejection Region. AAICSET-2015(Afro-Asian international conference of science, engineering and technology).By Dr. G.D. Acharya, Mr.K.H.Bhavsar. Page 561-564.

[3] Rebecca Brown ;A.P.Reynolds ,Univresity of south kerolina,USA. “Multipass friction stir welding in alloy 7050 T7451 : Effects on weld response variable and on weld properties” Pub: Elsevier Journal: Material science and engineering Year : 2009 Page no : 115-121

[4] A.P.Reynolds Univresity of south kerolina,USA. “Effects of thermal boundary conditionsin friction stir welded AA7050 T7 sheets” Pub: Elsevier Journal: Material science and engineering Year : 2010 Page no : 1537-1543

[5] A.P.Reynold .Univresity of south kerolina,USA. “Effects of initial basemetal temper on mechanical properties in AA7050 friction stir welds” Pub: MANEY(Institute of materials ,Minarals and mining) Journal: Science and technology of welding and joining Year : 2009 Volume 14 Page no : 282-287.

[6] Md. Reza E-Rabby ,A.P.Reynold ,Univresity of south kerolina,USA. “Effect of tool pin thread forms on friction stir weldability of different aluminum alloy” Pub: Elsevier Journal: Procedia engineering Year : 2014 Volume 90 Page no : 637-642

[7] “Design and development of simplified fixture for FSW”. - Design and development of fixture for single as well multi pass Friction stir welds as butt weld and bobbin tool weld.” 2017 IJCRT | Volume 5, Issue 3 September 2017 | ISSN: 2320-2882.By Kaushal Bhavsar, Dr.G.D.Acharya. Page 164-168.

[8] Harsha Badrinarayan;Ji Hoon Kim ;Cong min kim; Kazutaka Okamoto; R.H. Wagoner; Kwansoo Chung; Hitachi Research lab,Omika<Hitachi, Japan “Numerical simulation of friction stir butt welsing process AA5083-H18 sheets” Pub: Elsevier Journal: Europian journal of mechanics Year : 2010 Volume 29 Page no : 204-215.

[9] R. Nandan; G.G.Roy; T.Debroy Material science and technology devision ;Los Alamos national lab,USA. “Numerical modelling of 3D plastic flow and heat transfer during friction stir welding of stainless steel” Pub: MANEY(Institute of material,minral and mining) Journal:Science and technology of welding and joining Year : 2006 Volume : 11 Page no : 526-537.

[10] J.D. Robson;; A.P.Reynolds; Manchester Material science centre ,UK. University of south Carolina,USA. “Modelling microstructural evolution during multipass friction stir welding” Pub: MANEY(Institute of material,minral and mining) Journal:Science and technology of welding and joining Year : 2010 Volume : 15 Page no : 613-618

[11] E.Suzano; M.Beltrao; A.Roots; J.F.dos Santos; P.M.S.T. de castro; Institute of Material research ,Materials Mechanics,Solid state joining process, Germany. “Influence of the FSW clamping force on the final distortion and residual stress field” Pub: Elsevier Journal: Material science and engineering Year : 2012 Page no : 81-88.

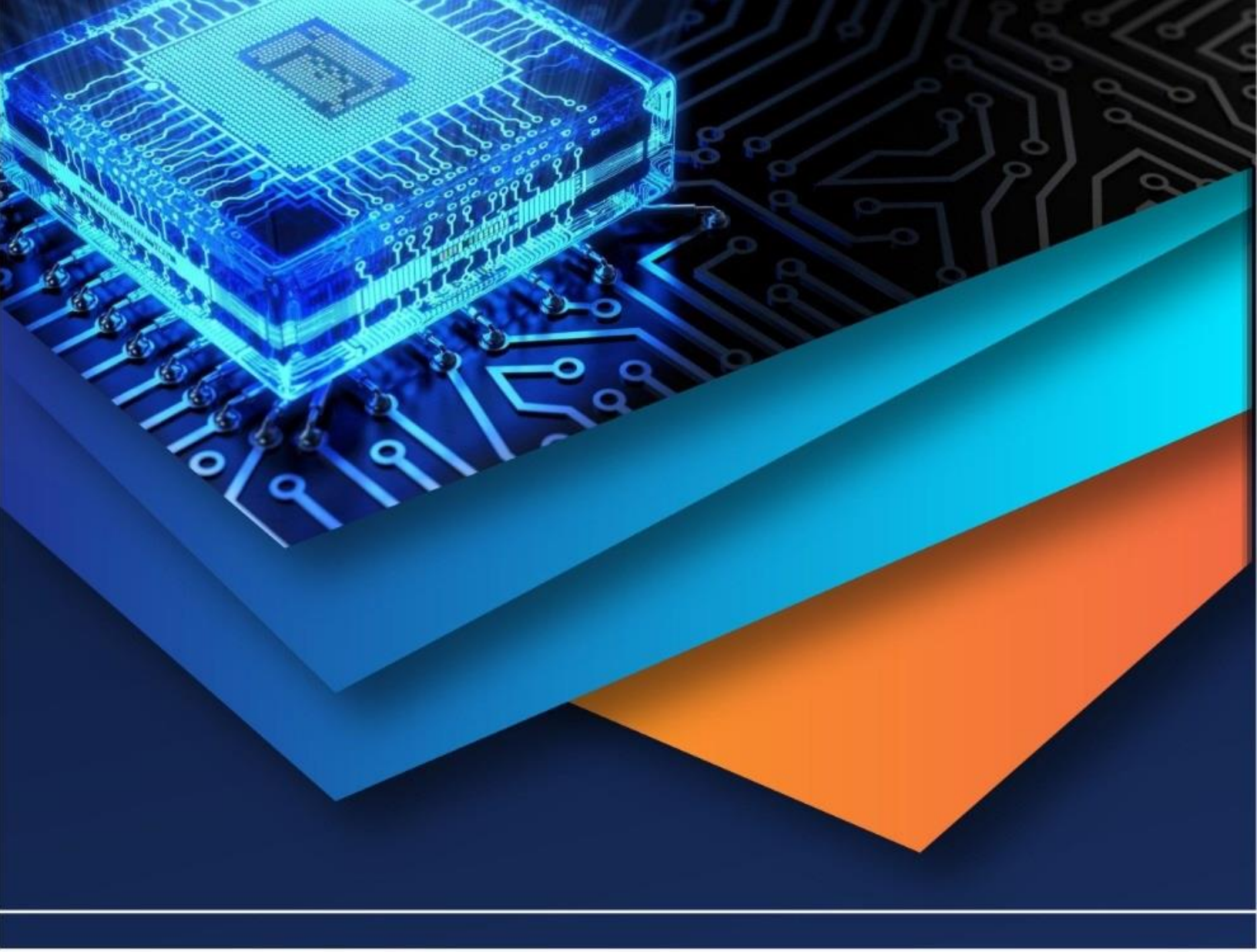
[12] H.M.Arbogh .,Institute of energy technology Norway, “Experimental validation of finite element codes for welding dformations” Pub: HAL Journal: Journal of material processing technology Year : 2010

[13] Dean Deng; Wei Liange; Hidekazu Murakava; Joining and welding research institute, Osaka University, Japan. “Determination of welding deformation in fillet welded joint by means of numerical simulation and comparison with experimental measurements” Pub: Elsevier Journal:Journal of material processing technology Year : 2007 Page – 219-225

[14] ISS training manual ,chapter – 9 , NASA (2008)

[15] R & D JOURNALS BOING ; R & D JOURNALS AIR BUS ; US AIRFORCE ARTICLES

[16] FSW –VI 2013 articles By The welding institute UK.



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