FWT WELD DEVELOPMENT REPORT:

Customer	RANE MADRAS		
Customer Contact	Mr. Arun Raja		
Customer P.O. Number	1001-46001 65051		
Description of Components	Rod Eye, Rod		
Tests conducted at lab	Prompt Metallurgical Services & FWT		
Tests Conducted on	21.09.22		
Report Document Number	01	Revision Number	00
Total Pages	17	Date Published	21/09/2022
Weld Engineer	Mr. Satesh	Contact No.	9766206538
Email	satesh@frictionwelding.in		

FWT CONTACT DETAILS:

For Additional Information, please contact:

DEPARTMENT	**SALES**
Address	Survey No. 326, A/P Gauddara, Gauddara Road, Khed Shivapur, District Division – Haveli, District – Pune, 412205 Maharashtra, India.
Mobile	+91 83088 27952 +91 89566 05809
Email	sales@frictionwelding.in dhaya@frictionwelding.in
Website	www.frictionwelding.in

AIM AND OBJECTIVES:

This study aims to demonstrate that testing carried out on a Rane madras project to demonstrate weld strength and integrity.
The parts examined in this report are the Socket & Rod components as per Drawing No.
The following parts were welded.

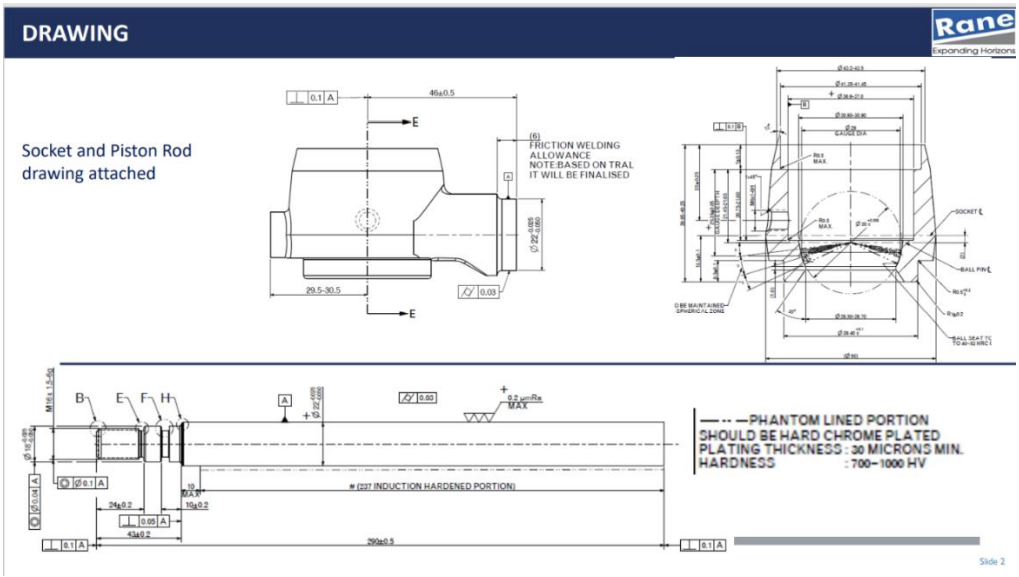


Fig 1.: Part Specification Input Drawing.

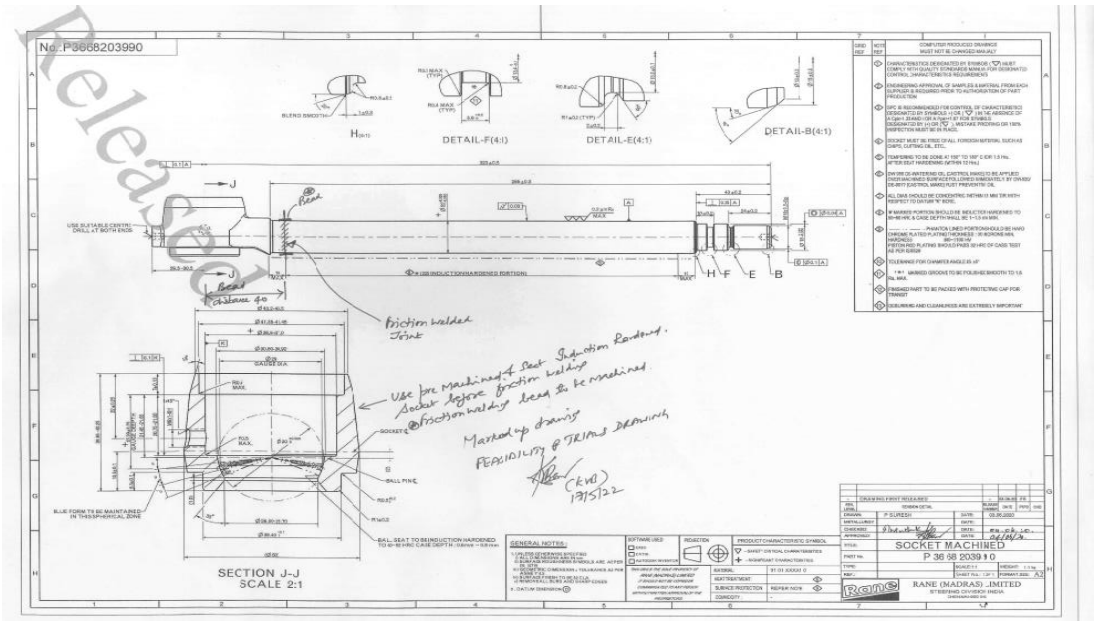


Fig 2.: Piston Rod Friction welding Drawing.

METHOD:

Feasibility check: Initially, the customer enquires the finished product's specifications for us. If the dimension of the material to be welded is within the capabilities of our current machine, we move on to the next step.

Drawing Reading: The customer offers us the fundamental component design with dimensions as well as the finished product design that he wants us to weld. Now that we are aware of the necessary dimensions and the settings to set on our machine for welding, we can determine whether the drawings of the various components provided for the raw materials that need to be welded are adequate.

Reverse Engineering: Here, we start planning from product and track step by step backwards which helps to start the process from scratch laying the foundation without leaving anything. By understanding the final product and keeping in mind the need for tolerances for further machining process to be carried out we quote for dimensions (via basic calculation) to our customer and demand some changes if necessary.

Process parameters optimization: We set the process parameters guiding the welding process before beginning the weld process. This covers the spindle's rotational speed, soft friction force, friction force, upset force, brake delay time, and welding modes (burn off, time specific, fixed position upset). After we optimise the process parameters by evaluating the required test passing criteria.

Welding process: Here, PIECE 1 is placed at the spindle, and PIECE 2 is placed at the clamp. Then we check to see if both clamps were applied correctly without leaving an overhang. Following that, the welding procedure is carried out flawlessly by the machine.

Post process inspection: We perform some GD&T testing when the welding is finished. We send the finished goods to our customer after cross verifying the specifications.

CUSTOMER REQUIREMENTS.

1. Part Name: - Piston Rod.
2. Application: - Steering wheel.
3. Tooling Components: - rod, rod eye locator, base bowl shim, vertical shim.
4. Material grade: - EN8 & EN 8 Forged
5. Weld strength required: - Equivalent to parent Material.
6. Types of tests to conduct: - Micro, Macro, Tensile & Bend test.

TOOL DESIGN.

PART NAME	MATERIAL	TREATMENT	FINISH	WEIGHT
Rod Eye Holder	EN19	Toughened (35-40 HRC)	BLACKODIZE	0.18kg
Base bowl for rod eye-LH	EN353	Case Hardened (50-55 HRC) (1.0-1.2mm)	BLACKODIZE	2.38kg
V-plate for rod eye	MS	NA	BLACKODIZE	0.06kg
vertical Shim	EN24T	Case Hardened (30-35 HRC) (1.2-1.5mm)	BLACKODIZE	0.61822kg
Base bowl for rod eye-RH	EN353	Case Hardened (50-55 HRC) (1.0-1.2mm)	BLACKODIZE	2.14kg

TOOL DESIGN:

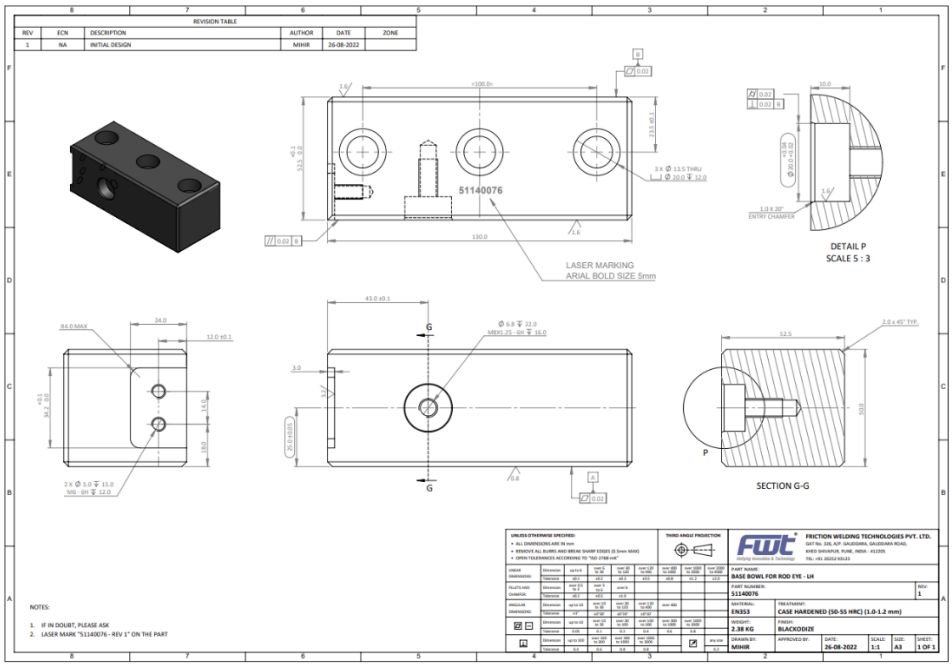


Fig 3.: Base Bowl for Rod Eye LH.

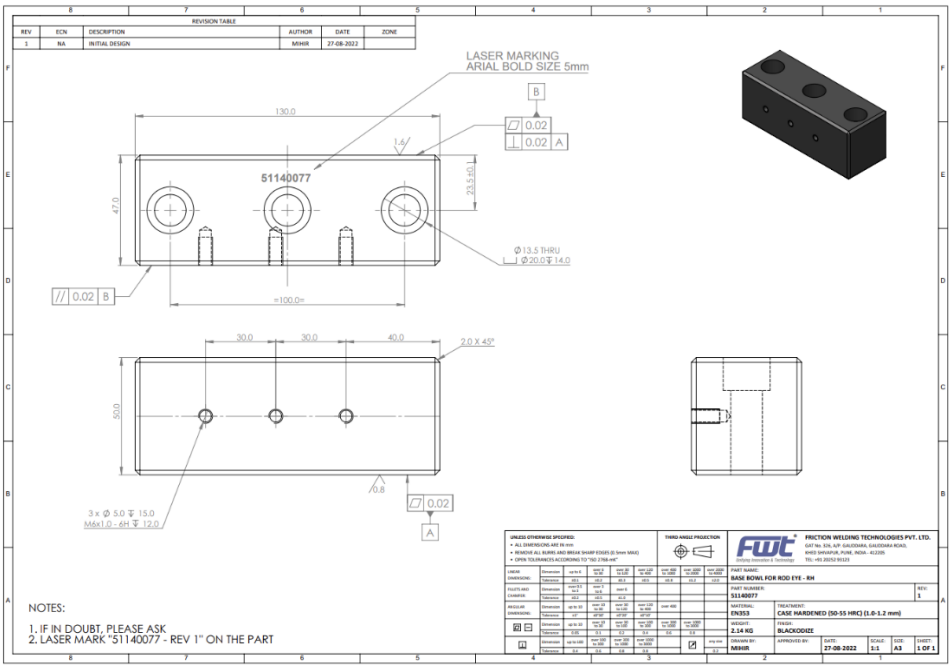


Fig 4.: Base Bowl for Rod Eye RH.

TOOL DESIGN:

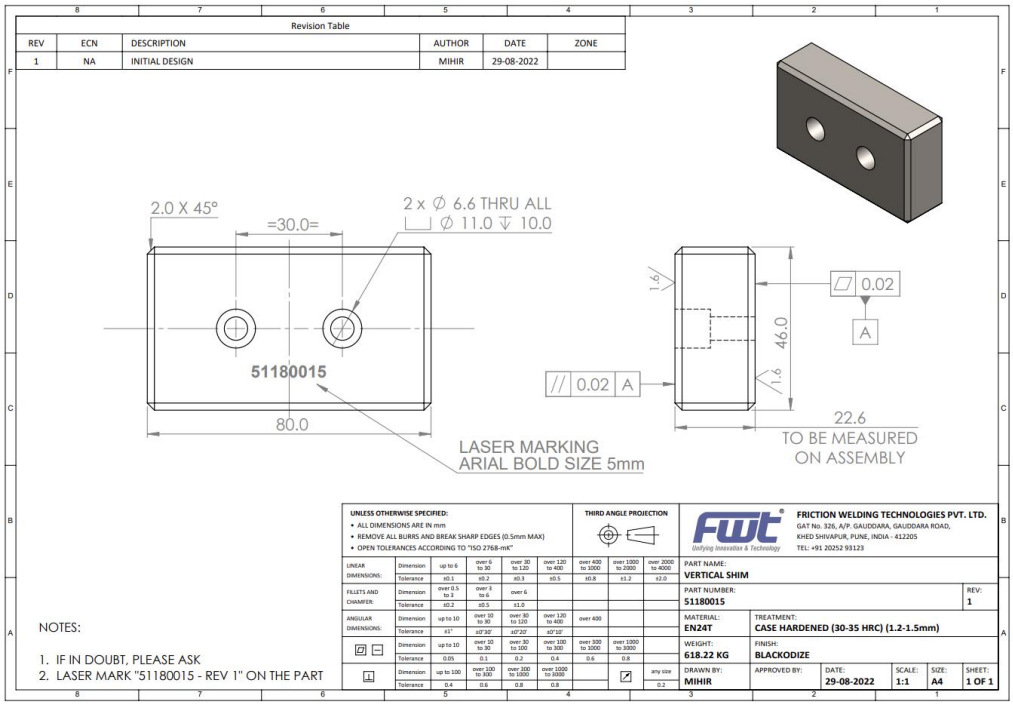


Fig 5.: Vertical Shim.

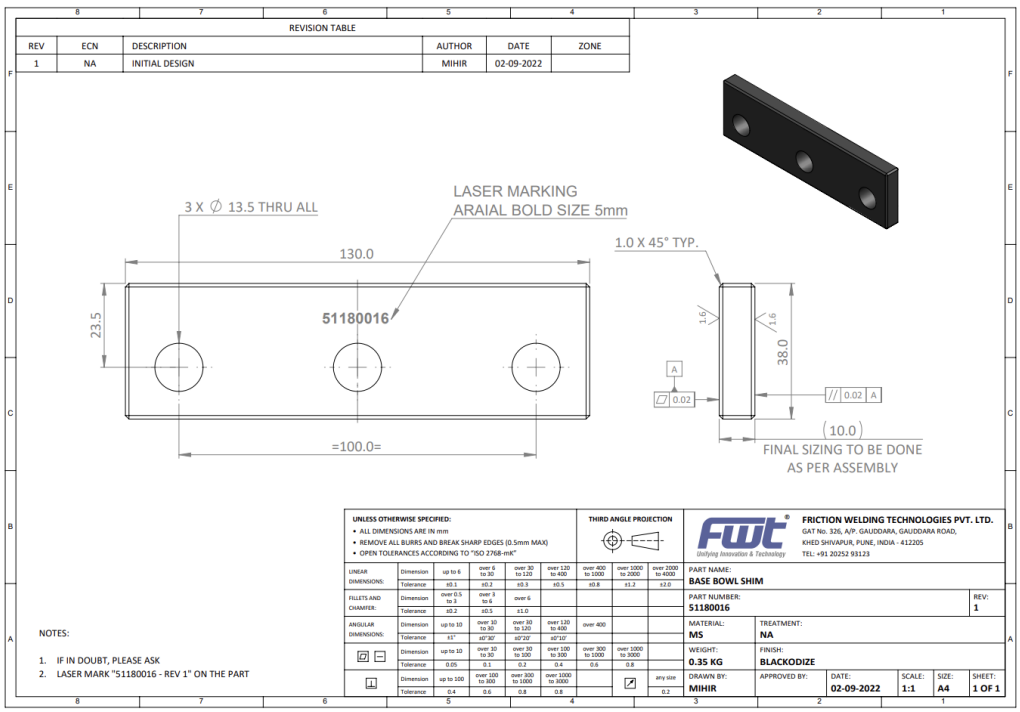


Fig 6.: Base Bowl Shim

TOOL DESIGN:

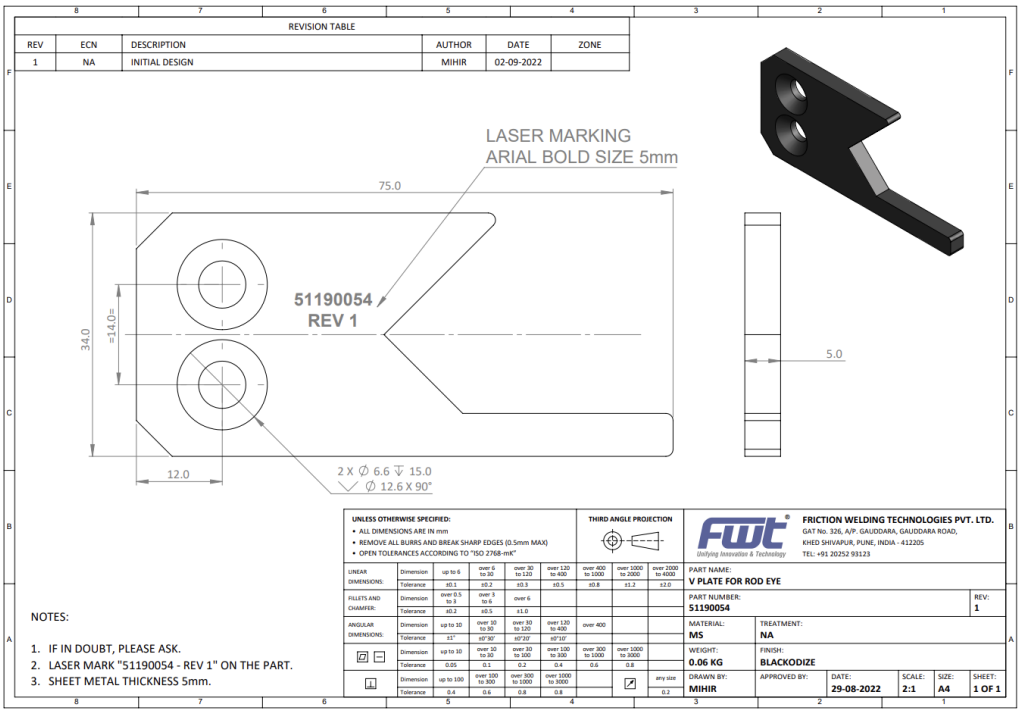


Fig 7.: V plate for Rod Eye.

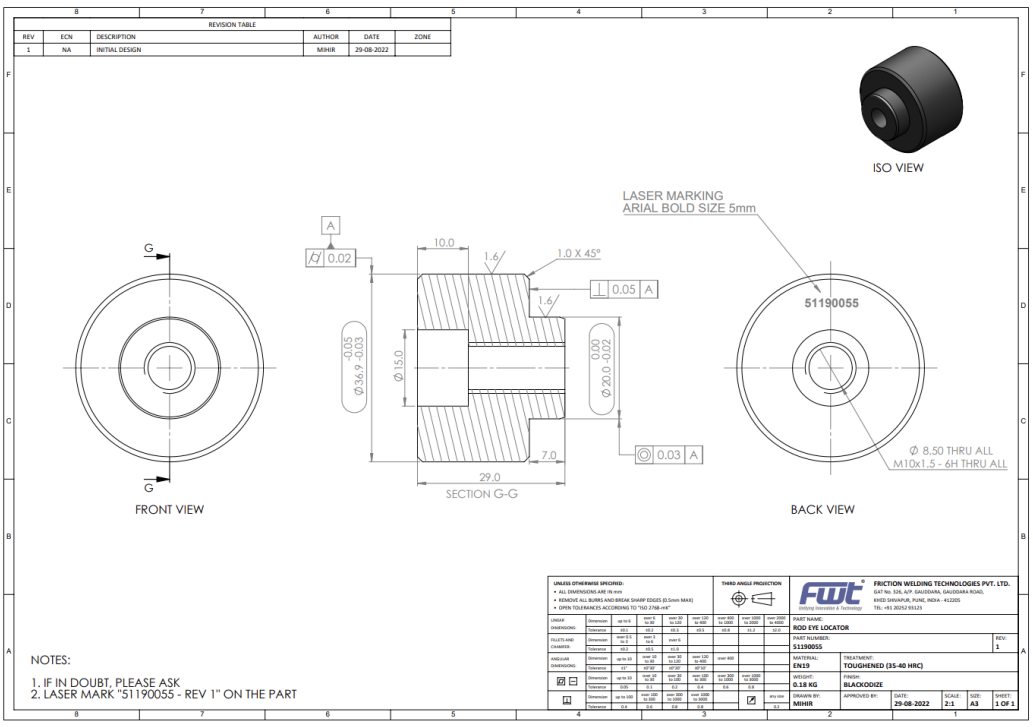


Fig 8.: Rod Eye Locator.

PROCESS PARAMETERS:

The Weld was carried out on a FWT 12 Ton direct drive Friction Welding Machine using the baseline parameters as below

Weld Speed: 1400 rpm, Weld Load: 15 kg.mm^2.

Job Description	Piston Rod
Material to be welded	EN8 to EN8(forged)
Welding length Tube (mm)	280.4
Welding length Piston Post (mm)	50.3
Total Length (mm)	330.7
Final Length (mm)	323.4
Loss Actual Measured (mm)	7.3
Shrinkage Range (mm)	8.0
Soft Friction time T1A (sec)	0
Friction time T1B (sec)	7.2
Burn Off (sec)	4.8 – 5.6
Brake Delay (sec)	0.1
Upset Delay (sec)	0.6
Upset Delay (sec)	3.0
Soft Friction Pr. 5.6kg.mm^2 (P1) bar	0
Friction Pr. 9.4 kg.mm^2 (P2) bar	40
Upset Pr. 18.7kg.mm^2 (P3) bar	80
Feed (mm/min)	85%
RPM	1400
Run out (mm)	0.2 - 0.4
Bore offset mm	0.05
Face offset 1st (mm)	0.7
Face offset 2nd (mm)	0.10

TENSILE TEST REPORT:

FRICTION WELDING TECHNOLOGIES PVT. LTD

Unit No. 9 & 10, Shivkamal Industrial Estate, S. No. 78/1/1, NDA Road, Shivane,Pune 411023 Cont. No. 020-25293123

TENSILE TEST REPORT

Machine Model	: **TUE-C-400**	Test File Name	: **Rane Madras 21.09.Utm**
Machine Serial No	: **2018/268**	Date	: **21/09/2022**
Customer Name	: **RANE MADRAS LIMITED**	Customer Address	: **CHENNAI**
Order No.	:	Test Type	: **Tensile**
Lot No.	:	Heat No.	:

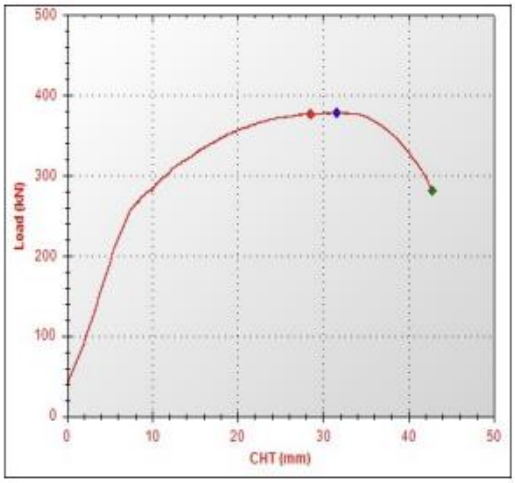
Input Data

Specimen Shape	: **Solid Round**	
Material Type	: **EN8 to EN8**	
Specimen Description	: **Rod To Rod**	
Specimen Diameter	: **22.45**	**mm**
Gauge Length For % Elogation	: **444.2**	**mm**
Pre Load Value	: **0**	**kN**
Max. Load	: **400**	**kN**
Max. Elongation	: **200**	**mm**
Specimen Cross Section Area	: **395.842**	**mm2**
Final Sp Diameter	: **14.7**	**mm**
Final Gauge Length	: **476.8**	**mm**
Final Area	: **169.72**	**mm2**

Output Data

Load At Yield	: **376.96**	**kN**
Elongation At Yield	: **30.420**	**mm**
Yield Stress	: **952.298**	**N/mm2**
Load at Peak	: **378.780**	**kN**
Elongation at Peak	: **31.660**	**mm**
Tensile Strength	: **956.896**	**N/mm2**
Load At Break	: **280.780**	**kN**
Elongation At Break	: **42.800**	**mm**
Breaking Strength	: **709.323**	**N/mm2**
% Reduction Area	: **57.13**	**%**
% Elongation	: **7.34**	**%**

Load Vs. Cross Head Travel



Tested By **Rishikesh**

Remark **Sample Broken in EN8 material**

TENSILE TEST:

Fig 9.: After Tensile Test

MICROSTRUCTURE TEST:

TC-6811

PROMPT METALLURGICAL SERVICES

Address : Survey No. 36, Hissa No. 1/3/1,
Between Khedekar Industries & Canara Bank, Narhe, Pune – 411041.
Mobile: 8149024626, 9850149329, 9850273858
Website : www.promptpune.com |**Email** : pms.vvraje@gmail.com / promptmetallurgicalservices@gmail.com

Scope : **Chemical Testing** - Optical Emission Spectrometer (Steel, Aluminium & Its Alloys, Copper & its Alloys)
Mechanical Testing : Hardness Test, Micro Hardness Test, Metallography Test, Tensile Test, Bend Test

F / 7.8 / 11 ***Test Report*** ***(Ferrous Metals & Alloys)***

Work Order No.	13635	Page No.	1 of 2
Test Report No / Date	ULR - TC681122000003850F / 20-09-2022	Challan No.	GDN - 22230206
Date of Performance	19,20-09-2022	Date of Receipt	19-09-2022
Customer Name & Address	M/s. Friction Welding Technologies Pvt. Ltd. , S.no.326,A/P. Gauddara Road, Khed Shivapur, Div. - Haveli, Pune 412205. Mo.9766206538.		
Customer's Data	RANE MADRAS, Job No. 3, P36 68 2039 9 0 - EN 8 Bar to EN 8 Forge.	Qty.	01 No.
Condition of the sample	Satisfactory		
Specifications	---	Temp.	24 °C
Methods Used	Micro Hardness (IS : 1501 - Part 1 - 2020) , Microstructure (ASM Vol. 9).		

I Chemical Testing - 1.Metal & Alloys

Sr. No.	Size (mm)	%C	%Mn	%Cr	%Mo	%Ni	%V	%Al	%W	%Si	%S	%P
A	Spectromax Observation	---	---	---	---	---	---	---	---	---	---	---

II Mechanical Testing - 1. Mechanical properties of metals

B	Identification	Bar	Forge Bar
C	Micro Hardness on Parent Material (HV1)	(229 - 234)	239.5
D	Micro Hardness At HAZ (HV1)	282.7	282.7
E	Depth of H.A.Z (mm)	1.20	1.50
F	Hardness On Weld Section (HV1)	290	

REMARK :

Observations given only .
For Microphotograph Ref. page 2 of 2.

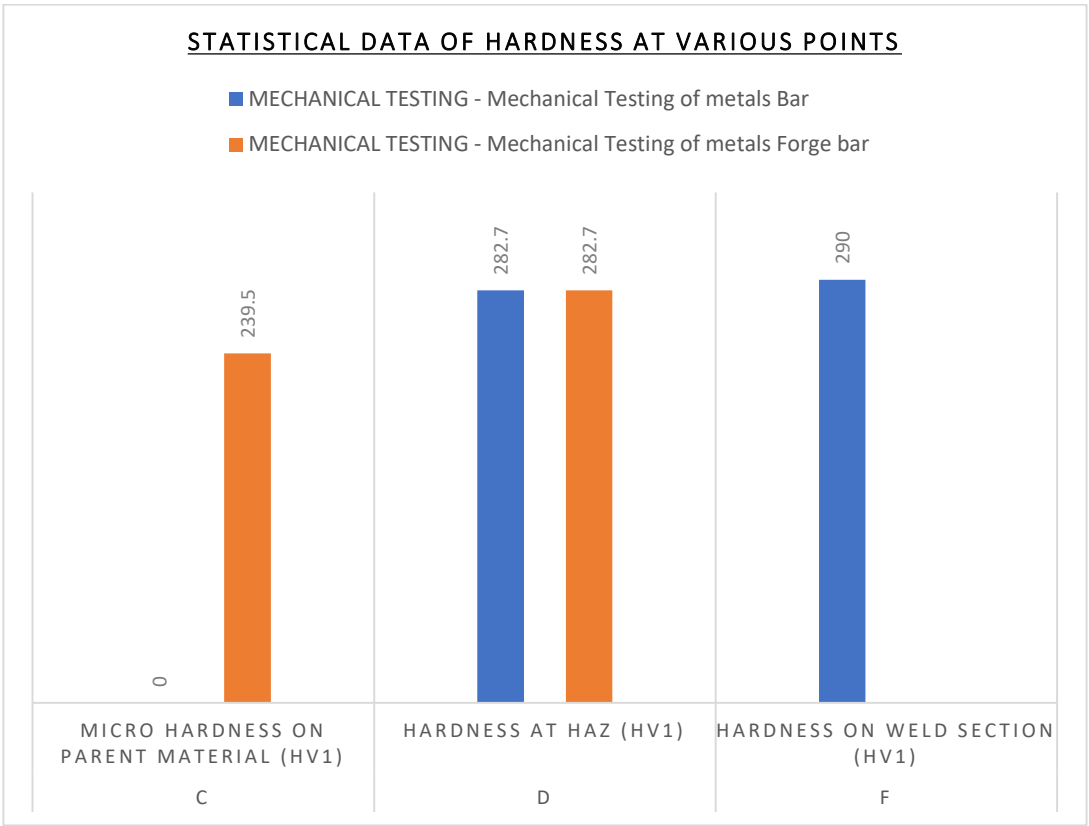
(Statement of the remark is based on the specification provided by the Customer)

Tested By : L. A. L. / V. V. R.

V. V. Raje / L. A. Londhe
Authorised Signatory.

(Terms and Conditions Overleaf)

GRAPHICAL REPRESENTATION OF HARDNESS:



MICRO STRUCTURE:

PROMPT METALLURGICAL SERVICES
Address : Survey No. 36, Hissa No. 1/3/1,
Between Khedekar Industries & Canara Bank, Narhe, Pune – 411041.
Mobile: 8149024626, 9850149329, 9850273858
Website : www.promptpune.com |**Email** : pms.vvraje@gmail.com / promptmetallurgicalservices@gmail.com
TC-6811
Scope : **Chemical Testing** - Optical Emission Spectrometer (Steel, Aluminium & Its Alloys, Copper & its Alloys)
Mechanical Testing : Hardness Test, Micro Hardness Test, Metallography Test, Tensile Test, Bend Test

F / 7.8 / 11 — ***Test Report*** — ***(Ferrous Metals & Alloys)***

2 of 2

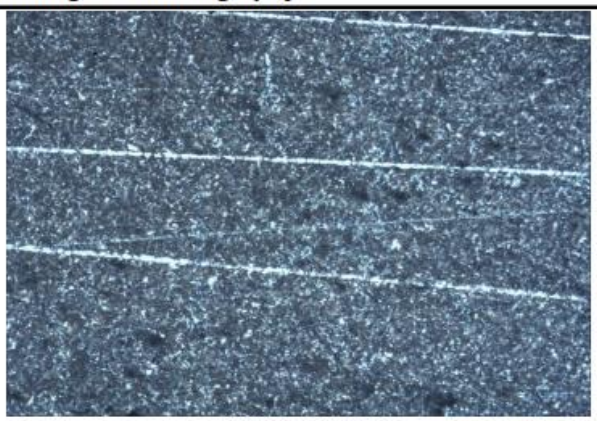
Report No./Date : ULR - TC681122000003850F / 20-09-2022 , W.N / P.Date : 13635 / 20-09-2022

Customer's name : M/s. Friction Welding Technology P.L ,Ch.No / R.Date - GDN-22230206 / 19-09-2022

Customer Data : RANE MADRAS, Job No. 3, P36 68 2039 9 0 - EN 8 Bar to EN 8 Forge.

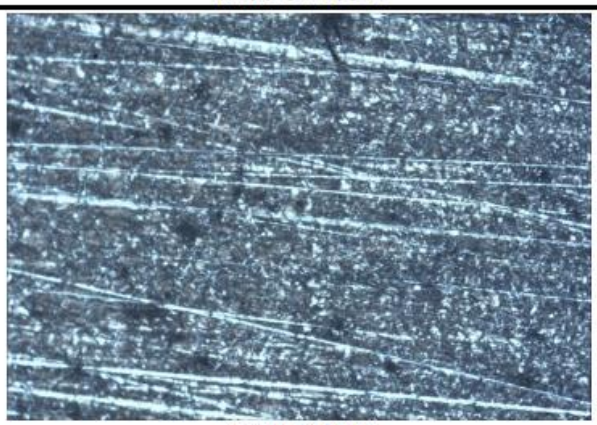
II Mechanical Testing - 2. Metallography

G



Middle : 100 X

H



Side : 100 X

Remark : Fusion is satisfactory.

(Statement of the remark is based on the specification provided by the Customer)

Tested By: LAL / VVR

V.V.Raje / L.A.Londhe
Authorised Signatory.

End Of Report

(Terms and Conditions Overleaf)

BEND TEST:

Fig 10.: Before Bend Test

Fig 11.: After Bend Test

Sample number	Span Length (mm)	Diameter (mm)	Angle of deviation	Observation
1	108	22	50°	No Cracks Observed

REMARK:

The weld's bend angle was measured at 45 degrees as that is what the customer requested. No cracks or failure were detected during the bend test up to 50°.

BEND TEST REPORT:

FRICTION WELDING TECHNOLOGIES PVT. LTD

Unit No. 9 & 10, Shivkamal Industrial Estate, S. No. 78/1/1, NDA Road, Shivane,Pune 411023 Cont. No. 020-25293123

Transverse Test Report

Machine Model	: TUE-C-400	Test File Name	: Rane madras Job 01 BT.Utm
Machine Serial No	: 2018/268	Date	: 22/09/2022
Customer Name	: RANE MADRAS LIMITED	Customer Address	: CHENNAI
Order No.	: Requirement min 45 degree	Test Type	: Transverse
size	:	Heat Number	:

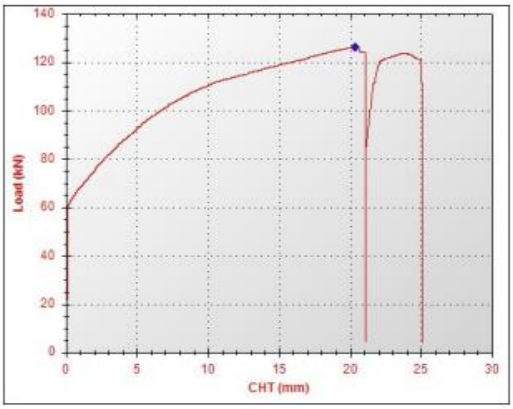
Input Data

Specimen Shape	: Solid Round	
SpecimenType	: EN8 to EN8	
Specimen Description	: on job test	
Specimen Diameter	: 22	mm
Span Length	: 108	mm
Pre Load Value	: 0	kN
Max. Load	: 400	kN
Max. Elongation	: 200	mm
Specimen C S Area	: 380.132	mm2

Output Data

Load at Peak	: 126.120	kN
C.H.Travel at Peak	: 20.410	mm
Transverse Strength	: 3256.213	N/mm2

Load Vs Displacement



Tested By **Rishikesh**

Remark **Bend Test OK, Angle -50 degree**

CONCLUSION:

The tests were all accurately carried out according to customer requirements. The outcomes met the specified parameters and were satisfactory. Based on the results from the test undertaken, the weld has a good strength, higher hardness than the parent material and the weld is uniform throughout the faying interface without cracks and pores.

RECOMMENDATIONS:

None.

SIGNED:

Name	Position	Signed
Mr. Satesh Bangar	Assistant Manager Manufacturing	

Thank You.