Effect of Process Parameter during TIG Welding on SS304

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ABSTRACT

Gas Tungsten Arc welding (GTAW) or Tungsten Inert Gas (TIG) is an electric arc welding process, which produces an arc between a non-consumable tungsten electrode and the work to be welded. TIG is used very commonly in areas, such as rail car manufacturing, automotive and chemical industries. Stainless steel is extensively used in industries as an important material, because of its excellent corrosion resistance. TIG welding is one of the welding processes, often used to weld similar and dissimilar metals. The major areas of research have been in characterization of weld, parameter optimization and strength of welded joints. This paper is aimed at, to give a brief idea about the research works done in the past, on TIG welding of stainless steel by various researchers, by highlighting the important conclusions and results arrived at and thereby providing the right direction for fresh researchers as well as for practical field.

Keyword: - *TIG Welding,* SS-304, *Radiography Test, Tensile Test*

1. PROBLEM DEFINITION

Design of Experiments refers to the process of planning, designing and analyzing the experiment so that valid and objective conclusions can be drawn effectively and efficiently. In order to draw statistically sound conclusions from the experiment, it is necessary to integrate simple and powerful statistical methods into the experimental design methodology. The success of any industrially designed experiment depends on sound planning, appropriate choice of design and statistical analysis of data and teamwork skills.

The three principles of experimental design such as randomization, replication and blocking can be utilized in industrial experiments to improve the efficiency of experimentation. These principles of experimental design are applied to reduce or even remove experimental bias. It is important to note that large experimental bias could result in wrong optimal settings or in some cases it could mask the effect of the really significant factors. Thus, an opportunity for gaining process understanding is lost, and a primary element for process improvement is overlooked.

1.1 OBJECTIVE OF WORK:

- Analysis – The analytical values will help user to perform the task.
- Strength – For different welding parameters strength will be derived.
- Quality – It will Improve the quality of the product.
- Reduce Time Consumption.
- Skill – It will improve skill of the worker.

2. EXPERIMENTAL METHODOLOGY

2.1 COMPONENTS:
(1) SPECIMEN

Fig. SPECIMEN SS-304 WITH TIG WELD

Type 304 is a variation of the basic 18-8 grade, type 302, with a higher chromium and lower carbon content. Lower carbon minimizes chromium carbide precipitation due to welding and its susceptibility to intergranular corrosion. In many instances, it can be used in the "as-welded" condition, while type 302 must be annealed in order to retain adequate corrosion resistance

2.2 EXPERIMENTAL SYSTEM DESCRIPTION:

- Test specimen size 250*18.6*5.03 mm (9nos).
- Universal Testing Machine, capacity up to 100KN with data acquisition as per ASTM E 1852.
- TIG welding machine of 3phase, 400V, 50HZ.
- M1TR Milling machine with DRO and other standard accessories of table size (1270*254mm).
- X-ray Radiography testing machine.

2.3 EXPERIMENTAL PROCEDURE:

- The raw material i.e. SS-304 was machined on M1TR milling machine using jig & fixtures.
- It was not easy to maintain specimen over fixture while machining.
- After machining the specimen, parting was carried out with use of hacksaw machine.
- Edge preparation of specimen was carried on grinding machine with help of skilled labor.
- After machining TIG welding was done.
- Welding slag and uneven surface on specimen was present after welding so surface finish was done on grinding machine.

- After surface finishing the specimen was handed to the laboratory for ultimate tensile strength test & radiography test.

2.4 OBSERVATION TABLE:

Parameters	Sample	Area	Ultimate load(N)	U.T.S(min. 515 Mpa)
CURRENT	1	94.46	42880	453.9
	2	93.56	34840	372.4
	3	90.40	46240	511.5
TIME (at55amp)	4	92.72	40280	434.4
	5	93.15	47740	512.5
	6	95.57	40560	424.4
NO. OF PASSES	7	94.46	42640	451.4
	8	93.50	38520	412.0
	9	92.07	30880	335.4

2.5 GRAPH:

(1) Sample 1:

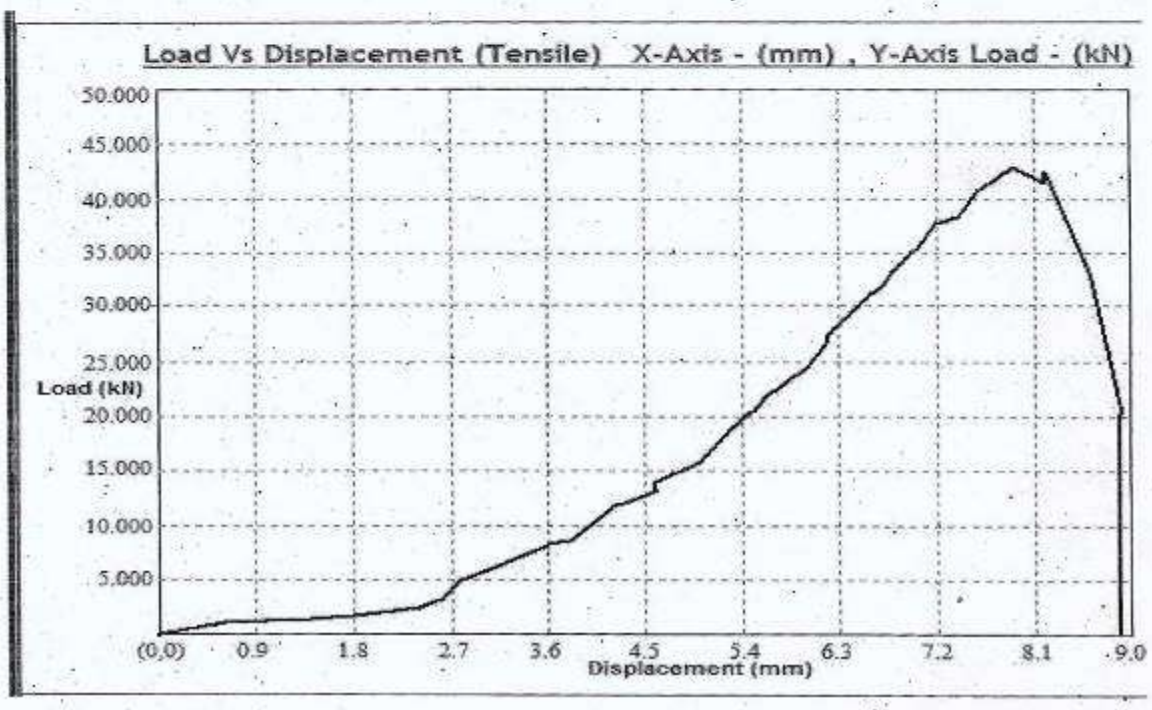
MET-HEAT ENGINEERS PVT. LTD.

857/2,G.I.D.C.,INDUSTRIAL ESTATE,MAKARPURA
VADODARA-390010
Machine No : 3

(1)

Test Date : 17-04-2017

Input Parameters		Results		
Batch No.		Ultimate Load	(kN)	42.88
Serial No.	56-ND-2017	Ult.Tensile Strength	(N/mm²)	453.949
Specimen Type	Flat			
Width (mm)	19.200			
Thickness (mm)	4.920			
C/S Area (mm²)	94.464			
Original Gauge Length	0.000			
Final Gauge Length (mm)	0.000			
Pre Load (%)	0.200			



2. Sample 2-

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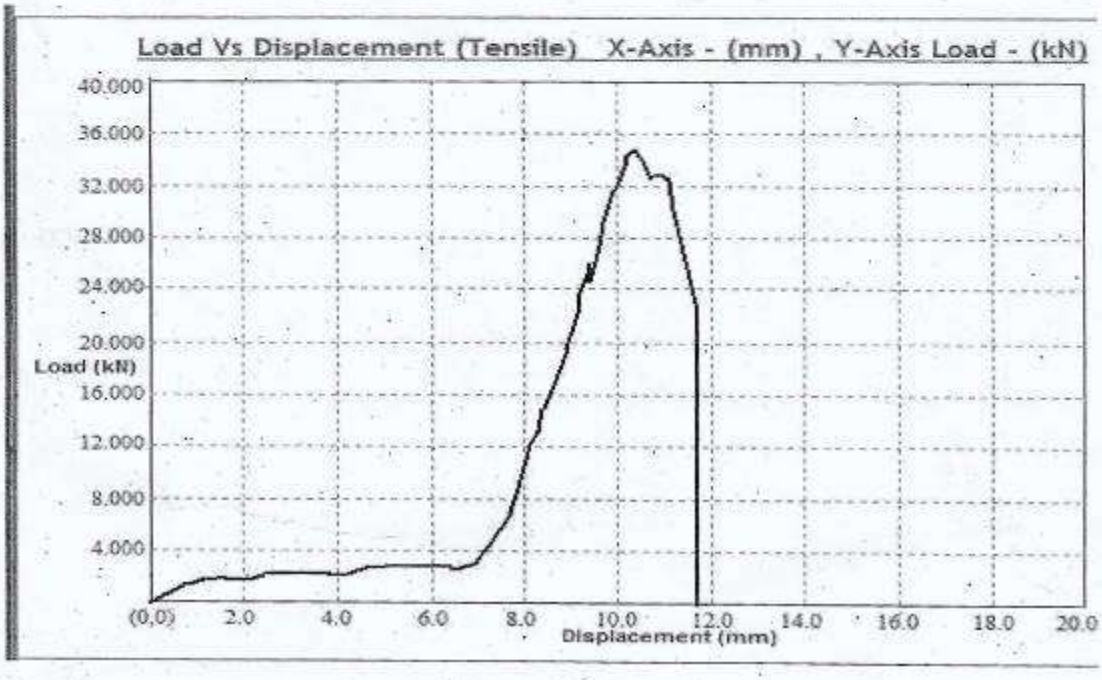
(2).

857/2,G.I.D.C.,INDUSTRIAL ESTATE,MAKARPURA
VADODARA-390010
Machine No : 3

Test Date : 17-04-2017

Input Parameters			Results		
Batch No.	:		Ultimate Load	(kN)	34.84
Serial No.	:	48-ND-2017	Ult.Tensile Strength	(N/mm²)	372.381
Specimen Type	:	Flat			
Width (mm)	:	18.600			
Thickness (mm)	:	5.030			
C/S Area (mm²)	:	93.558			
Original Gauge Length	:	0.000			
Final Gauge Length (m/m)	:	0.000			
Pre Load (%)	:	0.200			



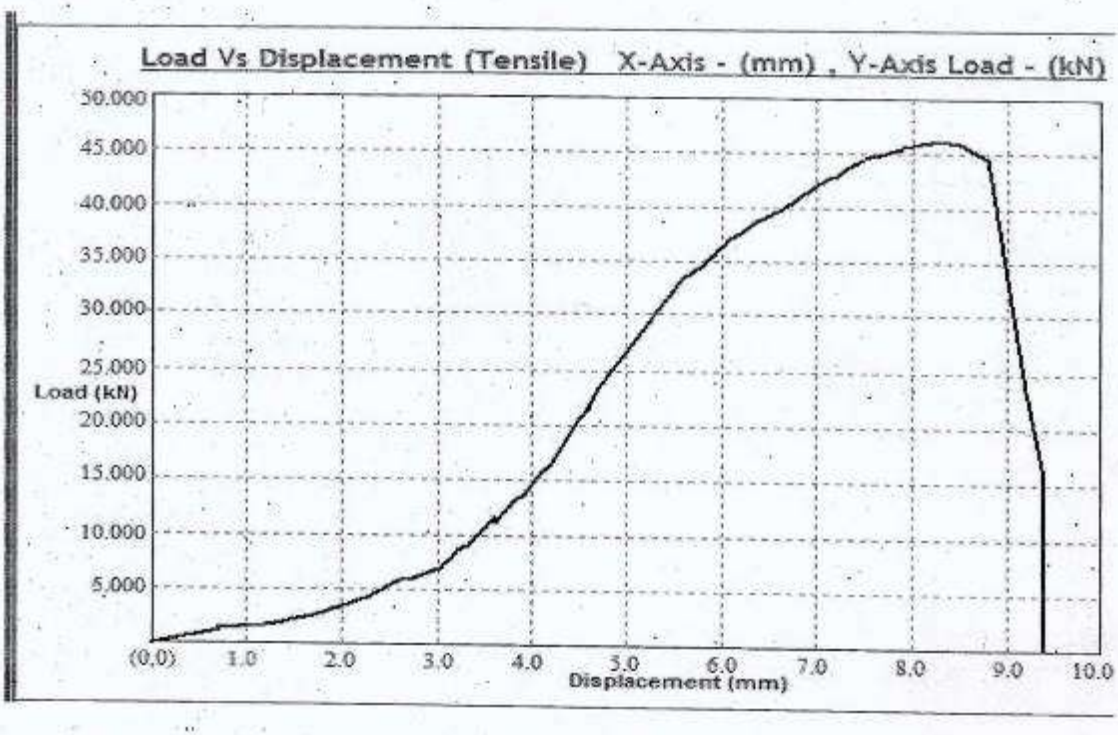
3. Sample 3

MET-HEAT ENGINEERS PVT. LTD. (3)

857/2,G.I.D.C.,INDUSTRIAL ESTATE,MAKARPURA
VADODARA-390010
Machine No : 3

Test Date : 17-04-2017

Input Parameters			Results		
Batch No.	:		Ultimate Load	(kN)	46.24
Serial No.	:	49-ND-2017	Ult.Tensile Strength	(N/mm²)	511.504
Specimen Type	:	Flat			
Width (mm)	:	18.300			
Thickness (mm)..	:	4.940			
C/S Area (mm²)	:	90.402			
Original Gauge Length	:	0.000			
Final Gauge Length (mm)	:	0.000			
Pre Load (%)	:	0.200			



4.

4. Sample 4

MET-HEAT ENGINEERS PVT. LTD.

(4)

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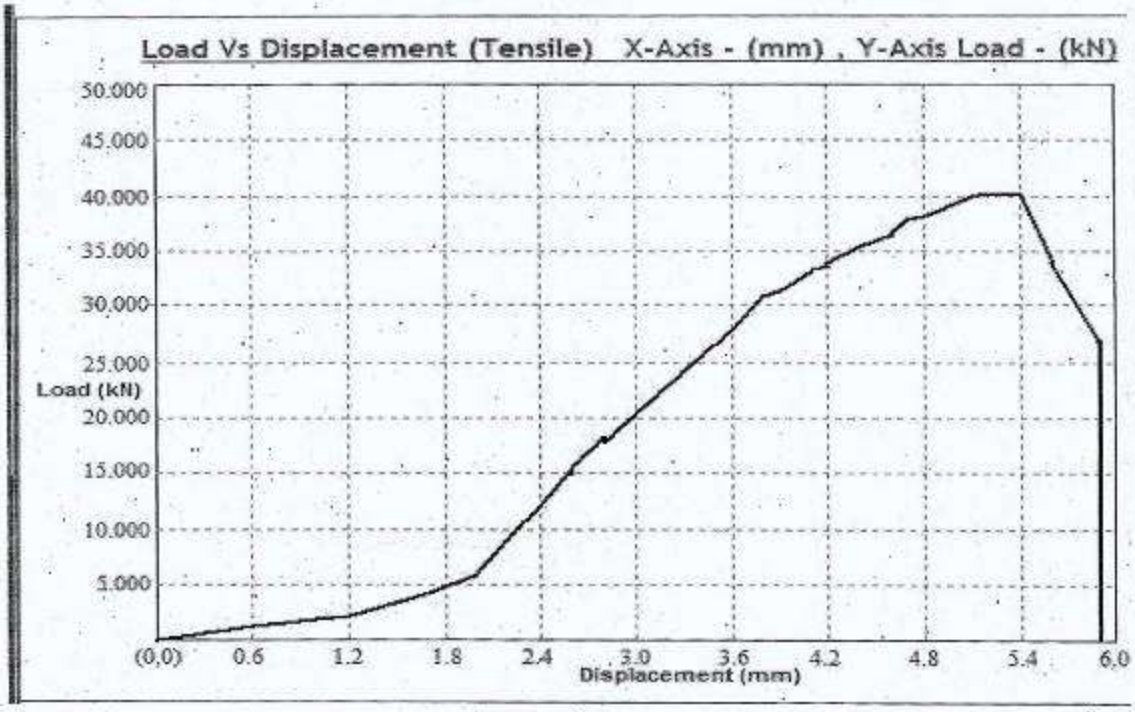
VADODARA-390010
Machine No : 3

Test Date : 17-04-2017

Input Parameters			Results		
Batch No.	:		Ultimate Load	(kN)	40.28
Serial No.	:	50-ND-2017	Ult.Tensile Strength	(N/mm^2)	434.426
Specimen Type	:	Flat			
Width (mm)	:	19.000			
Thickness (mm)	:	4.880			
C/S Area (mm^2)	:	92.720			
Original Gauge Length	:	0.000			
Final Gauge Length (mm)	:	0.000			
Pre Load (%)	:	0.200			



5. Sample 5

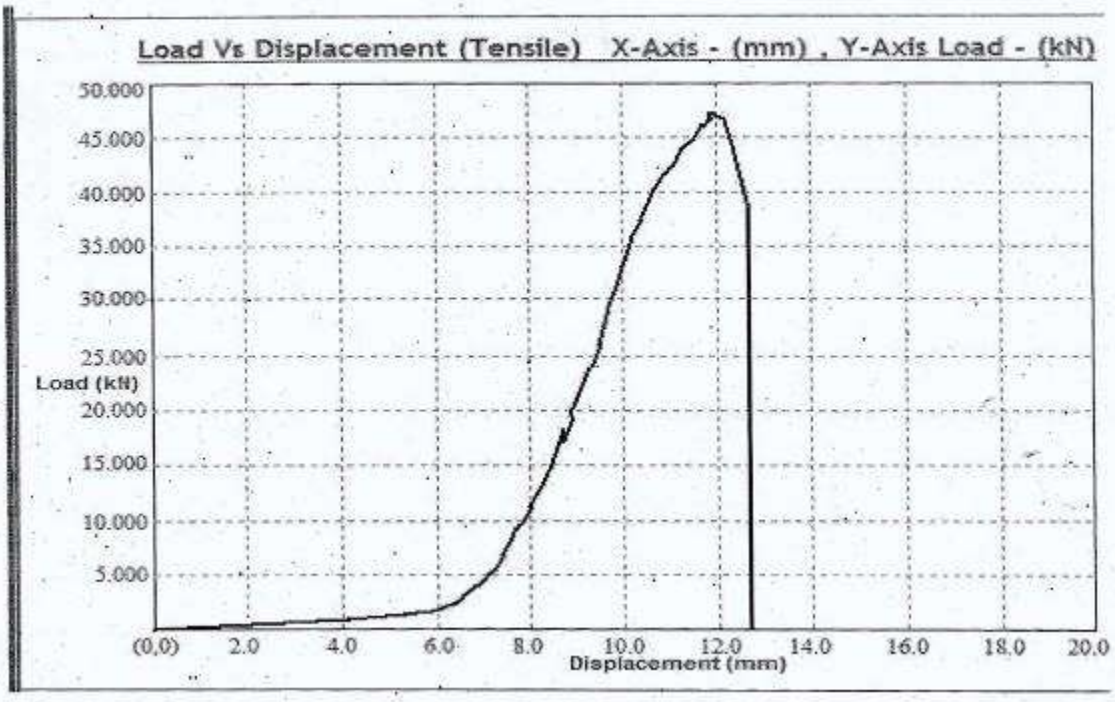
MET-HEAT ENGINEERS PVT. LTD.

857/2,G.I.D.C.,INDUSTRIAL ESTATE,MAKARPURA
VADODARA-390010
Machine No : 3

(5)

Test Date : 17-04-2017

Input Parameters		Results		
Batch No.		Ultimate Load	(kN)	47.44
Serial No.	51-ND-2017	Ult.Tensile Strength	(N/mm²)	509.286
Specimen Type	Flat			
Width (mm)	18.300			
Thickness (mm)	5.090			
C/S Area (mm²)	93.147			
Original Gauge Length	0.000			
Final Gauge Length (mm)	0.000			
Pre Load (%)	0.200			



6. Sample 6

MET-HEAT ENGINEERS PVT. LTD.

(6)

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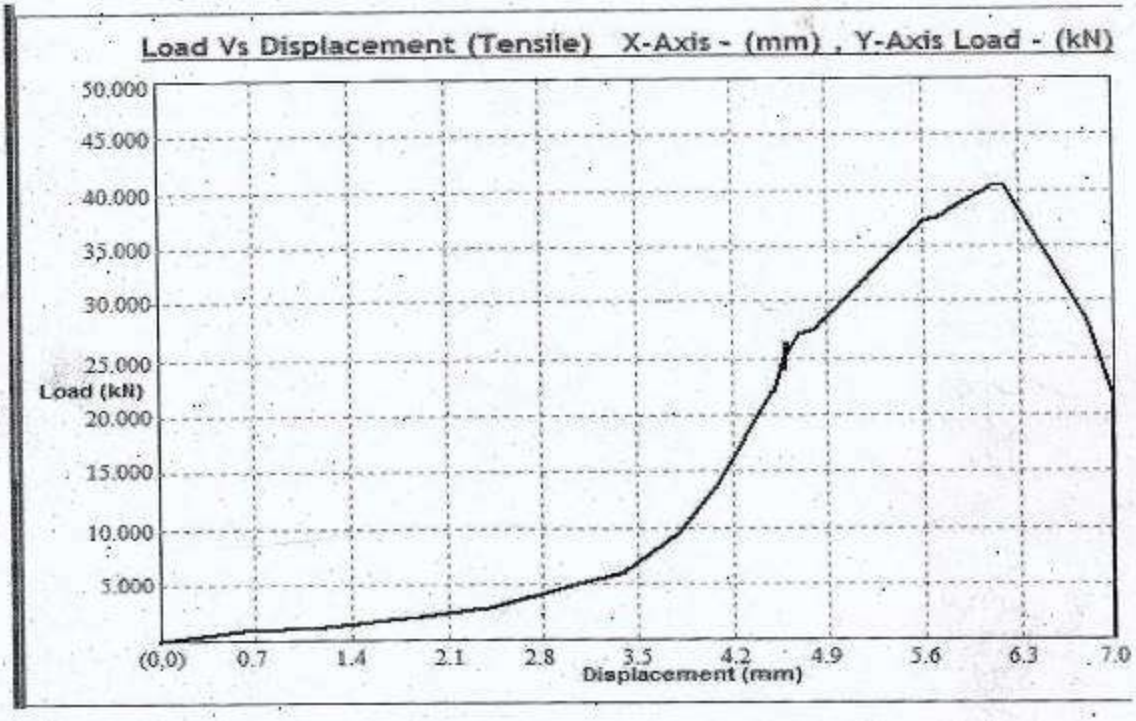
VADODARA-390010
Machine No : 3

Test Date : 17-04-2017

Input Parameters		Results		
Batch No.	:	Ultimate Load	(kN)	40.56
Serial No.	: 52-ND-2017	Ult.Tensile Strength	(N/mm²)	424.401
Specimen Type	: Flat			
Width (mm)	: 19.000			
Thickness (mm)	: 5.030			
C/S Area (mm²)	: 95.570			
Original Gauge Length	: 0.000			
Final Gauge Length (mm)	: 0.000			
Pre Load (%)	: 0.200			



7. Sample 7

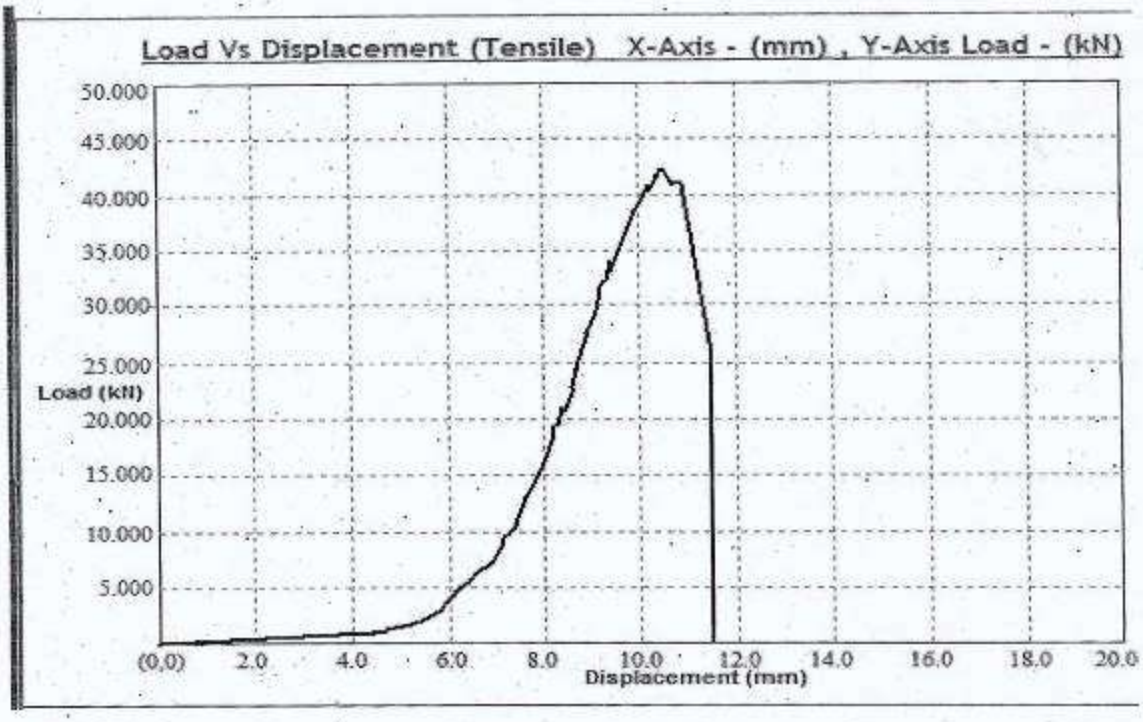
MET-HEAT ENGINEERS PVT. LTD.

857/2,G.I.D.C.,INDUSTRIAL ESTATE,MAKARPURA
VADODARA-390010
Machine No : 3

(7)

Test Date : 17-04-2017

Input Parameters		Results		
Batch No.		Ultimate Load	(kN)	42.64
Serial No.	53-ND-2017	Ult.Tensile Strength	(N/mm²)	451.408
Specimen Type	Flat			
Width (mm)	19.200			
Thickness (mm)	4.920			
C/S Area (mm²)	94.464			
Original Gauge Length.	0.000			
Final Gauge Length (mm)	0.000			
Pre Load (%)	0.200			



8. Sample 8

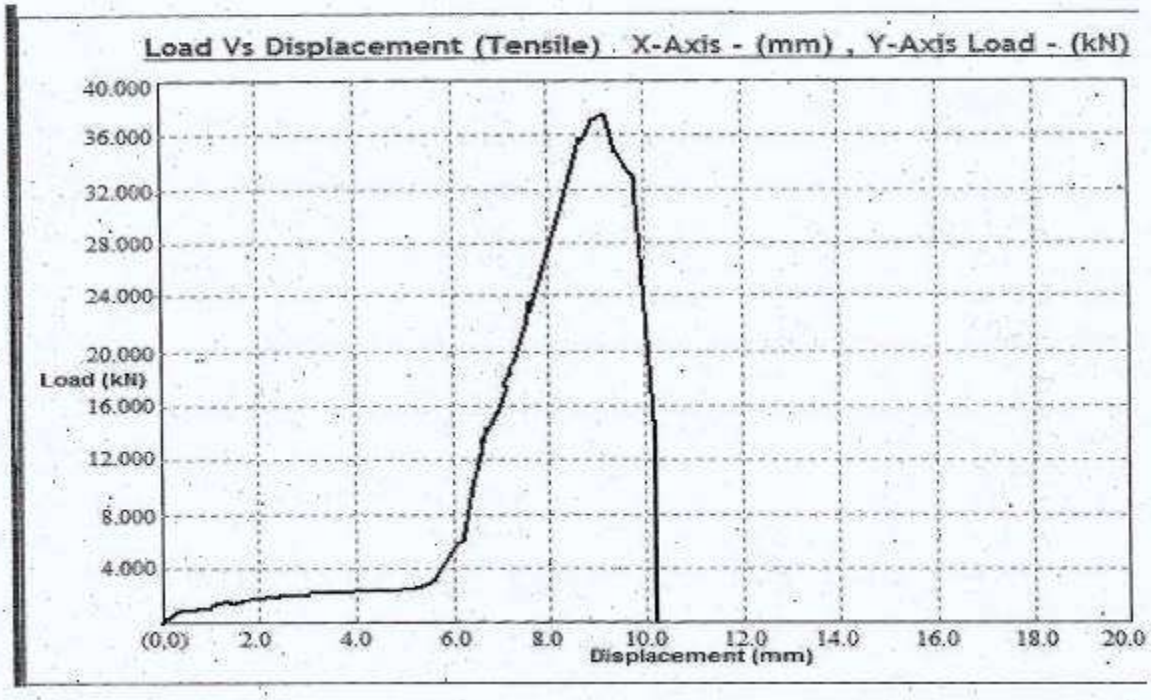
MET-HEAT ENGINEERS PVT. LTD.

(81)

857/2,G.I.D.C.,INDUSTRIAL ESTATE,MAKARPURA
VADODARA-390010
Machine No : 3

Test Date : 17-04-2017

Input Parameters		Results		
Batch No.		Ultimate Load	(kN)	38.52
Serial No.	54-ND-2017	Ult.Tensile Strength	(N/mm²)	411.979
Specimen Type	Flat			
Width (mm)	18.700			
Thickness (mm)	5.000			
C/S Area (mm²)	93.500			
Original Gauge Length	0.000			
Final Gauge Length (mm)	0.000			
Pre Load (%)	0.200			



9. Sample 9

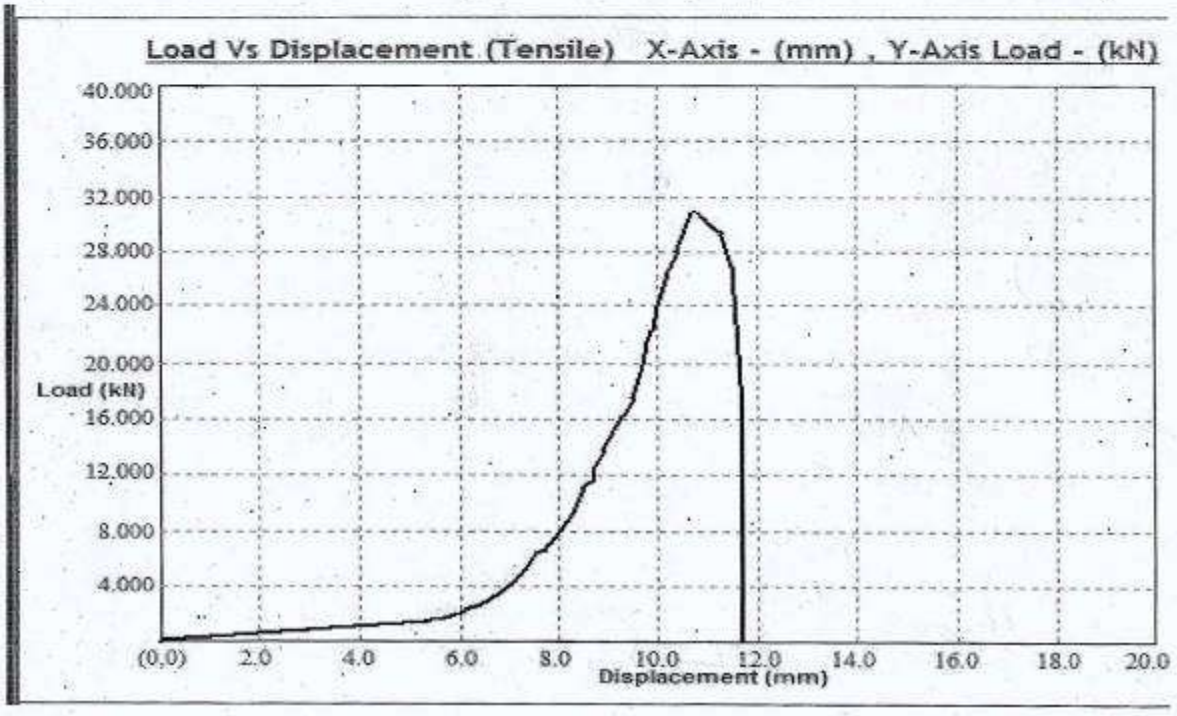
MET-HEAT ENGINEERS PVT. LTD.

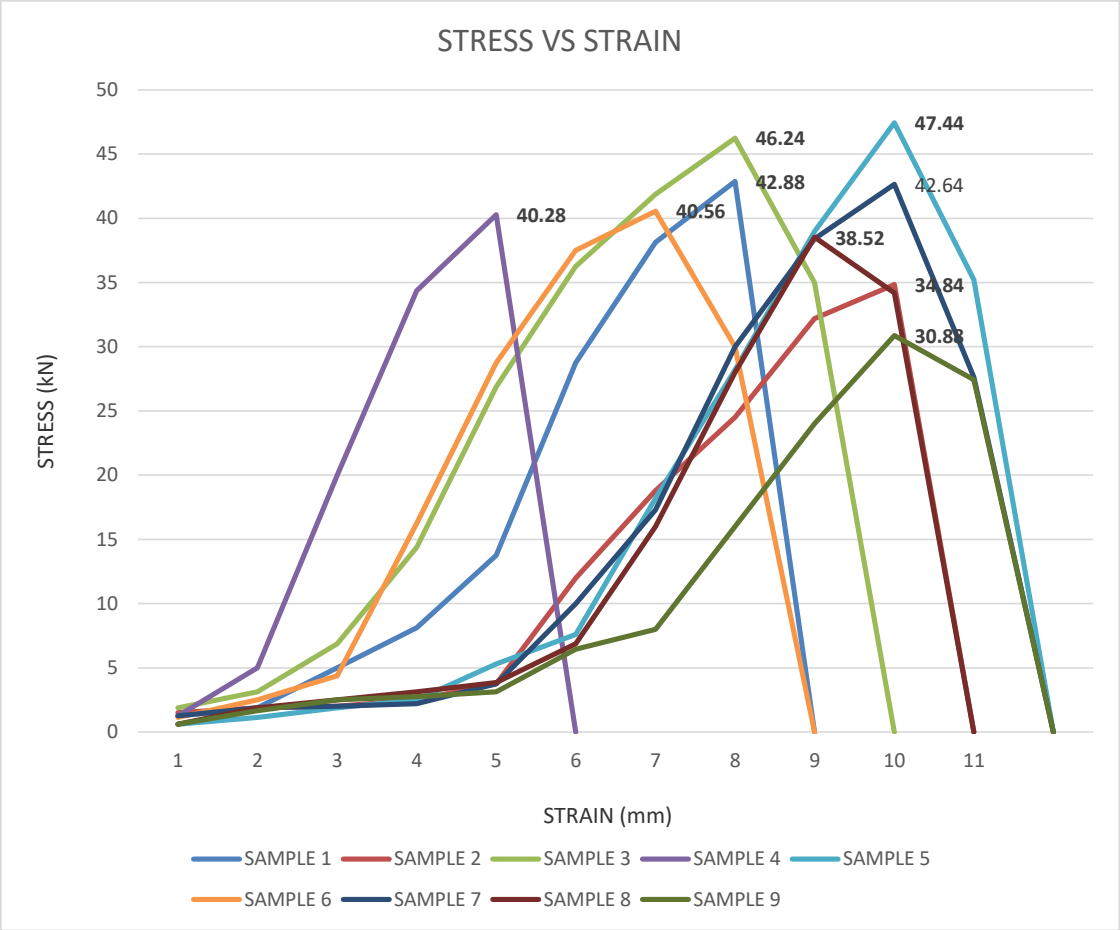
857/2,G.I.D.C.,INDUSTRIAL ESTATE,MAKARPURA
VADODARA-390010
Machine No : 3

(9)

Test Date : 17-04-2017

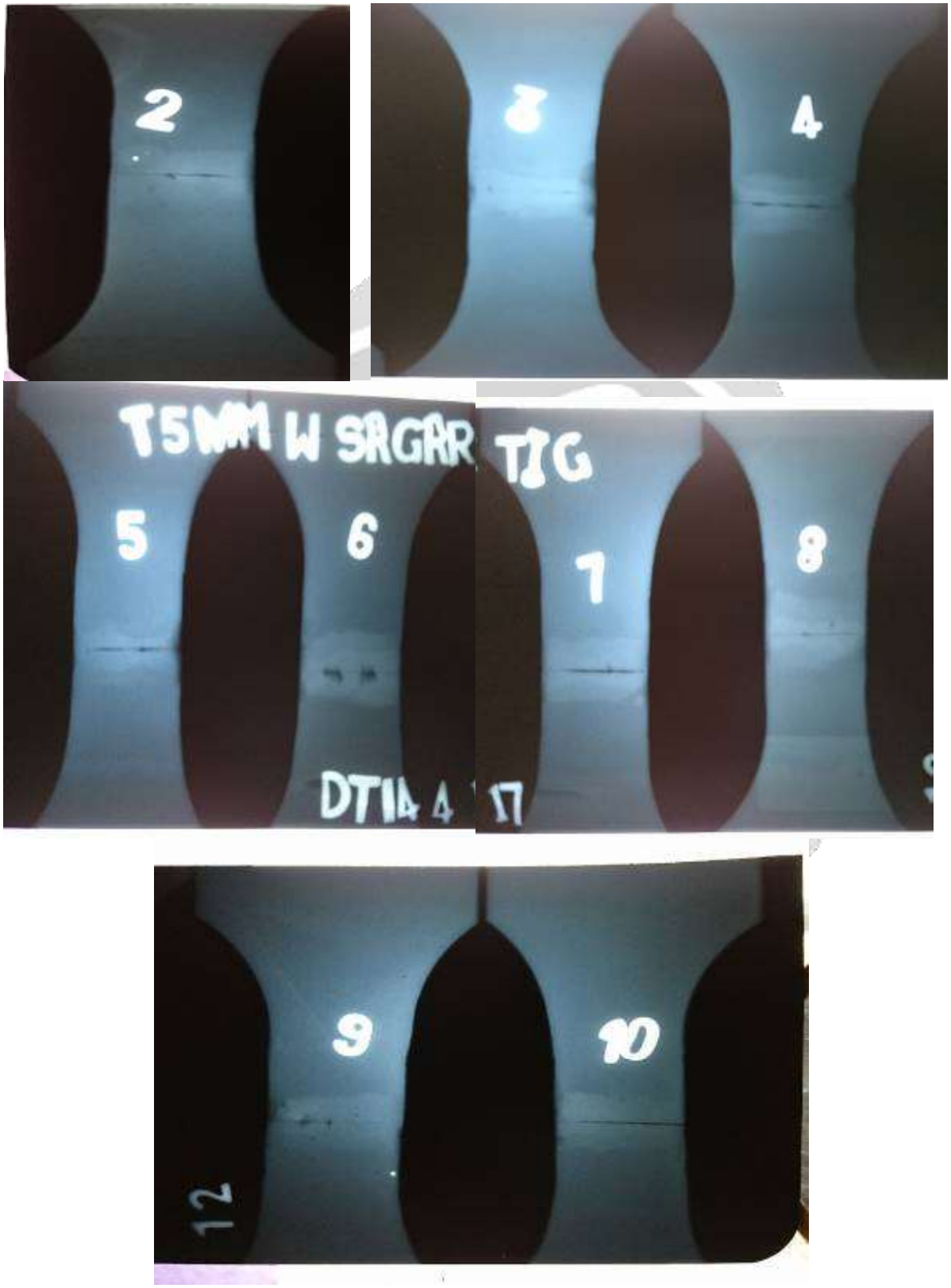
Input Parameters		Results		
Batch No.	:	Ultimate Load	(kN)	30.88
Serial No.	: 55-ND-2017	Ult.Tensile Strength	(N/mm²)	335.397
Specimen Type	: Flat			
Width (mm)	: 18.600			
Thickness (mm)	: 4.950			
C/S Area (mm²)	: 92.070			
Original Gauge Length	: 0.000			
Final Gauge Length (mm)	: 0.000			
Pre Load (%)	: 0.200			





(Comparative analysis of samples on stress vs strain diagram)

2.6 X-RAY RADIGRAPHY TEST RESULTS:



2.7 RESULTS:

SAMPLE	ULTIMATE LOAD(N)	U.T.S (at 55amp)	REMARKS
1	42880	453.9	Lack of penetration
2	34840	372.4	Lack of penetration
3	46240	511.5	Lack of penetration
4	40280	434.4	Lack of penetration
5	47740	**512.5(max)**	Lack of penetration
6	40560	424.4	Lack of penetration
7	42640	451.4	Lack of penetration
8	38520	412.0	Lack of penetration
9	30880	**335.4(min)**	Lack of penetration

3. CONCLUSIONS

1. From stress vs strain diagram & from observation table sample no.5 has highest value of U.G.S that is 47.44 mpa & Sample 9 has lowest value of U.G.S 30.82 mpa
2. There is lack of penetration in all the specimen and they are defected.

4. REFERENCES

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