

**EXPERIMENTAL INVESTIGATION AND STATISTICAL ANALYSIS OF  
VARIOUS PARAMETERS IN SYNERGIC MIG WELDING OF 304L  
STAINLESS STEEL**

Submitted by:

**SHANTI LAL MEENA**  
(Roll No. : **11/PRD/2010**)  
Mechanical Engineering Department

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**MASTERS OF TECHNOLOGY**

in

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Under the guidance of:

**Dr. QASIM MURTAZA**

**Associate Professor**

**Mr. M.S. NIRANJAN**

**Assistant Professor**

**Department of Mechanical Engineering**



**Department of Mechanical Engineering  
DELHI TECHNOLOGICAL UNIVERSITY  
(Formerly Delhi College of Engineering)**

**Bawana Road, New Delhi**

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## CERTIFICATE

Date:-\_\_\_\_\_

This is to certify that report entitled “**Experimental investigation and statistical analysis of various parameters in synergic MIG welding of 304L stainless steel**” by **Mr. Shantilal Meena** is the requirement of the partial fulfillment for the award of Degree of **Master of Technology (M. Tech.) in Production Engineering at Delhi Technological University**. This work was completed under our supervision and guidance. He has completed his work with utmost sincerity and diligence. The work embodied in this project has not been submitted for the award of any other degree to the best of my knowledge.

Dr. QASIM MURTAZA

(Associate Professor)

Department of Mechanical Engineering

DTU Delhi

Mr. M.S. NIRANJAN

(Assistant Professor)

Department of Mechanical Engineering

DTU Delhi

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**SHANTI LAL MEENA**

**(Roll No. - 11/PRD/10)**

## **ABSTRACT**

The experimental study is carried out to analyze effect of various welding parameters such as Welding current, Welding speed, plate thickness and gas flow rate, on bead geometry features such as, bead reinforcement height, bead width and bead penetration of synergic MIG through voltage transients for 304L stainless steel. Various thicknesses (i.e. 3mm, 6mm, 8mm, 12mm, and 16mm) are taken with 75% Argon and 25% CO<sub>2</sub> as the shielding gas. The mechanical strength of welds is influenced by the composition of metal, weld bead geometry and shape relationship. The study of weld bead geometry and shape relationship is important as these dimensions and ratios decide the load bearing capacity of weldments.

The design of experiment was prepared on the basis of 4 factors, 5 levels using Design of expert software. Response Surface Methodology was used to develop the mathematical models co-relating the process parameters with the bead geometry features. To identify the mode of metal transfer and the moment in which the transfer occurs is based on an oscillographical analysis of voltage (voltage versus time) by using Digital Signals Oscilloscope (DSO) with Synergic MIG machine. With the use of oscilloscope, it is possible to observe the format of the voltage traces produced by welding processes. For instance, during short-circuiting transfer, when the droplet is starting its development, voltage oscillates around a mean value but tends to zero when the drop touches the pool (short circuit).

Metallurgical investigations determine the variation of micro hardness across the weld metal zone, heat affected zone and the base metal. Knoop's micro hardness is carried out to determine the hardness values of the metal at various zones. Also the microstructure of the resultant welded metal was co-related with the process variables.

**Keywords:** Synergic MIG Welding, Bead Geometry, Digital Signals Oscilloscope, Response Surface Methodology, Weld Metallurgy, Micro Hardness,

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## LIST OF SYMBOLS

<b>Symbol</b>	<b>Represents</b>	<b>units</b>
P	Bead Penetration	(mm)
W	Bead Width	(mm)
H	Bead Height	(mm)
G	Gas flow rate	(Volts)
I	Current	(Ampere)
S	Travel Speed	(mm/min)
T	Plate thickness	(mm)

## ABBREVIATIONS

<b>CCD</b>	Central Composite Design
<b>RSM</b>	Response Surface Methodology
<b>HAZ</b>	Heat Affected Zone