# بسم الله الرحمن الرحيم

شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

# شبكة المعلومات الجامعية

# التوثيق الالكتروني والميكروفيلم

MONA MAGHRABY

# جامعة عين شمس

## التوثيق الإلكتروني والميكروفيلم

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# OPTIMIZATION OF FRICTION STIR WELDING PARAMETERS FOR 6063-T6 ALUMINUM ALLOY BY USING TAGUCHI METHOD

By

**Mostafa M. ElSadany**

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
**MASTER OF SCIENCE**
In
**Metallurgical Engineering**

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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**Title of Thesis:**

Optimization of Friction Stir Welding Parameters for 6063-T6 Aluminum Alloy by using Taguchi method.

**Key Words:** FSW, Aluminum, 6063-T6 Alloys, Taguchi method, ANOVA

**Summary:**

Friction stir welding is a solid state welding process that produces a weld by the friction heating and plastic material displacement caused by a rapidly rotating tool traversing the weld joint.

This study aims to determine the optimal process parameters of welding AA6063-T6 by using Taguchi method as a main design of experiments (DOE) that study combination of parameters with a small number of experiments instead of testing all possible combinations, thus save time, resources and reduce costs. Based on a review of the literature, rotational speed, travel speed and tool pin profile parameters were chosen for the experimental work.

The experimental results indicated that the optimum condition for maximum tensile strength value achieved with rotational speed at 900 rpm, travel speed at 45mm/min and round threaded TC pin design gives 160.7MPa T.S with 4.5% elongation and 74.7% weld efficiency. The percentage of contribution, which has been checked by ANOVA, found that travel speed 'TS' was the most significant factor, then tool pin design 'PS' came on the second place followed by rotational speed 'RS' as the least effective parameter. The average hardness value increased as the travel speed (TS) level increased and rotational speed (RS) level decreased, maximum hardness value observed in sample X3 with rotational speed 560 rpm, travel speed 45mm/min and tool pin design TC. All specimens with fully welding area had passed successfully the bending test with no voids or tunnel defects in both face and root tests and it was not affected by very small voids, the bending optimum condition at rotational speed 900 rpm, travel Speed 28mm/min and tool pin design TC respectively.

# Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have acknowledged all sources used and have cited them in the references section.

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# Nomenclature

| | |
|---|---|
| AS | Advanced Side |
| ASTM | American Society for Testing Materials |
| BM | Base Metal |
| FSP | Friction Stir Processing |
| FSW | Friction Stir Welding |
| GMAW | Gas Metal Arc Welding |
| GTAW | Gas Tungsten Arc Welding |
| HAZ | Heat Affected Zone |
| MIG | Metal Inert Gas |
| NZ | Nugget Zone |
| RS | Retreating Side |
| S/N ratio | Signal to Noise Ratio |
| SCC | Stress Corrosion Cracking |
| T.S | Tensile Strength |
| TIG | Tungsten Inert Gas |
| TMAZ | Thermo-Mechanically Affected Zone |
| TWI | The Welding Institute |
| UTS | Ultimate Tensile Strength |