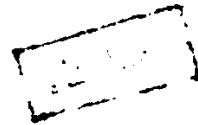


# *A Study of Some Factors Affecting the Cold Pressure Welding of Aluminium*

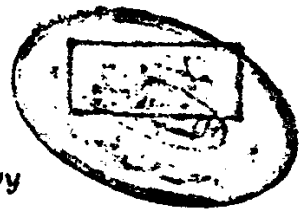
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M. A*



*6599*



*By  
Mahmoud Abdel Ghalik El Shinnawy  
B. Sc. Mechanical Engineering,  
Ain Shams University 1960  
Diplom of higher studies  
Cairo University 1967*

**1975**

*A Study of Some Factors Affecting  
the Cold Pressure Welding  
of Aluminium*

*Examiners*

*Signature Date*

*Prof. Dr.*

*Ahmed Salem El Sabbagh*

*Prof. of production engineering  
Ain Shams University*



*Prof. Dr.*

*Abdel Ghani Darwish*

*Prof. of production engineering  
El Azhar University*



*6.2.1975*

*Prof. Dr.*

*N.D. Loukashkine  
El Eibin Metallurgical institute  
for Higher. Studies*



*6/11/75*



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CONTENTS

|                                                                            | <u>Page</u> |
|----------------------------------------------------------------------------|-------------|
| Acknowledgment. . . . .                                                    | i           |
| List of symbols . . . . .                                                  |             |
| List of figures . . . . .                                                  |             |
| Abstract . . . . .                                                         | 1           |
| CHAPTER 1 INTRODUCTION. . . . .                                            | 3           |
| CHAPTER 2 REVIEW OF LITERATURE. . . . .                                    | 5           |
| 2.1 Definitions . . . . .                                                  | 5           |
| 2.2 Hypothesis for cold pressure welding<br>mechanism . . . . .            | 5           |
| 2.3 Area in metallic contact. . . . .                                      | 8           |
| 2.4 Factors affecting the pressure welding. . .                            | 10          |
| 2.4.1 Surface layers. . . . .                                              | 10          |
| 2.4.2 Surface cleaning. . . . .                                            | 11          |
| 2.4.3 Ratio of hardness of oxide to base metal.                            | 13          |
| 2.4.4. Welding temperature . . . . .                                       | 13          |
| 2.4.5 Effect of post heat treatment . . . . .                              | 16          |
| 2.4.6 Effect of metal prestraining . . . . .                               | 17          |
| 2.4.7 Effect of plate thickness in lap pressure<br>welding. . . . .        | 18          |
| 2.4.8 Effect of welding die shape on lap pres-<br>sure welding. . . . .    | 19          |
| 2.4.9 Effect of using foil metal inserts. . . .                            | 20          |
| 2.4.10 Length of the free end of the specimen<br>in butt welding . . . . . | 21          |
| 2.5 Statement of the problem. . . . .                                      | 27          |

|                                                                                      | <u>Page</u> |
|--------------------------------------------------------------------------------------|-------------|
| CHAPTER 3 EXPERIMENTAL WORK . . . . .                                                | 26          |
| 3.1 Materials used in butt welding. . . . .                                          | 26          |
| 3.2 Materials used in lap welding . . . . .                                          | 26          |
| 3.3 Preparation of specimens before welding .                                        | 27          |
| 3.4 Preparation of test specimens . . . . .                                          | 30          |
| 3.4.1 Specimens for the tensile test. . . . .                                        | 30          |
| 3.4.2 Specimens for the metallographic exami-<br>nation . . . . .                    | 33          |
| 3.5 Welding apparatus . . . . .                                                      | 33          |
| 3.6 Lap welding dies . . . . .                                                       | 35          |
| 3.7 The machine used in experiments . . . . .                                        | 35          |
| 3.8 Specimen cleaning techniques. . . . .                                            | 35          |
| 3.9 Welding techniques. . . . .                                                      | 38          |
| 3.10 Technique of lap welding with relative<br>motion at the weld interface. . . . . | 40          |
| 3.10.1 Manually induced relative motion . . . . .                                    | 40          |
| 3.10.2 Relative motion caused by using dissimi-<br>lar welding dies . . . . .        | 41          |
| 3.11 Tensile testing of the welded specimens .                                       | 41          |
| 3.12 Layout of experiments . . . . .                                                 | 41          |
| 3.13 Reliability of the experimental results.                                        | 45          |
| CHAPTER 4 RESULTS AND DISCUSSION. . . . .                                            | 47          |
| 4.1 Effect of different cleaning methods on<br>butt joint strength. . . . .          | 47          |
| 4.1.1 Effect of the adsorbed films on the joint<br>strength. . . . .                 | 54          |

|                                                                                                                             | <u>Page</u> |
|-----------------------------------------------------------------------------------------------------------------------------|-------------|
| 4.1.2 Effect of time elapsed between cleaning<br>and welding . . . . .                                                      | 54          |
| 4.2. Effect of relative motion at the weld<br>interface in lap welding. . . . .                                             | 56          |
| 4.2.1 Manually induced relative motion. . . . .                                                                             | 57          |
| 4.2.2 Relative motion induced by using pairs<br>of dissimilar welding dies. . . . .                                         | 60          |
| 4.3 Cold pressure lap welding conditions<br>for Al- 1.5 Mg-1.2 Mn alloy . . . . .                                           | 65          |
| 4.4 Effect of prestraining on the properties<br>of the pressure welded joints . . . . .                                     | 70.         |
| 4.5 Effect of specimen end shape on the<br>strength of the butt welded joints . . . . .                                     | 89          |
| 4.6 The relationship between the amount of<br>oxide at the weld interface and the pres-<br>sure lap joint strength. . . . . | 94          |
| CONCLUSION.....                                                                                                             | 100         |
| REFERENCES.....                                                                                                             | 103         |
| ARABIC SUMMARY.....                                                                                                         |             |

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| <u>LIST OF FIGURES</u>                                                                                                         | <u>Page</u> |
|--------------------------------------------------------------------------------------------------------------------------------|-------------|
| Fig. 1: Tension test specimen for butt welding.                                                                                | 32          |
| Fig. 2: Tension test specimen for lap welding                                                                                  | 32          |
| a) Free specimen                                                                                                               |             |
| b) Guided specimen                                                                                                             |             |
| Fig. 3: Pressure welding apparatus                                                                                             | 34          |
| Fig. 4: Lap welding dies                                                                                                       | 36          |
| Fig. 5: Determination of the welding deformation                                                                               | 36          |
| a) Butt welding                                                                                                                |             |
| b) Lap welding                                                                                                                 |             |
| Fig. 6: Discontinuities at the weld interface for                                                                              | 49          |
| a) Filed specimens                                                                                                             |             |
| b) Wire brushed specimens                                                                                                      |             |
| Fig. 7: Effect of the different cleaning methods on the relationship between $\sigma_w$ and $F_w$ in butt welding.             | 51          |
| Fig. 8: Effect of the different cleaning methods on the relationship between $\sigma_w$ and $\phi$ in butt welding.            | 52          |
| Fig. 9. Relationship between $F_t - F_w$ for both manually fricative scratched and wire brushed butt welded aluminium strips   | 58          |
| Fig.10: Relationship between $F_t - \phi$ for both manually fricative scratched and wire brushed butt welded aluminium strips. | 59          |

|                                                                                                                                                       | Page |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>Fig. 11:</b> Effect of using dissimilar welding dies on the $F_t$ - $F_w$ curve in lap welding aluminium strip                                     | 61   |
| a) Ring dies compared with ring/flat dies                                                                                                             |      |
| b) Spherical dies compared with spherical/flat dies.                                                                                                  |      |
| <b>Fig. 12:</b> Different modes of deformation at the weld interface when using sets of dissimilar welding dies                                       | 63   |
| a) Ring/circular flat set                                                                                                                             |      |
| b) Spherical/circular flat set.                                                                                                                       |      |
| <b>Fig. 13:</b> Comparison between the effect of manually induced relative motion and the use of dissimilar welding dies on the $F_t$ - $F_w$ curves. | 64   |
| <b>Fig. 14:</b> Effect of using dissimilar welding dies on the $F_w$ - $F_t$ curve for lap welding Al-Mg-Mn alloy                                     | 66   |
| <b>Fig. 15:</b> Relationship between $F_t$ - $\phi$ for lap welding Al-Mg-Mn alloy using circular flat welding dies.                                  | 67   |
| <b>Fig. 16:</b> Relationship between $\sigma_w$ - $F_w$ for butt welding different degrees of prestained aluminium rods                               | 72   |
| <b>Fig. 17:</b> Relationship between $\sigma_w$ - $\phi$ for butt welding different degrees of prestained aluminium rods.                             | 73   |

|                                                                                                                        | Page |
|------------------------------------------------------------------------------------------------------------------------|------|
| Fig. 18: Effect of $\epsilon$ on $\sigma_w$ max. and $\sigma_B$                                                        | 75   |
| Fig. 19: Effect of $\epsilon$ on $F_\sigma$ max.                                                                       | 77   |
| Fig. 20: Effect of $\epsilon$ on $\phi_\sigma$ max.                                                                    | 79   |
| Fig. 21: Effect of $\epsilon$ on $\sigma_w$ max./ $\sigma_B$ on a semi-log scale                                       | 81   |
| Fig. 22: Effect of $\epsilon$ on $\sigma_w$ max.                                                                       | 83   |
| Fig. 23: Effect of $\epsilon$ on $F_\sigma$ max.                                                                       | 84   |
| Fig. 24: Effect of $\epsilon$ on $\phi_\sigma$ max.                                                                    | 85   |
| Fig. 25: Effect of $\epsilon$ on $\sigma_w$ max. / $\sigma_B$                                                          | 86   |
| Fig. 26: Relationship between $F_t - F_w$ for lap welding<br>aluminium strips of different amounts of<br>prestraining  | 87   |
| Fig. 27: Relationship between $F_t - \phi$ for lap welding<br>aluminium strips of different amounts of<br>prestraining | 88   |
| Fig. 28: Effect of different specimen end shapes on<br>the strength of the butt welded joints                          | 90   |
| Fig. 29: Effect of the welding load on the amount of<br>oxides remaining at the weld interface.                        | 95   |
| Fig. 30: Principles of calculating the percentage of<br>discontinuities at the weld interface.                         | 96   |
| Fig. 31: Effect of the welding load $F_w$ on the oxide %<br>age at the weld interface in lap welding                   | 97   |
| Fig. 32: Effect of oxide percentage at the weld inter-<br>face on the tensile breaking load.                           | 99   |

(viii)

LIST OF SYMBOLS

| <u>Symbol</u> | <u>Unit</u>        | <u>Meaning</u>                                     |
|---------------|--------------------|----------------------------------------------------|
| D             | mm                 | Diameter of the flange of the butt welded joint.   |
| $\bar{d}_1$   | mm                 | Nominal diameter of the specimen used.             |
| $d_0$         | mm                 | Diameter of aluminium rod before cold rolling.     |
| $d_2$         | mm                 | Diameter of tensile test specimen                  |
| $F_t$         | kp                 | Tensile breaking load of the welded joint.         |
| $F_w$         | kp                 | Welding load.                                      |
| $F_{max}$     | kp                 | Welding load at the maximum joint strength.        |
| $t_0$         | mm                 | Initial strip thickness before rolling.            |
| $t_1$         | mm                 | Nominal strip thickness before welding.            |
| $t_2$         | mm                 | Final thickness of the lap welded joint.           |
| Y             | %                  | Percentage amount of oxides at the weld interface. |
| $\sigma_B$    | kp/mm <sup>2</sup> | Ultimate tensile strength of the base metal.       |

(ix)

| <u>Symbol</u>     | <u>Unit</u>        | <u>Meaning</u>                                                                                                                                                                     |
|-------------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $\sigma_f$        | kp/mm <sup>2</sup> | Flow stress of the base metal.                                                                                                                                                     |
| $\sigma_w$        | kp/mm <sup>2</sup> | Tensile breaking strength of the welded joint.                                                                                                                                     |
| $\sigma_{w \max}$ | kp/mm <sup>2</sup> | Maximum tensile strength of the welded joint.                                                                                                                                      |
| $\phi$            | %                  | Welding deformation.<br>$\phi = \frac{(D/d_o)^2 - 1}{2} \times 100 \quad \text{for butt welding.}$ $\phi = (1 - (t_2/t_1)) \times 100 \quad \text{for lap welding.}$               |
| $\phi_{\max}$     | %                  | Welding deformation at the maximum joint strength.                                                                                                                                 |
| $\epsilon$        |                    | Degree of prestraining of the specimen before welding.<br>$\epsilon = 2 \ln (d_i/d_o) \quad \text{for rods.}$ $\epsilon = \ln (t_o/t_1) \quad \text{for strips.}$                  |
| $\psi$            |                    | Reduction ratio of the specimen before welding.<br>$\psi = \frac{d - d_o}{d_o} \times 100 \quad \text{for rods.}$ $\psi = \frac{t - t_o}{t_o} \times 100 \quad \text{for strips.}$ |

## ABSTRACT

In the present work, the effect of some factors on the mechanical properties of cold pressure welds of aluminium and Al-Mg-Mn alloy was studied in both butt and lap welded Joints.

One of the studied factors is the method of surface cleaning. The results show that cleaning by chemicals only, fails to produce joints with any reliable strength, while; file cleaning gives the highest bond strength. However, surfaces can be welded if they are heated to 400°C/4 hours to ensure burning of the adsorbed surface films.

The elapsed time from surface cleaning to welding moment is found to have no effect in the interval from one minute to 570 hours, upon the joint strength, provided that the surfaces after cleaning are kept clean untouched, and stored away from any dust or organic film contamination.

A part of the work is utilized to investigate a new technique of lap welding, in which, higher joint strength can be achieved with lower welding loads and deformations by inducing a relative motion between the faying surfaces. This motion can be induced either manually or by using two dissimilar welding dies. No cleaning process is

required when welding with manually induced relative motion.

A great deal of the work is developed to study the effect of the degree of axial prestressing  $\epsilon$  on the bond strength. Up to  $\epsilon = 0.75$  the joint strength exceeds that of the base metal. However, the maximum joint strength can be obtained with  $\epsilon = 0.55$ .

Concerning the effect of the specimen geometry on the butt welded joint strength, the conical and hemispherical ends show lower threshold welding loads. On the other hand, the maximum bond strength can be attained at higher welding loads with the solid cylindrical flat end specimens.

The effect of the amount of oxides at the weld interface on the lap welded joint strength is investigated. It is shown that the breaking load decreases proportionally as the amount of oxide increases.

## Chapter 1

### INTRODUCTION

Pressure welding is one of the most ancient ever-known methods of metal joining. It simply consists of pressing two clean and coplanar surfaces together until they become close within interatomic distances in the solid state. This results in the existence of a metallic bond between the two joining surfaces forming a joint.

The earliest example of pressure welded work, may be the miniature head-rest found at Luxor in the innermost solid gold coffin of Tutankh-Amon (1350 B.C.).

However, in the last few years, cold pressure welding has gained special significance due to the advantage that no heating is required, thus avoiding the serious defects such as cracks, pores, shrinkage...etc, which may be caused when using thermal welding methods such as fusion welding<sup>(1)</sup>.

In addition, cold pressure welded joints can be attained between dissimilar metals as aluminium and copper which is generally met with practical difficulties when using fusion welding

Consequently, cold pressure welding has found many practical applications in industrial use. Welding of