

# Study the Factors Effecting On Resistance Spot Welding Of Low Carbon Steel Type (AISI 1005)

دراسة العوامل المؤثرة في لحام المقاومة النقطي للصلب المنخفض  
(AISI 1005) الكربون نوع

مقالة تقدم بها :

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## الملخص:

ان الهدف من هذا العمل هو لدراسة تأثير متغيرات لحام المقاومة AISI النقطي على الخواص الميكانيكية للصلب المنخفض الكربون نوع ( ) وأيجاد ظروف العمل الأمثل لكل من تيار وزمن اللحام . (1005)

X16 X تم تحضير العينات المستخدمة في هذا العمل و بأبعاد ( 0,6 ملم, و تم لحامها بواسطة ماكينة لحام المقاومة النقطي و باستخدام (75 تيار لحام مختلف ( 9600 ,2800 ) أمبير وأزمان مختلفة ( 5، 6، 7، 8 ) دورة. اختيار قوى القص أستعمل لتخمين الزمن و التيار الأمثل . كما تم إجراء اختبار الصلادة المجهرية و اختبار البنية المجهرية . أظهرت النتائج أنه يمكن الحصول على أقصى قوة قص وهي ( 3310 ) نيوتن عند تيار لحام (9600) أمبير و زمن لحام (7) دورة.

## WELDING CYCLES STAGES:

IT IS DEPENDING ON THE TIME DURING THE WELDING PROCESS WHICH IS DIVIDING INTO FOUR STAGES, FIG. (3)[6,7].

### .1 SQUEEZE TIME:

THE TIME BETWEEN THE INITIAL APPLICATION OF THE ELECTRODE FORCE ON THE WORK AND THE FIRST APPLICATION OF CURRENT.

### .2 WELD TIME:

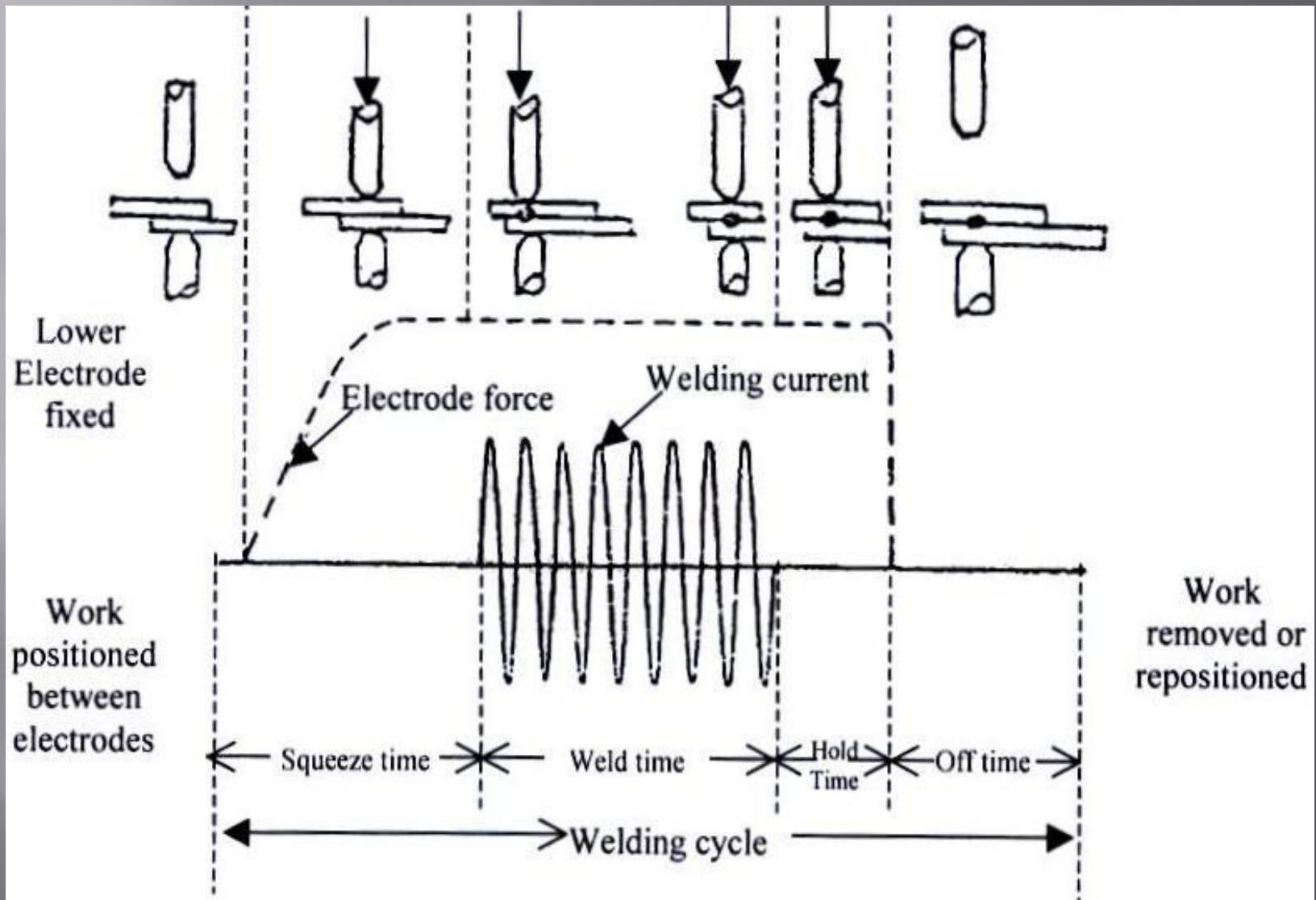
THE TIME THAT WELDING CURRENT IS APPLIED TO THE WORK IN MAKING A WELD BY SINGLE-IMPULSE.

### .3 HOLD TIME:

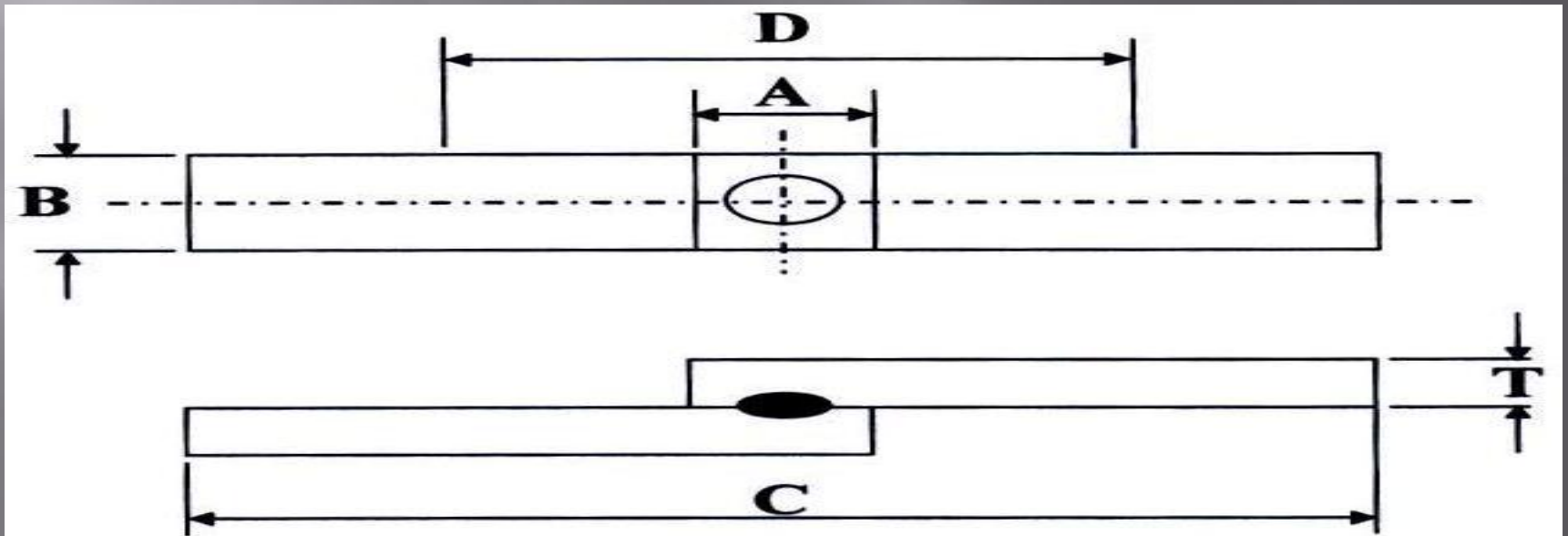
THE TIME DURING WHICH FORCE IS APPLIED AT THE POINT OF WELDING AFTER THE LAST IMPULSE OF CURRENT CEASES IN RESISTANCE WELDING.

### 4.4 OFF TIME:

REFER TO THE TIME BETWEEN TWO WELDING SPOT.



| T-Sheet Thickness (mm) | C-Length (mm) | B-Specimen Width (mm) | A-Overlap (mm) | D-Specimen Gage length |
|------------------------|---------------|-----------------------|----------------|------------------------|
| 0.5-1.5                | 15.87         | 3 inch = 76.2 mm      | 175            | 35                     |
| 1.5-3.0                | 25.4          | 4 inch = 101.6mm      | 230            | 50                     |
| 3.0-5.0                | 38.1          | 5 inch = 127 mm       | 260            | 60                     |
| 5.0-7.5                | 50.8          | 6 inch = 152.4mm      | 300            | 80                     |
| 7.5-10                 | 76.2          | 8 inch = 203.2mm      | 320            | 160                    |



**Table (2) Actual Chemical Composition for Steel Specimen.**

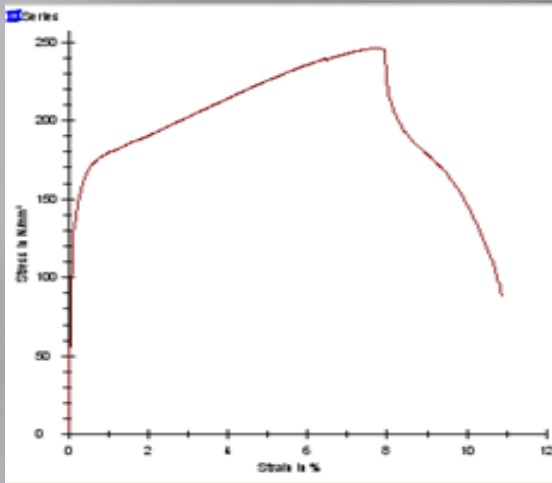
| <b>Element</b>  | <b>C</b> | <b>Mn</b> | <b>P</b> | <b>S</b> | <b>Si</b> | <b>Cu</b> | <b>Ti</b> | <b>V</b> | <b>Co</b> |
|-----------------|----------|-----------|----------|----------|-----------|-----------|-----------|----------|-----------|
| <b>Weight %</b> | 0.05     | 0.259     | 0.1      | 0.035    | 0.234     | 0.0281    | 0.02      | 0.01     | 0.02      |

**Table (3) Nominal Chemical Composition for Steel (AISI C-1005).**

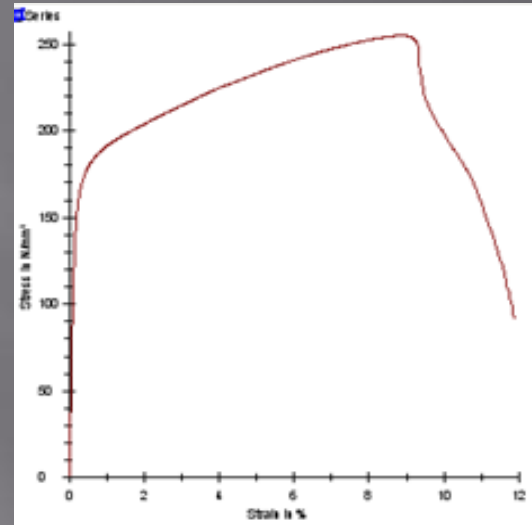
| <b>Element</b>  | <b>C</b> | <b>Mn</b> | <b>P</b> | <b>S</b> | <b>Si</b> | <b>Cu</b> | <b>Ti</b> | <b>V</b> | <b>Co</b> |
|-----------------|----------|-----------|----------|----------|-----------|-----------|-----------|----------|-----------|
| <b>Weight %</b> | 0.06     | 0.35      | 0.04     | 0.05     | 0.3       | 0.35      | 0.02      | 0.01     | 0.02      |

**Table (4) Standard Properties for Steel (AISI C-1005).**

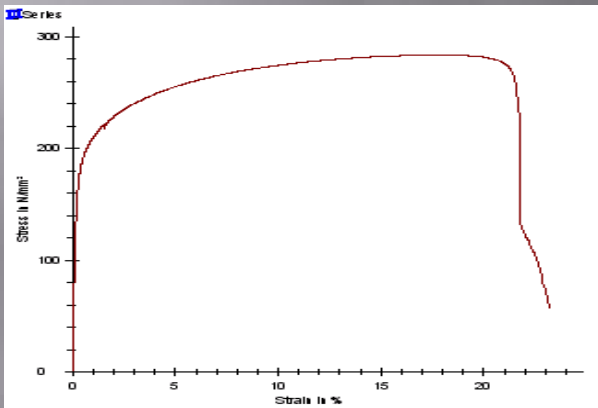
|  |                  |
|--|------------------|
| <b>Density (<math>\times 1000 \text{ kg/m}^3</math>)</b>       | <b>7.872</b>     |
| <b>Poisson's Ratio</b>   | <b>0.27-0.30</b> |
| <b>Elastic Modulus (GPa)</b>                                   | <b>190-210</b>   |
| <b>Thermal Expansion (<math>10^{-6}/^\circ\text{C}</math>)</b> | <b>12.6</b>      |
| <b>Specific Heat (J/kg-K)</b>                                  | <b>481</b>       |



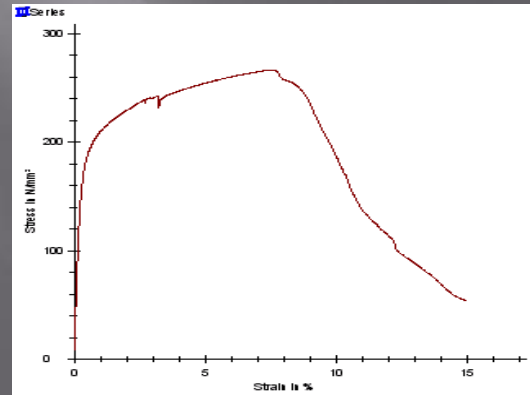
**5-CYCLE**



**6-CYCLE**

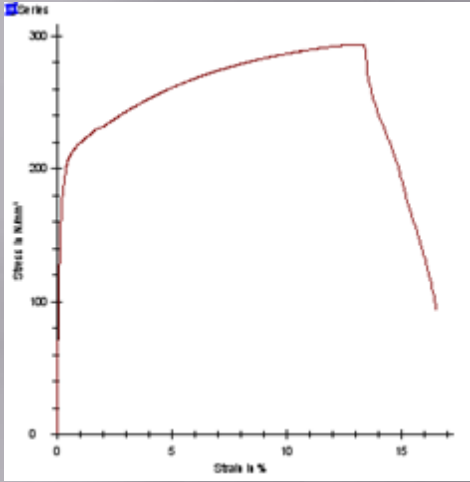


**7-CYCLE**

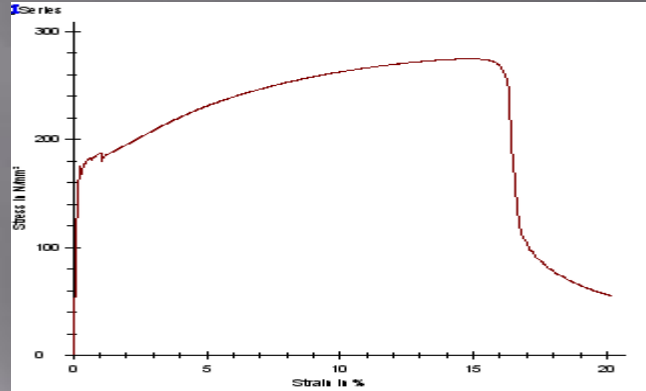


**8-CYCLE**

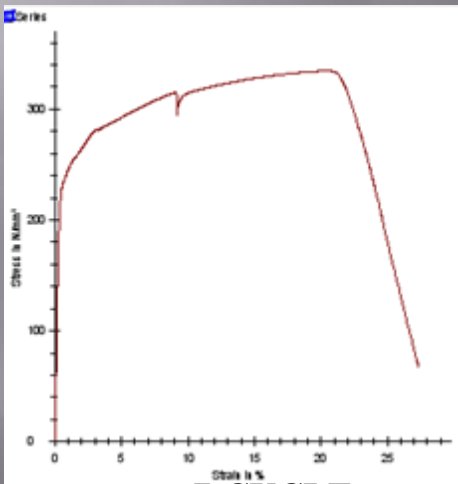
**Stress-Strain Test at (8200) Amp. for different**



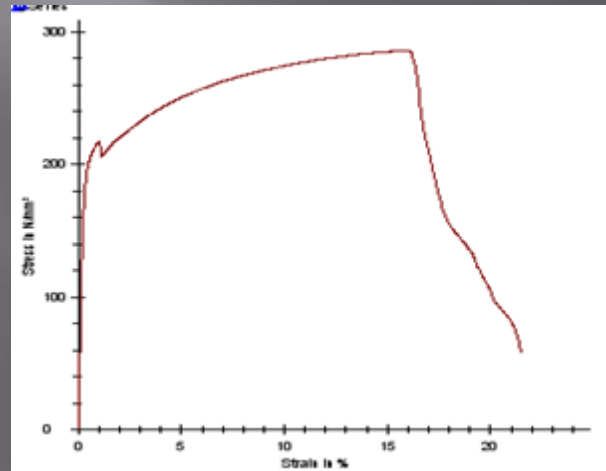
**5-CYCLE**



**6-CYCLE**



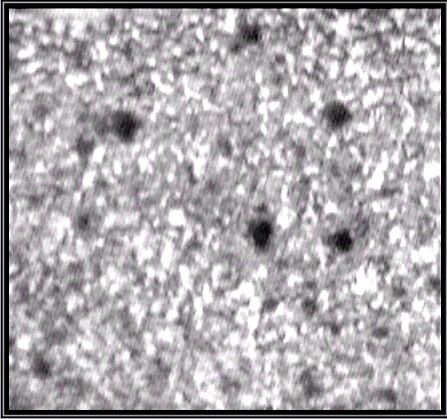
**7-CYCLE**



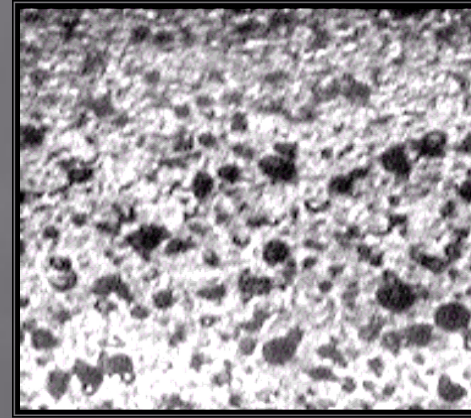
**8-CYCLE**

**Stress-Strain Test at (9600) Amp. for different time.**

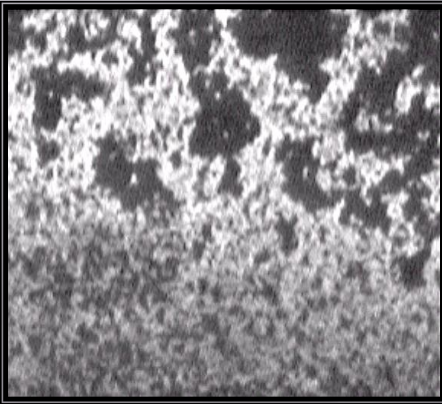




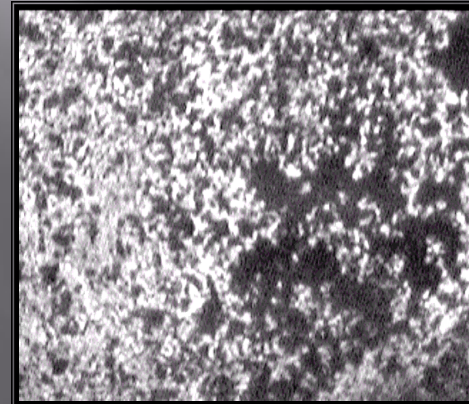
**Figure (8) Base Metal**



**Figure (9) Weld Zone**



**Figure (10) Base Metal+ HAZ**



**Figure (11) Weld Zone+ HAZ**

## Conclusion:

- 1- The low carbon steel has good weld ability for small thickness.
- 2- Increasing the current improve the shear force for the weld zone for different cycles and at (8200 and 9600) Amp.
- 3- The limit current is at (13600) Amp. at any time.
- 4- Increasing the time improve the shear force at (8200 and 9600) Amp.
- 5- The limit time is from (5-8) cycle /sec. at (8200 and 9600) Amp.
- 6- The optimum weld cycle time and current is (7) cycle at (9600) Amp.
- 7- The hardness of the base metal increased after spot welding process.