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# Mechanical properties of autogenous TIG welding in duplex stainless steel: comparison of pulsed and continuous current, and the He addition in shielding gas.

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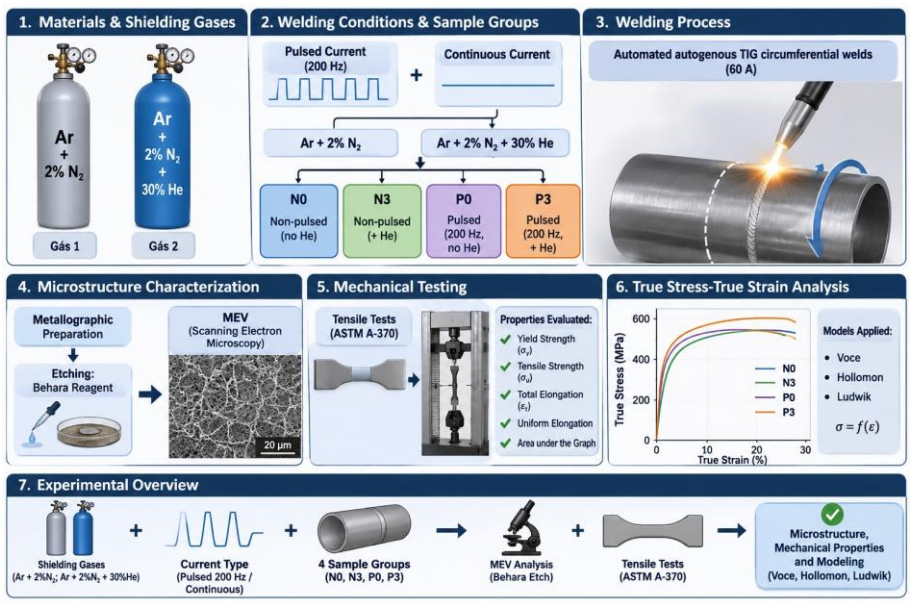
## Introduction

Duplex stainless steel (DSS) combines corrosion resistance, mechanical strength, and impact toughness. These characteristics are achieved by balancing the ferrite (50%) and austenite (50%). Manufacturing is a technological challenge because it is difficult to maintain the ideal biphasic proportion and avoid the precipitation of deleterious phases. In autogenous TIG welding, the primary concern is avoiding a high volumetric fraction of ferrite and nitride formation.

## Objectives

This work evaluated the influence of using or not using a pulsed arc on the mechanical properties of the autogenous TIG welding process for UNS S31803 stainless steel.

## Methodology




## Results and Discussion

In Table 1, the mechanical properties remained similar across the evaluated conditions, with little variation in the yield strength (P0–N3) and tensile strength (P0–N3).

| Amostra | Limite de Escoamento (MPa) | Limite de Resistência (MPa) | Deformação (%) |
|---|---|---|---|
| N0 | 685,345 | 805,87 | 0,348 |
| P0 | 641,91 | 804,735 | 0,226 |
| N3 | 724,23 | 840,22 | 0,315 |
| P3 | 662,68 | 829,425 | 0,29 |

Table 1. Average values of the mechanical properties obtained in the tensile test for the samples analyzed.

Microstructural analysis by SEM made it possible to investigate the full extent of the Heat-Affected Zone (HAZ) and to take precise measurements of the weld bead dimensions. Under both conditions evaluated no deleterious phases were observed in the fusion zone or in the HAZ, as shown in Figure 1.

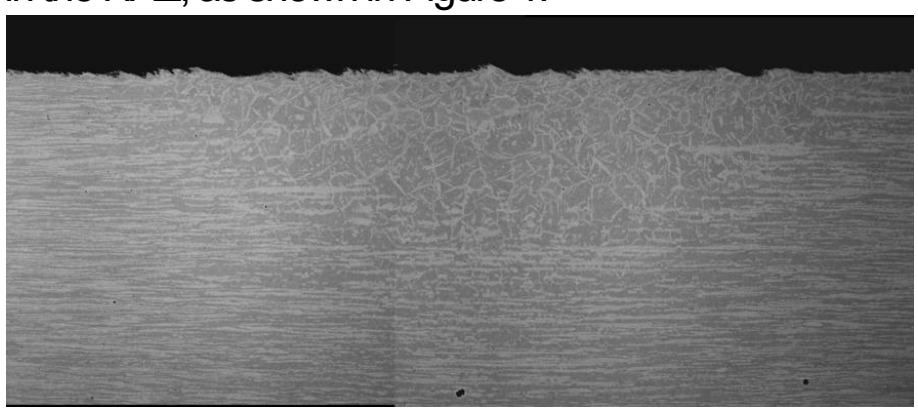


Figure 1. MEV of Sample D0-N6.

Because the average strength values were so similar across the groups, condition N3 was chosen to represent in detail the experimental tensile curves and those of the theoretical models, as shown in schematic Diagram 1 (a–b).

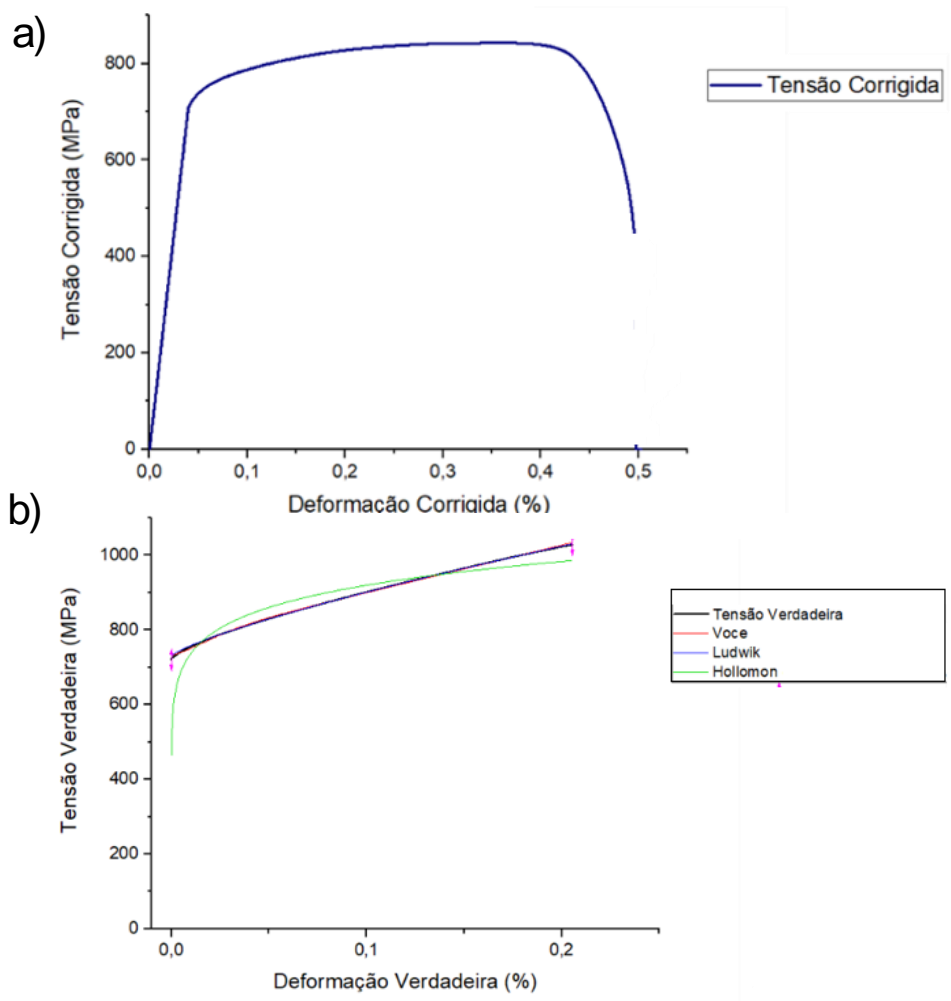



Diagram 1: (a) Corrected stress-strain curve from the tensile test; (b) comparison between the experimental true stress curve and the theoretical curves.

## Conclusions

- The microstructural observations indicated a strong modification of the grain geometry in the fusion zone.
- The continuous current weld had coarser grains.
- The addition of He to the shielding gas favored more weld penetration.
- All tested groups did not present sigma or chi.
- The tensile properties of all samples are in accordance with the standards, indicating that the welding does not significantly affect the mechanical properties.
- He gas can be added to provide greater penetration, and pulsed current can be used to observe better grain distribution without compromising mechanical properties

## References and Acknowledgments

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