

Evaluation of an Enhanced Flux Cored Consumable

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Introduction

- Honeywell FM&T, Kansas City Plant, is interested in the evaluation of a flux cored DeepTIG consumable.
- The DeepTIG Flux added to 308L filler wire is used to produce enhanced weld penetration compared to non-flux cored wire. This increase in penetration can be attributed to the additions of titanium, silicon, and chromium oxides.
- Increased penetration during welding is a result of two mechanisms:

- Arc constriction- Vaporized flux captures electrons in cooler regions of the arc. In these regions negatively charged particles are propelled to center of the arc due to a strong electric field resulting in a narrower, dense arc (figure 1).

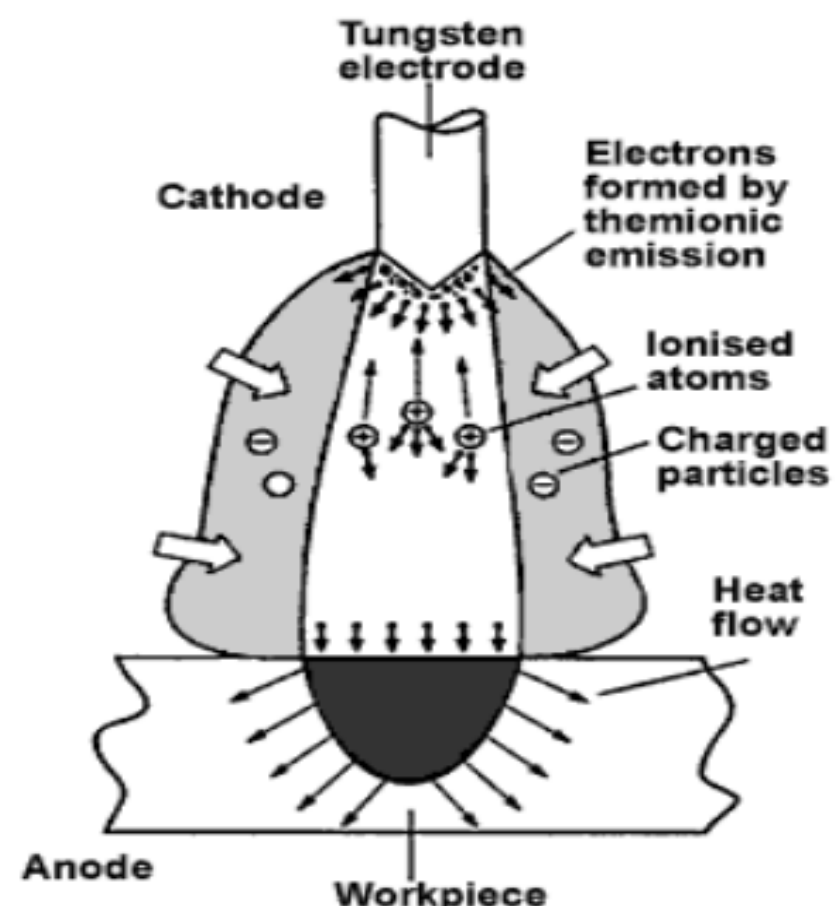


Figure 1: Mechanism proposed by Lucas and Howse for the A-TIG process

- Marangoni effect- Added oxides create a change in surface tension resulting in a deep, narrow weld pool .

Data

- The following Figures (figures 2 & 3) show the difference in weld penetration profile between the 308LSi and 308L SS7 DeepTIG Flux cored wire.

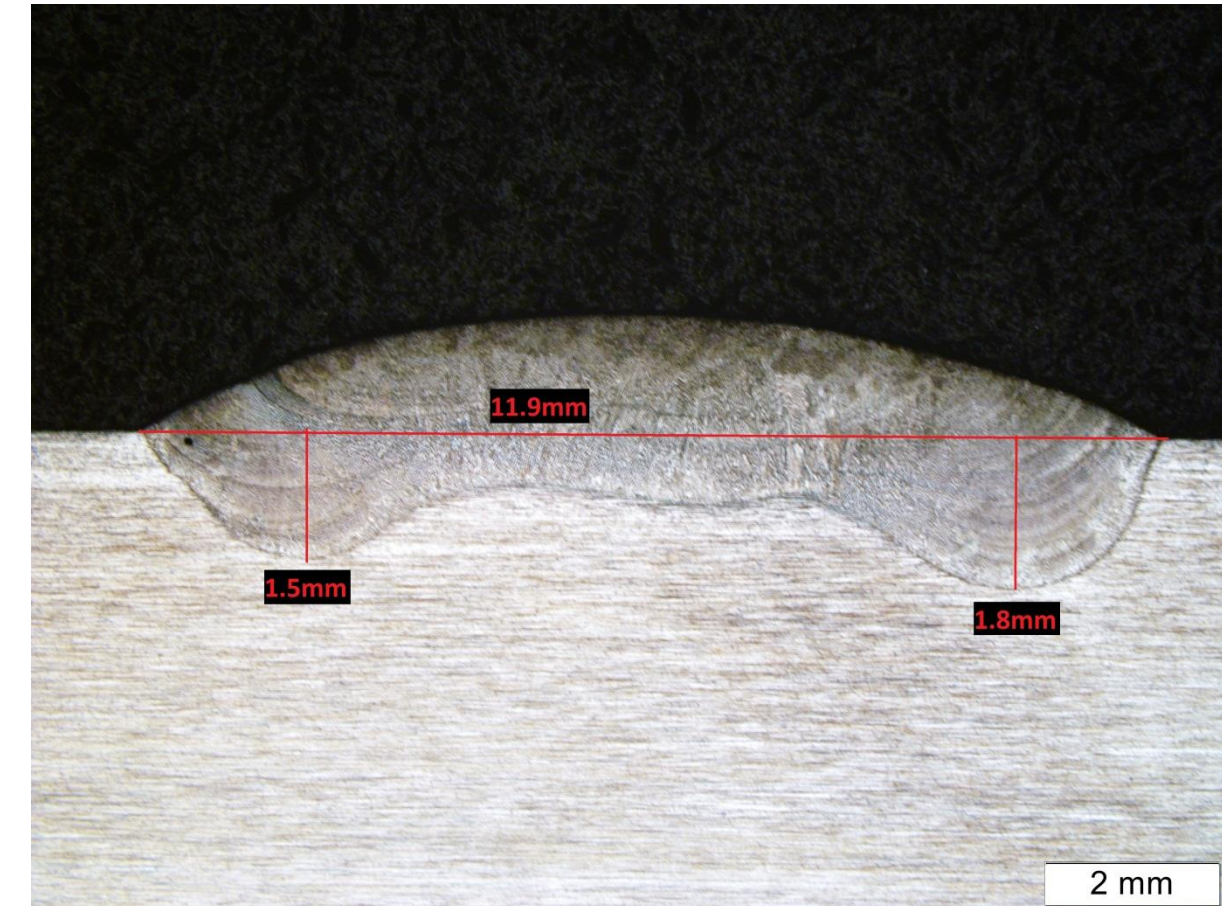


Figure 2: Weld with 308LSi Filler Wire

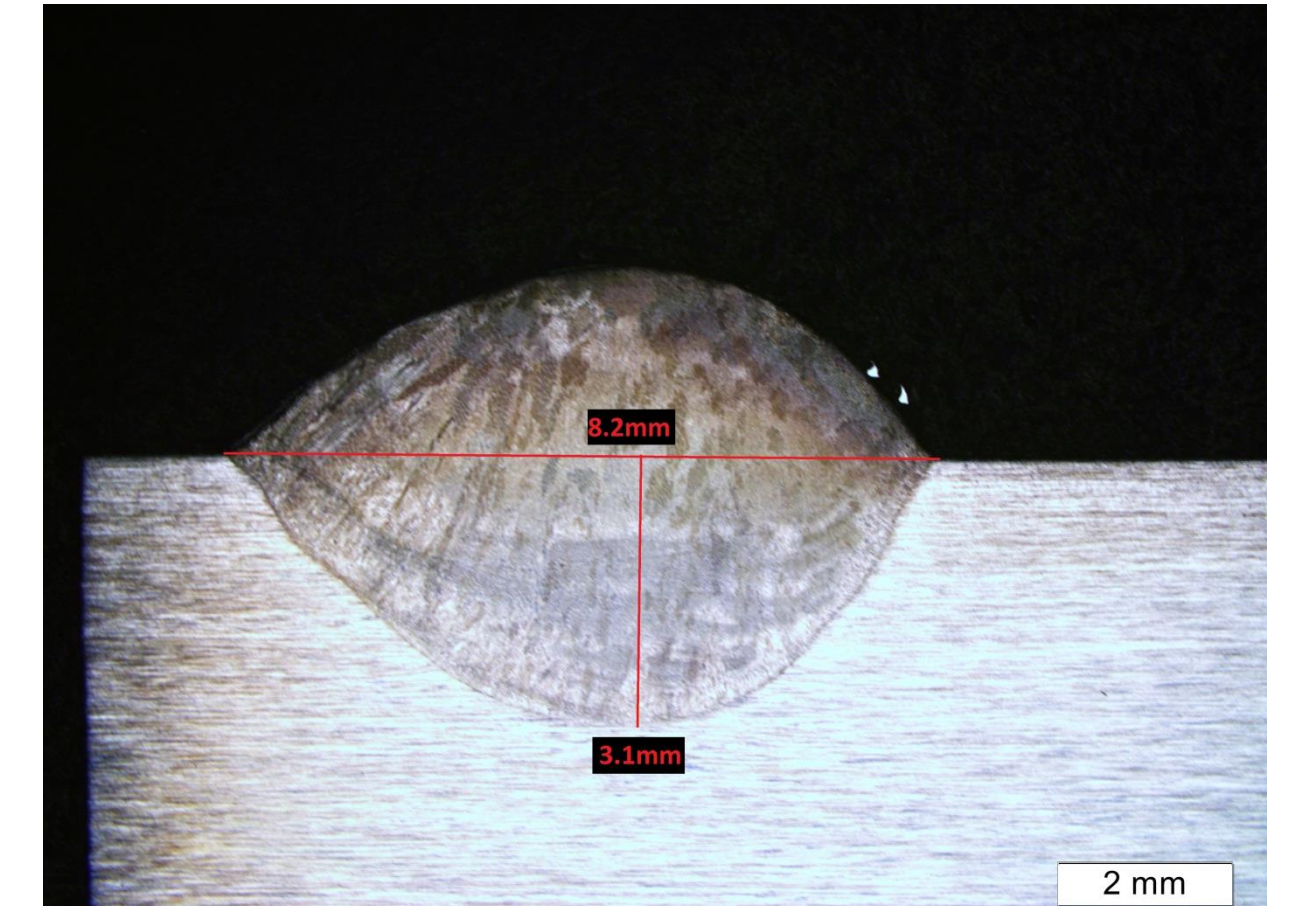


Figure 3: Weld with 308L SS7 DeepTIG Filler Wire

- Red lines on these figures show penetration and width measurements.
- These values were used to evaluate the enhanced DeepTIG wire

Procedure

- A series of 18 welds using an automated TIG process were made for evaluation:
 - 3 welds made with 308LSi for each shielding gas
 - 100% Argon, 100% Helium, 75/25% Argon/Helium
 - 3 welds made with 308L SS7 DeepTIG for each shielding gas
 - 100% Argon, 100% Helium, 75/25% Argon/Helium

Table 1: Weld process parameters.

Weld Parameters				
Current (Amps)	Voltage (Volts)	Travel Speed (In/Min)	Wire Feed (In/Min)	Gas Flow Rate (PSI)
200	11	4	45	35

- Samples mounted and polished to 1 micron.
- Etched with 10% Oxalic Acid for 45 seconds (5 Volts, 0.5 amps)

Shielding Gas Analysis

- Table 2 contains a cost/benefit analysis for the shielding gases and filler wires used in the project

Table 2: Cost/Benefit analysis.

Material	Cost	Benefit
25 lb Spool DeepTIG	\$867.50	Improves penetration by 36%
25 lb Spool 308L	\$268.75	None
Helium Gas	\$80.00	Improves penetration of 308LSi by 60%
75/25 Mixture	\$50.00	Slight increase in penetration
Argon	\$40.00	None

- DeepTIG wire offers a minimum increase in penetration of 36% (helium) compared to the non-flux cored 308LSi filler wire.
- Helium gas has greatest effect on weld penetration but required a larger flow rate, is more expensive, and is a finite resource.
- Weld volume and amount of shielding required will dictate whether the costs of the DeepTIG flux outweigh the costs of more expensive shielding gas.

Evaluation & Conclusion

Table 3: Penetration and width measurements for all weld samples..

Weld #	100% Argon				25% Helium+75% Argon				100% Helium			
	DeepTig		308LSI		DeepTig		308LSI		DeepTig		308LSI	
	Penetration (mm)	Width (mm)	Penetration (mm)	Width (mm)	Penetration (mm)	Width (mm)	Penetration (mm)	Width (mm)	Penetration (mm)	Width (mm)	Penetration (mm)	Width (mm)
1	2.8	8.2	1.7	11.7	3.7	6.95	1.99	12.03	3.82	5.81	3.19	9.11
2	3.1	8.2	1.9	9.4	3.9	6.9	1.61	11.68	4.1	5.92	2.41	9.68
3	2.2	9.1	1.8	11.9	3.38	6.94	1.71	11.99	3.87	6.41	3.06	7.25
Average	2.7	8.5	1.8	11	3.66	6.93	1.77	11.9	3.93	6.05	2.88	8.68

- 308L SS7 DeepTIG successful in increasing penetration with all shielding gases.
- Most drastic increase in penetration using 75% Ar + 25% He.
 - 1.89mm or 106% increase (75% Ar + 25% He)
 - 1.05mm or 37% increase (100% He)
 - 0.9mm or 36% increase (100% Ar)

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