



Manufacturing and Infrastructure Technology

Keyhole Gas Tungsten Arc Welding

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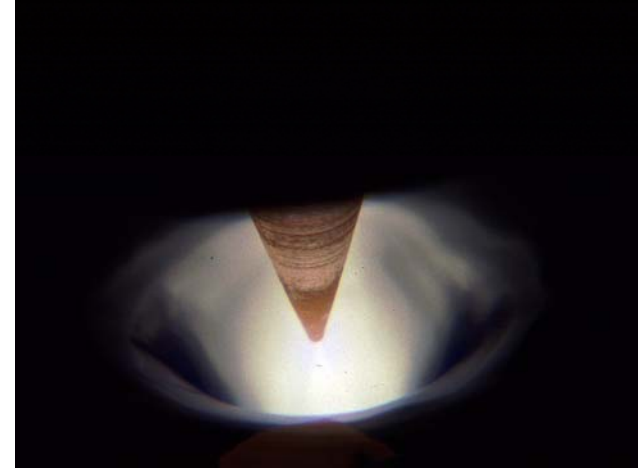
Perth

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Development of Keyhole GTAW

The images show a high current weld pool and a soap film analogue of its surface

- As might be inferred from the soap film analog, the surface geometry results from a dynamic balance between surface tension and arc pressure. Arc pressure is required to inflate the surface, but the stability is low.
- High current GTAW research has focused on increasing stability through reduction of the arc pressure.



Alternate surface geometries can be stable

Keyhole GTAW takes advantage of the natural forces of the arc and of surface tension to create a robust, full-penetration keyhole



- If the weld pool surface can be anchored both top and bottom surface tension will draw it into a stable structure approximating a minimal surface.
- Minimal surfaces are very stable as any distortion increases its surface area and in real systems generates an opposing force.

Keyhole Gas Tungsten Arc Welding

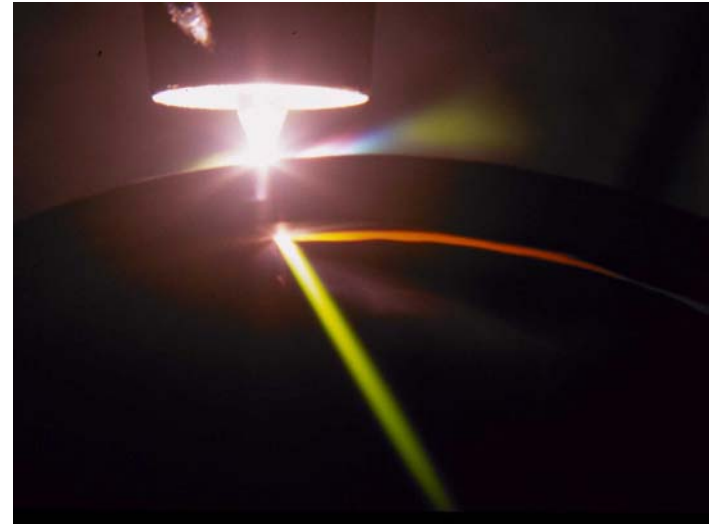
Of interest to anybody involved in the welding of stainless steel or titanium pipes.

Ideal for materials with low thermal conductivity, e.g. titanium and stainless steels.

Ideal for welding of tubular products in workshop, e.g. stainless steel pipe and titanium pipe.

Large productivity gains are achieved, with high quality welds.

Relatively inexpensive process.



Performance guide

3mm C-Mn steel, stainless steels and titanium at **750mm/min**

4mm 3CR12 ferritic stainless steels at **600 mm/min**

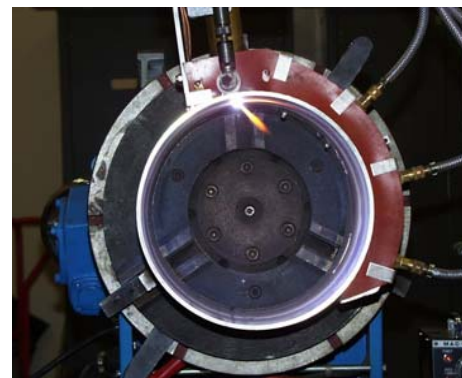
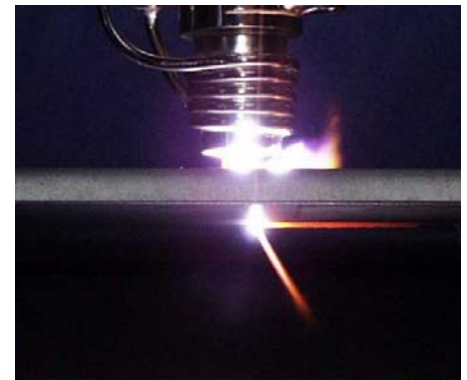
6 mm SAF 2205 duplex stainless steel at **500 mm/min**

8 mm C-Mn steel at **400 mm/min**

12 mm AISI 304 austenitic stainless steel at **250 mm/min**

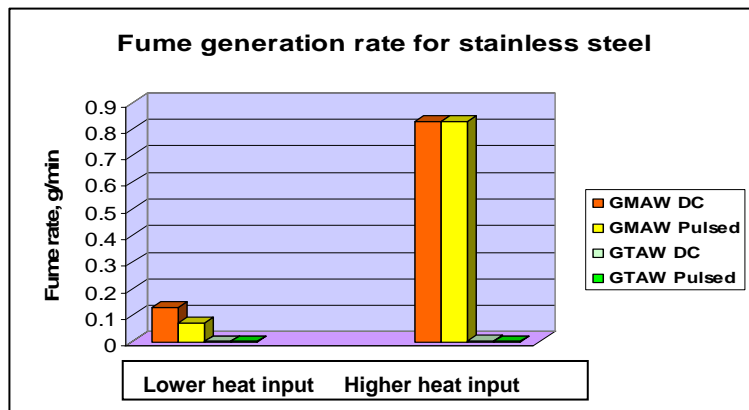
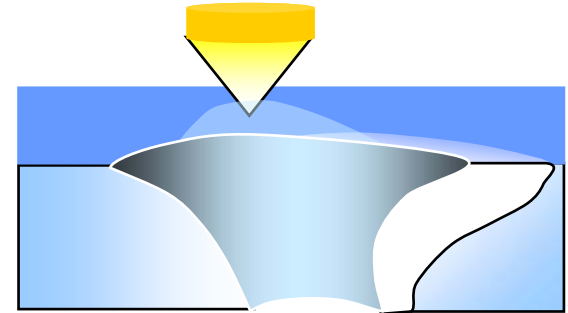
14 mm Grade 2 titanium at **250 mm/min**

Applications to plate and pipe.

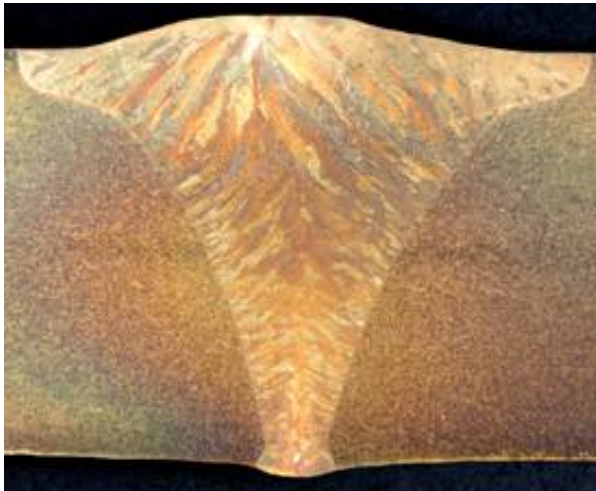


The Keyhole process offers a number of advantages

- High quality of GTAW
- Full penetration Keyhole mode
- Square-edge preparations
- Conventional power sources
- Minimum handling
- Minimum consumables
- Very robust operating characteristics
- Low fume



Process comparison: 12mm AISI 304



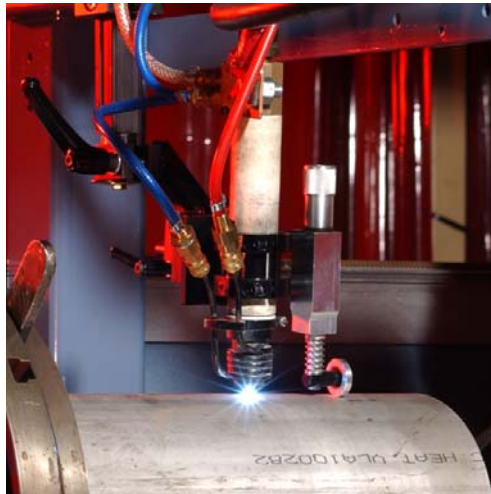
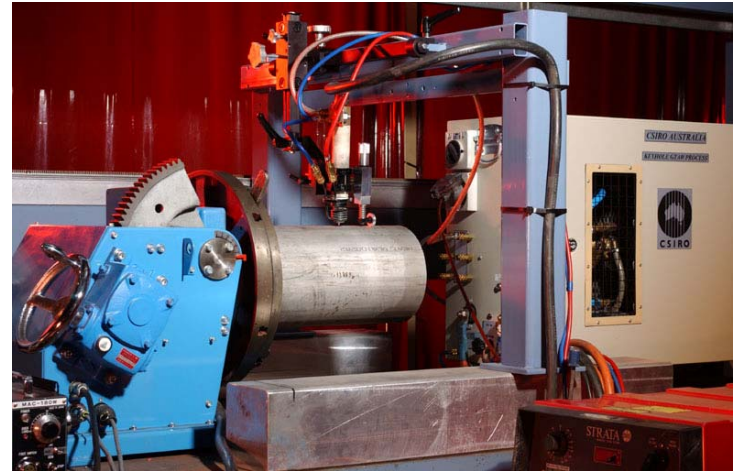
Keyhole GTAW
Closed square butt
50 g/m filler addition
1 pass at 300 mm/min.
Arc-on time 3 min 20 sec /m.



Conventional GTAW
Single V preparation
1000 g/m filler addition
7 passes at 200 mm/min
Arc-on time 35 min/m.

Process requirements and equipment

- A high current GTAW torch designed for keyhole mode operation
- 600 to 1000 amp constant current power source Water cooling for the welding torch
- An arc starting unit compatible with the anticipated welding currents
- Process mechanisation
- Operator control console or pendent
- Clean, squared edges with good fit-up (typically < 0.5 mm gaps)



- Trailing and backing shrouds
- Wire feeder
- Back purge pressure control
- Programmable controller
- Remote viewing (e.g. CCT)
- Mechanical or other device to control electrode-to-work-piece stand-off

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Thank You

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