WELDING
STUDY CENTER

SANITARY WELDING

Tip & Trick

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Hygienic: As defined in ASME BPE 'of or pertaining to equipment and piping systems that by design, materials of construction, and operation provide for the maintenance of cleanliness so that products produced by these systems will not adversely affect human or animal health'.

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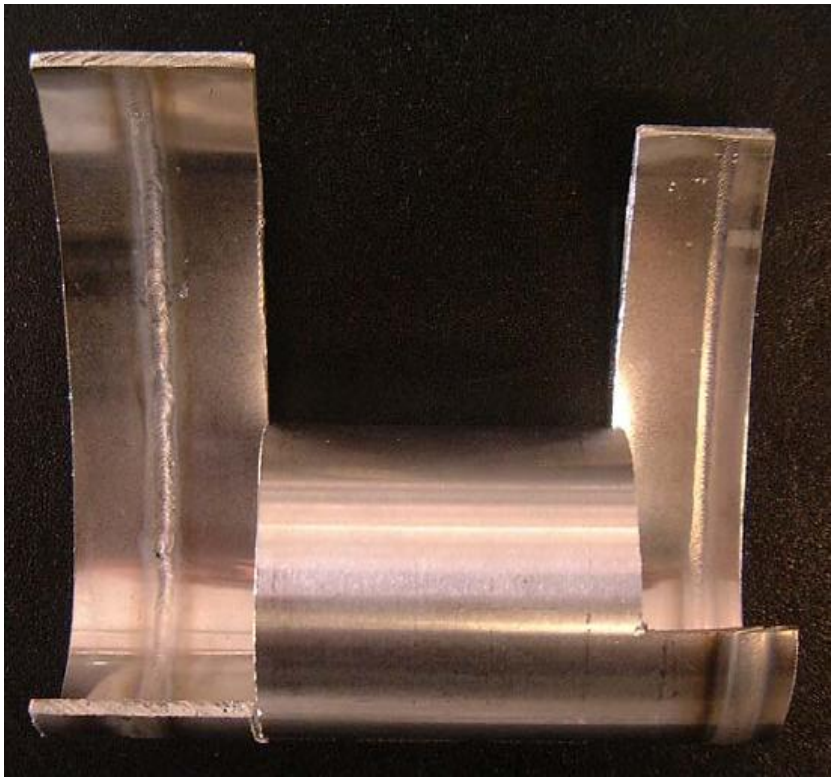
Ideal Hygenic Weld :

- full penetration
- no cracks or porosities
- no misalignment
- no internal colouration
- no concavity
- no convexity
- no lack of fusion
- no inclusions
- no increased surface roughness
- no associated metallurgical changes
- no icicles
- no visible arc strikes
- no undercut
- no burn through



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Basic Requirement

Of course, achieving the above in full is an unrealistic goal for both technical and economic reasons. Limits for these characteristics can be set within which the welds produced will still be hygienically acceptable.

Control of the welding process at all stages is the key to success in achieving this, and the reason why automated welding is the preferred method. Although manual welding can achieve equally good individual results, the required repeatability and consistency of welds cannot be guaranteed with manual methods.

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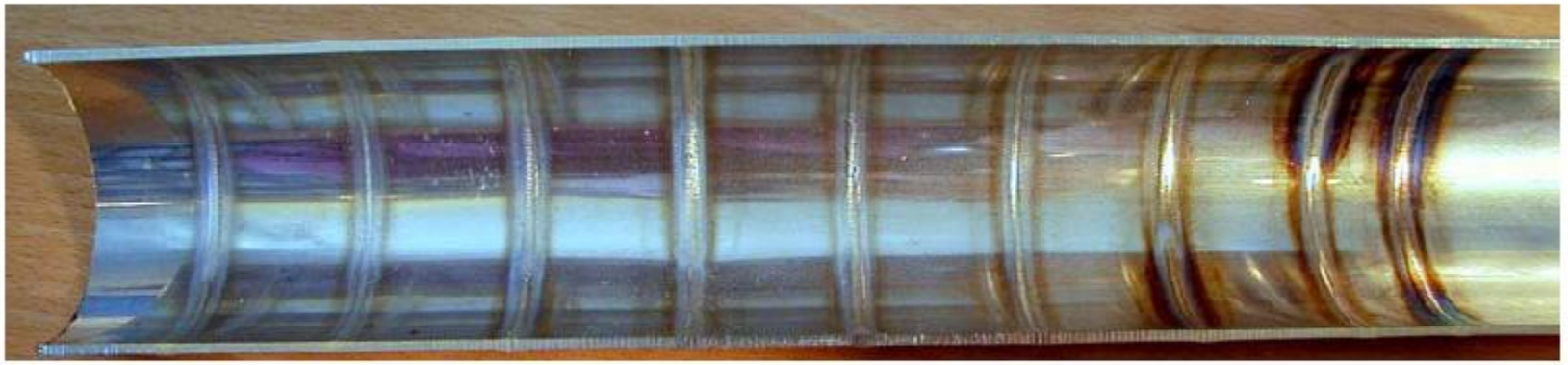
Discolouration Level

Correct purge technic is key success of Hygenic welding

Gas: Argon 99.998% Material: 316L/1.4404 Tube: 53 x 1.5 mm



1	2	3	4	5	6	7	8	9
12 ppm	20 ppm	25 ppm	30 ppm	40 ppm	60 ppm	115 ppm	150	300 ppm

Figure 3: Oxygen content in purge gas and discolouration level

Note : accepted welding for food industry just No. 1 sampai 5

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Correct purge technic is key success of Hygenic

Effective internal purging at all stages of the weld procedure is mandatory! For sufficient gas coverage the use of either silicone or rubber plugs on short tube pieces or gas chambers for longer isometrics are recommended (see Figures 4 and 5). Plugs are inexpensive and easy to handle, gas chambers are economic because only a small fraction of the internal tube volume has to be filled with gas.

Figure 4: Silicone Plugs

Figure 5: Gas chamber

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Tack Weld before welding

Whenever pre-tacking is needed purging also still mandatory during tacking

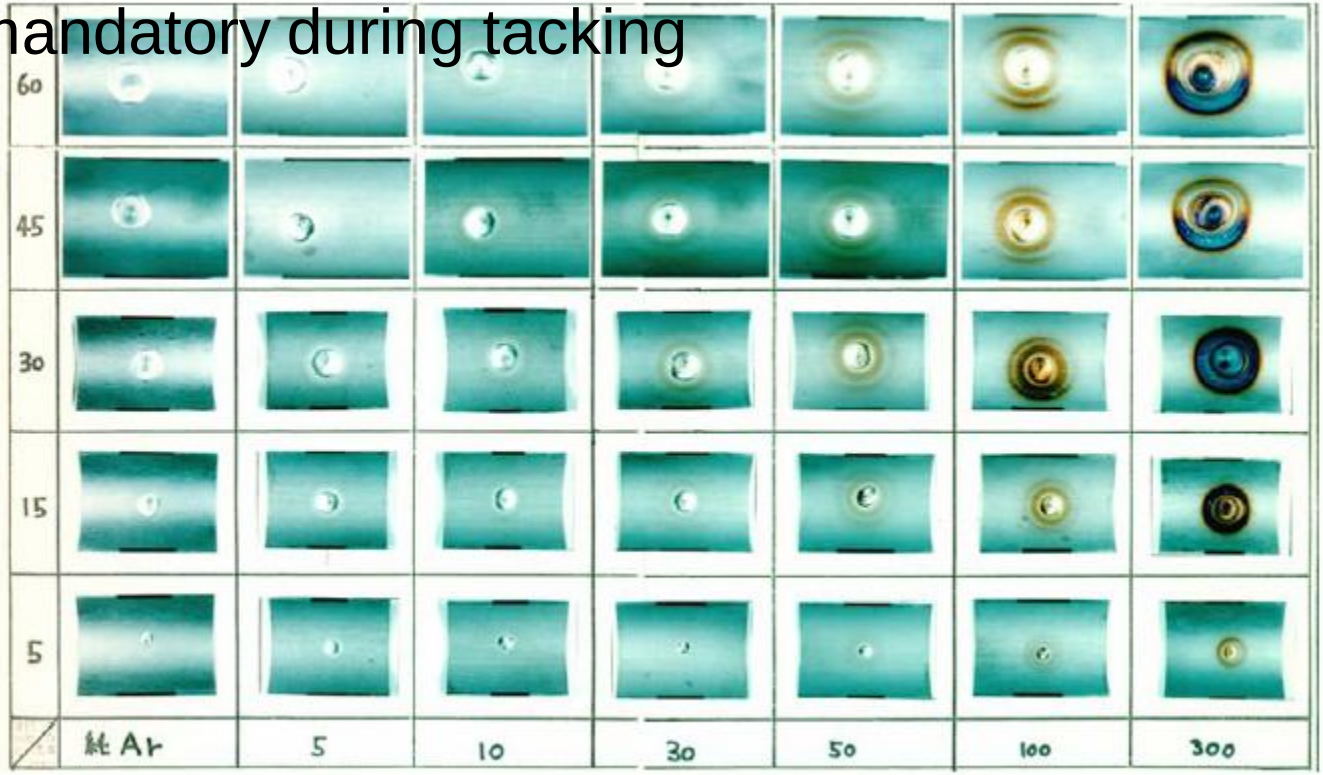

Figure 6. Effect of gas quality and weld time on welded points

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Tube Preparation

Adequate penetration and an even weld bead can only be achieved if the root gap of the weld is controlled and consistent. The quality of the tube end preparation is therefore critical to the completion of acceptable hygienic welds, and this quality is easily achieved by using mechanised preparation tools like tube saws and tube end facers. When used correctly, these tools will guarantee flat square tube ends without burrs or chamfers, which are necessary for first class welds using both orbital welding equipment and manual welding. Tools should be made from materials which are compatible with the tube material being welded. Where cutting lubricants are used these must be completely removed from the metal surfaces prior to welding to prevent formation of porosity in the weld area. Figures 7 and 8 show typical tube sawing and facing tools provided by the industry.

Figure 7: Tube saw

Figure 8: Tube facing machine

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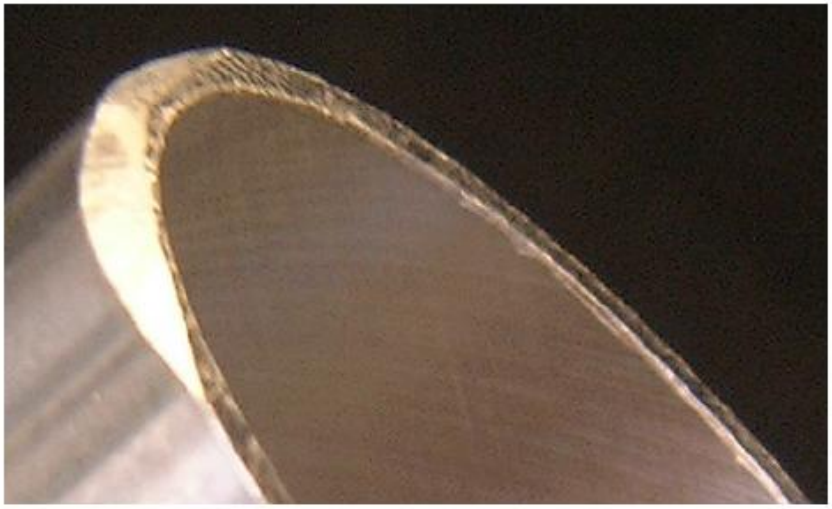
Check end preparation tube

Prepare tube ends (refer to Section 5.3.4. of this document) using equipment dedicated to a specified alloy type.



Avoid chamfers or other irregularities caused by excessive deburring (see above pictures).

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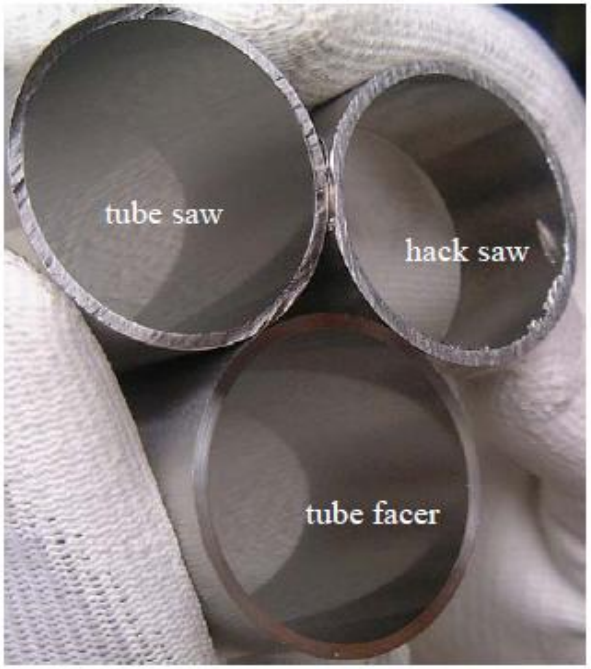
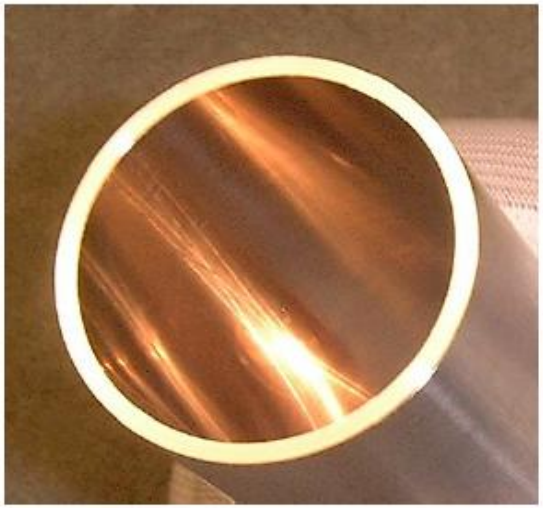
Surface Cutting Quality



This picture shows three surface and cutting qualities using a hacksaw, tube saw and tube facing machine.



The ideal tube preparation is rectangular, burr-free and has no chamfer.

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Tube Facing Machine

A special tube facing machine will ensure a perfect weld preparation for orbital welding.

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Tube alignment

Set up tube alignment correctly, either for manual welding or inside orbital weld head (gap and alignment).

First, place the part to be welded directly under electrode tip and ensure that both parts are properly aligned and have complete circumferential contact (no gap).

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Visual check and Material Verification

Verify dimension dia OD/ID , thickness, grade of material

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Set up Welding Equipment

The first step should be a functional check of the welding equipment (power supply, weld head/torches, gas system, cable couplings etc.). Then a purge equipment check is necessary (fittings, gas hoses, pressure regulators, flow meters, tight connections) to avoid leakages and unacceptably high oxygen levels.

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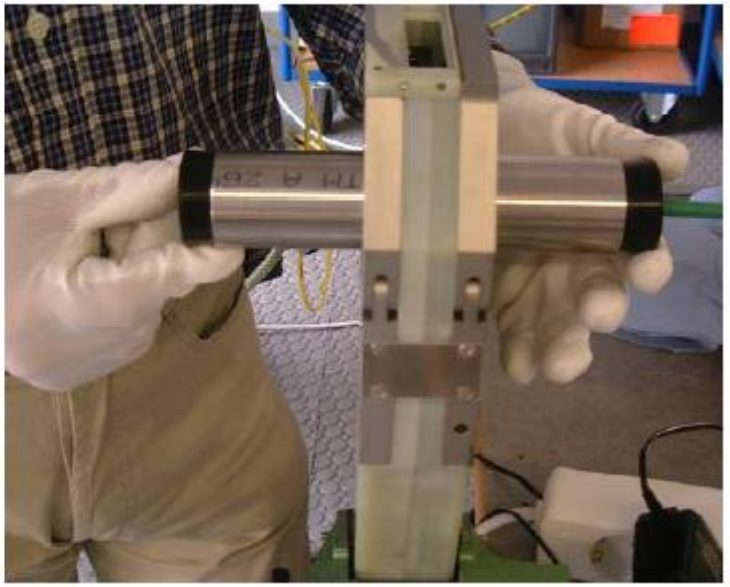
Set up Gas and Purge system

A functional and visible check of purge equipment (silicone plugs, purge chambers, etc.) ensures leakage-free connections and therefore minimises undesired oxygen entry into the system.



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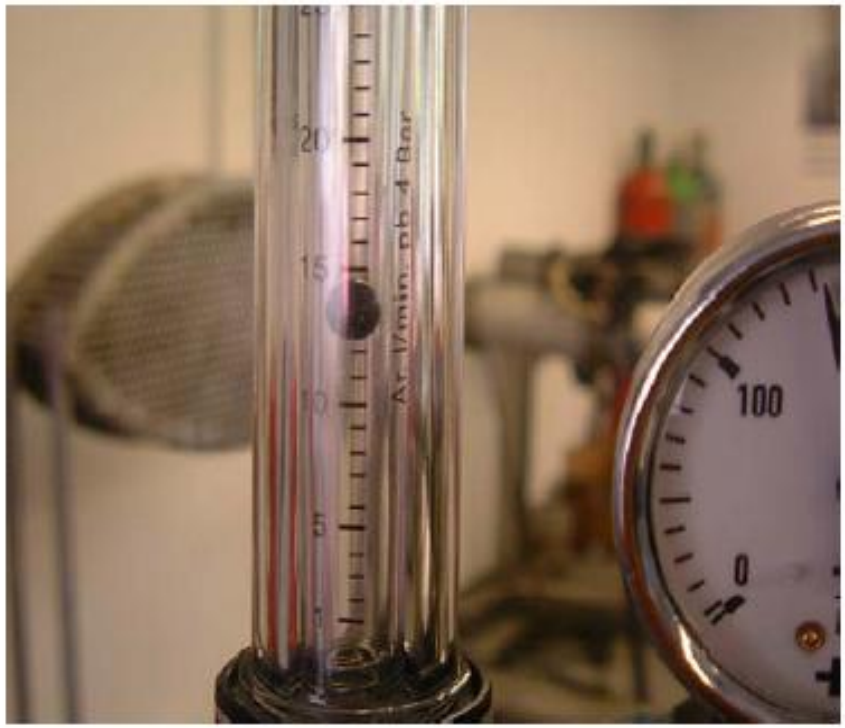
Oxygen Analyser

Oxygen analysers are recommended to measure purge gas quality.



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Purge Monitor

ARGWELD® MK III PURGE MONITOR

Low cost MK III monitor will indicate oxygen from atmosphere down to 1000 parts per million.

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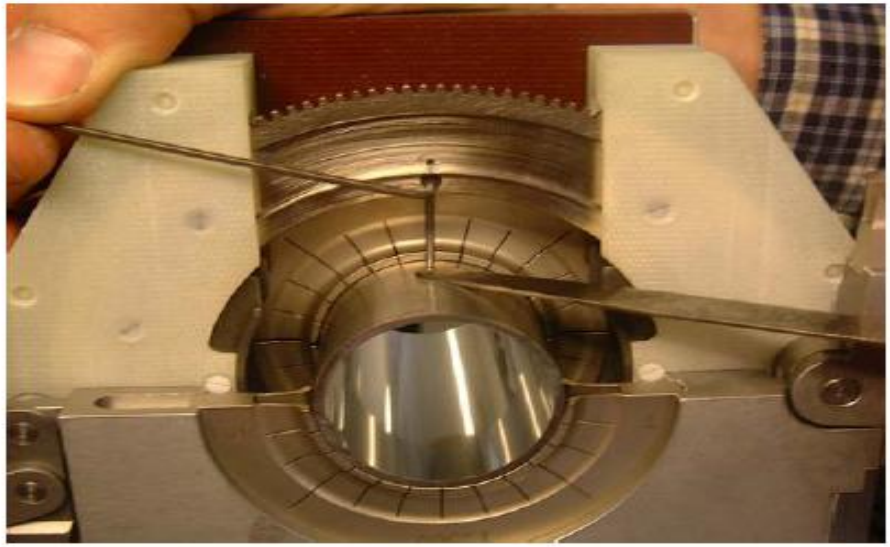
Welding program & Test

Essential for the weld quality and repeatability of pre-programmed welding parameters is the correct set-up and adjustment of the weld head. In particular, the selection and appropriate shape and length of the tungsten electrode will help to achieve a consistent arc and a constant arc gap for high quality welds. When using a closed chamber weld head, ensure that collet sizes correspond to tube diameter. Only clean weld heads will produce clean welds!



OPERATOR: [illegible]
WELD ID: _____
WELD HEAD MODEL: 8-2000
WELD HEAD SN: 34983

#	OD	WALL	TYPE	MAT	QTY
000	38.10	1.65	TUBE	SS	0001

PRE-PURGE	POST	UP-SLOPE	DOWN	ROT--DLY	
25	25	0.5	10.0	CW	4.2

LVL	PULSE	ROT	PRI--RPM--BCK
1	ON	CONT	0.00
	TIME	PRI--AMP--BCK	PRI-PULSE-BCK
1	4.2	70.0 20.0	0.20 0.20
2	10.1	70.0 20.0	0.20 0.20
3	10.1	60.0 20.0	0.20 0.20
4	10.1	66.0 20.0	0.20 0.20
5	10.1	64.0 20.0	0.20 0.20
6	7.2	64.0 20.0	0.20 0.20

ALL PARAMETERS PERFORMED AS PROGRAMMED

NOTES: _____

Choose correct welding parameters (if already pre-programmed) or develop appropriate welding parameters to match the Weld Procedure Specification (WPS).

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Electrode Preparation (Orbital & TIG Manual)

For a good quality orbital weld the correct shape and condition of the tungsten electrode are essential. To assure constant arc geometry and a long life cycle the tip of the tungsten has to be ground reproducibly using special grinding machines as shown in Figure 9.

Figure 9: Electrode grinding machine

Figure 10: Preshaped electrodes

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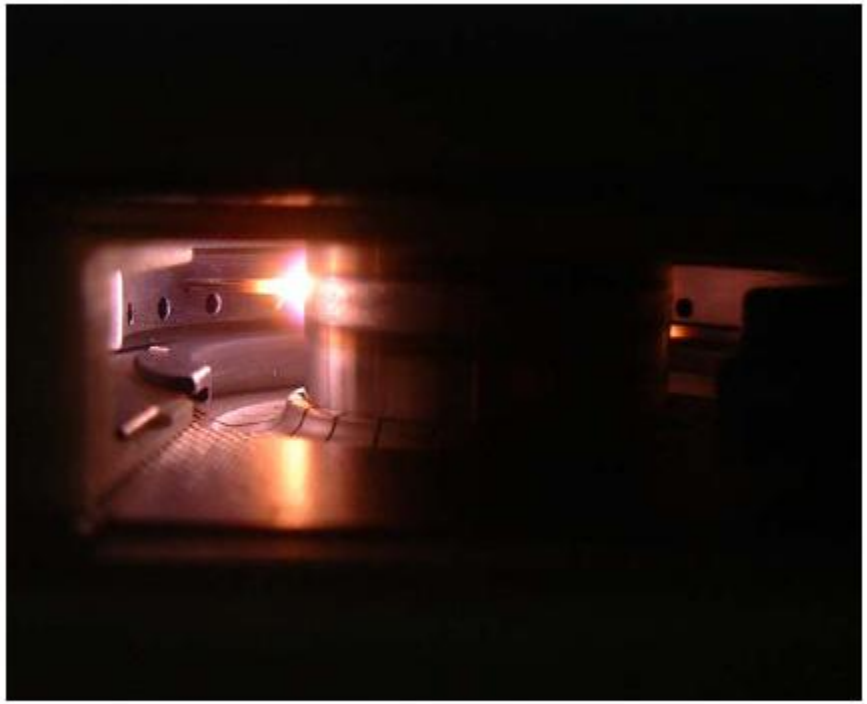
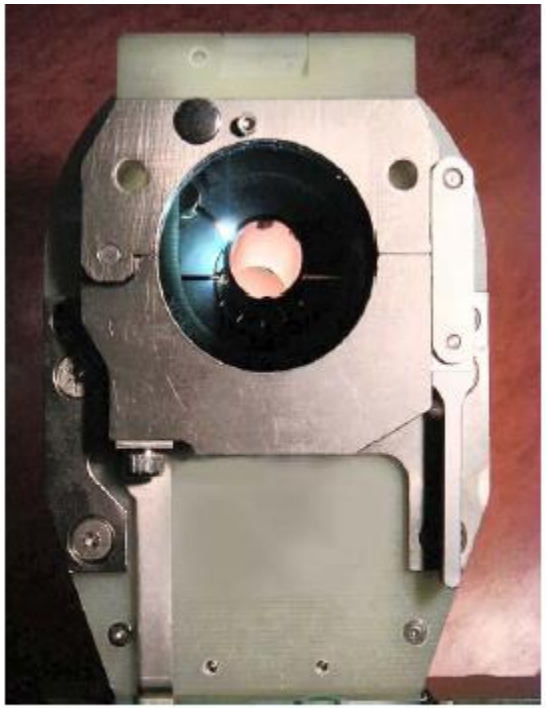
Welding Process





If possible, watch the first few welds through the weld head window to verify complete system functionality.

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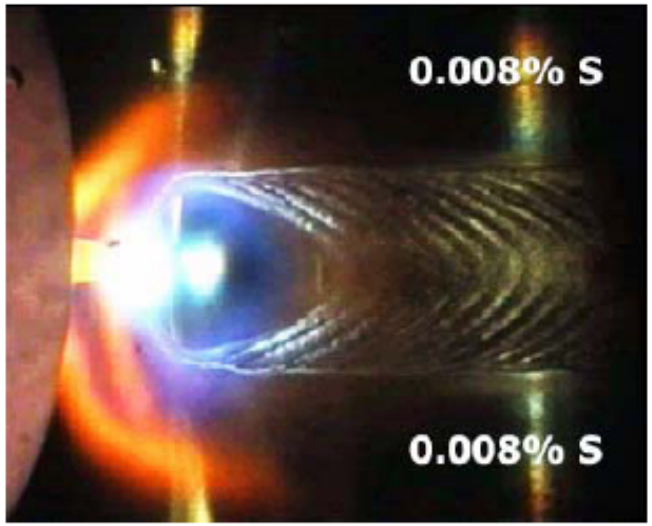
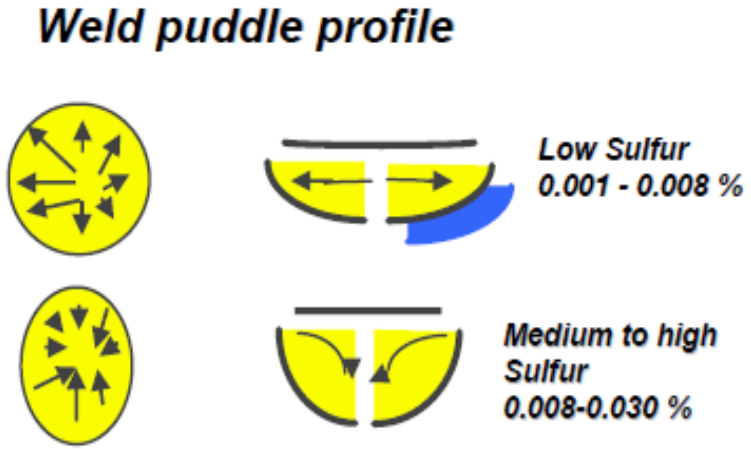
Sulphur content effect

The sulphur content of the base material is one of the most important criteria of the weldability of stainless steels. High sulphur content leads to a deeper weld penetration, hence welding a high sulphur component to one with a low sulphur content will cause the arc to wander towards the low sulphur side, as shown below.





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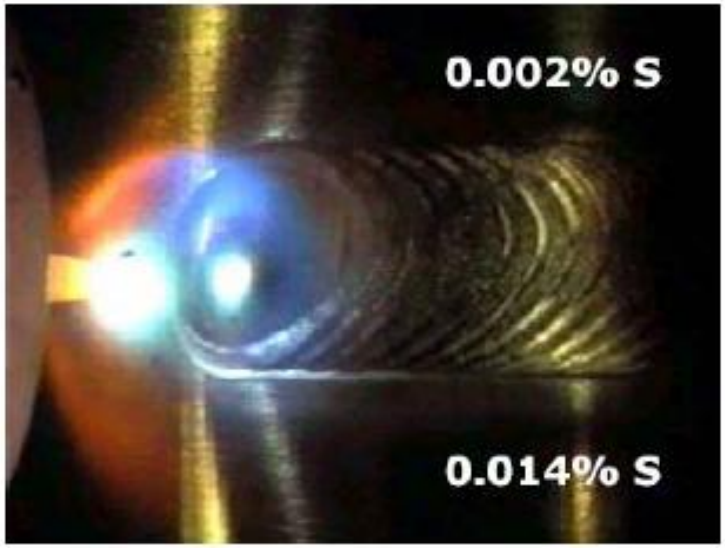
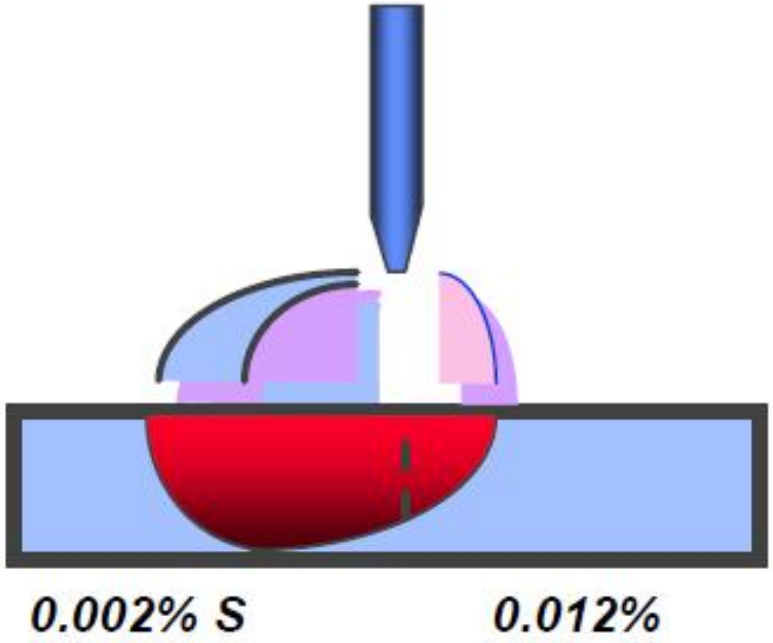
Sulphur content and effect to weld penetration

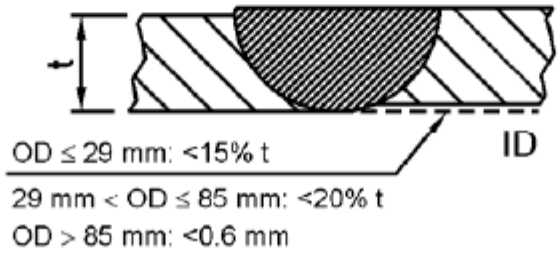


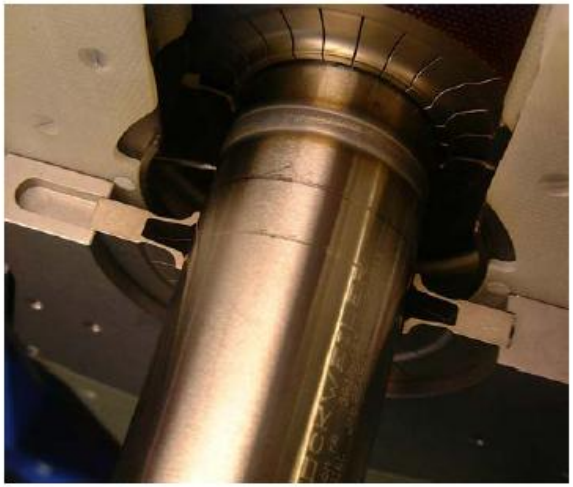


Inspection

Poor alignment between the walls of the two pipe pieces to be welded, can lead to a step in the inner surface of the weld area, which could retain material (product, dirt, etc.). This step can be a consequence of a missed coincidence between the axes of the two coupled components, an excessive mismatch between their diameters or thicknesses, or ovality of the tube ends. The maximum acceptable misalignment is:

<15% of the thickness of the thinner tube, for pipes with outside diameter less than or equal to 29 mm;
<20% of the thickness of the thinner tube, for pipes with outside diameter greater than 29 mm and less than or equal to 85 mm;
<0.6 mm for pipes with outer diameter greater than 85 mm.





Weld Bead acceptance creteria

The middle of the weld bead should not deviate more than 25% of the weld width from the ideal mid axis of the weld. Outside weld bead variation shall be the only rejection criteria if the weld is not accessible for internal inspection.

Straight, uniform weld bead

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Tack Weld Acceptance Creteria

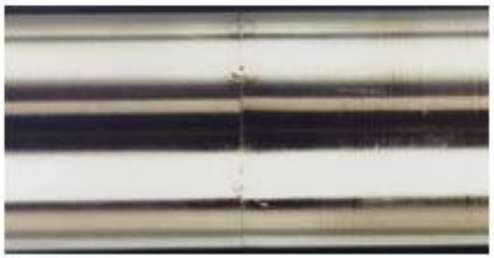

Fig. 9: Acceptable tacks

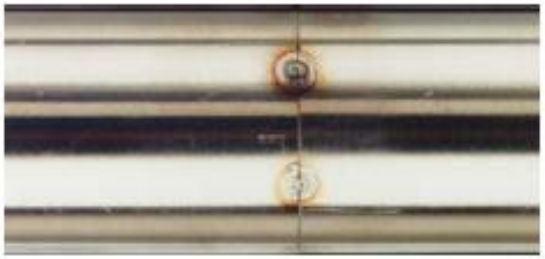

Fig. 10: Unacceptable tacks

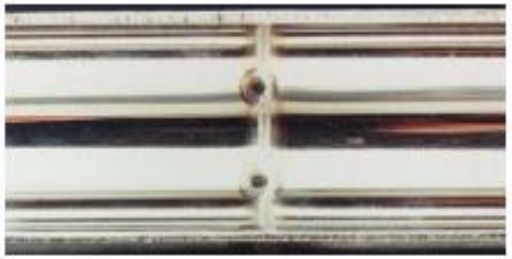

Fig. 11: Unacceptable tacks after welding