

# In line ... with the best welding results

Ferroline, Innoxline and Aluline shielding gas mixtures for arc welding





# In line ...

## ... with the most efficient processes

In metalworking, the effectiveness of production is heavily influenced by the welding process and welding work. Every quality and productivity improvement has a direct positive impact on total manufacturing costs.

Sounds simple, but it's not. Because the various materials being processed impose completely different requirements on the welding process and the shielding gas atmosphere. Messer has focused intensely on these specific requirements to achieve targeted improvements in results across an extremely wide range of welding work.

This led to the creation of our comprehensive, highly differentiated range of gas mixtures. What they all have in common is that they help you make your production operation measurably more efficient and therefore more cost-effective.



### Shielding gas mixtures for arc welding

We offer you the following product lines, which are specifically tailored to the base materials being processed:

**Ferroline** - for mild and low-alloy steels

**Inoxline** - for high-alloy steels and nickel-based alloys

**Aluline** - for aluminum and non-ferrous metals

### Our products for the most important arc welding processes

Processes	Plain steels	High-alloy steels	Aluminium
MAG/MIG	Ferroline C18 Ferroline C12 X2 Ferroline C6 X1 Ferroline C15.1	Inoxline C2 Inoxline C3 H1	Welding argon 4.6 Aluline He15 Aluline 4.8
TIG	Welding argon 4.6	Inoxline He3 H1	Welding argon 4.6 Aluline He15 Aluline 4.8

# In line ...

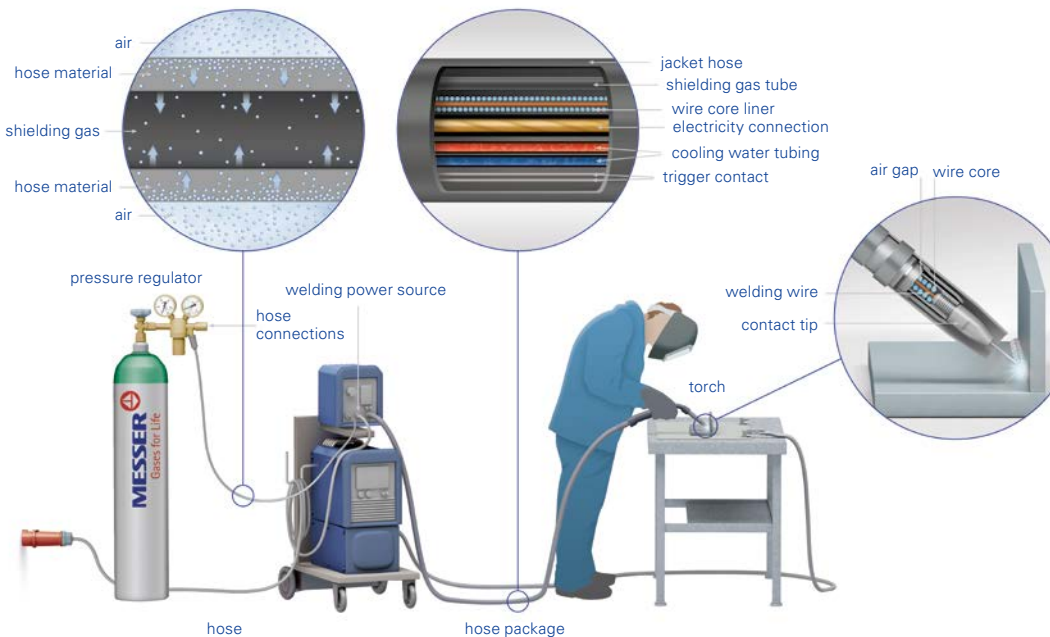
## ... with the lowest moisture level in the shielding gas

Shielding gas purity plays a key role both when processing sensitive metals such as titanium and when welding standard structural steels and aluminum. The quality requirements for shielding gases used in welding are defined in ISO 14175.

Despite high gas purity, pores and hydrogen cracking often occur. In most cases, these are caused by the moisture. That moisture also seeps in through leaks in the gas supply system, but mainly from the gas lines. To supply shielding gases,

hoses according to ISO 3821 or EN 1327 are recommended and labeled accordingly.

However, hardware-store-quality pressure hoses are often used. Though they are much less expensive, they allow moisture from the outside air to pass through the hose wall. That moisture is then absorbed into the dry shielding gas and is only slowly flushed out again. As a result, the user cannot fully benefit from the quality supplied by the gas manufacturer.

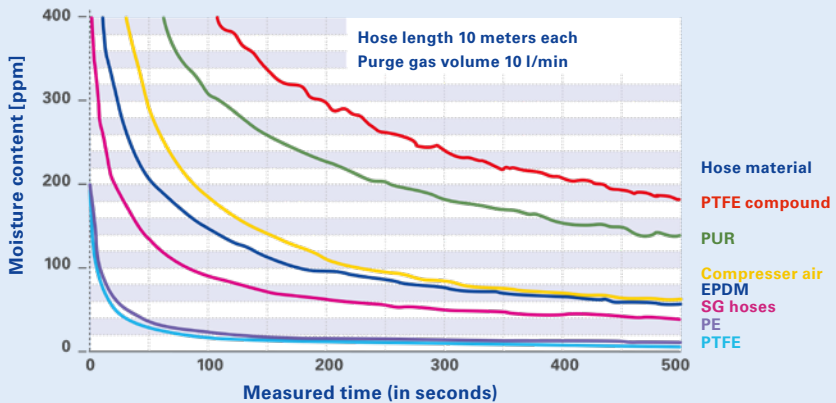




Pay careful attention to certified quality also when buying accessories! Our experts will be glad to help you with your selection.

### Moisture from hoses

Moisture content of the outflowing shielding gas depending on the purging time



# In line ...

## ... with certified welding processes

Many production and construction sectors require the certification of welding processes. The associated requirements are specified by standards and guidelines. The best-known standard is surely EN1090.

Because a welding process certification also stipulates the shielding gas group according to ISO 14175, the existing certification must be reviewed whenever the certified shielding gas is replaced with another.

Messer itself manufactures all shielding gases and gas mixtures according to the international standard ISO 14175. Compliance with that standard guarantees the high quality of the shielding gases and is required for welding process certification.

**We will be glad to support you and assist you with any required recertification.**

## ... with less welding fumes for greater workplace safety

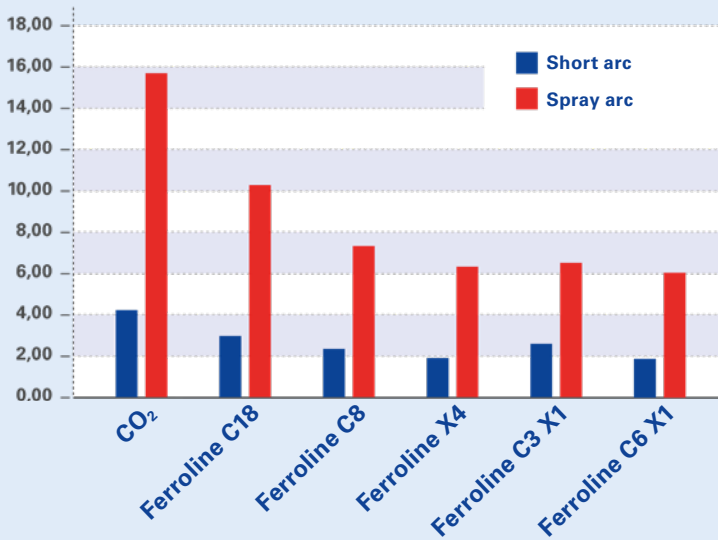
Until recently, the risk potential of welding fumes was assessed according to the quantity and size of the particles or according to special alloying elements (main components) – depending on the welding method and material.

In 2018, the International Agency for Research on Cancer (IARC) reassessed the risk of lung cancer due to welding fumes and established a correlation.

To protect welding personnel, a welding fume extraction system and personal protective equipment are often used. To comply with the new air purity requirements (e.g. TRGS 528), however, welding fume emissions themselves should also be reduced at the source. This mainly depends on the selection and adjustment of the welding process and of the filler material.

But the shielding gas, too, can reduce welding fumes: Messer has already been marketing the shielding gas Ferroline C8 (ISO 14175 - M20-ArC-8) for mild steels for a long time now. Even more effective in this regard is the shielding gas Ferroline C6 X1 (ISO 14175 - M24-ArCO-6/1).

Particle emission rate [mg/s]



Reduce welding fume-related health risks right “at the source” with our Ferroline shielding gases. We will be glad to advise you.

Shielding gas	Wire feed [m/min]		Voltage [V]		Current [A]	
	KL	SL/LL	KL	SL/LL	KL	SL/LL
<b>CO<sub>2</sub></b>	4.6	12.0	24.4	34.6	150	315
<b>Ferroline C18</b> 18% CO <sub>2</sub> , remainder argon	4.6	12.0	19.4	32	180	325
<b>Ferroline C8</b> 8% CO <sub>2</sub> , remainder argon	4.6	12.0	19.2	31.8	180	322
<b>Ferroline X4</b> 4% O <sub>2</sub> , remainder argon	4.6	12.0	19.0	31.6	180	330
<b>Ferroline C3 X1</b> 3% CO <sub>2</sub> , 1% O <sub>2</sub> , remainder argon	4.6	12.0	19.2	31.7	178	327
<b>Ferroline C6 X1</b> 6% CO <sub>2</sub> , 1% O <sub>2</sub> , remainder argon	4.6	12.0	19.2	31.8	179	325



# In line ...

... with lower production costs

Every business is obliged to analyze its production operations for savings potentials that will enable cost reduction. Without compromising on quality, of course.

The key is to closely examine the individual elements without losing the overall perspective. This is the only way to implement intelligent, targeted investments that make the entire production process more efficient and therefore more cost-effective.

## Example: Increased welding speed

In combination with higher utilization of production facilities, this can lead to a corresponding reduction in all fixed costs per product.

## Example: Lower costs for consumables and supplies

Where the consumption of shielding gases per unit time remains constant, higher welding speed also reduces the quantity of shielding gases used: Increasing the welding speed from 32 cm/min to 38 cm/min at a gas feed rate of 15 l/min for 1 m of welding wire reduces the quantity of gas consumed from 46.9 l to 39.5 l.

So it pays to make a more detailed economic analysis including relative performance, also for shielding gases, because it enables cost savings without loss of quality. We will be glad to prepare such analyses for you as part of our service package.





## ... with first-class service

No shielding gas user ever switches to a new gas mixture “just like that.” Because such a conversion requires professional support. We provide you with expert, individual and one-on-one support, answer your questions about gas-related welding methods and offer you many more benefits within the framework of our service package:

### Specialized consultation – right there at your premises

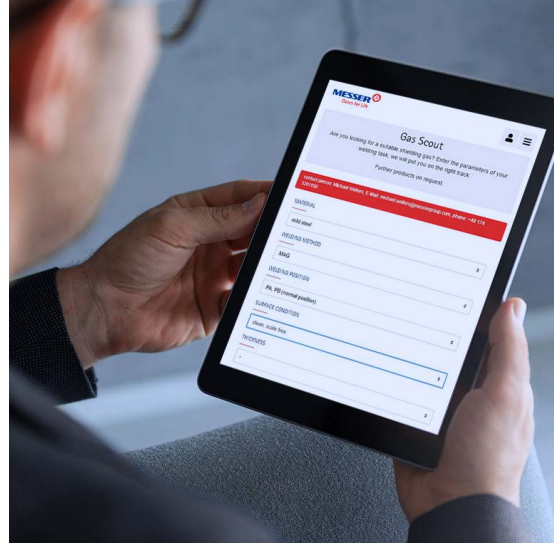
- Process optimizations to improve efficiency and quality
- Troubleshooting
- Process development
- Support in the selection of gases
- Guidance in conversion to WPQ (Welding Procedure Qualification)

### Technical training – to keep you up to date at all times

- Processes and their applications
- Use of different shielding gases
- Safe handling of technical gases

### Economic analysis – for faster and more efficient production

- Analysis of existing processes
- Documentation of optimization options
- Process modifications
- Profitability comparison before/after



### Shielding gas recommendations – with our digital tool “Gas Scout”

- Internet-based app helps users select the right shielding gas
- Specific suggestions, depending on process, material and other criteria
- Extensive information materials
- Direct contact with local welding specialists possible
- Via PC or smartphone

**Test now - simply via the Messer website in your country!**

**Or get in touch with us.**

**Discover the application areas, properties and measurable benefits of our Ferroline, Innoxline and Aluline shielding gas mixtures.**

## Ferroline – Shielding gases for MAG welding plain steels

In this application, the most frequently used shielding gas is ISO-14175 - M21-ArC-18, comprising 82 vol% argon and 18 vol% carbon dioxide. Messer markets this gas under the brand name **Ferroline C18**.

In addition to that, we offer you three new Ferroline mixtures. They all enable enhanced weld seam quality through the following properties:

### **Ferroline C12 X2**

(ISO 14175 - M24-ArCO-12/2): **much less welding spatter**

### **Ferroline C6 X1**

(ISO 14175 - M24-ArCO-6/1): **much less welding spatter, significantly higher welding speed**

### **Ferroline C15.1**

(ISO 14175 - M21-ArC-15,1): **less welding spatter, advantages in certified welding processes** (because it belongs to gases group M21 according to ISO 14175)





## Measurable benefits in direct comparison with Ferroline C18

- up to 20% faster welding
- up to 90% less rework (higher weld quality/ less slag on seams)
- significantly lower manufacturing costs

# Ferroline C12 X2

ISO 14175 - M24-ArCO-12/2

This shielding gas for manual, mechanized and automated MAG welding of mild and low-alloy steels comprises 86 vol% argon, 2 vol% oxygen and 12 vol% carbon dioxide.

## Application areas

- Joint welding on low-alloy and mild steel components
- suitable for all plate thicknesses
- suitable for all welding positions

## Properties

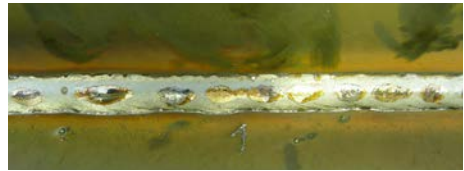
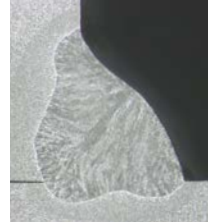
- steady, stable arc
- intense penetration
- finely rippled, smooth bead surface
- fine metal droplet transfer

## Benefits

- much less spatter
- less rework
- less slag formation
- shorter idle times

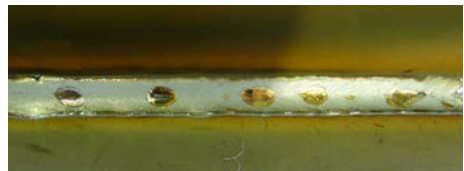
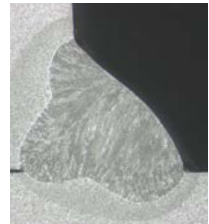
### Ferroline C18

I	252 A
U	32.3 V
V <sub>F</sub>	13.0 m/min
V <sub>W</sub>	32.0 cm/min
P	8.14 kW



### Ferroline C12 X2

I	260 A
U	32.0 V
V <sub>F</sub>	13.0 m/min
V <sub>W</sub>	32.0 cm/min
P	8.30 kW



I = current, U = voltage,  
V<sub>F</sub> = fire feed speed,  
V<sub>W</sub> = welding speed, P = power



# Ferroline C6 X1

ISO 14175 - M24-ArCO-6/1

This shielding gas for manual, mechanized and automated MAG welding of mild and low-alloy steels comprises 93 vol% argon, 1 vol% oxygen and 6 vol% carbon dioxide.

## Application areas

- Joint welding on low-alloy and mild steel components
- suitable for all plate thicknesses
- preferred welding positions: PA and PB

## Properties

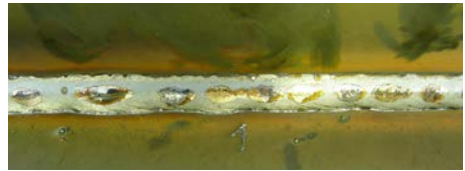
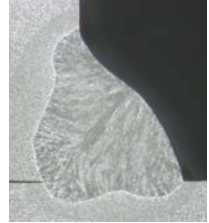
- steady, stable arc
- uniform penetration
- finely rippled, smooth bead surface
- fine metal droplet transfer

## Benefits

- high deposition efficiency
- nearly spatter-free
- less welding fumes
- less distortion
- lower gas consumption

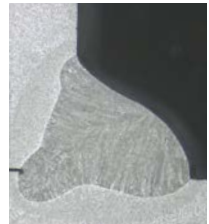
### Ferroline C18

I	252 A
U	32.3 V
V <sub>F</sub>	13.0 m/min
V <sub>W</sub>	32.0 cm/min
P	8.14 kW



### Ferroline C6 X1

I	292 A
U	31.5 V
V <sub>F</sub>	15.6 m/min
V <sub>W</sub>	38.4 cm/min
P	9.19 kW



# Ferroline C15.1

ISO 14175 - M21-ArC-15.1

This shielding gas for manual, mechanized and automated MAG welding of mild and low-alloy steels comprises 84.9 vol% argon and 15.1 vol% carbon dioxide.

## Application areas

- Joint welding on low-alloy and mild steel components
- suitable for all plate thicknesses
- suitable for all welding positions

## Properties

- steady, stable arc
- uniform penetration
- finely rippled, smooth bead surface
- fine metal droplet transfer

## Benefits

- less spatter
- less rework
- shorter idle times
- same gas group as Ferroline C18 (ISO 14175- M21-ArC-18)

### Ferroline C18

I	225 A
U	28.0 V
$V_F$	13.0 m/min
$V_W$	32.0 cm/min



### Ferroline C15.1

I	250 A
U	28.1 V
$V_F$	14.0 m/min
$V_W$	32.0 cm/min







# Inoxline – Shielding gases for arc welding high-alloy steels

While TIG welding uses mainly argon as a shielding gas, the MAG welding of high-alloy steels uses the shielding gas ISO 14175 - M12-ArC-2.5. It comprises 97.5 vol% argon and 2.5 vol% carbon dioxide. Messer markets it under the brand name **Inoxline C2**.

As with plain steels, Messer also offers attractive mixture alternatives here. They are characterized by the addition of small quantities of hydrogen, which makes them suitable for austenitic, high-alloy steels:

## **Inoxline C3 H1**

(ISO 14175 - M11-ArCH-3/1): **especially for MAG welding**


## **Inoxline He3 H1**

(ISO 14175 - R1-ArHeH-3/1.5): **especially for TIG welding**

With their low hydrogen content, both of these shielding gases enable more concentrated arc energy, which results in narrower, deeper penetration. This reduces arc energy, deformation and coarse grain formation. Our Inoxline shielding gases also inhibit heat tints and stabilize the arc.







Measurable benefits in direct comparison with Inoxline C2 (for MAG) and welding argon (for TIG)

- up to 30% faster welding
- up to 90% less rework (less heat tints)
- less distortion
- significantly lower manufacturing costs

# Inoxline C3 H1

ISO 14175 - M11-ArCH-3/1

Shielding gas for manual, mechanized and automated MAG welding of high-alloy austenitic steels. Particularly well-suited for joint welding on components of all plate thicknesses.

Composition: 96 vol% argon, 3 vol% carbon dioxide and 1 vol% hydrogen. Adding hydrogen while increasing CO<sub>2</sub> content at the same time stabilizes the arc, increases arc energy and improves welding results.

## Properties

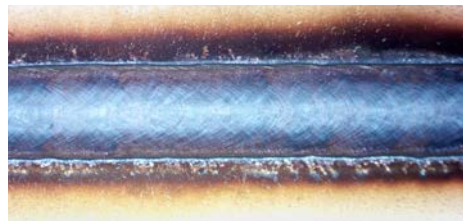
- greater arc stability
- less oxidation
- more reliable, uniform penetration
- reliable side wall fusion (less argon finger)
- less heat input

## Benefits

- less distortion
- less heat tints
- less rework

## Inoxline C2

I	195 A
U	23.2 V
V <sub>F</sub>	10.5 m/min
V <sub>W</sub>	15.0 cm/min
P	4.52 kW



## Inoxline C3 H1

I	171 A
U	24.3 V
V <sub>F</sub>	10.5 m/min
V <sub>W</sub>	15.0 cm/min
P	4.16 kW



# Inoxline He3 H1

ISO 14175 - R1-ArHeH-3/1.5

Shielding gas for manual, mechanized and automated TIG welding of high-alloy CrNi steels. Composition: 95.5 vol% argon, 3 vol% helium and 1.5 vol% hydrogen. This mixture is a reducing gas with high arc pressure.

## Properties

- narrower seams at a given penetration depth
- less heat input
- finely rippled, smooth bead surface
- also suitable for out-of-position welding

## Benefits

- higher welding speed
- less heat input
- less distortion
- less heat tints
- lower gas consumption
- lower energy costs



Less heat tints with higher plate thicknesses

Argon	
Welding speed	Current
21 cm/min	150 Ampere



Inoxline He3 H1	
Welding speed	Current
21 cm/min	120 Ampere



Inoxline He3 H1	
Welding speed	Current
28.5 cm/min	150 Ampere



Same penetration depth

## Aluline – Shielding gases for TIG and MIG welding aluminum and its alloys

For this application, the most frequently used shielding gas is **welding argon 4.6** (ISO 14175 I1-Ar) with a maximum allowable contamination level of 40 ppm (as specified by standards).

As advantageous alternatives to welding argon, Messer developed the Aluline mixtures:

### **Aluline He15**

(ISO 14175 - I3-ArHe-15): **inexpensive alternative to welding argon, higher welding speeds**

### **Aluline 4.8**

(ISO 14175 - I1-Ar): **higher purity, more stable arc, trouble-free welding process**







## Measurable benefits versus standard gas welding argon (ISO 14175 - I1-Ar)

- up to 30% faster welding
- reduced component distortion
- higher penetration
- fewer pores
- larger cleaning zone
- lower manufacturing costs

# Aluline He15

ISO 14175 - I3-ArHe-15

Aluline He15 is an economical alternative to pure argon. Composition: 85 vol% argon, 15 vol% helium. Helium's high thermal conductivity increases the heat input in the weld zone. This results in deep penetration with reliable fusion of the side walls. The helium content also lowers the cost of preheating or allows for significantly faster welding speed. This results in lower heat input to the component and reduces distortion. The risk of pore formation is also reduced.

## Application areas

- suitable for small and medium plate thicknesses

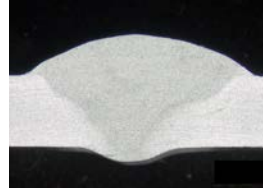
## Properties

- smooth bead surface
- good weld metal flow

## Benefits

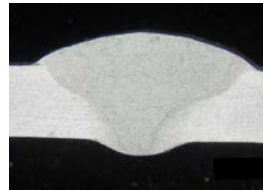
- up to 30% higher welding speed (with TIG)
- up to 10% higher welding speed (with MIG)
- increased penetration
- less distortion
- less preheating
- less pore formation

## Comparison MIG



### Welding argon

I	125 A
U	22.5 V
V <sub>F</sub>	7.0 m/min
V <sub>W</sub>	45.0 cm/min



### Aluline He15

I	120 A
U	23.0 V
V <sub>F</sub>	7.0 m/min
V <sub>W</sub>	50.0 cm/min

## Comparison with TIG



### Welding argon

I	180 A
U	14.9 V
V <sub>F</sub>	2.0 m/min
V <sub>W</sub>	30.0 cm/min



### Aluline He15

I	180 A
U	14.9 V
V <sub>F</sub>	2.0 m/min
V <sub>W</sub>	40.0 cm/min

# Aluline 4.8

ISO 14175 - I1-Ar

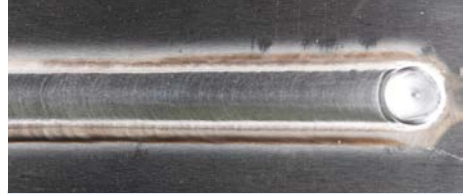
Aluline 4.8 is used for arc welding aluminum. Using higher purity shielding gases makes sense in this case. Aluline 4.8 comprises up to 100 vol% argon and contains no more than 20 ppm impurities. By contrast, welding argon (Argon 4.6) can contain up to 40 ppm impurities. The shielding gas can also become contaminated due to shielding gas hoses, oxides, base and filler materials or leaking gas nozzles, etc. Excessively high contamination levels can cause weld defects and thereby damage the weld seam.

## Benefits

- larger cleaning zone
- less rework
- better-looking seams

Example: When ACTIG welding aluminum, the purity of the shielding gas in the arc zone is crucial for the cleaning zone and the quality of the weld seam.

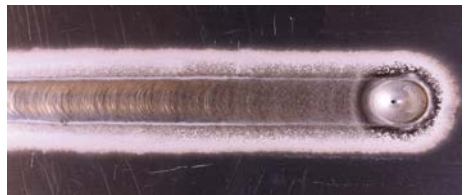
## Comparison cleaning zone



**Welding argon ISO 14175 - I1-Ar**

Composition: 99.996% argon  
max. 40 ppm impurities

I	180 A
U	14.9 V
$V_F$	1.5 m/min
$V_W$	28.0 cm/min



**Aluline 4.8 ISO 14175 - I1-Ar**

Composition: 99.996% argon  
max. 20 ppm impurities

I	250 A
U	28.1 V
$V_F$	1.5 m/min
$V_W$	28.0 cm/min

# Advice, Delivery, Service



## Technical centers – sources of innovation

For the development of new technologies in the field of welding and cutting, Messer operates technical centers in Europe, Asia and the Americas. These facilities provide ideal conditions for innovative projects as well as customer presentations and training courses.



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