

# Inoxline

Inert gas welding of high-alloy materials



## The right shielding gas for the right material

Rapid developments in base and filler metals demand a correspondingly wide-ranging program of shielding gases. This applies equally to TIG and to MIG/MAG welding.

### TIG Welding

For welding, argon is the gas predominantly used. Hydrogen admixtures raise the performance appreciably, but Hydrogen Content > 2 % is only suitable for automated application. Shielding gases with up to 2.5 % nitrogen are used for duplex steels in order to preserve the austenite content in the micro-structure. For full austenites, too, the addition of nitrogen can ensure compliance with low deltaferrite limits. Hydrogen admixtures cannot be used for duplex steels.

### MIG/MAG Welding

Austenitic steels are generally welded using an argon gas mix with 2.5 % CO<sub>2</sub> added. Oxygen can also be used, but this results in a more oxidized weld surface. Helium admixtures of 15 %, for example, also prove extremely effective in many cases. This is true, in particular, both for duplex steels and for full austenites.

### Backing gases

As a rule, so-called forming gases, nitrogenhydrogen mixtures, are used. The hydrogen component gives more protection against residual atmospheric oxygen. Under construction site conditions, higher hydrogen contents tend to be used than in the workshop. As a result of the latest regulations, hydrogen admixtures in backing gas are no longer used for duplex steels.

### Shielding gases for TIG welding of high-alloy steels according as DIN EN ISO 14175

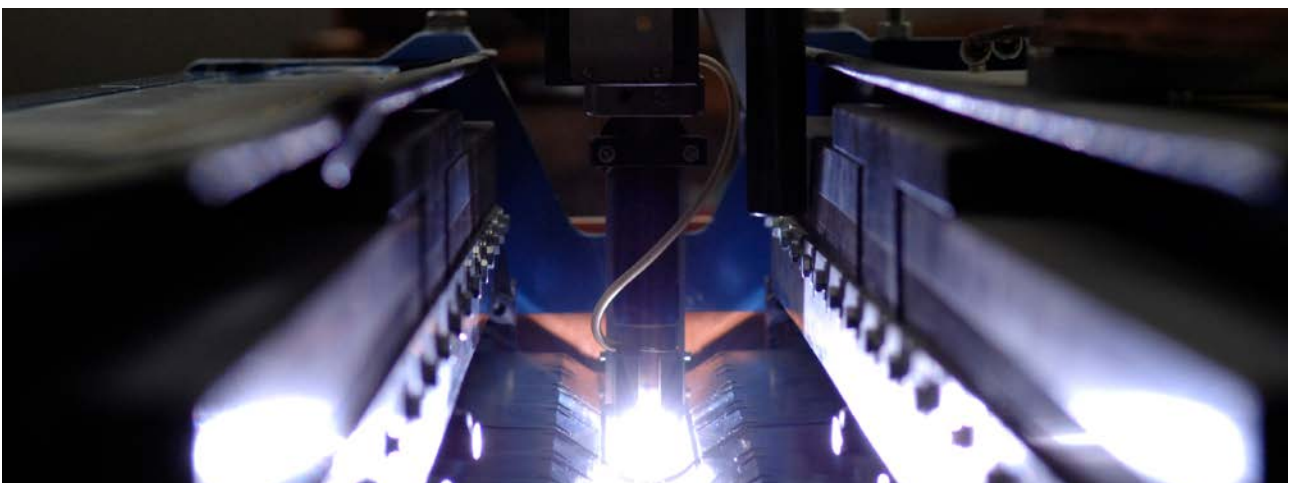
Welding argon 4.6	I1	TIG
Welding argon special 4.8	I1	TIG
Helium 4.6	I2	TIG
Inoxline H2	R1	TIG
Inoxline H5	R1	TIG
Inoxline H7	R1	TIG
Inoxline H20	R2	Plasma cutting
Inoxline H35	R2	Plasma cutting
Inoxline He3 H1	R1	TIG
Inoxline N1	N2	TIG
Inoxline N2	N2	TIG
Inoxline He15 N1	N2	TIG

### Shielding gases for MAG welding of austenitic steels according as DIN EN ISO 14175

Inoxline He30 H2 C	Z	MAG M
Inoxline He15 C2	M12	MAG M
Inoxline C2	M12	MAG M
Inoxline C3 X1	M14	MAG M
Inoxline X2	M13	MAG M
Ferroline X4	M22	MAG M

### Root protection according as DIN EN ISO 14175

Forming Gas H5	N5
Forming Gas H8	N5
Forming Gas H12	N5
Forming Gas H25	N5
Inoxline H2	R1
Welding argon	I1







## Practical Notes

### Materials Science Background

**Austenites** contain close to 20 % chromium and about 10 % nickel. As a rule, the typical structure has a ferrite content of 5 to 8 %. Materials frequently used: 1.4301, 1.4541, 1.4571. Austenitic chrome-nickel steels are either stabilized against intercrystalline corrosion by admixtures (usually titanium) or have a particularly low carbon content (LC qualities).

**Duplex steels** have high corrosion resistance, especially against media containing chlorides and, at the same time, have greater mechanical strength. Most important material: 1.4462. Duplex steels have a mixed structure with a 50 % ferrite content. Superduplex steels have an increased resistance to pitting.

**Fully austenites** have a maximum ferrite content of 2 %. This leads to an increased sensitivity to hot cracking. On the other hand, fully austenites have higher resistance to corrosion and to heat. Because of the extremely low ferrite content, these materials are non-magnetic. Typical materials: 1.4435 and 1.4439.

**Nickel base materials** are used for maximum corrosion resistance requirements at high temperatures of more than 1000 °C. They can no longer be classified as steel materials and are correspondingly identified by material numbers beginning with 2. When working with them, extreme cleanliness must be observed.

### TIG or MAG?

Extremely high weld qualities can be achieved with TIG, as the non-metallic embeddings and the forming of pores are extremely small. The welding speed is comparatively slow and the heat input high. Plasma welding, a variety of TIG welding, guarantees constant values and is used mainly for fully automated applications. MAG welding is often used for fillet welds. Particularly in the case of fully automated applications, it is also increasingly used for highly stressed welds.

### Pulse technique

In TIG welding, the pulse technique is used in the context of orbital technology to achieve a perfect weld, even with out-of-position welds. In MAG welding, on the other hand, the aim is low spatter or spatter free welding, even in the lower setting range. The safety of the process with regard to the penetration is also increased. Modern power sources provide customised programs, adapted to the shielding gases, allowing wide variation of the welding parameters. For high alloy steels, pulse welding can be generally recommended.

### Backing gas

When welding high alloy steel, backshielding is necessary. As a rule, a residual oxygen content of <20 ppm is required at the root pass. The degree of tarnish permissible depends on the purpose of the component. Small pipes are purged, the matching of the outlet aperture being important. In the case of larger pipes, the backing gas is directed on to the weld by auxiliary devices. It is important to ensure that the pre-purging time is long enough.

### Flux-cored wires

High alloy steels are mostly welded with solid wire electrodes. However, there are also applications for flux-cored wires. Here, the use of the rutile slag type dominates. Because of the slag covering, very smooth welds are formed, little pickling is necessary and there are practically no spatter problems. A distinction is made between slowly setting slag for normal position and rapidly setting slag for vertical welding. In special cases, metal powder wires are used, for example inside containers where the slag would cause problems. The spray arc is reached more quickly with these wires than with solid wires.

## Advice, Delivery, Service



### Technical centres – sources for innovation

For the development of new technologies in the field of welding and cutting, Messer operates technical centres in Germany, Hungary and China. These facilities provide ideal conditions for innovative projects as well as customer presentations and training courses.

### Portfolio of gases – comprehensive and clear

Messer offers a spectrum of gases that extends well beyond the standard fare: it ranges from just the right gas for each application, and clear, application-oriented product designations to the continuous introduction of new gas mixtures designed to address current trends.

### Specialised on-site consulting – right where you need it

Specifically in the context of your particular application, we can show you how to optimise the efficiency and quality of your processes. Along with process development, we support you with troubleshooting and process development.

### Cost analyses – fast and efficient

We will be glad to analyze your existing processes, develop optimisation proposals, support process modifications and compare our results with the previous situation – because your success is also our success.

### Training courses – always up to date

For the optimal handling of our gases, we can train you on processes and how to use them. Our training courses illustrate the use of various shielding gases for welding and explain how to handle them safely. This also includes the storage of the gases and the safe transport of small quantities. Information and training materials for your plant are also part of the service, of course.

**You can also download this brochure and many others from the Internet as a PDF file:**  
[www.messergroup.com](http://www.messergroup.com)



**MESSER**   
Gases for Life

**Messer Group GmbH**  
Kleinewefersstraße 1  
47803 Krefeld  
[welding-technology@messergroup.com](mailto:welding-technology@messergroup.com)  
[www.messergroup.com](http://www.messergroup.com)