MESSER
Gases for Life

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 austenite, too, the addition of nitrogen can ensure compliance with low delta ferrite limits. Hydrogen admixtures cannot be used for duplex steels.

MAG Welding

Austenitic steels are generally welded using an argon gas mix with added 2.5 % CO_2. 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 austenite.

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

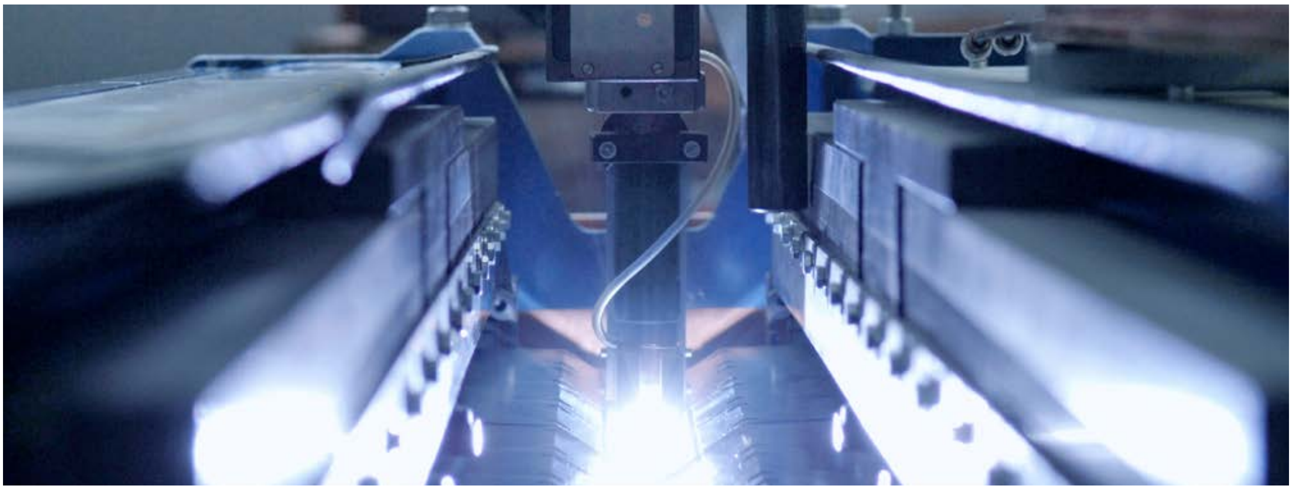
Welding argon 4.6	I1	TIG
Welding argon special 4.8	I1	TIG
Helium 4.6	I2	TIG
Inoxline H2	R1	TIG
Inoxline H5	R1	TIG
Inoxline H7	R1	TIG
Inoxline H20	R2	Plasma cutting
Inoxline H35	R2	Plasma cutting
Inoxline He3 H1	R1	TIG
Inoxline N1	N2	TIG
Inoxline N2	N2	TIG
Inoxline He15 N1	N2	TIG

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

Austenite contains 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. The most important material is 1.4462. Duplex steels have a mixed structure with a 50 % ferrite content. Super-duplex steels have an increased resistance to pitting.
Fully austenite has a maximum ferrite content of 2 %. This leads to an increased sensitivity to hot cracking. On the other hand, full austenite has higher resistance to corrosion and to heat. Because of the extremely low ferrite content, these materials are non-magnetic. Typical materials are 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. This is where essentially higher welding speed is implemented to achieve satisfactory weld seam quality.

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 customized 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, back shielding is necessary. As a rule, a residual oxygen content of <20 ppm is required at the root pass. The degree of permissible tarnish 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 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.

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.

Specialized on-site consulting – right where you need it

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

Cost analyses – fast and efficient

We will be glad to analyze your existing processes, develop optimization 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

Our training courses demonstrate the application of our various shielding gases and outline the safe handling with them. These also include the storage of the gases as well as the safe transport of small quantities. Information and training material for your company also belong to this service. We offer regular webinars on the usage of our products.

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