

For top-quality workmanship. Gases for root protection.

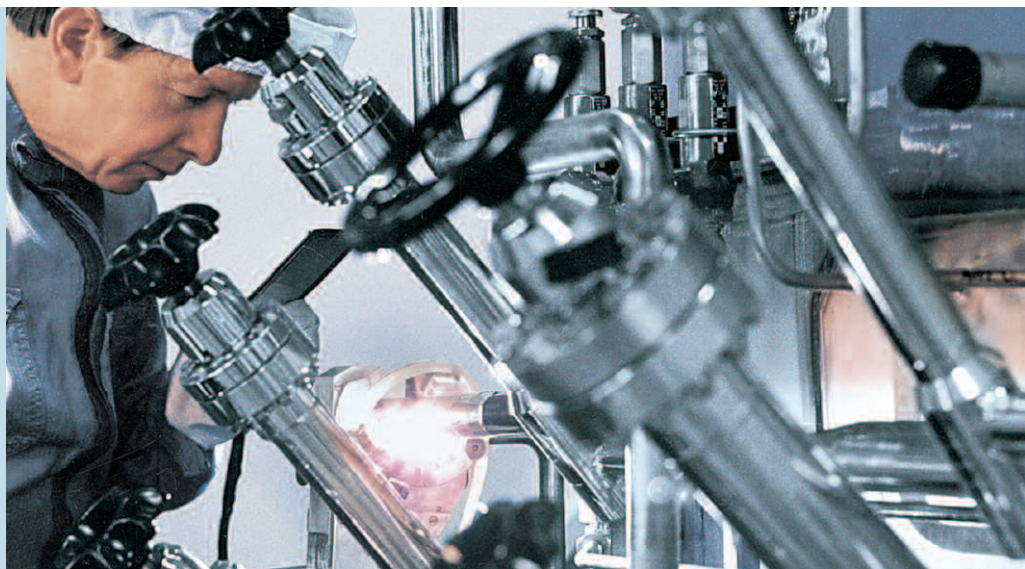
Competence Line

Argon	VARIGON® N
Nitrogen	

Performance Line

Forming gas 95/5 – 70/30
VARIGON® H

Welding with additional forming gas



When subjected to high temperatures and atmospheric oxygen, many metals tend to intense oxidation. The oxides generally appear as temper color, for example, with stainless steel or titanium materials. Temper colors will greatly impair the corrosion resistance of such metals. Furthermore, severe oxidation will impair the formation of weld roots. Thus, in many cases, the root side has to be protected against oxygen in order to ensure optimum corrosion resistance. The careful exclusion of atmospheric oxygen can prevent oxidation and temper colors.

Differentiating between two different purging methods

In the case of gas displacement, the backing gas pushes forward the air to be removed, with only little mixing occurring. This principle is conceivable, for example, for large vessels. With this method it is very important to take the relative density of the backing gas into account. In a – purely theoretical – ideal-case scenario, with this type of purging, only as much backing gas is used as that of the volume to be purged.

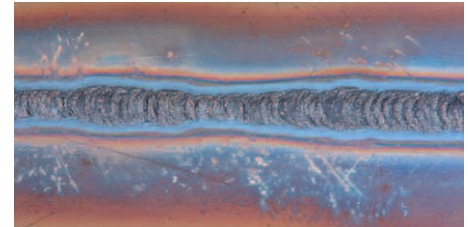
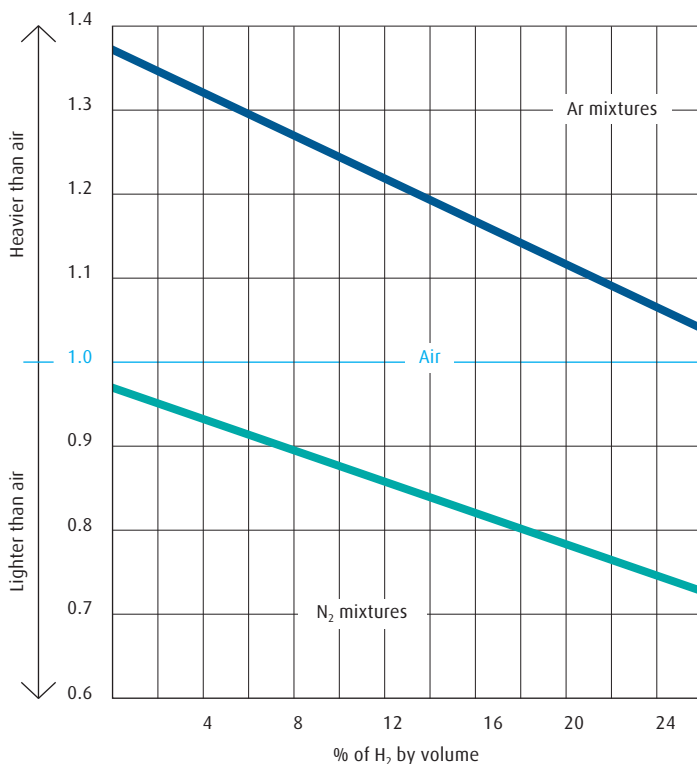
In the case of dilution purging, the backing gas is distributed uniformly throughout the area and mixes with the air to be removed. The purging continues until the amount of residual oxygen has fallen below a certain threshold. The amount of shielding gas required is thus several times that of the purging volume.

Two groups of gases are used for root protection

- Inert or low-activity gases, such as argon or nitrogen (4.6 or higher)
- Inert or low-activity gases with added hydrogen

Thanks to the reducing action of hydrogen, root-shielding gases containing hydrogen offer greater protection against the formation of temper colors. However, they are not suitable for all metals. The type of gas used for root protection primarily depends on the type of metal of the component to be purged. Steels that are sensitive to hydrogen or highly reactive metals, such as titanium, are generally purged with argon. Austenitic stainless steels can be protected with root shielding gases containing hydrogen, for example, with gases from the "Forming gas" or the VARIGON® H series.

Relative density of root shielding gases



TIG seam, root side , no root protection



TIG seam, root side, with root protection

Application advice

The gases for root protection are standardized in EN439.

- Group R (Ar-H₂ mixtures)
- Group I (Ar or Ar-He mixtures)
- Group F (N₂ or N₂-H₂ mixtures)

Minimum purging times have to be observed to prevent the formation of temper colors. The required purging time depends on the geometry of the component and on the volumetric flow rate of the gas. The recommended value for required backing gas volume for pipelines, for example, is 2.5–3 times the geometric volume of the component, calculated from the supply point to the welding point. Depending on pipe diameter, a gas flow rate of 5–12 l/min is recommended. The use of a measuring device to measure the residual oxygen content is recommended.

To prevent the formation of temper colors, after welding, purging should continue until the component has cooled to a temperature of below approx. 220 °C. If the root of the weld is not accessible after welding for reworking, a root shielding gas should be used when tacking the component since temper colors will not be dissolved by welding over the tack point.

In the case of Ti-stabilized stainless steels, gases containing N₂ cause a clearly visible yellowing of the root of the weld as a result of the formation of titanium nitride. With duplex and superduplex steels, using root-shielding gases that contain nitrogen or pure nitrogen improves corrosion resistance.

Safety information

Root shielding gases with a hydrogen content of more than 4 % can form explosive mixtures if they come into contact with air or oxygen. Users must take certain precautionary measures to prevent the formation of such gas mixtures. For safety reasons, DVS leaflet 0937 recommends burning-off if the hydrogen content in the root shielding gas is 10 % or higher.

When forming large, closed components, adequate ventilation must be available before inspection to prevent the risk of suffocation. When working in small rooms, oxygen depletion should be taken into account.

Root shielding gases for various materials

Shielding gas		Material
Argon		All fusion-weldable metals
VARIGON® H series	Ar-H ₂ mixtures	Austenitic stainless steels
Forming gas	N ₂ -H ₂ mixtures	Austenitic stainless steels (not Ti-stabilized) Unalloyed steels (not high-strength fine-grained steels!)
VARIGON® N series	Ar-N ₂ mixtures	Austenitic stainless steels (not Ti-stabilized)
	N ₂	Duplex and super duplex steels