STAINLESS STEELS AND THEIR CORROSION RESISTANT PROPERTIES

WELDING KNOWLEDGE PART 3
MULTISTRIKE® TUNGSTEN ELECTRODES

WELD PURGING PRODUCTS
INNOVATORS, MANUFACTURERS AND INTERNATIONALLY RENOWNED SPECIALISTS

MADE IN WALES ‘MANUFACTURER OF THE YEAR’ & WELSH BUSINESS AWARDS – EXPORTER OF THE YEAR

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Dear Reader,

Welcome to the fourth issue of Weld Purging World for 2021.

In this month’s issue we share an article on how to avoid loss of corrosion resistance during welding stainless steel, we discuss the benefits of switching to our MultiStrike® Tungsten Electrodes and we give full details on our NEW Argweld Weld Trailing Shields® and how they now feature a unique clip design, which means the welder can interchange different shield sizes without having to change the welding torch.

On page 10 you will also find our Technical Article: Welding Knowledge Part 3, which focuses on Small Diameter Tube Welding.

If you have any information that you would like to be featured in future issues of this publication, please contact me.

As always, we hope you enjoy the issue.

Best wishes,

Michaela
Marketing and Social Media Manager
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Stainless steels are often the choice of alloy because of their corrosion resistance and strength. They are some of the most durable metals.

Many industries, including the food, beverage, pharmaceutical, semiconductor, petrochemical and nuclear sectors rely on their corrosion resistance since even minimal product contamination of the product is unacceptable.

**How to avoid loss of corrosion resistance during welding**

Gas Tungsten Arc Welding (TIG) is the most commonly used stainless steel welding process. Any oxygen in the welding atmosphere can cause loss of chromium, essential in stainless steels to ensure resistance to corrosion.

To remove oxygen from the weld gas and thus prevent oxidation, a process known as Weld Purging is used. Weld purging is the act of removing, from the vicinity of the joint, oxygen, water vapour and any other gases or vapours that might be harmful to a welding joint as it is being welded and immediately after welding.

**Available Weld Purging Methods**

A wide variety of purging techniques have been developed to meet the requirements for protection of the weld from oxidation.

Inflatable Tube and Pipe Purging Systems restrict the volume to be purged and they can pay for themselves in just one weld. These reusable systems are available to accommodate pipe diameters from 1” – 88” (25 to 2,235 mm).

Measuring instruments (Weld Purge Monitors®) are an essential piece of equipment to check that the oxygen content is minimised before and during welding to avoid oxidation. They can measure to 1 ppm (accurate 10 ppm).

Low cost Argweld Weld Trailing Shields® can also be added to a TIG torch to provide an additional inert gas coverage to the joint surface during welding.

The use of Flexible Welding Enclosures® allows any size and shape of component to be welded in a totally inert atmosphere.

Weld Purge Film® can be glued either side of a joint inside pipe or tube to isolate the volume around the joint so that inert gas can be admitted for protection. The film can be removed simply by flushing with water after use.
MULTISTRIKE® TUNGSTEN ELECTRODES

Tungsten Electrodes are widely in use for TIG/GTAW Welding. Tungsten is a rare metallic element used for manufacturing the electrodes for striking and maintaining the arc in this process.

Tungsten is chosen for producing the welding arc because of its hardness and high-temperature resistance to carry the welding current to the arc. Tungsten has the highest melting point of any metal, 3,410 degrees Celsius (6,170ºF).

The role played by the electrode in GTAW (TIG) welding is crucial. It must have a high melting point and it must be non-consumable. Tungsten quickly established itself as the most suitable material.

Tungsten was chosen for producing the welding arc because of its high-temperature resistance - it has the highest melting point of any metal, 3,410 degrees Celsius (6,170ºF).

However, pure tungsten alone brings with it a number of disadvantages including erratic performance and poor arc initiation.

Specialists soon discovered that the addition of certain ‘rare earth’ compounds would significantly improve the overall performance.

Thoria was the compound originally chosen and which today is still the most widely used with its familiar red tip. However, thoria is radio-toxic so users need to be aware of guidelines for storage of electrodes and disposal of the dust created during any grinding process.

One way around these difficulties and health concerns, is to use the MultiStrike® Blue Tipped Tungsten Electrodes that contains non-radio-toxic compounds.

What can MultiStrike Tungsten Electrodes offer?

Blue Tipped MultiStrike® Tungsten Electrodes have been specifically designed by Huntingdon Fusion Techniques HFT® to address the growing concerns about the radio-toxic thoria that is present in standard red tipped tungsten electrodes, MultiStrike® Tungsten Electrodes are non-radiotoxic, non-thoriated and non-carcinogenic.

They maintain a high performance and will strike 10 times more arcs than red tipped thoriated tungsten, when tested under identical conditions.

Each packet of MultiStrike® Tungsten Electrodes carries a total traceability identification and are suitable for a wide variety of welding operations, particularly effective in the welding of titanium, stainless steel and aluminium AC and DC.
Argweld Weld Trailing Shields® provide an additional inert gas coverage during stainless steel and titanium pipe and sheet metal welding.

The addition of a low cost, reusable Argweld Weld Trailing Shield® can produce cost saving results.

Here at HFT®, we pride ourselves on product development and with the support of our scientific knowledge and over 45 years of experience we have recently launched our NEW DESIGN Argweld Weld Trailing Shield®.

What’s new?

Along with the new sleek design, our Argweld Weld Trailing Shields® have a NEW Unique clip design, which means the welder can interchange different shield sizes without having to change the welding torch.

With our name and logo stamped onto every new Argweld Weld Trailing Shield®, you can be sure the Shield you are using is a HFT design, we guarantee quality and 100% craftsmanship. They are built to last.

Each Argweld Weld Trailing Shield® produces perfect gas coverage, smooth gas movement and no leaking with every model carefully and individually tested to ensure quality performance every time. Made in the UK to European Standards and Quality Control Procedures.

Using a HFT® Argweld Weld Trailing Shield

There are many brands of Argweld Weld Trailing Shields® on the market today, make sure your Shield is stamped with the HFT® logo.

The Argweld Weld Trailing Shield® is connected to the argon gas supply, diffusing gas evenly without turbulence through the multi layers of stainless steel mesh built into the body of the shield. At each side, replaceable silicone rubber side shields provide a barrier to prevent the argon escaping sideways and remaining over the weld metal. As the welding torch is moved forward, the weld remains under an argon gas shield until the welded metal has cooled below its oxidation temperature.

Argweld Weld Trailing Shields® are reusable, with a temperature resistance of up to 230°C. They prevent re-work, eliminate the need for an expensive purge chamber and allow for faster welding.

For manual welding, the welder finds that with this lightweight and low cost tool, there is no difficulty in dragging it along the surface being welded. One further benefit is that it carries the welding torch at 90° to the weld.

If you have purchased a new Argweld Weld Trailing Shield® and would be interested in providing some comparison images, then please get in touch.
Weld Purge Monitors® are in use throughout the Welding Industry. Used during the welding of reactive alloys, they ensure the oxygen present is at a low enough level to avoid oxidation, which can lead to a loss of the alloys’ corrosion resistance properties.

For stainless steel, the oxygen level needs to be as low as 100 ppm. Recognising the requirement for a low cost, portable 100 ppm monitor, Weld Purging Experts Huntingdon Fusion Techniques HFT® designed and developed the PurgEye® 100 Weld Purge Monitor, which is now the World’s leading monitor for welding stainless steel.

Georgia Gascoyne, CEO Managing Director for HFT® said: “Our award winning PurgEye® 100 is really a game changer for the welding industry. Stainless steel is often the metal of choice in many different industries for its corrosion resistance properties, strength, weight and cost, so developing a monitor that can read accurately down to 100 ppm was a huge requirement.”

The PurgEye® 100 features an auto calibration at the touch of a button, which ensures the monitor is always reading correctly. It is IP65 rated for water and dust and also features a low sensor and low battery indicator. With a large, easy to read digital screen, the operator will immediately know when it is safe to start welding ensuring a perfect welding environment every time.

The PurgEye® 100 IP65 Weld Purge Monitor® indicates oxygen levels from atmospheric (20.94%) down to 100 ppm, which makes it perfect for welding stainless steel. HFT® also have a range of 1 ppm monitors, perfect for welding other alloys including titanium.

Ron Sewell, Chairman for HFT® said: “All of our Weld Purge Monitors® are manufactured in the UK, for guaranteed accuracy of oxygen indication to allow a weld start with minimal risk of oxidation.”

**EASY STAINLESS STEEL WELDING**

**CALENDAR: EVENTS IN THE INDUSTRY**

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It is often very challenging to carry out repair work on pipes containing liquids. One option to carry out this maintenance is to completely drain the system, which can prove costly.

Pipe Freezing Experts Huntingdon Fusion Techniques HFT® has introduced the Qwik-Freezer™ Systems to their Pipestoppers® Division. These systems use CO2 to create ice plugs or freeze seals in the pipes, avoiding the requirement to completely drain down systems.

Luke Keane, Technical Sales Manager for HFT® said: “Temporarily isolating the water in a system with CO2 Pipe Freezing Qwik-Freezer™ allows for repairs or modifications to be made without draining or shutting off the system, saving time, wastage and is quick and easy.”

A specially designed jacket is wrapped around the pipe at the point where the freeze is required. A nozzle on the jacket is then coupled to a cylinder of liquid CO2 by means of a high-pressure hose. When the liquid CO2 is injected into the space between the Qwik-Freezer™ jacket and pipe, it immediately reduces the temperature inside the Qwik-Freezer™ jacket to -78ºC (-109ºF) and this is transferred rapidly to freeze the pipe contents and thus seal the volume.

Qwik-Freezer™, the industry standard portable CO2 Pipe Freezing System requires little set-up time and is the only low cost CO2 Pipe Freezing System capable of making ice plugs in pipes up to 8” (200 mm) diameter.

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**PurgEye® 1000 Remote**

**Weld Purge Monitor® with PurgeNet™**

Monitor Your Weld Purge at a Distance

Scientific Developers of Weld Purging Technology and Manufacturers of Weld Purging Products since 1975

www.huntingdonfusion.com
Making butt welds in small diameter metal tubes presents problems not experienced with other applications. Control over consistency of deposit, particularly with diameters less than 15 mm, is difficult even when using a mechanised process. Perhaps more significantly the issue of adequate internal weld purging with inert gas can become a real headache.

As tube diameters increase, manual welding can be used with more confidence but the need to purge effectively to avoid oxidation at the weld root is crucial. This can lead to significant loss of corrosion resistance (refs 1 to 5) if critical elements such as chromium are present in the metal and since the majority of small tubes are destined for applications in aerospace, food and drink this can be serious.

The solution to the purging problem is to seal the tube on both sides of the joint, have a small entry hole for the gas at one end and a suitable exit hole at the far end for the unwanted gas to pass out, and then fill the interspace with inert gas. A whole host of approaches have been tried over the years: these include using screwed up paper, plastic foam and cardboard as sealants, but these are prone to leak and even burst into flames during the welding process. The only truly effective method is to use thermally resistant expandable plugs through which inert gas can be passed. Even then, because of the possibility of turbulence and feeder tube leaks, it is advisable to employ oxygen monitoring instrumentation to measure and control any residual oxygen content close to the joint to well below 100 ppm.

1. **Welding Techniques**

Because of the necessity to maintain close control over the weld pool GTAW is used almost exclusively. Virtually all the metal alloys employed in industrial sectors employing tubes can be welded and since the process is carried out in an inert atmosphere it produces results that are extremely clean, oxide free and without spatter.

Integrated into orbital welding equipment this is the most reliable method of creating fusion welds capable of meeting the many stringent quality demands made for applications in the aerospace, food, electronics and petrochemical industries. Here, inconsistency and the presence of even minor imperfections must be eliminated to avoid rejection.

Automatic orbital welding equipment can be expensive and for small batch production may not be acceptable. Recourse then has to be made to manual welding but skilled operators are essential if weld quality is to be maintained.

For full control over the weld pool, a good balance must be maintained between gravitational force and surface tension at every position of the torch. With automated welding, a computer-controlled welding process runs completely independently, without the need for any intervention from the operator.

Argon is the most commonly used purge gas but helium, nitrogen and hydrogen also offer protection as inert gases during root protection. On a cautionary note however there are limitations with regard to hydrogen- and nitrogen-containing backing gases. These are unsuitable for use with materials such as titanium that are sensitive to gas uptake, since this can lead to embrittlement and/or porosity formation. Nor should such mixtures be used with most fine-grain structural steels.
2. Protecting the weld from contamination using inert gas purging

The smallest expandable purging systems are in the region of 15 mm diameter and are typified by the Argweld® Weld Purge Plugs™ (Fig 1). These accommodate pipe diameters from 15 mm and offer some flexibility either side of the nominal size.

![Fig 1](image1.png)

Fig 1. Tube diameters from 15 mm can be purged effectively using this type of engineered plug. Inert gas passed in at one end can be analysed for oxygen level at the exit.

The Argweld purge plugs can be used up to 75°C continuously and 105°C intermittently. Optional high temperature seals are available for use continuously up to 120°C. A low-friction acetal copolymer thrust washer inserted between the top plate and wing nut provides easy expansion and release.

For tube diameters between 25 and the upper size for small tubes, considered to be 40 mm, there are fully integrated inflatable systems such as the Argweld® PurgElite® range (Fig 2).

![Fig 2](image2.png)

Fig 2. A family of integrated purge systems is available covering all tube diameters from 25 mm. Using the systems enables the welder to achieve low oxygen content.

These systems have a pair of inflatable dams connected by an armoured heat-resistant spinal tube. Once ready to start purging, the system is inserted into the bore with one purge dam either side of the weld joint. The spinal tube carries the gas to inflate the purge dams and the gas flow is then controlled automatically to release gas without causing turbulence. Only one gas connection is therefore required for both dam inflation and purging. The connecting spinal tube can be shortened or lengthened to accommodate special requirements.

Heat Resistant Covers with a temperature rating up to 300°C are available as accessories to protect the inflatable dams. These are attached with ties sewn into the covers.
Some currently available purge systems incorporate advanced control elements that include for example:

- IntaCal® technology to eliminate standard control valves and thus preclude any need for pre-setting.
- RootGlo® luminescent central bands that allow the operator to locate the purge system quickly and accurately by viewing through the weld root gap.
- PurgeGate® to prevent the dams from bursting due to excess pressure or flow.

3. Monitoring the purge gas oxygen content

The fact that even very small amounts of oxygen in the purge gas can cause discolouration around the weld underbead makes it desirable that sensitive instruments be employed to measure residual oxygen. Resorting to ‘do it yourself’ solutions such as the use of a flame at the exhaust end of the purged volume are prone to serious errors. They may be unsafe and only provide information about exit gas - nothing at all about the oxygen level at the weld root.

Two essential characteristics of a suitable instrument are that it must have an adequate measuring range and it must sample the gas inside the purge volume. The sensitivity should be such that an oxygen level as low as 10 ppm can be detected. Instruments that only display down to 1000 ppm (0.1%) are totally unsuitable.

A typical high sensitivity instrument will include a sampling tube, gas extraction facility and sensing electronics that are reliable and repeatable. It should be robust enough for site application and offer a calibration function.

Although many commercial monitoring systems are available these are generally not sensitive enough to meet the requirements for quality welding of sensitive alloys such as stainless steels and titanium where the presence of oxygen levels as low as 50 ppm are essential if loss of corrosion resistance (ref 2) and changes in reduction of mechanical properties are to be avoided. Typical of advanced monitoring systems is the PurgEye® (ref 6) family of instruments.

These specially designed instruments (Fig 3) can be used to continuously monitor oxygen levels and if required, interrupt the welding operation if levels increase above a pre-set limit. They are also useful as quality control tools and records can be stored using the data logging software interface.
Fig 3. Providing a sealed volume below the joint and purging with inert gas goes a long way to preventing oxidation. However, the purge gas itself needs to be continuously monitored to ensure that a low oxygen content is maintained. This can be undertaken by using a monitor capable of detecting very low levels of oxygen. Advanced instruments such as the PurgEye® range from Huntingdon Fusion Techniques meet these requirements.

4. Conclusions

Welding techniques and filler materials have been developed to accommodate the singular requirements for making fusion joints in small diameter tubes. Advanced inert gas purging systems are available to provide excellent protection against oxidation for tubes as small as 25 mm diameter. Research is being undertaken to develop devices for diameters down to 5 mm.

In conjunction with purging equipment it is essential that continuous monitoring of the purge gas in the region of the joint is undertaken if oxidation is to be prevented. For quality control purposes it is recommended that the whole sequence of the welding operation, but especially the purge gas oxygen level, is recorded.

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Huntingdon Fusion Techniques HFT® design and manufacture blue-tipped MultiStrike® Tungsten Electrodes.

- MultiStrike® Tungsten Electrodes are non radio-toxic, non-thoriated, non-carcinogenic.
- They will strike 10 times more arcs than a red tipped thoriated tungsten, when tested under identical conditions.
- Suitable for a wide variety of welding operations, particularly effective in the welding of titanium, stainless steel and aluminium AC and DC.
- Providing savings through longer life, more strikes per electrode before grinding, less re-work, less wastage and lower power requirements.

Eliminate the thoriated dust in the atmosphere by changing to MULTISTRIKE® TUNGSTENS so that when there is tungsten grinding dust, it is not radio-toxic.

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