

GUIDE



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Stukeley Meadow
Burry Port
Carrms
SA16 0BU
United Kingdom

Telephone +44 (0) 1554 836 836
Facsimile +44 (0) 1554 836 837
Email hft@huntingdonfusion.com
<http://www.huntingdonfusion.com>

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ARGWELD® A GUIDE TO WELD PURGING

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Water Soluble Purge Material

There are water soluble papers and plastics which can be used for purging and are ideal for the purging of pipe welds where there will be no access after welding to remove an inflatable purge system or disc assembly. Most pipe systems can be washed out prior to use and the water soluble purge dam will dissolve and vanish.

The paper material has been shown to leave large fibres after dissolving which can block filters in sensitive systems and paper is becoming an ecologically undesirable material as trees need to be cut down to make paper.

The plastic will dissolve away to molecular size leaving no traces.

Both the paper and the plastic will dissolve in cold water but they both dissolve better in hot water or hot water with steam.

Some applications will demand low halogen content of the purge material and manufacturers can provide trace element certificates if asked.



Dam made from Argweld® Water Soluble Purge Film



Argweld® Water Soluble Purge Film Kit

Welding Chambers (See Purging Enclosures)

Zircalloy

See 'Titanium'.

Any questions or comments about the information in this booklet, can be addressed to the company, see overleaf.

Trailing Shields

A trailing shield is used to attach to welding torches to provide extra gas shielding to titanium welds.

A trailing shield will help to keep a gas shield over welded metal for longer than is possible with a normal welding torch.

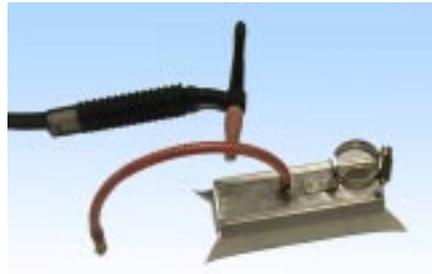
As the metal cools therefore the gas shield stays over it and oxidation is prevented.

Huntingdon Fusion Techniques Limited manufactures a range of shields to suit manual or automatic welding torches for TIG/GTAW or MIG/GMAW welding.

They can be flat, radiused for external welding or radiused for internal welding



External Shields manual and Automatic



Manual shield for flat plate



Manual Shield Radiused for internal welding

Argon

Argon is an inert gas and the one most commonly used for weld purging because it will not combine with hot metal.

Argon Asphyxiation

Argon does not support life and it is critical that personnel are never allowed into a tank or other receptacle while it is being purged or just after purging. There have been cases where welders have entered a purged environment and have died due to the lack of warning given by the brain that oxygen is not present.

Argweld®

Argweld® is a trade mark registered and owned by Huntingdon Fusion Techniques Limited, specialists in the field of weld purging.

Backing

Weld backing products are used mainly to provide a flat weld underbead but additionally can be used for weld purging.

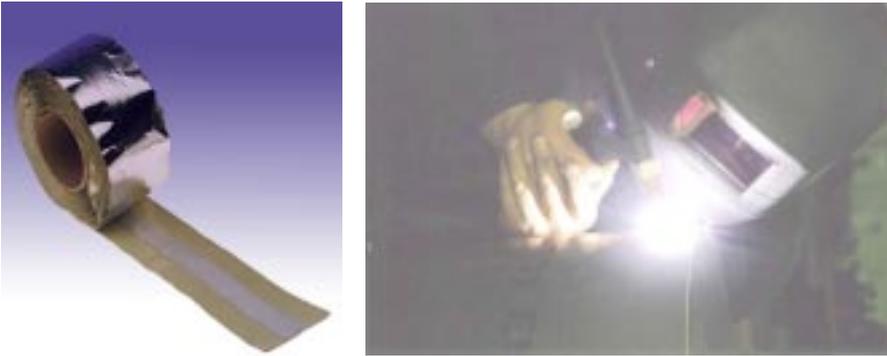
The advantages of backing products include, the elimination of the need for double sided welding, elimination of weld drop through, elimination of backgouging and the subsequent grinding etc

Backing Bars

Are generally used to weld large pipes and vessels to localise purging or to support the weld pool to enable single sided welding, eliminating double sided welding techniques. Backing bars can be difficult to manoeuvre out of large diameter pipes and tanks and backing tape or tiles may be easier to use.

Backing Tape

Argweld® Backing Tape is used for light duty TIG/GTAW, MIG/GMAW and Stick/MMA welding processes, for welding currents up to 160 amps



Bladders - See Inflatable Purge Systems

Ceramic Tiles

Ceramic Tiles are used mostly for submerged arc welding techniques to allow the advantages mentioned in the subject "Backing".

Ceramic Tiles are generally more expensive than backing tape, so they tend to be used for weld currents above 160 amps.



Copy of Technical Article available on request

Titanium

Titanium and Zircalloy are a very reactive materials and need to be welded with excellent purge cover both at the front side and the back side of the weld. Small components are mostly welded in purge chambers or purge enclosures while large components are welded with leading and trailing shields. It is generally recommended that oxygen content when welding titanium should be less than 20 ppm.

Titanium Purge Monitor

A purge monitor has been developed especially for welding Titanium. The Titanium monitor costs dramatically less than other instruments used for indicating low ppm values.



Argweld® Titanium Purge Monitor

Safety (See Argon Apshyxiation and Plugs)

Shields (See Trailing Shields)

Stainless Steel

The root of stainless steel should be purged on the back side as well as on the weld side. The reason that stainless steel has been chosen for use is probably for its cleanliness properties and it would seem a shame to use such expensive and high grade material if it is not back purged. Stainless steel which is not back purged will coke and oxidise and probably have porosity and uneven welds. Many stainless steel pipewelds in the process industries must be purged to prevent coking, which causes product entrapment and subsequent bacteria growth to contaminate products.

Styrofoam

See Foam/Dams, Pages 7 and 5

Tape

Masking Tape can be used to seal an area to be purged.

Care should be taken to try to avoid putting the sticky side of the tape in contact with metal which is going to get hot or to be welded.

The impurities in the adhesive could enter and contaminate the weld pool.

Backing tape and tiles are sometimes used to support a weld bead but they do not completely eliminate oxygen from the weld zone.

The root may still have to be ground and polished after welding if cleanliness or smoothness are required.

Purging Tape is available to stick to the backside of welds which cannot be easily or economically back purged with gas.

The adhesive aluminium tape can also be used in areas where the metal becomes too hot for the use of other masking or adhesive materials.



Chambers (See Purging Enclosures)

Cleanliness

Dirt contains moisture or other high vapour pressure contamination which will take a long time to purge out. Every space which has to be purged should be scrupulously clean.

The addition of any object which may contain dirt will cause longer purging times. Examples include welders gloves being inserted into weld enclosures (which contain grease or dirt) and will continuously outgas making it almost impossible for an enclosure to reach a satisfactorily low oxygen level.

Another matter to avoid is the use of welding manipulators inside an enclosure, as these may contain grease in a bearing and moisture in the grease.

Dams

Dams are fixed diameter discs used to block a pipe either side of the weld zone so that the air can be purged out of the space between them and around the weld root.

By reducing the volume to be purged, purging is thought to be faster than if the whole pipe were to be purged and that there would be good savings in time and gas. This is not necessarily the case as badly made dams can cause bigger problems.

Dams made of high quality rubber discs are acceptable, but the use of Foam, Polystyrene or Styrofoam is erroneous and should be strongly discouraged. These materials are very porous and are full of air and water vapour, which takes a very long time to outgas, so although a cavity might be thought to be free of air, as the weld starts and the cavity becomes warmer, the outgassing of the air and water vapour trapped in the dams is accelerated and will contaminate the weld space causing oxidised welds.

One further disadvantage of dam systems is that they are usually of a single fixed diameter and don't have the flexibility of inflatable systems for variation in size.

Dam systems may appear to be cheaper, but in fact will cost more money in damaged welds, rework, inspection, time taken to manufacture, gas wasted, than by using a properly constructed Argweld® Inflatable Purge System, manufactured from high quality materials.

Some dams are water soluble (See Water soluble Purge Material).

Definition

Purging is the removal of air which contains oxygen. Oxygen and some other gases need to be removed to prevent them from combining with the hot metal produced in welding.

Oxygen will form oxides which may lead to discoloration in the best case, to porosity and badly coked welds in the worst case.

Hydrogen in the presence of titanium and some steels can cause embrittlement of the metal.

Dissolvo

Dissolvo is the trade name for a water soluble paper. See 'Water Soluble Film'

Dissolvo is a paper imported from Japan to the USA where a Paper Converting Company converts it into packs which can be used for welding. The paper is affixed to the pipe with a water soluble adhesive paper tape.

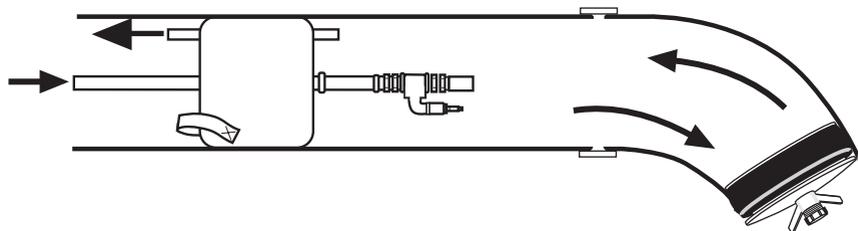
Because paper is made from wood, it never truly dissolves as it is only water dispersible and it leaves behind wood fibres which can clog sensitive filtration systems when it is washed out of the pipe.

Duplex

Duplex is a grade of stainless steel which needs to be well shielded with inert gas when welding and particularly back purged. Our customers generally seem to want to purge to 500 parts per million, which is 0.05%

Elbow Purging

When an assembly comprising a pipe piece and an elbow has to be purged, it can be done with a combination inflatable system and stopper unit. (See diagram below).



Reactive Metals

Titanium and Zirconium and their alloys are regarded as reactive metals. This is because they react very easily with atmospheric gases which can be harmful to the weld joint integrity.

Reasons for Purging

Purging is usually carried out on the back side of welds in stainless steels, duplex steels, zirconium alloys and titanium, etc, to eliminate oxygen and other atmospheric gases from mixing with the hot metal and causing oxidation, porosity and coking.

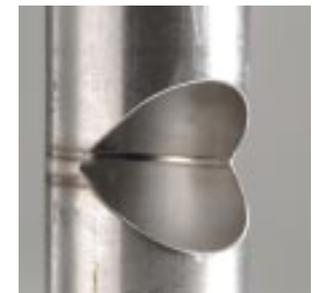
Stainless steel is chosen as a material for fabrication because of its cleanliness for critical applications and its corrosion resistance.

The corrosion resistance of stainless steel depends upon the formation of a very thin, stable, oxide film, rich in chromium, which is formed at normal temperature and pressure.

To prevent this film being damaged by contamination, the backside of a weld in stainless steel must be purged otherwise its corrosion resistance will be diminished.



Purged and Unpurged Manual Welds



Purged Automatic Weld



Unpurged Automatic Weld

Purging Enclosures

Purging enclosures, as opposed to “Welding Chambers”, are flexible plastic enclosures designed by Huntingdon Fusion Techniques Limited for the welding of reactive metals such as titanium and zircalloy, etc. They are available as standard in diameters of 900, 1200, 1500 and 1800 mm.

They come equipped with two pairs of glove ports and all feed throughs for gas, electricity, weld torches, etc.



Standard Round enclosures



Special Rectangular Enclosure

Flexible enclosures are used widely in the aerospace and racing car industries because of the speed of purging and the operator comfort.

Purging Shoes

Purging Shoes are often very large metal bars hollowed out to accept weld purge gas and maneuvered onto the back side of a weld inside a tank or large pipe being welded from the outside.

Often these shoes may have to be manipulated through an opening and this can be unwieldy and time consuming.

Welding Engineers can consider the use of ‘Backing Tape’ or ‘Quick Purge’ Systems for these applications.

Purging shoes are also another name for “Trailing Shields”.

Quick Purge

Argweld® Quick Purge Systems are an inflatable purge system for large pipes and vessels which can be inserted with just a small amount of space either side of the weld, allowing purging in very fast times. Typically, a 36” diameter Pipe or Tank can be purged in 7 - 10 minutes.

Enclosures and Chambers (See Purging Enclosures)

Purging a welding enclosure or welding chamber requires a lot of attention to ensure that a low oxygen level is achieved in the shortest possible time with the lowest usage of gas. Apply to Huntingdon Fusion Techniques Limited for a separate booklet about the purging of enclosures.

Flexible Enclosures (See Purging Enclosures)

Flow Meter

A flow meter should be used in purging, as flow rate is an important parameter in purging pipes or enclosures.

For most purging applications, Huntingdon Fusion Techniques Limited recommends the use of a two stage regulator, so that as the gas bottle empties, the flow rate does not change and risk damage to a weld

Flow Rates

The rate of flow of argon (or other) shielding gas will vary according to the job in hand and the stage of purging or welding. Some guide lines are as follows:

- 1) In general, at the beginning of a purge cycle, the flow rate should be kept low enough to allow the argon to flow gently into the area being purged so that it displaces the atmospheric gas without disturbance. It is undesirable to create turbulence and have the air mix with the argon.
- 2) Once the argon inlet nozzle is sufficiently surrounded by a purge argon blanket, the purge rate can be increased. Any resultant turbulence should be argon in argon and not cause a problem.
- 3) Flow rates in small volumes might typically be in the region of 10 litres/minute. Once the argon blanket is assured in larger volumes, the flow rate might be increased to 40 litres/minute to decrease purge time.
- 4) When purging a pipe weld the flow rate should be turned down to a minimum just before completion of the root, to avoid blowing the molten part of the weld out.

Foam

See Dams

Forming Gas

In continental Europe, purging is often referred to as 'Formieren' using a Nitrogen gas mixture instead of Argon. Nitrogen does generate extra heat during welding, so attention has to be paid to this plus any reaction between your metal and Nitrogen.

Gases for Purging

Purging is normally carried out with argon gas as it is totally inert and as it is readily available in the welding environment. In some countries nitrogen is used, however care must be taken not to use nitrogen where it may combine with hot metal to form undesirable nitrides.

With austenitic stainless steels, a mix of argon with 2%, 3% or 5% hydrogen can be used.

The hydrogen will combine with any oxygen molecules present to form H₂O (water) which evaporates into steam, which is carried away by the purge gas, thus preventing oxidation and leaving a bright shiny weld. Hydrogen mix gases should not be used with ferritic stainless steels (or martensitic) as hot (hydrogen) cracking may occur. Neither should hydrogen mixed gases be used with Titanium, as embrittlement will occur.

Heat Protected Pipe Purge Systems, See "Inflatable Purge Systems"

High Temperature Pipe Purge Systems See "Inflatable Purge Systems"

Hydrogen Mixed Gas (See Gases for Purging)

Purge Monitors

Huntingdon Fusion Techniques developed the first Welding Purge Monitor in 1975.

Until then, welders not using guesswork, may have been using oxygen monitors which are calibrated to provide readings at atmospheric levels, which is the area that most oxygen monitor users are interested in.

HFTL therefore designed a Welding Purge monitor from the ground floor up, which encompassed the features necessary for welding.

The Argweld® Weld Purge Monitors have the following features and advantages over Oxygen Monitors:

Argweld® Purge Monitors are calibrated for accuracy at 0.1%, Oxygen, the level at which it is important to have an accurate reading for welding.

Argweld® Purge Monitor sensors are built into a leaktight housing so that the sensor cannot see oxygen from sources other than those being measured.

Argweld® Purge Monitors are provided with a temperature compensation circuit to enable the accuracy to be maintained from -40 to +40 degrees Centigrade.

Argweld® Purge Monitors are provided with the accessories to measure oxygen flow from purged pipe and enclosure outlets as well as to be able to pump samples from the space being purged.

If you are offered an instrument which doesn't carry the label, "Argweld® Purge Monitor" there is a chance that it is not a Monitor which has been designed for welding and it will not provide accurate information and it will almost certainly cost you more to service and maintain.





Nylon and Aluminium Purge Plugs (12 mm - 900 mm)

Plugs (Continued)

Purging plugs are generally used at low pressure. As with all purging products, it is important to keep the sealing surfaces free from scale, dirt, oil or any other loose or contaminating material.

Purging plugs should not be used with high pressures nor should they be used as pressure testing devices without checking their ratings with the manufacturers and providing the correct safety and protection procedures.

A plug which has too much pressure applied to it from inside a pipe, can be ejected from the pipe like a missile and be harmful to anyone inadvertently standing in front of it.

Polystyrene

Polystyrene is often used as a cheap, fast way for making purge dams.

Polystyrene is porous and absorbs massive amounts of oxygen and water vapour.

This is a very bad material to use for weld purging and will prevent a good oxygen-free environment from being achieved.

Inflatable Pipe Purging Systems

Inflatable Pipe Purging Systems, sometimes known as Purge Bladders are practical for use in pipes from about 2 inches diameter and upwards.

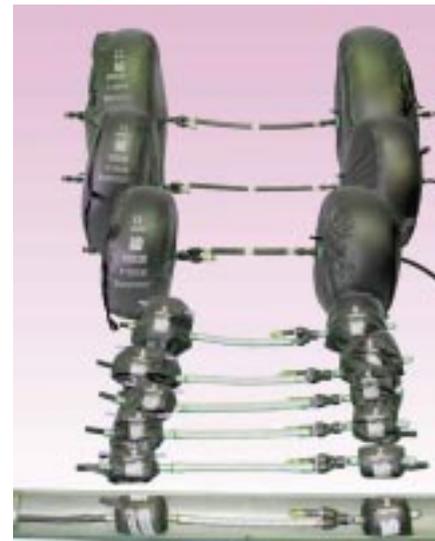
The systems comprise two robust inflatable dams which are protected with an outer cover to prevent damage by metal burrs.

The inflatable dams take up the variations in pipe diameter which are often encountered. For example, a 4 inch device can be used on 4 inch schedule 10 pipe to 4 inch schedule 160.

The two dams are connected together with a flexible spinal tube which can be any length and can be varied according to the application. The flexibility allows the systems to be drawn around elbows and bends.

For pre-heated pipes, systems are manufactured that are covered with heat resistant material, allowing use of the devices up to 300 degrees C for up to 24 hours.

Larger pipes and vessels can be quickly and efficiently purged with the Argweld Quick Purge system which reduces the space to be purged, so that a 36 inch pipe for example, can be ready for welding in about 10 minutes. (See Quick Purge)



2" - 72" Systems



Heat Covered Systems



Quick Purge Systems 8" - 72"----->

Outgassing

All materials have a Vapour Pressure and outgas. Higher vapour pressure materials must not be introduced into a purging environment. Examples are: Solvents - If you can smell it, the vapour pressure is high. Water - as it gets warm, you can see it (Steam/water vapour).

Many products contain liquids or gases that you cannot see, they will continually outgas in a purging environment and contaminate the weld.

Materials not to use in a weld purge space include wood(wood is 90% water), cloth(cloth is full of holes which will be full of air, therefore, welders' gloves should not be put in a weld enclosure). Plastic will outgas as a lot of it becomes warm.

Oxygen Monitors (see Purge Monitors)

Oxygen monitors are used widely to check that the oxygen in a system has been purged away sufficiently to begin welding. For stainless steel welding it is advisable to purge to an oxygen level of 0.1% or better (1,000 parts per million). When welding titanium the oxygen monitor should indicate down to 20 parts per million (ppm).

Partial Pressures

The pressure of a gas in a trapped volume is made up of the sum of the partial pressures of the gases present. In welding applications, that means that if a volume is filled with Argon and all oxygen and all oxygen and nitrogen has been expelled, the partial pressure of those gases can be considered as equal to zero.

The pressure of these gases outside the enclosed volume is much greater so they will try to force themselves into the volume, even though the pressure of argon in the volume may be greater.

Parts Per Million

Pure oxygen in air, ie 100% oxygen would be 1 million parts per million. 10% oxygen therefore is 100,000 ppm, 1% is 10,000 ppm and 0.1% is 1,000 ppm.

Paste for Purging

There are materials which can be mixed with solvents to form a paste, which can then be painted on the rear of joints to be welded. When they get hot from the welding arc, they give off hydrogen gas which combines with oxygen to produce water, which vaporises in the heat and boils off to prevent the weld from oxidising. The residue left from the paste is baked onto the surface in a glass like substance and is difficult to remove if required.

Pipe Purging (See Bladders, Dams, Water Soluble Plastic Film)

Plastic Film (See Water Soluble Film)

Water Soluble Film is used widely for purging applications. In pipe welding a dam is cut out to fit the inside diameter of the pipe to be purged and stuck to the pipe ID about 10 inches away from the weld line. For pipes of a small diameter the film can be screwed up into a ball and pushed down the pipe. Balls of water soluble film are more difficult to dissolve and require attention in order to ensure complete solubility.

Plate Purging

The back of a sheet metal or plate metal weld is less easy to purge than a pipe because it is difficult to trap a volume around the weld and remove the air from it. There are some devices on the market which are able to be fixed over a linear weld and are held on by magnetic or vacuum clamps. Once a volume is trapped, it can be purged. A further method is by the use of backing tape (See 'Backing Tape').

Plugs for Purging

Huntingdon Fusion Techniques Limited manufactures a range of high quality low cost pipe plugs for damming pipes and allowing purge gas to be inserted or air to be exhausted.

In some pipe fabrications it is possible that it is not appropriate or necessary to use Purge Bladders, Film or Dams. Typically in small bore or short length pipework pieces it is possible to use an expanding pipe plug.

Complex pipe work fabrications may have branches and stubs of varying diameters and require a number of different size, low cost but high quality damming devices. These low cost expanding pipe plugs have holes through the centre, through which the purge gas can be fed in and the air exhausted.