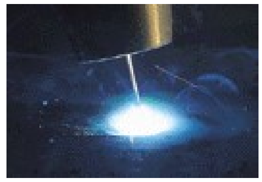


MIG GAS FLOW

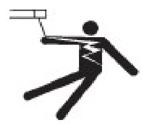
Understand And Set Proper Shielding Gas Flow and Reduce Waste

www.NetWelding.com

Our *MIG GAS FLOW "Self Study" Program* presents the important facts to show why setting shielding gas flow is important to produce quality welds and reduce gas waste.

It can be used as a "Self Study" program in less than 2 to 4 hours of effort.

WARNING!



- **Some procedures in this training material could be hazardous. PLEASE READ all material in the notes below.**
- **Shielding gases can leak and IN A CONFINED AREAS COULD CAUSE ASPHYXIATION AND DEATH.**
- **Contact with live electrical parts and ground CAN CAUSE SEVERE INJURY AND DEATH.**

SOME PROCEDURES IN THIS TRAINING MATERIAL COULD BE HAZARDOUS. READ AND UNDERSTAND ALL MATERIAL IN THESE NOTES:

Although shielding gases are not generally considered harmful under normal circumstances they are usually heavier than air. Thus they will sink to the floor level **AND IN A CONFINED AREA COULD CAUSE ASPHYXIATION AND DEATH**. Shut off shielding gas supply when not in use. **Check hose and connections periodically for leaks. Replace all suspect or worn hose**. **Some procedures such as checking flows at the MIG torch nozzle may involve having the welding power energized**. Keep hands away from tip and wire or you could be shocked. The welding wire must be prevented from feeding, so disconnect the pressure rolls and test to be sure the wire does not feed. **CONTACT WITH LIVE ELECTRICAL PARTS AND GROUND CAN CAUSE SEVERE INJURY AND DEATH. T**hese comments are **NOT MEANT TO BE COMPREHENSIVE.** Please carefully read and follow the equipment manufactures instructions. Also refer to publications on safe practices for welding and cutting available from the American Welding Society, 8669 Doral Blvd., Doral, FL 33166 including “Safety in Welding and Cutting” – ANSI/AWS Z49.1 available as a FREE download on their web site.–

How to Use This Learning Program

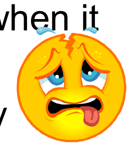
- The program allows you to quickly go through each page by using the arrows at the bottom.
- To review each page, you may want to set the viewing size to 75% to have the notes page show.
- Then scroll down with the scroll arrow on the right side margin.
  - the notes below each page explain some of the bullet points.

The PDF Leaning Program allows it’s use without the need for other than the free Adobe PDF reader on the computer.

What Shielding Gas Does

- As the name says; it shields the weld from air which is 21% Oxygen; 78% Nitrogen; and contains moisture (H_2O)
- The Nitrogen is the real killer making steel brittle (like glass) and causing porosity

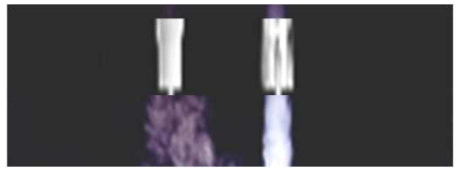
- Hydrogen causes steel to crack when it cools; a very bad actor
- Oxygen can cause CO gas porosity



Air contains Nitrogen, Oxygen and moisture. Nitrogen dissolves in molten weld metal and can form brittle nitrides and gaseous Nitrogen porosity as the molten metal cools. Oxygen forms with Carbon to form CO and CO_2 porosity. Moisture breaks down into Hydrogen and Oxygen in the arc. The Hydrogen readily dissolves in molten steel and will remain in solution in the solidified weld until the temperature reduces when it comes out at a Hydrogen ion which migrates through the steel and will cause cracking. This is particularly a problem in high strength steels. Although MIG is a “low hydrogen” process, moisture laden air can be a problem if allowed to enter the arc zone.

Argon or CO_2 Can Shield

- Argon is a neutral non reactive gas and CO_2 is a stable gas that can protect the molten weld metal



Proper shielding of the arc and weld puddle was the secret of the MIG invention! As stated in the original 1949 Airco patent they refer to the shielding as being; "***non-turbulent*** to exclude air from the arc."

To shield the arc and molten weld until it solidifies and cools an inert gas is used with a slow, steady non turbulent gas blanketing the weld area. There were several processes that were patented in the 1920's and '30's that did not provide this quality shielding and they were not fictional. Airco in 1949 is credited with the invention of the MIG process and the use of a quality shielding torch was part of their successful product.

Minimum Flow Rate

- Minimum acceptable flow rates depend on a number of variables (see notes).
- In general for Argon and CO_2 or mixtures of these gases :
  - for a ½ inch nozzle; flow rates of 20 to 25 CFH will be sufficient for most applications.
  - For a 5/8 inch nozzle; 25 to 30 CFH is sufficient.
  - For a ¾ inch nozzle, welding with cored wire at 400 to 500 amps; 35 to 40 CFH may be needed.
- In a draft of 3 to 4 MPH use 25 to 30 CFH. Beyond that, use a wind break- - a small one will work!

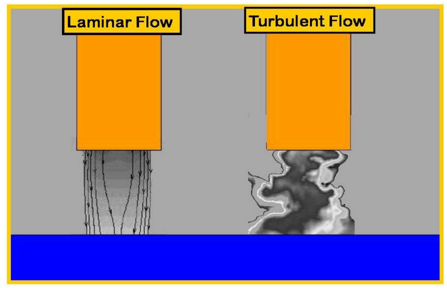
Many variables effect the minimum allowable flow rates such as the torch design, cup to work distance, welding current, gas mixture, type of wire, joint type (fillets require less than butts, etc.). In a closed shop environment with good general ventilation lower flows will be satisfactory. In fact some published data indicates flows as low as 15 CFH will be satisfactory. However these tests were probably done in an environment with no drafts.

When small drafts or local ventilation create an air flow past the work, a higher flow rate should be used. When drafts above 4 MPH are encountered a small wind break may be all that is needed. The welder can also block the draft by standing between the direction of the draft and the work piece.

Note for shielding gas mixtures which include Helium these flow rates do not apply. Consult the gas supplier for the specific recommendations for these shielding gases.

Excess Flow Rate Causes Turbulence

- The shielding gas stream should exit the torch nozzle with smooth minimum turbulent flow.
- If the velocity is too high, it will become turbulent and pull air into the gas stream.

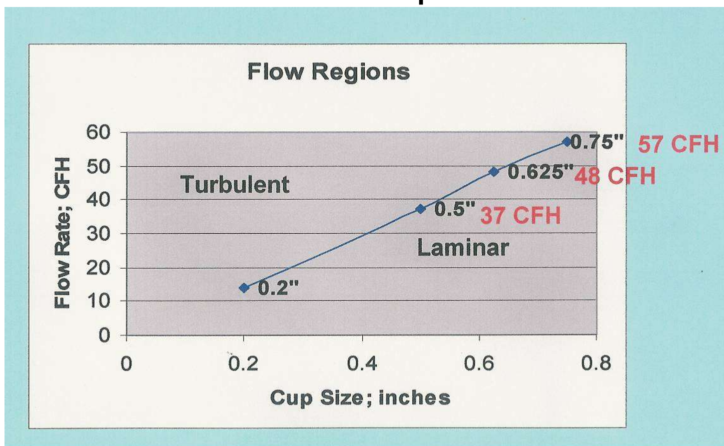


Excess flow rate causes air to be pulled into the shielding gas stream. As mentioned, the original Airco patent filed in 1949 says the shielding should be non-turbulent or have minimum turbulence. With turbulent flow the outer edges of the gas shield allow air to be pulled into the gas stream. As we'll see in the next few pages, the maximum flow before this occurs is not much higher than the general recommended flow rates!

How Much Flow Creates Turbulence?

The Welding Institute in England published the following:

For a ½ inch nozzle over 37 CFH; for 5/8 nozzle over 48 CFH and for a 3/4 inch nozzle over 57 CFH produces turbulent flow.



High gas flow surge at the weld start causes turbulence in the shielding gas stream. This turbulence causes air to be mixed into the shielding gas stream until the flow rate stabilizes to the preset level. The entrained air causes excess weld spatter and can cause internal weld porosity. This is even more noticeably with processes such as pulsed MIG.

There is little published information on the maximum desirable flow rates for GMAW. One useful technical article was published by The Welding Institute (TWI) in England [Wilkinson, M. E., Direct Gas Shield Analysis to Determine Shielding Efficiency. Report of The Welding Institute, Cambridge, England. Note: The data is applicable for Argon, CO2 or mixtures of these gases. For shielding gas mixtures which include Helium these flow rates do not apply. Consult the gas supplier for the specific recommendations for these shielding gases.] The R&D Manager at Linde/Praxair in a publication noted beyond about 50 CFH just pulls in air and should not be used.

NOTE: IT IS ALLOWED TO COPY THIS GRAPHIC DEPICTION OF MAXIMUM USABLE FLOW RATES FOR THE PURPOSE OF POSTING ON COMPANY BULLETIN BOARDS ETC TO SHOW CO-WORKERS THE REASON TO CONTROL FLOW RATES AND TO LIMIT MAXIMUM FLOW.

Maximum Flow Rates

- In general, for Argon and CO_2 or mixtures of these gases setting flow rates higher than about: :
  - **37 to 43 CFH on a 1/2 inch torch nozzle**
  - **50 to 60 CFH on a 5/8 inch torch nozzle**
  - **60 to 70 CFH on a 3/4 inch torch nozzle**

  is counter productive, and pulls excess moisture laden air into the gas stream.
- Air in the gas stream causes excess spatter, porosity and inferior properties

With solid MIG wires, some Oxygen can be tolerated since the silicon and manganese contained in the wire can combine with the Oxygen to form a silicon oxide or a manganese oxide and avoid the Carbon in the weld puddle forming a CO bubble. However Nitrogen at levels less than 2% in the shielding gas can cause porosity in single pass welds. It has also been reported that 6% Nitrogen in the shielding gas causes visible surface porosity. Unlike Oxygen, chemically combining Nitrogen into harmless compounds is not successful with solid wire. The Water Vapor can also be drawn into the arc where it will disassociate into Oxygen and Hydrogen. Hydrogen can cause more than porosity problems. It can cause cracking.

Reinforcing these flow rate recommendations is an article by Kevin Lyttle, Manager Praxair Welding R&D (now Linde/praxair) entitled "Simplified Shielding Gas Recommendations.". It was published in "Practical Welding Today" and although torch nozzle size is not mentioned since he is writing about production welding we can assume he's referring to the most commonly used 5/8 inch diameter nozzle. He states that 35 to 45 CFH shielding gas flow is the range that should be used in MIG welding. The article further states, *"In many instances production site surveys indicated that typical shielding gas flow rates exceed 50 CFH. This can contribute to poor weld quality as atmospheric gases are draw into the weld zone because of excessive weld turbulence. Optimum flow enhances weld quality and reduces shielding gas usage."*

Note for shielding gas mixtures which include Helium these flow rates do not apply. Consult the gas supplier for the specific recommendations.

Summary: MIG Gas Flow Rates

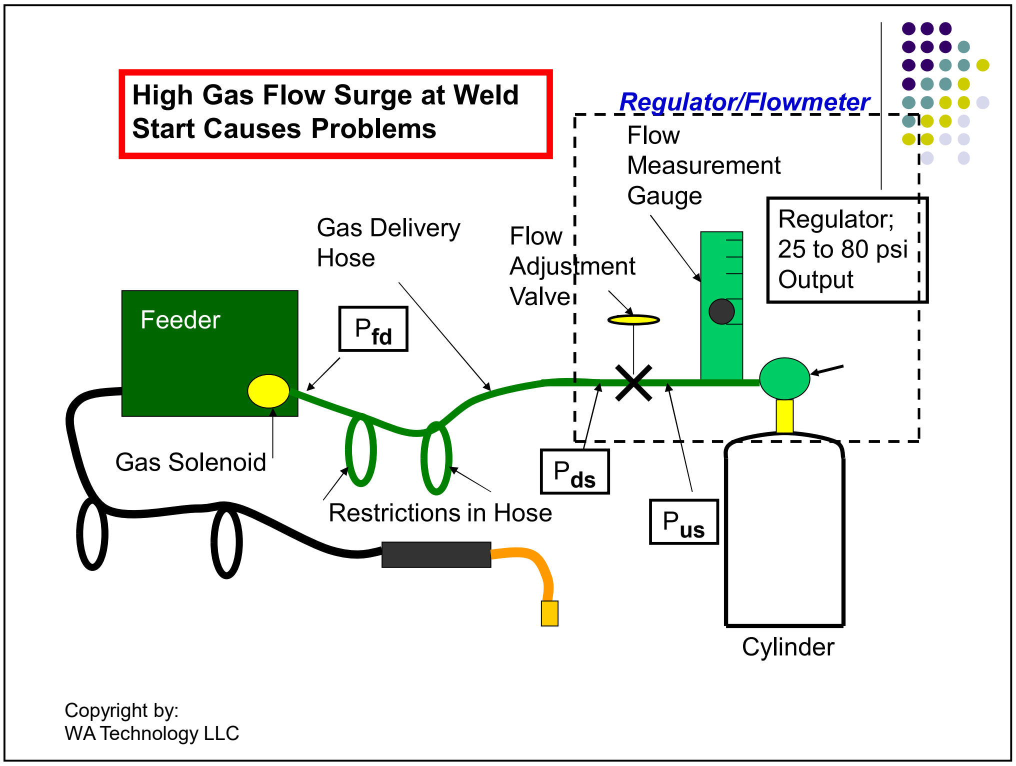
Considering Typical Parameters, the Following are Reasonable Gas Flow Rates for Argon/CO^2 Gas Mixtures and Straight CO^2 Shielding.

Nozzle Size	Minimum	Typical	Maximum
1/2 inch	18 CFH	22-27 CFH	~ 40 CFH
5/8 inch	22 CFH	30-35 CFH	~ 55 CFH
3/4 inch	30 CFH	35-40 CFH	~ 65 CFH

Many believe; *"If some is good more must be better when it comes to gas setting gas flow rates."* They Are Wrong!

Suggested MIG Gas Flow Rates are summarized in this table.

Note, we have found if sufficient extra shielding gas is supplied at the weld start to purge the *Gun Nozzle* and *Weld Start Area* at a *Flow Rate* that *DOES NOT* cause excess turbulence (*NOT the Normal Blast of Gas Found in Most MIG Welding Systems*) the steady state flow setting can be reduced to the low levels shown in the table. Our WA Technology patented *Gas Saver System* provides this condition. This system is described in subsequent slides.



This typical MIG system shows a regulator/flowmeter on a cylinder. These regulators typically operate from 25 to 80 psi (note 80 psi systems are often used when welding with carbon dioxide to reduce the formation of dry ice crystals. A regulator/flowgauge (one having a pressure gauge calibrated in CFH flow) usually operates with a critical orifice and the regulator varies pressure from 35 to over 75 psi. If using a pipeline, the pressure is frequently about 50 psi.

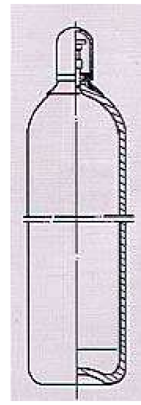
When welding stops, the pressure in the gas delivery hose, if using a cylinder supply, will be the regulator pressure, i.e. from 25 to 80 psi. If a pipeline supply, it will be the pipeline pressure since the flow control is a simple needle valve which will flow gas until the regulator or pipeline pressure is reached. Pds (pressure downstream) will equal Pus (pressure upstream) when welding is stopped.

The pressure needed to flow 30 to 40 CFH of shielding gas measured at the feeder will usually be 3 to 8 psi (Pfd = pressure at the feeder = pressure needed to flow gas through feeder and torch) .

Therefore excess gas will be stored in the gas delivery hose at a pressure much higher than needed. When the gas solenoid is opened the excess gas will be quickly expelled until the gas pressure in the hose reaches the amount needed to flow the preset gas flow. That usually occurs in a few seconds. This excess gas is wasted and even worse creates a gas flow that causes turbulence and pulls air into the shielding gas steam. This causes excess spatter at the weld start.

EXAMPLE OF THE EFFECT OF PRESSURE ON GAS VOLUME

- Consider an Argon gas cylinder. One holding 310 Cubic Feet (CF) of Argon (measured at standard pressure and temperature; that's what you pay for) has only 1.8 CF of internal volume. ***How does it hold all that gas?*** Because of the increased pressure over atmospheric.
- Gas volume in the cylinder is proportional to the absolute pressure. When full, at 2515 psia the volume of gas will be 2515/14.7 or 171 x 1.8 CF = 310 CF.



EXAMPLE, THE EFFECT OF PRESSURE ON GAS VOLUME

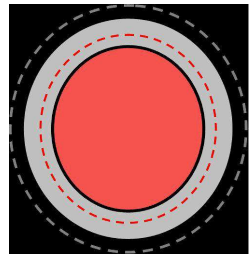
Consider an Argon gas cylinder. One holding 310 Cubic Feet (CF) of Argon (measured at standard pressure and temperature; that's what you pay for) has only 1.8 CF of internal volume. How does it hold all that gas? Because of the increased pressure over atmospheric.

The volume of gas in the cylinder is directly proportional to the absolute pressure. At 2500 psi = 2515 psia (psia = absolute pressure = the gauge reading +14.7 psi at sea level) the volume will be 2515/14.7 or 171 x 1.8 CF= 310 CF. At those pressures the Argon is still a gas but it's actually pretty heavy! (310 CF weights about 31 pounds.) It's about 30% the weight (density) of water!

Therefore when the shielding gas delivery hose is pressurized it holds more than the actual volume of the hose. How much more depends on the pressure.

Pressure and Hose Expansion Create Stored Gas & Waste

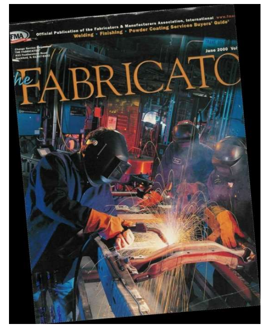
- A 1/4 inch ID, commercial gas delivery hose the high pressure can cause 5 times the amount of gas to be stored in the gas hose as needed.
- In addition the hose will increase in size and hold 13% more volume! Therefore the amount of gas in the hose is actually equal to **5.2 (due to pressure increase) x 1.13 = 5.9 times the hose volume**.



When welding stops the pressure in the gas hose can be as high as 80 psi versus the 3 to 8 psi needed to flow 35 CFH through the torch. Therefore if we assume 5 psi is needed to flow 35 CFH the extra gas in the gas hose will be 5.2 times the hose volume. In addition to the pressure causing increased gas volume, the hose expands when the pressure increases. We have measured a 13% increase in volume with 80 psi systems. Therefore the extra gas in the hose is actually equal to 5.9 times the hose volume.

Gas Waste Quantified

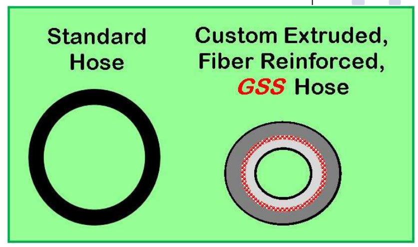
- Fabricator Magazine, quoted an Industrial Gas Company field engineer indicating 3 to 5 times the amount of shielding gas is used as is needed!
- Trailer Body Builders Magazine quoted a major Industrial Gas producer saying they find MIG users consume 3 to 6 times the amount of gas needed.
- We find 2 ½ to 4 times extra is typical.
- Other Industrial Gas Producer representatives find usage is even more than 6 times when leaks are present!



Little information has been published regarding shielding gas waste. The two articles referenced are significant since they quote knowledgeable sources who were willing to go on record about the significance of the problem. These two independent sources mention similar and very high loss values. These have been independently verified by other suppliers of shielding gas who have the data available, as well as our direct observations.

Simple Solution to Reducing Gas Waste at the Weld Start

- A simple, patented solution to the surge flow problem is called the Gas Saver System or *GSS*™. The system uses a custom made gas delivery hose with >80% less volume than conventional hoses.
- The small ID hose and peak flow limiting orifice reduces the gas waste by 85% over 1/4” ID hose.
- Pressure drop in the hose at normal flow rates is minimal.



In addition to the smaller volume hose, the *GSS* contains a built-in surge flow control orifice in the output fitting.

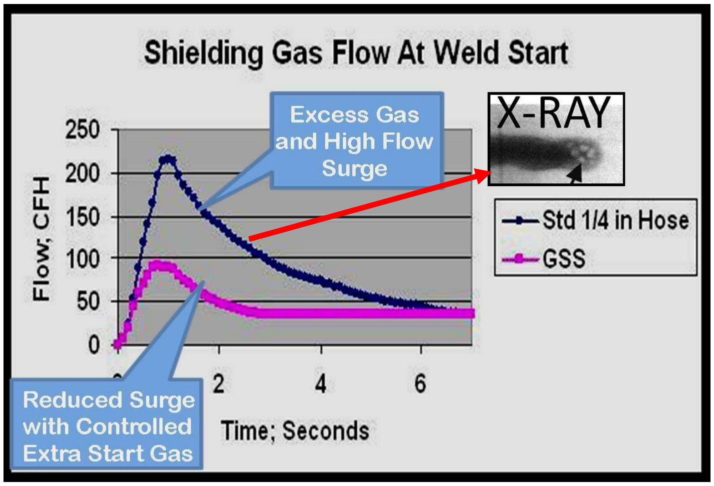
One question often asked is the pressure drop in the small diameter hose. The flow rates in MIG welding are very low, by flow standards. For example, even a small air compressor will usually supply 4 to 5 CFM of air. That is 240 to 300 CFH! In welding we are usually using about ½ CFM or 30 CFH! An adult walking at a slow pace will consume more air (about 50 CFH) than a normal MIG welding uses shielding gas!

The pressure drop in a 100 foot *GSS* system at normal shielding gas flow rates of 35 CFH will be under 10 psi.

Therefore a 50 foot *GSS* cab be used with the lowest quality pressure regulator/flowmeters (25 psi) and still give satisfactory performance. If pipelines with 50 psi are employed, systems exceeding 100 feet will not produce sufficient pressure drop to restrict flow to unacceptable levels. One ATV Manufacturer is using ~125 *GSSs* with 100 foot GSS from pipeline to feeders with excellent results.

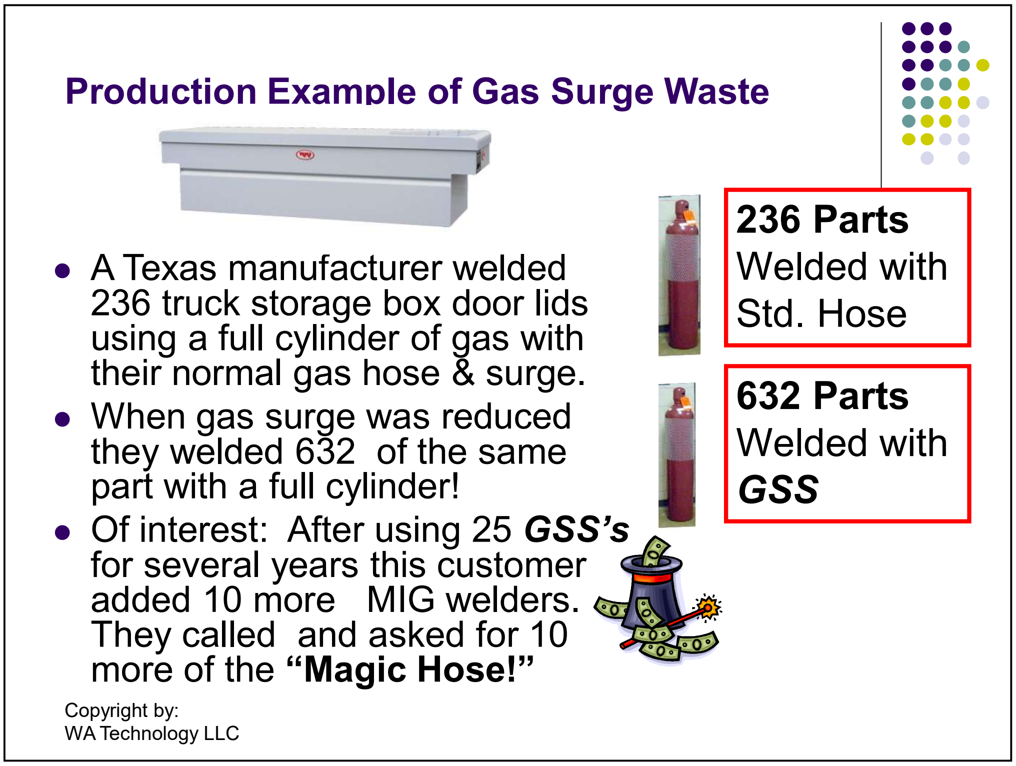
Weld Start Quality Improved Significantly

- Graph shows start flow with and without *GSS*. At > 200 CFH peak flow with their standard system internal weld start porosity was encountered. See details in notes.



A production application demonstrates a significant improvement in weld start quality with the *GSS* as well as gas savings.

Details of Quality Improvement: While testing the *GSS* in a shop doing repair of welds in pipe, the quality benefits were clearly demonstrated. This shop is often required to ultrasonically test all welds. Repair of the sub arc welds are made with MIG in pipe typically ½"inch thickness. These repairs must also pass ultrasonic tests. For a repair weld, starts are a significant part of the deposit. With the standard gas delivery system, flow surge at the start exceeded 220 CFH. With the *GSS* it was lowered to less than 90 CFH. The welder who was testing the system knew this excessive surge flow caused starting problems and stated that he; "*often cuts the wire and starts with it above the work to allow the initial surge flow to reduce in rate before the arc strikes!*" The pipe does not leave his work area until all welds are checked and pass. <u>*After a year in production the welder using the system reports he has found far less weld start porosity than previously.*</u>



A Texas based manufacturer of various types of truck storage boxes purchased a 25 foot Gas Saver System (*GSS*) covered in Module 4, to check for shielding gas savings caused by the gas surge at the weld start. They picked a repetitive job, welding doors, and started with a full cylinder of gas. Welding with 0.035 solid wire MIG, using their standard ¼ inch ID gas delivery hose, <u>236 doors</u> were completed with that cylinder. Putting on a new cylinder and the *GSS*, <u>632 doors</u> were welded before the cylinder was empty! That is 2.7 times more parts due to the reduced gas surge at the weld start!.

And the *GSS* still provides the proper amount of extra gas at the weld start and maintains the pressure in the hose to automatically compensate for restrictions. The extra flow purges the weld area and torch nozzle of moist air but at a flow rate that does not cause excess turbulence in the shielding stream.

The gas savings can be started as equal to *63%*. After these results *GSS* 's were purchased for the whole shop.

More Production Examples

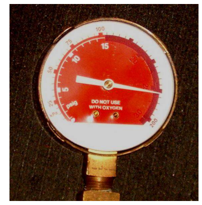
The following are a few production applications using the *GSS* and their gas savings

Truck Body Builder	50% gas savings
Pipe Shop	43% gas savings
Truck Tool Boxes	63% gas savings
ATV Producer	30 + % gas savings
Structural Aluminum	40% gas savings
Pipe Repair	33+ % gas savings and significant weld start quality improvement

These are just a few of the shops that have provide documented test evidence of the savings achieved. A number have purchased more systems when they have added welders.

Why Are Pressures So High?

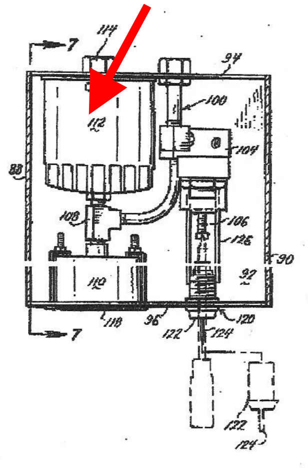
- The regulator or pipeline pressure must be a minimum of 25 psi to maintain the preset flow rates when spatter builds in the torch nozzle and the cables become twisted in production.
- Therefore *you must* have regulator or pipeline pressures above 25 psi to provide this “flow compensating” feature.
- Lower pressure will cause the flow to change as restrictions occur in production.



Flow controls use a needle valve or a flowgauge which uses a critical orifice. For these devices to maintain flow automatically as restrictions vary in production the pressure upstream of the needle valve or orifice must be twice the downstream pressure (measured as absolute pressure which equals gauge pressure plus 14.7 psi). Since pressures at the feeder are typically 5 psi or therefore 5 psi +15 psi = 20 psia then the upstream pressure must be 2 times that value or 40 psia. 40 psia = 25 psi is needed to have flow remain at the preset level as spatter builds in the torch and torch cables are bent and twisted while welding. That’s why the most popular regulator/flowmeters operate at a minimum of 25 psi and have since the introduction of the MIG and TIG welding process!

Extra Gas Needed at Start

- In 1980, Stauffer patented an idea to reduce gas waste. He used a low pressure regulator mounted near the feeder. However he realized this device did not supply sufficient gas at the start to quickly displace air in the torch and weld area.
- He added a large storage reservoir (see red arrow in photo) to provide that extra gas.



Stauffer in a patent published in 1980 discusses this issue. He clearly understood the problem and designed around it; he states in the patent teaching, "... air leaks back into the torch and lines when welding is stopped. The air must be quickly purged and replaced with inert gas to produce high quality welds. Also, it is critical to displace the air at the weld zone of the work piece upon initiating the weld. " Mounting flow controls devices, either flowmeters, orifices or regulators at the feeder eliminates this extra gas. We find welders increase the steady state flow in attempt to compensate for which causes even more gas waste!

What Occurs When Insufficient Extra Gas is Not Supplied

- Proper machine dynamic characteristics and settings are needed for a good weld start.
- However even with optimum machine and settings air must be excluded from the weld start zone.
- When Oxygen and particularly Nitrogen are introduced into the arc poor arc characteristics exist. This results in excess weld spatter
- Even a small amount of nitrogen will lead to weld porosity.

Starting a MIG arc requires the proper machine dynamic characteristics and settings. However even with the optimum machine and settings, shielding gas must exclude air from the weld start zone. As a test, just shut off the shielding gas supply and try to make a weld start. You'll see excessive spatter and a poor quality arc! When Oxygen and particularly Nitrogen are introduced into the arc these poor arc characteristics exist. Even a small amount of nitrogen will lead to weld porosity, even if it is only below the surface.

Gas Leaks Are Often Accepted

- Unfortunately many shop personnel know gas leaks exist but do not fully understand how much they are costing.
- While touring one of the companies many fabricating plants, one senior executive would throw out a handful of quarters on the floor. When asked what he was doing, he'd say; "That's what your doing everyday with shielding gas waste!" He'd leave the quarters!!

A pinhead size, 1/16 inch diameter leak will empty a cylinder in under 2 hours! Or cost over $40,000/yr in a pipeline supply.

A leak as small as an 0.035 inch diameter wire in a 50 psi pipeline or hose connected to it will flow 55 CFH of shielding gas. Since it will leak for 24/7 that's 482,000 CF/yr! If gas cost is $3.00/100CF ($0.03/CF) that's $14,500/year !! That's a good example to put on a bulletin board in the shop! Check your cost for shielding gas, it may be significantly higher.

If the leak is pinhead size (1/16 inch diameter) it will flow 170 CFH. That's 1,490,000 CF of gas/year! If gas cost is $3.00/100CF ($0.03/CF) that's $44,700/year ! Or it will empty a cylinder of gas in under two hours!

Leaks Can Occur in Fittings, Hose and Even Cylinder Valves

- **All connections and gas hose should be routinely checked with a leak detect solution. It will pay big dividends and improve weld quality.**
- **Don't assume the cylinder valve does not have a slow leak check it when changing cylinders.**
- **Also check that the regulator seat and regulators connection when installing on a new cylinder.**

Just because the cylinder valve looks good on the outside, internally it may have a slow leak. Check the contents pressure when you install the regulator to be sure it is full.

A recent experience is worth noting. A brand new regulator was installed on a cylinder and checked for leaks with a leak detection solution; as you always should. It had a leak, actually quite a few bubbles. Thinking it might be the new regulator seat it was tightened slightly more - -same leak. Still believing it may have been a faulty seat on the new regulator, an older regulator was installed- - same leak. The cylinder was returned to the distributor, he as expected, wanted to blame the “new” regulator. He went and got a regulator from his shelf and put it on- - guess what- - same leak. He didn’t need a leak detect solution, he just listened and said, “It must be a bad valve seat!”

Torch Leaks (page 1 of 2)

- One major leak area is where the gas enters the torch. This is particularly a problem with quick connect torc assemblies where smal tubes with very small "O" Rings are used.

Small "O" Ring on gas connector

One of the major area for leaks is the torch and especially where the torch connects to a quick disconnect fitting. It is after the solenoid valve so leaks won't occur when not welding but you'll need higher flow rates to compensate and we'll discuss later air will enter the leak! Replace these often (and lubricate if recommended by torch manufacturer). All systems will leak some gas out the back of the torch through the wire inlet. However this backflow should not become excessive.

Torch Leaks (page 2 of 2)

- A way to check for leaks from the gas solenoid to the torch cup is also an excellent way to maintain a record of each MIG system:
  - Use a portable flow tester to measure the gas flow out of the torch (our Part Number PFM.)
  - Then disconnect the gas delivery hose from the feeder and measure the gas flow leaving the gas hose.

Comparing the flow rate at the torch with the flow rate at the end of the gas delivery hose will tell you what the torch leaks are as well as those other possible internal leaks, Since your using the same gauge the results are accurate and repeatable.

This high quality portable gas flow gauge is available from WA Technology @ www.NetWelding.com

A Final Fact About Shielding - Gas Leaking Out Means Air Leaks In!

- Another somewhat difficult concept to grasp but an important one for all gas shielded welding is:
  - When gas leaks out of a hose or fitting there is an opening. Assuming the pressure inside is higher than the pressure outside, gas will leak out due to the pressure differential.
  - However a much more subtle thing occurs. Since a hole exits, ***air will move back into the shielding gas hose-*** explanation below.

In 1766, John Dalton found that a mixture of gases behaves as if each were separate. Therefore since there is no Nitrogen in our shielding gas hose the partial pressure of Nitrogen in the hose is 0. Since there is 78% Nitrogen in the surrounding air, the partial pressure of Nitrogen is 14.7 psia x .78 =11.5 psia. Therefore, there is a driving force for the Nitrogen to reach equilibrium of 11.5 psia into the hose leak!

Another way to think about Oxygen, Nitrogen or water vapor going back through the hole in our gas delivery hose where an Argon or CO_2 based shielding gas is leaking out is to consider Dalton's statement: "The gas molecules are spread very far apart. The Oxygen, Nitrogen or H_2O vapor will not likely hit an Argon or CO_2 molecule on its journey through the hole! In fact, considering the diffusion phenomena, it doesn't even care about the Argon or CO_2. To provide a picture of how far apart say Argon atoms are at atmospheric pressure as they escape from a leak consider: the density of Argon at room temperature and atmospheric pressure is 787 times less than liquid Argon. Therefore the spacing between Argon atoms in the gas is 787 times larger than in Argon Liquid! Pretty far apart!

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W A Technology

Overview of Patented Gas Saver System (*GSS*™)

The *GSS* is a Patented Gas Delivery Hose Incorporating a Start Flow Surge Limiter That Can Save 50% or More of MIG Shielding Gas Use and Improve Weld Start Quality.

The Problem – An orifice or a needle valve are used to set and control gas flow. With Regulator/ Flowmeters (photo right) outlet pressures range from 25 to 80 psi. Flowmeters used on pipelines allow pipeline pressure to exit the flow control valve when welding stops. A typical pipeline pressure is 50 psi.

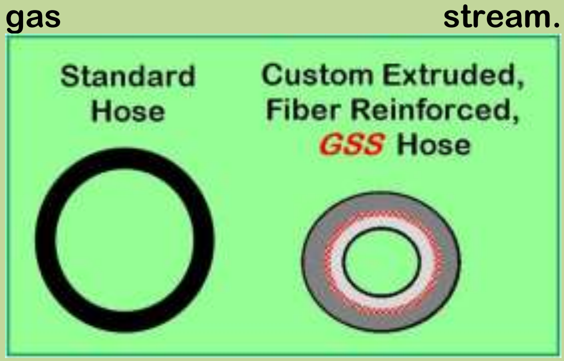
Flowgauge/Regulators (photo left) operate by setting a pressure above a critical orifice. For most MIG shielding gas flow rates, the pressure exiting the control orifice when welding stops will range from 40 to 70 psi.

However, the pressure needed at the feeder to set the desired flow can range 3 to 8 psi depending on gun length and restrictions that occur when welding, such as spatter in the gas diffuser ports, clogged conduits that also serve as the gas passage in the gun cable. When welding stops, gas fills to regulator or pipeline psi. Therefore, the pressure can be 80/3 = ***26* times** the pressure needed to flow the desired amount of gas!

Excess Pressure Means Excess Shielding Gas is stored in the gas delivery hose. Most of this excess gas is wasted every time the MIG gun switch is energized, even when just inching the wire. The excess can exceed the amount of gas used while welding!

The Solution - Our patented *Gas Saver System* (*GSS*) stores 80%+ less gas when welding stops.

The *GSS* solves this excess stored gas problem by utilizing a custom extruded, very heavy wall, gas delivery hose with much less volume than conventional hoses and uses a surge flow-limiting orifice. Excess stored gas creates another problem as it exits the gun nozzle with a high surge flow at the weld start. Start gas flow rates far exceed the level that allows smooth Laminar flow. It creates turbulent flow that pulls air into the shielding gas stream.

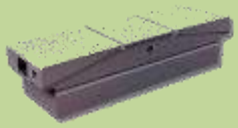


The surge flow restrictor not only adds to waste reduction, it improves weld starts. The start surge flow restrictor is sized so it *does not* limit normal gas flow settings. Welders often see this starting benefit as reduced spatter.

Superior Start Quality - Limiting start flow velocity to a rate that avoids excessive turbulence is achieved while quickly providing enough extra gas to purge the gun nozzle and weld start area. This controlled surge flow rate eliminates moisture-laden air from being mixed into the gas shield that results in excess spatter and possibly weld porosity.

The patented ***GSS*** design maintains system pressure to retain *Automatic Flow Compensation* built into standard gas delivery systems since the introduction of MIG and TIG processes! If the pressure is lower than 25 psi, this feature is lost!

Savings Proof: A manufacturer making truck boxes reported the following test results. They used their standard gas delivery hose and welded 236 truck box doors with one cylinder of shielding gas. With the ***GSS*** installed; the same welding conditions and flow rate while welding, they welded 632 of these doors with one cylinder! That is a 63% savings in gas use.

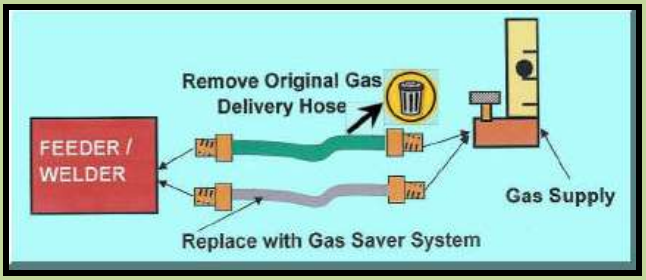


Bottom Line - The patented ***GSS*** has no moving parts to wear, maintain or knobs to adjust. It *does not* set the shielding gas flow rate while welding. The welder sets that steady state flow rate, typically with whatever device is being used or any quality flow control. Welders appreciate the start benefits and are not irritated by restrictors that set flow they cannot adjust or low-pressure devices that cause flow variations while welding!

The ***GSS*** is inexpensive with ***Payback*** measured in months. Well over 15,000 are in use, collectively saving millions of dollars of shielding gas per year and improving weld start quality.

Welders LOVE The Improved Starts

EASY TO INSTALL
Just Replace Your Gas Delivery Hose with Our GSS



Welders Setting Excess Flow?

We have another patented product that can be used in conjunction with our ***GSS***. Our Flow Rate Limiter and Lock (***FRLL***.)

This billet aluminum part fits over the flow control adjustment knob on most flowmeters. A set screw locks the ***FRLL*** on the knob so it cannot be turned higher than where it is set. A small brass lock blocks access to the set screw! A number of customers use both, like a motorcycle manufacturer and Tier 1 automotive exhaust supplier.