WA Technology

Check & Demo Shielding Gas Waste

Index

Rather Watch a Video Overview Than Read? See:
Short: *http://www.youtube.com/watch?v=RkJByj3U0eM*
Detailed: *http://www.youtube.com/watch?v=D-XuL3kubtI*

WAT-PTD (Pressure Test Device)

The WAT-PTD is an effective, simple tool to check and demonstrate a major reason for shielding gas waste - gas surge at weld start. It can be used to check flow restriction variations that occur in production, define when to clean gun cable conduits etc and measure pipeline pressure.

The relationship of gas volume with pressure must be understood to gain full benefit of the WAT-PTD. The following example of how much air is in a tire demonstrates how gas pressure effects gas volume. The tire is a 15 inch size, with an outer diameter of 25 inches, a width of 10 inches and is filled with 35 psi of air:

The volume formula for a toroid (photo upper left) is used to estimate physical tire volume:
Volume $=19.7 \times R \times r^2$
For the tire: $r = 10 \text{ in} / 2 = 5 \text{ in}$ and
$R = (15 \text{ in} + 5 \text{ in}) = 20 \text{ in}$
Then volume $= 19.7 \times 20 \text{ in} \times 5^2 \text{ in}^2 = 9{,}850 \text{ in}^3$
Converting to cubic feet, multiply $9{,}850 \text{ in}^3 \times 1 \text{ ft}^3 / 12^3 \text{ in}^3 = 5.7 \text{ ft}^3$ or CF

Is 5.7 CFH How Much Air is in the Tire? *NO!*

Assume tire pressure is 35 psi, gauge pressure. However we exist in an atmosphere of air which, at sea level, is 14.7 psi. The actual pressure, called absolute pressure, is 35 psi + 14.7 psi = 49.7 psia. The volume of air in the tire is proportional to the absolute pressure ratio times the physical volume. A deflated tire starts with 14.7 psia and increases to 49.7 psia. The amount of air in the tire is the physical volume of 5.7 CF multiplied by 49.7 psia / 14.7 psia for a total of 19.3 CF. Therefore the physical volume of 5.7 CF holds 19.3 CF of air when it is measured at atmospheric pressure.

A Welding Example

Consider a large shielding gas cylinder, one that must be rented. It has a physical internal volume of 1.8 CF. If gas cost is $0.15/CF (also stated as $15.00/100 CFH) for a fill-up, is all you have to pay 1.8 CF x $0.15 = $0.27? *NO WAY!* Lets calculate what you'll be charged.

The distributor fills the cylinder with 2500 psi of shielding gas. Then that cost will be: 1.8 CF X (2500 psi + 14.7 psi)/14.7 psi = 308 CF of gas when it is measured at atmospheric pressure. You'll be charged for 308 CF x $0.15/CF = $46.20 for the gas.

What is the Pressure in the Gas Delivery Hose from Gas Source to Welder/Feeder?

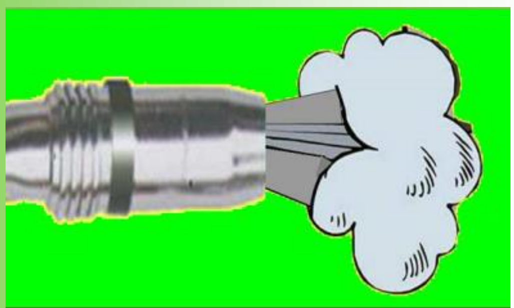
The gas pressure/volume relationship helps define why a great deal of gas is wasted at each MIG (or TIG) weld start (in addition, to causing inferior start quality.) If using a regulator/flowgauge (photo left) the regulator pressure is set above a very small orifice to determine flow. The gas must flow through the orifice, typically about 0.025 inches in diameter. The velocity of the gas in the orifice cannot exceed the speed of sound and at typical MIG flow rates, that limiting velocity controls the flow rate. The pressure downstream of the orifice will be whatever is required to flow the gas volume that is being controlled by the orifice. We have found the pressure will vary from 3 to 8 psi in production MIG operations. The amount will vary depending on restrictions. That is the pressure range needed to flow 25 to 35 CFH of shielding gas through the welder gas plumbing and out the MIG gun nozzle.

Every time welding stops, the gas solenoid in the welder/feeder closes, blocking that end of the gas delivery hose. However, gas will continue to quickly flow through the orifice until it reaches the regulator pressure, which can be 50 psi for a typical system. The delivery hose is then filled with 50 psi of gas, not the 3 to 8 psi in the hose when welding. That is (50 psi + 14.7 psi) / 14.7 psi (the absolute pressure ratio) or 4.4 times the physical hose volume of gas.

We have also measured a typical 1/4 inch ID gas delivery hose and found, when it is pressurized, it expands ~13% so the actual gas in the hose is 4.4 x 1.13 = 5 times the physical hose volume. (Note the same thing happens with a regulator/flowmeter (photo right) as gas flow rate is controlled by a velocity through the needle valve.)

Some regulators for CO^2 service use 80 psi to avoid ice particle formation. The gas volume is then (80 psi + 14.7 psi) / 14.7 psi = 6.44 times the hose volume. Accounting for hose expansion that equals 6.44 x 1.13 = 7.3 times the amount of gas as the physical hose volume. Lots of excess stored gas, ready to blast out!

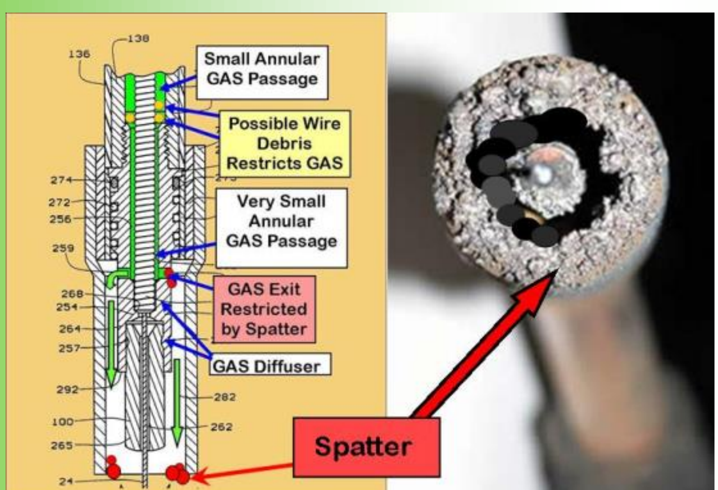
What Happens to The Extra Stored Gas?



The extra gas stored in the gas delivery hose when welding stops, "blasts out" of the MIG nozzle at every start or even when just inching the wire forward to cut off the end for a better start or to position the wire in the joint!

This does two things: 1) often wastes 40 to 50% of the total gas being used and 2) makes inferior weld starts since the high velocity pulls air into the gas stream degrading the shielding! We have measured peak flows over 200 CFH in production operations. Any flow rate over about 50 to 55 CFH causes turbulence that pulls air into the shielding gas stream. It takes some time after the flow returns to the preset value for the turbulence to return to a desired smooth, laminar flow. All of that time air is being pulled into the gas stream causing inferior shielding.

Then Why is the Gas Pressure so High?



When MIG welding, flow restrictions occur. These mostly come from spatter in the MIG nozzle, the small gas diffuser holes getting plugged with spatter and the small gas passage in the MIG gun cable being constricted as it changes shape when the MIG gun cable is bent and twisted.

To achieve what is called "Automatic Flow Compensation" the pressure upstream of the flow control orifice or needle valve must be greater than 25 psi. With a minimum of 25 psi upstream pressure, the flow will be controlled by the velocity in the orifice or needle valve and remain at the preset value regardless of the typical flow restrictions encountered when welding. For details about how automatic flow compensation works (employed since MIG was invented) visit: *http://www.netwelding.com/Automatic_Flow_Control.htm*

Now That the Relationship Between Pressure and Volume Has Been Defined:

Let's see what happens in a MIG system by using our WA Technology Pressure Test Device (WAT-PTD) on the following pages:

WAT-PTD (Pressure Test Device)

The WAT-PTD (a pair shown in photo left) can be installed at the gas supply end or the wire feeder/welder end of the gas delivery hose.

It consists of a 0 to 100 psi industrial quality pressure gauge with a male CGA 032 “B” connector on one end and a female CGA 032 “B” connector on the other. Simply unscrew the gas delivery hose and inset the WAT-PTD, then reinstall the gas delivery hose. The photo right shows The WAT-PTD installed on the outlet of a regulator/flowmeter.

What Will You See?

When welding, the pressure in the gas delivery hose will typically range from 3 to 8 psi (photo left shows 4 psi) depending on MIG gun type, cable length, spatter build-up and possibly the amount of debris that may have accumulated in the gun cable gas passage. The latter restriction is not obvious, but for most MIG gun cables the shielding gas delivery hose doubles as a retainer for the spiral wire liner. That liner can clog with debris from the wire, such as copper flakes or wire drawing lubricant and needs to be cleaned periodically.

Every time welding stops, gas continues to flow and quickly fills the hose with more gas volume, as observed by the pressure rising to the regulator or pipeline pressure. The regulator pressure of 53 psi is seen in photo right. The gauge helps visualize the excess shielding gas volume stored in the gas hose by using the information found on pages 1 and 2 of this bulletin. If using a regulator/flowmeter to set flows, the gas can be also observed flowing into the hose after welding stops!

The excess gas stored in the hose blasts out at a very high rate. The high gas flow can also be heard. The pressure drops to the welding rate of 3 to 8 psi.

The WAT-PTD can be used to check flow restriction variations that occur in production and point to the need for cleaning gun cable conduits, checking for spatter plugging the small gas diffuser holes, or other flow restrictions. It can also be used to check pipeline pressure an each welder to determine if pressure drops are occurring as welders are placed on line. Full details on “how to use” are presented in the instructions that come with the WAT-PTD.

Gas Saver System (*GSS*) Eliminates Waste

- Shielding gas waste at each start is determined by the hose volume and gas pressure. Our patented ***GSS*** (right) cuts hose volume about 80% while maintaining system pressure.
- Sufficient extra gas is provided to quickly purge the weld start area and gas nozzle of air. The extra start gas peak flow rate is limited to avoid turbulence by employing a flow restriction orifice at the feeder/welder end of the ***GSS*** hose. This peak flow control orifice ***does not*** interfere with the steady state flow rate that is set by the welder at the gas supply with an existing regulator/flowmeter, regulator/flowgauge on cylinder supply or a flowmeter or orifice on pipeline gas supply.
- The ***GSS*** simply replaces the existing gas delivery hose. It accomplishes the gas savings and improved weld starts with no moving parts, knobs to adjust or parts to maintain. Most important, it does not irritate welders! In fact, a number have mentioned they appreciate the improved starts.

Examples of Reduced Gas Usage

Fabricators have reported results using the ***GSS*** in carefully controlled tests of gas usage. There are 17 specific test results available on the following web page: ***http://netwelding.com/production_test_results.htm***
Here are two:

- A truck box manufacturer picked a part they make by the thousands, doors. They used cylinder gas supply to compare usage. With their standard gas delivery hose they were able to weld 236 doors with one gas cylinder. Just changing to the same length ***GSS***, using the same steady state gas flow, amps, volts, they welded 632 doors. That is a 63% total gas savings! They purchased 23 systems for all their MIG welders, and about a year latter, when adding 10 new welders called and asked for 10 more of the "magic hose!"

- A manufacture of OEM exhaust systems conducted a detailed black belt, lean manufacturing study on several robotic MIG welders. There was only 6 feet of gas delivery hose from their pipeline gas supply to their robot. They tested many of their muffler and exhaust pipe joints using cylinder supply to accurately measure gas use. They counted identical parts made with full cylinders. They reported savings of 25 to 41%. They installed WAT-FB6 ***GSS***'s on all 126 robots. They have also purchased a number of our patented Flow Rate Limiter & Lock products to limit the maximum allowable flow settings.

How Much Gas Can the *GSS* Save?

Depending on the number of weld starts and stops, number of tack welds, how often the MIG wire is inched forward to cut off the end for better starts or to position it in the joint, the gas waste and therefore savings the *GSS* can achieve will vary. Our customers report typical savings of from 30 to over 50% with an average of about 40%.

If welders are setting excessive flow rates or if there are gas leaks, this also adds to gas waste. We have two self study learning programs available for a nominal price that can be used to educate welders and welding supervisors about ways to reduce overall gas use.

Pair of Test Devices and Special Offer

In addition to the WAT-PTD, which is useful for checking flow restrictions and helping to demonstrate the issue of gas surge waste, there is another testing product we offer. The WAT-PFM is a portable flowmeter that can be used to check the actual gas flow exiting a MIG gun or TIG torch. This variable area flowmeter is accurate and very repeatable. The flow measurement ball rises in the calibrated tapered ID tube until the area around the ball allows the force of the flowing gas to balance the force of gravity on the ball. Our instructions also define a simple way to check for leaks from the gas inlet to a MIG wire feeder and the gun nozzle using the device.

For a limited time, if you purchase both a WAT-PTD and a WAT-PFM, we will supply, free of charge, our 70 page, Self Study Learning Program, "Optimizing Shielding Gas Use and Eliminating Waste;" WAT-LWM-SG, a $19.95 value. See this page for purchase details: ***http://netwelding.com/prod02.htm#WAT_PFM***

Purchase:
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WAT-PFM and
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WAT-LWM-SG
Learning Program