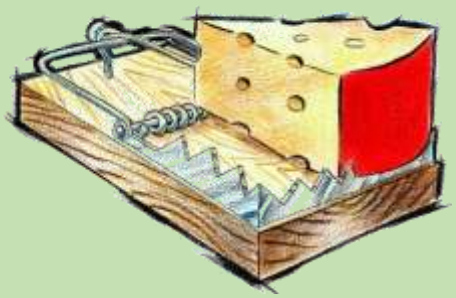
# Why Chart Industries Has Over 2500 GSSs Installed

1) Many customers report ***GSS*** shielding gas savings of up to 50+%;

2) Some fabricators don't understand they have a shielding gas waste problem or how our simple, low cost ***GSS*** works;

3) From my observation, the following are some reasons Chart, a customer since 2013 with over 2500 ***GSS***s continues to buy systems for new welders and for newly acquired fabricating companies:

***The First Reason:*** They know they were wasting shielding gas!



A customer recently said, *"I can't understand why every MIG welder doesn't use your great, low cost Gas Saver System (**GSS**)? Like the saying, Build a Better Mouse Trap and People Will Beat a Path to Your Door."*

I told him, "That only fits if they know they have *MICE!*"

I recall some years ago the VP of a major fabricator said he would load his pockets with quarters before visiting and touring one of their many plants. He'd toss them on the ground and welders would scurry to pick them up. The plant manager, conducting the tour, would ask, ***"What are you doing?"*** He'd say, ***"That is what you're doing every day- wasting shielding gas!"***

I have had fabricators tell me their gas supplier has checked their usage and said it was fine! *What a joke!* I was Director, Welding Market Development for Linde just before they changed their name to Praxair. The Groups function included training salesman and regional engineers about shielding gases. At that time we taught that a large amount of the shielding gas purchased was wasted!

Of interest, a Praxair engineering representative in an industrial magazine article said the average fabricator uses three to five times the amount of shielding gas they should (see Reference 1.) A friend, working for Praxair at the time, said their customer market surveys of shielding gas use showed gas waste was worse than that!

***The Second Reason:*** **Chart has a very knowledgeable, PhD Corporate Welding Engineer. He found our product on the Net and knew their fabricating plants would have to prove to themselves our *GSS* was cost effective. The initial plants that tried the product purchased prefitted hose as sold on our website.** (*Note: Lengths up to 25 feet are listed but we can supply prefitted hose 50 feet long and on occasion have made them 100 foot long. Honda ATV production near our location has over 125* ***GSS****s 100-foot-long. Their power sources are above the welding areas on heavy metal grating. The welding power and control cables from power source to wire feeder along with our* ***GSS*** *gas deliver hose from flowmeters on a pipeline supply are neatly arranged in cable trays.)*


**The Chart Welding Engineer, after tests showed significant shielding gas waste reduction, had all plants install the product. There are 12 locations with over 2500 welding systems using *GSS*s and saving gas waste year after year as no there are no moving or wear parts!**

**A key benefit is the *GSS* does not limit the welders steady state flow setting, which they still control with any quality flow control device. Many welders see and appreciate the reduced spatter starts.**

***The Third Reason:*** **The Chart Welding Engineer also understands that leaks in pipeline gas supply can be a significant cause of waste. He has a methodology similar to what we outline in our Home Study Course, Lean Welding Manufacturing – Learning Program.** [http://netwelding.com/Lean_Mfg._Tools.htm](http://netwelding.com/Lean_Mfg._Tools.htm)

**Our suggested method is to use a simple leak down test to quantify leaks in CFH and fixing.**

**In addition to fixing leaks, there needs to be an ongoing vigilance to systematically check the gas delivery systems. We offer several training programs to educate welding supervisors and welders. One is called "Lean Welding Manufacturing" Learning Program Optimizing Shielding Gas Use and Eliminating Waste" (part # LWM-SG).**

**This 71-page, inexpensive program, can be used as a self-study leaning program. It includes a method of making a spreadsheet providing a way of quantifying and periodically monitoring leak rates in pipeline gas supply.**

**The Chart Welding engineer is also well aware that welders setting flows above ~50 CFH is ineffective and just pulls air into the shielding gas stream. That flow rate as a maximum, was validated in a published article by Praxair, see (Reference 2.) We have another patented product that locks the flow control knob from turning on most flowmeters, which can be used to in addition to welder training.**


**Chart Background;** *From Their Website*:

**Chart Industries is an interesting growing company, now building products at the heart of the energy revolution. Abundant, clean burning and less costly than distillates on an energy equivalent basis, natural gas has become the global fuel of choice as a bridge to a non-carbon future that is still decades away.**

**A few years ago, Charts main products were the critical components in the separation of oxygen, nitrogen and argon from air. Their distribution and cryogenic storage products and engineered systems are fundamental to the delivery and end-use of liquid gases across a multitude of applications in industry and for energy. They also have a historical knowledge and products for producing LNG.**

**Chart Today:**

**They continue to fabricate products for producing and storing atmospheric industrial gas and have expanded their facilities for liquefaction, pressurization and shipping of natural gas.**

**This growing natural gas distribution business is very exciting.**

**Chart products and associated process technology are critical to the cryogenic stages used in natural gas processing. Liquefied Natural Gas (LNG) is natural gas that has been refrigerated to approx. -260°F (-162°C) and condensed. In its liquid state natural gas occupies around 1/600th the volume of its gaseous state making LNG the cost-efficient solution for storage and transportation over long distances and/or where no pipeline exists.**

**For more than 40 years Chart has pioneered the development and use of LNG and supplied equipment and solutions across the complete LNG value chain – Liquefaction, Storage, Distribution, End-use.**

**Europe, for example, has very limited supplies of gas and oil. They were getting a great deal of liquid natural gas from Libya by ship and gas from Russia by pipeline. Today, those are not stable, secure sources for gas. The US can fill some of that need.** The US has about 210 trillion cubic feet (Tcf) of proven shale gas resources. At the rate of U.S. natural gas consumption of about 27 Tcf per year, the U.S. has enough natural gas to last **about 90 years**.

**References:**

1) Weber, R., How to Save 20% on Welding Costs. Trailer/Body Builders, Volume 44, Number 3, January 2003.

2) Lyttle, K. and Stapon, G., Simplifying Shielding Gas Selection. Practical Welding Today, Vol. 9, No. 1, Jan/Feb 2005.

# APPENDIX A

### Case Examples of *GSS* Saving Shielding Gas

A number of fabricators have reported their ***GSS*** testing results. The following summarizes data from a just a few who have quantified test data:

**Truck Body Builder**

Double A Body Builders knew they were wasting shielding gas and wanted to reduce the high cost. Ken Ard, President, set up a test using two of his 23 MIG welders that were both welding with the same 0.035 wire and the same welding conditions. He started the test with one welder using their standard 25-foot gas delivery hose and the other with an equal length ***GSS***. Both welders operated at the same current. He also started with new coils of wire on each machine. When both cylinders were empty, he weighed the coils of wire. The one with the ***GSS*** had used twice as much wire. Since both welders were doing the same job, the one with the ***GSS*** also welded about twice as long! Needless to say, Ken purchased systems for all 23 MIG welders. When he expanded his business 2 years later, he purchased 20 additional systems.

**OEM Exhaust Manufacturer**

This company was conducting a Black Belt Lean Manufacturing study to reduce costs. They only had 6-foot gas delivery hose from their gas pipeline to their 126 MIG robotic welders. They purchased four 6-foot ***GSS***’s to test all their various weldments. Since the robots repeated each joint with precision, their test data is very accurate. Although on pipeline gas supply, they used cylinders for the tests. Since their pipeline operates at 50 psi they made sure, they used regulator/flowmeters that matched that pressure. Since they make many of the same parts, they could easily count the number of parts made with a full cylinder of gas and their standard hose and with the ***GSS***. After testing all their weldments, they found savings ranging from a low of 25% to in excess of 40%. They purchased systems for all 126 robots! Several other exhaust system fabricators have also installed ***GSS***s.

**APPENDIX A (continued)**

**Pipe Fabricator**

A pipe fabricator tested the ***GSS*** for gas savings. They again used cylinders to define a fixed amount of gas usage. In their case, they used flux-cored wire and on one job with their standard gas delivery hose, they welded 32 pounds of wire with one cylinder. Just substituting the ***GSS*** with no other changes in welding conditions or gas flow; they used 53 pounds of flux-cored wire with a full cylinder. That equates to a 41% shielding gas savings. They initially purchased 114 systems and added another 80 when they installed more welding machines in a shop they acquired.

**Chiller Manufacturer**

A company in Mexico conducted tests for their production of chillers. They purchased a 12-foot ***GSS*** and found savings ranged from 30% to a high of 42% easily justifying the investment. Since some of their applications use longer hoses than the 12-foot system tested, their savings will be even higher. Remember it's the excess gas volume stored in the gas hose that causes waste and excess turbulence on each weld start. They initially purchased 60 ***GSS***'s, after a year in use expanded their operation, and purchased an additional 55 systems.

**Truck Box Fabricator Tests *GSS***

A fabricator of truck boxes had 25 MIG welders. They knew they were using excess gas and wanted to try our ***GSS*** as a possible solution. They use pipeline gas supply but to test the ***GSS*** they purchased two gas cylinders with the same gas mixture they employ. They purchased a flowmeter that utilized a 50-psi regulator similar to their pipeline pressure. A part was selected that they made by the thousands, truck box doors. *With their standard gas delivery hose* and normal welding conditions, gas flow etc. they installed one of the full cylinders and proceeded to *welded 236 doors until the cylinder was empty.* Only replacing their gas delivery hose with the small volume *patented **GSS,** they used the same welder, same welding conditions, and the same shielding gas flow setting. The new cylinder was able to make 632 doors before it was empty! That was 63% less gas used.* Or 2.7 cylinders would be needed to weld 632 doors with their old system! After about a year using the 25 ***GSS***'s purchased, they expanded their operation and added 10 more welding machines. They called and asked for 10 more of the "Magic Hose!"

## APPENDIX B

**Measuring Gas Use and Waste is Easy:**

**Estimate What Your Shielding Gas Usage Should Be:**

First: Determine wire purchases in pounds over past say 6 months.

Second: The right column (in red) is based on typical CF gas flow rates and shows how much gas you should have purchased to weld each pound of wire.

Third: Find the CF of gas purchased in the same 6 month period.

Note: You'll need to convert purchases to Cubic Feet (CF.) If purchasing $CO_2$ in pounds, there are 8.74 CF per pound of $CO_2$. If purchasing liquid Argon in gallons there are 113 CF per gallon.

| Wire Type | Size | Typical Lbs/hr | CF Gas/ pound Wire Pur- |
|---|---|---|---|
| Solid | .035 | 3.5 | 10.0 CF |
| Solid | .045 | 7.0 | 5.0 CF |
| Cored | .035 | 6.5 | 5.5 CF |
| Cored | .045 | 7.5 | 5.0 CF |
| Cored | 1/16 | 11.0 | 3.5 CF |
| Cored | 3/32 | 14.5 | 2.5 CF |

EXAMPLE

You purchased 46,000 lbs. of 0.045 diameter solid wire in the past 6 months and during the same period 710,000 CF of Argon and $CO_2$ combined:

1. Multiple the value from the far-right column (red numbers) in the above table times the wire purchase amount; 5.0 CF/pound X 46,000 lb. of wire purchased = 230,000 CF of gas you should have purchased

2. But you purchased 610,000 CF of gas. Therefore 610,000 – 230,000 = 480,000 CF was wasted or 480,000 Wasted / 610,000 Purchased = **62% Gas Wasted!** ***You can do better!***

If you use several types of wire, treat each individually and add the total gas requirements

**The % Cost of Shielding Gas**

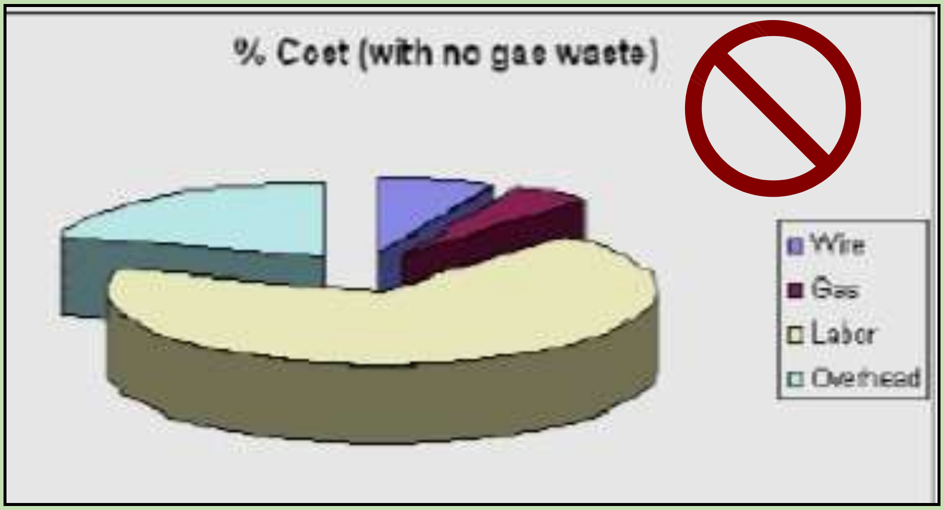
A typical way welding gas costs are presented simply multiplies the hours spent actually welding by the gas flow setting. This is based on an ***erroneous assumption*** that no gas is wasted. I see that approach in may cost estimates!

The cost of shielding gas is often quoted by gas suppliers as only about 5% of total welding cost. But this does not include the inevitable extra gas used which may not even come from leaks or excess flow settings! It's the "gas blast" at each weld start that wastes gas and makes inferior welds to what can be achieved.

**APPENDIX B (Continued)**

The following pie chart is typical of what is shown in most welding articles. Industrial gas companies and distributors often quote this low percentage number.

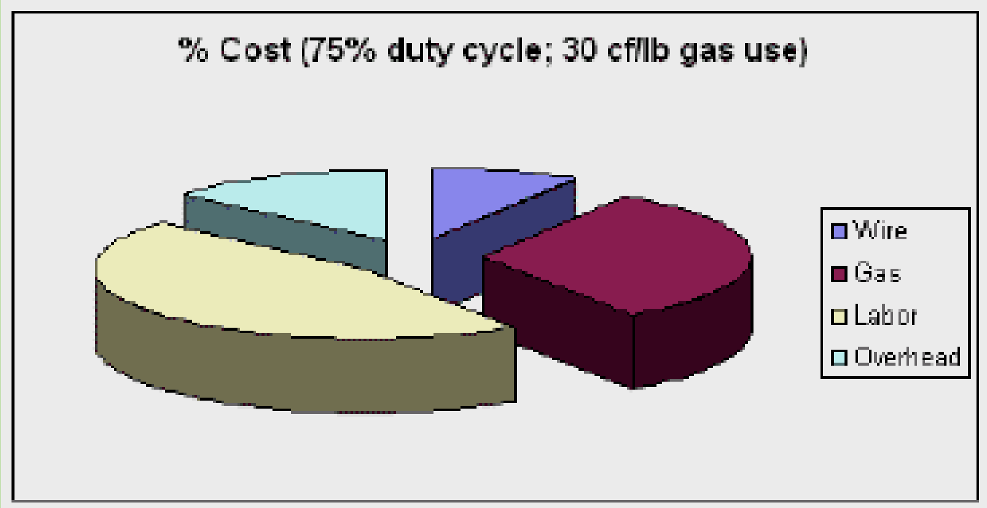
**Then why is your gas use so much more? You're not alone!**




If the typical gas waste (as defined in published literature) is used, a much different picture is found.

The pie chart below assumes the 30CF of shielding gas per pound of wire is used that the two published articles (one by a major gas supplier) site as typical. Now shielding gas costs are not 5% of total cost but rather **32%!! Depending on what you're paying for gas this could be you!**

**What is yours?**



## APPENDIX C

**Example of Some False Savings:** Low Pressure Devices mounted at the wire feeder to save gas actually cause gas waste and inferior weld starts!

Understanding the problems created by the start gas surge, some manufactures had introduced low-pressure devices in attempt to solve the gas waste problem. However, they forgo automatic flow compensation built into gas delivery systems since the inception of MIG welding! In fact, one manufacturer who introduced a low-pressure system to their line of flow controls wrote a technical article published in Flow Control Magazine that states: ***"… there are applications in which a compensated unit (***referring to higher pressure flow compensating regulator/flowmeters***) may be required. When long lines from the flowmeter to the gun cause back-pressure or when wind causes the shielding gas to blow off, the compensated system may be the solution to these problems."***

We have found these low-pressure devices create problems in ***"all cases,"*** not just where it's mentioned in the technical paper! A number of fabricators relayed the significant problems encountered with a low-pressure device that mounts at the wire feeder. It has two problems: 1) Lack of automatic flow compensation causing variations in flow from preset levels and 2) Since mounted at the wire feeder, insufficient extra gas at the start causing inferior weld starts.

Tests were conducted with this device versus a normal 25 psi regulator/flowmeter (photo left).The following table shows the test results with a conventional regulator/flowmeter that operates at 25 psi and a low-pressure "Gas Guard" device (photo right) both subjected to varying MIG gun flow restrictions. Both were initially set to flow 31 CFH (shown in green in the following table.) Placing a test pressure gauge after the low-pressure device showed only 9 psi was required to flow 31 CFH.

That 9 psi is well below the minimum 25 psi needed to provide automatic flow compensation which the developers of MIG (*who both sold shielding gas and understood flow issues)* knew and always employed for their gas flow controls as a minimum pressure! That means the shielding gas flow will not only be determined by the pressure upstream of the flow control device (in this instance an orifice) but also the downstream pressure that varies with flow restrictions. This low pressure device does not operate using the "choked flow" design.

For our tests, the controls were left at the initial settings as if they were padlocked. MIG gun restrictions were then added and removed and flow measured at the gun nozzle with a portable flowmeter.

**APPENDIX C (Continued)**

| Flow Control System | Typical Production Pressure Restriction Range; psi | | | | | |
|---|---|---|---|---|---|---|
| | 3 psi | 4 psi | 5 psi | 6 psi | 7 psi | 8 psi |
| *Conven-tional = 25 psi*  | 31 CFH | 31 CFH | 31 CFH | 31 CFH | 31 CFH | 31 CFH |
| Low Pressure Device; = 9 psi  | 37 CFH | 34 CFH | 31 CFH | 27 CFH | 23 CFH | 16 CFH |

With the conventional 25 psi regulator/ flowmeter the gas flow did not change with the restriction variations found in use. The pressure in the gas delivery hose automatically increased compensating for simulated spatter buildup in the gas diffuser, clogged gas passage in the MIG gun (which for many MIG guns is also the wire conduit,) spatter in the nozzle, twisted gun cables etc.

Note with the low-pressure "Gas Guard" device the flow reduced to a low of 16 CFH and rose to 37 CFH! Even worse, the CFH gauge stayed at the initial 31 CFH as pressure didn't change- reporting "Fake News!"

Several fabricators documented the problems with this device and discontinued their use. One discarded 50 and another 70 such systems!

Tests of another low-pressure device (yellow arrow, pic right) showed it produced even more flow variation! This device sets flow by setting pressure It reduces the surge but creates major flow variation problems more difficult to analyze!

**BE CAREFUL; SOME OF THESE "SURGE CONTROL DEVICES" DO NOT MENTION THEY USE LOW PRESSURE!**

A surge control flowmeter (photo left) at least indicates in the literature, *"operates at pressures lower than usual."* Unfortunately, it does not mention the problems the lower pressure creates or that it eliminates automatic flow compensation!

Welders just open the needle valve when restrictions occur and leave the high setting when restrictions reduce!

## APPENDIX D

### Example of Some False Savings with Two Devices: Bar Joist Fabrication

A Bar Joist manufacturer with 50 MIG welders purchased low-pressure regulator flow controls reported in our tests (shown in Appendix C.) They found welders were continually setting excessive flow rates. All 50 were discarded in favor of orifices placed at the feeders to control flow. Although the orifices set flow at 45 to 50 CFH, which should have been more than sufficient, the welders wanted more flow (*and some drilled out the orifice!)* The welding engineer called us and we found an interesting result.

We moved the flow setting orifice on one welder to the pipeline drop and installed our ***GSS.*** This provided a controlled amount of extra gas to purge the weld start area at a flow that did not produce excess turbulence. The welder using the ***GSS*** instantly stated he saw a "better arc!" In bar joist manufacture, welders are close to each other. With the fixed orifice at the feeder, there was no extra gas to purge the MIG gun nozzle and weld start area. It was obvious that the welder with the ***GSS*** had less spatter when starting and for much of the short weld. The welding engineer decided to lower the flow rate to 35 CFH on the welder with the ***GSS***. The arc was very stable, and more important the welder was still very happy! The ***GSS*** was still quickly supplying the same, controlled amount of gas at the start. It proved that providing more steady state gas flow, in this case 45 CFH, could not compensate for the inferior starts caused by the lack of extra starting shielding gas. After several months of testing to assure it worked in all draft conditions (which it did,) all 50 welders were equipped with ***GSS*** systems and flow controls placed back at the pipeline drop.

About a year after installing the ***GSS***'s, the welding engineer relayed that their bulk gas supplier called and asked if their workload had reduced since there was a 30+% reduction in gas deliveries! It had not!

***Reinforcing the problems associated with lack of purge gas at the weld start*** is a survey made of another bar joist fabrication shop were flowmeters had been placed at the gas inlets on 100 MIG wire feeders to "eliminate starting gas surge." When examining flow rates, about half were set at 50 to 55 CFH, with none less than 50. About 25% were set near the top of the flow tube at 65 to 70 CFH. The remaining 25% had the flow ball pinned to the top of the tube! (Could be 150 CFH.)

Perhaps not even knowing why, welders were trying to compensate for the lack of enough starting gas purge by setting higher flow rates. That is only a partial help! ***Therefore, attempting to reduce gas waste by moving the flowmeters to the wire feeder was actually wasting NOT saving gas!***

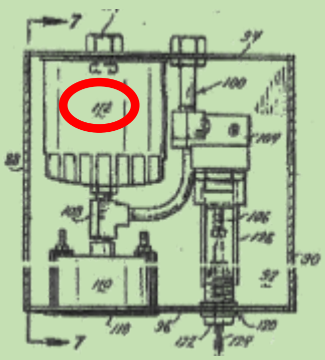
## APPENDIX E

**Stauffer in 1982 Knew Some Extra Gas Was Needed at Each Weld Start:**

**Some Manufacturers of Gas Flow Controls Today Don't!**

The preceding example observed at bar joist manufacturers (Appendix D,) defined that although it is important not to have an excessive gas flow rate to avoid air to be pulled into the shielding gas stream due to turbulence - ***some extra gas is needed at the weld start!***

That extra gas is necessary to purge the weld start area of air. In addition, air enters the MIG gun and MIG gun nozzle when welding stops. Stauffer in a 1982 patent defined the need stating; ***"... air leaks back into the MIG gun 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."***



That device mounted near the wire feeder providing the extra gas needed at the weld start. It had a reservoir (item 112, red circle, in his patent figure left) to store some initial gas to be expelled at the weld start. Unfortunately, the device used relatively low pressure to avoid excess surge flow, requiring the large reservoir and reducing the very important "Automatic Flow Compensation" feature!

**Flow Controls Mounted at Wire Feeder**


Some products have been sold and used that control flow at the MIG wire feeder gas inlet that "don't lower pressure," like regulator/flow controls and simple flow setting orifices, shown left. That reduces surge BUT provides no extra gas at the weld start. Welders observe the result and often increase gas flow where there is an adjustment or by drilling the orifice in attempt to compensate.

That is only a partial help and overall wastes NOT saves gas! Unlike the low-pressure feeder mount flow control regulators that have two problems 1) no automatic flow compensation and 2) lack of starting gas purge - ***these devices solve one but retain the lack of needed starting purge gas problem!***

Welders will often increase the steady state flow in attempt to compensate for the lack of gas purge and may not know the reason. They probably have seen a similar problem in the past when they started to weld without opening the gas cylinder! Takes a few seconds but the excess spatter is quickly seen!

***Been There Done That!*** LOL

## APPENDIX F

**Setting Gas Flow Rates:**

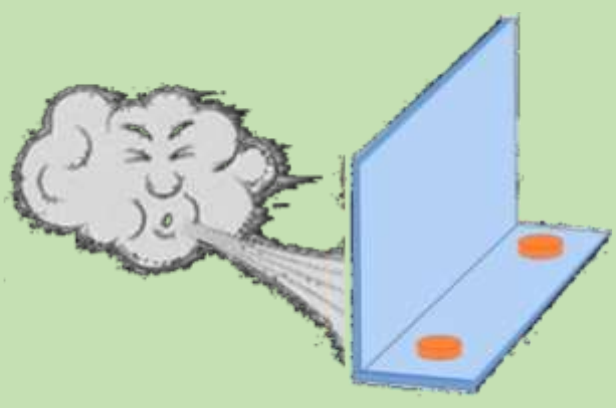
**This Chart provides a good summary of "*Usable Flow Rates*."**

| MIG Gun Nozzle Size Inside Diameter | Minimum Suggested Flow | Typical Flow Setting | Maximum Suggested Flow |
|---|---|---|---|
| 3/8 inch (For Access on Small Welders) | 15 CFH | 18-22 CFH | ~ 30 CFH |
| 1/2 inch (Typical on Small Welders) | 18 CFH | 22-27 CFH | ~ 40 CFH |
| 5/8 inch (Most Industrial Welders) | 22 CFH | 30-35 CFH | ~ 55 CFH |
| 3/4 inch (For Large Size Cored Wire) | 30 CFH | 30-40 CFH | ~ 65 CFH |

(For Argon Mixtures and $CO_2$.)

For Metric (SI) units - Multiply CFH x 0.472 = liters/min

Note: Maximum flow rate limit is set to avoid excess shielding gas turbulence. If exceeded, moisture laden air will mix into the shielding gas. These values are somewhat higher than defined in articles by The Welding Institute (UK) and the manager of welding R&D for Praxair (which states flows should not exceed 50 CFH for typical 5/8-inch ID nozzle.) $CO_2$ shielding tolerates the somewhat higher values shown. Exceeding these suggested maximum flows will not help handle drafts! If draft is over ~ 4 to 5 mph use a wind break.



DON'T EXCEED THE MAXIMUM SUGGESTED FLOW RATES.

It will just pull air into the shielding gas stream.

If the wind is more than 4 to 5 mph, use a windbreak

A piece of sheet metal held with magnets is often sufficient.