

Green Corvette (reduced energy use; GNC)

Summary



Corvette is one of the most energy efficient sports cars as owners are aware. However it's considered an energy waster by many of the general public and even enthusiasts who have not keep up with its light weight and significant technical advances! This report provides some statistics for an "elevator speech" that

can be used when getting uninformed comments from folks who do not understand its virtues. More importantly it provides some suggestions on how Chevy can expand the target market for Corvettes by providing a Green "reduced energy use" model mostly from existing parts. In keeping with the Corvettes image of being a tool for exploring leading edge technology, the use of a 2009 Formula 1 type KERS (Kinetic Energy Recovery System) could also be considered. It could capture some of the 42% of the energy delivered to the rear wheels wasted in braking! The KERS could also save the 17% gasoline energy wasted when idling. A KERS supplied battery or two could power an air-conditioning system and electrical requirements so the engine can be shut off when stopped.

The Corvette will not remain a viable product for GM if sales remain at the 16,956 units sold in 2009. With all the current emphasis on the global environment, saving energy and reducing gasoline use, there is a market for an even greater energy efficient "Green Corvette." By advertising the benefits of the "Green Corvette" the public would also see that the standard V8 models are also state of the art and more energy efficient than most sports cars (or many sedans for that matter!) It would help all Corvette enthusiasts.

It would probably not convince environmental activists who think we should all be riding bicycles! However even those folks (who require cars) would understand the Corvette with its light weight, efficient engines, low drag and very large cargo area is a great vehicle. It fact they can fit their Mercedes Trailblazer Mountain Bike in the back of a Corvette coupe by removing the front wheel!

Background:

It's irritating when folks suggest the Corvette is bad for the environment. When confronted with these uninformed comments I mention the recent 400 mile trip where I achieved 28 mpg in my 436 HP 2008 Coupe!

What really hurts is when a car enthusiast, who really should know better, raises the similar issues! In response, I proceed to mention that most other sports cars weight more, have less power and get poorer mileage! I credit the talented GM engineering and mention the hydroformed frame (aluminum on the Z06) that is very ridged promoting great handling, the aluminum front and rear cross members, the forged aluminum suspension members, the light weight composite fiberglass springs, the fiberglass reinforced sheet molding compound body panels, floors made from balsa wood sandwiched between structural plastic and that an NBA player can fit in it! I remind them the "old technology" pushrod engine is all aluminum, weights only 415 pounds and obtains 436 usable HP. Then discuss the Z06 model that achieves 505 HP developed from a similar "low technology" 16 valve naturally aspirated dry sump engine!

It's useful to quote some performance specs for other sports cars using Car & Driver, Road & Track etc road tests. The following are some useful to recite:

Car	Model	Weight lbs.	% Front /Rear	Engine Type	HP	0-60 sec.	EPA Cit/Hy mpg	Price
Green Vette	Coupe Mod V8	~2999	50/50	LS3 Modified Pushrod 16V-V8	~ > 425	~4.0 to 4.4	~20/31	Approx. \$65,000
Corvette*	Coupe '09	3217	52/48	Pushrod 16V-V8	436	4.1	16/26	\$49,500
Corvette*	Coupe '93	3333	52/48	Pushrod 16V-V8	300	5.1	17/25	\$34,000
Corvette*	Coupe '87	3216	52/48	Pushrod 16V-V8	240	6.3	15/23	\$27,999
Corvette	Z06 '09	3180	50/50	Pushrod 16V-V8	505	3.6	15/24	\$73,900
Corvette	ZR1 '09	3324	52/48	Prod 16V-V8 Super Charged	638	3.4	14/20	\$103,300
Porsche	Cayman S	3031	46/64	DOHC-24V-H6	320	4.8	19/26	\$60,200
Porsche	Carrera	3200	38/62	DOHC-24V-H6	345	4.8	18/26	\$76,300
Porsche	Carrera S	3279	38/62	DOHC-24V-H6	385	4.5	18/25	\$87,000
Ferrari	F430	3200	44/66	DOHC-32V-V8	483	3.5	11/16	\$167,000
Ferrari	458 Italia	3087	42/58	DOHC-32V-V8 DI	570	3.3	17 com	\$240,000
Ferrari	599 Fiorano	3722	46/54	DOHC-48V-V12	611	3.4	11/15	\$302,000
Ferrari	California	3817	46/54	DOHC-32V-V8 DI	453	4.0	9/16	\$225,000
Datsun*	260Z '74	2425	50/50	SOHC-12V-I6	162	8.0	20/28	\$5700
Nissan	350Z '08	3339	53/47	DOHC-24V-V6	306	5.6	18/25	\$31,000
Nissan	370Z '09	3230	54/46	DOHC-24V-V6	350	4.7	18/26	\$31,500
Lotus	Evora	3046	40/60	DOHC-24V-V6	276	4.9	30 com	\$75,000
Audi	R8	3605	44/56	DOHC-32V-V8 DI	420	4.7	12/19	\$123,000
Camaro	LT	3807	52/48	DOHC-24V-V6 DI	304	5.9	17/29	\$24,630
Camaro	SS	3860	52/48	Pushrod 16V-V8	426	4.8	16/24	\$33,400
Cadillac	CTS	3874	52/48	DOHC-24V-V6 DI	304	6.6	17/26	\$38,860
Cadillac	CTS V	4292	54/46	Pushrod 16V-V8 Super Charged	556	3.9	11/15	\$62,000

* Cars I've owned (2009 Vette specs same as my 2008)

Review of Some Cars in the Table:



Note; only the 1974 Datsun 260Z shown in the table weights less than 3000 lbs (in addition to the proposed Green Corvette!) Nissan has improved in recent years over the disastrous weight and size growth for what was a great car. However even the 350Z was heavier than the recent Vettes for a smaller, lower powered car. The new 370Z lost some weight, which they tout in all their marketing, but

it is still heavier than the standard and Z06 Vette!

Porsche is somewhat better with their smaller lower HP Cayman but it is about the same weight as the Vette with much lower power. The Carrera and Carrera S weight about the same as the standard Corvette with both having less power.

It is hard to compare the Ferrari to a Vette but it is worth looking at the power and weight. The Ferrari California with its V8 weights more than the standard Vette and has about the same HP. The V12 Ferrari 559 Fiorano weighs substantially more than any of the Vettes and the ZR1 has more HP. The Ferrari F430 weights about the same as the Vette with less HP than the Z06.

The new Ferrari 485 Italia is interesting. First it achieves 562 HP in a naturally aspirated V8. It is noteworthy that Ferrari was able to achieve the 562 HP at 9000 RPM from a 4.5 liter engine! They indicate this 2010 model achieves an overall 17 mpg with some reports of highway mileage of 21 mpg.

With some "Hot Rodding," the Z06 can match the power and gas mileage. For example, Katech offers a modified LS7 engine that develops 600 HP on 93 octane.

Lotus, as usual, develops their cars with low weight and less power. The latest Evora is no exception. It comes in at 3046 pounds with a Toyota 276 HP engine. It is reported to produce a combined EPA mileage of 30 mpg. Would not be an easy task to match that mileage but we can best the 4.9 second 0-60 time with the proposed "Green Corvette!"

Current Corvette Performance

As seen from the above table the Corvette does not take a back seat to any other sports car shown or many sedans for that matter when it comes to getting maximum use from gasoline. My current 2008 Coupe gets better highway mileage than my previous Vette, a 1993 40th Anniversary coupe and has $136/300 = 45\%$ more HP! Also note the 1 second improvement in 0 to 60 mph time for the 2008 Vette. It weights 116 pounds less as well.

Note the Vette performance and gas mileage relative to the Nissan 370Z. The Vette weighs slightly less than the latest “redesigned” Z and has $104/332 = 31\%$ more power. Averaging city and highway mileage yields 21 mpg for the Vette and 22 for the 370Z. Note the prior years 350Z weighed 122 lbs more than the Vette and average mileage was 21.5 mpg.

I recently achieved 28 mpg on a long trip with my 2008 Coupe. Even with a radar detector, on roads that are unfamiliar it is difficult to exceed much more than 5 mph over the posted speed limit and keep points free! That trip was on highways and rural roads with 55 and 65 mph posted limits. Therefore keeping at 60 and 70 mph averaged about 65 mph. At that pace, in the flat terrain where I live, 28 mpg was achieved.



The Ferrari F430, photo left, is considered an advanced technology sports car, and provides an interesting comparison. It has expensive

all aluminum construction. However it weights 20 pounds more than the Z06 and has 22 less HP. It achieves an EPA average mpg of 14 mpg verses the Z06 19.5. In addition to the low weight items mentioned for the Corvette C6 Coupe, the Z06 has a number of carbon fiber parts as well as a magnesium front cross member replacing the one made from aluminum in the standard Vette. There is one other measure that helps the Vette; low aerodynamic drag. It's hard to compare these numbers since different sources often have conflicting data. However one source sited the Ferrari F430 and the C6 Corvette Coupe. The Ferrari had a Cd of 0.34 while the C6 Coupe Cd is 0.29. Cd is only a part of the drag story; it must be multiplied by cross sectional

area. The same source quoted the Cd x Area as 6.1 ft^2 for the Vette and 7.3 ft^2 for the Ferrari. The Vettes 16% less drag helps provide the superior highway mileage.



The new Ferrari 458 Italia that replaces the F430 in 2010 has a Cd of. 0.33, higher than a standard C6 Vette. The Ferrari 458 is reported to have an EPA average of 17.1 mpg. It certainly looks slick, photo above!

Green Corvette (reduced energy use :)

Just who needs a more energy efficient Corvette? A very good question. Most of us who purchase Corvettes don't do so for great gas mileage! However the last spike in oil prices even caused me to use regular gas and set my display for average mpg!

Even worse, the recession caused 2009 Corvette sales to reduce to 16,956 a decline of 52% from 2008. And the 35,310 sold in 2008 was lower than the peak sales year in 1979 of over 50,000 cars. Even in 2007 40,561 were sold. Sales had not been below 20,000 (accept for 2 model change years) since 1963! If we are to keep the Corvette from bean counter cuts then the customer base needs to be broadened. The public also needs to be educated regarding the Corvettes leading edge technology that can provide improvements to the broad base of GM cars. Racing does improve the breed!

First Step:

Several options should be considered for the engine. Perhaps the LS3 can be modified with cylinder deactivation, using a cam optimized for fuel mileage and electronic mods to enhance mileage sacrificing some power. Another option would include direct fuel injection. That should allow leaner mixtures at part throttle! In the early days of government mandated emissions laws the base 1975 Corvettes 350 cid V8 was rated at 165 HP and 38,465 were sold!

The objective is NOT to have a cheap Vette! In fact the opposite is probably what is needed since the target market are folks who have sufficient money or a good job to get the needed credit to own a Vette. They don't want a cheap one just one that fits their idea of a quality, energy efficient design.

The following are thoughts on what might be done with existing parts and let the price fall where it provides a good margin for GM and dealers:

The Chassis:

1. Start with the best light weight technology, the Z06 aluminum hydroformed frame. Include the magnesium front suspension cross member. It may be desirable to have a convertible model available to increase sales. However since this car will not be used for "Track Days," Gymkhanas, etc the Z06 frame should be satisfactory.
2. The Z06 frame saves weight. How much? If we compare the Z06 to a standard Coupe the weight reduction is 37 pounds. However the LS7 weights 49 lbs more than the LS3 per GM figures. In addition it has larger, heavier wheels and tires, coolers for the engine, transmission and differential. The separate coolers include associated hoses and brackets. The Z06 also has heavier sway bars front and rear, larger heavier rotors and brake calipers as well as the plumbing and tank for the dry sump system. Therefore 37 lbs for the chassis, 49 lbs for the engine and perhaps 100 more pounds for the other HD items. A total of 186 pounds. Brings the total weight to about 3031 lbs. With some

effort, lighter wheels or perhaps some additional carbon fiber parts it should be possible to obtain a total weight of 2999!

Engine:

The LS3 modified with 4/8 cylinder deactivation, a cam designed for optimum mileage and the appropriate electronic MAP should be simple to try. Direct injection is also a logical next step.



Body/Interior:

1. Assume that standard narrower fenders would be fine. Don't need the ones from the wider Z06 or Grand Sport. However keep the Z06 hood to save weight and use the air scoop to get better breathing.
2. The interior must meet the desires of the target audience. Some focus groups are probably needed to define the requirements but my thought is to collaborate with a known designer! Not that anything needs to change in my opinion since I think my 3LT interior is fine! Don't really understand those that complain it is not as good as a Porsche or Ferrari. It looks great to me and is functional. However if the seat backs had a "Gucci Logo" bet many would rate it higher! In addition for the PETA folks consider a high end cloth option! Pick the expensive material my wife always seems to find when reupholstering a chair! Designer cloth interior might be what some potential buyer will opt to have on their "Green Corvette."
3. Definitely add and iPod connection and I would suggest that wiring be included to add an optional 150/300 WAT sub woofer in the rear! This could be a dealer installed option but make it dealer and enthusiast installable! (Miss the subwoofer I installed in my S-10!)

Gas Mileage:

1. Why does anyone worry about gas mileage when spending \$65,000 plus on a car? They may need to feel good about driving the vehicle. They may want their friends to think well of them. Not really sure but some folks have other motives than the lower cost of operation.
2. It may be possible to reach about 20 City and 31 highway EPA numbers with what was outlined.
3. It is possible to do even better! Several years ago when gasoline prices were skyrocketing I placed on our web site some ideas of saving gasoline. I also presented some graphics showing that only about 13% of the energy in gasoline gets to power the car. Of that 13%, 42% is

expended in braking. See this web page:
<http://netwelding.com/Save Gasoline 2.htm>

4. I suggested some ways to capture that braking energy using a simple Hot Rod trick I saw years ago on a Tee Bucket to hide the alternator. They mounted it on the rear end and powered it with a pulley connected near the universal. Suggested using a 250 amp truck alternator and energizing it with an electric clutch when the brake peddle was applied! It could charge some conventional or Li Hydride batteries and the energy used to power an air-conditioner etc. Formula 1 for 2009 had what they refer to as KERS (Kinetic Energy Recovery System.) The system used by Ferrari (photo above) uses a generator to power a battery. The generator is attached to the front of the engine and when activated becomes a motor and delivers 80 HP back to the engine! We could use some of that extra HP to launch the car after it comes to a stop (probably one of the highest energy usages.)



5. Another large loss in energy occurs when a motor vehicle is idling. It is reported that 17% of the energy in gasoline is wasted while idling! Now if we could use the KERS battery to power the electrical needs and air-conditioning when stopped, the engine could be shut down and restarted when moving. Depending how long we were stopped there might be energy left in the battery to still provide a starting boost.

6. Williams is using a 40,000 or higher RPM (some references reported 100,000 RPM) flywheel to store energy. The flywheel only weighs about 12 pounds! The black donut shape in the photo right is the high RPM flywheel. It is placed in a vacuum chamber (item above flywheel) to eliminate aerodynamic drag and to provide protection. The gearing and clutch required to deliver power back to the gearbox adds weight and is the key to the system. However a flywheel can store several times the energy per pound as a battery and it doesn't have a fixed life, chemical disposal issues etc! Long term flywheel storage could be the way we store wind and solar power to manager electrical power! By spinning that fast a great deal of energy can be stored.



Porsche Did It!

Porsche introduced 480 HP (**358 kW**) 911 GT3 racer fitted with a KERS style electrical flywheel generator capable of supplying up to 120 kW (**161 HP**) to a pair of electrical 60 kW (**82 HP**) motors driving the front wheels.

As with the 2009 F1 style KERS, the driver can trigger the additional power for between 6 and 8 seconds for additional thrust.



Located in the cabin next to the driver, the flywheel generator is an electric motor spinning at speeds of up to 40,000 rpm and storing energy mechanically as rotational energy. The flywheel generator is charged whenever the driver applies the brakes, with two electric motors reversing their function on the

front axle and acting themselves as generators.

Then whenever needed, such as accelerating out of a bend or overtaking, the driver is able to call up the extra energy from the charged flywheel/generator with the push of a button.

The flywheel is slowed down electromechanically in the generator mode thus supplying up to 120 kW (**161 HP**) to the two electric motors from its kinetic energy.

The race car will serve as a spearhead in technology and a “racing laboratory” providing know-how on the subsequent use of hybrid technology in road-going sports cars. Porsche reckons the system will also save fuel, cutting down on fuel weight and pit stops.

The following schematic view shows some of the key elements: 1) Power Electronics, 2) Portal shaft with two electric motors, 3) High-Voltage cable, 4) Electrical flywheel “Battery”, 5) Power electronics.



Bottom Line:

Corvette is one of the most energy efficient sports cars- however the general public and even some uninformed car enthusiasts often consider it an energy waster! The statistics presented provide information to help communicate its virtues to the “uneducated.” We also provided some thoughts on how Chevy can expand the target market for Corvettes by providing a “Green” reduced energy use model from existing parts (assume GM has thought of these and other ideas as well.) We suggest they consider adding a Formula 1 type KERS. The KERS could be used to recover some of the energy used in braking. Of the power that gets to the rear wheels 42% is expended in braking! It might also be used to save the 17% energy in gasoline that the average car reportedly wastes idling. Since only about 13% of the energy in gasoline gets to the rear wheels (a majority going to cooling water and exhaust heat along with idling) this could be a significant energy savings!

With only 16,956 units sold in 2009 the Corvette will not remain a viable product without increased sales. Expanding the market potential to those seeking an energy efficient sports car would increase sales. The marketing effort for this model would also assist in educating the general public to better understand the advanced engineering in all Corvettes.

GM could hire an outside firm to build the suggested “Green Corvette” to test the market. One of the companies making the Formula 1 KERS would no doubt be happy to provide a unit for this show car. The publicity this “Green Vette” would achieve could help all Corvette owners communicate the efficiencies of their exiting Vette and probably increase sales for the standard products!

Maybe Porsche beat us to the punch with the flywheel KERS system, but a fast follower usually does it better since you can start where they ended! Also they used it to gain more power in racing situations. Using the flywheel energy storage, as mentioned- to power accessories and shut down the engine when idling- would be easier and “Greener!” Maybe a small kick in the pants when starting off would help mileage and shorted 0-60 times!! How about putting the generator-motor on the driveshaft going to the transaxle and do both!

What think of the idea? Have some of your own ideas. Let me know by sending an email to: Jerry_Uttrachi@NetWelding.com

**Have a MIG (Wire) Welder?
A Friend with a MIG Welder?
Know Someone with a
Fabrication Shop?**

**Do Them a Big Favor and Have Them
Review the Shielding Gas Saving
Information on Our Web Site:**

www.NetWelding.com

***If You Have a Home Shop -
Have You Run Out of Shielding
Gas on a Saturday or Sunday?
We Have a Solution:***

How Much Gas Can Be Saved??

The best way to show the savings is with an example from one of our industrial customers who tested the system then bought them for all 35 of his MIG welders.



A Texas Truck Box manufacturer evaluated the system on a repetitive job, welding doors. With their

standard gas delivery hose they welded **236 doors** with a full cylinder of shielding gas. Just substituting their gas hose with our patented **GSS** maintaining the same flow settings they welded **632 doors!** That's a 63% reduction in shielding gas use.

Weld Performance Improvement

A small shop owner provided this feedback after he purchased a 3 foot **GSS** for his small MIG welder. Al Hackethal reported these findings:



"Well, I can't believe it. I never thought a hose could make that much of a difference. I had a small job that's been waiting for a while. The weld quality, and even penetration is considerable better. Almost no spatter! The weld seemed to be hotter and I turned my MIG down a notch.

Initially thought that my imagination had kicked in, but then realized that the gas I'm buying is actually working the way it's supposed to. Glad I found your website. This is one of the few things that really works better than any info could suggest. I understood the theory, though in practice I understood much better after the first couple of welds. Now I have better looking welds and almost no spatter, which means less grinding and finish work! In addition, the tip was cleaner after the job I just did.

This will provide savings in time, labor and maybe even consumables too. As a one man shop there's never enough time for anything.

Al also has a TIG welder with 300 amp water cooled torch and bought one of our Leather Cable Covers. His email said this about it!

Oh, the leather wrap for my TIG hoses worked very well and fits perfectly. I'd just replaced the hoses and was looking for something to protect them that was better than the nylon wrap that's available around here. Now I'm "TIGing" again too, and much safer. It's good to know the coolant hoses are well protected. Much better than using a 300 amp TIG and then realizing that I was standing in a puddle of coolant, which is what recently happened. Can't pay the bills if I electrocute myself!

Thanks for making products affordable".

Another Home Shop Writes About GSS System

Perry Thomasson has a very well equipped home shop. He uses a 175 amp MIG welder. However the small welder cart only held a medium size shielding gas cylinder and Perry



wanted to reduce the number of times he had to have it filled.

He purchased the largest cylinder his distributor offered for sale and chained it to a wall in his shop. He needed a much

longer gas delivery hose so he added a 50 foot conventional 1/4 inch ID hose. He found he was using a lot of gas.

He purchased a 50 foot long **GSS** and saved a significant amount of shielding gas while improving his weld starts by reducing the starting gas surge. Since his regulator/flowgauge had a hose barb on the output, we supplied Perry with a splice connection on the supply end of the **GSS**. He simply cut the existing gas delivery hose close to the regulator and spliced in the **GSS** hose. The welder end uses a standard CGA fitting that is supplied with the system.

Perry emailed a picture and said;

" The system works great. Thanks for the professional service and a great product."

A Professional Street Rod Builder Had This to Say About the GSS:

They use a 250 amp MIG welder with built in feeder and a 6 foot gas delivery hose. With their standard

gas delivery hose the peak shielding flow at weld start was measured at 150 CFH, far more than needed and enough to pull air into the shielding stream. Air is then sucked into the gas stream causing poor weld starts and possibly weld porosity.

With the **GSS** replacing their existing hose, the peak flow surge at the weld start was about 50 CFH and it quickly reduced to the 25 CFH setting. With the many short welds made and frequent inching of the wire, they used less than half the gas and had better starts.

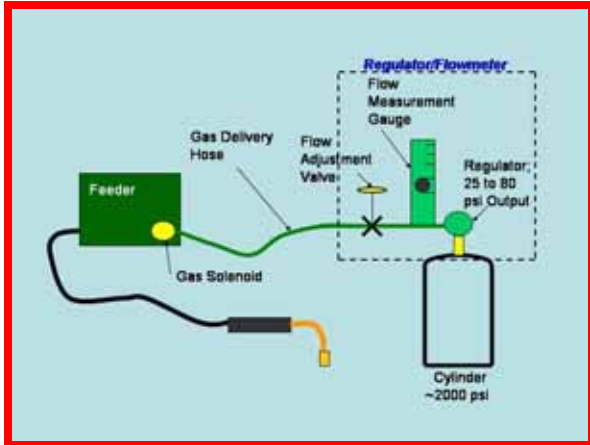


Kyle Bond, President, indicated a big benefit is the reduced time and effort

changing cylinders since it's required less frequently. He quickly saw the improvement achieved in weld start quality as a significant advantage! Kyle, an excellent automotive painter, was well aware of the effects of gas surge caused by pressure buildup in the delivery hose when stopped. He has to deal with the visible effects in the air hose lines on the spray gun in his paint booth! It's too bad we can't see the shielding gas waste as Kyle can the effects of excess pressure when he triggers his spray gun! The paint surge is visible and creates defects unless the gun is triggered off the part being painted! Kyle can manage the surge by triggering the paint gun off the part; unfortunately we can't start our weld with the MIG gun off the part ! The **GSS** has a built in surge flow limiting orifice that keeps the peak flow from becoming excessive. So you not only save gas you improve your weld starts!

How Does The GSS Work?

Gas waste occurs every time you pull the MIG torch trigger even if it's only to inch the wire to cut off the end.



To keep flow at the preset level the gas pressure in the cylinder regulator will be between 25 and 80 psi. Flowgauge regulators (those with a flow calibrated pressure gauge) operate in this pressure range as well.) However to flow shielding gas though the welder and torch typically requires 3 to 5 psi depending on restrictions. Therefore every time



welding stops the pressure in the gas hose raises to the regulator pressure of 25 to 80 psi. That stores up to 7 times the hose volume of gas in the hose. This is similar to your shielding gas cylinder which holds about 150 times the volume of gas as the physical volume of the cylinder due to the high pressure!

The patented **GSS** stores over 80% less gas than typical shielding gas hoses. In addition to the wasted gas (which you can hear when you pull the torch trigger) the high flow also

causes air to be pulled into the turbulent shielding gas stream! This is like starting with the gas cylinder shut off! You have probably experienced that before when you forgot to open the valve!

It takes a short time for the shielding gas flow to return to a smooth less turbulent (laminar) flow even when the start gas surge flow reduces. That can take several seconds so when making short welds or tack welds you're not getting all the benefits of the shielding gas you're purchasing!

SUMMARY:

The **GSS** can cut your gas use in half or more. It also has a surge restriction orifice built into the fitting at the welder- wire feeder end. That limits peak flow (*but not your set flow*) to a level that avoids excess turbulence for better starts. It allows a controlled amount of shielding gas to quickly purge the weld start area.

All you need to do is replace the exiting gas hose from cylinder regulator to welder with our patented GSS. It is available in various lengths at www.NetWelding.com.

There are more testimonials at:

http://www.netwelding.com/product/on_test_results.htm

Have more questions? See:

http://www.netwelding.com/Overview_GSS.htm

Or email us at:

TechSupport@NetWelding.com