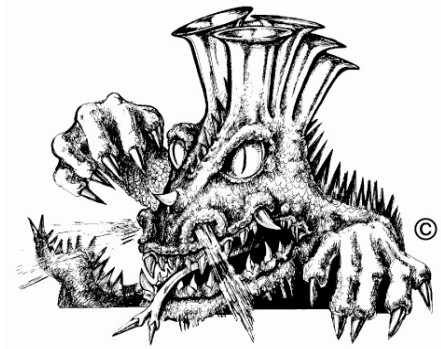

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Engineering, manufacturing, sales, service, calibration, testing, and modification of mechanical and electronic fuel injection systems and components for all types of racing and performance.

PROPOSAL FOR FUEL SUPPLY SYSTEM FOR NASCAR EFI

By James Kinsler Revised 10-1-11

--- DISCUSSION DRAFT --- Initial 7-18-11

With a carburetor, vapor bubbles can come into the float bowl from the fuel supply system and be vented out of it. As long as too many bubbles don't flow to the carburetor quickly, it can vent them off without lowering the level in the float bowl enough to lean the fuel rate significantly.

When vapor bubbles come to the fuel rails in an EFI system they may pass through the rails and out to the Pressure Relief Valve, then back to the fuel tank or they may pass through the injectors. Unfortunately, at wide open throttle, most of the fuel is being consumed by the engine, and little flows back through the PR Valve, so the bubbles often pass through the injectors. The bubbles are not distributed equally among the injectors. Most of the bubbles will pass out of one or two of them. The problem with this: The NASCAR engine builders have done an excellent job of developing the engines so they can run unusually lean brake specific fuel rates. If one cylinder starts running leaner due to the bubbles, that cylinder may run too hot, or detonate.

In 1969 we had a call from a good customer in Mexico City, Mexico. They are at about 7,350 foot altitude, and sometimes have temperature of 110 F in the shade. Any liquid boils easier with less pressure on it (altitude), and at a higher temperature. All of the cars would run quite well when they were cool in the morning, but after a few laps they would start to run lean, and it was not unusual to have an engine detonate and break. We developed our Vapor Separator System to fix this. We have improved both the layout of this system over the years and the quality of the components used in it. We have sold more than 2,600 of these kits... any car that has installed them properly has had no problems with fuel vapor.

A few facts:

1) Even racing gasoline has some stray light ends in some batches that boil off at about 90 F. It is common for this to vary batch to batch from most blenders. It is wise to plan for this possibility.

2) At the end of a hot soak, you should assume that every part of the fuel system has some vapor in it. It is excellent to locate the PR Valve after the engine fuel rails, so that when the electric main supply pump is turned on, all the vapor can be purged out of the rails, through the PR Valve and back to the tank. Note: In the past, we recommended that the fuel coming to the rails be split before them, so it would pass through them equally (in parallel). This would cut the velocity coming into each rail in half vs having all the of the fuel coming into one, then through the other (in series). The idea was to keep the velocity past each injector port in the rail more consistent. From much dyno data, looking at the exhaust gas temperatures, we believe that the rails can be run in series. This helps blow the vapor out of the rails when the main pump is first turned on, since the velocity will be higher, and is simpler and lighter to plumb.

3) We always assume that there is some boiling occurring in the fuel in the main fuel tank after running the car for a while. Actually, if the day is hot, and/or the car has been parked on hot asphalt, the fuel will be boiling before the car is even started. This boiling fuel causes the main system supply pump to pump less than it's rated flow, because it is not sucking in vapor free fuel, plus the slightest vacuum caused by the pump sucking the fuel into its inlet causes the fuel to boil more. It helps to locate the pump as low

as possible. Also, the PR Valve needs some flow through it to control the pressure (75 psi for this system) accurately. Because of this, we have found that we need to size the main supply pump about 25% larger than what the engine needs at its horsepower peak. Some of our customers insist on only 15% extra supply, and some of them have supply problems in the vehicle on a very hot day. The 25% extra flow causes very little fuel heating in the tank compared to the hot air surrounding it, and the radiation from the hot track surface. Typical NASCAR engine: 850 HP, .45 BSFC maximum on Sunoco E15 fuel = 383 lb/hr x 1.25 (25% extra) = 479 lb/hr. Weight of water at 80 F = 8.318 lb/gal. 8.318 x .74 sp.gr. this fuel = 6.155 lb/gal. at 80 F. 479 lb/hr/6.155 lb/gal = 78 gph required pump flow test using cool fuel.

4) Any time the fuel blows down from a high pressure to a low pressure, vapor is generated; the hotter the fuel, the more vapor. Any design of PR Valve makes vapor that flows back to the tank in the return fuel. In this system, the return from the PR Valve flows back to the VST, where the vapor is purged out.

5) In any fuel pump, the clearance between the vanes or gears and the housing allows fuel on the high pressure side of the pump to leak back to the low pressure (inlet) side. This generates vapor bubbles, which when they pass back through the pump to the high pressure side get smaller, but never turn to liquid again. These bubbles flow up to the fuel rails. We make a <u>very</u> special effort to minimize the internal clearances of all the main fuel supply pumps that we make; both electric and mechanical. Our Tough Pump mechanical fuel pump (which has been widely adopted by the World Of Outlaw sprint cars) has less internal leakage then that of our closest competitor. The more discerning teams are surprised that they can notice a difference in the way the engine runs both on the dyno, and out on the track... perhaps look at the details on the last two pages of these attachments. It is all about engine cycle to cycle consistency; as stated above, the bubbles do not go out to the different cylinders evenly. The Weldon-Kinsler electric fuel pump (shown near the back of the attachments) we are proposing to the NASCAR teams has minimum internal clearances.

<u>How Our Proposed System Works Looking at the system schematic...</u>

A. Fuel is sucked from the filter sock by the scavenge pump and sent to the top of the Vapor Separator Tank (VST). The VST has a baffling system in it to separate the bubbles out of the incoming fuel (remember, we assume that the fuel in the main tank is boiling). This VST will be stainless, with the scavenge pump mounts built onto it. We will attempt to mount it under the present buckeye.

B. The scavenge pump is sized to flow more than the engine needs at wide open throttle, so there will always be excess fuel flowing out of the top of the VST and back to the existing catch tank. This carries the vapor out of the VST. The line has a Kinsler Backpressure Valve in it set at 9 psi blowoff pressure, <u>so the VST will always have about 9 psi in it.</u> This prevents the fuel from boiling in the VST. It is critical that this line is routed back to the catch tank, to keep that tank as full as possible. It is important that this line is horizontal and at the top of the catch tank as it passes into it, so the flow will impinge on the wall of the tank (<u>not</u> down into the liquid) to dissipate the energy in the flow stream, and release the bubbles above the level of the fuel in the catch tank. <u>If the driver can monitor the VST pressure</u>, <u>he will know that he is about out of fuel</u> when the pressure starts to flutter and drop.

C. Proposed scavenge pump, at 9 psi output: This is a reliable production car pump; a Walbro GSS 307

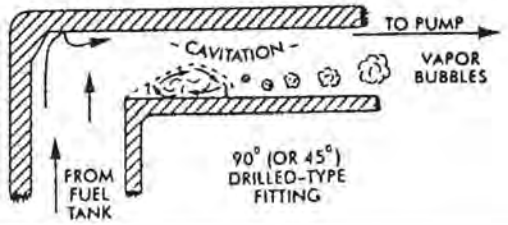
All	At 10.0 volts (under min. design voltage)	60 gph	369 lb/hr	4.2 amps	Weight .80 lb
Average	At 12.0 volts (minimum design voltage)	72 gph	443 lb/hr	4.8 amps	
Data	At 13.5 volts (typical operation)	80 gph	492 lb/hr	5.4 amps	

At 13.5 volts:	<u>Press, psi</u>	<u>gph</u>	<u>lb/hr</u>	<u>Amps</u>
	0	82.8	510	4.9
	6	81.1	499	5.2
	9	79.6	490	5.4
	12	78.0	482	5.6
	15	76.7	472	5.8
	18	75.2	463	6.0
	21	73.7	454	6.2

We test every pump we sell for flow, amps, and listen to each with a stethoscope. For NASCAR use, these pumps would also be run-in for ½ hour after being tested, then tested again. The flow of many production and most purpose built "racing" electric pumps vary about + or - 7%; mostly due to the electric motor manufacturing tolerances. This Walbro pump is much more consistent, and we would select pumps similar in flow for NASCAR use. We have many different pump brands and models if you want a different output.

D. The 9 psi pressure in the VST pushes the fuel out to the main electric fuel pump, and pressurizes its inlet to insure that no boiling can occur in its inlet line. Without this Pressurized Pump Inlet System (Registered) the pump has to suck the fuel into it, which lowers its pressure, often causing boiling in the pump inlet line.

NEVER use a "drilled block of metal" type angle fitting on ANY pump inlet hose... where the drills intersect there is a razor sharp edge that promotes pump inlet cavitation. The best solution is to make gentle bends with the hoses. However, if there is a really tight place, use a bent tube type hose end fitting.



In any pump, the incoming fuel must be accelerated to a higher velocity as it is sucked into the cavities created by the spinning vanes or gears. The vanes or gears do the pumping, but the acceleration of the fuel into them is achieved only by a drop in the pressure of the incoming fuel, which can cause boiling, creating vapor bubbles. Well designed pumps have close attention paid to the "porting"... the channels that guide the fuel into the vane or gear cavities. The 9 psi to the pump inlet helps prevent these bubbles, and also prevents almost all of the bubbles caused by the leakage from the high pressure side of the pump back past the vanes or gears to the low pressure side (see 5) above). Mount any pump as low as you can to help the fuel flow into it.

This 9 psi also travels back up the line from the outlet of the PR Valve and eliminates most or all of the vapor production from that valve. The backpressure on the PR Valve has very little affect on its pressure setting because of the large absolute pressure ratio occurring across its valve and seat.

E. For non Pressurized Pump Inlet installations, we recommend using a Kinsler Mega Monster (medium length) 45 micron stainless mesh filter on the inlet of the main electric (or mechanical) fuel pump to protect it. For non Pressurized Pump Inlet installations, we never recommend a paper (also called cellulose) type element on the inlet of a fuel pump, because any amount of liquid water (condensation in the fuel tank) will cause its fibers to swell, causing too much pressure drop for a pump inlet.

With this 9 psi Pressurized Pump Inlet system, running Sunoco E-15, we strongly recommend using our 10 micron paper Ultra-Monster filter on the pump inlet. A new element in a housing with 8AN inlet and outlet filter end caps has .25 psi pressure drop at 500 lb/hr. Any condensation in the fuel tank will be absorbed by the ethanol portion of the fuel. 25.4 microns is .001 inch, so 10 microns is about .39 thousandths of an inch. We much prefer this for our electric pump protection than the 45 micron screen (which is 1.8 thousandths of an inch) we recommend when there is no Pressurized Pump Inlet pressure.

Our Monster series of filters has that name due to the monstrous amount of filter media inside of them for their size. The Monster has 108 square inches of paper, the Mega Monster has 162, and the Ultra has 216. These very large element areas help prevent filter plugging even more than you might think. If a filter with 108 square inches of media will just flow just enough fuel when it is half plugged, that is like 54 square inches fully plugged, and 54 square inches that are like new. A filter with 216 square inches can have 162 square inches fully plugged, and still have 54 square inches that are like new, so twice the filter media area equals three times the dirt holding capacity. Also, the larger element has half the velocity through the filter media, which promotes better filtration per square inch.

The Ultra is only .15 lb more weight than the Monster dry, and .35 lb more wet. There really is no choice; you should use the Ultra. The extra wet weight doesn't matter, because you can recover most of this fuel when the car is about to run dry... see Recoverable CC in the Monster Filter table on Pg 5.

A small filter may be OK until you encounter dirt, then it can cause you havoc. Most racers run filters that are way too small; a bad mistake. Small and cute isn't what you need here... you need something effective.

F. We recommend using a Kinsler Mega Monster 10/3 micron filter just before the fuel rails to protect the injectors and the PR Valve from dirt coming from a wearing main fuel pump, and any dirt that passed through the pump inlet filter. This has a 10 micron paper outer layer to protect a 3 micron fiberglass inner layer. A little pressure drop due to the swelling of these 10 micron paper fibers due to moisture in the fuel, or the 3 micron layer becoming dirt laden is little problem on the 75 psi side... the supply pump will simply pump a little more pressure to overcome it. The PR Valve will still maintain the 75 psi in the fuel rails.

With paper, the dirt lodges at different levels of its thickness, thus it has much more dirt holding capacity per square inch than fiberglass. The ultimate fluid filters are made from glass fibers laid down by programmed machines... a 3 micron element will catch about 95% of all 3 micron and above particles. Most premium hydraulic systems use these; they cost more, but are cheap compared to wearing out an expensive system.

An added bonus of this second filter: No paper element has an absolute rating (regardless of what some manufactures claim) that is, if it is 10 micron it will catch particles about like this: many under 10 micron will be caught in the twisting "worm holes" going down through the paper's thickness, 80% of 10 micron or larger particles will be caught, 90% of 15 micron or larger particles, 95% of 20 micron or larger particles, and a few stray larger particles will get through. Every paper manufacturer has its own quality standard, and every batch varies. You've probably guessed... the second filter will very likely catch any over-10 micron size particles that got through the first filter. We REALLY like a second filter!

I don't believe the fuel in this filter should count toward "system capacity", as the pump will not be able to make enough pressure to push this fuel forward once it is mostly sucking air.

It is excellent to keep the dirt out of the vehicle in the first place by using a large fine micronic filter to fill the filling cans.

Never use a 10 micron stainless mesh filter for anything; it doesn't have enough dirt holding capacity, since all of the dirt is caught right on its surface. Never use porous bronze or ceramic filters; they can hold very little dirt.

MONSTER SERIES FILTERS We use deeper pleats and more pleats to pack in more square inches. More area gives more total dirt holding capacity and lowers the velocity through the media, which catches more dirt. We use very high quality paper, which is much more expensive, but it has much more consistent pore size, especially batch to batch, and many more pores per square inch. More pores give more dirt holding ability and less pressure drop. Our stainless mesh is a high quality very consistent weave. We use stainless end caps on all the elements.

The housings are lightweight hard anodized aluminum machined from seamless tube. They are impregnated with a sealer to prevent corrosion by alcohol... we have never seen corrosion in these even when running 100% methanol.

Operating Pressure: 400 psi. (The minimum burst pressure from our tests is 1,640 psi.)
Each filter assembly is purged at 2,000 lb/hr of gasoline to blow any dirt out of the clean side, then pressure tested for leaks at 160 psi before shipping.

MONSTER FILTERS			Flow tested with Sunoco E15 -- Pressure Drop, psi vs 500 & 2,000 lb/hr --						filter vertical			
Filter Size Name	Micron Size	Element Sq. In.	6AN fittings		8AN fittings		12AN fittings		Wt. Dry, lb	Wt Wet, lb	CC to fill	CC recoverable
			500	2,000	500	2,000	500	2,000				
Monster	10 paper	108	.49	5.68	.15	1.45	.04	.40	.60	.85	153	123
Mega Monster	10 paper	162			.23	1.60			.68	1.08	243	199
Ultra Monster	10 paper	216			.25	1.60	.08	.46	.77	1.27	307	255
Monster	10/3 p/f-glass	77			.24	1.50			.67	.90	144	93
Mega Monster	10/3 p/f-glass	116			.32	1.70			.76	1.12	219	148
Ultra Monster	10/3 p/f-glass	154			.35	1.70						
Monster	45 stain.mesh	74			.21	1.49			.71	.98	167	153
Mega Monster	45 stain.mesh	111							.81	1.21	244	225
Ultra Monster	45 stain.mesh	148							.90	1.34	270	253
Monster	No Elem	0			.24	1.40						
Mega Monster	No Elem	0			.24	1.45						
Ultra Monster	No Elem	0			.24	1.50						

Notes: We have always seen the pressure drop go up as we test our larger fresh filters; logic says it should go down. We believe it has to do with the deceleration of the fuel... it has to slow down more in the large housings, then speed up again as it leaves the filter; all the energy is not recovered. When the elements start to become dirty, the larger ones always have less pressure drop than the small ones.

The maximum flow will never be much over 500 lb/hr for NASCAR use. We showed the 2,000 lb/hr pressure drops to show you just how low a pressure drop these filters give.

Recoverable CCs: The fuel you can drain back out of the filter after it is full... some of the fuel stays within the element and housing. The filters were filled and drained in vertical position; outlet at bottom.

G. During a hot soak, the fuel in the fuel rails, the line from them to the PR Valve, the filter on the inlet of the rails, and the line from the main pump will boil, making bubbles that will be forced back toward the main pump. If this vapor fills the pump, it may be difficult to get it to start pumping, since it can't make even 10 psi pumping vapor, while it takes 75 psi to force the bubbly fuel through the PR Valve. A good help is to install a "bubble tight" check valve on the outlet of the fuel pump. I use " "(quote marks) because it is nearly impossible to keep components bubble tight in the system... even the little 10 micron particles will keep the valves from closing totally. We are microlapping our K-140 PR Valves for use in NASCAR with a final 1 micron diamond paste to make them bubble tight, but again the 10 micron particles may keep them from staying that way. I say "may" because any soft particles will be crushed by the force of the heavy springs in the PR Valve. We have supplied precision check valves and bubble tight K-140 PR Valves to all of the Indy 500 cars since 1997 because they want to keep fuel pressure in the system after shutting off the engine, to help restarting the engine, but it doesn't always work, especially because the only pressure accumulator in the system is the flexibility in the hoses... the tiniest leak will bleed off the pressure.

So why bother with the check valve? Because even if the pressure leaks down, when the fuel first tries to boil it will make pressure that curtails further boiling. As the fuel seeps back past the check valve, another bubble can form, but the rate of boiling will be tiny compared to what it would be without the check valve.

H. The fuel flows up through the fuel rails, and any that is not used by the engine is relieved out of the system by the PR Valve, which is set at 75 psi. Note: This is a relief valve, as it relieves fuel out of the system, compared to the carburetor pressure regulator valve, which is in the main line to the carb and controls the pressure to it at about 8 psi.

IT IS BEST NOT TO MOUNT ANY PR VALVE ON THE ENGINE... THE ENGINE SHAKE CAN SHORTEN DIAPHRAGM LIFE, AND IT CAN INTRODUCE PRESSURE VIBRATIONS INTO THE FUEL SYSTEM AS THE VALVE SEAT ON THE END OF THE SPRINGS VIBRATES WHEN IT IS OPEN Production cars often mount the PR valve on the fuel rail, but they have developed their engines to have very little vibration... most race engines shake many times as much. Hanging the PR Valve in the hoses may not look "engineered", but this will vibrate it the least.

I. We are being told that the engines being developed for the NASCAR EFI program run about the same power as the carburetor engines, and that they use about the same amount of fuel at wide open throttle. If the existing catch tank supplied enough fuel for the carburetor engines, we would expect it to do so for the EFI engines; you shouldn't need a second scavenge pump sucking at the front of the fuel tank for use on oval tracks.

J. This system should be compatible with the present fuel tank volume:

	Cubic inches
Volume lost inside tank: Since the car is kept running during refueling, the VST will also be filled. The only volume loss is the .045 stainless that the 3" tank is constructed from	3.2
Scavenge pump	7.0
6AN Aeroquip hose wall area, filter sock to scavenge pump, 25" long	4.0
6AN Aeroquip hose wall area, VST, through Back Pressure Valve to catch tank	3.0
Lost	17.2
Volume gained in pump inlet Monster Ultra filter: 255cc of recoverable fuel (see filter flow test chart above) divided by 16.39 cc/cubic inch = 15.56 cubic inches. Gained	15.6

These volumes are not exact; they are for discussion use only. Some racers prefer 4" diameter or larger tanks. The extra volume is good, but the fuel will wash away from the pump pickup line sooner under cornering, accel, braking g-loads as the tank is running empty, unless the sides are tapered.

K. It is excellent to allow monitoring of the VST pressure. When it drops or flutters it is time to head for the pits... most of our customers monitor this. It is also great for starting the engine: Energize the scavenge pump and main fuel pump, wait for the pressure to come up in the VST and the main system pressure, then engage the starter. Most of our systems start at one or two revolutions of the engine.

L. I really like external main fuel pumps, for serviceability, and different brands of pumps have different volumes... this would keep all of the fuel tanks the same, and use the existing tanks.

M. Allowing any diameter fuel rail would be good. We have never seen a performance gain vs rail diameter, as long as they are large enough, but larger rails can help if the engine builder runs into instantaneous pressure fluctuation problems. See our EFI Fuel Rail catalog page # 141, attached. Larger rails may help because the fuel is slightly compressible after running a few laps, because it contains absorbed air.

N. YOU MUST FILTER YOUR FUEL AS YOU FILL YOUR CAR FILLING CANS The goal is to keep the dirt out of the car in the first place. Never assume the fuel is clean as your receive it. I have seen many situations where the fuel was very clean for years, then suddenly there was a lot of dirt in it, usually not from the blender, but from a dirty delivery vehicle, or in-ground tank. Keep the dry breaks clean.

O. Only anhydrous alcohol is used for blending with gasoline; that is alcohol that has extremely little water in it. This "dry" alcohol has a tremendous affinity for water, which will hurt your engine's performance. You should only use well-sealed metal containers to store your fuel. Never use plastic, as some plastic will let the water vapor in the air pass through into the alcohol; we often see this. You should check your fuel's specific gravity to see if it has water in it... it will be heavier. We sell lab quality hydrometers to check this.

P. Over the years we have consistently seen about 72 psi fuel pressure as being about ideal for EFI systems. It gives very good atomization for power and good brake specific fuel consumption (bsfc), yet is not so high that the opening current required for most models of injectors is a problem (the higher the pressure,

the higher the opening current). The performance at 72 psi is always better than the 45 or so psi used on most production cars, so the 75 psi pressure that NASCAR has mandated to this point seems wise. We have never seen more than 75 psi make more power or economy, so we suggest that the upper limit be at least 85 psi, to accommodate the Safety Valve. We suggest that no lower pressure limit be imposed.

Q. I am told that the carb systems used 10AN hoses, and that when the car was running out of fuel, the Waterman cable driven gear pump could pump enough air to push much of the fuel in the 10AN line up to the carb. I don't believe that the electric pumps will be able to generate enough pressure once they are just sucking air, to be able to push the fuel up to the engine out of the supply hose against the minimum of 35 or so psi to run the engine.
To be able to make a good recommendation on hose size, we flowed 50 foot lengths of smooth liner neoprene hose that we stock. We measured the pressure drop across 50 feet, then divided by 50 to accurately obtain the pressure drop per foot. We used a Micro Motion Coriolis flow meter and three pressure ranges of 7" mirrored face Ashcroft test gauges that we retested on our dead weight gauge tester.

Hose Type	Aeroquip 6AN		Push-Lock 6AN		Aeroquip 8AN		Push-Lock 8AN	
Average Inside Diameter, in	.325		.362		.396		.508	
Area, square inches	.0830		.1029		.1232		.2027	
Hose length	50 ft	1 ft	50 ft	1 ft	50 ft	1 ft	50 ft	1 ft
Psi drop at 125 lb/hr	.80	.0160	.22	.0044	------		------	
250	2.40	.048	1.45	.029	------		------	
500	7.40	.148	4.60	.092	1.78	.036	.55	.011
1,000	25.2	.504	15.6	.312	6.63	.133	3.05	.061
1,500	51.4	1.03	32.2	.644	13.8	.276	6.62	.132
2,000	86.0	1.72	54.8	1.096	23.2	.470	11.6	.232
2,500	------		------		34.6	.692	17.5	.350
3,000	------		------		48.0	.960	24.4	.488
3,500	------		------		63.0	1.26	32.2	.644
4,000	------		------		80.8	1.62	41.1	.822

The maximum flow in your NASCAR fuel system will be under 500 lb/hr, so I underlined that data. If you have 9 feet from the main pump to the filter before the fuel rails, using Aeroquip 6AN hose will give you: 9 ft x .148 psi/ft = 1.3 psi max drop. Using 8AN Aeroquip: 9 ft x .036 psi/ft = .32 psi max drop. You might consider using the 8AN. We recommend running 8AN from the filter before the fuel rails to the rails, to lower the velocity going into the rails. 6AN or 8AN to the PR Valve is OK. Use 6AN from the PR Valve back to the VST; not smaller... it has to bypass full pump output at engine overrun, if all the fuel is shut off at the injectors. We recommend using an 8AN line from the VST to the Ultra filter, to the main pump.

If you experience continuing pump vapor lock problems after hot soaks, this solution always works: Put a tee fitting on the pump outlet. You must run the straight-through part of the tee to the check valve; if you were to run it off the side branch, you would be introducing a 90 degree fitting. Use hose to make a vertical stand-pipe 3" tall; put it on the side branch of the tee. Put an .011" restrictor fitting at the top of the standpipe, with a 3AN hose from it back to the tank. This will pass a lot of vapor, to let fuel come into the main electric pump from the VST, to "unlock" the pump, but only 10 lb/hr of fuel at 75 psi. This must have a little filter before it. We can supply these assemblies as a nice one-piece all metal assembly. Having the Ultra Monster filter mounted vertically above the pump acts as a reservoir of fuel to help the pump start pumping... this usually proves effective.

Regarding the hose data: The Push-Lock hose consistently had less pressure drop than the Aeroquip hose, especially at the lowest flows, after correcting for the area difference and applying the formula, which is between a linear and a square curve. We can see that the Push-Lock is smoother on the inside, so maybe it is related to wall friction. Any of you have any ideas? We can test hose for you.

I show the higher flows to answer the questions we get about what size hose to plumb pumps in the dyno room, large supercharged engines, etc. Also, I wanted you to see how quickly the pressure increases when the hose is undersize for the flow you want to pass through it.

R. We set up a complete system as we are proposing it on one of our flow benches, and have been doing extensive flow test work. It supplies vapor free fuel to the fuel rails even with the fuel in the tank boiling at a brisk rate.

S. MECHANICAL FUEL PUMP A different approach to the fuel supply system might be to mount one of our Tough Pumps (see the last two pages of the attached documents), or other brand of mechanical pump down low on the side of the engine. To make it very safe for a heavy frontal collision, I would propose having a drive pulley at the front of the engine, with a solid jackshaft about 15" long to locate the pump near the rear of the engine. It might also be placed at the back of the engine where the cable drive attaches.

The Tough Pump would be much more durable than any electric pump... we have had them in the field three years now and have yet to rebuild one. They come in regularly for flow rechecks; they just keep flowing like new. They are low priced compared to the specially developed electric pumps, and we have them in stock at all times.
We sell more Weldon electric fuel pumps than anyone else (and carry by far the largest stock), and are the official rebuild center for them, and we rebuild a lot of other pumps. The Weldon pumps hold up very well, but some of them get run a lot of hours. About 70% of the failures are electrical... the pump section is often OK. It would be nice to eliminate the electric motor for durability reasons, and it would also save the current draw.
You would still use the Vapor Separator Tank and scavenge pump. We would set the Back Pressure Valve at about 15 psi to get adequate starting pressure to the fuel rails. The VST would push the fuel up to the pump nicely. PLEASE LET ME KNOW YOUR THOUGHTS ON THIS.

T. We are an extremely well equipped and staffed research lab that makes racing fuel injection pieces and systems. We can test anything related to fuel systems, and we can make custom pieces for you.

U. This system that we are proposing is not expensive compared to all the ones we have seen over the years that didn't work, because of the havoc they caused. This system works, all day long, every day.

THIS IS A DISCUSSION DRAFT..... PLEASE GET BACK TO JIM KINSLER
WITH YOUR COMMENTS... SO HE CAN MAKE APPROPRIATE CHANGES
PLEASE DON'T HOLD BACK... ANY TINEST CRITIQUE WILL BE APPRECIATED!!!

James Kinsler

Kinsler Fuel Injection, Inc.

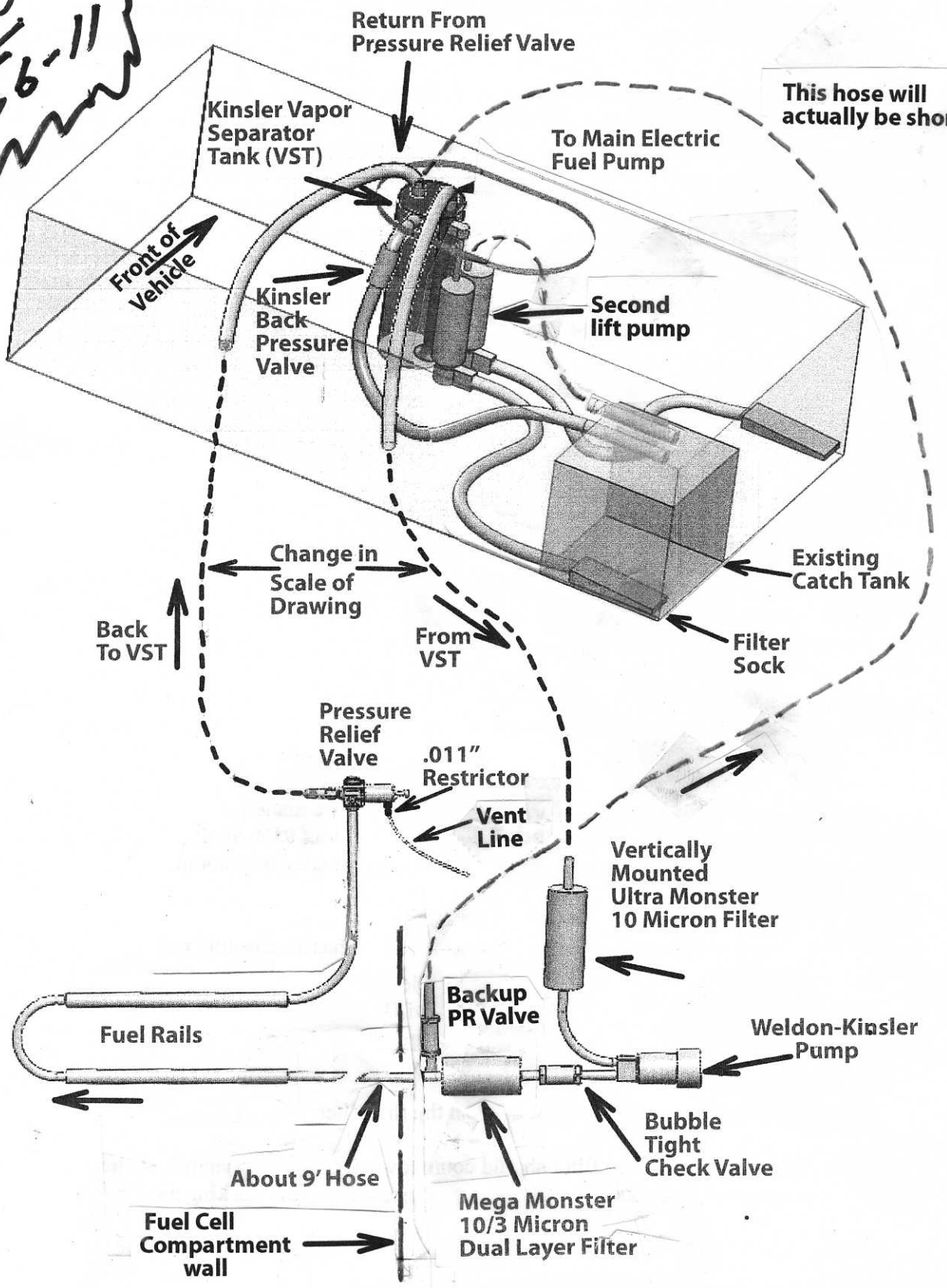
OK / 9-12-11 a.c. X

PROPOSAL FOR FUEL SUPPLY SYSTEM FOR NASCAR EFI

"NOW" 9-26-11

For Oval Tracks

9-12-11



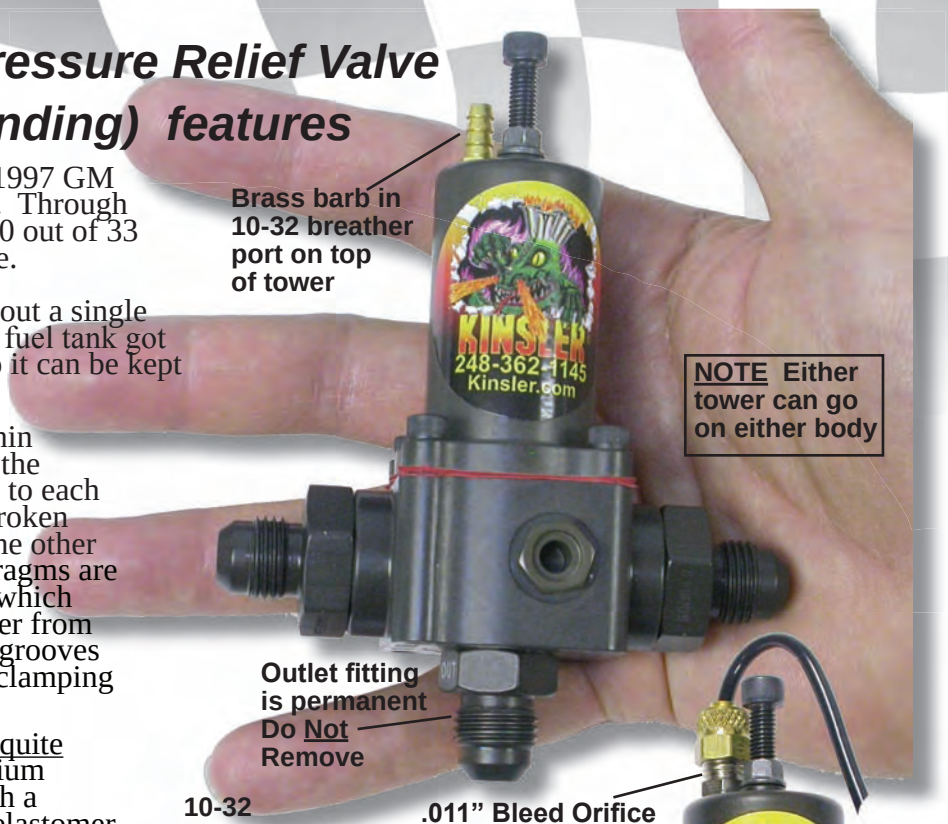
1834 Thunderbird TROY, MICHIGAN 48084 U.S.A.
www.kinsler.com Phone (248) 362-1145 Fax (248) 362-1032

K-140 *THE ULTIMATE Pressure Relief Valve*

Has unique (patent pending) features

We designed and developed this valve for the 1997 GM re-entry back to Indy; the Indy Racing League. Through 2002 all of the GM cars ran this valve; about 30 out of 33 cars. Since then, all the cars have run the valve.

We have shipped 4,680 valves since 1996 without a single failure in the field (unless the return line to the fuel tank got blocked off). Each valve is serial numbered so it can be kept track of by the teams.



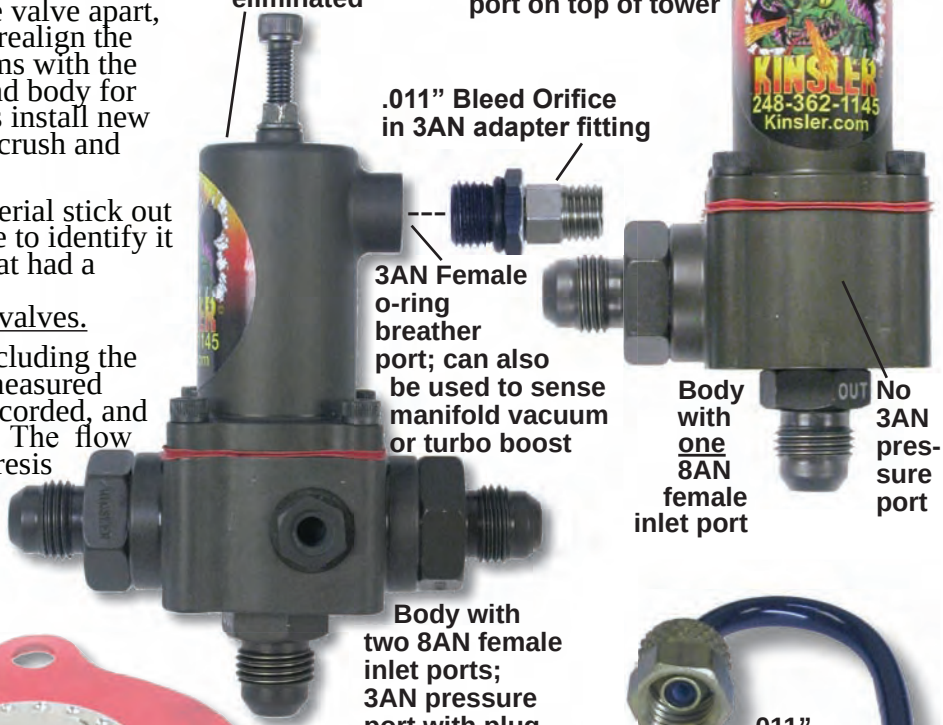
Diaphragms We use two thin diaphragms, installed with the weave at a 45 degree angle to each other, so if a thread were broken in one, it is backed up by the other diaphragm. The two diaphragms are crushed a total of .0044", which forces some of the elastomer from them into the four retainer grooves in the tower and the body, clamping them very securely.

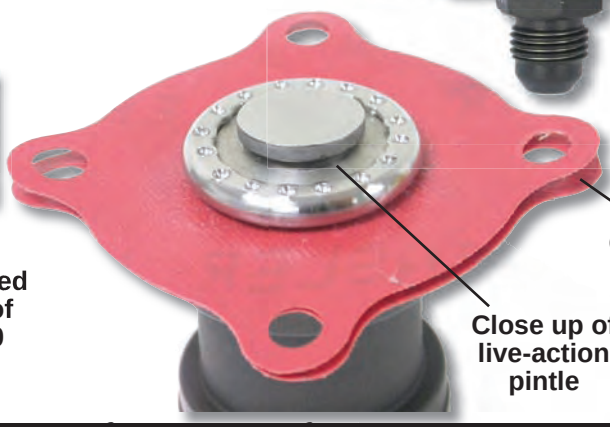
The diaphragm material is quite special: The fabric is premium quality, vacuum coated with a primer, then two different elastomer coatings to be compatible with gasoline, alcohol, and blends thereof. If you take the valve apart, you must be careful to realign the ridges on the diaphragms with the grooves in the tower and body for reassembly...we always install new diaphragms for proper crush and best sealing.

We let some of the material stick out of the sides of the valve to identify it from earlier models that had a rolling diaphragm; do not use those early valves.

All the components, including the springs, are carefully measured for each valve build, recorded, and kept for future service. The flow performance and hysteresis loop are also recorded.

Valve is LIGHT: 0.45 lb





Body with two 8AN female inlet ports; 3AN pressure port with plug

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K-140 Pressure Relief Valve

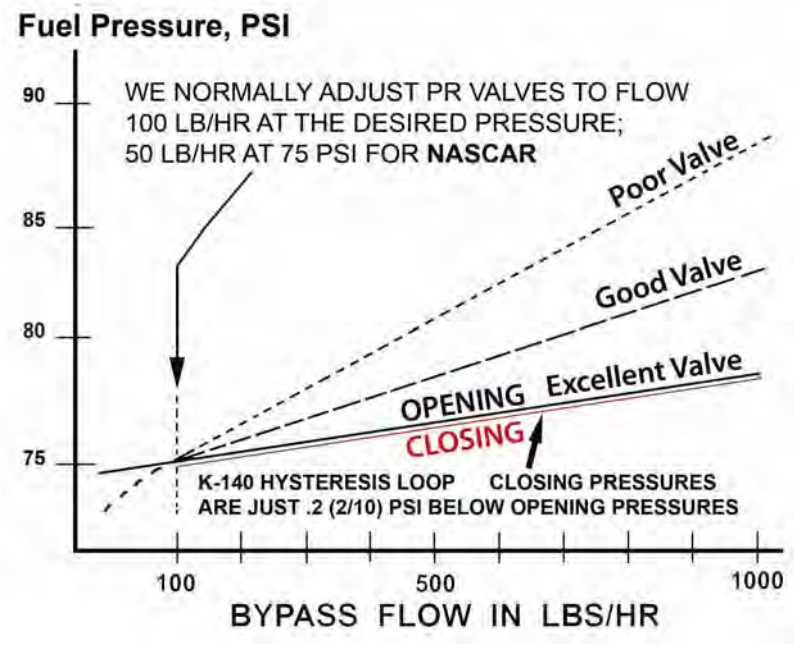
Extremely Precise Fuel Pressure Control

- > Light-weight
- > Compact
- > Adjustable
- > Vacuum/Boost Reference
- > Methanol Compatible
- > The Most Accurate Valve on the Market

FURTHER DISCUSION REGARDING THE K-140 PRESSURE RELIEF VALVE 9-10-11

Pressure Relief Valves (PRV) have a diaphragm assembly with a pintle or ball, with spring(s) above it to force it down onto the seat. Fuel pressure from the pump must rise to the set point to exert enough force on the diaphragm to lift the sealing device off the seat, allowing fuel to pass through the valve. To bypass more fuel, the spring(s) have to be compressed slightly more to open the valve a bit further, causing a rise in pressure. Our valve has less pressure rise (less slope) than any other valve because of its large efficient-flowing pintle and seat.

As the flow is decreased, the pressure decreases. Ideally, this would form one slightly slanted straight line (see graph to right),but friction in the valve makes the closing pressures slightly less than the opening ones. This result is called a hysterisis loop. Our valve has the tightest loop of any valve we have tested: the closing pressures are just .2 (2/10) psi lower than the opening pressures.



Our Swivel Pintle is self centering as the valve closes. The piston that carries the diaphragms and swivel pintle on its nose prevents any spring end angle from cocking the pintle carrier, but even if it could cock, the swivel pintle would cancel it out.

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Valves that use a “captured ball” to close off the flow against the seat are not self centering, and have no way to compensate for angle on the end of the spring, which cocks the plate that carries the ball, which moves the ball off center. This is important because most any valve will work while bypassing a lot of flow through it... the critical point of operation is when the fuel flow through it is low... you need the valve to close off tightly, ideally at the set operating pressure.

Optional: Both the pintle and the seat can be final lapped with 1 micron diamond paste for bubble tight close-off for NASCAR. The biggest downfall of other valves that we have tested is that they leak a lot when the sealing device is on the seat. THIS IS CRUCIAL WHEN THE FUEL FLOW FROM THE MAIN PUMP IS LOW.

Valve Durability All of our valve components are premium hard coated, sealed for use with alcohol, then the moving parts are micro lapped to a high polish. On our 12 station durability bench we have never had more than barely measurable wear after 300 hours of cycling, compared to other valves that wear badly. Our K-140 valve will perform very consistently for you, and be quite inexpensive in the long run... we don’t know of anyone that has replaced one of these... if you have, please call Jim Kinsler on his direct line at 248 362-1149 and tell him why you had to replace it.

Diaphragm Failure in any model valve WILL CAUSE FUEL TO SPRAY OUT OF THE VENT HOLE, possibly causing a fire, and the valve fails closed, deadheading the main fuel pump, except for the fuel passing out through the vent hole. While we have never had a diaphragm failure in our K-140 valve under normal operating conditions, we must protect against that possibility.

Seven pressure ranges (spring combinations)

KINSLER #	PSI	BAR	ADJ. SCREW	VAC. REF.	HOUSING MATERIAL	WEIGHT (LBS)	INLET DETAILS	OUTLET DETAILS
12100	17 - 37	1.2 - 2.5	Yes	Yes	Aluminum Hard Anodized	0.42	2 - 8 AN Female	1 - 6 AN Male Flare
12102	26 - 51	1.8 - 3.5						
12104	34 - 80	2.4 - 5.5						
12106	49 - 106	3.4 - 7.3						
12108	57 - 123	4.0 - 8.4						
12110	72 - 152	5.0 - 10.4						
12116	88 - 230	6.1 - 16.0						

Set at 75 PSI For NASCAR

Safety Valve Some of the Indy Cars have quick disconnect fittings on the fuel lines to the tank. In 2004 a line from the PRV back to the tank wasn’t secured properly... it blew off after three laps, deadheading the valve. The mechanical fuel pump made enough pressure to rupture the diaphragm, spraying the engine compartment with fuel, causing a fire. Our solution: We added a Safety Valve set at 87 psi; 14.5 psi above the 72.5 PRV setting. This higher pressure keeps the Safety Valve from opening during normal operation, so dirt can’t get between its poppet and seat and bleed off fuel. The mechanical pump easily makes the additional pressure.
Bleed Orifice We placed an .011” orifice in the PRV bleed port, which is adequate to vent the valve during normal operation, but will pass very little fuel (10 lb/hr at the NASCAR 75 psi mandate) if a diaphragm ruptures... thus the car can continue to run on the Safety Valve.

A Safety Tube is used to carry the fuel overboard or back to the fuel tank from the .011” orifice.
Most electric pumps don’t make enough pressure to rupture the diaphragm in most models of valves if the return line were blocked, but it could happen, so you must run a Safety Valve to protect the pump from overpressure. For safety, run the .011” orifice and Safety Tube. If you use the tower with the 3AN bleed port and connect it to the intake manifold to sense manifold vacuum, then you don’t need a Safety Tube, since the fuel would pass into the engine if a diaphragm were to rupture (while this wouldn’t be good, it should be safe). This will keep the system pressure within the calibration table range in the ECU, to be able to keep running in case of a diaphragm failure.

Safety Valve A poppet type valve is used because it can only fail "open", so it is a very safe device to use as the PRV backup. Poppet type valves are not used as the primary PRV because they have too much internal friction, especially if the spring is not extremely straight and square on the ends, causing a large hysterisis loop, and they go into a "buzz" much easier then diaphragm valves. We recommend that if you use an electric pump with a PRV set at 75 psi, the Safety Valve should be set at 82 psi. We would like to set it higher, but some electric pump models will overheat at higher pressure.

Vacuum – Boost Reference If you connect the 3AN side-of-the-tower breather port below the throttles in the intake manifold, the PRV will lower the fuel pressure when it sees vacuum. If it sees boost, the PRV will raise the fuel pressure. This broadens the useable range of the injectors. See table at right.
Note: The Piston can be lubed with different compounds to help with fuel system pressure fluctuations... a bit of damping, or the cavity partially filled with oil.

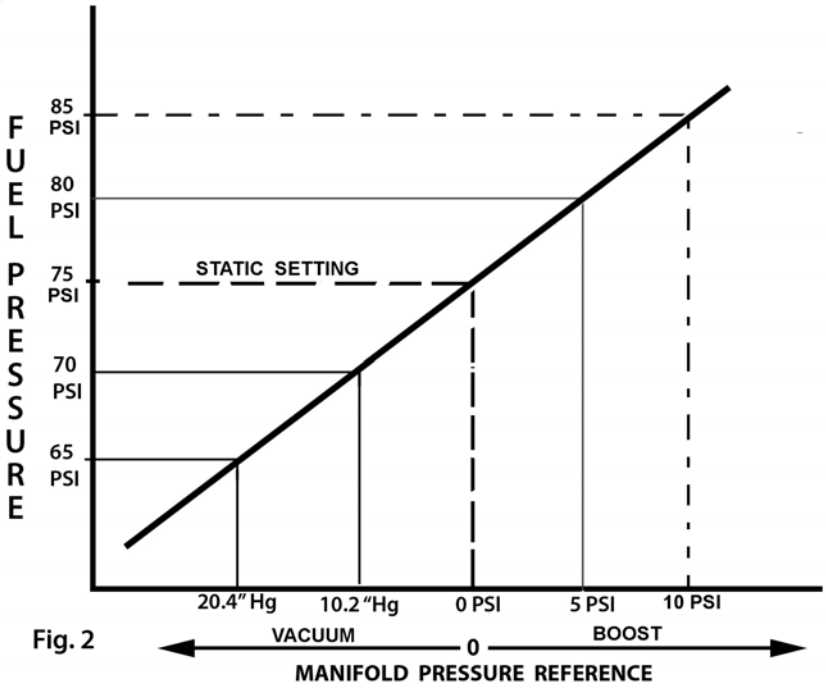

Fig. 2

Caution: Never use "stale" gas... that is, old gas that has sat around and oxidized. It has a distinctive acrid smell because some of the ingredients have changed to harsh chemicals that will attack the fuel cell and diaphragm elastomers. Don't let gasoline come in through the Safety Tube above the diaphragm and sit there, it will become stale.

Filtration Required It is critical that the PRV has a maximum of 10 micron (.39 thousandths of an inch particles) to it, as any dirt that gets between the pintle and the seat will prevent the valve from closing fully. Much better would be our 10/3 filter, which has a top layer of 10 micron paper to protect a 3 micron (.12 thousandths) absolute fiberglass bottom layer. It is best to supply the injectors with 3 micron filtration, so placing this filter before the fuel rails will protect the injectors and the PRV better.

A Pressure Regulator Valve controls the pressure going into a system, such as a carburetor. A Pressure Relief Valve controls the pressure in a system by relieving flow out of it and sending it back to the fuel tank, as in EFI system.

Monster Mesh series filters

Used for:

- **Injected or carburetted fuel systems**
- **Engine oil**
- Rear end
- **Transmission**

- **Indy Racing League**
  Toyota, Honda, and Chevrolet

- Drag
- Sprint
- Midget
- Street
- Off-road
- Road race
- Monster truck
- **Pull truck & tractors**
- Race Boats

Premium Filter Media

We use very high quality paper that has much more consistent pore size, and many more pores per square inch, especially batch to batch. More pores give more dirt catching ability and less pressure drop. Our stainless mesh is a high quality very consistent weave.

We use deeper pleats and more pleats to pack in more square inches of filter media for our housing sizes. More area lowers the velocity through the media which catches, more dirt.

Filter Name	Housing Length (not incl. fittings)	Housing Diameter	Media Square Inches	Microns in paper	Microns in stainless steel mesh	Filter Assembly Weight (Ounces) paper	Filter Assembly Weight (Ounces) stainless steel mesh	Fuel Compatibility	Housing Finish	Application	Available Ports
Laser Welded Filter #8194 Laser Welded Filter #8197	3.100"	2.160"	92	10	-	4.32	-	gasoline	stainless steel	EFI pump outlet	3/8" male barb 16mm x 1.5 female
Injector Protector #8170	2.910"	1.900"	45	10	-	5.92	-	gasoline	black anodized	EFI pump outlet	8 AN female*
Ano-BRL #4156	2.910"	1.900"	19	-	140	-	6.56	methanol	hard anodized (olive-grey color)	mechanical pump outlet	8 AN female*
Alum-BRL #4148	2.910"	1.900"	19	-	140	-	6.56	gasoline	red anodized	mechanical pump outlet	8 AN female*
Monster Mesh 8300 Series	4.035"	2.460"	MESH 74 (PAPER 108	10, 20, 40	25, 45, 70, 100, 218	9.12	10.88	gasoline methanol nitromethane	blue anodized and hard anodized	EFI pump inlet & outlet, mechanical pump inlet & outlet, oil	8 AN female 8 AN male flare 10 AN male flare 12 AN male flare
Mega Monster Mesh 8400 Series	5.240"	2.460"	MESH 111 (PAPER 162	10, 20, 40	25, 45, 70, 100, 218	10.56	12.96	gasoline methanol nitromethane	blue anodized and hard anodized	EFI pump inlet & outlet, mechanical pump inlet & outlet, oil	8 AN female 8 AN male flare 10 AN male flare 12 AN male flare
Ultra Monster Mesh 8500 Series	6.460"	2.460"	MESH 148 (PAPER 216	10, 20, 40	25, 45, 70, 100, 218	11.68	14.88	gasoline methanol nitromethane	blue anodized and hard anodized	EFI pump inlet & outlet, mechanical pump inlet & outlet, oil	8 AN female 8 AN male flare 10 AN male flare 12 AN male flare

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1834 Thunderbird Street Troy, Michigan 48084 U.S.A.
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www.kinsler.com

Engineering, manufacturing, sales, service, calibration, testing, and modification of mechanical and electronic fuel injection systems and components for all types of racing and performance.

WELDON-KINSLER ELECTRIC FUEL PUMP FOR NASCAR 6-21-11

Flow test of Weldon-Kinsler NASCAR fuel pump serial #155617, with control circuit update #3A. Flowtested on 6-20-11 All with 75.0 psi at pump outlet. Weight: 1.42 pounds without inlet or outlet fittings. Kinsler part # 10282

Volts	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	13.0	14.0	15.0	16.0	17.0	18.0
Flow, gph	49.4	55.0	61.2	66.6	73.1	----------78.3 constant output----------									
Amps	9.8	9.7	9.7	9.6	9.6	9.6	9.2	8.9	8.7	8.2	7.7	7.2	6.9	6.5	6.1

Discussion: The criteria was to have the fuel pump be able to supply enough fuel for the engine to run full power at 12.0 volts supply. This final control circuit and pump motor achieve this down to 10.5 volts.

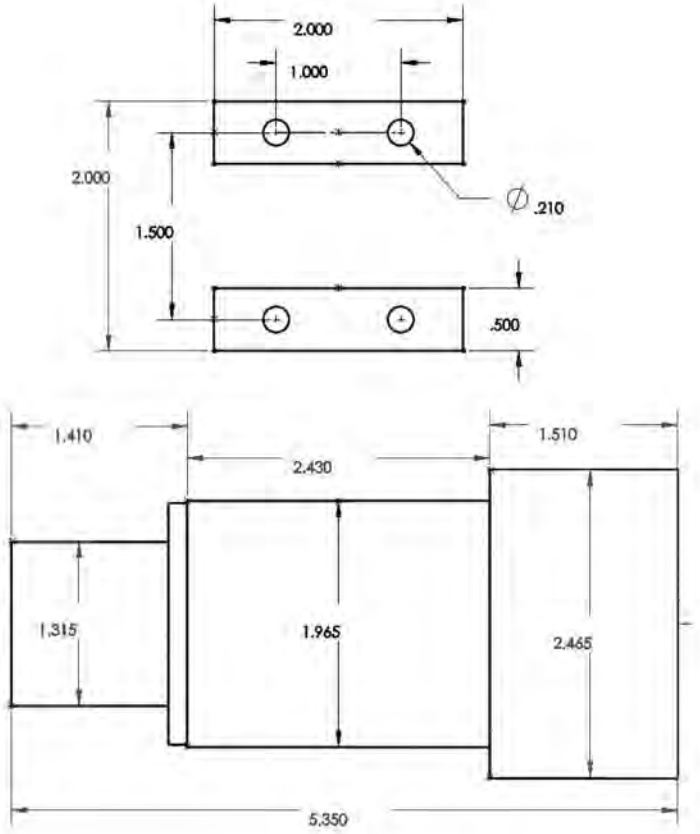
With the car operating at the normal 13.5 volts, the current draw will be about 7.9 amps.

The constant gph output from 10.5 through 18.0 volts is achieved by use of a very sophisticated electric controller on this premium quality brushless motor. This saves considerable current (amps). It is also good not to have the pump flow more as the supply voltage increases, for best fuel system performance.

The pump is safe to operate at 75 psi down to 8.0 volts, at which it has 49.4 gph. We like to allow about 6 gph flow through the PR Valve for it to control the pressure accurately, so this leaves about 43.4 gph available to the engine, which gives about 260 lb/hr, which at .45 brake specific fuel consumption indicates about 578 horsepower worth of fuel available.

If the driver has a fuel rail pressure gauge on the dash, he can drive the car as hard as he wishes as long as the pressure is at the minimum pressure that the EFI fuel map is programmed for.

If you have any questions, please feel free to call Brian directly at 248 362-6116.



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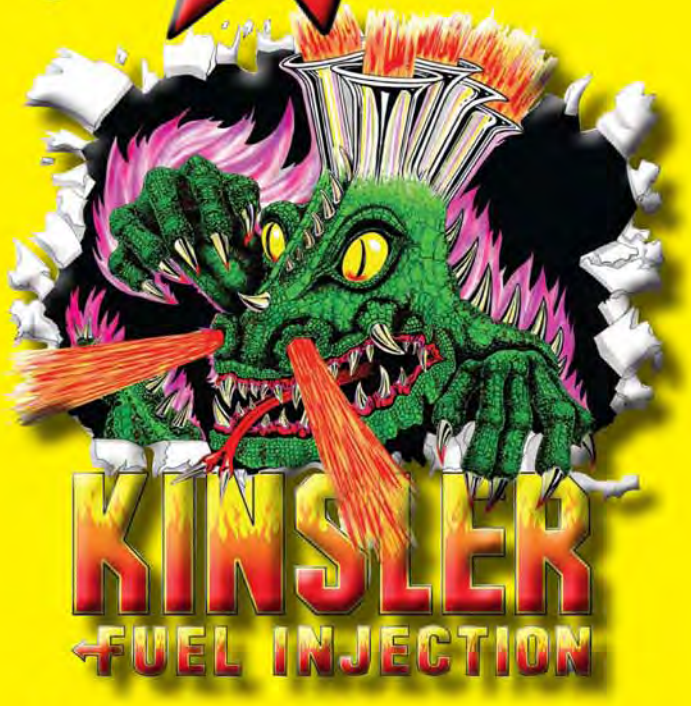
NEW

TOUGH® PUMP



Excellent Durability

Patent Pending

TOUGH® BECAUSE:

One Piece Gear-Shaft

High alloy steel, case hardened, precision ground, then proprietary coated. Does not allow any radial movement of the gear on the shaft, thus maintaining correct clearance between the gear teeth tips and the housing. A two piece gear and shaft introduces more tolerance, which can allow the tips to scrape the gear cavity walls.
Can ingest dirt and spit it out that would fail any other pump.

ONE PIECE GEAR-SHAFT

Rock Solid Housing

Evolved through housing deflection vs pressure tests. This final design is the strongest in the industry, combined with twelve 10-32 studs to super secure the extra rigid cover. MIL-Spec hard coated to +/- .0001" tolerance for consistent flow over a very long life. Good to 400 PSI; higher available.

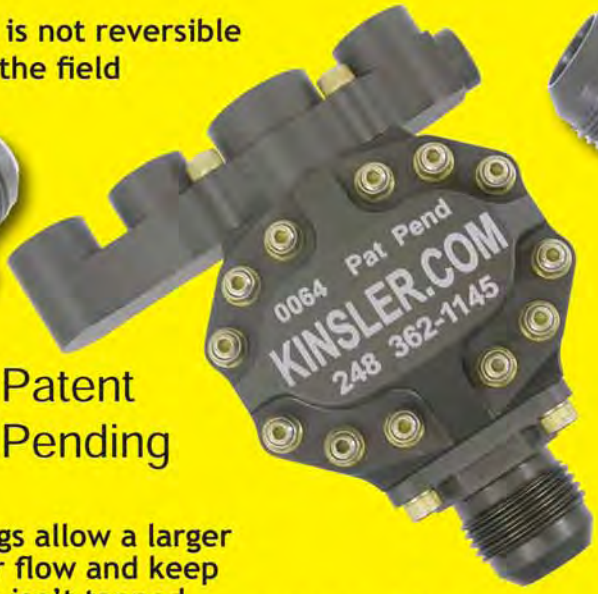
Steady Flow at EXTREME RPM

The inlet port comes straight into the gears rather than making a 90^{O} turn like most pumps. This combined with special internal design features to feed the fuel to the gears gives EXCELLENT top-end performance.... up to 7,000 pump RPM (14,000 engine RPM) without cavitation. Our larger diameter roller bearings are rated at higher load (output pressure) and 2,000 more pump RPM than those of other pumps.

Pressure Balance Plate System

*Our gear side plates are high alloy steel, heat treated very hard, ground to a 6 micro-inch finish, with end-to-end flatness of .0001". These are coated with a harder-than-carbide composite, then lapped to a 2 micro-inch mirror finish. This coating is so smooth that the torque required to drive the pump is significantly reduced. One plate is moveable. It has pump outlet pressure fed under it to keep it in constant contact with the gear faces, which gives minimum pump output flow drop vs pressure, and compensates for housing expansion due to temperature, and wear. For excellent priming during engine cranking, two coil s*prings keep the plate in contact with the gear faces.

Pump is not reversible in the field



Patent Pending

Inlet and outlet bolt-on-fittings allow a larger diameter inlet port for better flow and keep the housing strong because it isn't tapped for a large fitting thread.

Individual fittings:
6AN, 8AN, 10AN, 12AN

Outlet manifold fittings:
6AN, 8AN, 6AN (three port)
6AN, 6AN, 8AN, 6AN (four port)
The 8AN can be reduced to 6AN

Pump length and diameter, mounting nose diameter, and pump mounting bracket are industry standard. Will bolt on where any Hilborn, Waterman, DSR, or Enderle pump does.

3AN pressure tap

To prevent pressure from reaching the shaft seal, a static brass sleeve around the drive shaft is sealed to the housing and to the moveable plate by o-rings. This reduces the possibility of a seal leak and reduces friction on the drive shaft, because pressure is not forcing the seal lip to grip down onto the shaft... gives longer seal life and less drive torque. The seal cavity is vented back to the inlet side of the pump to further insure that there is no pressure on the seal. A snap ring positively locates the seal.

Mirror Smooth Finish

Six station durability test, and break-in bench

Each pump is flow tested, run-in for two hours, then reflowtested before shipping.

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Manufacturing, Sales, & Service. Constant flow, Electronic, and Lucas mechanical fuel injection.
Kinsler Fuel Injection, Inc.
1834 Thunderbird Street
Troy, MI 48084 USA

Tel: 248-362-1145
Fax: 248-362-1032

See Our New Web Site kinsler.com

Free Handbook/Catalog at kinsler.com

EFI FUEL RAILS - NEW .970" I.D. RAIL! READY

We can supply a completed fuel rail for our manifold or yours, or we can machine a rail to your print or supply a partially machined rail for you to finish. Individual components available !

WELD-IN INJECTOR BOSSES FOR MANIFOLD

— ALL LEGAL FUEL RAILS FOR NASCAR —

TO MACHINE YOUR OWN FUEL RAIL
SEE PAGE #144 FOR TOOLING

STANCHIONS

FUEL RAIL ADAPTER FITTINGS

STANCHION MOUNT STUDS

Our 8 AN fuel rails with .685" ID are more than adequate for most applications. Our 12 AN fuel rails with .970" ID have twice the cross-sectional area of the 8 AN rails... we recommend these for very high horsepower gas engines, most methanol engines, systems with very large injectors, or two injectors .... call our technicians for advice.

The problem: When a very large EFI injector is pulsed (opened), it takes a very quick "gulp" of fuel out of the rail, causing a large instantaneous pressure drop. These pressure drops can reinforce each other in a random ram tuning within the rail and attached fuel hoses that cause chaotic pressure pulsing; we have seen plus and minus 30 psi on a 130 psi supply (100 - 160 psi range). As the pressure waves travel through the fuel rail, some injectors are likely to open when there is a high or low local pressure...
this causes very significant cycle to cycle rich and lean conditions to the cylinders, as once the injector opens, it's simply a function of the pressure acting across it's outlet orifice(s). A pressure gauge will not respond accurately to these pulses as they are too fast; we use very fast response Kistler piezoelectric pressure transducers to analyze these systems.

Why the larger rails help: All fuel has some air in it, especially after the system has run a little, because the return fuel absorbs more air as it falls back into the tank. This makes the fuel a bit compressible, thus the larger rail assists the ability to take a "gulp" with less pressure fluctuation. We have seen the pressure fluctuations reduced just by switching from our 8 AN to our 12 AN rails.

Avoid using individual supply hoses to the injectors; they cause huge pressure drops because of the pulsing flows. If you must use them, make them all the same length, and as large an ID as possible... 3/16" ID is too small; 3/8" would be much better.

ALUMINUM FUEL RAILS

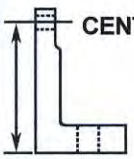
Extruded aluminum fuel rail material in bulk form, cut to desired length, partially machined, or machined to fit. Billet aluminum mounting stanchions are available in varying heights to aid in the installation of EFI injectors with different overall body lengths. We offer a complete line of mounting hardware and adapter fittings. Our extrusion design allows for the drilling and tapping of 8 AN female o-ring end ports (NO pipe thread which can crack the tube, or sealer compound to get in your fuel system).

10300	Extruded aluminum fuel rail tubing, 6061-T6 alloy, .680" I.D., .110" wall, .900" wide x 1.3" tall, priced per foot
10301	Extruded aluminum fuel rail tubing, 6061-T6 alloy, .970" I.D., .140" wall, 1.250" wide x 1.730" tall, priced per foot
10365	Labor, machine one end of extruded aluminum fuel rail for 8 AN female o-ringed thread
10366	Labor, machine both ends of one rail to square off raw cut piece
10303	Stanchion, 2.000" tall, L-type, billet aluminum
10305	Stanchion, 2.050" tall, L-type, billet aluminum
10308	Stanchion, 2.100" tall, L-type, billet aluminum, used on Kinsler manifolds with Bosch or Rochester EFI injectors
10310	Stanchion, 2.150" tall, L-type, billet aluminum
10312	Stanchion, 2.200" tall, L-type, billet aluminum
10313	Stanchion, 2.000" tall, L-type, billet aluminum, Special L-type, pad for installation of #10314 bell crank bracket
10314	Bracket, bolts to stanchion #10313 to mount Kinsler #5485 bell crank bearing, used on Buick V6 'Indy Light' cars
10317	Stanchion, 2.250" tall, L-type, billet aluminum
10319	Stanchion, 2.300" tall, L-type, billet aluminum

U-Type Stanchions are for severe vibration applications

10329	Stanchion, 2.100" tall, U-type, billet aluminum
10330	Stanchion, 2.220" tall, U-type, billet aluminum
10331	Stanchion, 1.960" tall, U-type, billet aluminum

10355	Injector cup extension, 1.135" long, 6 AN male + o-ring, billet aluminum
10357	Injector cup extension, 1.355" long, 6 AN male + o-ring, billet aluminum
10359	Injector cup extension, 2.0" long, 6 AN male + o-ring, billet aluminum, not machined for injector detail



Stanchion height is measured from bottom of stanchion to the centerline of the fuel rail mounting hole.

10348	Stud kit, set of (4) 5/16-18 x 1 1/4" studs with recess hex, washers, and jet nuts
10349	Bolt kit, set for mounting (4) U-type stanchions, 5/16-18 x 1 1/4" cap screws, (4) special washers, (4) small hex nuts for studs, cross bolts, washers, and nuts
10350	Bolt kit, set of (4) for mounting fuel rail to stanchion, 1/4-20 x 1" long small head 12-pt. bolts with washers and jet nuts

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TOOLING TO MACHINE FUEL RAILS AND INJECTOR POCKET MACHINING

Machining tools (purchase or rental) so you can machine your manifold and/or fuel rails. Fast and effective way to cut the complete detail in one operation.

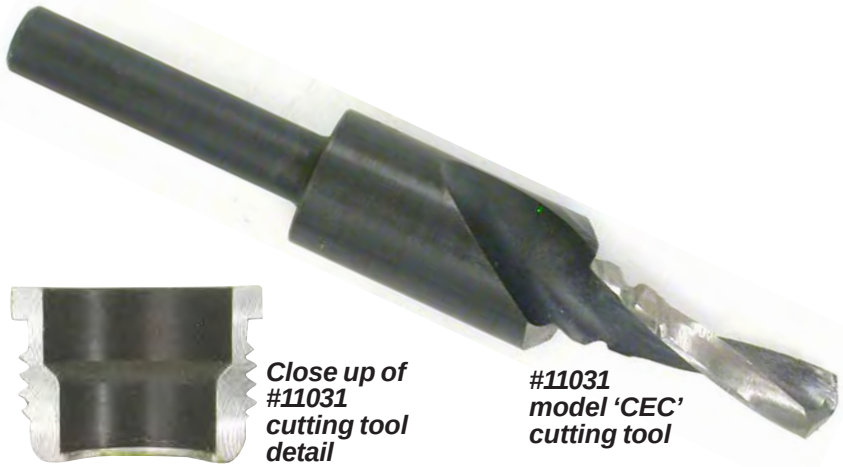
EFI INJECTOR DETAIL

11030	Model CEU. For EFI injector with captive o-ring on tip of outlet, boss inside diameter is straight-through design, to be used ONLY with fuel rails that have injector retaining clips or other suitable injector retention
11031	Model CEC. For EFI injector with captive o-ring on tip of outlet, inside diameter of boss will have an o-ring seat to stop injector body from contacting boss or manifold, select this tool when using extruded aluminum fuel rails without injector retainer clips
11032	Model CEB. For EFI injector using "bung" style seal for injectors with or without rail retainer clips
11033	Model CEP. For 'Pico' style EFI injector with captive o-ring on tip of outlet, inside diameter of boss will have an o-ring seat to stop injector body from contacting boss or manifold, select this tool when using extruded aluminum fuel rails without injector retainer clip
11045	Model CEV6. For 'EV6' style EFI injector with captive o-ring on tip of outlet, inside diameter of boss will have an o-ring seat to stop injector body from contacting boss or manifold, select this tool when using extruded aluminum fuel rails without injector retainer clip

INJECTOR DETAIL IN ALUMINUM RAIL

11001	One-step machining of o-ring style EFI injector detail into extruded aluminum fuel rail, for most Bosch, Rochester, Siemens, Lucas, and Nippondenso top feed injectors with .575" O.D. o-ring
11046	One-step machining of o-ring style EFI injector detail into extruded aluminum fuel rail, for most Keihin and Denso injectors with .432" O.D. o-ring

#11001



#11031 model 'CEC' cutting tool

Close up of #11031 cutting tool detail

Closeup of 8 AN + o-ring thread detail

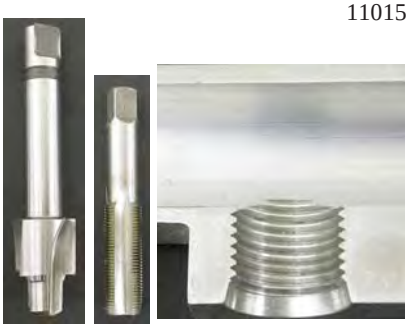
THREAD END OF ALUMINUM RAIL

11005	Counter bore cutter, machines 8 AN o-ring pocket, inlet/outlet of extruded aluminum fuel rail tube
11010	Tap, 8 AN (3/4-16 thread), inlet/outlet of extruded aluminum fuel rail tube
11003	Counter bore cutter, machines 12 AN o-ring pocket, inlet/outlet of extruded aluminum fuel rail tube
11015	Tap, 12 AN (1 1/16-12 thread), inlet/outlet of extruded aluminum fuel rail tube

RENTAL

Rental of special machining tools:
We send the tool(s) via UPS, Prepaid Credit Card or COD for the full purchase price. You may use the tool for 30 days maximum, at which time you may keep it or return it to us (in good shape); we will subtract the rental fee and refund or credit the difference. This only covers our handling costs and eventual resharpening; we are not really charging a rental fee. We appreciate your business and are glad to help you with your project.

11050	Rental of one machine tap: #11010, #11011, #11012, #11013, #11014
11051	Rental of special detail cutter: #11001, #11005, #11006, #11020, #11030, #11031, #11032, #11033, #11045, #11046



6 AN DETAIL IN ALUMINUM FUEL RAIL

Allows a 6 AN male + o-ring fitting or Kinsler #10355, #10357, or #10359 fuel cup extensions (see Page #141) to be screwed into fuel rail.

11006	Counter bore cutter, machines 6 AN o-ring pocket for injector extensions
11011	Tap, 6 AN (9/16-18 thread), thread pocket for injector extension for 6 AN fitting

PRESSURE TAP IN ALUMINUM RAIL

11012	Tap, 4 AN, (7/16-20 thread)
11013	Tap, 3 AN, (3/8-24 thread), thread pocket for PSI tap in extruded aluminum fuel rail tube

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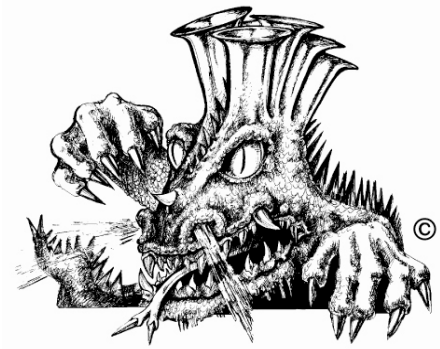
www.Kinsler.com Phone (248) 362-1145 Fax (248) 362-1032



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Engineering, manufacturing, sales, service, calibration, testing, and modification of mechanical and electronic fuel injection systems and components for all types of racing and performance.

Parts List for NASCAR EFI Fuel Supply System

Revised 9-17_13

Call Brian direct at (248) 362-6116 9:00 AM – 6:00 PM

K-140 Pressure Relief Valve, set at 75 psi, or specify whatever pressure you want.
For NASCAR use we use a final 1 micron diamond paste lap on the seat and pintle to make it bubble tight, and do extended testing... extra cost of 26.00

	Part No	Dealer Price
K-140 WITH 10-32 BREATHER PORT ON TOP OF TOWER		
With 10-32 brass barb fitting in breather port, two 8AN female ports in body, with adapter fittings to 6AN or 8AN (specify), 3AN pressure port in lower body with plug, with diamond lap and extended testing.	12106ND	483.65
Same, but without diamond lap or extended testing	12106N	457.65
Same, but with one 8AN port with 6AN or 8AN adapter fitting (specify); no 3AN pressure port in lower body, with diamond lap and extended testing	22106ND	473.85
Same, but without diamond lap or extended testing	22106N	447.85

K-140 WITH 3AN BREATHER PORT ON SIDE OF TOWER NEAR TOP...
specify how you want this clocked vs the lower body.

********THIS WILL BE THE BEST FOR NASCAR USE, AS WE ARE GOING TO MAKE A 3AN STRAIGHT x 3AN MALE FITTING WITH A BLEED ORIFICE IN IT, SO YOU CAN ATTACH A 3AN BRAIDED "SAFETY TUBE" *********
We cannot make a 3AN male fitting for the top of the tower because the 10-32 thread is not strong enough to support that heavier line, nor the torque of tightening it.

No 10-32 breather port on top of tower, two 8AN female ports in body, with adapter fittings to 6AN or 8AN (specify), 3AN pressure port in lower body with plug, with diamond lap and extended testing	32106ND	495.86
Same, but without diamond lap or extended testing	32106N	469.86
Same, but with one 8AN port with 6AN or 8AN adapter fitting (specify), no 3AN pressure port in lower body, with diamond lap and extended testing	42106ND	486.06
Same, but without diamond lap or extended testing	42106N	460.06
Adapter fitting, 3AN straight x 10-32 to adapt .011 Bleed Orifice to 3AN port on tower This is a bit expensive as we are presently having to modify a 3AN fitting to make it.		10.60

.011" Bleed Orifice 10-32, to go in top of tower instead of 10-32 barb fitting. This has .011 orifice (IMPORTANT: read "Further Discussion, K-140 PR Valve," part G)	I-4445	20.60
Safety Tube, 12 feet of black nylon tubing and ferrule nut, to attach to top of restrictor fitting.	I-1032	14.45
Safety Valve, set at 82 psi, to protect main pump if diaphragm blows out in any model PR Valve.	I-1125	144.25
MOUNT ASSY, for K-140, 6061-T6 billet alum, black anod, with four vibration iso. feet	22085N	89.65
Mount only, same as above, but without vibration isolation feet	12085N	76.75
Vibration isolation feet, four	12086N	12.90

MONSTER MESH SERIES FILTER ASSEMBLIES

All of this series for NASCAR are hard anodized and sealed for use with alcohol. All are available in 8AN female ports, and 8AN, 10AN, 12AN male fittings on ends. We can put any of the above on either end (specify). All filter assemblies in this series are purged at 1,000 lb/hr flow to blow out any dirt on the clean side, then pressure tested for leaks at 160 psi. Look at "filter options" at end of filter list.

MONSTER MESH (Short length)

Filter Assy, 10 micron paper, 8AN female ends	8350-010	140.90
Filter Assy, 45 micron stainless, 8AN female ends	8350-045	167.20
6AN male x 8AN st, large radius, optional for above filters, hard anodized, (two required)	6044	9.30
8AN male x 8AN st, large radius, optional for above filters, hard anodized, (two required)	6043	9.00
Filter Assy, 10 micron paper, 8AN male ends	8352-010	140.90
Filter Assy, 10/3 micron element, 8AN female ends	8350-103	159.40
Filter Assy, 10/3 micron element, 8AN male ends	8352-103	159.40
Filter Assy, 45 micron stainless, 8AN male ends	8352-045	167.20
Monster Mesh replacement element, 10 micron paper	8320	29.20
Monster Mesh replacement element, 10/3	8323	40.60
Monster Mesh replacement element, 45 micron stainless	8345	56.25

MEGA MONSTER MESH (Medium length)

Filter Assy, 10 micron paper, 8AN female ends,	8450-010	147.40
Filter Assy, 45 micron stainless, 8AN female ends,	8450-045	177.75
6AN male x 8AN st, large radius, optional for above filters, hard anodized (two required)	6044	9.30
8AN male x 8AN st, large radius, optional for above filters, hard anodized (two required)	6043	9.00
Filter Assy, 10 micron paper, 8AN male ends	8452-010	147.40
Filter Assy, 45 micron stainless, 8AN male ends,	8452-045	177.75
Mega Monster Mesh replacement element, 10 micron paper	8420	30.75
Mega Monster Mesh replacement element, 45 micron stainless	8445	61.80

ULTRA MONSTER MESH (Long length)

Filter Assy, 10 micron paper, 8AN female ends	8550-010	154.95
Filter Assy, 45 micron stainless, 8AN female ends,	8550-045	189.20
6AN male x 8AN st, large radius, optional for above filters, hard anodized (two required)	6044	9.30
8AN male x 8AN st, large radius, optional for above filters, hard anodized (two required)	6043	9.00
Filter Assy, 10 micron paper, 8AN male ends	8552-010	154.95
Filter Assy, 10/3 micron paper, 8AN female ends	8550-103N	169.75
Ultra Monster Mesh replacement element, 10 micron paper	8520	32.30
Ultra Monster Mesh replacement element, 10/3 micron paper	8523N	51.05
Ultra Monster Mesh replacement element, 45 micron stainless	8545	67.40

FILTER OPTIONS		
Clamp, heavy duty stainless steel, T-bolt style	8300	27.20
CHECK VALVES, BUBBLE TIGHT		
KFI 6AN only, 1 micron diamond paste micro lapped stainless steel poppet in hard anodized body	3155N	98.60
6AN hinged "toilet seat" check valve, hard anodized	3091N	80.65
8AN hinged "toilet seat" check valve, hard anodized	3092N	84.70
Backpressure Valve, 9 psi nominal, stainless steel poppet in hard anodized body	5732N	88.40
Scavenge Pump, electric Walbro GSS 307 Basic cost of pump	10271N	96.40
Flow test as received to qualify; pick ones that seem very good, for further testing	5793N	45.00
Run in for ½ hour; reflowtest... only ship those that flow and sound good	5796N	57.00
	TOTAL PRICE	198.40
Wire harness, for GSS 307 pump	12412	4.50
Filter socks, for GSS 307 pump		
5.4" x 2.25" Run this larger one if possible	12417	12.05
3.9" x 2.25"	12411	7.30
Weldon-Kinsler main electric fuel pump, with control #3A Brushless motor, 1.4 pounds without fittings (purchase fittings separately)	10282	1,968.00
Vapor Separator Tank, final design not finished. To be .035 wall stainless, to mount under present tank lid (buckeye cover).		---- ----
Kinsler Tough Pump, mechanical pump, model 200, with 8AN male inlet and outlet fittings; specify size. Specify rotation wanted (not changeable in the field) See last two pages in the NASCAR packet.	TP050011	963.70

We can mix and match parts. We have a huge amount of other parts... call Brian direct at 248 362-6116 with your questions or needs.

For NASCAR

K-140 Tower VS Body Clocking

3AN female breather port ; can also be manifold vacuum or turbo boost

Body Style 1
Two 8AN female inlet ports and 3AN pressure port with plug

Body Style 2
One 8AN female inlet port and no 3AN pressure port

*** Specify which body style you want, 1 or 2

*** Clocking:

A Has the 3AN breather port located to the right, as shown above. These will be kept made up in stock

B Has the 3AN breather port pointing up at you. These will be kept made up in stock

C Has the 3AN breather port pointing to the left. Built to order.

D Has the 3AN breather port pointing away from you. Built to order. (would be hidden behind the tower)

TO ORDER

Name_____ Ref. P.O. No._____ Date_____

Check one: ☐ 1A ☐ 1B ☐ 1C ☐ 1D

☐ 2A ☐ 2B ☐ 2C ☐ 2D

Specify Opening Pressure_____

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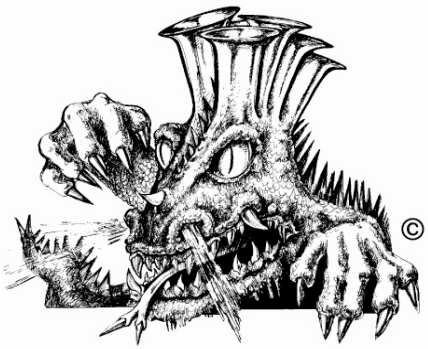

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Engineering, manufacturing, sales, service, calibration, testing, and modification of mechanical and electronic fuel injection systems and components for all types of racing and performance.

SUGGESTED PACKAGE OF PARTS FOR NASCAR EFI FUEL SUPPLY SYSTEM 9-22-11

Call Brian direct at (248) 362-6116 9:00 AM – 6:00 PM Revised 12-9-11

Revised 9-19-13

Company:_____ Name:_____

PO #_____ Date:_____

COMMENTS:

K-140 WITH 3AN BREATHER PORT ON SIDE OF TOWER NEAR TOP...

NOTE: Specify how you want this clocked vs the lower body. Clock _____

*********THIS WILL BE THE BEST FOR NASCAR USE, AS WE ARE GOING TO MAKE A 3AN STRAIGHT x 3AN MALE FITTING WITH A BLEED ORIFICE IN IT, SO YOU CAN ATTACH A 3AN BRAIDED "SAFETY TUBE" *********

We cannot make a 3AN male fitting for the top of the tower because the 10-32 thread is not strong enough to support that heavier line, nor the torque of tightening it.

QUAN			PRICE EACH
____	1) No 10-32 breather port on top of tower, two 8AN female ports in body, with adapter fittings to 6AN or 8AN (specify), 3AN pressure port in lower body with plug, with diamond lap and extended testing	32106ND	495.86
____	2) .011" Bleed Orifice 10-32, to go in top of tower instead of 10-32 barb fitting. This has .011 orifice (IMPORTANT: read "Further Discussion, K-140 PR Valve," part G)	I-4445	20.60
____	3) Adapter fitting, 3AN straight x 10-32 to adapt .011 Bleed Orifice to 3AN port on tower. This is a bit expensive as we are presently having to modify a 3AN fitting to make it.	I-2900	11.35
____	3b) .006" Bleed Orifice 3AN straight plus o-ring x 3AN male, brass, with screen In lieu of 2) and 3) above **(available 10-7-11)**	I-4455	30.45
____	4) Safety tube, 12 feet black nylon, with ferrule nut, for K-140 breather port fitting	I-1032	15.20
____	5) Safety Valve, set at 82 psi, to protect main pump if diaphragm blows out in any model PR Valve, 6AN male ends	I-1125	144.25
____	6) Swivel tee-fitting, for outlet of P.R. Valve, to connect to Safety Valve, 6AN ends	6151	22.00

MONSTER MESH SERIES FILTER ASSEMBLIES

All of this series for NASCAR are hard anodized and sealed for use with alcohol. All are available in 8AN female ports, and 8AN, 10AN, 12AN male fittings on ends. We can put any of the above on either end (specify). All filter assemblies in this series are purged at 2,000 lb/hr flow to blow out any dirt on the clean side, then pressure tested for leaks at 160 psi. Look at "filter options" at end of filter list.

	MONSTER MESH (Short length)		
____	7) Filter Assy, 10/3 micron element, 8AN male ends	8352-103	159.40
	MEGA MONSTER MESH (Medium length)		
____	8) Filter Assy, 10/3 micron element, 8AN male ends	8452-103	165.60
	ULTRA MONSTER MESH (Long length)		
____	9) Filter Assy, 10/3 micron element, 8AN male ends	8552-103	169.75
____	10) Filter Assy, 10 micron paper element, 8AN male ends	8552-010	154.95
	FILTER OPTIONS		
____	11) Clamp, heavy duty stainless steel, T-bolt style	8300	27.20
	CHECK VALVES, BUBBLE TIGHT		
____	12) KFI 6AN only, 1 micron diamond paste micro lapped stainless steel poppet in hard anodized body	3155N	98.60
____	13) Backpressure Valve, 9 psi nominal, stainless steel poppet in hard anodized body, 6AN male ends	5732N	88.40
____	14) Scavenge Pump, electric Walbro GSS 307 Basic cost of pump	10271N	96.40
	Flow test as received to qualify; pick ones that seem very good, for further testing	5793N	45.00
	Run in for ½ hour; reflowtest... only ship those that flow and sound good	5796N	57.00
		TOTAL PRICE	198.40
____	15) Wire harness, for GSS 307 pump	12412	4.50
	16) Filter socks, for GSS 307 pump		
____	5.4" x 2.25" Run this larger one if possible	12417	12.05
____	3.9" x 2.25"	12411	7.45
	(**Choose one or both)**		
____	17) Vapor Separator Tank, to fit under present NASCAR tank top lid (buckeye cover) To be .035 wall stainless. Final design not finished.	----	----
____	18) Vapor Separator Tank, 10" tall, standard Kinsler piece so you can set up the system and begin testing. Three 6AN fittings on top, 8AN fitting on bottom	5710	309.15
____	19) Weldon Electric Fuel Pump, model D2015-A (Dealer price is $680.00)	10295	648.00
	Labor, to run-in & flowtest Weldon pump for 1.5 hours	5793N	57.00
		TOTAL PRICE	705.00

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