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- [C5 Forced Induction/Nitrous](http://forums.corvetteforum.com/forumdisplay.php?f=86) (<http://forums.corvetteforum.com/forumdisplay.php?f=86>)
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QuickSilver2002

01-26-2004 01:50 AM

97 rail conversion info

Ok, I promised a complete post about the '97 fuel rail conversion, so here it is.

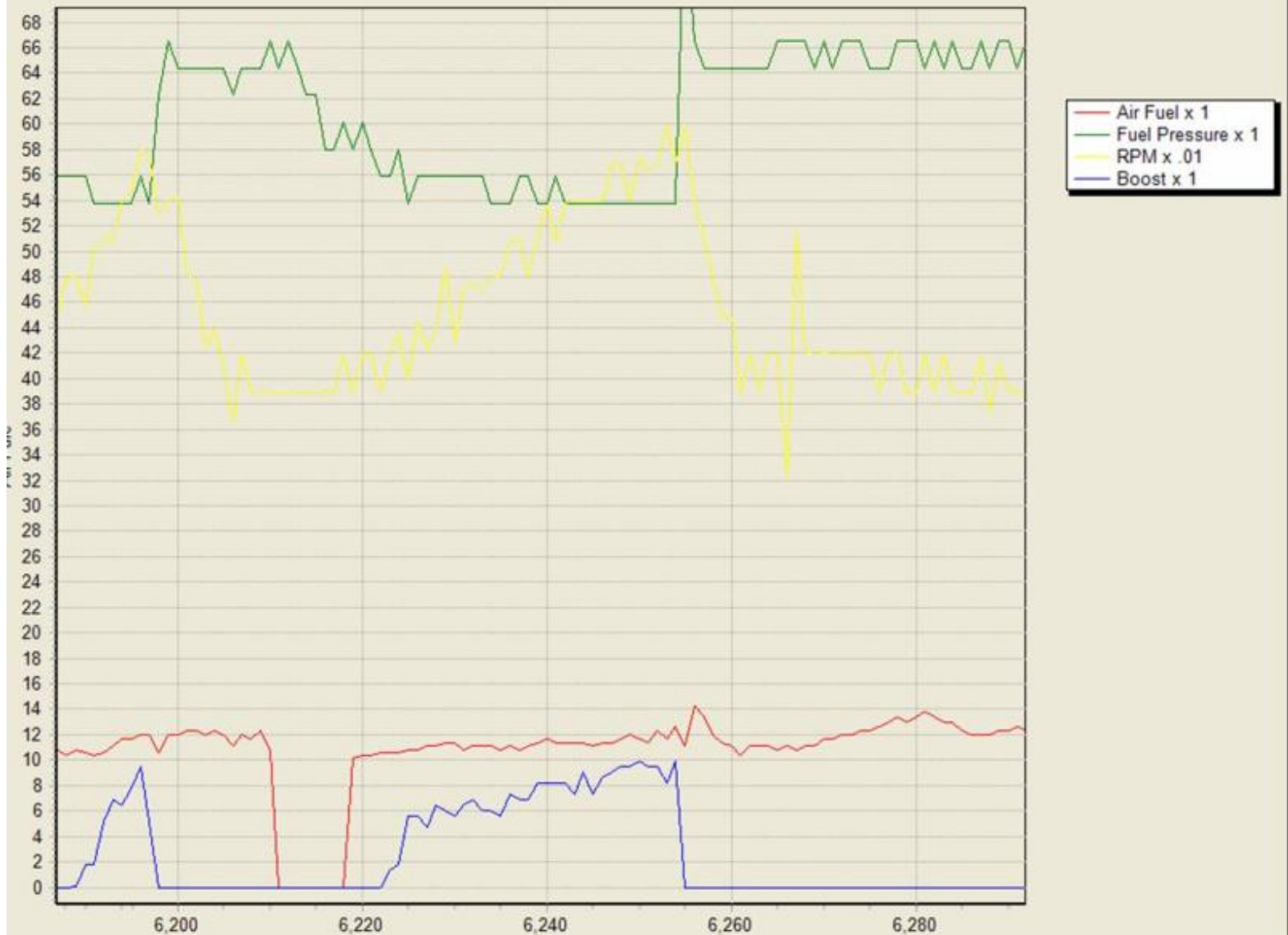
First the results; the big surprise for me was that the stock 97 regulator is boost referenced at 1:1. Here are the basic results.

Vacuum line connected at idle: 52psi
 Vacuum line connected at 5psi of boost: 65psi

Vacuum line disconnected at idle: 58psi
 Vacuum line disconnected at 5psi of boost : 58psi

My base setup is the racetronix intank + the KB boost a pump.

Here is a quick 3rd gear pull with my original '02 rail and filter based regulator (this is from my own data logging software).



6,200

6,220

6,240

6,260

6,280

And here is a quick 3rd gear pull with the '97 rail and regulator with the vacuum line connected (you might notice AF is pretty lean in this graph, but I was tuned for alky injection and had it turned off in this pull) I have no KR now, even being this lean (amazing what getting rid of that oil from the PCV does).



Now for the install info:

This upgrade is easy and can be done with a variety of parts. I went with all stock GM parts, but you could possibly save some money by modifying your existing rail or bending your own lines. You could also go with bigger lines and bigger aftermarket rails if you plan to go beyond 700RWHP. I have no idea what the real limit of this setup is, but I have been told by several people that it should support 700RWHP without any problems, but you might find some differing opinions out there. The fuel system seems to be one of those things that is not that well understood.

The conversion cost me \$300, but I got the rail and regulator for \$150 from someone who had an extra set. This pic shows a cart from GM parts direct with all the parts you will need. http://home.austin.rr.com/quicksilver2002/part_cart.jpg. It is roughly \$350, but could be cheaper (the shipping and handling is an estimate). There is one part missing from the list that you will probably want (to get a complete factory look). The existing steel braided supply line jumper is a little short for the new rail and you will most likely want to get the 97 style GM part# 10279630. GM parts direct currently has the wrong S&H price listed for this part \$40, but they will fix it if you email them (I had the same problem with the return jumper) You can see in this image that I had to stretch the supply hard line to make it reach. <http://home.austin.rr.com/quicksilver2002/97rail/DSC00014.jpg>

Ok, after you get these parts the install is pretty much a breeze (well, almost). The car is completely provisioned for this return line (they simply deleted it on the newer cars, put the regulator in the filter, and removed the connection from the fuel rail). The only pain is that you have to take the exhaust and intake manifold off the car. You might be able to keep your headers on, but I had those off too since I just happened to be doing a header install at the same time. I'm not going to go

into the details of removing the exhaust and intake. You can find that info in several places (like Is1howto.com)

The main area you have to get to is the tunnel cover. Once you get that off and have the line in hand you will be able to see exactly how it fits. There are clips that hold the line in place and the middle clip is open and ready for your new return line. There is one area where installing the line is a little bit of a problem. This is right where it goes around the bell housing and bends up and follows the fire wall. I would start here and then work your way back. You can see the factory clip in this area but you will most likely not be able to get the line into it unless you remove the bell housing. Just use a zip tie here. Start by pushing the line up in the gap on the driver's side of the motor (between the fire wall, brake booster, and head). Then slide it (toward the passenger side) along the fire wall and get it near the upper clip where the current lines are (I also zip tied here since the space was just to cramped to get it in the clip).

The rest is easy, just follow the tunnel lines back and slip it into the existing retaining clips. The back of the return line will end up near the back of you current filter and you will simply take off the current return line going to the fuel sender and hook it up to the new line (they are the same quick disconnect style and size). The new filter will take the pace of your old one (it only has the supply line in and out connections).

The rest of the install just involves swapping the injectors over to the new rail and I'm not going to go into those details since they are outlined in many different sources. The one thing that is different is the install of the regulator onto the rail. You will need to use the retaining ring from your current rail mounted dampener (whatever the heck that means). Anyway, you will need a set of those special pliers to get that ring off the old rail and onto the new one. They can be purchased at any auto parts store (you want the kind for an inner ring, not an outer ring). The regulator presses into the rail and then the retaining ring goes on. It is obvious once you see it, but you may need to use some mechanical advantage to get it fully pressed in. (be careful here because you could easily damage it). I also used a bit of oil on the o-ring to help it slide in and seal.

Here are a few pictures to reference. They are not that good and I wish I could have taken more, but it was so dark in my garage that it was hard to get good pictures. I did most of this work at night. Most of the stuff is also up under the car and I have no lift.

This shows the existing supply line (with the jumper on it) and the new return hard line in place. This also shows the area of the fire wall where you push the line up from below during the install (between the brake booster and drivers side head).
<http://home.austin.rr.com/quicksilver2002/97rail/DSC00004.jpg>

This shows the lines and retaining clips that run down the tunnel. The fuel lines are the black lines (the lighter colored ones are the brake lines).
<http://home.austin.rr.com/quicksilver2002/97rail/DSC00009.jpg>

Another view of the lines running down the tunnel.
<http://home.austin.rr.com/quicksilver2002/97rail/DSC00006.jpg>

This shows the old filter with the new return in place. The new return line has red lines on it to help show it. The line with the blue clip on it is the return line that goes to the fuel sender and is the one you connect to the new hard return line after the new filter is in place.
<http://home.austin.rr.com/quicksilver2002/97rail/DSC00008.jpg>

I hope this makes some sense (it is late and I'm tired) Post here if you have additional questions.

[Modified by QuickSilver2002, 10:23 PM 1/28/2004]

cfi_luz

01-26-2004 02:59 AM

Re: 97 rail conversion info (QuickSilver2002)

Very nice write up, I think you helped out a lot of people who have been eager to give this a try. :thumbs:

SleepieAce

01-26-2004 02:05 PM

Re: 97 rail conversion info (cfi_luz)

Quote:

Very nice write up, I think you helped out a lot of people who have been eager to give this a try. :thumbs:

:iagree: :yesnod: :thumbs: :cheers:

QuickSilver2002

01-28-2004 10:24 PM

Re: 97 rail conversion info (SleepieAce)

update original post with part# for longer fuel feed line.

[Modified by QuickSilver2002, 11:10 AM 1/29/2004]

jbsblownc5

01-29-2004 12:16 AM

Re: 97 rail conversion info (SleepieAce)

Quote:

Very nice write up, I think you helped out a lot of people who have been eager to give this a try. :thumbs:

:iagree: :yesnod: :thumbs: :cheers:

I agree, very detailed info with pics to boot!!

:cheers: :cheers:

JB

QuickSilver2002

01-29-2004 11:29 AM

Re: 97 rail conversion info (jbsblownc5)

Just a follow-up after more testing, this setup has made a world of difference. My fuel pressure is very consistent now. The only outstanding test is the extreme heat of the summer, but I think it will pass that test also.

Before my fuel pressure was dropping to 54 at 8psi of boost. This is an effective fuel pressure of 46psi (not good). Now my effective fuel pressure (actual - boost) is always 58psi.

The car is running so much better than it ever has. I made two changes at once, so I'm not sure how much is the more consistent fueling and how much is the exhaust improvement (I also switched from TPIS to LG headers and removed the cats). I'm guessing most is the exhaust, but is sure feels smooth now. My fear with the old setup was not so much the pressure drop but the balance of the fuel across the rail.

[Modified by QuickSilver2002, 8:42 PM 1/29/2004]

Stephen02Z06

01-29-2004 04:38 PM

Re: 97 rail conversion info (QuickSilver2002)

The wonderful thing now is that you can flatline the fuel injector flow rate in LS1-edit and let the fuel rail do all of the work for you instead of all of that damn trial and error with the rates changing from cell to cell. Maybe I missed it in your post but I suppose that you did that was well and that would contribute to a nice boost in performance because you have a mechanical advantage to increase fuel pressure at a boost referenced rate. If I had kept my Z06 this would have been a great mod to make the A/F ratio much easier to tune.

QuickSilver2002

01-29-2004 08:54 PM

Re: 97 rail conversion info (Stephen02Z06)

Quote:

The wonderful thing now is that you can flatline the fuel injector flow rate in LS1-edit and let the fuel rail do all of the work for you instead of all of that damn trial and error with the rates changing from cell to cell. Maybe I missed it in your post but I suppose that you did that was well and that would contribute to a nice boost in performance because you have a mechanical advantage to increase fuel pressure at a boost referenced rate. If I had kept my Z06 this would have been a great mod to make the A/F ratio much easier to tune.

Changing the flow rate tables is not really necessary. That table only goes up to 100KPA, so it is already flat lined at the 100kpa setting once you are in any boost.

I agree, making this mod on day1 would have made tuning so much simpiler and more consistent.

epylant

01-29-2004 09:42 PM

Re: 97 rail conversion info (QuickSilver2002)

First the results; the big surprise for me was that the stock 97 regulator is boost referenced at 1:1.

No surprise there - I'd be surprised if it wasn't 1:1! 1 PSI of additional pressure on top of the diaphragm (vacuum/boost reference) means 1 PSI of additional pressure under the diaphragm (where the fuel is). For a regulator not to be 1:1, there would have to be a piston between the fuel and vacuum reference that had different areas on each face (i.e., an FMU).

dads01dream

01-29-2004 09:43 PM

Re: 97 rail conversion info (QuickSilver2002)

Great write-up! This is one to keep on file for future reference. :seeya

QuickSilver2002

01-29-2004 10:17 PM

Re: 97 rail conversion info (epylant)

Quote:

First the results; the big surprise for me was that the stock 97 regulator is boost referenced at 1:1.

No surprise there - I'd be surprised if it wasn't 1:1! 1 PSI of additional pressure on top of the diaphragm (vacuum/boost reference) means 1 PSI of additional pressure under the diaphragm (where the fuel is). For a regulator not to be 1:1, there would have to be a piston between the fuel and vacuum reference that had different areas on each face (i.e., an FMU).

The main reason that I was so surprised is that anything you read about the ls1 states that it is a static fuel pressure based system. I figured the vacuum line was only an assist of some sort and that the pressure would still be static.

diynoob

01-29-2004 11:50 PM

Re: 97 rail conversion info (QuickSilver2002)

Very nice write up QuickSilver! Thank you for posting this. I want to do this to my car soon, and this is very helpful.

PS, I see your boost a pump peeking out in that last picture! Whassa matter, when it comes to pressure having trouble 'keeping it up'? :D

cfi_luz

02-01-2004 01:51 PM

Re: 97 rail conversion info (QuickSilver2002)

I was just wondering, but you did flatline your IFR in ls1edit didn't you since your fuel pressure is no longer static?

diynoob

02-01-2004 03:19 PM

Re: 97 rail conversion info (cfi_luz)

Quote:

I was just wondering, but you did flatline your IFR in ls1edit didn't you since your fuel pressure is no longer static?

Yes inquiring minds want to know... I would think you'd need to retune right after doing this mod.

diynoob

02-02-2004 12:11 PM

Re: 97 rail conversion info (diynoob)

:lurk:

vetterdstr

02-02-2004 01:00 PM

Re: 97 rail conversion info (QuickSilver2002)

Very helpfull and usefull info... that is what this place is all about!! I will be doing this conversion on my car soon... :smash:
Thanks again!!

VR :cheers:

QuickSilver2002

02-05-2004 10:16 PM

Re: 97 rail conversion info (diynoob)

Thanks for the positive feedback guys. I hope everyone continues to share and learn in a friendly manner. :thumbs:

My next jackstand upgrade "the boost ready 346 shortblock" may actually end up on ls1howto.com (with the help of jMx). If not, i'll put something up myself.

Quote:

I was just wondering, but you did flat line your IFR in ls1edit didn't you since your fuel pressure is no longer static? Yes inquiring minds want to know... I would think you'd need to retune right after doing this mod.

I did not change my IFR tables and here is my reasoning.

At part throttle the fuel trims will adjust for the slight fuel pressure changes. At full throttle the IFR table is always in the last cell on a FI car (it only goes up to 100kpa), so changing it is mute.

It would probably not hurt to change it, but I see no real compelling reason to do it on an FI car.

diynoob

02-05-2004 11:04 PM

Re: 97 rail conversion info (QuickSilver2002)

Quote:

I did not change my IFR tables and here is my reasoning.

Is the IFR table what defines injector flow at WOT? If so, wouldn't you have to tune that now that your fuel pressure (and thus injector flow) has changed?

cfi_luz

02-06-2004 12:38 AM

Re: 97 rail conversion info (diynoob)

I believe the IFR tables are what set your base injector flow values. The table is pressure referenced to make up for the static fuel pressure on the 99+ cars. But like quick said, it won't make a huge diff since it stops at 100kpa or whatever value it is. It will effect fuel flow at part throttle though (under vacuum), so you might want to check into that. I would say if you are already going to tune the car, just use the same value across the entire table, if you are already tuned it probably wont make a huge difference but we wont know for sure until some checks their A/F before and after.

QuickSilver2002

02-06-2004 01:36 AM

Re: 97 rail conversion info (diynoob)

Quote:

Is the IFR table what defines injector flow at WOT? If so, wouldn't you have to tune that now that your fuel pressure (and thus injector flow) has changed?

No the injector flow rate does not determine injector flow at WOT... It is part of the equation, but only the base number really matters. I'll try to explain.

The PCM uses the injector flow rate table to determine how many gm/sec of fuel the injector will flow at a given manifold pressure. This is used as part of the fueling equation that results in a specific pulse width being sent to the injector. The idea is that the injector flows more fuel at a vacuum and less fuel as manifold pressure goes up. The table goes from 20-100kpa. The problem is that on a FI car you will always be at or above 100kpa once you hit full throttle. This is why I say the scaling of the table is basically mute on a FI car. The base number is important, but the minor variation between 20-100kpa does not impact WOT on a FI car (only part throttle). So my suggestion is to keep the curve on that table the same as stock even if you put in the '97 style manifold pressure referenced regulator. The reason some are suggesting to make it flat is that the fuel pressure is now automatically adjusting for the change in manifold pressure. My point is that it is already flat where it really matters.

Now, the car might require some minor tuning after this conversion since it will run slightly richer than before at WOT (but I would guess that it would be totally optional since it should only be a point or two richer)

It is important to understand that the fueling equation is based on many factors. The basic idea is that it looks at the MAF data (incoming air), the configured volumetric efficiency of the motor at the current MAP and RPM, and the PE modifiers at the current RPM and coolant temp to determine how much fuel it should be adding to hit the desired A/F. It then figures out how big of a pulse width is required based on what the current injectors are suppose to flow at the current MAP. You have to remember that on a FI car the MAP readings will always be maxed out at WOT, so you basically loose one dimension of the tuning. Even worse, the MAF maxes out once you hit about 450hp. This is why tuning is so tricky and non-adaptive on a high HP FI car with the stock PCM. You end up being very RPM based up top and you really need some accurate A/F feedback to make sure it is getting the right amount of fuel.

One more thing I wanted to touch on again. People focus so much on fuel pressure and although this is very important there is something else that is much more important. Just like people focusing on boost and not CFM, the flow and balance of the fuel across the rail is much more important than fuel pressure on the end of one side of the rail. My point is basically that fuel pressure is a very rough indication of what is going on in terms of flow. A small dip in fuel pressure could be a much more serious condition in terms of flow across the entire rail. I'm no fluid dynamics expert by any means, but it just seems logical to me that regulation at the rail would improve the balance issue greatly. Just something to think about.

All times are GMT -5. The time now is 10:26 AM.

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cfi_luz

02-06-2004 03:28 AM

Re: 97 rail conversion info (QuickSilver2002)

Very well stated. The fact that the stock PCM cannot be tuned based on manifold pressure (on FI cars) and the fact that the MAF is pegged above ~470HP leaves a lot of variables in your tune. That is why I am the beta tester for the AEM which should be out for our cars sometime this year. Not only will it be able to have almost infinite tuning control it comes with built in 2 step, input for a wideband O2 (and automapping which is a great starting point to tune from), programmable outputs, etc. etc. The import guys have had this system for awhile now and it was just released for the vipers. I believe it outperforms the FAST and DFI systems for half the cost. Sorry for the rant, but just excited we may have a viable tuning solution soon which will cost the same or less when you figure in the cost of buying ls1edit, autotap (AEM has built in datalogging), wideband, etc.

dads01dream

02-06-2004 06:14 AM

Re: 97 rail conversion info (cfi_luz)

Do you have a website for AEM? I'd love to take a look at their other available products. Thanks. :cheers:

cfi_luz

02-06-2004 12:48 PM

Re: 97 rail conversion info (dads01dream)

Here is their page. They dont have a whole lot on it about the EMS, but they also support a forum dedicated strictly to the EMS and have techs online to help answer questions. Thats awesome, Accel and FAST don't have anything like that. Another cool product that just came out is a A/F gauge that actually uses a widebody o2 and is actually accurate (not just a light show like the autometer, etc). http://www.aempower.com/product_ems.asp

dads01dream

02-06-2004 02:26 PM

Re: 97 rail conversion info (cfi_luz)

:thumbs: Thanks for the info!

mikes99corvette

12-21-2004 09:14 PM

Does he know his **** of what.....EXCELLENT write up QUICKSILVER2002

When are you going to SAR.....My tranny was shipped today (Level V) will be here Monday or Tuesday. And then, I will be going back to Dyno for a final tune..... Not as fine as yours :)

Busa196

12-22-2004 09:03 AM

Excellent write up Quick.....even though I only understand about 50% of it :lol: :thumbs:

-Busa196-

SmoothFRC

12-23-2004 07:49 AM

So.... should i run mine with or without the vacuum line attached....

All times are GMT -5. The time now is 10:27 AM.

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GM Part #	Category	Description	Pack Qty	Unit Price	Quantity	Ext. Price	YOU SAVE	Core Charge	S&H Approx	TOTAL
*12556705	Fuel Injection Hardware	RAIL	1	\$138.54	<input type="text" value="1"/>	\$138.54	\$138.53	\$0.00	\$27.71	\$166.25
*10276216	Fuel Lines	PIPE	1	\$62.30	<input type="text" value="1"/>	\$62.30	\$46.99	\$0.00	\$45.00	\$107.30
*12554677	Fuel Injection Hardware	REGULATOR	1	\$34.78	<input type="text" value="1"/>	\$34.78	\$34.79	\$0.00	\$7.95	\$42.73
*10279629	All	HOSE	1	\$30.89	<input type="text" value="1"/>	\$30.89	\$23.30	\$0.00	\$6.18	\$37.07
*10287788	Fuel Filters	FILTER	1	\$8.06	<input type="text" value="1"/>	\$8.06	\$5.40	\$0.00	\$2.62	\$10.68

Subtotal: \$364.03

* indicates special order item, which is a special order non-returnable part.

