



2015 Spec Racer® Ford  
**GEN3**

# CONVERSION KIT ASSEMBLY MANUAL



SCCA ENTERPRISES  
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## INTRODUCTION

Before starting the conversion process please take time to **read these instructions completely**. Confusion and time will be saved with an overview of the entire process.

### Intro to the Ford Sigma 1.6 –liter GEN3 engine

**Care and feeding** of your new Sigma 1.6 L is similar to the existing 1.9 L, however we are stepping up to a modern engine using the newest technology. The internal clearances are tight so Ford calls for 5w20 in this Sigma 1.6 L engine. For our purpose, in cooler climates less than 65° F, 5w20 should be the best choice weight oil. We have been using 5w30 with very good results; having done a handful of bearing inspections, there has been no scuffing to date.

The combustion chamber is very efficient and has a stock compression ratio of 11 to 1.

We have done our best to achieve a high level of performance and maintain reliability. Our recommendation is to use only the best quality premium unleaded pump fuel you can buy. **If in doubt of the quality of fuel in your area, a 20 to 40 % mix of 100 OCT unleaded with 93 / 91 octane unleaded should be safe.**

We are delivering the engine with one range colder Premium NGK Iridium Spark Plugs. High compression / high turbulence combustion chambers require smaller plug gaps, so a plug gap of 0.035" is safe and recommended. Spark plugs are a **Spec Part**.

**The crankshaft bolt must never be loosened.** Crank damper / cam belt drive gear are not keyed to the crankshaft, engine damage will result. **If loosened for any reason, engine must be returned to SCCA Enterprises and brought back into spec at owners cost !** Cam timing is **Controlled**, and a compliance item.

The custom chrome moly flywheel serves as the Reference Wheel like the crank pulley on the 1.9 L engine. It uses a locating dowel and is not adjustable. The flywheel is a **Spec Part**.

**Thermostat placement** is in the water return path on the lower forward side of the block. Because of this it is more **important to warm up the engine slowly before on-track sessions**. This decreases the chances of spike overheating in the cylinder head.

## BEFORE YOU BEGIN

We assume that if you're doing this installation you have some familiarity with the existing SRF 1.9 L Gen 2. It's not mandatory, but some of the details will be more meaningful if you have experience with this car or have someone helping who has this experience. We also assume that your technical ability is at a level where you: perform your own car maintenance, have the ability to change your own engine, clutch, and transmission, as well as some general knowledge about electrical wiring and wire termination.



We assume that your Gen 2 SRF is in good working condition prior to attempting this conversion. The fuel and power systems should be well-maintained and operating trouble free. This GEN3 update requires the use of the in-tank fuel pump kit (Part # 1150002) and for this reason; fuel issues should be less of a concern. However, the kit relies on the existing power distribution harness. Some of these harnesses may be old and seen years of abuse, nicks, cuts, and slices. It is recommended that you take extra care in inspecting this and verifying it's in good shape. **Some of the early issues with the operation of the kit were traced to a bad existing power harness.** If you suspect a damaged power distribution harness, or would like to replace it, **Part # G1190501 GEN3 Power Harness contains no analog gauge wiring. GEN3 SRF is meant to use ECU DATA Stream and a suitable dash display for engine health information.**

## Tools Required

The tools required to complete this conversion are common to what it takes to perform heavy maintenance on the SRF. (Such as: motor swaps, clutch replacements, etc.)

Table 1 below details an abbreviated list of tools that you should have available to make this install go smoothly. These are also standard tools, but not commonly used in prep or maintenance of the SRF.

Electric drill	3/16" drill bit	1/8" drill bit
Engine hoist	1/4-20 Riv-Nut Installer	0.406" drill bit (13/32)
Center punch	10-32 Riv-Nut Installer	

Table 1 – Non-Common Tools

## Gen 2 Starting Point

This section describes the starting point that the car should be in before beginning the GEN3 kit conversion. It's for reference, as other levels of disassembly will also work, but this should serve as a generic guide at a minimum.

1. Start with your car on jack stands – and make sure it's sitting securely on them
2. Make sure battery is disconnected
3. Remove the 1.9 L Ford engine and set it aside. Keep this engine for now. We'll remove some of its components and use them on the new 1.6 L engine later in the process.
4. Remove the transmission from the engine bay and set it aside. We will be adding GEN3 specific components to this later in the process.
5. Remove the 1.9 EFI harness completely.
6. Keep the following wires from the distribution harness:
  - i. Starter solenoid wire
  - ii. Main power cable from battery to master switch
  - iii. Starter cable from master switch to starter (will need to be shortened)
  - iv. The alternator wires (Two sense and one power wire)

- v. Brake/rain light wires
  - vi. Any wires you're unsure of the function you should leave in place
7. Right side frame motor mount (The one beside the cam/cam belt): With the motor and mount removed, measure the distance from the top of the frame rail to the center of the engine mount hole. This distance should be between 1.625" and 1.75". If it is less than this the mount will need to be removed and replaced. A new mount # 391307 (2 required) can be installed by a CSR or anyone with the ability to weld steel. See Fig 2
  8. Remove the main battery ground wire, the battery's negative to ground, and put aside. You will use two (2) - 12" to 14" inch pieces to make updated ground leads in a later step.
  9. Remove the engine bay section of the shift shaft or linkage. Based on your preference you will need to bend this shaft or buy a new bent shift shaft that clears the oil pan sump.
    - a. Full size template included in the kit
  10. The coolant system fill / surge tank will need to be removed and updated with new relocated fittings. (See Figure 1) The fittings to update this are included in the standard kit and will need to be welded on. Details on this modification are shown later in this manual. There is an optional GEN3 coolant tank that can be purchased separately with these fittings already in place. (Part # G462800) Your CSR can have the 1.9 L tank updated for you. (They can also cap the bottom port with a plate so the large -12 cap is not needed)



**Figure 1 – Coolant Catch Tank (with new fittings and no cap)**

11. Finally be sure to clean all the grease and grime off your chassis.
  - a. Carefully clean / prepare the engine compartment
  - b. Inspect the frame and suspension components for defects or cracks

- c. Inspect the chassis harness / alternator wiring for chaffed wires, cracked or split wires and connectors. Clean off any corrosion from the connectors and terminal ends.

## Retained 1.9 EFI Components

Some of the parts from the 1.9 L engine will be used on the new GEN3 conversion. The steps below make sure you save the right parts from the engine that you pulled out in step 3 above.

Remove and set aside the following parts from your current SRF:

12. The complete Throttle body with IAC (See Figure 3)
13. Adjustable fuel pressure regulator (See Figure 4; if you don't have the adjustable one it can be purchased from SCCA Enterprises or your local CSR)
14. **New style Bosch Alternator (See Figure 6; If you have not upgraded, you will need to purchase it as its required for the GEN3)**

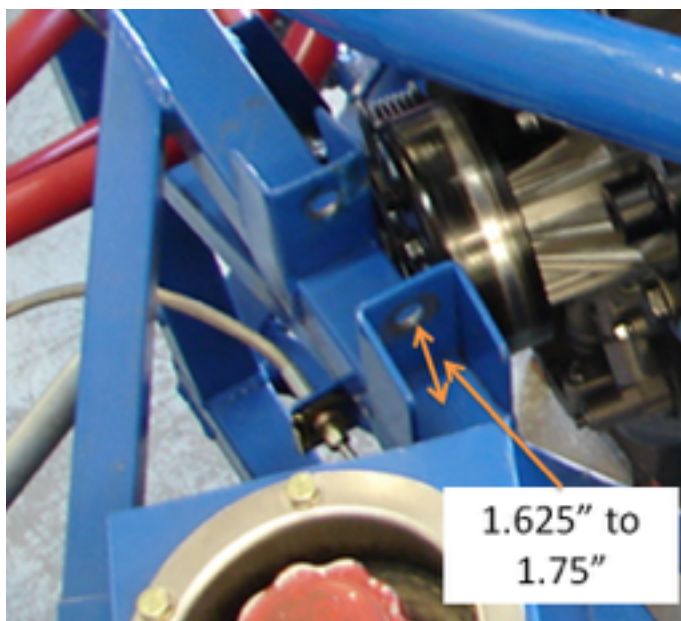


Figure 2 – Right Side Motor Mount

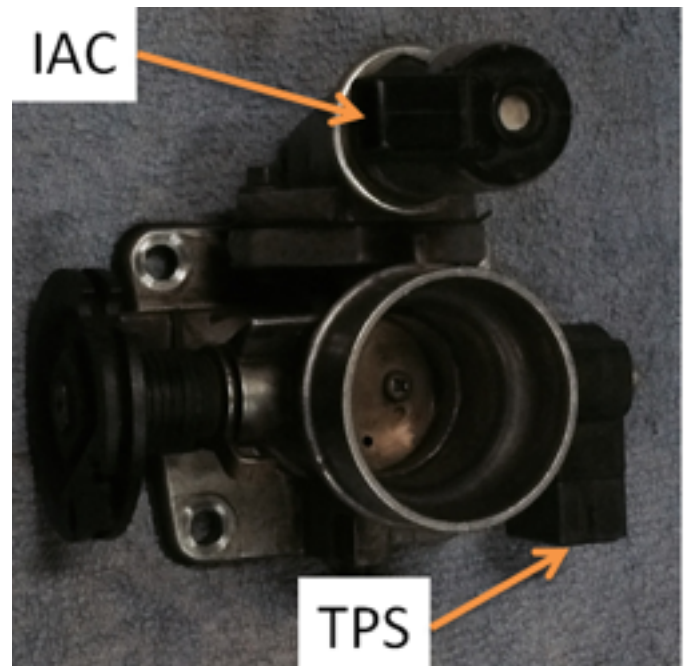


Figure 3 – 1.9 L Throttle Body w/ IAC



**Figure 4 – Adjustable FP Regulator**



**Figure 5 -- New Style Alternator with 1.9 L pulley**

### **GEN3 Parts to be painted:**

There are several new parts in the GEN3 conversion kit that should be painted with your color of choice to prevent rust. The following list of parts should be cleaned, debur'ed and painted now so they are dry and ready when you need them.

Part #	Description	Part #	Description
G480507	Oil Cooler Bkt	G480505 (x2)	Oil Cooler Fan Mgt Bkt
G591912	Fuel Filter Bkt	G1139301	Head Engine Mgt
G591905	Fuel Reg Adp Bkt	G183002A	Oil Catch bottle Bkt
G730001	Clutch Line Mgt Bkt		

**Table 2 – Parts For Painting**

***You're now ready to start the conversion. Let's go...***

## **GEN3 CONVERSION**

### **Ground Lug Bosses**

The frame has always been used as a ground path between the battery and engine. However, in this GEN3 application it is even more critical to establish a good low resistance ground path. The ground path from the engine to the battery helps the starter maintain a constant RPM, which is

important for hot and cold starting consistency. This section will add two ground lug bosses to the frame.

#### Ground Boss #1

15. Locate the 1.5" square tube; across from the battery (below coolant tube).
16. Remove paint or powder coat to ensure a clean ground connection.
17. Drill a 5/8" diameter hole in the center of the outside face of the 1.5" x 1.5" tube approximately 6.5" up from floor level.
18. Weld the boss (Part # G183001) to the frame and paint to match. (See Figure 6)

#### Ground Boss #2

19. Locate rearward angled 1"x1" tube just forward of the gearbox.
20. Drill a 5/8" diameter hole in the center of the tube approximately 6" down from main tube across from gearbox sheet metal cover.
21. Remove all paint or powder coat and degrease
22. Weld the boss to the frame. (See Figure 7)

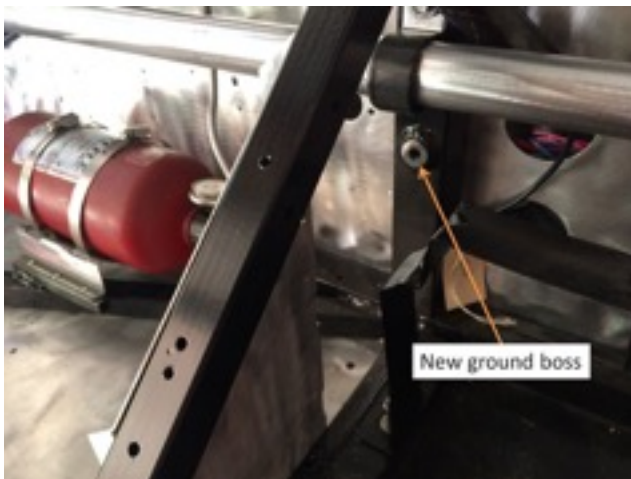


Figure 6 – Ground Boss #1 location



Figure 7 – Ground Boss #2 location

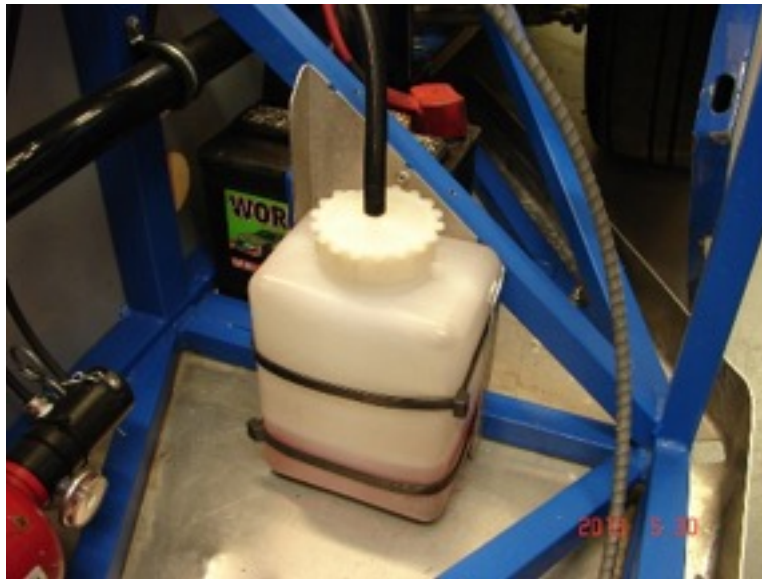
The bosses use 8mm x 1.25 bolts (part # G1010005) to secure the ground wires. This is done at a later step.

#### Coolant Recovery Tank

23. Remove coolant catch tank and bracket; Cut about .625" of the height of the bracket (or along center of the rivet holes), reinstall on front of RH side pod at former ECU mount with the supplied 3/16" rivets (Part # 1002000). (See Figure 8)
  - a. Some brackets may have more than 4 holes; however only 3 rivets are necessary.



24. The overflow line will be routed *before* the engine installation in a similar manner as the 1.9 L. Make sure this line is kink free and sealed to the tank. This is more sensitive than the 1.9L to leaks. The system must be able to push water out **AND** suck it back into the tank without pulling air into the system. (either through the hose end or holes in the line)

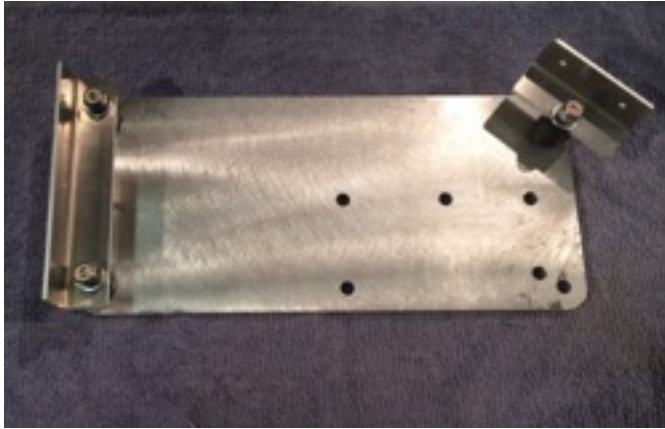


**Figure 8 – Coolant Catch Tank (New Location)**

## **ECU Mounting**

The new ECU (Engine Control Unit) mounts on drivers **LEFT** side of the chassis under the front edge of the side pod. (See Figure 10) It mounts using two (2) aluminum brackets (G392004 & G392003), three (3)  $\frac{3}{4}$ " x  $\frac{1}{4}$ -20 Rubber mounts (Part # G1010001),  $\frac{1}{4}$ -20 nuts and washers (Part # 1000364 & 1020392), and (5)  $\frac{1}{8}$ " pop rivets (Part # 1002068).

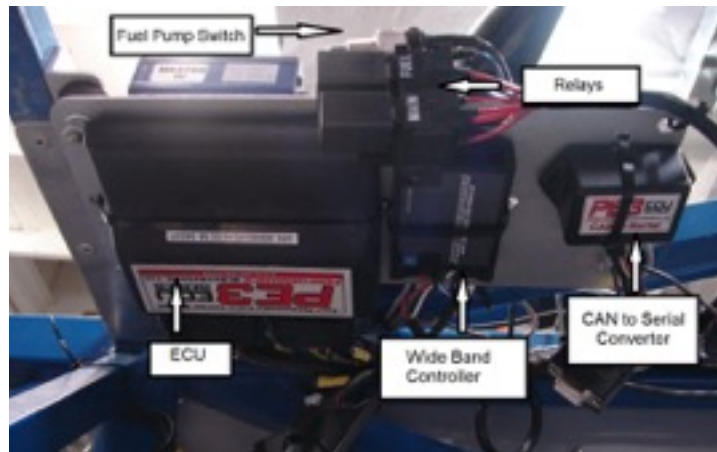
25. Locate the two (2) aluminum brackets, ECU mounting plate, hardware, and rubber standoffs. Assemble these together loosely, as shown in Figure 9, outside of the car.
26. Fit this assembly into the left side pod and hold or clamp into place. Mark the location of the  $\frac{1}{8}$ " rivet holes for drilling.
27. Drill and rivet the two angle brackets onto the frame with the supplied  $\frac{1}{8}$ " rivets.
28. Fully assemble the ECU mounting plate using  $\frac{1}{2}$ -20 rubber mounts, washers, and nuts. Tighten all hardware to about 5 ft-lbs. (See Figure 10)
29. The ECU and Wide Band Air Fuel system mounts to the underside of this assembly using the supplied Velcro. Ty-Wraps must be used to help secure the unit to the mounting plate. (Part # G1010030 & 1090021)



**Figure 9 – ECU Assembly Used as Template**



**Figure 10 – ECU Mounting Plate Assembly**



**Figure 11 – ECU and Wide Band Mounting  
(Looking at underside of ECU Plate)**

## **EFI harness and Ty-Wrap blocks**

This section describes the preparation and routing for the EFI (Electronic Fuel Injection) harness. The new EFI harness uses fewer wires and weighs less than the 1.9 L version. This step involves adding Ty-Wrap blocks to the frame to secure the harness providing a clean looking installation. The exact location of these tabs is not critical. The use of these is suggested as it provides a clean installation. However, if you have an existing method for strain relieving and routing wires that will be sufficient.

30. Locate 11 Ty-Wrap tabs (Part # 1090021)

- a. These Ty-Wrap tabs have one hole that is used to mount via a Pop Rivet to the desired location. To prevent rotation a 2<sup>nd</sup> hole can be drilled in the opposite side of these tabs. (See Figure 12)

31. Place 4 Ty-Wrap tabs evenly spaced on the vertical surface of the upper left side pod 1.5x1.5 tube. (See Figure 13) Drill and rivet in the desired location using supplied 1/8"



rivets.



Figure 12 – Ty-Wrap Tab (with 1 hole)



Figure 13 – EFI Harness ty-wrap tabs center section

32. Place 4 Ty-Wrap tabs on the bottom horizontal surface of the same tube along the engine box. (See Figure 14) Drill and rivet in the desired location using supplied 1/8" rivets.
33. Place 3 Ty-Wrap tabs across the same bottom surface of the rear tube. See Figure 15 (These are to hold the O2 harness that will be installed later in the assembly process.) Drill and rivet in the desired location using supplied 1/8" rivets.

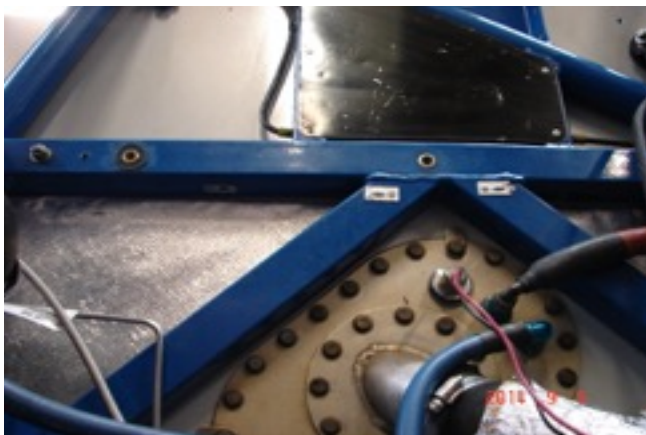


Figure 14 – EFI Harness Tabs Engine Bay



Figure 15 – Ty-wrap tabs for O2 sensor

There is a new *Momentary On* switch located next to the relay block, (See Figure 11) that will run the fuel pump, with **Master** and **IGN** switches in the “on” position). We used a momentary switch so that it can’t be left on and forgotten while it pumps out the fuel cell. To pump out the cell simply remove a fuel line from filter inlet, routing to a fuel jug, and hold the button down. It can also be used to purge the fuel system after the car has been in storage or if you have worked on the fuel system. The new switch should be tie-wrapped with the relays in a similar manner as the 1.9 L.

## Storage of the GEN3

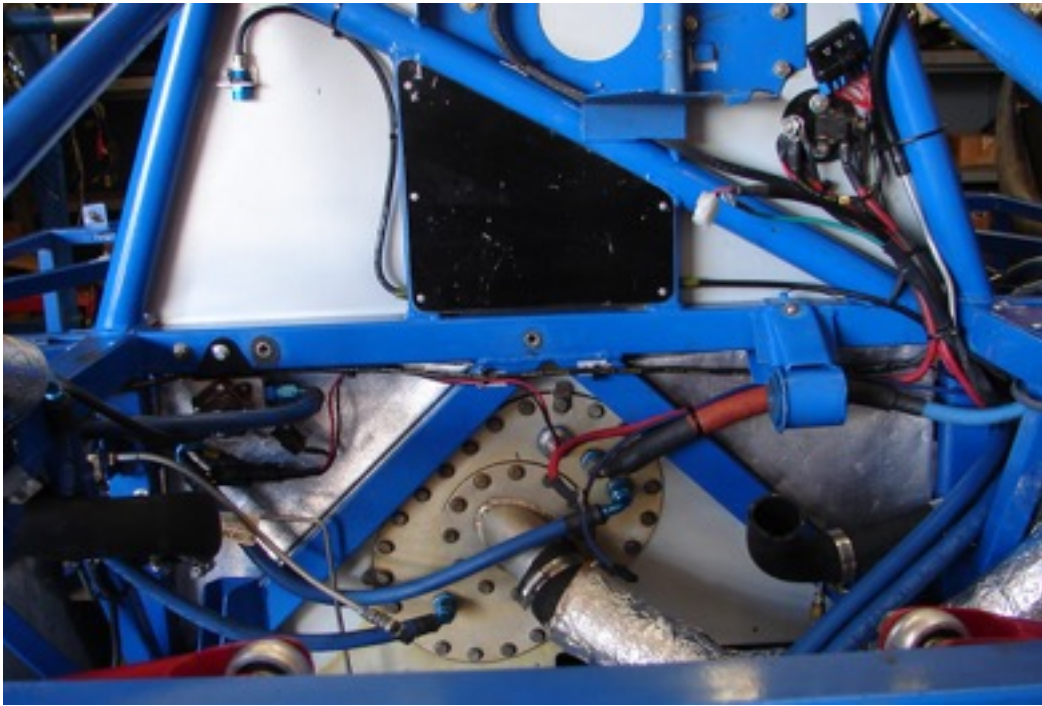
**Keep the Master in the OFF position ANYTIME the car is not going to be started for more than a few minutes.** It **will** drain the battery in a very short period! The new EFI closed loop system has a higher current draw versus the 1.9 L version.

## Wiring Harness Part 1

34. Route the harness along the drivers left side upper 1.5" square tube where the Ty-Wrap tabs have been installed. Install the ECU cable starting with the ECU plugs as this is a fixed point. The large connector will just reach into the engine bay.
  - a. **Note:** It's a good idea to clearance the upper right corner on the LR side Pod panel, so you don't chafe the harness on the edge of the panel.
35. Route the AFR cable, in the same manner, at least to the engine bay and leave in side pod or install in a manner that will keep it from harm during an engine change.
36. Run the long cable across engine bay and connect battery + to the switched side of the master switch. Turn the wire harness back and mount the fuse block on the back side of engine bay fire wall. (See Figure 17) For cars using the ladder bar HANS belt system the fuse block can be placed near the master switch side of the firewall.
37. Remainder of the harness installation will be done later following the engine installation.  
See Figure 16



Figure 16 – EFI Harness Installed (Part 1)



**Figure 17 – Harness in Engine Bay**

## **Dash Updates**

The GEN3 adds an ECU code light, pit speed limiter, and a rain map switch/light to the existing dash. The ECU light will flash trouble codes similar to an OEM check engine light. The rain map switch tells the ECU to use an alternate program for less torque in the 3000 to 5000 RPM range for more control. The pit speed limiter will active secondary rev and fuel limiter in any gear based on the speedo drive pulse generator on the gearbox. (This requires the transmission speed gear assembly) The dash sub harness from the ECU is set to mount the new lights and switches per “Dash Layout template” included in the kit.

38. Locate the new lights and switches in your dash per the provided template. Drill appropriate holes and installed new lights and switches with supplied hardware.

39. Connect the dash harness following the layout in Figure 18.

- a. If you choose not to connect any of these you must isolate the wires and protect them from shorting to each other or the frame. Rain map light/switch and pit speed limiter are not required for ECU to function. **(Failure to do so may result in blown fuses, missed track time, or damage to the ECU.)**
- b. Harness ECU + RED wire routes to cold side of the existing ignition switch. (See Figure 18)
- c. Harness ECU Light + BLK (shorter of the two BLK wires) connects to the BLK wire of the BLUE ECU Light. The RED wire from this BLUE ECU light connects to the cold side of the master with the ECU + RED wire from above step.
- d. Harness RAIN MAP LT WHITE wire connects to one side of the Rain Map SW. The BLK wire from the RAIN MAP LIGHT connects to the same side of this SW. The RED



wire from the RAIN MAP LIGHT connects to the switched side of the ignition. (The same side as the wires from ECU + and BLUE ECU LIGHT)

- e. Harness RAIN MAP SW BLK wire connects to the other side of the RAIN MAP SW.
- f. PIT SPEED SW BLK (Long pair of wires) to one side of the SPEED LIM SW
- g. PIT SPEED SW WHITE (Long pair of wires) to the other side of the SPEED LIM SW

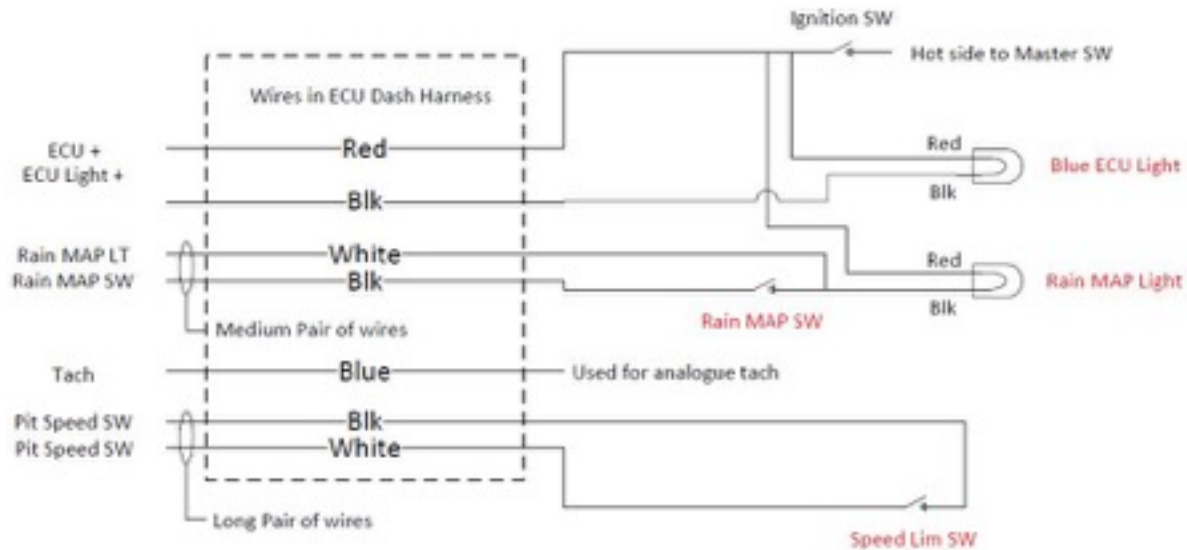


Figure 18 – Dash Wiring

## Ground Cable

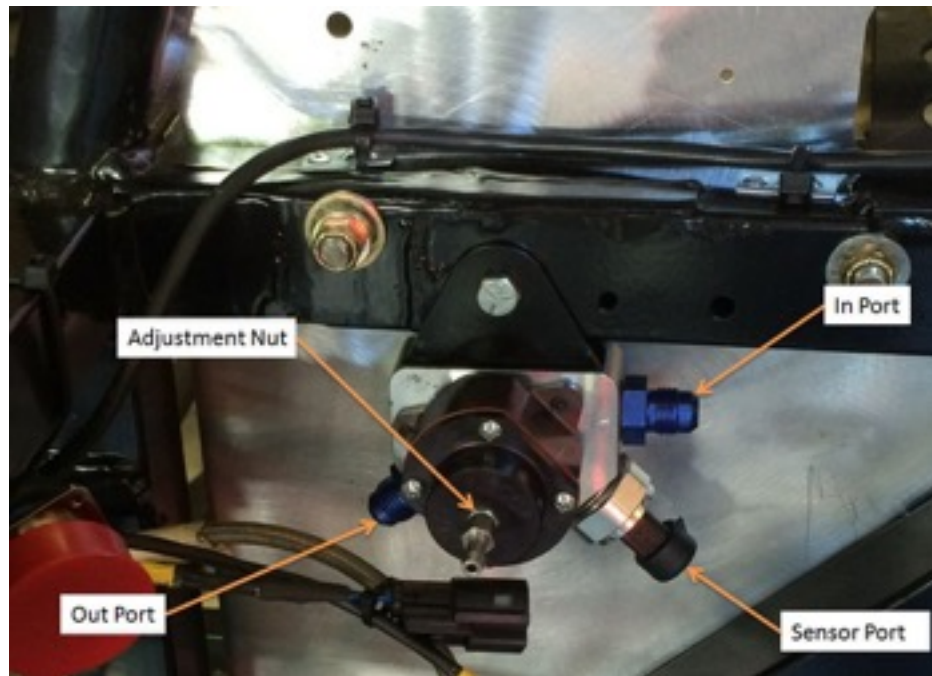
The new ground cables will be built from your existing ground cable. To build these new ground cables start by:

40. Coming back from the end of your current ground cable enough to assure you have clean copper wire.
41. Cut 2 lengths of cable -- 12" to 14" -- and crimp the new eyelets (part # G991818) on the cables. ***Be sure to slide 2, 2" pieces of heat shrink*** (part # G1010041) ***on the cables before you crimp both ends.*** Use a heat gun to shrink the tubing and seal the ends of the wire. *This heat shrink has glue in it and will help protect the wire from corrosion.*
42. Attach one of these new ground cables to the battery negative and then to the new chassis ground location. (Leave disconnected until you're ready to power the car.)
43. The other ground cable will run from the transmission to the rear frame ground location. This will be done during step 105.

## Installing the Fuel Regulator / Fuel PSI Sending Unit Adapter

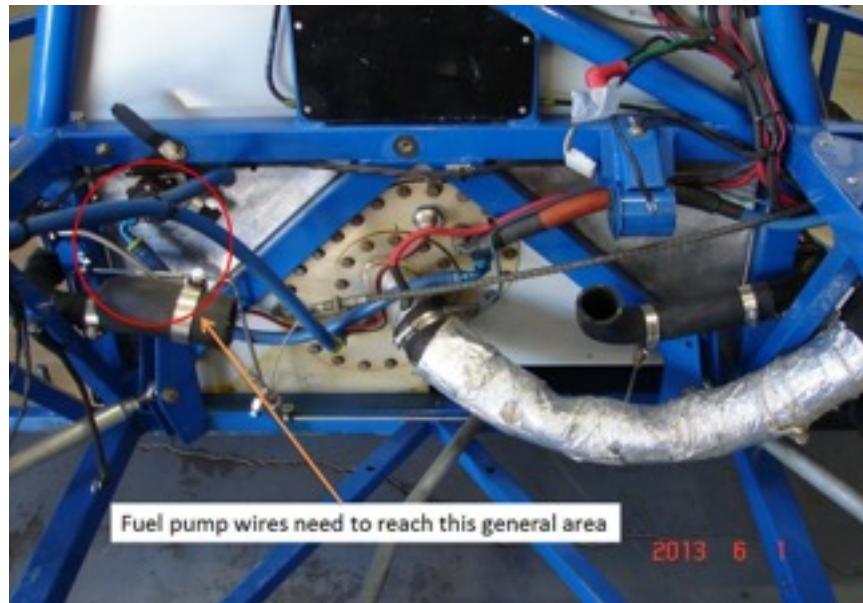
The GEN3 will use the adjustable fuel pressure regulator off of the 1.9 L engine. (This was taken off in an earlier step.) This will be mounted to an adapter bracket that needs to be located on the drivers left side, inside the engine compartment on the rear, facing the upper 1.5" square tube.

44. Measure 3" to 3.25" to the right of the left upper corner and install a 1/4-20 riv-nut (Part # G1010047) to mount the plate assembly. (See Figure 19)
  - a. Option: You can pop rivet this if you prefer.
  - b. Mounting too far in left or right makes hose install difficult.
45. Mount the fuel regulator adapter block to the mounting bracket (Part # G591904 & G591905) using 2 10-24 button head screws (Part # G1010026) and a drop of blue thread locker.
46. It is also recommended that you **very carefully de-burr the O-ring hole** in the adapter block where it receives the O-ring on the Fuel PSI regulator. Do this prior to installing the sensor or fittings. Make sure it is clean before proceeding.
47. Carefully attach the fuel pressure regulator to the adaptor block using the supplied hardware. (Part# 3x WM1010174)
  - a. Be very careful not to damage the sealing O-ring.
48. Attach the fittings (Part # 2x G691937) and sensor (Part #G980495) to the adaptor block.
49. Mount this assembly to the frame using a 1/4-20 bolt and washer. (Part # 1000106 & 1020392) (See Figure 19)



**Figure 19 – Fuel Pressure Regulator and Adapter Block**

**Note:** As mentioned previously, the In-tank Fuel Pump kit must be used. The wiring pigtail needs to reach the upper left hand corner of the engine box (See Figure 20) extending if necessary. **If you haven't updated to the in-tank fuel pump kit (Part # 1150002) It is mandatory for GEN3**, can be purchased from your area CSR.



**Figure 20 – In Tank Wire Reach**

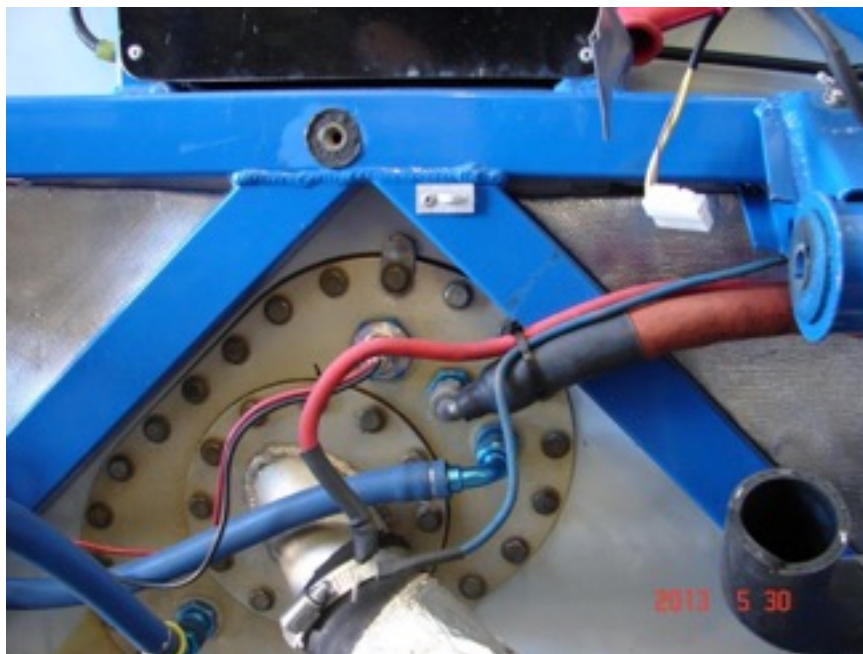
### **Filler Neck Location**

Filler neck placement will need to be adjusted from 1.9 L. While you are installing the in tank pump kit, or if you have previously installed the kit you will need to clock the position of the filler neck. This gives the filler hose clearance for the oil filter, which is now on the front side of the engine.

50. Remove the ¼ - 28 bolts from the filler neck plate and clock it to the 4:30 / 5:00 position.

The hose will curve down to within about 1" to 2" above the level with the floor. See Figure 21. A replacement gasket has been supplied (Part # 580627).

51. Reattach the filler hose. In some cases this hose is too tight or too short and will need to be replaced with a new one. (longer -- Part #G591916) This can be ordered from the CSR.



**Figure 21 – Filler Neck Clock Position**

## **New Oil Cooler**

The 1.6 L will use a larger oil cooler and a new oil cooler fan assembly. We will mount the new oil cooler and fan in this section but connect this into the car's electrical harness at a later step.

52. Locate the oil cooler, top mounting bracket, mounting hardware (1/4-20 bolts, washers, riv-nuts) between bracket and cooler, oil fittings (from your 1.9 L oil cooler), and assemble these together on the bench. (Part # G480503, G480507, 1000106, G1010047, & 1000410) (See Figure 23)
  - a. Install the riv-nuts into the oil cooler mounting bracket.
  - b. Note: Temporarily assemble the bracket to oil cooler. Hardware will be loosened later to add the fan's mounting bracket.
53. Locate the oil cooler assembly in the chassis and mark the three mounting locations starting with the lower location in the diagonal 1"x1" bar. Slide the cooler left/right until the lower mounting location lies up over the diagonal bar. Mark this location and the upper two locations in the horizontal 1"x1" bar.
54. Install riv-nuts in the three mounting locations and mount oil cooler using the 1/4" bolts and washers. (Part # G1010047, 1000106, & 1000410) In the lower location install the spacer and 1/4" hardware to the diagonal riv-nut location. (Part # G480506, G1010050, & 1020392)
  - a. Through bolt(s) can be used in place of riv-nuts if preferred. (Don't over torque.)
55. Test fit the top fan mounting bracket onto the oil cooler. (Part # G480505) Mark the center location that interferes with the rib in the oil cooler. Remove and drill a hole in this location. Use a round file to slot this to clear the rib in the oil cooler. Test fit and file as necessary. See Figure 22
56. Assemble the fan mounting brackets to the fan using the supplied hardware. (Part # G480504, G1010045, G1010046, 1016244, 1080606) Don't forget the fan rubber isolator washers. Tighten these before mounting to the oil cooler as the hardware is not easily reached once mounted to car. See Figure 24
57. The fan wiring harness (Part # G90502) should be routed from the switched side of the master switch and back into the right side pod. Use Ty-Wrap tabs or cable ties to secure this relay and connect the fan and ECU wires.





Figure 22 – Fan Mounting Bracket and Isolator



Figure 23 – Oil Cooler front

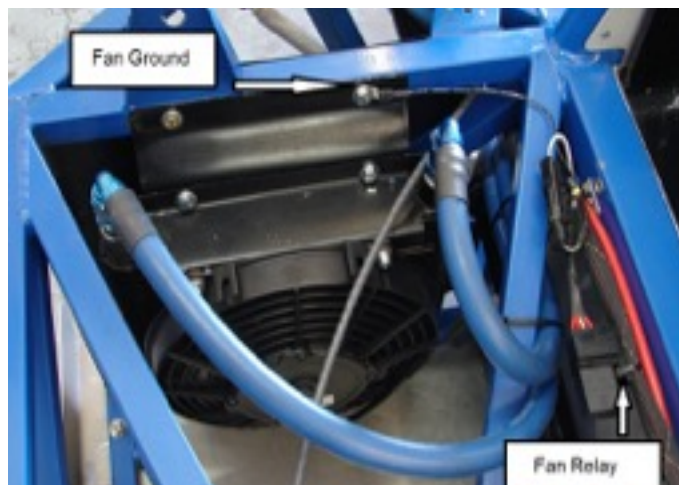
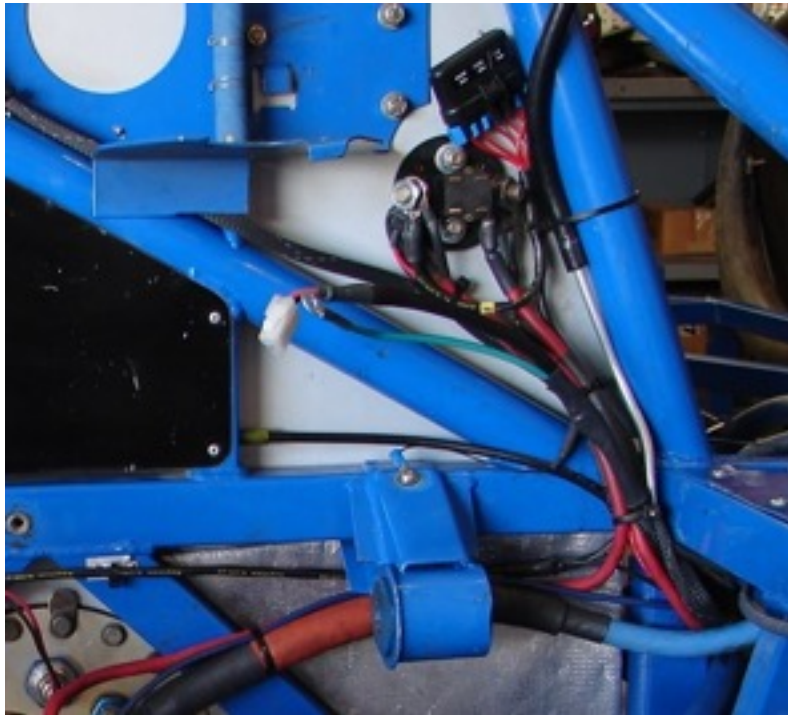


Figure 24 – Oil Cooler Top





**Figure 25 – Engine Bay - Master Switch**

**Note:** We will attach the oil lines later in the process. Be careful not to let dirt or debris fall into the fittings until these can be closed.

### **Coolant Tank Prep**

If you chose to update the cooling system fill / surge tank, please clean and inspect for damage before beginning this update. A tank can be bought with these fittings already installed or your local CSR can make these updates for you. See Figure 1 for visual reference before starting.

58. Cut off the -8 male fitting nearly flush with the body and weld the -6 male fitting supplied in the kit.(Part # G691931)
59. Drill a .8125" hole with a uni-bit approximately .75" above the bottom of the tank and 1.5" from the edge on the same side as the -6 fitting. Weld the modified -8 fitting (part # G462801) in this location. See Figure 1
60. Use the supplied cap (Part # G691933) for the lower fitting that has been eliminated.
  - a. This can be cut off and a plate welded over it instead of using the cap

This completes the tank update. Tank hookup will be done later in the manual.

## TRANSMISSION (GEARBOX) PREPARATION

The GEN3 SRF uses the same gearbox as the 1.9 L engine but with two simple modifications.

61. Start by looking at the gearbox from the 5th gear black (typically) sheet metal cover; locate the 8:00 position threaded bolt hole on the face that mounts the transmission to the motor. This is the dowel on the left side. See Figure 26
62. Using a .406 drill bit (this is the drill size for a 10mm x 1.5 Heli-Coil), drill the threads out all the way through.
63. Remove the locating pins from the transmission. (If any are present)
  - a. The locating dowels are in the transmission adapter plate. One of these will fill this location. A bolt will be added to this at a later step.

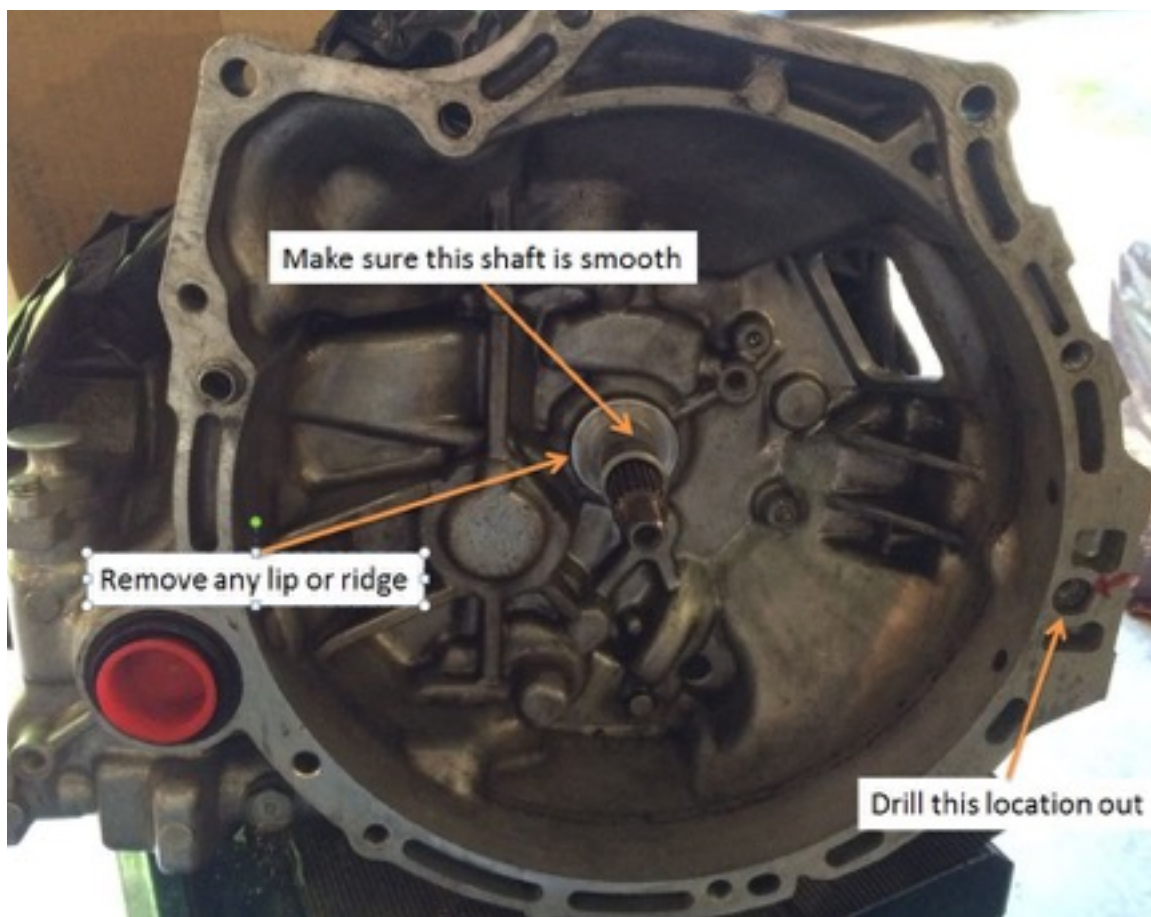


Figure 26 –Transmission Dowel Pin and T/O Tube

### Clutch Release Bearing

The GEN3 kit uses a hydraulic throw-out (T/O) bearing and Tilton clutch assembly. The next set of steps detail the prep work for this new throw-out bearing within the existing transmission.

64. Locate the base of the T/O bearing guide tube and make sure it is smooth and burr free. (See Figure 26) Use emery cloth or similar to remove any fine burs or nicks.
  - a. The new Tilton release bearing assembly has an O-ring in the inner diameter (I.D.) of the assembly body to help dampen and let it float on the T/O bearing guide tube.
65. Look closely at the base of the guide tube, there is a machined ring around the base of the tube. There is a small bur or un-machined edge around the outer diameter of the machined ring. Using a small file and/or emery cloth remove this un-machined edge carefully so the release bearing body sits flat against the machined ring on the gearbox case.
66. Once cleaned up, lube the guide tube and O-ring with thin grease lubricant and slide release bearing assembly on the guide tube. The fit of the T/O bearing assembly on the guide tube will be tight.

## **Clutch Release Bearing Line**

67. Locate the lines and hardware. (Part #'s G691804, G691803, G730001, G1010005, WM1010376) The remaining -3 fitting will be used on the clutch line to frame.
68. Install the bulkhead fitting in the mounting plate.
  - a. The upper fitting will be the bleed fitting and the lower one will be the pressure fitting
69. Install the bulkhead plate on the transmission in the clutch slave cylinder location. (See Figure 27)
70. Install the two (2) -3 to -3 adapters on the T/O bearing
71. Lightly attach the -3 fittings to the bulkhead location in the line bracket and on the release bearing body. (Four (4) total fittings)
72. Remove the nut and sealing "Olive" from each fitting so you can judge the length of -3 line needed for both locations.
73. Cut the -3 line to the proper length and assemble the lines.
74. When done install the lines and tighten **all** fittings. See Figure 28
75. Clutch Flex Line prep (This is the line from the bulkhead fitting on the car to the transmission). This is optional but provides a cleaner installation.
  - a. Shorten your clutch flex line to 10" and install the provided 90° fitting (Part # 1000380)

**Set the gearbox aside for reassembly later.**



Figure 27 – New Clutch Fittings

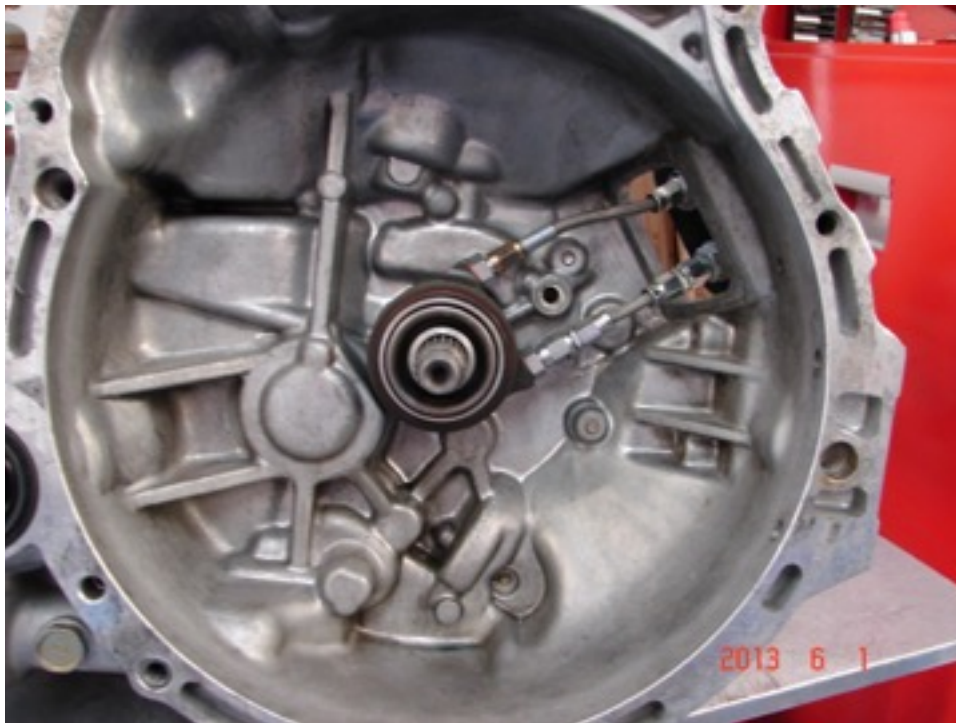


Figure 28 – T/O Bearing & Clutch Lines

It would also be a good idea to check the threaded holes in the gear case and repair if necessary.

**NOTE: There is a gap between the transmission housing and the adapter plate. Be careful not to drop anything in the gap. It's possible to modify the throw-out bearing fork boot to help keep debris out of the bell housing.**

## Shifter Shaft

76. Install the new bent shift tube on the 2<sup>nd</sup> half of the shift linkage. (Removed earlier in the manual)

- a. This bent shift shaft can be ordered from your CSR (Part # G392547) or bent from your existing Gen 2 part using the full-size template provided in the kit.

Note: In the kit is a longer fish mouth adapter and hardware (Part # G393474A, 1090031, & 1001105) that should be used to attach the shifter to the transmission. These are needed for the shift shaft to clear the oil pan and installed later in this manual.

*Pay attention to the clearance between the left rear lower control arm through bolt and shift shaft bolt. Depending on your engine mounts, you have either the stock fish mouth adapter or the longer one; locate the shift shaft in the proper location. Verify clearance to the engine in all gears.*

## Breather Bottle (New vented catch bottle)

The GEN3 uses a new breather system that is vented to open air. Because of this, at the end of a session it's possible to see some vapor or smell a hot oil type odor. The 1.9 L is vented to the air box and the oil vapor drawn into the intake tract. We almost never smell it.

### With the LR side-pod panel off:

77. Mount the small bracket (Part # G183002A) to the diagonal 1"x1" tube just in front of the left rear tire or just behind the left rock panel with the supplied 3/16" rivets. (Part # 1090099) This should be mounted so that the filter does not stick above the 1"x1" frame tubes and so that the output -12 fitting clears the main water tube.

78. Secure the bottle to this bracket with the provided hardware. (Part # G391505, 100380, 1020392, & 1000100) The top of the filter on the catch bottle should be just below the mounting flange on the center section.

- a. In some cases, both bottle mounting holes will not line up with the holes in the bracket. If this is the case, use one of these existing holes and drill a new hole in the proper location.

The hose between the bottle and motor are added later in the process.





**Figure 29 – New Breather Bottle and Mounting Bracket**

## **Fuel Filter Brackets**

79. Locate the fuel filter mounting block (Part # G591912) and riv-nut these into the chassis using 10-32 hardware supplied. (Part # 2x G1010048, 2x G1010049, & 2x 1016244) Locate the bracket approximately as shown in Figure 31. The location is not critical, as you will be measuring line lengths to confirm estimations.

## **ENGINE INSTALL**

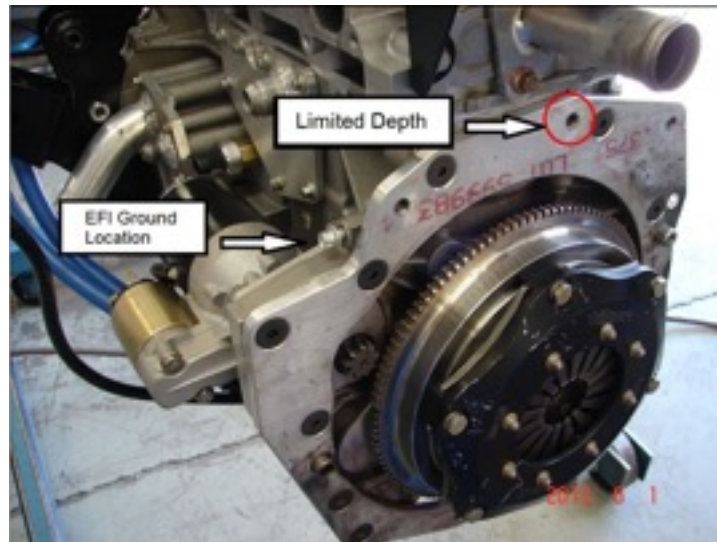
### **Engine Prep**

The engine is just a touch shorter and 60 pounds lighter than the 1.9 L. So it's a little easier to manipulate and attach to the gearbox in the chassis.

The engine comes with most of the accessories already installed. We will add the front motor mount and remove the intake and fuel rail assembly to prevent from damaging these during install. **(The intake is plastic and can be damaged, be careful. )**

80. Remove the Intake and fuel rail from the engine and set aside to be installed once the motor is in the car.

**Note:** Intake, exhaust header, alternator, and right side engine mount should not be installed at this point. (Installed once motor is mounted in car.)



**Figure 30 – Transmission bolt location**

**Note:** When bolting the transmission to the engine, use care with the transmission bolt (Part # G1010010) in the 12:30 to 1 o'clock position (See Figure 30; the **RED** circled bolt location). That bolt location in the adapter plate is against the engine block -- **using a bolt longer than 45 mm will crack the block or adapter plate**. Good idea to check the length of that bolt location when attaching the transmission to engine. (Some of the 1.9 L transmission to engine bolts are longer than 45mm)

81. Place your updated (from Step 75) transmission into the engine bay biased over to the left as much as possible.
82. Lift the motor into the chassis...
  - a. Mate the engine and transmission. (Be sure to line up the pilot bearing and input splines before tightening the transition bolts. DO NOT use these bolts to pull the transmission to the engine. If the splines are not lined up you will damage the clutch.) Secure the transmission using the provided bolts in these locations:
    - i. G1010010 45mm – Balance of transmission to engine plate mounting
    - ii. G1010008 25mm – Under engine into oil pan
  - b. Mount the Head engine bracket (Part # G1139301) to the engine using the supplied bolts and 13mm swivel socket. (Part # 2x G1010055 & G800013)
  - c. Attach the engine mounts in this order: under the alternator, lower left trans, upper trans and at the end of the cylinder head.
  - d. We find that we can pivot the engine / gear box assembly on the mount under the alternator to line up the rest, just our choice.
  - e. **Only after all bolts are in place do you tighten them.**

83. Connect the shift shaft to the transmission using the new longer fish mouth adaptor and hardware (Part # G393474A, 1090031, & 1001105).

**Note:** If you are having trouble with your mounts lining up we have produced a couple of new parts to help with that problem. Left lower transmission mount with ½” of horizontal adjustment and a shorter upper trans mount to help rotate up away from the lower 1x1 frame tubes. (Transmission mount “Lower” Part # 1139101A, Upper Part # 1139201, Base Shim Part # 391201B)

### **Assembly order from this point**

This is a suggested order of assembly from this point. The build process of each line is detailed below but this gives you an overview of the upcoming steps.

- a. Items below the intake (oil lines, starter wires, oil temp, oil pressure, crank trigger, water line #4, large water hose to RT side aluminum water tube, -6 water drain line, fuel line from cell to regulator, fuel line from cell to filter, breather line, Master Switch wiring)
- b. Intake and MAP sensor connector on bottom of intake (Followed by fuel rail and remaining harness connections)
- c. Alternator
- d. Remaining fuel lines and water lines

## **LINES AND CABLE BUILD**

On the first installation, it's time to make your new fuel and oil lines as well as cut your main 12V battery cable for the master switch. The GEN3 kit comes with the fittings and line to build the necessary fuel and water lines. However, the use of braided or other type of hose or ends is up to the owner.

### **Fuel Lines / Fuel Filter**

84. Secure your existing 1.9 L filter to the block (Installed in step 79) using the foam and Ty-Wrap provided. (Part # 2x 1090021 & 992006)

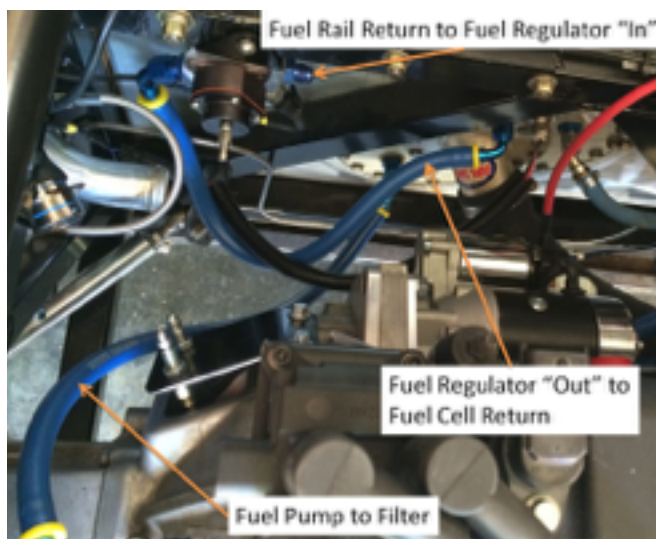




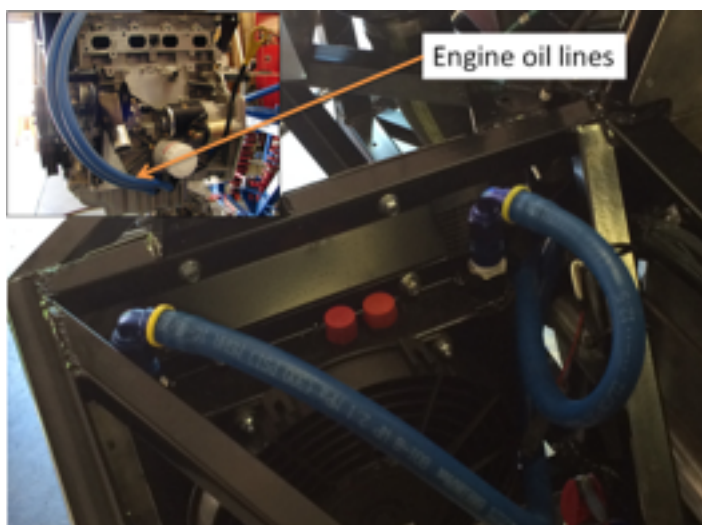
**Figure 31 – Fuel Filter Location**

85. Fuel cell to fuel filter line: measure and build the -6 fuel line with a 45° fitting (Part # 691921 & 698001A) on the output fitting from fuel cell and a 45° fitting to the fuel filter. The approximate length of this line is 20".
- a. One way to build these lines is to assemble one end, in this case a 45°, and attach to the fuel cell (loosely). Then route the uncut line to the filter and mark it with a Sharpie. Remove the line and cut off at mark. Finish the line by adding the other 45° fitting and assemble in the car tightening each fitting. This method may help get the proper length on some of the harder to measure locations.
86. Fuel filter to fuel rail line: Measure and build the -6 fuel line with a 120° fitting (Part #G691941) on the filter end and a 90° (Part # 691903) on the fuel rail end. The approximate length of this line is 29".
87. Fuel rail to Fuel Regulator/Adapter Block line: measure and build the -6 line from the fuel rail using a 45° fitting to the Fuel PSI / Regulator adapter block "IN" port using a 90° fitting. The approximate length of this line is 13".
88. Fuel Regulator/Adapter Block to fuel cell return line: Measure and build the -6 line from the Fuel PSI/Regulator adapter block "OUT" port using a 90° fitting to the return line on the fuel cell using a 90° fitting. The approximate length of this line is 16".

See Figure 32 for a fuel line routing...



**Figure 32 – Fuel Lines Routed**



**Figure 33 – Oil Cooler Lines**

## **Oil Lines**

In this step we will measure and build the oil lines to and from the oil cooler to the oil filter sandwich adapter on the engine. We will reuse your -8 to ½" NPT fittings on the oil cooler that were installed in step 56.

- a. Suggest a gentle bend up and over the fuel filler hose and then finish routing as normal. Be careful to protect the lines as they pass into the side pod from chafing on the side pod end plate.
- b. If you need new fittings for the oil cooler side of these lines the parts are:
  - iii. 2x -8 male x ½" male pipe

89. Start by assembling one of the 120° fittings (Part # G691925) on the uncut -8 oil line (Part # 698002A) and attaching to the oil filter sandwich adapter on the motor. (Either location) The approximate length of this line is 34".

90. Route this line with gentle bends to the oil cooler inner location. Mark the line and remove.

91. Cut the line at the mark; install the 90° fitting. (Part # 692410)

92. Assemble in the car and tighten each fitting.

93. Repeat for the second oil line. The approximate length of the 2<sup>nd</sup> oil line is 41". See fig 33 for picture of oil lines.

## **Battery Starter Cables**

The main battery cable (+) should remain running from the battery to the master switch hot side. We will shorten the starter and solenoid wires to match the new starter location.

94. Shorten the main 12V battery cable from the master switch running to starter to 24".

95. Shorten the starter solenoid wire approximately 24" to line up with the new starter location.

96. Strain-relieve these from vibration (especially the solenoid wire) by ty-wrapping together with fuel cell fill hose and vent line.

## Water Lines / Coolant Lines

We will build the new water coolant system lines. These will be:

- Line #1 - Water return line from the surge/filler tank to “T” fitting (-6 line)
- Line #2 – Line from “T” fitting to engine head water outlet next to large radiator hose (-6 line)
- Line #3 – Line from “T” fitting to end of cylinder head by #4 exhaust port (-4 line)
- Line #4 – Line from tank to water inlet adaptor plate on front side of motor (-8 line)
- Line #5 – Line on the radiator hose inlet adaptor front lower side of the engine to use as a cooling system drain. (-6)
  - o **Note:** The lengths listed are approximate. If in doubt build one end of the lines and test fit to verify your required length based on your routing preference.

97. Install the water surge/filler tank that was modified in step 10

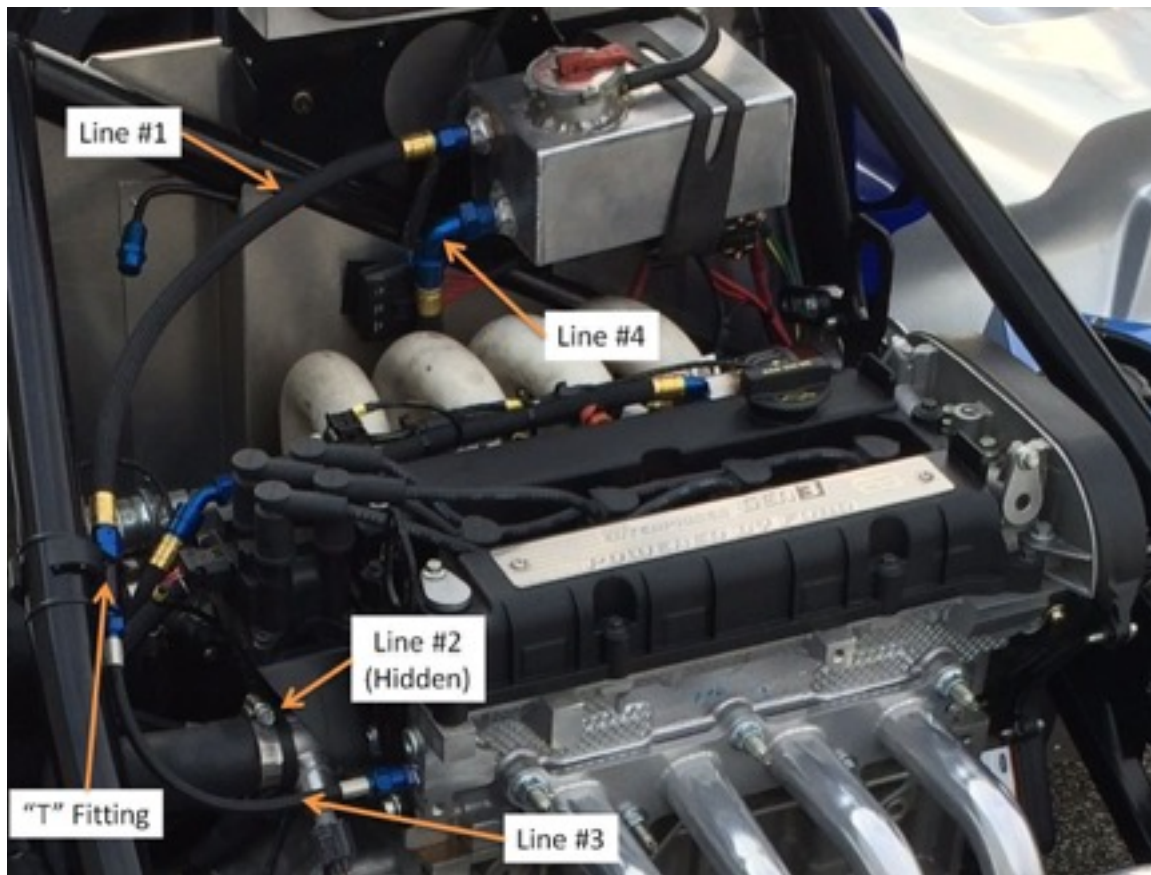
98. Assemble new water line #1: Using a -6 straight fitting (Part # 2x 691928), -6 hose (Part # 698001A), and 1 -6/-4/-6 “T” fitting (Part # G691943). This hose runs from the -6 on the surge tank over to the T fitting that can be located along the left side rear roll bar of the engine bay. The approximate length of this hose is 17”. See Figure 34

99. Assemble new water line #2: Using a -6 straight from the “T” fitting to a -6 90° fitting (Part # 691903) on engine left outlet location. The approximate length of this is 6”.

100. Assemble the new water line #3: Using -4 straight fittings (Part # 2x G691927) and the -4 hose (Part # G691926). The approximate length is 10” but is dependent on where you mount the T fitting. See Figure 34

**Important:** This line **must** flow water freely. This is the only path in the cooling system that by passes the radiator so warm water flows from the cylinder head to surge/fill tank and near the thermostat any time you run the engine from cold. **ENGINE DAMAGE WILL OCCUR IF ADEQUATE COOLANT IS NOT FLOWING THROUGH THIS CIRCUIT!!**

101. Assemble the new water line #4: Using a -8 straight fitting (Part # 680800) and the -8 hose (Part # 698002A) and a -8 90° fitting on the back motor location. The approximate length is 33”.



**Figure 34 – New Water Lines (Custom lines shown)**

102. Install the new right side radiator hose (Part # G691802) from the coolant tube to the back right side engine water fitting. (INLET SIDE)
103. Install the new left side radiator hose (Part # G691801) from the coolant tube to the left side engine water fitting. (OUTLET SIDE)

**Note:** The thermostat comes installed in the engine from SCCA Enterprises.

**Note about the water inlet adapter plate and system draining:**

The water inlet adapter plate includes a -6 male fitting located on the underside of the 1.25" hose fitting.

Assemble the new water line #5: A coolant drain hose added to your system that will reduce the mess made when working on the cooling system for any reason. From your -6 hose, cut a 7" piece and use 2 female push-on fittings (45° & straight) with a -6 plug in the straight fitting. This hose assembly is then attached to the -6 fitting on the adaptor plate and should be used to drain the cooling system by removing the plug from the straight fitting. This can be tie-wrapped to the fuel fill hose so that it is out of the way. (Part #'s 698001A, 691928, G691929, and 691921)



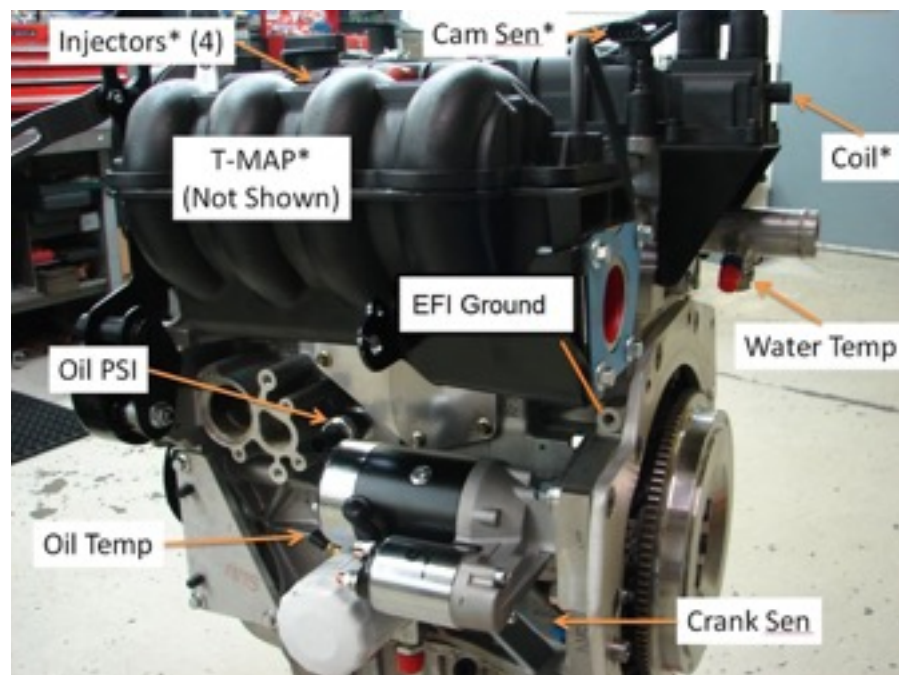
## Vent Line

We need to build the vent line that will run from the -12 on the front of the engine to the catch bottle installed in step 78. The -12 crankcase PCV adaptor plate below the intake manifold mounting location. (60° fitting to block)

- 104.Route this hose over to the vent bottle and terminate with a -12 30° fitting (Part # G691945). If needed, cut the breather hose before terminating at breather bottle. (Be careful not to cut this line too short. Its rigid and will make install/removal of this hard.)

## Wiring Harness Part 2

- 105.Attach the 2<sup>nd</sup> new ground cable (built in step 43) between the rear ground location and the existing transmission location using new hardware for the chassis ground (part # G1010005) and your existing bolt in the transmission. Tighten the chassis location.
- 106.Attach the main EFI ground eyelet to the 8 X1.25 hole in the block close to the upper inner starter bolt location and tighten.
- 107.Everything should reach to the proper connector from that point. Before the intake manifold is installed you can attach everything but the cam sensor, TPS, injectors, IAC and T- MAP sensor noted with \* in Figure 35. (TPS and IAC are located on the throttle body)
- 108.As shown in Figure 35 connect the following:
  - a. Oil PSI sensor (leads cross below the intake manifold)
  - b. Oil Temp sensor (leads cross below the intake manifold)
  - c. Crank sensor (located under the starter)
  - d. Water temp sensor (located on the water outlet fitting)
  - e. The speed sensor on the gearbox. (If present. Will be needed for pit speed limiter)



**Figure 35 – EFI Harness Connectors Before Intake Assembly**

109. Lay the rest of the harness aside until the intake manifold is in place.
- Once the intake is in place you can finish up the balance of connections
  - CAM Sensor, Coil, TPS, IAC, Injectors (4), T-MAP

## **Intake Manifold**

Throttle cable bracket assembly should come installed on the intake manifold.

Install the intake manifold (Part # G301036C) onto the engine using the supplied port O-rings and hardware. (O-ring Part # G301043) Torque the intake hardware to 16 ft-lbs.

- Connect the MAP sensor during this step.
110. Install your throttle body assembly and throttle cable bracket onto the intake manifold
- Leave the left two bolts holding the throttle cable bracket loose
111. Reroute your existing throttle cable and attach it to the cable. Do a test fit and get the throttle cable free play in the ballpark, remove the bracket and tighten the cable jam nuts. You should never need to remove the cable from the bracket again. Note : Optional Shorter GEN3 Throttle Cable (Part # G592301) is available.

## **Alternator / Belt Installation**

The GEN3 uses the updated Bosch alternator (**Spec Part**) from the 1.9 L engine (Part# 902127).

112. Install the new four-groove pulley on to the alternator. (Part # G902130)
- We are going to use a four- groove belt instead of the previous six-groove belt. We are also using a slotted bracket instead of the bar and rod ends.
113. Install the alternator with the new pulley in the car using the existing bottom bolt and the supplied top bolt and washer. (Part # G1010005 & G1000256) Note: The GEN3 does not use the rod end or 3<sup>rd</sup> bolt) Do not tighten at this point.
- Place the alternator on the bottom bracket and feed the bottom bolt in from the left. (It will pass under the intake manifold)
  - The middle pulley with no grooves drives the water pump. This pulley should turn in a counter clockwise direction, while the crank & alternator pulley's rotate clockwise.
114. Route the belt as shown in Figure 36. Start with the belt on the new alternator pulley and the lower crank pulley outer grooves. With the alternator loose, slide the belt over the water pump pulley. (This belt is tight and you may have to remove the upper bolt to get clearance.)
- The two halves of the belt are very close to each other where the belt wraps around the water pump pulley  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch. The belt doesn't need to be super tight and as the engine warms it will tend to tighten the belt. However, unlike the 1.9 L engine the belt also drives the water pump. ***IF YOU LOSE THE ALTERNATOR BELT ENGINE DAMAGE WILL OCCUR! It will be a matter of seconds before over heating occurs if the water pump stops turning. Make sure you set you data***

*system or warning lights to alert you if your battery voltage drops below the running voltage. (Typ an alarm  $\leq 13$  volts will work)*



**Figure 36 – Alternator Belt Routing**

**(Shown as reference, don't install alternator before engine)**

### **Vacuum Line Connections**

115. The 16" piece of hose vacuum hose on the intake manifold near the throttle body connects to the vacuum port on the Fuel PSI Regulator (Vacuum Hose Part #G1010040 )

This is required for proper air / fuel ratio. See Figure 37

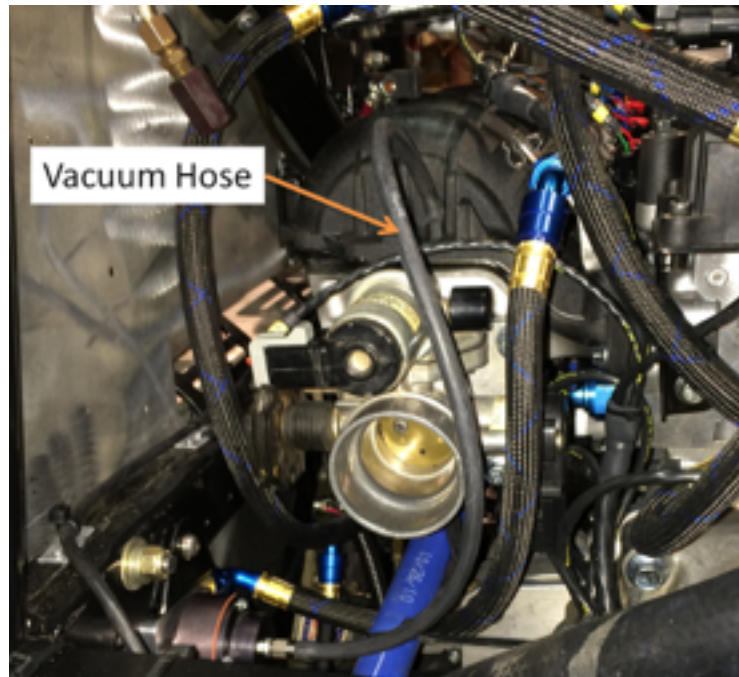


Figure 37 – Vacuum Line Connection

## Header / Muffler

116. Install the header using the supplied gasket (gasket comes on the motor under the protective plate) between the head and the header flange. Tighten the nuts to 30 ft-lb. Use the 1.9 rubber hanger and stud on the frame just as before.

- d. It's suggested to safety wire the springs to the header to prevent them from coming loose. (similar to a 2-cycle kart header) Vibration will cause these to pop off.
- a. When using the muffler (Part # G390523), replace the stinger outlet pipe with the header adapter, muffler, and stinger. Replace springs and tighten band clamps. See figure 38

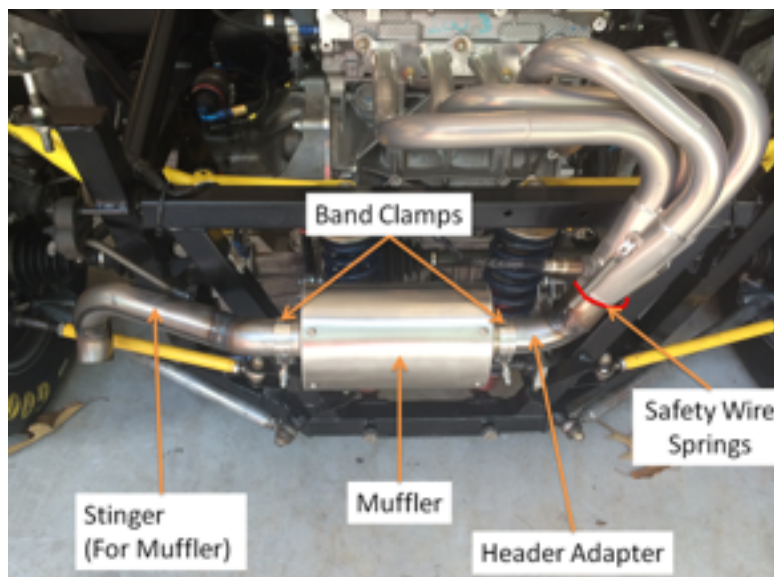




Figure 38 – Muffler

## GEN3 Air Box

The GEN3 will use a new air box (See Figure 39) that will mount to the frame behind the left side center section resting on the 1"x1" tubes. (In the general location of the header Y-pipe joint of the 1.9 L cars.)

117. Fit the intake tube to the throttle body and the onto the center section air inlet

118. With the air filter out, mark the mounting locations on the 1" x 1" tubes.

119. Remove the air box, drill the marked locations, the proper size for either ¼" Nutsurt or Well nuts. If you use Well nuts be sure and Debur the hole carefully.

Note: Well nuts are flexible to help protect the air box in mild impacts.

120. Install the air box, filter, and lid. (See Fig 40) **The gap between the air box and the center bodywork, is not designed to be and should not be sealed by any means.**



Figure 39 – New Air Box



Figure 40 – Air Box Installed

## Clutch Pedal Travel

The pedal travel or clutch release point needs to be set. We are using a pure racing type pressure plate. **It can be damaged by over stroking of the release bearing.** Do this, with the engine off and transmission in a gear.

121. Verify that the clutch system has been bled and is ready for use.

122. Ask a helper to very slowly depress the clutch pedal while you try and roll the car.

123. Set the pedal stop about 1/8 " to 3/16" past where the clutch releases (car just starts to roll)

- a. *It's very important not to over depress the pressure plate before you get the pedal stop in its ballpark. It normally takes about 3.3" of pedal pad travel. (Measured at the pedal foot pad)*

**Note:** The action of the clutch is very quick to grab and much less forgiving in action than the OEM unit we use in the 1.9 L. Be very careful with the clutch action your first couple uses.

## **Instrumentation**

The GEN3 PE3 ECU provides 2 basic CAN data protocols, PE STD and a streamlined Bosch Motorsport 4.3. Both will provide engine parameters to many of today's data systems.

Bosch 4.3 can be converted to Pectel Atlantic / Stack serial protocol via an optional PE CAN to Serial module for older serial data systems.

The ECU also provides a traditional "TACH" signal wire for interfacing with a traditional analogue gage. It is a square wave that varies as a function of RPM, 2 pulses per revolution.

For those that prefer traditional analogue gauges, you can use a similar setup as the 1.9. New Autometer Oil PSI / Water Temp Gauges kit (part # G1151002) The sending units can be added with Optional Gauge fitting kit (Part #G1151001) provides sending unit adaptors for both OIL PSI & Water sending units. OIL PSI adaptor, to be installed on top of the inner oil cooler/oil line fitting and a "Tee" fitting to be installed in the by-pass water bung on the radiator hose adaptor. (end of the cylinder head) Care must be taken not to restrict coolant flow when adding the TEMP sending unit. Wiring will also need to be completed See Autometer gauge instructions.

Competition Data Systems has a data system that will interface with the GEN3 ECU via the interface module using "CAN" protocol. This system is plug-n-play.

Follow the instructions that came with your CDS to establish connection with the car and verify the system is operating before proceeding. (i.e. verify that your "live" readings make sense on items like water temp and air temp) Other data systems can be used, but you will have to work with those vendors to verify this interface.

**Note:** Because the GEN3 drives the water pump off of the alternator (vs cam belt like the 1.9L) make sure you monitor the water temp and battery voltage with alarms or lights that will alert you when either of these becomes out of range. Recommend battery alarm below 12.7 volts. (13 will cause an alarm at idle but not on during run) This will alarm when belt comes off before water becomes hot.

## **Important**

### **BEFORE THE FIRST START CHECK LIST**

1. Double check your Belt routing of the alternator (Step 114)
2. Double check oil fittings are tight

3. Double check the water fittings are tight
4. Set fuel pressure to 45 PSI (all tuning was performed with this static pressure)
  - a. With pump running and engine off (use the momentary fuel pump switch)
  - b. Verify pressure with mechanical gauge on the fuel rail and verify your data system versus the mechanical gauge.
  - c. Remember that it may take time to prime the system with fuel.
5. Fill the cooling system with water and check level. This fills slower than the 1.9 L so take your time and make sure this is full. (Do this before you start the car.) After starting it I find it's best to let the engine idle with the cap off and continue to add as necessary. (See ***During Initial Start and warm up*** section below for more details)
6. Verify the engine oil level. (Recommendations for oil type in opening section of this manual)
  - a. **Note:** The engine uses a full length and width baffle between the oil sump and the crankshaft. We recommend running the oil level to ***the full mark*** to help minimize oil starving in very abrupt G loads. We've seen no adverse side effects to the higher level.
7. Verify the transmission oil level. (same as before)
8. Check the alternator belt is in the grooves as described and not over tight.
9. Make sure the new ground connections are clean and tight.

### TPS Sensor Calibration

The proper calibration of the TPS sensor has the biggest effect is on throttle tip in, just off idle and starting performance. There is almost no effect on full throttle as the upper 10% of the map is nearly all the same settings. We've found that one universal setting for the TPS is just not possible; TPS calibration is needed for each TPS sensor. Once you have completed it, it will pretty much never need to be done again, unless you change sensor or install a different throttle body with a different sensor. (In this case you would follow this same procedure. If this is not something you're comfortable with SCCA Enterprises can perform this step for you. You will need to send your Throttle Body with TPS sensor (and ECU if you have it already)

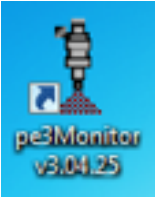

This TPS calibration, plus the fault codes and couple of other things in the software will not be password protected. All other parameters of the ECU will be password protected. ***Modifying any of the spec tuning by any means, passive or active, will be considered a drivetrain violation.***

**Check SCCA Enterprises web site for current PE Monitor V.XX ECU software**

You will need the Performance Electronics (PE) tuning software set up on a Windows PC (laptop) with a working Ethernet port. (RJ45 port) If your computer only has wireless connectivity you will need to find or borrow one with a wired Ethernet port. If you're unsure if your laptop has this port or not you can try and find port on the laptop where the RJ45 will fit. Odds are if you can find a port

for this cable to plug into it will be a wired Ethernet port. Once you have located this port -- plug the communication cable (Part # G992014) into the laptop and the other into the USB-B socket in the ECU wiring harness and follow the instructions below:

1. Turn on the “MASTER” and “IGNITION” switches

2. Open PE3 Monitor software (Icon or version may vary)	
3. The software should open with an option to “FIND ECU” If you need to open this option because the software did not open with this question or you closed the window: Select “Engine” from the top drop down menus and click “FIND ECU”	
4. Select “DIRECT” it will tell you if the ECU is found or not. “CLICK OK”	
<p>a. If a network connection is not seen wait 30 or 45 seconds and try again.</p> <p>b. Sometimes I’ve found you may need to cycle the “IGN Switch” and try again. You may need to give the PC a minute or so to complete the handshake with the ECU, your PC sees the ECU as a “NETWORK”. Some may take longer than others to complete the handshake. (Most of the time this connection is made within seconds)</p>	
<p><b>After communication is established with ECU:</b></p> <p><i>In this order...</i></p>	

[illegible][illegible]

The screenshot displays the AVL Cruise software interface. At the top, a menu bar includes File, Engine, Diagnostics, Tuning, Display, Data Acquisition, CAN Bus, and Help. Below the menu, a toolbar contains icons for various functions. The main workspace is divided into several panels:

- Engine Data:** A panel on the left showing real-time engine parameters. It includes a table with columns for RPM, Load, Fuel, TPS, Air, Battery, and Ignition. The values are: RPM 800, Load 0, Fuel 0.00, TPS 0.0%, Air 77.18, Battery 12.0 V, Ignition 0, P Data 100.0, MAP 100.0 kPa, Coolant 10.18, Water 101.1 MPa.
- Fuel Table:** A 3D surface plot showing the fuel injection map. It is labeled "Click 1" with an arrow pointing to the "Click" button in the TPS Quick Tables dialog.
- TPS Quick Tables:** A dialog box titled "TPS Quick Tables" showing a table of TPS values (0.0% to 100.0%) and corresponding fuel injection values. It is labeled "Click 2" with an arrow pointing to the "Click" button in the Ignition Comparison Factors dialog.
- Ignition Comparison Factors:** A dialog box titled "Ignition Comparison Factors" showing a table of ignition timing values (0.0 to 10.0 ms) and corresponding fuel injection values. It is labeled "Click 3" with an arrow pointing to the "Click" button in the Ignition Comparison Factors dialog.
- Engine Data Table:** A table at the bottom showing engine data for various RPM and Load values. It is labeled "Click 3" with an arrow pointing to the "Click" button in the Ignition Comparison Factors dialog.

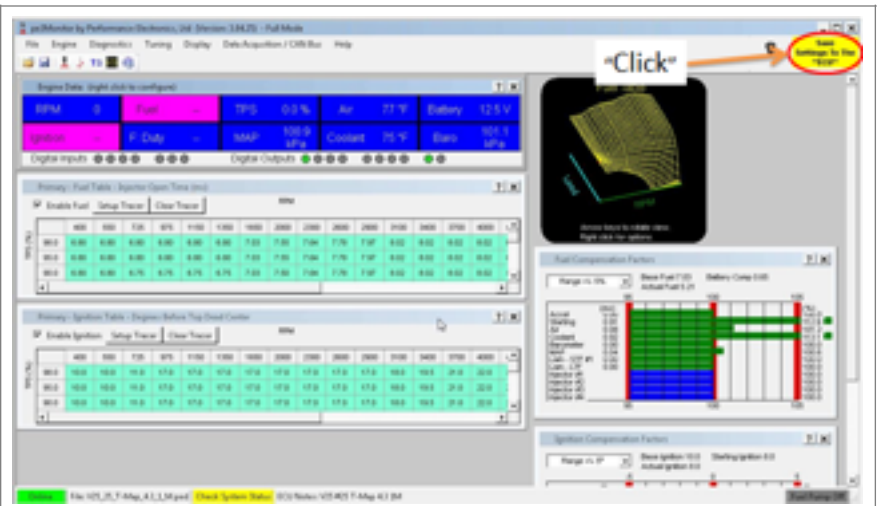
Arrows indicate the sequence of clicks required to set the engine parameters: "Click 1" points to the "Click" button in the TPS Quick Tables dialog, "Click 2" points to the "Click" button in the Ignition Comparison Factors dialog, and "Click 3" points to the "Click" button in the Ignition Comparison Factors dialog.

The box in the upper right hand corner will change to indicate “changes not saved to ECU” (Yellow Background)



10. Click “SAVE DATA TO ECU” in the upper right hand corner of the software view page.

This uploads the changes to the ECU. It does not save the file to your laptop



11. Then last “CLICK OK” on the Data saved window.



### Notes on ECU connectivity:

- If you get an error message such as “ECU Found!; Incorrect Version” you will need to contact your local CSR or Enterprises to have the firmware on the ECU updated to the latest. This can be done from your PC but will require additional support.
- IMPORTANT:** The initial startup of your car will cause the ECU to calibrate the Idle Air Control (IAC) and TPS for your hardware. (Your throttle body contains both of these devices) It's important that you let the car warm up to 190 degrees. When the water temp reaches this 170° mark leave the throttle alone until the temperature passes 180°. (i.e. don't stand there and rev the motor up and down over this temperature range) The ECU will run the calibration “learning” process over this temperature range. (It does this anytime its static over this temperature range)

### During Initial warm up or after any type of cooling system refill

**Water level** should be checked continuously during warm up. It is a little more difficult to bleed all the air out of this cooling system. To help this process, jack up the left side of the car with the engine running to bleed the air from the coolant system. **This is critical, make sure you watch the level during this process and add water as needed. Repeat this until the water level remains**

**constant.** This tank should remain full all the time. If you have bled the system and you see the water tank losing water you most likely have a leak in the coolant tank recovery hose. Check the fitting on the tank first then look for holes or nicks in the line.

### **Calibration of a Replacement O2 Sensor**

The first O2 sensor supplied with the kit has been pre-calibrated at SCCA Enterprises. In the future, if an O2 sensor replacement is needed, a free air calibration of this sensor is required.

This should be done when the sensor is in new condition.

With the sensor in clean fresh air (Out of the exhaust hanging off the back of the car works well):

- a. Turn your master switch on to heat the sensor...maybe 1 to 2 minutes on 75° day.( Longer if it's cooler)
- b. Check the status light on the controller. It should be flashing fast. If not, turn the adjusting screw counter clockwise very gently until it stops.
- c. Pause for a few seconds and start to turn the screw very slow and gently clockwise until the light just starts to flash fast. This is the set point. This is very important as the ECU uses the O2 signal in closed loop to adjust the air / fuel ratio. **Note: not a blanket fix at all. It has a limited +/- window of Fuel adjustment.**

You should only attempt a free air adjustment when sensors are in new condition or very low hours of use -- less than 8 to 10 hours or 2 events or less. If it is grossly fouled, low quality or leaded fuel is used MAJOR ENGINE DAMAGE CAN OCCUR. It would be a very good idea to keep a spare sensor. It's not something you can buy from an auto parts store as is. It is a required **Spec Part**. (Part # G990504)

### **Last but not least**

Have fun exploring the performance of the GEN3 Sigma 1.6. We have done our very best to maintain the reliability that we enjoy with the 1.9 L. It's going to be a new and exciting experience. Take some time and develop your new chassis settings for optimum performance.

***Happy Racing! – The SCCA Enterprises Team***

## RECOMMENDED SPARES LIST -- SPEC PARTS

We recommend a small spares package that would be a very good idea. This list is not all-inclusive but a good place to start. Your local CSR will be able to provide these as well as other parts not on this list.

Description	Part Number	QTY needed
Alternator belt	G991411	1
Oil filter / Motorcraft FL910S	G301022	1
Ignition relay	WM901006	1
Fuel pump relay	WM901006	1
O2 sensor	G990504	1
Starter	G992701	1
Oil PSI sending unit	G980495	1
Fuel PSI sending unit	G980495	1
Air filter	WM301020	1
Spark Plugs	G301041 (6510)	4
Thermostat	G300999	1
Oil filter adaptor O-ring	392499	1

Table 3 –Spares List

Some of these parts are unavailable at a typical auto parts store, and different than the 1.9 parts. These are basic parts that could keep the car from finishing a weekend, and will be wear and tear items in the future.

## APPENDIX A - GEN3 SPECIFICATIONS

### Optimum operation ranges

**HP peak:** 6100 / 6300 rpm  
**Torque peak:** 4900 / 5100 rpm (- 6 Ft-lb from peak range 2800 / 6100 rpm)  
**Lug limit** 4000 / 4200 rpm  
**Rev limiter** 6750 rpm

**Coolant temp** 180° to 195° F (zero fuel or timing trims)  
**Oil temp** 215° to 240°F

**OIL Spec / Oil change Capacity** approximately 4 quarts, with oil filter  
Use a name brand non-synthetic until leak-down numbers stop improving 10 / 30 hours  
Ford Recommends 5W20 Synthetic

We recommend /a name-brand synthetic (after break-in period)

Below 55°F 0W20 or 5W20 Oil temps under 200°F

Above 70°F 0W30 or 5W30

Above 95°F 10W30 or 10W40 -- severe service with oil temps over 250°F

**Note:** 1.6 is assembled with (.0008" / .0015") bearing clearances, to prevent bearing scuffing engine should be warmed before track sessions

**Cooling system:** Aluminum corrosion inhibitor is recommended

**OEM compression ratio: 11 to 1**

### FUEL

***"Best Quality "Premium Unleaded Pump Fuel" you can purchase.*** If in doubt of the quality of fuel in your area, a 20 to 40 % mix of 100 OCT unleaded with 93 / 91 OCT unleaded should be safe.

### Generic Torque Specs for Block /Head (Aluminum) fasteners -- Thread sizes:

**6mm** 5 Ft Lbs  
**8mm** 16 Ft Lbs  
**10mm** 35 Ft Lbs

**SPARK PLUGS** NGK LTR7IX-11 Iridium, Stock Number: 6510 Gap: .035" / .038"  
**Flywheel** Torque 65 ft. Lbs /.must maintain .100" step / Min weight 7 lb 3oz  
**Clutch** Cover Torque 18-20 ft. Lbs.

<b>Clutch Disc</b>	Minimum thickness .270"
<b>Intake</b>	Intake manifold nut torque 16 ft. lbs
<b>Exhaust</b>	Header nut torque 30 ft. lbs.

## **Performance Electronics PE3 ECU Specifications**

Sequential fuel injection / wasted spark , running in O2 based closed loop.

Target above 80% throttle .88 lambda with a 1% dead band.

Target idle .96 lambda with a 4% dead band and a linear slope in between.

Tuning based on Premium unleaded @ 45 PSI (pump running / engine off)

## **ECU Fault Codes**

<b>12</b>	Air Temp Sensor out of range
<b>13</b>	Coolant Temp Sensor out of range
<b>14</b>	TPS out of range
<b>15</b>	MAP out of range
<b>21</b>	Injector over current / out of range
<b>22</b>	Coil over current / out of range
<b>23</b>	Digital Output over current / out of range
<b>Rapid Flashing</b>	TPS Auto CAL Mode

## **ECU DATA Output Connector pin out**

1	CAN HIGH	
2	CAN LOW	
3	12V Pos	
4	GND	5 AMP MAX / Switched by the MASTER SWITCH

## **PE Serial Convertor wire color explanation**

Red	12V power
Black	GND
Purple	CAN HIGH
Orange	CAN LOW
Gray	Serial output / to data system / Pectel Atlantic Protocol @ 250K rate







## **APPENDIX B – GEN3 PARTS LIST**

Part #	Description	Remarks	Qty
580627	ROUND FUEL CELL GASKET		1
680800	-8 STRAIGHT FITTING	BOTTOM LEFT COOLANT TANK	1
691903	90 DEG -6 FITTING	FUEL/WATER LINES (SEE LINE INFO)	5
691921	-6 45 DEGREE FITTING	FUEL/WATER LINES (SEE LINE INFO)	4
691928	-6 STRAIGHT FEMALE P/O ALUM	WATER LINES (SEE LINE INFO)	4
692410	-8 90 DEGREE FITTING PUSH ON	WATER RETURN HOSE (1)/OIL COOLER LINES (2)	3
992006	FOAM	FUEL FILTER BRKT	1
1000100	1/4 x 20 x .5 BOLT	CATCH BOTTLE BRKT TO BOTTLE	2
1000106	1/4 X 20 X 1/2 BOLT	OIL COOLER (4)/FUEL PRES. BRKT TO FRAME (1)	5
1000255	WASHER M8 FLAT	BULK HEAD TO LINES (UNDER JAM NUT)	2
1000364	1/4 X 20 HEX NUT	FOR ECU PLATE BOLTS	6
1000380	3/8 x 24 JAM NUT	CLUTCH LINE	1
1001835	POP RIVET 1/8 X 3/16 ALUM	TYWRAP BLOCKS	48
1002000	POP RIVET 3/16 ALUM	COOLANT OVERFLOW BOTTLE BRKT.	3
1002068	POP RIVET 1/8 X 3/8 STEEL	ECU BRKTS.	6
1016244	10/32 FLAT WASHER	FUEL FILTER BRKT (2)/FAN (4)/OIL COOLER (4)	10
1020380	1/4 LOCK WASHER	CATCH BOTTLE BRKT	2
1020392	1/4 FLAT WASHER	CATCH BOTTLE BRKT (2)/ECU RUBBER MTS.(6)/FUEL REG MT(1)/oil cooler mount (3)	12
1080606	10/32 NYLOCK NUT	FAN/COOLER	4
1090021	TYWRAP	FUEL FILTER BRKT (1)/ECU TO PLATE (5)	6
1090099	POP RIVET 3/16 X 3/8 STEEL	CATCH BOTTLE BRKT.	2
698001A	-6 FUEL HOSE PER INCH	COOLANT LINES/FUEL LINES (SEE LINE INFO)	108
698002A	-8 OIL HOSE PER INCH	OIL/COOLANT LINES (SEE LINE INFO)	108
G1010001	STUDDER RUBBER MOUNT	ECU PLATE TO ECU BRKTS.	3
G1010005	8 X 1.25 10 OR 12 MM	CLUTCH LINE MTG. PLT. TO G/BOX (2)/ GROUND BUNGS (2)	4
G1010026	10/24 X 1/4 BUTTON HEAD	FUEL PRES. REG. BLOCK TO BRKT.	2
G1010030	VELCRO LOOP PER INCH	ECU TO MTG. BRKT	12
G1010031	VELCRO HOOK PER INCH	ECU TO MTG. BRKT	12
G1010038	TYWRAP BLOCK		24
G1010041	3/8 HEATSHRINK PER INCH	FOR GROUND CABLES	8
G1010045	RUBBER WASHER	FAN/COOLER	8
G1010046	10/32 X 3/4 PAN HEAD	FAN MOUNT	4
G1010047	1/4 X 20 NUT SERTS	OIL COOLER(3 IN FRAME), FAN (2 IN BRKT) FUEL PRES. REG BLOCK (1)	6
G1010048	10/32 NUT SERTS	FOR FUEL FILTER BRKT TO FRAME	2
G1010049	10/32 X .5 SS BUTTON HEAD	FUEL FILTER BRKT. TO FRAME	2

Part #	Description	Remarks	Qty
580627	ROUND FUEL CELL GASKET		1
680800	-8 STRAIGHT FITTING	BOTTOM LEFT COOLANT TANK	1
691903	90 DEG -6 FITTING	FUEL/WATER LINES (SEE LINE INFO)	5
691921	-6 45 DEGREE FITTING	FUEL/WATER LINES (SEE LINE INFO)	4
G1010050	1/4 X 20 X 1 1/2 BOLT	OIL COOLER SPACER	1
G1139261A	HYD T/O BRG ASSY		1
G1190503A	WIDEBAND KIT		1
G183001	WELD ON GROUND WIRE BUNG	WELD TO FRAME	2
G183002A	CATCH BOTTLE BRKT	ATTACH TO FRAME	1
G391505	OIL BREATHER TANK W/FILTER	ATTACH TO CATCH BOTTLE BRKT.	1
G391600	HEADER		1
G391605	TAIL PIPE		1
G392002	ECU MOUNTING PLATE		1
G392003	ECU BRKT 5"		1
G392004	ECU BRKT 2.5"		1
G462801	TUBE FOR COOLANT TANK	(ONLY IF MODIFYING OWN TANK)	1
G480503	G3 OIL COOLER		1
G480504	OIL COOLER FAN		1
G480505	OIL COOLER FAN MTG BRKT		2
G480506	OIL COOLER FAN SPACER		1
G480507	OIL COOLER BRKT		1
G691803	G3 SLAVE CYL INLET LINE		1
G691804	G3 SLAVE CYL BLEED LINE		1
G591904	FUEL REG ADAPTER	MOUNT TO ADAPTOR MOUNT	1
G591905	FUEL REG ADAPTER MOUNT	MTS FUEL PRES REG ADAP TO FRAME	1
G591912	FUEL FILTER BRKT	LEFT SIDE OF ENGINE BAY	1
G602012	-3 90 DEG TO -3 SS HOSE	CLUTCH LINE - END OF CHASSIS LINE (SHORTEN)	1
G691925	-8 X 120 DEG PUSH ON	OIL LINE AT ENGINE	2
G691926	-4 HOSE PER INCH	COOLANT LINES	10
G691927	-4 FEM TO 1/4 HOSE PUSH	COOLANT LINE - HEAD TO TEE	2
G691929	-6 MALE AN PLUG	FRONT LOWER DRAIN HOSE	1
G691931	-6 AN WELD ON ALUMINUM	(ONLY IF MODIFYING OWN TANK)	1
G691933	-12 CAP	BOTTOM OF COOLANT TANK (IF MODIFYING OWN TANK)	1
G691937	-6 MALE TO 9/16 - 18 O-RING	GO IN FUEL PRESS. REG. BLOCK	2
G691941	120 DEG -6 FITTING	FUEL LINES - END OF FUEL FILTER	1



Part #	Description	Remarks	Qty
580627	ROUND FUEL CELL GASKET		1
680800	-8 STRAIGHT FITTING	BOTTOM LEFT COOLANT TANK	1
691903	90 DEG -6 FITTING	FUEL/WATER LINES (SEE LINE INFO)	5
691921	-6 45 DEGREE FITTING	FUEL/WATER LINES (SEE LINE INFO)	4
G691943	4 X 6 X 6 TEE	COOLANT LINES	1
G691945	-12 30 DEG PUCH ON ALUM	OIL BREATHER LINE TO CATCH BOTTLE	2
G730001	CLUTCH LINE MTG PLATE	HOLD CLUTCH LINES TO TRANS	1
G90500A	EFI HARNESS ASSY		1
G90501	DASH HARNESS		1
G90502	FAN HARNESS		1
G980476	TOGGLE SWITCH	DASH	2
G980480	DASH LIGHT - GREEN	DASH	1
G980480B	DASH LIGHT - BLUE	DASH	1
G980495	OEM GM PSI SENSOR FUEL/OIL	GOES IN FUEL PRES. REG. BLOCK	1
G991818	GROUNGING LUG #6 X 5/16	GROUND CABLES (4)/STARTER CABLE (1)	5
G992012	PE3 SERIES ECU		1
WM1010174	5M X 20 SOCKET HEAD	FUEL PRES REG TO ADAP BLK	3
WM1010323A	-12 OIL HOSE PER INCH	OIL LINE BREATHER	19
WM1010376	-3 STRAIGHT BULKHEAD	CLUTCH LINE - CHASSIS CLUTCH LINE TO PLATE	1
WM802008	-3 TO -3 UNION	SLAVE SYL. BODY (MAY NEED SEALING WASHER) (LOCK TIGHT)	2
	SHIFTER LINKAGE DIAGRAM	SHIFTER	1
	DASH TEMPLATE DIAGRAM	DASH	1
G462800	HEADER TANK	OPTIONAL (EXTRA CHARGE)	1
G392547	BENT SHIFT SHAFT	OPTIONAL (EXTRA CHARGE)	1
G992013	SERIAL DATA CONVERTER	OPTIONAL (EXTRA CHARGE)	1
180512A	FIRE BOTTLE BRKT	OPTIONAL (CAN BE MOVED TO RIGHT SIDE OF CAR)	1
G592301	G3 THROTTLE CABLE	OPTIONAL (EXTRA CHARGE)	1
G591916	FUEL FILLER TUBE	OPTIONAL (EXTRA CHARGE)	1
G1190501	CHASSIS HARNESS	OPTIONAL (EXTRA CHARGE)	1
G1190502	G3 BATTERY CABLES	OPTIONAL (EXTRA CHARGE)	1
G112013	DATA CONNECTOR	OPTIONAL (EXTRA CHARGE)	1
G1151001	GAUGE KIT	OPTIONAL (EXTRA CHARGE)	1
1150002	IN TANK FUEL PUMP KIT	REQUIRED FOR 1.6 IF NOT PREVIOUSLY INSTALLED	1
902127	ALTERNATOR	REQUIRED FOR 1.6 IF NOT PREVIOUSLY INSTALLED	1

Part #	Description	Remarks	Qty
580627	ROUND FUEL CELL GASKET		1
680800	-8 STRAIGHT FITTING	BOTTOM LEFT COOLANT TANK	1
691903	90 DEG -6 FITTING	FUEL/WATER LINES (SEE LINE INFO)	5
691921	-6 45 DEGREE FITTING	FUEL/WATER LINES (SEE LINE INFO)	4
902127A	ALTERNATOR PIGTAIL	REQUIRED FOR 1.6 IF NOT PREVIOUSLY INSTALLED	1
G1192127	ALTERNATOR KIT	REQUIRED FOR 1.6 IF NOT PREVIOUSLY INSTALLED	1
<b>Parts List B</b>			
1001105	NYLOCK M12 X 1.75	SHIFTER BOLT	1
1090031	BOLT M12 X 1.75 X 90	SHIFTER JOINT TO TRANS	1
G1000256	8M FLAT WASHER LARGE OD	ALTERNATOR ADJUSTOR	1
G1010005	8 X 1.25 X 16 RED HD FLG BOLT	ALT. ADJ. BRKT.	1
G1010008	10 X 1.5 X 25 RED HD FLG BOLT	ADAPTOR PLATE TO GEAR BOX UNDER OIL PAN	2
G1010010	10 X 1.5 X 45 RED HD FLG BOLT	GEAR BOX TO ENGINE PLATE	4
G1010055	10 X 1.5 X 50 RED HD FLG BOLT	HEAD MOUNT TO HEAD	2
G1139301	HEAD ENGINE MOUNT RH	WITH G1010055	1
G393474A	FISHMOUTH ADP.	FOR BENT SHIFT SHAFT - 1"	1
G592230	AIRBOX KIT		1
G691801	OUTLET HOSE LEFT SIDE		1
G691802	INLET HOSE RIGHT SIDE		1
G800010	10 MM GEAR WRENCH	TO INSTALL INTAKE FASTENERS	1
G800013	13 MM FLEX SOCKET	INSTALL HEAD MOUNT BOLTS - G1010055 TO G1139301	1
G902130	G3 ALTERNATOR PULLEY		1
G991412	ALTERNATOR BELT		1
G992014	DOWNLOAD CABLE		1
WM1010117	3/8 AN WASHER 063	GOES WITH WM1010185	1
WM1010185	10M X 35 SOCKET HEAD	+ 1 WM1010206 + WM1010117 - eng plate to gear box above axle	1
WM1010206	10M HIGH COLLAR LOCK WASHER	USED WITH WM1010185	1
	FORD RACING STICKERS	Mandatory Nose / Both sides of the Tail	3

## APPENDIX C – ENGINE SHIPPING CHECKLIST

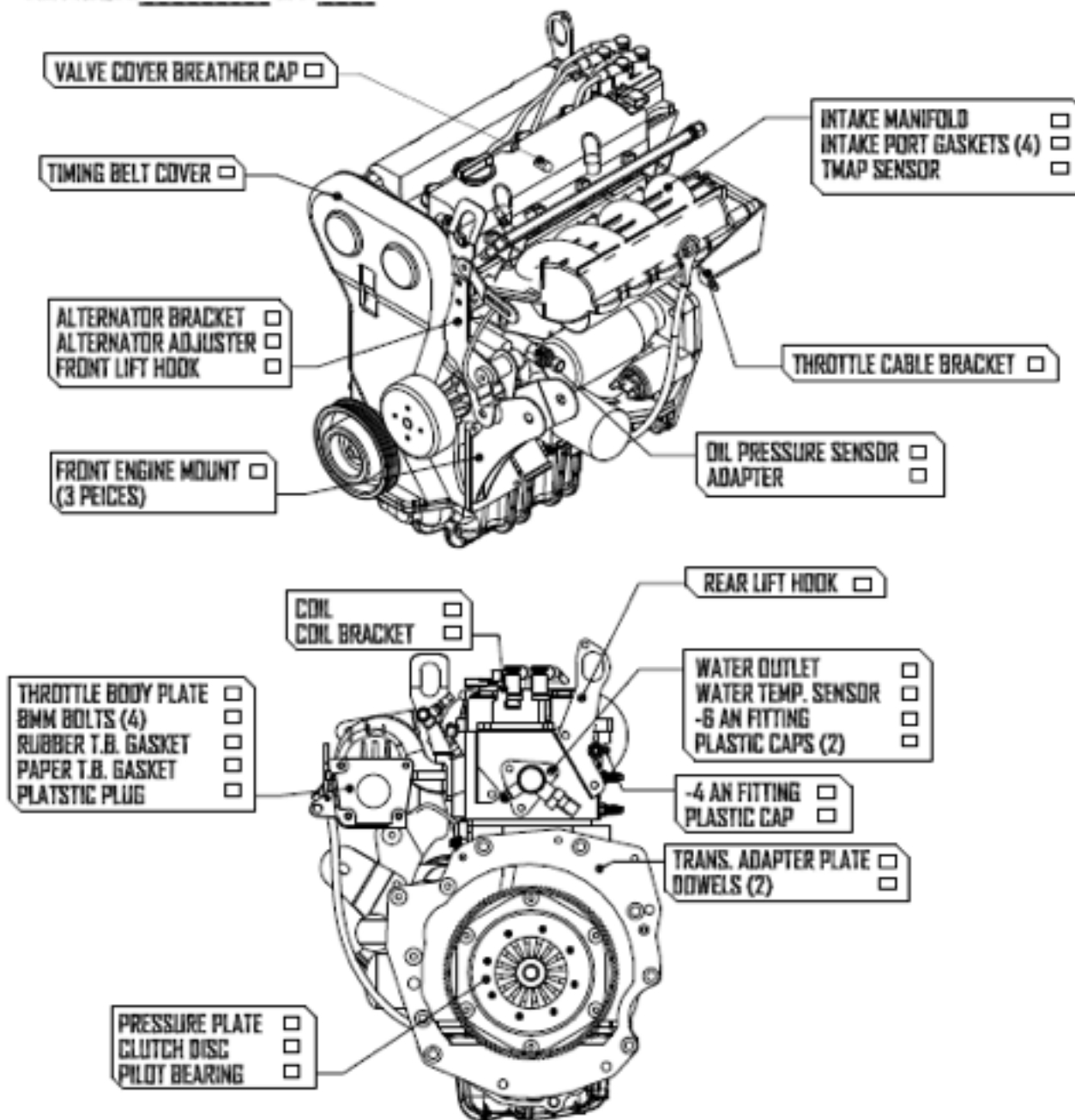
### Gen 3 ENGINE SHIPPING CHECKLIST

ENGINE NUMBER: \_\_\_\_\_

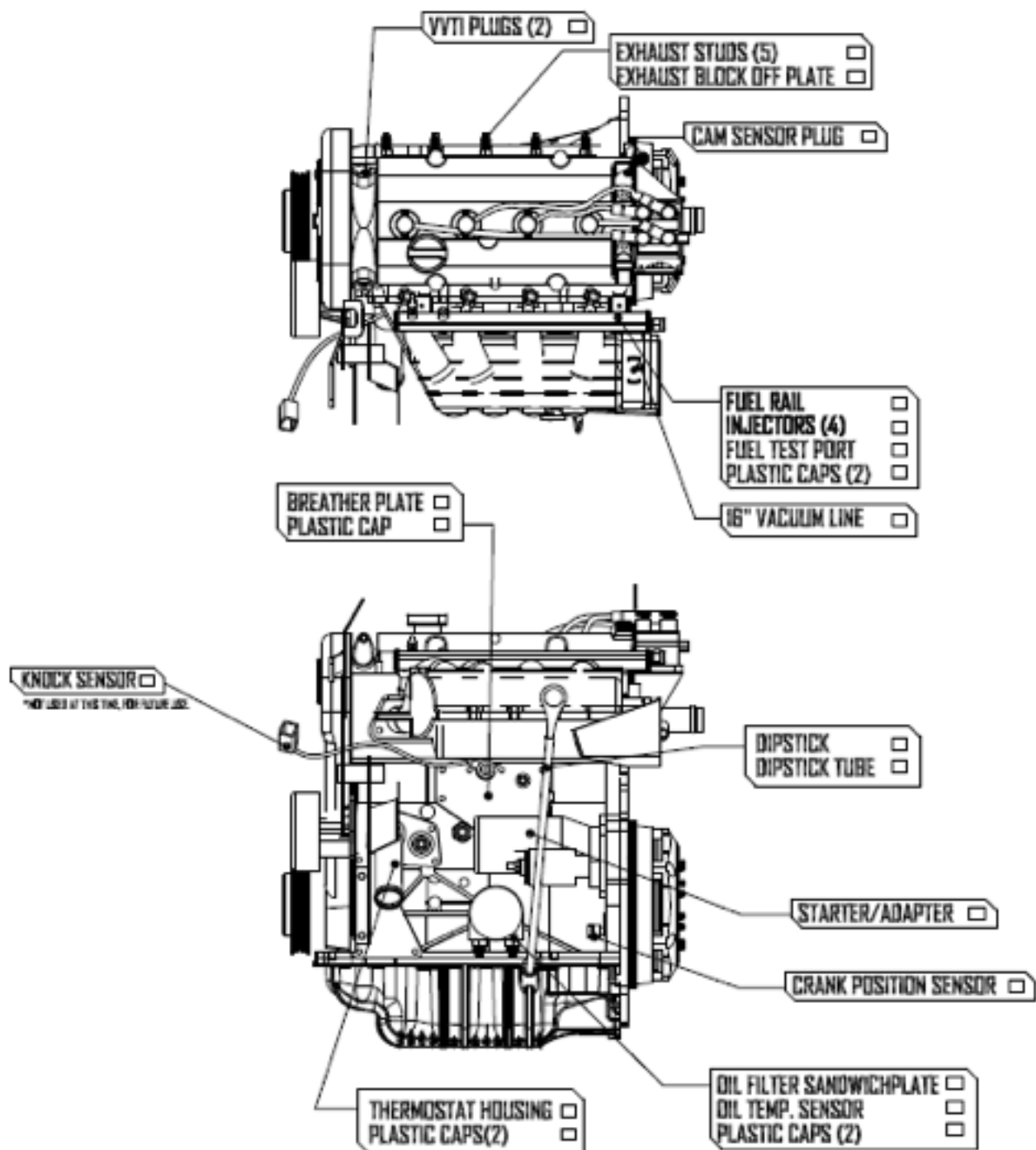
DATE: \_\_\_\_\_ BY: \_\_\_\_\_

SHORT? \_\_\_\_\_

REVISION: \_\_\_\_\_ BY: \_\_\_\_\_



# **Gen 3** ENGINE SHIPPING CHECKLIST



PAGE 2

## APPENDIX D – IMPORTANT ITEMS TO REMEMBER

### Pumping Out the Fuel Cell

To pump out the cell simply remove a fuel line from filter inlet, routing to a fuel jug, and hold the button down. It can also be used to purge the fuel system after the car has been in storage or if you have worked on the fuel system. The new switch can be tie-wrapped with the relays in a similar manner as the 1.9 L.

### Warming the Engine

1.6 L are assembled with (.0008 / .0015”) close bearing clearances, to prevent bearing scuffing engine should be warmed before track sessions

**When engine is not running, turn off Master!**

**Keep the Master in the OFF position ANYTIME the car is not going to be started for more than a few minutes.** It **will** drain the battery in a very short period! The new ECU has a higher nominal current draw versus the 1.9 L version.

### Break-in Motor Oil

Use a name-brand name non-synthetic oil until leak-down numbers stop improving -- approximately 10 to 30 hours

### Motor Oil Level

The engine uses a full length and width baffle between the oil sump and the crankshaft. We recommend running the oil level @ **full mark** to help minimize oil starving in very abrupt G loads. We've seen no adverse side effects to the higher level.

***IF YOU LOSE THE ALTERNATOR BELT ENGINE DAMAGE WILL OCCUR! It will be a matter of seconds before over heating occurs if the water pump stops turning.***



***THE ACTION OF THE CLUTCH IS VERY QUICK TO ENGAUGE*** and much less forgiving in action than the OEM unit we use in the 1.9 L. Be very careful with the clutch action your first couple uses.

## APPENDIX E – GEN3 LINE LIST

Approximate lengths and fitting information for fuel, water, and oil lines

### GEN3 fuel lines (-6 Lines)

20" 45 / 45	Fuel out of the cell (45) to the filter body (45)
29" 90 / 120	Filter (120) to the #1 injector end of the injector rail (90)
13" 90 / 45	#4 injector end of the rail (45) to PSI reg body inlet (90)
16" 90 / 90	PSI reg outlet (90) to cell return (90)

### GEN3 Water By Pass Lines (mix of -4 & -6 Lines)

10" 0 / 0	Head (-4) to Tee (-4)
17" 0 / 0	Tee (-6) to Filler tank (-6)
6" 90 / 0	Head Water outlet (-6 90) to Tee (-6)
7" 45 / 0	Drain Hose from main water return hose (-6) on thermostat plate
33" 90 / 0	Tank (-8) to lower Rad house adaptor (-8 90)

-4 male X 1/4" pipe male at the head and water outlet

-4X-6X-6 Tee at the roll bar connects all 3 lines

-6 male is welded to coolant filler tank

-6 male welded Main water return hose on thermostat plate (for drain)

-8 male lower left side coolant filler tank -8 male on lower Rad hose adaptor plate

### GEN3 Oil Lines (-8 Lines)

34" 120 / 90	Block adaptor (120) to Oil cooler (90)
41" 120 / 90	Block adaptor (120) to Oil cooler (90)

-8 male X 3/8" male pipe    Block adaptor

-8 male X 1/2" male pipe      Oil cooler

## **APPENDIX G – POWER DISTRIBUTION HARNESS**

### **Dash connections**

18 ga Pink with #8 eyelet	12V to IGN switch from Fuse panel	10 amp
18 ga L Blue W #8 eyelet	12V to Rain light switch from Fuse panel	10 amp
18 ga Green W #8 eyelet	12V to Rain light from rain light switch	
18 ga L Blue W.250" spade	12V to Brake light switch from Fuse panel	
18 ga Grey W.250"spade	12V to Brake light from brake light switch	
18 ga D Blue W female bullet	12V to Alternator charge light from fuse panel	5 amp
18 ga Brown W female bullet	Charge bulb to alternator "T" plug	
12 ga Red W #10 eyelet	12V to starter switch from master switch	not fused
12 ga D Blue W #10 eyelet	12V to starter solenoid from starter switch	
12 ga Black W 5/16"eyelet	Main ground to battery ground lug on frame	

### **Female Molex 2 way**

18 ga Pink W black	12V from fuse panel for data system	5 amp
18 ga Black	Ground to main ground eyelet for data system	

### **Master switch / Starter**

12 ga Red together	Switched side of the master switch to fuse panel
18 ga Yellow W 3/8" eyelet	Switched side of the master switch to Alternator plug
12 ga Green W 3/8" eyelet	Un-switched side of the master switch to Alternator
12 ga Green W 1/4" eyelet	Alternator output stud to Master switch

### **Alternator T connector**

Top of the Tee Red or Yellow	Voltage sensing from un-switched side of master switch
Leg of the Tee Black or Brown	Field charge from the dash charge light
12 ga D Blue	Starter Solenoid from starter switch

### **Brake light connector**

White	White splice to black to chassis ground eyelet
Red	Red splice to grey to brake light switch

Black

Black splice to green to rain light switch

