INSTALLATION INSTRUCTIONS FOR 500HP EFI STAGE 1 AND 2

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A color PDF of this manual is available, email tech@whipplesuperchargers.com for a copy

PREMIUM FUEL ONLY (91 OCTANE OR BETTER ALWAYS) RON+MON/2

Version A1R11
Last Updated June 28th, 2016

MUST KNOW INFORMATION!!
-EVERYBODY READ!!-

WATER FLOW – WATER FLOW – WATER FLOW

As of May 2002, Mercury Racing issued a service bulletin (attached to instructions) regarding engine water block pressure. In this bulletin, it's clear that Mercury Racing requires a minimum of 20-30lbs. of engine water pressure at wide-open throttle (WOT). If this pressure is not achieved or not maintained, you can have catastrophic engine failure of many types.

This leads us to your new supercharged engine. You're no longer running a thermostat in the engine, which was the largest water restriction in the stock system. Now, the largest restriction is the engine itself, this means pressure is only increased by flow in this given application. Because you are taking your stock engine and increasing the cylinder pressure for more peak power, to insure reliability, you need **more** water to keep the engine cool and at the same time, you need **more** water pressure to keep steam pockets from developing in your engine. With this in mind, you want a minimum of 25psi of block pressure @ WOT, maximum 35psi @ WOT. If you do not have this pressure, you may hurt your engine.

Whipple Superchargers has provided a stainless restrictor for the thermostat housing that will restrict the flow like a thermostat, but pressure still must be checked, as this may be too much restriction (ideally) or not enough (means you need more WATER). With this information in mind, you must understand, you must have more flow as well as pressure, if you restrict the outlet water too much and don't have proper flow, you will heat the engine up, still develop steam pockets and it could lead to engine failure.

- Ideally, the intercooler should be fed from a separate source. The intercooler does not need constant water flow at slow speeds. This means a separate pickup can be installed solely for the intercooler.
- You can run the intercooler off the drive side draft inlets, but never the engine.
- Mercury dual style water pickups do not let more water in, in fact, they have less water flow. Always block off the side draft inlets if your boat uses them on this dual style drives.
- Never run the engine off side draft inlets in the drive, never!
- If you have a stepped bottom or high "X" dimension, water flow may be very low at high speeds and caution must be taken.
- Test block pressure at various trim angles and in turns.
- Lower boost and or timing does not mean you're safer with less water, if steam develops, the engine will fail regardless, it needs pressure to push the steam out.

WATER FLOW – WATER FLOW – WATER FLOW

WHIPPLE CHARGER INSTALLATION INSTRUCTIONS FOR 500HP EFI STAGE 1 and 2

This product is intended for use on STOCK, UNMODIFIED, **WELL-MAINTAINED ENGINES.** Installation on a worn-out engine is not recommended and could result in failure of the engine or the supercharger. It is recommended to perform a compression test of all cylinders, and perform a cylinder pressure leak down procedure, check and change spark plugs, spark plug wires, distributor cap, and rotor if necessary. This will indicate the condition of the engine for reference. Whipple also recommends accurate fuel pressure and water block pressure gauges for constant monitoring during operation.

It is the purchaser's responsibility to follow all installation instruction guidelines and safety procedures supplied with the product as it is received by the purchaser to determine the compatibility of the product with the vessel or the device the purchaser intends to install the product on.

Whipple Supercharger assumes no responsibility for damages occurring from accident, misuse, abuse, improper installation, improper operation, lack of reasonable care, or all previously stated reasons resulting from incompatibility with other manufacturers' products.

***NOTICE: Installation of Whipple Supercharger products signifies that you have read this document and have agreed to the terms stated within.*

It is the purchaser's responsibility to follow all installation instruction guidelines and safety procedures supplied with the product as it is received by the purchaser to determine the compatibility of the product with the vessel or the device the purchaser intends to install the product on.

Whipple Supercharger assumes no responsibility for damages occurring from accident, misuse, abuse, improper installation, improper operation, lack of reasonable care, or all previously stated reasons resulting from incompatibility with other manufacturers' products.

There are no warranties expressed, implied, for merchantability or fitness for engine failure, parts failure, any type of damage to vessel in any way, or reimbursement for labor or inconvenience.

WARNING!! CONSTANT ABUSE OF THE REV LIMITER WILL CAUSE SEVERE ENGINE FAILURE!!

YOU MUST SEND YOUR ECU IN FOR REPROGRAMMING TO WORK WITH THE WHIPPLE SUPERCHARGER SYSTEM. ACCOMPANY EACH COMPUTER WITH NAME, SHIPPING INFORMATION, CONTACT INFO, BOAT INFO AND IF ANY MODIFICATIONS HAVE BEEN MADE TO THE ENGINE. WHIPPLE WILL PAY FOR STANDARD GROUND FREIGHT IN THE CONTINETAL U.S. IF YOU WANT FASTER SERVICE OR SHIPPING FROM FROM OUTSIDE THE CONTINENTAL U.S., PROVIDE PAYMENT INFORMATION FOR FREIGHT. SEND FACTORY ECU TO:

Ship to:
WHIPPLE SUPERCHARGERS
ATTENTION: MARINE ECU RECAL DEPARTMENT
3292 N. WEBER
FRESNO, CA 93722
559.442.1261

For best performance and continued reliability, the following are **MANDATORY.**

1. USE ONLY PREMIUM GRADE FUEL (91 OCTANE OR BETTER). NEVER USE LOWER OCTANE.
2. ALWAYS LISTEN FOR ANY SIGN OF ENGINE KNOCKING, IF PRESENT DISCONTINUE USE IMMEDIATELY.
3. DO NOT OPERATE ENGINE IN BOOST IF THE FUEL PRESSRUE IS BELOW THE PRESSURE SPECIFIED BY WHIPPLE INDUSTRIES.
4. NEVER CHANGE THE WHIPPLE COMPUTER CALIBRATION PROGRAM (ENGINE RUN FUEL, IGNITION TIMING OR THE RPM LIMITER, NOTHING!) THIS COMPLETE SUPERCHARGER SYSTEM IS DESIGNED AND ENGINEERED TO MAXIMUM PERFORMANCE FROM THE WHIPPLE CALIBRATION. ANY MODIFICATIONS TO PROGRAM MAY CAUSE SERIOUS DAMAGE TO THE ENGINE.

WARNING! The most important precaution you must take with the WHIPPLE CHARGER is cleanliness. This supercharger is a high quality, close tolerance compressor that cannot be subjected to dirt or any type of foreign material. Foreign material entering the supercharger will automatically void all warranties. DO NOT remove the protective seal on the supercharger prior to installation.

GENERAL INFORMATION

This system requires a major fuel system modification. Use extreme caution around the high flammable fuel and fuel vapors.

Always wear appropriate safety goggles and gloves when required.

Always use caution around flammable liquids. ☠

Always use anti-seize on bolt threads when installing stainless steel bolts into aluminum threads.

Run the engine before beginning installation of the kit until the fuel level is as close as possible to empty. Make sure that fuel tank does not have old gasoline and contains only fuel that is 91 octane or better before installing supercharger kit. If the octane of the fuel in the tank is old or unknown, **drain the tank until empty and fill with 91-octane premium fuel or higher**.

You will be required to disconnect a few wiring connectors. It may be helpful to tag the wires for future reference.

RECOMMENDED PREPERATION FOR INSTALL

It's mandatory that you replace the factory spark plugs, making sure to gap to .032 - .035. Whipple recommends NGK R5673-A8. You should also change the rotor, cap and spark plug wires. This will insure no ignition related problems.

TOOLS RECOMMENDED

The following tools are required to complete the installation of this supercharger kit. Metric socket set, standard socket set, screwdrivers, torx head sockets, standard and metric end wrenches, standard and metric Allen wrenches, anti-seize for all stainless steel bolts, Loctite™, Teflon tape or thread sealant, electric or battery operated drill motor, various hole saws, electrical tape, wire crimpers or solder iron, 90 lb. fuel pressure gauge with line kit and a torque wrench.

EXTRA PARTS REQUIRED

This system requires a new fuel system, we have supplied you with the appropriate male fuel fittings but you will be required to manufacture some fuel lines. Whipple recommends high grade, USGC approved lines only. This system also requires a new intercooler pickup to be installed, a sea-strainer is recommended. Whipple cannot supply intercooler pickups due to the various boat designs. Consult the boat manufacture for the best location and style to produce as much water flow as possible. You must never run smaller than a 5/8" ID line to the intercooler. If running a strainer, you should run a larger line to the strainer, as this will be a restriction. Max PSI in the intercooler is 50psi which will be very difficult to reach with Whipple designed inlet fittings. You do not want to run the intercooler tee'd off the sea pump line, this will rob water from the engine and will lower overall reliability.

SYSTEM PERFORMANCE INFORMATION

A Mercruiser scanner is an electronic tool used to display various engine parameters. This scanner can be installed and monitor all engine parameters while the boat is being operated. Some of these are items are: RPM, TPS volts, KNOCK RETARD, COOLANT temp, IAC counts, and any TROUBLE CODES. You can also put the engine in the set timing mode. You can purchase this scanner from Rinda Technologies, for more information, go to www.rinda.com or (773) 736-6633.

1. Idle speed system check - After the engine is at normal operating temperature (100deg. F), the engine will idle at 750 - 825 RPM, out of gear. To check the idle speed system, TPS voltage must be checked and set between .48-50v. You can use a MerCruiser scanner or a voltmeter. The blue wire is your signal wire, the TPS is a 5v sensor. The ECU is controlling idle mainly by spark advance, you can only monitor spark advance with a scan tool, it will move around dramatically to keep the engine running. Without a scan tool, monitor the engine rpm. The motor should never die when shifting or decelerating, if it does, it will need more air through the throttle blades. Open the throttle stop to increase the air flow at idle. Make sure to test in the lake, in gear, rpm should only drop slightly while in gear. If it falls below 650, it needs more air to idle properly in gear. *Note: The engine must be turned off for 5 seconds and re-started to properly reset the learning of the IAC system.*

IDLE AIR CONTROL (IAC) VALVE

The purpose of the IAC valve assembly is to control engine idle speed, while preventing stalls due to changes in engine load. The IAC valve, mounted on the throttle body, controls bypass air around the throttle valves.

72800

Moving a pintle IN, toward the seat (to decrease air flow), or OUT, away from the seat (to increase air flow), controls the amount of air moving around the throttle valve. If rpm is too low, more air is bypassed around the throttle valve to increase it. If rpm is too high, less air is bypassed around the throttle valve to decrease it.

The ECM moves the IAC valve in small steps, called counts. These can be measured by scan tool test equipment, which plugs into the DLC connector.

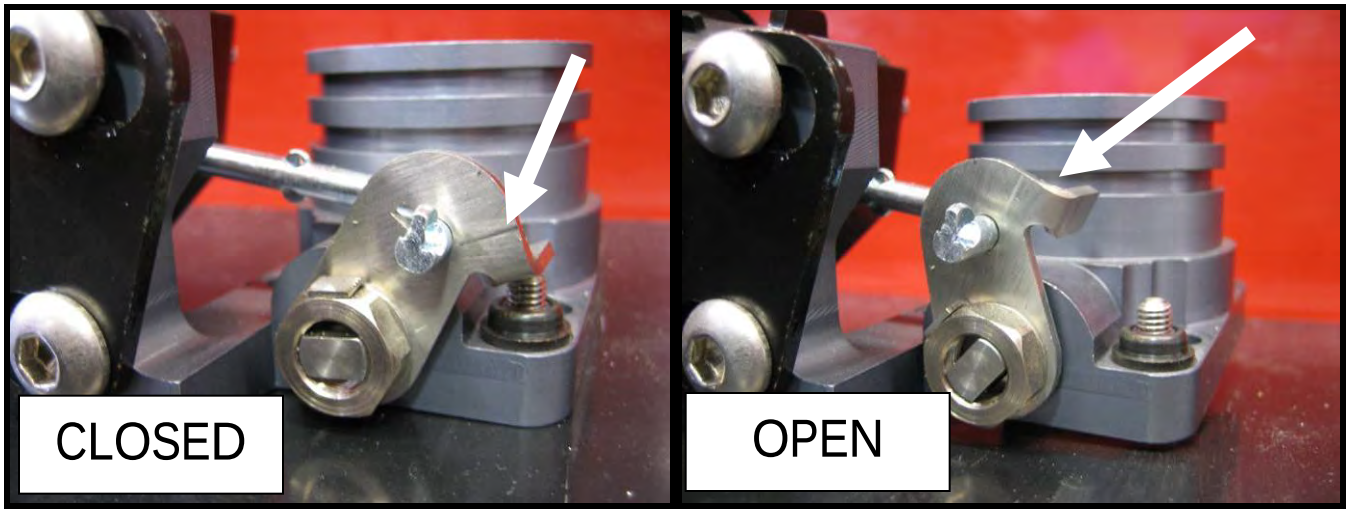
During idle, the proper position of the IAC valve is engine load, and engine rpm. If the rpm drops below specification and the throttle valve is closed, the ECM senses a near stall condition and calculates a new valve position to prevent stalling.

- Engine idle speed is a function of total air flow into the engine based on IAC valve pintle position.
- "Controlled" idle speed is programmed into the ECM, which determines the correct IAC valve pintle position to maintain the desired idle speed for all engine operating conditions and loads.
- The minimum idle air rate is set at the factory with stop screws. This setting allows enough air flow by the throttle valves to cause the IAC valve pintle to be positioned a calibrated number of steps (counts) from the seat during "controlled" idle operation.
- If the IAC valve is disconnected and reconnected with the engine running, the idle speed may be wrong. In this case, the IAC valve can be reset by doing the following: Turn off engine, wait ten seconds, and restart engine.

2. Check cooling system water pressure. The cooling system must be able to operate efficiently. Optimal performance will be gained if an external pick-up is installed for the Whipple Intercooler water. To check the performance of your cooling system, install a 0-50psi. pressure gauge on the water drain plug located on the bottom center of the block. The idle pressure may read 0-3psi. and full speed/RPM may read over 30psi. The minimum pressure allowed, for proper engine cooling, is 25psi at WOT. 35psi should be the maximum, if exceeded, you will have to minimize the restriction or reduce the flow to the engine. The reading should be obtained at high speed and high RPM. If the pressure is lower, another water pickup must be installed. Consult with Whipple Industries or your boat mfg. for recommendations. The Whipple intercooler will take water away from the engine if the water is teed from the stock system, so block pressure must be checked before and after.

3. Supercharger By-pass system. The supercharger is installed with a by-pass system. This allows the supercharger to operate at higher efficiency under vacuum operation. It is advised to verify the operation of the bypass valve. At idle and low engine loads, the bypass will be open. At higher loads (engine in boost) the bypass will be closed. As the throttle is opened quickly the bypass valve will close momentarily. This verifies the bypass will close and is functioning.

Actuator failure could lead to intercooler fires, poor performance and erratic idle. If the actuator fails, it could have an air leak which will result in poor idle qualities. A failed actuator will also allow the bypass to open it's internal butterfly during boost, which will circulate air and reduce airflow to the engine, consequently lowering the boost level and power.



COMMON ABREVIATIONS

ECT	Engine Coolant Temperature
IAT	Inlet Air Temperature
IAC	Idle Air Control
TPS	Throttle Position Sensor
MAP	Manifold Absolute Pressure
PCV	Positive Crankcase Ventilation
DEG	Degrees
KPA	Kilopascal
WOT	Wide Open Throttle
V	Volts
GND	Ground
ECM	Engine Control Module

STEP-BY-STEP INSTALLATION INSTRUCTIONS

1. Disconnect the battery power by selecting the disconnect mode on the battery switch or removing the ground cable from all batteries.

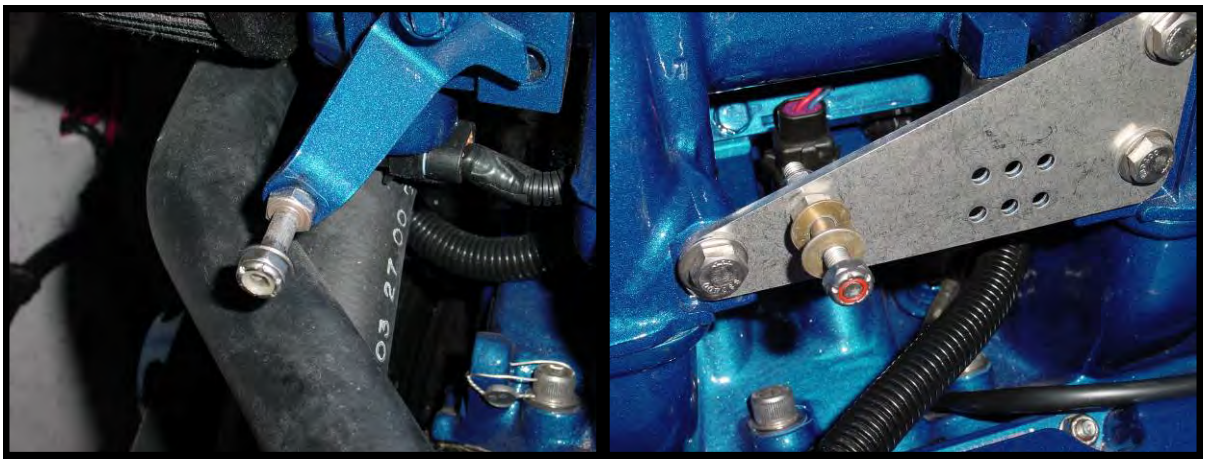
2. Loosen the stock adjustable idler nut to release tension of belt, remove the stock belt.

3. Remove the factory crank pulley and clean the front surface, the new SC crank pulley will mount to the surface of this later.

4. Wrap some masking tape around each electrical connector and mark each one to the corresponding sensor, this will allow for a simple installation later.

5. Unplug factory electrical plugs: Idle Air Control connector, Inlet Air Temp connector, both Engine Coolant Temp connectors, Manifold Absolute Pressure connector, both distributor connectors and electric fuel pump.

6. Remove stock throttle linkage, throttle body (throttle cable bolt and IAC motor) and air filter.



7. Remove PCV valve and convoluted tubing from intake manifold/valve covers.

8. Remove the distributor. **Note**: It helps to mark the position of the distributor before removal so it can be stabbed much closer to 8 degrees. You can take the distributor cap off, crank engine over until pointer faces directly forward.

9. Remove the entire stock fuel filter assembly.

10. Remove cool fuel assembly from the engine (pump/cooler).

11. Remove stock pickup brackets from intake.

12. Remove thermostat housing and all its connecting hoses.

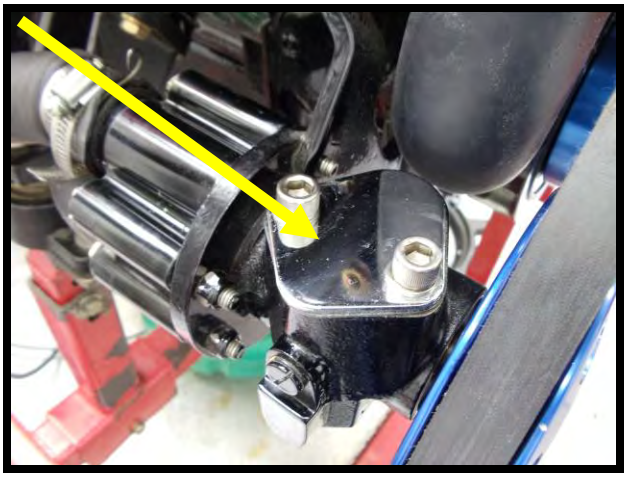
13. Remove entire intake manifold, both bottom and top assembly. Note: Must unplug all injector connectors before removing and pull away from fuel rail.

14. Push factory-wiring harness to backside of motor so it's out of the way.

15. Remove stock sensors from intake such as intake air temp sensor (located above #7 runner on intake) and 2 coolant temp senders (gauge and ECU).

16. Remove stock circulating water pump from block and all of it's connecting hoses.

17. Remove mechanical fuel pump from sea pump. Install chrome block off plate (and gasket) with supplied (2) – 3/8" x ¾" stainless allen bolts and AN washers.



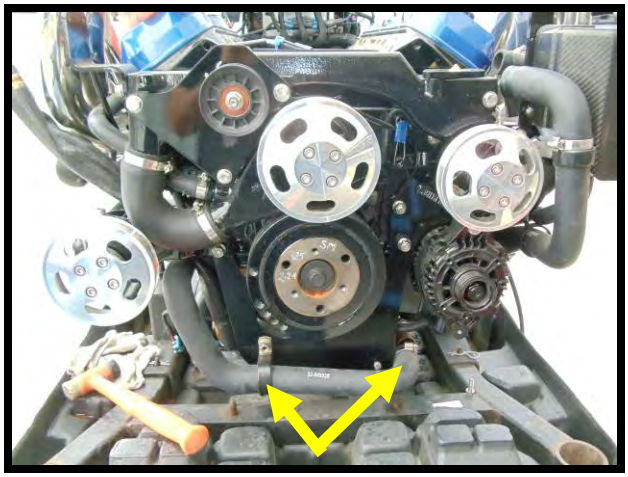
18. Remove stock adjustable idler support bracket from engine (this requires loosening of other brackets, reinstall them when done removing idler bracket).

19. Remove the factory fuel lines (3) from the fuel filter head.

FUEL IS UNDER PRESSURE!! Be very careful while removing the fuel rail bolts as fuel may be released under pressure. Prevent fuel spray by covering the injectors with a shop towel while the bolts are being loosened.

20. Remove the factory fuel filter head and element from engine by removing the (2) SHCS bolts.

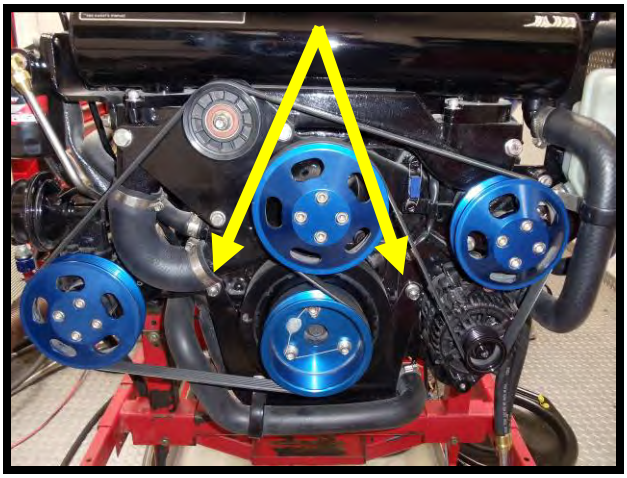
21. Remove the 1 ¼" water inlet hose to the cool fuel assembly by removing the hose clamp that secures it the fuel cooler. Also loosen the adel clamp holding the hose to the fuel pump assembly bracket.

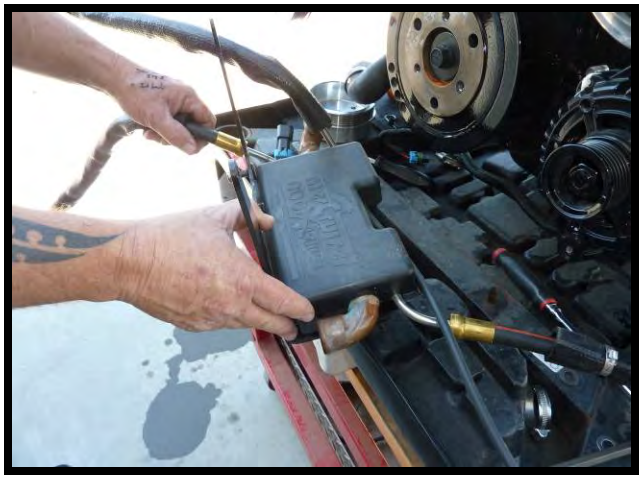


22. Remove the 1 ¼" water outlet hose from the cool fuel pump assembly by removing the hose clamp.

23. Remove the factory shift bracket from the header, this will be relocated later.

24. Remove the factory fuel pump assembly bracket from engine. To do this properly, remove the 1 ¼" water hose and drain the water from the cooling water. Remove the (2) nyloc nuts securing fuel pump assembly bracket (11mm socket).

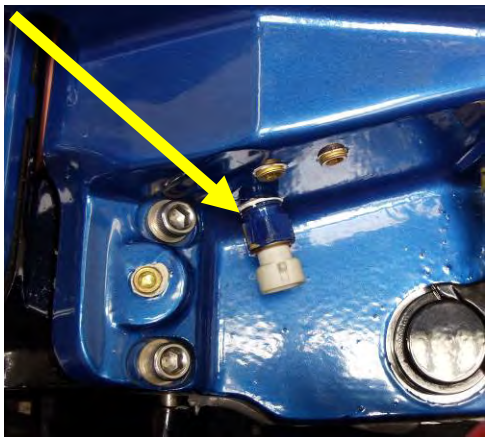




25. Remove cool fuel pump assembly from fuel pump bracket by removing the (4) bolts that secure it (7/16" socket).

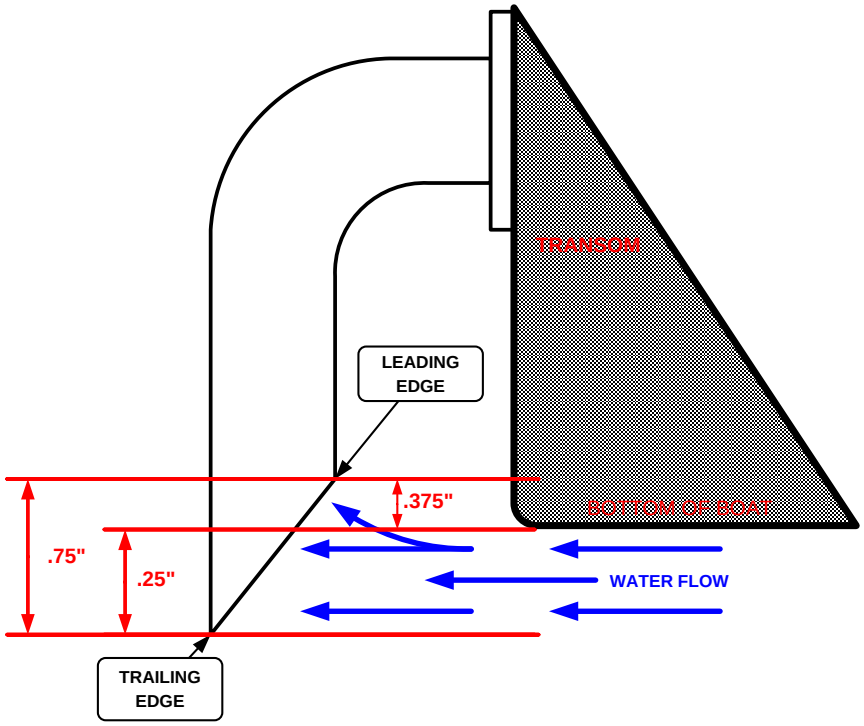
26. Install stock coolant temp sensors in new intake manifold and/or front of thermostat housing. Note: It does not matter which side. Note the 2-wire connector should have the tab horizontal with the engine to clear the support stand.

27. Install Inlet Air Temp sensor in the 3/8" NPT in the back side of intake manifold, apply light amount of pipe sealant.



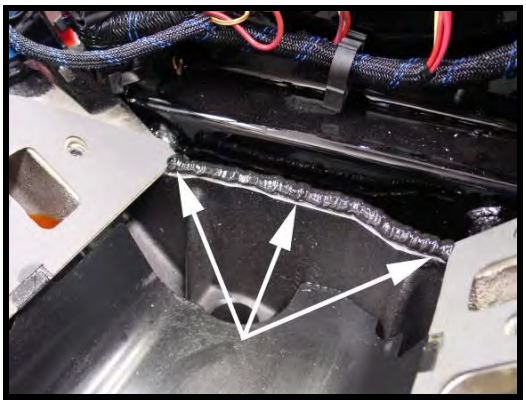
28. Intercooler and engine block water dump fittings: **DO NOT RESTRICT OUTLET!!!!**
    - ❑ Find visible location for both dumps above the water line. The ¼" block drains will drain at all times, including idle.
    - ❑ Mark your spots on the boat, and drill a hole using a hole saw. All systems include a -10AN transom dump for the steam relief dump (dual ¼" ID hoses). Stage 1 systems use a -12AN dump and Stage 2 uses the -16AN dump.
    - ❑ Apply marine type silicone to exposed wood and fiberglass as well as the back of thru hull fittings.
    - ❑ While holding thru-hull fitting (do not let it rotate) on outside of boat, install the supplied aluminum nut and tighten. Do the same for both thru-hull fittings.
    - ❑ Apply thread sealant to threads of supplied ¼" tee's male thread. Install tee fitting into thru-hull dump fitting that is tapped ¼" NPT. Install the 2 ¼" 90 degree barbed fittings (apply thread sealant) into female ends of tee fitting.
    - ❑ Once tightened, wipe the excess silicone off and let the silicone dry.

29. Find an accessible location on the transom of the boat, preferably 12"-24" past the centerline of the boat (v-bottom). Cat type boats should mount at the lowest point of one of the sponsons. In some cases, a bottom mount or an adjustable mount may be better suited, if this is the case, you will need to purchase this separately. Mark a spot for the stainless transom pickup. The pickup is made long so it can be cut to fit. You must cut an angle in the pickup. The forward lip should be higher than the bottom of the boat so it doesn't block water flow. The following diagram is an approximate guide, showing the maximum length (.75"). In some cases, you can be as high as flush if a small slot is made in the fiberglass to direct the water into the pickup. Consult with your boat MFG for suggestions and tips. **See following diagram as a guide**:



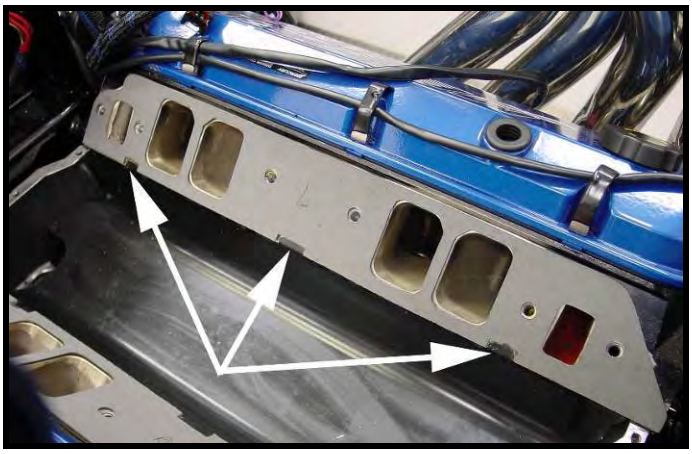
30. Clean intake manifold surface and apply new intake gaskets.

❑ Install 3/8” thick bead of black RTV silicone in the front and rear valley of the block as shown in **figure.**

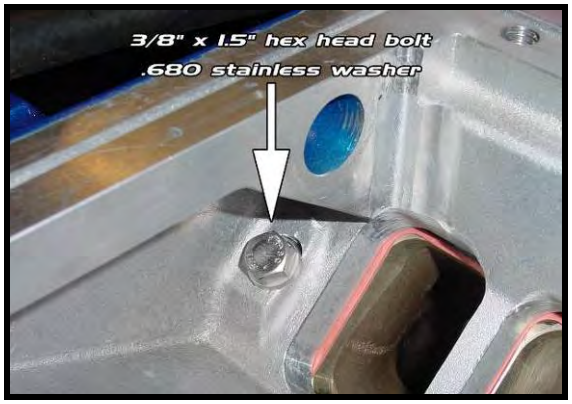


❑ ➲ **NOTE.** Apply a thick bead of black RTV silicone on the intake gaskets around the water passages to insure sealing around the water passages.

❑ Install gaskets to head. Make sure that the galley pan (which sits on heads) flanges clear the gasket, if not, notch around flanges as shown in **figure**.

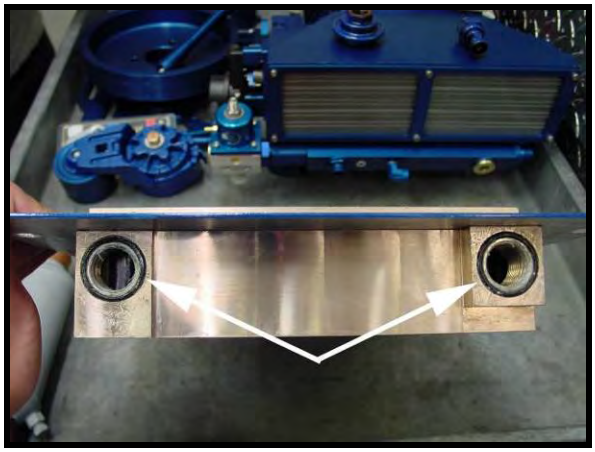


31. Install intake manifold using the (11) 3/8” x 1.5” stainless socket head allens and (1) 3/8” x 1.5” stainless hex head bolt. Also utilize the (12) .680” thick stainless washers. Utilize the hex bolt in the forward most bolt on the 2,4,6,8 side. **Note: Install all bolts hand tight and slide intake forward as much as possible, and then stab the distributor to make sure everything lines up. If it does, proceed, if it does not, you may have to file one of the openings, contact Whipple first. Torque bolts in two sequences, first sequence should be 25ft lbs. and the second sequence must be 35ft lbs.**



32. Install the supplied oring material around the intake manifold groove. Make sure you push it back and make it bunched up to allow some shrinkage later. Apply a light amount of grease or oil to oring.

33. Install the supplied black orings (stage 1 =2, stage 2 = 4) into the intercooler front face, apply marine type grease to hold orings in place while installing core and to help prevent ripping during installation.



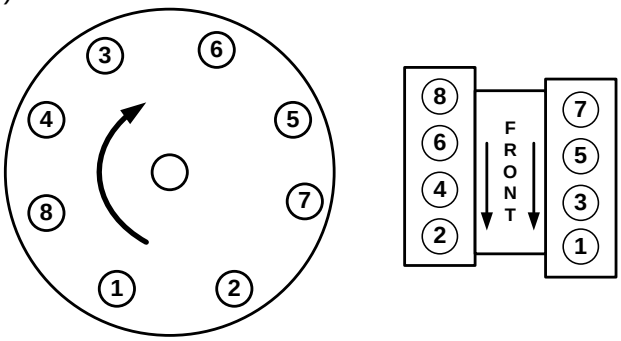
34. Place intercooler assembly into blower manifold.

35. Apply pipe teflon to threads of the –12 AN stainless fittings.

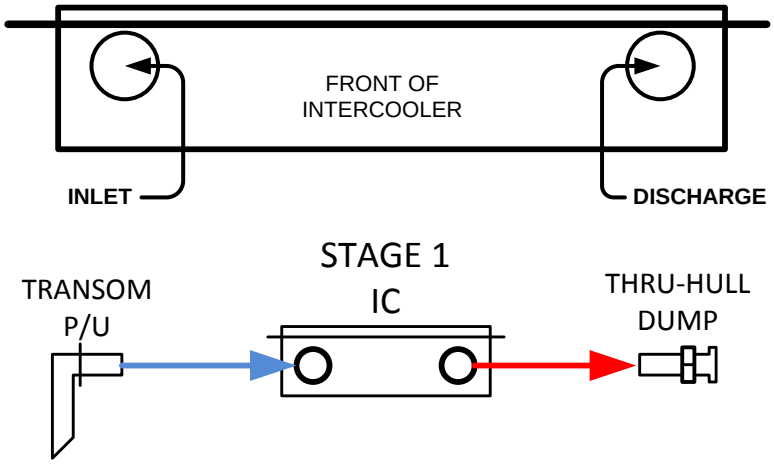
36. **Stage 1:** Install the (2) –12 AN stainless fittings into manifold/cooler. Tighten these evenly, do not tighten one all the way while the other is left uninstalled, this will not let the front of the core to seal against the intake evenly.

37. **Stage 2:** Install supplied oring to 1.375" thick MOAC spacer. Drop the spacer onto the intercooler core. Install the (2) –12 AN stainless fittings into the cooler hand tight. Do not tighten until after the SC assembly has been installed as the entire assembly must be slid forward together.

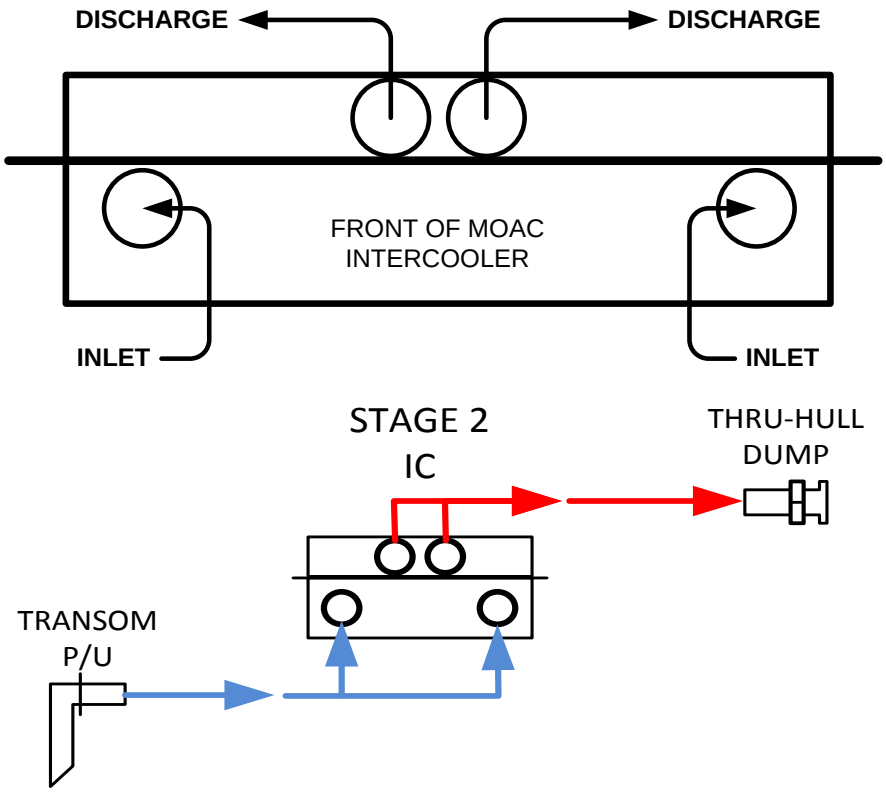
38. Reinstall the factory distributor with factory plug wires. (You may use MSD plug wires but always stick with a stock GM/Delco MARINE distributor).



39. (**Stage 1**) Before installing the front plate system, it is best to install the 90-degree push lock intercooler fittings now. Pre route intercooler hose, both from the pickup to the intercooler as well as from the intercooler to the dump fitting. One hose can come up towards the bottom front of the clear coolant reservoir and route along the factory cooling lines. This will keep the installation clean.

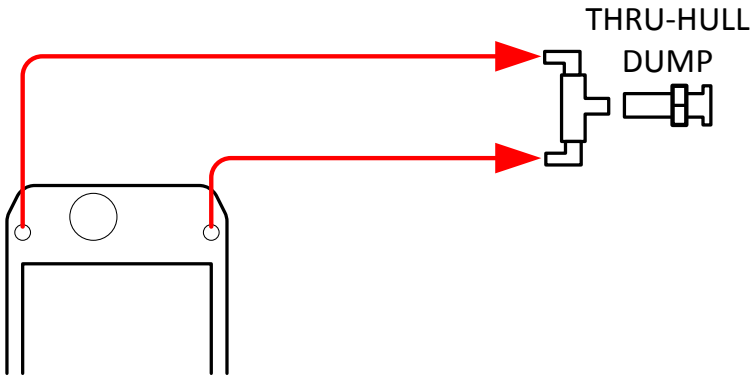


- ❑ **(Stage 2)** systems can now install the -16AN log fitting. The long log fitting (IN) goes to the bottom fittings and can face starboard or port. The short fitting (OUT) goes to the top fittings and can face starboard or port.
- ❑ **(Stage 2)** systems must supply and manufacture the in and out hose for the -16AN fittings. You can use steel braided or rubber hose. You can also use a 2 stage water pump, but never TEE FROM YOUR FACTORY LINE, the intercooler will rob far too much water.



40. Make sure the intercooler lines do not interfere with anything, can rub anything sharp or be in contact with something hot such as the headers.

41. (Steam relief hose routing) Install ¼" ID hose from each ¼" barbed hose on the rear of the intake manifold and route to ¼" 90° barbed fittings installed in tee/thru-hull fitting you installed earlier. Secure hose with #4 hose clamps.



42. Install new thermostat housing with the supplied 3/8" x ¾" socket head allen bolts and new thermostat gasket. Install supplied 5/8" stainless restrictor. This fits into the thermostat receiver groove located on the intake manifold. The flat side should go against the manifold while the extra material side should face the thermostat housing. **NOTE:** Do not install a thermostat without consulting Whipple; this system is made to run without a thermostat. 120deg thermostats can be used in cold climates, but require 3 3/16" holes drilled in flange for water psi relief. There are 2 extra bolt holes for different thermostat housings. Install the supplied (2) 3/8" x ¾" socket head allen bolts into these holes, apply light amount of pipe sealant to threads.

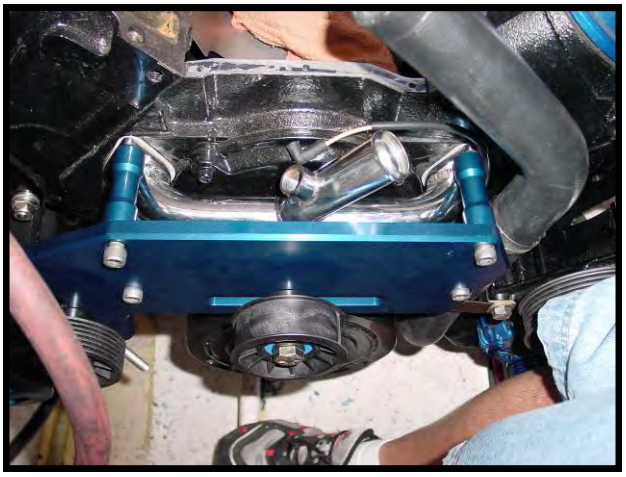
43. Wiring Instructions:

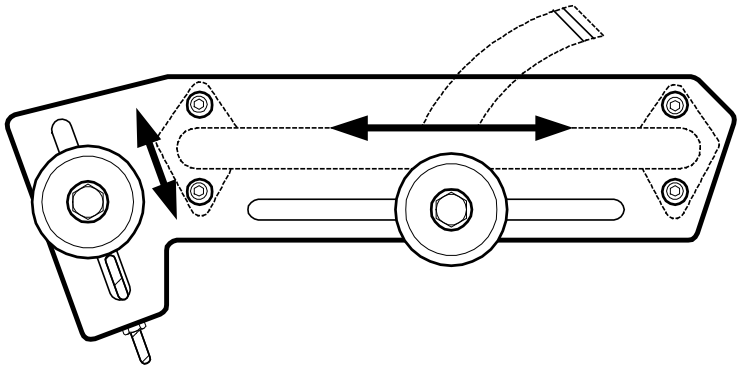
- ❑ Locate the 3-pin injector pigtail pre-installed to the throttle body. Cut the electric tape on the split loom and pull the wires back towards the rear of the motor for the new injector location.
- ❑ Trace the injector wires back until you reach the main solder junctions. There is a total of 3 wires for the injectors that are all soldered together. If you cut them at the solder point, you can use the Whipple supplied injector pigtail harness. Connect the blue pigtail wire to the factory blue wire (J1-1) using the supplied heat shrink butt connector. Connect the green pigtail wire to the factory green (J1-17) using the supplied heat shrink butt connector. Connect the black pigtail wire to the factory red wire using the supplied heat shrink butt connectors. Use heat gun to shrink connectors for proper weather sealing.
- ❑ Install factory connector to Inlet Air Temp sensor on back side of intake manifold.
- ❑ Connect brown engine coolant temp sensor wire for gauge (extend if necessary).
- ❑ Connect factory engine coolant temp sensor to sensor in front of intake manifold.
- ❑ Find the factory map sensor connector and plug in the wiring extension (female black 3 way and orange male 3 way). Route extension towards the front of the engine.

44. Make sure the mounting surface of the new crank pulley on the front of the balancer is perfectly flat. If necessary, remove the imperfections or paint with a good flat file.

- ❑ Install the Whipple crank pulley into the factory crank pulley and install to balancer using the 3/8" x 3" hex head bolts. Each bolt should get 1 AN flat washer (goes against crank pulley) and lock washer. Apply a small amount of Red Loctite™ on threads to new longer crank pulley bolts and torque to 35 foot-pounds.

45. Stainless water cross-over system:
    - ❑ Install stainless water cross over with new gaskets, this requires you to install the new billet belt system at the same time. Use the 2 aluminum U-shaped spacers that fit against the water cross over and through the new plate, use the 4 – 3/8" x 3.5" socket head allens and washers to secure.





46. Remote mount the IAC adapter:
    - ❑ Install the IAC manifold in place of the Merthacode bracket, or on top of it by spacing up.
    - ❑ Install IAC motor to IAC manifold.
    - ❑ Install the supplied -8 AN push lock fittings supplied to the 5/8" ID rubber cloth hose (cut to fit if needed).
    - ❑ Route -8 line from the IAC manifold to the starboard side fitting on the throttle body.

47. Supercharger assembly install:
    - ❑ Install supplied oring to bottom side of supercharger adapter plate. Apply light amount of grease to oring material and bunch up as tight as possible. Cut to fit and make sure you cut very straight, so it butts together evenly.
    - ❑ Install supercharger assembly onto billet spacer/manifold. Reinstall linkage plate to manifold as it was prepped by Whipple. Apply light amount of anti-seize to each bolt thread. Tighten socket head allen bolts to 35ft lbs.
    - ❑ Plug TPS connector into new TPS sensor.
    - ❑ Once you have pulled the injector connectors back far enough, plug them into the 8 new injectors.
    - ❑ Locate the IAC extension pigtail. Install this to factory IAC connector and route to new IAC position and connect to IAC motor on starboard side. **NOTE:** Do not get this mixed up with the distributor connector, which utilizes the same style connector. The factory IAC wiring utilizes the following wire colors (this is only an extension, therefore wires will never cross):
        a. Green/Black
        b. Green/White
        c. Blue/Black
        d. Blue/White

48. Install the (2) supplied 7.125" round support stands and install on the pre-installed studs in the front of the SC discharge plate. The hex end will go against the SC/intercooler adapter plate. Tighten using the hex area on stand.

49. Take the front plate assembly and install the drive collar. Slide collar and plate over the drive leaving it all loose. Install the supplied (1) 1/4" x 1" SHCS through the drive collar, leave loose at this time. Install the supplied (4) ¼" x ¾" SHCS through the front plate and into the drive collar, leave loose at this time. **Apply a light amount of blue Loctite #242 to threads.**

50. Install the supplied 3/8" x 1.5" button head allen bolt and supplied .870" stainless washer into recessed and slotted area of front plate. This will secure the plate to the support stands. **Do not tighten, just install hand tight.**

51. **!! CAUTION !!** With the front plate pushed against the support stands, tighten the collar around the drive by tightening the (1) ¼" x 1" SHCS bolt). Follow by tightening the (4) front ¼" x ¾" SHCS bolts. **Apply a light amount of blue Loctite #242 to threads.**

52. Torque the 3/8" X 1.5" button head allen bolts to 22 ft. lbs.

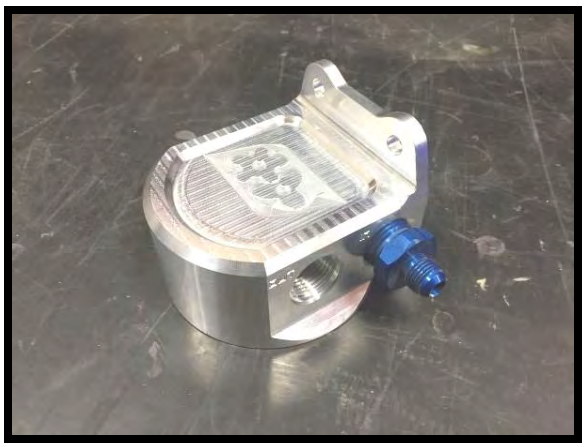
53. **!! CAUTION !!** Install the SC pulley to drive snout. Secure with the supplied 6mm x 14mm SHCS bolts. Hold pulley from spinning by using the supplied 10-rib belt around the pulley while torqueing the 6mm SHCS to 124 in/lbs.

54. Install the orange MAP sensor connector (extension) to the new 2-bar MAP sensor located on the back of the front tensioner plate.

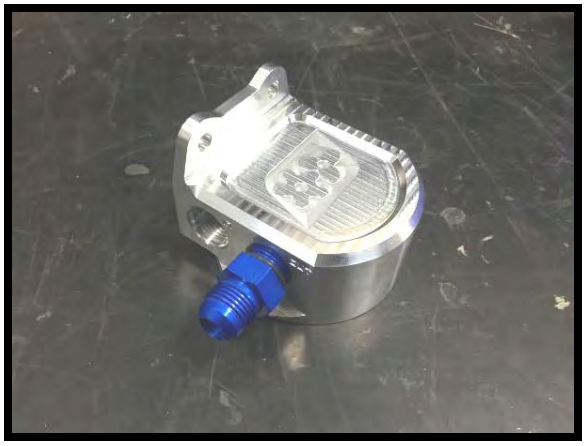
55. Install the stainless fuel filter head to filter element adapter into filter head.

56. Install the supplied 10AN oring fitting into the "IN" on the fuel filter head. Either "IN" works, use which fits best for your fuel plumbing. This will be the INLET from the fuel tank.

57. Install the supplied 10AN to 6AN oring fitting (with supplied oring) fitting into fuel filter “IN” if returning fuel back to the fuel filter. If returning to the fuel tank, skip this step.



58. Install the supplied 10AN oring fitting in the fuel filter head “OUT”. Either “OUT” will work, use which is best for your fuel plumbing, this will feed the fuel pump (inlet).



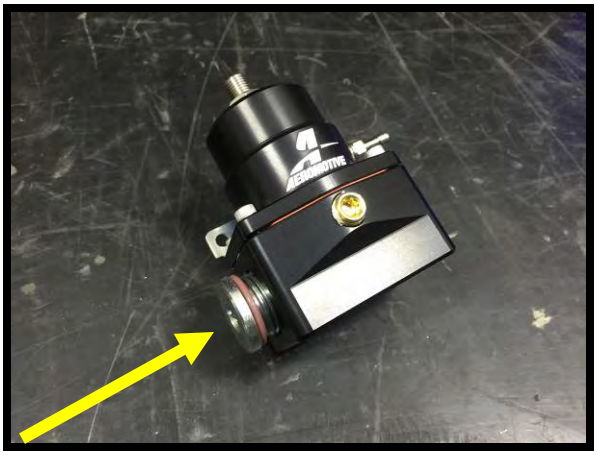
59. Install the supplied 10AN plug to the extra “OUT” port in the fuel filter head.

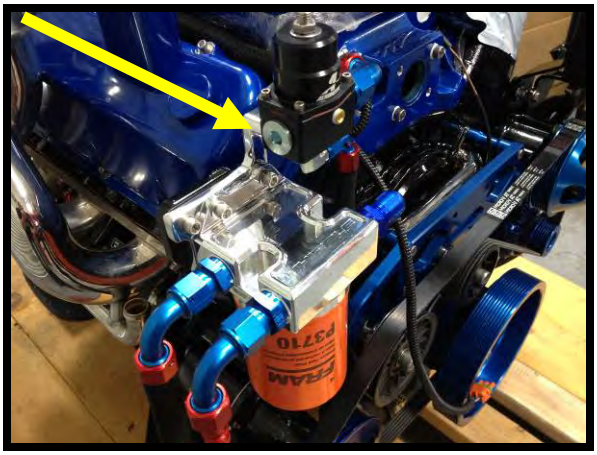
60. Install fuel filter element on to billet filter head.

61. Install 6AN to 6 oring 90deg bulk-head fitting into bottom of adjustable fuel PSI regulator (facing left side if looking at 1/8” NPT pipe port).

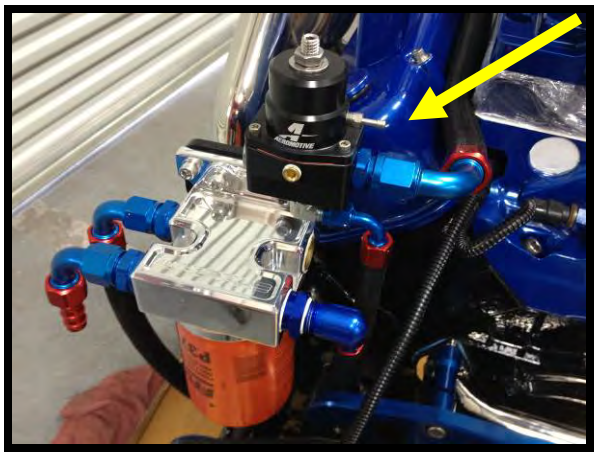
62. Install the 10AN flare to 10AN flow fitting with viton oring into adjustable fuel PSI regulator.

63. Install 10AN plug into adjustable regulator extra inlet port. If looking at logo on regulator, install on right side.

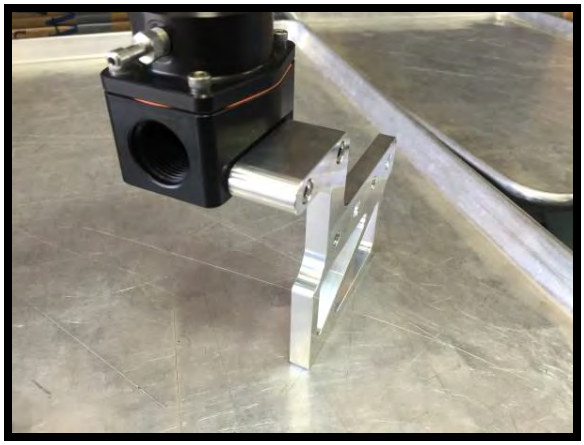
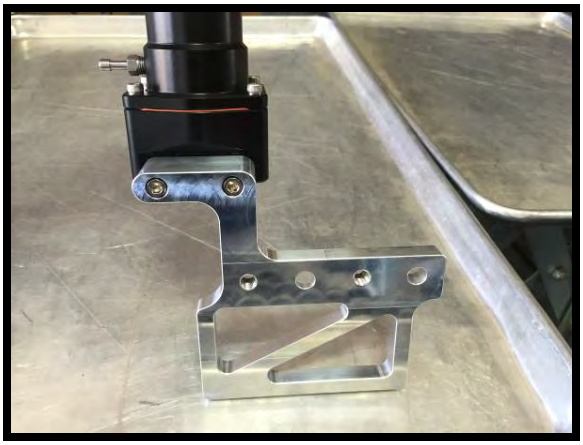




64. Install supplied 1/8" barbed fitting for regulator vacuum/boost reference into regulator with light amount of thread sealant.



65. Remove steel regulator mounting bracket, this will not be used (supplied by Aeromotive). Mount adjustable fuel pressure regulator to billet mount supplied. Secure with the (2) 10/24" x 1 1/8" socket head allen bolts. Mount the regulator billet bracket to the factory fuel filter bracket, using the supplied 5/16" x ¾" SHCS and5/16" x ¾" FHCS.

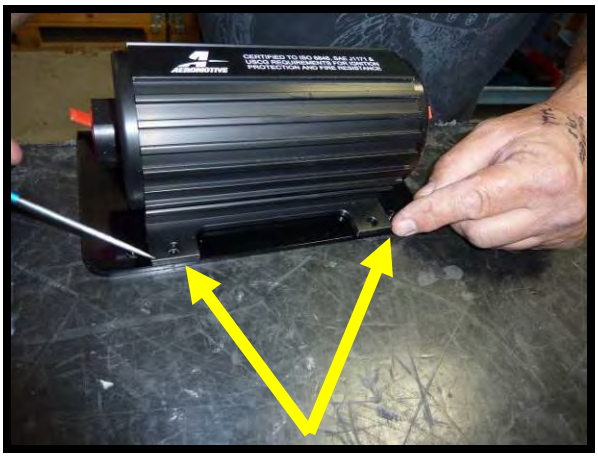



66. Mount fuel filter into factory location. Sandwich the regulator billet mount between the stock mount and billet fuel filter head. Use the supplied (2) 5/16" x 5/8" SHCS to secure.

67. Install the supplied 3/8" NPT to 6AN fuel fittings into fuel cooler, using light amount of pipe sealant to threads.

68. Install supplied 10AN flare to 10AN flow fittings, with supplied viton oring to the new fuel pumps in and out ports.

69. Set the new fuel pump on the factory cool fuel bracket. Put the pump to the edge of the plate, mark 4 holes for the pump and drill 4 holes using a 5/16" drill bit.



70. Mount the supplied fuel pump to the original factory cool fuel assembly bracket using the (4) ¼" x 1" SHCS bolts, (8) ¼" AN washers and (4) ¼" nyloc nuts. Use the supplied ¼" ID x ¼" rubber grommets between the pump and the bracket to help keep the pump from making extra noise.

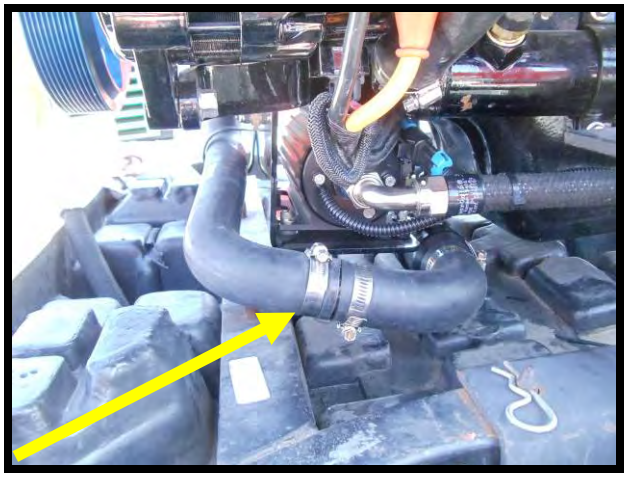

71. Prep the factory cool fuel bracket for the new fuel cooler. Drill the factory cool fuel assembly bracket roughly 3" apart, and .75" from back face using a 5/16" drill bit. The cooler will hang between the bracket and the oil pan.

72. Install cooler into the (2) 2 ¼" adel clamps, secure adel clamps using supplied (2) ¼" x ¾"" SHCS bolts. Secure bolts with the supplied (2) 1/4" AN washer and (2) ¼" Nyloc nuts.

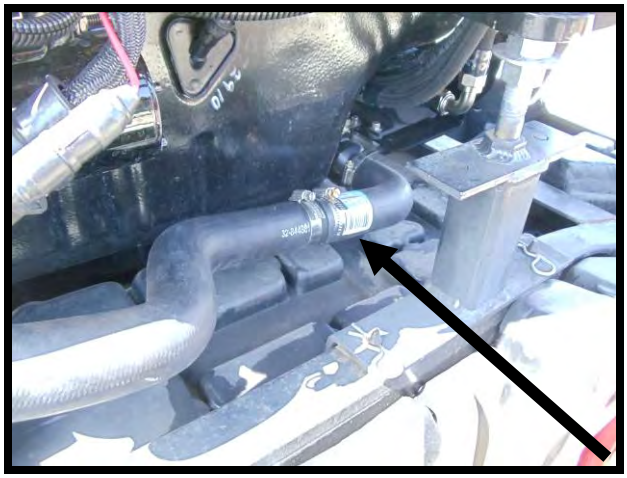
73. Remount the factory cool fuel assembly bracket to engine and secure with the factory (3) nyloc nuts (11mm socket). Torque to 35 ft/lbs.

74. Reinstall the factory 1 ¼" water feed line into the factory adel clamp mounted on the cool fuel pump assembly bracket.

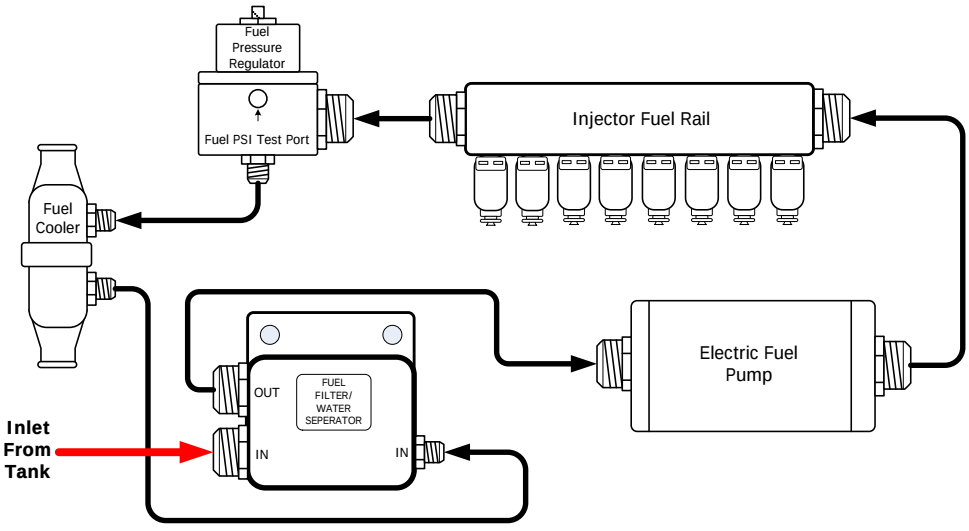
75. Install one of the supplied 1 ¼" 90deg rubber hoses to the port side of the fuel cooler. Secure with the supplied #20 hose clamp. Match the length to the factory feed line and cut to fit. Install the 1 ¼" stainless hose coupler and install both hoses onto hose barb. Secure both hoses with the supplied #20 hose clamps.



76. Install one of the supplied 1 ¼" 90deg rubber hoses to the starboard side of the fuel cooler. Secure with the supplied #20 hose clamp. Match the length to the factory outlet hose and cut the factory hose to fit.



77. **⚠ WARNING!! Manufacture only high quality, high-pressure fuel lines!! You must have a minimum of –10 (5/8" ID) hose to feed the fuel rail; anything smaller is unacceptable and will not feed the system with the proper amount of fuel flow.**

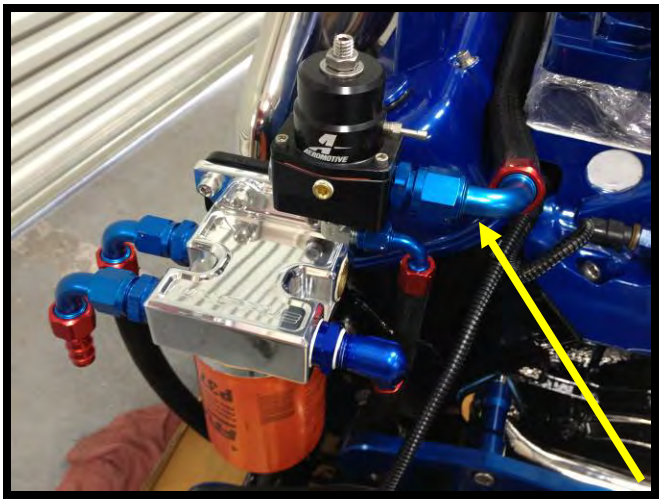


78. Manufacture 5/8" ID line from fuel tank to the – 10 AN fitting at the "IN" of the fuel filter head. **!! CAUTION !!** It's a must to run a minimum 5/8" ID hose from the tank. Try to limit 90-degree bends on the inlet side. NEVER USE A NON-RADIUSED 90DEG FITTING, ONLY RADIUS BENDS (XRP, RUSSEL, EARLS, Goodrich, ETC.)

79. Manufacture fuel line utilizing 5/8" ID hose from the filter "OUT" to the fuel pump "INLET".

80. Manufacture fuel line utilizing 5/8" ID hose from the pump out –10AN fitting to the fuel rail –10AN fitting on starboard side of rail.

81. Manufacture 5/8" ID fuel line from port side of fuel rail to adjustable regulator inlet fitting.

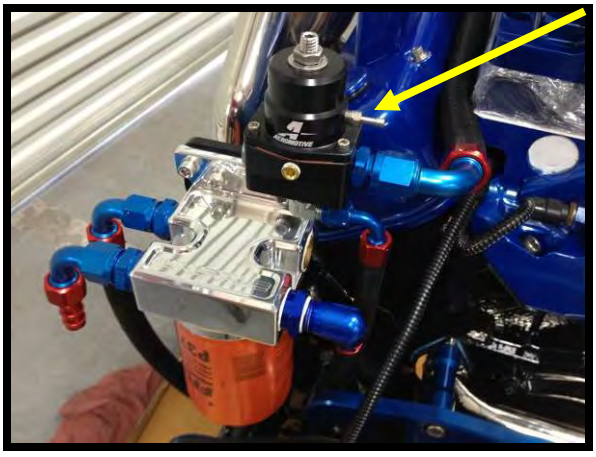


82. Now manufacture a 3/8" ID (-6AN) fuel line from the regulator return to the starboard side fitting of the new fuel cooler.

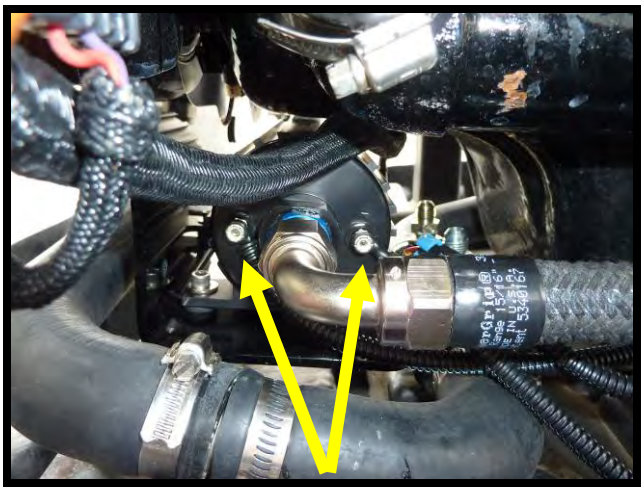
83. Manufacture another 3/8" ID (-6AN) fuel line from the fuel cooler port side fitting to the –6AN fitting to the ¼" to 6AN fitting of the billet fuel filter head.

It is recommended to use a few tie straps for this step: they're cheap!!!

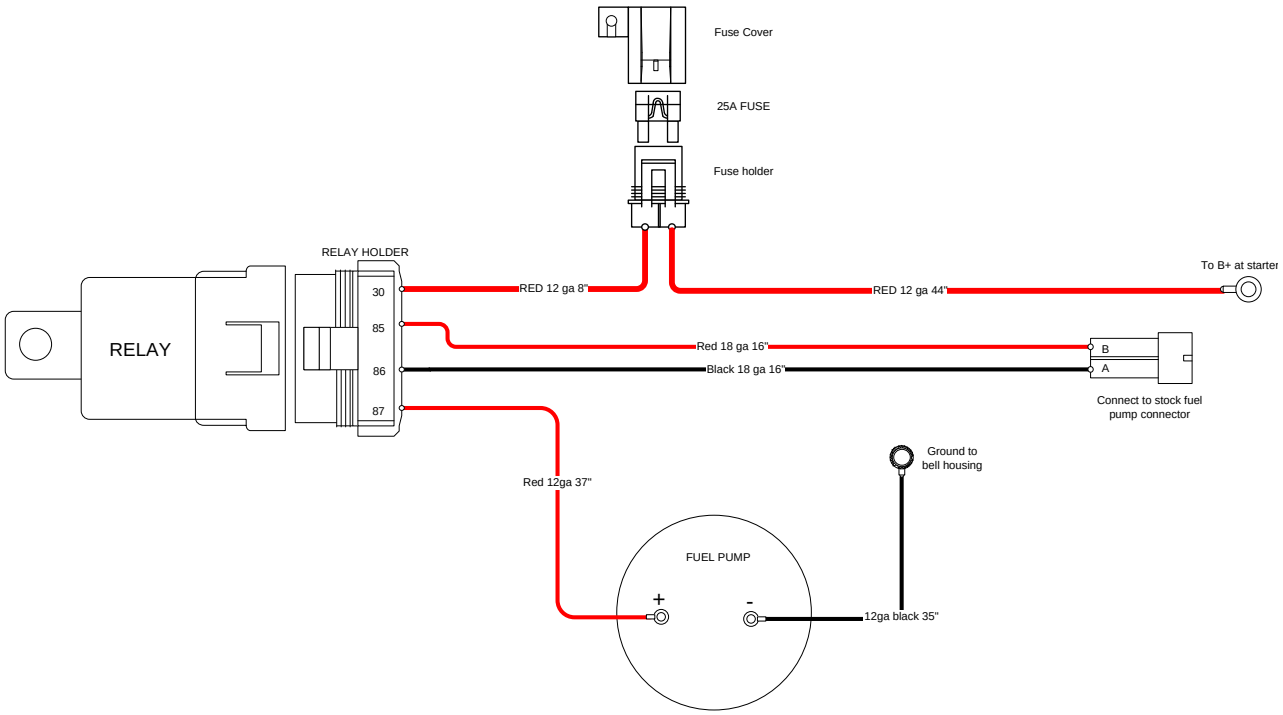
84. Locate the 1/8" barbed fitting on the backside of the intake manifold. Install the supplied 1/8" vacuum line to the 1/8" fitting to the adjustable regulator barbed fitting.



85. Route the supplied fuel pump relay harness from the IAC relocation bracket to the new supplied fuel pump. Install the red positive wire eyelet to the + positive.

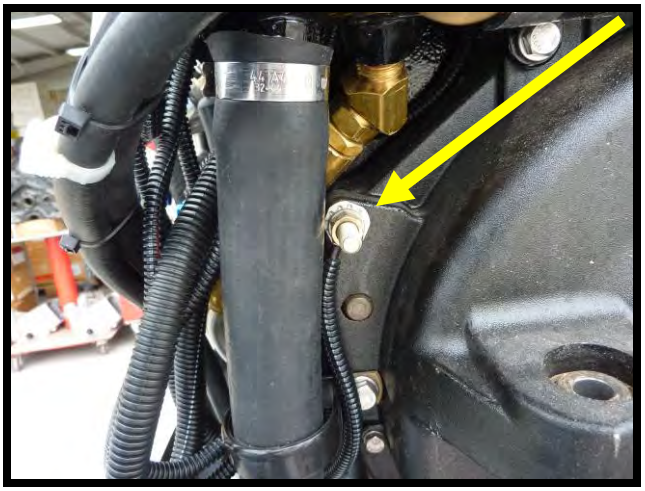


86. Connect the factory fuel pump 2-way connector to the new supplied fuel pump relay harness 2-way connector.



87. Route the new fuel pump relay harness red 12awg wire to the starter. **NEVER ROUTE RED POWER WIRE TO TRIM PUMPS!**

88. Install the new fuel pump relay harness black 12awg wire to the port side bell housing ground stud. Remove the factory nut, install the ground eyelet and secure grounds with the factory stud.



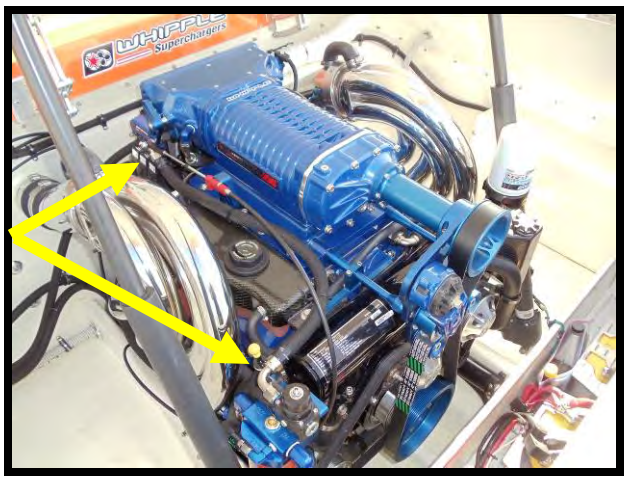
89. Use a few 12" zip-ties to secure the new relay harness and the rerouted wires on the port side for a clean installation.

90. Manufacture 5/8" ID line from fuel tank to the – 10 AN fitting at the "IN" of the fuel filter head. **!! CAUTION !!** It's a must to run a minimum 5/8" ID hose from the tank. Try to limit 90-degree bends on the inlet side. NEVER USE A NON-RADIUSED 90DEG FITTING, ONLY RADIUS BENDS (XRP, RUSSEL, EARLS, Goodrich, ETC.)

91. Manufacture fuel line utilizing 5/8" ID hose from the filter "OUT" to the fuel pump "INLET".

92. Manufacture fuel line utilizing 5/8" ID hose from the pump out –10AN fitting to the fuel rail –10AN fitting on starboard side of rail.

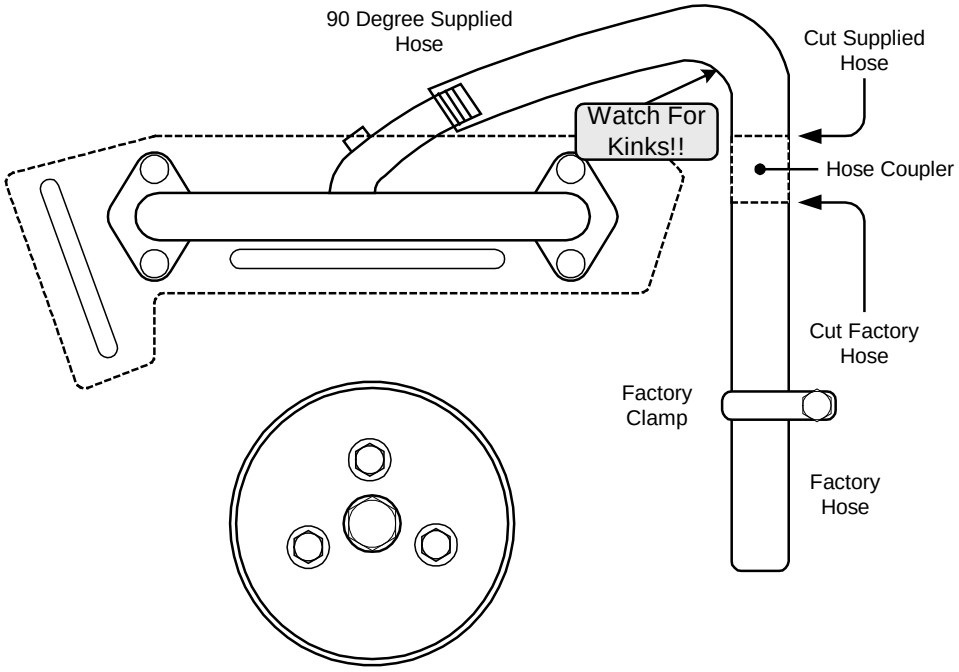
93. Manufacture 5/8" ID fuel line from port side of fuel rail to adjustable regulator inlet fitting.



94. Use rubber caps and stock hose clamps to block off header water dumps at the collector. We will only feed the headers at the bottom inlets, this will supply sufficient water for cooling.

95. Take the stock hose from the oil cooler and route back in factory position, which is the front of motor between crank pulley and power steering pulley. Locate supplied 90-degree hose. Use the supplied "U Bend" hose to connect to water crossover inlet. Install 90 degree hose to stainless cross over inlet. Move around until you find a place where the hose does not kink at the bend.

96. Cut both supplied hose and factory hose to fit (see **following diagram** for reference) making sure there are no kinks. Couple these hoses with the stainless coupler and #20 hose clamps. Secure factory hose with factory clamp off. **WATCH FOR KINKS IN HOSE!!!**



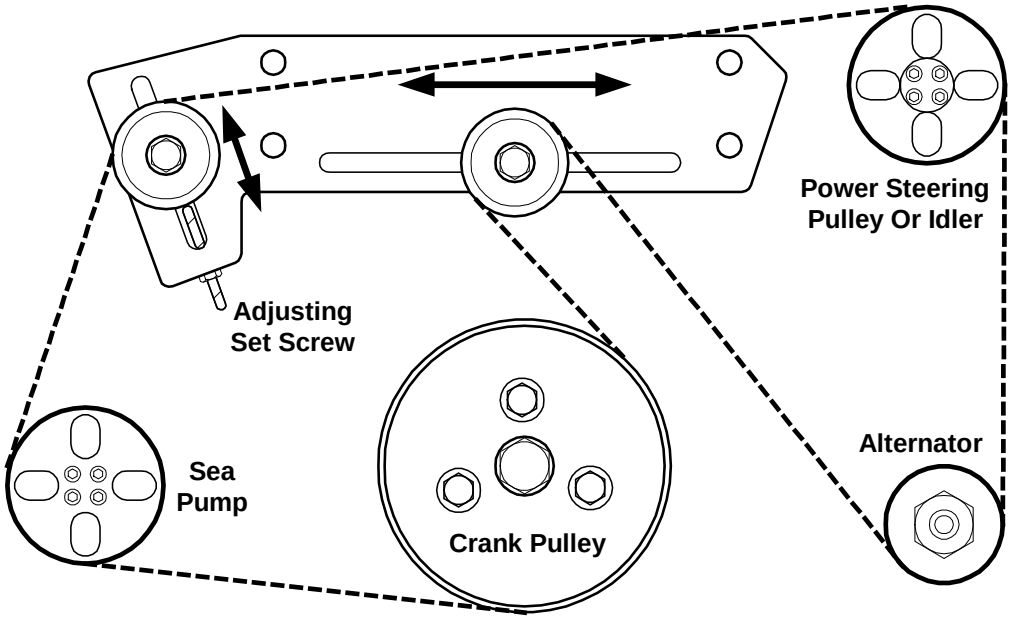
97. Install factory 1" hose and factory clamps to new thermostat housing and bottom water feed on stainless exhaust.

98. Take factory PCV valve from center of stock intake and install it in the port side valve cover rubber grommet. Route the new supplied 3/8" ID Rubber hose to the port side of throttle body. Install the supplied -6AN push lock fitting to -6AN fitting located in throttle body.

99. Insert the supplied valve cover breather into the starboard factory valve cover grommet. (PCV valve on one side, breather on opposite, does not matter what side).

100. Install factory 6 rib grooved idler on Whipple plate on diagonal position with adjusting setscrew up and down. Use the tee nut to slide back and forth, the idler spacer to space idler out correctly and the idler washer that centers the hex bolt on front side of idler bearing.

101. Install new 6 rib belt as shown in this diagram: Once installed tighten by using the all thread stud on the bottom of the idler **as shown in following diagram**.



102. Locate the 1/4" barbed fitting on the backside of intake manifold. Locate 1/4" plastic barb and rubber 90 fitting, assemble to 1/4" hose. Install supplied 1/4" vacuum line to this and route to map sensor that is located on backside of front plate. Secure with zip ties.

103. Locate the 1/8" barbed fitting on the backside of intake manifold. Install supplied 1/8" vacuum hose and route to fuel pressure regulator barbed port. Secure with zip ties.

104. **⚠ WARNING!!** Fill the new s/c compressor with oil per supplied instructions.

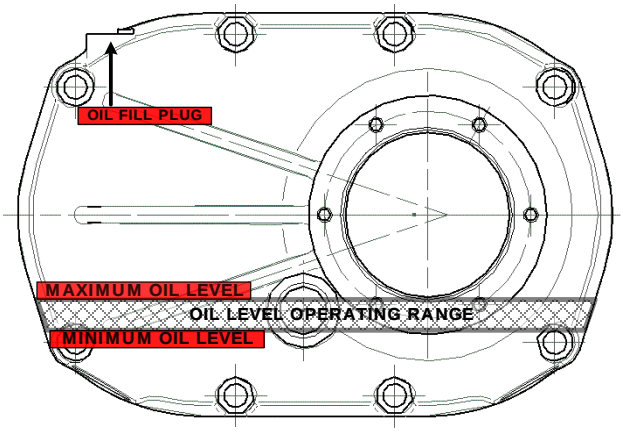
- ❑ Make sure the SC is sitting square/flat.
- ❑ Remove -4AN allen plug and fill SC with **WHIPPLE SC OIL ONLY!!**
- ❑ Fill to the middle of the sight glass. NOTE: The W200AX compressor takes a maximum of 6.8 fl/oz (200mL).
- ❑ Reinstall -4AN allen plug.
- ❑ NOTE: After running the SC, the oil level will lower due to oil filling the bearings. The proper level should be between the bottom of the sight glass and the middle.
- ❑ Change SC oil every 100 hours (every season) and only use **WHIPPLE SC OIL!!**

!! CAUTION !!

Severe damage to the compressor will occur if you overfill the supercharger front gear case.

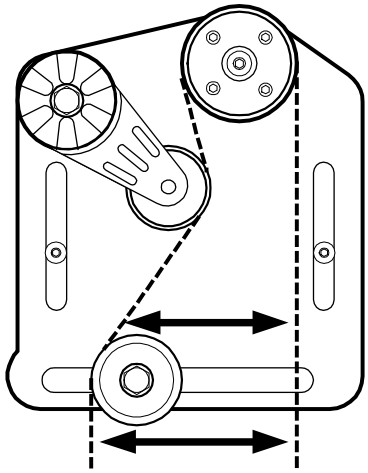
WHIPPLE SC OIL LEVEL

Fill to center of oil sight glass. 6.8 fl/oz. or 200cc.
DO NOT OVERFILL, WILL VOID WARRANTY!!

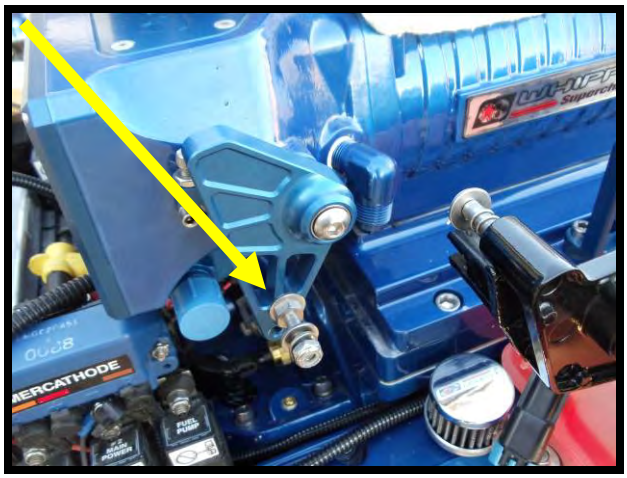


105. Install SC belt by releasing the tension from the tensioner and loosening the mounting bolt on the sliding idler.

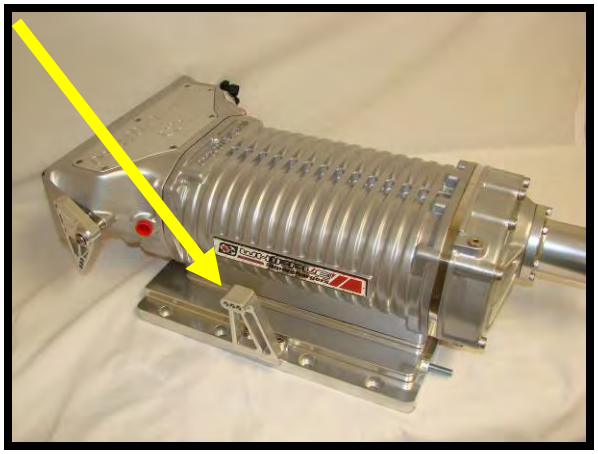
- ❑ Once belt is on all pulleys, push the sliding idler towards starboard side until you can release the tensioner so that it's pointing at approximately 5 O'clock position. Notice the stops on the tensioner, it must have play in both the forward and backwards to work properly. **See following diagram**.



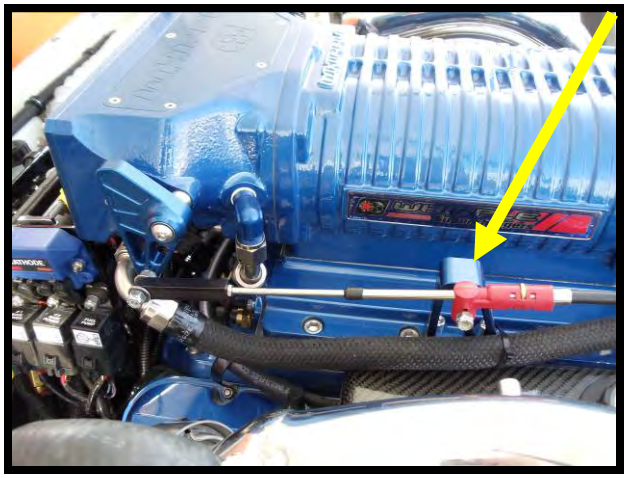
106. Install the supplied ¼"-20 x 1 ½" stud into the throttle arms upper ¼" hole.



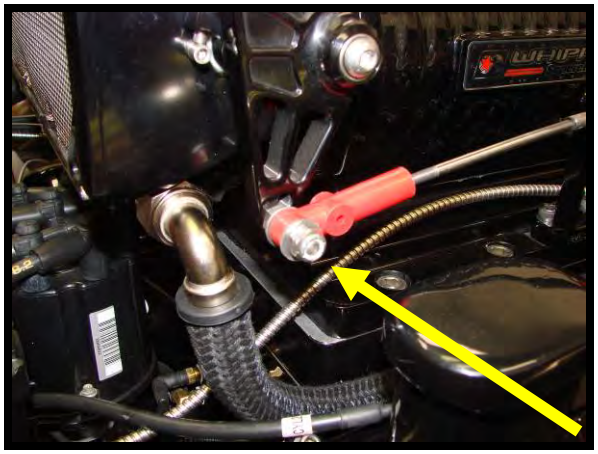
107. Install the supplied ¼"-20 x 1 ½" stud into the throttle anchor position.



108. Route the linkage to the front of the motor, starboard side. Test fit the factory linkage length to see what hole position on the anchor, as there are 3 hole positions for multiple length configurations. Once you've figured a position, install anchor to ¼" stud by using a supplied ¼" AN washer on both sides of the linkage anchor and secure with supplied ¼" nyloc nut.



109. To properly install the linkage end on the stud and throttle arm, its important to put a slight amount of “pre-load” on the linkage to ensure proper and consistent closing. Adjust the end enough that when you push over the stud, its not set in a neutral position, but pushing slightly on the linkage in a closed position. Install the supplied ¼” AN SS washer on both sides of the linkage arm. Secure with the supplied ¼” nyloc nut. Start at the bottom hole, then move the throttle to 100% open, verify that the linkage is at max opening. If not, move the stud up one hole and repeat.



110. Relocate the shifter bracket to the transom.

BEFORE STARTING THE ENGINE

MAKE SURE THE THROTTLE CABLE OPERATION IS CORRECT. WITH THE ENGINE OFF, MOVE THE THROTTLE A FEW TIMES TO FULL OPEN AND CLOSED POSITIONS. THERE SHOULD BE NO BINDING OR STICKING AND SHOULD OPERATE FREELY.

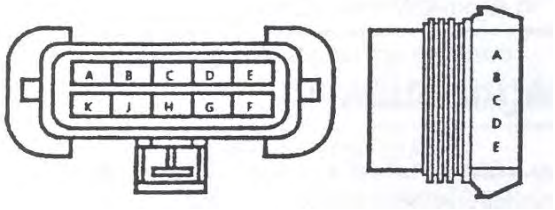
PRIME FUEL PUMP WITH FUEL!! DO NOT RUN THIS PUMP DRY UNDER ANY CIRCUMSTANCES!! THERE ARE NO WARRANTIES FOR PUMPS RAN DRY.

111. Adjust fuel pressure TEMPORARILY: **DO NOT RUN PUMP DRY, FILL FUEL FILTER WITH FUEL BEFORE TURNING ON PUMP!!!!**

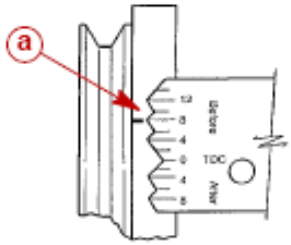
- ❑ Install quality mechanical fuel pressure gauge (do not use electric gauges to tune) to 1/8" pipe fitting on adjustable regulator.
- ❑ Prime fuel system so that filter is full of 91-octane gas. It helps significantly to remove the return fuel line from the regulator and plug the fitting. (Otherwise the pump can pull air from the return side)
- ❑ Turn key "on" and quickly bleed air from fuel line anywhere on pressure side.
- ❑ Turn key to on position, look at pressure and adjust close to **40lbs**. **This is temporary to get the engine running. This may take several key cycles.**

112. Check engine timing:

- ❑ Locate DLC (Diagnostic Trouble Connector) on port side rear black panel of engine. Should be on top near Merthacode. It has a plastic cover over it for water protection, remove this to do the timing setting.



- ❑ Connect timing light to number 1 ignition wire.
- ❑ Start the engine and let idle (may have to give some slight throttle).
- ❑ Connect the appropriate tool (timing tool #91-805747A1), Rinda scan tool or jump pins A & B on the DLC with a bare wire/paper clip to hold the engine in base timing mode.
- ❑ Manually adjust throttle so engine RPM is steady 1500rpm.
- ❑ If you have a Rinda scan tool, set the engine in "service mode" which will set it in base timing mode.
- ❑ Shine the timing light at the timing mark indicator located on the timing chain cover.
- ❑ Adjust the distributor until you get the desired 8 degrees BTDC. Clockwise to retard timing, counter-clockwise to advance timing.
- ❑ Torque distributor bolt down bolt to 25 foot-pounds.
- ❑ Verify that the motor is 8 degrees BTDC after the distributor was tighten, adjust if needed.
- ❑ Set scan tool to "normal mode" or remove the base timing tool.



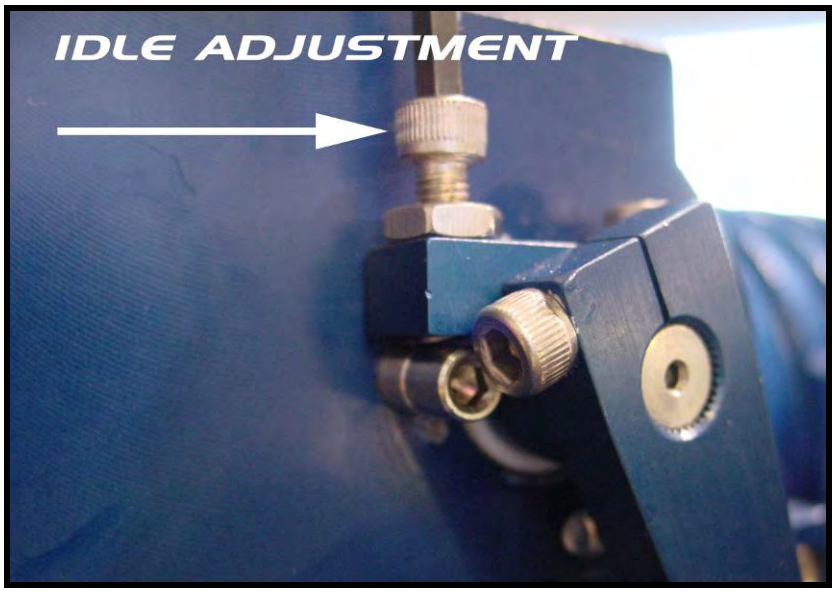
a - Timing Marks

113. Adjust fuel pressure, VERY IMPORTANT, MOTOR WILL NOT IDLE IF SET INCORRECTLY.
YOU MUST USE A HIGH QUALITY, HIGH ACCURACY MECHANICAL FUEL PRESSURE GAUGE ONLY!!!

- ❑ With **NO** vacuum reference, adjust fuel pressure regulator by turning top allen screw on regulator (clockwise for more pressure, counter clockwise for less) until you reach 40 lbs. of fuel pressure. Tighten nut on regulator so allen does not vibrate out. **DO NOT USE ELECTRIC FUEL PRESSURE GAUGES OR GAUGES THAT HAVE LARGE GAPS BETWEEN NUMBERS!!**
- ❑ Install 1/8" vacuum/boost line onto regulator barbed fitting. Secure lines with zip ties. With motor running in vacuum, pressure should drop once line is connected and will rise above 40 under boost. Under full boost, the fuel pressure must hold a steady 45lbs. of pressure (+/- 2lbs). If not, there is a restriction in the line.

IDLE SPEED SETTING

114. Some motors may need an idle adjustment. First, you must understand the ECU has a desired idle speed that the motor is always going to try to achieve. The rpm idle speed should be 750 rpm once motor is up in the 80+ range of engine coolant temperature.



- ❑ You must adjust the set screw to raise or lower the idle speed. Note that this is where the throttle stops in the relaxed or returned position. If you turn it counter clock wise, you will loosen the nut which must be tightened.

Engines that idle to high:

- ❑ This means either there's a vacuum leak, too much timing or there is too much air going by the throttle blades. To lower airflow at idle, take the set screw/throttle stop and lower it. This allows the throttle blade to close more when returned. Make small adjustments such as 1/8th turns. **NOTE: Don't forget to tighten locking nut after adjustment.**

Engines that idle to low:

- ❑ This means either there's not enough air being fed to engine or not enough timing. To increase airflow at idle, take the set screw/throttle stop and raise it so when the throttle is in its relaxed position, it will be slightly open more. Make small adjustments such as 1/8th turns. **NOTE: Don't forget to tighten locking nut after adjustment.**
- ❑ To raise the voltage, you must make the setscrew (acts as throttle stop when in returned position) open the throttle blade more. This will raise the RPM (if it's loping between 600-1000, open the blade). If the RPM is to high, you must close the blade (lower the voltage). If you do have a scanner, watch the IAC count. You want it to be between 20-50. You must shut the motor off for 5 seconds to reset the IAC motor. If you do not have a scanner, you can adjust this setscrew until you see the motor idles around 750 on the tachometer, the motor should not hunt more than 100 RPM.

- ❑ Rev engine up past 2500 rpm and bring back at a rapid rate. The motor should not die, it should come back to the desired idle speed within 1-5 seconds. If it dies, then it needs more air so follow instructions for engines that idle too low.

Motors that idle high only after revving the engine or there are no more adjustments to be made:

- ❑ This means the TPS voltage is slightly off and that it does not return to its "Closed Loop Idle System." To fix this, you must loosen the TPS sensor (located on port side of throttle body) and push the top out towards the back of the boat. This will lower the TPS voltage. Tighten allens and try starting it again. You may want to use the scanner or a volt-meter (0-5volt sensor output) to watch the voltage come down. Ideal voltage should be in the range of 0.48 – 0.50 volts.

MOTORS THAT START UP INCREDIBLY RICH MEANS YOU HAVE NOT SET THE TPS (THROTTLE POSITION SENSOR) VOLTAGE, FOLLOW INSTRUCTIONS TO PROPERLY ADJUST.

CRITICAL!!!

LAKE TEST
POST-INSTALLATION CHECKLIST

After installing the Whipple supercharger kit it is imperative that the following checklist be performed. Failure to perform these simple tests may result in severe engine damage.

1. Make sure 91 octane or higher is in the vessel. If unsure, then drain the tank completely empty and fill with 91 or higher.
2. With the thermostat removed, under full throttle operation, near full speed, block pressure should be a minimum of 25lbs. and maximum of 35lbs. If block pressure is not present, severe engine damage may occur. The motor should have 0-3lbs. at idle and should progressively get higher as speeds increase. A low water nose style pickup or external pickup may need to be installed. The Mercury side hole pickups will not generate enough water flow for proper operation. If you have an XZ drive with dual water pickups, it is be necessary to plug side draft holes to increase pressure.
3. Fuel pressure is the most critical parameter and must be checked during wide-open throttle operation. Install a quality fuel pressure gauge to the extra port at the auxiliary fuel rail added by Whipple (1/8" pipe). Attach the fuel pressure gauge with a long enough hose so that it may be visible during operation. Under WOT, full boost, max rpm, the fuel pressure should be 45 lbs (+/- 2lbs). This procedure takes two people – one to drive and the other to observe the gauge. Perform the test in a safe area. If it does not maintain fuel pressure, you must find the restriction, as this results in a lean air to fuel condition.

NEVER!!

1. Never run octane less than 91, higher octane is always recommended.
2. Do not use octane booster, these are very hard on the spark plugs and only increase a few points. Example: 87 octane with octane booster, may raise a few "points" to 87.5, which is not acceptable.
3. Do not hook the new fuel pump to the trim pump! It will lose voltage when the trim pump is used and the motor will run lean.
4. Never operate engine if overheating.
5. Never operate engine in boost if water temp exceeds 140.
6. Do not operate engine in boost if water pressure has fallen below standard levels.
7. Do not operate engine in boost if fuel pressure falls below standard levels.
8. Do not tee the vacuum/boost line feeding the Map sensor.
9. Do not design your own fuel system, the system is designed for use and installation as we specify.
10. Do not design your own water system, this system has been designed and tested to work according to our specifications.

11. Do not run more timing than 8 degrees base.
12. Never set engine timing out of base timing mode, it will not be accurate no matter what you think.
13. Never run a hotter spark plug than what is specified by Mercury Hi-Performance for the factory 500HP EFI.

MAINTENANCE AND SERVICE

It is recommended that the following items be checked at normal service intervals.

1. Check supercharger oil every 10-15 hours of operation.
2. Change supercharger oil every 100 hours or the beginning of a new season, whichever comes first. Use only Whipple SC oil.
3. Check the supercharger/accessory drive belts. Adjust or replace as required. Replace every 150 hours.
4. Inspect and clean fuel filter every 50 hours or once a season, whichever comes first.
5. Replace spark plugs every 50 hours or beginning of new season, whichever comes first. Utilize factory replacements. One heat range colder can be run and is recommended for engines that will be run very aggressively.
6. Replace spark plug wires every 100 hours, inspect every 50 hours.
7. Replace distributor cap and rotor every 100 hours, inspect every 50 hours.
8. Replace distributor every 250 hours or every 3 seasons, whichever comes first.

TROUBLE SHOOTING 500 HP EFI

	Symptom		Solution
1	When starting engine, black smoke pours out the exhaust, very strong fuel smell.	1	Check TPS voltage. Should be between .45-.55v with throttle closed.
		2	Verify that Map sensor extension harness is making proper connection and that no wires cross at any time.
		3	Verify that the ECT is plugged in and is making proper contact.
		4	Check base timing. Engine should be at 8 degrees in base timing mode.
		5	Check fuel pressure at the fuel rail with accurate MECHANICAL gauge. Should be 44 - 46psi @ idle.
		6	Install Mercury scan tool and perform code check.
2	Engine will not idle. Dies when going into gear. Hard starting. Idles below 600rpm.	1	Open throttle blade to allow more air to enter the engine. There is a screw that is used as a throttle stop when throttle is closed, loosen nut and adjust open.
		2	If the system has been installed for awhile, check that the idle air control motor filter is not plugged. Located below the IAC motor.
		3	Perform spark plug check, replace if worn or fouled.
3	Engine idles too high. Will not come down to idle rpm.	1	Adjust throttle blade stop so that the blade opens more at its closed position.
		2	Check base timing. Engine should be at 8 degrees in base timing mode.
		3	Check TPS voltage. Should be between .45-.55v with throttle closed.
		4	Verify that the linkage is closing all the way, some linkages may bind and not push the throttle body closed completely.
4	Lack of engine performance. Engine not pulling the same rpm as last season.	1	Check factory ignition such as distributor cap, rotor and wires. Replace if worn.
		2	Perform spark plug check, replace if worn or fouled.
		3	Verify that engine water block pressure is above 25lbs at WOT. Engine coolant temp should not exceed 120 if water flow is adequate.
		4	Check octane level, must be minimum of 91 octane.

Electronic Control Module (ECM) and Sensors

General Description

The MerCruiser Electronic Fuel Injection system is equipped with a computer that provides the operator with state-of-the-art control of fuel and spark delivery. Computers use voltage to send and receive information.

Computers and Voltage Signals

Voltage is electrical pressure. Voltage does not flow in circuits. Instead, voltage causes current. Current does the real work in electrical circuits. It is current, the flow of electrically charged particles, that energizes solenoids, closes relays and lights lamps.

Besides causing currents in circuits, voltage can be used as a signal. Voltage signals can send information by changing levels, changing waveform (shape), or changing the speed at which the signal switches from one level to another. Computers use voltage signals to communicate with one another. The different sections inside computers also use voltage signals to communicate with each other.

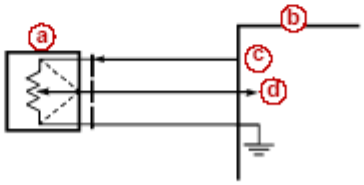
There are two kinds of voltage signals, analog and digital. Both of these are used in computer systems. It's important to understand the difference between them and the different ways they are used.

Analog Signals

An analog signal is continuously variable. This means that the signal can be any voltage within a certain range. An analog signal usually gives information about a condition that changes continuously over a certain range. For example, in a marine engine, temperature is usually provided by an analog signal. There are two general types of sensors that produce analog signals: the 3-wire and the 2-wire sensor.

THREE-WIRE SENSORS (MAP AND TP)

The following figure shows a schematic representation of a 3-wire sensor. All 3-wire sensors have a reference voltage, a ground and a variable "wiper." The lead coming off of the wiper will be the signal to the Engine Control Module (ECM). As this wiper position changes, the signal voltage returned to the computer also changes.



3-Wire Sensor

- **a** - Typical Sensor
- **b** - ECM
- **c** - Voltage Out
- **d** - Signal Input
- **e** - Sensor Ground

Engine Control Module (ECM)

The Engine Control Module (ECM) is the control center of the fuel injection system. It constantly monitors information from various sensors, and controls the systems that affect engine performance.

The ECM also performs a diagnostic function check of the system. It can recognize operational problems and store a code or codes which identify the problem areas to aid the technician in making repairs.

ECM FUNCTION

The ECM supplies 5 or 12 volts to power various sensors or switches. This is done through resistances in the ECM which are so high in value that a test light will not light when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. Therefore, the use of a **10 megohm input impedance digital voltmeter** is required to assure accurate voltage readings.

MEMORY

There are three types of memory storage within the ECM: ROM, RAM and EEPROM.

ROM

Read Only Memory (ROM) is a permanent memory that is physically soldered to the circuit boards within the ECM. The ROM contains the overall control programs. Once the ROM is programmed, it cannot be changed. The ROM memory is non-erasable, and does not need power to be retained.

RAM

Random Access Memory (RAM) is the microprocessor "scratch pad." The processor can write into, or read from, this memory as needed. This memory is erasable and needs a constant supply of voltage to be retained.

EEPROM

Electronic Erasable Programmable Read Only Memory (EEPROM) is the portion of the ECM that contains the different engine calibration information that is specific to each marine application.

Speed Density System

The Electronic Fuel Injection system is a speed and air density system. The system is based on "speed/density" fuel management.

Three specific data sensors provide the ECM with the basic information for the fuel management portion of its operation. That is, three specific signals to the ECM establish the engine speed and air density factors.

SPEED

The engine speed signal comes from the distributor's High Energy Ignition (HEI) module to the ECM on the distributor reference high circuit. The ECM uses this information to determine the "speed" or rpm factor for fuel and ignition management.

DENSITY

Two sensors contribute to the density factor, the Intake Air Temperature (IAT) [Multi-Port models only] and the Manifold Absolute Pressure (MAP) sensors.

The IAT sensor is a 2-wire sensor that measures the temperature of the air entering the intake manifold. The IAT sensor is a thermistor that changes its resistance depending on the air temperature. When the temperature is low, the resistance is high, and when the temperature is high, the resistance is low.

The Manifold Absolute Pressure (MAP) sensor is a 3-wire sensor that monitors the changes in intake manifold pressure which results from changes in engine loads. These pressure changes are supplied to the ECM in the form of electrical signals.

As intake manifold pressure increases (vacuum decreases), the air density in the intake manifold also increases, and additional fuel is required.

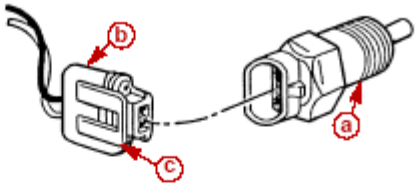
The MAP sensor sends this pressure information to the ECM, and the ECM increases the amount of fuel injected by increasing the injector pulse width. As manifold pressure decreases (vacuum increases), the amount of fuel is decreased.

These three inputs MAP, IAT and rpm are the major determinants of the air/fuel mixture, delivered by the fuel injection system.

The remaining sensors and switches provide electrical inputs to the ECM which are used for modification of the air/fuel mixture, as well as for other ECM control functions, such as Idle Air Control (IAC).

ENGINE COOLANT TEMPERATURE (ECT) SENSOR

The Engine Coolant Temperature (ECT) Sensor is a thermistor (a resistor which changes value based on temperature) immersed in the engine coolant stream. Low coolant temperature produces a high resistance, while high temperature causes low resistance.



73052

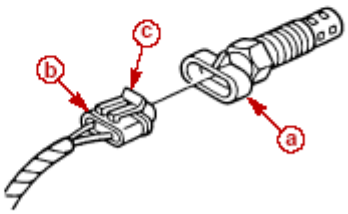
a - Engine Coolant Temperature (ECT) Sensor
b - Harness Connector
c - Locking Tab

The ECM supplies a 5 volt signal to the ECT through a resistor in the ECM and measures the voltage. The voltage will be high when the engine is cold, and low when the engine is hot. By measuring the voltage, the ECM knows the engine coolant temperature. Engine coolant temperature affects most systems the ECM controls.

A failure in the ECT circuit should set Code 14 (Code 15 on 7.4L MPI Models only). Remember, this code indicates a failure in the coolant temperature sensor circuit, so proper use of the chart will lead to either repairing a wiring problem or replacing the sensor.

INTAKE AIR TEMPERATURE (IAT) SENSOR

The Intake Air Temperature (IAT) sensor is a thermistor mounted on the underside of the plenum. Low temperature produces a high resistance, while high temperature causes a low resistance.



73047

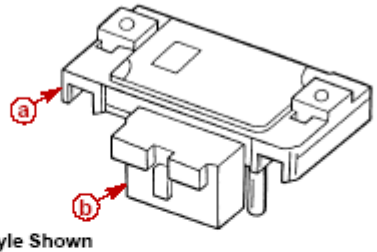
a - Intake Air Temperature (IAT) Sensor
b - Harness Connector
c - Locking Tab

The ECM supplies a 5 volt signal to the sensor through a resistor in the ECM and measures the voltage. The voltage will be high when the intake air is cold, and low when the intake manifold air is hot.

A failure in the IAT sensor circuit should set a Code 23 (also a code 25 on 7.4L MPI Models only).

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The Manifold Absolute Pressure (MAP) sensor is a pressure transducer that measures the changes in the intake manifold pressure. The pressure changes as a result of engine load and speed change, and the MAP sensor converts this to a voltage output.



73046

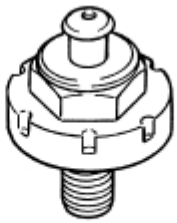
454 / 502 Mag Style Shown

a - Manifold Absolute Pressure (MAP) Sensor
b - Electrical Connector

A closed throttle on engine coast-down would produce a relatively low MAP output voltage, while a wide open throttle would produce a high MAP output voltage. This high output voltage is produced because the pressure inside the manifold is the same as outside the manifold, so 100% of outside air pressure is measured. When manifold pressure is high, vacuum is low. The MAP sensor is also used to measure barometric pressure under certain conditions, which allows the ECM to automatically adjust for different altitudes.

The ECM sends a 5 volt reference signal to the MAP sensor. As the manifold pressure changes, the electrical resistance of the MAP sensor also changes. By monitoring the sensor output voltage, the ECM knows the manifold pressure. A higher pressure, low vacuum (high voltage) requires more fuel, while a lower pressure, higher vacuum (low voltage) requires less fuel. The ECM uses the MAP sensor to control fuel delivery and ignition timing.

KNOCK SENSOR



73051

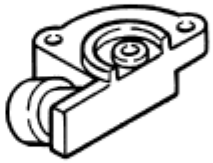
When abnormal engine vibrations (spark knock) are present, the sensor produces a voltage signal which is sent to the KS Module and then to the ECM. The ECM uses this signal to aid in calculating ignition timing.

KNOCK SENSOR CIRCUITRY (MEFI-3 MODELS ONLY)

The MEFI-3 ECM is used with the knock sensor to control spark knock. The KS module circuitry is within the MEFI-3 ECM. When spark knock is present, a small AC voltage signal is sent from the knock sensor to the ECM through pin connector J1-30. (If the engine has a second KS, its voltage signal goes through pin connector J1-14). An AC voltage monitor inside the ECM will detect the spark knock and start retarding spark timing. A Code will be set only if the ECM does not see any activity on the KS signal circuit(s).

THROTTLE POSITION (TP) SENSOR

The Throttle Position (TP) Sensor is a potentiometer connected to the throttle shaft on the throttle body. The TP has one end connected to 5 volts from the ECM and the other to ECM ground. A third wire is connected to the ECM to measure the voltage from the TP. As the throttle valve angle is changed, the voltage output of the TP also changes. At a closed throttle position, the voltage output of the TP is low (approximately .5 volt). As the throttle valve opens, the output increases so that at wide-open-throttle (W.O.T.), the output voltage should be near 4.5 volts. By monitoring the output voltage from the TP, the ECM can determine fuel delivery based on throttle valve angle (driver demand). A broken or loose TP can cause intermittent bursts of fuel from the injector and an unstable idle, because the ECM thinks the throttle is moving.



73049

If the TP circuit is open or shorted, the ECM will set a Code 21. A problem in any of the TP circuits will set a Code 21 (Code 22 on 7.4L (L-29) MPI Models only). Once a trouble code is set, the ECM will use a default value for TP.

DISTRIBUTOR REFERENCE (DIST REF)

GM refers to this as Ignition Control (IC). The distributor reference (engine speed signal) is supplied to the ECM by way of the "Dist Ref Hi" line from the High Energy Ignition (HEI). This pulse counter type input creates the timing signal for the pulsing of the fuel injectors, as well as the Ignition Control (IC) functions. This signal is used for a number of control and testing functions within the ECM.

Engine Control Module (ECM) and Delco EST Distributor System

The Delco EST Distributor operates independent of the ECM. Dwell time and spark advance are controlled by the ECM. Voltage signals between the two are processed by the Ignition Control (IC) module inside the distributor.

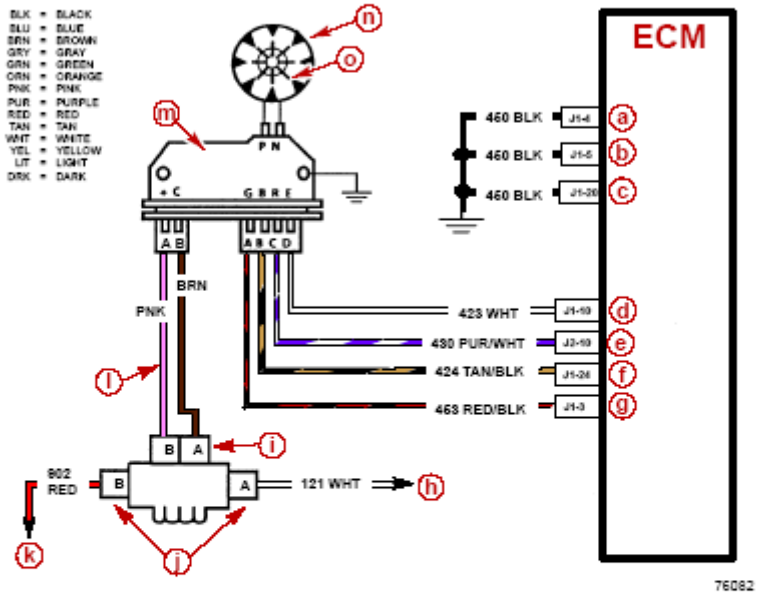
The ECM uses inputs from various sensors to calculate the ignition spark timing. It also uses a signal from the IC module to tell it what the engine rpm is. A circuit within the IC module converts the pickup coil voltage to a square wave engine rpm reference signal. This signal is called Reference High (REF HI). The ECM needs something to compare the REF HI value against. This is done by an additional signal called Reference Low (REF LO). These two signals give the ECM precise engine rpm. Two other lines between the ECM and IC module are called the bypass and IC circuits. They control the IC operation.

Once the ECM knows if the engine is in the cranking or running mode, the ECM will electronically control the spark timing accordingly.

Inside the distributor, the pick-up coil and pole piece will produce a voltage signal for cylinder spark.

The ECM controls the primary current going to the ignition coil. It sends a voltage signal to the IC module that sends a voltage signal to the ignition coil. This signal will trigger the coil creating secondary spark to be produced. The secondary spark is sent to the distributor and then to the correct cylinder by high tension leads.

The Ignition Control (IC) module maintains the base ignition timing. It also has a 27-degree spark advance built into it in case there is a Code for an IC operation failure detected while the engine is running. The engine will continue to run but at reduced performance.



Typical System Shown

- **a** - ECM Ground
- **b** - ECM Ground
- **c** - ECM Ground
- **d** - Ignition Control
- **e** - Distributor Reference HIGH
- **f** - Bypass
- **g** - Distributor Reference LOW
- **h** - To Tachometer
- **i** - 2-Way Black Connector
- **j** - 2-Way Gray Connector
- **k** - From Ignition Relay
- **l** - 2-Way Coil Jumper Harness
- **m** - IC Module
- **n** - 8 Cylinder Distributor
- **o** - Pick-up Coil

Spark Management

High Energy Ignition with Ignition Control (IC)

The Electronic Fuel Injection is controlled by an Engine Control Module (ECM). This module is the nerve/decision center of the system. It uses all the information it gathers to manage ignition spark, delivering increased fuel economy and maximum engine performance.

The system uses inputs from sensors to make decisions on the amount of spark advance or retard allowed.

The system has been designed to control ignition advance and retard electronically by the ECM.

In order for the ECM to properly calculate spark advance, it must always know at what speed the engine is running. The engine speed signal is accomplished by a circuit within the distributor module which converts the pickup coil voltage to a square wave reference signal that can be used by the ECM. This square wave engine speed reference signal is known as REF HI. The ECM must also have something to compare the REF HI value against. Therefore, an additional line is provided between the ECM and the distributor module that is known as REF LO. These two lines, between the ECM and the distributor, provide a precise indication of engine speed.

The two other lines between the ECM and distributor which control the Ignition Control (IC) operation are known as the bypass and IC circuits.

Modes Of Operation

There are two modes of ignition system operation:

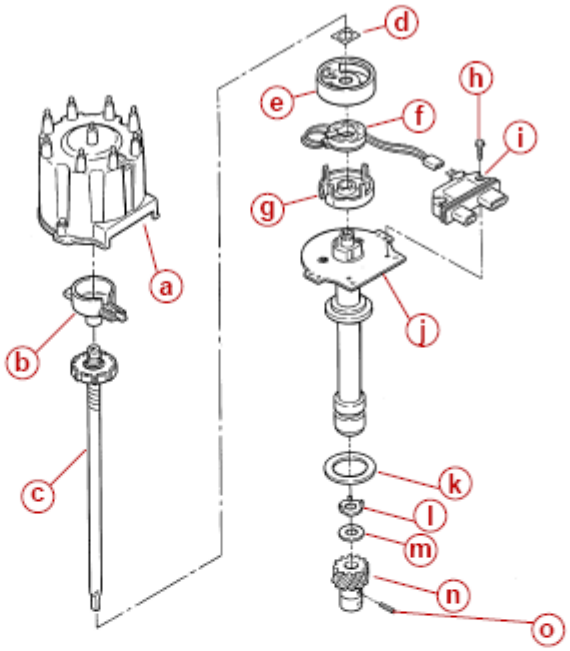
DISTRIBUTOR MODULE MODE

The ignition system operates independent of the ECM. The distributor module module in the distributor maintains a base ignition timing and is able to advance timing to a total of 27 degrees. This mode is in control when a Code 42 is detected while engine is running and will have a noticeable effect on engine operation.

ECM CONTROL MODE

The ECM control mode controls the ignition timing. The ECM calculates the desired ignition timing based on information it gets from input sensors.

DISASSEMBLY



72411

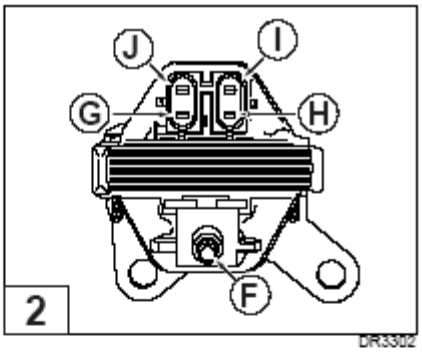
a - Cap
b - Rotor
c - Shaft Assembly
d - Retainer
e - Shield
f - Pickup Coil
g - Pole Piece
h - Screw
i - Module
j - Housing
k - Gasket
l - Tang Washer
m - Washer
n - Gear
o - Pin

NOTE: *Whenever disassembling distributor, the retainer (d) must be replaced. DO NOT attempt to use old retainer.*

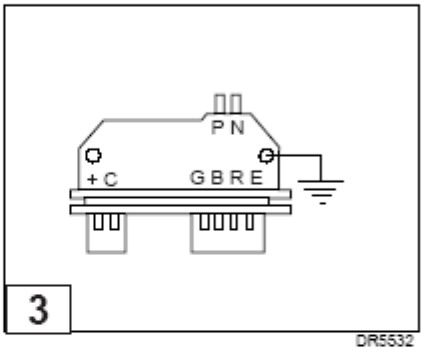
Ignition Coil

The design and construction of the ignition coil affects its output. The DI system ignition coil was designed to produce greater spark voltage, longer spark, and operate at higher RPM. The DI system coil has the secondary windings wrapped around the primary windings. The primary windings are wrapped around an iron core. The coil is not oil filled. The windings are covered in an epoxy compound for protection against moisture and arc-over.

There is an iron laminated square frame around the coil windings. This increases the magnetic flux path and stores energy to produce higher secondary spark voltage. The coil's mounting bracket is attached to the frame.



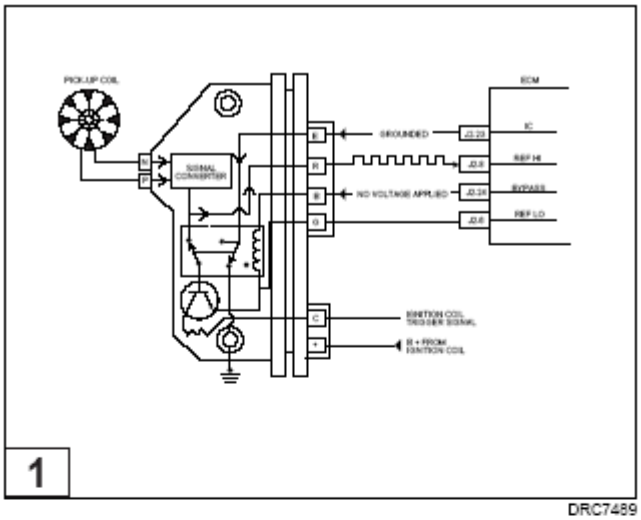
2 The coil generates a high secondary voltage (up to 35,000 volts) when the primary circuit is broken. It is attached to the distributor by a high tension wire connected to the post Ⓕ mounted on top of the coil. The coil has a pair of 2-wire connectors. They're used for battery voltage input Ⓖ, primary voltage sent to the distributor Ignition Control module Ⓗ, trigger signal from the Ignition Control module ①, and for a tach output signal Ⓙ.



Ignition Control (IC) Module

3 The Ignition Control (IC) module is located in the distributor. It is mounted by two screws that are used for a ground. The IC module is a solid state unit with transistorized relays and switches for controlling circuits. The IC module has several functions:

- It changes the analog signal ① of the pickup coil to a square digital signal.
- It sends the digital signal as a reference signal (REF HI) ② to the ECM for ignition control.
- It provides a ground reference (REF LO) ③.
- It provides a means for the ECM to control spark advance (BYPASS ④ and IGNITION CONTROL ⑤) called Ignition Control Mode.
- It provides a limited means of controlling spark advance without ECM input, called Module Mode.
- It provides the trigger signal ⑥ for the ignition coil.



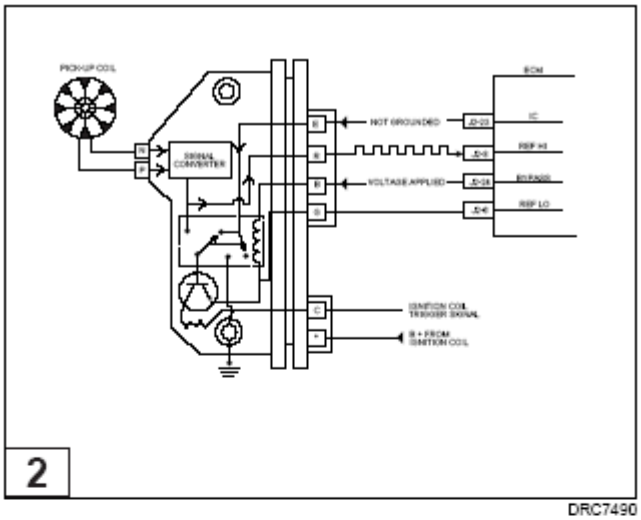
DRC7489

IC Operation - Module Mode (Cranking)

1 The following describes IC operation during cranking and when the engine starts running. To help understand how IC circuits operate, a relay with a double set of contact points is shown inside the IC module. Actually solid state circuitry is used, but showing a relay makes it easier to visualize how the IC functions.

1 During cranking, the relay is in a de-energized position. This allows a set of contact points to connect the pickup coil to the base of the transistor. When the pickup coil applies a positive voltage to the transistor, it turns "ON". When voltage is removed, the transistor turns "OFF". When the transistor turns "ON", current flows through the primary windings of the ignition coil. When it turns "OFF", the primary current stops and a spark is developed at the spark plug. A small amount of advance is built into the IC module, in case the engine remains in Module Mode.

1 With the relay de-energized, a set of contacts (shown "closed") would ground the IC line signal. No voltage is applied by the ECM to the BYPASS line .



DRC7490

IC Operation - Ignition Control Mode (Running)

2 The ECM constantly monitors engine RPM through the REF HI line. When engine RPM reaches a predetermined value (for this example 400 RPM), the ECM considers the engine running and applies five volts on the BYPASS line to the IC module. This energizes the relay and causes contact set for the pickup coil as well as contact set for the IC line to open. This con- nects the IC line to the base of the power transistor, and bypasses IC module timing control.

The DI system is now controlled by the timing (IC) signal from the ECM, and the time at which the spark occurs can be determined by a variable time circuit in the ECM.

Results Of Incorrect Operation

An open or ground in the BYPASS circuit or connector will cause the engine to run in Module Mode. This will cause reduced performance and poor fuel economy.

Open IC Line

While the engine is cranking, the ECM expects to see the IC signal pulled to virtually zero because it's grounded inside the IC module. If the IC line is open, it cannot be grounded by the module. The ECM IC signal will be able to rise and fall, or do what is called "toggling". The ECM recognizes "toggling" as an abnormal condition, and will not apply bypass voltage to the IC module when the engine reaches run RPM.

Since bypass voltage is not applied to the relay, it remains open. The engine continues to run on pick-up coil triggering, and stays in Module Mode. If this condition were to occur while the engine was running, the engine would stop, but it would restart and run in Module Mode with reduced power.

Grounded IC Line

During cranking, IC voltage would be at virtually zero so the ECM would not recognize a problem. When engine RPM reaches the value for the run condition, the ECM would apply bypass voltage to the IC module. Bypass voltage at the module switches the IC power transistor to the IC line. Because the IC line is grounded, it would have no voltage applied and could not operate the power transistor in order to enter Ignition Control Mode.

If the IC line should become grounded while the engine was running, the engine would stop and be difficult to restart.

Grounded Or Open BYPASS Line

While the engine is cranking, the IC line would be grounded and the ECM would not notice anything abnormal. When run RPM is reached, the ECM would apply voltage to the BYPASS line but because of the ground or open, it would not be able to energize the relay. Therefore, the relay would stay de-energized and the IC line would remain grounded.

When the ECM sees the IC line not "toggling" (i.e. not rising and falling), it will not enter Ignition Control Mode. Since the relay is de-energized, the engine would continue to run in Module Mode.

If this condition were to occur while the engine was running, it would simply operate in Module Mode.

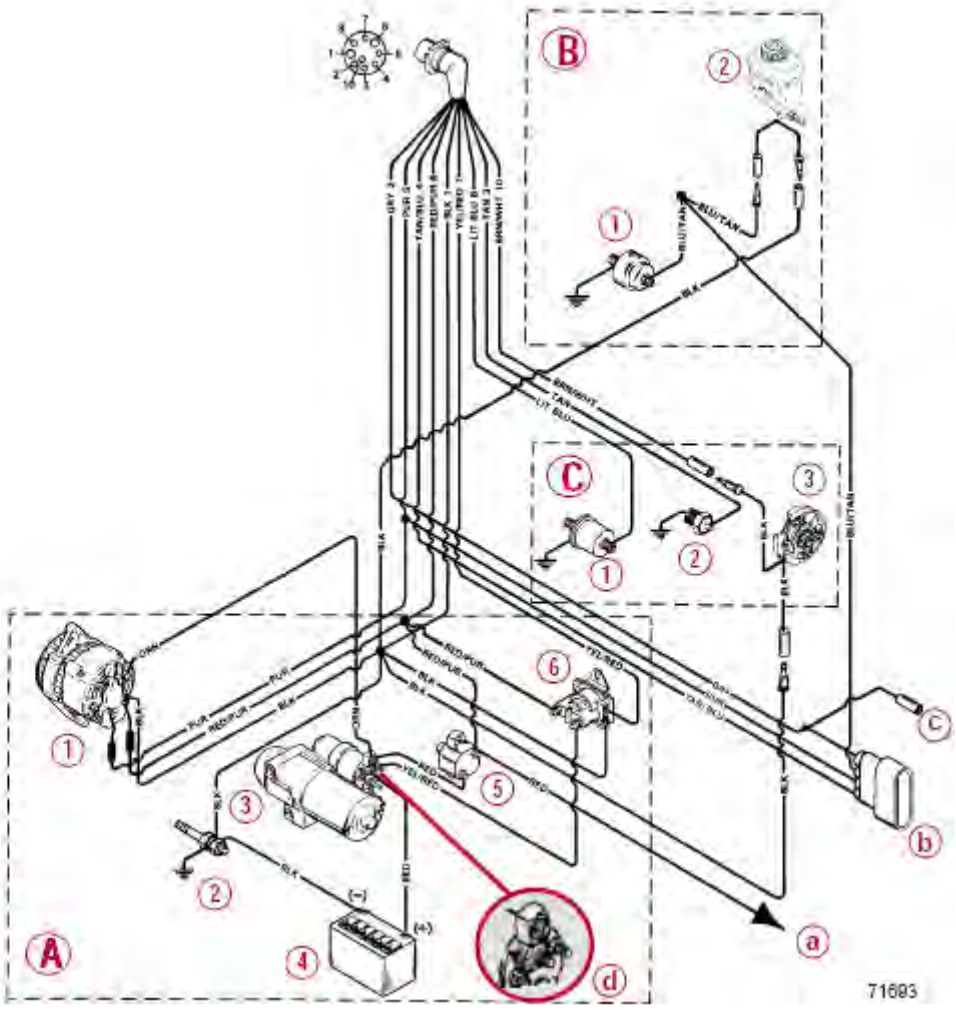
Open Or Grounded REF Hi Line

This line provides the ECM with engine speed (RPM) information. If this line were open or grounded, the ECM would not know that the engine is cranking or running, and would not make any attempt to control spark.

Open Or Grounded REF LO Line

This wire is grounded in the IC module and provides a reference ground from the IC module to the ECM. The ECM compares reference ground with reference high voltage. If this circuit is open, or grounded at any other location than through the IC module, it may cause poor performance.

Starting and Charging System Wiring Harness Diagrams



A - Charging And Starting System

1 - Alternator
2 - Ground Stud
3 - Starter Motor
4 - Battery
5 - Circuit Breaker
6 - Starter Slave Solenoid

B - Audio Warning System

1 - Oil Pressure Switch
2 - Drive Unit Oil Level Bottle Switch

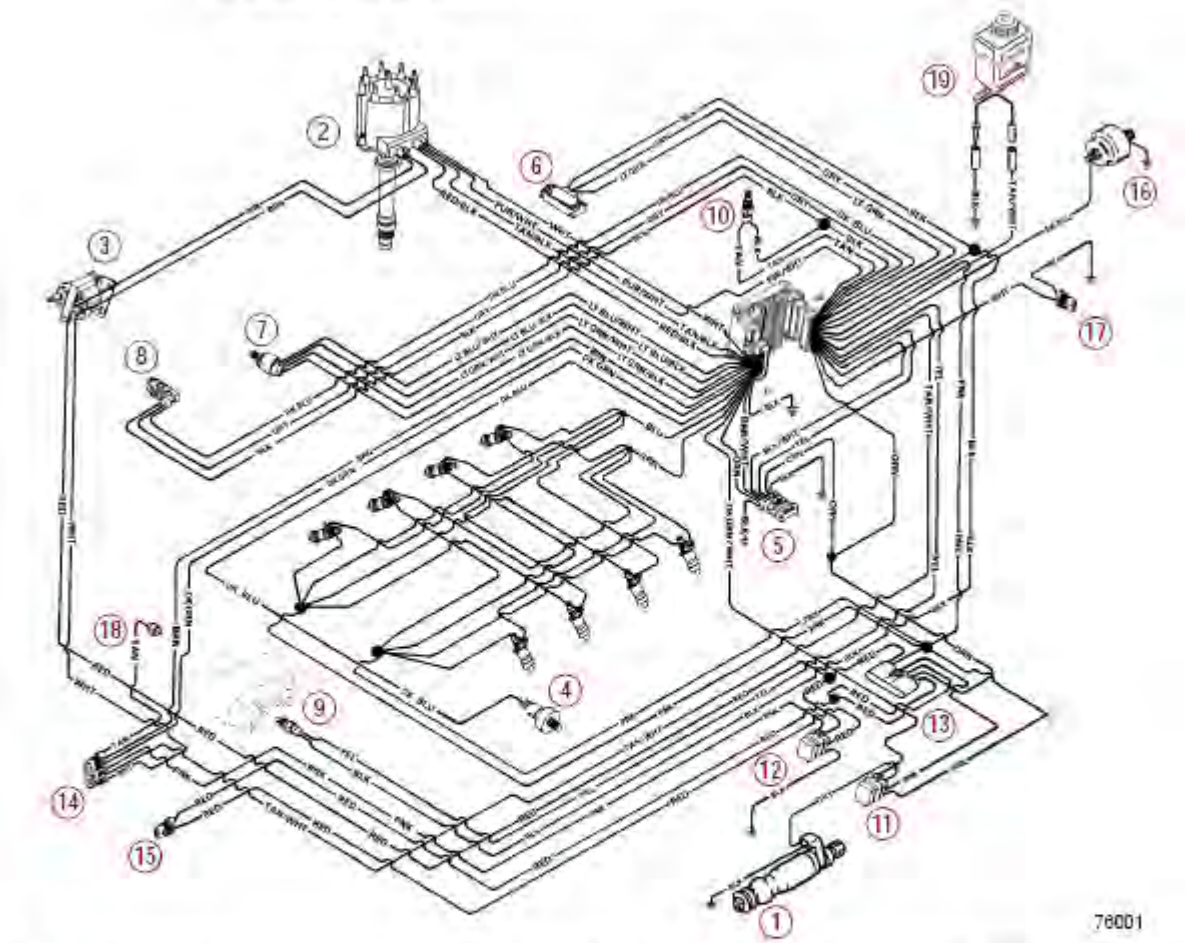
C - Instrumentation System

1 - Oil Pressure Sender
2 - Water Temperature Sender
3 - Trim Sender

a - Positive (12V) Power Wire To Fuel Injection System Harness
b - Harness Connector To Fuel Injection System Harness
c - Auxiliary Tachometer Lead
d - 90 Amp. System Fuse (DO NOT Remove)

NOTE: *All BLACK wires with a ground symbol are interconnected within the EFI system harness.*

NOTE: *Component position and orientation shown is arranged for visual clarity and ease of circuit identification.*



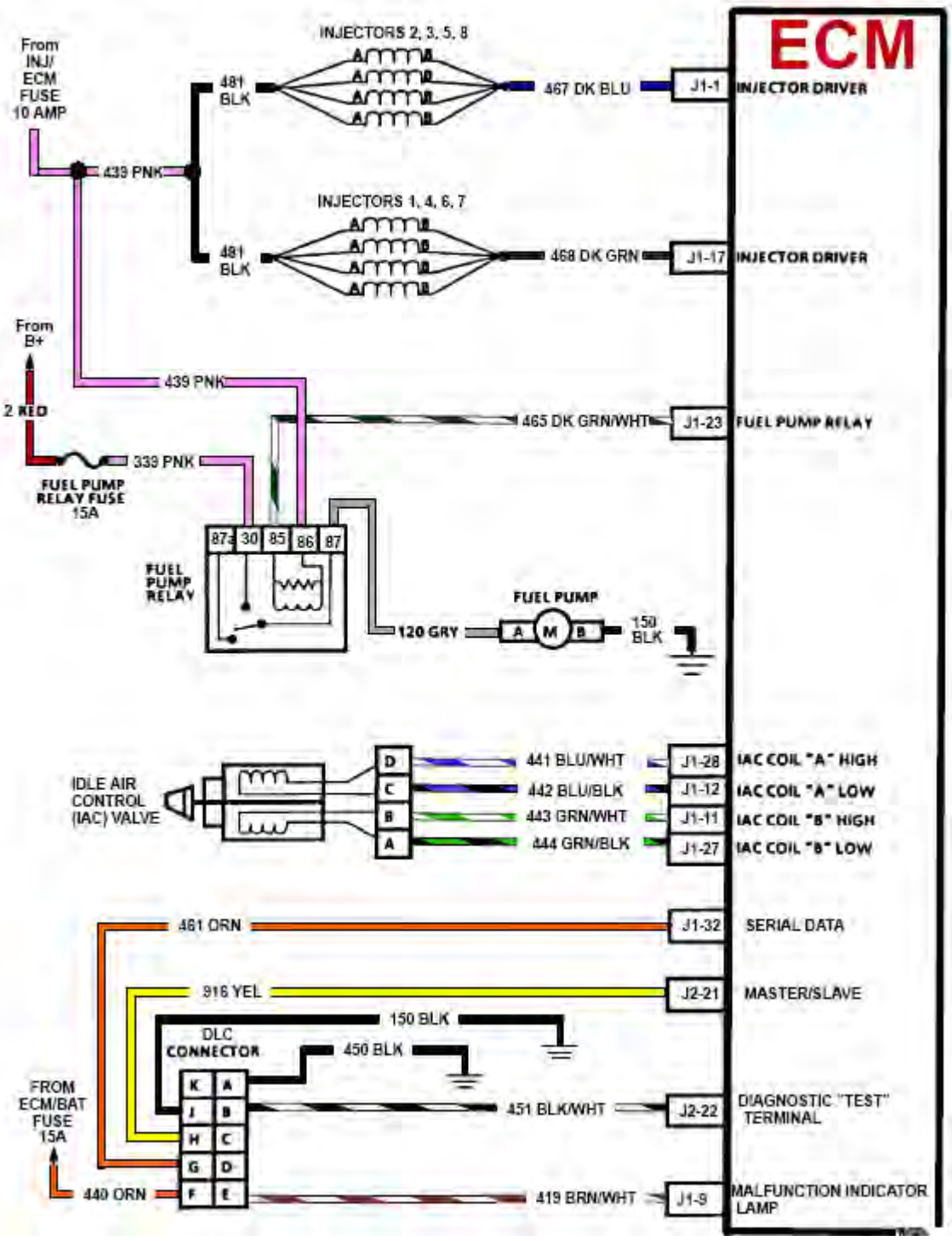
1 - Fuel Pump	13 - Fuses (15 Amp) Fuel Pump, (15 Amp) ECM / DLC / Battery, (10 Amp) ECM / Injector / Ignition / Knock Module
2 - Distributor	14 - Harness Connector To Starting/Charging Harness
3 - Coil	15 - Positive (+) Power Wire To Engine Circuit Breaker
4 - Knock Sensor (KS) Module	16 - Oil Pressure (Audio Warning System)
5 - Data Link Connector (DLC)	17 - Load Anticipation Circuit
6 - Manifold Absolute Pressure (MAP) Sensor	18 - Water Temperature Sender
7 - Idle Air Control (IAC)	19 - Gear Lube Bottle (Not used on Inboard models)
8 - Throttle Position (TP) Sensor	
9 - Engine Coolant Temperature (ECT) Sensor	
10 - Electronic Control Module (ECM)	
11 - Fuel Pump Relay	
12 - Ignition/System Relay	

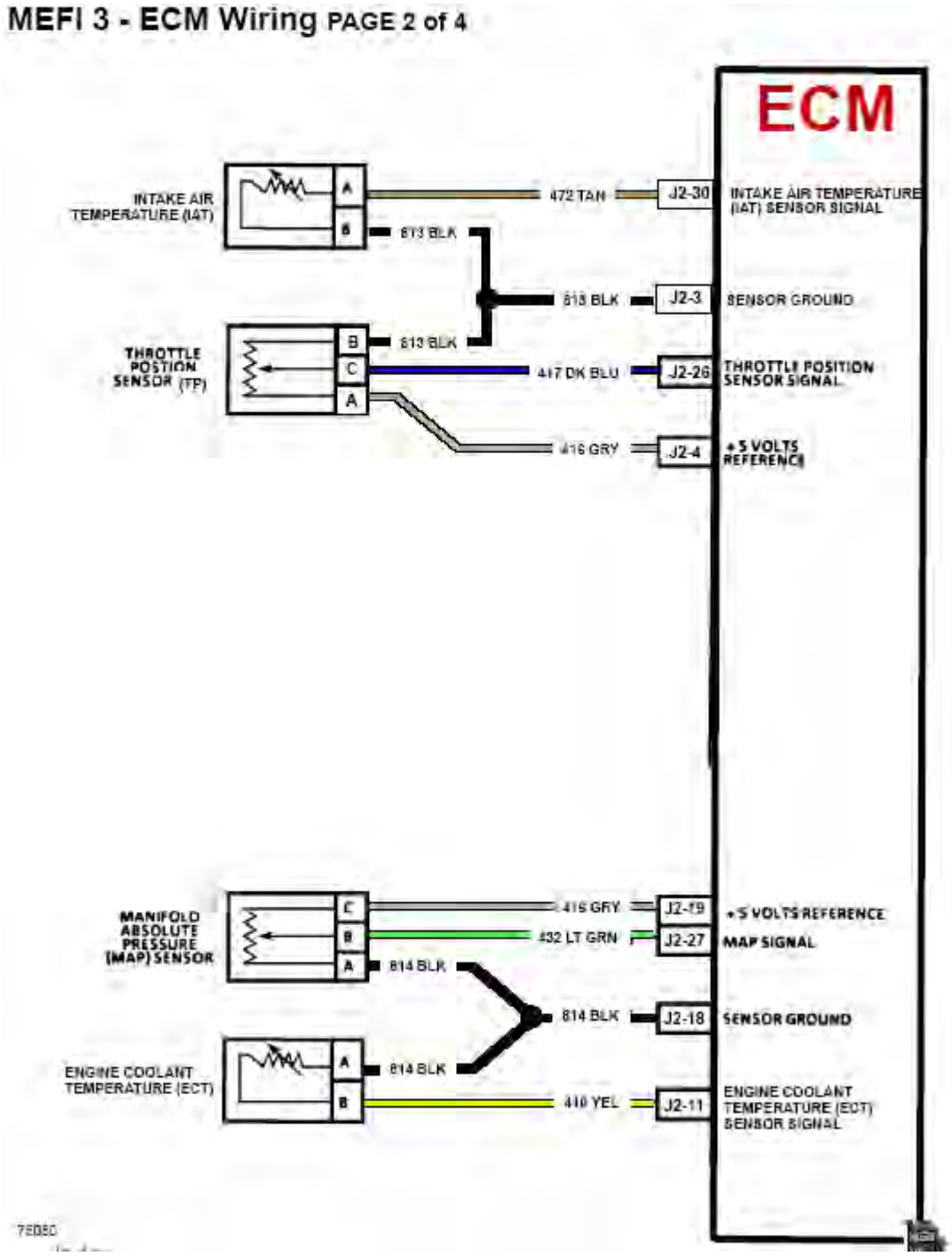
MEFI 3 CODES

Code Number	Connection	Conditions	Comments
14	ECT high	Minimum run time (10 sec) Sensor output high (cold) > 240 counts	Open circuit Faulty sensor
15	ECT low	Minimum run time (10 sec) sensor Sensor output low (hot) < 7 counts	Short circuit Faulty sensor
21	TPS high	Sensor output high (> 250 counts) anytime or, skewed high (> 70) @ < 700 rpm and < 70 kpa for at least 5 seconds	Open circuit, WOT Faulty sensor No reference ground
22	TPS low	Sensor output low (< 4 counts) anytime	Short circuit Faulty sensor No reference voltage
23	MAT high	Minimum run time (10 sec) Sensor output high (cold) > 253 counts	Open circuit Faulty sensor
25	MAT low	Minimum run time (10 sec) sensor Sensor output low (hot) < 7 counts	Short circuit Faulty sensor
33	MAP high	kpa > 80 and tps < 5% and rpm > 500 for at least 5 seconds	Open circuit Faulty sensor No Reference ground
34	MAP low	kpa < 14 and tps > 5% and rpm <300 for at least 0.5 seconds	Short circuit Faulty sensor No reference voltage
41	EST open (GM distributor only)	Ignore first 20 spark events requires 10 faults to set code	Open circuit Faulty ignition module
42	EST grounded	Ignore first 20 spark events requires 10 faults to set code	Short circuit Faulty reference pickup
43	Continuous knock	Must have continuous knock retard for at least 30 seconds	Incorrect base timing Faulty knock sensor
44	No knock	After 513 tdc knock free events, rpm > 3000 and MAP > 70 and filtered sensor noise < 0.14 volts	Disconnected sensor Broken/open circuit Faulty knock sensor

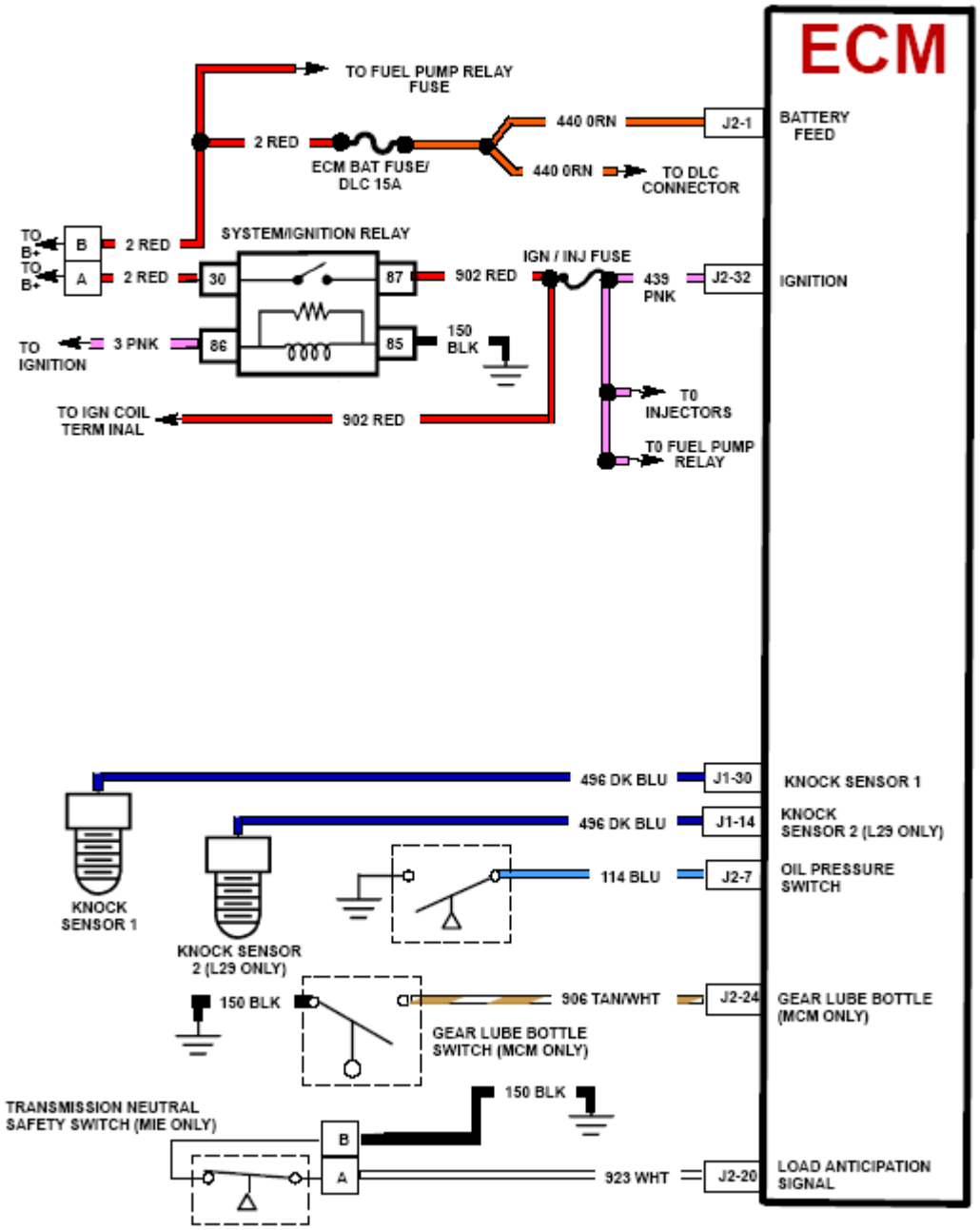
Code Number	Connection	Conditions	Comments
45	Coil driver fault	Ignore first 20 spark events requires 8 faults to set code	Open secondary wire Open primary cable
51	Checksum error	Reserved - Invalid ECM checksum	Bad ECM
61	Fuel pressure high	Minimum run time (10 sec) Sensor output high (> 4.9 volts)	Open circuit Faulty sensor Bad/wrong regulator
62	Fuel pressure low	Minimum run time (10 sec) Sensor output low (< 0.1 volts)	Short circuit Faulty sensor No fuel pump power

MEFI 3 - ECM Wiring PAGE 1 of 4

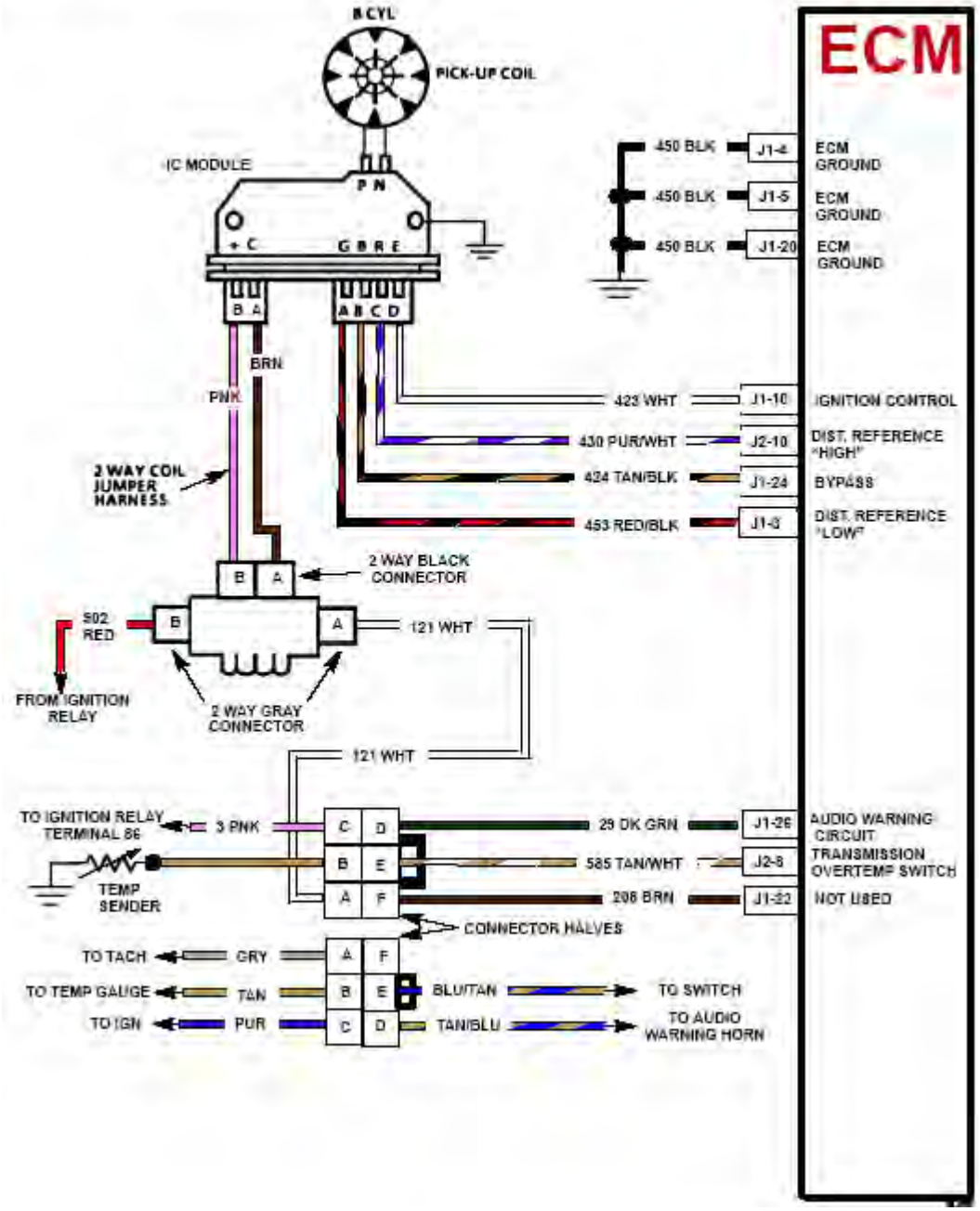



MEFI 3 - ECM Wiring PAGE 2 of 4
ECM
INTAKE AIR TEMPERATURE (IAT)
A
B
472 TAN
J2-30
INTAKE AIR TEMPERATURE (IAT) SENSOR SIGNAL
813 BLK
813 BLK
J2-3
SENSOR GROUND
THROTTLE POSTION SENSOR (TP)
B
C
A
813 BLK
417 DK BLU
J2-26
THROTTLE POSITION SENSOR SIGNAL
416 GRY
J2-4
+5 VOLTS REFERENCE
MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR
C
B
A
416 GRY
J2-19
+5 VOLTS REFERENCE
432 LT GRN
J2-27
MAP SIGNAL
814 BLK
814 BLK
J2-18
SENSOR GROUND
ENGINE COOLANT TEMPERATURE (ECT)
A
B
814 BLK
410 YEL
J2-11
ENGINE COOLANT TEMPERATURE (ECT) SENSOR SIGNAL

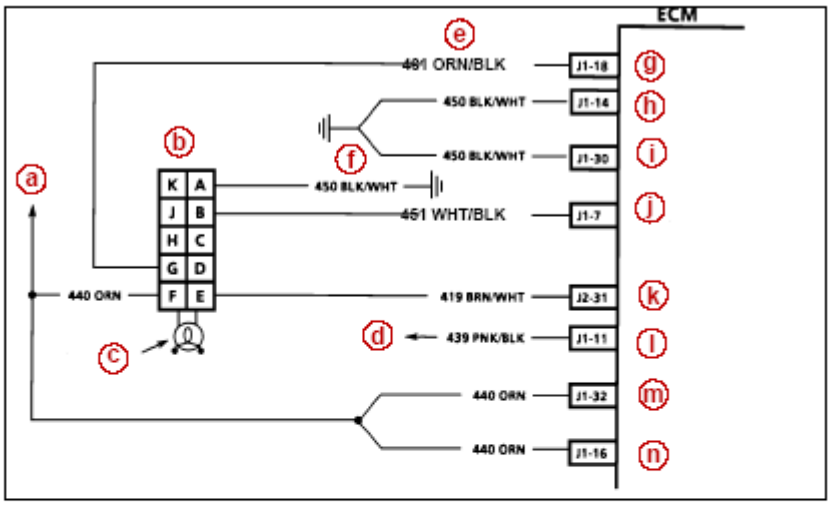
MEFI 3 - ECM Wiring PAGE 3 of 4



MEFI 3 - ECM Wiring PAGE 4 of 4



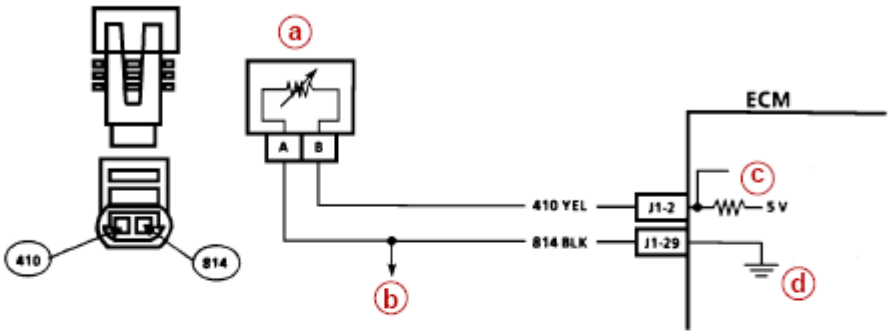
On-Board Diagnostic (OBD) System Check (Non-Scan)



a - ECM/DLC 15 Amp Fuse
b - DLC Connector
c - Marine Diagnostic Code Tool
d - ECM, Injector Knock Sensor Module 10 Amp Fuse
e - (ORN-Some models)
f - (BLK-Some models)
g - Serial Data
h - ECM Ground
i - ECM Ground
j - Diagnostic Test Terminal
k - Malfunction Indicator Lamp
l - Ignition Feed
m - Battery Feed
n - Battery Feed

Diagnostic Testing Without A Scan Tool (Non-Scan)

Code 14 (1 of 3): Engine Coolant Temperature (ECT) Sensor Circuit (Non-Scan)



a - Engine Coolant Temperature (ECT) Sensor
b - To Map Sensor
c - Engine Coolant Temperature (ECT)
d - Sensor Ground

CIRCUIT DESCRIPTION:

The Engine Coolant Temperature (ECT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage on CKT 410 to the sensor. When the engine coolant is cold, the sensor (thermistor) resistance is high; therefore, the ECM will see high signal voltage.

As the engine coolant warms, the sensor resistance becomes less, and the voltage drops.

DIAGNOSTIC AIDS:

An intermittent problem may be caused by a poor or corroded connection, rubbed through wire connection, a wire that is broken inside the insulation, or a corroded wire.

Any circuitry that is suspected as causing the intermittent complaint should be thoroughly checked for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, corroded terminals and/or wiring, or physical damage to the wiring harness. After repairs, clear codes following "Clearing Codes" procedure at the front of this section. Failure to do so may result in codes not properly being cleared. Check harness routing for a potential short to ground in CKT 410. See "Intermittents" in "Troubleshooting."

Code 14 (2 of 3): Engine Coolant Temperature (ECT) Sensor Circuit (Non-Scan)

TEST DESCRIPTION:

Number(s) below refer to step number(s) on the diagnostic table.

Step 2. This step checks if there is a problem with the ECM and wiring or if the problem is the coolant sensor.

Step 3. This step will isolate the problem to CKT 410 (5 volt reference) or to the sensor ground.

Step 6. Check the harness terminals thoroughly for loose connection. If the resistance or the coolant sensor is monitored, the resistance should steadily decrease as the engine coolant warms up. The resistance reading would stabilize when the thermostat opens.

Step 7. This step identifies if CKT 410 is open or shorted to ground.

IMPORTANT: If replacing the ECT, tighten hand tight plus 2-1/2 turns maximum.

STEP	ACTION	VALUE	YES	NO
			PROCEED TO	
1	Was the "On-Board Diagnostic" (OBD) System Check Performed?	–	Step 2	Go to OBD System Check
2	1. Ignition OFF. 2. Disconnect ECT sensor connector. 3. Ignition ON, engine OFF. 4. Connect DVOM across coolant sensor harness terminals. ***Is voltage above 4 volts?***		Step 6	Step 3
3	1. Connect positive DVOM lead from harness terminal "B" CKT 410 (5 volt reference). 2. Connect negative DVOM lead to a good ground (–) on engine. ***Is voltage above 4 volts?***		Step 10	Step 4
4	1. Remove DVOM. 2. Ignition ON. 3. Connect a test light to battery positive (B+). 4. Touch test light to sensor harness terminal "B" (CKT 410). ***Is test light on?***		Step 7	Step 5

Code 14 (3 of 3): Engine Coolant Temperature (ECT) Sensor Circuit (Non-Scan)

STEP	ACTION	VALUE	YES	NO
			PROCEED TO	
5	CKT 410 open, faulty connection at ECM, or faulty ECM.		–	–
6	Intermittent connections, faulty ECT sensor (refer to chart below for sensor values).		–	–
7	Disconnect J-1 connector. ***Is test light on?***		Step 8	Step 9
8	CKT 410 shorted to ground.		–	–
9	CKT 410 shorted to sensor ground or faulty ground.		–	–
10	Open sensor ground CKT 814, faulty connection at ECM, or faulty ECM.		–	–

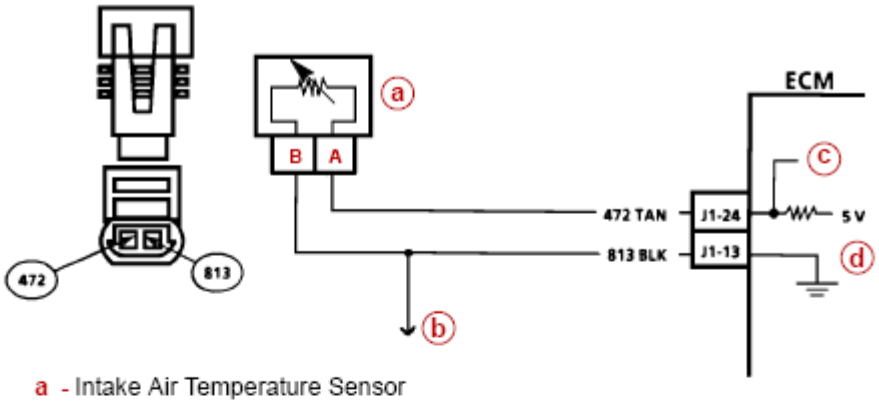
ECT Sensor		
Temperature - to - Resistance Values (Approximate)		
°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

Code 21 (2 of 2): Throttle Position (TP) Sensor Circuit (Non-Scan)

STEP	ACTION	VALUE	YES	NO
			PROCEED TO	
1	Was the "On-Board Diagnostic" (OBD) System Check Performed?	–	Step 2	Go to OBD System Check
2	1. Ignition OFF. 2. Disconnect throttle position sensor harness connector. 3. Ignition ON. 4. Connect DVOM from harness terminal "A" (5 volt reference to harness terminal "B" (sensor ground). ***Is voltage reading over 4 volts?***	–	Step 3	Step 6
3	Connect DVOM from harness terminal "A" (CKT 416) to harness terminal "C" (throttle position sensor signal, CKT 417). ***Is voltage reading over 4 volts?***	–	Step 4	Step 5
4	1. Ignition OFF. 2. Connect a test light to battery positive (B+). 3. Touch test light to harness terminal "C" (throttle position sensor signal). ***Is test light on?***	–	Step 7	Step 10
5	Connect DVOM between harness terminal "C" and engine ground (–). ***Is voltage over 4 volts?***	–	Step 8	Step 9
6	Connect DVOM from throttle position sensor harness terminal "A" to a good ground on engine. ***Is voltage over 4 volts?***	–	Step 14	Step 13
7	1. Disconnect ECM. 2. Touch test light to harness terminal "C" (throttle position sensor signal). ***Is test light on?***	–	Step 11	Step 12
8	Check for CKT 417 shorted to voltage.	–	–	–
9	Open or CKT 417, faulty connection at ECM or faulty ECM.	–	–	–
10	Throttle position sensor faulty.	–	–	–
11	Check for CKT 417 shorted to ground.	–	–	–
12	Faulty ECM.	–	–	–
13	Faulty connection at ECM, CKT 416, shorted to ground or faulty ECM.	–	–	–
14	Faulty connection at ECM, CKT 813 open or faulty ECM.	–	–	–

Index

Code 23 (1 of 2): Intake Air Temperature (IAT) Sensor Circuit (Non-Scan)



a - Intake Air Temperature Sensor
b - To TP Sensor
c - IAT Sensor Signal
d - Sensor Ground

CIRCUIT DESCRIPTION:

The Intake Air Temperature (IAT) sensor uses a thermistor to control the signal voltage to the Electronic Control Module (ECM). The ECM applies a voltage (about 5 volts) on CKT 472 to the sensor. When the air is cold, the sensor (thermistor) resistance is high; therefore, the ECM will see a high signal voltage. If the air is warm, the sensor resistance is low; therefore, the ECM will see a low voltage.

DIAGNOSTIC AIDS:

An intermittent problem may be caused by a poor or corroded connection, rubbed through wire connection, a wire that is broken inside the insulation, or a corroded wire.

Any circuitry that is suspected as causing the intermittent complaint should be thoroughly checked for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, corroded terminals and/or wiring, or physical damage to the wiring harness. After repairs, clear codes following "Clearing Codes" procedure at the front of this section. Failure to do so may result in codes not properly being cleared. If Code 21 is also set, check CKT 813 for faulty wiring or connections. Check terminals at sensor for good contact.

TEST DESCRIPTION:

Number(s) below refer to step number(s) on the diagnostic table.

Step 2. A Code 23 will set due to an open sensor, wire, or connection. This step will determine if the wiring and ECM are OK.

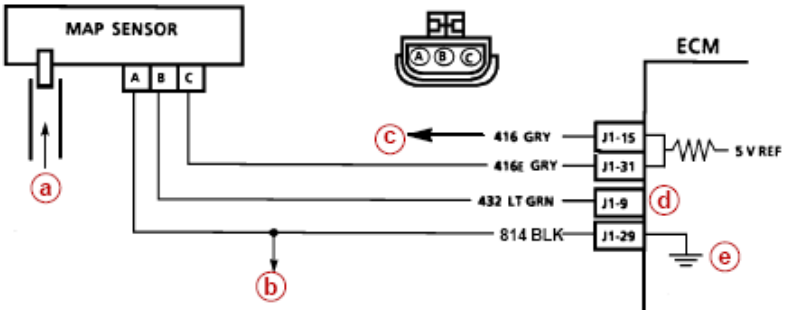
Step 3. If the resistance is greater than 25,000 ohms, replace the sensor.

Code 23 (2 of 2): Intake Air Temperature (IAT) Sensor Circuit (Non-Scan)

STEP	ACTION	VALUE	YES	NO
			PROCEED TO	
1	Was the "On-Board Diagnostic" (OBD) System Check Performed?	–	Step 2	Go to OBD System Check
2	1. Disconnect IAT sensor. 2. Ignition ON, Engine OFF. 3. Using a DVOM, check voltage between IAT sensor harness terminals.	Greater Than 4 Volts	Step 3	–
		Less Than 4 Volts	Step 5	–
3	Check resistance across IAT sensor terminals. It should be less than 25,000 Ohms, refer to table for approximate temperature to resistance values. ***Is it Less Than 25,000 Ohms?***	–	Step 4	Step 8
4	Check for signal circuit shorted to voltage. If not shorted to voltage, code 23 is intermittent.	–	–	–
5	Check for voltage between harness connector signal circuit and ground.	Greater Than 4 Volts	Step 6	–
		Less Than 4 Volts	Step 7	–
6	Faulty sensor ground circuit, faulty connections, or faulty ECM.	–	–	–
7	Open signal circuit, faulty connection, or faulty ECM.	–	–	–
8	Replace sensor.	–	–	–

IAT Sensor		
Temperature - to - Resistance Values (Approximate)		
°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

Code 33 (1 of 3): Manifold Absolute Pressure (MAP) Sensor Circuit (Non-Scan)



a - Manifold Absolute Pressure (Vacuum)
b - To ECT Sensor
c - To TP Sensor
d - Map Signal
e - Map And ECT Ground

CIRCUIT DESCRIPTION:

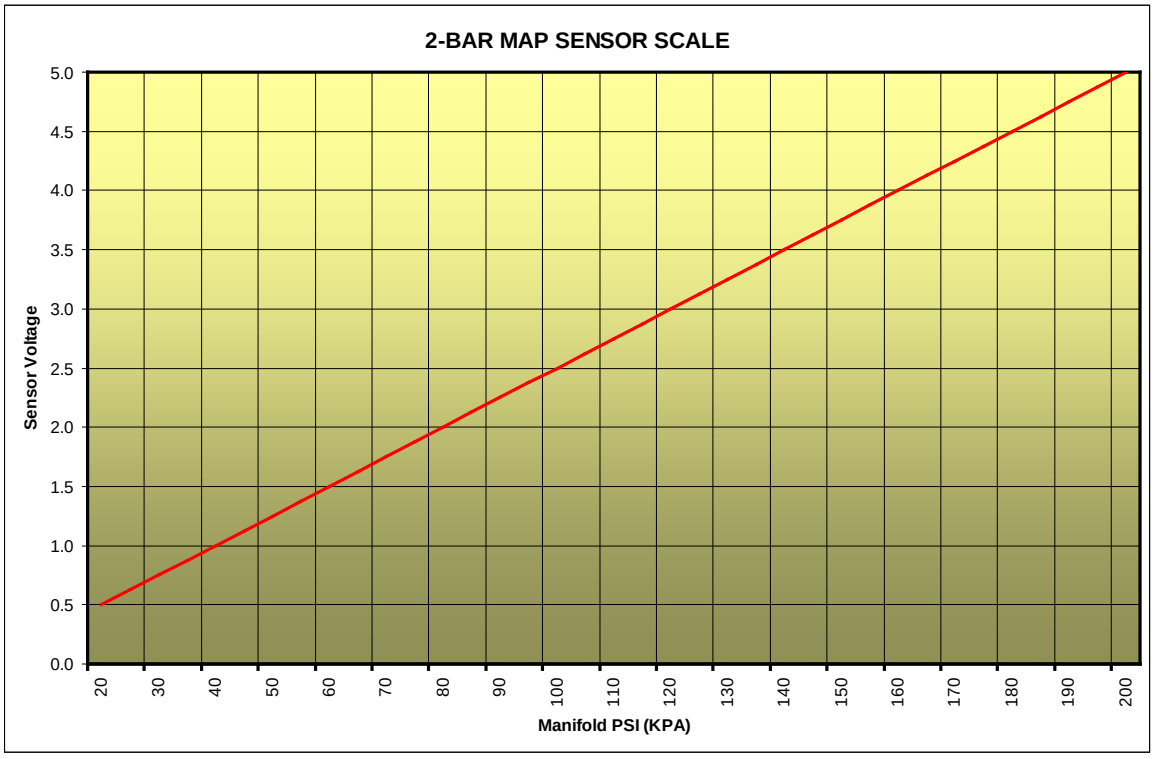
The Manifold Absolute Pressure (MAP) sensor responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1-1.5 volts at closed throttle idle, to 4-4.8 volts at Wide Open Throttle (low vacuum).

If the MAP sensor fails, the ECM will substitute a fixed MAP value and use the engine rpm to control fuel delivery.

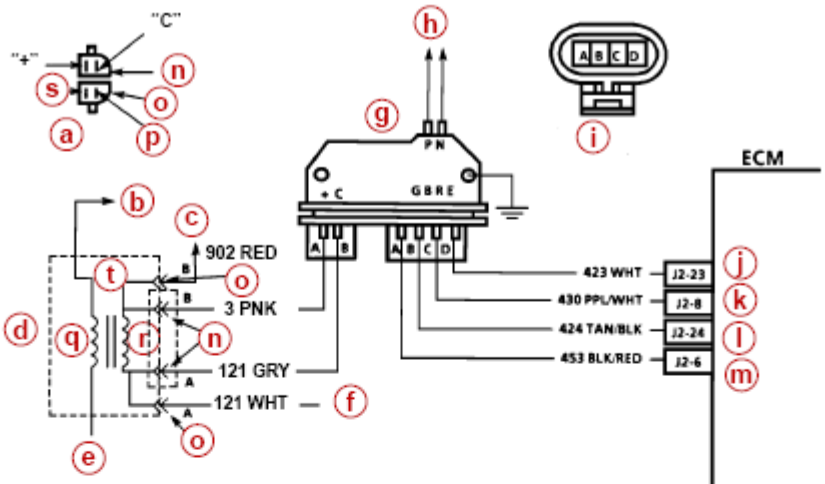
DIAGNOSTIC AIDS:

An intermittent problem may be caused by a poor or corroded connection, rubbed through wire connection, a wire that is broken inside the insulation, or a corroded wire.

Any circuitry that is suspected as causing the intermittent complaint should be thoroughly checked for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, corroded terminals and/or wiring, or physical damage to the wiring harness. After repairs, clear codes following "Clearing Codes" procedure at the front of this section. Failure to do so may result in codes not properly being cleared. If Code 14 is also set, check for open ground CKT 814.



Code 42 (1 of 3): Ignition Control (IC) Circuit (Non-Scan)



a - Ignition Coil Connector
b - Distributor
c - To System Relay
d - Ignition Coil
e - Distributor
f - In-Line Harness (Tach)
g - Ignition Control Module
h - Pick-Up Coil
i - Distributor 4 Terminal Connector
j - Ignition Control (IC)
k - Distributor Reference "High"
l - Bypass
m - Distributor reference "Low"
n - Black Connector
o - Gray Connector
p - Tachometer
q - Secondary
r - Primary
s - Ignition
t - Ignition Coil

CIRCUIT DESCRIPTION:

When the system is running on the ignition module, that is, no voltage on the bypass line, the ignition module grounds the IC signal. The ECM expects to detect no voltage on the IC line during this condition. If it detects a voltage, it sets Code 42 and will not go into the IC mode.

When the rpm for IC is reached (about 300 rpm), and bypass voltage applied, the IC should no longer be grounded in the ignition module, so the IC voltage should be fluctuating.

If the bypass line is open or grounded, the ignition module will not switch to IC mode so the IC voltage will be low and Code 42 will be set.

If the IC line is grounded, the ignition module will switch to IC but, because the line is grounded, there will be no IC signal. A Code 42 will be set.

Code 42 (2 of 3): Ignition Control (IC) Circuit (Non-Scan)

DIAGNOSTIC AIDS:

An intermittent problem may be caused by a poor or corroded connection, rubbed through wire connection, a wire that is broken inside the insulation, or a corroded wire.

Any circuitry that is suspected as causing the intermittent complaint should be thoroughly checked for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, corroded terminals and/or wiring, or physical damage to the wiring harness. After repairs, clear codes following "Clearing Codes" at the front of this section. Failure to do so may result in codes not properly being cleared.

TEST DESCRIPTION:

Number(s) below refer to step number(s) on the diagnostic table.

Step 2. Code 42 means the ECM has seen an open or short to ground in the IC or bypass circuits. This test confirms Code 42 and that the fault causing the code is present.

Step 3. Check for a normal IC ground path through the ignition module. An IC CKT 423 shorted to ground will also read more than 3000 ohms; however, this will be checked later.

Step 6. As the test light voltage touches CKT 424, the module should switch, causing the DVM reading to go from over 3000 ohms to under 1000 ohms. The important thing is that the module "switched."

Step 7. The module did not switch and this step checks for:

- IC CKT 423 shorted to ground.
- Bypass CKT 424 open.
- Faulty ignition module connection or module.

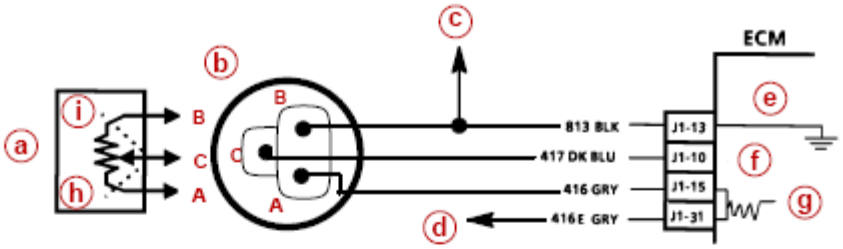
Step 8. Confirms that Coded 42 is a faulty ECM and not an intermittent in CKT 423 or CKT 424.

STEP	ACTION	VALUE	YES	NO
			PROCEED TO	
1	Was the "On-Board Diagnostic" (OBD) System Check Performed?	–	Step 2	Go to OBD System Check
2	1 Install Marine Diagnostic Code Tool. 2. Clear codes (refer to clearing codes). 3. Idle engine for one minute or until mal-function indicator light comes ON. 4. Ignition ON, engine stopped. 5. Enter "Service Mode" on code tool and note codes. ***Is Code 42 Present?***	–	Step 3	Step 12

Code 42 (3 of 3): Ignition Control (IC) Circuit (Non-Scan) (Continued)

3	1. Ignition OFF. 2. Disconnect ECM J1 and J2 connectors. 3. Ignition ON. 4. Use DVOM with selector in the OHMS range. 5. Probe ECM harness connector CKT 423 with DVOM to ground. It should read more than 3000 Ohms. ***Does it?***	–	Step 4	Step 5
4	Probe ECM harness connector CKT 424 with a test light connected to battery positive (B+). ***Is test light on?***	–	Step 13	Step 6
5	Open CKT 423, faulty connection or faulty ignition module.	–	–	–
6	With Ohmmeter connected to ECM harness CKT 423 and ground (–), probe harness CKT 424 with test light connected to battery positive (B+). As test light contacts CKT 424, resistance should change from over 3000 Ohms to under 1000 Ohms. ***Does it?***	–	Step 8	Step 7
7	Disconnect distributor 4-way connector. Connect Ohmmeter between CKT 423 and ground (–). Resistance should have gone high (open circuit). ***Does it?***	–	Step 9	Step 10
8	Reconnect ECM and idle engine for 1 minute or until code 42 sets. ***Does Code 42 Set?***	–	Step 11	Step 12
9	CKT 424 open, faulty connections, or faulty ignition module.	–	–	–
10	CKT 423 shorted to ground.	–	–	–
11	Faulty ECM.	–	–	–
12	Code 42 is intermittent. Refer to "Diagnostic Aids."	–	–	–
13	Disconnect ignition module 4-way connector. ***Is test light on?***	–	Step 14	Step 15
14	CKT 424 shorted to ground.	–	–	–
15	Faulty ignition module.	–	–	–

Code 21 (1 of 2): Throttle Position (TP) Sensor Circuit (Non-Scan)



a - Throttle Position Sensor
b - Front View Of Connector
c - To IAT Sensor
d - To Map Sensor
e - Sensor Ground
f - TP Signal
g - 5V Reference
h - Wide Open Throttle
i - Idle

CIRCUIT DESCRIPTION:

The Throttle Position (TP) sensor provides a voltage signal that changes, relative to the throttle blade. Signal voltage should vary from about .7 volts at idle to about 4.8 volts at Wide Open Throttle (W.O.T.).

DIAGNOSTIC AIDS:

An intermittent problem may be caused by a poor or corroded connection, rubbed through wire connection, a wire that is broken inside the insulation, or a corroded wire.

Any circuitry that is suspected as causing the intermittent complaint should be thoroughly checked for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections, corroded terminals and/or wiring, or physical damage to the wiring harness. After repairs, clear codes following "Clearing Codes" procedure at the front of this section. Failure to do so may result in codes not properly being cleared. If Code 23 is also set, check CKT 813 for faulty wiring or connections. Check terminals at sensor for good contact.

TEST DESCRIPTION:

Number(s) below refer to step number(s) on the diagnostic table.

Step 2. This step checks for a voltage from terminal "A" (5 volt reference) to terminal "B" (sensor ground).

Step 3. This step determines if the TP sensor signal circuit to the ECM is open.

Step 4. This step completes the test for the ECM and wiring. If the test light is not ON, the TP sensor has an internal problem.

Step 6. This step will identify if the problem is in the supply or ground circuit.

MERCURY Racing **service bulletin**

MERCRUISER HI-PERFORMANCE SERIES No. 2001-01

☐ WARRANTY INFORMATION ☑ SERVICE INFORMATION

▲ = Revised May 2002. This bulletin supercedes the previous bulletin 2001-01 April 2001

Engine Block Water Pressure Requirements

Models

All MerCruiser Hi-Performance Series Bravo Models.

Situation

LOW OR EXCESSIVE ENGINE WATER PRESSURE

▲CAUTION

Overheating from insufficient cooling water will cause engine and drive system damage. Ensure that there is sufficient water always available at water inlet holes during operation.

Engine water pressure has become an increased concern on MerCruiser Hi-Performance Series engines that make use of the dual water inlet Bravo gear case. The dual water inlet gear case may not supply adequate water pressure and flow to the engine at the high drive installation "X" dimension heights that were used with the Low Water Inlet gear case. The power package installer must verify that the drive height will provide the engine with an adequate flow of water that meets the Mercury Racing specification for block water pressure.

Block Water Pressure Specification

- 20-30 psi (138-207 kPa) at Wide Open Throttle (WOT)
- Take pressure readings at the block drains on either side of the engine.
- Test at varying trim angles and in turns.

Operating engine with block water pressure below 20 psi (138 kPa):

- Overheating and engine damage can occur.

Operating engine with block water pressure above 30 psi (207 kPa):

- Leaks at the water pump and head gasket as well as water hose failure.

GEAR CASE FEATURES THAT AFFECT WATER PRESSURE

Low Water Pickup Gear Case

- Water inlets located below torpedo to provide water pressure at higher "X" dimensions than with a dual water inlet gear case.
- Due to a small amount of total water inlet area, there is high suction at the water inlets. The results of which are:
  a. Will clog easily with any bottom contact.
  b. Susceptible to clogging if run close to the bottom in shallow water or operated in weedy areas.
- At positive trim angles the inlets are under the torpedo in a low pressure area and may not supply adequate cooling water.

Dual Water Inlet Gear Case

- Will self clean if plugged by incidental contact with bottom, run very close to the bottom in shallow water or operated in weedy areas. (See following information on how to clear a gear case that has become clogged)
- Can deliver water to engine at all trim angles and turning attitudes if the gear case is not installed at too high an "X" dimension.
- Has increased total water inlet area which slows the velocity of the incoming water. The water inlets are less likely to draw in weeds and debris with lower water velocity.

Correction

BLOCK WATER PRESSURE IS BELOW SPECIFICATION - DUAL WATER INLET GEAR CASE

- Lower the "X" dimension.
- Install stainless steel plugs in the upper 4 holes of the strut water inlets (See information following on installing plugs).
- Install a low water pickup gear case.
- Install a transom or through-hull water pick-up.

NOTE: *Because stepped bottom boats have a layer of air under the boat, engine overheating can occur due to an aerated water supply with the use of transom or through-hull water pickups. Do not locate water pick-ups in an aerated water supply.*

BLOCK WATER PRESSURE IS BELOW SPECIFICATION - LOW WATER INLET GEAR CASE

- Lower the "X" dimension.
- Change to a propeller that will reduce the positive trim angle of the gear case.
- Install a transom or through-hull water pick-up.

NOTE: Because stepped bottom boats have a layer of air under the boat, engine overheating can occur due to an aerated water supply with the use of transom or through-hull water pickups. Do not locate water pick-ups in an aerated water supply.

BLOCK WATER PRESSURE IS ABOVE SPECIFICATION - LOW WATER OR DUAL WATER INLET GEAR CASE

- ▲Install Water Bypass Kit P/N 863208A3.

INSTALLING PLUGS IN STRUT INLETS OF DUAL WATER INLET DRIVE

Plug the upper four strut water inlet holes on each side of the gear case with stainless steel plugs (P/N 22-16581).

1. Tap water inlet holes with a 1/16-27 tapered pipe tap. Tap only to the depth required to bring the head of the plug flush with the water inlet hole.
2. Coat threads of stainless steel plugs with Mercury/Quicksilver Perfect Seal and thread into tapped holes until flush.
3. Paint plugs to help retard corrosion.

CLEARING A DUAL WATER INLET DRIVE

If engine temperature begins to rise and clogging of the water inlets is suspected.

- Idle the boat out to deep water.
- Bring the boat up on plane but operate at a moderate speed until the engine temperature and block water pressure returns to normal.

If engine temperature is normal but block water pressure is low.

- Clear the line going to the block water pressure gauge. It may take several clearings before the engine and line are free of debris.

Warranty

Proper installation of the MerCruiser Hi-Performance Series power package is the responsibility of the installer. Thorough boat testing must be done to insure that Mercury's specification for block water pressure is met.

SOME GENERAL EXCLUSIONS FROM WARRANTY

- Modifications to the drive (plugging the upper strut water inlets) cooling water system or boat in order to bring the engine water pressure into the required specification.
- Component failures due to overheating or excessive water pressure.

LIMITED WARRANTY

All merchandise manufactured by Whipple Industries is fully warranted against defects in workmanship and materials to the original purchaser of the Whipple Supercharger System. The limited warranty must be signed, dated and returned to Whipple Industries within 14 days of the purchase date accompanied by a copy of the original sales invoice.

If an item is suspected of being defective, return it to Whipple Industries for inspection after obtaining the proper Return Authorization Number. If an item is determined to be defective, we will repair or replace it at our discretion within a period of one year from the shipping date on your invoice.

Whipple Industries Inc. limited warranty specifially does not apply to products which have been (a) modified or altered in any way, (b) subjected to adverse conditions suach as misuse, neglect, accident, improper installation or adjustment, dirt, or other contaminants, water, corrosion or faulty repair; or (c) used in other than those specifically recommended by Whipple Industries Inc. All products designed for off-road use are considered racing parts and carry no warranty, either expressed or implied, as we have no control over how they are used.

On warranty items, repair/replacements will be limited to parts manufactured by Whipple Industries and will not include claims for labor or inconvenience. All other merchandise distributed by Whipple Industries is warranted in accordance with the respective manufacturer's own terms of warranty. This warranty is expressly made in lieu of any and all other warranties expressed or implied, including the warranties of merchantability and fitness.

Whipple Industries will not be responsible for any other expenses incurred by the customer under the terms of this warranty, nor shall it be responsible for any damages either consequential, special, contingent, expenses or injury arising directly or indirectly from the use of these products.

Whipple Industries reserves the right to determine whether the terms of the warranty, set out above, have been properly complied with. In the event that the terms are not complied with, Whipple Industries shall be under no obligation to honor this warranty. By signing this form, you understand and agree to the terms above.

NAME (Print) _____ ADDRESS _____

SIGNATURE _____ CITY _____ STATE _____ ZIP _____

DATE _____ PHONE _____

SC SERIAL # _____ EMAIL _____

(Found on compressor bearing plate) (Optional)

VIN OR VESSEL # _____