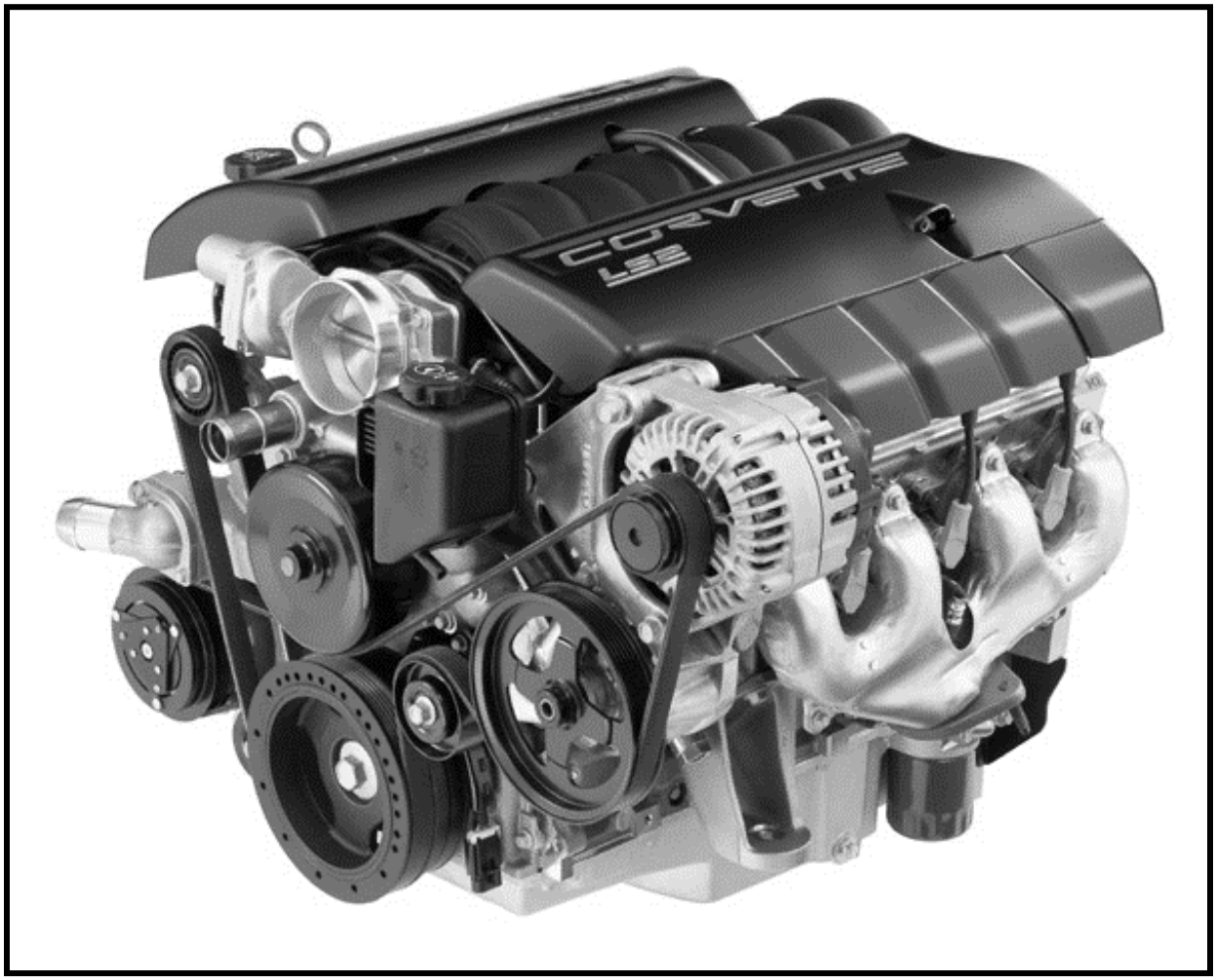
PAINLESS®

PERFORMANCE PRODUCTS



Wire Harness Installation Instructions

For Installing Harness Numbers:

60520: 05 – 06 GM LS2 EFI Harness - Throttle by Wire

Manual P/N 90543

Painless Performance Products recommends you, the installer, read this installation manual from front to back before installing this harness.

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If you have any questions concerning the installation of this harness, feel free to call Painless Performance Products' Tech Line at 1-800-423-9696. The Tech Line can be reached from 8 A.M. to 5 P.M. central time, Monday through Thursday, and 8 A.M. to 4:30 P.M. on Fridays.

We have attempted to provide you with as accurate of instructions as possible and are always concerned about corrections or improvements that can be made. If you have found any issues or omissions, or simply have comments or suggestions concerning these instructions, please write us at the above address, send us a fax at (817) 244-4024, or email us at support@painlessperformance.com. We sincerely appreciate your business.

Painless Performance Products, LLC shall in no event be liable in contract or tort (including negligence) for special, indirect, incidental, or consequential damages, such as but not limited to, loss of property damage, or any other damages, costs or expenses which might be claimed as the result of the use or failure of the goods sold hereby, except only the cost of repair or replacement.

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CAUTION: BEFORE THE REMOVAL OF YOUR ORIGINAL HARNESS AND/OR THE INSTALL OF YOUR NEW PAINLESS HARNESS, DISCONNECT THE POWER FROM YOUR VEHICLE BY REMOVING THE NEGATIVE OR POSITIVE BATTERY CABLE FROM THE BATTERY.

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1. INTRODUCTION

We at Painless Performance Products believe you have purchased the most up-to-date and easiest to install automotive fuel injection harness on the market. All components to this harness are new. All harnesses are tested for faults before they leave the factory floor. This harness is designed for easy installation, even if you have no electrical experience. Please read entire manual before installation.

The 60520 harnesses are complete wiring systems for the fuel injection systems on General Motors **throttle-by-wire** LS2 fuel injected engines and to control the 4L60E/4L65E automatic or T56 manual transmission. Engines with codes ZJA, ZJB, 5MC, YTA and 6MC are supported by this harness (see page 18). Factory 2002-03 LS6 computers with service number **12200411** are to be used with this harness. The computer must have 2002-03 ZO6 Corvette programming. The factory accelerator pedal and TAC module from the 2003 Corvette must also be used. If the pedal and TAC module are not taken from the donor vehicle, they can be purchased new. See page three for correct part numbers. Factory Corvette computers have an anti-theft feature programmed into them. Before the engine will run this anti-theft, feature must be programmed out. These harnesses include all wiring that is needed by the computer to run and control the fuel injection system and transmission. It is recommended that you have the computer reprogrammed to remove anything in the original factory programming that relates to a device or devices that are not being used in your particular vehicle. Good examples of possible unused computer functions are rear O2 sensors, anti-theft (removal required) and emissions (if not using the optional emissions harness and equipment).

NOTE: If you have purchased an LS2 with an engine code other than those listed above, you can still utilize this fuel injection wire harness after these engine modifications are made. Contact your local engine machinist shop for help with these modifications.

1.0.1. The 58X crank shaft sensor reluctor wheel must be replaced with part number 12559353. This replacement part number is a 24X crank shaft reluctor wheel from a 2005 Corvette LS2.

1.0.2. The crank shaft position sensor must be replaced with the part number 12560228.

1.0.3. The 4X camshaft sprocket must be replaced with part number 12576407. This is a 2X sprocket from a 2005 Corvette.

1.0.4. The cam shaft position sensor must be replaced with part number 12568983.

NOTE: Most remanufactured computers come without any programming and must be programmed before they can be used.

NOTE: The program in your computer must match the transmission that you plan on using. For instance, you cannot run a 4L60E transmission with a computer programmed for a T56.

Usually, the computer relays and fuse block can easily be mounted under the dash. Most of the wiring in the harness has been pre-terminated to the proper connector and all wire has been GM color-coded. All wiring is TXL, 600 volt, and 125 degree centigrade with cross-link insulation.

These fuel injection system harnesses have been divided into the following three major groups:

ENGINE GROUP: Includes wiring for the fuel injectors, ignition and charging system, and engine sensors.

DASH GROUP: Includes ignition feed wire, assembly line diagnostic link (DLC) connector, check engine light, computer connectors, brake switch wiring, gear shift indicator wiring, tachometer wiring, fuse block, ECM connectors, TAC module connector, fuel pump relay connector, cruise control wiring, accelerator pedal position to TAC module wiring.

TAIL GROUP: Includes transmission wiring and a power wire for the fuel pump.

2. ABOUT THESE INSTRUCTIONS

These instructions provide information for the installation of the 60520 LS2 throttle-by-wire fuel injection harness kits. The contents of these instructions are divided into the following major sections:

1. INTRODUCTION
2. ABOUT THESE INSTRUCTIONS
3. TOOLS NEEDED
4. PRE-INSTALLATION AND HARNESS ROUTING GUIDELINES
5. GENERAL INSTALLATION INSTRUCTIONS
6. GM LS2 FUEL INJECTION HARNESS KIT
7. TROUBLE-SHOOTING INSTRUCTIONS AND TROUBLE CODES

Sections are further divided into **Paragraphs** and **Steps**. Throughout, the **Figure** numbers refer to illustrations and the **Table** numbers refer to information in tables. These are located in or near the sections or paragraphs to which they correspond. Always pay careful attention to any notes or any text labeled **CAUTION**.

3. TOOLS NEEDED

In addition to your regular tools you will need the following:

Crimping tool	**NOTE: USE A QUALITY TOOL TO AVOID OVER-CRIMPING.**
Wire stripper	
Electric drill	
1 5/8" Hole saw	**NOTE: For the rubber grommet in the firewall.**
Continuity tester	**CAUTION: DO NOT USE A TEST LIGHT TO TEST THE COMPUTER OR SENSOR WIRING. YOU WILL DAMAGE THE COMPUTER.**

4. PRE-INSTALLATION AND HARNESS ROUTING GUIDELINES

The installation of your harness kit will consist of two parts:

- The physical routing, positioning, and securing of the harness, wire groups, and individual wires and connectors.
- The proper electrical connection of the individual circuits.

We cannot tell you how to route the harness in your automobile. That depends a great deal upon the particular make of the automobile and what extent you want to secure and conceal the harness. We do offer some general guidelines and routing practices starting in **Paragraph 5.3**, general installation instructions in **Section 5.0**, and precise instruction concerning the electrical connections you will have to make beginning in **Section 6.0**. To help you begin thinking through the installation of your wire harness read the following sections:

NOTE: Emission devices: The 60520 harness has no emission wiring included. The emissions kits are sold separately. If you are planning on connecting the factory emissions it is recommended to purchase the emissions harness and install it at the same time as the main harness.

4.1 TRANSMISSION FUNCTION

4.1.1 **T-56** If you are using a **T56 transmission,** tape off and store the orange/black and black/white (gear indicator switch) wires in the dash group and the 13-position (transmission) round connector in the tail section. Plug in the skip shift solenoid, reverse lockout solenoid and vehicle speed sensor connector to the transmission as shown in **Figure 6.28**. We have included a wire to turn on a skip shift light if you are planning on using one. This wire is white/black and provides a ground to the skip shift light. You must connect power to the other side of the light.

4.1.2 **4L60E** If you are using a **4L60E transmission,** tape off and store the skip shift light wire, skip shift solenoid and reverse lockout solenoid connectors. You must use the vehicle speed sensor (VSS), correct brake switch and a gear indicator switch. These are necessary to make the transmission work correctly. The brake switch should be closed (electrically connected) when the brakes **ARE NOT** being applied and open (not electrically connected) when the brakes **ARE** being applied. This is the opposite of a standard brake light switch. If you are using a pressure brake switch, a **SPDT** relay must be installed to unlock the converter when the brakes are applied.

4.2 GET TO KNOW THE ENGINE YOU ARE USING:

NOTE: The 2005-2006 LS2 engines had four oxygen sensors from the factory. We have included provisions for only two oxygen sensors, which include one on the driver side and one on the passenger side of the engine. We have removed the two rear oxygen sensors since they originally where behind the catalytic converters and most people don't want to run more than two oxygen sensors.

4.2.1 PPPI recommends the use of the following parts. See **Table 4.1 for 60520**. These will meet all requirements and are compatible with PPPI harnesses. The numbers given are GM and AC Delco part numbers.

4.2.2 Familiarize yourself with the harness by locating each of the harness groups and by looking at the connectors on the wire ends.

4.2.3 Decide where and how the computer, fuse block, TAC module, accelerator pedal and fuel pump relay will be mounted. PPPI wire harness kits are designed to mount either under the dash or in the kick panel on the passenger side. They must be no further apart than the wiring will allow (approx. 18 inches).

4.2.4 A good exercise is to lay out the wire harness on the floor beside your vehicle and identify all the connectors and wires.

4.2.5 You will want to route the harness through and around open areas. Inside edges provide extra protection from hazards and also provide places for tie wraps, clips and other support.

4.2.6 Route the harness away from sharp edges, exhaust pipes, and the hood, trunk and door hinges.

4.2.7 Plan where harness supports will be located. Use a support approximately every 6 inches unless the harness routes under the floor carpet.

4.2.8 Allow enough slack in the harness at places where movement could possibly occur (body to frame, frame to engine, etc.).

4.2.9 The wires should be bundled into harness groups and covered for protection. Use nylon ties, poly split loom or POWERBRAID.

LS2 Fuel Injection Harness ('05 – '06) Part # 60520

Main Computer	Service #12200411
Fuel Pump Relay	Painless #80130
Brake Switch	Delco# D850A
Gear Indicator Switch	Delco# D2286A
MAF/IAT Sensor	Delco# 213-364 GM# 25318411
Engine Coolant Temperature	Delco# 213-953 GM# 15326388
Oxygen Sensor (Pass & Drvr Side)	Delco# AFS75 GM# 25312184
MAP Sensor	Delco# 213-331 GM# 16212460
Oil Pressure	GM# 12573107

Knock Sensors (Pass & Drvr Side)	Delco# 213-362 GM #10456603
Coils	GM #12570616 GM# 12573190
Cam Position Sensor	GM #12568983
Crankshaft Position Sensor	GM #12560228 Delco# 213-354
Throttle Body	GM# 12570790
TAC Module	GM# 12578953
Cruise Control Switch	GM# 25111262
Accelerator Pedal	GM# 12565643

Table 4.1 Compatible Parts

5. GENERAL INSTALLATION INSTRUCTIONS

CAUTION:

- **DO NOT DISCONNECT THE BATTERY OR THE COMPUTER CONNECTORS WHILE THE IGNITION IS ON.**
- **DO NOT SHORT ANY WIRES IN THIS HARNESS TO GROUND (WITH THE EXCEPTION OF LABELED GROUND WIRES) OR DAMAGE TO THE COMPUTER WILL RESULT.**
- **GIVING OR RECEIVING A JUMP START MAY DAMAGE THE COMPUTER.**
- **DO NOT USE A TEST LIGHT WHEN TESTING COMPUTER SENSORS OR COMPUTER CIRCUITS. DAMAGE TO THE COMPUTER WILL RESULT!**
- **WHEN ROUTING THE WIRES FOR THE VEHICLE SPEED SENSOR (IF USED) MAKE CERTAIN THAT THEY ARE AT LEAST 12 INCHES AWAY FROM ANY IGNITION WIRING (SPARK PLUG WIRES, ETC.).**

NOTES:

- **There is a normal, small current drain on these fuel injected systems.**
- **NEVER FORCE ANY CONNECTOR.**
- **When connecting the plugs to the computer USE EXTREME CARE to make sure none of the pins in the computer are or become bent.**
- **The fuel pump and pressure regulator you are using MUST maintain a constant pressure of 55-60 PSI (pounds per square inch). If using a higher pressure pump you must add an inline regulator to bring the pressure down to the 55-60 range since the LS2 fuel system does not have a built-in regulator on the fuel rail. AC Delco part #GF822 is a fuel filter with a built-in regulator set at the stock fuel pressure for these LS2 engines.**

5.1 GROUNDING THE VEHICLE

A perfectly and beautifully wired automobile will nevertheless have problems if everything is not properly grounded. Don't go to the effort to installing a quality wire harness only to neglect proper grounding.

Note: The installer of this harness is responsible for all ground wires not provided with this part.

5.1.1 Connect a ground strap or cable (minimum of a 4 Ga. wire) from the negative battery terminal to the chassis (frame).

5.1.2 Connect a ground strap (minimum of a 4 Ga. wire) from the engine to the chassis (frame). **DO NOT RELY UPON THE MOTOR MOUNTS TO MAKE THIS CONNECTION.**

5.1.3 Connect a ground strap from the engine to the body.

5.2 ROUGH INSTALLATION

CAUTION: DISCONNECT THE POWER FROM YOUR VEHICLE BY REMOVING THE NEGATIVE BATTERY CABLE FROM THE BATTERY.

NOTE: Make no wire connections or permanent mounting of any kind at this time.

5.2.1 Position the computer and TAC module in their intended locations.

5.2.2 Drill a 1-5/8" hole for the firewall grommet near the computer for the engine group and tail section to pass through.

5.2.3 Route the engine group and transmission section through the hole. Push the grommet (already installed on the harness) into the hole until it is seated.

5.2.4 Route the dash group over to the driver's side of the car.

5.2.5 Route the fuse block and relays to the place they will be mounted.

5.3 HARNESS ATTACHMENT

NOTE: Harness routing and shaping will be a time-consuming task. Taking your time will enhance the beauty of your vehicle. Please take your time and be patient.

5.3.1 Permanently mount your computer. You should mount the fuse block, TAC Module and fuel pump relay at this time. Mount the accelerator pedal. Note the pigtail that plugs into the accelerator pedal and then to the TAC module is either 8ft or 12ft long depending on the harness purchased. Make sure the pigtail wires are not routed near any moving parts of the brake, clutch or accelerator pedal.

5.3.2 Mold harness groups to the contour of the dash, engine, frame, etc. Remember to route harness away from sharp edges, exhaust pipes, hinges, and moving parts.

5.3.3 Attach harness groups to your automobile with clips or ties starting at the computer and working your way outward.

NOTE: Do not tighten tie wraps or mounting devices at this time. Make all harness attachments LOOSELY.

5.3.4 When used every 1-1/2" or so on the visible areas of the harness, colored plastic wire ties make a very attractive assembly. Otherwise, a tie installed in other areas every 6" or so will hold the wires in place securely. **REMEMBER TO TAKE YOUR TIME**.

5.4 TERMINAL INSTALLATION INSTRUCTION

NOTE: In the following steps you will be making the circuit connections. Before you start, you should carefully read Sections 6.0, and continually refer to the wire charts, DOUBLE CHECKING your length calculations before cutting any wire or making any connections. These directions are for the wires, which do not have a connector already, installed on them.

5.4.1 Have all tools and connectors handy.

5.4.2 Select the correct terminal for the wire and application.

5.4.3 Determine the correct wire length and cut the wire. Remember to allow enough slack in the harness and wires at places where movement could occur. **DOUBLE CHECK YOUR CALCULATIONS**.

5.4.4 Strip insulation away from wire. Only strip as much insulation off as necessary for the type of terminal lug you are using.

NOTE: In the following step, make sure that the terminal is crimped with the proper die in the crimping tool. An improper crimp will not make a good connection. DO NOT OVER-CRIMP THE TERMINAL.

5.4.5 Crimp the terminal onto the wire.

5.4.6 Connecting the wires and connectors throughout the harness is a simple process. Make sure that each wire is properly routed and then attached. **DO NOT ATTACH THEN ROUTE AFTERWARD**.

5.4.7 When all the wires are attached, tighten the mounts and ties to secure the harness permanently.

5.4.8 Attach the connectors to the computer. **BE VERY CAREFUL NOT TO BEND ANY PINS**.

5.4.9 After all connections have been made throughout the harness, connect the battery to the vehicle.

CAUTION: BE SURE THE IGNITION IS OFF WHEN YOU RECONNECT THE BATTERY OR YOU CAN DAMAGE THE COMPUTER.

6.0 HARNESS INSTALLATION

6.1 KIT CONTENTS

Take inventory to see that you have everything you are supposed to have in this kit. If anything is missing, contact the dealer where you obtained the kit or contact Painless Performance at (817) 244-6898. The kit should contain the following items:

- The main fuel injection wire harness.
- Fuel Injection Installation Instructions P/N 90543 (This Booklet).
- 4" & 7" tie wraps.
- TAC Module to Accelerator Pedal Pigtail

6.2 SPECIFIC CIRCUIT CONNECTIONS

Note: If you have not already done so, read sections 4.0 and 5.0 of these instructions and think through the installation of the harness before securing or cutting any wires.

6.2.1 DASH SECTION INSTALLATION

The wires in this group consist of the diagnostic link connector (DLC) (SEE FIGURE **6.1**), the check engine light (pre-mounted into a mounting bracket), cruise control wires, gear indicator switch wires, clutch pedal position wires, brake switch wires, fuse block ignition wire and tachometer wires.

Note: You may need to connect the check engine light wires to their mates in the wire harness.

Note: Wire color (Example: BLK/WHT) is a black wire with a white stripe. The second color (the stripe) may not be bold. Observe all two-color wires closely.

Note: All connectors are labeled on the harness.

Note: All individual components are labeled on the harness.

CAUTION: DO NOT MAKE ANY CONNECTIONS WHILE THE COMPUTER IS PLUGGED INTO THE HARNESS.

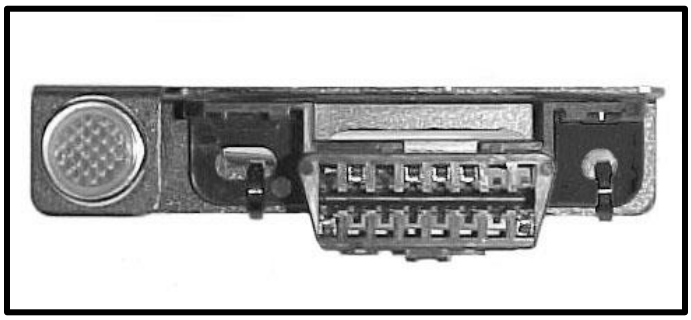

FIGURE 6.1 DLC Connector & Check Engine Light

A. Find a suitable location to mount the DLC connector (using the bracket that the light is mounted in) that will allow access to the front of the connector and still allow you to see the light while driving.

B. Mount the DLC connector using the bracket containing the check engine light in the place selected.

C. Locate the 18-gauge, pink, ignition hot activation wire labeled FUSE BLOCK IGNITION and attach it to a fused, 12-volt source where there is power **WHEN THE KEY IS IN THE START AND RUN POSITION**. This wire activates the relays that supply power to all the ignition hot circuits in the fuel injection harness. If the pink wire is connected correctly the check engine light will come on when the ignition switch is in the ON or START position. Do not connect the battery to test this until all connections are made.

D. **4L60E only:** Locate the **ORG/BLK** and **BLK/WHT** wires in the dash group. These two wires are for the Gear **INDICATOR** Switch. The **ORG/BLK** wire is the signal wire for the ECM to know the vehicle is in park or neutral. The **BLK/WHT** wire is a supplied ground wire for the gear indicator switch. If you have a GM column then you can use the combination switch Delco P/N D2286A and wire it as described in paragraph two or three below. The **ORN/BLK** wire needs to be grounded in park and neutral and ungrounded in drive. This can also be done with a toggle switch or a switch on the parking brake. **NOTE: The ORN/BLK and BLK/WHT wires are only needed if using a 4L60E transmission. If you are using a manual transmission then you will tape and stow these wires.**

D.1. The recommended switch is a combination reverse light, gear indicator **AND** neutral safety switch. You may use it for all these purposes if you wire it **EXACTLY** as shown in **Figure 6.4 Illustration B**

D.2. If you are going to use the recommended switch as a gear indicator for the computers benefit **ONLY**, then you will wire it as shown in **Figure 6.4 Illustration A**.

D.3. You may want to install your own switch. This switch must connect the **ORN/BLK** wire to ground only when the car is in **PARK OR NEUTRAL**. Use the **BLK/WHT** wire to supply ground to this switch. The other end of the **BLK/WHT** wire is already grounded throughout the harness.

E. **Manual Transmission only:** Locate the gray and pink Clutch Pedal Position wires. Connect these wires to a normally closed switch on the clutch pedal assembly. These wires need contact between them when the clutch pedal is not depressed and loose contact between them when the clutch pedal is depressed.

F. The Purple, Pink and Lt. Blue wires labeled BRAKE SWITCH are the wires that connect to the brake switch. The Purple and Pink wires are connected to the normally closed side of the brake switch. Pink is power and Purple is signal to let the computer know when the brake is applied. These wires must be connected so the lock up function of the torque converter will operate correctly. If you are not using a 4L60E then tape off and store these two wires. Connect the Lt. Blue wire to the normally open brake lamp side of the brake switch regardless of which transmission you are using. See **Figure 6.2.**

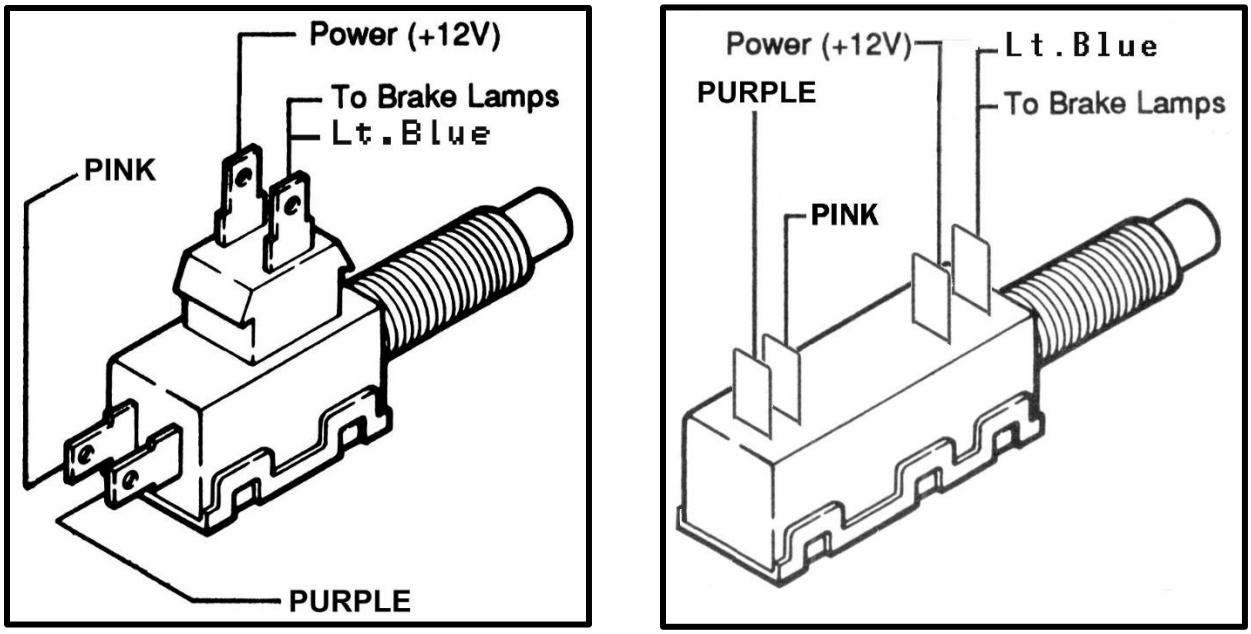

FIGURE 6.2 Brake Switch Connections

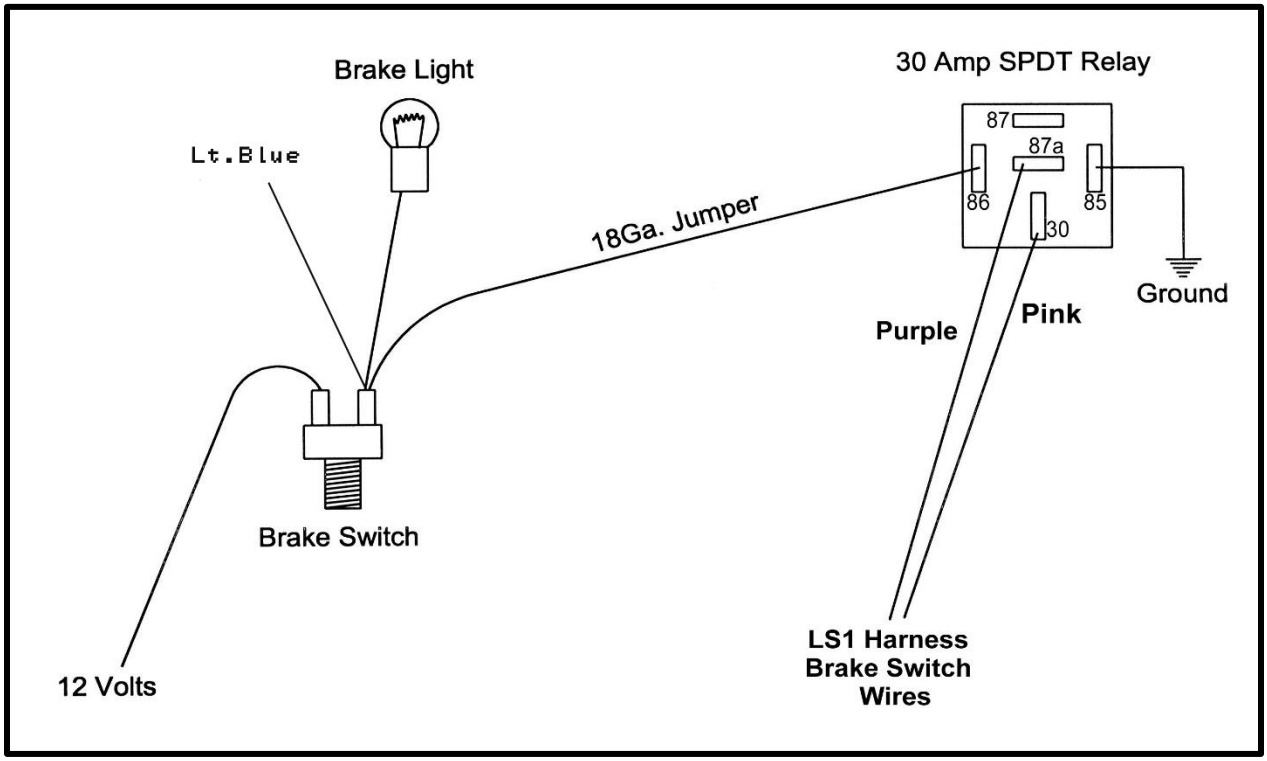

FIGURE 6.3 Brake Switch Relay

G. If your vehicle has a pressure type brake switch, you may use a relay as shown in **Figure 6.3**. The relay must be a **SPDT Relay** and wired correctly or it could result in a dangerous situation with the vehicle. The torque **converter may not unlock.**

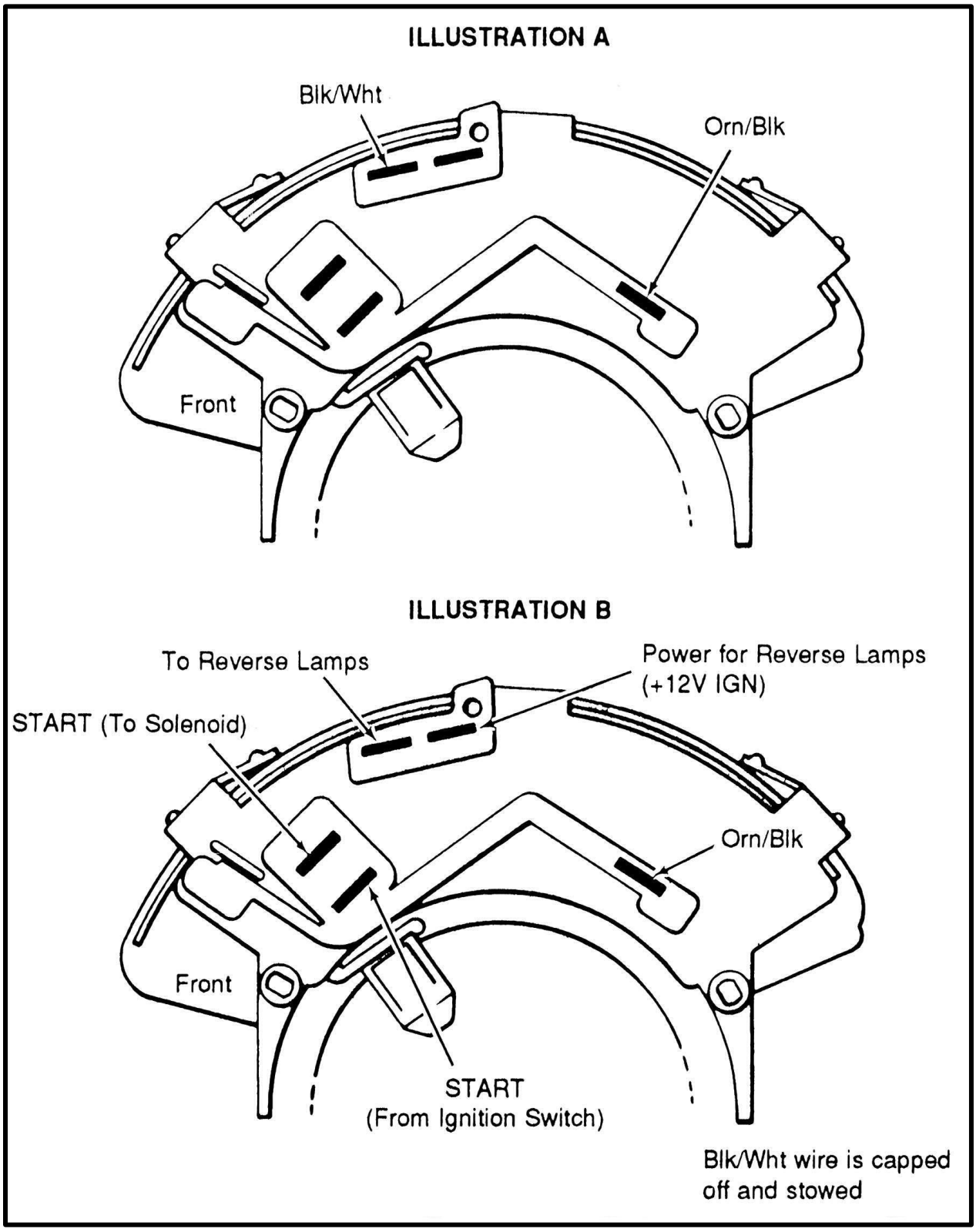

FIGURE 6.4 Gear Indicator Switch

CAUTION: **FAILURE TO WIRE THIS SWITCH CORRECTLY WILL RESULT IN A DANGEROUS SITUATION ON THE VEHICLE.** Illustration A is for Park/Neutral only. Illustration B is for Park/Neutral, Reverse and Gear Indicator.

H. Plug in the fuel pump relay to the fuel pump relay connector. The wire labeled FUEL TEST is a test point for the fuel pump. After the vehicle has been wired and tested, tape off this wire and store it in the harness.

I. Fan #1 relay wire (green) and fan #2 relay wire (blue) are **relay ground wires** activated by the computer. The factory cooling fan settings are listed below.

NOTE:

Fan #1 will come ON at 226°f and go OFF at 217°f.

Fan #2 will come ON at 235°f and go OFF at 226°f.

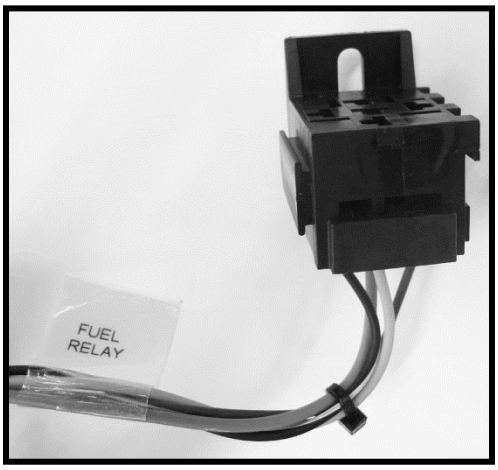

FIGURE 6.5 Fuel Pump Relay Connector

J. The wire labeled TACH (white) is the signal wire for a tachometer if used. A tachometer filter might need to be purchased depending on the brand of tachometer used.

K. The VSS output wire (green/white) sends out a signal to operate a speedometer.

L. The wire labeled SKIP SHIFT LIGHT (white/black) is only used with the T56 manual transmission. The computer grounds this wire to turn on the skip shift light if used.

M. **<u>Cruise Control:</u>** There are four cruise control wires in this harness. Most late model GM steering columns years 1983-1993 already have or can be retrofitted with a cruise control switch. See **Figure 6.6** for the proper connection of these wires to a factory GM cruise control switch part number 25111262. This harness kit does not include the connector needed because it has been discontinued by Delphi. The Pink wire is power (connector pin A). The Gray wire is the *cruise control on* switch signal (connector pin B). The Blu/Wht wire is the *cruise control set/coast* switch signal (connector pin D). The Gry/Blk wire is the *cruise control resume/acc*el switch signal (connector pin C).

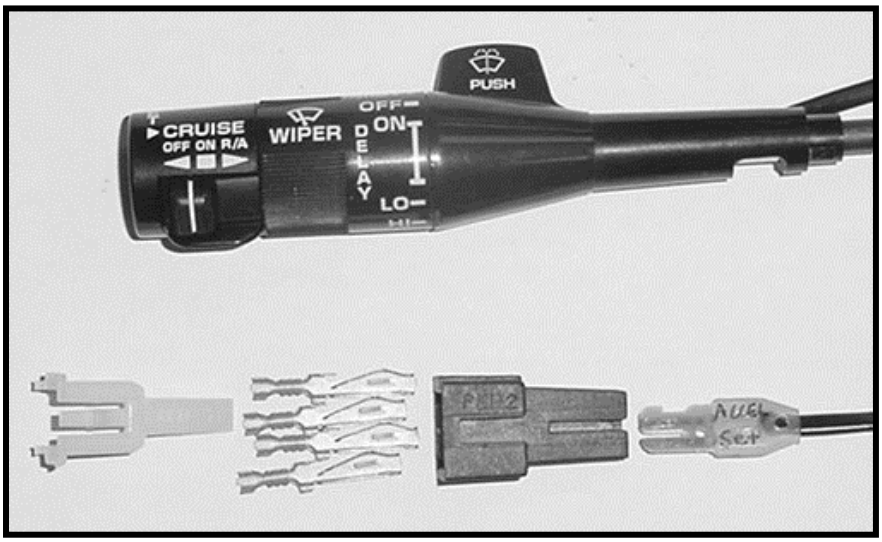

FIGURE 6.6 Cruise Control

N. Connect the TAC Module Pigtail to the TAC Module and the Accelerator Pedal.

6.2.2 Dash Section Connections

WIRE COLOR:	# OF WIRES:	LABELED:	CONNECT TO:
GRN, BLK, BLK/WHT, ORN	4	DLC	----------
GRAY, GRN/WHT, BLACK, ORANGE	4	Fuel Relay	Fuel Pump Relay
GREEN/WHITE	1	VSS Output	Speedometer
WHITE	1	Tach	Tachometer
ORANGE/BLACK, BLACK/WHITE	2	Gear Indicator	Gear Indicator Switch
PINK, PURPLE, LT.BLU	3	Brake Switch	Brake Switch
PINK	1	Fuse Block Ignition	Ignition Power
GREEN	1	Fan #1 Relay	Coolant Fan #1 Relay
BLUE	1	Fan #2 Relay	Coolant Fan #2 Relay
WHITE/BLACK	1	Skip Shift Light	Skip Shift Light
GRY, PNK	2	Clutch Pedal Pos.	CPP Switch
PNK, BLU/WHT, GRY/BLK, GRY	4	Cruise Control	Cruise Switch

Table 6.1 Dash Section

6.3 ENGINE GROUP INSTALLATIONS

The engine group is designed to be separated into left side (driver) and right side (passenger) sections. Each side is tie-wrapped separately, **BUT NOT LABELED**. The left side of the engine has the connectors for the cam position sensor, alternator, and engine coolant sensor, all of which **ARE** labeled. When you begin routing, **FIRST** separate the engine group into left and right sections and place them accordingly.

6.3.1. Before you connect any wires, separate the tail section from the engine group and place it out of the way.

6.3.2. Connect the two ring terminals labeled STARTER B+ with RED wires to the large battery terminal on the starter solenoid.

6.3.3. Locate the three large ring terminals with BLACK and BLK/WHT wires and ground them to the engine.

6.3.4. Using **Figure 6.7-6.25**, and the specific connections indicated in **Table 6.2**, connect the wiring as directed.

6.3.5. Engine Section Connections

WIRE COLOR:	# OF WIRES:	LABELED:	CONNECT TO:
LT. BLUE[1]	1	Knock #2	Passenger Side Knock Sensor
BLUE[1]	1	Knock #1	Driver Side Knock Sensor
TAN/WHITE, PURPLE/WHITE, BLACK, PINK	4	Drvr Side Oxy	Driver Side Oxygen Sensor
TAN, PURPLE, BLACK, PINK	4	Pass Side Oxy	Passenger Side Oxygen Sensor
ORANGE/BLACK, LT. GREEN, GRAY	3	MAP	MAP Sensor
BROWN/WHITE, RED, PINK/BLACK	3	CMP	Cam Position Sensor
BLUE/WHITE, YELLOW/BLACK, LT. GREEN	3	CKP	Crankshaft Position Sensor
PINK, BLACK	2	Inj #1	Driver Side Front Injector
PINK, LT. GREEN/BLACK	2	Inj #2	Passenger Side Front Injector
PINK, PINK/BLACK	2	Inj #3	Driver Side 2nd Injector
PINK, LT. BLUE/BLACK	2	Inj #4	Passenger Side 2nd Injector
PINK, BLACK/WHITE	2	Inj #5	Driver Side 3rd Injector
PINK, YELLOW/BLACK	2	Inj #6	Passenger Side 3rd Injector
PINK, RED/BLACK	2	Inj #7	Driver Side Rear Injector
PINK, BLUE/WHITE	2	Inj #8	Passenger Side Rear Injector
BLUE, GRN, PPL, BRN, PNK, YLW	6	Throttle Body	Throttle Body
YELLOW, BLACK/WHITE, PINK, PURPLE, TAN	5	MAF/IAT	MAF/IAT Sensor
BLACK, YELLOW	2	ECT	Engine Coolant Coil Connector
PURPLE, RED, GREEN, LT. BLUE, BROWN, BLACK, PINK	7	Drvr Coils	Driver Side Coil Connector
RED/WHITE, PURPLE/WHITE, LT.BLU/WHT, GRN/WHT, BRN/WHT, BLK, PNK	7	Pass Coils	Passenger Side Coil Connector
BLACK (3), BLACK/WHITE (3)	6	Ground	Engine Ground
RED (2)	2	Started B+	Starter Solenoid Batt. Term
RED, GREY	2	Alt.	Alternator
TN/WHT, BLK, GRY	3	Oil Pressure	Oil Pressure Sensor

1. Knock sensors will thread into the extra mounting holes on each side of the engine block. See **Figure 6.8** and **Figure 6.23** for the correct location to install the knock sensors.

TABLE 6.2 60520 Engine Section Connections

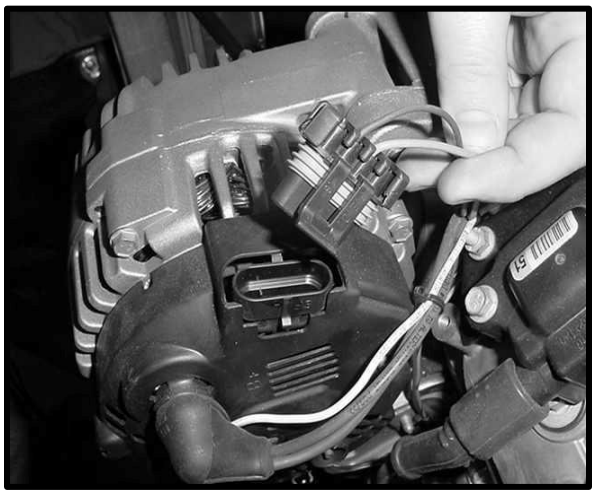

FIGURE 6.7 Alternator

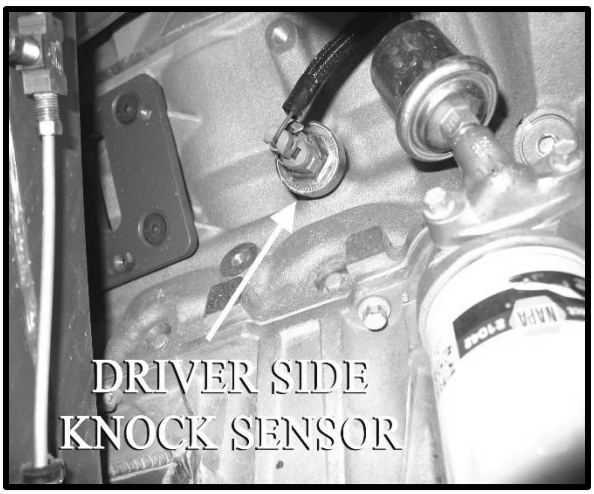

FIGURE 6.8 Knock Sensor Connector

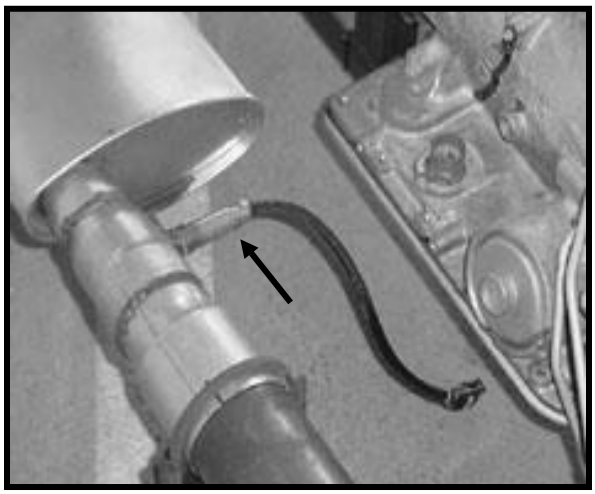

FIGURE 6.9 Oxygen Sensors

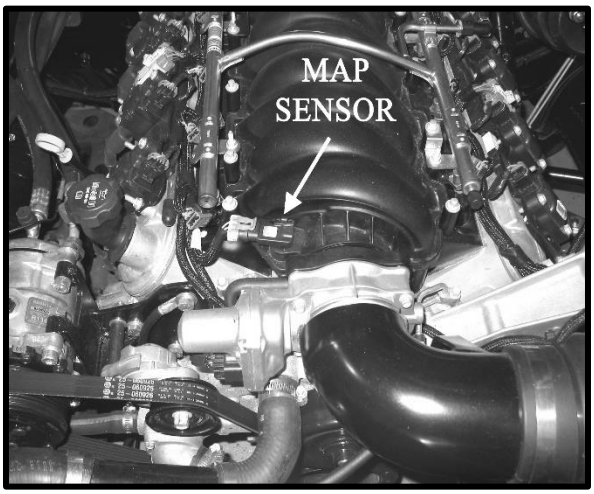

FIGURE 6.10 Map Sensor

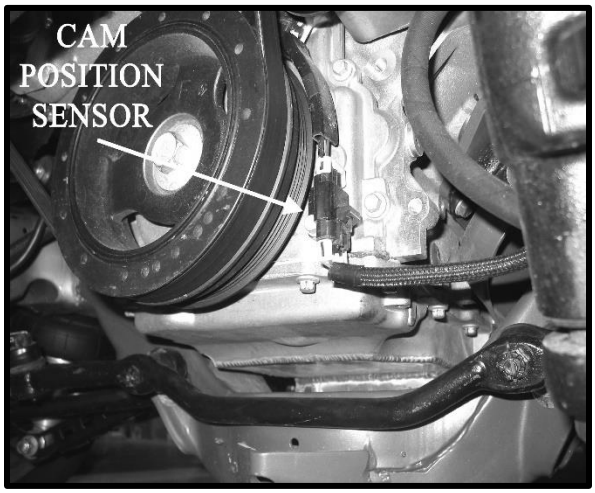

FIGURE 6.11 Cam Position Sensor

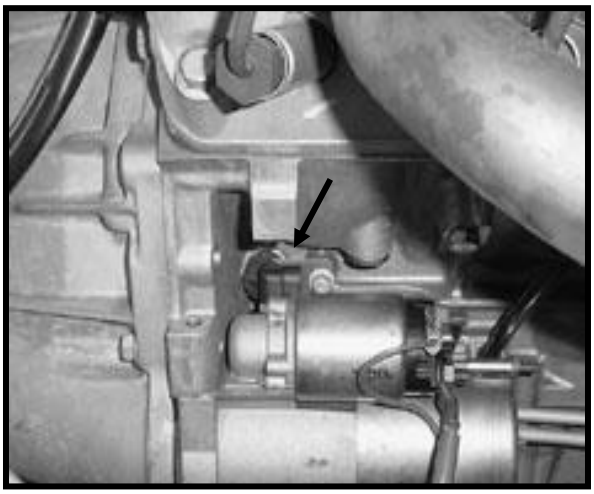

FIGURE 6.12 Crank Position Sensor

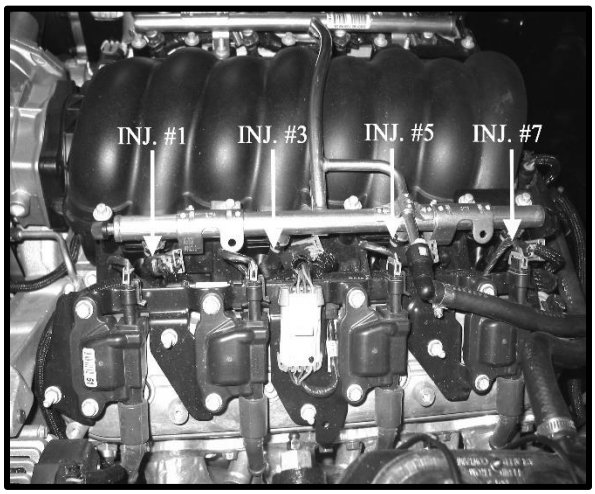

FIGURE 6.13 Injectors 1, 3, 5, 7

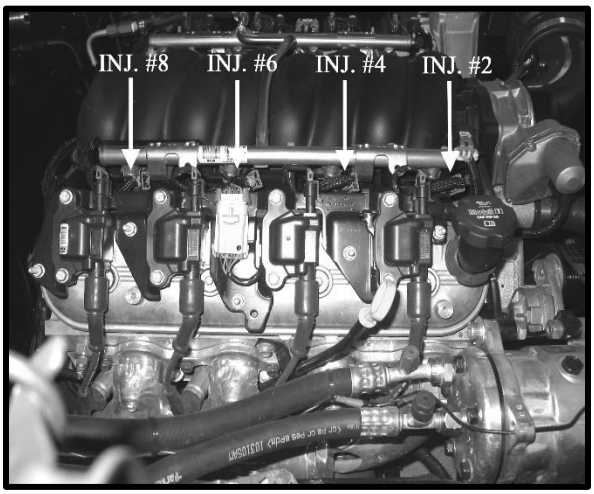

FIGURE 6.14 Injectors 2, 4, 6, 8

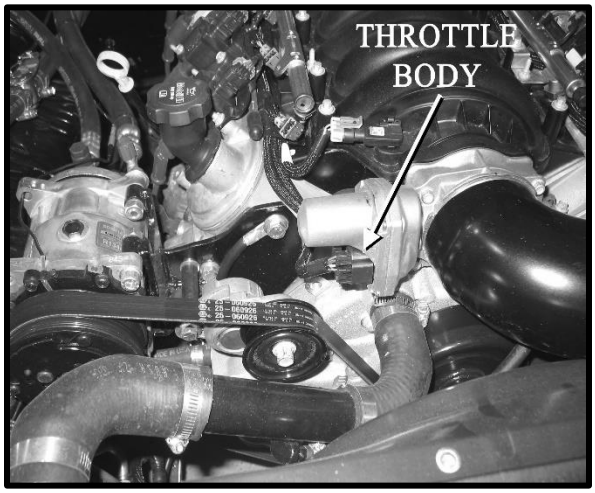

FIGURE 6.15 Throttle body

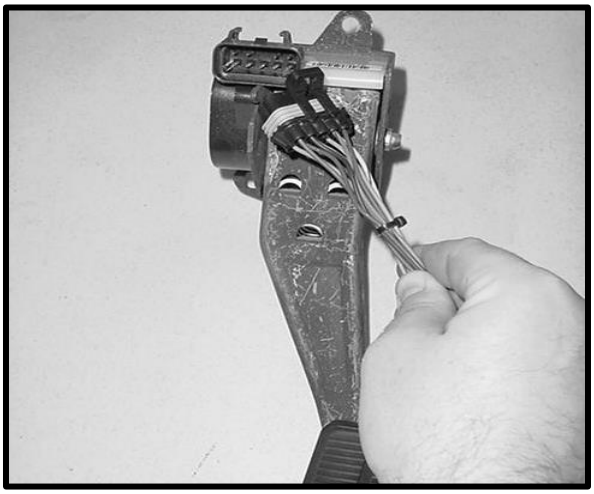

FIGURE 6.16 Accelerator Pedal

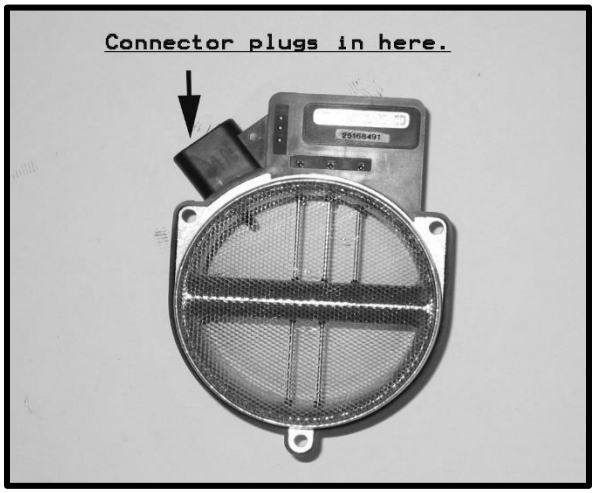

FIGURE 6.17 MAF/IAT Sensor

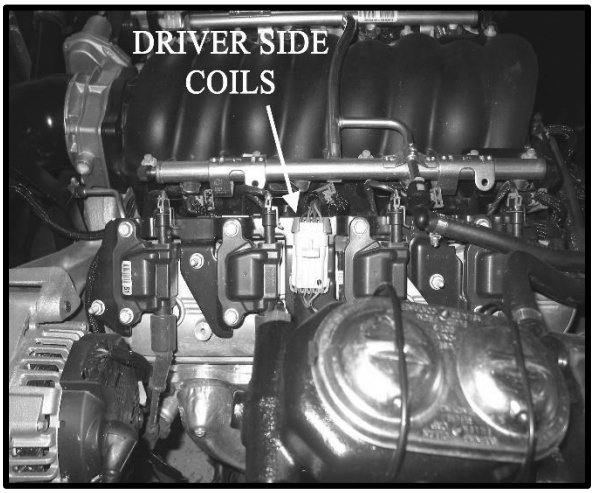

FIGURE 6.18 Driver Side Coil Connector

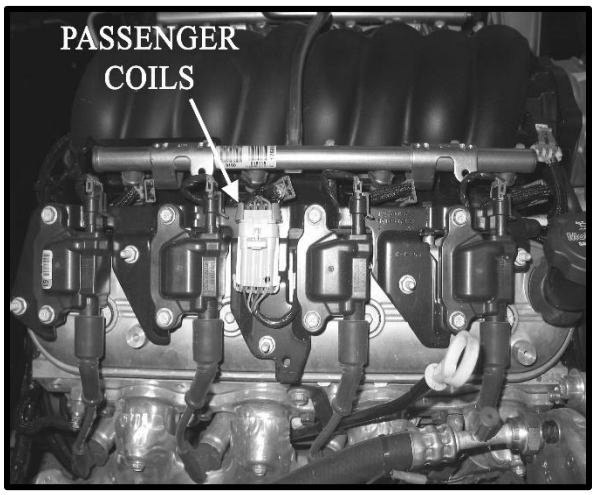

FIGURE 6.19 Passenger Side Coil Connector

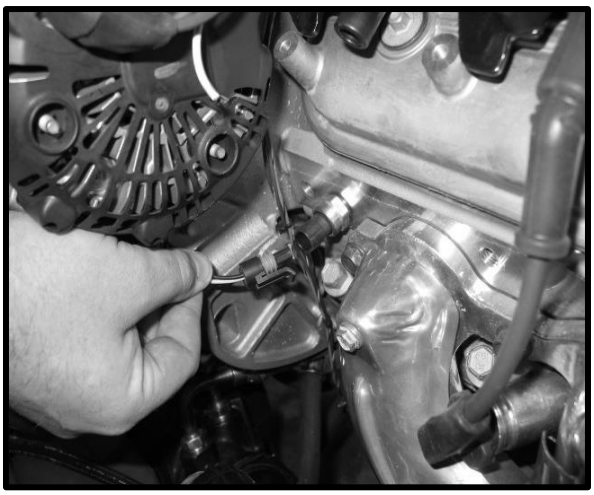

FIGURE 6.20 ECT Sensor

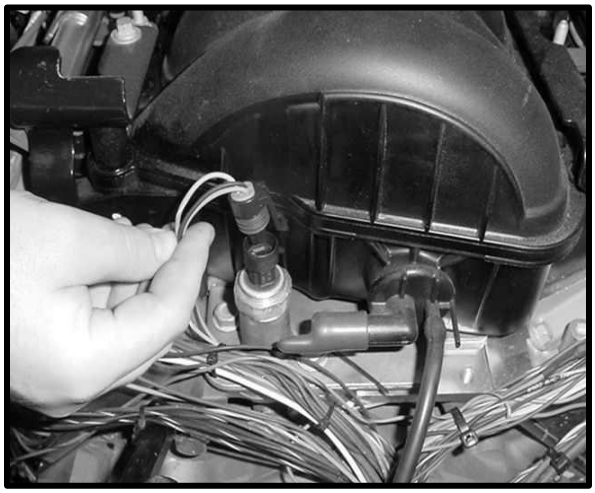

FIGURE 6.21 Oil Pressure Sensor

FIGURE 6.22 TAC Module Connections

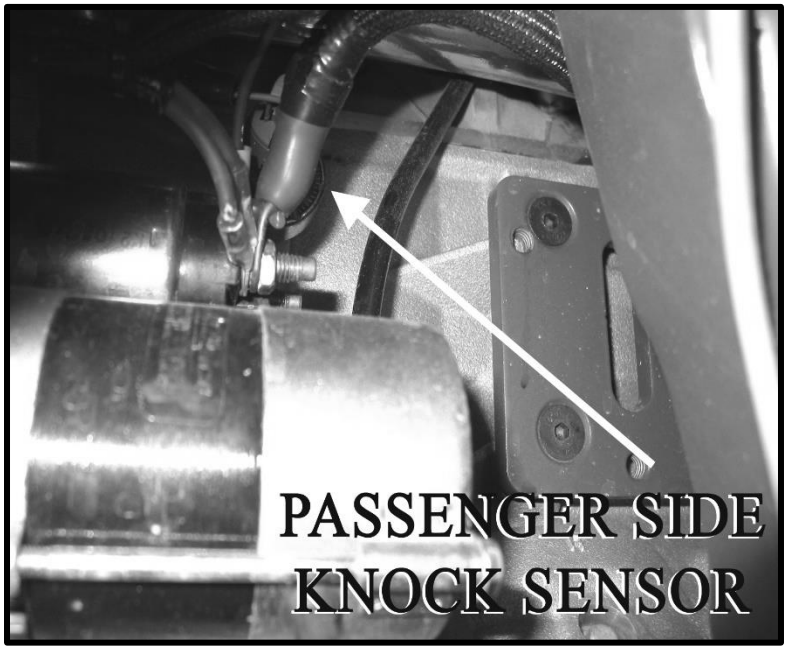

FIGURE 6.23 Passenger Side Knock Sensor
This knock sensor threads into the engine block behind the starter.

6.4 TAIL SECTION INSTALLATION

6.4.1 Locate the tail section that you earlier separated from the engine group. Begin routing it towards the rear of the vehicle. Be sure to avoid all sharp edges, moving or hot parts, or anything else that may damage the harness.

6.4.2 If you **ARE** using the 4L60E transmission, route the 13-position connector to the transmission and plug it in. Tape up the reverse lockout and skip shift solenoid connectors and store them in the harness.

6.4.3 If you **ARE** using the T56 manual transmission, route the reverse lockout and skip shift solenoid connectors to the transmission and attach them. Tape up the 13-position connector labeled TRANS and store it in the harness.

6.4.4 Take the connector for the Vehicle Speed Sensor (VSS) and connect to the Vehicle Speed Sensor.

6.4.5 Take the gray wire labeled FUEL PUMP and route it to the fuel pump. This is the power wire for the fuel pump.

6.4.6 Tail Section Connections

WIRE COLOR:	# OF WIRES:	LABELED:	CONNECT TO:
PURPLE/WHITE, LT.GRN/BLACK	2	VSS	Vehicle Speed Sensor
PINK, LT. GREEN	2	Reverse Lockout Sol.	Reverse Lockout Solenoid
PINK, GRAY	2	Skip Shift Sol.	Skip Shift Solenoid
BLUE, PINK (2), LT. GREEN, RED, BROWN, YELLOW/RED, ORANGE/BLACK, WHITE, TAN/BLACK, LT. BLUE/WHITE, RED/BLACK, YELLOW/BLACK	13	Transmission	Transmission
GRAY		Fuel Pump	Fuel Pump Power Term

TABLE 6.3 Tail Section Connections

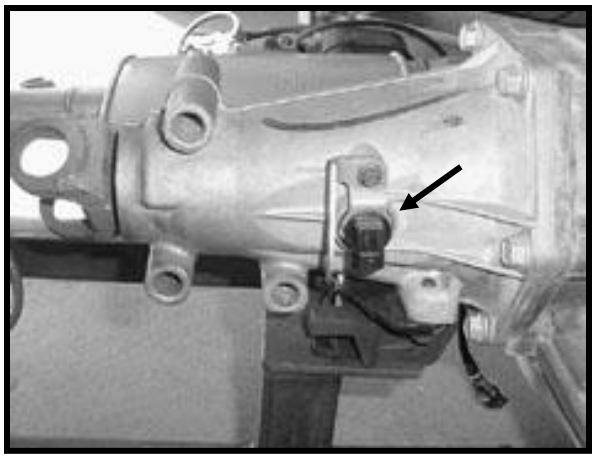

FIGURE 6.24 VSS (4L60E)

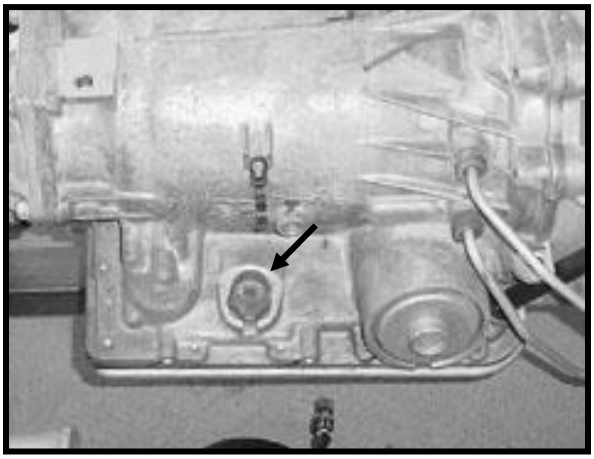

FIGURE 6.25 Transmission Connection (4L60E)

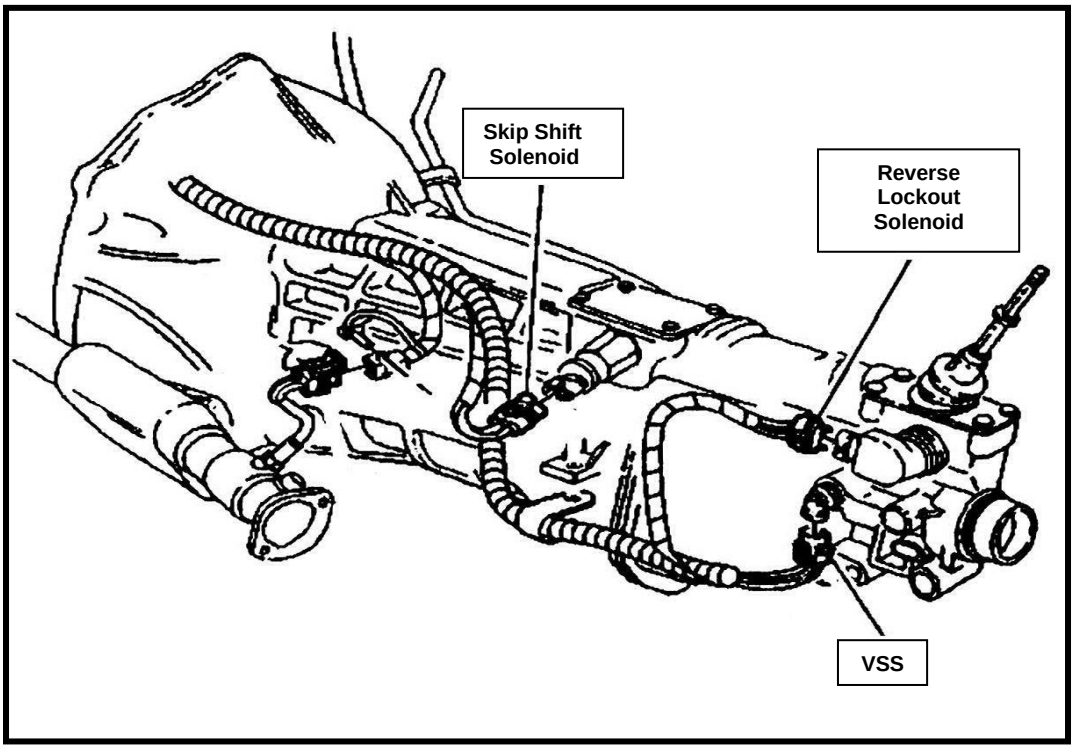

FIGURE 6.26 Transmission Connections (T56)

7. TROUBLE SHOOTING INSTRUCTIONS

If you are having trouble with your engine running badly or not running at all, first perform basic trouble-shooting (ensure that you are using the correct parts (Table 4.1), check for faulty connections, blown fuses, spark, fuel pressure, etc.), then see if the computer has stored a trouble code in its memory.

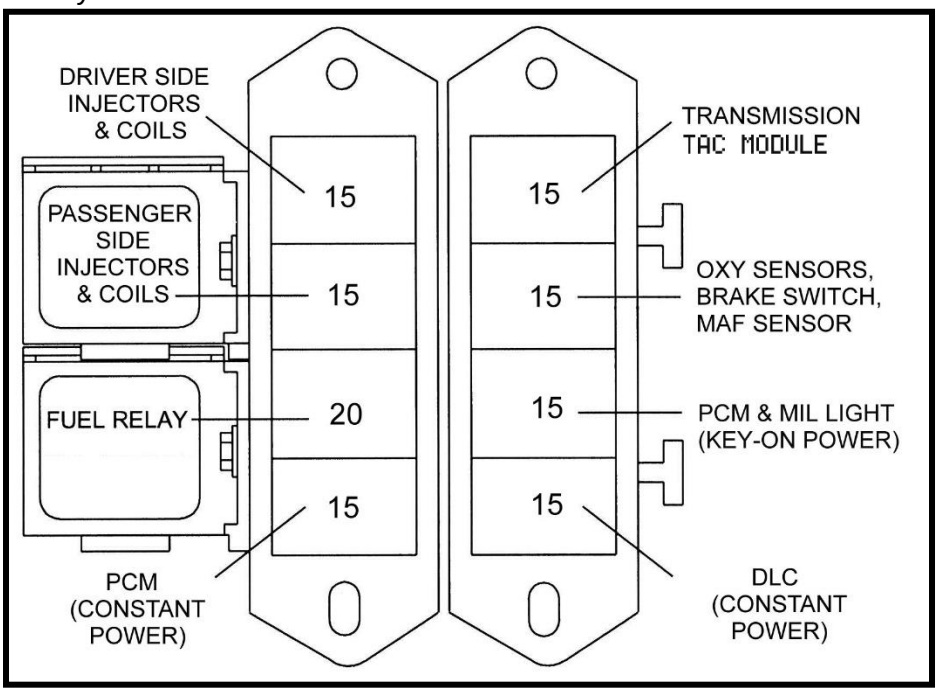

FIGURE 7.1 Fuse Identification

7.1 THE "CHECK ENGINE" LIGHT

Normally, the "check engine" light should come on when the ignition is turned on and then go out a few moments after the engine starts running. If it reappears, or stays on while the engine is running, the computer has detected a problem and a trouble code has been set.

NOTE: The engine will not run unless the computer has been reprogrammed to remove the antitheft functions. The computer will set codes for all unused emissions devices and the check engine light will stay on unless the emission functions are removed.

7.2 RETRIEVING TROUBLE CODES FROM THE COMPUTER

7.2.1 In order to retrieve the trouble codes stored in the computer, a scanner must be connected to the Assembly Diagnostic Link (DLC) connector (installed and connected in **Paragraph 6.2.1**). Follow the instructions provided with the scanner to read the codes set in the computer.

7.2.2 After you have read any codes, write them down for reference. Remove the cover from the DLC connector.

7.2.3 Take the codes one at a time and match them to the codes in a Corvette factory repair manual or to the list at the end of this manual. This will tell you what circuit the computer has detected a problem in.

Note: A code indicates a problem in a specific circuit, NOT THAT A PARTICULAR PART IS BAD.

7.2.4 Before taking more extensive corrective actions for any trouble codes make sure that all connections on the indicated circuit, **INCLUDING THE COMPUTER**, are clean and tight. Inspect the wiring in the circuit for any broken, shorted, or exposed wires. Finally, ensure all ground wires are clean and secure.

7.2.5 If a trouble code is detected and the problem has been fixed, clear the codes by first making sure the ignition is off then disconnecting the NEGATIVE battery cable for at least 3 minutes.

7.3 TROUBLE SHOOTING GUIDE FOR YOUR PAINLESS PERFORMANCE HARNESS

If you have installed your harness, made all the connections as outlined in the installation manual, and utilized the correct components as shown in the compatible parts list, the engine should start and run. If you are experiencing difficulties in getting the engine started, this trouble shooting guide should help you in diagnosing the problem.

- **FIRST AND FOREMOST, DO NOT TRY AND START YOUR ENGINE WITHOUT INSTALLING AND CONNECTING ALL OF THE COMPONENTS**. Attempting to do so will result in a “no start” situation. This includes things like the O2 sensors, knock sensors, the “PRNDL” switch (if it applies to your harness), relays, and the ECT. It’s easy to try and skip connections just to see the engine fire up, but this could cause countless difficulties trying to diagnose the issue.

- Before you attempt to start the engine, be sure that you have the correct ECM for your harness. The correct ECM is listed in the “compatible Parts List” on **page 8**. Also, make sure that the ECM you are using has been programmed by someone who is familiar with the programming procedures required for the ECM used in an engine transplant. There is more involved in programming for an engine transplant than just turning off the vehicle anti-theft. It is important to have someone who knows these tuning procedures so that you can be confident your ECM’s programming is correct for your application.

The first things to check if you are experiencing a “no start” situation, and your ECM has been programmed properly, are the battery (+) power to the harness and the grounds. Make sure the grounds are not stacked with each other. They can be on the same head or block area but should be bolted separately, not on top of each other. Also make sure that your vehicle is grounded properly, or your grounds will not do you any good. This means the negative battery cable should be bolted to the block or the frame using a star washer. The star washer allows your ground cable to cut through any paint and makes direct contact with the metal. Then, a ground strap (also using star washers) should be bolted from the block to the frame. Last, there should be a small ground strap from the block or head to the firewall. Only when these grounds are in place will the grounds for your harness be correct.

The battery (+) power to the harness should only come straight from one end of the positive battery cable, either at the battery or at the starter. The constant battery power is what provides power to the harness for the computer (ECM) memory. If it is not going to the positive battery cable, the ECM will have to relearn initial startup procedures every time you start it.

Last, make sure that the wire tagged “**12v IGN**.” wire is connected to an ignition hot source that has power **BOTH** in the ON/RUN position as well as the START position. An easy way to tell if you connected the wires to the correct power source is to look at the check engine light.

The check engine light has a direct correlation with the “**12v IGN**.” wire. If this wire is connected to the correct power source, the check engine light will come on when the key is turned to the ON/RUN position and will stay on when the key is turned all the way to the START position. If the light goes out in either of these ignition switch key positions, this means you are losing power to the “12v IGN” wire and must find another power source for it. The engine will never fire and start if this wire does not have the proper power source.

Also, make sure your check engine light is connected to the harness at the ALDL bracket. If you think you have connected the “**12v IGN.**” wire properly, and still do not have a check engine light when you turn the key on, check to see if the light is connected to the harness. Sometimes, the harnesses are not plugged into the light. The wires that connect to the light (**PINK** and **BROWN**) are tied together near the light. They are terminated so you can connect them to the 2 **BLACK** wires coming from the light.

FUEL PRESSURE: If you have checked all of the constant/switched power and your grounds but still have a “no start” problem, move onto the fuel system. The fuel pump should come on for a few seconds when you turn the key on and then shut off. This is to pressurize the fuel system, prepping it for start. If you turn the key on and do not hear the fuel pump come on and cycle, you need to check the fuel pump relay.

Make sure (as mentioned earlier) that the relay is plugged into the base. If it is plugged in properly, check to see if the relay might be defective. To do this, put 12 volts to the short wire marked “Test” coming out of the relay base. This wire is the same color as the wire providing power to the fuel pump. This “Test” wire will bypass the relay and apply 12 volts directly to the pump. If the fuel pump comes on when the 12 volts is applied, this tells you the relay is defective and needs to be replaced.

If your fuel pump does cycle with the key on you should check the fuel pressure. The fuel pressure should be about 58 to 60lbs. If it is not, you need a fuel pump that will deliver enough pressure to the injectors and the engine to run.

INJECTORS: LS injectors are susceptible to gumming up and sticking when the engine is left sitting for long periods of time (a year or more) with old fuel sitting in them. It is suggested that you clean the injectors if you do not know how long the engine has set.

If your injectors are clean and free, check to see if you have injector pulse. The best way to do this is to use a “NOID LIGHT” which can be found at any auto parts store. They are inexpensive and easy to use; you can buy a single light for the fuel injection system you are working on. Or you buy a set of 8 that will have a light for many different types of injectors. OEM offers singles (#25143 for the LS injectors) and Performance Tool offers a set of 6 (#W89500).

The light plugs into the injector connector. If you are getting an injector signal from the ECM, the light will flash. If the noid light does not flash, you are not getting the proper injector pulse signal from the ECM. This could be because the ECM is not getting the proper signal from the crankshaft position sensor, the ECM may have a bad driver, or one of the relays is either defective or not installed in the fuse block properly. These relays also control the coil power, and that is the next thing to check.

FIGURE 7.2 Noid Light

SPARK: if you have checked and cleared all of the previously mentioned components and still have a “no start” condition, you need to check for spark at the coils. You will need to test for 12 volts at the colored wire going to each coil. Then, check for continuity of the ground on the black wire going to each of the coils. If you do not have continuity to ground on the black wires, check the harness to the coils and the plug in the Painless harness to the coils. If all looks good there, you need to follow that wire back to its splice and then to the ground at the back of the block. Also, make sure the ground at the block is not stacked with any other ground on that bolt.

If all these things check out, you should be getting air/spark/fuel and that is what it takes to fire your engine. Remember, it does not pay to try and start your engine without everything installed and connected as it leads to undue frustrations.

7.4 WHEN TO CALL THE TECH LINE

7.4.1 These harness kits have been built with the highest regard to quality control. Before calling us please double check all connections and perform normal basic trouble-shooting (fuel pressure, timing, ignition system, etc.).

7.4.2 If you have any questions concerning the installation of this harness or having trouble in general, feel free to call Painless Performance Products' tech line at (817) 423-9696. Calls are answered from 8am to 5pm central time, Monday thru Friday, except holidays. Email questions to Tech@painlessperformance.com

7.5 ENGINE CODES

The Engine Code Sticker is located at the back of the driver side head.

FIGURE 7.3 Engine Code Sticker

DTC	Descriptor
DTC C1277 or P1571	Powertrain Indicated Traction Control Malfunction
DTC C1278	TCS Temporarily Inhibited By PCM
DTC C1281, C1283, or C1286	VSES Sensors Uncorrected
DTC C1282	Yaw Rate Sensor Bias Circuit Malfunction
DTC C1284 or C1285	Lateral Accelerometer Circuit
DTC C1287 or C1288	Steering Position Sensor Circuit
DTC C1291	Open Brake Lamp Switch Contacts During Deceleration
DTC C1292, C1293, or C1296	Master Cylinder Pressure Sensor Circuit
DTC C1294	Brake Lamp Switch Circuit Always Active
DTC C1295	Brake Lamp Switch Circuit Open
DTC P0101	Mass Air Flow (MAF) Sensor Performance
DTC P0102	Mass Air Flow (MAF) Sensor Circuit Low Frequency
DTC P0103	Mass Air Flow (MAF) Sensor Circuit High Frequency
DTC P0106	Manifold Absolute Pressure (MAP) Sensor Performance
DTC P0107	Manifold Absolute Pressure (MAP) Sensor Circuit Low Voltage
DTC P0108	Manifold Absolute Pressure (MAP) Sensor Circuit High Voltage
DTC P0112	Intake Air Temperature (IAT) Sensor Circuit Low Voltage
DTC P0113	Intake Air Temperature (IAT) Sensor Circuit High Voltage
DTC P0116	Engine Coolant Temperature (ECT) Sensor Performance
DTC P0117	Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage

TABLE 7.1 Diagnostic Trouble Codes

DTC	Descriptor
DTC P0118	Engine Coolant Temperature (ECT) Sensor Circuit High Voltage
DTC P0125	Engine Coolant Temperature (ECT) Insufficient for Closed Loop Fuel Control
DTC P0128	Engine Coolant Temperature (ECT) Below Thermostat Regulating Temperature
DTC P0131 or P0151	HO2S Circuit Low Voltage
DTC P0132 or P0152	HO2S Circuit High Voltage
DTC P0133 or P0153	HO2S Slow Response
DTC P0134 or P0154	HO2S Circuit Insufficient Activity
DTC P0135, P0141, P0155, or P0161	HO2S Heater Performance
DTC P0137 or P0157	HO2S Circuit Low Voltage
DTC P0138 or P0158	HO2S Circuit High Voltage
DTC P0140 or P0160	HO2S Circuit Insufficient Activity
DTC P0171 or P0174	Fuel Trim System Lean
DTC P0172 or P0175	Fuel Trim System Rich
DTC P0200	Injector Control Circuit
DTC P0218	Transmission Fluid Overtemperature
DTC P0230	Fuel Pump Relay Control Circuit
DTC P0300	Engine Misfire Detected
DTC P0325	Knock Sensor Module Performance
DTC P0335	Crankshaft Position (CKP) Sensor Circuit

TABLE 7.1 Diagnostic Trouble Codes Continued

DTC	Descriptor
DTC P0336	Crankshaft Position (CKP) Sensor Performance
DTC P0341	Camshaft Position (CMP) Sensor Performance
DTC P0342	Camshaft Position (CMP) Sensor Circuit Low Voltage
DTC P0343	Camshaft Position (CMP) Sensor Circuit High Voltage
DTC P0351-P0358	Ignition Coil Control Circuit
DTC P0410	Secondary Air Injection (AIR) System
DTC P0418	Secondary Air Injection (AIR) Pump Relay Control Circuit
DTC P0420 or P0430	Catalyst System Low Efficiency
DTC P0440	Evaporative Emission (EVAP) System
DTC P0442	Evaporative Emission (EVAP) System Small Leak Detected
DTC P0443	Evaporative Emission (EVAP) Purge Solenoid Control Circuit
DTC P0446	Evaporative Emission (EVAP) Vent System Performance
DTC P0449	Evaporative Emission (EVAP) Vent Solenoid Control Circuit
DTC P0452	Fuel Tank Pressure Sensor Circuit Low Voltage
DTC P0453	Fuel Tank Pressure Sensor Circuit High Voltage
DTC P0461	Fuel Level Sensor Performance
DTC P0462	Fuel Level Sensor Circuit Low Voltage
DTC P0463	Fuel Level Sensor Circuit High Voltage
DTC P0480	Cooling Fan Relay 1 Control Circuit
DTC P0481	Cooling Fan Relay 2 and 3 Control Circuit
DTC P0500	Vehicle Speed Sensor (VSS) Circuit

TABLE 7.1 Diagnostic Trouble Codes Continued

DTC	Descriptor
DTC P0502	Vehicle Speed Sensor (VSS) Circuit Low Input
DTC P0503	Vehicle Speed Sensor (VSS) Circuit Intermittent
DTC P0506 or P0507	Incorrect Idle Speed
DTC P0522	Engine Oil Pressure (EOP) Sensor Circuit Low Voltage
DTC P0523	Engine Oil Pressure (EOP) Sensor Circuit High Voltage
DTC P0530	Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit
DTC P0562	System Voltage Low
DTC P0563	System Voltage High
DTC P0567	Cruise Control Resume Switch Circuit
DTC P0568	Cruise Control Set Switch Circuit
DTC P0571	Cruise Control Brake Switch Circuit
DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610	ECU Malfunction
DTC P0608	Vehicle Speed Output Circuit
DTC P0645	Air Conditioning (A/C) Clutch Relay Control Circuit
DTC P0650	Malfunction Indicator Lamp (MIL) Control Circuit
DTC P0654	Engine Speed Output Circuit
DTC P0704	Clutch Switch Circuit
DTC P0706	Trans Range Switch Performance
DTC P0711	TFT Sensor Circuit Range/Performance

TABLE 7.1 Diagnostic Trouble Codes Continued

DTC	Descriptor
DTC P0712	Transmission Fluid Temperature (TFT) Sensor Circuit Low Input
DTC P0713	Transmission Fluid Temperature (TFT) Sensor Circuit High Input
DTC P0719	Brake Switch Circuit Low Input
DTC P0724	Brake Switch Circuit High Input
DTC P0740	TCC Enable Solenoid Circuit Electrical
DTC P0742	TCC System Stuck On
DTC P0748	Pressure Control Solenoid Circuit Electrical
DTC P0751	1-2 Shift Solenoid Valve Performance
DTC P0752	1-2 Shift Solenoid (SS) Valve Performance - No Second Or Third Gear
DTC P0753	1-2 Shift Solenoid Circuit Electrical
DTC P0756	2-3 Shift Solenoid Valve Performance
DTC P0757	2-3 Shift Solenoid (SS) Valve Performance - No Third Or Fourth Gear
DTC P0758	2-3 Shift Solenoid Circuit Electrical
DTC P0785	3-2 Shift Solenoid Circuit Electrical
DTC P0801	Reverse Inhibit Solenoid Control Circuit
DTC P0803	Skip Shift Solenoid Control Circuit
DTC P0804	Skip Shift Lamp Control Circuit
DTC P1111	Intake Air Temperature (IAT) Sensor Circuit Intermittent High Voltage
DTC P1112	Intake Air Temperature (IAT) Sensor Circuit Intermittent Low Voltage
DTC P1114	Engine Coolant Temperature (ECT) Sensor Circuit Intermittent Low Voltage
DTC P1115	Engine Coolant Temperature (ECT) Sensor Circuit Intermittent High Voltage

TABLE 7.1 Diagnostic Trouble Codes Continued

DTC	Descriptor
DTC P1120	Throttle Position (TP) Sensor 1 Circuit
DTC P1125	Accelerator Pedal Position (APP) System
DTC P1133 or P1153	HO2S Insufficient Switching
DTC P1134 or P1154	HO2S Transition Time Ratio
DTC P1220	Throttle Position (TP) Sensor 2 Circuit
DTC P1221	Throttle Position (TP) Sensor 1- 2 Correlation
DTC P1258	Engine Coolant Overtemperature - Protection Mode Active
DTC P1275	Accelerator Pedal Position (APP) Sensor 1 Circuit
DTC P1276	Accelerator Pedal Position (APP) Sensor 1 Performance
DTC P1280	Accelerator Pedal Position (APP) Sensor 2 Circuit
DTC P1281	Accelerator Pedal Position (APP) Sensor 2 Performance
DTC P1285	Accelerator Pedal Position (APP) Sensor 3 Circuit
DTC P1286	Accelerator Pedal Position (APP) Sensor 3 Performance
DTC P1336	Crankshaft Position (CKP) System Variation Not Learned
DTC P1380	Misfire Detected - Rough Road Data Not Available
DTC P1381	Misfire Detected - No Communication with Brake Control Module
DTC P1415 or P1416	Secondary Air Injection (AIR) System
DTC P1431	Fuel Level Sensor 2 Performance
DTC P1432	Fuel Level Sensor 2 Circuit Low Voltage
DTC P1433	Fuel Level Sensor 2 Circuit High Voltage
DTC P1441	Evaporative Emission (EVAP) System Flow During Non-Purge

TABLE 7.1 Diagnostic Trouble Codes Continued

DTC	Descriptor
DTC P1514	Throttle Body Performance
DTC P1515	Control Module Throttle Actuator Position Performance
DTC P1516	Throttle Actuator Control (TAC) Module Throttle Actuator Position Performance
DTC P1517	Throttle Actuator Control (TAC) Module Performance
DTC P1518	Throttle Actuator Control (TAC) Module Serial Data Circuit
DTC P1539	Air Conditioning (A/C) Clutch Feedback Circuit High Voltage
DTC P1546	Air Conditioning (A/C) Clutch Feedback Circuit Low Voltage
DTC P1574	Stoplamp Switch Circuit
DTC P1575	Extended Travel Brake Switch Circuit
DTC P1626	Theft Deterrent Fuel Enable Signal Lost
DTC P1630	Theft Deterrent Learn Mode Active
DTC P1631	Theft Deterrent Start Enable Signal Not Correct
DTC P1635	5 Volt Reference 1 Circuit
DTC P1637	Generator L-Terminal Circuit
DTC P1638	Generator F-Terminal Circuit
DTC P1639	5 Volt Reference 2 Circuit
DTC P1652	Powertrain Induced Chassis Pitch Output Circuit
DTC P1810	TFP Valve Position Switch Circuit
DTC P1860	TCC PWM Solenoid Circuit Electrical
DTC P1870	Transmission Component Slipping
DTC U1000 and U1255	Class 2 Communication Malfunction
DTC U1001-U1254	Lost Communication with XXX
DTC U1300, U1301, or U1305	Class 2 Data Link Shorted

TABLE 7.1 Diagnostic Trouble Codes Continued

Painless Performance Products, LLC
Limited Warranty and Return Policy

Chassis harnesses, fuel injection harnesses, and Trail Rocker units are covered under a lifetime warranty.

All other products manufactured and/or sold by Painless Performance are warranted to the original purchaser to be free from defects in material and workmanship under normal use. Painless Performance will repair or replace defective products without charge during the first 12 months from the purchase date. No products will be considered for warranty without a copy of the purchase receipt showing the sellers name, address, and date of purchase. You must return the product to the dealer you purchased it from to initiate warranty procedures