

Wire Harness Installation Instructions For Installing: Part # 65105 – Into 1992-1997 (5.7L) LT-1 Engines Part # 65205 – Into 1992-1997 (5.7L) LT-1 Engines



# Manual # 90537 Perfect Performance Products, LLC Painless Performance Products Division 2501 Ludelle Street Fort Worth, Texas 76105-1036 (800) 423-9696

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## PLEASE READ ALL INSTRUCTIONS PRIOR TO INSTALL

#### 1.0 Introduction

You have purchased what we at Painless Performance believe to be the most up-to-date and easiest -to-install automotive engine management system on the market. It is designed for easy installation, even if you have no electrical experience.

This harness is designed to be a complete wiring system for the computer and fuel injection system on General Motors LT-1 engines. This kit includes all wiring that is needed by the computer to run and control the fuel injection system. It is designed to use the part listed in **Table 4.1**. Using any other parts could cause the system to function improperly.

The system will work on LT-1 engines from 1992-1997 models. When using this harness on 1992-1993 LT-1 engines please call the Painless tech hot line and request a WH-399 distributor pigtail. When using this harness on a 1996 or 1997 engine, you must replace the Coil, Coil Output Wire and Knock Sensor with the parts from a 1992 thru 1995 engine. Painless Performance part number 60126 has the proper parts for this change. This harness will not have any of the wiring for the 700R4, 4L60 or 4L60E / 4L80E electronic transmissions. If you are running a 700R4 transmission and would like to have the lock-up functions you can purchase Painless Performance part number 60109. If you are running an electronic transmission you will need to contact an aftermarket transmission supplier for that harness and computer.

- Note: This harness does not have wiring for emission devices.
- Note: When installing the 65105 we recommend that you start from the back of the engine and work your way forward.
- Note: This system has been designed to run on the batch fire system. See note on page 22 for information.

Usually, the computer and dash group can easily be mounted under the dash. Most of the wiring in the harness has been pre-terminated to proper connector and all wire has been color-coded. All wring is 600 volt, 275° F, TXL. Standard automotive wire is GPT, 300 volt, 176°F, with PVC insulation.

This harness is divided into three major groups:

Engine Group	Includes wiring for the fuel injectors, distributor and sensors.
Dash Group	Includes ignition feed wires, assembly line diagnostic link (ALDL) connector, check engine light, computer connectors, tachometer wiring, relays and fuse block.
Tail Group	Includes power wire for the fuel pump.

#### 2.0 About these instructions

These instructions provide information for the installation of the 65105 LT-1 (92-97) fuel injection harness kit. The contents of these instructions are divided into major **Sections**, as follows:

- 1.0 Introduction
- 2.0 About These Instructions
- 3.0 Tools Needed
- 4.0 Contents of the 65105 Wiring Harness Kit
- 5.0 Pre-Installation and Harness Routing Guidelines
- 6.0 General Installation Instructions
- 7.0 GM 1992-1997 LT-1 System Wire Harness Installation
- 8.0 Trouble Shooting Instructions

**Sections** are further divided into **Paragraphs** and **Steps**. Throughout, the **Figure** numbers refer to illustrations and the **Table** numbers refer to information in table form. These are located in or near the sections or paragraphs to which they correspond. Please pay special attention to any **Notes** or any labeled **CAUTION**.

#### 3.0 TOOLS NEEDED

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

Crimping Tool Wire Stripper	Note: Use a quality tool to avoid over-crimping.
Continuity Tester	CAUTION: Do not use a test light to test the computer or sensor wiring or you will damage the computer.
Flootria Drill	

Electric Drill	
1 5/8" Hole Saw	(for the rubber grommet in the firewall)
Digital Voltmeter	

#### 4.0 CONTENTS OF THE 65105 WIRE HARNESS KIT

Take inventory to see that you have everything you are supposed to have in this kit. If anything is missing go to your dealer where you purchased the kit or contact Painless Performance at (800) 423-9696. This kit should contain the following items:

\*The main wiring harness with, the connectors already on the ends of most of the wires. \*PERFECT ECM 65105

\*Fuel Injection Installation Instructions, part number 90537 (this booklet)

\*Distributor, Idle Air Control and Throttle Position Sensor Adaptors

#### 5.0 PRE-INSTALLATION AND HANRESS ROUTING GUIDELINES

The installation of your harness kit will consist of two (2) steps

- \* 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 vehicle. That depends a great deal upon the particular make of the vehicle and what extent you want to secure and conceal the harness. We do offer some general guidelines and routing practices starting in **Paragraph 5.1.3**, general installation instructions in **Section 6.0** and precise instructions concerning the electrical connections you will have to make beginning in **Section 7.0**. To help you begin the installation of your wire harness, read the following sections:

#### 5.1 Understanding the engine that you are using.

- 5.1.1 The 1992-1997 LT-1 engine has two (2) oxygen sensors, one on the right side and one on the left side of the engine. Depending on the model of vehicle that the engine came out of you may or may not have two (2) knock sensors, one on the right side and one on the left side. For both the oxygen and knock sensors the PERFECT system has been designed to only require one of each sensor. You will reuse both the right side (passenger) O2 and right side knock sensor.
- 5.1.2 Painless Performance recommends the use of the following parts. See **Table 4.1**. These will meet all requirements and are compatible with this Painless Performance harness and controller. The following numbers listed in **Table 4.1** are GM or AC Delco part numbers, except for the 60126 part number which is a Painless number (for 1996-1997 engines only).
- 5.1.3 Familiarize yourself with the harness by locating each of the harness groups and by looking at the connectors on the wire ends.
- 5.1.4 Decide where and how the computer and relays will be mounted. Painless Performance wire harness kits are designed to mount both under the dash or in the kick panel side of the vehicle. They must be no further apart than the wiring will allow (approx 10 inches).
- 5.1.5 A good exercise is to lay out the harness on the floor beside your vehicle and identify all the connectors and wires.
- 5.1.6 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 supports.
- 5.1.7 Route the harness away from sharp edges, exhaust pipes, the hood and door hinges.
- 5.1.8 Plan where harness supports will be located. Use support approximately every 6 inches unless the harness routes under the carpet floor.
- 5.1.9 Allow enough slack in the harness at places where movement could possibly occur (body to frame, frame to engine, etc.).
- 5.1.10 The wires should be bundled into groups. Use tape, nylon ties or split loom.

#### 65105 LT-1 Fuel Injection Harness (1992-1997)

Intake Air Temperature	12110319
Ignition Module	D-1986-A
Coolant Temp. Sensor	25036979
Coil	D-573 <sup>2</sup>

16137039
17113099 1
AFS-105
10456126 <sup>2</sup>

- Note: Other parts may plug into the harness, but the part numbers <u>must</u> match the ones on this list for proper operation.
- 1. An adapter is included to adapt the 4-pin square IAC connector to the 1994-97 flat 4-pin IAC connector.
- 2. If you have a 1996 or 1997 engine you will need to purchase Painless Performance part number 60126 for the correct Coil, Coil Output and Knock Sensor.

 Table 4.1 Compatible Parts

#### 6.0 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 LABLED 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!

Notes:

- There is a normal, small drain of the battery on these fuel injection systems.
- Each connector in this harness is different and will not fit in the wrong place.
- <u>Never Force any Connector</u>
- When connecting the plugs to the computer <u>use extreme care</u> to make sure none of the pins in the computer are or become bent.
- The fuel pump you are using <u>MUST</u> be rated at a minimum of <u>45 PSI</u> (lbs. per square inch). Place the fuel filter in the <u>pressure</u> side of the pump for best possible operation.

#### 6.1 **GROUNDING THE VEHICLE**

A perfectly and beautifully wired vehicle 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.

- 6.1.1 Connect a ground strap or cable (minimum of a 4 GA. wire) from the negative battery terminal to the chassis (frame).
- 6.1.2 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**.
- 6.1.3 Connect a ground strap from the engine to the body.

#### 6.2 ROUGH INSTALLATION

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

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

- 6.2.1 Position the computer, fuse block and relay bases in their intended locations.
- 6.2.2 Drill a 1 5/8" hole for the firewall grommet near the computer for the engine group and tail sections to pass through.
- 6.2.3 Route the engine group and tail sections though the hole. Push the grommet (already installed on the harness) into the hole until it is seated.
- 6.2.4 Route the dash group over to the driver's side of the vehicle.
- 6.2.5 Route the fuse block and relay bases to where they will be mounted.

#### 6.3 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.

- 6.3.1 Permanently mount your computer. You should mount the parts (sensors, relays, etc.) that will be used for your engine at this time. These parts will vary by application.
- 6.3.2 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.
- 6.3.3 Attach harness groups to your vehicle 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.

6.3.4 When used every 1 <sup>1</sup>/<sub>2</sub>" 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.** 

#### 7.0 GM 1992-1997 LT-1 SYSTEM WIRE HARNESS INSTALLATION

#### 7.1 SPECIFIC CIRCUIT CONNECTION

Note: If you have not already done so, read sections 5.0 and 6.0 of these instructions and think through the installation of the harness before securing or cutting any wires.

#### 7.2 DASH SECTION INSTALLATION

The wires in this group consist of the assembley diagnostic link connector (ALDL) (SEE **FIGURE 7.1**), the check engine light (pre-mounted into a bracket) and four (4) other wires.

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

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

Note: Wire color (Example: Blk/Wht) is one wire with a stripe. The second color (the stripe) may not be bold. Observe all two-color wires closely.



FIGURE 7.1 Assembly Line Diagnostic Connector (ALDL)

- A. Find a suitable location to mount the ALDL connector that will allow access to the front of the connector and still allow you to see the light while driving.
- B. Mount the ALDL connector and the check engine light in the place selected.
- C. Locate the PINK ignition hot activation wire, labeled "Fuse Block Ignition B+ (18 GA.) for the fuse block and attach it to a 12V fused power source where there is power WHEN THE KEY IS IN THE START AND RUN POSISTION. This is the ignition feed power wire for the harness. If the pink wire is connected correctly, the check engine light will come on when the ignition is "ON or in START".

The three relays that have been supplied for you in the kit are the following:

•	••••••
Fuel Pump Relay	This relay will supply the 12V ignition hot power to your
	fuel pump when the key is on and in start
A/C Signal Relay	This relay will supply a ground for the computer to
	increase engine RPM when the A/C compressor has
	been turned on.
Ignition Relay	This relay will supply 12V ignition hot power to the O2
	sensor, check engine light and computer when the key has
	been turned on or start position.

Fuel Relay		
Tan		
Orange		
Grn/Wht		
Pnk/Blk		
<b>Red</b> (test lead wire)		
Ignition Relay		
Pink		
Pnk/Blk x 3		
Blk/Wht	An owner whether the second seco	
Red (test lead wire)	And a second sec	
A/C Relay	A REAL PROPERTY AND A REAL	
Green		
Grn/Wht		
Blk/Wht x3		
	and a	

FIGURE 7.2 65105 Relays and Relay bases

Note: You will have to install the relays in their housing after mounting the bases. All three relays are identical. Note: The little RED wire with the female terminal that comes out of the IGN. and Fuel Pump relay bases is a <u>test lead</u> only. It is not connected to anything. See Section 8.1

#### 7.3 ENGINE GROUP INSTALLATION

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 right side of the engine has connectors for the idle air control, throttle position sensor, distributor, injectors and map sensor, all of which **are** labeled. When you begin routing, **first** separate the engine group into left and right sections and place them accordingly.

- 7.3.1 Before you connect any wires, separate the tail section (fuel pump wire) form the engine group and place it out of the way.
- 7.3.2 Locate the two separate Blk/Wht wires in the harness that each end in a ring terminal and ground them to the engine each on their **<u>own separate</u>** ground source.
- 7.3.3 Using **Figure 7.1** thru **7.11** and the specific connections indicated in **Table 7.1**, connect the wiring as directed.
- 7.3.4 Check to make sure that the 65105 wire harness has the correct distributor connector (shown in Figure 7.7) on it for your particular engine. The 1992 & 1993 used the short connector (1") and the. When using this harness on 1992-1993 LT-1 engines please call the Painless tech hot line and request a WH-399 distributor pigtail. The 65105 harness includes in the kit the 1994-1997 long connector (2") see Figure 7.8. Plug in the correct pigtail to match your distributor.
- 7.3.5 Check to make sure that the 65105 wire harness has the correct Throttle Position Sensor connector on it for your particular engine. If you have a round style TPS you will need to find the pigtail adaptor in the kit a connect it to the TPS plug that is already on the harness. The other end of the pigtail will have your style of plug.
- 7.3.6 Check to make sure that the 65105 wire harness has the correct Idle Air Control connector on for your engine. If you have a square for pin plug you will need to remove the pigtail that has already been placed onto the harness.
- 7.3.7 The Pink wire labeled Coil Power needs to be connected to the wire that powered the coil on the original engine, or route to a fused ignition switched 12V power source.
- 7.3.8 The GRN wire tagged A/C POWER attaches to the A/C compressor power wire at the compressor if the vehicle is so equipped. This will increase the engine's RPM when the A/C is turned on.

#### 7.4 TERMINAL INSTALLATION INSTRUCTIONS

- Note: In the following steps you will be making the circuit connections. Before you start, you should carefully read <u>SECTION 7.0</u> and continually refer to the wire charts, <u>double-checking</u> 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.
- 7.4.1 Have all tools and connectors handy.
- 7.4.2 Select the correct terminal for the wire and application.
- 7.4.3 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**.
- 7.4.4 Strip insulation away from the wire. Strip only enough length necessary for the type of terminal lug you are using.

# Note: In the following steps, make sure that the terminal is crimped with proper die in the crimping tool. An improper crimp will not make a good connection. <u>DO NOT OVER CRIMP.</u>

- 7.4.5 Crimp the terminal onto the wire.
- 7.4.6 Connecting the wires and connectors throughout the harness is a repeating process. Make sure that each wire is properly routed and then attached. **Do not attach then route afterward.**
- 7.4.7 When all the wires are attached, tighten the mounts and ties to secure the harness permanently.
- 7.4.8 Attach the connectors to the computer. **Being very careful not to bend any pins**.
- 7.4.9 After all the 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 WILL DAMAGE THE COMPUTER.

#### 7.5 TAIL SECTION INSTALLATION

- 7.5.1 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.
- 7.5.2 Take the gray wire and route it to the fuel pump. This is the ignition 12V power wire for the fuel pump.

Wire Colors	# of Connectors in Connector	Labeled	Connects to:
Red/Blk,Pnk/Blk Red	4	DIST.	Distributor
Blk/Wht,Pnk/Blk Pur. , Blk	4	OYX	O2 Sensor
Blu.,Pnk/Blk or Grn.,Pnk/Blk	8	INJ #	Injectors
Dark Blue	1	KNOCK	Knock Sensor
Tan, Blk.	2	IAT	Intake Air Temp.
Blk., Blue, Gray	3	TPS	Throttle Position Sensor
Lt. Blu./Wht, Lt.Blu./E Lt.Grn/Wht, Lt.Grn/Bl	3lk 4 k	IAC	Idle Air Control
Yellow,Blk	2	CTS	Coolant Temp.
Red		STARTER	Battery B+
Lt.Grn, Gry., Blk.	3	MAP	Map Sensor
Wht., Blk., Pnk/Blk, Wht/Blk	4	IGN MOD	Ignition Module
Pnk., Wht.	2	COIL	Ignition Coil
Pnk/Blk, Wht/Blk	2	COIL	Ignition Coil
Blk/Wht	2	GROUND 1&2	Engine Ground

 Table 7.1 LT-1 Harness Connection Overview part#1

Wire Colors	# of Positions in Connector	Labeled	Connects to:
Gray		FUEL	Fuel Pump
Pnk.		COIL B+	Power for Coil
Pnk.		IGN B+	Ignition B+
Wht.		TACH	Tachometers

 Table 7.1 LT-1 Harness Connection Overview part #2



Figure 7.3 Knock Sensor



Figure 7.4 Oxygen Sensor



Figure 7.5 Ignition Module (top arrow) and Coil (bottom arrow)



Figure 7.6 Throttle Position Sensor (TPS) (top) and Idle Air Control (IAC) (bottom)



Figure 7.7 Distributor Connection



Figure 7.8 Distributor Pigtails ('92 & '93) 1" Top ('94-'97) 2" Bottom



Figure 7.9 LT-1 Harness Fuse-block



Figure 7.10 Manifold Absolute Pressure Sensor



Figure 7.11 PERFECT ECM

#### 8.0 TROUBLE SHOOTING INSTRUCTIONS

# Note: Only scanners with marine cartridges and marine cable plugs will communicate with the PERFECT computer.

If you are having trouble with your engine running badly or not running at all, first perform basic trouble shooting (checking for faulty connections, spark, fuel pressure, etc.) then see if the computer has stored any trouble codes in its memory.

#### 8.1 THE FUEL RELAY TEST WIRE

The small RED wire that is coming out of the relay is a TEST lead wire. If you do not hear your fuel pump prime when you turn on the ignition take a jumper wire and connect it from a 12V power source to the RED wire coming out of the FUEL PUMP RELAY. By supplying 12V to that wire you are bypassing the relay completely. You should hear the pump run. If you do not hear anything make sure that all connections are good and the pump has a good ground.

#### 8.2 THE CHECK ENGINE LIGHT

Normally, the "check engine" light should come on when ignition is initially turned on, and then go out few moments after the engine starts running. If the computer has detected a problem and a fault code has been set the light will come back on.

8.2.1 The computer identifies particular trouble codes by flashing the "check engine" light in a certain way. The codes are read by counting flashes:

A: The first digit (the "tens" digit) of the code is flashed quickly, followed by a brief pause, then the second digit (or "ones" digit) is flashed, followed by a longer pause. For example, three (3) quick flashes followed by a brief pause followed by two (2) flashes indicate a code 32.

B: The code will repeat itself. The next code, if any, will be displayed in the same manner.

Note: When you access the codes from the computer a code 12 (one flash followed by two flashes) will first be displayed. THIS DOES NOT INDICATE A PROBLEM. Code 12 will be flashed 2 times, followed by the particular trouble codes, if any. If the computer merely flashes code 12 there are no trouble codes stored. Code 12 means the engine is not running.

#### 8.3 **RETRIEVING TROUBLE CODES FROM THE COMPUTER**

- 8.3.1 In order to retrieve the trouble codes stored in the computer, locate the ALDL plug installed in **Section 7.2**. Turn the ignition on, BUT DO NOT START THE ENGINE. Connect a jumper wire from the ALDL terminal "A" to terminal "B" see **Figure 7.1** and observe the check engine light.
- 8.3.2 If you have read any codes (remember the normal code 12), write them down for reference Remove the jumper wire from the ALDL connector.
- 8.3.3 Take the codes one at a time and match them to the codes in **Table 8.1**. This will tell you in which circuit the computer has detected a problem.

# Note: A code indicated a problem is a specific circuit, NOT THAT A PARTICULAR PART IS BAD.

- 8.3.4 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 circuits for any broken, shorted, or exposed wires. Finally, insure all ground wires are clean and secure.
- 8.3.5 If you are getting a code from your computer and need to clear the code, other than 12, after you have replaced a part, readjusted a part, etc. You can do this by making the following steps.
  - A: Install a jumper wire from terminal A to terminal B
  - B. Ignition ON engine OFF
  - C. Move throttle from 0% (idle) to 100% (WOT) and back to 0%.
  - D. Remove the jumper wire.
  - E. Turn ignition OFF for at least 20 seconds.
  - F. Ignition ON engine OFF
  - G. Recheck for codes.

Code #	Circuit affected
13	Oxygen Sensor
14	Coolant Temp. High Voltage (COLD)
15	Coolant Temp. Low Voltage (HOT)
21	Throttle Position Sensor (high voltage)
22	Throttle Position Sensor (low voltage)
23	Intake Air Temp. Low Voltage (HOT)
25	Intake Air Temp. High Voltage (COLD)
33	MAP Sensor Circuit (high voltage)
34	MAP Sensor Circuit (low voltage)
41	Ignition Control Circuit (open IC circuit)
42	Ignition Control Circuit (grounded IC)
44	Knock Sensor Inactive
54	Heated Oxygen Low Voltage (lean)
55	Heated Oxygen High Voltage (rich)

**Table 8.1** Diagnostic Trouble Code Chart

#### 8.4 WHEN TO CALL PERFECT PERFORMANCE PRODUCTS TECH LINE

- 8.4.1 These harness kits have been built with the highest regard to strict quality control and tested before shipment. Before calling use please double check all connections and perform normal basic trouble shooting (fuel pressure, ignition, spark, etc.).
- 8.4.2 If you have any questions concerning the installation of this harness or are having trouble in general; feel free to call Painless Performance tech line at (800) 423-9696. Calls are answered from 8 AM to 5 PM CST, Monday-Friday, except holidays. Please leave a message if you are unable to reach is and we will return your call as soon as possible.

#### Note: HELPFUL INFORMATION ON THE PERFECT ECM CALIBRATIONS.

The PERFECT ECM has been specifically calibrated for your particular engine. This computer will NOT work with any other type of engine, nor will it work with a modified engine. The computer has been programmed with a REV. limit set @5,000 RPM. If your computer was to detect an engine malfunction it will first set the "check engine" engine light and then proceed to place itself into a "safe mode". This "safe mode" will still allow you to drive your vehicle, but it will not allow you to drive over 1,300 RPM. The computer will not take itself out of "safe mode" until the malfunction has been corrected. The computer will place itself into "safe mode" even if your vehicle starts to over-heat. Once the engine cools down the computer will place itself out of the mode and return back to normal functions. Engine over-heat temp. has been set at 250°.

E-mail:tech@painlessperformance.com WEB: www.painlessperformance.com

#### Painless Performance Limited Warranty and Return Policy

Chassis, fuel injection harnesses, and Striker ColdShot 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.



# Camshaft Installation Instructions For Installing: Part # 65205 – 1992-1997 (5.7L) LT1 Engines



# **Perfect Performance Products, LLC**

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We have attempted to provide you with as accurate instructions as possible, and are always concerned about corrections or improvements that can be made. If you have found any errors, omissions, or if you simply have comments or suggestions concerning these instructions, please write us at the address on the cover and let us know about them. Or, better yet, send us a fax at (817) 244-4024.

> <u>For Technical Questions</u> E-mail address: <u>tech@painlessperformance.com</u> Tech Line: (800) 423-9696

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#### **1.0 INTRODUCTION**

**Please read all instructions prior to install**. Use these instructions as a guide to install the camshaft into your LT1 engine. Not all facets of the installation process are covered with these instructions. Certain elements of the installation have a number of different methods to complete them. These instructions include what we at Painless Performance Products have found to work the best for us. You, as the end user, will decide what the best method for your camshaft installation is.

## 2.0 TOOLS AND PARTS NEEDED FOR INSTALLATION

You will at least need the following for this camshaft installation:

- Full set of mechanics tools
- Camshaft lube
- Silicone gasket sealant and tool for scraping off the old gaskets.
- Carburetor Cleaner/ Brake Cleaner
- New gaskets for the water pump, intake manifold, and front engine cover. (required)
- New gaskets for the valve covers and a crankshaft front oil seal are recommended but not necessarily required.
- 3 5/16"x4" Bolts

### **\*\*\*NOTICE THE BOLD PRINT BELOW\*\*\***

- Read this next part carefully and be sure to understand exactly what is being stated.
- The camshaft included in this kit <u>WILL NOT</u> work with the stock valve springs in your LT1! If the valve springs are not changed to the following required parts, permanent and expensive engine damage will occur. DO NOT ignore this information.
- The required parts are: Competition Cams P/N 26918-16 Beehive Springs Competition Cams P/N 787-16 Retainers Competition Cams P/N 648-16 Keepers
- Ordering these parts will ensure the valve springs will not bind. In the event the PARTS LISTED ABOVE are not used, the stock springs will bind the coils at full camshaft lift and possibly ruin the spring, pushrod, lifter and may even drop a valve into the combustion chamber resulting in the pistons to destroying themselves. So please follow these directions and purchase the parts listed above.

## 3.0 PRE-INSTALLATION GUIDELINES

During engine tear down it is recommended to inspect each engine part for excessive and/or abnormal wear. Any parts with excessive wear need to be replaced. High Performance parts such as camshafts and springs will only work to their peak performance levels when all of the engine's parts are within specifications. See the engine manufacturer's service manual for details.

3.1 **Disconnect the battery.** Drain the engine coolant. Remove the air-box if applicable. Remove the coolant passage hoses from the throttle body by squeezing the clamps with a pair of pliers (only if factory installed spring clamps are being used) and gently pull on the hoses. Remove the radiator hoses and the heater hoses. Twisting the hoses back and forth may aide this. Remove the PCV tubing from the throttle body, intake and valve covers. Unplug the TPS and IAC connectors from the throttle body. Release any residual pressure from the fuel system by carefully depressing the test port Schrader valve located on the fuel rail. Now, carefully disconnect the fuel lines from the injector fuel rail.



Figure 3-1 Intake Manifold Assembly

3.2 It is not necessary to remove the fuel injectors, fuel rail or throttle body. Using a ratchet and a correctly sized drive socket, carefully loosen and remove the intake manifold bolts. Then remove the intake manifold from the engine. It may be stuck because the gaskets are sticking to the heads, so carefully lift the manifold by lightly prying between the intake and cylinder heads. At this point, it would be a good idea to take note the oil will need to be changed. See Figure 3-1 for reference.

3.3 Now turn focus to the main accessory belt tensioner on the main accessory drive belt. Using a break over bar and correctly sized drive socket (13mm), carefully rotate the tensioner assembly and remove the drive belt. See Figure 3-2 for reference.



**Figure 3-2 Tensioner Assembly** 

3.4 Next remove the Alternator/Air Conditioning Compressor/Power Steering Pump Bracket Assembly. See Figure 3-3 for reference.



Figure 3-3 Alternator/Air Conditioning Compressor/Power Steering Pump Bracket Assembly

3.5 Remove the six water pump bolts and then remove the water pump. Now is a good time to clean the left over water pump gasket from the engine block. Use extra care when cleaning this sealing surface. Any scrapes or gouges of the aluminum pump housing will hinder the new gaskets sealing ability. Make sure none of the old gasket scraped from the engine block enters the coolant passages of the engine block. See Figure 3-4 for reference.



Figure 3-4 Water Pump and Hardware

3.6 Next remove the crankshaft harmonic balancer bolts and center hub bolt. A special tool can be obtained from GM to remove the hub or a longer center balancer bolt and a two jaw puller may be used as well. Either way, be cautious about damaging the crankshaft snout threads or press surface. Do not use a hammer to remove either of these parts. See Figure 3-5 for reference.



#### Figure 3-5 Crankshaft Harmonic Balancer and Hub

3.7 Using a 10mm socket remove the three bolts holding the distributor in place. Next carefully remove the distributor. See Figure 3-6 for reference.



**Figure 3-6 Distributor Assembly** 

3.8 Next remove the oil pan bolts and remove the oil pan. Note: If the engine is in the automobile, it may not be necessary to completely remove the oil pan. The oil pan only needs to be dropped down far enough to remove the timing cover. See Figure 3-7 for reference.



#### Figure 3-7 Oil Pan

3.9 Remove the timing cover bolts and carefully remove the timing cover. The timing cover is made of cast aluminum and can be easily warped or damaged. Be sure not to score the gasket surface with a prying tool. See Figure 3-8 for reference.



#### **Figure 3-8 Timing Cover**

3.10 Next remove the eight valve cover bolts and remove both valve covers. See Figure 3-9 for reference.



**Figure 3-9 Valve Covers** 

3.11 Next loosen the rocker arm nuts enough to turn them to the side of each valve spring. Once the rocker arms are turned to the side, remove the pushrods by pulling them up and out of the engine. See Figure 4-0 for reference.



**Figure 4-0 Rocker Arms and Pushrods** 

- 3.12 Next turn the engine over until the timing marks on the small crank sprocket and larger cam sprocket align. Now remove the three bolts on the camshaft sprocket. Then carefully pull the sprocket and chain off of the camshaft. Next remove the two torx bolts **Note:** At this point it is a good idea to check the slack in the timing chain. If it is more than the manufacture recommends replace the chain. If the sprockets are worn, replace them as well. A loose timing set will only hurt engine performance and eventually lead to failure. See Figure 4-1 for reference.
- 3.13 Now remove the camshaft retainer plate torx head screws and the retainer plate. Also remove the oil pump driveshaft assembly. See Figure 4-1 & 4-2 for reference.







#### Figure 4-2 Oil Pump Driveshaft Assembly

3.14 Next remove the Valve Lifter Guide Retainer, Valve Lifter Guides, and the Lifters. **Note: It is not necessary to remove the cylinder heads as pictured.** See Figure 4-3 for reference.



Figure 4-3 Lifters, Guides and Guide Retainer

3.15 Install three 5/16-18X4" bolts in the camshaft holes **Note: All camshaft** journals are the same diameter so care must be used in removing the camshaft assembly to avoid damage to the bearings. The key to removing the old camshaft and installing the new one without damaging the bearing material is to float (support the weight of) the camshaft while slowly removing it from the engine block. See Figure 4-4 for reference.



Figure 4-4 Camshaft Removal

#### **Caution:**

This camshaft removal process is delicate. Four bearings must be passed through with the camshaft lobes. Each camshaft lobe has sharp edges. These sharp edges will gouge the bearings and permanently damage them. Hold the camshaft inline with the motor as much as possible when pulling it out. You must support the weight of the camshaft against gravity and float it out of the engine. Twisting the camshaft back and forth may aide in this removal process. If the camshaft does not want to come out, push it back in. <u>Do not forcibly pull the</u> <u>camshaft out of the engine.</u>

### 4.0 CAMSHAFT INSTALLATION GUIDELINES

With a flashlight look down the camshaft bore into the engine block. Inspect the condition of the cam bearings. If they have significant gouges, scrapes or wear and discoloration, they should be replaced.

- 4.1 Remove the new camshaft from the camshaft box. Install the three 5/16-18 x 4" bolts from the old camshaft onto this new one. These bolts will again be used as a handle to aide in the installation of the camshaft. Spray the inside and outside of the camshaft liberally with carburetor cleaner and wipe it with a rag. This is to remove all of the left over metal shavings from the manufacturing process. Apply camshaft lube over each of the lobes and the bearing surfaces.
- 4.2 Carefully insert the new camshaft into the engine block. Caution: This camshaft installation process is delicate. The camshaft bearings are easily damaged by improperly installing the new camshaft. Hold the camshaft inline with the motor as much as possible. You must support the weight of the camshaft against gravity and float it into the engine. Twisting the camshaft back and forth may aide in this installation process. Remove the three 5/16"x 4" bolts from the front of the camshaft after it is fully inserted into the engine.



**Camshaft installation** 

4.3 Reinstall the camshaft retainer and torque the four bolts to 106 in/lb (12Nm). Reinstall the camshaft sprocket by aligning the alignment dot on it to 6 o'clock. The crankshaft alignment dot should still be in the 12 o'clock position. Wrap the camshaft chain around the camshaft sprocket and align the dowel pin on the camshaft to the hole in the camshaft sprocket. Thread the three camshaft bolts through the sprocket into the cam and torque them to 18 lb/ft (25 Nm).

- 4.4 Reinstall the lifters, lifter guides and lifter guide retainer. Reinstall the push rods. Make sure the pushrods are correctly aligned to the lifters. Realign the rocker arms to the pushrods and the valves.
- 4.5 <u>Note:</u> Engine firing order is 1, 8,4,3,6,5,7,2. Cylinders 1, 3, 5 and 7 are on the left bank. Cylinders 2, 4, 6 and 8 are on the right bank.

#### **Rocker Arm Adjustment**

- A. Turn crankshaft assembly until cast arrow on crankshaft balancer hub is in 12 o'clock position and number 1 cylinder is in firing position(Top Dead Center). Watch number 1 cylinder valves as crankshaft balancer hub arrow approaches 12 o'clock position. If a valve moves as arrow moves to position, engine assembly is in number 6 cylinder firing position. Crankshaft assembly must then be turned one more time to reach number 1 cylinder firing position.
- B. With engine assembly in number 1 cylinder firing position, following valves can be adjusted: **Exhaust: 1, 3, 4, 8** / **Intake: 1, 2, 5, 7**
- C. Back off rocker arm nut until lash is felt in the pushrod assembly. Then tighten rocker arm nut until all lash is removed. Zero lash can be felt by rotating the pushrod assembly between thumb and forefinger until there is no free play but pushrod assembly rotates with slight resistance.
- D. When all free play has been removed, tighten rocker arm nut one additional turn (360 degrees).
- E. Turn crankshaft assembly one revolution until hub arrow is again at 12 o'clock position. This is number 6 cylinder firing position. Now the following valves can be adjusted: **Exhaust: 2, 5, 6, 7 / Intake: 3, 4, 6, 8**

## 5.0 ENGINE REASSEMBLY GUIDELINES

- 5.1 Replace the crankshaft front oil seal and the front engine cover seal at this time. Apply a small amount of silicone into the corners where the oil pan, front engine cover and the engine block mate. Install the front engine cover with its bolts loosely. The crankshaft balancer hub is a press fit onto the crankshaft. Several methods can be used to install this hub onto the crankshaft. First method, purchase a longer bolt to get the hub started onto the crankshaft snout. Then use the original bolt to pull the hub the rest of the way on. Note: Use caution when tightening the longer bolt into the crankshaft as to not break it off when the bolt bottoms out in the snout of the crank. And also be careful to not try to pull too hard on the hub with the original bolt. This will only lead to ruining the threads in the crank.
- 5.2 The second method for installing the crankshaft harmonic balancer hub would be to purchase the Kent Moore tool part number J39046 from a dealership if they will allow you to. Torque center bolt to 75 lb-ft.
- 5.3 Now finish tightening the front engine cover bolts. Torque bolts to 97 lb-in.

- 5.4 Install the crankshaft harmonic balancer bolts (3). Preferably use blue LocTight and torque to 63 lb-ft.
- 5.5 Reinstall the Distributor by aligning the camshaft pin to the distributor drive. See Figure 3-6 for reference.
- 5.5 Scrape the old gaskets off of the water pump. Reinstall the water pump onto the engine block using the new gaskets. Torque the water pump bolts to 30 lb/ft (41Nm). Reinstall the valve covers. Torque the bolts to 106lb/in (12Nm). Reinstall the spark plugs wires onto the sparkplugs. Reinstall the main bracket assembly and the power steering pump, A/C compressor and Alternator.
- 5.6 Reinstall the main accessory drive belt. Reinstall the throttle body and torque the three bolts to 106lb/in (12Nm). Reinstall the intake manifold and torque the bolts to 35lb-ft using the numbered sequence in Figure 3-1. Reinstall the throttle body and torque the three bolts to 18lb-ft. Plug in the TPS and IAC connectors to the throttle body. Reinstall the PCV hoses onto the throttle body, valve covers and intake. Reinstall the radiator and heater hoses and fill the system with coolant. Reinstall the battery cables. Check all fluids and top off if needed. Start engine. Immediately check for proper oil pressure (30-50 psi at idle). The engine will seem a bit noisy for the first few seconds of run time. This noise is normal and should subside after the first few seconds. Change the oil and filter after the first 100 miles with the new cam.

# See Index on next page for fastener tightening specs.

#### SPECIFICATIONS

# FASTENER TIGHTENING SPECIFICATIONS

Accelerator Control Cable Bracket Bolt/Screw	12 N•m (106 lb. in.)
Camshaft Retainer Bolt/Screw	12 N•m (106 lb. in.)
Camshaft Sprocket Bolt/Screw	. 25 N•m (18 lb. ft.)
Connecting Rod Nut	ft.) + additional 55°
Coolant Air Bleed Pine Bolt/Screw	. 40 N•m (30 lb. ft.)
Cronkshaft Balancer Bolt/Screw	. 85 N•m (63 lb. ft.)
Crankshaft Balancer Hub Bolt/Screw	100 N•m (75 lb. ft.)
Crankshaft Bearing Can Bolt/Screw and Stud	105 N•m (77 lb. ft.)
Crankshalt Dearing Cap Doubleter and Stud Therew	. 15 N•m (11 lb. ft.)
Crankshall Real Oil Seal Housing Hub Dold Selew Hitter Housing	. 88 N•m (65 lb. ft.)
Cylinder Head Bolt/Serow	12 N•m (106 lb. in.)
	. 20 N•m (15 lb. in.)
Drain Plug	25 N•m (18 lb. ft.)
EGR Control valve Relay Nut	25 N•m (18 lb. ft.)
EGR Valve nut	25 N•m (18 lb. ft.)
EGR valve Pipe Bolt/Screw and Ivut	20 N•m (15 lb. ft.)
Engine Block Oil Gallery Plug	11 Nom (97 lb. in.)
Engine Front Cover Bolt/Screw	35  Nem (26  lb  ft)
Engine Oil Level Sensor Assembly	6  Nem (53  lb  ft)
Evaporative Emission Canister Purge Solenoid valve Bracket BoldScrew	35  Nem (26  lb. ft.)
Exhaust Manifold Stud and Bolt/Screw	100  Nem (74  lb  ft)
Flywheel Bolt/Screw	100  Nem (90  lb  ft)
Fuel Injection Fuel Rail Bolt/Screw	10  Nem (106  lb  in)
Fuel Pump Switch and Oil Pressure Gage Sensor Assembly	12  Nem (100  ID. III.)
Generator Bracket Bolt/Screw	40  Nem (30  lb. ft.)
Ignition Coil Stud	. 40 NºIII (50 ID. II.)
Intake Manifold Bolt/Screw and Stud	0 Mars (71 lb in )
First Pass	8 N M (/1 10.111.)
Final Pass	. 48 N•m (35 lb. lt.)
Knock Sensor Assembly	$20 \text{ N} \cdot \text{m} (15 \text{ ID}, 11.)$
MAP Sensor Bolt/Screw	6 N•m (53 lb. ft.)
Oil Filter Adapter Bolt/Screw	$23 \text{ N} \cdot \text{m} (1 / 10. \text{ ft.})$
Oil Level Indicator Tube Bolt/Screw	12 N•m (106 lb. in.)
Oil Pan Assembly	
Corner Nut/Bolt/Screw	$20 \text{ N} \cdot \text{m} (15 \text{ lb. ft.})$
Side Rail Bolt/Screw	. 11 N•m (97 lb. ın.)
Oil Pan Baffle Nut	. 40 N•m (30 lb. ft.)
Oil Pan Drain Plug	. 20 N•m (15 lb. ft.)
Oil Pump Bolt/Screw-to-Rear Crankshaft Bearing Cap	. 90 N•m (66 lb. in.)
Oil Pump Cover Bolt/Screw	9 N•m (80 lb. in.)
Oil Pump Driveshaft Bolt/Screw	. 18 N•m (13 lb. ft.)
Secondary Air Injection Pine-to-Exhaust Manifold Assembly	. 55 N•m (41 lb. ft.)
Secondary Air Injection Pump Bracket Bolt/Screw	. 40 N•m (30 lb. ft.)
Starter Motor Bolt/Screw	. 47 N•m (35 lb. ft.)
Throttle Body Bolt/Screw	. 25 N•m (18 lb. ft.)
Value Lifter Guide Retainer Bolt/Screw	. 25 N•m (18 lb. ft.)
Value Rocker Arm Ball Stud	. 68 N•m (50 lb. ft.)
Valve Bocker Arm Cover Bolt/Screw	12 N•m (106 lb. in.)
Water Dump Rolt/Screw and Stud	. 41 N•m (30 lb. ft.)
Water Pump Driveshaft Bearing Retainer Rolt/Screw	12 N•m (106 lb. in.)
water rump Driveshalt bearing Retainer Deutseren	

# ENGINE ASSEMBLY SPECIFICATIONS (5.7L LT1)

#### GENERAL

	370
Туре	Vð
1)pc	11 (350  CID)
Displacement	
Pore 101.60	mm (4.000 ° )
DOIC	mm (3 180")
Stroke 60.59	IIIII (3.400 )
Commencian Patio	10.5:1
Compression Rano	126572
Firing Order	5-4-5-0-5-7-2
THE CLOCK CONTRACTOR OF CONTRACT	

## Painless Performance Limited Warranty and Return Policy

Chassis harnesses and fuel injection harnesses 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.

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