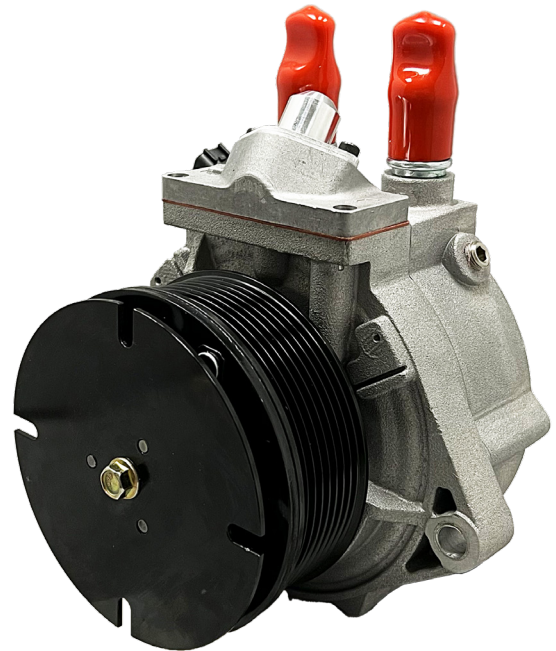


**Install Manual 2020 +
IC CE Bus Using
Cummins 6.7L ISB
w/Electric Fan Clutch**



Ventech 

LHG (Liquid Heat Generator)

Ventech Kit # 0077A

2024-10-22

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1. This Manual

The installation and service of Ventech products requires special expertise and training. Installations and servicing of Ventech products by untrained, unauthorized personnel and end-users voids all warranties and releases Ventech and Ventech authorized distributors, dealers and their personnel from responsibility for damage to Ventech products, any resulting collateral property damage and personal injury.

Any use, operation, installation, modification or application of the product not described in Ventech manuals, or subjecting the product to extreme or unusual conditions beyond the limits of specified performance characteristics is misuse of the product.

Failure to comply with all installation instructions is a misuse of Ventech products. The same applies for all repairs without using genuine Ventech service parts. This will void the products warranty coverage.

Symbol Identification

General Symbol Descriptions



DANGER: Indicates an imminently hazardous situation, which, if not avoided, **WILL** result in death or serious injury.



WARNING: Indicates a potentially hazardous situation, which if not avoided, **COULD** result in death or serious injury.



CAUTION: Indicates a potentially hazardous situation, which if not avoided, **MAY** result in minor or moderate injury or property damage. It may also be used to alert against unsafe practices.



NOTE: These symbols are used to alert the installer to important or useful information about proper installation of the equipment.

Scope and Purpose

These installation instructions are intended to support Ventech trained and authorized distributors and dealers in the installation of the Liquid Heat Generator (LHG). These instructions are not intended for use by untrained or unauthorized personnel.



Location of Liquid Heat Generator (LHG), installation of coolant lines, wiring and control devices are important for proper operation. Failure to comply with the installation instructions provided may result in poor operation or damage to LHG and vehicle components.

1.1 Kit Diagram and Part Descriptions

About this Manual

This document is an Installation Manual for Ventech’s LHG700 Series Rapid Supplemental Heater.

- The same **Heater Assembly** is used for all school bus applications.
- The same **Electrical Harness** and **Dashboard Switch** are used for all school bus applications.
- Different school buses require a specific Installation Kit, including unique **Mounting Bracket(s)**, **belt**, **belt-tensioner** and/or **Idler**, and **Hose** arrangements.

Confirm you have the correct Installation Kit

Make sure that you have the correct LHG Installation Kit for your school bus (See Cover of Manual). Different vehicles use the same LHG700 and the same ECU/Harness system. However, each vehicle platform requires a unique kit.

The Kit-specific information includes:

- Kit Parts List and Quantities
- Mounting Bracket Arrangement drawing (including fastener selection, etc).
- Coolant hose arrangement and configuration.

Check the Kit Parts List against the content of the Installation Kit box.

Manual Installation Notes: It is very important that the LHG be installed correctly not only to obtain maximum results, but also to minimize the possibility of unit failure. The following tips address some of the more common installation mistakes that have resulted in unit issues.

Torque:

Torque all fasteners according to the table. Over-torquing the fasteners may cause damage to the bolts and/or threaded components. Under-torquing the fasteners may allow fasteners to loosen.

Bolt Size	Bolt Class			
	8.8 (ft-lbs)	10.9 (ft-lbs)	8.8 (Nm)	10.9 (Nm)
8	16	22.9	21.8	31.1
10	31.6	45.2	43.0	61.5
12	55.1	78.9	74.9	107.3

Loc-Tite:

When there are no Loc-Nuts used in a particular fastener application, Loc-Tite 242 is to be applied to the bolt thread to secure the assembly.

Electrical:

In most applications, the LHG’s electrical system switch should be tied into an engine-run signal (in addition to power). Properly installed, the Ventech assembly will not draw on the battery. The connection should occur across a fuse (but on the ‘hot’ side of the fuse) at the panel to protect the LHG’s & the vehicle’s electrical system.

Belt:

Belt alignment is critical to maintain the integrity of the LHG and its kit, but also to protect the belt from damage. Ventech recommends that a laser alignment tool (i.e. Gates Part 91006) to verify that the belt ‘squares up’ across the entire path. A proper belt installation will have the tensioner approximately at its mid-range. IF the belt is installed too tightly, it can damage components &/or the belt itself.

1.2 Kit and Part Descriptions continued

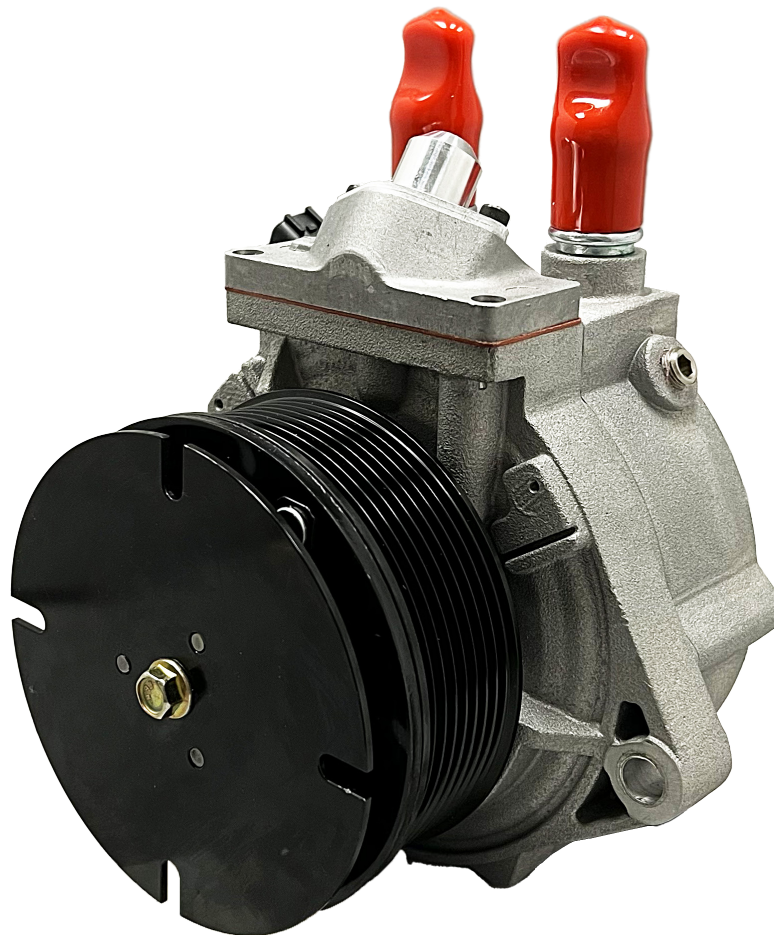
The Liquid Heat Generator System

Primary Purpose

The Liquid Heat Generator (LHG) is an Idle Reduction Technology designed to rapidly increase the temperature of the engine coolant, thus significantly reducing Idling and reducing the time it takes to warm up the passenger cabin and de-ice the windshield.

This action is especially necessary in northern cold countries, such as the Northern United States, Canada, Northern Europe, etc.

The LHG is a belt-driven vehicle accessory.

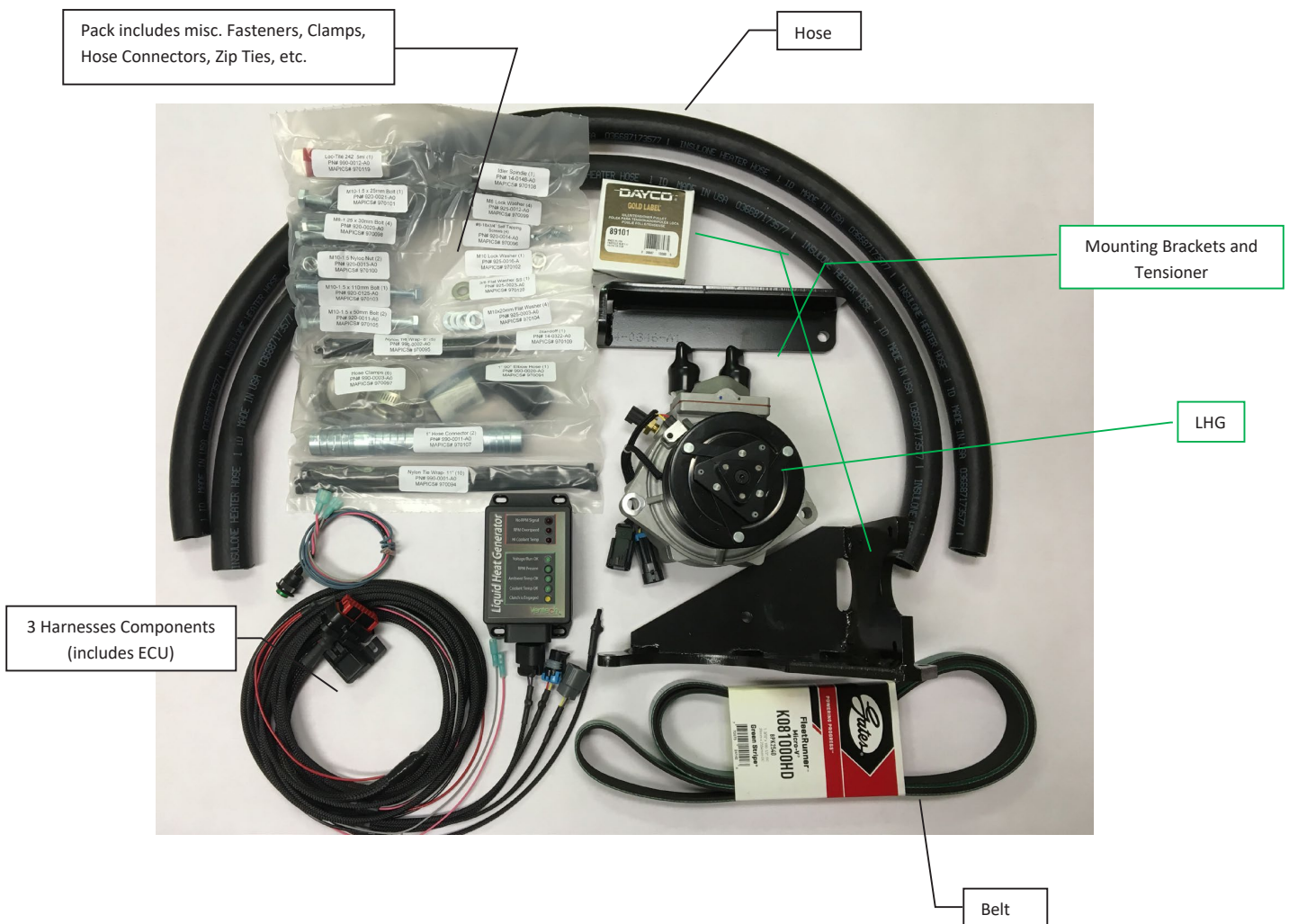


LHG700

Main Components of the LHG Installation

The LHG installation kit comprises of the following main assemblies and components. All parts needed to complete the installation can be found in the two boxes provided.

Box #1 (Installation Kit - Contents vary by Kit #):



1.3 Forward/Background

Sequence of Installation – IMPORTANT

The following Installation Instructions are broken down into the following tasks that should be followed in the order listed:

1. Mount the LHG Heater assembly
2. Perform the Plumbing
3. Install the Electrical Components
4. Bleed the Cooling System / Purge the LHG
5. Tidying up the installation
6. Pre-start checks

General References

- Secure hoses and wiring harnesses with cable ties and fit protective hoses around them at chafing points.
- Fit edge protectors on sharp edges.
- Apply blue (medium strength) thread locking compound to all threaded fasteners unless instructed otherwise.

Preparation

LHG Heater & Installation Kit

- Verify and identify all the components of the kit against the Parts List found in the appendices.

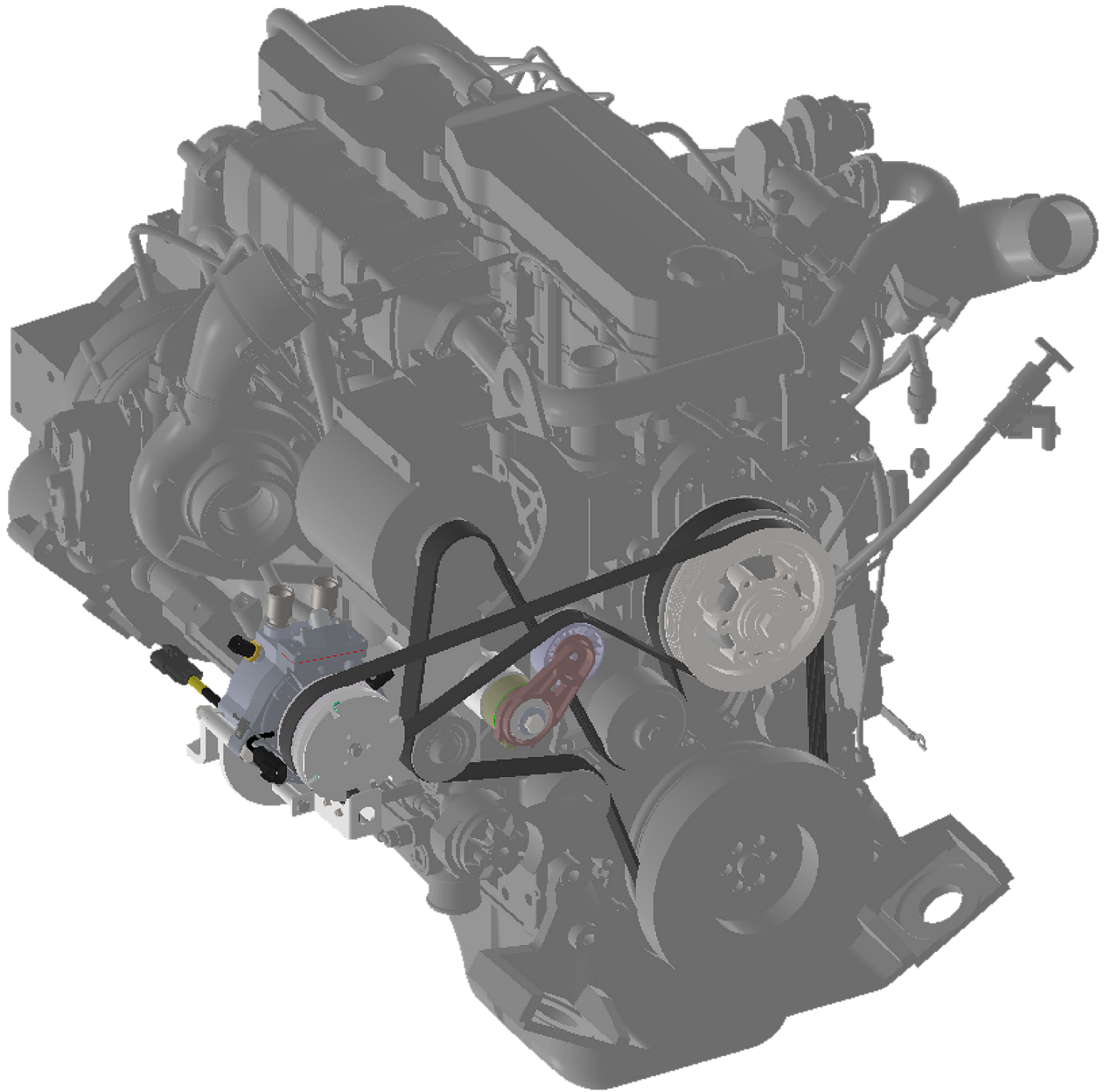
Vehicle



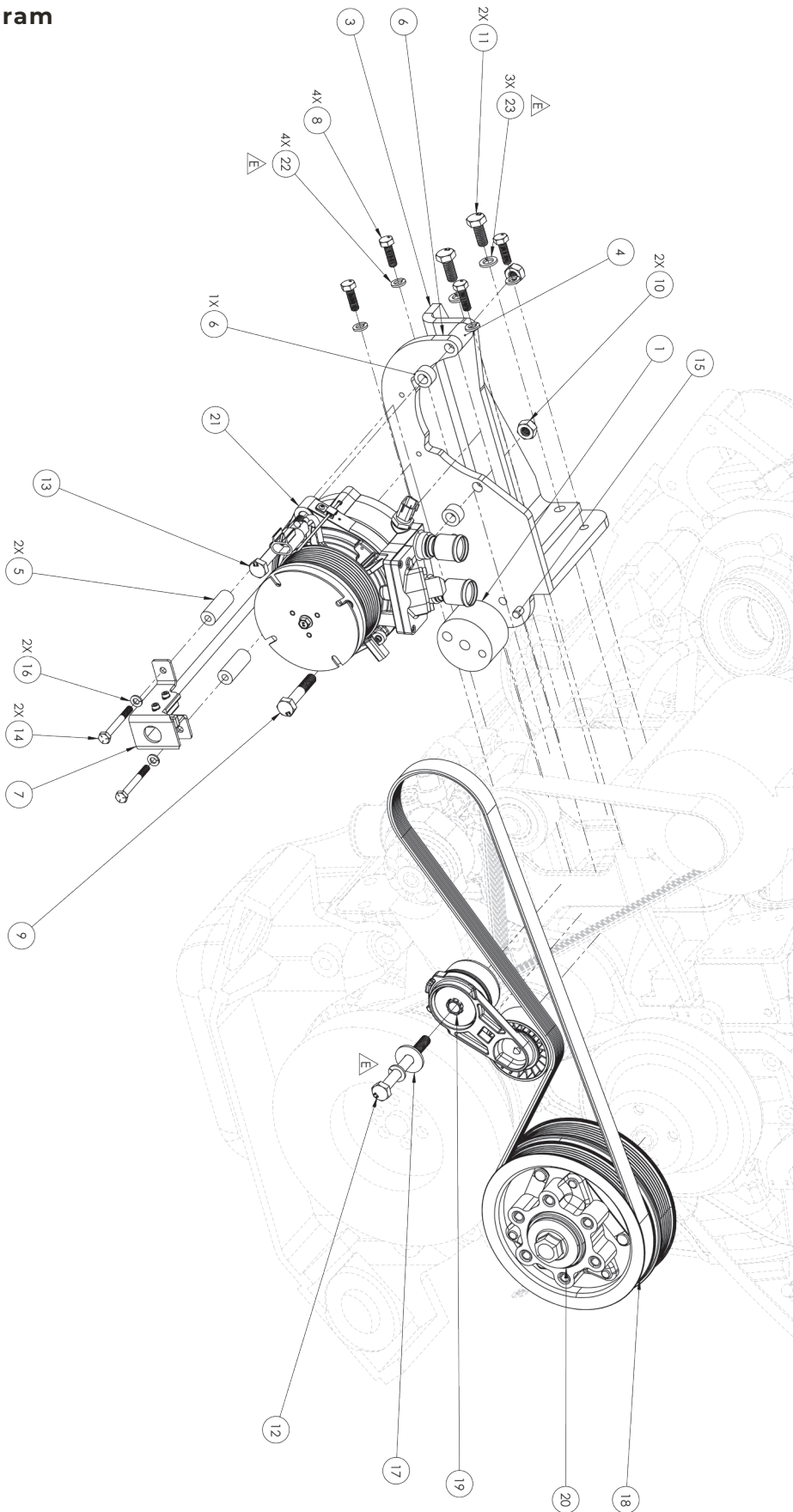
WARNING: Engine may be HOT! Allow engine to cool before removing parts and opening the coolant system.

- Release radiator pressure
- Disconnect battery ground cable
- Protect vehicle fenders, panels and interior with covers (or remove to ease access to engine)

1.4 On Engine Illustration



1.5 Exploded Diagram




ITEM #	PART #	DESCRIPTION/KIT 77A	QTY.
1	14-0525-B0	TENSIONER SPACER	1
2	14-0526-A0	LHG BOLT SPACER	2
3	14-0527-A0	REAR BRACE	1
4	14-0528-A0	REAR BRACE BOLT SPACER	1
5	14-0550-A0	FRONT SPEED SENSOR BOLT SPACER	2
6	140-0151-E0	LHG MOUNTING BRACKET	1
7	140-0154-A0	STD ROTOR RPM BRACKET ASSY	1
8	920-0010-A0	M8-1.25 X 25 HEX HD BOLT	4
9	920-0012-A0	M10-1.5 X 55 HEX HD BOLT	1
10	920-0013-A0	M10-1.5 NYLOC NUT	2
11	920-0021-A0	M10-1.5 X 25 HEX HD BOLT	2
12	920-0059-A0	M10-1.5 X 100 HEX HD BOLT	1
13	920-0130-A0	M10-1.5 X 90 HEX HD BOLT	1
14	920-0250-A0	1/4-20 X 2-1/4 HEX HEAD	2
15	921-0024-A0	8mm X 20mm DOWEL	1
16	925-0021-A0	1/4" SPLIT LOCK WASHER	2
17	925-0031-A0	M10 OVERSIZED WASHER	1
18	980-0078-A0	SERPENTINE BELT	1
19	982-0003-A0	TENSIONER, CCW, 70mm	1
20	983-0002-A0	CLUTCHED FAN PULLEY	1
21	LHG700 DSS 10	LHG700, DUAL-RPM, 1" FITTINGS	1
22	925-0012-A0	M8 LOCK WASHER, ZP	4
23	925-0016-A0	M10 LOCK WASHER, ZP	3
24	135-0038-A0	DELUXE ECU	1
25	130-0045-A0	DELUXE ECU HARNESS	1
26	135-0030-A0	DELUXE SWITCH ASSY	1
27	990-0001-A0	NYLON TIE WRAPS (11")	10
28	990-0002-A0	NYLON TIE WRAPS (8")	5
29	990-0012-A0	LOC-TITE (BLUE)	1
30	920-0014-A0	#8 x 3/4" SELF-TAPPING SCREWS	4
31	990-0011-A0	HOSE CONNECTOR	4
32	990-0003-A0	HOSE CLAMPS	10
33	N/A	SMALLER TENSIONER SPACER	1
34	990-0021-A0	90 DEGREE HOSE Type 1	3

1.6 OEM Belt Routing

IMPORTANT

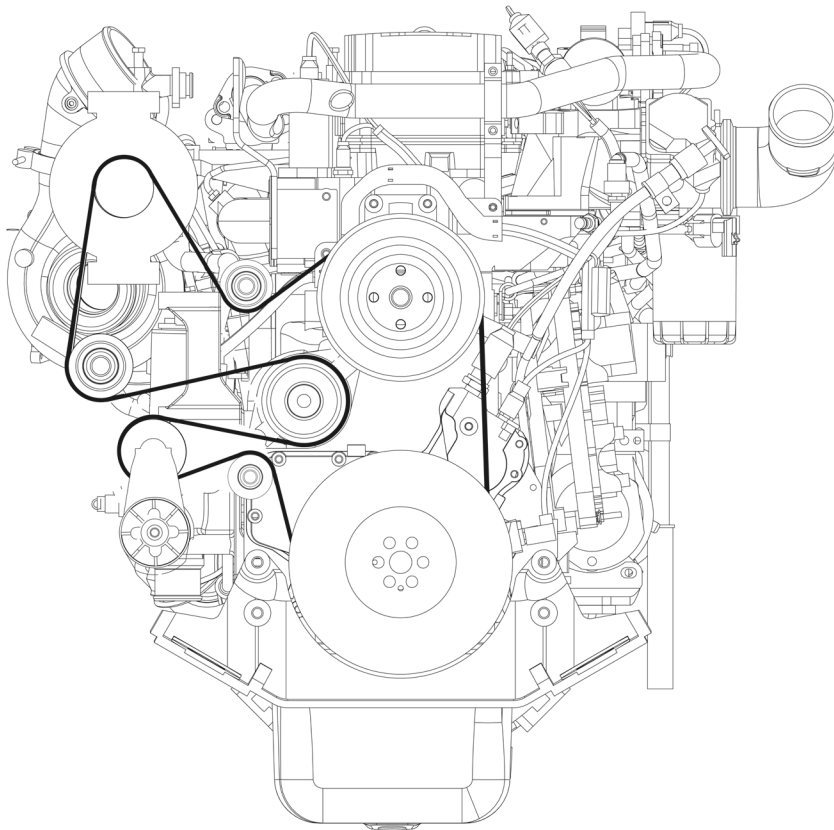
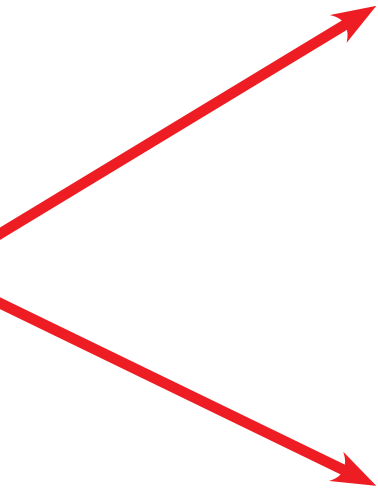
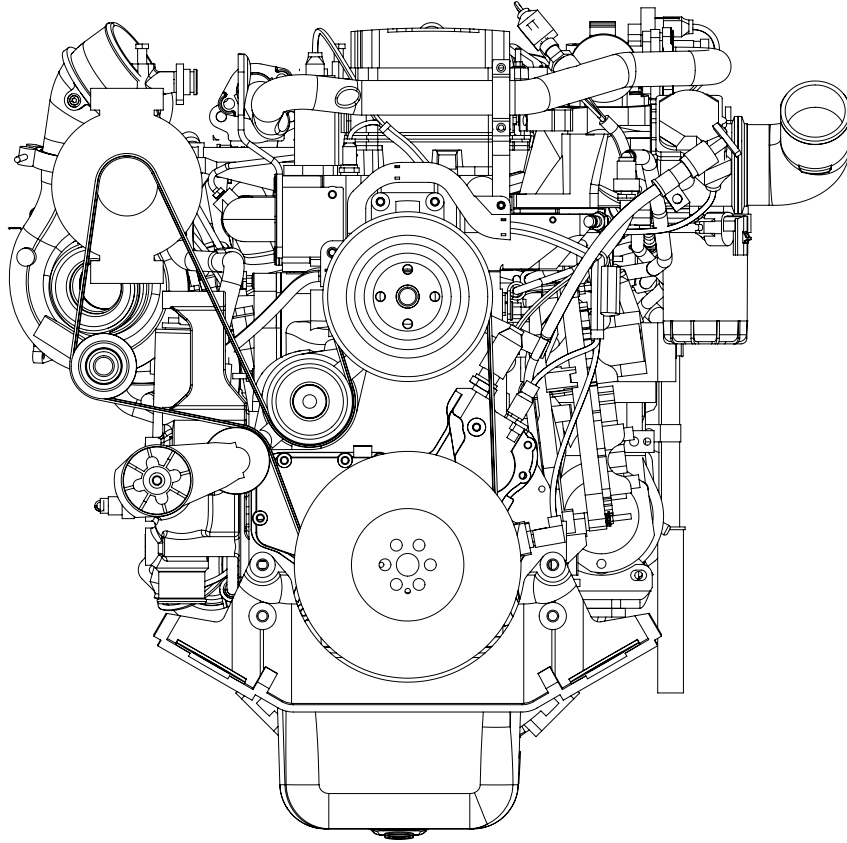
We have encountered different OEM belt routing and pulley configurations in the field.

During the installation process, you will be removing and re-installing the OEM serpentine belt using the same OEM belt routing.

To the right, we have illustrated two of the configurations that we have encountered in the field. 

IT IS IMPORTANT that you note the routing of YOUR OEM serpentine belt before removing it, so you can re-install it in the same manner.

If it is not in one of the configurations shown here, you may want to take pictures, or find a representation in the OEM manuals to make sure you know the serpentine belt routing.



1.7 Kit Parts List

1.8 Kit Configuration

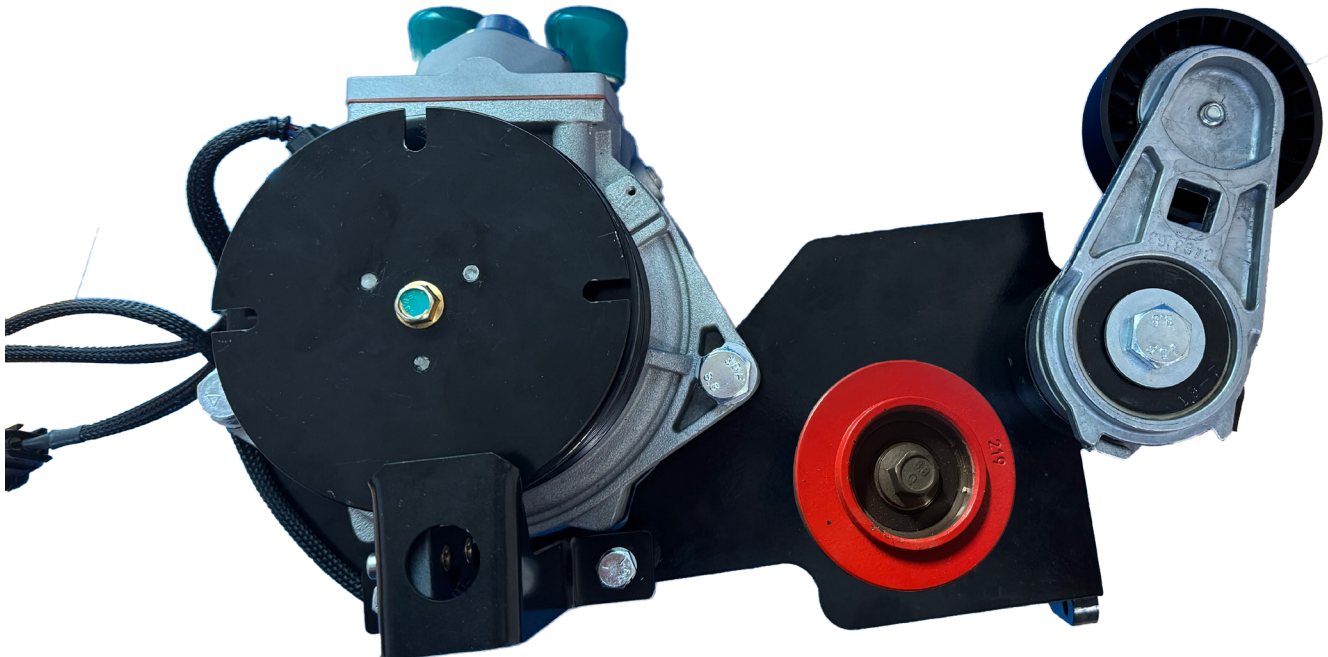
- 1) Gates #91006 Serpentine belt alignment tool
 - 1) 1/4" drive ratchet
 - 1) 1/4" drive, 8mm deep well socket
 - 1) 1/4" drive, 11mm deep well socket
 - 1) 1/4" drive, 13mm deep well socket
 - 2) 3/8" drive ratchets
 - 1) 3/8" drive 3" extension
 - 1) 3/8" drive 6" extension
 - 1) 3/8" drive 7/16" 12-point shallow well socket
 - 1) 3/8" drive, 13mm shallow well socket
 - 1) 3/8" drive, 17mm shallow well socket
 - 1) 1/2" ratchet "for serpentine belt tensioner"
 - 1) 11mm open/box end wrench
 - 1) 13mm open/box end wrench
 - 1) 17mm open/box end wrench
 - 2) Heater hose clamp off pliers
 - 1) Side cutters/dykes "to trim zip tie ends off"
 - 1) Cordless drill with Phillips bit tip
 - 1) 5/8" drill bit (or stepped-drill bit)
 - 1) 1/4" socket (for self-tapping screws)
- (17mm sockets for M10 bolts; 13mm sockets for M8 bolts)

1.9 Recommended Tools

LHG is a maintenance-free unit. It will require coolant flow into and out of the unit. The Clutch is engaged based on such parameters as coolant temperature, ambient temperature, RPM, available voltage, etc. As such, beyond the mounting of the LHG with bracketry, it will require plumbing and electrical connection.



Kit 77A will be configured as shown. The kit is to be mounted onto a standard IC CE bus equipped with a Cummins ISB6.7 engine and electric fan (for buses not equipped with electric fan, Kit 77A is recommended..



2. Kit 77A Mounting Bracket & LHG

3. Preparing for the Install

Note: The LHG is mounted on the passenger-side of the engine

For ease of access, the turbo charger tube may be removed to improve access to the installation area.

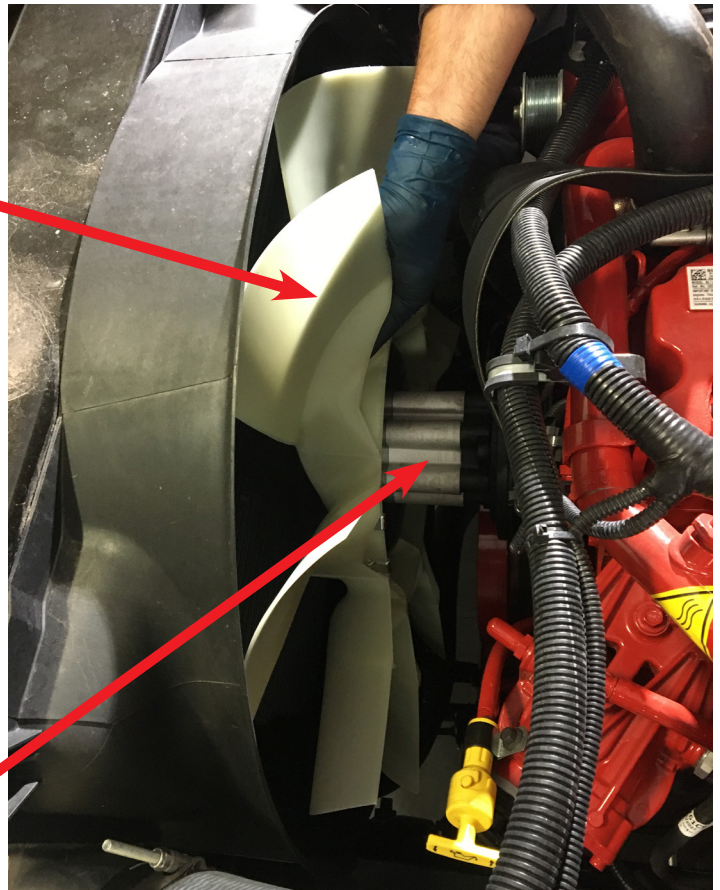


- Loosen turbo tube clamps fully
- Remove turbo charger tube
- Cover turbo tube duct to prevent foreign objects from entering opening
- Both coolant shut-off valves must be closed prior to installation of the LHG



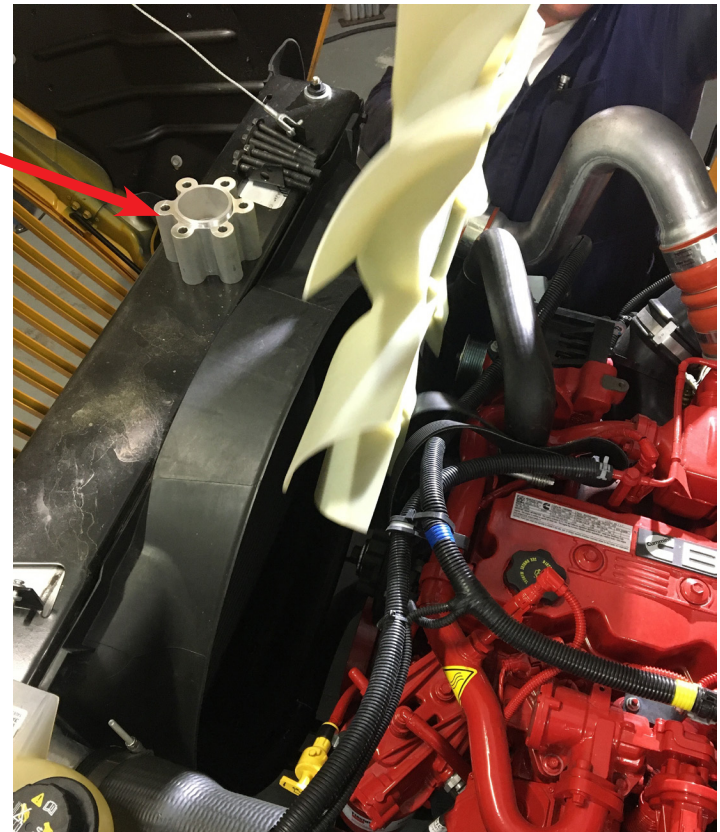
Remove Belt (8PK2108.2) and existing Idler Pulley (beneath alternator). Set aside Belt for later use. Bolts can be stored away. Idler Pulley will be reinstalled as described below.

Remove the fan.

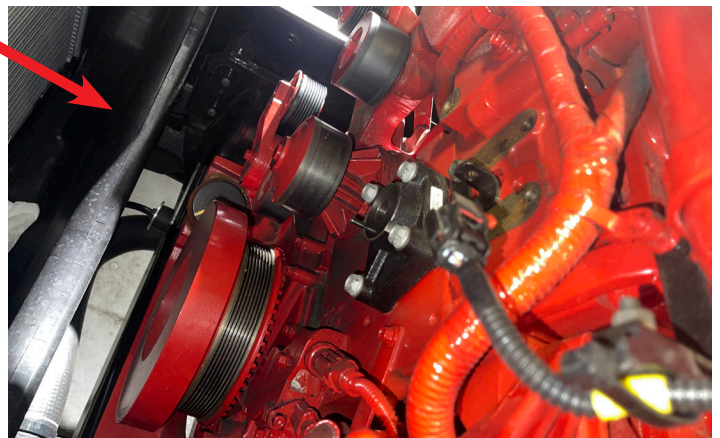


Remove the fan spacer.

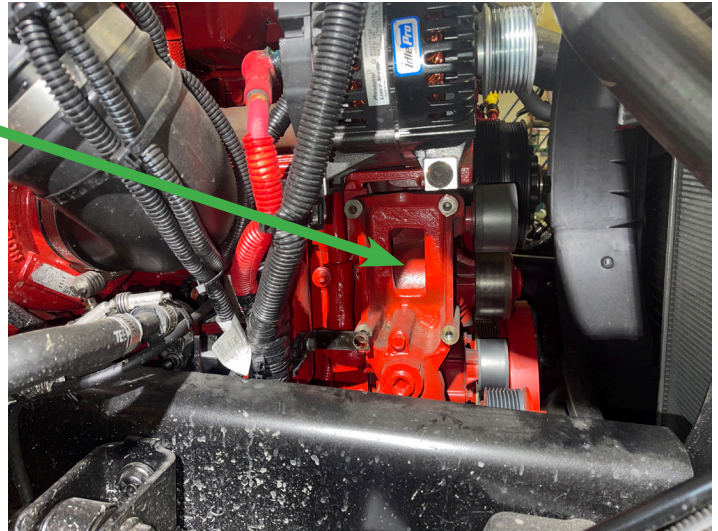
NOTE: Set aside the fan, fan spacer and bolts for use when re-installing the fan onto the Ventech supplied dual-belt, electric clutched pulley.



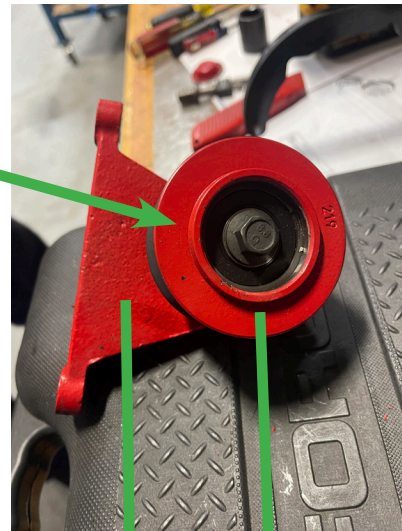
Disconnect the clutch wiring...
and remove OEM fan pulley



Remove OEM Pulley Bracket

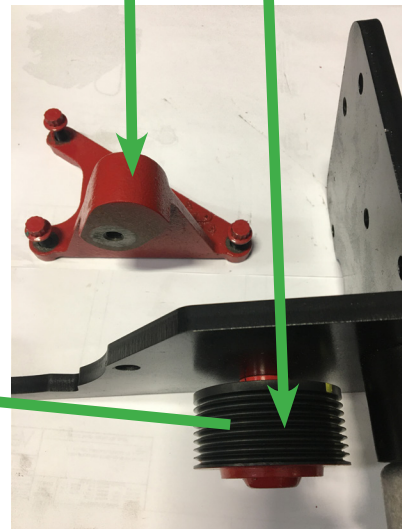


Remove OEM Pulley from Bracket



Attach OEM Pulley to LHG Bracket

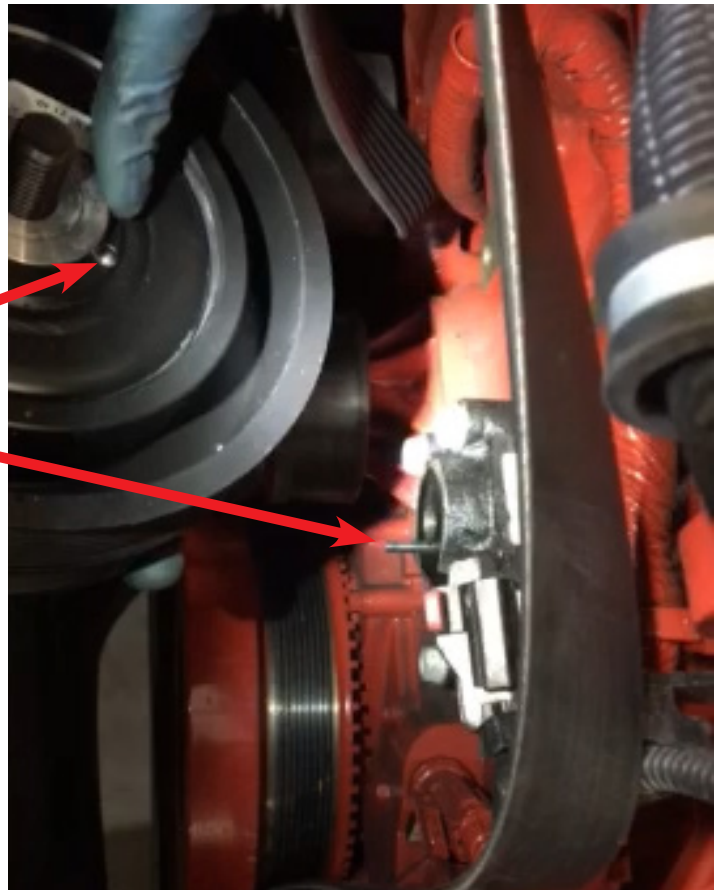
The bracket shown below has the belt tensioner already installed, though this will be addressed at a later point in the install process.



4. Installing the LHG Components

Install LHG Dual Clutched Fan Pulley

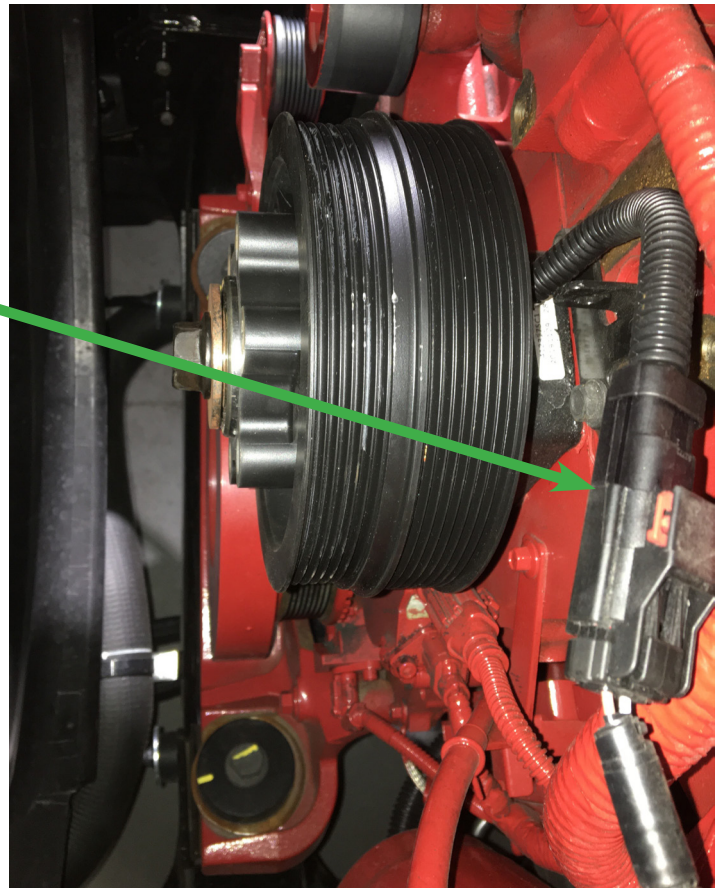
Identify the target hole on the pulley and the guide pin on the pulley mount.



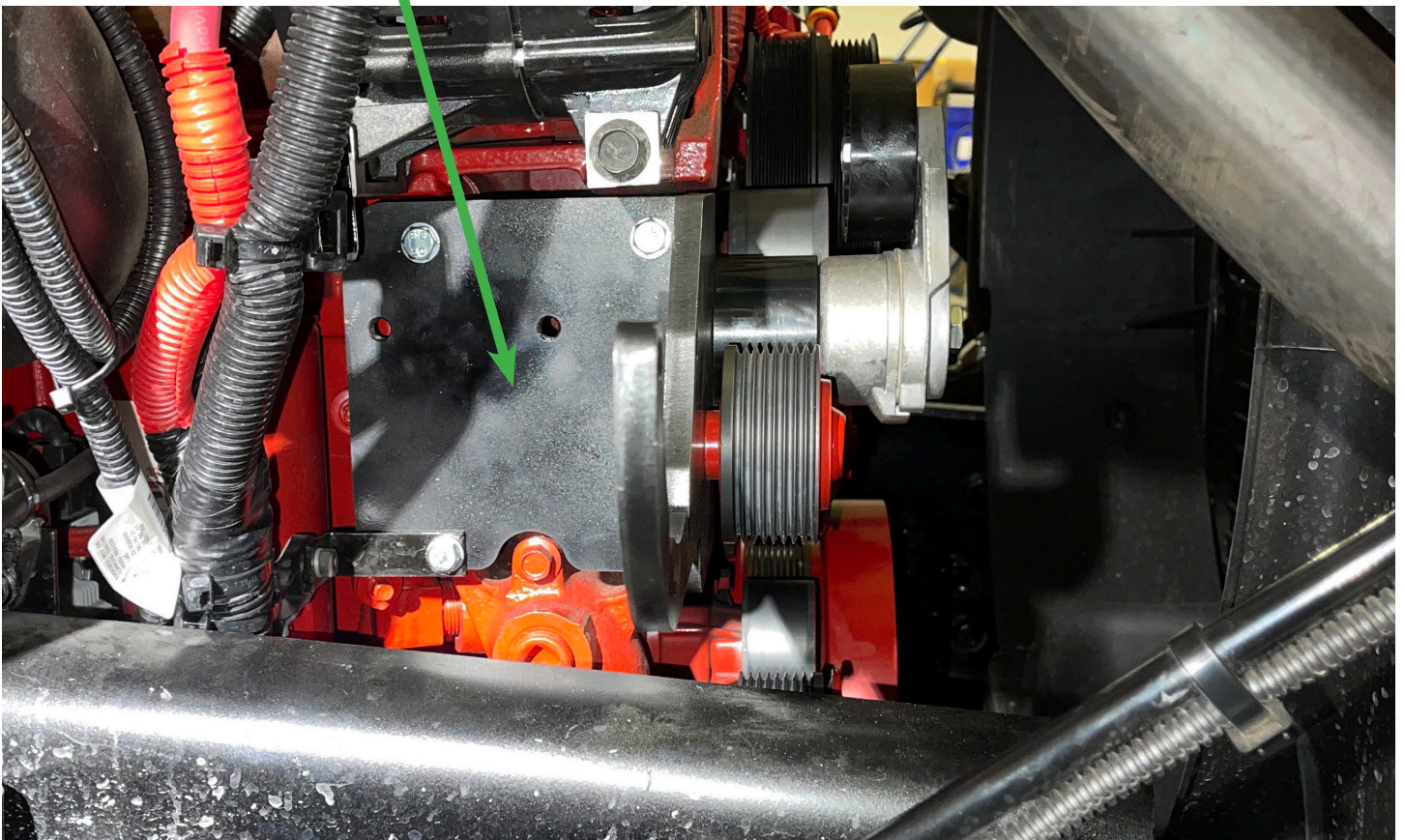
Carefully align the pin with the target hole and install the LHG Dual Clutched Fan Pulley.



Once the Pulley is in place and the bolt is torqued, plug in the lead for the electric clutch.



Install the LHG Front Bracket on the engine.



4.1 Install the spacer and the belt tensioner.

NOTE: we have noticed a slight difference in the configuration of belt placement on these engines.

For this reason, you have been supplied with two different belt tension spacers.

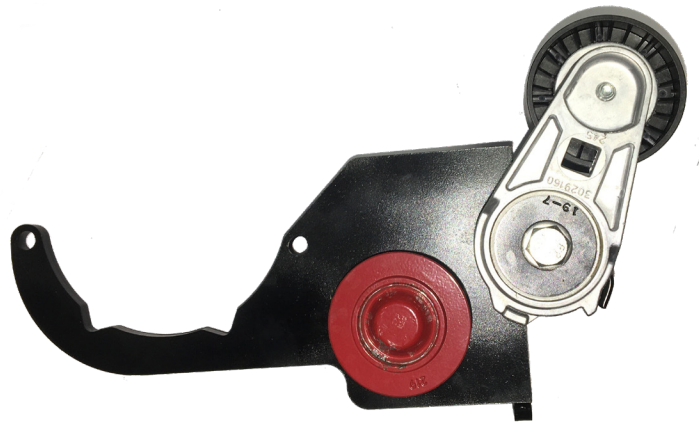
Unfortunately, at this point in the install, there will be no way to tell which one is ideal for your engine.

Choose one and install it, but save the other spacer in case you need it later.

The pin fits into the LHG bracket.

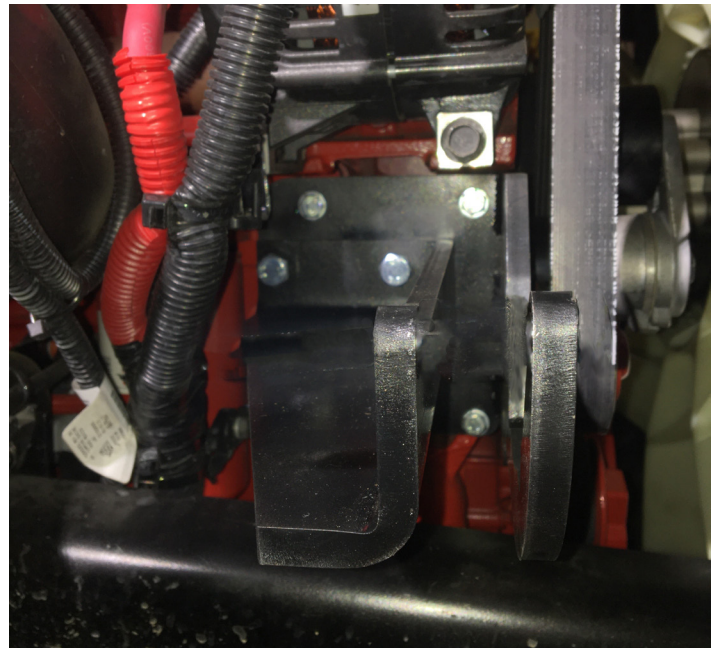
The final goal will be for the serpentine belt to be centered on the tensioner when the kit is fully installed.

The difference is subtle.



4.1 Install the back bracket.

When installed, the back bracket should appear as it does on to the right.



4.1 Install the Speed Sensor.

The Speed Sensor (shown right) mounts on the front bracket (as shown below right).

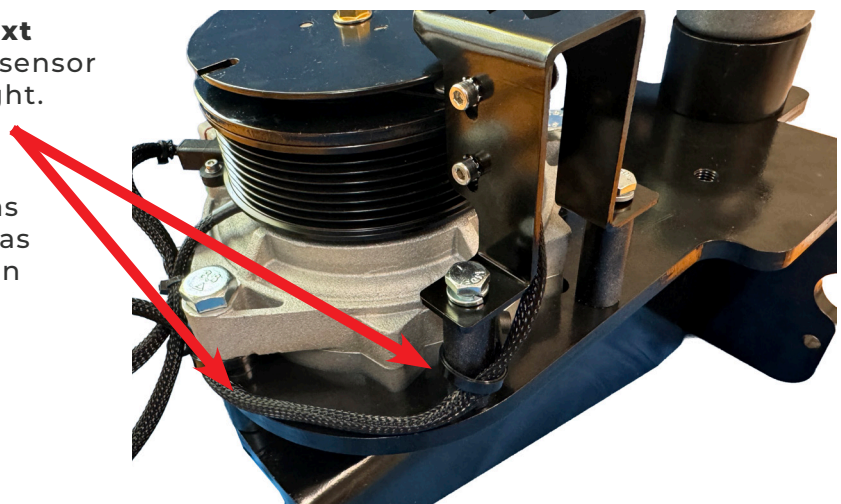
It is easier to install the sensor before installing the LHG on the front bracket.

Following the exploded diagram, install the spacers, sensor and torque the bolts.



AFTER you install the LHG in the next step, use the nylon ties, to route the sensor wire as shown in the image to the right.

Make sure the sensor adjustment is as far "up" away from the main bracket as possible - for now - so it will not get in the way or get damaged during LHG installation.



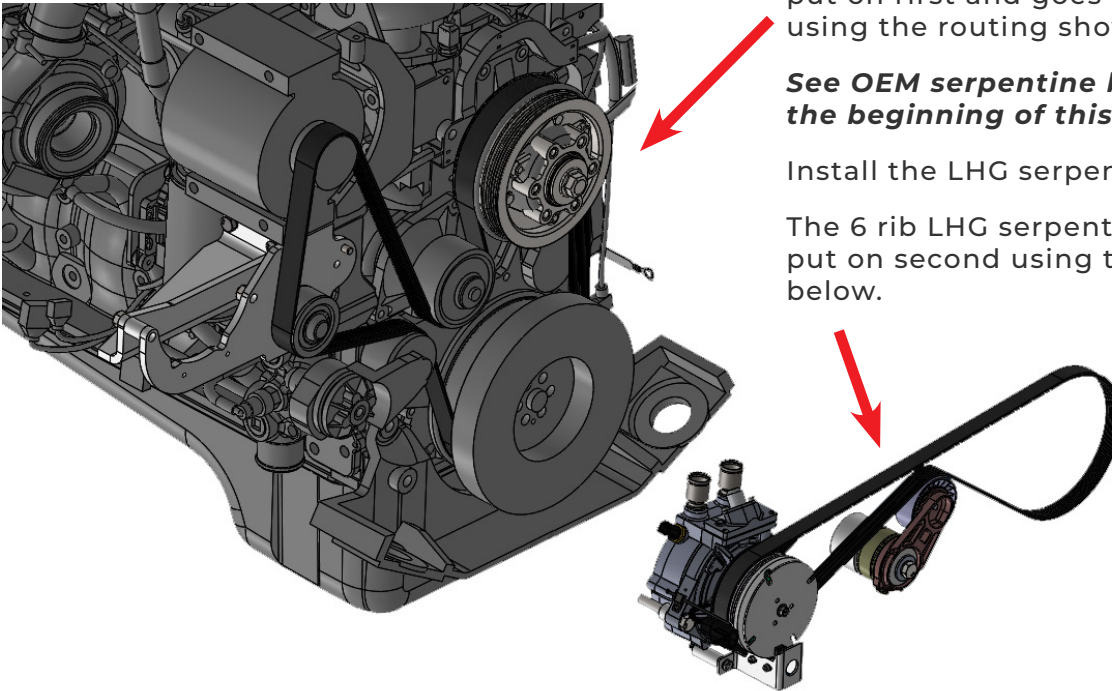
Install the OEM serpentine belt

The 8 rib OEM serpentine belt should be put on first and goes behind the LHG belt using the routing shown here.

See OEM serpentine belt information at the beginning of this manual.

Install the LHG serpentine belt.

The 6 rib LHG serpentine belt should be put on second using the routing shown below.



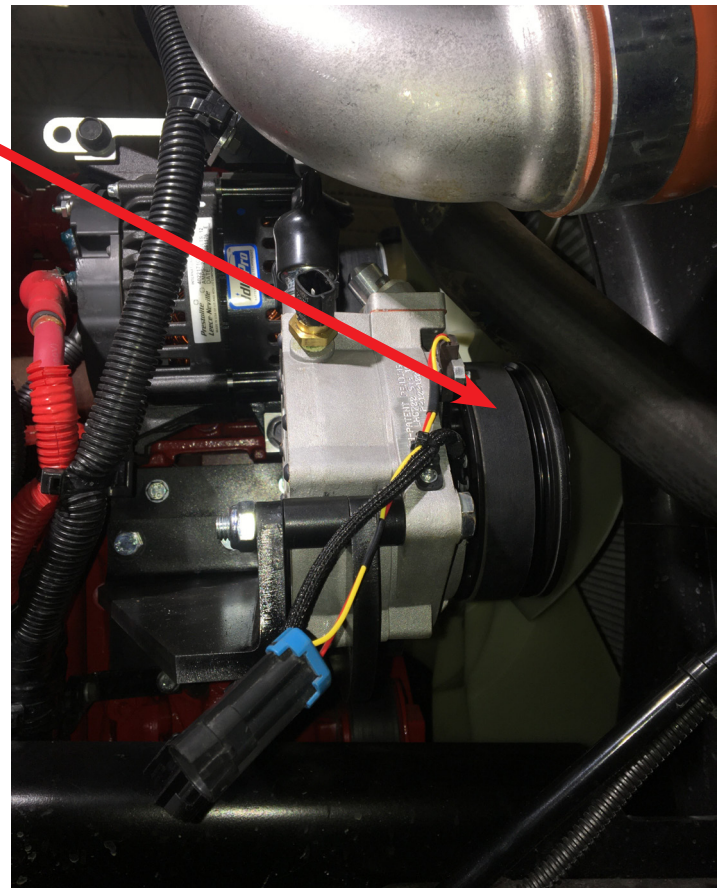
5. Install the LHG, belts and Fan

IMPORTANT, put the 6 rib LHG serpentine belt around the LHG pulley as shown to the right - BEFORE mounting on the bracket.

Very carefully, lower the LHG between the two brackets while also being careful not to hit or damage the speed sensor.

The image to the right shows how the LHG fits into the brackets. It is a tight fit, but should not need to be forced.

Using the spacers and bolts shown in the exploded diagram, attach the LHG to the brackets and torque all the bolts.



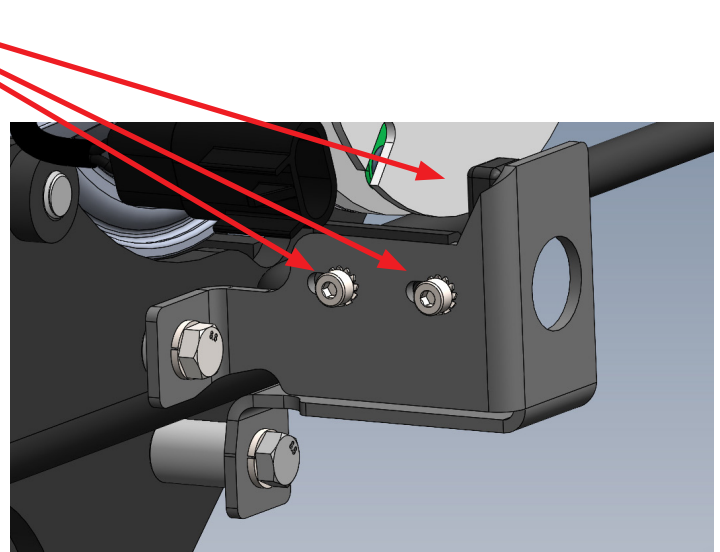
5.1 Set the RPM Sensor

Using a 0.020" feeler gauge and a 3mm Allen Wrench, slightly Loosen the two retaining bolts on the LHG RPM Bracket Assembly. Place the 0.020 gauge between the sensor and the speed disk.

Adjust the sensor distance so it is just touching the gauge as the gauge rests on the speed disk.

There should be a very small amount of resistance when you try to move the gauge.

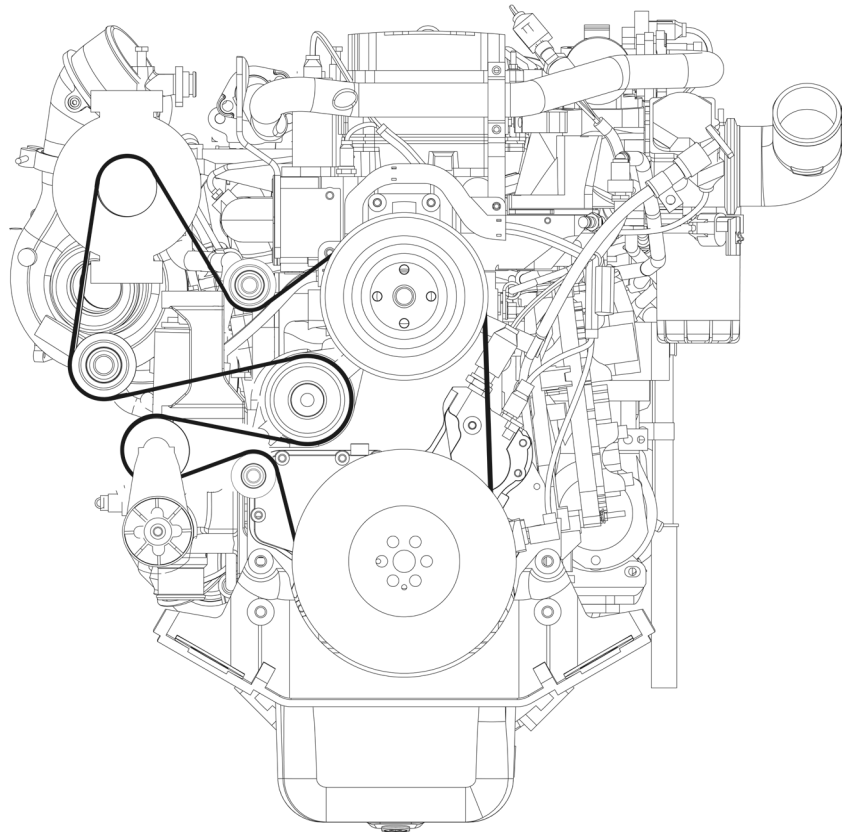
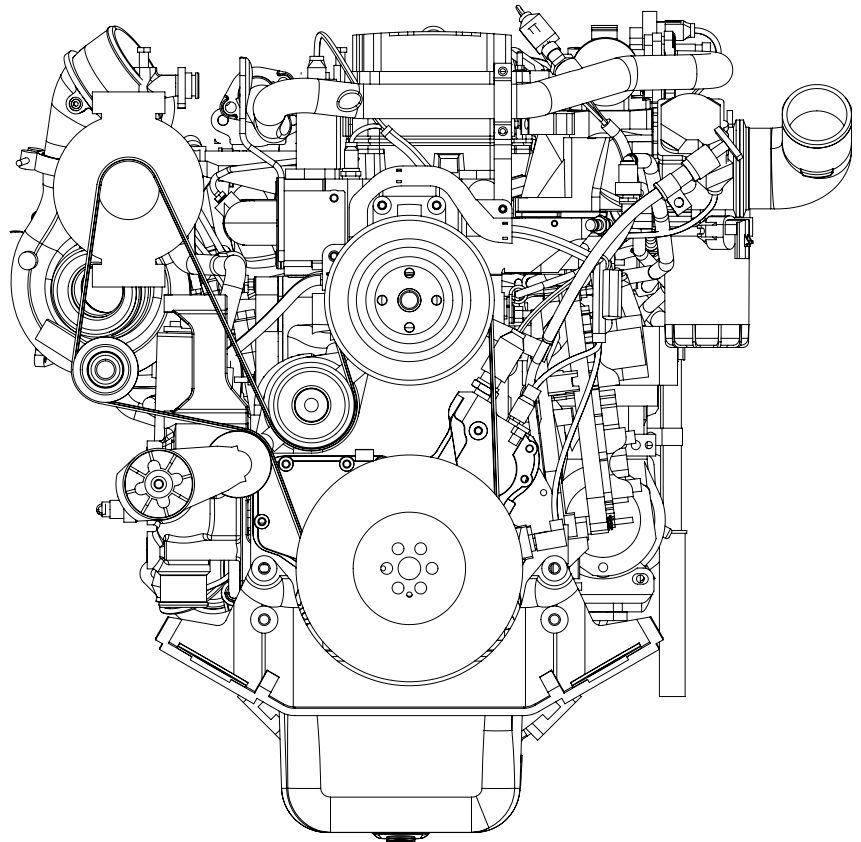
Once the sensor is in the correct position, lock it in place by tightening the retaining bolts.



As mentioned above, there are different serpentine belt configurations

The two shown here are examples of what we have seen in the field.

ROUTE YOUR OEM BELT AS IT WAS BEFORE THE LHG INSTALL.



BEFORE CONTINUING...

Verify that the LHG serpentine belt is as close as possible to centered and firmly on the LHG tensioner.

IF IT IS NOT:

You were supplied with two LHG tensioner spacers. Earlier in the instructions you chose one of the two spacers to install. There is a second spacer saved for just this situation.

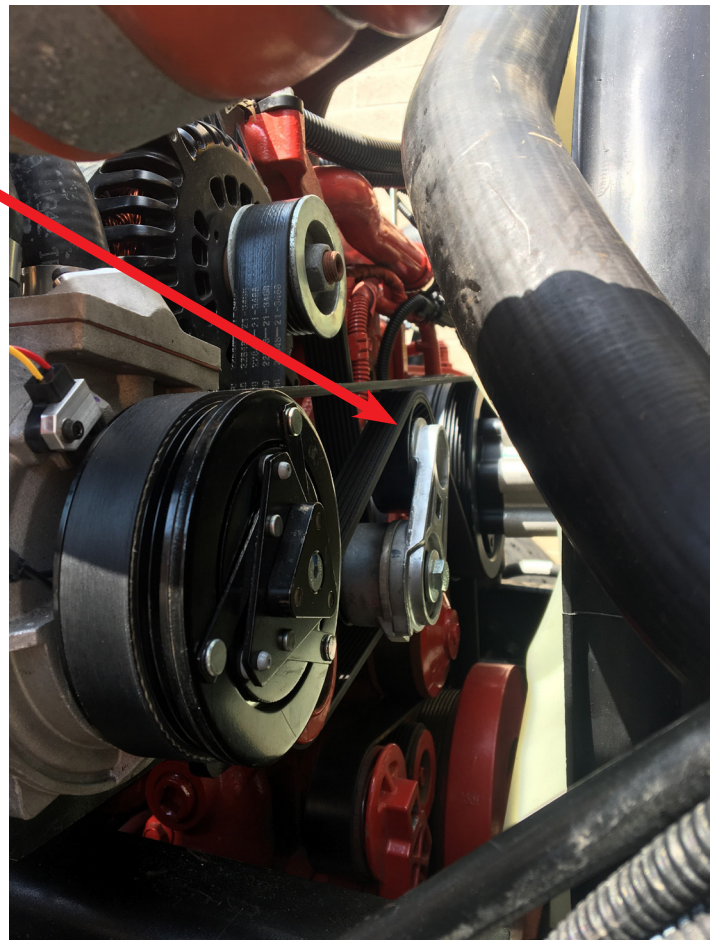
Remove the LHG belt.

Remove the LHG tensioner

Replace the LHG tensioner spacer you have just removed with the untried spacer. and re-install the tensioner and belt

With the different spacer in place, verify that the LHG serpentine belt is as close as possible to centered and firmly on the LHG tensioner.

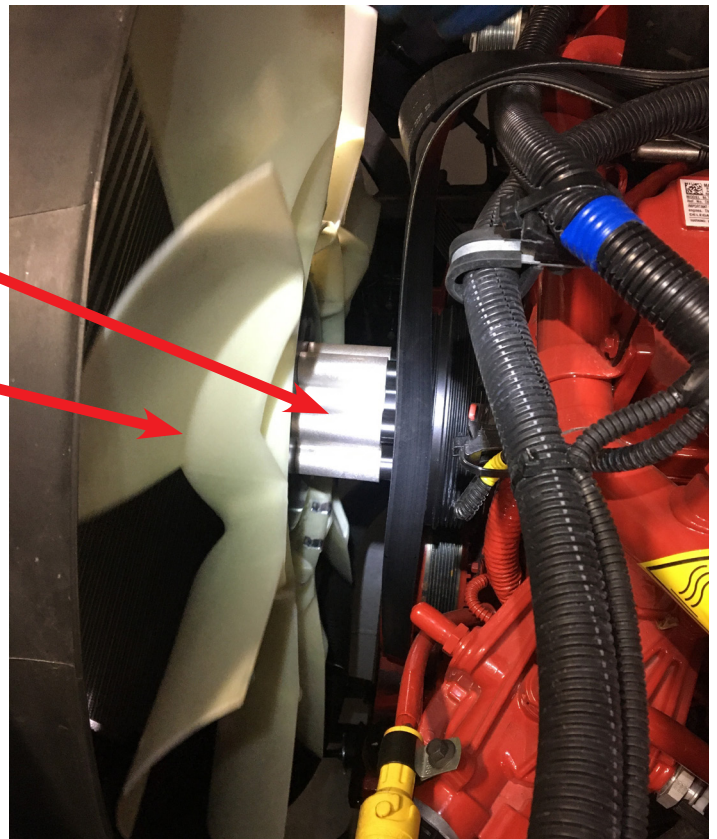
If the belt was better centered on the tensioner with the first spacer, Change it back.



Install OEM spacer and fan

Locte the OEM spacer and hardware that you removed and saved earlier in the process and install it onto the LHG fan pulley as shown to the right.

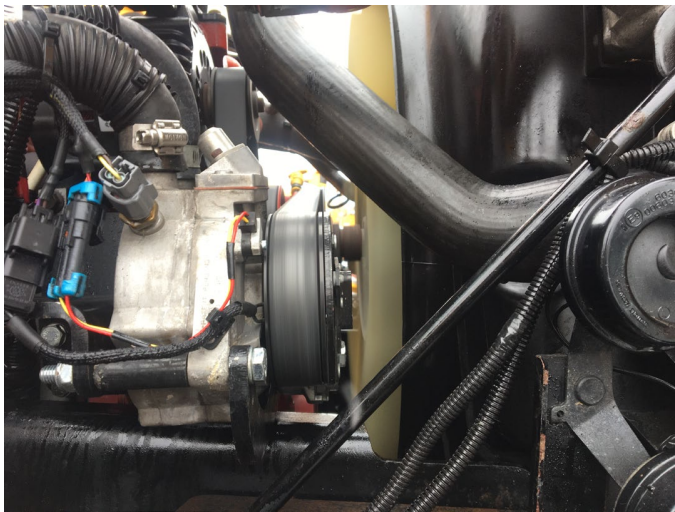
Next, install the OEM fan.



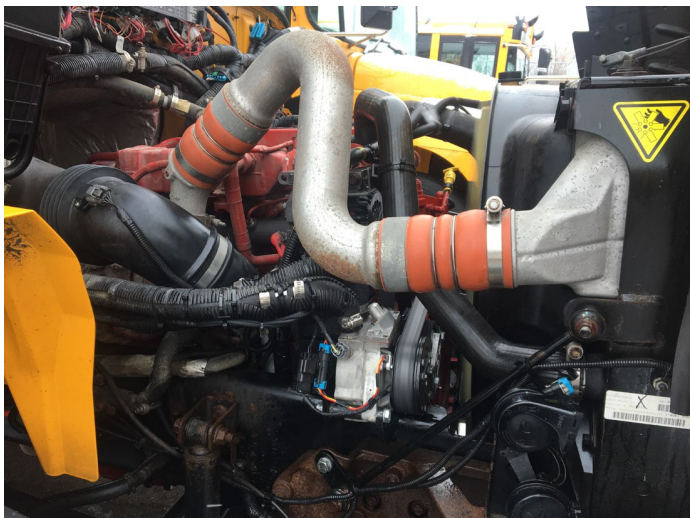
6. Plumbing Instructions (integration into the cooling system)



Remove Hose and cut approximately 1" off of lower end of hose. Replace, clamp and secure. The point of this exercise is to draw the hose away from the LHG sufficiently so that vibration during route will not cause the hose to meet the LHG/belt.



Cut 1" off of lower radiator hose (OEM) to radiator



LHG/bracket installation is complete. Reverse the initial procedure undertaken earlier to create ease of access (turbo charger tube removed to improve access to the installation area).

Proceed to plumbing & electrical installation procedures.



NOTE: Torque hose clamps to 2.0 – 2.5 Nm (18-22 lbf-in.)



NOTE: Avoid sharp bends and kinks when installing coolant hoses.



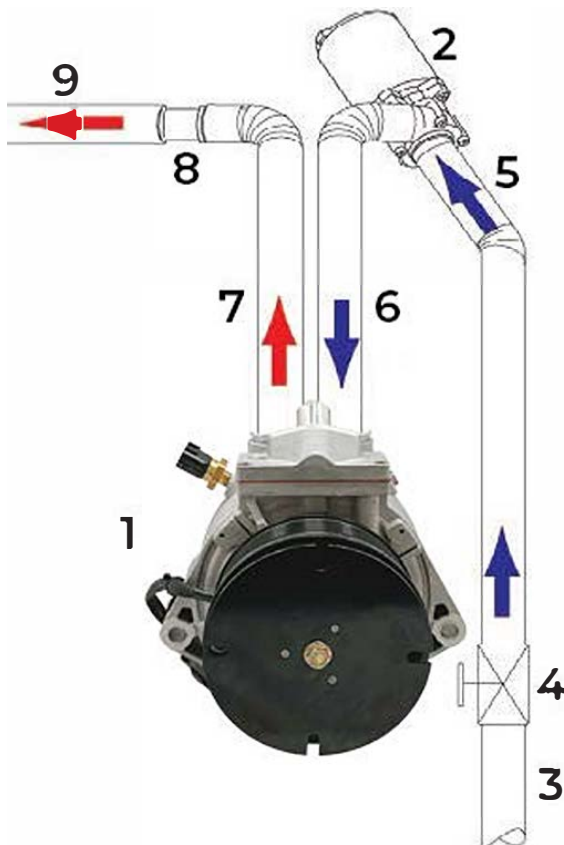
NOTE: Position hose clamps in such a way to avoid cutting or damaging adjacent components.

During installation, clamp vehicle coolant hoses with hose clamping pliers to prevent coolant spillage.

Typical Plumbing Arrangement

The LHG is typically plumbed the same in all installations. The LHG is plumbed in series with the heater coolant hose between the **Engine Coolant OUT** and **Heater Core IN** hoses.

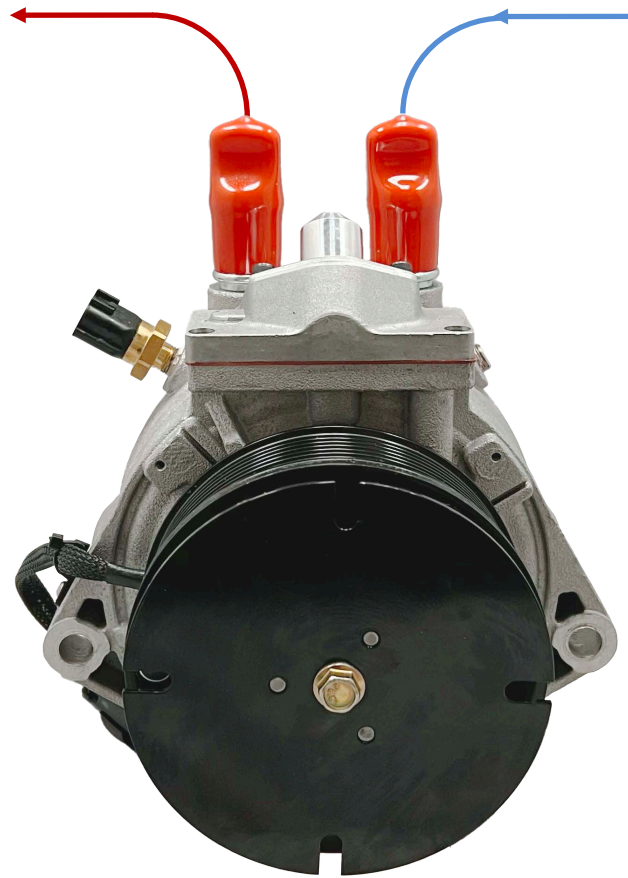
Diagram of Typical Plumbing Arrangement



Refer to this diagram for coolant flow and hose layout.

1. LHG Unit
2. Coolant Boost Pump (if present)
3. Supply Line from Engine
4. Shut-off Valve
5. Inlet to Booster Pump (if present)
6. Feed hose from Outlet of Boost Pump to Inlet of LHG
7. Outlet Hose with coupling to existing vehicle hose
8. Hose coupling
9. Line to Heating System

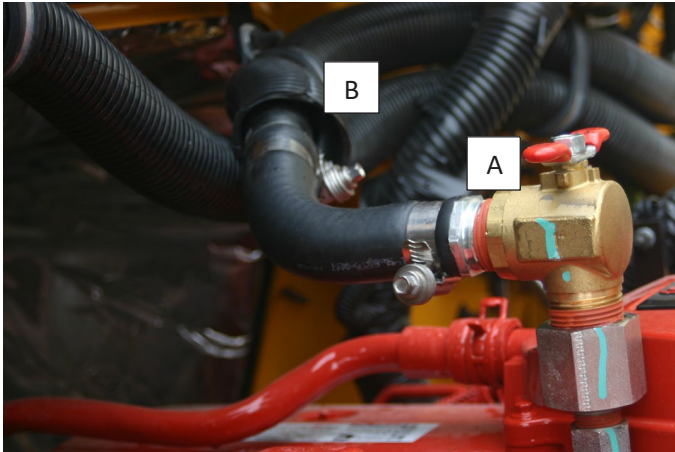
Identify Inlet and Outlet Ports of the LHG assembly



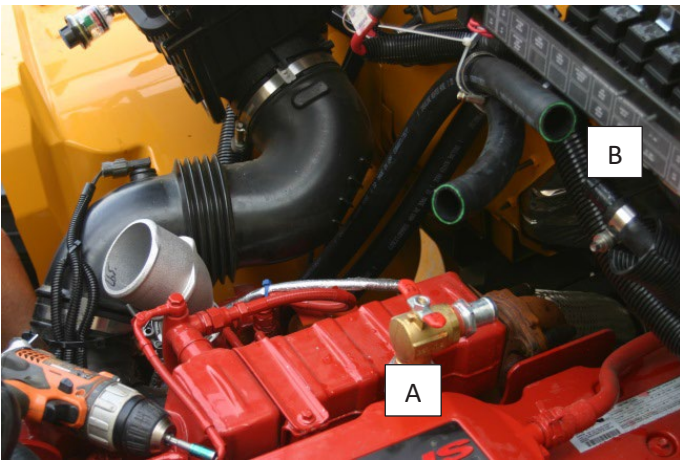
* The Outlet Port of the LHG is identified as the port adjacent to the LHG Temperature Sensor.

Plumbing Guidelines

- Each Installation Kit contains all necessary hoses, clamps, barbed-couplers and other miscellaneous fittings to complete the integration into the vehicle's cooling system.
- It should not be necessary to drain the cooling system to install the LHG. Typically, school buses are equipped with "summer valves" that isolate the cabin heater cores during warm periods.
- When available, close all heater core "Summer Valves" prior to installation and plumbing.
- Connect the LHG assembly between the Engine OUT and Heater Core IN coolant lines. Refer to the vehicle-specific information before hose installation.
- Refill coolant tank with manufacturer's approved fluids.



With the valve turned off at A and with a hose clamp applied above the OEM-supplied 90° elbow hose B, remove the elbow hose (above engine) [Save the elbow and one clamp for procedure to follow. The other clamp is to remain with the straight hose]. One end of the Ventech 53" hose is to be connected to the engine-mounted brass valve fitting. The other end connects to an elbow hose and then to the LHG Intake fitting. (Ultimately, "A" here will connect to "A" on the LHG as seen on the following page, and "B" matches to "B".) [As an additional note, some OE buses will not be equipped with the 90° hose as seen in the picture. In this event, the kit has an additional elbow and related

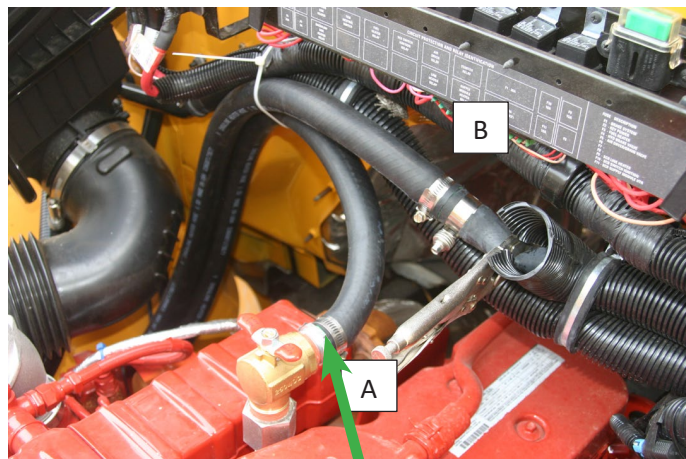


Parts for next step:

- 1 1" Coolant Hose – 53" Supplied by Customer
- 1 1" Coolant Hose – 49" Supplied by Customer

Preparations for next step:

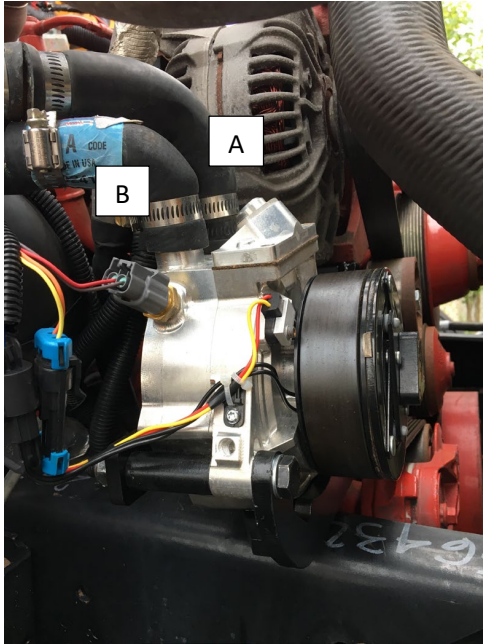
Turn brass fitting clockwise until oriented to "10 o'clock" if the rear of bus is "12". (see bottom of next page.)



Hoses at Bulkhead end: Lay out the 49" & 53" coolant hoses at both openings of recently opened plumbing (from prior step). Attach the 53" hose to the coolant outlet located at the top center of the engine. Connect with one of the OEM-supplied clamps freed up when the elbow was removed. Secure hose using provided Tie Wraps. Connect one end of the 49" hose to the open end of the bus coolant hose (opened when removing the elbow hose) and secure it with hose clamps.



If necessary, use one of the supplied 90 degree hoses at this location to prevent the main hose from bending too far (kinking).



Attach A from the previous page to the LHG intake fitting (A) with the Ventech-supplied 90° Elbow. The other hose (B) is to be attached to the LHG outflow fitting with the Ventech-supplied 90° Elbow Hose (B; fitting closest to the temp sensor). All hoses should be soundly clamped at this stage. Keep cut ends of clamps directed away from rubber hose.



Finished Hose Layout

As noted above, in some cases the Cummins engine is not fitted with the elbow hose as revealed in the first plumbing picture on prior page. The Kit 77A is shipped with an additional elbow hose, connector and clamps to compensate in the event your bus is not OE-equipped with the elbow hose going to the brass fitting.

Also note that coolant plumbing should be routed far up and away from exhaust plumbing.

Also, when available, Ventech recommends the use of convoluted conduit to protect the hose.

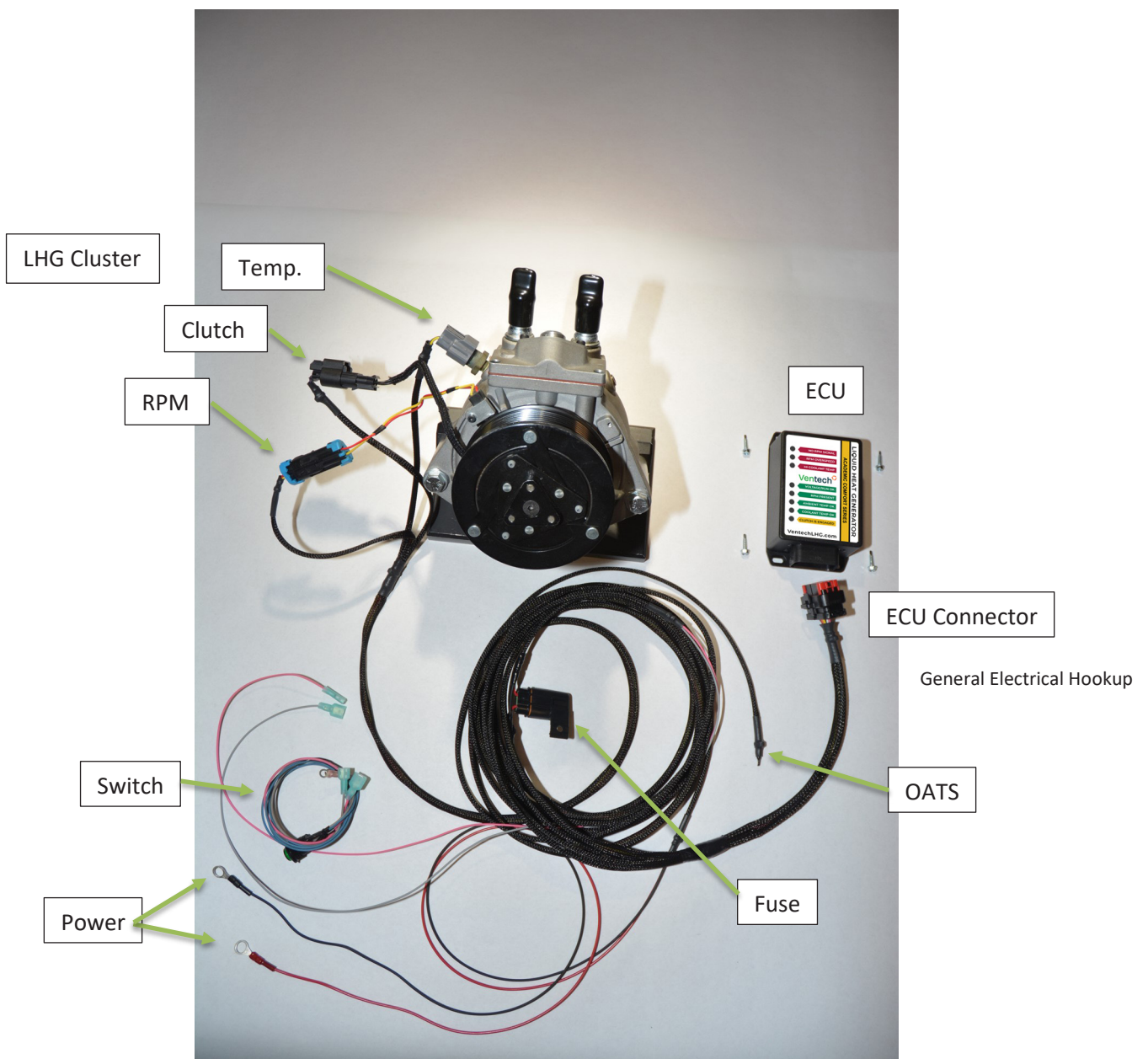


7. Electrical Components & Installation

Familiarity with the Electrical Harness and Control Unit

The LHG installation kit includes three main electrical components: the Electronic Control Unit, the LHG main Harness and the Panel Switch. Before you begin the electrical installation, get familiar with each component. The Main Harness connects the ECU to the LHG. The Panel Switch runs from the driver panel to the Main Harness, as well as to an “accessory-on” signal. The following picture is for reference only as the actual connections will be made AFTER the LHG and harness are installed:

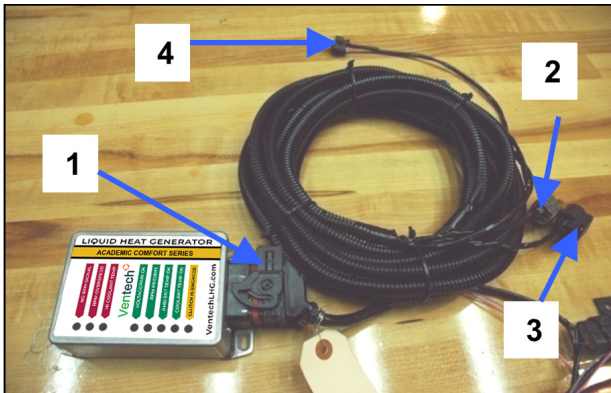
LHG System Harness



Electrical Components



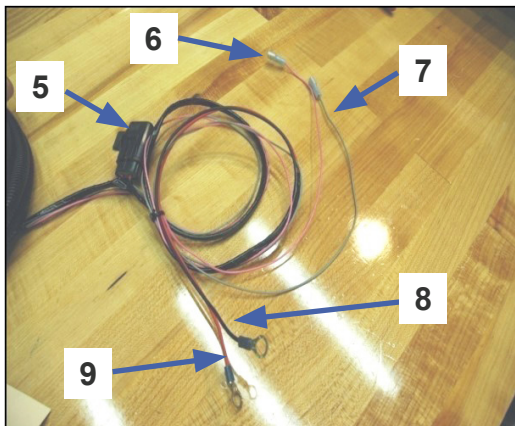
CAUTION: Do NOT route the harness near the exhaust system, turbocharger, or any other hot, or rotating, component. Do not remove the back cover of the LHG controller (no user serviceable parts inside & unauthorized opening and/or tampering with the controller will void all warranty).



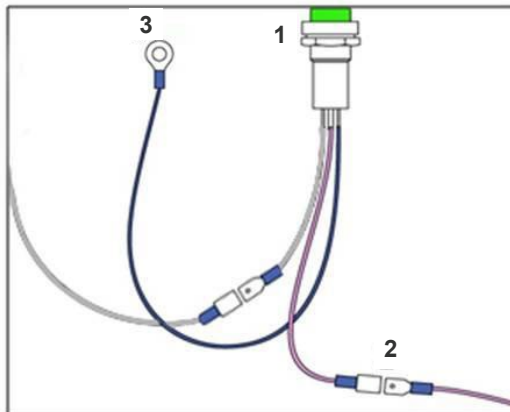
The control harness will be routed from the ECU controller unit, across the vehicle bulkhead, down to the coolant lines and along them to the LHG unit as shown in the next series of Figures.

- (1) To ECU
- (2) To temperature sensor (on LHG)
- (3) To clutch (on LHG)
- (4) To RPM Sensor (on LHG) *Not Shown Here*

OATS sensor (on separate 'leg' goes behind bumper)



- (5) Fuse holder
- (6) To switch (pink wire)
- (7) To switch (gray wire)
- (8) To chassis ground (black wire)
- (9) To battery positive (red wire)

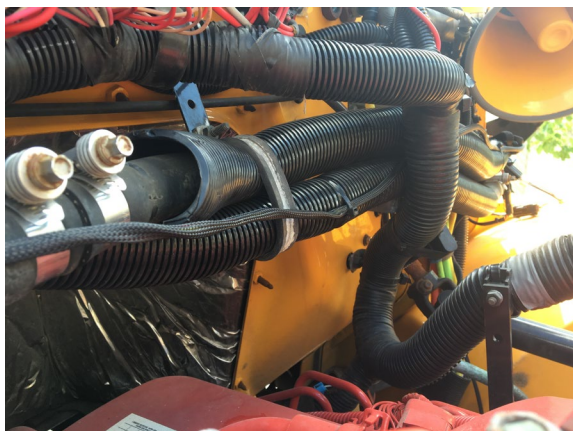
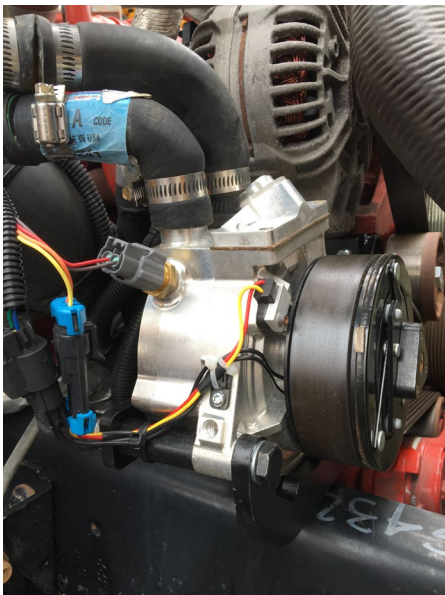


As shown below in the instructions, you will be connecting the pink wire of harness to pink wire (2) of switch (1), and the gray to the gray. You will also be routing the blue wire (3) from switch into left side of the fuse box mounted in the bus below the control panel and insert terminal into a circuit that has power during "Run" but off during "Engine Start" (Crank).



Connect the LHG Cluster Harness component to the mounted LHG as seen below.

Remember to leave a service loop (some slack) in the wiring ahead of securing the harness with zip ties. After mating the connectors at the LHG and securing the local wiring, proceed to route the harness along the plumbing to the bulkhead and then across the bulkhead to the driver's side.



Once the LHG harness component reaches the bulkhead, continue on with the harness until the driver's side is reached, securing the harness along the way with zip ties as needed.

7.1 Mounting the ECU



Warning: Do not remove back panel of LHG Control Unit. No serviceable parts inside. Unauthorized opening and/or tampering with the controller will void all warranties.

Identify a location on the driver's-side of the bulkhead (under-hood) to mount the Control Unit.

- The Controller location should be in a dry position and in close proximity with a bulkhead electrical grommet, enabling LHG control wiring (pink/gray) to pass through the grommet to the rear of the driver's panel.
- Use the four self-tapping screws provided to mount the Control Unit.
- Orient the Control Unit so that the connector is facing down and that there is enough room for the harness to project from the ECU unencumbered.
- The LHG harness connector to the ECU should be affixed to the mating connector on the Control Unit. Remember to leave enough surplus cable length so that the receptacle can easily engage the Control Unit without unnecessary tension on the harness.



Pink and Grey wires routed through the bulkhead grommet.

LHG Control Unit mounted in the driver's side of the bulkhead.

LHG Control Unit - mounted



Ventech ECU controls the operation of the LHG according to an algorithm shown in the table below. Until 2017, Ventech supplied the traditional

7.2 Switch Wiring and Installation

You will now make final electrical connections (in order) by following the instructions in the following pages:

- 1 Route Dashboard Switch wires, mount & connect Switch.
- 2 Connect LHG Clutch lead
- 3 Connect LHG RPM Sensor lead
- 4 Connect LHG Temperature Sensor lead
- 5 Route and secure the Outside Air Temperature Sensor
- 6 Route and terminate Engine "Run" Signal wire
- 7 Connect Battery Negative
- 8 Connect Battery Positive

Route Dashboard Switch Wires

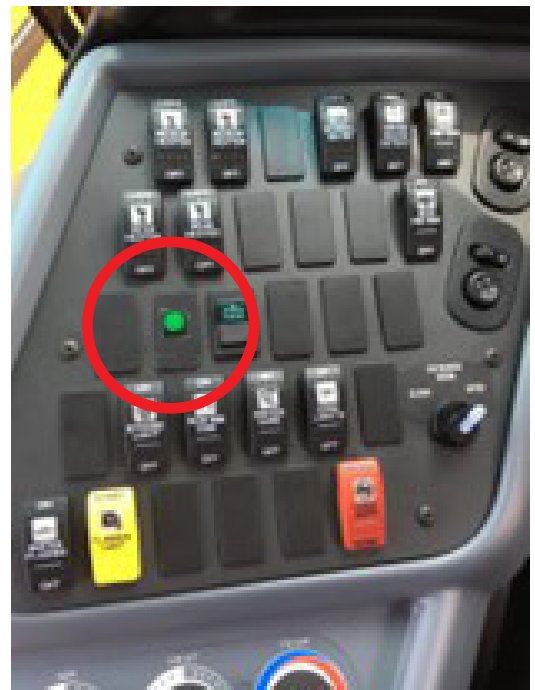
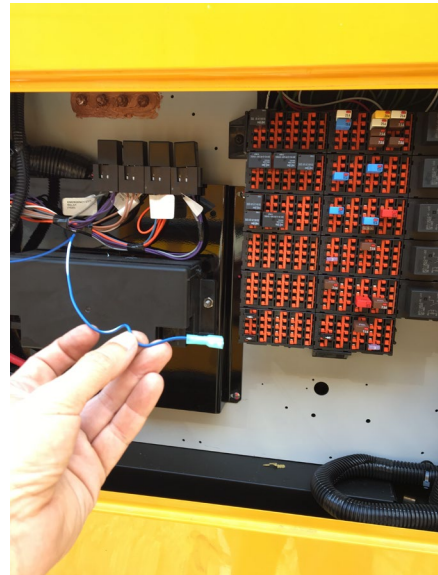
- Pull the first branch of the harness (above mentioned two individual wires colored Pink and Gray) through & up to the opened Driver's panel.
- Route this sleeve (containing two wires) through the grommet in the bulkhead so that the wires terminate at the vicinity of the dashboard switch panel where you intend to mount the LHG Control Switch (Green).



Dashboard Switch Installation

(pictures provided below)

- Identify the dashboard-mounted switch (switch assembly).
- Identify an unused switch plate at the driver panel for placement of the LHG Switch and remove the plate from the panel.
- Bore a 5/8" hole in the blank switch plate.
- Adhere Switch Sticker to switch plate.
- Mount the Green Dashboard Switch into the plate, and then return the plate to the dash.
- Connect the Pink and Grey spade terminals from the Dashboard Switch to the harness.
- Route third (Blue) wire from Switch Assy down toward outside fuse panel. Connect Blue Wire to a "Run" signal provided by the vehicle's electrical system.
- Close driver's Dash Panel.



The Outside Ambient Temperature Sensor (OATS) is shown below. This sensor detects the ambient air temperature and will engage the LHG at temperatures below 50°F (provided other conditions are in place...See Control Unit Logic Table section).



Close-up of OATS



Run the OATS part of the Power/OATS Harness along the chassis rail, and then into the lower channel of the grille. Zip tie it along the way to secure in place. The OATS sensor should be shielded from vehicle wind as it is used to determine static outside air temperatures.



Connecting Battery +Ve and –Ve.

The final step in the electrical installation is to connect power to the LHG Harness. The system requires a 12VDC source that is always ON. We recommend connection the Black and Red harness leads to the bulkhead Power and Chassis Ground terminals located on the bulkhead in the vicinity of the vehicle’s under-hood fuse panel.

Mount the Fuse by affixing it on the threaded bolt by the ECU. Ground and Positive terminals can be affixed to their respective locations on the bus bulkhead as seen above and below. Again, zip tie wires as appropriate to secure in place.

Red and Black wires on Harness branch, fitted with Ring terminals



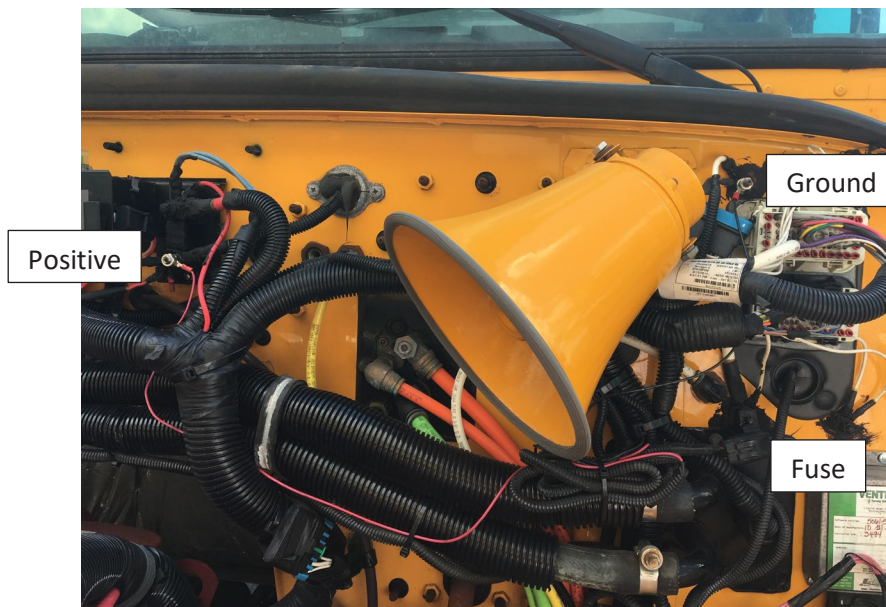
Fuse Holder and 10A Fuse. Mount the fuse holder against the bulk in a location that is accessible for service



Black Harness wire connects to a **Chassis Ground Terminal Post** on bulkhead that has a direct connection to the **Negative** post of the vehicle battery.



Red Harness wire connects to the **Vehicle 12V Terminal Post** that has a direct connection to the **Positive** post of the vehicle battery.



The Installation is complete.
Please proceed to the Initial Startup section.

**THE FOLLOWING PAGES CONTAIN
IMPORTANT INFORMATION.
PLEASE READ
BEFORE STARTING
THE SYSTEM FOR THE FIRST TIME**

8. Initial Start-up

8.1 Initial startup behavior

8.1.1 AIR PURGE

Firstly, the LHG ECU will disable the LHG for the first three (3) minutes of operation (engine idling). During these first three minutes, any air that may remain in the LHG coolant circuit will be purged from the system (air-purge).

During the Air-Purge all green LEDs on the ECU will cycle in sequence.

8.1.2 BURNISHING

The second run-up sequence step is an automatic Burnishing of the LHG's electromagnetic clutch. This step also takes about three (3) minutes and must be performed at Idle. During this second run-up sequence, the electromagnetic clutch will be cycled (burnished) 50 times. This burnishing process cleans the clutch surfaces that may have residue build-up from the LHG's time in storage.

During the Burnishing the yellow LED on the ECU will blink on and off.

8.1.3 The first start

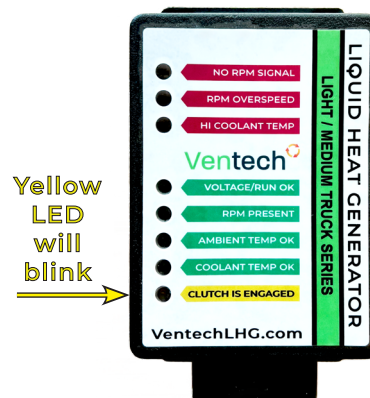
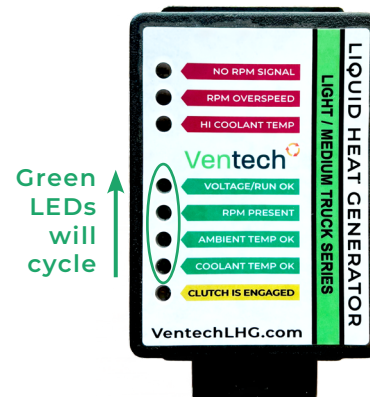
Start the vehicle engine and run at idle for ~6 minutes allowing the two run-up sequences to complete (air-purge and burnishing sequences).

8.1.4 Concluding the installation

While the engine is running, but after the two run-up sequences have been completed, check the following:

Hose connections for leaks.

Coolant level in the coolant recovery tank (add coolant as needed).



Appendix A: The LHG ECU (Digital Controller) Strategy

The Electronic Control Unit is designed to determine when to engage and disengage the LHG (via the LHG electromagnetic clutch) depending on various parameters, including temperatures, RPMs, vehicle voltage, internal timers, and other conditions.

Note: RPMs referenced below are LHG RPM, not Engine RPM. Kit #400 (Ford HeatStroke LHG) has a 1:1.66 ratio between Engine RPM and LHG RPM.

To the right is a summary of the parameters and set-points that determine whether the LHG will engage or disengage.

ALL the engagement parameters must be met to activate the clutch, while ANY individual disengagement parameter will deactivate the clutch.

NOTE: When the LHG clutch disengages, it will not re-engage until:

All conditions required to engage the clutch are met as seen above and 2 to 5 seconds have elapsed after ALL engagement parameters have been met (time delay varies depending on parameter).

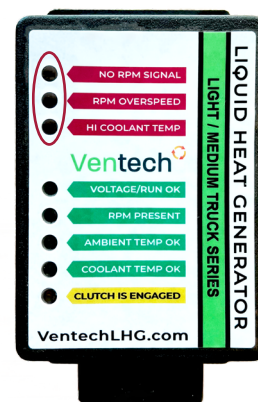
LHG Clutch Engages WHEN ALL OCCUR SIMULTANEOUSLY	LHG Clutch Disengages IF ANY ONE OCCURS
LHG RPM greater than 255 RPM	LHG RPM less than 256 RPM
and	or
LHG RPM less than 2,600 RPM	LHG RPM greater than 6,000 RPM
and	or
LHG Temperature less than 167°F (75°C)	LHG Temperature greater than 185°F (85°C)
and	or
Supply Voltage is above 13.0V (5 second delay),	RPM signal is unstable (rate of change > 400)
and	or
Outside Ambient Temperature (OATS) is less than 50°F (10°C)	Voltage to ECU is below 12.0V
	or
	RPM-RPM Differential >150 RPM over 50 milliseconds
	or
	RPM-RPM Differential 50-150 RPM over 3 seconds

Understanding the ECU LEDs during Normal Operation and as a Diagnostic Tool.

The Ventech ECU is equipped with 8 colored LEDs that indicate the operational status of the LHG heater system.

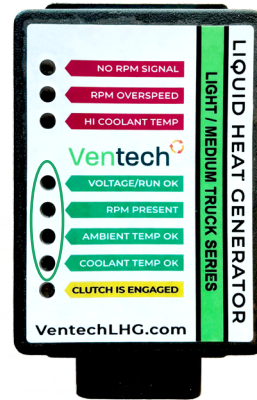
Three (3) LEDs are Red with corresponding descriptions (“No RPM Signal”, “RPM Overspeed”, and “Hi Coolant Temp”).

The Red LEDs are known as “Off-Flags”. Any illuminated Off-Flag will cause the LHG clutch to disengage.



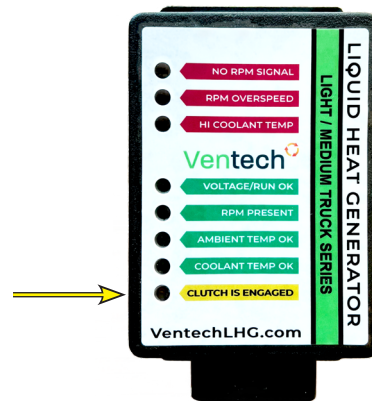
Four (4) LEDs are Green with corresponding descriptions (“Voltage/Run OK”, “RPM Present”, “Ambient Temp OK”, and “Coolant Temp OK”).

The Green LEDs are known as “On-Flags”. Every On-Flag must be illuminated for the LHG clutch to engage.



One (1) LED is Yellow: “Clutch Engaged” (LHG heater is engaged and producing heat).

The LEDs emulate the key parameters detailed in the table on page 48. In order for the LHG to engage, ALL Green LEDs must be ON and ALL Red LEDs must be OFF.



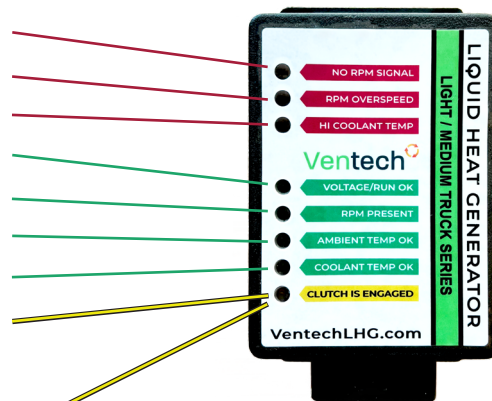
ECU LED Lights Defined

LED ON SOLID

- NO RPM SIGNAL (RPM less than 256)
- RPM OVERSPEED (LHG >6,000 / Engine >2,550)
- HI COOLANT TEMP (LHG Out Temp. >85°C / 185°F)
- VOLTAGE/RUN OK (Supply Voltage >13V)
- RPM Present (LHG >256 RPM)
- AMBIENT TEMP OK (Air Temp <10°C / 50°F)
- COOLANT TEMP OK (LHG Out Temp. <185°F / 167°F)
- CLUTCH IS ENGAGED (DC Clutch Voltage On)

LED FLASHING

Clutch is Burnishing



Understanding the ECU LEDs for Diagnostics

As noted above, when on solid, the red LEDs are "off-flags" that indicate a situation where the LHG will be disengaged. This does not necessarily indicate an error condition, as there are many situations when the LHG should not be engaged. For instance when the Engine RPMs are too high or when the coolant temperature does not need to be supplemented.

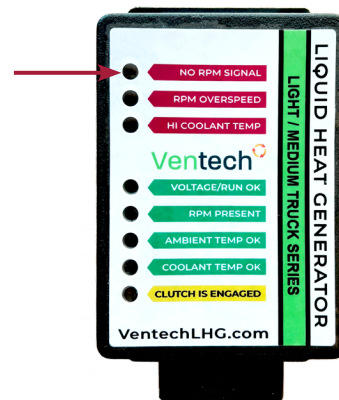
Below are some specific LHG ECU error conditions the LED light sequence associated with each.

These error conditions will remain showing on the ECU until the ignition is turned off, which will cause the LHG ECU to reset.

No Pulley RPM

The LHG Pulley and the LHG Clutch Rotor are independently monitored by the ECU to ensure that the LHG is running properly.

If the sensor for the Pulley fails, while the engine is running, the "NO RPM SIGNAL" LED will remain solidly on (other LEDs may be on as well) and the LHG will not engage.

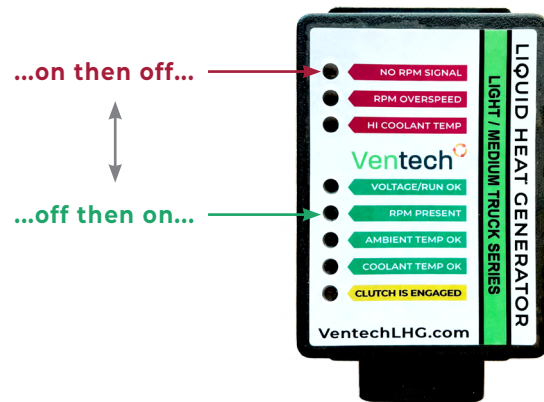


No Rotor RPM

If the Rotor RPM sensor fails, the ECU will not be able to monitor for problems with the clutch. Should this occur the ECU will disengage and/or prevent engagement of the LHG.

If the sensor for the Rotor fails, the "NO RPM SIGNAL" LED and the "RPM PRESENT" LED will alternately and repeatedly blink on and off.

Should this situation occur, contact Ventech for assistance. The LHG will cease to produce supplemental heat until the sensor is functional.



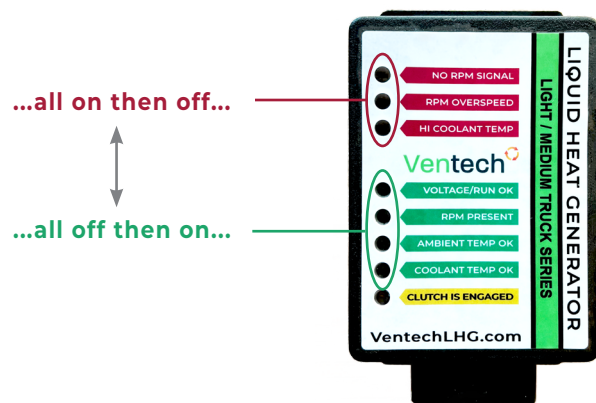
Slipping Clutch

A slipping LHG clutch prevents proper LHG operation and can lead to other problems including belt failure. For this reason, the LHG ECU is programmed to recognize and remedy clutch slippage using an automated burnishing sequence.

The ECU will attempt to correct a slipping clutch up to 5 times during continuous operation. Should this automated burnishing fail to eliminate clutch slippage, the ECU is programmed to disengage the LHG as a safety precaution.

If there is repeated clutch slippage, all of the red LEDs and the all of the green LEDs will alternately and repeatedly blink on and off.

Should this situation occur, Contact Ventech for assistance. The LHG will cease to produce supplemental heat until clutch slippage is corrected.



Automatic Burnishing after extended periods of Non-Operation of the Vehicle.

During vehicle storage, or other reasons for non-operation of the LHG heater system over an extended period, the electromagnetic clutch plates of the LHG can become compromised by surface rust or debris collecting on the bare metal surfaces.

If ignored, the clutch performance may be compromised resulting in clutch slippage and part failure. The LHG ECU addresses this potential condition by performing a periodic burnishing routine based on the number of days that the LHG has not been operated.

This feature is fully automatic and requires no user-intervention. Automatic burnishing will occur at the intervals described below:

At the intervals shown below, the automatic burnishing routine will start immediately after the vehicle’s engine is started, irrespective of ambient air temperature.

WAIT for the burnishing routine to complete before driving the vehicle.

If the burnishing routine is interrupted before completion (engine stopped), the full burnishing routine will restart the next time the engine is started.

Interval of Non-Operation	Burnish Cycles (upon startup after interval)	Approximate time to complete
14 Days	50 Clutch Cycles	~ 1 Minute
100 Days	100 Clutch Cycles	~ 3 Minutes

