



Container Refrigeration



OPERATIONS AND SERVICE MANUAL

For
Engine Emission System (EES)
RG15 Tier 4 Generator Sets



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SECTION 1

SAFETY SUMMARY

1.1 General Safety Notices

This Carrier Transicold EES has been designed with the safety of the operator in mind. During normal operation, all moving parts are fully enclosed to help prevent injury. During all pre-trip inspections, daily inspections, and problem troubleshooting, you may be exposed to moving parts. Please stay clear of all moving parts when the unit is in operation and when the START/RUN/OFF switch (SROS) is not in the OFF position.

Read these instructions carefully before operating the system. Safety alerts labeled DANGER, WARNING and CAUTION alert you to special instructions or precautions concerning procedures that would be hazardous if performed incorrectly or carelessly.

The safety alerts alone cannot eliminate all hazards. Strict compliance with these special instructions and common sense are major accident prevention measures.

1.2 Specific Warning And Caution Statements

To help identify the label hazards on the unit and explain the level of awareness each one carries, an explanation is given with the appropriate consequences:

DANGER

DANGER - means an immediate hazard that **WILL** result in severe personal injury or death.

WARNING

WARNING - means to warn against a hazard or unsafe condition that **COULD** result in severe personal injury or death.

CAUTION

CAUTION - means to warn against a potential hazard or unsafe practice that could result in minor personal injury, product or property damage.

NOTICE

NOTICE - means to warn against potential product or property damage.

The following statements are applicable to the refrigeration unit and appear elsewhere in this manual. These recommended precautions must be understood and applied during operation and maintenance of the equipment covered herein.

WARNING

Safety Considerations: Improper installation and improper servicing of this Engine Emission System (EES) can be hazardous. Only trained and qualified service personnel should install, repair or service this equipment. When working on this equipment, observe precautions in all literature including this manual, the equipment tags and labels attached to the unit, and other safety precautions that may apply. Follow safe work practices and utilize the appropriate protective equipment at all times.

WARNING

Hot Exhaust (Pipe and Gas): During filter regeneration, exhaust gas coming out of the tailpipe can exceed 700°F (370°C) and should not be directed onto materials that can melt or burn. The tailpipe, where it exits the DPF, can reach 1100°F (600°C). Follow installation instructions and the operator manual to prevent any component damage or personal injury.

WARNING

Just as with a standard muffler, the Diesel Particulate Filter (DPF) enclosure can reach 400°F (200°C) during filter regeneration and can cause burns if touched.

NOTICE

Under no circumstances should a technician electrically probe the modules at any point, other than the connector terminals where the harness attaches. Module components operate at different voltage levels and at extremely low current levels. Improper use of voltmeters, jumper wires, continuity testers, etc. could permanently damage the module.

1.3 Ash Handling

Ash is considered a hazardous material and must be collected using either a commercially available cleaning system or a vacuum with a HEPA filter. Follow the ash handling guidelines as prescribed by California Air Resources Board (CARB) at:

www.arb.ca.gov/diesel/tru/documents/ashguide.pdf.

1.4 Important Information: Your Rights and Responsibilities

Only factory authorized service locations should attempt to install and maintain the Engine Emission System (EES). All required procedures must be adhered to and all documentation must be properly filed. Proper operation must be confirmed at the time of installation.

1.4.1 Your Right to Maintenance Information

The California Air Resources Board (CARB) requires that Carrier Transicold provide detailed maintenance information for the diesel emission control system upon delivery to the end-user pursuant to section 2706(h)(2), Title 13, California Code of Regulations, at no additional cost to the owner. If you do not already have this information, contact either your local Carrier Transicold dealer or Carrier Transicold at 1-800-448-1661 for assistance.

1.4.2 Importance of Engine Maintenance

Proper engine maintenance is critical for the proper functioning of your diesel emission control strategy. Failure to document proper engine maintenance, including oil consumption records, may be grounds for denial of a warranty claim for a failed component of a diesel emission control strategy.

1.4.3 Importance of Properly Maintaining a Diesel Emission Control Strategy

Proper maintenance is critical for the diesel emission control strategy to function as intended. Failure to document proper diesel emission control strategy maintenance, including cleaning and/or ash removal of the system, replacement of consumables, and replacement of broken/failed parts, may be grounds for denial of a warranty claim for a failed component of a diesel emission control strategy.

SECTION 2

INTRODUCTION

2.1 Introduction

This guide has been prepared for the operator of a Carrier Transicold refrigeration unit with Engine Emission System (EES) installed. It contains basic information for the operation of the EES as well as safety information and troubleshooting tips.

The EES has been engineered to provide long, trouble-free performance when it is properly operated and maintained. In addition, a comprehensive maintenance program will help to ensure that the system continues to operate reliably. Such a maintenance program will also help to control operating costs, increase the working life of the system, and improve performance.

When an RG15 Tier 4 generator set unit is factory installed with the EES option, the unit PID number is RG21XX. When an RG15 Tier 4 generator set unit has an EES field installed, the unit PID number will change from RG20XX to RG21XX (i.e. RG2033 will change to RG2133).

2.2 Installation

Only factory authorized service locations should attempt to install and maintain the Engine Emission System (EES). All required procedures must be adhered to and all documentation must be properly filed. Proper operation must be confirmed at the time of installation.

2.3 Importance of Engine Maintenance

Proper engine maintenance is critical for the proper functioning of your diesel emission control strategy. Failure to document proper engine maintenance, including oil consumption records, may be grounds for denial of a warranty claim for a failed component of a diesel emission control strategy.

2.4 Importance of Diesel Emission Control Strategy

Proper maintenance is critical for the diesel emission control strategy to function as intended. Failure to document proper diesel emission control strategy maintenance, including cleaning and/or ash removal of the system, replacement of consumables, and replacement of broken / failed parts, may be grounds for denial of a warranty claim for a failed component of a diesel emission control strategy.

2.5 Fuel and Oil Requirements

2.5.1 Fuel Requirements

ONLY use Ultra Low Sulfur Diesel (ULSD) fuel for a unit equipped with an EES.

Diesel fuel with higher sulfur contents may foul the diesel oxidation catalyst (DOC) and prevent the filter from performing a proper regeneration.

Bio diesel up to a 5% blend can be utilized as long as the sulfur level meets the same criteria as ULSD (< 15 ppm). Some bio fuels may contribute to increased ash accumulation. While increased ash accumulation will not have any adverse effects on the filter efficiency, the filter may require more frequent cleaning.

2.5.2 Engine Oil Requirements

ONLY use API engine oil of CJ-4 (low ash) or better classification with a unit equipped with an EES. Mobile Delvac 1 with CK-4 specifications meets oil requirements.

Use of non-compliant oils will cause increased ash loading and reduce the effectiveness of the EES. See unit's Operator manual for proper weight of oil.

High ash oil may have the following effects:

- Increases frequency of regenerations
- Increases back pressure in DPF
- Can lead to higher fuel consumption

SECTION 3

DESCRIPTION

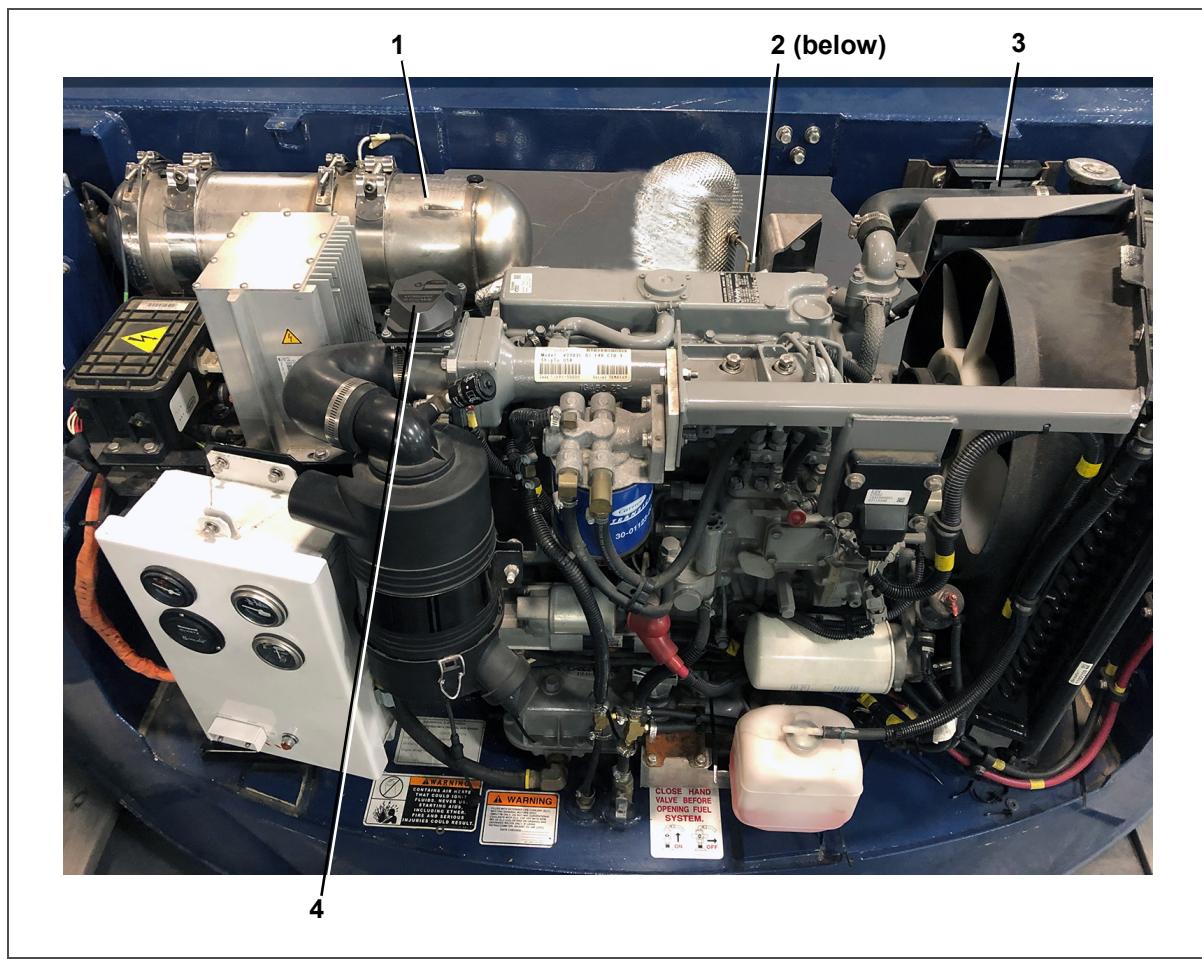
3.1 Engine Emission System (EES) Overview

In a diesel engine exhaust system, unburned diesel fuel results in soot accumulation. This can cause clogging in the filter which in turn causes engine exhaust back pressure to become too high. The Engine Emission System (EES), is an optional system that removes most of the soot particles from the exhaust. By removing the soot particles, cleaner air is discharged out of the exhaust system during operation and back pressure is reduced. The EES also functions as the muffler when installed and reduces the exhaust related noise emitted from the unit.

The process of burning off the particulate matter in the EES is called Regeneration. This is where temperature is increased to a level that oxidizes the captured soot, leaving only (fine) inorganic ash and significantly reducing back pressure. Refer to [Section 3.7](#) for a further explanation of Regeneration.

The major components of the ESS are the Exhaust System, Fuel Injector (Doser), Emissions Control Module (ECM), and Air Control Valve (ACV). Refer to [Figure 3.1](#) for component locations. Each of the major components are described in further detail below in this chapter.

Figure 3.1 Engine Emission System (EES) Components



- 1) Exhaust System
- 2) Fuel Injector (Doser)
- 3) Emissions Control Module (ECM)
- 4) Air Control Valve (ACV)

3.2 Exhaust System Description

3.2.1 Diesel Oxidation Catalyst (DOC)

Exhaust flows through the Diesel Oxidation Catalyst (DOC), [Figure 3.2](#), for initial filtration. Fuel is injected into the DOC to increase temperatures in the Diesel Particulate Filter (DPF) during regeneration. Refer to [Section 3.7](#) for a description of how regeneration works. There are no service requirements for the DOC.

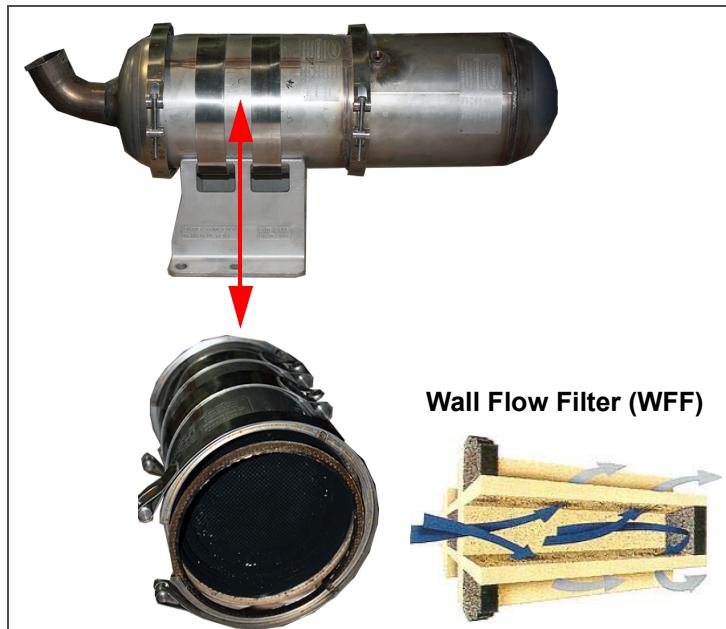
Figure 3.2 Diesel Oxidation Catalyst (DOC)



3.2.2 Diesel Particulate Filter (DPF)

The Diesel Particulate Filter (DPF), [Figure 3.3](#), traps particulate matter in a filter but allows exhaust gas to pass through. The DPF uses a Wall Flow Filter (WFF) design, which allows exhaust gases to pass through micro-porous walls. Particles of diesel soot and other debris is removed from the gas stream by filtration, but soot remains trapped in the DPF. As the amount of soot increases in the DPF, the back pressure in the exhaust increases as well. When the back pressure reaches a predetermined level, regeneration will occur to convert the captured soot into inorganic ash. Refer to [Section 3.7](#) for a description of how regeneration works. The DPF requires periodic ash removal and filter cleaning. Refer to [Section 6.4](#) for DPF Cleaning procedure.

Figure 3.3 Diesel Particulate Filter (DPF)

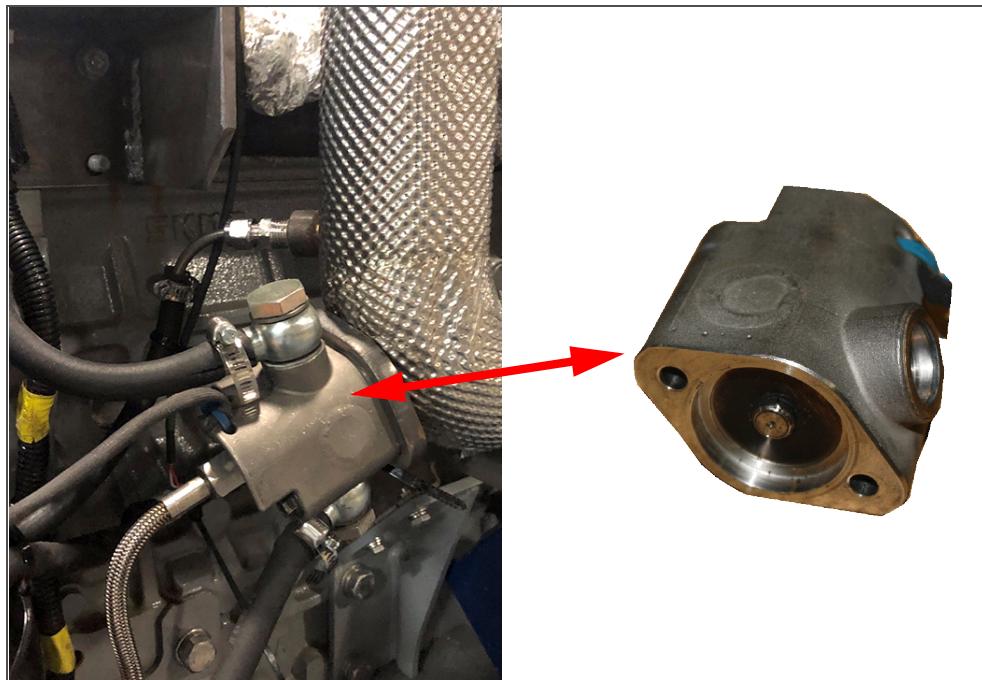


3.3 Fuel Injector (Doser) Description

3.3.1 Fuel Injector (Doser)

The Fuel Injector (Doser), [Figure 3.4](#), sprays a small amount of fuel into the exhaust. The Doser helps raise exhaust temperatures during active regeneration when the engine is too lightly loaded for passive regeneration to occur. During active regeneration, the Doser valve injects a fine mist of fuel into the exhaust stream, where it then ignites on the surface of the DOC to raise the exhaust temperature and oxidize the particulate matter in the DPF. Automatic regeneration is initiated by the Emissions Control Module (ECM). Refer to [Section 3.7](#) for a description of how regeneration works. The generator set radiator supplies coolant to the Doser to remove heat.

Figure 3.4 Doser



3.3.2 EES Fuel Pump and Filter

The EES Fuel Pump, [Figure 3.5](#), taps into the generator set fuel tank supply to pump fuel directly to the Doser during DPF regeneration. An in-line fuel filter / water separator is located between the pump and Doser.

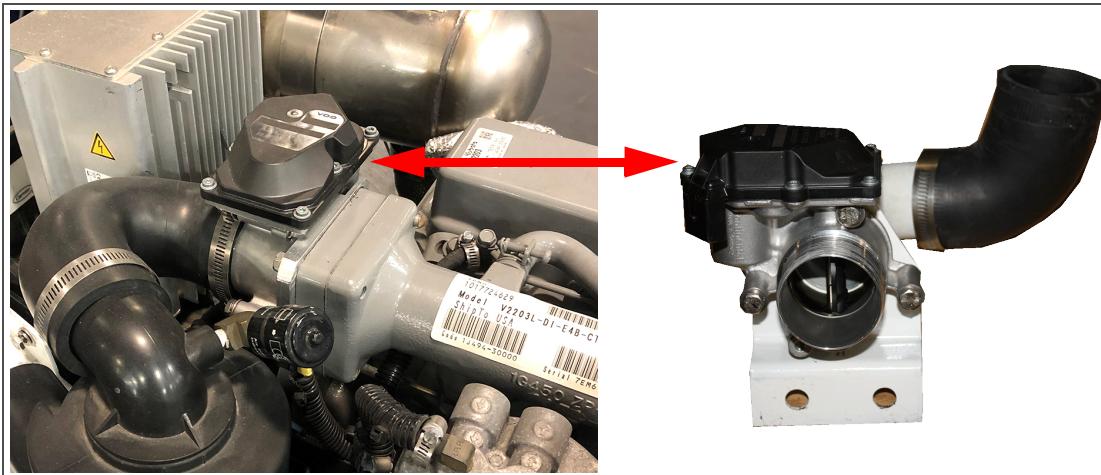
Figure 3.5 EES Fuel Pump



3.4 Air Control Valve (ACV) Description

The Air Control Valve (ACV), [Figure 3.6](#), restricts engine intake air which in turn raises exhaust temperatures. It is a normally-open valve that is located on the engine air intake hose. When the DPF requires regeneration and exhaust temperature is very low (for example, during minimal engine loading and/or extremely cold weather), the ACV is used for active-assist regeneration. During active-assist regeneration, the ACV changes the air-to-fuel ratio in order to raise exhaust temperatures high enough for the doser to activate and regenerate the DPF. Refer to [Section 3.7](#) for a description of how regeneration works.

Figure 3.6 Air Control Valve (ACV)



3.5 Emissions Control Module (ECM) Description

The Emissions Control Module (ECM), [Figure 3.7](#), monitors the EES parameters, using an internal back pressure sensor, along with temperature sensors mounted in three locations of the exhaust system. Based on the parameters, the ECM will initiate automatic regeneration when needed. Further diagnosing with the ECM requires the ECM Service Tool software. Refer to [ECM Service Tool](#) chapter for procedures.

Figure 3.7 Emissions Control Module (ECM)



The ECM will signal to the service light, [Figure 3.8](#), as part of alarm notification. A unit with an illuminated service light indicates immediate service is needed, and will continue to operate for up to 250 hours in order to protect load and allow adequate time for delivery. After 250 hours, the unit will shut down until the EES is repaired.

Figure 3.8 Service Light



3.6 Sensors

The temperature sensors monitor unit operation and report back to the ECM.

3.6.1 Exhaust Inlet Temperature Sensor (ESEIT)

The Exhaust Inlet Temperature Sensor (ESEIT), [Figure 3.9](#), monitors temperature entering the DOC. It is located just before the Doser and DOC. This temperature is directly dependent upon engine load and determines which type of regeneration is needed. When upstream temperatures are high enough (during high engine load), passive regeneration will occur. Refer to [Section 3.7](#) for a description of how regeneration works.

Figure 3.9 Exhaust Inlet Temperature Sensor (ESEIT)



3.6.2 Filter Inlet Temperature Sensor (ESFIT)

The Filter Inlet Temperature Sensor (ESFIT), [Figure 3.10](#), monitors exhaust temperature entering the DPF. It is located after the DOC and before the DPF. This temperature data is utilized to control and maintain regeneration temperature at approximately 1112 °F (600°C). This temperature is maintained by injecting fuel into the system (active regeneration), or in some cases, using the ACV to restrict engine air intake (active-assist regeneration).

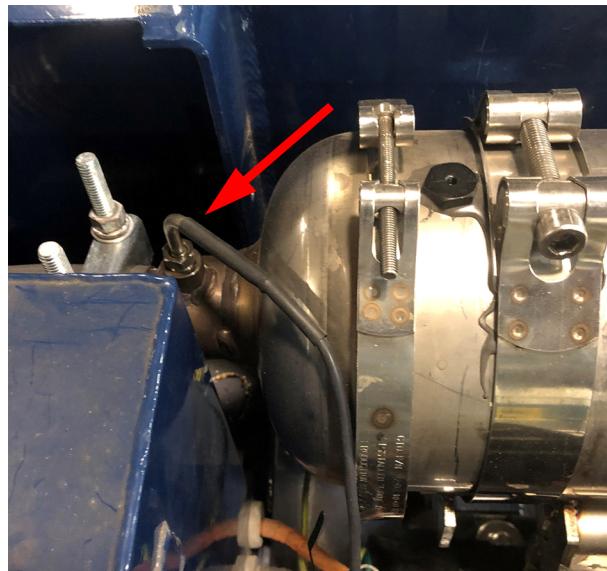
Figure 3.10 Filter Inlet Temperature Sensor (ESFIT)



3.6.3 Filter Outlet Temperature Sensor (ESFOT)

The Filter Outlet Temperature Sensor (ESFOT), [Figure 3.11](#), monitors exhaust temperature leaving the DPF. It is located after the DPF and before the tail pipe. This temperature data is utilized to verify that the regeneration process is being properly controlled.

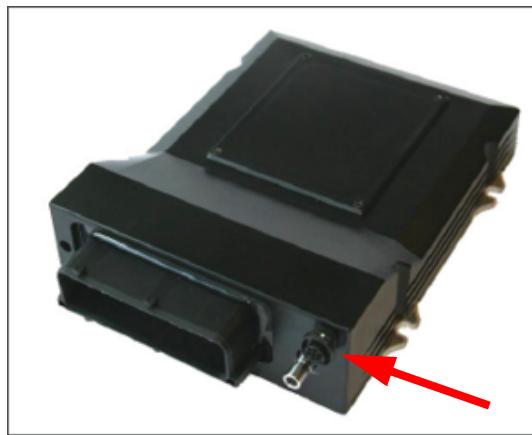
Figure 3.11 Filter Outlet Temperature Sensor (ESFOT)



3.6.4 Filter Back Pressure Sensor (ESFP)

The Filter Back Pressure Sensor (ESFP) measures back pressure at the upstream piping. It is located inside the ECM module. As the DPF gets filled with soot, back pressure will increase. The ESFP verifies that the regeneration process is being controlled properly.

Figure 3.12 Filter Back Pressure Sensor (ESFP)



3.7 Regeneration

To treat the diesel soot that gets captured in the DPF, a process called regeneration is utilized. During regeneration, the temperature in the DPF is increased to a level that oxidizes the captured soot, leaving only (fine) inorganic ash and significantly reducing back pressure. Regeneration is aided by the Diesel Oxidation Catalyst (DOC) which raises the temperature of the exhaust entering the DPF. Higher exhaust temperatures improve the regeneration process in the DPF. The target exhaust temperature for regeneration is 1112°F (600°C).

A regeneration generally takes 15 to 20 minutes and may occur 1 to 3 times per day depending on conditions.

The EES will initiate a regeneration cycle when the following conditions are met:

- Back pressure in the exhaust reaches 24 in/H₂O (6kPa) in low speed and 36 in/H₂O (9kPa) in high speed.
- Automatic regeneration initiated every 12 hours of run time, or for 6 hours of run time if temperatures are below 32°F (0°C) at the Emissions Control Module (ECM).

A manual regeneration can be initiated through the ECM Service tool. Refer to [Section 4.3](#) for procedures.

The three phases of regeneration are explained below:

1. Passive Regeneration

Condition: Engine exhaust temperature is above 662°F (350°C).

Description: During Passive Regeneration, exhaust temperatures are hot enough to start an exothermic reaction in the DOC without assistance. Only the DOC and DPF are required. Passive Regeneration saves fuel by extending intervals between Active or Active Assist Regenerations.

2. Active Regeneration

Condition: Engine exhaust temperature is in range of 446° to 662°F (230° to 350°C).

Description: During Active Regeneration, fuel is injected into the exhaust system to raise exhaust temperatures hot enough to start a reaction in the DOC. Fuel is injected into the upstream pipe by the Doser and then catalyzed in the DOC, which actively increases the exhaust temperature entering the DPF.

3. Active Assist Regeneration

Condition: Engine exhaust temperature is below 446° (230°C).

Description: During Active Assist Regeneration, the Air Control Valve (ACV) restricts engine air intake, which changes the air-to-fuel ratio and increases the exhaust temperature entering the DOC. Once the exhaust temperature reaches the level required for Active Regeneration, the Doser injects fuel into the upstream pipe.

After regeneration is complete, the exhaust temperature will be allowed to return to its normal state. All temperature data gets sent to the ECM. The ash that remains in the DPF after regeneration is only a fraction of the original mass; the reduced mass allows back pressure to return to near non-EES values. However, as ash continues to accumulate in the DPF, the base back pressure will continue to rise. Refer to Maintenance Schedule, [Section 6.2](#), to see intervals for cleaning DPF.

3.8 System Specifications

Table 3-1 System Specifications

Component	Specifications
Fuel Pump	12V, 7.5 Amp max draw 1.6 ohms @ room temperature ECM Service Tool: “D06 Fuel Pump” test mode
Air Control Valve (ACV)	ACV Connector: Pin 1: Sensor +5V Pin 2: Signal (PWM) Pin 3: Sensor - Pin 4: Motor + Pin 5: Motor - ECM Service Tool: “Do1 ACV” test mode
Fuel Injector (Doser)	Coil resistance: 12V, 1.2 ohms @ 77°F (25°C) ECM Service Tool: “D02 Injector” test mode Fuel doser current draw is outside the acceptable range of 0.5 - 6.5A for five seconds when energized.
Temperature Sensors: ESEIT, ESFIT, ESFOT	Range, cont: -40°F to 1382°F (-40°C to 750°C) Resistance: 230 ohms (RT) Fail shorted: -148°F (64°C) Fail opened: >2012°F (1100°C)

SECTION 4

ECM SERVICE TOOL

4.1 Overview and Initial Setup

The ECM Service Tool, **Figure 4.1**, is diagnostic software that can test the functionality of individual EES components, initiate regeneration, display alarm codes, provide current sensor readings, retrieve data from the ECM, and more.

The ECM Service Tool software v2.0.28 is required to communicate with the ECM. This can be downloaded from the Carrier Transicold website. With the software installed, connect the computer to the ECM through an ECM CAN Adapter, **Figure 4.2**, part number 07-00533-01.

Figure 4.1 ECM Service Tool

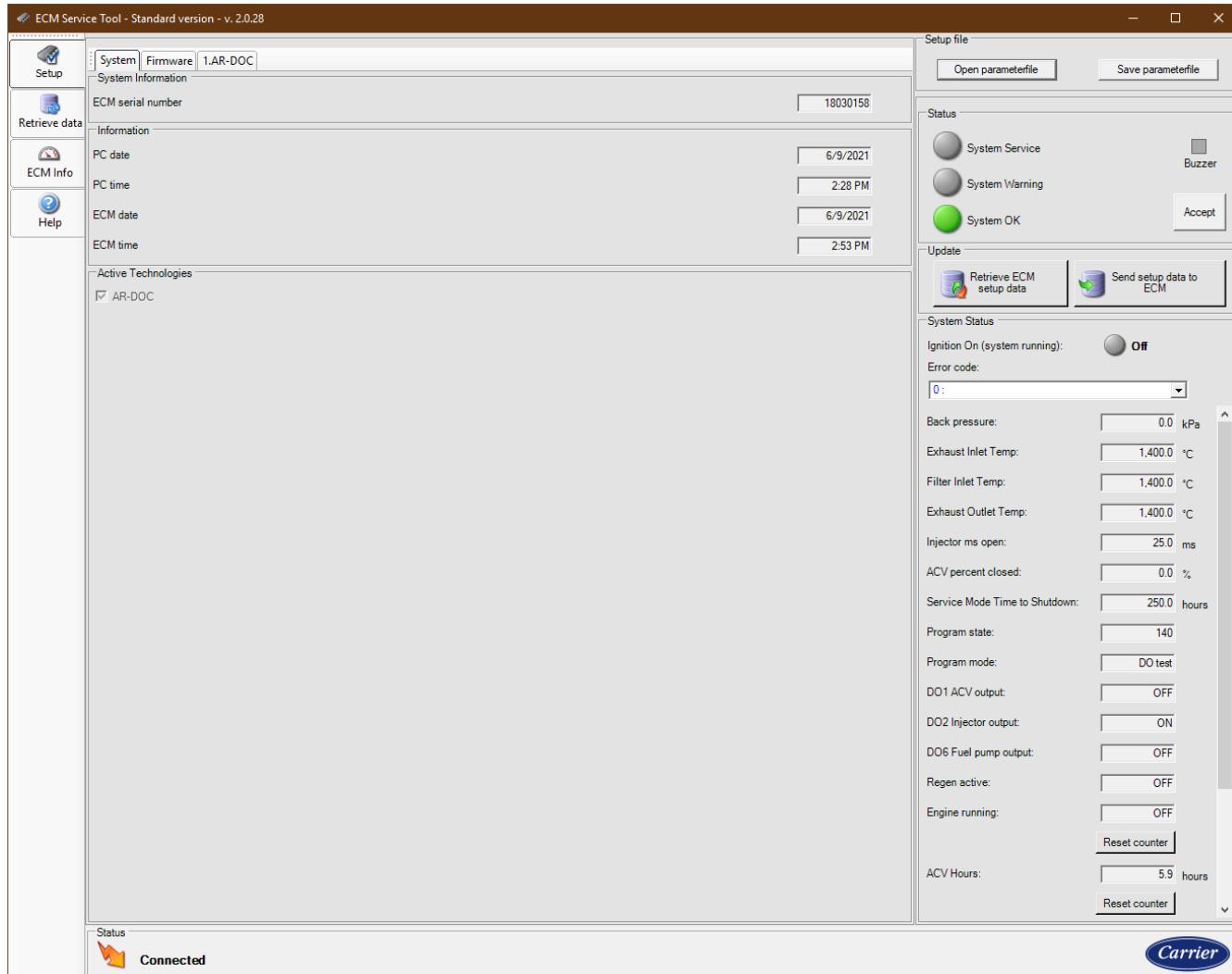


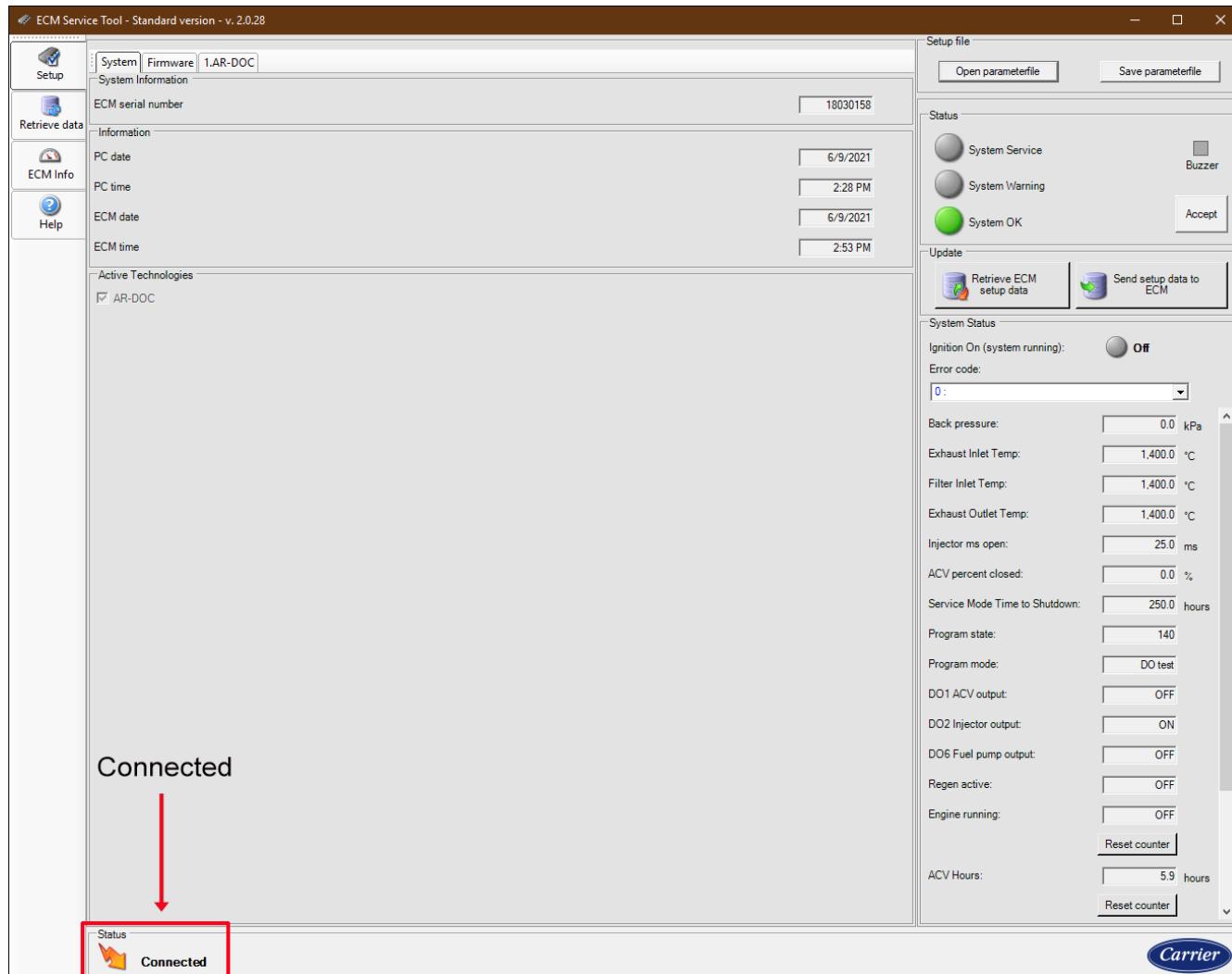
Figure 4.2 ECM CAN Adapter



When the ECM Service Tool program is first opened and the USB connector from the ECM CAN Adapter is connected to the computer, a message will indicate that a new driver has been installed. If the driver has not been installed properly, the software will automatically complete driver installation.

The ECM Service Tool will setup the port the first time you open the program. When the ECM is communicating, the status on the bottom left side of the screen will display "Connected". Refer to [Figure 4.3](#).

Figure 4.3 ECM Service Tool - Connected



4.2 Component Check

Component check, [Figure 4.4](#), is for testing the functionality of individual EES components by cycling the components on and off. Each component will energize for one cycle. The engine must be off.

NOTICE

When checking components, disengage the starter so that the unit will not start. Components should be tested with switch power only.

4.2.1 Air Control Valve (ACV)

1. From the Setup screen, click on the AR-DOC tab.
2. Click the DO1 ACV button once to activate ACV. The ACV will go through one cycle. As the ACV cycles, the motor will make a slight, audible sound which indicates that the valve is working properly.
3. Click the DO1 ACV button again to deactivate the ACV.

4.2.2 Injector (Doser)

1. From the Setup Screen, click on the AR-DOC tab.
2. Click the DO2 Injector button once to activate the injector. When the injector is activated, it will make a slight, audible click which indicates that the injector is working properly.
3. Click the DO2 Injector button again to deactivate the injector.

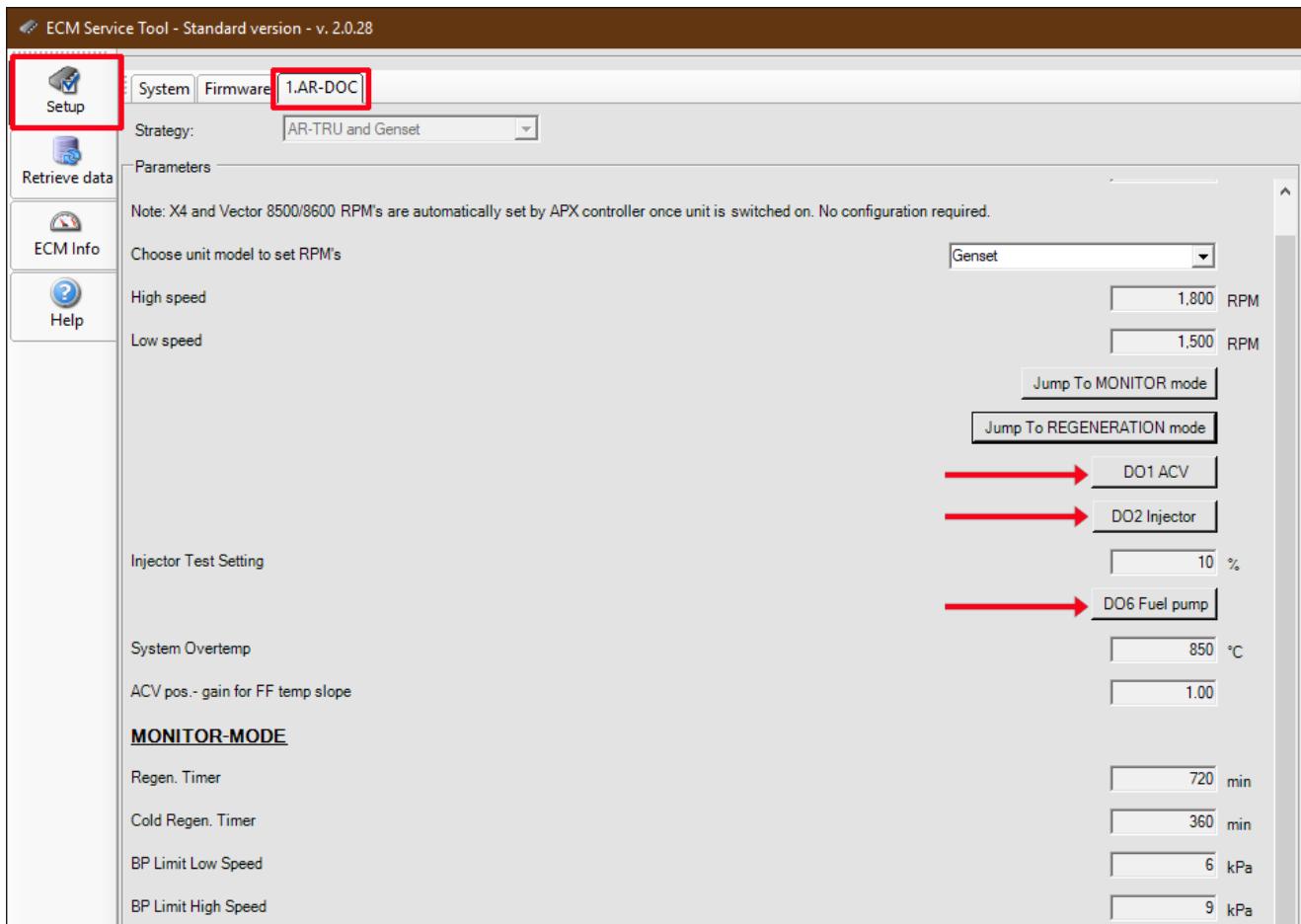
4.2.3 Fuel Pump

1. From the Setup Screen, click on the AR-DOC tab.
2. Click the DO6 Fuel pump button once to activate the fuel pump. As the fuel pump cycles, the pump motor will make a slight, audible sound which indicates that the fuel pump is working properly.
3. Click the DO6 Fuel pump again to deactivate the fuel pump.

! CAUTION

Do not activate the Injector (Doser) and Fuel Pump at the same time. This will result in raw fuel being sprayed into the exhaust system.

Figure 4.4 ECM Service Tool - Component Check



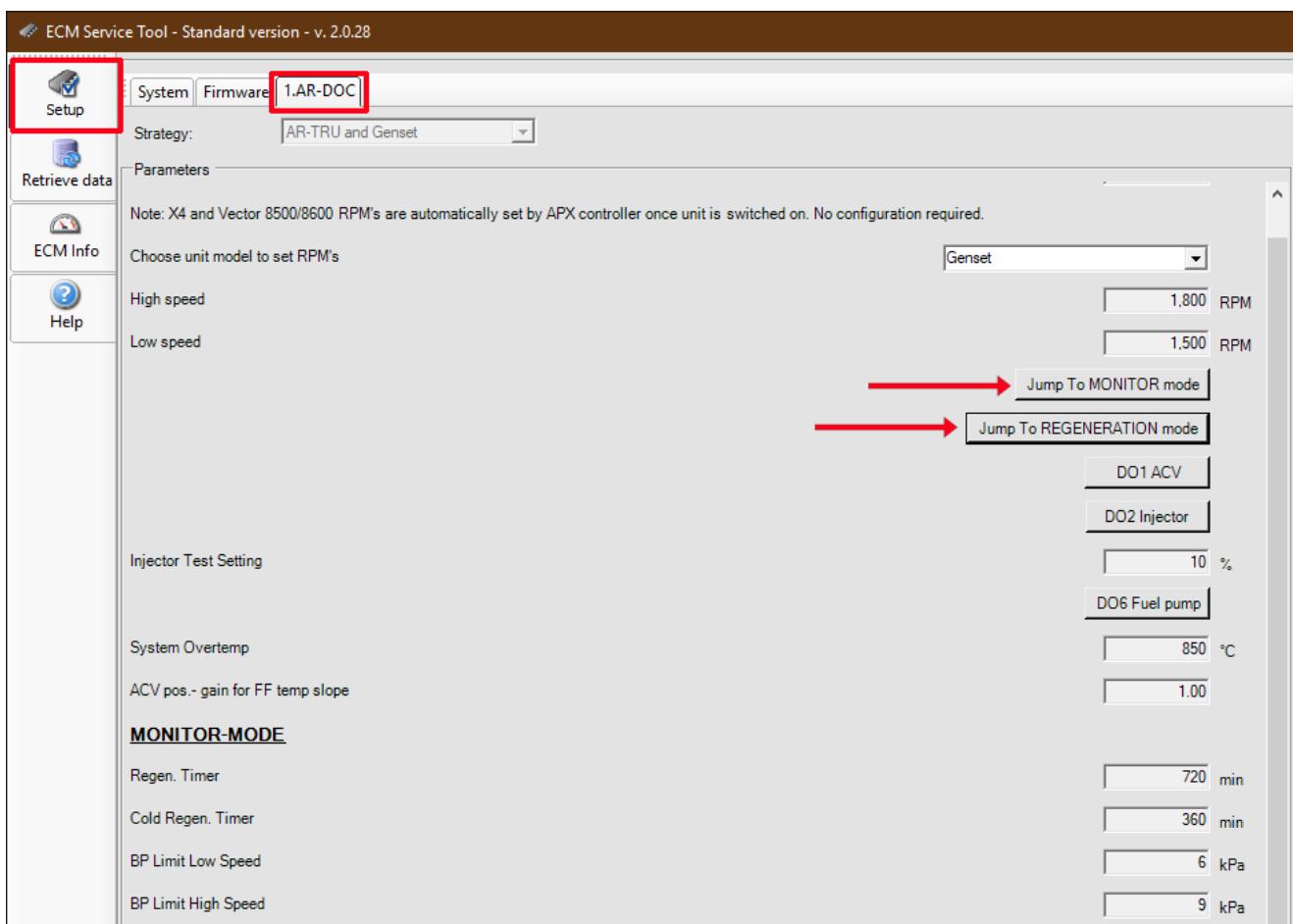
4.3 Initiating a Manual Regeneration

A manual regeneration can be initiated from the ECM service tool. Refer to [Figure 4.5](#).

Refer to [Section 3.7](#) for more details on the regeneration process.

1. From the Setup Screen, click on the AR-DOC tab.
2. Start the unit and allow the unit to run for 15 minutes to warm up the DPF.
3. Click the “Jump TO REGENERATION mode” button to initiate regeneration. The system will automatically start a complete regeneration as long as the following conditions are met:
 - No active alarms are present in the Error Code listing.
 - Back pressure is below 30kPa.
4. To stop a regeneration, click the “Jump To MONITOR mode” button.

Figure 4.5 ECM Service Tool - Manual Regeneration



4.4 Alarms

Alarm conditions where the EES becomes inoperable will initiate a 250 hour timer. After 250 hours, the unit will shut down until the system is repaired by a qualified technician. Once the alarm condition is corrected, the EES Service Light will go from Amber to Green and the timer will be reset. Refer to [Figure 4.6](#).

Refer to [Section 5.1](#) for a list of alarms and troubleshooting information.

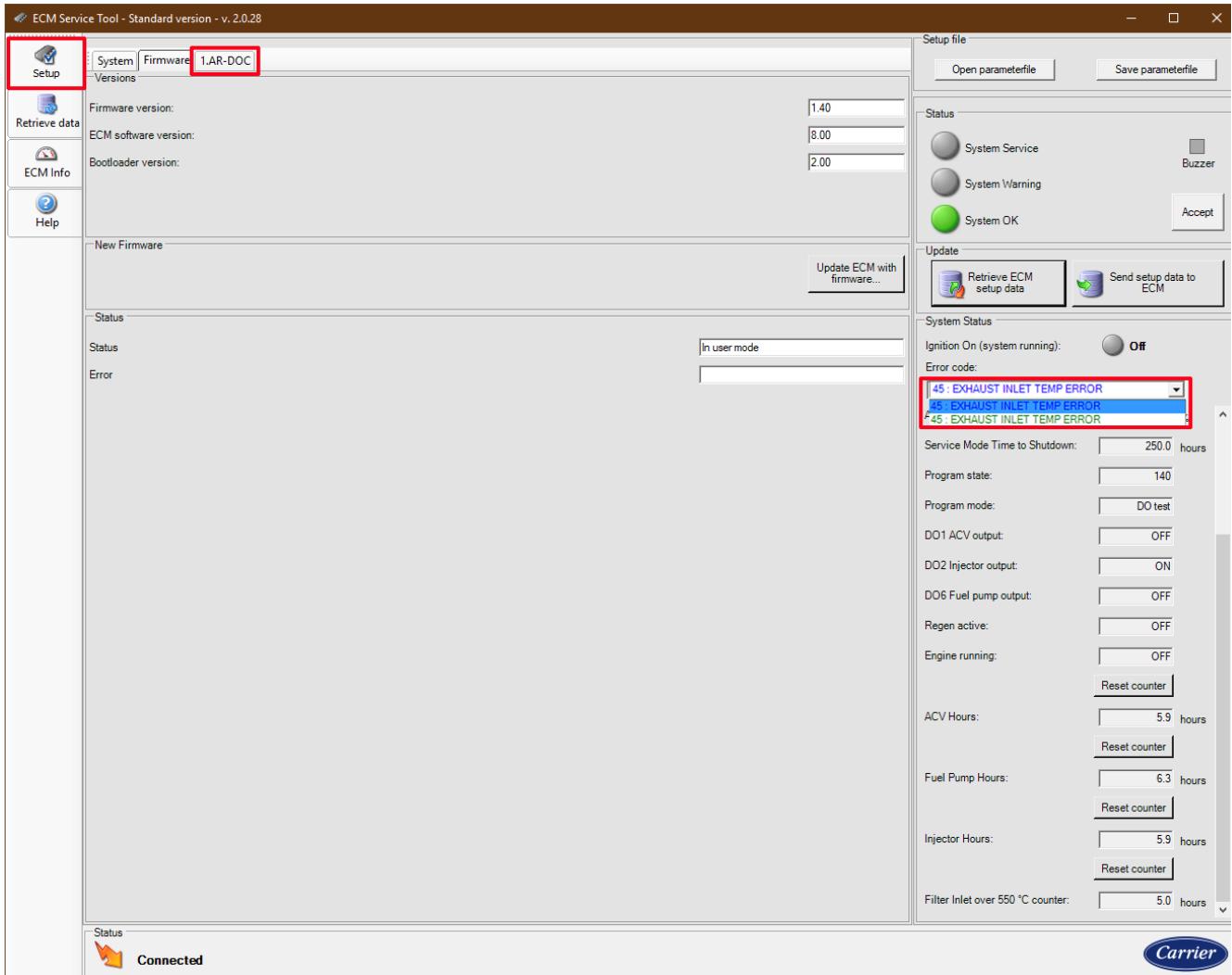
1. From the Setup Screen, click on the AR-DOC tab.
2. Alarms can be read with the unit running or turned off, as long as battery power is hooked up.

Red: Active alarm

Blue: Alarm has been corrected

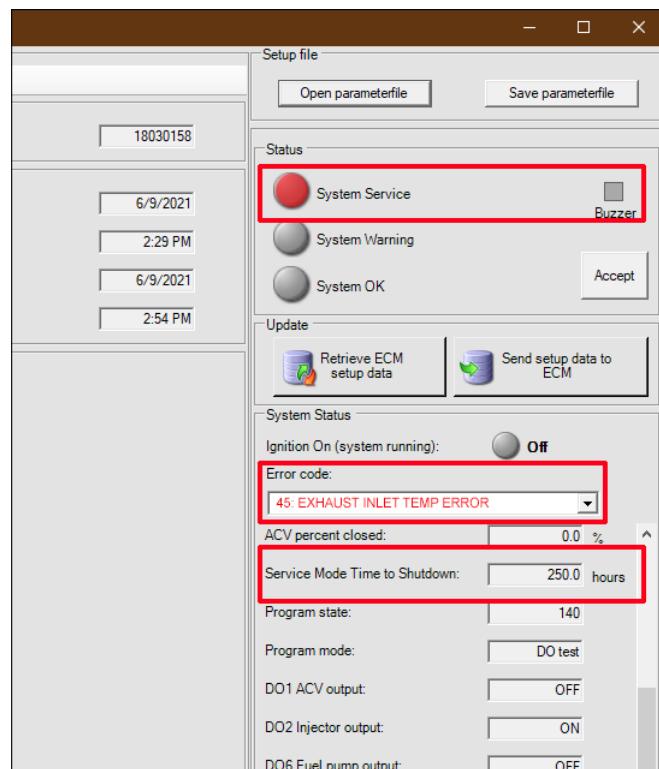
Green: Alarm has been cleared

Figure 4.6 ECM Service Tool - Alarms



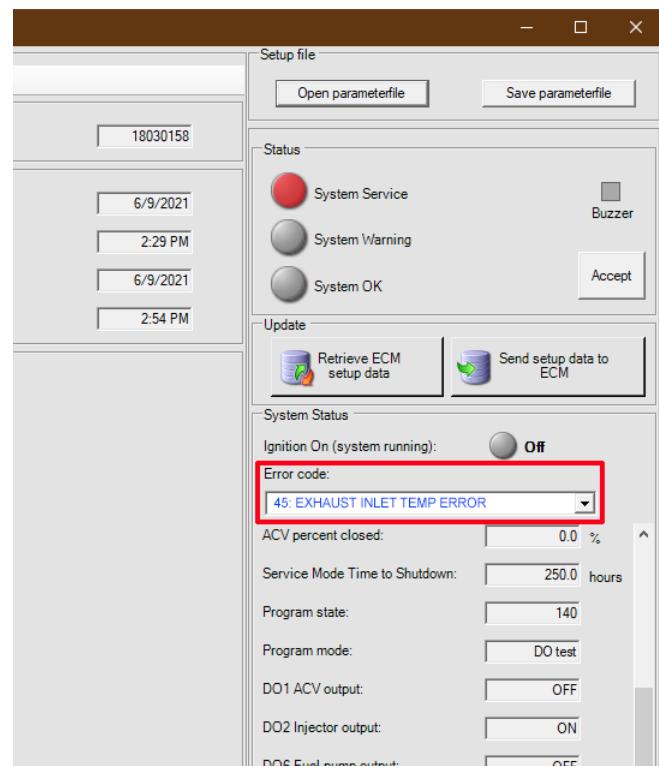
3. When an alarm occurs, the error code is logged in the drop down box. It is listed in red to indicate that it is an active alarm. The System Service indicator turns red. Alarm conditions where the EES becomes inoperable will initiate a 250 hour timer. After 250 hours, the unit will shut down until the system is repaired by a qualified technician. Refer to **Figure 4.7**.

Figure 4.7 ECM Service Tool - Alarms Active



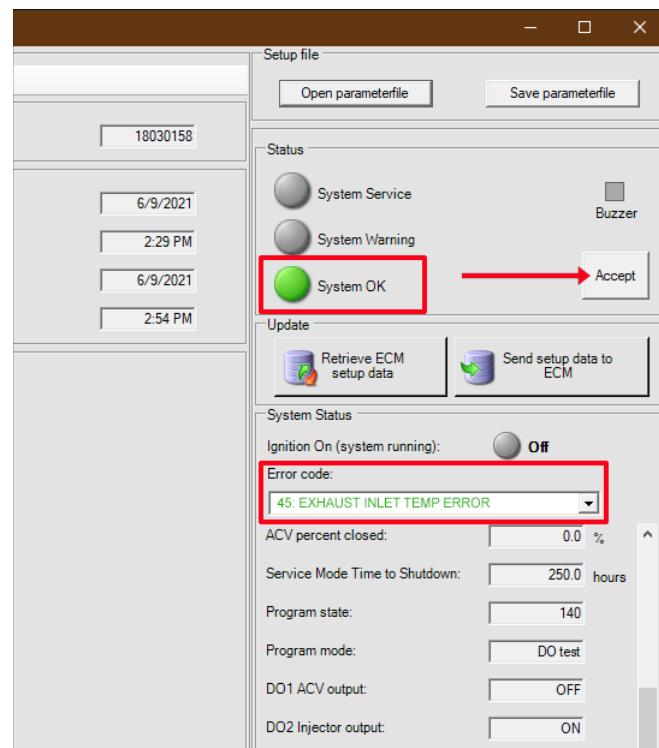
4. After the alarm has been corrected, the alarm text turns blue. Refer to **Figure 4.8**.

Figure 4.8 ECM Service Tool - Alarms Corrected



5. Once an alarm is corrected, turn the unit switch off and on. Then, click on the Accept button. Verify that the alarm text turns green and the System Indicator turns green. Refer to [Figure 4.9](#).

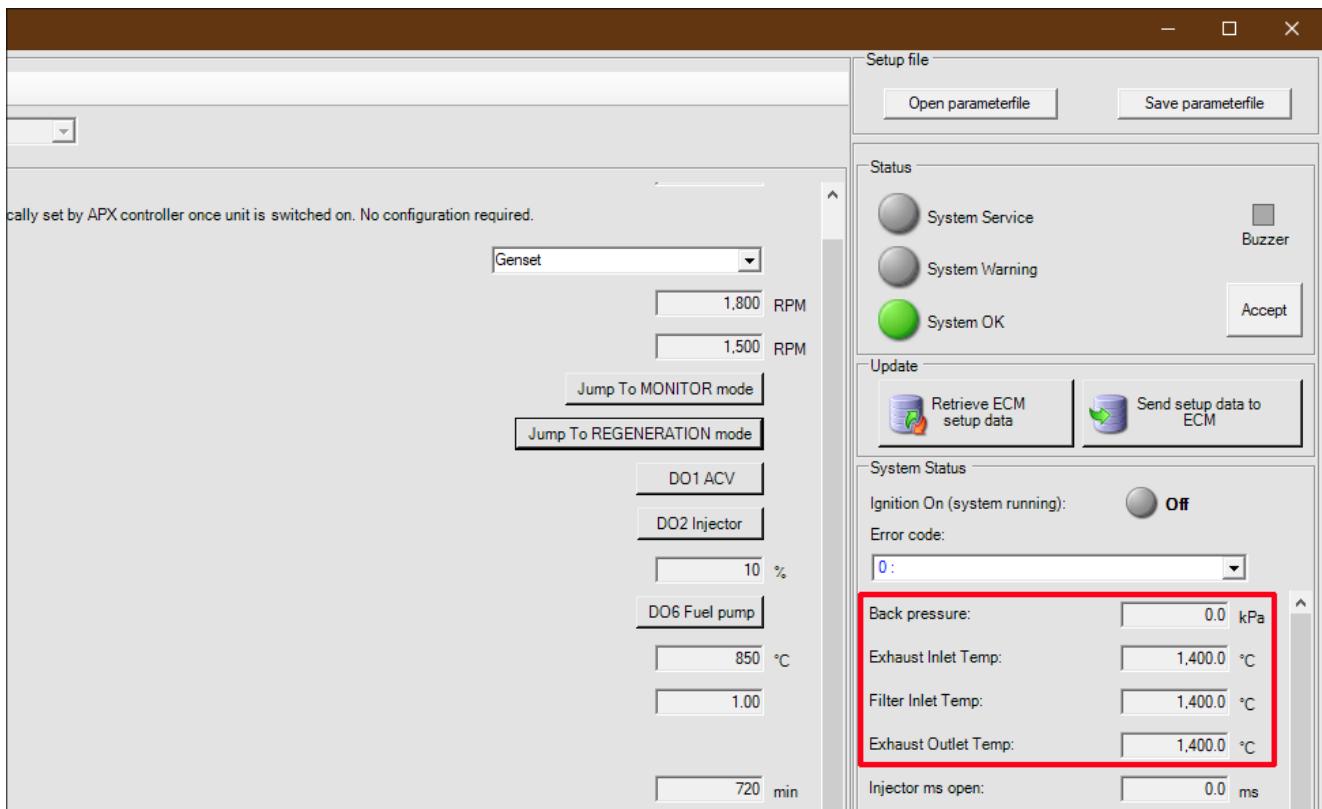
Figure 4.9 ECM Service Tool - Alarms Cleared



4.5 Sensor Readings

The ECM Service Tool can display current readings for the EES sensors on the Setup Screen from the AR-DOC tab. Refer to [Figure 4.10](#).

Figure 4.10 ECM Service Tool - Sensor Readings



The following sensors are monitored:

- Exhaust Inlet Temperature Sensor (ESEIT)
- Filter Inlet Temperature Sensor (ESFIT)
- Filter Outlet Temperature Sensor (ESFOT)
- Filter Back Pressure Sensor (ESFP)

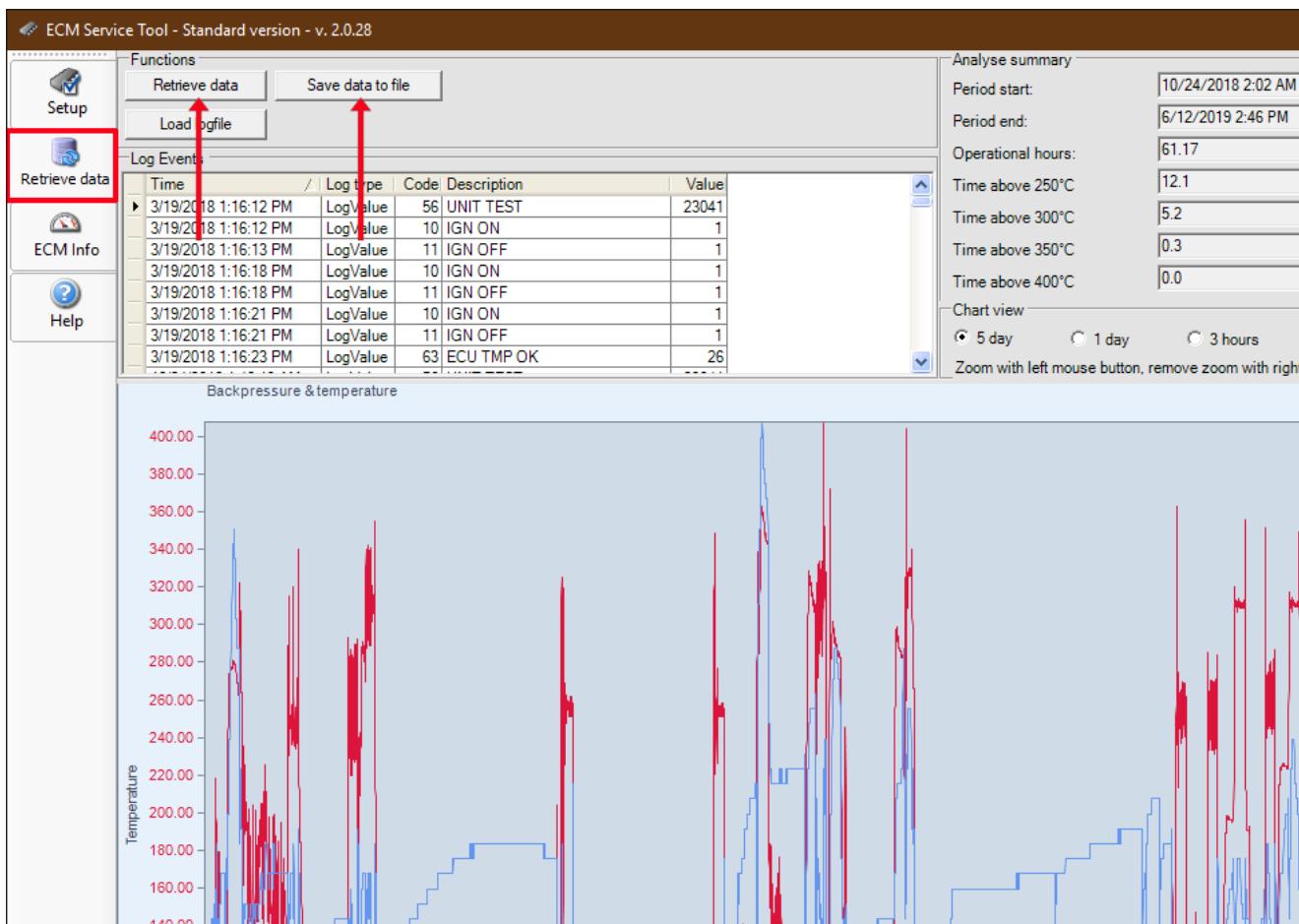
With the unit off, once exhaust system temperature has stabilized check sensor temperatures for Exhaust Inlet, Filter Inlet, and Filter Outlet. All readings should be within 1 or 2 degrees of each other.

4.6 Retrieving Data

An EES download may be necessary for troubleshooting the EES. Refer to [Figure 4.11](#).

1. From the Retrieve Data screen, click on the Retrieve data button. The “Receiving log data” dialog box will be displayed.
2. Once the data has been downloaded, the screen will update to show the log events. To save the data, click “Save data to file.”
3. The “Browse for folder” dialog box will appear. Find a location to save the files to, and then click “OK.”
4. Once the log data is downloaded, a dialog box will show “Logfiles saved.”. Click OK.
5. After the download is complete, two text files and one zip file will be saved.

Figure 4.11 ECM Service Tool - Retrieving Data

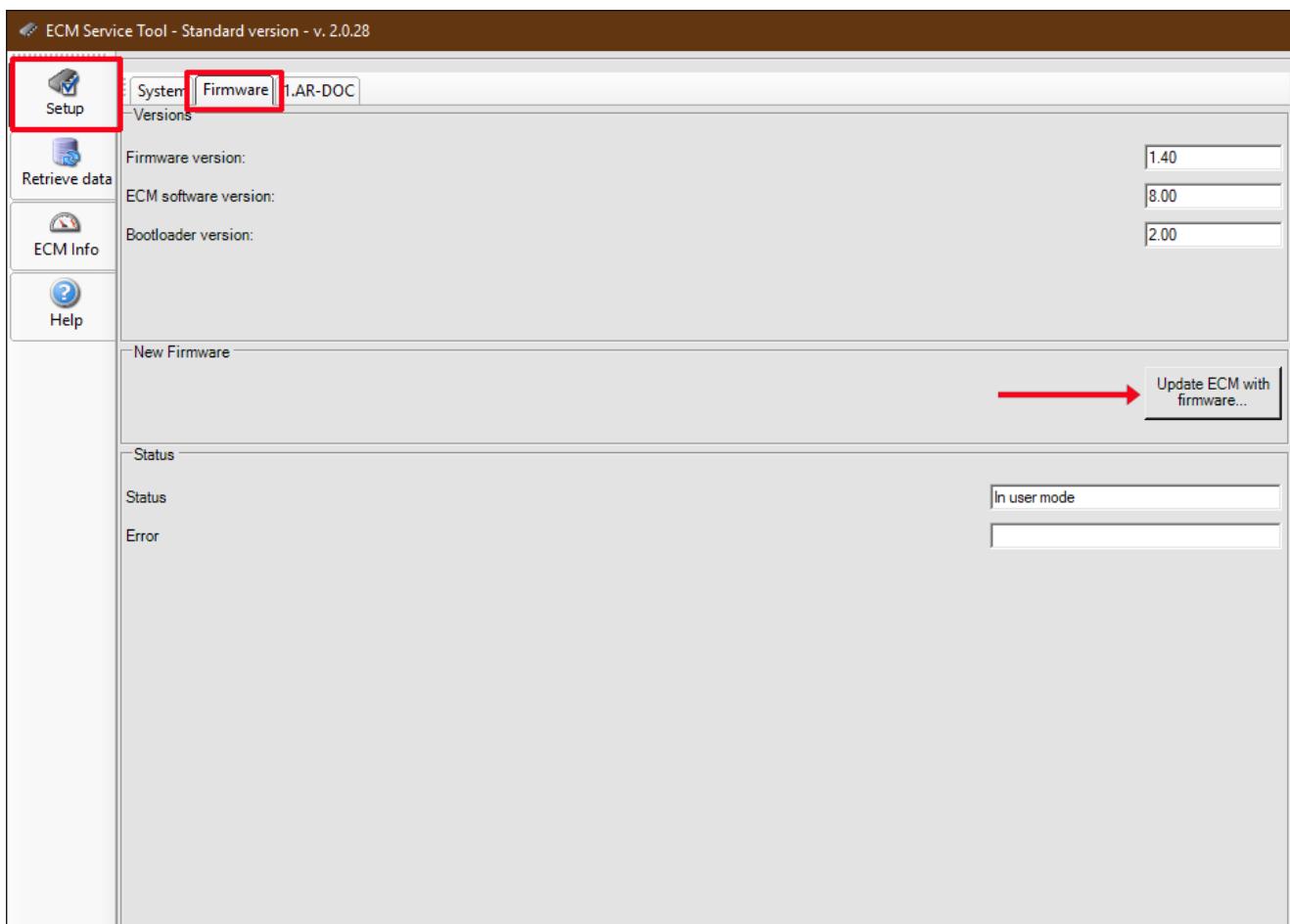


4.7 Programming the ECM with New Software

If the ECM needs to be updated with new firmware, use the ECM Service tool to do it. Refer to [Figure 4.12](#).

1. From the Setup screen, click on the Firmware tab.
2. Click on the “Update ECM with firmware” button. A window will prompt to locate the new software file.
3. Choose the new software file and click Open. A window will open showing progress of the download.
4. Once the update is complete the message “Update successful” is displayed. Click OK.
5. Confirm that the software / firmware revision has been updated.

Figure 4.12 ECM Service Tool - Software Update



SECTION 5

ALARMS AND TROUBLESHOOTING

5.1 Alarms

The EES monitors several parameters. If the EES fails to perform a successful regeneration, an alarm will be sent to alert the technician of the likely cause. This will aid in troubleshooting the system. Alarms generated by the EES are displayed as an Amber light on the EES Service Light, refer to [Figure 3.8](#) for location.

In order to read alarms, you will need to utilize the ECM Service Tool. Refer to [Section 4](#) for information on how to setup and use this tool.

Alarm conditions where the EES becomes inoperable will initiate a 250 hour timer. After 250 hours, the unit will shut down until the system is repaired by a qualified technician. Once the alarm condition is corrected, the EES Service Light will go from Amber to Green and the timer will be reset.

Alarm	Name	Cause / Troubleshooting
1	Back Pressure Exceeded	<p>The system needs to regenerate but has not been able to.</p> <p>The back pressure is above the threshold limit where the system can automatically or manual safely regenerate 120 in/H₂O (30 kPa).</p> <p>The EES has entered service mode.</p> <p>Take out the filter and perform a manual cleaning.</p> <p>Check for other alarms in queue and inspect the EES.</p>
2	High Back Pressure	<p>Back pressure is above the threshold limit where the system can automatically and safely regenerate 80 in/H₂O (15kPa).</p> <p>The EES has entered manual mode.</p> <p>Activate a manual regeneration. Refer to Section 4.3.</p> <p>Check for other alarms in queue and inspect the EES.</p>
3	Low Back Pressure	<p>The back pressure has been less than 4 in/H₂O (1 kPa) for more than four hours while the START/RUN/OFF switch has been active.</p> <p>Check the back pressure hose for cracks, leakage, or blockage.</p> <p>Replace the hose if damage is found.</p>
4	Back Pressure Offset Out of Range	<p>Check the back pressure hose for cracks, leakage or blockage.</p> <p>Replace the hose if damage is found.</p> <p>Verify back pressure by comparing an analog gauge to the transducer reading on the ECM Service Tool. Refer to Section 4.5.</p>
5	250 Hour Service Mode	<p>EES SERVICE REQUIRED, a 250 hour countdown timer will initiate.</p> <p>The time remaining before unit shutdown will be displayed on the ECM Service Tool. Refer to Section 4.4.</p> <p>Once the timer reaches zero, the unit will not run until the EES is repaired.</p>
12	ECM Voltage Low	<p>Voltage at the ECM is less than 10 Volts for 60 seconds.</p> <p>Inspect the connector and wires supplying power to the system.</p> <p>Replace the connector if damaged or corroded. Repair damaged wires.</p>
17	Low Oil Pressure Sensor Not Connected to ECM	<p>Digital input 3 (Engine run signal) is low and the engine has been detected running for more than 15 seconds and the alarm has been active for more than three seconds.</p> <p>Check the connection at the ECM. Replace the ECM if necessary.</p>
19	Filter Inlet Temp	<p>Filter Inlet Temperature is less than -100°C or more than 1100°C at any time.</p> <p>Inspect Filter Inlet Temperature Sensor (ESFIT). Refer to Section 3.6.2.</p> <p>Replace if necessary.</p>

Alarm	Name	Cause / Troubleshooting
20	Temp Sensor Drift	<p>One of the three temperature sensors differs more than +/-15°C from the average temperature of all the temperature sensors.</p> <p>Check the temperature value of all the temperature sensors using the ECM Service Tool. Refer to Section 4.5.</p> <p>Look for a temperature sensor that differs more than +/-15°C from the average temperature and replace that sensor.</p> <p>Temperature sensor drift is checked five hours after the ignition has been switched off.</p>
21	Frequent Regenerations	<p>The system is regenerating too frequently. The filter and DOC need to be checked and cleaned if necessary.</p> <p>The alarm is activated when the time measured between two regenerations started on back pressure gets below two hours.</p> <p>Alarm is cleared again when it is above two hours.</p>
33	AR No Temperature Rise	<p>The EES is in Start-up mode and did not reach regeneration mode three times in a row because of:</p> <ul style="list-style-type: none"> • Timeout in Start-up mode • Too low Filter Inlet Temperature • Too high Filter Outlet Temperature <p>Inspect EES components for proper functionality using manual regeneration. Refer to Section 4.3.</p> <p>Repair components as required.</p>
34	Check Fuel Pump Circuit	<p>Fuel Pump Current Draw is outside the acceptable range of 500 mA - 8.0 Amps when energized.</p> <p>Check fuel pump operation.</p> <p>Check fuse F15.</p> <p>Check the connector and wiring harness for damage or corrosion.</p> <p>Check the operation of the Fuel Pump with the ECM Service Tool. Refer to Section 4.2.</p>
35	Check Air Control Valve	<p>The feedback from the ACV position sensor does not correspond to the expected position.</p> <p>The ACV sensor output is less than ~140mV or the output is ~+/-205 mV away from the desired position for more than 15 seconds.</p> <p>Check fuse F15.</p> <p>Check the connector and wiring harness for damage or corrosion.</p> <p>Remove and physically inspect the valve for obstructions.</p> <p>Check the operation of the Air Control Valve (ACV) with the ECM Service Tool. Refer to Section 4.2.</p>
37	Check Fuel Injector Circuit	<p>Fuel Injector Current Draw is outside the acceptable range of 0.5 - 6.5 Amps when energized.</p> <p>Check fuel injector operation.</p> <p>Check fuse F15.</p> <p>Check the connector and wiring harness for damage or corrosion.</p> <p>Remove and physically inspect the injector for obstructions.</p> <p>Check the operation of the Fuel Injector with the ECM Service Tool. Refer to Section 4.2.</p>

Alarm	Name	Cause / Troubleshooting
38	System Over Temp	<p>Filter Outlet Temperature is more than 850°C during regeneration. In some rare cases regeneration may produce higher than expected temperatures leaving the DPF. This may be just after repairs with the back pressure still high. This indicates that there is excess soot in the DPF. In these cases, the EES will try to reduce temperatures by stopping fueling.</p> <p>If temperatures still exceed desired values, the unit will temporarily shut down to limit the burn rate of the soot.</p> <p>After about 15 minutes the unit will restart and regeneration will continue if needed.</p>
44	Filter Outlet Temp	<p>Filter Outlet Temperature is less than -100°C or more than 1100°C at any time.</p> <p>Inspect the Filter Outlet Temperature Sensor (ESFOT). Refer to Section 3.6.3.</p> <p>Check for exhaust leaks as this may indicate a leak in the system. Replace if necessary.</p>
45	Exhaust Inlet Temp	<p>Exhaust Inlet Temperature is less than -100°C or more than 1100°C at any time.</p> <p>Inspect the Exhaust Inlet Temperature Sensor (ESEIT). Refer to Section 3.6.1.</p> <p>Replace if necessary.</p>
53	ECM Output Failure	<p>ECM DO Current above 32A or output shorted to positive or negative supply or DO output circuits temperature above 125°C for more than two seconds. Check fuse F15.</p> <p>Perform a manual regeneration. Refer to Section 4.3.</p> <p>Replace the ECM if no outputs become energized.</p>
54	ECM Log Failure	<p>ECM is not able to log events.</p> <p>ECM internal data logger has failed.</p> <p>Replace the ECM.</p>
55	ECM Clock Failure	<p>ECM is not able to initialize.</p> <p>ECM internal clock has failed.</p> <p>Replace the ECM.</p>
62	ECM Temp Low	<p>ECM Temperature is less than -43°C.</p> <p>ECM internal temperature is below the accuracy threshold for the device.</p> <p>Allow the ECM to warm up.</p> <p>If alarm is not cleared after ECM is warmed above -38°C, replace the ECM.</p>
63	ECM Temp High	<p>ECM Temperature is more than 125°C.</p> <p>ECM internal temperature is above the accuracy threshold for the device.</p> <p>Allow the ECM to cool.</p> <p>If alarm is not cleared after ECM is cooled below 120°C, replace the ECM.</p>

5.2 Other Potential Failure Modes

- Cracked filter substrate
- Blocked Doser, lack of fuel supply, Doser problems
- Ruptured DPF housing or broken exhaust piping
- Excessive fuel and lube oil consumption

5.3 Troubleshooting with the EES Service Tool

During troubleshooting, individual EES components such as the fuel pump and Doser can be activated individually using the ECM Service Tool. The engine must be off and only one component can be energized at a time. Refer to [Section 4.2](#) for complete procedures.

Air Control Valve (ACV) - Press button once to activate ACV. It will go through one cycle. You should be able to hear the motor indicating that it is working.

Injector (Doser) - Press button once to activate and once more to shut off. You should hear a clicking noise indicating that it is working.

Fuel Pump - Press button once to activate and once more to shut off. You should be able to hear the pump motor indicating that it is working.

NOTE

Do not activate both the Doser and Fuel Pump at the same time. This will result in raw fuel being sprayed into the exhaust system.

5.4 Operation with 250 Hour Service Mode Alarm Active

If the unit has been operating with an active “250 Hour Service Mode” alarm, it means that the 250 hour window of continued operation has started and the timer is currently counting down. When the 250 hours is over, the generator set will shut down.

During this period, automatic regeneration, initiated by either BP or the regeneration timer will not be initiated, and BP will continue to rise. In cases where BP is below 120 in/H₂O (30kPa), a manual regeneration through the EES Diagnostic Tool will still be possible. If BP reaches 120 in/H₂O (30kPa), manual regeneration is no longer possible; the DPF will have to be removed and manually cleaned. Refer to the DPF Manual Cleaning procedure in [Section 6.4](#).

CAUTION

When back pressure is between 60 in/H₂O and 120 in/H₂O (15kPa and 30kPa), manual regeneration should only be initiated when the unit is running, and will continue to run in a Steady State (either high speed or low speed) for the entire regeneration process.

This may cause the unit to shut down and restart several times until the back pressure has reduced to 44 in/H₂O (11kPa). The alarm “EES System Overtemp” may display and self-clear after the unit is back to normal operation. It is recommend that as part of a repair after a prolonged “EES Service Required” event that the DPF be removed and manually cleaned.

SECTION 6

SERVICE

6.1 Engine Maintenance

When fitted with a EES, the engine should be maintained and serviced as per service recommendations in the RG15 Generator Set Operation and Service Manual (T-361).

6.2 EES Maintenance

Table 6-1 EES Maintenance

System	Operation
Every Service Interval or Yearly	
EES	Check the mounting straps and U-clamps for tightness or wear.
	Remove DPF module and clean filter to remove accumulated ash.
	Remove Fuel Injector (Doser), inspect and clean the injector nozzle and pipe.
Exhaust System	Check mounting hardware.
	Check all joint connections for any indications of leaks.
	Inspect exhaust pipes for damaged or missing insulation.

Maintenance and repair records must be maintained and submitted when requesting warranty for the EES. Records include maintenance history including engine hours, repair records including engine hours and any documented observations such as oil consumption trends, fuel consumption trends, and smoke emissions.

6.3 Service & Diagnostics

An illuminated service light, **Figure 6.1**, will indicate immediate service is needed. A unit with an illuminated service light will continue to operate for up to 250 hours in order to protect load and allow adequate time for delivery. After 250 hours, the unit will shut down until the EES is repaired.

Figure 6.1 Service Light



The ECM Service Tool is diagnostic software that can test the functionality of individual EES components initiate regeneration, display alarm codes, provide current sensor readings, retrieve data from the ECM and more. Further diagnosis with the ECM requires the following tools:

- ECM CAN Adapter: 07-00533-01
- ECM Service Tool software version 2.0.28.

Detailed information for ECM Service Tool instructions can be found in [Section 4](#).

6.4 DPF Manual Cleaning

During the EES preventative maintenance service, the DPF assembly should be removed and cleaned to remove all accumulated ash. Ash is considered a hazardous material and must be collected using either a commercially available cleaning system or using a vacuum with a HEPA filter.

Follow the ash handling guidelines as prescribed by CARB at: www.arb.ca.gov/diesel/tru/documents/ashguide.pdf.

Procedure:

1. Initiate a manual regeneration to oxidize accumulated diesel soot from the exhaust. Refer to [Section 4.3](#).
2. Shut down the engine and allow the DPF assembly to cool.
3. Disconnect the negative battery terminal and perform a lock-out / tag-out of the negative battery cable.
4. Remove the DPF module from the generator set.
5. Disassemble the DPF filter section and the DOC.
6. Remove ash from the DPF filter using either a commercially available cleaning system or a vacuum with a HEPA filter.
7. Using a new gasket (30-00510-63), reassemble the DPF filter section to the DOC. Tighten the v-clamp to specified torque. Refer to Installation Instructions for specified torques.
8. Reinstall the DPF assembly, with new inlet gasket, into the unit.
9. Properly align and tighten all clamps to specified torques. Refer to Installation Instructions for torques.
10. Remove lock-out / tag-out devices.
11. Reconnect negative battery cable to negative battery terminal.
12. Start the unit in Engine mode and initiate a regeneration. Check back pressure readings on the ECM Service Tool. Refer to [Section 4.5](#). If back pressure reading is higher than 120 in/H₂O (30 kPa), then the filter may require additional cleaning or possible replacement.
13. If back pressure reading is higher than 120 in/H₂O (30kPa), then filter may require additional cleaning, or possible replacement.

6.5 Carb Registration and System Labeling

The DPF needs to be registered with CARB using the ARBER website. At any point in time that the DOC is replaced in the EES, re-registration with CARD is required. When the Filter Assembly, including DOC and DPF, is installed, a CARB label is provided for each component (Refer to [Figure 6.2](#)). The CARB label will contain relevant information about filter substrate name, serial number and date of manufacture. The CARB label for DOC is placed on the DOC itself, but a duplicate is also provided to place on the generator set unit, on the front of the oil pan.

Figure 6.2 CARB Labels for DOC and DPF

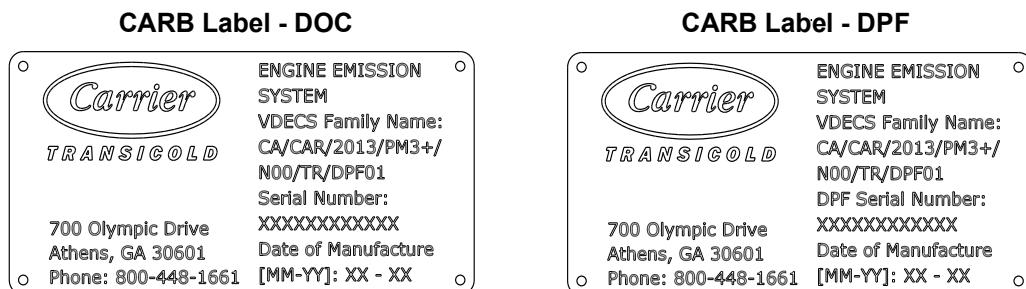


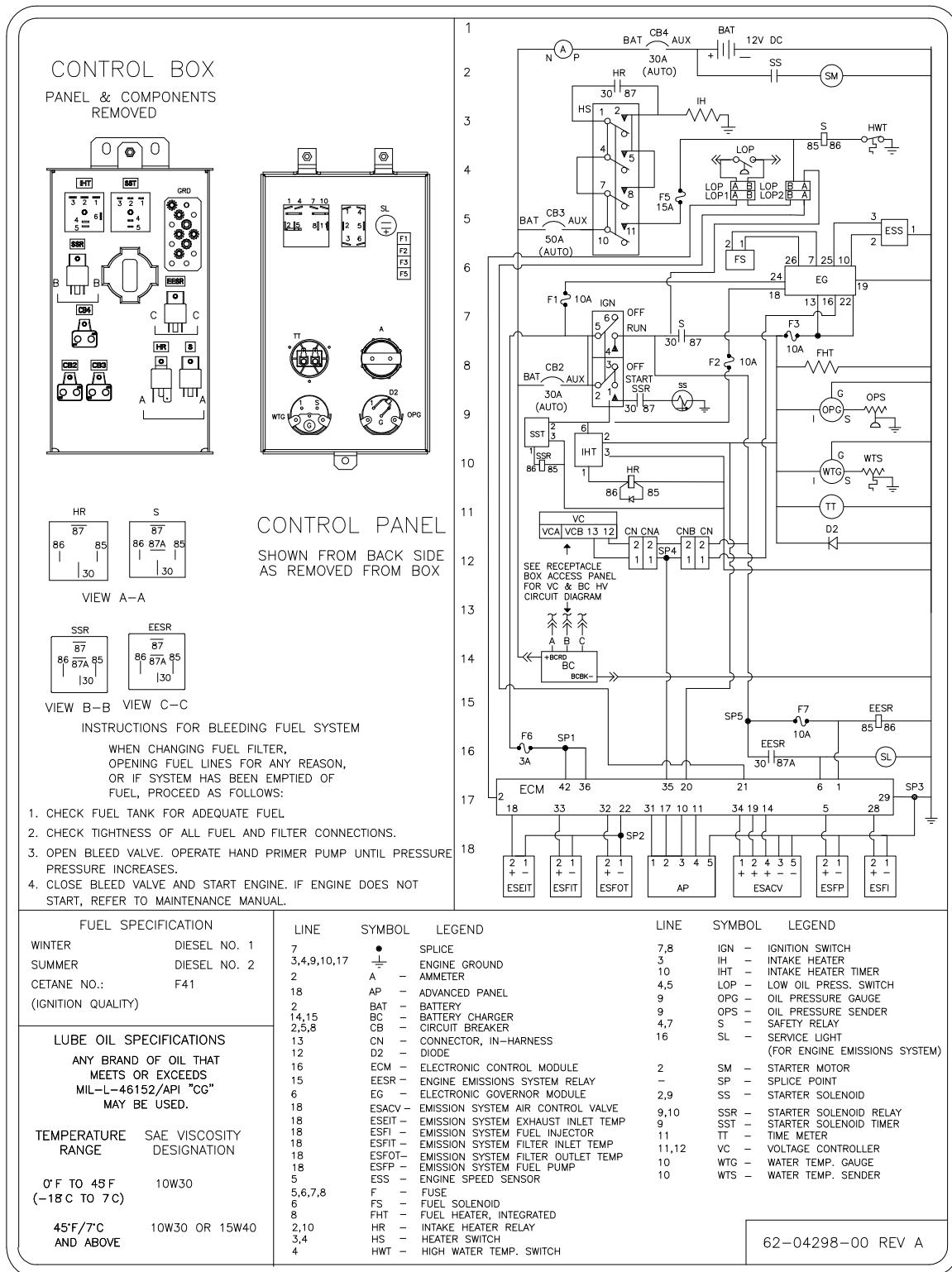
Figure 6.3 CARB Label Placement Location



SECTION 7

SCHEMATICS

Figure 7.1 Schematic



SECTION 8

PARTS

Table 8–1 Retrofit Kit #74-00326-00 for EES Field Installation

Item	Part Number	Description	Qty
1	76-00966-00	Unidrive Kit (see below)	1
2	76-00967-00	Exhaust Kit (see below)	1
3	76-00968-00	ACV Kit (see below)	1
4	76-00969-00	Coolant Kit (see below)	1
5	76-00970-00	Voltage Kit (see below)	1
6	76-00971-00	Fuel System Kit (see below)	1
7	76-00974-00	Control Box (see below)	1
8	44-60024-25	Sta-Strap	15
9	58-05100-00	Sta-Strap	25
10	22-04331-00	Clip, Push On	10
11	98-02736-00	Installation Instructions	1

Table 8–2 Unidrive Kit #76-00966-00

Item	Part Number	Description	Qty
1	86-04999-00	Weld Assembly	1
2	86-04171-01	Weld Assembly	1
3	44-01190-00	Cup, Snubber	1
4	73-00198-01	Shockmount	2
5	73-00175-05	Shockmount	2
6	73-00305-03	Shockmount	2
11	68-17518-00	Bracket	1
12	34-00655-08	Screw, Cap Hxhd	2
13	34-00663-11	Washer, Lock	2
14	34-06212-12	Washer, Plain	2
21	34-01151-08	Washer, Flat	2
22	34-01146-08	Washer, Lock	2
23	34-01145-06	Nut, Hex	2
24	34-00890-08	Washer, Special	1
25	--AA--06BZ-300	Screw, Cap Hxhd	1
26	34-00829-15	Washer, Plain	1
27	34-00667-15	Nut, Self Lock	1
28	34-00792-10	Screw, Cap Hxhd	4
29	34-00662-12	Washer, Plain	8
30	34-00667-12	Nut, Self Lock	4

Table 8-3 Exhaust Kit #76-00967-00

Item	Part Number	Description	Qty
1	86-05113-00	Bracket	1
2	86-05087-00	Bracket Assembly	1
3	86-05088-00	Bracket Assembly	1
4	30-00510-05	Filter Assembly	1
5	30-00552-00	Pipe, Flexible	1
6	30-00543-00	Pipe Assembly	1
8	12-00737-00	Sensor, Temperature	2
9	12-00740-00	Sensor, Temperature	1
10	30-00514-01	Washer	1
11	44-00486-01	Clamp	2
12	44-00485-01	Clamp	1
13	30-00427-00	Clamp, U-Bolt	1
14	68-19083-00	Plate, Nut	1
20	34-00964-00	Stud	2
21	34-00666-13	Nut, Hex	2
40	34-00655-08	Screw, Cap Hxhd	4
41	34-00663-11	Washer, Lock	4
42	34-06212-12	Washer, Plain	4
50	34-00807-08	Screw, Cap Hxhd	6
51	34-00807-12	Screw, Cap Hxhd	2
52	34-00663-13	Washer, Lock	8
53	66-U---1--5321-5	Washer, Plain	10
54	34-01324-13	Nut, Flanged	2
60	42-00697-00	Insulation	1
61	42-00698-00	Insulation	1
62	34-06317-00	Wire Tie	4
63	62-02972-00	Label	1

Table 8-4 Air Control Valve (ACV) Kit #76-00968-00

Item	Part Number	Description	Qty
1	48-00520-00	Plate, Adapter	1
2	12-00736-00	Valve	1
3	62-11908-00	Label	1
14	34-00655-18	Screw, Cap Hxhd	2
15	34-00655-14	Screw, Cap Hxhd	1
16	34-00663-11	Washer, Lock	3
17	34-00662-11	Washer, Plain	3

Table 8-5 Coolant Kit #76-00969-00

Item	Part Number	Description	Qty
1	58-05022-00	Hose, Formed	1
2	58-05021-00	Hose, Formed	1
3	58-00658-27	Hose, Fuel	1
4	58-00658-23	Hose, Fuel	1
5	30-00499-01	Valve Assembly	1
11	40-00727-00	Tee Assembly	1
12	40-00739-00	Fitting, Hose	2
13	40-00121-01	Bushing	2
14	40-00107-02	Tee	1
15	40-00771-00	Nipple, Hex	1
16	40-60026-03	Fitting	2
21	30-60055-05	Bolt, Banjo	2
22	42-60025-00	Seal	4
31	--KA--69JM-824	Clamp, Hose	2
32	44-00045-25	Clamp, Hose	4

Table 8-6 Voltage Kit #76-00970-00

Item	Part Number	Description	Qty
1	68-17703-00	Bracket	1
2	12-00718-04	Module	1
5	40-00761-00	Connector, Male	1
6	56-09293-00	Tube	1
7	58-04184-08	Hose, Fuel	1
11	66-U---1--5371-7	Screw, Mach Hxhd	4
12	66-U---1--5331-3	Washer, Lock	4
13	34-00829-09	Washer, Plain	4
15	34-00655-08	Screw, Cap Hxhd	4
16	34-00663-11	Washer, Lock	4
17	34-06212-12	Washer, Plain	8
20	44-00045-25	Clamp, Hose	2
21	58-00079-02	Sta-Strap	1

Table 8-7 Fuel System Kit #76-00971-00

Item	Part Number	Description	Qty
1	68-17702-00	Bracket	1
2	68-18487-00	Bracket	1
3	68-18488-00	Bracket	1
4	68-18504-00	Bracket	1
5	68-18505-00	Bracket	1
6	86-04808-00	Bracket Assembly	1
12	30-00531-00	Filter	1

Table 8-7 Fuel System Kit #76-00971-00

Item	Part Number	Description	Qty
13	30-00532-01	Pump, Fuel	1
21	40-00756-00	Fitting	1
22	40-00785-00	Fitting	1
23	40-00786-00	Fitting	1
24	40-00787-00	Fitting	1
25	40-00788-00	Fitting	1
30	34-00655-14	Screw, Cap Hxhd	1
31	34-00655-04	Screw, Cap Hxhd	4
32	34-00663-11	Washer, Lock	7
33	34-06212-12	Washer, Plain	7
34	34-00807-08	Screw, Cap Hxhd	2
35	34-00663-13	Washer, Lock	2
36	34-00829-13	Washer, Plain	2
37	66-U---1--5371-7	Screw, Mach Hxhd	4
38	66-U---1--5331-3	Washer, Lock	4
39	66-U---1--5321-8	Washer, Plain	4
41	79-04041-00	Hose Assembly	1
44	58-00659-06	Hose, Fuel	1
45	58-00658-15	Hose, Fuel	1
47	58-00658-28	Hose, Fuel	1
48	58-00848-22	Tube, Slit	1
61	44-00045-25	Clamp, Hose	10
62	44-00102-02	Clamp, Cushioned	2
72	58-05100-00	Sta-Strap	8

Table 8-8 Control Box Kit #76-00974-00

Item	Part Number	Description	Qty
1	22-04332-00	Wire Harness	1
2	62-10530-44	Label	1
3	62-04302-00	Label	1
4	62-04298-00	Label, Schematic	1
5	10-00286-18	Relay	1
6	22-00049-00	Lamp	1
7	22-00518-01	Base	1
8	22-00519-03	Jewel Assembly	1
10	34-00996-08	Screw, Hx Washhd	1
11	66-U---1--5321-2	Washer, Plain	2
12	34-00667-08	Nut, Self Lock	1
13	34-01153-15	Screw, Cap Hxhd	2
14	34-01146-08	Washer, Lock	2
15	34-01151-08	Washer, Flat	2

Table 8-8 Control Box Kit #76-00974-00

Item	Part Number	Description	Qty
16	34-00655-06	Screw, Cap Hxhd	1
17	34-00663-11	Washer, Lock	1
18	34-06212-12	Washer, Plain	1
20	44-00102-01	Clamp, Cushioned	2
21	44-00102-18	Clamp, Cushioned	2
22	34-00373-59	Clamp, Tube	1
25	44-60150-00	Clip, Harn Rtnr	2
26	44-60150-03	Clip, Harn Rtnr	2
27	58-01428-00	Sta-Strap	2

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Numerics

10-00286-18	8-4	34-06317-00	8-2
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**WARNING**

Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

- Always start and operate the engine in a well-ventilated area.
- If in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system.
- Do not idle the engine except as necessary.

For more information, go to
p65warnings.ca.gov/products/diesel