ATTENTION:
Keep a copy of this Owner’s Manual in the equipment cab.

The instructions, specifications, and recommendations in this manual are based on current information when this manual was released. ESW CleanTech, Inc. reserves the right to make changes at any time without obligation. If you find differences between your system and the information in this manual, contact your ESW CleanTech distributor or call ESW CleanTech at 1-800-398-6105.

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# ESW CleanTech Phoenix® Owner’s Manual

## Table of Contents

### General Information
- Cautions ........................................................................................................... 2
- Safety Warnings ................................................................................................. 2
- Owner’s Legal Obligations .................................................................................. 3
- Contact Information .......................................................................................... 3
- Installation ........................................................................................................... 4
- Engine Repower .................................................................................................. 4
- Acronyms ............................................................................................................. 5

### Phoenix System Description
- Product Summary .............................................................................................. 6
- PM Filter Assembly .............................................................................................. 7
- Control System ..................................................................................................... 8
- Regeneration System ........................................................................................... 9
- Low-Voltage Switch (Optional) .......................................................................... 10
- CARB-Verification Labels .................................................................................. 12

### Operations
- Pay Attention to the System, Engine and Equipment ....................................... 13
- Regenerating the Phoenix .................................................................................. 14
- Operator Interface Module .................................................................................. 14
- Conditions That May Damage the Phoenix ....................................................... 15

### Maintenance and Repair
- Your Right to Maintenance Information ........................................................... 19
- The Importance of Engine Maintenance ........................................................... 19
- The Importance of Properly Maintaining a Diesel Emission Control Strategy ... 19
- Maintenance Schedule ....................................................................................... 20
- Preventative Maintenance Labor and Parts ....................................................... 20
- Service Calls ........................................................................................................ 21
- Parts List .............................................................................................................. 22
- Troubleshooting .................................................................................................. 23
- Repair and Maintenance Clarifications .............................................................. 24
- Engine Oil Consumption and Lube Oil Ash ......................................................... 25

### Specifications ................................................................................................... 29

### Owner’s Obligations .......................................................................................... 32

### Warranty
- Product Warranty ............................................................................................... 34
- Installation Warranty ........................................................................................... 35
- ESW CleanTech Warranty Clarifications ............................................................ 36

### CARB Executive Order for the Phoenix ........................................................... 37
GENERAL INFORMATION
Cautions
Please study this manual and understand the requirements for the ESW CleanTech Phoenix system before operating your machine.

The pictures and descriptions in this manual are for a typical Phoenix system. Some parts, components and configurations for your particular system may vary from those shown here depending on the machine and application.

The use of parts which are materially different than the verified retrofit parts or systems may void the verification and the warranty.

The owner's obligations, routine observations and periodic maintenance requirements are described in this manual. Contact an ESW CleanTech distributor for further assistance.

Safety Warnings

- Before starting regeneration, park the machine on level ground in a well ventilated location far away from any combustible material. Turn the engine off. Do not regenerate indoors.
- The system may be hot when not normally expected:
  - Caution: The Phoenix emits hot exhaust gases during regeneration.
  - During regeneration, the engine will be off, but the Phoenix (including the downstream pipes) will be very hot.
  - The PM filter stays hotter much longer than a stock muffler will after operating under heavy load, after the engine is turned off, and after a completed regeneration cycle.
- Do not touch any of the PM filter assembly components or exhaust tubing during regeneration or after engine operation. All surfaces can become hot and may cause burns.
- After operating under heavy load, be very careful about operating or idling near any combustible material such as dry grass or trash. The PM filter retains heat much longer than a muffler which makes it possible for very hot exhaust gases to exit the tailpipe for several minutes (after the high-load operation) and be a potential source of ignition for any combustible material.
- Do not allow combustible material from the working environment to come in contact with the Phoenix (for example, paper, trash, sawdust).
- Inspect regularly for any fuel leaks. If any are found, contact your distributor immediately for further assistance.
- Be sure the Phoenix heat shield panels are in place. If any are missing, contact an ESW CleanTech-authorized distributor as soon as possible for service.
**Owner’s Legal Obligations**

Use of any alternative diesel fuels and or fuel additives not specifically listed in the CARB verification Executive Order (E.O.) is illegal and strictly prohibited. Operating with an unapproved alternative diesel fuel or fuel additive violates the E.O., negates the verification for that equipment, and removes compliance status for the equipment. The end-user must meet all other requirements in the E.O. for the Phoenix which is provided in this manual beginning on page 37. The E.O. for the Phoenix may also be obtained from the CARB website at http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm.

The installation of the Phoenix is based on the owner’s understanding that adding a new part to or altering an original part of a certified configuration could be considered a violation of the tampering prohibition of the Clean Air Act. The owner understands that the installation of the Phoenix will not violate tampering provisions of the Act, at the time of installation, because of the testing performed under the verification process—provided that the owner adheres to all installation instructions and meets all operating and maintenance requirements for the Phoenix.

- **Specific events that require action by the owner or operator** are given in the “Owner’s Obligations” section on page 32.
- **If any of these events occur**, it is the owner’s obligation to take the appropriate action. Failure to do so may be the basis for denying a warranty claim.

**Contact Information**

Contact an ESW CleanTech-authorized distributor for any sales or service support for your Phoenix system. The tables below for contact information are provided for the customer to complete at their convenience. For more information, contact your local ESW CleanTech product support representative, call ESW CleanTech at 1-800-398-6105, or visit www.eswgroup.com.

<table>
<thead>
<tr>
<th>Distributor</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td></td>
</tr>
<tr>
<td>Contact person</td>
<td></td>
</tr>
<tr>
<td>Contact person’s phone</td>
<td></td>
</tr>
<tr>
<td>Contact person’s fax</td>
<td></td>
</tr>
<tr>
<td>Contact person’s email</td>
<td></td>
</tr>
</tbody>
</table>
Name of local ESW CleanTech product support representative

Local ESW CleanTech representative’s phone

Local ESW CleanTech representative’s email

**Installation**

ESW CleanTech recommends that an ESW CleanTech-authorized technician installs the Phoenix system. The complete installation procedures are described in the *Phoenix Installation Manual*. Copies of the manual are available upon request from your distributor. The installation warranty (page 36) is the responsibility of the distributor that installs the Phoenix system.

**Attention:**

An ESW CleanTech-certified technician must commission the system; otherwise, that may be the basis for denying a warranty claim.

Warranty registration is submitted by the ESW CleanTech-authorized distributor.

**Engine Repower**

A DECS installed on a vehicle that is repowered may remain installed provided:

- The replacement engine meets all the terms and conditions of the governing Executive Order or conditional verification letter,
- The DECS is not more than ten years old (based on the date of manufacture), and
- The appropriate DECS engine label is affixed to the replacement engine in a visible location.
**Acronyms**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BP</td>
<td>backpressure</td>
</tr>
<tr>
<td>CARB</td>
<td>California Air Resources Board</td>
</tr>
<tr>
<td>CO</td>
<td>carbon monoxide</td>
</tr>
<tr>
<td>DECS</td>
<td>Diesel Emissions Control System</td>
</tr>
<tr>
<td>DPF</td>
<td>diesel particulate filter</td>
</tr>
<tr>
<td>EFC</td>
<td>exhaust flow conditioner</td>
</tr>
<tr>
<td>HC</td>
<td>hydrocarbons</td>
</tr>
<tr>
<td>LED</td>
<td>light emitting diode (system indicator light)</td>
</tr>
<tr>
<td>MLC</td>
<td>the electronic controller in the Phoenix system</td>
</tr>
<tr>
<td>MLinC</td>
<td>the software program used to communicate with the MLC</td>
</tr>
<tr>
<td>OEM</td>
<td>original equipment manufacturer</td>
</tr>
<tr>
<td>PM</td>
<td>particulate matter (diesel soot)</td>
</tr>
<tr>
<td>TC</td>
<td>thermocouple</td>
</tr>
<tr>
<td>ULSD</td>
<td>ultra-low sulfur diesel fuel</td>
</tr>
<tr>
<td>VDC</td>
<td>volts direct current</td>
</tr>
</tbody>
</table>
PHOENIX SYSTEM DESCRIPTION
**Product Summary**

The Phoenix has been verified by the California Air Resources Board to capture over 85% of the particulate matter (PM) from diesel engine exhaust ("Level 3 plus"). Features include:

- Stainless steel construction
- Rugged silicon carbide diesel particulate matter filter (PM filter)
- Modular design to facilitate installation, service and maintenance
- Filter regeneration when the equipment is parked and the engine is off (a complete regeneration cycle takes approximately 2 hours)
- ESW CleanTech MLC (the system controller)
- Sound attenuation eliminating the need for a muffler or silencer

The Phoenix (Figure 1) consists of three main subsystems: the PM filter assembly, the control system, and the regeneration system:

- The PM filter captures over 85% of the particulate matter (soot) from the diesel engine exhaust while the equipment is operating.
- The control system monitors the Phoenix and engine during operation and controls the regeneration cycle, which cleans out the PM filter.
- The regeneration system operates while the machine is parked, engine is off, and the operator has started regeneration in response to the flashing amber light. The complete regeneration cycle takes approximately 2 hours.

![Figure 1: Phoenix system schematic drawing.](image-url)
**PM Filter Assembly**

The PM filter assembly (Figure 2) is the core of the Phoenix system and it usually will replace the muffler. The assembly has important features listed below:

![PM Filter Assembly Diagram](image)

**Figure 2: PM Filter Assembly.**

ESW CleanTech provides a mounting assembly specifically designed for the Phoenix. Although the PM filter assembly replaces the stock muffler, it is important to note that the PM filter assembly is heavier than a typical muffler.

The PM filter includes ceramic materials; its care and handling require the following:

1. Do not drop or hammer.
2. Use appropriate equipment when lifting.
3. Protect from water intrusion.
4. Protect from accidental impacts.
5. Do not weld.
6. Protect flanges during transport (use the foam shipping covers).

**Attention: Handle with care!**

*The PM filter assembly creates backpressure on the engine*

In the process of removing over 85% of the soot and ash from the exhaust, the PM filter creates backpressure on the engine. At times, the backpressure from the PM filter (and Phoenix system as a whole) may be higher than the backpressure caused by a muffler. The actual amount of backpressure from the Phoenix varies instantaneously depending on the engine speed and load and the soot and ash loading in the PM filter. The regeneration process removes the carbonaceous part of the soot and thereby lowers the backpressure.
Control System
The MLC and some electrical components are housed in the Controls Box. The MLC monitors engine conditions and the Phoenix when the engine is operating. The MLC also continually logs operating data and records instances of unusual conditions. The MLC controls the regeneration cycle and it controls the system indicator lights (see Figure 3, also referred to as the LED’s). The MLC turns on the flashing amber light to alert the operator when regeneration is required.

Figure 3: Operator Interface Module.

The installing distributor will have installed the Operator Interface Module in a clearly visible and accessible location. The operator should look at the lights daily and respond accordingly: the meaning of each light and the appropriate actions for the operator to take are described in the “Operations” section of this manual starting on page 13.

If the operator neglects to regenerate the Phoenix, the MLC will turn on a flashing red light. At this point, the operator may experience a loss of power from the engine. The flashing red light indicates that the PM filter is well past due for regeneration. Further prolonged operation could damage the emission control system and engine exhaust components. The driver or operator should respond to a flashing red light according to the detailed explanation given in the “Red Light – Flashing” section on page 17.
**Regeneration System**

The regeneration system cleans out the PM filter. It consists of a fuel burner module and an air blower. Over a controlled cycle, heat and air are provided to the PM filter to oxidize the collected soot. The burner module (Figure 4) provides heat and the Blower Box (Figure 5) provides air. The regeneration process is controlled by the MLC.

**Before starting a regeneration**

Before starting regeneration, the machine must be parked on level ground in a well ventilated area far away from any combustible material and the engine must be off. Battery chargers must not be connected during regeneration. If parked underneath an overhead structure, there must be good air circulation and at least 18 inches of vertical clearance above the stack (Figure 6). Also, in cold weather, ESW CleanTech recommends starting regeneration soon after the engine is turned off so the fuel is still warm. After the operator pushes the start button (see Figure 7), the MLC powers the blower and ignites the burner to start the regeneration process.
**Typical regeneration cycle**

During regeneration, the blower moves the hot air from the burner through the PM filter causing the collected soot to oxidize. The burner turns off after approximately 75 minutes. The blower continues to run several minutes to cool down the burner. The PM filter will remain hot for several hours. A complete regeneration cycle takes approximately 2 hours.

**Elapsed time between regenerations**

Typically, the vehicle or equipment will operate approximately 8 to 32 hours between regeneration requests. The actual elapsed engine-on time between regenerations will depend on many factors including engine model, maintenance condition, engine load pattern, and operator behavior.

**Regeneration-on-demand option**

With the regeneration-on-demand option activated in the MLC, the operator may regenerate the system any time they want by pushing the start button; in this case, the amber LED does not have to be flashing in order to initiate regeneration. Operators use this feature when they want to ensure they have a soot-free filter, such as before starting a mission-critical trip.

Whether or not to activate the regeneration-on-demand feature is the customer’s preference. The option is not activated in the factory setting for the MLC. A trained technician using the MLinC program can activate the regeneration-on-demand option in the MLC.

**Do not start engine during regeneration; if engine is needed, do a controlled shutdown**

Starting the engine before the full two hours have elapsed may damage the PM filter. If the engine needs to be started before the regeneration has finished, then push and hold the regeneration start button for 5 seconds. This will stop the regeneration and allow the system to safely go through a controlled shutdown. After the system has finished the controlled shutdown (the blower will be off), the engine may be started without damaging the PM filter.

**Attention:**

⚠️ Damage to the PM filter caused by starting the engine during the regeneration cycle may be the basis for denying a warranty claim.

**Fuel pump may turn on and off at the start of regeneration**

During the first 7 minutes of burner operation, there may be periods when the fuel pump shuts off for a few seconds, then comes back on for a short time, then turns off again, and so on. Do not be alarmed if you hear the fuel pump turn off for short periods of time. Similarly, you may hear the glow plug relay click on and off repeatedly at the very start of regeneration.

**If burner fails to light**

If the burner fails to light, the red LED will turn on solid after a few minutes alerting the operator to push the button again. If the burner fails to light after repeated attempts, the amber LED will turn on solid indicating that service is required.
Low-Voltage Switch (Optional)

A low-voltage switch (Figure 8) is an option for the Phoenix for equipment that is operated intermittently. It is designed to disconnect power to the MLC in the event voltage drops to a set point. Once the engine is started, the low-voltage switch automatically resets and restores power to the MLC and Phoenix system.

Figure 8: Low-voltage switch.

CARB-Verification Labels

The Phoenix is provided with two CARB-verification labels. One is installed on the engine (see Figure 9) and the other one is attached to the wiring harness at the Phoenix’s Controls Box (Figure 10). If either label is missing, order replacements from an ESW CleanTech-authorized distributor. Be sure to order the correct label for your application (see the table below the pictures).

Figure 9: Example of CARB-verification label installed on engine.

Figure 10: CARB-verification label attached to wiring harness at Controls Box.

<table>
<thead>
<tr>
<th>Product</th>
<th>Application</th>
<th>Verification Family Name</th>
<th>Label Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phoenix</td>
<td>Off-road</td>
<td>CA/ECT/2009/PM3+/-N00/OF/DPF01</td>
<td>CUH-2401-1K</td>
</tr>
</tbody>
</table>

Product Application Verification Family Name Label Part Number
Phoenix Off-road CA/ECT/2009/PM3+/-N00/OF/DPF01 CUH-2401-1K
OPERATIONS
Pay Attention to the System, Engine and Equipment

The owner or operator should observe the Phoenix, engine and machine’s operation on a regular basis. See the “Operator Interface Module” section on page 15 for a detailed description of each light’s meaning and the appropriate response. Use the Troubleshooting (page 24) if you suspect the engine, Phoenix are not operating properly. Contact an ESW CleanTech-authorized distributor (or a properly trained technician under the owner’s control) when needed.

1. The operator or the owner’s technician should observe the green, amber and red lights before starting the engine and on a daily basis.

2. During engine operation, there should not be soot emissions from the Phoenix clamps or tailpipe. Notify an ESW CleanTech-authorized distributor (or the owner’s technician) if any unusual exhaust emissions are observed.

3. Periodically inspect the exhaust system for integrity. Note anything abnormal and make repairs as warranted. For vertical exhaust stacks, make sure the turn out stack or rain cap is in place and functioning properly. Contact an ESW CleanTech-authorized distributor as needed.

4. Periodically inspect the Phoenix fuel system for any leaks and for integrity. Make a note of anything abnormal and make repairs as needed. Contact an ESW CleanTech-authorized technician as needed.

5. Be sure the Phoenix heat shield panels are in place. If any are missing, contact an ESW CleanTech-authorized distributor as soon as possible for service.

Regenerating the Phoenix

The regeneration system is described in detail on page 10.

1. If the amber LED is flashing, the Phoenix needs to be regenerated.

2. At the end of the shift, park the machine on level ground, and turn the engine off.
   
   Reminders: park in a well ventilated area far from any combustible material and battery chargers should not be connected during regeneration.

3. Push the regeneration start button and hold for 5 seconds.
   
   Reminder: in cold weather, start the regeneration soon after the engine is turned off so the fuel is still warm.

4. The green LED should start flashing (and will continue to flash during regeneration).

5. Do not start the engine for at least 2 hours; allow the regeneration process to finish.
   
   Reminder: starting the engine too soon could damage the PM filter.

The green light on solid and the amber and red lights off indicate that the regeneration was successful. In this case, you may operate the equipment normally.
If the burner failed to start, the red LED will be on solid and the operator should push the regeneration start button again. If the burner fails to light after repeated attempts, the amber light will turn on solid. If the amber is on solid, contact a properly trained technician for service.

**Operator Interface Module**

The operator must observe the indicator lights on the Operator Interface Module (see Figure 11) before starting the engine and on a regular basis. The operator also must respond as needed. Note: all the LED’s will turn on briefly when the engine is first started. This allows a simple way for the operator to verify that all the lights are working.

![Operator Interface Module]

The label placed next to the lights (Figure 11) provides a brief description of each light’s meaning.

The light meanings are summarized in the table below (and are explained in greater detail after the table).

---

**Figure 11: Operator Interface Module.**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Meaning</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Green LED is off (while engine is on)</td>
<td>Phoenix needs service</td>
<td>Contact an ESW CleanTech-authorized distributor for service.</td>
</tr>
<tr>
<td>2. Green LED is on solid</td>
<td>MLC is on</td>
<td>No action required (unless indicated by the other lights).</td>
</tr>
<tr>
<td>3. Green LED flashing</td>
<td>Regeneration is in progress</td>
<td>Make sure engine is off. (Stay away from hot surfaces.)</td>
</tr>
<tr>
<td>4. Amber LED flashing</td>
<td>Phoenix needs to be regenerated</td>
<td>At the end of the shift, turn the engine off, push the regeneration start button (and confirm that the burner ignites).</td>
</tr>
<tr>
<td>5. Amber LED on solid</td>
<td>Phoenix needs service</td>
<td>Contact an ESW CleanTech-authorized distributor for service.</td>
</tr>
<tr>
<td>6. Red LED flashing</td>
<td>Phoenix is past due for regeneration</td>
<td>Follow the “Red Light – Flashing” instructions on page 17.</td>
</tr>
<tr>
<td>7. Red LED on solid</td>
<td>Burner did not ignite.</td>
<td>Push regeneration start button again.</td>
</tr>
</tbody>
</table>

---
Green Light Must Be ON While the Engine Is Operating
If the green light is off, there is likely no power to the Phoenix system. If there is a power disconnect, low-voltage switch or circuit breaker installed, check it. Contact an ESW CleanTech-authorized distributor for service if needed.

Green Light – Flashing
A flashing green light means regeneration is in progress and the engine must stay off.

CAUTION:
A flashing green light indicates that the system is regenerating and the Phoenix is hot.

Amber Light – Flashing
If the amber light starts flashing, then the Phoenix needs to be regenerated at the end of the shift. Engine must be off. The complete regeneration process takes 2 hours.

ATTENTION:
A flashing amber light means that the Phoenix needs to be regenerated (push regeneration start button). Engine must be off.

Amber Light – On Solid
A solid amber light indicates a broken sensor, disconnected sensor or system fault. Contact an ESW CleanTech-authorized distributor (or a properly trained technician under the owner’s control) as soon as practical.

ATTENTION:
A solid amber light indicates that service is required.
Verify that all the wiring harness connections are properly attached. If the amber light stays on, have the system serviced as soon as possible. For some faults, the solid amber light can only be turned off by connecting the service computer to the MLC and performing software operations with the MLinC program.

The amber light will turn on solid for a few seconds after the engine starts. This allows the operator to confirm that the LED itself is good.

Red Light – Solid
If the burner fails to ignite, the red light will turn on solid after a few minutes alerting the operator to push the button again. If the burner fails to ignite after repeated attempts, the amber light will turn on solid indicating that service is required before operating the engine.
In rare instances, a solid red light (with the green light off) indicates that the MLC is damaged. Contact an ESW CleanTech-authorized distributor (or a properly trained technician under the owner’s control) as soon as practical.

**Red Light – Flashing**
A flashing red light alerts the operator that the Phoenix is past due for regeneration. This condition may be caused by, but not limited to, excess diesel fuel, soot, engine lube oil, residual ash or foreign material in the exhaust system.

**ATTENTION:**
A flashing red light means that the Phoenix is past due for regeneration. Warranty coverage may be denied due to neglect.

If the red light is flashing, it could also be an indicator of another failure in the system or engine such as a fuel injector failure. Alternatively, the flashing red light may have come on because the operator did not respond to the amber light (flashing or solid) in a timely manner. Ignoring the amber light (flashing or solid) to the point that the flashing red light comes on may be grounds for denying a warranty claim.

If the red light starts flashing, failure to regenerate the Phoenix immediately may result in engine or Phoenix damage. If not regenerated immediately, the engine, exhaust system and Phoenix should be inspected for damage and repairs made as needed before the machine is put back into use. Continuing to operate the engine with a flashing red light may result in damage to the engine, exhaust system, or Phoenix and may be the basis for denying a warranty claim.
Conditions That May Damage the Phoenix

The operator should be aware of conditions that could result in damage or failure of the PM filter assembly or other parts of the system. If any of these events occur, it is the owner’s responsibility to have the Phoenix inspected and, if necessary, repaired.

![Warning]

See the owner’s legal requirements under the Clean Air Act and CARB regulations in the “Owner’s Legal Obligations” section on page 3.

Mechanical damage can occur if any system component is mishandled or accidentally impacted. The glow plug may be damaged if a battery charger is connected during regeneration. Internal damage to the PM filter assembly can occur from various forms of engine failure such as losing a turbo or head gasket. These events would cause foreign debris to enter the exhaust gas and then impact the PM filter assembly, likely causing some damage. Furthermore, losing a turbo, a failed injector, or a major oil leak could result in excessively high temperatures in the PM filter. If the engine loses the turbo, the driver should pull off the road to a safe location as soon as possible and shut the engine off.

Engine oil consumption has an impact on the operation and maintenance of the Phoenix. If engine oil consumption exceeds the engine manufacturer’s specification, the engine should be repaired. Failure to do so may damage the Phoenix and may be the basis for denying a warranty claim. High oil consumption will increase the rate of ash accumulation in the PM filter and will lead to more frequent maintenance. The “Engine Oil Consumption and Lube Oil Ash” section on page 27 explains the impacts of oil consumption and ash content on the operations and maintenance of the system.

Power washing the equipment should not be a problem for the PM filter assembly or Phoenix system. Avoid pointing the high-power wash at any Phoenix system components or connectors. However, depending on the power washing technique, it may be possible to loosen an electrical connector. If a connector comes loose, the amber LED might turn on. If the amber light comes on, follow the procedures in the Troubleshooting (page 24).

Turn out stacks or rain caps are required on vertical stacks to avoid water intrusion. Be sure the turn out or rain cap is in place and functioning properly. It is important that water does not enter the exhaust pipe where it could migrate to the PM filter. Avoid low hanging branches or other obstacles that could knock off the rain cap.
MAINTENANCE AND REPAIR
Your Right to Maintenance Information

The Air Resources Board requires that ESW CleanTech 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 ESW CleanTech at 1-800-398-6105.

The 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.

The 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.

Maintenance Schedule

ESW CleanTech recommends that an ESW CleanTech-authorized technician or a properly trained technician under the owner’s control perform the maintenance and repair of a Phoenix. Preventative maintenance is required once a year or every 2,000 hours (whichever comes first) to ensure that the system is maintained in good operating condition; however, the DPF may require cleaning more often than that depending on the engine’s oil consumption rate. See the “Engine Oil Consumption and Lube Oil Ash” section on page 27 for more information.

The owner is legally required to keep the Phoenix in good operating condition in order to comply with the Clean Air Act and CARB regulations (for systems operating in California). See the “Owner’s Legal Obligations” section on page 3.

Failure to have the preventative maintenance performed may be the basis for denying a warranty claim. Maintenance or repairs done by anyone other than an ESW CleanTech-authorized technician is the responsibility of the person or organization performing the work. The cost of parts and labor for preventative maintenance are not included in the purchase price of the Phoenix system. The parts and labor included in preventative maintenance are listed in the “Preventative Maintenance Labor and Parts” section below.
Preventative Maintenance Labor and Parts

The preventative maintenance by an ESW CleanTech-authorized technician includes:

- Inspect the Controls Box and components.
- Download data from the MLC and review the Instant Report.
- Confirm the system indicator lights are functioning properly.
- Inspect the Blower Box and components. Replace the air filter.
- Inspect the check valve and air-supply hose.
- Inspect and clean the burner module.
- Inspect the fuel metering pump and fuel filter. Replace filter if dirty. If the fuel filter is dirty, inspect the fuel in the tank and the fuel tank pick-up filter and replace it if it is dirty.
- Test solenoid valve and clean.
- Inspect the BP sensor and sensor breather. Clean out BP tubing and ports.
- Inspect and clean the DPF.
- Inspect exhaust tubing.
- Reinstall the PM filter assembly and confirm it is properly mounted.
- Inspect the sensors and wiring harness.
- Upgrade the MLC program if necessary.
- Check CARB-verification labels.
- Make repairs (if any of the above inspections showed repairs are needed).
- Perform comprehensive tests of the system’s operations.

PM Filter Maintenance

It may be necessary to periodically clean the PM filter (in addition to the cleaning during preventative maintenance) depending on the machine’s driving cycle and the ash content of the diesel fuel and lube oil. The collection of inorganic ash results in an increase in backpressure from the PM filter over time. If ash in the PM filter results in high backpressure then the amber light will flash. If the light begins flashing soon after regeneration, then it is likely that the PM filter has become loaded with ash and will need cleaning. Note: higher than normal oil consumption will increase the rate of ash accumulation in the PM filter, and thus may require more frequent maintenance.

ESW CleanTech recommends the use of low-ash engine oils (CJ-4 oil). These products have been specifically designed for use with a PM filter, and can significantly reduce the buildup of ash in the PM filter and extend the filter cleaning interval. See the “Engine Oil Consumption and Lube Oil Ash” section on page 27.

An ESW CleanTech-authorized distributor can clean the PM filter. They also will ensure that the collected material (ash and soot) is properly disposed in accordance with all applicable Federal, State and local laws governing waste disposal.
The PM filter is designed to process exhaust flow in only one direction. If the PM filter is removed for cleaning, be sure it is reinstalled in the proper flow direction as indicated by the arrow on the part tag (Figure 12).

![Part: CJF-203-B-PX Serial: 000000](image)

**Figure 12:** PM Filter (DPF) part tag and flow arrow.

**Exhaust Tubing and Components**
All tubing connections between the engine and the PM filter assembly should be gas-tight and leak-free. Also, all tubing between the engine and PM filter assembly must be in good condition. This requirement includes any other components such as exhaust brakes. Aluminized mild steel tubing or rusty tubing could flake off into the exhaust stream. If flaking occurs, the PM filter may plug, resulting in high backpressure and engine power loss. ESW CleanTech recommends stainless steel tubing between the turbo and the PM filter assembly. It is the engine owner or operator’s responsibility to ensure that all tubing in this critical area be maintained in good condition.

**Service Calls**
The MLC controls the green, amber and red indicator lights to provide system status as described in the “Operator Interface Module” section (page 15). However, not all conditions will be detected by the MLC (for example, a traffic accident that physically damages the PM filter assembly). Therefore, it is important that the owner and/or operator routinely observe the equipment and Phoenix operations in addition to watching the indicator lights. See the “Operations” section (page 13) for routine observations that the driver and/or owner should perform and the “Owner’s Obligations” section on page 32.

Upon any indication of a malfunction, promptly contact an ESW CleanTech-authorized distributor (or the owner’s technician). See the “Contact Information” section on page 3. Please be prepared with the following information:

1. Fault information and descriptions in as much detail as possible.
2. The data plate part number and serial number (see Figure 12).
## Parts List

A complete parts list was provided with the system. Contact your ESW CleanTech-authorized distributor if you need a replacement list. The major parts are listed in the table below.

### Phoenix System Major Parts List

<table>
<thead>
<tr>
<th>Item #</th>
<th>Qty</th>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>CJF-<em><strong>-</strong></em></td>
<td>Diesel Particulate Filter Assembly, Unidirectional</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>CPX-J___E___-___</td>
<td>Assembly, cone, inlet/burner/EFC/heat shield</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>CMA-<em><strong>-</strong></em></td>
<td>Sensor, RPM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or CUE-394-__</td>
<td>or Adaptor for alternator</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>CMA-5-13-___</td>
<td>Sensor, thermocouple</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>CMA-5-___</td>
<td>Sensor, thermocouple, burner</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>CMKP6.0-___</td>
<td>MLC (electronic control unit)</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>CUE-45</td>
<td>Sensor, Backpressure</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>CUE-73-___V</td>
<td>Regeneration Air Supply Blower</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>CUH-2401-1K</td>
<td>Kit, label, Verification, Phoenix</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>CUE-70-___V</td>
<td>Glow plug 12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or CUE-93-___V</td>
<td>or 24 Volt</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>CMA-___-___V</td>
<td>Controls Box – Phoenix</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>CPX-BB3-<em><strong>-</strong></em></td>
<td>Blower box</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>CPX-BB-___</td>
<td>Module, operator interface w/LEDs and label</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>CPX-FPA-<em><strong>-</strong></em></td>
<td>Fuel metering pump and filter assembly</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>CUE-15-___</td>
<td>Valve, motor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or CUP-74</td>
<td>or check, air</td>
</tr>
<tr>
<td>16</td>
<td>1</td>
<td>CHZ-OCJ-___</td>
<td>Cone, outlet (as applicable)</td>
</tr>
</tbody>
</table>

Spaces represent variables depending on specific configuration and application.

Parts that may be required for preventative maintenance are not covered by the product warranty as discussed in the “Maintenance Schedule” section on page 20 and are listed in the table below.

### Phoenix® Maintenance Parts List

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUP-76</td>
<td>Fuel tank pick-up filter</td>
</tr>
<tr>
<td>CUP-80</td>
<td>Air filter</td>
</tr>
<tr>
<td>CUP-81</td>
<td>Fuel filter</td>
</tr>
</tbody>
</table>
**Troubleshooting**

The LED's provide some troubleshooting information. See the “Operator Interface Module” section on page 15 for additional details. The following tables provide examples of LED conditions and the appropriate actions to take.

### Regeneration Not Finished – Burner Did Not Light

<table>
<thead>
<tr>
<th>LED Color</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green ON</td>
<td>Burner did not light. At your option, you may push the Regen button again to attempt to restart regeneration. Call for service if the system is not able to regenerate.</td>
<td></td>
</tr>
<tr>
<td>Amber FLASHING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red ON</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Regeneration Past Due!

<table>
<thead>
<tr>
<th>LED Color</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red FLASHING</td>
<td>See the “Red Light – Flashing” section on page 17. (If the red light just started flashing, regenerate immediately; otherwise, call for service.)</td>
<td></td>
</tr>
</tbody>
</table>

### Service Required

<table>
<thead>
<tr>
<th>LED Color</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amber ON</td>
<td>Service is required if the amber is on solid (no matter what the status is of the green or red LED's).</td>
<td></td>
</tr>
</tbody>
</table>

Use the table below to diagnose and resolve potential Phoenix operating problems.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Probable Cause</th>
<th>Remedy</th>
</tr>
</thead>
</table>
| 1. Green LED off (while engine is on) | No power to MLC  
Loss of MLC program (if amber on and green off)  
Faulty LED or wiring | Check fuse, wires and power source (battery).  
Contact an ESW CleanTech-authorized distributor for repair. |
| 2. Amber LED flashing again soon (within a few hours) after a regeneration | PM filter is loaded with ash  
Engine operating conditions have changed to cause increased soot emissions | Try regenerating again. If the problem persists, clean the PM filter.  
Check engine for excessive smoke or a bad injector. |
| 3. Unusual exhaust noises | Loose tubing connection(s)  
Loose clamp(s)  
Crack in exhaust tube  
Crack in PM filter  
Engine turbo problem | Tighten connection(s).  
Replace damaged tube.  
Contact an ESW CleanTech-authorized distributor for repair. |
| 4. White smoke during startup | Normal condensation inside the PM filter | No action required. |
| 5. Light soot dusting in exhaust tube | Normal condition | No action required. |
| 6. Visible emissions (white or black smoke during normal operations) | Engine problem resulting in oil or coolant loss  
PM filter failure  
Normal at first start up after regeneration or cleaning | Contact an ESW CleanTech-authorized distributor for repair.  
None required (if only visible at first start up after regeneration or cleaning). |
| 7. Engine surges or has power loss | Engine malfunction (most likely cause)  
Overloaded PM filter (amber or red LED will have been flashing for some time if this is the cause of engine surging or low power) | Repair the engine.  
If the engine passes all its diagnostic tests and regenerating the Phoenix does not solve the low power problem, then contact an ESW CleanTech distributor for service. (PM filter will likely need cleaning.) |

There is additional troubleshooting information in the *Phoenix and Vista Service and Troubleshooting Manual*. This manual is for trained technicians.
Repair and Maintenance Clarifications

The warranty (page 34) includes a section titled “Owner’s Warranty Responsibility” which clarifies that the owner or operator is responsible for making sure that the maintenance described in this owner’s manual is performed. In addition to the scheduled preventative maintenance, the amber light is another indicator that maintenance or repair is required.

**ATTENTION:**

*A solid amber light indicates that service is required.*

Cleaning the PM filter is a maintenance item and is not covered under warranty. If a repair is required, it may be covered under the installation or product warranty depending on the cause.

The table below provides a summary of service types (maintenance or repair) and what organization is responsible for the cost of the service.

<table>
<thead>
<tr>
<th>Service Type (and subtype)</th>
<th>Definition/Example</th>
<th>Cost Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance (unplanned)</td>
<td>High backpressure from PM filter overloaded with ash.</td>
<td>Owner</td>
</tr>
<tr>
<td>Maintenance (regularly planned)</td>
<td>High backpressure from PM filter overloaded with ash.</td>
<td>Owner</td>
</tr>
<tr>
<td>Maintenance (comprehensive preventative maintenance)</td>
<td>Clean out ash from the PM filter. Perform multi-step complete system check out.</td>
<td>Owner</td>
</tr>
<tr>
<td>Repair (warrantable)</td>
<td>System or component fails in normal application.</td>
<td>ESW CleanTech</td>
</tr>
<tr>
<td>Repair (warrantable)</td>
<td>System or component failed because it was installed improperly.</td>
<td>Installer</td>
</tr>
<tr>
<td>Repair (non-warrantable)</td>
<td>System or component damaged through abuse, neglect, or misapplication. Warranty period has lapsed.</td>
<td>Owner</td>
</tr>
</tbody>
</table>
**Engine Oil Consumption and Lube Oil Ash**

ESW CleanTech recommends that Phoenix owners monitor the oil consumption of their engines and know the ash content of the engine oil to ensure that the PM filter is scheduled for cleaning before it becomes overloaded with ash. This section of the manual provides information to extend the filter cleaning interval of the PM filter.

PM filters are designed to capture all solid particles coming from the tailpipe. While most of the captured material can be readily regenerated (oxidized) inside the filter, the PM filter will accumulate incombustible materials, collectively called “ash,” which cannot be regenerated and must be removed through offline cleaning.

The majority of the ash comes directly from oil consumed during engine operation, though small amounts of ash also come from the fuel and engine wear. Most of the ash that accumulates in PM filters is part of the lube oil additive package, and since the PM filter will capture all solid materials coming from the engine exhaust, all the ash from oil consumption will ultimately end up in the PM filter. Thus, the ash content of the lube oil and the oil consumption rate become critical factors in determining the rate of ash accumulation in the filter.

It is important to note that once the PM filter captures approximately 200 grams (about 7 ounces) of ash, it will no longer be possible to remove all the ash from the filter using existing cleaning techniques. Therefore, it is important to proactively clean your PM filter based on 1) oil consumption rate, and 2) lube oil ash content.

Pre-2007, CI-4 oil typically contains between 1.2 and 1.5% ash by weight. The new CJ-4 oils, designed especially for diesel engines with PM filters, contain approximately 1.0% ash, and will therefore result in a lower filter loading for a given amount of oil consumption. Given the ash content, the filter must be cleaned once the engine has consumed the following amount of oil:

- **Every 24 Quarts with CJ-4**
- **Every 16 Quarts with CI-4**

Using the ash content of these oils, the service intervals shown in Figure 13 are recommended to ensure optimum performance and cleanability of the PM filter.
The values presented above are provided as estimations and may not apply to all filters in all applications. Factors like engine duty cycle, soot composition, ash composition and others can also have an impact on the filter cleaning interval. Furthermore, the guide applies only to ash accumulation in the filter; if the engine does not meet the temperature requirements for regeneration or if there are excessive soot emissions (e.g., from a failed injector), more frequent filter cleaning may be required to remove the soot.

ESW CleanTech, as an industry leader in filter cleaning techniques, continues its efforts to improve its cost-effective filter cleaning solutions. As these techniques improve, we expect to be able to clean filters with ash loadings greater than 200 grams, thereby extending the cleaning interval beyond the values described above.

In summary, to ensure that the PM filter is fully cleanable, ESW CleanTech recommends that the customer monitor their oil consumption rate and schedule filter cleaning before the filter has accumulated 200 grams of ash. Customers can extend their filter cleaning interval by:

- Maintaining their engines to minimize oil consumption
- Switching to low ash oils
SPECIFICATIONS
### Phoenix System

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Weight</td>
<td>150 pounds</td>
</tr>
<tr>
<td>Materials of Construction</td>
<td>304 and 316 stainless steel and silicon carbide</td>
</tr>
<tr>
<td>Diesel Fuel Type (same as engine fuel)</td>
<td>CARB #2 diesel, ULSD and biodiesel up to B20</td>
</tr>
<tr>
<td>Fuel Consumption (per regeneration)</td>
<td>0.8 quarts</td>
</tr>
<tr>
<td>Power Consumption (avg. during regen.)</td>
<td>50 W</td>
</tr>
</tbody>
</table>

### ESW CleanTech MLC

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>12 V or 24V nominal</td>
</tr>
<tr>
<td>Real time clock</td>
<td>Battery-backed</td>
</tr>
<tr>
<td>Diagnostic and Programming I/O</td>
<td>9-pin DBF Serial (RS-232) (adapter from harness required)</td>
</tr>
</tbody>
</table>

#### Inputs

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PM Filter Assembly Inlet Temperature</td>
<td>Type K thermocouple, ungrounded</td>
</tr>
<tr>
<td>Burner Flame Temperature</td>
<td>Type K thermocouple, ungrounded</td>
</tr>
<tr>
<td>Engine RPM Sensor (Frequency)</td>
<td>0.5 to 12 kHz</td>
</tr>
<tr>
<td>Engine Electrical Power (Battery Voltage)</td>
<td>12 VDC or 24 VDC nominal</td>
</tr>
<tr>
<td>PM Filter Assembly Backpressure Sensor</td>
<td>0 – 5 VDC</td>
</tr>
</tbody>
</table>

#### Outputs

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Metering Pump (pulsed output)</td>
<td>12 or 24 VDC (same as input)</td>
</tr>
<tr>
<td>Power Relay</td>
<td>12 or 24 VDC (same as input)</td>
</tr>
<tr>
<td>Blower Speed Signal</td>
<td>0 – 10 VDC</td>
</tr>
<tr>
<td>Two Power Output Lines</td>
<td>5 VDC</td>
</tr>
<tr>
<td>Regeneration in-progress indicator</td>
<td>Green LED flashing</td>
</tr>
<tr>
<td>Regeneration requested indicator</td>
<td>Amber LED flashing</td>
</tr>
<tr>
<td>Phoenix system service indicator</td>
<td>Amber LED on solid</td>
</tr>
<tr>
<td>Excessively high backpressure indicator</td>
<td>Red LED flashing</td>
</tr>
<tr>
<td>Burner did not ignite (push button again)</td>
<td>Red LED solid</td>
</tr>
</tbody>
</table>
System dimensional drawings are provided in Figure 14 and Figure 15 below.

**Figure 14:** System dimensions (inches) with straight-inlet cone.

**Figure 15:** System dimensions (inches) with side-inlet cone.
OWNER’S OBLIGATIONS
The owner’s actions in the table below are mandatory for proper system operation. Failure to do the required action(s) could be the basis for denying a warranty claim or a fine by CARB.

<table>
<thead>
<tr>
<th>Event or Symptom</th>
<th>Owner’s Action Item</th>
<th>Manual Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial installation of Phoenix system.</td>
<td>Review this manual and know the requirements for the Phoenix system. Keep a copy of this manual in the equipment. Be sure that drivers and maintenance staff understand each item in the “Operations” section.</td>
<td>This entire manual. “Operations” (page 13).</td>
</tr>
<tr>
<td>Flashing amber light (Phoenix needs to be regenerated).</td>
<td>At the end of the shift, park the machine on level ground, turn off the engine, and push the regeneration start button.</td>
<td>“Regenerating the Phoenix” (page 14).</td>
</tr>
<tr>
<td>Solid amber light (bad sensor or system fault).</td>
<td>Contact a properly trained technician as soon as practical.</td>
<td>“Operator Interface Module” (page 15).</td>
</tr>
<tr>
<td>Flashing red light.</td>
<td>The Phoenix is past due for regeneration. Turn off the engine. If the red light just started flashing, regenerate immediately; otherwise, contact a properly trained technician as soon as practical.</td>
<td>“Operator Interface Module” (page 15).</td>
</tr>
<tr>
<td>Engine malfunction (such as turbo failure, injector failure, excess oil consumption, or leaky head gasket).</td>
<td>If the turbo fails, park in a safe place ASAP and shut the engine off. Contact a properly trained technician promptly. (System components may be damaged from foreign material.)</td>
<td>“Conditions That May Damage the Phoenix” (page 18).</td>
</tr>
<tr>
<td>Debris or other object impacts Phoenix system or components.</td>
<td>Contact a properly trained technician promptly since system components may be damaged, including hidden damage to internal components.</td>
<td>“PM Filter Assembly” (page 7) and “Conditions That May Damage the Phoenix” (page 18).</td>
</tr>
<tr>
<td>Tubing or exhaust component (turbo or exhaust brake, for example) between the engine and the PM filter assembly is removed, replaced or in poor condition.</td>
<td>Ensure that the tubing or component is installed properly and that no debris could enter the exhaust stream. (Debris or foreign matter in the exhaust stream can damage the PM filter or system components. Also, exhaust leaks may result in poor system performance and safety hazards.)</td>
<td>“Exhaust Tubing and Components” (page 22).</td>
</tr>
<tr>
<td>For a vertical exhaust stack, the rain cap or turn out stack is knocked off or somehow missing.</td>
<td>Replace the rain cap or turn out stack as soon as practical. If any water entered the exhaust pipe then contact a properly trained technician.</td>
<td>“PM Filter Assembly” (page 7) and “Conditions That May Damage the Phoenix” (page 18).</td>
</tr>
<tr>
<td>Oil consumption is more than the engine manufacturer’s specification.</td>
<td>Monitor and keep accurate records of the engine’s oil consumption rate. If oil consumption exceeds the specification, repair the engine so that oil consumption is within the manufacturer’s specification.</td>
<td>“Conditions That May Damage the Phoenix” (page 18) and “Engine Oil Consumption and Lube Oil Ash’ (p. 27).</td>
</tr>
<tr>
<td>Phoenix heat shield panel is missing.</td>
<td>Contact an ESW CleanTech-authorized distributor as soon as possible for service.</td>
<td>“Safety Warnings” (p. 2) and “Operations” (p. 13).</td>
</tr>
</tbody>
</table>
WARRANTY
**Product Warranty**

YOUR WARRANTY RIGHTS AND OBLIGATIONS

ESW CleanTech, Inc. warrants the diesel emission control system in the application for which it is sold or leased to be free from defects in design, materials, workmanship, or operation of the diesel emission control system which cause the diesel emission control system to fail to conform to the emission control performance level it was verified to, or to the requirements in the California Code of Regulations, Title 13, Sections 2700 to 2706, and 2710, for the periods of time listed in Table 1, provided there has been no abuse, neglect, or improper maintenance of your diesel emission control system, vehicle or equipment, as specified in the owner’s manuals. Where a warrantable condition exists, this warranty also covers the engine from damage caused by the diesel emission control system, subject to the same exclusions for abuse, neglect or improper maintenance of your vehicle or equipment. Please review your owner’s manual for other warranty information. Your diesel emission control system may include a core part (e.g., particulate filter, diesel oxidation catalyst, selective catalytic reduction converter) as well as hoses, connectors, a back pressure monitor (if applicable), and other emission-related assemblies. Where a warrantable condition exists, ESW CleanTech will repair or replace your diesel emission control system at no cost to you including diagnosis, parts, and labor.

### Table 1: Warranty Period

<table>
<thead>
<tr>
<th>Engine Type</th>
<th>Engine Size</th>
<th>Warranty Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Road</td>
<td>Light heavy-duty, 70 to 170 hp, Gross Vehicle Weight Rating (GVWR) less than 19,500 lbs.</td>
<td>5 years or 150,000 miles</td>
</tr>
<tr>
<td></td>
<td>Medium heavy-duty, 170 to 250 hp, GVWR from 19,500 lbs. to 33,000 lbs.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heavy heavy-duty, exceeds 250 hp, GVWR exceeds 33,000 lbs.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heavy heavy-duty, exceeds 250 hp, GVWR exceeds 33,000 lbs., and the truck is:</td>
<td>2 years, unlimited miles</td>
</tr>
<tr>
<td></td>
<td>1. Typically driven over 100,000 miles per year, and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Has less than 300,000 miles on the odometer at the time of installation.</td>
<td></td>
</tr>
<tr>
<td>Off-Road (includes portable engines), Stationary, Marine, Locomotives, TRU and APU</td>
<td>Under 25 hp, and for constant speed engines rated under 50 hp with rated speeds greater than or equal to 3,000 rpm</td>
<td>3 years or 1,600 hours</td>
</tr>
<tr>
<td></td>
<td>At or above 25 hp and under 50 hp</td>
<td>4 years or 2,600 hours</td>
</tr>
<tr>
<td></td>
<td>At or above 50 hp</td>
<td>5 years or 4,200 hours</td>
</tr>
</tbody>
</table>

### WARRANTY COVERAGE

For an engine used in an application listed in Table 1, the warranty period will be the years or hours or miles of operation shown in Table 1, whichever occurs first. If any emission-related part of your diesel emission control system is defective in design, materials, workmanship, or operation of the diesel emission control system thus causing the diesel emission control system to fail to conform to the emission control performance level it was verified to, or to the requirements in the California Code of Regulations, Title 13, Sections 2700 to 2706, and 2710, within the warranty period, as defined above, ESW CleanTech will repair or replace the diesel emission control system, including parts and labor.

In addition, ESW CleanTech will replace or repair the engine components to the condition they were in prior to the failure, including parts and labor, for damage to the engine proximately caused by the verified diesel emission control strategy. This also includes those relevant diagnostic expenses in the case in which a warranty claim is valid. ESW CleanTech may, at its option, instead pay the fair market value of the engine prior to the time the failure occurs.
OWNER'S WARRANTY RESPONSIBILITY
As the vehicle, engine, or equipment owner, you are responsible for performing the required maintenance described in your owner's manual. ESW CleanTech recommends that you retain all maintenance records and receipts for maintenance expenses for your vehicle, engine, or equipment, and diesel emission control system. If you do not keep your receipts or fail to perform all scheduled maintenance, ESW CleanTech may have grounds to deny warranty coverage. You are responsible for presenting your vehicle, equipment, or engine, and diesel emission control system to an ESW CleanTech distributor as soon as a problem is detected. The warranty repair or replacement should be completed in a reasonable amount of time, not to exceed 30 days. If a replacement is needed, this may be extended to 90 days should a replacement not be available, but must be performed as soon as a replacement becomes available.

If you have questions regarding your warranty rights and responsibilities, you should contact ESW CleanTech at 1-800-398-6105 or the California Air Resources Board at 9528 Telstar Avenue, El Monte, California 91731, or (800) 363-7664, or electronic mail: helpline@arb.ca.gov.

Installation Warranty

YOUR WARRANTY RIGHTS AND OBLIGATIONS
The installer must warrant that the installation of a diesel emission control system is free from defects in workmanship or materials which cause the diesel emission control system to fail to conform to the emission control performance level it was verified to, or to the requirements in the California Code of Regulations, Title 13, Sections 2700 to 2706. The warranty period and the extent of the warranty coverage provided by the installer must be the same as the warranty provided by ESW CleanTech, and the same exclusions apply.

OWNER'S WARRANTY RESPONSIBILITY
As the vehicle, engine, or equipment owner, you are responsible for presenting your vehicle, engine, or equipment, and diesel emission control system to the installer as soon as a problem with the installation is detected.

If you have questions regarding your warranty rights and responsibilities, you should contact the installer or ESW CleanTech at 1-800-398-6105 or the California Air Resources Board at 9528 Telstar Avenue, El Monte, California 91731, or (800) 363-7664, or electronic mail: helpline@arb.ca.gov.

ESW CleanTech Warranty Clarifications
(Which do not limit or modify the provisions of the Product Warranty or Installation Warranty in any way)

The product warranty above is the sole warranty made by ESW CleanTech. There are no other warranties, expressed or implied, of merchantability or fitness for a particular purpose.

For the purpose of the product warranty and installation warranty, abuse or neglect includes vehicle accidents, ignoring the system indicator lights, blending lubricating oil with fuel, or any engine failure or condition that are not proximately caused by the diesel emission control system that allows excess lubricating oil, coolant, contaminants or debris to enter the exhaust system. The owner shall not use any fuel additive or lube oil additive that is not approved by EPA or CARB for use in diesel engines equipped with catalytic mufflers.

ESW CleanTech recommends that the verified diesel emissions control strategy be installed and serviced by ESW CleanTech authorized personnel. Improper installation or service by unauthorized or untrained personnel may result in a denial of coverage under the product warranty or installation warranty.
CARB EXECUTIVE ORDER FOR THE PHOENIX
State of California
AIR RESOURCES BOARD
EXECUTIVE ORDER DE-13-004

The diesel emission control strategy described herein qualifies as a potential compliance
option for the Air Resources Board’s (ARB) in-use diesel fleet rules.

Pursuant to the authority vested in ARB by the Health and Safety Code, Division 26,
Part 5, Chapter 2; and pursuant to the authority vested in the undersigned by Health
and Safety Code Sections 39515 and 39516 and Executive Order G-02-003;

Relating to Exemptions under Section 38395 of the Vehicle Code, and Verification
under Sections 2700 to 2711 of Title 13 of the California Code of Regulations (CCR)

ESW CleanTech, Incorporated (ESW CleanTech)
Phoenix Diesel Particulate Filter System (Phoenix)

ARB has reviewed ESW CleanTech’s request for verification of the Phoenix system.
Based on an evaluation of the data provided, and pursuant to the terms and conditions
specified below, the Executive Officer of ARB hereby finds that the Phoenix system
reduces emissions of diesel particulate matter (PM) consistent with a Level 3 device
(greater than or equal to 85 percent reductions) (Title 13, CCR, Sections 2702 (f) and
Section 2708) and is compliant with the 2009 nitrogen dioxide emissions limit.
Accordingly, the Executive Officer determines that the system merits verification and,
subject to the terms and conditions specified below, classifies the Phoenix system as a
Level 3 Plus system for off-road equipment, which includes portable equipment, that
use certain diesel engines. Engines for which the Phoenix system is verified, the
verified parts list, the verified labels, swapping and re-designation information, and other
product information can be found here:

http://www.arb.ca.gov/diesel/verdev/companies/esw/phoenix.htm

The aforementioned verification is subject to the following terms and conditions:

- The engine must be used in off-road equipment.
- The application must not be a transport refrigeration unit, auxiliary power unit,
rubber-tired gantry crane, marine vessel, or locomotive.
- The engine must be certified for off-road applications unless it belongs to the family
1CEXH035993AV and is used to power off-road equipment.
- The engine must have a minimum displacement of 3.4 liters and maximum
displacement of 12 liters.
- The engine must have a rated power of at least 100 horsepower but not more than 450 horsepower.
- Only one filter may be installed per engine.
- The engine must be in its original certified configuration.
- The engine must have a PM certification level of at most 0.2 grams per brake horsepower-hour (g/bhp-hr), and greater than 0.01 g/bhp-hr.
- The engine must not be certified as having exhaust gas recirculation (EGR).
- The engine must not have an internal EGR system.
- The engine must not have a pre-existing original equipment manufacturer (OEM) diesel oxidation catalyst (DOC) unless the following conditions are met:
  - The DOC is left in place and not removed.
  - The Phoenix system is installed downstream of the DOC.
  - The backpressure is measured upstream of the DOC.
- The engine must not be certified to have an OEM diesel particulate filter (DPF).
- The engine must have a four-stroke combustion cycle.
- The engine may be turbocharged or naturally aspirated.
- The engine may be mechanically or electronically controlled.
- The engine must be well maintained and not consume lubricating oil at a rate greater than that specified by the engine manufacturer.
- Lube oil, or other oil, must not be mixed with the fuel.
- The engine must be operated on fuel that has a sulfur content of no more than 15 parts per million by weight.
- The system must not be operated with fuel additives, as defined in Section 2701 of Title 13, of the CCR, unless explicitly verified for use with fuel additive(s).
- The system must not be used with any other systems or engine modifications without approval from ARB and the manufacturer.
- The system must be installed with a backpressure monitor to notify the operator when the backpressure limit is reached. The notification must occur and be clearly
visible to the operator while the vehicle or equipment is in use.

- The other terms and conditions specified below.

IT IS ALSO ORDERED AND RESOLVED: That installation of the Phoenix system, manufactured by ESW CleanTech Incorporated, 8755 Mira Mesa Boulevard, Suite 123-122, San Diego, California 92121, has been found not to reduce the effectiveness of the applicable vehicle pollution control system, and therefore the Phoenix system is exempt from the prohibitions in Sections 38390 and 38391 of the Vehicle Code for installation on off-road equipment. This exemption is only valid provided the engines meet the aforementioned conditions.

ARB reserves the right in the future to review this Executive Order and the exemption and verification provided herein to assure that the exempted and verified add-on or modified part continues to meet the standards and procedures of CCR, Title 13, Section 2222, et seq. and CCR, Title 13, Sections 2700 through 2711.

The Phoenix system consists of the following major system components, listed in order from exhaust inlet to outlet as they are arranged within the exhaust system of the vehicle: one inlet cone and burner assembly (includes one catalyzed exhaust flow conditioner), one silicon carbide wall-flow DPF, and one outlet cone. The Phoenix system also includes a backpressure monitor and warning system. The major components of the Phoenix system are identified in the parts list. The parts list and schematics of the approved product and engine labels are available on the website shown above.

The Phoenix system is comprised of a single silicon carbide wall-flow DPF designed to filter the exhaust from a single engine. Phoenix systems with multiple DPFs, including designs with two or more filter components canned together or multiple individually-canned filter components in parallel or in series (or any combination thereof), are not valid under this Executive Order. Channeling exhaust from a single engine through multiple Phoenix systems, deployed in parallel or in series or any combination thereof, is also not valid under this Executive Order.

No changes are permitted to the system. ARB must be notified, in writing, of any changes to any part of the Phoenix system. Any changes to the system must be evaluated and approved in writing by ARB. Failure to do so shall invalidate this Executive Order.

ESW CleanTech must provide each installer with the specific criteria used to determine the compatibility of the Phoenix system with a candidate engine pursuant to Section 2706(t), Title 13, CCR.

ESW CleanTech must ensure that the installation of the Phoenix system conforms to all applicable industrial safety requirements.
Prior to the sale of a Phoenix system, ESW CleanTech must provide each prospective owner/purchaser with a written estimate of the number of hours of vehicle operation that will typically elapse before regeneration is required. ESW CleanTech must also provide, in writing, the length of time of a typical regeneration event.

Changes made to the design or operating conditions of the Phoenix system, as exempted by ARB, which adversely affect the performance of the vehicle’s pollution control system, shall invalidate this Executive Order.

This Executive Order is valid provided that installation instructions for the Phoenix system do not recommend tuning the vehicle to specifications different from those of the vehicle manufacturer.

Marketing of the Phoenix system using identification other than that shown in this Executive Order or for an application other than that listed in this Executive Order shall be prohibited unless prior written approval is obtained from ARB.

This Executive Order shall not apply to any Phoenix system advertised, offered for sale, sold with, or installed on a motor vehicle prior to or concurrent with transfer to an ultimate purchaser.

A copy of this Executive Order must be provided to the ultimate purchaser at the time of sale.

As specified in Section 2708(j)(Title 13, CCR) of the Verification Procedure, Warranty, and In-Use Compliance Requirements for In-Use Strategies to Control Emissions from Diesel Engines (Procedure), ARB assigns each diesel emission control strategy a family name. The designated family name for the verification as outlined above is:

CA/ECT/2009/PM3+/N00/OF/DPF01

The designated family name CA/ECT/2009/PM3+/N00/OF/DPF01 replaces the previous name CA/CLE/2009/PM3+/N00/OF/DPF01.

As stated in the Procedure, ESW CleanTech is responsible for recordkeeping requirements (Section 2702), honoring the required warranty (Section 2707), and conducting in-use compliance testing (Section 2709).

Proper engine maintenance is critical for the proper functioning of the diesel emission control strategy. The owner of the vehicle on which the diesel emission control strategy is installed is strongly advised to adhere to all good engine maintenance practices. Failure to document proper engine maintenance, including keeping records of the engine’s oil consumption, may be grounds for denial of a warranty claim.

Use of system parts or replacement parts not authorized by ESW CleanTech may be grounds for denial of a warranty claim.
This Executive Order is valid provided that the diesel fuel used in conjunction with the system complies with Title 13, CCR, Sections 2281 and 2282, and if biodiesel is used, the biodiesel blend shall be 20 percent or less subject to the following conditions:

- The biodiesel portion of the blend complies with the American Society for Testing and Materials specification D9751 applicable for 15 parts per million sulfur content.
- The diesel fuel portion of the blend complies with Title 13, CCR, Sections 2281 and 2282.

Other alternative diesel fuels such as, but not limited to, ethanol diesel blends and water emulsified diesel fuel are excluded from this Executive Order.

The Phoenix system must not be located over any occupied space (e.g., driver or passenger compartments) or any other location deemed unacceptable by ESW CleanTech, and must not be installed in a way which would result in noncompliance with any applicable safety standards.

Systems verified under this Executive Order shall conform to all applicable California emissions regulations.

The terms and conditions of this Executive Order must be satisfied regardless of where the system is sold in order for the system to be considered verified.

Systems sold as verified, or which carry the ARB-approved label, must satisfy all the terms and conditions of this Executive Order.

This Executive Order does not release ESW CleanTech from complying with all other applicable regulations.

Violation of any of the above conditions shall be grounds for revocation of this Executive Order.

This Executive Order hereby supersedes the conditional verification letter with reference number 11-081-335 (dated June 16, 2011).

Executed at El Monte, California, and effective this 6th day of September 2013.

Annette Hahner, Chief
Mobile Source Control Division