GENERAL DESCRIPTION

The ISL-07 Cummins diesel engine installed in the NOVA LFS vehicle is equipped with a CPF system. The CPF lowers exhaust emissions to comply with EPA (Environmental Protection Agency) and CARB (California Air Resources Board) emission requirements. **This vehicle must only be operated with ultra low-sulfur diesel fuel.** When checking the exhaust system emissions, make sure that other vehicle parts (VGT [Variable Geometry Turbo], injectors, fuel pump, compressor cooler and tubing, CPF and tubing) that can affect emission levels are all working properly and at optimal performance.

The CPF is made of a heavy-gauge stainless steel, which ensures the antipollution system a maximum useful life. The vertical, aluminized steel, exhaust pipes are tubes designed and shaped to harmonize with the shape of engine components. The pipes are fitted to the connections with U-bolts.

The CPF is an integral part of the Cummins ISL-07 engine system. Therefore, when replacement of the CPF is considered, it must be compliant with this engine system. Replace it only with the proper part. See the Nova Bus Parts Manual for proper replacement and see the section **Diesel Particulate Filter (DPF)** further in this document.

The exhaust system, excluding the CPF, is encased in fabric heat shields. These are designed and installed for the proper dissipation of heat that builds up during normal operation. **The vehicle must not be returned to service without these shields properly fitted in place.** See Figure 2.

MAINTENANCE

**WARNING:**
If the engine is running in a closed space, the exhaust system must be vented outdoors.

The exhaust system should be inspected for weak spots and leaks. Wrinkled or dented pipes can create excessive counter pressure, a loss of power, as well as damage to combustion chamber components. Exhaust leaks are usually the result of loose fitting bolts, corroded pipes or punctured CPFs. The damaged parts must be replaced immediately.

The catalyzer drain plug on the underside of the unit should be cleaned periodically to avoid clogging.

**CAUTION:**
Failure to inspect and clean the test hole periodically can result in damage to the catalyzer.

For more maintenance information, see the Cummins Diesel Engine Manuals.
Figure 1 - Exhaust System

Figure 2 - Fabric Heat Shields
CATALYZER DAMAGE

Possible damage to the catalyzer, and related failure of the CPF system, can be detected from the following symptoms:

- Air intake overheating
- Engine head overheating
- Engine overheating
- Loss of power
- Low engine power
- Engine decrease power (automatic protection)
- Noisy VGT
- Overheating VGT
- Oil temperature too high
- Exhaust backpressure too high
- Engine stall test rpm too low

Perform a Cummins exhaust backpressure test, in accordance with CUMMINS TROUBLESHOOTING AND REPAIR MANUAL. Perform a stall test and see the CUMMINS ENGINE MANUAL for normal rpm values during the test.

NOTE:

Proper maintenance of this system is essential to keep emissions in line with emission standards.

REPLACEMENT OF THE FLEXIBLE JOINT BETWEEN THE VGT AND THE CPF

See Figures 3 and 4.

REMOVAL

1. Remove the existing hose and replace it. If possible use the same upper and lower retaining clamps to hold the new joint in place.

INSTALLATION

In order to eliminate undue pressure on the flexible joint, install the joint according to the following steps:

1. Attach the first section of the flexible joint to the turbocharger with the attachment collar. See Figure 3.
2. Attach the second section of the flexible joint to the CPF. Make sure that you do not stress the flexible joint between the two sections of hose. The exhaust intake should be placed inside the hose to create a proper seal. See Figure 4.

REPLACING THE CPF

REMOVAL

CAUTION:

Take all necessary safety precautions regarding shields for mouth and nose, hands and eyes, to prevent any health risks.

CAUTION:

The CPF is very heavy and contains fragile components, such as catalyzer tiles. HANDLE WITH CARE. Prior to removal it should be properly supported, so that it can either be lowered from its installed position, or the vehicle can be raised to facilitate removal of the CPF.

NOTE:

Proper maintenance of this system is essential to keep emissions in line with emission standards.
1. Remove the flexible joint clamps from the inlet end of the CPF.
2. Remove the nuts from the pipe clamps attaching the vertical exhaust pipes to the CPF. Push the clamps back on the pipes.
3. While supporting the weight of the CPF, remove the bolts from the rear bracket, attaching the rear of the CPF to the chassis. See Figure 5 (b).
4. While supporting the weight of the CPF, remove the bolts from the front bracket that attaches the front of the CPF to the chassis. See Figure 5 (a).
5. Lower the CPF. Take care not to damage the large o-rings at both the inlet and outlet ends of the CPF.

**NOTE:**
Inspect parts for wear or damage. Refer to the Parts manual for replacement parts.

**INSTALLATION**

**NOTE:**
Before installation, check the condition of all components. See the parts manual if replacements are needed.

**NOTE:**
The o-ring (gasket) located at the attachment collar must be replaced each time the diesel particulate filter is removed for cleaning.

1. Position the CPF on the support used during the removal procedure.
2. Bolt the front and rear brackets into place.
3. Use the sleeve to join the exhaust elbow to the exhaust outlet of the CPF. Fasten with a U-bolt. Take care to install the elbow so that there will be no contact at the joint between the elbow and the exhaust pipe during operation.

**DIESEL PARTICULATE FILTER (DPF)**

The **DPF** is installed inside the CPF before the exhaust outlet end. It is designed to collect the excess soot passing through the catalyzer and to prevent this soot from being exhausted into the atmosphere.

**NOTE:**
See the Cummins Operator’s manual for additional information.

**NOTE:**
The DPF installed on this vehicle **CANNOT BE CLEANED MANUALLY**. It is designed to be cleaned in one of two ways ONLY.
1. Through a Cummins reconditioned exchange program
2. A fully-automatic, high-pressure air and collection device, either on-site or at another maintenance facility

See the Cummins Operator’s Manual for additional information regarding recommended intervals for removal and exchange or cleaning.

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Figure 5 - Muffler/Catalyzer Attachment to Chassis

(A) FRONT ATTACHMENT- VIEW FROM UNDERSIDE
(B) REAR ATTACHMENT- VIEW FROM UNDERSIDE
**REGENERATION**

On an on-going basis, the system maintains a level of cleanliness through a **REGENERATION** process, where the engine burns off accumulated soot at a very high temperature, thus minimizing harmful emissions.

There are three methods for exhaust regeneration — **PASSIVE**, **ACTIVE** and **STATIONARY**. Exhaust regeneration can be performed at any time, but certain requirements must be met:

**PASSIVE**

- The Cummins ISL-07 engine has been optimized for passive regeneration, and is the first course of action to assure filter cleanliness.
- Converts particulate matter by means of NOasser while the vehicle is operating

**ACTIVE**

- The oxidation of soot during the normal vehicle operating cycle, by the introduction of hydrocarbons.
- The effect of this is that it increases exhaust temperatures to oxidize the soot filter. This method increases exhaust temperature by means of the VGT and fuel dosage.
- The filter cleaning takes 15 to 20 minutes; it is not essential that this maintenance period be continuous.

**STATIONARY**

**WARNING:**

**DO NOT PERFORM A STATIONARY REGENERATION OF THE CPF (CUMMINS PARTICULATE FILTER) EXHAUST SYSTEM INSIDE A BUILDING, OR IN AN AREA THAT HAS A CANOPY OR SIMILAR STRUCTURE. SEE THE CUMMINS MANUALS PROVIDED WITH THIS VEHICLE.**

- Introduction of hydrocarbons while the vehicle is stationary, in neutral, since the operating cycle does not support filter regeneration.
- Used as a last resort to assure filter cleanliness

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**CAUTION:**

*Exhaust outlet temperature at the end of the tailpipe can be as high as 1100°F (600°C) (during regeneration).*

There are two conditions that prevent regeneration from taking place.

1. threshold speed,
2. engine ignition from the rear engine compartment.

There are progressive stages of need for regeneration indicated by the DPF lamp as depicted in Figure 6. See the **OPERATOR’S MANUAL** for more details on lamp location.

(a) **ON** - Solid

- The first stage (On - Solid) should allow the vehicle to complete a typical shift of operation. This provides time for a vehicle to return to a maintenance facility or change duty cycle without impacting the current mission.
- The lamp will also acknowledge when effective assistance (changing duty cycle or initiating a stationary regeneration) has been provided by turning off. However, if assistance has not been sufficiently long to complete the regeneration, the lamp will return to the appropriate indication stage.

(b) **Flashing**

- The DPF Lamp provides an indication that the filter has **NOT** been able to regenerate under the previous engine operating conditions and is in need of assistance in order to perform an active regeneration.
- Assistance can be provided by changing the duty cycle/load of engine or initiating a stationary regeneration.

(c) **Flashing with amber ENGINE WARNING LAMP**

- During a stationary regeneration of the particulate filter the engine speed will increase to aid the regeneration process. Any auxiliary device that is dependant on engine speed for proper operation should be disengaged during a stationary regeneration.

The following vehicle conditions must be satisfied before a stationary regeneration can be started:

- Zero vehicle speed
- Accelerator pedal at idle
- Service brake released (brake pedal **NOT** pressed)
- J1939 parameter stating the current gear is neutral and the selected gear is neutral
- Engine start from the rear engine compartment

*Figure 6 - DPF Warning Lamp*
Cummins offers an electronic maintenance tool, a computer software program, entitled INSITE. INSITE can be used to diagnose the post-treatment system. All diagnostics and information are completely integrated into the INSITE maintenance tool. A screen in INSITE is prepared to warn and instruct service technicians for stationary regeneration:

- Park the vehicle securely
- Set up a safe exhaust area
- Check exhaust system surfaces
- Prepare for engine speed change during regeneration

Regeneration can only start after confirmation from a service technician that all conditions noted above have been met. See the CUMMINS MAINTENANCE AND OPERATOR'S MANUALS for additional information on the INSITE program.

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**TROUBLESHOOTING GUIDE**

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<th>SOLUTION</th>
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<tr>
<td>Unusual noise</td>
<td>a. Break or crack in exhaust</td>
<td>a. Inspect CPF for breaks or cracks. If CPF is unserviceable, replace</td>
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<td></td>
<td>b. Loose or damaged connections.</td>
<td>b. Inspect exhaust system for broken brackets or leaking gaskets. Replace</td>
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<td>damaged parts as required</td>
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<tr>
<td>Exhaust system restricted</td>
<td>CPF outlet pipe or pipes plugged.</td>
<td>Repair or replace pipe.</td>
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<td></td>
<td>c. White smoke. (Steam), or coolant leaking into</td>
<td>c. Verify engine gaskets and replace where necessary,</td>
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<td></td>
<td>engine - accompanied by odor.</td>
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<tr>
<td>Decreased engine performance</td>
<td>Blocked air intake system</td>
<td>Verify air intake system and remove any blockage.</td>
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<td>Excessive fuel consumption</td>
<td>Air intake system restriction</td>
<td>Inspect ductwork for damage and/or kinking in ducts. Check for damage to</td>
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<td>rain cap (optional) or badly installed item.</td>
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<td></td>
<td>b. Turbocharger seals damaged</td>
<td>b. Check for damage and replace.</td>
</tr>
<tr>
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<td>Damage to, or failure of CPF system</td>
<td>Verify and replace, if necessary.</td>
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<td>Engine overheating</td>
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<tr>
<td>protection)</td>
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<td>Noisy turbocharger</td>
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Table 1 - Troubleshooting Guide