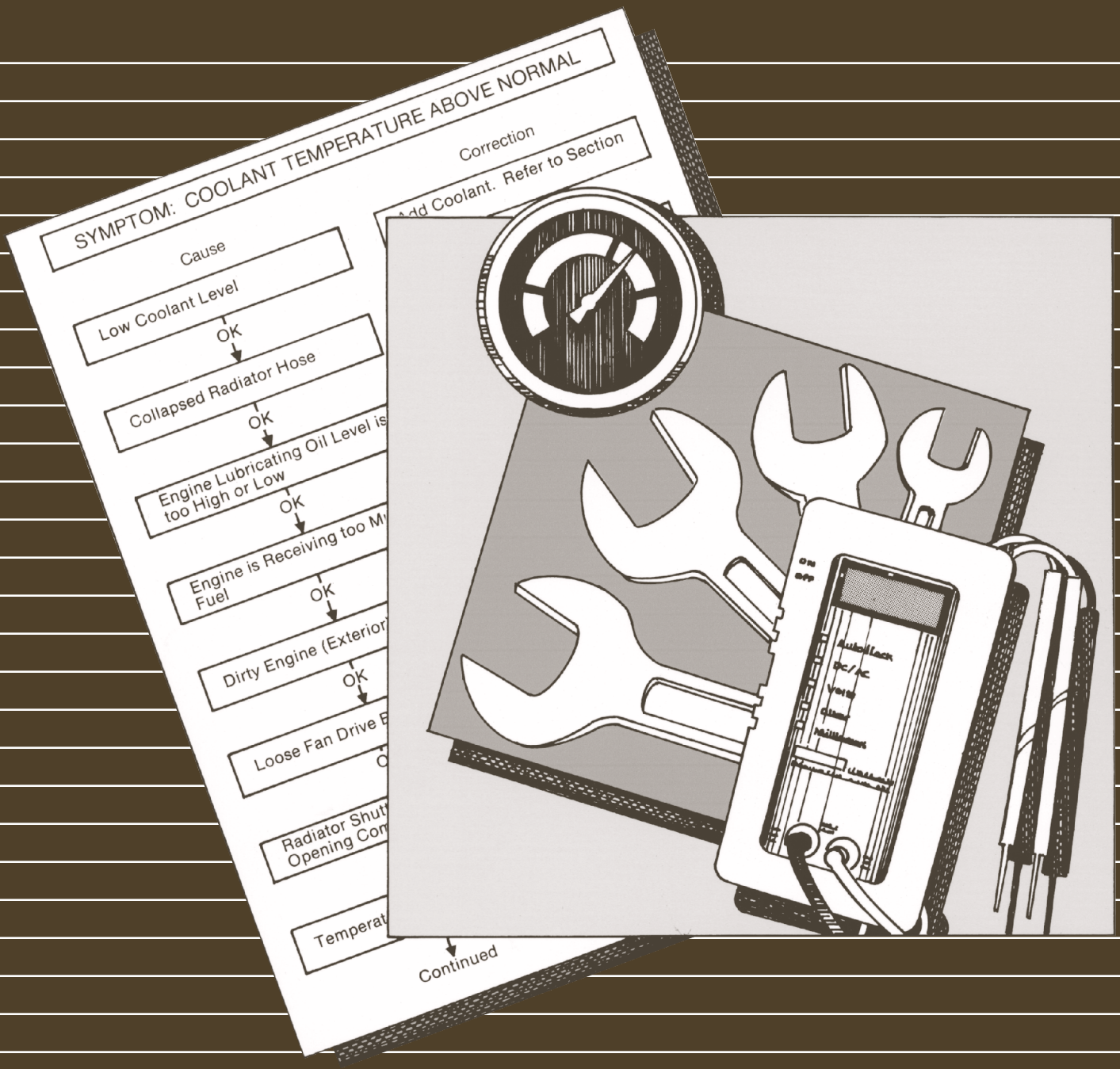
Fault Code Troubleshooting Manual
QSB6.7 CM2350 B112
Volume 1



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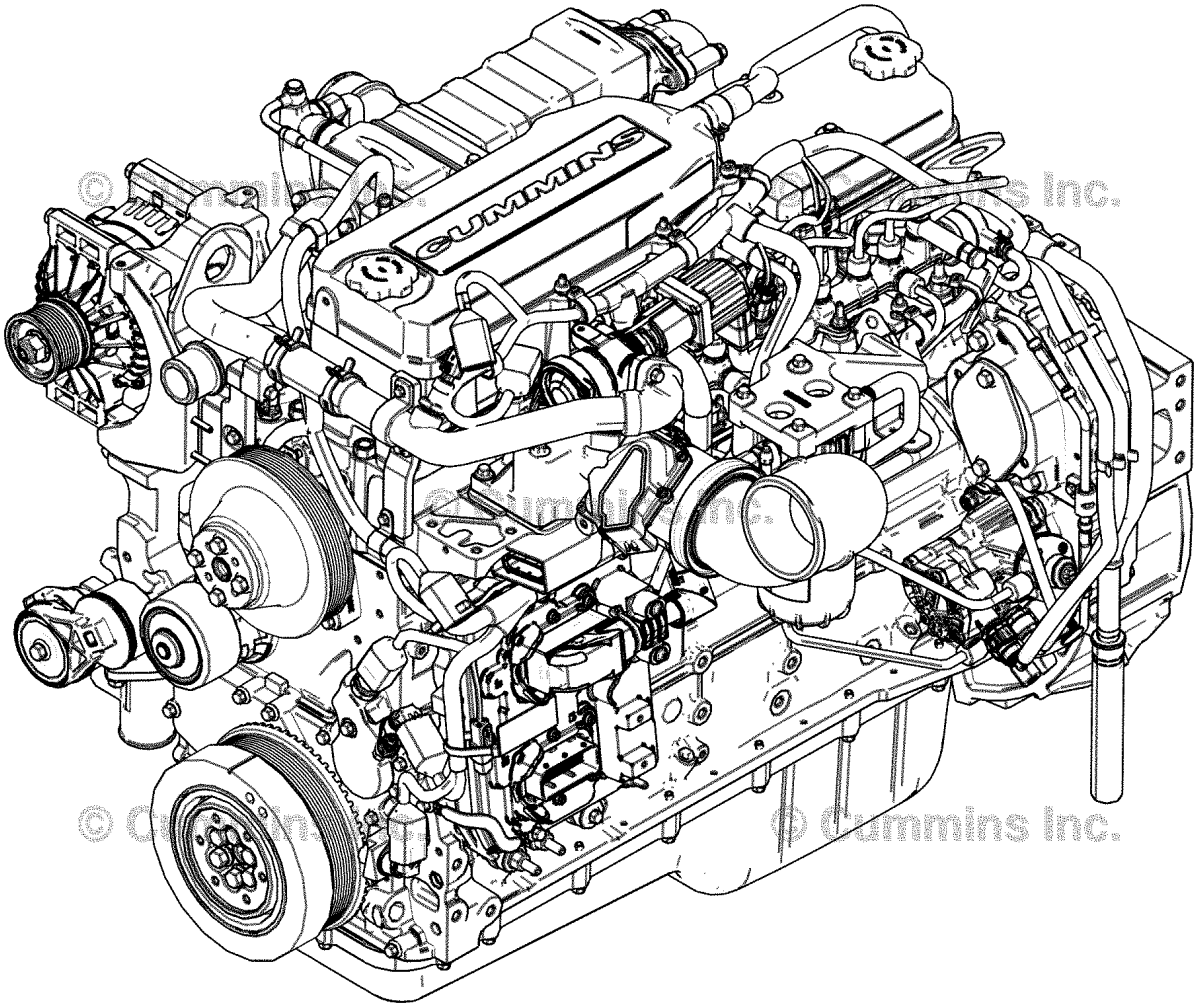

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Foreword

Thank you for depending on Cummins® products. If you have any questions about this product, please contact your Cummins® Authorized Repair Location. You can also visit cumminsengines.com or quickserve.cummins.com for more information, or go to locator.cummins.com for Cummins® distributor and dealer locations and contact information.

Read and follow all safety instructions. See the General Safety Instructions in Section i - Introduction.

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Section i - Introduction

Section Contents

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About the Manual

General Information

Cummins Inc. manuals are created to support Cummins® products. For information on components or fault codes not supplied by Cummins Inc., contact the original equipment manufacturer or supplier.

The content of this manual is based on the information in effect at the time of publish. Cummins Inc. reserves the right to make any changes at any time without obligation. If differences are found between your engine and the information in this manual, contact a Cummins® Authorized Repair Location.

About

Cummins® manuals are divided into sections. Each section consists of procedures which are associated with the title of the section.

When viewing a manual online, the sections of the manual are displayed to the left of the procedure display. If a section is clicked, it will expand to show the procedures within that section. to view a procedure, click on the procedure title.

When viewing a printed manual, the table of contents provides the list of sections and their subsequent procedures, with page numbers located to the right.

How to Use the Manual

General Information

This manual is organized to provide an easy flow from problem identification to problem correction.

A list of troubleshooting symptoms containing the most common problems is in the Troubleshooting Symptoms, Section (TS). The manual is designed to use the Troubleshooting Symptoms as a guide to locating the problem and directing the end user to the correct procedure for making the repair. Complete the following steps to locate and correct the problem.

1 Locate the symptom on the Section Contents pages of Section TS.
   - Reference to the page number where the Troubleshooting Symptom Tree is found is made to the right of the symptom tree title.

2 The left column of boxes in the Troubleshooting Symptom Charts indicates a probable cause of the problem, starting at the top with the simplest and easiest to repair, and continuing downward to the most difficult.
   - The right column of boxes provides a brief description of the corrective action with a reference number to the correct procedure used to make the repair.

3 Locate the probable cause in the left column then turn to the procedure referenced in the right column.

4 The Troubleshooting Symptom Charts are based on the following assumptions:
   - The components have been installed according to the manufacturer's specifications.
   - The easiest repairs are done first.
   - All generic solutions are designed for the most common applications and Original Equipment Manufacturer (OEM).

Refer to the Original Equipment Manufacturer's service manual for their specifications.

Symbols

General Information

The symbols have been used in this manual to help communicate the intent of the instructions. When one of the symbols appears, it conveys the meaning defined below.

NOTE: It is possible to have four symbols for each text and graphic combination.

⚠ WARNING ⚠
Serious personal injury or extensive property damage can result if the warning instructions are not followed.

⚠ CAUTION ⚠
Minor personal injury can result or a part, and assembly, or the engine can be damaged if the caution instructions are not followed.

Indicates a **REMOVAL** or **Dissassembly** step.

Indicates an **INSTALLATION** or **ASSEMBLY** step.

INSPECTION is required.

CLEAN the part or assembly.

PERFORM a mechanical or time **MEASUREMENT**.

LUBRICATE the part or assembly.

Indicates that a **WRENCH** or **TOOL SIZE** will be given.

TIGHTEN to a specific torque.

PERFORM an electrical **MEASUREMENT**.

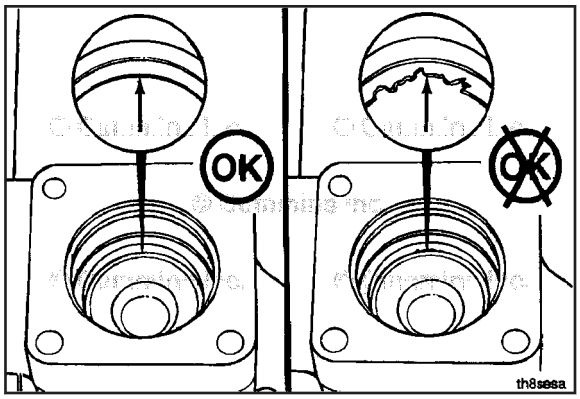
Refer to another location in this manual or another publication for additional information.

The component weighs 23kg [50 lbs] or more. To reduce the possibility of personal injury, use a hoist or get assistance to lift the component.

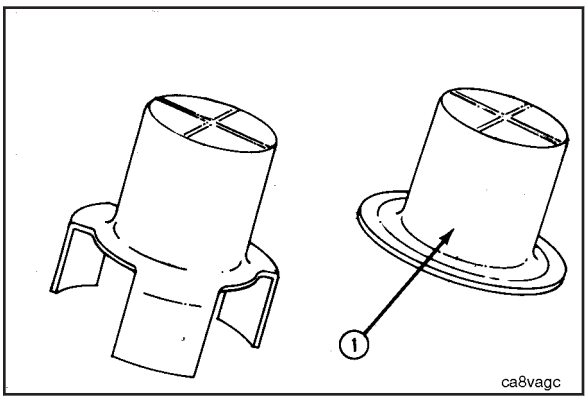
Illustrations

General Information

Some of the illustrations throughout this manual are generic and will **not** look exactly like the engine or parts used in your application. The illustrations can contain symbols to indicate an action required and an acceptable or **not** acceptable condition.



The illustrations are intended to show repair or replacement procedures. The procedure will be the same for all applications, although the illustration can differ.



General Safety Instructions

Important Safety Notice

Read and understand the safety information and precautions before performing any repair or operating equipment. This procedure contains general safety precautions that **must** be followed to provide personal safety. **Always** follow procedures to mitigate safety concerns.

Work Environment

Follow these recommended practices when servicing products.

- **Always** follow on-site safety requirements.
- **Always** follow local training, certification, authorization, and specific customer requirements. Do **not** work on products unless proper training has been completed to allow safe repair completion. Do **not** operate equipment unless proper training has been completed to allow safe operation..
- Work in a well-ventilated area away from ignition sources.
- If adverse weather conditions are present, take appropriate safety precautions when performing work.
- **Always** be aware of hazardous conditions that may exist in the work environment.

Best Practices

Follow these recommended practices when servicing or operating equipment.

- **Always** wear protective glasses and protective shoes.
- Remove rings, watches, long jewelry, or metallic items.
- Do **not** wear loose fitting or torn clothing, jewelry, long hair, etc.. These increase the risk for personal injury.
- Do **not** perform any repairs, or operate equipment, when fatigued or impaired due to drugs or alcohol.
- **Always** use tools that are in good condition.
- Do **not** work on equipment with the key switch ON or that is running unless otherwise directed by troubleshooting procedures.
- If any work **must** be performed while the key switch is ON or the unit is running, use extreme caution around hot components, moving parts, etc.
- Exercise caution when working on products that have just been turned off. Hot parts may cause burns or ignite or melt common materials.
- Do **not** bleed the fuel system of a hot engine. Contact with hot manifolds or other components can cause a fire.
- Do **not** attempt to rotate the crankshaft by pulling or prying on the fan. **Only** use proper engine barring techniques.
- Do **not** lift components that weigh 23 kg [50 lb] or more. Use mechanical help or seek assistance.
- Exercise caution when working around rotating parts. Rotating parts can cause cuts, mutilation, or strangulation.
- Exercise caution when working on electrical components. High voltages can cause serious injury or death.
- Relieve system pressure as instructed before removing or disconnecting lines, fittings, or related items.
- **Always** test for pressure leaks as instructed.
- **Always** torque fittings and connections to the required specifications. Over or under tightening can damage threads and create leaks.
- **Always** use the same fastener part number, or equivalent, when replacing fasteners.

Perform the following prior to beginning work on any products.

- Shutdown the equipment unless otherwise directed by troubleshooting procedures.
- **Always** allow the product to cool.
- **Always** ensure the product is properly supported by blocks or stands. Do **not** work on a product supported **only** by lifting jacks or hoists.
- Disconnect the battery unless otherwise directed by troubleshooting procedures.
- Disconnect the starting motor, if equipped, unless otherwise directed by troubleshooting procedures.

- Place a "Do NOT Operate" tag in the operator area or near the product controls.
- Become familiar with the tools required for performing the task at hand and how to use those tools correctly.
- Use only genuine Cummins or Cummins Recon replacement parts as instructed.

Personal Protective Equipment (PPE)

To reduce the possibility of personal injury, personal protective equipment (PPE) should be utilized. Various types of PPE are listed below. Use proper judgment to determine which types of PPE are required for a given task. **Always** meet on-site safety regulations for required PPE. Proper maintenance of safety equipment **must** be practiced. Integrity of safety equipment **must** be checked to ensure equipment functionality is maintained.

Eye Protection

Eye protection **must always** be worn. Wear appropriate eye protection based on the task being completed. Types of eye protection to consider are listed below.

- Safety glasses. Exposure to flying particles or debris, chemicals or caustic liquids, gases or vapors.
- Polarized safety glasses. Working in outdoor or bright lighting environments.
- Over-the-glass safety glasses. Add protection to prescription glasses.
- Safety goggles. Handling caustic liquids or chemicals.
- Shade or arc rated eyewear. Exposure to welding. Use appropriate filter ratings.

Foot Protection

Protective shoes **must always**be worn. Wear appropriate foot protection based on the task being completed. Types of protective footwear to consider are listed below.

- Steel toed shoes. Exposure to falling or rolling objects. Working with or around parts, tools, and equipment.
- Chemical resistant. Exposure to chemicals and other fluids.
- Overshoes and overboots. Add protection to everyday work shoes.
- Foot, toe, and metatarsal guards. Add protection to everyday work shoes.
- Electrical hazard safety toe shoes. Exposure to electrical hazards.
- Leather footwear or shoe protectors. Exposure to welding or arc flash.
- Cold protection. Exposure to cold weather.

Head and Face Protection

Wear appropriate face protection based on the task being completed. Types of head and face protection to consider are listed below.

- Hard hats. Exposure varies. Consider welding, heat, or arc-rated.
- Visors. Exposure varies. Consider welding, heat, or arc-rated.
- Face liners. Exposure to cold weather.
- Face shields. Exposure to liquid splash. Handling caustic liquids or chemicals.

Hand Protection

Wear appropriate type and fit of gloves based on the task being completed. Types of protective gloves to consider are listed below.

- Heat resistant or insulated. Exposure to hot items.
- Flame resistant. Exposure to welding or arc flash.
- Impact resistant. Performing repetitive impact and vibration work. Using pneumatic tools.
- Impervious. Exposure to high pressure fluids.
- Chemical resistant. Exposure to chemicals, fluids, or batteries.
- Cut resistant. Handling sharp objects or tools.
- Cold weather. Exposure to cold weather.

Hearing Protection

When working around operating equipment, appropriately rated hearing protection should be worn. Types of hearing protection to consider are listed below.

- Single use ear plugs.
- Pre-formed ear plugs.
- Ear muffs.

Protective Clothing

Wear appropriate protective clothing based on the task being completed. Types of protective clothing to consider are listed below.

- Flame resistant. Exposure to electrical hazards. Exposure to oil and gas or generator set applications. Performing welding.
- Chemical resistant. Exposure to chemicals.
- High visibility. Exposure to reduced visibility working environments. Working on mining, oil and gas, or sites with large equipment.

Respiratory Protection

Wear appropriate respiratory protection based on the task being completed. Types of respiratory protection to consider are listed below.

- Disposable respirators. Exposure to dust and particles, welding fumes, nuisance odors, nuisance level acid gas.
- Reusable respirators. Exposure to cleaning, machining, welding, sanding, grinding, etc.

Fall Protection

Utilize fall protection if a task is being completed more than 1.2 m [4 ft] above a solid surface. Types of fall protection to consider are listed below.

- Fall harness and lanyard combinations.
- Safety nets.
- Guardrails.

Fuels

Follow these recommended practices when interacting with equipment that uses different fuel types. For information regarding proper handling of various substances, refer to the manufacturer's safety data sheet.

Diesel Fuel

- Protect eyes.
- Protect skin.
- **Always** test for fuel leaks as instructed.
- Do **not** dilute.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Provide extra ventilation to the work area.
- Do **not** troubleshoot or repair fuel leaks while the engine is running.
- If material is spilled, avoid contact and dispersal with runoff, soil, waterways, drains, and sewers. Absorb with sand, clay, or commercial absorbent. Transfer to containers and neutralize the material. Flush spill area with soap and excess water.
- Report spills effecting water source contamination to local authorities immediately.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.
- **Always** torque fittings and connections to the required specifications. over or under tightening can damage threads and create leaks.

Gasoline

- Protect eyes.
- Protect skin.
- **Always** be alert for the smell of gas.

- **Always** test for fuel leaks as instructed.
- Do **not** dilute.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Vapors accumulate near the floor. Check the work floor, sumps, and low lying areas for ignition sources before servicing equipment..
- Provide extra ventilation to the work area.
- Do **not** troubleshoot or repair fuel leaks while the engine is running.
- If material is spilled, avoid contact and dispersal with runoff, soil, waterways, drains, and sewers. Absorb with sand, clay, or commercial absorbent. Transfer to containers and neutralize the material. Flush spill area with soap and excess water.
- Report spills effecting water source contamination to local authorities immediately.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.
- **Always** torque fittings and connections to the required specifications. over or under tightening can damage threads and create leaks.

Biodiesel

- Protect eyes.
- Protect skin.
- **Always** test for fuel leaks as instructed.
- Do **not** dilute.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Vapors accumulate near the floor. Check the work floor, sumps, and low lying areas for ignition sources before servicing equipment..
- Provide extra ventilation to the work area.
- Do **not** troubleshoot or repair fuel leaks while the engine is running.
- If material is spilled, avoid contact and dispersal with runoff, soil, waterways, drains, and sewers. Absorb with sand, clay, or commercial absorbent. Transfer to containers and neutralize the material. Flush spill area with soap and excess water.
- Report spills effecting water source contamination to local authorities immediately.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.
- **Always** torque fittings and connections to the required specifications. over or under tightening can damage threads and create leaks.

Compressed Natural Gas

- Protect eyes.
- Protect skin.
- **Always** be alert for the smell of gas. Compressed natural gas is typically treated with an odor producing chemical for leak detection. Non-refined sources of natural gas (landfill gas, biogas, coal bed gas, wellhead gas, etc.) can **not always** be detected by smell.
- **Always** test for fuel leaks as instructed. Odorant can fade.
- Upon entering a room or approaching a vehicle where the smell of gas is present, immediately shutoff all engines and ignition sources.
- Natural gas ignites when there is a 5% - 15% mixture in the air. Asphyxiation can occur when concentration reaches 21% or more.
- Do **not** start equipment or nearby equipment until a suspected gas leak is corrected and the area is ventilated.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Work in areas that do **not** share common ventilation with areas containing ignition sources.
- Store and service natural gas fueled equipment in large, well-ventilated areas, or outside.
- Provide extra ventilation to the work area.

- Natural gas accumulates near the ceiling. Check the ceiling of the work area for ignition sources before servicing equipment.
- **Only** disconnect gas lines in a well-ventilated area.
- Do **not** troubleshoot or repair gas leaks while the engine is running.
- Natural gas ignition systems produce high voltage during operation. Do **not** touch ignition wiring or components while the engine is operating. If necessary, use **only** insulated tools.
- Natural gas exhaust systems operate at higher temperatures than similar diesel exhaust systems. Do **not** touch exhaust components. Do **not** route lines or hoses which deteriorate from heat exposure near exhaust components or in the flow path of the exhaust.
- **Always** torque fittings and connections to the required specifications. over or under tightening can damage threads and create leaks.

Liquefied Natural Gas

- Protect eyes.
- Protect skin.
- **Always** be alert for the smell of gas. Liquefied natural gas may **not** have an odor. Non-refined sources of natural gas (landfill gas, biogas, coal bed gas, wellhead gas, etc.) can **not always** be detected by smell.
- **Always** test for fuel leaks as instructed. Odorant can fade.
- Upon entering a room or approaching a vehicle where the smell of gas is present, immediately shutoff all engines and ignition sources.
- Natural gas ignites when there is a 5% - 15% mixture in the air. Asphyxiation can occur when concentration reaches 21% or more.
- Do **not** start equipment or nearby equipment until a suspected gas leak is corrected and the area is ventilated.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Work in areas that do **not** share common ventilation with areas containing ignition sources.
- Store and service natural gas fueled equipment in large, well-ventilated areas, or outside.
- Provide extra ventilation to the work area.
- Natural gas accumulates near the ceiling. Check the ceiling of the work area for ignition sources before servicing equipment.
- **Only** disconnect gas lines in a well-ventilated area.
- Do **not** troubleshoot or repair gas leaks while the engine is running.
- Natural gas ignition systems produce high voltage during operation. Do **not** touch ignition wiring or components while the engine is operating. If necessary, use **only** insulated tools.
- Natural gas exhaust systems operate at higher temperatures than similar diesel exhaust systems. Do **not** touch exhaust components. Do **not** route lines or hoses which deteriorate from heat exposure near exhaust components or in the flow path of the exhaust..
- Liquefied natural gas is stored in vehicle tanks at extremely cold temperatures. If there is a liquefied natural gas spill, evacuate the area immediately and do not attempt to make contact with the liquid.
- **Always** torque fittings and connections to the required specifications. over or under tightening can damage threads and create leaks.
- Vapors accumulate near the floor. Check the work floor, sumps, and low lying areas for ignition sources before servicing equipment.

Liquefied Petroleum Gas

- Protect eyes.
- Protect skin.
- **Always** be alert for the smell of gas. Liquefied petroleum gas is typically treated with an odor producing chemical for leak detection.
- **Always** test for fuel leaks as instructed. Odorant can fade.
- Upon entering a room or approaching a vehicle where the smell of gas is present, immediately shutoff all engines and ignition sources.

- Do **not** start equipment or nearby equipment until a suspected gas leak is corrected and the area is ventilated.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Work in areas that do **not** share common ventilation with areas containing ignition sources.
- Store and service natural gas fueled equipment in large, well-ventilated areas, or outside.
- Provide extra ventilation to the work area.
- Liquefied petroluem gas accumulates near the floor. Check the work floor, sumps, and low lying areas for ignition sources before servicing equipment.
- **Only** disconnect gas lines in a well-ventilated area.
- Do **not** troubleshoot or repair gas leaks while the engine is running.
- Liquefied petroleum gas ignition systems produce high voltage during operation. Do **not** touch ignition wiring or components while the engine is operating. If necessary, use **only** insulated tools.
- Liquefied petroleum gas exhaust systems operate at higher temperatures than similar diesel exhaust systems. Do **not** touch exhaust components. Do **not** route lines or hoses which deteriorate from heat exposure near exhaust components or in the flow path of the exhaust..
- Liquefied natural gas is stored in vehicle tanks at extremely cold temperatures. If there is a liquefied natural gas spill, evacuate the area immediately and do not attempt to make contact with the liquid.
- **Always** torque fittings and connections to the required specifications. over or under tightening can damage threads and create leaks.

Power Generation Applications

Follow these recommended practices when interacting with equipment in generator set applications.

Power generation applications produce high voltage during operation. When servicing a generator set, the following safety precautions **must** be taken.

- Remove any debris from the generator set.
- Keep the floor clean and dry throughout servicing
- Service access doors **must** be secured in the "open" position before working on enclosed generator sets.
- Use insulated or non-conducting tools.
- Prevent accidental or remote starting. Disconnect the starting battery cables. Disconnect the negative (-) terminal first.
- Isolate all auxiliary supplies.
- Switch the generator set control panel "off."
- Place a "Do **Not** Operate" tag on the control panel.
- Lock the generator set circuit breaker in the "Open" position.
- Activate the manual "Emergency Stop" device.
- Do **not** step on the generator set when servicing, entering, or leaving the generator room.

Aftertreatment

Follow these recommended practices when interacting with equipment that utilize aftertreatment systems. For information regarding proper handling of various substances, refer to the manufacturer's safety data sheet.

Diesel Exhaust Fluid

- Avoid breathing vapor or mist.
- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes.
- Protect skin. In case of contact with skin, wash with soap and water.
- Do **not** ingest. If ingested, contact a physician immediately.

Diesel Particulate Filter

- Protect eyes.
- Protect skin.

- Avoid stirring up exhaust particulate dust.
- Avoid inhalation of exhaust particulate dust. Wear a dust mask. If respiratory irritation or discomfort occurs, leave the dusty area. Utilize breathing assistance or oxygen if necessary.
- Elevated concentrations of metals in the form of dust, soot, and contaminants are contained in these filters. Health regulations may exist for the materials found in these filters such as Zinc, Molybdenum, polynuclear aromatic hydrocarbons. Potentially toxic materials found in these filters are oxides of calcium, zinc, phosphorous, silicon, sulfur, and iron.
- Proper disposal of the exhaust dust and filter are required. Dispose of in accordance with local and environmental regulations.
- Diesel particulate filter maintenance **must** be completed by appropriately trained personnel.

Selective Catalytic Reduction (SCR) Catalyst

- Protect eyes.
- Protect skin.
- Avoid stirring up exhaust catalyst dust.
- Avoid inhalation of exhaust catalyst dust. Wear a dust mask. If respiratory irritation or discomfort occurs, leave the dusty area. Utilize breathing assistance or oxygen if necessary.
- Do **not** cut open exhaust catalyst assemblies.
- Proper disposal of the exhaust catalyst is required. Dispose of in accordance with local and environmental regulations.

Oxidation Catalysts

Types of Oxidation Catalysts may include, but are not limited to the following.

- Diesel Oxidation Catalyst (DOC)
- 3-way Oxidation Catalyst

When working with oxidation catalysts, perform the following.

- Protect eyes.
- Protect skin.
- Avoid stirring up exhaust catalyst dust.
- Avoid inhalation of exhaust catalyst dust. Wear a dust mask. If respiratory irritation or discomfort occurs, leave the dusty area. Utilize breathing assistance or oxygen if necessary.
- Do **not** cut open exhaust catalyst assemblies.

Common Substances

Follow these recommended practices when interacting with the following substances. For information regarding proper handling of various substances, refer to the manufacturer's safety data sheet.

Coolant

- Coolant is also referred to as antifreeze.
- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes. Receive medical attention immediately.
- Protect skin. In case of contact with skin, wash with soap and water. Remove contaminated clothing. If injection occurs, it is a medical emergency. Receive medical attention immediately.
- Do **not** ingest. If ingested, drink excess water for dilution and seek medical attention.
- Do **not** pour used antifreeze into containers that have been used to store other chemicals or products, such as oil or gasoline, unless they have been thoroughly cleaned.
- If material is spilled, avoid contact and dispersal with runoff, soil, waterways, drains, and sewers. Provide adequate ventilation to the area. Absorb with sand, clay, or commercial absorbent. Transfer to containers and neutralize the material. Flush spill area with soap and excess water.
- Report spills effecting water source contamination to local authorities immediately.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.

Liquid Nitrogen

- Work in a well-ventilated area.
- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes. Receive medical attention immediately.
- Protect skin. In case of contact with skin, receive medical attention immediately.
- Wear protective clothing and gloves that insulate.
- Handle items with tongs or wire hooks.
- Avoid prolonged breathing of liquid nitrogen vapors. Utilize breathing assistance or oxygen if necessary.

Lubricating Oil

See Lubricating Oil in the "Hazardous Substances" step.

Refrigerant

- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes. In case of frostbite, use lukewarm water, not hot. Seek medical attention if irritation continues.
- Protect skin. Wear leather or insulated gloves. In case of contact with skin, wash with soap and water. Seek medical attention if irritation continues.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.
- **Only** disconnect liquid refrigerant lines in a well-ventilated area. liquid refrigerant systems **must** be properly emptied and filled using equipment that prevents the release of refrigerant gas into the atmosphere. Federal law requires capturing and recycling refrigerant in the United States of America.

Solvents

- Follow the manufacturer's instructions for safe handling practices.
- Follow the manufacturer's recommendations for use.
- Some solvents are flammable and toxic..
- Protect eyes. In case of contact with eyes, follow manufacturer's recommendations.
- Protect skin. In case of contact with skin, follow manufacturer's recommendations.
- Dispose of in accordance with manufacturer's recommendations.

Starting Aids (Starting Fluid)

- Do **not** use starting fluid if the intake air heater option is used.
- Do **not** use volatile cold starting aids in underground mine or tunnel operations. The local United States Bureau of Mines inspector can provide more information and instructions.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Work in a well-ventilated area.
- Avoid inhalation.

Hazardous Substances

Hazardous substances are known to some state and federal agencies to be carcinogenic and cause reproductive harm. Hazardous substances that may be encountered during service events are listed below.

Diesel Engine Exhaust

- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes.
- Protect skin. In case of contact with skin, wash with soap and water.
- Avoid inhalation.

Lubricating Oil

- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes.
- Protect skin. In case of contact with skin, wash with soap and water.
- Do **not** ingest. If ingested, contact a physician immediately..
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.

- Do **not** allow water droplets to enter a container of hot oil. A violent reaction can result.

Mercury

- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes.
- Protect skin. In case of contact with skin, wash with soap and water.
- Do **not** ingest. If ingested, contact a physician immediately.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.

Vanadium Pentoxide

- Can be found in some selective catalytic reduction (SCR) catalysts.
- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes.
- Protect skin. In case of contact with skin, wash with soap and water.
- Do **not** ingest. If ingested, contact a physician immediately.
- Avoid inhalation of vapors or airborne particles.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.

Electrical Components

Follow these recommended practices when interacting with electrical components.

Batteries

- Protect eyes. Wear safety glasses or goggles. In case of battery acid contact with eyes, flush with water for a minimum of 15 minutes. Receive medical attention immediately.
- Protect skin. Wear rubber gloves and a chemical apron. In case of battery acid contact with skin or clothing, rinse with water for several minutes. Avoid spreading the acid. Receive medical attention immediately.
- Do **not** open the battery caps with your face over or near the battery.
- Remove rings, watches, long jewelry, or metallic items when working with or near batteries.
- Ventilate the battery compartment before servicing the battery.
- Work in a well-ventilated area.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Use insulated or non-conducting tools.
- Neutralize static buildup by contacting the nearest ground surface before working on a battery.
- Do **not** lift batteries by the posts.
- Do **not** touch both battery terminals with your bare hands at the same time.
- Disconnect the negative (-) battery cable first.
- Attach the negative (-) battery cable last.

Common Hazards

Follow these recommended practices when interacting with equipment as the following hazards may exist.

High Temperature Area

Be alert for high temperature areas which may cause severe burns. High temperature areas may be encountered in the following situations.

- On products that have just been turned off.
- On or around exhaust related components (turbocharger, aftertreatment systems, etc).
- In exhaust gas flow paths.
- Contacting hot fluid lines, tubes, or compartments.

Recommended Practices:

- Allow components to cool before servicing. Verify the temperature of the component. Utilize an infrared gun, temperature sensor, temperature gauge, or other reliable method to determine component temperature. Take appropriate precautions before starting work.

- Protect eyes.
- Protect skin. Wear insulated gloves.
- Ensure surrounding items do not come in contact with hot components or exhaust. Contact may ignite or melt those materials.

Heavy Objects

Be alert when working with heavy objects.

- Do **not** lift components that weigh 23 kg [50 lb] or more. Use mechanical help or seek assistance.
- Use mechanical help to move items whenever possible. Make sure the load is securely fastened to the equipment.
- Make sure lifting devices, like chains, hooks, slings, etc., are in good condition and are rated for the correct capacity before use.
- Make sure lifting devices are positioned correctly before use.
- Use a spreader bar when necessary.
- If the item can be lifted manually, squat to lift and lower the item. Do **not** bend at the waist.
- Maintain balance when lifting items by keeping feet apart or staggered if possible.
- If the item must be carried, make sure the path is clear when carrying the item to, and placing the item in, the desired location.

Pressurized Areas

Be alert for pressurized areas. Pressurized areas may be encountered in the following situations.

- Air, Oil, Fuel, and Cooling systems.
- When disconnecting or removing lines, fittings, or related items.
- When disconnecting a device from a pressurized system.
- When removing or loosening caps on tanks or pressurized systems.

Injuries that may result when interacting with pressurized areas are listed below.

- High pressure spray can penetrate the skin. Serious injury or death may result.
- Hot fluid spray can cause burns. See "High Temperature Area."

Recommended Practices:

- Protect skin. Wear impervious gloves. If skin penetration from high pressure spray occurs, it is a medical emergency. Receive medical attention immediately.
- Check for pressure leaks as instructed. **Never** check for pressure leaks with your hand.
- Allow product to cool before accessing pressurized areas.
- Relieve system pressure as instructed.
- Slowly loosen fill caps to relieve pressure before servicing.

Job Safety Assessment

Completing a Job Safety Assessment (JSA) prior to performing work helps identify job safety hazards and prevent incidents. Use the guidelines below to assess if a situation is safe or at risk prior to performing designated work. If deteremined to be at risk, take appropriate precautions to prepare for, or eliminate, the hazard. If the risks are uncontrollable, consult a knowledgeable resource to find a safe practice solution. A knowledgeable resource may include, but is not limited to, one of the following:

- Site supervisor
- Customer
- Work supervisor

Always check with the site where work is being performed to determine if safety assessment documentation is required.

Work Practices

Job Safety Analysis.

- Assess the job to identify safety hazards that may occur during the repair event.

Ascending or Descending

- Maintain 3 points of contact when using steps, ladders, or entering and exiting a unit.

Communication

- When working with others, make sure you understand what each other is doing to safely complete the task.

Eyes On Hands and Work.

- Confirm if you will be able to maintain an unobstructed view of your hands at all times while performing the task.

Eyes On Path

- Watch for hazards in your path to avoid trip or slip hazards. Examples are pits, platform edges, etc.

Line Of Fire

- Position yourself so that you avoid striking against, or being struck by, anything that can swing, fall, or roll.

Pinch Point

- Prevent exposure of all parts of your body to a nip hazard or pinch point.

Rushing

- Take adequate time to safely perform the job. Do **not** rush or take short cuts.

Follow Procedures

- Utilize QuickServe® Online or other standard procedures when available.
- Make sure the procedures are correct and safe.

Ergonomics

Back-Bending and Twisting

- Avoid bending forward more than 45 at your waist.
- Avoid working with your back twisted with loads over 23 kg [50 lb].

Knee

- Avoid bending your knee more than 90.
- Avoid kneeling for more than 4 hours per day.

Lifting and Lowering

- Squat to pick up parts.
- Keep loads close to the body when lifting or carrying.
- Use a team lift or a lifting device if the object is more than 23 kg [50 lb].

Pulling or Pushing

- Pull with your arms.
- Push with your legs.
- Avoid exerting more force than necessary.
- Avoid moving heavy load(s) too quickly.

Tools and Equipment

Selection

- Select the correct tool or equipment to perform the task.

Condition

- Confirm the tool or equipment is free of defects before use.
- Confirm that safety devices are in place before use.

Use

- Use the tool or equipment as directed.
- Follow the manufacturer's instructions.

Personal Protective Equipment (PPE)

Eye, Face, and Head Protection

- Confirm the eye, face, or head protection you plan to use are adequate for performing the task at hand.

Foot Protection

- Confirm the foot protection you plan to use is adequate for performing the task at hand in the current environment.

Fall Protection

- Fall protection should be used if you are working more than 1.2 m [4 ft] above the floor.
- Use fall protection if you have been properly trained to do so. If you are not trained to use fall protection, allow someone who has received proper training to perform the task.

Hand Protection

- Avoid exposing hands to cuts or burns while completing the task.
- Confirm the proper glove type is being used for the task at hand. Examples are cut-resistant, chemical-resistant, electric shock-resistant, electric arc flash, welding, etc.

Hearing Protection

- Hearing protection should be worn when required or recommended.

Body Protection

- Body parts should be protected from work hazards.
- Avoid contact with sharp edges, hot surfaces, etc.

Work Prcedures

Training

- Confirm if you have received task and safety training for the job being performed.

Working Alone

- Avoid working alone.
- Avoid working where you are **not** able to be seen or heard by another person.
- If you **must** work alone, notify others of your location and schedule check-in times.

Lockout and Tagout

- Lock out or tag out energy sources before work. Examples are electrical, mechanical, hydraulic, and pneumatic.

Barricades and Warnings

- Mark overhead work areas with barricade tape or signs.
- Mark open floor hazards with barricade tape, signs, or cones.

Confined Space

- Confirm if a confined space entry permit is required.
- If required, confirm the permit is posted, signed, and dated correctly.

Hot Work

- Confirm a functional fire extinguisher is readily available.
- Maintain separation between ignition sources and fuel sources.

Place Wheel Chocks

- Place wheel chocks at either the front or back tire of the unit prior to starting the task.

Spotter

- Use a spotter when moving a customer's unit.
- Confirm the driver can see and hear the spotter when moving.

Housekeeping (The 5 S's - Scrap or Segregate, Set to Order, Spotless, Standardize, and Sustain)

- Remove parts, extension cords, air hoses, and liquids from the work area that may cause trip, slip, or fall hazards.

General Repair Instructions

General Information

This system incorporates the latest technology at the time it was manufactured; yet, it is designed to be repaired using normal repair practices performed to quality standards.

⚠ WARNING ⚠

Cummins Inc. does not recommend or authorize any modifications or repairs to components except for those detailed in Cummins Service Information. In particular, unauthorized repair to safety-related components can cause personal injury or death. Below is a partial listing of components classified as safety-related:

1 Air Compressor
2 Air Controls
3 Air Shutoff Assemblies
4 Balance Weights
5 Cooling Fan
6 Fan Hub Assembly
7 Fan Mounting Bracket(s)
8 Fan Mounting Capscrews
9 Fan Hub Spindle
10 Flywheel
11 Flywheel Crankshaft Adapter
12 Flywheel Mounting Capscrews
13 Fuel Shutoff Assemblies
14 Fuel Supply Tubes
15 Lifting Brackets
16 Throttle Controls
17 Turbocharger Compressor Casing
18 Turbocharger Oil Drain Line(s)
19 Turbocharger Oil Supply Line(s)
20 Turbocharger Turbine Casing
21 Vibration Damper Mounting Capscrews
22 Manual Service Disconnect
23 High Voltage Interlock Loop
24 High Voltage Connectors/Connections and Harnesses
25 High Voltage Battery System
26 Power Inverter
27 Generator Motor
28 Clutch Pressure Plate

- Follow all safety instructions noted in the procedures
- Follow the manufacturer's recommendations for cleaning solvents and other substances used during repairs. Some solvents have been identified by government agencies as toxic or carcinogenic. Avoid excessive breathing, ingestion and contact with such substances. **Always** use good safety practices with tools and equipment
- Provide a clean environment and follow the cleaning instructions specified in the procedures
- All components **must** be kept clean during any repair. Contamination of the components will cause premature wear.
- Perform the inspections specified in the procedures
- Replace all components or assemblies which are damaged or worn beyond the specifications

- Use genuine Cummins new or ReCon® service parts and assemblies
- The assembly instructions have been written to use again as many components and assemblies as possible. When it is necessary to replace a component or assembly, the procedure is based on the use of new Cummins or Cummins ReCon® components. All of the repair services described in this manual are available from all Cummins Distributors and most Dealer locations.
- Follow the specified disassembly and assembly procedures to reduce the possibility of damage to the components

Welding on a Vehicle with an Electronic Controlled Fuel System

⚠CAUTION⚠

Disconnect both the positive (+) and negative (-) battery cables from the battery before welding on the vehicle. Attach the welder ground cable no more than 0.61 meters [2 feet] from the part being welded. Do not connect the ground clamp of the welder to any of the sensors, wiring harness, electronic control units or the components. Direct welding of any electronic components must not be attempted. Sensors, wiring harness, and electronic control unit should be removed if nearby welding will expose these components to temperatures beyond normal operation. Additionally, all electronic control unit connectors must be disconnected

General Cleaning Instructions

Definition of Clean

Parts **must** be free of debris that can contaminate any engine system. This does **not** necessarily mean they have to appear as new.

Sanding gasket surfaces until the factory machining marks are disturbed adds no value and is often harmful to forming a seal. It is important to maintain surface finish and flatness tolerances to form a quality sealing surface. Gaskets are designed to fill small voids in the specified surface finish.

Sanding gasket surfaces where edge-molded gaskets are used is most often unnecessary. Edge-molded gaskets are those metal carriers with sealing material bonded to the edges of the gasket to seal while the metal portion forms a metal to metal joint for stability. Any of the small amounts of sealing material that can stick to the parts are better removed with a blunt-edged scraper on the spots rather than spending time polishing the whole surface with an air sander or disc.

For those gaskets that do **not** have the edge molding, nearly all have a material that contains release agents to prevent sticking. Certainly this is **not** to say that some gaskets are **not** difficult to remove because the gasket has been in place a long time, has been overheated or the purpose of the release agent has been defeated by the application of some sealant. The object however is just to remove the gasket without damaging the surfaces of the mating parts without contaminating the engine (don't let the little bits fall where they can not be removed).

Bead blasting piston crowns until the dark stain is removed is unnecessary. All that is required is to remove the carbon build-up above the top ring and in the ring grooves. There is more information on bead blasting and piston cleaning later in this document.

Cummins Inc. does **not** recommend sanding or grinding the carbon ring at the top of cylinder liners until clean metal is visible. The liner will be ruined and any signs of a problem at the top ring reversal point (like a dust-out) will be destroyed. It is necessary to remove the carbon ring to provide for easier removal of the piston assembly. A medium bristle, high quality, steel wire wheel that is rated above the rpm of the power tool being used will be just as quick and there will be less damage. Yes, one **must** look carefully for broken wires after the piston is removed but the wires are more visible and can be attracted by a magnet.

Oil on parts that have been removed from the engine will attract dirt in the air. The dirt will adhere to the oil. If possible, leave the old oil on the part until it is ready to be cleaned, inspected and installed, and then clean it off along with any attracted dirt. If the part is cleaned then left exposed it can have to be cleaned again before installation. Make sure parts are lubricated with clean oil before installation. They do **not** need to be oiled all over but do need oil between moving parts (or a good lube system priming process conducted before cranking the engine).

Bead blasting parts to remove exterior paint is also usually unnecessary. The part will most likely be painted again so all that needs happen is remove any loose paint.

Abrasive Pads and Abrasive Paper

The keyword here is "abrasive". There is no part of an engine designed to withstand abrasion. That is they are all supposed to lock together or slide across each other. Abrasives and dirt particles will degrade both functions.

⚠ WARNING ⚠

Abrasive material must be kept out of or removed from oil passages and parts wear points. Abrasive material in oil passages can cause bearing and bushing failures that can progress to major component damage beyond reuse. This is particularly true of main and rod bearings.

Cummins Inc. does **not** recommend the use of emery cloth or sand paper on any part of an **assembled** engine or component including but **not** limited to removing the carbon ridge from cylinder liners or to clean block decks or counterbores.

Great care **must** be taken when using abrasive products to clean engine parts, particularly on partially assembled engines. Abrasive cleaning products come in many forms and sizes. All of them contain aluminum oxide particles, silicon carbide, or sand or some other similar hard material. These particles are harder than most of the parts in the engine. Since they are harder, if they are pressed against softer material they will either damage the material or become embedded in it. These materials fall off the holding media as the product is used. If the products are used with power equipment the particles are thrown about the engine. If the particles fall between two moving parts, damage to the moving parts is likely.

If particles that are smaller than the clearance between the parts while they are at rest (engine stopped), but larger than the running clearance then damage will occur when the parts move relative to each other (engine started). While the engine is running and there is oil pressure, particles that are smaller than the bearing clearance are likely to pass between the parts without damage and be trapped in the oil filter. However, particles larger than the bearing clearance will remove material from one part and can become embedded in one of the parts. Once embedded in one part it will

abrade the other part until contact is no longer being made between the two parts. If the damage sufficiently degrades the oil film, the two parts will come into contact resulting in early wear-out or failure from lack of effective lubrication.

Abrasive particles can fly about during cleaning it is **very** important to block these particles from entering the engine as much as possible. This is particularly true of lubricating oil ports and oil drilling holes, especially those located downstream of the lubricating oil filters. Plug the holes instead of trying to blow the abrasive particles and debris with compressed air because the debris is often simply blown further into the oil drilling.

All old gasket material **must** be removed from the parts gasket surfaces. However, it is **not** necessary to clean and polish the gasket surface until the machining marks are erased. Excessive sanding or buffing can damage the gasket surface. Many newer gaskets are of the edge molded type (a steel carrier with a sealing member bonded to the steel). What little sealing material that can adhere is best removed with a blunt-edged scraper or putty knife. Cleaning gasket surfaces where an edge-molded gasket is used with abrasive pads or paper is usually a waste of time.

⚠ WARNING ⚠

Excessive sanding or grinding the carbon ring from the top of the cylinder liners can damage the liner beyond reuse. The surface finish will be damaged and abrasive particles can be forced into the liner material which can cause early cylinder wear-out or piston ring failures.

Tape off or plug all openings to any component interior before using abrasive pads or wire brushes. If really necessary because of time to use a power tool with abrasive pads, tape the oil drillings closed or use plug and clean as much of the surface as possible with the tool but clean around the oil hole/opening by hand so as to prevent contamination of the drilling. Then remove the tape or plug and clean the remaining area carefully and without the tool. DO NOT use compressed air to blow the debris out of oil drilling on an assembled engine! More likely than **not**, the debris can be blown further into the drilling. Using compressed air is fine if both ends of the drilling are open but that is rarely the case when dealing with an assembled engine.

Gasket Surfaces

The object of cleaning gasket surfaces is to remove any gasket material, not refinish the gasket surface of the part.

Cummins Inc. does **not** recommend any specific brand of liquid gasket remover. If a liquid gasket remover is used, check the directions to make sure the material being cleaned will **not** be harmed.

Air powered gasket scrapers can save time but care must be taken to **not** damage the surface. The angled part of the scraper must be against the gasket surface to prevent the blade from digging into the surface. Using air powered gasket scrapers on parts made of soft materials takes skill and care to prevent damage.

Do **not** scrape or brush across the gasket surface if at all possible.

Solvent and Acid Cleaning

Several solvent and acid-type cleaners can be used to clean the disassembled engine parts (other than pistons. See Below). Experience has shown that the best results can be obtained using a cleaner that can be heated to 90° to 95° Celsius (180° to 200° Fahrenheit). Kerosene emulsion based cleaners have different temperature specifications, see below. A cleaning tank that provides a constant mixing and filtering of the cleaning solution will give the best results. Cummins Inc. does not recommend any specific cleaners. Always follow the cleaner manufacturer's instructions. Remove all the gasket material, o-rings, and the deposits of sludge, carbon, etc., with a wire brush or scraper before putting the parts in a cleaning tank. Be careful not to damage any gasket surfaces. When possible, steam clean the parts before putting them in the cleaning tank.

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturers recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

Experience has shown that kerosene emulsion based cleaners perform the best to clean pistons. These cleaners should **not** be heated to temperature in excess of 77°C (170°F). The solution begins to break down at temperatures in excess of 82°C (180°F) and will be less effective.

Do **not** use solutions composed mainly of chlorinated hydrocarbons with cresols, phenols and/or cresylic components. They often do **not** do a good job of removing deposits from the ring groove and are costly to dispose of properly.

Solutions with a pH above approximately 9.5 will cause aluminum to turn black; therefore do **not** use high alkaline solutions.

Chemicals with a pH above 7.0 are considered alkaline and those below 7.0 are acidic. As you move further away from the neutral 7.0, the chemicals become highly alkaline or highly acidic.

Remove all the gasket material, o-rings, and the deposits of sludge, carbon, etc., with a wire brush or scraper before putting the parts in a cleaning tank. Be careful to **not** damage any gasket surfaces. When possible use hot high

pressure water or steam clean the parts before putting them in the cleaning tank. Removing the heaviest dirt before placing in the tank will allow the cleaner to work more effectively and the cleaning agent will last longer.

Rinse all the parts in hot water after cleaning. Dry completely with compressed air. Blow the rinse water from all the capscrew holes and the oil drillings.

If the parts are **not** to be used immediately after cleaning, dip them in a suitable rust proofing compound. The rust proofing compound **must** be removed from the parts before assembly or installation on the engine.

Steam Cleaning

Steam cleaning can be used to remove all types of dirt that can contaminate the cleaning tank. It is a good method for cleaning the oil drillings and coolant passages

⚠WARNING⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

Do **not** steam clean the following components:

- Electrical Components
- Wiring Harnesses
- Belts and Hoses
- Bearings (ball or taper roller)
- Electronic Control Module (ECM)
- ECM Connectors
- Capacitive Coil Driver Module (CCD)
- Ignition Coils and Leads
- NOx Sensor
- Fuel Control Valve
- Throttle Driver and Actuator.

Plastic Bead Cleaning

Cummins Inc. does **not** recommend the use of glass bead blast or walnut shell media on **any** engine part. Cummins Inc. recommends using **only** plastic bead media, Part Number 3822735 or equivalent on any engine part. **Never** use sand as a blast media to clean engine parts. Glass and walnut shell media when **not** used to the media manufacturer's recommendations can cause excess dust and can embed in engine parts that can result in premature failure of components through abrasive wear.

Plastic bead cleaning can be used on many engine components to remove carbon deposits. The cleaning process is controlled by the use of plastic beads, the operating pressure and cleaning time.

△CAUTION△

Do not use bead blasting cleaning methods on aluminum pistons skirts or the pin bores in any piston, piston skirt or piston crown. Small particles of the media will embed in the aluminum or other soft metal and result in premature wear of the cylinder liner, piston rings, pins and pin bores. Valves, turbocharger shafts, etc., can also be damaged. Follow the cleaning directions listed in the procedures.

△CAUTION△

Do not contaminate wash tanks and tank type solvent cleaners with the foreign material and plastic beads. Remove the foreign material and plastic beads with compressed air, hot high pressure water or steam before placing them in tanks or cleaners. The foreign material and plastic beads can contaminate the tank and any other engine parts cleaned in the tank. Contaminated parts may cause failures from abrasive wear.

Plastic bead blasting media, Part Number 3822735, can be used to clean all piston ring grooves. Do **not** sure any bead blasting media on piston pin bores or aluminum skirts.

Follow the equipment manufacturer's cleaning instructions. Make sure to adjust the air pressure in the blasting machine to the bead manufacturer's recommendations. Turning up the pressure can move material on the part and cause the plastic bead media to wear out more quickly. The following guidelines can be used to adapt to manufacturer's instructions:

1 Bead size: U.S. size Number 16 — 20 for piston cleaning with plastic bead media, Part Number 3822735

2 Operating Pressure — 270 kPa (40 psi) for piston cleaning. Pressure should not cause beads to break.

3 Steam clean or wash the parts with solvent to remove all of the foreign material and plastic beads after cleaning. Rinse with hot water. Dry with compressed air.

⚠CAUTION⚠

The bead blasting operation must not disturb the metal surface. If the metal surface is disturbed the engine can be damaged due to increased parts clearance or inadequate surface finish on parts that move against other parts.

When cleaning pistons, it is **not** necessary to remove all the dark stain from the piston. All that is necessary is to remove the carbon on the rim and in the ring grooves. This is best done by directing the blast across the part as opposed to straight at the part. If the machining marks are disturbed by the blasting process, then the pressure is too high or the blast is being held on one spot too long. The blast operation **must not** disturb the metal surface.

Walnut shell bead blast material is sometimes used to clean ferrous metals (iron and steel). Walnut shell blasting produces a great amount of dust particularly when the pressure if the air pressure on the blasting machine is increased above media manufacturer's recommendation. Cummins Inc. recommends **not** using walnut shell media to clean engine parts due to the risk media embedment and subsequent contamination of the engine.

Cummins Inc. now recommends glass bead media **NOT** used to clean any engine parts. Glass media is too easily embedded into the material particularly in soft materials and when air pressures greater than media manufacturer's recommend are used. The glass is an abrasive so when it is in a moving part, that part is abrading all the parts in contact with it. When higher pressures are used the media is broken and forms a dust of a very small size that floats easily in the air. This dust is very hard to control in the shop, particularly if **only** compressed air (and not hot water) is used to blow the media after it is removed from the blasting cabinet (blowing the part off inside the cabinet may remove large accumulations but never removes all the media).

Bead blasting is best used on stubborn dirt/carbon build-up that has **not** been removed by first steam/higher pressure washing then washing in a heated wash tank. This is particularly true of pistons. Steam and soak the pistons first then use the plastic bead method to safely remove the carbon remaining in the grooves (instead of running the risk of damaging the surface finish of the groove with a wire wheel or end of a broken piston ring. Make sure the parts are dry and oil free before bead blasting to prevent clogging the return on the blasting machine.

Always direct the bead blaster nozzle "across" rather than directly at the part. This allows the bead to get under the unwanted material. Keep the nozzle moving rather than hold on one place. Keeping the nozzle directed at one-place too long causes the metal to heat up and be moved around. Remember that the spray is **not** just hitting the dirt or carbon. If the machining marks on the piston groove or rim have been disturbed then there has **not** been enough movement of the nozzle and/or the air pressure is too high.

Never bead blast valve stems. Tape or use a sleeve to protect the stems during bead blasting. Direct the nozzle across the seat surface and radius rather than straight at them. The object is to remove any carbon build up and continuing to blast to remove the stain is a waste of time.

Fuel System

When servicing any fuel system components, which can be exposed to potential contaminants, prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. If the surrounding areas are **not** cleaned, dirt or contaminants can be introduced into the fuel system.

The internal drillings of some injectors are extremely small and susceptible to plugging from contamination. Some fuel injection systems can operate at very high pressures. High pressure fuel can convert simple particles of dirt and rust into a highly abrasive contaminant that can damage the high pressure pumping components and fuel injectors.

Electrical contact cleaner can be used if steam cleaning tools are **not** available. Use electrical contact cleaner rather than compressed air, to wash dirt and debris away from fuel system fittings. Diesel fuel on exposed fuel system parts attracts airborne contaminants.

Choose lint free towels for fuel system work.

Cap and plug fuel lines, fittings, and ports whenever the fuel system is opened. Rust, dirt, and paint can enter the fuel system whenever a fuel line or other component is loosened or removed from the engine. In many instances, a good practice is to loosen a line or fitting to break the rust and paint loose, and then clean off the loosened material.

When removing fuel lines or fittings from a new or newly-painted engine, make sure to remove loose paint flakes/chips that can be created when a wrench contacts painted line nuts or fittings, or when quick disconnect fittings are removed.

Fuel filters are rated in microns. The word micron is the abbreviation for a micrometer, or one millionth of a meter. The micron rating is the size of the smallest particles that will be captured by the filter media. As a reference, a human hair

is 76 microns [0.003 in] in diameter. One micron measures 0.001 mm [0.00004 in.]. The contaminants being filtered out are smaller than can be seen with the human eye, a magnifying glass, or a low powered microscope.

The tools used for fuel system troubleshooting and repair are to be cleaned regularly to avoid contamination. Like fuel system parts, tools that are coated with oil or fuel attract airborne contaminants. Remember the following points regarding your fuel system tools:

- Fuel system tools are to be kept as clean as possible.
- Clean and dry the tools before returning them to the tool box.
- If possible, store fuel system tools in sealed containers.
- Make sure fuel system tools are clean before use.

Acronyms and Abbreviations

General Information

The following list contains some of the acronyms and abbreviations used in this manual.

ANSI	American National Standards Institute
API	American Petroleum Institute
ASTM	American Society of Testing and Materials
ATDC	After Top Dead Center
bhp	Brake Horsepower
BTU	British Thermal Unit
BTDC	Before Top Dead Center
°C	Celsius
CAN	Controller Area Network
CARB	California Air Resources Board
CCA	Cold Cranking Amperes
CCV	Closed Crankcase Ventilation
CES	Cummins Engineering Standard
CIB	Customer Interface Box
C.I.D.	Cubic Inch Displacement
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CPL	Control Parts List
cSt	Centistokes
DEF	Diesel Exhaust Fluid
DOC	Diesel Oxidation Catalyst
DPF	Diesel Particulate Filter
ECM	Engine Control Module
EFC	Electronic Fuel Control
EGR	Exhaust Gas Recirculation
EPA	Environmental Protection Agency
ESN	Engine Serial Number
°F	Fahrenheit
ft-lb	Foot-Pound Force
FMI	Failure Mode Indentifier
GVW	Gross Vehicle Weight
Hg	Mercury
hp	Horsepower
H_2O	Water
inHg	Inches of Mercury
in H_2 0	Inches of Water
ICM	Ignition Control Module
IEC	International Electrotechnical Commission
JSA	Job Safety Assessment
km/l	Kilometers per Liter
kPa	Kilopascal
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LTA	Low Temperature Aftercooler
MCRS	Modular Common Rail System

MIL	Malfunction Indicator Lamp
MPa	Megapascal
mph	Miles Per Hour
mpq	Miles Per Quart
N•m	Newton-meter
NOx	Nitrogen Oxides
NG	Natural Gas
O2	Oxygen
OAT	Organic Acid Technology
OBD	On-Board Diagnostics
OEM	Original Equipment Manufacturer
OSHA	Occupational Safety and Health Administration
PID	Parameter Identification Descriptions
PPE	Personal Protective Equipment
ppm	Parts Per Million
psi	Pounds Per Square Inch
PTO	Power Takeoff
QSOL	QuickServe® Online
REPTO	Rear Engine Power Takeoff
RGT	Rear Gear Train
rpm	Revolutions Per Minute
SAE	Society of Automotive Engineers
SCA	Supplemental Coolant Additive
SCR	Selective Catalytic Reduction
STC	Step Timing Control
SID	Subsystem Identification Descriptions
TDC	Top Dead Center
TSB	Technical Service Bulletin
ULSD	Ultra Low Sulfur Diesel
VDC	Volts of Direct Current
VGT	Variable Geometry Turbocharger
VS	Variable Speed
VSS	Vehicle Speed Sensor

Section TF - Troubleshooting Fault Codes

Section Contents

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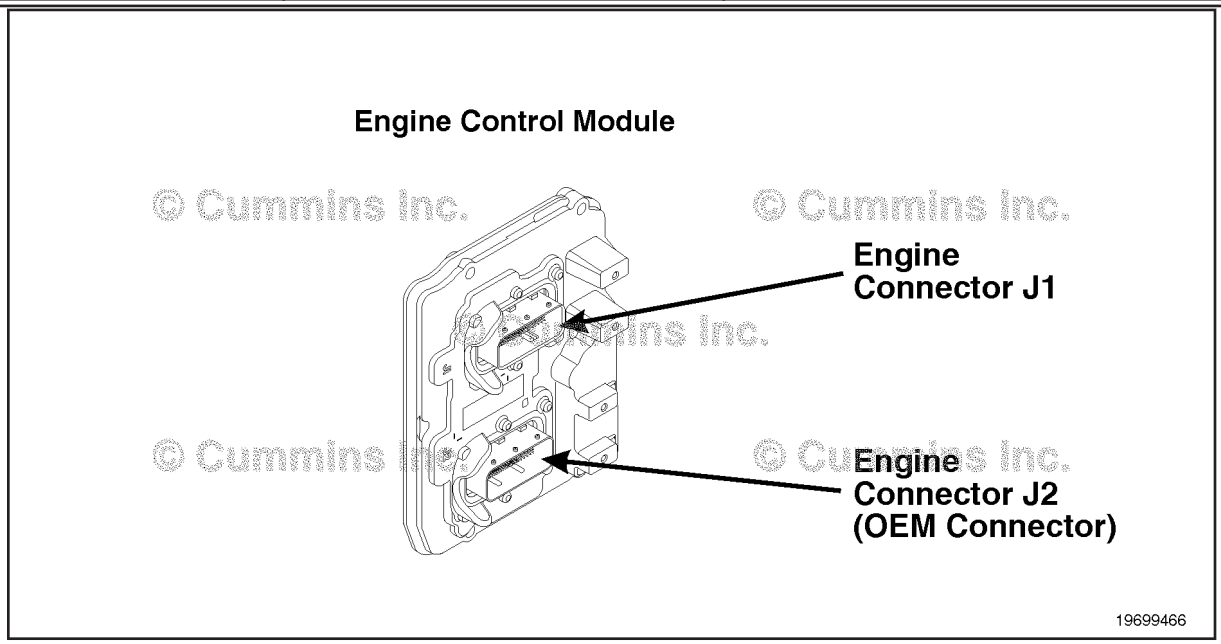
Fault Code 111

Engine Control Module Critical Internal Failure - Bad Intelligent Device or Component

CODES	REASON	EFFECT
Fault Code: 111 PID(P), SID(S): S254 SPN: 629 FMI: 12/12 Lamp: Red SRT:	Engine Control Module Critical Internal Failure - Bad Intelligent Device or Component. Error internal to the engine control module (ECM) related to memory hardware malfunctions or internal ECM voltage supply circuits.	Engine may **not** start or may be difficult to start.



Engine Control Module (ECM)

Circuit Description:

The ECM has internal diagnostics that continuously run and check the internal memory.

Component Location:

The Engine Control Module (ECM) is mounted on the intake manifold side of the engine.

Conditions for Running the Diagnostics:

This diagnostic runs continuously when the keyswitch is in the ON position or when the engine is running.

Conditions for Setting the Fault Codes:

The Engine Control Module (ECM) detected a read or write error internal to the ECM.

Action Taken When the Fault Code is Active:

- The ECM illuminates the red STOP ENGINE lamp immediately after the diagnostic runs and fails.
- The engine may **not** start.

Conditions for Clearing the Fault Code:

- To validate the repair, perform a key cycle, start the engine and let it idle for 1 minute.
- The fault code status displayed by INSITE™ electronic service tool will change to INACTIVE immediately after the diagnostic runs and passes.
- The ECM will turn off the red STOP ENGINE lamp immediately after the diagnostic runs and passes.

The Reset All Faults command in INSITE™ electronic service tool can be used to clear active and inactive faults.

Shop Talk:

This fault code can **only** be caused by an internal ECM problem. Repairs are **not** possible for the ECM.

Refer to Troubleshooting Fault Code 111.

FAULT CODE 111 - Engine Control Module Critical Internal Failure - Bad Intelligent Device or Component

Associated Procedures			
Procedure Title	**Procedure Number**	**Service Model Name**	**Bulletin Number**
Engine Control Module	Refer to Procedure 019-031	ISX12/ISX11.9 CM2250	2883445
Engine Control Module	Refer to Procedure 019-031	QSX15 CM2250 ECF	2883557
Engine Control Module	Refer to Procedure 019-031	PowerGen QSX15 CM2250 ECF	4310661
Engine Control Module	Refer to Procedure 019-031	PowerGen QSX15 CM2250	4310664
Engine Control Module	Refer to Procedure 019-031	QSX11.9 CM2250 ECF	2883561
Engine Control Module	Refer to Procedure 019-031	QSB6.7 CM2250 EC	2883621
Engine Control Module	Refer to Procedure 019-031	QSB3.3 CM2250 EC	2883647
Engine Control Module	Refer to Procedure 019-031	ISF3.8 CM2220 ISF3.8 CM2220 AN ISF3.8 CM2220 IAN	4021704
Engine Control Module	Refer to Procedure 019-031	ISZ13 CM2150	4022133
Engine Control Module	Refer to Procedure 019-031	ISF2.8 CM2220 E ISF2.8 CM2220 AN ISF2.8 CM2220 IAN	4022178
Engine Control Module	Refer to Procedure 019-031	ISF3.8 CM2220 F103	4310839
Engine Control Module	Refer to Procedure 019-031	ISB4.5, ISB6.7, ISD4.5, and ISD6.7 CM2150 SN	4022188
Engine Control Module	Refer to Procedure 019-031	ISL8.9 CM2150 SN	4022190
Engine Control Module	Refer to Procedure 019-031	ISM11 CM876 SN	4022196
Engine Control Module	Refer to Procedure 019-031	ISX15 CM2250 GX CM2250	4022250
Engine Control Module	Refer to Procedure 019-031	ISB6.7 CM2250	4022254
Engine Control Module	Refer to Procedure 019-031	QSB6.7 CM2250	4022255
Engine Control Module	Refer to Procedure 019-031	QSL9 CM2250	4022256
Engine Control Module	Refer to Procedure 019-031	ISC8.3 and ISL9 CM2250	4022257
Engine Control Module	Refer to Procedure 019-031	Marine QSB6.7 CM2250	4310611
Engine Control Module	Refer to Procedure 019-031	ISB6.7 CM2350 B101	2883567
Engine Control Module	Refer to Procedure 019-031	ISL9 CM2350 L101	4310787
Engine Control Module	Refer to Procedure 019-031	ISX12 CM2350 X102	4310646
Engine Control Module	Refer to Procedure 019-031	ISX15 CM2250 SN	4310736
Engine Control Module	Refer to Procedure 019-031	ISX15 CM2350 X101	4310641
Engine Control Module	Refer to Procedure 019-031	ISF2.8 CM2220 F101	4310846
Engine Control Module	Refer to Procedure 019-031	ISX15 CM2250 SN	4310736
Engine Control Module	Refer to Procedure 019-031	ISB4.5 CM2350 B104	4332646
Engine Control Module	Refer to Procedure 019-031	ISB6.7 CM2350 B103	4332641
Engine Control Module	Refer to Procedure 019-031	QSB6.7 CM2350 B105	4332778
Engine Control Module	Refer to Procedure 019-031	QSL9 CM2350 L102	4332796
Engine Control Module	Refer to Procedure 019-031	ISB/ISD4.5 CM2150 B119	4358465
Engine Control Module	Refer to Procedure 019-031	ISB/ISD6.7 CM2150 B120	4358470
Engine Control Module	Refer to Procedure 019-031	ISL8.9 CM2150 L110	4358475
Engine Control Module	Refer to Procedure 019-031	ISF3.8 CM2220 F110	4358480
Engine Control Module	Refer to Procedure 019-031	QSL9 M CM2250 L106	4358343
Engine Control Module	Refer to Procedure 019-031	ISL9 CM2350 L111	4367223
Engine Control Module	Refer to Procedure 019-031	QSB6.7 CM2350 B112	4358498

Associated Procedures			
Procedure Title	**Procedure Number**	**Service Model Name**	**Bulletin Number**
Engine Control Module	Refer to Procedure 019-031	QSZ13 CM2150 Z101	4358364
Engine Control Module	Refer to Procedure 019-031	QSZ13 CM2150 Z102	4358369
Engine Control Module	Refer to Procedure 019-031	QSF2.8 CM2880 F105	4358561
Engine Control Module	Refer to Procedure 019-031	QSB4.5 CM2350 B106	4367376
Engine Control Module	Refer to Procedure 019-031	QSF3.8 CM2350 F107	4367316
Engine Control Module	Refer to Procedure 019-031	ISF3.8 CM2350 F109	4367218
Engine Control Module	Refer to Procedure 019-031	QSG12 CM2350 G110	4367323
Engine Control Module	Refer to Procedure 019-031	QSG12 CM2350 G113	5467252
Engine Control Module	Refer to Procedure 019-031	ISV5.0 CM3230 V104	4367291
Engine Control Module	Refer to Procedure 019-031	QSF2.8 CM2880 F114	4383734
Engine Control Module	Refer to Procedure 019-031	QSB6.7 CM2250 B128	4388601
Engine Control Module	Refer to Procedure 019-031	QSL9 CM2250 L115	4388626
Engine Control Module	Refer to Procedure 019-031	ISF2.8 CM2220 F117	4388578
Engine Control Module	Refer to Procedure 019-031	QSL9 CM2350 L107	4367386
Engine Control Module	Refer to Procedure 019-031	QSF3.8 CM2350 F118	4388708
Engine Control Module	Refer to Procedure 019-031	QSF3.8 CM2350 F119	4388703
Engine Control Module	Refer to Procedure 019-031	QSB6.7 CM2350 B130	4388668
Engine Control Module	Refer to Procedure 019-031	QSB4.5 CM2350 B122	4388767
Engine Control Module	Refer to Procedure 019-031	QSL9 CM2350 L118	4388673
Engine Control Module	Refer to Procedure 019-031	X15 CM2350 X114B	5411181
Engine Control Module	Refer to Procedure 019-031	X15 CM2350 X116B	5411186
Engine Control Module	Refer to Procedure 019-031	QSB4.5 CM2250 B131	4388774
Engine Control Module	Refer to Procedure 019-031	QSB3.3 CM2250 B137	5411058
Engine Control Module	Refer to Procedure 019-031	QSX15 CM2350 X118	5467247
Engine Control Module	Refer to Procedure 019-031	QSX15 CM2250 X115	4388739
Engine Control Module	Refer to Procedure 019-031	ISB6.7 CM2350 B142	5411131
Engine Control Module	Refer to Procedure 019-031	B6.7 CM2350 B121B	5411223
Engine Control Module	Refer to Procedure 019-031	ISF2.8 CM2220 F126	5411159
Engine Control Module	Refer to Procedure 019-031	F3.8 CM2350 F120B	5411237
Engine Control Module	Refer to Procedure 019-031	L9 CM2350 L116B	5411330
Engine Control Module	Refer to Procedure 019-031	B4.5 CM2350 B129B	5411247
Engine Control Module	Refer to Procedure 019-031	B4.5 CM2350 B147B	5411252
Engine Control Module	Refer to Procedure 019-031	B6.7 CM2350 B135B	5411257
Engine Control Module	Refer to Procedure 019-031	B6.7 CM2350 B148B	5411262
Engine Control Module	Refer to Procedure 019-031	L9 CM2350 L119B	5411267
Engine Control Module	Refer to Procedure 019-031	QSB6.7 CM2350 B145	5411273
Engine Control Module	Refer to Procedure 019-031	QSL9 CM2350 L122	5411278
Engine Control Module	Refer to Procedure 019-031	QSB4.5 CM2350 B144	5411382
Engine Control Module	Refer to Procedure 019-031	L9 CM2350 L123B	5411465
Engine Control Module	Refer to Procedure 019-031	QSF3.8 CM2350 F125	5411494
Engine Control Module	Refer to Procedure 019-031	QSF2.8 CM2880 F131	5411489
Engine Control Module	Refer to Procedure 019-031	QSF2.8 CM2880 F124	5411484
Engine Control Module	Refer to Procedure 019-031	ISF2.8 CM2220 F122	5467376
Engine Control Module	Refer to Procedure 019-031	F3.8 CM2350 F132B	5467327
Engine Control Module	Refer to Procedure 019-031	R2.8 CM2220 R101B	5467556
Engine Control Module	Refer to Procedure 019-031	ISB5.9 CM2880 B110	4332883

TROUBLESHOOTING SUMMARY

⚠CAUTION⚠

To reduce the possibility of damaging a new engine control module (ECM), all other active fault codes must be investigated prior to replacing the ECM.

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the ECM.**		
STEP 1A:	**Check the ECM.**	**Fault Code 111 inactive?**	
STEP 1B:	**Check the inactive counts of Fault Code 111.**	**Less than 3 counts?**	
STEP 2:	**Check ECM calibration and clear fault codes.**		
STEP 2A:	**Check if an ECM calibration update is available.**	**If a calibration update for this fault code is available, does the ECM contain that revision or higher?**	
STEP 2B:	**Disable the fault code.**	**Fault code inactive?**	

TROUBLESHOOTING STEP

STEP 1: Check the ECM.

STEP 1A: Check the ECM.

Condition:
- Connect all components.

Action	Specification/Repair	Next Step
Check the ECM. • Turn the keyswitch OFF and wait 5 seconds. • Start the engine and let it idle for 1 minute.	Fault Code 111 inactive? **YES**	1B
	Fault Code 111 inactive? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in the Associated Procedures Table.	2A

STEP 1B: Check the inactive counts of Fault Code 111.

Condition:
- Turn the keyswitch ON.

Action	Specification/Repair	Next Step
Check the inactive counts of Fault Code 111. • Use INSITE™ electronic service tool to read the inactive counts of Fault Code 111.	Less than 3 counts? **YES**	2A
	Less than 3 counts? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in the Associated Procedures Table.	Repair complete

STEP 2: Check ECM calibration and clear fault codes.

STEP 2A: Check if an ECM calibration update is available.

Condition:
- Connect all components.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Compare the ECM code and revision number in the ECM to the calibration revisions listed in the ECM Calibration Revision History for applicable changes related to this fault code. • Use INSITE™ electronic service tool to find the present ECM code and revision number in the ECM. The ECM code and revision number are found in the Calibration Information section of System ID and Dataplate in Features and Parameters.	If a calibration update for this fault code is available, does the ECM contain that revision or higher? **YES**	2B
	If a calibration update for this fault code is available, does the ECM contain that revision or higher? **NO** **Repair:** If necessary, calibrate the ECM. Refer to Procedure 019-032 in Section 19.	2B

STEP 2B: Disable the fault code.

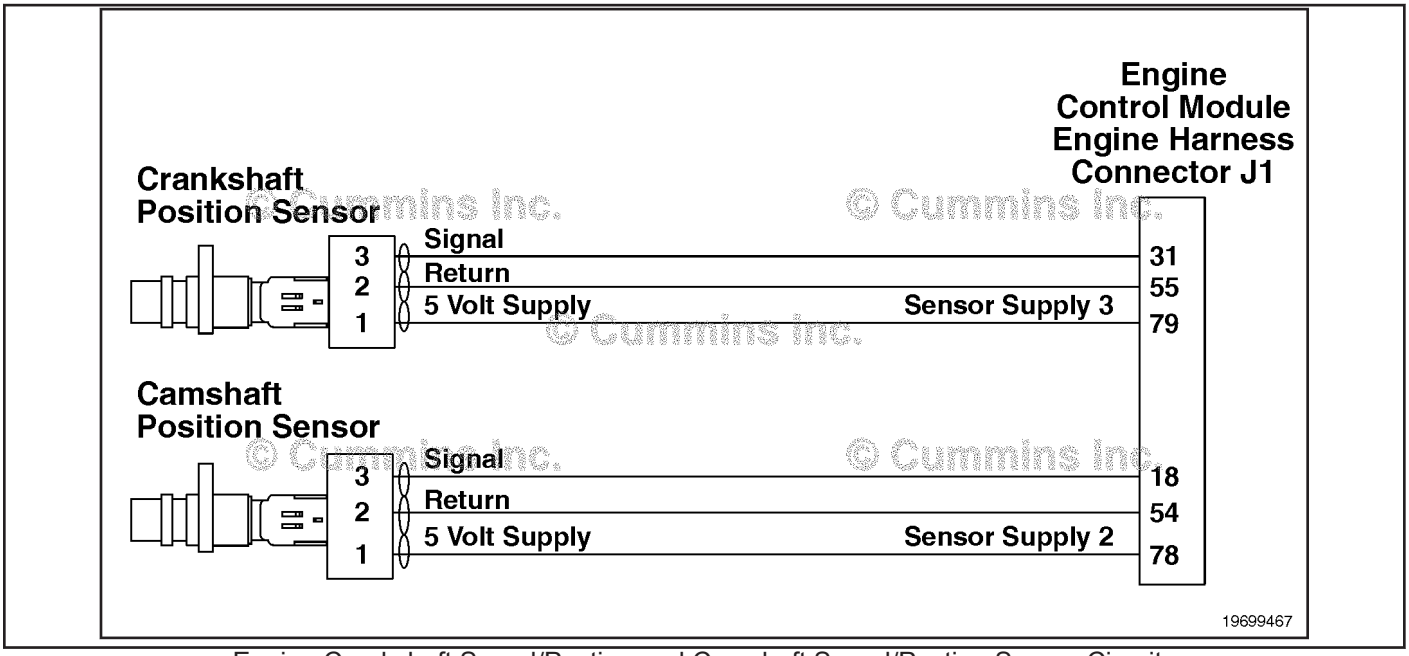
Condition:
- Connect all components.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Disable and clear the fault code. • Operate the engine within the "Conditions for Clearing the Fault Code" found in the Overview section of this troubleshooting procedure.	Fault code inactive? **YES**	Repair complete
	Fault code inactive? **NO** **Repair:** Return to the troubleshooting steps or contact a Cummins® Authorized Repair Location if all steps have been completed and checked again.	1A

Fault Code 115

Engine Magnetic Speed/Position Lost Both of Two Signals - Data Erratic, Intermittent, or Incorrect

CODES	REASON	EFFECT
Fault Code: 115 PID(P), SID(S): P190 SPN: 612 FMI: 2/2 Lamp: Red SRT:	Engine Magnetic Speed/Position Lost Both of Two Signals - Data Erratic, Intermittent, or Incorrect. The ECM has detected the primary and backup speed sensor signals are connected backwards.	The engine will shut down or will **not** start.



Engine Crankshaft Speed/Postion and Camshaft Speed/Postion Sensor Circuits

Circuit Description:

The crankshaft position and camshaft position sensors are Hall effect type sensors. The engine control module (ECM) provides a 5 volt supply to the position sensor and a return circuit. As the teeth on the crankshaft speed ring or the dimples in the back of the camshaft gear move past the position sensor, a signal is generated on the position sensor signal circuit. The ECM interprets this signal and converts it to an engine speed. A missing tooth on the crankshaft gear is used by the ECM to determine the position of the engine.

Component Location:

The crankshaft position and camshaft position sensor location varies, depending on engine model.

Conditions for Running the Diagnostics:

This diagnostic runs continuously when the engine is running.

Conditions for Setting the Fault Codes:

The Engine Control Module (ECM) detected the crankshaft position and camshaft position signal inputs to the ECM are reversed.

Action Taken When the Fault Code is Active:
- The ECM illuminates the red STOP ENGINE lamp immediately after the diagnostic runs and fails.

Conditions for Clearing the Fault Code:
- To validate the repair, perform a key cycle, start the engine and let it idle for 1 minute.
- The fault code status displayed by INSITE™ electronic service tool will change to INACTIVE immediately after the diagnostic runs and passes.
- The ECM will turn off the red STOP ENGINE lamp immediately after the diagnostic runs and passes.
- The Reset All Faults command in INSITE™ electronic service tool can be used to clear active and inactive faults.

Shop Talk:

This fault code indicates the crankshaft position sensor and the camshaft position sensor wiring harness connectors are reversed. As a result, the engine will **not** start.

Refer to Troubleshooting Fault Code 115.

FAULT CODE 115 - Engine Magnetic Speed/Position Lost Both of Two Signals - Data Erratic, Intermittent, or Incorrect

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	**Check for Fault Code 115.**	**Active or inactive counts of Fault Code 115?**	
STEP 1B:	**Check the battery voltage.**	**Battery voltage acceptable in normal and cranking conditions?**	
STEP 2:	**Check engine control module (ECM) calibration and clear fault codes.**		
STEP 2A:	**Check if an ECM calibration update is available.**	**If a calibration update for this fault code is available, does the ECM contain that revision or higher?**	
STEP 2B:	**Disable the fault code.**	**Fault code inactive?**	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for Fault Code 115.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for fault codes. • Use INSITE™ electronic service tool to read the fault codes.	Active or inactive counts of Fault Code 115? **YES**	1B
	Active or inactive counts of Fault Code 115? **NO**	Repair complete.

STEP 1B: Check the battery voltage.

Condition:
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Normal conditions: • At least +12 VDC (12 volt systems) • At least +24 VDC (24 volt systems). Cranking conditions: • At least +6.2 VDC (12 volt systems) • At least +12 VDC (24 volt systems).	Battery voltage acceptable in normal and cranking conditions? **YES**	2A
	Battery voltage acceptable in normal and cranking conditions? **NO** **Repair:** Charge or replace the battery(s). See equipment manufacturer service information.	2A

STEP 2: Check ECM calibration and clear fault codes.

STEP 2A: Check if an ECM calibration update is available.

Condition:
- Connect all components.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Compare the ECM code and revision number in the ECM to the calibration revisions listed in the ECM Calibration Revision History for applicable changes related to this fault code. • Use INSITE™ electronic service tool to find the present ECM code and revision number in the ECM. The ECM code and revision number are found in the Calibration Information section of System ID and Dataplate in Features and Parameters.	If a calibration update for this fault code is available, does the ECM contain that revision or higher? **YES**	2B
	If a calibration update for this fault code is available, does the ECM contain that revision or higher? **NO** **Repair:** If necessary, calibrate the ECM. Refer to Procedure 019-032 in Section 19.	2B

STEP 2B: Disable the fault code.

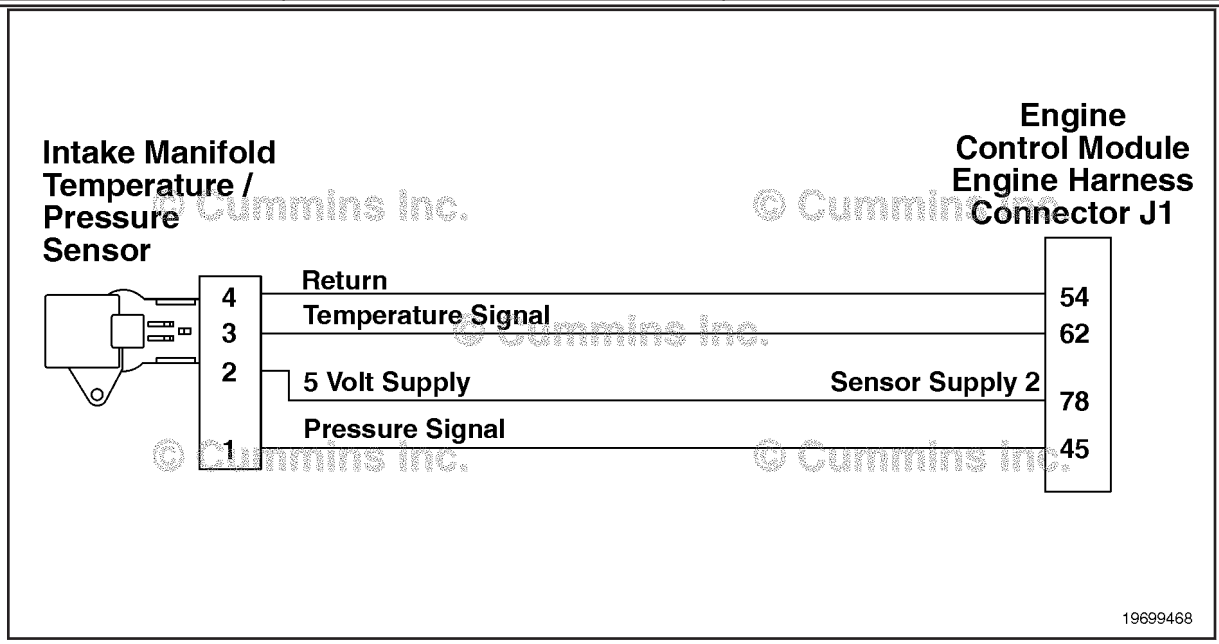
Condition:
- Connect all components.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Disable and clear the fault code. • Operate the engine within the "Conditions for Clearing the Fault Code" found in the Overview section of this troubleshooting procedure.	Fault code inactive? **YES**	Repair complete.
	Fault code inactive? **NO** **Repair:** Return to the troubleshooting steps or contact a Cummins® Authorized Repair Location if all steps have been completed and checked again.	1A

Fault Code 122

Intake Manifold 1 Pressure Sensor Circuit - Voltage Above Normal or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 122 PID(P), SID(S): P102 SPN: 102 FMI: 3/3 Lamp: Amber SRT:	Intake Manifold 1 Pressure Sensor Circuit - Voltage Above Normal or Shorted to High Source. High signal voltage detected at the intake manifold pressure circuit.	Possible reduced engine performance.



Intake Manifold Pressure/Temperature Sensor Circuit

Circuit Description:

The engine control module (ECM) provides a 5 volt supply to the intake manifold pressure sensor on the sensor supply circuit. The ECM also provides a ground on the sensor return circuit. The intake manifold pressure sensor provides a signal to the ECM on the intake manifold pressure sensor signal circuit. This sensor signal voltage changes based on the pressure in the intake manifold.

Component Location:

The intake manifold 1 pressure/temperature sensor is located in the air intake manifold.

Conditions for Running the Diagnostics:

This diagnostic runs continuously when the keyswitch is in the ON position or when the engine is running.

Conditions for Setting the Fault Codes:

The Engine Control Module (ECM) detected the intake manifold pressure signal voltage was out of range high.

Action Taken When the Fault Code is Active:

- The ECM illuminates the amber CHECK ENGINE lamp immediately when the diagnostic runs and fails.

- A default value of the intake manifold pressure reading is used.
- Exhaust Gas Recirculation (EGR) valve operation will be disabled.

Conditions for Clearing the Fault Code:

- To validate the repair, perform a key cycle, start the engine and let it idle for 1 minute.
- The fault code status displayed by INSITE™ electronic service tool will change to INACTIVE immediately after the diagnostic runs and passes.
- The ECM will turn off the amber CHECK ENGINE lamp immediately after the diagnostic runs and passes.
- The Reset All Faults command in INSITE™ electronic service tool can be used to clear active and inactive faults.

Shop Talk:

The intake manifold pressure sensor shares supply and return wires in the engine harness with other sensors. Opens and shorts in the engine harness can cause multiple fault codes to be active. Before troubleshooting Fault Code 122, check for multiple faults.

Possible causes of this fault code include:

- Open return circuit in the engine harness, connectors, or sensor
- Signal wire shorted to sensor supply or battery voltage.
- Malfunctioning intake manifold pressure/temperature sensor

Refer to Troubleshooting Fault Code 122.

FAULT CODE 122 - Intake Manifold 1 Pressure Sensor Circuit - Voltage Above Normal or Shorted to High Source

Associated Procedures			
Procedure Title	**Procedure Number**	**Service Model Name**	**Bulletin Number**
Engine Control Module	Refer to Procedure 019-031	ISF2.8 CM2220 E ISF2.8 CM2220 AN ISF2.8 CM2220 IAN	4022178
Engine Control Module	Refer to Procedure 019-031	ISF3.8 CM2220 ISF3.8 CM2220 AN ISF3.8 CM2220 IAN	4021704
Engine Control Module	Refer to Procedure 019-031	ISF3.8 CM2220 F103	4310839
Engine Control Module	Refer to Procedure 019-031	ISB4.5, ISB6.7, ISD4.5, and ISD6.7 CM2150 SN	4022188
Engine Control Module	Refer to Procedure 019-031	ISL8.9 CM2150 SN	4022190
Engine Control Module	Refer to Procedure 019-031	ISM11 CM876 SN	4022196
Engine Control Module	Refer to Procedure 019-031	ISZ13 CM2150	4022133
Engine Control Module	Refer to Procedure 019-031	ISB6.7 CM2250	4022254
Engine Control Module	Refer to Procedure 019-031	ISC8.3 and ISL9 CM2250	4022257
Engine Control Module	Refer to Procedure 019-031	ISX15 CM2250 GX CM2250	4022250
Engine Control Module	Refer to Procedure 019-031	ISX12/ISX11.9 CM2250	2883445
Engine Control Module	Refer to Procedure 019-031	QSL9 CM2250	4022256
Engine Control Module	Refer to Procedure 019-031	QSB6.7 CM2250	4022255
Engine Control Module	Refer to Procedure 019-031	QSB6.7 CM2250 EC	2883621
Engine Control Module	Refer to Procedure 019-031	QSX11.9 CM2250 ECF	2883561
Engine Control Module	Refer to Procedure 019-031	QSX15 CM2250 ECF	2883557
Engine Control Module	Refer to Procedure 019-031	PowerGen QSX15 CM2250 ECF	4310661
Engine Control Module	Refer to Procedure 019-031	PowerGen QSX15 CM2250	4310664
Engine Control Module	Refer to Procedure 019-031	QSX15 CM2350 X118	5467247
Engine Control Module	Refer to Procedure 019-031	QSB3.3 CM2250 EC	2883647
Engine Control Module	Refer to Procedure 019-031	Marine QSB6.7 CM2250	4310611
Engine Control Module	Refer to Procedure 019-031	ISB6.7 CM2350 B101	2883567
Engine Control Module	Refer to Procedure 019-031	ISL9 CM2350 L101	4310787
Engine Control Module	Refer to Procedure 019-031	ISX12 CM2350 X102	4310646
Engine Control Module	Refer to Procedure 019-031	ISX15 CM2350 X101	4310641
Engine Control Module	Refer to Procedure 019-031	ISF2.8 CM2220 F101	4310846
Engine Control Module	Refer to Procedure 019-031	ISX15 CM2250 SN	4310736
Engine Control Module	Refer to Procedure 019-031	ISB4.5 CM2350 B104	4332646
Engine Control Module	Refer to Procedure 019-031	ISB6.7 CM2350 B103	4332641
Engine Control Module	Refer to Procedure 019-031	QSK78 CM2250 K104	4332682
Engine Control Module	Refer to Procedure 019-031	VTA903 CM2250 V105	4332841
Engine Control Module	Refer to Procedure 019-031	QSB6.7 CM2350 B105	4332778
Engine Control Module	Refer to Procedure 019-031	QSL9 CM2350 L102	4332796
Engine Control Module	Refer to Procedure 019-031	ISB/ISD4.5 CM2150 B119	4358465
Engine Control Module	Refer to Procedure 019-031	ISB/ISD6.7 CM2150 B120	4358470
Engine Control Module	Refer to Procedure 019-031	ISL8.9 CM2150 L110	4358475
Engine Control Module	Refer to Procedure 019-031	IF3.8 CM2220 F110	4358480

Associated Procedures			
Procedure Title	**Procedure Number**	**Service Model Name**	**Bulletin Number**
Engine Control Module	Refer to Procedure 019-031	QSL9 M CM2250 L106	4358343
Engine Control Module	Refer to Procedure 019-031	ISL9 CM2350 L111	4367223
Engine Control Module	Refer to Procedure 019-031	QSK95 CM2350 K111	4358519
Engine Control Module	Refer to Procedure 019-031	QSB6.7 CM2350 B112	4358498
Engine Control Module	Refer to Procedure 019-031	QSZ13 CM2150 Z101	4358364
Engine Control Module	Refer to Procedure 019-031	QSZ13 CM2150 Z102	4358369
Engine Control Module	Refer to Procedure 019-031	QSF2.8 CM2880 F124	5411484
Engine Control Module	Refer to Procedure 019-031	QSF2.8 CM2880 F105	4358561
Engine Control Module	Refer to Procedure 019-031	QSB4.5 CM2350 B106	4367376
Engine Control Module	Refer to Procedure 019-031	QSF3.8 CM2350 F107	4367316
Engine Control Module	Refer to Procedure 019-031	ISF3.8 CM2350 F109	4367218
Engine Control Module	Refer to Procedure 019-031	QSG12 CM2350 G110	4367323
Engine Control Module	Refer to Procedure 019-031	QSG12 CM2350 G113	5467252
Engine Control Module	Refer to Procedure 019-031	QSK23 CM2250 K109	4367358
Engine Control Module	Refer to Procedure 019-031	ISF2.8 CM2220 F117	4388578
Engine Control Module	Refer to Procedure 019-031	QSK60 CM2250 K112	4367454
Engine Control Module	Refer to Procedure 019-031	QSL9 CM2350 L107	4367386
Engine Control Module	Refer to Procedure 019-031	QSB6.7 CM2250 B128	4388601
Engine Control Module	Refer to Procedure 019-031	QSL9 CM2250 L115	4388626
Engine Control Module	Refer to Procedure 019-031	QSB6.7 CM2350 B130	4388668
Engine Control Module	Refer to Procedure 019-031	QSL9 CM2350 L118	4388673
Engine Control Module	Refer to Procedure 019-031	QSF3.8 CM2350 F118	4388708
Engine Control Module	Refer to Procedure 019-031	QSF3.8 CM2350 F119	4388703
Engine Control Module	Refer to Procedure 019-031	QSB4.5 CM2350 B122	4388767
Engine Control Module	Refer to Procedure 019-031	X15 CM2350 X114B	5411181
Engine Control Module	Refer to Procedure 019-031	X15 CM2350 X116B	5411186
Engine Control Module	Refer to Procedure 019-031	QSB4.5 CM2250 B131	4388774
Engine Control Module	Refer to Procedure 019-031	QSB3.3 CM2250 B137	5411058
Engine Control Module	Refer to Procedure 019-031	QSX15 CM2250 X115	4388739
Engine Control Module	Refer to Procedure 019-031	ISB6.7 CM2350 B142	5411131
Engine Control Module	Refer to Procedure 019-031	B6.7 CM2350 B121B	5411223
Engine Control Module	Refer to Procedure 019-031	ISF2.8 CM2220 F126	5411159
Engine Control Module	Refer to Procedure 019-031	F3.8 CM2350 F120B	5411237
Engine Control Module	Refer to Procedure 019-031	L9 CM2350 L116B	5411330
Engine Control Module	Refer to Procedure 019-031	B4.5 CM2350 B129B	5411247
Engine Control Module	Refer to Procedure 019-031	B4.5 CM2350 B147B	5411252
Engine Control Module	Refer to Procedure 019-031	B6.7 CM2350 B135B	5411257
Engine Control Module	Refer to Procedure 019-031	B6.7 CM2350 B148B	5411262
Engine Control Module	Refer to Procedure 019-031	L9 CM2350 L119B	5411267
Engine Control Module	Refer to Procedure 019-031	QSB6.7 CM2350 B145	5411273
Engine Control Module	Refer to Procedure 019-031	QSL9 CM2350 L122	5411278
Engine Control Module	Refer to Procedure 019-031	QSB4.5 CM2350 B144	5411382
Engine Control Module	Refer to Procedure 019-031	L9 CM2350 L123B	5411465
Engine Control Module	Refer to Procedure 019-031	QSF3.8 CM2350 F125	5411494
Engine Control Module	Refer to Procedure 019-031	ISF2.8 CM2220 F122	5467376
Engine Control Module	Refer to Procedure 019-031	F3.8 CM2350 F132B	5467327
Engine Control Module	Refer to Procedure 019-031	R2.8 CM2220 R101B	5467556

Associated Procedures			
Procedure Title	**Procedure Number**	**Service Model Name**	**Bulletin Number**
Engine Control Module	Refer to Procedure 019-031	ISB5.9 CM2880 B110	4332883
Engine Wiring Harness	Refer to Procedure 019-043	ISF2.8 CM2220 E ISF2.8 CM2220 AN ISF2.8 CM2220 IAN	4022178
Engine Wiring Harness	Refer to Procedure 019-043	ISF3.8 CM2220 ISF3.8 CM2220 AN ISF3.8 CM2220 IAN	4021704
Engine Wiring Harness	Refer to Procedure 019-043	ISF3.8 CM2220 F103	4310839
Engine Wiring Harness	Refer to Procedure 019-043	ISB4.5, ISB6.7, ISD4.5, and ISD6.7 CM2150 SN	4022188
Engine Wiring Harness	Refer to Procedure 019-043	ISL8.9 CM2150 SN	4022190
Engine Wiring Harness	Refer to Procedure 019-043	ISM CM876 SN	4022196
Engine Wiring Harness	Refer to Procedure 019-043	ISZ CM2150	4022133
Engine Wiring Harness	Refer to Procedure 019-043	ISB6.7 CM2250	4022254
Engine Wiring Harness	Refer to Procedure 019-043	ISC8.3 and ISL9 CM2250	4022257
Engine Wiring Harness	Refer to Procedure 019-043	ISX15 CM2250 GX CM2250	4022250
Engine Wiring Harness	Refer to Procedure 019-043	ISX12/ISX11.9 CM2250	2883445
Engine Wiring Harness	Refer to Procedure 019-043	QSL9 CM2250	4022256
Engine Wiring Harness	Refer to Procedure 019-043	QSB6.7 CM2250	4022255
Engine Wiring Harness	Refer to Procedure 019-043	QSB6.7 CM2250 EC	2883621
Engine Wiring Harness	Refer to Procedure 019-043	QSX11.9 CM2250 ECF	2883561
Engine Wiring Harness	Refer to Procedure 019-043	QSX15 CM2250 ECF	2883557
Engine Wiring Harness	Refer to Procedure 019-043	PowerGen QSX15 CM2250 ECF	4310661
Engine Wiring Harness	Refer to Procedure 019-043	PowerGen QSX15 CM2250	4310664
Engine Wiring Harness	Refer to Procedure 019-043	QSB3.3 CM2250 EC	2883647
Engine Wiring Harness	Refer to Procedure 019-043	Marine QSB6.7 CM2250	4310611
Engine Wiring Harness	Refer to Procedure 019-043	ISB6.7 CM2350 B101	2883567
Engine Wiring Harness	Refer to Procedure 019-043	ISL9 CM2350 L101	4310787
Engine Wiring Harness	Refer to Procedure 019-043	ISX12 X101	4310646
Engine Wiring Harness	Refer to Procedure 019-043	ISX15 X101	4310641
Engine Wiring Harness	Refer to Procedure 019-043	ISF2.8 CM2220 F101	4310846
Engine Wiring Harness	Refer to Procedure 019-043	ISX15 CM2250 SN	4310736
Engine Wiring Harness	Refer to Procedure 019-043	ISB4.5 CM2350 B104	4332646
Engine Wiring Harness	Refer to Procedure 019-043	ISB6.7 CM2350 B103	4332641
Engine Wiring Harness	Refer to Procedure 019-043	QSK78 CM2250 K104	4332682
Engine Wiring Harness	Refer to Procedure 019-043	VTA903 CM2250 V105	4332841
Engine Wiring Harness	Refer to Procedure 019-043	QSB6.7 CM2350 B105	4332778
Engine Wiring Harness	Refer to Procedure 019-043	QSL9 CM2350 L102	4332796
Engine Wiring Harness	Refer to Procedure 019-043	ISB/ISD4.5 CM2150 B119	4358465
Engine Wiring Harness	Refer to Procedure 019-043	ISB/ISD6.7 CM2150 B120	4358470
Engine Wiring Harness	Refer to Procedure 019-043	ISL8.9 CM2150 L110	4358475
Engine Wiring Harness	Refer to Procedure 019-043	IF3.8 CM2220 F110	4358480
Engine Wiring Harness	Refer to Procedure 019-043	QSL9 M CM2250 L106	4358343
Engine Wiring Harness	Refer to Procedure 019-043	ISL9 CM2350 L111	4367223
Engine Wiring Harness	Refer to Procedure 019-043	QSK95 CM2350 K111	4358519

Associated Procedures			
Procedure Title	**Procedure Number**	**Service Model Name**	**Bulletin Number**
Engine Wiring Harness	Refer to Procedure 019-043	QSB6.7 CM2350 B112	4358498
Engine Wiring Harness	Refer to Procedure 019-043	QSZ13 CM2150 Z101	4358364
Engine Wiring Harness	Refer to Procedure 019-043	QSZ13 CM2150 Z102	4358369
Engine Wiring Harness	Refer to Procedure 019-043	QSF2.8 CM2880 F105	4358561
Engine Wiring Harness	Refer to Procedure 019-043	QSF2.8 CM2880 F124	5411484
Engine Wiring Harness	Refer to Procedure 019-043	QSB4.5 CM2350 B106	4367376
Engine Wiring Harness	Refer to Procedure 019-043	QSF3.8 CM2350 F107	4367316
Engine Wiring Harness	Refer to Procedure 019-043	ISF3.8 CM2350 F109	4367218
Engine Wiring Harness	Refer to Procedure 019-043	QSG12 CM2350 G110	4367323
Engine Wiring Harness	Refer to Procedure 019-043	QSG12 CM2350 G113	5467252
Engine Wiring Harness	Refer to Procedure 019-043	QSK23 CM2250 K109	4367358
Engine Wiring Harness	Refer to Procedure 019-043	ISF2.8 CM2220 F117	4388578
Engine Wiring Harness	Refer to Procedure 019-043	QSK60 CM2250 K112	4367454
Engine Wiring Harness	Refer to Procedure 019-043	QSL9 CM2350 L107	4367386
Engine Wiring Harness	Refer to Procedure 019-043	QSB6.7 CM2250 B128	4388601
Engine Wiring Harness	Refer to Procedure 019-043	QSL9 CM2250 L115	4388626
Engine Wiring Harness	Refer to Procedure 019-043	QSB6.7 CM2350 B130	4388668
Engine Wiring Harness	Refer to Procedure 019-043	QSL9 CM2350 L118	4388673
Engine Wiring Harness	Refer to Procedure 019-043	QSF3.8 CM2350 F118	4388708
Engine Wiring Harness	Refer to Procedure 019-043	QSF3.8 CM2350 F119	4388703
Engine Wiring Harness	Refer to Procedure 019-043	QSB4.5 CM2350 B122	4388767
Engine Wiring Harness	Refer to Procedure 019-043	X15 CM2350 X114B	5411181
Engine Wiring Harness	Refer to Procedure 019-043	X15 CM2350 X116B	5411186
Engine Wiring Harness	Refer to Procedure 019-043	QSB4.5 CM2250 B131	4388774
Engine Wiring Harness	Refer to Procedure 019-043	QSB3.3 CM2250 B137	5411058
Engine Wiring Harness	Refer to Procedure 019-043	QSX15 CM2250 X115	4388739
Engine Wiring Harness	Refer to Procedure 019-043	QSX15 CM2350 X118	5467247
Engine Wiring Harness	Refer to Procedure 019-043	ISB6.7 CM2350 B142	5411131
Engine Wiring Harness	Refer to Procedure 019-043	B6.7 CM2350 B121B	5411223
Engine Wiring Harness	Refer to Procedure 019-043	ISF2.8 CM2220 F126	5411159
Engine Wiring Harness	Refer to Procedure 019-043	F3.8 CM2350 F120B	5411237
Engine Wiring Harness	Refer to Procedure 019-043	L9 CM2350 L116B	5411330
Engine Wiring Harness	Refer to Procedure 019-043	B4.5 CM2350 B129B	5411247
Engine Wiring Harness	Refer to Procedure 019-043	B4.5 CM2350 B147B	5411252
Engine Wiring Harness	Refer to Procedure 019-043	B6.7 CM2350 B135B	5411257
Engine Wiring Harness	Refer to Procedure 019-043	B6.7 CM2350 B148B	5411262
Engine Wiring Harness	Refer to Procedure 019-043	L9 CM2350 L119B	5411267
Engine Wiring Harness	Refer to Procedure 019-043	QSB6.7 CM2350 B145	5411273
Engine Wiring Harness	Refer to Procedure 019-043	QSL9 CM2350 L122	5411278
Engine Wiring Harness	Refer to Procedure 019-043	QSB4.5 CM2350 B144	5411382
Engine Wiring Harness	Refer to Procedure 019-043	L9 CM2350 L123B	5411465
Engine Wiring Harness	Refer to Procedure 019-043	QSF3.8 CM2350 F125	5411494
Engine Wiring Harness	Refer to Procedure 019-043	ISF2.8 CM2220 F122	5467376
Engine Wiring Harness	Refer to Procedure 019-043	F3.8 CM2350 F132B	5467327
Engine Wiring Harness	Refer to Procedure 019-043	R2.8 CM2220 R101B	5467556
Engine Wiring Harness	Refer to Procedure 019-043	ISB5.9 CM2880 B110	4332883

Associated Procedures			
Procedure Title	**Procedure Number**	**Service Model Name**	**Bulletin Number**
Intake Manifold Air Temperature Sensor	Refer to Procedure 019-059	QSK60 CM2250 K112	4367454
Intake Manifold Pressure Sensor	Refer to Procedure 019-061	QSK23 CM2250 K109	4367358
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	ISF2.8 CM2220 E ISF2.8 CM2220 AN ISF2.8 CM2220 IAN	4022178
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	ISF3.8 CM2220 ISF3.8 CM2220 AN ISF3.8 CM2220 IAN	4021704
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	ISF3.8 CM2220 F103	4310839
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	ISB4.5, ISB6.7, ISD4.5, and ISD6.7 CM2150 SN	4022188
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	ISL8.9 CM2150 SN	4022190
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	ISM11 CM876 SN	4022196
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	ISZ13 CM2150	4022133
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	ISB6.7 CM2250	4022254
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	ISC8.3 and ISL9 CM2250	4022257
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	ISX15 CM2250 GX CM2250	4022250
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	ISX12/ISX11.9 CM2250	2883445
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	QSL9 CM2250	4022256
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	QSB6.7 CM2250	4022255
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	QSB6.7 CM2250 EC	2883621
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	QSX11.9 CM2250 ECF	2883561
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	QSX15 CM2250 ECF	2883557
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	PowerGen QSX15 CM2250 ECF	4310661
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	PowerGen QSX15 CM2250	4310664
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	QSB3.3 CM2250 EC	2883647
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	Marine QSB6.7 CM2250	4310611
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	ISB6.7 CM2350 B101	2883567
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	ISB6.7 CM2350 B101	2883567
Intake Manifold Pressure/ Temperature Sensor	Refer to Procedure 019-159	ISL9 CM2350 L101	4310787