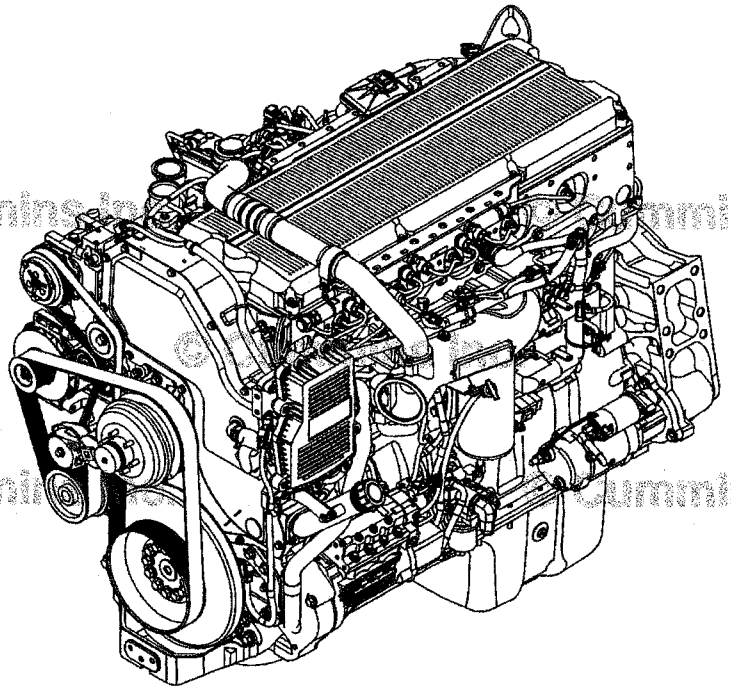
Operation and Maintenance Manual
ISX15 CM2250



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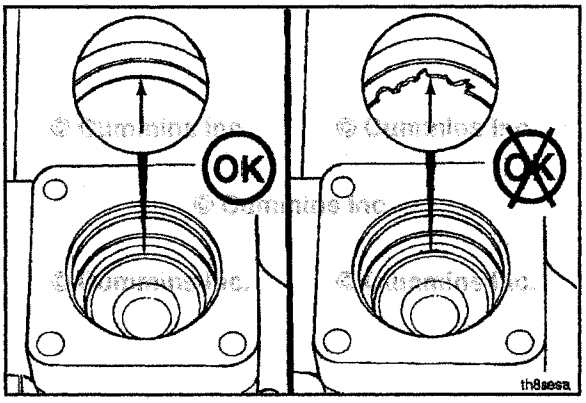
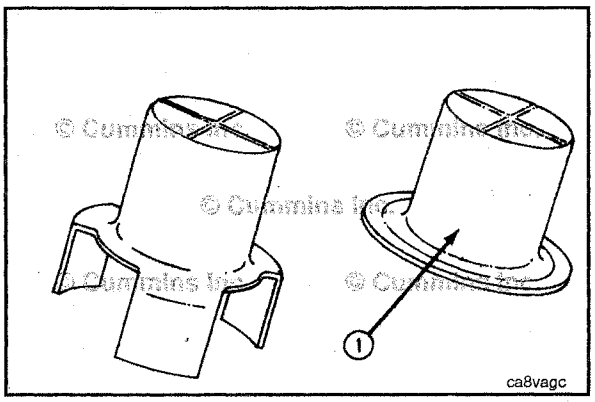
Illustrations

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.



Acronyms and Abbreviations

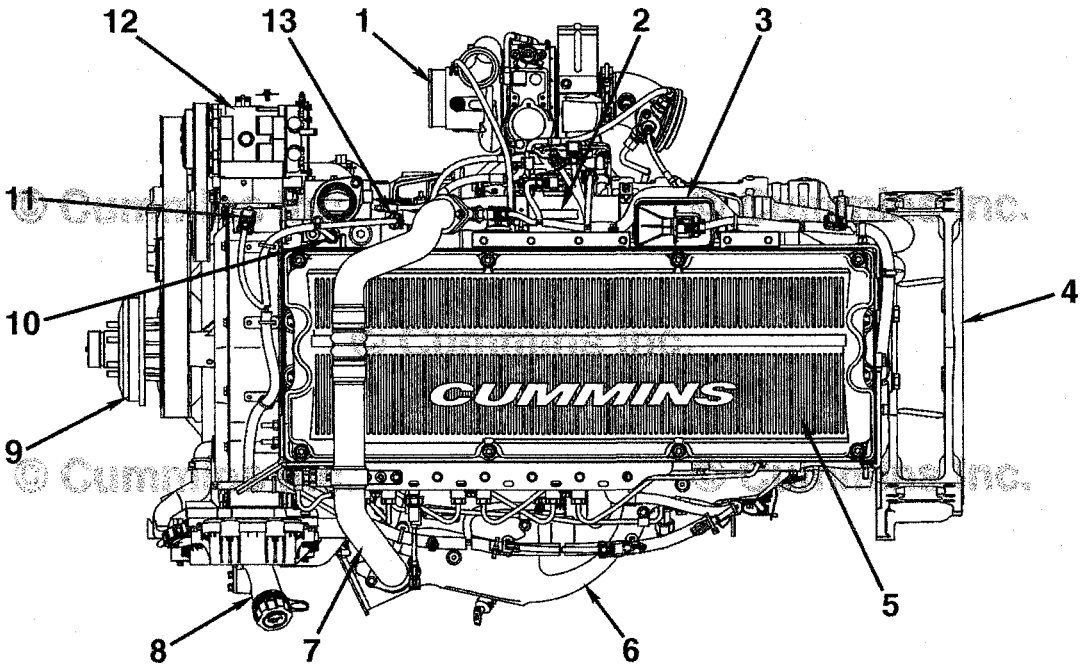
General Information

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

API	American Petroleum Institute
ASTM	American Society of Testing and Materials
BTU	British Thermal Unit
°C	Celsius
CARB	California Air Resources Board
C.I.D.	Cubic Inch Displacement
CNG	Compressed Natural Gas
CPL	Control Parts List
cSt	Centistokes
DEF	Diesel Exhaust Fluid
ECM	Electronic Control Module
EGR	Exhaust Gas Recirculation
EPA	Environmental Protection Agency
°F	Fahrenheit
FMI	Failure Mode Indentifier
GVW	Gross Vehicle Weight
Hg	Mercury
hp	Horsepower
H_2O	Water
ICM	Ignition Control Module
km/l	Kilometers per Liter
kPa	Kilopascal
LNG	Liquid Natural Gas
LPG	Liquified Petroleum Gas
LTA	Low Temperature Aftercooling
MIL	Malfunction Indicator Lamp
MPa	Megapascal
mph	Miles Per Hour
mpq	Miles Per Quart
N•m	Newton-meter
NG	Natural Gas
OBD	On-Board Diagnostics
OEM	Original Equipment Manufacturer
PID	Parameter Identification Descriptions
ppm	Parts Per Million
psi	Pounds Per Square Inch
PTO	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
VS	Variable Speed

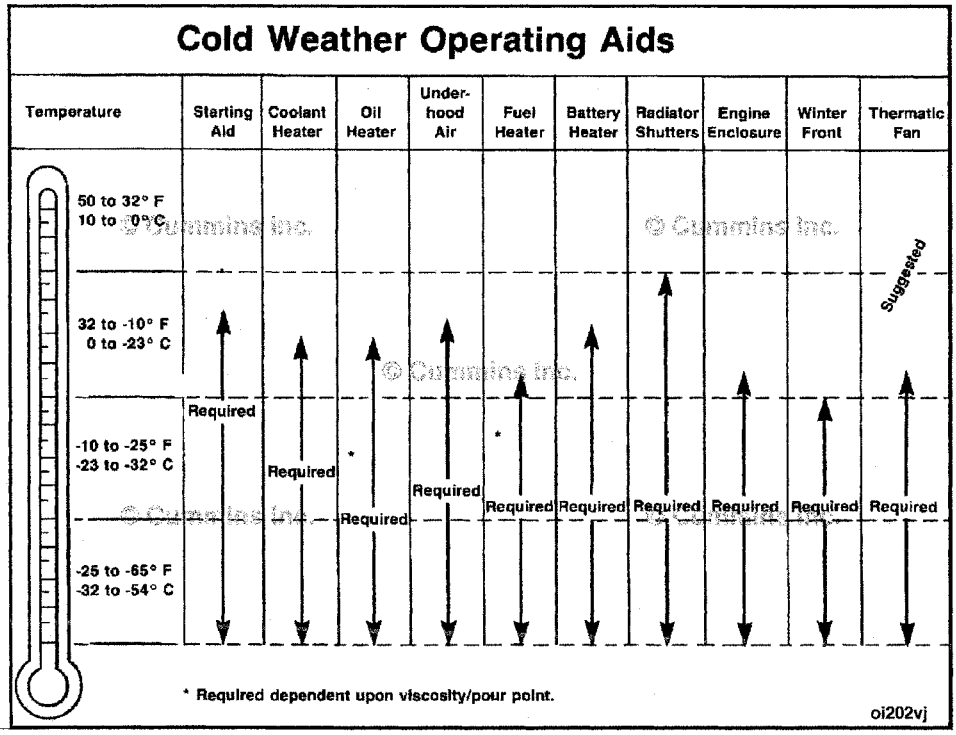
Engine Diagrams

Engine Views



Top View - ISX15 CM2520

1 Turbocharger, variable geometry
2 Exhaust mass flow measurement
3 EGR valve
4 Flywheel housing
5 Rocker lever cover
6 Air intake manifold
7 EGR crossover tube
8 Lubricating oil fill tube
9 Fan hub
10 Coolant temperature sensor
11 Camshaft position sensor
12 Refrigerant compressor
13 Exhaust gas pressure sensor



Winterfronts and Shutters

Winterfronts and shutters can be used on a vehicle or equipment to reduce air flow through the radiator core into the engine compartment. This can reduce the time required to warm the engine and help maintain the engine coolant temperature. The engine coolant temperature specifications are in the Maintenance Specification (Section V).

Unique Operating Characteristics of an Engine with EGR

Variable Geometry Turbocharger

The variable geometry turbocharger is used to create back pressure in the exhaust system to aid in the exhaust gas recirculation (EGR) flow. Non-EGR engines typically utilize wastegated turbochargers that minimize the amount of exhaust manifold back pressure in the exhaust manifold, but do **not** use all of the exhaust gas flowing through the turbocharger. The design of the variable geometry turbocharger helps create the back pressure needed for EGR flow and still control boost pressure since there is no exhaust gas being wastegated around the turbine wheel.

What to expect with Variable Geometry Turbocharged Engines:

1. Turbocharger boost can fluctuate depending on speed, load, and desired EGR flow.
   - Boost will peak briefly at a snap throttle and return to a lower boost setting at the same throttle position and engine load. The control system aids in throttle response and by design, will overshoot it's boost needs rather than undershoot.
   - Boost can also increase when you let off the throttle, as the control system closes down the variable geometry in anticipation of the next on throttle event.
   - When the engine is at a constant speed and experiences no load change, boost can still fluctuate as EGR flow demand is changed by the control system.
2. Boost pressure can vary day to day.
   - Boost pressures can vary depending on power requirements, EGR flow requirements, and ambient conditions. Because the control system can closely control the turbocharger the engine **only** gets the boost pressure it needs. For example: The driver can notice boost pressures of around 172 kPa [25 psi] while

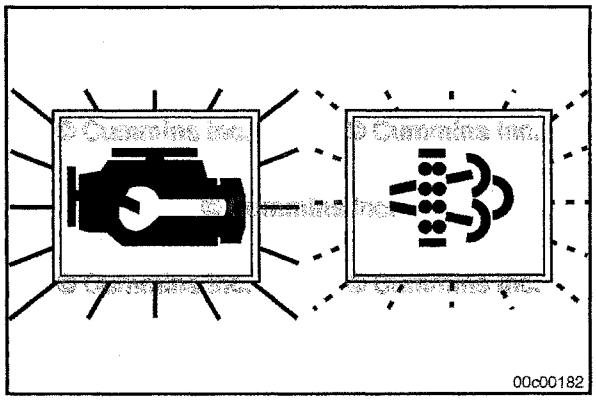
A flashing AFTERTREATMENT DIESEL PARTICULATE FILTER lamp combined with an illuminated WARNING or CHECK ENGINE lamp indicates that the aftertreatment diesel particulate filter needs be regenerated immediately. Engine power will be reduced automatically.

When these lamps are illuminated, a stationary regeneration is required.

- Follow the instructions in Unique Operating Characteristics of an Engine with Aftertreatment, in Section 1.

NOTE: If a stationary regeneration is **not** performed, the STOP ENGINE lamp will illuminate and the vehicle will need to be taken to a Cummins® Authorized Repair Location.

NOTE: Stationary regeneration is considered a normal maintenance practice and is **not** covered by Cummins Inc. warranty.

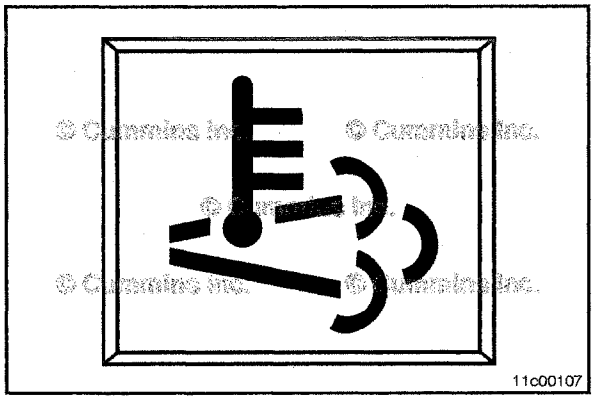


High Exhaust System Temperature Lamp

The HIGH EXHAUST SYSTEM TEMPERATURE lamp indicates, when illuminated, that exhaust temperatures are high due to regeneration of the aftertreatment diesel particulate filter. This lamp can illuminate during normal engine operation or during stationary regeneration.

NOTE: The OEM determines whether or **not** the HIGH EXHAUST SYSTEM TEMPERATURE lamp is installed on the vehicle. The OEM also specifies the temperatures, vehicle speeds, and other conditions at which the lamp illuminates. Refer to the OEM service manual for additional information regarding this lamp.

When this lamp is illuminated, make sure that the exhaust pipe outlet is **not** directed at any surface or material that can melt, burn, or explode.



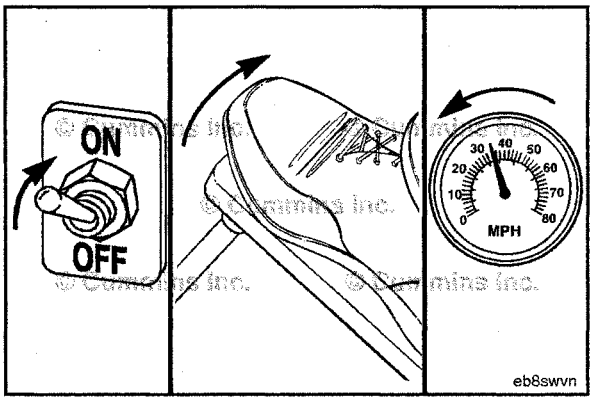
⚠WARNING⚠

When this lamp is illuminated, the exhaust gas temperature could reach 800°C [1500°F], which is hot enough to ignite or melt common materials, and to burn people.

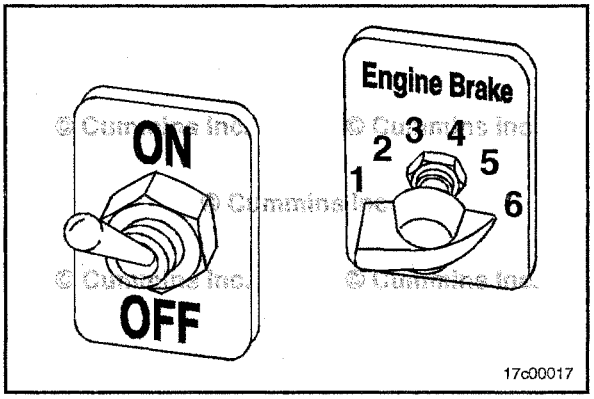
- Keep the exhaust outlet away from people and anything that can burn, melt, or explode.
- Nothing within 0.6 m [2 ft] of the exhaust outlet
- Nothing that can burn, melt, or explode within 1.5 m [5 ft] (such as gasoline, wood, paper, plastics, fabric, compressed gas containers, and hydraulic lines).
- In an emergency, turn off the engine to stop the flow of exhaust.

NOTE: The HIGH EXHAUST SYSTEM TEMPERATURE lamp does **not** signify the need for any kind of vehicle or engine service; it merely alerts the vehicle operator to high exhaust temperatures. It will be common for the HIGH EXHAUST SYSTEM TEMPERATURE lamp to illuminate on and off during normal vehicle operation as the engine completes regeneration.

To reduce vehicle speed, put the engine brake on/off switch in the ON position. Remove your foot from the accelerator pedal and clutch pedal. The engine brakes will immediately begin to operate, slowing the vehicle.



For operation on dry pavement when maximum retarding power is required, put the position selector switch in the highest position.



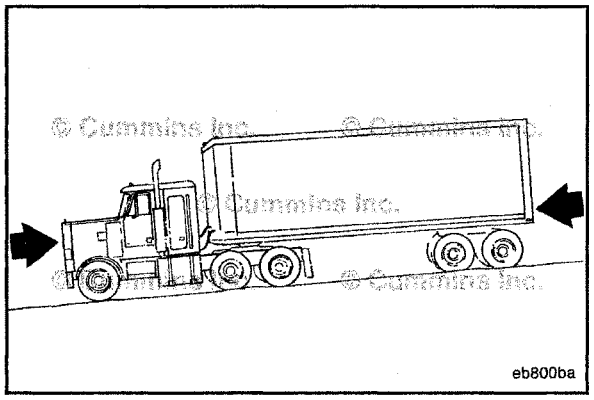
Tips for Operation on Grades with Dry Pavement

⚠WARNING⚠

To reduce the possibility of personal injury or property damage, always be prepared to use the vehicle service brakes for emergency stopping. The safe control speed of a vehicle will vary with the size of the load, the type of load, the grade, and the road conditions.

NOTE: Always be prepared to use the vehicle service brakes for emergency stopping.

Vehicles equipped with properly operated engine brakes are capable of traveling downhill at slightly higher control speeds than vehicles **not** equipped with engine brakes.

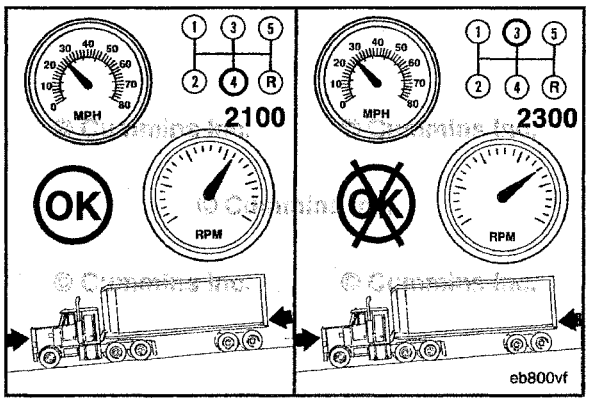


△CAUTION△

Never exceed governed engine speed as engine damage can occur.

NOTE: The optimum braking power of engine brakes is reached at rated engine speed. Correct gear selection, therefore, is critical.

Once you have determined the safe speed for your vehicle, operate the engine brakes with the transmission in the lowest gear that will **not** cause the engine speed to exceed the rated engine speed.



Section 2 - Maintenance Guidelines

Section Contents

Daily Maintenance Procedures - Overview

General Information

Preventative maintenance begins with day-to-day awareness of the engine and its system. Before starting the engine, check the oil and coolant levels. Look for:

- Leaks
- Loose or damaged parts
- Worn or damaged belts
- Any change in engine appearance.
- Odor of fuel

Engine Operation Report

The engine **must** be maintained in top mechanical condition if the operator is to get optimum satisfaction from its use. The maintenance department needs daily running reports from the operator to make necessary adjustments in the time allocated. The daily running report also helps to make provisions for more extensive maintenance work as the reports indicate the necessity.

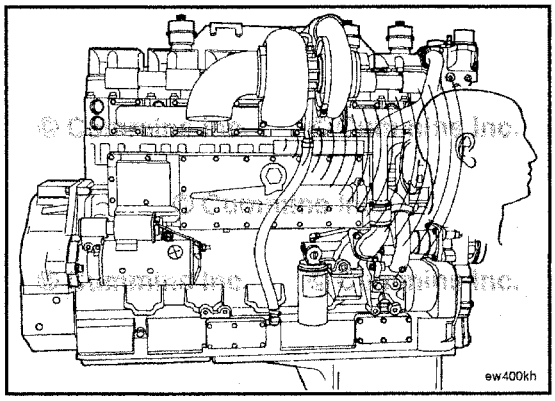
Comparison and intelligent interpretation of the daily report, along with a practical follow-up action, will eliminate most failures and emergency repairs.

Report to the maintenance department any of the following conditions:

- Low lubricating oil pressure
- Low power
- Power increases or engine surge
- Erratic or no accelerator control or response
- Any warning lights flashing or staying on
- Abnormal water or oil temperature
- Unusual engine noise
- Excessive smoke
- Excessive use of coolant, fuel, or lubricating oil
- Any fuel, coolant, or lubricating oil leaks
- Loose or damaged parts
- Worn or damaged belts

Unusual Engine Noise

During daily maintenance checks, listen for any unusual engine noise that can indicate that service is required.



Section 4 - Maintenance Procedures at 40,000 Kilometers [25,000 Miles], 800 Hours, or 6 Months

Section Contents

Section 5 - Maintenance Procedures at 80,000 Kilometers [50,000 Miles], 1500 Hours, or 1 Year

Section Contents

Section 6 - Maintenance Procedures at 200,000 Kilometers [125,000 Miles] or 3000 Hours

Section Contents

Section 8 - Maintenance Procedures at 241,000 Kilometers [150,000 Miles] or 4500 Hours

Section Contents

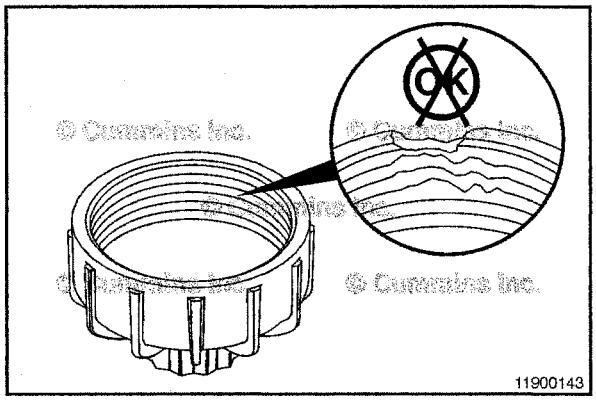
Clean and Inspect for Reuse

Inspect the aftertreatment DEF dosing unit filter cap for cracks or holes that could create a DEF leak path.

Inspect the condition of the threads on the aftertreatment DEF dosing unit cap. If the threads are damaged, replace the aftertreatment DEF dosing unit filter cap.

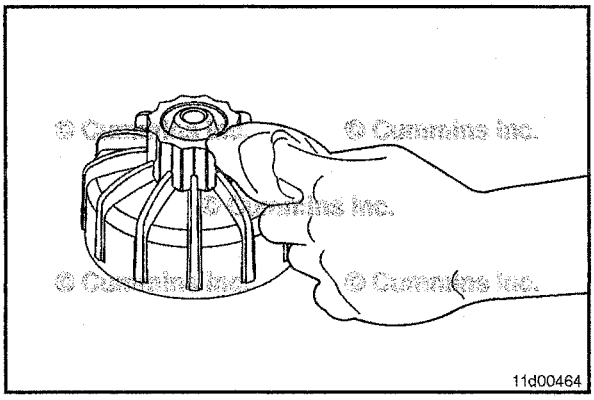
Inspect the aftertreatment DEF dosing unit threads. This is especially important if the aftertreatment DEF dosing unit cap was damaged.

If the aftertreatment DEF dosing unit threads are damaged, replace the entire aftertreatment DEF dosing unit.



Clean the aftertreatment DEF dosing unit cap with warm water and a clean cloth.

NOTE: **Never** operate the vehicle with the DEF cap removed.



Install

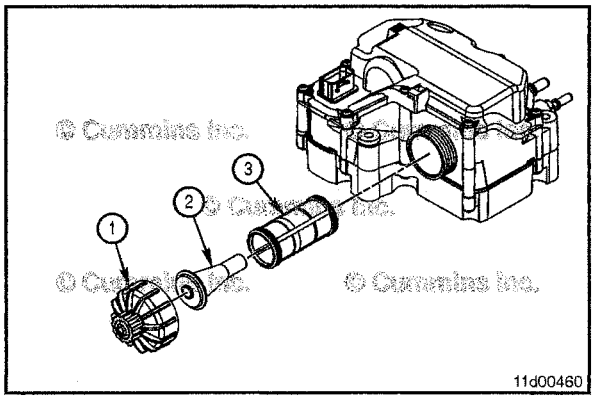
NOTE: Lubrication of the DEF filter o-rings is **not** required.

1 Slide the DEF filter equalizing element into the DEF filter cartridge.

2 Insert the assembly into the aftertreatement DEF dosing unit.

3 Install and tighten the cap.

Torque Value: 20 N•m [177 in-lb]



Section 11 - Maintenance Procedures at 480,000 Kilometers [300,000 Miles] or 6750 Hours

Section Contents

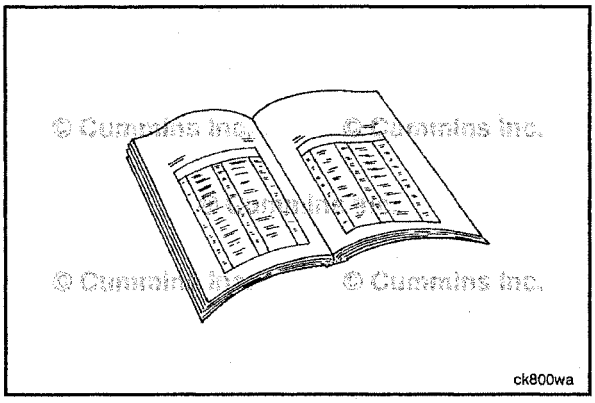
Finishing Steps

⚠CAUTION⚠

Do not use solvent to clean the rocker cover gasket. Solvent can damage the gasket material and cause it to swell.

- Install the rocker lever cover and gasket. Refer to Procedure 003-011 in Section A.
- Install the EGR crossover tube. Refer to Procedure 011-070 in Section A.
- Operate the engine and check for proper operation.

NOTE: If the malfunction resulted in coolant, oil, excessive fuel, or excessive black smoke entering the exhaust system, the aftertreatment system **must** be inspected. Contact the Local Cummins® Authorized Repair Location.



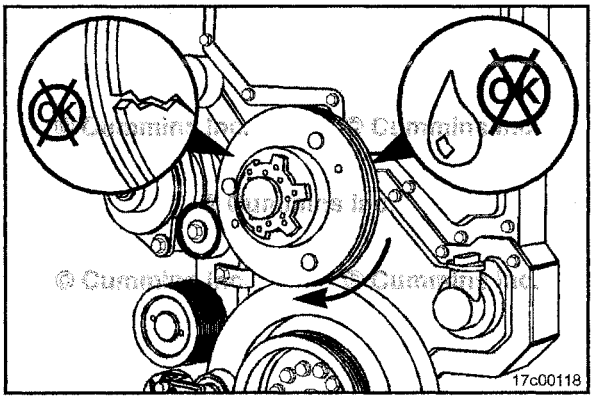
Fan Hub, Belt Driven

Maintenance Check

Inspect the fan hub for the following:

- Freedom of rotation
- Cracks
- Grease seal leakage.

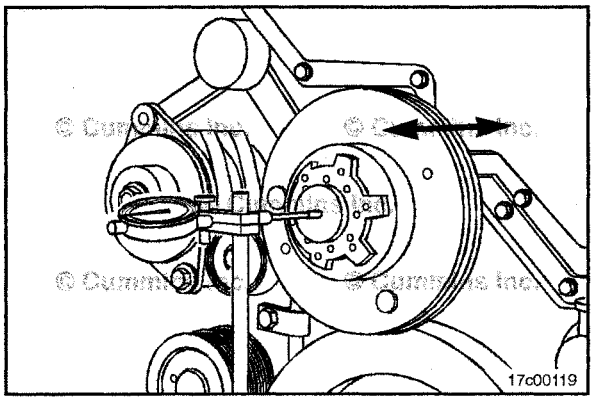
Repair or replace the fan hub if the fan hub does **not** rotate freely or if there is evidence of cracks or grease seal leakage.



Measure the fan hub end clearance.

Fan Hub End Clearance

mm		in
0.08	MIN	0.003
0.25	MAX	0.009



Section A - Adjustment, Repair, and Replacement

Section Contents

EGR Crossover Tube

Preparatory Steps

⚠WARNING⚠

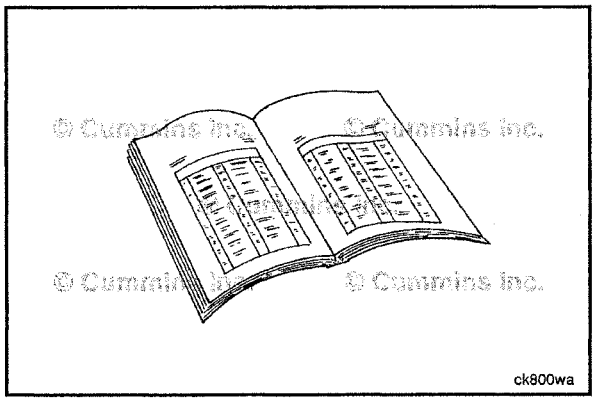
Wear safety glasses or a face shield, as well as protective clothing, to reduce the possibility of personal injury when using a steam cleaner or high-pressure water.

⚠WARNING⚠

The EGR crossover tube can be hot. To reduce the possibility of personal injury, allow the engine to cool before removing.

NOTE: When removing the EGR crossover tube do **not** bend the tube at the hose section of the tube. Bending the tube at this location can cause exhaust leaks when the tube is installed.

- Use steam or high-pressure water to clean the engine, specifically around the EGR crossover tube joints.
- Some applications may require removal of the air cleaner. Refer to the OEM service manual.
- Disconnect the exhaust gas pressure sensor wiring harness connector from the sensor. Contact a local Cummins® Authorized Repair Location.



Remove

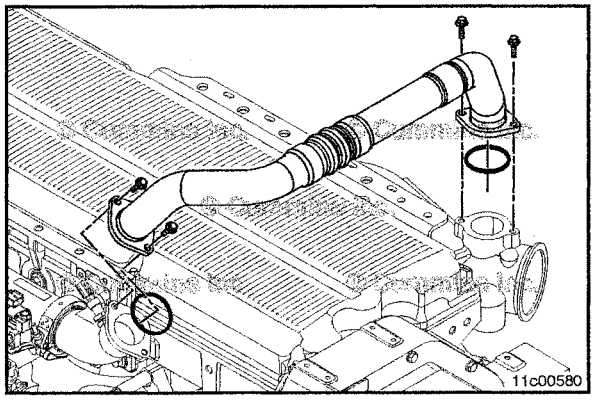
Remove the fastener(s) from the p-clip(s) retaining the crossover tube.

NOTE: Some chassis are equipped with an additional crossover tube p-clip on the exhaust side of the engine.

NOTE: When removing the EGR crossover tube and capscrews ensure you do **not** damage the exhaust gas pressure sensor.

Remove the two mounting capscrews from the EGR crossover tube ends.Remove the EGR crossover tube.

Remove and discard the press in place seals from each end of the crossover tube.



Clean and Inspect for Reuse

⚠WARNING⚠

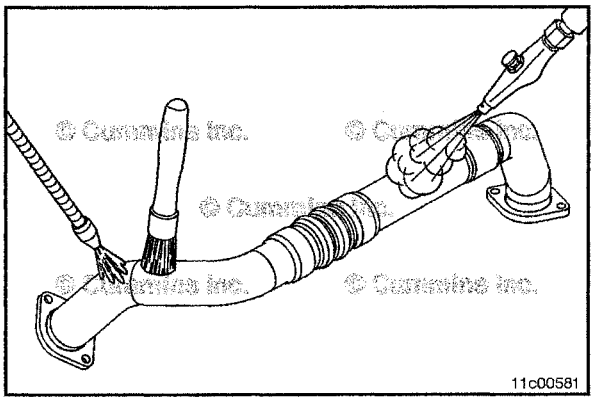
When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

⚠WARNING⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the EGR crossover tube with safety solvent.

Dry with compressed air.



System Diagrams - Overview

General Information

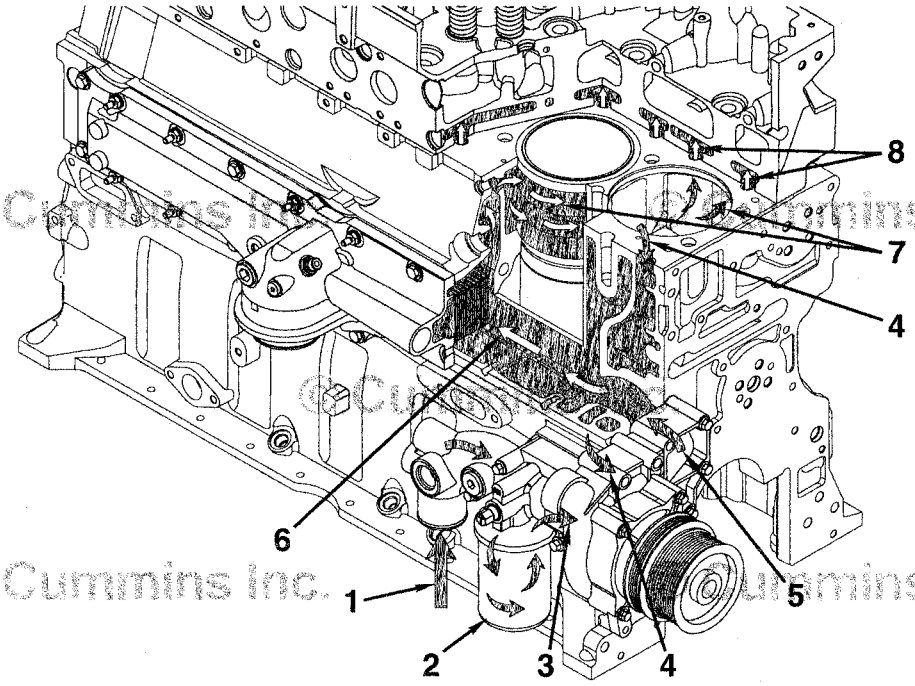
The following drawings show the flow through the engine systems. Although parts can change between different applications and installations, the flow remains the same. The systems shown are:

- Fuel System
- Lubricating Oil System
- Coolant System
- Intake Air System
- Exhaust System
- Compressed Air System.

Knowledge of the engine systems can help you in troubleshooting, service, and general maintenance of your engine.

Flow Diagram, Cooling System

Flow Diagram



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1 Coolant inlet
2 Coolant filter
3 Coolant flow from coolant filter to water pump
4 Coolant bypass flow from thermostat
5 Coolant flow from water pump
6 Coolant flow past lubricating oil cooler
7 Coolant flow around cylinder liners
8 Coolant flow to cylinder head.

Section L - Service Literature

Section Contents

Division and Regional Offices - Locations

Australia Regional Office	**Cummins Engine Company Pty. Ltd.**	2 Caribbean Drive Scoresby, Victoria 3179 Australia Telephone: (61-3) 9765-3222 FAX: (61-3) 9763-0079 **NOTE:** This office also serves New Zealand.
Cummins Americas Regional Office	**Cummins Americas Inc.**	3350 SW 148 Avenue Suite 205 Miramar, FL 33027 Telephone: [1-954] 431-5511 Fax: [1-954] 433-5797 **NOTE:** This office serves Puerto Rico and South America excluding Brazil.
China Beijing	**Cummins (China) Investment Co. Ltd**	28F, Tower A, GATEWAY, No.18, Xiaguangli North Road, East Third Ring, Chaoyang District Beijing, Beijing ZIP / Postal Code: 100027 China Telephone: [86-10] 84548888 Telefax: [86-10] 67876347
Brazil	**Cummins Brasil Ltda.**	Rua Jati, 266 07180-900 Guarulhos Sao Paulo Brazil Phone: [55-11] 6465-9811 Fax: [55-11] 6412-1483
Daventry	**Cummins Engine Company Ltd (Africa)**	Royal Oak Way South Daventry, Northants ZIP / Postal Code: NN11 5NU United Kingdom Telephone: [44-1327] 886000 Telefax: [44-1327] 886106
Daventry	**Cummins Engine Co. Ltd (Serving Czech Republic)**	Royal Oak Way South Daventry, Northants ZIP / Postal Code: NN11 5NU United Kingdom Telephone: [44-1327] 886000 Telefax: [44-1327] 886106
Daventry	**Cummins Engine Company Ltd (Middle East)**	Royal Oak Way South Daventry, Northants ZIP / Postal Code: NN11 5NU United Kingdom Telephone: [44-1327] 886000 Telefax: [44-1327] 886106
Dubai United Arab Emirates	**Cummins Middle East FZE**	Units ZF 5/6 Jebel Ali Free Zone P.O.Box No 17636 Dubai United Arab Emirates Phone: [971-4] 883 8998 Fax: [971-4] 883 7971

Nebraska	**Kearney**	Cummins Central Power, LLC 515 Central Avenue Kearney, NE 68847 Telephone: (308) 234-1994 FAX: (308) 234-5776
Nevada	**Elko**	Cummins Rocky Mountain, LLC 5370 East Idaho Street Elko, NV 89801 Telephone: (702) 738-6405 FAX: (702) 738-1719
Nevada	**Las Vegas**	Cummins Rocky Mountain, LLC 2750 Losee Road North Las Vegas, NV 89030 Telephone: (702) 399-2614 FAX: (702) 399-7457
Nevada	**Sparks**	Cummins Rocky Mountain, LLC 150 Glendale Avenue Sparks, NV 89431 Telephone: (775) 331-4983 FAX: (775) 331-7429
New Jersey	**Newark**	Cummins Metropower, Inc. 41-85 Doremus Ave. Newark, NJ 07105 Telephone: (973) 491-0100 FAX: (973) 578-8873
New Mexico	**Albuquerque**	Cummins Rocky Mountain, LLC 1921 Broadway N.E. Albuquerque, NM 87102 Telephone: (505) 247-2441 FAX: (505) 842-0436
New Mexico	**Farmington**	Cummins Rocky Mountain, LLC 1101 North Troy King Road Farmington, NM 87401 Telephone: (505) 327-7331 FAX: (505) 326-2948
New York	**Bronx**	Cummins Metropower, Inc. 890 Zerega Avenue Bronx, NY 10473 Telephone: (718) 892-2400 FAX: (718) 892-0055
New York	**Albany**	Cummins Northeast, Inc. 101 Railroad Avenue Albany, NY 12205 Telephone: (518) 459-1710 FAX: (518) 459-7815
New York	**Buffalo**	Cummins Northeast, Inc. 480 Lawrence Bell Dr. Williamsville, NY 14221-7090 Telephone: (716) 631-3211 FAX: (716) 626-0799

Distributors and Branches - China, People's Republic

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	Shenyang	Cummins Engine (China) Investment Co., Ltd. ShenYang Workshop & Branch Office. No.5-2 Seventh Street, Shenyang Economic-Technological Development Area, Shenyang, Liaoning 110141, China. Telephone: (86-24) 25506611 Fax: (86-24) 25365599
	Kunming	Cummins (China) Investment Co. Ltd. Kunming Branch. Room 606, Hongta Mansion, No.155 Beijing Road, Kunming, Yunnan 650011, Telephone: (86-871) 3579471/511/579/958 Fax: (86-871) 3579210
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	Wuhan	Cummins Engine (China) Investment Co., Ltd. Wuhan Branch. No.2 Zhang Po Road, Dong Xi Hu District, A-Kaili Commercial Building, Wuhan, Hubei 430040, China. Telephone: (86-27) 83081677 Fax: (86-27) 83259369 / 83259370
	Guangzhou	Cummins (China) Investment Co., Ltd. Guangzhou. Branch G/F, Unit 1 & 2, Block 5, Xing Hui Yuan, NO. 46, Jinsui Road, Zhu Jiang New City, Guangzhou, Guangdong 510623, China. Telephone: (86-20) 38621009 Fax: (86-20) 38621144

Southeast Asia Regional Office - Singapore Singapore	
Cummins Diesel Sales Corporation 8 Tanjong Penjuru ZIP / Postal Code: 609019 Singapore Telephone: (65) 265-0155 Fax - Parts/MIS/Shipping: (65) 6264-0664	

Countries Covered:		
	Bangladesh	Malaysia
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	Cambodia	Singapore
		Sri Lanka
	Indonesia	Thailand
	Laos	Vietnam

Latin America Regional Office - Miramar (U.S.A.)	
Cummins Americas, Inc. 3350 SW 148 Avenue Suite 205 Miramar, FL 33027 U.S.A. Telephone: (954) 431-5511 Fax: (954) 433-5797	

Countries Covered:		
	Argentina	
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	Chile	
	Colombia	
		Paraguay
	Dominican Republic	Peru
		Uruguay
	El Salvador	Venezuela
	Eucador	
	Costa Rica	Honduras
	Dominican	Nicaragua

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COLOMBIA	**Bogota**	Cummins de los Andes S.A. Avenida Ciudad de Cali No. 11-22 Location: Bogota, Cundinamarca Colombia Telephone: (57-1) 294-8444 Fax: (57-1) 2294-8431
COLOMBIA	**Bucaramanga**	Cummins API Ltda. Kilómetro 7 Vía a Girón - Zona Industrial A.A. 1821 Bucaramanga, Colombia Bucaramanga, Santander Colombia Telephone: (57-76) 468060 / 469262 / 469263 Fax: (57-76) 468065
COLOMBIA	**Cali**	Tecnodiesel Limitada Apartado Aereo No. 6398 Carrera 8, No. 27-43 Cali, Valle Colombia Telephone: (57-2) 442-2422 Fax: (57-2) 442-1798

MACAU	**- See Hong Kong**	Cummins Hong Kong Ltd. 2/F Unison Industrial Centre 27-31 Au Pui Wan Street, Fo Tan, Shatin, N.T.cccc Hong Kong, Hong Kong Hong Kong S.A.R. Telephone: (852) 2606-5678 Fax: (852) 2691-1641
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MADEIRA ISLANDS	**- See Portugal**	Electro Central Vulcanizadora, Lda Rua Conselheiro Martins de Carvalho Lote 1480 Restelo Lisbon 1400 Portugal Telephone: (351-21) 3034800 Fax: (351-21) 3034801 / 2
MALAYSIA	**Kuala Lumpur**	Scott & English (M) Sdn Bhd 12 Jalan U1/15, Seksyen U1 Hicom-Glenmarie Industrial Park Shah Alam, Selangor Darul Ehsan 40150 Malaysia Telephone: (60-3) 7805-1111 Fax: (60-3) 7803-5122
MALI	**- See Senegal (Matforce)**	Matforce 10 Avenue Faidherbe Dakar Senegal Telephone: (221-8) 399500 Fax: (221-8) 399531 / 399550
MALTA	**Valletta**	International Machinery Ltd Regency House 254 Republic Street Valletta, Malta Malta Telephone: (356-21) 232620 / 233343 Fax: (356-21) 235484 / 247571
MARTINIQUE		Cummins Power South, LLC 9900 N.W. 77 Ave. Hialeah Gardens, FL 33016 Telephone: (305) 821-4200 Fax: (305) 557-2992
MEXICO	**Guadalajara**	Distribuidora Megamak de Occidente Metalurgia No. 2980 Fracc. Alamo Industrial Guadalajara, Jalisco 45560 Mexico Telephone: (52-3) 666-0329 / 666-0383 Fax: (52-3) 666-0333

VIETNAM	**Hanoi**	Diethelm & Co. Ltd., Engrg. 94, Tran Quoc Toan Street, Hoan Kiem District Hanoi Vietnam Telephone: (84-4) 9424-725 Fax: (84-4) 9424-730
VIETNAM	**Ho Chi Minh City**	Diethelm & Co. Ltd., Engrg. 189 Dien Bien Phu Street, Ward 15 Binh Thanh District Ho Chi Minh City, S.R. Vietnam Telephone: (84-8) 5121-334 Fax: (84-8) 5121-335
WESTERN SAMOA	**-See SOUTH PACIFIC ISLANDS**	(Please contact) Cummins 2 Caribbean Drive Scoresby 3179 Victoria AUSTRALIA Telephone: (61-3) 9765-3222 Fax: (61-3) 9763-0079
YEMEN	**Sana'a**	Zubieri Trading Company Al Qiyadah Street Sana'a Republic of Yemen Telephone: (967-1) 223943 / 224051 Fax: (967-1) 221611 / 245838
SERBIA & MONTENEGRO		Cummins Dizel Motori Prodaja i Servis Autoput, 22 11080 Zemum Beograd, Serbia & Montenegro Serbia & Montenegro Telephone: (381-11) 314 90 71 Fax: (381-11) 314 91 27
ZAMBIA	**Ndola**	Cummins Zambia Ltd Lufunza Avenue Ndola, Zambia Zambia Telephone: (260-2) 610 729 Fax: (260-2) 612 756
ZIMBABWE	**Harare**	Cummins Zimbabwe (Pvt) Ltd. 72 Birmingham Road Southerton, Zimbabwe Zimbabwe Telephones: (263-4) 621871 / 2 / 3 / 4 / 5 Fax: (263-4) 621880

Air Compressor Air Pressure Rises Slowly

Cause	Correction
STEP 1 Air intake system restriction to air compressor is excessive	Replace the air compressor air cleaner (if installed). Check the air intake piping. Check engine air intake restriction if the air compressor inlet is plumbed to the vehicle or equipment intake system. Refer to Section 3 .
OK Go To Next Step	
STEP 2 Air system leaks	Block the vehicle wheels and check the air system for leaks with spring brakes applied and released. Check for leaks from the air compressor gaskets and the air system hoses, fittings, tanks, and valves. Refer to the OEM service manual . For applications fitted with selective catalytic reduction exhaust systems, check the air supply line to the dosing control unit.
OK Go To Next Step	
STEP 3 Air governor is malfunctioning or **not** set correctly	Check the air governor for correct operation. Refer to the OEM service manual .
OK Go To Next Step	
STEP 4 Carbon buildup is excessive in the air discharge line, downstream air valves, or cylinder head	Check for carbon buildup. Replace the air compressor discharge line, cylinder head, or air compressor. Check the turbocharger for oil leaks. Check the intake tube for oil. Refer to Section 5 .
OK Go To Next Step	
STEP 5 Air system component is malfunctioning	Check the operation of the air system valves, air dryers, and other OEM-installed air system components. Refer to the OEM service manual .
OK Go To Next Step	
STEP 6 Contact a Cummins® Authorized Repair Facility	

Coolant Temperature Above Normal - Sudden Overheat

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to the OEM service manual .
OK Go To Next Step	
STEP 2 Fan drive belt is broken	Check the fan drive belt. Replace the belt, if necessary. Refer to Section 3 .
OK Go To Next Step	
STEP 3 Coolant level is below specification	Check the coolant level. Check for an external leak. Refer to Section 3 . Sample the lubricating oil and have a laboratory check for coolant in the oil (internal leak).
OK Go To Next Step	
STEP 4 Charge-air cooler fins, radiator fins, or air conditioner condenser fins are damaged or obstructed with debris	Inspect the charge-air cooler, air conditioner condenser, and radiator fins. Clean, if necessary. Refer to the OEM service manual .
OK Go To Next Step	
STEP 5 Cooling system hose is collapsed, restricted, or leaking	Inspect the hoses. Refer to Section 7 .
OK Go To Next Step	
STEP 6 Radiator cap is **not** correct, is malfunctioning, or has low-pressure rating	Check the radiator pressure cap. Refer to Section 4 .
OK Go To Next Step	
STEP 7 Radiator shutters are **not** opening completely, or the shutterstat setting is wrong	Inspect the radiator shutters. Repair or replace if necessary. Check the shutterstat setting. Refer to the OEM service manual .
OK Go To Next Step	
STEP 8 Cold weather radiator cover or winterfront is closed	Open the cold weather radiator cover or the winterfront. Maintain a minimum of 784 cm^2 [122 in^2] or approximately 28 x 28 cm [11 x 11 in] of opening at all times. Refer to Section 1 .
OK Go To Next Step	

Engine Difficult to Start or Will Not Start (No Exhaust Smoke)

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to the OEM service manual .
OK Go To Next Step	
STEP 2 Vehicle antitheft feature active	Enter the correct "PIN" or verify the antitheft feature is disabled using electronic service tool the OEM service manual .
OK Go To Next Step	
STEP 3 Keyswitch circuit is malfunctioning	Check the vehicle, equipment, or vessel keyswitch circuit. Refer to the OEM service manual .
OK Go To Next Step	
STEP 4 Fuel level is low in the tank	Fill the supply tank. Refer to Section V .
OK Go To Next Step	
STEP 5 Air in the fuel system	Prime the fuel pump. Refer to Section V .
OK Go To Next Step	
STEP 6 Battery voltage is low	Check the battery connections. Refer to Section A .
OK Go To Next Step	
STEP 7 Fuel inlet restriction	Check the fuel filter. Refer to Section A .
OK Go To Next Step	
STEP 8 Electronic control module (ECM) is locked up	Disconnect the battery cables for 30 seconds. Connect the battery cables, and start the engine.
OK Go To Next Step	
STEP 9 Moisture in the wiring harness connectors	Dry the connectors with Cummins® electronic cleaner, Part Number 3824510.
OK Go To Next Step	
STEP 10 Contact a Cummins® Authorized Repair Facility	

Engine Speed Surges Under Load or in Operating Range

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to OEM service manual .
OK Go To Next Step	
STEP 2 Engine speed also surges at idle	Refer to Engine Speed Surges at Low or High Idle symptom tree .
OK Go To Next Step	
STEP 3 Air in the fuel system	Prime the fuel pump. Refer to OEM service manual .
OK Go To Next Step	
STEP 4 Fuel drain line restriction	Check the fuel drain lines for restriction. Refer to the OEM service manual .
OK Go To Next Step	
STEP 5 Fuel inlet restriction	Check the fuel filter. Refer to OEM service manual .
OK Go To Next Step	
STEP 6 Air intake system restriction is above specification	Check the air intake system for restriction. Clean or replace the air filter and inlet piping as necessary. Refer to Procedure 018-019 in Section V .
OK Go To Next Step	
STEP 7 Exhaust system restriction is **not** within specification	Check the exhaust system for restrictions. Contact a Cummins® Authorized Repair Location.

Lubricating Oil Consumption Excessive

Cause	Correction
STEP 10 Lubricating oil drain interval is excessive	Verify the correct lubricating oil drain interval. Refer to Section 2 .

OK

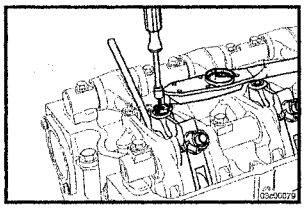
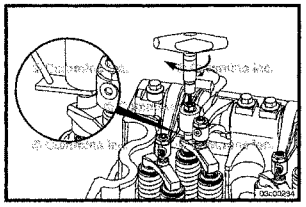
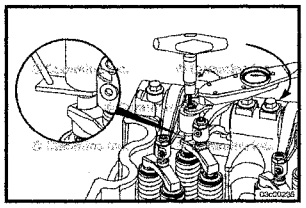
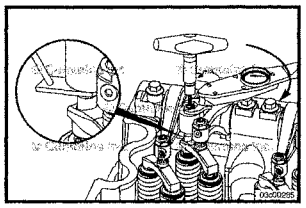
Go To Next Step

STEP 11

Contact a Cummins® Authorized Repair Facility

Turbocharger Boost Pressure Low

Cause	Correction
STEP 1 Intake and exhaust system restricted	Check the intake and exhaust systems for restrictions. Inspect the intake air filter and replace as necessary.
OK Go To Next Step	
STEP 2 Air intake or exhaust leaks	Check for loose or damaged piping connections and missing pipe plugs. Check the turbocharger and exhaust manifold mounting. Refer to Section 5 .
OK Go To Next Step	
STEP 3 Contact a Cummins® Authorized Repair Facility	

Component or Assembly (Procedure)	Ref.No./ Steps	Metric	U.S.	
Maintenance Procedures at 800,000 Kilometers [500,000 Miles], 10,000 Hours, or 5 Years - Torque Values				
Engine Brake Assembly (020-004)		20 N•m	[177 in-lb]	
Overhead Set (003-004)		0.6 N•m	[5 in-lb]	
		45 N•m	[33 ft-lb]	
		20 N•m	[177 in-lb]	

Diesel Exhaust Fluid Recommendations and Specifications

General Information

⚠WARNING⚠

It is unlawful to tamper with or remove any component of the aftertreatment system. It is also unlawful to use a Diesel Exhaust Fluid (DEF) that does not meet the specifications provided or to operate the vehicle/ equipment with no Diesel Exhaust Fluid (DEF).

⚠WARNING⚠

Diesel Exhaust Fluid (DEF) contains urea. Do not get the substance in your eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. Do not swallow internally. In the event the diesel exhaust fluid is ingested, contact a physician immediately. Reference the Materials Safety Data Sheet (MSDS) for additional information.

⚠CAUTION⚠

Never attempt to create Diesel Exhaust Fluid by mixing agricultural grade urea with water. Agricultural grade urea does not meet the necessary specifications required and the aftertreatment system may be damaged.

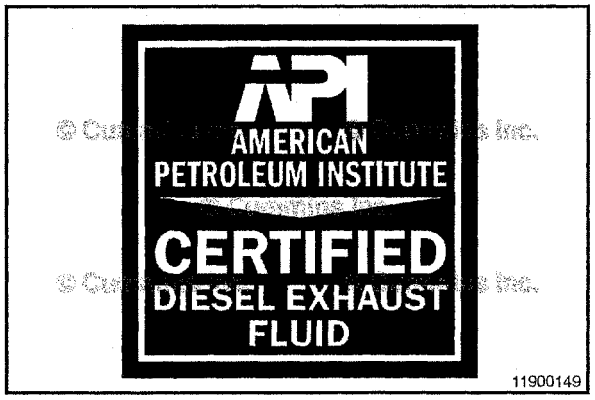
Cummins Inc. requires the use of Diesel Exhaust Fluid meeting ISO 22241-1. There is NO acceptable substitute.

NOTE: Some locations may reference the DIN 70070 standard. Diesel Exhaust Fluid specification limits of this standard are identical to ISO 22241-1.

Cummins Inc. is not responsible for failures or damage resulting from what Cummins Inc. determines to be abuse or neglect, including but not limited to: operation without correctly specified Diesel Exhaust Fluid; lack of maintenance of aftertreatment; improper storage, or shutdown practices; unauthorized modifications of the engine and aftertreatment. Cummins is also not responsible for failures caused by incorrect Diesel Exhaust Fluid or by water, dirt or other contaminants in the Diesel Exhaust Fluid

For further details and discussion of Diesel Exhaust Fluid (DEF) for Cummins® engines. Refer to the Diesel Exhaust Fluid Specifications for Cummins® Selective Catalytic Reduction Systems, Service Bulletin Number 4021566.

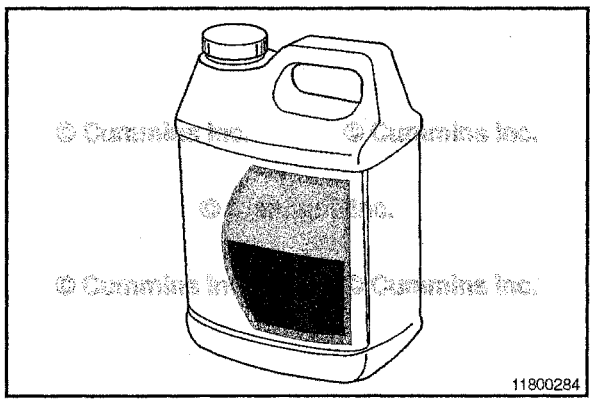
For engines using SCR operating in the United States and Canada, it is also strongly recommended that the Diesel Exhaust Fluid (DEF) used be certified by the American Petroleum Institute (API). This would be indicated by a symbol on the container/dispensing system as shown.



To ensure the correct Diesel Exhaust Fluid (DEF) is used, Cummins Inc. recommends the use of Fleetguard® Diesel Exhaust Fluid. Fleetguard® carries different quantity options from small to bulk containers.

For customers located in the United States and Canada, for assistance locating Diesel Exhaust Fluid (DEF), contact the Cummins Customer Assistance Center: 1-800 DIESELS (1-800-343-7357).

For customers outside of the United States and Canada, contact you local Cummins authorized repair location for assistance in locating Diesel Exhaust Fluid (DEF).



Testing SCA Concentration Level CC-2602 Test Kit

Precautions and Instructions for Proper Kit Use

Carefully follow the instructions to test the coolant. Take the appropriate action recommended by the kit.

- The coolant sample to be tested **must** be between 10°C [50°F] and 54°C [130°F]. If the sample is too cold or too hot, you will get incorrect results.
- To get the best color match results, compare test strip pads to the color chart in daylight or under cool white fluorescent lighting. If unsure about a specific color match when a test does fall between two colors on the color chart, choose the lower numbered (or lettered) block. It is safer to underestimate your results than to overestimate.
- The test strips do have a limited shelf life and are sensitive to humidity and extreme heat. Proper handling and storage is necessary to protect the life of the strips.
- Keep the cap tightly sealed on the test strip bottle **except** when removing a strip. Store away from direct sunlight and in an area where the temperature will generally stay below 32°C [90°F].
- Do **not** use the test strips after the expiration date stamped on the bottle.
- Discard the kit if the top pad on the unused strips have turned light brown.
- Use one strip at a time and take care **not** to touch any of the pads on the strip. Doing so will contaminate the pads and skew the test results.
- If the strip container is left uncapped for 24 hours, moisture in the air will render the strips useless, even though no discoloration will be evident.
- **Only** use the color chart supplied with the kit.
- Following the correct test times is very important. Use a clock or stopwatch.
- Do **not** utilize the test kit to maintain minimum SCA concentration levels (i.e., 1.5 units).
- When performing service that requires draining the cooling system, take special precautions to collect coolant in a clean non-galvanized container, seal to prevent contamination, and save for reuse.

Probablizer:

- 3318169S Plug - Installs on the engine for easy coolant sampling
- 3318168S Cap - Use with Monitor C bottle to sample coolant
- CC2700 Monitor C™ - Use lab analysis of coolant samples for more detailed analysis.

CC2602 Coolant Test Kit

- Works with any SCA formulation. Call 1-800-22FILTER (800-223-4583) if you have this test kit and the color chart does **not** show the number of units of SCA per gallon of coolant.)

Weights and Measures - Conversion Factors

Conversion Chart

Quantity	U.S. Customary		Metric		From U.S. Customary To Metric Multiply By	From Metric To U.S. Customary Multiply By
	Unit Name	Abbreviation	Unit Name	Abbreviation		
Area	sq. inch	in^2	sq. millimeters	mm^2	645.16	0.001550
			sq. centimeters	cm^2	6.452	0.155
	sq. foot	ft^2	sq. meter	m^2	0.0929	10.764
Fuel Consumption	pounds per horsepower hour	lb/hp-hr	grams per kilowatt hour	g/kW-hr	608.277	0.001645
Fuel Performance	miles per gallon	mpg	kilometers per liter	km/l	0.4251	2.352
	gallons per mile	gpm	liters per kilometer	l/km	2.352	0.4251
Force	pounds force	lbf	Newton	N	4.4482	0.224809
Length	inch	in	millimeters	mm	25.40	0.039370
	foot	ft	millimeters	mm	304.801	0.00328
Power	horsepower	hp	kilowatt	kW	0.746	1.341
Pressure	pounds force per sq. inch	psi	kilopascal	kPa	6.8948	0.145037
	inches of mercury	in Hg	kilopascal	kPa	3.3769	0.29613
	inches of water	in H_2O	kilopascal	kPa	0.2488	4.019299
	inches of mercury	in Hg	millimeters of mercury	mm Hg	25.40	0.039370
	inches of water	in H_2O	millimeters of water	mm H_2O	25.40	0.039370
	bars	bars	kilopascals	kPa	100.001	0.00999
	bars	bars	millimeters of mercury	mm Hg	750.06	0.001333
Temperature	fahrenheit	°F	centigrade	°C	(°F-32) ÷ 1.8	(1.8 x °C) + 32
Torque	pound force per foot	ft-lb	Newton-meter	N•m	1.35582	0.737562
	pound force per inch	in-lb	Newton-meter	N•m	0.113	8.850756
Velocity	miles/hour	mph	kilometers/hour	kph	1.6093	0.6214
Volume: liquid displacement	gallon (U.S.)	gal.	liter	l	3.7853	0.264179
	gallon (Imp*)	gal.	liter	l	4.546	0.219976
	cubic inch	in^3	liter	l	0.01639	61.02545
	cubic inch	in^3	cubic centimeter	cm^3	16.387	0.06102
Weight (mass)	pounds (avoir.)	lb	kilograms	kg	0.4536	2.204623
Work	British Thermal Unit	BTU	joules	J	1054.5	0.000948
	British Thermal Unit	BTU	kilowatt-hour	kW-hr	0.000293	3414
	horsepower hours	hp-hr	kilowatt-hour	kW-hr	0.746	1.341