



SNOW WOLF SB-1050

Config Manual

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Snow Wolf 1050

Operators Manual

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OVERVIEW

PURPOSE OF MANUAL

This publication presents the operator's instructions for the Snow Wolf SB1050 Snow Blower, manufactured by Airport Technologies Inc. For your safety and continuing satisfaction, read this manual completely prior to operation and keep it handy in your vehicle at all times. The information it contains will become more valuable as the vehicle gets more use.

SCOPE

This Operator's Manual provides information for use by the vehicle operator under the following headings:

GENERAL INFORMATION

General information regarding the equipment and components mounted on the vehicle.

OPERATION

Driving recommendations, the use of instruments and controls, shifting instructions and selection of components for off-road use.

MAINTENANCE

The procedures for the daily operator walk around inspection. These procedures include the maintenance requirements for the engines and drive train components along with the steering, cooling and air intake systems.

RELATED MANUALS

Airport Technologies Inc. - Snow Wolf SB1050 Snow Blower Service & Parts Manual.

SAFETY PRECAUTIONS

INTRODUCTION

This section provides information on safe procedures for users and describes vehicle safety labels that warn of hazards.

Safety is a prime concern to all of us. Since the operator is the key to safe job performance he or she must be aware of basic safety precautions to help prevent serious injury and damage to property. The safest machine must still be operated with care and the knowledge of its hazards. Know the capabilities of your equipment and its hazards. You must be thoroughly familiar with all controls, gauges and instruments.

It is the responsibility of the operator to know what specific requirements, precautions and work area hazards exist. A common understanding should be reached by all personnel to assure safe performance in operating the equipment.

Learn beforehand as much about the vehicle as possible!

SAFETY LABELS

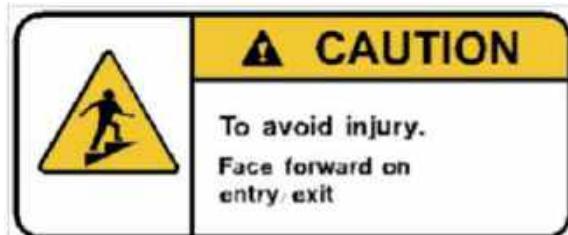
This section is a summary listing of the safety labels and their location on the vehicle.



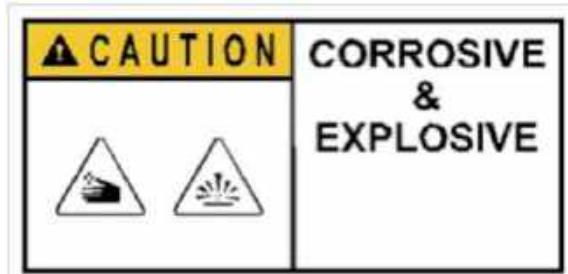
Label located on all access steps



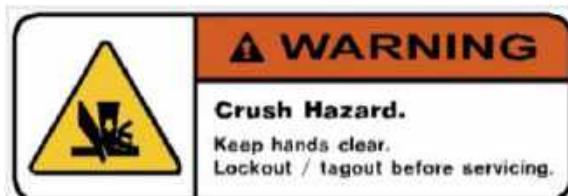
Label located inside engine enclosure access doors



Label located on access stairway



Label located on battery box



Label located at crush hazard points

AIRPORT TECHNOLOGIES INC. LIMITED WARRANTY

1. LIMITED WARRANTY

Except as provided below, this vehicle is covered by a 12 month warranty with the exception of the Carrier and Blower engines which are covered for 2 years. (subject to Cummins normal warranty provisions). Airport Technologies Inc. ("ATI") warrants to the user that this Snow Blower is free from defects in material and workmanship. This warranty shall apply only if the vehicle is properly maintained and used in service which is normal for the particular vehicle. Normal service for a Snow Blower means service which does not subject the vehicle to stresses or impacts greater than normally result from the careful use of the vehicle. If the buyer or subsequent owner discovers a defect or nonconformity it must notify Airport Technologies Inc. in writing within ten (10) days after the date of discovery.

Airport Technologies Inc. makes no warranty whatsoever as to (1) Integral parts, components, attachments, or trade accessories not manufactured by Airport Technologies, but instead, the applicable warranties, if any, of the respective manufacturers thereof shall apply; (2) Any vehicle or component, part, attachment or accessory damaged by misuse, neglect or accident; (3) Any vehicle or component, part attachment or accessory which shall have been repaired, altered, or assembled in any way by others than Airport Technologies Inc. which, in the sole judgement of Airport Technologies Inc. affects the performance, stability or purpose for which it was manufactured; (4) Frames or cross-members which have been subject to welding, heat treatment or corrosion caused by the use of acids after delivery to the first user; (5) Products or parts which are not defective, but which may wear out and have to be replaced during the warranty period, including, but not limited to, tires, fluids, gaskets and light bulbs. Airport Technologies Inc. assumes no responsibility for the assembly of its parts or sub-assemblies into finished products unless the assembly is performed by Airport technologies Inc.

2. DISCLAIMERS OF WARRANTIES

THE WARRANTIES SET FORTH IN PARAGRAPH 1 ARE THE EXCLUSIVE WARRANTIES GIVEN BY AIRPORT TECHNOLOGIES INC. AIRPORT TECHNOLOGIES INC. HEREBY DISCLAIMS AND EXCLUDES ALL OTHER WARRANTIES, WHETHER EXPRESS, IMPLIED OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY, ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, AND ANY IMPLIED WARRANTIES OTHERWISE ARISING FROM COURSE OF DEALING OR USAGE OF TRADE.

3. BUYER'S REMEDIES

If the product fails to conform to the warranties set forth in paragraph 1 and such nonconformity is not due to misuse or improper maintenance, buyer shall notify Airport Technologies Inc. as provided in paragraph 1, and shall make the product available for inspection by Airport Technologies Inc. or its designated agent. At the request of Airport Technologies Inc. any defective part shall be returned to Airport Technologies Inc. for examination, with transportation charges prepaid. Within a reasonable time Airport Technologies Inc. shall provide the repair or replacement of any nonconforming or defective parts. THIS REMEDY SHALL BE THE EXCLUSIVE AND SOLE REMEDY.

4. EXCLUSION OF CONSEQUENTIAL AND INCIDENTAL DAMAGES

IN NO EVENT SHALL AIRPORT TECHNOLOGIES INC. BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, WHETHER RESULTING FROM NONDELIVERY OR FROM THE USE, MISUSE, OR INABILITY TO USE THE PRODUCT OR FROM DEFECTS IN THE PRODUCT OR FROM THE NEGLIGENCE OF AIRPORT TECHNOLOGIES INC.
*Your specific warranty may vary according to contract.

VEHICLE EXTERIOR ARRANGEMENT



Front View



Rear View



Left View



Right View

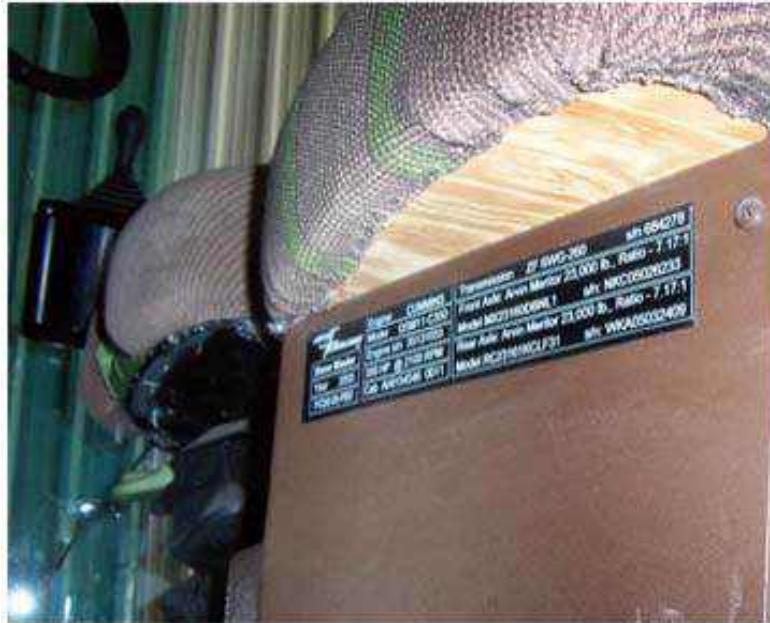
VEHICLE IDENTIFICATION

VIN LOCATIONS

The Vehicle Identification information is located in two areas on the vehicle.

VIN DATA DECAL

The Airport Technologies Inc. Vehicle Identification Data Sticker is located under the training seat in the vehicle cab.



VIN Decal

VIN DATA PLATE

A Vehicle Identification Plate is located at the front of the right outside frame rail. This information must be determined before the correct repair parts can be identified. The information is also required for warranty registration and to process a warranty claim.



VIN Data Plate

VIN INFORMATION

The plate states vehicle's serial number and model year. The gross axle weight ratings (GAWR) are based upon the lowest rated weight carrying capacity of the complete axle assemblies, which include the axle, tires, rims, wheels, and suspension. The gross vehicle weight rating (GVWR) is the sum of the individual gross axle weight ratings.

ENGINE/TRANSMISSION IDENTIFICATION

Engine Governed Speed - The RPM shown is as set at the factory. Higher resetting could damage the engine and would void the warranty. Lower resetting would result in a loss of power and speed.

PARTS/WARRANTY

When requesting service or ordering service parts, refer to the engine/transmission data plates and provide the Dealer or Airport Technologies Inc. service representative with the following information (for the specific location of engine/transmission data plates refer to manufacturers operators manuals):

The vehicle serial number, the engine, transmission model and arrangement/part number, when listed the engine, transmission serial number. Include any optional equipment listed on the engine/transmission option plates.

The engine/transmission serial number range and form number of the publication from which parts are being identified.

The part number, name and quantity of each part required.

VEHICLE ENTRY AND EXIT PROCEDURE



CAUTION

Steps, grab handles, and other safety related items must be replaced if cracks, excessive wear, deformed parts, etc. are seen on the vehicle. Tighten loose fasteners and replace missing fasteners.



CAUTION

Use steps and hand holds when getting in or out of vehicle.

- ❖ Vehicle must be at a complete stop and parking brake applied.
- ❖ Steps, handholds, and walkway surfaces must be clean and secure.
- ❖ Always face vehicle when getting in or out.
- ❖ DO NOT jump on or off vehicle.
- ❖ Maintain three (3) points of contact with vehicle at all times.

INTRODUCTION

Falls, slips, jumps, and insecure footing are common contributors to serious and painful injuries. Make sure steps and walkways are free of mud, ice, grease etc. Use safe practices as listed in this section to avoid such injuries.

GETTING IN AND OUT OF THE VEHICLE

You may use grab handles, cab door, fender, door frame, or steering wheel for handholds. DO NOT use hoses, harness, control knobs, mounting hardware, filters, or brackets.

Watch for Blower components, step lips, and door frame header when climbing in or out of the vehicle.

Use the following safety tips when getting in or out of your vehicle:

- 1) ALWAYS inspect your vehicle and the area surrounding your vehicle before getting in or out
- 2) ALWAYS face the vehicle when getting in or out.
- 3) ALWAYS maintain three (3) points of contact (one foot, two hands, and/or one hand, two feet) when getting in or out of the vehicle. Use steps and handholds provided.

It is the operator's responsibility to become familiar with the vehicle and know the correct entry/exit points of contact.

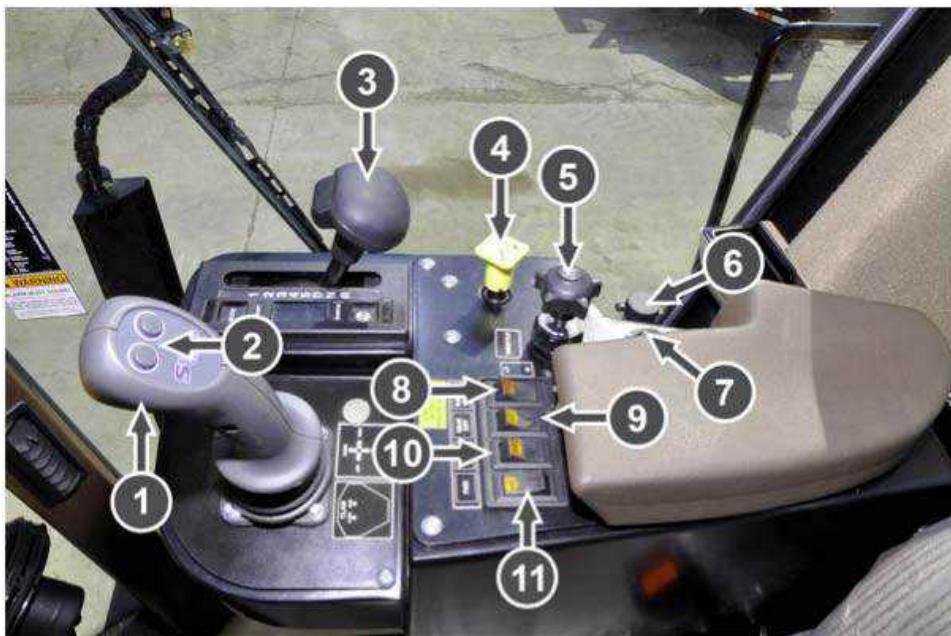
OPERATION

INSTRUMENTS AND CONTROLS

Read and understand the information in this section to ensure proper driving procedures and avoid hazardous operating conditions. Be familiar with the normal use and readings of the instruments and controls shown in this section before putting the vehicle in operation.

The following figures and tables list and identify the instruments and controls that can be factory installed on your vehicle by AIRPORT TECHNOLOGIES INC. It is important to note that not all the items shown will be installed on your vehicle, as some items are optional equipment. Additional instruments and controls added after the vehicle leaves the factory may not be reflected in this group.

AIRPORT TECHNOLOGIES INC. reserves the right to change modify, or relocate the position or function of instruments and controls without prior notification to customers.

MAIN CONSOLE*Main Console*

Ref.	Description	Normal Use or Reading
1	Joystick	Bankhead Control – hold left to turn volute left, push right to turn volute right. Pull back to lift the bankhead and push forward to lower the bankhead.
2	Joystick Buttons	Controls for Loading Chute - left button retracts chute. Right button extends chute.
3	Transmission Shifter	Directional control and shifting of the transmission.
4	Park Brake Switch	Pull knob out to apply the parking brake. Push knob in to release the parking brake.
5	Blower Engine Hand Throttle Control	Turn the knob clockwise to decrease engine RPM, counter clockwise to increase engine RPM. Pushing the center knob returns the engine to curb idle speed.
6	Power Supply	12V accessory power source.
7	Power Mirrors Switch	Mirror adjustment for left and right hand mirrors.
8	Transfer Case HI/LOW Switch	Three positions ON/OFF/ON rocker switch activates vehicle high low transfer case.
9	Front Diff Lock Switch	Two positions OFF/ON rocker switch activates front axle differential lock.
10	Rear Diff Lock Switch	Two positions OFF/ON rocker switch activates rear axle differential lock.
11	Four Wheel Drive Switch	Two positions OFF/ON rocker switch activates FWD.

HPTO/AUGER CONTROL*Right Hand Lower Pedestal*

Ref.	Description	Normal Use or Reading
1	HPTO Clutch On/Off	OFF/ON switch controls the engagement of the Hydraulic PTO clutch.
2	Status Lights	Green LED lights indicate the operating status.
3	Status Lights	Red LED lights indicate trouble codes.
4	Cutter Wheel Speed Control	Variable speed control of the speed of the cutter wheels and conveying system. Clockwise raises speed. Counter clockwise lowers speed.

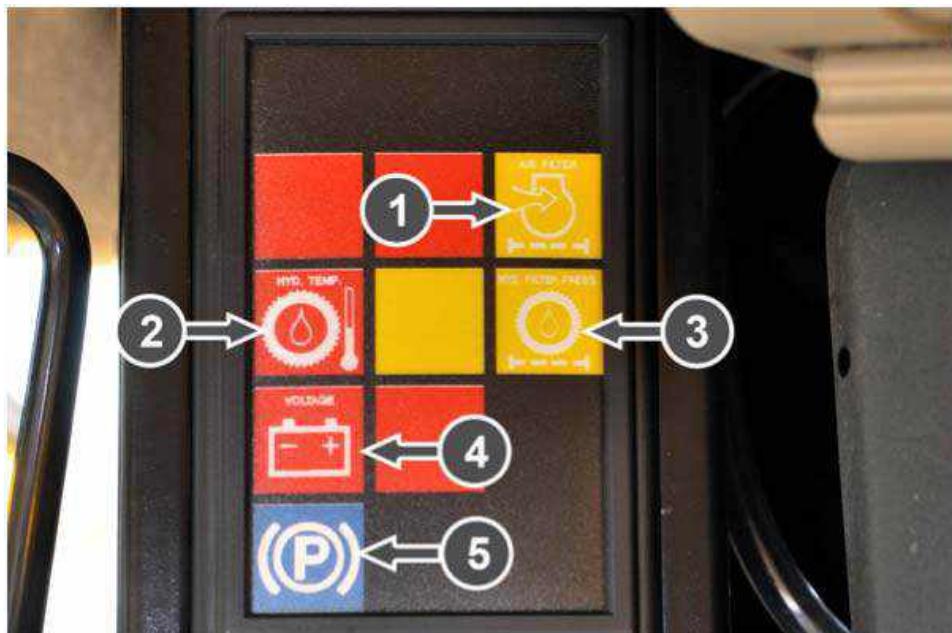
MURPHY PANEL



Right Hand Pedestal

Ref.	Description	Normal Use or Reading
1	Murphy Electronic Information Centre for the chassis carrier engine.	Indicates the operating parameters of the engine.
2	Amber Warning Light	Indicates a fault has occurred with the operation of the engine.
3	Red STOP Warning Light	Indicates a serious fault has occurred with the operation of the engine. Stop the vehicle as soon as possible and do not start again until fault has been corrected.
4	Audible Warning	Indicates that the Murphy Panel detects a fault with the carrier engine function. Operator will then need to scroll through functions for detail on alarm.

WARNING LIGHT DISPLAY



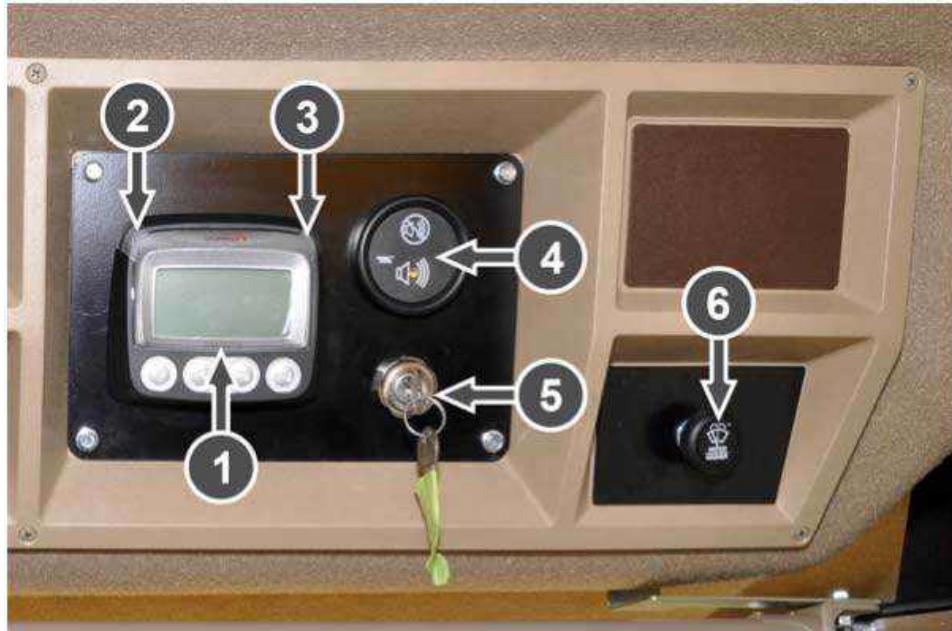
Right Hand Upper Pedestal

Ref.	Description	Normal Use or Reading
1	Air Filter Restriction Warning Light	Indicates the air filter is restricted and needs replacing.
2	Hydraulic Oil Temperature Warning Light	Indicates high hydraulic oil temperature. Stop the vehicle as soon as possible and do not start again until fault has been corrected.
3	Hydraulic Oil Filter Restriction Warning Light	Indicates the hydraulic oil filter is plugged or requires service.
4	Voltage Warning Light	Indicates a fault is detected with vehicle's charging system.
5	Parking Brake Light	Indicates the parking brake is applied.

OVERHEAD CONTROLS*Overhead Right Hand Roof*

Ref.	Description	Normal Use or Reading
1	Left Side Wiper Switch	Two positions OFF/ON rocker switch activates left side wiper system.
2	Right Side Wiper Switch	Two positions OFF/ON rocker switch activates right side wiper system.
3	Deluge Washer Switch	Two positions momentary OFF/ON rocker switch activates deluge washer pump.

OVERHEAD CONTROLS

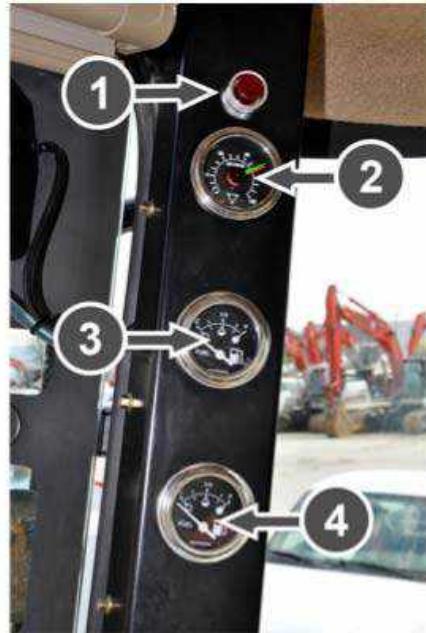


Overhead Console Right Side

Ref.	Description	Normal Use or Reading
1	Murphy Electronic Information Centre for the blower engine.	Indicates the operating parameters of the engine. Please refer to Operator Manual Section 10 for detailed instructions on using the Murphy Panel.
2	Amber Warning Light	Indicates a fault has occurred with the operation of the engine. Please refer to Operator Manual Section 10 for detailed instructions on using the Murphy Panel.
3	Red STOP Warning Light	Indicates a serious fault has occurred with the operation of the engine. Stop the vehicle as soon as possible and do not start again until fault has been corrected. Please refer to Operator Manual Section 10 for detailed instructions on using the Murphy Panel.
4	Audible Warning	Indicates that the Murphy Panel detects a fault with the carrier engine function. Operator will then need to scroll through functions for detail on alarm. Please refer to Operator Manual Section 10 for detailed instructions on using the Murphy Panel.
5	Ignition Switch	Blower engine start.
6	Windshield Wiper Switch	Two speed, intermittent speed control of windshield wiper system. Only active when park brake released.

OVERHEAD CONTROLS*Overhead Console Left Side*

Ref.	Description	Normal Use or Reading
1	Beacon Light Switch	Two position OFF/ON rocker switch activates rotating beacon.
2	Hazard Warning Switch	Two position OFF/ON rocker switch activates the hazard lights.
3	Road Light Switch	Two position OFF/ON rocker switch activates road lights.
4	Field Light Switch	Two position OFF/ON rocker switch activates field lights.
5	Work Light Switch	Three positions OFF/LOW/HIGH rocker switch activates work lights. Low and High beam.
6	Temperature Switch	Controls the air temperature inside the cab. The blue range is cooler, while the red range is hotter.
7	Fan Speed Switch	Four positions OFF/1/2/3 controls the amount of air flow inside the cab.
8	Mirror Heat Switch	Two position momentary OFF/ON rocker switch activates the mirror heaters.
9	Stereo Radio/Tape Player	Refer to the operating manual insert for instructions.

AIR BRAKE/FUEL LEVEL GAUGES*Left Hand Upper Pedestal*

Ref.	Description	Normal Use or Reading
1	Low Air Pressure Warning Light	Light illuminates when the air pressure is under 65 psi, a buzzer also sounds.
2	Dual Air Pressure Gauge	Normal reading 110-125 psi, minimum reading 90 psi, (white – front system, red – rear system).
3	Chassis Carrier Engine Fuel Gauge	Indicates the amount of fuel in the tank.
4	Blower Engine Fuel Gauge	Indicates the amount of fuel in the tank.

STEERING COLUMN*Foot Pedals/High Idle*

Ref.	Description	Normal Use or Reading
1	Idle Switch	When activated increases chassis carrier engine idle speed while the vehicle park brake is applied.
2	Ignition Switch	Chassis carrier engine start.
3	Horn Switch	Sounds vehicle horn.
4	Brake Pedal	Depress the pedal to operate the vehicle brake system. Refer to the brake section in this manual for brake system operation.
5	Throttle Pedal	Depress the pedal to accelerate the vehicle.

STEERING COLUMN*Shutdown/Turn Signal*

Ref.	Description	Normal Use or Reading
1	Blower Engine Shutdown Override Switch	When depressed will override engine shut down protection. Use this switch only in emergency situations.
2	Turn Signal Switch	Activates the turn signal indicators.

OPERATOR STATION/SEATS AND SEAT BELTS

START SWITCH



**Sound the horn before starting engine
in order to clear personnel away from
the vehicle.**

Chassis Carrier Engine Start switch (E) is located on right side of steering column.

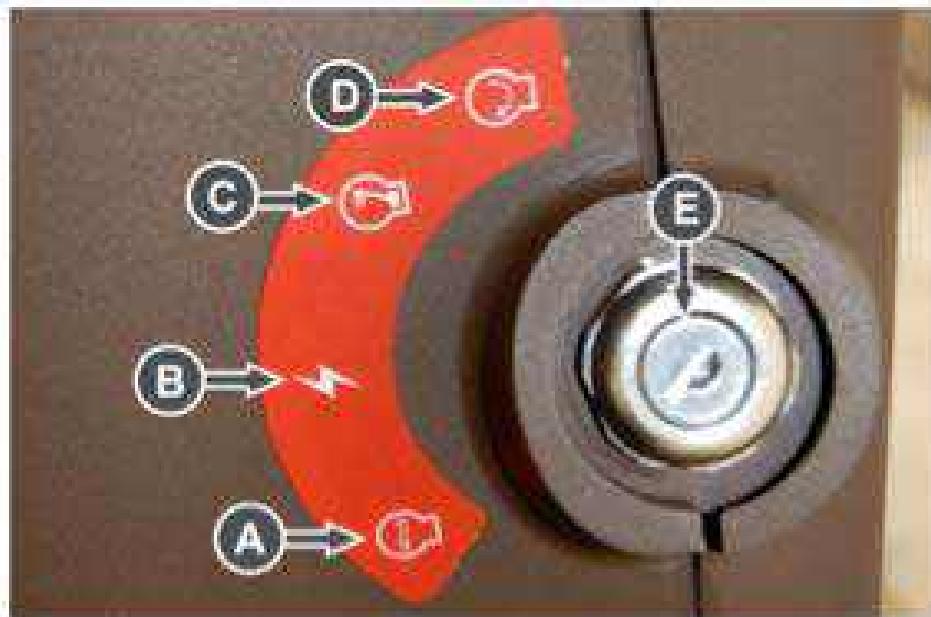
NOTE: To perform a bulb check, see CHECKING WARNING LIGHTS in the Operating Engine section.

With the key inserted, turn the start switch (E) from the Off position (A) to the Start position (D) to crank and start the engine. As soon as the engine is started release the key. When released the Start switch will return to the Run position (C).

If engine will not crank, check for:

- 1) Transmission Lever is in Neutral

For accessories only (engine Off), turn key to Accessories position (B).



Carrier Engine Start Switch

Ref.	Description
A	Off position
B	Accessories position
C	Run position
D	Start position
E	Start Switch

HORN

Horn button is located on right side of steering column. Press button (A) to sound horn.



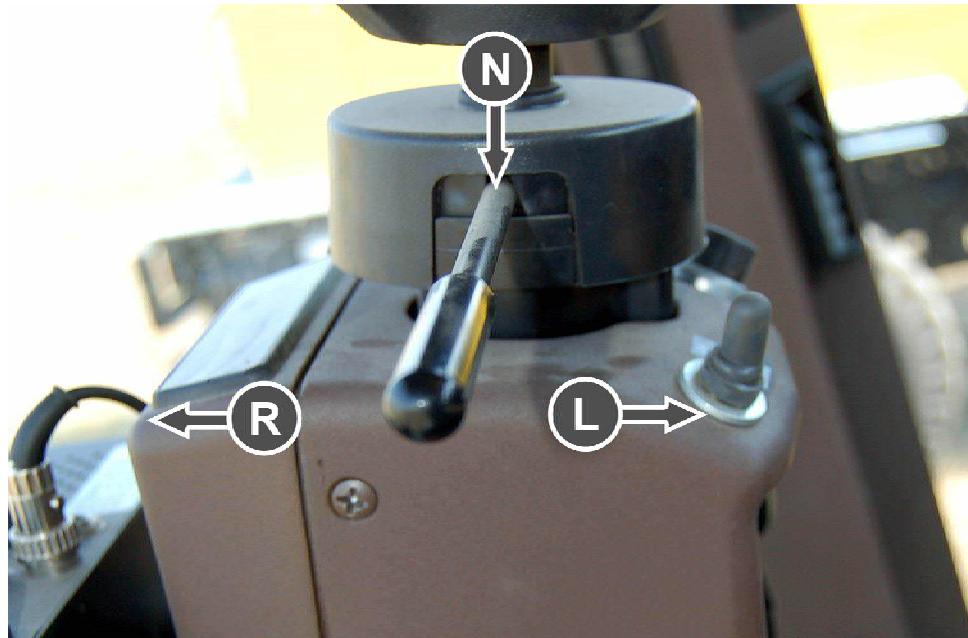
Horn Switch

Ref.	Description
A	Horn Button

TURN SIGNALS

NOTE: The turn signals are not self cancelling. After a turn is completed the operator must return the stalk to the neutral position. Right and left turn indicator lights (A) glow steadily in direction of indicated turn.

Turn signals are operable whenever ignition key is in Accessory or Run position.



Turn Signal Switch

Ref.	Description
N	Neutral position
R	Right turn position
L	Left turn position

STEERING WHEEL HEIGHT ADJUST

To prevent loss of steering control,
adjust steering wheel only when the
vehicle is stopped.

NOTE: Only a slight tightening of the hub (A) is needed to hold steering wheel in position.

Loosen hub (A). Push or pull wheel to the desired height. Tighten hub (A) to lock.



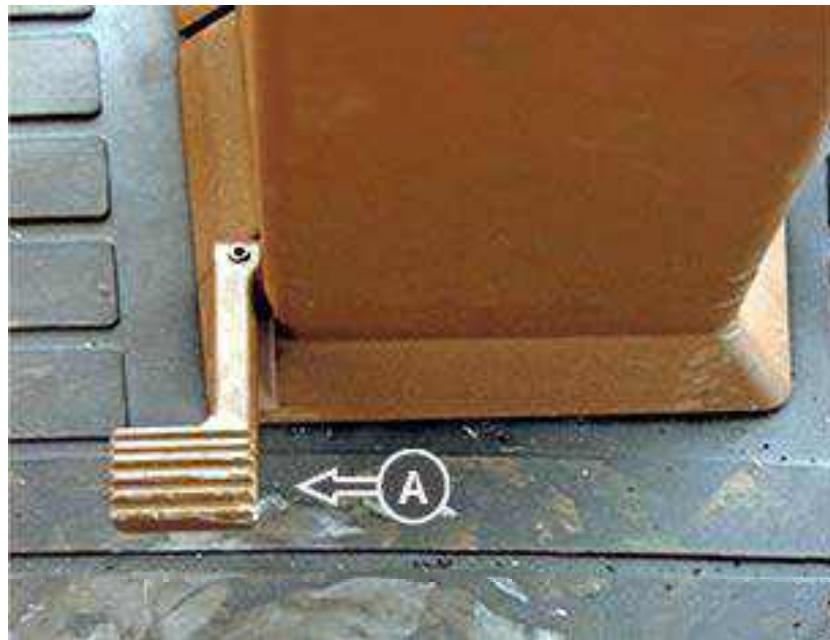
Steering Wheel Height Adjustment

Ref.	Description
A	Hub

STEERING WHEEL TILT ADJUST

To prevent loss of steering control, adjust the steering wheel only when the vehicle is stopped. The steering column is spring loaded to the upward position. Do not step on pedal without holding the steering wheel in both hands.

Press pedal (A) to release lock on steering column. Put column in desired position. Releases pedal (A). The steering column locks into position when the pedal is released.

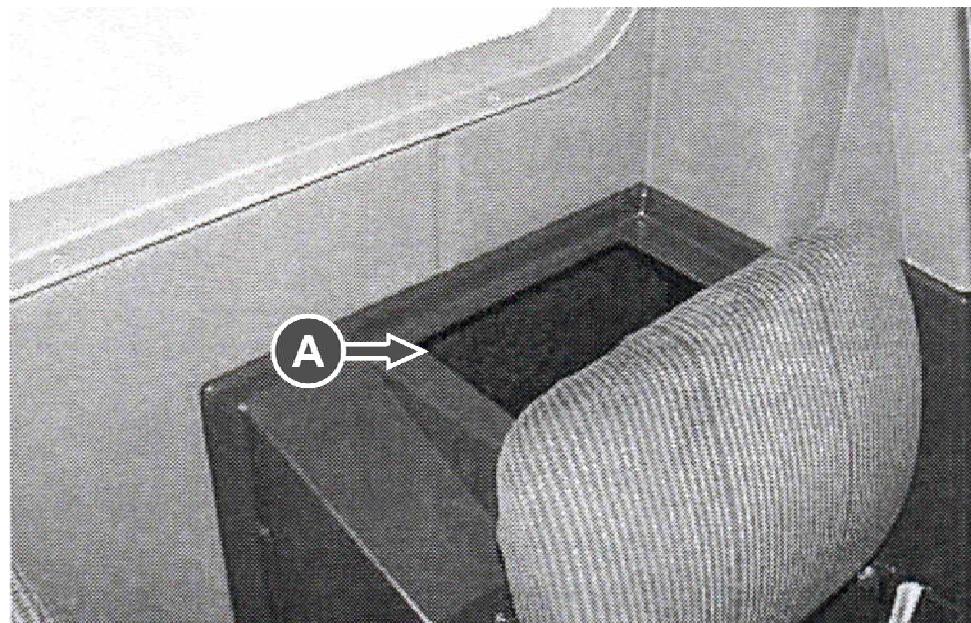


Column Tilt Adjustment Pedal

Ref.	Description
A	Pedal

STORAGE TRAY

A tray is located in left rear corner of cab.



Storage Tray

Ref.	Description
A	Tray

CAB DOOR LOCK

This lock uses the ignition key.



Cab Door Handle

Ref.	Description
A	Cab Door Lock

EMERGENCY EXIT

Pull tab (A) to begin removal of rubber rope (B).

Continue to pull until rope is removed from around window. The window can now be pushed out and allowed to fall free.



Emergency Exit Tab

Ref.	Description
A	Tab
B	Rope

COMFORT COMMAND OPERATOR'S SEAT

The Comfort Command operator's seat has an air suspension system for added operator comfort. The seat has a self-contained electric compressor to adjust the seat suspension to match the operator's height and weight. Seat adjustments are as follows:

- Vertical Shock Dampener
- Height Adjustment
- Fore/Aft Adjustment
- Fore/Aft Attenuator Lock-Out
- Seat Bottom Tilt
- Seat Bottom Fore/Aft Adjustment
- Seat Back Tilt
- Seat Back Lumbar Support
- Left Hand Armrest



Comfort Command Operator's Seat

Ref.	Description
A	Operators Seat

SEAT SUSPENSION AND FORWARD AND REARWARD ADJUSTMENT

Vertical shock dampener handle (A) allows the operator to limit the amount of "upward motion" the seat suspension provides.

Push the control forward for the softest ride. Move the handle back for the firmest ride. Between these two positions is the medium firmness position.

Height adjustment is made with handle (B). To raise the seat, pull up on the handle. To lower the seat, push down on the handle.

NOTE: The suspension can be adjusted to reach limits in the minimum and maximum heights which, in effect, locks out the suspension system, making it rigid. The

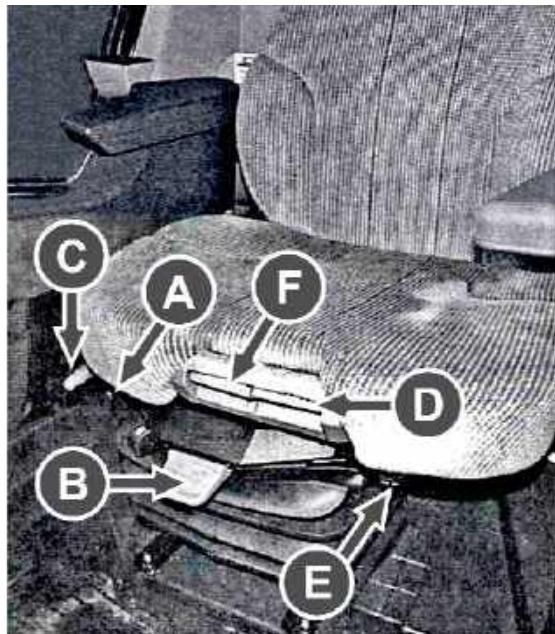
suspension height control will also hit the limits if adjusted too close to the extremes.

The forward/rearward adjustment handle (C) allows the seat to slide forward or rearward for best working position.

Seat bottom tilt control handle (D), allows the front of the seat cushion to be raised or lowered for the best working position.

Attenuator lockout lever (E) locks out or releases the forward or rearward movement. Pull up on the handle to lock; push down on the handle to release.

The forward/rearward adjustment handle (F) allows the seat bottom to slide forward or rearward for the best working position.



Comfort Command Operator's Seat Adjustments

Ref.	Description
A	Vertical Shock Dampener Control
B	Height Adjustment Knob
C	Forward/Rearward Adjustment Handle
D	Seat Bottom Tilt Control Handle
E	Forward/Rearward Attenuator Lock-Out Lever
F	Seat Bottom Forward/Rearward Adjustment Handle

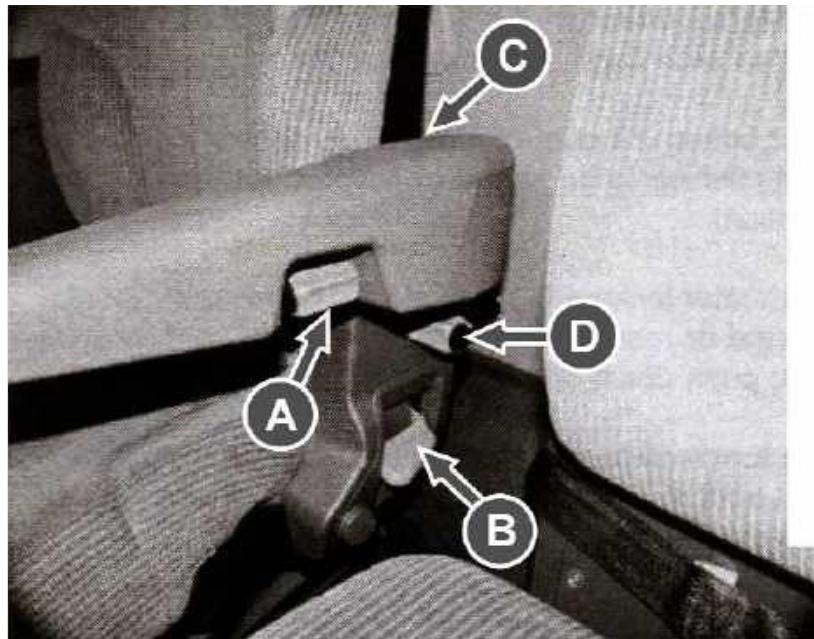
ADJUSTING LEFT-HAND ARMREST AND SEAT BACK

To adjust the left-hand armrest up or down, use knob (A). Rotate the knob clockwise to lower and counter clockwise to raise.

Pull up on handle (B) to adjust seat back angle. Release handle when seat back is in desired position.

To adjust the lumbar back support, use dial (C). Rotate the dial clockwise to increase support and counter clockwise to decrease support.

Turn knob (D) clockwise or counter clockwise to adjust left-hand armrest tension.



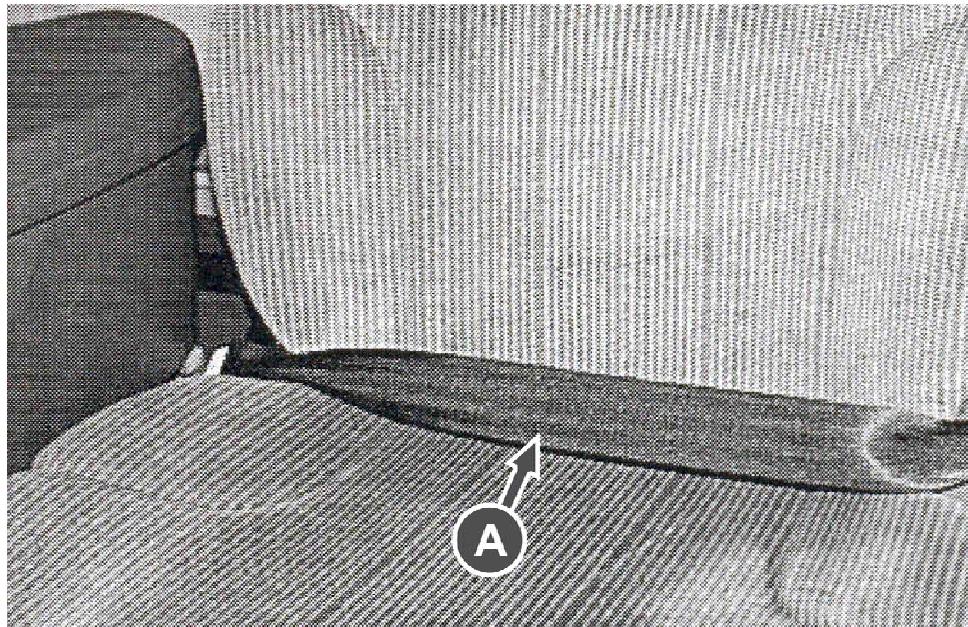
Comfort Command Operator's Seat Armrest Adjustments

Ref.	Description
A	left-Hand Armrest Height Adjustment Knob
B	Seat Back Angle Adjustment Handle
C	Lumbar Back Support Adjustment Knob
D	Left-Hand Armrest Tension Adjust Knob

SEAT BELTS

Inspect the seat belt and mounting hardware on your machine at least once a year. If the seat belt system, including the mounting hardware, buckle, belt or retractor, shows any sign of damage such as cuts, fraying, extreme or unusual wear, discoloration or abrasion, the entire seat belt system should be replaced immediately. For your safety, replace the belt system only with replacement parts approved for your machine.

Seat belts are standard equipment on both the operator and instructional seats. The lap type seat belts have push button quick release and automatic belt retraction to allow unrestricted exiting and entering of the seats.



Comfort Command Operator's Seat

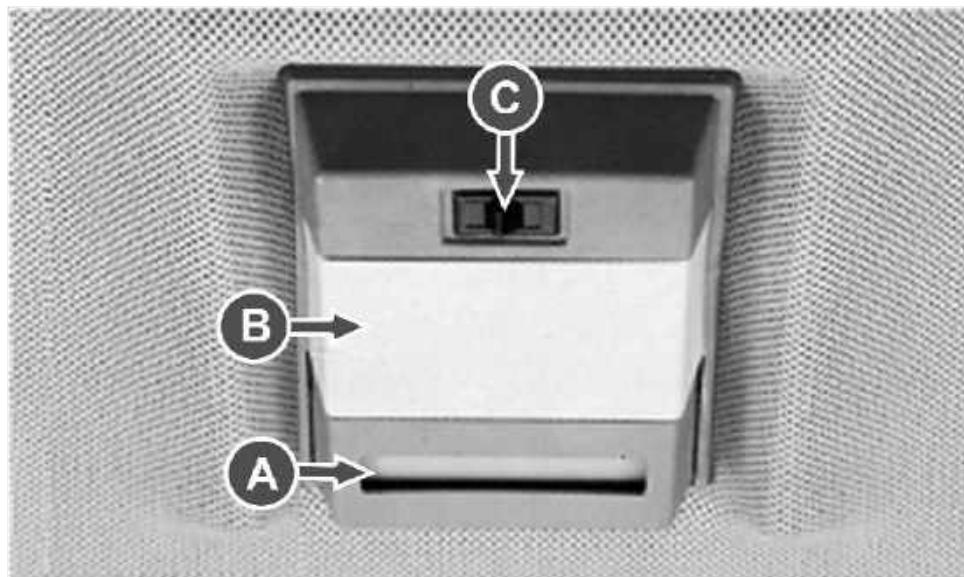
Ref.	Description
A	Seat Belt

CAB INTERIOR LIGHTS

Place switch (C) to right position to activate dome light (B).

Place switch (C) to left position to activate front console and armrest console light (on when Road or Field lights are on).

Place switch (C) to center position to turn interior lights off.



Cab Interior Lamp

Ref.	Description
A	Front Console and Armrest Console Light
B	Dome Light
C	Dome Light Switch

BRAKE SYSTEM OPERATION

INTRODUCTION

The brake system is a dual air mechanical type for the front and rear axles. The system is equipped with a dual air supply system and a dual brake treadle valve which controls the braking action of the front and rear systems. A failure in one of these systems will result in partial loss of vehicle braking power. The rear brakes are equipped with spring brake chambers which provide the parking brake function and emergency brake action in the event of a rear air system failure.

Both front and rear air systems supply pressure to the spring brake system circuit for the rear brakes. If the air system that supplies the front brake fails, the rear brakes can be applied normally. If the rear brake system fails, the front system as well as the rear spring chambers will still remain pressurized. When the brake treadle valve is depressed, with a rear system failure, the front brakes apply normally and air is vented from the rear spring chamber cavities allowing spring force to apply the brakes in direct proportion to the amount of air pressure delivered to the front axle. This gives the driver the "modulated" feel of normal service braking.

In the event of a pressure failure in either system, a buzzer sounds and a red warning light is activated on the instrument panel allowing the operator to safely stop or slow the vehicle. A total failure in the air system or pressure dropping below 35 PSI, will result in application of the spring brakes automatically.

OPERATION RECOMMENDATIONS

Following are some helpful tips that will enable you to get the most effective braking and maximum life from the brake system.

- 1) Do Not "ride the brake" when not intending to stop.
- 2) Improperly inflated tires will reduce braking efficiency as well as tire life.
- 3) Apply brakes gradually, only as hard as road and load conditions require. Pedal pressure should be reduced as speed drops to enable use of a light pressure at end of stop.
- 4) Full travel of the brake treadle should not be obstructed by any foreign object or floor mat.
- 5) Use light, steady pressure to maintain or reduce speed on downgrades. Do not use on-and-off brake application. This increases the loss of brake system air pressure, which will cause automatic application of the spring brakes if the pressure drops below 35 psi. Use a steady service brake application to reduce speed.
- 6) Avoid locking up the wheels when braking. Locking up the wheels reduces stopping ability, hampers steering and causes uneven tire wear.
- 7) Be sure the low air pressure gauge, alarm and warning light are properly operating. Before moving vehicle, air gauge should register at least 100 PSI.
- 8) After driving through deep water, dry the brakes by applying light pressure on the treadle while maintaining a slow forward speed with an assured stopping distance ahead until brake performance returns to normal.

DAILY OPERATOR'S CHECKS AND SERVICES

DAILY CHECKS AND SERVICES

This group presents the items that must be checked by the operator before putting the vehicle in service each day. These checks must also be done on each new shift of operations or if a new driver is to operate the vehicle.

NOTE: If your checks uncover any items that need attention, repair, replacement or adjustment, report it NOW. DO NOT operate your vehicle until all deficiencies are corrected.

CHECKS MADE WITH THE ENGINES OFF

WALK-AROUND INSPECTION

Before starting the engines, perform the following steps:

- 1) Look under the vehicle for fluid leaks. If fluid is found, determine what type of fluid it is and where it came from. Repair the leak and replenish the lost fluid as necessary.
- 2) Check for damaged, loose or missing parts. Repair or replace the parts as necessary.

CHECK WHEELS, TIRES, WHEEL LUGS AND TIRE PRESSURES



Explosive separation of a tire and rim parts can cause serious injury or death. Only attempt to mount a tire if you have the proper equipment and experience to perform the job. Have it done by a qualified repair service.

Always maintain the correct tire inflation pressure. Do not inflate the tires above the recommended pressure.

When inflating tires, use a clip-on chuck and extension hose long enough to allow you to stand to one side and not in front or over the tire assembly. Use a tire safety cage if available.

- 1) Inspect the wheels and tires, Do not operate with low pressure, cuts, bubbles, damaged rims or missing lug bolts and nuts.

CHECK THE CARRIER ENGINE OIL LEVEL

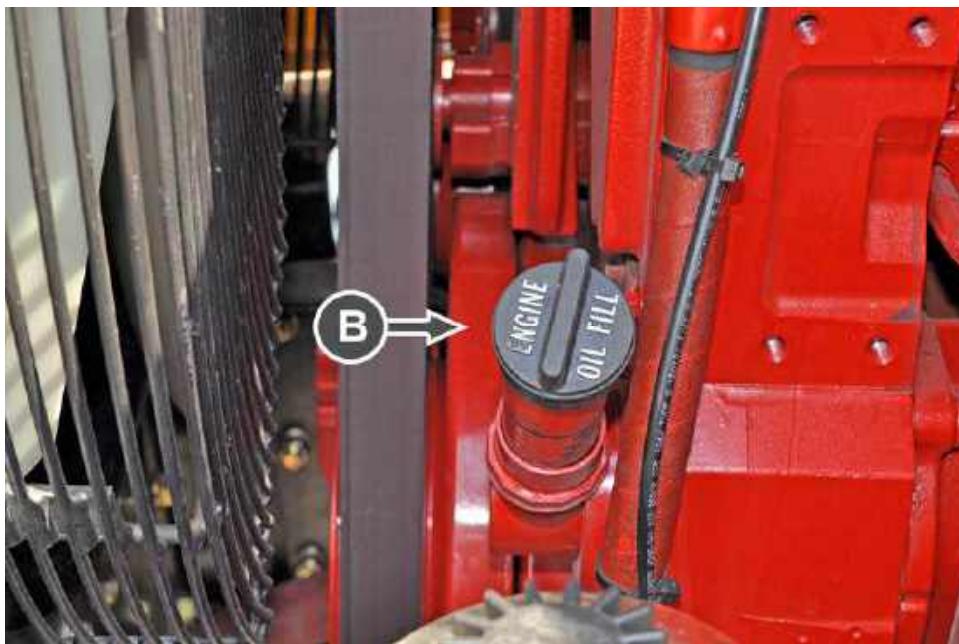
Do not start and operate the engine if it has a low oil reading on the engine dipstick.

Check the engine oil level with the engine stopped. If the engine has just been stopped, wait approximately 20 minutes to allow the oil to drain back into the pan. The carrier engine oil dipstick (A) is located on the right hand side of the vehicle. Remove the dipstick and check the oil level. The oil level should be in crosshatched area on the dipstick (C). If the oil level is low, add the correct grade of oil through the fill port (B) to maintain the correct level on the dipstick.



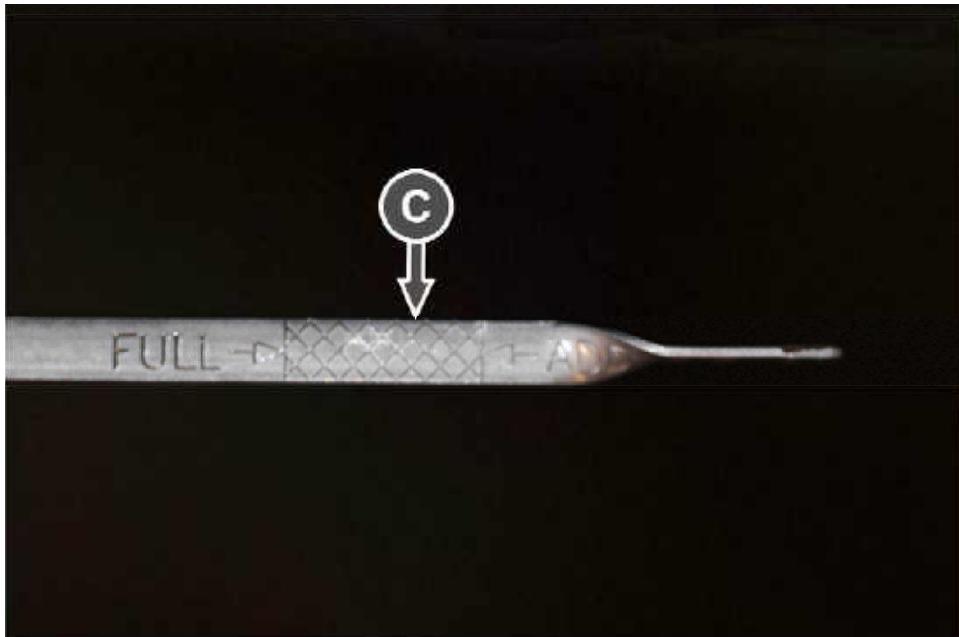
Carrier Engine Oil Dipstick Location

Ref.	Description
A	Dip Stick



Carrier Engine Oil Fill Location

Ref.	Description
B	Oil Fill Port



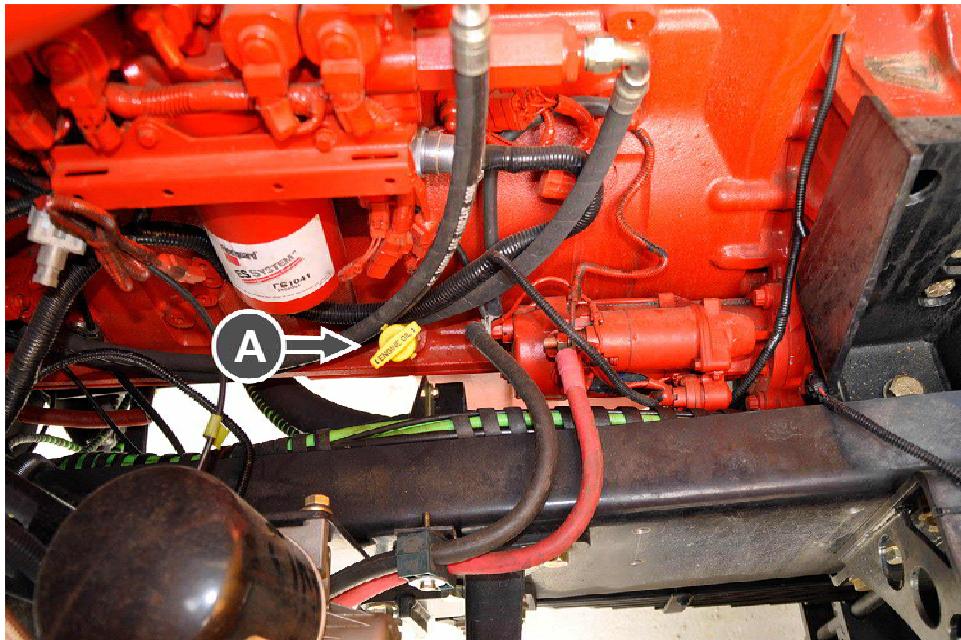
Crosshatched Area On The Dipstick.

Ref.	Description
C	Oil Dipstick

CHECK THE BLOWER ENGINE OIL LEVEL

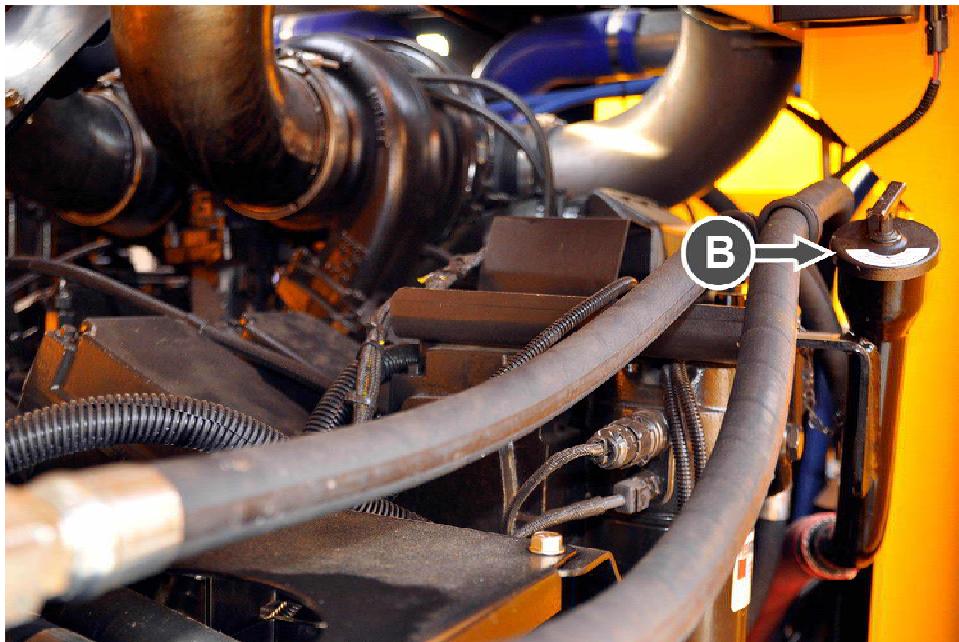
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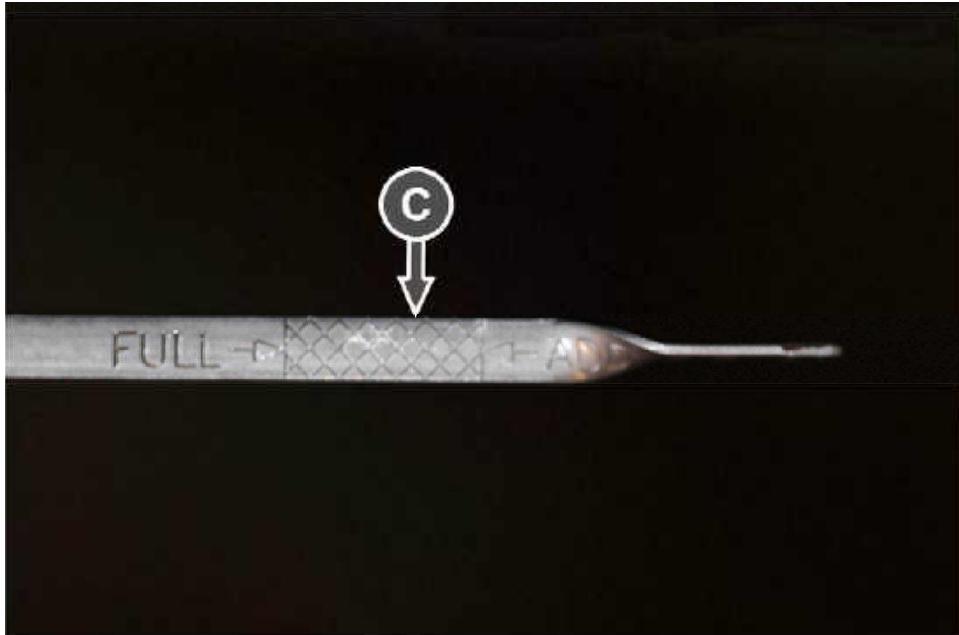
Blower Engine Oil Dipstick Location

Ref.	Description
A	Dip Stick



Blower Engine Oil Fill Location

Ref.	Description
B	Oil Fill Port

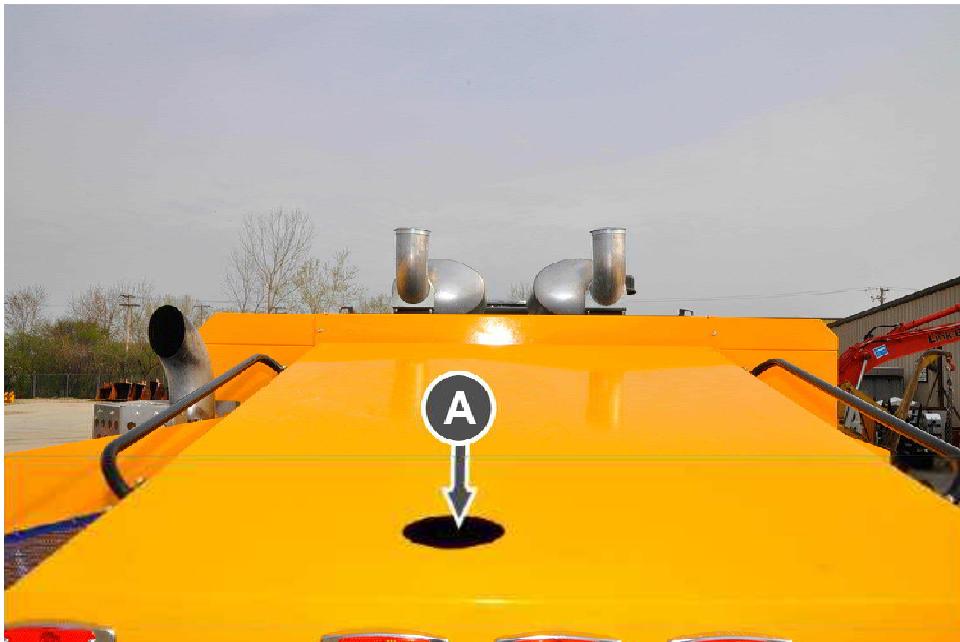


Crosshatched Area On The Dipstick.

Ref.	Description
C	Oil Dipstick

CHECK THE CARRIER ENGINE COOLANT LEVEL

Check the coolant level with the engine stopped. If the engine has just been stopped, wait approximately 20 minutes to allow the engine coolant to cool. The radiator inspection point (A) is located on top of the rear engine enclosure at the rear of the vehicle. Remove the radiator cap (D) and visually check level inside the radiator. If the level is more than 1" (2.5 cm) below the neck opening add engine coolant.



Carrier Engine Coolant Location

Ref.	Description
A	Carrier Engine Radiator

CHECK THE BLOWER ENGINE COOLANT LEVEL

Check the coolant level with the engine stopped. If the engine has just been stopped, wait approximately 20 minutes to allow the engine coolant to cool. The radiator inspection point (B) is located (A) on top of the front engine enclosure on the left side of the vehicle. Remove the radiator cap (D) and visually check level inside the radiator. If the level is more than 1" (2.5 cm) below the neck opening add engine coolant.



Blower Engine Coolant Location

Ref.	Description
A	Blower Engine Radiator

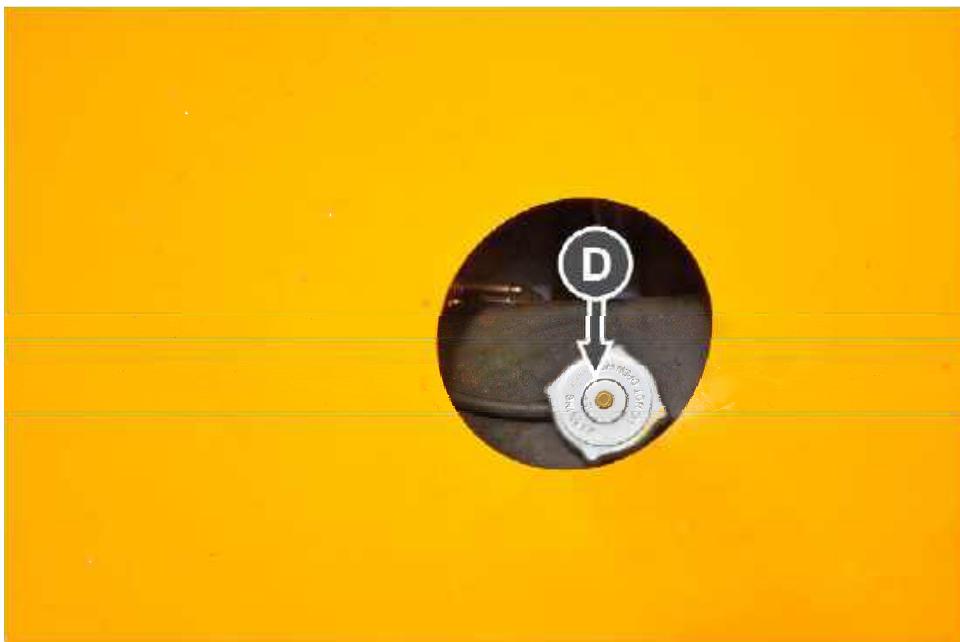
CHECK THE BLOWER ENGINE AIR CHARGE COOLANT LEVEL

Check the coolant level with the engine stopped. If the engine has just been stopped, wait approximately 20 minutes to allow the engine coolant to cool. The radiator inspection point (C) is located on top of the front engine enclosure on the right side of the vehicle. Remove the radiator cap (D) and visually check level inside the radiator. If the level is more than 1" (2.5 cm) below the neck opening add engine coolant.



Blower Engine Coolant Location

Ref.	Description
A	Blower Engine Radiator



Radiator Cap

Ref.	Description
A	Radiator Cap

CHECK THE DRIVE BELTS, PULLEYS AND BELT TENSIONS

Check both engines fan and accessory drive belts for cracks, frays and damage. Check all the belt pulleys for chipped flanges or cracks. Replace faulty components as necessary. Check the belt tensions. Belts should deflect 1/2 inch (12 mm) when pushed firmly.

CHECK THE WINDSHIELD WASHER/DELUGE FLUID LEVEL

The two reservoirs are located behind the cab along the right side frame rail. Visually inspect washer fluid levels. If necessary, add washer solvent for the windshield washer system at cap (A), or for the deluge system at cap (B).

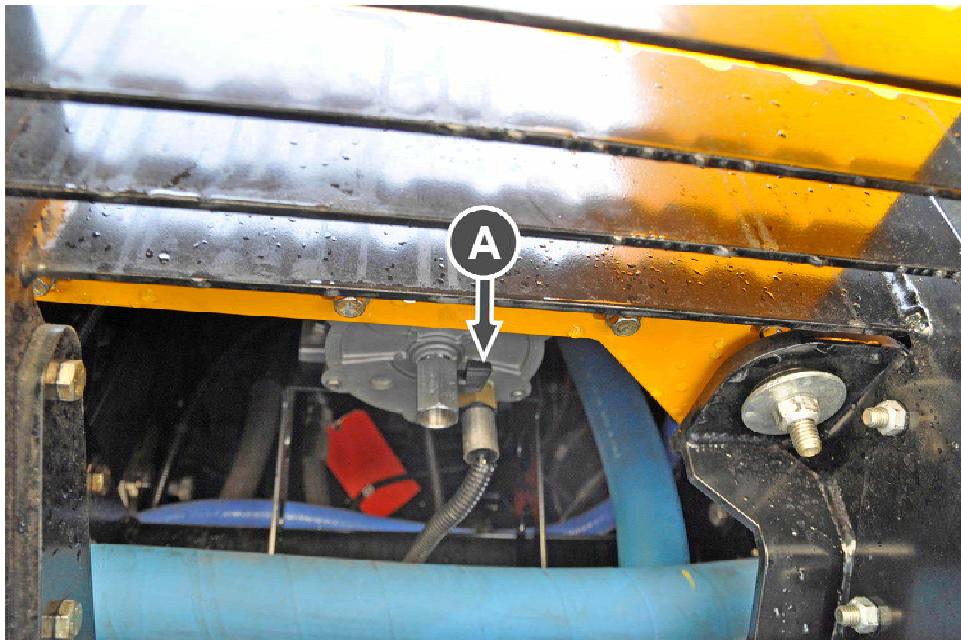


Windshield Washer/Deluge Tanks

Ref.	Description
A	Windshield Washer System
B	Deluge System Tank

CHECK THE FUEL/WATER SEPARATOR

Drain the fuel/water separator by turning the thumb screw (A) on the bottom of the separator to remove any water from the bowl.



Fuel Water Separator

Ref.	Description
A	Thumb Screw

TURN ON BOTH ELECTRICAL MASTER SWITCHES

Check to make sure both electrical Master Switches (A) & (B) have been turned on. The carrier engine switch is located behind the right rear wheel of the vehicle. The blower engine switch is located behind the right front wheel of the vehicle.

NOTE: Both of these switches should be turned off again at the conclusion of vehicle operations.



Carrier Engine Master Switch

Ref.	Description
A	Master Switch



Blower Engine Master Switch

Ref.	Description
B	Master Switch

MISCELLANEOUS CHECKS AND SERVICES

FUEL LEVEL

Check the fuel level and fill the fuel tank.



Under no circumstances should any gasoline, gasohol or alcohol be blended with diesel fuel. This practice creates an extreme fire hazard and under certain conditions an explosive hazard and will damage the engine.

BATTERY

Check the battery cables for looseness and corrosion.



The battery posts, wire terminals and related accessories contain lead and lead compounds, chemicals known to cause cancer and reproductive harm. Wash hands thoroughly after handling.

HYDRAULICS

Check all the air and hydraulic lines to ensure they are secure and not subject to chafing against sharp objects.

Check for hydraulic system leaks. Visually check underneath the vehicle for signs of hydraulic oil leakage. Check the following items for signs of leakage:

- 1) Hydraulic Pump
- 2) Hydraulic Fluid Reservoirs
- 3) Hydraulic Filter
- 4) Hydraulic Cylinders
- 5) Control Valves
- 6) Hydraulic Lines

If leakage is detected, identify the source and correct the problem.

LIGHTS AND EQUIPMENT

- 1) Turn on all the lights to make sure they are working properly.
- 2) Check the horns for operation (air and steering column).
- 3) Check the seat belts for cuts or tears in the belt and for proper locking operation.
- 4) Check the windshield wipers/washers for operation.
- 5) Check the back-up alarm for operation.

CHECKS MADE WITH THE ENGINE OPERATING**WARNING**

Set the parking brake and chock the wheels before attempting to check the following with the engine operating. Unexpected and possible sudden vehicle movement may occur if these precautions are not taken.

OIL LEVEL CHECK

Always maintain the proper fluid level. The transmission fluid cools, lubricates, and transmits hydraulic power. If fluid level is too low, the torque converter and clutches do not receive an adequate supply of fluid causing delayed engagement and the transmission could overheat. If the level is too high, the fluid aerates—causing the transmission to shift erratically and overheat. Fluid may be expelled through the breather or dipstick tube when the fluid level is too high.

CHECK THE TRANSMISSION FLUID LEVEL**CAUTION**

Do not start the engine until the presence of sufficient transmission fluid has been confirmed. Remove the transmission dipstick (1) and be sure that the static fluid level is between the lower dipstick mark (engine not running mark) and the upper dipstick mark (engine running at normal operating temperature).

With the engine operating, transmission in neutral, parking brakes engaged, and wheels chocked check the following:

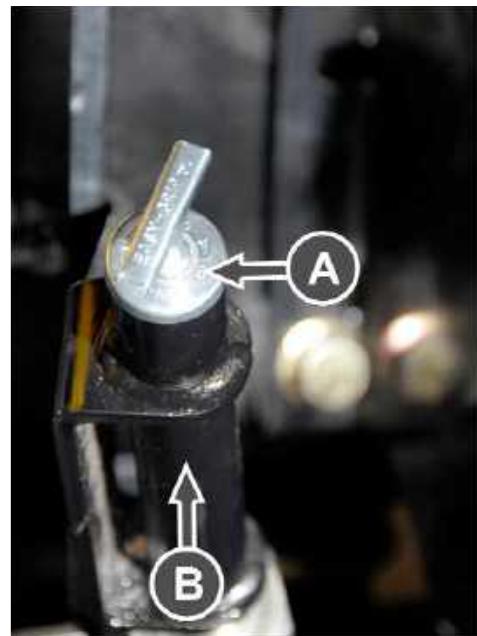
COLD CHECK PROCEDURE

The purpose of the cold check is to determine if the transmission has enough fluid to be operated safely until a hot check can be made.

NOTE: The fluid level rises as fluid temperature rises. DO NOT fill above the "COLD CHECK" bands if the transmission fluid is below normal operating temperatures. The "COLD RUN" band is between the "COLD FULL (D)" and the "COLD ADD (C)" marks. During operation, an overfull transmission can become overheated,

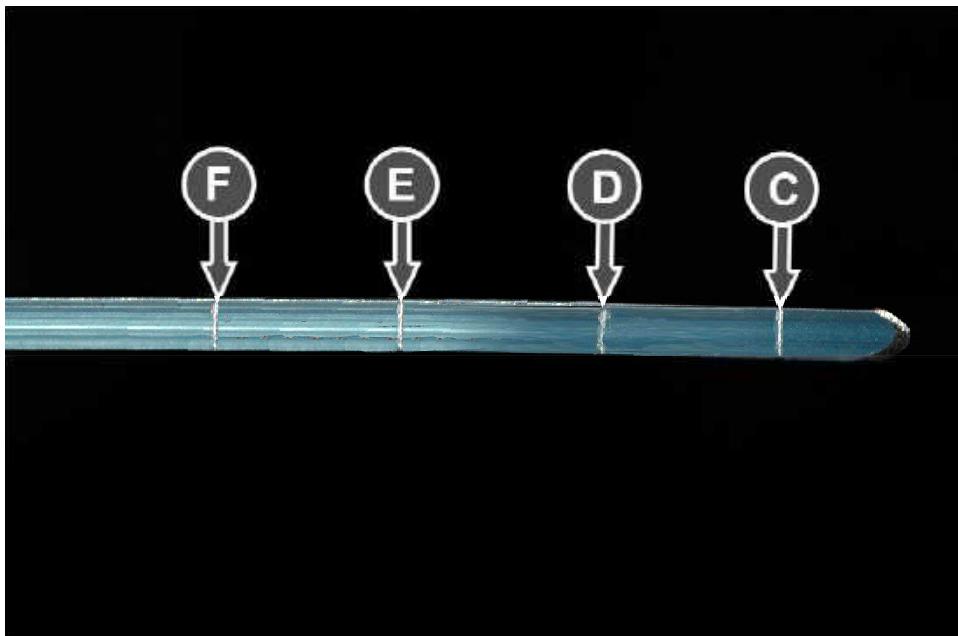
leading to transmission damage.

- 1) Park the vehicle on a level surface. Apply the parking brake and chock the wheels.
- 2) Run the engine for at least one minute. Shift to **D** (Drive), then to **N** (Neutral), and then to **R** (Reverse) to fill the hydraulic system.
- 3) Shift to **N** (Neutral) and allow the engine to idle (500–800 rpm). With the engine running, remove the dipstick from the tube and wipe the dipstick clean.
- 4) Insert the dipstick into the tube until it stops and remove. Check the fluid level reading. Repeat the check procedure to verify the reading.
- 5) If the fluid level is within the “COLD Add (C), Full (D)” band, the transmission may be operated until the fluid is hot enough to perform a “HOT RUN” check. If the fluid level is not within the “COLD Add (C), Full (D)” band, add or drain as necessary to bring it to the middle of the “COLD Add (C), Full (D)” bands.
- 6) Perform a HOT RUN check at the first opportunity after the normal operating sump temperature of 71°C–93°C (160°F–200°F) is reached.



Transmission Oil Level Dipstick

Ref.	Description
A	Transmission Oil Level Dipstick
B	Transmission Tube



Transmission Dipstick Oil Level Marks

Ref.	Description
C	Cold Add Oil Level Mark
D	Cold Full Oil Level Mark
E	Hot Add Oil Level Mark
F	Hot Full Oil Level Mark

HOT CHECK PROCEDURE

Operate the transmission in D (Drive) until normal operating temperatures are reached:

Sump temperature 71°C–93°C (160°F–200°F)

Converter-out temperature 82°C–104°C (180°F–220°F)

NOTE: When performing the Hot Check procedure, the fluid must be at operating temperature to be sure of an accurate check and help prevent transmission damage. The fluid level rises as temperature increases. During operation, an overfull transmission can become overheated leading to transmission damage.

- 1) If the transmission temperature gauge is not present, check fluid level when the engine water temperature gauge has stabilized and the transmission has been operated under load for at least one hour.
- 2) Park the vehicle on a level surface and shift to N (Neutral). Apply the parking brake and chock the wheels. Allow the engine to idle (500–800 rpm).
- 3) With the engine running, remove the dipstick from the tube and wipe clean.
- 4) Insert the dipstick into the tube until it stops. Then remove it. Check fluid level reading.

- 5) Repeat the check procedure to verify the reading.

NOTE: Safe operating level is within the “HOT RUN” bands on the dipstick. The “HOT RUN” band is between the “HOT FULL (F)” and the “HOT ADD (E)” marks.

- 6) If the fluid level is not within the “HOT RUN” band, add or drain as necessary to bring the fluid level to within the “HOT RUN” band.

ELECTRONIC FLUID CHECK PROCEDURE

Use the following procedure to display fluid level information.

Press the **DISPLAY MODE** button once.

Fluid Level Display Criteria. As soon as fluid level information is requested, the TCM checks to see if conditions are right to allow display. Certain operating conditions must have been met for a period of two minutes before fluid level is displayed.

These operating conditions are:

Engine at idle

Sump fluid temperature at 60–104°C (140–220°F)

Transmission output shaft stopped

Transmission in **N** (Neutral)

Oil level sensor functioning properly

NOTE: To optimize the accuracy of the electronic fluid level measurement, be sure sump temperature is in the normal operating range of 71–93°C (160–200°F).

If the two minute period has elapsed before the fluid level data request, information is displayed immediately. However, if the two minute period has not elapsed, there will be a countdown display before fluid level information displays. The countdown display flashes constantly on the monitor digit. Countdown starts at 8 and decreases sequentially to 1 during the two minute period. When fluid level data is requested, and the two minute countdown is in process, the flashing display shows the number corresponding to the countdown progress. For example—if the fluid level data was requested in the middle of the two minute countdown period, the display would flash a 5 or a 4 and decrease to 1.

The Shift Selector Display will display the fluid level information two characters at a time.

Display Sequence

oL oK

oL Lo 01

oL HI 01

Interpretation of Display

Fluid level is correct

Fluid level is .9463 Litre (1 quart low)

Fluid level is .9463 Litre (1 quart high)

CHECK THE FLUID LEVEL IN THE HYDRAULIC TANKS

This vehicle is equipped with three hydraulic oil tanks. The two tanks located under the cowling behind the cab serves as the hydrostatic drive motors on the bankhead. The tank located on the left rear frame rail serves the vehicles steering and bankhead lift and chute controls.

Check the hydraulic oil level site glass (A). The fluid level should around the mid point of the site glass. If low, unscrew the oil fill tank cap (B) and add hydraulic oil.



Hydraulic Oil Level Site Glass

Ref.	Description
A	Oil Level Site Glass
B	Oil Fill Port

CHECK THE FLUID LEVEL IN THE HPTO HYDRAULIC TANK

This vehicle is equipped with a HPTO oil tank. The tank is located behind the cab stairs located on the left front frame rail.

NOTE: *The oil system requires a specific grade of fluid. DO NOT mix with regular grade of hydraulic oil*

Check the hydraulic oil level site glass (A). The fluid level should around the mid point of the site glass. If low, unscrew the oil fill tank cap (B) and add the oil.



HPTO Oil Level Site Glass

Ref.	Description
A	Oil Level Site Glass
B	Oil Fill Port

AIR BRAKE SYSTEM

Check the air brake system dual pressure gauge (located on instrument panel). Pressures for both the front and rear brake systems must be in the normal range (110-125 psi). If the pressure is below 90 psi in either system, determine the source and correct the problem.

EXHAUST SYSTEM



EXHAUST FUMES CAN Kill YOU!

Do not operate the vehicle until all exhaust component hazards have been corrected. Do not start the engine until you're positive there is adequate ventilation.

Inspect all the exhaust components for leaks, damage and corrosion.

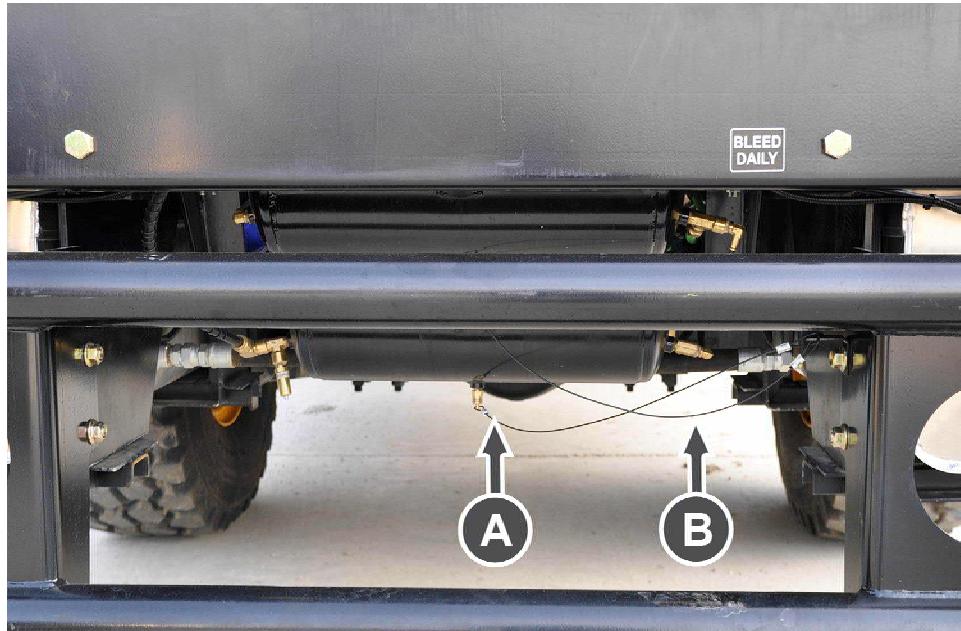
All internal combustion engines give off various fumes and gases while running. Do not start or run engine in a closed or poorly ventilated building where the exhaust gases can accumulate. Avoid breathing these gases as they may contain poisonous carbon monoxide which can endanger your health or life if inhaled steadily for even a few minutes.

CHECKS MADE AFTER OPERATION

CHECK FOR MOISTURE IN THE AIR RESERVOIRS

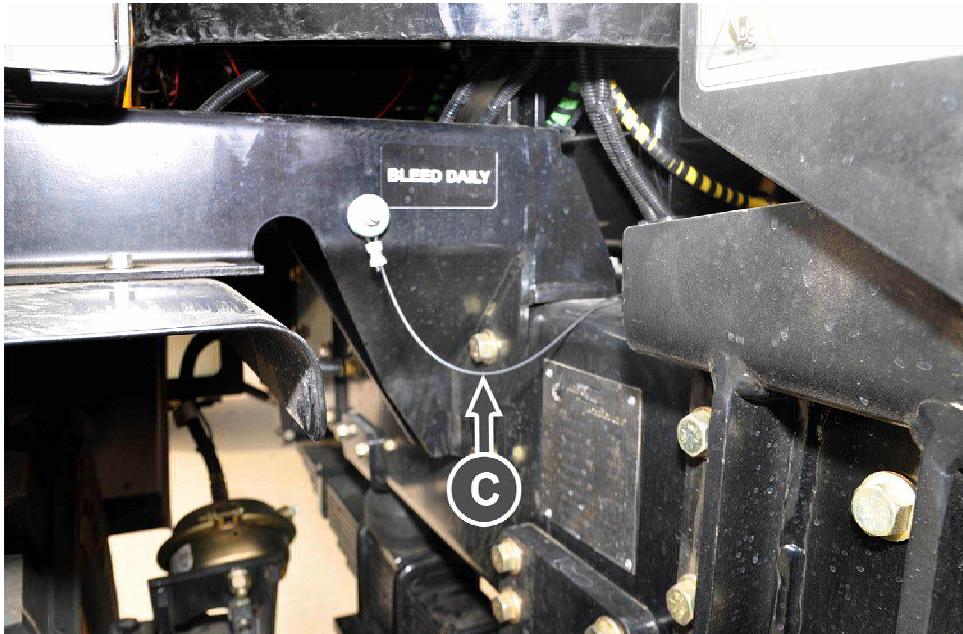
The vehicle is equipped with three air reservoirs. Two are located at the rear of the vehicle and one is located at the front.

Drain each reservoir by pulling down on each cable to open the drain valve (A) & (B) & (C). If any moisture is present have the vehicle air system serviced.



Rear Air Tank Drains

Ref.	Description
A	Tank 1
B	Tank 2



Front Air Tank Drain

Ref.	Description
C	Tank 3

ENGINE STARTING AND SHUTDOWN

CUMMINS ENGINE STARTING ABOVE 32°F(0°C)

Before starting the engine and operating any system, read your Cummins Operation and Maintenance Manual provided. Complete all daily operator's checks and services identified in this manual.

NOTE: Startability will be improved at temperatures below 32°F (0°C) by the use of a cylinder block coolant heater or other means to heat the crankcase oil. This helps alleviate white smoke and misfire during cold weather startup.

Make sure the parking brakes are applied by having the parking brake control knob pulled out.

This Vehicle is equipped with a neutral safety switch that will prevent starting if transmission is not in neutral.

Follow the engine manufacturers operation and maintenance manual supplied with your truck for engine starting and operating procedures.

Avoid long engine idling periods since this causes over-cooling of the engine. Overcooling of the engine results in incomplete fuel combustion causing carbon build-up in combustion chamber and oil dilution by unburned fuel. This results in damage to the engine and shortened engine life. Prolonged engine idle in hot weather may cause engine overheating and resultant damage to the engine.

CUMMINS ENGINE STARTING WITH JUMPER CABLES



Improper jumper cable connection can cause an explosion resulting in personal injury. Prevent sparks near the batteries as they could cause vapors to explode. Do not allow jumper cable ends to contact each other or the engine.

NOTE: Refer to the engine manufacturers operation and maintenance manual supplied with your Snow Blower for instructions on jump starting the engine.

CUMMINS ENGINE SHUTDOWN

PARKING BRAKE MUST BE APPLIED WHENEVER DRIVER IS OUT OF CAB. If the parking brake is not applied and air reservoirs are manually drained, the spring brake may not set. Conversely, if the chassis air system is depleted and the vehicle is to be moved for repair, the spring brakes can be released by backing out the spring release bolts on the top of each chamber. Before manual release of spring brakes, secure vehicle with wheel chocks to keep it from rolling. Avoid parking on a steep slope even though the parking brake capability exceeds federal safety standards of a **20% grade (110 slope)**.

Bring vehicle to complete stop.

Make sure that the parking brakes are applied by having the parking brake control knob pulled out.

Shift transmission gear selection to "N" (neutral).

Refer to the engine manufacturers operation and maintenance manual supplied with your vehicle for engine shutdown and after operation procedures.

STARTING PROCEDURE - AFTER EXTENDED SHUTDOWN/OIL CHANGE

Refer to the engine manufacturers operation and maintenance manual supplied with your Snow Blower for instructions on starting the engine after extended shutdown or an oil change.

DRIVING RECOMMENDATIONS

GENERAL SAFETY



Before the vehicle moves sit down and fasten your seat belt. Failure to use your seat belt can result in serious injury or death.

Safety is a prime concern to all of us. Since the operator is the key to safe job performance, the operator must be aware of basic safety precautions to help prevent serious injury and damage to property.

The safest machine must still be operated with care and with knowledge of its performance capabilities. Know the capabilities of your equipment - and its limitations. You must be thoroughly familiar with all controls, gauges and instruments.

It is the responsibility of the operator to know what specific requirements, precautions and work area hazards exist, and to discuss these with the foreman or supervisor. A common understanding should be reached by all personnel to assure safe performance in operating the equipment.

It is the responsibility of the operator to know what specific requirements, precautions and work area hazards exist, and to discuss these with the foreman or supervisor. A common understanding should be reached by all personnel to assure safe performance in operating the equipment.

Learn - beforehand! - as much about the operating area as possible: Conditions of surfaces? Holes, obstructions, mud, snow or ice? Aircraft and vehicle traffic? Thick dust, smoke, fog? Eliminate the element of surprise - and you'll need to deal with fewer emergencies.

Plan ahead - stay alert - drive sensibly - and you will avoid having and causing accidental equipment damage and personal injury.

ALWAYS drive at a safe speed.

Keep a safe distance from vehicle in front. MAINTAIN PROPER STOPPING DISTANCE UNDER ALL CONDITIONS OF SPEED AND LOAD! Drive defensively - the driver of that other vehicle CAN make a mistake.

Listen for unusual noises in the engine, transmission or driveline. Stop and investigate cause for any noise or vibration as soon as possible.

Continue to monitor all gauges for proper readings.

Note the axle, tire and GVW ratings for this vehicle and do not allow these to be exceeded.

Do not operate on side slopes, or park on grades exceeding 20%. Before backing up, assure yourself that the area is clear. Be sure back-up lights and reverse alarm are operating.

Observe the preventive maintenance and lubrication schedules, and see that your vehicle is inspected and serviced according to recommendations.

BRAKES



WARNING

Never depend upon the parking brake to stop your vehicle. Failure to follow this procedure could result in extensive equipment damage and serious personnel injury.



WARNING

Repeated on-off application of the service brakes on downgrades can reduce air pressure to a dangerously low level.

AVOID FANNING THE FOOT PEDAL WHILE STOPPING.
Failure to follow this procedure could result in extensive equipment damage and serious personnel injury.

Check for proper service braking action after vehicle is in motion. Do not operate vehicle if brakes are defective.

Apply the parking brake, when loaded, on a 20% grade to be sure it will hold the vehicle without use of the service brakes. Have them repaired immediately if parking brakes will not hold the vehicle.

Set your parking brake **EVERY TIME** you leave the vehicle.

Apply light steady brake pressure continuously on a long downgrade. Do not use on-and-off brake application. This causes greater brake wear and heat buildup.

STEERING**WARNING**

Failure to correct steering system malfunctions could result in a very hazardous condition.

STOP IMMEDIATELY! HAVE THE UNIT REPAIRED - DO NOT START AGAIN until the steering system operates properly

Improper steering action can also indicate tire trouble. Failure to follow this procedure could result in extensive equipment damage and serious personnel injury.

Be alert to any changes in steering action. The need for inspection or servicing may be indicated by "hard" steering, excessive free play or unusual sounds when turning or parking.

Different modes of drive line lock-up will affect steering and handling of your vehicle. Always know what mode of lock-up you are in and drive accordingly.

TRANSMISSION

STOPPING AND PARKING

Since due to the converter there is no rigid connection existing from the engine to the axle, it is recommended to secure the vehicle on upgrades, or downgrades against unintended rolling not only by applying the parking brake but additionally by a block on the wheel, if the driver has the intention to leave the vehicle.

TOWING

When towing or pushing this vehicle, the transmission's output shaft must be disconnected regardless of the travel distance or speed. At a longer distance, the best solution would be to transport the vehicle with a low loader.

ELECTRICAL SYSTEM

INTRODUCTION

This section provides information on the vehicle electrical system. Included in this information are the following: general description of electrical system, battery care and maintenance, jump starting with an engine booster cable, and welding precautions.

GENERAL DESCRIPTION

The carrier engine features a 12 volt starting and charging system. The vehicle lighting and accessory operation is 12 volt. The blower engine uses a separate 24 volt battery, starting and charging system. Alternators are sized for cold weather operation with all standard electrical accessories operating. The voltage regulator is built into each alternator. All major circuits are protected against overload by either automatic reset type circuit breakers or replaceable fuses located in cab panel or main electrical junction box.

BATTERY CARE AND MAINTENANCE



The battery posts, wire terminals and related accessories contain lead and lead compounds, chemicals known to cause cancer and reproductive harm. Wash hands thoroughly after handling.



Hydrogen gases are produced during normal battery operation or charging. Sparks or flame can cause this gas to ignite and explode, if they are brought near vent openings. Serious burns can result if the sulfuric acid in battery is spilled on skin or in eyes. Flush or wash away immediately with clear water.

**CAUTION**

If a vehicle sits idle the batteries must be recharged at least every 180 days, more if possible. Failure to follow this practice could result in the batteries becoming sulfated. The battery will never perform up to its specifications if it becomes sulfated.

**CAUTION**

Make sure ground polarities of fast charger, booster battery or alternator (when installing a battery) are matched to ground polarity of vehicle battery before connecting a fast charger, booster battery or installing a new battery. Improper usage of fast charger, hook-up of booster battery or installing battery can cause damage to electrical system or to alternator. Do not attempt to polarize alternator.

To assure the utmost life and performance from your original equipment batteries, it will be necessary to take steps to assure that the batteries are properly cared for. To maintain the battery, proceed as follows:

NOTE: If the battery continually requires water, the voltage regulator setting may be too high, resulting in overcharging, or the battery cell maybe shorting out.

- 1) Wash the batteries with a solution of baking soda and water.
- 2) Disconnect the battery terminals and remove corrosion from the battery posts and terminals with the appropriate terminal cleaning tool.
- 3) After cleaning, dry off the top of the battery.
- 4) With the battery cables still disconnected, check the state of the battery charge for each battery by using the method listed below:
- 5) Check the no-load voltage across the (-) and (+) battery terminals.
- 6) Finally connect the battery cables coat the battery terminals and posts with a light film of grease. This will retard further corrosion.

Use the following chart to determine the actual condition of the batteries when checked by the methods in step 4.

12 Volt Batteries No Load Voltage	Battery Condition
12.6 or more	100% Charged
12.4	75% Charged
12.2	50% Charged
12.0	25% Charged
11.7 or less	Completely Discharged

JUMP STARTING ENGINE WITH A BOOSTER CABLE**WARNING**

Improper jumper cable connection can cause an explosion resulting in personal injury.

**WARNING**

Prevent sparks near the batteries as they could cause vapors to explode. Do not allow jumper cable ends to contact each other or the engine.

NOTE: Follow your engine manufacturer's operator's manual for engine starting procedures using jumper cables.

WELDING ON VEHICLE CHASSIS

The battery posts, wire terminals and related accessories contain lead and lead compounds, chemicals known to cause cancer and reproductive harm. Wash hands thoroughly after handling.



Failure to observe the following steps may result in damaging the vehicle.

NOTE: Tag and mark all cables and harnesses during removal to aid in installation.

- 1) Disconnect all cables from the batteries. Isolate cables from the frame and each other.
- 2) Disconnect all wire harness from both engine ECU's.
- 3) Disconnect all wire harness from the transmission ECU.
- 4) Disconnect the positive (+) and negative (-) cables at both alternators.
- 5) Proceed with welding.
- 6) Connect the positive (+) and negative (-) cables to both alternators.
- 7) Connect the wire harnesses to both engine ECU's.
- 8) Connect the wire harnesses to the transmission ECU.



Failure to reconnect the harnesses and cables in the correct positions will result in damaging the electrical components of vehicle.

BASIC OPERATION (BLOWING SNOW)

BLOWER OPERATION

- 1) Decrease blower engine RPM's to low Idle. (approximately 650 RPM'S) *
- 2) Engage blower clutch. **Never engage blower clutch with blower engine above low idle.**
- 3) Increase blower engine. RPM'S to full throttle. (2,100 RPM'S)
- 4) Set the fan discharge opening so snow delivery will be with the wind if possible. The angle or direction in which the snow is discharged can be instantly changed by the operator while the machine is blowing.
- 5) Lower the blower head until full weight is on the road surface.
- 6) Shift truck transmission into a low gear and 4 wheel drive. Slowly move truck into snow. Maintain a steady forward movement. Do not ram. Ramming into hard frozen snow may cause damage to components.
- 7) While watching the blower engine tachometer, increase forward movement into the snow until blower engine reaches its 1,700 RPM's.
- 8) Do not drop below blower engine's RPM below 1,700 RPM's. To increase engine RPM'S, reduce the forward movement of the truck.

NOTE: The snowblower casting distance and discharge volume are at maximum at full engine torque/RPM's. (Cummins QSX 30 is at 1,700 RPM.) To decrease casting distance, it is advised that the volute discharge be varied, or a spot chute be used.

GENERAL BLOWING TIPS

SAFETY FIRST

- 1) Always keep watch on all gauges during blowing operations.
- 2) Be alert as discharged snow streams may carry damaging rocks, ice and debris.
- 3) Rotating reels and fans are a potential hazard.

NEVER LEAVE UNIT UNATTENDED

- 1) Before leaving cab always return all controls to neutral.
- 2) Set parking brake.
- 3) Lower blower to the ground.
- 4) Shut down engine.

SHUT DOWN ENGINE FOR REPAIR OR MAINTENANCE

- 1) Never perform operators maintenance with engines running.
- 2) Never attempt to work on or around blower head without lowering blower head to the ground and shutting down engines.

REPLACING TORQUE FUSE PINS (SHEAR PINS)

**Use only proper torque fuse pins
(shear bolts) powertrain saver unit
flanges.**

- 1) The helical cutter is protected by means of torque fuse pins (shear pins). The design of these pins allows maximum clearing performance in any type of snow. Yet, when obstacles are encountered which the machine is not designed to handle, the torque fuse pins will shear and prevent damage to the drive train.
- 2) Use only Manufacturer supplied shear pins. These pins are designed for maximum efficiency and safety of the blower power train.
- 3) Excessive rate of attack when first contacting a snow bank may cause unnecessary shearing of pins. To avoid this, always start out slowly and increase forward speed gradually.

UPON DETECTION OF SHEARED TORQUE FUSE PINS (SHEAR PINS)

**Never attempt to work on or around
blower head without shutting off both
engines.**

- 1) Disconnect blower drive.
- 2) Disconnect PTO clutch.
- 3) Back vehicle away from snow bank.
- 4) Lower blower to ground.
- 5) Shut down engines.

It may be necessary to clear snow and foreign objects from blower head to avoid shearing of new pins. Drive out broken shear pin ends. Note: Install new pins and tighten nuts to 220 ft/lbs(298.32Nm).

Do not preload shear pins by over tightening as this may cause premature shearing.



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3000/4000 **OPERATOR'S MANUAL**

RUGGED DUTY SERIES

JANUARY 2010



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Operator's Manual

2010 JANUARY
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Allison Transmission

VOCATIONAL MODELS

Rugged Duty Series (RDS)

3000 and 4000 Product Families

4th Generation Controls with Prognostics

3000 RDS 3500 RDS 4000 RDS 4500 RDS 4700 RDS



Allison Transmission, Inc.

P.O. Box 894 Indianapolis, Indiana 46206-0894

www.allisontransmission.com

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IMPORTANT SAFETY INFORMATION

IT IS YOUR RESPONSIBILITY to be completely familiar with the warnings and cautions in this manual. These warnings and cautions advise of specific methods or actions that can result in personal injury, equipment damage, or cause the equipment to become unsafe. These warnings and cautions are not exhaustive. Allison Transmission could not possibly know, evaluate, or advise the service trade of all conceivable procedures by which service might be performed or of the possible hazardous consequences of each procedure. Accordingly, ANYONE WHO USES A SERVICE PROCEDURE OR TOOL WHICH IS NOT RECOMMENDED BY ALLISON TRANSMISSION MUST first be thoroughly satisfied that neither personal safety nor equipment safety will be jeopardized by the service methods used.

Vehicle manufacturers integrate Allison transmissions into vehicles used for a variety of vocations and services. The vehicle manufacturer is responsible for identifying the specific operating conditions to which the vehicle will be subjected and to communicate the appropriate means for preventing unintended vehicle movement within those conditions, in order to ensure vehicle and operator safety. The vehicle owner and operator should be aware of and follow the vehicle manufacturer's operating instructions and warnings related to parking and preventing unintended vehicle movement.

Proper service and repair is important to the safe and reliable operation of the equipment. The service procedures recommended by Allison Transmission (or the vehicle manufacturer) and described in this manual are effective methods for performing service and diagnostic operations. Some procedures require using specially designed tools. Use special tools when and in the manner recommended.

The **WARNINGS**, **CAUTIONS**, and **NOTES** in this manual apply only to the Allison transmission and not to other vehicle systems which may interact with the transmission. Be sure to review and observe any vehicle system information provided by the vehicle manufacturer and/or body builder at all times the Allison transmission is being serviced.

WARNINGS, CAUTIONS, NOTES

Three types of headings are used in this manual to attract your attention:



WARNING: A warning is used when an operating procedure, practice, etc., which, if not correctly followed, could result in personal injury or loss of life.



CAUTION: A caution is used when an operating procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment.



NOTE: A note is used when an operating procedure, practice, etc., is essential to highlight.

RUGGED DUTY SERIES

1.0 SCOPE OF MANUAL

1.1 SCOPE OF MANUAL

This Operator's Manual contains a variety of information about the Allison 3000 and 4000 Product Families Transmission, and its Allison 4th Generation Controls with Prognostics features. Refer to the Table of Contents to locate information by subject in this publication.

Additional information about your transmission is available at www.allisontransmission.com using the publications links shown on the home page. Refer to the Sales and Service Locator at www.allisontransmission.com to find contact and location information for Allison Transmission distributors and dealers.

If you need to contact an Allison Transmission representative, refer to the Customer Service section at the end of this publication for contact information.

RUGGED DUTY SERIES

2.0 INTRODUCTION

2.1 KEEPING THAT ALLISON ADVANTAGE



V01724

Rugged Duty Series (RDS) transmissions are ideally suited for any vehicle that operates on/off highway and/or requires Power Takeoff (PTO) operation. Refer to [Figure 2–1](#) and [Figure 2–2](#) for non-PTO applications and

[Figure 2–3](#) and [Figure 2–4](#) for PTO applications. Refer to [Figure 2–5](#) and [Figure 2–6](#) for 4700 RDS transmissions.

Abbreviations

ABS	Anti-lock Brake System
CMC	Customer Modifiable Constant
DMD	Display Mode/Diagnostic button
DOC™	Diagnostic Optimized Connection™
DTC	Diagnostic Trouble Code
EMI	Electromagnetic Interference
FCC	Federal Communications Commission
FM	Filter Life Monitor
I/O	Input/Output
KOH	Potassium Hydroxide
MIL	Malfunction Indicator Light—(OBD II).
MY	Model Year
OEM	Original Equipment Manufacturer
OLS	Oil Level Sensor
PTO	Power Takeoff
PWM	Pulse-Width Modulated
RFI	Radio Frequency Interference
RDS	Rugged Duty Series
RMR	Retarder Module Request
TAN	Total Acid Number
TCM	Transmission Control Module
TM	Transmission Health Monitor
TID	Transmission Identification Number
TPS	Throttle Position Sensor
VIM	Vehicle Interface Module

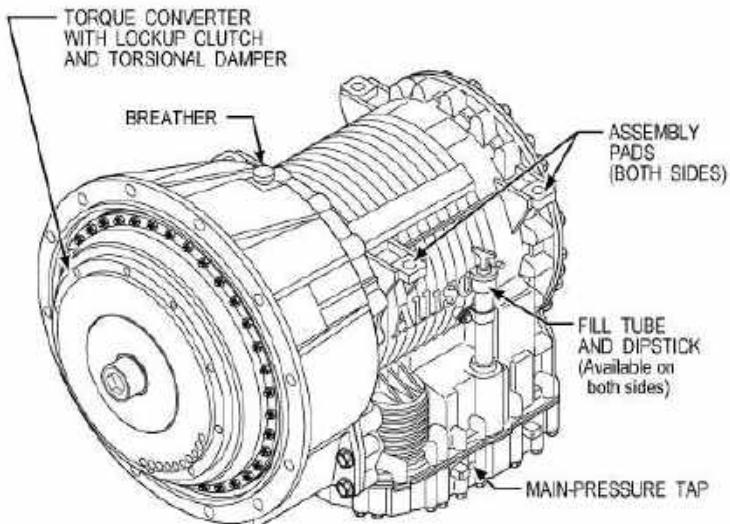
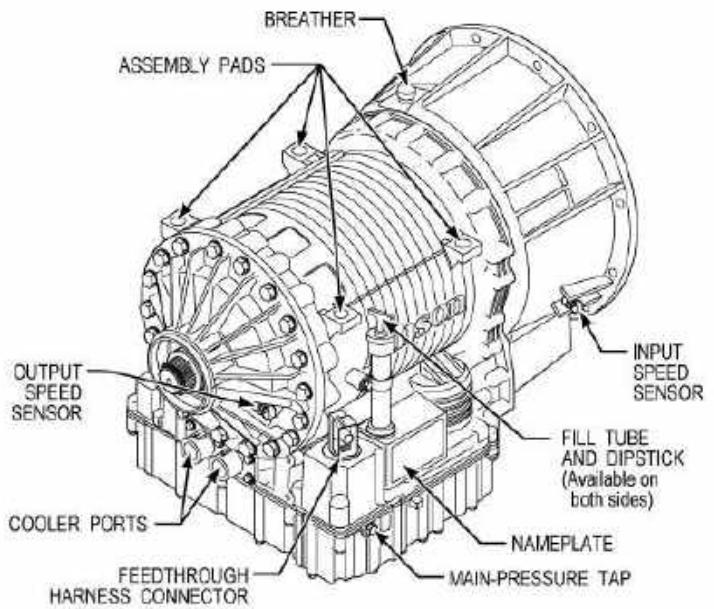
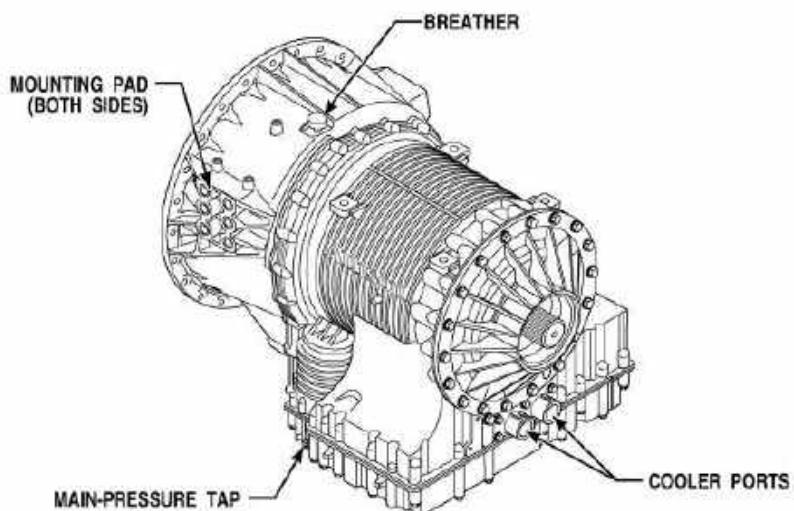
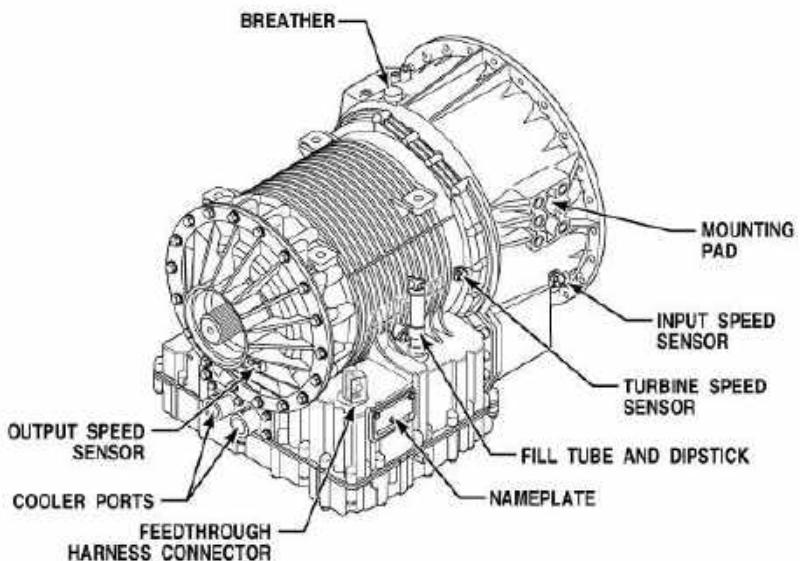
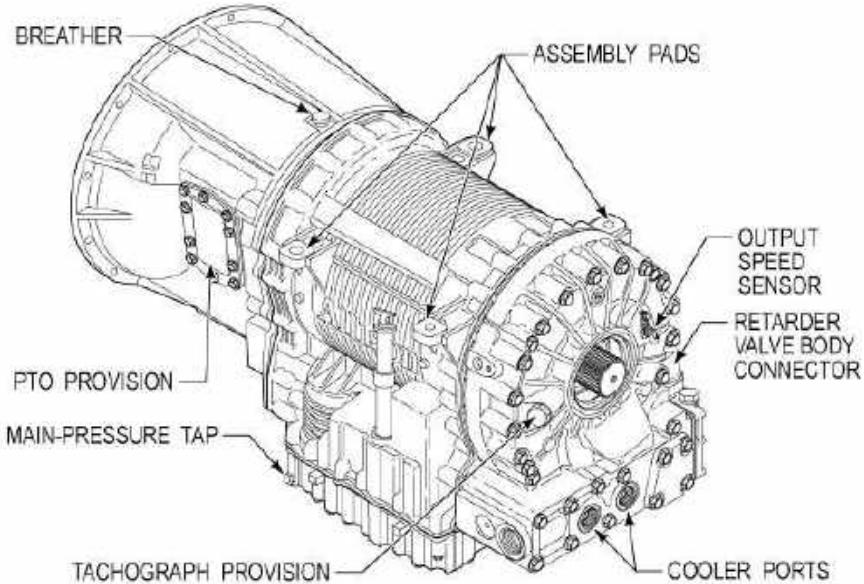


Figure 2-1. 3000/3500 RDS

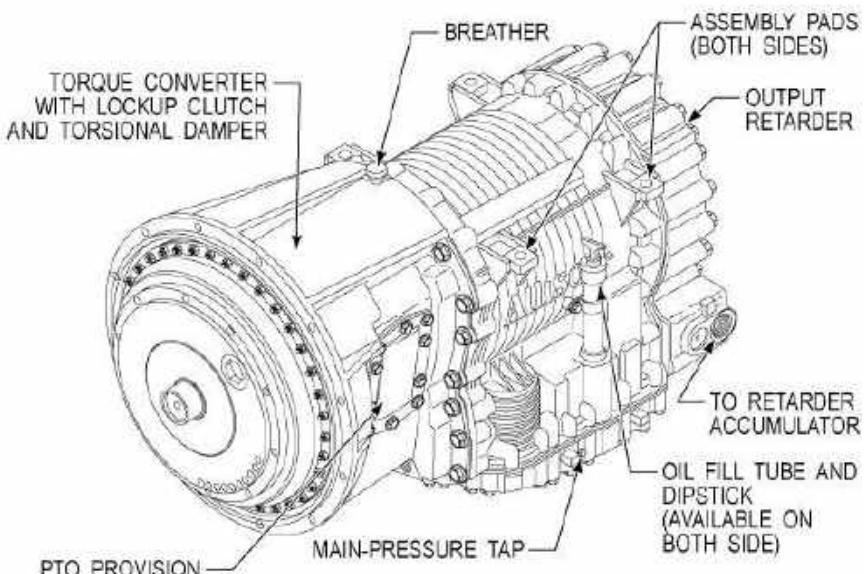


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Figure 2-2. 4000/4500 RDS



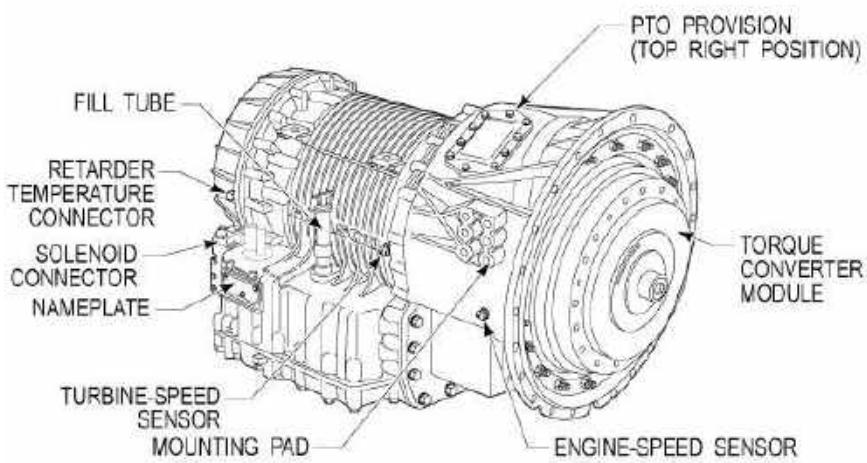
LEFT-REAR VIEW



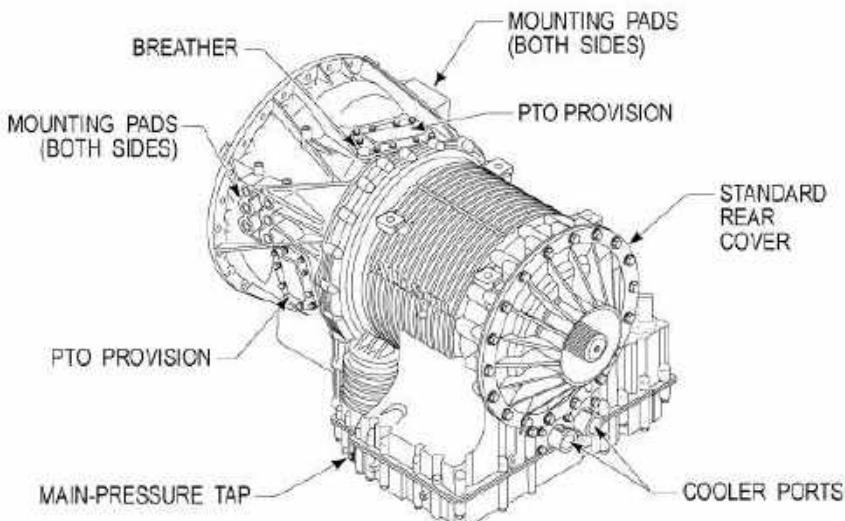
LEFT-FRONT VIEW

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Figure 2–3. 3000/3500 RDS with PTO and Retarder



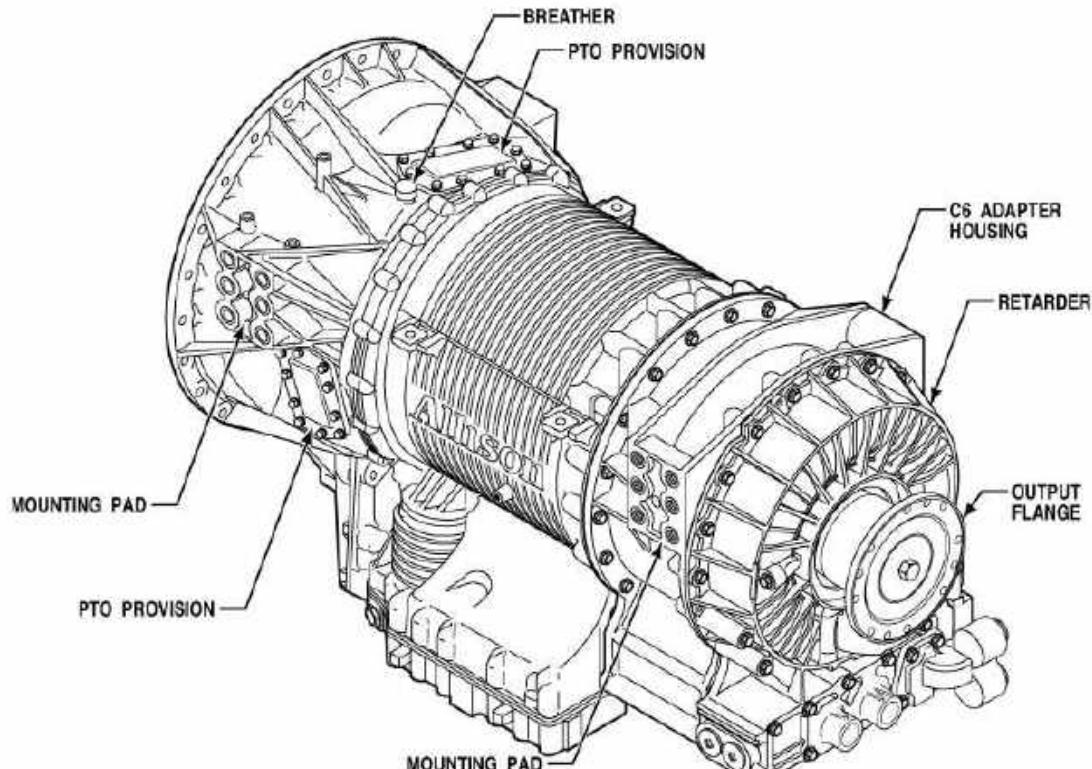
RIGHT-FRONT VIEW



LEFT-REAR VIEW

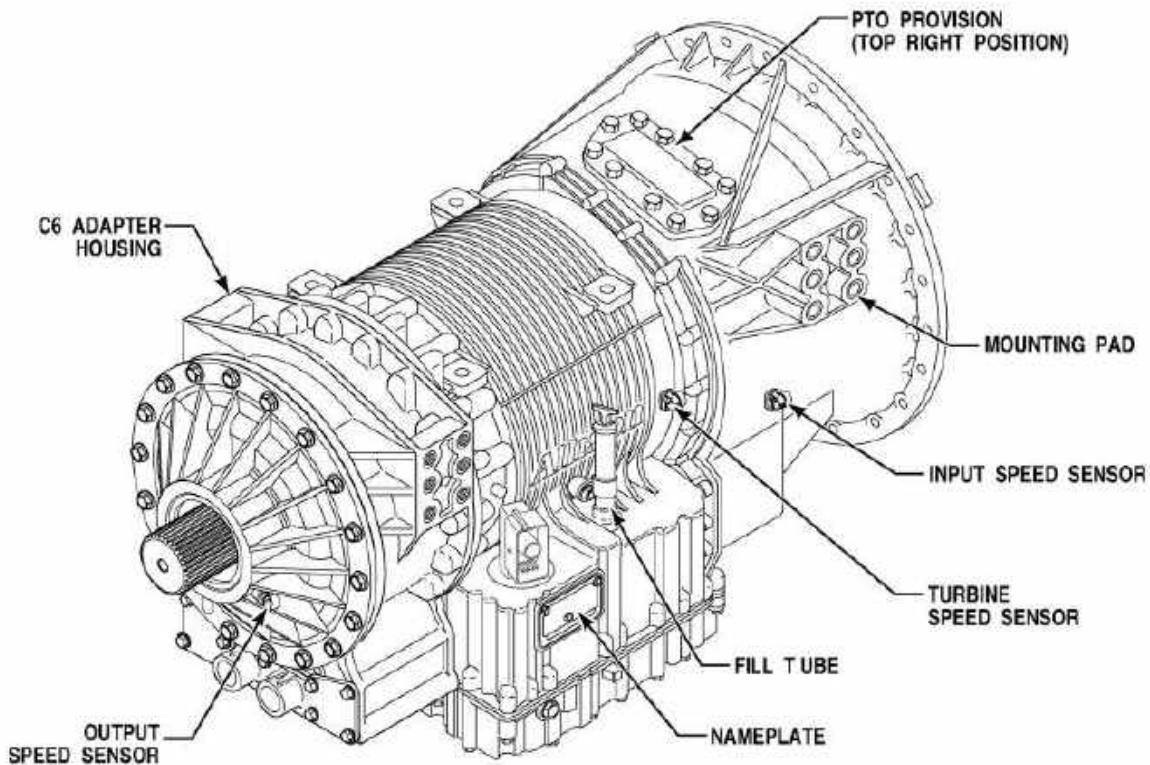
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Figure 2-4. 4000/4500 RDS with PTO and Retarder (Right-Front View) with PTO and without Retarder (Left-Rear View)



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Figure 2–5. 4700 RDS with PTO and Retarder



V07332.01.00

Figure 2-6. 4700 RDS with PTO

Typical vocations for this model include:

- Airport Support
- Baggage Transport Vehicle
- Concrete Mixer
- Concrete Pumper
- Dump Truck
- Equipment Hauler
- Farm/Agriculture
- Front Loader – Landfill
- Front Loader – No Landfill
- Heavy Equipment Transport (HET)
- Liquid Waste Hauler
- Materials Hauler
- Municipal Services Maintenance Vehicle
- Packing Recycling Truck
- Public Utility Vehicle
- Rear Loader – Landfill
- Rear Loader – No Landfill
- Roll On/Roll Off – Landfill
- Roll On/Roll Off – No Landfill
- Sewer/Septic Vacuum – Landfill
- Sewer/Septic Vacuum – No Landfill
- Side Loader – Landfill
- Side Loader – No Landfill
- Special Snow Removal Vehicle
- Street Cleaning Vehicle
- Transfer/Relocation Vehicle
- Wood Chip Hauler
- Wrecker
- Yard Tractor/Spotter

RUGGED DUTY SERIES

3.0 DRIVING TIPS

3.1 THE AUTOMATIC EXPERIENCE

Smooth automatic upshifts and downshifts, without interruption of power to the wheels, occur in your Allison automatic transmission based on engine rpm, throttle position, vehicle load, road speed, and driver or feature request, such as manually preselecting ranges.

Allison automatic transmissions, along with a vehicle specification appropriate for the particular duty cycle, can provide superior fuel efficiency and optimum fuel economy. In vehicles with a manual or automated manual transmission, the power interrupts that occur during shifts reduce the engine's inertia energy, resulting in lower average wheel horsepower. Because the engine is not working efficiently, it cannot run at full load. With an Allison automatic transmission, there is no power interrupt during shift changes. The inertia energy built up by the engine is maintained, equating to higher wheel horsepower. As a result, not as much engine horsepower is needed to get the job done. Allison automatic transmissions provide smooth, seamless shifts at all points of the power curve, there is no jarring power interrupts to jostle the driver. Allison automatic transmission equipped vehicles are more nimble in traffic and easier to maneuver on congested routes. Allison RDS series fully automatic transmissions vehicles keep you on schedule with maximum operating economies and improved vehicle performance.

As conditions permit, the Allison automatic transmission automatically upshifts until the highest range selected on the shift selector is attained. Your Allison automatic transmission model is programmed to have five or six forward gears, except the 4700 RDS. The 4700 RDS has a manually selectable low range shown as 1st range when manually selected by the operator at the shift selector. The 5th and 6th gear ratios are both overdrive ratios (overdrives are in 6th and 7th range for the 4700 RDS). If **D** (Drive) was selected the transmission can upshift up to 5th range for a 5-speed or 6th range in the case of the 6-speed model. There is also a lockup clutch inside the torque converter that is applied during normal operation while in 2nd range or higher. Range upshifts and downshifts are accomplished without disengaging the lockup clutch.



NOTE: The number of forward ranges available is determined at the vehicle Original Equipment Manufacturer (OEM) based on a number of vehicle attributes, such as driveline design and governed engine speed. For example, if governed engine speed can exceed 2200 rpm in your vehicle, it is recommended the OEM program the Transmission Control Module (TCM) with 5 forward ranges instead of 6.

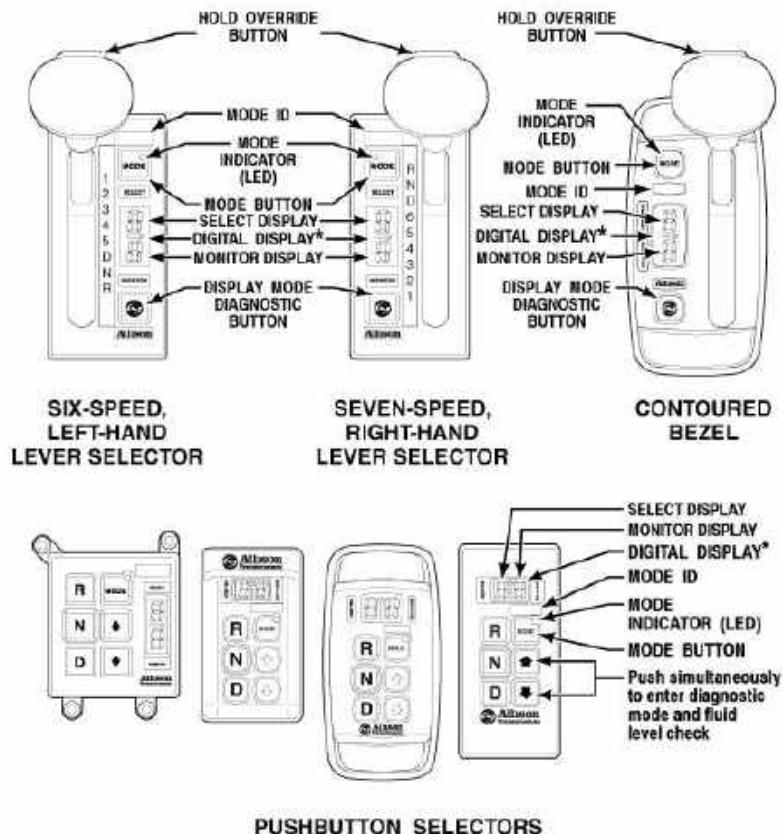
3.2 STARTING THE ENGINE



WARNING: When starting the engine, make sure the service brakes are applied. Failure to apply service brakes may result in unexpected vehicle movement.

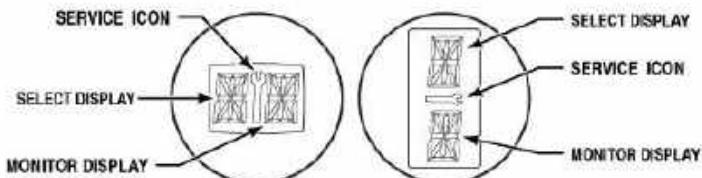
No special procedure is required. Verify the brakes are applied and **N** (Neutral) has been selected. If the vehicle is equipped with a lever style selector, **the neutral start circuit will not allow the engine to start if the lever is not in the N (Neutral) position.**

The keypad pushbutton shifter automatically initializes in Neutral. When this condition is present and the ignition is turned on, the digital display indicates "N" for Neutral in both the SELECT and MONITOR display windows. This indicates **N** (Neutral) has been both selected and attained and the engine may now be started. Refer to [Figure 3–1](#) and [Table 4–1](#) for additional information.



*NOTE: The first number displayed in the digital display is the highest forward range available and second number is range attained in selected position.

Visually confirm that the range selected was attained. If display is flashing, shift is inhibited.



Location of service icon on vertical and horizontal digital display

Figure 3–1. Typical Allison 4th Generation Prognostics Shift Selectors

3.3 COLD WEATHER STARTS

If the Transmission Fluid Temperature (TFT) sensor detects the transmission fluid is below -7°C (20°F), the transmission is programmed to start in 2nd gear, (3rd gear for 4700 RDS transmission).

If the transmission fluid temperature is below 10°C (50°F) follow these procedures when making directional shift changes:

- To shift from forward to reverse, select **N** (Neutral) and then **R** (Reverse).
- To shift from reverse to forward, select **N** (Neutral) and then **D** (Drive) or another forward range.



NOTE: During cold fluid conditions, always place the transmission in **N** (Neutral) prior to any direction changes.



NOTE: Failure to follow these procedures during cold fluid conditions, may cause the **CHECK TRANS** light to illuminate and the transmission to be restricted to **N** (Neutral).

Transmission operation at extremely cold ambient temperatures may require preheating or the use of a TES 295 transmission fluid. Refer to [3.3.1 PREHEATING REQUIREMENT](#).

3.3.1 PREHEATING REQUIREMENT. If ambient temperatures drop below the specified minimum levels for the fluid type, preheat the transmission fluid before beginning transmission operation. The minimum fluid temperatures at which the transmission may be safely operated without preheating are shown in [Table 3–1](#).

Table 3–1. Fluid Type Specifications for Minimum Temperature

Fluid Type	Minimum Temperature	
	Celsius	Fahrenheit
TES 295	-35	-31
TES 389	-25	-13

Preheat the transmission fluid using one of the following methods:

- Use an auxiliary heat source such as a sump heater
- Operate the transmission in **N** (Neutral) with the engine running at idle for a minimum of 20 minutes before attempting range operation.



CAUTION: Transmission malfunction or damage may occur if you operate the transmission with the fluid temperature below the minimum fluid temperature specification limit.

3.4 HIGH FLUID TEMPERATURE

The transmission is considered to be overheated when any of the following temperatures are exceeded:

Sump fluid	121°C (250°F)
Fluid to cooler	149°C (300°F)
Retarder out fluid	165°C (330°F)

Typical continuous sump temperature is 93°C (200°F).

If the transmission overheats during normal operation, make sure the transmission fluid level is correct. Refer to [5.8 PERIODIC FLUID LEVEL CHECKS](#).



CAUTION: The engine should never be operated for more than 10 seconds at full throttle with the transmission in range and the output stalled. Prolonged operation of this type will cause the transmission fluid temperature to become excessively high and will cause severe overheat damage to the transmission.

If the engine temperature gauge indicates a high temperature, the transmission is probably overheated. Stop the vehicle and check the cooling system. If it appears to be functioning properly, run the engine at 1200–1500 rpm with the transmission in **N** (Neutral). This should reduce the transmission and engine temperatures to normal operating levels in 2 or 3 minutes.

If the transmission and engine temperatures do not decrease, reduce the engine rpm. If the engine temperature indicates a high temperature, an engine or radiator problem is indicated. If high temperature in either the engine or transmission persists, stop the engine and have the overheating condition investigated by maintenance personnel.



NOTE: Some shift schedules may be inhibited as a result of operating conditions, such as engine or transmission fluid temperature.

3.5 TURNING OFF THE VEHICLE

Always select **N** (Neutral) before turning the vehicle off.

3.6 PARKING BRAKE



WARNING: If you leave the vehicle and the engine is running, the vehicle can move unexpectedly and you or others could be injured. If you must leave the engine running, **DO NOT LEAVE** the vehicle until you have completed all of the following procedures:

- Put the transmission in **N** (Neutral).
- Be sure the engine is at low idle (500–800 rpm).
- Apply the parking and emergency brakes and make sure they are properly engaged.
- Chock the wheels and take other steps necessary to keep the vehicle from moving.

The parking brake is only intended to secure an unattended vehicle with the ignition **off**. Always maintain the vehicle parking brake system according to the manufacturer's specifications. The parking brake may not have sufficient capacity to restrain a vehicle with the engine running and the transmission in a forward or reverse range. When the vehicle is unattended and the engine is running, the transmission **must be in N** (Neutral) with the **brakes fully applied** and the **wheels chocked**.



WARNING: The vehicle service brakes, parking brake, or emergency brake must be applied whenever **N** (Neutral) is selected to prevent unexpected vehicle movement. Selecting **N** (Neutral) does not apply the vehicle brakes unless an auxiliary system to apply the parking brake is installed by the OEM.

3.7 ENGINE-DRIVEN POWER TAKEOFF (PTO)



CAUTION: Do not exceed the engagement and operational speed limits imposed on the driven equipment during the operation of the PTO. Exceeding the speed limits produces high hydraulic pressure in the PTO that can damage the PTO components. Consult the vehicle manufacturer's literature for these speed limits.

If a PTO is present, it is normally mounted on either the left or right side of the 3000 Product Family transmission. On the 4000 Product Family transmission, the PTO is located on the left side or on the top of the transmission. The PTO drive gear is engine-driven and therefore provides direct engine power. The PTO can be operated when the vehicle is either moving or stopped.

The PTO gear is in constant mesh with the drive gear in the converter housing. However, the PTO may either be constant-drive (output always powered) or clutch-driven. When the PTO is clutch-driven, the clutch is part of the PTO, not the transmission. A clutch-driven PTO is powered only when the PTO clutch is engaged.

All Allison transmission-equipped vehicles with PTO enabled have engagement and operational speed limits programmed into the Transmission Control Module/Electronic Control Unit (TCM/ECU) to help protect PTO equipment. Be sure the limits for PTO engagement and operational speeds are not exceeded. Consult the vehicle manufacturer's literature for these speed limits. Some speed limits have default values which are programmed out of the operating range and need to be set for your particular PTO duty cycle. Consult your vehicle manufacturer to see if your transmission has been programmed and what operational limits have been established.

When the programmed engagement speed is exceeded, the PTO will not engage. The PTO engagement must be retried after the speed has been reduced. When operational speeds (either engine or transmission output) are exceeded, the PTO deactivates and the PTO engagement process must be repeated.

3.8 DRIVING ON SNOW OR ICE



WARNING: Using the retarder on wet or slippery roads may cause loss of traction on the drive wheels—your vehicle may slide out of control. To help avoid injury or property damage, turn the retarder enable to OFF when driving on wet or slippery roads.



NOTE: The retarder is disabled automatically whenever the vehicle ABS is active. However, in the event the ABS malfunctions, it is recommended that the retarder enable switch, if equipped, be disabled.

If possible, reduce vehicle speed and select a lower range before losing traction. Select the range that will not exceed the speed expected to be maintained.

Accelerate or decelerate very gradually to prevent the loss of traction. It is very important to decelerate gradually when a lower range is selected. It is important that you reach the selected lower range before attempting to accelerate. This avoids an unexpected downshift during acceleration.

3.9 ROCKING OUT



WARNING: To help avoid injury or property damage caused by sudden movement of the vehicle, do not make shifts from **N** (Neutral) to **D** (Drive) or **R** (Reverse) when the throttle is open. The vehicle may lurch forward or rearward and the transmission can be damaged. Avoid this condition by making shifts from **N** (Neutral) to a forward range or **R** (Reverse) only when the throttle is closed and the service brakes are applied.



CAUTION: DO NOT make **N** (Neutral) to **D** (Drive) or directional shift changes when the engine rpm is above idle. Also, if the wheels are stuck and not turning, do not apply full power for more than 10 seconds in either **D** (Drive) or **R** (Reverse). Full power for more than 10 seconds under these conditions causes the transmission to overheat. If the transmission overheats, shift to **N** (Neutral) and operate the engine at 1200–1500 rpm until it cools (2–3 minutes).

If the vehicle is stuck in deep sand, snow, or mud, it may be possible to rock it out using the following procedure:

1. Shift to **D** (Drive) and apply a steady, light throttle (never full throttle). Refer to [Figure 3-1](#) and [Table 4-1](#) for additional information.
2. When the vehicle has rocked forward as far as it will go, apply and hold the vehicle service brakes.
3. When engine has returned to idle, select **R** (Reverse).
4. Release the vehicle service brakes and apply a steady, light throttle (never full throttle) allowing the vehicle to rock in **R** (Reverse) as far as it will go.
5. Apply and hold the vehicle service brakes and allow the engine to return to idle.

This procedure may be repeated in **D** (Drive) and **R** (Reverse) if each directional shift continues to move the vehicle a greater distance.

3.10 TOWING OR PUSHING



CAUTION: Failure to lift the drive wheels off the road, disconnect the driveline, or remove the axle shafts before pushing or towing can cause serious transmission damage.

When the engine cannot be started, it may become necessary to push or tow the vehicle. Before pushing or towing a vehicle do one of the following:

- Lift the drive wheels off the road
- Disconnect the driveline
- Remove the axle shafts



NOTE: When the axle shafts are removed, make sure the wheel openings are covered to prevent loss of lubricant and entry of dust and dirt.

An auxiliary air supply is usually required to actuate the vehicle brake system.

3.11 OPERATING DOWN STEEP GRADES (REAR-DISCHARGE MIXER)



CAUTION: With this transmission, the service brakes must be used when backing a loaded rear-discharge mixer down a grade. But too much brake application, particularly on an unpaved surface, can lock the front brakes and reduce steering control. A crash could then occur. To help prevent injury or property damage:

1. Drive forward down the grade and then exit by backing up the grade when you can do so.
2. If equipped, use the trailer brake when backing the mixer down a grade. Do not use the trailer brake as a parking brake once the vehicle is at the bottom of the grade.
3. If a trailer brake is not available, back the mixer down the grade by modulating the service brakes to control and maintain a safe, steady vehicle speed. Avoid abrupt stops and starts.

RUGGED DUTY SERIES

4.0 SELECTING RANGE AND SHIFT SCHEDULES

4.1 SELECTING RANGE

If your vehicle is equipped with an Allison Transmission 4th Generation Controls with Prognostics shift selector, a keypad pushbutton shift selector or a lever shift selector will be used. Examples of these shift selectors are shown in [Figure 4-1](#). Some vehicle Original Equipment Manufacturers (OEMs) may choose to use their own shift selector. See the vehicle OEM for information about their selectors as needed. This Operator's Manual only provides information about Allison shift selectors.



NOTE: The transmission starts in 2nd gear if the Transmission Fluid Temperature (TFT) sensor detects the transmission fluid is below -7°C (20°F).

When a forward range, such as **D** (Drive), has been selected, the transmission starts in the lowest forward gear programmed in the Transmission Control Module (TCM) calibration. Usually that would be 1st range but some vehicles may be programmed for 2nd gear start instead. Refer to [Table 4-1](#) for more information and driving tips for each range.

The 4700 RDS transmission is a seven-speed transmission, which includes Low as another forward range manually selected by the operator. Low is shown as 1st range in the Monitor display if manually selected. What is normally known as 1-5 or 1-6 forward ranges for the five and six speed models is shown as ranges 2 -7 in the 4700 RDS transmission. Gear ratios for 2-7 are the same as 1-6 in the 4000 RDS transmission.



NOTE: Check the digital display window in the shift selector to verify the selected range whenever a button is pushed or the lever is moved to be sure the range selected is shown. A flashing or blank SELECT display indicates the range selected was not obtained due to an active inhibit or active DTC.



NOTE: If equipped with a HIGH IDLE switch, turn the HIGH IDLE off before shifting from **N** (Neutral) to **D** (Drive) or **R** (Reverse). The shift from **N** (Neutral) to **D** (Drive) or **R** (Reverse) is inhibited when engine speed is above idle.



WARNING: To help avoid unexpected vehicle movement that might cause death, serious injury, or property damage, always have your foot on the brake, the throttle released, and the engine at idle before making a **N** (Neutral) to **D** (Drive); **N** (Neutral) to **R** (Reverse); **D** (Drive) to **R** (Reverse); or **R** (Reverse) to **D** (Drive) selection.



NOTE: Before making any direction changes or shifting from **N** (Neutral) to any range, make sure the vehicle has come to a complete stop and the engine has returned to idle. Refer to [3.9 ROCKING OUT](#) if the vehicle is stuck.



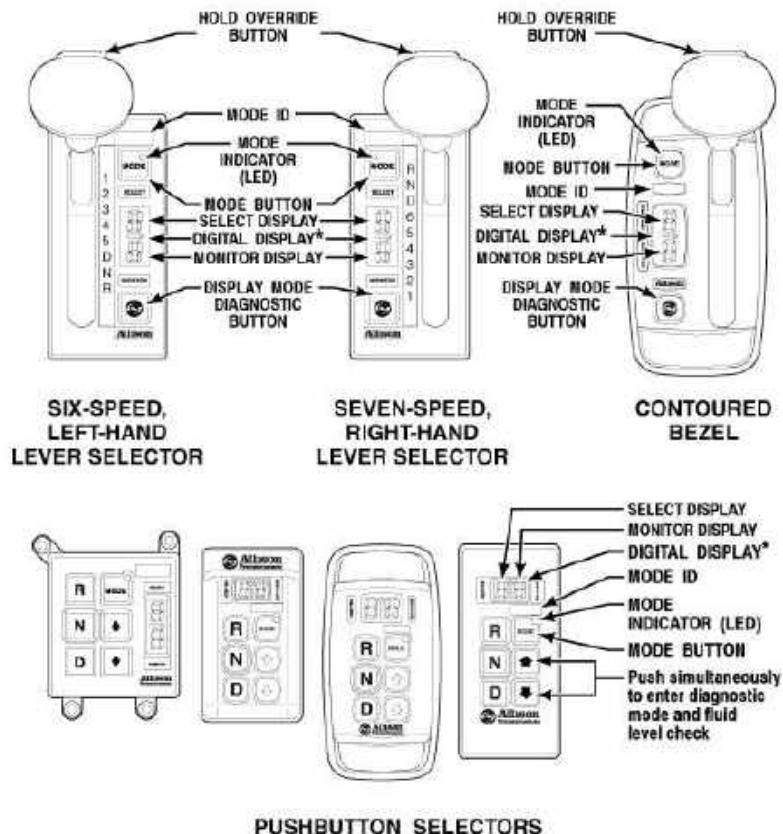
NOTE: Conditions responsible for illuminating the **CHECK TRANS** light will not allow any shift selector changes until the DTC related to the condition goes inactive. The MONITOR display shows the range the transmission has locked in because of an active DTC. The SELECT display goes blank when the **CHECK TRANS** light is on. Move the vehicle to a safe location before turning off the vehicle and seek qualified assistance if needed. Even if the transmission is not in Neutral, the operator is still able to view DTCs by simultaneously pressing the ↑ (Upshift) and ↓ (Downshift) arrows, if equipped with the keypad pushbutton shift selector, or by pressing the **DISPLAY MODE/DIAGNOSTIC** (DMD) button, if equipped with the lever shift selector.

Refer to [5.0 CARE AND MAINTENANCE](#), [6.0 DIAGNOSTICS](#), and [7.0 PROGNOSTICS SHIFT SELECTORS COMPONENTS AND FUNCTIONS](#) for additional information about using the shift selectors to access, read, or clear transmission prognostic information and DTCs.

4.1.1 USING KEYPAD PUSHBUTTON SHIFT SELECTOR TO SELECT RANGE. If your vehicle is equipped with the keypad pushbutton shift selector, ranges are selected by pressing and releasing the button for the desired range. For example, press and release the N button to select **N** (Neutral), the D button to select **D** (Drive) and the R button to select **R** (Reverse). You may also manually select a lower forward gear below the (D) position by pushing the ↓ (Downshift) arrow after pressing **D** (Drive).

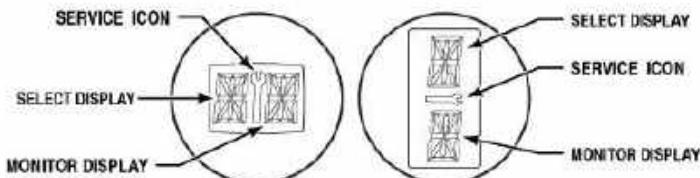
4.1.2 USING LEVER SHIFT SELECTOR TO SELECT RANGE. If your vehicle is equipped with the lever shift selector, make sure the vehicle is in **N** (Neutral) before starting the engine. The neutral start circuit will not allow the engine to start if the lever is not in **N** (Neutral). To go to range using a lever shift selector, press the hold override button to release the lever from its detent position and move the lever to the range you want. Refer to [Figure 4–1](#).

You may manually select a lower forward gear below the (D) position by moving the lever to the lower range you would like to “range hold”.



*NOTE: The first number displayed in the digital display is the highest forward range available and second number is range attained in selected position.

Visually confirm that the range selected was attained. If display is flashing, shift is inhibited.



Location of service icon on vertical and horizontal digital display

25414

Figure 4–1. Typical Allison 4th Generation Prognostics Shift Selectors

4.1.3 SELECTOR DISPLAY FLASHING (INHIBITS). When appropriate, the transmission control system automatically invokes an inhibit to protect against certain types of abusive operation, such as:

- **Engine speed inhibit:** prevents shift from neutral to either a forward range or reverse if the engine speed is above 900 rpm.
- **Direction change inhibit:** prevents shifting the transmission from forward-to-reverse or from reverse-to-forward if vehicle speed is more than the allowed speed threshold, or if the engine speed is above 900 rpm. Rocking out by shifting from **D** (Drive) to **R** (Reverse) and **R** (Reverse) to **D** (Drive) is still available to the operator provided the vehicle speed detected is below the limit allowed for rocking out the vehicle.

When shifts are inhibited, the TCM puts the transmission in **N** (Neutral) and the RANGE SELECT character flashes an R for reverse inhibit or the RANGE SELECT character flashes the highest forward range number for a drive inhibit. After a range inhibit has occurred the driver must re-select range to exit the inhibit after bringing the vehicle to stop and/or returning to engine idle.

Shifts from **N** (Neutral) to **D** (Drive) or **N** (Neutral) to **R** (Reverse) are also inhibited when the TCM has been programmed (by input/output function) to detect that auxiliary equipment is in operation and the shift should not be allowed.

Table 4–1. DESCRIPTION OF AVAILABLE RANGES

Description of Available Ranges (refer to Figure 4–1)	
	<p>WARNING: If you leave the vehicle and the engine is running, the vehicle can move unexpectedly and you or others could be injured. If you must leave the engine running, do not leave the vehicle until you have completed all of the following procedures:</p> <ol style="list-style-type: none">1. Put the transmission in N (Neutral).2. Be sure the engine is at low idle (500–800 rpm).3. Apply the parking brakes and emergency brake and make sure they are properly engaged.4. Chock the wheels and take any other steps necessary to keep the vehicle from moving.

Table 4–1. DESCRIPTION OF AVAILABLE RANGES (cont'd)

Description of Available Ranges (refer to Figure 4–1)	
	WARNING: R (Reverse) may not be attained due to an active inhibitor. Always apply the service brakes when selecting R (Reverse) to prevent unexpected vehicle movement and because a service brake inhibit may be present. When “ R ” is flashing, it indicates the shift to R (Reverse) is inhibited. Determine if diagnostic codes are active if R (Reverse) is not attained. Refer to 7.6 SELECTOR DISPLAY DESCRIPTIONS FOR ACTIVE DTCs AND INHIBITS .
	CAUTION: Do not idle in R (Reverse) for more than five minutes. Extended idling in R (Reverse) can cause transmission overheating and damage. Always select N (Neutral) whenever time at idle exceeds five minutes.
	NOTE: Check the digital display window in the shift selector to verify the selected range whenever a button is pushed or the lever is moved to be sure the range selected is shown (i.e., if the N (Neutral) button is pressed, N should appear in the digital display). A flashing display indicates the range selected was not attained due to an active inhibit.
R	Completely stop the vehicle and let the engine return to idle before shifting from a forward range to R (Reverse) or from R (Reverse) to a forward range. The digital display will display R when R (Reverse) is selected.
	WARNING: When starting the engine, make sure the service brakes are applied. Failure to apply the service brakes can result in unexpected vehicle movement.
	WARNING: Vehicle service brakes, parking brake, or emergency brake must be applied whenever N (Neutral) is selected to prevent unexpected vehicle movement. Selecting N (Neutral) does not apply vehicle brakes, unless an auxiliary system to apply the parking brake is installed (refer to the Operator's Manual for the vehicle).
	WARNING: If you let the vehicle coast in N (Neutral), there is no engine braking and you could lose control. Coasting can also cause severe transmission damage. To help avoid injury and property damage, do not allow the vehicle to coast in N (Neutral).

Table 4–1. DESCRIPTION OF AVAILABLE RANGES (cont'd)

Description of Available Ranges (refer to Figure 4–1)	
N	Use N (Neutral) when starting the engine to check vehicle accessories and for extended periods of engine idle operation (longer than five minutes). For vehicles equipped with the pushbutton selector, N (Neutral) is selected by the TCM during start-up. For vehicles equipped with the lever selector, the vehicle will not start unless N (Neutral) has been selected. If the vehicle starts in any range other than N (Neutral), seek service immediately. N (Neutral) is also used during stationary operation of the Power Takeoff (PTO) (if the vehicle is equipped with a PTO). The digital display shows N when N (Neutral) is selected. Always select N (Neutral) before turning off the vehicle engine.
	WARNING: D (Drive) may not be attained due to an active inhibitor. Always apply the service brakes when selecting D (Drive) to prevent unexpected vehicle movement and because a service inhibit may be present. When “ D ” is flashing, it indicates the shift to D (Drive) is inhibited. Determine if diagnostic codes are active if D (Drive) is not attained. Refer to 7.6 SELECTOR DISPLAY DESCRIPTIONS FOR ACTIVE DTCs AND INHIBITS .
	CAUTION: Do not idle in D (Drive) for more than five minutes. Extended idling in D (Drive) may cause transmission overheating and damage. Always select N (Neutral) if time at idle exceeds five minutes.
	NOTE: If equipped with a HIGH IDLE switch, turn the HIGH IDLE switch off before shifting from N (Neutral) to D (Drive) or R (Reverse). D (Drive) or R (Reverse) will not be attained unless the shift is made with the engine at idle. Also, be aware of other interlocks that would prevent attaining D (Drive) or R (Reverse). Example: “service brakes not applied” (service brake interlock present).
D	The transmission initially attains first range when D (Drive) is selected (except for those units programmed to start in second-range). As vehicle speed increases, the transmission upshifts automatically through each range. As the vehicle or equipment slows down, the transmission automatically downshifts to the correct range. The digital display shows the highest range available in D (Drive).

Table 4–1. DESCRIPTION OF AVAILABLE RANGES (cont'd)

Description of Available Ranges (refer to Figure 4–1)	
	WARNING: To avoid loss of control, use a combination of downshifting, braking, and other retarding devices. Downshifting to a lower transmission range increases engine braking and can help you maintain control. The transmission has a feature to prevent automatic upshifting above the lower range selected. However, during downhill operation, if engine governed speed is exceeded in the lower range, the transmission will upshift to the next higher range to prevent engine damage. This will reduce engine braking and could cause a loss of control. Apply the vehicle brakes or other retarding device to prevent exceeding engine governed speed in the lower range selected.
7* 6** 5** 4** 3 2	Lower ranges provide greater engine braking for going down grades (the lower the range, the greater the braking effect). Occasionally, it may be desirable to restrict automatic shifting to a lower range because of: <ul style="list-style-type: none">• Road conditions• Load• Traffic conditions, etc. The pushbutton shift selector arrow buttons access individual forward ranges. Push the ↑ (Upshift) or ↓ (Downshift) arrows for the desired range. The digital display shows the range chosen. Even though a lower range is selected, the transmission may not downshift until vehicle speed is reduced (this prevents excessive engine speed in the lower range).
1	First-range provides the vehicle with its maximum driving torque and engine braking effect. Use first-range when: <ul style="list-style-type: none">• Pulling through mud and deep snow.• Maneuvering in tight spaces.• Driving up or down steep grades. For vehicles equipped with the pushbutton selector, push the ↓ (Downshift) arrow until first-range appears in the select window.

* Only available in 4700/4800 RDS models

** Actual ranges available depend on programming by vehicle manufacturer.

4.2 SHIFT SCHEDULES AND AUTOMATIC RANGE SHIFTS

The transmission initially attains first range when D (Drive) is selected (except for those units programmed to start in 2nd range and the 4700 RDS). As vehicle speed increases, the transmission automatically upshifts through

each range. As the vehicle or equipment slows down, the transmission automatically downshifts to the correct range. The SELECT display shows the highest range available in **D** (Drive).

The points at which shifts occur depend upon predetermined speeds and other operating conditions. A transmission shift calibration includes several sets of shift points which may be used according to current or anticipated operating conditions for both upshift and downshift points.

 **NOTE:** The vehicle OEM or bodybuilder is responsible for evaluating the driveability of shift schedules in the intended vehicle and duty cycle. For additional details regarding these shift schedules and/or other options for primary and secondary shift schedules, contact a qualified Allison Transmission service outlet for further information.

4.2.1 UPSHIFTING. As long as the Transmission Control Module (TCM) calculates there is enough vehicle power and vehicle acceleration available to grant and keep the next upshift then there are no other limitations imposed on upshifting until the vehicle attains its top range displayed in the SELECT display on the selector. Vehicle power and acceleration characteristics are monitored by the transmission controls to attempt to eliminate shift cycling. Shift cycling is an upshift followed closely by a downshift which is then followed by another upshift and so on.

 **NOTE:** If shift cycling is noted use the alternate shift schedule by pressing the **MODE** button. The operator can also manually select the next lower range (using the shift selector) to hold that lower range until conditions are met to grant the upshift point again without shift cycling.

4.2.1.1 HOLD SCHEDULE FOR UPSHIFTS

As a standard feature of each shift calibration, the transmission controls incorporate a "**hold upshift**" shift schedule, which the operator may select if the transmission is not operating in its highest range. When this schedule is active, the shift points for upshifts are raised in order to hold the transmission in its current gear and inhibit upshifting beyond the current range. Holds are activated by selecting the current range or a lower range on the shift selector.



CAUTION: A typical use of the "hold" feature is to maximize engine braking when operating downhill. However, in order to prevent over-speeding the engine, the hold function is not infinite. It will permit shifts from the hold range to the next higher range at some speed above the shift calibration speed.

4.2.2 DOWNSHIFTING. Downshifts are allowed to occur as long as transmission output speed is low enough to keep from overspeeding the engine after completing the downshift. When a range downshift is manually selected by the operator, but the transmission output speed is determined to be above the limits, the transmission stays in the range it was in even though a lower range was requested by the operator. A shift to a lower range can occur when the operator applies the vehicle service brakes or a retarding device, such as an exhaust brake, engine brake, or retarder. This action reduces the transmission output speed which in turn lowers the vehicle speed, allowing the transmission to shift to the lower range.

4.2.2.1 PRESELECT SCHEDULE FOR DOWNSHIFTS

The preselect downshift schedule is similar to the hold feature. The operator may initiate the preselect downshift shift schedule by selecting any forward gear on the shift selector that is lower than the gear currently in use. When a range has been "preselected" in this manner, shifts to and from gears above the preselected gear range occur at higher than normal engine speeds. Shifts below the preselected range are not affected.

Preselect downshifting is beneficial in maintaining higher engine speed, resulting in increased engine braking or engine brake performance during downhill operation or vehicle deceleration cycles. However, preselect shifts are permitted only if an engine over-speed condition will not occur after completion of the downshift.



NOTE: Preselecting during normal operation may result in reduced fuel economy.

4.2.2.2 NON-ENGINE BRAKE OPERATION

Two choices of preselect shift schedules are available for governing preselected downshifts during normal transmission operation. One of the following choices is selected when the TCM is programmed by the vehicle OEM:

- **Standard Preselects** – downshifts occur so the engine speed after the shift is approximately 300 rpm above the engine governed speed

- **Low Preselects**— downshifts occur so the engine speed after the shift is approximately 150 rpm above the engine governed speed

4.2.2.3 ENGINE BRAKE OR EXHAUST BRAKE OPERATION

When the TCM detects the engine brake is enabled, it commands use of a preselect shift schedule in order to enhance engine brake performance. The default speeds for these shifts are known as the Alternate Engine Brake Preselects.

- **Alternate Engine Brake Preselects** – downshifts occur at engine speeds approximately midway between 1000 rpm and the Standard Preselects for your transmission model.

As an option, the preselect shift points during engine brake operation can be specified to be the same schedule selected when the TCM is programmed by the vehicle OEM for non-engine brake operation:

- **Standard Preselects** – downshifts occur so the engine speed after the shift is approximately 300 rpm above the engine governed speed
- **Low Preselects**— downshifts occur so the engine speed after the shift is approximately 150 rpm above the engine governed speed



NOTE: Specify Standard or Low Preselects when the TCM is programmed.

The preselect schedule chosen above will be activated for downshifts that occur while the engine brake is active and until operation in a specified gear is reached. This specified gear is the Engine Brake Preselect Range CMC that is programmable using Allison DOC® For PC-Service Tool. If this CMC is set to a value higher than 2nd gear, then downshifts from the Engine Brake Preselect Range to 2nd gear will be made as standard (non-engine brake) closed throttle downshifts. Additionally, if the TCM is programmed to make engine brake preselect downshifts at Standard Preselects or Low Preselects speeds, downshifts between the Engine Brake Preselected Range to an even lower gear can be specified to use the Alternate Engine Brake Preselect downshift speeds. The lowest gear to use this downshift schedule is also a CMC (Alternate Engine Brake Preselect Range). If this option is specified and the Alternate Engine Brake Preselect Range CMC is higher than 2nd gear, downshifts from the Alternate Engine Brake Preselect Range to 2nd gear use normal (non-preselect) closed throttle shift speeds.



NOTE: If an exhaust brake or engine compression brake is installed on the engine, then they must be integrated to the transmission controls. Shift quality issues will arise if not properly integrated to the transmission controls.

4.2.2.4 RETARDER MODE SHIFT SCHEDULE

The retarder mode shift schedule is automatically activated when the retarder is switched on in order to raise closed throttle downshifts for additional cooling during retarder operation. Retarder closed throttle downshifts occur at speeds approximately halfway between the normal closed throttle downshift and the preselect downshift for each range. Refer to [4.3 USING THE HYDRAULIC RETARDER](#).

4.2.3 ACCELERATOR CONTROL. The position of the accelerator pedal influences when automatic shifting occurs. An electronic throttle position signal tells the TCM how much the operator has pressed the pedal. When the pedal is fully pressed, upshifts occur automatically at higher engine speeds. A partially pressed position of the pedal causes upshifts to occur at lower engine speeds.

4.2.3.1 KICKDOWN SHIFT SCHEDULE

Kickdown is an optional shift schedule which is activated when the kickdown input function is enabled. If shift schedule S2, S3, or S4 is in use and kickdown is active, all shifts revert to schedule S1, Wide Open Throttle (WOT) shift points. Similarly, if shift schedule S6, S7, or S8 is in use and kickdown is active, all shifts revert to schedule S5, WOT shift points.

4.2.4 PRIMARY AND SECONDARY SHIFT SCHEDULES. The primary shift schedule is normally used each time the vehicle is started and is specified in such a way to accommodate normal vehicle operation.

The secondary shift schedule is an alternate shift schedule the TCM only uses upon request. The request for this schedule can be a dedicated request from the operator or can be interlocked with the operation of another vehicle system.

Primary and secondary shift schedules may be changed using the **MODE** button but some applications may use a dash-mounted switch. The **MODE** indicator LED illuminates while in secondary shift schedule. The vehicle might also have a dash-mounted light that illuminates when the secondary mode schedule is active.

Frequently, either performance or economy shift points are selected for the primary shift schedule (reflecting the most commonly used state of the

vehicle), and the other set of shift points are selected for the secondary shift schedule.

The primary and secondary shift schedules must be specified when the TCM is programmed. The vehicle OEM determines which primary/secondary shift schedule combination they would like the transmission to have when the vehicle is built.

4.2.5 PERFORMANCE/ECONOMY SHIFT SCHEDULES. Currently, Allison Transmission offers the following commonly available shift schedules to the OEM(s):

- **S1 & S5** - Performance: WOT upshifts near Full Load Governed Speed (FLGS)
- **S2 & S6** - Performance: WOT upshifts at a fixed (less than 100) percent of Full Load Governed Speed (FLGS)
- **S3 & S7** - Economy: Upshifts at speeds which pull engine down to a fixed rpm after the shift
- **S4 & S8** - Economy: Upshifts at speeds which pull engine down to a fixed rpm (and less than S3) after the shift
- **S9** - Economy: Upshifts and downshifts occur at speeds that are even lower than the S4 shift strategy

Schedules S1 through S4 are typically used with engines using all-speed governors. Schedules S5 through S8 are designed to provide the same WOT upshifts as the corresponding S1 through S4 schedules. However, the S5 through S8 part throttle shift schedules have been modified.

4.2.6 LOAD-BASED SHIFT SCHEDULING (LBSS). The LBSS shifting strategy option combines the advantages of both performance and economy shift schedules. LBSS is part of the standard Shift Energy Management (SEM) calibration for approved engines. The controls automatically select the economy shift schedule when an unloaded state of the vehicle is detected (based on capability of the vehicle to accelerate quickly), then automatically switch to performance shift points when the vehicle is loaded and its ability to accelerate is reduced. The resulting operation can continuously modify transmission shifting to keep the engine near its more efficient speeds, which can produce improved overall vehicle fuel economy while still enabling high productivity during loaded conditions.

Performance mode is commanded upon each initialization of the TCM. The switch to economy is commanded by the TCM only when it is determined the economy mode in LBSS is available based on the evaluation of the vehicle operating system. The mode is also reset to performance when any of the following are detected:

- Neutral has been commanded for more than 20 seconds
- Transmission has been in first range for more than 120 seconds
- An engine derate condition has been detected
- Loss of torque data from the engine

In addition to providing the capability to automatically switch between performance and economy schedules, the availability of economy mode in LBSS is selectable as a CMC, with Allison DOC® For PC-Service Tool, within the shift calibration as follows:

Table 4–2. LBSS ECONOMY MODE

CMC Setting	Selection	Description
1	Reserved 1	Reserved for future use
2	Reserved 2	Reserved for future use
3	Low	This setting keeps the vehicle in economy mode when lightly loaded or on low upgrades. The vehicle will always be in performance mode if carrying a load or when negotiating moderate grades.
4	Medium	This is the default value. This setting keeps the vehicle in economy mode more than the default setting. When the vehicle is empty, even on moderate grades, economy mode is normally in use. Likewise, economy mode also is used on nearly-level grades with moderate loads. Performance mode will be commanded when heavily loaded or with moderate loads on larger grades
5	High Grades	This setting keeps the vehicle in economy mode in most circumstances. Performance will typically be commanded only when negotiating severe when heavily loaded. This setting permits higher powered vehicles to be in economy mode for most operation except during the most demanding operating conditions

4.2.7 OVER-TEMPERATURE SHIFT SCHEDULE. Regardless of operator request, the TCM automatically limits transmission operation to 4th range or below during oil over-temperature conditions. If the transmission is above 4th range when over-temperature occurs, the preselect shift schedule is used for all downshifts until 4th range is reached.

4.2.8 CRUISE MODE SHIFT SCHEDULE. This shift schedule is activated when a J1587 or J1939 datalink message is received to indicate cruise control is active. Shift points for this operation are modified in order to reduce the frequency of upshifts and downshifts during cruise operation. This shift schedule is a standard feature of each shift calibration.

The vehicle cruise control features interact with retarder activation/deactivation and are determined by calibration and CMC(s). Refer to [4.3.2 RETARDER/CRUISE CONTROL INTERACTIONS](#).

4.3 USING THE HYDRAULIC RETARDER

A hydraulic retarder is optional on all of the models covered in this manual. The purpose of the retarder is to assist in stopping the vehicle during stop-and-go driving and to control the downhill speed of the vehicle on a grade. For both of these uses, the retarder extends the life of the service brakes and enhances vehicle control. The retarder automatically disengages when the vehicle approaches a stop.

When the retarder enable switch is turned on to enable the retarder system, a special retarder mode shift schedule is activated. This shift schedule allows downshifts at higher than the normal road speeds. Increased coolant flow through the transmission cooler and engine radiator occurs due to the raised downshift points. Refer to [4.3.1 RETARDER CAPACITY REDUCTION](#).



NOTE: The transmission retarder is configured as either a low, medium, or high capacity retarder by TCM calibration. Allison Transmission requires written vehicle OEM approval before a service outlet increases the retarder capacity at a customer's request. Existing vehicle drivelines, differentials, axles, and the cooling system must be designed for the additional retarder torque generated if a higher capacity retarder calibration is installed. The cost to modify retarder capacity is the responsibility of the customer.

The amount of Retarder Modulation Request (RMR) is controlled by the operator and depends on the type of retarder control used in the vehicle. Various hand, foot and automatic control techniques are used. Refer to [Table 4-3](#). In Allison 4th Generation Controls with Prognostics, the TCM also activates or limits retarder operation in response to torque speed control

or electronic retarder control messages received on the vehicle's J1939 Datalink. Contact your OEM to understand how the retarder controls have been integrated into your vehicle.

The presence of a retarder must be autodetected as part of Allison 4th Generation Controls with Prognostics.



NOTE: The retarder enable switch is used to turn the retarder off for slippery road conditions.



WARNING: DO NOT USE THE RETARDER DURING INCLEMENT WEATHER OR WHEN ROAD SURFACES ARE SLIPPERY.

Use of the hydraulic retarder during inclement weather or when road surfaces are slippery could result in death, serious injury, or property damage. On vehicles which have a primary retarder control based upon closed throttle position, brake pedal position, or brake apply pressure, always manually disable the retarder controls during inclement weather or slippery road conditions, using the OEM provided retarder enable switch if present.

If the transmission retarder does not apply, death, serious injury, or property damage may occur. Operator should be prepared to apply vehicle brakes or other retarder device if the transmission retarder does not apply.

If the transmission retarder does not function, death, serious injury, or property damage may occur. Be sure to test for proper retarder function periodically. If a retarder is present but is not detected by "autodetect," the retarder will not function. Whenever the retarder does not apply, seek service help immediately.

Regardless of the type of Allison retarder controls on your vehicle (refer to [Table 4-3](#)) the following safety features are common to each configuration:

- The retarder can be disabled when inclement weather or slippery road conditions are present
- Vehicle brake lights should always be on when the retarder is applied (periodically verify they are working)
- Anti-lock Brake System (ABS) sends a signal to the TCM to indicate the brake system is activated



NOTE: The retarder is automatically disabled and the lockup clutch is disengaged whenever the ABS is active. In the event the ABS malfunctions, it is recommended the retarder enable switch be disabled, if equipped.



NOTE: If your transmission has a retarder but it is not functioning, it may not have been autodetected during vehicle manufacture. Consult the nearest Allison Transmission service outlet to have autodetect reset or the retarder enabled using the Allison DOC® For PC—Service Tool.



NOTE: A common cause for retarder performance complaints is incorrect transmission fluid level. Fluid level must be set correctly for highest retarder effectiveness. As little as 2 liters (2 quarts) too high or too low can reduce retarder effectiveness and increase transmission temperature. Refer to [5.8 PERIODIC FLUID LEVEL CHECKS](#).



NOTE: The retarder requires about two seconds to reach full capacity. Be sure to anticipate this delay when using the retarder to prevent unnecessary service brake applications during non-emergency stops.



NOTE: When the transmission fluid or engine water temperature (engine water temperature is an OEM option) exceeds programmed limits, retarder capacity is automatically gradually reduced to minimize or avoid possible system overheating.



CAUTION: Observe the following cautions when driving a vehicle equipped with a retarder:

- THE RETARDER WORKS ONLY WHEN THE ENGINE IS AT CLOSED THROTTLE.
- OBSERVE TRANSMISSION AND ENGINE TEMPERATURE LIMITS AT ALL TIMES. Select the lowest possible transmission range to increase the cooling system capacity and total retardation available.
- In the event of OVERHEATING, DECREASE THE USE OF THE RETARDER; USE THE SERVICE BRAKES TO SLOW THE VEHICLE.
- OBSERVE THE RETARDER/SUMP “OVERTEMP” LIGHT to be sure it responds properly to retarder temperature.

Table 4–3. Types of Retarder Control

Type	Description	Amount of Application
Manual	Separate apply pedal	Zero to Full apply
	Hand lever*	Six levels based on lever position
Automatic	Auto “Full On”**	“Full On” when closed throttle sensed
Brake Pressure Apply**	Single pressure switch	Off or “Full On” (based on brake pressure)
	Three pressure switches	1/3, 2/3, or “Full On” (based on brake pressure)
Pedal Position**	Special brake pedal	1/3, 2/3, or “Full On” (based on brake pressure)
J1939 Data Link	Digital message from engine controller	Zero to Full Apply

Table 4–3. Types of Retarder Control (cont'd)

Type	Description	Amount of Application
Combinations of the above systems**	Auto "half-on" plus pressure switch*	Half capacity at closed throttle or "Full On" with brake pressure
	Auto "1/3 on" plus two pressure switches*	1/3, capacity at closed throttle or 2/3 and "Full On" with brake pressure
	Hand lever plus pressure switch*	6 levels of modulation with lever, or "Full On" with brake pressure
	Foot pedal plus pressure switch	Full modulation with separate pedal, or "Full On" with brake pressure
	Hand lever plus interface for special pedal*	6 levels of modulation with lever, or 3 levels of modulation based on pedal position

* These control systems may apply the retarder at high speed on grades when the vehicle has road speed limiting and the retarder is enabled.

** For retarder apply systems integrated with the service brake system, the retarder is most effective when applied with light brake pedal pressure for 1–2 seconds to allow the retarder to fully charge. Added pedal pressure can be applied when more aggressive braking is desired.

4.3.1 RETARDER CAPACITY REDUCTION.



NOTE: In the event of excessively high temperatures in the transmission fluid and/or engine coolant during retarder operation, the maximum available retarder capacity may be reduced, affecting vehicle operation.

Retarder capacity is reduced if the transmission retarder-out or transmission sump temperature exceeds specified limits, as detected by temperature sensors which are integral to the transmission. In addition, retarder capacity is reduced in the event of elevated engine water temperature based on:

- engine water temperature as communicated to the TCM with an engine coolant sensor or via an SAE J1939 or J1587 datalink, or
- detection by an engine water temperature sensor which provides an analog input signal to the TCM. This sensor is supplied and installed by the vehicle builder.

4.3.1.1 BASED ON RETARDER TEMPERATURE

If the retarder temperature exceeds 143°C (290°F), the TCM raises the closed throttle downshift points by activating the preselect downshift schedule. Use

of the preselect downshift schedule forces downshifts to occur at higher than normal road speeds, increasing coolant flow through the transmission cooler and engine radiator.

If the retarder temperature exceeds 149°C (300°F), retarder capacity begins to reduce. Capacity reduction continues until it is reduced to approximately 27% of the maximum available retarder capacity.



NOTE: If the output speed increases 300 rpm above the speed at which capacity reduction starts, full retardation is restored.

If the retarder temperature exceeds 166°C (330°F), the retarder temperature indicator output activates. This illuminates a retarder over-temperature light that alerts the operator of excessive retarder temperature. The retarder temperature light deactivates when the retarder temperature drops below 159°C (318°F). If the retarder temperature remains above 166°C (330°F) for ten consecutive seconds, an active DTC P2740 (retarder oil temperature hot) is logged by the TCM. When the temperature drops and remains below 166°C (330°F) for ten consecutive seconds, the DTC becomes inactive and is stored in memory.

4.3.1.2 BASED ON TRANSMISSION SUMP TEMPERATURE

Independent of the retarder temperature, if the transmission sump temperature exceeds 117°C (240°F), retarder capacity will similarly be reduced as described above. The over-temperature indicator is activated and the over-temp DTC is logged if the sump temperature exceeds 121°C (250°F) for fifteen minutes, exceeds 128°C (262°F) for more than one minute, or instantaneously reaches 132°C (270°F).

4.3.1.3 BASED ON ENGINE WATER TEMPERATURE

If optional engine water capacity reduction and/or preselect downshifts are used, similar responses occur based on excessive engine water temperature. The capacity is reduced at the rate/slope programmed into the calibration and may continue to be reduced at this rate until:

- The retarder is operating at approximately 27.5% of its maximum capacity
- The retarder is deactivated by the operator or by vehicle operating conditions which eliminate the need for retardation
- Engine water temperature is returned to a level that does not invoke the capacity reduction



NOTE: Full retardation is restored if the output speed increases 300 rpm above the speed at which water capacity reduction starts.

4.3.2 RETARDER/CRUISE CONTROL INTERACTIONS. Two control features affect retarder operation when the vehicle is equipped with cruise control:

- Feature 1: Cruise Control Retarder Auto On Disable

This feature only applies to electronic engines that communicate with the transmission on either J1587 or J1939. The TCM calibration must specify this feature to be either on or off. If the feature is on in the calibration, the TCM prohibits retarder operation when cruise control is active but the throttle is closed, which implies downhill coasting operation. This feature is highly recommended if the retarder apply system automatically applies the retarder at high levels at closed throttle.

If the feature is off in the calibration or the engine is not electronic, the TCM commands retarder operation whenever the cruise control goes to zero throttle. This mode of operation is only acceptable if the subsequent level of retarder apply is less than 25%.

- Feature 2: Retarder Cancel Cruise Control

This feature provides for a short flash of the retarder indicator output whenever the requested retarder level is increased. The retarder indicator output must be wired to the engine cruise control to turn off cruise control when the level of retardation requested is changed. This operation emulates the effect of applying the service brakes. Feature 2 is an optional feature that must be specified for the controls calibration.

RUGGED DUTY SERIES

5.0 CARE AND MAINTENANCE

5.1 PERIODIC INSPECTIONS



NOTE: The terms fluid and oil are used interchangeably in this publication. Both terms refer to the fluid or oil in the transmission and no other components.

It is very important to continually monitor the fluid level and connections for the electronic and hydraulic circuits. Keep the transmission clean to make inspection easier. Make regular periodic inspections for:

- Proper transmission fluid fill. Refer to [5.8 PERIODIC FLUID LEVEL CHECKS](#).
- Transmission fluid that is discolored, has a strong odor, or exceeded oil analysis limits.
- Presence of engine coolant in the transmission fluid.



NOTE: Transmission overhaul is required when the transmission has been contaminated with engine coolant. Allison Transmission recommends all clutch friction plates, lockup clutch, solenoids, and rusted/damaged parts be replaced during the rebuild.

- Presence of transmission fluid in the engine cooling system.
- Leaking fluid around fittings or hydraulic lines.
- Dripping oil from the transmission or output seal area. Refer to [Figure 5–1](#) and [Figure 5–2](#)) for non-PTO applications, and [Figure 5–3](#) and [Figure 5–4](#) for PTO applications. Refer to [Figure 5–5](#) and [Figure 5–6](#) for 4700 RDS transmissions.
- Debris that is blocking the breather located on top of the torque converter housing. Refer to [Figure 5–1](#) and [Figure 5–2](#) for non-PTO applications, and [Figure 5–3](#) and [Figure 5–4](#) for PTO applications. Refer to [Figure 5–5](#) and [Figure 5–6](#) for 4700 RDS transmissions.

- Loose bolts securing transmission to engine or vehicle components attached to the transmission.
- Loose engine and transmission mounts.
- Harnesses interfacing with transmission controls and vehicle function are still in good condition.

Report any abnormal condition to service management. Immediately correct any problems found during this inspection to prevent further vehicle and/or transmission damage.

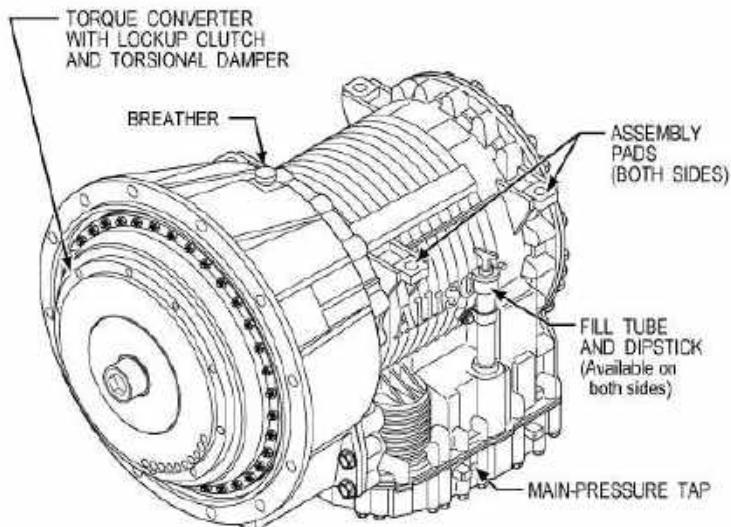
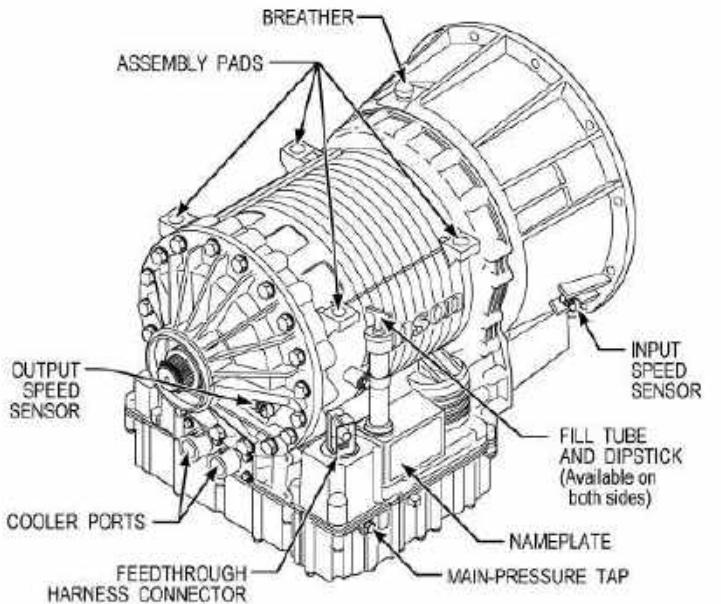
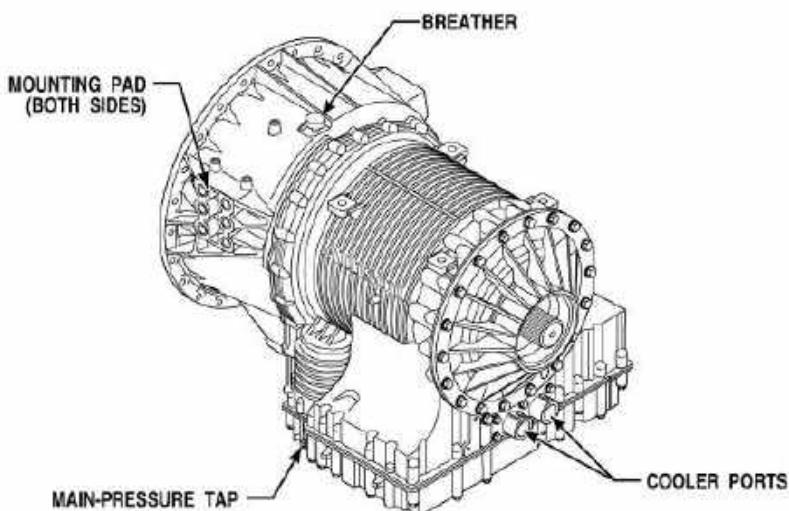
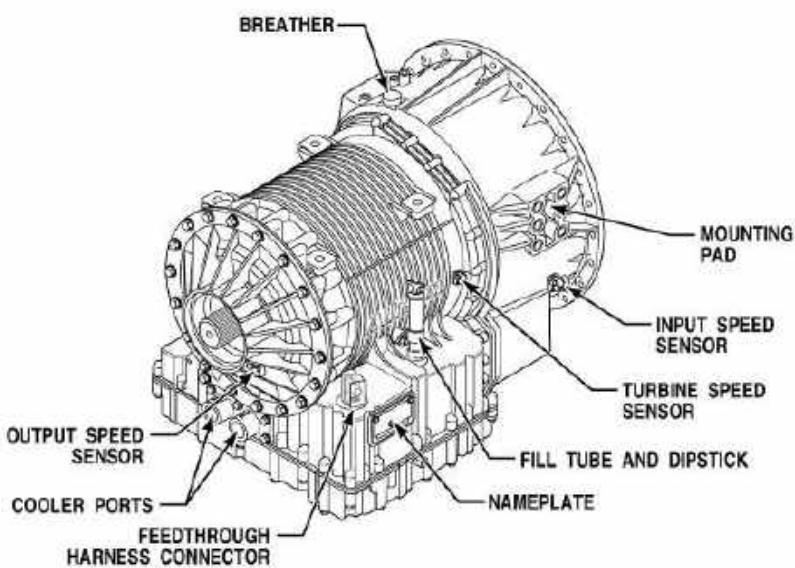
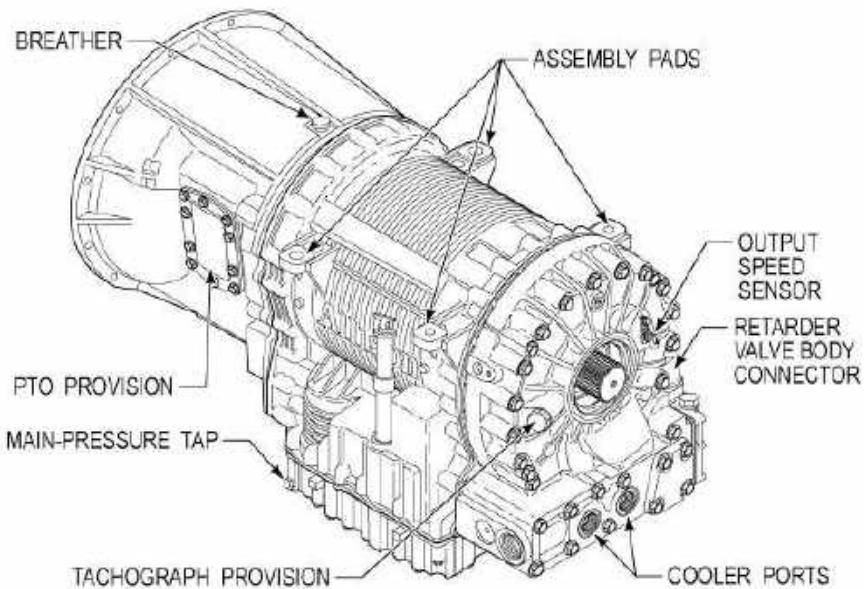


Figure 5-1. 3000/3500 RDS

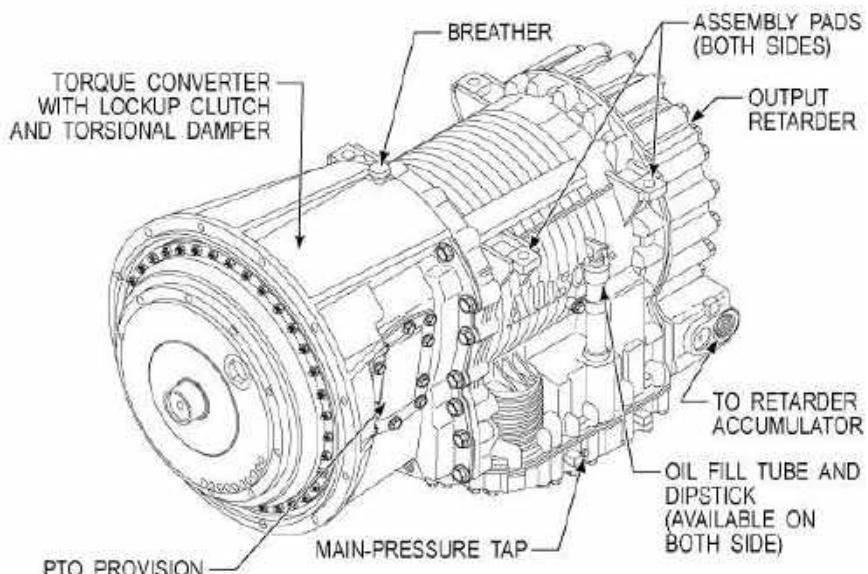


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Figure 5-2. 4000/4500 RDS



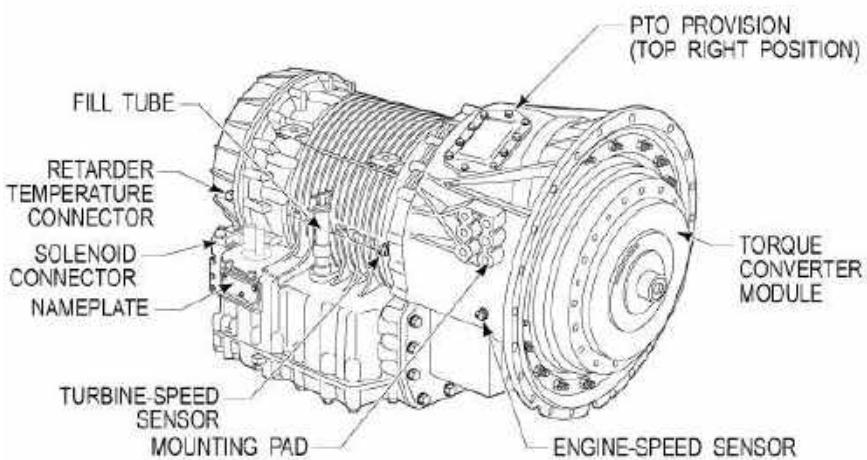
LEFT-REAR VIEW



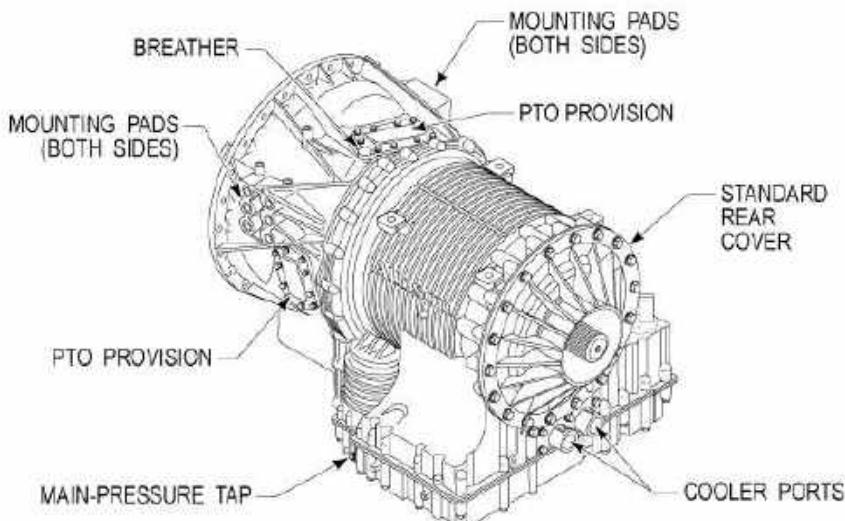
LEFT-FRONT VIEW

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Figure 5-3. 3000/3500 RDS with PTO and Retarder



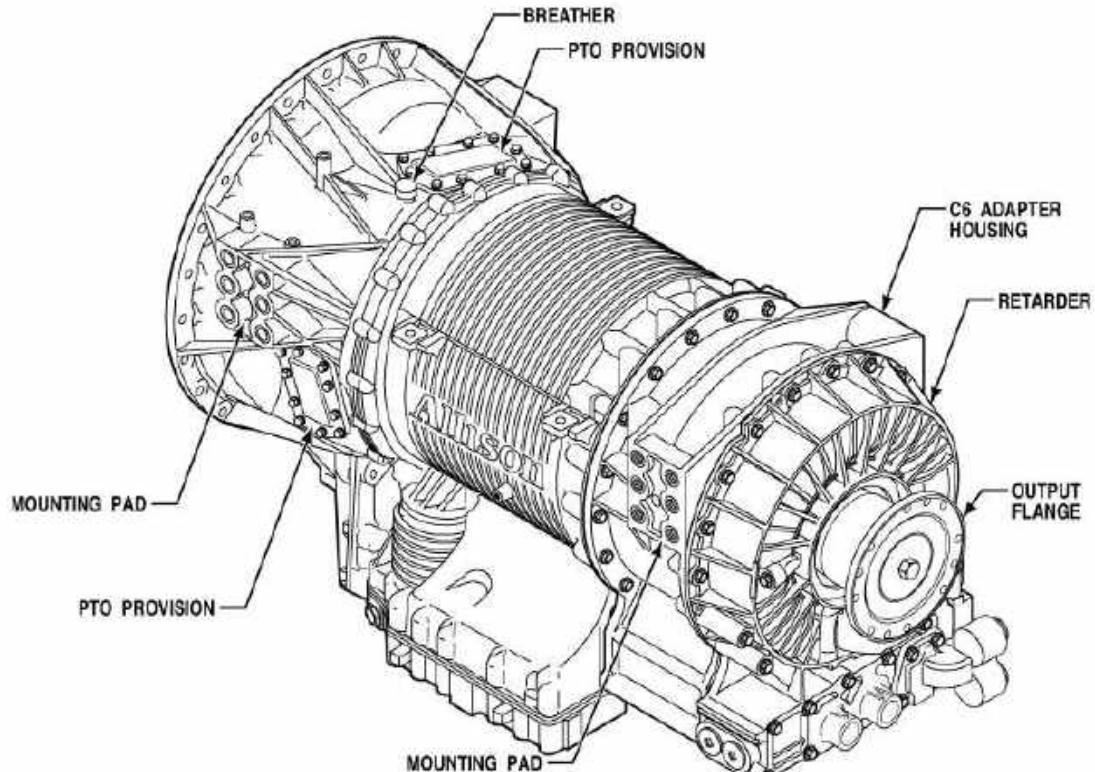
RIGHT-FRONT VIEW



LEFT-REAR VIEW

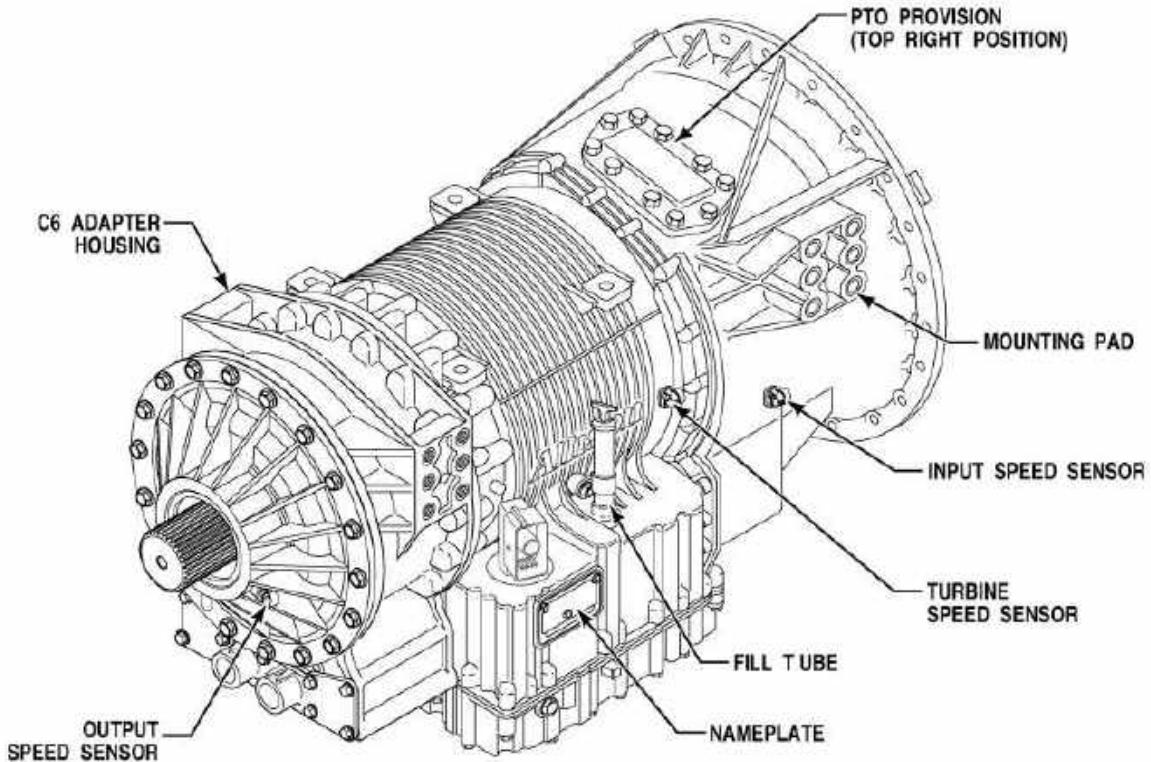
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Figure 5–4. 4000/4500 RDS with PTO and Retarder (Right-Front View) with PTO and without Retarder (Left-Rear View)



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Figure 5–5. 4700 RDS with PTO and Retarder



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Figure 5–6. 4700 RDS with PTO

5.2 PREVENT MAJOR PROBLEMS

You can help keep minor problems from becoming major problems by contacting an Allison Transmission distributor or dealer when one of these conditions occur:

- A shift quality issue
- A driveability issue such as a vibration
- Transmission, hydraulic line or fitting is leaking fluid



NOTE: Dampness around the breather and output seal is normal. If there is a drip associated with the dampness at the breather, output seal, or elsewhere on the transmission then repair the cause of the leak.

- **CHECK TRANS** light illuminates

5.3 IMPORTANCE OF TRANSMISSION FLUIDS

Proper transmission fluid selection is important to transmission performance, reliability, and durability. The fluid used in the transmission does the following:

- Provides the working medium for the torque converter, controls, and clutch application
- Transfers heat from the transmission to the cooler
- Lubricates gears and bearings
- Carries rust inhibiting chemicals throughout the transmission
- Achieves optimum coefficient of friction for the clutch application
- Maintains clutch engagement
- Carries contaminants to the filters

5.4 RECOMMENDED AUTOMATIC TRANSMISSION FLUIDS

Only use fluids meeting Allison Transmission specification TES 295 or TES 389 in your transmission. For a list of currently approved transmission fluids, go to the Allison Transmission web site at: www.allisontransmission.com, select SERVICE, Fluids.

Allison Transmission recommends you take the following into consideration when selecting the appropriate fluid type for your transmission:

- Fluids meeting specification TES 295 are preferred over TES 389 fluids for use in all 3000 and 4000 Product Families transmission applications.

- TranSynd®, a TES 295 fluid, is available through Allison distributors and dealerships.
- TES 295 fluids are fully qualified for Severe Duty and Extended Drain intervals.
- A fluid meeting TES 295 specification is required in order to use Prognostics Features in A51, A52, A53 series TCMs calibrated prior to October 09, 2009 if Calibration Identification Number (CIN) starts with 4A.
 - The Prognostics packages available in A51, A52, A53 TCMs calibrated after October 09 2009 to a CIN starting with 4C allows a selectable fluid type between either TES 295 or TES 389 fluid.
- A TES 295 fluid allows you to operate at a lower ambient temperature than a TES 389 type fluid. Refer to [Table 5–1](#).
- A TES 389 fluid is the minimum fluid requirement approved for use in 3000 and 4000 Product Families transmissions.
- To extend the TES 389 fluid drain intervals beyond the recommended mileage or hours change interval, use a fluid analysis program. Refer to [5.6 FLUID ANALYSIS](#).
- When choosing a fluid type to use, consider what the minimum fluid operating temperature of the fluid will be based on the ambient temperatures reached in the geographical location for the vehicle. Refer to [3.3.1 PREHEATING REQUIREMENT](#).

Table 5–1. Transmission Fluid Minimum Operating Temperature Requirements

Fluid Type	Minimum Operating Conditions	
	Celsius	Fahrenheit
TES 295	–35	–31
TES 389	–25	–13

5.5 KEEPING FLUID CLEAN



CAUTION: Containers or fillers that have had antifreeze solution or engine coolant in them must NEVER be used to hold transmission fluid. Antifreeze and coolant solutions contain ethylene glycol and water which, if put into the transmission, can cause damage.

Make sure that transmission fluid is clean, free of chemical contaminants, and within fluid specification limits. Refer to [Table 5–2](#).

Handle transmission fluid in clean, residue-free containers and fillers to prevent any foreign material or chemical contamination of the transmission fluid.

5.6 FLUID ANALYSIS

Transmissions used in high cycle rate applications should use fluid analysis to make sure fluid is changed as soon as needed. Transmission protection and fluid change intervals may be optimized by monitoring fluid oxidation according to the tests and limits. Refer to [Table 5–2](#). Consult your local telephone directory for firms in your area that provide a fluid analysis service. Use only one fluid analysis firm to ensure consistent and accurate fluid analysis. Refer to Technician's Guide for Automatic Transmission Fluid, GN2055EN, for additional information.

Table 5–2. Fluid Oxidation Measurement Limits

Test	Limit
Viscosity	±25 change from new fluid
Total Acid Number (TAN)	+3.0* change from new fluid
Solids	2 percent by volume

* mg of potassium hydroxide (KOH) to neutralize a gram of fluid.

5.7 TRANSMISSION FLUID REFILL

The fluid refill volume will be less than the volume listed for the initial fill due to some fluid remaining in the external circuits as well as in various transmission component cavities. After refill, verify the fluid level is correct. Refer to [5.8 PERIODIC FLUID LEVEL CHECKS](#).



NOTE: Quantities listed in [Table 5–3](#) are approximate and do not include external lines and cooler hoses.

Table 5–3. Transmission Fluid Capacity

Transmission	Sump	Initial Refill		Refill	
		Liters	Quarts	Liters	Quarts
3000 Product Family	4 inch	27	29	18	19
	2 inch	25	26	16	17
4000 Product Family*	4 inch	48	51	40	42
	2 inch	41	43	33	35

* Subtract 2.8 Liters (3 Quarts) for transmissions without PTO.

5.8 PERIODIC FLUID LEVEL CHECKS

Even though transmission fluid is not consumed during transmission operation as engine oil might be, periodic fluid level checks should be made prior to placing the vehicle in service or just after returning from service. Periodic fluid level checks help prevent human error or mechanical failure of a vehicle or transmission component. Periodic checks also help to detect fluid leaks, cooler failure (contaminating the transmission fluid), fluid overfill, fluid underfill or the wrong kind of fluid used the last time the transmission was serviced.

Check the transmission fluid level by one of the following methods:

- Dipstick
- Using Allison 4th Generation shift selector to electronically check the Oil Level Sensor (OLS) located in the transmission control valve module



NOTE: OLS is not available in the 4700 RDS transmission equipped with the retarder option.

- Using Allison DOC® For PC-Service Tool to check the level with the OLS

The dipstick is marked with temperature bands for a COLD and HOT fluid level check. The fluid check marked COLD is designed to allow the fluid level to be checked from 16°C (61°F) to 60°C (140°F).



NOTE: Only use this check to confirm adequate fluid volume for a cold start-up and not to set fluid levels for continued operation.

The OLS is designed to automatically compensate for fluid temperature fluctuations (thermal expansion) that is, within its operating band parameters for fluid temperature. Allison Transmission recommends using the Allison 4th

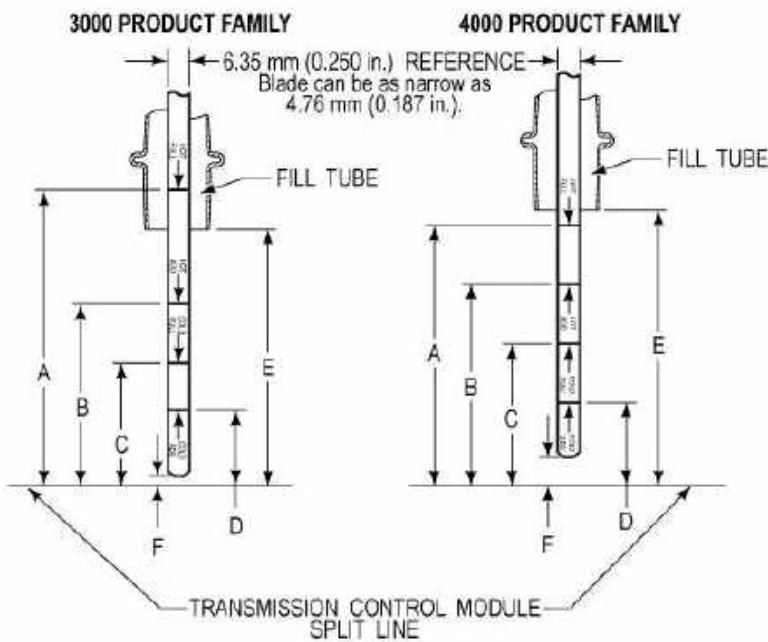
Generation controls shift selector to check the OLS. This method is more accurate than the dipstick method.

Use the dipstick method if any of the following situations exist:

- If transmission fluid temperature is below the allowed temperature to check it electronically, conduct a COLD CHECK to determine whether there is enough fluid to start and move the vehicle.
- If the vehicle does not have an Allison 4th Generation shift selector, or the OEM has not integrated the electronic messages regarding oil level into their selector.
- If the OLS or vehicle wiring is defective, or the OLS was not auto detected, preventing electronic access to fluid level.

5.8.1 FLUID CHECK USING DIPSTICK.

There are two temperature bands marked on the dipstick to allow for transmission fluid expansion when the temperature increases. The lower band, referred to as COLD CHECK, is used when the transmission fluid is below operating temperature. The upper band, referred to as HOT CHECK, is used when the transmission fluid is at normal operating temperature. The OEM may refer to these as COLD FULL/COLD ADD (COLD CHECK) and HOT FULL/HOT ADD (HOT CHECK). Refer to [Figure 5–7](#) for further information on dipstick markings.



OIL SUMP	TRANSMISSION/SUMP DESCRIPTION	DIMENSION A	DIMENSION B	DIMENSION C	DIMENSION D	DIMENSION E	DIMENSION F**
2.00 in. and 4.00 in.	4000 PRODUCT FAMILY	105.7 mm (4.10 in.)	78.2 mm (3.06 in.)	66.0 mm (2.60 in.)	*	132.6 mm (5.22 in.)	13.8 mm (0.54 in.)
2.00 in.	3000 PRODUCT FAMILY	101.6 mm (4.00 in.)	73.7 mm (2.90 in.)	60.8 mm (2.40 in.)	*	86.6 mm (3.41 in.)	5.9 mm (0.23 in.)
4.00 in.	3000 PRODUCT FAMILY	101.6 mm (4.00 in.)	63.5 mm (2.50 in.)	45.7 mm (1.80 in.)	*	86.6 mm (3.41 in.)	5.9 mm (0.23 in.)

NOTE: Calibrate level marking locations with respect to transmission control module split line and fill tube.
Scale none.

*Dimension determined by installation.

**Reference dimension only. Actual dimension to be determined by installation.

Figure 5-7. Standard Transmission Dipstick Markings

COLD CHECK: The COLD CHECK band verifies the transmission has adequate fluid for start-up and operation until it can be checked at the operating (hot) temperature. Only use this check to confirm adequate fluid level for a cold start-up and not to set fluid levels for continued operation. Typically, the check is most accurate with fluid temperatures of 16-49°C (61-120°F).



NOTE: With engine off the fluid level should reach the hot run band or higher on the dipstick even at cold ambient temperatures. The cold check band is calibrated on the stick for the fluid level attained while the transmission is running and in N (Neutral). Do not move the vehicle until the fluid level reaches the cold full mark with engine running and transmission in N (Neutral).

HOT CHECK: The HOT CHECK band checks the fluid level at the normal operating temperature, 71-93°C (160-200°F). Fluid level checks at operating temperature offer the best assurance of maintaining the correct fluid level. Typically, the transmission is at operating temperature at the end of the shift or at the end of the day.

The fluid must be maintained above the COLD CHECK mark to assure the fluid is above the charging pump suction port inside the transmission. This prevents charging pump cavitation which causes aeration of the fluid and erratic operation of the transmission. If the fluid is above the HOT CHECK mark, it may contact the rotating parts of the transmission causing fluid aeration which results in erratic transmission operation, and may cause overheating and power loss.



CAUTION: Transmission damage can result from extended operation at low fluid level conditions.



NOTE: Do not overfill the transmission. Overheating, oil foaming out of the breather, and power loss may occur if driven while transmission is overfilled.

5.8.1.1 COLD CHECK PROCEDURE



NOTE: The correct fluid level cannot be determined unless the transmission is in a level position.



CAUTION: DO NOT start the engine until the presence of sufficient transmission fluid has been confirmed. Remove the transmission fluid dipstick and be sure the static fluid level is near the HOT FULL mark.



WARNING: If you leave the vehicle and the engine is running, the vehicle can move unexpectedly and you or others could be injured. If you must leave the engine running, do not leave the vehicle until you have completed all of the following procedures:

1. Put the transmission in **N** (Neutral).
2. Be sure the engine is at low idle (500–800 rpm).
3. Apply the parking brakes and emergency brake and make sure they are properly engaged.
4. Chock the wheels and take any other steps necessary to keep the vehicle from moving.

A COLD CHECK determines if the transmission has enough fluid to be operated safely until a HOT CHECK can be made. Complete a COLD CHECK after the presence of transmission fluid has been confirmed with the engine off. The transmission fluid temperature should be between 16–49°C (61–120°F).



NOTE: Always check fluid level with the dipstick in the unscrewed or loose position.

Complete a COLD CHECK procedure using the dipstick as follows:

1. Move the vehicle to a level surface, put the transmission in **N** (Neutral) and set the parking brake.
2. With the engine idling (500–800 rpm), shift to **D** (Drive) and then to **R** (Reverse) to clear air from the hydraulic circuits.
3. Run the engine at idle (500–800 rpm) in **N** (Neutral) for about one minute.
4. Clean debris from around the end of the fill tube before removing the dipstick.
5. Remove the dipstick and wipe it clean.
6. Insert the dipstick into the fill tube, pushing down until it stops, but still in its loose or unscrewed position.
7. Remove the dipstick and observe the fluid level. If the fluid on the dipstick is within the COLD CHECK band (refer to [Figure 5–7](#)), the level

is satisfactory. If the fluid level is not within this band, add or drain (refer to [5.7 TRANSMISSION FLUID REFILL](#)) as necessary to bring the level within the COLD CHECK band.

8. Perform a HOT CHECK at the first opportunity after normal operating temperature (71-93°C (160-199°F)) is reached.



CAUTION: DO NOT operate the transmission for extended periods of time until a HOT CHECK has verified proper fluid level. Transmission damage can result from extended operation at improper fluid level conditions.



CAUTION: The fluid level rises as fluid temperature rises. DO NOT fill the transmission above the COLD CHECK band if the transmission fluid is below normal operating temperatures. During operation, an overfull transmission can become overheated, leading to transmission damage.



CAUTION: Obtain an accurate fluid level by imposing the following conditions:

- Engine is idling (500–800 rpm) in **N** (Neutral)
- Transmission fluid is at the normal operating temperature
- The vehicle is on a level surface
- Apply the parking brake and chock the wheels

5.8.1.2 HOT CHECK PROCEDURE



NOTE: Always check fluid level with the dipstick in the unscrewed or loose position.

To complete a HOT CHECK procedure using the dipstick do the following:

1. Be sure fluid has reached normal operating temperature of 71-93°C (160-200°F). If a transmission temperature gauge is not present, measure fluid level when the engine water temperature gauge has stabilized.
2. Park the vehicle on a level surface and shift to **N** (Neutral).
3. Apply the parking brake and allow the engine to idle (500–800 rpm).
4. Clean debris from around the end of the fill tube before removing the dipstick.

5. Remove the dipstick and wipe it clean.
6. Insert the dipstick into the fill tube, pushing down until it stops, but still in its loose or unscrewed position.
7. Remove the dipstick and observe the fluid level. The safe operating level is anywhere within the HOT RUN band on the dipstick. Refer to [Figure 5–7](#).
8. If the level is not within the HOT RUN band, add or drain fluid as necessary to bring the level within the HOT RUN band. Refer to [5.7 TRANSMISSION FLUID REFILL](#).
9. Measure fluid level more than once. Be sure fluid level measurements are consistent. If readings are not consistent, be sure the transmission breather is clean and not clogged. Refer to [Figure 2–1](#) and [Figure 2–2](#) for non-PTO applications and [Figure 2–3](#) and [Figure 2–4](#) with PTO applications for the location of the fill tube and dipstick. For the 4700 RDS, refer to [Figure 2–5](#) and [Figure 2–6](#) for the location of the fill tube and dipstick.
10. If readings are still not consistent, contact your nearest Allison distributor or dealer.

5.8.1.3 TRANSMISSION DIPSTICK MARKINGS ILLUSTRATION

Refer to [Figure 5–7](#).

5.8.2 FLUID LEVEL CHECKS USING ALLISON 4TH GENERATION SHIFT SELECTORS.

The OLS is standard in your transmission. With the OLS and an Allison 4th Generation shift selector, you can get a more accurate electronic fluid level check than with a dipstick.

5.8.2.1 ELECTRONIC FLUID LEVEL CHECK PREREQUISITES

- OLS is functional and is auto-detected by the Transmission Control Module (TCM).
- Vehicle has an Allison 4th Generation shift selector.

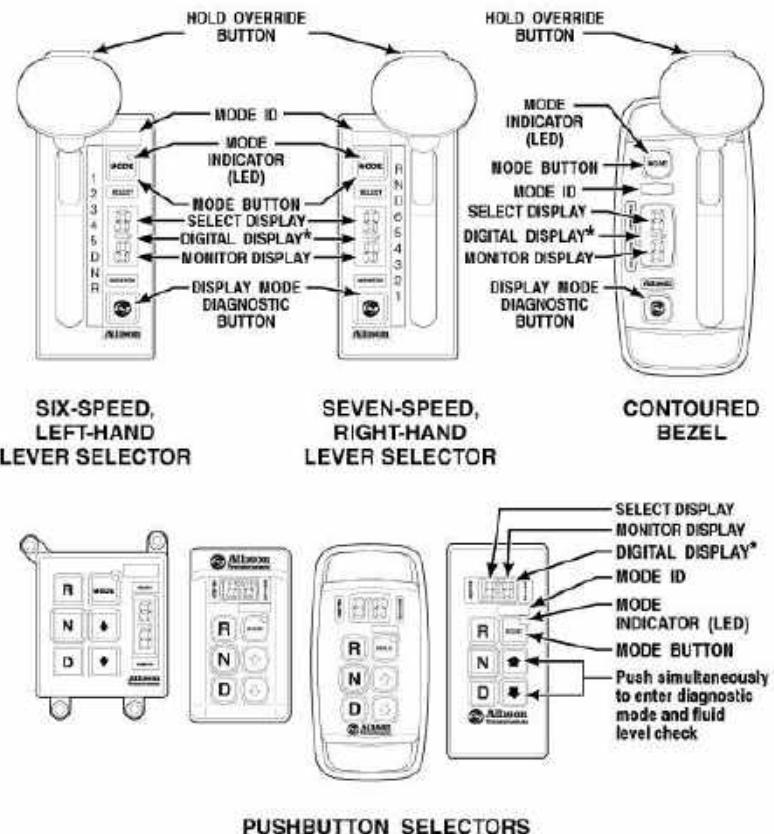


NOTE: OLS is not available in the 4700 RDS transmission equipped with the retarder option.

5.8.2.2 ELECTRONIC FLUID LEVEL CHECK PROCEDURE

The OLS is designed to measure transmission fluid level. To check the fluid level electronically from the shift selector, do the following:

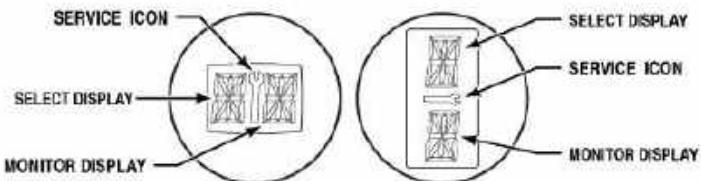
1. Be sure transmission fluid has reached the correct operating temperature band for the OLS:
 - A52, A53 TCMs calibrated after October 09 2009 can be checked from 40-104°C (104- 219° F).
 - Any other TCM model or previous calibrations prior to October 09 2009 can be checked from 60-104° C (140- 219° F).
 - If a transmission temperature gauge is not present, measure fluid level when the engine water temperature gauge has stabilized.
2. Park the vehicle on a level surface and shift to **N** (Neutral)
3. Apply the parking brake and allow the engine to idle (500–800 rpm).
4. Make sure vehicle is stopped with transmission output at 0 rpm.
5. Allow a settling period of two minutes to facilitate oil drain back time.
The TCM communicates status once fluid level request is initiated.
6. Fluid level measurement and readout may be initiated by pressing once on:
 - **DISPLAY MODE/DIAGNOSTIC** button on the lever selector.
Refer to [Figure 5–8](#).
 - ↑ (Upshift) and ↓ (Downshift) arrows simultaneously on the keypad of the pushbutton selector. Refer to [Figure 5–8](#).
7. To exit the fluid level display mode, press any range button on the pushbutton shift selector or press the **DISPLAY MODE/DIAGNOSTIC** button on the lever shift selector



PUSHBUTTON SELECTORS

*NOTE: The first number displayed in the digital display is the highest forward range available and second number is range attained in selected position.

Visually confirm that the range selected was attained. If display is flashing, shift is inhibited.



Location of service icon on vertical and horizontal digital display

Figure 5-8. TYPICAL ALLISON 4TH GENERATION SHIFT SELECTOR

5.8.2.3 FLUID RANGE DETECTED FOR OIL LEVEL SENSOR (OLS)

The OLS has a detection range of up to LO 4 to HI 3 that can display on the selectors. The actual oil level to add may be greater than 4 liters (4.22 quarts) if the transmission is more than 4 liters (4.22 quarts) low from the full mark. The actual fluid volume to drain may be more than 3 liters (3.17 quarts) if the transmission is overfull by more than 3 liters (3.17 quarts).

5.8.2.4 DISPLAY OF FLUID LEVEL AND FLUID LEVEL CODES

After obtaining the fluid level reading mode, the display provision of the transmission shifter indicates fluid level status to the operator by sequentially flashing the fluid level information two characters at a time to the SELECT and MONITOR digital displays. Refer to [Figure 5–8](#).

A delayed fluid level check is indicated by a “—” in each of the digital displays (SELECT and MONITOR) followed by a numerical countdown. The countdown, from 8 to 1, indicates the time remaining in the two minute waiting (settling) period.

An alphanumeric code (other than “o, L”) indicates either a fault code, unacceptable conditions to receive the fluid level information, or there is a system malfunction.

The following is an explanation of what will appear in the single digital display.

- **Correct Fluid Level**—“o, L” is displayed (represents Fluid (Oil) Level Check Mode), followed by “o, K”. The “o, K” display indicates the fluid is within the correct fluid level zone. The sensor display and the transmission dipstick may not agree exactly because the OLS compensates for fluid temperature.
- **Low Fluid Level**—“o, L” is displayed (represents Fluid (Oil) Level Check Mode), followed by “Lo” (represents low fluid level) and the number of quarts the transmission is low. For example: “2” indicates 2 additional quarts will bring the fluid level within the middle of the “o, K” zone.
- **High Fluid Level**—“o, L” is displayed (represents Fluid (Oil) Level Check Mode), followed by “Hi” (represents High Oil Level) and the number of quarts the transmission is overfilled. For example: “1” indicates 1 quart of fluid above the full transmission level.
- **Invalid For Display**—“o, L” (represents Fluid (Oil) Level Check Mode), followed by “—” and an alphanumeric which is a fault code and indicates conditions are not acceptable to receive the fluid level information, or there is a system malfunction.

The following is an explanation of what appears in the SELECT and MONITOR digital displays.

- **Correct Fluid Level**

SELECT	MONITOR	Description
“o”	“L”	Represents Fluid (oil) Level Check Mode
“o”	“K”	Fluid (oil) level is within the correct fluid level zone

- **Low Fluid Level**

SELECT	MONITOR	Description
“o”	“L”	Represents Fluid (oil) Level Check Mode
“L”	“o”	Represents Low Fluid (oil) Level
“0”	“2”	The number of quarts the transmission is low

- **High Fluid Level**

SELECT	MONITOR	Description
“o”	“L”	Represents Fluid (oil) Level Check Mode
“H”	“I”	Represents High Fluid (oil) Level
“0”	“1”	The number 1 indicates 1 quart of fluid above the full transmission level

- **Invalid for Display**

SELECT	MONITOR	Description
“o”	“L”	Represents Fluid (oil) Level Check Mode
“__”	“__”	The dashes are followed by a numerical display which is a fault code that indicates conditions are not proper to receive the fluid level information or there is a system malfunction.

The shift selector shows invalid for display codes two characters at a time. An invalid for display code is returned when the fluid level data is requested, but an operational condition has not been met. The invalid for display codes and their meaning are shown in [Table 5–4](#).

Table 5–4. Invalid for Display Codes

Display (Former)	Display (MY08, Cal/Sfw or newer)	Interpretation of Display
oL — OX	oL — OX	Settling time too short*
oL — 50	oL — EL	Engine rpm too low
oL — 59	oL — EH	Engine rpm too high
oL — 65	oL — SN	N (Neutral) must be selected
oL — 70	oL — TL	Sump fluid temperature too low
oL — 79	oL — TH	Sump fluid temperature too high
oL — 89	oL — SH	Output shaft rotation
oL — 95	oL — FL	Sensor failure

* A number between 8 and 1 that flashes during the countdown period.



NOTE: A51, A52, A53 TCMs calibrated after October 09 2009 may be electronically checked for oil level from 40-104°C (104- 219° F). Otherwise, perform the electronic oil level check from 60-104°C (140- 219° F).

5.9 PROGNOSTICS FEATURES

The Prognostics package contains functions that maximize fluid and filter use, as well as a feature which provides an indication of when the clutch system wear is significant enough to warrant transmission repair. You can then schedule the repair at your convenience. Refer to [Table 5–5](#) for Prognostics Function Description.

Table 5–5. Prognostics Function Description

Prognostics Function Name	Description
Oil Life Monitor (OM)	Displays the percentage of fluid life remaining

Table 5–5. Prognostics Function Description (cont'd)

Prognostics Function Name	Description
Filter Life Monitor (FM)	Notifies that main and lube filters need changed
Transmission Health Monitor (TM)	Notifies that one or more clutches, C1-C5, needs replaced

 **NOTE:** The term **TRANS SERVICE** indicator refers to the lighted wrench icon in the shift selector.

Allison Transmission 4th Generation Controls with Prognostics has a **TRANS SERVICE** indicator, between the SELECT and MONITOR display window on all Allison 4th Generation Controls with Prognostics lever and keypad pushbutton shift selectors. Refer to [Figure 3–1](#). The OEM may choose to use their own selector but provide the **TRANS SERVICE** indicator for Prognostics as a lamp or via a message on a display unit.

When a specified threshold is detected for any of the serviceable conditions, the **TRANS SERVICE** indicator is illuminated to alert the operator. Failure to attend to the service condition and reset the **TRANS SERVICE** indicator within a defined operating period results in illumination of the **CHECK TRANS** light, indicating the increased probability that the service condition will develop into a more serious condition. Refer to [6.2.1 CHECK TRANS LIGHT](#).

5.9.1 PROGNOSTICS PREREQUISITES. The following requirements must be met to use the Prognostics features and functions:

- Vehicle harness has a wire for the filter life indicator switch (wire 118).
- The OEM has ordered your calibration from Allison Transmission with Prognostics enabled.

 **NOTE:** It is important to note that if Prognostics is **disabled**, it is not available at all in the calibration. This is different than the OEM ordering your calibration with Prognostics off. Defaulting Prognostics off means it could be enabled in the future without recalibrating to a different calibration provided the other conditions are met to use Prognostics.

- If the CIN starts with 4A, use TES 295 transmission fluid. If the CIN starts with 4C, TES 295 or TES 389 transmission fluid may be used
- Using Allison Transmission High Capacity Main and Lube Filters

- Using Allison 4th Generation Controls with Prognostics keypad pushbutton or lever shift selector. Refer to [Figure 3–1](#).



NOTE: Allison Transmission may approve some OEM selectors for Prognostics, provided the **TRANS SERVICE** indicator or message display is integrated by the OEM. At the time of this publication there are no capable OEM selectors for Prognostics.

5.9.2 PROGNOSTICS FEATURES AVAILABILITY. The vehicle manufacturer specifies whether they want Allison Prognostics Feature Package to be made available in the calibration and in what configuration, for example defaulted on or off. The Oil Life Monitor (OM), Filter Life Monitor (FM), and Transmission Health Monitor (TM) are the individual functions included in the Allison Prognostics Feature Package. These individual functions cannot be turned on or off separately within the Allison Prognostics Feature Package.



NOTE: Prognostics features for the 4700 RDS transmission are only available with Calibration Identification Numbers (CINs) starting with 4C as part of January 2010 enhancements. Not all OEM's implemented 4C calibrations at the time of this publication. Check with your local Allison dealer, distributor, or OEM dealer to determine if Prognostics Features are part of your transmission features for your specific 4700 RDS model.

The transmission calibration can be made for the vehicle manufacturer (or the customer) so the Prognostics Feature is in one of the following states:

- Available and the Prognostics Features are defaulted on and therefore monitoring Oil Life Monitor (OM), Filter Life Monitor (FM), and Transmission Health Monitor (TM) presently.
- Available and the function is defaulted off and therefore available but not monitoring Oil Life Monitor (OM), Filter Life Monitor (FM), and Transmission Health Monitor (TM) presently.
- Disabled and therefore not available within this Transmission Control Module (TCM) calibration .

Methods to turn the Prognostics Package Features on or off (provided all other requirements are met), include the following:

- Through the shift selector (if allowed by TCM programming). Refer to [5.9.3 PROCEDURE TO TURN PROGNOSTICS ON AND OFF](#).
- Using the Allison DOC® For PC-Service Tool, Customer Modifiable Constant (CMC) can be toggled to enabled or disabled for the Allison

Prognostics Feature Package provided the OEM ordered a calibration that has the Allison Prognostics Feature Package as a programmable feature.

- Recalibrate the TCM provided wire 118 is in the harness. This can be done at an authorized Allison distributor or dealer.



NOTE: Prognostics should not be turned on after recalibration of the TCM until all other requirements for the fluid filters, selector, and harness are met. If wire 118 is not in the vehicle harness, DTC P0848, Pressure Switch 2 (PS2) Circuit High, will be active. If the selector is not a Prognostics capable selector (there is no wrench icon in the selector) then DTC U0304, Software Incompatible with Gear Shift Control Module 1, is active.

The OEM initially specifies how they want the calibration configured for operator access regarding reset for Prognostics functions through the selector. The vehicle owner may then have the CMC toggled to either enabled or disabled to allow or disallow the Prognostics Package reset from the shift selector via programming features in Allison DOC® For PC-Service Tool.

Reset methods for the Prognostics Package and reset of individual features in the package include the following: (Refer to [5.9.3 PROCEDURE TO TURN PROGNOSTICS ON AND OFF](#)).

- Oil Life Monitor (OM) and Filter Life Monitor (FM) may be reset through the selector by different shift pattern sequences.
- Oil Life Monitor (OM) and Filter Life Monitor (FM) may be reset by SAE J1939 datalink messages.
- Oil Life Monitor (OM), Filter Life Monitor (FM), and Transmission Health Monitor (TM) may be reset individually with Allison DOC® For PC-Service Tool.
- Transmission Health Monitor (TM) is always manually reset with Allison DOC® For PC-Service Tool and cannot be manually reset through the selector. Individual clutch reset is allowed with Allison DOC® For PC-Service Tool.
- The Prognostics CMC can be set to restrict Prognostic Package resets to the Allison DOC® For PC-Service Tool only. Individual functions, such as the Oil Life Monitor (OM), Filter Life Monitor (FM), and Transmission Health Monitor (TM) may not be restricted individually for reset by the service tool. Restriction to reset by the service tool only affects the whole Prognostics Package, which is handled by a single Prognostics CMC.

- Filter Life Monitor (FM) and Transmission Health Monitor (TM) automatically reset themselves if monitored conditions allow.



NOTE: An Allison service outlet can assist with programming and recalibration to enable Prognostics, at customer expense, as long as all Allison Transmission requirements are met prior to the enabled feature being turned on.



NOTE: The three Prognostics functions, Oil Life Monitor (OM), Filter Life Monitor (FM), and Transmission Health Monitor (TM), are enabled or disabled as a group and cannot be enabled or disabled individually.



CAUTION: Prognostics requires the use of Allison approved TES 295 or TES 389 fluids (TES 389 available only with 4C CINs; 4A CINs must use TES 295 fluid only) and Allison High Capacity Filters if turned ON. If any other fluids or filters are used, the Prognostics feature MUST BE turned OFF. Prognostics information will not be accurate with any other transmission fluids and could result in missed maintenance activities resulting in transmission damage. If Prognostics functions are not programmed or are turned OFF, refer to [5.0 CARE AND MAINTENANCE](#) and review the miles/hours/months fluid and filter change interval charts or visit www.allisontransmission.com, click Service, Fluid/Filter Change Interval, then Fluids, and read the current revision of Service Tips 1099 for details.

5.9.3 PROCEDURE TO TURN PROGNOSTICS ON AND OFF.



WARNING: To help avoid unexpected vehicle movement that might cause death, serious injury, or property damage, always have your foot on the brake, the throttle released, and the engine at idle before making a **N** (Neutral) to **D** (Drive); **N** (Neutral) to **R** (Reverse); **D** (Drive) to **R** (Reverse); or **R** (Reverse) to **D** (Drive) selection.

The Prognostics feature can be turned on with the Allison DOC® For PC-Service Tool or, if the specific calibration allows it, the operator can do the following:

1. Set the vehicle brakes to prevent movement of the vehicle.
2. With engine off, turn the ignition on (do not start the engine). Wait for initialization to complete (wait for N N to display in the selector).

3. Move the shift selector (for a lever) or press the keypad (for a pushbutton) through the following sequence of range positions, pausing no more than three (3) seconds between consecutive shifts:
N-D-N-R-N-D-N-R-N-D-N-R-N.
4. Watch for the wrench icon between the SELECT and MONITOR display to illuminate and then turn off. That tells the operator they have successfully enabled the Allison Prognostics Feature Package, consisting of the Oil Life Monitor (OM), Filter Life Monitor (FM), and Transmission Health Monitor (TM).

If another **TRANS SERVICE** indicator is installed in the dash or incorporated in an OEM message display, it too should also briefly illuminate in similar fashion as the wrench icon.

Disabling the Prognostics feature can be done with Allison DOC® For PC-Service Tool or, if the specific calibration allows it, the operator can do the following:

1. Set the vehicle brakes to prevent movement of the vehicle.
2. With engine off, turn the ignition on (do not start the engine). Wait for initialization to complete (wait for N N to display in the selector).
3. Move the shift selector (for a lever) or press the keypad (for a pushbutton) through the following sequence of range positions, pausing no more than three (3) seconds between consecutive shifts:
N-D-N-R-N-D-N-R-N-D-N-R-N.
4. Watch for the wrench icon to illuminate and then turn off. That tells the operator they have successfully disabled the Allison Prognostics Feature Package, consisting of the Oil Life Monitor (OM), Filter Life Monitor (FM), and Transmission Health Monitor (TM).

If another **TRANS SERVICE** indicator is installed in the dash or incorporated in an OEM message display, it too should also briefly illuminate in similar fashion as the wrench icon.

5.9.4 NORMAL PROGNOSTICS INDICATION AT ENGINE START. Once Prognostics is monitoring the system, normal operation at engine start is as follows:

1. A system bulb check illuminates the wrench icon between the SELECT and MONITOR display of the selector for approximately 0.5 seconds.
2. If Prognostics features are enabled, the wrench icon illuminates again for 3 seconds after the bulb check.
 - If Prognostics features are disabled, the wrench icon does not illuminate again after the bulb check.

- The **TRANS SERVICE** indicator, if installed, should behave the same way as described for the wrench icon in Step 2.



NOTE: If the shift calibration permits a maximum allowable gear in primary mode that is different than the maximum allowable gear in secondary mode, Prognostics enabling/disabling is only permitted in the shift mode with the highest maximum allowable range. If you have a higher range set of gears in secondary mode than in primary mode to enable Prognostics, push the **MODE** button so the mode light is illuminated first.



NOTE: The three Prognostics functions, Oil Life Monitor (OM), Filter Life Monitor (FM), and Transmission Health Monitor (TM), are enabled or disabled as a package and cannot be enabled or disabled individually.

5.9.5 SETTING FLUID TYPE FOR PROGNOSTICS. To select transmission fluid type do the following:

- With the engine off and the ignition on, perform the following sequence on the selector, **N-R-N-D-N-R-N-D-N-R-N-D-N**.

The wrench icon flashes if TES 389 is the current setting and illuminates solidly if TES 295 is the current setting. To change the transmission fluid type, wait 5 seconds after entering transmission fluid type mode and perform one of the following sequences to select the proper transmission fluid type:

- **N** (Neutral) **R** (Reverse) **N** (Neutral) to select TES 295 (the wrench icon illuminates solidly showing TES 295 has been selected).
- **N** (Neutral) **D** (Drive) **N** (Neutral) to select TES 389 (the wrench icon begins to flash showing TES 389 has been selected).

The selector exits 30 seconds after entering transmission fluid type mode or the ignition may be turned off to exit earlier. Only one transmission fluid type selection may be made after entering transmission fluid type mode. All other attempts will be ignored. Transmission fluid type mode needs to be entered again if the wrong type of transmission fluid is selected.

5.9.6 OIL LIFE MONITOR (OM). Based on the vehicle's duty cycle, this feature determines fluid life and alerts you when a fluid change is required. Not only does it help you get maximum fluid life while providing the maximum protection for the transmission, the OM also saves you money by preventing unnecessary fluid changes.

Oil life is calculated based on hours of engine and transmission operation. Miles are approximated from the hours and calibrated information. The number of shifts per mile (shift density) determines the duty cycle of the transmission and the oil life limits are based on the observed duty cycle. Hours are accumulated when the engine is running, including when the vehicle is stationary for Power Takeoff (PTO) operation, or for extended idle time.



NOTE: Oil life is continuously calculated on the following cumulative effects:

- Operating hours
 - Output revolutions
 - Shift density (shifts per mile)
 - Retarder accumulator applies (if equipped)
-

5.9.6.1 FLUID CHANGE NOTIFICATION

The wrench icon illuminates when remaining fluid life reaches 1%. Afterwards, every time the vehicle is started and **D** (Drive) is selected the wrench icon illuminates again and stays on for two minutes to remind the operator a fluid change is needed. This occurs until service is performed and the OM is reset.



NOTE: If the OM mode has been accessed via the shift selector, a number between 0 and 99 is displayed indicating the percentage of fluid life remaining before a change is required.

Calendar based fluid requirements still apply with OM (refer to [5.0 CARE AND MAINTENANCE](#)). If the OM has not indicated the need for a fluid change before 60 months for TES 295 fluid, or 24 months for TES 389 fluid, it is necessary to change the fluid and filters per calendar requirements and then reset the OM. Calendar requirements are not required if a fluid analysis program is in place. Refer to [5.6 FLUID ANALYSIS](#).

5.9.6.2 READ AND RESET OIL LIFE MONITOR (OM) FROM SELECTOR

READ OM. With engine off and ignition on, push the **DISPLAY MODE/DIAGNOSTIC (DMD)** button twice on the lever selector to enter OM mode. With engine off and ignition on, push the ↑ (Upshift) and ↓ (Downshift) arrows simultaneously twice on the keypad pushbutton selector to enter OM mode. The oil life left is displayed as a percentage between 0 and 99 in the shift selector display window.

RESET OM. The OM may be reset back to 99% by either of these methods:

- Display the OM information and press and hold the **DISPLAY MODE/DIAGNOSTIC** (DMD) button for 10 seconds.
- With the ignition on and the engine off, shift between **N-D-N-D-N-R-N** to reset the value displayed to 99 pausing no more than 3 seconds between consecutive shifts.

The wrench icon illuminates briefly following a reset to acknowledge the reset was successful.

RESET with Allison DOC® For PC-Service Tool. If the value displayed remains unchanged, then it is possible the reset may be restricted to Allison DOC® For PC-Service Tool only.

HISTORY. Allison DOC® For PC-Service Tool may also be used to review reset history and the mileage recorded at the time of reset. Fluid life remaining will be displayed from 100% down to -100% when viewing records in the service tool. A negative % indicates how far past due it is on the oil change. A historical record of the last six resets, including mileage at the time of each reset, may also be viewed using the Allison DOC® For PC-Service Tool Diagnostics Program.

DTC P0897 . If transmission maintenance continues to be unattended, the **CHECK TRANS** light illuminates and DTC P0897, Transmission Fluid at Limit, sets.



CAUTION: Transmission fluid and filter change frequency is determined by the severity of transmission service. To help avoid transmission damage, more frequent changes may be necessary than recommended in the general guidelines due to operating conditions and duty cycle.

For the appropriate recommended change interval guidelines for your specific transmission configuration, refer to [Table 5–6](#), or [Table 5–7](#) or [Table 5–8](#).

5.9.7 FILTER LIFE MONITOR (FM). This feature provides an alert when the transmission's fluid filters need to be replaced. It helps extend filter change intervals to reduce routine maintenance downtime and saves you money in the long run, all while providing maximum protection for the transmission. The Filter Life Indicator (FLI) pressure switch signals the TCM when fluid exiting the main filter drops below a pre-determined pressure. Both the main and lube filters **must be** changed when the wrench icon in the selector display indicates the main filter should be changed. The differential pressure limit is verified for a period of time to be sure there is no false indication of the need to change filters.



NOTE: The 4700 RDS model does not have the FLI pressure switch and valve body. FM is based on transmission duty cycle and other measured transmission parameters, instead of an FLI pressure switch.

5.9.7.1 FILTER CHANGE NOTIFICATION

The wrench icon flashes on and off for two minutes after **D** (Drive) is selected. Once the Filter Life Monitor (FM) mode has been accessed via the shift selector, The “oK” or “Lo” message is displayed in the selector display window. “oK” means the filters do not need to be changed, and “Lo” means the filters need to be changed.

DTC P088A, Deteriorated Filter, sets along with the wrench icon illuminating for filter restriction but this DTC does not illuminate the **CHECK TRANS** light.

DTC P088B, Very Deteriorated Filter, illuminates the **CHECK TRANS** light if filter service is not performed within a certain period of time of the wrench icon illuminating.

5.9.7.2 READ AND RESET FILTER LIFE MONITOR (FM) FROM SELECTOR

Read FM. With engine off and ignition on, push the **DISPLAY MODE/DIAGNOSTIC** (DMD) button three times on the lever selector to enter FM mode. With engine off and ignition on, push the ↑ (Upshift) and ↓ (Downshift) arrows simultaneously three times on the keypad pushbutton selector to enter FM mode.

The message “oK” or “Lo” is displayed in the selector display window. The message “oK” means the filters do not need to be changed, and “Lo” means the filters need to be changed.

Reset FM. The FM automatically resets once the new filters have been installed and the Filter Life Indicator (FLI) pressure switch no longer detects low pressure at the filter.

The FM can also be reset manually by either of these methods:

- Press and hold the **MODE** button for 10 seconds while in FM mode.
- With ignition on and engine off, shift between **N-R-N-R-N-D-N** to reset the FM, pausing no more than 3 seconds between consecutive shifts.

The wrench icon illuminates briefly following a reset to acknowledge the reset was successful.

If the value displayed remains unchanged, it is possible the reset may be restricted to Allison DOC® For PC-Service Tool only. The FM still resets automatically even if restricted from manual reset through the selector.

History. Allison DOC® For PC-Service Tool Diagnostics Program may be used to display the amount of transmission operation from the initial service indication until the filter reset occurred. Allison DOC® For PC-Service Tool indicates the FM as -- Expired “YES” or “NO”.



CAUTION: Transmission fluid and filter change frequency is determined by the severity of transmission service. To help avoid transmission damage, more frequent changes may be necessary than recommended in the general guidelines due to operating conditions and duty cycle.

For the appropriate recommended change interval guidelines for your specific transmission configuration, refer to [Table 5–6](#), or [Table 5–7](#) or [Table 5–8](#).

5.9.8 TRANSMISSION HEALTH MONITOR (TM). This prognostic feature determines clutch life status of the transmission’s clutches and alerts you when clutch maintenance is required. It helps avoid costly repairs and downtime by taking the guesswork out of scheduling routine transmission maintenance, and it ensures your transmission is operating at its maximum performance level. The clutch life status is determined by monitoring the cumulative changes and the calculated running clearance of the transmission clutches.

5.9.8.1 CLUTCH MAINTENANCE NOTIFICATION

The TM feature determines when clutch maintenance is needed. If any of the clutches (except lockup) reaches a remaining life of approximately 10% or if any of the clutch running clearances (except lockup) exceeds a maximum value, then the wrench icon in the selector is steadily illuminated from just after ignition on until ignition is turned off. If TM mode has been accessed via the shift selector, an “OK” or “Lo” is displayed. The “OK” message means no clutch maintenance is needed, and the “Lo” message means an unacceptable clutch life status exists and clutch maintenance is required.

DTC P2789, Clutch Adaptive Learning at Limit, sets if multiple warnings have occurred due to the TM actively detecting issues with the clutch system and illuminating the **CHECK TRANS** light.

5.9.8.2 READ AND RESET TM FROM SELECTOR

Read TM. With engine off and ignition on, push the **DISPLAY MODE/DIAGNOSTIC** (DMD) button four times on the lever selector to enter TM mode. With engine off and ignition on, push the ↑ (Upshift) and

↓ (Downshift) arrows simultaneously four times on the keypad pushbutton selector to enter TM mode.

The message “oK” or “Lo” is displayed in the selector display window. The message “OK” means clutch system maintenance is not required at this time. The message of “Lo” means clutch system maintenance is required.

Reset. The TM feature automatically resets when appropriate conditions are detected. TM can only be manually reset using Allison DOC® For PC-Service Tool. When resetting TM with the service tool, individual clutches or all clutches can be reset. Operator reset through the shift selector is not allowed.

History. The Allison DOC® For PC –Service Tool may be used to display the amount of transmission operation from the initial service indication until the service reset. The Allison DOC® For PC-Service Tool also displays “OK” or “Not OK” for each clutch.

5.9.9 FLUID AND FILTER CHANGE INTERVAL RECOMMENDATIONS .



CAUTION: Transmission fluid and filter change frequency is determined by the severity of transmission service. To help avoid transmission damage, more frequent changes may be necessary than recommended in the general guidelines due to operating conditions and duty cycle.

For the appropriate recommended change interval guidelines for your specific transmission configuration, refer to [Table 5–6](#), or [Table 5–7](#) or [Table 5–8](#).



CAUTION: Transmission fluid and filters **must be changed** whenever there is evidence of dirt or high temperature conditions. A high temperature condition is indicated when the transmission fluid is discolored, has a strong odor, or has exceeded oil analysis limits.

There are three methods recommended by Allison Transmission to help you determine when to change the fluid and filters in your Allison transmission. The methods are as follows:

- When a Prognostics indicator becomes active (shown by illuminating the wrench icon between the SELECT and MONITOR display in all Allison Transmission 4th Generation with Prognostics keypad pushbutton and lever selectors).
- When recommendations listed in the Fluid and Filter Change Interval Tables are met. Refer to [Table 5–6](#), [Table 5–7](#), or [Table 5–8](#).

- When a fluid analysis program indicates a fluid change is necessary. Filter changes must still occur based on either of the events occurring above.

5.9.9.1 FLUID AND FILTER CHANGE INTERVAL SCHEDULES WITH PROGNOSTICS TURNED ON



NOTE: Calendar based change intervals must still be adhered to for both fluid and filter changes even if Prognostics has not indicated to the operator for either fluid or filter maintenance yet, unless fluid analysis is used. If maintenance is done because the fluid or filters reached the calendar based change interval, the OM and FM should be manually reset at that time. Refer to [5.9.6 OIL LIFE MONITOR \(OM\)](#) and [5.9.7 FILTER LIFE MONITOR \(FM\)](#).



NOTE: Allison Transmission High Capacity filters are required in order to use Filter Life Monitor (FM) feature with Prognostics on maintenance schedule as shown in [Table 5–6](#).



NOTE: Either TES 295 or TES 389 fluid types are required to use the OM feature with Prognostics on. A mixture of TES 389 and TES 295 fluid must continue to use the TES 389 fluid change intervals until two fluid changes with only TES 295 fluid have occurred, at which time the TES 295 schedule may be used.



NOTE: Look at OM % left and/or fluid condition at the time of filter change to determine if it is in the best interest of the customer to change the fluid.

Table 5–6. Prognostics On Fluid and Filter Change Intervals

	Fluid Change Intervals	High Capacity** Main and Lube Filter Change Intervals	Suction Filter Assembly Change Interval
TES 295 Fluids* (includes TranSynd®)	<p>Whichever is first of the following:</p> <ul style="list-style-type: none"> • If the wrench icon in the selector is illuminated steady for 2 minutes after D (Drive) is selected • 60 calendar months** <p>NOTE: Always replace main and lube filters with the fluid change**.</p>	<p>Whichever is first of the following:</p> <ul style="list-style-type: none"> • If the wrench icon in the selector is flashing on and off for 2 minutes after D (Drive) selected • Any time the fluid is changed • 60 calendar months** 	At time of transmission overhaul
TES 389 Fluids*	<p>Whichever is first of the following:</p> <ul style="list-style-type: none"> • If the wrench icon in the selector is illuminated steady for 2 minutes after D (Drive) is selected • 24 calendar months** <p>NOTE: Always replace main and lube filters with the fluid change**.</p>	<p>Whichever is first of the following:</p> <ul style="list-style-type: none"> • If the wrench icon in the selector is flashing on and off for 2 minutes after D (Drive) selected • Any time the fluid is changed • 24 calendar months** 	At time of transmission overhaul

NOTE: TES 389 fluid type choice for prognostics is available only if TCM has a 4C or later CIN; all 4A CINs must use TES 295 fluid only if prognostics is enabled and ON.

* Either TES 295 or TES 389 fluid types are required to use the Oil Life Monitor (OM) feature with Prognostics on as shown in this table. A mixture of TES 389 and TES 295 fluid must continue to use the TES 389 schedule shown in this table until two fluid changes with only TES 295 fluid have occurred, at which time the TES 295 schedule may be used.

** Allison Transmission High Capacity filters are required in order to use the Filter Life Monitor (FM) feature with Prognostics as shown in this table.

5.9.9.2 FLUID AND FILTER CHANGE INTERVAL SCHEDULES WITH PROGNOSTICS DISABLED OR TURNED OFF



NOTE: A mixture of TES 389 and TES 295 fluid must continue to use the TES 389 fluid change intervals until two fluid changes with only TES 295 fluid have occurred, at which time the TES 295 schedule may be used.



CAUTION: Transmission fluid and filter change frequency is determined by the severity of transmission service. To help avoid transmission damage, more frequent changes may be necessary than recommended in the general guidelines due to operating conditions and duty cycle.

For the appropriate recommended change interval guidelines for your specific transmission configuration, refer to [Table 5–6](#), or [Table 5–7](#) or [Table 5–8](#).



NOTE: Change fluid/filters at or before recommended mileage, months, or hours have elapsed, whichever occurs first. For vehicles that average less than 40 km/h (25 mph), operating hours represent a more reliable measure of fluid life; therefore, fluid change intervals should not be based on mileage only.

Table 5–7. Prognostics Disabled or Turned Off Fluid and Filter Change Intervals

General Vocation* Refer to Table 5–8 for additional information on severe vocations.			
	Fluid Change Intervals	High Capacity Main*** and Lube Filter Change Intervals	Suction Filter Assembly Change Interval
TES 295 Fluids** (includes TranSynd®)	<p>Whichever is first of the following:</p> <ul style="list-style-type: none"> • 480 000 km (300,000 miles) • 6000 hours of operation • 48 calendar months <p>NOTE: Always replace main and lube filters with the fluid change ***.</p>	<p>Whichever is first of the following:</p> <ul style="list-style-type: none"> • Any time the fluid is changed • 120 000 km (75,000 miles) • 3000 hours of operation • 36 calendar months 	At time of transmission overhaul
TES 389 Fluids**	<p>Whichever is first of following:</p> <ul style="list-style-type: none"> • 40 000 km (25,000 miles) • 1000 hours of operation • 12 calendar months <p>NOTE: Always replace main and lube filters with the fluid change ***.</p>	<p>Whichever is first of the following:</p> <ul style="list-style-type: none"> • Any time the fluid is changed • 40 000 km (25,000 miles) • 1000 hours of operation • 12 calendar months 	At time of transmission overhaul

* General Vocation includes all non-retarder transmissions not identified as severe, and intercity coaches with duty cycles of less than one stop per mile.

** A mixture of TES 389 and TES 295 fluid must continue to use the TES 389 schedule shown in this table until two fluid changes with only TES 295 fluid have occurred, at which time the TES 295 schedule may be used.

*** This information is based on using Allison Transmission High Capacity filters and a TES 389 or TES 295 fluid type with Prognostics Features not available or turned off.

Table 5–8. Prognostics Disabled or Turned Off Fluid and Filter Change Intervals

Severe Vocation*			
	Fluid Change Intervals	High Capacity ** Main and Lube Filter Change Intervals	Suction Filter Assembly Change Interval
TES 295 Fluids *** (includes TranSynd®)	<p>Whichever is first of the following:</p> <ul style="list-style-type: none"> • 240 000 km (150,000 miles) • 6000 hours of operation • 48 calendar months <p>NOTE: Always replace main and lube filters with the fluid change **.</p>	<p>Whichever is first of the following:</p> <ul style="list-style-type: none"> • Any time the fluid is changed • 120 000 km (75,000 miles) • 3000 hours of operation • 36 calendar months 	At time of transmission overhaul
TES 389 Fluids ***	<p>Whichever is first of the following:</p> <ul style="list-style-type: none"> • 20 000 km (12,000 miles) • 500 hours of operation • 6 calendar months <p>NOTE: Always replace main and lube filters with the fluid change **.</p>	<p>Whichever is first of the following:</p> <ul style="list-style-type: none"> • Any time the fluid is changed • 20 000 km (12,000 miles) • 500 hours of operation • 6 calendar months 	At time of transmission overhaul

* Severe Vocation includes all retarder equipped transmissions, or vocations for On/Off Highway, Refuse, Transit, and Intercity Coach with duty cycle greater than one (1) stop per mile.

** This information is based on using Allison Transmission High Capacity filters and a TES 389 or TES 295 fluid type with Prognostics Features not available or turned off.

*** A mixture of TES 389 and TES 295 fluid must continue to use the TES 389 schedule shown in this table until two fluid changes with only TES 295 fluid have occurred, at which time the TES 295 schedule may be used.

5.9.9.3 FLUID AND FILTER CHANGE PROCEDURE



NOTE: Do not drain the transmission fluid if only filters are being replaced.



WARNING: Avoid contact with the hot fluid or the sump when draining transmission fluid. Direct contact with the hot fluid or the hot sump may result in bodily injury.

Drain Fluid

1. Drain the fluid when the transmission is at operating temperature of 71–93°C (160–200°F). Hot fluid flows quicker and drains more completely.
2. Remove the drain plug from the control module and allow the fluid to drain into a suitable container.
3. Examine the fluid for contamination.



NOTE: At each fluid change, examine the drained fluid for evidence of dirt or water. A normal amount of condensation appears in the fluid during operation.

Replace Filters (Refer to [Figure 5–9](#)).

1. Remove 12 bolts (1), two filter covers (2), two gaskets (3), two O-rings (4), two O-rings (5), and two filters (6) from the bottom of the control module.
2. When reinstalling parts, lubricate and install new O-rings (4) and (5) on each cover (2). Lubricate O-ring inside filter (6) and push filter onto cover (2). Install new gaskets (3) on cover (2) and align holes in gaskets with holes in cover.



CAUTION: Do not use the bolts to draw the filter covers to the control module. Do not use an impact wrench to tighten the bolts. Using an impact wrench to tighten the bolts may cause stripped threads and expensive parts replacement. Use a torque wrench to tighten the bolts.

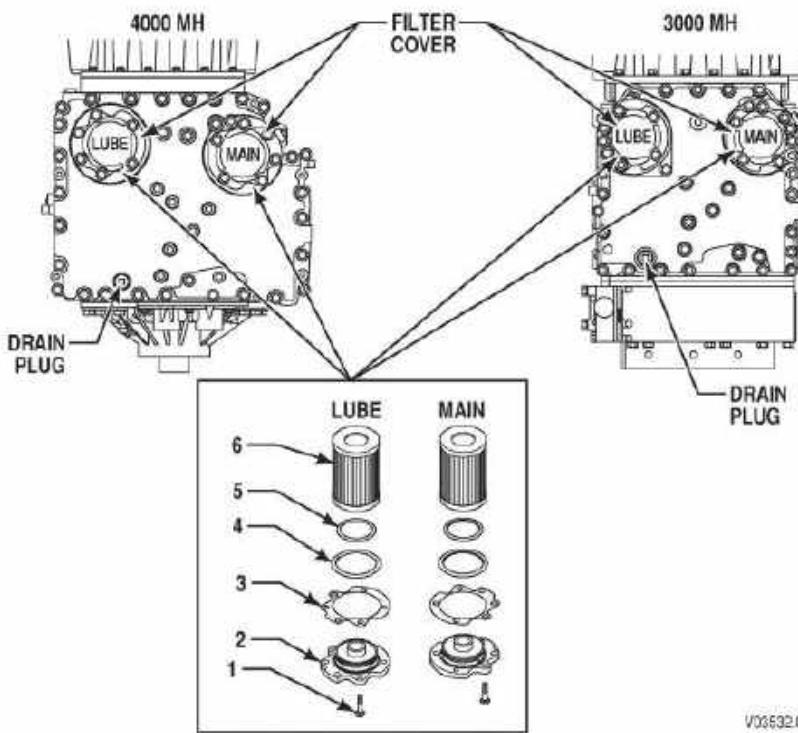


Figure 5–9. Location of Filters for Service

3. Install filter and cover assemblies into the filter compartment. Align each filter/cover assembly with the holes in the channel plate/sump. Push the cover assemblies in by hand to seat the seals.
4. Install 12 bolts into cover and tighten to 51–61 N·m (38–45 lb ft).
5. Replace the drain plug O-ring. Install the plug and tighten to 25–32 N·m (18–24 lb ft).

5.9.9.4 REFILL TRANSMISSION

Refer to [5.7 TRANSMISSION FLUID REFILL](#).

RUGGED DUTY SERIES

6.0 DIAGNOSTICS

6.1 OVERVIEW

Diagnostic features are provided with the transmission control system to assist in troubleshooting of malfunctions and/or the monitoring of specific operating parameters. When a control system malfunction is detected, a series of Diagnostic Trouble Codes (DTCs) are used to identify and clarify the nature of the malfunction. These DTCs are each named by a 5 character alphanumeric string that refers to a diagnostic algorithm running pass/fail tests to help identify a malfunction in the transmission or vehicle operation. Most DTCs have some kind of diagnostic response that the operator notices, such as an illuminated **CHECK TRANS** light, selector display change, lock in range, or inhibit shifts condition.

DTCs are logged in the Transmission Control Module (TCM) memory by severity and by their active/inactive status with the most severe and active codes listed first. A maximum of five DTCs (numbered d1–d5) from most recent to oldest may be read from the shift selector. As DTCs are added, the oldest inactive DTC (historic) is dropped from the list. If all DTCs are active, the DTC with the lowest priority is dropped from the list.

An active code is any code that is current in the TCM decision-making process and has failed the DTC test(s) associated with that specific diagnostic algorithm. Historical codes, which are by definition inactive, are codes that are no longer failing their algorithm but are retained in the TCM in order to help the technician analyze possible causes and provide them direction if the vehicle is brought in before they are cleared from the queue.

DTCs can be cleared manually by the operator or they clear automatically from last (d5) to first (d1) in the queue after a number of engine starts, without becoming active again.

6.2 DIAGNOSTIC TROUBLE CODE RESPONSE

The electronic control system is programmed to inform the operator of a problem with the transmission system via the **CHECK TRANS** light and shift

selector display while it automatically takes action to protect the operator, vehicle, and transmission. When the Transmission Control Module (TCM) flags a Diagnostic Trouble Code (DTC) as active, the TCM may take a combination of diagnostic responses as listed in the table below. Refer to [Table 6–1](#).

Table 6–1. Diagnostic Trouble Code (DTC) Response

Category of Response	Actions Taken
Do Not Shift (DNS)	Release lockup (LU) clutch and inhibit LU operation
	Inhibit shifts from the current attained range
	Turn on the CHECK TRANS light
	Display the current attained range in the MONITOR window of the shift selector
	Blank the SELECT window of the shift selector
	Disable ability for shift selectors to respond to any range change request from the operator using the shift selector(s).
Solenoids OFF (SOL OFF)	All solenoids are commanded off resulting in hydraulic default operation of the transmission - PCS1 and PCS2 are on hydraulically when off electrically.
Return to Previous Range (RPR)	When speed sensor ratio or PS1 tests do not pass, the TCM commands the same range as commanded before the shift.
Neutral No Clutches (NNC)	When certain speed sensor ratio or PS1 tests do not pass, the TCM commands a neutral condition with no clutches applied.
Do Not Adapt (DNA)	The TCM stops adaptive shift control while the code is active.

6.2.1 CHECK TRANS LIGHT. Each time the engine is started, the **CHECK TRANS** light illuminates briefly for a bulb check. After a few seconds it should turn off. If the **CHECK TRANS** light does not illuminate briefly after the ignition is turned on, or if the **CHECK TRANS** light remains steadily on after ignition and engine start, have the vehicle and transmission system checked by a qualified Allison Transmission technician.

If the **CHECK TRANS** light is steadily illuminated due to an active DTC, the shift selector blanks the SELECT and only shows a range the transmission has locked into in the MONITOR window of the selector, seek immediate attention from a qualified Allison Transmission technician. Perform service as soon as possible in order to minimize the potential for damage to the

transmission or vehicle. The transmission can be operated for a short time in the current attained range in order to get the vehicle to a safe location for service assistance. If the vehicle engine is turned off, prepare for the possibility that at engine restart the transmission may be locked in **N** (Neutral) and will not accept operator requests to change range if a DTC that causes a **CHECK TRANS** light is active at time of engine restart.



NOTE: Some DTCs may be logged without the TCM activating the **CHECK TRANS** light. Contact your Allison Transmission authorized service outlet whenever there is a transmission-related concern. They have the equipment to access and troubleshoot DTCs.

6.3 USING SHIFT SELECTOR FOR ACCESSING DIAGNOSTICS INFORMATION

6.3.1 INTERPRETING DTC MESSAGE SEQUENCE ACROSS SELECTOR DISPLAYS. Up to five DTCs may be displayed from the selector once the diagnostic display mode has been initiated by the operator (refer to [6.3.3 READ/CLEAR DIAGNOSTIC TROUBLE CODES \(DTCs\) USING LEVER SHIFT SELECTOR](#), and [6.3.4 READ/CLEAR DIAGNOSTIC TROUBLE CODES \(DTCs\) USING KEYPAD PUSHBUTTON SHIFT SELECTOR](#)).

DTCs are seven characters in length and are displayed in four character strings. Three of the four character strings consist of two characters. The first position in the character string is one character in length and it is the code type, designated by a P or U.

Each character string displays for 1-2 seconds in a sequential pattern in the selector display until the DTC completes the message cycle. The message continues to repeat itself until the operator presses the **MODE** button to read the next DTC in the queue (if any) or requests to exit diagnostics mode (refer to [6.3.3.4 EXITING DIAGNOSTIC MODE USING LEVER SHIFT SELECTOR](#) and [6.3.4.4 EXITING DIAGNOSTIC MODE USING KEYPAD PUSHBUTTON SHIFT SELECTOR](#)). The diagnostics mode times out and returns the selector to normal operating mode after approximately 10 minutes of operator inactivity.

The first two characters in the first string displays the position of the DTC in the queue, d1 (newest) through d5 (oldest). The next five characters that display in the selector define the DTC.

The following example illustrates the method for displaying any DTC stored in the queue. In this example we have the newest code, d1, as it would appear in the selector display for DTC P2534:

Table 6–2. Displaying DTC P2534 Stored in the Queue

RANGE SELECT WINDOW	RANGE MONITOR WINDOW
d*	1*
(blank display)	P**
2***	5***
3****	4****

* d1 Code list position (Note: d1=newest code, d5=oldest code in memory)

** Code type

*** Main code

**** Sub code

- d1; P; 25; 34 repeats until the next DTC (d2) is accessed by pressing the **MODE** button or when the operator exits diagnostic display mode.



NOTE: The **MODE** indicator on the selector, (refer to [Figure 3–1](#)), will be illuminated simultaneously with the display of the DTC. If the DTC is currently active, the **MODE** indicator is not illuminated then the DTC is inactive (historic). Inactive DTCs will not inhibit or limit transmission performance. Only active DTCs limit transmission performance. The inactive codes kept in the queue for reference to assist with troubleshooting an intermittent problem.

The next example shows the display of DTC U0115 which is next in the queue (d2), after the operator pressed the **MODE** button.

Table 6–3. Displaying DTC U0115 Stored in the Queue

RANGE SELECT WINDOW	RANGE MONITOR WINDOW
d*	2*
(blank display)	U**
0***	1***
1****	5****

* d2 Code list position (Note: d1=newest code, d5=oldest code in memory)

** Code type

*** Main code

**** Sub code

- d2; U; 01; 15 repeats until the next DTC (d3) is accessed by pressing the **MODE** button or when the operator exits diagnostic display mode.

Refer to [6.3.4.4 EXITING DIAGNOSTIC MODE USING KEYPAD PUSHBUTTON SHIFT SELECTOR](#).

6.3.2 MEANING OF MODE INDICATOR IN DIAGNOSTIC MODE. If the **MODE** indicator is illuminated (refer to [Figure 3–1](#)), while reading DTCs out of the selector display, the displayed DTC is active. If the **MODE** indicator is not illuminated, the displayed DTC is inactive (historic).



NOTE: An illuminated **MODE** indicator while driving the vehicle does not mean there is an active DTC, this means a secondary shift schedule, typically an economy shift schedule, is active.

6.3.3 READ/CLEAR DIAGNOSTIC TROUBLE CODES (DTCs) USING LEVER SHIFT SELECTOR.

6.3.3.1 READING DTCs WITH PROGNOSTICS ON USING LEVER SHIFT SELECTOR

- To read DTCs with prognostics on using the lever shift selector, press the **DISPLAY MODE/DIAGNOSTIC (DMD)** button five times to enter diagnostic mode.
- Press the **MODE** button to read the next DTC in the queue, if any.



NOTE: For 4700 RDS transmission retarder models, press the **MODE** button four times.

6.3.3.2 READING DTCs WITH PROGNOSTICS OFF USING LEVER SHIFT SELECTOR

- To read DTCs with prognostics off using the lever shift selector, press the **DISPLAY MODE/DIAGNOSTIC (DMD)** button two times to enter diagnostic mode.
- Press the **MODE** button to read the next DTC in the queue, if any.



NOTE: For 4700 RDS transmission retarder models, press the **MODE** button once.



NOTE: Be sure to record all displayed DTCs before they are cleared. This is essential for troubleshooting.

6.3.3.3 CLEARING DTCs USING LEVER SHIFT SELECTOR

While in diagnostic mode, clear all active DTCs by pressing and holding the **MODE** button for approximately three seconds until the **MODE** indicator

flashes. Release the **MODE** button. The **MODE** indicator should not remain illuminated if the active DTC shown in the display has cleared.

To clear all stored DTCs that are stored in TCM history, press and hold the **MODE** button for ten seconds. The **MODE** indicator flashes a second time indicating all codes are cleared from the queue.



NOTE: Any codes that cause the **CHECK TRANS** light to illuminate are considered severe enough to warrant immediate attention from a qualified repair facility. Schedule repair as soon as possible.



NOTE: If an active DTC is cleared while the transmission is locked in range because of the diagnostic response to an active DTC, the transmission remains in that locked range even after clearing the active DTC. **N** (Neutral) must be manually selected or the ignition must be cycled.



NOTE: Some codes will self-clear once the conditions that caused the active code are not present, they will still be stored as inactive in the DTC queue. Some DTCs require an ignition cycle before they can be cleared from active status.



NOTE: If the condition(s) that caused the active code are still present, the code becomes active again.

6.3.3.4 EXITING DIAGNOSTIC MODE USING LEVER SHIFT SELECTOR

The operator can request to exit the diagnostic mode by one of the following methods:

- Momentarily press the **MODE** button once
- Moving the lever shift selector to any range
- Automatically leaves diagnostic mode after approximately ten minutes of operator inactivity at the lever shift selector, returning the lever shift selector back to a normal operating mode

6.3.4 READ/CLEAR DIAGNOSTIC TROUBLE CODES (DTCs) USING KEYPAD PUSHBUTTON SHIFT SELECTOR.

6.3.4.1 READING DTCs WITH PROGNOSTICS ON USING KEYPAD PUSHBUTTON SHIFT SELECTOR

- To read DTCs with prognostics on using the keypad pushbutton shift selector, simultaneously press the ↑ (Upshift) and ↓ (Downshift) arrows five times to enter diagnostic mode.
- Press the **MODE** button to read the next code in the queue, if any.



NOTE: For 4700 RDS transmission retarder models, press the **MODE** button four times.

6.3.4.2 READING DTCs WITH PROGNOSTICS OFF USING KEYPAD PUSHBUTTON SHIFT SELECTOR

- To read DTCs with prognostics off using the keypad pushbutton shift selector, simultaneously press the ↑ (Upshift) and ↓ (Downshift) arrows two times to enter diagnostic mode.
- Press the **MODE** button to read the next code in the queue, if any.



NOTE: For 4700 RDS transmission retarder models, press the **MODE** button once.



NOTE: Be sure to record all DTCs displayed before they are cleared. This is essential for troubleshooting.

6.3.4.3 CLEARING DTCs USING KEYPAD PUSHBUTTON SHIFT SELECTOR

While in diagnostic mode, clear all active codes by pressing and holding the **MODE** button for approximately three seconds until the **MODE** indicator flashes. Release the **MODE** button. The **MODE** indicator should not remain illuminated if the active DTC shown in the display has cleared.

To clear all stored DTCs press and hold the **MODE** button for ten seconds. The **MODE** indicator flashes a second time indicating all codes are cleared from the queue.



NOTE: Any codes that cause the **CHECK TRANS** light are considered severe enough to warrant immediate attention from a qualified repair facility. Schedule repair as soon as possible.



NOTE: If an active indicator is cleared while the transmission is locked in range because of the diagnostic response to an active DTC, the transmission remains in that locked range even after clearing the active indicator. **N** (Neutral) must be manually selected or the ignition must be cycled.



NOTE: Some codes will self-clear once the conditions that caused the active code are not present, they will still be stored as inactive in the DTC queue. Some DTCs require an ignition cycle before they can be cleared from active status.



NOTE: If the condition(s) that caused the active code are still present, the code becomes active again.

6.3.4.4 EXITING DIAGNOSTIC MODE USING KEYPAD PUSHBUTTON SHIFT SELECTOR

The operator can request to exit the diagnostic mode by one of the following methods:

- Momentarily press the ↑ (Upshift) and ↓ (Downshift) arrows once
- Press any range button, **D** (Drive), **N** (Neutral), **R** (Reverse)
- Automatically exits diagnostic mode and returns to normal operating mode after approximately 10 minutes of operator inactivity at the pushbutton shift selector.

6.3.4.5 DIAGNOSTIC TROUBLE CODE (DTC) LIST AND DESCRIPTION

Table 6–4. Diagnostic Troubleshooting Codes (DTC) and Descriptions

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
C1312	Retarder Request Sensor Failed Low	No	May inhibit retarder operation if not using J1939 datalink

Table 6–4. Diagnostic Troubleshooting Codes (DTC) and Descriptions (cont'd)

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
C1313	Retarder Request Sensor Failed High	No	May inhibit retarder operation if not using J1939 datalink
P0122	Pedal Position Sensor Low Voltage	No	Use default throttle values. Freezes shift adapt.
P0123	Pedal Position Sensor High Voltage	No	Use default throttle values. Freezes shift adapt.
P0128	Transmission Fluid Over Temperature	No	Use hot mode shift schedule. Holds fourth range. TCM is inhibited. Freezes shift adapt.
P0602	TCM Not Programmed	Yes	Lock in Neutral
P0610	TCM Vehicle Options (TransID) Error	Yes	Use TID A calibration
P0613	TCM Processor	No	All solenoids off
P0614	Torque Control Data Mismatch—ECM/TCM	Yes	Allows operation only in reverse and second range
P0634	TCM Internal Temperature Too High	Yes	SOL OFF (hydraulic default)
P063E	Auto Configuration Throttle Input Not Present	Yes	Use default throttle values
P063F	Auto Configuration Engine Coolant Temp Input Not Present	No	None
P0658	Actuator Supply Voltage 1 (HSD1) Low	Yes	DNS, SOL OFF (hydraulic default)
P0659	Actuator Supply Voltage 1 (HSD1) High	Yes	DNS, SOL OFF (hydraulic default)
P0702	Transmission Control System Electrical (TransID)	Yes	Uses TID A calibration

Table 6–4. Diagnostic Troubleshooting Codes (DTC) and Descriptions (cont'd)

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P0703	Brake Switch Circuit Malfunction	No	No Neutral to Drive shifts for refuse packer. TCM inhibits retarder operation if a TPS code is also active.
P0708	Transmission Range Sensor Circuit High Input	Yes	Ignore defective strip selector inputs
P070C	Transmission Fluid Level Sensor Circuit—Low Input	No	None
P070D	Transmission Fluid Level Sensor Circuit—High Input	No	None
P0711	Transmission Fluid Temperature Sensor Circuit Performance	Yes	Use default sump temp
P0712	Transmission Fluid Temperature Sensor Circuit Low Input	Yes	Use default sump temp
P0713	Transmission Fluid Temperature Sensor Circuit High Input	Yes	Use default sump temp
P0716	Turbine Speed Sensor Circuit Performance	Yes	DNS, Lock in current range
P0717	Turbine Speed Sensor Circuit No Signal	Yes	DNS, Lock in current range
P0719	Brake Switch ABS Input Low	No	TCM assumes ABS is OFF
P071A	RELS Input Failed On	Yes	Inhibit RELS operation
P071D	General Purpose Input Fault	Yes	None
P0721	Output Speed Sensor Circuit Performance	Yes	DNS, Lock in current range
P0722	Output Speed Sensor Circuit No Signal	Yes	DNS, Lock in current range

Table 6–4. Diagnostic Troubleshooting Codes (DTC) and Descriptions (cont'd)

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P0726	Engine Speed Sensor Circuit Performance	No	Default to turbine speed
P0727	Engine Speed Sensor Circuit No Signal	No	Default to turbine speed
P0729	Incorrect 6 th Gear Ratio	Yes	DNS, Attempt 5 th , then 3 rd
P0731	Incorrect 1 st Gear Ratio	Yes	DNS, Attempt 2 nd , then 5 th
P0732	Incorrect 2 nd Gear Ratio	Yes	DNS, Attempt 3 rd , then 5 th
P0733	Incorrect 3 rd Gear Ratio	Yes	DNS, Attempt 4 th , then 6 th
P0734	Incorrect 4 th Gear Ratio	Yes	DNS, Attempt 5 th , then 3 rd
P0735	Incorrect 5 th Gear Ratio	Yes	DNS, Attempt 6th, then 3 rd , then 2 nd
P0736	Incorrect Reverse Gear Ratio	Yes	DNS, Lock in Neutral
P0741	Torque Converter Clutch System Stuck Off	Yes	None
P0776	Pressure Control Solenoid 2 Stuck Off	Yes	DNS, RPR
P0777	Pressure Control Solenoid 2 Stuck On	Yes	DNS, RPR
P0796	Pressure Control Solenoid 3 Stuck Off	Yes	DNS, RPR
P0797	Pressure Control Solenoid 3 Stuck On	Yes	DNS, RPR
P0842	Transmission Pressure Switch 1 Circuit Low	Yes	DNS, Lock in current range
P0843	Transmission Pressure Switch 1 Circuit High	Yes	DNS, Lock in current range
P0880	TCM Power Input Signal	No	None
P0881	TCM Power Input Signal Performance	No	None

Table 6–4. Diagnostic Troubleshooting Codes (DTC) and Descriptions (cont'd)

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P0882	TCM Power Input Signal Low	Yes	DNS, SOL OFF (hydraulic default)
P0883	TCM Power Input Signal High	No	None
P0894	Transmission Component Slipping	Yes	DNS, Lock in first
P0960	Pressure Control Solenoid Main Mod Control Circuit Open	Yes	None
P0962	Pressure Control Solenoid Main Mod Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0963	Pressure Control Solenoid Main Mod Control Circuit High	Yes	None
P0964	Pressure Control Solenoid 2 (PCS2) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P0966	Pressure Control Solenoid 2 (PCS2) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0967	Pressure Control Solenoid 2 (PCS2) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P0968	Pressure Control Solenoid 3 (PCS3) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P0970	Pressure Control Solenoid 3 (PCS3) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0971	Pressure Control Solenoid 3 (PCS3) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)

Table 6–4. Diagnostic Troubleshooting Codes (DTC) and Descriptions (cont'd)

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P0973	Shift Solenoid 1 (SS1) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0974	Shift Solenoid 1 (SS1) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P0975	Shift Solenoid 2 (SS2) Control Circuit Open	Yes	7-speed: Allow 2 through 6, N, R
P0976	Shift Solenoid 2 (SS2) Control Circuit Low	Yes	7-speed: Allow 2 through 6, N, R. Inhibit TCM operation
P0977	Shift Solenoid 2 (SS2) Control Circuit High	Yes	7-speed: Allow 2 through 6, N, R
P0989	Retarder Pressure Sensor Failed Low	No	None
P0990	Retarder Pressure Sensor Failed High	No	None
P1739	Incorrect Low Gear Ratio	Yes	Command 2 nd and allow shifts 2 through 6, N, R
P1891	Throttle Position Sensor PWM Signal Low Input	No	Use default throttle values
P1892	Throttle Position Sensor PWM Signal High Input	No	Use default throttle values
P2814	Engine Coolant Temperature Sensor Circuit Low Input	No	Use default engine coolant values
P2815	Engine Coolant Temperature Sensor Circuit High Input	No	Use default engine coolant values
P2637	Torque Management Feedback Signal (SEM)	Yes	Inhibit SEM
P2641	Torque Management Feedback Signal (LRTP)	Yes	Inhibit LRTP
P2670	Actuator Supply Voltage 2 (HSD2) Low	Yes	DNS, SOL OFF (hydraulic default)

Table 6–4. Diagnostic Troubleshooting Codes (DTC) and Descriptions (cont'd)

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P2671	Actuator Supply Voltage 2 (HSD2) High	Yes	DNS, SOL OFF (hydraulic default)
P2685	Actuator Supply Voltage 3 (HSD3) Low	Yes	DNS, SOL OFF (hydraulic default)
P2686	Actuator Supply Voltage 3 (HSD3) High	Yes	DNS, SOL OFF (hydraulic default)
P2714	Pressure Control Solenoid 4 (PCS4) Stuck Off	Yes	DNS, RPR
P2715	Pressure Control Solenoid 4 (PCS4) Stuck On	Yes	DNS, SOL OFF (hydraulic default)
P2718	Pressure Control Solenoid 4 (PCS4) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2720	Pressure Control Solenoid 4 (PCS4) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P2721	Pressure Control Solenoid 4 (PCS4) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P2723	Pressure Control Solenoid 1 (PCS1) Stuck Off	Yes	DNS, RPR
P2724	Pressure Control Solenoid 1 (PCS1) Stuck On	Yes	DNS, RPR
P2727	Pressure Control Solenoid 1 (PCS1) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2729	Pressure Control Solenoid 1 (PCS1) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)

Table 6–4. Diagnostic Troubleshooting Codes (DTC) and Descriptions (cont'd)

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P2730	Pressure Control Solenoid 1 (PCS1) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P2736	Pressure Control Solenoid 5 (PCS5) Control Circuit Open	Yes	Inhibit retarder operation
P2738	Pressure Control Solenoid 5 (PCS5) Control Circuit Low	Yes	Allow 2 through 6, N, R. Inhibit retarder and TCM operation
P2739	Pressure Control Solenoid 5 (PCS5) Control Circuit High	Yes	Inhibit retarder operation
P2740	Retarder Oil Temperature Hot	No	None
P2742	Retarder Oil Temperature Sensor Circuit—Low Input	No	Use default retarder temp values
P2743	Retarder Oil Temperature Sensor Circuit—High Input	No	Use default retarder temp values
P2761	TCC PCS Control Circuit Open	Yes	Inhibit TCM operation
P2763	TCM PCS Control Circuit High	Yes	Inhibit TCM operation
P2764	TCM PCS Control Circuit Low	Yes	7-speed: allow 2 through 6, N, R. Inhibit TCM operation
P278A	Kickdown Input Failed ON	No	Inhibit kickdown operation
P2793	Gear Shift Direction Circuit	Yes	Ignores PWM input from shift selector
P2808	Pressure Control Solenoid 6 (PCS6) Stuck Off	Yes	DNS, RPR
P2809	Pressure Control Solenoid 6 (PCS6) Stuck On	Yes	DNS, RPR

Table 6–4. Diagnostic Troubleshooting Codes (DTC) and Descriptions (cont'd)

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P2812	Pressure Control Solenoid 6 (PCS6) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2814	Pressure Control Solenoid 6 (PCS6) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P2815	Pressure Control Solenoid 6 (PCS6) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
U0001	Hi Speed CAN Bus Reset Counter Overrun (IESCAN)	No	Use default values, inhibit SEM
U0010	CAN BUS Reset Counter Overrun	No	Use default values, inhibit SEM
U0100	Lost Communications with ECM/PCM (J1587)	Yes	Use default values
U0103	Lost Communication With Gear Shift Module (Shift Selector) 1	Yes	Maintain range selected, observe gear shift direction circuit
U0115	Lost Communication With ECM	Yes	Use default values
U0291	Lost Communication With Gear Shift Module (Shift Selector) 2	Yes	Maintain range selected, observe gear shift direction circuit
U0304	Incompatible Gear Shift Module 1 (Shift Selector) ID	Yes	Ignore shift selector inputs
U0333	Incompatible Gear Shift Module 2 (Shift Selector) ID	Yes	Ignore shift selector inputs

Table 6–4. Diagnostic Troubleshooting Codes (DTC) and Descriptions (*cont'd*)

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
U0404	Invalid Data Received From Gear Shift Module (Shift Selector) 1	Yes	Maintain range selected, observe gear shift direction circuit
U0592	Invalid Data Received From Gear Shift Module (Shift Selector) 2	Yes	Maintain range selected, observe gear shift direction circuit

RUGGED DUTY SERIES

7.0 PROGNOSTICS SHIFT SELECTORS COMPONENTS AND FUNCTIONS

7.1 SELECT/MONITOR DISPLAY

A two-character vacuum fluorescent blue-green display is included on the face of each lever and keypad pushbutton shift selector. The left character, called the SELECT display appropriately designates **N** (Neutral), **R** (Reverse), or the highest gear available of the selected forward range. The right character of the display, called the MONITOR display, designates the actual gear being commanded by the TCM. The display of any other character in the SELECT or MONITOR display denotes a non-standard operating condition.

7.2 BACKLIGHTING

During normal vehicle operation, backlighting is provided for the range legend strip on the lever shift selector and for all six keypad buttons of the pushbutton shift selector.

The digital (range) display, the **MODE** and **RANGE** buttons are illuminated on the keypad pushbutton and lever shift selectors. The brightness of both is adjusted automatically, depending upon the brightness setting of the dash dimmer switch.



NOTE: The shift selector microprocessor, which controls the selector backlighting, is initialized by an ignition signal and not by power in the headlight circuit. Therefore, the shift selector backlighting and dimmer are functional only when both the headlights **and** the ignition are turned on.

When the headlights and dimmer are turned off, daylight conditions are assumed and the selector lighting is restored to full brightness.

If the selector is not wired into the dimmer circuit, the Digital Range Display is always at full brightness (as if the dash lights are off), but there is no backlighting for the **MODE** and **RANGE** buttons. When illuminated, the

TRANS SERVICE (shown as a wrench icon) indicator on the shift selector is at full brightness.

7.3 MODE BUTTON

The **MODE** button is located on the bezel face of the lever or keypad pushbutton shift selector. The button can be pressed anytime after engine start to activate the alternate shift schedule or special function.

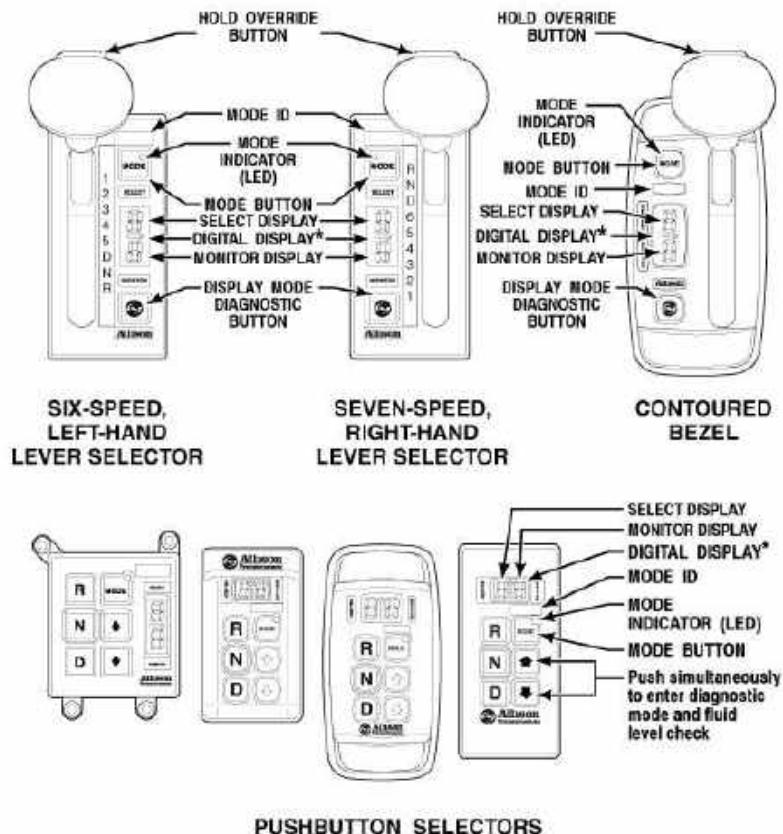
The **MODE** button performs the following functions:

- Activates a special function programmed into the TCM, which is typically an alternate ECONOMY or PERFORMANCE shift schedule
- Toggles to the next DTC while in DTC display mode
- Clears (erases) active and inactive DTCs from TCM memory.



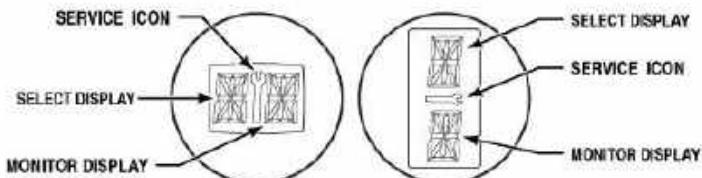
NOTE: DTCs cannot be cleared individually. All active DTCs clear first, followed by the inactive (historic) DTCs, provided the **MODE** button is pressed long enough while in the DTC display mode. Refer to [6.0 DIAGNOSTICS](#) for information and the procedure on reading and clearing (erasing) DTCs.

A MODE ID is located near the **MODE** button to identify the purpose associated with the **MODE** button selection. Refer to [Figure 7-1](#) for the location of the **MODE** button and MODE ID on a lever shift selector. These items are located in similar positions on all keypad pushbutton shift selectors.



*NOTE: The first number displayed in the digital display is the highest forward range available and second number is range attained in selected position.

Visually confirm that the range selected was attained. If display is flashing, shift is inhibited.



Location of service icon on vertical and horizontal digital display

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Figure 7–1. Typical Allison 4th Generation Prognostics Shift Selectors

7.4 MODE INDICATOR (LED)

A small red Light Emitting Diode (LED) located near the **MODE** button illuminates when an alternate shift schedule, such as ECONOMY or other programmed function, is activated.

This LED also illuminates while reading all active DTCs. Inactive (historic) DTCs do not light the **MODE** indicator when they are shown in the selector display window.



NOTE: Do not confuse the mode indicator lamp (red LED) with the **MODE** button. The **MODE** indicator displays mode function, active shift schedules or active, stored DTCs. Pushing on the indicator lamp thinking it is the **MODE** button may damage the LED.

7.5 TRANS SERVICE INDICATOR (WRENCH ICON)

The **TRANS SERVICE** (wrench icon) indicator illuminates in the event a service condition relating to a transmission clutch, fluid or filter life occurs. The **TRANS SERVICE** indicator is located between the **SELECT** and **MONITOR** displays on the shift selector display. Refer to [Figure 7-2](#).

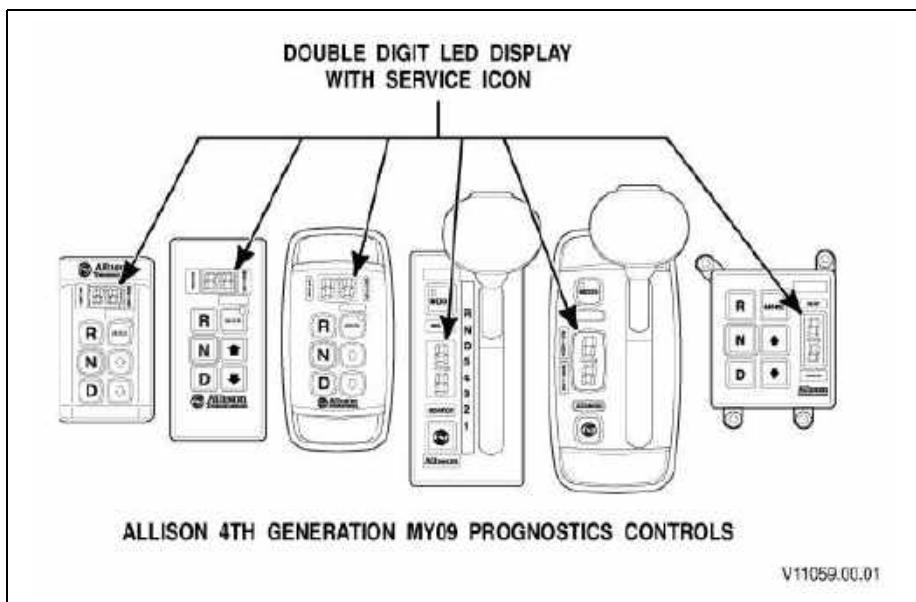


Figure 7-2. Typical Allison 4th Generation Prognostics Controls Shift Selectors with SELECT, MONITOR Digital Displays and Trans Service Indicator

For additional information regarding these conditions, refer to [5.9.6 OIL LIFE MONITOR \(OM\)](#), or [5.9.7 FILTER LIFE MONITOR \(FM\)](#), or [5.9.8 TRANSMISSION HEALTH MONITOR \(TM\)](#).

7.6 SELECTOR DISPLAY DESCRIPTIONS FOR ACTIVE DTCs AND INHIBITS

RANGE SELECT Blank: With an active DTC, the SELECT display on the shift selector is blank. The MONITOR display indicates the range in which the transmission is locked. The **CHECK TRANS** light is also activated. Refer to [6.0 DIAGNOSTICS](#).

RANGE SELECT Flashing: The flashing display indicates a requested shift is either temporarily or permanently inhibited. The inhibit may clear if the cause of the inhibit clears within 3 seconds of the shift request. Otherwise, the operator must re-select the desired range. Refer to [7.6 SELECTOR DISPLAY DESCRIPTIONS FOR ACTIVE DTCs AND INHIBITS](#).

Wrench Icon Illuminated: This indicator is only functional if prognostics are enabled in the TCM controls calibration. This indicator is illuminated upon the detection of a service issue relating to clutch, filter, or fluid life. The appearance of the indicator (lit steadily or flashing) varies for each of the conditions monitored by the system. Refer to [7.5 TRANS SERVICE INDICATOR \(WRENCH ICON\)](#).

All Segments Illuminated: If all segments of the display are on for more than 12 seconds, the TCM has not completed initialization. A DTC is associated with this condition. It is normal for all segments to illuminate for a brief time during initialization of the selector and controls.

SELECT/MONITOR BOTH BLANK: This condition indicates either a lack of power to the selector or the J1939 communication datalink has failed. Continuous blank indicates loss of power to the selector. If the blank display changes to a single or double cat-eye display, other conditions exist. Refer to cat-eye discussions below.

(|) Single Cat-Eye: This display indicates a selector fault other than loss of power and is always accompanied by a selector-related DTC. The single cat-eye is displayed in the SELECT location immediately after the fault is detected.

(|)(|) Double Cat-Eyes: This display indicates a failure of the J1939 communication link and is always accompanied by a DTC. The cat-eyes are illuminated in both the SELECT and MONITOR locations after approximately 12 seconds of blank display.



WARNING: Without the J1939 communication datalink, the shift selector cannot display the selected transmission range. Vehicle operation will be affected.

7.7 SELECTOR DISPLAY IS INOPERATIVE

In the event communication with the J1939 datalink is lost, limited communication between the TCM and the Allison keypad pushbutton and lever shift selectors continues through direction signal wire 134. This limited communication allows the operator to select **D** (Drive), **N** (Neutral), or **R** (Reverse) in order to get the vehicle to a service location. Operator requests for range upshifts and downshifts will not be recognized, and the shift selector display will not display the selected transmission range due to the lack of a J1939 datalink signal.



WARNING: Assuming proper installation of direction signal wire 134, most Allison shift selectors may still be used to command transmission direction changes in these circumstances. Due to the failure of the J1939 datalink communication, however, the shift selector cannot display the selected range. When this condition exists, it is advisable to slowly and carefully apply the throttle each time a change of direction has been selected in order to verify the direction of operation before accelerating the vehicle. This feature is not available with "strip pushbutton" shift selector models.

7.8 LEVER SHIFT SELECTOR

The Allison lever shift selector (refer to [Figure 3-1](#)) is an electromechanical control that has three locked positions to prevent accidentally selecting **R** (Reverse), **N** (Neutral), or **D** (Drive).

Lever shift selector positions are:

- **R** (Reverse)
- **N** (Neutral)
- **D** (Drive)
- Some number of lower forward range positions

The lever shift selector positions should agree with the number of ranges programmed in the Transmission Control Module (TCM).

In addition to the features listed in [7.0 PROGNOSTICS SHIFT SELECTORS COMPONENTS AND FUNCTIONS](#), the lever shift selector also includes the following features:

- **HOLD OVERRIDE:** The **HOLD OVERRIDE** button is a finger-controlled button integrated into the top and front side of the lever shift selector knob. This button uses a detent feature with three locked positions to prevent accidental range selection. Press the **HOLD OVERRIDE** button to release the detent and move the lever from the locked position. Once **D** (Drive) is selected, lower forward range positions may be selected without pressing the **HOLD OVERRIDE** button.
- **DISPLAY MODE/DIAGNOSTIC (DMD):** The DMD button, when pressed, allows access to fluid level information, prognostics information, and DTC information, depending on how many times it was pressed. Refer to [Figure 3–1](#) and [Table 4–1](#).

7.9 KEYPAD PUSHBUTTON SHIFT SELECTOR

The Allison keypad pushbutton shift selector (refer to [Figure 3–1](#) and [Table 4–1](#)) has six buttons on the keypad that cause the following transmission operations to occur:

- **R:** Press to select reverse
- **N:** Press to select neutral
- **D:** Press to select drive
- **↑ (Upshift) arrow:** Press to select the next higher forward range
- **↓ (Downshift) arrow:** Press to select the next lower forward range
- **MODE:** Multi-functional use. Refer to [7.3 MODE BUTTON](#)

The **↑ (Upshift)** and **↓ (Downshift)** arrows are only functional while in a forward range, and not in **N** (Neutral) or **R** (Reverse).

Pressing both the **↑ (Upshift)** and **↓ (Downshift)** arrows simultaneously when the transmission is in Neutral invokes requests for reading oil level, prognostics information or DTCs. Refer to [7.0 PROGNOSTICS SHIFT SELECTORS COMPONENTS AND FUNCTIONS](#) and [7.9 KEYPAD PUSHBUTTON SHIFT SELECTOR](#). If the transmission is locked in range due to an active DTC, the system still allows the operator to review the DTC in the selector with simultaneous button presses on the **↑ (Upshift)** and **↓ (Downshift)** arrows even though the transmission is not in **N** (Neutral).

Conditions which illuminate the **CHECK TRANS** light disable the shift selector. The SELECT display is blank and the MONITOR display shows the

range actually attained. For a detailed explanation, refer to [6.2.1 CHECK TRANS LIGHT](#).

RUGGED DUTY SERIES

8.0 CUSTOMIZING CONTROLS AND TCM PROGRAMMING

8.1 VEHICLE AND TRANSMISSION SIGNAL INTERFACE OVERVIEW

This section describes the vehicle interface connections to the transmission controls and transmission signals. The vehicle interfaces discussed in this section may be provided through a SAE J1939 vehicle communications interface and include:

- **CHECK TRANS** indicator
- Wrench Icon. Used for Prognostics features for needed scheduled transmission maintenance
- **RANGE INHIBITED** or **RANGE INHIBIT** indicator
- Neutral Start
- Speedometer signal
- Reverse Warning
- Anti-Lock Brake System (ABS) status
- Service Brake status
- Retarder Modulation signals (if equipped)
- Engine Water Temperature signal
- Range Request signals
- Other miscellaneous Transmission Input/Output (I/O) signals that control Auxiliary Vehicle functions by using either discrete electrical signals, J1939 messages, or a combination of both

8.2 INPUT AND OUTPUT FUNCTIONS OVERVIEW

Input and Output (I/O) functions are built into each transmission control system to allow additional functional controls of specialized transmissions

and/or auxiliary vehicle operations that are tailored for the expected vocation of the vehicle.

Control signals are generally needed by each I/O function to work. These control signals, known as inputs, may be a combination of the following:

- Discrete analog switched signal voltages or switched-to-ground signals that control the on/off state of the needed input(s) that in turn allow the enabled I/O function to switch to on or off. Each input(s) must be wired to the correct vehicle circuits and the correct TCM pins through the correct OEM supplied switches, relays, connectors, and other components as needed.
- Various vehicle controller datalink messages from various controllers on the vehicle communications datalink such as, SAE J1939, and/or SAE J1708/J1587.
- Use of monitored vehicle and/or transmission data such as, temperatures, various speeds, and specific range attained that are then compared with program limits and CMC parameters within the TCM to turn the I/O function on and off.

Various combinations of these I/O functions are assembled into I/O packages. One or many I/O packages may exist in any specific I/O group. The I/O group is contained in your TCM as part of its calibration and software for the exact vocation of your vehicle. This strategy allows the vehicle OEM(s) maximum flexibility for choosing which I/O functions and discrete input circuits, labeled by wire number and TCM pin assignments, they want to control the I/O functions on your vehicle. To provide flexibility to the OEM(s) and customer, specific discrete input circuits to specific TCM pins vary between vocations and I/O packages and groups, even when the packages are contained within the same I/O group.

The calibration of each TCM, which also contains the programming of how your I/O is configured by the group and package, was selected for your vehicle by your vehicle OEM. To fit a customers exact I/O requirement for their vehicle it may be necessary for the TCM to have individual I/O functions or packages re-programmed, or possibly recalibrate the TCM, for a different I/O group. Most often reprogramming I/O with the Allison DOC® For PC—Service Tool is all that is needed. However, you will have to take your vehicle to a qualified technician if you need to determine what I/O has been enabled or disabled by your OEM, body builder, or service location. A qualified Allison or OEM technician can download and review your calibration information within the “I/O Wires Report” Section that is part of “Diagnostic Reports” contained in the Allison DOC® For PC—Service Tool. Your vehicle I/O or body builder should be consulted as well for information such as wiring diagrams, regarding how individual I/O functions were integrated in your vehicle.

Allison Transmission I/O information is also available as a separate publication in Fourth Generation Electronic Controls I/O Group and Package Info Sheets. The publication number is IO4105EN. This publication discusses various groups, packages, and wire numbers associated with specific vocations and related I/O functions. Purchase information is included for you at the Publications menu of www.allisontransmission.com. Browse by keyword or publication number or it may be ordered from an Allison service outlet.

Additionally, you may consult the Vocational Model Guide, SA3748, for more I/O information. This publication is available for free download from the Publications menu of www.allisontransmission.com. Browse by keyword or publication number.



NOTE: At the customer's request, and usually at the customer's expense, an Allison Service Outlet can:

- Run a report showing the present vehicle I/O configuration
- Enable/disable different I/O features and set the related CMC(s)
- Calibrate the TCM in order to get a new group with different I/O packages

Proper chassis wiring and connectors, switches, relays, lamps, indicators, datalink messages, and CMC(s) must all be integrated into the vehicle and verified to be working properly before a newly programmed I/O feature or function works. If components for I/O functions are not integrated correctly in the vehicle, some of the enabled I/O features can inhibit the transmission from going to range or cause active DTCs.



NOTE: All feature-related components must be integrated in the vehicle build prior to enabling the I/O feature. Features listed as "Not Enabled" must be enabled by Allison reprogramming-certified personnel.

8.3 CONTROLS SYSTEM OVERVIEW

The Allison 4th Generation Controls system provides the functional control for Allison transmissions. The transmission control system consists of the components shown in [Figure 8-1](#) for the 3000 and 4000 Product Families.

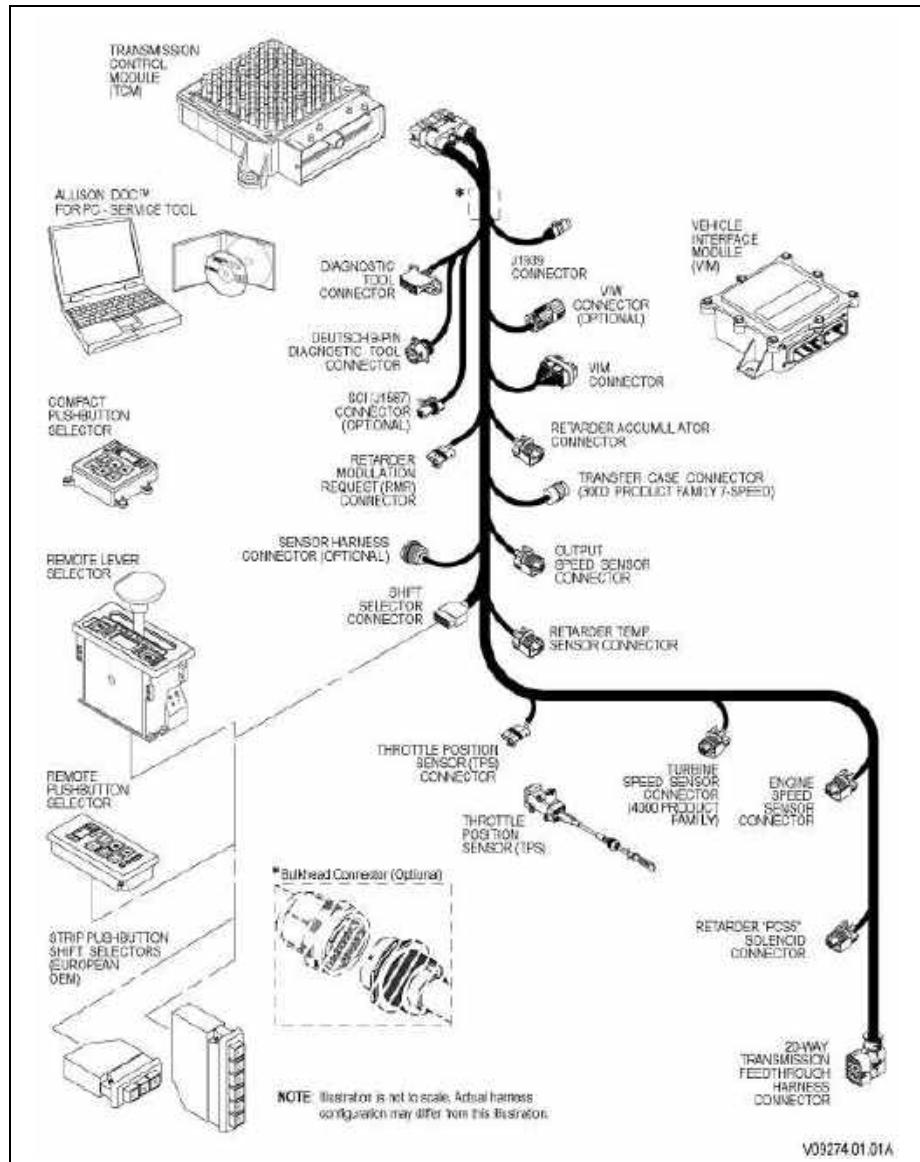


Figure 8–1. Typical Allison 4th Generation Controls Components

8.4 TRANSMISSION CONTROL MODULE (TCM) HARDWARE DESCRIPTION

Harness Connector- the TCM interfaces to your vehicle harness with one connector and uses an 80-pin connector interfaced to the vehicle harness. Refer to [Figure 8-1.](#)

TCM Power Requirements- TCM models A51, A52 and A53 are offered to the OEM(s) for the 3000 and 4000 Product Families transmissions. All A51 and A52 TCM configurations are compatible with 12-volt vehicle electrical systems. However, the A53 Max-Feature TCM is also compatible with a 24-volt vehicle electrical systems. See your vehicle dealer if you need assistance in determining which TCM is installed in your vehicle.



NOTE: Allison electronic controls are designed and manufactured to comply with all FCC and other guidelines regarding radio frequency interference/electromagnetic interference (RFI/EMI) for transportation electronics. Manufacturers, assemblers, and installers of radio-telephone or two-way communication radios have the sole responsibility to correctly install and integrate those devices into Allison transmission-equipped vehicles to the customer's satisfaction.

8.5 TRANSMISSION CONTROL MODULE (TCM) PROGRAM AND CALIBRATION OVERVIEW

The TCM program includes the basic logic and algorithms which command all of the various elements of transmission operation. The program is an integral element of the TCM structure and is defined as having a specific software level.

The TCM calibration includes all of the variables pertaining to the specific vehicle in which the TCM will be installed. Each calibration is based on input from the vehicle manufacturer and, once compiled, must be downloaded into the TCM to make it operational. Refer to [4.2 SHIFT SCHEDULES AND AUTOMATIC RANGE SHIFTS](#), for additional information regarding the shift calibration.

Functional control of the transmission results from the integration of the calibration data sets with the elements of the software program, in conjunction with the following:

- Matching TCM software to transmission hardware (Trans ID). Refer to [8.6 TRANSMISSION IDENTIFICATION \(TID\) WIRE](#).
- Automatic detection of other features (Autodetect). Refer to [8.7 AUTODETECT](#).

- Adaptive shifting. Refer to [8.8 ADAPTIVE SHIFTING](#).
- Transmission and controls diagnostics. Refer to [6.0 DIAGNOSTICS](#).
- Transmission prognostics. Refer to [7.0 PROGNOSTICS SHIFT SELECTORS COMPONENTS AND FUNCTIONS](#).
- Communication via vehicle datalinks. Refer to [7.6 SELECTOR DISPLAY DESCRIPTIONS FOR ACTIVE DTCs AND INHIBITS](#).
- Shift inhibits. Refer to [4.1.3 SELECTOR DISPLAY FLASHING \(INHIBITS\)](#).
- Control of the retarder. Refer to [4.3 USING THE HYDRAULIC RETARDER](#).

8.6 TRANSMISSION IDENTIFICATION (TID) WIRE

Using data transmitted over wire 176, the Trans ID feature assists the Transmission Control Module (TCM) in identifying the build generation of the transmission and subsequent selection of a shift calibration appropriate for that level of transmission hardware. Generally, TCM(s) with newer versions of the software may be matched with transmission hardware originally released with an earlier version of the software, as long as both are in the Allison 4th Generation Controls family. Trans ID will not permit an Allison 4th Generation TCM to control a transmission configured for an earlier-generation control system; nor will a controller from an earlier-generation control system function with transmission hardware configured for Allison 4th Generation Controls. If a calibration for the identified level of transmission hardware does not exist in the TCM, a DTC is set.

8.7 AUTODETECT

The Autodetect software feature automatically detects the presence of transmission components or input signals, thus permitting the use of different features or input signals with a common TCM. Autodetect checks for the presence of a valid input signal denoting the presence of each of the features listed. Diagnostic functions relating to each of these items are executed if the feature is detected and used. Refer to [Table 8-1](#) for the presence of the following transmission components or data inputs.

Table 8-1. Transmission Components or Data Inputs.

Retarder	Present, Not Present
Oil Level Sensor (OLS)	Present, Not Present

Table 8–1. Transmission Components or Data Inputs. (cont'd)

Throttle ^a	Analog, J1587, J1939
Engine Coolant Temperature	Analog, J1587, J1939

^a A pulse width modulated (PWM) throttle source is not “autodetected.” This source requires a unique calibration or can be manually selected using Allison DOC® For PC—Service Tool.

8.8 ADAPTIVE SHIFTING

Adaptive shifting is a basic design feature of the shift controls which optimizes shift quality. This is accomplished by frequent monitoring of critical characteristics in the clutch engagement process and making continuous adjustments to certain characteristics which improve subsequent shifts.

The transmission shift calibration is based on several different types of shifts, such as full throttle, part throttle, closed throttle, upshifts, and downshifts. Each shift is associated with specific speed and throttle position parameters. To optimize each type of shift for normal driving, it is necessary for the shift controls to have experienced operation and shifting in a wide variety of operating conditions. A drive-in period under various driving conditions is required before the adaptive controls can be expected to optimize each and every shift. You should begin to see shift quality converge to the adapted level after five shifts of a particular shift type.

8.9 COMMUNICATION THROUGH VEHICLE DATALINKS

All Transmission Control Modules (TCMs) are capable of communicating with other vehicle systems over an SAE J1939 datalink. Some TCM models are also capable of communication using an SAE J1587 datalink or an International Standard Organization (ISO) 9141 communication link protocol. If the engine is electronically controlled, throttle position data may be communicated from the engine controls to all TCM models over the SAE J1939 datalink. TCM models A52 and A53 are also capable of communication using the SAE J1587 protocol.

SAE J1587 capability is only available with 3000 and 4000 Product Families transmission using TCM models A52 and A53. SAE J1587 does not support the display of prognostics information. Check with your vehicle OEM or Allison Transmission distributor or dealer for the capabilities of the TCM in your vehicle or if you need assistance in determining the datalink types available for your vehicle.

8.10 INFORMATION DISPLAYS

The OEM may supply and install a remote display for use in displaying transmission status and service information broadcast over the vehicle datalink. Such information may include the transmission range selected, transmission range attained, sump temperature indicator, prognostic information, and DTCs. If the display is reading on the J1587 datalink, the display of transmission prognostics information is not supported. Refer to [7.6 SELECTOR DISPLAY DESCRIPTIONS FOR ACTIVE DTCs AND INHIBITS](#).

8.11 SHIFT INHIBITS

When necessary, the transmission control system automatically activates an inhibit to protect against certain types of abusive operation. For example:

- **Engine speed inhibit:** prevents an attempt to shift the transmission from N (Neutral) to either a forward range or reverse if the engine speed is above 1260 rpm.



NOTE: There is no shift inhibit detection of high output speed/high throttle position for EVS calibrations.

RUGGED DUTY SERIES

9.0 EXTERNAL WIRE HARNESES, VEHICLE INTERFACE MODULE, AND RETARDER CONTROLS

9.1 WIRE HARNESES



NOTE: The external harness connecting transmission controls is part of the vehicle chassis harness and typically will not have an Allison Transmission part number. The harness parts are usually only available through the vehicle manufacturer and their vendors. Check with the OEM or dealer first to determine their wire harness service parts availability. Any Allison distributor or dealer can assist with determining serviceability of the external harness as well. The internal transmission harness inside the transmission is an Allison part and only available from an Allison distributor or dealer.

The transmission controls require the use of wiring harnesses to connect the various system components, including:

- Transmission Control Module (TCM)
- Main connector on the transmission
- Engine speed sensor on the transmission
- Turbine speed sensor on the transmission (4000 Product Families)
- Transmission output speed sensor on the transmission
- Serial communication datalink
- Shift selector
- Diagnostic connector
- Retarder controls (if equipped)
- Vehicle interface wiring
- Throttle Position Sensor (TPS) (only with mechanically controlled engines)

- Optional Vehicle Interface Module (VIM)

All wiring harnesses and connectors which mate to Allison connectors/components are typically supplied and installed by the vehicle manufacturer. Harnesses may consist of a single piece, or may be divided into multiple segments joined by bulkhead connectors.

9.2 VEHICLE INTERFACE MODULE (VIM)

The VIM contains relays and fuses necessary to interface the transmission controls with the vehicle wiring system. When ordering the VIM, specify 12 or 24 volts to properly match the vehicle electrical system.

In some cases, the OEM or body builder may choose not to use the Allison VIM. In these cases, the OEM must specify and install components which provide a proper interface between vehicle wiring and the transmission control system.

9.3 RETARDER CONTROLS

In order to meet the needs of operators in a wide variety of applications, vocations, and vehicle configurations, several retarder apply systems are offered for transmission models in the Allison 3000 and 4000 Product Families.

Certain types of apply systems may not be recommended for specific vocations. For example, factors such as retarder performance that may not be appropriate for the class or vehicle type or difficulty in installation. However, there are typically two or more apply types available for most vehicles.

In addition to the standard analog controls approach, the possible integration of the retarder with numerous other vehicle systems through a common SAE J1939-based vehicle controller creates additional design flexibility when determining methods of potential operator control of the transmission retarder.

The Transmission Control Module (TCM) must be calibrated to the proper method to ensure desired retarder operation. Operator controls of the retarder can be accomplished by either of the following methods:

- **Both Analog and J1939.** Input is based on a Retarder Enable switch for activation, plus one or more Allison Retarder Modulation Request (RMR) components to select the desired level of retardation. In addition, retardation is requested or limited based on messages from an SAE J1939-based vehicle controller.
- **J1939 Only.** Retardation is requested or limited based on messages from an SAE J1939-based vehicle controller.

The analog components that can be used with the 3000 and 4000 Product Families retarder are available from Allison Transmission. These components provide control over retarder operation and include various types of retarder operator and vehicle interface controls. Some of the available operator controls, known also as Retarder Modulation Request (RMR) devices include:

- Foot pedal
- Hand lever
- Automatic apply at closed throttle
- Apply integrated with service brakes
- One-step, two-step or three-step applies

Refer to [Table 4–3](#) for the various types of retarder controls available.

The retarder apply system does not actuate the retarder directly. The driver uses the retarder operator controls to request a desired level of retardation, ranging from none, up to the maximum available from the specific retarder/transmission configuration in use. The TCM processes the request in conjunction with other input data which defines the current operating status of the transmission and vehicle. The TCM turns the retarder on at the requested level when conditions are appropriate for retarder operation.

Refer to [4.3 USING THE HYDRAULIC RETARDER](#) for additional information about the retarder controls, retarder performance, and retarder usage.

RUGGED DUTY SERIES

10.0 TRANSMISSION COMPONENTS

10.1 TORQUE CONVERTER

The torque converter multiplies engine torque and transfers smooth, uninterrupted power to the wheels quickly. The torque converter consists of these four components:

- Pump—input element driven directly by the engine
- Turbine—output element hydraulically driven by the pump
- Stator—reaction (torque multiplying) element
- Lockup Clutch—mechanically couples the pump and turbine when commanded by the Transmission Control Module (TCM).

When the pump turns faster than the turbine and the stator is stationary, the torque converter is multiplying torque. When the turbine approaches the speed of the pump, the stator starts to rotate with the pump and turbine. When this occurs, torque multiplication stops and the torque converter functions as a fluid coupling. The lockup clutch is located inside the torque converter and consists of the following components:

- Piston and backplate—driven by the engine
- Clutch plate/damper (located between the piston and the backplate)—splined to the converter turbine

The lockup clutch/torsional damper is engaged and released in response to electronic signals from the TCM. Lockup clutch engagement provides a direct drive from the engine to the transmission input. This eliminates converter slippage and maximizes fuel economy and vehicle speed. The lockup clutch releases at lower speeds or when the TCM detects conditions requiring it to be released.

The torsional damper tries to absorb engine torsional vibration in an attempt to prevent transmitting engine torsional vibration on through to transmission components (clutches, etc), or items bolted to the transmission.

10.2 PLANETARY GEARS AND CLUTCHES

A series of three helical, constant mesh planetary gear sets and shafts provides the mechanical gear ratios and direction of travel for the vehicle. The planetary gear sets are controlled by five multi-plate clutches that work in pairs to produce up to six forward speeds and one reverse speed. The clutches are applied and released hydraulically in response to electronic signals from the Transmission Control Module (TCM) to the appropriate solenoids.

10.3 COOLER CIRCUIT

The transmission fluid is cooled by an integral (transmission-mounted) or remote-mounted oil cooler. Connections to the cooling circuit are located at the front or rear of the transmission to facilitate installation of remote cooler lines. On retarder models, only the rear cooler ports may be used. The integral cooler is mounted on the lower rear portion of the transmission, replacing the remote cooler manifold. Integral cooler oil ports are internal requiring coolant to be routed to and from the cooler.

10.4 RETARDER

The self-contained retarder is at the output of the transmission and consists of a vaned rotor which rotates in a vaned cavity. The rotor is splined to and driven by the output shaft. When the retarder is activated, the fluid in the accumulator is displaced into the retarder cavity. The pressurized fluid in the cavity acting against the rotating and stationary vanes causes the retarder rotor and output shaft to reduce speed, slowing the vehicle or limiting speed on a downhill grade. Refer to [4.3 USING THE HYDRAULIC RETARDER](#) for additional information. When the retarder is deactivated, the retarder cavity is evacuated and the accumulator is recharged with fluid.

The retarder housing also allows the addition of either a remote or integral cooler for transmission sump fluid in addition to retarder out fluid. A bypass cover is placed over the sump cooling ports when the provision is not used. The sump cooler ports are located on the lower right rear face of the retarder housing. Refer to [Figure 2–3](#), [Figure 2–4](#), [Figure 2–5](#) and [Figure 2–6](#).

10.5 CONTROL VALVE MODULE

The 3000 and 4000 Product Family Transmission control valve module is bolted to the transmission main housing, and contain the main and lube filters. The control valve module also contains a main valve body assembly and solenoid valve body assembly. The Transmission Control Module (TCM) issues commands that actuate the range clutch solenoids to govern fluid

flow to the commanded range clutches and lockup clutch contained in the torque converter.

The control valve module contains the following components:

- Various valves and valve bodies controlling and routing hydraulic pressure to the rest of the transmission
- Range clutch and lockup clutch solenoids
- Diagnostic valve, valve body, and diagnostic pressure switch
- Main filter life indicator valve, valve body, and filter life pressure switch
- Turbine speed sensor (3000 Product Family only)
- Sump temperature sensor

10.6 TRANSMISSION SPEED SENSORS

Three speed sensors are integral to the transmission assembly. The speed sensors provide the transmission input speed, converter turbine speed, and transmission output speed signals to the Transmission Control Module (TCM). For the specific location of the speed sensors, refer to [Figure 2–3](#), [Figure 2–4](#), [Figure 2–5](#), and [Figure 2–6](#).

The transmission input speed sensor is located on the converter housing and the transmission output speed sensor is located on the output housing. Both speed sensors require connection to the wiring harness.

The mounting provision for the turbine speed sensor differs between the transmission model families:

- For transmission models in the 3000 Product Families, the turbine speed sensor is internal to the transmission and does not require an external connection
- For transmission models in the 4000 Product Families, the turbine speed sensor is external to the transmission and requires connection to the wiring harness

RUGGED DUTY SERIES

11.0 GENERAL GUIDELINES

11.1 WELDING ON VEHICLE

Observe the following precautions when welding on the vehicle:

- Disconnect the wiring harnesses from the Transmission Control Module (TCM).
- Disconnect the TCM power and ground circuits from the battery, and any electronic control ground wires connected to the frame or chassis.
- Do not connect welding cables to electronic control components.
- Do not weld on electronic control components.
- Cover electronic control components and wiring to protect them from hot sparks, heat, etc.

11.2 PAINTING ON VEHICLE

11.2.1 ELECTROSTATIC PAINTING. If the vehicle chassis or body is painted using an electrostatic painting process, electrical voltage must not be discharged through the Transmission Control Module (TCM). To prevent this possibility, Allison recommends installing the TCM after the electrostatic paint process is complete. If the TCM is installed prior to electrostatic painting, make sure:

- the TCM is not painted.
- the elements being painted are properly and continuously grounded during the entire painting process.



NOTE: Allison Transmission is not responsible for TCM damage resulting from improper grounding during electrostatic painting of the vehicle.

During electrostatic painting, the paint droplets receive an electrostatic charge attracting them to be grounded surfaces. Voltages at the spray gun can exceed several thousand volts. The charge which builds up on an improperly

grounded chassis or body can be discharged through the TCM, resulting in damage to the TCM.

11.2.2 PAINTING OF TRANSMISSION CONTROL COMPONENTS. While it may be desirable to paint chassis-mounted components in order to enhance the overall vehicle appearance and/or provide corrosion protection, the transmission control components **must not** be painted. Painting transmission control components can:

- compromise the integrity of connectors and connector seals.
- reduce thermal conductivity from inside the TCM to ambient air.
- cover labels or other identification, hindering the process to service these components.

11.3 ENVIRONMENT

Allison Transmission designed the Allison controls and components to operate in normal vehicle cab and chassis environments. The Allison controls and components can withstand moisture, direct light, heat, and shock loads. The Transmission Control Module (TCM), Allison shift selectors and their connectors are sealed, but are not considered immersible. Installation of the Allison controls and components must meet the environmental requirements in Allison 4th Generation Controls Data. In addition, mount the Allison controls and components away from direct exposure to road hazards and weather. In order to meet the temperature limits listed in Allison 4th Generation Controls Data, allow for free air movement around each component. The air movement dissipates heat away from the components. Exceeding the temperature limits reduces the life of the components.

11.4 COMPONENT ACCESS REQUIREMENTS

Access to service the controls and components is necessary throughout the life of the vehicle. Consider service access to transmission components when installing auxiliary vehicle controls and components, including the effort required to remove covers, body parts, or chassis members to gain access to the transmission component(s) being serviced.

RUGGED DUTY SERIES

12.0 CUSTOMER SERVICE

12.1 ORDERING PARTS

12.1.1 TRANSMISSION NAMEPLATE. The nameplate (refer to [Figure 12–1](#)) is located on the right side of the transmission and is imprinted with the following:

- Transmission model (for Specialty Series vocational models)
- Serial number
- Date code
- TransID number
- Engineering groups (for Specialty Series vocational models)

Use all of these numbers when ordering replacement parts or requesting service information.

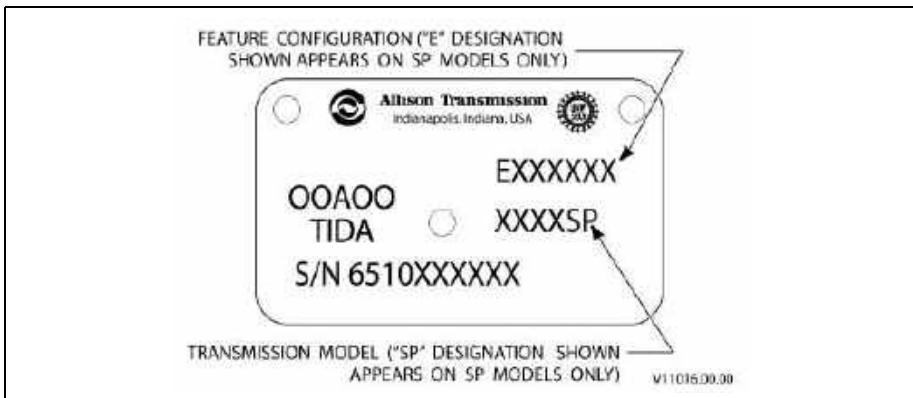


Figure 12–1. Transmission Nameplate

12.1.2 GENUINE PARTS. Allison Transmission recommends that only Allison genuine parts be used in an Allison transmission. Order all replacement parts from an authorized distributor or dealer. Service outlets can be located on the Allison Transmission web site at www.allisontransmission.com. Additionally, distributors and dealers are listed in the yellow pages under Transmission - Truck, Tractor, Etc.".

12.2 OWNER ASSISTANCE

The satisfaction and goodwill of the owners of Allison transmissions are of primary concern to Allison Transmission, its distributors, and their dealers.

As an owner of an Allison transmission, you have service locations throughout the world that are eager to meet your parts and service needs with:

- Expert service by trained personnel.
- Emergency service 24 hours a day in many areas.
- Complete parts support.
- Sales teams to help determine your transmission requirements.
- Product information and literature.

Normally, any situation that arises in connection with the sale, operation, or service of your transmission will be handled by the distributor or dealer in your area. Check the telephone directory for the Allison Transmission service outlet nearest you or use Allison Transmission's Sales and Service Locator tool on the Allison Transmission web site at www.allisontransmission.com. You may also refer to Allison Transmission's Worldwide Sales and Service Directory (SA2229EN).

We recognize, however, that despite the best intentions of everyone concerned, misunderstandings may occur. To further assure your complete satisfaction, we have developed the following three-step procedure to be followed in the event a problem has not been handled satisfactorily.

Step One—Discuss your problem with a member of management from the distributorship or dealership. Frequently, complaints are the result of a breakdown in communication and can be resolved quickly by a member of management. If you have already discussed the problem with the Sales or Service Manager, contact the General Manager. All Allison Transmission dealers are associated with an Allison Transmission distributor. If the problem originates with a dealer, explain the matter to a management member of the distributorship with whom the dealer has his service agreement. The dealer will provide his Allison Transmission distributor's name, address, and telephone number on request.

Step Two—When it appears the problem cannot be readily resolved at the distributor level without additional assistance, **contact the Allison Technical Assistance Center at 800-252-5283**. They will place you in contact with the Regional Customer Support Manager for your area.

For prompt assistance, please have the following information available:

- Name and location of authorized distributor or dealer.
- Type and make of vehicle/equipment.
- Transmission model number, serial number, and assembly number (if equipped with electronic controls, also provide the Transmission Control Module (TCM) assembly number).
- Transmission delivery date and accumulated miles and/or hours of operation.
- Nature of problem.
- Chronological summary of your transmission's history.

Step Three—If you are still not satisfied after contacting the Regional Customer Support Manager, **present the entire matter to the Home Office by writing to the following address:**

Allison Transmission
Manager, Warranty Administration
PO Box 894, Mail Code PF9
Indianapolis, IN 46206-0894

The inclusion of all pertinent information will assist the Home Office in expediting the matter.

When contacting the Home Office, please keep in mind that ultimately the problem will likely be resolved at the distributorship or dealership using their facilities, equipment, and personnel. Therefore, it is suggested that **Step One** be followed when experiencing a problem.

Your purchase of an Allison Transmission product is greatly appreciated, and it is our sincere desire to assure complete satisfaction.

12.3 SERVICE LITERATURE

Additional service literature is available. Allison service literature provides fully illustrated instructions for the operation, maintenance, service, overhaul, and parts support of your transmission. To be sure that you get maximum performance and service life from your unit, you may order publications from an Allison Transmission distributor or www.allisontransmission.com/publications/.

12.4 ALLISON TRANSMISSION DISTRIBUTORS



NOTE: For a complete and up-to-date listing of Allison Transmission Service Centers, go to www.allisontransmission.com/locator/

EASTERN REGION

Atlantic Detroit Diesel-Allison, LLC
19 C Chapin Road
Pine Brook, NJ 07058
973-575-0309

Covington Power Services
8015 Piedmont Triad Parkway
Greensboro, NC 27409
336-292-9240

Detroit Diesel-Allison Canada East
Attn: Div. of Integrated Power
Systems Corp.
2997 Avenue (rue) Watt
Quebec, Quebec G1X 3W1
418-651-5371

Florida Detroit Diesel-Allison, Inc.
2277 N.W. 14th Street
Miami, FL 33125-0068
305-638-5300

Harper Power Products, Inc
10 Diesel Drive
Toronto, Ontario M8W 2T8
416-259-3281

Johnson & Towers, Inc.
2021 Briggs Road
Mount Laurel, NJ 08054
856-234-6990

New England Detroit Diesel-Allison,
Inc.
90 Bay State Road
Wakefield, MA 01880-1095
781-246-1810

Penn Detroit Diesel-Allison, LLC
8330 State Road
Philadelphia, PA 19136-2986
215-335-0500

Western Branch Diesel, Inc.
3504 Shipwright Street
Portsmouth, VA 23703
757-673-7000

W.W. Williams S.E., Inc.
3077 Moreland Avenue
Conley, GA 30288
404-366-1070

CENTRAL REGION

Central Power Systems & Services,
Inc.
9200 Liberty Drive
Liberty, MO 64068
816-781-8070

Clarke Power Services, Inc.
3133 East Kemper Road
Cincinnati, OH 45241
513-771-2200

Inland Power Group, Inc.
13015 West Custer Avenue
Butler, WI 53007-0916
262-781-7100

Interstate PowerSystems, Inc.
2501 American Boulevard, East
Minneapolis, MN 55425
952-854-5511

Stewart & Stevenson Power
Products, LLC
1000 Louisiana, Suite 5900
Houston, TX 77002
713-751-2600

United Engines, LLC
5555 West Reno Street
Oklahoma City, OK 73127
405-947-3321

Waterous Power Systems (A Division
of Integrated Power Systems Corp.)
10025 – 51 Avenue
Edmonton, Alberta T6E OA8
780-437-8200

W.W. Williams M.W., Inc.
1176 Industrial Parkway, North
Brunswick, OH 44212-2342
330-225-7751

MEXICO REGION

Detroit Diesel-Allison de Mexico
S.A.de C.V.
Av. Santa Rosa No. 58 Col.
Ampliacion Norte
San Juan Ixtacala, Tlalnepantla C.P.
54160, Estado de Mexico
525-5-5333-1800

WESTERN REGION

ABC Transmissions, Ltd 9357 – 193rd Street Surrey, British Columbia V4N 4E7 604-888-1211	Stewart & Stevenson Power Products, LLC 5170 E 58th Place Commerce City, CO 80022 303-287-7441
Allison West 14775 Wicks Boulevard San Leandro, CA 94577-6779 510-351-6101	Valley Power Systems, Inc 425 South Hacienda Boulevard City of Industry, CA 91745-1123 626-333-1243
Pacific Power Products Company 7215 South 228th Street Kent, WA 98032 253-854-0505	W.W. Williams S.W., Inc. 2602 S. 19th Avenue Phoenix, AZ 85009 602-257-0561
Smith Power Products, Inc. 3065 West California Avenue Salt Lake City, UT 84104 801-415-5000	

NOTES

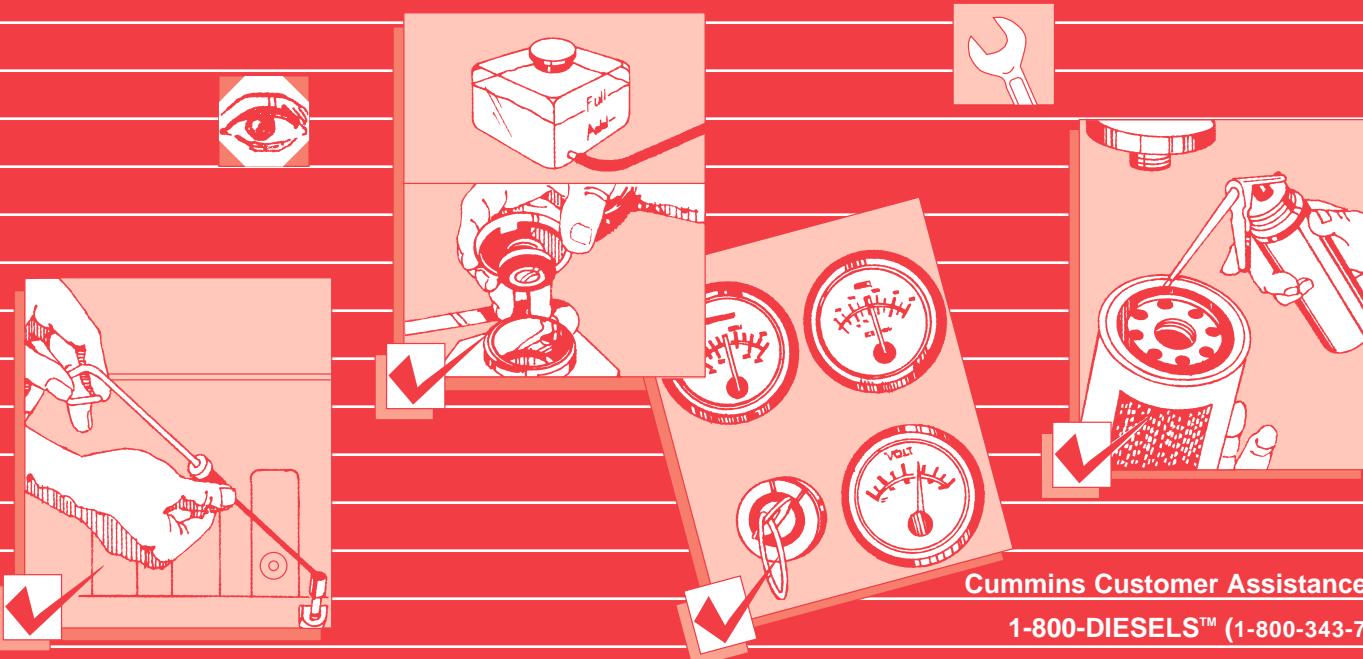
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Owners Manual

QSX15 Industrial and Power Generation Engines



Cummins Customer Assistance Center

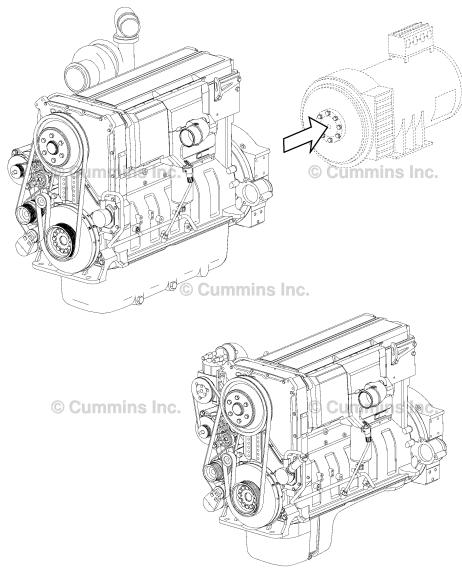
1-800-DIESELS™ (1-800-343-7357)

APPLICABLE ONLY IN U.S.A. AND CANADA



Owners Manual

QSX15 Industrial and Power Generation Engines



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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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Important Reference Numbers

Fill in the blank spaces provided below. This will provide a reference whenever service or maintenance is required.

Description	Number	Comments/Additional Information
Engine		
Engine Model		
Engine Serial Number (ESN)		
Control Parts List (CPL)		
Electronic Control Module (ECM) Part Number(s)		
Electronic Control Module (ECM) Serial Number(s)		
Governor Control Module (GCM) (if applicable)		
Belt Part Number(s)		
Filter Part Numbers:		
Air		
Lubricating Oil		
Fuel*		
Fuel (Water Separator)		
Coolant (if equipped)		
Crankcase/Breather (if equipped)		

To buy Cummins Parts and Service Manuals, Training Guides, or Tools go to our website at <https://store.cummins.com>

Description	Number	Comments/Additional Information
Eliminator™ Filter Centrifuge (if equipped)		
*The number of fuel filters may vary by application. Record all fuel filters.		
Aftertreatment (if applicable):		
Aftertreatment Diesel Particulate Filter (if equipped)		
Aftertreatment Diesel Exhaust Fluid Dosing Unit Filter (if equipped)		
Aftertreatment Diesel Exhaust Fluid Dosing Air Oil Separator (if equipped)		
Clutch or Marine Gear (if applicable):		
Model		
Serial Number		
Part Number		
Oil Type		
Sea Water Pump:		
Model		
Part Number		

Section i - Introduction

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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.



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.



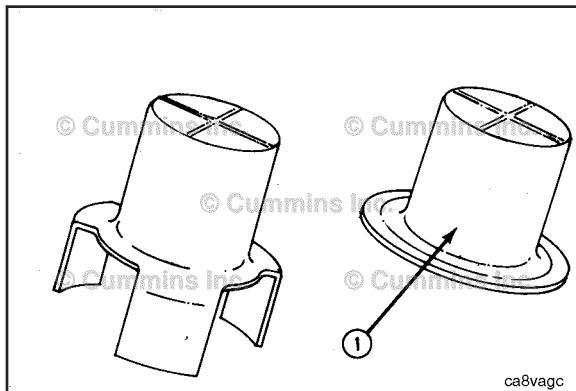
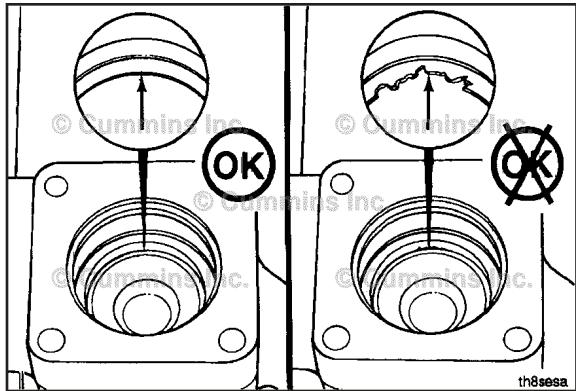
PERFORM an electrical **MEASUREMENT**.

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 petroleum 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 determined 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 Procedures

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.

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 Identifier
GVW	Gross Vehicle Weight
Hg	Mercury
hp	Horsepower
H₂O	Water
inHg	Inches of Mercury
in H₂O	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 E - Engine Identification

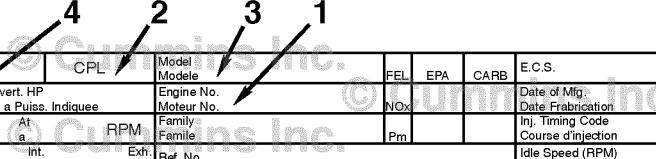
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Engine Identification

Engine Dataplate



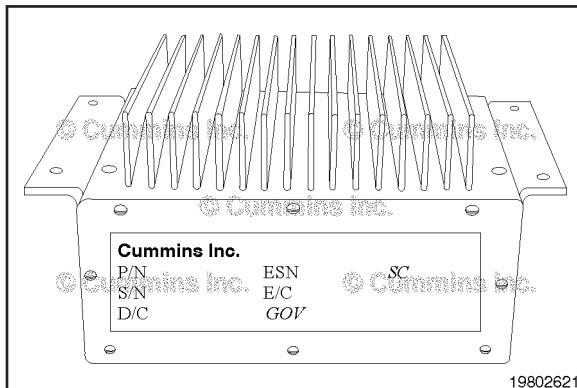
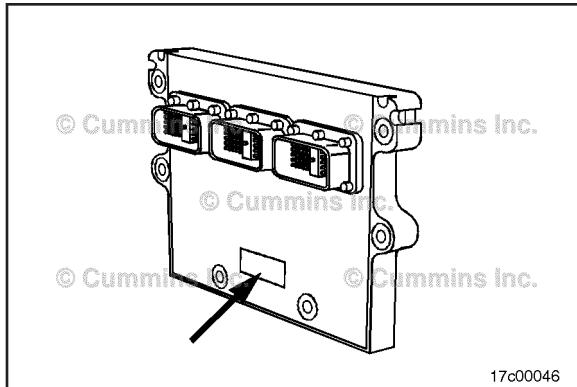
Engine Cert. ID	Displacement pouces	CPL	Model/Modèle	FEL	EPA	CARB	E.C.S.	 Made in U.S.A. 3412261
Certificat d'identité	Fuel Rail et Advert. HP Debit/combust. a Puiss. Indiquée		Engine No./Moteur No.	NOx			Date of Mfg. Date Fabrication	
Advertised HP Puiss. Indiquée (ch)	At a	RPM	Family/ Family	Pm			Inj. Timing Code Course d'injection	
Valve Lash Cold (mm) Jeux soupapes a Froid	Int. Adm.	Exh. Ech.	Ref. No.				Idle Speed (RPM) Vitesse Ralentie	

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The engine dataplate, located on top of the rocker lever cover, provides the model identification and other important data about the engine.

Have the following engine data available when communicating with a Cummins Authorized Repair Location. The data on the dataplate are **mandatory** when sourcing service parts:

1. Engine serial number (ESN)
2. Control parts list
3. Model
4. Advertised horsepower and rpm.



ECM Dataplate

Industrial Applications

The electronic control module (ECM) dataplate is located on the front of the ECM.

The abbreviations on the dataplate are explained as follows:

- P/N =Part number
- S/N = Serial number
- D/C = Data code.

Power Generation

The electronic control module (ECM) dataplate is located on the front of the ECM.

The abbreviations on the dataplate are explained as follows:

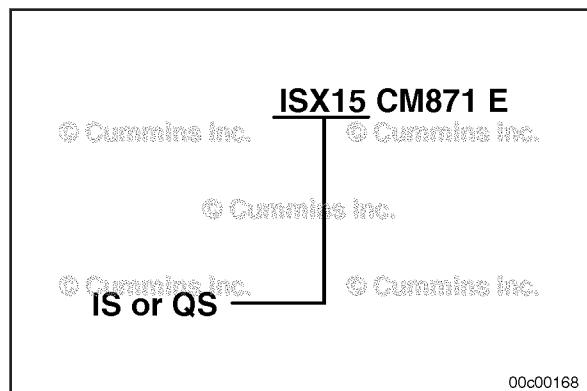
- P/N = Part number
- S/N = Serial number
- D/C = Date code.

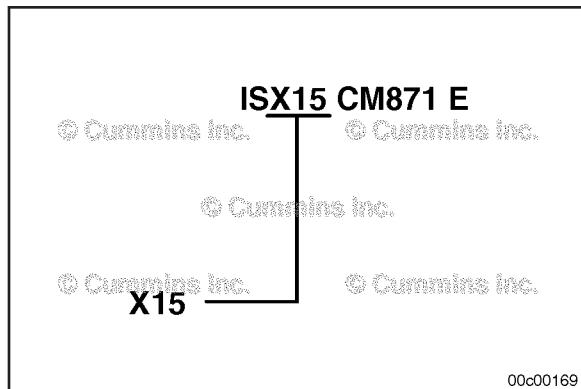
Cummins® Service Engine Model Product Identification

General Information

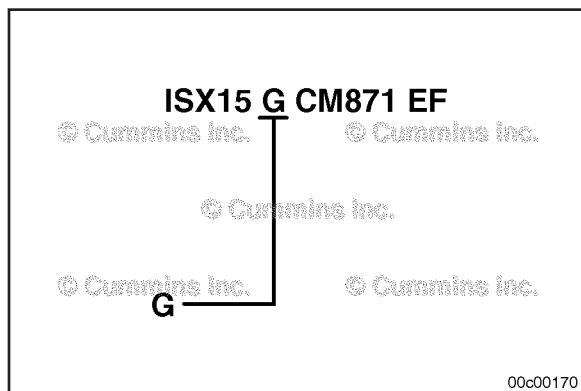
The Cummins® Service Engine Model Nomenclature procedure describes how engines are identified within Cummins service organization. This method was introduced for models after and including manufacture year 2007.

Electronic engines are identified by the first two letters, either an "IS" for On-Highway automotive or "QS" for Off-Highway industrial market applications.





The third letter is the engine platform designation followed by the engine liter size.



If the engine operates on a fuel type other than diesel, the type will be identified after the liter size.

The control system is identified with the letters "CM" followed by the control system model number.

ISX15 CM871 E

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CM871

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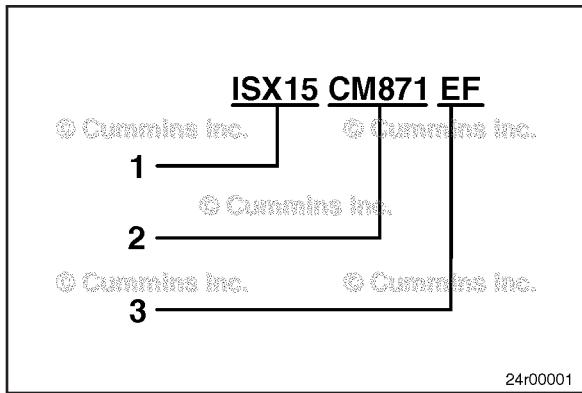
The technology identifier after the control system designates the prevailing technology used with the engine. (See table in this procedure for letter designations.)

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Example:

- 1 On-Highway automotive "X" 15 liter engine
- 2 Control system number 871
- 3 Technology supported; Electric EGR and Diesel Particulate Filter

Technology	Name	Suffix
Exhaust Gas Recirculation	Not used	None
	Pneumatic	P
	Electric	E
Diesel Particulate Filter (DPF)	Not used	None
	Full Flow DPF	F
	Partial Flow DPF	F2
Diesel Oxidation Catalyst	Not used	None
	DOC	C
3-Way Oxidation Catalytic Converter	Not used	None
	3-Way Catalyst	J
Selective Catalytic Reduction System	Not used	None
	Air Driven	S
	Airless	A
Nox Sensor	Not used	None
	Nox Sensor	N
Modular Common Rail System	Used only on QSK19, 38, 50 , 60 HHP Engines	MCRS
Integrated Dosing Control Unit	Not Used	None
	Integrated	I

Technology	Name	Suffix
Urea Quality Sensor	Not Used	None
	UQS	Q

Section 1 - Operating Instructions

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Operating Instructions - Overview



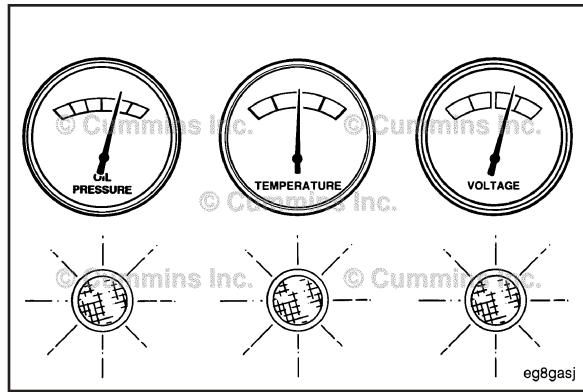
General Information

Correct care of your engine will result in longer life, better performance, and more economical operation.

Follow the daily maintenance checks listed in Maintenance Guidelines (Section 2).

The new Cummins® engine associated with this manual does **not** require a "break-in" procedure. This section of the manual provides all of the necessary information required for proper engine operation.

U.S. legislation requires that stationary compression ignition internal combustion engines designated for emergency use are limited to emergency operations and required maintenance and testing.



Check the oil pressure indicators, temperature indicators, warning lights, and other gauges daily to make sure they are operational.

Check the oil pressure, coolant temperature, and other engine parameters daily via the OEM front panel to make sure they are operational. Check the panel regularly for any alarm messages. Take appropriate action to rectify the alarm condition or contact your nearest Authorized Cummins® Distributor.

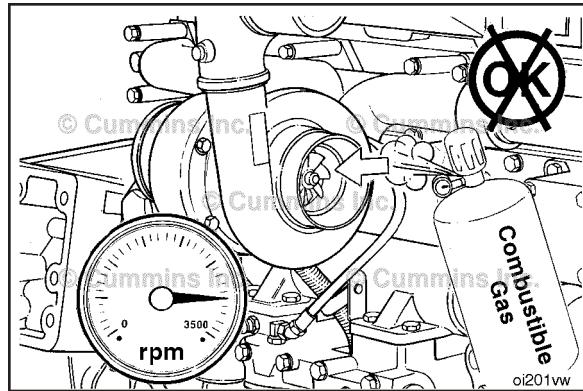
⚠ WARNING ⚠

Do not operate a diesel engine where there are or can BE COMBUSTIBLE vapors. These vapors can be sucked through the air intake system and cause engine acceleration and over speeding that can result in a fire, an explosion, and extensive property damage. Numerous safety devices are available, such as air intake shutoff devices, to minimize the risk of over speeding where an engine, due to its application, is operating in a combustible environment, such as due to a fuel spill or gas leak. Remember, Cummins Inc. has no way of knowing the use you have for your engine. The equipment owner and operator ARE responsible for safe operation in a hostile environment. Consult A Cummins® Authorized Repair Location for further information.

⚠ CAUTION ⚠

Do not expose the engine to corrosive chemicals. Corrosive chemicals can damage the engine.

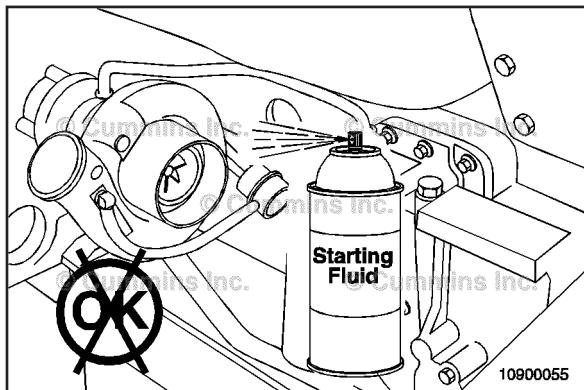
Cummins recommends the installation of an air intake shutoff device or a similar safety device to minimize the risk of overspeeding when an engine is operating in a combustible environment, such as due to a fuel spill or gas leak.



Cold Weather Starting

General Information

Follow the Normal Starting Procedure in this section. In cold weather, the engine can run longer at idle but **only** until the minimum specified oil pressure is detected by the engine control module (ECM).



Using Starting Aids

Cold weather starting aids are available for the engine. Contact a Cummins® Authorized Repair Location for more information.

Starting Procedure After Extended Shutdown or Oil Change

General Information

Follow the Normal Starting Procedure in this section. The engine will run at idle **only** until the minimum specified oil pressure is detected by the engine control module (ECM).

Normal Starting Procedure

General Information

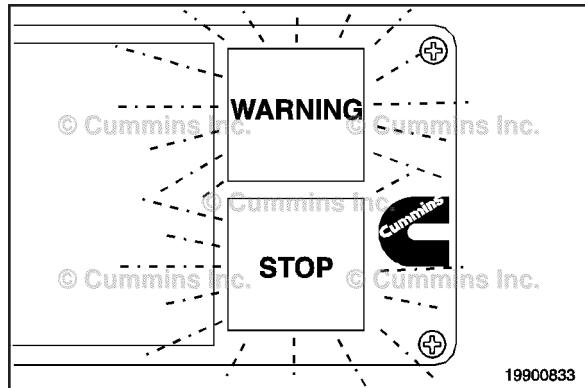
The STOP or STOP ENGINE lamp is red and indicates the need to stop the engine as soon as it can be safely done. The engine **must** then remain shut down until it can be repaired.

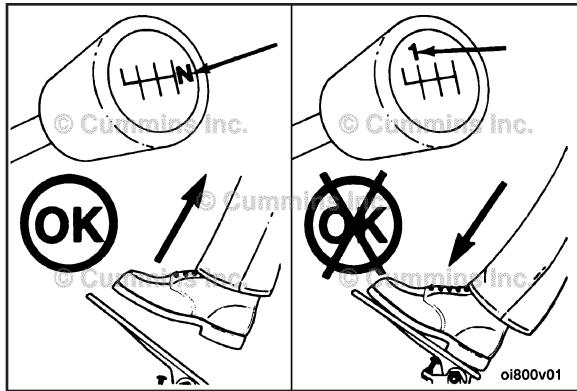
The WARNING or CHECK ENGINE lamp is yellow. When it illuminates, the engine is in need of repair at the first available opportunity.

The yellow lamp will flash for 30 seconds at keyswitch ON when one of the following occurs:

- Maintenance required (if Maintenance Monitor is enabled)
- Water-in-fuel is detected
- Low coolant level.

If the warning light flashes for 30 seconds at keyswitch ON and water is drained from the suction side water-separating fuel filter, the pressure side fuel filter **must** be replaced.





CAUTION

Do not depress the accelerator pedal or move the accelerator lever from the idle position while cranking the engine. This can result in engine overspeed and severe damage to the engine.

CAUTION

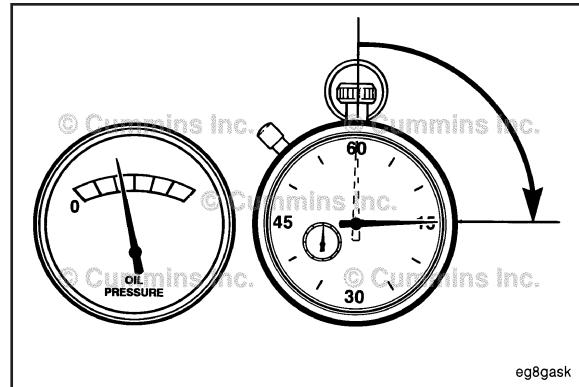
To prevent damage to the starting motor, do not engage the starting motor for more than 30 seconds. Wait 2 minutes between each attempt to start (electrical starting motors only).

NOTE: Engines equipped with air starting motors require a minimum of 480 kPa [70 PSI] air pressure.

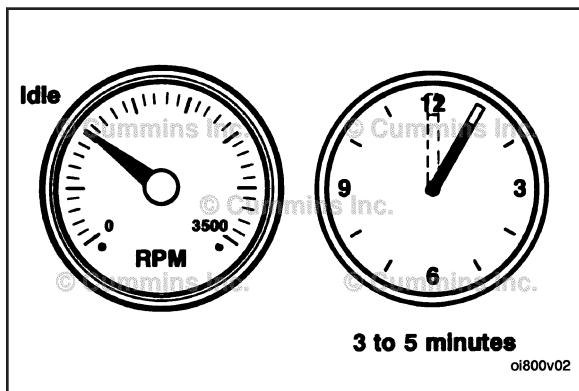
- Disengage the driven unit, or if equipped, put the transmission in neutral.
- With the accelerator pedal or lever in the idle position, turn the keyswitch to the ON position, then turn the keyswitch to the START position.
- If the engine does **not** start after three attempts, check the fuel supply system. Absence of blue or white exhaust smoke during cranking indicates no fuel is being delivered.

△CAUTION△

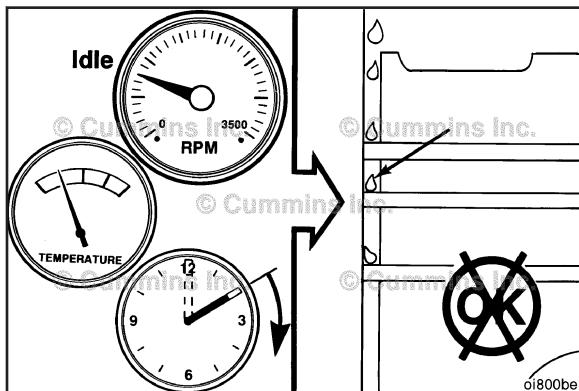
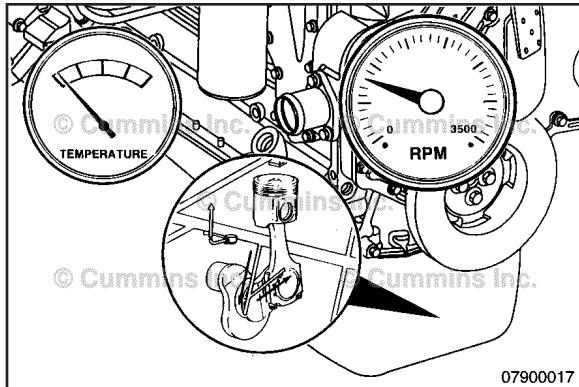
The engine must have adequate oil pressure within 15 seconds after starting. If the warning lamp indicating low oil pressure has not gone out or there is no oil pressure indicated on a gauge within 15 seconds, shut OFF the engine immediately to reduce the possibility of engine damage. The low oil pressure troubleshooting procedure is located in Troubleshooting Symptoms (Section TS).



Idle the engine 3 to 5 minutes before operating with a load.



Normal Starting Procedure
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Section 1 - Operating Instructions

After starting a cold engine, increase the engine speed (rpm) slowly to provide adequate lubrication to the bearings and to allow the oil pressure to stabilize.

CAUTION

Do not operate engine at low idle for long periods with engine coolant temperature below the minimum specification in Coolant Recommendations and Specifications (Section V). Low coolant temperature can result in:

- Fuel dilution of the lubricating oil
- Carbon buildup in the cylinder
- Cylinder head valve sticking
- Reduced performance.

Jump Starting



⚠️ WARNING ⚠️

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

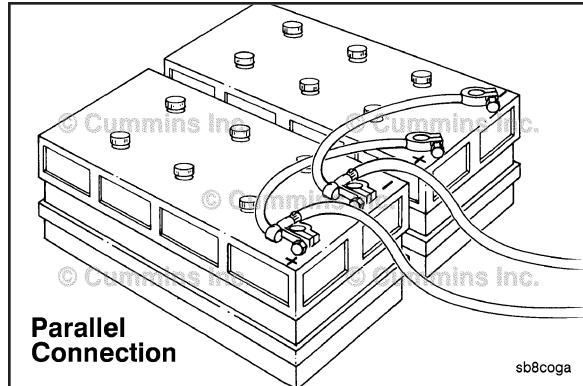
⚠️ CAUTION ⚠️

When using jumper cables to start the engine, make sure to connect the cables in parallel: Positive (+) to positive (+) and negative (-) to negative (-). When using an external electrical source to start the engine, turn the disconnect switch to the OFF position. Remove the key before attaching the jumper cables.

⚠️ CAUTION ⚠️

To reduce the possibility of damage to engine parts, do not connect jumper starting or battery charging cable to any fuel system or electronic component.

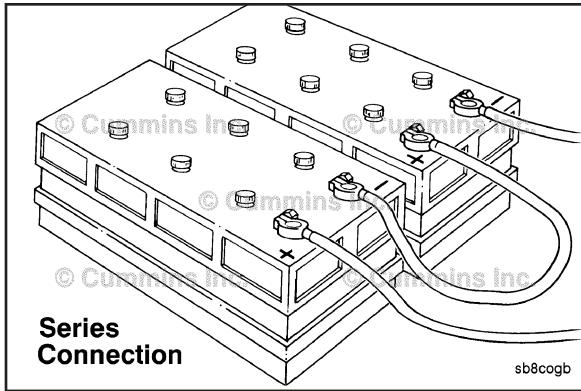
The accompanying illustration shows a typical parallel battery connection. This arrangement doubles the cranking amperage.



Normal Starting Procedure
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Section 1 - Operating Instructions



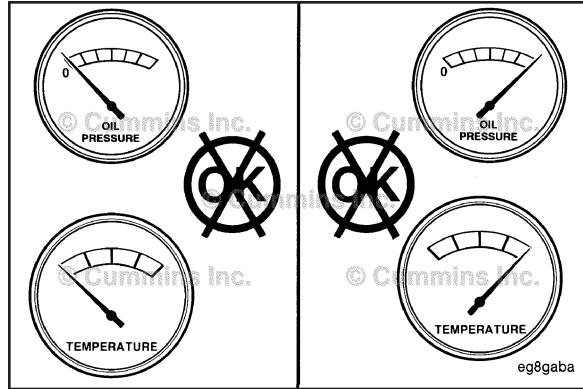
This illustration shows a typical series battery connection. This arrangement, positive (+) to negative (-), doubles the voltage.

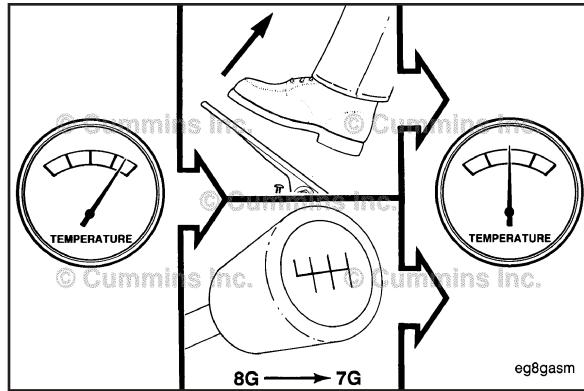
Operating the Engine

Normal

If equipped, monitor the oil pressure and coolant temperature gauges frequently. Refer to Lubricating Oil System specifications and Cooling System specifications, in Maintenance Specifications (Section V) for recommended operating pressures and temperatures. Shut off the engine if any pressure or temperature does **not** meet the specifications.

Continuous operation with engine coolant temperature above or below the engine coolant temperature specifications listed in Maintenance Specifications (Section V) can damage the engine.





If an overheating condition starts to occur, reduce the power output of the engine by releasing the accelerator pedal or lever or shifting the transmission to a lower gear, or both, until the temperature returns to the normal operating range. If the engine temperature does **not** return to normal, shut off the engine, and refer to Troubleshooting Symptoms (Section TS), or contact a Cummins® Authorized Repair Location.

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).

Engine Operating Range

General Information

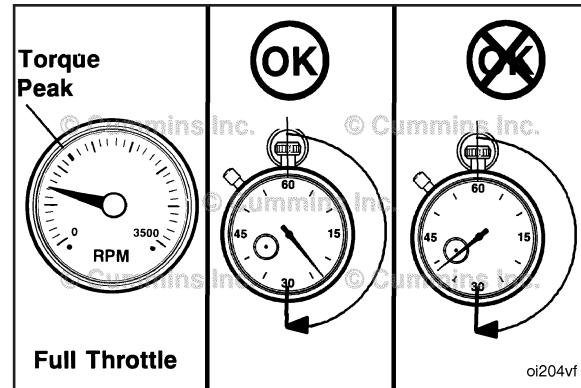
△ CAUTION △

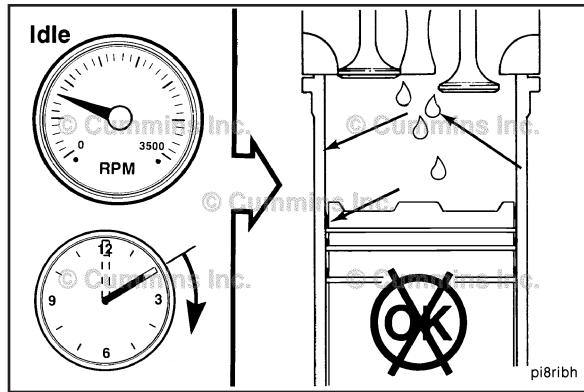
Do not operate the engine at full throttle below peak torque rpm (refer to engine dataplate for peak torque rpm) for more than 30 seconds. Operating the engine at full throttle below peak torque will shorten engine life to overhaul, can cause serious engine damage, and is considered engine abuse.

△ CAUTION △

Do not operate the engine beyond the maximum engine speed. Operating the engine beyond the maximum engine speed can cause severe engine damage. Use proper operating techniques for the vehicle, vessel, or equipment to prevent engine overspeed. The maximum engine speed specification is listed in Maintenance Specifications (Section V).

Cummins® engines are designed to operate successfully at full throttle under transient conditions down to peak torque engine speed. This is consistent with recommended operating practices.





CAUTION

Do not idle the engine for excessively long periods. Long periods of idling, more than 10 minutes, can cause poor engine performance.

Engine Shutdown

General Information

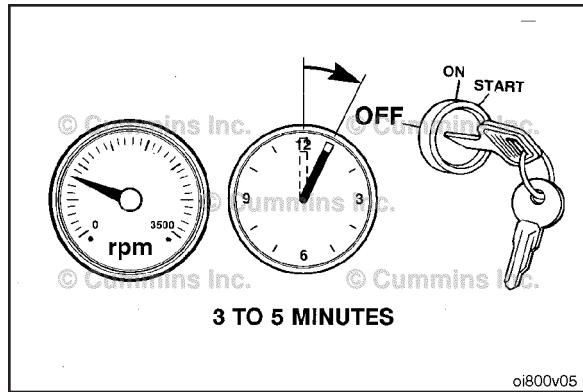
CAUTION

Failure to follow the correct shutdown procedure may result in damage to the turbocharger, if equipped, and shorten the turbocharger life.

Allow the engine to idle 3 to 5 minutes before shutting the engine off after a full-load operation. This allows adequate cool down of pistons, cylinders, bearings, and turbocharger, if equipped.

NOTE: For engines equipped with an electronic control module (ECM) ensure the keyswitch is turned off for a minimum of 100 seconds prior to disconnecting the continuous (unswitched) battery power supply. If the unswitched battery power supply is disconnected in less than 100 seconds after the keyswitch is turned off active fault codes and incorrect ECM information can occur.

Turn the ignition switch to the OFF position. If the engine does **not** shut down, contact a Cummins® authorized repair location.



oi800v05

Electromagnetic Interference (EMI)

General Information

Some applications utilize accessories such as (CB radios, mobile transmitters, etc.) if not installed and used correctly the radio frequency energy generated by these accessories can cause electromagnetic interference (EMI) conditions to exist between the accessory and the Cummins electronically controlled systems. Cummins is **not** liable for any performance problems with either the electronically controlled systems or the accessory due to EMI. EMI is **not** considered by Cummins to be a system failure and therefore is **not** warrantable.

System EMI Susceptibility

Your Cummins product has been designed and tested for minimum sensitivity to incoming electromagnetic energy. Testing has shown that there is no performance degradation at relatively high energy levels; however, if very high energy levels are encountered, then some noncritical diagnostic fault code logging can occur. The electronically controlled systems EMI susceptibility level will protect your systems from most, if **not** all, electromagnetic energy-emitting devices that meet the legal requirements.

System EMI Radiation Levels

Your Cummins product has been designed to emit minimum electromagnetic energy. Electronic components are required to pass various Cummins and industry EMI specifications. Testing has shown that when the systems are properly installed, they will not interfere with onboard communication equipment or with the vehicle's, equipment's, or vessel's ability to meet any applicable EMI standards and regulated specifications.

If an interference condition is observed, follow the suggestions below to reduce the amount of interference:

- 1 Locate the transmitting antenna as far away from the electronically controlled systems and as high as possible.
- 2 Locate the transmitting antenna as far away as possible from all metal obstructions (e.g., exhaust stacks)

- 3 Consult a representative of the accessory supplier in your area to:
 - Accurately calibrate the device for proper frequency, power output, and sensitivity (both base and remote site devices **must** be properly calibrated)
 - Obtain antenna reflective energy data measurements to determine the optimum antenna location
 - Obtain optimum antenna type and mounting arrangement for your application
 - Make sure your accessory equipment model is built for maximum filtering to reject incoming electromagnetic noise.

Notes

Section 2 - Maintenance Guidelines

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Maintenance Guidelines - Overview

General Information

Cummins Inc. recommends that the system be maintained according to the Maintenance Schedule in this section.

If the system is operating in ambient temperatures below -18°C [0°F] or above 38°C [100°F], perform maintenance at shorter intervals. Shorter maintenance intervals are also required if the system is operated in a dusty environment or if frequent stops are made. For gas fueled generator sets, shorter maintenance intervals are also required, if operating at loads below 70% for prolonged periods. Contact your local Cummins® Authorized Repair Location for recommended maintenance intervals.

Some of these maintenance procedures require special tools or must be completed by qualified personnel. Contact your local Cummins® Authorized Repair Location for detailed information.

If your system is equipped with a component or accessory not manufactured or supplied by Cummins Inc., refer to the component manufacturer's maintenance recommendations.

OEM supplied equipment and components can impact on the performance and reliability of the engine if they are not correctly maintained.

Use the chart provided in this section as a convenient way to record maintenance performed.

Maintenance Schedule

General Information

Daily or Refueling - Maintenance Check (1)

- Fuel-Water Separator - drain
- Lubricating Oil Level - check
- Coolant Level - check
- Fan, Cooling - check
- Drive Belts - check
- Air Intake Piping - check
- Charge-Air Piping - check
- Air Tanks and Reservoirs - drain
- Crankcase Breather Tube - check

Every 250 Hours, or 6 Months^{1, 4}

- Lubricating Oil and Filters - change
- Supplemental Coolant Additive (SCA) and Antifreeze Concentration - check
- Fuel Filter (Spin-On Type) - change

Every 1,500 Hours, or 1 Year^{2,3}

- Coolant Filter - change

- Coolant Filter Head - Inspect for reuse
- Cooling Fan Belt Tensioner - check
- Air Leaks, Air Intake and Exhaust Systems - check
- Air Cleaner Restriction - check
- Engine Wiring Harness - check

Every 6,000 Hours, or 2 Years³

- Crankcase Breather Tube - check
- Radiator Hose - check
- Cold Weather Starting Aids - check
- Engine Steam Cleaning - clean
- Engine Mounting Bolts - check
- Vibration Damper, Viscous - inspect for reuse
- Overhead Set - adjust
- Crankcase Breather (Internal) - replace

Every 10,000 Hours, or 5 Years³

- Fan Hub, Belt Driven - replace
- Air Compressor Discharge Lines - check

1 The lubricating oil drain intervals can be adjusted based on fuel consumption and engine duty cycle. See the Oil Drain Interval section of this procedure for more details.

- 2 Follow the manufacturer's recommended maintenance procedures for the starter, alternator, generator, batteries, electrical components, charge-air cooler, air compressor, air conditioner compressor, and fan clutch
- 3 Perform maintenance at whichever interval occurs first. At each scheduled maintenance interval, perform all previous maintenance checks that are due for scheduled maintenance.
- 4 Test the SCA concentration level every 6 months unless the concentration is over three units; then check at every oil drain interval until the concentration is below three units. For coolant condemnation limits, Refer to Procedure 018-004 in Section V.

Oil Drain Intervals

All Others Without EGR

Select an oil drain interval based on oil classification for Recreational Vehicle, Refuse, Mixer, Dump, Delivery, Logging, Fire Truck, or Crane vehicle applications.

Oil Classification	Kilometers	Miles	Hours	Months
CES 20071	11,500	7000	300	6
CES 20076 and CES 20078, CES 20081 ¹	14,500	9000	400	6

If the application is **not** one of the above, select the oil drain interval Extreme Severe Duty, Severe Duty, Normal Duty, or Light Duty based on how you use the engine. See Oil Drain Intervals by severity km [mi] located in this section.

- Follow oil drain interval Extreme Severe Duty if the vehicle operates under either of the conditions listed in Extreme Severe Duty.
- Follow oil drain interval Severe Duty if the vehicle operates under either of the conditions listed in interval Severe Duty.

- Follow oil drain interval Normal Duty if the vehicle operates under either of the conditions listed in interval Normal Duty and does **not** meet any of the conditions listed in interval Severe Duty.
 - Follow oil drain interval Light Duty if the vehicle operates under both of the conditions listed in interval Light Duty and does **not** meet any of the conditions listed in interval Severe Duty or interval Normal Duty.
- 1 When used with ultra-low sulfur diesel fuel (15 ppm sulfur), if the sulfur content of the fuel is greater than 15 ppm, the oil change intervals **must** be reduced by 20 percent.

Oil Classification	Extreme Severe Duty	Severe Duty	Normal Duty ³	Light Duty ³
	<1.27 km/liter [3 mpg]	< 2.3 km/liter [5.5 mpg]	2.3 to 2.8 km/liter [5.5 to 6.5 mpg]	> 2.8 km/liter [6.5 mpg]
CES 20071	7,000 km [4,500 mi]	24,000 km [15,000 mi]	56,500 km [35,000 mi]	72,500 km [45,000 mi]
CES 20076, CES 20078, CES 20081 ¹	10,000 km [6,000 mi]	32,000 km [30,000 mi]	64,500 km [40,000 mi]	80,500 km [50,000 mi]

NOTE: Extending the oil and filter change interval beyond the recommendation will decrease engine life due to factors such as corrosion, deposits, and wear.

NOTE: If the sulfur content of the fuel is greater than 0.50 percent, the oil change intervals **must** be reduced by an additional 20 percent.

- 1 When used with ultra-low sulfur diesel fuel (15 ppm sulfur). If the sulfur content of the fuel is greater than 15 ppm, the oil change intervals **must** be reduced by 20 percent.
- 2 For Normal and Light duty cycles **only** (outlined in the above table): If Valvoline Premium Blue™ or Valvoline Premium Blue Extreme™ is being used; the oil drain intervals listed in the above chart can be increased by 8,050 km [5,000 miles]. All other oil brands **must** follow the oil drain intervals listed above.

The oil drain intervals for industrial engines are based on the duty cycle (as reflected by fuel consumption) and lubricating oil quality. The table below specifies the maximum oil drain interval for the listed lubricating oil classifications based on the three different duty cycles: Heavy, Medium, and Light.

- Follow oil drain interval Heavy Duty if the equipment uses more than 57 liter [15 gal] of fuel per hour.
- Follow oil drain interval Medium Duty if the equipment uses between 42 to 57 liter [11 to 15 gal] of fuel per hour.
- Follow oil drain interval Light Duty if the equipment uses less than 42 liter [11 gal] of fuel per hour.

NOTE: Extending the oil and filter change interval beyond the recommendation will decrease engine life due to factors such as corrosion, deposits, and wear.

12 Gallon Oil Drain Interval - Duty Cycle (Fuel Consumption)			
Oil Classification	Heavy >57 liters/hour [15 gallons/hour]	Medium 42 to 57 liters/ hour [11 to 15 gallons/hour]	Light < 42 liters/hour [11 gallons/hour]
API CD-4, CE-4, CF-4 ^{1, 3}	125	250	375
API CG-4 ³	250	375	500
API CH-4 ³	400	525	650
CES 20076, 20078, 20081/ CH-4 ^{2, 3}	500	625	750

14 Gallon Oil Drain Interval - Duty Cycle (Fuel Consumption)			
Oil Classification	Heavy >57 liters/hour [15 gallons/hour]	Medium 42 to 57 liters/ hour [11 to 15 gallons/hour]	Light < 42 liters/hour [11 gallons/hour]
CES 20078/CI-4/ACEA E7	580	730	875
CES 20081/CJ-4/ACEA E9/ JAMA DH-2	580	730	875

22 Gallon Oil Drain Interval - Duty Cycle (Fuel Consumption)			
Oil Classification	Heavy >57 liters/hour [15 gallons/hour]	Medium 42 to 57 liters/ hour [11 to 15 gallons/hour]	Light < 42 liters/hour [11 gallons/hour]
CES 20078/CI-4/ACEA E7	910	1140	1375
CES 20081/CJ-4/ACEA E9/ JAMA DH-2	910	1140	1375

- 1 The oil classifications CD, CE, and CF have been obsoleted by API and **must not** be used, as their specifications are no longer controlled.
- 2 Valvoline Premium Blue™ and Premium Blue™ 2000 meet CES 20076 standards.
- 3 Use the following procedure for the lubricating oil filter specification table. Refer to Procedure 018-003 in Section V.

The table below lists typical duty cycles by application.

NOTE: The actual duty cycle can vary from the chart below. In those cases, it is necessary to change the lubricating oil as a function of average fuel consumption. Therefore, select a column based on the representative fuel consumption range.

Typical Duty Cycles by Applications		
Heavy	Medium	Light
Air Compressor	Articulated Dump Truck	Crane
Combine	Irrigation Equipment	Rear Dump Truck
Dozer	Scraper	
Dragline	Skidder	
Excavator		
Farm Tractors		
Forage Harvester		
Rock Drill		
Tub Grinder		

For Generator Drive engines, this service interval is based on load factor (as reflected by fuel usage), lubricating oil quality, lubricating system capacity, and operating speed 1,500 rpm (50 Hz) or 1,800 rpm (60 Hz). Premium grade oils (API CG-4, CH-4, and CES 20076) are recommended for the QSX15 engine. The oil grades CD, CE, and CF have been obsoleted by API and **must not** be used, as their specifications are no longer controlled. There are two recommended methods for determining the proper oil change interval:

- Fixed hour method; based on fixed hours of operation or months of service, whichever occurs first.
- Chart method; based on known fuel consumption rates.

If the chart method is **not** used or, for all stand-by power applications, the oil **must** be changed at a regular interval or 12 months, whichever occurs first:

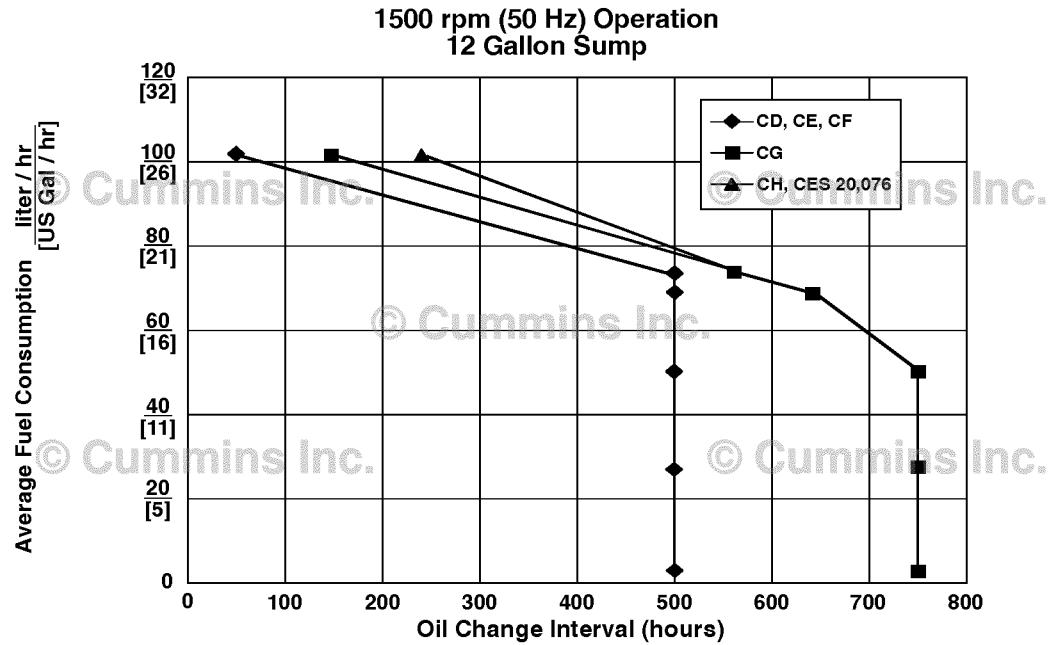
Application	Operating Speed	Sump Size	Change Interval
Standby power	1,500 rpm (50 Hz)	45 liters [12 gal]	125 Hours or 12 Months
All other applications		45 liters [12 gal]	250 Hours or 12 Months
Standby power	1,500 rpm (50 Hz)	53 liters [14 gal]	145 Hours or 12 Months
All other applications		53 liters [14 gal]	290 Hours or 12 Months
Standby power	1,800 rpm (60 Hz)	83 liters [22 gal]	250 Hours or 12 Months
All other applications		83 liters [22 gal]	500 Hours or 12 Months

The chart method is recommended to provide the lowest total cost of operation while still protecting the engine. Due to differing availability outside North America, lower grade oil (CD, CE, and CF) are also depicted, however their classifications have been obsoleted by API, and oil change intervals are greatly reduced.

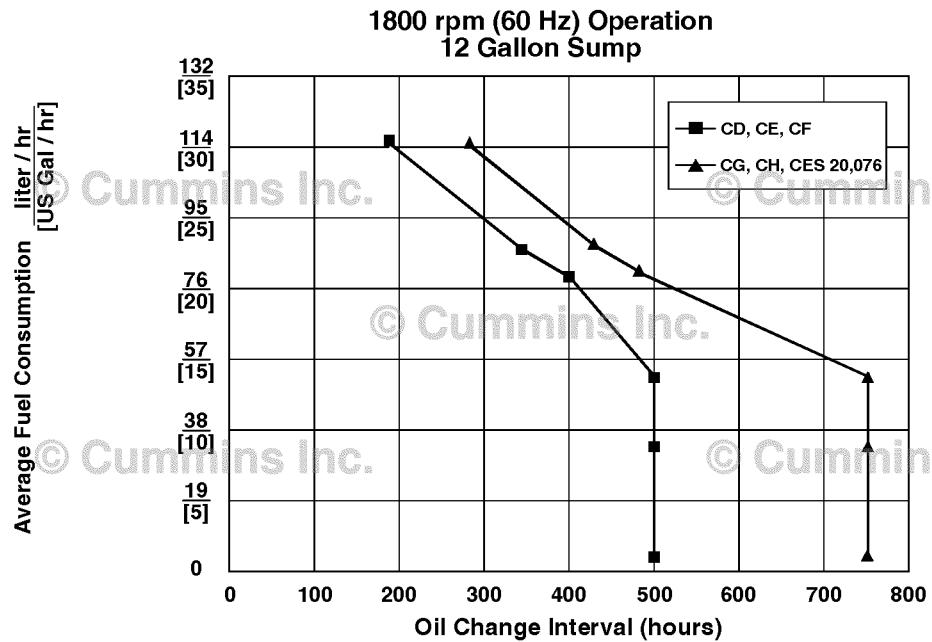
The charts **must** be used as guidelines because actual oil drain intervals will also depend on operation and maintenance practices. It is suggested that oil analysis **must** be used periodically for prime power applications (every 100 hours) to make sure the proper oil change interval is being applied.

To use the charts, locate the chart for the appropriate sump size and operating speed. Find the fuel consumption rate in liters per hour or U.S. gallons per hour on the left vertical axis. Draw a horizontal line from left to right across the chart, parallel with the bottom of the chart, until it intersects the curve.

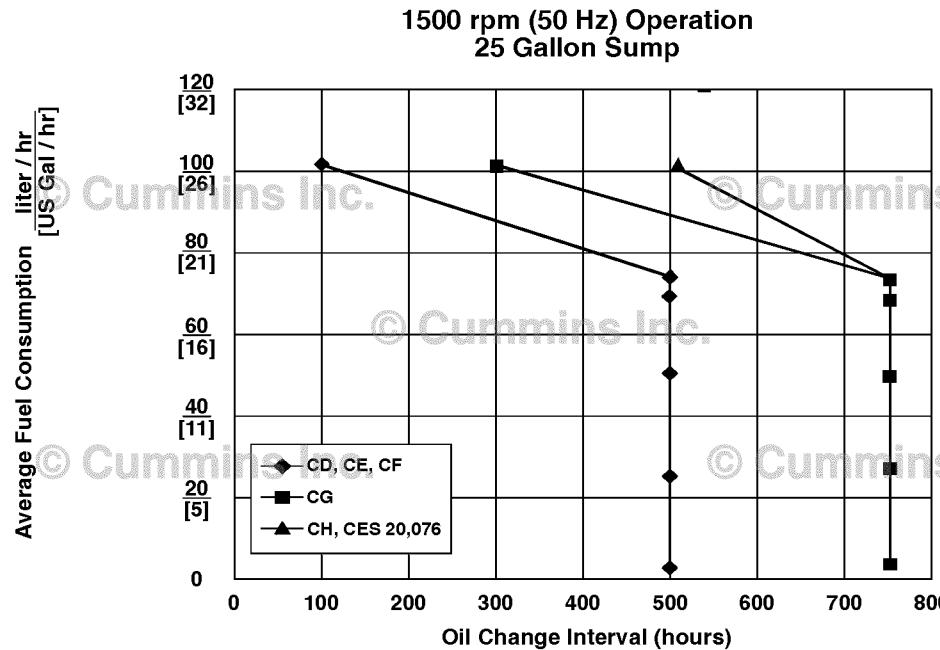
From the intersection point on the curve, draw a line perpendicular to the bottom of the chart. The number the line intersects across the bottom of the chart represents the recommend oil change interval in hours.



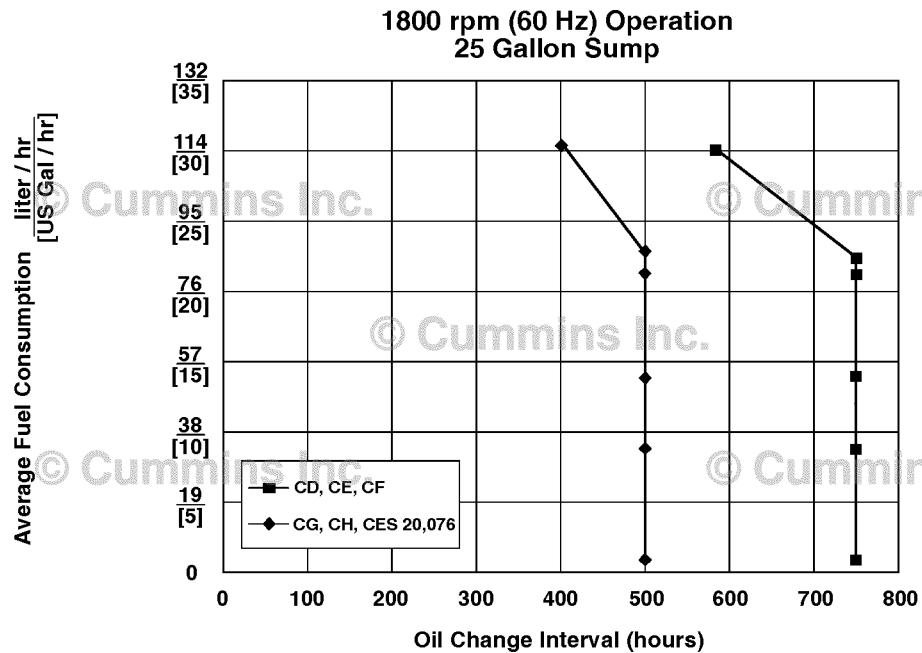
17c00173



17c00174



17c00175



17c00176

Maintenance Record Form

Maintenance Data

Maintenance Record	
Product Serial No.:	Product Model:
Owner's Name:	Equipment Model/Number:

Key to table headings:

A = Date

B = Schedule km [Miles], Hours or Time Interval

C = Actual km [Miles] Hour or Time

D = Maintenance Check Performed

E = Check Performed By

F = Comments

Notes

Section L - Service Literature

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Additional Service Literature

General Information

The following publications can be purchased:

Bulletin Number	Title of Publication
3379001	Fuels for Cummins® Engines
3810340	Cummins® Engine Oil Recommendations
3387251	Coolant Additives and Filtration
3387266	Cold Weather Operation
3666209	Cooling System Maintenance Extended Interval
3666239	Troubleshooting and Repair Manual, Signature™, ISX, and QSX15 Engines
3666259	Troubleshooting and Repair Manual, Electronic Control System, Signature™, ISX, and QSX15 Engines
3666393	Troubleshooting and Repair Manual Generator-Drive Control System QSX15, QSK45, and QSK60 Engines
3666394	Troubleshooting and Repair Manual PowerCommand® Control QSX15, QSK45, and QSK60 Generator Sets
3666414	QSX15 Industrial Wiring Diagram
3666349	QSX15 Generator Drive Wiring Diagram
3666466	QSX15 PowerCommand® Control Wiring Diagram

Service Literature Ordering Location

Contact Information

Service literature can be obtained from the appropriate location listed below:

- Any Cummins® Distributor
- Iron Mountain Fulfillment Services
 - Help Desk (U.S.): 1-800-646-5609
 - Help Desk (Outside U.S.): 1-630-283-2420
 - Email: CECOTeam@ironmountain.com
- QuickServe® Online Store
 - <https://store.cummins.com/store>

Cummins Customized Parts Catalog

General Information

Cummins is pleased to announce the availability of a parts catalog compiled specifically for you. Unlike the generic versions of parts catalogs that support general high volume parts content; Cummins Customized catalogs contain only the new factory parts that were used to build your engine.

The catalog cover, as well as the content, is customized with you in mind. You can use it in your shop, at your worksite, or as a coffee table book in your RV or boat. The cover contains your name, company name, address, and telephone number.

This new catalog was designed to provide you with the exact information you need to order parts for your engine. This will be valuable for customers that do not have easy access to Cummins QuickServe Online.

Additional Features of the Customized Catalog include:

- Engine Configuration Data
- Table of Contents
- Separate Option and Parts Indexes
- Service Kits (when applicable)
- ReCon Part Numbers (when applicable)

Ordering the Customized Parts Catalog

Ordering by Telephone

- North American Distributors, Original Equipment Manufacturers and Cummins Factory personnel order by calling Iron Mountain Fulfillment Services (IMFS) at 1-800-646-5609.

- International Distributors and Original Equipment Manufacturers order the CPC from their regional Cummins Parts Distribution Centers (PDC).
- International PDC orders are called into Iron Mountain at (++) 630-283-2420.
- Retail Credit Card Orders require a 2 step ordering process.

Ordering On-Line

Access the Cummins QSOL store at <https://store.cummins.com>

- Find the Customized Parts Catalog button located on the left of the homepage
- Select format. Your Price is also shown here
- Finalize Shopping Cart and Check Process as described on the website

North America call Iron Mountain Fulfillment Services (IMFS) at 800-646-5609, International customers call (++) 630-283-2420. Provide IMFS the catalog detail as described on the website. This step is required until we have our On Line form available.

Required information needed for your Customized Parts Catalog Order.

- Customer Name
- Street Address
- Company Name (optional)
- Telephone no.
- Credit Card No.
- Cummins Engine Serial Number (located on the engine data plate)

Unfortunately not all Cummins Engines can be supported by Customized Parts Catalogs. Engines older than 1984 or newer than 3 months may not have the necessary parts information to compile a catalog. We will contact you if this occurs and explain why we are unable to fill your order.

Customized Parts Catalogs are produced specifically for a single customer. This means they are not returnable for a refund. If we make an error and your catalog is not useable, we will correct that error by sending you a new catalog.

Notes

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General Information.....	S-1

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Service Assistance

General Information

To contact the nearest Cummins® Authorized Repair Location, utilize the Service Locator at www.cummins.com.

Cummins Inc. provides a 24-hour, toll free telephone number to aid in technical and emergency service when a Cummins® Authorized Repair Location can **not** be reached or is unable to resolve an issue with a Cummins® product.

U.S. and Canada

- 1-800-CUMMINS™ (1-800-286-6467)

Mexico

- 01-800-CUMMINS (2866467)
- Email: contacto.mexico@cummins.com

Australia/New Zealand

- For Australia: 1-800-CUMMINS (1800 286 646)
- For New Zealand: 0-800-CUMMINS (0800 286 646)
- Email: marketingsouthpac@cummins.com

Brazil

- 0800 CUMMINS (0800 286 6467)
- Email: falecom@cummins.com

Europe

- From the UK, Ireland, Germany, France, and the Netherlands - Freephone: 00 8000 2866467

To buy Cummins Parts and Service Manuals, Training Guides, or Tools go to our website at <https://store.cummins.com>

- Email: emea.customerassistance@cummins.com

China

- 400 810 5252 or (+86) 400 810 5252
- Email: customersupport@cummins.com

India

- 800 210 2525
- Email: powermaster-India@cummins.com

Russia

- Primary: +7 495 926 8624
- Alternate: +7 962 943 1211

For All Other Areas:

- +44 (0) 1327 886464

Routine Service and Parts

General Information

Personnel at Cummins Authorized Repair Locations can assist you with the correct operation and service of your system. Cummins has a worldwide service network of more than 5,000 Distributors and Dealers who have been trained to provide sound advice, expert service, and complete parts support. Check the telephone directory, refer to the directory in this section, or the Service Locator at www.cummins.com for the nearest Cummins Authorized Repair Location.

Section V - Maintenance Specifications

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General Engine Specifications

Listed below are general specifications for this engine.

Horsepower..... Refer to the engine dataplate.

Engine Speed..... Refer to the engine dataplate.

Engine Speed

400 to 450 hp.....	1800 rpm
--------------------	----------

500 to 600 hp.....	2000 rpm
--------------------	----------

Displacement..... 15 liters [912 C.I.D.]

Bore and Stroke..... 137 mm [5.40 in] x 169 mm [6.65 in]

Dry Engine Weight:

Power Generation.....	1370 kg [3020 lb]
-----------------------	-------------------

Industrial.....	1524 kg [3360 lb]
-----------------	-------------------

Wet Engine Weight:

Power Generation.....	1475 kg [3250 lb]
-----------------------	-------------------

Industrial.....	1628 kg [3590 lb]
-----------------	-------------------

Lubricating Oil System

Specifications

Oil Pressure at Idle (minimum allowable at 93°C [200°F] oil temperature)..... 103 kPa [15 psi]

Oil Pressure at No-Load Governed Speed (automotive and industrial **only**)..... 241 to 276 kPa [35 to 40 psi]

Pressure Drop Across Oil Filter (maximum allowable with 15W40 oil at operating temperature)..... 172 kPa [25 psi]

Oil Capacity of Standard Engine:

Combination Full-Flow/Bypass Filter Capacity..... 3.78 liters [1 gal]

Oil Capacity of Standard Engine:

Oil Pan Capacity: Automotive and Industrial

High..... 45.4 liters [12 gal]

Low..... 37.8 liters [10 gal]

Oil Capacity of Standard Engine:

Oil Pan Capacity: Power Generation (for oil pan option OP1493)

High..... 83.3 liters [22 gal]

Low..... 72.0 liters [19 gal]

Oil Capacity of Standard Engine:

Oil Change Capacity (oil pan and filter filled to capacity):

Automotive and Industrial..... 45.4 liters [12 gal]

Power Generation (for oil pan option OP1493)..... 87.0 liters [23 gal]

Total Lubricating Oil System Capacity Including Filter:

Automotive and Industrial..... 49.21 liters [13 gal]

Power Generation (for oil pan option OP1493)..... 90.8 liters [24 gal]

Oil Pressure Range:

Cold Engine..... Up to 1034 kPa [150 psi]

Warm Engine..... 241 to 276 kPa [35 to 40 psi]

Cooling System

General Information

Cummins Inc. recommends the use of fully-formulated antifreeze or coolant containing a precharge of supplemental coolant additive (SCA). The antifreeze or coolant **must** meet the specifications outlined in the Technology and Maintenance Council (TMC) Recommended Practice (RP) 329 (ethylene glycol) or Recommended Practice (RP) 330 (propylene glycol). The use of fully-formulated antifreeze or coolant significantly simplifies cooling system maintenance.

Copies of Technology and Maintenance Council (TMC) specifications can be obtained through Cummins Inc., or by contacting:

Technology and Maintenance Council

American Trucking Association

2200 Mill Road

Alexandria, VA 33314-5388

Phone: (703) 838-1763

Fax (703) 836-6070

Fully-formulated antifreeze contains balanced amounts of antifreeze, SCA, and buffering compounds, but does **not** contain 50 percent water. Fully-formulated coolant contains balanced amounts of antifreeze, SCA, and buffering compounds already premixed 50/50 with deionized water.

The following pages explain water, antifreeze, and SCA's and how to test antifreeze and SCA levels.

This section also contains information on cooling system maintenance and a coolant treatment chart that is used to determine the correct SCA service filter.

Alternative maintenance practices for cooling systems can be found in Cummins® Coolant Requirements and Maintenance, Bulletin 3666132.

Specifications

Industrial Applications

Coolant Capacity

Engine only	24 liters [25 qt]
-------------------	-------------------

Standard Modulating Thermostat

Temperature Range.....	82 to 93°C [180 to 200°F]
------------------------	---------------------------

Maximum Coolant Pressure (exclusive of pressure cap - closed thermostat at the maximum no-load governed speed)

All ratings.....	227 kPa [33 psi]
------------------	------------------

Coolant Alarm Activation Temperature

Ratings Below 565 Horsepower.....	107°C [225°F]
-----------------------------------	---------------

Ratings of 565/600 Horsepower.....	110°C [230°F]
------------------------------------	---------------

Maximum Allowable Top Tank Temperature

Ratings Below 565 Horsepower.....	107°C [225°F]
-----------------------------------	---------------

Ratings of 565/600 Horsepower.....	110°C [230°F]
------------------------------------	---------------

Power Generation, Standby.....	110°C [230°F]
--------------------------------	---------------

Power Generation, Prime.....	104°C [220°F]
------------------------------	---------------

Minimum Recommended Top Tank Temperature

Minimum Temperature.....	70°C [160°F]
--------------------------	--------------

Minimum Allowable Draw Down

Minimum Allowable Draw Down.....	2.4 liters [2.5 qt] or 10 Percent of System Capacity (whichever is greater)
----------------------------------	---

Minimum Recommended Pressure Cap

Industrial.....	103 kPa [15 psi]
-----------------	------------------

Power Generation.....	69 kPa [10 psi]
-----------------------	-----------------

Minimum Fill Rate

Without Low-Level Alarm..... 19 liters/min [5 gpm]

Maximum Degaeration Time

Time..... 25 minutes

Fan-on Coolant Temperature

Temperature..... 95°C [203°F]

Fan-on Intake Air Temperature

Temperature..... 88°C [190°F]

Shutter Opening Temperature

Coolant 85°C [185°F]

Intake Air..... 60°C [140°F]

Cummins®/Fleetguard® Filter Specifications

Specifications

Fleetguard® filters are manufactured by Cummins Filtration Inc., which is a subsidiary of Cummins Inc. Fleetguard® filters are developed through joint testing at Cummins Inc. and at Cummins Filtration Inc. Fleetguard® filters are standard on new Cummins® engines. Cummins Inc. recommends their use.

Fleetguard® products meet all Cummins Inc. Source Approval Test standards to provide the quality filtration necessary to achieve the engine's design life. If other brands are substituted, the purchaser **must** insist on products that the supplier has tested to meet Cummins Inc. high quality standards.

Cummins Inc. can **not** be responsible for problems caused by nongenuine filters that do **not** meet Cummins Inc. performance or durability requirements.

Cummins Inc. requires a lubricating oil filter be used that meets Cummins Inc. Source Approval Method 10,765.

Filter Type	
Lubricating Oil Filter	
Cummins® Part Number	2882673 and 2882674
Fleetguard® Part Number	LF9070 and LF9080
Fuel-Water Separator	
Cummins® Part Number	4010650 and 4010651
Fleetguard® Part Number	FS1007 and FS1040
Coolant Filter	
Fleetguard® Part Number	WF2125 ¹
	WF2126 ²

Filter Type	
	WF2127 ³
Crankcase Breather Filter	
Cummins® Part Number	3102738

- 1 This filter is designed for use with Fleetguard® extended service cooling system, which extends cooling system service to 1 year, 241,402 km [150,000 mi], or 4000 hours, whichever comes first. This filter is used for cooling systems up to 76 liters [20 gal]. Refer to Cummins® Coolant Requirements and Maintenance, Bulletin 3666132. Fleetguard® ES coolant **must** be used for all fill and top-off, which is critical for extended cooling system maintenance intervals.
- 2 This filter is designed for extended service intervals up to 80,467 km [50,000 mi] when using TMC RP329 or RP330 coolants and is used for cooling systems up to 76 liters [20 gal]. Refer to Cummins® Coolant Requirements and Maintenance, Bulletin 3666132.
- 3 This filter has been designed for extended service intervals of 80,467 to 241,402 km [50,000 to 150,000 mi]. It has no chemical additives and can be used in the following systems:
 - Cooling systems above 76 liters [20 gal] in capacity.
 - See maintenance chart below.

When using WF2127 filter, the following volumes of treatment **must** be added at the designated distances:

Cooling System Capacity	80,467 km [50,000 mi] Service Interval with RP329/330 Coolant or Treated Water (Fleetcool or DCA4)	241,402 km [150,000 mi] Service Interval with ES Coolant (ES Liquid)
0 to 76 liters [0 to 20 gal]	0.95 liters [1 qt] (10 units)	0.95 liters [1 qt] (15 units)
76 to 151 liters [20 to 40 gal]	1.89 liters [2 qt] (20 units)	1.89 liters [2 qt] (30 units)

Cooling System Capacity	80,467 km [50,000 mi] Service Interval with RP329/330 Coolant or Treated Water (Fleetcool or DCA4)	241,402 km [150,000 mi] Service Interval with ES Coolant (ES Liquid)
151 to 227 liters [40 to 60 gal]	2.84 liters [3 qt] (30 units)	2.84 liters [3 qt] (45 units)
227 to 303 liters [60 to 80 gal]	3.79 liters [4 qt] (40 units)	3.79 liters [4 qt] (60 units)
303 to 379 liters [80 to 100 gal]	0.94 liters [5 qt] (50 units)	0.94 liters [5 qt] (75 units)

NOTE: Filters **must** meet Cummins Inc. Source Approval Method 10,769. Fleetguard® filters meet Cummins Inc. Source Approval Method 10,769. The standard filter for the Signature™ engine is Fleetguard® WF2126. For systems larger than 379 liters [100 gal], use 0.94 liters [1 qt] per 57 liters [15 gal]. Consult vehicle manufacturer for total cooling system capacity.

Fuel Recommendations and Specifications

Fuel Recommendations

⚠ WARNING ⚠

Do not bleed the fuel system of a hot engine; this can result in fuel spilling onto a hot exhaust manifold, which can cause a fire.

⚠ CAUTION ⚠

Due to the precise tolerances of diesel injection systems, it is extremely important that the fuel be kept clean and free of dirt or water. Dirt or water in the system can cause severe damage to both the fuel pump and the fuel injectors.

⚠ CAUTION ⚠

Do not use diesel fuel blended with lubricating oil in engines equipped with an aftertreatment device. Service intervals for aftertreatment devices will be reduced.

Fuel Recommended Properties	
Cummins Inc. recommends the use of fuels that meet the following specifications:	
Property	Recommended Specifications
Viscosity (ASTM D445)	1.3 to 4.1 centistokes [1.3 to 4.1 mm per second] at 40°C [104°F].
Cetane Number (ASTM D613)	40 minimum above 0°C [32°F]. 45 minimum below 0°C [32°F].
Sulfur Content (ASTM D129 or D1552)	Not to exceed 0.05 mass percent for engines without aftertreatment devices. For engines with aftertreatment devices, sulfur content can not exceed 0.0015 (15 ppm) mass percent.

Fuel Recommended Properties	
Active Sulfur (ASTM D130)	Copper strip corrosion not to exceed number 3 rating after three hours at 50°C [122°F].
Water and Sediment (ASTM D1796)	Not to exceed 0.05 volume percent.
Carbon Residue (Rams bottom, ASTM D524 or Conradson, ASTM D189)	Not to exceed 0.35 mass percent on 10 volume percent residuum.
Density (ASTM D287)	42 to 30° API gravity at 0.816 to 0.876 g/cc at 15°C [60°F].
Cloud Point (ASTM D97)	6°C [10°F] below lowest ambient temperature at which the fuel is expected to operate.
Ash (ASTM D482)	Not to exceed 0.02 mass percent (0.05 mass percent with lubricating oil blending). Oil blending is prohibited on engines with aftertreatment devices.
Distillation (ASTM D86)	The distillation curve must be smooth and continuous.
Acid Number (ASTM D664)	Not to exceed 0.1 mg KOA per 100 ml.

- 1 For additional information on fuel recommendations and specifications, refer to Fuels for Cummins® Engines, Bulletin 3379001,. See ordering information in the back of this manual.

Lubricating Oil Recommendations and Specifications

General Information

- The use of quality engine lubricating oils, combined with appropriate oil drain and lubricating oil filter change intervals, is a critical factor in maintaining engine performance and durability.
- Cummins Inc. recommends the use of a high quality 15W-40 multi-viscosity heavy-duty engine lubricating oil that meets the requirements of Cummins® Engineering Specification (CES) 20078, or 20081 (such as Valvoline™ Premium Blue™ or Valvoline™ Premium Blue Extreme™). For areas where products meeting CES 20078, or 20081 are **not** readily available, a product meeting American Petroleum Institute (API) CH-4 or CES 20076 can be used, but at a reduced drain interval. Reference the Oil Drain Intervals by severity of service km [mi] section. The oil grades CC, CD,CE CF, CG-4, and CF-4 have been obsoleted by API and **must not** be used.
- Reference the Maintenance Schedule in the appropriate Owners or Operation and Maintenance Manuals.
- Shortened drain intervals can be required with monograde oils, as determined by close monitoring of the oil condition with scheduled oil sampling. Use of single-grade oils can affect engine oil control.
- Synthetic engine oils, API Group III and Group IV basestocks, are recommended for use in Cummins® engines operating in ambient temperature conditions consistently below -25°C [-13°F]. Above this temperature, petroleum-based multigrade lubricants are recommended. Synthetic 0W-30 oils that meet API Group III and Group IV basestocks can be used in operations where the ambient temperature **never** exceeds 0°C [32°F]. 0W-30 oils do **not** offer the same level of protection against fuel dilution as do higher multigrade oils. Higher cylinder wear can be experienced when using 0W-30 oils in high-load situations.

For further details and an explanation of engine lubricating oils for Cummins® engines, refer to Cummins® Engine Oil Recommendations, Bulletin 3810340.

Additional information regarding lubricating oil availability throughout the world is available in the Engine Manufacturing Association (EMA) Lubricating Oils Data Book for Heavy Duty Automotive and Industrial Engines. The

data book can be ordered from: Engine Manufacturers Association, Two North LaSalle Street, Suite 2200, Chicago, IL 60602; Phone: (312) 827-8700, Facsimile: (312) 827-8737 (www.enginemanufacturers.org).

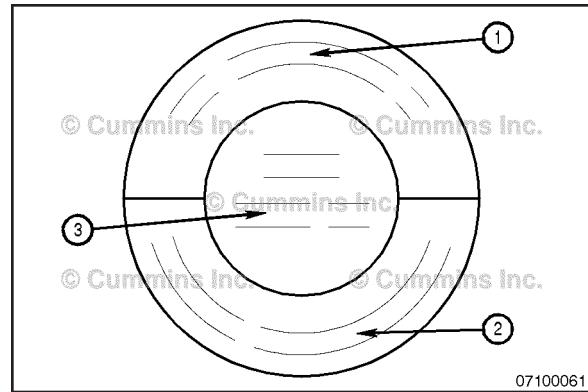
Oil viscosity **must** be chosen according to the typical climate conditions experienced by the user. Use of 15W-40 is recommended for the best engine durability at higher ambient temperatures. For cold conditions 5W-30 viscosity can be used for easier starting and improved oil flow.

AfterMarket Oil Additive Usage

Cummins Inc. does **not** recommend the use of aftermarket oil additives. Present high-quality fully additive engine lubricating oils are very sophisticated, with precise amounts of additives blended into the lubricating oil to meet stringent requirements defined in (1) Cummins® Engineering Specification CES 20076 that is similar to API CH-4, in (2) CES 20078 that is similar to API CI-4, and in (3) CES 20081 that is similar to API CJ-4. These furnished oils meet performance characteristics that conform to the lubricant industry standards. Aftermarket lubricating oil additives are **not** necessary to enhance engine oil performance and in some cases can reduce the finished oil's capability to protect the engine.

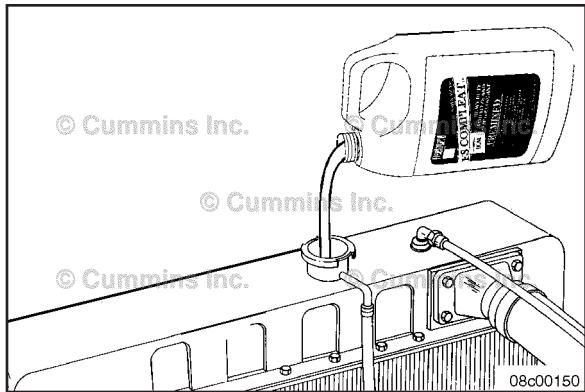
The API service symbols are shown in the accompanying illustration.

- 1 The upper half of the symbols display the appropriate oil categories.
- 2 The lower half contains words to describe additional oil information.
- 3 The center section identifies the SAE oil viscosity grade.



New Engine Break-in Oils

Special "break-in" engine lubricating oils are **not** recommended for new or rebuilt Cummins® engines. Use the same lubricating oil that will be used during normal operation.



Coolant Recommendations and Specifications

Fully Formulated Coolant/Antifreeze

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

NOTE: Low-silicate antifreeze meeting ASTM D4985 is inadequate for these extended service intervals of 80,467 to 241,402 km [50,000 to 150,000 miles].

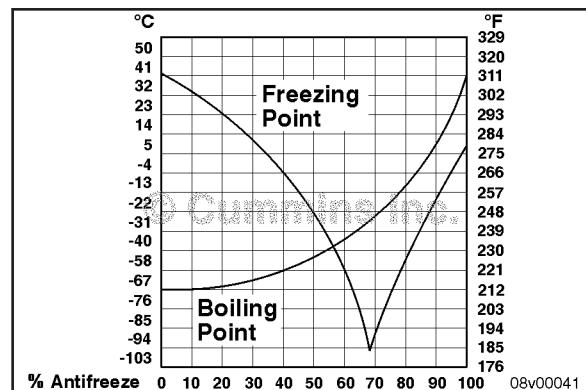
Cummins Inc. recommends using either a 50/50 mixture of good-quality water and fully formulated antifreeze, or fully formulated coolant when filling the cooling system. The fully formulated antifreeze or coolant **must** meet CES14603 specifications.

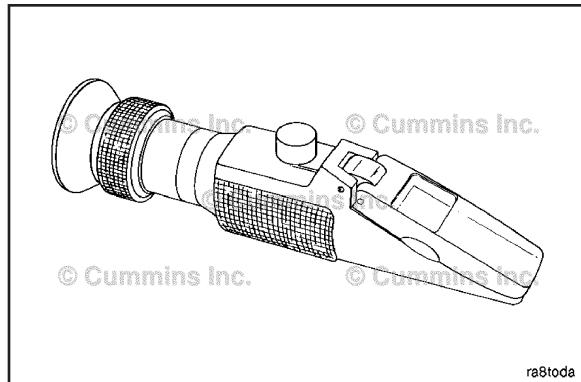
Good-quality water is important for cooling system performance. Excessive levels of calcium and magnesium contribute to scaling problems, and excessive levels of chlorides and sulfates cause cooling system corrosion.



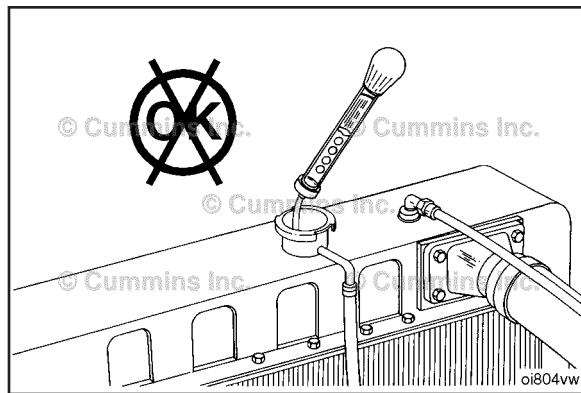
Water Quality	
Calcium Magnesium (Hardness)	Maximum 170 ppm as $(\text{CaCO}_3 + \text{MgCO}_3)$
Chloride	40 ppm as (Cl)
Sulfate	100 ppm as (SO_4)

Fully formulated antifreeze **must** be mixed with quality water at a 50/50 ratio (40-percent to 60-percent working range). A 50/50 mixture of antifreeze and water gives a -36°C [-33°F] freezing point and a 110°C [230°F] boiling point, which is adequate for locations in North America. The actual lowest freezing point of ethylene glycol antifreeze is 68 percent. Using higher concentrations of antifreeze will raise the freezing point of the solution and increase the possibility of a silica gel problem.





A refractometer **must** be used to measure the freezing point of the coolant **accurately**.

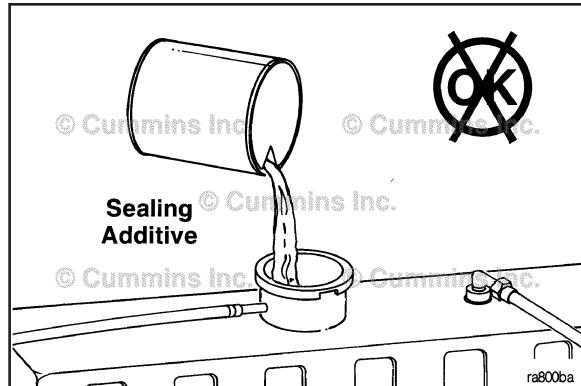


Do **not** use a floating ball hydrometer. Using a floating ball hydrometer can give an incorrect reading.

Cooling System Sealing Additives

Do **not** use sealing additives in the cooling systems. The use of sealing additives can:

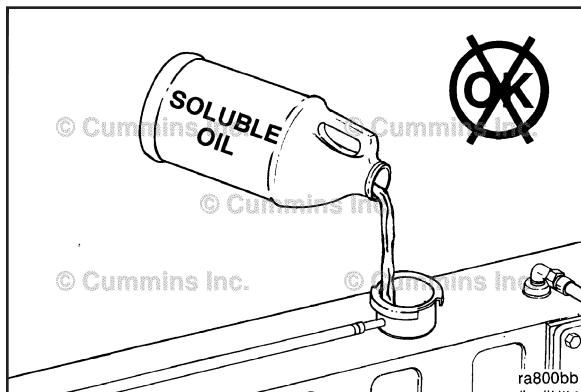
- Build up in coolant low-flow areas
- Clog coolant filters
- Plug radiator and oil cooler.



Cooling System Soluble Oils

Do **not** use soluble oils in the cooling system. The use of soluble oils can:

- Allow cylinder liner pitting
- Corrode brass, aluminum, and copper
- Damage heat transfer surfaces
- Damage seals and hoses.



Fleetguard® DCA4 Service Filters and Liquid Precharge

Coolant Filter Options for Standard Service or Extended Service Intervals:

WF2125 - This filter designed for use with a Fleetguard® extended service cooling system, which extends cooling system service up to 1 year, 241,402 km [150,000 miles], or 4000 hours, whichever comes first. This filter is used for cooling systems up to 76 liters [20 gal]. Refer to Service Bulletin, Coolant Requirements and Maintenance, Bulletin 3666132. Fleetguard® ES coolant must be used for all fill and top-off, which is critical for extended cooling system maintenance intervals.

WF2126 - This filter is designed for extended service intervals up to 80,467 km [50,000 miles] when using TMC RP329 or RP330 coolants and is used for cooling system up to 76 liters [20 gal]. Refer to Service Bulletin, Coolant Requirements and Maintenance, Bulletin 3666132.

WF2127 - This filter has been designed for extended service interval of 80,467 to 241,402 km [50,000 to 150,000 miles]. It has no chemical additives and can be used in the following systems:

- Cooling systems above 76 liters [20 gal] in capacity.
- See maintenance chart in this procedure.

When using WF2127 filter, the following volumes of treatment **must** be added at the designated mileages:

Cooling System Capacity	80,467 km [50,000 mile] Service Interval with the RP329/330 Coolant or Treated Water (Fleetcool or DCA4)	241,402 km [150,000 mile] - Service Interval with ES Coolant (ES Liquid).
0 to 76 liters [0 to 20 gal]	1 liter [1 qt] (10 units)	1 liter [1 qt] (15 units)

Cooling System Capacity	80,467 km [50,000 mile] Service Interval with the RP329/330 Coolant or Treated Water (Fleetcool or DCA4)	241,402 km [150,000 mile] - Service Interval with ES Coolant (ES Liquid).
76 to 151 liters [20 to 40 gal]	1.9 liter [2 qt] (20 units)	1.9 liter [2 qt] qt (30 units)
151 to 227 liters [40 to 60 gal]	2.8 liters [3 qt] (30 units)	2.8 liters [3 qt] (45 units)
227 to 303 liters [60 to 80 gal]	3.8 liters [4 qt] (40 units)	3.8 liters [4 qt] (60 units)
303 to 379 liters [80 to 100 gal]	4.7 liters [5 qt] (50 units)	4.7 liters [5 qt] (75 units)

NOTE: Filters **must** meet Cummins Inc. SAM 10769. Fleetguard® filters meet Cummins Inc. SAM 10769. For systems larger than 416 liters [100 gal], use 1 liter [1 qt] of SCA per 57 liters [15 gal]. Consult the vehicle manufacturer for total cooling system capacity.

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 and 54°C [50 and 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 coolant 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 gallon of coolant.

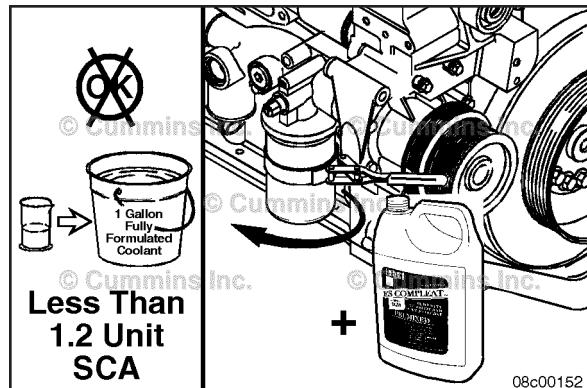
Test Intervals



Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

Testing is recommended if the operator is **not** sure of his cooling system condition due to leaks, uncontrolled topping off of the system, or major coolant loss.

If the concentration is below 1.2 units per 3.8 liters [1gal], replace the filter and precharge with liquid.



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Check the SCA concentration level at least every 6 months, and anytime the coolant condition is unknown or corrosion is apparent within the cooling system.

Use Fleetguard® coolant test kit, CC2602, to check the concentration level. Instructions are included with the test kit.

Call the following numbers to get answers to any questions you have about cooling system maintenance:

Cummins Inc.	Fleetguard®
1-800-DIESELS	1-800-22FILTER
1-800-343-7357	1-800-223-4583

Coolant Replacement Requirements

⚠ WARNING ⚠

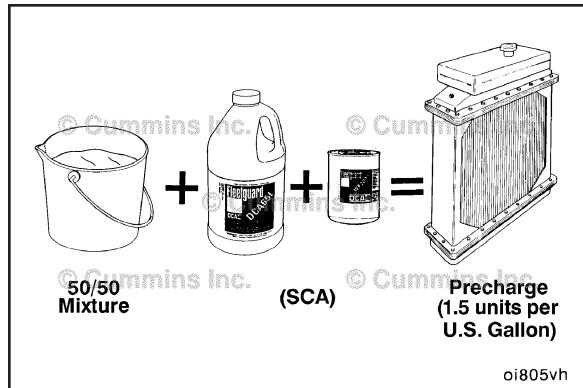
Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

NOTE: Dispose of used coolant/antifreeze in accordance with federal, state, and local laws and regulations.

Drain and flush the cooling system after 6000 hours or 3 years of service. However, if Fleetguard® ES coolant and ES filters are used, check chloride, sulfate, and pH levels according to Service Bulletin, Coolant Requirements and Maintenance, Bulletin 3666132, to determine whether the coolant **must** be replaced. Refill with either new fully formulated coolant or ES coolant.



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Notes

Section W - Warranty

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All Engines Worldwide Generator Drive Engines Warranted

This Warranty applies to new Engines sold by Cummins and delivered to the first user on or after April 1, 1999, that are used in generator drive applications anywhere in the world where Cummins approved service is available. These Engines will have the following rating designations:

Standby Power Rating

Engines of this rating are applicable for supplying emergency power for the duration of the utility power outage. No overload capability is available for this rating. Under no condition is an Engine allowed to operate in parallel with the public utility at the Standby Power rating. This rating should be applied where reliable utility power is available. A Standby rated Engine is to be sized for a maximum of an 80 percent average load factor and 200 hours of operation per year. This includes less than 25 hours per year at the Standby Power rating. Standby rating should never be applied except in true emergency power outages. Negotiated power outages contracted with a utility company are not considered an emergency.

Unlimited Time Running Prime Power Rating

Engines with this rating are available for an unlimited number of hours per year in a variable load application. Variable load is not to exceed a 70 percent average of the Prime Power rating during any operating period of 250 hours. Total operating time at 100 percent Prime Power shall not exceed 500 hours per year.

A 10 percent overload capability is available for a period of one hour within a twelve hour period of operation. Total operating time at the 10 percent overload power shall not exceed 25 hours per year.

Limited Time Running Prime Power Rating

Engines of this rating are available for a limited number of hours in a non-variable load application. It is intended for use in situations where power outages are contracted, such as in utility power curtailment. Engines may be operated in parallel to the public utility up to 750 hours per year at power levels never to exceed the Prime Power rating.

Limited Time Running Prime Power ratings differ from Unlimited Time Running in that even though the maximum power output of the Engines is the same, the Limited Time Running allows the Engine to be parallel to the public utility and run at the full Prime Power rating and must never exceed the Prime Power rating.

Continuous/Base Power Rating

Engines with this rating are available for supplying utility power at a constant 100 percent load for an unlimited number of hours per year. No overload capability is available for this rating.

Continuous/Base Power ratings differ from Unlimited Time Running Prime Power ratings in that the Continuous/Base Load ratings are significantly reduced from the Prime Power ratings. Continuous/Base Load ratings have no load factor or application restrictions.

Coverage

Base Engine Warranty

This Warranty covers any failures of the Engine, under normal use and service, which result from a defect in material or factory workmanship (Warrantable Failure).

Coverage begins with the sale of the Engine by Cummins and continues for the Duration stated below. The Duration commences either on the date of delivery of the Engine to the first user, or on the date the Engine is first leased, rented or loaned, or when the Engine has been operated for 50 hours, whichever occurs first.

Base Engine Warranty

Duration

Whichever Occurs First

Rating	Months	Hours
Standby Power	24	400
Unlimited Prime Power	12	Unlimited
Limited Prime Power	12	750

Base Engine Warranty

Duration

Whichever Occurs First

Rating	Months	Hours
Continuous/Base Power	12	Unlimited

Engine aftertreatment components included in the Cummins Critical Parts List (CPL) and marked with a Cummins part number are covered under Base Engine Warranty.

Additional Coverage is outlined in the Emission Warranty section.

Extended Major Components Warranty

The Extended Major Components Warranty covers Warrantable Failures of the Engine cylinder block, camshaft, crankshaft and connecting rods (Covered Parts). Bushing and bearing failures are not covered. The Duration commences either on the date of delivery of the Engine to the first user, or on the date the Engine is first leased, rented or loaned, or when the Engine has been operated for 50 hours, whichever occurs first.

Extended Major Components Warranty

Duration

Whichever Occurs First

Rating	Months	Hours
Standby Power	36	600
Unlimited Prime Power	36	10,000
Limited Prime Power	36	2,250
Continuous/Base Power	36	10,000

Consumer Products

To buy Cummins Parts and Service Manuals, Training Guides, or Tools go to our website at <https://store.cummins.com>

This Warranty on Consumer Products in the United States* is a LIMITED Warranty. **CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.** Any implied Warranties applicable to Consumer Products terminate concurrently with the expiration of the express Warranties applicable to the product. In the United States*, some states do not allow the exclusion of incidental or consequential damages, or limitations on how long an implied Warranty lasts, so the limitations or exclusions herein may not apply to you.

These Warranties are made to all Owners in the chain of distribution and Coverage continues to all subsequent Owners until the end of the periods of Coverage.

Cummins Responsibilities

During The Base Engine Warranty

Cummins will pay for all parts and labor needed to repair the damage to the Engine resulting from a Warrantable Failure when performed during normal business hours. All labor costs will be paid in accordance with Cummins published Standard Repair Time guidelines.

Alternators, starters and fans ARE covered for the duration of the Base Engine Warranty on B3.3 Engines.

Cummins will pay for the lubricating oil, antifreeze, filter elements and other maintenance items that are not reusable due to the Warrantable Failure.

Cummins will pay reasonable travel expenses for mechanics to travel to and from the Engine site, including meals, mileage and lodging when the repair is performed at the site of the failure.

Cummins will pay reasonable labor costs for Engine removal and reinstallation when necessary to repair a Warrantable Failure.

During The Extended Major Components Warranty

Cummins will pay for the repair or, at its option, replacement of the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner Responsibilities

During The Base Engine Warranty

To buy Cummins Parts and Service Manuals, Training Guides, or Tools go to our website at <https://store.cummins.com>

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during Warranty repairs unless such items are not reusable due to the Warrantable Failure.

During The Extended Major Components Warranty

Owner is responsible for the cost of all labor needed to repair the Engine, including the labor cost for Engine removal and reinstallation. When Cummins elects to repair a part instead of replacing it, the Owner is not responsible for the labor needed to repair the part.

Owner is responsible for the cost of all parts required for the repair except for the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during repair of a Warrantable Failure.

During The Base Engine And Extended Major Components Warranties

Owner is responsible for the operation and maintenance of the Engine as specified in the applicable Cummins Operation and Maintenance Manual. Owner is also responsible for providing proof that all recommended maintenance has been performed.

Before the expiration of the applicable Warranty, Owner must notify a Cummins distributor, authorized dealer or other repair location approved by Cummins of any Warrantable Failure and make the Engine available for repair by such facility. Service locations are listed on the Cummins Worldwide Service Locator at cummins.com.

Owner is responsible for communication expenses, meals, lodging and similar costs incurred as a result of a Warrantable Failure.

Owner is responsible for non-Engine repairs, "downtime" expenses, fines, all applicable taxes, all business costs and other losses resulting from a Warrantable Failure.

Owner is responsible for providing sufficient access to and reasonable ability to remove the Engine from the installation in the event of a Warrantable Failure.

Owner is responsible for maintaining an operating Engine hourmeter. If the hourmeter is not operational, Engine usage will be estimated at 400 hours per month.

Emission Warranty

Products Warranted

This Emission Warranty applies to new Engines marketed by Cummins that are used in the United States* or Canada in generator drive applications for Off-Highway use. This Warranty applies to Engines delivered to the ultimate purchaser on or after April 1, 1999 for Engines up to 750 horsepower and on or after January 1, 2000 for Engines 751 and over.

Coverage

Cummins warrants to the ultimate purchaser and each subsequent purchaser that the Engine is designed, built and equipped so as to conform at the time of sale by Cummins with all U.S. Federal emission regulations applicable at the time of manufacture and that it is free from defects in workmanship or material which would cause it not to meet these regulations within the longer of the following periods: (A) Five years or 3,000 hours of operation for industrial applications, five years or 3,500 hours of operation for industrial spark-ignited Engines (GTA855, G855, G5.9C, G8.3C, GTA8.9E, QSK19G, QSK60G) and five years or 2,500 hours of operation for industrial spark-ignited Engines (GKTA19-GC), whichever occurs first, as measured from the date of delivery of the Engine to the ultimate purchaser, or (B) The Base Engine Warranty.

If the vehicle in which the Engine is installed is registered in the state of California, a separate California Emission Warranty also applies.

Limitations

Engines with an emissions certification listed below must be operated using only diesel fuel having no more than the corresponding maximum sulfur content. Failure to use the specified fuel as listed in the Cummins Fuel Bulletin #3379001 Table 1 (Cummins Inc. Required Diesel Fuel Specifications) can damage the Engine and aftertreatment system within a short period of time. This damage could cause the Engine to become inoperable and failures

attributable to the use of incorrect fuels will be denied Warranty Coverage. Fuel specifications also need to comply with local fuel regulations (EN590 for Europe and ASTM D975 for North America) for Warranty eligibility.

Maximum sulfur levels by emissions certification level as listed on the Engine's dataplate are:

EPA 2007/2010/2013/2017	max. 15 parts per million
EPA Tier 4 Interim / Final	max. 15 parts per million
EU Stage IIIB 2011	max. 15 parts per million
Euro 4/5	max. 50 parts per million
Euro 6	max. 10 parts per million

Additions to Limitations for HHP LBNG Engines:

Engines with an emissions certification listed below must be operated using only pipeline natural gas or non-commercial natural gas having no more than the corresponding sulfur content. Failure to use the specified fuel as listed in the engines applicable Operation and Maintenance Manual, Procedure 018-002 in Section V – Maintenance Specifications, can damage the Engine and after treatment system within a short period of time. This damage could cause the Engine to become inoperable and failures attributable to the use of incorrect fuels will be denied Warranty Coverage.

**Maximum Sulfur Levels by Emissions
Certification Level as listed on the Engine's
Dataplate are (High Horsepower Lean-Burn
Natural Gas Engines):**

EPA Tier 2 Nonroad	Maximum 20 parts per million (ppmv)
EPA NSPS	Maximum 20 parts per million (ppmv)

Before a claim for excessive oil consumption will be considered, Owner must submit adequate documentation to show that consumption exceeds Cummins published standards.

Failure of belts and hoses supplied by Cummins is not covered beyond the first 500 hours or one year of operation, or expiration of the Base Warranty, whichever occurs first after the Warranty start date.

Parts used to repair a Warrantable Failure may be new Cummins parts, Cummins approved rebuilt parts or repaired parts. Cummins is not responsible for failures resulting from the use of parts not approved by Cummins.

A new Cummins or Cummins approved rebuilt part used to repair a Warrantable Failure assumes the identity of the part it replaced and is entitled to the remaining Coverage hereunder.

Cummins is not responsible for Engine performance problems or failures resulting from:

- 1 Use or application of the Engine inconsistent with its rating designation as set forth above.
- 2 Inadequate or incorrect installations deviating from Cummins Generator Drive Installation Guidelines.

CUMMINS IS NOT RESPONSIBLE FOR WEAR OR WEAROUT OF COVERED PARTS.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

THE WARRANTIES SET FORTH HEREIN ARE THE SOLE WARRANTIES MADE BY CUMMINS IN REGARD TO THESE ENGINES. CUMMINS MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

In the United States* and Canada, this Warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Outside the United States* and Canada, in the case of consumer sales, in some countries, the Owner has statutory rights which cannot be affected or limited by the terms of this Warranty.

Nothing in this Warranty excludes or restricts any contractual rights the owner may have against third parties.

* United States includes American Samoa, the Commonwealth of Northern Mariana Islands, Guam, Puerto Rico and the U.S. Virgin Islands.

All Engines United States And Canada Industrial (Off-Highway) Coverage

Products Warranted

This Warranty applies to new Engines sold by Cummins and delivered to the first user on or after April 1, 1999, that are used in Industrial (Off-Highway) applications in the United States* and Canada, except for Engines used in marine, generator drive, QSK95 T4 locomotive and certain defense applications, for which different Warranty Coverage is provided.

Base Engine Warranty

This Warranty covers any failures of the Engine, under normal use and service, which result from a defect in material or factory workmanship (Warrantable Failures).

Coverage begins with the sale of the Engine by Cummins. Coverage continues for two years or 2,000 hours of operation, whichever occurs first, from the date of delivery of the Engine to the first user, or from the date the unit is first leased, rented or loaned, or when the Engine has been operated for 50 hours, whichever occurs first. If the 2,000 hour limit is exceeded during the first year, Coverage continues until the end of the first year.

Engine aftertreatment components included in the Cummins Critical Parts List (CPL) and marked with a Cummins part number are covered under Base Engine Warranty.

Additional Coverage is outlined in the Emission Warranty section.

Extended Major Components Warranty

The Extended Major Components Warranty covers Warrantable Failures of the Engine cylinder block, camshaft, crankshaft and connecting rods (Covered Parts).

Bushing and bearing failures are not covered.

This Coverage begins with the expiration of the Base Engine Warranty and ends three years or 10,000 (3,000 hours for A Series Engines) hours of operation from the date of delivery of the Engine to the first user, or from the date the unit is first leased, rented or loaned, or from when the Engine has been operated for 50 hours, whichever occurs first.

Consumer Products

The Warranty on Consumer Products in the United States* is a LIMITED Warranty. **CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.** Any implied Warranties applicable to Consumer Products in the United States* terminate concurrently with the expiration of the express Warranties applicable to the product. In the United States*, some states do not allow the exclusion of incidental or consequential damages, or limitations on how long an implied Warranty lasts, so the limitations or exclusions herein may not apply to you.

These Warranties are made to all Owners in the chain of distribution and Coverage continues to all subsequent Owners until the end of the periods of Coverage.

Cummins Responsibilities

During The Base Engine Warranty

Cummins will pay for all parts and labor needed to repair the damage to the Engine resulting from a Warrantable Failure.

Alternators, starters, and fans ARE covered for the duration of the Base Engine Warranty on A Series and B3.3 Engines.

Alternators and starters are covered for the duration of the Base Engine Warranty on QSK23 Engines.

Cummins will pay for the lubricating oil, antifreeze, filter elements and other maintenance items that are not reusable due to the Warrantable Failure.

Cummins will pay reasonable costs for mechanics to travel to and from the equipment site, including meals, mileage and lodging, when the repair is performed at the site of the failure.

Cummins will pay reasonable labor costs for Engine removal and reinstallation when necessary to repair a Warrantable Failure.

During The Extended Major Components Warranty

Cummins will pay for the repair or, at its option, replacement of the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner Responsibilities

During The Base Engine Warranty

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items provided during Warranty repairs unless such items are not reusable due to the Warrantable Failure.

During The Extended Major Components Warranty

Owner is responsible for the cost of all labor needed to repair the Engine, including the labor to remove and reinstall the Engine. When Cummins elects to repair a part instead of replacing it, Owner is not responsible for the labor needed to repair the part.

Owner is responsible for the cost of all parts required for the repair except for the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during repair of a Warrantable Failure.

During The Base Engine And Extended Major Components Warranties

Owner is responsible for the operation and maintenance of the Engine as specified in the applicable Cummins Operation and Maintenance Manual. Owner is also responsible for providing proof that all recommended maintenance has been performed.

Before the expiration of the applicable Warranty, Owner must notify a Cummins distributor, authorized dealer or other repair location approved by Cummins of any Warrantable Failure and make the Engine available for repair by such facility. Service locations are listed on the Cummins Worldwide Service Locator at cummins.com.

Owner is responsible for communication expenses, meals, lodging and similar costs incurred as a result of a Warrantable Failure.

Owner is responsible for non-Engine repairs, "downtime" expenses, cargo damage, fines, all applicable taxes, all business costs and other losses resulting from a Warrantable Failure.

Limitations

Engines with an emissions certification listed below must be operated using only diesel fuel having no more than the corresponding maximum sulfur content. Failure to use the specified fuel as listed in the Cummins Fuel Bulletin #3379001 Table 1 (Cummins Inc. Required Diesel Fuel Specifications) can damage the Engine and aftertreatment system within a short period of time. This damage could cause the Engine to become inoperable and failures attributable to the use of incorrect fuels will be denied Warranty Coverage. Fuel specifications also need to comply with local fuel regulations (EN590 for Europe and ASTM D975 for North America) for Warranty eligibility.

Maximum sulfur levels by emissions certification

level as listed on the Engine's dataplate are:

EPA 2007/2010/2013	max. 15 parts per million
EPA Tier 4 Interim / Final	max. 15 parts per million
EU Stage IIIB 2011	max. 15 parts per million
Euro 4/5	max. 50 parts per million
Euro 6	max. 10 parts per million

Cummins is not responsible for failures or damage resulting from what Cummins determines to be abuse or neglect, including, but not limited to: operation without adequate coolants or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage, starting, warm-up, run-in or shutdown practices; unauthorized modifications of the Engine. Cummins is also not responsible for failures caused by incorrect oil, fuel or diesel exhaust fluid or by water, dirt or other contaminants in the fuel, oil or diesel exhaust fluid.

For power units and fire pumps (package units), this Warranty applies to accessories, except for clutches and filters, supplied by Cummins which bear the name of another company.

Cummins Compusave units are covered by a separate Warranty.

Before a claim for excessive oil consumption will be considered, Owner must submit adequate documentation to show that consumption exceeds Cummins published standards.

Failures of belts and hoses supplied by Cummins are not covered beyond the first 500 hours or one year of operation, whichever occurs first.

Parts used to repair a Warrantable Failure may be new Cummins parts, Cummins approved rebuilt parts or repaired parts. Cummins is not responsible for failures resulting from the use of parts not approved by Cummins.

A new Cummins or Cummins approved rebuilt part used to repair a Warrantable Failure assumes the identity of the part it replaced and is entitled to the remaining Coverage hereunder.

For all A Series Applications, including Industrial, travel reimbursement for non-transportable equipment will be limited to 4.0 hours, \$0.25/mile and 250 miles maximum. Any costs beyond this limit are the customer's responsibility.

CUMMINS DOES NOT COVER WEAR OR WEAROUT OF COVERED PARTS.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

THESE WARRANTIES SET FORTH HEREIN ARE THE SOLE WARRANTIES MADE BY CUMMINS IN REGARD TO THESE ENGINES. CUMMINS MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

This Warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Emission Warranty

Products Warranted

This Emission Warranty applies to new Engines marketed by Cummins that are used in the United States* and Canada in vehicles designed for Industrial Off-Highway use. This Warranty applies to Engines delivered to the ultimate purchaser on or after April 1, 1999, for Engines up to 750 horsepower and on or after January 1, 2000, for Engines 751 horsepower and over.

Coverage

To buy Cummins Parts and Service Manuals, Training Guides, or Tools go to our website at <https://store.cummins.com>

Cummins warrants to the ultimate purchaser and each subsequent purchaser that the Engine is designed, built and equipped so as to conform at the time of sale by Cummins with all U.S. Federal emission regulations applicable at the time of manufacture and that it is free from defects in workmanship or material which would cause it not to meet these regulations within the longer of the following periods: (A) **Five years or 3,000 hours of operation for industrial applications, five years or 3,500 hours of operation for industrial spark-ignited Engines (GTA855, G855, G5.9C, G8.3-C, GTA8.9E, QSK19G) and five years or 2,500 hours of operation for industrial spark-ignited Engines (GKTA19-GC), whichever occurs first, as measured from the date of delivery of the Engine to the ultimate purchaser, or (B) The Base Engine Warranty.

If the vehicle in which the Engine is installed is registered in the state of California, a separate California Emission Warranty also applies.

Limitations

Engines with an emissions certification listed below must be operated using only diesel fuel having no more than the corresponding maximum sulfur content. Failure to use the specified fuel as listed in the Cummins Fuel Bulletin #3379001 Table 1 (Cummins Inc. Required Diesel Fuel Specifications) can damage the Engine and aftertreatment system within a short period of time. This damage could cause the Engine to become inoperable and failures attributable to the use of incorrect fuels will be denied Warranty Coverage. Fuel specifications also need to comply with local fuel regulations (EN590 for Europe and ASTM D975 for North America) for Warranty eligibility.

Maximum sulfur levels by emissions certification level as listed on the Engine's dataplate are:

EPA 2007/2010/2013	max. 15 parts per million
EPA Tier 4 Interim / Final	max. 15 parts per million
EU Stage IIIB 2011	max. 15 parts per million
Euro 4/5	max. 50 parts per million
Euro 6	max. 10 parts per million

Failures, other than those resulting from defects in materials or workmanship, are not covered by this Warranty.

Cummins is not responsible for failures or damage resulting from what Cummins determines to be abuse or neglect, including, but not limited to: operation without adequate coolant or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage, starting, warm-up, run-in or shutdown practices; unauthorized modifications of the Engine. Cummins is also not responsible for failures caused by incorrect oil, fuel or diesel exhaust fluid or by water, dirt or other contaminants in the fuel, oil or diesel exhaust fluid.

Cummins is not responsible for non-Engine repairs, "downtime" expenses, cargo damage, fines, all business costs or other losses resulting from a Warrantable Failure.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

* United States includes American Samoa, the Commonwealth of Northern Mariana Islands, Guam, Puerto Rico and the U.S. Virgin Islands.

** Emissions Warranty for BLPG Industrial Off-Highway Engines is 5 years / 3,500 hours.

All Engines International Industrial (Off-Highway) Coverage

Products Warranted

This Warranty applies to new Engines sold by Cummins and delivered to the first user on or after April 1, 1999, that are used in Industrial (Off-Highway) applications anywhere in the world where Cummins approved service is available, except the United States and Canada. Different Warranty Coverage is provided for Engines used in marine, generator drive, QSK95 T4 locomotive and certain defense applications.

Base Engine Warranty

This Warranty covers any failures of the Engine, under normal use and service, which result from a defect in material or factory workmanship (Warrantable Failure).

Coverage begins with the sale of the Engine by Cummins. Coverage continues for two years or 2,000 hours of operation, whichever occurs first, from the date of delivery of the Engine to the first user, or from the date the unit is first leased, rented or loaned, or when the Engine has been operated for 50 hours, whichever occurs first. If the 2,000 hour limit is exceeded during the first year, Coverage continues until the end of the first year.

Engine aftertreatment components included in the Cummins Critical Parts List (CPL) and marked with a Cummins part number are covered under Base Engine Warranty.

Extended Major Components Warranty

The Extended Major Components Warranty covers Warrantable Failures of the Engine cylinder block, camshaft, crankshaft and connecting rods (Covered Parts).

Bushing and bearing failures are not covered.

This Coverage begins with the expiration of the Base Engine Warranty and ends three years or 10,000 hours (3,000 hours for A Series Engines) of operation, from the date of delivery of the Engine to the first user, or from the date the unit is first leased, rented or loaned, or when the Engine has been operated for 50 hours, whichever occurs first.

These Warranties are made to all Owners in the chain of distribution, and Coverage continues to all subsequent Owners until the end of the periods of Coverage.

Cummins Responsibilities

During The Base Engine Warranty

Cummins will pay for all parts and labor needed to repair the damage to the Engine resulting from a Warrantable Failure.

Alternators, starters, and fans ARE covered for the duration of the Base Engine Warranty on A Series and B3.3 Engines.

Alternators and starters are covered for the duration of the Base Engine Warranty on QSK23 Engines.

Cummins will pay for the lubricating oil, antifreeze, filter elements and other maintenance items that are not reusable due to a Warrantable Failure.

Cummins will pay reasonable costs for mechanics to travel to and from the equipment site, including meals, mileage and lodging, when the repair is performed at the site of the failure.

Cummins will pay reasonable labor costs for Engine removal and reinstallation when necessary to repair a Warrantable Failure.

During The Extended Major Components Warranty

Cummins will pay for the repair or, at its option, replacement of the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner Responsibilities

During The Base Engine Warranty

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during Warranty repairs unless such items are not reusable due to the Warrantable Failure.

During The Extended Major Components Warranty

Owner is responsible for the cost of all labor needed to repair the Engine, including the labor to remove and reinstall the Engine. When Cummins elects to repair a part instead of replacing it, Owner is not responsible for the labor needed to repair the part.

Owner is responsible for the cost of all parts required for the repair except for the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during repair of a Warrantable Failure.

During The Base Engine Warranty And Extended Major Components Warranties

Owner is responsible for the operation and maintenance of the Engine as specified in the applicable Cummins Operation and Maintenance Manual. Owner is also responsible for providing proof that all recommended maintenance has been performed.

Before the expiration of the applicable Warranty, Owner must notify a Cummins distributor, authorized dealer or other repair location approved by Cummins of any Warrantable Failure and make the product available for repair by such facility. Service locations are listed in the Cummins Worldwide Service Locator at cummins.com.

Owner is responsible for communication expenses, meals, lodging and similar costs incurred as a result of a Warrantable Failure.

Owner is responsible for non-Engine repairs, "downtime" expenses, cargo damage, fines, all applicable taxes, all business costs and other losses resulting from a Warrantable Failure.

Limitations

Engines with an emissions certification listed below must be operated using only diesel fuel having no more than the corresponding maximum sulfur content. Failure to use the specified fuel as listed in the Cummins Fuel Bulletin #3379001 Table 1 (Cummins Inc. Required Diesel Fuel Specifications) can damage the Engine and aftertreatment system within a short period of time. This damage could cause the Engine to become inoperable and failures attributable to the use of incorrect fuels will be denied Warranty Coverage. Fuel specifications also need to comply with local fuel regulations (EN590 for Europe and ASTM D975 for North America) for Warranty eligibility.

Maximum sulfur levels by emissions certification level as listed on the Engine's dataplate are:

EPA 2007/2010/2013	max. 15 parts per million
EPA Tier 4 Interim / Final	max. 15 parts per million
EU Stage IIIB 2011	max. 15 parts per million
Euro 4/5	max. 50 parts per million
Euro 6	max. 10 parts per million

Cummins is not responsible for failures or damage resulting from what Cummins determines to be abuse or neglect, including, but not limited to: operation without adequate coolants or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage, starting, warm-up, run-in or shutdown practices; unauthorized modifications of the Engine. Cummins is also not responsible for failures caused by incorrect oil, fuel or diesel exhaust fluid or by water, dirt or other contaminants in the fuel, oil or diesel exhaust fluid.

For power units and fire pumps (package units) the Warranty applies to accessories, except for clutches and filters supplied by Cummins which bear the name of another company.

Cummins Compusave units are covered by a separate Warranty.

Before a claim for excessive oil consumption will be considered, Owner must submit adequate documentation to show that consumption exceeds Cummins published standards.

Failures of belts and hoses supplied by Cummins are not covered beyond the first 500 hours or one year of operation, whichever occurs first.

Parts used to repair a Warrantable Failure may be new Cummins parts, Cummins approved rebuilt parts or repaired parts. Cummins is not responsible for failures resulting from the use of parts not approved by Cummins.

A new Cummins or Cummins approved rebuilt part used to repair a Warrantable Failure assumes the identity of the part it replaced and is entitled to the remaining Coverage hereunder.

For all A Series Applications, including Industrial, travel reimbursement for non-transportable equipment will be limited to 4.0 hours, \$0.25/mile and 250 miles maximum. Any costs beyond this limit are the customer's responsibility.

CUMMINS DOES NOT COVER WEAR OR WEAROUT OF COVERED PARTS.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

THESE WARRANTIES SET FORTH HEREIN ARE THE SOLE WARRANTIES MADE BY CUMMINS IN REGARD TO THESE ENGINES. CUMMINS MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

In the case of consumer sales, in some countries, the Owner has statutory rights which cannot be affected or limited by the terms of this Warranty.

Nothing in this Warranty excludes or restricts any contractual rights the Owner may have against third parties.

Worldwide HHP Marine Commercial Propulsion And Auxiliary Products Coverage

Products Warranted Marine

This Warranty applies to new Engines sold by Cummins Inc., hereinafter "Cummins", and used in HHP marine commercial propulsion and marine auxiliary applications anywhere in the world where Cummins approved service is available and delivered to the first user on or after July 1, 2002. This Warranty excludes all Engines branded and sold as Cummins Recreational and Light Commercial Marine Products. The "Product" consists of a new Cummins Engine, as well as accessories, which are approved and supplied by Cummins and which are either installed by Cummins or a Cummins authorized distributor. These Products have the following designation:

HHP Marine Commercial Propulsion And Marine Auxiliary (excluding generator drive engines)

Intermittent Rating

This power rating is intended for intermittent use in variable load applications where full power is limited to two hours out of every eight hours of operation. Also, reduced power operations must be at or below 200 RPM of the maximum rated RPM. This rating is an ISO10555 Fuel Stop Power Rating and is for applications that operate less than 1,500 hours per year.

Medium Continuous Rating

This power rating is intended for continuous use in variable load applications where full power is limited to 6 hours out of every 12 hours of operation. Also, reduced power operations must be at or below 200 RPM of the maximum rated RPM. This rating is an ISO10555 Fuel Stop Power Rating and is for applications that operate less than 3,000 hours per year.

Heavy Duty Rating

This power rating is intended for continuous use in variable load applications where full power is limited to 10 hours out of every 12 hours of operation. Also, reduced power must be at least 200 RPM below the maximum rated RPM. This rating is an ISO10555 Fuel Stop Power Rating and is for applications that operate less than 5,000 hours per year.

Continuous Rating

This power rating is intended for continuous use in applications requiring uninterrupted service at full power. This rating is an ISO10555 Standard Power Rating.

Marine Generator Drive

Prime Power

Engines with this rating are available for an unlimited number of hours per year in variable load applications. Variable load is not to exceed a 70 percent average of the Prime Power.

A 10 percent overload capability is available for a period of one hour within a 12 hour period of operation. Total operating time at the 10 percent overload power shall not exceed 25 hours per year. This power rating conforms to ISO 8528 guidelines.

Continuous Power

Engines with this rating are available for supplying utility power at a constant 100 percent load for an unlimited number of hours per year. No overload capability is available for this rating.

Continuous Power ratings differ from Prime Power ratings in that the Continuous Load ratings are significantly reduced from the Prime Power ratings. Continuous Load ratings have no load factor or application restrictions. This power rating conforms to ISO 8528 guidelines.

Base Engine Warranty

This Warranty covers any failures of the Product, under normal use and service, which result from a defect in Cummins material or factory workmanship (Warrantable Failure). Coverage begins with the sale of the Engine by Cummins and ends at the time and hours stated in the following table. The Duration commences on either the date of delivery of the Product to the first end-user, or the date the unit is first leased, rented or loaned, or when the Product has been operated for 50 hours, whichever occurs first.

Rating	Duration	
	Years	Hours
Intermittent	1	1,500*
Medium Continuous	1	3,000*
Heavy Duty	1	5,000*
Continuous	1	Unlimited
Prime Power	1	Unlimited
Continuous Power	1	Unlimited
QSK95 - ALL Ratings	1	Unlimited

*Excludes QSK95

Extended Major Components Warranty

The Extended Major Components Warranty applies to Engines other than B and C Series. It covers Warrantable Failures of the Engine cylinder block, camshaft, crankshaft and connecting rods (Covered Parts). Bushing and bearing failures are not covered. This Coverage begins with the expiration of the Base Engine Warranty and ends at three years or 10,800 hours of operation, whichever occurs first, after the date of delivery to the first end-user, or the date the unit is first leased, rented or loaned, or when the Product has been operated for 50 hours, whichever occurs first.

These Warranties are made to all Owners in the chain of distribution and Coverage continues to all subsequent Owners until the end of the periods of Coverage.

Cummins Responsibilities

During Base Engine Warranty

Cummins will pay for all parts and labor needed to repair the damage to the Product resulting from a Warrantable Failure when performed during normal business hours. All labor costs will be paid in accordance with Cummins published Standard Repair Time guidelines to the Cummins authorized repair location.

When it is necessary for mechanics to make on-site Warranty repairs, Cummins will pay reasonable travel expenses, including meals, mileage and lodging, for mechanics to travel to and from the repair dock.

Cummins will pay for the lubricating oil, antifreeze, filter elements and other maintenance items that are not reusable due to the Warrantable Failure.

Cummins will pay for reasonable labor costs for Engine removal and reinstallation when necessary to repair a Warrantable Failure.

During The Extended Major Components Warranty

Cummins will pay for the repair or, at its option, replacement of the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner Responsibilities

During The Base Engine Warranty

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during Warranty repairs unless such items are not reusable due to the Warrantable Failure.

During The Extended Major Components Warranty

Owner is responsible for the cost of all labor needed to repair the Engine, including the labor cost for Engine removal and reinstallation. When Cummins elects to repair a part instead of replacing it, the Owner is not responsible for the labor needed to repair the part.

Owner is responsible for the cost of all parts required for the repair except for the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during repair of a Warrantable Failure.

During The Base Engine And Extended Major Components Warranties

Owner is responsible for the operation and maintenance of the Product as specified in the applicable Cummins Operation and Maintenance Manual. Owner is also responsible for providing proof that all recommended maintenance has been performed.

Before the expiration of the applicable Warranty, Owner must notify a Cummins distributor, authorized dealer, or other repair location approved by Cummins of any Warrantable Failure and make the Engine available for repair by such facility. Locations in the United States and Canada are listed in the Cummins U.S. and Canada Sales and Service Directory; other locations are listed in the Cummins International Sales and Service Directory.

In the event of any Product failure, Owner is responsible for the cost of towing the boat to the repair dock and for all associated docking and harbor charges.

Owner is responsible for communication expenses, meals, lodging and similar costs incurred as a result of a Warrantable Failure.

Owner is responsible for maintaining the Engine hourmeter in good working order at all times and to ensure that the hourmeter accurately reflects the total hours of operation of the Product.

Owner is responsible for the costs to investigate complaints, unless the problem is caused by a defect in Cummins material or factory workmanship.

Owner is responsible for non-Engine repairs, "downtime" expenses, cargo damage, fines, all applicable taxes, all business costs and other losses resulting from a Warrantable Failure.

Limitations

Cummins is not responsible for failures or damage resulting from what Cummins determines to be abuse or neglect, including, but not limited to: operation without adequate coolants or lubricants; overfueling; overspeeding; lack of maintenance of cooling, lubricating or intake systems; improper storage, starting, warm-up, run-in or shutdown practices; unauthorized modifications to the Engine. Cummins is also not responsible for failures caused by incorrect oil or fuel, or by water, dirt or other contaminants in the fuel or oil.

Cummins is not responsible for failures resulting from:

- 1 Use or application of the Product inconsistent with its rating designation set forth above.
- 2 Incorrect installation.

Before a claim for excessive oil consumption will be considered, Owner must submit adequate documentation to show that oil consumption exceeds Cummins published standards.

Cummins is not responsible for failures of marine maintenance components supplied by Cummins beyond 90 days after the Coverage start date. Marine maintenance components include, but are not limited to: zinc plugs, oil filters, fuel filters, air filters, water filters, fuel/water separator filters, expansion tank pressure caps.

Failure of belts and non-shielded hoses supplied by Cummins are not covered beyond 90 days after the date of delivery of the Product to the first user, or the date the unit is first leased, rented or loaned, or when the Product has been operated for 50 hours, whichever occurs first.

Parts used in Warranty repairs may be new Cummins parts, Cummins approved rebuilt parts, or repaired parts. Cummins is not responsible for failures resulting from the use of parts not supplied by Cummins.

Parts used to repair a Warrantable Failure may be new Cummins parts, Cummins approved rebuilt parts, or repaired parts. Cummins is not responsible for failures resulting from the use of parts not approved by Cummins.

A new Cummins or Cummins approved rebuilt part used to replace a Warranted Part assumes the identity of the Warranted Part it replaced and is entitled to the remaining Coverage hereunder.

Cummins Inc. reserves the right to interrogate Electronic Control Module (ECM) data for purposes of failure analysis.

CUMMINS DOES NOT COVER WEAR OR WEAROUT OF COVERED PARTS.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

THIS WARRANTY AND THE EMISSION WARRANTY SET FORTH HEREIN ARE THE SOLE WARRANTIES MADE BY CUMMINS IN REGARD TO THESE ENGINES. CUMMINS MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

In the United States* and Canada, this Warranty gives you specific legal rights, and you may also have other rights, which vary from state to state.

Outside the United States* and Canada, in case of consumer sales, in some countries the Owner has statutory rights, which cannot be affected or limited by the terms of this Warranty.

Nothing in this Warranty excludes or restricts any contractual rights the Owner may have against third parties.

Emission Warranty

Products Warranted

This Emission Warranty applies to new Engines certified to United States EPA 40 CFR 94 & 1042 sold by Cummins that are installed on vessels flagged or registered in the United States*.

Coverage

Cummins warrants to the first user and each subsequent purchaser that the Engine is designed, built and equipped so as to conform at the time of sale by Cummins with all United States Federal emission regulations applicable at the time of manufacture and that it is free from defects in material or factory workmanship which would cause it not to meet these regulations within the longer of the following periods: (A) Five years or 5,000 hours of operation, whichever occurs first, as measured from the date of delivery of the Engine to the first user, or the date the unit is first leased, rented or loaned, or when the Engine has been operated for 50 hours, whichever occurs first, or (B) The Base Engine Warranty.

Limitations

An Owner may elect to have maintenance, replacement or repair of the emission control parts performed by a facility other than a Cummins distributor, an authorized dealer or a repair location approved by Cummins, and may elect to use parts other than new genuine Cummins or Cummins approved rebuilt parts and assemblies

for such maintenance, replacement or repair; however, the cost of such service or parts and subsequent failures resulting from such service or parts will not be covered under this emission control system Warranty.

Failures, other than those resulting from defects in materials or factory workmanship, are not covered by this Warranty.

Cummins is not responsible for failures or damage resulting from what Cummins determines to be abuse or neglect, including, but not limited to: operation without adequate coolants or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage, starting, warm-up, run-in or shutdown practices; unauthorized modifications of the Engine. Cummins is also not responsible for failures caused by incorrect oil or fuel or by water, dirt or other contaminants in the fuel or oil.

Cummins is not responsible for non-Engine repairs, "downtime" expenses, cargo damage, fines, all applicable taxes, all business costs or other losses resulting from a Warrantable Failure.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

* United States includes American Samoa, the Commonwealth of Northern Mariana Islands, Guam, Puerto Rico, and the U.S. Virgin Islands.

California Emission Control System Warranty, Off-Highway Products Warranted

This Emission Control System Warranty applies to off-road diesel engines certified with the California Air Resources Board beginning with the year 1996 for engines up to 750 horsepower, beginning with the year 2000 for 751 horsepower and over, marketed by Cummins, and registered in California for use in industrial off-highway applications.

Your Warranty Rights and Obligations

The California Air Resources Board and Cummins Engine Company, Inc., are pleased to explain the emission control system warranty on your engine. In California, new off-road diesel engines must be designed, built and equipped to meet the State's stringent anti-smog standards. Cummins must warrant the emission control system on your engine for the periods of time listed below provided there has been no abuse, neglect or improper maintenance of your engine.

Your emission control system may include parts such as the fuel injection system and the air induction system. Also included may be hoses, belts, connectors and other emission-related assemblies.

Where a warrantable condition exists, Cummins will repair your off-road diesel engine at no cost to you including diagnosis, parts and labor.

Manufacturer's Warranty Coverage

This warranty coverage is provided for 5 years or 3,000 hours of engine operation, whichever first occurs from the date of delivery of the engine to the first user. If any emission-related part on your engine is defective, the part will be repaired or replaced by Cummins.

Coverage

This emission control system warranty applies to the following emission control parts:

Turbocharger	Electronic Control System
Compressor Wheel	Control Module
Turbine Wheel	Intake Manifold Pressure Sensor
Turbine Oil Seal	Coolant Temperature Sensor
Wastegate Valve	
Wastegate Actuator/Controller	
Intake Manifold	
Charge Air Cooler	
Exhaust Manifold	
Fuel System	
Actuators (Fueling & Timing)	
Fuel Pressure Sensor	
Injectors (TP)	

Owner's Warranty Responsibilities

As the off-road diesel engine owner, you are responsible for the performance of the required maintenance listed in your Cummins Operation and Maintenance Manual. Cummins recommends that you retain all receipts covering maintenance on your off-road diesel engine, but Cummins cannot deny warranty solely for the lack of receipts or for your failure to ensure the performance of all scheduled maintenance.

You are responsible for presenting your off-road diesel engine to a Cummins dealer as soon as a problem exists. The warranty repairs should be completed in a reasonable amount of time, not to exceed 30 days.

As the off-road diesel engine owner, you should also be aware that Cummins may deny you warranty coverage if your off-road diesel engine or a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.

Your engine is designed to operate on diesel fuel only. Use of any other fuel may result in your engine no longer operating in compliance with California's emissions requirements.

If you have any questions regarding your warranty rights and responsibilities, you should contact Cummins Customer Assistance Department at 1-800-343-7357 (1-800-DIESELS) or the California Air Resources Board at 9528 Telstar Avenue, El Monte, CA 91731.

Prior to the expiration of the applicable warranty, Owner must give notice of any warranted emission control failure to a Cummins distributor, authorized dealer or other repair location approved by Cummins and deliver the engine to such facility for repair. Repair locations are listed in Cummins United States and Canada Service Directory.

Owner is responsible for incidental costs such as: communication expenses, meals, lodging incurred by Owner or employees of Owner as a result of a warrantable failure.

Owner is responsible for business costs and losses, "downtime" expenses, and cargo damage resulting from a warrantable failure. CUMMINS IS NOT RESPONSIBLE FOR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDE BUT ARE NOT LIMITED TO FINES, THEFT, VANDALISM OR COLLISIONS.

Replacement Parts

To buy Cummins Parts and Service Manuals, Training Guides, or Tools go to our website at <https://store.cummins.com>

Cummins recommends that any service parts used for maintenance, repair or replacement of emission control systems be new, genuine Cummins or Cummins approved rebuilt parts and assemblies, and that the engine be serviced by a Cummins distributor, authorized dealer or the repair location approved by Cummins. The owner may elect to have maintenance, replacement or repair of the emission control parts performed by a facility other than a Cummins distributor, an authorized dealer or a repair location approved by Cummins, and may elect to use parts other than new genuine Cummins or Cummins approved rebuilt parts and assemblies for such maintenance, replacement or repair; however, the cost of such service or parts will not be covered under this emission control system warranty.

Cummins Responsibilities

Repairs and service will be performed by any Cummins distributor, authorized dealer or other repair location approved by Cummins using new, genuine Cummins or Cummins approved rebuilt parts and assemblies. Cummins will repair any of the emission control parts found by Cummins to be defective without charge for parts or labor (including diagnosis which results in determination that there has been a failure of a warranted emission control part).

Emergency Repairs

In the case of an emergency where a Cummins distributor, authorized dealer, or other repair location approved by Cummins is not available, repairs may be performed by any available repair location using any replacement parts. Cummins will reimburse the Owner for expenses (including diagnosis), not to exceed the manufacturer's suggested retail price for all warranted parts replaced and labor charges based on the manufacturer's recommended time allowance for the warranty repair and the geographically appropriate hourly labor rate. A part not being available within 30 days or a repair not being complete within 30 days constitutes an emergency. Replaced parts and paid invoices must be presented at a Cummins authorized repair facility as a condition of reimbursement for emergency repairs not performed by a Cummins distributor, authorized dealer, or other repair location approved by Cummins.

Warranty Limitations

Cummins is not responsible for failures resulting from Owner or operator abuse or neglect, such as: operation without adequate coolant, fuel or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or air intake systems; improper storage, starting, warm-up, run-in or shutdown practices.

The manufacturer warrants to the ultimate purchaser and each subsequent purchaser that the engine is designed, built, and equipped so as to conform with all applicable regulations adopted by the Air Resources Board, and that it is free from defects in materials and workmanship which cause the failure of a warranted part.

Any warranted part which is not scheduled for replacement as required maintenance, or which is scheduled only for regular inspection to the effect of "repair or replace as necessary" is warranted for the warranty period.

Any warranted part which is scheduled for replacement as required maintenance is warranted for the period of time prior to the first scheduled replacement point for that part.

The owner will not be charged for diagnostic labor which leads to the determination that a warranted part is defective, if the diagnostic work is performed at a warranty station.

The manufacturer is liable for damages to other engine components caused by the failure under warranty of any warranted part.

Cummins is not responsible for failures resulting from improper repair or the use of parts which are not genuine Cummins or Cummins approved parts.

These warranties, together with the express commercial warranties and emission warranty are the sole warranties of Cummins. There are no other warranties, express or implied, or of merchantability or fitness for a particular purpose.

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CALIFORNIA
Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

Cummins Inc.
Box 3005
Columbus, Indiana, U.S.A., 47202

Registered Office
Cummins Ltd.
49 - 51 Gresham Road,
Staines,
Middlesex TW18 2BD,
England
Registration 573951 England

Cummins Customer Assistance Center
1-800-DIESELS™ (1-800-343-7357)
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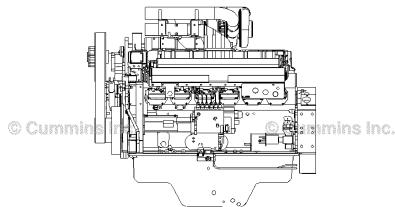
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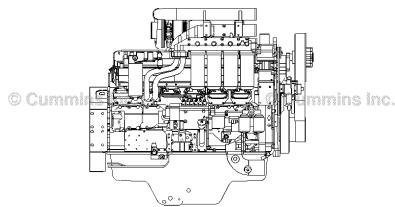


Owners Manual

QST30 Series Engine



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Foreword

This manual contains information for the correct operation and maintenance of your Cummins engine.

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

Keep this manual with the equipment. If the equipment is traded or sold, give the manual to the new owner.

The information, specifications, and recommended maintenance guidelines in this manual are based on information in effect at the time of printing. Cummins Inc. reserves the right to make changes at any time without obligation. If you find differences between your engine and the information in this manual, contact your local Cummins Authorized Repair Location or call 1-800-DIESELS (1-800-343-7357) toll free in the U.S. and Canada.

The latest technology and the highest quality components were used to produce this engine. When replacement parts are needed, we recommend using only genuine Cummins or ReCon® exchange parts.

NOTE: Warranty information is located in Section W. Make sure you are familiar with the warranty or warranties applicable to your engine.

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Important Reference Numbers

Fill in the part name and number in the blank spaces provided below. This will give you a reference whenever service or maintenance is required.

Name	Number	Number
Engine Model		
Engine Serial Number (ESN)		
Control Parts List (CPL)		
Fuel Pump Part Number		
Electronic Control Module (ECM)		
Electronic Control Module Serial Numbers (ECM)		
Filter Part Numbers:		
• Air Cleaner Element		
• Lubricating Oil		
• Fuel		
• Fuel-Water Separator		
• Coolant		
• Crankcase Ventilation		
• Cummins Particulate Filter		
Governor Control Module (GCM) (if applicable)		
Belt Part Numbers:		

•		
•		
•		
Clutch or Marine Gear (if applicable):		
• Model		
• Serial Number		
• Part Number		
• Oil Type		
• Sea Water Pump		
- Model		
- Part Number		

Section i - Introduction

Section Contents

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Symbols

General Information

The following 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:



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, an assembly, or the engine can be damaged if the caution instructions are **not** followed.



Indicates a **REMOVAL or DISASSEMBLY** 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.



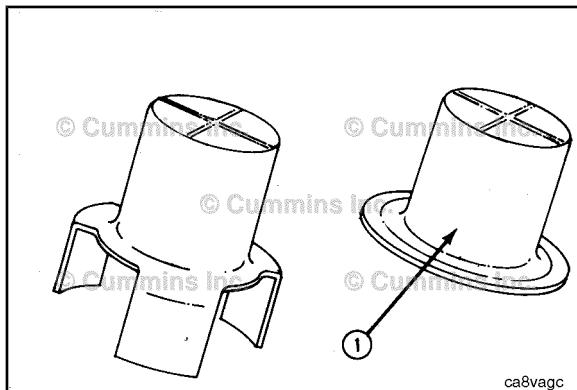
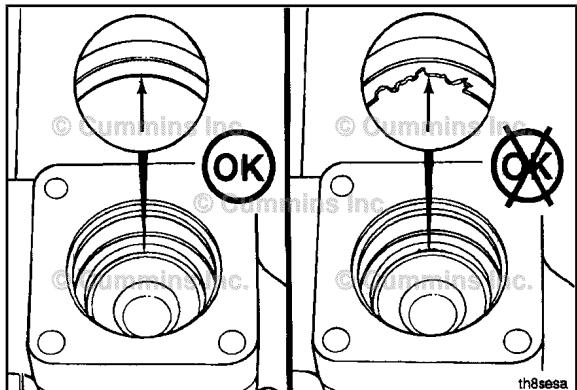
PERFORM an electrical **MEASUREMENT**.



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



The component weighs 23 kg [50 lb] or more. To avoid 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



Improper practices, carelessness, or ignoring the warnings can cause burns, cuts, mutilation, asphyxiation or other personal injury or death.

Read and understand all of the safety precautions and warnings before performing any repair. This list contains the general safety precautions that **must** be followed to provide personal safety. Special safety precautions are included in the procedures when they apply.

- Work in an area surrounding the product that is dry, well lit, ventilated, free from clutter, loose tools, parts, ignition sources and hazardous substances. Be aware of hazardous conditions that can exist.
- **Always** wear protective glasses and protective shoes when working.
- Rotating parts can cause cuts, mutilation or strangulation.
- Do **not** wear loose-fitting or torn clothing. Remove all jewelry when working.
- Disconnect the battery (negative [-] cable first) and discharge any capacitors before beginning any repair work. Disconnect the air starting motor if equipped to prevent accidental engine starting. Put a "Do **Not** Operate" tag in the operator's compartment or on the controls.
- Use ONLY the proper engine barring techniques for manually rotating the engine. Do **not** attempt to rotate the crankshaft by pulling or prying on the fan. This practice can cause serious personal injury, property damage, or damage to the fan blade(s) causing premature fan failure.
- If an engine has been operating and the coolant is hot, allow the engine to cool before slowly loosening the filler cap to relieve the pressure from the cooling system.

- **Always** use blocks or proper stands to support the product before performing any service work. Do **not** work on anything that is supported **ONLY** by lifting jacks or a hoist.
- Relieve all pressure in the air, oil, fuel, and cooling systems before any lines, fittings, or related items are removed or disconnected. Be alert for possible pressure when disconnecting any device from a system that utilizes pressure. Do **not** check for pressure leaks with your hand. High pressure oil or fuel can cause personal injury.
- To reduce the possibility of suffocation and frostbite, wear protective clothing and **ONLY** disconnect liquid refrigerant (Freon) lines in a well ventilated area. To protect the environment, liquid refrigerant systems **must** be properly emptied and filled using equipment that prevents the release of refrigerant gas (fluorocarbons) into the atmosphere. Federal law requires capturing and recycling refrigerant.
- To reduce the possibility of personal injury, use a hoist or get assistance when lifting components that weigh 23 kg [50 lb] or more. Make sure all lifting devices such as chains, hooks, or slings are in good condition and are of the correct capacity. Make sure hooks are positioned correctly. **Always** use a spreader bar when necessary. The lifting hooks **must not** be side-loaded.
- Corrosion inhibitor, a component of SCA and lubricating oil, contains alkali. Do **not** get the substance in eyes. Avoid prolonged or repeated contact with skin. Do **not** swallow internally. In case of contact, immediately wash skin with soap and water. In case of contact, immediately flood eyes with large amounts of water for a minimum of 15 minutes. **IMMEDIATELY CALL A PHYSICIAN. KEEP OUT OF REACH OF CHILDREN.**
- Naptha and Methyl Ethyl Ketone (MEK) are flammable materials and **must** be used with caution. Follow the manufacturer's instructions to provide complete safety when using these materials. **KEEP OUT OF REACH OF CHILDREN.**
- To reduce the possibility of burns, be alert for hot parts on products that have just been turned off, exhaust gas flow, and hot fluids in lines, tubes, and compartments.
- **Always** use tools that are in good condition. Make sure you understand how to use the tools before performing any service work. Use **ONLY** genuine Cummins® or Cummins ReCon® replacement parts.

- **Always** use the same fastener part number (or equivalent) when replacing fasteners. Do **not** use a fastener of lesser quality if replacements are necessary.
- When necessary, the removal and replacement of any guards covering rotating components, drives, and/or belts should only be carried out by a trained technician. Before removing any guards the engine **must** be turned off and any starting mechanisms **must** be isolated. All fasteners **must** be replaced on re-fitting the guards.
- Do **not** perform any repair when fatigued or after consuming alcohol or drugs that can impair your functioning.
- Some state and federal agencies in the United States of America have determined that used engine oil can be carcinogenic and can cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil.
- Do **not** connect the jumper starting or battery charging cables to any ignition or governor control wiring. This can cause electrical damage to the ignition or governor.
- **Always** torque fasteners and fuel connections to the required specifications. Overtightening or undertightening can allow leakage. This is critical to the natural gas and liquefied petroleum gas fuel and air systems.
- **Always** test for fuel leaks as instructed, as odorant can fade.
- Close the manual fuel valves prior to performing maintenance and repairs, and when storing the vehicle inside.
- Coolant is toxic. If **not** reused, dispose of in accordance with local environmental regulations.
- The catalyst reagent contains urea. Do **not** get the substance in your eyes. In case of contact, immediately flood eyes with large amounts of water for a minimum of 15 minutes. Avoid prolonged contact with skin. In case of contact, immediately wash skin with soap and water. Do **not** swallow internally. In the event the catalyst reagent is ingested, contact a physician immediately.
- The catalyst substrate contains Vanadium Pentoxide. Vanadium Pentoxide has been determined by the State of California to cause cancer. Always wear protective gloves and eye protection when handling the catalyst assembly. Do not get the catalyst material in your eyes. In Case of contact, immediately flood eyes with large amounts of

water for a minimum of 15 minutes. Avoid prolonged contact with skin. In case of contact, immediately wash skin with soap and water.

- The Catalyst substrate contains Vanadium Pentoxide. Vanadium Pentoxide has been determined by the State of California to cause cancer. In the event the catalyst is being replaced, dispose of in accordance with local regulations.
- California Proposition 65 Warning - Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

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
BTDC	Before Top Dead Center
°C	Celsius
CO	Carbon Monoxide
CCA	Cold Cranking Amperes
CARB	California Air Resources Board
C.I.B.	Customer Interface Box
C.I.D.	Cubic Inch Displacement
CNG	Compressed Natural Gas
CPL	Control Parts List
cSt	Centistokes
DEF	Diesel Exhaust Fluid
DOC	Diesel Oxidation Catalyst
DPF	Diesel Particulate Filter
ECM	Electronic Control Module

EGR	Exhaust Gas Recirculation
EPA	Environmental Protection Agency
°F	Fahrenheit
ft-lb	Foot-Pound Force
FMI	Failure Mode Identifier
GVW	Gross Vehicle Weight
Hg	Mercury
hp	Horsepower
H₂O	Water
inHg	Inches of Mercury
in H₂O	Inches of 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
NOx	Mono-Nitrogen Oxides
NG	Natural Gas
O2	Oxygen
OBD	On-Board Diagnostics
OEM	Original Equipment Manufacturer
PID	Parameter Identification Descriptions
ppm	Parts Per Million
psi	Pounds Per Square Inch
PTO	Power Takeoff
REPTO	Rear Power Take Off
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
VDC	Volts of Direct Current
VS	Variable Speed
VSS	Vehicle Speed Sensor

Notes

Section E - Engine Identification

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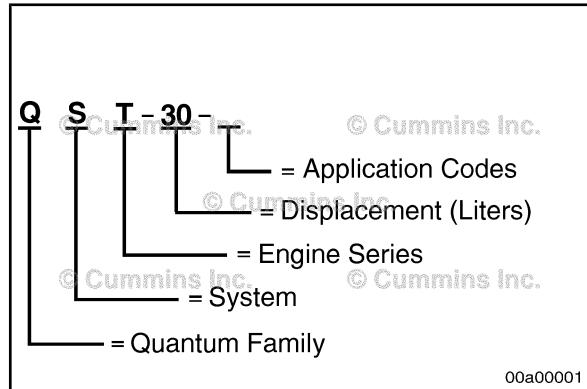
Engine Identification

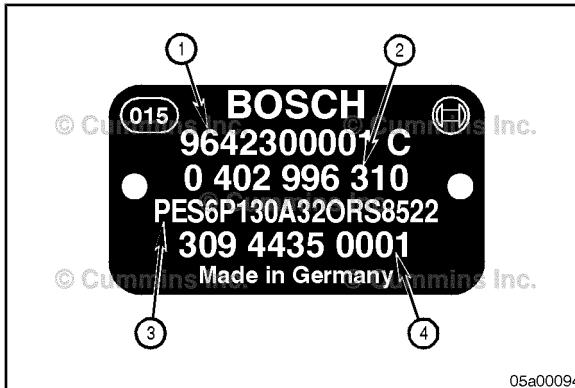
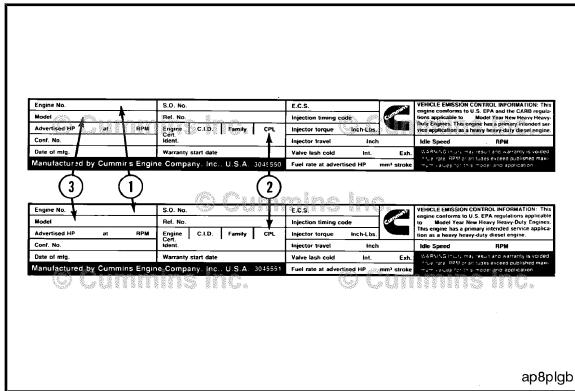
Cummins® Engine Nomenclature

The model name provides identification data for the engine. Refer to the illustration for the model name identification.

The application codes are:

- C** = Construction
- D** = Generator drive
- F** = Fire pump
- G** = Generator set
- L** = Locomotive
- M** = Marine
- P** = Power unit
- R** = Railcar.





Engine Dataplate

The engine dataplate shows specific facts about your engine. The engine serial number (ESN) (1), control parts list (CPL) (2), model (3), and horsepower and rpm ratings provide information for ordering parts and performing service.

The engine dataplate **must not** be changed unless approved by Cummins Inc.

The engine dataplate on the QST30 Series engine is located on the left-bank side of the aftercooler.

Fuel Injection Pump Dataplate

Bosch™

This is an illustration of the dataplate on the Bosch™ fuel injection pump. The dataplate is mounted on the outboard side of the injection pump housing.

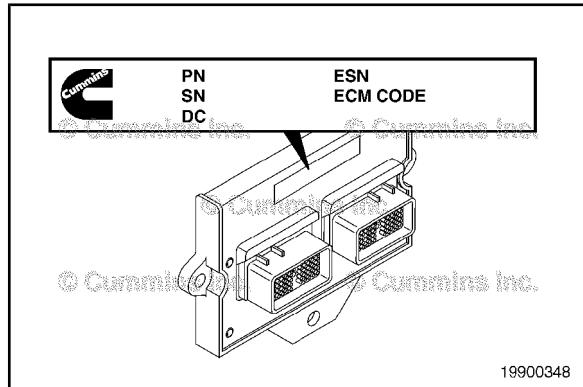
1. Injection pump serial number
2. Bosch™ part number
3. Bosch™ pump identification code
4. Cummins part number (first seven digits on this line).

ECM Dataplate

Industrial Applications

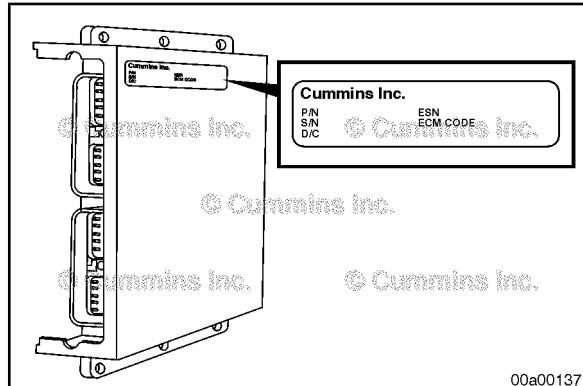
The external ECM dataplate contains the following data about the engine and ECM:

1. PN - ECM part number
2. SN - ECM serial number
3. DC - Date code (the date the ECM was programmed at the factory)
4. ESN - Engine serial number
5. ECM CODE - The ECM calibration identifier.



Generator-Drive

The external ECM dataplate is located at the top of the ECM.



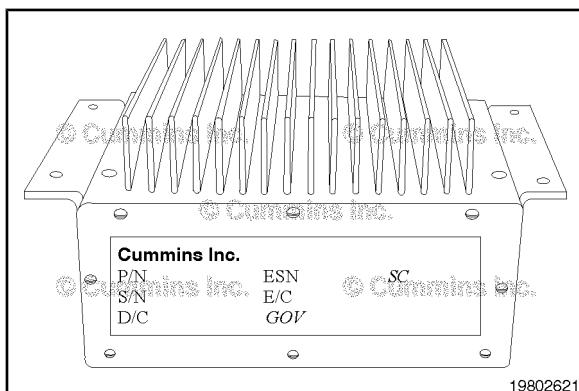
Engine Identification
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QST30
Section E - Engine Identification



The external ECM dataplate contains the following data about the engine and ECM:

1. PN - ECM part number
2. SN - ECM serial number
3. DC - Date code (the date the ECM was programmed at the factory)
4. ESN - Engine serial number
5. ECM CODE - The ECM calibration identifier.



The external ECM dataplate for the generator-drive control system is located on the side of the ECM, opposite the ECM connectors.

Section E - Engine Identification

The external ECM dataplate for the generator-drive control system contains the following data about the engine and ECM:

1. P/N - ECM part number
2. S/N - ECM serial number
3. D/C - Date code (the date the ECM was programmed at the factory)
4. ESN - Engine serial number
5. E/C - Electronic configuration
6. GOV - Governor type (GOV, this entry will be blank)
7. S/C - Software calibration option.

Cummins Inc.	
P/N	ESN
S/N	E/C
D/C	© Cummins Inc. © GOV Inc.
© Cummins Inc.	© Cummins Inc.
19802622	

Notes

Section 1 - Operating Instructions

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Operating Instructions - Overview



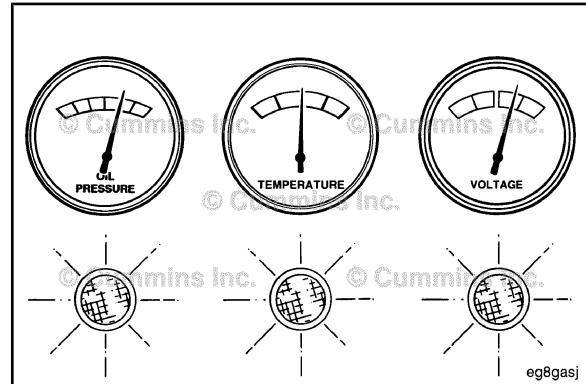
General Information

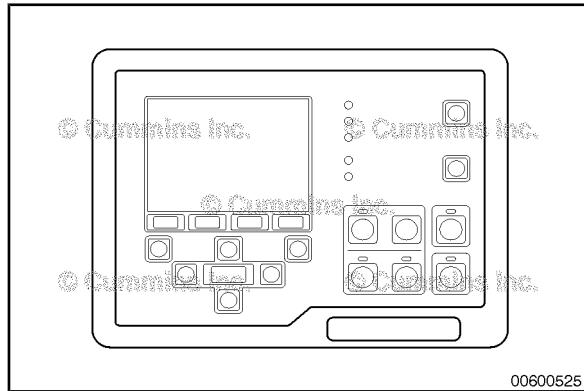
Correct care of your engine will result in longer life, better performance, and more economical operation.

Follow the daily maintenance checks listed in Maintenance Guidelines (Section 2).

The **new** Cummins® engine associated with this manual does **not** require a "break-in" procedure. This section of the manual provides all of the necessary information required for proper engine operation.

Check the oil pressure indicators, temperature indicators, warning lights, and other gauges daily to make sure they are operational.





For the PowerCommand Controller 3300 Generator Set Control the automatic and manual modes are selected via push buttons. Cummins® Inc recommends that the Generator Set is operated in automatic mode.

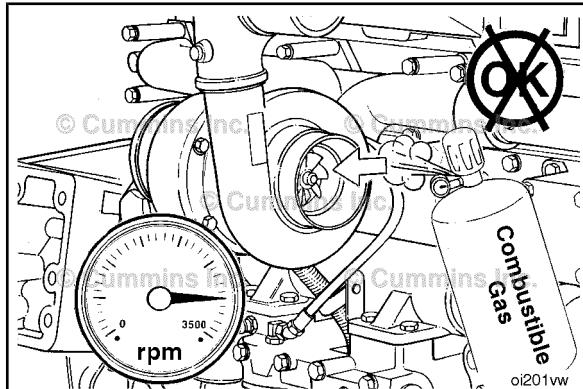
⚠ WARNING ⚠

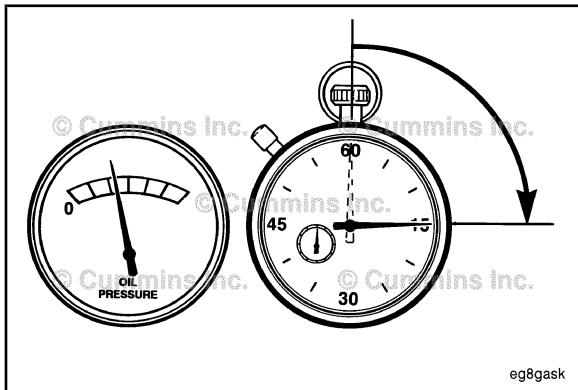
DO NOT OPERATE A DIESEL ENGINE WHERE THERE ARE OR CAN BE COMBUSTIBLE VAPORS. The vapors can be sucked through the air intake system and cause engine acceleration and overspeeding that can result in a fire, an explosion, and extensive property damage. Numerous safety devices are available, such as air intake shutoff devices, to minimize the risk of overspeeding where an engine, due to its application, might operate in a combustible environment, such as due to a fuel spill or gas leak. Remember, Cummins has no way of knowing the use you have for your engine. **THE EQUIPMENT OWNER AND OPERATOR ARE RESPONSIBLE FOR SAFE OPERATION IN A HOSTILE ENVIRONMENT. CONSULT YOUR CUMMINS AUTHORIZED REPAIR LOCATION FOR FURTHER INFORMATION.**

Cummins recommends the installation of an air intake shutoff device or a similar safety device to minimize the risk of overspeeding when an engine is operating in a combustible environment, such as due to a fuel spill or gas leak.

⚠ CAUTION ⚠

Do not expose the engine to corrosive chemicals. Corrosive chemicals can damage the engine.

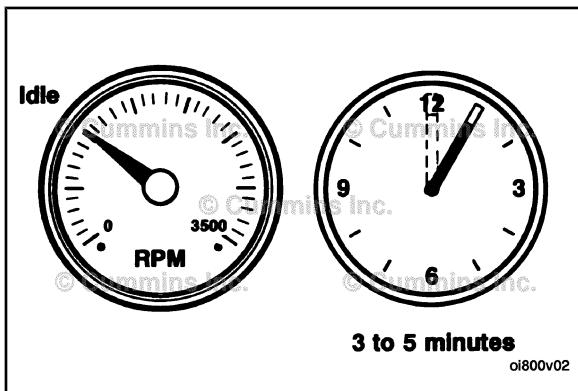




Normal Starting Procedure General Information

△CAUTION△

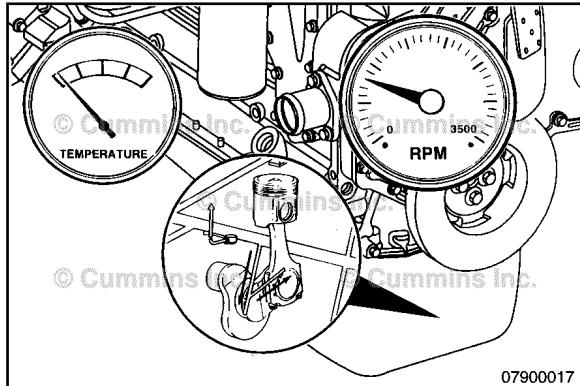
The engine must have adequate oil pressure within 15 seconds after starting. If the WARNING lamp indicating low oil pressure has not gone out or there is no oil pressure indicated on a gauge within 15 seconds, shut off the engine immediately to avoid engine damage. The low oil pressure troubleshooting procedure is located in Troubleshooting Symptoms (Section TS).



Idle the engine 3 to 5 minutes before operating with a load.

Section 1 - Operating Instructions

After starting a cold engine, increase the engine speed (rpm) slowly to provide adequate lubrication to the bearings and to allow the oil pressure to stabilize.

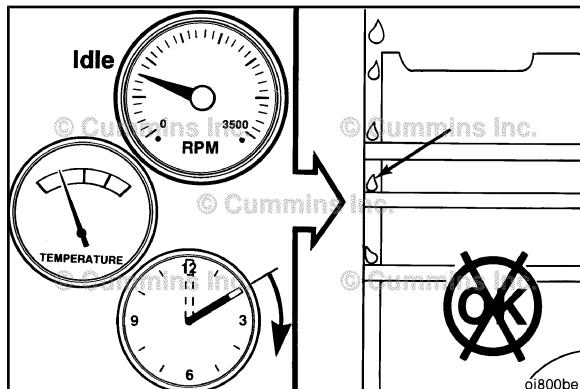


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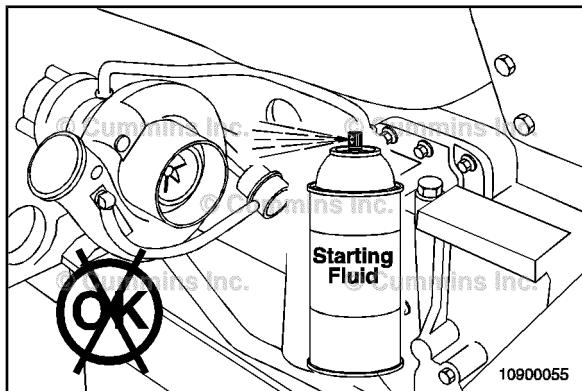
△CAUTION△

Do not operate engine at low idle for long periods with engine coolant temperature below the minimum specification in Maintenance Specifications (Section V). This can result in the following:

- Fuel Dilution of the lubricating oil
- Carbon build up in the cylinder
- Cylinder head valve sticking
- Reduced performance



oi800be



Using Starting Aids

Cold weather starting aids are available for your engine. Contact a local Cummins Authorized Repair Location for more information.

Starting Procedure After Extended Shutdown or Oil Change General Information

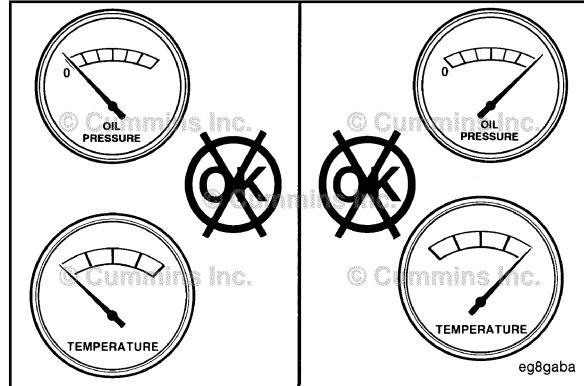
Follow the Normal Starting Procedure in this section. The engine will **not** start until the minimum cranking oil pressure is detected by the ECM. It can take more cranking time to start the engine after an extended shut down or oil change.

Operating the Engine

Normal

If equipped, monitor the oil pressure and coolant temperature gauges frequently. Refer to Lubricating Oil System specifications and Cooling System specifications, in Maintenance Specifications (Section V) for recommended operating pressures and temperatures. Shut off the engine if any pressure or temperature does **not** meet the specifications.

Continuous operation with engine coolant temperature above or below the engine coolant temperature specifications listed in Maintenance Specifications (Section V) can damage the engine.

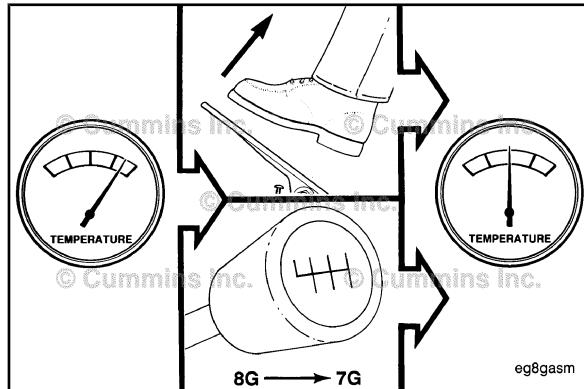


Operating the Engine

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QST30

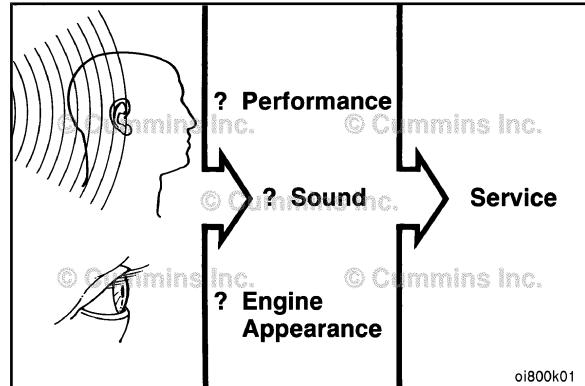
Section 1 - Operating Instructions



If an overheating condition starts to occur, reduce the power output of the engine by releasing the accelerator pedal or lever or shifting the transmission to a lower gear, or both, until the temperature returns to the normal operating range. If the engine temperature does **not** return to normal, shut off the engine, and refer to Troubleshooting Symptoms (Section TS), or contact a Cummins® Authorized Repair Location.

Most failures give an early warning. Look and listen for changes in performance, sound, or engine appearance that can indicate service or engine repair is needed. Some changes to look for are:

- Engine misfires
- Vibration
- Unusual engine noises
- Sudden changes in engine operating temperatures or pressures
- Excessive smoke
- Loss of power
- An increase in oil consumption
- An increase in fuel consumption
- Fuel, oil, or coolant leaks.



Cold Weather

It is possible to operate engines in extremely cold environments if they are properly prepared and maintained. Satisfactory performance of an engine in low ambient temperature conditions requires modification of the engine, surrounding equipment, operating practices and maintenance procedures.

The correct engine coolant lubricating oil and fuels **must** be used for the cold weather range in which the engine is being operated. Below are the recommendations for these critical engine fluids:

Ambient Temperature

0 to -32°C [32 to -25°F]

Use 50-percent ethylene glycol antifreeze and 50-percent water for the engine coolant mixture.

Refer to Maintenance Specifications (Section V) Lubricating Oil recommendations for the correct specifications.

The Diesel fuel **must** have maximum cloud and pour points 6°C [10°F] lower than the ambient temperature in which the engine operates.

-32 to -54°C [-25 to -65°F]

Use 60-percent ethylene glycol antifreeze and 40-percent water for the engine coolant mixture.

Refer to Maintenance Specifications (Section V) Lubricating Oil recommendations for the correct specifications.

The Diesel fuel **must** have maximum cloud and pour points 6°C [10°F] lower than the ambient temperature in which the engine operates.

Cold Weather Operating Aids

Temperature	Starting Aid	Coolant Heater	Oil Heater	Under-hood Air	Fuel Heater	Battery Heater	Radiator Shutters	Engine Enclosure	Winter Front	Thermatic Fan	Crankcase Breather Heater (External Breather)
50 to 32° F 10 to 0° C											
32 to -10° F 0 to -23° C											
-10 to -25° F -23 to -32° C	Required										
-25 to -65° F -32 to -54° C											



* Required dependent upon viscosity/pour point.

The cold weather operating aid is required for cold weather situations.

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).

Engine Operating Range

General Information

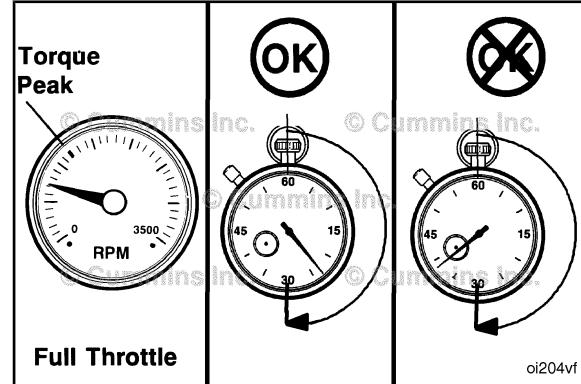
△CAUTION△

Do not operate the engine at full throttle below peak torque rpm (refer to engine dataplate for peak torque rpm) for more than 30 seconds. Operating the engine at full throttle below peak torque will shorten engine life to overhaul, can cause serious engine damage, and is considered engine abuse.

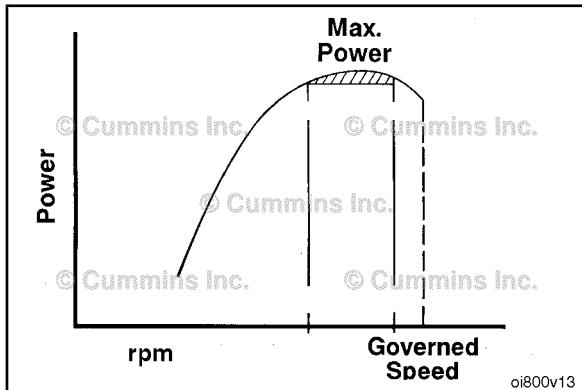
△CAUTION△

Do not operate the engine beyond the maximum engine speed. Operating the engine beyond the maximum engine speed can cause severe engine damage. Use proper operating techniques for the vehicle, vessel, or equipment to prevent engine overspeed. The maximum engine speed specification is listed in Maintenance Specifications (Section V).

Cummins® engines are designed to operate successfully at full throttle under transient conditions down to peak torque engine speed. This is consistent with recommended operating practices.



oi204vf



Driving Techniques General Information

The engine produces maximum power at an rpm less than governed engine speed.

To obtain optimum engine performance on a grade, allow the engine speed to load down to near peak torque before shifting. This will result in an engine operating speed in the maximum power zone after the shift is completed.

Refer to the engine dataplate for peak torque rpm and governed speed rpm.

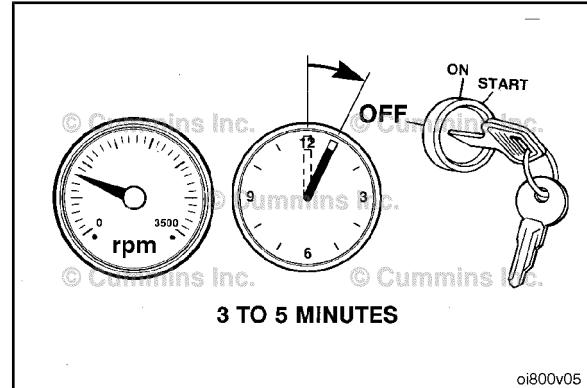
Engine Shutdown General Information

Allow the engine to idle 3 to 5 minutes before shutting it off after a full-load operation. This allows adequate cool down of pistons, cylinders, bearings, and turbocharger components.

Turn the ignition switch to the OFF position. If the engine does **not** shut down, refer to Troubleshooting Symptom (Section TS) in appropriate Operation and Maintenance manual.

△CAUTION△

Failure to follow the correct shutdown procedure may result in damage to the turbocharger and shorten the turbocharger life.



oi800v05

Electromagnetic Interference (EMI)

General Information

Some engine applications utilize accessories (CB radios, mobile transmitters, etc.) that generate and use radio frequency energy that, if **not** installed and used properly, can cause electromagnetic interference (EMI) conditions to exist between the accessory and Cummins electronic controlled fuel system. Cummins is **not** liable for any performance problems with either the fuel system or the accessory due to EMI. EMI is **not** considered by Cummins to be an engine failure and therefore is **not** warrantable.

System EMI Susceptibility

Your Cummins product has been designed and tested for minimum sensitivity to incoming electromagnetic energy. Testing has shown that there is no engine performance degradation at relatively high energy levels; however, if very high energy levels are encountered, then some noncritical diagnostic fault code logging can occur. The fuel system EMI susceptibility level will protect your engine from most, if **not** all, electromagnetic energy-emitting devices that meet the Federal Communications Commission legal requirements.

System EMI Radiation Levels

Your Cummins product has been designed to emit minimum electromagnetic energy. Electronic components are required to pass various Cummins and industry EMI specifications. Testing has shown that when the engine is properly installed, it will not interfere with onboard communication equipment or with the vehicle's, equipment's, or vessel's ability to meet any applicable EMI standards and regulated specifications.

If an interference condition is observed, follow the suggestions below to reduce the amount of interference:

- 1 Locate the receiving antenna as far away from the engine and as high as possible.
- 2 Locate the receiving antenna as far away as possible from all metal obstructions (e.g., exhaust stacks)
- 3 Consult a representative of the accessory supplier in your area to:
 - Accurately calibrate the device for proper frequency, power output, and sensitivity (both base and remote site devices **must** be properly calibrated)
 - Obtain antenna reflective energy data measurements to determine the optimum antenna location
 - Obtain optimum antenna type and mounting arrangement for your application
 - Make sure your accessory equipment model is built for maximum filtering to reject incoming electromagnetic noise.

Section 2 - Maintenance Guidelines

Section Contents

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Maintenance Record Form	2-10
Maintenance Data.....	2-10
Maintenance Schedule	2-2
General Information.....	2-2
Oil Drain Intervals.....	2-3

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Maintenance Guidelines - Overview

General Information

Cummins Inc. recommends that the engine be maintained according to the Maintenance Schedule in this section.

If the engine is operating in ambient temperatures below -18°C [0°F] or above 38°C [100°F], perform maintenance at shorter intervals. Shorter maintenance intervals are also required if the engine is operated in a dusty environment or if frequent stops are made. For gas fueled generator sets, shorter maintenance intervals are also required, if operating at loads below 70% for prolonged periods. Contact your local Cummins® Authorized Repair Location for recommended maintenance intervals.

Some of these maintenance procedures require special tools or must be completed by qualified personnel. Contact your local Cummins® Authorized Repair Location for detailed information.

If your engine is equipped with a component or accessory not manufactured by Cummins Inc., refer to the component manufacturer's maintenance recommendations.

Use the chart provided in this section as a convenient way to record maintenance performed.

Maintenance Schedule

General Information

All maintenance procedures listed for previous intervals **must** also be performed.

Maintenance Procedures at Daily Interval

- Air Intake Piping - Maintenance Check
- Air Cleaner Precleaner - Maintenance Check
- Air Cleaner Restriction - Maintenance Check
- Air Tanks and Reservoirs - Maintenance Check
- Engine Coolant Level - Maintenance Check
- Fuel-Water Separator - Drain
- Engine Lubricating Oil Level - Maintenance Check
- Centinel™ Oil Level - Maintenance Check

Maintenance Procedures at 250 Hours or 6 Months

- Fuel Lift Pump Inlet Screen - Clean
- Fuel Filter (Spin-on Type) - Replace and Prime
- Lubricating Oil and Filters - Change (Non-Centinel™ Engines Only)
- Lubricating Oil Analysis - Maintenance Check (Centinel™ Equipped Engines Only)
- Crankcase Breather Tube - Maintenance Check
- Supplemental Coolant Additive - Maintenance
- Coolant Filter - Replace
- Drive Belts - Maintenance Check
- Fan, Cooling - Maintenance Check
- Charge Air Cooler (CAC) - Maintenance Check

Maintenance Procedures at 1000 Hours or 1 Year

- Lubricating Oil Filters - Change (Centinel™ Equipped Engine Only)

Maintenance Procedures at 2000 Hours or 1 Year

- Engine Steam Cleaning - Clean
- Radiator Hoses - Maintenance Check
- Air Compressor Discharge Lines - Maintenance Check
- Engine Mounts - Maintenance Check
- Crankshaft - Maintenance Check
- Overhead Set - Adjust
- Engine Oil Heater - Maintenance Check
- Coolant Heater - Maintenance Check
- Fan Drive Idler Pivot Arm Assembly - Maintenance Check
- Drive Belt, Cooling Fan - Adjust

Maintenance Procedures at 6000 Hours or 2 Years

- Cooling System - Clean
- Fan Hub Belt Driven - Maintenance Check
- Water Pump - Maintenance Check
- Turbocharger - Maintenance Check
- Vibration Damper, Viscous - Maintenance Check
- Air Compressor Unloader Valve Assembly - Maintenance Check

Oil Drain Intervals**△CAUTION△**

Improperly applied extended oil and filter change intervals will decrease engine life due to factors such as corrosion, deposits, and wear.

With a continuously operating Centinel™ System, the oil drain interval can be extended until the oil analysis requires the oil to be changed or the oil is known to be contaminated. Oil analysis is required at 250 hour intervals when using the Centinel™ System and **must** include soot measurement. Fleetguard® oil analysis kit, Part Number CC 2543, meets this requirement. The oil degradation limits can be found in the Centinel™ oil analysis recommendations table in Section V of this manual.

Premium oil filters, such as Fleetguard LF 9000 series filters, or equivalent, are also required when using Centinel™ with spin-on filters.

There are three recommended methods used to determine the proper oil and filter change interval:

- Fixed Hours Method (based on fixed hours, or months; whichever occurs first)
- Chart Method (based on known fuel consumption rates)
- Centinel™ system (based on lubricating oil analysis).

Reference the table below for the Fixed Hours Method to determine the lubrication oil and filter change interval, unless using the chart method.

Fixed Hours Method Oil Intervals				
Application	Oil Filters	Sump Capacity	Oil Grade	Change Interval
Industrial	LF670 full-flow and LF777 bypass	76 liters [20 gal]	Standard or Premium	250 hours or 6 months
Industrial	LF670 full-flow and LF777 bypass	133 liters [35 gal]	Standard or Premium	250 hours or 6 months
Industrial	LF9001 Venturi combo	76 liters [20 gal]	Standard or Premium	250 hours or 12 months
Industrial	LF9001 Venturi combo	133 liters [35 gal]	Standard	250 hours or 12 months

Fixed Hours Method Oil Intervals				
Application	Oil Filters	Sump Capacity	Oil Grade	Change Interval
Industrial	LF9001 Venturi combo	133 liters [35 gal]	Premium	500 hours or 12 months
Power Generation	LF670 full-flow and LF777 bypass	76 liters [20 gal]	Standard or Premium	250 hours or 12 months
Power Generation	LF670 full-flow and LF777 bypass	133 liters [35 gal]	Standard or Premium	250 hours or 12 months
Power Generation	LF9001 Venturi combo	76 liters [20 gal]	Standard or Premium	250 hours or 12 months
Power Generation	LF9001 Venturi combo	133 liters [35 gal]	Standard	250 hours or 12 months
Power Generation	LF9001 Venturi combo	133 liters [35 gal]	Premium	500 hours or 12 months

Refer to 018-003 (Lubricating Oil Recommendations and Specifications) in Section V for determining the oil performance classification.

△CAUTION△

Inaccurate fuel consumption records can result in incorrect oil change intervals that can result in premature engine wear and/or deposits.

△CAUTION△

Do not extend oil change intervals beyond the maximum point shown when fuel consumption rates are less than the minimum shown. Doing so can result in shortened engine life due to oil degradation processes associated with lightly loaded engines.

Chart Method:

There has been an increased emphasis on extended oil drain intervals for high-horsepower engines. This is one way that longer intervals can be achieved. The chart method, when coupled with a thorough oil analysis program, is a viable option accepted by Cummins Inc.

Do not extend oil and filter change intervals beyond the Fixed Hour Method, unless the chart method is used.

The chart method is recommended to provide the lowest total cost of operation while still protecting the engine.

The information listed below is required when using the chart method to determine the correct oil and filter change interval for the engine.

- Oil sump capacity
- Average fuel consumption rate
- Classification of oil as standard or premium.

Determine the engine oil sump capacity:

Sump capacity in gallons can be determined by knowing the volume of the oil required to touch the high-level mark on the dipstick. Refer to Procedure 018-017 (Lubricating Oil System) in Section V for oil sump capacities. It is imperative that the sump volume be known when using the chart method.

Determine the fuel consumption rate:

To use the chart method effectively, accurate fuel consumption records **must** be kept and maintained. Fuel consumption information **must** be in liters per hour (lph) or gallons per hour (gph) units to use the charts. Fuel consumption rates can change over time due to an increasing or decreasing engine duty cycle. Accurate records are essential in determining average fuel consumption during a given oil change interval.

To read the chart:

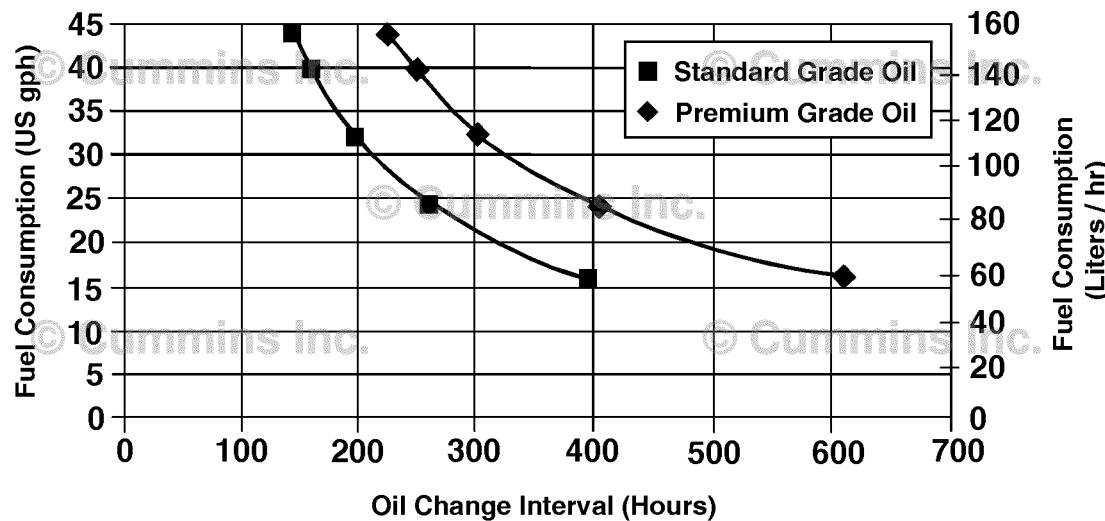
Select the chart representing the correct oil sump capacity. The left vertical axis of the chart represents fuel consumption in gallons per hour (gph) and the right vertical axis represents fuel consumption in liters per hour (lph).

Determine the intersection point of the fuel consumption rate on the applicable interval curve by drawing a horizontal line. From this point, draw a vertical line down until it intersects with the horizontal axis representing hours. This point represents the acceptable oil change interval.

Oil Filters:

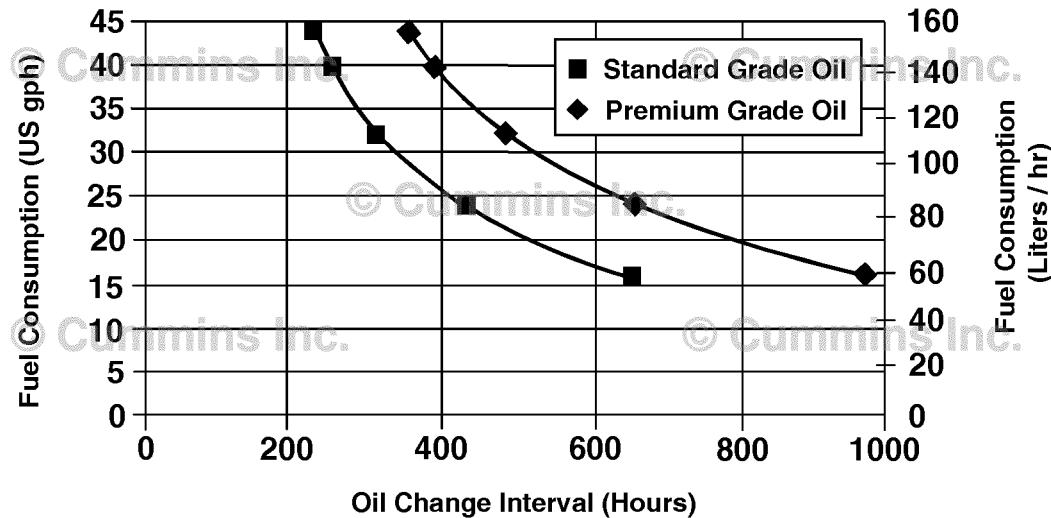
Premium filters are recommended, in conjunction with premium grade oils, when using the premium grade oil curves to determine oil change intervals. Premium filters contain synthetic media materials to provide more efficient filtration for the entire service life and to extend the media life over conventional cellulose media. Premium filters are made with synthetic media and have the StratPore™ designation on the outside of the filter. Stratapore™ filters have the efficiency, capacity, and strength needed for this extended service.

QST30 Oil Change Interval 76 Liter (20 US Gallon) Sump



07a00130

QST30 Oil Change Interval 132 Liter (35 US Gallon) Sump



07a00131

Maintenance Record Form

Maintenance Data

Maintenance Record	
Engine Serial No.:	Engine Model:
Owner's Name:	Equipment Name/Number:

Key to table headings:

A = Date

B = km [Miles], Hours or Time Interval

C = Actual km [Miles] or Hours

M = Maintenance Check Performed

E = Check Performed By

F = Comments

Notes

Section L - Service Literature

Section Contents

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Additional Service Literature General Information

The following publications can be purchased by contacting a Cummins Distributor:

Bulletin	Title of Publication
3810340	Cummins Engine Oil Recommendations
3379001	Fuel for Cummins Engines
3666132	Cummins Coolant Requirements and Maintenance
3379000	Air For Your Engine
3387266	Cold Weather Operation
3666217	Troubleshooting and Repair Manual, QST30 Series Engine
3666214	Troubleshooting and Repair Manual, Electronic Control System, Industrial QST30 Series Engine
3666184	Troubleshooting and Repair Manual, Electronic Control System, QST30 Generator -Drive Series Engine
3666393	Troubleshooting and Repair Manual, Generator Control System, QSX15, QST30, QSK45, and QSK60 Series Engine
3666323	Troubleshooting and Repair Manual, Generator-Drive Fuel Control Governor, QST30 Series Engine
3666190	QST30 Shop Manual
3672102	Generator-Drive Parts Catalog
3672140	Parts Catalog (construction)
3666234	QST30 Industrial Wiring/Fault Code Diagram
3666185	QST30 Generator-Drive Wiring/Fault Code Diagram
3666196	INSITE™ QST30 Generator-Drive User's Manual
3884884	QST30 Generator-Drive Pocket Fault Card
3884888	QST30 Generator-Drive Governor Bulletin

Service Literature Ordering Location Contact Information

Region

United States and Canada

All Other Countries

Ordering Location

Cummins Distributors

or

Credit Cards at 1-800-646-5609

or

Order online at www.powerstore.cummins.com

Cummins Distributors or Dealers

Cummins Customized Parts Catalog

General Information

Cummins is pleased to announce the availability of a parts catalog compiled specifically for you. Unlike the generic versions of parts catalogs that support general high volume parts content; Cummins Customized catalogs contains only the new factory parts that were used to build your engine.

The catalog cover, as well as the content, is customized with you in mind. You can use it in your shop, at your worksite, or as a coffee table book in your RV or boat. The cover contains your name, company name, address, and telephone number. Your name and engine model identification even appears on the catalog spine. Everybody will know that Cummins created a catalog specifically for you.

This new catalog was designed to provide you with the exact information you need to order parts for your engine. This will be valuable for customers that do not have easy access to the Cummins Electronic Parts Catalog or the Cummins Parts Microfilm System.

Additional Features of the Customized Catalog include:

- Engine Configuration Data
- Table of Contents
- Separate Option and Parts Indexes
- Service Kits (when applicable)
- ReCon Part Numbers (when applicable)

Ordering the Customized Parts Catalog

Ordering by Telephone

North American customers can contact their Cummins Distributor or call Gannett Direct Marketing Services at 1-800-646-5609 and order by credit card. Outside North America order on-line or make an International call to Gannett at (+ +)502-454-6660.

Ordering On-Line

The Customized Parts Catalog can be ordered On-Line from the Cummins Powerstore by credit card.

Contact GDMS or the CUMMINS POWERSTORE for the current price; Freight may be an additional expense.

Information we need to take your Customized Parts Catalog Order. This information drives the cover content of the CPC.

- Customer Name
- Street Address
- Company Name (optional)
- Telephone no.
- Credit Card No.
- Cummins Engine Serial Number (located on the engine data plate)
- Please identify the required media: Printed Catalog, CD-ROM, or PDF File

Unfortunately not all Cummins Engines can be supported by this parts catalog. Engines older than 1984 or newer than 3 months may not have the necessary parts information to compile a catalog. We will contact you if this occurs and explain why we are unable to fill your order.

Customized Parts Catalogs are produced specifically for a single customer. This means they are not returnable for a refund. If we make an error and your catalog is not useable, we will correct that error by sending you a new catalog.

Notes

Section V - Maintenance Specifications

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General Engine

General Specifications

Valve settings:

Intake valve adjustment.....	0.43 mm [0.017 in]
Exhaust valve adjustment.....	0.80 mm [0.032 in]
QST30 aspiration.....	Turbocharged and aftercooled engine
Bore and stroke.....	140 mm x 165 mm [5.51 in x 6.5 in]

Compression ratio:

United States EPA and CARB Tier Two Certified Industrial Engines.....	14.7:1
United States EPA and CARB Tier One Certified Industrial Engines.....	15.7:1
All other engines.....	14.0:1

Displacement.....	30.5 liters [1861 cu in]
-------------------	--------------------------

Firing order.....	R1-L1-R5-L5-R3-L3-R6-L6-R2-L2-R4-L4
-------------------	-------------------------------------

Engine type.....	4 cycle, 50 degree vee, 12 cylinder
------------------	-------------------------------------

Engine weight.....	2998 kg [6610 lb]
--------------------	-------------------

Crankshaft rotation (viewed from the front of the engine).....	Clockwise
--	-----------

Lubricating Oil System

Specifications

Oil pressure, main rifle (15W-40 oil at 107°C [225°F])

Maximum at rated rpm.....	448 kPa [65 psi]
Minimum at rated rpm.....	245 kPa [36 psi]
Minimum at idle rpm.....	.98 kPa [14 psi]

Maximum oil temperature..... 120°C [248°F]

Oil pan capacity:

Sump only	76 liters [20 gal]
Sump only	132 liters [35 gal]

Oil filter capacity (each filter):

Full-flow filter (four spin-on filters required).....	2.65 liters [0.70 gal]
Bypass filter (two spin-on filters required).....	2.27 liters [0.60 gal]
Venturi combo filter (four spin-on filters required).....	2.52 liters [0.67 gal]

Total system capacity:

When using 75-liter [20-gal] oil pan.....	90 liters [24 gal]
When using 132-liter [35-gal] oil pan.....	148 liters [39 gal]

NOTE: The total lubricating oil system capacity is the summation of the oil pan capacity at the high mark on the dipstick, the full-flow or Venturi combo oil filter capacity, and the capacity of any bypass filters that are used.

Cooling System Specifications

Coolant capacity (engine only).....	85 liters [23 gal]
Standard modulating thermostat range.....	77 to 90°C [170 to 194°F]
Minimum pressure cap.....	.48 kPa [7 psi]
Coolant temperature:	
Minimum top tank.....	71°C [160°F]
Maximum at engine outlet.....	100°C [212°F]
Maximum deaeration time.....	25 minutes
Minimum draw down	
Of system capacity.....	8 percent

Cummins/Fleetguard® Filter Specifications

Specifications

Fleetguard® is a subsidiary of Cummins Inc. Fleetguard® filters are developed through joint testing at Cummins Inc. and Fleetguard®. Fleetguard® filters are standard on new Cummins engines. Cummins Inc. recommends their use.

Fleetguard® products meet all Cummins Inc. Source Approval Test standards to provide the quality filtration necessary to achieve the engine's design life. If other brands are substituted, the purchaser **must** insist on products that the supplier has tested to meet Cummins Inc. high-quality standards.

Cummins Inc. is **not** responsible for problems caused by non-genuine filters which do **not** meet Cummins Inc. performance and/or durability requirements.

Filter Types and Part Numbers:

Lubricating Oil Filter (Full Flow)

Cummins Part Number.....	3889310
Fleetguard® Part Number.....	LF670

Lubricating Oil Filter (Bypass)

Cummins Part Number.....	3889311
Fleetguard® Part Number.....	LF777

Lubricating Oil Filter (Venturi Combo)

Cummins Part Number.....	3406809
Fleetguard® Part Number.....	LF9001

Fuel Filter (20 micron, no water separation)

Cummins Part Number.....	3313306
Fleetguard® Part Number.....	FF202

Fuel Filter (10 micron, with water separation)

Cummins Part Number.....3089916
Fleetguard® Part Number.....FS1006

Fuel Prefilter (140 micron, no water separation)

Cummins Part Number.....4010476
Fleetguard® Part Number.....FF2203

Coolant Filter

Cummins Part Number.....3100308
Fleetguard® Part Number.....WF2075

Fuel Recommendations and Specifications

General Information

⚠️WARNING⚠️

Do not mix gasoline, alcohol, or gasohol with diesel fuel. This mixture can cause an explosion.

⚠️CAUTION⚠️

Due to the precise tolerances of diesel injection systems, it is extremely important that the fuel be kept clean and free of dirt or water. Dirt or water in the system can cause severe damage to both the fuel pump and the injectors.

Cummins Inc. recommends the use of ASTM number 2 D fuel. The use of number 2 D fuel will result in optimum engine performance.

At operating temperatures below 0°C [32°F], acceptable performance can be obtained by using blends of number 2 D and number 1 D.

NOTE: Lighter fuels can reduce fuel economy.

The viscosity of the fuel **must** be kept above 1.3 cSt at 40°C [104°F] to provide adequate fuel system lubrication.

The following chart lists acceptable emergency fuels.

Acceptable Emergency Fuels - Cummins Fuel System									
Number 1D Diesel	Number 2D Diesel	Number 1K Kerosene	Jet-A	Jet-A1	JP-5	JP-8	Jet-B	JP-4	CITE
1	OK	1	1	1	1	OK	NOT OK	NOT OK	NOT OK
1. OK - only if fuel lubricity is adequate. Refer to Fuel for Cummins Engines, Bulletin 3379001.									
Any adjustment to compensate for reduced performance with a fuel system using substitute fuel is not warrantable.									

Additional information for fuel recommendations and specifications can be found in Fuel for Cummins Engines, Bulletin 3379001. See ordering information in Section L.

Lubricating Oil Recommendations and Specifications

General Information

The use of quality engine lubricating oils and appropriate oil drain and filter change intervals are critical factors in maintaining engine performance and durability.

Cummins Inc. recommends the use of oil that meets the American Petroleum Institute (API) performance categories of CF-4, CG-4, CF-4/SG, or CG-4/SF. Oil with an older API classification of CD or CE can be used in areas of the world outside North America where oils meeting the current API categories are **not** available. However, if using CD or CE classification oil, the oil **must** be changed at the standard service interval and **only** extended if scheduled oil sampling is used for close monitoring of oil condition. Oil with an API classification of CC can be used in areas of the world outside North America where oils meeting the current API categories are **not** available. If used, they **must** be changed at one half the normal recommended service intervals. Oil with an API classification of CA or CB **must not** be used.

The oil supplier is responsible for the quality and performance of their product.

Cummins Inc. recommends engine oil with a nominal ash content of 1 to 1.5 percent mass. Oils with higher ash content, up to 1.85 percent ash, can be used in areas where the sulfur content of the fuel is normally 1 to 1.5 percent mass. Limiting ash content is critical to the prevention of valve and piston deposit formation.

For further details and discussion of engine lubricating oils for Cummins engines, refer to service bulletin Cummins Engine Oil Recommendations, Bulletin 3810340.

New Engine Break-in Oils

Special break-in engine lubricating oils are **not** recommended for new or rebuilt Cummins engines. Use the same type of oil during the break-in as is used in normal operation.

Synthetic or partially synthetic engine oils, however, can **not** be used in a new or rebuilt engine during break-in. Use a standard petroleum-based oil for the first drain interval.

Additional information regarding lubricating oil availability throughout the world is available in the Engine Manufacturer's Association Lubricating Oils Data Book for Heavy-Duty Automotive and Industrial Engines. The data book can be ordered from the address below:

Engine Manufacturer's Association

One Illinois Center

2 N Lasalle Street

Chicago, IL U.S.A. 60601

Phone: (312) 644-6610

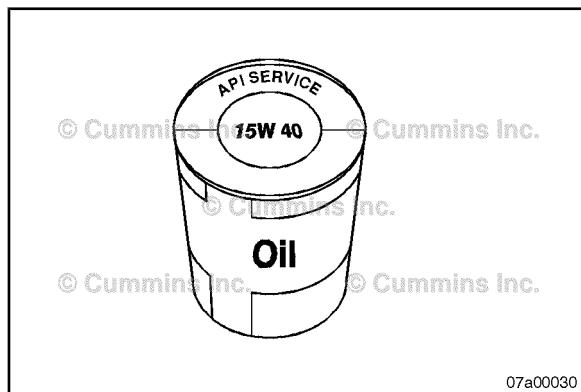
The oil performance classifications represented in the following chart as standard or premium have been determined through field experience and engine testing. Engine component wear and deposits are limiting factors in evaluating useful oil life. Contact a Cummins representative or oil supplier representative(s) for further assistance, if needed.

Cummins Inc. recommends the use of a high-quality 15W-40 multiviscosity, heavy-duty engine oil that meets the requirements of Cummins Engineering Standard (CES) 20071, 22072, 20075, 20076, and 20077. The oil categories CC, CD, and CE have been obsoleted by API and are **not** to be used as their specifications are no longer controlled. Engine oils that meet CES 20076 and 20077 are also considered premium oils when using the Chart Method. ACEA and API designations have **not** been assigned to CES 20076 and 20077 as of yet.

Oil Performance Classification			
API Category	Cummins Engine Standard (CES)	ACEA	Classification of Oil Charts
CC, CD, CE	N/A	N/A	N/A

Oil Performance Classification			
API Category	Cummins Engine Standard (CES)	ACEA	Classification of Oil Charts
CF-4/SG, CG-4SH	20075	E2, E3	Standard
CH-4	20072, 20071	E5	Premium
N/A	20076, 20077	N/A	Premium

ACEA = European Automobile Manufacturers Association



Viscosity Recommendations

The viscosity of an oil is a measure of its resistance to flow. The Society of Automotive Engineers has classified engine oils into viscosity grades. Oils that meet the low temperature (-18°C [0°F]) requirement carry a grade designation with a W suffix. Oils that meet both the low and high temperature requirements are referred to as multigrade or multiviscosity grade oils.

Cummins Inc. has found that the use of multigrade lubricating oil improves oil consumption control and engine cranking in cold conditions while maintaining lubrication at high operating temperatures and can contribute to improved fuel consumption.

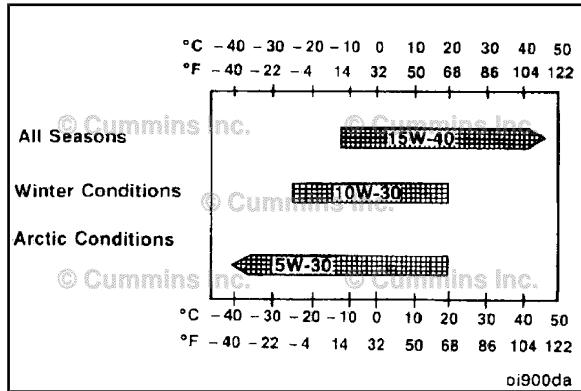
△CAUTION△

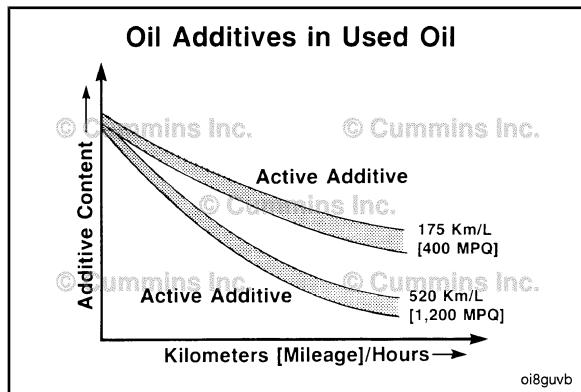
When single-grade oil is used, make sure the oil will be operating within the temperature ranges, as shown.

Cummins Inc. recommends the use of multigrade lubricating oils with the viscosity grades for the ambient temperatures indicated. This picture shows **only** the preferred oil grades.

Single-grade oils can be substituted for short durations until the recommended multigrade is procured. Arctic condition oils are available commercially with better low temperature properties. Consult your supplier.

The primary criterion for selecting an oil viscosity grade is the lowest temperature the oil will experience while in the engine oil sump. Bearing problems can be caused by the lack of lubrication during the cranking and start up of a cold engine when the oil being used is too viscous to flow properly. Change to a lower viscosity grade of oil as the temperature of the oil in the engine oil sump reaches the lower end of the ranges shown in the picture.





As the engine oil becomes contaminated, essential oil additives are depleted. Lubricating oils protect the engine as long as these additives are functioning properly. Progressive contamination of the oil between oil and filter change intervals is normal. The amount of contamination will vary depending on the operation of the engine, hours or miles on the oil, fuel consumed, and new oil added.

Arctic Operation

△CAUTION△

The use of a synthetic base oil does not justify extended oil change intervals. Extended oil change intervals can cause engine damage.

If an engine is operated in ambient temperatures consistently below -23°C [-10°F] and there are no provisions to keep the engine warm when it is **not** in operation, use a synthetic engine oil with adequate low temperature properties.

The oil supplier **must** be responsible for meeting the performance service specifications.

Refer to Section 2 for the use of the Chart Method to allow extended oil change intervals.

Coolant Recommendations and Specifications

General Information

Cummins Inc. recommends the use of fully formulated antifreeze or coolant containing a precharge of Supplemental Coolant Additive (SCA). The antifreeze or coolant **must** meet the specifications outlined in The Maintenance Council (TMC) Recommended Practice (RP) 329 (ethylene glycol) or RP 330 (propylene glycol). The use of fully formulated antifreeze or coolant significantly simplifies cooling system maintenance.

Copies of TMC specifications can be obtained through Cummins Inc., or by contacting:

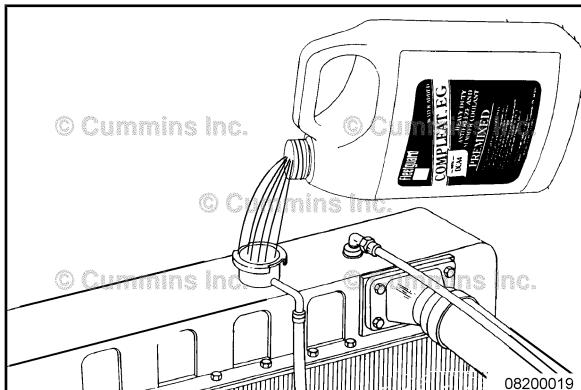
The Maintenance Council
American Trucking Association
2200 Mill Road
Alexandria, VA 22314-5388
Phone: (703) 833-1763
Fax: (703) 836-6070

Fully formulated antifreeze contains balanced amounts of antifreeze, SCA, and buffering compounds, but does **not** contain 50 percent water. Fully formulated coolant contains balanced amounts of antifreeze, SCA, and buffering compounds already premixed 50/50 with deionized water.

The following pages give an explanation of water, antifreeze, and SCA's. They also explain how to test antifreeze and SCA levels.

This section also contains information on cooling system maintenance and a coolant treatment chart that is used to determine the correct SCA service filter.

Alternative maintenance practices for cooling systems can be found in Cummins Coolant Requirements and Maintenance, Bulletin 3666132.



Water Quality	
Calcium	Maximum 170 ppm
Magnesium (Hardness)	as ($\text{CaCO}_3 + \text{MgCO}_3$)
Chloride	40 ppm as (Cl)
Sulfur	100 ppm as (SO_4)

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Fully Formulated Coolant/Antifreeze

Cummins Inc. recommends using either a 50/50 mixture of high quality water and fully formulated antifreeze or fully formulated coolant when filling the cooling system. The fully formulated antifreeze or coolant **must** meet TMC RP 329 or TMC RP 330 specifications.

High quality water is important for cooling system performance. Excessive levels of calcium and magnesium contribute to scaling problems and excessive levels of chlorides and sulfates cause cooling system corrosion.

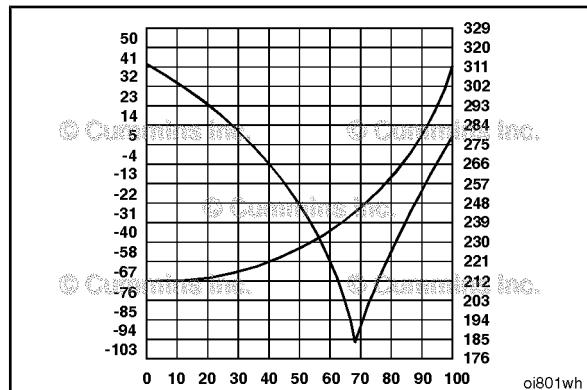
Section V - Maintenance Specifications

Cummins Inc. recommends using Fleetguard® Compleat. It is available in both glycol forms (ethylene and propylene) and complies with TMC standards.

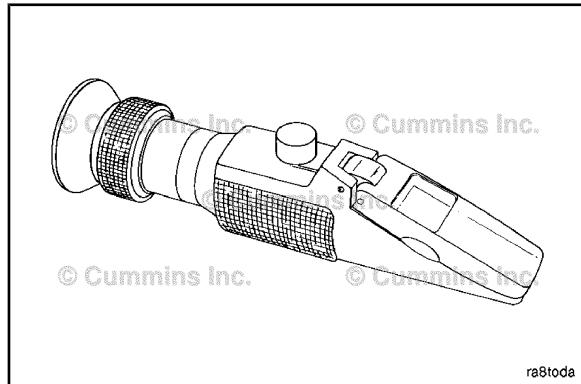


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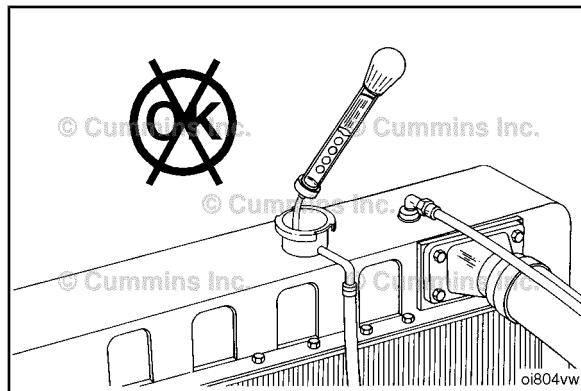
Fully formulated antifreeze **must** be mixed with high quality water at a 50/50 ratio (40 to 60 percent working range). A 50/50 mixture of antifreeze and water gives a -36°C [-34°F] freezing point and a boiling point of 110°C [228°F], which is adequate for locations in North America. The actual lowest freezing point of ethylene glycol antifreeze is at 68 percent. Using higher concentrations of antifreeze will raise the freezing point of the solution and increase the possibility of a silica gel problem.



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A refractometer **must** be used to accurately measure the freezing point of the coolant.

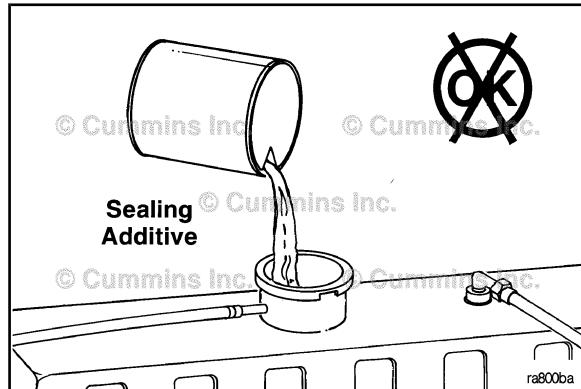


Do **not** use a floating ball hydrometer. Floating ball hydrometers can give incorrect readings.

Cooling System Sealing Additives

Do **not** use sealing additives in the cooling system. The use of sealing additives will:

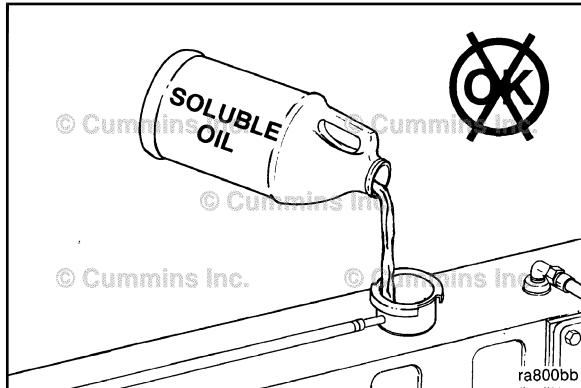
- Build up in coolant low flow areas
- Clog coolant filters
- Plug radiator and oil cooler.



Cooling System Soluble Oils

Do **not** use soluble oils in the cooling system. The use of soluble oils will:

- Allow cylinder liner pitting
- Corrode brass and copper
- Damage heat transfer surfaces
- Damage seals and hoses.



Fleetguard® DCA4 Service Filters and Liquid Precharge

DCA4 Service Filters		DCA (Fleetcool) Service Filters	
Part Number	SCA Units	Part Number	SCA Units
WF2070	2	WF2050	2
WF2071	4	WF2051	4
WF2072	6	WF2052	6
WF2073	8	WF2053	8
WF2074	12	Not available	12
WF2075	15	WF2054	15
WF2076	23	WF2055	23
WF2077	(blank filter without SCAs)	WF2077	(blank filter without SCAs)

DCA4 Liquid			DCA (Fleetcool) Liquid		
Part Number	Size	SCA Units	Part Number	Size	SCA Units
DCA60L	0.47 liter [1 pt]	5	DCA30L	0.47 liter [1 pt]	5
DCA65L	1.89 liter [2 qt]	20	DCA35L	1.89 liter [2 qt]	20
DCA70L	3.78 liter [1 gal]	40	DCA40L	3.78 liter [1 gal]	40
DCA75L	18.9 liter [5 gal]	200	DCA45L	18.9 liter [5 gal]	200
DCA80L	208 liter [55 gal]	2200	DCA50L	208 liter [55 gal]	2200

Install service filter(s) and/or liquid containing the number of SCA units below:

Maintenance Intervals for Cooling Systems up to 76 liters [20 gal]						
Service Interval			System Size in liters [gal]			
Kilometers	Miles	Hours	4-19 [1-5]	19-38 [6-10]	42-57 [11-15]	60-76 [16-20]
72001-80000	45001-50000	1126-1250	8	12	23	30
64001-72000	40001-45000	1001-1125	4	12	15	26
56001-64000	35001-40000	876-1000	4	8	12	23
48001-56000	30001-35000	751-875	4	6	12	20
40001-48000	25001-30000	626-750	4	6	10	18
32001-40000	20001-25000	501-625	2	6	8	15
24001-32000	15001-20000	376-500	2	4	6	12
16001-24000	10001-15000	251-375	2	4	6	8
0-16000	0-10000	0-250	2	2	4	6

Maintenance Intervals for Cooling System up to 1514 liters [400 gal]										
System Size in liters [gal]										
Hours	79-144 [21-30]	117-189 [31-50]	193-284 [51-75]	288-378 [76-100]	382-568 [101-150]	572-757 [151-200]	761-946 [201-250]	950-1135 [251-300]	1139-1325 [301-350]	1329-1574 [351-400]
751-1000	25	50	80	100	150	200	250	300	350	400
501-750	20	35	60	75	110	150	190	225	260	300
251-500	15	25	40	50	75	100	125	150	175	200

Maintenance Intervals for Cooling System up to 1514 liters [400 gal]											
0-250	10	15	20	25	40	50	65	75	90	100	

Notes:

- A. Consult the vehicle equipment manufacturer's maintenance information for total cooling system capacity.
- B. When draining and replacing the coolant, **always** pre-charge the cooling system to a SCA level of 1.5 units per gallon. This concentration level **must not** be allowed to go below 1.2 units and **must** be controlled when the level is greater than 3 units. Action needed when the level goes below 1.2 is a filter and liquid pre-charge; from 1.2 to 3.0 units, filter **only**; above 3.0, test at every oil change until level falls to 3.0 or below.

When performing service which requires draining the cooling system, take special precautions to collect it in a clean container, seal it to prevent contamination, and save for reuse.

- A. Change coolant filters at each oil change to protect the cooling system. Consult the coolant capacity chart to determine the correct coolant filter for a given cooling system capacity and oil drain interval.

Supplemental Coolant Additive (SCA)

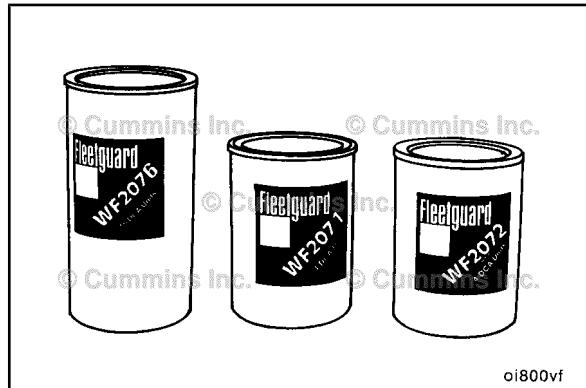
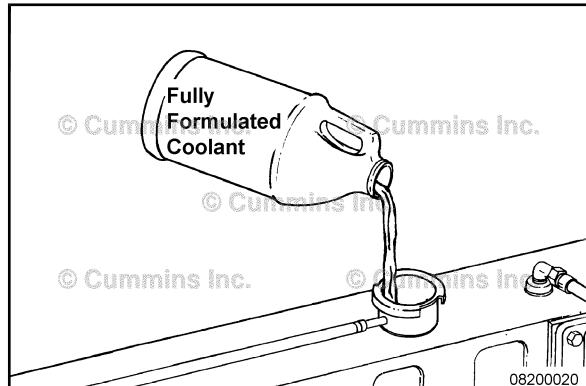
Fully formulated products contain SCA's and are required to protect the cooling system from fouling, solder blooming, and general corrosion. The coolant filter is required to protect the coolant system from abrasive materials, debris, and precipitated coolant additives.

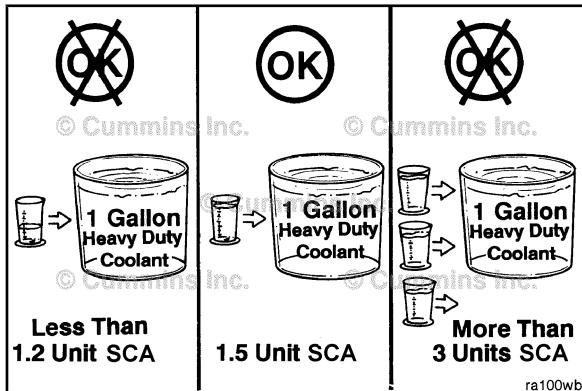
Supplemental coolant additives, or equivalent, are used to prevent liner pitting, corrosion, and scale deposits in the cooling system.

Use the correct Fleetguard® coolant filter to maintain the recommended SCA concentration in the system.

Maintain the correct concentration by changing the service filter at each oil drain interval.

The correct filter is determined by the total cooling system capacity and oil drain interval. Refer to the Coolant Capacity Charts.





△CAUTION△

Insufficient concentration of the coolant additives will result in liner pitting and engine failure.

The SCA concentration **must not** fall below 1.2 units or exceed 3 units per gallon of cooling system capacity.

Use the correct Fleetguard® coolant filter to maintain the recommended SCA concentration in the system.

Maintain the correct concentration by changing the service coolant filter at each oil drain interval.

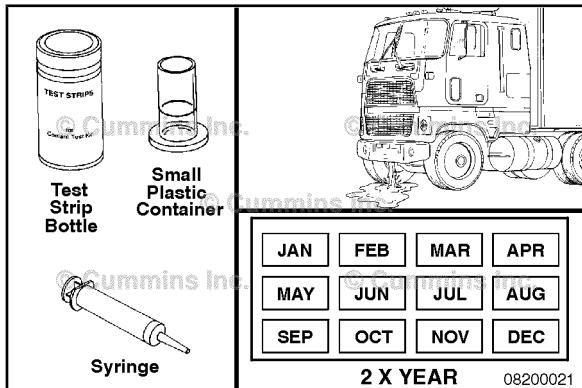
NOTE: The correct filter is determined by the total cooling system capacity and oil drain interval.

Testing SCA Concentration Level CC-2602 Test Kit

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

Precautions and Instructions for Proper Kit Use

- The coolant sample to be tested **must** be between 10 and 54°C [50 and 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 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 any of the pads on the unused strips have turned light brown or pink.
- 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 affect the test results.
- If the strip container is left uncapped for 24 hours, moisture in the air will render the strips useless, although no discoloration will be evident.
- **Only** use the color chart supplied with the kit.
- Clean and dry the sample cup and syringe after each use. This will prevent contaminating future samples.
- Following the correct test times is very important. Use a clock or stopwatch.



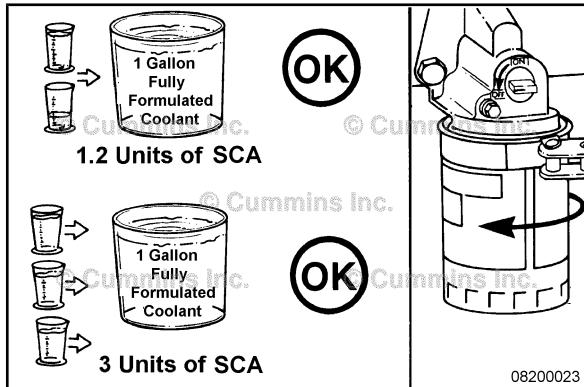
Test Intervals

Testing is recommended if the operator is **not** sure of his cooling system condition due to leaks, uncontrolled topping off of the system, or major coolant loss.

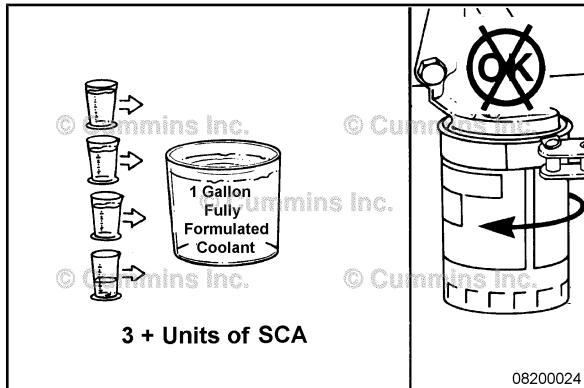
Testing is also recommended twice a year to monitor the SCA level. If the SCA level is above 3 units, test at subsequent oil drain intervals until the concentration is back under 3 units. When the concentration is back under 3 units, start installing the correct service filters at each drain interval.

If the concentration is below 1.2 units per gallon, replace the filter and precharge with liquid.

If the concentration is 1.2 to 3 units per gallon, replace the filter.

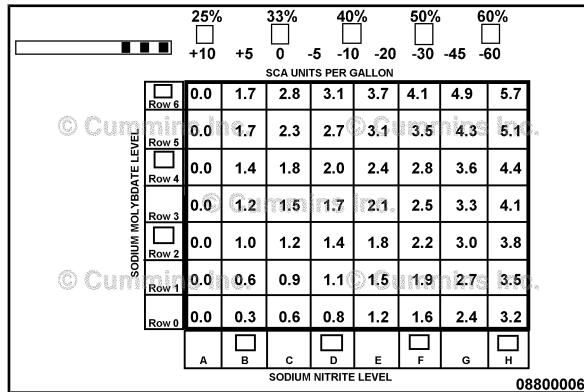


If the concentration is above 3 units per gallon, do **not** replace the service filter. Test the coolant at subsequent oil drain intervals until the concentration is back under 3 units. When the concentration is back under 3 units, start installing service filters at each oil change interval.



Coolant Recommendations and Specifications

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QST30

Section V - Maintenance Specifications

Do **not** utilize the test kit to maintain minimum SCA concentration levels (i.e., 1.5 units).

In some instances the A or B reading can be high. However, it is the combined reading that is important. Therefore, always follow the chart.

Cummins 1-800-DIESELS
1-800-521-4005

© Cummins Inc.

1-800-22-FILTERS Inc.
1-800 - 223 - 4583

© Cummins Inc.

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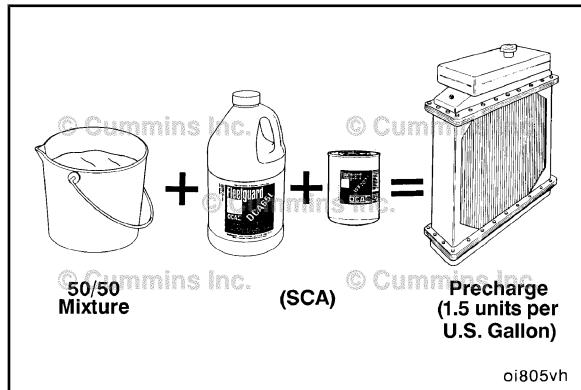
Call the numbers listed above to get answers to any questions you have about cooling system maintenance.

CC2602 Coolant Test Kit:

- Works with any SCA formulation (Call 1-800-521-4005 if you have this test kit and the color chart does **not** show the number of units of SCA per gallon of coolant).

Probabilizer:

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



Coolant Replacement Requirements

⚠️ WARNING ⚠️

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

Drain and flush the cooling system after 6,000 hours or 2 years of service. Refill with either new fully formulated coolant or a 50/50 mixture of high quality water and fully formulated antifreeze, and install the correct service coolant filter.

Section W - Warranty

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All Engines Worldwide Generator Drive Engines Warranted

This Warranty applies to new Engines sold by Cummins and delivered to the first user on or after April 1, 1999, that are used in generator drive application anywhere in the world where Cummins approved service is available. These Engines will have the following rating designations:

Standby Power Rating

Engines of this rating are applicable for supplying emergency power for the duration of the utility power outage. No overload capability is available for this rating. Under no condition is an Engine allowed to operate in parallel with the public utility at the Standby Power rating. This rating should be applied where reliable utility power is available. A Standby rated Engine is to be sized for a maximum of an 80 percent average load factor and 200 hours of operation per year. This includes less than 25 hours per year at the Standby Power rating. Standby rating should never be applied except in true emergency power outages. Negotiated power outages contracted with a utility company are not considered an emergency.

Unlimited Time Running Prime Power Rating

Engines with this rating are available for an unlimited number of hours per year in a variable load application. Variable load is not to exceed a 70 percent average of the Prime Power rating during any operating period of 250 hours. Total operating time at 100 percent Prime Power shall not exceed 500 hours per year.

A 10 percent overload capability is available for a period of one hour within a twelve hour period of operation. Total operating time at the 10 percent overload power shall not exceed 25 hours per year.

Limited Time Running Prime Power Rating

Engines of this rating are available for a limited number of hours in a non-variable load application. It is intended for use in situations where power outages are contracted, such as in utility power curtailment. Engines may be operated in parallel to the public utility up to 750 hours per year at power levels never to exceed the Prime Power rating.

Limited Time Running Prime Power ratings differ from Unlimited Time Running in that even though the maximum power output of the Engines are the same, the Limited Time Running allows the Engine to be parallel to Public Utility and run at the full Prime Power rating and must never exceed the Prime Power rating.

Continuous/Base Power Rating

Engines with this rating are available for supplying utility power at a constant 100 percent load for an unlimited number of hours per year. No overload capability is available for this rating.

Continuous/Base Power ratings differ from Unlimited Time Running Prime Power ratings in that the Continuous/Base Load ratings are significantly reduced from the Prime Power ratings. Continuous/Base Load ratings have no load factor or application restrictions.

Coverage

Base Engine Warranty

This Warranty covers any failures of the Engine, under normal use and service, which result from a defect in material or factory workmanship (Warrantable Failure).

Coverage begins with the sale of the Engine by Cummins and continues for the Duration stated below. The Duration commences either on the date of delivery of the Engine to the first user, or on the date the Engine is first leased, rented or loaned, or when the Engine has been operated for 50 hours, whichever occurs first.

Base Engine Warranty

Rating	Months	Hours
Standby Power	24	400
Unlimited Prime Power	12	Unlimited
Limited Prime Power	12	750
Continuous/Base Power	12	Unlimited

Extended Major Components Warranty

The Extended Major Components Warranty applies to Engines other than B and C series and covers Warrantable Failures of the Engine cylinder block, camshaft, crankshaft and connecting rods (Covered Parts). Bushing and bearing failures are not covered. This coverage begins with the expiration of the Base Engine Warranty and continues for the following stated Duration. The Duration commences either on the date of delivery of the Engine to the first user, or on the date the Engine is first leased, rented or loaned, or when the Engine has been operated for 50 hours, whichever occurs first.

Extended Major Components Warranty

Rating	Months	Hours
Standby Power	36	600
Unlimited Prime Power	36	10,000
Limited Prime Power	36	2,250

Continuous/Base Power	36	10,000
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Consumer Products

This Warranty on Consumer Products in the United States is a LIMITED Warranty. **CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.** Any implied Warranties applicable to Consumer Products terminate concurrently with the expiration of the express Warranties applicable to the product. In the United States, some states do not allow the exclusion of incidental or consequential damages, or limitations on how long an implied Warranty lasts, so the limitations or exclusions herein may not apply to you.

These Warranties are made to all Owners in the chain of distribution, and Coverage continues to all subsequent Owners until the end of the periods of Coverage.

Cummins Responsibilities

During Base Engine Warranty

Cummins will pay for all parts and labor needed to repair the damage to the Engine resulting from a Warrantable Failure when performed during normal business hours. All labor costs will be paid in accordance with Cummins published Standard Repair Time guidelines.

Cummins will pay for the lubricating oil, antifreeze, filter elements and other maintenance items that are not reusable due to the Warrantable Failure.

Cummins will pay reasonable travel expenses for mechanics to travel to and from the Engine site, including meals, mileage and lodging when the repair is performed at the site of the failure.

Cummins will pay reasonable labor costs for Engine removal and reinstallation when necessary to repair a Warrantable Failure.

During the Extended Major Components Warranty

Cummins will pay for the repair or, at its option, replacement of the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner Responsibilities

During the Base Engine Warranty

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during Warranty repairs unless such items are not reusable due to the Warrantable Failure.

During the Extended Major Components Warranty

Owner is responsible for the cost of all labor needed to repair the Engine, including the labor cost for Engine removal and reinstallation. When Cummins elects to repair a part instead of replacing it, the Owner is not responsible for the labor needed to repair the part.

Owner is responsible for the cost of all parts required for the repair except for the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during repair of a Warrantable Failure.

During the Base Engine and Extended Major Components Warranties

Owner is responsible for the operation and maintenance of the Engine as specified in the applicable Cummins Operation and Maintenance Manual. Owner is also responsible for providing proof that all recommended maintenance has been performed.

Before the expiration of the applicable Warranty, Owner must notify a Cummins distributor, authorized dealer or other repair location approved by Cummins of any Warrantable Failure and make the Engine available for repair by such

facility. Locations in the United States* and Canada are listed in the Cummins United States and Canada Sales and Service Directory; other locations are listed in the Cummins International Sales and Service Directory.

Owner is responsible for communication expenses, meals, lodging and similar costs incurred as a result of a Warrantable Failure.

Owner is responsible for non-Engine repairs, "downtime" expenses, fines, all applicable taxes, all business costs and other losses resulting from a Warrantable Failure.

Owner is responsible for providing sufficient access to and reasonable ability to remove the Engine from the installation in the event of a Warrantable Failure.

Owner is responsible for maintaining an operating Engine hourmeter. If the hourmeter is not operational, Engine usage will be estimated at 400 hours per month.

Limitations

Cummins is not responsible for failures or damage resulting from what Cummins determines to be abuse or neglect, including, but not limited to: operation without adequate coolants or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage, starting, warm-up, run-in or shutdown practices; unauthorized modifications to the Engine. Cummins is also not responsible for Engine performance problems or failures caused by incorrect oil or fuel, or by water, dirt or other contaminants in the fuel or oil.

This Warranty does not apply to accessories supplied by Cummins which bear the name of another company. Such non-warranted accessories include, but are not limited to: alternators, starters, fans**, air conditioning compressors, clutches, filters, transmissions, air cleaners and safety shutdown switches.

Before a claim for excessive oil consumption will be considered, Owner must submit adequate documentation to show that consumption exceeds Cummins published standards.

Failure of belts and hoses supplied by Cummins is not covered beyond the first 500 hours or one year of operation, whichever occurs first after the Warranty start date.

Parts used to repair a Warrantable Failure may be new Cummins parts, Cummins approved rebuilt parts or repaired parts. Cummins is not responsible for failures resulting from the use of parts not approved by Cummins.

A new Cummins or Cummins-approved rebuilt part used to repair a Warrantable Failure assumes the identity of the part it replaced and is entitled to the remaining coverage hereunder.

Cummins is not responsible for Engine performance problems or failures resulting from:

1. Use or application of the Engine inconsistent with its rating designation as set forth above.
2. Inadequate or incorrect installations deviating from Cummins Generator Drive Installation Guidelines.

CUMMINS IS NOT RESPONSIBLE FOR WEAR OR WEAROUT OF COVERED PARTS.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

THE WARRANTIES SET FORTH HEREIN ARE THE SOLE WARRANTIES MADE BY CUMMINS IN REGARD TO THESE ENGINES. CUMMINS MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

In the United States* and Canada, this Warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Outside the United States* and Canada, in case of consumer sales, in some countries, the Owner has statutory rights which cannot be affected or limited by the terms of this Warranty.

Nothing in this Warranty excludes or restricts any contractual rights the owner may have against third parties.

* Includes American Samoa, the Commonwealth of Northern Mariana Islands, Guam, Puerto Rico and the U.S. Virgin Islands.

** Alternators, starters and fans ARE covered for the duration of the Base Engine Warranty on B3.3 Engines.

All Engines United States and CanadaIndustrial (Off-Highway)

Coverage

Products Warranted

This warranty applies to new Engines sold by Cummins and delivered to the first user on or after April 1, 1999, that are used in Industrial (Off-Highway) applications in the United States* and Canada, except for Engines used in marine, generator drive and certain defense applications, for which different warranty coverage is provided.

Base Engine Warranty

This warranty covers any failures of the Engine, under normal use and service, which result from a defect in material or factory workmanship (Warrantable Failures).

Coverage begins with the sale of the Engine by Cummins. Coverage continues for two years or 2,000 hours of operation, whichever occurs first, from the date of delivery of the Engine to the first user, or from the date the unit is first leased, rented or loaned, or when the Engine has been operated for 50 hours, whichever occurs first. If the 2,000 hour limit is exceeded during the first year, Coverage continues until the end of the first year.

Extended Major Components Warranty

The Extended Major Components Warranty covers Warrantable Failures of the Engine cylinder block, camshaft, crankshaft and connecting rods (Covered Parts).

Bushing and bearing failures are not covered.

This Coverage begins with the expiration of the Base Engine Warranty and ends three years or 10,000* hours of operation from the date of delivery of the Engine to the first user, or from the date the unit is first leased, rented or loaned, or from when the Engine has been operated for 50 hours, whichever occurs first.

*3,000 hours for A Series Engines.

Consumer Products

The warranty on Consumer Products in the United States is a LIMITED warranty. **CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.** Any implied warranties applicable to Consumer Products in the United States terminate concurrently with the expiration of the express warranties applicable to the product. In the United States, some states do not allow the exclusion of incidental or consequential damages, or limitations on how long an implied warranty lasts, so the limitations or exclusions herein may not apply to you.

These warranties are made to all Owners in the chain of distribution, and Coverage continues to all subsequent Owners until the end of the periods of Coverage.

Cummins' Responsibilities

During The Base Engine Warranty

Cummins will pay for all parts and labor needed to repair the damage to the Engine resulting from a Warrantable Failure.

Cummins will pay for the lubricating oil, antifreeze, filter elements, and other maintenance items that are not reusable due to the Warrantable Failure.

Cummins will pay reasonable costs for mechanics to travel to and from the equipment site, including meals, mileage and lodging, when the repair is performed at the site of the failure.

Cummins will pay reasonable labor costs for Engine removal and reinstallation when necessary to repair a Warrantable Failure.

During The Extended Major Components Warranty

Cummins will pay for the repair or, at its option, replacement of the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner's Responsibilities

During The Base Engine Warranty

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items provided during warranty repairs unless such items are not reusable due to the Warrantable Failure.

During The Extended Major Components Warranty

Owner is responsible for the cost of all labor needed to repair the Engine, including the labor to remove and reinstall the Engine. When Cummins elects to repair a part instead of replacing it, Owner is not responsible for the labor needed to repair the part.

Owner is responsible for the cost of all parts required for the repair except for the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during repair of a Warrantable Failure.

During The Base Engine and Extended Major Components Warranties

Owner is responsible for the operation and maintenance of the Engine as specified in the applicable Cummins Operation and Maintenance Manual. Owner is also responsible for providing proof that all recommended maintenance has been performed.

Before the expiration of the applicable warranty, Owner must notify a Cummins distributor, authorized dealer or other repair location approved by Cummins of any Warrantable Failure and make the Engine available for repair by such facility. Locations in the United States and Canada are listed in the Cummins Off-Highway Authorized Dealer Directory.

Owner is responsible for communication expenses, meals, lodging and similar costs incurred as a result of a Warrantable Failure.

Owner is responsible for non-Engine repairs, "downtime" expenses, cargo damage, fines, all applicable taxes, all business costs and other losses resulting from a Warrantable Failure.

Limitations

Cummins is not responsible for failures or damage resulting from what Cummins determines to be abuse or neglect, including, but not limited to: operation without adequate coolants or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage, starting, warm-up, run-in or shutdown practices; unauthorized modifications of the Engine. Cummins is also not responsible for failures caused by incorrect oil or fuel or by water, dirt or other contaminants in the fuel or oil.

For power units and fire pumps (package units), this warranty applies to accessories, except for clutches and filters, supplied by Cummins which bear the name of another company.

Except for power units and fire pumps, this warranty does not apply to accessories which bear the name of another company. Such non-warranted accessories include, but are not limited to: alternators, starters, fans**, air conditioning compressors, clutches, filters, transmissions, torque converters, steering pumps, and non-Cummins fan drives, engine compression brakes and air compressors.

Cummins Compusave units are covered by a separate warranty.

Before a claim for excessive oil consumption will be considered, Owner must submit adequate documentation to show that consumption exceeds Cummins published standards.

Failures of belts and hoses supplied by Cummins are not covered beyond the first 500 hours or one year of operation, whichever occurs first.

Parts used to repair a Warrantable Failure may be new Cummins parts, Cummins-approved rebuilt parts, or repaired parts. Cummins is not responsible for failures resulting from the use of parts not approved by Cummins.

A new Cummins or Cummins-approved rebuilt part used to repair a Warrantable Failure assumes the identity of the part it replaced and is entitled to the remaining coverage hereunder.

For all A Series Applications, including industrial, travel reimbursement for non-transportable equipment will be limited to 4.0 hours, \$0.25/mile and 250 miles maximum. Any costs beyond this limit are the customer's responsibility.

CUMMINS DOES NOT COVER WEAR OR WEAROUT OF COVERED PARTS.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

THESE WARRANTIES SET FORTH HEREIN ARE THE SOLE WARRANTIES MADE BY CUMMINS IN REGARD TO THESE ENGINES. CUMMINS MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Emission Warranty

Products Warranted

This emission warranty applies to new Engines marketed by Cummins that are used in the United States* in vehicles designed for Industrial Off-Highway use. This warranty applies to Engines delivered to the ultimate purchaser on or after April 1, 1999 for Engines up to 750 horsepower, on or after January 1, 2000 for Engines 751 horsepower and over.

Coverage

Cummins warrants to the ultimate purchaser and each subsequent purchaser that the Engine is designed, built and equipped so as to conform at the time of sale by Cummins with all U.S. Federal emission regulations applicable at the time of manufacture and that it is free from defects in workmanship or material which would cause it not to meet these regulations within the longer of the following periods: (A) ***Five years or 3,000 hours of operation, whichever occurs first, as measured from the date of delivery of the Engine to the ultimate purchaser, or (B) The Base Engine Warranty.

If the vehicle in which the Engine is installed is registered in the state of California, a separate California Emission Warranty also applies.

Limitations

Failures, other than those resulting from defects in materials, or workmanship, are not covered by this warranty.

Cummins is not responsible for failures or damage resulting from what Cummins determines to be abuse or neglect, including, but not limited to: operation without adequate coolant or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage, starting, warm-up, run-in or shutdown practices; unauthorized modifications of the Engine. Cummins is also not responsible for failures caused by incorrect fuel or by water, dirt or other contaminants in the fuel.

Cummins is not responsible for non-Engine repairs, "downtime" expenses, cargo damage, fines, all business costs or other losses resulting from a Warrantable Failure.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

* Includes American Samoa, the Commonwealth of Northern Mariana Islands, Guam, Puerto Rico, and the U.S. Virgin Islands.

** Alternators, starters, and fans ARE covered for the duration of the Base Engine Warranty on A Series and B3.3 Engines.

*** Emissions Warranty for B LPG Industrial Off-Highway engines is 5 Years / 3,500 Hours.

All Engines International Industrial (Off-Highway)

Coverage

PRODUCTS WARRANTED

This warranty applies to new Engines sold by Cummins and delivered to the first user on or after April 1, 1999, that are used in industrial (off-highway) applications anywhere in the world where Cummins-approved service is available, except the United States* and Canada. Different warranty coverage is provided for Engines used in marine, generator drive and certain defense applications.

BASE ENGINE WARRANTY

This warranty covers any failures of the Engine, under normal use and service, which result from a defect in material or factory workmanship (Warrantable Failure).

Coverage begins with the sale of the Engine by Cummins. Coverage continues for two years or 2,000 hours of operation, whichever occurs first, from the date of delivery of the Engine to the first user, or from the date the unit is first leased, rented or loaned, or when the Engine has been operated for 50 hours, whichever occurs first. If the 2,000 hour limit is exceeded during the first year, coverage continues until the end of the first year.

EXTENDED MAJOR COMPONENTS WARRANTY

The Extended Major Components Warranty covers Warrantable Failures of the Engine cylinder block, camshaft, crankshaft and connecting rods (Covered Parts).

Bushing and bearing failures are not covered.

This coverage begins with the expiration of the Base Engine Warranty and ends three years or 10,000* hours of operation, from the date of delivery of the Engine to the first user, or from the date the unit is first leased, rented or loaned, or when the Engine has been operated for 50 hours, whichever occurs first.

*3,000 hours for A series engines.

These warranties are made to all Owners in the chain of distribution, and Coverage continues to all subsequent Owners until the end of the periods of Coverage.

Cummins' Responsibilities

DURING THE BASE ENGINE WARRANTY

Cummins will pay for all parts and labor needed to repair the damage to the Engine resulting from a Warrantable Failure.

Cummins will pay for the lubricating oil, antifreeze, filter elements, and other maintenance items that are not reusable due to a Warrantable Failure.

Cummins will pay reasonable costs for mechanics to travel to and from the equipment site, including meals, mileage and lodging, when the repair is performed at the site of the failure.

Cummins will pay reasonable labor costs for Engine removal and reinstallation when necessary to repair a Warrantable Failure.

DURING THE EXTENDED MAJOR COMPONENTS WARRANTY

Cummins will pay for the repair or, at its option, replacement of the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered part.

Owner's Responsibilities

DURING THE BASE ENGINE WARRANTY

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during warranty repairs unless such items are not reusable due to the Warrantable Failure.

DURING THE EXTENDED MAJOR COMPONENTS WARRANTY

Owner is responsible for the cost of all labor needed to repair the Engine, including the labor to remove and reinstall the Engine. When Cummins elects to repair a part instead of replacing it, Owner is not responsible for the labor needed to repair the part.

Owner is responsible for the cost of all parts required for the repair except for the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during repair of a Warrantable Failure.

DURING THE BASE ENGINE AND EXTENDED MAJOR COMPONENTS WARRANTIES

Owner is responsible for the operation and maintenance of the Engine as specified in the applicable Cummins Operation and Maintenance Manual. Owner is also responsible for providing proof that all recommended maintenance has been performed.

Before the expiration of the applicable warranty, Owner must notify a Cummins distributor, authorized dealer or other repair location approved by Cummins of any Warrantable Failure and make the product available for repair by such facility. Locations are listed in the Cummins International Sales and Service Directory.

Owner is responsible for communication expenses, meals, lodging and similar costs incurred as a result of a Warrantable Failure.

Owner is responsible for non-Engine repairs, "downtime" expenses, cargo damage, fines, all applicable taxes, all business costs and other losses resulting from a Warrantable Failure.

Limitations

Cummins is not responsible for failures or damage resulting from what Cummins determines to be abuse or neglect, including, but not limited to: operation without adequate coolants or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage, starting, warm-up, run-in or shutdown

practices; unauthorized modifications of the Engine. Cummins is also not responsible for failures caused by incorrect oil or fuel or by water, dirt or other contaminants in the fuel or oil.

For power units and fire pumps (package units) the warranty applies to accessories, except for clutches and filters supplied by Cummins which bear the name of another company.

Except for the accessories noted previously, Cummins does not warrant accessories which bear the name of another company. Such non-warranted accessories include, but are not limited to: alternators, starters, fans*, air conditioning compressors, clutches, filters, transmissions, torque converters, steering pumps, non-Cummins fan drives, and air cleaners.

Cummins Compusave units are covered by a separate warranty.

Before a claim for excessive oil consumption will be considered, Owner must submit adequate documentation to show that consumption exceeds Cummins published standards.

Failures of belts and hoses supplied by Cummins are not covered beyond the first 500 hours or one year of operation, whichever occurs first.

Parts used to repair a Warrantable Failure may be new Cummins parts, Cummins-approved rebuilt parts, or repaired parts. Cummins is not responsible for failures resulting from the use of parts not approved by Cummins.

A new Cummins or Cummins-approved rebuilt part used to repair a Warrantable Failure assumes the identity of the part it replaced and is entitled to the remaining coverage hereunder.

For all A Series Applications, including industrial, travel reimbursement for non-transportable equipment will be limited to 4.0 hours, \$0.25/mile and 250 miles maximum. Any costs beyond this limit are the customer's responsibility.

CUMMINS DOES NOT COVER WEAR OR WEAROUT OF COVERED PARTS.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

THESE WARRANTIES SET FORTH HEREIN ARE THE SOLE WARRANTIES MADE BY CUMMINS IN REGARD TO THESE ENGINES. CUMMINS MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

In case of consumer sales, in some countries, the Owner has statutory rights which cannot be affected or limited by the terms of this warranty.

Nothing in this warranty excludes or restricts any contractual rights the Owner may have against third parties.

* Alternators, starters, and fans ARE covered for the duration of the base engine warranty on A series and B3.3 engines.

California Emission Control System Warranty, Off-Highway

Products Warranted

This Emission Control System Warranty applies to off-road diesel engines certified with the California Air Resources Board beginning with the year 1996 for engines up to 750 horsepower, beginning with the year 2000 for 751 horsepower and over, marketed by Cummins, and registered in California for use in industrial off-highway applications.

Your Warranty Rights and Obligations

The California Air Resources Board and Cummins Engine Company, Inc., are pleased to explain the emission control system warranty on your engine. In California, new off-road diesel engines must be designed, built and equipped to meet the State's stringent anti-smog standards. Cummins must warrant the emission control system on your engine for the periods of time listed below provided there has been no abuse, neglect or improper maintenance of your engine.

Your emission control system may include parts such as the fuel injection system and the air induction system. Also included may be hoses, belts, connectors and other emission-related assemblies.

Where a warrantable condition exists, Cummins will repair your off-road diesel engine at no cost to you including diagnosis, parts and labor.

Manufacturer's Warranty Coverage

This warranty coverage is provided for 5 years or 3,000 hours of engine operation, whichever first occurs from the date of delivery of the engine to the first user. If any emission-related part on your engine is defective, the part will be repaired or replaced by Cummins.

California Emission Control System Warranty, Off-Highway

Coverage

This emission control system warranty applies to the QST30 emission control parts:

Fuel Metering System

- Fuel Injection Pump
- Fuel Injector

Air Induction System

- Grid Heater System (if equipped)
- Intake Manifold
- Turbocharger
- Aftercooler Core (if equipped)
- LTA Water Pump and Plumbing (if equipped)

Electronic controls

- Engine Control Module
- Ambient Pressure Sensor
- Boost Pressure Sensor
- Intake Air Temp Sensor
- Engine Speed Sensor
- Engine Position Sensor (if equipped)
- Needle Lift Sensor (if equipped)
- Hoses, belts, connectors assemblies, clamps, fittings, tubing, sealing gaskets or devices, and mounting hardware.

Miscellaneous Items Used in Above Systems

Owner's Warranty Responsibilities

As the off-road diesel engine owner, you are responsible for the performance of the required maintenance listed in your Cummins Operation and Maintenance Manual. Cummins recommends that you retain all receipts covering maintenance on your off-road diesel engine, but Cummins cannot deny warranty solely for the lack of receipts or for your failure to ensure the performance of all scheduled maintenance.

You are responsible for presenting your off-road diesel engine to a Cummins dealer as soon as a problem exists. The warranty repairs should be completed in a reasonable amount of time, not to exceed 30 days.

As the off-road diesel engine owner, you should also be aware that Cummins may deny you warranty coverage if your off-road diesel engine or a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.

Your engine is designed to operate on diesel fuel only. Use of any other fuel may result in your engine no longer operating in compliance with California's emissions requirements.

If you have any questions regarding your warranty rights and responsibilities, you should contact Cummins Customer Assistance Department at 1-800-343-7357 (1-800-DIESELS) or the California Air Resources Board at 9528 Telstar Avenue, El Monte, CA 91731.

Prior to the expiration of the applicable warranty, Owner must give notice of any warranted emission control failure to a Cummins distributor, authorized dealer or other repair location approved by Cummins and deliver the engine to such facility for repair. Repair locations are listed in Cummins United States and Canada Service Directory.

Owner is responsible for incidental costs such as: communication expenses, meals, lodging incurred by Owner or employees of Owner as a result of a warrantable failure.

Owner is responsible for business costs and losses, "downtime" expenses, and cargo damage resulting from a warrantable failure. CUMMINS IS NOT RESPONSIBLE FOR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDE BUT ARE NOT LIMITED TO FINES, THEFT, VANDALISM OR COLLISIONS.

Replacement Parts

Cummins recommends that any service parts used for maintenance, repair or replacement of emission control systems be new, genuine Cummins or Cummins approved rebuilt parts and assemblies, and that the engine be serviced by a Cummins distributor, authorized dealer or the repair location approved by Cummins. The owner may elect to have maintenance, replacement or repair of the emission control parts performed by a facility other than a Cummins distributor, an authorized dealer or a repair location approved by Cummins, and may elect to use parts other than new genuine Cummins or Cummins approved rebuilt parts and assemblies for such maintenance, replacement or repair; however, the cost of such service or parts will not be covered under this emission control system warranty.

Cummins Responsibilities

Repairs and service will be performed by any Cummins distributor, authorized dealer or other repair location approved by Cummins using new, genuine Cummins or Cummins approved rebuilt parts and assemblies. Cummins will repair any of the emission control parts found by Cummins to be defective without charge for parts or labor (including diagnosis which results in determination that there has been a failure of a warranted emission control part).

Emergency Repairs

In the case of an emergency where a Cummins distributor, authorized dealer, or other repair location approved by Cummins is not available, repairs may be performed by any available repair location using any replacement parts. Cummins will reimburse the Owner for expenses (including diagnosis), not to exceed the manufacturer's suggested retail price for all warranted parts replaced and labor charges based on the manufacturer's recommended time allowance for the warranty repair and the geographically appropriate hourly labor rate. A part not being available within 30 days or a repair not being complete within 30 days constitutes an emergency. Replaced parts and paid invoices must be presented at a Cummins authorized repair facility as a condition of reimbursement for emergency repairs not performed by a Cummins distributor, authorized dealer, or other repair location approved by Cummins.

Warranty Limitations

Cummins is not responsible for failures resulting from Owner or operator abuse or neglect, such as: operation without adequate coolant, fuel or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or air intake systems; improper storage, starting, warm-up, run-in or shutdown practices.

The manufacturer warrants to the ultimate purchaser and each subsequent purchaser that the engine is designed, built, and equipped so as to conform with all applicable regulations adopted by the Air Resources Board, and that it is free from defects in materials and workmanship which cause the failure of a warranted part.

Any warranted part which is not scheduled for replacement as required maintenance, or which is scheduled only for regular inspection to the effect of "repair or replace as necessary" is warranted for the warranty period.

Any warranted part which is scheduled for replacement as required maintenance is warranted for the period of time prior to the first scheduled replacement point for that part.

The owner will not be charged for diagnostic labor which leads to the determination that a warranted part is defective, if the diagnostic work is performed at a warranty station.

The manufacturer is liable for damages to other engine components caused by the failure under warranty of any warranted part.

Cummins is not responsible for failures resulting from improper repair or the use of parts which are not genuine Cummins or Cummins approved parts.

These warranties, together with the express commercial warranties and emission warranty are the sole warranties of Cummins. There are no other warranties, express or implied, or of merchantability or fitness for a particular purpose.

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CALIFORNIA
Proposition 65 Warning

**Diesel engine exhaust and some of its constituents are known
to the State of California to cause cancer, birth defects, and
other reproductive harm.**

Cummins Inc.
Box 3005
Columbus, Indiana, U.S.A., 47202

Registered Office
Cummins Ltd.
49 - 51 Gresham Road,
Staines,
Middlesex TW18 2BD,
England
Registration 573951 England

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Cummins Customer Assistance Center
1-800-DIESELS (1-800-343-7357)
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Operation and Maintenance manual



Rotary cutter blower head KFS 170 V

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Toni Kahlbacher
GmbH & Co. KG
Straßenerhaltungs- und
Winterdienstgeräte
A - 6370 Kitzbühel
Post: St.-Johanner-Str. 48

Werk Kitzbühel:
St.-Johanner-Straße 75
Tel.: (0 53 56) 62 511 - 0
Fax: (0 53 56) 62 511 - 19
e-mail: info@kahlbacher.com
www.kahlbacher.com

UID: ATU31937009
DVR: 0454231
QS: ISO 9001 30795045
FN: 18214k
Landesgericht Innsbruck
Gerichtsstand: Kitzbühel

Werk Amstetten:
A - 3363 Amstetten-Neufurth
Friedenstraße 50
Tel.: (0 74 75) 53 355 - 0
Fax: (0 74 75) 53 355 - 823
e-mail: info.amst@kahlbacher.com



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1 GENERAL

1.1 Introduction

With this operating manual we want to make a brochure available for the operating personnel of this snow remover, which deals in a clearly arranged mode with all important questions of use, safety at snow clearing and maintenance and service.

Please use this operator's manual and make yourself well acquainted with the product.

For all safety devices and operating procedures the manufacturer of the carrier vehicle is responsible. Safety devices, which concern to the safe snow clearing with the blower head, have to be included in the safety concept of the carrier vehicle. The operating manual of the carrier vehicle or the documentation of the vehicle's manufacturer is significant.



Moreover the following regulations must be observed:

- * User Guidelines
- * The national accident prevention rules
 - General rules
 - Accident prevention rules for powered tools
 - Accident prevention rules for air traffic

1.2 Intended use

'Kahlbacher' airport snow removers are exclusively designed for use in snow removal particularly in airport areas. Snow is taken up at the front, transported to the blower wheel by the feeder augers and the preparatory cutting device. From there it is blown out laterally through the ejection chute. Any other use is not in the responsibility of the manufacturer.

1.3 Operation

'Kahlbacher' snow removers may only be put into operation when all safety devices have been checked and all performance tests and required maintenance work have been carried out. Putting safety devices out of operation is prohibited; Accidents due to safety devices made ineffective will entail criminal prosecution.

The tests and maintenance work prescribed by the engine manufacturers must also be carried out.

While being operated the snow remover must be monitored with regard to its operational safety.

The compact snow jet that is blown out laterally at a high speed may injure people or damage things.

Special caution is required during turning the ejection chute and when the snow removal unit works as a part of a clearing convoy.

The chute flap may only be used when the blower wheel rotation speed is on a low level!



Please pay attention to the fact that if snow is taken up off center lateral forces will occur that may affect the motor vehicle's tracking stability. It must also be taken into account that the freshly cleared area behind the snow remover may cause skidding conditions.

The snow remover must be operated by persons who were specifically trained for it and who hold the required driver's license and know the safety regulations that are to be observed.

In the case of trouble in safety-related sub-assemblies the operation must be stopped immediately for troubleshooting by competent personnel that was trained specifically for service and repair of this type of machine.

When the snow remover is in action the operating personnel must stay in the seats in the driver's cabin.

1.4 Maintenance and repair

Maintenance and repair work must be carried out by qualified personnel that was instructed specifically for this type of machinery. The maintenance instructions and intervals must be observed.

When repair work is done the manufacturer documents must be used (plan of the hydraulic assembly, wiring diagram).

At this construction type alterations are principally inadmissible.

If changes are indispensable, however, the manufacturer's consent must be sought; the manufacturer has to take appropriate measures to maintain the validity of the safety regulations.

If the snow remover is changed in any way without the manufacturer's approval, or if non-original spare parts are used, the liability of the manufacturer will become extinct.

The leadings fixed on some building components of the snow remover must not be opened, the set-points fixed by leadings must not be altered.

The snow remover must be checked for operational safety by qualified personnel at least once a year or, if necessary, more frequently (see point 4.11).

Only the working stock included in the working stock list point 4.16 may be used. Liquid waste arising from maintenance or repair work must be collected and disposed of in compliance with the relevant statutory regulations.

1.5 Safety

The snow remover KFS 170 V is equipped with safety and protection systems and was subjected to a safety verification and certification.

Nevertheless this operator's manual must be attended absolutely as misuse or operating errors lead to risk of injury and danger to life or danger of damaging the machine or other material goods.

1.5.1 Safety and protection devices

1.5.1.5 Transportation lock for snow blowerhead

Safety devices must be installed to prevent unintentional lowering of the snow blowerhead.

For example stop valves at the „raise“ connection of the lifting cylinder or a mechanical lock prevent lowering for example at burst hose or line.



Fig. 1: Transportation lock applied

1.5.2 Checking the safety and protection devices

The safety devices must be checked for:

- being installed
- proper position
- being securely fastened
- regulated function

The safety devices must be checked

- before starting work every time
- at every service
- once a year or more frequently if required, by qualified personnel (see point 4.11)

1.6 Accident prevention rules

The snow remover must be operated only by persons who were sufficiently trained in handling it, who are holders of the required driving licenses, and who have studied the operator's manual



Before operating the snow remover the operator must check every time:

- if the safety and protection devices are installed and work properly
- if the operating facilities work correctly

While in use the equipment must be monitored for its operational safety.

Entering the danger zone in front of or beside the snow remover in action is dangerous and therefore strictly prohibited!

Also, take into account the extended distance the moved snow remover requires for stopping due to packed snow!

Entering the zone of the laterally ejected snow jet is prohibited.

Special caution is required when the ejection chute is turned and when the snow remover is a part of a clearing convoy.

Also, take into account the far range of the ejected snow.

When snow is ejected with chute flap, take into account the change of direction of the snow jet.

When the snow blower is to be transported it must be lifted and the transport lock must be applied (lock valves or mechanical safety devices).

While the snow blower is in action the operating personnel must remain in the prescribed places in the driver's cabin.

If snow is taken up off center lateral forces will occur that may affect the motor vehicle's tracking stability

Works on the whole hydraulic system may only be done, when system is at zero pressure and cylinders are discharged.

Works on the nitrogen-diaphragm reservoirs of the throwing wheel cage fastening device may only be carried out by the manufacturer or in authorized workshops, the required special equipment must be used (e.g. changing the gas-prefill pressure)!

Any servicing or repair works may only be carried out after stopping the engine, withdrawing the ignition key from the lock, and securing the battery isolation switch against restarting!

Please observe the Road Traffic Regulations and internal service rules.

2 Technical description

2.1 Main components:

The high-speed rotary cutter blower KFS 170 M2 consists of the following main components:

- Rotary snow blowerhead
- Feeder augers propelled hydraulically
- Electric supply system

2.2 How it works, general information

A driving engine (carrier vehicle) drives the blower wheel including the attached preparatory cutting and transporting device of the snow blower.

The two lateral feeder augers are driven hydrostatically via a hydraulic pump (carrier vehicle).

All operating and control functions are operated electro hydraulically from the driver's cabin.

2.3 Blowerhead

2.3.1 Structural components

The blowerhead consists by and large of the following structural components:

- Blower stage with laterally mounted feeder augers
- Throwing wheel cage with ejecting chute
- 6-blade throwing wheel with attached preparatory cutting and transporting device
- Ejecting chute turning and throwing wheel cage fastening device
- Snow blower frame
- Upper and lower supports
- Spindle-regulated support wheels
- Lifting and lowering device
- Mounting frame mounted flexibly on the chassis, with support girder and backward braces.

2.3.2 How it works

The snow that is transported to a mound by the lateral snow plows is taken up directly by the preparatory cutting and transporting device due to the carrier vehicle's advancing speed.

The relatively short feeder augers they are mounted on both sides of the blower stage transport the remaining snow to the center, which requires little power, and also into the cutting and transporting system.

From there the snow masses are transported into the throwing wheel cage through further axial acceleration and blown away radially through the ejection chute by the throwing wheel, which is designed for optimal long-range throw.

The transporting device (patented) effects so-called 'forced transportation', i.e. gags in the ejection chute are impossible during snow clearing.

The throwing wheel cage with the ejection chute can be turned hydraulically and is kept in the desired position by 4 throwing wheel cage fasteners and a multi-disc brake; thus the axial play between throwing wheel cage and blower stage, which is necessary for the swinging procedure, is eliminated at the same time.

The blowerhead is suspended vibration-decoupled with steel – rubber – steel bearing on two adjustable supports at the top and two rigid brackets at the bottom on the mounting frame.

When activating at the control panel the two double-acting hydraulic cylinders are pressurized, the blowerhead is lifted or lowered.

In action the blowerhead weight is partially allocated to the front axle by the blowerhead discharging system - which acts on the lifting cylinders via discharging pressure, thus the bearing pressure of the blowerhead is reduced.

The blowerhead discharging is activated when the blowerhead is lowered.
So the running wheels are discharged.

When activating the function Lifting the clearing position with blowerhead discharging is switched off automatically.

On the blower frame two large-size spindle-regulated support wheels with vibration reducing multilayer solid tires are mounted. They are to be adjusted so as to ensure that the Vulkollan-scrapers lie evenly on the road surface.

2.7

Feeder augers driven hydraulically

Two axial piston hydraulic motors with directly mounted planet reducing gear are built into the side parts of the blower stage and drive the feeder augers directly.

Overload protection should be effected in each hydraulic circuit by pressure sensors, which swivel back the pump units and show a warning symbol in the cabin when maximal system pressure is reached.

If the warning light does not go out the clearing work must be stopped.

Control via a 3-step switch at the driver's cabin. (Snow amount control)

2.12 Hydraulic control blower head

2.12.1.2.1 „Lift“, „Lower“ and „clearing position“

The functions "lift", "lower" are activated by a control unit in the cabin. The hydraulic cylinders are pressurized and proceed "lift" and "lower" of the blowerhead. In clearing position the blowerhead should always be discharged.

2.12.1.2.2 Ejection chute turning left - right

Operating the control unit activates the function turning the ejection chute to the left or to the right side, the hydraulic motor is charged with pressure oil. The multi-disc brake and the 4 throwing wheel cage fastening cylinders are charged with pressure oil at the same time (parallel connection with hydraulic motor), the multi-disc brake opens, the fastening cylinders lift off and the hydraulic motor swivels the ejection chute with a planetary gear and bevel / toothed segment. After unhand the single lever switch, the brake is engaged again, the pressroom of the fixing cylinders are charged and the contact pressure is rebuilt by a pressure reservoir.

So the connection, free from float and secured against screwing, between blowerhead body, ejection chute (throwing wheel cage) and blowerhead frame is made.

In the outer end positions the swiveling process is turned off automatically by proximity switches.

2.12.2.5 Blower wheel speed control (Throwing range control)

Rotation speed adjustment by the carrier vehicle.

2.12.2.6 Feeder auger speed control (Snow amount control)

Rotation speed adjustment by the carrier vehicle.

2.12.3.3 „EMERGENCY-OFF“

An emergency-off function, which stops immediately all movements of the blower wheel and the feeder augers, must be installed and described by the carrier vehicle's manufacturer.

2.16 Electric system

Sidelights at the blowerhead are activated by the provided outlet (PIN5 and PIN6).

On the frame are sensors for the turning of the ejection chute which are also activated by the outlet (PIN1 +, PIN2 left, PIN3 right).

3.2.9 Turning the ejection chute



Attention – Accident and injury danger!

The compact snow jet , that is blown out laterally at a high speed may injure people or damage things if they are hit. Specially caution is required during turning the ejection chute and when the snow removal unit works as a part of clearing convoy.

While turning the ejection chute, there must be nobody in the danger area. Ejection with chute flap may only be done when throwing wheel revolution speed is low.
Attention: The direction of the snow jet is turned!!!!

3.5

In action for snow removal

In the interest of safety we request urgently there, that the following points regarding the rotating snow-clearing unit are observed:



When the snow-clearing unit is running no repairs, maintenance or adjustments must be made.

Any kind of work to be carried out should be done in any case with the clearing unit at a stand still and the engine switched off.

Standing directly in front of the rotating snow-clearing unit or to the side thereof is dangerous to life and therefore forbidden.

3.5.1

Working with the snow blower

- At the place of use lower the snow blower in „clearing position“
- Activate “Blower ON”,
- Move the ejection chute into desired position using the single lever switch.
- If it is possible, take off the snow mounds centrally, in order to achieve direct entry into the pre-cutting and transport fittings of the blower wheel.



Attention: Risk of injury and loss of life!

Only work in the area of the snow intake of the cutter blower when the engine is turned off and the working gear is at a standstill.
Apply up the parking brake

Take out the ignition key and keep somewhere safe.



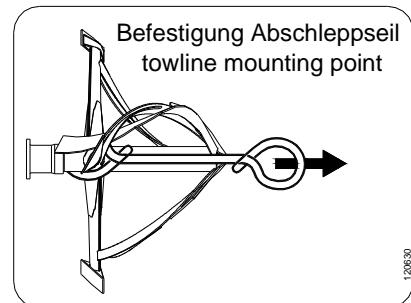
Attention!

- When the machine is at a standstill for a longer time always lower the blowerhead

To avoid freezing, the rests of the snow should be removed after turning off the engines

3.11 Towing

If it is necessary to tow the cutter blower forwards, the round sling in the tool kit in the driver's cab can be fastened simply corded at the preparatory cutting device tube behind the spokes and the free ends stucked to the tow-car. There the sling has to be fastened, that no lateral pressure is exerted at the preparatory cutting device tube.



No possibility to brake by the tow-car, when towing with round sling.

4

Maintenance

- Only qualified personnel that is appropriately informed about possible danger is allowed to do maintenance work on the snow remover.
- Keep to the maintenance intervals or shorten them accordingly in case of extreme use.



Maintenance work may only be carried out when the engine is **switched off and cold**, the key has been removed.
Protect keys from unauthorized individuals.

For handling and disposing of the working stock, filters and cleansing agents there are to observe the instructions of the relevant legislator.

After completion of maintenance, check whether all tools were removed and all protection devices have been fastened again.

4.2

After the first 10 working hours

- Visual control of tightness of hydraulic screwed connection
- Check tightness of screwed connection

4.7

After every 600 working hours

- Change hydraulic oilfilters
- Change hydraulic oil

ATTENTION: Do not use water for cleaning.
Never let hydraulic engines operate without oil.

4.8

After each operation

After each snow removal action, carry out visual control and repair possible damage. If necessary, establish cause of damage and repair or have repaired by delivery company or its representative.

4.9 If required

- Wash
New and freshly painted vehicles only need frequent cleaning with water during the first weeks, do not use a steam jet.
Do not wash vehicle in the sun.
Do not point water jet at aggregates that are still warm.
Protect generator and starter from splash water.
Rinse sponge diligently and frequently.
When using a steam jet device, leave a minimum distance of 0.30 m between the jet and the painted coat.
After cleaning with a jet stream device, grease lubricating points, see lubricating chart.
Wash vehicle more frequently during the winter months.

4.11 Annual check by experts

Experts are people with adequate training who are familiar with the construction of the snow remover and the relevant safety regulations.

The snow remover and in particular the hydraulic hose and pipelines must be checked for their working reliability at least once annually by experts in accordance with the check list in the appendix.

The results of the check must be written down and must be kept at least until the next check, e.g. in a test book, a test card file or a test report.

4.13 Every 6 years

At the latest six years after the manufacturing date, the hydraulic tubes must be replaced.

The duration of use depends on the operation conditions.

The manufacturing date is stated on the tubes.

4.14 Maintenance Schedule

alle 6 Jahre / every 6 years						
alle 5 Jahre / every 5 years						
alle 2 Jahre / every two years						
einmal jährlich / once a year					⊗	
nach jeweils 120h / after each 120h					⊗	
nach jeweils 600h / after each 600h					⊗	
nach jeweils 300h / after each 300h					⊗	
nach jeweils 200h / after each 200h					⊗	
nach jeweils 50h / after each 50h	▷				⊗	
bei Bedarf / if required	○	○	△		▷	□
Tagl. nach Einsatz / daily after use					□	□
Tagl. vor Einsatz / daily before use					□	□
Getriebeöle / gear oil	□	○	▽			
Hydrauliköl / hydraulic oil	□	○	▽			
Fahrzeugbeleuchtung / vehicle lighting	□	◇	△	▽	⊗	
Laufräder Vorbau / running wheels	□		△			
Räumleisten / clearing rails	□			▽		
Schmierstellen / lubrication points					▷	
Hydraulikverschraubungen / fittings	□				⊗	⊗
Hydraulikschläuche / hydraulic hoses	□			▽		

WZ1069 / 07.09.2009

4.15 Working stocks

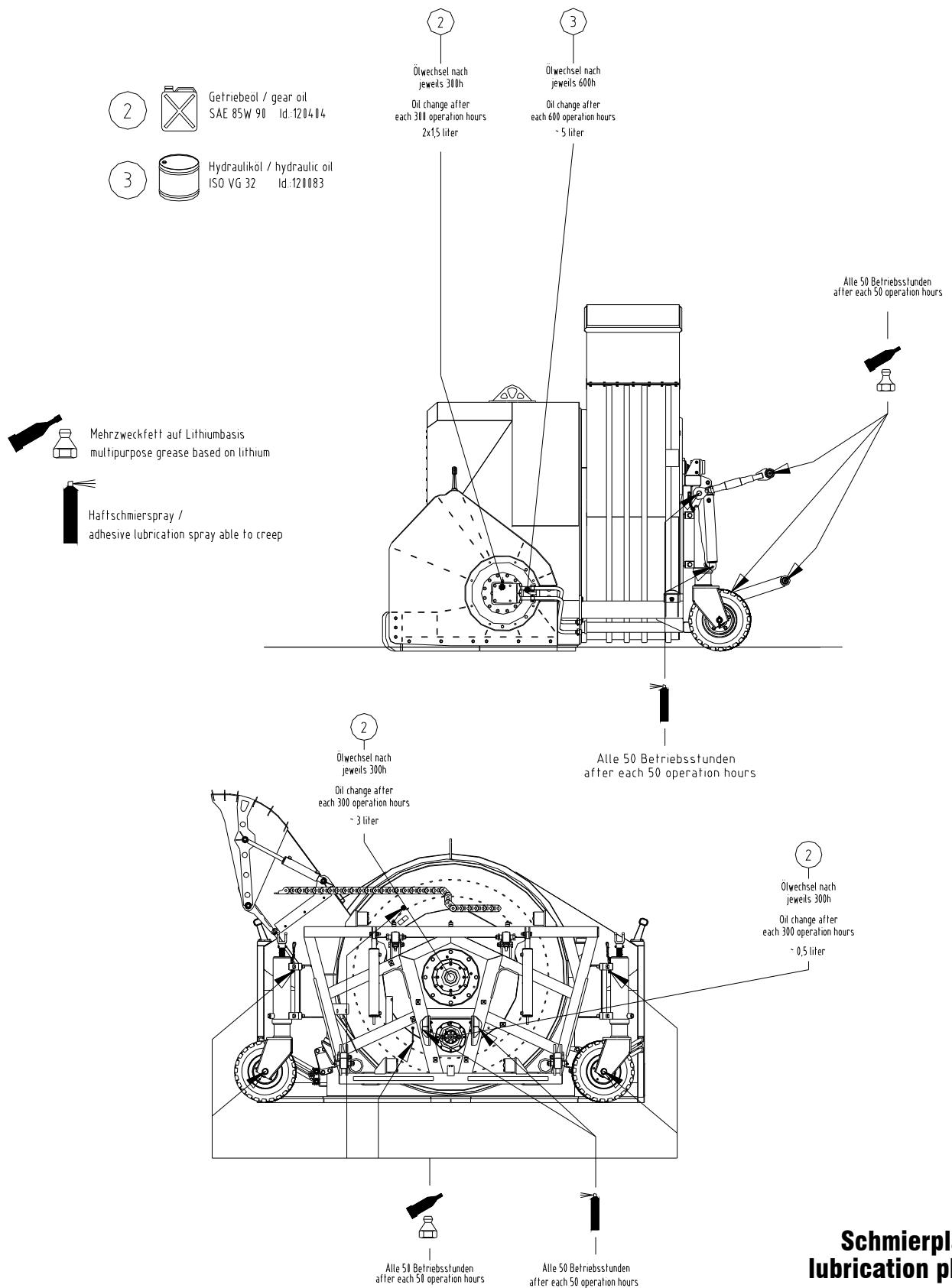
4.15.1 Lubricants original filling:

- Throwing wheel bearing (3 ltr.)
Industrial gear oil
DIN 51517, part 3, CLP 220, ISO CC SAE 85W90 120404 (OMV)
Gear oil 85W-90
- Planetary gear feeder augers (2x1,5 ltr.)
Industrial gear oil SAE 85W90 120404 (OMV)
Gear oil 85W-90
- Planetary gear throwing wheel (0,5 ltr.)
Industrial gear oil SAE 85W90 120404 (OMV)
Gear oil 85W-90
- Nipple lubricating points
Lithium-12- hydroxystearaly + EP additions NLG division 2, drop point min. 180°C.
- Gliding points (adhesive spray)
Special adhesive lubricant, water resistant, NLGI-Kl. 2, drop point min. 230°C.

4.15.2 Hydraulic fluids

- Hydraulic system (5 l)
Multigrade hydraulic oil ISO VG 32
(Center viscosity at 40°C in c ST). OMV hyd HLP-M32
120083

4.16 Lubrication chart



**Schmierplan /
lubrication plan**

KFS170 V

5 Repair and sparepart procurement

5.1 Repair work

Repair of the snow remover may only be done out by trained expert personnel who is adequately informed about possible sources of danger and familiar with the safety regulations.

When repair work is required, the snow remover must be placed on even firm ground and must be secured against rolling away.

It is prohibited to render safety devices inoperable.

Only original spare parts may be used.

Changes at this implement construction type certificated vehicle may only be carried out with the written consent of the producer

For handling and depositing of used oil, filters and cleansing agents follow the legal regulations.



Protect key against unauthorized utilization

Open hydraulic screwed connections and hydraulic pipes only when hydraulic system is depressurized (engine of vehicle is turned off, hydraulic cylinder is completely pulled in and relieved.)

After completion of maintenance work, check whether all tools have been removed from the vehicle and whether all protecting devices have been remounted.

Make sure before starting that nobody is in the danger zone of the engine or the vehicle.

5.2 Sparepart procurement

When ordering spare parts please give type, year of construction and factory number together with the denomination and stock number from the spare part list.

You may order by telephone or in writing at the delivery company or one of its representatives.

Please order spare parts, which you need for repair after the snow clearing season as early as possible, in order to avoid terms delays in delivery for the following season.

5.3.2 Correction of faults

5.3.2.5 One or both feeder augers do not turn

- Hydraulic pipes are incorrectly or incompletely connected - check hydraulic coupling for correct sequence of plugs and tighten
- Foreign matter blocks the feeder auger - immediately switch to „neutral”, turn off engine of snow blower and remove foreign matter

ATTENTION:

When driving against block, the measuring must be done within a few seconds, afterwards change back to idle running

5.3.2.6 Blowerhead cannot be lifted

- Transport safety device is locked - open transport safety device
- Too little oil in the hydraulic system - refill oil
- Lifting cylinder is leaky - put in new seal
- No pressure in hydraulic system - check hydraulic system
oil pressure should be approx. 120 bar

5.3.2.7 Ejection chute turning is not possible

- Throwing wheel cage fastening device not movable - check cylinder
- Fault in hydraulic system - check
- Guiding device is iced-up - defrost and grease adhesive lubricant (spray)
- Proximity switch is defect - change switch

6 Technical data**6.1 Rotary cutter blower**

Width of clearing.....	2900 mm
Diameter of blower wheel	1700 mm
Diameter of feeder augers.....	800 mm
Width of feeder augers	730 mm
Clearing capacity up to approx. height	1640 mm
Turning range of ejection chute approx.	150 degrees
Ejection range approx.	20 - 60 m
Weight (Blower head + mounting frame).....	3010 kg

6.13 Motional hydraulic

Controlled feeding amount 50 l/min, max. working pressure 220 bar
Controlled feeding amount 35 l/min, max. working pressure 190 bar

6.15 Feeder auger drive

Rotary speed:

Stage 1	110 min-1
Stage 2	150 min-1 (central position / main drive)
Stage 3	185 min-1

Max. working pressure 420 bar

6.16 Blower wheel gear

Rotary speed:

Stage 1	200 min-1
Stage 2	245 min-1
Stage 3	290 min-1 (central position / main drive)
Stage 4	330 min-1
Stage 5	390 min-1

Changes reserved!

**7 Declaration of conformity for machines
Within the scope of Directive 98/37/EG**



Manufacturer:

Toni Kahlbacher GmbH & Co. KG
Engine construction – machinery trade
Postal address: St.-Johanner-Str. 48
Works: St.-Johanner-Str. 48 - 50 u. 75
Tel.: 053 56 / 625 11 - 0
Fax: 053 56 / 625 11 - 19
6370 Kitzbühel

We declare herewith on our sole responsibility that the product to which this declaration relates conforms to the standard specification/s or normative document/s mentioned below.

Description of the machine:

Rotary cutter blower KFS 170 M2

Relevant regulations to which the machine conforms:

EG- Directive 98/37/EG, 2004/108/EG, 2006/95/EG, EN 60204-1 in its present form.

The harmonized standard specifications are found in:

EN ISO 12100-1, Safety of machines, fundamentals, general guidelines for design, Part 1: Basic terminology, systematics.

EN ISO 12100-2, Safety of machines, fundamentals, general guidelines for design, Part 2: Technical guidelines and specifications

National standards and specifications

EN 13021 Winter service equipment - safety requirements

Kitzbühel, August 2007

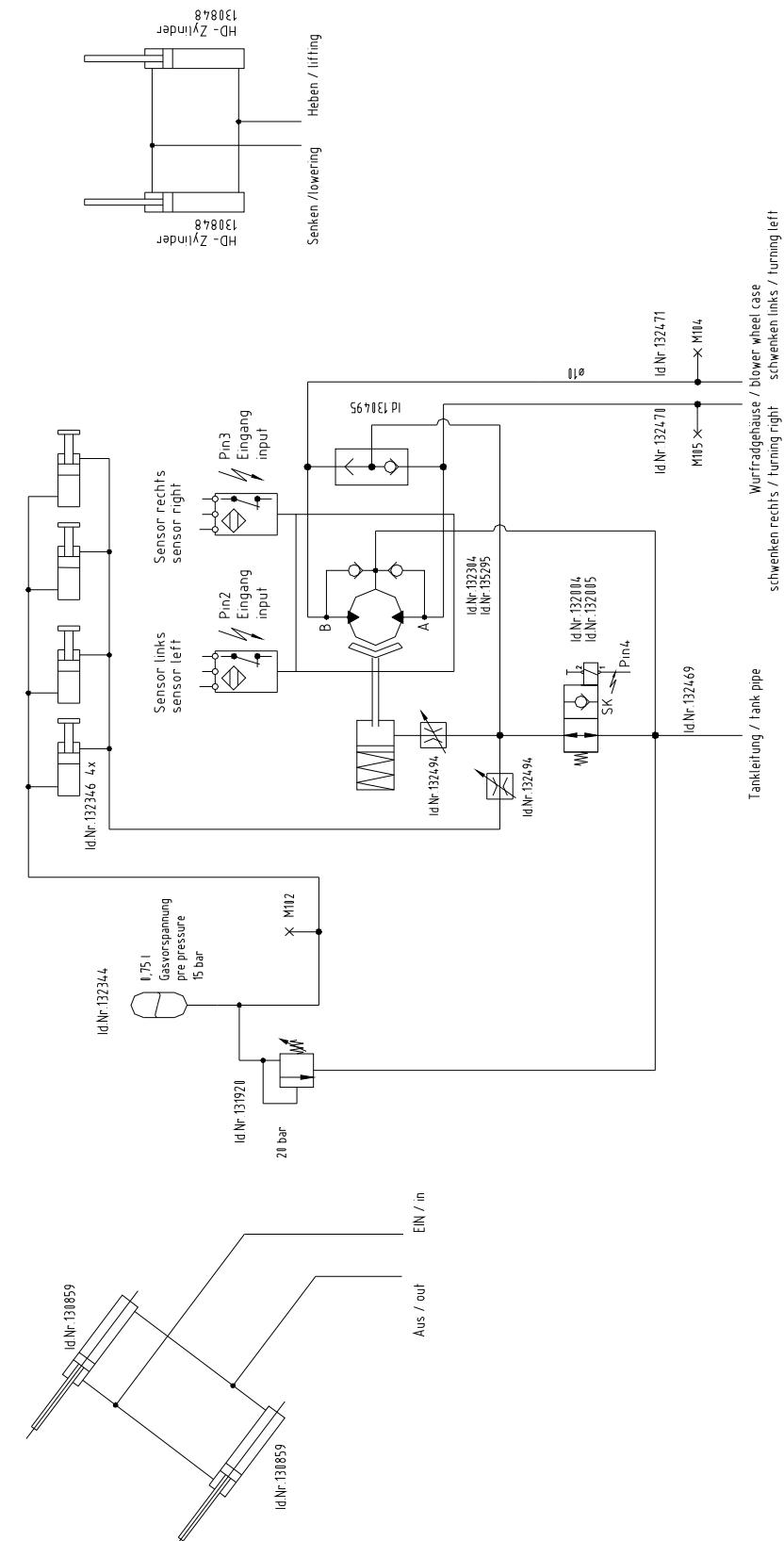
Horst Kahlbacher sr.
Chief Executive

Hydraulic Schema

Hebe und Senkeinrichtung / lifting and lowering device

Wurfradgehäuse / blower wheel case

Kammblende hydraulisch / folding chute hydraulically



Wurfradgehäuse / blower wheel case schwenken rechts / turning right

Tankleitung / tank pipe schwenken links / turning left

Senken / lowering Heben / lifting

KAHLBACHER

HD-Schema KFS170 V
Bewegungs und Arbeitshydraulik Blatt 1

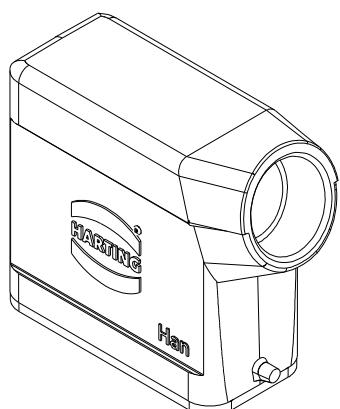
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			Gep.: 31.08.2019 Totschling
			Norm: Blatt 1
			Werkstoff:
			Schz 1003
			Datum: Name: ID Nr: schz1003
			Best. Änderung Datum: Name: ID Nr: schz1003

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A 31

9 Electric Interface KFS170 V blower head

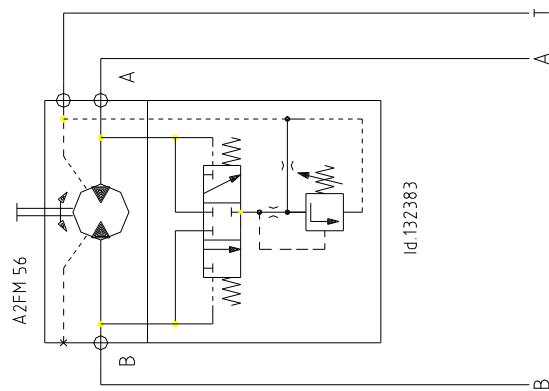
PIN	Belegung / configuration	
1	Sensor + / sensor + 24V DC	
2	Sensor Wurfradgehäuse links / sensor blower wheel housing left	
3	Sensor Wurfradgehäuse rechts / sensor blower wheel housing right	
4	Sperrventil / lock valve 24V DC	
5	Begrenzungsleuchte links / side marker lamp left 24V DC	
6	Begrenzungsleuchte rechts / side marker lamp right 24V DC	
7	Frei / free	
8	Frei / free	
9	Frei / free	
10	Frei / free	
<u>-</u>	Masse - / ground -	



10-poliger Hartingstecker/ 10 pole connector :
Id.:150414 / Id.:150408

ZUFÜHRSPRÄLEN / feeder augers

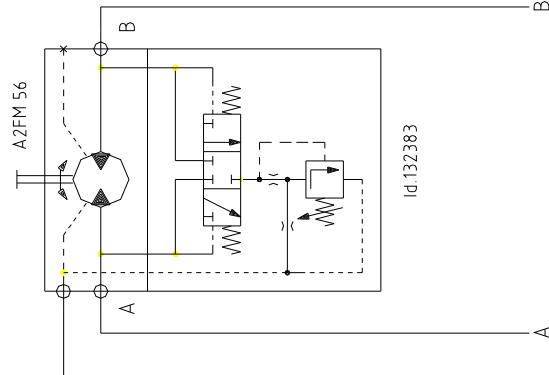
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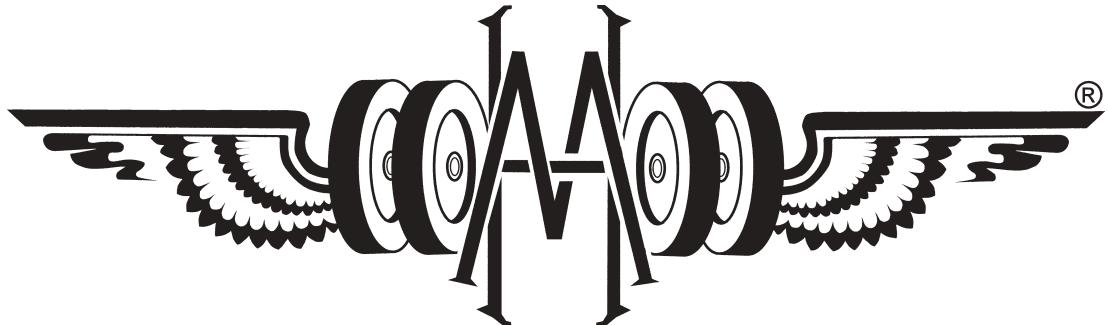
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		Datum	Name	HD-Schema KFS170 V	
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		Gepr.	31.08.2009	Prüfung	
		Norm.		Blaft 2	
		Werkstoff		Schz 1003	
		ID Nr.	Schz1003	Name	
		Datum		Blaft 1	
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				Detaillierte Anlagen der zu einer einzelnen Grundanordnung wieder verwendeten Bauteile können zugleich gezeichnet werden. Wir behalten uns alle Rechte nach DIN 34 von	
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Marmon-Herrington

OPERATORS MANUAL

MARMON-HERRINGTON ALL-WHEEL DRIVE

13001 Magisterial Drive • Louisville, KY 40223
(502) 253-0277 • (800) 227-0727 • Fax (502) 253-0317
E-mail: info@marmon-herrington.com

RD09/07



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FOREWORD

This manual has been prepared for owners and operators of vehicles equipped with Marmon-Herrington All-Wheel-Drive systems and components. For additional technical assistance, contact Marmon-Herrington Customer Service.

Please observe and follow all procedural and maintenance guidelines to ensure reliable operation and optimum service life. The Marmon-Herrington basic service schedule will integrate seamlessly with most preventative maintenance programs.

Marmon-Herrington shall not be liable for component failures or damages caused by operational abuse or neglect. Please review the Warranty Statement for a detailed explanation of coverage and claim reporting procedures.

We thank you for your investment in Marmon-Herrington equipment, and look forward to serving your needs in the tradition of engineering excellence.

GENERAL OPERATION STATEMENT

As close as engineers try to match gear ratios and tires for a given application, the reality is that there will always be some degree of ratio mismatch between front and rear axles. When a vehicle is operated on a hard, dry surface with the front axle engaged (AWD, 4X4, 6X6 modes), the tires are not able to slip and relieve the torsional forces being generated.

As such, Marmon-Herrington equipped vehicles are designed for "**as needed**" AWD operation only, in "off-road" or poor traction conditions. They **are not** intended to be driven in AWD mode on hard, dry surfaces.

Note: Seek expert advice when considering tire size or gear ratios changes.

SHIFTING OF AXLE OR TRANSFER CASE

Marmon-Herrington Axles and Transfer Cases use no clutching or synchronization devices, and therefore should only be shifted when the vehicle is at a complete stop. This applies to front axle engagement, high and low ranges, and locking differentials. The only exceptions are those vehicles equipped with Marmon-Herrington® **Safety-Shift** system, which are calibrated to shift up to 5 mph.

"Shifting on the fly" generally results in two types of damage. The first is degradation of the engagement teeth due to relative rotation of the drive gears and shift collars. This type of damage can prevent the case from shifting normally, as the teeth become burred and cannot mesh.

The second condition occurs when a shift is actually completed at excessive speed. This results in extreme torque loading that is transmitted through the transfer case, drive shafts, and axles. The extent of possible damage increases proportionately with the vehicle speed.

SAFETY-SHIFT

In late 2003 Marmon-Herrington introduced Safe-T-Shift, an electronic management system developed to help prevent shift-on-the fly events. It consists of a microprocessor that receives speed information from a remote sensor in the transfer case. The system is calibrated to activate the shift solenoids at the first detection of motion, and then cancel control functions at 5 mph.

The actual completion of a shift still relies on the tooth alignment of the gear sets, and the vehicle may need to roll a few feet before the transfer case can shift. Because the system becomes active at first motion, and maintains air pressure thereafter, it is possible to accelerate rapidly to a speed greater than 5 mph before the tooth alignment occurs, thus allowing the teeth to grind against each other. In this case, the shift may occur while decelerating at a speed great enough to cause shock damage. For this reason, it is essential that the operator allow the vehicle to "walk" or idle forward until the shift is complete (indicated by the appropriate dash signal) before accelerating normally.



Note: Vehicles built after December 2007 are equipped with a 2nd generation Safe-T-Shift system which does not require motion to become active. It will activate the solenoids at a complete stop, and then cancel at 5 mph. This updated system simplifies the shift operation and allows for easier troubleshooting. Call Marmon-Herrington Customer Service to verify your vehicles system.

SHIFT PROCEDURE

1. With the vehicle at a complete stop, select the desired range or axle position.
2. Place the main transmission in gear.
3. Allow the vehicle to idle forward (or backwards) at walking speed until the shift is complete (as per the appropriate dash indicator).
4. Accelerate normally.

In case of a manual transmission, ease the clutch out in low gear, allowing the vehicle to “walk” until shift is complete (as per the appropriate dash indicator).

Some possible exclusions to the Safe-T-Shift program are those vehicles fitted with a transfer case mounted PTO, Freightliner factory installations, and any with Rockwell transfer cases.

SUMMARY

Before retreating from the subject of shifting, it must be reemphasized that **no transfer case, PTO, axle differential, or power divider should ever be shifted while the vehicle is in motion. The engagement of these components is intended for off-road use only, in poor traction conditions.**

TORQUE

“Torque Shock” or “Torque Loading” is a damaging mode of failure that is easily avoidable. It generally occurs in situations when a vehicle is operating in an area of low traction at high RPM with the wheels spinning. When the tires make abrupt contact with a tractable surface, a violent shock-load is transmitted through the drive train. This can result in damage to axles, drive shafts, transfer cases and transmissions.

Simply engaging the front axle and operating in low range at lower speeds will allow the vehicle to proceed without imparting undue stress on the drive train.

TRANSFER CASES

OPTIONAL POWER-TAKE-OFF (PTO)

On transfer cases with this option, the PTO is mounted on the rear of the case and driven by the input shaft. The PTO is a signal speed device that will operate at the same RPM as the main transmission in forward or reverse.

When mounting equipment to be driven by the PTO, it must be connected by way of a double universal joint type shaft to minimize thrust forces and shock loads to the PTO and transfer case, as well as the equipment being driven.

PTO ENGAGEMENT

The PTO should only be shifted when vehicle is at a complete stop. The PTO is engaged by way of an integrated shift cylinder using 95 - 115 PSI. Before engagement, the transfer case should be shifted to its neutral position. Automatic transmissions should be shifted to neutral and parking brakes set before engagement. In the case of a manual transmission, depress the clutch and allow for RPM drop. With the transfer case in neutral and PTO engaged, the main transmission may now be shifted to a drive gear for operation. Before disengaging the PTO, allow RPM to drop to idle, and shift main transmission to neutral.

If a task requirement calls for using the PTO while the vehicle is moving, the transfer case may be shifted to high or low range after PTO is engaged. **Before using equipment while in motion, check with manufacturer to ensure that this is an approved operation.**

“PD” T-CASES – MVG750PD, MVG1200PD, MVG2000PD

This series of transfer cases feature a proportioning differential between the front and rear outputs. This allows for the front drive axle to be constantly driven in a 30% front - 70% rear configuration.

In severe conditions where wheel slip is encountered, the differential may be manually locked, creating a solid link between front and rear output shafts. The differential lock should be disengaged as soon as traction is restored.

TOWING

In most cases the optimal procedure for towing is to remove the driveshaft from the axle that is being towed (example: front wheels lifted; rear wheels being towed). **Towing a vehicle without removing the driveshaft from the towed axle will result in bearing and gear damage.**

The only exceptions are transfer cases that are fitted with PTOs, as these units are plumbed for a switchable neutral position. In the case of a PTO style transfer case that can not be shifted into neutral due to air system failure, the driveshaft at the axle being towed must be removed.

TESTING

When performing diagnostics on a dynamometer or rolling test rack without the front axle engaged (front wheels stationary), limit test intervals to 2 minutes. While the front output pilot shaft employs a needle roller bearing to protect it from relative rational heat damage, it should be allowed to cool for a few minutes between intervals.



FRONT AND REAR DRIVE AXLES

The Marmon-Herrington line of drive axles are rated from 8,000 - 23,000 pounds based on application and suspension components. The line includes front, rear and tandem drive axles in both single and double reduction configurations. A lighter series of front drive axle offers **single reduction with optional free-wheel hubs**.

Models with double reduction gear ratios utilize "wet" planetary hubs that require attention during scheduled preventative maintenance.

All Marmon-Herrington front drive axles have standard "double-cardan" steering joints which provide smoother steering and resist steering wheel "fight back" in full deflection turns. Latest joint designs are permanently lubed, and require no maintenance. Earlier units have plugs at each cap that can be removed to add non-pressurized grease.

Axles fitted with locking differentials should never be shifted while in motion as stated in the **SHIFTING PROCEDURES** section.

FREE WHEEL HUBS

On axles with free wheel hubs, the hubs must be completely engaged when the transfer case is in AWD mode and the front axle is being driven. In either mode (AWD or 2WD) both hubs must be either fully engaged or fully disengaged. Failure to observe these practices will result in component failure.

The hub is engaged by rotating the handle clockwise in accordance with its markings. On some axle models, a rubber cover will need to be removed to manipulate the hubs. Reinstall these protective covers after setting hub positions. If the hub selector is difficult to turn, rock the top of the tire back and forth by hand while twisting the selector handle.

Never operate the vehicle on hard, dry surfaces with the hubs engaged. This will result in gear train damage and tire wear.

INTRODUCTION

The efficiency and life of mechanical equipment is as dependent on proper lubrication as it is on proper engineering design. The importance of proper lubrication is increased because of greater gear tooth and bearing pressures and higher speeds in present day vehicles. For this reason we are vitally interested in promoting widespread usage of the best possible lubricants for our products.

It is advisable to consider the reputation of the refiner or vendor when selecting a lubricant. He is responsible for the quality and correct application of his product. A high quality lubricant incorrectly applied may greatly reduce the maximum service built into our product. Past experience has proven that a large portion of service problems can be traced to an improper lubricant or to an incorrect lubricant application.

Our purpose in compiling these specifications is to provide a guide to aid in the selection of a lubricant which will render the most satisfactory service.

We recommend a good quality gear lube for use in our axles and transfer cases. Suitable grades include 75w/90 thru 85w/140 and SAE90. Synthetics or mineral products are both appropriate.

LUBRICATION

A. LUBRICATION OF THE FRONT AXLE DIFFERENTIAL CARRIER

With new axles, the original lubricant should be drained at 1,000 miles (1,600 km) but no later than 3,000 miles (4,800 km). Change every 10,000 miles (16,000 km) or annually. Drain the lubricant initially used in the assembly while the assembly is still warm. Axles **SHOULD NOT** be flushed with any solvent such as kerosene. All new axles should be checked for correct oil level before being placed into service.

Fill axle housings to bottom of level hole (in carrier and/or housing) with specified lubricant with the vehicle on level ground.

The most satisfactory results will be obtained only when the lubricant is of the correct viscosity API GL-5 or MILL2105B. For general use, use **SAE 85-140 EP Multi-Viscosity gear lube**. Higher or lower viscosity may be required for extremely hot or cold weather.

VENTS

When filling wheel ends, take care not to over-fill the hubs. This results in lube being pumped up the vent tube, and out the vent. When this occurs, enough lube can be purged to cause heat damage to the planetary system.

If lube is observed leaking from the vent, the vent and its tube must be removed and flushed with solvent. This cleans the inner walls of residual lube which can cause a capillary effect, resulting in continued siphoning. Ensure correct lube level after reinstalling tube and vent.

B. FRONT DRIVE STEERING AXLE WHEEL ENDS, UNIVERSAL JOINTS, BEARINGS, BUSHINGS AND KNUCKLE PINS

The frequency of lubricant changes depends upon individual operating conditions, speed and loads. Change whenever seals are replaced or when brakes are relined or at 10,000 miles (16,000 km) or annually.

Use a high grade Lithium chassis lubricant that conforms to NLGI-2EP requirements.

1. Check for looseness
2. Apply grease
3. Observe lube purging - except in the case of cardon joints
4. If the above is not successful, remove cup or joint and check old grease. If rusty, gritty or burned, replace.

NOTE: Axle shaft cardan joints are not serviceable with pressurized grease.

IMPORTANT: At rebuild time, before installing wheel bearings onto spindle, coat bearing journals with a film of grease to deter fretting corrosion. Apply 1/16" on spindle hub and knead into the bearings. Apply by hand, repack every 10,000 miles (16,000 km) or annually.

C. BRAKE LUBRICATION

A high temperature waterproof grease in a Number 1 NLGI Grade is recommended for lubricating the brake actuating system. It should be a smooth textured corrosion resistant grease free of filters and abrasives. It should maintain a satisfactory softness under normal parking and storage temperatures so the brakes can be



applied and released. Vehicles operating in extremely cold weather (below -40°) require a grease conforming to MIL-G-25013C.

WEDGE BRAKES AND CHAMBERS (ON-HIGHWAY AND OFF-HIGHWAY)

On-Highway – Change whenever seals are replaced or when brakes are relined.

Off-Highway – Change grease every 12 months (maximum), whenever seals are replaced and when brakes are relined. However, the change interval may be shorter than 12 months depending on the severity of service operations. This can be determined by initially scheduling an inspection of the internal parts and lubricant every 2 months until the first 12 month period has passed. At each inspection look for contaminated or hardened grease, or for the lack of grease.

CAM BRAKES (ON-HIGHWAY AND OFF-HIGHWAY)

On-Highway – Every 10,000 miles (16,000 km) or every 6 months for all components depending on severity of service.

Off-Highway – For all components, change grease every 4 months (maximum), whenever seals are replaced and brakes are relined. However, the change interval may be shorter than 4 months depending on the severity of service operation. This can be determined by initially scheduling an inspection of internal parts. At each inspection look for contaminated or hardened grease or for the lack of grease.

D. LUBRICATION OF TIE-ROD AND DRAG LINK

Use the same type of grease as for the wheel bearings.

E. LUBRICATION OF DRIVELINES

Off-Highway – The change interval will differ greatly and be determined largely on the type of vehicle or machinery being used, type of operation and severity of service. The lubricant change interval could be, for example, one (1) day maximum or three (3) months maximum. This can be determined by initially scheduling daily or weekly inspections of universal joint, shaft, and slip yoke parts. Check seals, bearings, splines, etc., and check condition of grease in the assemblies by purging with new grease. Look for contaminated or hardened grease or for the lack of grease. Also, check to make sure grease purges from all four (4) bearing and seal positions of the cross.

LUBRICATION PROCEDURES FOR UNIVERSAL JOINTS (DRIVE SHAFTS ONLY)

1. Check for looseness.
2. Apply grease.
3. Observe lube purging from all seals until new grease comes out.
4. If grease does not purge, manipulate the "U" joint until purging occurs.
5. If the above is not successful, remove cup or joint and check old grease. If rusty, gritty or burnt, replace the complete universal joint.

LUBRICATION PROCEDURES FOR SLIP YOKES AND SPLINES

1. Check for looseness or sideplay.
2. Apply grease until purging takes place at air hole in end of slip yoke.

NOTE: Axle shaft cardan joints are not serviceable with pressurized grease.

F. LUBRICATION OF TRANSFER CASE

Use same type and viscosity of gear lube as used in the differential carrier. Fill to the bottom of the fill hole. **DO NOT OVERFILL** as this may cause the case to run hot, or cause lubricant to be pumped out of the vent.

Transfer Case may be mounted at various approved angles by the vehicle manufacturer and normally should be filled to the bottom of the tapped hole. Capacities will vary depending upon the angle of mounting.

Lubricant should be drained at 1,000 miles (1,600 km) but no later than 3,000 miles (4,800 km). Change every 10,000 miles (16,000 km) or annually. Drain the lubricant initially used in the assembly while the assembly is still warm. Transfer Case **SHOULD NOT** be flushed with any solvent such as kerosene.

G. MAGNETIC DRAIN PLUGS

Any drive axle or transfer case while it is working, generates wear particles at a fairly steady rate. These wear particles are very fine but hard. If these hard wear particles are allowed to circulate in the lubricant, the anti-friction bearings will wear at a faster rate than they would if the hard wear particles were removed as they are generated.

MAINTENANCE SCHEDULE – AXLES

1,000 Miles

1. Change lube in differential and hubs no later than 3,000 miles.

5,000 Miles

1. Re-torque wheel nuts after 100 and 500 miles, then every 5,000 miles thereafter.
2. Clean vent and vent tubes.
3. Check operation of differential lock control pressure switch.

10,000 Miles

1. Change lube in differential and hubs.
2. Lube brake cam bushings and brake levers.

15,000 Miles

1. Check shoe clearance and brake lining wear.

30,000 Miles

1. Check brake shoes, drums and parts for wear.
2. Check and re-torque mounting bolts.
3. Lube brake shoe rollers.

60,000 Miles

Check and adjust wheel bearings.

Note: Change lube annually if vehicle operates less than prescribed mileage periods.



Marmon-Herrington

MAINTENANCE SCHEDULE – TRANSFER CASES

1,000 Miles

Change Lube.

10,000 Miles

Change lube and check vent every 10,000 miles.

Note: Change lube annually if vehicle operates less than prescribed mileage periods.

Viscosity is dependant on ambient regional temperature:

Tropic Zone: SAE 85W/140

Normal Zone: SAE 85W/90 - SAE 85W/140 – SAE 90

Frigid Zone: SAE 80W – SAE 75W/140 – SAE 75W – 90

LUBRICATION GUIDE

Acceptable Grades (-26C to 38C / -14.8F to 100F)

BP hypergear EP

Castrol EXP, Dynadrive 80W/90

ELF Tranself TYPE B

ESSO Gear Oil GX 80W/90

GX-D85W/90

MOBIL Mobilube HD

Shell Spirax HD

Total Transmission TM 85W/90

Lithium Based Lube (Grease)

Specification: NLGI-2EP

Acceptable Grades:

MOL LZS-2 EP

AGIP GR MU/EP2

SHELL Alvania EP2

Use AGIP AUTOL TOP 2000 for brake rollers.

Lubrication and Inspection Points - Axles

1. Oil level plug (hubs)
2. Oil fill and drain plugs (hubs)
3. Vent and vent tube (wheel ends)
4. Oil level and drain plugs (housing)
5. Differential vent (housing)
6. Lube fittings at brake arms
7. Slack adjuster

SERVICE AND MAINTENANCE

HIGH PRESSURE CLEANING

When using high pressure cleaning equipment, it should be applied in such a way that:

- the water jet does not penetrate the shaft oil seals
- the cleaning water does not enter through the breather orifices

PRESERVATION FOR STORAGE

The transfer case should be stored inside a room with low air circulation with maximum relative humidity of 60% and a temperature between 15 and 20 C.

We recommend to issue storage cards to keep record of the preservation details and dates.

Our transfer cases were filled for the test run in our factory. The remaining quantity of oil protects the unit temporarily against corrosion.

If intending to store the unit for more than 4 months, carry out the following preservation procedure.

1. Remove breather and seal bore by means of suitable plug.
2. Fill gear oil according to instruction chapter ("oil change and maintenance").
3. Rotate transfer cases in such a way that all interior surfaces are coated with oil.
4. Turn shafts and at the same time shift twice every position of all shifting cylinders (see chapter "handling").

When storage conditions are favorable (less than 60% humidity) repeat procedure points 3 - 5 every 6 months.

When conditions are extreme (arctic or tropical, high humidity, high variation of temperature, storage location is near to sea) repeat procedure points 3 - 5 every four months.

CAUTION: Before putting the transfer case into use the breather must be installed!



Marmon-Herrington

DESCRIPTION

TECHNICAL DATA

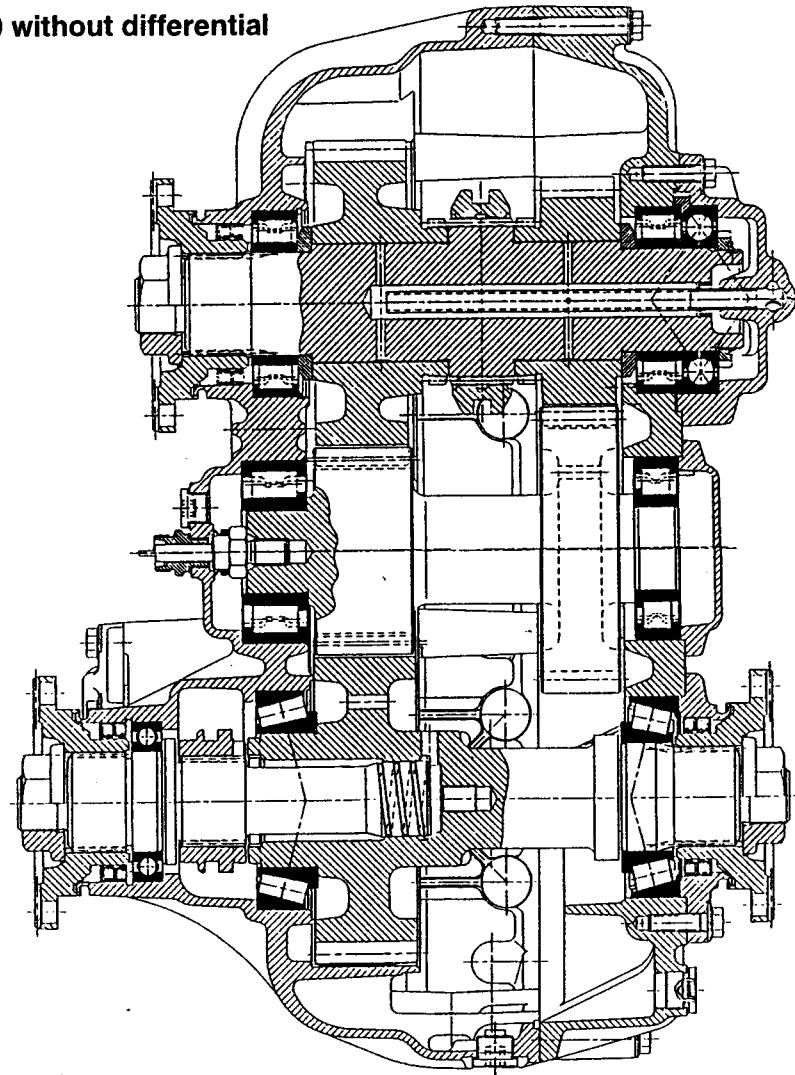
TRANSFER CASE TYPE	INPUT TORQUE MAX. Nm (lbft)	INPUT SPEED MAX. (r.p.m.)	WEIGHT APPROX. (w/o oil. PTO) kg	RATIO	
				on-road	off-road
VG 750 w/o diff.	8,000 (5900)	3,500	115	1.00	2.1
VG 750 w. diff.	8,000 (5900)	3,500	125	1.00	2.1
VG 1200 w/o diff.	12,000 (8850)	3,000	220	1.00	1.75/1.22/1.91
VG 1200 w. diff.	12,000 (8850)	3,000	230	1.00	1.75
VG1600/300 w/o diff.	18,000 (13275)	2,800	305	0.89	1.536
VG 1600/396 w/o diff.	18,000 (13275)	2,800	290	0.89	1.536
VG 1600/300 w. diff.	18,000 (13275)	2,800	315	0.89	1.536
VG 1600/396 w. diff.	18,000 (13275)	2,800	300	0.89	1.536
VG 2000/300 w/o diff.	25,000 (18436)	2,800	335	0.89	1.536
VG 2000/396 w/o diff.	25,000 (18436)	2,800	330	0.89	1.536
VG 2000/300 w. diff.	25,000 (18436)	2,800	355	0.89	1.536
VG 2000/396 w. diff.	25,000 (18436)	2,800	350	0.89	1.536



Marmon-Herrington

DESIGN

MVG 750 without differential



The MVG 750 without differential 3-shaft design, 2-speed transfer case with clockwise input drive direction.

Housing: two-pieces aluminum

Bearing application:
Input shaft - cylinder roller and 4-point-bearing
Intermediate shaft - cylinder roller bearings
Output shaft - tapered roller bearings
Front output shaft - roller bearing, slide bearing

Lubrication: splash lubrication or splash / force feed lubrication with pump at input shaft

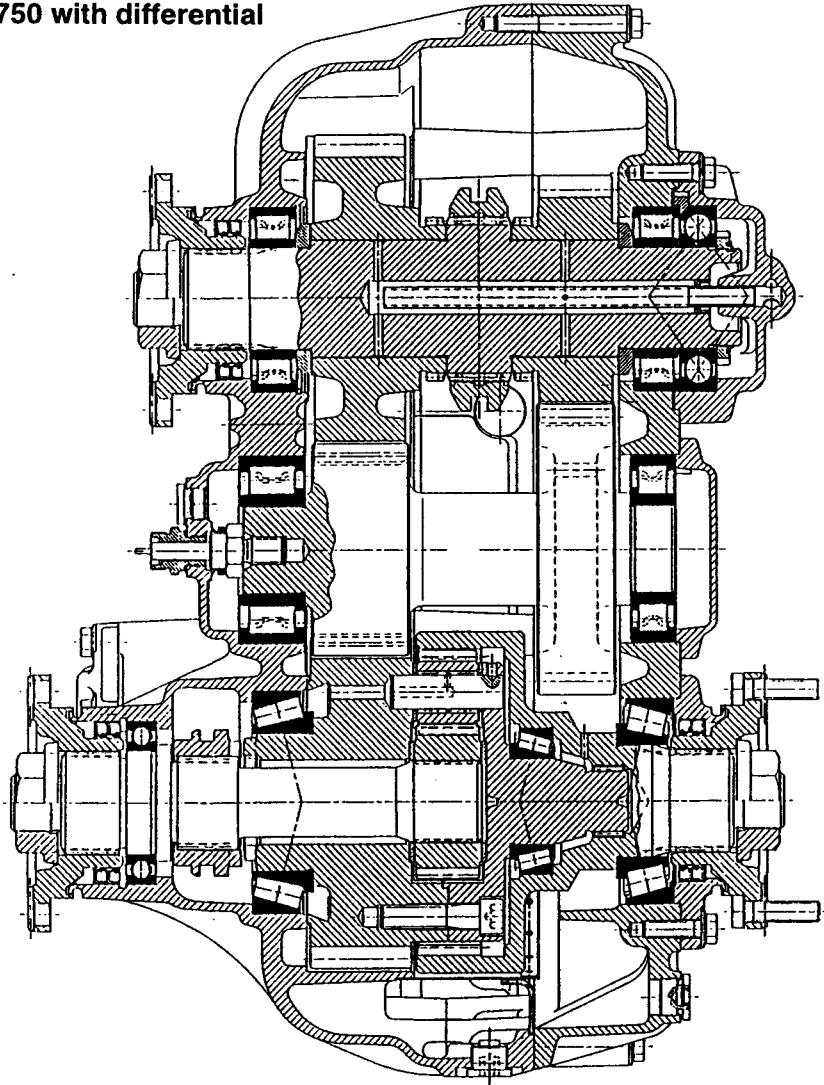
Shifting: pneumatic - 2 or 3 positions

Front drive: pneumatic operation

Options: pneumatic operation PTO;
synchronisation;
ADM

DESIGN

MVG 750 with differential



The MVG 750 with differential 3-shaft design, 2-speed transfer case with clockwise input drive direction.

The spur gear planetary differential has a torque distribution ratio between front and rear axle of (1 : 2.00)

Housing: two-pieces aluminum

Bearing application:
Input shaft - cylinder roller and 4-point-bearing
Intermediate shaft - cylinder roller bearings
Output shaft and differential - tapered roller bearings
Front output shaft - needle bearing
Front output shaft - roller bearing, slide bearing

Lubrication: splash lubrication or splash / force feed lubrication with pump at input shaft

Shifting: pneumatic - 2 or 3 positions

Front drive: pneumatic, differential pneumatically lockable

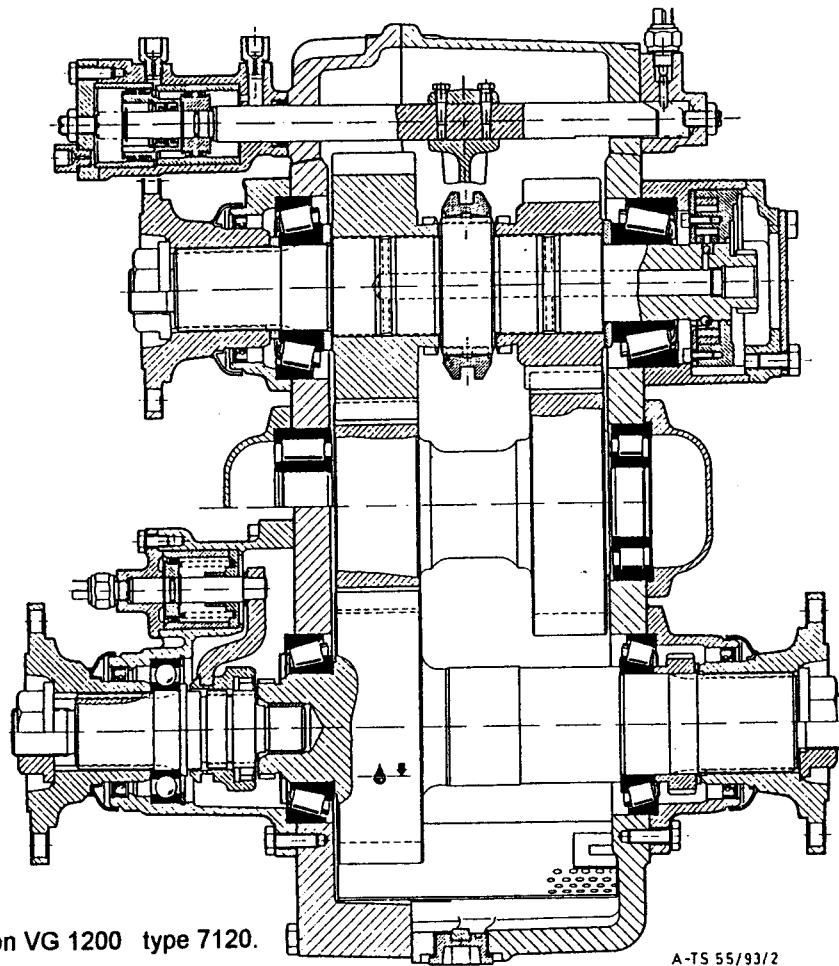
Options: pneumatic operation PTO;
synchronisation;
ADM



Marmon-Herrington

DESIGN

MVG 1200 without differential



The MVG 1200 without differential 3-shaft design, 2-speed transfer case with clockwise input drive direction.

Housing: two-parts

Bearing application:
Input shaft - taper roller bearings
Intermediate shaft - cylinder roller bearings
Output shaft - tapered roller bearings
Front output shaft - roller bearing, slide bearing

Lubrication: splash lubrication or splash / force feed lubrication with pump at input shaft

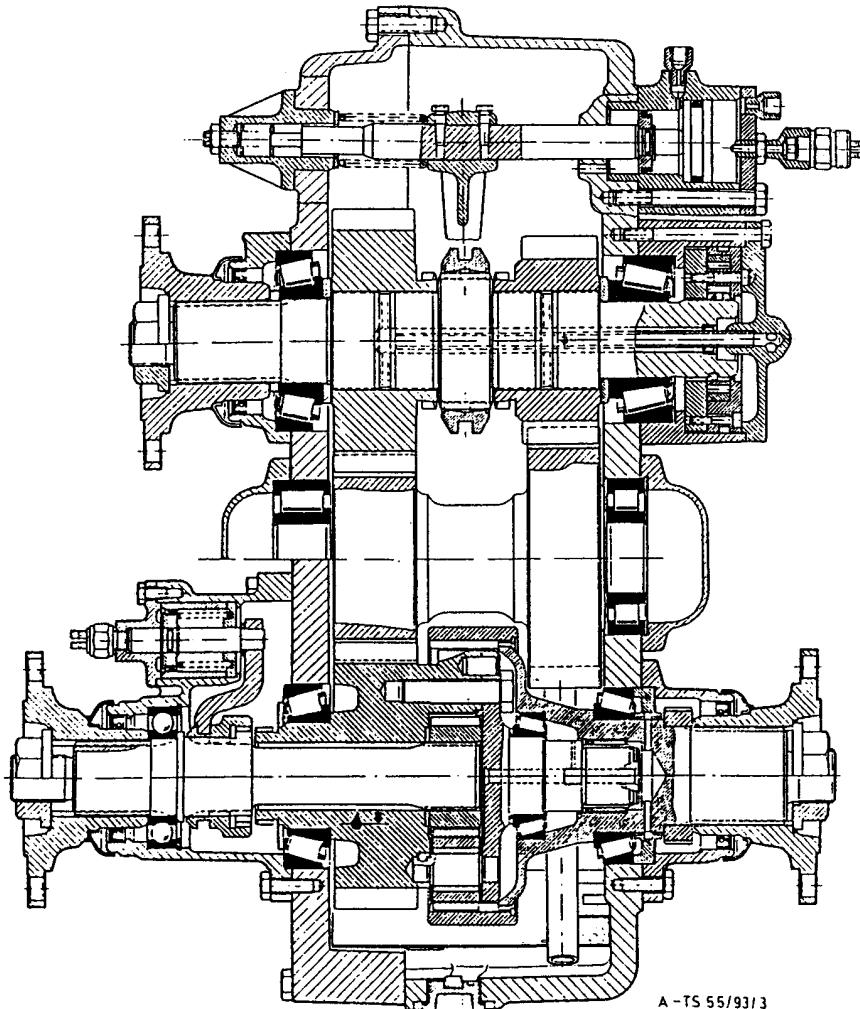
Shifting: mechanical - 3 positions
pneumatic - 2 or 3 positions

Front drive: pneumatic operation

Options: pneumatic operation PTO; without front drive; rear engine drive version; version towable
without disconnecting the drive shaft in neutral position; external oil cooler connection; electronic speedometer connection; input drive direction counter-clockwise; synchronisation; ADM

DESIGN

MVG 1200 with differential



Cross section VG 1200 type 7124.

The MVG 1200 with differential 3-shaft design, 2-speed transfer case with clockwise input drive direction (view to input flange).

Housing: two-parts

Bearing application:
Input shaft - taper roller bearings
Intermediate shaft - cylinder roller bearings
Output shaft and differential - tapered roller bearings and needle bearing
Front output shaft - roller bearing, slide bearing

Lubrication: splash lubrication or splash / force feed lubrication with pump at input shaft

Shifting: mechanical - 3 positions
pneumatic - 2 or 3 positions

Front drive: pneumatically, differential pneumatically lockable

Options: pneumatic operation PTO; rear engine drive version; pump fitting at front and rear drive; version towable without disconnecting the drive shaft in neutral position; external oil cooler connection; electronic speedometer connection; input drive direction counter-clockwise; synchronisation; ADM

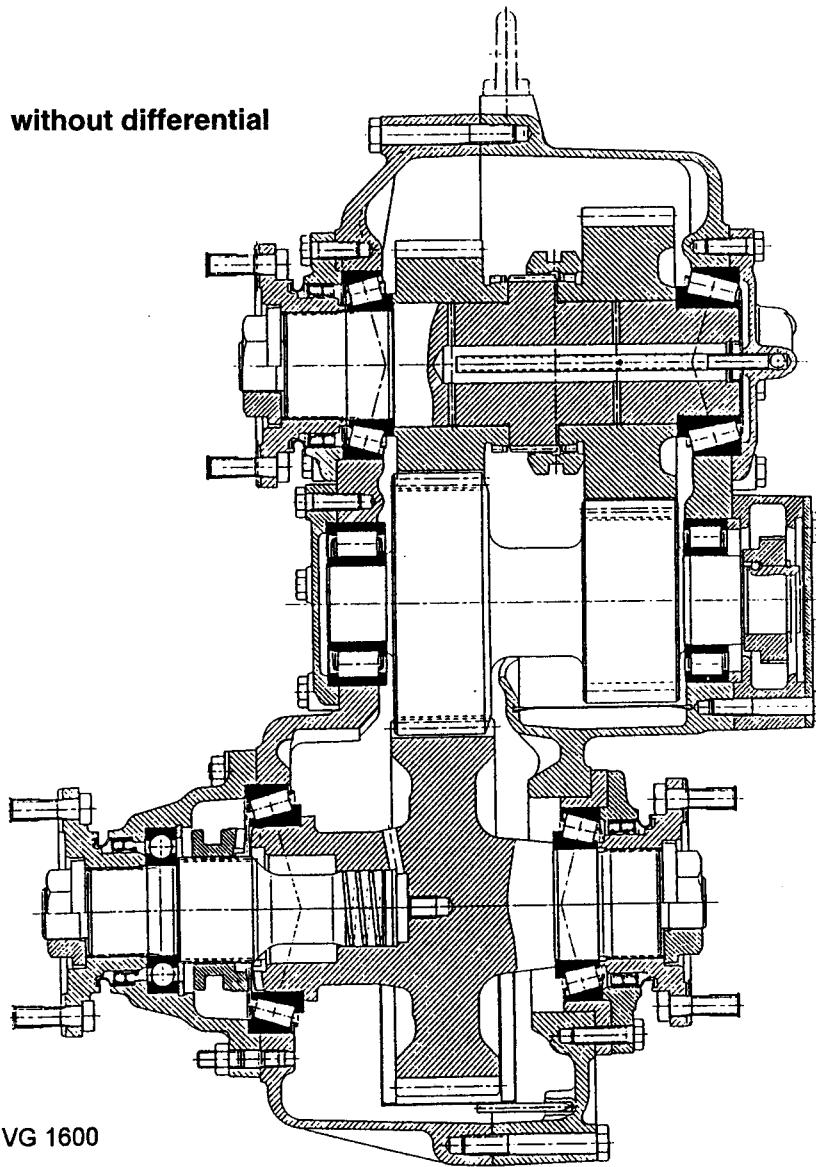


DESIGN

MVG 1600

without differential

MVG 2000



The MVG 1600 / MVG 2000 without differential is a 3-shaft design, 2-speed transfer case with clockwise input drive direction (view to input flange).

Housing: two-parts

Bearing application:	Input shaft	- taper roller bearings
	Intermediate shaft	- cylinder roller bearings
	Output shaft	- tapered roller bearings
	Front output shaft	- roller bearing, slide bearing

Lubrication: splash lubrication or splash / force feed lubrication with pump at input shaft for the executions with PTO and for external cooling system, rear engine drive version and version with mechanical shifting

Shifting: mechanical - 3 positions
pneumatic - 2 or 3 positions

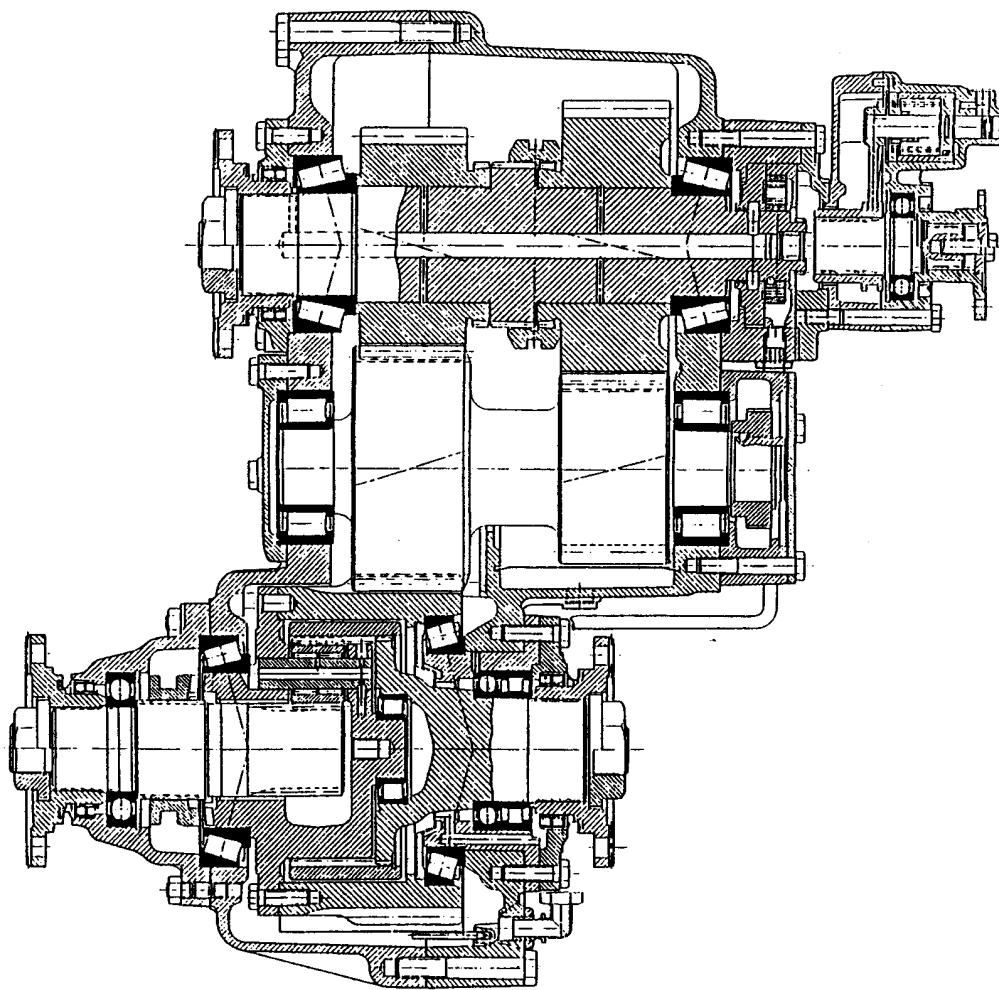
Options: pneumatic operation PTO; without front drive; rear engine drive version; pump fitting at front and rear side; external oil cooler connection; electronic speedometer connection; input drive direction counter-clockwise; synchronisation; ADM

DESIGN

MVG 1600

with differential

MVG 2000



Cross section VG 2000

The MVG 1600 / MVG 2000 with differential 3-shaft design, 2-speed transfer case with clockwise input drive direction (view to input flange).

Housing: two-parts

Bearing application:	Input shaft	- taper roller bearings
	Intermediate shaft	- cylinder roller bearings
	Output shaft and differential	- tapered roller bearings and needle bearing
	Front output shaft	- roller bearing, slide bearing
	Rear drive	- cylinder roller bearing, 4-point bearing

Lubrication: splash lubrication or splash / force feed lubrication with pump on input shaft for the executions with PTO and for external oil cooling system

Shifting: mechanical - 3 positions
pneumatic - 2 or 3 positions

Front drive: pneumatic, differential pneumatically lockable

Options: pneumatic operation PTO; rear engine drive version; pump fitting at front and rear side;
external oil cooler connection; electronic speedometer connection; input drive direction counter-clockwise; synchronisation; ADM



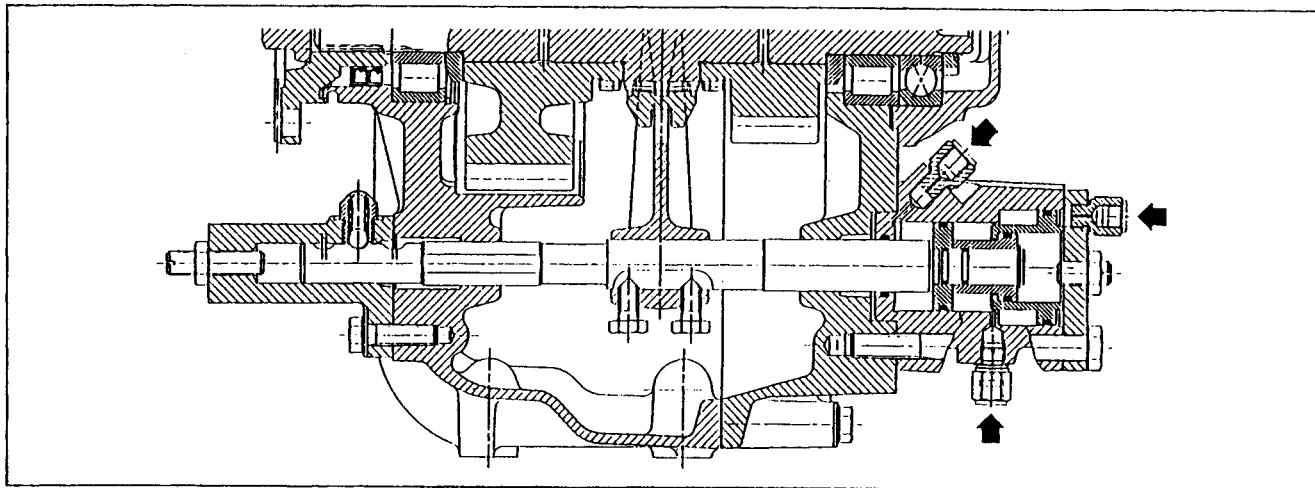
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DESCRIPTION - Shift mechanism

Pneumatic Shifting:

High and Low
3 positions without return spring

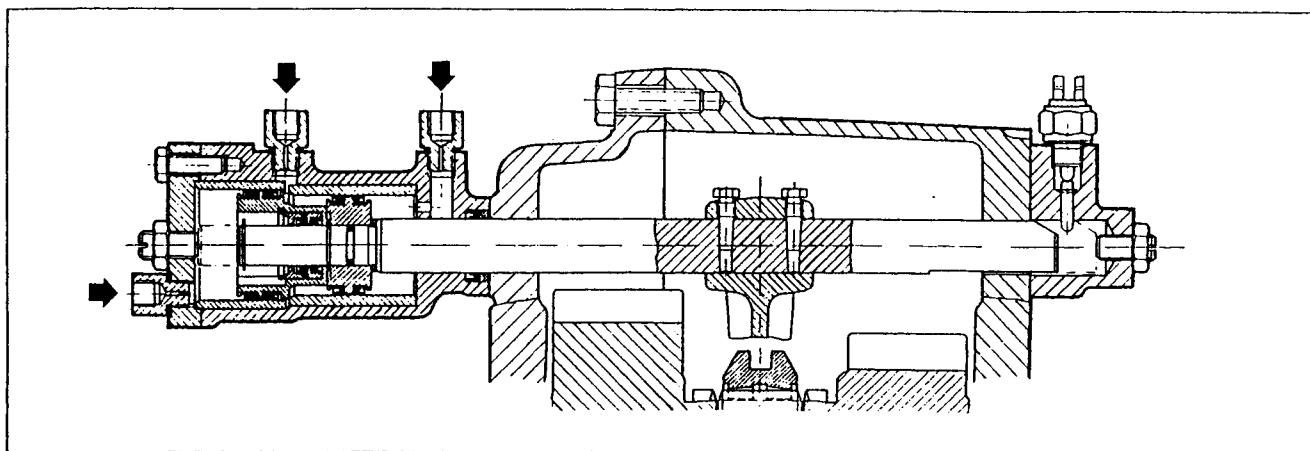
MVG 750



Pneumatic Shifting:

High and Low
3 positions without return spring

MVG 1200

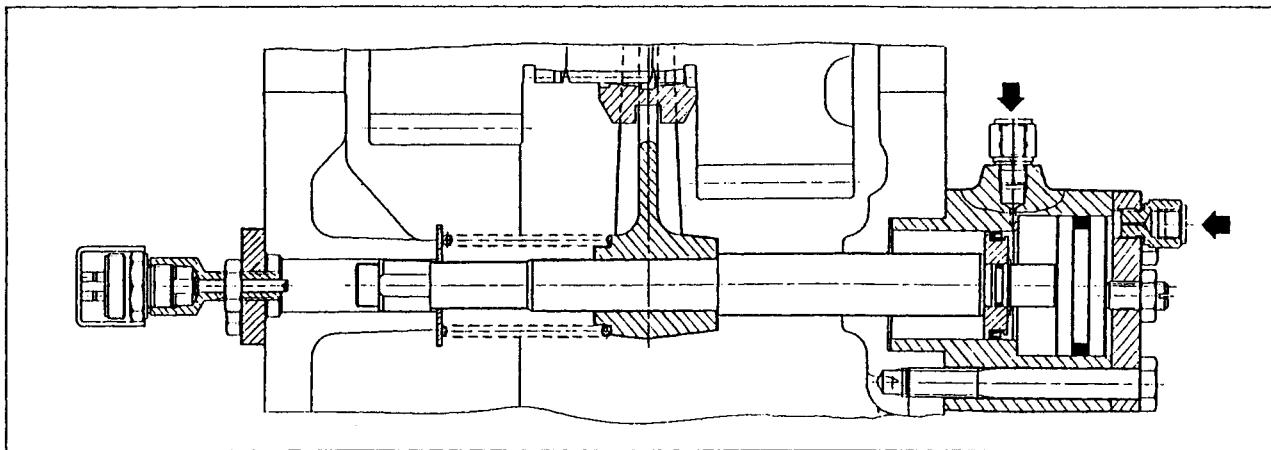


DESCRIPTION - Shift mechanism

Pneumatic Shifting:

High and Low
2/3 positions without return spring

MVG 1200 / MVG 1600 / MVG 2000



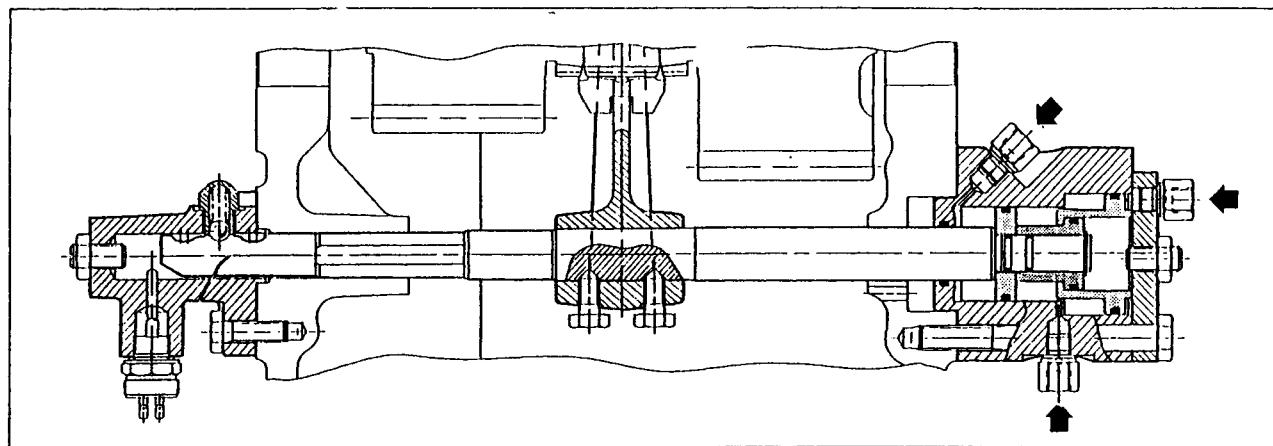
Attention:

For "pneumatic shifting with spring" we want to point out that in case of an air pressure loss the gear changes due to the spring pressure on MVG 1200 from high to low and on MVG 1600 and MVG 2000 from low to high.

Pneumatic Shifting:

High and Low
3 positions with defent, without return spring

MVG 1600 / MVG 2000



Marmon-Herrington

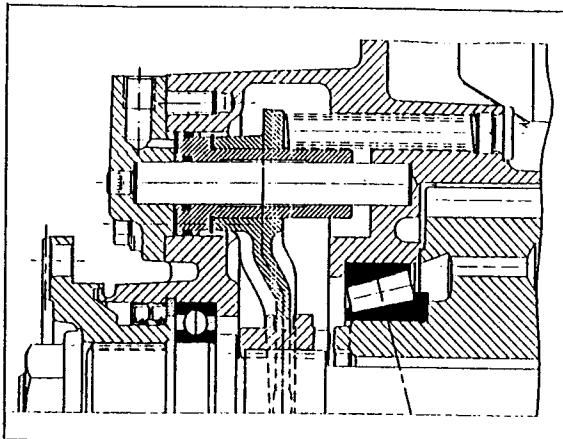
DESCRIPTION - Shift mechanism

Engagement of the front axle drive as well as the PTO is performed pneumatically (6.5 to 8 bar air pressure). Disengaging is done by the return spring which is installed in the shifting cylinder.

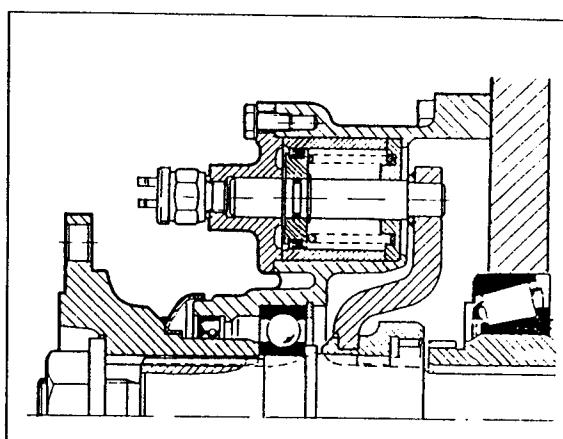
Pneumatic Shifting:

High and Low
2/3 positions without return spring

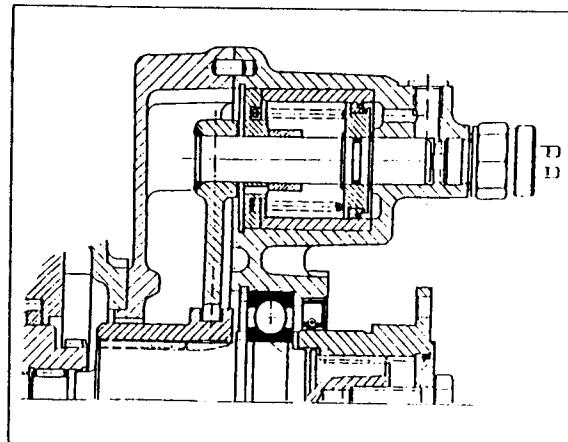
MVG 750



MVG 1200



N 200 Pneumatic Shifting: Power Take Off (PTO)



Magnetic drain plugs perform the vital function of trapping small metallic particles that circulate in the lubricant, through the gears and bearings, causing rapid wear and premature failure.

REFERENCE ONLY:

- A. Never add lubricant to axle or transfer case unless it is the same make and grade as that which is already in the axle or transfer case. If the same lubricant is not available, drain and refill.

- B. **CHECKING LEVEL**
Remove filler plug. Lubricant should be level with bottom of tapped filler hole.

- C. **AIR VENTS**
Check every 2,000 miles (3,200 km) – Clean in solvent.

SCHEDULED MAINTENANCE SERVICES

COMPONENT

COMPONENT	(CODE)
Front Axle Differential Carrier	(1) (2) (4) (6)
Steering Axle Wheel Ends	(2) (5) (6)
Brake Lubrication	(2) (6)
Tie Rod Lubrication	(3) (6)
Drag Link Lubrication	(3) (6)
Drivelines Lubrication	(2) (3) (6)
Transfer Case Lubrication	(1) (2) (4) (6)
Wheel Bearing Lubrication	(5) (6)

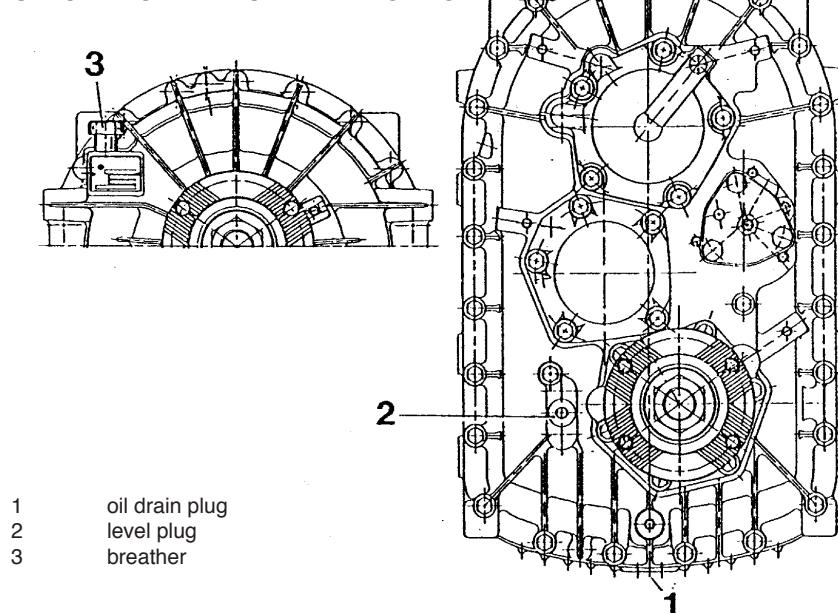
(CODE)

1. Change after first 1,000 miles (1,600 km)
2. Check each 1,000 miles (1,600 km)
3. Lubricant every 2,000 miles (3,200 km)
4. Drain and refill every 10,000 miles (16,000 km)
5. Repack every 10,000 miles (16,000 km)
6. More frequent intervals may be required under adverse operating conditions.

LUBRICATION GUIDE: TRANSFER CASE MODELS: MVG750, MVG1200, MVG2000

SERVICE AND MAINTENANCE

OIL CHANGE AND OIL LEVEL CHECK



MVG750

OIL CHANGE (recommended in warm condition)
 - drain gear oil at drain plug (1)
 - clean magnet of drain plug
 - mount drain plug with new seal
 - fill new gear oil at filling bore/level bore (2) until it flows over
 - mount level plug (2) with new seal
 - unscrew breather (3), clean it and mount it again

OIL LEVEL CHECK

- open oil filling/level plug (2)
 - oil level must reach edge of level bore, if necessary top up
 - mount level plug with new seal

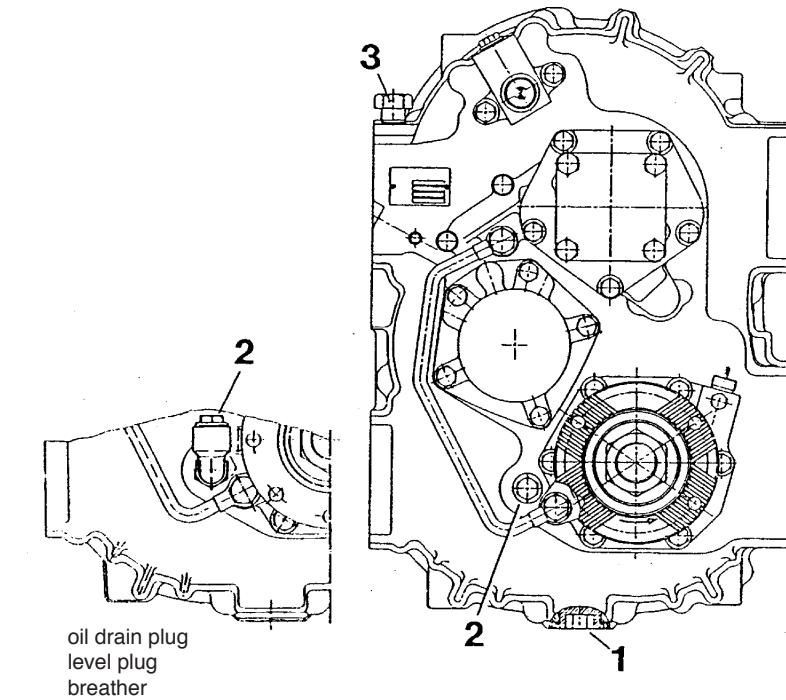
without longitudinal differential
approx. 6,4 l
13.5 pts.

with longitudinal differential
approx. 5,5 l
11.6 pts.

ATTENTION: Assure correct oil level. Low level causes lack of lubrication and reduces durability.
Too high level causes excessive splashing and leads to overheating of transfer case.



Marmon-Herrington



MVG1200

OIL CHANGE (recommended in warm condition)

- drain gear oil at drain plug (1)
- clean magnet of drain plug
- mount drain plug with new seal
- fill new gear oil at filling bore/level bore (2) until it flows over
- mount level plug (2) with new seal
- unscrew breather (3), clean it and mount it again

OIL LEVEL CHECK

- open oil filling/level plug (2)
- oil level must reach edge of level bore, if necessary top up
- mount level plug with new seal

without longitudinal differential

approx. 4,6 l
9.7 pts.

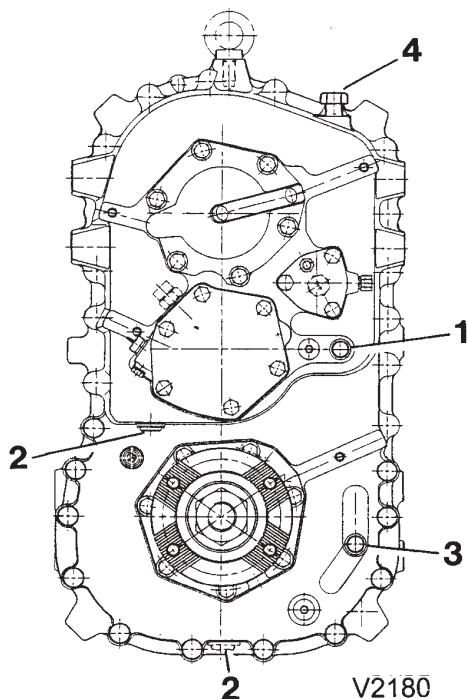
with longitudinal differential

approx. 3,5 l
7.8 pts.

ATTENTION: Assure correct oil level. Low level causes lack of lubrication and reduces durability.
Too high level causes excessive splashing and leads to overheating of transfer case.

MVG1600

- | | |
|---|------------------|
| 1 | Oil filling plug |
| 2 | Oil drain plug |
| 3 | Oil level plug |
| 4 | Breather |



Drain oil by unscrewing both oil drain plugs (2)

Install oil drain plugs (2) with new seals

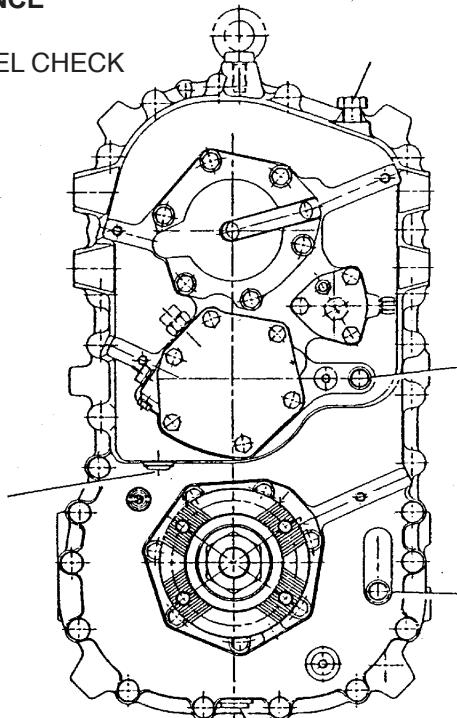
Fill oil through oil filling bore (1) until it starts to overflow at oil level bore (3)

After setting of correct oil quantity Install oil level plug (3) with new seal

Clean and install breather (4)

SERVICE AND MAINTENANCE

OIL CHANGE AND OIL LEVEL CHECK



- 1 oil filling plug
- 2 oil drain plug
- 3 level plug
- 4 breather

ATTENTION: Assure correct oil level. Low level causes lack of lubrication and reduces durability.
Too high level causes excessive splashing and leads to overheating of transfer case.

MVG2000 (Long Drop)

OIL CHANGE (recommended in warm condition)

- drain gear oil at drain plug (2)
- clean magnet of drain plug
- mount drain plug with new seal
- fill new gear oil at filling bore/level bore (1) until it flows over (3)
- mount level plug (3) with new seal
- unscrew breather (4), clean it and mount it again

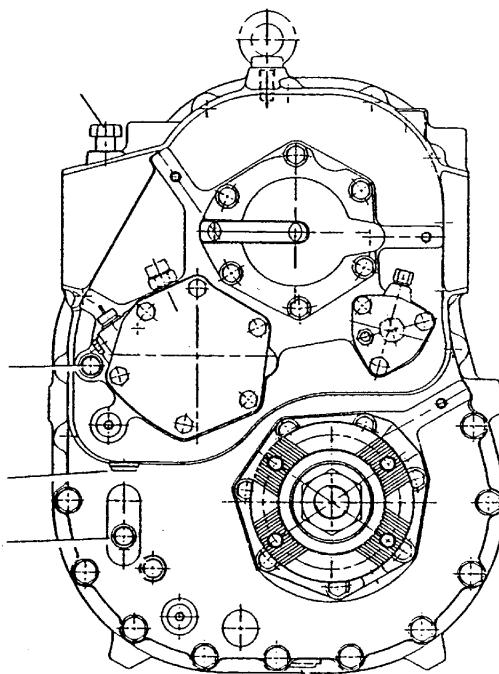
OIL LEVEL CHECK

- open oil filling/level plug (3)
- oil level must reach edge of level bore, if necessary top up
- mount level plug with new seal

without longitudinal differential
approx. 7,1 l
15 pts.

with longitudinal differential
approx. 6,5 l
13.74 pts.

MVG2000 (Short Drop)



- 1 oil filling plug
- 2 oil drain plug
- 3 level plug
- 4 breather

ATTENTION: Assure correct oil level. Low level causes lack of lubrication and reduces durability.
Too high level causes excessive splashing and leads to overheating of transfer case.

OIL CHANGE (recommended in warm condition)

- drain gear oil at drain plug (1)
- clean magnet of drain plug
- mount drain plug with new seal
- fill new gear oil at filling bore/level bore (2) until it flows over
- mount level plug (2) with new seal
- unscrew breather (3), clean it and mount it again

OIL LEVEL CHECK

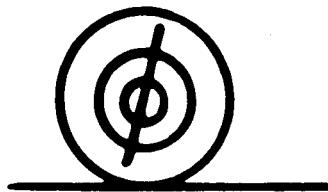
- open oil filling/level plug (2)
- oil level must reach edge of level bore, if necessary top up
- mount level plug with new seal

without longitudinal differential
approx. 9,0 l
19 pts.

with longitudinal differential
approx. 8,4 l
17.75 pts.

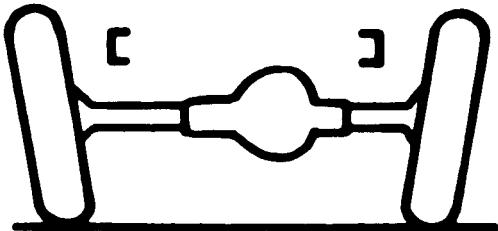
FRONT AXLE

CASTER



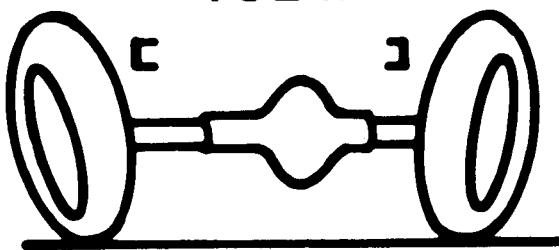
CASTER: Backward tilt of king pin at top. To cause front wheels to run straight normally, straighten up after turn, and give trailing action to wheels.

CAMBER



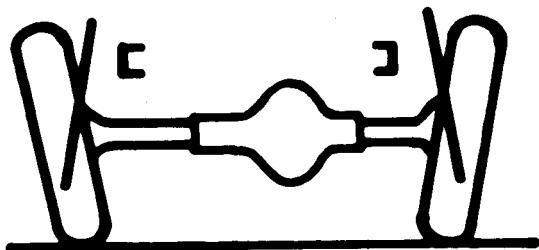
CAMBER: Outward tilt of front wheels at top. To bring road contact point of wheel more nearly under center of load. Important tire saving adjustment.

TOE IN



TOE-IN: Drawing together of front wheels at front at hub height. To prevent excessive tire wear.

KING PIN INCLINATION



KING PIN INCLINATION: Inward tilt of king pin at top to compensate for shearing action on king pin which would result if wheels were left vertical and had no camber and no king pin inclination.

DRAG LINK & TIE ROD NOMENCLATURE:

The term **DRAG LINK** is the component that connects the Front Axle steering arm to the steering gear box.

The term **TIE ROD** is the component that connects the left and right front axle wheels.

ADJUSTMENTS

A. CASTER

A change in axle caster could indicate front axle housing distortion, which might be caused by a minor accident, or a permanent set in the front springs.

This is read by a protractor mounted on the pinion U-joint. Consult the respective axle specifications to determine the actual caster reading.

TO CORRECT:

If front springs are badly distorted, it is advisable to install new leaves or complete new springs.

It may only be necessary to install tapered shims between the front axle spring pads and springs. The position of the thick part of the shim will be determined by the direction in which the axle must be tilted in order to bring the caster angle to the correct specification.

B. CAMBER

Front wheel camber is controlled by the axle housings, and cannot be changed.

TO CORRECT:

Call the Factory. The application of heat will destroy the heat treatment and make the housing susceptible to distortion.

C. TOE-IN

Front wheel toe-in is controlled by the length of the tie rod.

For smooth operation and ease of steering at highway speeds, the axle has been adjusted such that the wheel mounting surfaces at the front are slightly closer together than on the rear side. This difference should measure $1/8" \pm 1/6"$.

TO CORRECT:

The length of the tie rod is adjusted by rotating the threaded end (ends) through a complete turn.

Turning the tie-rod one way will slightly increase the toe-in, while rotating it the other way will slightly decrease it with each turn.

In the event the tie rod becomes bent, it should be replaced, as it will again bend easily even though straightened to its original form.

D. TIE ROD ENDS

Tie rod yoke pins should be adjusted to eliminate lost motion. Tie rod pins and bushings, or ball sockets, should be replaced if worn.

E. STEERING GEAR

The steering gear should be adjusted to eliminate excessive looseness. The standard original steering gear is used, therefore, the original service operation applies.

F. U-BOLT AND STUD NUTS

Front spring U-bolt nuts should be securely tightened. If the front axle continues to shift on the springs, it is an indication that the spring center bolts are sheared and they should be replaced.

G. WHEELS AND TIRES

Check wheels and tires for runout and balance.

See that tires are inflated to recommended pressure, in order to provide the **SAME TIRE ROLLING RADIUS, FRONT AND REAR.**



H. WHEEL BEARINGS

In order to ensure top performance long bearing life, the tapered-roller bearings must be properly preloaded upon assembly anytime the outer and assembly is disassembled. Proper adjustment is obtained by tightening the inner bearing nut, with the bearings in position, until the hub will no longer turn. Then back off the nut approximately 1/8 revolution, install retainer and outer nut, and lock in position. The hub should now turn freely with no perceivable end-play. Consult the specific axle maintenance manual for a more detailed procedure.

I. GENERAL INFORMATION

(1) Lubrication — Lubricate the front axle assembly in accordance with the Lubrication Chart of this manual.

DO NOT OVER LUBRICATE. If the differential, universal joints, or hub bearings are over-lubricated, the lubricant will be pressurized past the oil seals and vents and may do damage by destroying the seal as well as entering the brakes.

(2) **LOOSE ADJUSTMENTS** — As soon as a looseness is noted in the hub bearings pivot pins, or other adjustable points, attention should be given to these items. Normal wear is slight but develops more rapidly as looseness occurs. If a unit is operated for a long length of time with a prevailing perceptible looseness, it will impose a pounding action on the parts involved. This may result in severe damage or destruction of parts and cause the necessity of replacement. This service repair can be avoided by preventive maintenance in eliminating the looseness as it develops, by performing the necessary adjustments.

TROUBLE SHOOTING

PROBLEM	POSSIBLE CAUSE
Transfer case or axle running "Hot"	Improper lubrication
Excessive driveline or gear noise	Driveline imbalance Improper lubrication Loose or worn parts
Steering instability (shimmy)	Wheels and/or tires out of balance Over or under inflated tires Worn or loose parts Improper lubrication Overload
Excessive or uneven tire wear	Wheels and/or tires out of balance Improper alignment Over or under inflated tires.

LUBRICATION GUIDE:
FRONT DRIVING STEER AXLES: MODELS: MT10/11, MT14/17, MT22/23

MODEL	MT10/11 AXLE	MT14/17 AXLE	MT22/23 AXLE
WHEEL ENDS		2.0 pints	2.0 pints
DIFFERENTIAL	17.0 pints	17.0 pints	17.0 pints

NOTE: All capacities approximate

MT14, MT17, MT22, MT23

LUBRICATION POINTS: (Fig. 1 and 2)

- 1 — oil level check & filter bore screw plug
- 2 — oil drain bore screw plug
- 3 — vent valve
- 4 — steering swivel bearings (bottom-top)
- 5 — slack adjuster
- 6 — brake camshaft bearings
- 7 — tie-rod ball joints

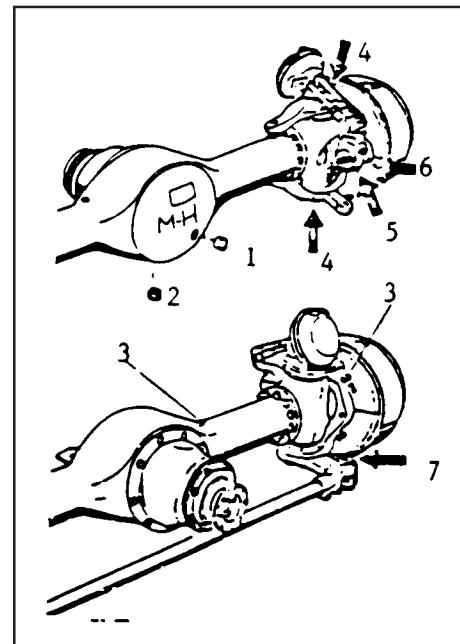
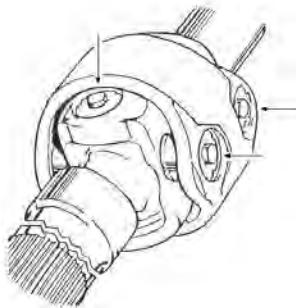


fig. 1

CARDAN-JOINT SERVICE

The Cardan-Joint caps are fitted with plugged threaded ports that are used for disassembly/assembly. While these ports will accept a standard zerk fitting, we recommend that only a needle attachment be used to flow lube into these joints. Adding lube under pressure may result in the failure of the cup seal.



MT10, MT11

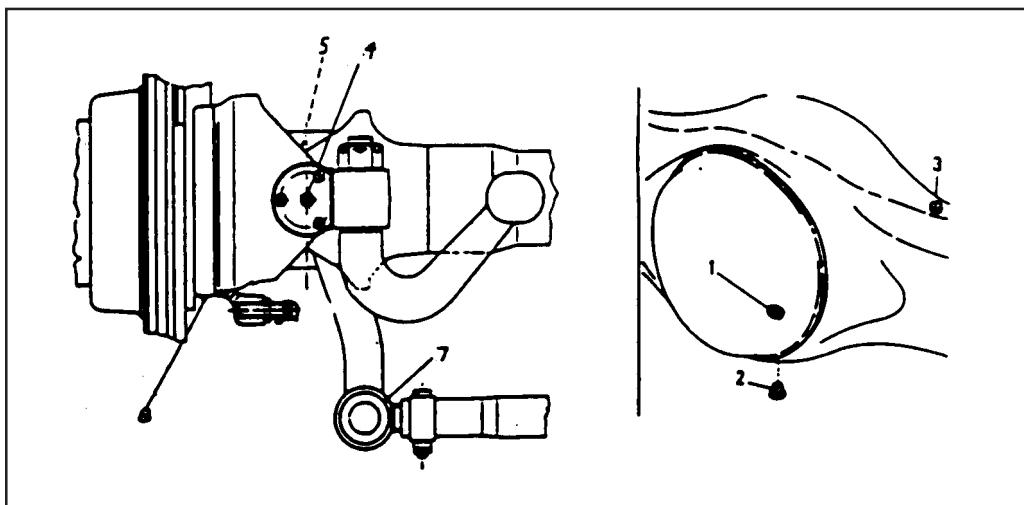
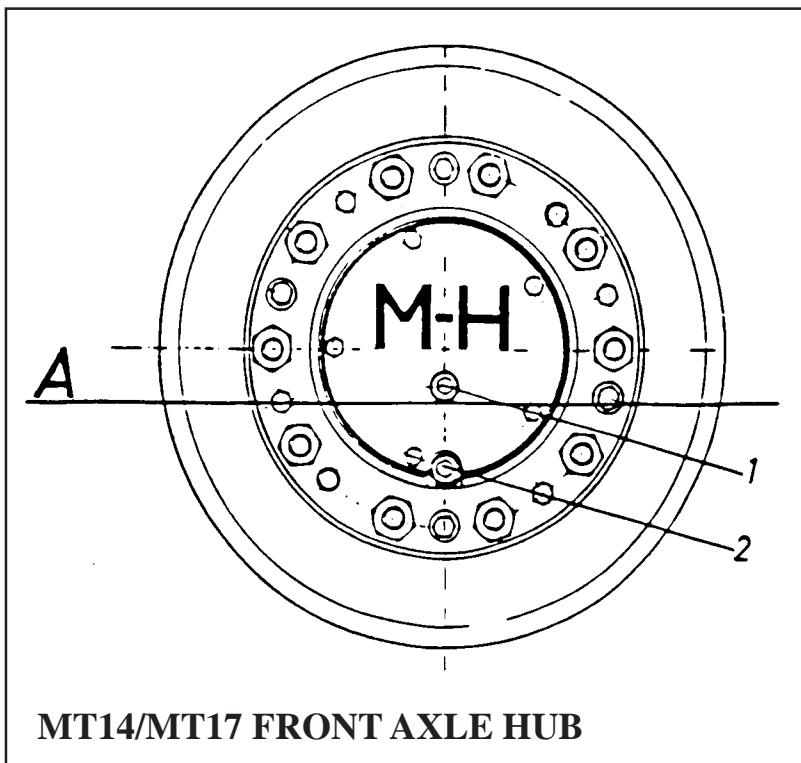


fig. 2

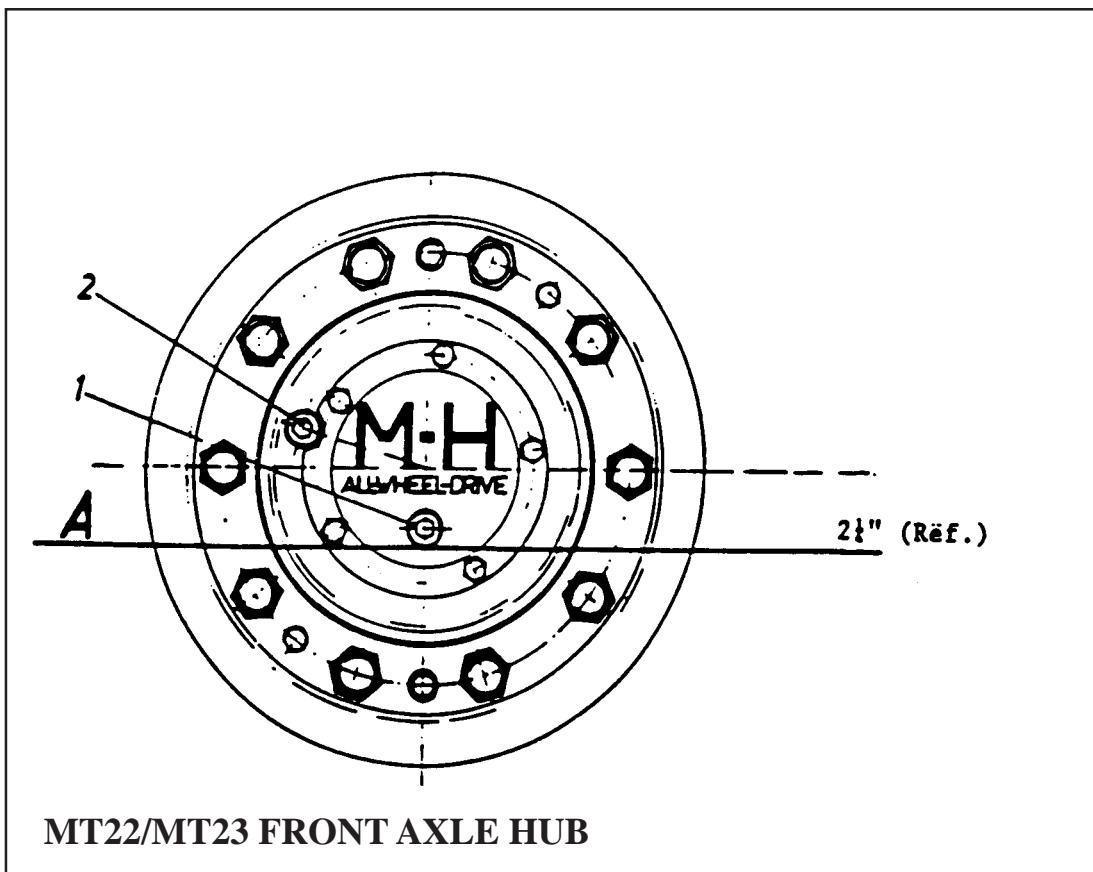


Marmon-Herrington

OIL LEVEL OF WHEEL HUBS: MT14, MT17, MT22, MT23



- 1 — Plug for **OIL FILLING** and inspection hole
- 2 — Plug for **DRAIN** hole
- A — Line of **OIL LEVEL**

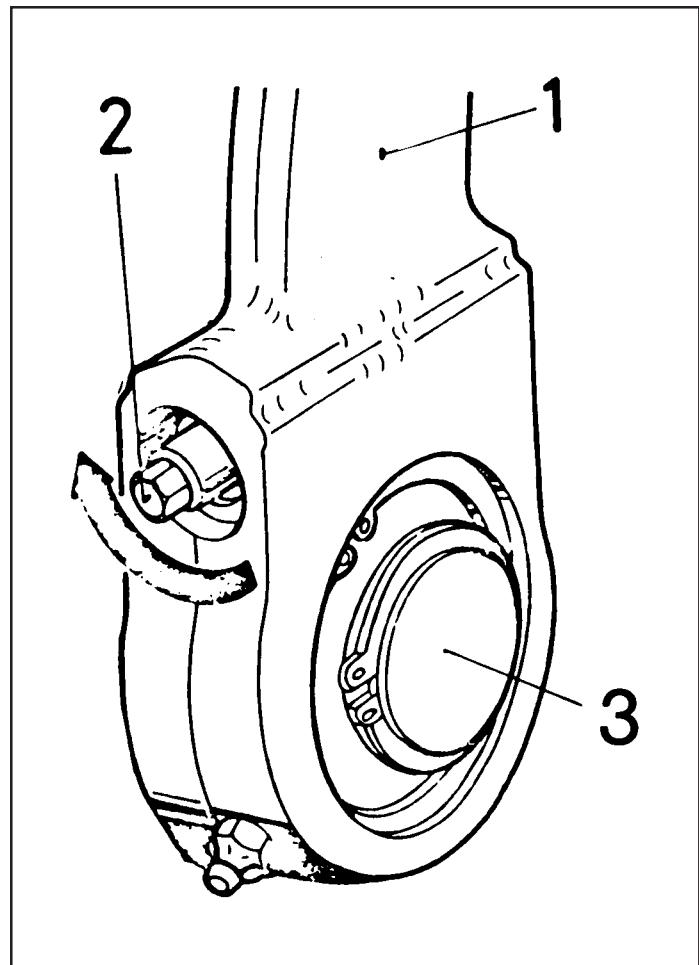


BRAKE LEVER ADJUSTING: MT11, MT14, MT17, MT22, MT23 MODEL AXLES

1 — brake lever

2 — worm shaft

3 — cam shaft



MANUAL SLACK ADJUSTERS:

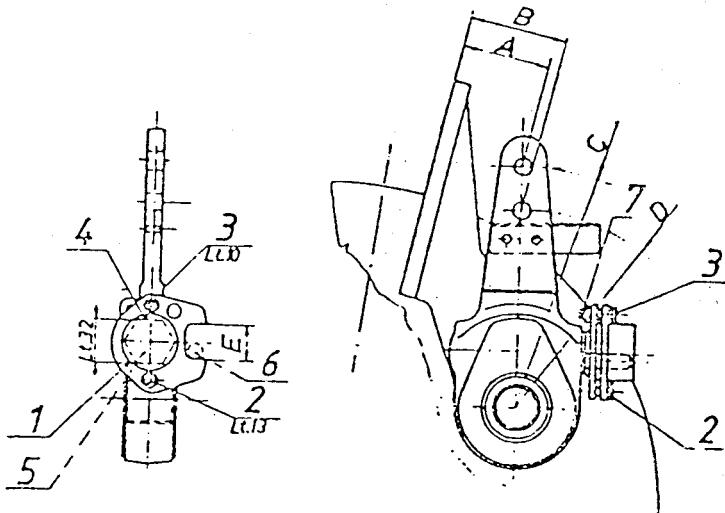
Adjustment of the front brake is performed by turning off the worm gears of the adjustable brake lever.

Using a wrench, turn the worm shaft until the brakes stop wheel rotation. Now back off the worm shaft until only a slight drag is felt turning the wheel by hand. The shoe clearance can be checked with a feeler gauge through an opening in the brake cover plate.

AUTOMATIC SLACK ADJUSTER

ITEMS:

- 1 — Adjusting plate
- 2 — Setscrew (hex. dist. 13)
- 3 — Setscrew (hex. dist. 10)
- 4 — Plastic protection cap
- 5 — Hex. adjusting ring (hex. dist. 32)
- 6 — Stop pin
- 7 — Plastic thread protector



The slack adjuster requires no mainenance, since it is automatically readjusted according to brake lining wear.

When replacing the brake linings, or after repairing the axle, perform adjustment of the show clearance and automatic slack adjuster as follows:

ADJUSTMENT DATA:

A = Distance between the chamber holder plane and the brake lever bore.

B = Distance between the chamber holder plane and the brake lever bore.

C = Brake lever installation radius.

D = Brake lever installation radius.

a. Adjusting position of the brake lever and the shoe clearance:

- Remove setscrews (2,3).
- Take care of the plastic thread protector (7).
- Remove the adjusting plate (1) and the plastic protection cap (4).

By turning the hex adjusting ring (5) to proper direction, adjust for the specified distance between the seating surface and the brake lever bore. (Start adjustment from a distance greater than specified. If required, also adjust the push rod clevis.)

- After the above operation adjust the shoe clearance to 0.3 — 0.6 mm.

REPLACEMENT PARTS

When ordering replacement parts for **MARMON-HERRINGTON ALL-WHEEL DRIVE** conversions, the following information should be given:

1. **FACTORY ORDER NUMBER** (found on I.D. Plate on driver's door panel or small plate affixed to axle housing). This will be a six (6) digit number. (See illustrations this page.)
2. Component for which parts are required, i.e. front drive axle or transfer case.
3. Model of axle and/or transfer, i.e. MR-90, MR-226.

The information necessary for replacement parts and/or warranty claim procedures will be found on either plate design.

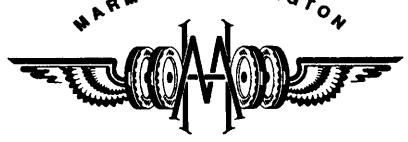
MARMON-HERRINGTON			
SALES ORDER	0000-00	TYPE	<input type="text"/>
S/N	<input type="text"/>	RATIO	<input type="text"/>

WARRANTY CLAIM PROCEDURE

When ordering parts which you feel might be covered under warranty, advise the following information:

1. **FACTORY ORDER NUMBER** (found on I.D. Plate on driver's door panel or small plate affixed to axle housing). This will be a six (6) digit number. (See illustrations this page.)
2. Date unit was put into operation.
3. Mileage of unit at time of failure.
4. Nature of failure.

Upon receipt of the above, you will be advised as to how to proceed with the claim.

 ALL-WHEEL DRIVE LOUISVILLE, KENTUCKY U.S.A.	
FACTORY ORDER NO.	<input type="text" value="0000-00"/>
INSTALLED BY	<input type="text"/> <input type="text"/>
FRONT DRIVING AXLE	
MODEL	<input type="text"/>
CAPACITY	<input type="text"/>
SERIAL NO.	<input type="text"/>
RATIO	<input type="text"/>
TRANSFER CASE	
MODEL	<input type="text"/>
SERIAL NO.	<input type="text"/>



Marmon-Herrington

MARMON-HERRINGTON WARRANTY

This is to certify that we, Marmon-Herrington Company, Louisville, Kentucky, warrant each new chassis remanufactured, or assembly or part furnished for the remanufacture of a truck chassis against defects in material and workmanship under normal use and service. Marmon-Herrington's obligation under this warranty is limited to replacement of, at our factory, any part or parts thereof which shall, within one (1) year after delivery of such vehicle to the final user, but not later than eighteen (18) months after installation of the all-wheel drive conversion kit, or prior to the time when such vehicle has been operated twelve thousand (12,000) miles, whichever first occurs, be returned to us with transportation charges prepaid, and which our examination shall disclose to our satisfaction to have been thus defective.

Service parts are manufactured to the same standards as production installed parts. However, since the installation thereof, as well as the age and condition of the receiving vehicle are beyond the control of Marmon-Herrington, Service Parts are warranted for a period of ninety (90) days or five thousand (5,000) miles whichever first occurs. All other regular warranty conditions apply.

On vehicles operating OVERSEAS, the determination of defects will be made at Marmon-Herrington Company, Louisville, Kentucky, from complete information supplied in writing by overseas distributors or recognized acting distributors. Complete information is defined to mean: vehicle serial number, user's name, date of delivery, mileage at time of breakage, date of breakage, type of service, nature of break or fault, distributor's recommendation (for our guidance only), and any other pertinent information. After determination of our obligation, any parts to be replaced will be shipped to distributor or acting distributor in accordance with his instructions.

This warranty is in lieu of all other warranties expressed or implied and of all other obligations or liabilities incurred by Marmon-Herrington. Marmon-Herrington neither assumes nor authorizes any other person to assume any other liability in connection with this sale, including but not limited to indirect or consequential damages.

This warranty shall not apply to any vehicle which shall have been repaired or altered in any way so as in our judgment, to affect its stability or reliability, nor which has been subject to misuse, negligence, or accident, nor which shall have been operated at a speed exceeding the factory rated speed or loaded beyond the factory rated load capacity or operated in violation of Marmon-Herrington's instructions.

Marmon-Herrington makes no warranty whatever on components of the original manufacturer's chassis not related to the modification work. Also, no warranty is made on tires, rims, ignitions, or other parts usually warranted separately by their respective manufacturers.

The manufacturers reserve the right to make changes in design, and changes or improvements upon their product, without notice, and without incurring any obligation to install such changes or improvements upon their products theretofore manufactured.

This warranty shall become effective only when the Warranty Certificate has been returned to Marmon- Herrington and validated by same.

WARRANTY REPAIR AND CLAIM PROCEDURE

Initial Failure Reporting

1. Operator must call Marmon-Herrington Customer Service prior to performing any repairs and receive a Work Authorization Number to be eligible for reimbursement. The work authorization number does not guarantee payment but is an acknowledgement that the vehicle is within the warranty period in terms of date and mileage, and that a claim has been activated. It will be the responsibility of the operator to ensure that their repair facility is aware of and complies with the guidelines of this policy.
2. To expedite the authorization process, you will need the Sales Order Number or "S" number found on the front of this certificate. You will also need the Vehicle Identification Number or the last six digits of the "VIN", the date the vehicle was placed in service, and the current mileage. Please note the following:
 - This Warranty Registration should have been submitted at the time of delivery. If our records do not include a warranty registration, you must complete one before any authorization for repair can be issued. We will make them available by mail or fax upon request.
3. Marmon-Herrington will pre-approve .5 hours diagnosis/inspection time prior to your call for repair authorization. If the diagnosis/inspection complaint does not reveal a warrantable failure, or result in a warrantable repair, the customer will be responsible for all charges including diagnosis/inspection time.
4. The Operators Manual contains information covering proper equipment use and maintenance schedules. Operators must adhere to these guidelines to be eligible for reimbursement, and service records must be provided upon request.

Pre-Repair Requirements

1. Authorization for repairs will require a written estimate/repair order of costs after determination that a warrantable condition is found to exist.
2. Estimates must contain the following information:
 - A list of all parts necessary for specific job and if applicable, all parts that will be invoiced back to Marmon-Herrington.
 - The cost of disassembly, inspection and diagnosis of any portion of the vehicle to determine extent of repairs needed.
 - Current labor costs, reflecting both hourly rate and number of hours to effect repairs must be listed.
 - Miscellaneous charges such as "shop supplies" must be defined. Actual dollar amounts must be listed, as percentages will not be accepted.
 - Sublet repairs must also be defined and included in the estimate at their actual dollar amount.
 - NOTE: If it becomes necessary to exceed the original estimate in terms of parts or labor, the repair facility must call Marmon-Herrington Customer Service for additional authorization.
3. Only the use of Marmon-Herrington supplied parts will constitute reimbursement unless prior approval has been obtained.

Parts Ordering

1. While Marmon-Herrington operates a full service Parts Department, replacement parts needed to effect Warranty repairs must be acquired through Customer Service to be eligible for reimbursement.

Post Repair requirements.

1. The final invoice or work order must include the following:
 - Customer name, address, and phone number.
 - The Vehicle Identification number.
 - The Sales Order Number or "S" number, which the customer can provide or can be located on the ID tag, fixed to the transfer case or axle.
 - The Axle or Transfer Case Model and Serial Number, also located on the ID tag.
 - Mileage IN / Mileage Out.
 - The Cause and Correction of the repair including detailed description of repairs and parts replaced.
 - The date the repair order was open and the date the repairs were completed.
 - The Work Authorization Number obtained from Customer Service.

Notes to Repair Facilities

1. Miscellaneous charges such as "shop supplies" must be listed as separate line items and shown on the final invoice as stated in "Pre-Repair Requirements". Invoices for sublet repairs must be made available upon request.
2. All repairs must comply with any or all state and DOT requirements.
3. Downtime of vehicle and incurred costs associated due to the delay of parts shipments or any other condition beyond our control is not reimbursable and should not be listed on the invoice.
4. All failed parts that are required to be returned to Marmon-Herrington must be received before payment will be made. The Return Authorization will be sent with the replacement parts when shipped from Marmon-Herrington.
5. All Claims must be submitted within 60 days of completion of repairs to be eligible for reimbursement.

For Work Authorization call: 800.227.0727 ext. 282

To Submit Claims by Fax: 502.253.0317

Submit Claims by Mail to: Marmon-Herrington Company
Customer Service Department
13001 Magisterial Drive
Louisville, KY 40223

NOTES

NOTES



Marmon-Herrington



Marmon-Herrington

13001 Magisterial Drive • Louisville, KY 40223
(502) 253-0277 • (800) 227-0727 • Fax (502) 253-0317
E-mail: info@marmon-herrington.com

JW06/02

Marmon-Herrington Literature Order Form

Literature available on line at www.Marmon-Herrington.com

Sales Literature – No Charge	Part	Quantity	Parts Manuals:	Part	Price	Quantity	Extended Cost:
MVG 750 Transfer Case	TCSL001		MVG 750 Transfer Case	TCPM001	*		
MVG 1200 Transfer Case	TCSL002		MVG 1200 Transfer Case	TCPM002	*		
MVG 2000 Transfer Case	TCSL003		MVG 1600SD Transfer Case	TCPM004	*		
MT 8 Axle	AXSL001		MVG 1600LD Transfer Case	TCPM005	*		
MT 10 Axle	AXSL002		MVG 1600PLD Transfer Case	TCPM006	*		
MT 11 Axle	AXSL003		MVG 2000LD Transfer Case	TCPM003	*		
MT 14 Axle	AXSL004		MT 8 Axle	AXPM001	*		
MT 17 Axle	AXSL005		MT 10 Axle	AXPM002	*		
MT 22 Axle	AXSL006		MT 11 Axle	AXPM003	*		
MT 23 Axle	AXSL007		MT 14 Axle	AXPM004	*		
Driver Controlled Locking Differential	AXSL008		MT 17 Axle	AXPM005	*		
4 Page Brochure	PRBR001		MT 22 Axle	AXPM006	*		
Total Sales Literature			MT 23 Axle	AXPM007	*		
			R/RF 22 Axle	AXPM008	*		
			CT-8 Axle	AXPM009	*		
			MTL Carrier	MTLM009	*		
Repair Manuals:							
	MVG 750 Transfer Case		TCRM001	*			
	MVG 754 Transfer Case		TCRM005	*			
	MVG 1200 Transfer Case		TCRM002	*			
	MVG 1600 Transfer Case		TCRM004	*			
	MDB 1610 Drop Box		DBM002	*			
	MDB 500 Drop Box		DBM003	*			
	MVG 2000 Transfer Case		TCRM003	*			
	MT10/MT11 Axles		ARM001	*			
	MT14/MT17 Axles		ARM002	*			
	MT22/MT23 Axles		ARM003	*			
	R/RF 22 Axle		ARM004	*			
	CT-8 Axle		ARM005	*			
Operators Manuals:							
	General		OMG-2	*			

Method of Payment

Check Enclosed

Purchase Order/P.O. # _____
(only w/current M-H Account)

Mastercard/VISA – Card # _____

Exp. Date _____

Authorized Card User's Signature: _____

Credit Card Orders Or Current
Customers' Purchase Orders
May Be Faxed — **502/253-0317**

Ship Order to the following address

Company: _____

Name: _____

Address: _____

City/State: _____ Zip Code: _____

Country: _____ Postal Code: _____

Telephone Number: _____ Fax Number: _____

Sub Total: _____
Total Quantity Sales Literature: _____ *No Charge*

KY Sales Tax: _____

Standard Shipping: _____ *No Charge*

TOTAL Due: _____

* Call for current pricing