204-006 General Safety Instructions

Important Safety Notice

WARNING

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

- Dosing Control Unit
- NOx Sensor.

Plastic Bead Cleaning

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

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

CAUTION

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

CAUTION

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

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

Follow the equipment manufacturer's cleaning instructions. Make sure to adjust the air pressure in the blasting machine to the bead manufacturer's recommendations. Turning up the pressure can move material on the part and cause the plastic bead media to wear

204-009 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
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	Engine Control Module
EFC	Electronic Fuel Control
EGR	Exhaust Gas Recirculation
EPA	Environmental Protection Agency

View Related Topic

016-999 Mounting Adaptations - Overview

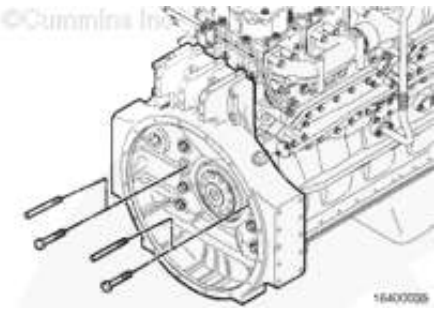
General Information

The QSK23 is available with a SAE 0 or SAE 1 flywheel/flywheel housing combination. The SAE 0 flywheel has a ring gear count of 138 teeth. The SAE 1 flywheel ring gear has 118 teeth.

Tapped holes for transmission mounting are:

- 24 - 7/16-14 UNC-2B for SAE number 1 flywheel housing
- 16 - M12 x 1.75 for SAE number 0 flywheel housing.

The flywheel housing has two magnetic pickup locations. A magnetic pickup hole is currently dedicated for use by the electronic engine control system. The magnetic pickup hole available for customer use is M22 x 1.5.



Last Modified: 08-Jul-2003

Engine Noise Excessive — Turbocharger

Symptom Tree t052

Printable Version

This is symptom tree

Cause	Correction

Refer to Engine Noise Diagnostic Procedures - General Information at the end of Section TS before using this symptom tree.

Turbocharger is **not** correct	Check the turbocharger part number and compare it to the Control Parts List (CPL), Bulletin 3379133 or 4021327. Replace the turbocharger if necessary. Refer to Procedure 010-033.

OK

Air intake or exhaust piping is contacting the chassis or cab	Inspect the air piping, chassis, and cab for contact points. Refer to the OEM service manual.

OK

Air intake or exhaust leaks	*Inspect the air intake and exhaust systems for air leaks. Refer to Procedure 010-024.*

OK

Check valve between the LTA and the engine radiator is installed backward	Check the installed direction of the check valve. Remove and install the check valve in the proper direction if necessary. Refer to the manufacturer's instructions and specifications.

OK

Coolant temperature is above specification	Refer to the Coolant Temperature Above Normal - Gradual Overheat symptom tree.

OK

Aftercooler element is restricted	Inspect the aftercooler element for restriction. Clean or replace the core if necessary. Refer to Procedure 010-031.

Last Modified: 14-May-2003

Action

Check the belt driven accessories.

Remove the drive belts and operate the engine under the condition where vibration occurs.

Did the vibration go away with the drive belts removed?

YES	NO
Repair or replace the malfunctioning belt driven accessory. Refer to the OEM service manual.	**No Repair**
Go to 2D	**Go to 2E**

Guided Step 2E - Check for a damaged vibration damper.

Conditions

- Engine not running.

Action

Remove and visually inspect the vibration damper.

Use Procedure 001-052 in the appropriate service manual for vibration damper inspection specifications.

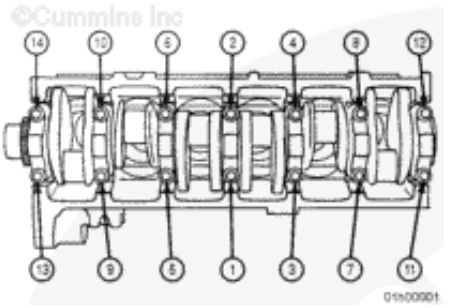
Is the vibration damper damaged or out of specification?

YES	NO
Replace the vibration damper. Use Procedure 001-052 in the appropriate service manual for replacement instructions.	**No Repair**
Repair complete	**Go to 2F**

Use the following steps to tighten the capscrews in the sequence shown.

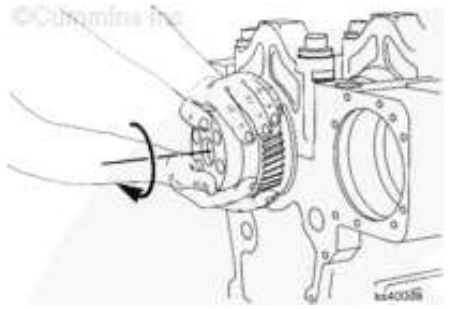
Torque Value:

1. 285 n.m [210 ft-lb]
2. 580 n.m [428 ft-lb]
3. Tighten 90°



Turn the crankshaft by hand. If the pistons have **not** been removed, use the barring mechanism.

The crankshaft will turn freely if the main bearings are installed correctly.

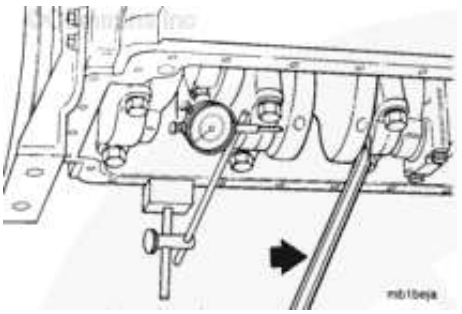


Use a dial indicator to measure the crankshaft end clearance.

Crankshaft End Clearance		
New Minimum	**New Maximum**	**Worn Limit**
0.14 mm [0.0055 in]	0.32 mm [0.0125 in]	0.60 mm [0.0236 in]

If the clearance is **not** within specifications, check for foreign material. Oversize thrust bearings are available to adjust the end clearance.

The upper and lower thrust bearing on the same side of the main caps **must** be the same thickness.



Install

WARNING

To reduce the possibility of severe burns, wear protective gloves when installing the heated ring gear.

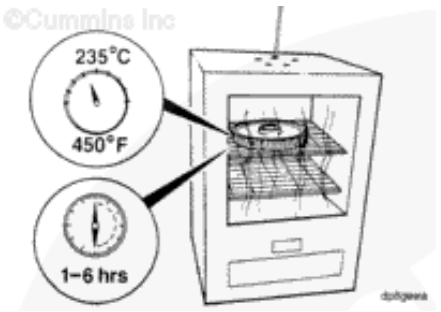
CAUTION

Do not exceed the specified time or the temperature. Damage to the gear and the gear teeth will result.

CAUTION

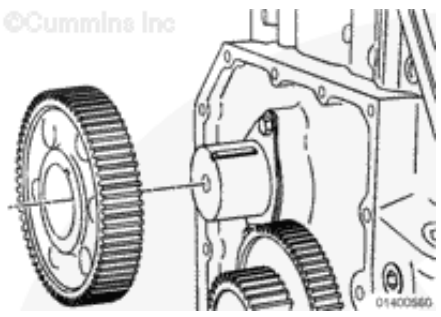
Do not attempt to install the gear without using heat. Damage to the camshaft and camshaft gear can result.

Use an oven and adjust the heat to 235°C [450°F]. Heat the gear for a minimum of 1 hour, but no more than a maximum of 6 hours. The inside diameter of the gear will become larger and will simplify installation.



CAUTION

Allow the gear to cool slowly. Do not use water or oil to reduce the cooling time. This will cause the gear to crack.



Procedure 013-009 in Section 13.

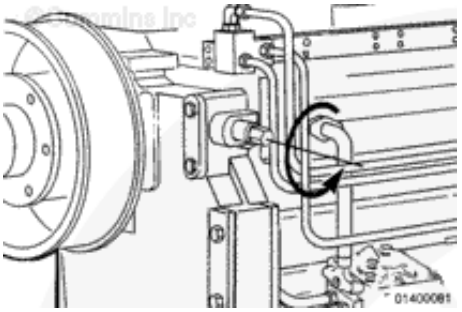
Start the engine and check for leaks.

Rotation Check

To rotate the engine crankshaft, push in on the engine barring device and rotate **counterclockwise**.

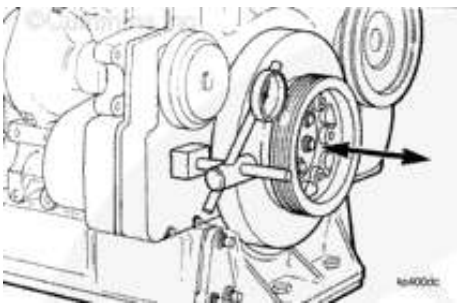
Rotate the crankshaft through two complete revolutions.

If the engine does **not** turn freely, the equipment can have a malfunction. Refer to the equipment manufacturer's instructions. The engine can have internal problems. Refer to the relevant procedure for inspection and replacement of internal engine components.



CAUTION

Extreme care must be used in prying against the viscous vibration damper. Sharp pry bars can damage the damper casing, resulting in a leak of the viscous vibration damper fluid and ultimate failure of the vibration damper.



Measure the crankshaft end clearance with a dial indicator.

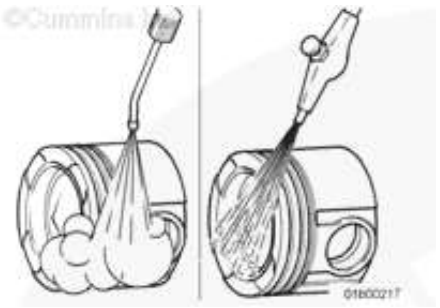
Measure the end clearance. Refer to Procedure 001-006 in Section 1.

- Remove the piston cooling nozzles. Refer to Procedure 001-046.
- Remove the piston and connecting rod assembly and disassemble. Refer to Procedure 001-054.

Clean and Inspect for Reuse

WARNING

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



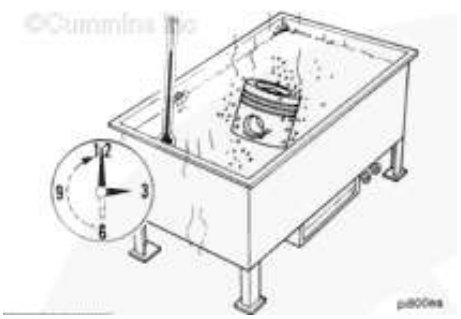
Use steam to clean the outer layers of carbon from the piston surface. The bead-blast method can be used to clean the top of the piston. If this method is used, cover the ring grooves.

The oil gallery holes **must** be covered before using the bead blast method.

It is **only** necessary to remove the carbon buildup. It is **not** necessary to make the piston crown appear new.

WARNING

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



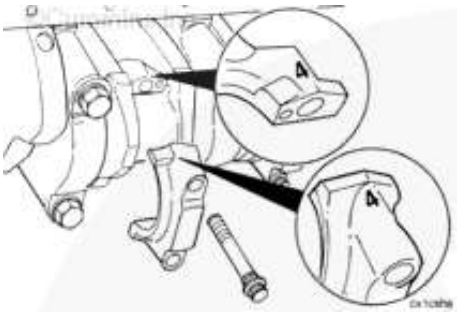
Remove the guide pins and install the connecting rod cap.

Always use the torque-turn method to tighten the connecting rod capscrews.

Use the following steps to tighten the capscrews alternately and evenly.

Torque Value:

1. 196 n.m [145 ft-lb]
2. Tighten 90°

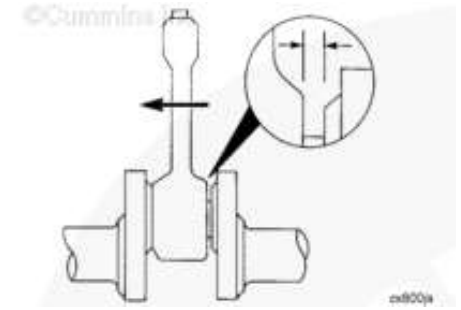


Check the side clearance between the connecting rod and the crankshaft.

The connecting rod **must** move freely from side to side.

Connecting Rod and Crankshaft Side Clearance New or Remanufactured Parts

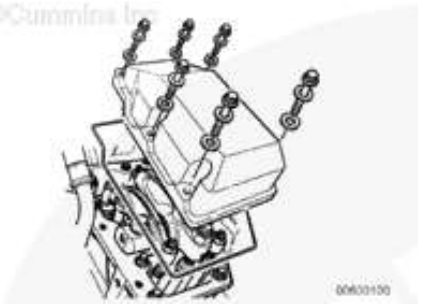
mm		in
0.200	MIN	0.008
0.374	MAX	0.015



Finishing Steps

- Install the piston cooling nozzles. Refer to Procedure 001-046 in Section 1.
- Install the cylinder head. Refer to Procedure 002-004.
- Install the rocker lever housing. Refer to Procedure 003-013 in

- Remove the rocker lever cover. Refer to Procedure 003-011 (Rocker Lever Cover) in Section 3.



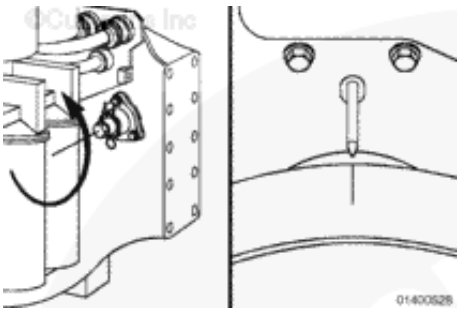
Adjust

If the rocker lever assemblies were removed for this repair, use this step to determine the correct cylinder to set.

Lubricate the adjusting screw threads with clean engine oil prior to making valve and injector adjustments.

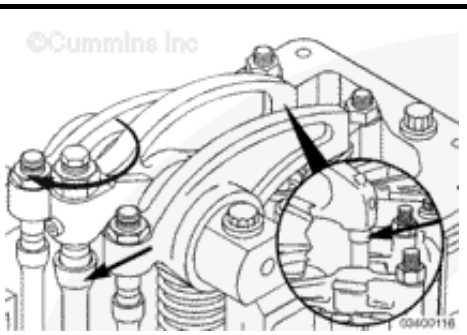
All adjusting screws **must** be loose on all cylinders and the push rods **must** remain in alignment.

Bar the engine to the next valve set mark on the damper. Setting can begin on any valve set mark.



To determine which cylinder is ready for setting, identify the cylinders that would be in position for injector setting, refer to the chart in this procedure. For example, if the engine was barred to the “1.6 TOP” mark, cylinder 2 or 5 would be in position for injector setting.

For these two cylinders, turn the injector

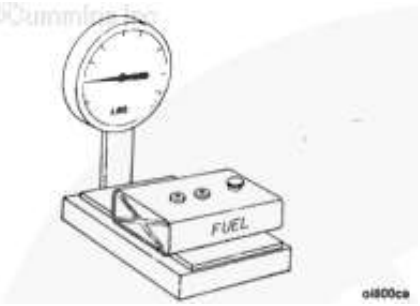


005-010 Fuel Consumption

Initial Check

Refer to the fuel consumption check list sheets in the back of this section.

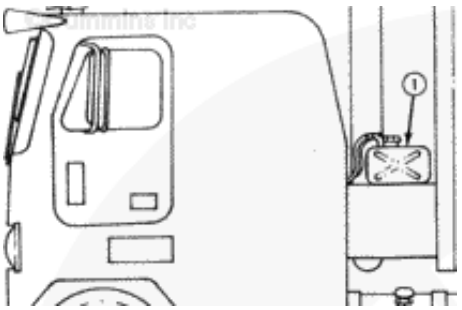
The most accurate method to check the fuel consumption is to weigh the fuel used during a specific time interval.



Use a scale capable of measuring within 0.045 kg [0.1 lb] to weigh the fuel tank.

Fill the fuel tank. Weigh the tank and the fuel. The weight of Number 2 diesel fuel is 0.844 kg per liter [7.03 lb per gallon].

Install a remote fuel tank (1) with enough capacity to run 80 km [50 mi] or 1 hour.



Test

010-023 Air Intake Manifold

Preparatory Steps

• Remove the fuel drain lines. Refer to Procedure 006-013 in Section 6. • Remove the fuel supply lines. Refer to Procedure 006-024 in Section 6. • Remove the fuel filter assembly. Refer to Procedure 006-015 in Section 6. • Drain the cooling system. Refer to Procedure 008-018 in Section 8. • Remove the coolant filter assembly. Refer to Procedure 008-060 in Section 8. • Remove the intake piping. Refer to the OEM service manual.		

Remove

Generator-Drive

Remove the 42 capscrews and the intake manifold.		