MERCURY Racing

Service Bulletin

Sterndrive No. 2012-05

Circulate to: ☐ Sales Manager ☐ Accounting ☑ Service Manager ☑ Technician ☐ Parts Manager

QC4v Specifications

Models Affected

Models Covered	Serial Number Or Year
QC4v 1350	0M965309 and above
QC4v 1100	0M965309 and above

Scope

Worldwide

General Engine Specifications (QC4v)

Crankshaft horsepower[1]	1350, 1100 HP (1007, 820 kW)
Displacement	9.04 L (552 cid)
Cylinder arrangement	V8, 90°
Valve arrangement	DOHC
Valves per cylinder	4
Cylinder numbering	Port bank (1, 3, 5, 7), starboard bank (2, 4, 6, 8)
Rotation	Clockwise facing front
Bore	116 mm (4.57 in.)
Stroke	107 mm (4.2 in.)
Compression ratio	7.8:1
Turbocharger	Water-cooled, boost controlled
Alternator	105 amp/1491 watt
Battery requirements	Group 31 type
Ignition type	PCM 09 distributorless with sequential individual coils
Engine firing order	1-8-7-2-6-5-4-3
Spark plug type	NGK R-7437-9
Spark plug gap	0.6 mm (0.023 in.)
Fuel system	Sequential fuel injection and electric fuel pump
Emission control system	Electronic engine control (EC)

1. Kilowatts/horsepower rating is in compliance with the SAE J1228/ISO 3046 Standard. Usable power will be reduced by gear losses.

Engine Operating Limitations (QC4v)

Maximum wide-open throttle (WOT) RPM	6000–6500 RPM
Rev limit[2.]	6520 RPM
Idle RPM in gear	700 RPM
Idle RPM out of gear	800 RPM
Maximum fuel system flow rate	295–360 gal/kW-hr
Fuel pressure	4 bar, map referenced
Coolant thermostat is fully open at temperature	85 °C (185 °F)
Minimum water pressure supplied to the engine	170 kPa (25 psi) at 6500 RPM
Maximum water pressure supplied to the engine	241 kPa (35 psi) at 6500 RPM
Minimum oil pressure at idle (hot)	1 bar (14.5 psi)
Minimum oil pressure at 6500 RPM (hot)	3 bar (43.5 psi)
Maximum oil temperature at 6500 RPM (hot)	140 °C (284 °F)

Fuel Requirements

Use a major brand of unleaded gasoline, preferably without alcohol. Mercury Marine recommends fuels that contain fuel injector cleaner for added internal cleanliness.

⚠ WARNING

Fuel leakage is a fire or explosion hazard, which can cause serious injury or death. Periodically inspect all fuel system components for leaks, softening, hardening, swelling, or corrosion, particularly after storage. Any sign of leakage or deterioration requires replacement before further engine operation.

NOTICE

The use of improper fuel can cause serious damage to the engine. Damage resulting from the use of improper fuel is considered engine misuse and is not covered under the limited warranty. Use only the recommended fuel in the engine.

OCTANE REQUIREMENTS (U.S./CANADA)

Engine	FUEL TYPE	MINIMUM POSTED OCTANE
1350 QC4v	Unleaded	(R+M) ÷ 2 = 91 or RON = 98*

NOTE: **Research Octane Number*

1350 OCTANE REQUIREMENTS (OUTSIDE THE U.S./CANADA)

Engine	FUEL TYPE	MINIMUM POSTED OCTANE
1350 QC4v	Unleaded[3.]	(R+M) ÷ 2 = 91 or RON = 98*

NOTE: **Research Octane Number*

2. Engines are equipped with an ignition system that has a built-in 6520 RPM rev limiter. Engine is performing normally if it will not exceed this RPM.
3. Mercury Racing does not recommend using leaded gasoline. Leaded gasoline is acceptable in areas where unleaded gasoline is not available; however, lead particles may build up in the exhaust passages and/or the combustion chambers.

USING REFORMULATED (OXYGENATED) FUELS (USA ONLY)

This type of fuel is required in certain areas of the U.S. The two types of oxygenates used in these fuels are alcohol (ethanol) or ether (MTBE or ETBE). If ethanol is the oxygenate that is used in the gasoline in your area, refer to the **Fuel containing alcohol** section.

These reformulated fuels are acceptable for use in your Mercury engine.

FUEL CONTAINING ALCOHOL

If the fuel in your area contains either methanol (methyl alcohol) or ethanol (ethyl alcohol), you should be aware of certain adverse effects that can occur. These adverse effects are more severe with methanol. Increasing the percentage of alcohol in the fuel can also worsen these adverse effects.

Some of these adverse effects are caused because the alcohol in the fuel can absorb moisture from the air, resulting in a separation of the water/alcohol from the gasoline in the fuel tank.

The fuel system components on your Mercury engine will withstand up to 10% alcohol content in the gasoline. We do not know what percentage your boat's fuel system will withstand. Contact your boat manufacturer for specific recommendations on the boat's fuel system components (fuel tanks, fuel lines, and fittings).

Fuel containing alcohol may increase:

- Corrosion of metal parts.
- Deterioration of rubber or plastic parts.
- Fuel permeation through rubber fuel lines.
- Starting and operating difficulties.

IMPORTANT: Operating a Mercury Marine engine with gasoline containing alcohol creates unique problems as a result of long storage periods common to a boat. Cars normally consume alcohol-blend fuels before they absorb enough moisture to cause problems; however, boats often sit idle long enough for phase separation to occur. In addition, alcohol can wash protective oil films from internal components causing corrosion.
IMPORTANT: Because of possible adverse effects of alcohol in gasoline, it is recommended that only alcohol-free fuel be used where possible.

If only fuel containing alcohol is available, or if the presence of alcohol is unknown, increased inspection frequency for leaks and abnormalities is required.

Oil Recommendations

Engine Crankcase Oil

Preferred Oils
Mercury Verado Synthetic Brand 25W-50
Always change the oil and oil filter at the same intervals

Important Oil Practices

Do Not Use
Straight weight oils
Nondetergent oils
Oils containing solid additives
Multiviscosity oils other than the ones recommended
Low quality oils
Do Not Mix
Different brands of oils, straight weight or multiviscosity
Different weights of straight weight or different weights of multiviscosity oils

Capacities

Unit	Capacity	Fluid Type
Crankcase oil capacity with new filter	13.5 Liter (14.3 US qt)	Mercury Verado Brand Synthetic 25W-50
Closed cooling system	Approximately 19 Liter (20 US qt)	Dex-Cool Extended Life Antifreeze/Coolant (50-50 mix)
M8 drive unit capacity	4.73 Liter (5 US qt)	High Performance Gear Lubricant
Transom input shaft bearing housing (driveline model)	0.47 Liter (0.5 US qt)	High Performance Gear Lubricant
Transmission fluid capacity	Approximately 4.5 Liter (4.75 US qt)	Type F[4.] or FA, ATF

Maintenance Charts

Engine and Transmission

Interval	Task
Check prior to every use and every 3 hours of operation	Engine oil (reservoir), power steering and transmission fluid - Check level
	Battery - Check water level, check for loose connections, and inspect for damage
After each use	Flush the raw water cooling system if used in salty, brackish, or mineral-laden water
	Seawater strainer - Check for debris and clean
Every 25 hours or 90 days of operation	Seawater pickups - Check for marine growth or debris
	Engine oil and filter - Change
	Anodes - Inspect and replace if 50% eroded
	Initial valve lash adjustment
Every 50 hours of operation or once a year, whichever occurs first	Perform 25 hour maintenance items
	Inspect condition and tension of all drive belts
	Inspect cooling system hoses and clamps
	Inspect exhaust system condition and tighten clamps
	Inspect electrical system for loose or damaged wires
Every 75 hours of operation	Inspect and adjust valve lash
	Clean high-pressure fuel filter
	Replace water separating filter
	Transmission oil and filter change
Every 100 hours of operation or once yearly, whichever occurs first	Perform 25 and 50 hour maintenance items
	Seawater pickup pump - Disassemble and inspect
	Engine alignment - Check
Every 150 hours of operation	Replace accessory and oil drive belts
Closed cooling system	Replace extended life coolant every four years

4. This is the preferred fluid, use type FA only if type F is not available.

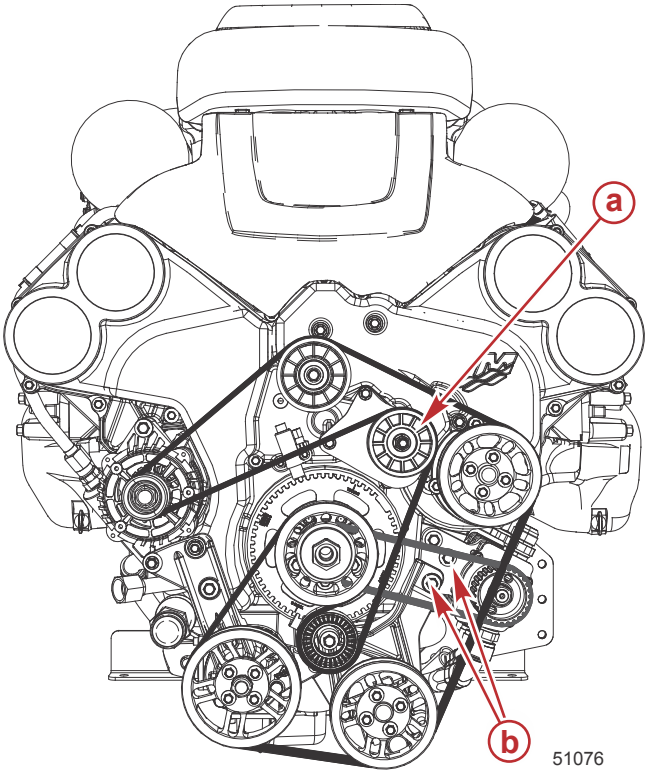
Dry Sump M8 Drive, Transom, Trim, and Steering Systems Maintenance Schedule

Interval	Task
Check prior to use and every 3 hours of operation	Drive, transom, and propeller - Inspect
	Lower gear housing oil - Check level
	Power trim pump oil - Check level and inspect for any water contamination. Replace fluid if necessary.
Weekly	Anodes - Inspect for erosion
Initial break-in at 25 hours	Lower gear housing oil filter and oil - Change the oil and filter
Every 25 hours of operation or every 90 days, whichever occurs first	Tie-bar mounting bracket nuts - Inspect and tighten to specifications as needed
	Propeller shaft - Lubricate
	Propeller nut - Tighten to the specified torque
	Sterndrive - Inspect, clean, and spray with rust preventative
Every 50 hours of operation or once a season, whichever occurs first	Perform 25 hour maintenance items
	Sterndrive unit input splines (internal and external) - Lubricate
	Drive input shaft U-joint crosses - Inspect and lubricate
	Drive mounting nuts - Tighten to 136 Nm (100 lb-ft)
Saltwater use: Every 50 hours or 60 days of operation, whichever occurs first **Freshwater use:** Every 100 hours or 120 days of operation, whichever occurs first	Steering system - Inspect for loose, damaged, or missing parts. Lubricate the steering cylinder pivot points.
Every 100 hours of operation or once a season, whichever occurs first	Perform 25 and 50 hour maintenance items
	Drive unit bellows and clamps - Inspect
	Lower gear housing oil - Change the oil
	Driveline models - Lubricate and inspect the engine to transom driveshaft U-joint crosses and slip joint
	Steering head and remote control - Inspect and lubricate
Every 200 hours of operation or at rebuild	Lower gear housing oil filter and oil - Change the oil and filter
Every 200 hours of operation or once a year, whichever occurs first	Perform 25, 50, and 100 hour maintenance items
	Transom input shaft bearing housing (driveline models only) - Change the oil

Drive Belt Routing

Belt Tightening Specifications	
Serpentine belt sonic tension (cold)	550–600

Belt Tightening Specifications	
Oil pump belt deflection (center)	25 mm (1 in.)



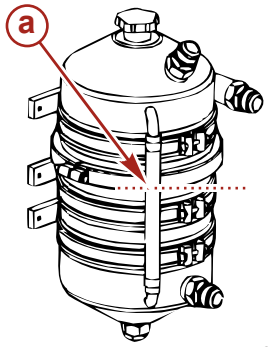
a - Serpentine belt tensioning pulley
b - Oil pump adjustment screws

Checking Fluid Levels

Checking Engine Oil (Reservoir)

Oil consumption is greatly dependant upon engine speed, with consumption being highest at wide-open throttle and decreasing substantially as engine speed is reduced. It is not uncommon for big block high performance engines to use up to one quart of oil in one to five hours if the engine is operated continuously at the upper end of the RPM range.

1. With the engine at normal operating temperature and engine speed at idle, check the oil reservoir sight tube.



a - Oil reservoir sight tube

2. The oil level is correct if the oil in the tube is level with the center of the reservoir split ring.

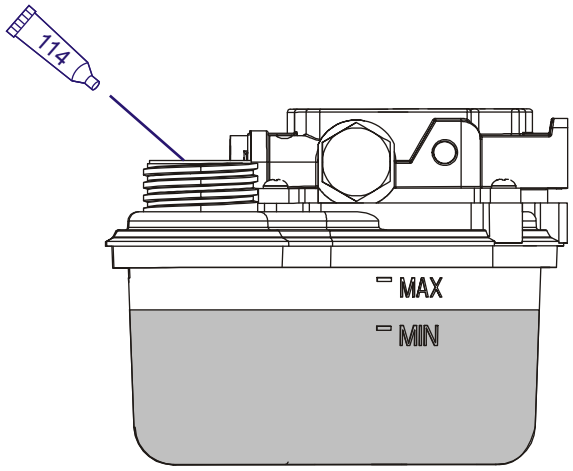
IMPORTANT: Do not overfill engine oil.

NOTE: *If the engine is not operated for a period of time (several days or longer), a certain amount of oil may drain from the reservoir back into the engine. When the engine is started this oil will be pumped back into the reservoir.*

Checking Power Trim Pump Fluid

IMPORTANT: Check oil level with sterndrive unit in the full down/in position.

1. Place the sterndrive unit in the full down/in position.
2. Check the fluid level in the trim pump reservoir. The level should be between the "MIN" and "MAX" level marks on the reservoir.
3. If necessary, remove the fill cap and add fluid until the level in the reservoir reaches the "MIN" level mark. It is acceptable to fill the reservoir beyond the "MIN" level mark, but do not overfill past the "MAX" level mark.



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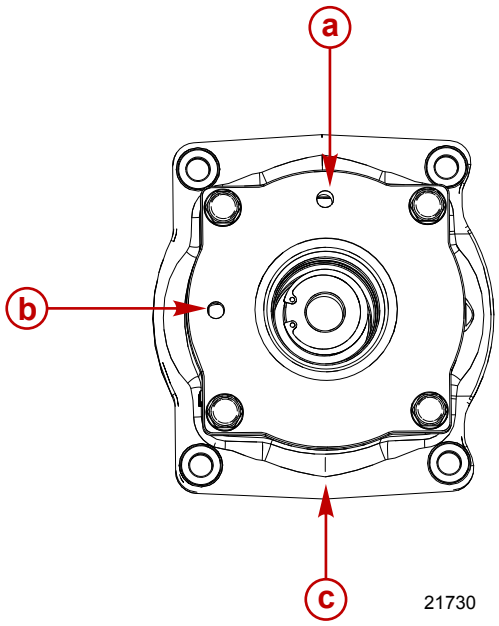
Tube Ref No.	Description	Where Used	Part No.
114	Power Trim and Steering Fluid	Trim pump reservoir	92-858074K01

4. Raise the sterndrive unit two or three times to bleed air out of the system. The fluid level may drop. Add more fluid if necessary, but do not overfill past the "MAX" level mark.
5. Replace the fill cap.

Checking Transom Input Shaft Bearing Housing (Driveline Models Only)

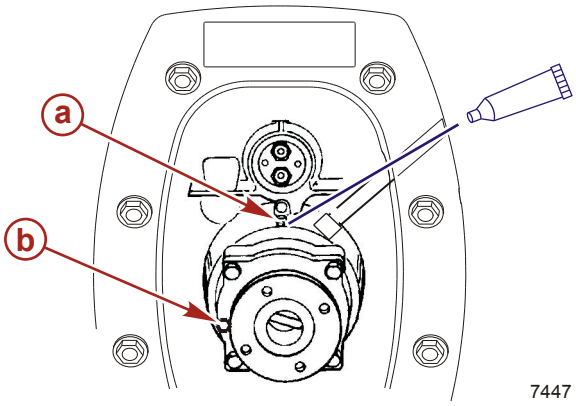
1. Remove the level indication (middle) pipe plug from the input shaft bearing housing. The gear lube level should be to the bottom of the hole. If not, remove the pipe plug from the top of the input shaft housing.

2. Fill the input shaft bearing housing through the top pipe plug hole with fluid until gear lube flows from the middle pipe plug hole (do not overfill).



a - Fill hole
b - Check level here
c - Drain

3. Install the pipe plugs into the input shaft bearing housing and tighten securely.



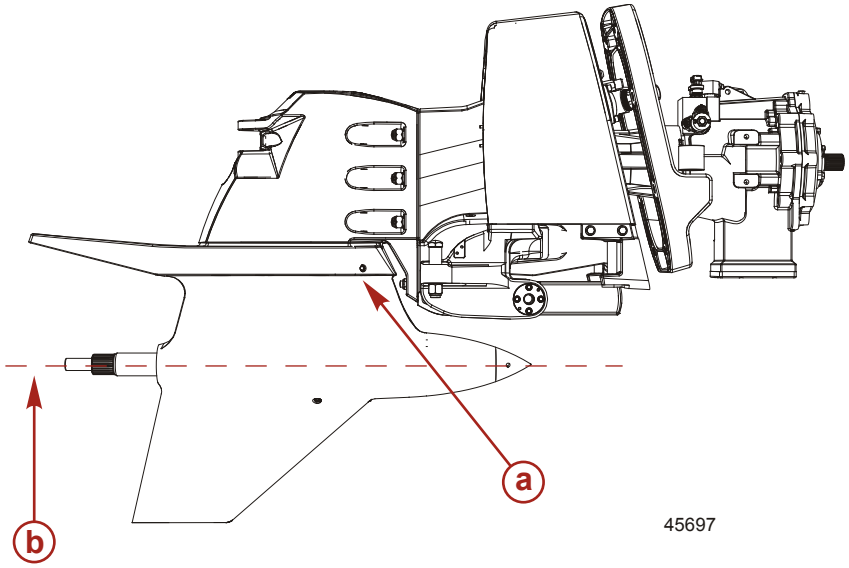
a - Fill pipe plug hole
b - Oil level pipe plug hole

Tube Ref No.	Description	Where Used	Part No.
87	High Performance Gear Lubricant	Transom input shaft bearing housing	92-858064K01

Checking M8 Drive Unit Gear Lube

1. Remove the upper vent plug from the gearcase. The gear lube level should be to the bottom of the vent plug hole with the propeller shaft level.
2. If gear lube level is low, add fluid until gear lube comes out of the vent plug opening.

3. Install the vent plug.



a - Vent plug opening
b - Level propeller shaft

Tube Ref No.	Description	Where Used	Part No.
87	High Performance Gear Lubricant	M8 drive unit	92-858064K01

Checking Transmission Fluid Level

The transmission must be level to check the fluid level in the transmission.

1. Start the engine, and shift the transmission through the forward, reverse, and neutral positions: shut off the engine.
2. Remove the dipstick and check the fluid level against the markings on the measure.
3. Add fluid (Type F[5], ATF) in 200 cc (½ pint) intervals until the level is at, or just below the "FULL" mark, do not overfill.

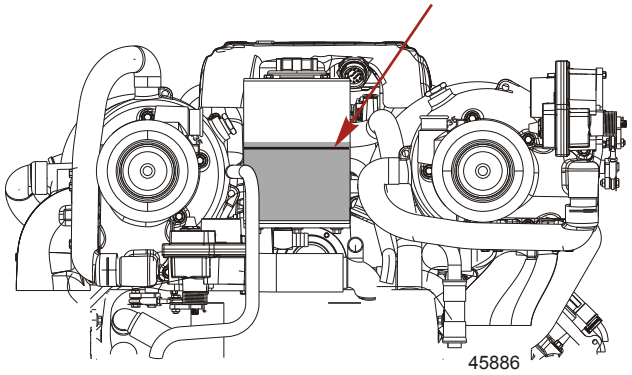
Closed Cooling System

The fluid in the coolant reservoir should be maintained at approximately 6 mm (¼ in.) above the baffle plate.

Use the recommended antifreeze to replenish the reservoir.

5. Use type FA only if type F is not available

Tube Ref No.	Description	Where Used	Part No.
122	Extended Life Antifreeze/ Coolant	Closed cooling system	92-877770K1



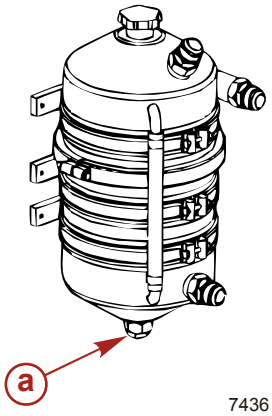
Coolant level is 6 mm (¼ in.) above the baffle plate

Changing Fluids

Changing Crankcase Oil (Reservoir) and Filters

This procedure is the preferred method for servicing the engine oil supply system. If there is limited access to the oil pump, change the fluid in the oil tank and replace the oil filter. The amount of oil needed when not using the oil pump to scavenge the oil from the engine is approximately 9.5 Liters.

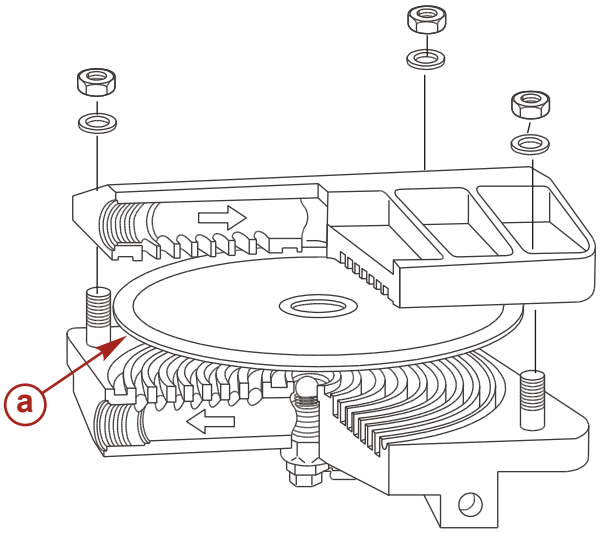
1. Place a sufficiently sized container, 19 Liter (20 US qt) below the oil reservoir.
2. Remove the plug from the reservoir bottom and let the oil drain.



a - Oil drain plug

3. Loosen the oil pump mounting bolts and remove the belt. Using an electric drill, manually turn the oil pump pulley (clockwise) to discharge any remaining engine oil into the reservoir to be drained.
4. To replace the spin-on oil filter: Loosen the filter approximately ¼ turn and wait one minute for the oil to drain into the engine sump, then remove it.
5. Replace it with a new filter. Be sure to lubricate the seal with engine oil before installing it.
6. Remove the cover of the screen-style filter and mark the element so it can be returned to its original orientation with the correct side up. Clean the element with solvent.

IMPORTANT: The screen-style filter element must always be returned to its original orientation (correct side up) to prevent the oil from flowing through it in the wrong direction.



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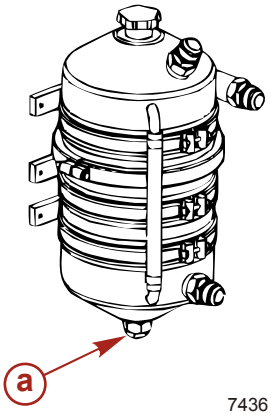
a - Oberg screen-style filter

7. Reassemble the filter assembly, making sure that the screen is installed with the up side in the proper orientation.
   NOTE: *Engine to reservoir oil line lengths affect total oil capacity and will vary with each installation.*
8. Install the bottom oil reservoir plug and tighten securely.



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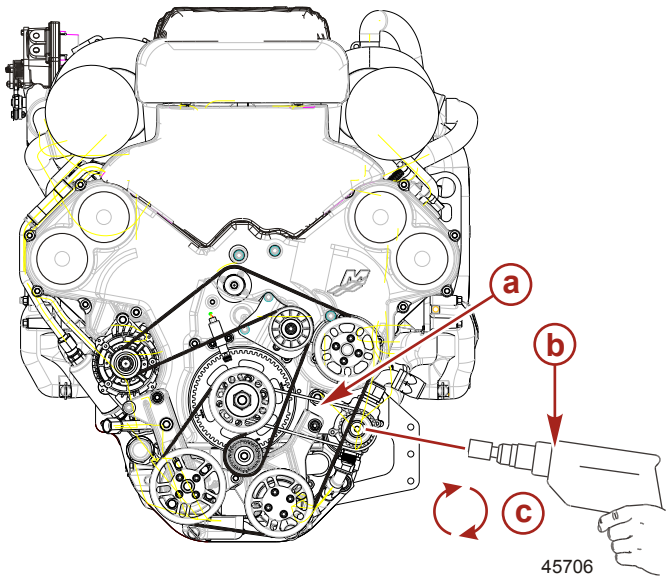
a - Oil drain plug

9. Begin by filling the oil reservoir with 12.8 Liter (13.5 US qt).

10. Using an electric drill motor, manually turn the oil pump pulley (clockwise) to prime the engine oiling system until reaching an oil pressure of 276 kPa (40 psi).



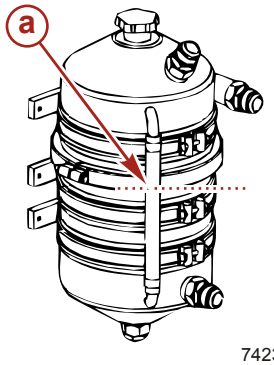
a - Oil pump pulley
b - Electric drill motor
c - Clockwise direction of electric drill motor

11. Add any additional oil to the reservoir to bring the oil level to approximately 25.4 mm (1 in.) below the bottom of the reservoir split ring.
12. Install the oil pump belt and tighten the pump mounting fasteners. Tension the oil pump belt to specifications.

Description	Measurement
Oil pump belt	When the belt can be twisted with two fingers approximately 1/4 turn.

NOTE: *Engine oil level in the reservoir will increase as the engine oil temperature increases.*

13. Start the engine and observe the engine oil level in the reservoir. The oil level should be even with the bottom of the reservoir split ring. Shut off the engine if it is necessary to add oil.



a - Oil reservoir sight tube

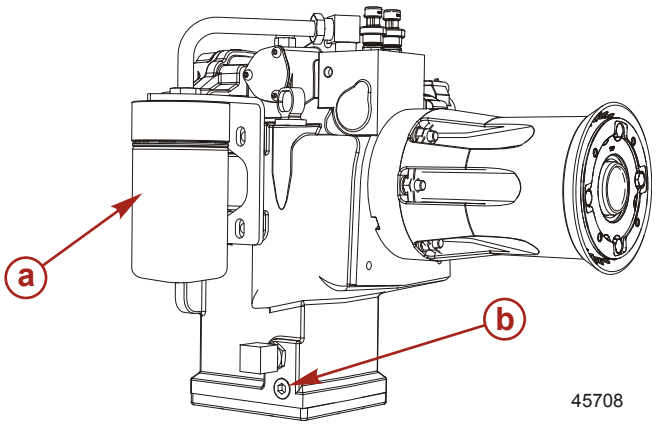
14. Operate the engine at idle and monitor the oil pressure and oil level at the reservoir sight tube.

Cleaning the Fuel Filter

The fuel filter is reusable—clean it with an ultrasonic cleaner, or back flush it with a nonabrasive cleaning solution such as carburetor cleaner.

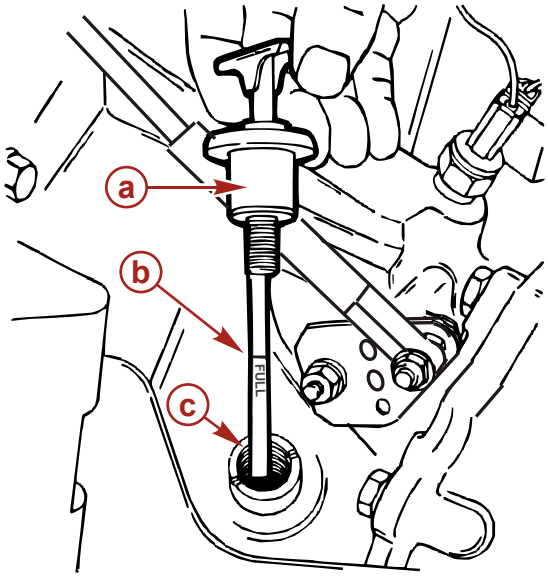
Changing Transmission Fluid

1. Place a suitable container (approximately 3.8 Liter (4 US qt) under the transmission lower fitting.
2. Remove the drain plug and the filter.



a - Filter
b - Drain plug

3. Install the transmission drain plug.
4. Apply clean transmission fluid to the seal on the filter and tighten it one turn beyond the contact point.
5. Fill the transmission through the dipstick tube with three quarts of Type F[6] or FA transmission fluid.
6. Start the engine and let it run for at least two minutes at 1500 RPM, return the engine to idle and shift the transmission from forward to reverse several times.
7. Stop the engine and check the transmission oil level with the dipstick. If additional oil is required, add it in 200 cc (½ pint) increments through the dipstick tube to bring the level up to the "FULL" mark.



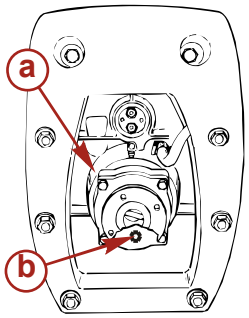
a - Dipstick
b - "FULL" mark
c - Dipstick tube

6. Use type FA only if type F is not available

Changing Drive Unit Oil (Dry Sump)

Transom Bearing Support—Driveline Models Only

1. Place a container below the input shaft housing and remove the bottom pipe plug.



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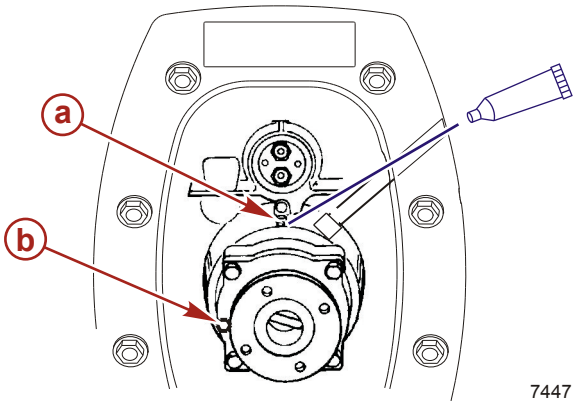
a - Input shaft housing
b - Oil drain pipe plug

IMPORTANT: Do not overfill the input shaft housing reservoir or damage to the transom components could occur.

2. Fill the input shaft housing with fluid through the top pipe plug hole "a" until oil flows from oil level pipe plug hole "b." Install the pipe plugs "a" and "b" into the input shaft housing and tighten securely.



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a - Fill pipe plug hole (fill through here)
b - Oil level pipe plug hole

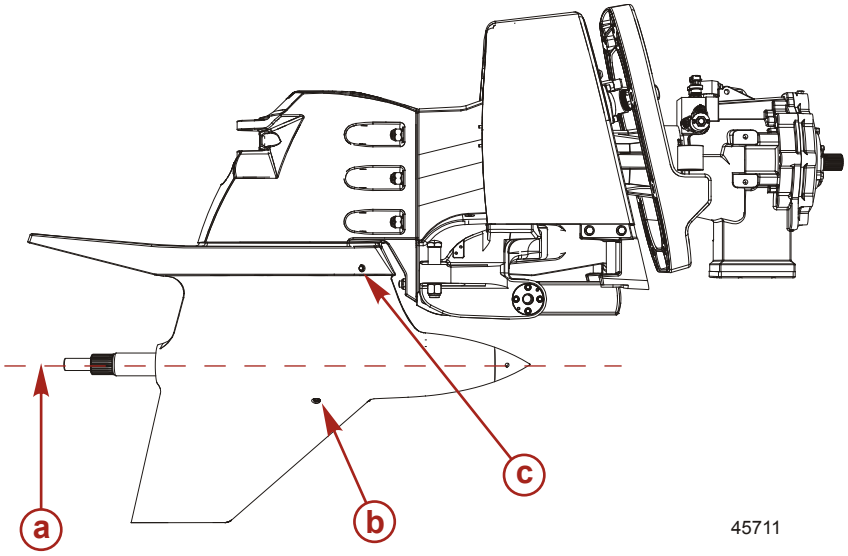
Tube Ref No.	Description	Where Used	Part No.
87	High Performance Gear Lubricant	Input shaft housing	92-858064K01

Drive Fluid Only—All Models

NOTE: *Refer to the M8 service manual if the filter must be replaced.*

1. Place the drive unit in a position so that the propeller shaft is level.

2. Remove the upper oil level plug and sealing washer from the gearcase.



a - Level propeller shaft centerline
b - Fill/drain plug and sealing washer
c - Oil level plug

IMPORTANT: If water drains from the gearcase, or if gear lube appears milky; the drive unit is leaking. Have the unit checked immediately by your authorized Mercury Marine dealer.

3. Remove the lower fill/drain plug and sealing washer from the gearcase and allow the oil to drain into a suitable container.
4. Fill the drive unit with fluid through the lower fill/drain hole until oil comes out of the top oil level plug opening.
5. Install the upper oil level plug and sealing washer.
6. Remove filler tube and quickly install the lower fill/drain plug and sealing washer.

Tube Ref No.	Description	Where Used	Part No.
87	High Performance Gear Lubricant	Gearcase	92-858064K01

Flushing the Raw Water Cooling System

⚠ WARNING

Rotating propellers can cause serious injury or death. Never operate the boat out of the water with a propeller installed. Before installing or removing a propeller, place the drive unit in neutral and engage the lanyard stop switch to prevent the engine from starting. Place a block of wood between the propeller blade and the anti-ventilation plate.

NOTICE

Operating the engine out of the water at high speeds creates suction, which can collapse the water supply hose and overheat the engine. Do not operate the engine above 1400 RPM out of the water and without sufficient cooling water supply.

To reduce corrosion and prevent silt and salt buildup in the cooling system, flush with fresh water.

1. Install a flushing hose from a water tap to the flushing connector. Consult your boat owner's manual for the location of the flushing connector.
2. Completely open the water tap. Place the remote control in neutral position and start the engine. Operate the engine at idle speed, in neutral, for about 10 minutes or until discharge water is clear. Stop the engine, shut off the water, and remove the flushing hose.

Cooling System Preparation for Cold Weather Storage

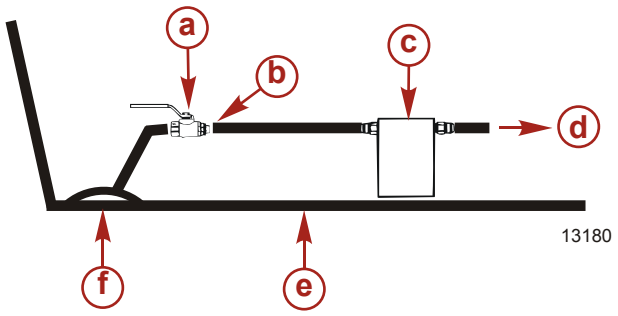
NOTICE

Water trapped in the seawater section of the cooling system can cause corrosion or freeze damage. Drain the seawater section of the cooling system immediately after operation or before any length of storage in freezing temperatures. If the boat is in the water, keep the seacock closed until restarting the engine to prevent water from flowing back into the cooling system. If the boat is not fitted with a seacock, leave the water inlet hose disconnected and plugged.

Using Antifreeze

NOTE: *A nontoxic and environmentally safe propylene glycol antifreeze containing a rust inhibitor must be used when preparing the seawater portion of the cooling system for cold weather or extended storage. Be certain to follow the manufacturer's recommendations.*

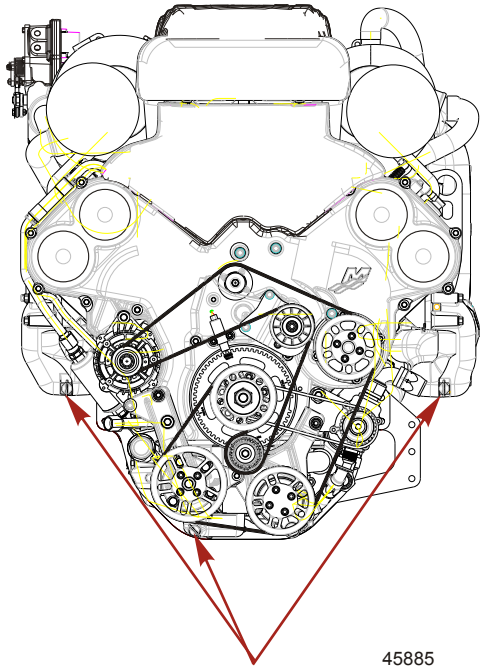
1. Place premixed propylene glycol antifreeze into an appropriate container that will allow the seawater inlet hose to be placed into the container.
2. If the boat is in the water, close the seawater inlet valve.
3. Remove the drain plugs from the exhaust manifold and the seawater pump—allow the water to drain from the engine.
4. Install the drain plugs.
5. Loosen the hose clamp and remove the seawater inlet hose from the downstream side of the valve.
6. Place the hose into the container of premixed antifreeze. The antifreeze mixture should be at the correct concentration level to protect the engine to the lowest temperature to which it will be exposed during cold weather or extended storage.



- **a -** Seawater inlet valve
- **b -** Disconnect the hose at the valve and place into container of antifreeze
- **c -** Sea strainer
- **d -** To the seawater pump
- **e -** Boat hull
- **f -** Seawater pickup

7. Operate the engine at idle until antifreeze is expelled from the exhaust manifolds of the engine.
8. Stop the engine and reconnect the seawater hose.

9. Remove the drain plugs and drain the coolant from the seawater section of the engine.



Three drain plugs for the raw water section

10. Install the drain plugs.
11. If the boat is in the water, do not open the seawater inlet valve until the power package is ready for recommissioning.

Power Package Recommissioning

IMPORTANT: Do not install the battery until all engine maintenance is completed.

1. Ensure that all cooling system hoses are connected properly, the hose clamps are tight, and all of the drain plugs are installed and tight.

⚠ CAUTION

Disconnecting or connecting the battery cables in the incorrect order can cause injury from electrical shock or can damage the electrical system. Always disconnect the negative (-) battery cable first and connect it last.

2. Install a fully-charged battery. Clean the battery cable clamps and terminals and reconnect the cables. Tighten each cable clamp securely when connecting.
3. Coat battery terminal connections with an anti-corrosion agent.
4. Refer to **Flushing the Raw Water Cooling System** before starting the engine.
5. Supply water to the engine cooling system.

Engine Starting Procedure

IMPORTANT: The throttle should not be advanced until the engine idles and runs smoothly and the water temperature reaches a minimum of 54 °C (130 °F). Advancing the throttle prematurely while the PCM is in its rich running mode will result in poor engine starting and performance.

1. Connect the main permanent fuel line to the engine.
2. Start the engine.
3. Repeat the cranking procedure until the engine starts and runs smoothly. Observe the instrumentation to ensure all systems are functioning.
4. Do not advance the throttle until the engine idles and runs smoothly and the water temperature reaches a minimum of 54 °C (130 °F).
5. Inspect engine for fuel, oil, fluid, water, and exhaust leaks.

6. Check the steering system.
7. Check shifting and throttle control for proper operation.

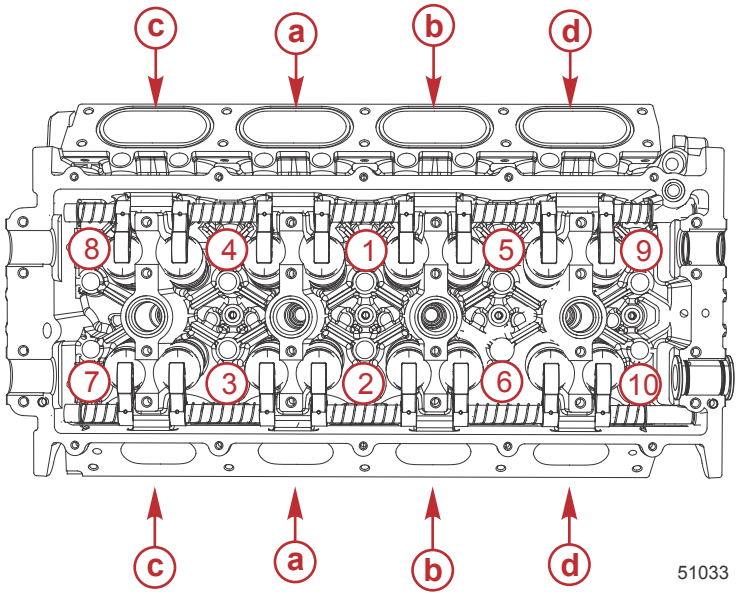
Fastener Tightening Specifications, Sealers, and Lubricants

If a component requires two different tightening sequences (two different size fasteners), follow the numerical sequence first, followed by the alphabetical sequence. Always use the specified lubricant, on the fasteners, to achieve the specified clamping force.

Cylinder Head

Description		Nm	lb-in.	lb-ft
Numerical sequence	**First**	40	–	30
	Second	80	–	59
	Third	150	–	111
	Fourth	200	–	148
	Final	250	–	184

Description		Nm	lb-in.	lb-ft
Alphabetical sequence	**First**	25	–	18
	Final	55	–	41



Cylinder head tightening sequence

Tube Ref No.	Description	Where Used	Part No.
	8M0061729—ARP Ultra-Torque™	Threads of the studs, and contact surfaces of the washers and nuts	Obtain Locally

Crankshaft and Connecting Rod Fasteners

Description		Nm	lb-in.	lb-ft
Main caps	**First**	60	–	44
	Final	120	–	89

Description		Nm	lb-in.	lb-ft
Connecting rod screws	**First**	40	–	30
	Final	+ 55°		

Tube Ref No.	Description	Where Used	Part No.
	8M0061729—ARP Ultra-Torque™	Threads of the studs and screws, and contact surfaces of the washers, screws, and nuts	Obtain Locally

Torsional Damper, Timing Wheel, and Pulley

Description		Nm	lb-in.	lb-ft
Torsional damper	**First**	325	–	240
	Final	+ 90°		

Description		Nm	lb-in.	lb-ft
Timing wheel	**First**	30	–	22
	Final	66	–	49

Description	Nm	lb-in.	lb-ft
Crankshaft pulley Allen-head screw	220	–	162

Tube Ref No.	Description	Where Used	Part No.
	8M0061729—ARP Ultra-Torque™	Threads of the studs, nuts, screw, and contact surfaces of the washers, and nuts	Obtain Locally

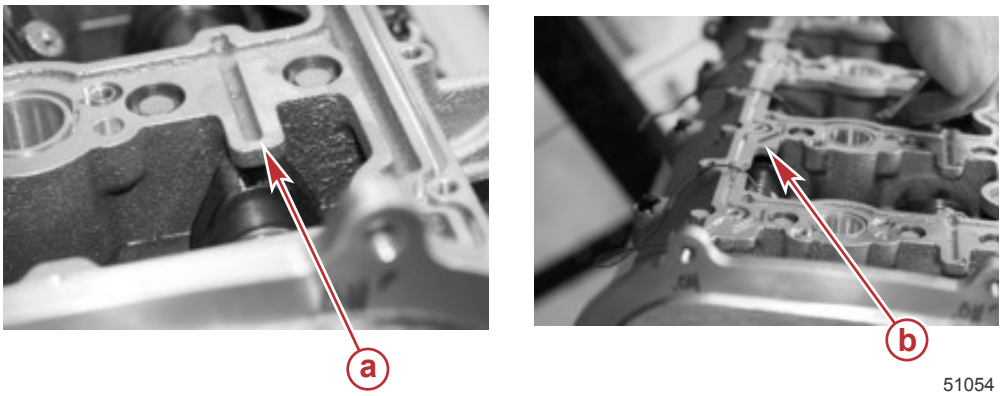
Components

Description		Nm	lb-in.	lb-ft
Bell housing	**First**	20	177	15
	Final	40	–	30
Timing chain cover	**First**	15	133	–
	Final	30	–	22
Seawater pump	**8 mm**	30	–	22
	10 mm	40	–	30
Intake manifold	**First**	15	133	–
	Final	30	–	22
Coolant pump		30	–	22
Throttle housing		10	89	–
Fuel rails		10	89	–

Description		Nm	lb-in.	lb-ft
Alternator	**Upper**	40	–	30
	Lower	30	–	22
Fuel pump		20	177	–
Oil pump		40	–	30
Starter		55	–	41
Spark plug		27	–	20
Camshaft cover		10	89	–
Power steering pump		40	–	30
Transmission mounting screws		48	–	35
Ignition coils		10	89	–
Pulleys with 8 mm screws		30	–	22
Idler pulleys		40	–	30
Exhaust logs		30	–	22
Turbocharger mounting screws		30	–	22

Checking Valve Clearances and Adjusting Valve Lash

1. Disconnect and remove the coil packs, and completely loosen, but do not remove the spark plugs. Leaving the plugs in place prevents the shims from falling into the combustion chamber.
2. Align the camshaft lobe with the spray bars as required for each intake or exhaust valve measurement.



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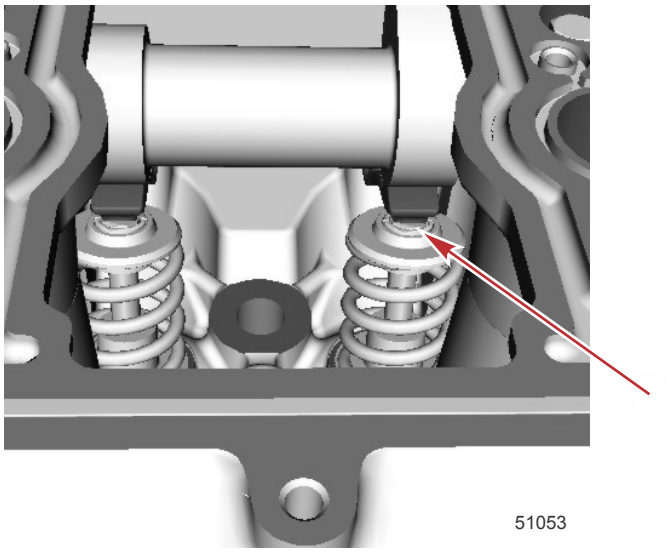
a - Intake spray bar
b - Exhaust spray bar

3. Measure the clearance between the follower and the valve shim with an angled feeler gauge.



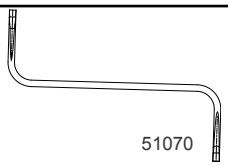
Valve Lash Specification	
Intake valve	0.460–0.560 mm (0.018–0.022 in.)
Exhaust valve	0.640–0.740 mm (0.025–0.029 in.)

Inspection

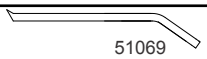
1. Inspect all tool contact surfaces for sharp edges or burrs before using any tools that contact the camshaft follower. Remove any imperfections before using the tool.
2. Inspect the shims for chips, burrs, or scratches before installing them. Discard any defective shims.
3. Always use a lint-free cloth to clean any surfaces, tools, or shims that come in contact with components used underneath the camshaft cover. There are small passages that are easily blocked by dirt or foreign material.
4. Do not rely on the printed thickness of the shim. You must verify the clearance after installing a new shim.

Removing and Installing Shims

1. Install the plugs into the five oil drain holes in each head to prevent a shim from falling into the crankcase.
2. Block the oil drain passage at the front of each head to prevent a shim from falling into the opening.
3. Use the follower tool to move the follower away from the valve stem. Place the tool as close to the pivot point as possible to avoid damaging the face of the follower.

Follower tool	8M0064657
	Adjusting valve lash.

4. Use the magnet to remove the shim. Measure the thickness of the shim to decide which size shim is needed.

Magnet pick	8M0064644
	Adjusting valve lash.

5. Apply a small dab of high-pressure grease to the pick (opposite end of magnet) and place the shim on the pick so that the number is facing up or away from the valve stem when installed.
6. Use the camshaft follower tool and your fingers to slide the camshaft follower into position while avoiding contact with the side of the camshaft and scratching the face of the camshaft follower.
7. Repeat the valve clearance measuring procedure to ensure it is within the clearance specification.

8. Install the camshaft cover and tighten the fasteners to the specified torque.

Description		Nm	lb-in.	lb-ft
Camshaft cover	**First**	15	133	–
	Final	30	–	22