FUEL SYSTEM

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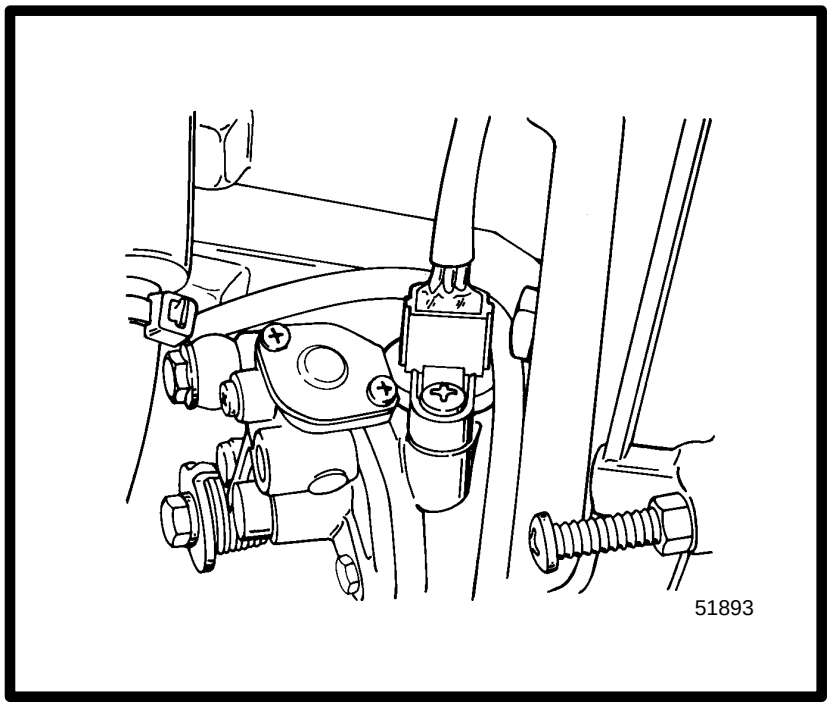


OIL INJECTION

Table of Contents

⚠ CAUTION

Be careful not to get dirt or other contamination in tanks, hoses or other components of the oil injection system during installation.

⚠ CAUTION

Engines with oil injection must be run on a fuel mixture of 50:1 for the first 30 gallons of fuel. Refer to engine break-in procedure in the Operation and Maintenance Manual.

⚠ CAUTION

If an electric fuel pump is to be used on engines with oil injection, the fuel pressure at the engine must not exceed 6 psig. If necessary, install a pressure regulator between electrical fuel pump and engine and set at 6 psig maximum.

Operation of the Oil Injection System

The oil injection system delivers oil mixture on engine demand, from 100 to 1 at idle to 50 to 1 at wide open throttle.

The remote oil tank can be removed from the boat for easy refilling. The remote tank holds enough oil for over 150 gallons of fuel at wide open throttle.

The remote oil tank supplies the oil reservoir mounted on the engine. The oil reservoir feeds the oil pump and contains enough oil for at least 30 minutes of full throttle running after the remote tank is empty. The warning horn will sound if the oil level in oil reservoir is low.

The oil injection pump feeds oil into the fuel just before the fuel pump. The oil injection pump is driven by the crankshaft and is connected to the throttle linkage for metering the varied flow of oil per engine RPM. The motion sensor will sound the warning horn if the drive system for the injection pump becomes inoperative.

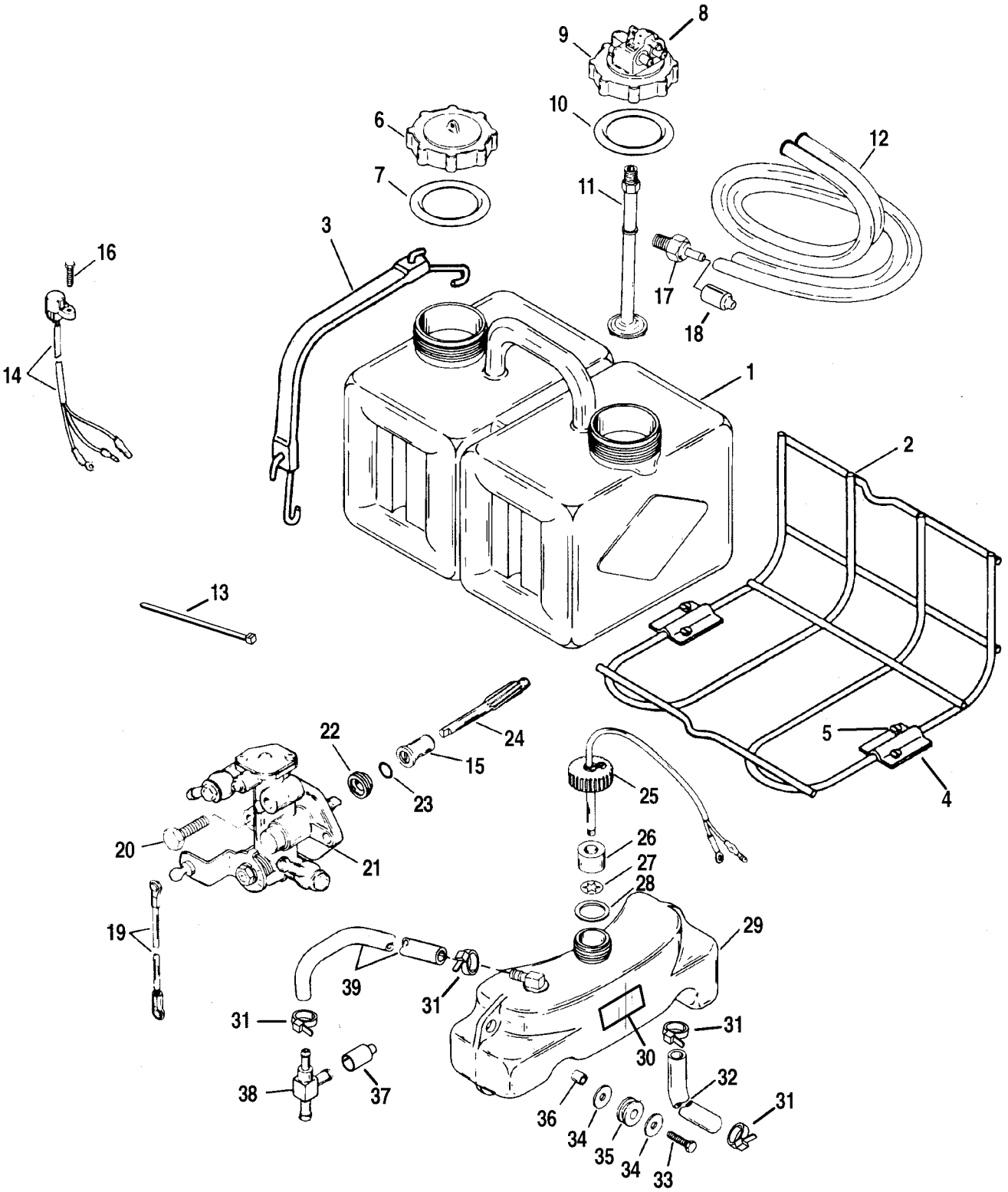
FINAL CHECKS BEFORE OPERATION OF ENGINE

- Make sure fill cap gaskets are in place and caps are tight on engine oil reservoir and remote oil tank.
- Mix a gasoline and oil mixture of 50:1 in the remote fuel tank during the initial break-in of the engine.
- Be certain the warning horn is installed and is operational. Refer to Instrument and Warning Horn Installation.
- Each time the key switch is turned from the “off” to “on” position (engine not running); the warning horn will sound momentarily. This tells you the warning system for the oil injection system is functional and the warning horn is operational. If warning horn does not sound or horn stays on when key is turned to the “ON” position, refer to oil injection system troubleshooting chart following to correct the problem.

CHECKING OPERATION OF THE OIL INJECTION SYSTEM (ENGINE RUNNING)

1. Operate engine following the break-in procedure outlined in the Operation and Maintenance Manual. If warning horn should sound an intermittent “beep,” “beep,” “beep” during operation, this indicates a problem occurred in the oil injection system. Refer to troubleshooting following, to correct the problem.
2. After engine has been run for a short time, check that no oil is leaking out of engine oil reservoir fill cap.

OIL INJECTION COMPONENTS



OIL INJECTION COMPONENTS

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	TANK-Oil			
2	1	BRACKET KIT-Oil Tank Hold Down			
3	1	CORD/HOOK KIT			
4	3	BRACKET-Hold Down			
5	6	SCREW (#12-11 x .750)			
6	1	CAP ASSEMBLY-Oil Tank			
7	1	O RING-Cap			
8	1	HOUSING ASSEMBLY-Adaptor			
9	1	CAP ASSEMBLY-Housing Adaptor			
10	1	O RING			
11	1	TUBE-Oil Pick Up			
12	1	HOSE-Oil Line			
13	5	CABLE TIE (8.00 in.)			
14	1	SENSOR ASSEMBLY			
15	1	BEARING ASSEMBLY-Drive Gear			
16	1	SCREW (#10-16 x .600)-Sensor Attaching			
17	1	CHECK VALVE (CRANKCASE)			
18	1	PLUG			
19	1	LINK-Throttle Lever To Oil Pump			
20	1	SCREW **(#10-32 x .625)**			
20	1	SCREW **(#10-32 x 1.125)**			
21	1	PUMP ASSEMBLY-Oil			
22	1	BUSHING-Worm			
23	1	O RING			
24	1	GEAR-Driven			
25	1	CAP ASSEMBLY-Oil Reservoir			
26	1	FLOAT ASSEMBLY			
27	1	PUSHNUT			
28	1	GASKET-Reservoir Cap			
29	1	RESERVOIR-Oil			
30	1	DECAL-Reservoir Warning			
31	4	CABLE TIE (8.00 in.)			
32	1	TUBING (15.500 in. Bulk) (Cut 4.750 in.)			
33	3	SCREW (#10-32 x .875)			
34	6	WASHER-Oil Reservoir Screw			
35	3	GROMMET-Oil Reservoir Screw			
36	3	BUSHING-Oil Reservoir Screw			
37	1	PLUG			
38	1	FITTING-Oil Tubing			
39	1	TUBING (57.00 in. Bulk) (Cut 5.250 in.)			

Oil Injection Components

① REMOTE OIL TANK

Holds 3 gallons of oil.

The tank is pressurized by air from crankcase pressure thus forcing oil up the outlet hose to the oil reservoir on engine.

② OIL PICK UP TUBE

A filter screen is located in end of tube to prevent dirt or other particles from entering the system.

③ OIL RESERVOIR

The oil reservoir feeds the oil pump and contains enough oil for at least 30 minutes of full throttle running after the remote tank is empty. The warning horn will sound if the oil level in oil reservoir is low.

④ OIL INJECTION PUMP

Injection pump is driven off the crankshaft.

The oil injection pump is a variable metering pump. At idle the pump will meter the oil at approximately 100 to 1 gasoline to oil ratio and at WOT, 50 to 1 ratio.

⑤ 2 PSI CHECK VALVE

If oil flow to reservoir is obstructed and injection pump continues to pump oil, the 2 PSI valve will open to allow air to enter reservoir to prevent a vacuum.

⑥ 2 PSI CHECK VALVE

This valve prevents gasoline from being forced into the oil lines.

⑦ LOW OIL (FLOAT) SENSOR

If oil level drops in oil reservoir, the sensor will signal the warning module to sound the warning horn.

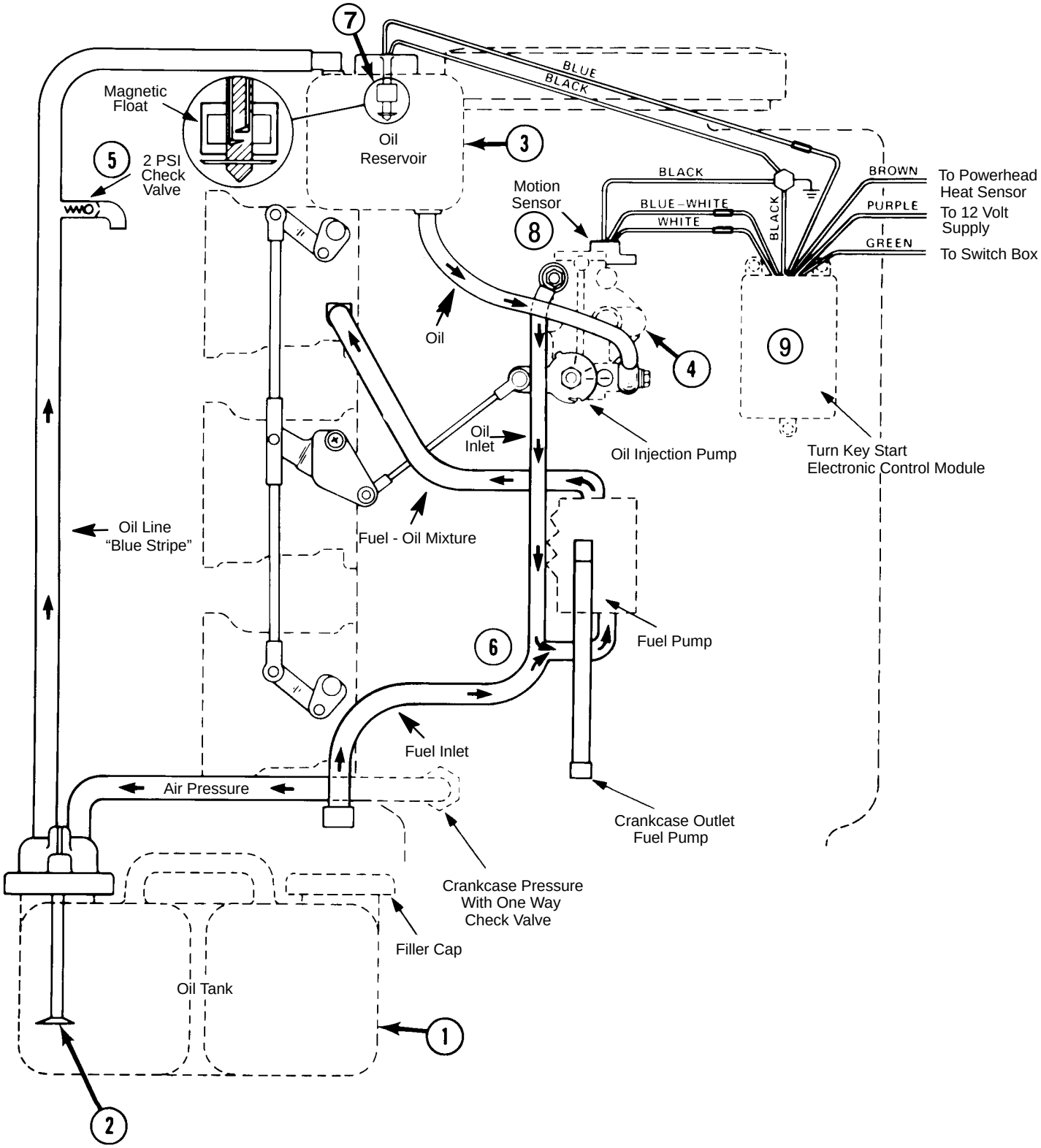
⑧ MOTION SENSOR

Senses the rotation of the oil injection pump drive system. If the drive system for the injection pump becomes inoperative, the sensor will signal the warning module to sound the warning horn.

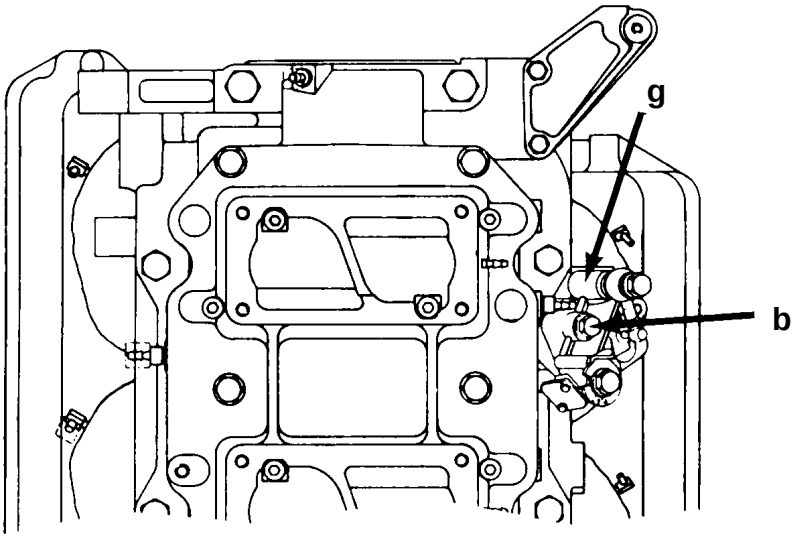
⑨ TKS ECM

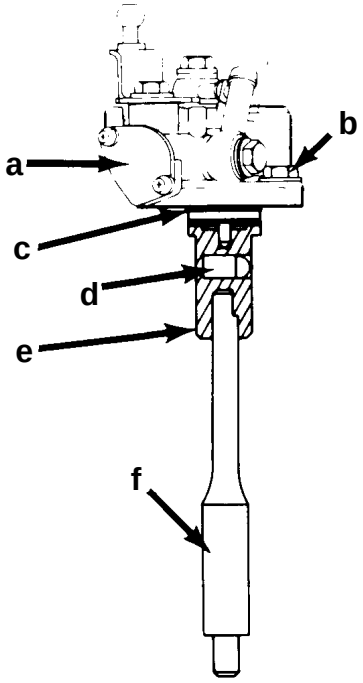
- Sounds the warning horn briefly when key switch is turned on, to indicate that the system is operational.
- While engine is running, the module continuously monitors the rotation of the drive system for the oil injection pump by picking up pulses from the motion sensor. If drive system becomes inoperative, the module will sound the warning horn.
- If oil level drops in the engine oil reservoir, the low oil (float) sensor will signal the module to sound the warning horn.

Oil Injection Flow System



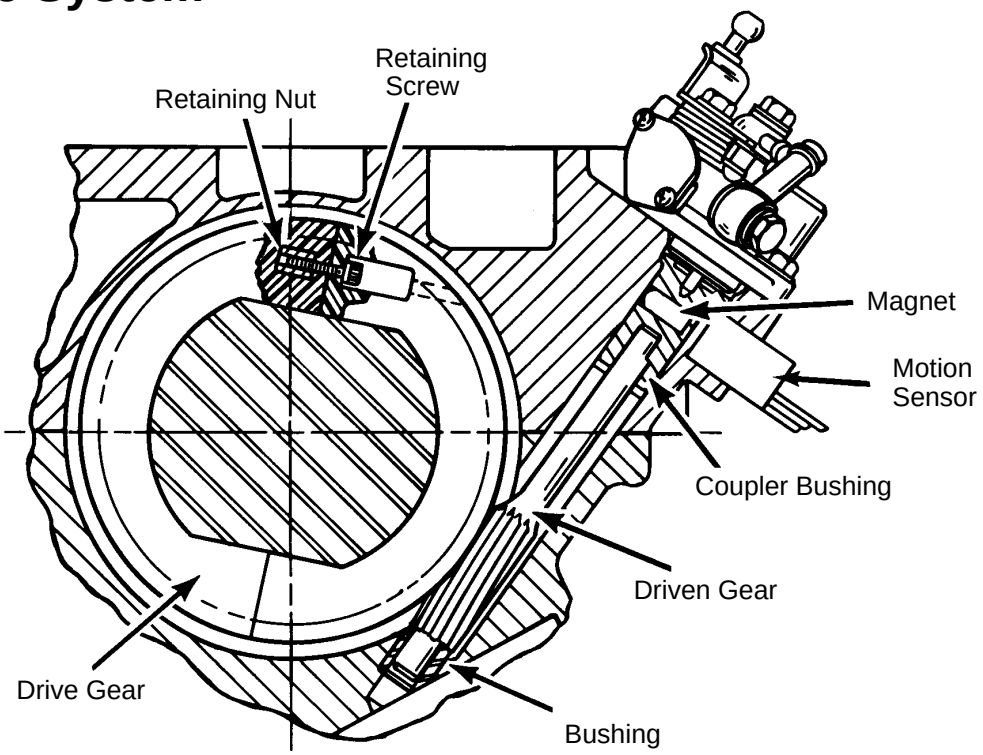
Pump Drive Assembly





a - Oil Pump
b - Retaining Bolts (2)
c - O-ring
d - Magnet
e - Coupler
f - Driven Gear
g - Oil Pump (Installed)

Pump Drive System



Set Up Instructions for Oil Injection System

⚠ CAUTION

Be careful not to get dirt or other contamination in tanks, hoses or other components of the oil injection system during installation.

⚠ CAUTION

Oil injected engines additionally, must be run on a 50:1 gasoline/oil mixture in the fuel tank for the first 30 gallons of fuel. Refer to engine break-in procedures in the Operation & Maintenance Manual.

⚠ CAUTION

If an electric fuel pump is to be used on engines with oil injection, the fuel pressure at the engine must not exceed 6 psig. If necessary, install a pressure regulator between electrical fuel pump and engine and set at 6 psig maximum.

INSTALLING REMOTE OIL TANK

1. The remote oil tank should be installed in an area in the boat where there is access for refilling.

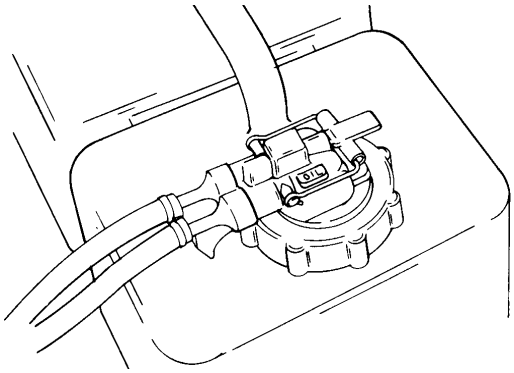
The tank should be restrained to keep it from moving around, causing possible damage.

An acceptable means of restraining the tank would be the use of eye bolts and an elastic retaining strap about the mid-section of the tank taking care that any metal hooks do not puncture the tank.

Keep in mind, when installing in tight areas, that this tank will be under pressure when the engine is operating and will expand slightly.

2. Oil hoses when routed thru engine well, must be able to extend to the hose fittings on engine.
3. Oil hoses must be arranged so they cannot become pinched, kinked, sharply bent or stretched during operation of the engine.

NOTE: *An oil hose extension kit (41729A3) is available for the remote oil tank.*



22750

Quick Disconnect Type Hose Connection

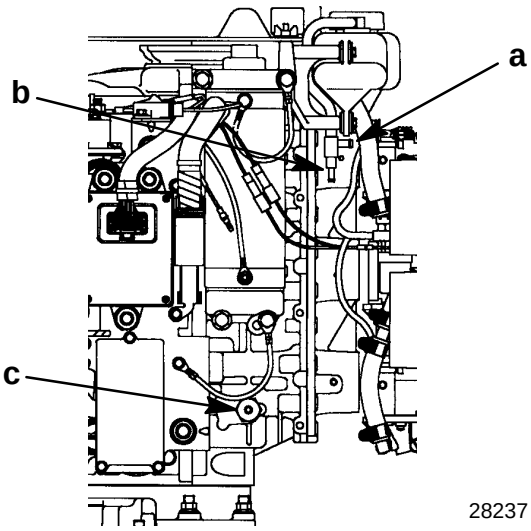
INSTALLING OIL HOSES TO ENGINE

Route remote oil tank hoses to starboard side of engine.

4. Remove (and discard) the shipping cap from hose fitting (a).
5. Connect oil hose from remote oil tank (hose with blue stripe) to fitting (a). Secure with sta-strap.

NOTE: *Fitting barb (b) is a vent and does not get connected to a hose.*

6. Remove (and discard) shipping cap from pulse fitting (c).
7. Connect the second oil hose from remote oil tank to pulse fitting. Secure with sta-strap.



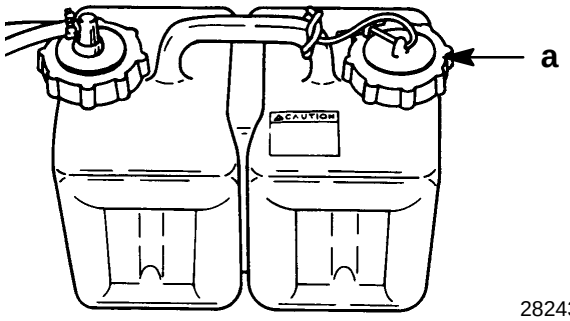
28237

a - Hose Fitting
b - Vent
c - Pulse Fitting

FILLING THE OIL INJECTION SYSTEM

Quicksilver 2-Cycle Outboard Oil is recommended for this oil injection system. In emergency, when Quicksilver oil is not available, substitute a high quality 2cycle oil that is intended for outboard use and meets BIA rating TC-W3, shown on oil container. BIA rating TC-W3 is the Boating Industry Association's designation for approved, 2-cycle water-cooled outboard oils.

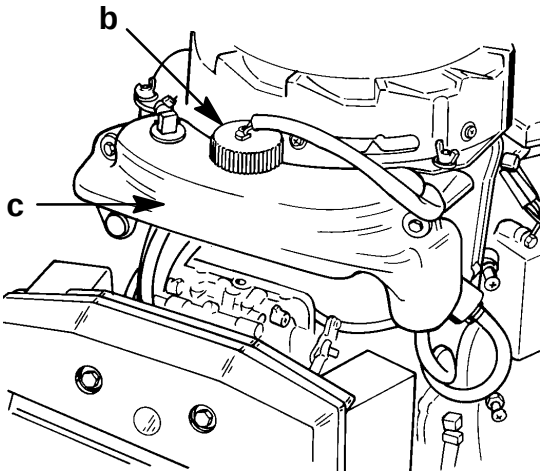
1. Fill remote oil tank with Quicksilver TCW-3 2-Cycle Oil. Tighten fill cap (a).



28243

a - Fill Cap

2. Remove fill cap (b) from the engine oil tank (c) and fill the tank with oil. Reinstall the fill cap.



50047

b - Fill Cap
c - Engine Mounted Oil Reservoir

3. Loosen the fill cap (b) on the engine mounted oil tank. Run the engine until the all the air has been vented out of the tank and oil starts to flow out of the tank. Re-tighten fill cap.

⚠ CAUTION

Be certain that the fill caps on the engine oil tank and remote oil tank are installed tight. An air leak, at one of the caps on the remote oil tank, will prevent oil flow to the engine oil tank. A loose fill cap on the engine oil tank will cause oil leakage.

Bleeding Air from Oil Injection Pump and Oil Injection Outlet Hose

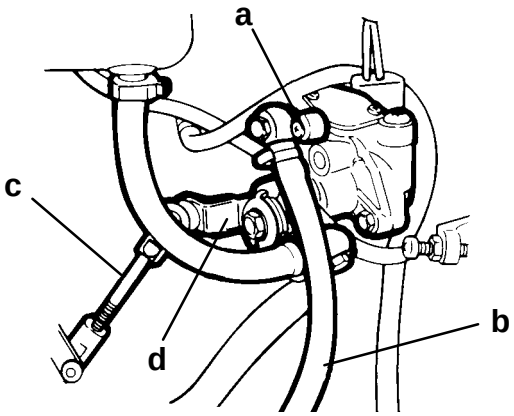
BLEEDING AIR FROM OIL INJECTION PUMP

With engine not running, place a shop towel below the oil injection pump. Loosen bleed screw (a) three to four turns and allow oil to flow from bleed hole. Re-tighten bleed screw. This procedure allows the pump to fill with oil.

BLEEDING AIR FROM OIL INJECTION PUMP OUTLET HOSE

Any air bubbles in outlet hose in most cases will be purged out of the system during operation of the engine.

NOTE: *If air bubbles persist, they can be purged out of the hose by removing link rod and rotating the pump arm full clockwise while operating engine at 1000 to 1500 RPM: If necessary, gently pinch the fuel line between the fuel tank and the fuel pump "Tee" fitting. This will cause the fuel pump to provide a partial vacuum which will aid in removal of the air. Reinstall link rod.*

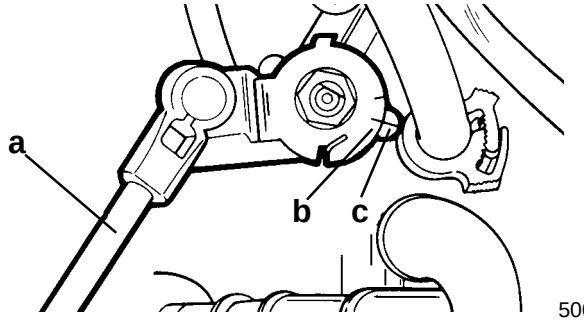


50047

a - Bleed Screw
b - Outlet Hose
c - Link Rod
d - Pump Arm

Adjusting Oil Injection Pump

When throttle linkage is at idle position, alignment mark on oil injection arm should be in-line with mark on casting as shown. If necessary, adjust link rod.



50060

a - Link Rod
b - Alignment Mark
c - Casting Mark

OPERATION OF THE OIL INJECTION SYSTEM

1. Make sure fill cap gaskets or O-rings are in place and caps are tight on engine reservoir tank and remote oil tank.
2. Make sure a remote gasoline and oil mixture of 50:1 is used during the initial break-in of the engine or after extended storage.
3. Be certain the warning horn is operational.

Each time the key switch is turned from the “off” to “on” position (engine not running); the warning horn will sound momentarily. This tells you the warning system for the oil injection system is functional and the warning horn is operational. If warning horn does not sound or horn stays on when key is turned to the “ON” position, refer to oil in injection system troubleshooting chart following to correct the problem.

The oil injection warning sound is an intermittent “beep”, “beep”, “beep”, etc. The overheat warning sound is a continuous “beep” (not intermittent).

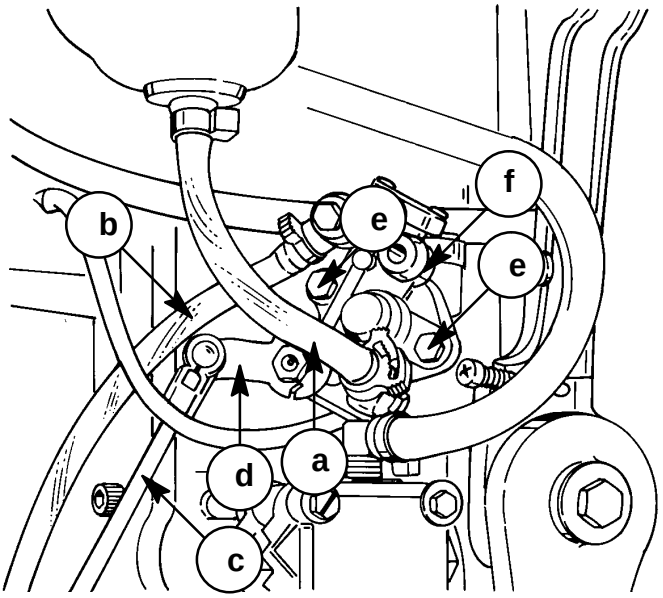
CHECK OPERATION OF THE OIL INJECTION SYSTEM (ENGINE RUNNING)

1. Operate engine following the break-in procedure outlined in the Operation and Maintenance Manual. If warning horn should sound an intermittent “beep”, “beep”, “beep” during operation, this indicates a problem occurred in the oil injection system. Refer to troubleshooting following, to correct the problem.
2. After engine has been run for a short time check that no oil is leaking out of engine mounted oil reservoir fill cap.

Oil Injection Pump

Oil Pump Removal

1. Disconnect and plug inlet hose to oil pump.
2. Disconnect outlet hose on oil pump.
3. Disconnect link arm from oil pump injection arm.
4. Remove two bolts securing oil pump to powerhead and remove pump.



51892

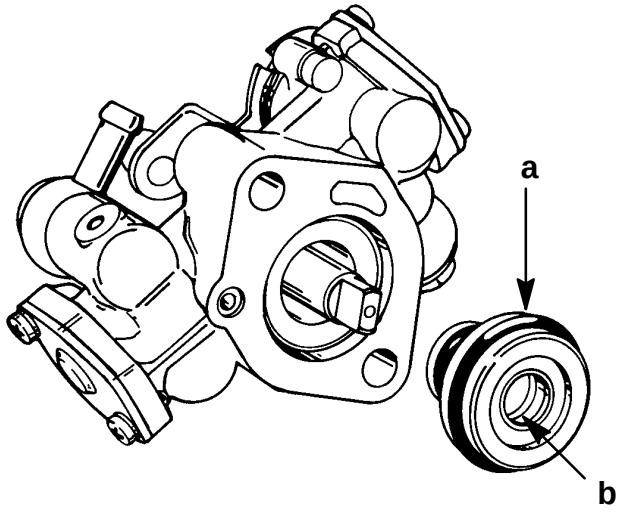
a - Inlet Hose
b - Outlet Hose
c - Link Arm
d - Injection Arm
e - Bolts
f - Oil Pump

Worm Bushing

Worm Bushing Removal

1. Grasp bushing and remove from oil pump.

NOTE: *If seal is defective, seal and bushing are replaced as an assembly.*

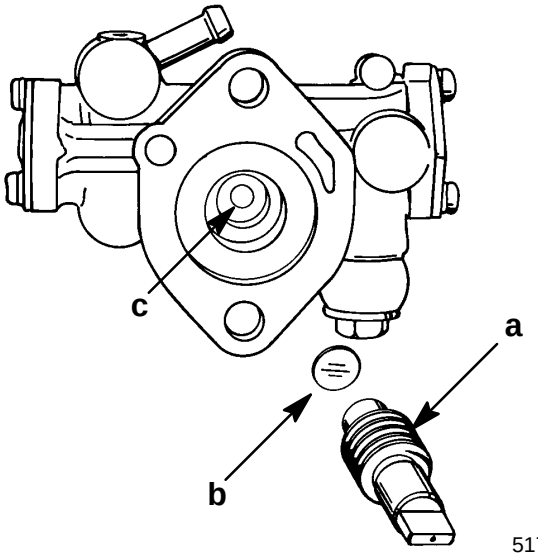


51782

a - Bushing
b - Seal

Worm Bushing Installation

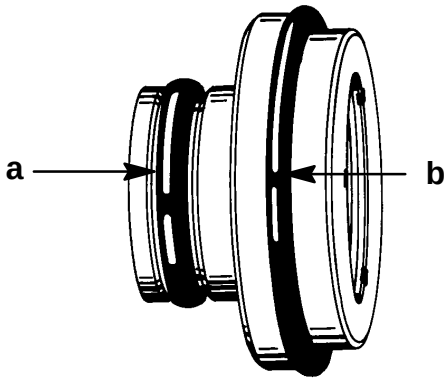
IMPORTANT: If worm shaft is removed from oil pump with worm bushing, verify thrust washer is positioned in center of worm shaft pocket before reinstalling worm shaft.



51782

a - Worm Shaft
b - Thrust Washer
c - Pocket

1. Inspect bushing O-rings for cuts and abrasions. Replace O-rings if necessary.



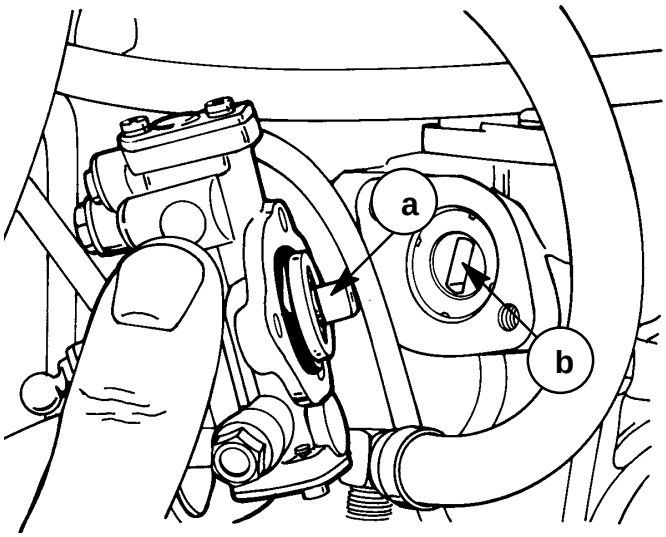
51782

a - O-rings

2. Reinstall bushing/seal assembly.

Oil Injection Pump Installation

1. Align oil pump worm shaft with coupler in powerhead.



51782

a - Worm Shaft
b - Coupler

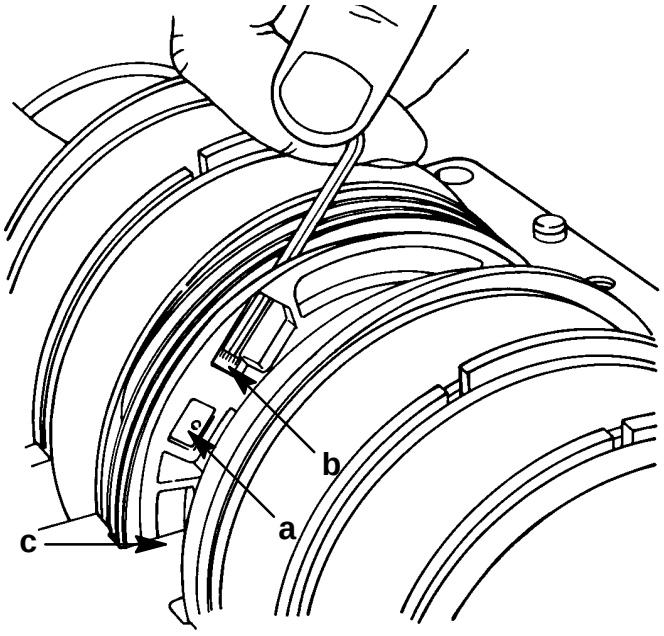
2. Apply Loctite 271 to threads of attaching bolts and secure oil pump to powerhead. Torque bolts to 25 lb. in. (2.8 N·m).
3. Connect inlet and outlet hoses to oil pump. Secure hoses with clamps.
4. Connect link arm to oil pump arm.
5. Prior to starting engine, refer to "**BLEEDING AIR FROM OIL INJECTION PUMP**" and "**ADJUSTING OIL INJECTION PUMP**," SECTION 1D, for proper procedures.

Installing Drive Gear (for Oil Injection Pump) Onto Crankshaft

IMPORTANT: Oil pump drive gear retaining screws ARE STAKED after installation. DO NOT remove drive gear from crankshaft unless gear is damaged or shows signs of excessive wear.

REMOVAL OF DRIVE GEAR

1. Rotate crankshaft to gain access to two drive gear retaining allen screws.
2. Remove two screws and remove drive gear from crankshaft. DO NOT reuse retaining screws as screw threads may be damaged by factory staking process.



51892

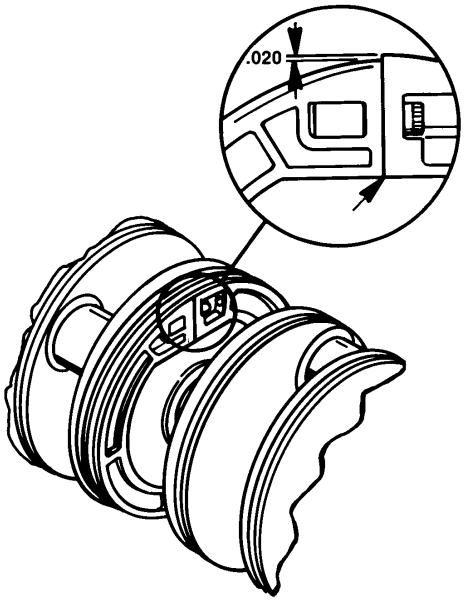
a - Retaining Nut
b - Allen Screw
c - Center Main Bearing (Hidden)

INSTALLATION OF NEW DRIVE GEAR

1. Align drive gear halves on crankshaft with retaining screw access holes towards center main bearing.
2. Clean retaining screw threads with Loctite Primer T (92-59327-1). Apply Loctite 680 (obtain locally) to screw threads.
3. Secure drive gear halves together with retaining nuts and allen screws. Torque screws to 8 Ib. in. (0.9 N·m)
4. Check gear halve split lines. Split should be drawn tight together (zero clearance) if gear halves are properly installed.

⚠ CAUTION

Gear tooth mismatch at split line must not exceed .020 in. (0.50 mm) or gear failure will result.



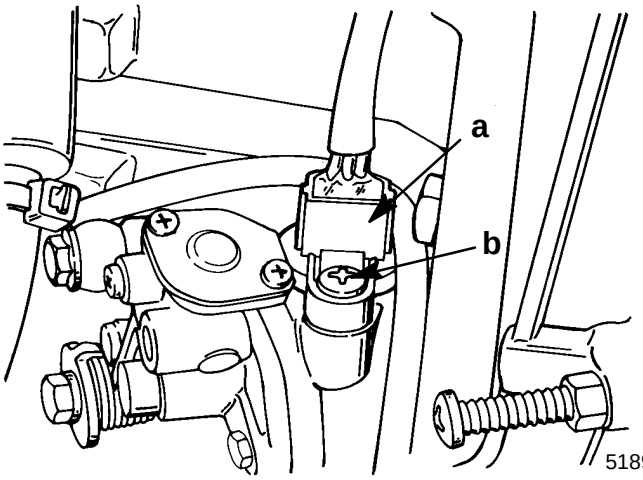
50755

Motion Sensor

Testing Procedure--Refer to “Oil Injection System Trouble Shooting Chart,” following:

Removal--Remove screw securing sensor to oil pump Disconnect WHITE and BLUE/WHITE leads from WARNING MODULE. Remove BLACK LEAD from engine ground. Remove MOTION SENSOR from powerhead.

Installation--Insert MOTION SENSOR into pocket behind oil pump. Secure sensor with screw. Torque screw to 30 Ib. in. (3.4 N·m). Connect WHITE and BLUE/WHITE leads to respective leads of WARNING MODULE. Secure BLACK sensor lead to engine ground.



51893

a - Motion Sensor
b - Screw [Torque to 30 Ib. in. (3.4 N·m)]

Oil Injection System Trouble Shooting Chart

TROUBLE SHOOTING THE OIL INJECTION SYSTEM

If a problem occurs with the oil injection system and the warning horn sounds in a pulsating manner, stop engine and check if problem is caused by (1) low oil level, (2) the oil injection pump, or (3) a faulty warning sensor or module.

1. Check oil level in engine reservoir tank. If oil level is not to the top of tank the problem is low oil level. There is a safety reserve of oil left in the reservoir after the low oil warning is sounded that allows you enough oil for 30 to 40 minutes of full throttle operation. Refer to trouble shooting chart to correct the problem.
2. If engine reservoir is full of oil, then the problem may be in the oil injection pump. DO NOT run engine on straight gas when a problem may be in the oil injection pump. Engine can be run by connecting a remote tank of 50:1 fuel and oil mixture to engine or in an emergency add (approx. a 50:1 ratio) of oil from the 3 gallon remote oil tank to the straight gas. Refer to trouble shooting chart to correct the problem.

Problem: Oil Level in Engine Oil Reservoir Tank is Low But Not Low in Remote Oil Tank.

Possible Cause	Corrective Action
Fill cap is leaking air on the remote tank.	Make sure O-rings or gaskets are in place and caps are tight
Quick disconnect on remote oil tank is not fully connected	Re-connect
Remote oil hose (blue stripe) is blocked	Check length of hose for a kink
Remote pulse hose (second hose) is blocked or punctured.	Check length of hose for a kink
Remote pulse hose check valve is faulty (this valve is located at the engine end of the hose).	Replace check valve.
A restricted oil outlet filter in the remote tank.	Remove filter and clean.

Problem: Warning Horn Does Not Sound When Ignition Key is Turned to “ON” Position.

Possible Cause	Corrective Action
Horn malfunction or open (tan) wire between horn and Engine.	Use a jumper wire to ground tan lead (at engine terminal block) to engine ground. Warning horn should sound. If not, check tan wire between horn and engine for open circuit and check horn.
Faulty TKS ECM	Check if all TKS ECM leads are connected to harness leads. If so, module may be faulty.
Using incorrect side mount remote control or ignition/ choke assembly.	See info on remote control SECTION 1D.

Problem: Warning Horn Stays on When Ignition Key is Turned to “ON” Position.

Possible Cause	Corrective Action
Engine overheat sensor	If horn sounds a continuous signal, the engine overheat sensor may be faulty. Disconnect overheat sensor and turn ignition key to “ON” position. If horn still sounds a continuous signal, the ECM is faulty. Replace module and re-test. If signal does not sound, then engine overheat sensor is faulty. Replace and re-test.
Faulty TKS ECM	Check connections - replace module.

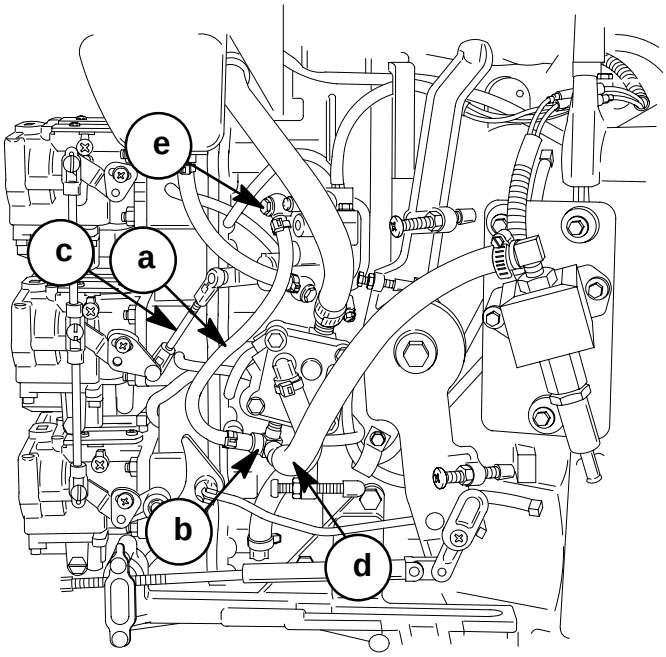
Problem: Warning Horn sounds when Engine is Running and Oil Level in Engine Reservoir is Full.

Possible Cause	Corrective Action
Faulty engine ignition system (incorrect voltage pulse being sent to the ECM	Look at the ignition coil lead connections on the ignition switch box and determine what coil lead has the green wire from the ECM connected to it. Check that coil for correct voltage using DVA. If the voltage to the coil is correct, then the voltage to the warning module is correct.
Defective low oil sensor (located in fill cap of engine oil reservoir.)	Do not remove cap from oil reservoir. Disconnect both low oil sensor leads from terminal connectors. Connect an ohmmeter between leads. There should be NO continuity thru sensor. If continuity exists, sensor is faulty. Replace cap assembly.
Defective motion sensor at the oil injection pump	**All spark plugs must be removed and spark leads grounded to prevent engine from starting when checking motion sensor.** 1. Disconnect white lead from module assembly. Check voltage from the white lead from module. Voltage should be 12V ± 1V. 2. Re-connect white lead from module. Sensor leads must be connected to module for remaining checks. Insert probe into wire connection for voltage checks. 3. Check output voltage to the sensor by connecting voltmeter to (blue/white) sensor lead. Remove spark plugs and ground spark plug leads. Turn ignition to “ON”. Use emergency start rope and rotate flywheel while observing voltmeter. Output voltage should peak at 5V ± 1V and then drop to less than 1.0 volt during every 2 revolutions of the engine. 4. If NO voltage is present, then one of two possibilities exists: a. Motion sensor defective -- replace and repeat test for voltage. b. Drive system defective -- test as in following section.
Drive system of the oil injection pump.	Check drive system as follows: 1. Use a 50:1 gas and oil mixture and start engine. Be sure engine has proper cooling water. 2. Disconnect link rod connected between oil injection pump and carburetor linkage. 3. Disconnect outlet hose of oil injection pump and observe if injection pump is pumping oil. If pump is not pumping oil, the drive system to the pump is faulty.

If all of the checks are positive, the ECM is faulty. Replace Module and re-test.

Oil Pump Volume (Flow) Test

NOTE: *The following specifications are determined with the engine running off a remote fuel supply with pre-mix fuel. The oil pump output hose (clear) must be disconnected from the input fuel line TEE fitting and directed into a graduated container. The input fuel line TEE fitting from which the oil line was removed MUST BE CAPPED OFF to prevent fuel leakage while the engine is running.*



a - Oil Pump Output Hose (Clear)
b - Tee Fitting
c - Link Arm
d - Input Fuel Line
e - Oil Pump

Flow specifications are as follows:

@ 1500 RPM with oil pump link arm ATTACHED = 6.8cc ± 10% in 3 MINUTES

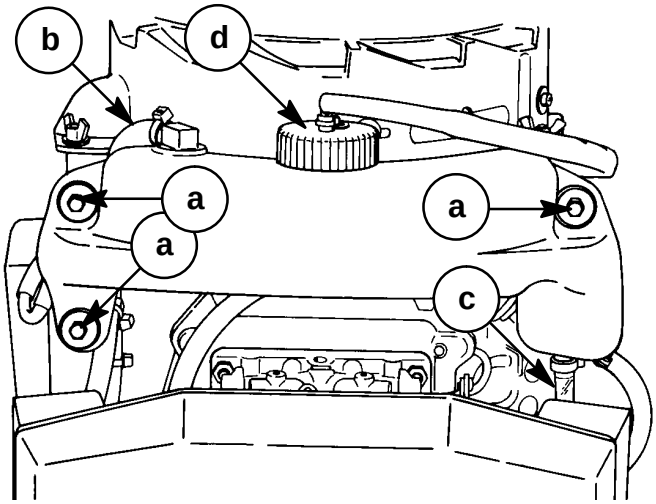
@ 1500 RPM with oil pump link arm DISCONNECTED =17cc ± 10%in 3 minutes

Engine Mounted Oil Reservoir

REMOVAL

NOTE: *If oil reservoir contains oil, the clear oil hose going to the oil pump should be plugged upon removal to prevent oil spillage.*

1. Disconnect input oil hose to oil reservoir.
2. Remove oil reservoir cap BLACK and LIGHT BLUE leads from their respective connections.
3. Disconnect clear input hose to oil pump and plug off hose.
4. Remove three bolts securing oil reservoir to power- head and remove reservoir.



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a - Bolts
b - Input Oil Hose
c - Oil Pump Input Hose (Clear)
d - Oil Cap

INSTALLATION

1. Apply Loctite 222 (obtain locally) to threads of 3 attaching bolts and secure oil reservoir to powerhead. Torque bolts to 25 Ib. in. (2.8 N·m).
2. Install input oil hose to top of oil reservoir and secure with sta-strap.
3. Connect oil cap BLACK lead to engine ground and LIGHT BLUE LEAD to TKS ECM.
4. Connect clear output hose from oil reservoir to oil pump. Secure hose with STA-STRAPS.