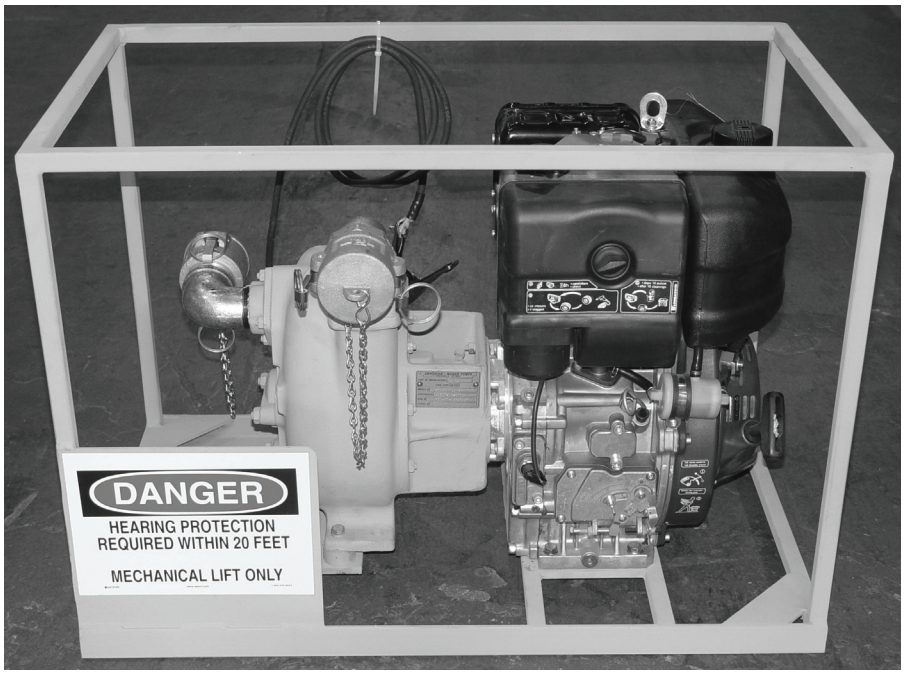
TM 5-4320-371-14&P

TECHNICAL MANUAL
OPERATOR, UNIT,
MAINTENANCE MANUAL
FOR
PUMP UNIT, CENTRIFUGAL
DIESEL-DRIVEN
SELF-PRIMING

100 GPM FUEL @ 100 FEET HEAD
TYPE I, SIZE 2
(NSN 4320-01-483-1067)
MODEL: NOVO 2 SPPAE



HEADQUARTERS, DEPARTMENT OF THE ARMY
MARCH 2009

Cautions and Warnings

⚠ CAUTION

Maximum Lifting Speed: 15 feet/second.

Never leave liquid in the pump casing. Drain the casing immediately through the drain plug (figure 3, #23). During winter months and cold weather, the liquid could freeze and damage the pump casing.

In order to gain maximum life and smooth performance, the engine should be run at reduced speed and/or load (75%) for the first fifty (50) hours of operation.

Low levels, as well as high levels, can damage the engine and cause premature engine failure. See figure 21 for oil dipstick orientation.

If the control device is not engaged properly, the engine will not operate properly.

Reassemble the head (figure 47, #19) taking care not to touch the shaft (figure 47, #07) with the stationary seal seat (figure 47, #25). This is a brittle material and could fracture.

⚠ WARNING ⚠

If the liquid is hazardous, take all necessary precautions to avoid damage and injury before emptying the pump casing.

Residual liquid may be found in the pump casing, head and suction line. Take the necessary precautions if the liquid is hazardous, flammable, corrosive, poisonous, infected, etc.

Hearing protection must be worn when within 20 feet of the pump/motor unit.

During repair operations, when using compressed air, wear eye protection.

If any external leaks are found while pumping hazardous product, immediately stop operations and repair.

Engine contains hazardous materials; take necessary precautions before doing any maintenance procedures.

The pump and engine assembly weigh in excess of 140 pounds. Mechanical lift only.

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., 20 MARCH 2009

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REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

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1 IDENTIFICATION

1.1 Manufacturer

American-Marsh Pumps, 185 Progress Road, Collierville, TN 38017, United States of America

1.2 Type of Pump

Horizontal self-priming centrifugal pump with open impeller for handling liquids containing solids in suspension. These pumps can operate satisfactorily with liquids containing air or dissolved gases.

1.3 Model

NOVO 2 SPPAE Series
This type of pump has a 2" suction and a 2" discharge NPT connection. The SPPAE models are close coupled to Lombardini 15LD400 diesel engines. **Engine must be filled with diesel fuel ONLY.**

1.4 Year of Manufacture

The year of manufacture is indicated on the pump data plate.

1.5 Instruction Book Identification

Prepared: December, 2003 **Edition:** 01 **Revision:** 01 **Date of Revision:** May, 2004

1.6 Nameplate Information

1.6.1 Pump Data Plate (figure 1)

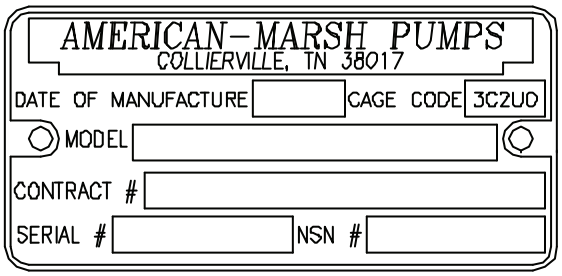


Figure 1

Date of Manufacture	:	Date the pump was manufactured (i.e. May 03 or 05/03)
Model	:	Model of Pump Unit (i.e. AM-XXXX 125 GPM WTR)
Contract Number	:	Army contract number (i.e. XXXXXX-XX-X-XXXX)
Serial Number	:	Denotes the serial number of the pump unit (i.e. XXXXXXX)
NSN	:	National Stock Number (i.e. XXXX-XX-XXX-XXXX)

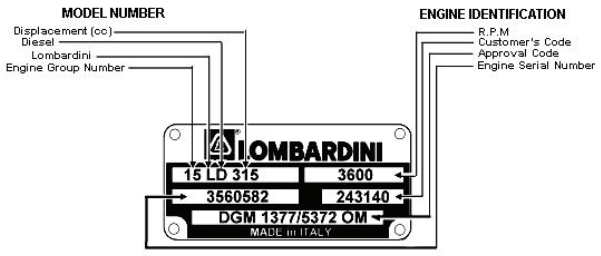


Figure 2

1.6.2 Engine Data Plate (figure 2)

When requesting parts for the pump/engine unit, be sure to use the serial number stamped on the PUMP data plate.

1.7 Field of Application

These pumps are suitable for handling liquids of viscosity up to 50 cSt containing solids in suspension. They are used in industry, civil engineering, shipbuilding, wastewater treatment, construction and agriculture.

2 WARRANTY

American-Marsh Pumps guarantees that only high quality materials are used in the construction of our pumps and that machining and assembly are carried out to high standards.

The pumps are guaranteed against defective materials and/or faulty craftsmanship for a period of one year from the date of shipment unless specifically stated otherwise.

Replacement of parts or of the pump itself can only be carried out after careful examination of the pump by qualified personnel.

The warranty is not valid if third parties have tampered with the pump.

This warranty does not cover parts subject to deterioration or wear and tear (mechanical seals, diaphragms, pressure and vacuum gauges, rubber or plastic items, etc.) or damage caused by misuse or improper handling of the pump by the end user.

Parts replaced under warranty become the property of American-Marsh Pumps.

Contact the American-Marsh Pumps' factory:
Phone: **(901) 860-2300**
Fax: **(901) 860-2323**

3 GENERAL INSTRUCTIONS

The pump and motor unit must be examined upon arrival to ascertain any damage caused during shipment. If damaged immediately notify the carrier and/or the sender. Check that the goods correspond exactly to the description on the shipping documents and report any differences as soon as possible to the sender. Always quote the pump type and serial number stamped on the data plate.

The pumps must be used only for applications for which the manufacturers have specified:

- **The construction materials**
- **The operating conditions (flow, pressure, temperature, etc.)**
- **The field of application**

In case of doubt, contact the manufacturer.

4 HANDLING AND TRANSPORT

4.1 Method of Transport

The pump must be transported in the horizontal position

4.2 Installation

During installation and maintenance, all components must be handled and transported securely by using suitable slings. Handling must be carried out by specialized personnel to avoid damage to the pump and persons. The lifting rings attached to various components should be used exclusively to lift the components for which they have been supplied.

Maximum lifting speed: 15 feet/second

5 STORAGE

5.1 Pump

1. Store the pump under cover whenever possible. If the pump must be stored in the open, cover it with a tarpaulin.
2. Avoid the accumulation of moisture around the pump.

⚠ CAUTION

3. **Never leave liquid in the pump casing. Drain the casing immediately through the drain plug (figure 3, #16). During winter months and cold weather, the liquid could freeze and damage the pump casing.**

⚠ WARNING ⚠

If the liquid is hazardous, take all necessary precautions to avoid damage and injury before emptying the pump casing.

From time to time, turn the shaft to avoid encrustation inside the pump.

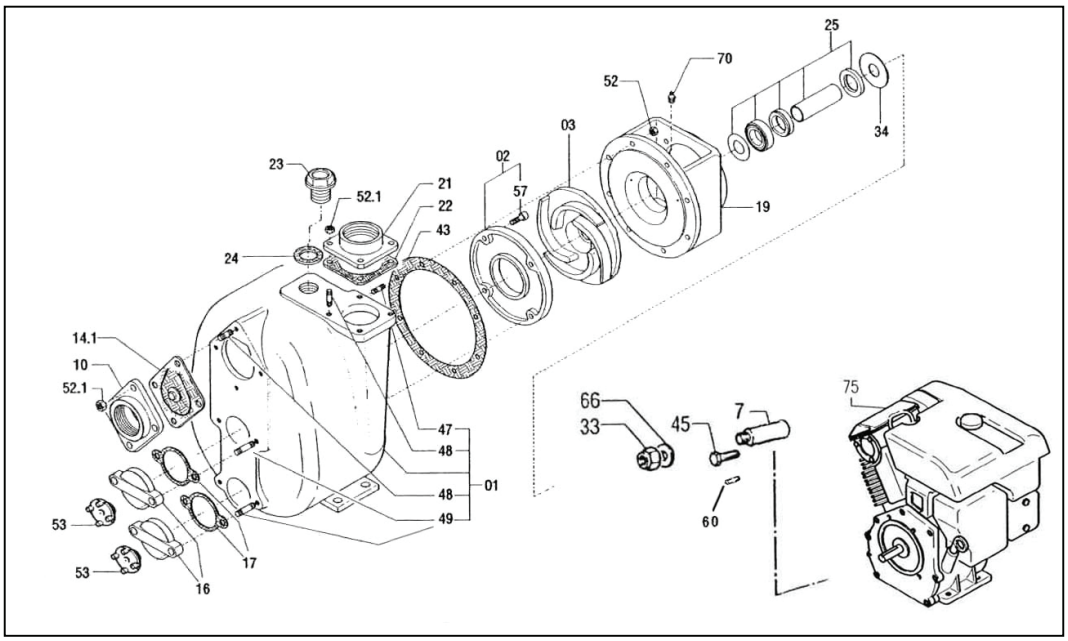


Figure 3

4. Wrap the pump in a plastic film.
5. For extended storage, longer than 6 months, flush the pump casing (figure 3, #01) with a rust inhibitor that is compatible with the pumped fluid and use.
6. Seal all openings with tape.
7. Wrap the pump in a plastic film.

45.2 Engine

⚠ WARNING ⚠

Residual liquid may be found in the pump casing, head and suction line.
Take the necessary precautions if the liquid is hazardous, flammable, corrosive, poisonous, infected, etc.

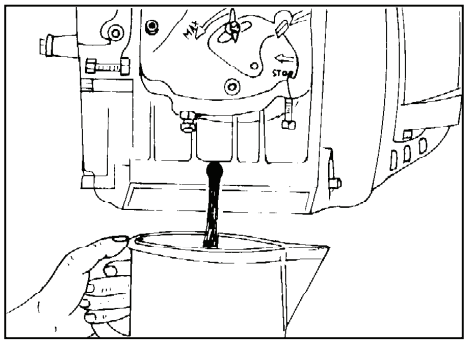


Figure 4

5.2.1 Temporary Protection (More than 1 month but less than 6 month storage)

1. Let the engine run at idling speed in no-load conditions for 15 minutes.
2. Fill the crankcase with protection oil MIL-1-644-P9 and let engine run at ¾ full speed for 5 to 10 minutes.
3. When the engine is warm, empty oil pan and fill with standard new oil. See figure 4.
4. Remove fuel tube and empty the fuel tank. See figure 5.

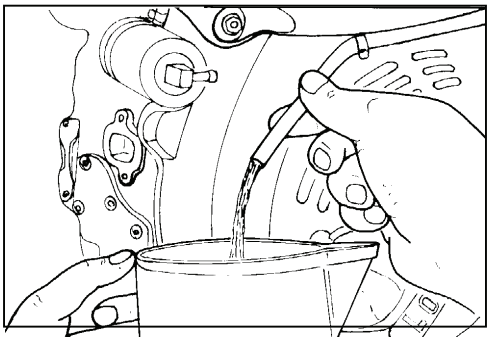


Figure 5

5. Remove fuel filter, replace cartridge if dirty and refit. See section 8.7.3.
6. Carefully clean cylinder fins, heads and fan.
7. Seal all openings with tape.

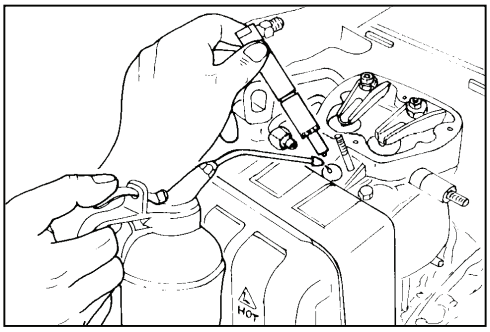


Figure 6

8. Remove the two nuts (figure 7, #13) that hold the injector plate (figure 7, #12) above the injector (figure 7, #15).
9. Loosen and remove the rigid fuel line (figure 7, #18) from the side of the injector (figure 7, #15).
10. Loosen and remove the injector vent line (figure 7, #10).
11. Remove injector (figure 7, #15), pour a spoonful of oil SAE 30 into the cylinder and rotate engine manually to distribute the oil. Refit the injectors (figure 7, #15). See figure 6.
12. Spray oil type SAE 10W into exhaust and intake manifold, rocker arms, valves, tappet, etc. Grease all unpainted parts.
13. Wrap the engine in a plastic film.
14. Store engine in a dry place, if possible not directly on the soil and far from high voltage electric lines.

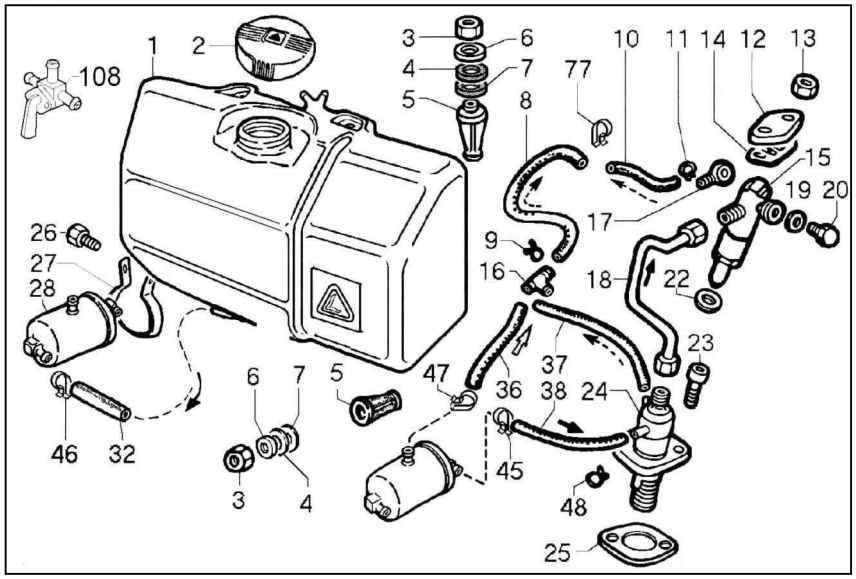


Figure 7

5.2.2 Permanent Protection (Greater than 6 months)

In addition to the above instructions:

1. For the lubrication (engine & pump) and injection system as well as for moving parts use rustproof oil MIL-L-21260 P10 – grade 2, SAE 30. Let the engine and pump run with rustproof oil and drain any excess.
2. Coat all external unpainted surfaces with antirust type MIL-C-116173D – grade 3.

6 INSTALLATION

Clean the suction and discharge lines thoroughly before connecting them to the pump.
The suction line must have a diameter equal to that of the pump suction connection. (For larger diameters, consult American-Marsh Pumps.) If possible, avoid curves, elbows and constrictions, which can limit the flow of liquid into the pump. Do not install a foot valve in the suction line; the pump casing has an integral non-return valve incorporated into the suction port.
Install the pump as close as possible to the liquid to be pumped. Try, where possible, to reduce the length of the suction line.
The pumps covered in this manual can pull a positive prime. Submergence, vapor pressure and suction pipe friction loss affect the suction pressure on the pump. Without sufficient suction pressure, the pump will not perform as required.
This suction line must be rigid to allow the pump to pull the water up and into the casing. The suction valve must be fully open at all times while the pump is operation.

The suction line connections must be completely airtight; check pipe threads, flange gaskets, quick couplings, etc.
The discharge line must let air escape from the system while the pump is priming.
The suction and discharge lines must be mounted in such a way as not to create a strain on the pump casing.
Engine driven pumps **must** have lengths of flexible hose to isolate the pipe work from the vibrations caused by the internal combustion engine.

7 STARTING

Before operating the pump, check that the electrical and mechanical parts of the system have been correctly installed.
Check that all safety devices are operative.

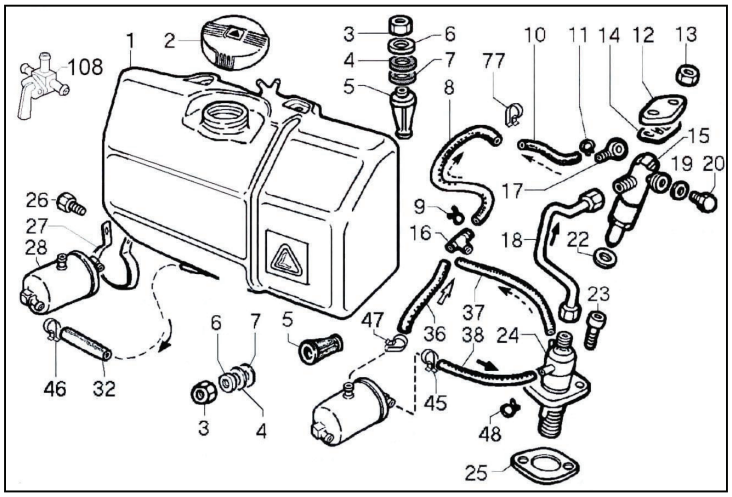


Figure 8

7.1 First Time Operation

⚠ WARNING ⚠

Hearing protection must be worn when within 20 feet of the pump/motor unit.

1. Clean the outside of the pump and motor unit.
2. Remove protections and covers.
3. Remove antirust with an appropriate solvent or degreaser.
4. Ensure that the pump/motor unit rotates freely.
5. Turn the fuel cutoff switch to the "ON" position.
6. Remove the two nuts (figure 8, #13) that hold the injector plate (figure 8, #12) above the injector (figure 8, #15).
7. Loosen and remove the rigid fuel line (figure 8, #18) from the side of the injector (figure 8, #15).
8. Loosen and remove the injector vent line (figure 8, #10).
9. Remove injector (figure 8, #15), pour a spoonful of oil SAE 30 into the cylinder and rotate engine manually to distribute the oil. Refit the injectors (figure 8, #15). See figure 6.
10. Remove the oil drain plug (figure 24, #45) and drain the protective oil. Fill crankcase with standard oil.

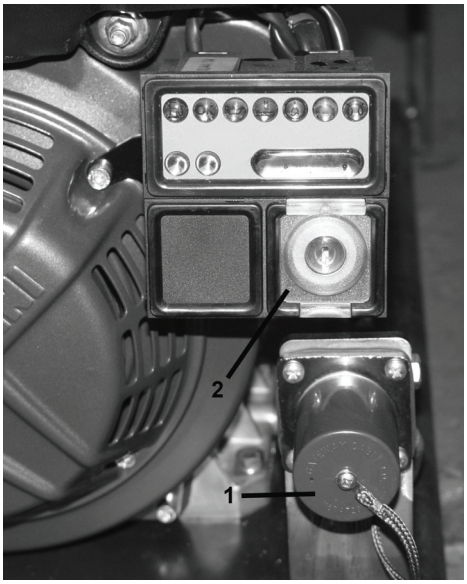
⚠ CAUTION

In order to gain maximum life and smooth performance, the engine should be run at reduced speed and/or load (75%) for the first fifty (50) hours of operation.

11. Remove the fill plug on the top of the casing, fill the casing completely full of liquid and replace the fill plug.
12. Pull slowly on the starter rope until the exhaust valve cracks open (the pull becomes easier).
13. Pull the rope quickly to start the pump unit.

Extreme cold starting (Temperatures <32°F)
(See the control panel picture to the right)

1. Pull the cover off of the NATO plug (#1) and connect to external 24 volt system.
2. Flip up the clear key cover (#2).
3. Insert the key.
4. Turn the key clockwise to the first position. This will heat the glo-plug. Depending on the extreme cold ambient temperature, this step may have to be performed several times to heat up the cylinder. The glo-plug light will go out when ready to proceed to next step.
5. Turn the key clockwise to the last position to crank the engine. Do not exceed cranking the engine for more than 20 seconds. If the engine does not start return to step 4.
6. Turn the key counter-clockwise and use the kill switch to turn the unit off.



Engine Control Panel

7.2 After First Time Operation

1. Ensure that the pump/motor unit rotates freely.
2. Check fluid levels in the engine and pump (fuel, oil, etc.).
3. Ensure that the pump/motor unit is lubricated properly.
4. The engine can be shut down by using the kill switch located below the fuel filter. See section 8.7.9.

7.2.1 PRIMING

If the pump does not prime, proceed to the Troubleshooting, Section 10.
Engine driven pumps should be brought up gradually to the running speed. **Never change the accelerator limit stop: at higher speeds than that for which the engine is set, the pump would absorb more power that the engine can supply. NEVER exceed the maximum speed shown on the Engine nameplate. Maximum speed of the pump is 3600 RPM.**

When the pump has primed:
- ❖ If the pump does not seem to be operating properly, it must be stopped and the cause found. See Troubleshooting, Section 10.

8 ENGINE MAINTENANCE

Before maintenance is carried out, the pump must be stopped.

⚠ WARNING ⚠

Residual liquid may be found in the pump casing, head and suction line.
Take the necessary precautions if the liquid is hazardous, flammable, corrosive, poisonous, infected, etc.

⚠ WARNING ⚠

During repair operations, when using compressed air, wear eye protection.

8.1 Engine Specifications

Engine Specifications:

Model:	Lombardini 15LD400
Displacement:	400 cm^3
Full Speed HP:	9.38 hp (7.0 kW)

Capacities:

Fuel Capacity:	1.32 gallons (5.0 liters)
Oil Sump:	1.59 quarts (1.5 liters)

8.1.1 Engine Cutaway (figures 9 & 10)

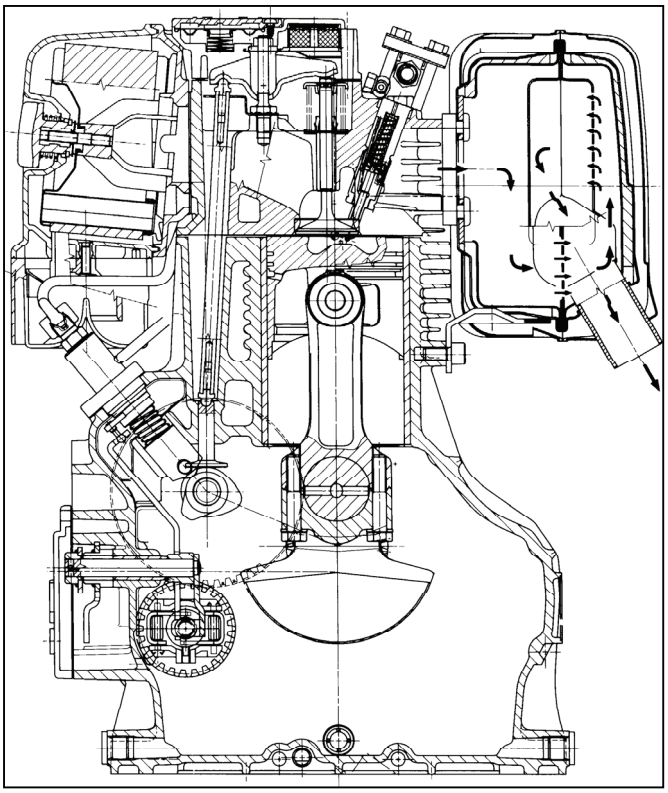


Figure 9

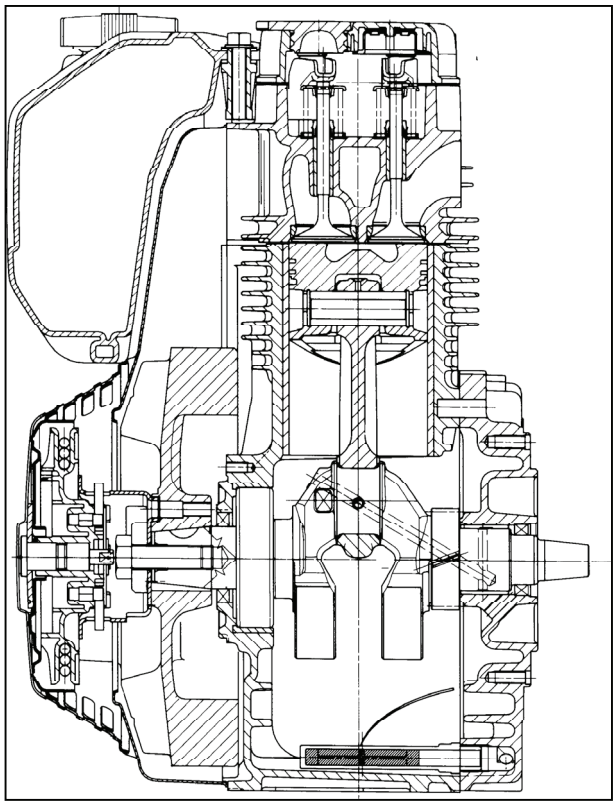


Figure 10

8.2 Engine Oil Recommendations (1 Quart Capacity)

See temperature chart (figure 11) for appropriate oil recommendation.

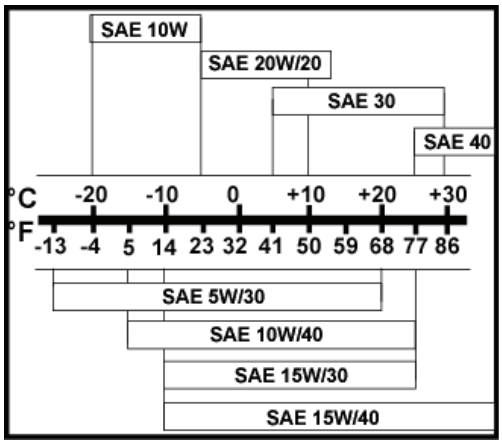


Figure 11

8.3 Engine Maintenance Chart

OPERATION	COMPONENT	Repair Section	INTERVAL (HOURS)						
			NOTES	10	50	125	250	500	1000
CLEANING	Head & Cylinder Fins	8.5.1	(*)		●		●		
	Fuel Tank	8.5.2							●
	Injector	8.5.3						●	
	Oil Filter Cartridge	8.5.4					●		
	Dry Air Filter Cartridge	8.5.5	(*)		●		●	●	●
INSPECTION	Oil Level	8.6.1		●					
	Dry Air Filter Cartridge	----		●					
REPLACEMENT	Oil	8.7.1	(**)		□		●	●	●
	Oil Filter Cartridge	8.7.2							●
	Fuel Filter Cartridge	8.7.3					●		
	Dry Air Cleaner Cartridge	8.7.4	(°)						
	Injector	8.7.5	(***)						
	Fuel Pump	8.7.6	(***)						

□ First replacement
(*) Under severe working conditions, clean daily
(**) See recommended type
(***) Replace after 2500 hours or once per two years
(°) Examine and replace as necessary

8.4 Fuel System Diagram

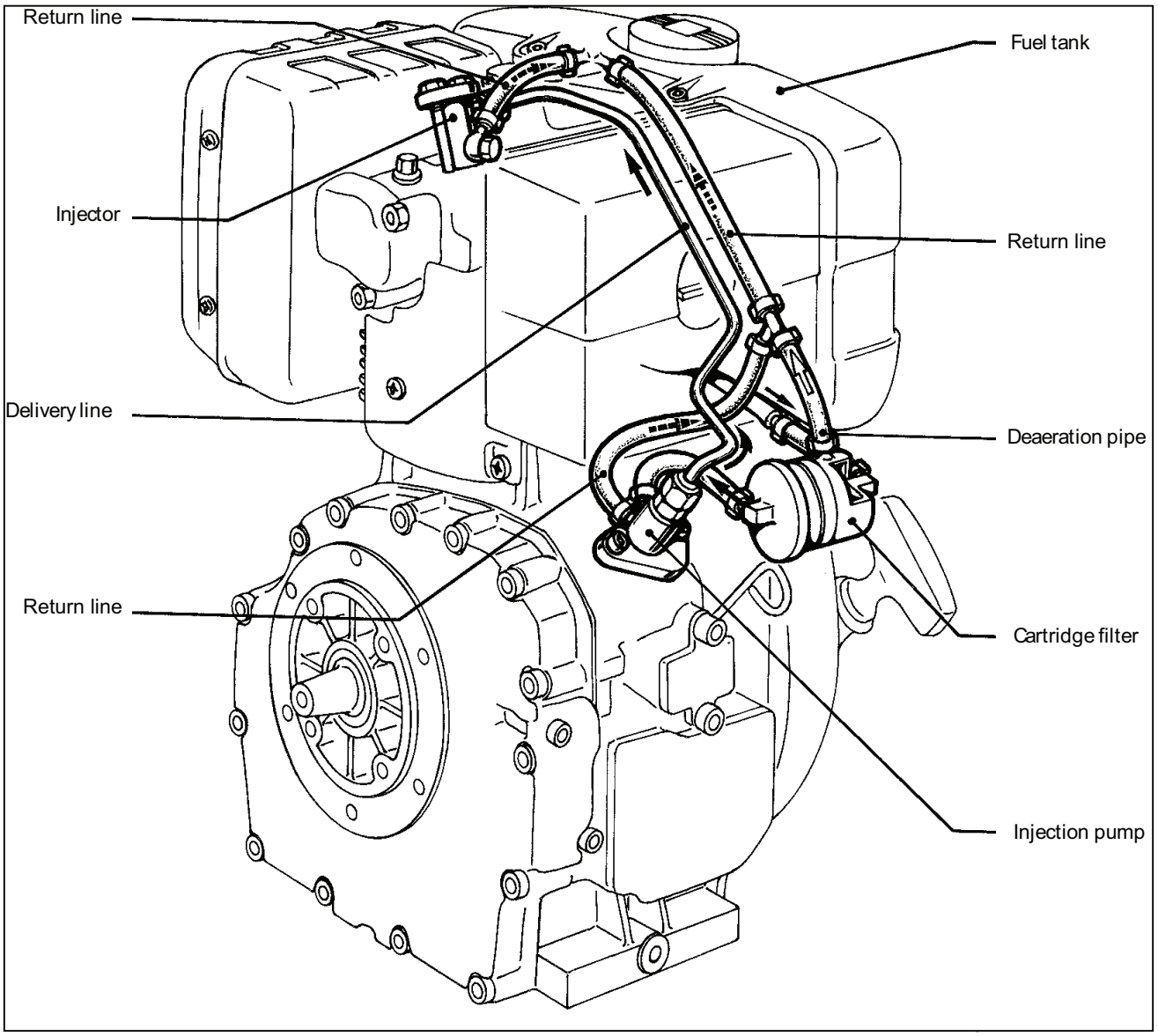


Figure 12

⚠ WARNING ⚠

Engine contains hazardous materials; take necessary precautions before doing any maintenance procedures.

8.5 Oil Lubrication System Diagram

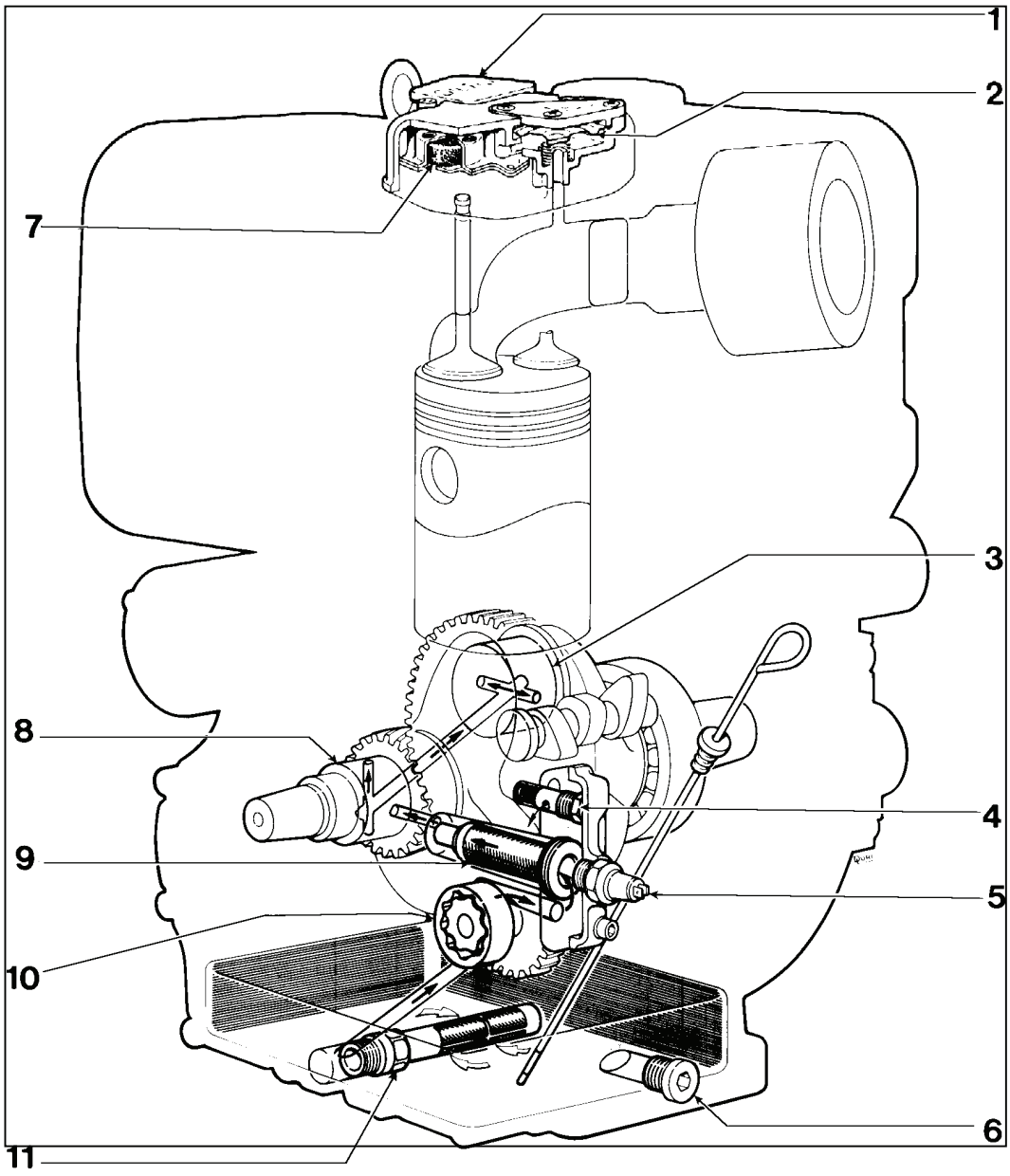


Figure 13

1 – Oil fill cap
2 – Safety valve
3 – Rod journal
4 – Pressure control valve
5 – Pressure switch
6 – Oil drain plug
7 – Metal filter element
8 – Main journal
9 – Oil filter
10 – Oil pump
11 – Strainer

8.5 Cleaning

8.5.1 Head & Cylinder Fins

Clear any debris and/or dirt that may accumulate around the engine head and cylinder. Because this type of engine is of the air-cooled type, these fins must be kept clean so that the engine will not overheat.

8.5.2 Fuel Tank (figure 14, #1)

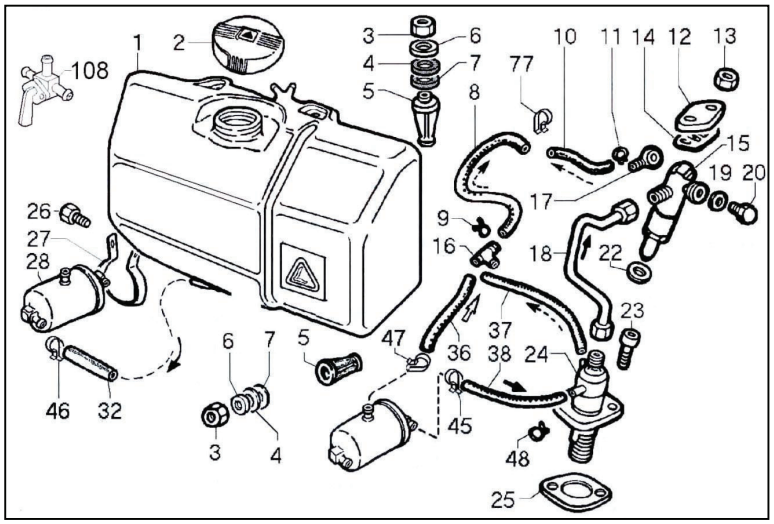
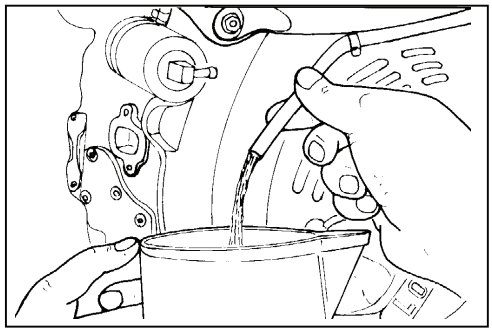


Figure 14

1. Unscrew the upper and lower stud nuts (figure 14 #3 and #33) on the fuel tank and remove washers (figure 14, #4, #6, #29 & 34).
2. Completely empty the fuel tank (figure 14, #1) to make sure that no impurities remain. See figure 15.
3. When reassembling, tighten the upper nuts to 10 lb.-ft. and the lower nuts to 7 lb.-ft.
4. Inspect all hose clamps and fuel lines to insure there are no air or fuel leaks.



5. Inspect tank breather fuel line (figure 14, #36), for clogs.

Figure 15

8.5.3 Injector (figure 16, #15)

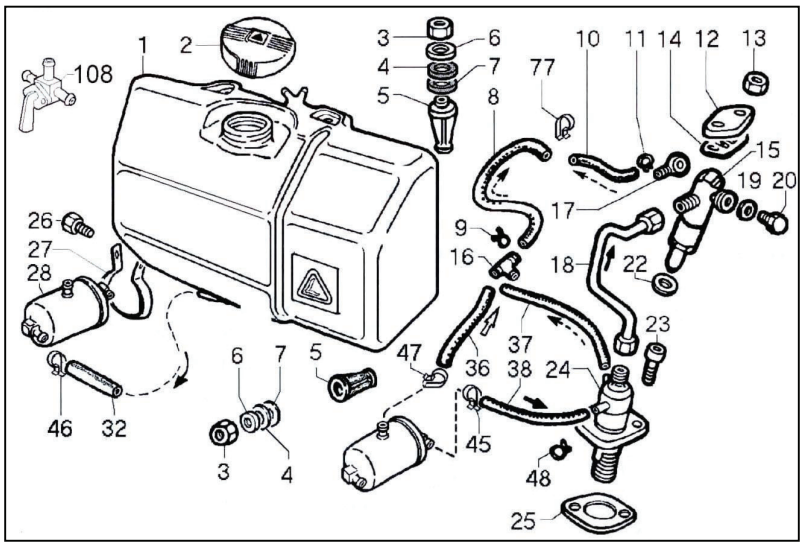


Figure 16

The injector is located on top of the engine.

1. Loosen the rigid steel fuel line (figure 16, #18) from the injector pump (figure 16, #24) to the injector (figure 16, #15) and move out of way.
2. Loosen two nuts (figure 16, #13) and remove injector cover plate (figure 16, #12) and cover plate gasket (figure 16, #14). Remove the injector by pulling up until it is clear of the engine.
3. Make sure that the injector nozzle, the part of the injector that sits in the cylinder, is clear of debris and carbon residue. Clean off the carbon residue with emery cloth. If the injector (figure 16, #15) is clogged, it will need to be replaced.
4. Prior to placing back onto engine, spray some oil on the injector seat ensuring that the injector slides back into place. See figure 17. Refit the injector by pushing it back into place.
5. Reassemble in reverse order.

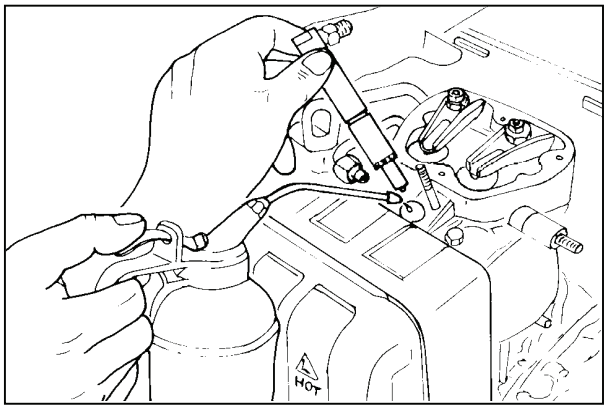


Figure 17

8.5.4 Oil Filter Cartridge (figure 18, #83)

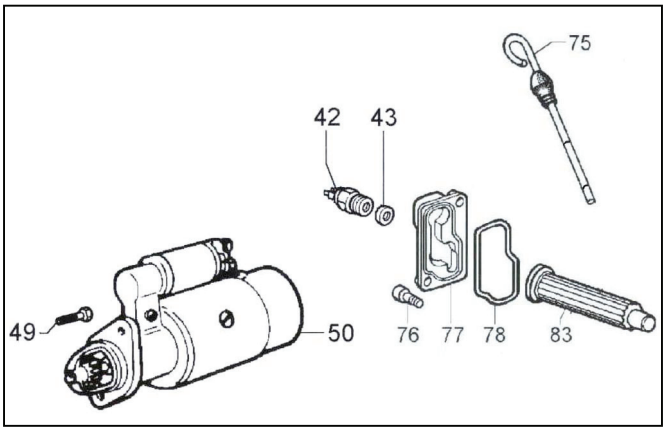


Figure 18

The oil filter cartridge is located behind the oil pressure switch. Refer to Figure 13.

1. Loosen and remove the two cover screws (figure 18, #76) that hold the oil filter cartridge cover (figure 18, #77) to the engine.
2. Remove the cover (figure 18, #77) and gasket (figure 18, #78).
3. Pull the oil filter cartridge (figure 18, #83) out of the engine and clean. **The oil filter can be washed with diesel fuel and re-used up to three times before replacement.**
4. Reassemble in reverse order.

8.5.5 Dry Air Filter Cartridge (figure 19, #83)

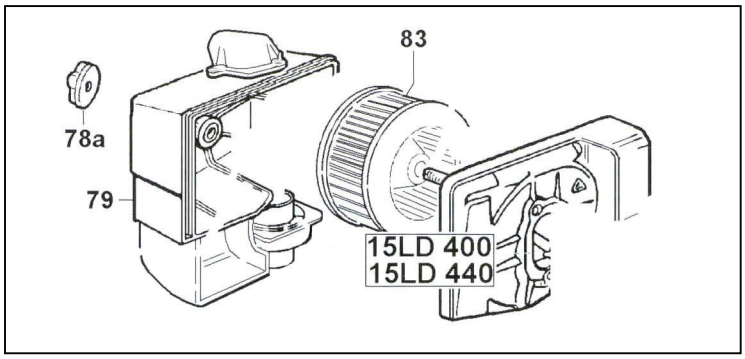


Figure 19

The dry air filter (figure 19, #83) consists of a primary filter.

1. Loosen the filter cover knob (figure 19, #78a) to loosen the filter housing cover (figure 19, #79).
2. Remove the filter housing covering (figure 19, #79).
3. Remove the dry air filter (figure 19, #83).
4. Reassemble in reverse order.

8.6 Inspection

8.6.1 Oil Sump Level

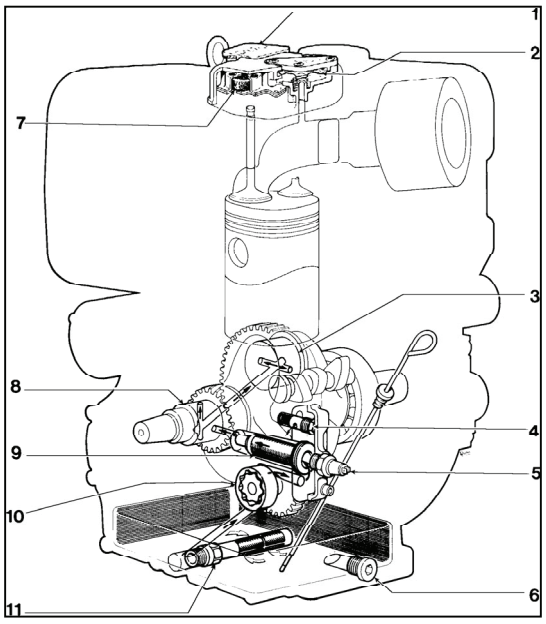


Figure 20

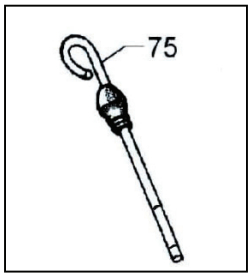


Figure 21

Maintaining proper oil level in the engine will assure proper operation.

⚠ CAUTION

Low levels, as well as high levels, can damage the engine and cause premature engine failure. See figure 20 for oil dipstick orientation.

1. Remove the oil dipstick (figure 21, #75) and check the oil level against the graduations etched on the dipstick.
2. Adjust the oil level accordingly.

Inspection: Oil level should be between the graduations etched on the dipstick.

78.7 Replacement

Components that require replacement on the engine primarily deal with filtering parts for the air, fuel and oil systems. These filters are easily replaceable. See figures 11 & 12 for a graphical representation of the oil lubrication & fuel systems.

8.7.1 Oil

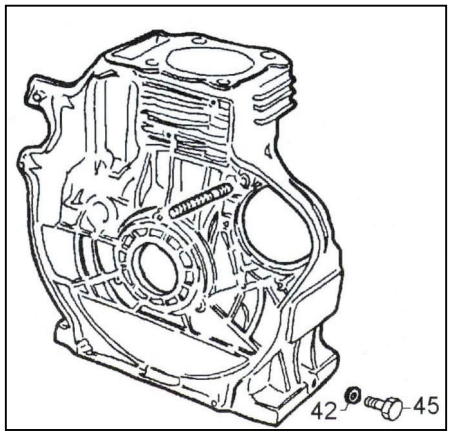


Figure 24

To ensure proper engine operation, the oil should be changed according to the schedule. In harsh or dirty environments, the oil should be checked and changed more often.

1. Remove the oil drain plug (figure 24, #45) and discard of oil properly. **Note that there are two oil drains 180 degrees apart. See figure 25.**
2. Replace oil drain plug (figure 24, #45).

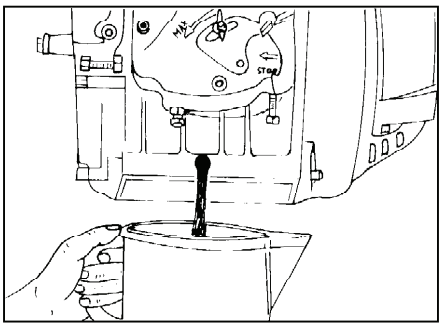


Figure 25

3. Remove oil fill cap (figure 26, #62).
4. Refill engine with appropriate grade of oil. Replace oil fill cap (figure 26, #62).
5. Check level of oil with dipstick.

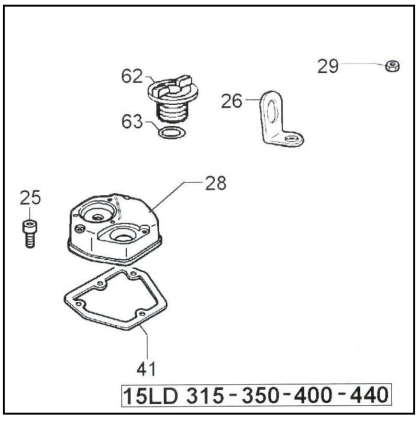


Figure 26

8.7.2 Oil Filter Cartridge (figure 27, #83)

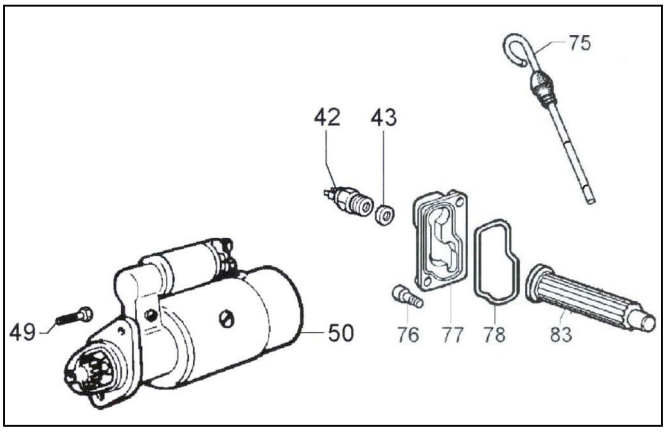


Figure 27

The oil filter cartridge is designed to strain the oil prior to it being pumped to the journal bearings deeper in the engine. **The oil filter can be used up to 3 times before needing replacement. Refer to Section 8.5.4 for instructions on cleaning.**

1. Remove the two cartridge cover cap screws (figure 27, #76).
2. Remove the cartridge cover (figure 27, #77) and gasket (figure 27, #78) from the side of the engine.
3. Pull the oil filter cartridge (figure 27, #83) out of the engine and replace.
4. Reassemble in reverse order.

8.7.3 Fuel Filter Cartridge (figure 28, #28)

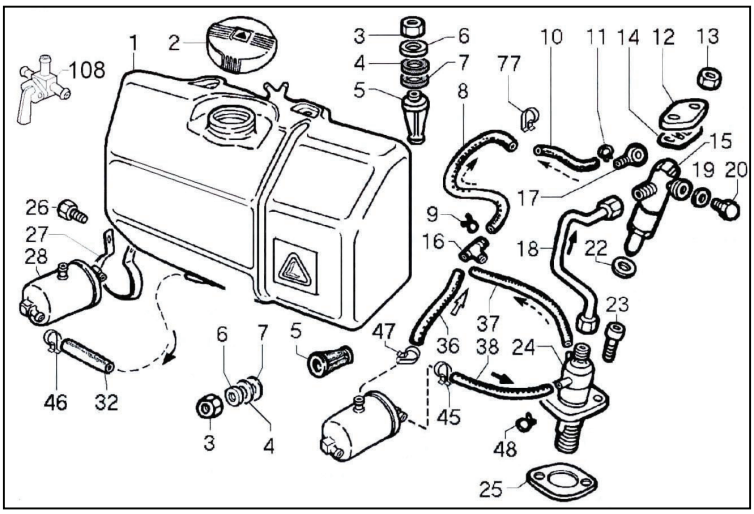


Figure 28

The primary fuel filter cartridge (figure 28, #28) is mounted below the fuel tank (figure 28, #1).

1. Loosen the support bolt (figure 28, #26) and bracket (figure 28, #27) that hold the fuel filter (figure 28, #28) to the engine.
2. Loosen fuel clamps (figure 28, #45, #46 & #47) and pull the three fuel hoses (figure 28, #32, #36 & #38) from the fuel filter (figure 28, #28).
3. Remove the fuel filter (figure 28, #28) and replace.
4. Reassemble in reverse order. See figure 29.

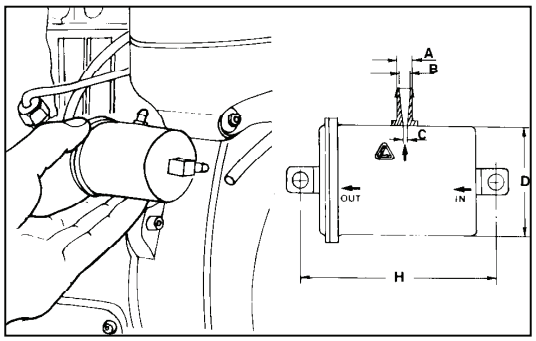


Figure 29

8.7.4 Dry Air Filter Cartridge (figure 30, #83)

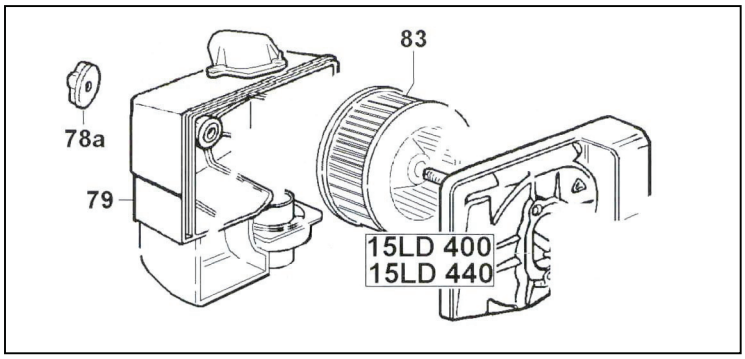


Figure 30

The dry air filter (figure 30, #83) consists of a primary filter.

1. Loosen the filter cover knob (figure 30, #78a) to loosen the filter housing cover (figure 30, #79).
2. Remove the filter housing covering (figure 30, #79).
3. Remove the dry air filter (figure 30, #83).
4. Replace the dry air filter (figure 30, #83).
5. Reassemble in reverse order.

8.7.5 Injector (figure 31, #15)

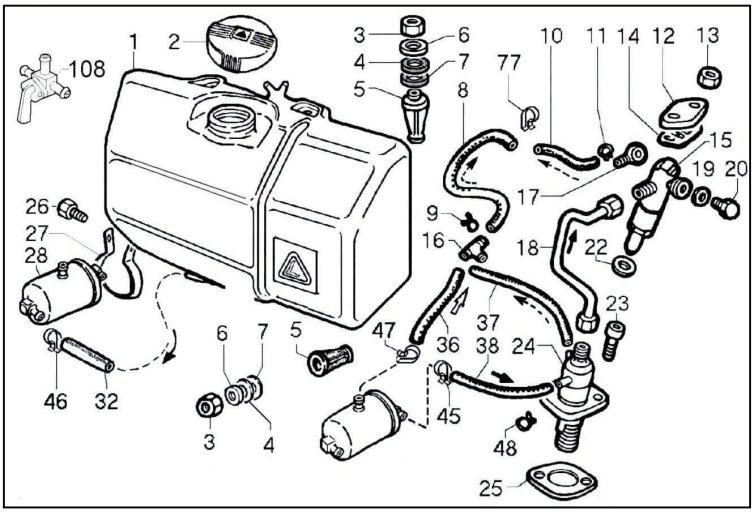


Figure 31

Over time, the injector will get plugged and will require replacement. During the Inspection portion of preventative maintenance, see the Engine Maintenance Chart on page 12, **if the injector tip appears clogged or damaged, the injector should be replaced immediately.**

1. Remove the two nuts (figure 31, #13) that hold the injector plate and gasket (figure 31, #12 & 14) above the injector (figure 31, #15).
2. Loosen and remove the rigid fuel line (figure 31, #18) from the side of the injector (figure 31, #15).
3. Loosen and remove the injector vent line (figure 31, #10).
4. Remove and replace the injector (figure 31, #15) and the injector gasket (figure 31, #22).
5. Reassemble in reverse order. See figure 32.

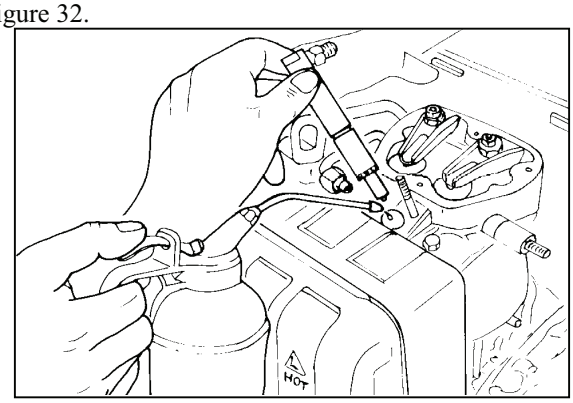


Figure 32

8.7.6 Fuel Pump (figure 33, #24)

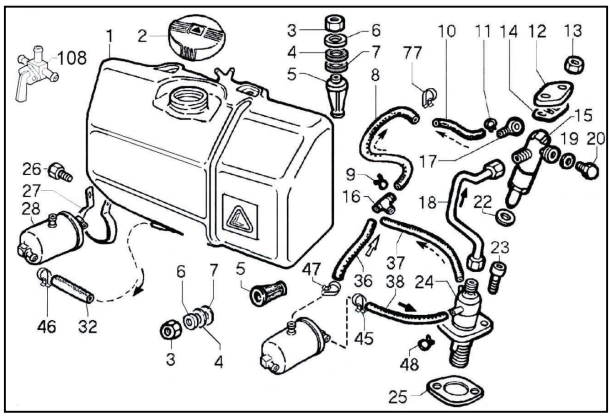


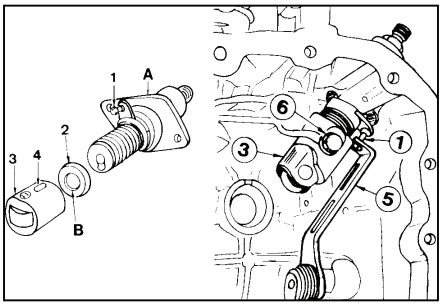
Figure 33

The fuel pump (figure 33, #24) pressurizes the fuel from the fuel tank (figure 33, #1) and sends it to the injector (figure 33, #15) for injection into the engine cylinder. The fuel pump (figure 33, #24) is controlled by the camshaft via tappets.

1. Remove the air cleaner cover.
2. Loosen and remove the rigid fuel line (figure 33, #18) from the top of the fuel pump (figure 33, #24).
3. Remove the inlet (figure 33, #38) and outlet (figure 33, #37) fuel hoses from the fuel pump (figure 33, #24).
4. Loosen and remove the two fuel pump housing screws (figure 33, #23).
5. Take care in removing the fuel pump (figure 33, #24) as the control delivery device will be engaged to the yoke lever (see figure 34).
6. Be sure that if the fuel pump shim (figure 33, #25 & figure 35, C) is to be replaced that it is replaced by the equal thickness shim. Shims are available in sizes from 0.002 inches to 0.020 inches in thickness. **If a different shim thickness is installed than what was originally in the engine, the fuel could be delayed entering the combustion chamber affecting engine operation.**
7. Take care that the fuel pump spacer (figure 35, #C) is not dropped into the oil sump during the removal of the fuel pump (figure 33, #24). **If the fuel pump spacer falls into the oil sump, injection pump (figure 33, #24) will be impaired.**
8. Reassemble in reverse order. Be sure that when reinserting the fuel pump (figure 33, #24) back into the engine housing that the control device is directed towards the yoke of the lever which should be in maximum delivery position.

⚠ CAUTION

If the control device is not engaged properly, the engine will not operate properly.



1 – Control device
2 – Spacer
3 – Tappets
4 – Guide
5 – Lever
6 – Set screw

Figure 34

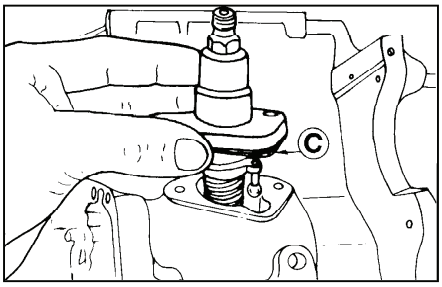


Figure 35

8.7.7 Stopping the Engine

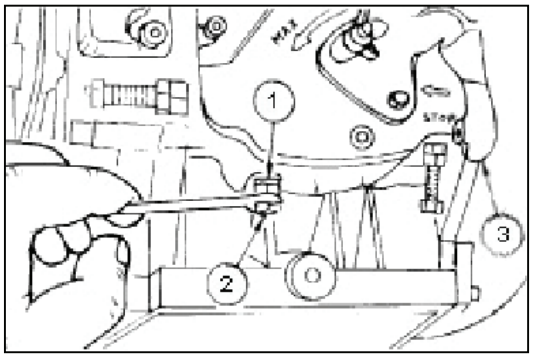


Figure 39

The engine can be stopped by activating the engine kill switch (figure 39, #3).

8.7.8 Pull Rope (figure 40, #14)

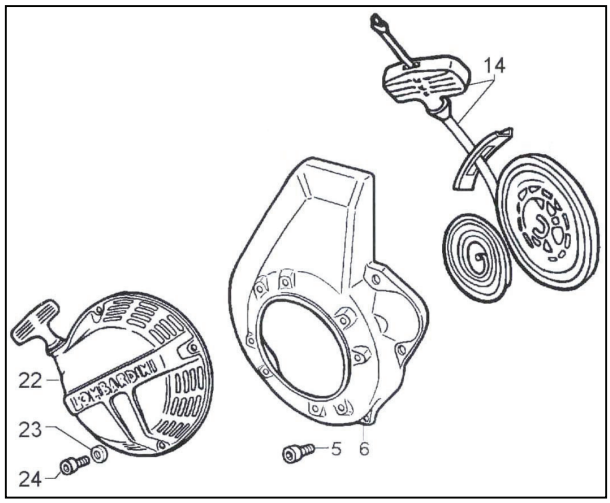


Figure 40

1. Remove the four cover screws and lock washers (figure 40, #23 & #24).
2. Remove and discard remainder of worn pull rope (figure 40, #14) and spring (figure 40, #25). The pull rope and spring come together in an assembly. **Do not try and fix a broken pull rope, order the entire assembly instead.**
3. Replace pull rope (figure 40, #14) and spring (figure 40, #25).
4. Reassemble in reverse order.

8.7.9 Pump & Motor Unit Replacement

The complete unit must be replaced due to the inability to repair the engine.

9 PUMP MAINTENANCE

Before maintenance is carried out, the pump must be stopped.

⚠ WARNING ⚠

Residual liquid may be found in the pump casing, head and suction line.
Take the necessary precautions if the liquid is hazardous, flammable, corrosive, poisonous, infected, etc.

⚠ WARNING ⚠

During repair operations, when using compressed air, wear eye protection.

9.1 Pump Maintenance Chart

OPERATION	COMPONENT	Repair Section	INTERVAL (HOURS)						
			NOTES	10	50	125	250	500	1000
CLEANING	Suction & Discharge Connections	9.2.1	(*)		●		●	●	●
	Exterior of Pump	9.2.2			●		●	●	●
INSPECTION	Check Valve Assembly	9.3.1	(*)	●	●	●	●	●	●
	Mechanical Seal	9.3.2	(**)	●					
	Impeller & Casing	9.3.3	(□)					●	●
REPLACEMENT	Check Valve Assembly	9.4.1	(°)					●	●
	Impeller	9.4.2	(°)						●
	Casing	9.4.3	(°)						
	Casing Wear Plate	9.4.4	(°)						
	Mechanical Seal Assembly	9.4.5							●

(*) Under severe working conditions, check daily
(**) Add 1 pump of grease into the seal chamber every 10 hours
(°) Examine and replace as necessary
(□) Inspect Casing for leakage daily

9.2 Cleaning

9.2.1 Suction & Discharge Connections

Keeping the suction and discharge connections clean will ensure that the hoses will connect to the pump unit with ease. A thread compound compatible with the pumped fluid can be used to aid in the connection or disconnection of the suction and discharge lines.

9.2.2 Exterior of Pump

Generally keep the exterior of the pumping assembly clean and clear of debris. This will extend the life of the pump casing and ensure smooth operation.

9.3 Inspection

9.3.1 Check Valve Assembly (figure 41, #14.1)

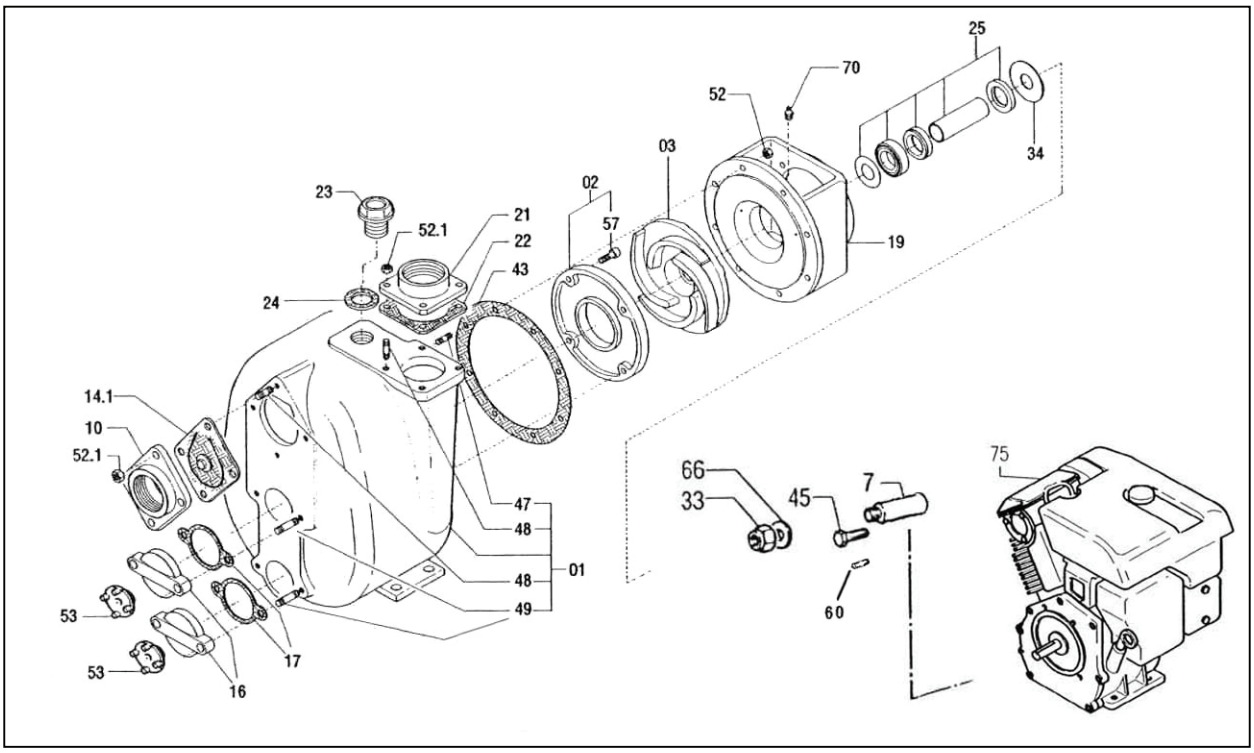


Figure 41

The check valve assembly (figure 41, #14.1) ensures that when the pump is in the off position liquid in the casing does not siphon out of the pump. If the pump casing (figure 41, #01) does not stay completely filled with product after operation, the check valve assembly (figure 41, #14.1) has failed and needs to be replaced. To check to see if the pump is still full of product after operation, unscrew the plug (figure 41, #23) to see if there is product in the casing (figure 41, #01). It is essential that this valve seats completely against the suction port. There is an integral valve weight that also needs to be inspected to ensure that corrosion has not decreased its effectiveness. If the check valve (figure 41, #14.1) is worn and not seating properly, the check valve assembly (figure 41, #14.1) must be replaced (see section 9.4.1). If the valve weight appears to be damaged or is not functioning properly, the check valve assembly (figure 41, #14.1) needs to be replaced (see section 9.4.1).

Another way to inspect the check valve assembly (figure 41, #14) is to unscrew the piping from the suction flange (figure 41, #10) to see if the product leaks out of the pump. If the product is leaking out of the pump, the check valve assembly (figure 41, #14.1) needs to be replaced.

Inspection: Check to make sure pump is maintaining prime.

9.3.2 Mechanical Seal (figure 42, #25)

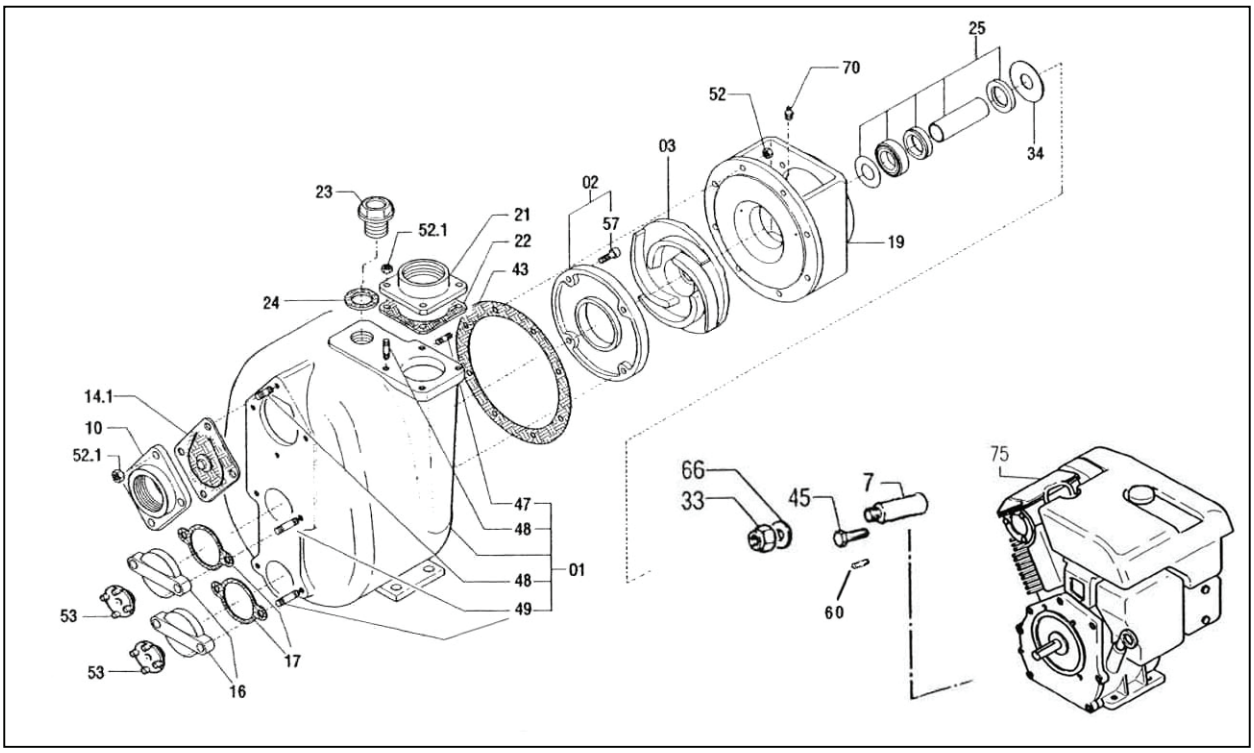


Figure 42

The mechanical seal assembly (figure 42, #25) can be inspected without taking the pump unit apart. The mechanical seal (figure 42, #25) is a dynamic seal that rotates with the shaft assembly and keeps the pumped liquid with the pump assembly. Over time this seal will wear and begin to leak. The seal assembly (figure 42, #25) is constructed of hard, yet brittle, materials that are susceptible to cracking if extreme shock loads are applied to the pump and motor assembly. Take great care in handling and inspecting the mechanical seal (figure 42, #25). Any visible leakage is considered a seal failure and means that the seal assembly needs to be replaced.

Inspection: Inspect the area between the shaft (figure 42, #7) and the head (figure 42, #19) for leakage. If there is leakage at this point, the mechanical seal (figure 42, #25) has failed and needs to be replaced.

9.3.3 Impeller & Casing (figure 43, #03 & #01)

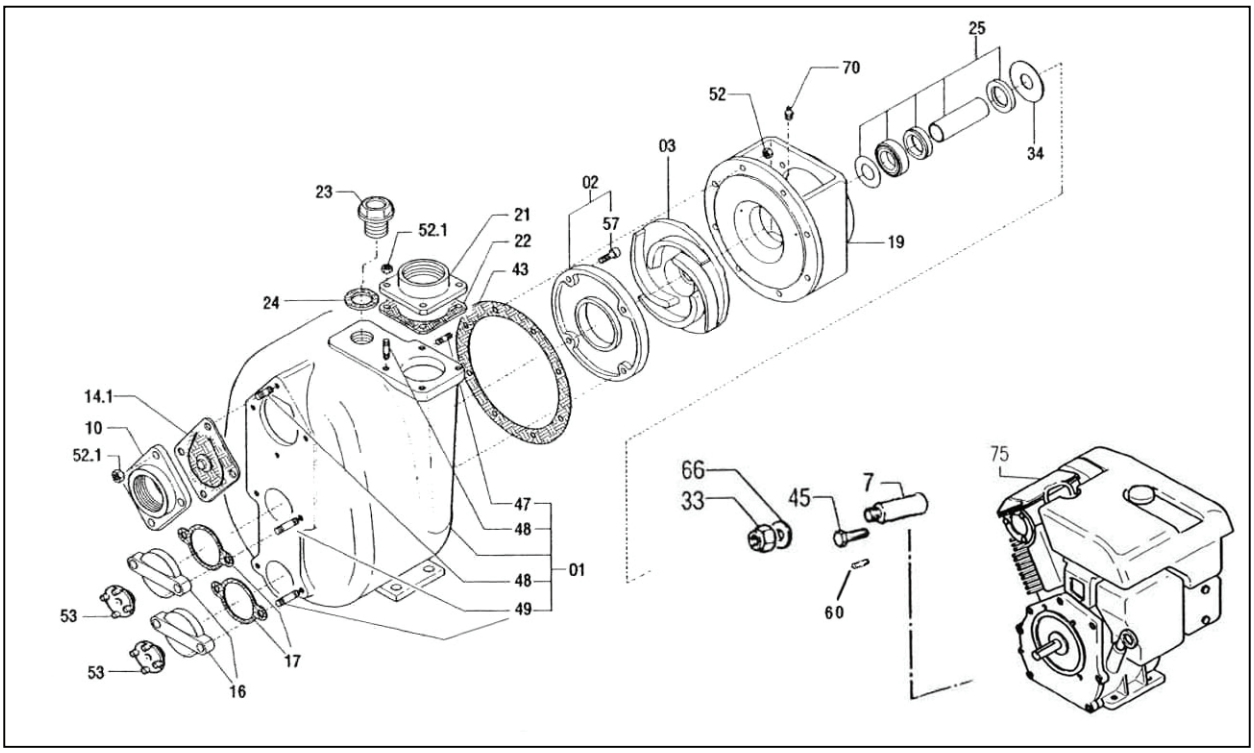


Figure 43

The impeller (figure 43, #03) turns with the shaft assembly and generates the flow and pressure of the pump assembly. The impeller (figure 43, #03) is the "heart" of the pump and if this item is damaged, substantial decreases in pump performance will be noted. To inspect the impeller (figure 43, #03), do the following:

1. Empty the pump casing (figure 43, #01) through the drain plug (figure 43, #16).
2. Unscrew the casing nuts (figure 43, #52) and remove the pump casing (figure 43, #01), taking care not to damage the casing gasket (figure 43, #43).
3. Inspect the interior of the casing (figure 43, #01) for damage and wear.
4. Inspect the impeller vanes (figure 43, #03) for damage and wear.
5. Check the distance between the impeller (figure 43, #03) and the casing (figure 43, #01) as described in Impeller Adjustment Section 9.5.
6. Reassemble in reverse order.

If the impeller (figure 43, #03) appears to be damaged it must be replaced. If the impeller (figure 43, #03) cannot be adjusted as described in Section 9.5 Impeller Adjustment, the impeller (figure 43, #03) may be damaged and needs to be replaced (see section 9.4.2).
Inspect the flat-machined surface inside of the casing (figure 43, #01). If this surface is substantially corroded or damaged, the casing (figure 43, #01) must be replaced (see section 9.4.3).

Inspection: Check pump daily for external leaks

⚠ WARNING ⚠

If any external leaks are found while pumping hazardous product, immediately stop operations and repair.

Replacement

9.3.4 Check Valve Assembly (figure 44, #14.1)

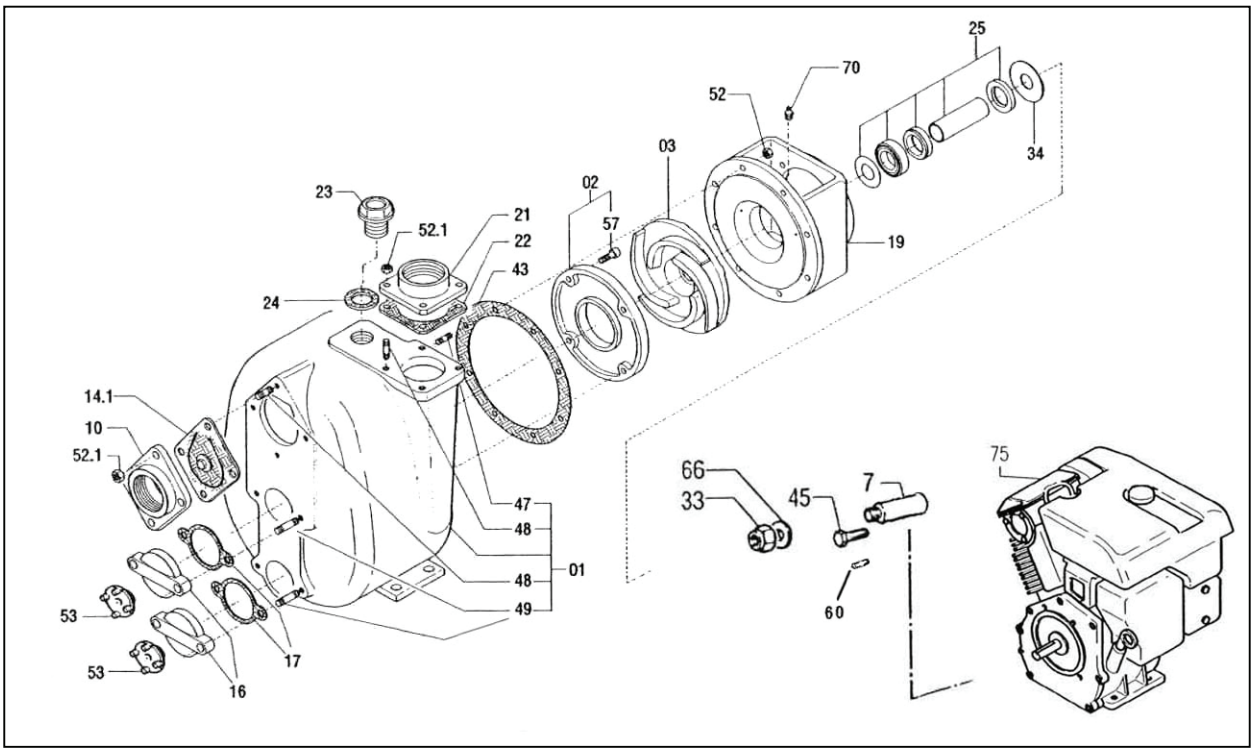


Figure 44

1. Drain the casing (figure 44, #01) through the drain plug (figure 44, #16).
2. Remove the suction flange nuts (figure 44, #52.1).
3. Slip off the suction flange (figure 44, #10).
4. Slip off the check valve (figure 44, #14.1).
5. Mount the new check valve ((figure 44, #14.1) with the hinge towards the top.
6. Clean the valve seat of the suction flange and reassemble it.
7. Some check valves have a tongue, which protrudes outside the suction flange. In this case, the weight of the check valve must be borne while tightening the nuts by pulling this tongue.
8. Reassemble in reverse order.

9.3.5 Impeller Assembly (figure 45, #03)

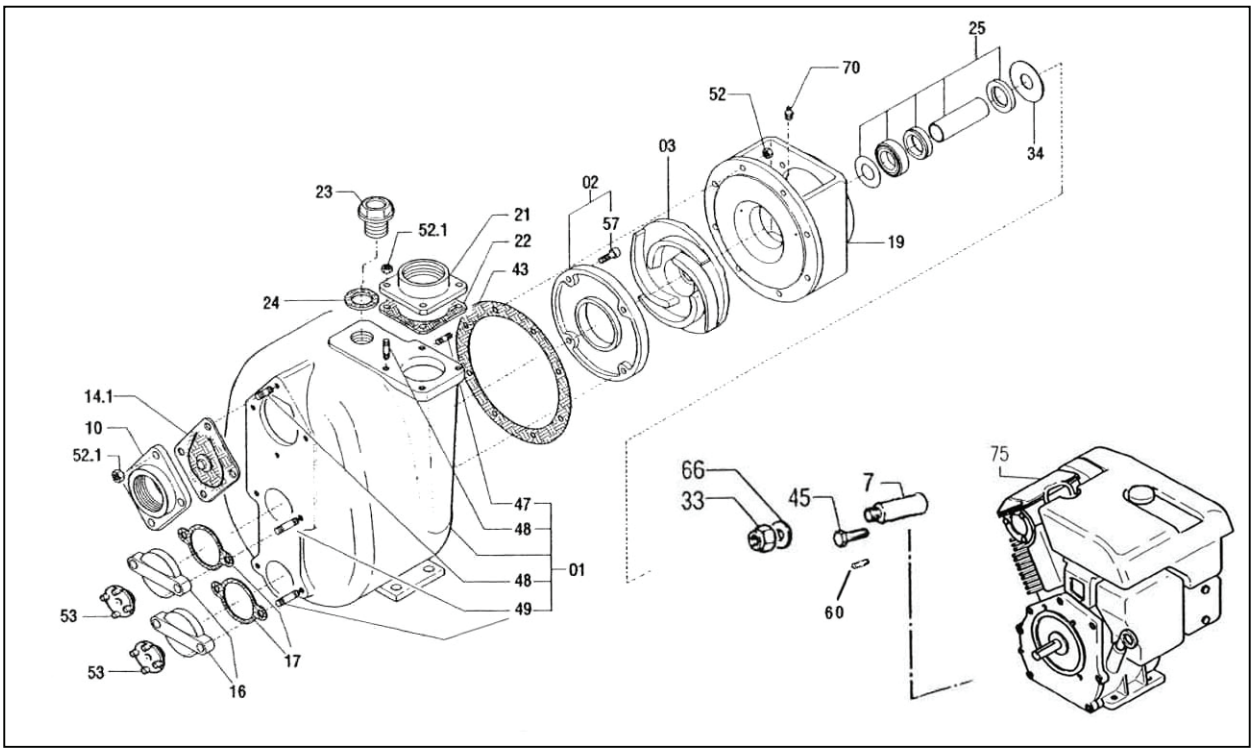


Figure 45

1. Drain the casing (figure 45, #01) through the drain plug (figure 45, #16).
2. Unscrew the nuts (figure 45, #52) and remove the pump casing (figure 45, #01), taking care not to damage the casing gasket (figure 45, #43).
3. Block the impeller (figure 45, #03) and unscrew the self-locking impeller nut (figure 45, #33).
4. Remove the impeller (figure 45, #03) and replace it with a new one.
5. If necessary, replace the casing gasket (figure 45, #45).
6. Check the distance between the impeller (figure 45, #03) and the casing (figure 45, #01) as described in Impeller Adjustment Section 9.5.
7. Reassemble in reverse order.

9.3.6 Casing Assembly (figure 46, #01)

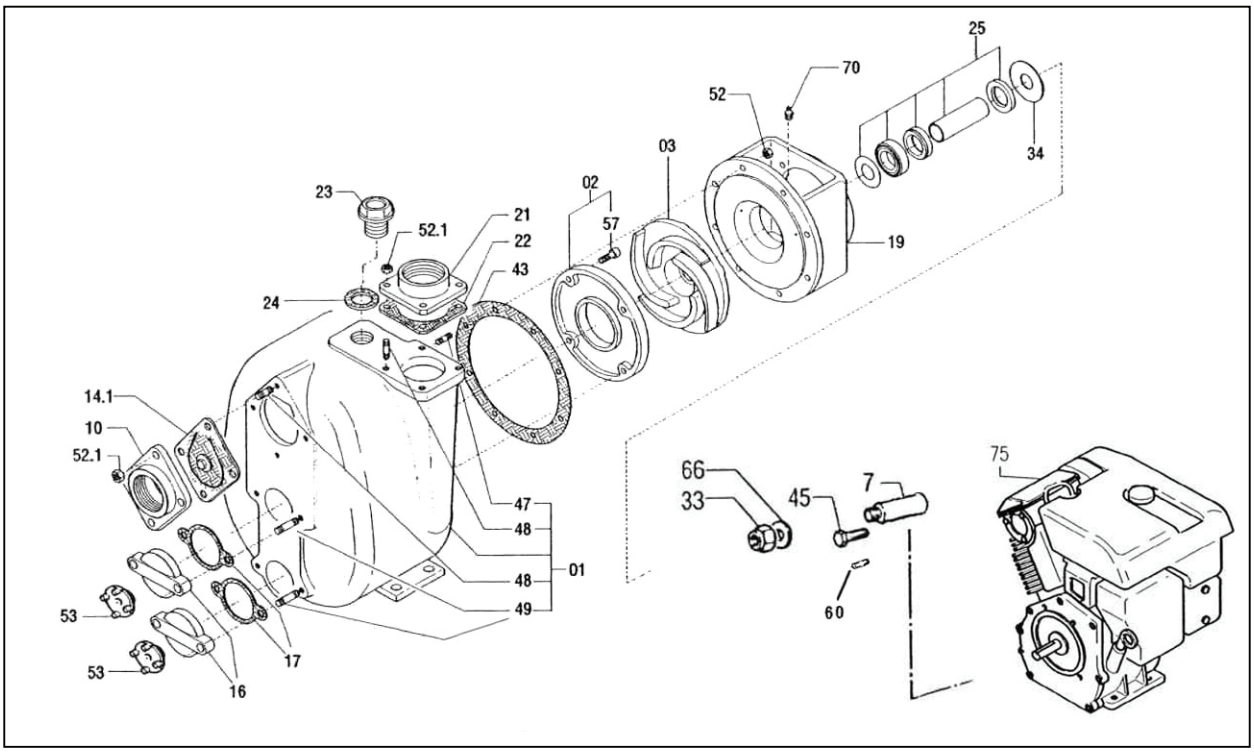


Figure 46

1. Drain the casing (figure 46, #01) through the drain plug (figure 46, #16).
2. Unscrew the nuts (figure 46, #52) and remove the pump casing (figure 46, #01), taking care not to damage the casing gasket (figure 46, #43).
3. Replace the pump casing (figure 46, #01).
4. Reassemble in reverse order.

9.3.7 Casing Wear Plate (figure 47, #02)

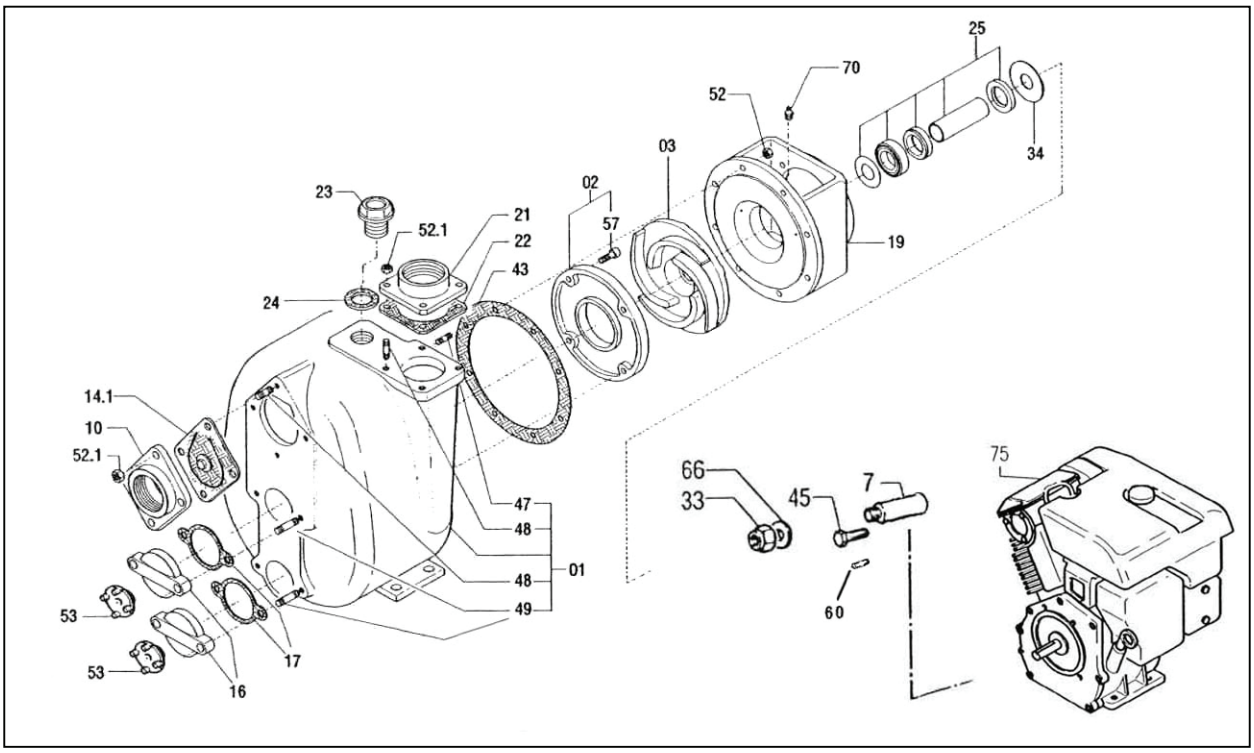


Figure 47

1. Drain the casing (figure 47, #01) through the drain plug (figure 47, #16).
2. Unscrew the nuts (figure 47, #52) and remove the pump casing (figure 47, #01), taking care not to damage the casing gasket (figure 47, #43).
3. Remove the three wear plate screws (figure 47, #57). Remove the casing wear plate (figure 47, #02).
4. Replace the casing wear plate (figure 47, #02).
5. Reassemble in reverse order.

9.3.8 Mechanical Seal Assembly (figure 48, #25)

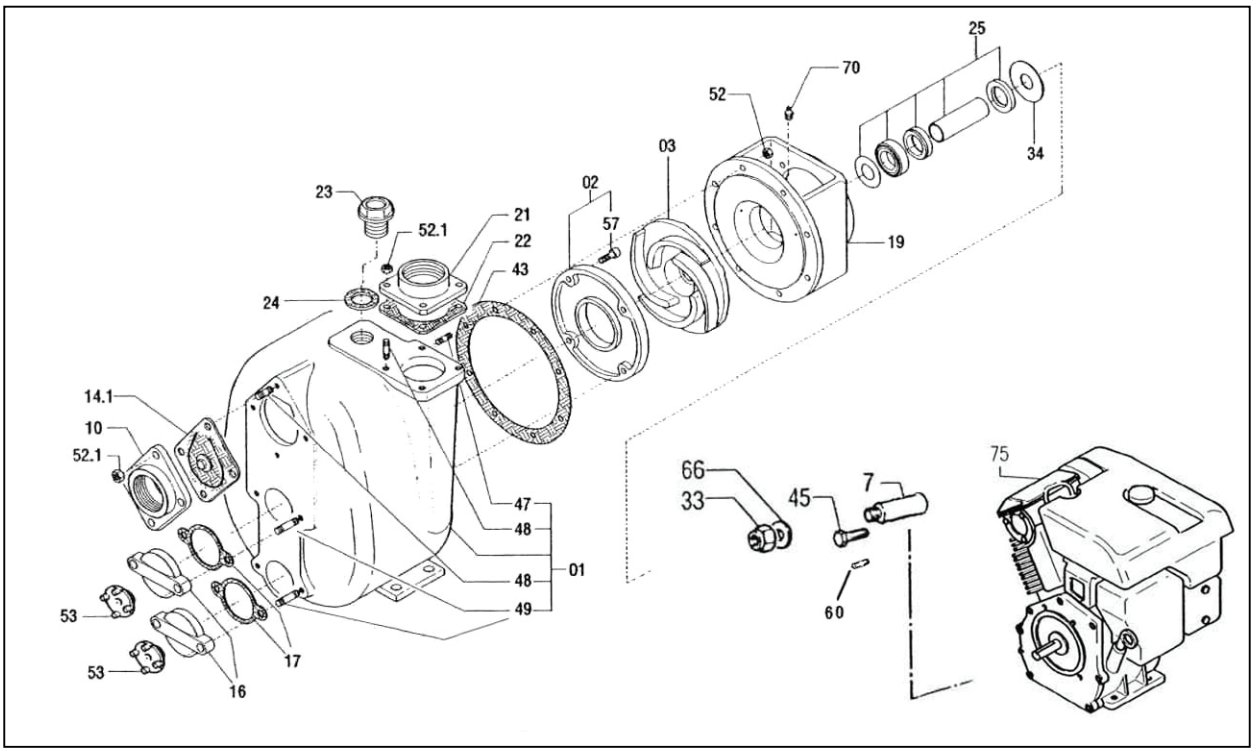


Figure 48

1. Drain the casing (figure 48, #01) through the drain plug (figure 48, #16).
2. Unscrew the nuts (figure 48, #52) and remove the pump casing (figure 48, #01), taking care not to damage the casing gasket (figure 48, #43).
3. Block the impeller (figure 48, #03) and unscrew the self-locking impeller nut (figure 48, #33).
4. Remove the impeller (figure 48, #03).
5. Remove the head (figure 48, #19). Remove the impeller key (figure 48, #60). The rotating part of the mechanical seal (figure 48, #25) mounted on the shaft sleeve will slide off of the shaft (figure 48, #07) together with the head (figure 48, #19).
6. Remove the stationary seat (figure 48, #25) and its gasket from the head (figure 48, #19).
7. Remove the lip seal (figure 49, #41).
8. Wash the head (figure 48, #19) with solvent to remove any residue of grease and clean the seats and the outer surface of the lip seal (figure 49, #41).
9. Mount a new lip seal (figure 49, #41) in the head (figure 48, #19). To facilitate assembly, smear a little lubricant compatible with the pumped fluid on the seat and the outer surface of the lip seal (figure 49, #41).
10. Mount the stationary portion of the mechanical seal (figure 48, #25) together with its gasket. To facilitate this operation, wet the seat on the head (figure 48, #19) and the gasket with a lubricant compatible with the pumped fluid. If necessary, use a wooden plunger or similar to push the stationary seat into its seat.

⚠ CAUTION

11. **Reassemble the head (figure 48, #19) taking care not to touch the shaft (figure 48, #07) with the stationary seal seat (figure 48, #25). This is a brittle material and could fracture.**
12. Slip the sleeve (figure 49, #31) and seal onto the shaft and push to overcome the slight resistance offered by the lip seal (figure 49, #41). Take care that the mechanical seal (figure 48, #25) does not slip off of the shaft sleeve.
13. Mount the seal support ring (figure 49, #34). Push this forward until it is possible to reassemble the impeller key (figure 48, #60).
14. Reassemble the impeller (figure 48, #03), the impeller washer (figure 48, #66) and tighten the impeller nut (figure 48, #33).
15. If necessary, replace the casing gasket (figure 48, #43).
16. Check the distance between the impeller (figure 48, #03) and the casing (figure 48, #01) as described in Impeller Adjustment Section 9.5.
17. Reassemble the casing gasket (figure 48, #43) after smearing both sides with grease compatible with the pumped liquid.
18. Reassemble the casing (figure 48, #01) and tighten the nuts (figure 48, #52), checking that the impeller (figure 48, #03) is free to rotate.

19. Fill the seal chamber with grease compatible with the pumped liquid by using the grease fitting (figure 48 #70).

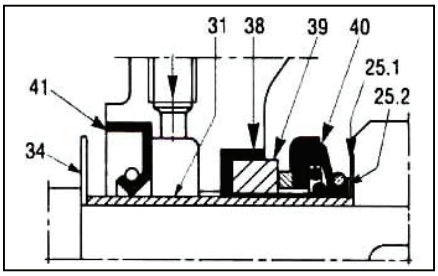


Figure 49

9.4 Impeller Adjustment

In all models, the distance between the top of the impeller blades and the surface of the wear plate must be between 0.012" and 0.024" (see figure 52). To achieve this, dimensions A & B in figure 52 must be as nearly as possible equal. To this end, use the shims (figure 51, #25.1 & 25.2) supplied with spare mechanical seal (figure 50, #25). These shims (figure 51, #25.1 & 25.2) are used to move the impeller (figure 50, #03) further forward if it is too far from the casing or too near the head (figure 50, #19). The shims (figure 51, #25.1 & 25.2) should be mounted between the seal support ring and the impeller (see figure 51). Further adjustments can be carried out using casing gaskets (figure 50, #48). The presence of a case gasket 0.020" thick then creates the correct distance (see figure 52).

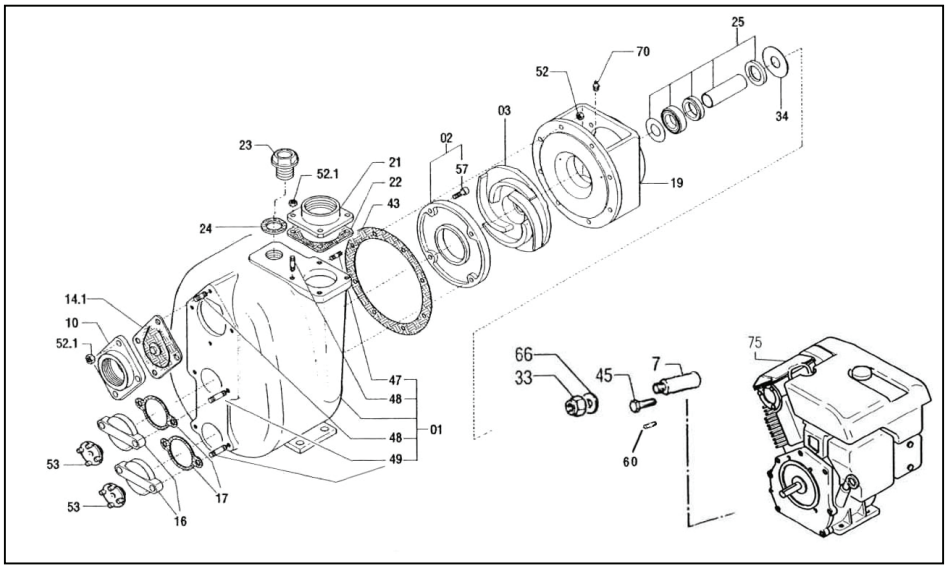


Figure 50

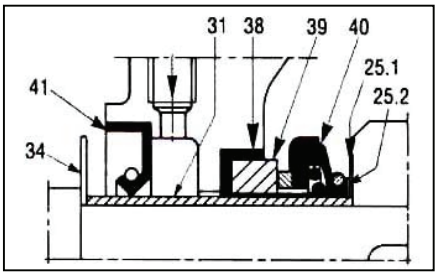


Figure 51

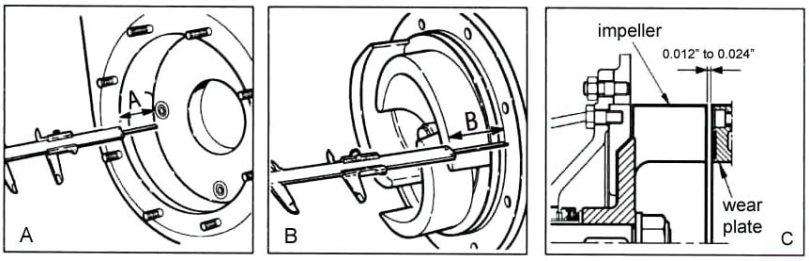


Figure 52

10 TROUBLESHOOTING

The following tables contain possible causes of some failures that may occur during operation. Always perform these simple checks before removing or replacing any part.

10.1 Engine Troubleshooting Chart

	POSSIBLE CAUSE	Repair Section	TROUBLE									
			Engine Does Not Start	Engine Starts But Stops	No Acceleration	Non-uniform Speed	Black Smoke	White Smoke	Too Low Oil Pressure	Increased Oil Level	Excessive Oil Consumption	Oil and Fuel Dripping From Exhaust
Fuel Circuit	Clogged Piping	8.5.2	●									
	Clogged Fuel Filter	8.7.3	●	●	●							
	Air Inside Fuel Circuit	8.5.2	●	●	●							
	Clogged Tank Breather	8.5.2	●	●	●							
	Faulty Feed Pump	8.7.6	●	●								
	Stuck Injector	8.7.5	●									
	Stuck Injection Pump Delivery Valve	8.7.6	●									
	Wrong Injector Setting	8.7.5					●					
	Excessive Plunger Blow-By	8.7.9								●		
	Stuck Injection Pump Delivery Control	8.7.6	●		●	●						
	Wrong Injection Pump Setting	8.7.6			●		●					
Lubrication	Too High Oil Level	8.6.1				●		●			●	
	Stuck Pressure Relief Valve	8.7.9							●			
	Worn Oil Pump	8.7.9							●			
	Air Inside Oil Suction Pipe	8.6.1							●			
	Faulty Pressure Gauge or Switch	8.7.9							●			
	Clogged Oil Suction Pipe	8.7.9							●			
Settings/Repairs	Advanced Injection	8.7.6	●									
	Retarded Injection	8.7.6					●					
	Worn Out or Stuck Piston Rings	8.7.9						●			●	●
	Worn Out Cylinders	8.7.9						●			●	●
	Worn Out Valve Guides	8.7.9						●			●	●
	Sticking Valves	8.7.9	●									
	Worn Out Bearings	8.7.9							●			
	Crankcase Vapor Re-circulation System	8.7.9				●	●				●	●
	Crankshaft Not Turning Freely	8.7.9					●					
	Pull Rope is Damaged	8.7.8	●									
	Damaged Cylinder Head Gasket	8.7.9	●									

10.2 Pump Troubleshooting Chart

POSSIBLE CAUSE	Repair Section	TROUBLE									
		Pump Does Not Prime	**Loss of Suction Lift**	**Pump Doest Not Deliver Liquid**	**Not Enough Capacity**	**Not Enough Pressure**	**Pump Pulls Too Much Power**	**Pump Vibrates & Is Noisy**	**Pump Jams**	**Mechanical Seal Leaks**	**Mechanical Seal Overheats**
Pump Casing Is Empty or Not Sufficiently Full	9.3.1	●	●	●		●		●		●	●
Liquid In The Casing Is Overheated	7.2.1	●						●		●	●
Air Leaks In The Joints or Cracks In The Suction Line	--	●	●		●						
Discharge Line Under Pressure	--	●									
Low Rotational Speed Of The Pump	8.7.7	●	●	●	●	●					
The Impeller Is Worn or Broken	9.4.2	●		●	●	●		●			
The Casing is Worn (Cutwater)	9.4.3	●		●	●	●					
Suction Strainer (If Equipped) Is Clogged	--	●		●	●						
The Impeller Is Clogged	9.3.3	●		●	●	●	●	●	●		
The Suction Lift Is Too High	--	●	●	●	●	●					
Air Entering Through The Mechanical Seal	9.3.2	●								●	●
Head Required By The System Is Greater Than Rated Head Of Pump	--			●		●					
Excessive Friction Loss In The Suction Line	--			●							
Suction Or Discharge Lines Are Clogged	--		●	●	●						
Diameter of Suction Line Is Too Small	--				●						
Viscosity Of Pumped Liquid Too High	--			●		●	●		●		
Rotational Speed Too High	8.7.7						●	●		●	●
Friction Inside The Pump From Rotating Parts in Contact With Non-rotating Parts	9.3.3						●	●	●	●	●
Pump Operating At Too Low Capacity	8.7.7				●			●			
Pump is Cavitating	8.7.7			●	●	●	●	●			
Pull Rope is Damaged	8.7.9	●									
Mechanical Breakdown	8.7.10							●	●	●	●

11 MAINTENANCE ALLOCATION CHART

Operation Section	Task	Operation	Duration to Accomplish Task (Hours)
Engine Components			
8.5.5	Dry Air Cleaner	Inspection	0.10
8.5.5		Cleaning	0.25
8.7.4		Replacement	0.25
8.8.3	Fuel Filter Cartridge	Replacement	0.50
8.8.6	Fuel Pump	Replacement	0.50
8.6.2	Fuel Tank	Cleaning	0.50
8.6.1	Head & Cylinder fins	Cleaning	0.25
8.6.3	Injector	Cleaning/Inspection	0.50
8.8.5		Replacement	0.75
8.6.4	Oil Filter Cartridge	Cleaning	0.50
8.8.2		Replacement	0.50
8.7.1	Oil Level	Inspection	0.10
8.8.1		Replacement	0.25
8.7.2	Valve/Rocker Rocker Clearance	Inspection	1.00
8.7.2		Adjustment	0.50
Pump Components			
9.3.3	Impeller	Inspection	0.25
9.4.2		Replacement	0.50
9.3.3	Casing	Inspection	0.25
9.4.3		Replacement	0.50
9.3.1	Check Valve Assembly	Inspection	0.10
9.4.1		Replacement	0.50
9.2.2	Exterior of Pump	Cleaning	0.25
9.3.2	Mechanical Seal Assembly	Inspection	0.10
9.4.4		Replacement	1.00
9.2.1	Pump Suction & Discharge Connections	Cleaning	0.25
	Casing Wear Plate	Replacement	0.50

NOTE: All tasks can be done with GMTK.

12 TORQUE CHART

BOLT SIZE		TIGHTENING TORQUE	
Metric	Standard	Lbf ft	Nm
4 mm	5/32”	2.7	3.6
5 mm	3/16”	5.2	7.0
6 mm	1/4”	8.9	12.0
7 mm	9/32”	14.6	19.8
8 mm	5/16”	21.8	29.6
9 mm	11/32”	28.0	38.0
10 mm	3/8”	38.7	52.5
12 mm	1/2”	65.6	89.0
14 mm	9/16”	99.6	135
16 mm	5/8”	151	205
18 mm	11/16”	190	257
20 mm	3/4”	264	358
49 mm	7/8”	321	485
24 mm	15/16”	411	557

13 PARTS BREAKDOWN

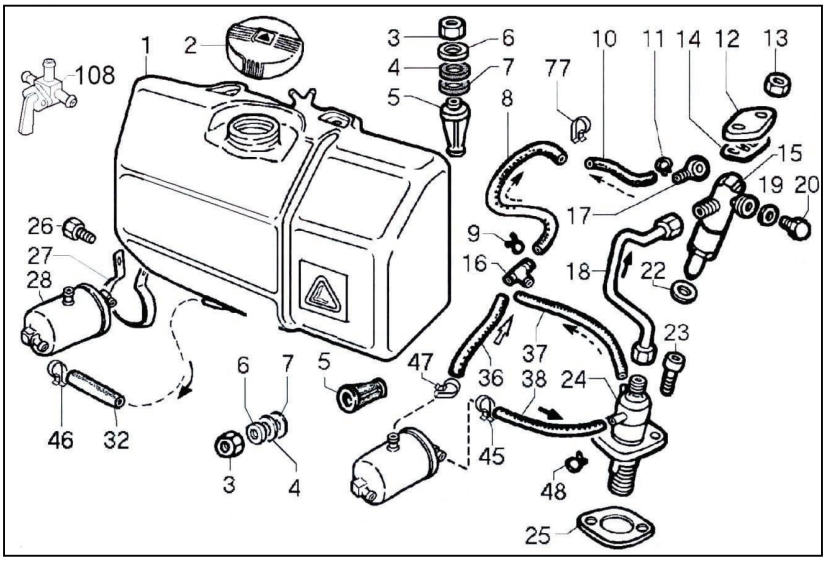


Figure 53, Fuel System

Figure 57, Fuel System							
Item	Description	QTY	Part Number	Item	Description	QTY	Part Number
1	Fuel Tank	1	898103317	20	Union Bolt	1	891901171
2	Fuel Tank Cap	1	899043079	22	Gasket	1	894670099
3	Nut (M8)	4	893240164	23	Screw (M6x20)	2	899730013
4	Rubber Washer	4	897701154	24	Injection Pump	1	896590359
5	Spacer	4	893527384	25	Gasket	1	894580160
6	Washer	4	897625272	26	Screw (M6x12)	1	899730319
7	Rubber Washer	4	897701154	27	Fuel Filter Clamp	1	893617197
8	Fuel Line	1	899375846	28	Fuel Filter	1	893730088
9	Clamp	2	893630113	32	Fuel Line	1	899375846
10	Fuel Line	1	899375846	36	Fuel Line	1	899375846
11	Clamp	1	893630050	37	Fuel Line	1	899375845
12	Injector Flange	1	893902310	38	Fuel Line	1	899375846
13	Nut (M6)	2	893203050	45	Clamp	1	893630050
14	Injector Plate	1	896370512	46	Clamp	1	893630050
15	Injector	1	895010066	47	Clamp	1	893630050
16	Pipe Fitting	1	892527092	48	Clamp	1	893630113
17	Banjo Union	1	897270108	77	Clamp	2	893630050
18	High Pressure Fuel Line	1	899376029	108	Fuel Shutoff Valve	1	441030
19	Copper Gasket	2	894670001				

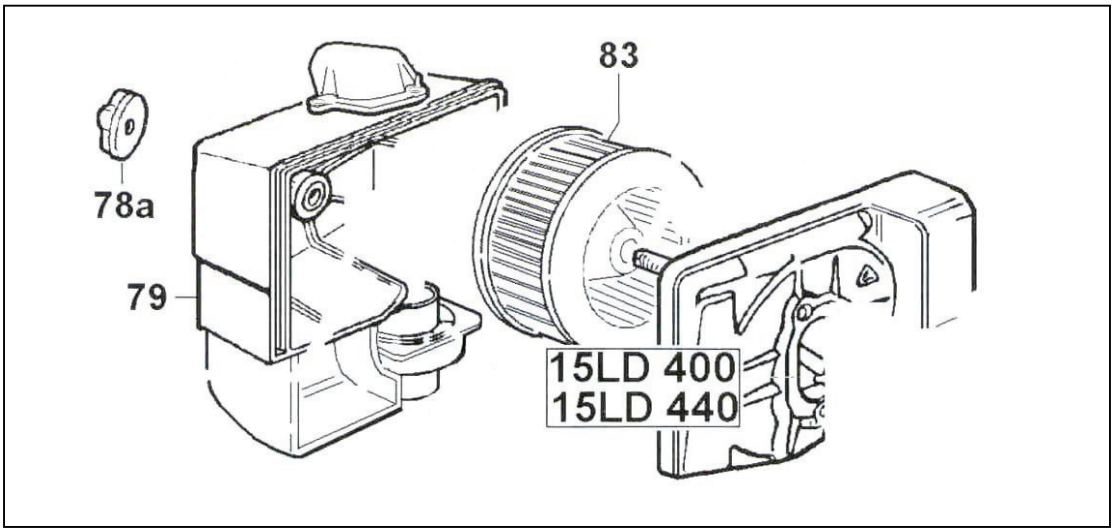


Figure 54, Intake

Figure 58, Intake			
Item	Description	Quantity	Part Number
78a	Knob	1	896560040
79	Air Cleaner Cover	1	892750390
83	Air Cleaner Element	1	892175237

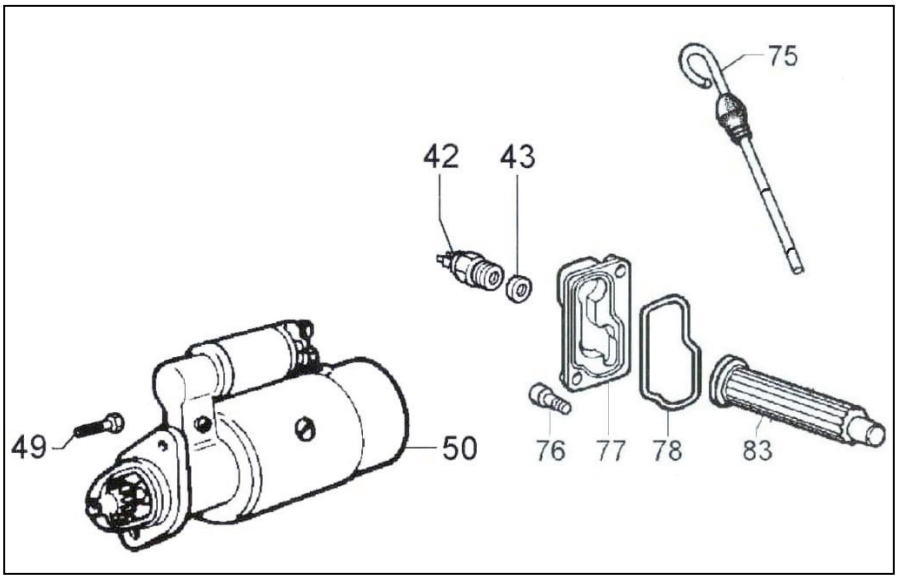


Figure 55, Crankcase

Figure 55, Crankcase			
Item	Description	Quantity	Part Number
42	Oil Pressure Switch	1	896745052
43	Copper Gasket	1	894670059
49	Screw (M10 x 25)	2	899730044
50	Starting Motor 24V	1	895840178
75	Oil Dipstick	1	891400420
76	Screw (M6x16)	2	899730010
77	Oil Filter Head	1	899220114
78	O-Ring	1	891200234
83	Oil Filter Element	1	892175129

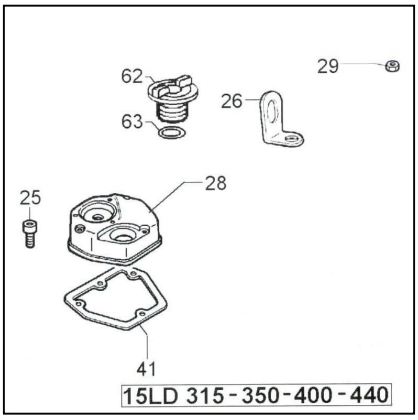


Figure 56, Lubrication System

Figure 56, Lubrication System			
Item	Description	Quantity	Part Number
25	Screw (M6x40)	3	899730010
26	Lift Eye	1	898506003
28	Rocker Arm Cover Assy.	1	892125650
29	Safety Nut	2	893203050
30	Special Nut	2	891557146
41	Gasket	1	894400058
62	Filler Oil Cap	1	899032086
63	O-Ring	1	891200082

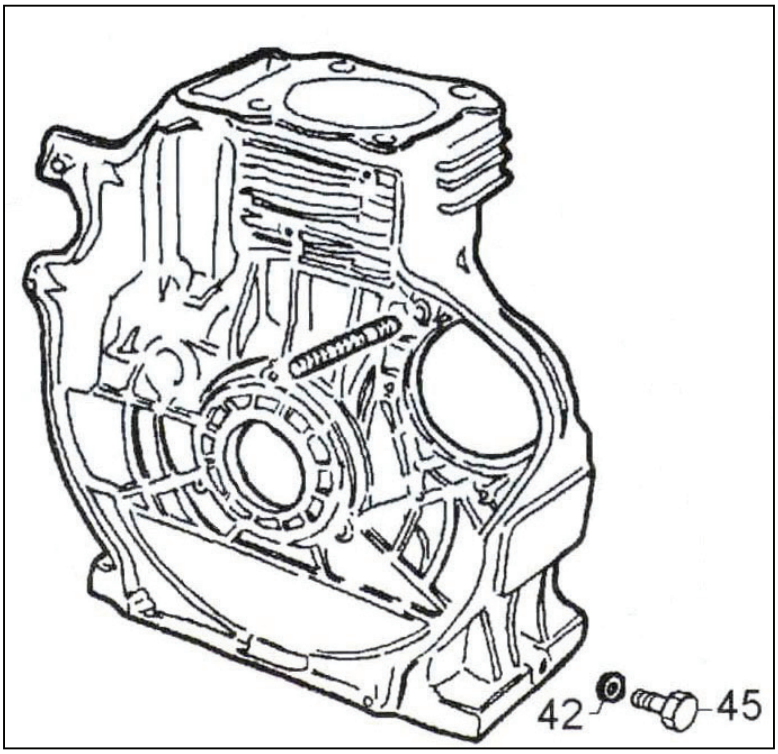


Figure 57, Cylinder Head/Crank

Figure 57, Cylinder Head/Crank			
Item	Description	Quantity	Part Number
42	Gasket	2	894350007
45	Plug (M14)	2	899040012

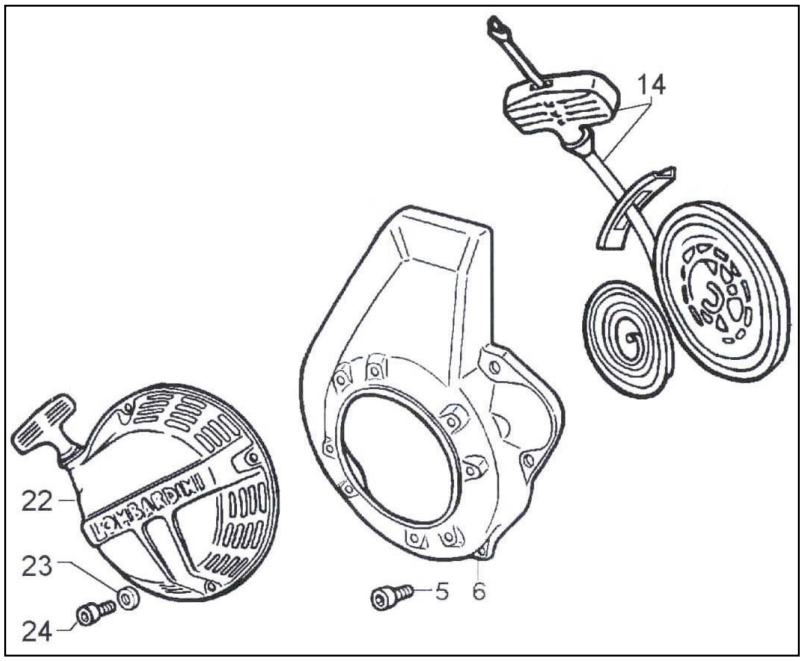


Figure 58, Starting

Figure 58, Starting			
Item	Description	Quantity	Part Number
5	Screw (M6x12)	5	899732084
6	Shroud	1	892569498
14	Handgrip & Rope	1	894904038
22	Rewind Starter	1	891472033
23	Washer (D6)	4	897625007
24	Screw (M6x8)	4	899730309
25	Spring	1	895801539

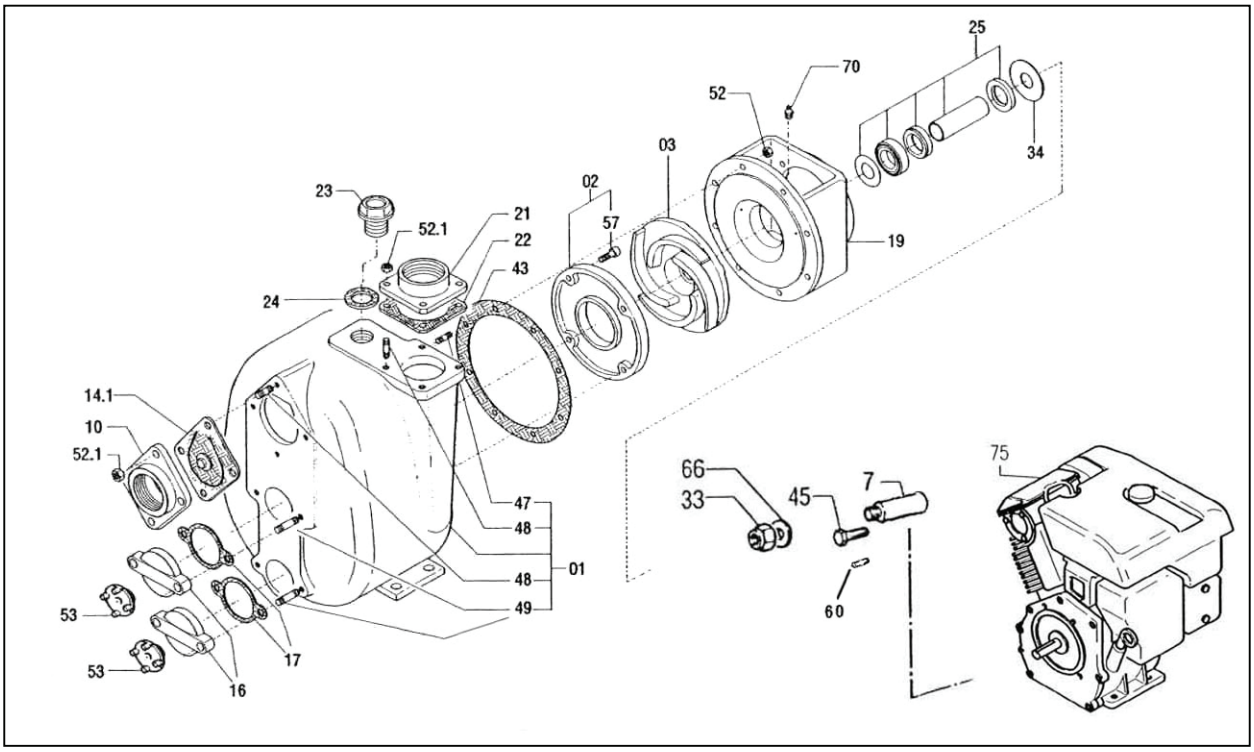


Figure 59, Pump Assembly

Figure 59, Pump Assembly			
Item	Description	Quantity	Part Number
1	Casing	1	8810016935
2	Wear Plate	1	8810016934
3	Impeller	1	8810005371
7	Shaft	1	8810014374
10	Suction Flange	1	8810006414
14.1	Check Valve Assembly	1	8810009015
16	Cover	3	8810006473
17	Gasket, in Gasket Assy.	3	8810014381
19	Head	1	8810006342
21	Discharge Flange	1	8810005083
22	Gasket, in Gasket Assy.	1	8810014381
24	Gasket, in Gasket Assy.	1	8810014381
25	Mechanical Seal Assembly	1	8810026299
33	Impeller Nut (M14x1.5)	1	8810001464
34	Water Deflector	1	8810004139
43	Casing Gasket, in Gasket Assy.	1	8810014381
45	Screw (M8x35), in Fastener Assy.	4	8810014357
47	Stud (M8x20), in Fastener Assy.	4	8810014357
48	Stud (M8x20), in Fastener Assy.	8	8810014357
49	Stud (M10x30), in Fastener Assy.	2	8810014357
52	Nut (M8), in Fastener Assy.	8	8810014357
52.1	Nut (M8), in Fastener Assy.	8	8810014357
53	Nut, in Fastener Assy.	6	8810014357
57	Screw (M8x20), in Fastener Assy.	3	8810014357
60	Impeller Key (Not Shown)	1	8810001621
66	Impeller Washer (M18)	1	8810001709
70	Grease Zerk	1	87100014
75	Lombardini 15LD400 Engine	1	441113

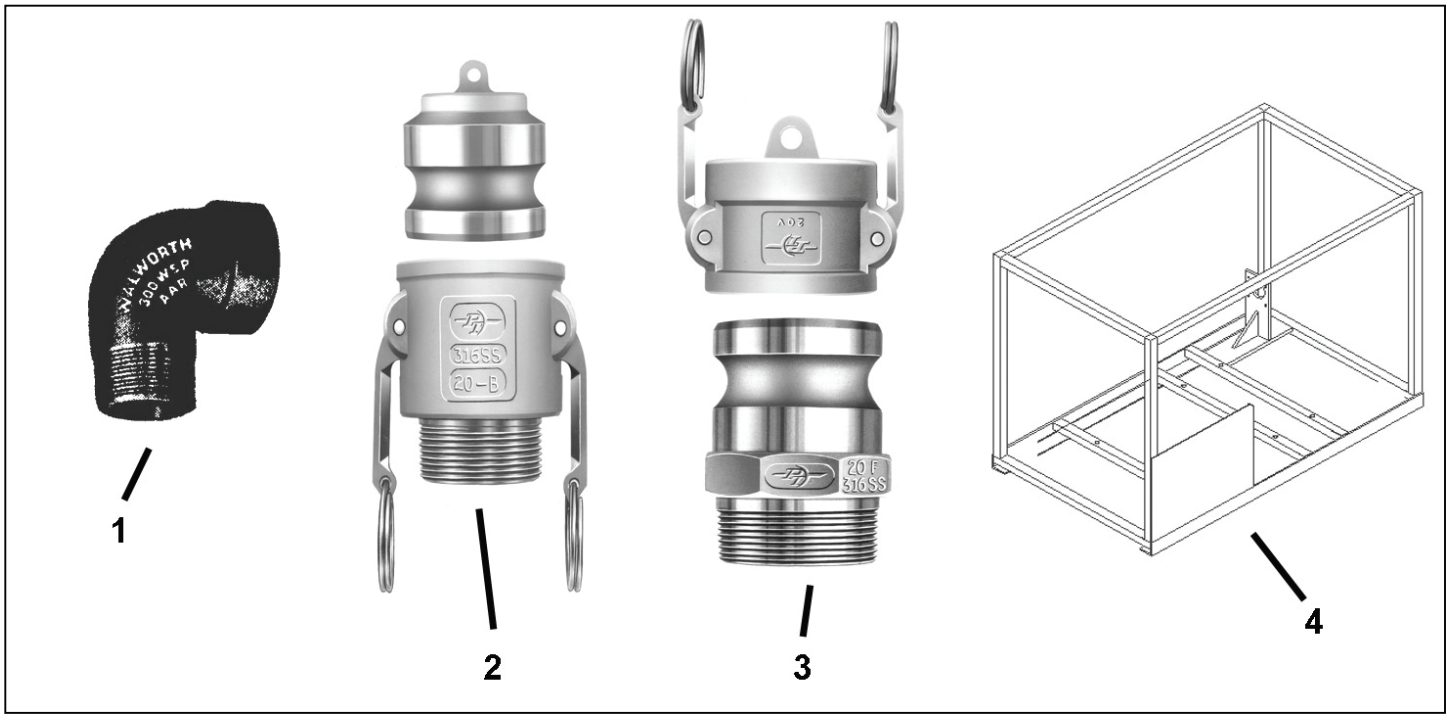


Figure 60, Pump Accessories

Figure 60, Pump Accessories			
Item	Description	Quantity	Part Number
1	1.5” 90 Degree Galvanized Street Elbow	2	441075
2	Suction Coupling	1	441309
3	Discharge Coupling	1	441310
4	Base	1	61726108

By Order of the Secretary of the Army:

GEORGE W. CASEY, JR.
General, United States Army
Chief of Staff

Official:

JOYCE E. MORROW
Administrative Assistant to the
Secretary of the Army
0906301

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PART I – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	Title
TM 5-4320-371-14&P	20 Mar 09	Operator & Maint Manual for Pump, Diesel-Driven, 100 GPM Fuel, 100 Ft Head

ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Provide exact wording of recommended changes, if possible).
	0019001	3	1	1		Step No. 2 says to secure doors open with locking bar or hooks from where to what? The bars or hooks are not identified.
	9919004	4	1	1		Step No. 19 states to remove locking bars, pins or hooks from where to what? The bars, pins, or hooks are not identified. Where are they stored?

**Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	Signature
Your Name		*Your Signature*

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PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

SAMPLE

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ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Provide exact wording of recommended changes, if possible).

**Reference to line numbers within the paragraph or subparagraph.*

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PUBLICATION NUMBER	DATE	TITLE
TM 5-4320-371-14&P	20 Mar 09	Oper & Maintenance Manual for Pump Unit Diesel-Driven, 100 GPM Fuel @ 100 Ft Head

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

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ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Provide exact wording of recommended changes, if possible).

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigrams = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. lathes
1 cu. meter = 1000 cu. decimeters = 35.31 feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	metric tons	short tons	1.102
pound-feet	newton-meters	1.356	kilograms	pounds	2.205
pound-inches	newton-meters	.11296			

Temperature (Exact)

ºF Fahrenheit temperature 5/9 (after subtracting 32) ºC Celsius temperature

PIN: 085338-000