OPERATORS MANUAL
MARINE DIESEL ENGINES
W-13, W-21, W-27, W-33

PUBLICATION NO. 32363

WESTERBEKE

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Member National Marine Manufacturers Association

CALIFORNIA
PROPOSITION 65 WARNING

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

⚠ WARNING

Exhaust gasses contain Carbon Monoxide, an odorless and colorless gas. Carbon Monoxide is poisonous and can cause unconsciousness and death. Symptoms of Carbon Monoxide exposure can include:

- ***Dizziness***
- ***Nausea***
- ***Headache***
- ***Weakness and Sleepiness***
- ***Throbbing in Temples***
- ***Muscular Twitching***
- ***Vomiting***
- ***Inability to Think Coherently***

IF YOU OR ANYONE ELSE EXPERIENCE ANY OF THESE SYMPTOMS, GET OUT INTO THE FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shut down the unit and do not restart until it has been inspected and repaired.

This WARNING DECAL is provided by WESTERBEKE and should be fixed to a bulkhead near your engine or generator.

WESTERBEKE also recommends installing CARBON MONOXIDE DETECTORS in the living/sleeping quarters of your vessel. They are inexpensive and easily obtainable at your local marine store.

FOREWORD

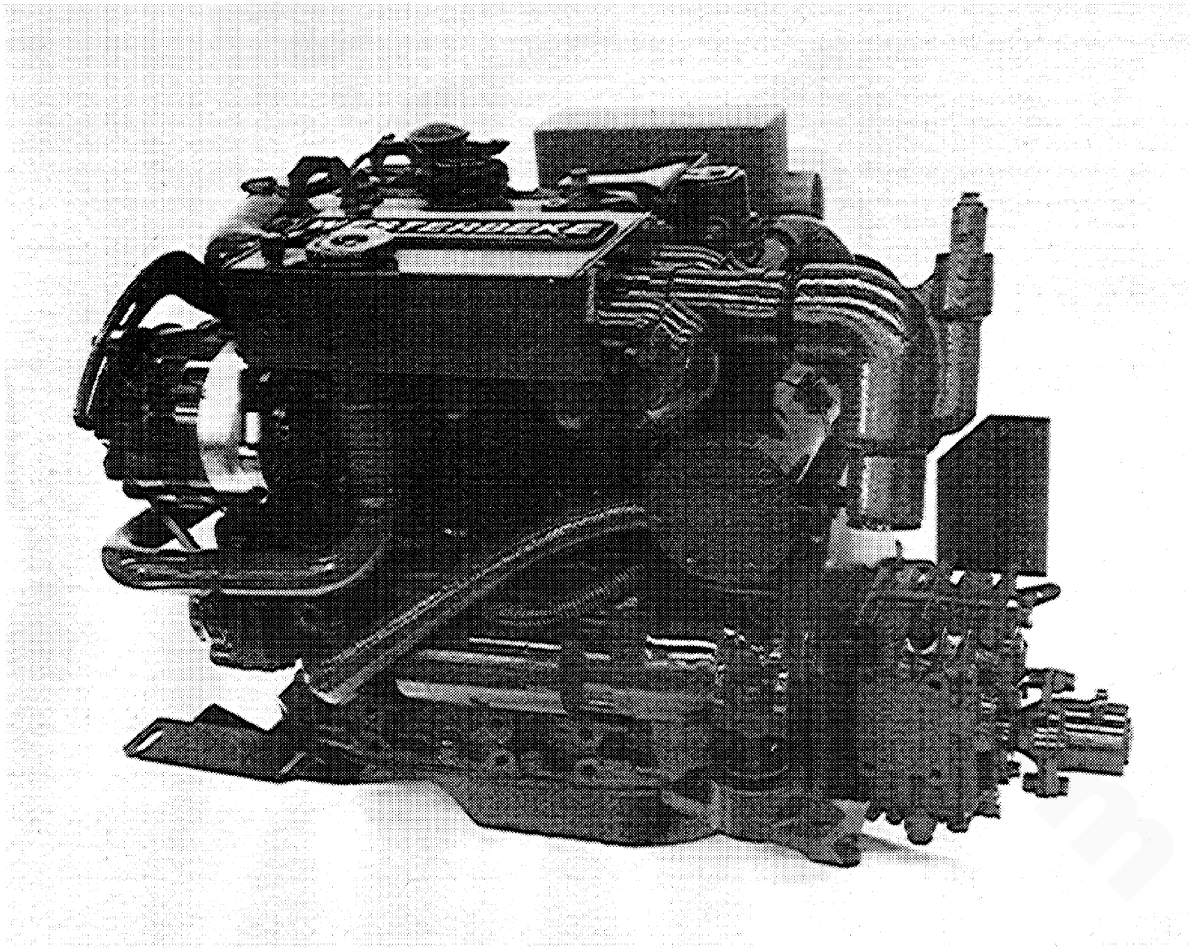
Thank you for having selected a Westerbeke Diesel Engine for your use.

This manual describes the procedures for proper handling and maintenance of the Engine Models W13, W21, W27 and W33.

To maintain your engine always in its best operating condition and to enable it to perform best, it is important to handle it properly and carry out complete maintenance according to this manual.

If you have any questions about your engine or in the event of a failure, please contact your nearest distributor or dealer.

We look forward to your continued patronage.



LEFT SIDE, W-21 WITH 2:1 HBW-50 TRANSMISSION

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GENERAL SPECIFICATIONS

ITEM	CHARACTERISTIC	W13	W21	W27	W33
ENGINE SPECIFICATIONS	Type	Vert.,4 cycle,water cooled diesel engine			
	Combustion chamber	Swirl chamber type			
	No. of cylinders	2	3	4	4
	Bore & stroke (inches)	2.76x3.07	2.87x3.07	2.87x3.07	3.07x3.07
	Cu. In. displacement	37	60	80	91
	Compression ratio	23	23	23	23
	Firing order	1-2	1-3-2	1-3-4-2	1-3-4-2
	Dry weight, std. (lbs)	298	374	434	498
FUEL SYSTEM	Fuel	#2 diesel fuel only			
	Injection pump	Bosch type			
	Nozzle	Throttling type			
	Injection pressure	All models: 1707 lbs.			
	Governor	Centrifugal weight type			
LUBRICATION SYSTEM	Lubrication system	Pressure lubrication			
	Oil filter	Filter paper type			
	Engine oil capacity	2.5 qts	4.0 qts	4.0 qts	4.2 qts For accuracy, depend on dipstick markings
COOLING SYSTEM	Cooling system	Forced circulation, water cooling by heat exchanger			
	Coolant capacity	6 qts	5 qts	8 qts	8 qts Always fill to top of filler neck
ELECTRICAL SYSTEM	Starter V-HP	12-2	12-2	12-2	12-2
	Alternator V-A	12-50	12-50	12-50	12-50
	Glow plug	Sheathed type - all models			
	Battery capacity	60 AH	75 AH	90 AH	90 AH

CAUTIONS IN HANDLING ENGINE

* Always use proper engine oil and watch oil pressure during operation.
* Use clean fuel, free from impurities and water content.
* Prevent entry of air and water into the fuel system.
* In case the starter motor pinion fails to engage with the ring gear at the time of starting, turn on the starter switch again after the starter motor has come to a complete stop.
* Prevent the temperature of cooling water from falling too low.
* Pay attention to the color of exhaust gas.
* Clean or replace the fuel filter and oil filter periodically.
* Replenish or replace oil as specified.

SAFETY PRECAUTIONS

* Never put the engine in operation in improperly ventilated places.
* Do not touch moving parts during operation.
* Do not touch hot parts such as exhaust pipe, and do not place combustible materials there.
* Inspect and adjust parts of the engine only after it is stopped.
* Check and refill engine oil, cooling water and fuel after the engine is brought to a stop.
* In checking the level of and refilling cooling water, remove the pressure cap after the temperature of the water has fallen enough.
* Always use tools of proper sizes and full caution during servicing.

BREAKING IN

Service life of your engine is dependent upon how your engine is operated and serviced during the initial 50 hours of operation!

Your new engine needs 50 hours of conditioning operation for breaking each moving part in and maximizing performance and life of engine. Perform this conditioning carefully, bearing the following points in mind:

CAUTION:

* Idle and warm up your engine from 3 to 5 minutes.
* Avoid hasty acceleration.
* Use caution not to overload the engine.
* Inspect, maintain and service your engine in accordance with the instructions in this manual.

Explanation:

"Breaking in" a new engine is basically a seating of the piston rings to the cylinder walls. This is not accomplished by long periods of running idle, nor by early running under full load, nor by varying loads with intervals of fast acceleration and/or excessive speed.

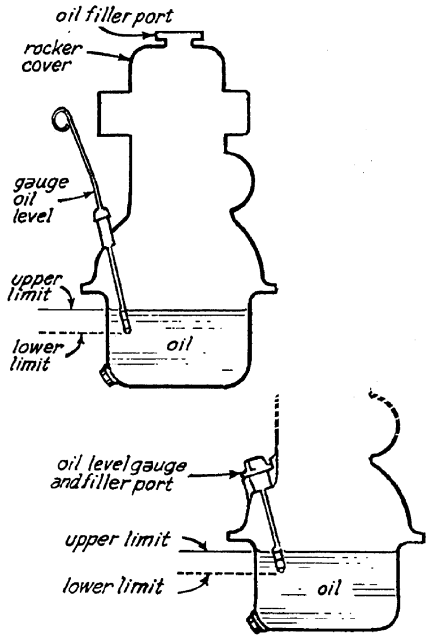
Idle running may glaze the cylinder walls causing oil consumption and smoky operation. Excessive speeds and loads may score cylinder walls with similar results.

As indicated above, use a short warm up at idle and put engine under moderate load and speed for the first ten hours of operation. For the next forty hours, use approximately 70% load. This kind of careful operation will result in best results from your engine.

PREPARATIONS

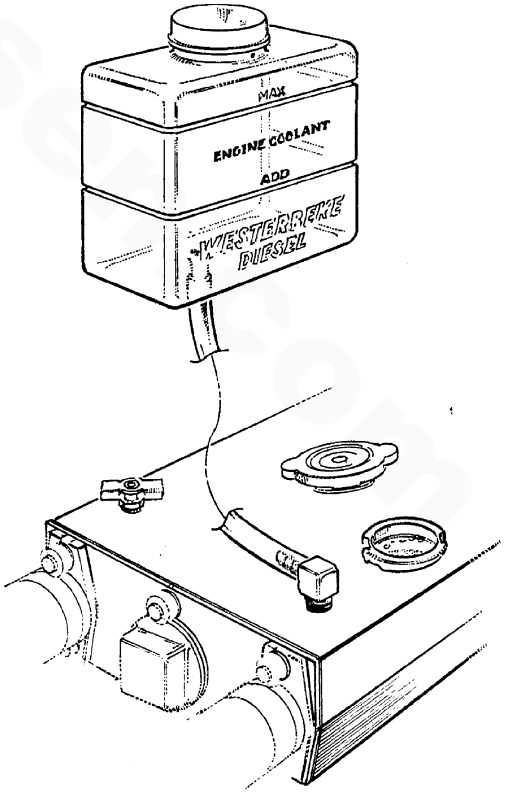
Take steps as shown below in starting your engine for the first time or after a prolonged shut-down.

1. Fill your engine with oil up to or near the upper limit on the dipstick. Use a good grade of oil with API specification of CC or better. For quantity of oil, you may refer to the General Specifications page. However, it is best always to be guided by dipstick measurement as angle of installation has some effect.



2. Your engine is supplied with a coolant recovery system to which the following instructions apply:

   a) Fill engine completely to the neck of the manifold cap.
   b) Then fill the recovery tank to the bottom level line. Need for adding coolant is indicated when a cold engine has coolant level below the bottom level line.
   c) In winter add antifreeze as described on page 16. Antifreeze may be used year round if changed annually.



3. Fill the fuel tank with Diesel fuel. The interior of the fuel tank must be maintained clean. Be careful not to allow introduction of dirt when filling fuel.

4. Engine oil, coolant and transmission levels should be checked at least once a day prior to engine use.

STARTING PROCEDURES

Instrument panel, description and use of:

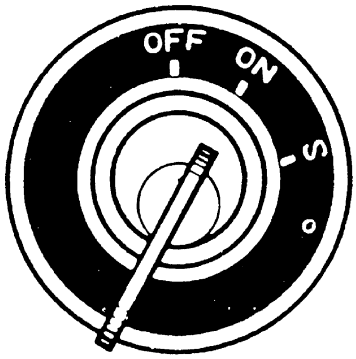
Note 1: When engine is stopped after use, the water temperature and oil pressure gauges may stay at their running readings.

Note 2: When engine is next to be used, turn start switch to "ON". The temperature and pressure gauges will "ZERO" and the voltmeter will register battery voltage. The electric fuel pump, mounted on the engine, will also begin to operate, purging any air accumulated in the system.

Note 3: The engine is now prepared for starting.

STARTING PROCEDURES

1. Turn the starter switch to the "ON" position. If making an initial start after lay-up, fuel filter servicing or repairs, allow fuel pump to work 15-25 seconds to purge the system of any air. Check that clutch is in neutral and that throttle is in full forward.



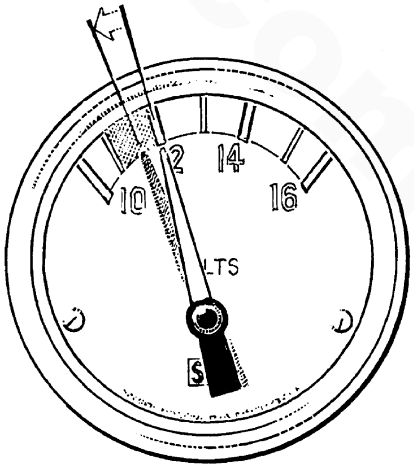
2. Glow plug preheating

   With key in "ON" position, push in about 1/4 inch or enough so that voltmeter indicates discharge. Hold key in depressed position until glow plugs are sufficiently hot. Follow Table below for preheating time.

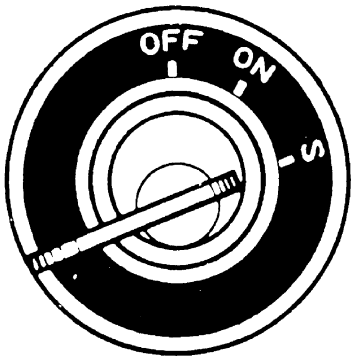
Quick-heat type (Y114T)

Atmospheric temperature	Preheating time
+5°C (+41°F) or higher	Approx. 10 sec.
+5°C (+41°F) to -5°C (+23°F)	Approx. 20 sec.
-5°C (+23°F) or lower	Approx 30 sec.
Limit of continuous use	1 minute

3. Proper glow plug function is indicated by voltmeter drop when key is depressed. This drop will be slight but discernible. If no voltage drop is noted, it may indicate defective glow plugs or a faulty preheat circuit (check for loose connection).



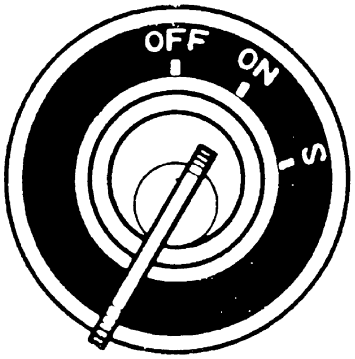
4. Starting



Continuing to hold the key depressed, turn to the "START" position. The starter motor will run thereby cranking the engine. Hold throttle open until engine runs and then reduce throttle.

Should the engine not start even when the starter switch is left at "S" position for 10 seconds, take your hand off the starter switch for 30 seconds, and then attempt to start the engine again by sufficiently preheating the glow plug. The starter motor should never be allowed to run for more than 30 seconds at a time.

5. Operation



As soon as the engine has started, release the key. The key will automatically return to the "ON" position. Leave the key at "ON" during operation. Check that with engine running, oil pressure and battery charge voltage are registering and that raw water is discharging with the exhaust.

During engine operation, do not turn the key to "S" position. This may damage the starter motor.

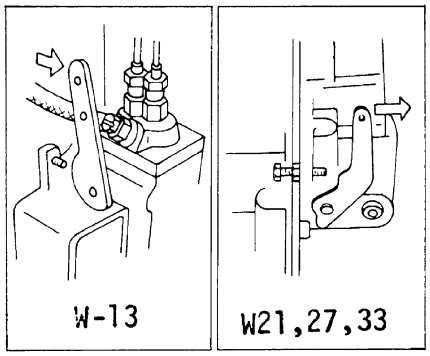
6. Warm-up operation

Run a few minutes at "IDLE" position to assure that all functions are operating. Then operate under reduced load until water temperature rises into the 140-150° range.

STOPPING PROCEDURE

1. Stop

To stop the engine move the throttle control through the idle position to stop. As the throttle is moved past idle there will be increased resistance to movement because a spring loading must be overcome. Hold the throttle firmly against the pressure until the engine comes to a complete stop.



2. Starter switch off

With the engine stopped, turn the starter key back to "OFF" position. The battery will be discharged if the key is left at "ON" position. An engine alarm buzzer is provided to warn the operator of this possibility. Best precaution is always to remove the key.

CAUTIONS ON STARTING AND OPERATION

1. Normal starting

Follow the procedures below for routine starting of your engine.

1) Check the engine and transmission oil levels and refill if necessary.
2) Insure that you have sufficient fuel. Keep tank as full as possible.
3) Check cooling water level, and refill if necessary.
   Note: Check for leaks of water or oil, particularly when signs of such leak are found on the bottom of the engine or in the drip tray.
4) Start the engine in accordance with the procedures given on the preceding pages.
5) Allow the engine to warm up to 140°-150° F before placing the engine under heavy load.

2. Starting under cold conditions

The following three adverse conditions concur as the atmospheric temperature drops exceedingly, and the engine must, under such conditions, be started by taking steps described below:

LUBRICATING OIL TURNS VISCOUS - Make certain that oil used is adequate for the prevailing atmospheric temperature. Check the oil also for deterioration.

VOLTAGE ACROSS BATTERY TERMINALS DROPS - Check that the battery is fully charged.

THE TEMPERATURE OF INTAKE AIR IS LOW AND COMPRESSION TEMPERATURE DOES NOT RISE ENOUGH - Allow the glow plug to operate sufficiently to aid starting. See table on page 8.

3. Cautions during operation

Confirm that the oil pressure is normal during normal operation.

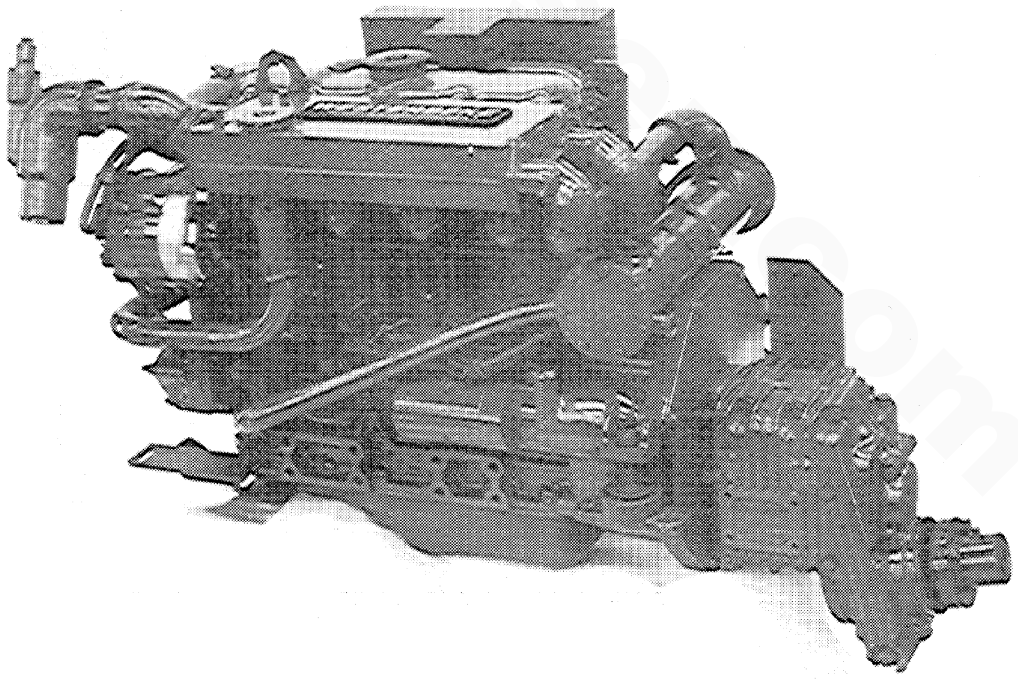
Confirm that exhaust gas is as follows:

* While engine is cold.....White smoke
* When the engine grows warm.....Almost smokeless
* When the engine is overloaded.....Some black smoke

Check for abnormal noise such as knocking, friction or leaking sounds, and vibration and blow-back sounds.

Check for leaks of fuel and engine oil.

A knocking sound is heard while the engine is cold, during quick acceleration and at idle. Confirm that no knocking sound is heard in other cases.



LEFT SIDE, W-33 WITH 2:1 VEE DRIVE

LUBRICATION SYSTEM

1. Engine oil

For engine lubrication, use diesel engine oil. Diesel engine oils are classified according to the API Specifications into grades CA, CB, CC and CD. Any one of them is usable, but use of CC or higher grades prepared by well-known makers is recommended.

2. Engine oil viscosity

Use oil having viscosity best suited to the atmospheric temperature. Use of an all-season oil SAE10W-30 with minimum viscosity change under different temperatures is suggested.

Atmospheric temperature	Viscosity
20°C (68°F) or higher	SAE 30 or 10W-30
5°C (41°F) - 20°C (68°F)	SAE 20 or 10W-30
5°C (41°F) or lower	SAE 10W-30

3. Oil pressure

The oil pressure during operation of the engine is indicated by the oil pressure gauge.

During normal operation.....Oil pressure will range between 50 and 70 PSI.

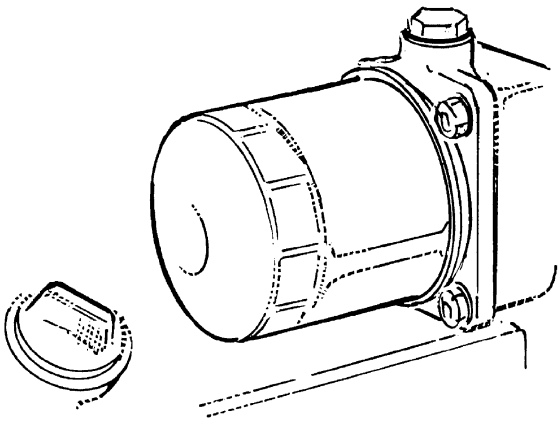
At the time of cranking.....Pressure will rise proportionately with speed.

4. Engine oil change

To renew engine oil, discharge old oil through the sump drain hose attached at front of engine while engine is still warm.
Drain old oil completely, replace the hose, plug the end securely and add fresh oil through the oil inlet port on the valve cover.
After refilling oil, idle the engine for several minutes and stop. Then check the quantity of oil by the oil level gauge. Fill to but not over the high mark on the dipstick.

5. Replacement of oil filter

Being a replaceable cartridge type, the oil filter requires no cleaning inside.
In installing the oil filter, apply engine oil thinly on to the O-ring, and then tighten it by hand firmly.



When removing the used filter, cover over with a plastic bag. This will allow both filter element and spilled oil to be collected cleanly without spilling oil in the bilge.

Note A: After market filters are not recommended since the material standard or diameters of important items might be entirely different from genuine parts.

Note B: Immediately after filter change and oil fill, run engine to ensure that oil pressure is normal and that there are no oil leaks.

FUEL SYSTEM

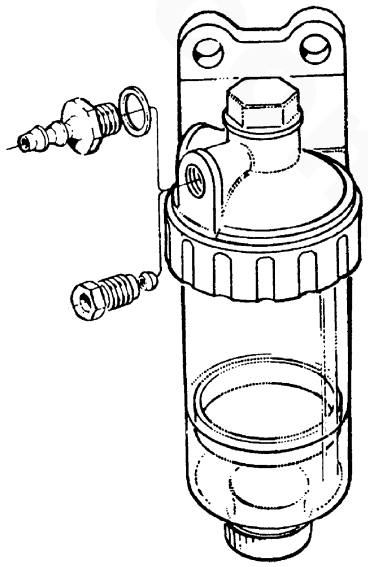
1. Diesel fuel

USE #2 DIESEL FUEL. NEVER USE KEROSENE OR HEAVY OIL.

In cold weather, particularly, much water vapor is produced when much air is present in the fuel tank. The tank, therefore, should be kept full as much as possible.

The fuel tank, furthermore, needs to be kept completely free of dirt and water.

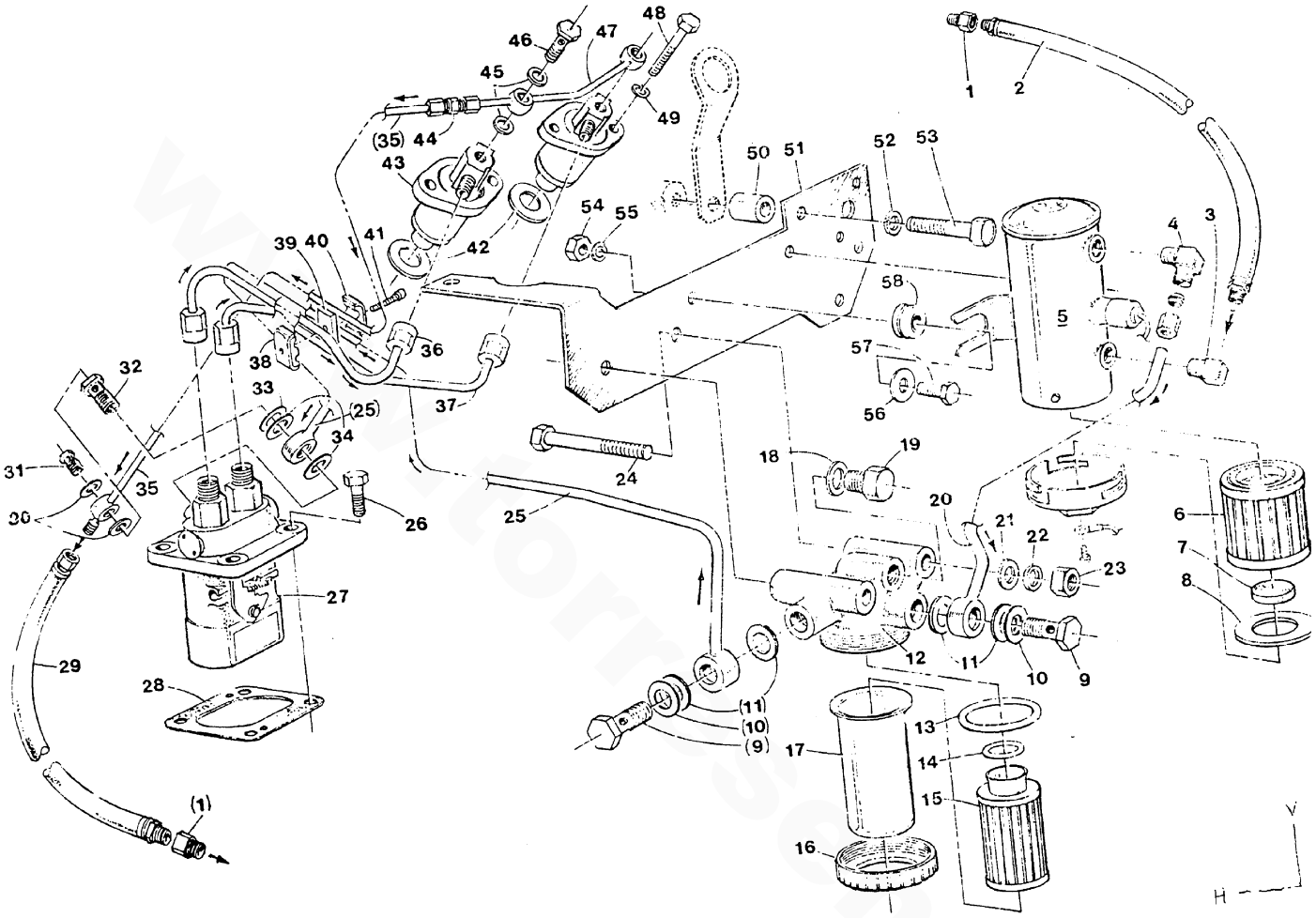
2. To this end, it is most desirable that a primary fuel filter of the water entrapment type be installed between the fuel tank and engine. Such a filter is available under part #32974. (See your local dealer.)



Water entrapment filter #32974 is shown opposite. Inspect frequently for presence of water in the clear bowl. Drain it off by loosening the air vent and opening the drain.

3. Notes on fuel system

See below a typical exploded view of a fuel system. The one shown is for the W13. Those for the W21, W27 and W33 are similar except for the number of cylinders.



The Westerbeke self-bleeding fuel system is automatic in operation. Therefore, it is unlikely that the operator will be forced to service the system at sea.

For that unlikely possibility, however, it is recommended that the following parts be carried onboard.

Banjo washers 11, 30, 31, 33, 34, 45
Injector seat washers 42
Lift pump filter and gaskets 6, 7, 8
Fuel filter element and gaskets 13, 14 ,15

If a leak should develop at a banjo or washer that cannot be remedied by a simple tightening of the screw, renew the washers.

The engine can be started by taking the steps described on pages 8 and 9. In cases where the engine cannot be started easily, loosen two injection nuts on the nozzle side, turn the speed control lever to "full open" position, turn the starter motor and then tighten the nuts firmly.

4. Cleaning fuel filter and replacing filter element

After the first 50 hours of operation, loosen the retainer ring #16 and discard filter element #15. Clean bowl #17 and re-install new filter, using new gasket #13 and #14.

This same treatment is required of the filter element #6 in the fuel lift pump. Similarly, replace new filter element #6 using new gasket #7 and #8.

After the first 50 hour change, the change period may be increased to 200 hours or once per season.

5. Fuel injection pump

The fuel injection pump is one of the most important components of the diesel engine and thus it calls for the utmost caution in handling. Furthermore, the fuel injection pump has been thoroughly shop-adjusted and should never be readjusted carelessly.
Such adjustment, whenever necessary, should be performed at an authorized service station as a precision pump tester and skills are required.

To obtain long and satisfactory use of your injection pump:

Always use fuel which is free from impurities.
Clean and renew the fuel filter periodically.
Inspect water entrapment filter regularly.

COOLING SYSTEM

1. Cooling water

As cooling water, use soft water with least impurity content such as tap water (potable water) or rainwater, and never use hard water or foul water. Use of hard water or water containing much impurity will lead to collection of scale in the engine and heat exchanger with resultant decline in cooling effects.

2. Antifreeze

In cold districts, care should be taken to prevent cooling water from freezing. Cooling water when frozen expands to break the

heat exchanger and the cylinder block, and it is essential that antifreeze be added to cooling water in a quantity being proportional to the lowest temperature of the district. It is recommended that the antifreeze mixture be used throughout the year.

*Antifreeze of poor quality will cause corrosion of the cooling system, and thus always use antifreeze prepared by a reliable maker, and never use it mixed with antifreeze of a different brand.

*Make sure that the cooling system of the engine is cleaned well before adding antifreeze.

*Recommended antifreeze for year round use is ZEREX Long Life Coolant (antirust contained).

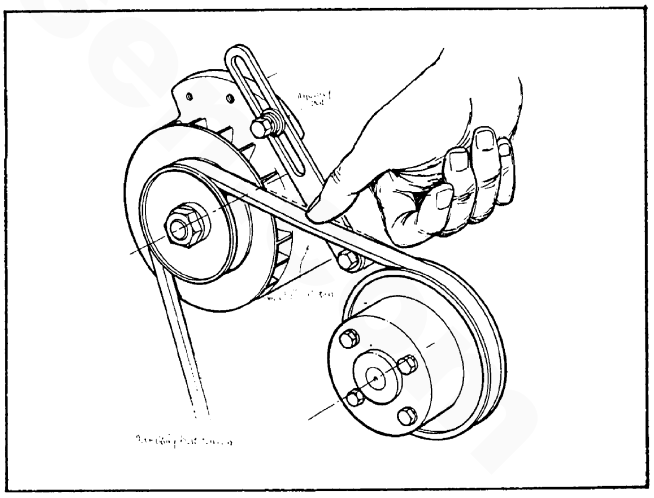
ANTIFREEZE ADDITION DATA

Antifreeze Concentration %		13	23	30	35	45	50	60
Freezing temperature	°C	-5	-10	-15	-20	-30	-40	-50
	(°F)	(23)	(14)	(5)	(-4)	(-22)	(-40)	(-58)

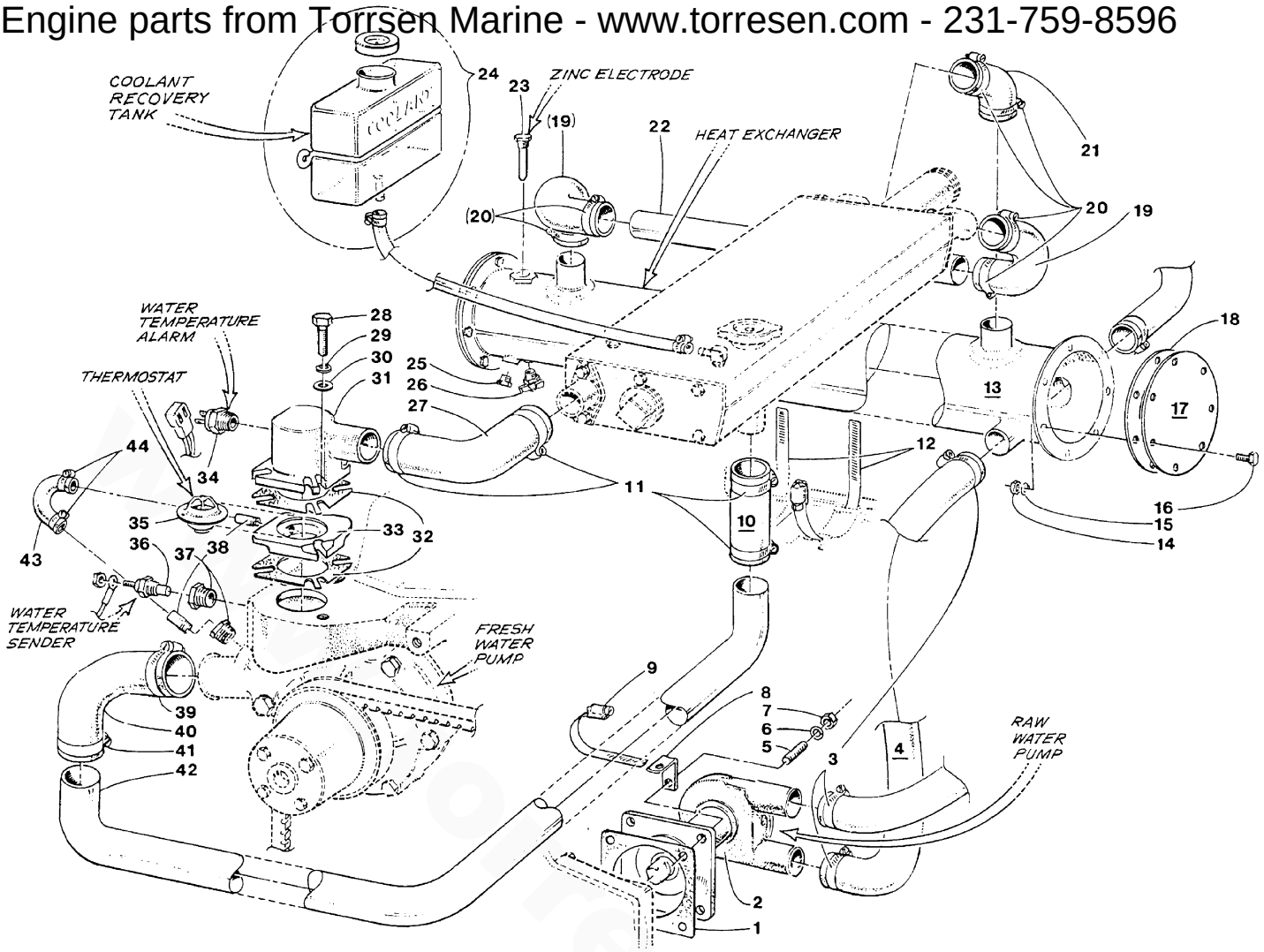
Note: It is advisable that antifreeze concentration be selected on the basis of a temperature which is about 5°C (10°F) lower than the actual atmospheric temperature.

3. Alternator belt tension

The alternator belt is properly tense if it deflects 10 to 12 mm (0.39 to 0.47 in) as it is depressed with a finger between the pulley and pulley of the long distance side. Excessive tension can cause quick wear of the belt and bearings of the water pump and the alternator. Excessive slackness or presence of oil on the belt, on the other hand, can lead to engine overheating and insufficient charging due to a slipping belt.



CAUTION:
Never attempt to adjust tension of the fan belt while the engine is in operation.



4. Fresh water cooling system (See Note 5 on page 6.)

The system consists of a sea water pump which pumps raw sea water through a heat exchanger to remove heat from the coolant. The raw water is discharged overboard through the exhaust line.

The engine coolant (fresh water with or without antifreeze) is circulated by the fresh water pump in continuous circuit. Pumped through the cylinder block, cylinder head, heat exchanger and back to the fresh water pump.

The total system is very reliable and requires only a daily check of the water level in the system plus routine check of hose clamps and fittings.

It is likely that zinc electrodes will waste away from contact with sea water. It is also possible for the raw water pump impeller to fail due to lack of sea water or deterioration. An early sign of impeller failure is less water and more steam at the exhaust through hull fitting.

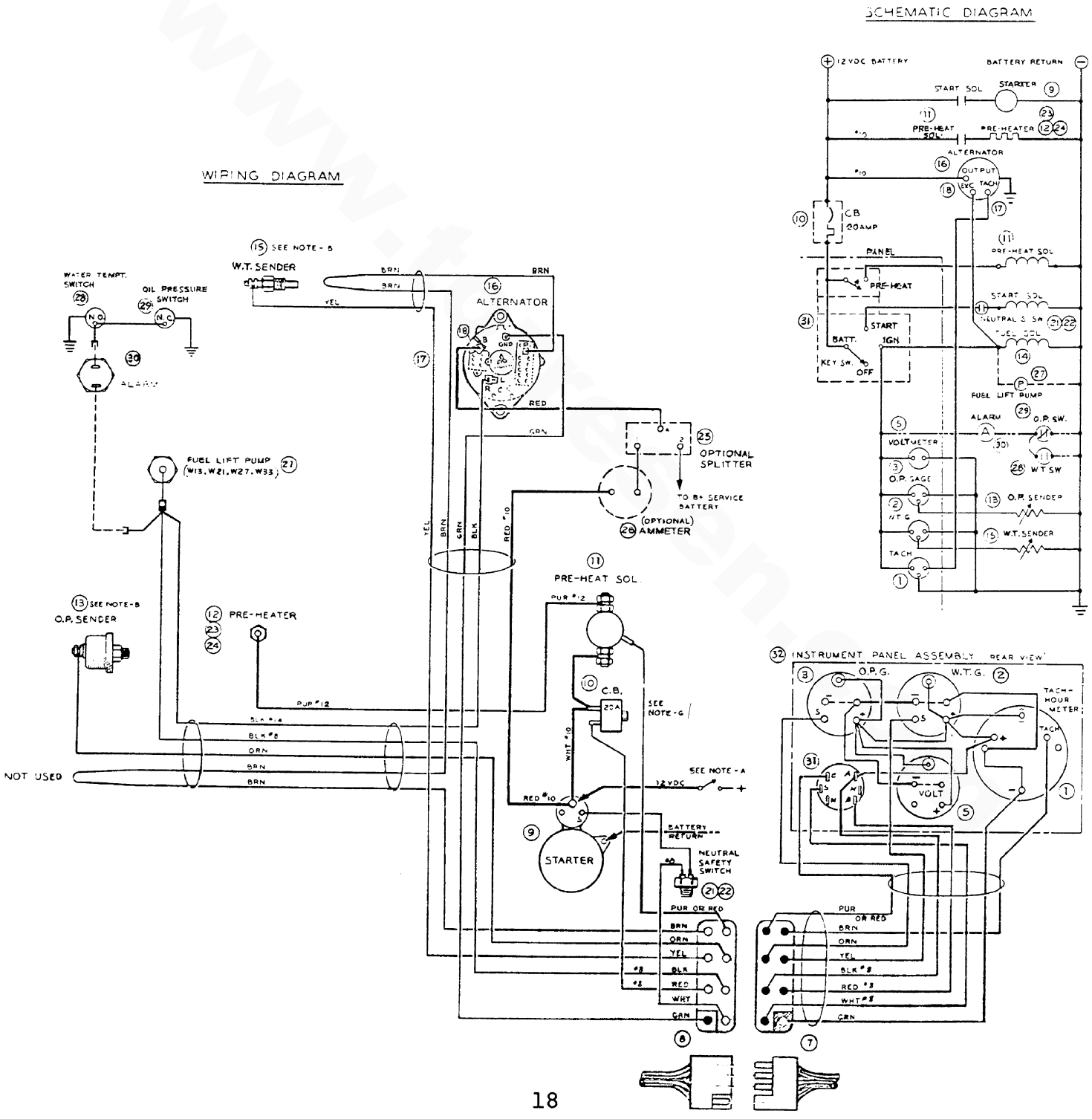
It is recommended, therefore, that zinc electrodes, an impeller kit, a pump belt and a thermostat with gasket be kept onboard at all times. These parts should be ordered from your nearest stocking dealer and used as inspection dictates.

WIRING DIAGRAM

Your engine is of 12V system and its electric circuit is as shown in the diagram below.

For installing electrical parts, connect them correctly by referring to the diagram and at the same time check for damaged wire sheathing and confirm that grounding is provided properly. Care must always be taken while working on the electrical system.

Never shut the engine battery switch off while the engine is running. Damage to the alternator will result should this be done.



RECOMMENDED MAINTENANCE SERVICE

Check and service your engine at specified intervals to maintain it in its best conditions and permit it to perform as it should. As for those asterisked items, it is suggested that you have them performed by an authorized distributor or dealer.

1. Daily inspection before use

   A. Checkup of engine oil level and refilling

      No refill is required if the level is near the upper limit line of the gauge.

   B. Checkup of cooling water and refilling

      Refill up to the filler cap neck.

   C. Check your fuel supply

   D. Checkup of gauges and meters

      After starting your engine, check oil pressure, water temperature and voltage reading.

   E. Checkup for loose parts (fan belt or bolt, etc.), damage and leaks

   F. Checkup for abnormality with exhaust gas, noise and vibration

2. Servicing following initial 50 hours of operation

   A. Renewal of engine oil

   B. Replacement of oil filter

   C. Renewal of cooling water

   D. Adjustment of valve clearance (See SERVICE DATA)

   *E. Tightening of bolts and nuts

   *F. Adjustment of engine idle

3. Servicing at every 100 hours of operation

   A. Renewal of engine oil

   B. Replacement of oil filter

C. Cleaning of fuel filter

D. Adjustment of engine idle

4. Servicing at every 200 hours of operation

A. Replacement of engine mounted fuel filter elements

B. Replacement of fuel filter (cartridge type)

5. Servicing at every 400 hours of operation

A. Cleaning of fuel tank

*B. Adjustment of valve clearance

*C. Checkup of starter motor, alternator and regulator

Check the brush and surface of commutator for the degree of wear. Replace the brush if it is worn beyond the limits of wear.

*D. Checkup of glow plugs

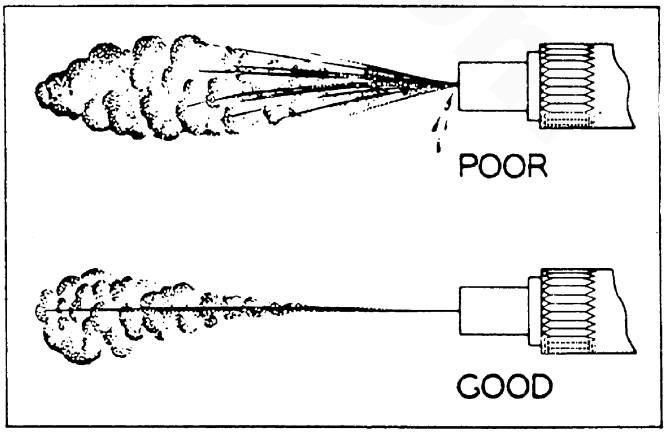
Check the glow plugs for blow-out.

E. Removal of cooling water and flushing is suggested.

6. Servicing at every 800 hours of operation

*A. Checkup of nozzles

Set the injection starting pressure to 1707^{+142}_{-0} psi and eliminate undesirable injection conditions including "after dripping".



*B. Checkup of compression pressure

Remove each glow plug and check cylinders, one by one, using a compression pressure gauge. If the pressure differs by more than 2.5 kg/cm^2 (35.6 psi) between cylinders or if the cylinder pressure is less than 26 kg/cm^2 (369.8 psi) at 320 RPM for the W13 and at 280 RPM for the W21, W27 and W33, correct it.

*C. Fuel injection adjustment

In case of severe vibration during idling, have it repaired at an authorized distributor or dealer which is equipped with a pump tester.

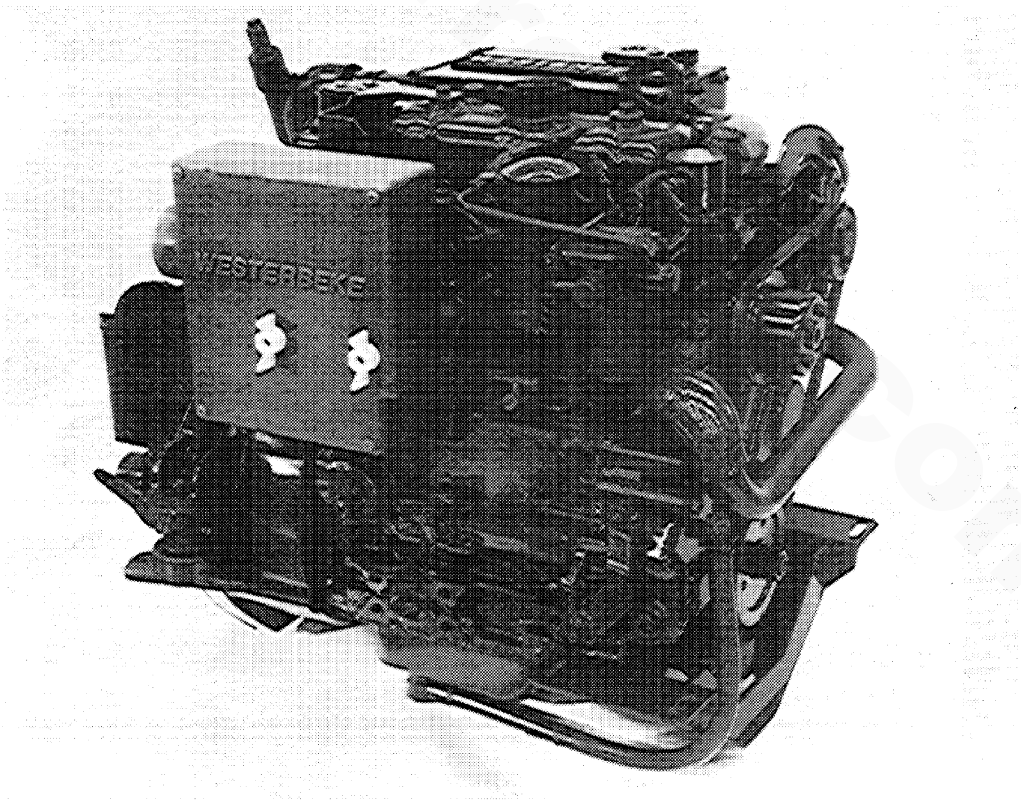
*D. Checkup of alternator and regulator

Regulate the voltage and current by use of a circuit tester.

*E. Checkup of starter motor pinion and flywheel ring gear

Rectify the chamfered area that has been severely damaged by use of an oil stone or some pencil grinder, and replace the part if it is damaged all over.

*F. Tightening of bolts and nuts



RIGHT FRONT QUARTER, W-21 WITH 2:1 REDUCTION GEAR

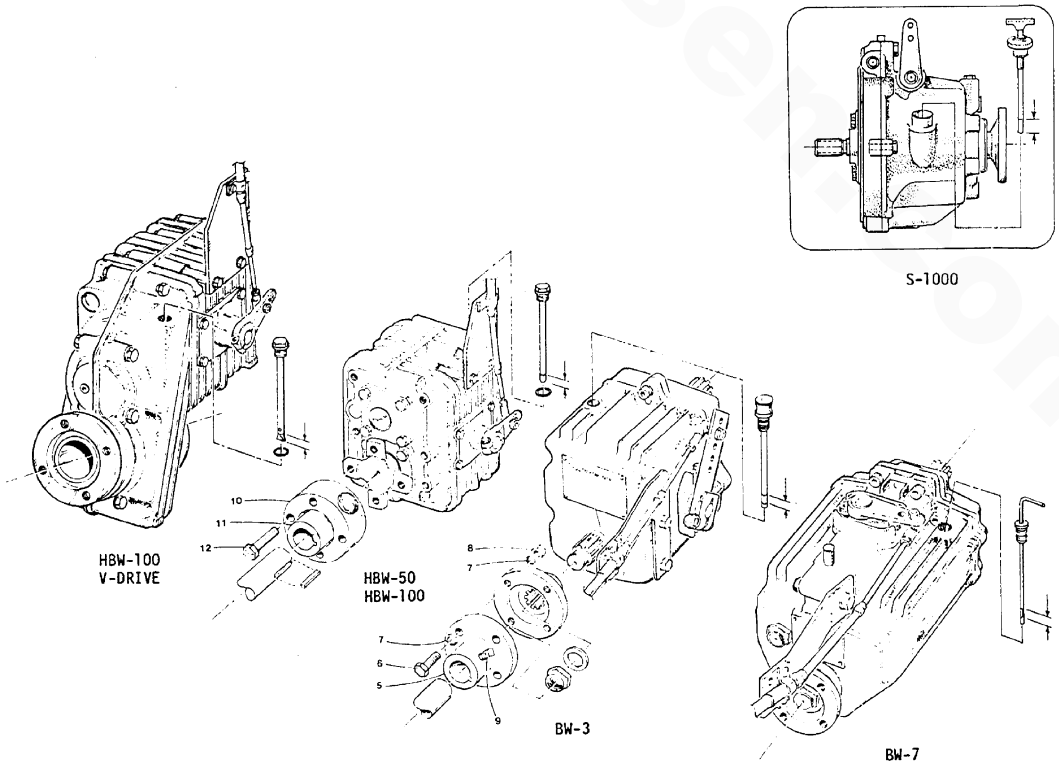
TRANSMISSIONS

Each engine model may be fitted with a variety of transmission options. For ratio and/or type, see table below.

Model	1:1	1.5:1	2:1	2.5:1	V-Drive 2:1
W13	S-1000	HBW-100	BW-3 HBW-50	HBW-50	HBW150V
W21	S-1000	HBW-100	HBW-50	BW-7 HBW-100	HBW150V
RD-60	S-1000	HBW-100	HBW-50	BW-7 HBW-100	HBW150V
W27	S-1000	HBW-100	HBW-100	BW-7 HBW-150	HBW150V
RD-80	S-1000	HBW-100	HBW-100	BW-7 HBW-150	HBW150V
W33	S-1000	HBW-100	HBW-100	BW-7 HBW-150	HBW150V
Rotation	Left Hand	----------Right Hand----------			

These transmissions have their own oil sumps and dipsticks. "S" and "HBW" units use ATF lubricant, while "BW" units may use either ATF or 30 weight engine oil.

The transmissions, their dipsticks and markings are illustrated in the sketches below. For dipsticks that are threaded in the case, measure oil by dropping dipstick on the case. Do not screw in.



1. ENGINE DOES NOT START

	PROBLEM	REMEDY
a.	Starting switch is defective	Correct connections and contacts
b.	Deficient drive torque of the starter motor	The battery is exhausted, trouble with the starter motor, or dirty or loose wiring
c.	Improper viscosity of engine oil	Check the viscosity and renew oil if necessary
d.	Engine too cold	Use glowplug starting aid
e.	Seizure of moving parts	Rectify
f.	Air present in fuel system	Purge thoroughly with electric fuel pump
g.	No fuel in fuel tank	Refill
h.	Fuel filter clogged	Clean or renew

2. ENGINE STALLS WHILE IN OPERATION

	PROBLEM	REMEDY
a.	Fuel tank is empty	Refill
b.	Fuel filter clogged	Clean or renew
c.	Air present in fuel system	Retighten fuel line connections to allow electric fuel pump to run long enough to purge air thoroughly

3. IMPROPER OIL PRESSURE

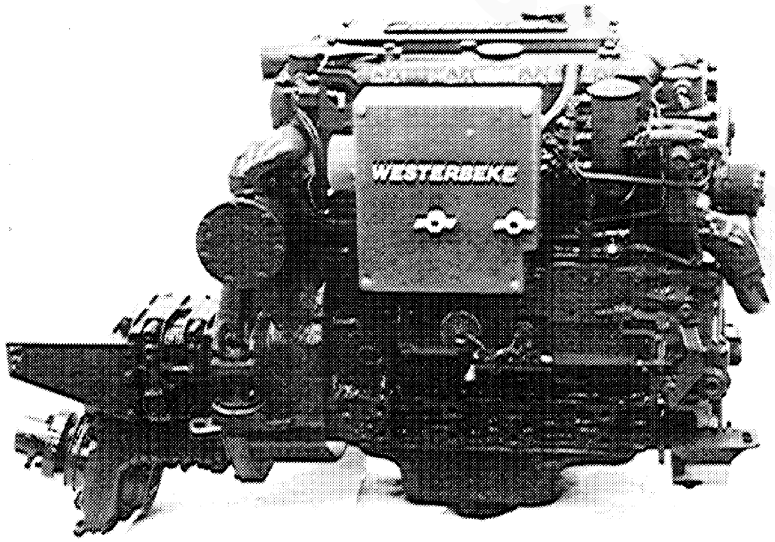
	PROBLEM	REMEDY
a.	Oil shortage	Refill
b.	Oil leak through connections	Repair
c.	Oil pressure switch defective	Replace

4. ENGINE OVERHEATING

PROBLEM	REMEDY
a. Cooling water shortage	Refill
b. Water leaks	Repair
c. Belt loose or smeared with oil	Clean or renew
d. Raw water pump defective	Repair or renew

5. BATTERY IS UNDERCHARGED

PROBLEM	REMEDY
a. Belt tension improper	Rectify
b. Faulty wiring circuit	Rectify
c. Alternator not functioning (observe voltmeter)	Replace
d. Battery faulty	Replace
e. Faulty voltage regulator	Repair or renew



RIGHT SIDE, W-27 WITH 2:1 VEE DRIVE

1. Valve clearance (engine cold) (both intake and exhaust) — 0.25 mm (0.010 in.)

2. Compression pressure

W13	32 kg/cm^2 at 320 RPM
W21 - W27 - W33	32 kg/cm^2 at 280 RPM

3. Engine oil capacity (including oil filter

W13	2.8 liters (0.74 U S gal)
W21	3.5 liters (0.93 U S gal)
W27	4.5 liters (1.19 U S gal)
W33	5.0 liters (1.32 U S gal)

4. Firing order

W13	1-2
W21	1-3-2
W27 - W33	1-3-4-2

5. Injection timing - BTDC of compression stroke when started at smoke set position.

Marine Engine	23° ± 1.5°
Generator	19° ± 1.5°

6. Injection starting pressure — 1707 $^{+142}_{0}$ psi

7. Cooling water capacity (in engine body alone)

W13	2.1 liters (0.56 U S gal)
W21	3.0 liters (0.79 U S gal)
W27	3.5 liters (0.92 U S gal)
W33	3.7 liters (0.98 U S gal)

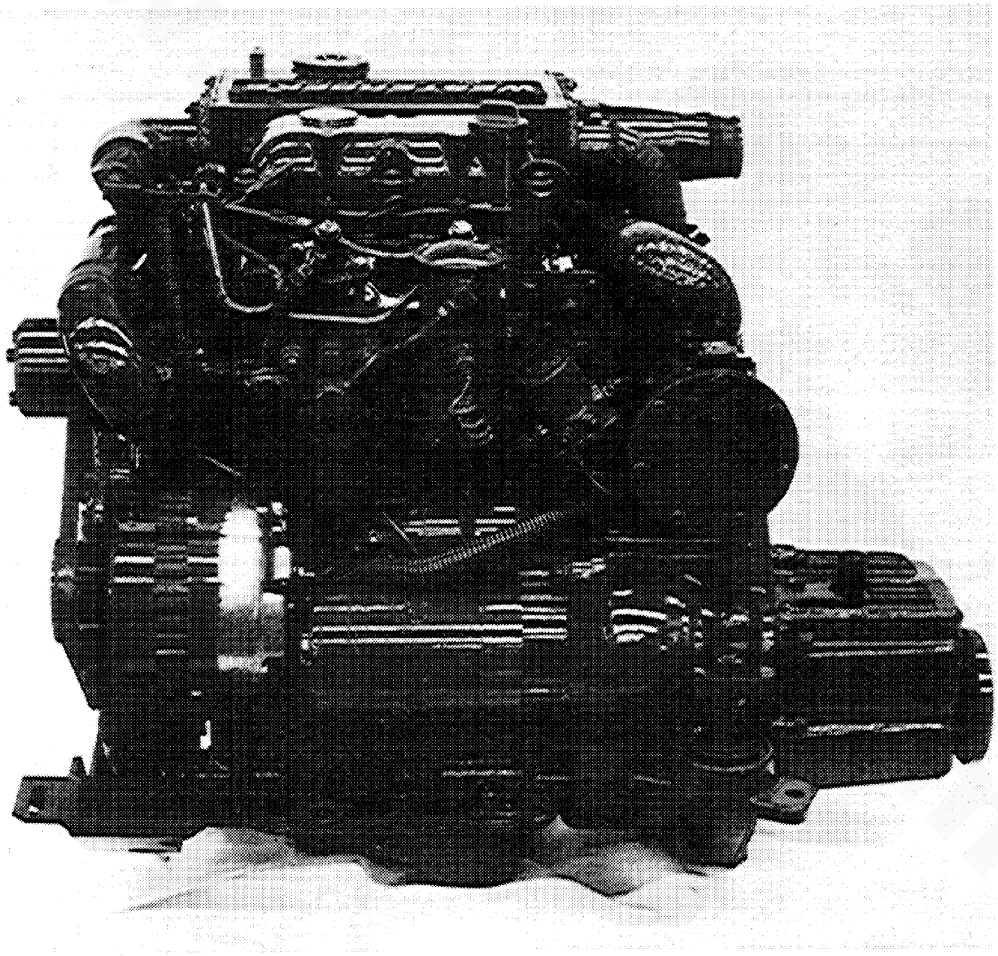
TABLE OF TIGHTENING TORQUES

		kg-m	lb/ft.
Cylinder head bolt	(M10) W21, W27, W33	7-8	50.7-57.9
	(M12) W21	11-12	79.6-86.8
	W13, W27	12-13	86.8-94.0
	(M14) W33	15-16	108.5-115.7
Crank pulley nut	W13	15-20	108.5-144.6
	W21, W27, W33	20-25	108.5-180.8
Main bearing cap bolt	W21, W27, W33	5.0-5.5	36.2-43.4
Connecting rod cap nut	W13, W21, W27	3.2-3.5	23.1-25.3
Connecting rod cap bolt	W33	11.5-12.5	83.2-90.4
Flywheel bolt		11.5-12.5	83.2-90.4
Oil pan drain plug		5-6	36.2-43.4
Oil filter		1.1-1.3	8.0-9.4
Delivery valve holder (injection pump)		4-5	28.9-36.2
Holder mounting bolt, nozzle		1.5-2.0	10.8-14.5
Holder body and retaining nut, nozzle		6-8	43.4-57.9
Glow plug		1.5-2.0	10.8-14.5
General screw tightening torque	M6	0.7	5.1
	M8	1.7	12.3
	M10	3.5	25.3
	M12	6.4	46.3
	M14	9.5	68.7

"WESTERBEKE GENUINE PARTS" are superior and reliable because they have been produced under an excellent quality control system and have passed the standard after strict inspection.

After market parts are not recommended from the viewpoint of their material standard and manufacturing method which may be entirely different from those of genuine parts.

"WESTERBEKE GENUINE PARTS" are available from our authorized distributors and dealers. Please order your spare parts from your nearest distributor or dealer.



LEFT SIDE, W-13 WITH 2:1 BW-3 TRANSMISSION