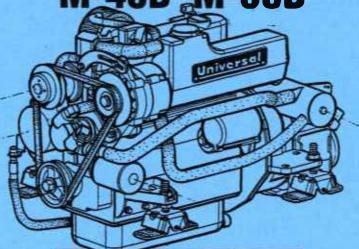
OPERATORS MANUAL

Universal

MARINE DIESEL ENGINES
M3-20B M-25XPB M-35B

M-40B M-50B



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WESTERBEKE CORPORATION + 150 JOHN HANCOCK ROAD MYLES STANDISH INDUSTRIAL PARK + TAUNTON, MA 02780 WEBSITE: WWW.WESTERBEKE.COM

NAMA Member National Marine Manufacturers Association

CALIFORNIA PROPOSITEIN 65 WARNING

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

A WARNING:

Exhaust gasses contain Carbon Manualde, an odorless and coloriess gas. Carbon Mounxide is poisonous and care unconsciousness and death. Symptoms of Carbon Monoxide exposure can include:

- Dizziness
- 6-1-1-1
- Headache
- Throbbing in Temples
- · Muscular Twitching
- · Vomiting
- Weakness and Sleepiness Inability to Think Coherently

IF YOU OR ANYOM ELSE EXPERIENCE ANY OF THESE STUPTOMS. SET OUT MITO THE FRESH AND GOVERNATELY. If symptoms parsist, seek medical attention. Shut down the unit and do not restart matil it has been inspected and repaired.



This WARNING DECAL is provided by UNIVERAL and should be fund to a bulkhead near your engine or generator. LEVESAL also recommends installing CORON MUNICIPE DETECTURS in the living/sleeping quarters of part ressel. They are inexpensive and easily obtainable at your local marine store.

SAFETY INSTRUCTIONS

INTRODUCTION

Road this safety manual carefully. Most accidents are consed by failure to follow fundamental rules and precautions. Know when dangerous conditions exist and take the necessary procautions to protect yourself, your personnel, and your outchiners.

The following safety instructions are in compliance with the American Boat and Yacht Council (ABYC) standards

PREVENT BLECTRIC SHOCK

A WARMING: Do not trace AC electrical connections while engine is numing, or when connected to shore power. Lethal voltage is present at these coreactions!

- Do not operate this machinery without electrical endocures and covers in place.
- Shut off electrical power before accessing electrical
- Use insulated mats whenever working on electrical equipment.
- Make sure your clothing and skin are dry, not damp (particularly stores) when handling electrical configurent.
- Remove was watch and all jewetry when working on electrical emigracy
- Do not connect whire shore power to vessel's AC circuits, except through a ship-to-sinue double throw causier switch. Damage to vessel's AC generator may result if this procedure is not followed.
- E Cleanical shock results from bandling a charged capaciter. Obstange capacitor by sharing terminals together

PREVENT BURNS — HOT ENGINE

A WARNUG: Do not touch hot engine parts or exhaust system components. A running engine gets very bot!

 Always check the engine coolant level at the coolant recovery tank.

A WARNING: Steam can cause injury or death!

In case of an engine overheat, allow the engine to cool before touching the engine or checking the coolant.

PREVENT BURINS - FIRE

A WARNING: Fire can cause injury or death!

- Prevent flash fires. Do not smoke or permit flames or sparks to occur near the carbureter, feel line, filter, fuel pump, or other potential sources of spilled fuel or fuel vapors. Use a smable container to camb all fuel when removing the fuel line, carbureter, or fuel filters.
- Do not operate with a Coast Grand Approved fiame arester removed. Backfire can cause severe injury or death.
- Do not operate with the air cleaner silence removed.

 Rackfire can cause severe injury or death.
- Do not smoke or permit flames or span's to occur near the fuel system. Keep the compartment and the engine/generator c ean and free of debris to minimize the changes of fue. Wipe up all spalled fact and engine oil.
- Be aware diesel fuel will born.

PREVENT BURNS - EXPLOSION

A WARMING: Explosions from fuel rapors can cause injury or death!

- Follow re-fiseling safety instructions. Keep the vessel's hat thes closed when fueling. Open and venalate cahin after furling. Check below for furnes/apor before nunning the blower. Run the blower for four minutes before starting your engine.
- All fuel vapors are highly explosive. Use extreme care when handling and straing fuels. Store fuel in a well-ventilated area away from spark-producing expulpement and out of the reach of children.
- Do not fill the fuel tank(s) while the engine is running.
- Shot off the fiel service valve at the engine when servicing the filel system. Take care in catching any fuel that might spall. DO NOT allow any smoking, open fames, or other sources of fine near the fuel system or engine when servicing. Ensure proper ventilation exists when servicing the fuel system.
- Do not alter or trooffy the fuel system.
- Be sure all fuel supplies have a positive shutoff valve.
- Be certain fuel line fixings are adequately rightened and free of leaks.
- Make sare a fire extinguisher is insuled ocarby and is properly maintained. Be families with its proper use. Extinguishers rated ABC by the NFPA are appropriate for all applications encountered in this environment.



SAFETY INSTRUCTIONS

ACCIDENTAL STARTING

A WARNING: Accidental starting can cause injury or death!

- Disconnect the banezy cables before servicing the engine' generator. Remove the negative lead first and recurrent it less
- Make certain all persoonel are clear of the engine before starting.
- Make certain all covers, grands, and batches are reinstalled before starting the engine.

BOTTERY EXPLOSION

A WARNOS: Cattory explosion can case being or death!

- Do not smoke or allow an open flame near the banery being serviced. Lead acid baneries emit hydrogen, a highly explosive gas, which can be ignited by electrical arring or by lit tobacco product. Shat off all electrical equipment in the vicinity to prevent electrical arring during servicing.
- Never connect the negative (-) beffery cable to the positive (+) chances on terminal of the stance solutoid. Do not test the battery condition by shorting the exminals together. Spades could ignite battery gases or fuel vapors. Vendate any compartment containing batteries to prevent accumulation of explosive gases. To avoid sparks, do not disturb the battery charger connections while the battery is being charged.
- Avoid contacting the terminals with took, etc., to prevent burns or sports that could cause an explosion. Remove wistwatch rings, and any other jewelty before bandling the burney.
- Always arm the banery charger off before discommuning the banery connections. Remove the negative lead first and reconnect it last when discommening the banery.

BATTERY ACID

A WARDON: Solfwic acid in Catheries can cause severe injury or death!

When servicing the bancry or checking the electrolyte level, wear rubber gloves, a rubber apron, and eye protection. Batteries contain sulfuric acid which is destructive. If it comes in contact with your skin, wash it off at once with water. Acid may splash on the skin or into the eyes inadvertently when removing electrolyte caps.

TOXEC EXMAUST BASES

A WARNENG: Carbon especiale (CV) is a deadly gast

- Ensure that the exhaust system is adequate to expel gases discharged from the engine. Check the exhaust system regularly for leaks and make sure the exhaust manifolds are somety affacted and no warping exists. Pay "lose attention to the oranifold, water injection allow, and exhaust pipe nipple.
- Be sure the unit and its surroundings are well ventilated.
- In addition to causing unspection of the exhaust system, install a carbon monoxide detector. Consult your boat builder or dealer for unstallation of approved detectors.
- For additional information refer to ABYC T-22 (educational information on Carbon Monoxide).

A WARRING: Carbon comeride (CO) is an lavisble odories gas. Inhalation produces in-like symptoms, causes or death!

- Do not use copper tubing in diesel exhaust systems. Diesel numes can capidly desurely copper tubing in exhaust systems. Exhaust sulfur causes rapid describeation of copper orbing resulting in exhaust/water leakage.
- Do not install exhaust outlet where exhaust can be drawn through portholes, vents, or air conditioners. If the engine exhaust discharge outlet is near the waterline, water could enter the exhaust discharge outlet and close or respect the flow of exhaust. Avoid overloading the craft.
- Although diesel engine exhaust gases are not as toxic as exhaust fumes from gasoline engines, carbon oronaxide gas is present in diesel exhaust fumes. Some of the symptoms or signs of carbon monoxide inhalation or poissuing are:

Vaniting

Dizzioes

Throbbing in temples

Muscular twinching

Intense beataire

Weakness and sleepiness

AVORS MOVING PARTS

A WARNOOG: Retating parts can cause injury or death!

■ Do not service the engine while it is running. If a sinuation arises in which it is absolutely necessary to make operating adjustments, use extreme care to avoid touching moving parts and hot exhaust system components.



SAFETY INSTRUCTIONS

- Do not wear loose chaling or jewelry when servicing equipment; the back loog hair and avoid wearing loose jackers, shirts, sleeves, rings, necklases or bracelets that could be catight in moving parts.
- Make sure all attaching hardware is properly tightened.

 Keep proceedive shields and guards in their respective places at all times.
- Do not check fluid levels or the drive belt's remain while the engine is operating.
- Stay clear of the drive shaft and the transmission coupling when the engine is running; hair and clothing can easily be caught in these rotating parts.

HAZARDOUS NOISE

WARNING: High noise levels can cause latering loss!

- Never operate an engine without its muffler installed
- Do not run an engine with the air in take (alence)
- Do not run engines for long periods with their enclosures

A WARNING: Do not work on machinery when you are mentally or physically incapacitated by fatigue!

OPERATORS MANUAL

Many of the preceding safety aps and warings are repeated in your Operators Manual along with other cautions and cotes to highlight critical information. Read your manual carefully, maintain your equipment and follow all safety precedures.

ENGINE INSTALLATIONS

Preparations to install an engine should begin with a fourough examination of the American Boat and Yacht Council's (ABYC) standards. These standards are a combination of sources including the USCG and the NFPA.

Sections of the ABYC standards of particular interest are:

H-2 Ventiletion

P-1 Exhaust systems

P-4 Inboard engines

E-9 DC Electrical systems

All installations must comply with the Federal Code of Regulations (FCR).

ABYC, NFPA AND USCG PUBLICATIONS FOR DISTALLING DIESEL ENGINES

Read the following ABYC, NFPA and USCG publications for safety codes and standards. Follow their renouncendations when installing your engine.

ABYC (American Boat and Yacht Council)
"Safety Standards for Small Craft"

Order from

ABYC 15 East 26th Street New York, NY 10010

NFPA (National Fire Protection Association)

Fire Protection Standard for Motor Craft"

Order from:

National Fire Production Association 11 Tracy Drive Avon Industrial Park Avon, MA 02322

USCG (United States Coast Guard)
"USCG 33CFR183"

Order irom:

U.S. Government Printing Office Washington, D.C. 20404



INSTALLATION

When installing UNIVERSAL engines and generators it is important that since attention be paid to the following information:

GODES AND REGULATIONS

Strict federal regulations, ABYC guidelines, and safety codes must be complied with when installing engines and recordus in a marine environment

SIPHON-BREAK

For installations where the exhaust manifold/water injected exhaust elbow is close to or will be below the vessel's waterline, provisions must be made to install a siphon-treak in the raw water supply hose to the enhaust elbow. This hose must be looped a minimum of 20° above the vessel's waterline. Failure to use a siphon-break when the exhaust manifold injection port is at or below the load waterline will result in raw water damage to the engine and possible flanding of the boat.

If you have any doubt about the position of the water-injected exhaust elbow relative to the vessel's waterine under the vessel's various operating conditions, install a siphon-break.

MITE A sighton-break requires periodic aspection and cleaning to ensure proper operation. Failure to properly maintain a sighten-break can result in constraphic engine damage. Consult the sighton-break manufacturer for proper maintenance.

EXHAUST SYSTEM

The exhaust hose must be certified for marine use. The system must be designed to prevent water from emering the exhaust under any sea conditions and at any angle of the vessels hull.

A detailed 40 page Marine testallation Manual covering gasoline and diesel, engines and generators, is available from your UNIVERSAL dealer.

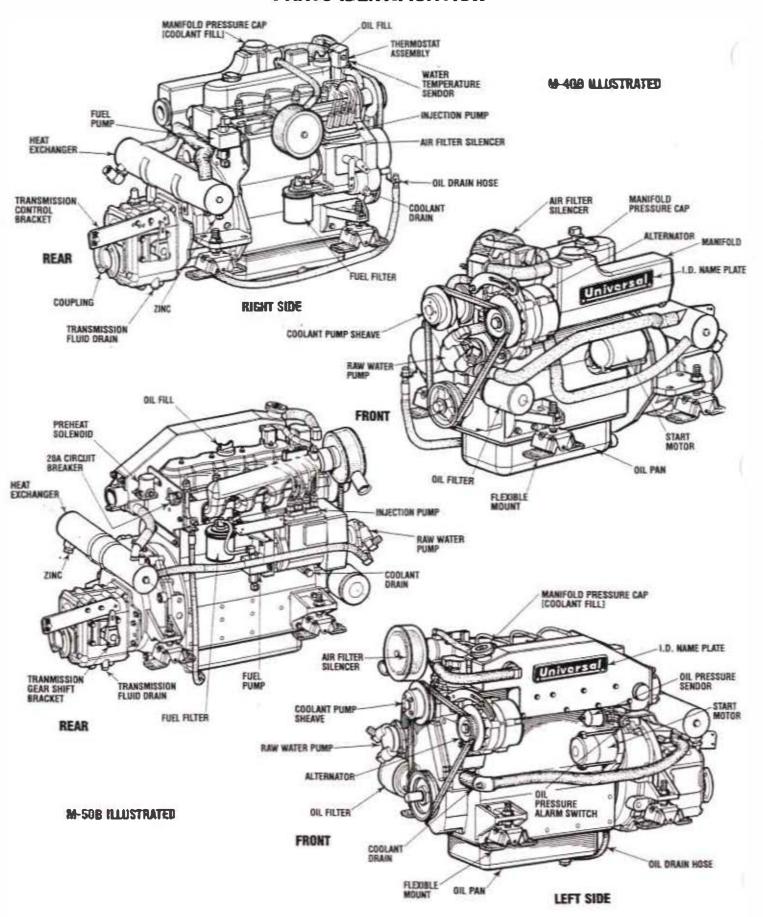


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PARTS IDENTIFICATION



INTRODUCTION

These new high performance UNIVERSAL matter diesel engines are a product of UNIVERSAL WESTERBEKE'S design technology and their combined years of experience manufacturing quality manne engines. We take great pride in the superior durability and dependable performance of our manne engines. Thank you for selecting UNIVERSAL

In order to get the full use and benefit from your engine, it is important that you operate and coatculan it currently. This manual is designed to belp you do this. Heave read this manual carfully and chiserve all the safety precamicus throughout. An execusive network of UNIVERSAL WESTERBEKE distributions, dealers and service centers are available worklywide. Should your engine require servicing, contact your nearest dealer for assistance.

This is your operates manual. A Parts Catalog is also provided and a Technical Manual is available from your UNIVERSAL dealer Also, if you are planning to install this equipment, coord your UNIVERSAL dealer for UNIVERSAL'S installation manual.

WARRANTY PROCEDURES

Your UNIVERSAL Warranty is included in a separate folder. If you have not received a customer identification card registering your warranty 60 days after submitting the warranty registration form, please contact the factory in writing with model information, including the unit's serial number and commission date.

Universal

Customer identification
UNIVERSAL OWNER

MAIN STREET HOMETOWN, USA

Model M-358

Ser #D704XXXX

Expires 7/20/2000

TYPICAL CUSTOMER IDENTIFICATION CARD

The UNIVERSAL serial number is an alphanuseic comber that can asset in determining the date of manufacture of your UNIVERSAL engine. The first character indicates the decade [A=1960s, B=1970s, C=1980s, D=1990, etc.], the second character represents the year in the decade, and the fourth and fifth numbers represent the month of manufacture.

PRODUCT SOFTWARE

Product software (tech data, parts lists, manuals, browners and cambogs) provided from sources other than UNIVERSAL are not within UNIVERSAL'S CONTROL

UNIVERSAL CANNOT BE RESPONSIBLE FOR THE CONTENT OF SUCH SOFTWARE, MAKES NO WAR-RANTIM OR REPRESENTATIONS WITH RESPECT THERETO, INCLUDING ACCURACY, TIMELINESS OR COMPLETENESS THEREOF AND WILL IN NO EVENT BE LIABLE FOR ANY TYPE OF DAMAGE OR INTURY NCURRED IN CONNECTION WITH OR ARISING OUT OF THE FURNISHING OR USE OF SUCH SOFTWARE

UNIVERSAL customers should also keep in mind the time span between princines of UNIVERSAL product software and the unavoidable existence of earlier UNIVERSAL manuals. In summation, product software provided with UNIVERSAL products, whether from UNIVERSAL or other suppliers, times not and cannot be refied upon exclusively as the definitive authority on the respective product. It not only makes good sense but is imperative that appropriate representatives of UNIVERSAL or the supplier in question be consulted to determine the accuracy and currentness of the product software being consulted by the customer.

NOTES, CAUTIONS AND WARNINGS

As this manual takes you through the operating procedures, maintenance schedules, and crabbath ring of your manner engine, critical information will be highlighted by NOTES, CAUTIONS, and WARNINGS. An explanation fullway:

IIIE An operating procedure essential to note.

CAUTION: Procedures, which if not strictly observed, can result in the damage or destruction of your cogine.

A WARRANG: Proceedings, which if not property belowed, can result in pursuand injury or loss of tile.

INTRODUCTION

SERVAL MUMBER LOCATION

An identification manufact that displays the cogine model oursher and engine serial number is mounted on the side of the engine's manifold Take the time to enter this information on the blank decal provided below. This will provide a muck गरिकार भोश अनेताह क्यांता वर्षायां वर्षायां आर्थेय तर्पारांता parts.



Fill in the information for your reference.

VACERSTANDUE THE DESEL BREDE

The diesel engine closely resembles the gravatine engine, since the mechanism is exentially the same. The cylinders are arranged above a closed cranismess, the cranishaft is of the same general type as that of a gastaline engine, and the diesel engine has the same types of valves, camshaft, pistons. connecting rods and lubricating system.

To a great extent, a diesel engine requires the same preventive maintenance as a gasoline cogine. Most important are proper ventilation and proper trainmanance of the fuel, lubricating and enoting systems. Replacement of fuel and lubricating filter elements at the time periods sperified and िक्काना केन्द्रोत्तर कि व्याप्यात्त्रात्त्वा (क्षत्रत् अनंतान्त्र स्तः) in the fuel system are exercial. Also important is the consistent use of a brand of high description diesel lubrication oil क्यांत्राची प्रकारिको हिए (ब्रिड्स) कार्याक्य

The diesel engine does differ from the gasoline engine, however, in its method of bandling and firms of fuel. The carburecor and ignition systems are done away with and in their place is a single compount (the fuel injection ramp) which performs the function of both.

ORDERING PARTS

Whenever replacement parts are needed, always provide the engine model musher and engine serial musher as they appear on the silver and black identification nameplate located on the manifuld. You must provide us with this information so we can identify your engine. In addition, include a complete part description and part number for each part needed (see the separately furnished Parts Catalog). Also ensist upon UNIVERSAL VESTERBEICE packaged parts because will fit or general parts are frequently not made to the same specifications as original equipment.

SPARES AND ACLESSURES.

Cerain spares will be received to support and maintain YOUR UNIVERSAL marine engine Your UNIVERSAL! WESTERBEKE dealer will assist you in preparing an on board coveries of space parts. See the UNIVERSAL SPARE BV775 page in this manual for a suggested list.

PRETTECTUS YOUR DEVESTMENT

Care at the focusty during assembly and thorough testing have resulted in a UNIVERSAL diesel engine capable of many thousands of hours of dependable service. However the manufactures count control how or where the engine is installed in the vessel or the manner in which the unit is overated and serviced in the field. This is up to the

MIC Dix milaton seche to energy foul euline file.
Proper engine installation and alignment.
An efficient well-designed exhaust system that includes an anti-sipture break to prevent water from entering the engine.
Changing the engine oil and oil filters every 100 operating
Proper maintenance of all engine compunents according to the maintenance schedule in this manual.
Use dean, thered diesel fuel.
Winterize your engine according to the LAY-UP AND



ADMIRAL CONTROL PANEL

UNIVERSAL offers two optional panels. Refer to the instruction page that applies to the panel you purchased

ADMIRAL PANEL

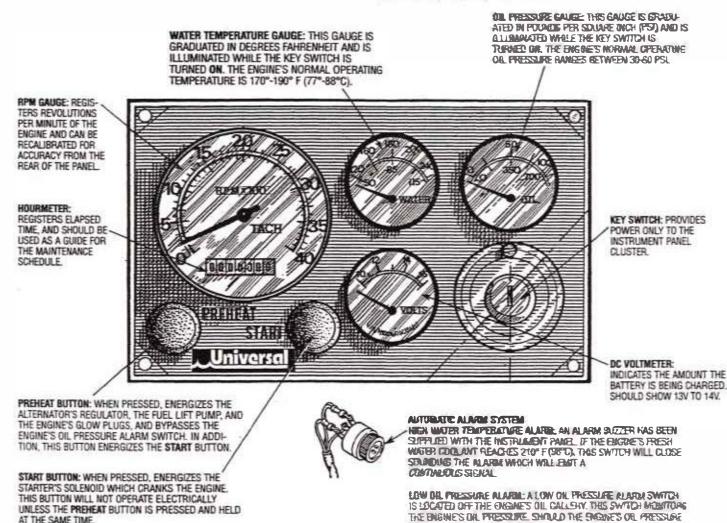
This manually operated control panet is equipped with a Key Switch and RPM gauge with an ELAPSED TIME meter which measures the engine's tunning time in bours and in 1/10 hours. The panet also includes a WATER TEMPERATURE gauge which indicates water temperature in degrees Faltenheit, an OIL PRESSURE gauge which measures the engine's oil pressure in pounds per square inch, and a DC control circuit VOLTAGE gauge which measures the system's voltage. All gauges are illuminated when the key switch is turned on and remain illuminated while the engine is in operation. The panet also currents two robber-booted pashbuttons, one for PREHEAT and one for START.

When the engine is shut down with the Key Switch torned off, the water temperature gauge will creature to register the last temperature reaching indicated by the gauge before electrical power was turned off. The oil pressure gauge will fall to zero when the Key Switch is turned off. The temperature gauge will once again register the engine's true temperature when electrical power is restared to the gauge.

A separate alarm buzzer with harness is supplied with every Admiral Panel. The installer is responsible for electrically connecting the buzzer to the four-pin connection on the engine's electrical harness. The installer is also responsible for installing the buzzer in a location where it will be dry and where it will be audible to the operatur should it cound while the engine is running. The buzzer will sound when the ignition key is named on and should alence when the engine has started and the engine's oil pressure rises above 15 psi.

Mote. Refer to the WIRING DIAGRAM in this manual for the installation of two engine serdors.

FALL TO 5 - 10 PSI, THE SWITCH WILL OPEN SOUNDING THE ALAPIA. BY THIS EVENT, THE ALARIA WILL BUIT A PLUSATING SHEVAL.





CAPTAIN CONTROL PANEL

CAPTAIN PANEL

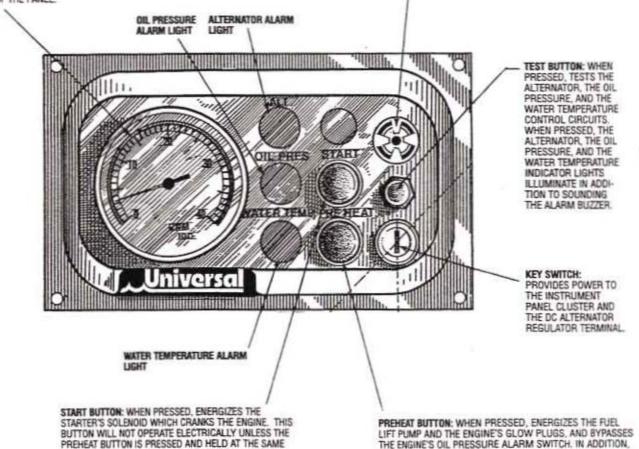
This manually-operated control panel is equipped with a Key Switch, an RPM gauge, PREHEAT and START buttons, an INSTRUMENT TEST button and three indicator buttons, one for ALTERNATOR DISCHARGE, one for low OIL PRESSURE.

and one for high ENGINE COOLANT TEMPERATURE It also includes an alarm brozer for low OIL PRESSURE or high WATER TEMPERATURE. The RPM gange is illuminated when the Key Switch is named on and remains illuminated while the engine is in operation.

RPM GAUGE: REGISTERS REVOLUTIONS PER MINUTE OF THE ENGINE AND CAN BE RECALIBRATED FOR ACCURACY FROM THE REAR OF THE PANEL. ALARSE THE ALARM WILL SOUND IF THE RIGHTES OIL PRESSURE FALLS
BELOW 5 - 10 PSI, IN THIS EVENT, THE ALARM WILL EDGT A PULL SOUNG
SIGNAL THE MARREWALL ALSO SOLDED IF THE WAITER TEMPERATURE IN
THE RESINCTER COOLDE CROUIT RISES TO 210°T. IN THIS EVENT, THE
ALARM WILL ENIT A SIGNAL

NOTE THE ALARM WALL SOUND WHEN THE KEY SWITCH IS TURNED ON.
THIS SOURDORS IS NORMAL ONCE THE INGINE STARTS AND THE ORGANS
ON PRESSURE REACHES IS PS. THE ALARM WILL STLENCE.

THIS BUTTON ENERGIZES THE START BUTTON.





DIESEL FUEL, ENGINE OIL AND ENGINE COOLANT

BESEL FUEL

Use fuel that meets the requirements or specification of Class 2-D (ASTM), and has a cetage rating of #45 or better.

Care Of The Fuel Supply

Ese only clean diesel fuel! The clearance of the conquirents in your fuelin jection pump is very critical; invisible durt particles which might pass through the filter can damage these finely finished parts. It is important to buy clean fuel, and teep it clean. The best fuel can be rendered unsatisfactory by careless bandling or improper surage facilities. To assure that the fuel going into the tank for your engine's daily use is clean and pure, the following practice is advisable.

Preciose a well-known brand of fuel.

Install and regularly service a good, visital-type oftentwater separates between the fuel tank and the engine. Rayour 500 MAM (micron rated often #2 or #10) is a good example of such a filter.

ENGINE OIL

Use a beavy duty engine oil with an API classification of CF or CG-4 or better. Change the engine oil after an initial 50 bours of break-in operation, and every 100 bours of operation thereafter. For recommended oil viscosity, see the following chart:

Operating Temperature	Oil Vocasity
Above 68°F (20°C)	SAE 30 or 10W-30, 15W-40
41°-68" (5-20°C)	SAE 20 or 10W-30, 15W-40
Below 41°F (5°C)	SAE 10W-30, 15W-40

A CAITION: Do not allow two or more brands of engine oil to mix. Each brand contains its own additives; additives of different brands could react in the mixture to produce properties barnetal to your conjunc.

ENGAGE COOLANT

UNIVERSAL returnmends a mixture of SO% anniverse and SO% distilled water is free from the civenicals that can curvely member engine surfaces.

The maintenage performs double chay. It allows the engine to the at proper tenementaries by constituting heat away from the capine to the capine and behinders and propert the caping carent from rust and capacian. Look for a good quality emittened the capacine Supplemental Cooling Additives (SCAs) that heep the antireve chamically behaved crucial to long term protection.

The distilled water and antificence should be premixed before being premed into the cooling circuit.

USE Look for the new environmentally-friendly long lasting antifree that is now available.

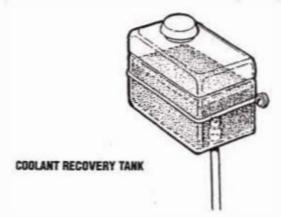
Antiferer mixtures will protect against an unexpected freeze and they are beneficial to the engine's cooling system. They retard just and add to the life of the circulating pump seal.

ANTIFREEZE PROTECTION

Antifreeze concentration	23%	30%	35%	50%
Hezing Temperature	14°F	84	44	-40°F
	(-5°C)	(-13°C)	(-20°C)	(40°C)

COOLAST RECOVERY TANK

A coolant recovery tank left is supplied with each
UNIVERSAL diesel engine. The purpose of this recovery
tank is to allow for engine coolant expansion and contraction
daring engine operation, without the loss of coolant and
without introducing air into the cooling system. This kit is
provided and must be installed before coming the engine.





PREPARATIONS FOR INITIAL START-UP

PRESTART INSPECTION

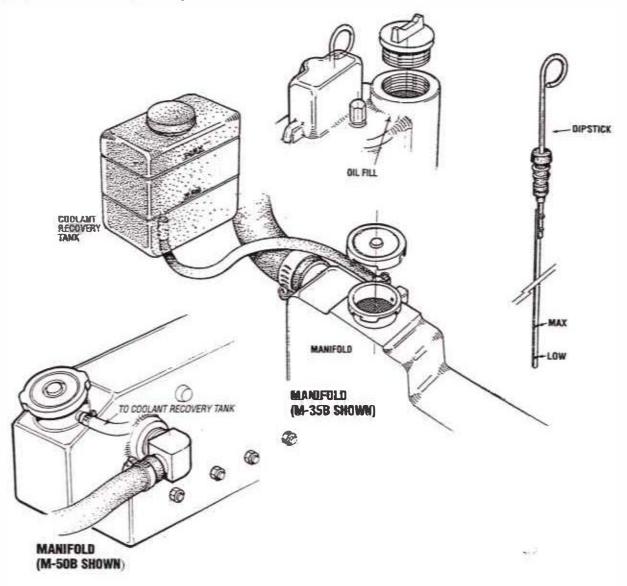
Before starting your expine for the first time or efter a prolonged layoff — check the following items.

- Check the eogine oil level; add oil to maintain the level at the high mark on the objects.
- Deak the fuel supply and examine the fuel ther/separator bowls for contaminants.
- Check the transmission fluid level

NOTE Refer to the specifications pages in this manual for field, oil, and recomission types and quarties.

- Check the DC electrical system inspect wire connections and battery cable connections.
- Visually examine the unit. Look for loose or missing part, disconnected wires, unarrached bases, and check threaded connections.
- Check the coolant level in the plastic recovery tank and at the manifold.

to the ENGINE COOLING CIRCUIT section of this manual





STARTING/STOPPING PROCEDURE

STARTING PROCEDURE

Place the transmission in neutral and advance the thronte commol to slightly open.

A CALMON: Make certain the transmission is in neutral. Starting in gene could result in serious demaye to your transmission, your book, and ressets nearty.

Turn the KEY SWITCH to the ON postion (2 o'clock)

PREFER: Depress the PREHEAT switch. The volumes and panel lights, gauges and morers will be activated. The PREHEAT switch should be depressed in accordance with the following chart:

Temperature/Preheat

Atmospheric Temperature	Preheating Time				
+41°F(+5°C) or Nigher	Approx. 10 seconds				
+41°F(+5°C) to 23°F (-5°C)	Approx. 15 seconds				
+23°F(-5°C) or lower	Approx 20 seconds				
Limit of continuous use	30 seconds before cranking				

START: While still depressing the PREHEAT switch, depress the START switch. This will engage the starter soleroid. Upon engine starting, release the START switch. Do not release the PREHEAT switch until the oil pressure reaches 15 psi. Then as long as the high water temperature and low oil pressure protective currents do not activate, the engine will remain energined and continue to run.

MOTE: When saring: A voltage drop will occur when the proheat switch is depressed.



Should the cages: not start when the START switch is depressed for 10 to 20 seconds, release both switches and west 30 seconds, repeat the protection above and preheat longer. Never run the starter for more than 39 seconds.

ACAUTION: Prolonged cranking interests without the engine starting can result in the engine exhaust system filling with raw water. This may kappen because the pump is pumping raw water through the raw water cooling system during cranking. This raw water can enter the engine's opinizes by way of the exhaust manifold once the exhaust system fills. Prevent this from happening by classing the raw water supply through-bad shurt-off, draining the exhaust manifold, and correcting the cause of the exhaust water entry is not a correcting the cause, the course from raw water entry is not a correcting the cause, the course/operator should keep this in mind.

Once the cagine starts, check instruments for proper oil pres-

Next accompl to engage the states while the engine is naving.

Depressing the Preheat switch for 10-15 second intervals will help stabilize the engine RPM until the operating temperance reaches 170°-190°F (77°-88°C) and a propeller load is applied to the engine. When the engine is nothing and the preheat switch is depressed, a charging load on the DC alternation will be discernible.

STARTING UNDER COLD CONDITIONS

Make certain the hybridating oil conforms with the ratings for the prevailing temperature. Check the table on the engine oil section of this manual

The basery should be fully charged to minimize voltage drop.

Use a sufficient amount of preheat to aid in starting, see Temperature/Preheat chart on this page.

STOPPING PROCEDURE

To step the engine, being the throads to an idle position and place the transmission in neutral. Allow the engine to idle for a few moments to stabilize temperatures. Pull the STOP lever to sind down the engine. Then turn OFF the key to close down the electric first pump and the estimates.

Made certain the key switch is in the OFF postion (12 o'clock). If the Key Switch is left ON, the battery will discharge. An engine alarm buzzer is provided to ware the operator of this condition (Key Switch ON). The best method of preventing the battery from discharge is to remove the key from the Key Switch after stopping the eogine. (The extra key should be stowed in a safe place.)



BREAK-IN PROCEDURE

THE FURST 50 HOURS

Arthough your engine has experienced a minimum of one hour of test operations in ensure accurate assembly and proper operation of all systems, break-in time is required. The service his of your engine is dependent upon how the engine is operated and serviced during its initial 50 hours of the.

You new engine regains approximately 50 hours of initial conditioning operation to break in each moving part in order to maximize the performance and service life of the engine. Petform this conditioning carefully, keeping in mind the following:

- L Start the engine according to the Starting Procedure section in this manual; run the engine at fast idle while checking that all systems (raw water pump, oil pressure, benery charging) are functioning.
- 2. Allow the engine to warm up (preferably by running at fast idle) until the water temperature gauge moves into the 130°-140°F range.
- 3. While using the vessel, run the engine at varying engine spans for the first 25 hours.
- 4. Avoid rapid acceleration, especially with a cold engine.
- 5. Use causion not to over load the engine. The presence of a gray or black exhaust, and the mability of the engine to reach its full med type, are signs of an overload.
- 6. During the next 25 hours, the engine may be operated at verying engine spins, with abort runs at full rated rpm.

 Avoid prolonged idling during this break-in period.

Breaking-in a new engine basically involves seating the piston rings to the cylinder walls. This cannot be accomplished by long periods of running at title, nor by early running at full rpm. Idle running may glaze the cylinder walls, resulting in excessive oil consumption and smoky operation. Excessive speed or heavy over-loading especially with a cold engine, may cause scoring of the cylinder walls, producing similar results. Operate the engine in moderation during the 50-hour break-in period. (Don't baby the engine, but do not abuse it.)

RECOMMENDED RPM RANGES								
MODEL	IOLE RPM	CRUISE RPM	MAXIMUM RPM					
M3-20B	1000 - 1200	2500 - 3000	3500 - 3600					
M25XPB	1000 - 1200	2000 - 2500	2900 - 3000					
M35B	800 - 1000	2000 - 2500	2900 - 3000					
M40B	800 - 1000	2000 - 2500	2900 - 3000					
M50B	800 - 1000	2000 - 2500	2700 - 2800					

EUIE Attempting to reduce title speed below the minimum shown may produce unstable engine operation and stabling.

NOTE: The propeller should be either 2 or 3 blade. It should allow the engine to reach its maximum rated ipm at full open throatle underway in forward good to ensure the availability of rated horsepower when needed.

NOTE: See the TRANSMISSION socion of this manual for break-in information on your transmission.

THE DAILY ROUTINE

CHECK LIST

Each day before starting your engine, 1 ke a few moments to run this check list:

- Visually inspect the cropine for fuel, oil, or water leaks
- Deck the oil level.
- Deat the consission fluid level.
- Obeck for losse wires at the alternator.
- Check the starting batteries level (weekly)
- Check drive bein for wear and proper tension (weekly).
- Log your engine coming time. These bours relate to
- Check fuel supply, always keep fuel tank(s) as full as possible.
- ☐ Look for clean fuel in the fuel/water separator bowl.☐ Check the coolant level in the plastic recovery task.

NOTE: Excessive loss of coolant indicates a cooling system lenk. Check the entire system. If necessary, use a cooling system tent pressure tester to pressure the cooling system to locate the area of leadings. In cases of excessive coolant loss, refill the system as outlined in the ENGINE COOLING CIRCUIT section in this manual.

START YOUR ENGINE

NOTE: See STARTING/STUPPING PROCEDURE in this manual for more detailed instructions.

- 1. Put consmission in central throttle advanced
- 2 Turn KEY to the ON position (2 o'clock)
- 3. Depress PREHEAT (10 to 15 seconds).
- 4. While pressing PREHEAT, push START.
 As engine times release START.
- Hold PREHEAT until oil pressure reaches 15 psi and/or alacto shuts off.

MITE Should engine fail to start, wan 30 seconds, repeat the above procedure, and PREHEAT longer.

 Allow a few minutes for the engine to warm at a comfortable rpm (approx. 1200 rpm), then reduce the rpm, shift into gear, and get underway.

A CAUTION: When shifting the transmission, always reduce the engine rate to idle, then shift the transmission firmly from one direction to another. A slight passe in quartral will allow the propeller to slow. Shifting at high rate will damage the transmission/damper plate.

ALARMS AND CIRCUIT BREAKER

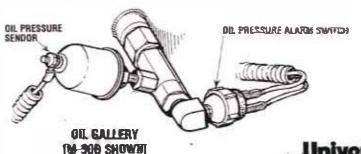
ENGINE CIRCUIT BREAKER

The DC harness on the engine is protected by an engineoriented operated reset circuit bracker (20 amps DC).

Excessive current draw or electrical overload anywhere in
the instrument panel wiring or engine wiring will cause the
breaker to rip. In this event most engines will shut down
because the open breaker disconnects the fuel supply. If
this should occur, check and repair the source of the problem.
After repairing the fault reset the preaker and restart the
engine.

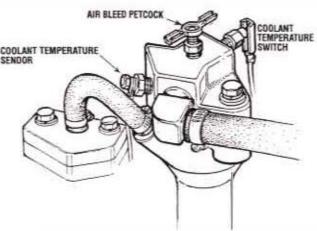
LOW OIL PRESSURE ALARM SWITCH

A low oil pressure alarm switch is located off the engine's oil gallery. This switch's sensor monitors the engine's oil pressure. Should the engine's oil pressure fall to 5-10 psi (0.4-0.7 kg/cm²), this switch will activate a pulsating alarm.



COOLANT TEMPERATURE SWITCH

A coolant temperature switch is located on the thermoso bousing. This switch will activate a continuous alarm i the coolant's operating temperature reaches approximately 210°F (99°C).



THERMOSTAT ASSEMBLY
(NS-500 SHOWN)

MAINTENANCE SCHEDULE

A WARNING: Never attempt to perform any service while the engine is running. Wear the proper safety equipment such as grapples and gloves, and use the current bods for each job. Discovered the battery terminals ober servicing any of the engine's OC electrical equipment.

NUTE Many of the following maintenance jobs are simple but others are more difficult and may require the expert browledge of a service mechanic

	CHECK		HOURS OF OPERATION		IN		CTD AMADON OF COSTUDE OF		
SCHEDULED MAINTENANCE	DAY	50	100	250	500	750	1000	1250	EXPLANATION OF SCHEDULED MAINTENANCE
Fuet Supply									Diesel No. 2 rating of 45 cetane or higher.
Fuel/Water Separator									Check for water and dirt in fuel (drain/replace filter if necessary).
Engine Oil Lavel									Oil level should indicate between MAX, and LOW on dipstick.
Coolant Level									Check at recovery tank; if empty, check at manifold. Add coolant if needed.
Drive Belts									Inspect for proper tension (3/8° to 1/2' dependion) and adjust if needed. Check belt edges for wear.
Visual Imspection of Engine	-	Dire		will in			स्ट टीट्स स्ट'ड केंद्र		Check for fuel, oil and water leaks. Inspect wiring and electrical connections. Keep bolts & russ tight. Check for loose belt tension.
Engine Throttle and Transmission Control Cables and Shutoff Levers									Check for loose fittings, cotter pins, etc. Lubricate with WD-48 or equivalent.
Adjust Engine Idle Speed									Adjust to (750-1200 rpm).
Fuel Filter				0	0	0			Initial change at 50 hrs, then change every 250 hrs.
Starting Butteries)									Every 50 operating hours check electrolyte levels and make sure connections are very tight. Clean off excessive corrosion.
Engine Oil and Filter									Initial engine oil & filter change at 50 hrs., then change both every 100 hours.
• Torque Cytinder Head Hold Down Bolts									At engine overhaul or cylinder head overhaul.
Eubricate Panel Key Switch with "Lockeze"									At first 100 hrs., then each year at winterizing.
Transmission Fluid									Initial fluid change at 50 hrs., then every 250 hrs. or once a year.
Air Cleaner									Clean the filter and element.
Exhausi System									Initial check at 50 hrs., then every 500 hrs. Inspect for leaks. Check siphon break operation. Check the exitated above for carbon and/or corrosion builday on inside passages; clean and replace as necessary. Check that all coveraions are tight.

MAINTENANCE SCHEDULE

NOTE: Use the engine how meter gauge to log your engine hows or record your engine hours by running time.

SCHEDUI FD	CHECK HOURS OF OPERATION						DOM ANGRODI OF CONCOUNTS		
MAINTENANCE	EACH DAY	50	100	250	500	750	1000	1250	EXPLANATION OF SCHEDULED MAINTENANCE
Engine Hoses				Ū	D		O		Hose should be hard & fight. Replace if soft or spongy. Check & tighten all hose clamps.
Heat Exchanger Zmc Anode			0	0	D		U		Clean or replace anode. Open heat extranger end cap and clean out debris. Remove every 1000 hours for professional cleaning and pressure testing.
Cleatric Feel Lift Pamp Filter (if applicable)		Ū		Ū	Ū		Ū		Clean at 50 hours, then clean every 250 hours.
Raw Water Pump						Ū			Remove pump cover and inspect impeller for wear, replace if needed. Also replace gasket. Lubricate both when reassambled. Inspect pump for internal wear, cover plate wear and carn wear.
Coolan System									Drain, flush, and refill cooling system with appropriate artificeze mix.
*Fuel Injectors								, i	Check and adjust injection opening pressure and spray condition (see Engine Adjustments).
*Starter Motor									Check solenoid and motor for corrosion. Remove and lubricate. Clean and lubrica e the States motor pinion drive.
*Preheat Circuit	ij				0				Check operation of preheat solenoid. Remove and clean glow plugs; check resistance (1.1-1.2 ohms).
*Engine Cylinder Charge ession and Valve Clearance									Incorrect valve clearance will result in poor engine periormance; check compression pressure and arming, and adjust valve clearances.
DC Alternator									Check DC charge from alternator. Check mounting bracket, tighten electrical connections.
Heal Exchanger									Remove, have professionally cleaned and pressure tested.
* Engine Transmission Damper Plate									Chattering at idle and low rpms is an indication of damper plate wear. Remove and replace.

^{*}UNIVERSAL recommends this service be performed by an authorized mechanic,

ENGINE COOLING CIRCUIT

DESCRIPTION

The engine is fresh water cooled (engine coolant) by an engine-mounted heat exchanger. Raw water is pumped through the heat enchanger by a gear-driven, positive displacement impeller pump. After the raw water cools the engine coolant in the heat exchanger, it mixes with the engine's exchange gears, cools the exhaust gears, and dischanges overboard.

The engine's coolant is circulated by a belt-driven centrifugal-type metal impeller pump mounted on the front of the engine. The engine's coolant temperature is the most animally controlled.

The engine's coolant must be charged according to the maintenance schedule in this manual. If the coolant is allowed to become contaminated, it can lead to overheating problems.

ACAUTION: Proper cooling system maintenance is critical; a substantial number of engine latines can be traced back to cooling system corresion.

A coolant reservery tank allows for engine coolant expansion and coordenion during engine operation, without any significant loss of coolan and without introducing air into the cooling system. This tank is best located at or above the engine manifold level, and should be easily somewhere.

Drain the engine coolant by loosening the train plug on the engine block and opening the manifold pressure cap. Flush the system with fresh water, then start the refull process. See the Parts Identification photos in this manual for locations.

NUTE: The percock on the heat exchanger can also be used to help drain engine ecolors.

AWARNING: Bewer of the hot styles coolant. West protective gloves.

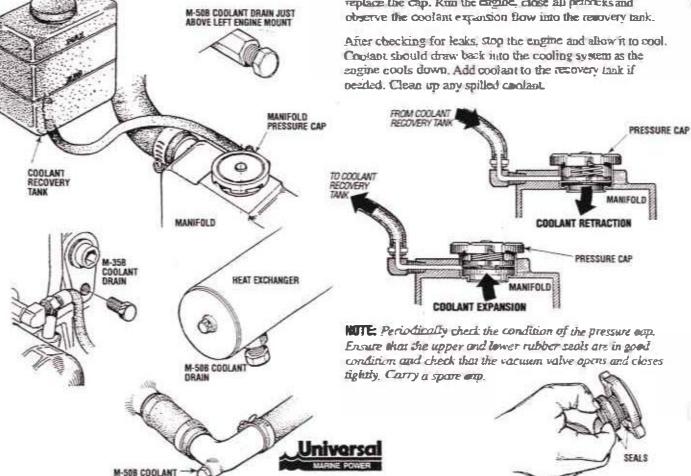
To Refill With Coolast

With the engine running in idle, slowly pour clean premixed coolant into the manifold.

LUTE. Open the percods on the thermostal housing and heat exchanger to help remove air from the system. When a stendy flow of coolant appears at the drain plug opening, close the water drain plug and continue to fill the system until the manifold remains full. Close the percode on the heat exchanger when antipeze flows from it.

Monitor the coolant in the manifold and add as needed. Fill the manifold to the filler neck and install the pressure cap. The pressure on the therm was shruid also be opened when refilling to allow trapped air to escape.

Remove the cap on the coolant recovery tent. fill with coolant this to ballway between LOW and MAX, and replace the cap. Run the capine, close all percents and observe the coolant expansion flow into the recovery tank.



ENGINE COOLING CIRCUIT

RAW WATER COOLING CIRCUIT

The taw water flow is created by a positive displacement impeller pump. This pump draws water directly from the occan, lake, or river from a through-hull opening through a base to the water strainer. The taw water passes from the strainer through the pump to a beat exchanger (through the breatexchanger tubes) where it oools the engine's circularing fresh water coolant. The taw water is then discharged into the water injected exhaust elbow, mixing with, and cooling the exhaust gasses. This mixture of exhaust gas and raw water is driven through the seep tobe and overheard.

Raw Water Pump

The raw water pump is a self-priming, rotary pump with a mon-ferrous locating and a property impeller. The impeller has flexible vanes which wipe against a curved cam plate within the impeller bouring, producing the pumping action. On no account should this pump be run dry as water acts as a lubricant for the impeller. There should always be a spare impeller and impeller cover gasket aboard (an impeller kit). Raw water pump impeller feitures occur when lubricant (raw water) is not present during engine operation. Such faithres are not warranable, and operators are cautioused to make sure raw water flow is present at start-up.

Changing the Raw Water impeller

- 1. Close the raw water intake.
- 2 Remove the inlet and outlet port hoses from the pump, noting the port location and positioning.
- Remove the pump assembly and its gasket from the engine.
- Remove the times hex head screws that hold the bousing to the cover.
- 5. Tap the housing/cover as subly on its side to loosen and separate the cover from its housing.
- Remove the cover and its O-sing and remove the impeller gasket and plate.

7. Remove the retaining ting (circlip) and pry out the impeller. Take care not to lose the key off the shaft's keyway.

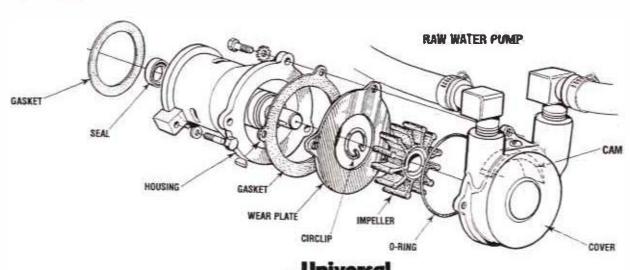
A CAUTION: If any of the varies have broken off the impeller they must be found to prevent blockage in the coaling circuit. They often can be found in the heat exchanger.

- 8. Replace the gastet, impeller, and O. ring.
- 9. Apply a film of pettoleum jelly or silicone to the inner surface of the impeller investig

HITE Just coat the surface, do not over apply.

- 10. Install the tropeller gashet and O-ring.
- Mount the pump to the engine taking care that the end seal and gasket are in place. Do not tighten the pump mounting screws, just finger tight.
- Reassemble the bose connections and open the raw water intake.
- Start the engine in idle, this will allow the pump to align uself with its drive shaft.
- 14. Stop the cagine and tighten the pump assembly unounting sactus.
- Start and run the engine, check for leaks and check for a normal operating emperature.

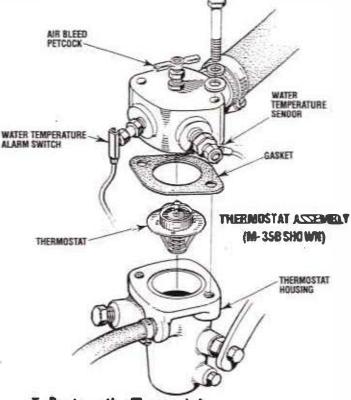
NOTE: Should a failure occur with the pumps internal parts (seals and bearings) it may be more cost efficient to purchase a new pump. The price of individual parts along with labor costs could match the price of a new pump.



ENGINE COOLING CIRCUIT

THERMOSTAT

A thermostal, located near the manifold at the front of the engine, controls the conlant emperatore as it community Bows through the closed cooling arount. When the engine is first started the closed thermoset prevents coolant from flowine (some coolant is by-passed through a hole in the thempsalt to Dievent the extraust manifold from overteeing). As the engine warms up the therman gradually opens. The themostar is acceptible and can be checked cleaned, or replaced easily, Curry a space thermostat and easket.

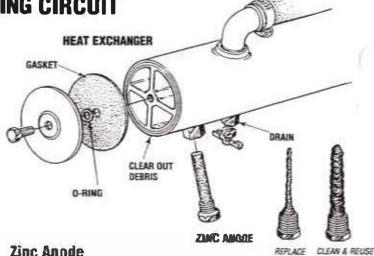


To Replace the Thermostal

Remove the two can sciews and disassemble as illustrated. When assembling the new thermosta and gasket put a thin coar of sealant on both sides of the gasket before pressing in place. Run the engine and check for normal temperatures and that there are no leaks at the thermostal housing.

Heat Exchanger

The heat exchanger is a copper tube which encloses a number of small copper pubes. Raw water is pumped dirough the small copper tubes and the freshwater coolant from the change is circulated around the copper tubes. The raw water removes heat from the freshwater coolant. To keep the heat exchange operating efficiently, it should be removed from the engine every 1000 hours to be therrughly elegated and अस्टिश्ट दिशस्त्र



A zinc anode (or pencil) is located in the raw water cooling cocuit within the heat exchanger. The purpose of the zinc anode is to sacrifice itself to electrolysis acom taking place in the raw water cooling circuit thorsby radioing the effects of electrolysis on other components of the system. The condition of the zinc anode should be checked manualy and the anode cleaned or replaced, as required. Spare another should be carried orboard. The area in the exchanger where the anale is located should periodically be cleaned of anote debris.

RAW WATER INTAKE STRAMER

NOTE: Always install the strainer at or below the waterline so the strainer will always be self printing.

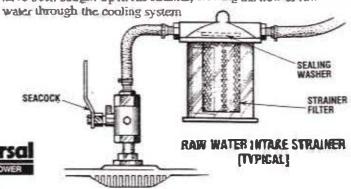
A clean raw water mocke strainer is a viral component of the engine's cooling system. Include a visual inspection of this strainer when making your periodic engine check. The water in the place should be clear.

Perform the following maintenance after every 100 hours of eocracion:

- 1. Close the raw water seasock
- 2. Remove and clean the strainer filter.
- 3. Clean the class.
- 4. Replace the scaling washer if necessary.
- 5. Reassemble and install the strainer
- 6. Open the seareck
- 7. Run the engine and check for leaks.

NOTE: Also follow the above procedure after having run hard aground

If the engine temperature gauge ever shows a higher than normal reading, the cause may be that silt, leaves to seek oney have been caught up in the strainer, slowing the flow of raw



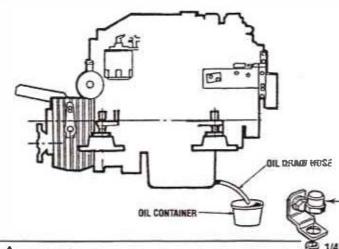
ENGINE OIL CHANGE

ORALN THE STIMP

The engine oil should be warm. Remove the oil drain hose from its attachment bracket and lower it into a container and allow the oil to drain, or attach a pump to the end of the drain hose and pump out the oid oil. Make sure the oil drain hose is capped and properly secured in its bolder after all the old oil has been drained.

INTE Thread size for the lube oil drain hase capped and is 1/4 NPT.

Always observe the old oil as it is removed. A vellow/gray emulsion indicates the presence of water in the oil. Although this condition is rate, it does require prough attention to prevent schools damage. Call a competent mechanic if water is present in the oil. Raw water present in the oil can be the result of a foult in the enhant system attached to the engine and/or a siphomog of raw water through the raw water cooling circuit into the exhaust, filling the engine. This problem is often caused by the poor location or the lack of an antisiphon valve. See UNIVERSAL'S Installation Manual.



AWARNONG: Used engine oil contains harmful contaourants. Avoid prolonged skin contact. Clean skin and nails trumwyby using soap and water. Launder or discard clothing or rays containing used oil. Discard used oil property.

Replacing the Oil Filter

When removing the used oil filter, you may find it helpful and cleaner to punch a hole in the upper and lower portion of the old filter to drain the oil from it into a container before removing it. This helps to lessen spillage.

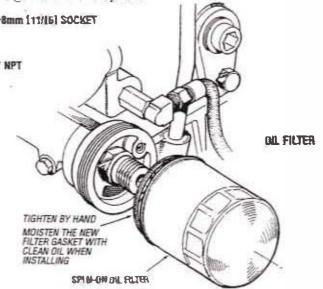
MITE Do not punch this hole without first largening the filter to make certain it will come off!

An automotive filter wrench should be helpful in comoving the old oil filter. Place some paper towels and a plastic bag around the filter when our rewing it to each any oil left in the filter. Impact the old oil filter as it is removed to make sure that the tubber sealing gasket comes off with the old oil filter. If this rubber sealing gasket comes off with the old oil filter. If this rubber sealing gasket comes sealed against the engine block geoty remove it. When installing the new oil filter element, wipe the filter gasket's sealing surface on the engine block free of oil and apply a thin cost of clean engine oil to the rubber gasket on the new oil filter. Serew the filter family by hand.

NOTE: Use germine UNIVERSAL oil filters - generic filters are not recommended.

REFALL THE OIL SUMP

Add fresh oil through the oller cap. After refilling, run the engine for a few moments while checking the engine's oil pressure. Make sure there is no leakage around the new oil filter or from the oil drain system, and then stop the engine. Then check the quantity of oil with the tabe oil dipotick. If the engine requires additional oil, fill to, but not over the high mark on the dipositek.



REMOTE OIL FILTER (OPTIONAL)

DISTALLATION

This popular accessory is used to relocate the engine's oil filter from the engine to a more convenient location such as an engine room builthead.

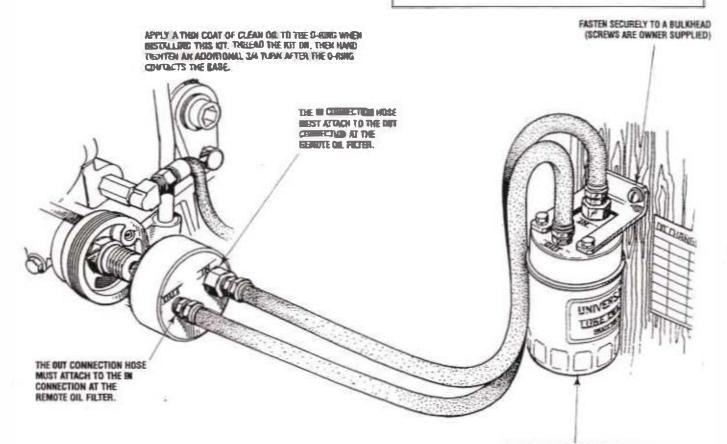
NOTE: Refer to ENGINE OIL CHANGE in this manual for instructions on removing the oil filter.

To install, simply remove the engine oil filter and thread on WESTERBEKE's remove oil filter lost as shown. Always install this kit with the oil filter facing down as it heartest.

Come your WESTERBERE dealer for more information

MOTE Westerbeke is not responsible for engine failure due to accorner installation of the Remote Oil Filter.

A CAUTION: It is vital to install the bil lines correctly. It the bil lines in the reverse directive, the bypass valve in the filter assembly will prevent the bil from reaching the engine causing an internal engine failure. If there is no oil pressure reading, starting to immediately and check the bose causestims.







FUEL SYSTEM

FUEL ADDITIVES

If fungus or bacteria is causing fuel problems, you should have an authorized dealer correct these problems. Then use a discel fuel blocke to sterilize the fuel (follow the menufacturer's instructions).

SPARES

While the likelihood of having to service the fuel system at sea is shim, the possibility does exist. Therefore, we recommend that hanjo washers, injector seat washers, and a fuel filter be carried on board at all times. Purchase medici spares from your local UNIVERS AL dealer or distributor. If a leak should develop at a banjo washer that cannot be currected by a simple rightening of the fitting, replace the sealing washer.

RUEL LIFT PIMP

The on-engine fiel system is virtually self priming. Under ordinary circumstances the engine's electric fiel lift pump, which is energized by the key switch/prefered tenton will supply a continuous flow of feel from the tenk. This fuel is drawn through the fuel/water separator to the engine lift pump, the primary spin on fuel filter, and the injection pump.

WARNING: Do not allow smoking or open figures near the fuel system when servicing. Also provide proper ventilation.

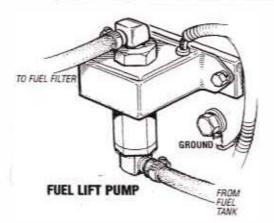
FUEL PRIMING

If it becomes occessary to bleed air from the system use the following procedure:

Lower all the high pressure injector lines (not injectors) and crank the engine starter motor, as fuel spures from between the out and the line, nighten the injector lines in sequence and then righten the bleed screw.

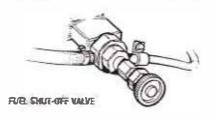
NUTE Do not attempt this procedure on a hot engine

A WARNING: Always wear protective clothing, safety glasses and gloves when bleeding high pressure injector lines.



FUEL RETURN LINE SHAIT-OFF VALVE [M-508]

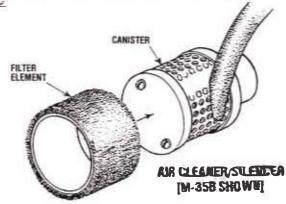
A shat-off valve is located on the fuel return line near the injection pump. This valve must be fully open.

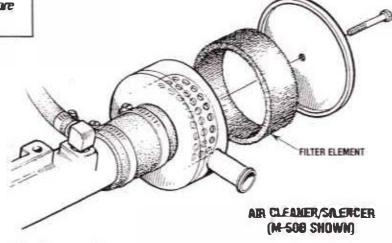


Air Cleaner/Silencer

Some UNIVERSAL engines use a replaceable air filter element wrapped around a metal canister. This element can be removed and brushed off or element with an air hose. When it become too contaminated it can be replaced. The canister with its interior element should also be convoved and cleaned periodically. Sumply wash the assembled unit in a non-flavimable cleaning solvent. Use this same cleaning procedure for other UNIVERSAL air cleaners that use a similar type canister.

MITE: To operate efficients a diesel engine must intake a continuous volume of clear air. Hard starting, an erratic idle, and black exhaust smoke are all symptoms of a restricted air intake.





FUEL SYSTEM

AWARNONG: Shart off the final valve at the tank when servicing the fuel system. Take care in carbaing any fuel that may spill. BU NUT allow any smaking, open frames or other squares of five near the final system when servicing the fuel system.

FUEL FILTERS

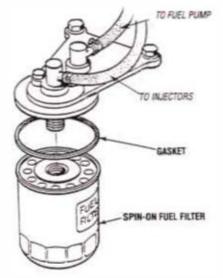
The fuel injection pump and the fuel injecture are precisely manufactured and they must receive clean diesel fuel, free from water and dirt. To ensure this flow of clean fuel, the fuel must pass through at least two fuel filters, a fuel/water separator and the engine's spin-on fuel filter. Visually inspect, clean, and change these filters according to the manufacture schedule in this manual.

- 1. Start fuel supply off.
- 2. Lower the fiel filter, turning counterclockwise with a filter wrench.
- Using a rag, wipe clean the sealing face on the bousing bracket so the new filter can be seated properly.
- 4. Lightly oil the scaling O-ring on the new fiber. To reinstall, num the filter assembly clockwise carefully until the O-ring common the scaling surface of the housing bracket.

 Turn 2/3 further with the filter wrench.
- 5. Turn on the fuel and start the engine. The normal preheat function should quickly prime the system and the engine should start.

METE The carridge contains fuel Take care not to spill it during discussions, perform the FRIMING THE FUEL SYSTEM after replacing the spin-on filter.

FUEL FRUTER

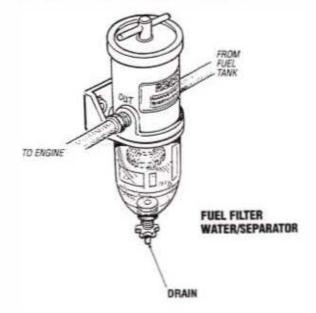


FUEL WATER SEPARATOR

A primary fuel filter of the water separating type must be installed between the fuel tank and the engine to remove water and other contaminants from the fuel before they can be carried to the fuel system on the engine.

Most installars include a type of filter water separate with the installation package as they are aware of the problems that contaminates in the fuel can cause.

A typical fuel the water acquired is illustrated in this diagram. This is the Raycor Model SOO MA. Keep in mind that if a water separate type filter is not installed between the fuel supply tank and engine mounted fuel system, any water in the fuel will affect the fuel pump, engine filter, and injection equipment. The owner/operator is responsible for making carried the fuel resulting the engine's injection equipment is free of impurities. This process is accomplished by installing and maintaining a proper filtration/separation system.



DC ELECTRICAL SYSTEM

ENGINE 12 VOLT DC CONTROL CERCUIT

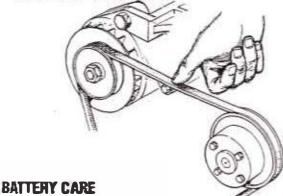
The engine has a 12 volt DC electrical control circuit that is shown on the witing diagrams that follow. Refer to these diagrams when troubleshooting or when servicing the DC electrical system on the engine.

DRIVE BELT ARJUSTMENT

A CAUTION: Drive belts must be properly tensioned. Lease drive belts will not provide proper alternation charging and will eventually damage the alternation. Drive belts that are too tight will pull the alternation out of alignment and/or cause the alternation to mean out pre-maturely.

Belt masion adjustment is made by privating the alternator on its base mounting bolt.

- Loosen the alternatur adjusting strap boilt and the base mounting boilt
- Pivot the alternator on the base mounting bolt to the left or right as required.
- Tegher the base mounting belt and the adjusting strap bolt.
- Operate the engine for about 5 minutes at idle, then shut down and recheck belt tension.



Review the manufacturer's recommendations and then employed by systematic maintenance schedule for your engine starting batteries and house batteries.

- Monitor your volunces for proper charging during engine operation.
- Check the electrolyte level and specific gravity with a hydrometer.
- Use only disalled water to bring electrolytes to a proper level.
- Make certain that battery cable connections are clean and tight to the battery posts (and to your engine).
- Keep your batteries clean and free of ourosion.



GLOW PLUGS

The glow plugs are wired through the preheat solenoid.

When PREHEAT is pressed at the control panel this solenoid should "thick" on and the glow plug should begin to get bot.

Inspection

To unspect the plug, remove the electrical terminal convertions, then unsures or unclamp each plug from the cylinder head. Thoroughly clean each plug's up and threads with a soft brush and cleaning solution to remove all the corbon and oil deposits. While cleaning, examine the up for wear and burn excession; if it has croded too much, replace the plug.

Testing

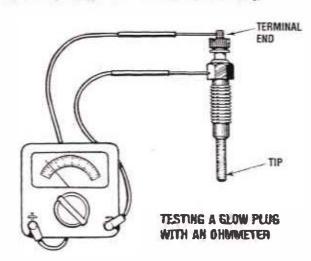
An accorate way to test glow plug's with an obmneter. Touch one prod to the glow plug's wire connection and the other to the body of the glow plug, as shown. A good glow plug will have a 1.0. 1.5 ohm resistance. This method can be used with the plug in or out of the engine. You can also use an amusely, so test the power drain (8 - 9 amps per plug).

A WARNING: These glow plugs will became very bot to the louch. Be careful not to burn your fingers when testing the plugs.

Re-install the plugs in the engine and test them again. The plugs should get very hot (at the terminal end) within ? to 15 seconds. If the plugs don't heat up quickly, check for a should when reinstalling the glow plugs, use and same compound on the threads.

WARNING: Do not keep a glow plug on for more than 30 seconds.

ELOW PLUS TIGHTENING TOROUS 7.11 R-6 [1.0-1.5 10-40]



DC ELECTRICAL SYSTEM

DESCRIPTION

The charging system consists of an alternative with a mounted voltage regulator, as engine DC wiring between a mounted DC circuit breaker, and a battery and connection wires. Hermose of the use of integrated circuits (IC's) the electronic voltage regulator is very compact and is mounted internally or on the back of the electrostor.

Alternator Troubleshooting

If you suspect that the alternator is not producing enough voltage to charge the engine's barrery, check the following:

A WARRING: A failed abstraction can become very hot. Do not touch until the afternatur has capital down.

- Male ceraio your alternator is securely mounted.
- Check the drive belts for groper tension.
- I begins for loose or discountered wires at the alternatur.

MITE An isolator with a direle, a solenoid, or a battery selector switch is usually mounted in the circuit to isolate the batteries so the stating battery is not discrepted along with the house batteries. If the isolator is charging the stating battery, the alternative is OK and the problem is in the battery charging circuit.

A WARNING: Start off the engine battery switch or disconnect from the battery when working on the engine electrical system.

Checking for Proper Voltage

If you suspect the alternator has failed perform the following tests with the engine off:

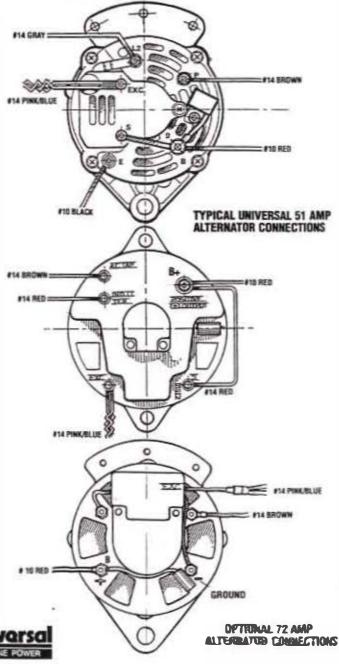
- i. Using a volument connect the voluments and wire clip to the cuspor terminal B.
- Connect the volumeter negative wire to any ground on the engine.
- 3. Check the backry voltage. It should read 12 to 13 volts.
- 4. Check the voltage between the oldernator (+) positive terminal B and any engine ground. If the circuit is good, the voltage at the alternator should be the same as the banery (mless there's an isolator in the circuit, then the reading would be zero).

A CAUTION: To avoid damage to the battery charging circuit, sever shat off the conjunct battery switch when the empire is remaind.

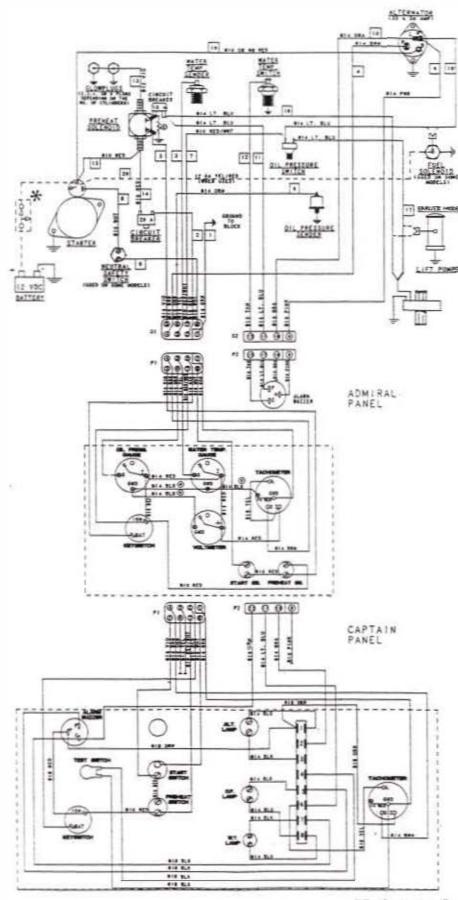
A WARRING: Leture starting the engine make cartain that everyone is clear of moving parts! Reep away from sheaves and belts during test procedures.

- 5. Start the engine.
- 6. The voltage reading for a properly operating alternator should be between 13.5 and 14.5 volts. If your alternator is over- or uniferhaping, have it repaired at a reliable service shop.

MITE Before removing the alternator for repair, use your volumeter to ensure that 12 volts DC enciration is present at the R terminal if the previous test showed only battery voltage at the B campa terminal.

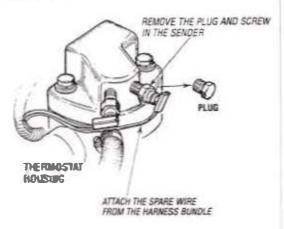


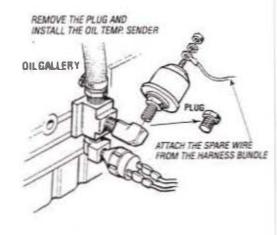
DC ELECTRICAL SYSTEM WIRING DIAGRAM #39144



These diagrams illustrate the 12 will eagains grown electrical circuit. The two optional instrument panels, the CAPTADI PAMEL and the ADMIRAL PAMEL are Garganizal below.

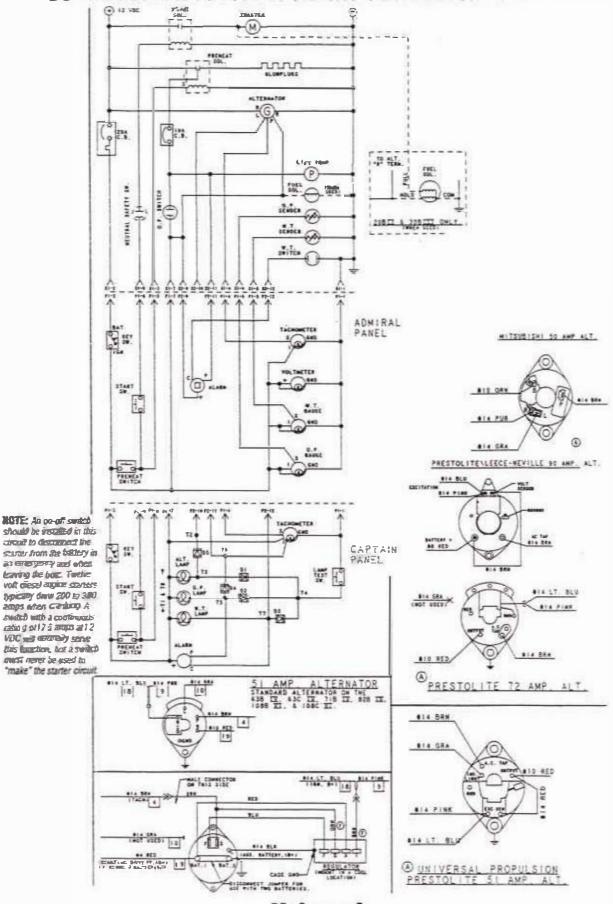
When an ADMIRAL PANEL is installed, two additional instrumed seasons are exembled to the engine to provide 64th for the panel 52495 (refer to the Massirations below).



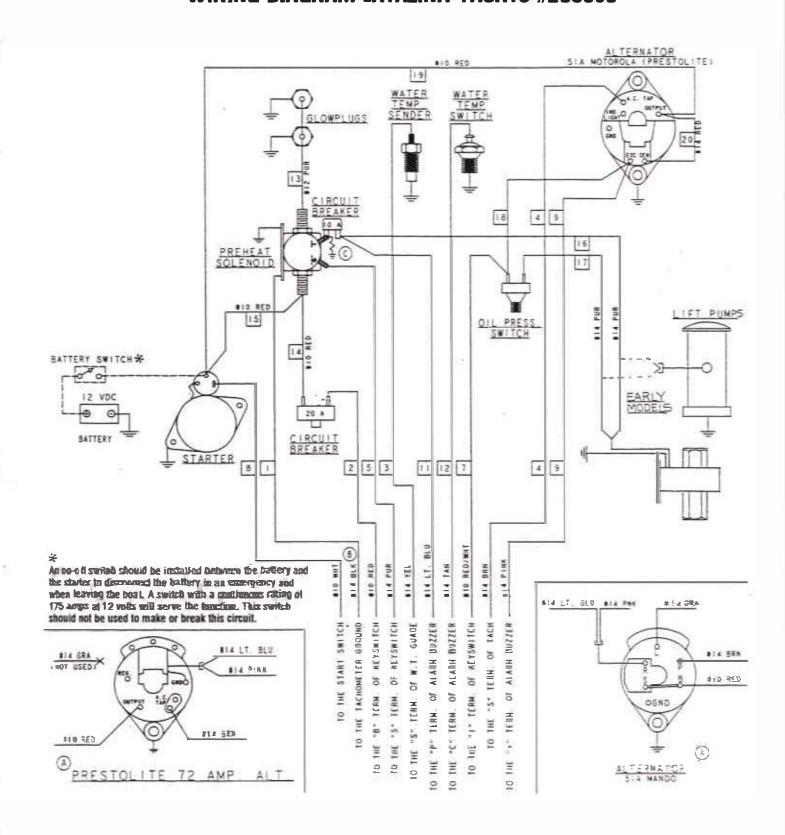


Solice As on-off system should be estimated in this colonial by discomment the system from the factory in the factor of the

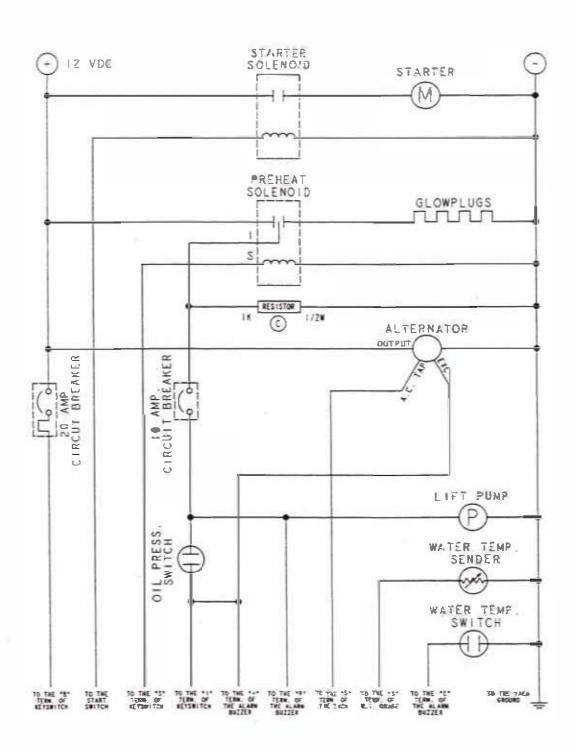
DC ELECTRICAL SYSTEM WIRING SCHEMATIC #39144



WIRING DIAGRAM CATALINA YACHTS #200360



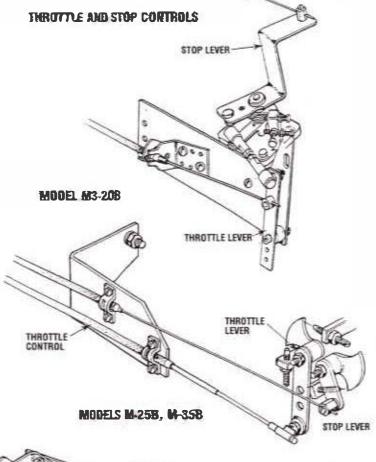
WIRING SCHEMATIC CATALINA YACHTS #200360



26

ENGINE ADJUSTMENTS

NOTE: UNIVERSAL recommends that the following engine adjustments be performed by a competent engine mechanic. The information below is provided to assist the mechanic



Remove the valve tocker cover to expose the engine's valve train. Remove the glow plugs from each of the cylinders to enable the engine to be easily rotated by hand to position each cylinder for valve adjustment.

Valves are adjusted with the piston in the cylinder being adjusted at IDC (Top Dead Center) of its compression stocke. Each cylider—is adjusted following the engine's fining order.

FIRMS DROER

3 CYLODER MODELS

1-2-3

4 CYLINDER MODELS

1-3-4-2

Adjust the valves beginning with Cylinder #1. Rotate the crankshaft slowly and observe the operation of the valves for Cylinder #1. Watch for the intake valve to open indicating the piston is on its intake stroke (the piston is moving down in the cylinder). Continue to rotate the crankshaft slowly and look for the intake valve to close. The piston is now starting its compression stroke (the piston is moving up in the cylinder towards TDC).

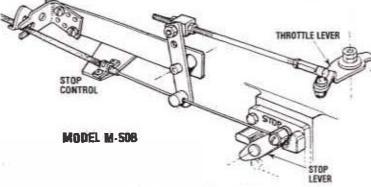
Watch the timing hole in the bell bousing for timing numbers to appear. Position the ITC Mark in alignment with the north in the timing hole. The piston in Cylinder #1 is now at IDC. Adjust the valves in Cylinder #1. Proceed to the next cylinder in the firing order.

Three Cylinder Models

Rotate the crankshaft 240° in the normal direction of manus and adjust the #3 Cylinder's valves. Rotate the crankshaft another 240° and adjust the #2 Cylinder's valves.

Four Cylinder Models

Rotate the crankshaft 180° in the normal direction of rotation and adjust the #3 Cylinder's valves. Rotate the crankshaft another 180° and adjust the #4 Cylinder's valves. Rotate the crankshaft another 180° and adjust the #2 Cylinder's valves.

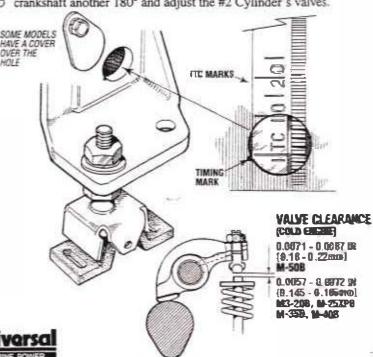


THROTTLE AND STOP ASSEMBLY

The throule and engine stop levers are located on the outboard side of the engine just below the fuel migazing pump. Brackets are provided for owner-installed push-pull cables that run to the steering station. The throule high speed adjustment has been factory set and is wire locked. The throutle idle screw is adjustable. These levers and trackets should be periodically lubricated and checked for loose festenings.

VALVE CLEARANCE

NOTE: Valve adjustment should not be necessary under normal operating conditions. These adjustments, when required should be performed by an authorized mechanic.



ENGINE ADJUSTMENTS

MOTE UNIVERSAL recommends that the following engine edjustments be performed by a competent engine mechanic. The information below is provided to assist the mechanic.

TESTING ENGINE COMPRESSION

Make extrain the oil level (dipstick) is at the currect level and the air intake filter is clean. The hanery and service motor must also be in good condition.

- 1. Warm the cugine to normal operating various various
- Move the control lever to a position for shutting off the fuel.
 (Disconnect the wires if a fuel shutdown solenoid is used).
- 3. Remove all the glow plugs from the engine and install the compression gauge/adapter combination to the cylinder on which the compression is to be measured.



- 4. Close the law water smooth (thru-hull).
- 5. Crank the engine and allow the gauge to reach a maximum reading Record the reading.
- Repeat this process for each cylinder.
 COMPRESSION PRESSURE 412 469 per [2.84 3.23 MPa] at oration speed.

MAZONITUM PERMASSIBLE DIFFERENCE RETWEEN GROUND ERS IS 10% OR LESS. LIMUT 327 pei 12.25 MPz]

NOTE if the readings are below the limit the engine needs an overhaul

- Re-install the glow plugs (use anti-seize compound on the threads) and reset the fuel shut-off to the run position.
- & Open the raw water seamed (thro-hall).

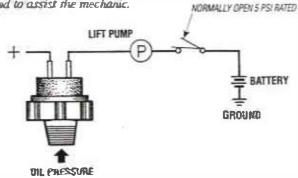
OIL PRESSURE

The eagine's oil pressure, during operation, is indicated by the oil pressure gauge on the instrument panel. Ouring ocumal operation, the oil pressure will range between 40 and 60 psi (2.8 and 4.2 kg/cm²).

NOTE A newly started, cold engine van have an oil pressure reading up to 60 psi (4.2 kg/cm²). A warmed engine can have an oil pressure reading as low as 35 psi (2.5 kg/cm²). These readings will vary depending upon the temperature of the engine and the spms.

LOW DI Pressure

The specified safe minimum oil pressure is 5 - 10 psi. A gradual loss of oil pressure usually indicates a worn bearings. For additional information on low oil pressure readings, see the ENGINE TROUBLESHOOTING chart.



Testing Oil Pressure

To test the oil pressure, remove the oil pressure sender, then install a mechanical oil pressure gauge in its place. After warming up the engine, set the engine speed at idle and read the oil pressure gauge.

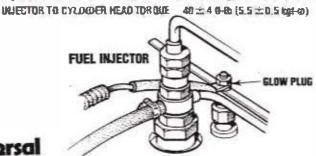
OIL PRESSURE
OIL PRESSURE
GAUGE
OIL PRESSURE
SENDOR
OIL PRESSURE
SENDOR
OIL PRESSURE
SWITCH

FLIEL INJECTORS

In case of severe vibrations and defonation voice, have the injectors checked and overhapled by an anticipized fuel injection service center. Poor fuel quality, contaminants and loss of positive fuel pressure to the injection pump can result in injector faults. Since fuel injectors must be serviced in a clean morn environment it is best to eatry at least one extra injector as a space should a problem occur.

Before removing the old injector, clean the area around the base of the injector to help prevent any most or deixis from falling down into the injector hole. If the injector will not lift out easily and is held in by carbon build-up or the like, work the injector side-to-side with the aid of the socket wrench to free it, and then lift it out.

The injector seals in the cylinder head on a copper sealing waster. This washer should be removed with the injector. replace with a new washer when the new injector is insulted.





ENGINE TROUBLESHOOTING

The following trouble shooting chart describes certain problems, the probable causes of the problems, and the resonant actions to overcome the problems.

Ampere musual reset circuit breather located on the bruches on the left side of the engine. The prohest solenoid is musualed on the same bracket.

Problem	Probable Cause	Voltage
Key switch on, PREHEAT switch	1. Battery Switch not on.	Check switch and/or battery connections.
depressed: no panel indications, fuel saleman or electrical fuel pump	2. 20-Amp circuit breaker tropted.	2. Reset breater, if breater trips again, check present solls and check circuit for shorts to ground.
	3. 10-Amp overher tripped.	3. Check vollage at and after breaker.
	4. Loose battery currenters.	4. Crest (+) conversion to stater subject and (+) conversion to state subject conversions.
	Preheat solenoid not operating.	5. Check solenoid.
Key switch on, PREHEAT switch	Connection to solenoid faulty.	Check connection at solenoid.
depressed: START sould depressed; no sould proportion.	2. Faulty START switch.	2. किलो असे किएस्स
	3. Faulty sciencist	Check that 12 volts are present at some subsocial activation connection.
	4. Loss history constants	4. Oracle (+) currenters to sold substituted and (+) connection a expert ground stud. Oracle to the currenters.
	5. Low batteries.	5. Check battery charge state.
Engine cranks, but does not	1. faulty rucking systems.	Check that fuel valves are open.
start.	2. Posturat solemoid taulty.	2. Check substrait
	3. Low compression.	3. Compression test the engine.
Engine can't be stopped.	Faulty shut-off lever at engine.	Reconnect shut off lever
	2. Push-pull shut-off cable from shearing station to engine disconnected.	2. Recursived pushings (able,
Engine stops.	Fuel lift pump failure.	 Fuel lift pump should make a distinct ticking sound. Replace poxip with spare.
	2. Switches and/or uning boss or discoveried.	2. Expect warmy for short circuits and bosse consections. Inspect switches for proper operand.
	3. Fuel starvation.	3. Check fuel supply, fuel values, fuel IR pump.
	4. 28 Amp distalt breaker squirq.	4. Check for high OC arrayage draw during operation. Ensure breater is not overly Servative to heat which would casse tripping.
	5. প্রিকার স্থানার ভারতার	5. Check for blockage, collegeed little, carbon besides at extract allow.
	6. Water in fuel,	E. Pump water from fuel Gnic(s); change fallers and bleed fuel system.
Battery not charging	Alternator drive.	Check drive belt tension, Atemator should turn freely. Check for loose care recours. Check OvOvi with volumeter. Ensure 1 viols are present at the Exc tensoral.

ENGINE TROUBLESHOOTING

Problem	Probable Cause	Verification Remedy
Battery runs down.	Oil Pressure switch.	 Observe if gauges and panel lights are activated when engine is not েক্টেক্ট্য নির the nit pressure switch.
	2. High resistance best to pround.	2. Check with a fised sensitive (0 - 25 amplitudes in bettery lines. (Do not sent angine.) Remove concernings and replace after sind is located.
	3. Lov resiscere teatr.	3. Check all weres for terror attre rise to locate the fault.
	4. AGETODIE	4. Discriment abstracts at Original, after a good battlery charping, if isologies stops, remove abstractor and beach test. Repair or replain
	5. Poor battery connections.	Check cable connections at battery.
ingine overnesis.	Raw water not circulating.	 Broken or loose belt at raw water pump.
BUTE. S'ELL ENDINE COMO OTHER STEELES	2. विकास का विकासिक प्र	2. Raw water pump failure. Check impelier replace.
		23. Costulation at law water intoles or raw water filles
		20. Thermasse — remove and test in but water. Rentace themselet.
		2x_Loss of coolina — mineric brokes, frose champs, drain plug, etc. for leads.
		26 Bruken or knose belts — Egitte-View
		Ze. Air leak in system, man engine and open cooling system persons heat exchanger, manifold, etc. to bleed air. Add coolant as neede
Extra ust smoking problems	Blue smoke.	Incorrect grade of engine oil.
		1a. රීන්කෙන s ගන්නින් with නමුරු ලබ් (ගේ is Noving ගර ගිරෙනු) the සම්කණ්ඩ
	2. Whate smoke.	2. Graine is runting cold
		Za. faulty injects or internal injector firming.
	3. Black or gray stroke.	3. Improper grade of bel.
		3a. Fuel born recording the to high hard pressure in extrains or resolutions in proper community (Check for resolutions in extract system check at intake).
		3. प्रकारकार्ग अस्ति केले अंडरका, तांत्रस्थित्वले valves वर poor
		3c. Lack of air — check air make and an filter. Check for proper ventilation.
		3d. Overhead
		3e. Propeller.
Transmission will not shift in or out of geat, or drive the vessel.	Transmission failure.	1a. Check cable connections at steering station and at transministrate level.
		12 Check transferson find
		15. Check shall containings or engine do user place.
		1d, Check engine's damper plate.
Excessive vibration	Faulty engine alignment	Check the shalt/fransmission coupling.
		12 hopes at some mount
	2. Oness beautys support structure of property created at the support.	2. Inspect probables and shaft.

CONTROL PANEL TROUBLESHOOTING MANUAL STARTER DISCONNECT (TOGGLE SWITCHES)

MILE The engine around system is protected by a 20 amp manual reset circuit breaker located on the engine as close as possible to the power source.

Problem	Probable Cause	Vojura Par
PREHEAT depressed, no panel indications full dishunid, electric fuel surror and	Oil Pressure switch.	Check switches and/or battery connections.
Organi topical util Greature!	2. 20 sum count breaker tripped	 Reset bresizes to opens again, check the as sales aid circuit for shorts to ground.
START SWITCH DEPRESSED, no starter	Connection to solenoid faulty.	Check connection.
entronment	2. faulty switch	2. Circle swetch with about the
	3. Faulty sciencial.	3. Check that 12 volts are present at the colonial curve time.
	4. Losse tattery contections.	4. Check Galley connections
	5. Low battery.	Check battery charge state.
NO IGNITION, cranks, does not start.	Faulty fueling system.	Check for fuel.
	2. Check for air in the fuel system.	2. Alter System to bleed.
	3. Faulty fuel lift pump.	Replace fuel lift pump.
NOT CHARGING BATTERY	Faulty alternator drive.	 Check the drive belt and its tension. Be sure the alternator nums beety. Check for toose connectors. Check the cost of with a volumeter. Ensure 12V are present at the regulator terminal.
BATTERY RUNS DOWN	Oil pressure switch.	 Observe if the gauges and panel lights are activated when the engine is not revent. Test the oil pressure switch.
	2. Figh resistance leak to ground.	 Check the wiring, losert abretove (025 amp) meter in battery lines (Do NOT start engine). Remove core exists and replace other short is located.
	3. Low resistance leak to ground.	3. Check all wires for temperature rise to locate the texts
	4. Faulty abstrator,	4. Mer E good battery chargens, decomes alternation at output, if hadage stops. Remove alternation and beach test. Plasair or replace.

TRANSLESSEATING WATER TEMPERATURE AND DR. PRESSURE GAUGES

If the gauge reading is other than what is ourmally indicated by the gauge when the instrument panel is congrict, the first step is to check for 12 volts DC between the ignition (B+) and the Negative (B-) imminals of the gauge.

Assuming that there is 12 volts as required, leave the instrument panel energized (key switch on) and perform the following steps:

- 1. Disconnect the sender wire at the gauge and see if the gauge reads acro, which is the normal reading for this sinution.
- 2. Connect the standar terminal at the gauge to ground and see if the gauge reads full scale, which is the normal crading for this situation.

If both of the above gauge tests are positive, the gauge is undoubtraily OK and the problem lies either with the conductor from the sender to the gauge or with the sender.

If either of the above gauge tests are negative, the gauge is probabily defective and should be replaced.

Assuming the gauge is OK, check the anndarins from the sender to the sender terminal at the gauge for continuity.

Check that the engine block is connected to the ground.

Some states have isolated ground terminals and if the batery is emocrated to the states (both plus and minus terminals), the ground side will not necessarily be connected to the block.



TACHOMETER

TACHOMETER/HOUR METER

The technical hour meter used in propulsion engine instrument panels commins two separate electrical circuits with a common ground. One circuit operates the hour meter and the other the tachometer. The nour meter circuit operates on 12 volus alternator charging voltage supplied to the (+) terminal on the back of the instrument.

The technical circuit operates on AC voltage 6-8 volts, fed from one of the diodes in the alternaturand supplied to the technical in put technical while the engine is running, and the alternature producing battery charging voltage 13.0-14.8 volts DC.

The following are procedures to follow when troubleshooting a fault in either of the two circuits in a technical four states.

Hour meter inoperative

Check for the proper DC voltage between (+) and (-) terminals.

- 1. Voltage present meter is de lective cepair or replace.
- Voltage not present trace (+) and (-) electrical connections for fault (Jump 12 volts DC to meter (+) reminal to verify the operation.)

Tachometer looperative

Check for the proper AC voltage between achimeter input terminal and (-) terminal with the engine running.

- L Voltage present ancount adjusting mater durough calibration access hole. No results, repair or replace mater.
- 2 AC voltage not present check for proper alternate DC output voltage.
- Check for AC voltage at tach terminal on alternative to ground.
- 4. Check electrical connections from technical input terminal to alternate connection.

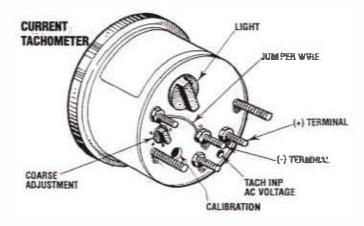
Tachometer Sticking

- L. Check for proper AC voltage between "each imp." terminal
- Check for good ground connection between more (-) terminal and alternature.
- Check that alternator is well grounded to engine block at alternator pivot bolt.

Tachometer Inaccurate

- a. With a hand-held tack on the front of the crankshalt pulley retaining nut or with a Grobe type tack, read the front crankshan pulley rom at idle.
- b. Adjust the exchanger with a small Phillips type screw-driver through the calibration access bole in the rear of the exchanger. Zero the each and bring a to the spin indicated by the strobe or hand tach. (Verify the spin at idle and at high speed). (Adjust the tach as nearlest.)

MOVE: Current model exhameters use a coarse adjustment dial to set the tachometer to the crankshaft pulley spins. The calibrating screw is then used for fine raning.



IDLE SPEED ACCUSTMENT & TACHO METER CHECK (New Installation)

Checking the idle speed

NUTE In a new installation having new instrument panets, the tock-ometer may not always be correctly calibrated to the engine's rom. This calibration should be checked in all new installations.

- L Warm up the engine to ocennal operating temperature.
 Remove any speaks on the crankshaft pulley with a clean cloth and place a piece of sainable reflecting tape on the pulley to facilitate use of a photoelectric type tachameter.
- 2 Start and wile the capine
- 3. Aim the light of the tachumeter onto the reflecting upe to confum the engine spead. Check the instrument panel by using the instrument coarse adjustment to calibrate the instrument reading to the closest R.P.M. that the photo each is showing. Then use the fine calibration adjustment to bring the instrument to the exact reading as the photo such
- 4. Adjust the idle speed if the engine speed is not within the specified value.

NORMAL LOUE SPEED: 800 - 1000 rpm.

WATER HEATER CONNECTIONS

WATER HEATER INSTALLATIONS

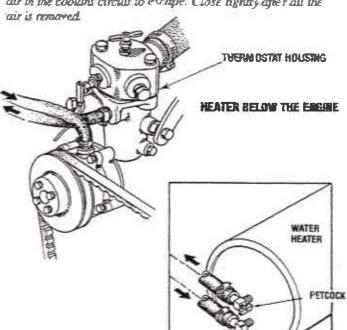
This engine is equipped with connections for the plumbing of engine coolant to heat an on-board water heater. The water bester should be contact in a convenient luxation either in a high or low position in relation to the engine, so that the contexting itoses from the bester to the engine can run in a reasonably direct line without any loops which might trap air.

Hoses should rise continuously from their low point at the heater to the engine so that air will rise manually from the heater to the engine. If capped air is able to rise to the board, then a n air bleed petcock must be installed at the higher fitting on the beater for bleeding air while filling the system.

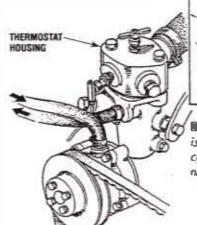
MITE: If any portion of the having circuit rises above the engine's classed cooling system pressure cap, then a pressuriced (aluminum) remote expansion tank [Ka #024177] must be installed in the circuit to become the highest point. Tee the remote expansion tank into the heater circuit, choosing the highest of the two connections for the return. Tee at the heater, and plumb a single time up to the tank's location and the other back to the engine's return. Install the remote expansion tank in a convenient location so the fresh water coolant level can easily be checked. The remote expansion tank will now serve as a check and system fill point. The plostic coolant remover; tank is not used when the remote expansion tank kit is installed, since this tank serves the same function

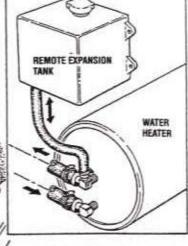
The pressure cap on the engine's manifold should be installed after the engine's cooling system is filled with coolant. Finish filling the cooling system from the remote tank after the system is filled and is free of air and exhibits good coolant carollation. During engine operation, checking the engine's coolant should be done at the remote tank and not at the engine manifold cap. The bose connect on from the beater to the remote expansion mank should be comed and supported so it rises continuously from the beater to the tank, enabling any air in the system to rise up to the tank and out of the system.

EUTE: Air bleed percocks are located on the engine's heat exchanger and on the thermostal housing. Open these pacocks when filling the engine's fresh water system to allow air in the coolars circuit to excape. Close tightly after all the



MEATER ABOVE THE ENGINE





NOTE: The remove expansion work is for filling and the expansion of coolant. Water houser coolant flow need no: 80 through the tank.

HOSE CONNECTIONS

The bose adapters (nipples) coming off the engine (decrows at housing and water pump housing) are sized for 3/8" LD, hose. An adapter is available (#302391) that will increase the size to 5/8" LD, hose.



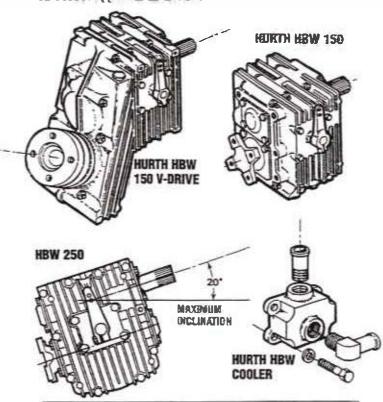
ALAPTER PH SEESEN

HURTH HBW TRANSMISSIONS

CESCRIPTION

The information below is specific to the HBW

Frankrissions the TRANSMISSION TROUBLESHOOTING
SECTION applies to all madels.



A CAUTION: The position of the machanism behind the actuation lever is factory-adjusted to ensure equal shift lever travel from neutral position A and B. If this mechanism is in any way lampared with, the transmission mananty will be void.

SHAFT COUPLINGS

WESTEROEKE remoments a flexible connection between the transmission and the propeller shaft if the engine is flexibly mountain in order to compensate for angular deflections. The installation of a special propeller throat hearing is not required, since the propeller throat will be absorbed by the transmission bearing, provided the value specified under SPECIFICATIONS is not exceeded. However, the output shaft should be protected from additional loads. Special care should be taken to prevent torsional vibration. When using a universal joint shaft, make certain to observe the manufacturers incrutions.

Even with the engine solidly mounted, the use of flexible coupling or "DRIVESAVER" will reduce stress in the gear-box bearings canced by half distortions, especially in wooden boats or where the distance between transmission output flange and stern gland is less than about 600mm.

Drivesaver is a product of Gobe Marine Rockland MA



MOTE When vistalling the transmission, make certain that shifting is not impeded by restricted manability of the cable or rod linkage, by unstainbly positioned guide sheaves, too small a bending radius or other restrictions. In order to mount a support for shift control cable connections, use the two thrested holes located above the cable bracket mounted on the goar kousing. Refer to the WESTERBEKE parts list.

SHIFT LEVER

The transmission is statable for single lever ramote control.

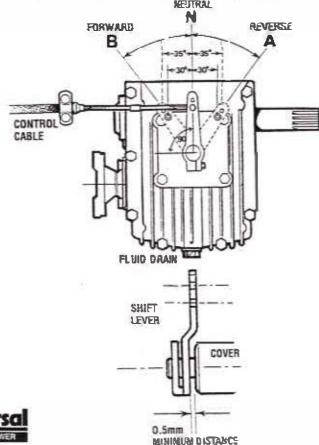
Upon loosening the retaining screw, the actuating lever can be moved to any position required for the control elements (cable or rod linkage). Make cartain that the shift lever does not contact the actuating lever cover plate the minimum distance between lever and cover should be 0.5mm.

The control cable or rod should be arranged at right angle to the actuating shift lever when in the neutral position. The neutral position of the operating lever on the control console should coincide with the neutral position of this lever.

The shifting travel, as measured at the pivot point of the actuating lever, between the neutral position and end positions A and B should be at least 35mm for the outer and 30mm for the inner pivot point.

A greater amount of shift lever travel is in no way detrimental and is recommended. However, if the lever travel is shorter, proper clutch engagement might be impaded which, in turn, would mean promaine wear, excessive host generation and clutch plate failure. This would be indicated by slow clutch engagement or no engagement at all.

NOTE Chack for proper lever travel at loast each season.

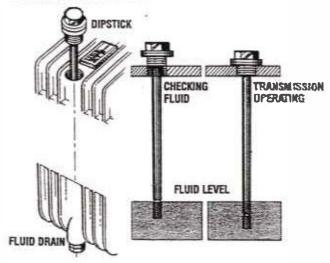


HURTH HBW TRANSMISSIONS

MITTAL OPERATION

All HBW marine transmissions are test-run on a test stand with the engine at the factory prior to delivery. For safety reasons the fluid is drained before shipment.

Fill the granbox with Automatic Transmission Fluid (DEXTRON III). The fluid level should be up to the index mark on the dipsock. To check the fluid level, just insert the dipsock, do not surew it in. Screw the dipsock into the case after the fluid level is chacked and tighten. Do not forget the scaling ring under the hexhead of the dipsock. Check for leaks and make a visual proposition of the coupling, oil cooler and boses, and shift cables.



FLUED CHANGE

Change the fluid for the first time after about 25 hours of operation, then every 250 operating bours or at least once a year or when you change engine till.

Removing the fluid

Push a surion pump bone down through the dipstick hole to the bottom of the housing and snok out the fluid. If space allows, use the transmission drain. Remove the drain plug from the bottom of the transmission and allow the fluid to drain into a container, then transmission and properly dispose of the used fluid. After tunning the engine, shut down and recliect the fluid level.

DRAM PLUG TORQUE 28 - 25 MAIS

NOTE: When changing the fluid, take care not to lose the drain plug scaling washer. The drain plug will look without this scaling washer.

A WARNING: Merer pull out the dipstick while the engine is running. But fluid will splash from the dipstick hole. This could cause severe burns.

LOCKING THE PROPELLER

Locking of the gropellor shaft by an additional brake is not required: use the gran shift lever position opposite your direction of travel for this purpose. Never put the gear shift in the position corresponding to the direction of travel of the boat.

WHEN LINGER SAIL OR BEING TOWED

Rozaion of the propeller without load, such as when the boat is being sailed, being towed, or anchored in a river, as well as operation of the engine with the propeller suppost (for charging the battery), will have no demonstrated effects on the transmission.

DAILY OPERATION

☐ Check the transmission fluid.
☐ Visually check the gest shift linkage and transmission.
☐ Shift the engine in neutral, allowing a few manutes at idle to warm the fluid.
☐ Shift imo gest.

NOTE: Too low an idle speed will produce a chargering noise from the transmission gear and damper plate. In such cases the idle speed s hould be increased

For additional information refer to the following text in this Transmission Section: SHAFT COUPLINGS, MAINTENANCE AND TRANSMISSION TROUBLESHOOTING.

HBW TRANSMISSIONS SPECIFICATIONS

General	(Huth Standard Tracorication) Case- bardaned helical gears, with a savo- operated multiple disc clutch.
Gear ratio (optional)	2.63 . 1 (HBW 150A - 3R) 2.99 : 1 (HBW 150V - 3R) 2.74: 1 (HBW 250 - 3R)
Propeller	See propele reconviewants
Lebricating Fluid	ATF-Type A or Dectron - II or III
Transacity Capacity	H8W 150A 0.30 U.S. qts (0.561 Gers) H8W 150V 1.11 U.S. qts (1.05 liters) HBW 250 D.75 U.S. qts (0.79 liters)
Propeller Shall Direction of Rotation	Right bend - standard transmission

HURTH HBW TRANSMISSIONS

OPERATING TEMPERATURE

A WARDONG: If the transmission fluid temperature is too high, stop the engine immediately and check the transmission fluid.

Normal operating temperature of the transmission Unid simuld be in the range of 122°F (50°C) to 212°F (100°C). A maximum temperature of 266°F (130°C) may be only reached for a short time.

Make certain there is enough spane around the transmission in provide good semilation and cooling.

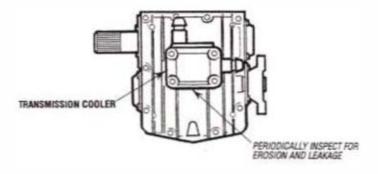
TRANSMISSION COOLER

Coolers are standard equipment for the HBW 100, 125, 190, 150A, 150V, and the 250 (no cooler is reassay) for the HBW 35 and 50).

The cooler is a separate part of the construction which prevents any possibility of sociant diluting the transmission that. However, the continued flow of coolant thru the sociar will, in time, crude the inside of the cooler causing external leaks:

A transmission cooler may last ten years or more but, in some circumstances, depending on operating hours, impical waters, maintenance, etc. it might only last half that time.

UNIVERS AL recommends having a spare cooler aboard.



MARITENANCE

Transmission trainers are is minimal. Keep the enterior brusing clean, check the fluid level as part of your regular rounne, and change the fluid every 300 operating hours.

Periodically inspect the transmission and the cooler for leaks and corresion. Lubricate the cable connectors.

Lay-up/Winterize

Straige requires special care, follow these procedures:

- Drain want from the transmission oil cooler and replace with a proper transme of autificent coulant.
 - This operation will normally occur when the engine raw water coulong system is properly winnerized
- (use beat resistant paint).
- Fill the transmission with Dextron III ATF fluid to prevent internal corrosion (extended storage only, twelve nooths or more).
- flange and propeller shaft coupling flange before removing the boat from the water. Separate the flanges and spray with lubricant.
- Inspect the gear shift cable, livings, and austinomiss.

 Look for currosion of the end fixings, cracks or cuts in
 the condinit, and benefing of the actualor rods. Lubricate
 all moving page.

NOTE if the transmission is to be stured for a long time (twelve manufes or more), it should be upped off with fluid to prevent internal corresion. Reduce the fluid level before putting the engine back into service.

HURTH MARINE GEAR ZF Industries Marine US Pleadquarters 3131 SW 42nd Street Fort Landerviale, FL 33312 Tel: (954) 581-4040

Fax: (954) 581 4077

TRANSMISSION TROUBLESHOOTING [HURTH]

CONTROL CABLES

The enajority of transmission difficulties arise as a result of improper clumb adjustments (reasonal transmissions) or problems with countd cables (bydraulic transmissions) rather than from problems with the transmission itself.

HURTH cluments in particular, are very pressive to improper shift adjustments.

If you expecience operating problems with the consumeron, shut the engine down. First check the consumeron fluid level, then have a below move the cocking shift lever through the full range — from neural to full forward back to neural, into full reverse, and back to neural — while you observe the actuaing lever on the consumeron. If the remote is stiff to operate, break the cable loose at the consumeron and my again. If it is stiff soiff, check the cable for kinks or executively tight bends, and check any linkage for binding

A new cable and perhaps a new linkage mechanism may be needed. While the cable is loose, shift the transmission in and out of gear using the lever on the side of the transmission to make some there's no binding inside the case.

If the transmission passes these tests, crank the engine and have a helper put it in forward and reverse while you observe the propeller shaft; if the shaft isn't turning, the transmission needs professional attention. If it does turn but there's no threat check to see you still have a propeller on the end of the shaft or, if you have a folding or feathering propeller, that it isn't stock in the "no pitch" position.

MOTE li you suspect a major problem in your transmission, impediately contact your UNIVERSAL dealer or an authorized marine transmission facility.

Problem	Probable Cause	Verification/Remedy
Transmission gears cannot be shifted.	Shifting lever is loose.	Tighten damping bolt on shifting lever.
ramy m sunde (sim Zon-	 Stational capitle is to taken, then or unanacted. Cabit codes is to severe. 	2. Obesit the cable, ranked or replace.
	1. Said lever is bireful applied comprise.	 Betach the shift cable and operate the lever by Nand. Clearance should be 0.02 in (0.5mm).
Transmission shifts into gear, but tails to propel the boat	 Output coupling is not turning. 	Transmission needs professional attention.
	2. Properly stair is not turning. Output coupling is bening.	 The coupling bods are pheared or the coupling is sligping on the propeller shall. Tighten or replace set screens, lays, pins and coupling lights as conservy.
	property start are look training.	 tispect the propeler it way be missing or damaged. A fulfing propeler very be januared. A variable pitch propelar may be in "no pitch" position.
ामें बाह्त का कान्यक प्र थंडावा विकास कार्या कार्या कार्या कार्या	1. Lever traves in the B most exposition in to A. Refer to despress.	 Adjust cover plate until the lever is exact mid position Refer to SHFT LEVER TEXT AND CLAGRAM.
	2. Sift her trade is instituted.	2. Check shift lever cable length. Rules to SHIFT LEVER DIASRAL
	3. Shift lever is binding against cover plate.	3. Check clearance, adjust if necessary.
Chattering transmission noise, mainly at low a significant.	1. The engine or propeller generates torsional visrations in the drive unit which produces a window up noise in the transvission.	1. Mount a flexible coupling with another stiffness factor between the procession coupling and the drivested. A higher stiffness factor might be sufficient.
		Inspect the damper plate between the engine and the transmission. Replace if necessary.
Transmission noise becomes louder.	 Damage starting on flexible coupling due to wear or taligue, possibly due to creating- ment between angine and the drive shall. 	 Check alignment, inspect flexible coupling. If noise persists, inspect the dumper plate between the transmission and the angine. Replace if necessary.
	2. Begivering der eage at bezongs in trans- messing due to tensional velocities, naveing valvous fluid, overtrad, wrong eligioness of transmission, or excessive engine output.	2. एक्ट्रकंडरेक १५५६ एक्ट्रकंकार्य ग्राम्संकर
Boat fails to attain specified max speed.	Operating temperature is high.	 Wrong type of fluid, use ATF. Check fluid level.
	2. Operating without cooling.	2. Check cooler. Inspect coolant hoses and coolant flow,
Oil Leakage.	 Corrosion at radial sealing ring and shaft. Developed sealing ring. 	Transmission needs professional attention.
	2. Misalignment of output flanges.	Check alignment. Must be within 0.003 in (0.08mm).

MOTE: If you suspect a major problem in you transmission, immediately contact your UNIVERSAL dealer or an authorized marine prosmission facility.



LAY-UP AND RECOMMISSIONING

LAY-UP

Many owners rely on their boat/ards to prepare their craft, architing engines and generators, for lay-up during the off-seam or for long periods of macrovay. Others prefer to

The following procedures will allow you to perform your own lay-up and recommissioning or you may use them as a check list for others. These procedures should afford your engage protection during a lay-up and also help familiarize you with the maintenance needs of your engine.

If you have any questions regarding lay-up procedures, call your local servicing dealer, he will be more than willing to provide accordance.

PROPELLER SHAFT COUPLING

The transmission and propeller half couplings should always be opened up and the boits removed when the boat is frauled out of the water or moved from land to water, and during strage in a craille. The flexibility of the boat often puts a severe strain on the propeller shaft or coupling, or both, while the boat is taken out or put in the water. In some cases, the shaft has actually been been by these strains. This does not apply to small boats that are hauled out of the water when not in use, unless they have been dry for a considerable period of time.

FRESH WATER COOLING SYSTEM

A 50-50 solution of antiferese and distilled water is recommended for use in the freshwater cooling system at all times. This solution may require a higher concentration of antiferes, depending on the area's winter climate. Check the solution to make sure the antiference procedure is adequate.

Should more antifreeze be needed, drain an appropriate amount from the cogine block and add a more concentrated mixture. Operate the engine to ensure a complete circulation and mixture of the antifreeze concentration devoglous the cooling system. Now recheck the antifreeze solution's concepts.

LUBSECATRUM SYSTEM

With the engine warm, drain all the engine oil from the oil sump. Remove and replace the oil filter. (Place some paper tracks and a plastic bag around the filter to catch the oil during its removal.)

When installing the new oil filter, he sure to apply a small amount of oil on the cubber sealing gasket at the base of the filter. Fill the sump with the correct arrount of oil for your engine model. (Refer to the SPECIFICATIONS section of this manual.) Use an oil with an AP1 specification of CF or CG4 or better. Run the engine and check for proper oil pressure and make sure there are not leaks. Stop the engine, check oil level and add oil as needed to bring level to dipatick full mark.

A CANTON: Do not leave the engine's old engine oil in the sump over the lay-up period. Engine oil and combined deposits cambine to produce harmful chemicals which can reduce the life of the engine's internal parts.

FUEL SYSTEM

Top off your fuel teaks with No. 2 diesel fuel. Fuel additives shauld be estited at this time to control algae, and a fuel conditioner such as STABIL. Care should be taken that the additives used are compatible with the primary filestwater separates used in the system. Change the element in your primary fuel filestwater separates, if the fuel system contains one, and clean the separates achines though.

Change the fast filter elements on the engine and bleed the system as needed. Start the engine and allow it to run for 5-10 minutes to make sure no air is left in the fuel system. Check for any leads that may have been created in the fuel system during this servicing, correcting them as needed.

RAW WATER CIRCUIT

Close the through-hall fitting. Remove the raw water intake bose from the fitting. Place the end of this hose into a 5-gallon backet of clean fresh water. Before starting the engine, check the zinc anode found in the heat exchanger on the engine and clean or replace it as required. Clean the raw water strainer, if one is installed in the inside of the hall.

Sum the engine and allow the raw water pump to draw fresh water directly the system. When the bucket is empty, stop the engine and refull the bucket with an annifecent solution slightly stronger then needed for winter freeze protection in your area.

Start the engine again and allow all of this mature to be drawn through the raw water system. Once the bucket is empty, stop the engine. This antiference mixture should protect the raw water circuit from freezing during the witner laying, as well as providing crayosion protection.

Remove the impeller from your raw water pump (some emitteen minute will accompany it, so each it in a backet). Examine the impeller Acquire replacement if occided and a cover gasket. Do not replace the impeller (1940 the pump) until recommissioning, but replace the cover and gasket.

LINE If engine storage is going to be a lengthy one, 12 months and beyond, it is wise to rouse the engine by hand two complete turns every additional 4 months to allow the injection pump companents to move. This will help prevent their sticking during extended storage periods.

LAY-UP AND RECOMMISSIONING

STARTER MUTOR

Lubrication and cleaning of the states drive pinion is advisable, if access to the states permits its removal. Make sure the battery connections are shut off before attempting to remove the states. Take care in properly replacing any electrical connections removed from the states.

CYLINDER LUBRICATION

it is not necessary to remove the glow plugs from the cylinder head to squire light engine oil into the cylinders for the few months of normal lay-up. However, if you anticipate a longer lay-up period (12 months or more), we recommend that this procedure be performed. The light oil in the cylinders will prevent the pistons' rings from sticking to the cylinder walls. With oil in the cylinders, num the engine over by band two revolutions.

TRANSMISSION

Check or change fluid in the gangnission as required. If the engine is to be layed up 12 months or more, fill the gangnission to the very top to prevent corresion. Lower the fluid to its narmal level at recommissioning. Wipe off grine and grusse and toucht up uppainted areas. Protect coupling and output flange with anticorresion costing.

SPARES

Lay-up time provides a good opportunity to imspect your UNIVERSAL engine to see if external items such as drive belts or coolant hoses need replacement. Check your basic spares left and order news oot on hand, or replace those items used during the lay-up, such as filters and zinc anodes.

BATTERIES

If batteries are to be left on board during the lay-up period, make some they are fully charged and will remain that way, to prevent them from freezing. If you have any doubt that the batteries will not remain fully charged, or that they will be subjected to severe environmental conditions, remove the batteries and store them in a warmer, more compatible environment.

WARNING: Lead acid batteries entit introgen, a highly explosive gas, which can be ignited by electrical arcing or fighted tobacco products. On not smoke or allow an open flame near the battery being serviced. Shut off all electrical equipment in the ricinity to prevent electrical arcing during servicing. We are number gloves, a robber apron and eye protection when servicing testeries.

RECOMMISSIONING

The recommissioning of your UNIVERSAL engine after a seasonal lay-up generally follows the same or centure as those presented in the PREPARATIONS FOR STAKING section regarding preparation for stating and normal starts. However, some of the lay-up procedures will need to be consultracted before starting the engine.

- 1. Remove the al-spaked cloths from the intake mignifold
- 2. Remove the taw water pump cover and gashet. Discard the gasket Install the raw water pump impeller removed through lay-up (or a replacement if required). Install the raw water pump cover with a new cover easier.
- Recommend the shaft coupling and check for proper abgoment
- 4. Reinstall the batteries that were removed during the layup, and reconnect the battery cables, making sure the terminals are clean and that the connections are tight. Check to make sure the baneoies are fully charged.
- 5. Overk the amodifice of the zone abode in the raw water current and clean or replace the anode as occided. Note that it is not occessary to flush the anotherze freshwater solution from the raw water coolant system. When the engine is put into operation, the system will self-flush in a short period of time with no adverse affects.
- Start the engine in accordance with precident in the PREPARATIONS FOR ONITIAL START-UP section of this month.

UNIVERSAL MARINE ENGINES SPECIFICATIONS

	GENE	RAL		
Description M-358, M-40B, M-50B	Diesel, four-cycle, four-cyfinder, fresh water-cooled, Vertical, in-line overhead valve mechanism.			
Description M3-208, M-25XPB	tresh water	Diesel, tour-cycle, three-cylinder, fresh water-cooled, Vertical, in-line overhead valve mechanism.		
Displacement M3-208 M-25XPB M-35B M-408 M-508		es [Liters] [7/177] [1:900] [1:335] [1:498] [1:857]		
Aspiration	Neturally a	S) Fair		
Combission Crambes	Sphercal	Type, three vorex system		
Borz & SOTAKE M3-298 M-25XPB M-35B M-408 M-508	2.99 x 29 2.99 x 29 2.09 x 3.0	mî 8 (67 x 869) 0 (76 x 736) 0 (76 x 736) 9 (78 x 78.4) 4 (80 x 92.4)		
Contact Valid	23:1			
Fairing Order MG-2000, MA-251079 M-3520 , M-4600, M-508	1-2-3	2		
Weight 0G-288 M-25XP8 M-358 M-408 M-508	1.85 [Kg] 1 241 [110 295 [134, 352 [159, 356 [161, 329 [248,	ଡ଼ି ୠ 5j		
Direction of Rotation	Clockwise	when viewed from the front		
LU	BRICATIO	IN SYSTEM		
Description	Forced La	puration by gear pump		
Lube (iii Fiber	Fall Brie 9	ගා ක මිස ජනලා		

Description	Forces labration by gest pump
Luce Oil Fater	ित्री किक्स्प्राण का बिक्स संक्रास्त्री
Light State (1997) May 250 May 1998 May 250 Ma	Ceart Liers 4.0 (3.8) 4.0 (3.8) 4.5 (4.3) 10.5 (9.9)
(perating ()) Pressure	42 - 54 psi (294 - 441Kpa) at raled speed
Of Grade	API Specification of or CG-4.

Transmission Specifications: Refer to the transmission section in this manual.

Ü	OOLING SYSTEM
Description	Fresh water-cooled block, thermosiztically- controlled with heat exchanger.
Operating Temperature	170° - 190° F (77° - 28° Cī
Fresh Water Pump	Coronago type, mend impeles, bell-driven.
Raw Water Pump	Positive displacement nubber impoler; bell-driven.
Coclant Capacity M3-208 M-25XP8 M-35B M-408 M-506	Overs [Vers] 3/5 (35] 4.0 (3.8] 6.0 (5.6) 4.5 [4.3] 12.0 [11.4]

FUEL SYSTEM

EUTHORNE	Open flow, self priming
Fuel Nozzle Type	[Bosch] throttle type
fuel Injection Promp	to-line planger type [Bosch]
Fuel	No.2 diesal di (cantane rateg of 45 or higher)
Fuel Lift Pump	12 volt 5 lit caterally solid state

ELECTRICAL SYSTEM

Starting Battery	12 Volt, (-) negative ground.
Battery Capacity	400 - 600 Craid Cramking Areps (CCA)
DC Charging Alternator	51 Amprazed, belt dimen
Starting Aid	Glow pages sheathed type
Starter	12 Volt, reduction gest
Alternator	51 Amp करि मिस्ति व्यक्तिका

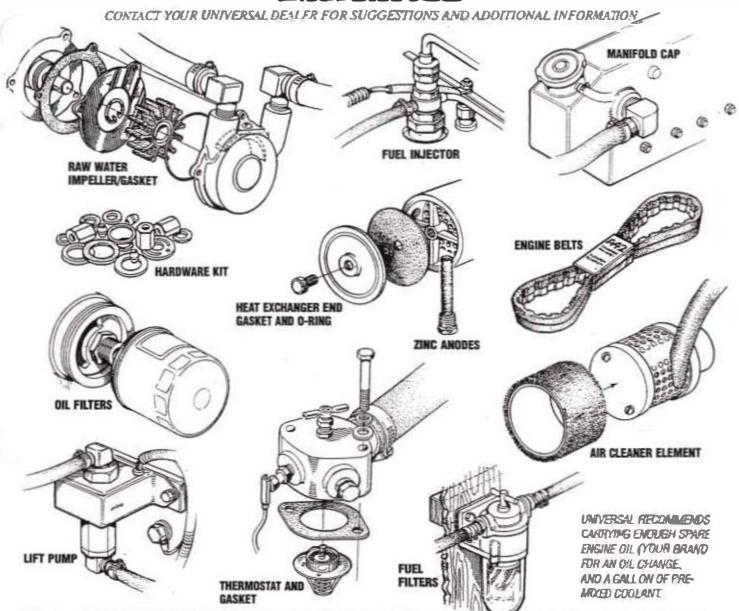
TUNE-UP SPECIFICATIONS

Compression Pressure

[at 250 RPM] MG-20R, M-251PB M-152, M-408	412 - 469 PSI [2.84 - 3.23 MPai
M-50B	512-540 PSI [35.3 - 37 2 MPa]
निक्कार निकार	1991 PSI [13.73 MPa] static timed
Engine Toning	18° (0.314 850) before TDC Establish
Valve Clearance (engine COLD) M3-208 M-25XPB M-35B M-408	inches (mm] 0.0637 - 0.6072 [0.145 - 0.185] 00057 - 0.0072 [0.145 - 0.185] 0.0057 - 0.0072 [0.145 - 0.185] 0.0057 - 0.0072 [0.145 - 0.185]
M-508	0.0071 - 0.0087 (0.18 - 0.22)

SUGGESTED SPARE PARTS

(MIVERSAL MARAGE ENGRES



UNIVERSAL SPARE PARTS KITS

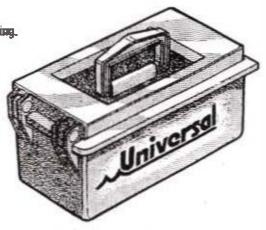
UNIVERSAL also offers two Spare Parts Kits, each packaged in a rugged birged bodbox.

Kit "A" includes the basic spares.

Kit "B" is for more extensive off-shore craising.

KIT A

Impeller Kit
Heat Enchanger Gaskel
Fuel Filter with Gaskel
Oil Filter
Bell
Zinc Anodes





KII B

broefler lift

Oil Filter
Water Pump Repair Kit
Zinc Anodes
Heat Exchanger Gaske
Thermostal Kit
Complete Gaskel Kit
Injector
Fuel Filter with Gast
Belt
Glow Plog

STANDARD HARDWARE

BOLF HEAD MATRICINGS

BOA STREET CHASES are ambessed on the Read of each bolt.

Customary (mink) brids are identified by markings two to grade eight (Struggest). The marks correspond to two marks less than the actual grade, i.e., a grade seven bolt will display five embossed marks.

Metric built class numbers destify only by their Strongth with 10.9 the





11125

- 1. Use the tortice values listed below when specific torque values are not available.
- 2. These turques are based on clear, dry favoris. Finduce forque by 10% when engine oil is used.
- 3. Perfore torques by 30% or more, when threating capacities into attribute.

Copurer Body Size (Inches) - (Thread)	SAE Grade 5 Torque FI-Cà (Nun)	SAE Grade 6-7 Torque R-Lib (No)	SAE Grade 8 Torque FI-Lib (Hm)
1/4 - 20	8 (11)	10 (14)	12 (16)
- 28	10 (14)		14 (19)
5/16 - 18	17 (23)	19 (26)	24 (33)
- 24	19 (26)		27 (37)
3/8 - 16	31 (42)	34 (45)	44 (60)
- 24	35(47)		49 (66)
7/16 - 14	49 (66)	55 (5)	70 (95)
- 20	55 (75)		78 (106)
1/2 - 13 - 20	75 (102) 85 (115)	85 (115)	105 (142) 120 (1তী)
9/16 - 12	110 (149)	120 (163)	155(21 ⁰)
- 18	120 (163)		170(231)
5/8 - 11 - 18	150 (203) 170 (231)	167 (226)	240 (ZE)
3/4 - 10	270 (366)	280 (380)	375 (508)
- 15	295 (400)		420 (569)
7/8 - 9	395 (536)	440 (597)	605 (833)
- 14	435 (590)		675 (915)
1 - B	590 (800)	660 (895)	910 (1234
- 14	668 (895)		990 (1342

Bolt Dia.	Wrench Size	Grade 4.6 PI-Lb (Nm)	FI-Lb (Nm)	Grade 8.8 - 9.8 Ft-Lb (Nm)	Grade 10.9 Ft-Lb (Nm)
M3	5.5 ccs	03 (0.5)	0.5 (0.7)	1 (1:3)	1.5 (Z)
M4	7 sun	0.6 (1.1)	1 (1.5)	2 (3)	3 (LS)
M5	8 scc)	1.5 (2.5	2 (3)	45 (5)	6.5 (S)
M8 M9 M10	13 mm 13 mm	3 (4) 7 (9.5) 14 (19)	4 (5.5) 10(13) 18 (25)	75 (19) 18 (25) 37 (38)	11 (19) 25(26) 25 (75)
M12	18:mm	26 (35)	33 (45)	報酬	97 (130)
M14	21:mm	37 (35)	55 25)	106(MAD)	151 (205)
M16	24:mm	39 (80)	65 115)	139(2)引	232 (315)
M18	27 cm	81 (110)	118 (160)	52 (22)	29 (435)
M20	30 cm	138 (160)	186 (ZZ)	33 (42)	57 (529)
M22	33 cm	158 (215)	225 (30)	32 (42)	520 (840)
M24	35 mm	203 (275)	258 (363)	553 (750)	789 (1070)
M27	41 mm	295 (400)	417 (365)	811 (1100)	1154 (1565
M30	46 cm	402 (545)	568 (770)	1103 (1495)	1571 (2130
M33	5 Taxon	546(7.40)	774 1050)	1500 (2035)	2139 (2900
M36	55 mm	700 (950)	992 (1345)	1925 (2610)	2744 (3720

SEALANTS & LUBRICANTS

STEED STAND

Oil based FERMOEX #2 and its 186H TACK equivalent are excellent all purpose scales. They are effective in just about any joint in contact with contact, one water, oil or feel.

A light coasing at Off, or LIOUED TERLINI can be used on number gasters and O-range.

LOCTITE hydraulic reci seedork should be used on oil adapter hoses and the oil liter assembly.

Cost both surfaces of the oil pan gasket with high temp RED SILICONE state.

When installing gaskets that seal around water (content) passages, cost both sets with WAVITE SILICONE grease.

High-capes ALFESTAF STRAYS are useful for holding grades in passing (unity assembly).

Specialized प्रक्रीयों करबंधक such as HYLDMAR work करने in applications खाक तक राजनेक्टांकरण प्रकारकार HYLDMAR & partically स्थितकर छ। राज्यार प्रकारको खाद खादेकर के से स्थानक प्रेमी और को अर्थन tise UQUED TESLON for seeing goe plays and dimps feet correct coders coverys. Do not use type seeding!

BOUTS & FASTENERS/ASSEMBLIES

Lightly of head botts and other testerees as you assentials from Bolts and plugs that personals the visite jacket should be stated with デザルルシン 72 or HIGH TACK

When assembling the Briving out the bolt threads with LOCTITE blue.

And-seize components and tivead locking achieves soch as LOCITTE protect foreign components yet allows them to came apert when recessory LOCITTE offers levels of locking according to the job.

ing boxes.

Happy oil all \$1500 and Colorada Composes when assertion, Alerys not clean copies aid.



STANDARD AND METRIC CONVERSION DATA

LENGTH-DISTANCE

Inches (in) \times 25.4 = Millimeters (min) \times .0394 = Inches Feet (ft) \times .305 = Meters (m) \times 3.281 = Feet Miles \times 1.609 = Kilometers (km) \times .0621 = Miles

VOLUME

Cubic Inches $\{in^i\}$ x 16.387 = Cubic Centimeters x .061 = in^{-1} Imperial Pints (IMP pt) x .568 = Liters (L) x 1.76 = IMP pt Imperial Quarts (IMP qt) x 1.137 = Liters (L) x .88 = IMP qt Imperial Gailons (IMP qt) x 1.201 = US Quarts (US qt) x .833 = IMP qt Imperial Quarts (IMP qt) x 1.201 = US Quarts (US qt) x .833 = IMP qt Imperial Gallons (IMP qt) x 1.201 = US Gallons (US qt) x .833 = IMP qt Imperial Ounces x 29.573 = Milliters x .034 = Ounces US Pints (US pt) x .473 = Liters(L) x 2.113 = Pints US Quarts (US qt) x .946 = Liters (L) x 1.057 = Quarts US Gallons (US qai) x 3.785 = Liters (L) x .264 = Gallons

MASS-WEIGHT

Ounces (oz) \times 28.35 = Grants (g) \times .035 = Ounces Pounds (lb) \times .454 = Kilograms (kg) \times 2.205 = Pounds

PRESSURE

Pounds Per Sq In (psi) x 6.895 = KBopascats (kPa) x .145 = psi Inches of Mercury (Hg) x .4912 = psi x 2.036 = Hg Inches of Mercury (Hg) x 3.377 = KBopascats (kPa) x .2961 = Hg Inches of Water (H:O) x .07355 = Inches of Mercury x 13.783 = $\frac{1}{100}$ Inches of Water (H:O) x .03613 = $\frac{1}{100}$ inches of Water (H:O) x .248 = KBopascats (kPa) x 4.026 = H:O

TORQUE

Pounds-Force Inches (in-b) x .113 = Newton Meters (Nm) x 8.85 = in-b) Pounds-Force Feet (ff-b) x 1.356 = Newton Meters (Nm) x .738 = ft-b)

VELBCITY

Miles Per Hour (MPH) x 1.609 = 10 ameters Per Hour (KPH) x .621 = MPH

POWER

Horsepower (Hp) \times .745 = XBowatts (Kw) \times 1.34 = MPH

FUEL CONSUMPTION

Miles Per Hour IMP (MPG) x 354 = Kilometers Per Liter (Km/L) Kilometers Per Liter (Km/L) x 2352 = IMP MPG Miles Per Gallons US (MPG) x 425 = Kilometers Per Liter (Km/L) x 2352 = US MPG

TEMPERATURE

Degree Fahrenheit (°F) = (°C X 1.8) + 32 Degree Celsius (°C) = (°F - 32) x .56



METRIC CONVERSIONS

5 1 10 2 10 Milli	INCHES Meters 0.0254 0.0508 0.0762 0.1016 0.1270 0.1524 /ERT METER	7 8 9 10 11 12	381.00 \$08.00 635.00 762.00 889.00 1016.00 ER, 100 CENTIN ERS Meters 0.1778 0.2032 0.2286 0.2540 0.2794 0.3048 METERS, MOVE	0.1 0.2 0.3 0.4 0.5 0.6	0.0394 0.0787 0.1181 0.15 5 0.1969 0.393 ETER = 39.37 I METERS TO Inches 3.937 7.8 4 11.811 15.748 19.685 23.622	***************************************	0.5906 0.7874 0.9843 1.1811 1.3780 1.5 48 FEET) Inche 27.559 31.496 35.433 39.3 (43.307
2 3 4 1 5 10 10 Milli 10 Milli 11 2 3 4 6 TD CONV Yards 1 2 3 4 5 6 MUV	50.80 76.20 101.60 127.00 254.00 METERS = 1 INCHES Meters 0.0254 0.0508 0.0762 0.1016 0.1270 0.1524 VERT METER YARDS Meters 0.91440	20 25 30 35 40 CENTIMETE TO MET Inches 7 8 9 10 11 12 S TO CENTII	\$08.00 635.00 762.00 889.00 1016.00 ER, 100 CENTIN ERS Meters 0.1778 0.2032 0.2286 0.2540 0.2794 0.3048	2 3 4 5 10 IETERS = 1 M Meters 0.1 0.2 0.3 0.4 0.5 0.6	0.0787 0.1183 0.15 5 0.1969 0.393 ETER = 39.37 I METERS TO Inches 3.937 7.8 4 11.811 15.748 19.685	25 30 35 40 NCHES (3.3) D INCHES Meters 0.7 0.8 0.9 1.0	0.9843 1.1811 1.3780 1.5 48 FEET) Inche 27.559 31.499 35.433 39.3 (
3 4 1 1 5 1 1 10 2 10 MILLI Inches 1 1 2 3 4 5 6 (76.20 101.60 127.00 254.00 METERS = 1 INCHES Meters 0.0254 0.0508 0.0762 0.1016 0.1270 0.1524 /ERT METER YARDS Meters 0.91440	25 30 35 40 CENTIMETE TO MET Inches 7 8 9 10 11 12 S TO CENTII	635.00 762.00 889.00 1016.00 ER, 100 CENTIN ERS Meters 0.1778 0.2032 0.2286 0.2540 0.2794 0.3048	3 4 5 10 IETERS = 1 M Meters 0.1 0.2 0.3 0.4 0.5 0.6	0.1181 0.15 5 0.1969 0.393 ETER = 39.37 I METERS TO Inches 3.937 7.8 4 11.811 15.748 19.685	25 30 35 40 NCHES (3.3) D INCHES Meters 0.7 0.8 0.9 1.0	1.1811 1.3780 1.5 48 FEET) Inche 27.559 31.499 35.433 39.3 (
4 1 1 5 1 1 1 1 0 MILLI Inches	101.60 127.00 254.00 METERS = 1 INCHES Meters 0.0254 0.0508 0.0762 0.1016 0.1270 0.1524 /ERT METER YARDS Meters 0.91440	30 35 40 CENTIMETE TO MET Inches 7 8 9 10 11 12 S TO CENTII	762 00 889.00 1016.00 ER, 100 CENTIN ERS Meters 0.1778 0.2032 0.2286 0.2540 0.2794 0.3048	4 5 10 IETERS = 1 M Meters 0.1 0.2 0.3 0.4 0.5 0.6	0.15 5 0.1969 0.393 ETER = 39.37 I METERS TO Inches 3.937 7.8 4 11.811 15.748 19.685	30 35 40 NCHES (3.3) D INCHES Meters 0.7 0.8 0.9 1.0	1.1811 1.3780 1.5 48 FEET) Inche 27.559 31.499 35.433 39.3 (
5 1 1 10 2 10 MiLLII Inches 1 2 3 4 6 6 (TO CONV Yards 1 2 3 4 5 MOV	127.00 254.00 METERS = 1 INCHES Meters 0.0254 0.0508 0.0762 0.1016 0.1270 0.1524 /ERT METER YARDS Meters 0.91440	35 40 CENTIMETE TO MET Inches 7 8 9 10 11 12 S TO CENTII	889.00 1016.00 ER, 100 CENTIN ERS Meters 0.1778 0.2032 0.2286 0.2540 0.2794 0.3048	10 IETERS = 1 M Meters 0.1 0.2 0.3 0.4 0.5 0.6	0.1969 0.393 ETER = 39.37 I METERS TO Inches 3.937 7.8 4 11.811 15.748 19.685	35 40 NCHES (3.3 D INCHES Meters 0.7 0.8 0.9 1.0	1.5 48 FEET) Inche 27.559 31.499 35.433 39.3 (
10 2 10 Milli	254.00 METERS = 1 INCHES Meters 0.0254 0.0508 0.0762 0.1016 0.1270 0.1524 VERT METER YARDS Meters 0.91440	TO MET Inches 7 8 9 10 11 12 S TO CENTIL	1016.00 R, 100 CENTIN ERS Meters 0.1778 0.2032 0.2286 0.2540 0.2794 0.3048	10 IETERS = 1 M Meters 0.1 0.2 0.3 0.4 0.5 0.6	0.393 ETER = 39.37 I METERS TO Inches 3.937 7.8 4 11.811 15.748 19.685	40 NCHES (3.3 in the control of the	1.5 48 FEET) Inche 27.559 31.499 35.433 39.3 (
10 Milli Inches 1 2 0 3 0 4 0 5 6 0 TO CONV	METERS = 1 INCHES Meters 0.0254 0.0508 0.0762 0.1016 0.1270 0.1524 /ERT METER YARDS Meters 0.91440	TO MET Inches 7 8 9 10 11 12 S TO CENTIL	ERS Meters 0.1778 0.2032 0.2286 0.2540 0.2794 0.3048	0.1 0.2 0.3 0.4 0.5 0.6	3.937 7.8 4 11.811 15.748 19.685	0.7 0.8 0.9 1.0	27.55: 31.49: 35.43: 39.3
1 2 3 4 5 5 MOV	Meters 0.0254 0.0508 0.0762 0.1016 0.1270 0.1524 VERT METER YARDS Meters 0.91440	7 8 9 10 11 12 S TO CENTII	Meters 0.1778 0.2032 0.2286 0.2540 0.2794 0.3048	0.1 0.2 0.3 0.4 0.5 0.6	3.937 7.8 4 11.811 15.748 19.685	0.7 0.8 0.9 1.0	27.559 31.499 35.439 39.3
1 2 3 4 5 5 MOV	Meters 0.0254 0.0508 0.0762 0.1016 0.1270 0.1524 VERT METER YARDS Meters 0.91440	7 8 9 10 11 12 S TO CENTII	Meters 0.1778 0.2032 0.2286 0.2540 0.2794 0.3048	0.1 0.2 0.3 0.4 0.5 0.6	3.937 7.8 4 11.811 15.748 19.685	0.7 0.8 0.9 1.0	27.559 31.499 35.439 39.3
2	0.0508 0.0762 0.1016 0.1270 0.1524 /ERT METER YARDS Meters 0.91440	8 9 10 11 12 S TO CENTII	0.2032 0.2286 0.2540 0.2794 0.3048	0.2 0.3 0.4 0.5 0.6	7.8 4 11.811 15.748 19.685	0.8 0.9 1.0	31.49 35.43 39.3
3 (0.0762 0.1016 0.1270 0.1524 /ERT METER YARDS Meters 0.91440	8 9 10 11 12 S TO CENTII	0.2032 0.2286 0.2540 0.2794 0.3048	0.2 0.3 0.4 0.5 0.6	11.811 15.748 19.685	0.9 1.0	35.43 39.3
3 (0.0762 0.1016 0.1270 0.1524 /ERT METER YARDS Meters 0.91440	9 10 11 12 IS TO CENTII	0.2286 0.2540 0.2794 0.3048	0.3 0.4 0.5 0.6	11.811 15.748 19.685	0.9 1.0	35.43 39.3
4 (6 5 6 6 70 CONV	0.1016 0.1270 0.1524 /ERT METER YARDS Meters 0.91440	10 11 12 IS TO CENTII	0.2540 0.2794 0.3048	0.4 0.5 0.6	15.748 19.685		
5 (6 (70 CONV Yards 1 2 3 4 5 MOV	0.1270 0.1524 /ERT METER YARDS Meters 0.91440	11 12 IS TO CENTIL	0.2794 0.3048	0.5 0.6	19.685		
Yards 1 2 3 4 5 MOV	0.1524 /ERT METER YARDS Meters 0.91440	12 IS TO CENTIL	0.3048	0.6			- 42'2A
Yards 1 2 3 4 5 MOV	YARDS Meters 0.91440	TOMET	METERS, MOVE	DEDIMEN SO		1.2	47.24
1 2 3 4 5 MOV	Meters 0-91440			DECIMAL PE	INT TWO PLAC	_	HEHT
1 2 3 4 5	Meters 0-91440		ERS		METERS TO	YARDS	
2 3 4 5 MOV			Meters	Meters	Yards	Meters	Yard
3 4 5 Movi	1.82880	6	5.48640	1	1.09361	6	6.5616
3 4 5 Movi		7	6,40080	2	2.18723	7	7.6552
4 5 MOV	2.74320	8	7,31520	3	3.28084	8	8.768
5 MOV	3.65 60	9	8.22960	4	4.37445	9	9.842
MOV	4.57200	10	9.14400	5	5.46807	10.	10.936
		POINT FOR I	TIGHER VALUE	e.g. 6,00	O METERS = 6,	561.68 YARI	200
	POUNDS	TO KILO	GRAMS I	KIL	OGRAMS	TO POUNE	os
ID	kg	lb	kg	kg	lb	kg	lb
1	0.454	6	2.722	1	2.205	6	13.22
2	0.907	7	3,175	2	4.409	7	15.43
3	1.361	8	3.629	3	6.614	8	17.63
4	1.814	9	4.082	4	8.818	9	19.84
5	2.268	10	4.566	5	11.023	10	22.04
	GALLO	NS TO LI	TERS		ITERS TO	GALLONS	
Gallons	Liters	Gallons	Liters	Liters	Gallons	Liters	Gallo
1	3. 9	10	37.86	1	0.26	60	15.60
2	7.57	20	75.71	2	0.56	90	23.7
3	11.36	30	113.57	5	1.32	120	31.32
4	15.14	40	151.42	10	2.64	150	39.62
5	18.93	50	189.28	20	5.28	180	47.5
		TO LITE		1 12	LITERS T		D -4
Pints	Liters	Pints	Liters	Liters	Pints	Liters	Pnt
1	0.47	6	2.84	1	2.11	6 7	12.6
2	0.95	7	3.31	2	4.23		
3	1.42	8	3.79	3	6.34	8	16.9
4	1.89	9	4.25	4 5	8.45	10	19.02
5	2.37	10	4.73		10.57	10	21.1
32 4	10 50	60	TEMPER 0 75	RATURE 85 95	105 140	175 2	12 °F

80 100

EUROPEAN MARITIME COUNCIL CERTIFICATION EUROPEAN ECONOMIC COUNCIL

Declaration of Conformity

Application of Council Directives

EMC EVBUEEC 9

Standard(s) to Which Conformity is declared

ENS0081-1 ENS0082-2

21920

Manufacturer's Name and Address

Westerbeke Covprezaion • 41 Ledin Drive Avon Industrial Paris • Avon, MA 02322, USA

Type of Equipment

Marine Diesal Engine

Prodoct Name

Universal Marine Diesel Engine

Model(s)

M25-XPB, M3SR, M40B

Product Options

411

Supplementary Information

1.) The equipment listed is only for use in Marine Applications absent books.

2.) The equipment fixed must be located below decks on the vessel and perman entity installed in it's location.

3.) The equipment listed must be wired to the grounding system of the vessel.

I the undersigned, hereby declare that the equipment specified also we conforms to the above Directive(5) and

Standard(s).

Place Avon Massachusetts, U.S.A.

(Signature)

Date January 1, 1996

Carleton F. Bryant, Chief Operating Officer

INTERNATIONAL MARINE CERTIFICATION INSTITUTE CERTIFICATE · Imcl. We hereby certify that the engines(s) seed below most the EC Directive 94/25/EC. 1999 LM.C.I. Power Rosting Report MANUFACTURER Westerbeke Corporation ADDRESS Avon Industrial Park, Avon, MA 02333 USA MODEL NAME M 25 - XPB SPECIFICATIONS Inboard Engine Type Fuel Type Diesel Aspiration Type Mahural Rating Level Highest Output (1) (2) (3) (4) Lowest Output/5) Crankshaft Pow (kW) 18.3 Propeller shaft Pow kW 17.8 at RPM 3.000 Certification Number WESTERIDO04 Lars E. Grandolm Signed Name Title Managing Director EU Notified Body No 0609 Date 27-Jun-99 Manufacturer's verification statement Power rating is in accordance with IMCI Proceedure. Compliance verified in accordance with ISO 8665 and ISO 15584 (only for inboard petrol engines). This application form has not been lodged with any other notified body Westerbeke Corporation Company: Date: 27-Jun-99 Carl F. Bryant Name Title: Chief Operating Officer Stry Signature

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CERTIFICATE

-Imci:

·Imcl.

We hereby certify that the engines(s) stated below meet the EC Diversive 94/25/EC.
1995 NALCI. Power Failing Report

	d Type				
	gne Type				
Engine Type Indicard					
SPECIFICATIONS	ECIFICATIONS				
MODEL NAME MISSB	DEL NAME	M 35B			
		Avon Industrial Park, Avon, MA 02333 USA			
MANUFACTURER Westerbeke Corporate	MUFACTURER				

Rating Level		Highest Output (1)	(2)	(3)	(4)	Lowest Output(5)
Crankshaft Power	(kW)	25,1				
Propeller shaft Power	(kW)	24,3				
at RPM	(mm)	3.000				

Certification Number	/ WESTERIDION / /			
Signed	Les & hankolas			
Name	Lars E. Grantelm			
Title	Managing Director			
EU Notfied Body No	0609			
Date	1-Mar-99			

	Manufacturer's verification statement		
Power rating is in accordance with IMCI Proceedure. Compliance verified in accordance with ISO 8665 and ISO 15584 (only for inboard petrol engines). This application form has not been lodged with any other notified body.			
Company:	Wasterbeke Corporation		
Date:	1-Mar-99		
Name:	Carl F. Bryant		
Date: Name: Title:	Chief Operating Officer		
Signature:	1 By another		

INTERNATIONAL MARINE CERTIFICATION INSTITUTE Rond Point Schuman 6, Box 6 • B • 1040 BPIJXELLES • BELGIGUE • Inc. +32 (0) 2-238-7892 • Inc. +32 (0) 2-238-7700

CERTIFICATE

We hereby certify that the engines(s) stated below most the EC Directive 94/25/EC.
1999 LM.C.L. Power Rebing Report

MANUFACTURER	Westerbeke Corporation	
ADDRESS	Avon Industrial Park, Avon, MA 02333 USA	
MODEL NAME	Universal M 408	
SPECIFICATIONS		
Engine Type	Inboard	
Fuel Type	Diesel	
Aspiration Type	Natural	

Rating Level		Highest Output (1)	(2)	(3)	(4)	Lowest Output(5)
Crankshaft Power	(kW)	26,6				
Propeller shaft Power	(kW)	26,1				
at RPM	(min')	3.000				

Certification Number	, O WESTERIDON
Signed	Jack 5 nowlow
Name	Lars E-Gerholm
Title	Managing Director
EU Notified Body No	0609
Date	16-Sep-99

	Manufacturer's verification statement		
Power rating is in accordance with IMCI Proceedure. Compliance verified in accordance with ISO 8665 and ISO 15584 (only for inboard petrol engines). This application form has not been lodged with any other notified body.			
Company:	Westerbeke Corporation		
Date:	16-Sap-99		
Name:	Carl F. Bryant		
Date: Name: Trie:	Chief Operating Officer		
Signature:	Toman M		

