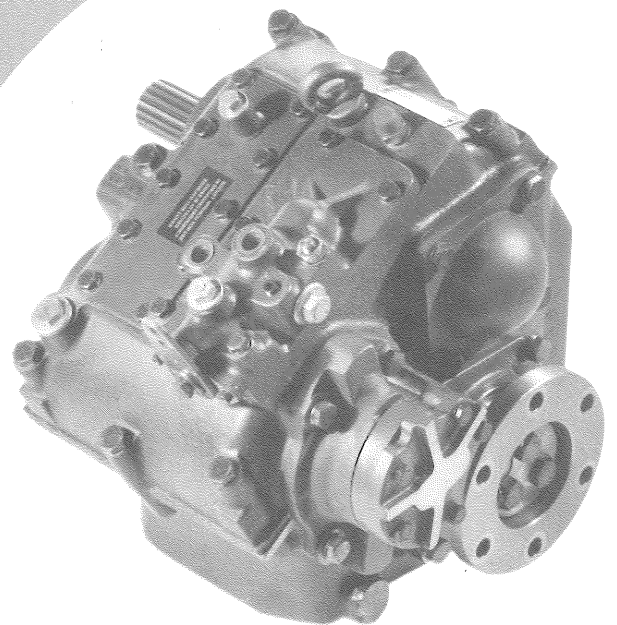


Marine Transmissions

PRM 1000

Workshop Manual



The following international symbols are used in this service manual.



WARNING: THIS SYMBOL WARNS OF POSSIBLE PERSONAL INJURY



CAUTION: THIS SYMBOL WARNS OF POSSIBLE DAMAGE TO TRANSMISSION

Newage Transmissions operate a policy of product improvement and therefore reserve the right to change specifications without prior notification. Whilst every effort is made to ensure complete accuracy of the information in this manual no liabilities for inaccuracies or the consequences thereof can be accepted by the manufacturer or the distributor/dealer who supplied the manual.

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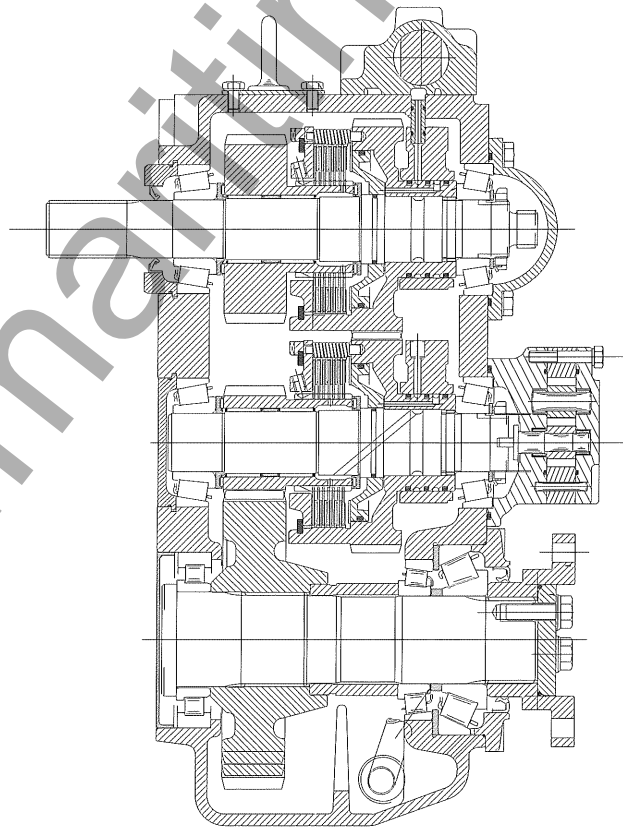


Fig.1 PRM1000 Sectional View

FOREWORD

Provided it is correctly installed, aligned and maintained, the PRM1000 gearbox should have a long and trouble-free life. This workshop manual contains important instructions to ensure that this is so, and it is of the utmost importance that these are carefully followed. Newage Transmissions Ltd. can accept no responsibility under warranty or otherwise for any loss or damage resulting from failure to observe these instructions.

To avoid prejudicing your rights under warranty, do not undertake any repair or other work on the gearbox during the warranty period without first contacting Newage Transmissions Ltd. or an authorised distributor for advice. In the event of failure, you should do this via the engine distributor who supplied the gearbox, or his local dealer; if this is not possible, you should notify the local Newage distributor/dealer or Newage Transmissions Ltd. direct, quoting the serial number.

CLAIMS UNDER WARRANTY

Claims for replacement of parts under warranty must always be submitted with the gearbox serial number to the distributor who supplied the gearbox; if this is not possible, application may be made to the nearest distributor, who must, however, be advised of the supplier's name and address.

SERVICE PARTS

The comprehensive illustrated parts list gives full information and ordering procedure.

PRE-DELIVERY TEST

Before it leaves the factory, every gearbox is subjected to a final test and inspection which includes the following:-

1. Flush clean.
2. Fill with oil to correct level.
3. Pressurise the case, and check for oil leaks.
4. Check for noise levels.
5. Check for drag in neutral.
6. Check input spline dimensions.
7. Check bolt torques.
8. Check coupling concentricity.
9. Check for conformance to customer spec.
10. Record time to working temperature
11. Record gearbox temperature (Deg. C).
12. Record valve block force N to F (lbf).
13. Record valve block force N to R (lbf).
14. Record oil pressure @ 1800rpm (lb/sq.in) in forward, neutral and reverse.

IDENTIFICATION PLATE

Every PRM gearbox is fitted with an identification plate on the top half of the gearcase before it leaves the factory; an example of such a plate is shown below.

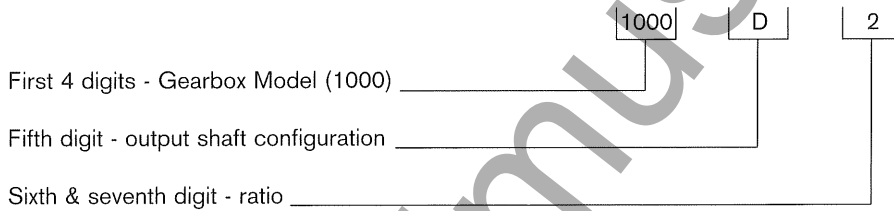
NEWAGE	PRM	COVENTRY
123456		R1234
1000D2		
MADE IN ENGLAND		

NEWAGE	PRM	COVENTRY
MADE IN ENGLAND		

Please complete the above box with serial number and specification of your own gearbox.

It will be noted that there are two lines of numbers.

The top line is the gearbox serial number, and should always be quoted when ordering spare parts; the lower line is the gearbox specification, in the example given this translates as follows:-



NOTE: Throughout this manual, engine, gearbox and propeller rotation are always described as seen looking forward from the propeller to the engine.

1. GENERAL DATA

1.1 Specifications

Gear ratios

1.528:1, 2.033:1, 2.857:1, and 4.0:1 Note: 4.0:1 not available as 10° down angle

POWER RATING - 10° DOWN ANGLE ONLY

GEAR RATIOS	PLEASURE		LIGHT COMMERCIAL		HEAVY COMMERCIAL	
	BHP	kW	BHP	kW	BHP	kW
1.528:1	12.95	9.66	9.52	7.10	8.95	6.67
2.033:1	12.64	9.43	9.52	7.10	8.95	6.67
2.857:1	11.50	8.58	9.52	7.10	8.95	6.67

NOTE: Down angle not available with 4.0:1 ratio

NOTE: These powers are expressed in BHP and kW per 100 rev/min engine speed, and are measured at the engine flywheel. Ratings have been established to ensure the long trouble-free life of the gearbox which should not therefore, be used at powers in excess of those shown.

POWER RATING - OFFSET ONLY

GEAR RATIOS	PLEASURE		LIGHT COMMERCIAL		HEAVY COMMERCIAL	
	BHP	kW	BHP	kW	BHP	kW
1.528:1	14.04	10.47	10.39	7.75	9.82	7.33
2.033:1	12.64	9.43	9.96	7.44	9.40	7.02
2.857:1, 4.00:1	11.50	8.58	9.96	7.44	9.40	7.02

NOTE: These powers are expressed in BHP and kW per 100 rev/min engine speed, and are measured at the engine flywheel. Ratings have been established to ensure the long trouble-free life of the gearbox which should not therefore, be used at powers in excess of those shown.

Input speed:

Maximum operating speed 3000 rev/min continuous
3500 rev/min intermittent

SERVICE CLASSIFICATION DEFINITIONS

Pleasure: limited to planing hull pleasure craft with a maximum of 500 hours operating time per year, of which not more than 5% should be at full engine throttle, with the balance of usage at 90% or less of full throttle. The use of PRM marine gearboxes according to this classification in any commercial boat, or in sport-fishing charter boats or long-range pleasure cruisers, is not approved.

Light commercial: planing or semi-displacement craft used in pleasure or commercial application may qualify for light commercial rating if annual usage is less than 1500 hours and full throttle operation is limited, with most operating time at partial throttle.

Heavy commercial: all displacement and semi-displacement craft used for commercial applications should be classified as heavy commercial duty. In this type of vessel (such as trawlers, purse seiners, lobster and crab boats, tugs, ferries, offshore supply boats etc.) the gearbox is expected to work at full governed engine speed. The power setting of the engine must be known and must be within the permitted heavy commercial rating of the gearbox.

IMPORTANT NOTE

1. It is essential that the engine, transmission model, reduction ratio and propeller size are correctly matched so that the engine can attain its rated speed appropriate to the relevant service classification without labouring.

2. It is also necessary to ensure the torsional compatibility of the complete propulsion system from engine through to propeller, since disregarding this may result in gear noise, particularly at low speed operation and may even result in damage to the engine as well as to transmission components.

Newage Transmissions Limited will provide all possible information and assistance to help find solutions to potential torsional problems, but it is the ultimate responsibility of the person assembling the drive and driven equipment to ensure that they are torsionally compatible.

Input rotation:

May be either clockwise or anti-clockwise (see section 2)

Output rotation:

Clockwise or anti-clockwise as required (see section 4)

Approximate weights and oil capacities

DRY WEIGHT			OIL CAPACITY		
PRM1000D	86kg (190lb)	excluding drive	3.0 litres	(5.28 pints)	plus the amount
PRM1000D4	93kg (205lb)	coupling, adaptor	4.0 litres	(7.04 pints)	needed to fill
PRM1000A	118kg (260lb)	and cooler.	3.5 litres	(6.16 pints)	the cooling
Additional weight, power take off: 11.2kg (24.7lb)					

Operating pressure:

Minimum:- 3000kPa (440 lb/in²)
Maximum:- 3300kPa (485 lb/in²) } Oil pressures should be measured at a gearbox temperature of 70°C and an input speed of approximately 1500rpm. (See page 48 for pressure gauge point. Pressure gauge available as an option).

NOTE: Pressure may vary at different operating speeds; it is likely that, on start up, when the gearbox is cold, significantly higher pressures may occur.

Operating oil temperature:

The normal operating temperature should be in the range 50°C to 80°C with a maximum of 90°C permissible for very short periods only.

Transmission cooling:

An oil cooler is necessary to ensure that correct operating temperatures are maintained and the gearbox is provided with two 3/8 inch BSP connectors on the valve block to allow it to be fitted. The size of the cooler depends on a number of factors including the engine horse power, operating speed, duty cycle, inlet water temperature and ambient temperature.

Suitable coolers are available from Newage Transmissions Ltd.

Engine mounting adaptors:

Available in SAE 1, 2, and 3.

Input drive couplings:

Flexible drive couplings are available to suit flywheels of 11.5" and 14" nominal diameter to SAE J620C.

Gearcase:

Heavy duty cast iron for use in the marine environment, constructed in two halves for ease of servicing; ribbed internally for rigidity and strength.

Input shaft:

1000D, 1000A: 39.7 mm diameter with 12/24 DP 18 tooth involute spline.

Propeller thrust:

Ahead and astern thrust is carried by output shaft bearings of ample capacity for all Newage approved ratings.

Output flange:

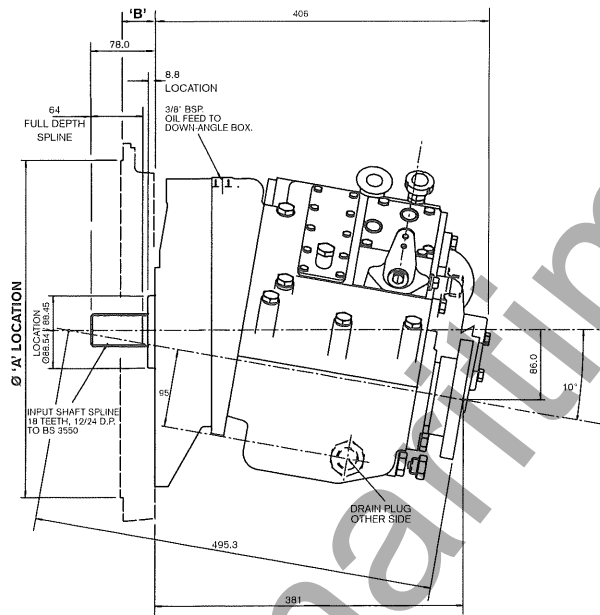
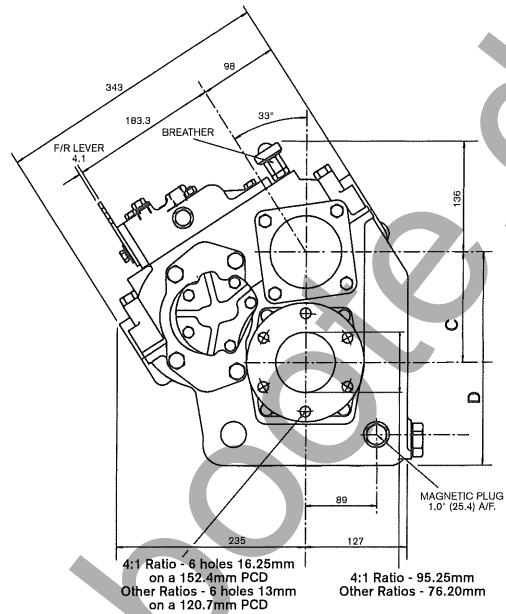
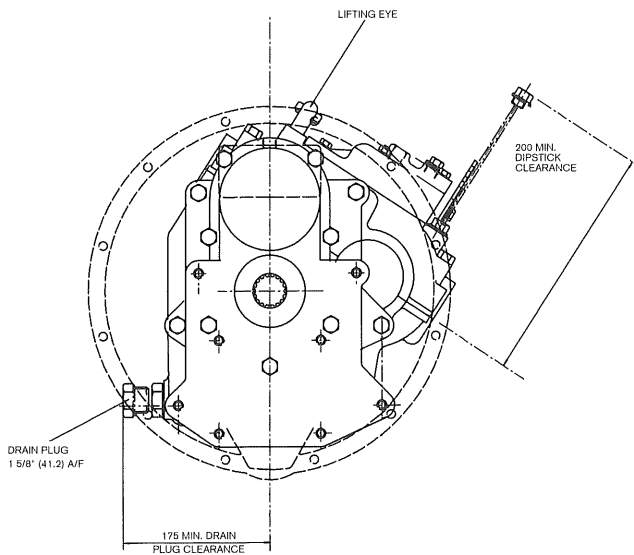
All ratios except 4:1 - 146mm (5.75 in) diameter, with 6 holes, 13mm (0.512 in.) diameter on 121mm (4.75 in.) pitch circle diameter.

4:1 ratio only - 184mm (7.25 in.) diameter, with 6 holes 16.3mm (0.614 in.) diameter on 152mm (6.0 in.) pitch circle diameter.

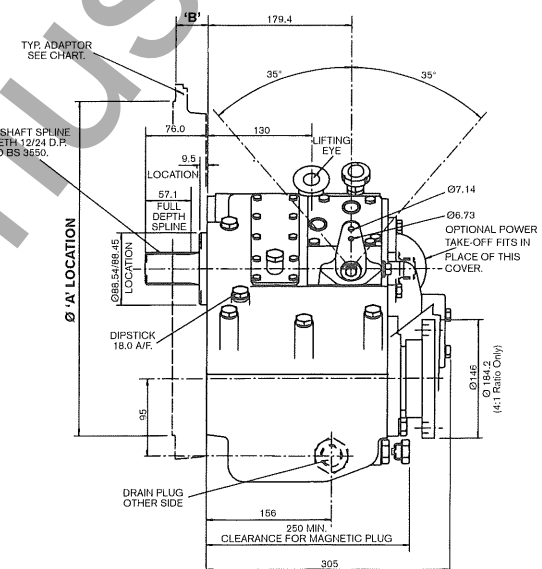
Installation angle:

The maximum fore and aft installation angle at rest is 17°.

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DOWN-ANGLE



DROP-CENTRE

RATIOS	DROP CENTRE DISTANCE	
	'C' mm	'D' mm
4:1	174.0	336.0
other	135.0	262.0

ADAPTORS (NOMINAL)	'A'	'B'
	mm	mm
SAE1	511.17	50.80
SAE2	447.67	36.57

IMPORTANT NOTE

All information given in this manual is correct at the time of going to press. However, in the interests of technical progress, design specifications are subject to change without notice. Accordingly, data given herein should be regarded as a general guide only and does not form part of any contract. Any specific performance requirements must be made known to us in writing with customer orders for goods. Illustrations are approximate only and do not form part of any contract with us; certified installation drawings are available on request. All goods are supplied in accordance with our standard terms and conditions of sale.

INSTALLATION ANGLE

The maximum fore and aft installation angle permissible at rest is 17°.

Fig. 2

2. INTRODUCTION

Newage Transmissions Ltd. PRM1000 marine transmission are oil-operated gearboxes of the counter-shaft type with separate oil-operated multi-disc clutches (which need no adjustment) for both ahead and astern drive. This design permits full power to be transmitted in astern as well as ahead, and also allows right-hand or left-hand propeller rotation in ahead drive, with identical ratios in ahead and astern.

The PRM1000 can be fitted to both left-hand (anti-clockwise) and right-hand (clockwise) rotating engines (see section 3.4)

NOTE: throughout this manual, engine, gearbox and propeller rotations are described as seen when standing behind the boat, i.e. facing forwards towards the transmission and engine.

3. CONSTRUCTION

3.1 Gearcase

The gearcase has been kept free from hydraulic pipes, cylinders and associated components. The only items mounted externally are the oil pump, valve block, oil cooler and operating lever.

A magnetic drain plug is provided at the rear face of the gearcase; this can be removed if required to allow suitable pipework to be connected to a hand-operated drain pump.

Connections are provided on the valve block for the oil cooler pipes and pressure gauge.

3.2 Gear train

The transmission comprises an input shaft assembly, a layshaft assembly and an output shaft.

The input shaft, which is supported by a taper roller bearing at either end, incorporates a drive pinion of the required ratio, running on needle roller bearings, an emergency operating device (see section 6.4), the forward drive clutch assembly (when used with a right-hand propeller), the clutch gear and a hydraulically actuated piston to operate the clutch.

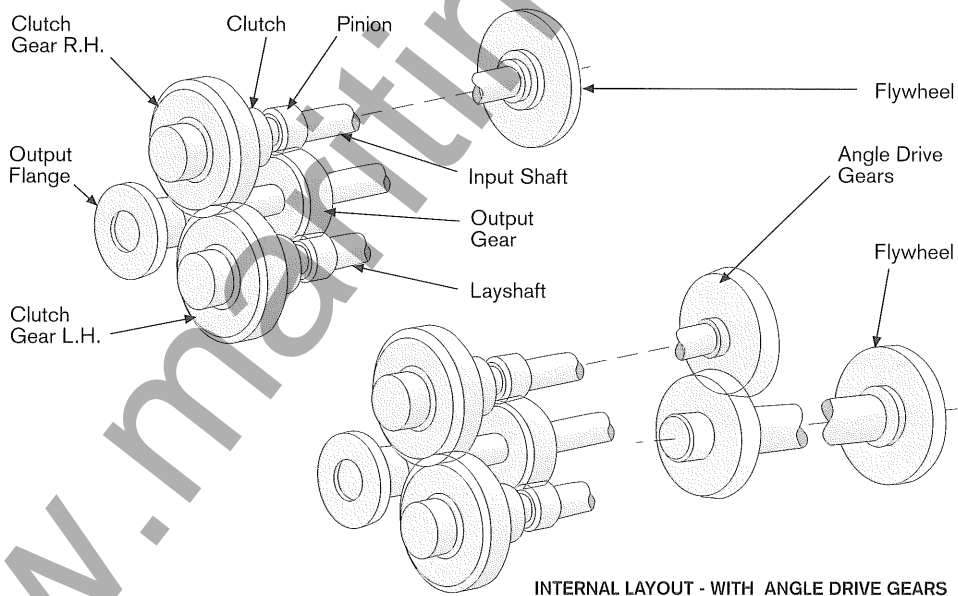


Fig 3. Internal layout, PRM1000A/D

The layshaft is similarly supported by taper roller bearings and also incorporates a drive pinion of the same ratio, also running on needle roller bearings, the reverse drive clutch assembly (when used with a right-hand propeller), a clutch gear of the opposite hand rotation to that on the input shaft, and a hydraulically actuated piston which operates the clutch.

The output shaft runs on amply proportioned bearings, arranged in such a way that propeller thrust can be satisfactorily absorbed; it also carries the output gear and incorporates the output flange.

3.3 Gear train (angle drive)

The angle drive unit incorporates a pair of conical involute gears (supported on bearings of ample size for all factory approved ratings) arranged so that the output shaft runs at an angle of 10° down relative to the input shaft and reducing the centre line distance between the engine crankshaft and the gearbox output shaft. This allows the engine to be installed as near to the horizontal as possible whilst maintaining the required propeller shaft line.

3.4 Oil pump

A cast iron gear-type pump externally mounted at the rear of the gearcase and driven by the layshaft, supplies oil at high pressure for actuating the clutch assemblies, and at lower pressure for lubrication. It should be noted that pressure may vary at different operating speeds. It is also likely that, on start up, when the gearbox is cold significantly higher pressures may occur.

When the transmission is used with anti-clockwise engines (looking at the flywheel), or with clockwise engines if the gearbox is a PRM1000A the oil pump is fitted in its standard position. For clockwise engines, or anti-clockwise for PRM1000A the pump is turned through 180° (see illustrations).

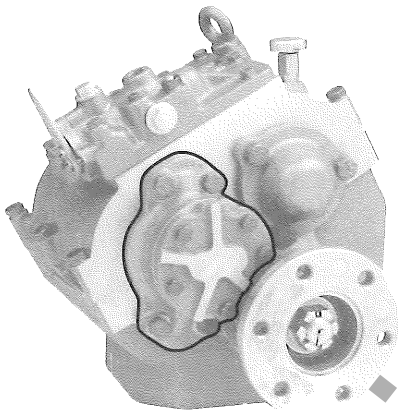


Fig. 4
Pump mounting position
anti-clockwise engines

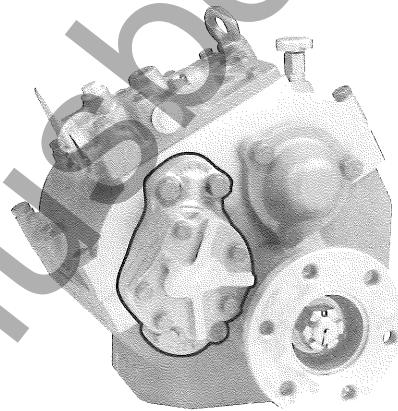


Fig. 4
Pump mounting position
clockwise engines

NOTE: Unless otherwise specified at the time of ordering, it will be assumed an anti-clockwise rotating engine is being used and the oil pump will be mounted accordingly.

If a clockwise rotating engine is specified when the order is placed, the pump will automatically be mounted in the appropriate position.

3.5 Valve block

The valve block is located on the top of the gearcase and contains the main control valve, integral with which is the high pressure valve controlling the supply of oil to the clutch assemblies. Oil which is surplus to clutch operation requirements is used for lubrication purposes.

The control valve is fitted with a spring-loaded neutral detent which provides a positive neutral position ensuring correct selection of either ahead or astern drive.

3.6 Neutral safety switch

A neutral safety start switch, which prevents the engine from being started unless the gearbox is in neutral, is fitted as standard.

This device is of obvious benefit, since it will help prevent accident or damage caused by a boat moving ahead or astern on engine start-up in a crowded marina or other area.

The switch is located on the valve block (See item C27 on the parts list) and should be wired into the starter circuit as shown in Fig. 5.

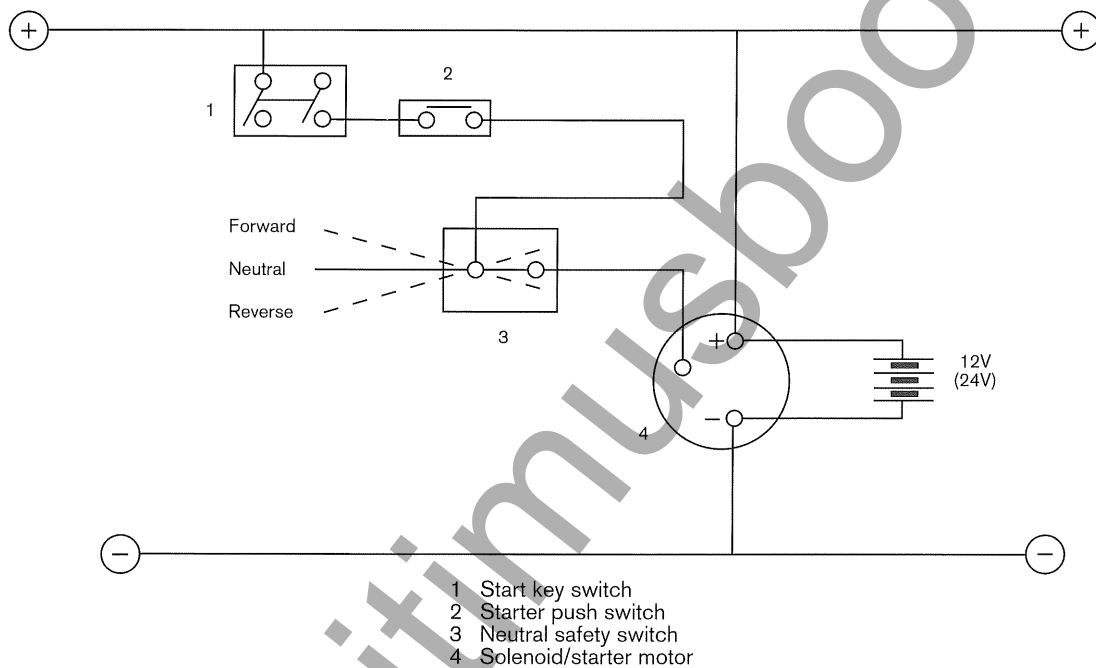


Fig. 5. Wiring diagram, neutral safety start switch

4. OPERATING SYSTEM

4.1 Output rotations









With the control lever at the mid-point of travel or neutral position and the engine running, the splined input shaft and the clutch gear rotate at engine speed. The clutch gear is in constant mesh with the clutch gear on the layshaft which is therefore also driven at engine speed, but in the opposite rotation. Since neither clutch is engaged, the drive pinions do not rotate.

When the control lever is moved to the 'ahead' position the hydraulic system is actuated and oil is directed at high pressure to the clutch on the appropriate shaft; the clutch engages and engine drive is directed to the forward drive pinion. The pinion turns the gear on the output shaft and the propeller shaft and propeller are rotated in the direction corresponding to ahead movement of the vessel.

Similarly, when the control lever is moved to the 'astern' position, the clutch on the opposite shaft is engaged and drive applied to the reverse pinion. This turns the output shaft gear in the opposite direction; and the propeller shaft and propeller rotate in the direction corresponding to astern movement of vessel.

NOTE: the above descriptions are reversed when considering PRM1000A angle drive unit.

GEARBOX OUTPUT ROTATION

Engine rotation anti-clockwise		Engine rotation clockwise			
	PRM1000A	PRM1000D		PRM1000A	PRM1000D
Lever Backward					
Lever Forward					

- NOTE:** (i) Rotations are as seen looking from the propeller forward to the gearbox.
- (ii) Anti-clockwise engines are the most common, and the standard gearbox build therefore assumes an anti-clockwise input.

4.2 Hydraulic system

Oil is pumped from the gearbox sump through the internal supply pipe to the control block. This incorporates a high pressure valve which ensures that the correct operating pressure is maintained.

When the operating lever is moved, oil is delivered under pressure to a feeder on either the input shaft or the layshaft and thence to a piston which actuates the appropriate clutch for either ahead or astern drive.

Excess oil is then used for lubricating the gearbox also the angle drive and PTO if fitted.

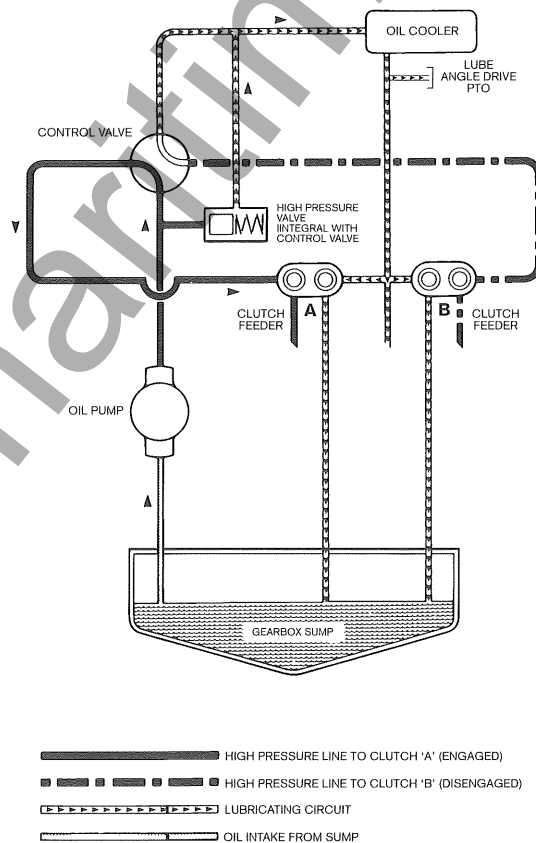


Fig. 6. Hydraulic and lubricating oil circuits

4.3 Lubrication

Lubrication oil is delivered via the internal supply to the control block. Irrespective of whether ahead or astern is engaged, oil is diverted from the discharge side of the pressure relief valve to an external oil cooler. After passing through the cooler, the oil is directed through channels in the valve block and thence through the layshaft and drive shaft to lubricate the clutch assemblies.

4.4 Approved oils

TEMP	TYPE OF OIL
Below Zero	10W30 or 20W engine oil to API designation CD
0°C to 30°C	10W30 or 15W40 engine oil to API designation CD
Above 30°	10W30 or 40W engine oil to API designation CD

NOTE: Gearboxes are despatched from the factory without oil.

It is essential that only good quality engine oil, supplied by a recognised and well known manufacturer, is used in the PRM1000. Do not mix different brands, types or grade of oil.

Note: This oil specification also applies to gearboxes fitted with the electronic trolling valve (available 1996).



CAUTION: Failure to comply with the above oil types may result in the forfeiture of warranty cover since no claims under warranty will be entertained if oil of the wrong specification is used.

5. INSTALLATION

5.1 General

The Newage PRM1000 marine gearbox is supplied with a choice of adaptor plates to SAE1, SAE2, and SAE3 dimensions enabling it to be fitted to engines having flywheel housings of equivalent specification.

Drive is transmitted from the engine to the gearbox via a flexible centre drive plate (damper plate) which bolts to the engine flywheel. The gearbox input shaft is driven from the centre spline.

These drive plates have a degree of torsional flexibility, the purpose being to reduce engine torsional or cyclic vibrations and prevent them being passed to the transmission.

The strongest engine vibrations are usually those caused by the firing cycle. Diesel engines which have high compression ratios, usually generate stronger vibration pulses than petrol (gasolene) engines; and it is often the case that of two engines of roughly equivalent size, the one having the greater number of cylinders will tend to run more smoothly than the one with fewer cylinders, although this is by no means always the case.

In all marine installations, correct alignment of the engine, gearbox and propeller shaft is extremely important - misalignment can cause noise, vibration and premature failure - and it is strongly recommended that all the procedures detailed in this manual are carefully followed.



CAUTION: It is particularly important to ensure the torsional compatibility of the complete propulsion system from engine through to propeller since disregarding this may result in gear noise at low speed operation and in extreme cases damage or failure of components.

Newage Transmissions Ltd. will provide all possible information and assistance to help find solutions to potential torsional problems, but it is the ultimate responsibility of the person assembling the drive and driven equipment to ensure that they are torsionally compatible.

5.2 Checking the engine flywheel housing

Attach a dial test indicator, calibrated in units of 0.025mm (0.001in.) or smaller, to the flywheel so that the measuring stylus of the indicator is perpendicular to the bore of the flywheel housing (bore A on Fig.7). Rotate the flywheel and check the deviation on the indicator over one complete revolution: this should not exceed 0.152mm (0.006in.) total indicator reading.

With the dial test indicator still attached to the flywheel, re-position the stylus so that it is perpendicular to the face of the flywheel housing (face B on Fig. 7). Rotate the flywheel and check the deviation over one complete revolution; again, this should not exceed 0.152mm (0.006in.) total indicator reading.

5.3 Checking the engine flywheel

Attach a dial test indicator, calibrated to 0.025mm (0.001in.) or less, to the engine flywheel housing so that the measuring stylus of the indicator is perpendicular to the bore of the register in the flywheel (bore C on Fig. 7). Rotate the flywheel through one complete revolution and note the deviation, this should not exceed 0.125mm (0.005in.) total indicator reading.

With the dial test indicator still attached to the flywheel housing, reposition the stylus so that it is perpendicular to the face of the flywheel register (D on Fig. 7). Rotate the flywheel through one complete revolution and note the deviation, this should not exceed 0.125mm (0.005in.) total indicator reading.

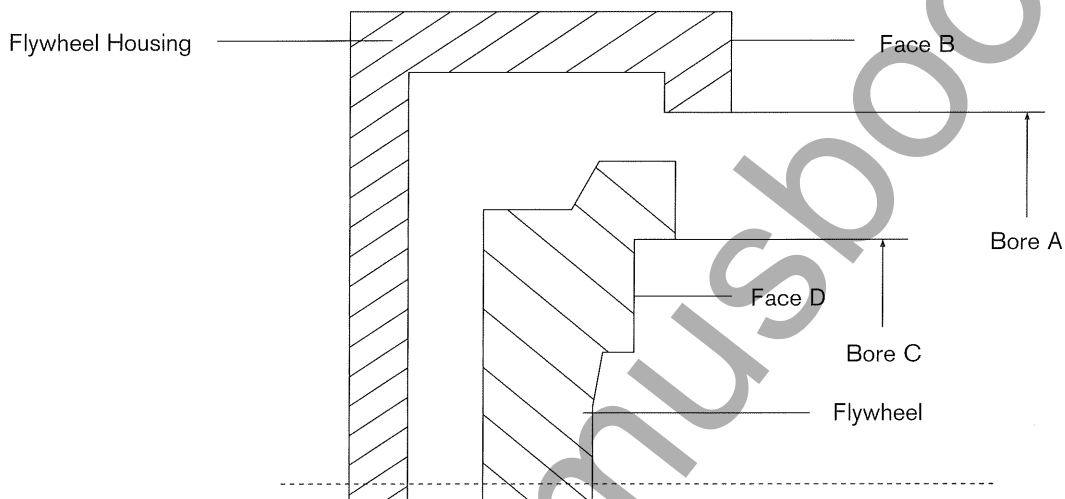


Fig. 7. Checking the flywheel and flywheel housing

5.4 Mounting the gearbox to the engine



CAUTION: Failure to carry out the following mounting instructions correctly can cause vibration that could result in component or gearbox failure.

1. Taking care to ensure correct alignment, bolt the adaptor flange to the front of the gearbox; the maximum misalignment allowable between the adaptor and the gearbox is 0.002in (0.05mm).
2. Using an alignment mandrel if available, mount and bolt the flexible input coupling to the flywheel via the holes provided. If the flywheel and couplings are to SAE standard, the outside diameter of the coupling should be a close fit in the flywheel register.

If no mandrel is available, tighten the mounting bolts just sufficiently to prevent free movement, assemble the gearbox to the coupling, and rotate the engine two or three revolutions by hand to align the plate. Tighten up two or three opposite bolts, using the inspection window provided in the gearbox adaptor flange.

3. Remove the gearbox and fully tighten the flexible input coupling bolts.
4. Offer up the gearbox and adaptor to the input coupling and engine flywheel housing at the correct attitude to provide the output shaft offset and insert the gearbox input shaft into the centre of the coupling (it may be necessary to rock the shaft slightly to ensure that the shaft enters). Press the assembly fully into position, align the mounting holes in the adaptor flange with those on the flywheel housing and tighten fully. See torque chart page 42.

5.5 Oil Cooler

All Newage PRM1000 gearboxes must be fitted with an oil cooler to maintain correct working temperature (50-80°C). To permit a suitable cooler to be fitted, two $\frac{3}{8}$ in. BSP connections are provided on the valve block.

NOTE: these are blanked off with plastic "Redcap" plugs on delivery from the factory.



CAUTION: Failure to correctly install an oil cooler into the lubrication circuit can result in damage to the gearbox see figs 8, 9, 10, 11 and 12 for correct circuit. After a gearbox failure it is extremely important to flush the cooler and hoses completely to remove any contamination. Failure to do so could result in the new/repaired gearbox failing prematurely.

The gearbox oil cooler is normally mounted on the gearbox adaptor flange or the bulkhead of the boat, and then connected into the cooling system on the engine; one method of arranging the engine and gearbox cooling circuit is shown at Fig. 8.

NOTE: cooling water must pass through gearbox cooler before engine cooler.

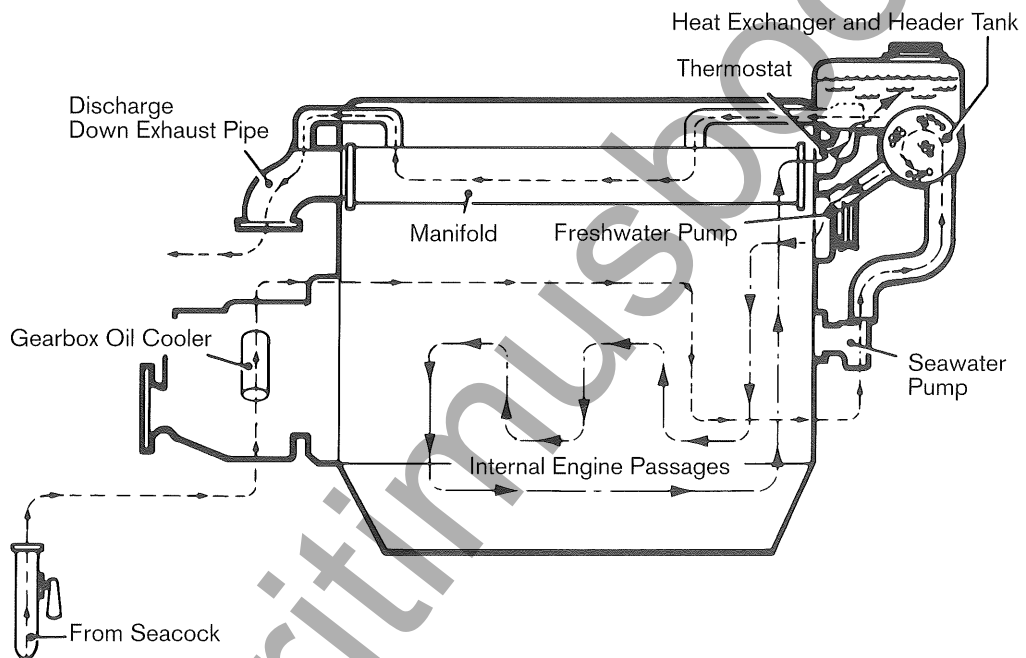


Fig. 8. Engine and gearbox cooling circuit



CAUTION: Remove the "Redcap" plugs from the valve block and gearbox prior to the installation of the cooler. Connect suitable hoses to the connections on the oil cooler and valve block, which can then be incorporated into the engine cooling system as outlined at Fig. 8.



CAUTION: Operating oil temperature should not exceed 90°C under any circumstances. If the checks listed in the fault-finding chart have been carried out without any fault being found and the gearbox consistently runs at a temperature higher than 80°C, Newage strongly recommends that a larger capacity oil cooler be fitted.

5.5.1 PRM1000D standard gearbox

Remove the "Redcap" seals from the valve block and, using suitable hoses, connect the valve block outlet to the oil cooler inlet and the cooler outlet to the valve block inlet as shown at fig. 9, then plumb it into the engine cooling system as outlined at fig. 8.

NOTE: Connectors are taper threads i.e. no washers needed.

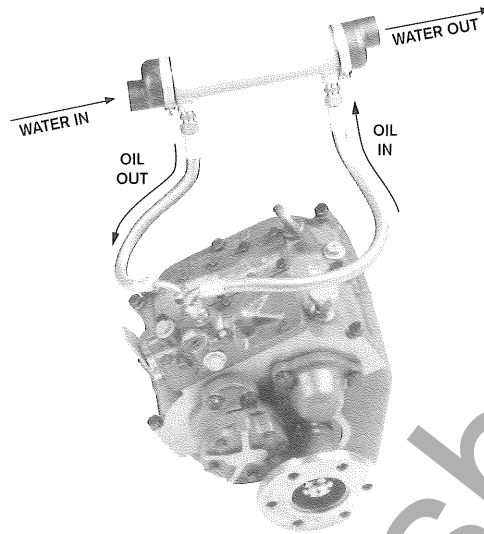


Fig. 9. Oil cooler connections PRM1000D

5.5.2 PRM1000D oil cooler with power take-off

Oil returned from the cooler to the valve block is first passed through the power take-off unit to provide lubrication. The method of connecting the cooling system is as follows:

- remove "Redcap" plugs from the valve block.
- connect the valve block outlet to oil cooler inlet.
- connect the oil cooler outlet to the PTO inlet.
- complete the circuit by connecting the PTO outlet to the valve block inlet.

The oil cooler can now be connected to the engine cooling system as outlined at fig. 8.

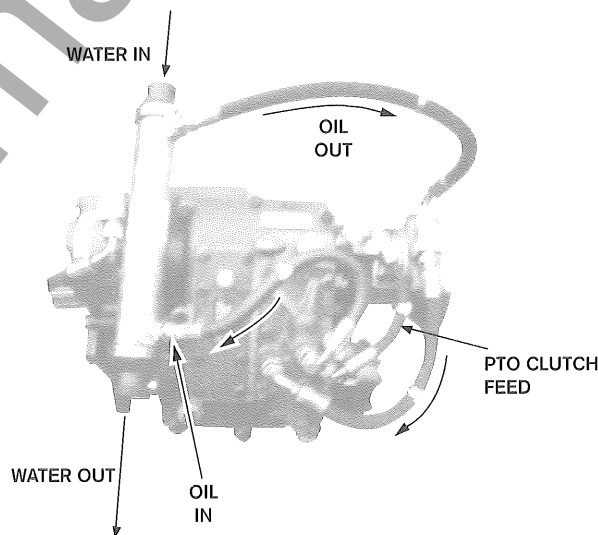


Fig. 10. Oil cooler connections PRM1000D with power take-off

5.5.3 PRM1000A oil cooler with angle drive

Oil returned from the cooler to the valve block is first passed through the angle drive to provide lubrication. The method of connecting the cooling system is as follows:

- remove "Redcap" plugs from the valve block.
- connect the valve block outlet to oil cooler inlet.
- connect the oil cooler outlet to the angle drive inlet.
- complete the circuit by connecting the angle drive outlet to the valve block inlet.

The oil cooler can now be connected to the engine cooling system as outlined at fig. 8.

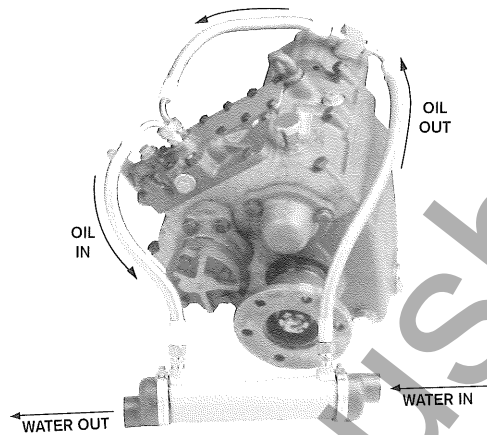


Fig. 11. Oil cooler connections PRM1000A with angle drive

5.5.4 PRM1000A oil cooler with PTO

Oil returned from the cooler to the valve block is first passed through the angle drive and then the PTO to provide lubrication. The method of connecting the cooling system is as follows:

- remove "Redcap" plugs from the valve block.
- connect the valve block outlet to oil cooler inlet.
- connect the oil cooler outlet to the angle drive inlet.
- connect the angle drive outlet to the PTO.
- complete the circuit by connecting the PTO outlet to the valve block inlet.

The oil cooler can now be connected to the engine cooling system as outlined at fig. 8.

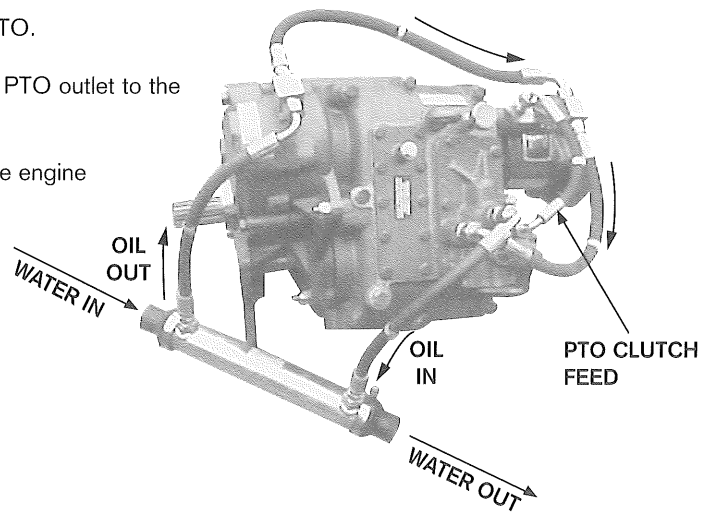


Fig. 12. Oil cooler connections PRM1000A with power take-off

5.6 Alignment to propeller shaft



CAUTION: Alignment between the propeller shaft and the mating flange on the gearbox output shaft is extremely important since excessive vibration and stress may lead to premature failure if correct alignment is not achieved.

In the majority of boats whose hulls are rigid enough to prevent excessive flexing in heavy sea conditions, (which could cause the engine and transmission to shift relative to the propeller shaft), it is generally considered preferable to couple the propeller shaft direct to the gearbox output flange by means of a rigid coupling.

The two main conditions when a flexible coupling should be used are:

- a) in boats whose hulls are not sufficiently rigid to prevent the flexing referred to above,
- b) in cases where the engine is mounted on flexible mounts.

In both instances, the flexible coupling helps to isolate engine vibration or other movement from the propeller shaft thus enabling correct alignment with the propeller shaft and stern tube to be maintained.

Whether a solid or flexible coupling is used, it is extremely important that the following points are carefully checked:

- i) the coupling should be a tight press fit on the shaft and the keyway accurately made to the correct size, and
- ii) the two halves of the coupling should be carefully aligned. This should be done by bringing the two flanges close enough together so that a feeler gauge can be used to check the vertical and horizontal alignment.
- iii) alignment should only be carried out with the boat afloat. The maximum permissible misalignment being 0.05mm.

Since the propeller shaft line is normally fixed in the boat, alignment is usually obtained by adjusting engine mount shims on the mounts themselves.

NOTE: Whenever possible, the engine and gearbox should be installed whilst the hull is afloat, otherwise there is a danger of the hull distorting because of insufficient support over its surface. If the engine and transmission are fitted before the hull is in the water, the installation should be very carefully re-checked for alignment after launching.

In designing PRM1000, SAE standards were adhered to as far as possible. However, other manufacturers of similar sized transmissions have a different, but common, output coupling spigot, which is not to SAE. This spigot size has become the industry standard and most proprietary flexible output couplings are made to suit.

5.7 Installation angle

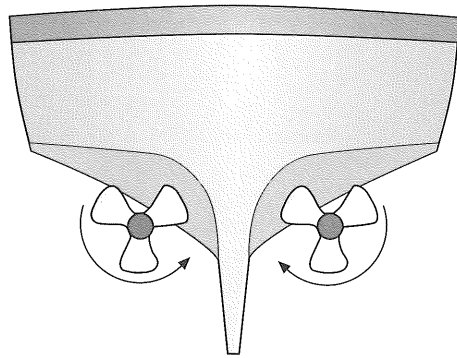
The transmissions should normally be installed so that the maximum fore and aft angle relative to the water line does not exceed 17° with the boat at rest. Please consult Newage Transmissions Ltd. if installation angles greater than this are required.

5.8 Twin installation

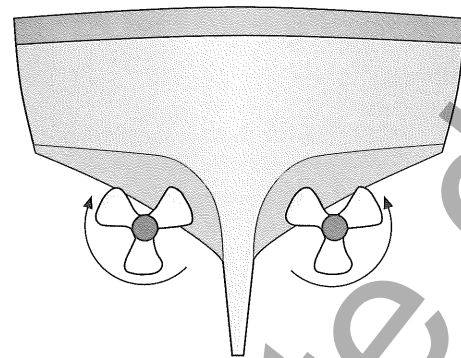
The rotation of the propeller, even in a single engine installation, tends to have a slight "turning" effect on the handling of the boat, but this can normally be corrected with very slight adjustments on the rudder.

In twin installations, the turning effect on the handling of the boat will be much more pronounced if both propellers rotate in the same direction. It is therefore desirable that "handed" (i.e. counter-rotating) propellers be fitted. For this reason PRM gearboxes are capable of providing either hand of output rotation with any of the available gear ratios.

It is also preferable for the starboard (right-hand) propeller to rotate clockwise and the port (left-hand) anti-clockwise rather than the other way about. In the latter case, when the propeller blades are at the lowest point of their rotational arc they tend to create a vacuum which affects the other propeller by reducing the flow of water to it. When the boat is making a tight turn with one gearbox in "ahead" and the other in "astern", the thrust side of one propeller will be acting diametrically opposite to the other, causing the boat to be deflected off line which delays completion of the manoeuvre.



NORMAL APPLICATIONS

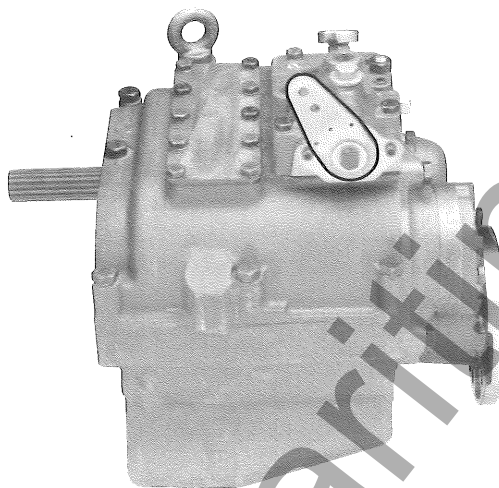


SPECIAL APPLICATIONS

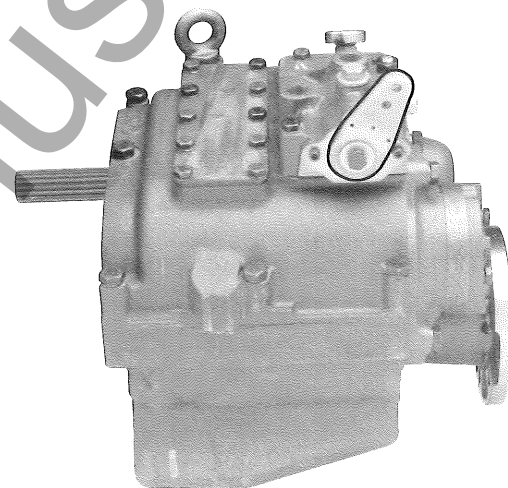
Fig. 13 Propeller rotation twin installations

When connecting remote control units for twin engine/gearbox installations, please remember that moving the gearbox operating lever forwards will produce output rotation as engine (generally left-hand, or anti-clockwise).

Therefore, in order to ensure that the propeller shafts counter-rotate outwards in "ahead", the operating cables should be connected so that the operating lever on the starboard gearbox moves back when the remote control operating levers are in the "ahead" position providing right-hand rotation.



**PORT ENGINE LEVER FORWARD
LH PROPELLER ROTATION**



**STARBOARD ENGINE LEVER BACK
RH PROPELLER ROTATION**

Fig. 14. Operating lever position, twin installations

5.9 Remote control operating systems

The PRM1000 can be used with remote control operating systems which links the engine throttle to the gearbox operating lever - e.g. Morse Controls single lever type.

The following points should be noted:

- i) The gearbox operating lever is provided with a positive neutral position, which greatly assists the setting up of the remote control unit.



CAUTION: ii) care should be taken to ensure that the cable moves the gearbox operating lever approximately 2mm short of its maximum forward or backward travel to prevent the lever being brought hard up against the end stop with every gear shift.

The control equipment should in all cases be connected in accordance with the manufacturer's recommendations.

6. OPERATION

6.1 First time usage



CAUTION: Before starting the engine fill the gearbox to the correct level with a suitable oil (refer to recommended list, section 4.4 page 15).

NOTE: screw dipstick fully down when checking oil level.

Ensure the gearbox is in neutral, (the neutral safety switch should be wired into the starter circuit to avoid uncontrolled boat movement on start up). See fig. 5 (page 13) for wiring circuit. Start and run the engine for a short time so that the oil circulates through the cooling circuit. Stop the engine and allow the oil to settle, re-check the level and top up to the maximum (higher) mark on the dipstick.



CAUTION: Using the gearbox with insufficient oil will lead to low pressure, unsatisfactory operation, overheating and eventual failure. Equally, over-filling the gearbox may cause overheating and oil leaks; it is the duty of the owner/operator to make sure that the oil level is correct at all times.

6.2 Drive selection

The PRM1000 has been designed and tested to ensure rapid shifts from ahead to astern or vice versa and can be operated at full horsepower ratings and speeds. In these circumstances the transmission will respond rapidly.



CAUTION: Full power reversals, however, do place abnormal, even if short-lived, loads on the gearbox, and operating life will be prolonged if full power reversals are reserved for emergency only. Newage Transmissions Ltd. recommend that when changing direction the engine speed be brought down to approximately 1000 rev/min. For this reason it is recommended that a proprietary single lever remote control operating system is fitted which links the engine throttle control to the gearbox operating lever.

6.3 Trailing (free wheeling) the propeller

The bearings used in the Newage PRM1000 gearbox have been carefully selected to ensure that prolonged trailing (free wheeling) of the propeller will not have any detrimental effect on the transmission. This allows the propeller to turn freely with the engine shut down and makes the Newage PRM1000 particularly suited for use in auxiliary sailboats, motor sailers or multi-engine installations where the boat may be operated with one or more engines shut down.

It is not therefore necessary to provide any propeller shaft locking device to protect the transmission, although in the case of sailing yachts and other high performance sailboats fitted with two bladed propellers, it may be desirable to fit a propshaft lock so that the propeller can be locked behind the dead-wood to reduce drag.

Where propellers are allowed to free-wheel they can be a useful source of free auxiliary power; if a flat pulley is fitted to the propeller shaft a small generator can be belt driven for charging batteries.



CAUTION: Care must be taken not to apply excessive side-load which would cause vibration and misalignment.

6.4 Emergency operation

Included as standard in every Newage PRM1000 gearbox is a "Get You Home" device allowing the gearbox to be mechanically locked in 'ahead' drive in the unlikely event of hydraulic clutch failure.



WARNING: To operate first switch off the engine, select neutral on the operating lever, and disconnect the operating cable, then:

The method of operation is as follows:

1. Remove the 10 top cover securing screws (A10) and the top cover (A7) (located alongside the valve block). the hexagon key for operating the emergency device is clipped to the underside of the top cover.
2. Decide which shaft has to be locked up. Since the majority of engines have left-hand (anti clockwise) rotating flywheels as seen looking forward from propeller to the gearbox to the gearbox, the appropriate shaft to "lock-up", is as follows:-

For left-hand propeller rotation, use the left-hand shaft (right-hand shaft if angle drive (PRM1000A) is fitted).

For right-hand propeller rotation, use the right-hand shaft (left-hand shaft if angle drive (PRM1000A) is fitted).

3. Locate the clutch end plate (item D9/E9). This has three tapped holes, angled to facilitate access. Rotate the shaft until one of the holes is uppermost and insert hexagon key (Allen key). See drawing pages 50/52.
4. Screw the grub screw (item D10/E10) as tight as possible.
5. Rotate the shaft and similarly tighten the other two screws.



CAUTION: Ensure that sufficient oil remains in the gearbox to avoid further damage and refit the top cover, tighten the bolts to correct torque see chart page 42.

The engine can now be run, but to minimise the possibility of further damage being caused to the transmission, we recommend that engine speed is limited to $\frac{1}{3}$ full throttle.



WARNING: When emergency drive is engaged, neither astern nor neutral is available and there is no means of stopping the boat using the gearbox. You must therefore handle the boat with great care, particularly during docking.



CAUTION: Disconnection of the operating cable is very important in order to prevent accidental selection of direction whilst the clutch is mechanically locked. After emergency drive has been used, you must seek qualified assistance to check the transmission thoroughly before it is used again. Never use the top cover for topping up the oil, because of the danger of introducing foreign bodies and creating oil leaks.

7. ROUTINE MAINTENANCE

7.1 Initial maintenance (after 25 hours running)



WARNING: Hot oil can cause burns. Do not work on the gearbox with the engine running.

Drain all oil from the gearbox, the magnetic drain plug is located on the rear face of the casing. This requires a 1" A/F spanner to remove, refit drain plug and washer and refill with one of the recommended lubricants (see page 15, section 4.4). Operate the engine and gearbox, allowing the oil to circulate, then stop the engine and allow to settle. Re-check the oil level and top up if necessary to the maximum mark on the dipstick. Note: dipstick has to be fully screwed in to check oil level.

7.2 Daily checks

1. Check the gearbox oil level.
2. Make visual inspection of the general condition of the transmission and check for oil leaks, especially at the output shaft seal and at gasket sealing surfaces.

7.3 Annual checks

1. Check oil cooler connections.
2. Check propeller shaft alignment and correct if necessary.
3. Check remote control operating linkage is accurately adjusted to give correct travel on the gearbox operating lever.
4. Check that all fasteners are correctly tightened see torque chart page 42)

7.4 Winter storage

Drain water from the transmission oil cooler to avoid freezing or the collection of harmful deposits.

7.5 Other maintenance operations

1. The gearbox oil should be changed at periods which correspond to the intervals at which engine oil changes are carried out.
2. The gearbox oil should also be changed if it has been contaminated by water or if the gearbox has suffered major mechanical damage.

8. FAULT FINDING

The following fault finding chart is designed to help diagnose some of the problems which might be encountered. It assumes that the installation and operating instructions in this manual have been followed and we advise that these are checked before proceeding to fault finding.

SYMPTOM	CAUSE	REASON	REMEDY
No drive ahead or astern	No oil pressure	Damaged oil pump Broken input drive plate Broken input shaft Broken output shaft	Remove oil pump and replace complete. Replace input drive plate. Replace input shaft. Replace output shaft.
Intermittent or complete loss of drive	Oil leaks	Damaged oil seals or gaskets	Check leakage area and replace relevant gasket or seal. Re-fill to correct level on dipstick.
Propeller speed does not increase with engine speed ahead or astern	Low oil pressure to both clutches	Damaged or worn oil pump Remote control cable not allowing correct gearlever movement Pressure relief valve defective	Replace oil pump complete. Remove cable and operate lever by hand adjust cable if necessary. Remove valve block and replace spring.
Propeller speed does not increase with engine speed in one direction only	Low oil pressure to one clutch	Piston rings worn Feeder worn Damaged 'O' ring in hydraulic circuit Blocked hydraulic feed in valve block Damaged clutch plates	Remove appropriate clutch shaft replace worn feeder or piston rings. Check 'O' rings in feeder connectors and piston Remove valve block and examine. Remove and examine appropriate clutch and replace if necessary.
Excessive noise from gearbox at low speeds	Engine idle speed too low Torsional vibration	Faulty adjustment Torsional incompatibility of driveline components	Increase idling speed. If not cured by increasing engine idling speed refer to engine supplier.
Excessive noise throughout operating range	Defective input coupling Propeller shaft misalignment	Input coupling worn or damaged Hull flexing or faulty installation	Remove, examine and replace input coupling if necessary. Check the alignment of the propeller shaft coupling. If necessary rectify by adjusting shims under the engine mounts or engine mounts themselves.
Excessive vibration throughout operating range	Propeller out of balance Engine/gearbox misalignment	Propeller damaged or badly machined Defective bearing	Check pitch, weight, diameter and balance of propeller. Remove transmission and check flywheel face is flat or flexible coupling is correctly aligned. (see section 5.3) Isolate defective bearing and replace.

SYMPTOM	CAUSE	REASON	REMEDY
Excessively high oil temperature	Power too high Defective oil cooler or cooler too small Oil level too high/low Incorrect oil type Defective oil pressure relief valve Slipping clutches	Incorrect engine rating for gearbox Damaged or blocked oil cooler, incorrectly specified cooler size Damaged or collapsed relief valve spring Worn clutches, low oil pressure	Re-assess engine power. Replace oil cooler or re-specify cooler size. Fill to correct oil level on dip stick. Fill with correct oil type. Remove and examine valve spring. Replace if necessary. Replace defective clutch, see remedy for low oil pressure.
Oil level needs constant topping up	Oil leaks	Defective oil seals, 'O' rings, or gaskets Defective oil cooler and hoses	Clean the outside of the gear box particularly around output shaft and valve block, inspect for leaks. Check for traces of water in the gearbox oil or oil in the cooling water system. Replace cooler or hoses as necessary.
Excessive internal pressure	Escape of pressure from gearbox when dipstick is removed	Defective breather causing leaks past oil seals	Contact distributor or factory for advice.
Difficult to move single lever control	Control lever on valve block too stiff Faulty installation	Defective valve or detent spring Remote control operating cable badly installed or kinked	Contact distributor or factory for advice. Check the installation and eliminate all tight bends in the cable.
No neutral	Control system not moving gear lever correctly Seized or dragging clutch	Incorrect control cable set-up Clutch/es badly worn or seized causing permanent engagement of a direction	Check cable installation. Check clutch and replace as necessary.



WARNING: Before carrying out any service work always ensure that the engine is switched off and disconnect the operating cable from the gearbox.



CAUTION: The above operations should be carried out by suitably qualified personnel and strictly in accordance with the procedures detailed in the workshop manual.

9. SERVICING AND REPAIRS - GENERAL



WARNING: Do not carry out any servicing or repair work without first switching off the engine and disconnecting the control cable.

Before removal of the gearbox for repair or overhaul carefully study the following procedures. Use proper hand tools, slings or hoists for the job - **WORK SAFELY**

Keep all work areas, tools and gearbox clean. Wipe up any spilled oil or fluids to prevent accidents. Wear correct safety equipment i.e. safety glasses and safety shoes to guard against personal injury.

Remember **HOT OIL CAN CAUSE BURNS - WORK SAFELY - USE COMMON SENSE.**

Drawings showing all internal components are contained in the parts lists. See page 43.

9.1 Seals

Remove oil seals carefully to prevent damage if they are to be re-used, however it is best to replace these items. Carefully examine all cast iron piston rings for wear and corresponding wear/damage in the bores. Take care not to break these rings.

9.2 Bearings

If removing taper roller bearings for re-use keep them in matched sets and protect all bearings from contamination.

9.3 Cleaning



WARNING: If using cleaning solvents these can be toxic, flammable, a skin irritant or give off harmful fumes. Avoid prolonged contact, vapour inhalation, or smoking. Failure to take care can result in injury or death.

Rinse all metal parts in solvent to remove dirt, grease and oil.

Be careful to remove solvent from items before re-fitting.

9.4 Inspection

9.4.1 Gearcase

Inspect for cracks. Check sealing surfaces for any scratches, damage etc. which will lead to oil leaks. Check all threads for damage.

9.4.2 Gears

Inspect for any chipped broken or cracked gear teeth, also for any excessive wear, i.e. gear pitting.

9.4.3 Bearings

Inspect for any damage, pitting or over-heating.

9.4.4 Clutch plates

Inspect all clutch plates for signs of overheating and/or distortion. Check friction surfaces for wear. Replace if oil grooves have worn away.

9.4.5 Clutch components

Inspect clutch components for wear, damage, overheating or debris. Check all oil feed holes are clear.

9.4.6 Threaded parts

Inspect for stripped or damaged threads.

10. SERVICING AND REPAIR PROCEDURES



CAUTION: When re-assembling the gearbox all threaded fasteners must be tightened to the torques listed in table, page 42 to prevent premature failure.

The servicing, repair and replacement of input shaft and layshaft assemblies and components is simplified by the fact that the gearcase is constructed in two separate halves, the top half being easily removable to give access to the two top shafts.

Some servicing operations can be carried out with the gearbox still mounted to the engine (provided, of course, that the engine compartment is sufficiently large to allow this); examples are the replacement or repair of the valve block and the oil pump. To repair or replace the input shaft, layshaft or output shaft, however, you will need to remove the gearbox from the engine.

If the details outlined below are carefully followed no difficulty will be found in stripping and rebuilding the gearbox. It is most important that all components are perfectly clean and in good condition before re-assembly.



CAUTION: The input shaft and layshaft are supported by taper roller bearings. Each time a shaft is stripped for inspection, component repair or replacement it will be necessary to recalculate the number of shims required to load the bearings correctly. Shimming procedures are described in section 10.10.

10.1 Valve block

The complete valve block is easily removed for inspection and servicing with the gearbox still in the boat, as follows:-

1. Disconnect the control cable(s) from the lever (C4) on the valve block.
2. Disconnect the oil cooler pipes and the wiring from the neutral switch (C27) if fitted.
3. Remove the 5 bolts (C18/20/26) and one nut (C23) together with washers (C19/24) securing the valve block to the gearcase.
4. To remove the control valve (C11) and piston (C14), simply remove the two cap screws (C6) and withdraw the valve from the valve block (C16).



CAUTION: Take care not to lose the detent ball and springs (C12/13).

5. Inspect the seal (C8) seal bore in (C5) and bearing (C10), and replace if worn, damaged or defective. Check that the valve spring (C15) has retained its correct free length (62mm) if not replace it.
6. To assemble and refit the valve block, simply reverse the above procedure. It will be necessary to lightly grease the seal bore (C5) and seal diameter of valve (C11) to avoid damaging the seal (C8) when re-fitting.

10.2 Oil pump assembly

The oil pump assembly can be removed with the gearbox in position on the engine.

1. Note the mounting position of the pump (for refitting). See section 3.4 Fig. 4.
2. Remove the four bolts and washers (A25/A24) securing the oil pump to the main case and withdraw the pump assembly complete with 'O' rings and shims.
3. Inspect the 'O' rings (B2/3) and replace if necessary. If in good condition store carefully until required for refitting.

If the pump is damaged in any way, the complete pump assembly (B1) must be replaced.



CAUTION: If a new pump assembly is fitted the clutch shaft must be reshimmed. See section 10.10.

10.3 Oil Strainer

The gearbox oil strainer is attached to the end of the oil suction pump which feeds the pump and is situated in the sump. It may be removed for inspection or cleaning, as follows:

1. Remove the drain plug and washer (A29/A28) in the bottom of the gearbox (rear right hand side), and remove the strainer, which is only a push fit onto the pump suction pipe (B5). Note: 1⁵/₈ inch A/F spanner required.
2. Wash the strainer in a suitable cleaning solvent to remove any debris which may have become attached to it. (See section 9.3).
3. To refit, reverse above procedure.
4. Refit the drain plug and washer in the bottom of the gearcase.

10.4 Removing the transmission from the boat



CAUTION: Before commencing work see section 9. The following instructions must be complied with to avoid damage to the gearbox.

1. Ensure that the gearbox operating lever (C4) is in the neutral position, disconnect the operating cable or cables, and the wiring for the neutral safety switch.
2. Drain the gearbox oil into a suitable container and disconnect the oil cooler pipes.
3. Unscrew and withdraw the bolts connecting the gearbox output flange from the flexible coupling or mating half coupling on the propeller shaft.



CAUTION: Sling ropes around the gearbox securely to provide support while it is being removed from the engine.

4. Remove the bolts securing the adaptor flange to the flywheel housing.
5. Slacken the bolts which secure the flexible drive coupling to the flywheel.
6. Withdraw the gearbox, if necessary rocking the unit slightly in order to disengage the input shaft spline from the internal spline in the coupling, and lift clear.

10.5 Removing the input shaft and layshaft assemblies

1. Remove the gearbox from the boat as described in section 10.4.
2. Remove the 4 bolts and washers (A25/A24) securing the oil pump and withdraw the oil pump, shims and 'O' rings, noting the position of the pump for refitting. (Note: keep the pump shims with the pump assembly).
3. Withdraw the 4 bolts and washers (A6/A24) securing the shaft end cover (A5) and remove. (Note: keep the shims and 'O' rings with the end cover).
4. Remove the 5 bolts and 1 nut retaining the valve block and remove it.
5. Remove the 7 bolts securing the gearcase top half and lift clear.
6. Lift the input shaft assembly, and input cover (D33) from the gearcase.
7. Lift the layshaft assembly and layshaft cover (E33) from the gearcase.

10.6 Servicing input shaft and layshaft assembly components

See pages 50/52 for assembly drawing.

10.6.1 Input shaft oil seal

In the event of an oil leak caused by a damaged seal, remove the input cover (D33) from the shaft and, using a hardwood drift and hammer, remove the seal from the housing.

Fit a new seal (D34) in the input cover (D33) and refit.

10.6.2 Drive end bearing

To renew a damaged or worn bearing:-

1. Support the relevant shaft in a vice and remove the input cover (D33) (this applies only to the input shaft).
2. Using a pulley extractor with its jaws located behind the pinion, withdraw the clutch pinion (D6/E6), spacer (D5/E5), and bearing (D4/E4).
3. Refit the clutch pinion to the shaft.
4. Refit the spacer and bearing, inspecting for wear and replacing where necessary.
5. Locate the new bearing (D1/D2 E1/E2) on the shaft and, using either a hand press or a hardwood drift and hammer, gently drive the assembly into position. Take care not to damage the bearing rollers or raceways during this operation. Note:- if the bearing is correctly located a small amount of pinion end float will be detected i.e. between 0.13 to 0.45mm.
6. Reposition the input cover (D33) on the shaft (input shaft only).

NOTE: if new bearings are fitted, they must be re-shimmed as described in section 10.10.

10.6.3 Clutch assemblies

Clutch plates which have discoloured and/or distorted by overheating or if the groove pattern on the friction plates have been worn away they need to be changed as follows, these instructions apply to both directional clutches:-

1. Remove the drive pinion bearing as previously described in section 10.6.2.
2. Remove the large circlip (D8/E8) from clutch gear (D23/E23).
3. Withdraw the complete clutch assembly from the shaft noting the position of the pull off springs and location pins (D18/E18).
4. Position shaft upright and locate the 3 location pins in the clutch gear.
5. Fit the clutch end plate (D14) into the clutch gear and fit the pull-off springs over the location pins. Then, starting with one of the driven clutch plates (D12) build up the replacement clutch onto the clutch end plate (D14).
6. Replace the clutch end cover (D9) onto the clutch pack, replace the circlip into the clutch gear.
7. Replace the drive pinion into the clutch pack until it touches the thrust bearing.
8. Position the thrust bearing, thrust washer and bearing on the shaft and gently drive the bearing into position. With the bearing correctly located, the drive pinion should be able to move a small amount fore and aft. See section 10.6.2.

10.6.4 Clutch gear

To fit a new clutch gear (D23/E23) first remove the clutch pack as previously described in section 10.6.3 and then proceed as follows:-

1. Withdraw the two thrust washers (D15/D17) (E15/E17) and one thrust bearing (D16/E16) located in front of the piston.
2. Tap out the piston (D21/E21) from the clutch gear. If difficult to remove, this may be left until a later stage.
3. Remove the lock nut (D29/E29) and tab washer (D28/E28) from the rear end of the shaft.
4. Position the shaft assembly such that the front face of the clutch body is supported face downwards on a plate; the shaft may now be driven out forwards through a suitable hole in the plate.
5. The clutch gear, feeder, piston and rear end bearing will now be free for inspection and replacement if necessary.
6. Refit the clutch gear and feeder, examine the feeder piston rings and replace if worn (for piston rings and feeder removal, refer to section 10.6.7).
7. Insert the piston into the clutch gear, examine the 'O' rings for wear or damage, and replace if necessary.
8. Position the bearing on the rear end of the shaft and gently drive into position.
9. Refit the lock nut and tabwasher.
10. Replace the clutch assembly as described in section 10.6.3



CAUTION: It is advisable to renew both clutch gears together as damage to one often results in damage to its mating gear. It is also strongly recommended that piston seals and tab washers are also replaced.

10.6.5 Drive pinion

It is advisable to renew both drive pinions together if one is worn or damaged. To ensure that the drive pinion of the correct ratio is used please refer to the parts list page 51/53. If a different ratio from that originally supplied is required, the output gear as well as both pinions will need to be changed.

To replace the drive pinion, follow the procedure set out in section 10.6.2

10.6.6 Rear end bearing

To renew a rear end bearing, follow the procedure as described in section 10.6.4.

10.6.7 Piston rings and feeder

Excessive wear or damage may necessitate replacement of the piston rings and feeder in the following manner:-

1. Remove the non drive end bearing as described and remove the feeder and spacer.
2. Remove the piston rings from the shaft with the aid of a special piston ring extractor or a piece of thin steel. Raise one end of the top ring out of the groove and insert the steel strip between the ring and the shaft. Rotate the strip around the shaft applying slight forward pressure to the raised portion of the ring until it rests on the land above the groove, where it can be eased off. Repeat this with the other two rings.
3. Take out the new rings from the packing and clean off any grease or inhibitor.
4. If a ring loading tool is available, fit this around the shaft, load the rings onto the tool and locate in their approximate position. Gently withdraw the tool and allow the rings to locate in their respective grooves.
5. Where a loading tool is not available use a thin metal strip, long enough to lay along the shaft above the grooves. Expand each ring just sufficiently to allow it to be placed in its approximate position over the strip. Gently withdraw the strip and locate the rings in their respective grooves (see Fig. 15).
6. Compress each ring in turn and carefully fit the new feeders and bearing onto the shaft, and gently drive the bearing into position.

NOTE: It is advisable and strongly recommended that piston seals and tab washers are replaced.

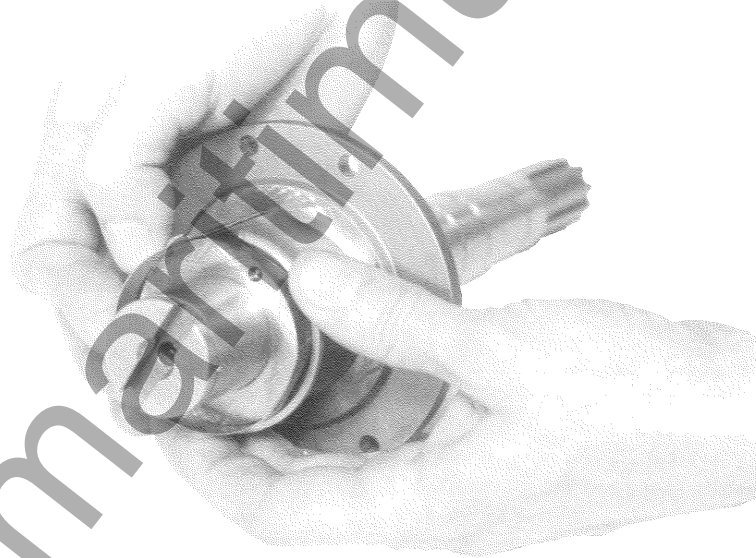


Fig. 15. Piston ring fitting procedure

10.7 Replacement of input shaft and layshaft assemblies

1. Position the input shaft assembly in the gearcase, ensure that the input cover assembly (D33) is correctly located in the groove. Examine the 'O' ring for wear or damage and replace if necessary.
2. Position the layshaft in the casing, ensure that the layshaft cover (E33) is correctly located in the groove. Examine the 'O' ring for wear or damage and replace if necessary.
3. Fit two new 'O' rings (D30/E30) to each feeder connector, then coat the mating surfaces of the two case halves with a jointing compound. Pass a length of wire through the holes in the top half of the gearcase into the feeder connectors to ensure that they are correctly located, and fit the top half of the gearcase to the lower.

4. Replace the two front gearcase bolts and ensure the gearcase halves are square.
5. Replace the remaining gearcase bolts and tighten all seven to the correct torque. See torque chart page 42.
6. Shim and refit the input shaft rear cover (A5) replace the 'O' ring if damaged.
7. Shim and refit the oil pump, replacing the 'O' rings if damaged. Take care that the oil pump is fitted in the correct position to ensure the required direction of rotation. See section 3.4.
8. Refit the valve block, replacing the gasket.
9. Refit the seven bolts securing the adaptor plate to the gearbox.
10. Offer-up the gearbox and adaptor plate to the engine and secure with the 10 bolts (12 bolts for SAE2 adaptors).
11. Re-connect the oil cooler pipes see Section 5.5 and the control cable or cables.

NOTE: Shimming procedures are described in section 10.10

10.8 Servicing the output shaft assembly

Removal of the output assembly will necessitate removing the gearbox from the boat (see section 10.4). Then proceed as follows:-

1. Remove input shaft and layshaft assemblies as described in section 10.5.
2. Remove the three bolts (F15) securing the output flange (F12) , remove it together with 'O' ring (F11) and washer (F13).
3. Support the gearbox front face down on a plate with a hole sufficiently large enough to allow the Shamban seal (F21) and shaft to pass through.
4. Press the output shaft through the bearings, this will remove the Shamban seal and leave the output gear and spacer behind.
5. Remove the seal housing (F16) together with 'O' ring (F18) this will then allow the bearings to be extracted from the casing for examination and replacement if required.
6. The inner race of the front roller bearing (F1) can now be removed from the shaft if required.
7. The output gear (F2) and spacer (F3) can now be lifted clear of the casing for further examination.
8. Wear on any of the output shaft bearings may also result in damage to the output gear (F2) and mating pinions (D6/E6). All these components must be carefully examined and replaced if necessary.



CAUTION: the output thrust bearing assembly (F5) is supplied as a pre-adjusted unit, therefore if either bearing is worn or damaged, the complete assembly must be replaced. ON NO ACCOUNT SHOULD INDIVIDUAL BEARINGS BE REPLACED.

9. Examine 'O' rings and seals for wear or damage, replacing where necessary.

10.8.1 Refitting output shaft to gearcase

1. Press inner race of front bearing (F1) onto the output shaft end abutment.
2. Press outer race of bearing (F1) into the main casing making sure it seats against the shoulder at the bottom of the bore.
3. Position the output gear (F2) and spacer (F3) into the casing.
4. Feed output shaft through the gear and spacer.

NOTE: Coat bearing rollers (F1) with clean grease this will aid assembly and prevent rollers from being trapped when finally assembling shaft.

5. Stand case and shaft upright on firm base and fit the smaller of the two rear bearing cones (F6) onto the shaft making certain it is firmly against the spacer (F9).
6. Press or drive the small bearing cup into the casing until it is flush with the bore face. Fit the spacer (F7) and large bearing cup to the spacer. Fit shims (F8) and spacer (F9) to the output shaft.
7. Press or drive the bearing cone onto the output shaft.
8. Refit the rear seal housing (F16) together with the 'O' ring (F18). Fill the gap between the seal lips with clean grease.
9. Fit the output flange (F12) 'O' ring (F11) and washer (F13).
10. Apply Loctite 270 to the three off coupling bolts (F15) and tighten to 136Nm (100 lbft).
11. Finally fit front Shamban seal (F21) flush with gearbox face.

10.9 Output shaft oil seal replacement

If there is enough space and clearance when the propeller shaft coupling is disconnected to allow the output flange to be withdrawn, the oil seal may be renewed without removing the gearbox from the boat. If not, first remove the gearbox as described in section 10.4. and then proceed as follows:-

1. Prevent the output flange from turning by 'baring' it with a lever locked against bolts placed in the output flange holes and remove screws and spacer.
2. Using pulley extractors, withdraw the output flange, remove the oil seal housing (F16) 4 bolts (F19) and extract the oil seal.
3. Examine the housing 'O' ring and renew if worn or damaged.
4. Check the oil seal running surface for wear, and if grooved, replace the output flange.
5. Fit a new seal (F17) ensuring it is driven square into the housing and refit the housing, taking care not to damage the 'O' ring (F18).
6. Smear the oil seal diameter of the output flange with clean grease, replace the 'O' ring (F11) and gently drive it into position on the shaft.
7. Replace the washer, apply Loctite 270 to the three screws and tighten to a torque of 136Nm (100 lbft).

10.10 Shimming procedures - input shaft and layshaft

The allowable end float on the taper bearing is 0-0.075mm (0-0.003in) clearance: this should be checked with the aid of a depth micrometer as follows:

1. Press the bearing outer cup firmly into position and measure between the face of the gearcase and the top of the bearing outer as shown in Fig. 16.
2. Measure the depth of the recess in the oil pump and in the output shaft end cover as in Fig. 17, and make up the difference between the two dimensions with shims.

If no depth micrometer is available, the following method may be used:-

1. Remove the 'O' ring from the oil pump or end cover.
2. Fit enough shims to cause the oil pump or end cover to stand proud.
3. Rotate the shaft, slowly tightening the securing bolts until the shaft starts to bind. Use feeler gauges or shims around the pump or end cover (Fig. 18) to ensure that the gap is uniform and that they are positioned squarely on the rear face of the gearcase.
4. Measure the gap by means of feeler gauges or shims, and deduct shims to this figure plus 0.075mm (0.003in) from the shims already installed.
5. Remove the requisite number of shims, tighten the oil pump or end cover, and test by rotating the shaft.
6. Remove the oil pump or end cover and refit with the 'O' ring installed.

NOTE: Shims are available in two thicknesses, 0.254mm (0.010in) and 0.05mm (0.002in). As an example of their use, if an end float reading of 0.584 (0.023in) is obtained, use two shims of 0.254mm (0.010in) and one of 0.05mm (0.002in), giving a final end float or clearance of 0.025mm (0.001in).

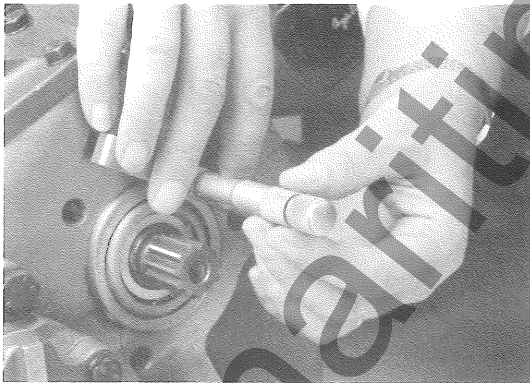


Fig. 16

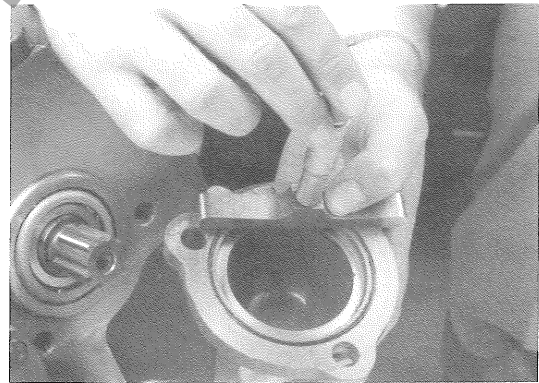


Fig. 17

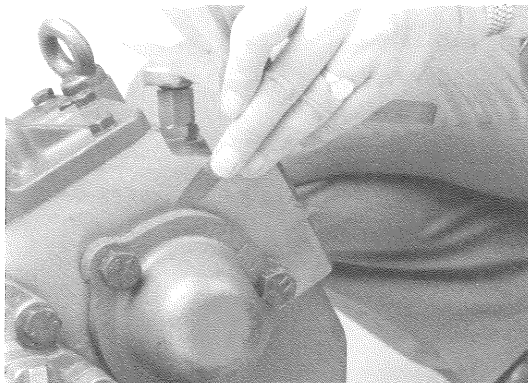


Fig. 18

11. CLUTCHED POWER TAKE-OFF UNIT

The clutched PTO mounts on the rear face of the gearbox and is driven directly by the input shaft. It replaces the end cover which is normally fitted and also performs the function of the cover in sealing the gearbox case against oil loss and correctly positioning the input rear bearing. The PTO unit is the link between the gearbox and the hydraulic pump.

Oil pressure taken from the gearbox control valve at the point usually used for fitting an oil pressure gauge is used to engage the PTO clutch for driving the hydraulic pump. With the lever in the disengaged position, no pressure is applied to the clutch plates, so no drive is activated. Low pressure oil from the return line of the oil cooler is directed to the PTO for lubrication.

11.1 Specification

The clutched PTO is designed to accommodate hydraulic pumps, with splined input shaft, conforming to SAE J744C, series 'B' specification, two or four bolt fixing.

SAE J744C series 'B' specification limits the torques and horsepower which may be transmitted by the PTO as follows:-

210Nm (155lb.ft)
22kW (29.5hp) per 1000 rev/min

Pumps of larger capacity than this must not be used. The PTO is designed to drive hydraulic pumps of the gear, vane or piston type, conforming to SAE J744C series 'B' specification only. IT EMPHATICALLY MUST NOT BE FITTED WITH ANY ADAPTION TO DRIVE AN OUTRIGGER PULLEY, as the mounting is not adequate to support side loads.

Advice cannot be given on the design of the ancillary power circuits of which the PTO forms part, it is expected that such circuits are designed in accordance with the recommendations of the manufacturers of the hydraulic equipment, and be properly safeguarded against overloading.

11.2 Installation

The following procedure must be followed when fitting a clutched PTO to an existing PRM1000 gearbox. If the gearbox is already installed on an engine or in a boat, it can be performed with the gearbox in situ.

1. Remove the 4 bolts securing the oil pump and withdraw the oil pump, gasket, shims and 'O' rings, noting the position of the pump for refitting (see section 3.4). Keep the shims, gasket and 'O' rings with the pump assembly.
2. Remove the 4 bolts securing the shaft end cover and remove the cover together with the shims and 'O' ring.
3. Insert the 4 studs (H6) into the holes from which the end cover bolts were removed.
4. Take the 'O' ring (A4) previously used with the shaft end cover and insert it into the groove in the joint face of the PTO body.
5. Take the shims previously used with the end cover and locate them in the recess in the PTO body joint face.
6. Remove transit bung (H53) from PTO body (this operation requires an 8mm long series Allen key).
7. Offer up the PTO to the gearbox and locate it on the 4 studs. Slide the PTO up to the joint face. If this is prevented by tooth misalignment on the drive spline, remove the PTO and rotate the clutch body (H47) slightly and repeat.
8. Locate the 4 nuts (H1) on the studs and tighten to a torque of 56Nm (41 lb.ft).
9. Remove the cover plate (H15) and joint (H50) from the rear face of the PTO body.
10. Secure the clutch body to the gearbox shaft by inserting the cap screw (H12) into the centre of the clutch body and tighten to a torque of 68Nm (50 lb.ft). (This operation requires a long series 8mm A/F Allen key).
11. Remove the pressure plug (C22) from the valve block and replace it with a union (H14) and bonded seal (H13).
12. Fit identical components into the port which is situated directly behind the operating lever on the PTO body.
13. Fit the oil feed pipe (H5) from the valve block to the PTO.
14. Remove the oil return pipe which connects the oil cooler to the valve block.

15. Insert the union (H22) into the PTO and fit the tee piece (H3) and bonded seal (H2) into the union.
16. Refit the oil cooler return pipe into the tee piece.
17. Insert the pipe adaptor (H4) into the valve block.
18. Fit the oil lubrication pipe (H7) from the tee piece on the PTO to the pipe adaptor on the valve block.

NOTE: See sections 5.5.2/5.5.4, Figs 10 to 12 for oil circuits.

19. Refit the oil pump, replacing the 'O' ring if damaged. Take care that the pump is fitted in the correct position relating to engine rotation see Section 3.4.

11.3 Fitting the hydraulic pump

The adaptor flange is designed to accept any hydraulic pump which has a flange to SAE J744C series 'B' specification, two or four-bolt fixing.

1. Take the pump and offer up to the PTO flange, locating the pump shaft spline with the drive adaptor in the PTO and seating the pump in the spigot on the flange face.
2. Secure the pump by 2 or 4 off - M12 bolts on the flange face.
3. The pump is now ready for piping into the hydraulic circuit as specified by the pump manufacturer. Once fully installed the gearbox should be run with the pump off-load to check the PTO for correct hydraulic function and running.

11.4 Strip and rebuild procedures

A replacement parts kit exists for replacing the PTO clutch (see parts list page 59)

1. Remove the pump from the PTO.
2. Remove the cap screw (H12) securing the clutch body to the gearbox shaft (This operation requires a long series 8mm A/F Allen key).
3. Disconnect the pressure and lubrication pipes from the PTO.
4. Remove the gearbox oil pump as described in section 10.2
5. Remove the 4 nuts (H1) securing the PTO to the gearbox and withdraw the PTO from the studs and drive spline. (Note: keep the shims and 'O' ring with the PTO body).
6. Remove the 4 cap screws (H11) securing the cover (H31) and withdraw it from the PTO body.
7. The clutch body assembly can now be withdrawn from the PTO body allowing the clutch plates to be replaced.
8. Unlock and remove the 6 clutch securing bolts (H33).
9. Remove the clutch end cover (H34) and withdraw the clutch plates, ferrules, pins and springs.
10. Stand the shaft in an upright position with the bolts refitted in the clutch body.
11. Locate the 3 spring guide pins (H35) in the clutch body.
12. Fit the clutch end plate (H39) over the spring location pins and place the clutch return springs (H37) over the location pins.
13. Locate the 6 ferrules (H36) on the 6 bolts and starting with one of the clutch friction plates (H41) build up the replacement clutch with alternate plates on to the clutch return plate.
14. Replace the clutch end cover (H34), locating it on the location pins, and finger tighten the 6 bolts.
15. Ensure that the pull-off springs are correctly located and that the clutch plates are free to travel in the clutch body.
16. Tighten the 6 bolts to 15Nm (11lb.ft) and close the tab washer (H40) over the bolt heads.
17. Refit the clutch body into the PTO taking care not to damage the piston rings on the feeder boss.
18. Refit the cover assembly. The drive adaptor (H32) is best located on one clutch plate at one time. Once located, turn the adaptor until it engages with the next plate and so on.
19. Refit the cap screws in the bearing housing and tighten to a torque of 58Nm (43 lb.ft).
20. Refit the PTO as described in section 11.2.

11.4.1 Bearing replacement

The PTO bearing can be replaced with the unit in situ on the gearbox.

1. Remove the hydraulic pump from the PTO.
2. Remove the 4 cap screws (H11) securing the cover (H31) and withdraw it from the PTO body. Take care not to damage the gasket (H49).
3. Remove the circlip (H28) and press out the drive adaptor and bearing.
4. Remove the circlip (H29) and press the drive adaptor off the bearing.
5. Inspect the bearing for wear or damage and replace it if necessary. Refit the bearing and assemble in reverse order to the above.
6. When refitting the 4 cap screws, tighten to a torque of 58Nm (43 lb.ft).

11.4.2 PTO drive replacement

If damage or excessive wear occurs on the splined drive extension from the main gearbox, it will be necessary to replace the input shaft see Section 10.7 for replacement of this shaft. It will be necessary to remove the PTO for this operation.

The procedure for replacement is given in Section 10.5 of this workshop manual.

12. 10° DOWN-ANGLE DRIVE UNIT

12.1 Retrofitting to an existing PRM1000D

The following procedure must be followed when retrofitting an angle drive to an existing gearbox:-

1. Drain all oil from the gearbox.
2. Remove the output shaft Shamban seal (F21) from the main gearbox and discard, it will be necessary to punch a hole in the centre to extract. Remove input seal (D34) and discard.
3. Taking care not to lose the gasket, shims or 'O' rings, remove the oil pump from the gearbox, rotate it through 180 degrees and bolt it back into position ensuring that the 'O' ring is correctly located in its groove and that the shims are properly located in the pump recess.
4. Coat the input shaft of the main gearbox with an anti-fretting grease (e.g. "Molycote BR2 Plus").
5. Grease the gasket (G24) and fit to the front face of the main gearbox. (Note: the fitting kit contains two gaskets the larger one is for PRM1000D).

NOTE: This kit also services the previous model PRM601 therefore spacer MT4672 (G26) is not required for PRM1000D.

6. Remove the tape, securing the location ring (G23) and offer up the angle drive to the main gearbox, locating the gearbox input shaft into the splined gear (G22).
7. Secure the two assemblies with 6 studs (G25) and nuts (G4), tightening to a torque of 101.5Nm (75 lb.ft).
8. Screw the metering union (G20) into the top of the angle drive unit, fit tee piece (G7) sealing washer (G5) and loosely connect the oil pipe (G27) to it.
9. Connect the free end of the oil pipe to the valve block in the line returning oil from the oil cooler and tighten the oil pipe connections. See Fig. 11 page 19 for oil cooler circuit.
10. The dipstick **MUST** be replaced by the new one supplied with the angle drive unit as the oil level rises with angle drive facility.
11. Refill the gearbox with a recommended oil see section 4.4 and check the level. Re-check the oil level after initial start up to allow for oil in cooler system.
12. Fit the adaptor plate to the front face of the angle drive, and tighten the bolts to 101.5Nm (75 lb.ft) torque.

The complete unit can be fitted to the engine as described in section 5.4

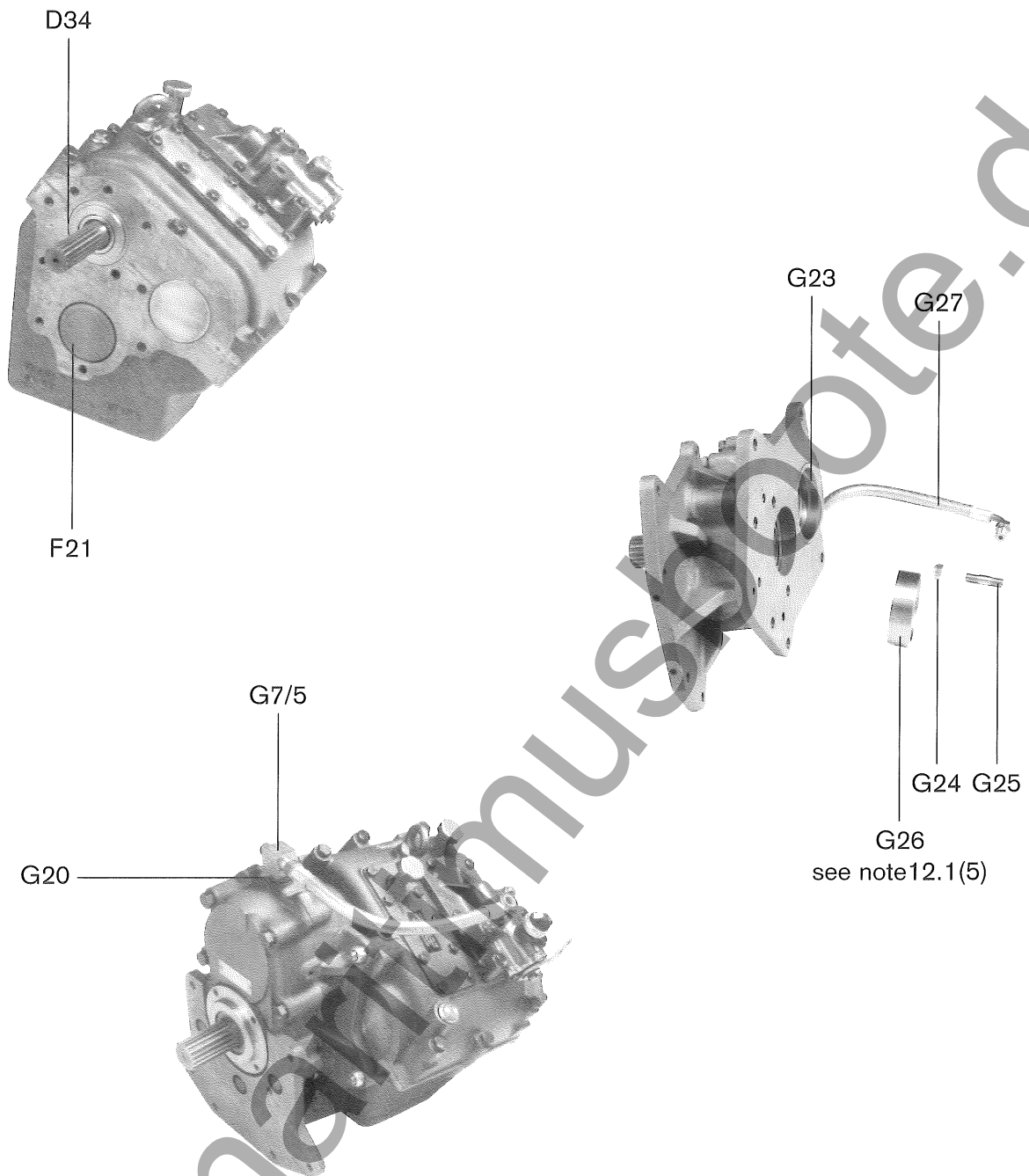


Fig. 19. Angle drive fitting procedure



CAUTION: when running the installation after fitting the angle drive unit, it should be remembered that the sense of forward/reverse direction on the operating lever is now different (see section 5.8)

If in any doubt about your ability to carry out the above procedure correctly, return both angle drive and gearbox to the factory for fitting.



CAUTION: it is essential that the instructions at page 36 are followed **PRECISELY** otherwise serious damage may occur when the unit is operated. Newage Transmissions Ltd. will not accept responsibility from claims under warranty or otherwise in respect of loss or damage caused by failure to follow these instructions.

12.2 Replacement of the angle drive gears and bearings

12.2.1 MT0345 angle drive

Because of the converging shaft centres, care should be taken when dismantling this unit; departure from correct procedure may result in damage to the gear teeth or bearings.

1. Remove the angle drive from the main gearbox in the reverse order to the procedure described in section 12.1.
2. Tape the input shaft spline teeth to prevent damage to the oil seal during removal. Remove the four socket head cap screws securing the input shaft front oil seal housing and shims and withdraw the housing, taking care not to misplace the shims. Inspect the oil seal for wear or damage and replace if necessary.
3. Withdraw the spacer (G23) and shims from the output bearing rear housing and remove the output bearing cup.
4. Remove the seven bolts which secure the two case halves.
5. With the unit laid on a horizontal surface, rear face down, separate the two case halves and lift the front case half off the rear half. Two M8 tapped holes are provided in the front case half to assist in separating the case halves.
6. All bearings and gears are now free for inspection. If damage or excessive wear has occurred the appropriate bearing must be replaced. If damage to either gear is apparent, then BOTH gears must be replaced.
7. To replace a damaged bearing, it will be necessary to remove the bearing cone from the gear using pulley extractors located behind the bearing roller.



CAUTION: If any bearing has to be replaced due to breakage then it is likely that the remaining bearings and the gears have also suffered damage as a result. They should therefore be carefully inspected and if necessary replaced.

12.2.2 To re-assemble the unit proceed as follows:

1. Press the bearings onto the input and output gears and fit the bearing cups to the case halves.
2. Locate the input gear in the rear case half and the output gear in the front case half.
3. Coat the mating surfaces of the two gearcase halves with a jointing compound and aligning the dowel in the front output bearing housing with the front case half offer the top half of the gearcase to the lower.
4. Refit the seven bolts securing the case halves and tighten to a torque of 101.5Nm (75 lb.ft).
5. Refit the four cap screws (G8) securing the front output bearing housing and tighten to a torque of 12Nm (9 lb.ft).
6. To shim input shaft bearings proceed as follows:-

NOTE: shimming is best done prior to fitting oil seal (G18). Shim bearings to give zero to 0.08mm end float.

- a) Position sufficient shims in the oil seal housing (G19) to cause it to stand approximately 0.125mm proud of the gearcase when fitted.

NOTE: take care not to damage seal or seal surface of the shaft.

- b) Fit screws (G8) "finger tight", whilst rotating the input shaft to seat the bearing (the shaft should rotate freely).
 - c) Measure the gap below the seal housing with feeler gauges and remove from the shim pack in the seal housing the amount of shims corresponding to that measurement.
 - d) Replace the seal housing.
7. To shim output shaft bearings proceed as follows:
 - a) Insert spacer (G23).
 - b) Apply hand pressure to the spacer and rotate the shaft to seat the bearings.
 - c) Measure the step between the gearcase face and the end of the spacer.
 - d) Remove the spacer and position shims of equivalent value between the bearing cup and the recess in the spacer.
 8. Refit the angle drive to the main gearbox as described in the section 12.1.

13. OPTIONAL TROLLING VALVE DESCRIPTION

This unit can be supplied as a factory fitted option or is available for retro-fitting.

13.1 Description

The Newage trolling valve is available as an option on the PRM1000. This is electronically operated which allows variable speed of the propeller to zero whilst allowing a maximum engine speed of up to 1200 rpm. The trolling valve runs with the gearbox oil.

13.2 Trolling valve installation data

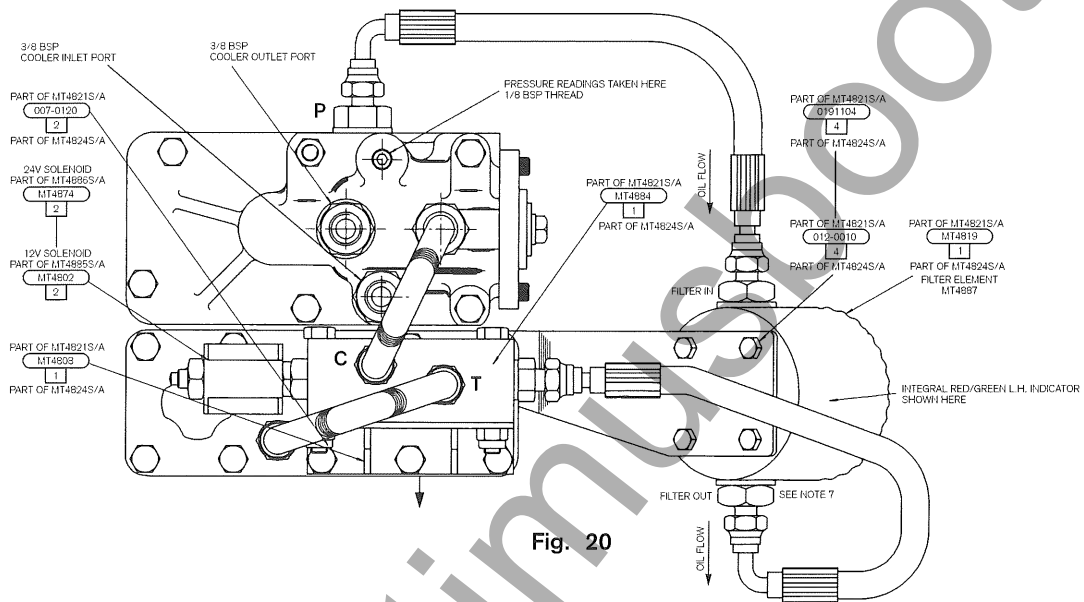


Fig. 20

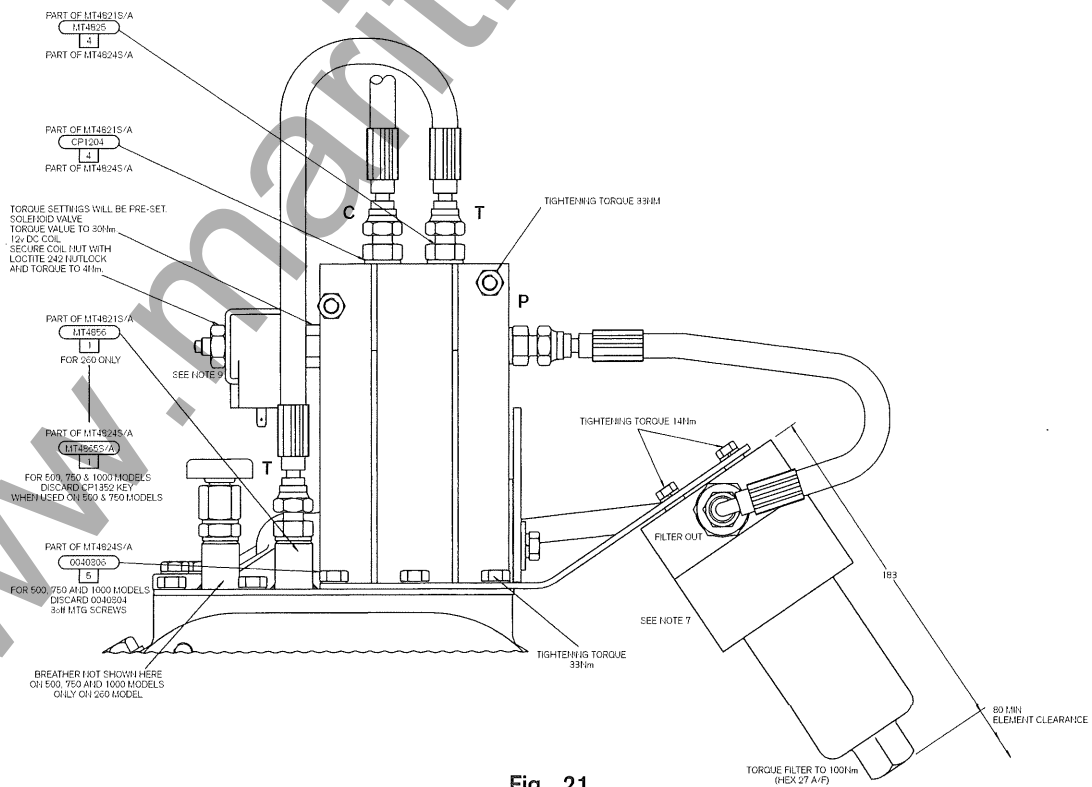


Fig. 21

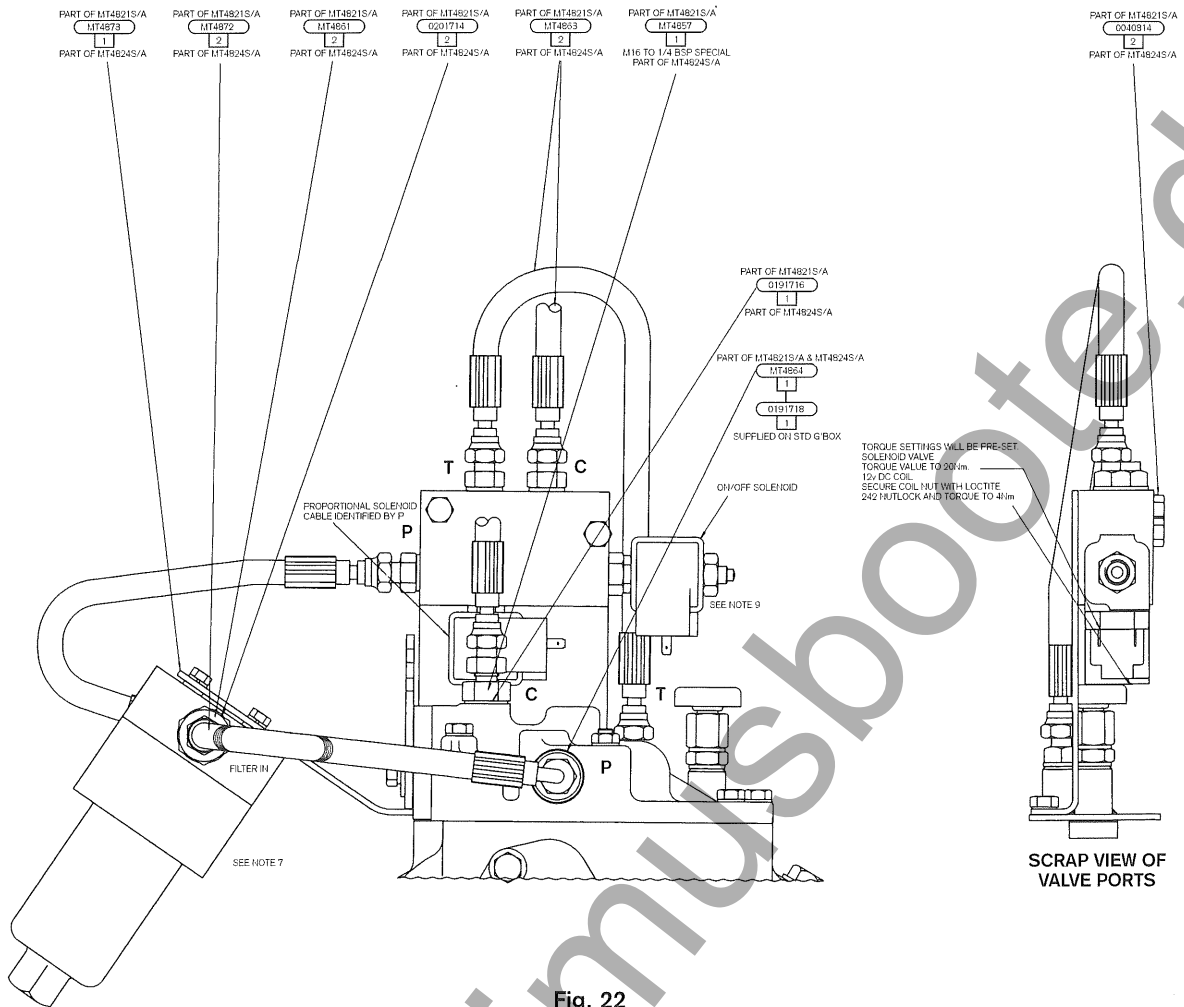


Fig. 22

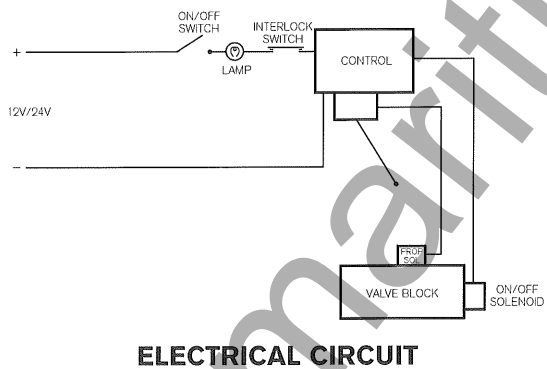
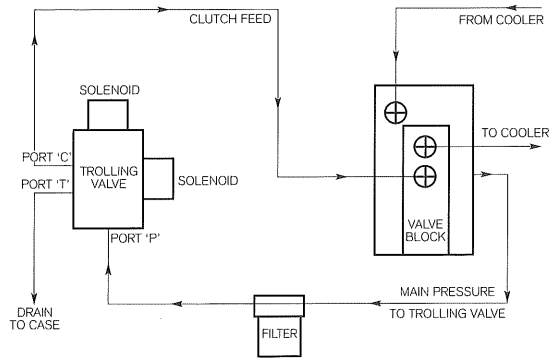
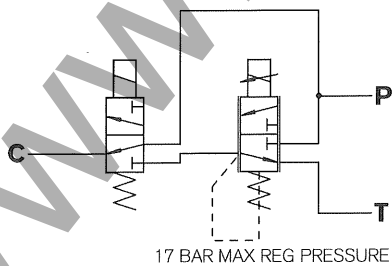


Fig. 23



TROLLING VALVE BASIC CIRCUIT DIAGRAM

Fig. 24



SCHEMATIC LAYOUT

Fig. 25

PART NUMBER	DESCRIPTION
MT4821S/A	TROLLING VALVE ASSEMBLY 260
MT4824S/A	TROLLING VALVE ASSEMBLY 500, 750, 1000
MT4885S/A12V	OPERATING LEVER ASSEMBLY
MT4886S/A24V	OPERATING LEVER ASSEMBLY

13.3 Trolling valve fitting instructions.

1. MT4820 one 3m length 6 core cable to be supplied loose with one socket end connector and two Hirschman connectors on solenoid cables. If required one 3m 6 core extension cable can be supplied under above part number.
2. Fuel rack switch to be left with bare wires. Customer to connect wires and supply mounting bracket.
3. When retrofitting trolling valve to a standard gearbox use MT1538 control valve within the valve block assembly.
4. Prior to retrofitting trolling valve to old gearbox, drain gearbox and cooler and clean drain plug. Refill with clean oil to the correct level. Run the gearbox to fill cooler circuit and re-fill accordingly. See section 4.4 for correct oil.
5. The control lever is pre-set and should not require any adjustment.
6. Cooler pipe connections remain as standard gearbox.
7. The oil filter can be resited if necessary up to 1/2 metre from the gearbox. If this is desired the customer must supply the additional filter bracket. The filter must be installed vertically on the engine and gearbox installation with the bowl facing downwards. Replace 10 micron element after initial 50hrs operation and as determined by the filter indicator reading thereafter. The system must not be run with the filter indicator in the red.
8. If used with a clutch PTO, then the clutch pressure feed must be taken from the 1/8 BSP tapping in the valve block or port 'P' in the proportional valve. Under no circumstances should the PTO connection be taken from port 'C' clutch feed line. Any pipes left disconnected must be capped with plugs to prevent any contamination of the valve assembly.
9. The trolling valve system is failsafe and will return to full pressure in the event of electrical failure. In the event of mechanical failure eg. (sticking valve) the on/off solenoid on the side of the proportional valve can be manually moved by depressing the button in the centre of the solenoid. This will release the valve and return to full pressure.
10. The trolling valve system must not be operated above 1200 rpm engine speed. An interlock switch is provided to switch off the trolling valve should overspeed occur.

14. TOOL KIT

Dipstick	18mm A/F
Drain plug (magnetic)	1in.A/F
Strainer plug	1 ⁵ / ₈ in. A/F
Output coupling bolts	17mm A/F
Spanners	19mm A/F
	17mm A/F
	13mm A/F

14.1 Tightening torques. **NOTE:** These figures are for dry threads only.

RECOMMENDED TIGHTENING TORQUES		
	Nm	lbf.ft
Upper to lower gearcase bolts	56.0	41.5
Upper to lower gearcase studs	56.0	41.5
Valve block to upper gearcase	28.0	21.0
Operating lever to valve block	28.0	20.6
End cover to valve block	9.5	7.0
Pump body to gearcase	56.0	41.5
End cover to gearcase	56.0	41.5
Pump cover to pump body	28.0	21.0
Coupling to output shaft bolts (Loctite 270)	136.0	100.0
Top cover to upper gearcase	28.0	21.0
Adaptor plate to gearbox	98.0	72.5
P.T.O. to rear gearcase	56.0	41.5
Angle drive to front gearcase	98.0	72.5

15. REPLACEMENT PARTS ORDERING

When ordering replacement parts the following should be quoted:

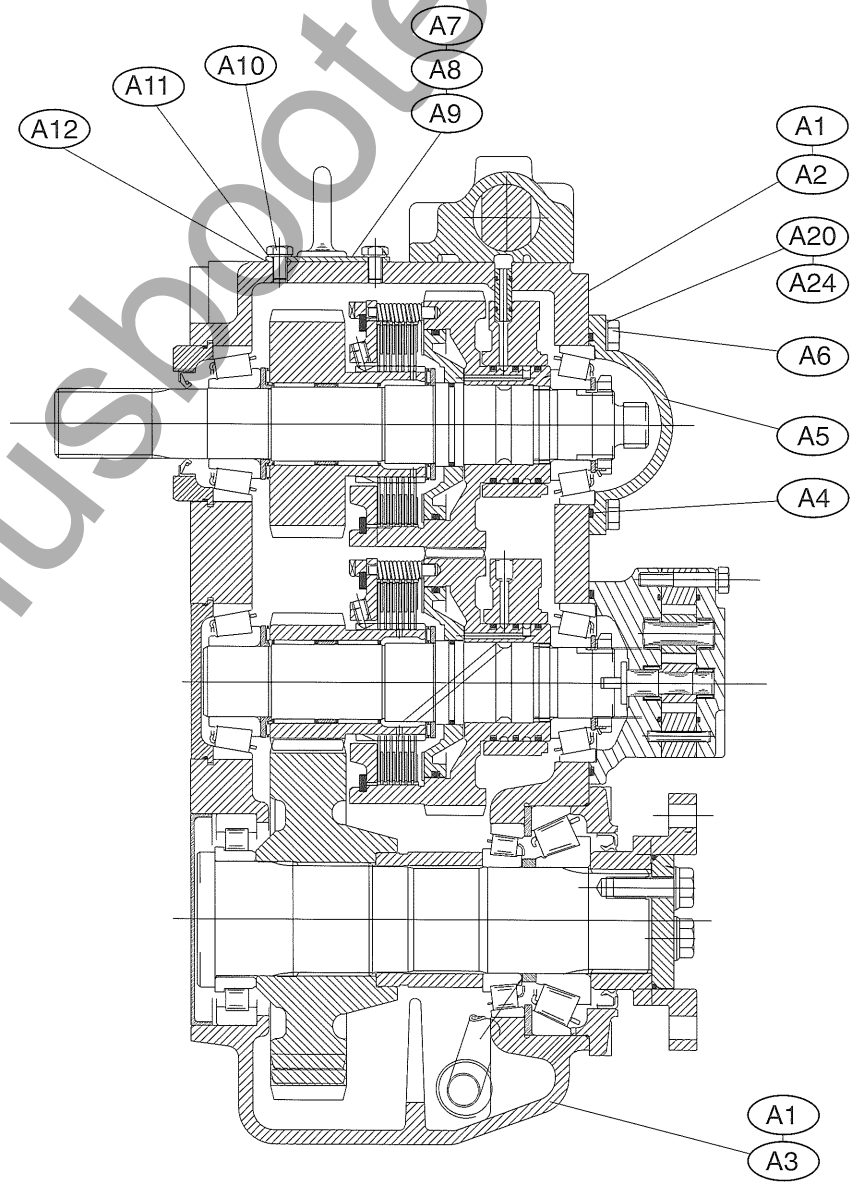
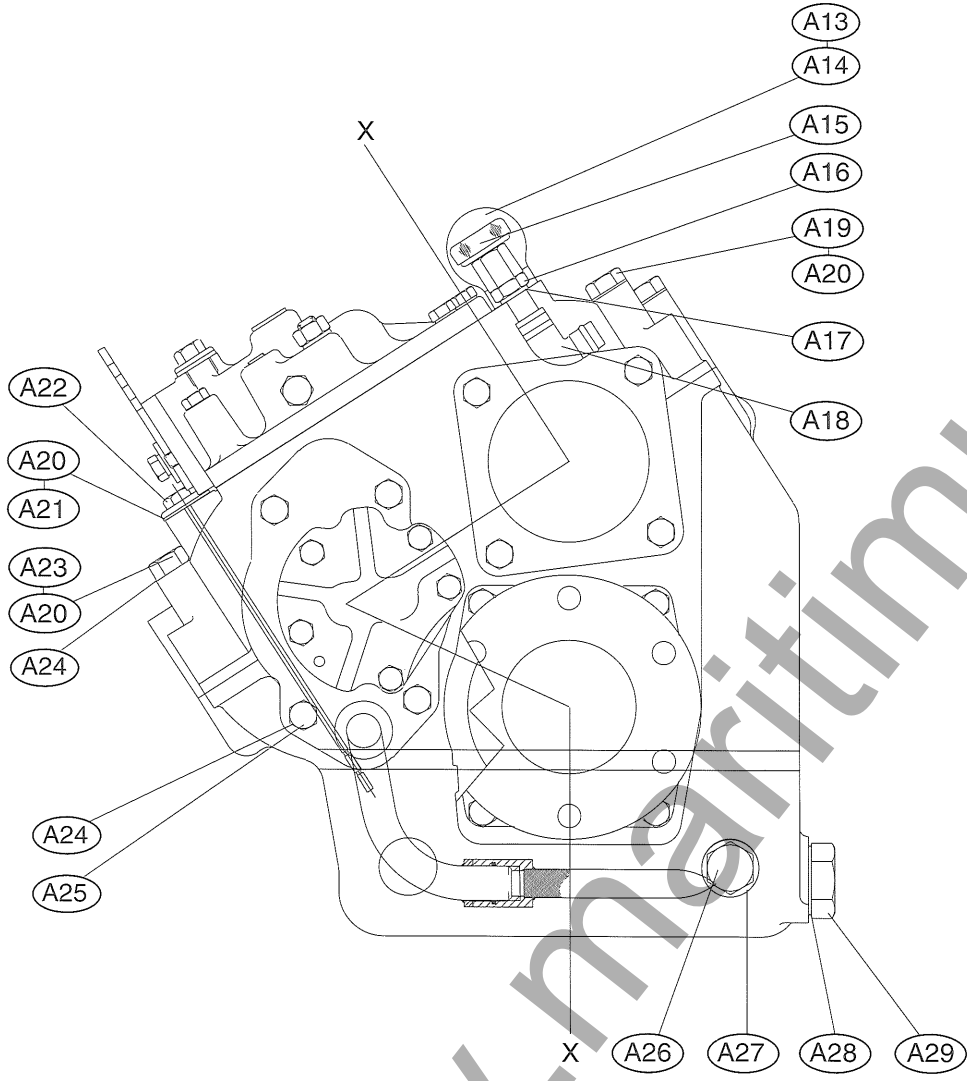
- Gearbox model and serial number
- Description(s) and part number(s) of the component(s) required
- Quantity required
- Orders and enquiries for replacement parts must be made through Newage distributor/dealer network

NOTE: Enquiries relating to a technical or service nature can be made direct to:



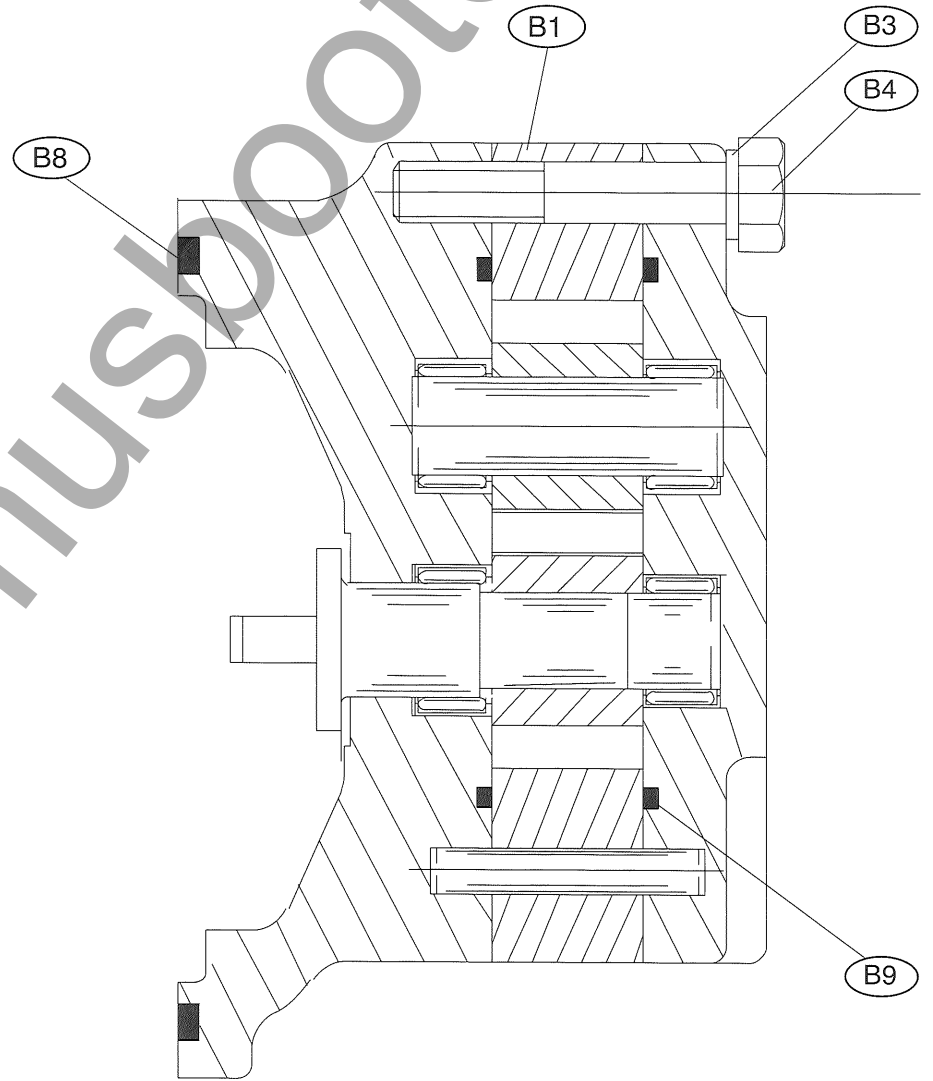
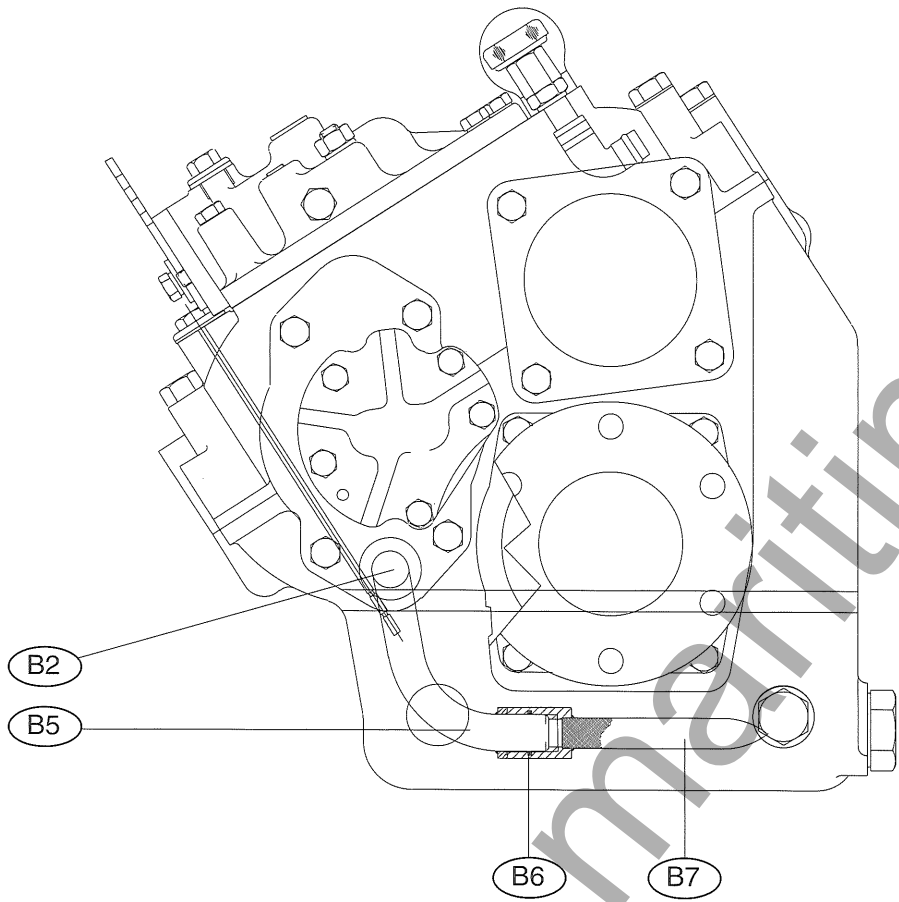
PARTS LIST

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SECTION A - GEARCASE ASSEMBLY			
ITEM NO.	DESCRIPTION	PART NO.	QTY
A1	Case sub-assembly - all ratios except 4:1	MT0403	1
A2	Gearcase - top - not supplied separately	MT4615	1
A3	Gearcase - bottom - not supplied separately	MT4837	1
A1	Case sub-assembly - 4:1 ratio only	MT0409	1
A2	Gearcase - top - not supplied separately	MT4615	1
A3	Gearcase - bottom - not supplied separately	MT4883	1
A4*	'O' ring	004124	2
A5	Rear cover	MT4512	1
A6	Bolt M10 x 25	0041008	4
A7	Top cover	MT4743S/A	1
A8	Plug BSP	CP1123	1
A9	Washer BSP	CP1139	1
A10	Screw - top cover	0040804	10
A11	Washer	CP1223	10
A12 *	Gasket (top cover)	MT343	1
A13	Eyebolt	CP1339	1
A14	Washer	0201609	1
A15	Breather	CP1383	1
A16	Bulk head nut	CP1385	1
A17	Washer - breather	CP1204	1
A18	Breather tube	CP1382S/A	1
A19	Bolt M10 x 70	0041017	2
A20	Bolt M10 x 90	0041021	4
A21	Washer	CP1068	1
A22	Dipstick	0800687	1
A22	Dipstick - 4:1 ratio gearbox only	MT1137	1
A22	Dipstick - gearbox with angle drive	40M153	1
A23	Bolt - Not illustrated M10 x 110	0041023	1
A24	Dowty washer M10	0201706	21
A25	Screw	0041009	4
A26	Drain plug (magnetic)	CP1331	1
A27	Bonded washer	0201714	1
A28	Bonded washer	0201720	1
A29	Plug	0150100	1
A30	Dowel - not illustrated	MT4540	2

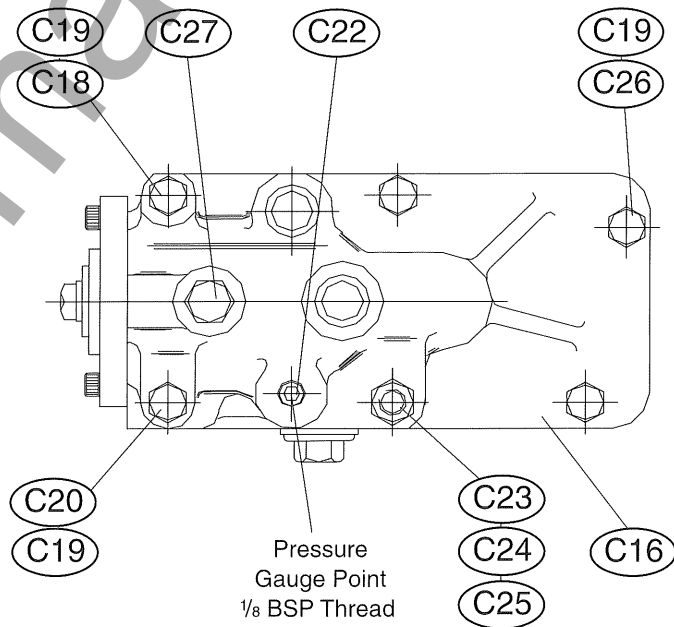
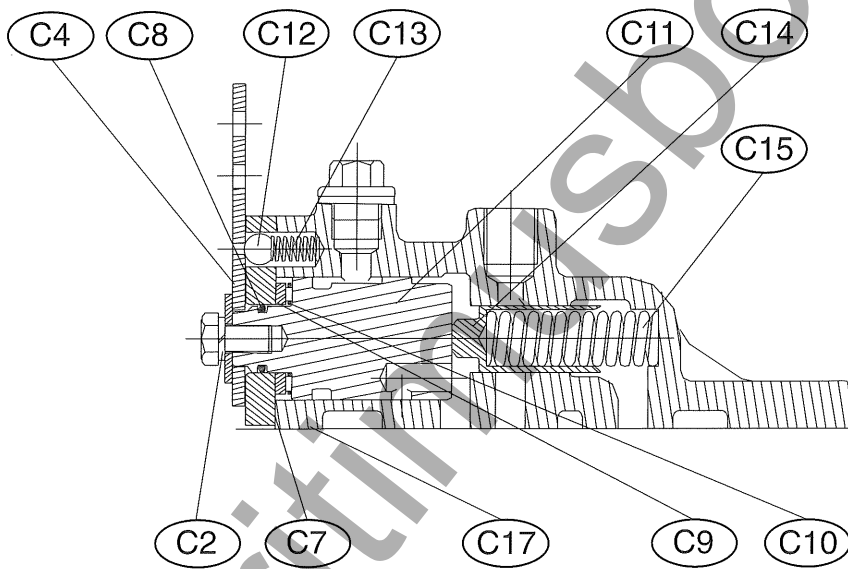
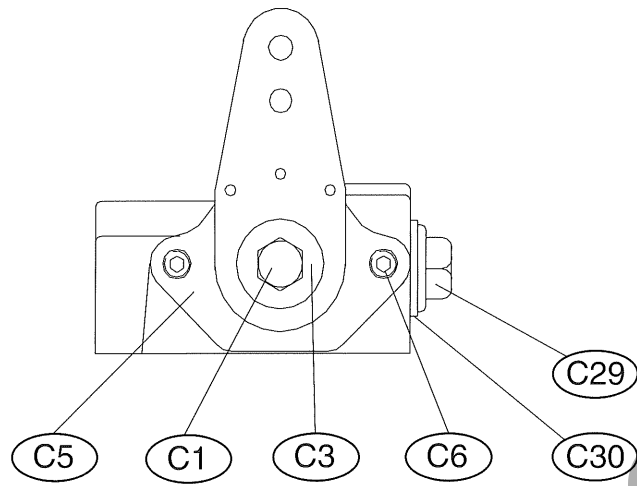
* Part of gasket/seal kit MT443



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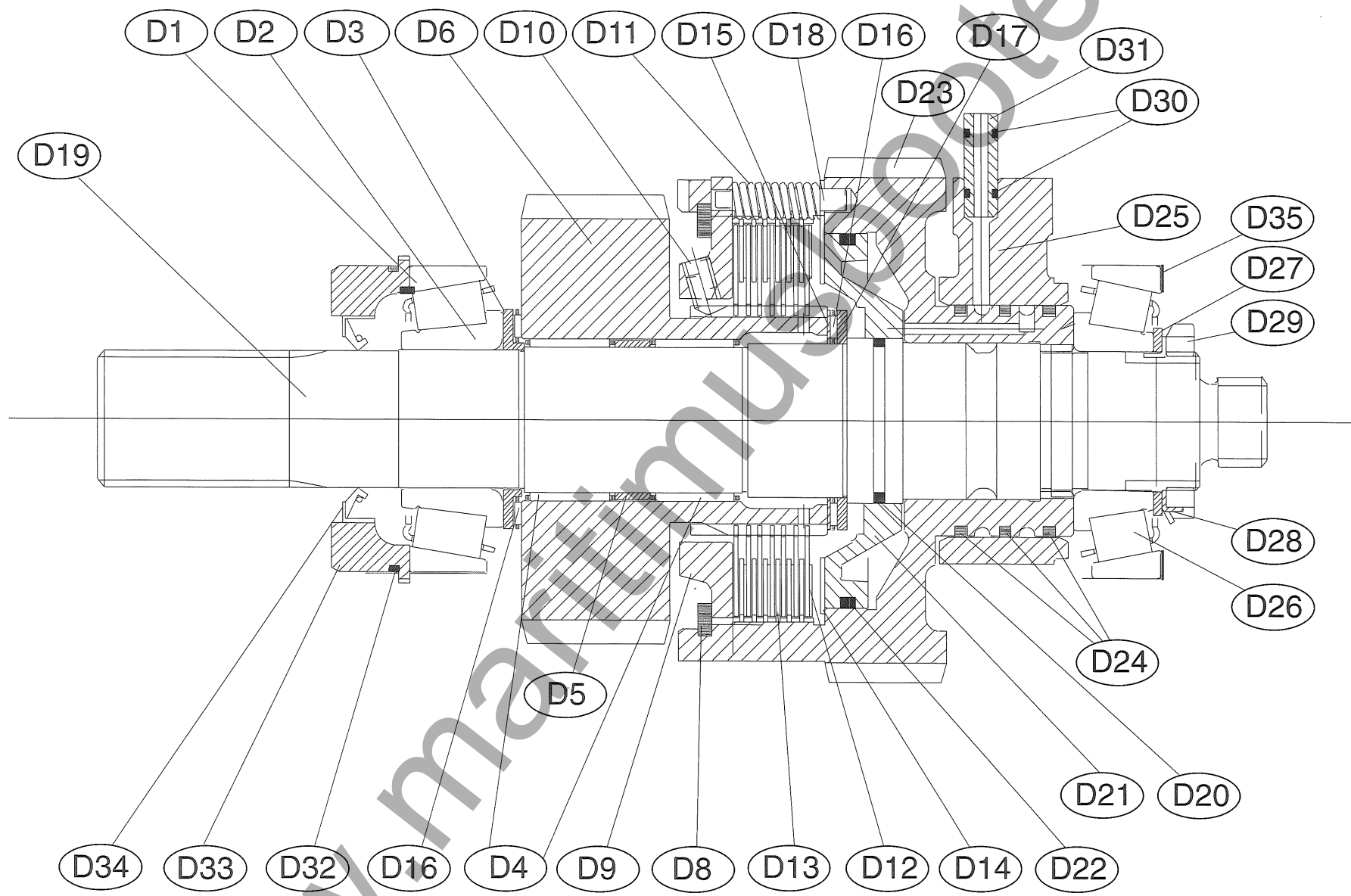
SECTION B - OIL PUMP ASSEMBLY			
ITEM NO.	DESCRIPTION	PART NO.	QTY
B1	Oil pump (Kit)	MT0416-KIT	1
B2 *	'O' ring	001254	2
B3	Washer	0191105	5
B4	Bolt	0040812	5
B5	Oil pipe - internal - all ratios except 4:1	MT4545	1
B5	Oil pipe - internal 4:1 ratio only	MT4546	1
B6 *	'O' ring	000872	1
B7	Strainer	MT4547	1
B8 *	'O' ring	004124	1
B9 *	'O' ring	0430682	2

* Part of gasket/seal kit MT0443



SECTION C - VALVE BLOCK ASSEMBLY			
ITEM NO.	DESCRIPTION	PART NO.	QTY
C	Valve block assembly	MT0411	1
C1	Screw	0040806	1
C2	Spring washer	0191105	1
C3	Washer	MT979	1
C4	Operating lever	MT977	1
C5	End cover	MT978	1
C6	Cap screw	0081220	2
C7 *	Gasket	MT1081	1
C8 *	Nu-lip seal	MT8082	1
C9	Thrust race	CP1308	1
C10	Thrust bearing	CP1307	1
C11	Control valve	MT4656	1
C12	Detent ball	CP1077	1
C13	Detent spring	MT305	1
C14	Piston	MT4751	1
C15	Valve spring 3000 Kpa (440 psi)	MT4928	1
C16	Valve block	MT4780	1
C17 *	Gasket	MT1073	1
C18	Bolt	0040812	1
C19	Washer	CP1223	5
C20	Bolt	0040815	1
C21	Redcap seal (transit only)	MT477	2
C22	Pressure plug	MT311	1
C23	Nut	0051001	1
C24	Washer	0191710	1
C25	Stud	MT1292	1
C26	Screw	0040808	3
C27	Switch and ball assy } Bonded seal }	MT0214 } 0201715 }	1 assy
C29	Plug (M18 pressure port)	0150318	1
C30	Bonded seal	0191718	1

* Part of valve block gasket kit: MT0392 or gasket/seal kit: MT0443



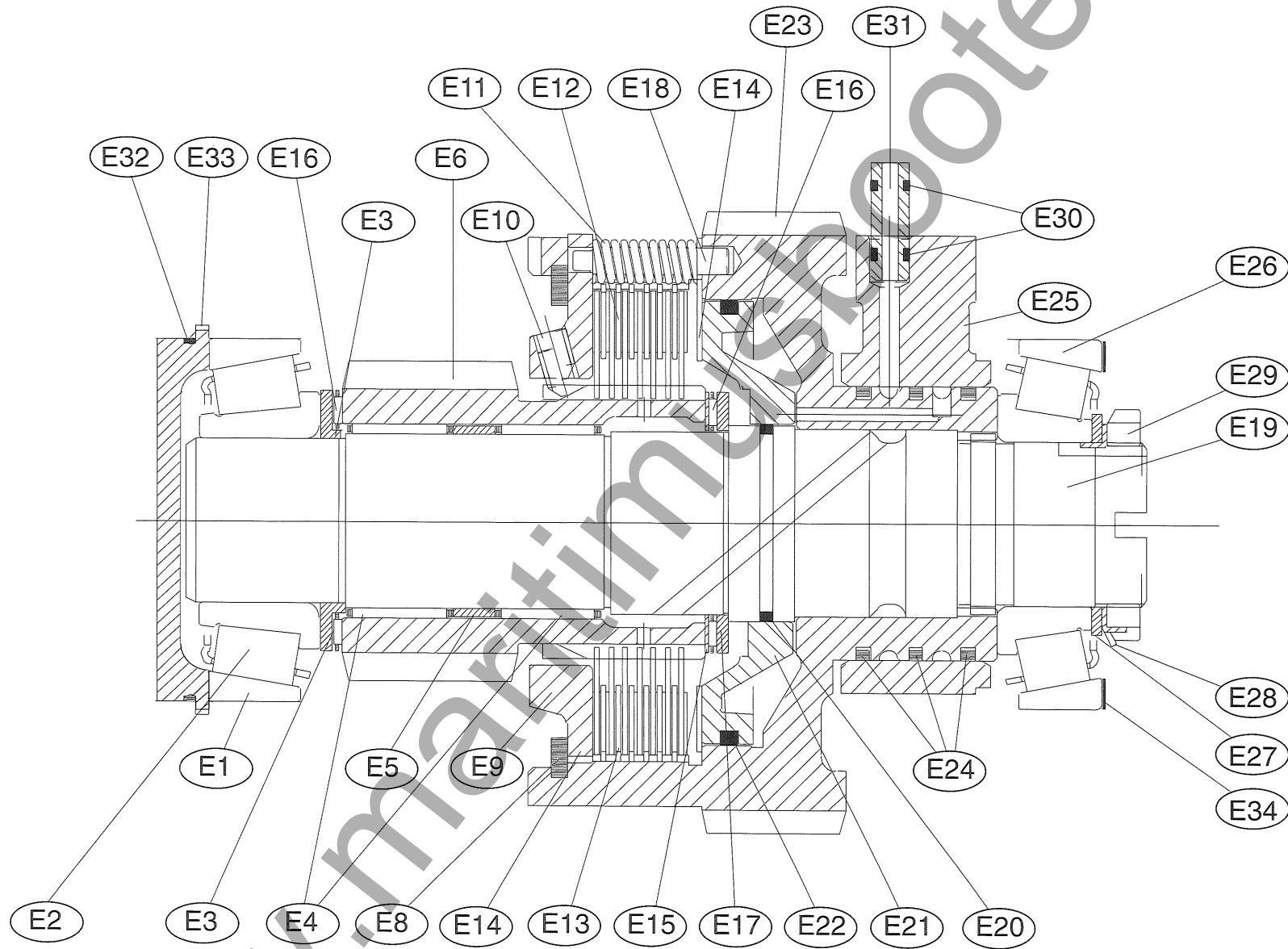
SECTION D - INPUT SHAFT ASSEMBLY			
ITEM NO.	DESCRIPTION	PART NO.	QTY
D1	Bearing cup	055U056	1
D2	Bearing cone	055C025	1
D3	Spacer	MT4715	1
D4	Needle roller bearing	0564201	2
D5	Spacer	MT4723	1
D6	Pinion (1.5:1) 36T	MT4798 S/A	1
D6	Pinion (2:1) 30T	MT4799 S/A	1
D6	Pinion (3:1) & (4:1) 22T	MT4800 S/A	1
D8 □	Circlip	0341200	1
D9 □	Clutch end cover	MT4794S/A	1
D10 □	Grub screw - part of MT4794S/A	014V512F	3
D11 □	Spring	MT4649	3
D12 □	Clutch plate	MT4602/S	7
D13 □	Clutch plate	MT4535	6
D14 □	Clutch end plate	MT4534	1
D15	Thrust washer	CP1363	1
D16	Thrust bearing	CP1337	2
D17	Thrust washer	CP1338	1
D18	Location pin	MT4801	3
D19	Input shaft	MT4716	1
D20 *	'O' ring	001873	1
D21	Piston	MT4655	1
D22 *	'O' ring	004254	1
D23	Clutch gear RH identification groove	MT4949	1
D24 !	Piston ring	MT4539	3
D25	Feeder	MT4511	1
D26	Bearing	0540452	1
D27	Spacer	MT4518	1
D28	Lockwasher	010W401	1
D29	Locknut	010N401	1
D30 *	'O' ring	000372	4
D31	Connector	MT1057	2
D32 *	'O' ring	003473	1
D33	Input cover	MT4514	1
D34 *	Oil seal	0400403	1
D35 **	Shim 0.002"	MT1076/02	As req'd.
D35 **	Shim 0.010"	MT1076/10	As req'd.

□ Part of clutch pack kit MT0432

! Part of piston ring kit MT0441

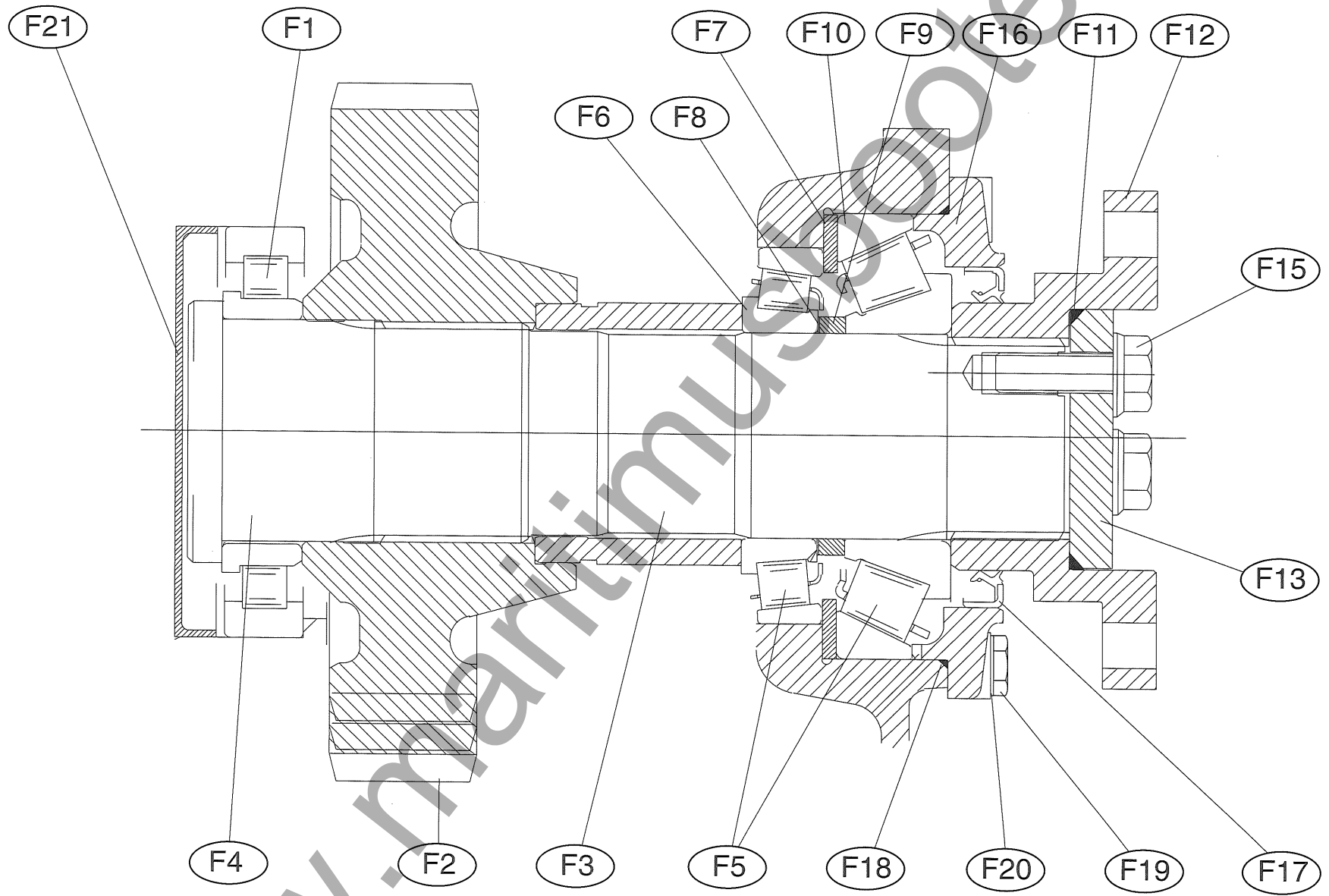
* Part of gasket/seal kit MT0443

** Part of shim kit MT0120



SECTION E - LAYSHAFT ASSEMBLY			
ITEM NO.	DESCRIPTION	PART NO.	QTY
E1	Bearing cup	055U056	1
E2	Bearing cone	055C025	1
E3	Spacer	MT4715	1
E4	Needle roller bearing	0564201	2
E5	Spacer	MT4723	1
E6	Pinion (1.5:1) 36T	MT4798 S/A	1
E6	Pinion (2:1) 30T	MT4799 S/A	1
E6	Pinion (3:1) & (4:1) 22T	MT4800 S/A	1
E8 □	Circlip	0341200	1
E9 □	Clutch end cover	MT4794S/A	1
E10 □	Grub screw - part of MT4794S/A	014V512F	3
E11 □	Spring	MT4649	3
E12 □	Clutch plate	MT4602/S	7
E13 □	Clutch plate	MT4535	6
E14 □	Clutch end plate	MT4534	1
E15	Thrust washer	CP1363	1
E16	Thrust bearing	CP1337	2
E17	Thrust washer	CP1338	1
E18	Location pin	MT4801	3
E19	Layshaft	MT4717	1
E20 *	'O' ring	001873	1
E21	Piston	MT4655	1
E22 *	'O' ring	004254	1
E23	Clutch gear LH	MT4948	1
E24 !	Piston ring	MT4539	3
E25	Feeder	MT4511	1
E26	Bearing	0540452	1
E27	Spacer	MT4518	1
E28	Lockwasher	010W401	1
E29	Locknut	010N401	1
E30 *	'O' ring	000372	4
E31	Connector	MT1057	2
E32 *	'O' ring	003473	1
E33	Layshaft cover	MT4515	1
E34	Shim 0.002"	MT1076/02	As req'd.
E34	Shim 0.010"	MT1076/10	As req'd.

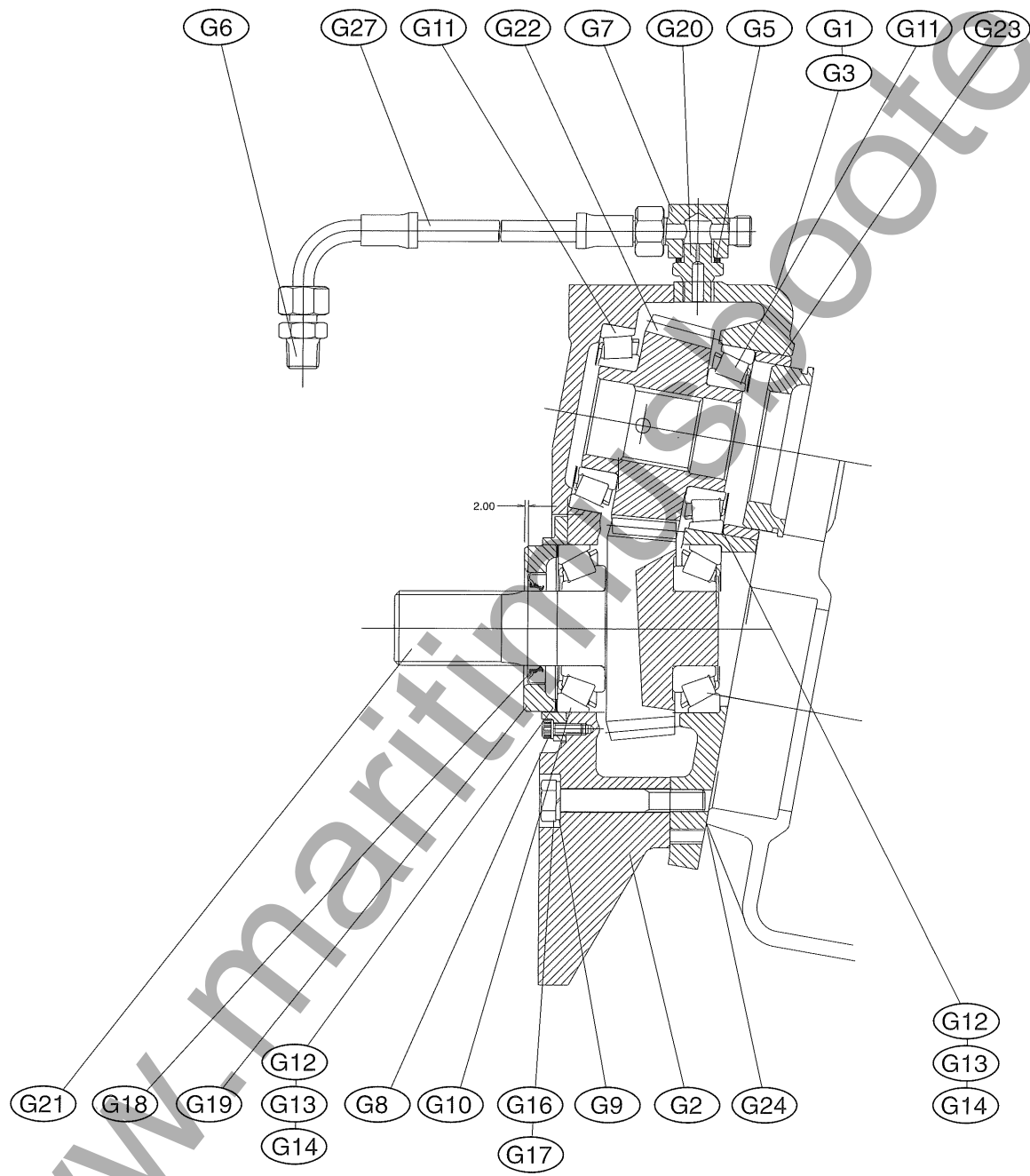
- Part of clutch pack kit MT0432
! Part of piston ring kit MT0441
* Part of gasket/seal kit MT0443
** Part of shim kit MT0120



SECTION F - OUTPUT SHAFT ASSEMBLY			
ITEM NO.	DESCRIPTION	PART NO.	QTY
F1	Bearing	0536541	1
F2	Output gear 1.5:1 55T	MT4881	1
F2	Output gear 2:1 61T	MT4841	1
F2	Output gear 3:1 63T	MT4842	1
F2	Output gear 4:1 87T	MT4882	1
F3	Spacer	MT4843	1
F4	Output shaft	MT4838	1
F5	Bearing assembly comprising:-	MT0178	1
F6	Bearing		1
F7	Spacer		1
F8	Shims	Not sold separately	As req'd
F9	Spacer		1
F10	Bearing		1
F11 *	'O'ring	043693	1
F11 *	'O' ring (4:1)	043883	1
F12	Output flange (all ratios except 4:1)	MT4892	1
F12	Output flange (4:1)	MT4893	1
F13	Washer	MT4894	1
F13	Washer (4:1)	MT4932	1
F15	Bolt M12 (Durluk)	01207035	3
F16	Seal housing	MT4897	1
F17 *	Oil seal	0400781	1
F18 *	'O' ring	0431303	1
F19	Bolt	0041009	4
F20	Washer	0201706	4
F21 *	Seal (Shamban)	06912012	1

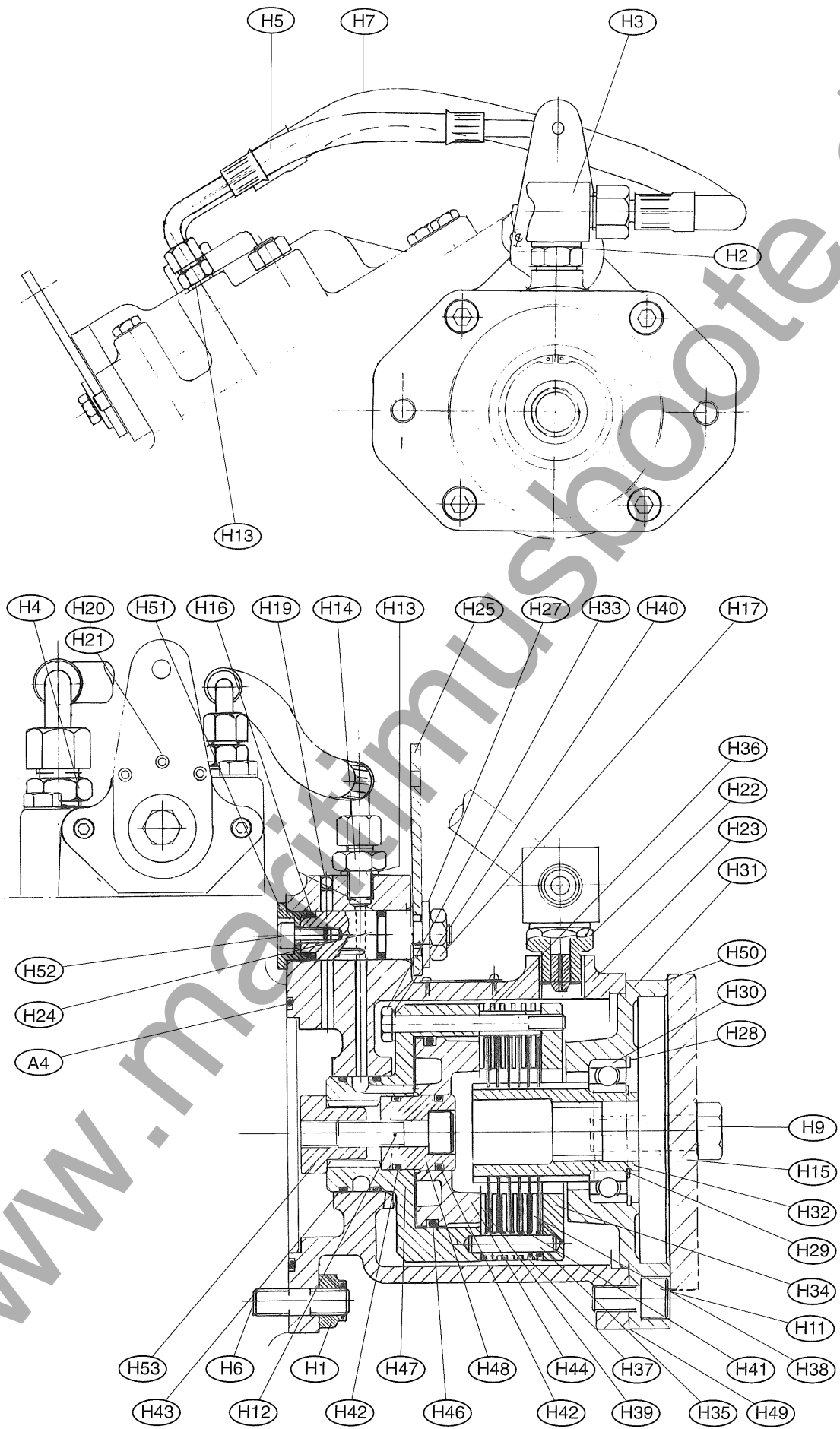
* Part of gasket/seal kit MT0443

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SECTION G - DOWN ANGLE DRIVE UNIT			
ITEM NO.	DESCRIPTION	PART NO.	QTY
G	Down angle drive unit	MT0345	1
G1	Gearcase S/A	MT0344	1
G2	Half case (front) - not supplied separately	MT4776	1
G3	Half case (rear) - not supplied separately	MT4775	1
G4	Nyloc nut (not illustrated)	0051205	6
G5	Dowty washer	0201715	1
G6	Adaptor	CP1255	1
G7	Tee piece	CP1367	1
G8	Cap screw	0081316	4
G9	Spring washer	0191107	7
G10	Taper bearing	0540401	2
G11	Taper bearing	0540551	2
G12	Shim .002"	057353A	6
G13	Shim .010"	057353C	6
G14	Shim .031"	057353E	2
G15	Dowel (not illustrated)	40M629	2
G16	Bolt	041217	1
G17	Bolt	0041219	3
G18 *	Oil seal	0400403	1
G19	Oil seal housing	MT4778	1
G20	Union sub assy	MT4583	1
G21	Input gear	MT4658	1
G22	Output gear	MT4779	1
G23	Location ring	MT4777	1
G24	Gasket (PRM601 only)	MT4599	1
G24	Gasket (PRM1000 only)	MT4994	1
G25	Stud (not illustrated)	MT4642	6
G26	Spacer (not illustrated PRM601 only)	MT4672	1
G27	Oil pipe	MT766	1
G28	Dipstick (not illustrated)	40M153	1
G29	Shims (not illustrated)	057390A/C/E	3

** Part of gasket/seal kit MT0443



SECTION H - POWER TAKE-OFF			
ITEM NO.	DESCRIPTION	PART NO.	QTY
H	Power Take-Off	MT0205	1
H1	Nyloc nut	0051006	4
H2	Dowty washer	0201715	1
H3	Tee piece	CP1367	1
H4	Pipe adaptor	CP1255	1
H5	Hose - clutch feed	MT5008	1
H6	Stud	MT5009	4
H7	Oil pipe - cooler circuit	MT766	1
H8	Shimming kit - not illustrated	MT0120	As req'd.
H9	Bolt	0041208	2
H11	Cap screw M12 x 20	0081620	4
H12	Cap screw	0081535L	1
H13	Bonded seal	CP1224	2
H14	Union	CP1341	2
H15	Cover plate	MT1293	1
H16 *#	Seal - Nulip	MT8082	2
H17	Nut	0050801	1
H19	Ball ³ / ₁₆ " diameter	CP1180	1
H20	Detent ball ⁵ / ₁₆ " diameter	CP1191	1
H21	Spring	MT305	1
H22	Union sub assy.	MT4583	1
H23	Body	MT1310	1
H24	Selector valve	MT1626	1
H25	Operating lever	MT5007	1
H27	Washer	MT979	1
H28	Circlip	0250550	1
H29	Circlip	0330300	1
H30	Ball bearing	0513010	1
H31	Cover	MT1309	1
H32	Drive adaptor	MT5004	1
H33 □	Bolt	0010420	6
H34 □	Clutch end cover	MT1113	1
H35 □	Pin	MT1155	3
H36 □	Ferrule	MT1156	6
H37 □	Spring	MT1157	3
H38 □	Clutch plate	MT116	5
H39 □	Clutch end plate	MT117	1
H40 □	Tab washer	MT351	3
H41 □	Clutch plate	MT731/S	6
H42 *#	'O' ring	001123	2
H43 *	Piston ring	0071722	2
H44	Piston	MT1347	1
H46 *#	'O' ring	002874	1
H47	Clutch body	MT5003	1
H48	Plug	MT1549	1
H49 #	Joint (gasket)	MT5011	1
H50 #	Joint (gasket)	MT5012	1
H51	End cap	MT1625	1
H52	Cap screw (transit only)	0081312L	1
H53	Transit bung	MT1620	1

- * Part of PTO piston ring kit MT0442
□ Part of PTO clutch pack MT0153
Part of PTO gasket kit MT0397