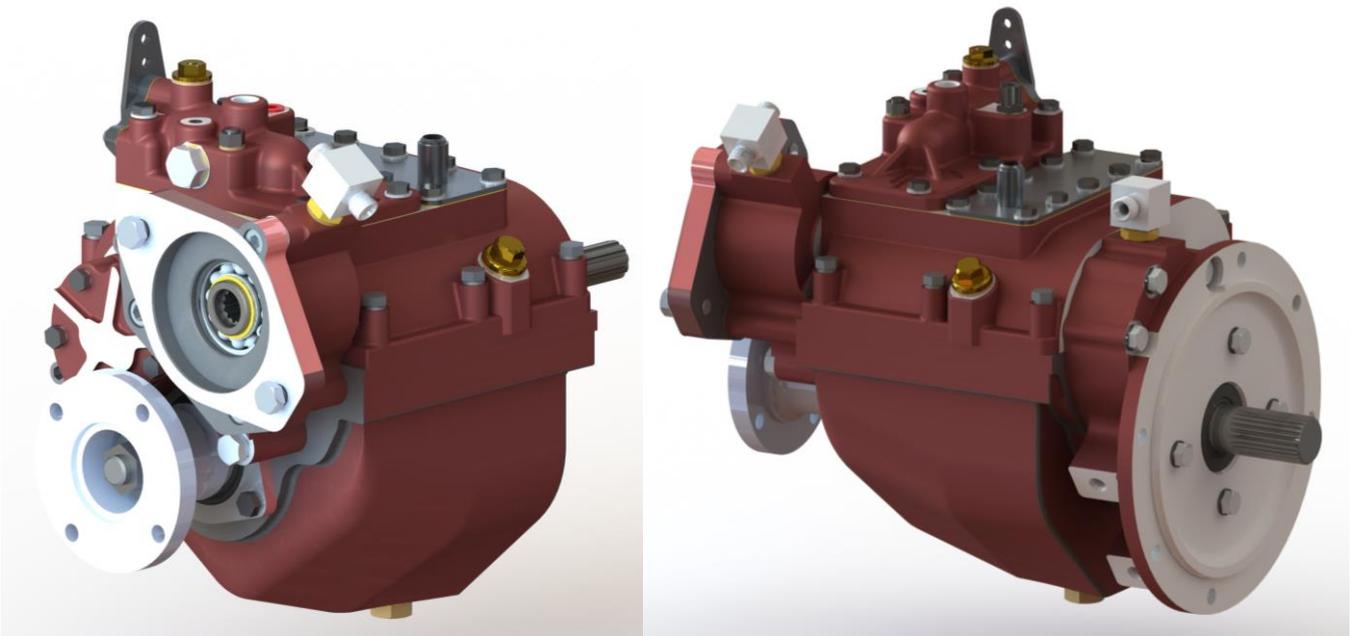




NEWAGE

**PRM 280D & 280DP
PRM 280C & 280CP
Workshop Manual**



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PRM280D - PRM280DP - PRM280C & PRM280CP Manual

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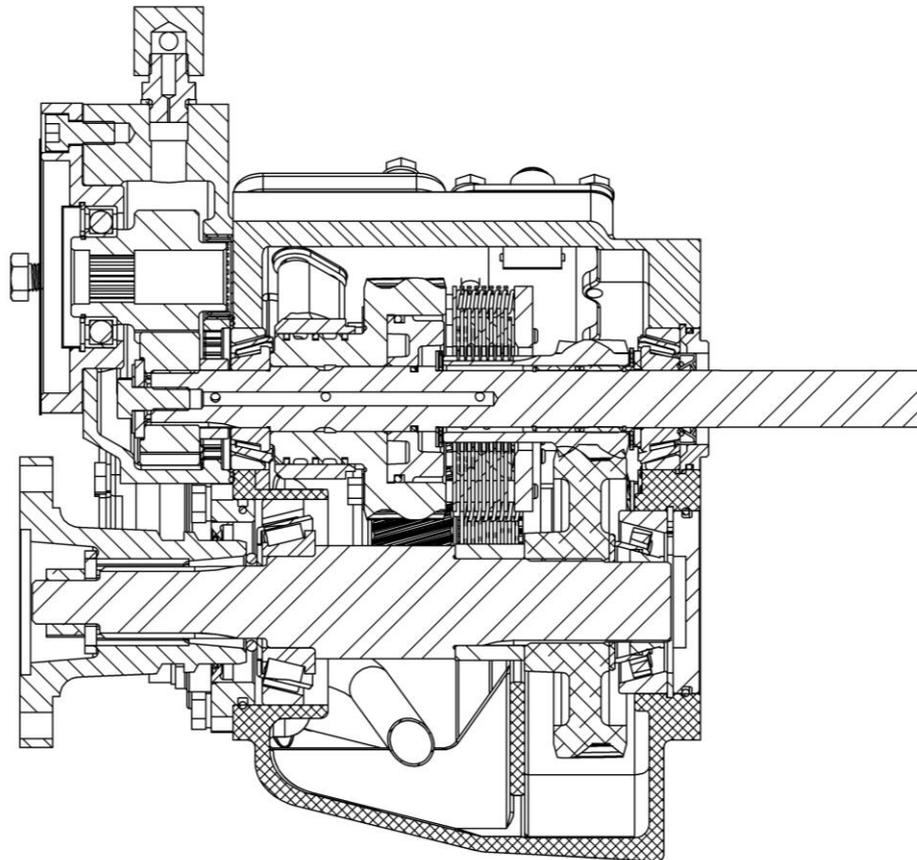


Fig.1 PRM280DP Sectional View

FOREWORD

Provided it is correctly installed, aligned and maintained, the PRM280D & PRM280DP 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 PRM Newage Limited 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 PRM Newage distributor/dealer or PRM Newage Limited 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:-

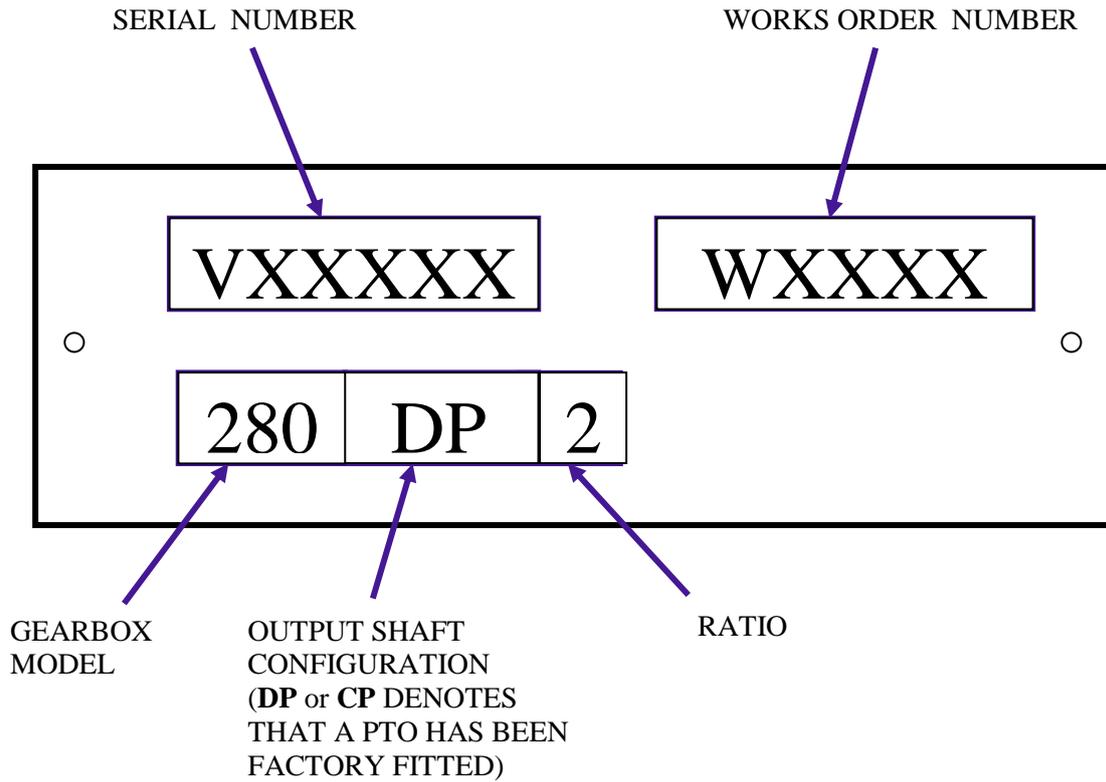
Flush clean.

1. Fill with oil to correct level.
2. Pressurise the case and check for oil leaks.
3. Check for noise levels.
4. Check for drag in neutral.
5. Check input spline dimensions.
6. 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 @ 2000rpm (lb/sq.in) in forward, neutral and reverse.

IMPORTANT NOTICE: ONLY REMOVE BREATHER, DIP STICK, OIL DRAIN PLUG OR OIL LEVEL PLUG ONCE THE GEARBOX IS AT AMBIENT TEMPERATURE. REMEMBER HOT OIL CAN CAUSE BURNS – WORK SAFELY.

IDENTIFICATION PLATE

Every PRM Gearbox is fitted with an identification plate on the top half of the gear case before it leaves the factory: an example of such a plate is shown below;



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

1. GENERAL DATA

1.1 Specifications

Gear ratios

1.96:1, 2.94:1

POWER RATING

| GEAR RATIOS | PLEASURE | | LIGHT COMMERCIAL | | HEAVY COMMERCIAL | |
|-------------|----------|------|------------------|------|------------------|------|
| | BHP | KW | BHP | KW | BHP | KW |
| 1.96:1 | 3.93 | 2.93 | 3.79 | 2.83 | 3.58 | 2.67 |
| 2.94:1 | 3.93 | 2.93 | 3.79 | 2.83 | 3.58 | 2.67 |

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 4000 rev/min continuous
4500 rev/min intermittent

SERVICE CLASSIFICATION DEFINITIONS

Pleasure: limited to planning 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: planning 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.

PRM Newage 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 dry weight:

| | |
|---------------|---|
| 280D & 280C | 48kg (106 lb) (excluding drive coupling, adaptor flange and oil cooler) |
| 280DP & 280CP | 63kg (138 lb) (excluding drive coupling, adaptor flange and oil cooler) |

Oil capacity:

| | |
|---------------|---|
| 280D & 280C | 1.85 litres (3.05 pints) (plus the amount required to fill the cooling circuit) |
| 280DP & 280CP | 2.05 litres (3.60 pints) (plus the amount required to fill the cooling circuit) |

Operating pressure:

| | |
|---|---|
| Minimum:- 1800kPa (265 lbin ²) | Oil pressures should be measured at a gearbox temperature of 70°C |
| Maximum:- 2180kPa (320 lb/in ²) | and an input speed of approximately 1500rpm. |

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 PRM Newage Ltd.

Engine mounting adaptors:

Available in SAE 2,3,4 and5, Velvet Drive (Borg Warner) also available.

Input drive couplings:

Flexible drive couplings are available to suit flywheels of 7.5", 10" and 11.5" nominal diameter to SAE J620C, and to other dimensions.

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:

25.4mm diameter with SAE 10 spline.

Propeller thrust:

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

Output flange:

127mm (5 in.) diameter, with 4 holes 12mm (0.453 in.) diameter on 108mm (4.25 in.) pitch circle diameter, and female spigot, 63.5mm (2.50in) diameter.

Installation angle:

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

2. INTRODUCTION

PRM Newage Ltd. PRM280D, PRM280DP, PRM280C and PRM280CP 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 PRM280D, PRM280DP, PRM280C and PRM280CP 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 front 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 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.

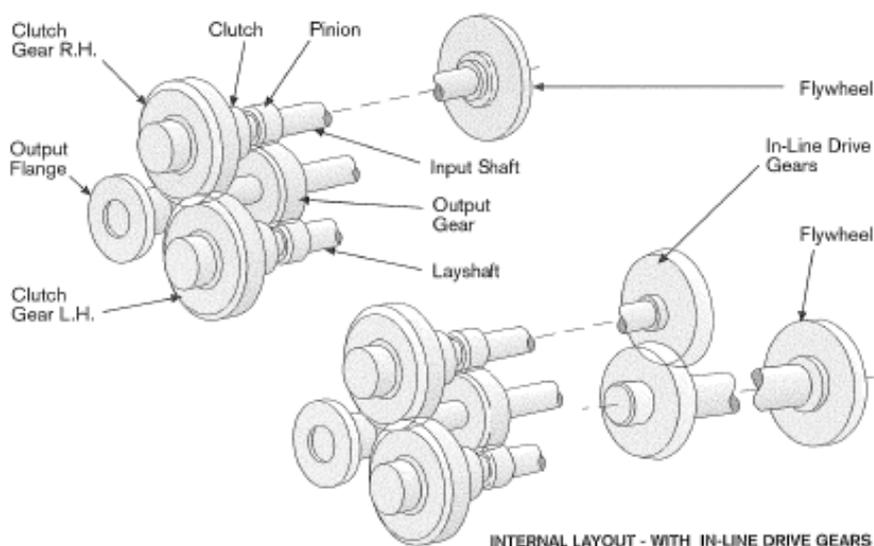


Fig 3. Internal layout, PRM280

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 (in-line)

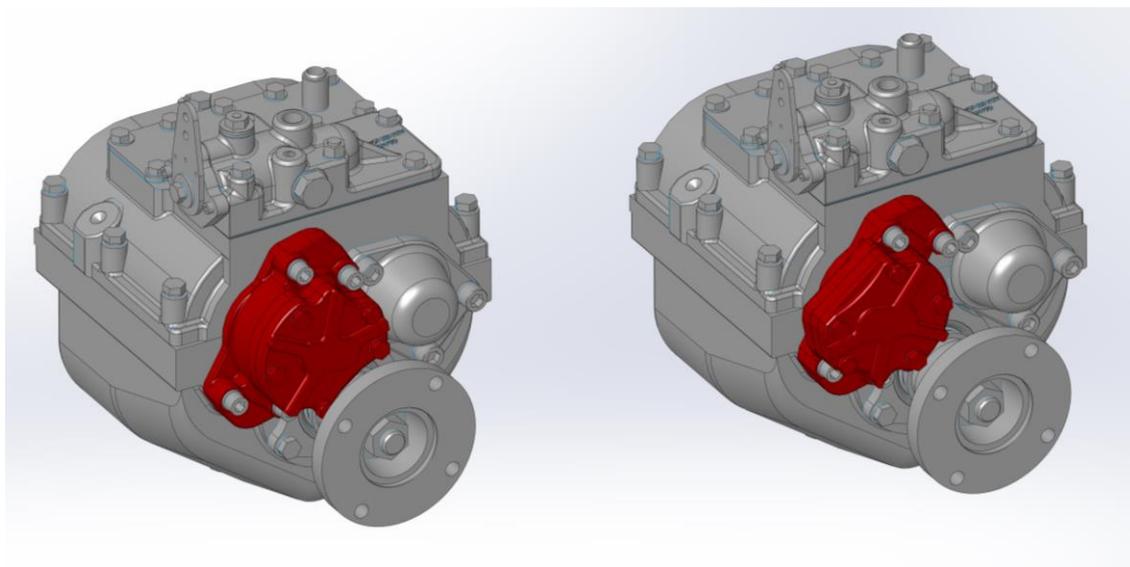
The in-line gearbox incorporates a matching pair of involute gears, so arranged that the input shaft of the main gearbox is stepped down to the same centre line as the output shaft. This brings the propeller shaft into line with the engine crankshaft.

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) the oil pump is fitted in its standard position. For clockwise engines the pump is turned through 180° (see Fig. 4)

Fig. 4



Pump Mounting Position Standard
Anti-Clockwise Engines **PRM280D & PRM280DP**
Pump Mounting Position
Clockwise Engines **PRM280C & PRM280CP**

Pump Mounting Position
Clockwise Engines **PRM280D & PRM280DP**
Pump Mounting Position Standard
Anti-Clockwise Engines **PRM280C & PRM280CP**

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 (As Standard)

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 available as an optional extra.

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. PRM Newage Ltd. strongly recommends the use of this device.

When fitted, 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.

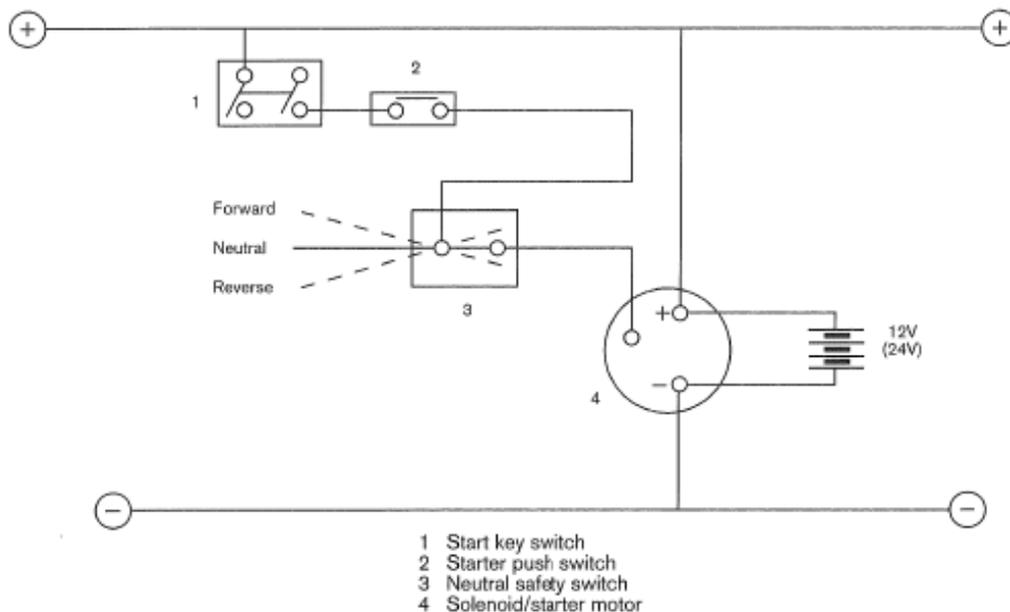


Fig 5 Wiring diagram, neutral safety start switch

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.

GEARBOX OUTPUT ROTATION

| ENGINE ROTATION ANTI-CLOCKWISE | | ENGINE ROTATION CLOCKWISE | |
|-----------------------------------|---|------------------------------|---|
| | PRM280D & PPM280DP | | PRM280D & PPM280DP |
| LEVER BACKWARD |  | LEVER BACKWARD |  |
| LEVER FORWARD |  | 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 and inline unit.

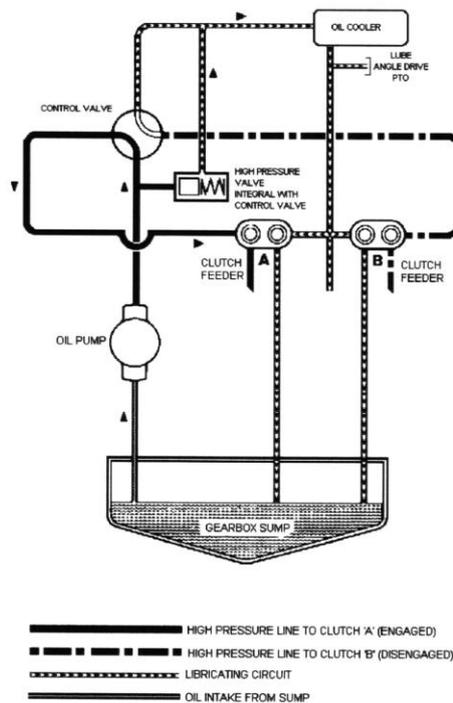


Fig.6 Hydraulic and lubricating oil circuits

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 dispatched 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 PRM260 & PRMDP. 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 PRM280D, PRM280DP, PRM280C and PRM280CP marine gearbox is supplied with a choice of adaptor plates to SAE2, SAE3, SAE4, SAE5 and Velvet Drive (Borg Warner) specifications 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 (gasoline) 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. PRM Newage 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 (0.001 in.) 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 (0.001 in.) 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.

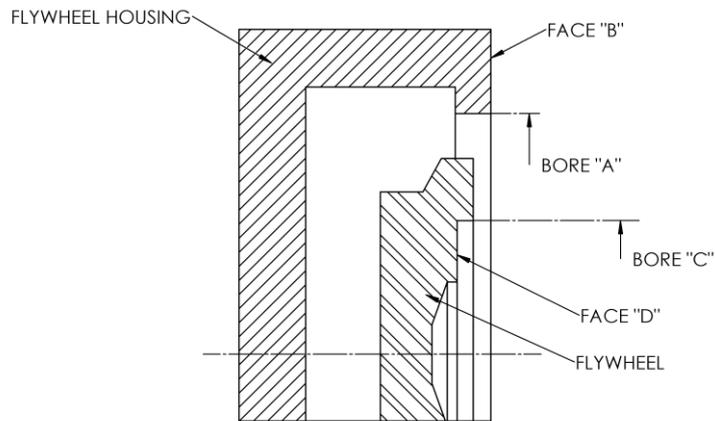


FIG. 7 CHECKING THE FLYWHEEL AND FLYWHEEL HOUSING

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 (you may need 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 32.

5.5 Oil Cooler

All Newage PRM280 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 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 page 16 fig. 8/9 for correct circuit. After a gearbox failure it is extremely important to flush 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.

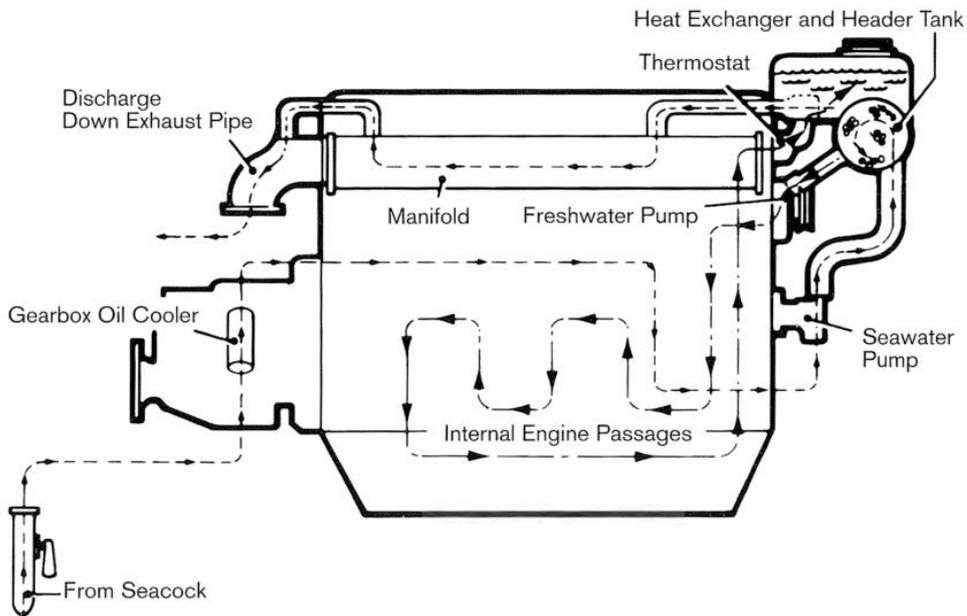


Fig.8 Engine and gearbox cooling circuit



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 above.



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.

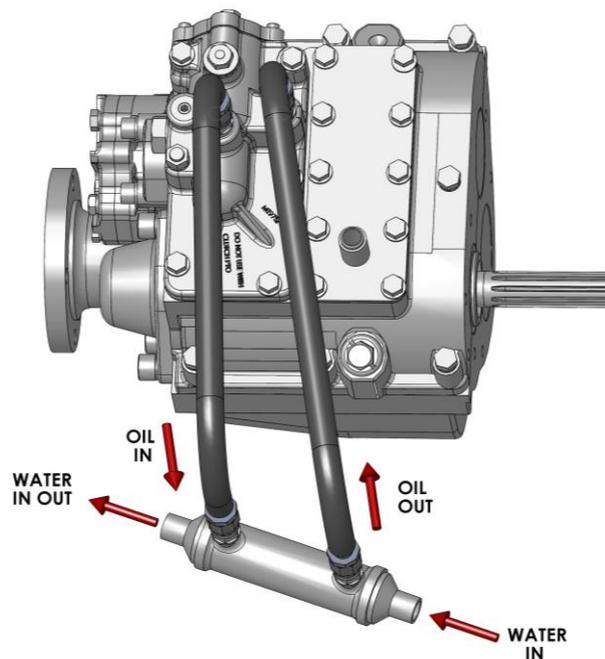


Fig. 9 Oil Cooler Connections

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 PRM280D & PRM280DP, 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 PRM Newage 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.

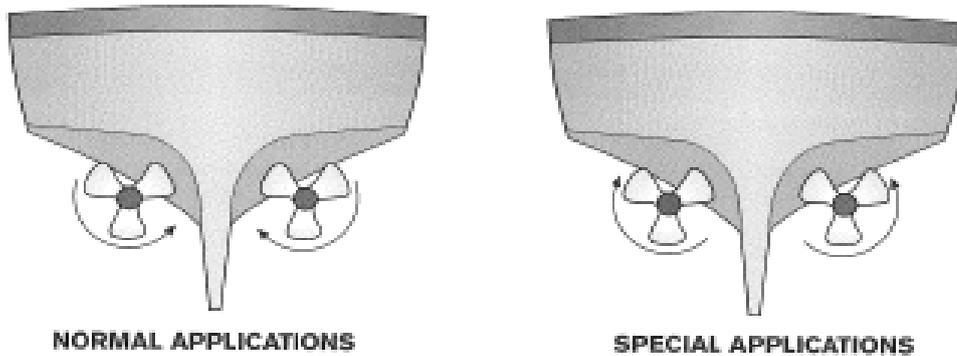
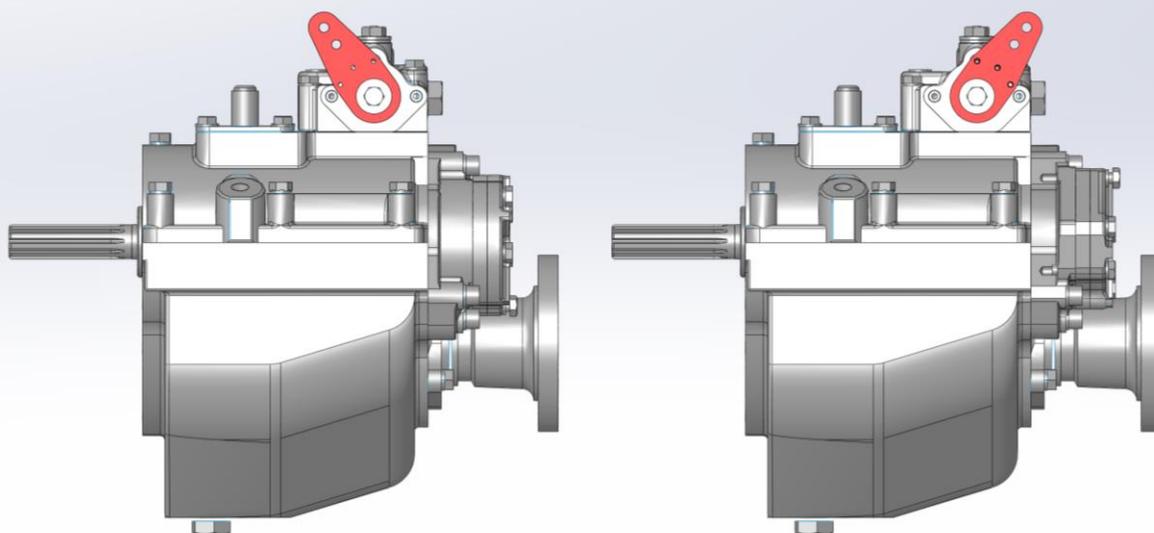


Fig.10 Propeller rotation twin installations

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. 11 Operating Lever Position, Twin Installations

5.9 Remote control operating systems

The PRM280 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 14). Note: screw dipstick fully down when checking oil level.

Ensure the gearbox is in neutral, (it is recommended that the optional neutral safety switch be wired into the starter circuit to avoid uncontrolled boat movement on start up). 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 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 PRM280 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. PRM Newage 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 PRM280D, PRM280DP, PRM280C and PRM280CP 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 PRM280D, PRM280DP, PRM280C and PRM280CP 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 PRM280D, PRM280DP, PRM280C and PRM280CP 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 (A7) and the top cover (A6) (located alongside the valve block).
2. Select the shaft which provides the appropriate propeller rotation (see note below) and rotate until a dimple on the outer edge of the clutch end cover (D27) is uppermost.
3. Take one of the top cover screws (A7) and screw it into the threaded hole in the clutch end cover directly below the dimple (thereby clamping the clutch and providing drive).



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 32. Check that the dipstick does not foul the head of the clamping screw: if it does, remove the dipstick and plug the hole with a clean cloth.

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 1/3 full throttle

NOTE: Assuming a LH anti-clockwise rotating engine, as seen looking forward from the propeller to the gearbox, the appropriate shaft to lock up is as follows:

For left-hand propeller rotation, the left-hand shaft or for right-hand propeller rotation, the right-hand shaft.



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.

7. ROUTINE MAINTENANCE

7.1 Initial maintenance (after 25 hours running)

Drain all oil from the gearbox, the drain plug is located at the front of the casing in the centre of the transmission. This requires a 1" NF spanner to remove, refit drain plug and washer and refill with one of the recommended lubricants (see 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 check

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 32).

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 CHART

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.

To avoid prejudicing warranty rights, no repair or other work should be done on the gearbox during the warranty period without first contacting PRM Newage Ltd. or an authorised distributor or dealer for advice.

| 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 or with pump repair kit. 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 or with pump repair kit. 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. |

Chart continues overleaf

| 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 gearbox 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 Clutches 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 off and disconnect the operating cable from the GEARBOX.



CAUTION: The above operations should be carried out by suitably qualified persons 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 33.

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 32 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 10.8.

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 valves 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 (B6/7) 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.

10.3 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 disconnect the wiring from the neutral safety switch, if fitted.
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/ WARNING: 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.

10.4 Removing the input shaft and layshaft assemblies

1. Remove the gearbox from the boat as described in section 10.3.
2. Undo the 4 bolts (B6) 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. Remove the 3 bolts (A11) and Spring Washers (A12) securing the shaft end cover (A10) and remove. (Note: keep the shims (D31) and 'O' ring (A20) with the cover).
4. Remove the 5 bolts (C18/20/26) and 1 nut (C23) retaining the valve block and remove it.
5. Remove the 7 bolts and washers (A3/A4) securing the gearcase top half (A1) and lift clear.
6. Lift the input shaft assembly and oil seal housing (D1) from the gearcase.
7. Lift the layshaft assembly and
8. front end cover (E1) from the gearcase.

10.5 Servicing input shaft and layshaft assembly components

See pages 40/42 for assembly drawing.

10.5.1 Input shaft oil seal

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

Fit a new seal (D30) in the housing (DI) and refit the housing.

10.5.2 Drive end bearing

To renew a damaged or worn bearing:-

1. Support the relevant shaft in a vice and remove the oil seal housing (DI) (this applies only to the input shaft).
2. Using a pulley extractor with its jaws located behind the pinion, withdraw the clutch pinion (D/E7), thrust washer (D/E5), thrust bearing (D/E4) and end bearing (D/E2). Check that needle bearings (D/E8) are in good condition.
3. Refit the clutch pinion to the shaft.
4. Replace the thrust washer and thrust bearing, inspecting for wear and replacing where necessary.
5. Locate the new bearing (D/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 pinion endfloat of between 0.13 - 0.45mm will be present.

6. Reposition the oil seal housing (DI) on the shaft (input shaft only).

NOTE: if new bearings are fitted, they must be re-shimmed as described in section 10.8.

10.5.3. 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 bearings (D/E2) as previously described. (Section 10.5.2)
2. Unlock and remove the 6 clutch securing bolts (D/E21) taking care not to lose any locating ferrules (D/E22).
3. Withdraw the complete clutch from the shaft, noting the position of the pull-off springs (D29).
4. Stand the shaft upright and locate the retaining pins (D28) in the clutch gear (D/E32).
5. Fit the clutch end plate (D/E24) over the pins and then, starting with one of the driver clutch plates (D/E25), build up the replacement clutch on to the end plate (D/E24).
6. Position the ferrules (D/E22) in the spaces between the driven clutch plates and fit the pull-off springs over the pins.
7. Replace the end cover (D/E27) locating the pins (D/E28) into the blind holes.
8. Refit the securing bolts (D/E21) and locating strips by (D/E23) by feeding them through the Gear (D/E32) on the clutch shaft. **Finger tighten these bolts only, at this stage.**
9. Turn the shaft upside down and ensuring that the pull-off springs are correctly located tighten the bolts to 12.2 Nm and close the lock strips over the bolt head.
10. Replace the drive pinion, (D/E7) turning slightly to insert the driver clutch plates until it touches the bottom.
11. Replace the thrust bearing and washer (DIE 11/12) circlip (D/E6) and taper bearing (D/E2).

10.5.4 Clutch gear

To fit a new clutch gear (D/E32) first remove the clutch pack as previously described in section 10.5.3, and proceed as follows:

1. Position the shaft assembly so that the front face of the clutch gear is supported face downwards on a plate, and press the shaft out through a suitable hole in the plate.
2. The clutch gear, piston (D/E23), feeder (D/E16) and rear end bearing (D/E20) will now be free for inspection and replacement if necessary.

To reassemble:

3. Fit new 'O' rings (D/E13, D/E14) and insert the piston (D/E15) into the clutch gear (D/E32).
4. Fit new piston rings (DIE17) to the feeder (for piston rings and feeder removal refer to section 10.5.7). Refit the clutch gear to the feeder, and press the assembly on to the shaft.
5. Place the rear end bearing (D/E20) on to the shaft and gently drive it into position.
6. Replace the clutch as described in 10.5.3.

NOTE: It is advisable to renew both clutch gears together since damage to one will often result in damage to its mating gear. It is also strongly recommended that the piston seals and tab washers are also replaced.

10.5.5 Drive pinion

As with the clutch gears it is advisable to renew both drive pinions at the same time. To ensure that the drive pinion of the correct ratio is used, please refer to the parts list at the back of this manual. If a different ratio from that originally supplied is required, the output gear will also need to be changed.

To replace the drive pinion, follow the procedure set out in section 10.5.2.

10.5.6 Non drive end bearing

Withdraw sufficient clutch securing bolts to permit light bearing pullers to be located behind the feeder, and pull off the bearing. Before refitting, examine the bearing carefully and replace it if it shows any sign of damage.

10.5.7 Piston rings and feeder

If they are damaged or excessively worn, the piston rings and feeder will need replacing. The procedure is as follows:-

1. Remove the non drive end bearing as described and remove the feeder and spacer.
2. Use a piston ring extractor or a piece of thin steel to remove the rings from the clutch gear.
3. Raise one end of the top ring out of the groove and insert the steel strip between the ring and the clutch gear. Rotate the strip around the clutch gear, applying slight forward pressure to the raised portion of the ring until it rests on the land above the groove. The ring can then be eased off the gear. Repeat for the second ring.
4. Clean off any grease or rust inhibitor from the new rings.
5. 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.
6. Compress each ring in turn and carefully fit the new feeders and spacers.

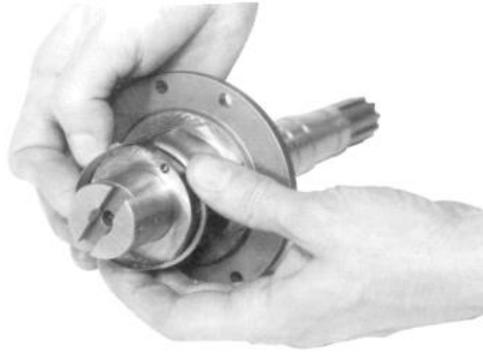


Fig.12 Fitting piston rings

10.6 Replacement of input shaft and layshaft assemblies

1. Position the input shaft assembly in the gearcase, ensuring that the seal housing (D1) is in its correct position.
2. Position the layshaft in the casing ensuring the end cover (E1) is correctly located.
3. Coat the mating surfaces of the two gearcase halves with a jointing compound and, to ensure that the feeder connectors are located correctly, pass some wire through the holes in the top half of the gearcase and the feeder connectors and fit the top half of the gearcase to the lower, checking that the two halves are square to each other. The connector 'O' rings (D/E19) should be examined for damage or wear and renewed if necessary.
4. Refit the 7 gearcase bolts (A3/19) and tighten them to the correct torque (see torque chart page 32)
5. Shim and refit the input shaft end cover (A10), replacing the 'O' ring if damaged.
6. 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 provide the required direction of rotation. See section 3.4.
7. Refit the valve block, replacing the gasket (C17).

8. Taking care to ensure correct alignment (section 5.4), refit the adaptor to the gearbox, and the input coupling to the engine flywheel. Tighten the securing bolts to correct torque (see torque chart page 32)
9. Reconnect the oil cooler pipes and the control cable as described in sections 5.5 and 5.9.
10. Reconnect the gearbox output flange to the propeller shaft coupling and carefully realign as described in section 5.6.

NOTE: shimming procedures are described in section 10.8.

10.7 Servicing the output shaft assembly

To remove the output shaft assembly, first remove the gearbox from the boat (see section 10.3), then proceed as follows:-

1. Remove the input shaft and layshaft assemblies (see section 10.4)
2. Undo the nut (F18) and washer (F17), and remove the output coupling (F9).
3. Remove the output shaft front end cover (F 1).
4. Undo the three screws (A21), and remove the rear seal housing (F12) and the shims located between the seal housing and the bearing.
5. To remove the shaft from the gearbox, drive or press the shaft on the front end, allowing the rear bearing (F10) and shaft (F8) to be removed from the rear end of the gearbox, leaving the front bearing inner race, output gear and spacers behind.

10.7.1 Front bearing and output gear

1. Once the output shaft has been taken out of the gearbox, the output gear (F6) can be lifted from the gear case.
2. Remove the circlip (F3) from the bearing bore; this allows the bearing outer race (F4) to be removed from its bore by means of a press or a hardwood drift and hammer.
3. Check the bearing and output gear for any defect or damage and replace them if necessary.

10.7.2 Rear bearing and oil seal

1. If the oil seal (F13) is damaged, press it out from its housing (F12) and renew.
2. If the rear bearing (F10) is damaged, remove it from the shaft by means of a soft hammer or hand press.

IMPORTANT NOTE: all 'O' rings, oil seals and circlips should be renewed whenever the output shaft is stripped.

10.7.3 Re-assembling the output shaft assembly

1. Press the outer race of the new bearing into the gearcase until it just clears the circlip groove in the bore.
2. Fit the circlip (F3) into the groove in the bore of the gearcase.
3. Press the rear bearing inner race (F 10) onto the shaft until it seats on the shoulder provided on the output shaft.
4. Assemble the shaft from the rear. Feed the spacer (F7), drive gear (F6), spacer (F5) and front bearing inner race (F4) onto the shaft. Press the shaft home until the inner race is fully loaded onto the shaft and outer race is seated up to the circlip in the bore.
5. Locate the rear bearing outer race in the rear bore and press it home.
6. Re-calculate and fit the number of shims required (see section 10.8), fit a new 'O' ring (F11) to the oil seal housing (F12) and secure the housing to the gearcase.
7. Fit the 'O' ring (F2) to the end cover (F1) and refit the cover in the front bore.
8. Refit the 'O' ring (F16), output coupling (F9), washer (F17), and nut (F18). Tighten the nut to 285Nm (210 lbf.ft).

10.8 Shimming procedures 10.8.1 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 gear case and the top of the bearing cup as shown in Fig. 13.
2. Measure the depth of the recess in the output shaft end cover as in Fig. 14 , 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. 15) 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.

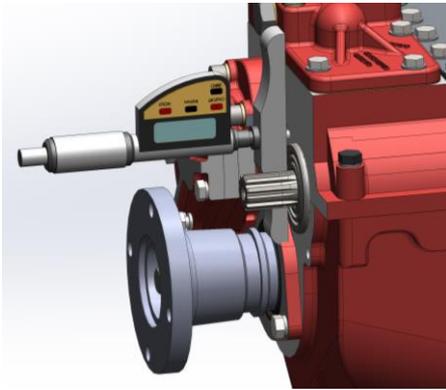


Fig. 13

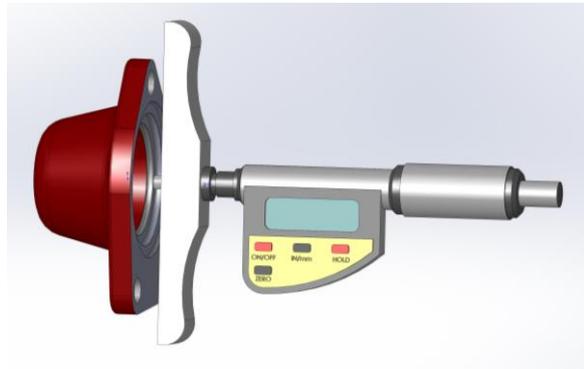


Fig. 14

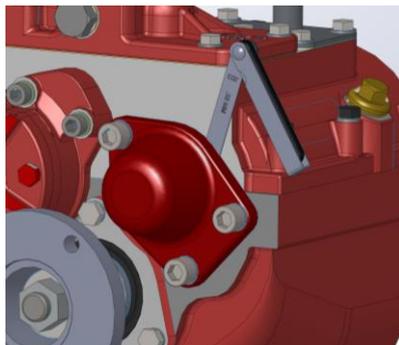


Fig. 15

10.8.2 Output shaft

1. With the output shaft fitted in the gearcase and the bearing driven into position, press the bearing outer cone firmly into place and measure from the gearcase to the top of the bearing outer.
2. Measure the height of the spigot on the seal housing from the face which is fitted to the gearcase.
3. Make up the difference between the two dimensions with shims.

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 (0.001 in).

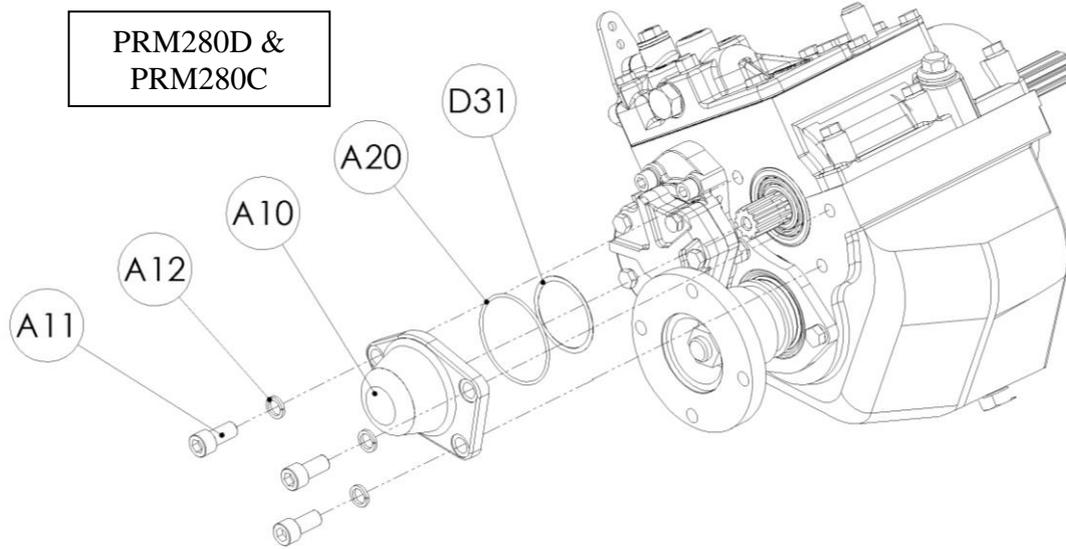
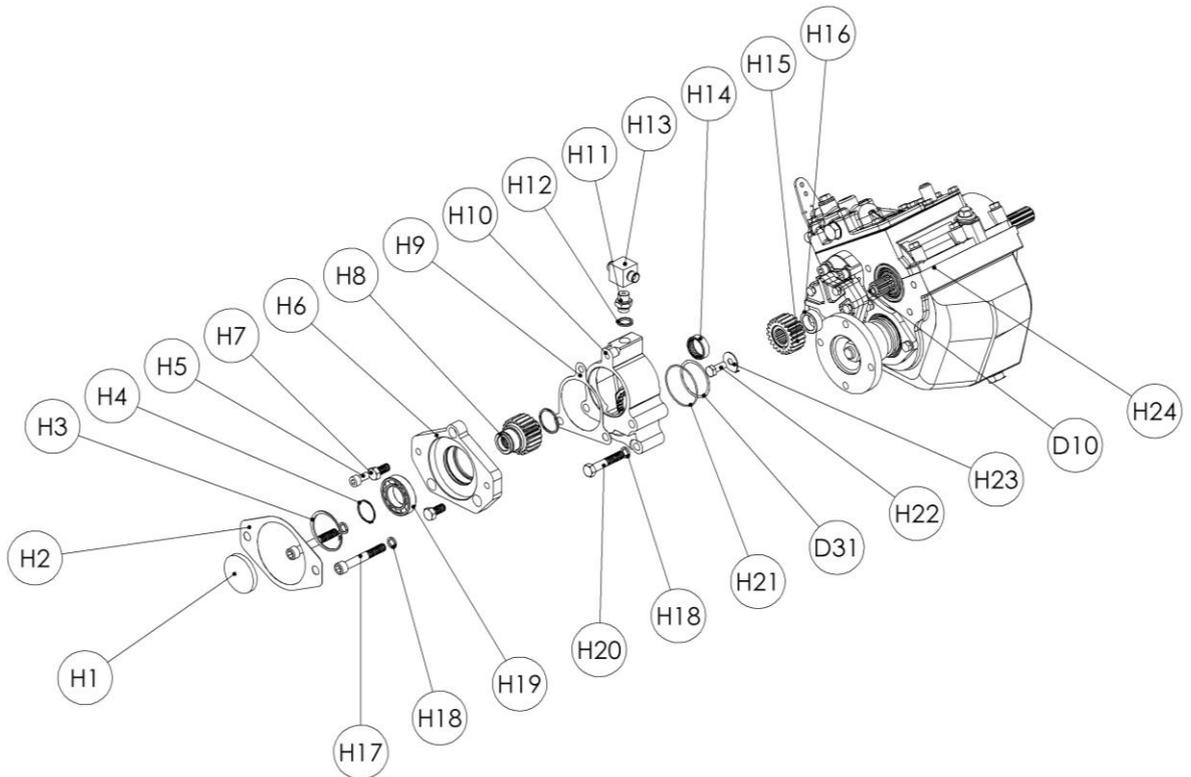


Fig.16

Fig.17a
PRM280DP &
PRM280CP
(MT0579)



PRM280DP
(MT0579-SAL1)

PRM280DP-SAL1

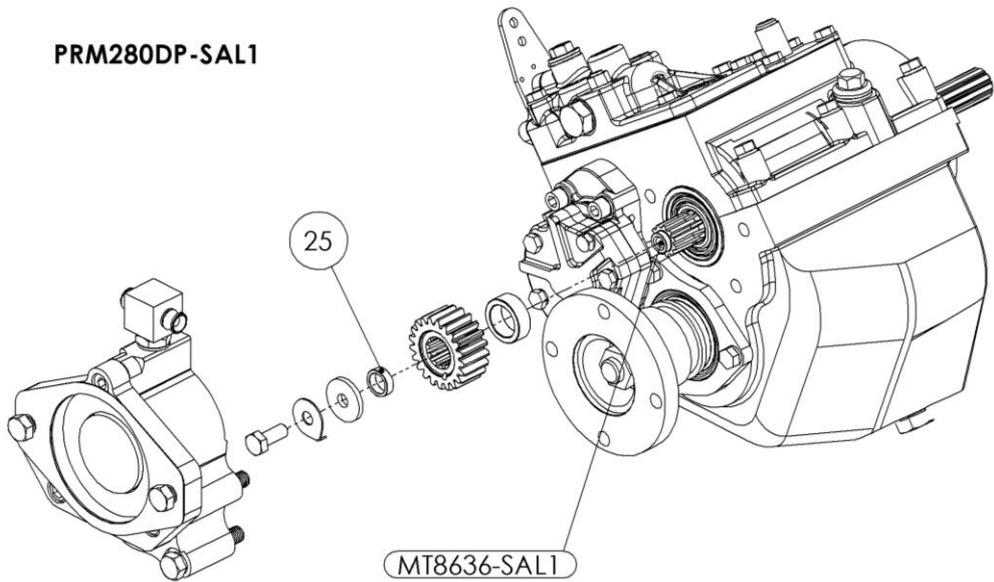


Fig.17b

PRM280DP
(MT0579-SAL2)

PRM280DP-SAL2

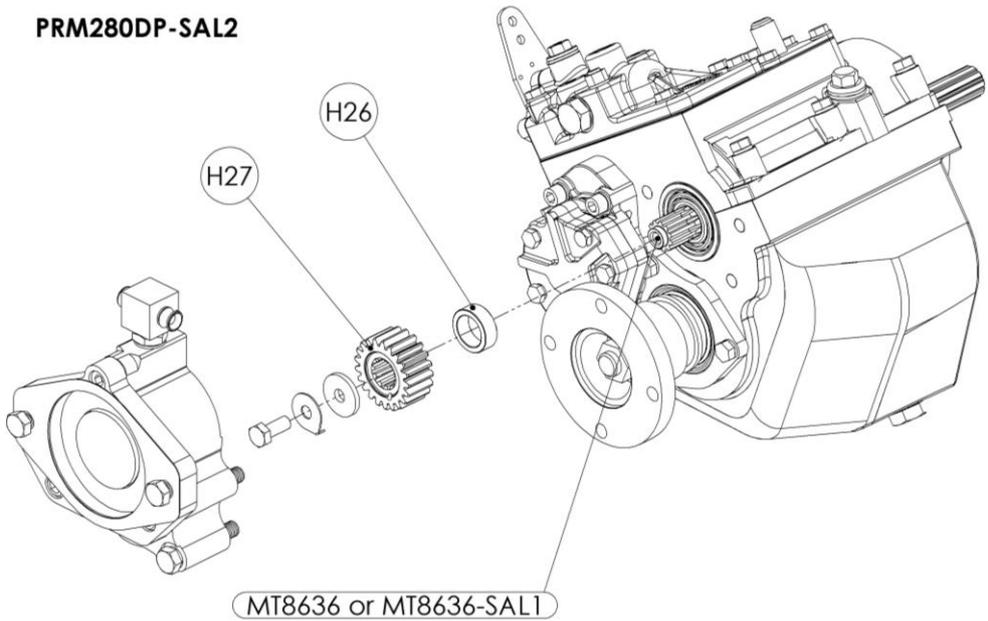


Fig.17c

11.1 FITMENT OF P.T.O. TO AN EXISTING PRM280D GEARBOX

- 1 Remove the Bolts (A11) Washers (A12) and Cover (A10) from rear of gearbox taking care not to lose the shims (D31). Discard the "O" ring (A20). Replace the shims against the Bearing outer race (use grease if required)
- 2 Fit the Spacer (H16) and Drive Gear (H15) to the Input shaft (D10)
- 3 Secure Spacer and Gear using Washer (H24), Tab washer (H23) and Bolt (H22). Tighten to 48Nm (35.5 lbf.ft) and bend up the locking tab to secure.
- 4 Pass the P.T.O. unit over the gear (H15) and push against the face of the gearbox, ensuring that the "O" ring (H21) and Shims (D31) are not dislodged or trapped.
- 5 Locate and tighten bolts (H20 and H17) with spring washers (H18) to a torque of 98Nm (72.5 lbf.ft)
- 6 Connect Oil pipe assembly between the Tee Piece (H13) and the Valve Block.
- 7 Fit Hydraulic Pump to the P.T.O. unit.



CAUTION: The P.T.O. shaft rotates in the opposite direction to the Gearbox Input Shaft.

11.2 TO REPAIR AN EXISTING P.T.O.

- 8 Removal of the unit is a reversal of that described above (13.1)
- 9 The Output Gear (H8) and Bearing (H19) can be removed without removing the P.T.O. unit from the gearbox.
- 10 To do this first remove the bolts (H17 and H5) together with Washers (H18) and remove the Adaptor Flange (H6) together with the Output Gear and Bearing.
- 11 To remove the Gear (H8) first remove the circlip (H4) and drift out from the Bearing (H19) ensuring you do not cause any damage.
- 12 To remove the Bearing (H8) from the Adaptor Flange (H6) remove the Circlip (H3) and drift out the Bearing ensuring you do not cause any damage.
- 13 If the Needle Bearing (H14) requires replacing, then the P.T.O. unit must be removed from the Gearbox.
- 14 Once the P.T.O. has been removed then the Needle Bearing can be drifted out.
- 15 The Drive gear (H15) can be removed from the Input Shaft (D10) however then Tab washer (H23) must be replaced upon reassembly.
- 16 Assembly is the reverse of all described above (13.2)

11.3 P.T.O. OIL COOLER CONNECTIONS

- 1 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:
- 2 remove "Redcap" plugs from the valve block.
- 3 connect the valve block outlet to oil cooler inlet.
- 4 connect the oil cooler outlet to the PTO inlet.
- 5 complete the circuit by connecting the PTO outlet to the valve block inlet.

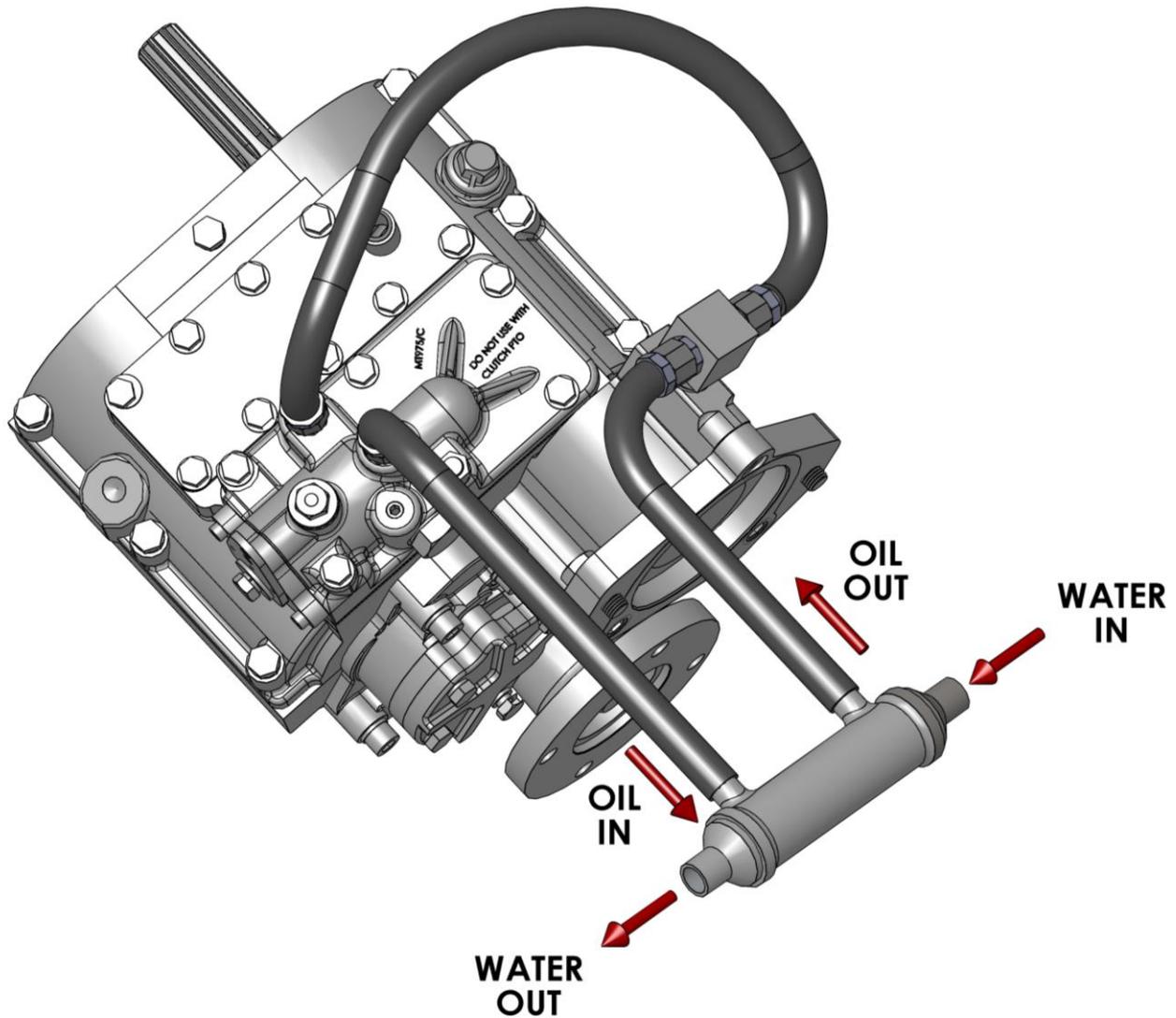


FIG. 18. OIL COOLER CONNECTIONS PRM280DP - POWER TAKE-OFF

12 TOOL KIT

| | |
|--------------------|--------------------|
| Dipstick | 18mm A/F |
| Drain plug | 1 in.A/F |
| Output flange nut | 1 1/8 in. A/F |
| Pump socket screws | 16 in. A/F Hex key |
| Spanners | 7/16 in. A/F |
| | 9/16 in. A/F |

12.1 Tightening torques. Note: These figures are for dry threads only.

| RECOMMENDED TIGHTENING TORQUES | | |
|------------------------------------|------|--------|
| | Nm | lbf.ft |
| Upper to lower gearcase bolts | 54.2 | 40.0 |
| Valve block to upper gearcase | 28.5 | 21.0 |
| Operating lever to selector valve | 27.9 | 20.6 |
| End cover to valve block (loctite) | 9,5 | 7.0 |
| Pump body to gearcase | 41.0 | 30.0 |
| Oil seal housing to gearcase | 54.0 | 40.0 |
| Pump cover to pump body | 28.0 | 21.0 |
| Coupling to output shaft | 285 | 210 |
| Top cover to upper gearcase | 28.0 | 21.0 |
| Adaptor plate to gearbox | 58.3 | 43.0 |

13 REPLACEMENT PARTS ORDERING

Orders and enquiries for replacement parts must be made through Newage distributor/dealer network

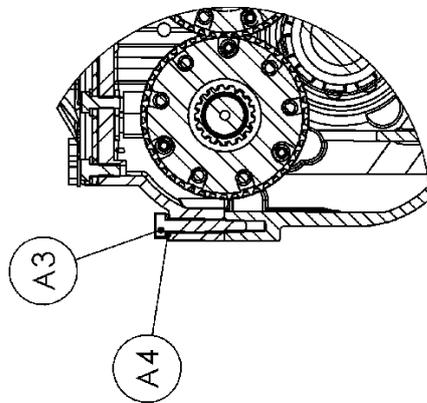
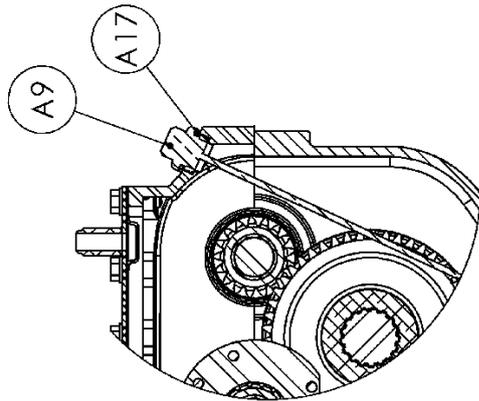
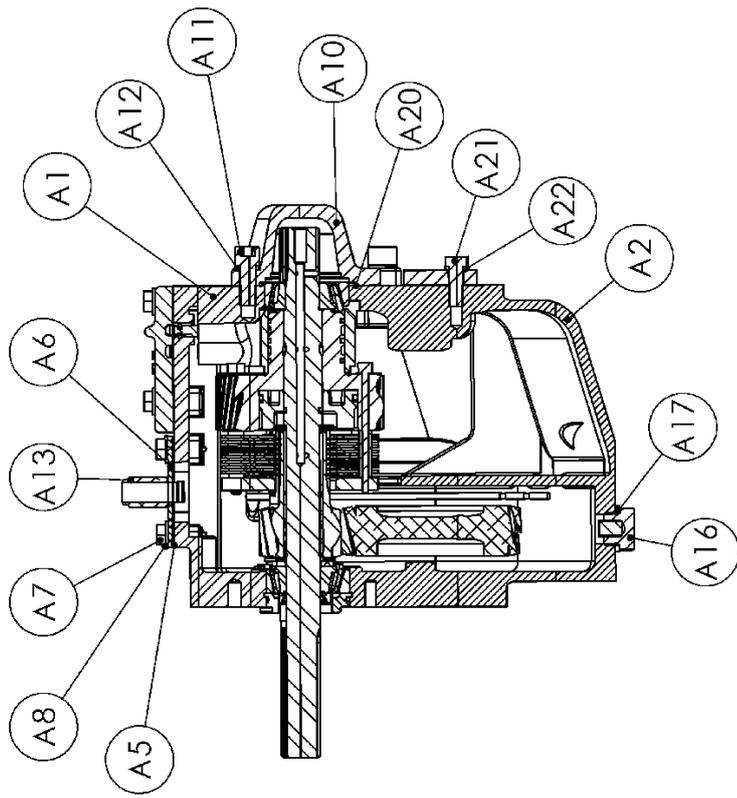
When ordering replacement parts the following should be quoted:

- Gearbox model and serial number
- Description(s) and part number(s) of the component(s) required
- Quantity required

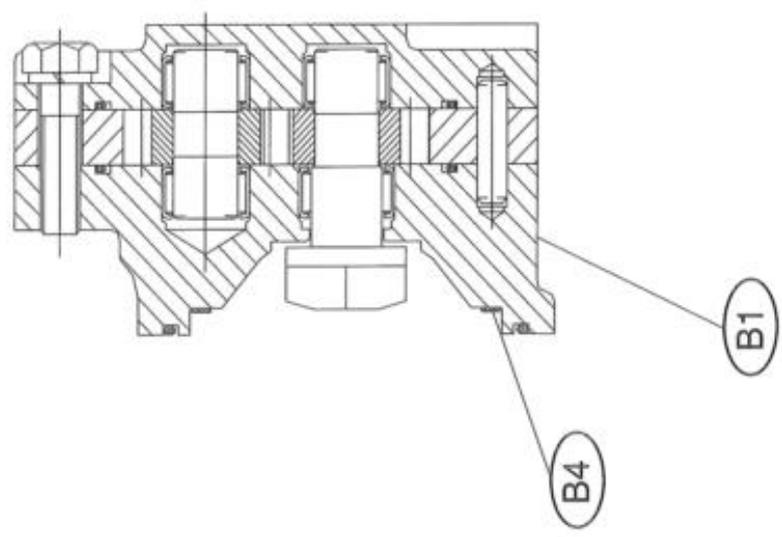
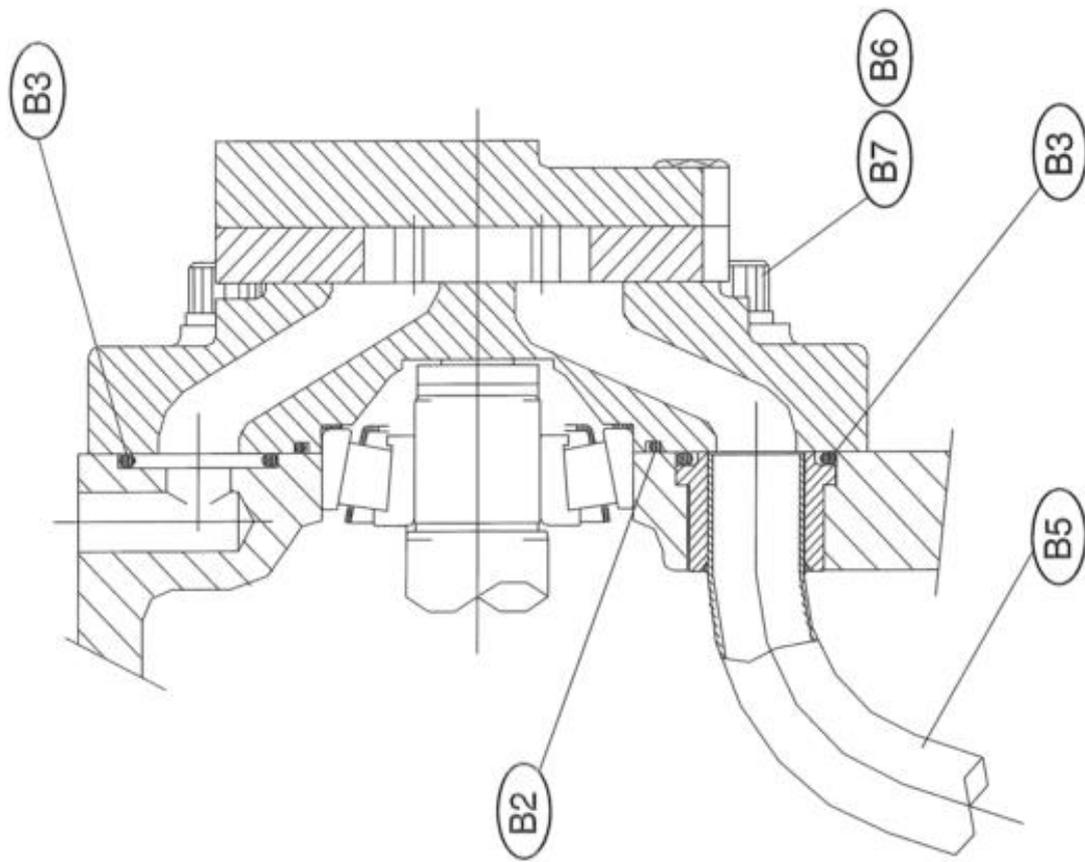
NOTE: Enquiries relating to a technical or service nature can be made direct to:

**PRM NEWAGE LIMITED
BARLOW ROAD
COVENTRY
CV2 2LD
ENGLAND
TEL: +44 (0)24 76617141 FAX: +44 (0)24 7661184**

PARTS LIST



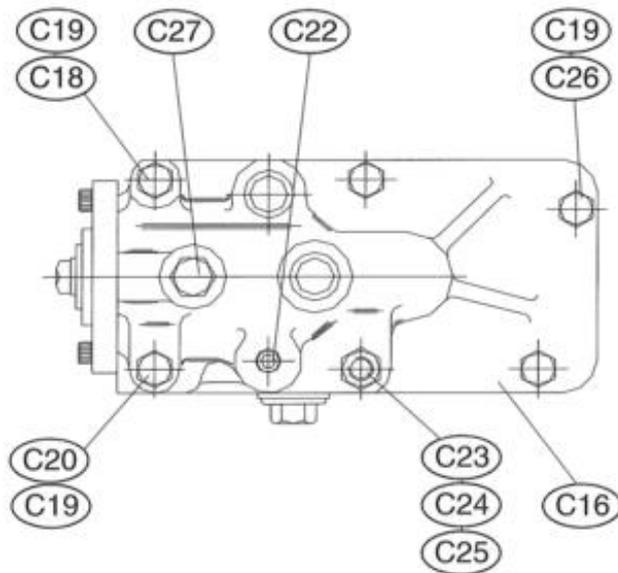
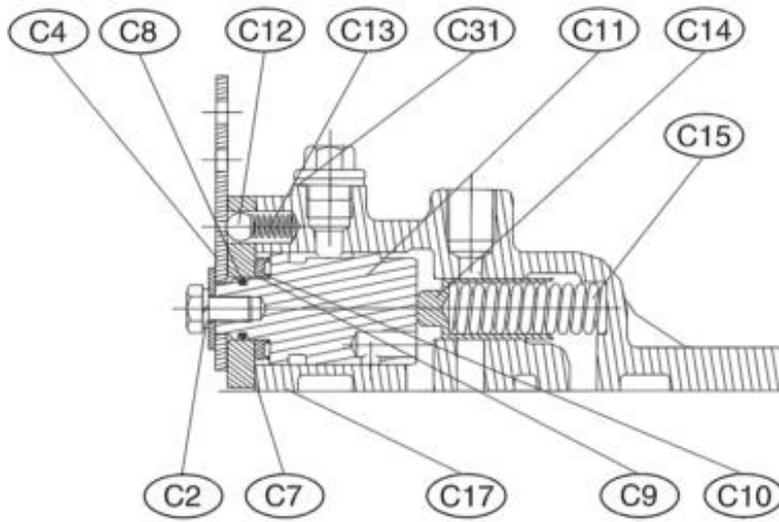
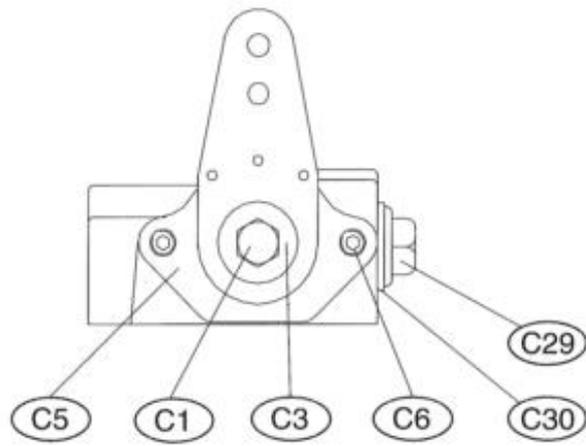
| SECTION A - GEARCASE ASSEMBLY (PRM280D SHOWN) | | | |
|--|--|-----------------|------------|
| ITEM NO. | DESCRIPTION | PART NO. | QTY |
| A | Case sub-assembly (A1 & A2) | MT0591 | 1 |
| A1 | Gearcase - top - Not supplied separately | MT8651 | 1 |
| A2 | Gearcase - bottom - Not supplied separately-PRM280D &DP | MT8652 | 1 |
| | Gearcase - bottom - Not supplied separately-PRM280C & CP | MT8689 | 1 |
| A3 | Bolt | UBF113 | 6 |
| A4 | Washer | W108 | 6 |
| A5 * | Gasket | MT343 | 1 |
| A6 | Top cover | MT1203 | 1 |
| A7 | Screw | USF32 | 10 |
| A8 | Washer | CP1223 | 10 |
| A9 | Dipstick | MT471 | 1 |
| A10 | End cover* (PRM280D & PRM280C) | MT8646 | 1 |
| A11 | Screw* (PRM280D & PRM280C) | 0081625 | 3 |
| A12 | Washer* (PRM280D & PRM280C) | 0191107 | 3 |
| A13 | Breather | CP1057 | 1 |
| A16 | Drain plug (magnetic) | CP1331 | 2 |
| A17 | Washer | 0201714 | 2 |
| A19 | Case half bolt (not illustrated) | UBF173 | 1 |
| A20 | 'O' ring* (end cover) (PRM280D & PRM280C) | 002873 | 1 |
| A21 | Bolt | USF53 | 3 |
| A22 | Washer | W108 | 3 |



| SECTION B - OIL PUMP ASSEMBLY | | | |
|--------------------------------------|--------------------|-----------------|------------|
| ITEM NO. | DESCRIPTION | PART NO. | QTY |
| B1 | Oil pump (Kit) | MT0296-KIT | 1 |
| B2 * | 'O' ring | 002873 | 1 |
| B3 * | 'O' ring | 001254 | 4 |
| B4 ** | Shims (0.002 inch) | MT1075/02 | A/R |
| B4 ** | Shims (0.010 inch) | MT1075/10 | A/R |
| B5 | Oil pipe | MT736 | 1 |
| B6 | Cap Head Bolt | 0111312 | 4 |
| B7 | Washer | CP1224 | 4 |

*Pad of gasket/seal kit MT0382

** Part of shim kit MT0067

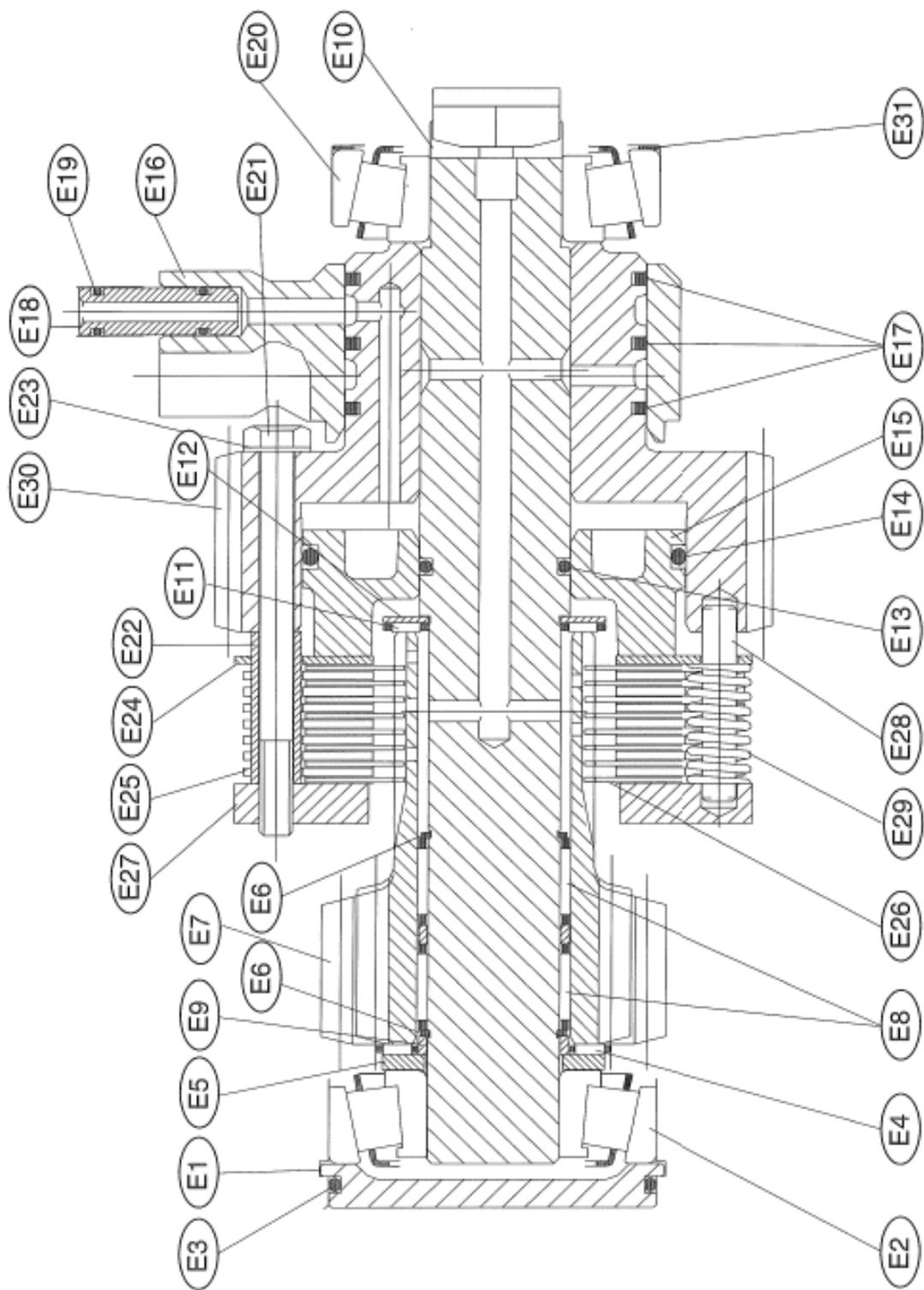


| SECTION C - VALVE BLOCK ASSEMBLY | | | |
|---|---------------------------------|-----------------|------------|
| ITEM NO. | DESCRIPTION | PART NO. | QTY |
| C | Valve block assembly | MT0354 | 1 |
| C1 | Screw | 0040806 | 1 |
| C2 | Spring washer | 0191105 | 1 |
| C3 | Washer | MT979 | 1 |
| C4 | Operating lever | MT977 | 1 |
| C5 | End cover | MT978 | 1 |
| C6 | Cap screw | 0081220 | 2 |
| C7 * | Gasket | MT1081 | 1 |
| C8 * | Nu-lip seal | MT8082 | 1 |
| CO | 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 1800 Kpa (260 psi) | MT4772 | 1 |
| C16 | Valve block | MT4780 | 1 |
| C17 * | Gasket | MT1073 | 1 |
| C18 | Bolt | UBF102 | 1 |
| C19 | Washer | CP1223 | 5 |
| C20 | Bolt | UBF122 | 1 |
| C21 | Redcap seal (transit only) | MT477 | 2 |
| C22 | Pressure plug | MT311 | 1 |
| C23 | Nut | UN505 | 1 |
| C24 | Washer | CP1224 | 1 |
| C25 | Stud | MT1079 | 1 |
| C26 | Screw | USF52 | 3 |
| C27 | Plug | CP1360 | 1 |
| C27 | or neutral safety switch | MT0214 | 1 |
| | Switch | CP1358 | 1 |
| | Ball | CP1077 | 1 |
| C28 | Bonded seal | 0201715 | 1 |
| C29 | Plug | 0150318 | 1 |
| C30 | Bonded seal | 0191718 | 1 |
| C31 | Bonded seal | 0201715 | 1 |

* Part of valve block gasket kit MT0392 or gasket/seal kit MT0382

| SECTION D - INPUT SHAFT ASSEMBLY | | | |
|----------------------------------|--|---------------|-----|
| ITEM NO. | DESCRIPTION | PART NO. | QTY |
| D1 | Oil seal housing PRM280D & PRM280DP ONLY | MT1615 | 1 |
| D2 | Taper roller bearing | 0540251 | 1 |
| D3 * | 'O' ring PRM280D & PRM280DP ONLY | 002433 | 1 |
| D4 | Thrust bearing | 0602801 | 1 |
| D5 | Thrust washer | 0592502 | 1 |
| D6 • | Spring ring | 0300250 | 2 |
| D7 | Pinion 1.96:1) includes 2 off D8 and D9 (27T) | MT1598S/A | 1 |
| D7 | Pinion 2.94:1) includes 2 off D8 and D9 (17T) | MT1599S/A | 1 |
| D8 | Needle roller bearing | 0562504 | 2 |
| D9 | Needle bearing spacer | MT1600 | 2 |
| D10 | Input shaft 280D & 280DP ONLY (includes D32) not available separately | MT8636S/A-KIT | 1 |
| | Input shaft 280C & 280CP ONLY (includes D32) not available separately | MT8689S/A-KIT | 1 |
| D11 | Thrust bearing | CP1388 | 1 |
| D12 | Thrust washer | 0592501 | 1 |
| D13 * | 'O' ring | 001123 | 1 |
| D14 * | 'O' ring | 002874 | 1 |
| D15 | Piston | MT1347 | 1 |
| D16 | Feeder | MT1601 | 1 |
| D17 ! | Piston ring | MT292 | 3 |
| D18 | Connector | MT1057 | 2 |
| D19 * | 'O' ring | 000372 | 4 |
| D20 | Bearing | 0540251 | 1 |
| D21 • | Bolt | 0010424 | 6 |
| D22 • | Ferrule | M1-730 | 6 |
| D23 • | Tab strip | MT351 | 3 |
| D24 • | End plate | MT117 | 1 |
| D25 • | Clutch plate driven | MT116 | 7 |
| D26 • | Clutch plate driver | MT731 /S | 8 |
| D27 • | Clutch end cover | MT1113 | 1 |
| D28 • | Pin | MT357-2 | 3 |
| D29 • | Spring | MT120 | 3 |
| D30 * | Input shaft oil seal | MT165 | 1 |
| D31 ** | Shim (0.002 inch) | MT1075/02 | A/R |
| D31 ** | Shim (0.010 inch) | MT1075/10 | A/R |
| D32 | Clutch gear (includes D10) not available separately | MT1591 | 1 |

- Part of clutch pack kit MT0079
- ! Part of piston ring kit MT0439
- * Part of gasket/seal kit MT0382
- ** Part of shim kit MT0067



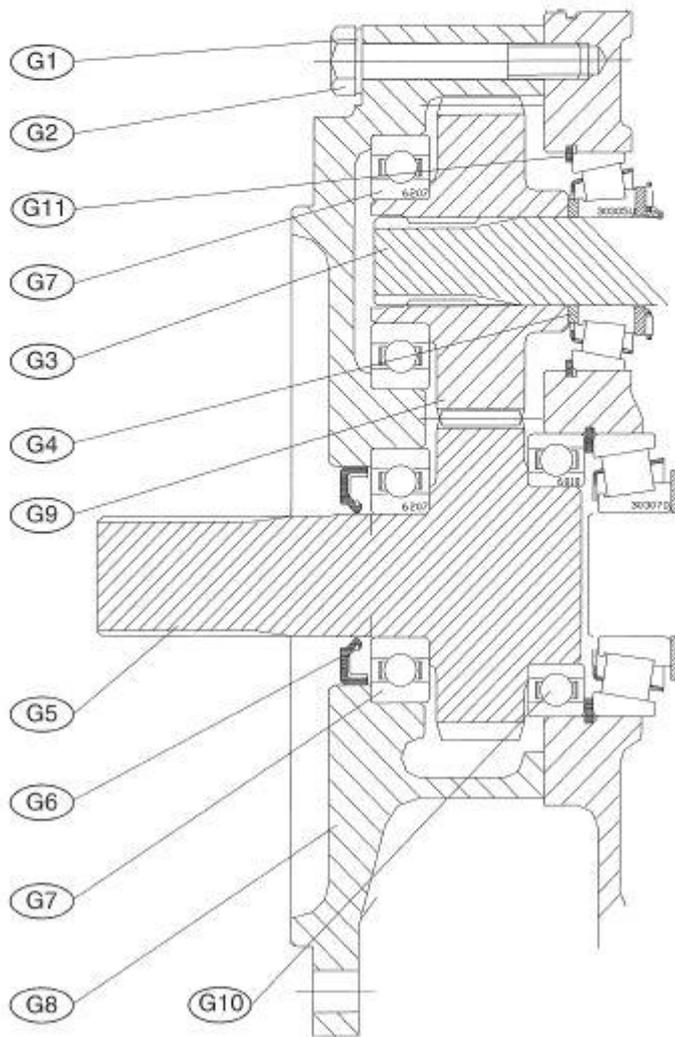
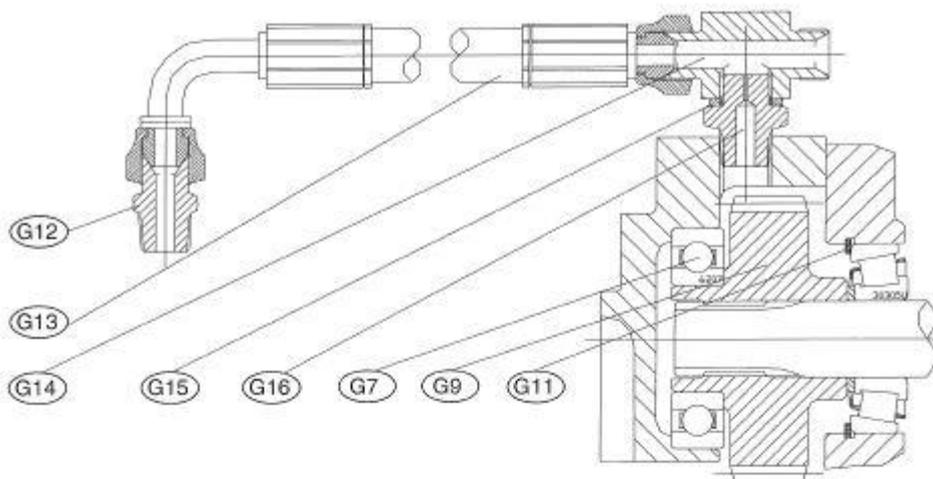
| SECTION E - LAYSHAFT ASSEMBLY | | | |
|--------------------------------------|---|-----------------|------------|
| ITEM NO. | DESCRIPTION | PART NO. | QTY |
| E1 | End cover | MT1614 | |
| E2 | Taper bearing | 0540251 | 1 |
| E3 * | 'O' ring | 002433 | 1 |
| E4 | Thrust bearing | 0602801 | 1 |
| E5 | Thrust washer | 0592502 | 1 |
| E6 • | Spring ring | 0300250 | 2 |
| E7 | Pinion 1.96:1) includes 2 off E8 and E9 (27T) | MT1598S/A | 1 |
| E7 | Pinion 2.94:1) includes 2 off E8 and E9 (17T) | MT1599S/A | 1 |
| E8 | Needle roller bearing | 0562504 | 2 |
| E9 | Needle bearing spacer | MT1600 | 2 |
| E10 | Layshaft (includes E30) not available separately | MT1597S/A | 1 |
| E11 | Thrust bearing | CP1388 | 1 |
| E1 2 | Thrust washer | 0592501 | 1 |
| E13 * | O' ring | 001123 | |
| E14 * | O' ring | 002874 | 1 |
| E15 | Piston | MT1347 | 1 |
| E16 | Feeder | MT1601 | 1 |
| E1 7 ! | Piston ring | MT292 | 3 |
| E18 | Connector | MT1057 | 2 |
| E19 * | 'O' ring | 000372 | 4 |
| E20 | Bearing | 0540251 | |
| E21 • | Bolt | 0010424 | 6 |
| E22 • | Ferrule | MT730 | 6 |
| E23 • | Tab strip | MT351 | 3 |
| E24 • | Clutch end plate | MT117 | 1 |
| E25 • | Clutch plate driven | MT116 | 7 |
| E26 • | Clutch plate driver | MT731/S | 8 |
| E27 • | Clutch end cover | MT1113 | 1 |
| E28 • | Pin | MT120 | 3 |
| E29 • | Spring | MT357-2 | 3 |
| E30 | Clutch gear (includes E10) not available separately | MT1593 | 1 |
| E31 ** | Shim (0.002 inch) | MT1075/02 | AR |
| E31 ** | Shim (0.010 inch) | MT1075/10 | AR |

- Part of clutch pack kit MT0079
- ! Part of piston ring kit MT0439
- * Part of gasket/seal kit MT0382
- ** Part of shim kit MT0067

| SECTION F - OUTPUT SHAFT ASSEMBLY | | | |
|--|-------------------------------|-----------------|------------|
| ITEM NO. | DESCRIPTION | PART NO. | QTY |
| F1 | End cover | MT996 | 1 |
| F2 * | 'O' Ring | 003124 | 1 |
| F3 | Circlip | 0250800 | 1 |
| F4 | Bearing | 0540352 | 1 |
| F5 | Spacer | MT995 | 1 |
| F6 | Output gear 1.96:1 (53 teeth) | MT1100 | 1 |
| F6 | Output gear 2.94:1 (50 teeth) | MT1098 | 1 |
| F7 | Spacer | MT1102 | 1 |
| F8 | Output shaft | MT1097 | 1 |
| F9 | Output coupling | MT753 | 1 |
| F10 | Bearing | 0540401 | 1 |
| F11 * | O' ring | 003504 | 1 |
| F12 | End cover | MT319 | 1 |
| F13 | Oil seal | MT349 | 1 |
| F14 ** | Shim (0.002inch) | MT1076/02 | AR |
| F14 ** | Shim (0.010 inch) | MT1076/10 | AR |
| F15 | Spacer | MT1082 | 1 |
| F16 * | O' ring | 001506 | 1 |
| F17 | Washer | 0191820 | 1 |
| F18 | Nut | 0061210 | 1 |

* Part of gasket/seal kit MT0382

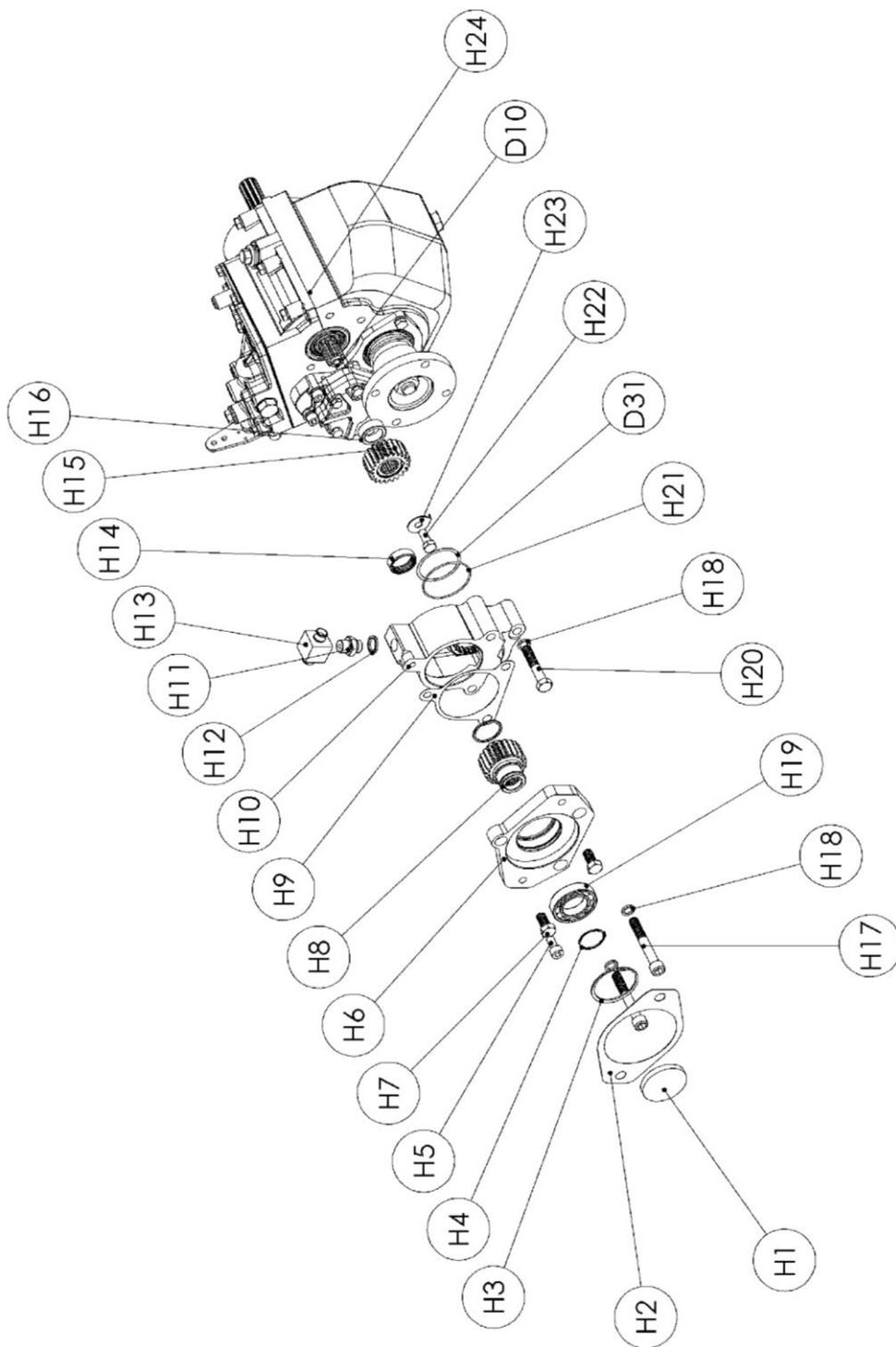
** Part of shim kit MT0067



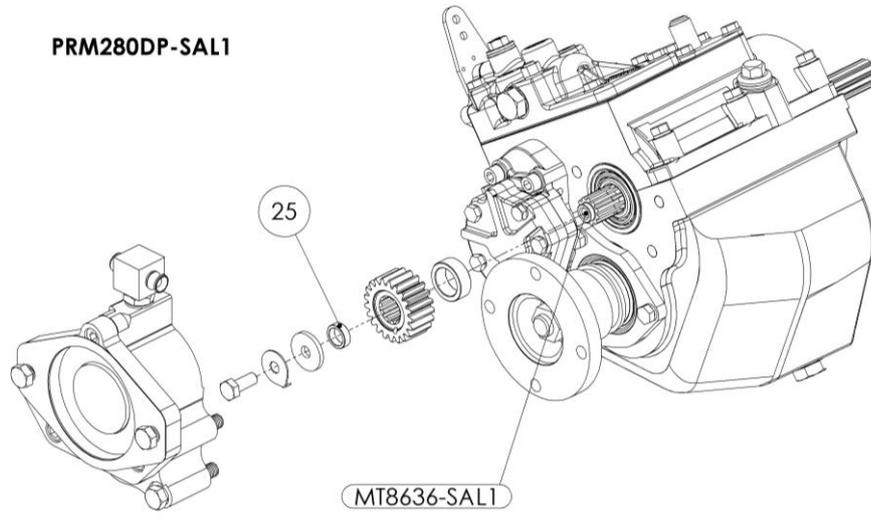
| SECTION G – IN-LINE UNIT (PRM280C & PRM280CP) | | | |
|--|--------------------|-----------------|------------|
| ITEM NO. | DESCRIPTION | PART NO. | QTY |
| G1 | Bonded Seal | 0201706 | 7 |
| G2 | Bolt M10 x 65 | 0041016 | 3 |
| G2 | Bolt M10 x 75 | 0041018 | 4 |
| G3 | Input Shaft | MT1634 | 1 |
| G4 | Spacer | MT1636 | 1 |
| G5 | Input Gear | MT1430 | 1 |
| G6* | Oil Seal | 0400351 | 1 |
| G7 | Bearing | CM2017 | 2 |
| G8 | Gearcase | MT1429 | 1 |
| G9 | Output Gear | MT1431 | 1 |
| G10 | Ball Bearing | 051510 | 1 |
| G11 | Internal Circlip | 0250620 | 1 |
| G12 | Adaptor | CP1255 | 1 |
| G13 | Oil Pipe | MT766 | 1 |
| G14 | Tee Piece | CP1367 | 1 |
| G15 | Bonded Seal | 0201715 | 1 |
| G16 | Union Sub Assembly | MT4583 | 1 |

* Part of Gasket/ Seal Kit MT0382

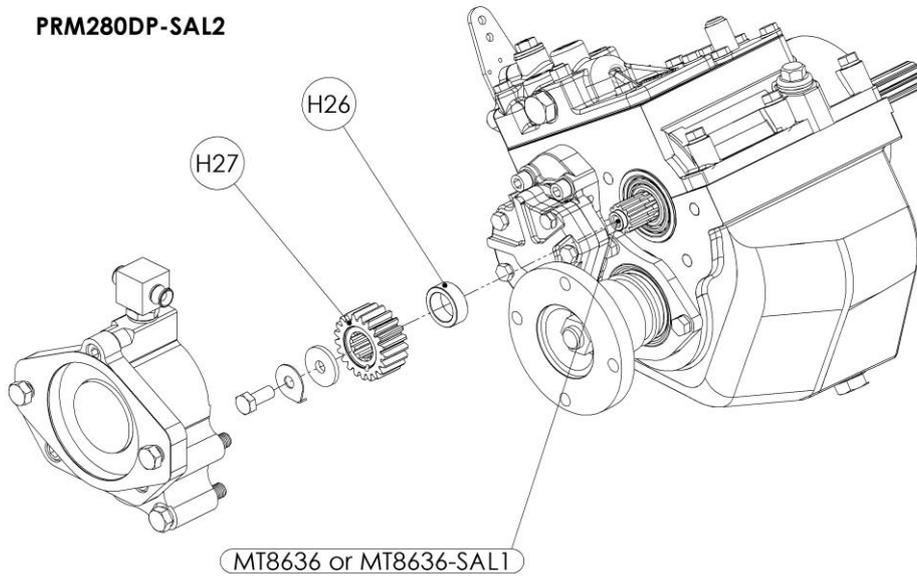
PTO - MT0579 / MT0579-SAL1 & MT0579-SAL2



PRM280DP-SAL1



PRM280DP-SAL2



| SECTION H – POWER TAKE OFF UNIT – MT0579 | | | |
|---|--|-----------------|------------|
| ITEM No. | DESCRIPTION | PART No. | QTY |
| H1 | TRANSPORT COVER | 06906208 | 1 |
| H2 | GASKET | MT5079 | 1 |
| H3 | CIRCLIP - BEARING TO HOUSING | 0250620 | 1 |
| H4 | CIRCLIP - BEARING TO GEAR | CM2067 | 1 |
| H5 | CAP HEAD SCREW M10 X 20 LONG | 0081520 | 1 |
| H6 | ADAPTOR FLANGE | MT8629 | 1 |
| H7 | SCREW M12 X 25 LONG | 0041208 | 2 |
| H8 | OUTPUT GEAR | MT8630 | 1 |
| H9 | GASKET | MT8633 | 1 |
| H10 | PTO HOUSING | MT8628 | 1 |
| H11 | ADAPTOR | MT4583 | 1 |
| H12 | SEALING WASHER | 0201715 | 1 |
| H13 | TEE PIECE | CP1367 | 1 |
| H14 | NEEDLE BEARING | 0563003 | 1 |
| H15 | DRIVE GEAR FROM INPUT SHAFT | MT8631 | 1 |
| H16 | SPACER | MT8647 | 1 |
| H17 | CAP HEAD SCREW M12 X 85 | 0081685 | 2 |
| H18 | SPRING WASHER M12 TYPE A | 0191107A | 3 |
| H19 | BALL BEARING | 40M433 | 1 |
| H20 | HEX HEAD BOLT M12 X 65 LONG | 0041216 | 1 |
| H21 | “O” RING | 04306420 | 1 |
| H22 | SCREW M10 X 25 LONG | 0041008 | 1 |
| H23 | TAB WASHER | MT8632 | 1 |
| H24 | WASHER | MT8635 | 1 |
| H25* | CENTRALISING BUSH – SALVAGE 1 | MT8657 | 1 |
| H26* | SPACER – SALVAGE 2 (REPLACES H16 – MT8647) | MT8647-SAL | 1 |
| H27* | DRIVE GEAR – SALVAGE 2 (REPLACES H15 – MT8631) | MT8631-SAL | 1 |

NOTES:



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