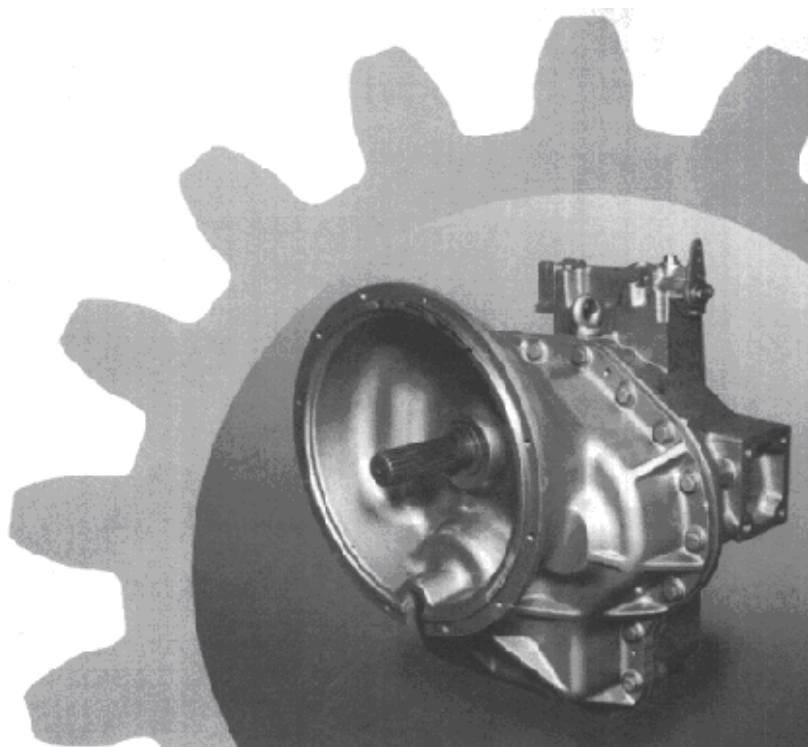




Marine Transmissions

PRM 1500 WORKSHOP MANUAL



PRM 1500 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.

CONTENTS LISTING

SECTION	CONTENTS	PAGE NO.
	List of Illustrations/Drawings/Tools/ Parts Lists	4-6
	Foreword	7
	Warranty Information	7
	Pre-Delivery Test	7
	Identification Plate Information	8
1.	General Data	9
1.1	Specifications	9-12
1.2	Basic Installation Data	13-14
2.	Introduction	15
3.	Construction	15
3.1	Geartrain	15
3.2	Oil Pump	15
3.3	Valve Block	15
3.4	Neutral Safety Switch	16
4.	Operating System	17
4.1	Output Rotations	17
4.2	Hydraulic System	19
4.3	Lubrication	19
4.4	Approved Oils	19
5.	Installation	19
5.1	General	19
5.2	Checking Flywheel	20
5.3	Checking Flywheel Runout	20
5.4	Mounting Gearbox to Engine	21
5.5	Oil Cooler	21
5.5.1	Fitting Oil Cooler to Standard Gearbox	22
5.5.2	Fitting Oil Cooler to P.T.O.	22
5.6	Alignment to Propeller Shaft	23
5.7	Installation Angle	23
5.8	Twin Installation	24
5.9	Remote Control Operating Systems	25
6.	Operation	26
6.1	First Time Operation	26
6.2	Drive Selection	26
6.3	“Trailing” The Propeller	26
6.4	Emergency Operation	27
7.	Routine Maintenance	28
7.1	Initial Maintenance	28
7.2	Daily Checks	28
7.3	Annual Checks	28
7.4	Winter Storage	28
7.5	Outer Maintenance Operations	28
8.	Fault Finding	29
9.	Servicing & Repairs	31
9.1	Seals	31
9.2	Bearings	31
9.3	Cleaning	31
9.4	Inspection	31
9.4.1	Inspection Gearcase	31
9.4.2	Inspection Gears	31

SECTION	CONTENTS	PAGE NO.
9.4.3	Inspection Bearings	31
9.4.4	Inspection Clutch Plates	32
9.4.5	Clutch Components	32
9.4.6	Inspection Threaded Parts	32
10.	Servicing & Repair Procedures	33
10.1	Valve Block	33
10.2	Oil Pump	34
10.3	Oil Strainer	34
10.4	Removing the Transmission	34
10.5	Overhauling the Input & Lay Shaft	35
10.6	Overhauling the Clutches	35
10.7	Replacement of Piston Rings	36
10.8	Servicing of Secondary & Output Shafts	36
10.8.1	Deep Case	36
10.8.2	Shallow Case	37
10.9	Shimming Procedures	38
10.9.1	Shimming Input & Lay Shafts – Micrometer Method	38
10.9.2	Shimming Input of Lay Shafts – Feeler Gauge Method	38
10.9.3	Shimming Secondary & Output Shafts – Feeler Gauge Method	38
10.9.4	Shim Sizes Available	38
11.	Power Take-Off Units	39
11.1	P.T.O. Descriptions	39
11.2	P.T.O. Specifications	39
11.3	Fitting Hydraulic Pump	39
11.4	Retro-fitting of P.T.O's	39
11.4.1	Suitable Valve Blocks for P.T.O.	39
11.4.2	Retro-fitting of 209NM P.T.O.	40
11.4.3	Retro-fitting of 640NM P.T.O.	42
12.	Trolling Valve Description	43
12.1	Trolling Valve Specification	43
12.2	Retro-fitting of Trolling Valve	43
13.	Tool Kit & Applications	44
13.1	Tightening Torques	44
14.	Replacement Parts Ordering	45

LIST OF ILLUSTRATIONS & PARTS LISTS

ILLUSTRATIONS

ILLUS. NO.	SUBJECT	PAGE NO.
Fig. 1	Installation Drg. "Deep" Case	13
Fig. 2	Installation Drg. "Shallow" Case	14
Fig. 3	Internal Layout – "Deep"	48
Fig. 4	Internal Layout – "Shallow"	51
Fig. 5	Wiring Diagram for Neutral Safety Start Switch	16
Fig. 6	Hydraulic & Lubricating Oil Circuits	18
Fig. 7	Checking Run-Out of Flywheel & Flywheel Housing	20
Fig. 8	Engine & Gearbox Cooling Circuit	22
Fig. 9	Oil Cooler Connection To PRM1500 Gearbox.	22 *
Fig. 10	Propeller Rotation on Twin Installations	24
Fig. 11	Operating Lever Positions on 1500 Twin 1500S Installations	24
Fig. 12	Operating Lever Positions on 1500D Twin Installations	25
Fig. 13	Piston Ring Fitting Procedure	36
Fig. 14)	Taper Roller Bearing End Float Shimming Procedures	38
Fig. 15)	Taper Roller Bearing End Float Shimming Procedures	38
Fig. 16)	Taper Roller Bearing End Float Shimming Procedures	38

PARTS LIST

SECTION/DRAWING	SUBJECT	PAGE NO.
A	PRM1500D Gearcase Assy Parts List	47
WM3-1	PRM1500D Sectional View	48
WM3-1	PRM1500D General Assy	49
B	PRM1500S Gearcase Assy Parts List	50
WM12-1	PRM1500S Sectional View	51
WM12-2	PRM1500S General Assy	52
C	PRM1500D Secondary Pinion Shaft Parts List	53
WM5	PRM1500D Secondary Pinion Shaft Sub Assy Sectional View	54
D	Lay shaft Sub Assy Parts List	55
WM1	Lay shaft Sub Assy Sectional View	56
E	Input Shaft Sub Assembly Parts List	57
WM2	Input Shaft Sub Assembly Sectional View	58
F	PRM1500D Output Shaft Sub Assembly Parts List	59
WM4	PRM1500D Output Shaft Sub Assembly Sectional View	60
G	PRM1500S Output Shaft Sub Assembly Parts List	61
WM13	PRM1500S Output Shaft Sub Assembly Sectional View	62
H	PRM1500D Oil Pump / Hose & Strainer Parts List	63
WM6-1	PRM1500D Oil Pump & Hose Sectional View	64
WM6-2	PRM1500D Strainer & Hose Sectional View	65
J	Standard “ <i>soft shift</i> ” Valve Block Sub Assembly Parts List	66
WM7-1	Standard “ <i>soft shift</i> ” Valve Block Sub Assembly Sectional View	67
K	209 NM – PTO Parts List	68
WM8-1	209 NM – PTO Sub Assembly Sectional View	70
WM8-2	PRM1500D 209 NM – PTO Pipework Schematic	71
WM8-3	PRM1500S 209 NM – PTO Pipework Schematic	72
WM8-4	PRM1500D 209 NM – PTO Pipework Sectional View	73
WM8-5	PRM1500S 209 NM – PTO Pipework Sectional View	74
L	640 NM – PTO Parts List	75
WM9-1	640 NM – PTO Sub Assembly Sectional View	76
WM9-2	PRM1500D 640 NM – PTO Pipework Schematic	77
WM9-3	PRM1500S 640 NM – PTO Pipework Schematic	78
WM9-4	PRM1500D 640 NM – PTO Pipework General Assembly	79
WM9-5	PRM1500S 640 NM – PTO Pipework General Assembly	80
M	PRM1500S Trolling Valve Parts List	81
WM10-1	PRM1500S Trolling Valve General Assembly	82
N	PRM1500D Trolling Valve Parts List	83
WM10-2	PRM1500D Trolling Valve General Assembly	84
P	PRM1500S Oil pump / Hose & Strainer Parts List	85
WM6-3	PRM1500S Oil Pump & Hose Sectional View	86
WM6-4	PRM1500S Strainer & Hose Sectional View	87

Q	"Trolling Valve" Valve Block Sub Assembly Parts List	88
WM7-2	"Trolling Valve" Valve Block Sub Assembly Sectional View	89
R	"PTO" Valve Block Sub Assembly Parts List	90
WM7-3	"PTO" Valve Block Sub Assembly Sectional View	91
S	Trolling Valve Joystick Controller & Switch Parts List	92
WM11-1	Trolling Valve Schematic	93
WM11-2	Trolling Valve Joystick Controller Detail	94
WM11-3	Trolling Valve Mounting Detail	95

FOREWORD

Provided it is correctly installed, aligned and maintained, the PRM 1500 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.

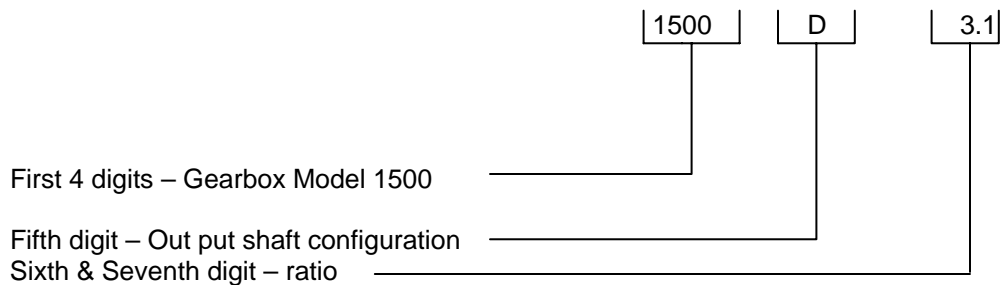
NEWAGE	PRM	COVENTRY
123456		R1234
1500 D3.1		
MADE IN ENGLAND		

NEWAGE	PRM	COVENTRY
MADE IN ENGLAND		

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

It should 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

PRM 1500

NOMINAL POWER RATINGS, PRM 1500 DEEP CASE MARINE GEARBOX							
MODEL	RATIOS	PLEASURE		LIGHT COMMERCIAL		HEAVY COMMERCIAL	
		BHP	KW	BHP	KW	BHP	KW
1500D31SAE1	3.12:1	21.06	15.70	19.65	14.65	18.28	13.63
1500D31SAE2							
1500D39SAE1	3.88:1	21.06	15.70	19.65	14.65	18.28	13.63
1500D39SAE2							
1500D45SAE1	4.50:1	21.06	15.70	19.65	14.65	18.28	13.63
1500D45SAE2							
1500D49SAE1	4.90:1	18.28	13.63	16.87	12.58	15.46	11.53
1500D49SAE2							
Maximum operating speeds: intermittent 3000 rev/min, continuous 2500 rev/min							

(D) **Denotes Deep Case:** manufactured only with integral SAE1 or SAE2 adaptor housings. If there is a need to convert from SAE1 to SAE3, then additional adaptor ring is available as accessory.

NOMINAL POWER RATINGS, PRM 1500 SHALLOW CASE MARINE GEARBOX							
MODEL	RATIOS	PLEASURE		LIGHT COMMERCIAL		HEAVY COMMERCIAL	
		BHP	KW	BHP	KW	BHP	KW
1500S12SAE3	1.22:1	21.06	15.70	19.65	14.65	18.28	13.63
1500S15SAE3	1.56:1	21.06	15.70	19.65	14.65	18.28	13.63
1500S19SAE3	1.94:1	21.06	15.70	19.65	14.65	18.28	13.63
1500S22SAE3	2.25:1	21.06	15.70	19.65	14.65	18.28	13.63
1500S24SAE3	2.45:1	21.06	15.70	19.65	14.65	18.28	13.63
1500S30SAE3	3.0:1	18.93	14.12	17.52	13.07	15.77	11.76
Maximum operating speeds: intermittent 3000 rev/min, continuous 2500 rev/min							

(S) **Denotes Shallow Case:** manufactured only with integral SAE3 adaptor housings. If there is a need to convert from SAE3 to SAE1 then additional adaptor ring is available as accessory.

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 and should not therefore, be exceeded.

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 important 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. In addition, it may 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. However, it is the ultimate responsibility of the person assembling the drive and driven equipment to ensure that they are torsionally compatible.

Operating Pressure

Minimum -2827kPa ($410\text{lb}/\text{in}^2$), maximum 3100 kPa ($450\text{lb}/\text{in}^2$). Two tapped holes, 1 hole 1/8 in BSP on the top and 1 hole M18 on the side of the valve block are provided so that a pressure gauge can be fitted if required. The gear selector is designed with modulated engagement for soft shift.

Oil Cooling

The normal operating temperature of the oil should be in the 50°C - 80°C range, and should not be permitted to exceed 90°C . An oil cooler is necessary to ensure that correct operating temperatures are maintained. Two 1/2 in BSP connections are provided on the valve block to allow it to be fitted. The size of the cooler will depend on a number of factors, including the transmitted horsepower, operating speed, duty cycle, inlet water temperature and ambient temperature.

Propeller Thrust

Both ahead and astern thrust is carried by the output shaft taper roller bearings, which are of ample capacity for all factory-approved ratings.

APPROXIMATE WEIGHT AND OIL CAPACITY		
GEARBOX TYPE	APPROXIMATE DRY WEIGHT	OIL CAPACITY
PRM1500D (deep Case)	300 kg (663 lb)	8.0 litre (14 pint)
PRM1500S (Shallow Case)	260 kg (570 lb)	10.0 litre (17.6 pint)

Note: Weight excluding drive coupling and cooler.

Note: Oil capacity does not include amount to fill cooling circuit.

FLEXIBLE INPUT COUPLINGS FOR PRM 1500		
MANUFACTURER	FLYWHEEL SIZE	PART NO.
Centa Transmissions Ltd.	SAE 11.5in	(CF-DS-40-011-61230) MT
	SAE 14in	(CF-DS-40-014-61229) MT
Torflex – KT410	14in	(1KT4100031) MT8424
Vulkan Industries Ltd.	11 1/2 in	(Vulkardan-E3414) MT8425
	SAE 11.5in	(Vulkardan-E3411S4000 Series) MT 8426
	SAE 14in	(Vulkardan-E3411S4000 Series) MT
R & D Marine Ltd.	SAE 11.5 in	(1200lb.ft (1630Nm) MT8328
	SAE 14 in	(1200lb.ft (1630Nm) MT8329

OTHER ACCESSORIES	
PART NO.	DESCRIPTION
MT8330S/A	Oil Cooler, PRM1500S engines to 340kW
MT8331S/A	Oil Cooler, PRM1500D engines to 393kW
MT0199 – Kit	Clutched power take-off for SAE 'B' hydraulic pump 209NM max
MT0492 – Kit	Clutched power take-off for SAE 'C' hydraulic pump 640NM max
MT0497-Kit	Shallow Case Adaptor Ring to SAE1
MT0415-Kit	Deep Case Adaptor Ring to SAE3

Note: When ordering it is necessary to specify the flywheel size.

The choice of coupling must be made by the engine manufacturer/boat builder to ensure vibratory torque levels within the driveline are kept to a minimum within the engine operating speed range. This is particularly important as PRM1500 uses two-stage gear reduction.

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.

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 accessories and pressure gauge.

Input shaft:

44.75 mm diameter with 12/24DP 20 teeth.

Propeller thrust:

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

Installation angle:

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

Output flanges:

- a. Deep type box uses MT 8176: Φ 267.0, with 8 holes Φ 26.2 on 222.26 PCD.
- b. Shallow type box uses MT 8175: Φ 185.0, with 6 holes Φ 16.25 on 152.4 PCD.

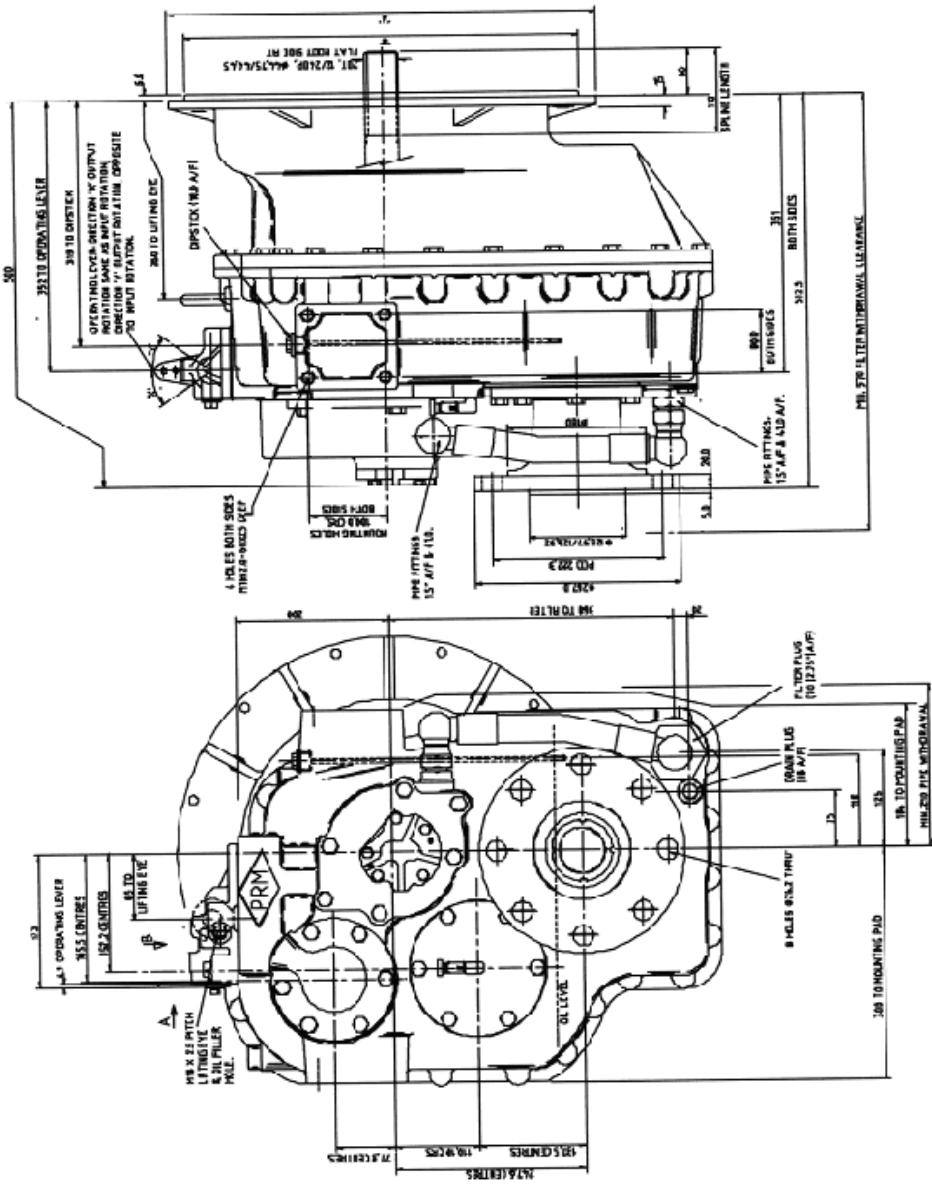


Fig 1. Installation Drawing (PRM1500D – Deepcase)

2. INTRODUCTION

Newage Transmissions Ltd. PRM1500 marine transmissions 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 PRM1500 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 towards the transmission and engine.

3. CONSTRUCTION

3.1. Geartrain

There are two types of geartrain – a three shaft “shallow” design, and a four shaft “deep” design. All shafts run in taper roller bearings. The engine must rotate A.C.W. looking on flywheel.

The “shallow” type will therefore have output rotation opposite to input rotation with operating lever to rear of box, i.e. with input shaft clutch engaged. With a R/H this gives forward motion.

The “deep” type will therefore have output rotation the same as input rotation with input shaft clutch engaged. With a L/H propeller this gives forward motion.

It is normal practise for the input clutch to be used for “ahead” motion on single propeller installations, with the layshaft clutch engaging astern.

All input and lay-shafts incorporate a hydraulically activated piston operating the clutch pack, set into a clutch gear, which also contains the emergency get you home device. This will engage the drive pinion (available in various ratios), which is set on needle bearings, and so transmit drive.

The output shaft runs on amply proportioned bearings, so allowing propeller thrust to be absorbed in either direction.

3.2 Oil Pump

A cast iron gear-type pump externally mounted at the rear of the gearcase and driven by the input shaft 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.

3.3 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 that 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.

The standard fit valve block is of “soft-shift” design. When using a P.T.O. or trolling valve, a special valve block is to be used instead.

3.4 Neutral Safety Starter 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 marine or other area.

The switch is located on the valve block (refer to Drg. WM7-1 item J8) and should be wired into the starter circuit as shown in Fig. 5.

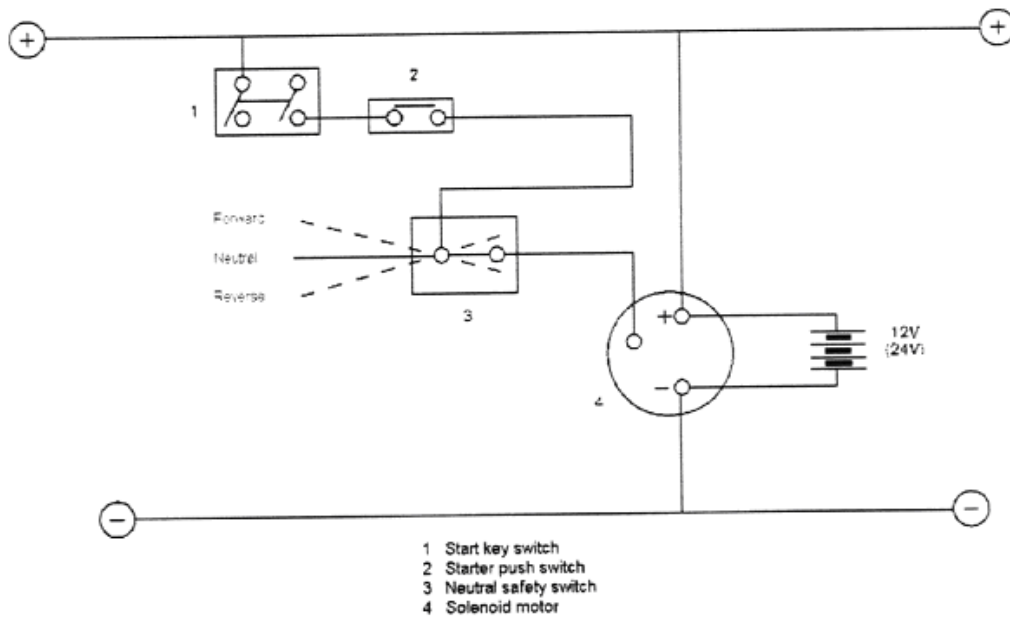


Fig 5. Wiring diagram, neutral safety switch

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

GEARBOX TYPE	SHALLOW	DEEP	ENGINE
Operating Lever Backwards			
Operating Lever Forwards			

NOTE: (i) Rotations are as seen looking from the propeller forward to the gearbox.
(ii) Engine must be ACW looking on flywheel.

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.

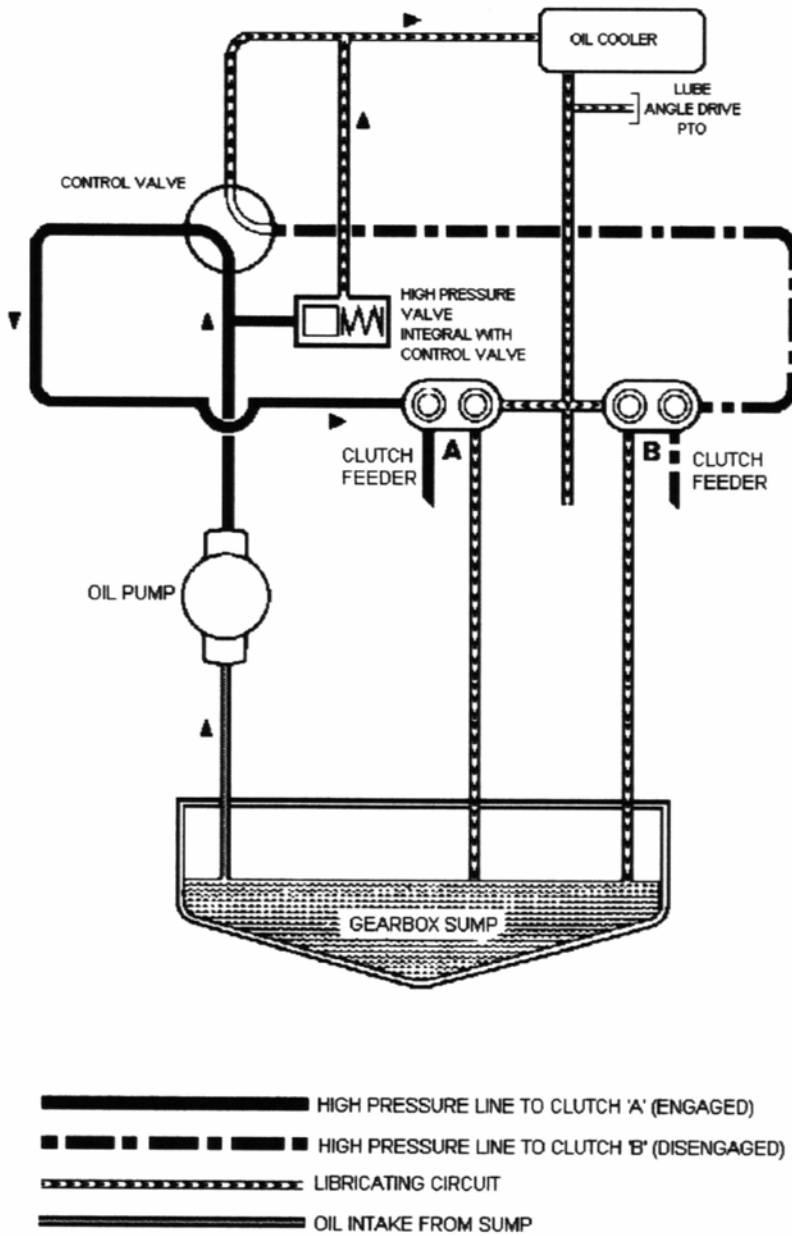


Fig 6. Hydraulic and lubricating oil circuits

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°C	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, be used in the PRM1500. Do not mix different brands, types or grade of oil.



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 PRM1500 marine gearbox is supplied with a choice of adaptor sizes to SAE1, SAE2, and SAE3 dimensions enabling it to be fitted to engines having flywheel housings of equivalent specification. See installation drgs. Page no. 12 & 13.

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.

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 dia 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 (9.006in.) 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.

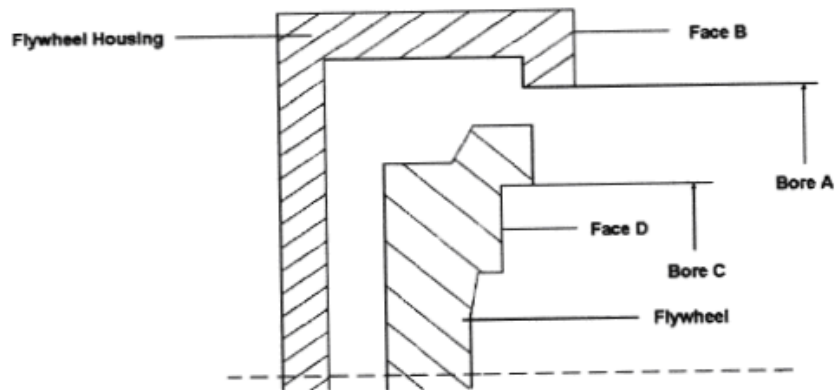


Fig. 7. Checking the flywheel and flywheel housing.

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 34.

5.5 Oil Cooler

All Newage PRM1500 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 3/8in. 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 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.

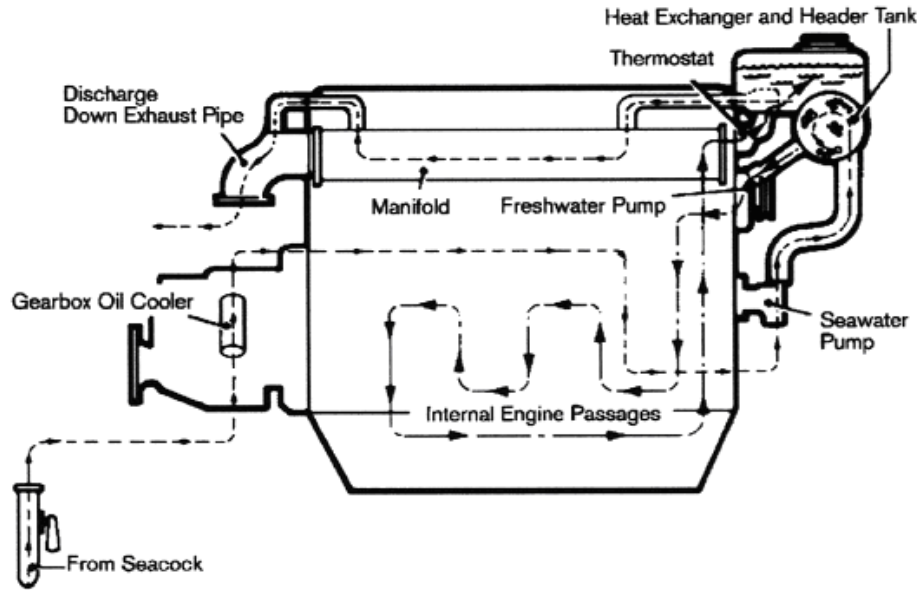


Fig. 8. Engine and gearbox cooling circuit.



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 Fitting Oil Cooler to PRM1500 Standard Gearbox

Remove “Redcap” seals from valve block and using fittings and hoses supplied, plus extensions as necessary, connect the valve block outlet to the oil cooler inlet, and the valve block inlet to the oil cooler outlet. Plumb the cooler into the engine water circuit. Refer to Drg. WM14.

Fig. 9 Oil Cooler Connections

5.5.2 Fitting Oil Cooler to P.T.O. - See Drgs. WM 8 and 9.

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.
- 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 PRM1500 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

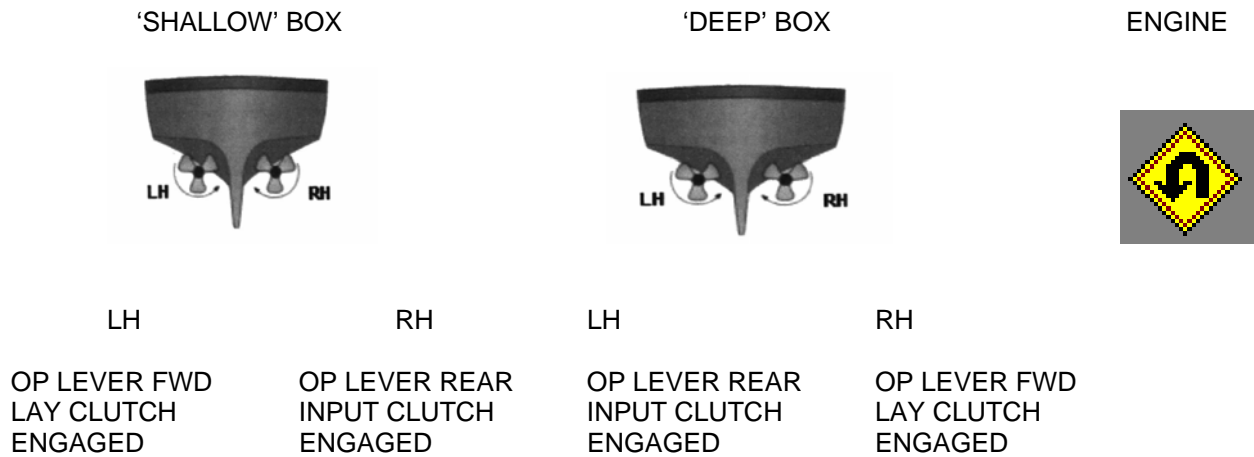
The transmissions should normally be installed so that the maximum fore and aft angle relative to the water line does not exceed 17°C with the boat at rest. Please consult Newage Transmissions Ltd. if installation angles greater than this are required.

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. Also 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.

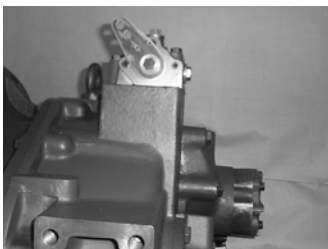


AHEAD MOTION: VIEWED ON REAR WITH ACW ENGINE

Fig. 10 Propeller Rotation on Twin Installations

When connecting remote control units for twin installations, ensure that propellers counter-rotate outward with “ahead” selected. The gearbox operating levers will read to move in opposite directions to achieve this refer to 4.1 regarding output rotation of gearboxes.

Fig. 11a



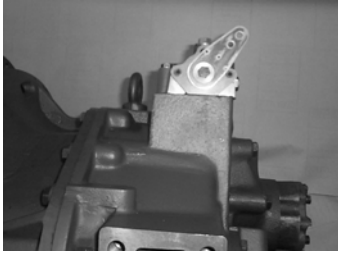
SHALLOW BOX PORT SIDE
LEVER FORWARDS SUITS
LH PROPELLER – AHEAD

Fig. 11b



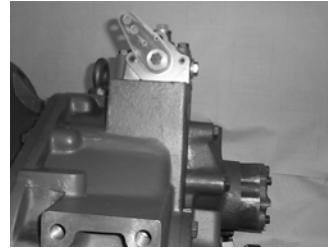
SHALLOW BOX STARBOARD SIDE
LEVER BACKWARDS
SUITS RH PROPELLER - AHEAD

Fig. 12a



DEEP BOX PORT SIDE
LEVER BACKWARDS SUITS
LH PROPELLER – AHEAD

Fig. 12b



DEEP BOX STARBOARD SIDE
LEVER FORWARDS SUITS
RH PROPELLER - AHEAD

5.9 Remote Control Operating Systems

The PRM1500 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: 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

(Deep type), note dipstick should be fully screwed home, or until oil flows from the level hole (shallow type). Repeat this process as necessary to confirm correct oil level with all circuits full.



CAUTION: Before starting the engine fill the gearbox to the correct level with a suitable oil (refer to recommended list, section 4.4 page 17).

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 15) 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 as required.



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 PRM1500 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. recommends 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 be 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 PRM1500 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 PRM1500 particularly suited for use in 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.

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 PRM1500 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. Decide which shaft requires locking up. On single installation “ahead” will require the input shaft clutch locking providing that “shallow” type boxes are fitted with an RH propeller and “deep” type boxes are fitted with a LH propeller (as per normal practise). Twin installations will obviously require the port side box locked on one shaft and the starboard box locked on the other shaft to give both drives “ahead”.
2. To lock up the input shaft first remove the oil pump assy (refer to Drg. WM2) followed by its gasket and shims, and then the bearing cup. Using item E31, a long series 4.0 hexagon allen key, align ½ holes & screws 2 at a time and lock up all 4 screws item E30.
 - 2a. Re-assy. ensuring shims are replaced and gasket is in usable condition.
3. To lock up the layshaft first remove the encover (Ref to drg. WM1) or P.T.O. assy (Refer to WM8 or 9 and Sections 11.2 or 11.3) complete with gaskets, ‘O’ rings and shims as applicable. Then remove bearing cup. Using item D31, a long series 4.0 hexagon allen key, align ½ holes & screws 2 at a time and lock up all 4 screws item D30.
 - 3a. Re-assembly ensuring shims are replaced and all gaskets and all ‘O’ rings are in usable condition.



CAUTION: Ensure that sufficient oil remains in gearbox to avoid any further damage.
The engine can now be run but to minimise the possibility of any more damage being caused to the transmission it is recommended that engine speed is limited to 1/3 full throttle. Disconnect the operating cable to the gearbox operating lever to prevent accidental selection of other clutch. After emergency drive has been used the transmission must be checked over thoroughly before being used again.



WARNING: When emergency drive “ahead” is engaged neither astern or neutral will be available; therefore there will be no means of stopping the boat using engine power. Great care is therefore required when manoeuvring or docking.

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 using the magnetic drain plug located at the rear of the box. This requires a 1" A/F spanner. Clean any debris from magnet and re-fit. (Refer to Drgs. WM 3-2 and 12-2). The oil strainer should also be checked and replaced if necessary (refer to Drg. WM6) requiring spanners of 70.0 (2.75), 41.0, 38.0 (1.5") A/F.

Refill using a recommended lubricant (see 4.4 chart Page 17) as per instructions 6.1.

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 that 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 that 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	REFER TO DRG. NO.
No drive ahead or astern	No oil pressure	Damaged oil pump Broken layshaft Broken input drive plate Broken Input shaft Broken output shaft	Remove oil pump & replace complete Replace layshaft S/A Replace input drive plate Replace input shaft S/A Replace output shaft S/A	WM1 WM2 WM13
Intermittent or complete loss of drive	Oil leaks, lack of oil	Damaged oil seals or gaskets, low oil level	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.	WM6 WM7
Propeller speed does not increase with engine speed in one direction only	Low oil pressure to one clutch	Piston rings or 'O' ring worn. Damaged clutch plates Blocked hydraulic feed in valve	Remove appropriate clutch shaft replace worn piston rings/'O' rings. Remove & examine appropriate clutch & replace if necessary. Remove valve block and examine.	WM1 WM2 WM7
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 fault installation	Remove, examine & 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 & balance of propeller. Remove transmission & check flywheel face is flat or flexible coupling is correctly aligned. (see section 5.3) Isolate defective bearing & replace.	WM 1,2,5,4,13

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 dipstick. Fill with correct oil type. Remove & examine valve spring. Replace if necessary. Replace defective clutch, see remedy for low oil pressure	WM7 WM1 WM2
Oil level needs constant topping up	Oil leaks.	Defective oil seals, 'O' rings, or gaskets. Defective oil cooler & 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.	
Escape of pressure from gearbox when checking oil level etc. oil leaks.	Excessive internal pressure	Defective breather causing leaks past oil seals.	Contact distributor or factory for advice.	WM 3,12
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.	WM7
No neutral	Control system not moving gear lever correctly. Seized or dragging clutch.	Incorrect control cable set-up. Clutch badly worn or seized causing permanent engagement of a direction.	Check cable installation. Check clutch and replace as necessary.	WM1 WM2



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 5.

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 together with their shims, and protect all bearings from contamination.

9.3 Cleaning



WARNING: If using cleaning solvents these can be toxic, flammable, and 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 to prevent premature failure.

It should be noted, that each shaft has one gear assembled to it using oil injection. If this equipment is not available the shaft gear sub assy. can be supplied ready-assembled if replacement parts are required. Also note that the output shaft cannot be removed from the case half without specialised oil injection equipment.

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: All shafts are supported in taper roller bearings. Each time a shaft is dismantled it will be necessary to check for correct shimming – see 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 refer to Drg. WM7-1.

1. Disconnect the control cable(s) from the lever (J8) on the valve block.
2. Disconnect the oil cooler pipes and the wiring from the neutral switch (J16) if fitted.
3. Remove the 6 bolts (J24, 25, 22, 26) and together with washers (J28, 27) securing the valve block to the gearcase.
4. To remove the control valve (J5) and piston (J6), simply remove the two cap screws (J18) and withdraw the valve from the valve block (J2).



CAUTION: Take care not to lose the detent ball and springs (J13, J15).

5. Inspect the seal (J31) seal bore in (J3) and bearing (J32), and replace if worn, damaged or defective. Check that the valve spring (J10) 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 (J3) and seal diameter of valve (J5) to avoid damaging the seal (J31) when re-fitting.

10.2 Oil Pump

The oil pump can be removed with the gearbox in position on the engine, refer to Drg. WM6-1.

1. Remove the 6 bolts and washers (H13, 15, 16, 17, 12) securing the oil pump to the maincase and withdraw the pump complete with gasket and shims.
2. Inspect the gasket (H11) 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 (H1) must be replaced.



CAUTION: If a new pump assembly is fitted the clutch shaft must be reshimmed. See section 10.10 and refer to Drg. WM2.

10.3 Oil Strainer

The gearbox oil strainer is attached to the end of the oil pump feed hose, and is situated in the sump. It may be removed for inspection/replacement as follows: (Refer to Drgs. WM3, 6 and 12).

1. Loosen hose connecting at oil pump (38.0 A/F) disconnect hose at other end (38.0 A/F) and remove large brg. (70.0 A/F item P23/H23) together with its sealing washer and the oil strainer.
2. Wash the strainer in a suitable cleaning solvent, or replace if damaged. Dry thoroughly.
3. Refit with minimum strain applied to hose.

10.4 Removing the Transmission



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 (J8) 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 that 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 Overhauling The Input & Layshaft & Clutch Assemblies

1. Remove gearbox from boat as described in section 10.4.
2. Referring to Drgs. WM2 and 6, remove 6 bolts and washers securing the oil pump and withdraw pump with its shims and gasket.
Note: Retain shims with pump.
3. Referring to Drgs. WM1, 8 and 9:
 - 3a. If cover D14 is fitted, undo 6 hexagon screws and remove cover with gasket and shims. Retain as a set, or
 - 3b. If 209Nm P.T.O. MTO199 is fitted, undo 4 cap screws, remove P.T.O.End Cover Assy. and unscrew, but do not remove cap screw K41 in centre of unit. Undo 4 cap screws holding P.T.O. Body K6 onto P.T.O. Housing K2. Remove P.T.O. assy. and shims K43 on end of cap screw K41. Housing K2 with its gasket and shims can now be removed by releasing 4 nuts K45. Retain parts as a set or,
 - 3c. If 640Nm P.T.O. MT8279 is fitted, undo 4 cap screws L10 and remove P.T.O. Remove P.T.O. support bracket if required. Release 4 nuts L8 and remove housing L2 with gasket and shims. Retain as a set.
4. Case can now be split by removing screws – retain 2 dowels.
5. The shaft assemblies can now be removed from box for inspection.

10.6 Clutch Assembly Overhaul

1. Referring to Drgs. WM1 and 2, using a pulley extractor located behind the pinion, withdraw the pinion, taper roller bearing and various bearings and spacers.
2. Remove circlip D16/E16 followed by end plate D7/E7, clutch plates D17/E17 and D18/E18, thrust washer D9/E9, springs D23/E23 and piston D6/E6.
3. Note the clutch gear D37/E34 and bearing D10/E10 can only be removed with special oil-injection equipment.
4. The clutch plates should be inspected for discolouring or distortion, caused by overheating, or lack of groove pattern caused by wear, and replaced if at all doubtful. All bearings and seals should likewise be inspected for damage or wear.
5. Commence re-assembly by refitting piston into clutch gear, locating over 2 pins D22/E22.
6. Refit 12 springs and large thrust washer. Place thrust wash E15/D15 over shaft with small chamfer downwards. Position thrust bearing D11/E11 next, followed by thrust washer D13/E13 with large chamfer away from bearing. Fit 2 off snap rings D8/E8 into grooves.
7. Locate 7 off each type of clutch plate into clutch gear using plain steel D17/E17 first and alternating with friction plat D18/E18 followed by end plate D7/E7.
8. Temporarily refit pinion on its bearings so as to line up clutch plate splines then remove.
9. Fit circlip D16/E16 into clutch gear groove.
10. Re-assemble pinion with its bearings and spacers followed by thrust bearing D11/E11 and thrust washer D29/E29.

11. Hold thrust washer firmly against shoulder on shaft, check for pinion end float. There should be a minimum of 0.1mm.
12. Press on transfer roller bearing cone carefully so as not to trap thrust bearing.
13. Re-check to confirm pinion end float and refit shafts into box.



CAUTION: If clutch gears or pinions are found to be worn or damaged, it is strongly recommended that they are changed as a set. It is also false economy not to change all seals and piston rings during overhaul.

10.7 Replacement of Piston Rings



Fig. 13. Piston ring fitting procedure

1. Remove piston ring using special extractor pliers, or small screwdriver to ease the ring from its groove.
2. Replacement is a delicate operation as the rings are fragile. If a ring loading tool is not available use thin shim steel strip to carry the ring along the shaft and into its groove.
3. Liberally lubricate the piston ring and its mating part before assembly. Refer to fig. 13.

10.8 Servicing of Secondary & Output Shafts

Note these will require the use of oil injection equipment to remove them completely from the case.

10.8.1 Removal of Secondary and Output Shafts from Deep Type Case

1. Referring to WM 4 and WM5.
2. Remove plug F15 from front case and replace with M16 x 1.5 pitch screw 40mm or larger. Screw in to support the end of the output shaft.
3. Remove locknut F13 followed by spacer F3, seal F9, coupling F2 and bearing housing assy. F4 (use 2 off screws F16 to jack housing from case if necessary). Keep bearings and shims safely together.
4. Remove endcover C2 (use 2 off screws C6 to jack housing from case if necessary).
5. Referring to 10.4 and 10.5 split the gear case, remove the rear half.
6. Using oil injection equipment remove the output shaft gear F17.

7. Unscrew 8 cap screws F14 together with end plate F6. The shaft assy may now be removed from the gear case.
8. The secondary shaft may now be lifted out. This gear will also require oil injection equipment to remove it from its shaft.
9. Inspect the gears, bearings and seals and replace with new as necessary.
10. Commence re-assembly by placing output shaft into front case half. Adjust the M16 screw to support the shaft with its bearing F7 just below the end plates (F16) mounting face.
11. Secure end plate into position and lock its screws up fully.
12. Fit secondary shaft assembly into case half, followed by output shaft gear, which needs to be oil injected into position.
13. Rebuild case and end cover/bearing housing S/A's noting that locknuts used must have a minimum "run-up torque" when moving along their threads, as stated in chart 13.1 (Tightening Torques). Any nut that is too loose a fit should be replaced.
14. It is strongly recommended that oil seals G9, G10 and G11 are replaced with new items.
15. Check shimming with reference to 10.9.3 and 10.9.4.

10.8.2 Removal of Output Shaft from Shallow Type Case

1. Referring to WM13.
2. Remove plug G15 from front case and replace with M16 + 1.5 pitch screw 40mm or longer. Screw in to support the end of the output shaft.
3. Remove locknut G13 followed by spacer G3, seal G9, coupling G2 and bearing housing assy G4 (using 2 off screws G16 to jack housing from case if necessary). Keep bearings and shims safely together.
4. Referring to 10.4 and 10.5 split the gear case, remove the rear half.
5. Using oil-injection equipment remove the output gear G18 to G23 as fitted.
6. Unscrew 8 cap screws G14 together with end plate G6. The shaft assy may now be removed from the gear case.
7. Inspect the gears, bearings and seals and replace with new as necessary.
8. Commence re-assembly by placing output shaft into front case half. Adjust the M16 screw to support the shaft with its bearing G7 just below the endplate (G6) mounting face.
9. Secure end plate into position and lock its screws up fully.
10. Fit gear using oil injection equipment.
11. Rebuild case and bearing housing S/A noting that lock nuts used must have a minimum "run-up torque" when moving along their threads, as stated in chart 13.1 (Tightening Torques). Any nut that is too loose a fit should be replaced.
12. It is strongly recommended that oil seals G9, G10 and G11 are replaced with new items.
13. Check shimming with reference to 10.9.3 and 10.9.4.

10.9 Shimming Procedure

The allowable endfloat on all shafts between their taper roller bearings is 0.00/0.05 (0.000"/0.002"). This can be checked with the use of depth micrometers, or feeler gauges. Refer to figs. 14, 15 and 16.

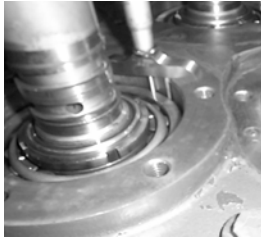


Fig. 14

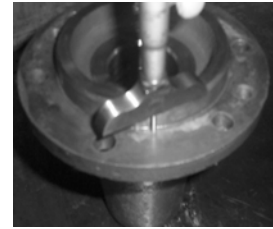


Fig. 15

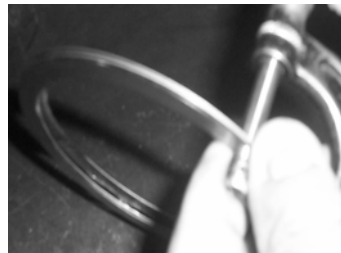


Fig. 16

10.9.1 Input & Layshafts - Micrometer Method

1. Measure depth of bearing inside case – ensuring bearing is correctly seated.
2. Measure length of pump or cover, or PTO Housing, location diameter with gasket removed.
3. Deduct 2 from 1, and add 0.10 (0.004") to allow for gasket to give shims required.

10.9.2 Input & Layshaft – Feeler Gauge Method

1. Fit enough shims to make pump or cover, or PTO housing stand proud of box, with gasket removed.
2. Tighten screws or nuts and rotate shaft until it starts to bind, ensure the gap between case and component is even all round.
3. Measure gap produced and deduct 0.10 (0.004") to allow for gasket.
4. Deduct this final figure from actual shims originally fitted.

10.9.3 Secondary & Output Shafts

1. Assemble with no shims in place, and tighten screws whilst rotating shaft until it starts to bind. Ensure gap between case and endcap, or housing, is even all round.
2. Measure this gap with feelers and fit that amount of shims.

10.9.4 Shims are available in thicknesses of 0.05 (0.002"), 0.075 (0.003"), 0.25 (0.010"), 0.40 (0.016"), 1.00 (0.025").

11. POWER TAKE-OFF UNITS

11.1 The hydraulically operated PTO units available are of 2 sizes – MT0199 rated at 209Nm and MT8279 rated @ 640Nm, the former is mechanical lever operated and the latter solenoid valve operated. They both take their drive from the layshaft, replacing the standard cover fitment. The PTO provides a clutched link between the gearbox and a hydraulic pump. Oil pressure is taken from the valve block to operate the PTO clutch. Low pressure oil direct from the oil cooler provides lubrication for the internal PTO components.

11.2 Specification

Two sizes of PTO are available.

- a. 209Nm (155lbft), 22KW (29.5HP) per 1000rpm.
 - b. 640Nm (472lbft), 67KW (90 HP) per 1000rpm.
-
- a. The 209Nm PTO is to SAE J744C series 'B', with splined output and 2 or 4 bolt flange mounting. The clutch control is via a mechanical lever. See Drg. WM8.
 - b. The 640Nm, PTO is to SAE J744C series 'C' with splined output and 4-bolt flange mounting. The clutch control is via electric (12V or 24V) solenoid. See Drg. WM9.

Pumps of larger capacity must not be used. The PTO's are designed to drive hydraulic pumps of the gear, valve, or piston type conforming to SAE J744C specification only. They must emphatically NOT be fitted with any adaptor drive to an outrigger pulley, as the mounting will not support the inflicted side loads.

Advice cannot be given regarding the design of ancillary power circuits, of which the PTO forms part. It is expected that such circuits are in accordance with the recommendations of the manufacturers of the hydraulic equipment used, and to be adequately safe guarded against overloading.

11.3 Fitting of Hydraulic Pump

The 209Nm PTO requires 2 or 4 bolts of M12 thread to attach the required pump. The joint face will need sealing against leaks.

The 640Nm PTO requires 4 bolts of ½" UNC thread to attach the required pump. The joint face will need sealing against leaks.

Once fitted the pump can be piped-up as specified by the manufacturer. After installation is complete, the gearbox should be run with the pump off-load to check PTO for correct hydraulic functioning.

11.4 Retro –Fitting of PTO's

11.4.1a Note that the standard gearbox without PTO uses a special "soft Shift" valve block assembly MT0494" which is not suitable for PTO applications. The 209NM PTO requires valve block assy. "MT0503", and the 640NM requires valve block assy "MT0504".

11.4.1b If a trolling valve is also to be used with a PTO installation, then the valve block assembly will be part no. "MT0513". Refer to 12.1f regarding special instructions.

11.4.2 Retro-Fitting of 209Nm PTO “MTO199”

Refer to Drgs. WM1 & 8.

1. Remove end cover D14 and gasket D32 – retain gasket if to be re-used. Discard end cover and its screws. Remove screw D26 and discard.
2. Select shims E4/D25 to suit new PTO adapter housing K2 (Refer to 10.8 for shimming procedures).
3. Fit 2 plugs K3 to housing K2 if necessary (requires special gun).
4. Fit 3rd piston ring K41 to layshaft. (Refer to 10.7 for piston ring replacement procedures).
5. Fit 6 studs K44 to gearcase using “Loctite stud-lock” on threads.
6. Fit correct shims K4 and housing K2 with its gasket K56/D32 using 6 off nuts K45.
7. From PTO assembly “MT0199” remove the transit cover plate and 2 screws and disregard. Disassemble end cover assy. K9 by removing 4 screws K30, retaining gasket K10.
8. From inside the PTO, unscrew the central cap screw and remove the retaining bung, these items can be discarded.
9. Determine the shims to produce running clearance at ‘X’ of 0.5mm nominally.
- 9a. Measure dimension ‘B’ (Protrusion of lay shaft from PTO adaptor housing K₂ & ‘A’ (minimum depth to clutch body housing K₃ inside PTO).
- 9b. Deduct ‘B’ from ‘A’ noting amount and whether the product is positive or negative. If positive add the amount to 0.5mm to obtain shims required. If negative deduct from 0.5mm to obtain shims required. Shim sizes available are 0.1mm and 0.5mm.

e.g. of shim calculation.

‘A’	14.30				
‘B’	<u>14.55-</u>				
	<u>0.25-</u>	Note negative product			
	0.50				
	<u>0.25-</u>				
	<u>.25</u>	shims			

Therefore fit 2 off 0.1 shims
(giving theoretical clearance at ‘X’ of 0.45)

‘A’	14.55				
	<u>14.30-</u>				
	<u>0.25</u>	– Note positive product			
	0.50				
	<u>0.25+</u>				
	<u>.75</u>	shims			

Therefore fit 2 off 0.1 & 1 off 0.5 shims
(giving theoretical clearance at ‘X’ of 0.45)

10. Determine shims to give minimum endfloat of splined drive adaptor K5.
- 10a. Measure dimension ‘C’ (minimum depth to plug K1 inside PTO) & ‘D’ (minimum protrusion of splined drive adaptor K5 from PTO housing K2).

- 10b. Deduct 'D' from 'C' and divide by 2.0. Shims are available in 2.0mm only. e.g. of shim calculation.

$$\begin{array}{r} C \qquad 35.0 \\ D \qquad \underline{26.0} \\ \hline 11.0 \text{ shim gap} \\ \underline{2.0} \text{ divide} \\ \hline 5.5 \text{ shims} \end{array}$$

therefore fit 5 off shims (2.0 thick)

11. Stick 'O' ring L34 to PTO body K6 using a light smear of clean grease.
12. Assemble PTO with shims K40, drive adaptor K5, cap screw K42, shims K43 and 4 off screws K33 to main gearcase. Leaving screws K3 loose, lock up cap screw K42 tight. Check to conform endfloat of PTO Body K6 is approximately 0.5mm. Tighten 4 screws K33.
13. Re-assemble end cover assembly K9 (being careful to align splined drive shaft K15 through clutch plate splines) using original gasket K10, if serviceable, and tighten 4 screws K30.
14. Attach pipework as per G.A. (drgs. WM8).
15. Change valve block assembly to "MT0503", as required, for use with this PTO. Refer to 10.1

11.4.3 Retro-fitting of 640NM PTO
Refer to Drgs. WM 1 & 9

1. Repeat as 11.4.2
2. Repeat as 11.4.2
3. Repeat as 11.4.2
4. Repeat as 11.4.2
5. Repeat as 11.4.2
6. Repeat as 11.4.2

7. Bolt adaptor ring L3 onto PTO adaptor housing L2 using 4 off screws L5, sealing joint with Hermatite or similar compound.

8. Using 4 off screws L10 fit PTO assy. L1 onto adaptor ring L£, again sealing joint with Hermatite.
9. Remove blanking screws from case arm mounting holes where fitted.

10. Bolt support arm assembly onto main gearcase, and adjust to firmly support PTO body (Ref. G.A drg. WM9). Seal threads against oil leaks.

11. Attach pipework as per G.A.

12. Change Valve Block Assembly to "MT 0504" as required for use with this PTO. (Refer to 10.1)

12. TROLLING VALVE

A trolling valve assembly is available as an option. This electronically operated valve allows variable speed of the propeller down to zero, whilst allowing a maximum engine speed of 120rpm. The valve uses the gearbox oil. Valve block assembly "MT0513" is required to replace "MT0494" for use with trolling valve.

12.1 Specifications

- a. One 3m length of 6-core cable is supplied loose, with one socket end connector and 2 Hirschman connectors on solenoid cables, as part no. "MT4820".
- b. The fuel rack switch is left with bare wires. Customer is to connect wires and provide suitable mounting brackets.
- c. The control lever is pre-set and should not require any adjustment.

12.2 Retro-Fitting of Trolling Valve

Refer to Drg. WM10

1. Remove two screws from suitable positions on gear case joint (see G.A.). Discard these screws, and using new screws N13/M13 fit mounting plate N1/M1.
2. Change valve block assembly for "MT0513" as required with this trolling valve. (Refer to 10.1).
3. Assemble proportional valve and solenoids on mounting plate using screws and nuts N14/M14 and N15/M15.
4. Attach pipework and electrical connections as per G.A.
5. Mount joystick controller in suitable position and connect to solenoids. (Refer to drg. WM11).
6. The cooler circuit connections remain as on standard box.
7. The oil filter can be re-sited, if necessary, up to 0.5m from the gearbox. For this case the customer must provide the required mounting bracket. Note that the filter must be installed vertically with the bowl facing downwards. The 10-micron element must be replaced after initial 50 hours operation, and with regard to the filter indicator reading thereafter. The system must not be run with the indicator in the red.
8. If used with a PTO then the clutch pressure feed for the PTO must be taken from either the 1/8" BSP tapping on the valve block or port 'P' on the proportional valve. Under no circumstances should the PTO connection be taken from Port 'C' (clutch feed line).
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 (e.g. sticking valve) the on/off solenoid at the side of the proportional valve can be operated manually by depressing the button in the centre of the solenoid. This will release the valve and return to full pressure.
10. The trolling valve must not be operated above 1200rpm. An inter-lock switch is fitted to prevent this.
11. Prior to retro-fitting a trolling valve to an older gearbox, drain gearbox and cooler circuit and clean oil strainer. Refill to correct oil level and follow procedure 6.1.

13. **TOOL KIT & APPLICATIONS**

18mm A/F	Spanner	>	Dipstick
70mm (2.75") A/F	Spanner	>	Oil hose & strainer
41mm	Spanner	>	Bung
38mm (1.5") A/F	Spanner		
19mm A/F	Spanner	>	Gearcase joint
17mm A/F	Spanner		
13mm A/F	Spanner		
10 A/F	Hex Allen Key		
8 A/F	Hex Allen Key		Extended
6 A/F	Hex Allen Key		Extended: Get You Home Device

13.1 **Tightening Torques**

	RECOMMENDED TIGHTENING TORQUES		"RUN-UP" TORQUE	
	Nm	Lbf.ft	Nm	Lbf.ft
Gearcase Bolts	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 nut	1000	738	42.0	31.0
Adaptor plate to gearbox	98.0	72.5		
Input/Lay Shaft Nut	340	250	29.0	21.0
Secondary Shaft Nut	340	250	42.0	31.0
Output Shaft Internal Nut	476	350	53.0	39.0
P.T.O. to rear gearcase	56.0	41.5		

14. REPLACEMENT PARTS ORDERING

When ordering replacement parts the following should be quoted:

- a. Gearbox model and serial number.
- b. Description(s) and part number(s) of the component(s) required.
- c. Quantity required.
- d. 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:

**NEWAGE TRANSMISSIONS LIMITED
BARLOW ROAD
COVENTRY CV2 2LD
ENGLAND**

TEL: +44 (0) 24 7661 7141

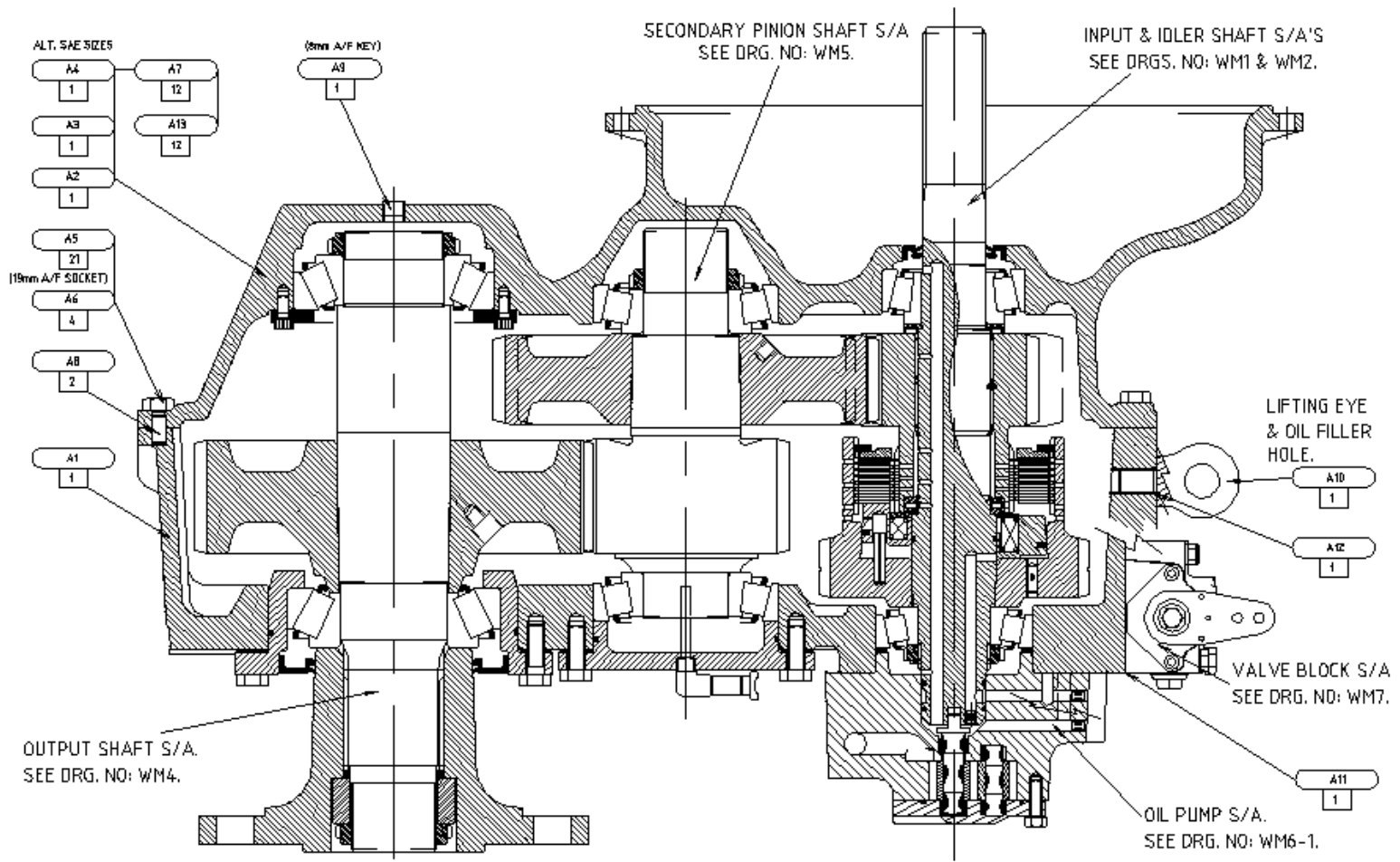
FAX: +44 (0) 24 7661 1845

EMAIL: mail@newage-prm.co.uk

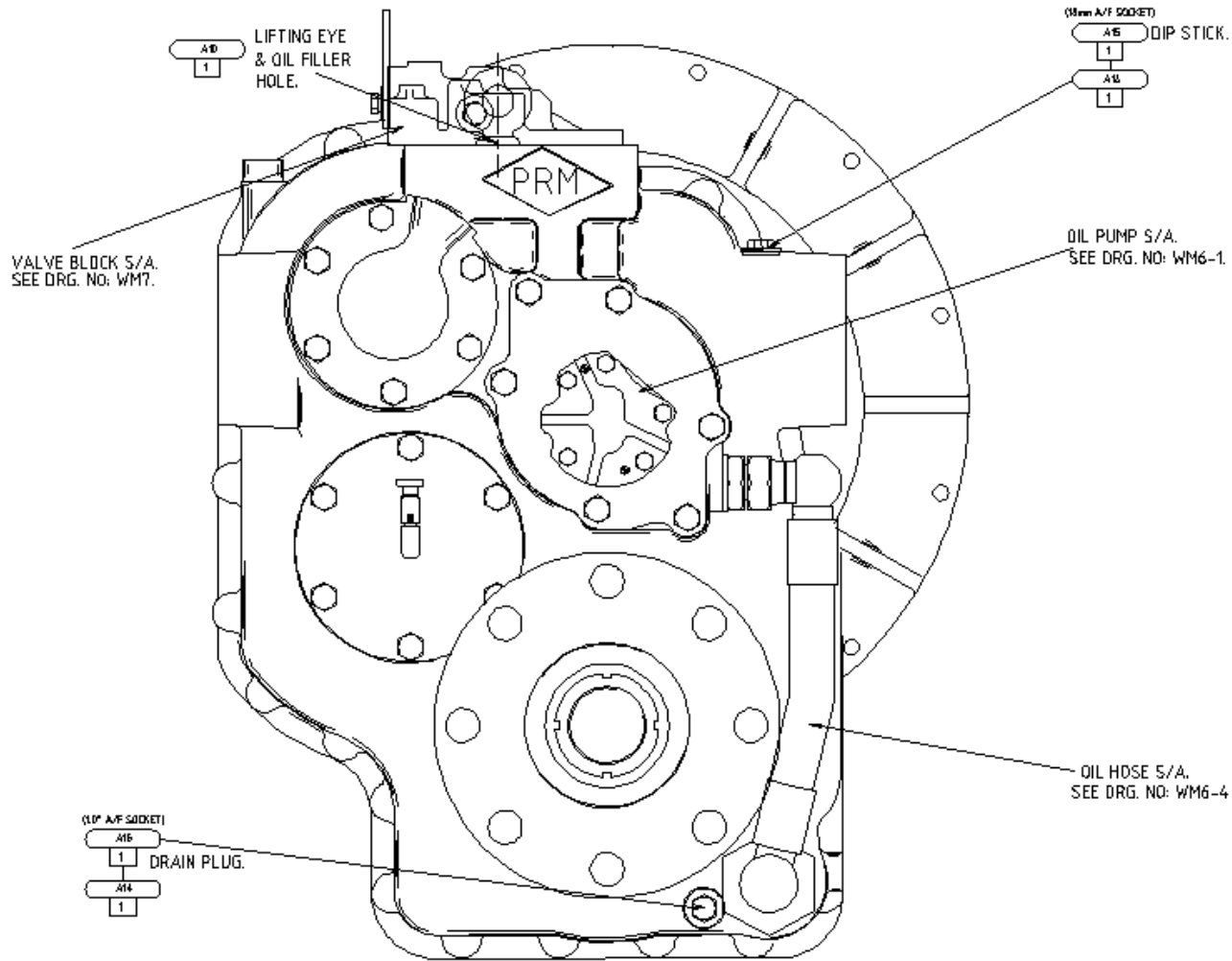
WEB: www.newage-prm.co.uk

DRAWINGS & PARTS LIST

SECTION A – GEARCASE ASSEMBLY (DEEP CASE)			
ITEM NO.	DESCRIPTION	PART NO.	QTY.
A1	Rear deep gear case	MT8223	1
A2	Front deep gear case (SAE1)	MT8221	1
A3	Front deep gear case (SAE2)	MT8222	1
A4	Adapter ring (SAE1 to SAE3)	MT8239	1
A5	Hex head screws	0041211	21
A6	Hex head bolts	004-0060	4
A7	Screws (Adapter ring)	USF74	12
A8	Dowel	010-0040	2
A9	Screwed plug	0150416	1
A10	Lifting eye	CP1412	1
A11	Gasket (valve block)	MT8322	1
A12	'O' – ring	002-0340	1
A13	Washer (Adapter ring)	W125	12
A14	Bonded washer	0201714	1
A15	Dipstick	0801305	1
A16	Oil drain plug (magnetic)	CP1331	1



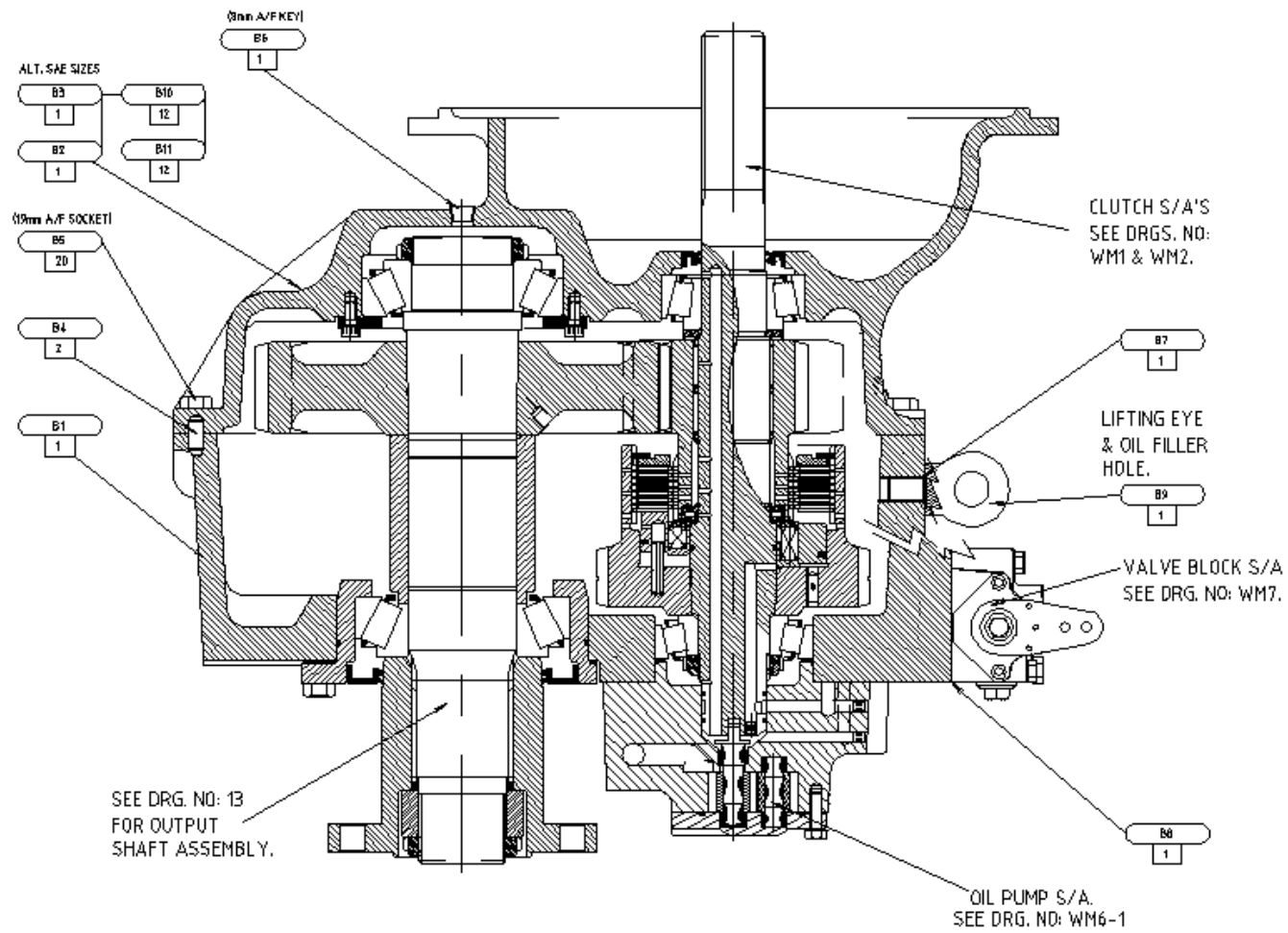
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PRM1500 DFFP G.A. SFF PARTS I IST 'A'.

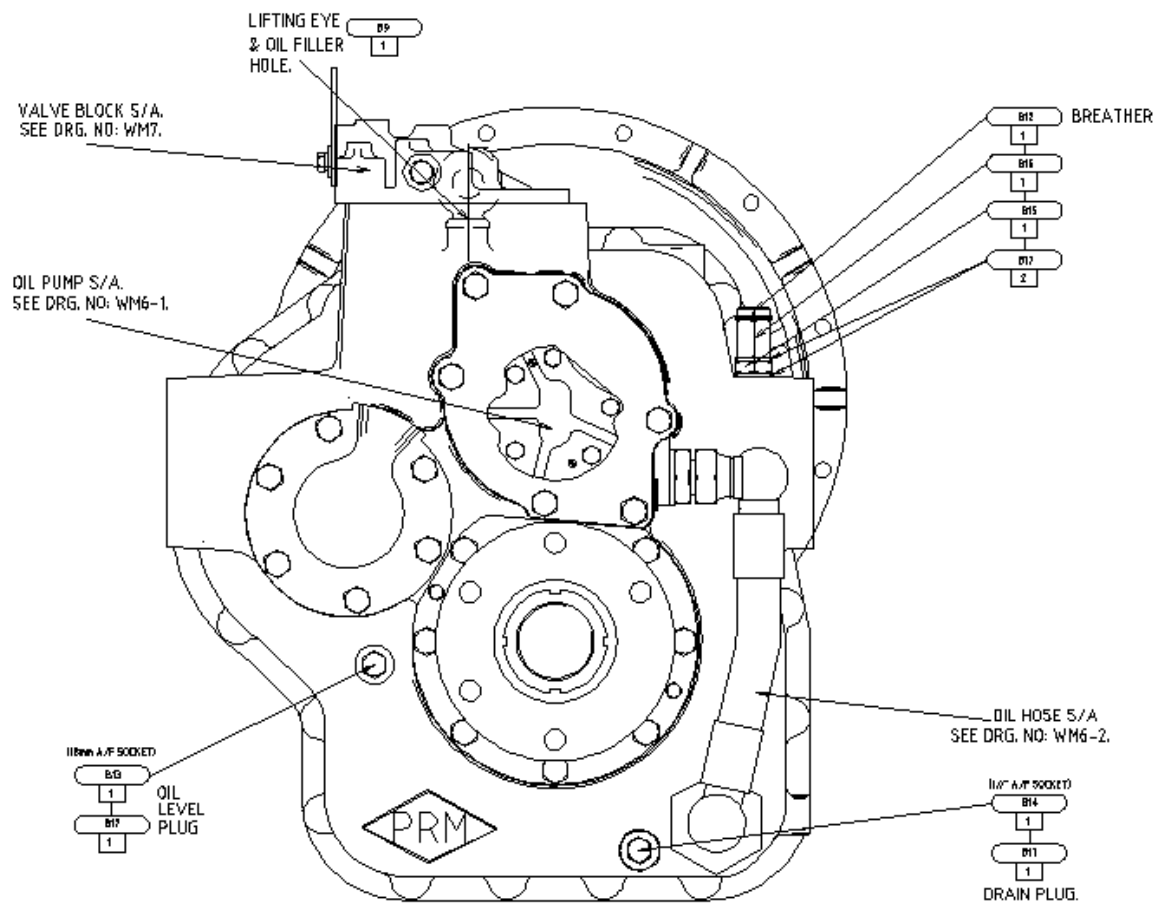
DRG. No:PRM1500WM3-2. MTG.

SECTION B – GEAR CASE ASSEMBLY (SHALLOW CASE)			
ITEM NO.	DESCRIPTION	PART NO.	QTY.
B1	Rear shallow gear case	MT8251	1
B2	Front shallow gear case	MT8250	1
B3	Adapter ring (SAE3 to SAE1)	MT8342	1
B4	Dowel	010-0040	2
B5	Hex head screw	0041211	20
B6	Screwed plug	0150416	1
B7	'O' ring	002-0340	1
B8	Gasket (valve block)	MT8322	1
B9	Lifting eye	CP1412	1
B10	Screws (adapter ring)	0020608	12
B11	Washers (adapter ring)	W108	12
B12	Breather	008-0080	1
B13	Oil level plug	CP1189	1
B14	Oil drain plug (magnetic)	CP1331	1
B15	Straight adapter M/M	CP1416	1
B16	Barrel nut	CP1418	1
B17	Bonded washer	0201714	1



SECTIONAL VIEW: PRM1500 SHALLOW G.A. SEE PARTS LIST 'B'.

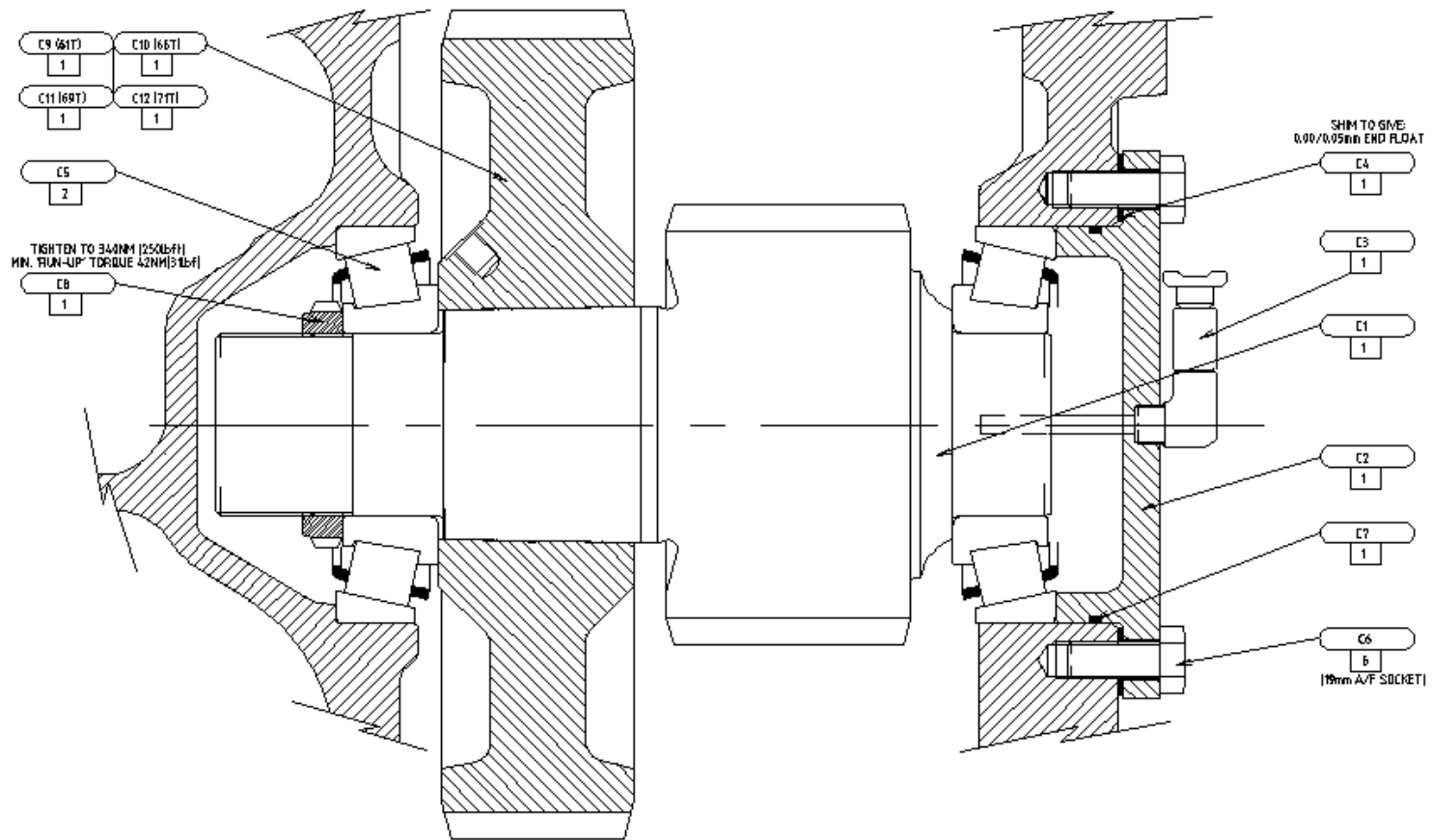
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SECTIONAL VIEW: PRM1500 SHALLOW G.A. SEE PARTS LIST 'B'.

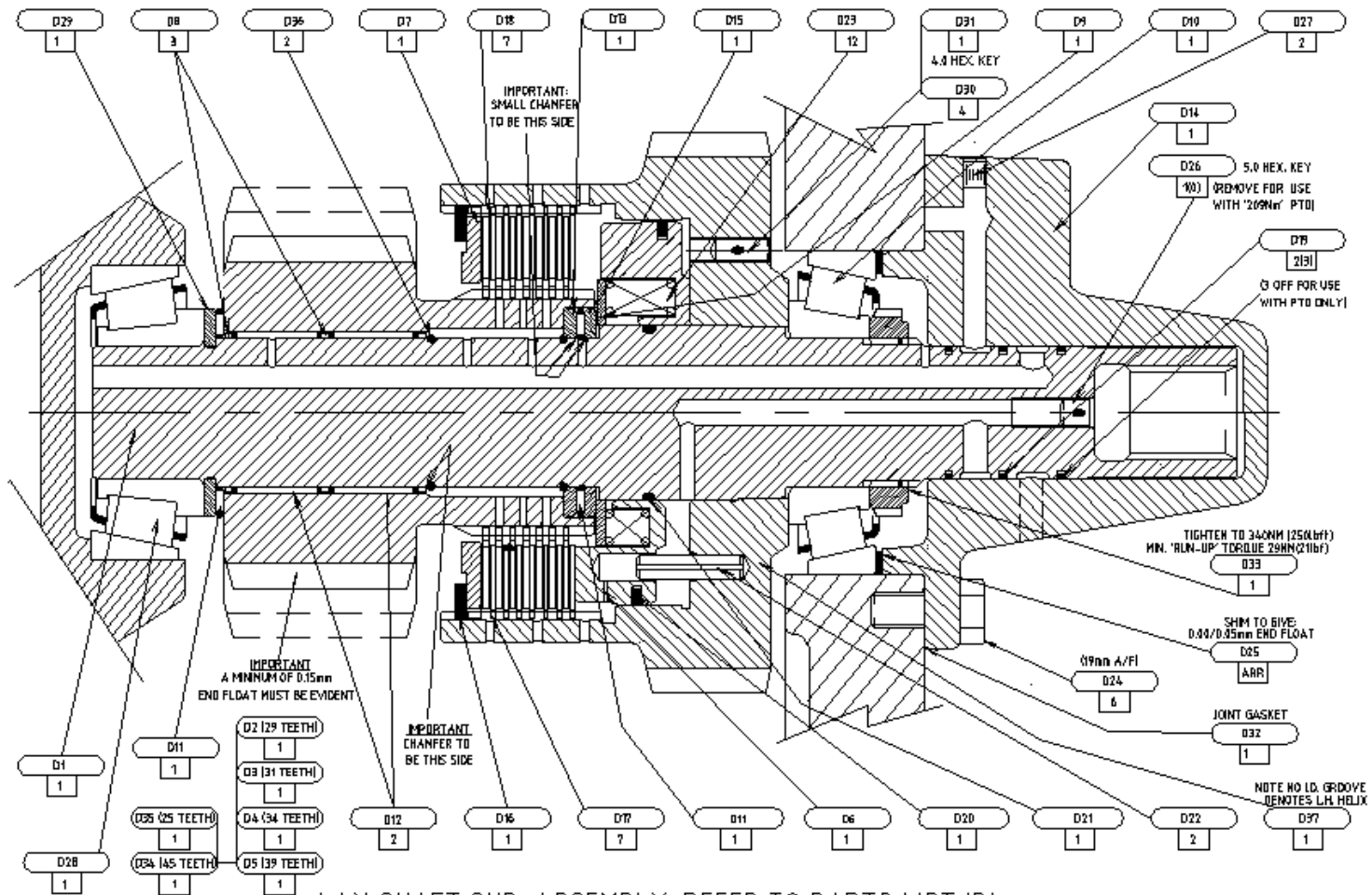
DRG. No: PRM1500WM12-2. MTG.

SECTION C – SECONDARY PINION SHAFT ASSEMBLY (DEEP CASE)			
ITEM NO.	DESCRIPTION	PART NO.	QTY.
C1	Secondary pinion shaft	MT8225	1
C2	End cover (secondary shaft)	MT8158	1
C3	Breather	MT8315S/A	1
C4	Shims	MT8157/A..E	A.R.
C5	Taper roller bearing	0540603	2
C6	Hex head screw	0041209	6
C7	'O' – ring	0431253	1
C8	Locknut	075F601	1
C9	Secondary pinion (61 teeth) 1.56:1	MT8130	1
C10	Secondary pinion (66 teeth) 1.94:1	MT8131	1
C11	Secondary pinion (69 teeth) 2.23:1	MT8230	1
C12	Secondary pinion (71 teeth) 2.45:1	MT8231	1

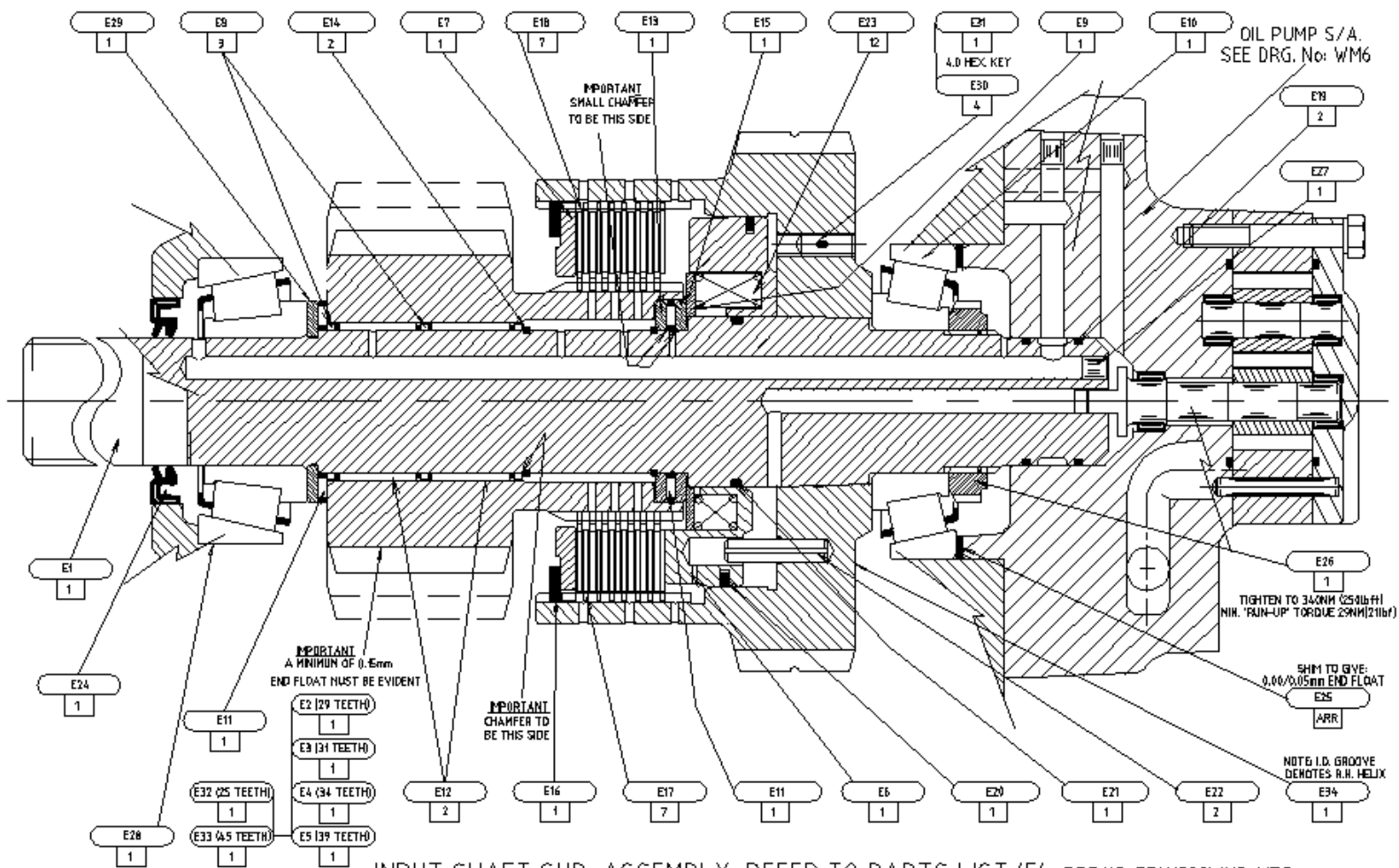


PRM1500DEEP SECONDARY PINION SHAFT SUB-ASSEMBLY. SEE PARTS LIST 'C'. DRG.NO: PRM1500WMS. MTG.

SECTION D – LAY SHAFT ASSEMBLY			
ITEM NO.	DESCRIPTION	PART NO.	QTY.
D1	Lay shaft	MT8275	1
D2	Pinion (29 teeth) 2.45:1	MT8229	1
D3	Pinion (31 teeth) 2.25:1	MT8228	1
D4	Pinion (34 teeth) 1.94:1	MT8126	1
D5	Pinion (39 teeth) 1.56:1	MT8125	1
D6	Piston	MT8312	1
D7	Clutch reaction plate	MT8134	1
D8	Spacer	MT8303	3
D9	Thrust washer	MT8313	1
D10	Taper roller bearing	0540503	1
D11	Needle bearings	0605501	2
D12	Needle bearings	0565001	2
D13	Thrust washer	MT8249	1
D14	PTO manifold cover	MT8274	1
D15	Thrust washer	0595001	1
D16	Internal circlip	0251350	1
D17	Clutch plate (plain)	MT8136	7
D18	Clutch plate (friction)	MT8135S/A	7
D19	Piston rings	MT8141	2(3>PTO)
D20	Piston rings	MT8138	1
D21	'O' –ring	0430533	1
D22	Spiral pins	028S835	2
D23	Compression springs	0311048	12
D24	Hex head screw	0041209	6
D25	Shims	057110/A..E	A.R.
D26	Grub screw	014C610F	1(0>PTO)
D27	Sealing plugs	073080	2
D28	Taper roller bearing	0540454	1
D29	Thrust washer	MT8168	1
D30	Get you home emergency screw	014V520F	4
D31	Get you home emergency screw key	CP1420	1
D32	Gasket	MT8357	1
D33	Self locking nut	075F501	1
D34	Pinion (45 teeth) 1.22:1	MT8124	1
D35	Pinion (25 teeth) 3.00:1	MT8128	1
D36	Spring rings	MT8240	2
D37	Clutch gear L.H.	MT8140	1

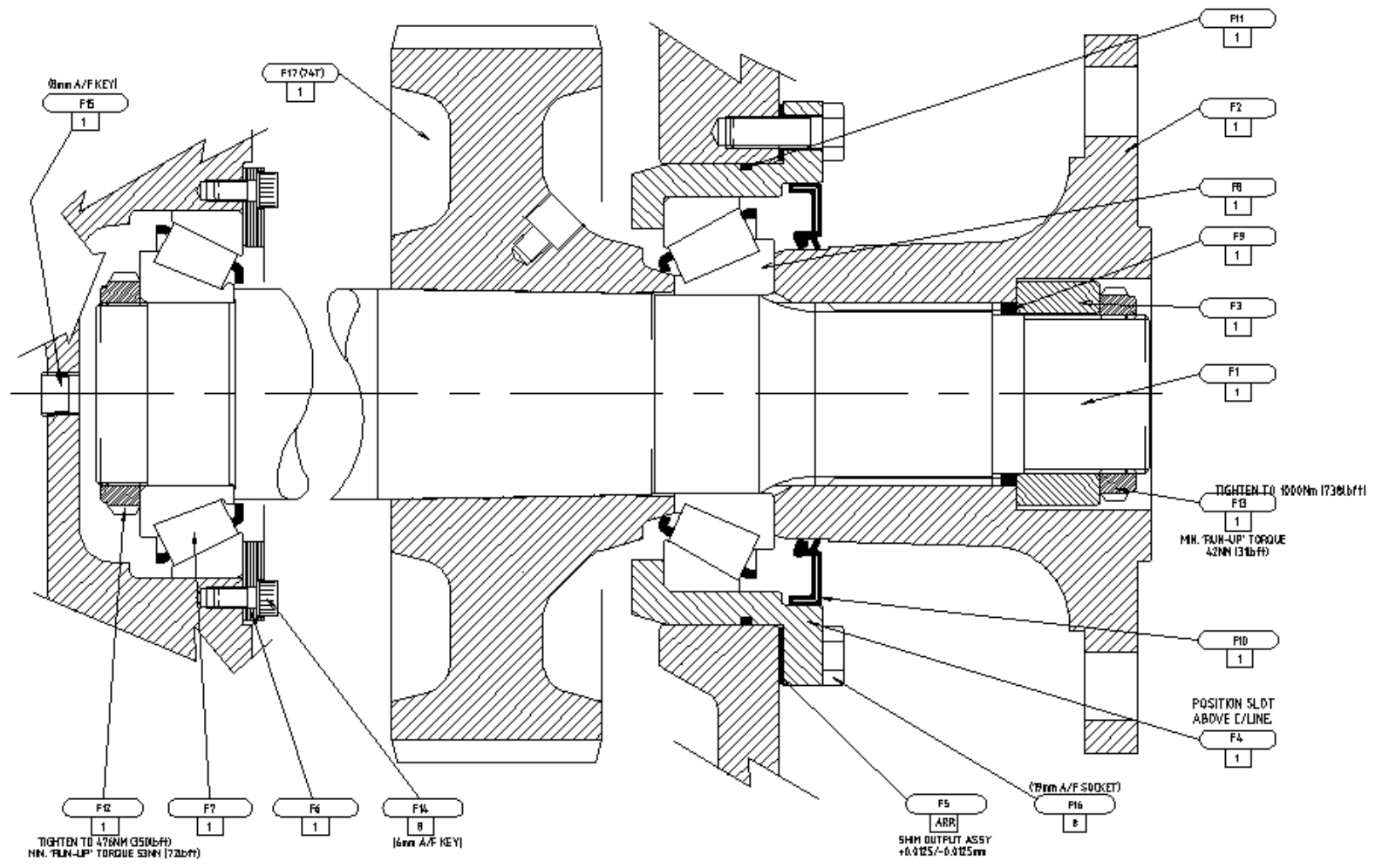


SECTION E – INPUT SHAFT ASSEMBLY			
ITEM NO.	DESCRIPTION	PART NO.	QTY.
E1	Input shaft	MT8216	1
E2	Pinion (29 teeth) 2.45:1	MT8229	1
E3	Pinion (31 teeth) 2.25:1	MT8228	1
E4	Pinion (34 teeth) 1.94:1	MT8126	1
E5	Pinion (39 teeth) 1.56:1	MT8125	1
E6	Piston	MT8312	1
E7	Clutch Reaction plate	MT8134	1
E8	Spacer	MT8303	3
E9	Thrust washer	MT8313	1
E10	Taper roller bearing	0540503	1
E11	Needle bearing	0605501	2
E12	Needle bearing	0565001	2
E13	Thrust washer	MT8249	1
E14	Spring ring	MT8240	2
E15	Thrust washer	0595001	1
E16	Internal circlip	0251350	1
E17	Clutch plate (plain)	MT8136	7
E18	Clutch plate (friction)	MT8135S/A	7
E19	Piston ring	MT8141	2
E20	Piston ring	MT8138	1
E21	'O' –ring	0430533	1
E22	Spiral pin	028S835	2
E23	Compression spring	0311048	12
E24	Oil seal	0400455	1
E25	Shims	057110/A..E	A.R.
E26	Self locking nut	075F501	1
E27	Sealing plug	073080	2
E28	Taper roller bearing	0540454	1
E29	Thrust washer	MT8168	1
E30	Get you home emergency screw	014V20F	4
E31	Get you home emergency screw key	CP1420	1
E32	Pinion (25 teeth) 1.22:1	MT8124	1
E33	Pinion (45 teeth) 3.00:1	MT8128	1
E34	Clutch gear R.H.	MT8139	1



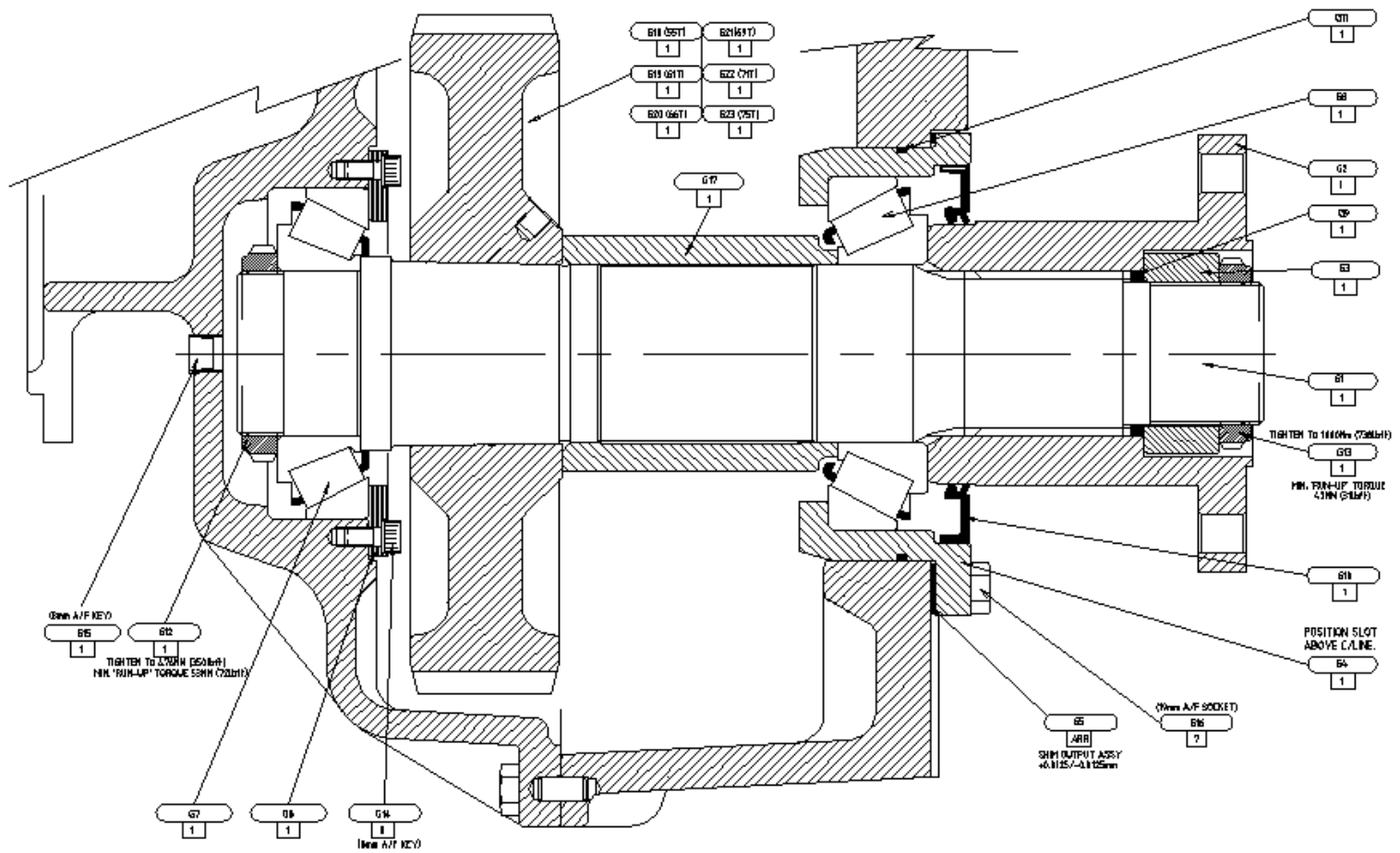
INPUT SHAFT SUB-ASSEMBLY: REFER TO PARTS LIST 'E'. DRG.NO: PRM1500WM2. MTG.

SECTION F – OUTPUT SHAFT ASSEMBLY (DEEP CASE)			
ITEM NO.	DESCRIPTION	PART NO.	QTY.
F1	Output shaft Assembly	MT8161ASSY	1
F2	Output flange	MT8176	1
F3	Output coupling washer	MT8165	1
F4	Output seal housing	MT8162	1
F5	Shims	MT8163/A..E	A.R.
F6	End plate	MT8147	1
F7	Taper roller bearing	0540701	1
F8	Taper roller bearing	0540702	1
F9	Nu-lip seal	0740601	1
F10	Oil seal	0401101	1
F11	'O' –ring	0431693	1
F12	Locknut	075F701	1
F13	Locknut	075F601	A.R.
F14	Socket cap screw	0081420L	8
F15	Pressure plug	0150416	1
F16	Hex head screw	0041210F	8
F17	Output gear (74 teeth) 2.00:1	MT8226	1



PRM1500 DEEP OUTPUT SHAFT SUB-ASSEMBLY: REFER TO PARTS LIST 'F'. DRG.NO: PRM1500WM4. MTG.

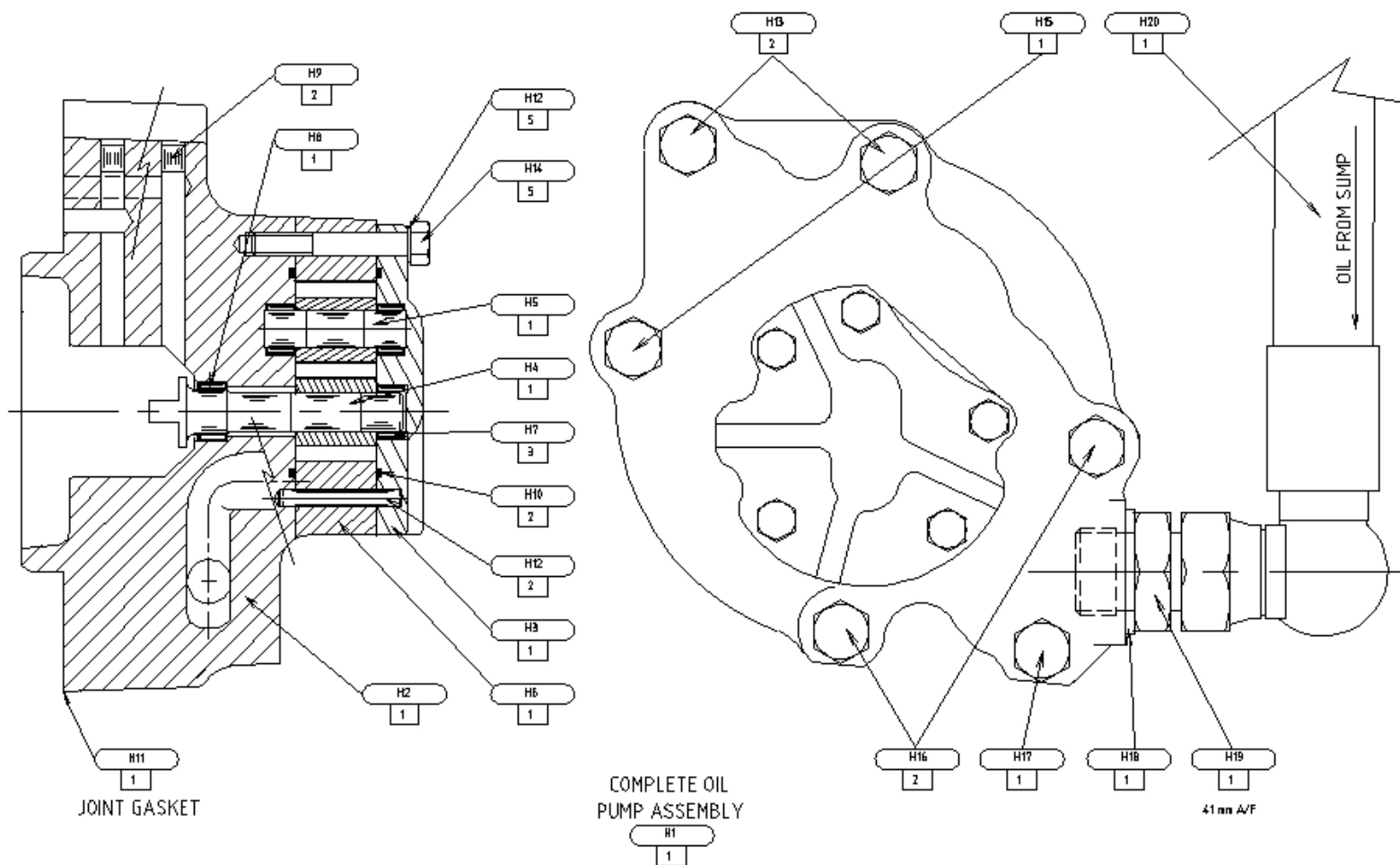
SECTION G – OUTPUT SHAFT ASSEMBLY (SHALLOW CASE)			
ITEM NO.	DESCRIPTION	PART NO.	QTY.
G1	Output shaft	MT8257	1
G2	Output flange	MT8175	1
G3	Output coupling washer	MT8165	1
G4	Output seal housing	MT8258	1
G5	Shims	MT8163/A..E	A.R.
G6	End plate	MT8147	1
G7	Taper roller bearing	0540701	1
G8	Taper roller bearing	0540702	1
G9	Nu-lip seal	0740601	1
G10	Oil seal	0401101	1
G11	'O' ring	0431693	1
G12	Locknut	057F701	1
G13	Locknut	075F601	1
G14	Socket cap screw	0081420L	8
G15	Pressure plug	0150416	1
G16	Hex head screw	0041210F	1
G17	Spacer	MT8261	1
G18	Output gear (55 teeth) 1.22:1	MT8262	1
G19	Output gear (61 teeth) 1.56:1	MT8263	1
G20	Output gear (66 teeth) 1.94:1	MT8264	1
G21	Output gear (69 teeth) 2.25:1	MT8265	1
G22	Output gear (71 teeth) 2.45:1	MT8266	1
G23	Output gear (75 teeth) 3.00:1	MT8267	1



PRM1500 OUTPUT SHAFT (SHALLOW) REFER TO PARTS LIST 'G'.

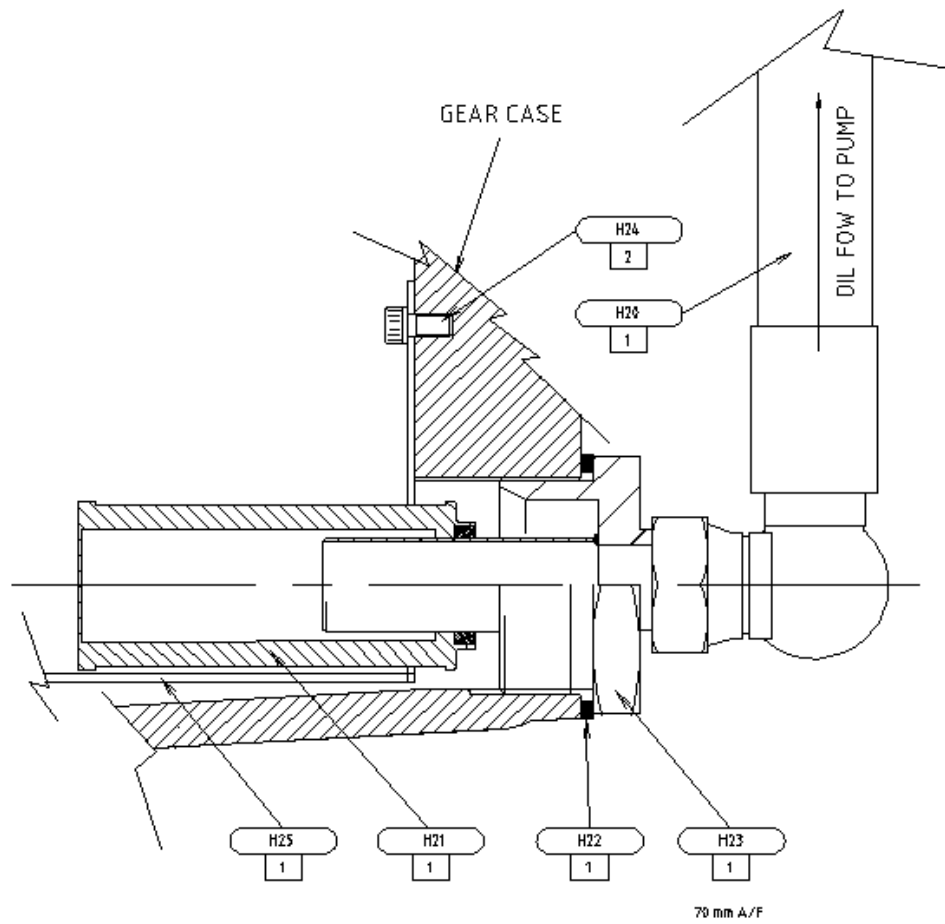
DRG. NO: PRM1500WM13. MTG.

SECTION H – OIL PUMP ASSEMBLY & OIL HOSE / STRAINER –(DEEP CASE)			
ITEM NO.	DESCRIPTION	PART NO.	QTY.
H1	Complete oil pump Assembly	MT0478	1
H2	Oil pump body	MT8280	1
H3	Pump cover	MT1491	1
H4	Drive spindle	MT8218	1
H5	Pump spindle S/A	MT0459	1
H6	Pump plate	MT8148	1
H7	Needle bearing	0560801	3
H8	Needle bearing	0560901	1
H9	Sealing plug	073080	2
H10	'O' –ring	0430682	2
H11	Gasket	MT8169	1
H12	Spring washer	0191105	5
H13	Hex head bolt	0041215	2
H14	Hex head bolt	0040814	5
H15	Hex head bolt	0041219	1
H16	Hex head bolt	0041211	2
H17	Hex head bolt	0041210F	1
H18	Bonded washer	0201720	1
H19	M/M adapter	0081420L	1
H20	Flexible hose Assy.	MT8308	1
H21	Oil strainer	MT8212	1
H22	Bonded washer	0201760	1
H23	Special adapter	MT8307	1
H24	Socket cap screw	081310L	2
H25	Baffle	MT8208	1



PRM1500DEEP PUMP SUB-ASSEMBLY & OIL HOSE. SEE PARTS LIST 'H'.

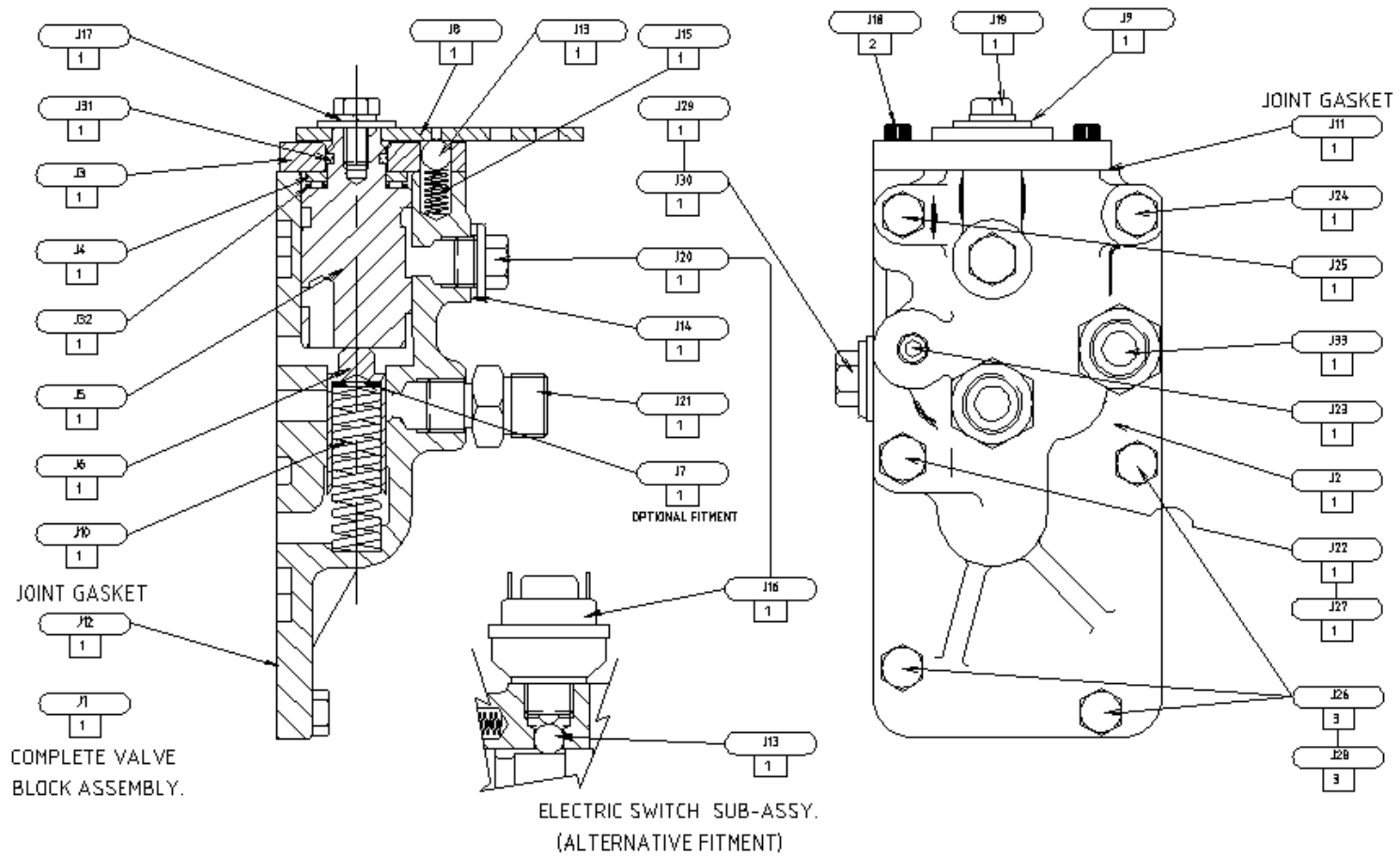
DRG.NO: PRM1500WM6-1. MTG.



PRM1500DEEP OIL STRAINER & OIL HOSE. SEE PARTS LIST 'H'.

DRG.NO: PRM1500WM6-2. MTG.

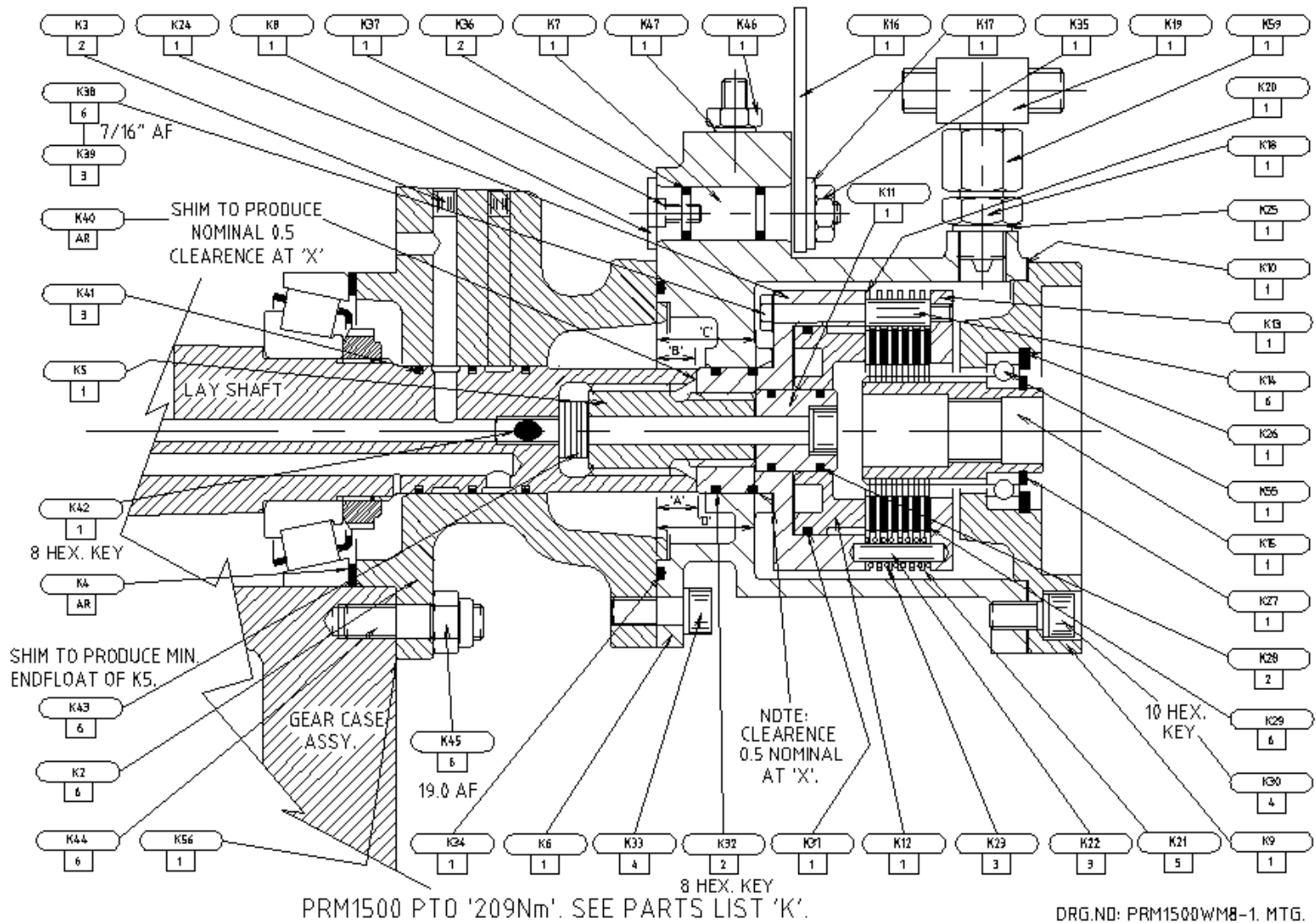
SECTION J – VALVE BLOCK ASSEMBLY (SOFT SHIFT) REFER TO DRG 7-1			
ITEM NO.	DESCRIPTION	PART NO.	QTY.
J1	Complete valve block Assy.	MT0494	1
J2	Valve block body	MT8369	1
J3	End cover	MT978	1
J4	Thrust race	CP1308	1
J5	Control valve	MT4656	1
J6	Piston	MT4751	1
J7	Spacer (optional)	0191007ZP	1
J8	Operating lever	MT977	1
J9	Washer	MT979	1
J10	Spring	MT4928	1
J11	End cover gasket	MT1801	1
J12	Joint gasket	MT8322	1
J13	Steel ball (optional)	CP1077	2
J14	Bonded seal	0201715	1
J15	Spring	MT305	1
J16	Switch (optional)	CP1358	1
J17	Spring washer	0191105	1
J18	Socket cap screw	0081220	2
J19	Hex head screw	0040806	1
J20	Plug (optional)	CP1360	1
J21	M/M adapter	CP1446	1*
J22	Hex head screw	0041014	1
J23	Pressure plug	MT311	1
J24	Hex head screw	0040812	1
J25	Hex head screw	0040815	1
J26	Hex head screw	0040808	3
J27	Bonded washer	0191710	1
J28	Bonded washer	0191708	5
J29	Bonded washer	0191718	1
J30	Plug	0150318	5
J31	Nu-lip seal	MT8802	1
J32	Thrust bearing	CP1307	1
J33	M/M adapter	CP1416	1*

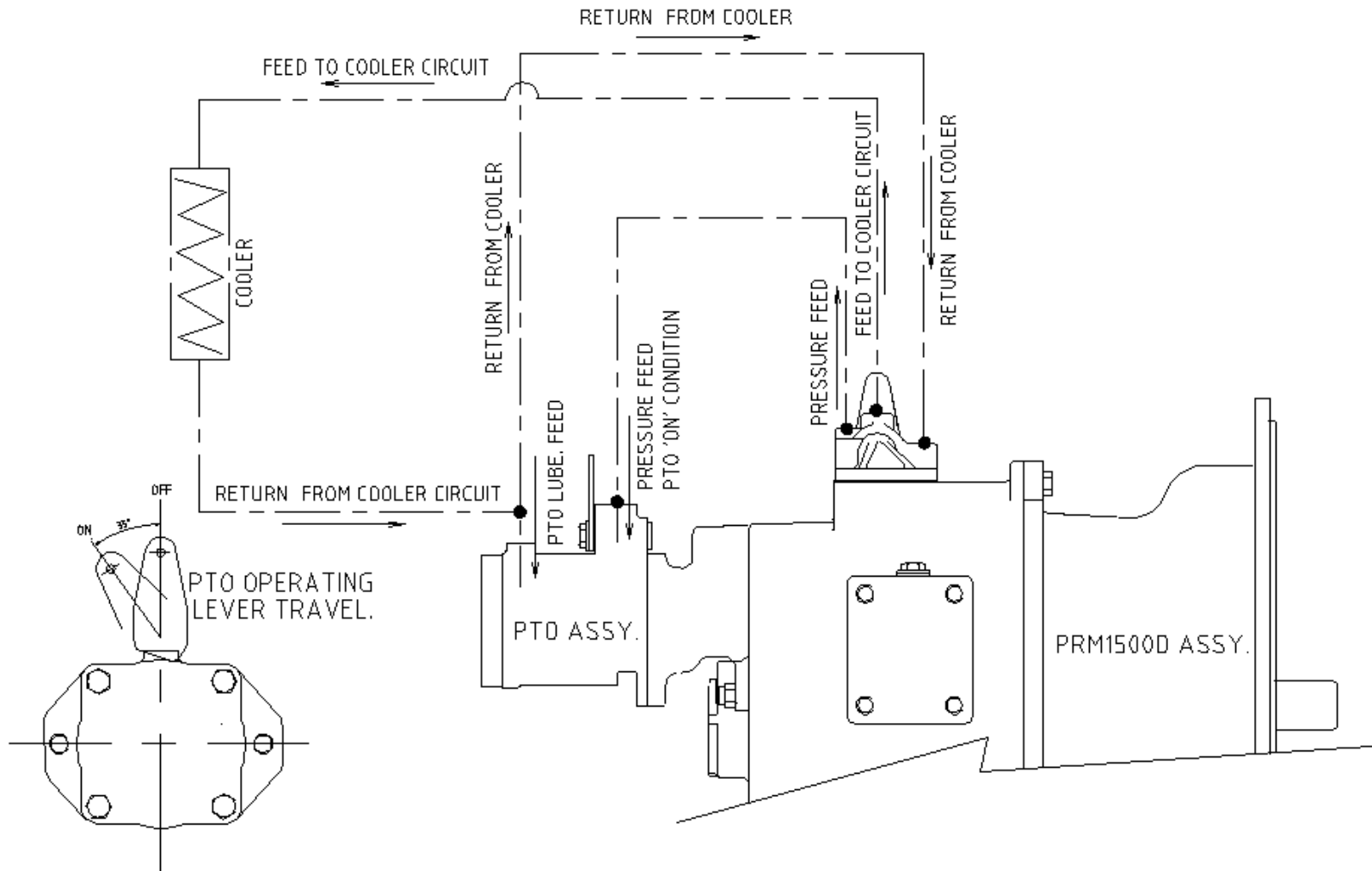


PRM1500 VALVE BLOCK (SOFT SHIFT) SUB-ASSEMBLY. SEE PARTS LIST 'J'. DRG.NO: PRM1500WM7-1.MTG.

SECTION K – 209NM PTO – REFER TO DRG. WM8-1, WM8-2, WM8-3, WM8-4, WM8-5			
ITEM NO.	DESCRIPTION	PART NO.	QTY.
K1	209NM PTO S/A	MT0199	1
K2	Adapter housing	MT8276	1
K3	Sealing plug	073080	2
K4	Shims	057110/A..E	A.R.
K5	Splined adapter	MT8278	1
K6	PTO body	MT1310	1
K7	Selector valve	MT1626	1
K8	End cap	MT1625	1
K9	Cover	MT1309	1
K10	Joint gasket	MT5011	1
K11	Plug	MT1549	1
K12	Piston	MT1347	1
K13	Clutch end cover	MT113	1
K14	Ferrule	MT1156	6
K15	Drive adapter	MT5004	1
K16	Operating lever	MT5007	1
K17	Washer	MT979	1
K18	Union S/A	MT4583	1
K19	'T' piece	CP1367	1
K20	Clutch end plate	MT117	1
K21	Clutch plate	MT116	5
K22	Pin	MT1155	3
K23	Spring	MT1157	3
K24	Clutch body	MT5003	1
K25	Bonded washer	0201715	1
K26	Internal circlip	0250530	1
K27	External circlip	0330300	1
K28	'O' ring	001123	2
K29	Clutch plate sintered	MT731/S	6
K30	Socket cap screw	0081620	4
K31	'O' ring	002874	1
K32	'O' ring	0071722	2
K33	Socket cap screw	0081525	4
K34	'O' ring	004124	1
K35	Hex nut	0050801	1
K36	'O' ring	000753	2
K37	Socket cap screw	0081312L	1
K38	Hex head bolt	0010420	6
K39	Washer	MT351	6
K40	Shims	MT8284/A/B	A.R.
K41	Piston ring	MT8141	3
K42	Socket cap screw	0081592F	1
K43	Washer	0191008	A.R.
K44	Stud	005-0050	6
K45	Nyloc nut	0051205	6
K46	M/M adapter	CP1341	2
K47	Bonded washer	CP1224	2

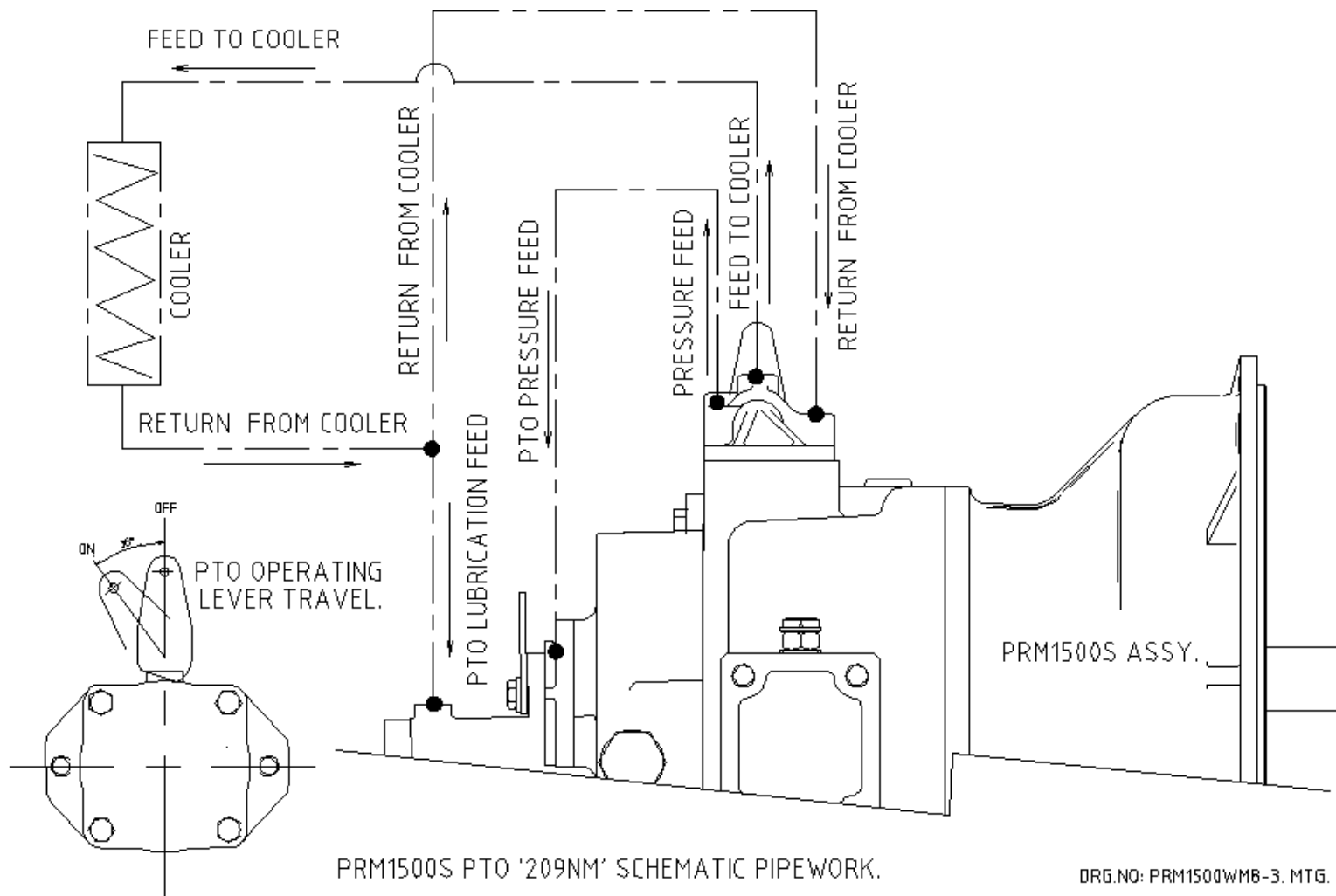
SECTION K – 209NM PTO – REFER TO DRG. WM8-1, WM8-2, WM8-3, WM8-4, WM8-5			
ITEM NO.	DESCRIPTION	PART NO.	QTY.
K48	Flexible hose	MT8396	2
K49	Flexible hose	?	1
K50	Flexible hose	?	1
K51	Bonded washer	020715	2
K52	Bonded washer	0191718	1
K53	Plug	0151318	1
K54	M/M adapter	CP1286	2
K55	Ball bearing	0513010	2
K56	Gasket	MT8357	1
K57	Cooler: PRM1500 Shallow type	MT8330	1
K58	Cooler: PRM1500 Deep type	MT8331	1

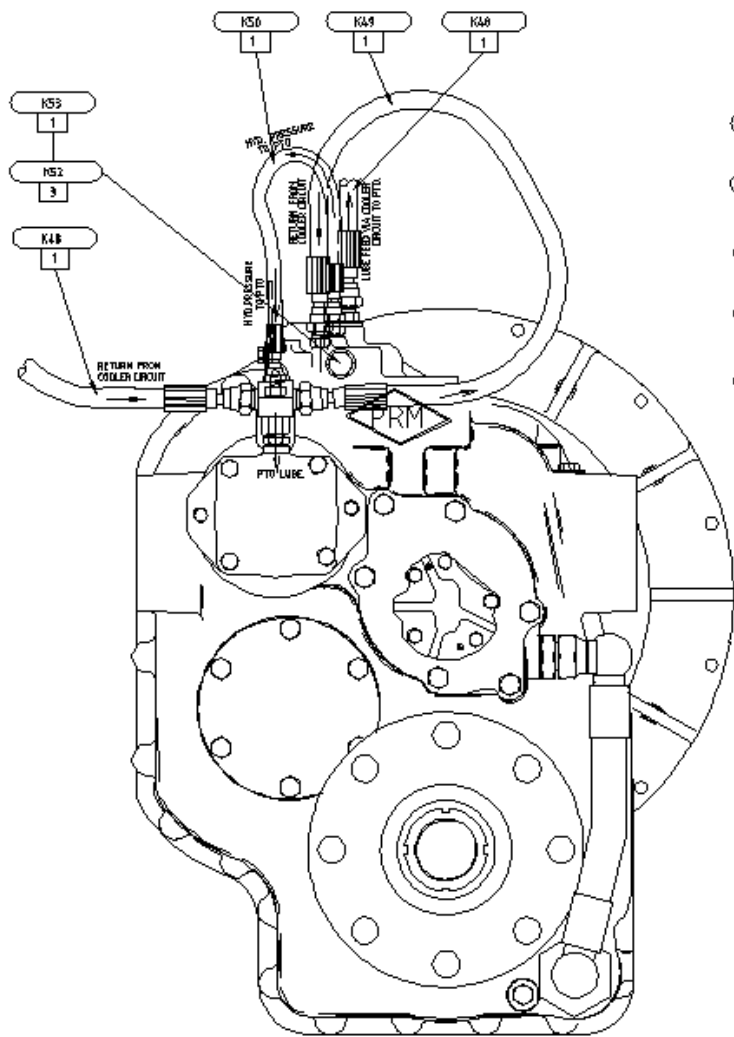




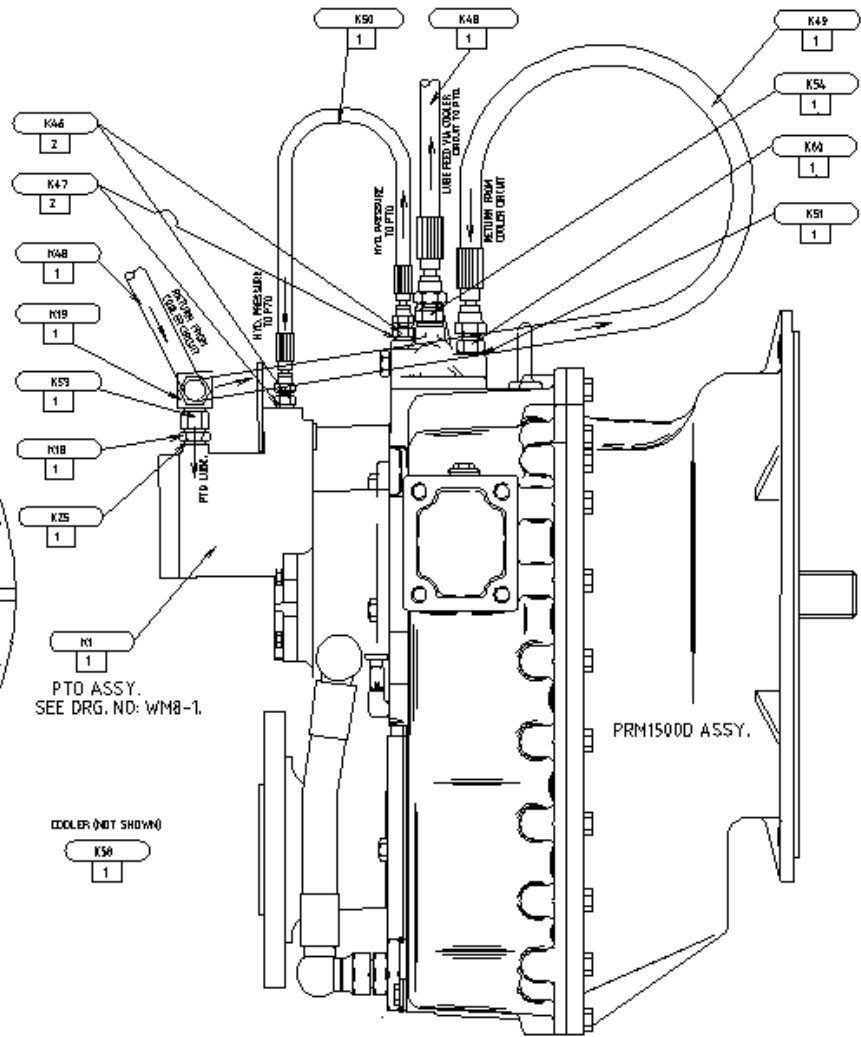
PRM1500D PTO '209NM' SCHEMATIC PIPEWORK.

DRG.NO: PRM1500WM8-2. MTG.

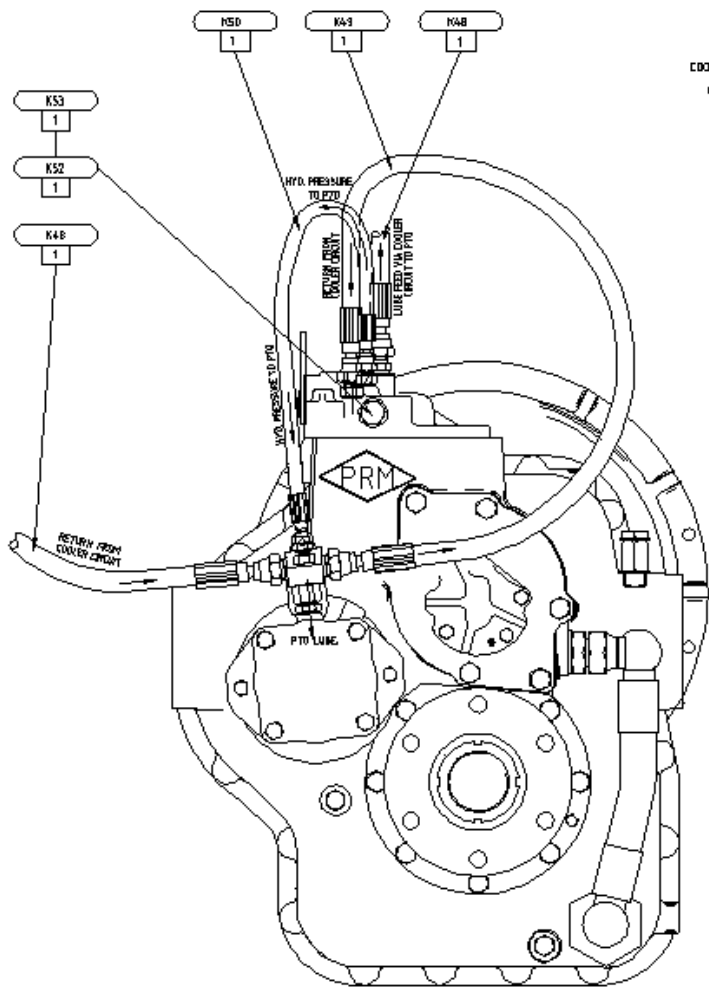




PRM1500D PTO '209Nm' PIPEWORK. SEE PARTS LIST 'K'.

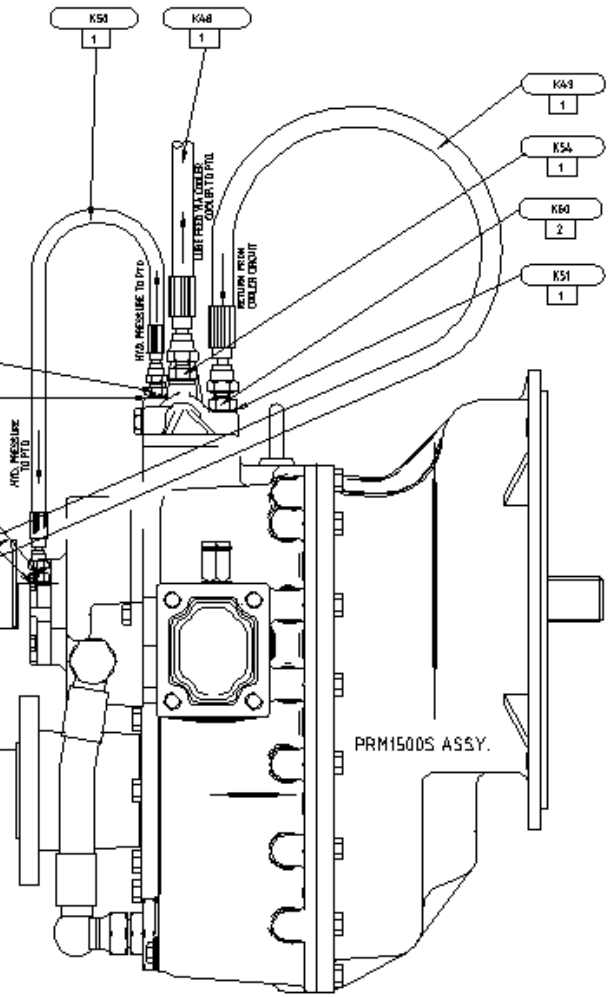


DRG. NO: PRM1500WM8-4. MTG.



COOLER (NOT SHOWN)
K57
1

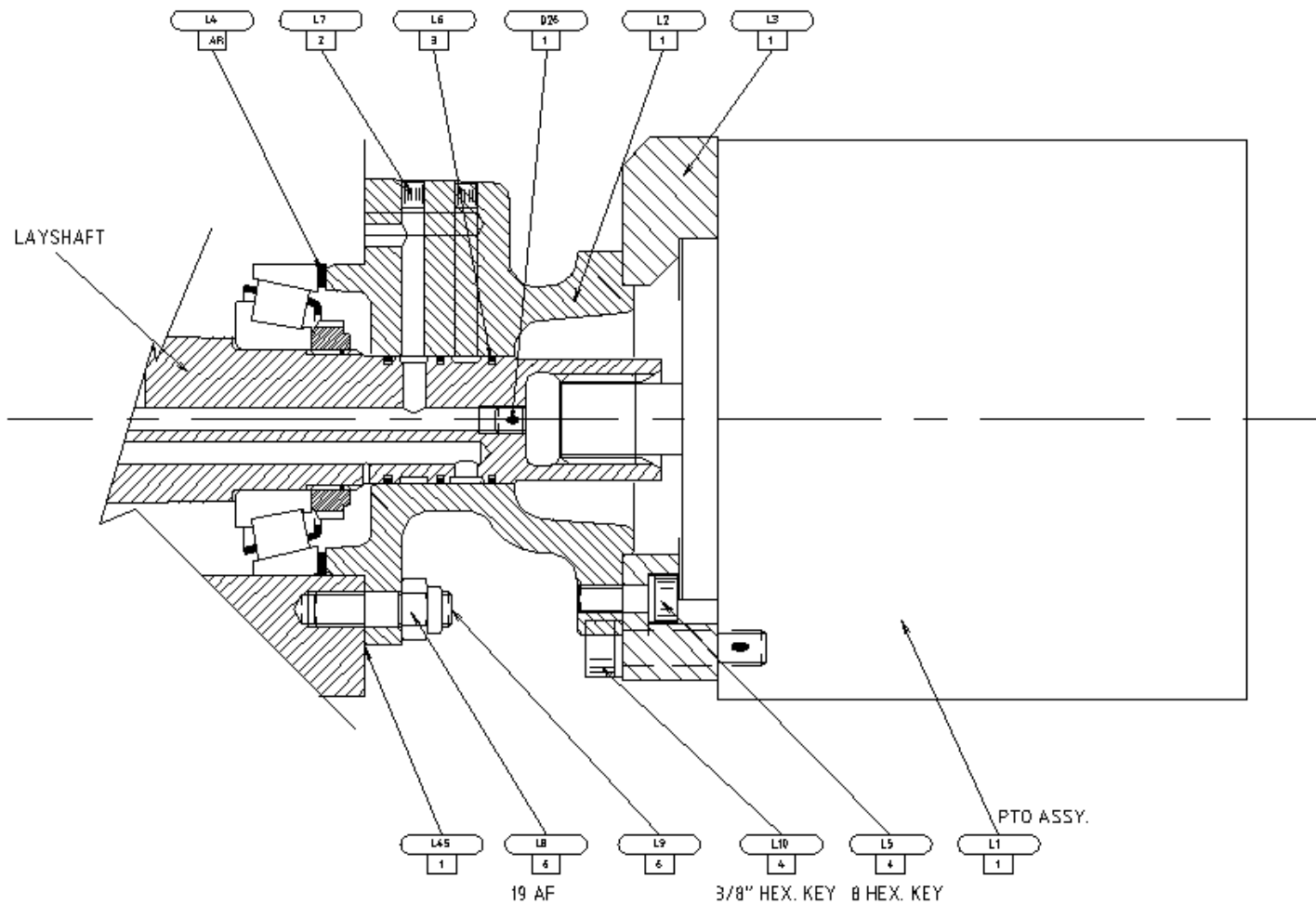
K46
2
K47
2
K48
1
K49
1
K50
1
K51
1
K25
1
K1
1
PTO ASSY.
SEE DRG. NO: WMB-1.



PRM1500S PTO '205Nm' PIPEWORK. SEE PARTS LIST 'K'.

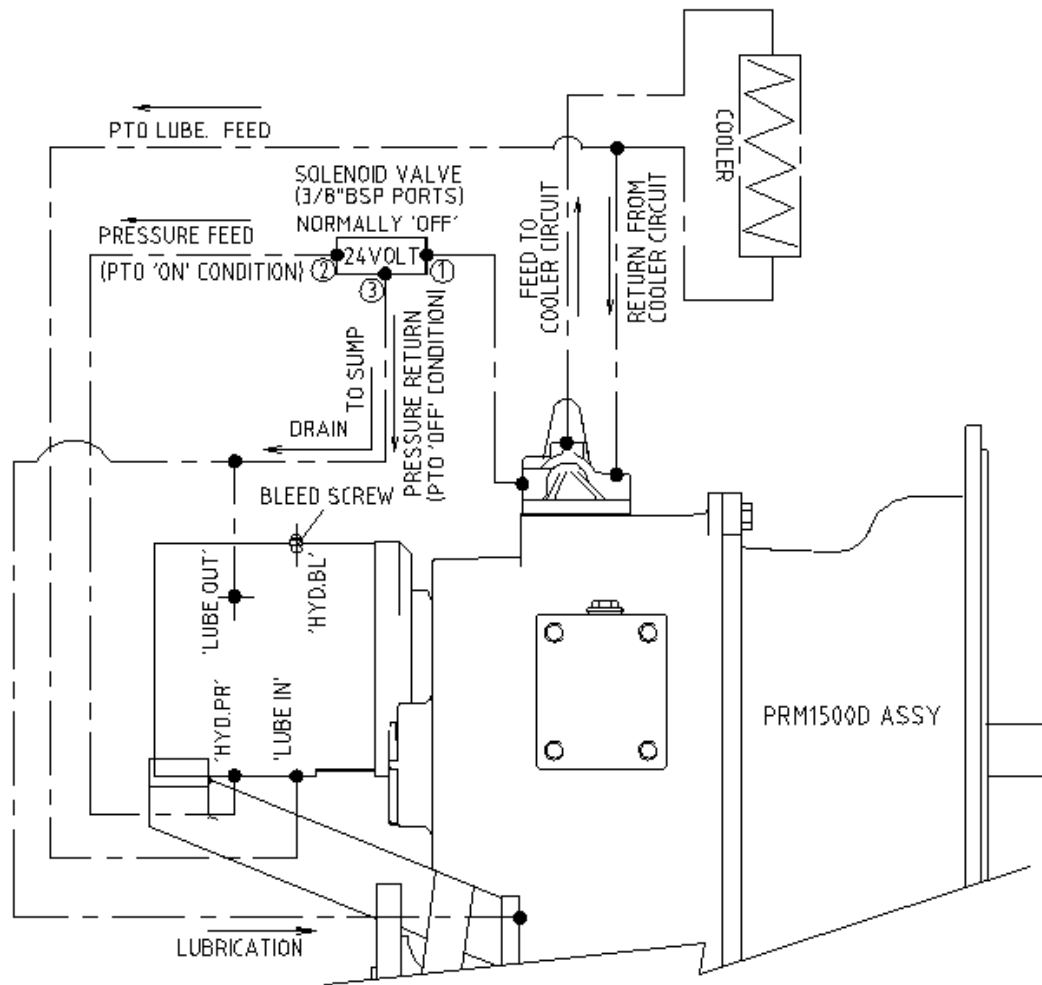
DRG.NO: PRM1500WMB-5. MTG.

SECTION L – 640NM PTO – REFER TO DRG. WM9-1, WM9-2, WM9-3, WM9-4, WM9-5			
ITEM NO.	DESCRIPTION	PART NO.	QTY.
L1	640NM PTO S/A	MT8279	1
L2	Adapter housing	MT8276	1
L3	Adapter ring	MT8277	1
L4	Shims	057110/A..E	A.R.
L5	Socket cap screw	0081525	4
L6	Piston ring	MT8141	3
L7	Sealing ring	073080	2
L8	Nyloc nut	0051205	6
L9	Stud	005-0050	6
L10	Socket cap screw	0771516P	4
L11	Solenoid valve	MT8346	1
L12	24v solenoid	MT4874	1
L13	Line body	MT8345	1
L14	'T' piece adapter M/M/M	CP1445	1
L15	'T' piece adapter M/M/M	CP1456	1
L16	Swivel adapter M/F	CP1427	1
L17	Swivel adapter M/M	CP1429	1
L18	Straight adapter M/M	CP1286	3
L19	Straight adapter M/M	CP1442	2
L20	JIC adapter M/M	CP1443	1
L21	Straight adapter M/M	MT4825	1
L22	Straight adapter M/M	CP1459	1
L23	Bonded washer	0201715	7
L24	Flexible hose	MT8396	2
L25	Swivel adapter M/F	CP1462	1
L26	'O' ring	CP1454	1
L27	Flexible hose	?	1
L28	Flexible hose	?	1
L29	Flexible hose	?	1
L30	Flexible hose	?	1
L31	Bonded washer	0191718	1
L32	Breather (1500S only)	008-0080	1
L33	Barrel nut	CP1418	1
L34	Bonded washer	CP1204	1
L35	Flexible hose	?	1
L36	Swivel adapter M/F	CP1449	1
L37	'T' piece adapter M/M/M	0081312L	1
L38	Bonded washer	0201714	1
L39	Flexible hose	?	1
L40	Rubber pad	MT8356	1
L41	Support arm (Deep)	MT8343	1
L42	Support arm (Shallow)	MT8434	1
L43	Plain washer	019-1011	3
L44	Hex head screw	004-1210	3
L45	Gasket	MT8357	1
L46	Cooler: PRM1500 Shallow type	MT8330	1
L47	Cooler: PRM1500 Deep type	MT8331	1



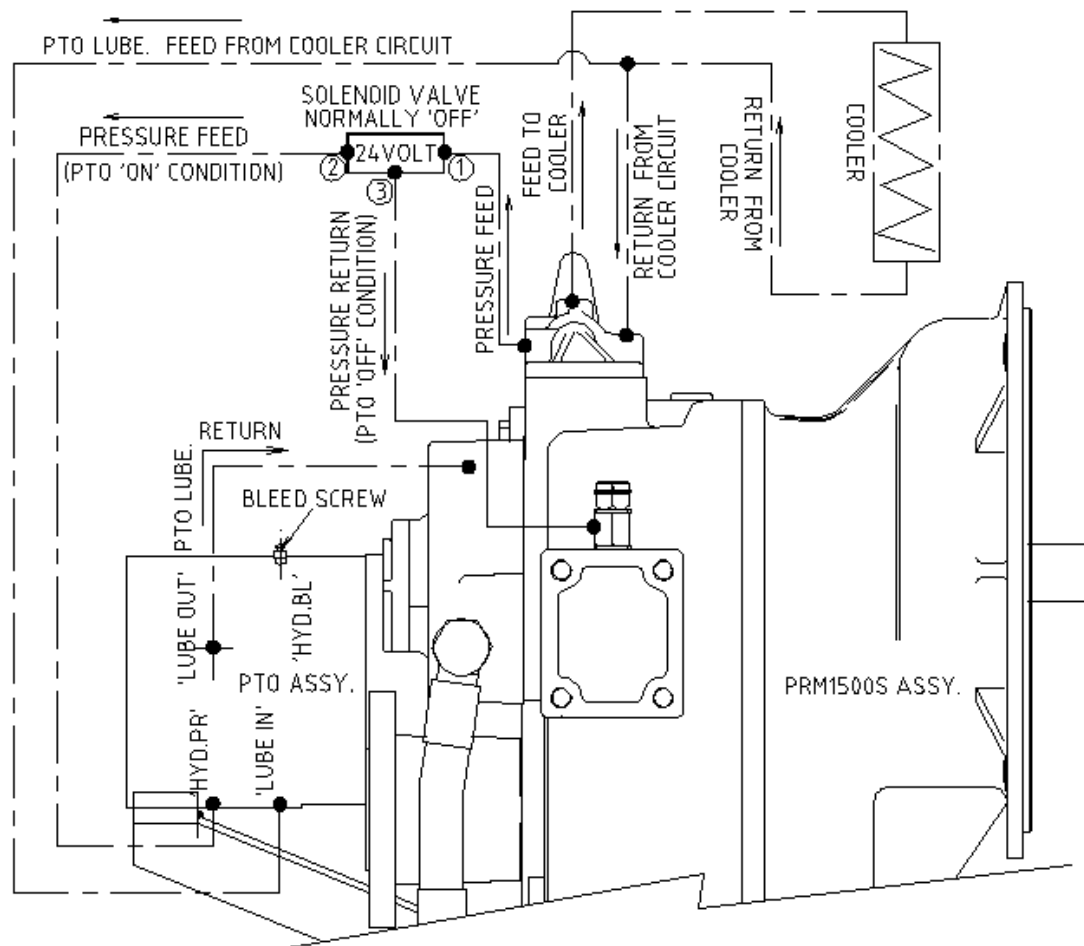
PRM1500 PTO '640NM' MOUNTING DETAILS. SEE PARTS LIST 'L'.

DRG.NO: PRM1500WM9-1. MTG.



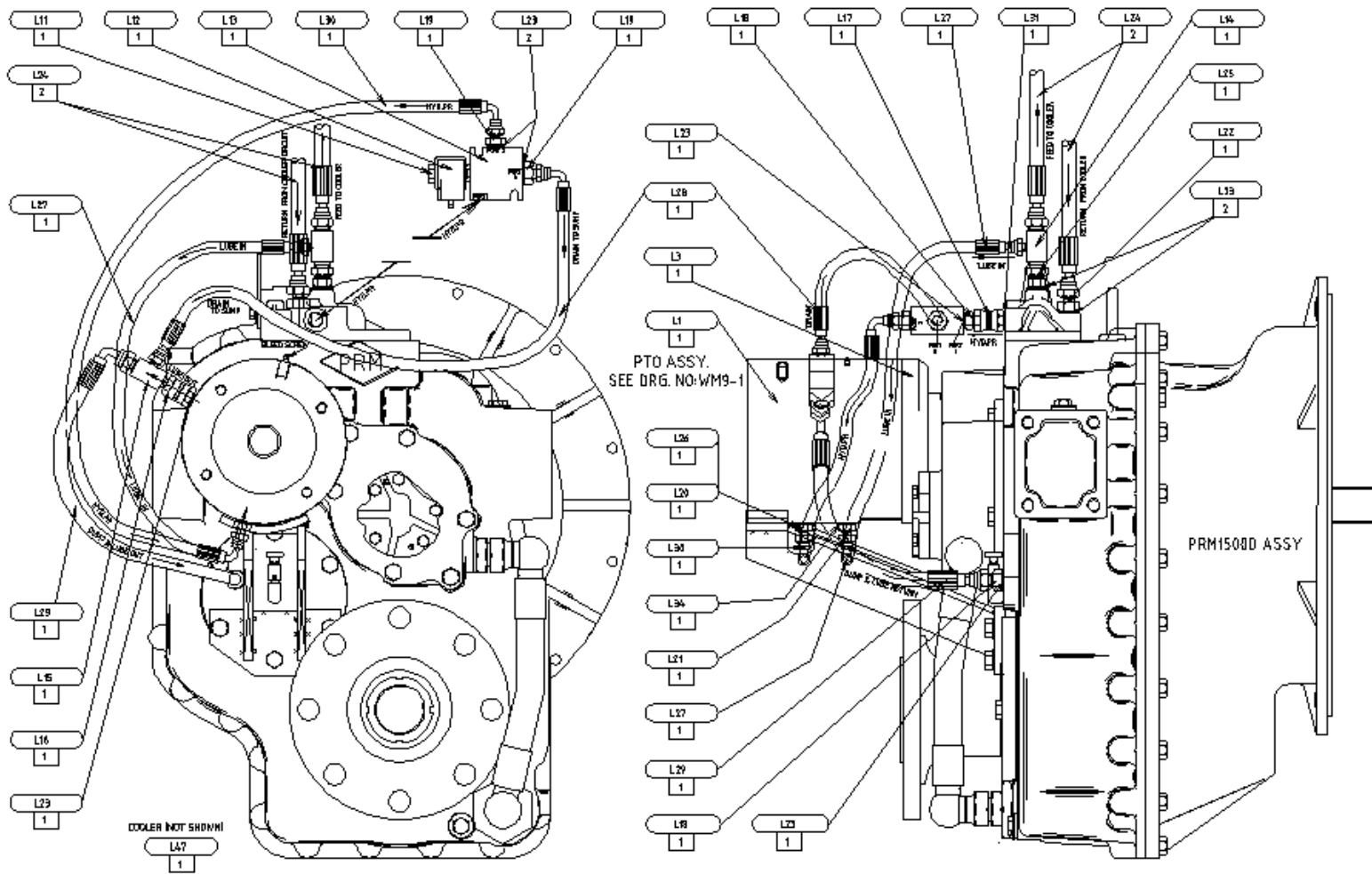
PRM1500D PTO '640NM' SCHEMATIC PIPEWORK. SEE PARTS LIST 'L'.

DRG.NO: PRM1500WM9-2.MTG.



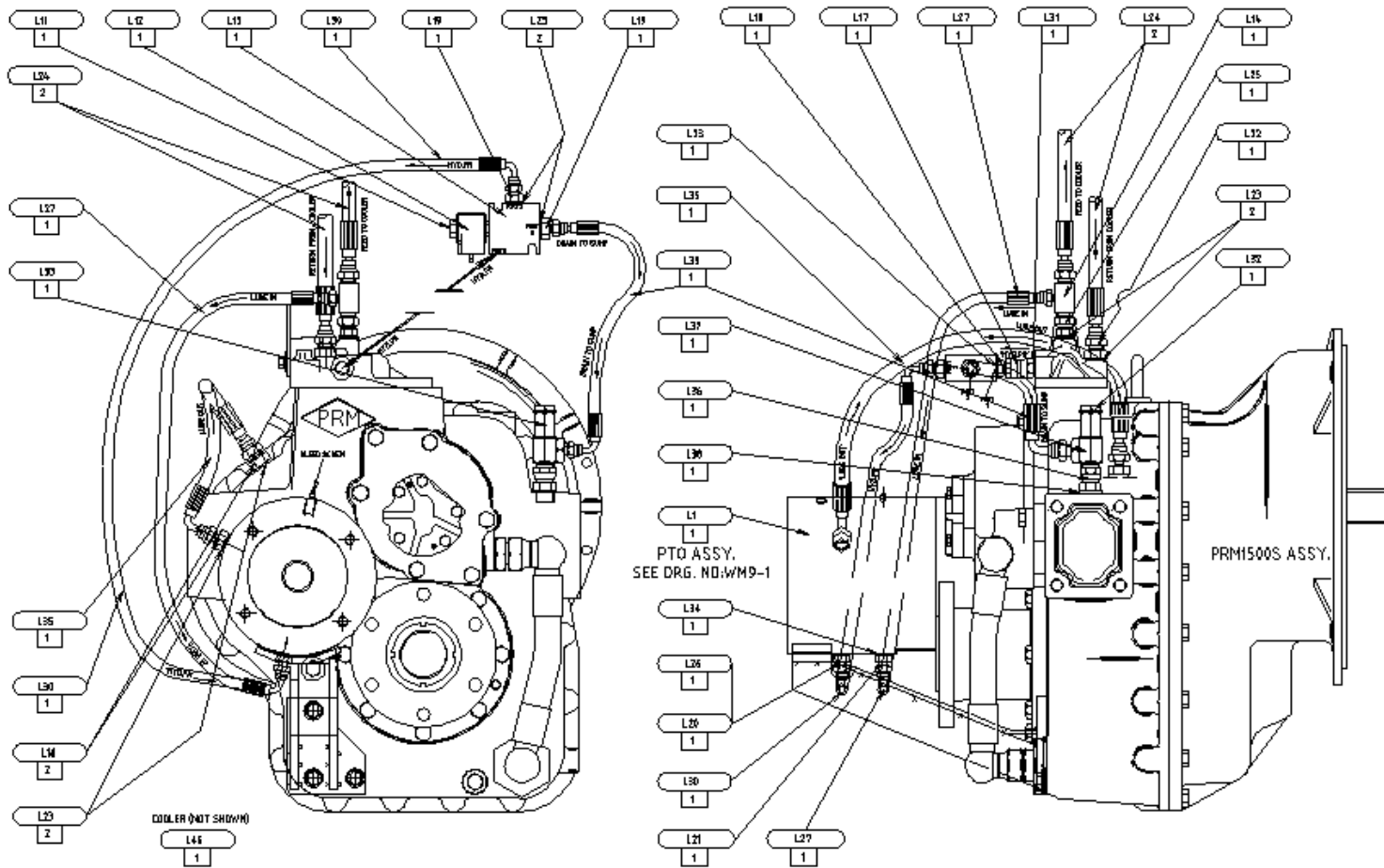
PRM1500S PTO '640NM' SCHEMATIC PIPEWORK.

DRG.NO: PRM1500WM9-3, MTG.



PRM1500D PTO '640NM' PIPEWORK. SEE PARTS LIST 'L'.

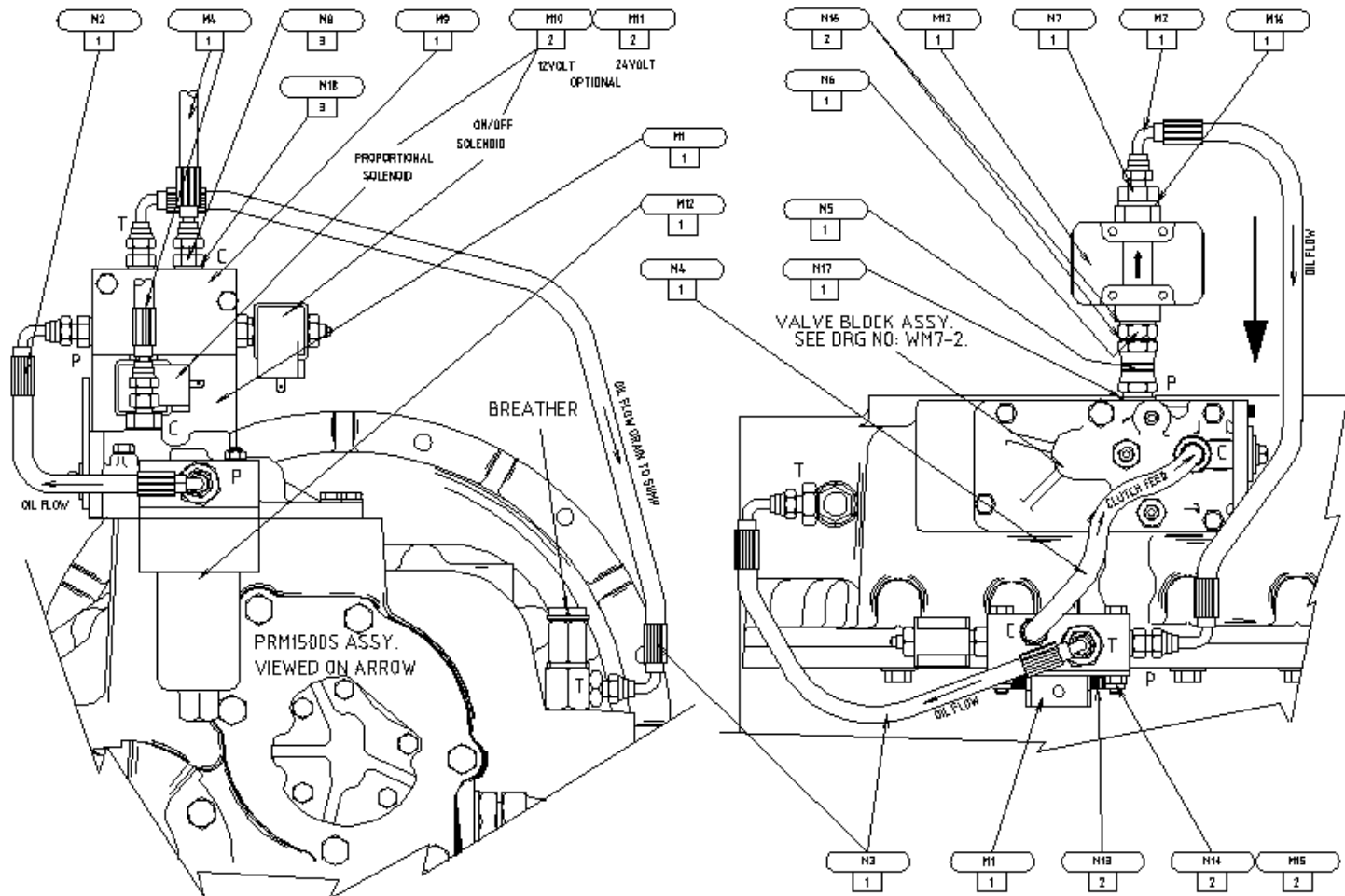
DRG. NO: PRM1500WM9-4. MTG.



PRM1500S PTO '64.0NM' PIPEWORK. SEE PARTS LIST 'L'.

DRG.NO: PRM1500WM9-5. MT6.

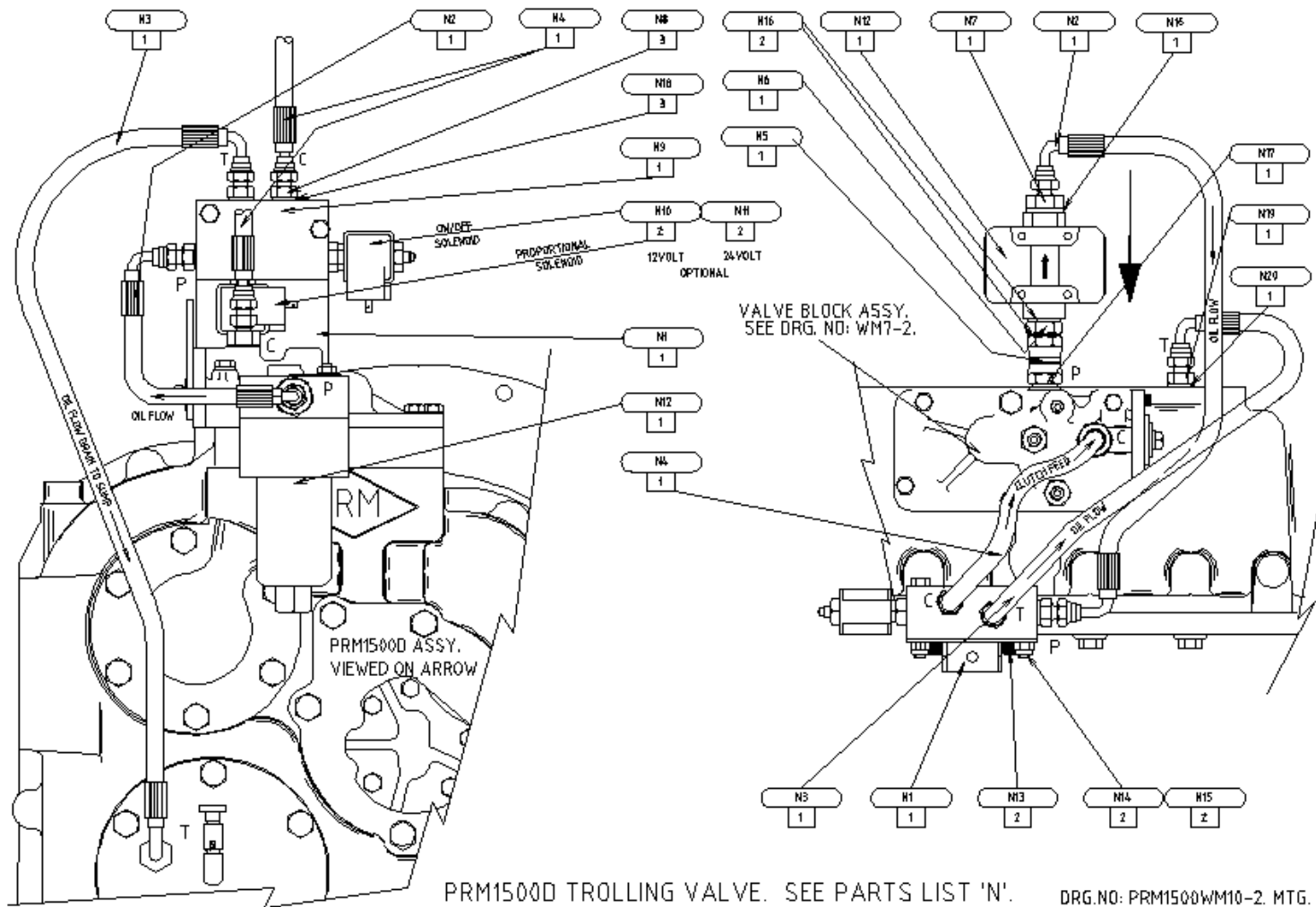
SECTION M – PRM1500 TROLLING VALVE (SHALLOW CASE ONLY)			
ITEM NO.	DESCRIPTION	PART NO.	QTY.
M1	Mounting bracket	MT8391	1
M2	Flexible hose	MT4872	1
M3	Flexible hose	MT8390	1
M4	Flexible hose	MT4863	1
M5	Swivel adapter	CP1463	1
M6	M/M adapter	CP1416	1
M7	M/M adapter	MT4861	1
M8	M/M adapter	MT4825	3
M9	Proportional valve	MT4884	1
M10	12v solenoids (optional)	MT4802	2
M11	24v solenoids (optional)	MT4874	2
M12	Filter	MT4819	1
M13	Socket cap screw	0081635	2
M14	Hex head bolt	0040814	2
M15	Nyloc nut	007-0120	2
M16	Bonded washer	0201714	3
M17	Bonded washer	091718	1
M18	Bonded washer	CP1204	3



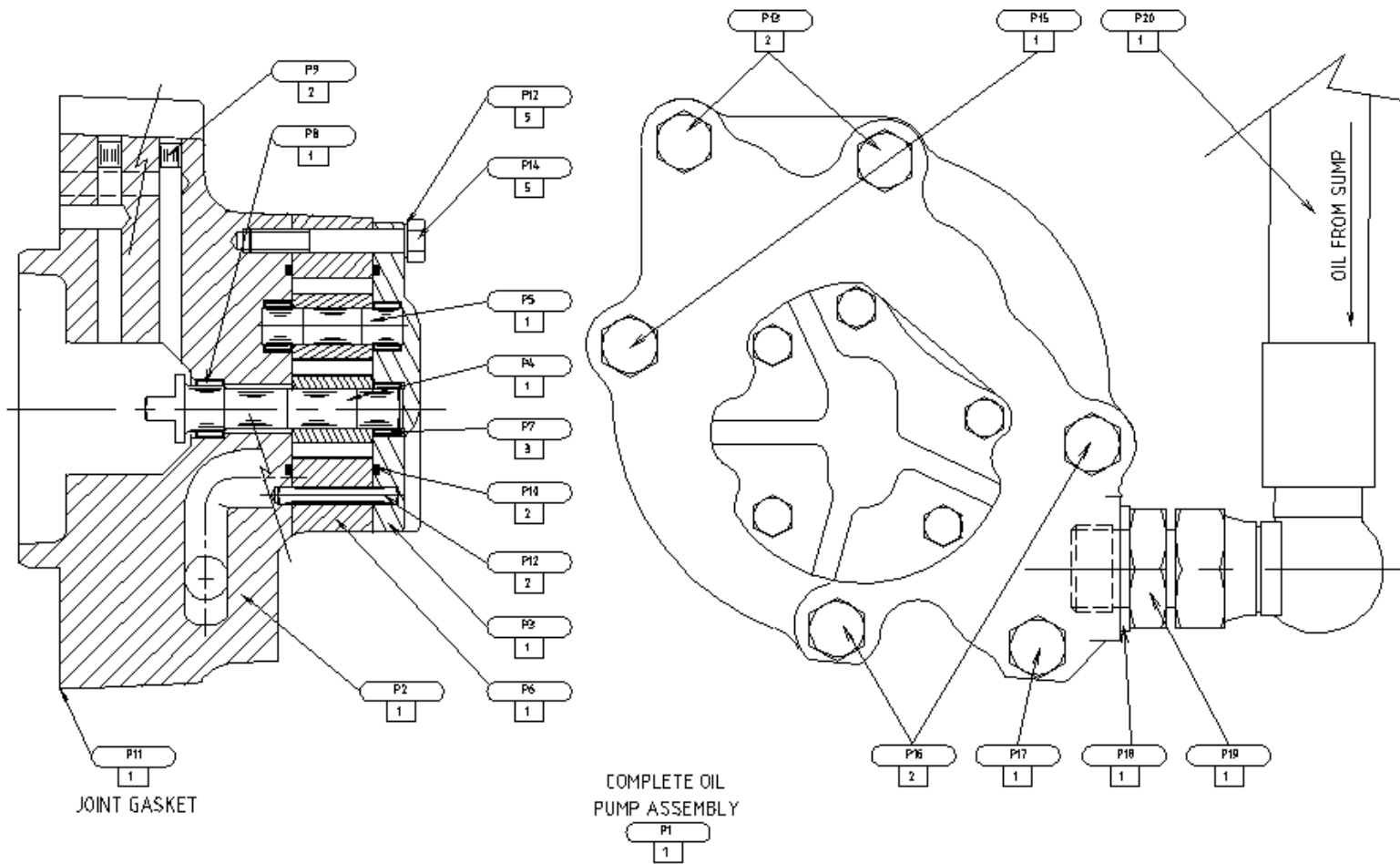
PRM1500S TROLLING VALVE. SEE PARTS LIST 'M'.

DRG.NO: PRM1500WM10-1. MTG.

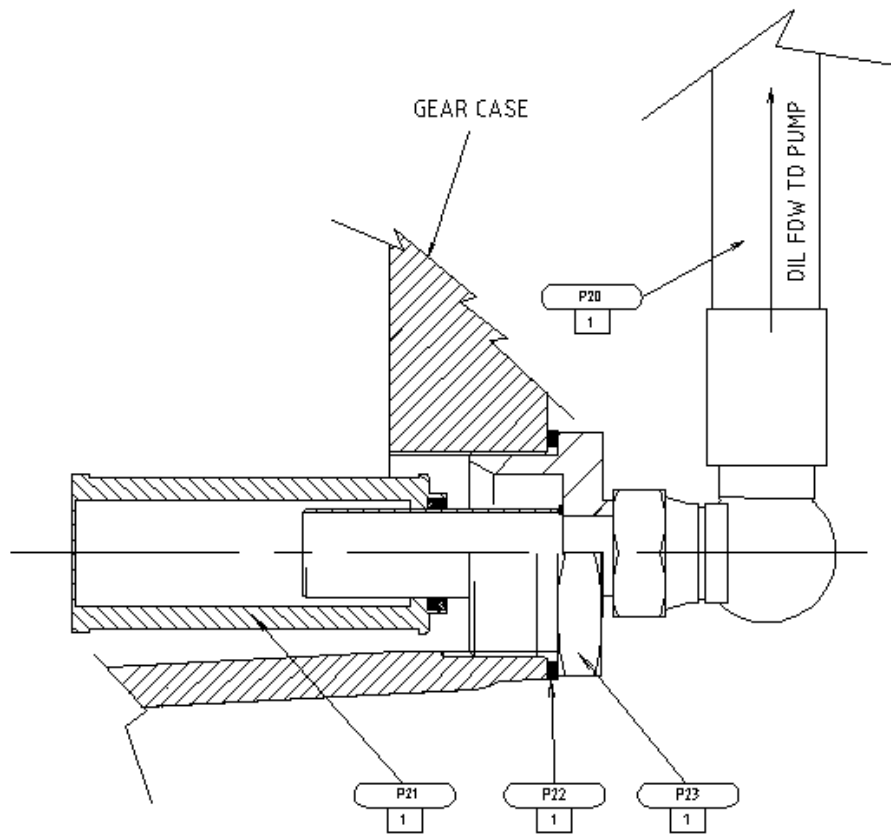
SECTION N – PRM1500 TROLLING VALVE (DEEP CASE ONLY)			
ITEM NO.	DESCRIPTION	PART NO.	QTY.
N1	Mounting bracket	MT8391	1
N2	Flexible hose	MT4872	1
N3	Flexible hose	MT8390	1
N4	Flexible hose	MT4863	1
N5	Swivel adapter	CP1463	1
N6	M/M adapter	CP1416	1
N7	M/M adapter	MT4861	1
N8	M/M adapter	MT4825	3
N9	Proportional valve	MT4884	1
N10	12v solenoid (optional)	MT4802	2
N11	24v solenoid (optional)	MT4874	2
N12	Filter	MT4819	1
N13	Socket cap screw	0081635	2
N14	Hex head bolt	0040814	2
N15	Nyloc nut	007-0120	2
N16	Bonded washer	0201714	3
N17	Bonded washer	091718	1
N18	Bonded washer	CP1204	3
N19	Bonded washer	0201715	1
N20	M/M adapter	CP1442	1



SECTION P - OIL PUMP ASSEMBLY & OIL HOSE / STRAINER –(SHALLOW CASE)			
ITEM NO.	DESCRIPTION	PART NO.	QTY.
P1	Complete oil pump Assy.	MT0478	1
P2	Oil pump body	MT8280	1
P3	Pump cover	MT1491	1
P4	Drive spindle	MT8218	1
P5	Drive spindle S/A	MT0459	1
P6	Pump plate	MT8148	1
P7	Needle bearing	0560801	3
P8	Needle bearing	0560901	1
P9	Sealing plug	073080	2
P10	'O' ring	0430682	2
P11	Gasket	MT8169	1
P12	Spring washer	091105	5
P13	Hex head bolt	0041215	2
P14	Hex head bolt	0040814	5
P15	Hex head bolt	0041219	1
P16	Hex head bolt	0041211	2
P17	Hex head bolt	0041210F	1
P18	Bonded washer	0201720	1
P19	M/M adapter	0081420L	1
P20	Flexible hose assembly	MT8308	1
P21	Oil strainer	MT8212	1
P22	Bonded washer	0201760	1
P23	Special adapter	MT8307	1



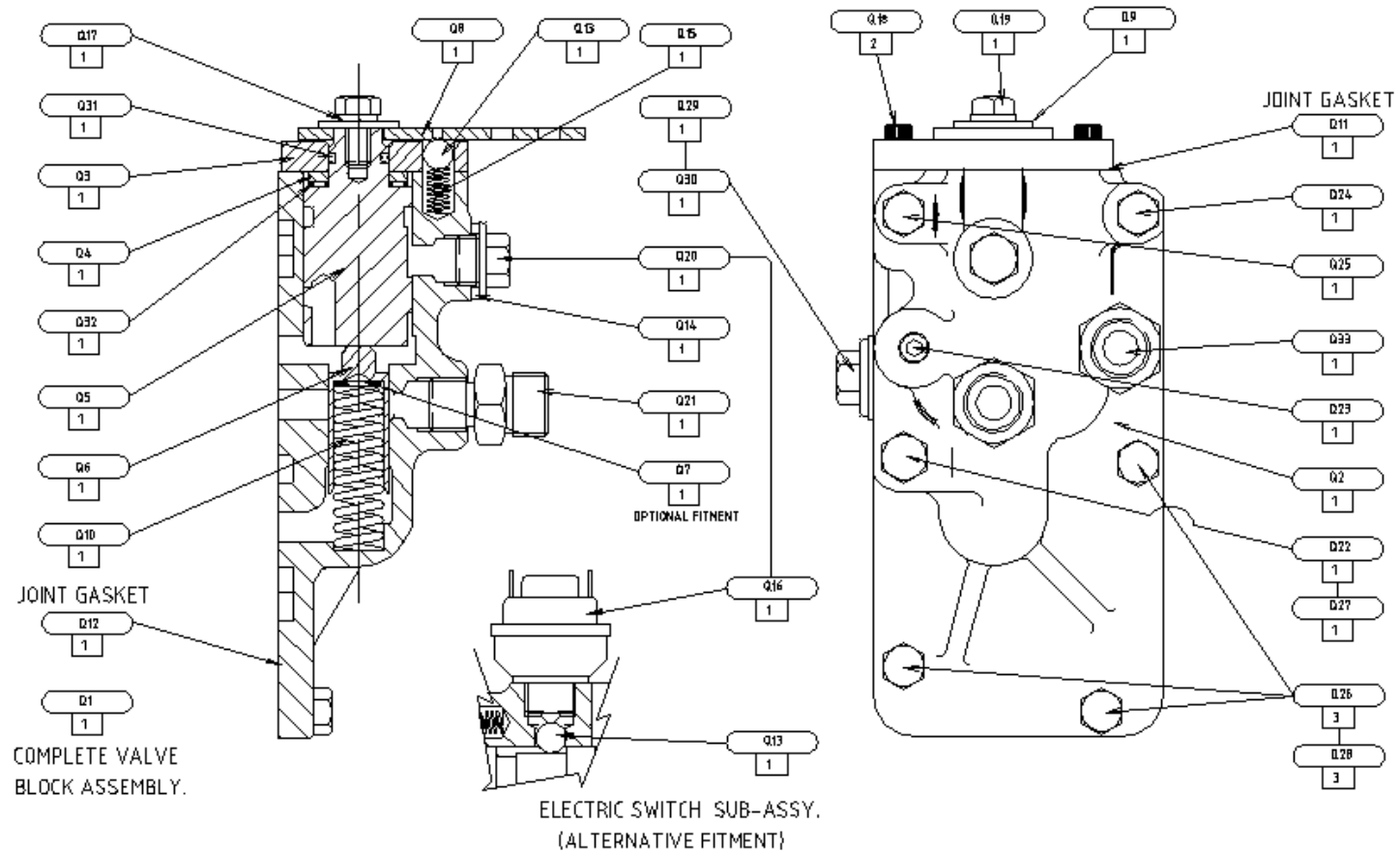
PRM1500SHALLOW PUMP SUB-ASSEMBLY & OIL HOSE. SEE PARTS LIST 'P'. DRG.NO: PRM1500WM6-3. MTG.



PRM1500SHALLOW OIL STRAINER & OIL HOSE. SEE PARTS LIST 'P'.

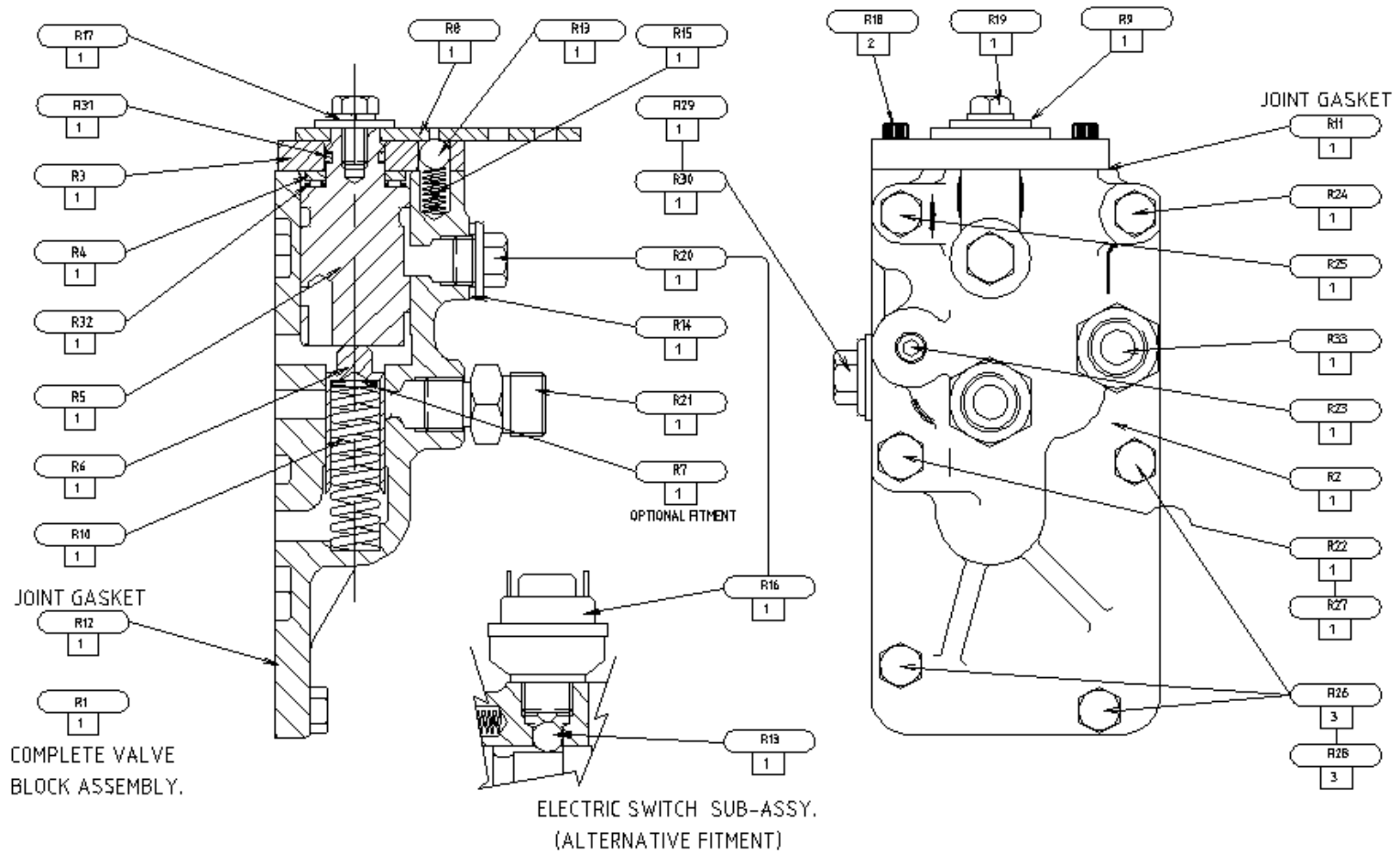
DRG.NO: PRM1500WM6-4. MTG.

SECTION Q - VALVE BLOCK (TROLLING) REFER TO DRG. WM7-2			
ITEM NO.	DESCRIPTION	PART NO.	QTY.
Q1	Complete valve block Assy.	MT0513	1
Q2	Valve block body	MT8360	1
Q3	End cover	MT978	1
Q4	Thrust race	CP1308	1
Q5	Control valve	MT1538	1
Q6	Piston	MT4751	1
Q7	Spacer /shim (optional)	0191007ZP	1
Q8	Operating lever	MT977	1
Q9	Washer	MT979	1
Q10	Spring	MT4928	1
Q11	End cover gasket	MT1081	1
Q12	Joint gasket	MT8322	1
Q13	Steel ball (optional)	CP1077	2
Q14	Bonded seal	0201715	1
Q15	Spring	MT305	1
Q16	Switch (optional)	CP1358	1
Q17	Spring washer	0191105	1
Q18	Socket cap screw	0081220	2
Q19	Hex head screw	0040806	1
Q20	Plug (optional)	CP1360	1
Q21	M/M adapter	CP1446	1
Q22	Hex head screw	0041014	1
Q23	Pressure plug	MT311	1
Q24	Hex head screw	0040812	1
Q25	Hex head screw	0040815	1
Q26	Hex head screw	0040808	3
Q27	Bonded washer	0191710	1
Q28	Bonded washer	0191708	5
Q29	Bonded washer	0191718	1
Q30	Plug	0150318	5
Q31	Nu-lip seal	MT8802	1
Q32	Thrust bearing	CP1307	1
Q33	M/M adapter	CP1448	1



PRM1500 VALVE BLOCK (TROLLING) SUB-ASSEMBLY. SEE PARTS LIST 'Q'. DRG.NO: PRM1500WM7-2. MTG.

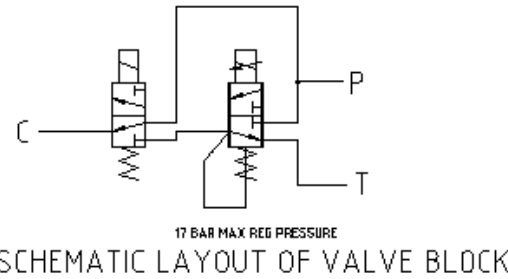
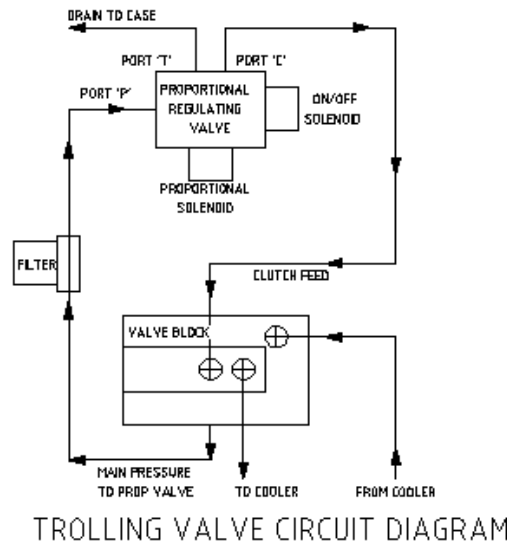
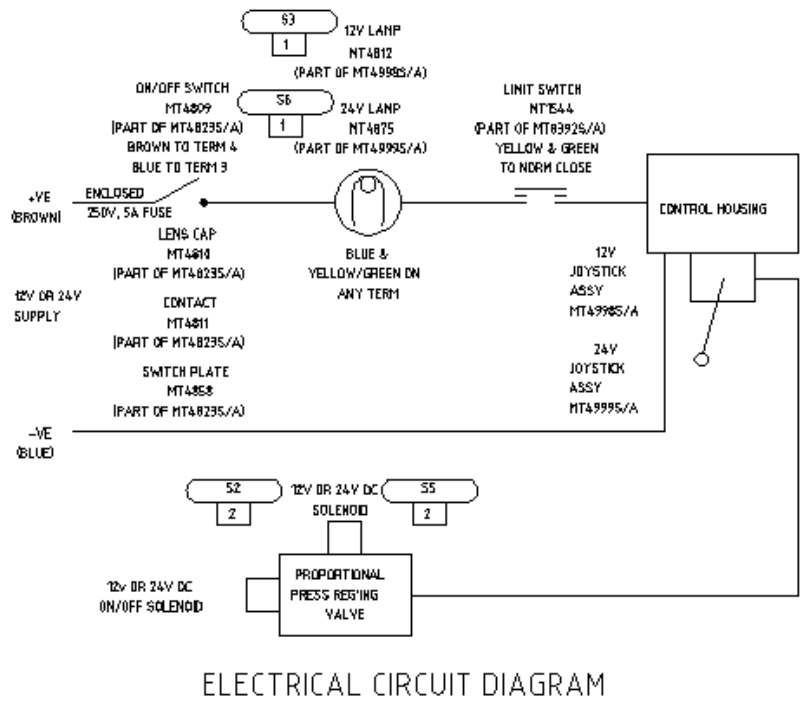
SECTION R – VALVE BLOCK (PTO) REFER TO DRG. WM7-3			
ITEM NO.	DESCRIPTION	PART NO.	QTY.
R1	Complete valve block Assy.	MT0504	1
R2	Valve block body	MT8360	1
R3	End cover	MT978	1
R4	Thrust race	CP1308	1
R5	Control valve	MT4656	1
R6	Piston	MT4751	1
R7	Spacer /shim (optional)	0191007ZP	1
R8	Operating lever	MT977	1
R9	Washer	MT979	1
R10	Spring	MT4928	1
R11	End cover gasket	MT1081	1
R12	Joint gasket	MT8322	1
R13	Steel ball (optional)	CP1077	2
R14	Bonded seal	0201715	1
R15	Spring	MT305	1
R16	Switch (optional)	CP1358	1
R17	Spring washer	0191105	1
R18	Socket cap screw	0081220	2
R19	Hex head screw	0040806	1
R20	Plug (optional)	CP1360	1
R21	M/M adapter	CP1446	1
R22	Hex head screw	0041014	1
R23	Pressure plug	MT311	1
R24	Hex head screw	0040812	1
R25	Hex head screw	0040815	1
R26	Hex head screw	0040808	3
R27	Bonded washer	0191710	1
R28	Bonded washer	0191708	5
R29	Bonded washer	0191718	1
R30	Plug	0150318	5
R31	Nu-lip seal	MT8802	1
R32	Thrust bearing	CP1307	1
R33	M/M adapter	CP1448	1



PRM1500 VALVE BLOCK (PTO) SUB-ASSEMBLY. SEE PARTS LIST 'R'.

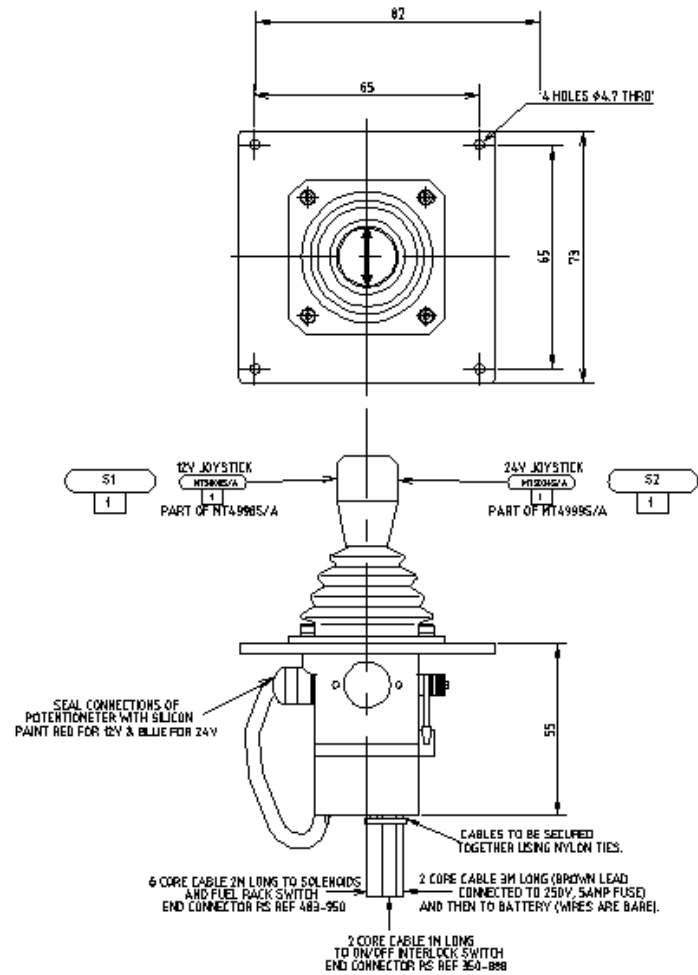
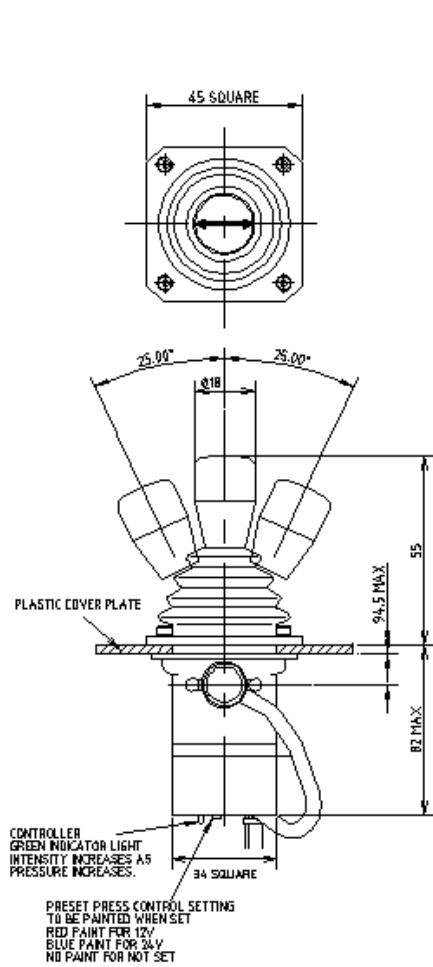
DRG.NO: PRM1500WM7-3. MTG.

SECTION S – TROLLING VALVE JOYSTICK CONTROLLER & SWITCH			
ITEM NO.	DESCRIPTION	PART NO.	QTY.
S1	12 Volt joystick Assy.	MT500S/A	1
S2	12 Volt solenoid	MT4802	2
S3	12 Volt lamp	MT4812	1
S4	24Volt joystick Assy.	MT5024S/A	1
S5	24 Volt solenoid	MT4874	2
S6	24 Volt lamp	MT4875	1

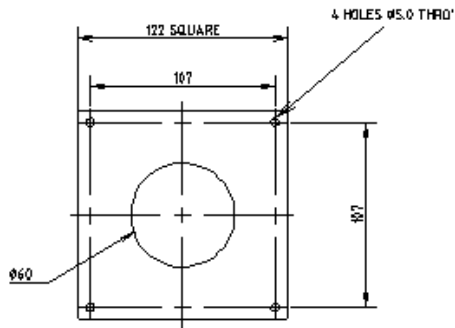


PRM1500DEEP & PRM1500SHALLOW TROLLING VALVE. SCHEMATICS.

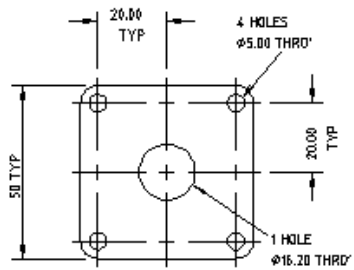
DRG.NO: PRM1500WM11-1. MTG.



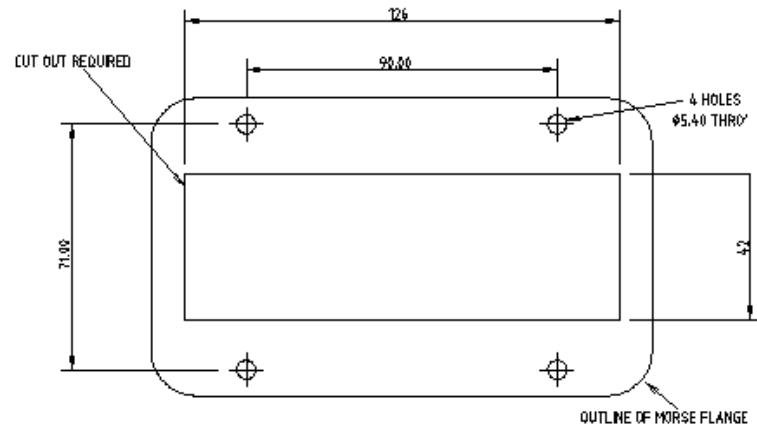
PRM1500DEEP & SHALLOW, TROLLING VALVE JOYSTICK CONTROLLER DETAILS. DRG.NO: PRM1500WM11-2. MTG.



TEMPLATE FOR MTG JOYSTICK
CONTROLLER
(SCALE 1:2)



SWITCH PLATE MT4858



TEMPLATE FOR MTG OPTIONAL MORSE CONTROL

PRM1500S & PRM1500D TROLLING VALVE: VARIOUS MOUNTING DETAILS.

DRG.NO: PRM1500WM11-3. MTG.