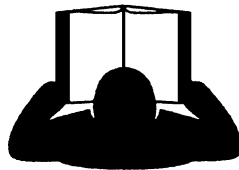


INSTRUCTION AND PARTS MANUAL
MODEL PH50
PLANEMATIC DRIVE

 **PULL MASTER**

A  **DOVER** COMPANY

THE LOGICAL CHOICE



READ THIS MANUAL BEFORE INSTALLING, OPERATING OR SERVICING THIS PRODUCT. THIS MANUAL CONTAINS IMPORTANT INFORMATION. MAKE THIS MANUAL AVAILABLE TO ALL PERSONS RESPONSIBLE FOR THE OPERATION, INSTALLATION, SERVICING AND MAINTENANCE OF THIS PRODUCT.

Pullmaster Limited Warranty

Effective 8/1/2008
SUPERSEDES ALL PRIOR WARRANTIES

Seller warrants that each article (whether Gear Drive Products, Brake Products and/or Winch Products, all of which are covered hereunder) sold under this order shall at the time of shipment (i) conform to applicable specifications, and (ii) be free from defects in material and workmanship during normal and ordinary use and service (the "Warranty").

Buyer's exclusive remedy and Seller's sole obligation under this Warranty shall be, at Seller's option, to repair or replace any article or part thereof which has proven to be defective, or to refund the purchase price of such article or part thereof. Buyer acknowledges that Buyer is knowledgeable concerning the articles covered by this Warranty and sold in connection therewith which are being purchased, that Buyer has reviewed this Warranty and that the remedies provided hereunder are adequate and acceptable to Buyer.

This Warranty shall expire one (1) year from the date the article is first shipped by Seller. Notice of claimed breach of this Warranty must be given by Buyer to Seller within the applicable period. Such notice shall include an explanation of the claimed warranty defect and proof of date of purchase of the article or part thereof for which warranty coverage is sought. No allowances shall be made by Seller for any transportation, labor charges, parts, "in and out" costs, adjustments or repairs, or any other work, unless such items are authorized in writing and in advance by Seller. Nor shall Seller have any obligation to repair or replace items which by their nature are expendable.

If an article is claimed to be defective in material or workmanship, or not to conform to the applicable specifications, Seller will either examine the article at Buyer's site or issue shipping instructions for return to Seller. This Warranty shall not extend to any articles or parts thereof which have been installed, used, or serviced otherwise than in conformity with Seller's applicable specifications, manuals, bulletins, or instructions, or which shall have been subjected to improper installation, operation, or usage, misapplication, neglect, incorrect installation, overloading, or employment for other than normal and ordinary use and service. This Warranty shall not apply to any article which has been repaired, altered or disassembled, or assembled by personnel other than those of Seller. This Warranty shall not apply to any article upon which repairs or alterations have been made (unless authorized in writing and in advance by Seller). This Warranty shall not apply to any articles or parts thereof furnished by Seller to Buyer's specifications and/or furnished by Buyer or acquired from others at Buyer's request.

SELLER MAKES NO EXPRESS WARRANTIES AND NO IMPLIED WARRANTIES OF ANY KIND, OTHER THAN THE WARRANTY EXPRESSLY SET FORTH ABOVE. SUCH WARRANTY IS EXCLUSIVE AND IS MADE AND ACCEPTED IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Buyer expressly agrees that Seller is not responsible to perform any work or investigation related in any way to tensional vibration issues and is not responsible for the detection or remedy of Natural Frequency Vibration of the mechanical system in which the unit is installed. Buyer acknowledges, understands and agrees that this Warranty does not cover failures of the unit which result in any manner from the operation of the machine or unit at vibration frequencies at or near the natural frequency vibration of the machine in such a way that damage may result. Buyer expressly agrees that Seller is not responsible for failure damage or accelerated wear caused by machine or ambient vibration. Further, Buyer acknowledges and agrees that Buyer is always solely responsible for determination and final approval of the "application factor" which may be used in Seller's calculations, and this application factor is 1.0 unless otherwise stated in Seller's quotation specifications.

The remedies for this Warranty shall be only those expressly set forth above, to the exclusion of any and all other remedies of whatsoever kind. The limited remedies set forth above shall be deemed exclusive, even though they may fail their essential purpose. No agreement varying or extending the foregoing Warranty, remedies, exclusions, or limitations shall be effective unless in a writing signed by an executive officer of Seller and Buyer. This Warranty is non-transferable. If a party who had purchased articles from Buyer, or from persons in privity with Buyer, brings any action or proceeding against Seller for remedies other than those set forth in this Warranty, Buyer agrees to defend Seller against the claims asserted in such action or proceeding at Buyer's expense, including the payment of attorneys' fees and costs, and indemnify Seller and hold Seller harmless of, from and against all such claims, actions, proceedings or judgments therein. Buyer also agrees to defend and indemnify Seller of, from and against any loss, cost, damage, claim, debt or expenses, including attorneys' fees, resulting from any claims by Buyer or third parties to property or injury to persons resulting from faulty installation, repair or modification of the article and misuse or negligent operation or use of the article, whether or not such damage to property or injury to persons may be caused by defective material, workmanship, or construction. **ADVISORY:** *Winches and hoists are not approved for lifting or handling personnel or persons unless specifically approved in writing from Seller for the specific intended application.*

Under no circumstances shall Seller be liable (i) for any damage or loss to any property other than the warranted article or part thereof, or (ii) for any special, indirect, incidental, or consequential damage or loss, even though such expenses, damages, or losses may be foreseeable.

The foregoing limitations on Seller's liability in the event of breach of warranty shall also be the absolute limit of Seller's liability in the event of Seller's negligence in manufacture, installation, or otherwise, with regard to the articles covered by this Warranty, and at the expiration of the Warranty period as above stated, all such liabilities shall terminate. Buyer's purchase of any article(s) covered by this Warranty shall constitute acceptance of the terms and conditions hereof and shall be binding upon Buyer and Buyer's representatives, heirs and assigns. The laws of the Province of British Columbia shall govern Buyer's rights and responsibilities in regard to this Warranty and the transaction(s) subject thereto, and the Province of British Columbia shall be the exclusive forum and jurisdiction for any action or proceedings brought by Buyer in connection herewith or any dispute hereunder. If any of the terms and conditions contained within this Warranty are void, the remaining provisions thereof are and shall remain valid and enforceable.

Note: *Prices and specifications contained in this price book are subject to change without notice.*

SAFETY RECOMMENDATIONS



WARNING

FAILURE TO COMPLY WITH THE FOLLOWING SAFETY RECOMMENDATIONS AND LOCAL RULES AND REGULATIONS COULD RESULT IN PROPERTY DAMAGE, SEVERE INJURY OR DEATH.

1. Do not install, operate or service Planematic drive before reading and understanding manufacturer's instructions.
2. The Planematic drive described herein is not designed for operations involving lifting or moving personnel.
3. Do not lift or carry loads over people.
4. Do not exceed recommended operating pressure (psi) and operating volume (gpm).
5. Do not jerk the Planematic drive. Always smoothly accelerate and decelerate load.
6. Do not operate a damaged, noisy or malfunctioning Planematic drive.
7. Do not leave a load suspended for any extended period of time.
8. Never leave a suspended load unattended.
9. The Planematic drive should be maintained and operated by qualified personnel.
10. Inspect Planematic drive mounting bolts and hoses before each shift.
11. Warm up equipment before operating Planematic drive, particularly at low ambient temperatures.
12. Do not weld any part of the Planematic drive.
13. Verify circulation return before operating Planematic drive.
14. Ensure equipment stability before operating Planematic drive.
15. Wear proper clothing to avoid entanglement in rotating machinery.
16. Always stand clear of the load.
17. Use only recommended hydraulic oil.
18. Keep hydraulic system clean and free from contamination at all times.
19. Maintain Planematic drive and equipment in good operating condition. Perform scheduled maintenance regularly.
20. In case of a power failure or breakdown leading to an unexpected stop of the hydraulic power circuit, stand clear of the area and the load being hoisted. Take the necessary precautions to prevent access to the area where the load is halted.
21. The noise level of the Planematic drive is 86 dBA measured on a distance of 1.00 meter, 1.60 meters high. The measuring equipment used was: Realistic #42-3019.
22. Clean up any oil spillage immediately.
23. Wear proper clothing and personal protection equipment such as footwear, safety goggles and a hard hat. Read manual first.

DESCRIPTION OF THE MODEL PH50

The PULLMASTER Planematic drive is a high performance, highly efficient, planetary hydraulic drive with reversing speed 4.3 times faster than forward speed.

The main components of this unit are:

- + hydraulic motor
- + brake housing
- + hydraulically released multi-disc brake with static and dynamic function
- + primary planetary reduction
- + final drive housing
- + final planetary reduction
- + output shaft

FUNCTION IN FORWARD ROTATION:

In forward rotation the torque and rpm of the hydraulic motor are transmitted to the sun gear of the primary planet reduction. The sprag clutch which connects the motor drive shaft to the automatic brake assembly permits free rotation in forward direction* (brake is not effective in forward direction).

The output torque and rpm of the primary reduction are transmitted to the final reduction by the final sun gear which is splined to the primary planet hub. The output shaft is splined to the final planet hub. When the rotation is stopped, the suspended load or the tension in the reverse direction causes the sprag clutch to lock and the maximum permissible load is held safely by the disc brake. The pressure required to rotate the output shaft may vary up to 200 psi (14 bar) without load.

* With the exception of models supplied with brake effective in both directions, brake assembly permits free rotation in forward direction.

FUNCTION IN REVERSE ROTATION:

In reverse rotation, hydraulic pressure from the reversing side of the hydraulic motor is channelled to the brake piston, causing the brake piston to release the multi-disc brake against the brake springs. The sprag clutch locks motor drive shaft with the connecting shaft. Connecting shaft coupled with brake hub and primary internal gear causes the primary reduction to rotate at the rpm of hydraulic motor, thus eliminating the primary reduction. Elimination of primary reduction in this manner increases the output shaft speed and decreases the output torque 4.3 times of forward direction. Based on standard motor, pressure required to rotate the output shaft, without load depending upon speed, may vary from 450 to 750 psi (31 to 52 bar).

If the applied load drives the Planematic faster than desired, the motor consumes more oil than is supplied and pressure at the reversing port decreases. The brake partially applies and slows the drive. In this manner, the motor continuously regulates brake pressure to safely and smoothly control the load without counterbalance or holding valves.

The partially applied brake results in temperature. This temperature is dissipated by an internal circulation flow, supplied out of the hydraulic motor or from an external source. For models with external circulation, required flow is approximately 4.5 (US) gpm (17 l/min). The circulation return line must go to the reservoir directly.

IMPORTANT: For proper drive function, system back pressure in the brake housing and at the motor return port must never exceed the allowable limits listed in the SPECIFICATIONS section of this manual.

MODEL CODING FOR PLANEMATIC DRIVE MODEL PH50

P H 50 X - XX - XXX - XX X - X XXX

BASIC UNIT _____

P = Planematic drive

TYPE OF UNIT _____

H = High speed reverse

SIZE OF UNIT _____

50 = 50,000 lb-in output torque

REDUCTION RATIO _____

Used for non standard reduction ratios only

TYPE OF BRAKE _____

(Clockwise & counterclockwise rotation of shaft established by looking at the motor)

- 3 Automatic brake*, clockwise shaft rotation, internal circulation flow
- 4 Automatic brake*, clockwise shaft rotation, external brake release, internal circulation flow
- 5 Automatic brake*, counterclockwise shaft rotation, external brake release, internal circulation flow
- 6 Automatic brake*, counterclockwise shaft rotation, internal circulation flow
- 7 Automatic brake*, clockwise shaft rotation, external circulation flow
- 8 Automatic brake*, clockwise shaft rotation, external brake release, external circulation flow
- 9 Automatic brake*, counterclockwise shaft rotation, external brake release, external circulation flow
- 10 Automatic brake*, counterclockwise shaft rotation, external circulation flow
- 11 Brake effective in both directions, external circulation flow
- 17 Brake effective in both directions, external circulation flow, external brake release

*Automatic brake = spring applied, automatically released by the hydraulic pressure of the motor

HYDRAULIC MOTOR _____

- 97 WM51 hydraulic motor, 2 inch gear section, 5.1 cid

OUTPUT SHAFT _____

- 1 splined output shaft, 29 teeth, 10/20 DP (STANDARD)
- 2 keyed output shaft, 3.00 diameter 3/4 inch square key
- 3 splined output shaft with inboard flange adaptor
- 4 splined output shaft with outboard flange adaptor
- 5 splined output shaft, 22 teeth, 10/20 DP
- 6 splined output shaft, 23 teeth, 2 x 1/2NC

OPTIONS _____

Absence of a letter denotes no options supplied with the drive

DESIGN REVISION _____

This letter for factory use only

SPECIFICATION NUMBER _____

Describes features not identified by preceding codes

OPTIONS

REDUCTION RATIO:

The reduction ratio of the standard PULLMASTER Planematic drive is 41.2:1. Drives with different reduction ratios and altered output performances are optionally available.

TYPE OF BRAKE:

The standard PULLMASTER Planematic drive output shaft rotates forward in clockwise direction as viewed from the motor end of the unit. Standard brake is effective only during reverse rotation and automatically functions during operation.

Drives with counterclockwise forward rotation and drives with brake effective in both directions are optionally available. Drives with porting to allow brake release from an external power source are optionally available.



FAILURE TO PROPERLY VENT EXTERNAL BRAKE RELEASE PORT WILL TRAP BRAKE PRESSURE AND ALLOW THE LOAD TO DROP, CAUSING PROPERTY DAMAGE, SEVERE INJURY OR DEATH. PLANEMATIC DRIVES SUPPLIED WITH EXTERNAL RELEASE OPTION MUST BE CONNECTED ACCORDING TO "TYPICAL HYDRAULIC CIRCUIT".

OUTPUT SHAFT:

The standard PULLMASTER Planematic drive has a 29 teeth, 10/20 DP splined output shaft. Drives with keyed or splined output shafts or adaptor flanges are optionally available.

OPTIONAL GEAR SECTION FOR THE HYDRAULIC MOTOR:

The performance of the standard PULLMASTER Planematic drive can be changed by using different gear sections. (Contact the factory for performance information.)

HYDRAULIC MOTORS FOR HIGH PRESSURE HYDRAULIC SYSTEMS:

The operating pressure of the standard PULLMASTER Planematic drive is limited to 2200 psi (152 bar). For hydraulic systems operating with a higher range of hydraulic pressure, the drive can be supplied with a hydraulic piston motor, which will provide for the same basic performance. (Contact the factory for this requirement.)

The PULLMASTER WINCH CORPORATION may consider other options for quantity requirements.

SPECIFICATIONS

Performance specifications are based on standard hydraulic motor and gear ratio. Performance specifications for Planematic drives supplied with optional motors and/or reductions are provided in attached supplement.

MAXIMUM OUTPUT TORQUE:

Forward:	50,000 lb-in	5649 Nm
Reverse:	11,630 lb-in	1314 Nm

MAXIMUM OUTPUT RPM:

Forward:	48 rpm
Reverse:	208 rpm

MAXIMUM OPERATING PRESSURE:

2200 psi 152 bar

MAXIMUM OPERATING VOLUME:

50 (US) gpm 189 l/min

MINIMUM OPERATING VOLUME:

17 (US) gpm 64 l/min

REDUCTION RATIO:

Forward:	41.2 : 1
Reverse:	9.5 : 1

OUTPUT SHAFT: Axial or Radial load

See OVERHUNG LOAD RATING

PERFORMANCE AT VARYING PRESSURE OR VOLUME:

See PERFORMANCE GRAPHS

PERMISSIBLE SYSTEM BACK PRESSURE AT MOTOR RETURN PORT:

65 psi 4.5 bar

PERMISSIBLE PRESSURE AT CIRCULATION SUPPLY PORT:

30 psi 2 bar

CIRCULATION OIL VOLUME:

Models with external circulation	4.5 gpm	17 l/min
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OVERHUNG LOAD RATING

PG-50-OH

The magnitude and location of a load is dependent on the following factors:

SF = service factor (Table A)

AF = application factor (Table B)

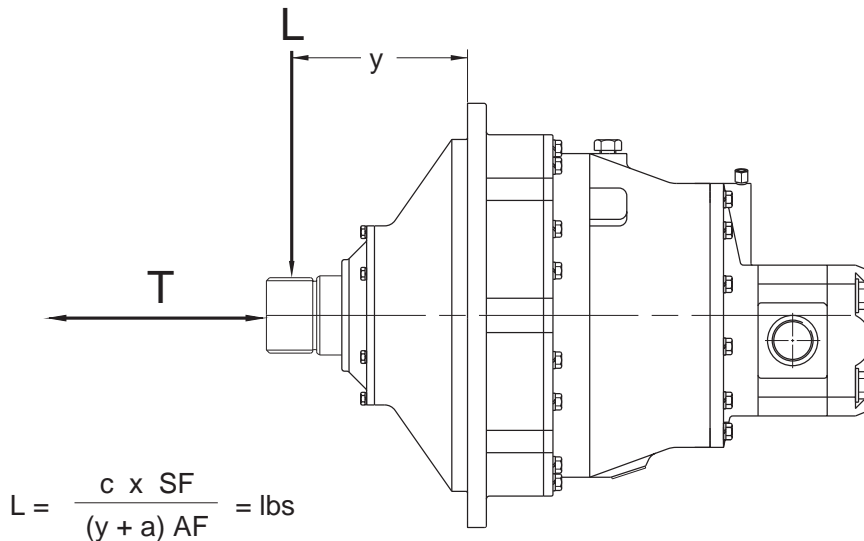
a = bearing geometry constant = -3.10

T = basic thrust or tension load = 25,300

c = basic load constant = 51,000

L = allowable overhung load in lbs.

y = distance of load centre to mounting face in inches



Allowable thrust or tension load in lbs. = T x SF

TABLE A

24 hr. day, continuous duty, full load	0.75
8 hr. day, continuous duty, full load	1.00
3 hr. day, intermittent duty, full load	1.50
Intermittent duty at variable loads, up to full load occasionally	2.68

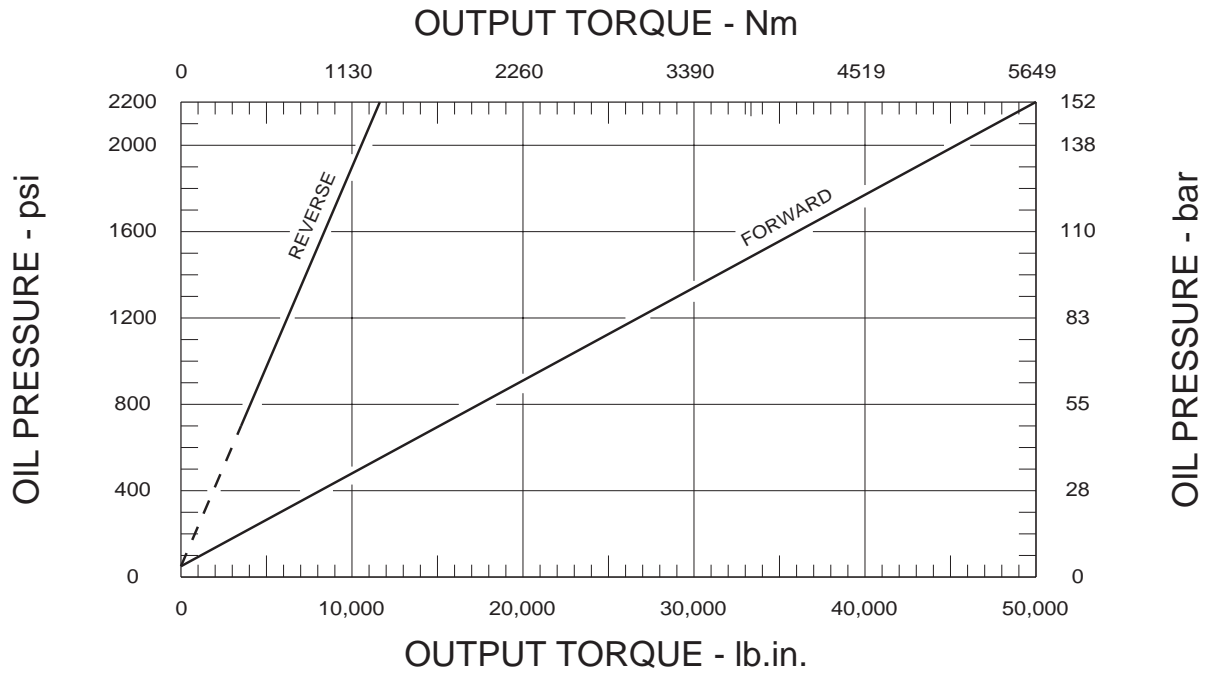
TABLE B

Chain drive	1.00
Gear	1.25
V-belt	1.50
Flat belt	2.50

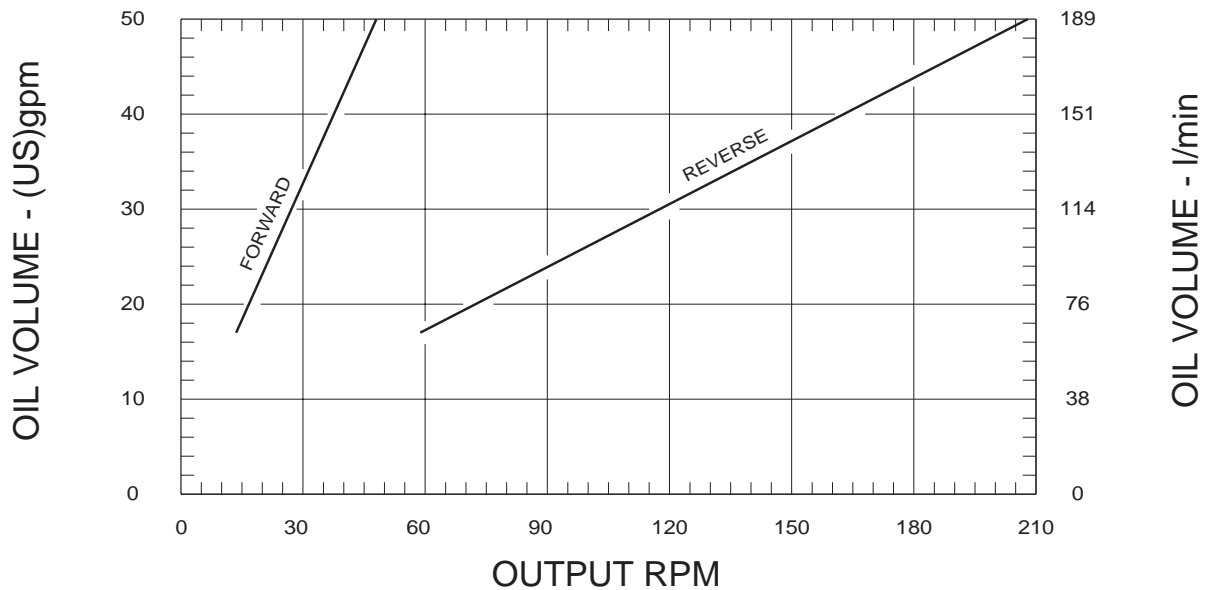
PERFORMANCE GRAPHS

PG-PH50

OUTPUT TORQUE VS. OIL PRESSURE



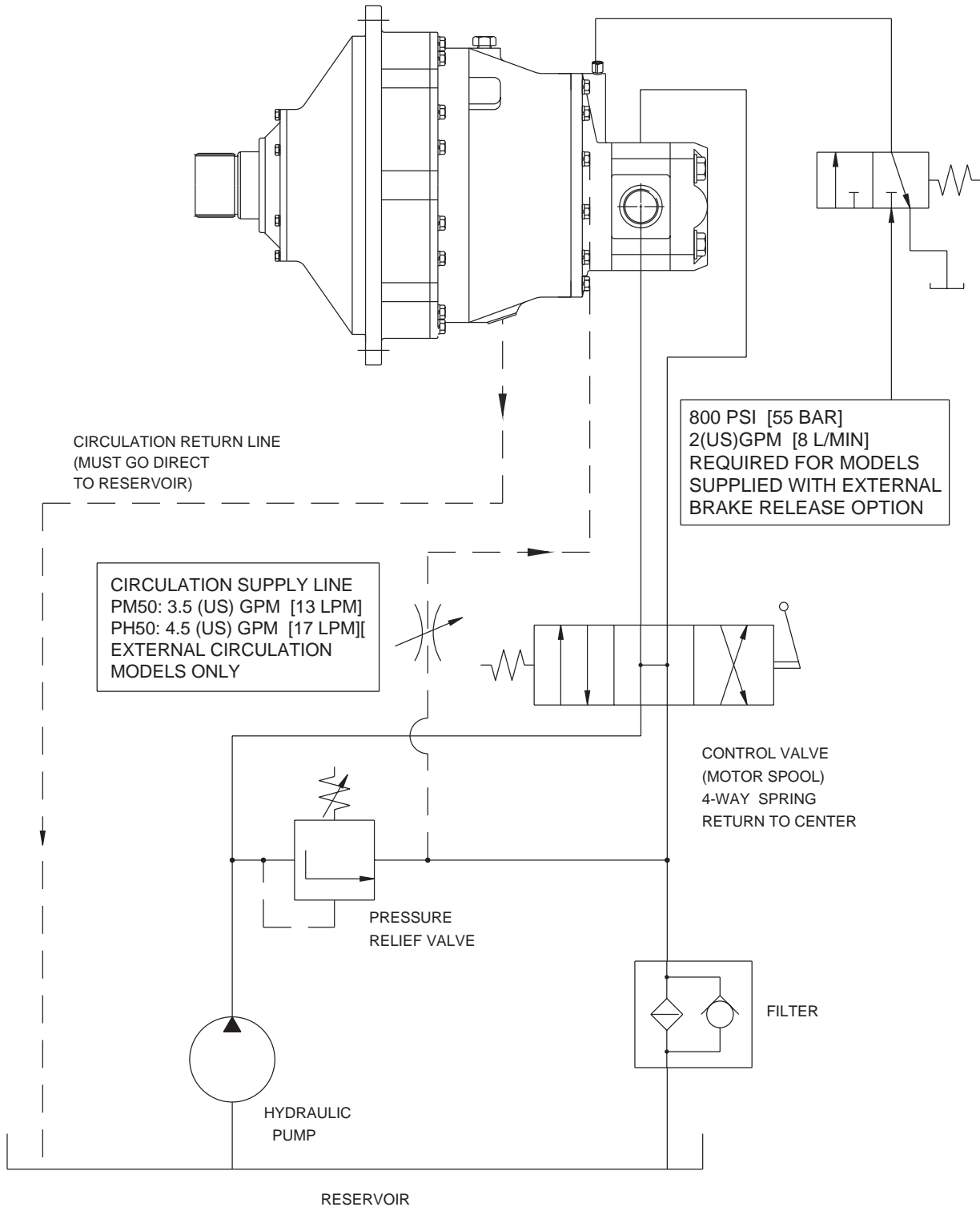
OUTPUT RPM VS. OIL VOLUME



Performance graphs are based on standard hydraulic motor and gear ratio.

TYPICAL HYDRAULIC CIRCUIT

HC-PMH50-A



RECOMMENDATIONS

HYDRAULIC FLUID:

The hydraulic fluid selected for use with PULLMASTER Planematic drives should be a high grade, petroleum based fluid, with rust, oxidation and wear resistance. Fluid cleanliness and operating viscosity are critical to drive reliability, efficiency and service life.

For optimum performance, the recommended viscosity range at operating temperature is 81 - 167 SUS (16 - 36 CS). For extreme operating conditions of short duration, the maximum viscosity range of 58 - 4635 SUS (10 - 1000 CS) should not be exceeded.

For optimum performance, the drive recommended hydraulic fluid temperature operating range is 80 - 150F (27 - 66 C). For extreme operating conditions of short duration, the maximum temperature range of -5 - 180F (-21 - 82 C) should not be exceeded.

LUBRICATION:

The Planematic drive mechanism requires an oil bath lubrication of the internal components. Depending on the model code, circulation is supplied internally by the motor or externally (see TYPICAL HYDRAULIC CIRCUIT). If the unit is internally circulated, fill the Planematic with hydraulic oil through one of the filler / drain ports before operating.

HYDRAULIC PUMP:

For maximum performance of the PULLMASTER Planematic drive, the hydraulic pump must supply the maximum flow of hydraulic fluid at the hydraulic pressure stated in SPECIFICATIONS.

HYDRAULIC CONTROL VALVE:

The standard control valve used for operating the PULLMASTER Planematic drive must have a four-way, spring return to neutral feature, which provides for open flow from the pressure ports of the drive to the reservoir in neutral position of the control (motor spool). It is important to point out that good speed control depends on the "metering" characteristics of the control valve. The better the oil flow is "metered" the better will be the speed control.

HYDRAULIC PRESSURE RELIEF:

The hydraulic circuit for the PULLMASTER Planematic drive requires a pressure relief set at the operating pressure (see SPECIFICATIONS). Usually, a pressure relief is part of the hydraulic control valve. Where this is not the case, a separate pressure relief valve must be installed and set at the recommended maximum pressure.

HYDRAULIC RESERVOIR:

It is recommended that the hydraulic reservoir has sufficient capacity to provide good heat dissipation in order to prevent over-heating of the hydraulic fluid. The hydraulic reservoir should be made from clean and scale-free material to prevent contamination of the hydraulic fluid. In order to prevent air from being mixed with the hydraulic fluid, the reservoir should have an over-flow baffle separating the return lines from the suction line and all return lines should enter the reservoir below the fluid level. The reservoir should be mounted close to and above the hydraulic pump in a location which provides for free air circulation around the reservoir.

HYDRAULIC HOSES:

The following hydraulic hoses are recommended for maximum efficiency of the PULLMASTER Planematic drive:

Pressure lines:	Equivalent to SAE 100R12-20
Circulation return line:	Equivalent to SAE 100R4-12
Circulation supply line:*	Equivalent to SAE 100R6-6

* Only for models with external circulation.

It is recommended that a larger size of hydraulic hose is installed where the pressure lines or the circulation lines are excessively long.

HYDRAULIC FILTER:

Hydraulic filter recommendations for the hydraulic circuit of the PULLMASTER Planematic drive, based on a return line filter, are given as follows:

Average Atmosphere:	10 microns
Dusty Atmosphere:	5 microns

In order to prevent accidental stoppage of the return line flow, the oil filter should have a by-pass feature.

INSTALLATION INSTRUCTIONS



DANGER

**FAILURE TO FOLLOW INSTALLATION INSTRUCTIONS
WILL RESULT IN PROPERTY DAMAGE,
SEVERE INJURY OR DEATH.**

To ensure satisfactory operation, the PULLMASTER Planematic drive must be properly installed. Observe the following installation instructions:

- 1) The Planematic drive mounting structure must be strong enough to withstand operating torques without excessive deflection.
- 2) The Planematic drive mounting surface and pilot bore must be machined.
- 3) Position the Planematic drive using a lifting eyebolt in the tapped hole provided.
- 4) Use eight 3/4 inch diameter mounting bolts (grade 5 or better). Evenly tighten bolts per BOLT TORQUE CHART.
- 5) Use only recommended circuit components and hydraulic hoses.
- 6) Plumb a separate circulation return line directly to tank. Keep the return line above the drive to maintain housing oil level at all times.
- 7) Fill Planematic drive housing with oil through filler/drain port before operating. Units ported for external circulation can be filled through circulation supply line.

IMPORTANT: System brake housing back pressure must never exceed the limit allowed in the SPECIFICATIONS section of this manual.

Before loading the Planematic drive, verify adequate brake circulation flow by checking at the circulation return line port while driving in reverse direction.

OPERATING INSTRUCTIONS



DANGER

**FAILURE TO FOLLOW INSTALLATION INSTRUCTIONS
WILL RESULT IN PROPERTY DAMAGE,
SEVERE INJURY OR DEATH.**

Verify proper installation, acceptable system back pressure and adequate brake circulation flow before operating the Planematic drive.

- 1) The standard Planematic drive brake applies only in counterclockwise rotation as viewed from the motor end of the unit. The drive has no brake during clockwise rotation. Ensure brake option is appropriate for particular application.
- 2) The Planematic drive hydraulic motor is supplied through a single lever control valve with **reverse**, **neutral** and **forward** positions. Drive speed is regulated by metering the control valve lever. Standard brake automatically releases when driving in reverse direction and sets when control valve lever is returned to **neutral** position.

Refer to OPTIONS section of this manual for explanation of optional brake configurations.

- 3) Verify installation and connection by slowly driving a full test load through a safe distance, forward and reverse. Complete functional test by driving test load at full speed, forward and reverse, several times.

If Planematic drive does not function properly after following above procedure, refer to TROUBLESHOOTING section of this manual.

TROUBLE SHOOTING

GENERAL:

Typical Planematic drive operating problems are caused by a malfunctioning hydraulic system. Verify hydraulic pressure and flow at the drive motor are as specified before dismounting or disassembling Planematic.

IMPORTANT: Ensure that the hydraulic system reservoir is full and that the system pump is running at full rpm before doing any system checks.

HYDRAULIC SYSTEM VOLUME AND PLANEMATIC SPEED:

The Planematic output speed depends on the hydraulic flow supplied to the drive motor. Maximum output speed and required hydraulic volume appear in the SPECIFICATIONS section of this manual. If the Planematic does not rotate at desired output speed, install a flow meter at the drive motor forward port. Fully open control valve and measure hydraulic flow. Verify hydraulic operating volume as specified.

HYDRAULIC SYSTEM PRESSURE AND PLANEMATIC TORQUE:

The Planematic output torque depends on the hydraulic pressure supplied to the drive motor. Maximum output torque and required hydraulic pressure appear in the SPECIFICATIONS section of this manual. If the Planematic does not produce desired output torque, install pressure gauges at both drive motor gauge ports. Stall the drive, fully open control valve and measure hydraulic pressure at motor ports. Verify hydraulic operating pressure and maximum allowable motor return port back pressure as specified.

Sources of potential hydraulic flow and/or pressure loss include the hydraulic pump, relief control valves and slipping belts on a v-belt driven pump.

If the hydraulic volume and pressure are per specification, refer to the following TROUBLESHOOTING chart to identify failure probable causes.

FAILURE	PROBABLE CAUSE
<p>Drive will not produce maximum rated torque as listed in SPECIFICATIONS.</p>	<ul style="list-style-type: none"> a) Hydraulic system supply pressure or back pressure not per SPECIFICATIONS. Refer to procedure described in TROUBLE SHOOTING - HYDRAULIC SYSTEM PRESSURE AND PLANEMATIC TORQUE to verify system pressures. b) Damaged or worn hydraulic motor.
<p>Drive will not produce rated speed or rpm as listed in SPECIFICATIONS.</p>	<ul style="list-style-type: none"> a) Hydraulic system supply volume, supply pressure or back pressure not per SPECIFICATIONS. Refer to procedures described in TROUBLE SHOOTING - HYDRAULIC SYSTEM VOLUME AND PLANEMATIC SPEED and HYDRAULIC SYSTEM PRESSURE AND PLANEMATIC TORQUE to verify system pressures and volumes. b) Damaged or worn hydraulic motor.
<p>Drive will not reverse (brake will not release).</p>	<ul style="list-style-type: none"> a) Leaking brake piston O-ring. Both piston O-rings must seal to develop hydraulic brake release pressure. b) Leaking brake release pressure port O-ring. O-ring is located on the motor adaptor and seals release oil pressure at the brake housing. Failure of this O-ring results in significant leakage between the motor adaptor and brake housing. c) Hydraulic brake release pressure not per SPECIFICATIONS. Gauge release pressure at external brake release port on motor adaptor. d) Plugged brake release pressure port. Hydraulic passages in the motor adaptor and brake housing must be clear to allow oil passage to reach brake piston.

TROUBLE SHOOTING CONTINUED

FAILURE	PROBABLE CAUSE
Brake will not hold load.	<ul style="list-style-type: none"> a) Hydraulic system back pressure not per SPECIFICATIONS. Refer to procedure described in TROUBLE SHOOTING - HYDRAULIC SYSTEM PRESSURE AND PLANEMATIC TORQUE to verify system back pressure at motor. b) Brake piston release oil being trapped by hydraulic system control valve. Control valve spool must open motor ports to reservoir when in the neutral position. Refer to RECOMMENDATIONS - HYDRAULIC CONTROL VALVE. c) Worn brake and/or divider plates. Inspect brake plates and divider plates for wear as described in SERVICE INSTRUCTIONS - DISASSEMBLY OF BRAKE ASSEMBLY. d) Damaged brake and/or divider plates. Plate discoloration and distortion will occur if plates overheat due to insufficient circulation flow. Required brake circulation flow is listed in SPECIFICATIONS. Plate abrasion damage will occur if contamination is present in hydraulic fluid. e) Damaged over-running clutch. Inspect sprag clutch, connecting shaft and motor drive shaft as described in SERVICE INSTRUCTIONS - DISASSEMBLY OF BRAKE ASSEMBLY. f) Damaged brake springs. Measure brake springs as described in SERVICE INSTRUCTIONS - DISASSEMBLY OF BRAKE ASSEMBLY. Verify springs are straight and length is as indicated. g) Seized brake piston. Brake piston could be seized by hydraulic fluid contamination, scored brake housing bore or damaged piston O-rings.
Brake vibrates or chatters when lowering load.	<ul style="list-style-type: none"> a) Inadequate hydraulic flow. Refer to procedure described in TROUBLE SHOOTING - HYDRAULIC SYSTEM VOLUME AND PLANEMATIC SPEED to verify supply. b) Inadequate hydraulic control. System control valve must have good metering characteristics. c) Foamy hydraulic fluid. Foam will occur if air is mixed with hydraulic oil. d) Worn brake and/or divider plates. Inspect brake plates and divider plates for wear as described in SERVICE INSTRUCTIONS - DISASSEMBLY OF BRAKE ASSEMBLY. e) Damaged brake plates and/or divider plates. Plate discoloration and distortion will occur if plates overheat due to insufficient circulation flow. Required brake circulation flow is listed in SPECIFICATIONS. Plate abrasion damage will occur if contamination is present in hydraulic fluid. f) Damaged over-running clutch. Inspect sprag clutch, connecting shaft and motor drive shaft as described in SERVICE INSTRUCTIONS - DISASSEMBLY OF BRAKE ASSEMBLY.
Oil leaks.	<ul style="list-style-type: none"> a) Damaged O-ring. Static O-rings seal between the end cover and final housing, final housing and brake housing, brake housing and motor adaptor. Another O-ring seals brake release pressure between the motor adaptor and brake housing. A failed O-ring will result in oil leakage at that particular area. b) Worn or damaged output shaft seal. Excessive circulation return line back pressure can damage this seal. Refer to procedure described in TROUBLE SHOOTING - HYDRAULIC SYSTEM PRESSURE AND PLANEMATIC TORQUE to measure back pressure. Back pressure must never exceed the allowable circulation return line back pressure listed in SPECIFICATIONS. Back pressure will be higher at start-up and during cold weather when oil viscosity is greater.

Refer to the SERVICE INSTRUCTIONS if it becomes necessary to disassemble the Planematic drive.

SERVICE INSTRUCTIONS

GENERAL:

Before attempting disassembly of the PULLMASTER Model PH50 Planematic drive, the following instructions for disassembly and reassembly should be read and understood.

It is suggested that all expendable parts, such as O-rings and oil seals, are not reused on reassembly. It is therefore important to have a Planematic seal kit (Part No. 23134) and, if the hydraulic motor has to be serviced, a motor seal kit (Part No. 23121) on hand before the unit is taken apart. If working on the hydraulic motor, two new needle bearings item 875, (Part No. 25723) are also required.

- NOTES:**
- 1) Backup washers may be included with seal kit. Install with oil seals as per instructions. If not present in seal kit, the oil seals supplied do not require backup washers.
 - 2) Pocket seal strip is included in the motor seal kit. Pocket seals are not required if thrust plates are not slotted.

A clean working area is of prime importance, similar to conditions used for service work on any other hydraulic component. All parts, as they are removed from the Planematic assembly, should be carefully inspected for wear and damage. Thoroughly clean parts before reassembly. Do not use solvent to clean the brake friction plates. During reassembly, lubricate all O-rings and oil seals before installation.

In the following service instructions, reference to parts is made by number and shown on the applicable group drawings.

DISASSEMBLY

For the majority of required service or repair work, disassembly is required only on the brake housing of the PULLMASTER Planematic drive. There are no special tools needed for service or repair work and no adjustments or calibrations are necessary. Proceed with the disassembly as follows:

DISASSEMBLY OF HYDRAULIC MOTOR ASSEMBLY:

If the analysed service or repair work requires access to the interior of the brake housing, the hydraulic motor should not be disassembled. In this case, the hydraulic motor should be removed together with the motor adaptor as a complete assembly. If a problem has been analysed to be in the hydraulic motor, proceed with the disassembly as follows:

Refer to PARTS REFERENCE on page 26 and MOTOR GROUP drawing G1033 on page 27.

- 1) Remove four hex capscrews item 951, together with lockwashers item 953, from motor assembly.

NOTE: Failure to exercise care when removing the motor port end cover or gear housing could permanently damage the machined surfaces of these motor components. Take care not to damage machined surfaces of motor components at disassembly.

- 2) Remove (pry loose if necessary) port end cover item 870, together with bearings item 875, and ring seal item 877. Thrust plate item 885, and dowel pins item 865, may stay in gear housing.
- 3) If thrust plate comes off with end cover, carefully pry it off of bearings item 875, and discard pocket seals item 887.
- 4) Remove gear set item 881, which consists of two gears which are a matched set.
- 5) Carefully pry gear housing item 861, off of motor adaptor item 800. Thrust plate item 885, and dowel pins item 865, may stay in gear housing.
- 6) If thrust plate stayed on motor adaptor, carefully pry it off of bearings item 875, and discard pocket seals item 887.
- 7) Discard body seals item 869. It is also advisable to replace ring seals item 877, at this time. Bearings item 875, have to be removed to allow access to ring seals.

SERVICE INSTRUCTIONS CONTINUED

NOTE: Pocket seals, body seals, and ring seals in the hydraulic motor assembly are not part of the PULLMASTER Planematic drive seal kit. The seal kit for the hydraulic motor can be ordered from the factory under Part No. 23121.

REMOVAL OF HYDRAULIC MOTOR ASSEMBLY:

If disassembly of the hydraulic motor is not necessary, proceed as follows:

- 1) Remove 12 hex capscrews item 821, together with lockwashers item 823, from motor adaptor item 800. Since brake springs item 752, apply pressure against inside of motor adaptor, it is recommended that hex capscrews are unscrewed, one turn at a time, until spring pressure has been released. Complete motor assembly, including motor adaptor, can now be removed from brake housing
- 2) For models with internal circulation, ensure that hole in orifice plug item 804, is clear. For models with external brake release option, verify that shuttle item 802, moves freely.
- 3) Remove and discard O-ring item 801, and O-ring item 707. (O-ring item 801, seals pressure transfer hole for automatic brake release and is situated on flange of brake housing.)
- 4) Remove bearing carrier item 610, with ball bearing item 609. Inspect ball bearing item 609, and replace if necessary.
- 5) Proceed to applicable DISASSEMBLY OF BRAKE ASSEMBLY.

DISASSEMBLY OF BRAKE HOUSING ASSEMBLY:

Refer to BRAKE GROUP drawing G1038 on page 25.

- 1) Pull motor drive shaft item 730, along with sprag clutches item 723, out of connecting shaft item 600.
- 2) Disassemble sprag clutch assembly by removing circlip item 727, from motor drive shaft item 730. Remove sprag clutch aligner item 724, support washer item 717, and sprag clutches item 723, from motor drive shaft. Inspect bore of connecting shaft and outer diameter of motor drive shaft where both parts engage with sprag clutches. If parts show any deep indentations or surface damage, they must be replaced.
- 3) Remove connecting shaft item 600, together with brake hub item 720.
- 4) Remove retaining ring item 602, to disassemble brake hub from connecting shaft and inspect needle bearing item 603. If needle bearing is damaged, press out of connecting shaft and replace.
- 5) Remove 13 divider plates item 714, and 12 friction plates item 715, and inspect for damage or wear. Plates should be flat and smooth. Plates should not show heat discoloration. Fibre material on friction plates should be intact and grooved. Replace plates if damaged.
- 6) Remove internal gear item 430, two thrust washers item 615, and thrust bearing item 617.
- 7) Remove primary sun gear item 440, from center of primary planet hub item 400.
- 8) Pull primary planet hub assembly out of ball bearing item 777, and oil seal item 775.
- 9) Remove 16 capscrews item 111, and lockwashers item 113, to separate brake housing item 700, from final housing item 100.
- 10) Remove and discard O-ring item 107.
- 11) Remove six capscrews item 771, and lockwashers item 773, one turn at a time, to relieve pressure being exerted by brake springs item 752.
- 12) Remove spring stopper item 770, and discard O-ring item 779.
- 13) Check planet hub stopper item 304, on spring stopper item 770, for wear and replace if less than 0.21 inch thick.
- 14) Press ball bearing item 777, out of spring stopper item 770. Remove and discard oil seal item 775.

SERVICE INSTRUCTIONS CONTINUED

- 15) Remove 16 brake springs item 752. Examine springs for damage and measure overall length. Overall spring length should be 1.99 inch. Springs measuring less than 1.93 inch should be replaced.
- 16) Pull brake piston item 750, out of brake housing, using two tapped holes in brake piston and two 1/2 inch - 13 NC capscrews. (Two capscrews item 771, from spring stopper item 770, can be used. Alternatively, turn brake housing over and gently tap uppermost surface of brake piston with soft-headed hammer until it falls out onto workbench.)
- 17) Remove and discard O-ring item 751, and O-ring item 753.
- 18) Check brake piston outside diameters and inside diameters of brake housing for surface scratches due to particles in hydraulic fluid (contamination). If there is any evidence of surface damage, polish with fine emery cloth.

DISASSEMBLY OF PRIMARY PLANET HUB ASSEMBLY:

Inspect three primary planet gears item 420, for damage or wear. If necessary, disassemble as follows:

- 1) Remove circlips item 411, and press planet pins item 410, out of primary planet hub item 400. Remove planet gears item 420, and inspect needle bearings item 423, and two thrust washers item 421. Replace if damaged.
- 2) Press sungear stopper item 444, out of primary planet hub and measure thickness. If less than 0.21 inch thick, replace sungear stopper.

All parts have now been removed from brake housing and there is no need for further disassembly unless a failure has been analysed in the remaining drive assembly.

DISASSEMBLY OF FINAL DRIVE AND OUTPUT SHAFT ASSEMBLY:

Refer to PARTS REFERENCE on page 22 and FINAL DRIVE GROUP drawing G1037A on page 23.

If final drive or output shaft assembly requires service or repair, disassemble as follows:

- 1) Remove final sungear item 340, from center of three final planet gears item 320.
- 2) Pull out final planet hub assembly and inspect for wear or damage. If final planet hub gears item 320, require removal, take off circlip item 311, from planet pin item 310, and press planet pin out of final planet hub item 300. Remove final planet gear item 320, and inspect thrust washers item 321, and needle bearing item 323. Replace if damaged.
- 3) If Planematic drive includes an inboard or outboard flange, remove capscrew item 153, lockwasher item 155, and flange cap item 154, to slide off flange item 152.
- 4) Remove six hex capscrews item 163, and lockwashers, item 165. Pull off end cover item 156, and discard O-ring item 167, and oil seal item 157.
- 5) Untab lockwasher item 161, from locknut item 159. Unscrew locknut and remove lockwasher and keyed washer item 149. Output shaft item 150, can now be pressed out of tapered roller bearings items 151 and 103.
- 6) Check sungear stopper item 160, for wear and replace if less than 0.21 inch thick.

The Pullmaster Planematic drive has now been completely disassembled.

REASSEMBLY

Thoroughly clean all parts. Use only new, well-greased O-rings and oil seals. Unless otherwise specified, torque fasteners per BOLT TORQUE CHART.

REASSEMBLY OF FINAL DRIVE AND OUTPUT SHAFT ASSEMBLY:

Reassemble final drive and output shaft assembly by reversing disassembly procedure.

- 1) Press sungear stopper item 160, into end of output shaft item 150, and press output shaft into tapered roller bearings items 151 and 103.

SERVICE INSTRUCTIONS CONTINUED

- 2) Slide keyed washer item 149, and lockwasher item 161, onto output shaft against tapered roller bearing item 151. Screw locknut item 159, onto output shaft against lockwasher. Tighten locknut to a point where 5 to 15 pounds of pull is required to rotate output shaft item 150, freely. Bend tabs of lockwasher into openings on locknut to lock output shaft into position.
- 3) Press new, well-greased oil seal item 157, into end cover item 156, and place new, well-greased O-ring item 167, onto flange.
- 4) Fasten end cover to final housing item 100, using six capscrews item 163, and lockwashers item 165.
- 5) Reassemble final planet hub assembly. Press needle bearing item 323, into planet gear item 320. Position thrust washers item 321, on either side of planet gear and press planet pin item 310, into planet hub. Retain with circlip item 411.
- 6) Insert final planet hub assembly into final housing. Ensure that planet hub spline is fully engaged.
- 7) Install final sungear item 340. Verify circlip item 341, is installed on sungear.

REASSEMBLY OF PRIMARY DRIVE:

If primary planet hub assembly was disassembled, reassemble by reversing disassembly procedure.

- 1) Press sungear stopper item 444, into primary planet hub item 400.
- 2) Press needle bearing item 423, into planet gear item 420.
- 3) Position thrust washers item 421, on either side of planet gear and press planet pin item 410, into planet hub.
- 4) Retain with circlip item 411.

REASSEMBLY OF BRAKE HOUSING ASSEMBLY:

Reassemble brake housing assembly by reversing disassembly procedure.

- 1) Install new, well-greased O-rings item 751 and 753, into glands of brake piston item 750.
- 2) Slide brake piston into brake housing with holes for brake springs facing out of brake housing (see BRAKE GROUP drawing).
- 3) Install 16 brake springs item 752, in brake piston. Piston has 18 holes and two holes which have no brake springs installed should be located opposite to each other.
- 4) Install new, well-greased oil seal item 775, into spring stopper item 770, and press ball bearing item 777, into place.
- 5) Press planet hub stopper item 304, onto spring stopper item 770, and install new, well-greased O-ring item 779.
- 6) Install spring stopper item 770, onto brake housing item 700, using six capscrews item 771, and lockwashers item 773. Tighten capscrews, one turn at a time, to evenly compress brake springs item 752.
- 7) Install new, well-greased O-ring item 107, into outer flange O-ring groove in brake housing and fasten brake housing to final housing item 100, with 16 capscrews item 111, and lockwashers item 113.
- 8) Install primary planet hub assembly through ball bearing item 777, and oil seal item 775, engaging teeth with final sungear item 340.
- 9) Install primary sungear item 440.
- 10) Install two thrust washers item 615, (with thrust bearing item 617, between) on top of planet hub item 400.
- 11) Install internal gear item 430, on top of thrust washer, engaging teeth of three planet gears item 420.
- 12) If needle bearing item 603, was replaced, press into connecting shaft item 600. Slide brake hub item 720, onto connecting shaft and fasten with retaining ring item 602. Install connecting shaft assembly into internal gear item 430.

SERVICE INSTRUCTIONS CONTINUED

- 13) Starting and finishing with divider plate, alternately install 13 divider plates item 714, and 12 friction plates item 715.
- 14) Install two sprag clutches item 723, onto motor drive shaft item 730. Slide sprag clutch aligner, and support washer item 717, onto motor drive shaft and fasten with circlip item 727.

IMPORTANT: For proper brake function, verify that sprag clutches are installed correctly. Motor drive shaft should turn freely in clockwise rotation and lock up in counterclockwise rotation (for standard rotation).

- 15) Carefully install motor drive shaft assembly into center bore of connecting shaft item 600, engaging spline in primary sun gear item 440, until flange of sprag clutch aligner comes into contact with connecting shaft.
- 16) Slide ball bearing item 609, with bearing carrier item 610, onto connecting shaft item 600.
- 17) Use grease to temporarily hold new O-ring item 801, into recess on flange of motor adaptor item 800. Install new, well-greased O-ring item 707, onto motor adaptor pilot.
- 18) Position motor adaptor item 800, at brake housing, aligning brake release pressure transfer holes of motor adaptor and brake housing. Tighten 12 capscrews item 821, with lockwashers item 823, one turn at a time, to evenly compress springs.

REASSEMBLY OF HYDRAULIC MOTOR:

If hydraulic motor was disassembled, proceed with reassembly as follows:

- 1) Clean all parts thoroughly before reassembly and apply grease liberally to all seals. Use only new seals (seal kit Part No. 23121) for hydraulic motor.
- 2) Install six new pocket seals item 887, on each thrust plate item 885. Seal kit includes a single strip of rubber. Using a sharp knife, cut lengths to fit openings in thrust plates. Press one thrust plate, together with six pocket seals, onto bearings item 875, installed in motor adaptor item 800, so pocket seals are against motor adaptor.
- 3) Install new, well-greased body seal item 869, on each side of gear housing item 861. Slide gear housing together with body seals, onto motor adaptor, lined up on two dowel pins. Tap on tight using soft-headed hammer.
- 4) Install gear set item 881, in gear housing (longer gear with internal spline goes into top position).
- 5) Press other thrust plate item 885, complete with six new pocket seals item 887, onto bearings installed in port end cover item 870, so pocket seals are facing port end cover.
- 6) Install port end cover item 870, together with two bearings item 875, and new ring seal item 877, onto gear housing, lined up on two dowel pins item 865. Tap on tight using a soft-headed hammer. Install and lightly torque four hex capscrews item 951, and lockwashers item 953, to approximately 50 ft-lb (70 Nm).
- 7) Plumb Planematic assembly to hydraulic supply and torque motor capscrews according to following procedure:
 - Ensure that circulation supply flow is being supplied to and vented from brake housing. If an internal circulation model, fill with hydraulic oil through one of three filler / drain ports before running.
 - Run Planematic drive in hoisting direction, with no load, at reduced speed (approximately 30% of maximum hydraulic volume).
 - With Planematic drive running, evenly tighten four capscrews item 951, to 200 ft-lb (271 Nm)
 - Test motor operation by running Planematic drive at full speed in both directions.

SERVICE INSTRUCTIONS CONTINUED

IMPORTANT: After performing any service or repair work, reinstall Planematic drive according to INSTALLATION INSTRUCTIONS. Before operating Planematic drive, ensure that circulation oil is being supplied to brake housing. If an internal circulation model, fill with hydraulic oil through the uppermost drain port before running. To ensure proper reassembly, run Planematic drive in both directions without load. To ensure proper reinstallation, refer to test procedures described in INSTALLATION and OPERATING INSTRUCTIONS.

RECOMMENDED MAINTENANCE

In order to maintain the PULLMASTER Planematic drive in peak operating condition at all times, it is recommended that the following preventive maintenance procedure is carried out every 12 months or 500 operating hours, whichever occurs first.

- 1) Disconnect all hydraulic connections and remove the Planematic drive from its mounting.
- 2) Disassemble the Planematic drive in accordance with the SERVICE INSTRUCTIONS.
- 3) Discard and replace all O-rings and oil seals.
- 4) Inspect all parts for wear and replace if necessary.
- 5) Clean all parts thoroughly with solvent before reassembly.
- 6) Follow INSTALLATION and OPERATING INSTRUCTIONS when returning Planematic drive to its mounting.

When ordering parts for the PULLMASTER Planematic drive, always quote the complete model and serial numbers of the unit.

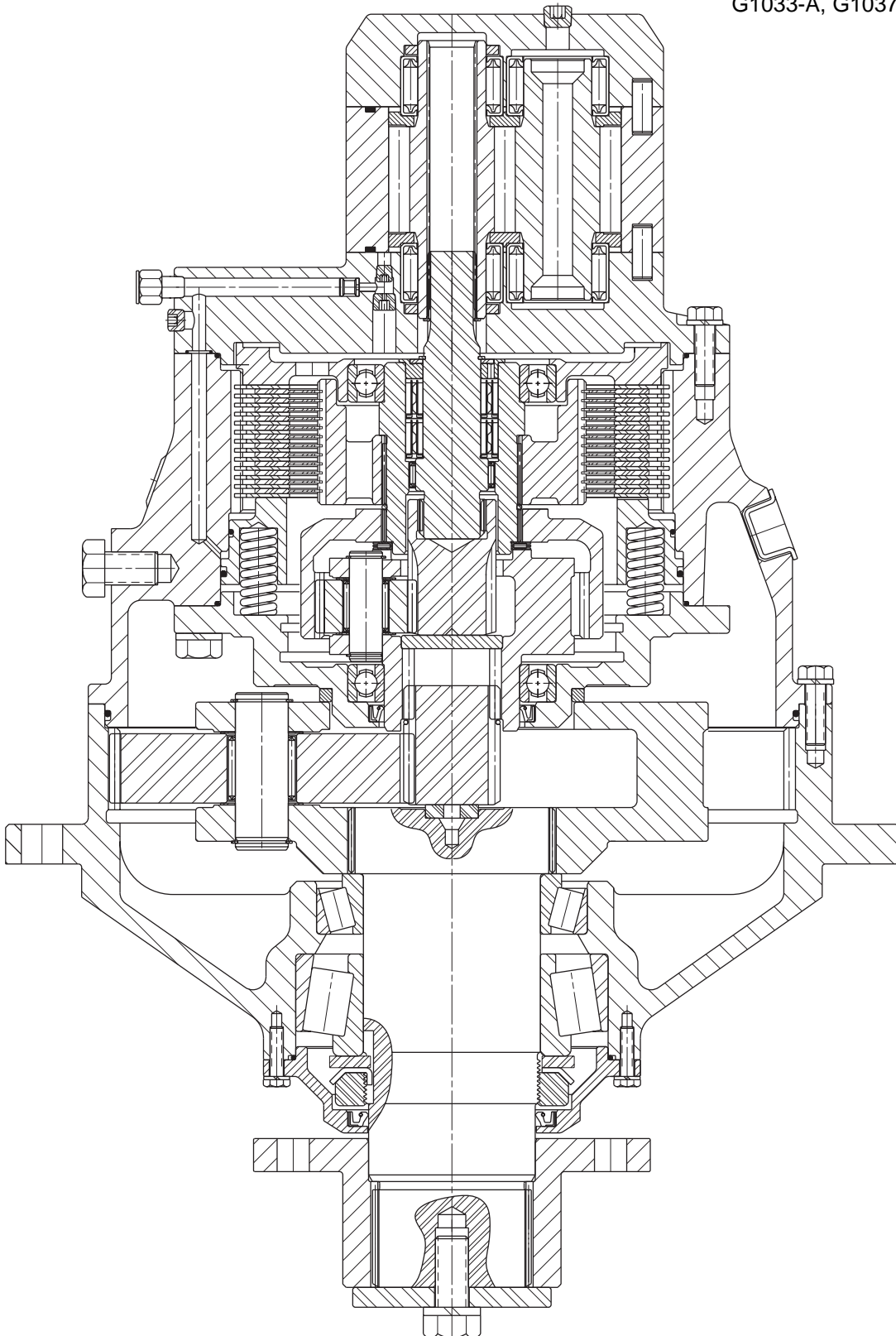
MODEL NO. _____

SERIAL NO. _____

PULLMASTER WINCH CORPORATION reserves the right to change specifications and the design of PULLMASTER Planematic drives at any time without prior notice and without incurring any obligations.

ASSEMBLY DRAWING

G1033-A, G1037-A & G1038



PARTS REFERENCE - FINAL DRIVE

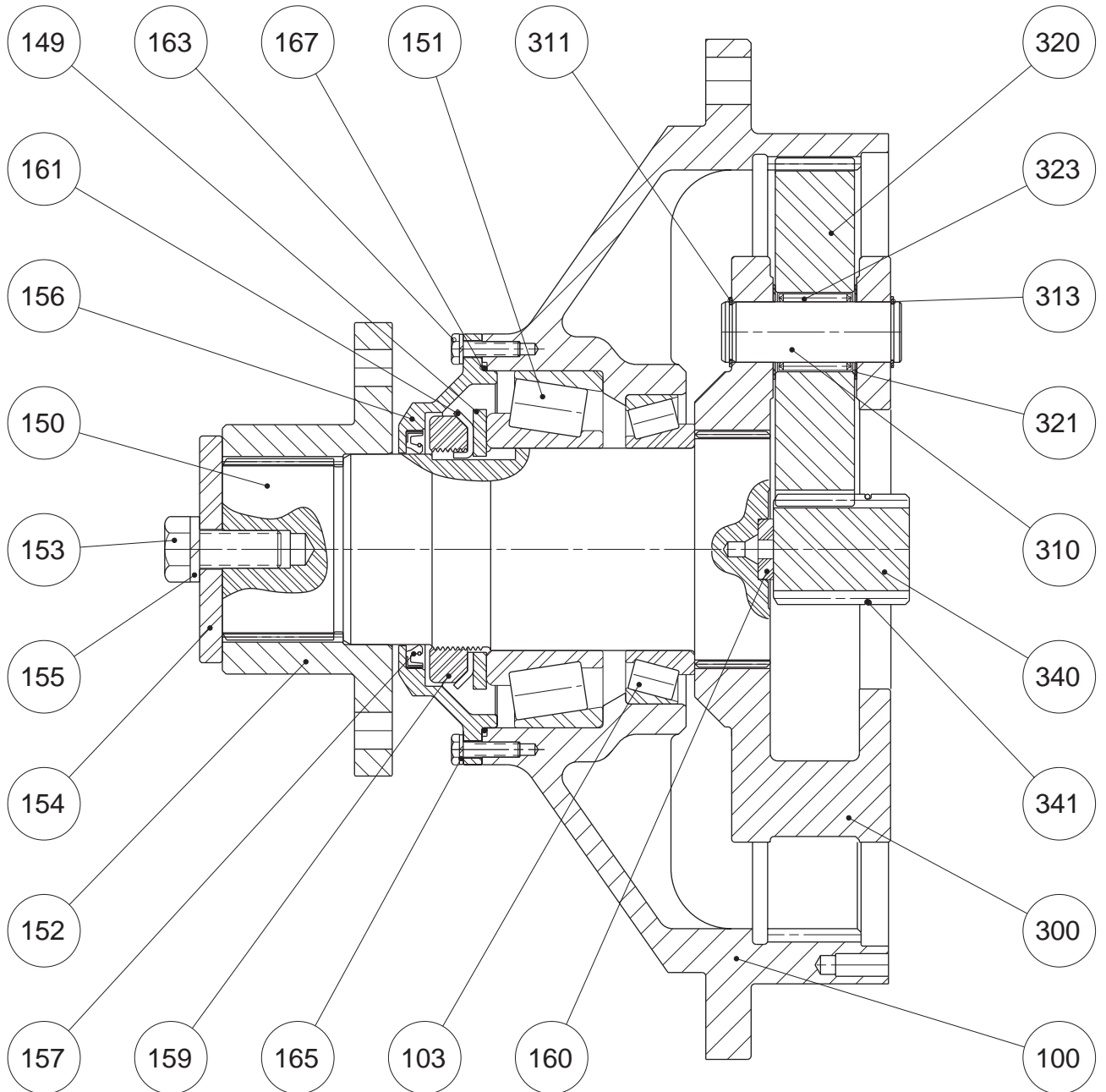
ITEM NO.	QTY.	PART NO.	DESCRIPTION
100	1	21394	FINAL HOUSING
103	1	25806	BEARING - TAPERED ROLLER SKF #32017 X
149	1	26006	WASHER KEYED TIMKEN K91517
150	1	*	OUTPUT SHAFT
151	1	25805	BEARING - TAPERED ROLLER SKF #33217
152	1	*	FLANGE
153	*	*	CAPSCREW - HEX HEAD GRADE 5
154	1	*	FLANGE CAP
155	*	*	LOCKWASHER
156	1	21398	END COVER
157	1	25933	OIL SEAL
159	1	25803	LOCKNUT #TAN17
160	1	20450	SUNGEAR STOPPER
161	1	25804	LOCKWASHER #WH17
163	6	25808	CAPSCREW - HEX HEAD 1/4 - 20 NC X 1.00 GRADE 5
165	6	25130	LOCKWASHER 1/4"
167	1	25061	O-RING -163 6"ID 3/32"CS
300	1	21414	PLANET HUB
310	3	20162	PLANET PIN
311	3	25122	CIRCLIP ROTOR CLIP C-100
313	3	25411	CIRCLIP ROTOR CLIP SH-100
320	3	20158	PLANET GEAR
321	6	25098	THRUST WASHER TORRINGTON #TRA 1625
323	3	25097	NEEDLE BEARING TORRINGTON #BH1620
340	1	21418	SUNGEAR
341	1	25809	CIRCLIP ANDERTON #A1000-0175

* These parts vary according to Output Shaft Code. Refer to APPENDIX A.

Refer to PAGE 24 for drive seal kit and PAGE 21 for ASSEMBLY DRAWING.

FINAL DRIVE GROUP

G1037-A



Group drawings may reference more parts than are actually present in a specific assembly. Parts that are referenced on the drawing but are not on the PARTS REFERENCE list should be ignored.

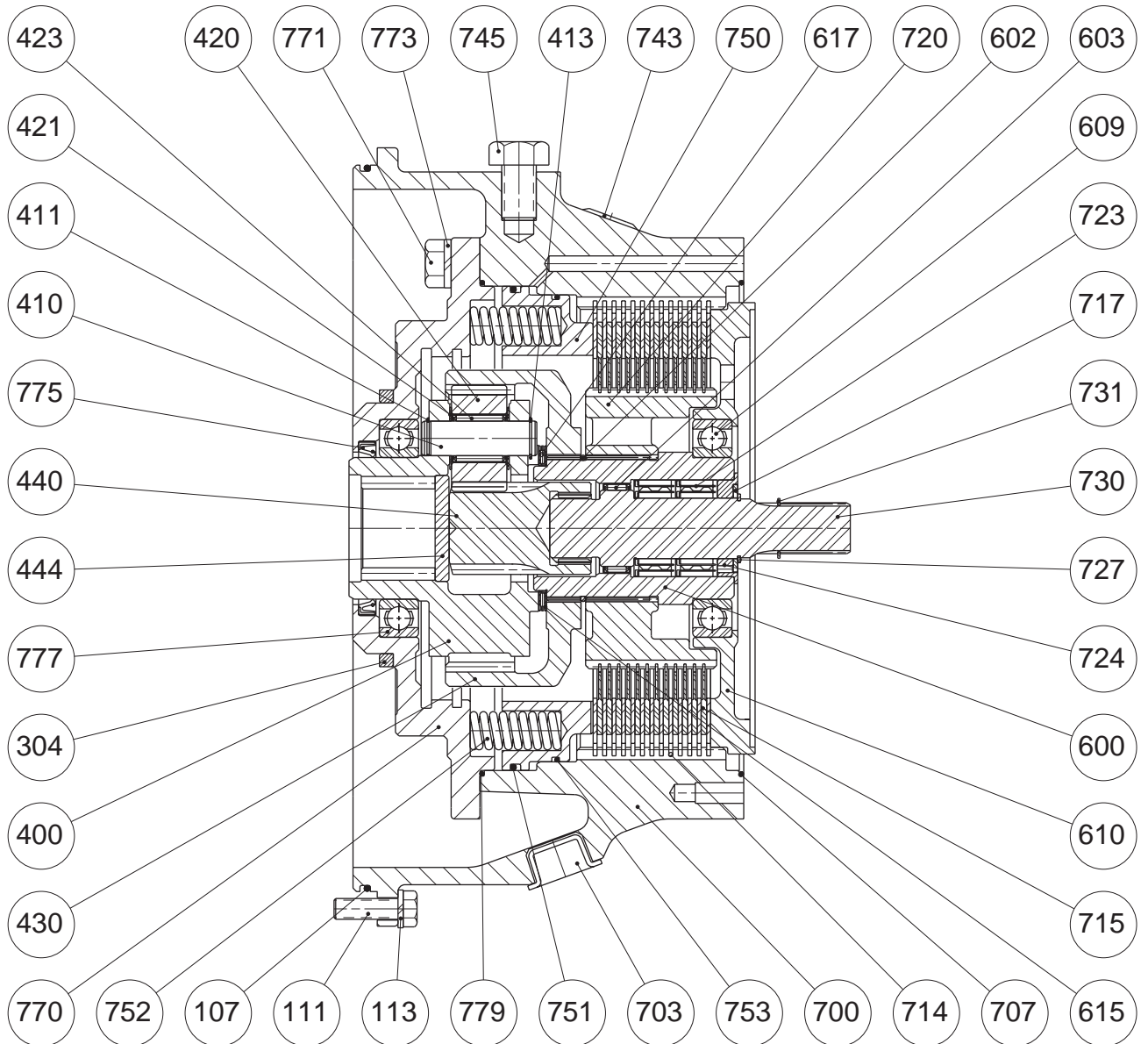
PARTS REFERENCE - BRAKE GROUP

ITEM NO.	QTY.	PART NO.	DESCRIPTION
107	1	25339	O-RING -278 12"ID 1/8"CS
111	16	25264	CAPSCREW -HEX HEAD 3/8 - 16NC X 1.00 GRADE 5
113	16	25037	LOCKWASHER 3/8"
304	1	21180	PLANET HUB STOPPER
400	1	21395	PLANET HUB
410	3	20080	PLANET PIN
411	3	25060	CIRCLIP ROTOR CLIP C-62
413	3	25119	CIRCLIP ROTOR CLIP SH-62
420	3	20101	PLANET GEAR
421	6	25064	THRUST WASHER TORRINGTON #TRA 1018
423	3	25269	NEEDLE BEARING TORRINGTON #BH 1016
430	1	21427	INTERNAL GEAR
440	1	21417	SUNGEAR
444	1	21397	SUNGEAR STOPPER
600	1	21425	CONNECTING SHAFT
602	1	20035	RETAINING RING
603	1	25811	NEEDLE BEARING TORRINGTON #B228
609	1	25810	BALL BEARING #6013
610	1	21415	BEARING CARRIER
615	2	25755	THRUST WASHER TORRINGTON #TRA 3648
617	1	25756	THRUST BEARING TORRINGTON #NTA 3648
700	1	21393	BRAKE HOUSING
703	1	25331	PLASTIC CAPPLUG 3/4 NPT THREADED
707	1	25192	O-RING -174 8-3/4"ID 3/32"CS
712	1	21484	BRAKE SPACER
714	13	21252	DIVIDER PLATE
715	12	25194	FRICTION PLATE
717	1	25729	SUPPORT WASHER ANDERTON #R.28/40/2.0
720	1	21426	BRAKE HUB
723	2	25187	SPRAG CLUTCH BORG WARNER #X138769
724	1	21193	SPRAG CLUTCH ALIGNER
727	1	25492	CIRCLIP ROTOR CLIP SH-106
730	1	21416	MOTOR DRIVE SHAFT
731	1	25500	CIRCLIP ROTOR CLIP C-93
743	2	25237	PIPE PLUG 3/4 - 14 NPT
745	1	25807	CAPSCREW - HEX HEAD 5/8 - 11NC X 1.00 GRADE 5
750	1	21434	PISTON
751	1	25191	O-RING -90 DURO -267 8-1/4"ID 1/8"CS
752	16	20028	BRAKE SPRING
753	1	25190	O-RING -90 DURO -171 8"ID 3/32"CS
770	1	21423	SPRING STOPPER
771	6	25081	CAPSCREW - HEX HEAD 1/2 - 13NC X 1.50 GRADE 5
773	6	25014	LOCKWASHER 1/2"
775	1	25802	OIL SEAL
777	1	25810	BALL BEARING #6013
779	1	25192	O-RING -174 8-3/4"ID 3/32"CS
		23134	DRIVE SEAL KIT, CONTAINS ITEMS: 107, 157, 167, 707, 751, 753, 775, 779 AND 801

Refer to PAGE 21 for TYPICAL ASSEMBLY DRAWING.

PARTS REFERENCE - BRAKE GROUP

G1038



Group drawings may reference more parts than are actually present in a specific assembly. Parts that are referenced on the drawing but are not on the PARTS REFERENCE list should be ignored.

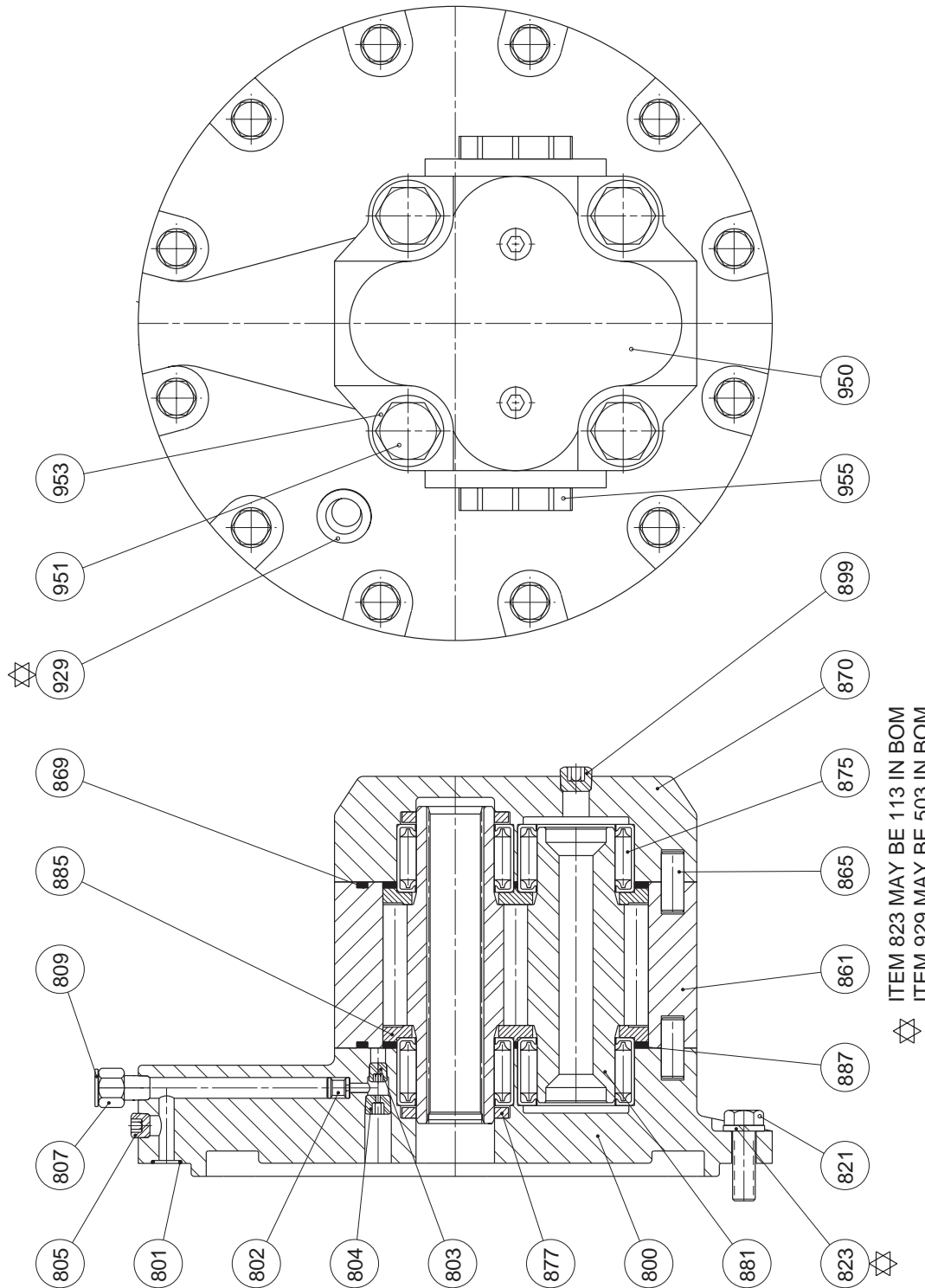
PARTS REFERENCE - MOTOR GROUP

ITEM NO.	QTY.	PART NO.	DESCRIPTION
800	1	21390	MOTOR ADAPTOR
801	1	25310	O-RING -012 3/8"ID 1/16"CS
802	1	*	*
803	1	25370	PIPE PLUG 1/16 - 27 NPT
804	1	*	*
805	2	25040	PIPE PLUG 1/8 - 27 NPT
807	1	*	*
809	1	*	*
821	12	25118	CAPSCREW - HEX HEAD 3/8 - 16NC X 1.25 GRADE 5
823	12	25037	LOCKWASHER 3/8"
861	1	25724	GEAR HOUSING
865	4	25326	DOWEL PIN
869	2	25612	SEAL - BODY
870	1	21758	PORT END COVER SUB-ASSY WITH PLUGS
875	4	25723	NEEDLE BEARING
877	2	25722	SEAL - RING
881	1	25728	GEAR SET -097 (2" GEAR WIDTH)
885	2	25725	THRUST PLATE
887	12	25656	SEAL - POCKET
899	2	25031	PIPE PLUG 1/4 - 18 NPT
929	1	*	*
950	1	**	SUB-ASSY MOTOR -097 (2" GEAR WIDTH)
951	4	25324	CAPSCREW - HEX HEAD 5/8 - 11NC X 5.25 GRADE 5
953	4	25325	WASHER
955	2	25557	PLASTIC CAPLUG 1.625" - 12 THREADED
		23121	MOTOR SEAL KIT, CONTAINS ITEMS: 869, 877 AND 887
			* These parts vary according to Brake Code. Refer to APPENDIX B.
			** ITEM 950, MOTOR SUB-ASSY, CONTAINS ITEMS: 800, 802, 803, 804, 805, 807, 809, 861, 865, 869, 870, 875, 877, 881, 885, 887, 899, 929, 951, 953, AND 955

Refer to PAGE 24 for drive seal kit and PAGE 30 for TYPICAL ASSEMBLY DRAWING.

MOTOR GROUP

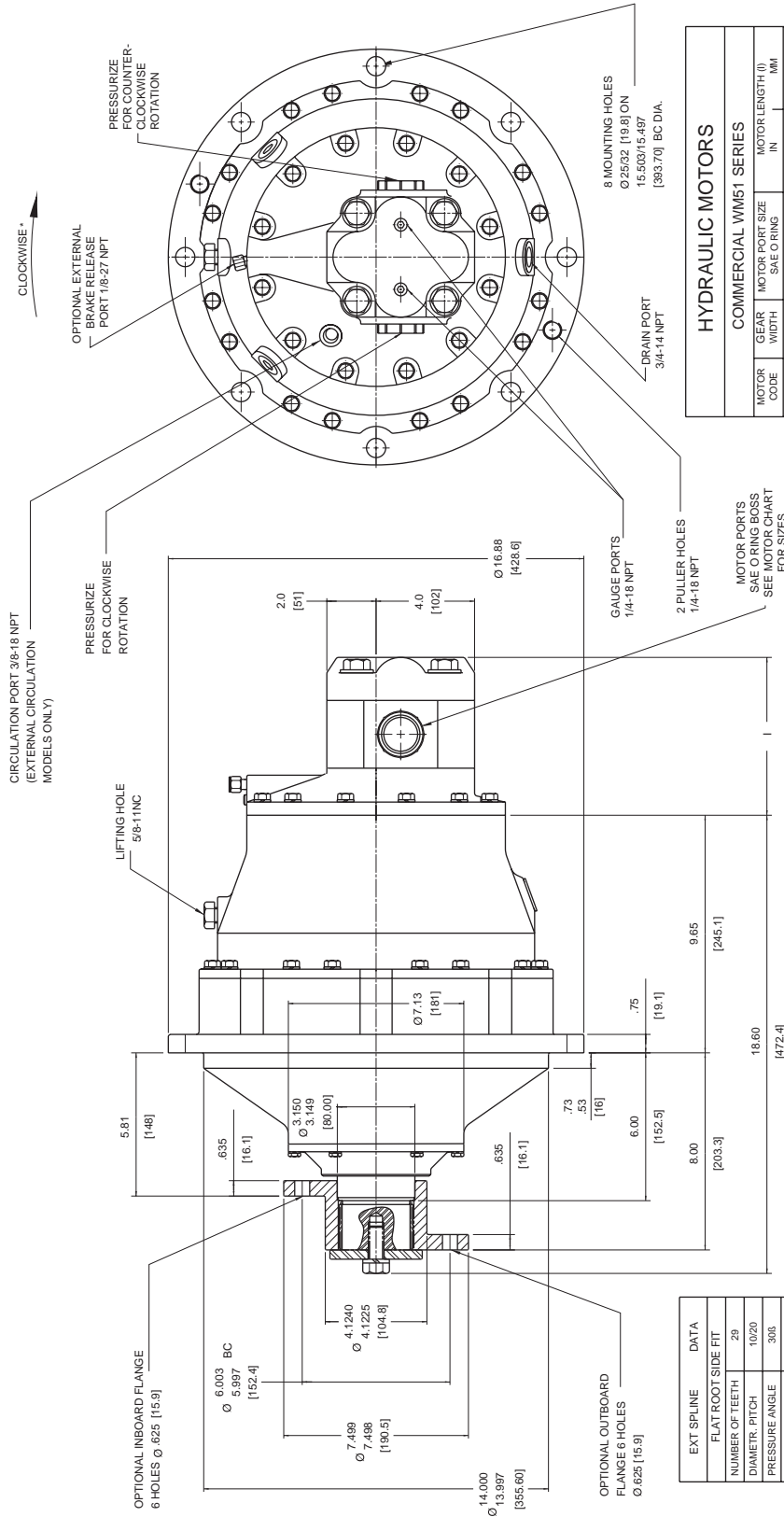
G1033-A



Group drawings may reference more parts than are actually present in a specific assembly. Parts that are referenced on the drawing but are not on the PARTS REFERENCE list should be ignored.

INSTALLATION DRAWING

11018-D



HYDRAULIC MOTORS			
COMMERCIAL WM51 SERIES			
MOTOR CODE	GEAR WIDTH	MOTOR PORT SIZE SAE O RING	MOTOR LENGTH (I) IN MM
-95	2.50"		6.9 175
-96	2.25"	1.625-12	6.7 169
-97	2.00"		6.4 163
-98	1.50"	1.312-12	5.9 150
-99	1.00"	1.062-12	5.4 137
-114	1.75"	1.312-12	6.2 156
-139	2.00"	1.25" SPLIT FLANGE	6.4 163

EXT SPLINE DATA
FLAT ROOT SIDE FIT
NUMBER OF TEETH - 29
DIAMETR. PITCH - 10/20
PRESSURE ANGLE - 30°
MAJOR DIAMETER - 3.000

* NOTE - CLOCKWISE & COUNTER-CLOCKWISE OUTPUT SHAFT ROTATION IS ESTABLISHED BY LOOKING AT THE HYDRAULIC MOTOR

APPENDIX A

ITEM NO.	PART DESCRIPTION	OUTPUT SHAFT CODE					
		- 1	- 2	- 3	- 4	- 5	- 6
		PART NUMBER					
150	OUTPUT SHAFT	21399	22375	21399	21399	21804	22165
150A	KEY	N/A	22203	N/A	N/A	N/A	N/A
152	FLANGE	N/A	N/A	21419	21805	N/A	N/A
153	CAPSCREW	N/A	N/A	25139 (5/8"-11NC X 1.5)	25139	N/A	(QTY. 2) 25013 (1/2"-13NC X 1.25)
154	FLANGE CAP	N/A	N/A	21420	21420	N/A	22166
155	LOCKWASHER	N/A	N/A	25359 (5/8")	25359	N/A	(QTY. 2) 25014 (1/2")

APPENDIX B

ITEM NO.	PART DESCRIPTION	BRAKE CODE							
		- 3	- 4	- 5	- 6	- 7	- 8	- 9	- 10
		PART NUMBERS							
802	SHUTTLE	N/A	20849	20849	N/A	N/A	20849	20849	N/A
804	ORIFICE PLUG	21483	21483	21483	21483	N/A	N/A	N/A	N/A
804	1/8-27 NPT PIPE PLUG	N/A	N/A	N/A	N/A	25040	25040	25040	25040
807	1/8-27 NPT PIPE PLUG	25040	N/A	N/A	25040	25040	N/A	N/A	25040
807	1/8-27 NPT PIPE ADAPTOR	N/A	25622	25622	N/A	N/A	25622	25622	N/A
809	1/8 NPT CAPLUG	N/A	25374	25374	N/A	N/A	25374	25374	N/A
929	3/8 NPT CAPLUG	N/A	N/A	N/A	N/A	25393	25393	25393	25393
929	3/8-18 NPT PIPE PLUG	25085	25085	25085	25085	N/A	N/A	N/A	N/A
950	MOTOR SUB-ASSY	21938	22014	22015	22016	22017	22018	22019	22020

BOLT TORQUE CHART

BOLT DIAMETER Inches	TORQUE Lb-ft	TORQUE Nm
1/4	9	12
5/16	18	24
3/8	32	43
7/16	50	68
1/2	75	102
9/16	110	149
5/8	150	203
3/4	265	359
7/8	420	569
1	640	868
1 1/8	800	1085
1 1/4	1000	1356
1 3/8	1200	1627
1 1/2	1500	2034

NOTE: Unless otherwise specified, torque bolts per above chart.

