

# Product Maintenance Information



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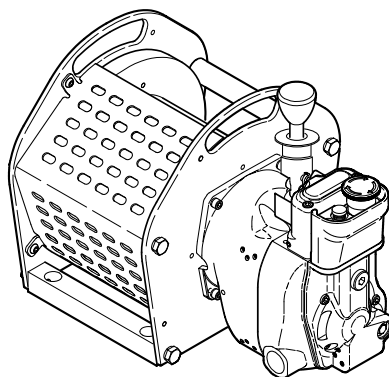
## Liftstar and Pullstar Air Winch Models

LS2-300R, LS2-600R, PS2-1000R, LS2-1500R, PS2-2400R

LS2-300R( )-E and CE, LS2-600R( )-E and CE, LS2-1500R( )-E and CE,

LS2-1500R( )-CE

PS2-1000R( )-E and CE and PS2-2400R( )-E



(Dwg. MHP2628)



**Save These Instructions**



Form MHD56276  
Edition 3  
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Only allow **Ingersoll Rand** trained technicians to perform maintenance on this product. For additional information contact **Ingersoll Rand** factory or nearest Distributor.

**For additional supporting documentation refer to Table 1 'Product Information Manuals' on page 2.**

**Manuals can be downloaded from [ingersollrandproducts.com](http://ingersollrandproducts.com)**

The use of other than genuine **Ingersoll Rand** replacement parts may result in safety hazards, decreased performance and increased maintenance and will invalidate all warranties.

Original instructions are in English. Other languages are a translation of the original instructions.

Refer all communications to the nearest **Ingersoll Rand** Office or Distributor.

**Table 1: Product Information Manuals**

Publication	Part/Document Number	Publication	Part/Document Number
Product Safety Information Manual (Non-Man Rider)	MHD56250	Product Information Manual (Non-Man Rider)	MHD56282
Product Parts Information Manual	MHD56283		

## INSPECTION

Frequent inspections should be performed on equipment in regular service. Refer to Product Information Manual Form MHD56282.

### Records and Reports

Inspection records, listing all points requiring periodic inspection should be maintained for all load bearing equipment. Written reports, based on severity of service, should be made on the condition of critical parts as a method of documenting periodic inspections. These reports should be dated, signed by the person who performed the inspection, and kept on file where they are readily available for authorized review.

### Periodic Inspection

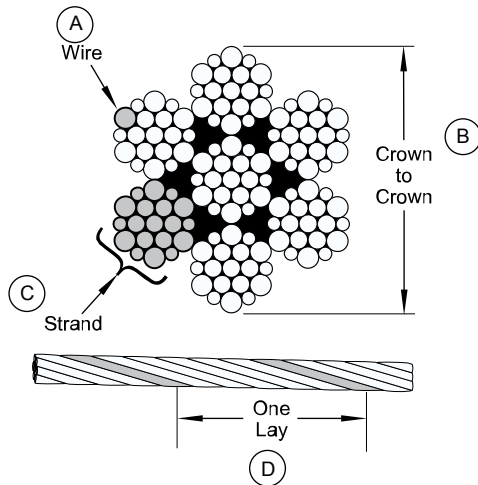
Periodic inspection intervals for winch use under various conditions is listed below:

NORMAL	HEAVY	SEVERE
yearly	semiannually	quarterly

Disassembly may be required as a result of frequent inspection findings or in order to properly inspect the individual components. Disassembly steps are described in the "MAINTENANCE" on page 5. Maintain written records of periodic inspections to provide an accumulative basis for continuing evaluation. Inspect all items listed in "Frequent Inspection", refer to the Product Information Manual. Also inspect the following:

1. **Siderails and Uprights.** Check for deformed, cracked or corroded main components. Replace damaged parts.
2. **Fasteners.** Check retainer rings, capscrews, nuts and other fasteners on winch, including mounting bolts. Replace if missing or damaged and tighten if loose.
3. **Drum and Sheaves.** Check for cracks, wear or damage. Replace if necessary.
4. **Wire Rope.** In addition to "Frequent Inspection" requirements, also inspect for the following:
  - a. Build-up of dirt and corrosion. Clean with steam or a stiff wire brush to remove dirt and corrosion if necessary.
  - b. Loose or damaged end connection. Replace if loose or damaged.
  - c. Check wire rope anchor is secure in drum.
  - d. Verify wire rope diameter. Measure the diameter of the wire rope from crown-to-crown throughout the life of the wire rope. Recording of the actual diameter should only be done with the wire rope under equivalent loading and in the same operating section as accomplished during previous inspections. If the actual diameter of the wire rope has decreased more than 1/64 inch (0.4 mm) a thorough examination of the wire rope should be conducted by an experienced inspector to determine the suitability of the wire rope to remain in service. Refer to Dwg. MHP0056 on page 2.

5. **All Components.** Inspect for wear, damage, distortion, deformation and cleanliness. If external evidence indicates damage, disassemble as required to conduct a detailed inspection. Inspect gears, shafts, bearings, sheaves, springs and covers. Replace worn or damaged parts. Clean, lubricate and reassemble.
6. **Brakes.** Individually test brakes installed to ensure proper operation. Brakes must hold a 125% rated load at mid drum without slipping. If indicated by poor operation or visual damage, disassemble and repair brake(s). Check all brake for wear, deformation or foreign deposits. Clean and replace components as necessary. Adjustments cannot be made to the disc brake and must be repaired as described in the "MAINTENANCE" section on page 5.
7. **Foundation or Supporting Structure.** Check for distortion, wear and continued ability to support winch and rated load. Ensure winch is firmly mounted and that fasteners are in good condition and tight.
8. **Drum Guard.** Verify fasteners are tight and in good condition. Ensure guard is in good condition.
9. **Emergency Stop Valve.** During winch operation verify the emergency stop valve operation. Valve must stop winch operation quickly. Valve must reset properly. Refer to 'Emergency Stop Valve' in the "OPERATION" section in Product Information Manual for procedures.
10. **Overload Device.** Ensure overload device is properly set to stop the winch when loads exceed 125% (+/- 10%) of winch rated capacity. If winch does not shut down, contact your distributor or the factory for repair information.
11. **Limit Switches.** Test winch set points by operating winch through three complete cycles to ensure consistent limit switch operation within +/- 0.5 m of set points.
12. **Labels and Tags.** Check for presence and legibility of labels. Replace if damaged or missing.



(Dwg. MHP0056)

# INSPECTION REPORT

**Ingersoll Rand Models LS2-300R, LS2-600R, LS2-1500R, PS2-1000R or PS2-2400R Air Winch**

<b>Model Number:</b>	<b>Date:</b>
<b>Serial Number:</b>	<b>Inspected by:</b>

<b>Reason for Inspection: (Check Applicable Box)</b>	
1. Scheduled Periodic Inspection: ( ___ Months ___ Years)  2. Discrepancy(s) noted during Frequent Inspection 3. Discrepancy(s) noted during maintenance 4. Other: _____	<b>Operating Environment:</b> Normal ___ Heavy ___ Severe ___

Refer to the Product Information Manual Form MHD56282 and Product Parts Information Manual Form MHD56283 and "INSPECTION" section for general inspection criteria. Also, refer to appropriate National Standards and Codes of practice. If in doubt about an existing condition, contact the nearest **Ingersoll Rand** Distributor or the factory for technical assistance.

COMPONENT	CONDITION		CORRECTIVE ACTION		NOTES
	Pass	Fail	Repair	Replace	
Uprights and Siderails					
Disc Brake (125% Load Test)					
Disc Brake (Visual Inspection)					
Motor					
Controls					
Air System					
Fasteners					
Reduction Gears					
Labels and Tags			---		
Shafts					
Drum Guard					
Wire Rope Wedge			---		
Emergency Stop Valve					
Overload Device			---		
Wire Rope			---		
Other Components (list in NOTES section)					
<b>TESTING</b>			<b>Pass</b>	<b>Fail</b>	<b>NOTES</b>
Operational (No Load)					
Operational (10% Load)					
Operational (Maximum Test Load*)					

\* Maximum test load is 125% of rated line pull. Testing to more than 125% of rated load may be required to comply with standards and regulations set forth in areas outside the USA.

This form may be photocopied and used as an inspection record.

## TROUBLESHOOTING

This section provides basic troubleshooting information. Determination of specific causes to problems are best identified by thorough inspections performed by personnel instructed in safety, operation and maintenance of this equipment. The chart below provides a brief guide to common winch symptoms, probable causes and remedies.

SYMPTOM	CAUSE	REMEDY
Winch will not operate.	Insufficient or no air supply to winch.	Check air supply line connections and hoses.
	Winch is overloaded.	Reduce load to within rated capacity.
	Disc brake does not release.	Inspect brake piston seals and replace if seals appear to be leaking.
	Emergency stop valve engaged.	Reset emergency stop valve.
	Motor may be damaged.	Disassemble and clean the motor and replace any broken or damaged parts.
	Air leak.	Check hose and fitting connections. Inspect hose(s) for breaks. Tighten fittings and repair or replace hoses as necessary.
	Overload device engaged.	Reduce load to within rated capacity of winch. If overload device cannot be reset, contact factory.
Load continues to move when winch is stopped.	Air lines freeze due to water in air supply.	Install or drain air system moisture traps, moisture collecting air receivers and compressor aftercoolers. After corrective action has been taken, disconnect lines at winch inlet and purge with clean, dry air or nitrogen.
	Brake is slipping.	Check brake friction disc wear.
Winch does not lift/pull load.	Winch is overloaded.	Reduce load to within rated capacity.
	Winch motor controls sticking.	Check pendant/throttle levers spring return to normal (neutral) position when released.
	Motor may be damaged.	Remove and disassemble motor as described in "MAINTENANCE" on page 5. Examine all parts and replace any that are worn or damaged.
	Insufficient air supply.	Verify air supply pressure and volume at winch inlet meets the requirements listed in the "SPECIFICATIONS" section in Product Information Manual. Clean air line filter.
Oil leak from motor end of winch.	Brake is not releasing.	Check brake release pilot hole is not restricted. Check seals on cylinder piston are not damaged. Brake will start to release at 50 psig (3.5 bar/350 kPa).
	Reduction assembly is leaking.	Disassemble winch and inspect reduction assembly seals.
Motor does not run smoothly or makes excessive noise during operation.	Winch is overloaded.	Reduce load to within rated capacity.
Winch runs slow.	Worn or broken gear set bearings.	Examine each bearing. Install new bearings where necessary.
	Improper hose or fitting sizes.	Check fittings, connections and hoses for correct size and length. Replace parts that may cause restricted air flow. Inspect air line filter.
	Motor may be damaged.	Remove and disassemble motor as described in "MAINTENANCE" on page 5. Inspect all parts and replace all worn or damaged parts.
	Insufficient air supply.	Verify air supply pressure and volume at winch inlet meets the requirements. Refer to "SPECIFICATIONS" section in Product Information Manual. Clean air line filter.

# MAINTENANCE

## **WARNING**

- Never perform maintenance on the winch while it is supporting a load.
- Before performing maintenance, tag controls:

**WARNING - DO NOT OPERATE, EQUIPMENT BEING REPAIRED.**

- Only allow Ingersoll Rand Certified Service Technicians to perform maintenance on this winch.
- After performing any maintenance on the winch, test winch to 125% of its rated line pull at mid drum before returning to service. (Testing to more than 125% of rated line pull may be required to comply with standards and regulations set forth in areas outside the USA.)
- Shut off air system and depressurize air lines before performing any maintenance.
- Do not use Trichloroethylene to clean parts.
- Use of other than genuine Ingersoll Rand parts may result in safety hazards, decreased performance and increased maintenance and will invalidate all warranties.

## ■ Maintenance

Personnel trained and certified by the owner/user are the only personnel authorized to do repair or maintenance on a winch. Correct disassembly (to prevent loss or damage of good parts), repair, assembly, testing and adjusting are critical to proper winch operation. Maintenance procedures are technical in nature and require training and experience to accomplish correctly. In addition, repair and testing require specialized equipment that is not typically found at the winch-mounting site.

Proper use, inspections and maintenance increase the life and usefulness of your Ingersoll Rand equipment. During assembly, lubricate gears, nuts, capscrews and all machined threads with applicable lubricants. Use of antiseize compound and/or thread lubricant on capscrew and nut threaded areas prevents corrosion and allows for easy disassembly of components.

It is extremely important that mechanics and operators be familiar with the servicing procedures of these winches or similar products, and are physically capable of conducting the procedures. These personnel shall have a general working knowledge that includes:

1. Proper and safe use and application of mechanics common hand tools as well as special Ingersoll Rand or recommended tools.
2. Safety procedures, precautions and work habits established by accepted industry standards.

Ingersoll Rand cannot know of, or provide all the procedures by which product operations or repairs may be conducted and the hazards and/or results of each method. If operation or maintenance procedures not specifically recommended by the manufacturer are conducted, it must be ensured that product safety is not endangered by the actions taken. If unsure of an operation or maintenance procedure or step, personnel should place the product in a safe condition and contact supervisors and/or the factory for technical assistance.

The Maintenance Interval Chart below is based on intermittent operation of equipment for eight hours each day, five days per week. If the equipment is in operation for more than eight hours a day or is operated in severe applications or environments, more frequent maintenance should be performed.

INTERVAL	MAINTENANCE CHECK
Start of each shift (Operator or Maintenance Personnel)	Make a thorough visual inspection of winch for damage. Do not operate winch if damage is found. Operate winch at low RPM in both directions. Winch must operate smoothly without sticking, binding or abnormal noises. Check operation of brake.
Yearly (Maintenance Personnel)	Inspect the winch gearing, shafts and bearings for wear and damage. Repair or replace as necessary. Check all supporting members, including foundations, fasteners, nuts, sheaves and rigging, etc. for indications of damage or wear. Repair or replace as required.

## **NOTICE**

- Refer to the Product Parts Information Manual for drawings unless specified elsewhere.

## ■ Adjustments

### ■ Motor Removal

Refer to Dwg. MHP2617 and MHP3717.

Use the following procedure to remove the motor.

1. Shut off and bleed down main air supply to winch.
2. Disconnect and tag air lines.
3. To remove a motor from a winch not equipped with a free spool, stand winch in a vertical position properly supported with the motor end up. Winches with a free spool assembly must be supported so that no damage occurs to free spool parts when winch is in a vertical position.

4. Remove four capscrews (86) and lockwashers (2) that attach air motor assembly to the upright (5) and remove motor assembly.
5. Store motor in a clean area until further disassembly is necessary.

### ■ Disc Brake

No brake adjustment is required.

## **NOTICE**

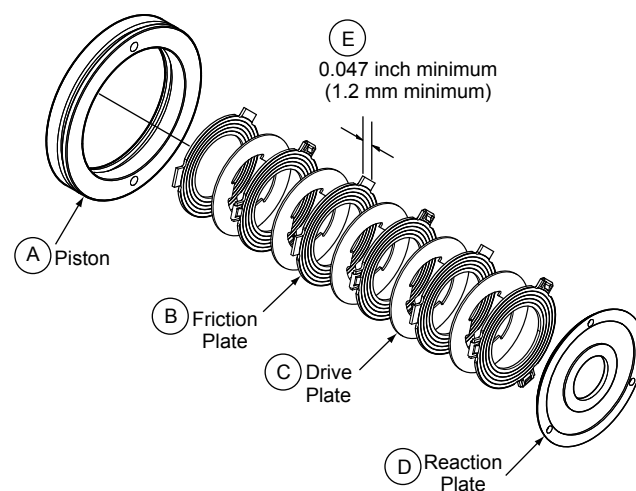
- Original brake disc thickness is 0.059 in (1.5 mm).

It is recommended that the brake assembly be removed for inspection and maintenance once each year.

Refer to MHP2638, A. Piston; B. Friction Plate; C. Drive Plate; D. Reaction Plate; E. 0.047 inch (1.2 mm) minimum. If this dimension is less than shown, the friction plates (66) and (72) must be replaced.

1. Remove motor as described in 'Motor Removal' section on page 5.
2. Remove the reaction plate (81), friction plate (76) and (77), drive plate (78) and piston (73).
3. Inspect the friction plate (76) and (77) for wear. If friction plate thickness is uneven or is less than 0.047 in (1.2 mm) replace all friction plates.
4. Remove, discard and replace existing 'O' rings on piston (73).

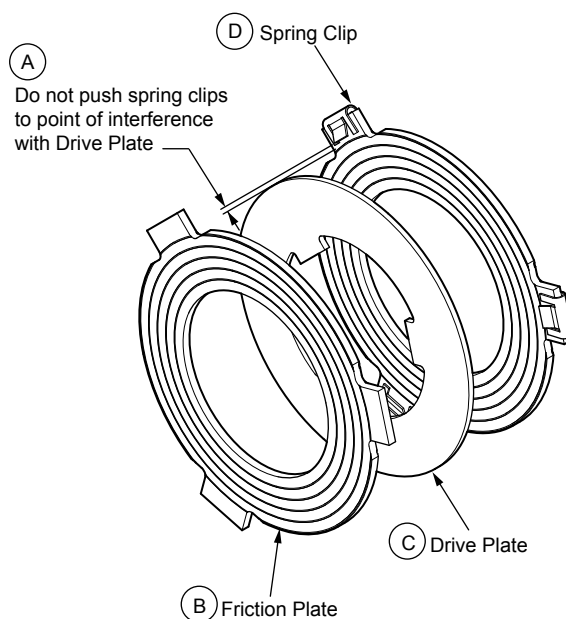
No further disassembly is required, if only the brake is to be serviced.



(Dwg. MHP2638)

## **WARNING**

- Ensure drive plates make full contact with the friction plates, without interference from spring clips.



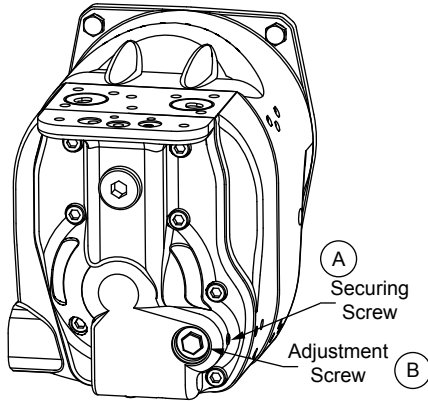
(Dwg. MHP3046)

## Overload Device



- Overload is factory set and should not be adjusted without consulting an Authorized Certified Service Technician.

- Connect winch to an air supply.
- Release securing screw and adjusting screw in order to increase or decrease the SWL (increase SWL by tightening the adjusting screw). Adjustment must be made for an overload of 125% maximum of SWL.
- Tighten securing screw.
- Check winch operation at rated load. If necessary repeat adjustment.



(Dwg. MHP2683)

## Disassembly



- Refer to the Product Parts Information Manual for drawings unless specified elsewhere.

### General Disassembly Instructions

The following instructions provide necessary information to disassemble, inspect, repair, and assemble product. Parts drawings are provided in Product Parts Information Manual.

If a product is being completely disassembled for any reason, follow the order of topics as they are presented. It is recommended that all maintenance work on product be performed in a clean dust-free work area. In the process of disassembling product, observe the following:

- Never disassemble product any further than is necessary to accomplish needed repair. A good part can be damaged during the course of disassembly.
- Never use excessive force when removing parts. Tapping gently around perimeter of a cover or housing with a soft hammer, for example, is sufficient to break the seal.
- Do not heat a part with a flame to free it for removal, unless part being heated is already worn or damaged beyond repair and no additional damage will occur to other parts. In general, products are designed to permit easy disassembly and assembly. The use of heat or excessive force should not be required.
- Keep work area as clean as practical, to prevent dirt and other foreign matter from getting into bearings or other moving parts.
- All seals, gaskets and 'O' rings should be discarded once they have been removed. New seals and 'O' rings should be used when assembling product.
- When grasping a part in a vise, always use leather-covered or copper-covered vise jaws to protect the surface of part and help prevent distortion. This is particularly true of threaded members, machined surfaces and housings.
- Do not remove any part which is a press fit in or on a subassembly unless removal of that part is necessary for repairs or replacement.
- When removing ball bearings from shafts, it is best to use a bearing puller. When removing bearings from housings, drive out bearing with a sleeve slightly smaller than outside diameter of bearing. The end of sleeve or pipe which contacts bearing must be square. Protect bearings from dirt by keeping them wrapped in clean cloths.

### Drum Guard Disassembly

**For LS2-300R, LS2-600R and PS2-1000R**  
Refer to Dwg. MHP2618.

- Remove screws (44) from uprights (5).
- Remove drum guard (43) and keep with screws until reassembly.

**For LS2-1500R and PS2-2400R**  
Refer to Dwg. MHP3724.

- Remove screws (6) and washer (8) from spacer (27).
- Remove drum guards (37) and (38) and keep with screws until reassembly.

### Winch Disassembly

**For LS2-300R, LS2-600R and PS2-1000R**  
Refer to Dwg. MHP2618, MHP2617 and MHP2620.

- Shut off, bleed down air supply, then disconnect and tag air lines.
- Remove winch from its mounting and keep in clean work area on a sturdy work bench.

- Position several blocks of wood on the work bench and put the winch in a vertical position with the motor end up. If winch is equipped with a free spool option, make sure the weight of the winch does not rest on the free spool knob (238) or cause damage to the free spool parts.
- Remove capscrews (86) and lockwashers (2) that attach air motor assembly to upright (5). Remove motor and keep motor assembly aside for further disassembly, if required.

### For LS2-1500R and PS2-2400R

Refer to Dwg. MHP3724, MHP3723 and MHP3721.

- Shut off, bleed down air supply then disconnect and tag air lines.
- Remove winch from its mounting and keep in clean work area on a sturdy work bench.
- Position several blocks of wood on the work bench and put the winch in a vertical position with the motor end up. If winch is equipped with a free spool option, make sure the weight of the winch does not rest on the free spool knob (8) or cause damage to the free spool parts.
- Remove capscrews (86) and lockwashers (2) that attach air motor assembly to motor flange (26). Remove motor and keep motor assembly aside for further disassembly, if required.
- Remove capscrews (49) and lockwashers (2) that attach motor flange (26) to upright (11). Remove the gearbox assembly and keep aside for further disassembly, if required.

### Free Spool Disassembly

#### For LS2-300R, LS2-600R and PS2-1000R

Refer to Dwg. MHP2618 and MHP2620.

- Remove capscrews (1) and washers (2) that attach one upright (5) with free spool assembly from winch assembly.
- Loosen and remove knob (238) from shaft (245).
- Turn lever (237) to disengage free spool and remove free spool assembly from end cover (3).
- Tap pin (236) from lever (244) and remove lever.
- Pry bushings (141) from end cover.
- Remove shaft (244), spring (243) and cam (242).
- Remove spring stopper (246), spring (247) and retainer ring (248).
- Remove retainer ring (49), press shaft and bearing assembly from gear (253).
- Remove retainer ring (252) and press bearing (251) from shaft (245).

#### For LS2-1500R and PS2-2400R

Refer to Dwg. MHP3724, MHP3723 and MHP3721.

- Remove capscrews (17) and washers (22) that attach upright (12) with free spool assembly from winch assembly.
- Loosen and remove knob (8) from shaft (5).
- Turn lever (9) to disengage free spool and remove free spool assembly from end cover (6).
- Tap pin (11) from lever (18) and remove lever.
- Pry bushings (2) from end cover.
- Remove shaft (18), spring (219) and cam (3).
- Remove spring stopper (20), spring (21) and retainer ring (13).
- Remove retainer ring (14), press shaft and bearing assembly from gear (30).
- Remove retainer ring (15) and press bearing (1) from shaft (5).

### Drum Wear Rings

#### For LS2-300R, LS2-600R and PS2-1000R

- Examine the drum wear rings (40) for wear. If thickness is less than 0.040 in (1 mm), replace drum wear rings.

#### For LS2-1500R and PS2-2400R

- Examine drum wear rings (41) for wear. If thickness is less than 0.040 in (1 mm), replace drum wear rings.

### NOTICE

- Original thickness of drum wear rings is 0.060 in (1.5 mm).

### Disc Brake Disassembly

#### For LS2-300R, LS2-600R and PS2-1000R

Refer to Dwg. MHP2647.

- Remove control valve and motor assembly and keep aside.
- Remove capscrews (25) (black) and make sure that the brake and reducer assembly come out together.
- Use the two jack screw holes in the piston (73) to remove piston (73) and brake reaction plate (81).
- Remove 'O' ring (16) and (74) from piston (73) and discard.
- Remove drive plates (78), friction plates (77) and splined hub coupling (75).
- Remove 'O' ring (16) from brake housing (69) and discard.

#### For LS2-1500R and PS2-2400R

The disc brake disassembly will be done at the same time as "Air Gear Motor Assembly".

### Reduction Gear Disassembly

#### For LS2-300R, LS2-600R and PS2-1000R

Refer to Dwg. MHP2647.

- Remove fill plug (14) and drain oil from reduction gear into an applicable container.
- Remove capscrew (24) then remove reduction gear assembly from brake housing (69). Keep brake assembly in a clean area if no disassembly is required.
- Remove capscrews (22) and washers (23) that attach end cover (15).
- Remove retainer ring (12) from sliding gear (20).

## NOTICE

- It may be necessary to use small quantity of air pressure in fill hole of reduction gear end cover (15) to remove from housing (27).

5. Remove and discard 'O' ring (16) on reduction gear end cover (15).
6. It is not necessary to remove bearing (39) from end cover (15) unless damaged. Replace as necessary.
7. Remove bearing (13) and oil seal (17). Replace seal and bearing if necessary.
8. Remove bearing (21) and ring gear (19).
9. Hold the end cover (15) and tap out shaft (20).
10. Remove retainer ring (36) from sun gear (34).
11. Hold the reducer housing (27) and lightly tap out sun gear (34).
12. Tap out gear shafts (33) and remove planet gears (31), spacers (30), needle bearings (28) and bearing rings (29).
13. Remove retainer ring (49). Remove sun gear (34).
14. Remove retainer ring (36) and bearing (35).
15. Remove brake housing (69) from reduction gear housing (27).
16. Remove and discard gasket (26) and 'O' ring (16) from brake.
17. Remove bearing (38) and replace if necessary.

### For LS2-1500R and PS2-2400R

Refer to Dwg. MHP3723.

1. Remove fill plug (24), level plug (50) and drain plug (51). Drain oil from reduction gear into an applicable container.
2. Remove capscrew (4) and washers (5) then remove gear ring (38) from motor flange (26).
3. Remove 'O' rings (23), (19) and (20) from flange motor (26).
4. Remove primary gear sub-assembly (1), sun gear 12 teeth (25), retainer ring (8) and bearing (14).
5. Remove capscrew (3) and washers (6) then remove reduction gear end cover (32) from half reducer housing (31).
6. Remove gear ring (48) and keep planetary support assembly aside for further disassembly.
7. Remove gear ring (38) from half reducer housing (31). Remove 'O' ring (20) from gear ring (38).
8. Remove 'O' rings (22) from half reducer housing (31).
9. Remove retainer ring (9) from sliding gear (28).
10. Remove bearings (12), (13) and oil seal (16) from reduction gear end cover (32).

### Air Gear Motor Disassembly

#### For LS2-300R, LS2-600R and PS2-1000R

Refer to Dwg. MHP2617.

1. Remove capscrews (44) from cover plate (102).
2. Remove gasket (101). Remove check valve (83) and ball (84).
3. Remove capscrews (100) and remove motor cover (97) from motor housing (87).
4. Remove valve (94), valve (105) and springs (96).
5. Remove 'O' ring (93) only if necessary (to remove 'O' rings, it is necessary to cut them). The two bearings (91) mounted in the motor housing are bonded with Loctite® 603 or equivalent.
6. If necessary, remove gears (92) and (104). Use a bearing punch or standard drift punch to press gears from motor housing (87).
7. To remove both bonded bearings (91) from motor housing (87), use the same bearing punch and a hammer. Two or three strikes are sufficient.
8. If necessary, remove bearings (91) from drive gear (92) and idle gear (104) (use a suitable bearing extractor).

### For LS2-1500R and PS2-2400R

Refer to Dwg. MHP3717.

#### Disc Brake Disassembly

1. Remove plug (14) from brake housing (69).
2. Remove capscrews (126) and make sure that the brake assembly comes out.
3. Remove gasket (16) from motor housing (87).
4. Use the two jack screw holes in the piston (73) to remove piston (73) and brake reaction plate (81).
5. Remove 'O' rings (16) and (74) from piston (73) and discard.
6. Remove drive plates (78), friction plates (77), friction plates with springs (76) and splined hub coupling (75).

### Control Valve Disassembly

Refer to Dwg. MHP2622 for LS2-300R, LS2-600R and PS2-1000R. Refer to Dwg. MHP3718 for LS2-1500R and PS2-2400R.

1. Remove capscrews (137) and lockwashers (2). Remove spools (142).
2. Remove capscrews (612) and lockwashers (2) and stop plate (117).
3. Remove knob (129).
4. Remove capscrew (118), lockwasher (23) and nut (240) and make sure that the bushing (119), spring (120) and retractable handle come out.
5. Remove capscrew (126) and lockwasher (125).
6. Remove lever (128) and coupling (124). Remove screw (127).
7. Remove retainer (140), spindle shaft (131) and gear (138).
8. Remove retainer (140), spindle shaft (131) and gear cam (139).
9. Remove pins (132) from spindle shafts (131). Remove bushings (133) and (141).

### Pendant Disassembly (optional feature)

Refer to Dwg. MHP2640 or MHP2641.

1. Remove the fittings (327) and the lifting eye (501).
2. Loosen the plugs (518) and remove with springs (177) and balls (84).
3. Tap out pin (502) and remove the levers (503).
4. Remove screws (173) from pendant handle (514).
5. Remove the valve assemblies (165) with 'O' rings (171) and (166) and protectors (170).
6. Remove the emergency stop valve (164) or plug (507) from the handle.
7. Remove retainer ring (512) and exhaust washer (41).

### Emergency Stop Disassembly (optional feature)

Refer to Dwg. MHP2621.

1. Remove capscrews (168) and lockwashers (2).

2. Remove emergency stop (179) from end cover (183). Remove 'O' rings (175).
3. Loosen the emergency stop button (164). Remove retainer rings (178).
4. Remove springs (177) and balls (84).
5. Remove screw (173) and pull valve (165) with 'O' ring (171), 'O' ring (166) and protector (170).
6. Loosen the check valve (83) and remove ball (84).
7. Remove 'O' rings (166).

### Emergency Stop Valve and Overload Disassembly

Refer to Dwg. MHP2621.

1. Remove 'O' rings (90) and discard.
2. Remove setscrew (180). Remove capscrews (103).
3. Remove emergency stop end cover (183).
4. Remove ball (84). Remove valve seat (186).
5. Remove seal (189) and axle (188).
6. Remove 'O' Rings (187). Remove spring (193).
7. Loosen the tightening screw (102).
8. Loosen the regulating screw (192). Remove 'O' ring (191) and discard.
9. Remove gasket (101) from motor cover (97).
10. Remove valve seat (205). Remove spring (213).
11. Remove capscrews (214).
12. Remove caps (202) and (211), washers (208) and (206), sleeve (209) and diaphragm (212).
13. Remove seals (203) and (210).
14. Pull nut (194) and remove plunger (198) with diaphragm (196) from base plate (199).
15. Loosen the nut (194) and remove plunger (198) and washer (195).
16. Remove 'O' rings (197) and discard.
17. Install a screw (dia. M5) in threaded hole on base plate (199) and pull it from motor cover (97).
18. Remove seal (189) and 'O' ring (201).

### Limit Switch Disassembly

Refer to Dwg. MHP3372.

## CAUTION

It is not recommended to disassemble limit switch. Contact factory if repair is required.

1. Remove and tag hose connections if not done.
2. Remove nuts (504) from rods (502). Remove cover (505), gasket (490) and housing (486) from limit switch adapter (450).
3. Remove capscrews (499) and pull spindle switch assembly (501) from limit switch adapter (450).
4. Keep limit switch assembly in a clean, dry area until winch reassembly.

## Cleaning, Inspection and Repair

### Cleaning

## CAUTION

- A bearing that appears loose or does not rotate smoothly must be replaced. Failure to observe this precaution will result in bearing and/or winch component damage.

Clean all winch component parts in solvent (except for the brake friction discs). The use of a stiff bristle brush will facilitate the removal of accumulated dirt and sediments in the drum and reduction assembly. If drum wear rings have been removed it may be necessary to carefully scrape old Loctite® from the drum wear ring grooves. Dry each part using low pressure, filtered compressed air. Clean the brake friction discs using a wire brush or emery cloth. Do not wash the brake friction discs in liquid. If the brake friction discs are oil soaked, they must be replaced.

### Inspection

All disassembled parts should be inspected to determine their fitness for continued use. Pay particular attention to the following:

1. Inspect all gears for worn, cracked, or broken teeth.
2. Inspect all bushings for wear, scoring, or galling.
3. Inspect all bearings for play, distorted races, pitting and roller or ball wear or damage. Inspect bearings for freedom of rotation.
4. Inspect shafts for ridges caused by wear. If ridges caused by wear are apparent on shafts, replace the shaft. Inspect all surfaces on which oil seal lips seat. These surfaces must be very smooth to prevent damage to the seal lip.
5. Inspect all threaded items and replace those having damaged threads.
6. Inspect the brake stationary plates and friction discs for oil. If the friction discs have become oil-soaked, replace them. If the stationary plates have become glazed, sand them lightly using fine emery cloth and a flat surface as backing. Inspect the remaining brake parts for warpage or other damage, and replace damaged parts as necessary.
7. Measure the thickness of the brake friction discs. The brake friction discs must show an even wear pattern. If the brake friction discs are 0.047 in (1.2 mm) or less, replace the discs.

### Repair

Actual repairs are limited to the removal of small burrs and other minor surface imperfections from gears and shafts. Use a fine stone or emery cloth for this work. Do not use steel wool.

1. Worn or damaged parts must be replaced. Refer to the Product Parts Information Manual for specific replacement parts information.

- Inspect all remaining parts for evidence of damage. Replace or repair any part which is in questionable condition. The cost of the part is often minor in comparison with the cost of redoing the job.
- Smooth out all nicks, burrs, or galled spots on shafts, bores, pins, or bushings.
- Examine all gear teeth carefully, and remove nicks or burrs.
- Polish the edges of all shaft shoulders to remove small nicks which may have been caused during handling.
- Remove all nicks and burrs caused by lockwashers.
- Replace all gaskets, oil seals, and 'O' rings removed during winch disassembly.

## Winch Assembly

### NOTICE

- Refer to the Product Parts Information Manual MHD56283 for drawings unless specified elsewhere.

#### For LS2-300R, LS2-600R and PS2-1000R

Apply a light coat of Loctite® 243 to all threaded components prior to assembly. Refer to Dwg. MHP2618.

- Install wear rings (40) in the grooves provided in the drum (10) after applying a large quantity of grease. Press wear rings into position and make sure that there is no gap between drum and wear rings. Make sure the gap between the ends of each wear ring is approximately 1/8 in (3 mm).
- Position wear ring gaps and make sure that they are staggered (offset) from each other by 4 in (100 mm).
- Install exhaust washers (41) onto drum (10) and attach with retainer ring (42).
- For winches without free spool:**
  - Install gear (253) onto drum (10) and attach with retainer ring (249).
  - Install bearing (6) onto drum (10).
  - Install end cover (3) onto upright (5) and attach with capscrews (1) and lockwashers (2).
  - Install plugs (4) and (18) onto end cover (3).
  - Install upright (5), end cover and bearing onto drum (10).
  - Keep the assembly in a vertical position, with the upright on the bench.
- For winches with free spool:**
  - Install bearing (6) onto drum (10).
  - Install end cover (3) equipped with free spool clutch assembly (refer to free spool assembly) onto upright (5) and attach with capscrews (1) and lockwashers (2).
  - Pull plunger out for free spooling.
  - Install upright (5), end cover and bearing onto drum (10).
  - Keep the assembly in a vertical position, with the upright on the bench and make sure that the plunger do not touch the bench.
- Install spacers (45) and (46) on upright and install capscrews (7) and lockwashers (8) without totally tightening.
- Install upright (5) on spacer and install capscrews (7) and lockwashers (8) without totally tightening.
- Install spacer (11) with grease on sliding gear (20).
- Lubricate wear rings with grease and install motor gear brake assembly in drum bore. Make sure that the motor gear brake assembly rotates freely in the drum wear rings.
- Partially lift out motor gear brake assembly and do a check for the position of the wear rings. Attach with capscrews (86) and lockwashers (2) and make sure the torque is 1.4 mdaN.
- Keep the winch in a horizontal position and do a check for clutch free spool. Tighten the capscrews (7) and make sure the torque is 4.7 mdaN.

#### For LS2-1500R and PS2-2400R

Refer to Dwg. MHP3724.

- Install wear rings (40) in the grooves provided in the drum (10) after applying a large quantity of grease. Press wear rings into position to remove any gaps between drum and wear rings. Make sure the gap between the ends of each wear ring is approximately 1/8 in (3 mm). Position wear ring gaps and make sure that they are staggered (offset) from each other by 4 in (100 mm).
- Install 'O' rings (40) and (39) onto drum (36).
- Install end cover (9) on upright (12) and attach with capscrews (7) and washers (8).
- Install bearing (10) into end cover (9).
- Install end cover (9) on upright (12) and attach with capscrews (7) and washers (8).
- Install muffler disc (14) into muffler housing (13).
- Install 'O' Ring (43) on muffler disc with few drops of Loctite® 601.
- Install muffler on upright (12) and attach with capscrews (44). Apply a light coat of Loctite® 243 on all threaded parts.
- Install stud (30) on spacers (27). Apply a light coat of Loctite® 243 on all threaded parts.
- Install upright (12) on the drum (36).
- Keep the winch in a vertical position with the muffler on the bench. Install spacers (27), tie rod (28), nuts (17), screw (15) and washers (16) without tightening.
- Install upright (11) on spacers (27) and tie rod (28). Install screw (15), nut (17) and washers (16) without tightening.
- Install retainer ring (45).
- Lubricate wear rings with grease. Install reduction gear assembly into the drum bore and make sure that the reduction gear assembly rotates freely in the drum wear rings.
- Attach with screws (4) and washers (5) then with screws (49) and washers (5) and make sure the torque is 5.4 mdaN.
- Keep the winch in a horizontal position on large plate with a flat surface. Pat with hammer on the uprights and make sure that all the parts are in good position.
- Install screw (15), nuts (17) and lock washers (16). Make sure that the screws are tightened and nuts staggered. While tightening the spacers (17) make sure that there is a good contact with the plate and the torque is 9.5 mdaN.

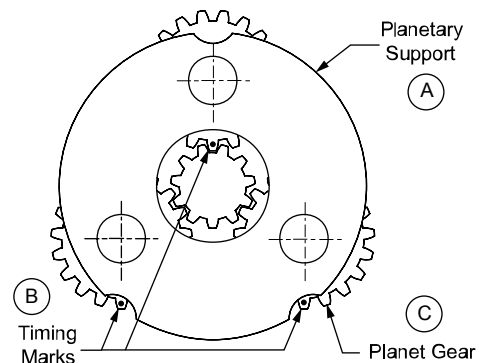
## Assembly

### Reduction Gear Assembly

#### For LS2-300R, LS2-600R and PS2-1000R

Refer to Dwg. MHP2647.

- If bearing was removed, install bearing (38) into brake housing (69).
- Install new gasket (26), lubricate and install 'O' ring (16) onto brake housing (69).
- Install oil seal (37) in brake housing (69), with lip towards motor.
- Install plug (14) onto brake housing (69).
- Install brake assembly (69) to reducer housing (27). Make sure that the holes are aligned and attach with capscrew (24).
- Install oil seal (17) onto cover (15) and make sure that the lip of the seal is towards planet gear support.
- Install bearings (39) and (13) onto cover (15).
- Install sliding gear (20) into bearings (39) and (13) and attach with retainer ring (12).
- Lubricate and install 'O' rings (16) on cover (15).
- Install bearing (35) onto sun gear (34) and attach with retainer ring (36).
- Install sun gear (34) onto planet gear support (32) and attach with retainer ring (49).
- Install two needle bearings (28), two bearing rings (29) with a spacer (30) between each planet gear (31).
- Install planet gears with bearings into planet gear support (32). Make sure that the planet gears (31) are installed with the smaller gear head diameter is near to the side of the planet gear support (32) with timing notches, time planet gears as shown in Dwg. MHP1406 on page 8 and locate with gear shaft (33).
- Install bearing (21) onto planet gear support (32).
- Lubricate the diameter of sun gear for lip seal.
- Install planet gear assembly into reducer housing (27), be careful of lip seal (37).
- Fill the planet gear assembly with clean SYNTHETIC OIL MOBIL SHC 629, capacity of gear box: 0,15 litres.
- Install ring gear (19).
- Install reduction gear end cover assembly to reducer housing and attach with capscrews (22) and washers (23).
- Install plug (14) into cover (15).
- Install retainer ring (36) onto sun gear (34) (brake housing side).



(Dwg. MHP1406)

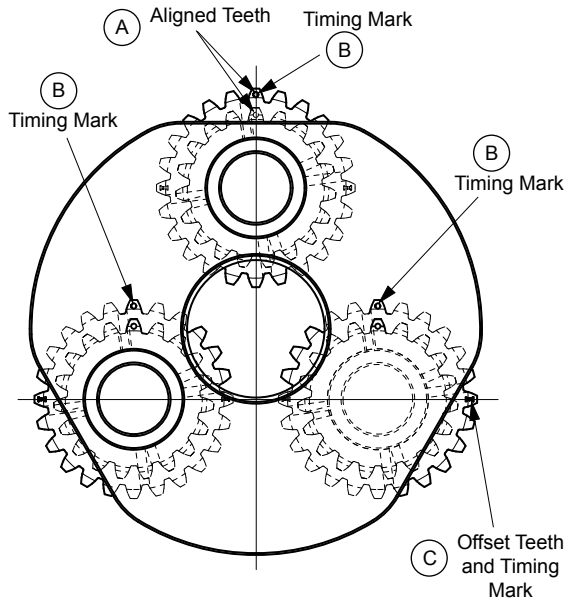
#### For LS2-1500R and PS2-2400R

Refer to Dwg. MHP3723.

- Assemble planet support assembly. Install bearings (47), internal bearing rings (46), needle bearings (36) and (37), spacers (43) and rings (44) in three planetary gears (39). Install planetary gear assemblies into planetary carrier (42). Make sure that the planetary gears (39) are installed with the smaller gear head diameter is near to the ring gear (48). Before installing all these parts, soak them in oil SYNTHETIC OIL MOBIL SHC 629 220 Cst.
- Align planetary gear assemblies with small holes in planetary carrier and install planet axles (40).
- Time planet gears as shown in Dwg. MHP3048, A. Aligned Teeth; B. Timing Mark; C. Offset Teeth and Timing Mark. Use the assembled sun gear (25) to maintain timing position.
- Install bearings (14) and retainer ring (8) on sun gear (25).
- With sun gear (25) still in place, install planetary assembly in ring gear (48) and be careful when you keep ring gear flat on surface with planet support assembly facing up.
- Install the two bearings (14) into the planetary support (42).
- Lubricate and install 'O' ring (20) on gear ring (38), before apply grease into the groove.
- Lubricate and install 'O' rings (22) on half reducer housing (31).
- Align two holes with 'O' rings and using two marks on external diameter of gear ring and half reducer housing and assemble these parts.
- Align teeth of sun gear (25), gear ring (38) and primary gear sub-assembly (1). Install this last assembly and keep this assembly in a vertical position, with the gear ring (38) on the bench.
- Lubricate and install 'O' ring (20) on reduction gear end cover (32), before apply grease into the groove.
- Lubricate and install oil seal (16) into reduction gear end cover (32).
- Install bearings (13) on outshaft (28). Install these two parts into reduction gear end cover (32) and take care of the lips of the oil seal.
- Install bearings (12) and retainer ring (9) on outshaft (28).
- Align capscrew holes and install reduction gear end cover (32) on half reducer housing (31) and attach with screws (3) and lockwasher (6).
- Apply a large quantity of grease and install ring (29) and gear (30) on output shaft (28).
- Keep the winch in a vertical position with the out shaft on the bench.
- Fill the gearbox with clean SYNTHETIC OIL MOBIL SHC 629 220 Cst, capacity: 0,26 litre.
- Install sun gear (27) and bearing (15) with three drops of Loctite® 603 on primary gear sub-assembly (1).
- Lubricate and install 'O' rings (20), (23) and (19), plug (52), fill plug (24), level plug (50) and drain plug (52) on motor flange (26).
- Align the two holes for filling and draining oil. Install the motor flange (26) on the gear ring (38) and attach with screws (4) and lockwasher (5). Do not apply the torque for the moment but apply after installing the gearbox into the drum.
- Lubricate and install the two oil seal (17), take care of the position of the main lip. For the first oil seal, the main lip will be placed toward the gearbox. For the second, the main lip will be placed towards you.
- Install bearing (11) and retainer ring (10).
- Remove the sun gear (27) and install the retainer ring (7).



25. After applying a large quantity of grease (grease : UNIL OPAL HT 300 or equivalent) on the spline. Install 'O' rings (18) and spacer ring (34) on sun gear.



(Dwg. MHP3048)

### Free Spool Assembly

#### For PS2-1000R

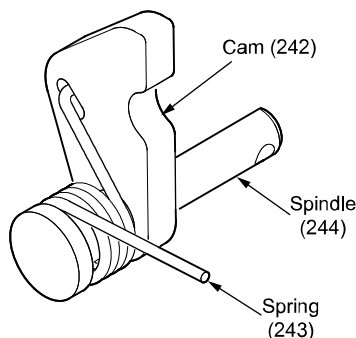
Refer to Dwg. MHP2620.

1. Install bearing (251) onto shaft (245) and secure with retainer ring (252).
2. Press fit shaft assembly into gear (253).
3. Attach shaft assembly with retainer ring (49).
4. Install spring (247) onto shaft, retainer ring (248) will stop spring.
5. Install spring stopper (246) with flat side towards the gear (253).
6. Install spring (243) onto the spindle (244) and make sure that the bent end of the spring is facing away from the spindle head.
7. Install cam (242) onto the spindle (244). Cam needs to be placed on the spindle and make sure that the bent end of the spring will engage slot in the cam. Refer to Dwg. MHP2639 on page 9.
8. Install spindle cam assembly into plate (3) hole with bushings (141).
9. Position the spring end and cam (242) and make sure that the capscrew (241) is between.
10. Install handle (237) and make sure that the bushing is in place. Align pin holes and attach with pin (236).
11. Turn the cam (242) using the lever to clear the hole and slide shaft assembly with spring stopper into center hole of the plate (3). Push in until you hear a click.
12. Install knob (238).

#### For PS2-2400R

Refer to Dwg. MHP3721.

1. Install bearing (1) onto shaft (5) and secure with retainer ring (15).
2. Press fit shaft assembly into gear (16).
3. Attach shaft assembly with retainer ring (14).
4. Install spring (21) onto the shaft, retainer ring (13) will stop spring for long drum version.
5. Install spring stopper (20) with flat side towards the gear (253).
6. Install spring (19) onto the spindle (18). Make sure that the bent end of the spring is facing away from the spindle head.
7. Install cam (3) onto the spindle (18). Cam needs to be placed on the spindle and make sure that the bent end of the spring will engage slot in the cam. Refer to Dwg. MHP2639 on page 9.
8. Install spindle cam assembly into free spool clutch support (6) hole with bushings (2).
9. Position spring end and cam (3) and make sure that the capscrew (10) is between.
10. Install handle (9) and make sure that the bushing is in place. Align pin holes and secure with pin (11).
11. Turn the cam (3) using the lever to clear the hole and slide shaft assembly with spring stopper into center hole of free spool clutch support (6). Push in until you hear a click.
12. Install knob (8).



(Dwg. MHP2639)

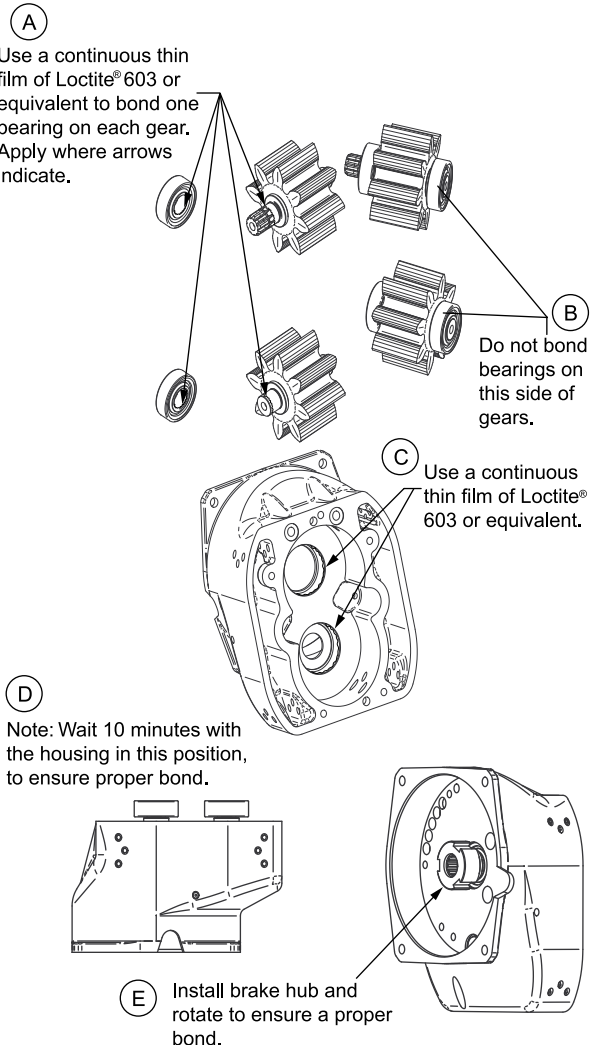
### Control Valve Assembly

Refer to Dwg. MHP2622 or Dwg. MHP3718.  
The assembly is in opposite order of the disassembly.

### Air Gear Motor Assembly

Refer to Dwg. MHP2617, MHP2644 and MHP3717.

1. Wipe and clean the grease from each bearing (91).
2. Clean interior and exterior diameter of the bearings with Loctite® 7063 or equivalent.
3. Apply a continuous thin film of Loctite® 603 or equivalent on interior diameter of two bearings (91).
4. Apply a continuous thin film of Loctite® 603 or equivalent on one side of the drive gear shaft (92) and one side of the idle gear shaft (104). Install the two Loctite® bearings (91) to gears.
5. Install remaining two bearings (91) to the other side of the gear shafts with no Loctite®.
6. Apply a thin film of Loctite® 603 or equivalent on bore for bearings on the motor housing (87).
7. Install drive gear (92) and idle gear (104) into motor housing and make sure that the drive gear and the idle gear are completely inside the motor housing.
8. Set the motor housing and make sure that the outer side of the motor is in a down position, the drive gear shaft is up. Let the motor housing be in position for 10 minutes until Loctite® is properly bonded.
9. Install splined hub (75). Turn the drive gear shaft and make sure that the bond is correctly set.
10. Install pins (88) on motor cover (97).
11. Install exhaust washer (99) with a point of Loctite® 601 or equivalent on motor cover.
12. Install motor cover (97) on motor housing and attach with capscrews (100).
13. Lubricate and install 'O' rings (93) on valves (94) and (105).
14. Install springs (96), valves (94) and (105) on motor cover (97). Lubricate valves with Mobilgrease XHP 222 or equivalent.



(Dwg. MHP2644)

### NOTICE

Be careful when you install valves (94) and (105) in motor cover and make sure that the 'O' rings do not slip out of grooves on valves.

### Motor without Emergency Stop and Overload Assembly

1. Install gasket (101).

2. Install cover (102) and attach with capscrews (44).

### ■ Motor with Emergency Stop and Overload Assembly

Refer to Dwg. MHP2621.

1. Lubricate and install seal (189) and 'O' ring (201) on base plate (199).
2. Lubricate and install 'O' ring (197) on plunger (198).
3. Install diaphragm (196) on plunger and attach with nut (194) and washer (195).
4. Install plunger assembly on base plate and make sure that the plunger moves easily in the bore of the base plate.
5. Install spring (213) on motor cover (97).
6. Install seal (210) on cap (202). Install seal (203) on cap (211).
7. Install cap (202), washer (206), spacer tube (209), washer (208), cap (211), diaphragm (212), washer (206) into valve seat (205) and attach with capscrew (214) and Loctite® 243 or equivalent. Do not over tighten, apply torque for snug fit.
8. Lubricate and install 'O' rings (204) on valve seat (205).
9. Install emergency stop valve assembly (179) into motor cover and make sure that you do not damage the 'O' rings (90).
10. Lubricate and install 'O' rings (191) on regulating screw (192).
11. Install regulating screw (192) into emergency stop end cover (183).
12. Lubricate spring (193) with grease and install into regulating screw (192).
13. Install setscrew (102) with Loctite® 243 or equivalent onto emergency stop end cover.
14. Install seal (189) on axle (188). Install axle (188) into valve seat (186).
15. Install the second seal (189) on axle (188).
16. Lubricate and install 'O' rings (187) on valve seat (186).
17. Install valve assembly into emergency stop end cover.
18. Lubricate ball (84) with grease and install into emergency stop end cover.
19. Install gasket (101) with grease on motor cover.
20. Install emergency stop end cover assembly on motor cover. Attach with capscrews (103) and make sure that the torque is 10 ft lbs (14 Nm).
21. Lubricate and install 'O' rings (90) on emergency stop end cover.
22. Install setscrew (180). Install plug (182).

### ■ Disc Brake Assembly

#### For LS2-300R, LS2-600R and PS2-1000R

Refer to Dwg. MHP2647.

1. Keep the gear box in a vertical position with reduction gear end cover on a bench.
2. Install splined hub (75) on sun gear (34).
3. Install friction plate (77) then friction drive plate (78) into brake housing (69), alternating between each.
4. Lubricate and install 'O' rings (74) and (16) onto piston (73).
5. Install reaction plate (81) into piston (73) and make sure that the threaded holes out.
6. Install piston into brake housing (69).
7. Install gasket (26) on motor housing (87).
8. Remove plug (14).
9. Temporarily install the motor on the brake housing. Partially lift out and turn the motor to align splines in the splined hub (75) and on drive gear (92). For correct assembly, make sure that the brake housing is completely inside the motor housing.
10. Remove the motor and install brake springs (82). Push the motor and make sure that the motor is in correct position.
11. Install the motor and plug (14) on brake housing. Attach with capscrews (25).

#### For LS2-1500R and PS2-2400R

Refer to Dwg. MHP3717.

1. Install friction plate (77), friction drive plate (78) then friction plate with spring (76) into brake housing (69) alternating between each.
2. Install splined hub (75) on drive motor (92).
3. Lubricate and install 'O' rings (74) and (16) onto piston (73).
4. Install reaction plate (81) into piston (73) and make sure that the threaded holes out.

5. Install piston into brake housing (69). Install gasket (26) on motor housing (87).
6. Install two plugs (167).
7. Install the brake housing into motor housing (87). Partially lift out and turn the motor to align splines in the splined hub (75) and on drive gear (92). For correct assembly, make sure that the brake housing is completely inside the motor housing.
8. Remove the motor and install brake springs (82) at equal distance. Push the motor and make sure that the motor is in correct position.
9. Install motor and plug (14) on brake housing. Attach with capscrews (126).

### ■ Limit Switch Assembly

Refer to Product Information Manual for adjustments.

Refer to Dwg. MHP3372.

1. Install limit switch adapter (450) on drum end cover (78). Attach with capscrews (98) and lockwashers (73).
2. Install spindle switch assembly (501) on limit switch adapter (450). Attach with capscrews (499).
3. Install one gasket (490) on each end of the housing (486).
4. Thread one nut (73) and washer (73) on each rod (502).
5. Install four rods in limit switch adapter (450). Tighten the nut (73) and make sure that the full thread of the rod engages in the limit switch adapter.
6. Install housing (486) and housing cover (505). Position housing with cap assembly (498) hole on top. Align housing cover holes with rods.
7. Install nuts (504) on rods (502) to attach housing and housing cover.

### ■ Pendant Assembly

Refer to Dwg. MHP2640 or MHP2641.

1. Install 'O' rings (166) and protector (170) on valves (165). Install valve assemblies in handle (514).
2. Install levers (503) in pendant handle (514) with pin (502). Stake pin in pendant handle at both ends to secure.
3. Install screws (504) in levers. Install screws (173) in handle.
4. Install balls (84) and springs (177) in handle (514). Secure in position with plugs (518).
5. On pendants with emergency stop, install emergency stop button (164). On pendants without emergency stop button, install plug (507).
6. Install exhaust washer (41) and secure in handle with retainer ring (512).
7. Adjustment:
  - a. Connect the inlet of the pendant to 100 psi (7 bar) air supply.
  - b. Connect a manometer at the outlet of the lever to be adjusted.
  - c. Apply a small amount of Loctite® No. 243 on the adjustment screw (521).
  - d. Tighten the adjustment setscrew to obtain a pressure of 15 psi (1 bar) without actuating the lever.
  - e. Release the adjustment setscrew by a half turn (pressure must fall to zero).
  - f. Push the lever. Check that pressure reaches 93 +/- 7 psi (6.5 +/- 0.5 bar). Check that there is no leak at the exhaust.
  - g. Release the lever, exhaust must occur and result in rapid pressure reduction.
  - h. Repeat operations 'f' and 'g', 2 to 3 times.
  - i. Disconnect the manometer. Check to ensure that there are no leaks when the lever is not activated.
  - j. Repeat the operations from '8b' to '8i' with each lever.

### ■ Drum Guard Installation

Refer to Dwg. MHP2618.

To install a wire rope guard or reverse the position of the guard use the following procedures:

1. Position guard (43) between uprights (5) and align screw holes.
2. Install screws (44) to secure guard.

## TESTING

### ■ Operational Tests

Prior to initial use, all new, altered or repaired winches shall be tested to ensure proper operation.

1. Operate winch in both directions with no load.
2. Check operation of free wheel clutch and brake.
3. Check operation of limit switches and other safety devices when provided.
4. Check all winch mounting fasteners are secure.

### ■ Load Test

Prior to initial use, all new, extensively repaired, or altered winches shall be load tested by or under the direction of a person trained in safety and operation of this winch, and a written report furnished confirming the rating of the winch. Test loads shall not be less than 100% of rated line pull and should not exceed 125% of the rated line pull. Testing to more than 125% of rated capacity may be required to comply with standards outside of the USA.

# TORQUE CHART

## Standard Coarse Thread Torque

Size	SAE Grade 5			SAE Grade 8		
	Dry	Lubricated	PTFE	Dry	Lubricated	PTFE
1/4-20	8-10	6-7	4	12-14	9-10	5-6
5/16-18	17-20	13-15	8-9	25-28	18-21	11-13
3/8-16	31-35	23-26	14-16	44-49	33-37	20-22
7/16-14	49-56	37-42	22-25	70-79	52-59	31-36
1/2-13	75-85	57-64	34-38	106-121	80-90	48-54
9/16-12	109-123	82-92	49-55	154-174	115-130	69-78
5/8-11	150-170	113-128	68-77	212-240	159-180	95-108
3/4-10	267-302	200-227	120-136	376-426	282-320	169-192
7/8-9	429-487	322-365	193-219	606-687	455-515	273-309
1-8	644-729	483-547	290-328	909-1030	681-772	409-463
1 1/8-7	794-900	596-675	357-405	1288-1460	966-1095	580-657
1 1/4-7	1121-1270	840-952	504-571	1817-2059	1363-1545	818-927

## Standard Fine Thread Torque

Size	SAE Grade 5			SAE Grade 8		
	Dry	Lubricated	PTFE	Dry	Lubricated	PTFE
1/4-20	10-11	7-8	4-5	14-15	10-12	6-7
5/16-24	19-22	14-16	9-10	27-31	20-23	12-14
3/8-24	35-40	26-30	16-18	49-56	37-42	22-25
7/16-20	55-63	41-47	25-28	78-88	58-66	35-40
1/2-20	85-96	64-72	38-43	120-136	90-102	54-61
9/16-18	121-137	91-103	55-62	171-194	128-146	77-87
5/8-18	170-193	127-144	76-87	240-272	180-204	108-122
3/4-16	297-337	223-253	134-152	420-476	315-357	189-214
7/8-14	474-537	355-403	213-242	669-758	502-568	301-341
1-12	704-798	528-599	317-359	995-1127	746-845	448-507
1 1/8-12	1023-1159	767-869	460-572	1444-1637	1083-1227	650-736
1 1/4-12	1425-1615	1069-1211	641-727	2012-2280	1509-1710	905-1026

## Metric Coarse Thread Torque

Size	Class 8.8 / 9.8			Class 10.9		
	Dry	Lubricated	PTFE	Dry	Lubricated	PTFE
M6x1	9-10	6-7	4	11-12	8-9	5-6
M8x1.25	21-23	16-18	9-11	26-30	20-22	12-13
M10x1.5	41-47	31-35	19-21	53-60	39-45	24-27
M12x1.75	71-81	54-61	32-36	91-103	68-77	41-46
M14x2	115-130	86-98	52-59	147-166	110-125	66-75
M16x2	165-187	124-140	74-84	227-257	170-193	102-116
M20x2.5	321-364	241-273	144-164	443-502	332-376	199-226
M22x2.5	439-497	329-373	197-224	605-686	454-514	272-309
M24x3	556-630	417-473	250-284	767-869	575-652	345-391
M30x3.5	1103-1250	827-938	496-563	1521-1724	1141-1293	685-776

## Metric Fine Thread Torque

Size	Class 8.8 / 9.8			Class 10.9		
	Dry	Lubricated	PTFE	Dry	Lubricated	PTFE
M8x1	22-25	17-19	10-11	28-32	21-24	13-14
M10x1.25	44-49	33-37	20-22	56-63	42-47	25-28
M12x1.25	78-89	59-67	35-40	100-113	75-85	45-51
M14x1.5	125-141	93-106	56-64	159-180	119-135	72-81
M16x1.5	176-200	132-150	79-90	243-276	183-207	110-124
M18x1.5	257-291	193-219	116-131	355-402	266-302	160-181
M20x1.5	358-406	268-304	161-183	494-559	370-420	222-252
M22x1.5	484-548	363-411	218-247	667-756	500-567	300-340
M24x2	609-690	456-517	274-310	839-951	630-713	378-428
M30x2	1227-1390	920-1043	552-626	1692-1918	1269-1438	761-863

**Notes:**

- Definitions:  
**DRY:** Cadmium plate, zinc plate, and oiled fasteners.  
**LUBRICATED:** Molybdenum sulfide paste, carnauba wax, molybdenum sulfide grease and copper-based anti-seize coated fasteners.  
**PTFE:** 2% minimum PTFE coated fasteners.
- All torque values foot-pounds unless noted.
- SAE grade 5 equivalent to ASTM A325 Type 2 and ASTM A449.
- SAE grade 8 equivalent to ASTM A354 Grade BD, ASTM A490 Type 1.
- If mixing fasteners use lowest torque value.
- Torque values 75 to 85% of fastener proof load ref.

