# Product Maintenance Information

## Liftchain Industrial Hydraulic Hoist Models

**LC2H060S, LC2H120D, LC2H180T and LC2H250Q**

## Save These Instructions

Ingersoll Rand
Industrial Technologies

Form MHD56467
Edition 1
Nobember 2010
45923653

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 www.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 | MHD56295 | Product Parts Information Manual | MHD56466 |
| Product Information Manual | MHD56465 | | |

# INSPECTION

Perform frequent inspections on equipment in regular service. Refer to Product Information Manual.

## ■ Periodic Inspection

Refer to Table 2 'Inspection Classifications' on page 2 for suggested inspection classifications for Periodic Inspection Intervals. Select conditions most appropriate to application.

**Table 2: Inspection Classifications**

| Conditions | Normal | Heavy | Severe |
|---|---|---|---|
| **Typical Use (operating time)** | Infrequent | Regular | Continual/Constant |
| **Load Range** | Usually light loads, occasional max. loads | Usually medium loads, frequent max. loads | Usually max. loads or almost max. loads |
| **Installation** | Protected/Enclosed/Dry | Not Sheltered/Exterior | Full Exposure |
| **Atmosphere** | Clean/Non-Corrosive | Dirty/Non-Corrosive/Freshwater Marine | Dirty/Corrosive/Saltwater Marine |
| **Climate** | Dry/Stable Temperature | Wet/Moderate Temperature Fluctuations | Wet/Severe Temperature Fluctuations |

Maintain written records of periodic inspections to provide an accumulative basis for continuing evaluation. Inspect all items listed in 'Frequent Inspection' in the Product Information Manual. Also inspect the following at the suggested intervals recommended in Table 5 'Maintenance Interval Chart' on page 3.

1. **Fasteners.** Check all rivets, split pins, capscrews and nuts. Replace if missing or tighten if loose.
2. **All Components.** Inspect for wear, damage, distortion, deformations and cleanliness. If external evidence indicates damage, disassemble as required to conduct a detailed inspection. Check gears, shafts, bearings, sheaves, chain guides, springs and covers. Replace worn or damaged parts. Clean, lubricate and reassemble.
3. **Hooks.** Inspect hooks carefully for cracks using magnetic particle or other suitable non-destructive method. Inspect hook retaining parts. Tighten or repair if necessary.

**Table 3: Hook Throat Normal and Discarded Width**

| Hoist Model | Capacity metric tons | Throat Width | | Discard Width | |
|---|---|---|---|---|---|
| | | in. | mm | in. | mm |
| LC2H060S | 6 | 1.89 | 48 | 2.17 | 55.2 |
| LC2H120D | 12 | 2.56 | 65 | 2.94 | 74.8 |
| LC2H180T | 18 | 3.50 | 89 | 4.03 | 102.4 |
| LC2H250Q | 25 | 3.98 | 101 | 4.57 | 116.2 |

4. **Load Chain Sprocket.** Check for damage or excessive wear. Replace if necessary. Observe the action of load chain feeding through hoist. Do not operate a hoist unless load chain feeds through hoist and hook block smoothly and without audible clicking or other evidence of binding or malfunctioning.
5. **Motor.** If performance is poor, remove and check for wear or damage to shafts. Replace worn or damaged motor.
6. **Brake.** Raise a load equal to rated capacity of hoist a few inches (cms) off the floor. Verify hoist holds the load without drift. If drift occurs, disassemble. Remove brake discs as described in 'Disc Brake Disassembly' on page 8. Check and clean brake parts each time hoist is disassembled. Replace brake discs if grooves are no longer visible.

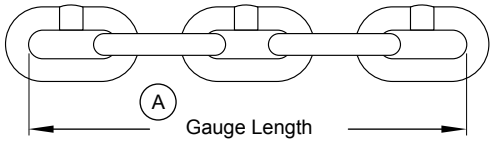
**⚠ WARNING**

- **Worn or improperly functioning brakes may cause excessive heat build up and sparks.**

7. **Supporting Structure.** Check for distortion, wear and continued ability to support hoist and rated load.
8. **Trolley** (if equipped). Check that the trolley wheels track beam properly and trolley is correctly adjusted in accordance with manufacturer's literature. Check that wheels and beam are not excessively worn and inspect side plates for spreading due to bending. Do not operate hoist until problem has been determined and corrected.
9. **Load Chain End Anchors.** Ensure both ends of load chain are securely attached. Secure if loose, repair if damaged, replace if missing. Check chain stoppers are correctly installed and functional.
10. **Load Chain.** Check the chain for stretching. Measure the load chain over five link sections all along chain, paying particular attention to the most frequently reeved links. Refer to Dwg. MHP0041 on page 2, **A.** Gauge Length. When any five links in the working length reaches or exceeds the discard length, replace entire chain. Refer to Table 4 'Load Chain Normal and Discard Length' on page 2. Always use genuine **Ingersoll Rand** replacement chain. Zinc plated load chain is standard on Liftchain hoists.

**Table 4: Load Chain Normal and Discard Length**

| Hoist Model | Chain Size | Normal Length | | Discard Length | |
|---|---|---|---|---|---|
| | mm | in. | mm | in. | mm |
| LC2H060S | 16 x 45 | 8.85 | 225 | 8.90 | 228 |
| LC2H120D | | | | | |
| LC2H180T | | | | | |
| LC2H250Q | | | | | |




(Dwg. MHP0041)

11. **Chain Container.** (optional feature) Check for damage or excessive wear and that chain container is securely attached to the hoist. Secure or replace if necessary.
12. **Labels and Tags.** Check for presence and legibility. Replace if necessary.

## ■ 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 review.

## ■ Maintenance Intervals

Refer to 'Periodic Maintenance' and Table 5 on page 3 for maintenance interval guidance.

**Table 5: Maintenance Interval Chart**

**Normal Application**

| **The following work can be completed by owner maintenance personnel** | | | | | | | |
|---|---|---|---|---|---|---|---|
| System Filter | Inspect system hydraulic filter every 45 days or 125 hours. | | | | | | |
| Grease Fittings | Lubricate grease fittings every 180 days or 500 hours. | | | | | | |
| **It is recommended that the following work be completed by an Ingersoll Rand trained technician.** | | | | | | | |
| **Standard Components** | **1 Year or 1,000 hrs** | **2 years or 2,000 hrs** | **3 years or 3,000 hrs** | **4 years or 4,000 hrs** | **5 years or 5,000 hrs** | **6 years or 6,000 hrs** | **8 years or 8,000 hrs** |
| Inspect Motor | | | X | | X | X | X |
| Inspect Disc Brake | | | | | X | | X |
| Inspect Gearbox | | | | | X | | X |
| **Optional Components** | | | | | | | |
| Chain Container | | | X | | X | | X |

**Heavy Application**

| **The following work can be completed by owner maintenance personnel** | | | | | | | |
|---|---|---|---|---|---|---|---|
| System Filter | Inspect system hydraulic filter every 30 days or 100 hours. | | | | | | |
| Grease Fittings | Lubricate grease fittings every 90 days or 250 hours. | | | | | | |
| **It is recommended that the following work be completed by an Ingersoll Rand trained technician.** | | | | | | | |
| **Standard Components** | **1 Year or 1,000 hrs** | **2 years or 2,000 hrs** | **3 years or 3,000 hrs** | **4 years or 4,000 hrs** | **5 years or 5,000 hrs** | **6 years or 6,000 hrs** | **8 years or 8,000 hrs** |
| Inspect Motor | | X | | X | | X | X |
| Inspect Disc Brake | | | | X | | X | X |
| Inspect Gearbox | | | | X | | X | X |
| **Optional Components** | | | | | | | |
| Chain Container | | X | | X | | X | X |

**Severe Application**

| **The following work can be completed by owner maintenance personnel** | | | | | | | |
|---|---|---|---|---|---|---|---|
| System Filter | Inspect system hydraulic filter every 30 days or 100 hours. | | | | | | |
| Grease Fittings | Lubricate grease fittings every 90 days or 250 hours. | | | | | | |
| **It is recommended that the following work be completed by an Ingersoll Rand trained technician.** | | | | | | | |
| **Standard Components** | **1 Year or 1,000 hrs** | **2 years or 2,000 hrs** | **3 years or 3,000 hrs** | **4 years or 4,000 hrs** | **5 years or 5,000 hrs** | **6 years or 6,000 hrs** | **7 years or 7,000 hrs** |
| Inspect Motor | | X | X | X | X | X | X |
| Inspect Disc Brake | | | X | X | X | | X |
| Inspect Gearbox | | | X | | X | | X |
| **Optional Components** | | | | | | | |
| Chain Container | | X | X | X | X | X | X |

**Note 1:** Hours are for actual hoist and trolley operation. Perform an annual hoist load test for all applications.

Recommend complete general overhaul.

# INSPECTION REPORT

## Ingersoll Rand Liftchain Industrial Hydraulic Hoist

| | |
|---|---|
| **Model Number:** | **Date:** |
| **Serial Number:** | **Inspected by:** |

**Reason for Inspection: (Check Applicable Box)**

| | | |
|---|---|---|
| | 1. Scheduled Periodic Inspection ( ___ Quarterly ___ Semiannually ___ Yearly) | **Operating Environment:** Normal ___ Heavy ___ Severe ___ |
| | 2. Discrepancy(s) noted during Frequent Inspection | |
| | 3. Discrepancy(s) noted during maintenance | |
| | 4. Other: _____ | |

Refer to the Product Information and Parts Information Manual and "INSPECTION" section for the 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** | |
| Fasteners | | | | | |
| Gears | | | | | |
| Shafts | | | | | |
| Bearings | | | --- | | |
| Load Bearing Sheave | | | | | |
| Chain Guides | | | | | |
| Springs | | | --- | | |
| Covers, Housings | | | | | |
| Hooks | | | --- | | |
| Top | Actual Hook Throat Width: _____ inches / _____ mm (Refer to Table 3 'Hook Throat Normal and Discarded Width' on page 2 for minimum/maximum acceptable widths.) | | | | |
| | Hook Twist | | | --- | (maximum 10%) |
| | Hook Crack Test Method Used: Dye Penetrant _____ Magnetic Particle _____ Other: _____ | | | | |
| Bottom | Actual Hook Throat Width: _____ inches / _____ mm (Refer to Table 3 'Hook Throat Normal and Discarded Width' on page 2 for minimum/maximum acceptable widths.) | | | | |
| | Hook Twist | | | --- | (maximum 10%) |
| | Hook Crack Test Method Used: Dye Penetrant _____ Magnetic Particle _____ Other: _____ | | | | |
| Hook Latch | | | --- | | |
| Brake (100% Load Test) | | | --- | | |
| Brake (Visual Inspection) | | | | | |
| Tail Pin (End Anchor) | | | | | |
| Load Chain: | | | --- | | |
| Working length(s) maximum wear: _____ inches / _____ mm (Refer to Table 4 'Load Chain Normal and Discard Length' on page 2.) | | | | | |
| Supporting Structure | | | | | |
| Labels and Tags | | | --- | | |
| Other Components (List in NOTES section) | | | | | |

| **Testing:** | **Pass** | **Fail** | **NOTES** |
|---|---|---|---|
| Operational (No Load) | | | |
| Operational (100% Load) | | | |
| Operational (Maximum Test Load*) | | | |

* Testing to more than 100% of rated capacity may be required to set overload device.

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 **Ingersoll Rand** trained technicians. The chart below provides a brief guide to common hoist and trolley symptoms, probable causes and remedies.

| SYMPTOM | CAUSE | REMEDY |
|---|---|---|
| Hoist will not operate. | Insufficient oil supply. | Verify oil supply pressure and volume at winch inlet meets the requirements listed in the "SPECIFICATIONS" section in Product Information Manual. Clean oil filter. |
| | Hoist is overloaded. | Reduce load to within rated capacity. |
| | Motor is damaged. | Replace. Refer to "MAINTENANCE" on page 5. |
| | Relief valves set too low. | Adjust system relief valves to meet the requirements listed in the "SPECIFICATIONS" section in Product Information Manual. |
| Load continues to move when hoist is stopped. "DOWN" direction. | Hoist is overloaded. | Reduce load to within rated capacity. |
| | Brake is slipping. | Check brake springs and brake disc linings for wear. Refer to on page 5. |
| Hoist will not lift rated capacity. | Hoist is overloaded. | Reduce load to within rated capacity. |
| | Insufficient oil supply. | Verify oil supply pressure and volume at winch inlet meets the requirements listed in the "SPECIFICATIONS" section in Product Information Manual. Clean oil filter. |
| | | Check oil supply line connections, hoses and valves. |
| | Relief valve is partially open. | Remove relief valve and visually inspect and repair or replace worn or damaged parts. Clean all parts thoroughly in a suitable solvent. Reassemble, reinstall and reset relief valve pressure setting. |
| | Motor is damaged. | Check for worn motor. |
| Hook lowers but will not raise. | Hoist is overloaded. | Reduce load to within rated capacity. |
| | Insufficient oil supply. | Check at hoist power supply connection with hoist under load. Raise pressure to rated capacity. |
| Load chain jumps on sprocket or is making a snapping sound. | Worn or rusted chain. | Refer to "INSPECTION" on page 2 to determine wear limit. Replace if necessary. |
| | Incorrect chain. | Replace with correct chain. |
| | Worn sprocket or chain guide. | Replace worn parts. |
| | Capsized hook. | Correct as described in "MAINTENANCE" on page 5. |
| | Hoist not in line with load. | Align hoist with load. Do not "yard" or "side pull". |
| | Incorrectly reeved load chain. | Check load chain is correctly reeved. |
| | No oil on load chain. | Lubricate load chain. |
| Trolley (optional feature)<br>Trolley will not stop or trolley wheels slip. | Damaged beam. | Repair or replace beam. |
| | Excessive oil, grease or paint on track of beam. | Clean off oil, grease or paint. |
| | Trolley not spaced for beam clearance. | Check trolley spacing. Refer to the manufacturer's literature. |

# MAINTENANCE

**⚠ WARNING**

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

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

- **Only allow Ingersoll Rand trained technicians to perform maintenance on this product.**
- **After performing any maintenance on the hoist dynamically test the hoist to 100% of its rated capacity, in accordance with ASME B30.16 standards, before returning hoist to service. Testing to more than 100% of rated capacity may be required to comply with standards and regulations set forth in areas outside the USA.**
- **Shut off hydraulic system and depressurize 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.**

## ■ General

Correct disassembly (to prevent loss or damage of good parts), repair, assembly, testing and adjusting are critical to proper product 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 product-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.

## ■ Maintenance Intervals

Refer to 'Maintenance Intervals' on page 2 for recommended maintenance schedule.

## ■ Adjustments

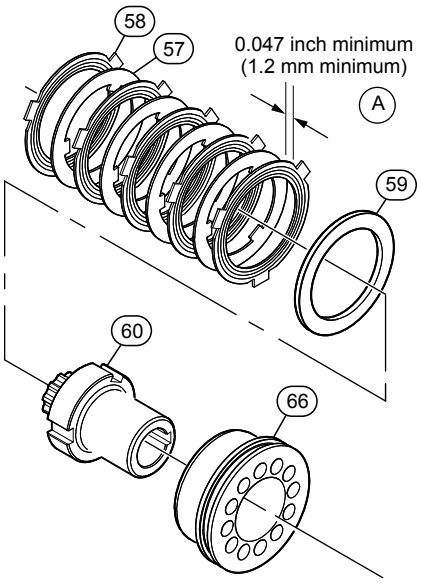
### ■ *Disc Brake*

Disc brake adjustment is not required. If disc brake does not hold rated load, disassemble and repair.

If brake slippage occurs during tests prior to placing winch in service or during normal use of the winch, follow the winch disassembly procedure and check friction disc (58) thickness as shown in Dwg. MHP2858 on page 6, **A:** 0.047 inch minimum (1.2 mm minimum). If this dimension is less than shown, the friction discs (58) must be replaced.

***NOTICE***

- **Original brake friction plate thickness is 0.047 in (1.2 mm).**
- **Dwg. MHP2858 may not be a true representation of actual parts. Use for disc thickness and stacking order.**




(Dwg. MHP2858)

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

### *Load Chain Replacement*

**WARNING**

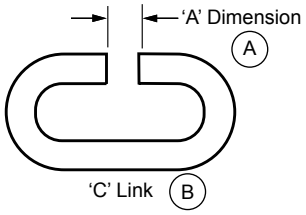
- **NEVER splice a load chain except when installing a new load chain by the following method. Always discard link used to connect old chain with new.**

Excessive chain wear cannot be detected by casual observation. Chain is case hardened and once the case hardening is worn through, wear will progress rapidly and the strength of the chain will be considerably reduced. Further, the chain will no longer fit the chain sprocket properly, greatly increasing the chance of malfunction and chain breakage.
One chain sprocket will outlast several chains if chain is replaced as recommended. The use of a worn chain will cause the chain sprocket to wear rapidly.
If the chain is visibly damaged, examine chain sprocket and chain guide. Install a new chain sprocket if the old one is visibly worn. Install a new guide if old one is broken or distorted.
It is suggested that a short length of load chain be available when replacing hoist load chain. Feeding a short length of load chain through bottom block assembly or power head assembly prior to installing new load chain may simplify installation. Weld on perpendicular load chain must always face away from chain sprocket. Refer to Dwg. MHP0472 on page 6, **A.** Load Chain; **B.** Chain Wheel; **C.** Chain Weld To Outside On Powered Chain Wheels; **D.** Standing Link.

**NOTICE**

- **For ease of installation, do not remove old chain from hoist. Use the old chain to feed new chain through hoist.**
- **The chain buffer (4) and limit stop washer (8) are not required on the non-metallic chain container.**

1. Hoist must be hung and connected to air supply. Reduce air pressure to 60 psi (4 bar).
2. Remove chain container, if used.
3. Disconnect chain end from hoist body if attached.
4. Remove chain buffer (4) and limit stop washer (8).
5. Remove load hook.
6. Run hoist slowly in lifting direction until chain free end is approximately 2 ft (60 cm) from hoist.
7. Using an abrasive wheel, cut a section from the last link as shown in Dwg. MHP0817 on page 6, **A.** 'A' dimension; **B.** 'C' Link. Use a 'C' link which is the same size as the chain. Refer to Table 6 "C' Link Dimension' on page 6.




(Dwg. MHP0817)

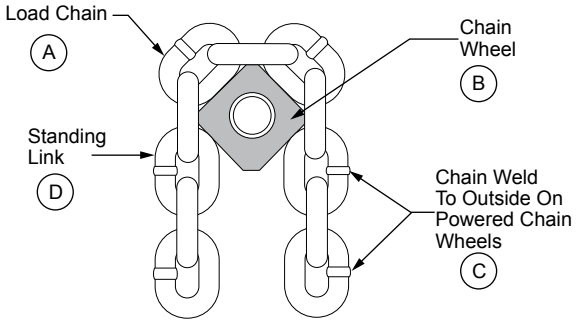
**Table 6: 'C' Link Dimension**

| Hoist Model | Chain Size | 'A' Dimension | |
|---|---|---|---|
| | mm | in. | mm |
| LC2A015S | 8 x 24 | 0.4 | 10 |
| LC2A030D | | | |
| LC2A040S | 13 x 36 | 0.6 | 16 |
| LC2A060S | 16 x 45 | 0.8 | 20 |
| LC2A060Q | 8 x 24 | 0.4 | 10 |
| LC2A080D | 13 x 36 | 0.6 | 16 |
| LC2A120D | 16 x 45 | 0.8 | 20 |
| LC2A180T | | | |
| LC2A250Q | | | |

**CAUTION**

- **Do not distort link in any manner. Link must be able to pass over the chain sprocket and idler wheels without binding.**

8. Connect new chain to old chain by hooking end of new chain onto 'C' link. Make certain welds and links on new chain match positioning of welds and links on chain being replaced.
9. Slowly run hoist in raise direction, running off old chain and reeving new chain over the chain wheel. **The first link of new chain over the chain wheel must be a standing link.** Refer to Dwg. MHP0472 on page 6.




(Dwg. MHP0472)

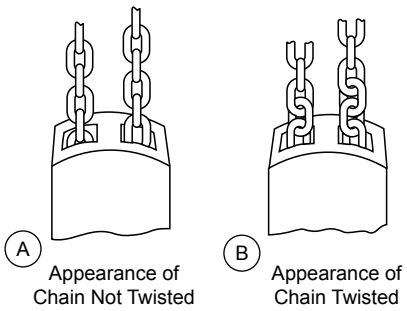
10. Reinstall load hook, chain buffer and limit stop washer. Connect free end of chain to hoist body.

**WARNING**

- **Ensure chain does NOT become twisted during reeving. All chain welds must align while chain is hanging free.**

### *Determining Twisted, Kinked or 'Capsized' Load Chain*

Ensure chain is not twisted, kinked or 'capsized' during installation. Refer to Dwg. MHP0020 on page 6, **A.** Appearance of Chain Not Twisted; **B.** Appearance of Chain Twisted.



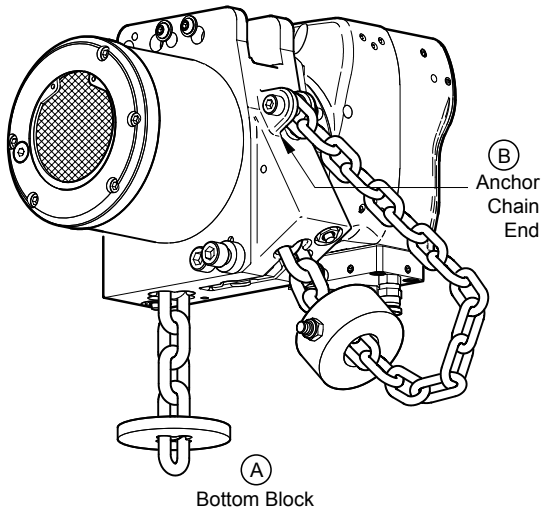

(Dwg. MHP0020)

### *Chain Reeving*

**NOTICE**

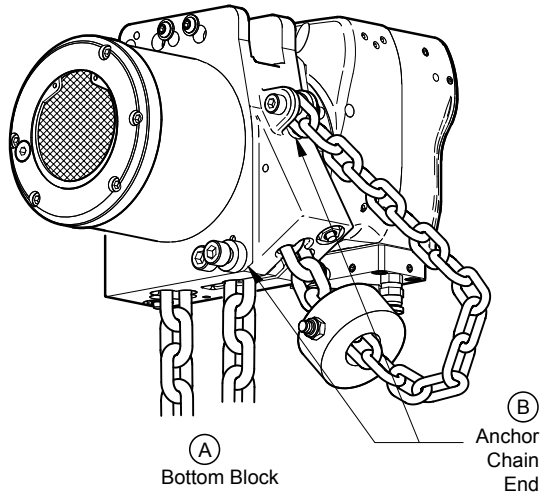
- **Illustrations may not be a true representation of actual hoist bodies. Use for reeving instructions only.**

**Single Fall**




(Dwg. MHP2664)

**Double Fall**




(Dwg. MHP2665)

**Triple Fall Hoist**

Refer to Dwg. MHP3044 on page 7.

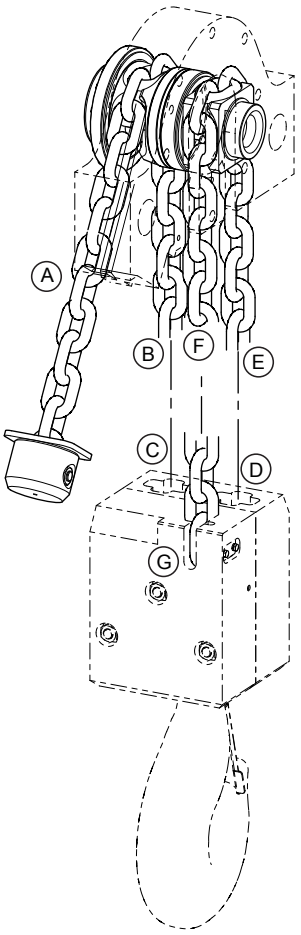
To feed load chain through bottom hook assembly:

1. Install 'C' link in the last link of the load chain extending from hoist (A). Connect the new load chain to the 'C' link. The end link must be a standing link (perpendicular to the axle of hoist sprockets).
2. Run the hoist to feed chain through hoist body and down to (C) on the hook block.
3. The axis of the sprocket wheel (120) in hook block assembly must be perpendicular to the rotation axle of hoist sprockets (30) and (50) of the hoist.
4. Insert last link of load chain in the opening to bottom block (C). First link must be inserted parallel to the axis. The sprocket of bottom hook assembly and the following standing links must have the welds turned to the outside position with the sprocket. Refer to Dwg. MHP0472 on page 6.
5. After exiting the bottom hook assembly at (D), feed the last link of the load chain into hoist opening (E) and around sprocket (50).
6. After exiting the hoist at (F), position the last link of the load chain in the slot (G) in the bottom hook assembly and attach it with anchor pin (219) and retainer ring (224).

**⚠ WARNING**

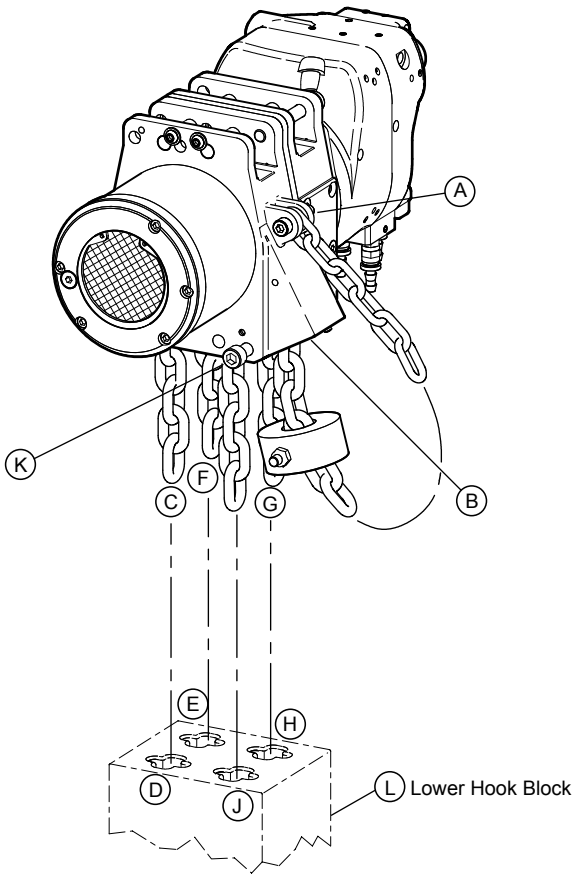
- **Chain must not be twisted.**

7. On the free end of the load chain, install buffer (4) with capscrew (5) and nut (7) (this buffer activates the bottom switch limit). As a minimum attach the buffer to the 9th link from the load chain end.




(Dwg. MHP3044)

**Quad Fall Hoist**




(Dwg. MHP2830)

Refer to Dwg. MHP2830 on page 7, **L.** Lower Hook Block.

To feed load chain through bottom hook assembly:
1. Install 'C' link in the last link of the load chain extending from hoist (B). Connect the new load chain to the 'C' link. The end link must be a standing link (perpendicular to the axle of hoist sprockets).
2. Run the hoist to feed chain through hoist body and down to (D) on the hook block.
3. The axis of the sprocket wheel (120) in hook block assembly must be perpendicular to the rotation axle of hoist sprockets (30) and (50) of the hoist.
4. Insert last link of the load chain in the opening to bottom block (D). First link must be inserted parallel to the axis. The sprocket of bottom hook assembly and the following standing links must have the welds turned to the outside position with the sprocket. Refer to Dwg. MHP0472 on page 6.
5. After exiting the bottom hook assembly at (E), feed the last link of the load chain into hoist opening (F) and around sprocket (50).
6. After exiting the hoist at (G), run load chain down to (H) on the hook block. Feed load chain through opening.
7. After exiting the bottom hook assembly at (H), position the last link of the load chain in the slot (K) in the chain guide housing (58) and attach it with capscrew (41) and lockwasher (44).

**⚠ WARNING**

- **Chain must not be twisted.**

8. On the free end of the load chain, install buffer (4) with capscrew (5) and nut (7) (this buffer activates the bottom switch limit). As a minimum attach the buffer to the 9th link from the load chain end.

## ■ Hydraulic System General Maintenance

Hydraulic systems operate efficiently when properly maintained. The following information should be developed into a routine maintenance procedure to ensure the hydraulic system and components operate efficiently.

### ■ *Hydraulic Motor*

Inspect as recommended per motor manufacturer's literature. Establish a schedule as part of an overall maintenance schedule.

### ■ *Reservoir*

Maintain fluid level at all times. The fluid should be checked after the first 10 hours of initial operation. If satisfactory, routine checks should be made each 100 hours of operation to verify that the fluid (class and type) meets the requirements of the pump. Change fluid every 1000 to 2000 hours of operation depending upon severity of application and operating environment. If manufacturer's requirements recommend fluid changes sooner, follow those recommendations.

### ■ *Spare Parts*

Spare filter elements should be available to allow filter replacement as necessary to maintain a clean hydraulic oil supply. Other spare parts (hoses, fittings, etc.) should also be available to limit equipment downtime in the event that repairs are necessary.

### ■ *Cleanliness*

Keep equipment clean. A thick layer of dirt acts as insulation, causing the hydraulic system to retain heat resulting in higher operating temperatures.
If the system is opened for inspection or repair, a clean work area prevents foreign contaminants from entering the system and damaging component internal parts.

### ■ *Filter Maintenance*

**Filters must be maintained.** The key to good filtration is effective filter maintenance. Check filter condition frequently.
Keep a record of how often filters need replacing and use this record to establish a service schedule. Routinely replacing the filter before it affects operation of the product reduces unexpected downtime and potential wear. A system may be equipped with the best filters available, and the filters positioned properly so they can do the most good, but, if the filters are not replaced when dirty, the money spent for the filters and their installation will have been wasted. A filter that gets dirty after 1 day of service and then is not cleaned until 29 days later allows 29 days of unfiltered fluid. A filter is only as good as the maintenance given to it.

**Service Suggestions:**
1. Set up a filter maintenance schedule and follow it carefully.
2. Replace the original filter cartridge after 50 hours of operation.
3. Change or clean filters as required or indicated by visual indicators on filters supplied with such devices.
   a. Average Operating Environment - replace filter cartridge after each 500 hours of operation.
   b. Dirty Operating Environment - replace filter cartridge after each 250 hours of operation.
4. Clean suction strainers after first 10 hours of operation and every 100 hours thereafter.
5. Inspect filter elements that have been removed from the system for signs of other system damage.
6. Do not return to the system any fluid that has leaked out.
7. Always keep supplies of fresh fluid covered tightly.
8. Use clean containers, hoses and funnels when filling reservoir. Use of a filter cart when adding fluid is highly recommended.
9. Use common sense precautions to prevent entry of dirt into components that have been temporarily removed from the system.
10. Make sure that all clean-out holes, filler caps and breather cap filters on the reservoir are properly fastened.
11. Do not run the system unless all normally provided filtration devices are in place.
12. Make certain that the fluid used in the system is a type recommended by the manufacturers of the system or components.

The above recommendations are based on an open system equipped with micro-air breathers. Open systems without micro-air breathers are not recommended. Visual inspection cannot be used to determine cartridge replacement. Particles below 40 microns are not visible to the human eye.
Before changing from one type of fluid to another (for example, from a petroleum base to a fire-resistant fluid) consult component and filter manufacturers on the selection of the fluid and the filters that should be used. Follow recommended flushing procedures when changing fluids. Also consult ANSI B93.5M-1979 "Practice for the Use of Fire Resistant Fluids for Industrial Hydraulic Fluid Power Systems."

## ■ Disassembly

**NOTICE**

- **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 reassemble product. Parts drawings are provided in Product Parts Information Manual unless otherwise noted.

If 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 the product be performed in a clean dust free work area.

In the process of disassembling the product, observe the following:
1. Never disassemble product any further than is necessary to accomplish needed repair. A good part can be damaged during the course of disassembly.
2. 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.
3. 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, product is designed to permit easy disassembly and reassembly. The use of heat or excessive force should not be required.
4. Keep work area as clean as practical, to prevent dirt and other foreign matter from getting into bearings or other moving parts.
5. All seals, gaskets and 'O' rings should be discarded once they have been removed. New seals, gaskets and 'O' rings should be used when reassembling product.
6. When grasping a part in a vise, always use leather-covered or copper-covered vise jaws to protect the surface of the part and help prevent distortion. This is particularly true of threaded members, machined surfaces and housings.
7. Do not remove any part that is a press fit in or on a subassembly unless removal of that part is necessary for repairs or replacement.
8. 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 that contacts bearing must be square. Protect bearings from dirt by keeping them wrapped in clean cloths.

### ■ *Hoist Disassembly*

**NOTICE**

- **It is recommended to remove load chain and chain bucket for a complete hoist disassembly.**

1. Shut off and bleed down hydraulic oil supply to product.
2. Disconnect and tag all hydraulic lines.
3. Remove hoist from its mounting and place in clean work area on a sturdy work bench.
4. Position several blocks of wood on the work bench and stand hoist in a vertical position with motor end up.

### ■ *Disc Brake Disassembly*

Refer to Dwg. MHP2824.
1. Remove motor and piping as described in 'Disassembly'.
2. Carefully remove capscrews (75) and washers (122) one half turn at a time each, until spring compression is relaxed. Separate the motor adapter (74) from brake housing (61).
3. Remove springs (71).
4. Remove brake housing (61) with piston (63).
5. Remove and discard '0' rings (68), (70) from piston (63).
6. Remove coupling (65) and 72 from brake housing (61).
7. Remove friction plates (66) and drive plates (67). Note stacking order.

### ■ *Reduction Gear Disassembly*

Refer to Dwgs. MHP3108 and MHP3110.
1. Motor, disc brake assembly, '0' rings (40), spacer (97) and retainer ring (10) must be removed from pinion shaft (25) before reduction gear assembly can be removed from hoist body.
2. Remove drain plug (143) and drain oil from reduction gear into a suitable container.
3. Remove capscrews (4) and lockwashers (44) that secure reduction gear assembly to hoist body (36).
4. Remove reduction gear end cover (5) and 'O' ring (6) from ring gear (23).
5. Remove 'O' ring (138) and bearings (132) and (137).
6. Turn reduction gear end cover over so that retainer ring (24) is facing up.
7. Remove stop ring (24), dampeners (135), 'O' ring (29), and exhaust washer (3) from muffler cover (136).
8. Unscrew muffler cover (136) from reduction gear end cover (5) and remove 'O' ring (64).

9. Remove primary gear assembly (126) and sun gear (152).
10. Remove ring gear (23), planet support assembly (341), sun gear (153) and ring gear (19).
11. Remove retainer ring (14) and bearing (11).
12. Remove pinion shaft (25) from planet support assembly (341).
13. Remove bearing (11) from gear carrier (17).

**NOTICE**

- **It is not necessary to disassembly planet support assembly (341), unless replacing parts.**

a. 6 and 12 ton Hoists:

Tap out planet axles (16) and remove planet gears (140), needle bearings (142) and (144), bearing rings (141), spacers (146) and (147) and ring (148).

14. Remove reducer housing (22) from hoist body (36).
15. Remove and discard 'O' rings (6).

### *Powerhead Body Disassembly*

**6 ton Single and 12 ton Double Fall**
Refer to Dwg. MHP3108.
1. Ensure reduction gear, disc brake and motor assemblies have been removed.
2. Remove chain limit stop washer (110) from chain. Remove load chain from hoist body (36).
3. Remove pins (43) from hoist body using drift pin and hammer.
4. Remove chain stripper (31). Pull sprocket assembly (30) from hoist body (36). Remove adapter ring (59) on 6 ton and 12 ton hoists.
5. Remove oil seal (20) and discard.
6. Remove bearings (8) and (39) from sprocket if necessary.
7. Remove 'O' rings (6) and (104).

**18 ton Triple and 25 ton Quad Fall**
Refer to Dwg. MHP3110.
1. Ensure reduction gear, disc brake and motor assemblies have been removed.
2. Remove chain limit stop washer (110) from load chain. Remove load chain from hoist body (36) and chain guide housing (58).
3. Remove capscrews (98), lockwashers (44), nuts (99) and top hook assembly or clevis from hoist.
4. Remove capscrews (41) and lockwashers (44) from chain guide housing (58).
5. Separate hoist body (36) and chain guide housing (58).
6. Remove pins (43) from hoist body using drift pin and hammer.
7. Remove chain stripper (31). Pull sprocket assembly (30) from hoist body (36).
8. Remove oil seal (20).
9. Remove bearings (8) from sprocket if necessary.
10. Remove capscrew (41) and lockwasher (44) from chain guide housing.
11. Pull sprocket assembly (50) and adapter (150) from chain guide housing (58).
12. Remove bearings (149) and 'O' rings (105) from sprocket (50) if necessary.
13. Remove 'O' rings (104).

### *Hydraulic Motor*

Refer to Dwg. MHP2824.
Do not disassemble hydraulic motor. Contact factory or **Ingersoll Rand** trained Technician for maintenance information.

## Cleaning, Inspection and Repair

Use the following procedures to clean, inspect, and repair the components of the hoist system.

### *Cleaning*

**CAUTION**

- **Bearings that are loose, worn or rotate in the housing must be replaced. Failure to observe this precaution will result in additional component damage.**

Clean all hoist 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 on the gears and frames. If bushings have been removed it may be necessary to carefully scrape old Loctite® from the bushing bore. 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. Replace bearings if rotation is rough or bearings are excessively worn.
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 drive plates and friction discs for oil. If the friction discs have become oil-soaked, replace them. If the drive 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 disc. The brake friction disc must show an even wear pattern. Refer to "Adjustments" on page 5.

### *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 applicable Product Parts Information manual for specific replacement parts information.
2. 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.
3. Smooth out all nicks, burrs, or galled spots on shafts, bores, pins, or bushings.
4. Examine all gear teeth carefully, and remove nicks or burrs.
5. Polish the edges of all shaft shoulders to remove small nicks which may have been caused during handling.
6. Remove all nicks and burrs caused by lockwashers.
7. Replace all gaskets, oil seals, and 'O' rings removed during hoist disassembly.

## Assembly

### *General Assembly Instructions*

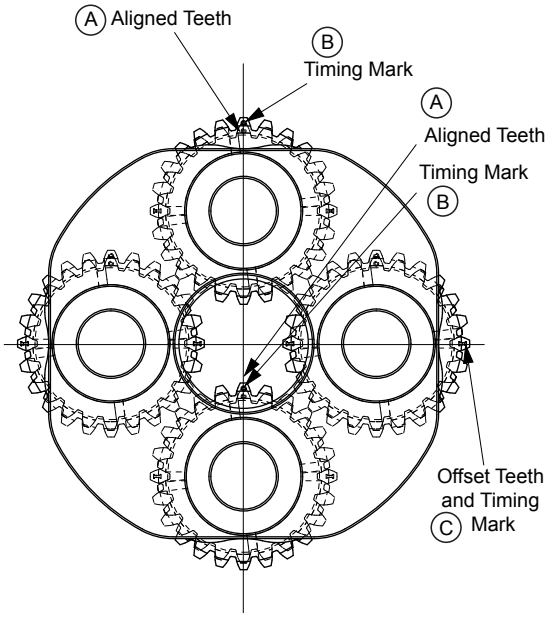
- **Use all new gaskets and seals.**
- **Replace worn parts.**
- **Assemble parts using match marks attached during disassembly. Compare replacement parts with originals to identify installation alignments.**
- **Lubricate all internal parts with rust and oxidation inhibiting lubricant, ISO VG 100 (SAE 30W).**
- **Apply a light coat of Loctite® 243 to all threaded components prior to assembly.**

**NOTICE**

- **Refer to the Product Parts Information Manual for drawings unless otherwise noted.**

### *Reduction Gear Assembly*

Refer to Dwgs. MHP3108 and MHP3110.
1. Lubricate and install 'O' rings (6) and (138) and bearing (137) in reduction gear end cover (5).
2. Assemble planet support assembly (341). Install bearings (147), internal bearing rings (141), needle bearings (142) and (144), spacers (146) and rings (148) in four planetary gears (140). Install planetary gear assemblies into planetary carrier (17). Ensure that planetary gears (140) are installed with the smaller gear head diameter nearest the ring gear (19).
3. Align planetary gear assemblies with small holes in planetary carrier and install planet axles (16).
4. Time planet gears as shown in Dwg. MHP3049, on page 10, **A.** Aligned Teeth; **B.** Timing Mark; **C.** Offset Teeth and Timing Mark. Use the sun gear (153) to maintain timing position.
5. Install bearings (11) and retainer ring (14) on sun gear (153).
6. With sun gear (153) still in place, install planetary assembly in ring gear (19) carefully remove sun gear (153) without removing planetary assembly and place ring gear flat on surface with planetary assembly facing up.
7. Align gears with ring gear (23) and install over planetary assembly and ring gear.
8. Install assembled sun gear (152) in primary gear assembly (126).
9. Install assembled primary gear assembly (126) on planet housing (17).
10. Install bearing (132) on primary gear assembly (126) with three drops of Loctite ® 603 on external ring of bearing.
11. Install pinion shaft (25) through reduction gear housing assembly so it locates in the sun gear of primary gear assembly.
12. Lubricate and install 'O' ring (6) in reduction gear end cover (5).
13. Align capscrew holes and install reduction gear end cover (5) on ring gear (23).
14. Install 'O' ring (64) on muffler cover and thread muffler cover into reduction gear end cover (5).
15. Install exhaust washer (3), 'O' ring (29), and dampeners (135) in muffler cover (136) and secure with retainer ring (24).
16. Install capscrews (4) and lockwashers (44) through reduction gear assembly parts.




(Dwg. MHP3049)

### *Hydraulic Motor Assembly*

Refer to Dwg. MHP3109.
Ensure motor is assembled in accordance with motor manufacturer's literature.

### *Power Head Body Assembly*

**6 ton Single and 12 ton Double Fall**
Refer to Dwgs. MHP3108.
1. Lubricate and install '0' ring (6) on hoist body (36)
2. Install oil seal (20) in hoist body (36) with lip of seal towards sprocket.
3. Install bearing (8) on sprocket (30) on shaft external gear teeth end.
4. Install two oil seals (37) in bore of sprocket (30). Seal lips must face away from each other.
5. Install bearing (38) in sprocket bore and secure with retainer ring (9).
6. Tap sprocket (30) into hoist body (36).
7. Install bearing (39) or (8) on sprocket and in bore of hoist body.
8. Install chain stripper (31) and tap pins (43) in until flush.
9. Align and install reducer assembly on hoist body. Secure with capscrews (4). Torque to 47 Nm and refer to "TORQUE CHART" on page 11. Use an alternating pattern.
10. Install limit stop valve assemblies (340).
11. Fill with recommended oil. Refer to "LUBRICATION" section in Product Information manual. Install plug (1) in reducer housing (22).
12. Lubricate and install load chain, limit stops and load hook. Refer to procedures in 'Load Chain Replacement' on page 6.

**18 ton Triple and 25 ton Quad Fall**
Refer to Dwg. MHP3110.

1. Lubricate and install '0' ring (6) on hoist body (36).
2. Install oil seal (20) in hoist body (36) with lip of seal towards sprocket.
3. Install bearing (8) on sprocket (30) shaft external gear teeth end.
4. Install two oil seals (37) in bore of sprocket (30). Seal lips must face away from each other.
5. Install bearing (38) in sprocket bore and secure with retainer ring (9).
6. Tap sprocket (30) into hoist body (36).
7. Install bearing (8) on sprocket and in bore of hoist body.
8. Install chain stripper (31) and tap pins (43) in until flush.
9. Lubricate and install '0' rings (104) on hoist body.
10. Install '0' ring (105) and bearing (149) on sprocket (50).
11. Install bearing (38) on pinion shaft (218).
12. Install '0' rings (40) and spacer (97) on pinion shaft (218) and secure with retainer ring (10).
13. Tap assembled pinion shaft into sprocket (50). Install retainer ring (9).
14. Install assembled sprocket in chain guide housing (58).
15. Install '0' ring (105) and bearing (149) on sprocket and in bore of chain guide housing.
16. Assemble chain guide housing to hoist body with adapter positioned between. Clamp with capscrews (41) and lockwashers (44). Refer to "TORQUE CHART" on page 11 for torque requirements.
17. Align and install reducer assembly on hoist body. Secure with capscrews (4) and washers (44). Torque to 4,7 Nm and refer to"TORQUE CHART" on page 11 for torque requirements. Use an alternating pattern.
18. Install limit stop valve assemblies (340).
19. Fill with recommended oil. Refer to "LUBRICATION" section in Product Information manual. Install plug (1) in reducer housing (22).
20. Lubricate and install load chain, limit stops and load hook. Refer to procedures in 'Load Chain Replacement' on page 6.

### *Bottom Hook Assembly*

**6 ton Single and 12 ton Double Fall**
Refer to Dwg. MHP3006.
1. Install thrust bearing (125) and ring halves (124) on hook (106).
2. Place load chain and hook assembly between hook block halves (118) and (218).
3. Press half hook blocks (118) and (218) together.
4. Install capscrews (56), lockwashers (122) (6 ton only) and nuts (123). Refer to "TORQUE CHART" on page 11 for torque requirements.

**18 ton Triple Fall**
Refer to Dwg. MHP3018.
1. Install '0' rings (129) and bearings (119) on sprocket (120).
2. Install thrust bearing (125) and ring halves (124) on hook (106).
3. Position sprocket and hook assemblies between hook block halves (118) and (218).
4. Tap half hook blocks together and install capscrews (133), lockwashers (122) and nuts (123). Refer to "TORQUE CHART" on page 11 for torque requirements.

**25 ton Quad Fall**
Refer to Dwg. MHP3029.
1. Install '0' rings (129) or quad rings (130) (6 ton hoist only) and bearings (119) on sprockets (120).
2. Install a sprocket assembly in each hook block half.
3. Install thrust bearing (125) and ring halves (124) on hook (106).
4. Install pin (131) in center ring (132).
5. Position hook assembly and center ring assembly between hook block halves (118) and (218).
6. Tap half hook blocks together and install capscrews (133), lockwashers (122) and nuts (123). Refer to "TORQUE CHART" on page 11 for torque requirements.

## Load Test

Prior to initial use, all extensively repaired hoists shall be load tested by or under the direction of an **Ingersoll Rand** trained technician and a written report furnished confirming the rating of the tested equipment.

Dynamically load test hoist to 125% of its rated capacity in accordance with ASME B30.16 standards. Testing to more than 125% may be necessary to comply with standards and regulations set forth in areas outside 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**:

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

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