

# Bass Harbor Terminal Transfer Bridge No. 6339 Bass Harbor, Maine



**Prepared for:** Maine Department of Transportation

**Prepared by:**

 **Vanasse Hangen Brustlin, Inc.**  
South Portland, Maine

**Gresham Consulting, LLC (Mechanical)**

**Total Control Systems, LLC (Electrical)**

**Date:** December 2015

---



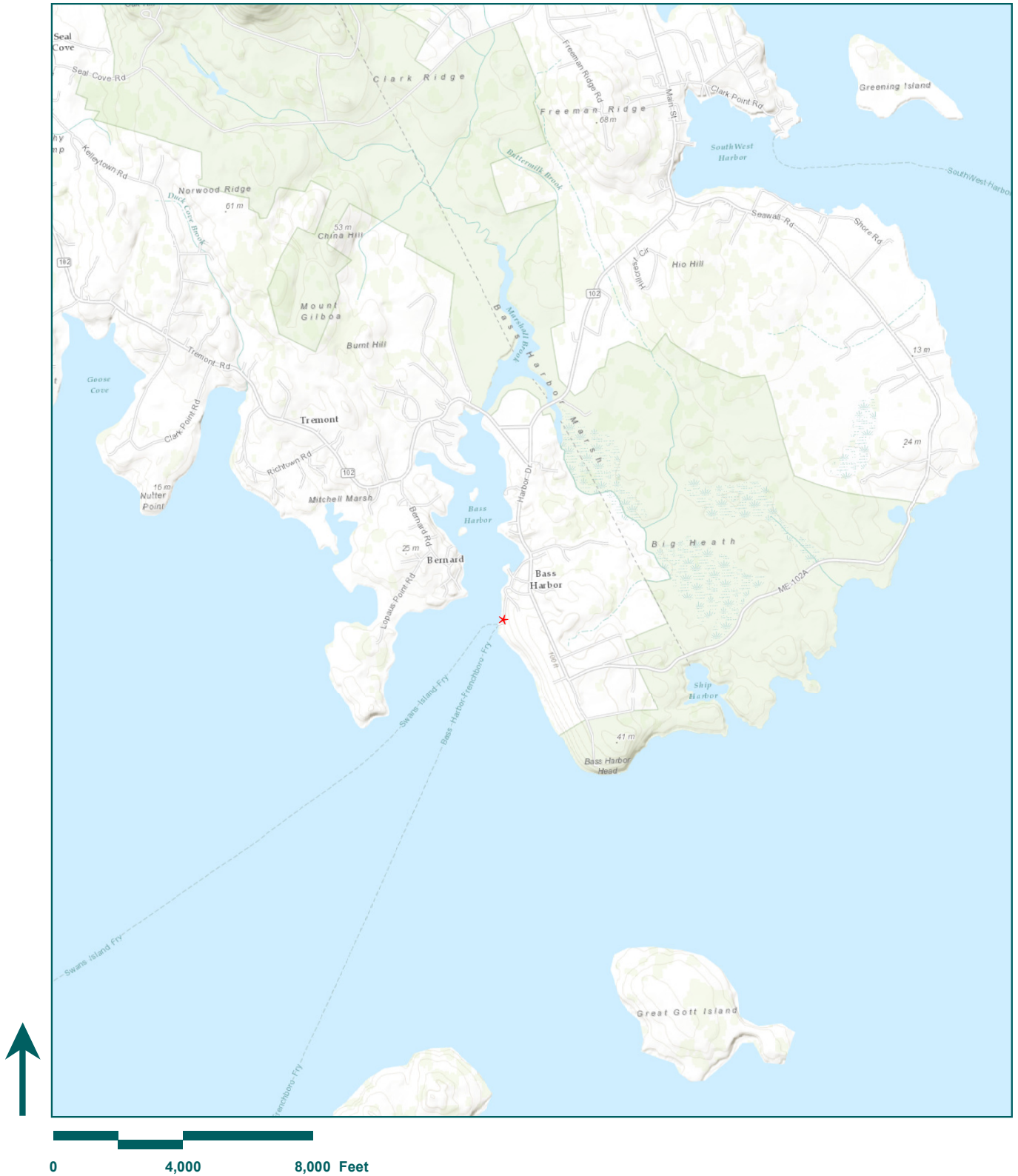
---

## Table of Contents

Location Map.....	iv
Introduction .....	1
Bridge Description .....	1
Transfer Bridge .....	1
Hoist Towers .....	2
Dolphin System .....	2
Section 1: Operating Procedures .....	7
1.1 General Operation of Transfer Bridge.....	7
1.2 Operating Procedures.....	7
1.3 Operating with Radio Control.....	9
1.4 Backup Operating Procedures.....	9
1.4.1 Loss of Power .....	9
1.4.2 Transfer Bridge and Apron Manual Operation.....	10
Section 2: Maintenance Procedures .....	12
2.1 Facility Maintenance and Structural Inspection .....	12
2.1.1 Daily .....	12
2.1.2 Monthly.....	12
2.1.3 Seasonal .....	12
2.1.4 Annual .....	12
2.1.5 Biennial .....	13
2.1.6 Quinquennial .....	13
2.2 Mechanical Maintenance .....	14
2.2.1 Mechanical Equipment/Systems .....	14
2.2.2 Mechanical Inspection and Maintenance Schedule .....	22
2.2.3 Inspection and Maintenance Equipment .....	40
2.2.4 Inspection and Maintenance Procedures .....	40
2.2.5 Safety Precautions .....	42
2.3 Electrical Maintenance.....	43
2.3.1 Introduction .....	43
2.3.2 Electrical Inspection and Maintenance Schedule .....	43

2.3.3 Inspection and Test Equipment.....	45
2.3.4 Inspection and Maintenance Procedures .....	46
2.3.5 Safety Precautions .....	54
2.3.6 Maintenance Procedure for Lockout/Tagout System .....	54
Section 3: Troubleshooting.....	57
3.1 General Troubleshooting Precautions .....	57
3.2 Troubleshooting Precautions Related to Generator.....	57
3.3 Troubleshooting Tables .....	59
Section 4: Appendices	
APPENDIX 4.1—Ferry Terminal Plans 2010	
APPENDIX 4.2—Selected Lincolnville/Islesboro Ferry Terminal Plans	
APPENDIX 4.3—Fracture Critical Member Inspection Plan	
APPENDIX 4.4—Mechanical	
Appendix 4.4.1—Mechanical Maintenance Check List	
Appendix 4.4.2—Mechanical Spare Parts List	
Appendix 4.4.3—Mechanical Equipment Vendor List	
Appendix 4.4.4—Mechanical Equipment Nameplate Table	
Appendix 4.4.5—Mechanical Manufacturers' Maintenance Manuals	
APPENDIX 4.5—Electrical	
Appendix 4.5.1—Electrical Maintenance Check List	
Appendix 4.5.2—Electrical Spare Parts List	
Appendix 4.5.3—Electrical Equipment Vendor List	
Appendix 4.5.4—Electrical Manufacturer's Maintenance Manuals	

# Location Map



44.14.05 N Latitude, and 68.20.54 W Longitude

**Figure 1 – Site Location Map  
Ferry Terminal  
Bass Harbor, Maine**

---

## Introduction

The movable transfer bridge at the Bass Harbor Ferry Terminal in Bass Harbor, Maine allows pedestrian and vehicular traffic to load onto the ferry. The transfer bridge is adjustable for varying tides and various loading conditions. The ferry runs from Frenchboro and Swans Island to Bass Harbor several times a day. The ferry terminal was constructed in 1997 and was rehabilitated in 2013.

The purpose of this manual is to describe the operation of and recommended maintenance for the transfer bridge. Section 1 of the manual describes the general operation of the transfer bridge. Section 2 includes maintenance recommendations for the structural, mechanical and electrical systems. Section 3 includes trouble shooting procedures to follow if the transfer bridge is not functioning as designed. Section 4 contains several appendices.

### Bridge Description

*Deck:* Open steel grid deck, with a 3ft wide concrete-filled section for pedestrians.

*Transfer Bridge Superstructure:* Counterweighted single-span 70ft long bascule bridge consisting of two steel through girders with transverse floor beams.

*Transfer Bridge Substructure:* Two hoist tower foundations on concrete filled sheet piles and one stub abutment. Six dolphins supported on piles.

*Original Construction:* 1997

*Rehabilitation:* 2013

*Design Loading:* HS 20

Appendices 4.1 contains a copy of the rehabilitation plans for Bass Harbor, dated 2010. Also included are the design plans for Lincolnville and Islesboro, dated 2008, which were referenced because original design plans for Bass Harbor were not available. The Islesboro ferry terminal is very similar to the Bass Harbor ferry terminal. Key plan and elevation figures are included at the end of this section.

### ***Transfer Bridge***

The transfer bridge is a counterweighted bascule type operated by a hoist system. At the free end of the transfer bridge is an apron that rests on the ferry. The hoists for the bridge and apron are operated by separate brake motors. A dog and pawl system mechanically locks the bridge in position and prevents it from dropping if the brake were to slip.

The transfer bridge is a non-redundant two through girder type. It is supported by a hoist system containing components that are also non-redundant. These members are steel and primarily in tension and are therefore considered to be fracture critical members (FCMs). A sketch plan identifying the fracture critical members and components is included in Appendix 4.3. The transfer bridge consists of two W36 x210 girders supported on the land side by hinge bearings resting on the abutment. At 56ft from the hinge bearings, the two girders are supported by the transverse hoist and counter weight beams. The transfer bridge bears on these two W36x210 beams and cantilevers an additional 14ft beyond to an adjustable apron. The transfer bridge floor beam framing consists of nine W18x40 and two W18x50 floor beams at 6'-7 1/2" on center that support the steel grid decking above. The main girders and floor beams are painted steel beams. The grid decking is galvanized steel with a 3ft wide section filled with concrete for pedestrian use.

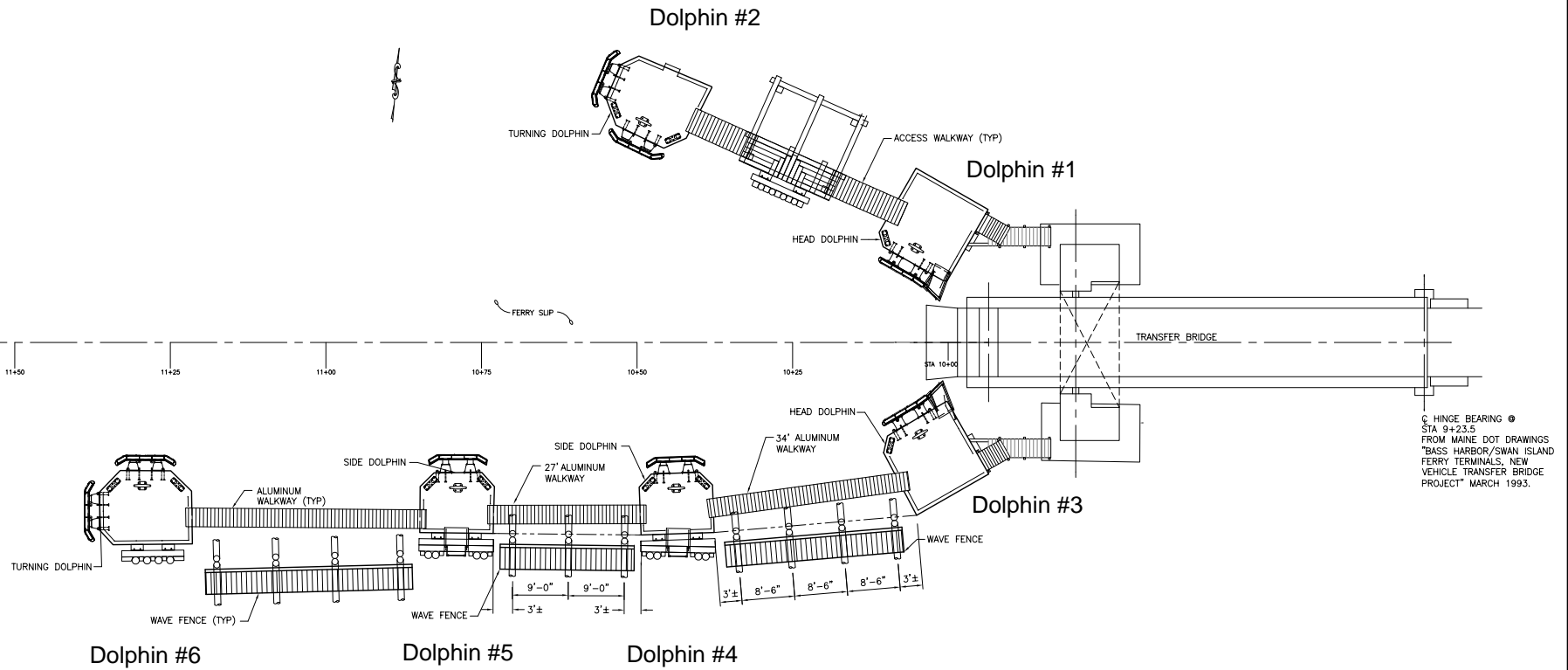
### ***Hoist Towers***

The hoists towers are located approximately 56ft from shore and support the free end of the transfer bridge. The towers are 28 feet tall and steel framed. The hoist towers support the main hoist, transfer bridge counterweight, and apron counter weight mechanical system. The hoist and counter weight cables connect to either side of the structure at the hoist and counter weight beam. The transfer bridge bears on these two beams.

### ***Dolphin System***

The ferry terminal pen consists of six dolphins with fenders. The dolphins are comprised of a concrete cap supported by steel pipe piles. The fenders are attached to the concrete caps which have elastomeric fender elements supporting steel panels faced with high density polyethylene sheeting. The steel panels are also held in position by the 1" diameter multi-directional panel support chains.

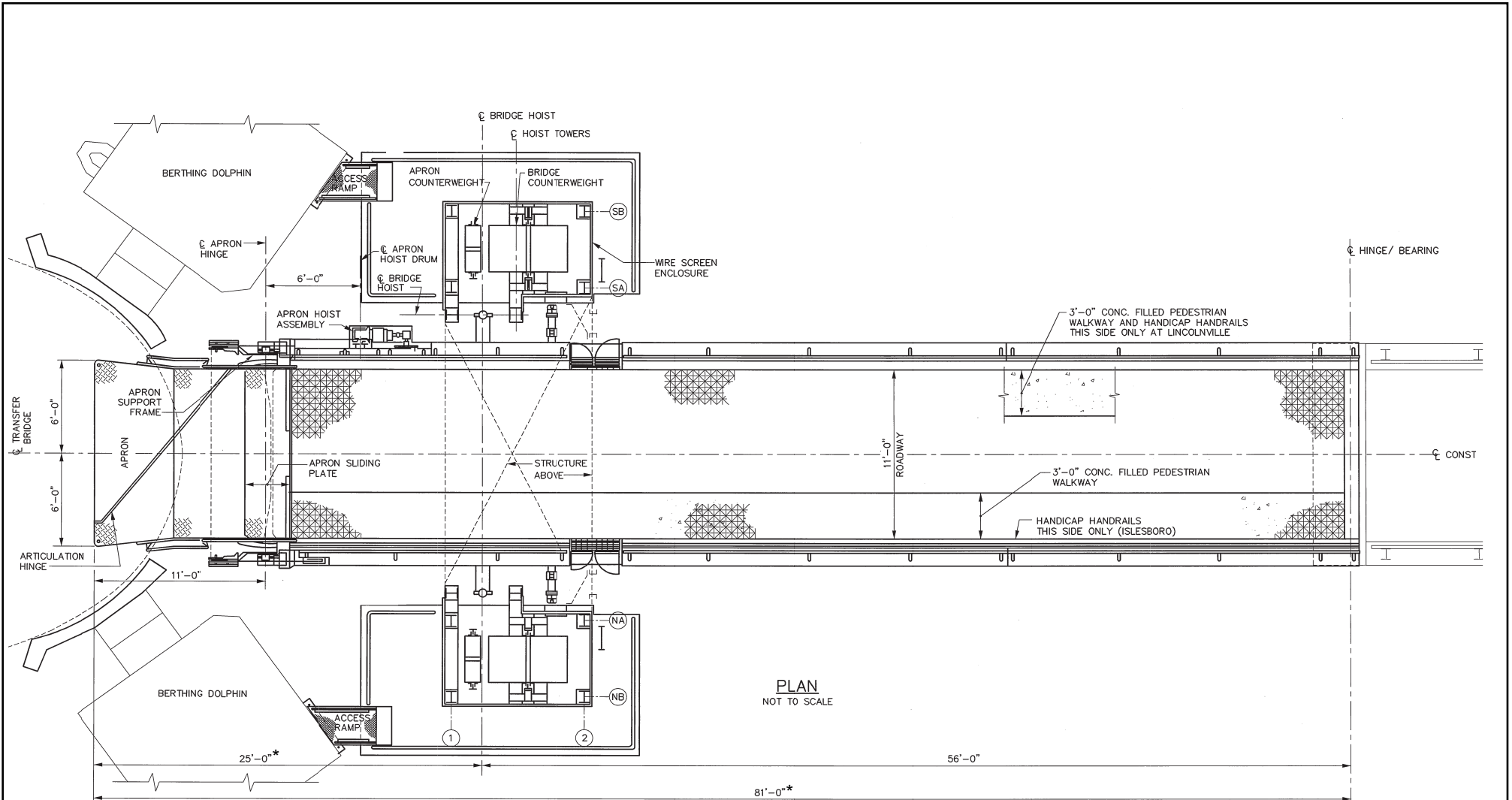
There are access walkways at the top and between each dolphin.



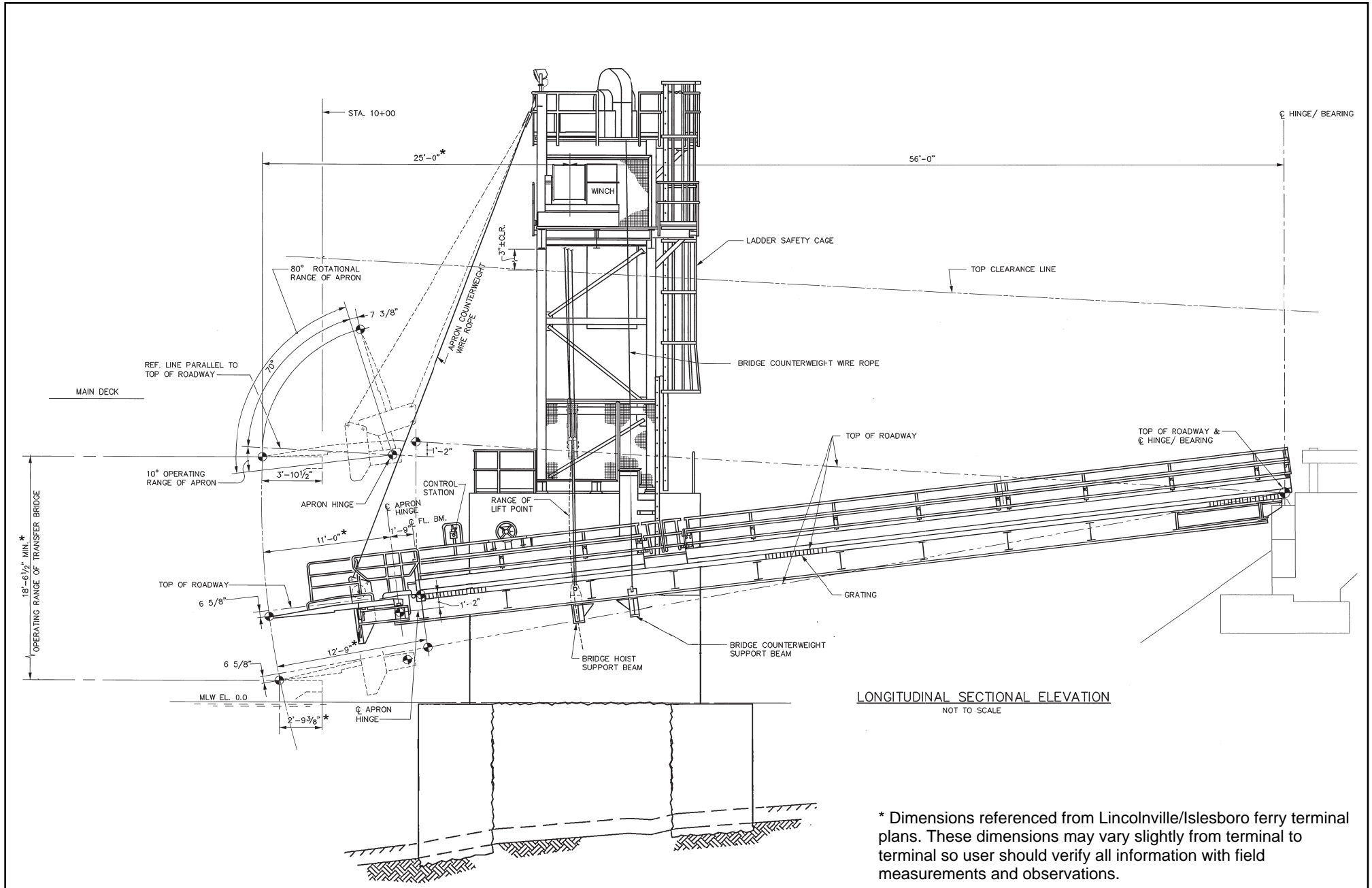
○ HINGE BEARING  
 STA 9+23.5  
 FROM MAINE DOT DRAWINGS  
 "BASS HARBOR/SWAN ISLAND  
 FERRY TERMINALS, NEW  
 VEHICLE TRANSFER BRIDGE  
 PROJECT" MARCH 1993.

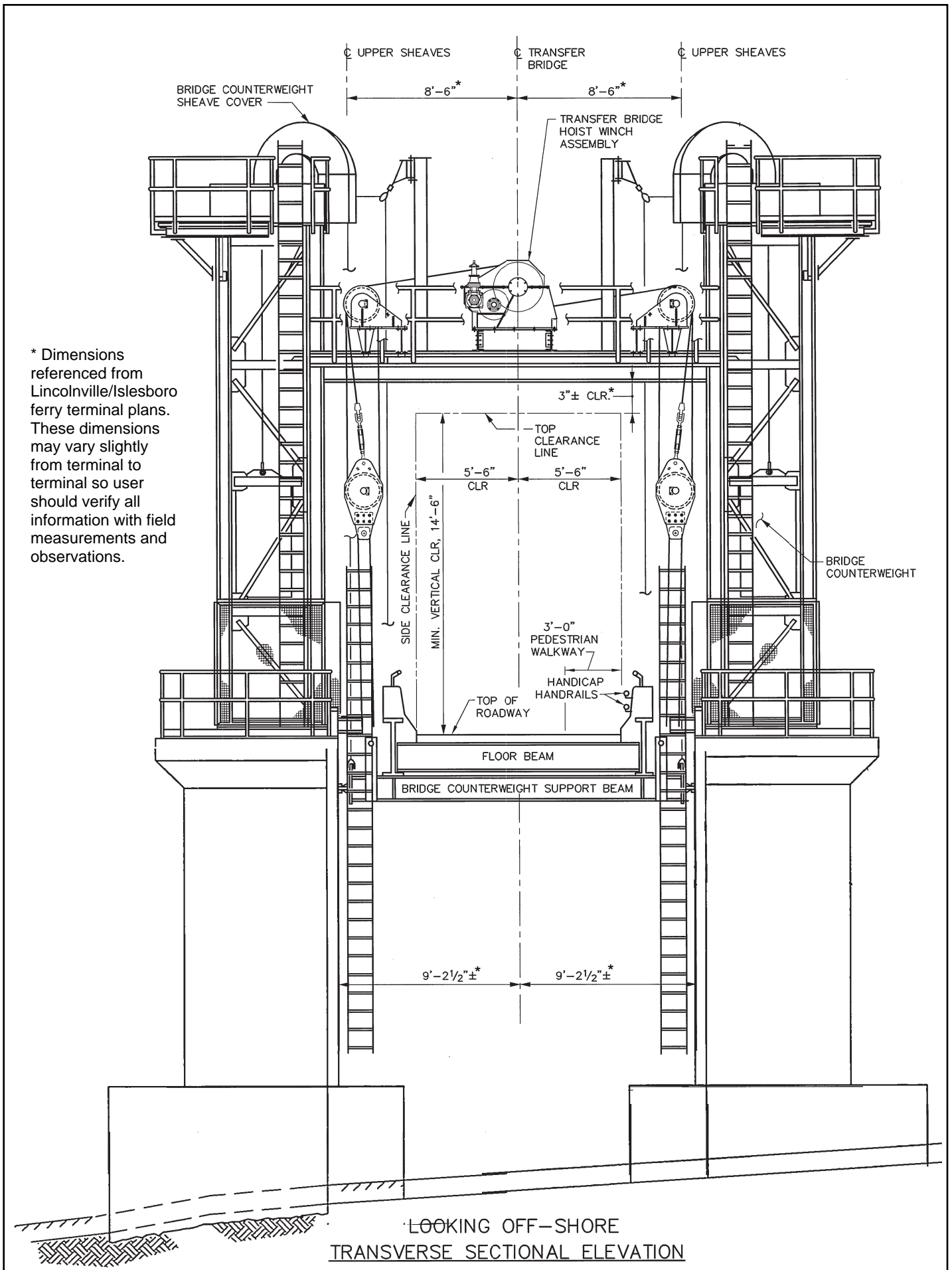
**BASS HARBOR TERMINAL PLAN**  
 SCALE: 1"=10'-0"

3



\* Dimensions referenced from Lincolnville/Islesboro ferry terminal plans. These dimensions may vary slightly from terminal to terminal so user should verify all information with field measurements and observations.





---

## Section 1: Operating Procedures

### ***1.1 General Operation of Transfer Bridge***

The transfer bridge is operated from either a control panel located on the bridge near the apron hinge, a control panel on the walkway accessed from the dolphin or a hand held radio transmitting controller. The controls are not locked and as such anyone at the location can operate the bridge -- not only the States' designated operators. All of the designated operators of the bridge need to review this manual and be thoroughly trained in all procedures required to properly operate and adjust the bridge and apron positions. The transfer bridge and apron must be positioned so that a smooth transition from the land to the ferry and from the ferry to the land is achieved. Improper positioning of either component may unevenly load and/or induce dynamic loads into the structural components, causing the vehicle to bottom out or present a tripping hazard to pedestrians. Adjustments will also need to be made as the loading changes on the ferry. Below is an outline of the general operating procedures.

### ***1.2 Operating Procedures***

The following is a simplified operating procedure:

1. Ferry enters slip
2. Operator (typically an able ferry seaman) turns on the remote control or climbs onto the bridge or along the dolphin to access and open a control station if the remote is unavailable
3. Operator operates the bridge
4. Operator operates the apron
5. Operator monitors the unloading and loading of vehicles and pedestrians, making adjustments to the bridge and apron positions to accommodate vehicles of different sizes
6. Operator views the height of the ferry deck and makes adjustments as needed
7. Operator raises apron to a predefined angle
8. Operator raises bridge to a predefined angle
9. Operator closes and latches control station if used or turns off the remote controller
10. Operator leaves the bridge and climbs onto the ferry from the dolphin if using a local control station

The following is a detailed operating procedure:

1. Ferry enters the slip and achieves proper position to load or unload vehicles and pedestrians.
2. The operator climbs onto the bridge either by transfer directly from the ferry to the bridge or by walking from the dolphin along the walkway and onto the bridge or the platform by the tower.
3. The operator releases the clasp and opens either the platform control station or the bridge control station and positions the bridge using the BRIDGE selector switch to a height at which the apron can be lowered onto the deck of the ferry using the UP and DOWN directions. After the operator positions the transfer bridge, he/she lowers the apron to contact the deck using the APRON UP and DOWN directions. He/she then adjusts the position of the transfer bridge and apron to provide as close to a straight line as possible. The E-stop can be used at any time to stop the bridge or apron motion. When the bridge is lowering, the pawl is held in the withdrawn position with white globe light not illuminated. When the bridge reaches the appropriate height, lowering should be halted. The operator should then jog the bridge up until the pawl engages by raising the transfer bridge slightly until the white globe light illuminates showing that the pawl has engaged. With the pawl engaged, the transfer bridge is locked into position and ready to safely unload or load vehicles and pedestrians. Note that if the bridge is lowered too far, its motion will be halted by the BRIDGE FULLY LOWERED limit switch. If the bridge is raised too far its motion will be halted by the BRIDGE FULLY RAISED limit switch.
4. Using the control in the control station either on the platform or the bridge, the operator lowers the apron onto the deck by turning APRON selector switch in the DOWN direction. The angle of the pivot from the apron to the bridge should then be observed to assure that vehicles can pass over it without bottoming out. Readjustment may be needed. When the vehicles are unloaded, the able ferry seaman signals the passengers to begin off-loading, allowing the vehicles to off-load first, then the pedestrians. When the ferry is empty, the able ferry seaman signals the passengers to begin on-loading, allowing the pedestrians to load first, then the vehicles.
5. The operator monitors the unloading and loading of vehicles and pedestrians. Monitoring assures that vehicles do not bottom out and that the apron is in full contact with the deck and prevents the creation of a tripping hazard for the pedestrians.
6. The operator views the type of each vehicle and makes adjustments as needed.
7. Upon completing the transfer of vehicles and pedestrians, the apron is raised to a predefined angle using the APRON selector switch in the control station. Should the apron be raised too high, the toggle block will trigger the apron fully raised limit switch and stop the apron.

8. Upon completing the raising of the apron, the bridge is raised to a predefined angle using the BRIDGE selector switch in the control station. As the bridge raises, the white pawl globe light will turn on and off, indicating that the pawl is engaged (illuminated) or withdrawn (not illuminated). Should the bridge be raised too high, the counterweight will contact and trigger the BRIDGE FULLY RAISED limit switch stopping the travel.
9. The operator then closes and latches the control station. It is important to latch the station enclosure to prevent water entry into the controls.
10. The operator leaves the bridge and climbs onto the ferry.

### **1.3 Operating with Radio Control**

The transfer bridge system is also provided with remote controls. The remote transmitter is carried on the ferry while the receiver is located on the machinery platform.

The remote is provided with the same controls that the control station provides, including operation of the bridge, apron and emergency-stop. In addition, it remotely controls the ship or platform tower lights.

It should be noted that the control needs to be turned on to be able to operate the transfer bridge and if the E-stop has been depressed, stopping all motion, it must be turned and allowed to pop up to reset and resume operation.

### **1.4 Backup Operating Procedures**

#### **1.4.1 Loss of Power**

Should utility service fail, the generator will be started by the automatic transfer switch which constantly monitors the utility service and the generator output power for suitability to operate the transfer bridge system. Should the automatic transfer switch fail to start the generator, the generator may be started by turning the RUN-STOP-AUTO switch to the RUN position. After about 15 seconds to stabilize, the HERTZ (frequency) meter will show 60 and the transfer switch may be switched to the EMERGENCY mode, if not already in that mode, by the use of the manual controls on the control face inside the exterior door of the unit. If the transfer switch fails to switch to the EMERGENCY mode automatically or by the use of the controls stated above, open the inside door and manually change the state of the transfer switch with the red manual operation rod located in the unit.

Should the transfer bridge motor fail to operate electrically, the bridge may be moved manually as described in Section 1.4.2 below. Caution needs to be used in this operation. In order to prevent the motor from energizing while the handwheel is in use, the motor electrical feeds must be opened by opening (turning off - handle down) of the local in-sight disconnect switch located next to the hoist. This is the first line of protection. The brake on the hoist brake-motor is hand released by pulling the small release button extending from the brake cover until it latches out. This releases

the brake to allow manual. See Section 1.4.2.1 below for manual hand cranking procedures and manual operation of the pawl.

Should the apron motor fail to operate electrically, the apron may be moved manually as described in Section 1.4.2 below. Caution needs to be used in this operation. In order to prevent the motor from energizing while the handwheel is in use, the motor electrical feeds must be opened by opening (turning off - handle down) of the local in-sight disconnect switch located immediately to the right of the apron brake-motor. This is the first line of protection. The brake on the apron brake-motor is hand released by pulling the small release button extending from the brake cover until it latches out. This releases the brake to allow manual. A pin needs to be inserted into the manual operation reducer to motor shaft coupling prior to operation. See Section 1.4.2.2 below for manual hand cranking procedures.

### **1.4.2 Transfer Bridge and Apron Manual Operation**

In the event that there is a complete loss of electrical power and the emergency generator is unavailable or otherwise disabled, the bridge and apron can be manually operated.

It is extremely important that lock out/tag out procedures discussed in Section 2.3.6 are followed to prevent inadvertent operation of the machinery drive systems during manual operation.

#### **1.4.2.1 Transfer Bridge Manual Operation**

Perform the following steps to manually operate the transfer bridge:

1. Lock out/tag out power to the bridge drive machinery. See Section 2.3.6 for this procedure.
2. Install the handwheel onto the input shaft. This will require removing the cover that protects the input shaft. A pipe wrench may be required.
3. Disengage the pawl by turning the release bolt on the side of the parallel shaft reducer in a clockwise direction until the pawl is disengaged. Removal of the inspection cover on the parallel shaft reducer may be necessary to allow visual confirmation that the pawl is disengaged. *Note: Measure exposed length of bolt prior to turning so that it can be returned to that position when re-engaging pawl.*
4. Raise/lower the bridge to the desired elevation by turning the handwheel.
5. Before allowing traffic to pass over the bridge, engage the pawl by turning the release bolt on the side of the parallel shaft reducer in a counterclockwise direction until it is back to its original position. Removal of the inspection cover on the parallel shaft reducer may be necessary to allow visual confirmation that the pawl is engaged.

Repeat these five steps in reverse order to move the transfer bridge away from the ferry and back to its original position.

### 1.4.2.2 Apron Manual Operation

Perform the following steps to manually operate the apron:

1. Lock out/tag out power to the apron drive machinery. See Section 2.3.6 for this procedure.
2. Insert pin through the disconnect coupling to connect the handwheel reducer output shaft to the drive motor input shaft. It may be necessary to rotate the handwheel back and forth slightly when inserting the pin to align the holes in the disconnect coupling with those on the motor shaft.
3. Raise/lower the apron to the desired elevation by turning the handwheel.

Repeat these three steps in reverse order to move the apron away from the ferry and back to its original position.

DRAFT

---

## Section 2: Maintenance Procedures

### 2.1 Facility Maintenance and Structural Inspection

The facility maintenance and structural inspection recommendations are listed below by recommended frequency. The frequency listed for each maintenance item is the minimum recommended and it should be increased as necessary to maintain the bridge in good condition.

#### **2.1.1 Daily**

The following maintenance items should be performed each day:

- Conduct a cursory review visual inspection of the bridge, electrical and hydraulics system components.
- Exercise the transfer bridge through its full range of motion and check that all bridge, electrical and hydraulics system components are functioning properly. Look and listen for signs that the structure is not functioning properly.

#### **2.1.2 Monthly**

The following maintenance items should be performed each month:

- Walk over, under, on and around the Terminal and the transfer bridge looking for any signs of distress or damage.

#### **2.1.3 Seasonal**

The following maintenance items should be performed during the winter, or in the spring and the fall each year, as noted:

- Clear snow from the approaches and deck to keep bridge open for pedestrian use during the winter. Use care during snow removal operations to not damage the bridge deck joints. Do not use any de-icing salts on the bridge. Use sand as necessary.
- Water wash and clean sand and other debris from the wearing surface each spring and fall.
- Water wash and clean sand and other debris from the bridge deck joints each spring and fall and inspect the joints for damage.
- Water wash and clean sand and other debris from the bridge seat each spring and fall and inspect for damage.

#### **2.1.4 Annual**

The following maintenance items should be performed once per year:

- Inspect pavement on bridge approaches and repair.
- Clear any weeds or other unwanted vegetation that grows up on the bridge approaches.

- Repair concrete and guardrail on bridge approaches if rails or posts are damaged or deteriorated.
- Clean any sand and debris from the bridge deck, the horizontal surfaces of the bridge railing or curbs, and from the vertical gaps between rail panels and posts.
- Inspect the condition of the fender system each spring. Replace any missing or damaged members or connection hardware within 6 months of notification.

### **2.1.5 Biennial**

The following maintenance items should be performed every two years:

- Engage an experienced bridge inspection team to perform a comprehensive Fracture Critical and Routine Inspection of the entire bridge and provide an inspection report to the State. The report should include specific maintenance recommendations based on the inspection findings. This biennial inspection will help identify any problems that develop in their early stages when they can be addressed most cost effectively.
- At the same time as the Fracture Critical and Routine inspection, engage experienced Electrical and Mechanical Engineers to perform a comprehensive Electrical and Mechanical Inspection and provide an inspection report. The report should include specific maintenance recommendations based on the inspection findings. This biennial inspection will help identify any problems that develop in their early stages when they can be addressed most cost effectively.

### **2.1.6 Quinquennial**

The following maintenance items should be performed every five years:

- Engage an experienced underwater bridge inspection team to perform a comprehensive underwater inspection. The report should include specific maintenance recommendations based on the inspection findings. This biennial inspection will help identify any problems that develop in their early stages when they can be addressed most cost effectively.
- Engage an experienced bridge inspection team to perform a visual and non-destructive inspection and testing on the pins and hardware associated with the link bars. This quinquennial inspection will help identify any problems that develop in their early stages when they can be addressed most cost effectively.

## 2.2 Mechanical Maintenance

### 2.2.1 Mechanical Equipment/Systems

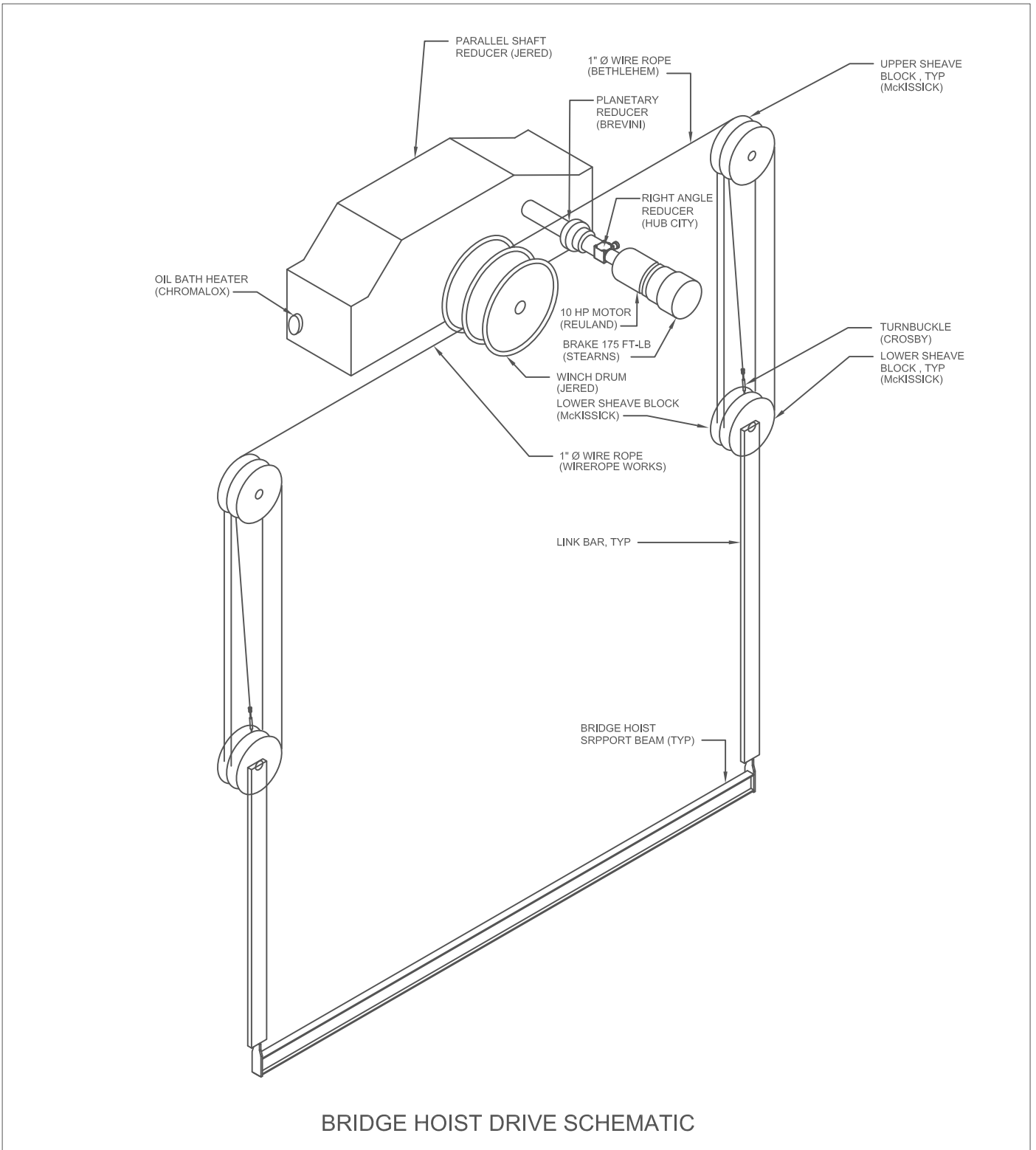
The bridge is a counterweighted bascule type operated by the bridge hoist system. At the tip of the bridge is an apron used to set onto the ferry itself. The apron is operated by the apron hoist system.

#### 2.2.1.1 Bridge Hoist Machinery

Refer to the Bridge Hoist Machinery Schematic on the following page for a graphic presentation of the system. The machinery for the bridge hoist system is mostly located on a fixed platform above the bridge, spanning between the two counterweight towers. The drive consists of a motorbrake coupled to the primary input shaft of a right angle gear reducer. This reducer provides no mechanical advantage to normal operation of the drive system. Its purpose is to allow manual operation of the bridge via a large handwheel. The handwheel can be mounted to the secondary input shaft of the right angle reducer to provide a 2:1 ratio for manual operation. The output shaft of the right angle reducer is coupled to the input side of a 25:1 ratio planetary reducer. The output shaft of the planetary reducer is coupled to the input side of a large, parallel shaft, primary reducer.

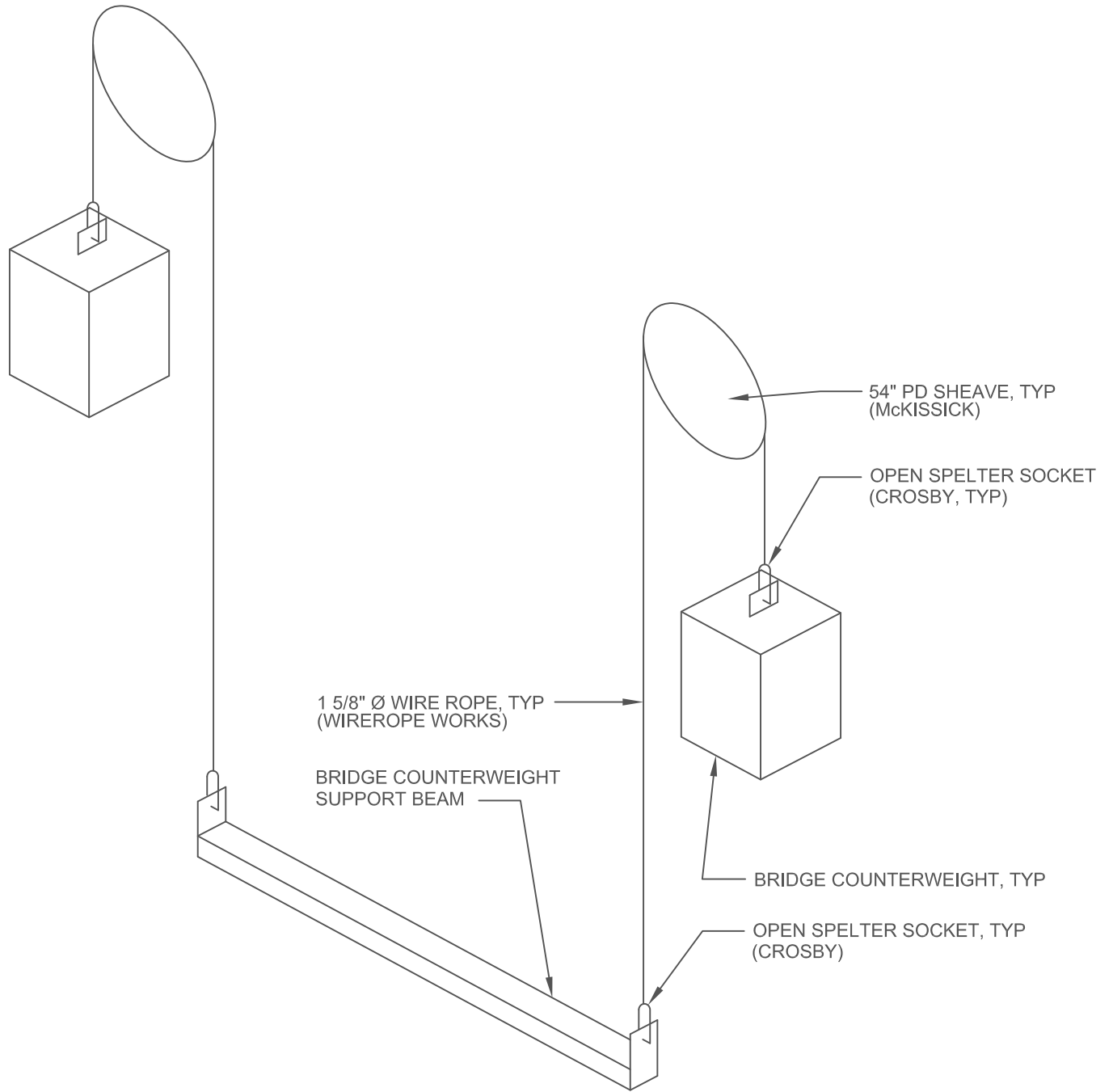
The output shaft of the primary reducer is coupled to the main hoist drum. The hoist drum is mounted on a shaft supported by two journal type bearings. As the drum rotates, the one (1) inch diameter operating ropes raise and/or lower the bridge, depending on the direction of the drum's rotation. There are two operating ropes, one for each side of the bridge. The operating ropes pass through a reeving system that is symmetrically located about the centerline of the bridge in each counterweight tower. As the operating ropes wind/unwind from the main hoist drum they travel toward the counterweight towers where they pass over the upper sheave assemblies. The ropes travel down to their lower sheave assemblies, back up over their upper sheave assemblies, and then finally back down to their lower sheave assemblies where they are anchored to their lower sheave casings. This reeving provides a five (5) part line on each side of the bridge for hoisting operations.

A pawl system is incorporated into the primary reducer. Standard operating procedure recommends the engagement of the pawl prior to use of the by pedestrian or vehicular traffic. The pawl locks the primary reducer output shaft to prevent rotation during use of the bridge for loading/unloading of the ferry.



### *2.2.1.2 Bridge Counterweight System*

Refer to the Bridge Counterweight System Schematic on the following page for a graphic presentation of the system. The bridge counterweight system is comprised of two separate counterweight systems, one located in each counterweight tower. The main counterweight system is simple and straight-forward. A 54" diameter, single groove sheave supported on a 5" diameter shaft by a pair of anti-friction roller bearings. A 1-5/8" diameter wire rope is anchored to a bridge support beam beneath the roadway. The rope passes up over the 54" diameter sheave, down to a sheave assembly connected to the top of the counterweight and then back up to an anchorage point fixed to the underside of the 54" diameter sheave platform at the top of the counterweight tower. These two individual ropes are the only support for the bridge and counterweight including any live loads applied to the bridge.

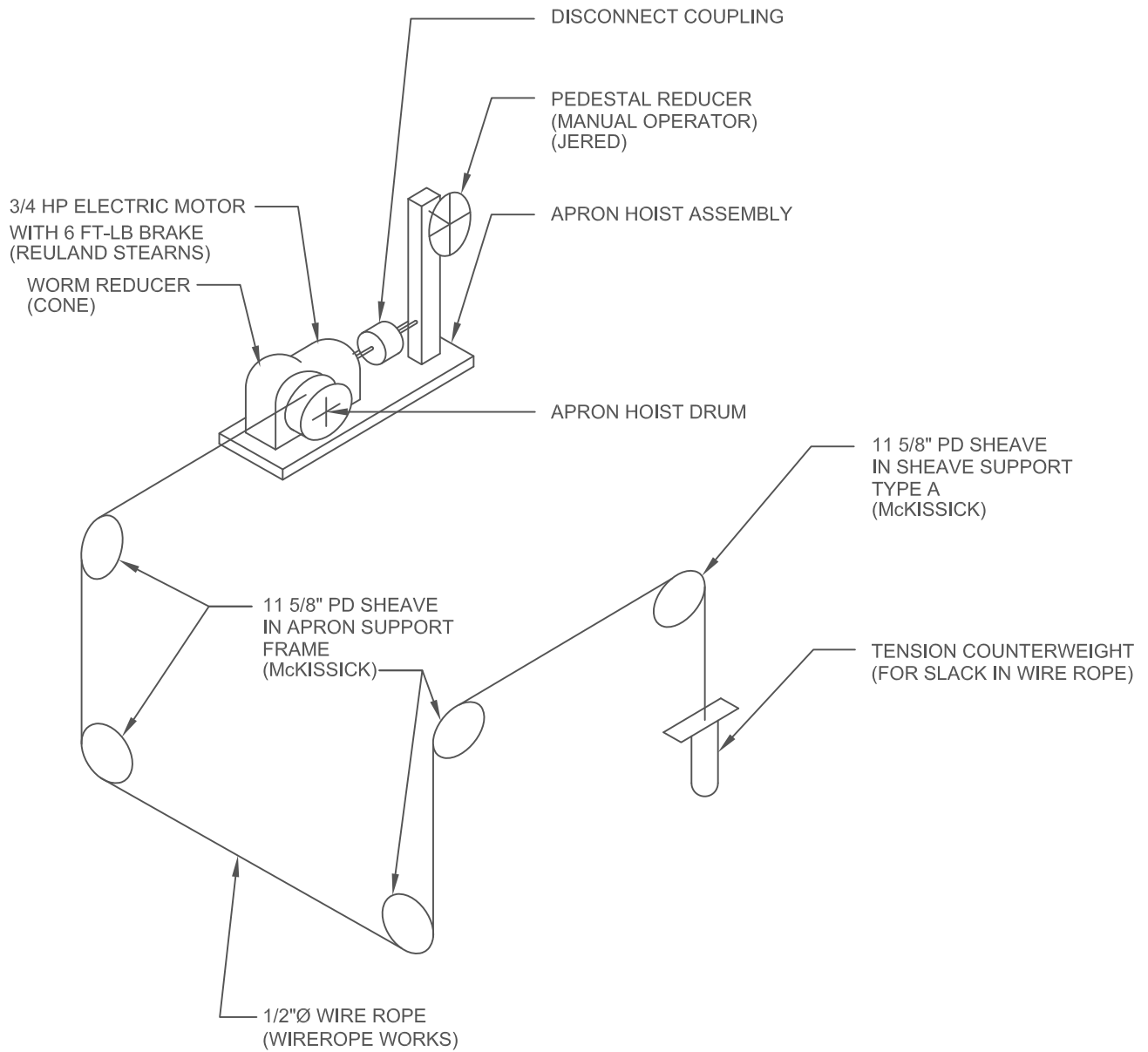


BRIDGE COUNTERWEIGHT SYSTEM SCHEMATIC

### *2.2.1.3 Apron Hoist Machinery*

Refer to the Apron Hoist Machinery Schematic on the following page for a graphic presentation of the system. The machinery for the apron hoist system is located at the roadway level of the bridge. The apron drive consists of a motorbrake coupled to the input shaft of a 200:1 worm gear reducer. The apron hoist drum is mounted on the output shaft of this worm reducer. As the drum rotates, the half (0.5) inch diameter apron rope raises and/or lowers the apron, depending on the direction of the drum's rotation. The apron rope passes through a reeving system with deflector sheaves mounted along the sides and bottom of the bridge structure. This reeving provides a single part line for apron hoisting operations.

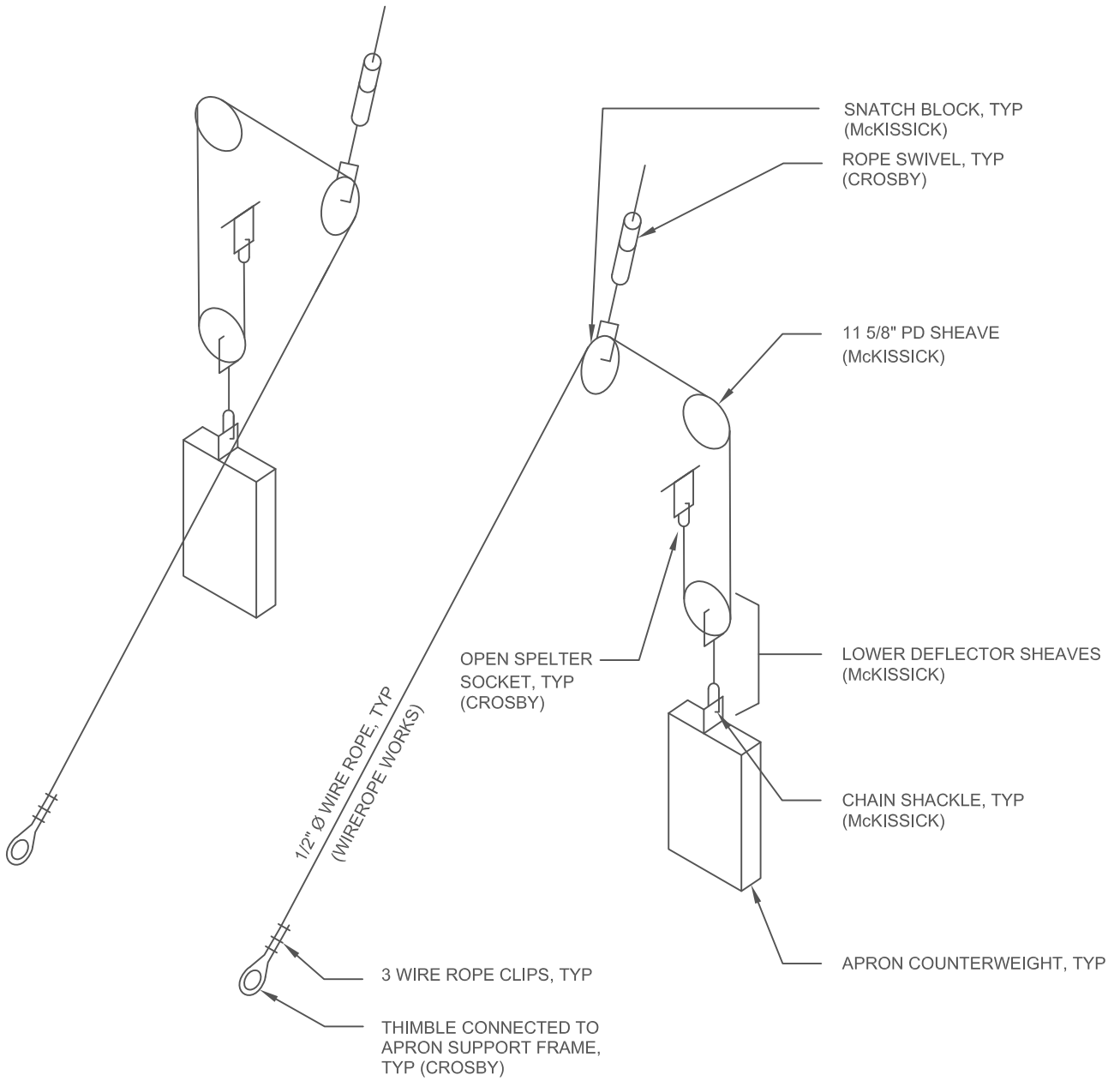
There is a pedestal style custom bevel reducer whose output is coupled to the rear shaft of the motorbrake. There is a handwheel mounted on the input shaft that can be rotated to provide manual operation of the apron in the event of a power failure.



APRON HOIST DRIVE SCHEMATIC

#### *2.2.1.4 Apron Counterweight System*

Refer to the Apron Counterweight System Schematic on the following page for a graphic presentation of the system. The apron counterweight system is comprised of two separate counterweight systems, one located in each counterweight tower. The apron counterweight system is slightly more elaborate than the bridge counterweight system. A half (0.5) inch diameter wire rope is attached to each side of the apron support frame near the toe of the apron. This wire rope extends up to a swivel mounted snatch block on a support pole up on the bridge hoist machinery platform. This swivel mount allows the snatch block to move during raising/lowering of the apron in order to maintain proper alignment of the wire rope in the snatch block sheaves. The wire rope passes over this swivel mounted snatch block and over a deflector sheave that is mounted to a platform on top of the counterweight tower(s) as the bridge's main counterweight sheaves (54" diameter sheaves). The rope passes through the floor of this platform to a lower deflector sheave assembly that is shackled to the top of the auxiliary counterweight and then back up to an anchor on the bottom side of the platform.



APRON COUNTERWEIGHT SYSTEM SCHEMATIC

### **2.2.2 Mechanical Inspection and Maintenance Schedule**

The importance of regular preventive maintenance cannot be over-emphasized. In addition to regular maintenance, some of the equipment requires exercise to keep it in operating condition. Maintenance is performed best not in response to equipment failure, but when performed on a schedule.

Perform a visual inspection for the machinery and mechanical equipment and associated components. Identify and record all deficiencies. Clean, remove and replace inspection covers as required to perform the inspections. Record the date, time and any condition that may affect the inspection results at the time of testing.

The machinery and mechanical equipment inspection includes a cursory audible and visual examination for:

1. Smooth operation
2. Secure fasteners and mountings
3. Abnormal vibration
4. Overheating
5. Abnormal wear
6. Proper alignment
7. Clean and sufficient amounts of lubrication
8. Paint and coatings condition

The following Mechanical Maintenance and Inspection table lists the systems that require inspection and/or maintenance on a regular basis. The table is to be used to schedule regular maintenance. Lubrication Diagrams follow the table and provide a visual reference of the lubrication points for the various mechanical components.

Maintenance Checklists have been appended to the end of this manual. They are to be duplicated and used by maintenance personnel in the field to provide a hard copy record of the maintenance activities performed.

**MECHANICAL INSPECTION AND MAINTENANCE SCHEDULE**

Equipment	Monthly	Quarterly	Semi-Annually	Annually
<b>BRIDGE HOIST MACHINERY</b>				
<b>Disc Brake (Stearns)</b>				
Inspect all bolts for rust, corrosion and tightness.		X	X	X
Check friction disc clearance, adjust if necessary.				X
Inspect condition of friction discs and measure thickness, replace if necessary.				X
<b>Electric Motor (Reuland)</b>				
Inspect mounting bolts for rust, corrosion and tightness.		X	X	X
Lubricate motor bearings.				X
<b>Right Angle Reducer (Hub City)</b>				
Inspect mounting bolts for rust, corrosion and tightness.		X	X	X
Inspect all flange, seal carrier and bearing cover bolts for tightness.		X	X	X
Inspect for oil leaks.	X	X	X	X
Clean off all corrosion, dirt and oils. Repaint any damaged areas.		X	X	X
Inspect the oil level.	X	X	X	X
Inspect oil for contaminants, water and metal particles.	X	X	X	X
Change oil.				X

Equipment	Monthly	Quarterly	Semi-Annually	Annually
<b>Right Angle Reducer (Hub City) – Continued</b>				
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.	X	X	X	X
<b>Planetary Reducer (Brevini)</b>				
Inspect mounting bolts for rust, corrosion and tightness.		X	X	X
Inspect all flange, seal carrier and bearing cover bolts for tightness.		X	X	X
Inspect for oil leaks.	X	X	X	X
Clean off all corrosion, dirt and oils. Repaint any damaged areas.		X	X	X
Inspect the oil level.	X	X	X	X
Inspect oil for contaminants, water and metal particles.	X	X	X	X
Change oil.				X
Lubricate bearings.	X	X	X	X
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.	X	X	X	X
<b>Parallel Shaft Reducer (JERED)</b>				
Inspect reducer supports and support members for corrosion and indications of stress.		X	X	X
Inspect mounting bolts for rust, corrosion and tightness.		X	X	X
Inspect all flange, seal carrier and bearing cover bolts for tightness.		X	X	X

Equipment	Monthly	Quarterly	Semi-Annually	Annually
<b>Parallel Shaft Reducer (JERED) – Continued</b>				
Inspect for oil leaks.	X	X	X	X
Clean off all corrosion, dirt and oils. Repaint any damaged areas.		X	X	X
Inspect the oil level.	X	X	X	X
Sample and test oil by a qualified test agency. Change oil based on test results.				X
Lubricate cartridge and sleeve bearings.	X	X	X	X
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.	X	X	X	X
Remove inspection cover and visually inspect gear teeth for problems.			X	X
Observe inside housing for corrosion or other debris.			X	X
Inspect hydraulic hose for chafing or other damage.			X	X
Change hydraulic pump oil.				X
Inspect pawl assembly for proper operation while inspection cover is removed.			X	X
<b>Hoist Drum</b>				
Inspect all external bolts for tightness.		X	X	X
Inspect drum rope grooves for wear or imprinting damage.			X	X

Equipment	Monthly	Quarterly	Semi-Annually	Annually
<b>Hoist Drum – Continued</b>				
Inspect drum shaft journal bearing housings and mounting bolts for rust, corrosion and tightness.		X	X	X
Lubricate drum shaft bearings	X	X	X	X
<b>Wire Rope and Deflector Sheaves</b>				
Lubricate wire ropes.			X	X
Inspect wire ropes for damage or breaks, particularly at end connections.			X	X
Inspect upper sheaves for cracks in hub, web and rim.			X	X
Lubricate upper sheave case bushings.	X	X	X	X
Inspect upper sheaves for cracks in hub, web and rim.			X	X
Lubricate lower sheave case bushings.	X	X	X	X
Inspect turnbuckle assembly for corrosion or damage.			X	X
Lubricate turnbuckle threads.		X	X	X
Inspect link bar and pin connections for visual damage, as well as any rust or corrosion. Repaint any damaged areas.		X	X	X
Lubricate link bar upper and lower pin connections.	X	X	X	X

Equipment	Monthly	Quarterly	Semi-Annually	Annually
<b>BRIDGE COUNTERWEIGHT MACHINERY</b>				
Lubricate wire ropes.			X	X
Inspect wire ropes for damage or breaks, particularly at end connections.			X	X
Inspect sheaves for cracks in hub, web and rim.			X	X
Inspect sheave rope grooves for wear or imprinting damage.			X	X
Inspect sheave bearing housings and mounting bolts for rust, corrosion and tightness.		X	X	X
Lubricate sheave bearings.	X	X	X	X
Inspect turnbuckle assembly for corrosion or damage.			X	X
Lubricate turnbuckle threads.		X	X	X
Inspect guide rails for straightness and any damaged areas.		X	X	X
Lubricate guide rails.		X	X	X
Inspect guide brackets and fasteners for any damage.		X	X	X
Inspect counterweight box for corrosion or damage.		X	X	X

Equipment	Monthly	Quarterly	Semi-Annually	Annually
<b>APRON HOIST MACHINERY</b>				
<b>Pedestal Reducer (JERED)</b>				
Inspect mounting bolts for rust, corrosion and tightness.		X	X	X
Clean off all corrosion, dirt and oils. Repaint any damaged areas.		X	X	X
Lubricate input and output shaft bearings.		X	X	X
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.	X	X	X	X
Inspect disconnect coupling and manually operate it.			X	X
Lubricate disconnect coupling.	X	X	X	X
Verify presence of slide coupling engagement pin			X	X
<b>Disc Brake (Stearns)</b>				
Inspect all bolts for rust, corrosion and tightness.		X	X	X
Check friction disc clearance, adjust if necessary.				X
Inspect condition of friction discs and measure thickness, replace if necessary.				X
<b>Electric Motor (Reuland)</b>				
Inspect mounting bolts for rust, corrosion and tightness.		X	X	X
Lubricate motor bearings.				X

Equipment	Monthly	Quarterly	Semi-Annually	Annually
<b>Right Angle Reducer (Cone)</b>				
Inspect mounting bolts for rust, corrosion and tightness.		X	X	X
Inspect all flange and bearing cover bolts for tightness.		X	X	X
Inspect for oil leaks.	X	X	X	X
Check the oil level.	X	X	X	X
Change oil.				X
Lubricate bearings.	X	X	X	X
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.	X	X	X	X
Inspect hoist drum for cracks, damage, corrosion or imprinting.		X	X	X
<b>Wire Rope and Deflector Sheaves</b>				
Lubricate wire ropes.			X	X
Inspect wire ropes for damage or breaks, particularly at end connections.		X	X	X
Inspect deflector sheaves for corrosion or other damage.		X	X	X
Inspect deflector sheave rope grooves for wear or imprinting damage.		X	X	X
Lubricate deflector sheave bushings.	X	X	X	X

Equipment	Monthly	Quarterly	Semi-Annually	Annually
<b>Miscellaneous</b>				
Inspect apron hinge for any damage and freedom of motion.		X	X	X
Inspect articulating hinge for any damage and freedom of motion.		X	X	X
Inspect apron pivot for any damage and freedom of motion.		X	X	X
Lubricate apron hinge bearings.	X	X	X	X
Lubricate apron transverse roller.	X	X	X	X
Inspect sliding plate for damage or bent edges.		X	X	X

Equipment	Monthly	Quarterly	Semi-Annually	Annually
<b>APRON COUNTERWEIGHT MACHINERY</b>				
Lubricate wire ropes.			X	X
Inspect wire ropes for damage or breaks, particularly at end connections.			X	X
Inspect lower deflector sheaves for damage and rope groove wear.			X	X
Inspect upper deflector sheaves for damage and rope groove wear.			X	X
Inspect upper deflector sheave support and mounting bolts for rust, corrosion and tightness.		X	X	X
Lubricate lower deflector sheave bushings.	X	X	X	X
Lubricate upper deflector sheave bushings.	X	X	X	X
Inspect upper swivel and snatch block for rust and corrosion.		X	X	X
Inspect upper swivel and snatch block for freedom of movement.		X	X	X
Lubricate upper snatch block sheave bushings.	X	X	X	X
Lubricate upper snatch block swivel bushings.	X	X	X	X
Inspect guide rails for straightness and any damaged areas.		X	X	X
Lubricate guide rails.		X	X	X
Inspect guide brackets and fasteners for any damage.		X	X	X
Inspect counterweight box for corrosion or damage.		X	X	X

## MECHANICAL LUBRICATION LEGENDS

LUBRICATION FREQUENCY	
M	Monthly
Q	Quarterly
S	Semi-Annually
A	Annually

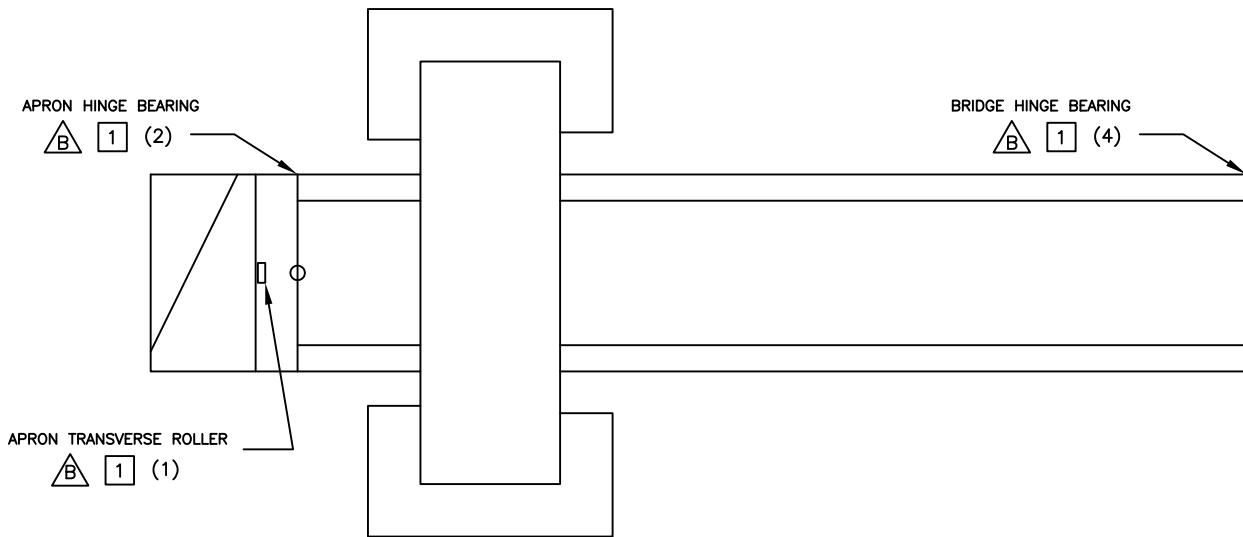
LUBRICATION TYPE	
A	Mobilux EP1
B	Mobilux EP2
C	Mobilgear SHC634
D	Mobiltac 275
E	Vitalife 400 or BioLube
F	Mobil DTE-26M
G	Light Oil (WD-40)

LUBRICATION TYPE	
◇	Oil Reservoir - Check Level and Fill as Required
○	Grease Gun - Remove Plug, Fill and Replace Plug
△	Grease Gun - Alemite Fitting
⬡	Brush or Swab
➔	Oil Can

**MECHANICAL LUBRICATION SCHEDULES**

Equipment	Locations	Frequency	Qty.	Type	Application
<b>BRIDGE HOIST MACHINERY</b>					
Motor (Reuland)	1	A		B	△
Right Angle Reducer (Hub City)	1	A	5 Pints	C	◇
Planetary Reducer (Brevini)	1	A		C	◇
Parallel Shaft Reducer (JERED)	1	A	35 Gal	C	◇
Parallel Shaft Reducer (JERED) -Hydraulic Pump	1	A		F	◇
Drum Shaft Bearings	2	M		B	△
Hoist Ropes	2	S		E	⊙
Upper Sheave Case	2	M		B	△
Lower Sheave Case	2	M		B	△
Link Bar Pins (Upper)	2	M		B	△
Link Bar Pins (Lower)	2	M		B	△
Turnbuckle Threads	2	Q		G	⇒
Bridge Hinge Bearing	2	M		B	△
<b>BRIDGE COUNTERWEIGHT MACHINERY</b>					
Sheave Shaft Bearings (Cooper)	2	M		B	△
Guide Rails	4	Q		D	⊙
Counterweight Ropes	2	S		E	⊙
Turnbuckle Threads	2	Q		G	⇒

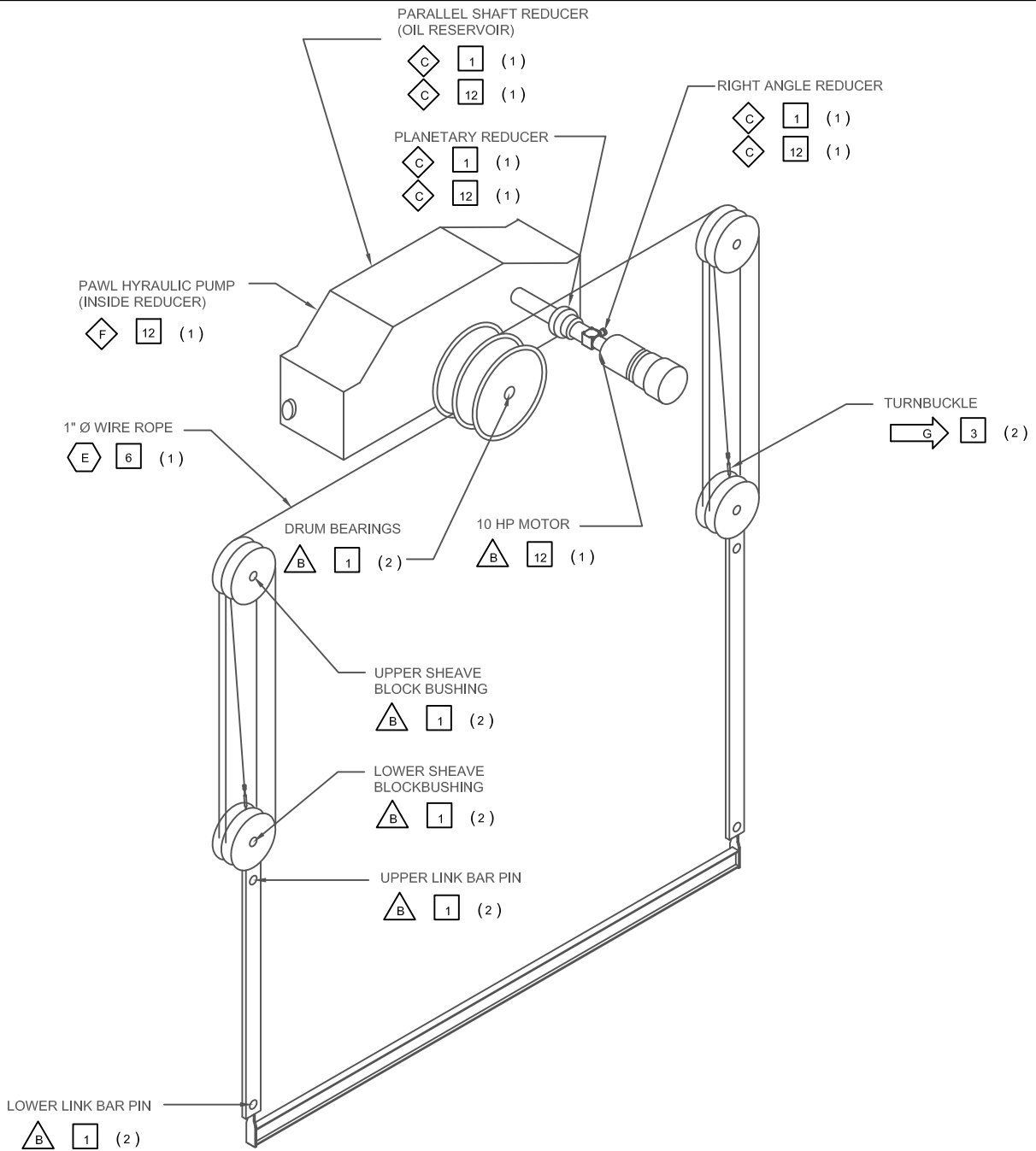
Equipment	Locations	Frequency	Qty.	Type	Application
<b>APRON HOIST MACHINERY</b>					
Pedestal Reducer (JERED)	1	Q		B	△
Disconnect Coupling	1	M		G	⇒
Motor (Reuland)	1	A		B	△
Worm Reducer (Cone)	1	A	2.3Gal	C	◇
Hoist Ropes	1	S		E	◻
Deflector Sheaves	5	M		B	△
Apron Hinge Bearings	2	M		B	△
Apron Transverse Roller	1	M		B	△
<b>APRON COUNTERWEIGHT MACHINERY</b>					
Snatch Block	2	M		B	△
Swivel	2	M		B	△
Deflector Sheaves (Upper)	2	M		B	△
Deflector Sheaves (Lower)	2	M		B	△
Guide Rails	4	Q		D	◻
Counterweight Ropes	2	S		E	◻



LUBRICATION LEGEND	
SYMBOL	APPLICATION
◇	OIL RESERVOIR— CHECK MONTHLY AND ADD OIL AS REQUIRED
○	GREASE GUN— REMOVE PLUG, FILL AND REPLACE PLUG
△	GREASE GUN—ALEMITE FITTING
⬡	BRUSH OR SWAB
➡	OIL CAN
□	SERVICE FREQUENCY IN MONTHS
( )	NUMBER OF SERVICE LOCATIONS

LUBRICANT LIST			
CODE	SPEC.	MFR.	LUBRICANT
A	NLGI #1	MOBIL	MOBILUX EP1
B	NLGI #2	MOBIL	MOBILUX EP2
C	ISO 460	MOBIL	MOBILSHC 634
D	ASTM D445	MOBIL	MOBILTAC 275
E	--	CROSBY	VITALIFE 400 OR BIOLUBE
F	--	MOBIL	DTE-26M
G	--	WD-40	Light Oil

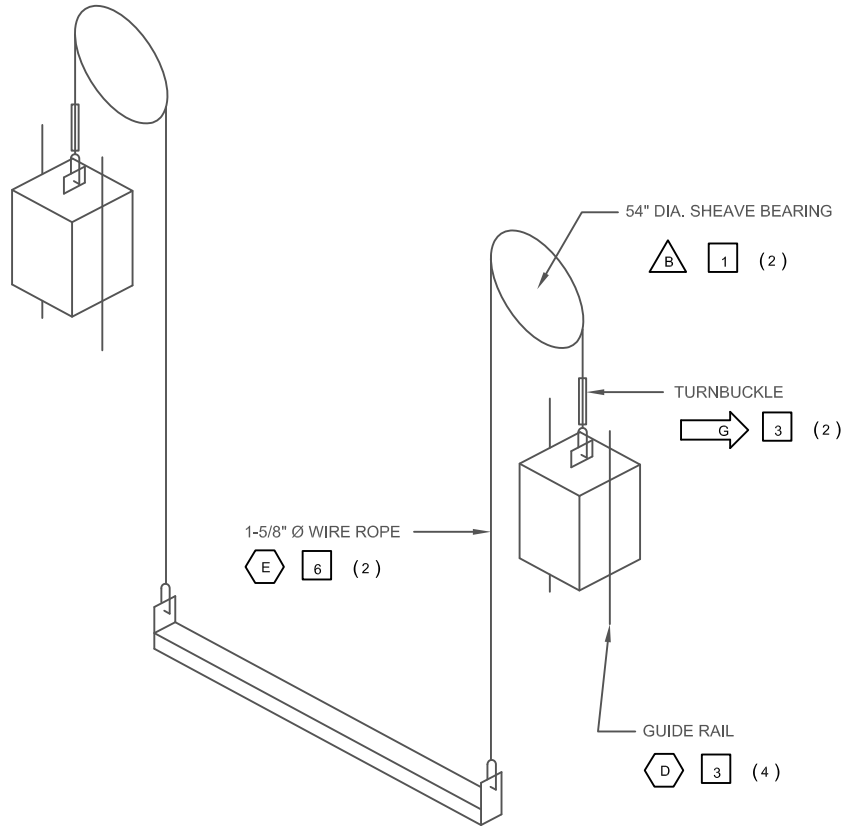
BRIDGE AND APRON LUBRICATION DIAGRAM



LUBRICATION LEGEND	
SYMBOL	APPLICATION
◇	OIL RESERVOIR- CHECK MONTHLY AND ADD OIL AS REQUIRED
○	GREASE GUN- REMOVE PLUG, FILL AND REPLACE PLUG
△	GREASE GUN-ALEMITE FITTING
⬡	BRUSH OR SWAB
→	OIL CAN
□	SERVICE FREQUENCY IN MONTHS
( )	NUMBER OF SERVICE LOCATIONS

LUBRICANT LIST			
CODE	SPEC.	MFR.	LUBRICANT
A	NLGI #1	MOBIL	MOBILUX EP1
B	NLGI #2	MOBIL	MOBILUX EP2
C	ISO 460	MOBIL	MOBILSHC 634
D	ASTM D445	MOBIL	MOBILTAC 275
E	--	CROSBY	VITALIFE 400 OR BIOLUBE
F	--	MOBIL	DTE-26M
G	--	WD-40	Light Oil

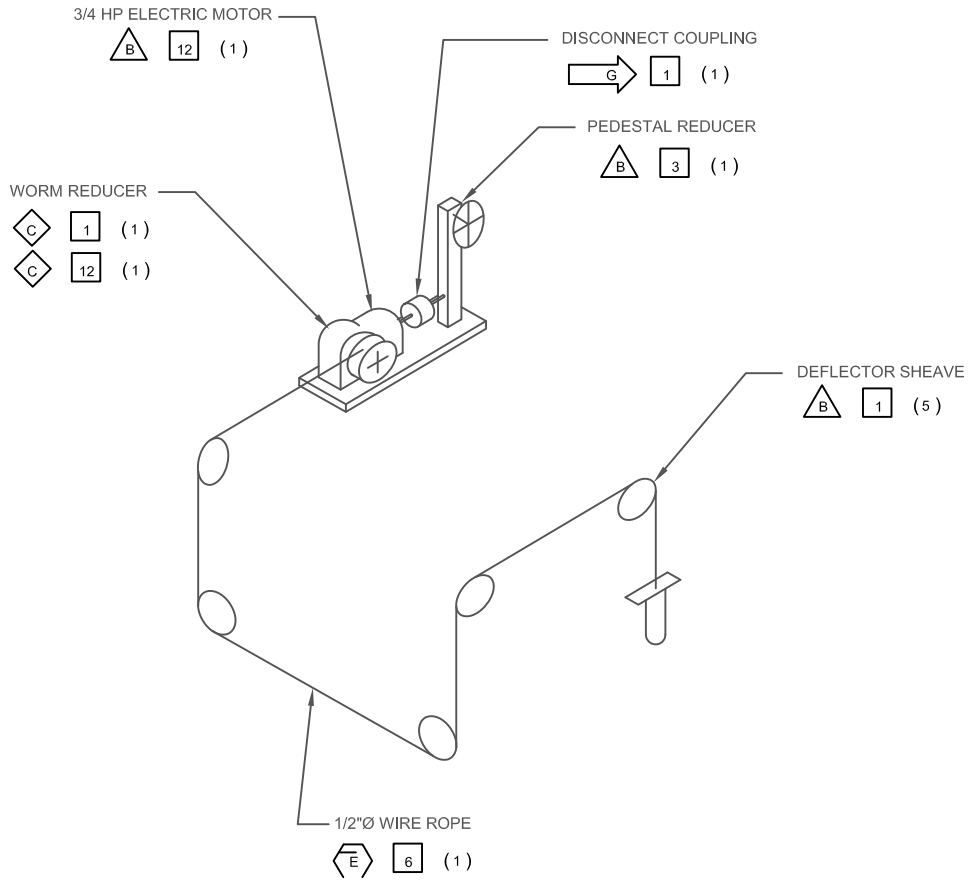
BRIDGE HOIST MACHINERY LUBRICATION DIAGRAM



LUBRICATION LEGEND	
SYMBOL	APPLICATION
◇	OIL RESERVOIR- CHECK MONTHLY AND ADD OIL AS REQUIRED
○	GREASE GUN- REMOVE PLUG, FILL AND REPLACE PLUG
△	GREASE GUN-ALEMITE FITTING
⬡	BRUSH OR SWAB
➡	OIL CAN
□	SERVICE FREQUENCY IN MONTHS
( )	NUMBER OF SERVICE LOCATIONS

LUBRICANT LIST			
CODE	SPEC.	MFR.	LUBRICANT
A	NLGI #1	MOBIL	MOBILUX EP1
B	NLGI #2	MOBIL	MOBILUX EP2
C	ISO 460	MOBIL	MOBILSHC 634
D	ASTM D445	MOBIL	MOBILTAC 275
E	-	CROSBY	VITALIFE 400 OR BIOLUBE
F	-	MOBIL	DTE-26M
G	-	WD-40	Light Oil

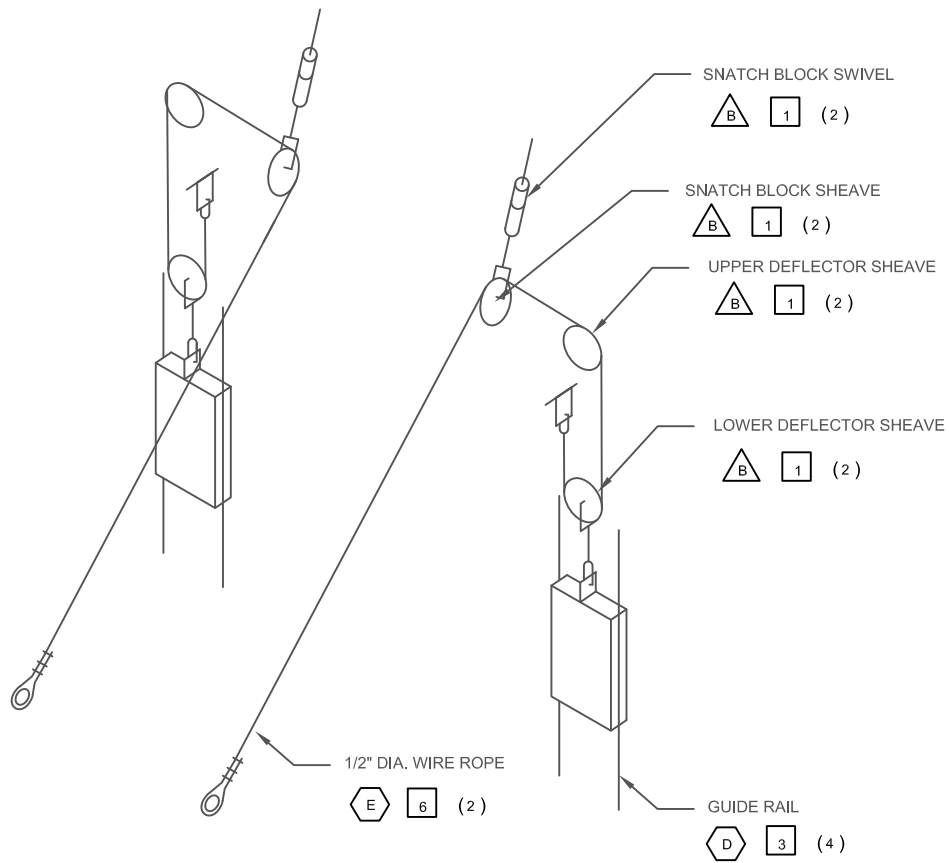
## BRIDGE COUNTERWEIGHT SYSTEM LUBRICATION DIAGRAM



LUBRICATION LEGEND	
SYMBOL	APPLICATION
$\diamond$	OIL RESERVOIR- CHECK MONTHLY AND ADD OIL AS REQUIRED
$\circ$	GREASE GUN- REMOVE PLUG, FILL AND REPLACE PLUG
$\triangle$	GREASE GUN-ALEMITE FITTING
$\hexagon$	BRUSH OR SWAB
$\rightarrow$	OIL CAN
$\square$	SERVICE FREQUENCY IN MONTHS
( )	NUMBER OF SERVICE LOCATIONS

LUBRICANT LIST			
CODE	SPEC.	MFR.	LUBRICANT
A	NLGI #1	MOBIL	MOBILUX EP1
B	NLGI #2	MOBIL	MOBILUX EP2
C	ISO 460	MOBIL	MOBILSHC 634
D	ASTM D445	MOBIL	MOBILTAC 275
E	--	CROSBY	VITALIFE 400 OR BIOLUBE
F	--	MOBIL	DTE-26M
G	--	WD-40	Light Oil

### APRON HOIST MACHINERY LUBRICATION DIAGRAM



LUBRICATION LEGEND	
SYMBOL	APPLICATION
◇	OIL RESERVOIR- CHECK MONTHLY AND ADD OIL AS REQUIRED
○	GREASE GUN- REMOVE PLUG, FILL AND REPLACE PLUG
△	GREASE GUN-ALEMITE FITTING
⬡	BRUSH OR SWAB
➡	OIL CAN
□	SERVICE FREQUENCY IN MONTHS
( )	NUMBER OF SERVICE LOCATIONS

LUBRICANT LIST			
CODE	SPEC.	MFR.	LUBRICANT
A	NLGI #1	MOBIL	MOBILUX EP1
B	NLGI #2	MOBIL	MOBILUX EP2
C	ISO 460	MOBIL	MOBILSHC 634
D	ASTM D445	MOBIL	MOBILTAC 275
E	--	CROSBY	VITALIFE 400 OR BIOLUBE
F	--	MOBIL	DTE-26M
G	--	WD-40	Light Oil

APRON COUNTERWEIGHT SYSTEM LUBRICATION DIAGRAM

### **2.2.3 Inspection and Maintenance Equipment**

The following equipment and tools need to be included as a kit for the inspection and maintenance of this bridge:

- Screw driver and wrench sets
- Flashlight
- Grease Gun
- Scraper (for grease removal)
- Feeler Gages
- Vernier Caliper

### **2.2.4 Inspection and Maintenance Procedures**

The following are the inspection and maintenance procedures for each machinery system. In the cases of complex equipment which have been provided with their own maintenance manuals, those manuals will be referred to.

#### **2.2.4.1 Bridge Hoist Machinery**

The major portion of the bridge hoist machinery is located on a platform above the roadway that spans between the counterweight towers. Manufacturers' maintenance manuals for this equipment are included for reference in Appendix 4.4.5.

The bridge hoist machinery is made up of the following components:

- Brake
- Motor
- Right angle reducer
- Planetary reducer
- Parallel shaft reducer
- Hoist drum
- Hoist Drum Shaft and Bearings
- Drive machinery support
- Operating ropes
- Deflector sheave assembly (upper)
- Deflector sheave assembly (lower)
- Link bar assemblies
- Handwheel (for manual operation)

#### *2.2.4.2 Bridge Counterweight System*

The bridge counterweight system is made up of two separate, identical systems, one located in each counterweight tower. Manufacturers' maintenance manuals for this equipment are included for reference in Appendix 4.4.5.

Each bridge counterweight system is made up of the following components:

- Bridge counterweight sheave
- Bridge counterweight sheave shaft and bearings
- Bridge counterweight sheave support and cover
- Bridge counterweight rope
- Bridge counterweight and balance plates
- Bridge counterweight guide rails
- Bridge counterweight support beam

#### *2.2.4.3 Apron Hoist Machinery*

The apron hoist machinery is located at the cantilevered end of the bridge, along the sides and below the roadway. Manufacturers' maintenance manuals for this equipment are included for reference in Appendix 4.4.5.

The apron hoist machinery is made up of the following components:

- Pedestal reducer
- Motorbrake
- Worm reducer
- Hoist drum
- Drive machinery support
- Operating rope
- Operating rope tensioner
- Deflector sheaves

#### *2.2.4.4 Apron Counterweight System*

The apron counterweight system is made up of two separate, identical systems, one located in each counterweight tower. Manufacturers' maintenance manuals for this equipment are included for reference in Appendix 4.4.5.

Each apron counterweight system is made up of the following components:

- Apron counterweight rope
- Apron deflector sheaves
- Apron counterweight rope swivel assembly

- Apron counterweight and balance plates
- Apron counterweight guide rails

### **2.2.5 Safety Precautions**

Tag out and lock out electrical equipment before attempting to work on associated mechanical items. Mechanical equipment should never be inspected or replaced without first disconnecting the electrical power for the machinery system.

The bridge and apron motors are provided with the ability to manually operate but are not provided with manual operation interlocks. This can cause serious injury if the system is manually operated during the inspection or maintenance procedure.

When all maintenance or repairs have been completed, replace all guards and covers over sheaves, gears, and other rotating machinery before reapplying power to the system(s).

All machinery components and fabricated equipment must be lubricated properly before operation, as per the manufacturer's requirements and the procedures of this manual.

Listen for and report any unusual sounds while equipment is operating. They could be a warning of equipment problems or failure.

Wear protective equipment to prevent damage to eyes, hearing, and hands when performing maintenance or repairs.

Use only tools, which are designed and defined as proper for any given task.

When lifting heavy objects without lifting equipment, use correct lifting techniques and wear a back brace.

When lifting heavy components or pieces of equipment, ensure that the lifting equipment is adequately rated for the weights involved.

Keep all work areas clean and clear of clutter that might cause an accident or damage to equipment.

Use cutting torches and other sources of fire carefully. Gears, wire ropes and other components have lubricants that burn readily.

Observe all safety instructions given in equipment supplier's instructions.

## **2.3 Electrical Maintenance**

### **2.3.1 Introduction**

#### *General Description*

The transfer bridge is a counterweighted bascule type operated by a hoist system. At the free end of the transfer bridge is an apron that rests on the ferry. The apron is operated by a separate winch system.

Individual brake-motors operate the hoist and winch for the bridge and apron, respectively. The bridge hoist is also provided with a pawl system to physically lock the bridge in position and prevent it from dropping if the brake should slip or with a live load on the bridge.

The motors are powered from across the line starters in a control panel on shore. The control system and interlocking are provided within the control panel also. The actuation of both the apron and bridge takes place from small control stations mounted to the handrail of the bridge and the tower in addition to a remote control carried on the ferry.

Utility power is provided as 480 VAC 3 phase. Standby power is available from a local generator.

In addition, the bridge, flood, walkway, ship and dolphin lighting is powered from the control panel, the lighting and auxiliary circuit breaker panel, and the astronomical timer.

### **2.3.2 Electrical Inspection and Maintenance Schedule**

The importance of regular preventive maintenance cannot be over-emphasized. In addition to regular maintenance, some of the equipment requires exercise to keep it in operating condition. Maintenance is performed best, not in response to equipment failure but when performed on a schedule. Table 2.3.2-1 lists the systems that require inspection and/or maintenance on a regular basis. Following this is the test equipment required, general inspection and maintenance procedures.

Perform a visual inspection of the electrical control equipment and associated components. Identify and record all deficiencies. Clean, remove, replace and secure equipment covers as required to perform the inspections. Inspect for damage to or deterioration of conduit, fittings and boxes. Record the date, time and any condition that may affect the inspection results at the time of testing.

The electrical equipment inspection includes a cursory examination for smooth operation, uniform and regular movement, proper and secured mounting, evidence of vibration or overheating, wear, cracking, rust, moisture, loose terminations, alignment, spring tension, evidence of arcing, dirt accumulation, grounding and bonding, safety interlocks, weather tightness and paint condition. Also perform insulation resistance and motor current draw testing.

Table 2.3.2-1 should be used to schedule regular maintenance.

**TABLE 2.3.2-1 ELECTRICAL INSPECTION AND MAINTENANCE SCHEDULE**

Equipment	Weekly	Monthly	Quarterly	Bi-Yearly	Yearly
Control Equipment			X		
Standby Generator		X			
Automatic Transfer Switch					X
Molded case circuit breakers - inspection					X
Molded case circuit breakers – trip test					Biennially
Breaker Panels					X
Flexible cables and conduit		X			
Bridge and Apron Hoist Motors				X	
Brakes and pawl operation				X	
Contactors and Overload Relays				X	
Control Relays and Timers				X	
Exterior lighting & photocells	X				
Transformers					X
Fuses					X
Limit Switches and actuators				X	
Motor Disconnects					X
Control Station Pilot Devices				X	
Bypass Switches				X	
Radio Control System		X			
Equipment Security				X	
Panel Heating			X		
Conduit and Wiring Systems				X	

Terminations				X	
Enclosures and Boxes					X
Control switches		X			
Pawl indication	X				
Receptacles				X	
Surge arrestors					X

*Monthly*

- Test operation
- Exercise all limit switches
- Check cabinets for moisture buildup

*Seasonally*

- See Annually below. Perform annual maintenance each year just before peak season.

*Annually*

- Test operation
- Motor and conductor insulation testing and charting
- Motor load current

**2.3.3 Inspection and Test Equipment**

The following equipment and tools need to be included as a kit for the inspection and maintenance of this bridge:

- Screw driver and wrench sets
- Flashlight
- Circuit tester
- VOM
- Recording VOM
- Clamp-on ammeter
- Megohm meter
- Receptacle tester including GFI trip test
- Electricians toolkit
- Battery load tester (Generator starting battery)
- Battery hydrometer

- Personal Protective Equipment

### ***2.3.4 Inspection and Maintenance Procedures***

The following are the inspection and maintenance procedures for each equipment group. In the cases of complex equipment which have been provided with their own maintenance manuals, those manuals will be referred to.

#### ***2.3.4.1 Control Equipment***

The major portion of the control equipment is located in and around the control panel at the abutment to the bridge approach. Manufacturers' maintenance manuals for this equipment are included for reference in the appendix.

The controls are made up of the following components:

- Standby Power Generator
- Automatic transfer switch
- Circuit breakers - 1, 2 and 3 pole 480 volt
- Starters
- Contactors
- Overload relays
- Time delay relays
- Astronomical Timers
- Photocells
- Power distribution blocks
- Grounding box, grounding bar and ground bonding
- Utility service disconnect
- Ship-Shore power disconnect

In addition, the system is provided with:

- Bridge fully raised and fully lowered limit switches
- Apron fully raised and fully lowered limit switches
- Pawl proximity switch
- Control stations with operator controls and emergency stop buttons
- Radio control transmitter and receiver
- Lighting and lighting control

***Warning! Disconnect power to all electrical and electromechanical equipment before servicing!***

### 2.3.4.2 Standby Generator

The Standby Generator is located in the generator building next to the ticket house at the top of the approach. Manufacturers' maintenance manuals for this equipment are included for reference in Appendix 4.5.3.

Because of the durability of diesel engines, most maintenance is preventive in nature. Preventive diesel engine maintenance consists of the following operations:

- General inspection
- Lubrication service
- Cooling system service
- Fuel system service
- Servicing and testing starting batteries
- Monthly engine exercise

It is a good idea to establish and adhere to a schedule of maintenance and service based on the specific power application and the severity of the environment. If the generator set will be used frequently or subjected to extreme operating conditions, the recommended service intervals should be reduced accordingly. Some of the factors that can affect the maintenance schedule include:

- Using the diesel generator set for continuous duty (primary power)
- Extreme ambient temperatures
- Exposure to weather
- Exposure to salt water
- Exposure to dust, sand or other airborne contaminants

In addition to time intervals, the best way to keep track of maintenance intervals is to use the running time meter on the generator set to keep an accurate log of all service performed.

## GENERATOR MAINTENANCE SCHEDULE

<i>Maintenance Item</i>	<i>Weekly</i>	<i>Monthly</i>	<i>Biannually</i>	<i>Yearly</i>	<i>Biennially</i>
Inspection	X				
Check coolant heater	X				
Check coolant level	X				
Check oil level	X				
Check fuel level	X				
Check/clean air cleaner		X			
Check battery charger		X			
Drain fuel filter		X			
Drain water from fuel tank		X			
Trim surrounding vegetation		X			
Check coolant concentration			X		
Check drive belt tension			X		
Drain exhaust condensate			X		
Check starting batteries			X		
Check and clean louvers			X		
Check batter charger				X	
Change oil and filter				X	
Clean crankcase breather				X	
Change air cleaner element				X	
Check radiator hoses				X	
Change fuel filter				X	
Clean cooling system					X

### *General Inspection*

**WARNING** - The engine generator may start automatically at any time. It is provided with a remote control in the automatic transfer switch. Prior to any work on this unit, turn off the automatic control.

When the generator set is running, maintenance personnel need to be alert for mechanical problems that could create unsafe or hazardous conditions. Following are several areas that should be inspected frequently to maintain safe and reliable operation.

### *Exhaust System*

With the generator set operating, inspect the entire exhaust system including the exhaust manifold, muffler and exhaust pipe. Check for leaks at all connections, welds, gaskets and joints, and make sure that the exhaust pipes are not heating surrounding areas excessively. Repair any leaks immediately. Verify that rain water cannot enter exhaust pipe.

### *Fuel System*

With the generator set operating, inspect the fuel supply lines, return lines, filters and fittings for cracks or abrasions. Make sure the lines are not rubbing against anything that could cause an eventual breakage. Repair any leaks or alter line routing to eliminate wear immediately.

### *DC Electrical System*

Check the terminals on the starting batteries for clean and tight connections. Loose or corroded connections create resistance which can hinder starting. Verify that the battery charger is fully functional.

### *Engine*

Monitor fluid levels, oil pressure and coolant temperatures frequently. Most engine problems give an early warning. Look and listen for changes in engine performance, sound, or appearance that will indicate that service or repair is needed. Be alert for misfires, vibration, excessive exhaust smoke, loss of power or increases in oil or fuel consumption.

### *Lubrication Service*

Check the engine oil level when the engine is shut down at the interval specified in the table. For accurate readings on the engine's dipstick, shut off the engine and wait approximately 10 minutes to allow the oil in the upper portions of the engine to drain back into the crankcase. Follow the engine manufacturer's recommendations for API oil classification and oil viscosity. Keep the oil level as near as possible to the "full" mark on the dipstick by adding the same quality and brand of oil.

Change the oil and filter at the intervals recommended in the table. Check with the engine manufacturer for procedures for draining the oil and replacing the oil filter. Used oil and filters must be disposed of properly to avoid environmental damage or liability.

### *Cooling System Service*

Check the coolant level during shutdown periods at the interval specified in the table. Use a coolant solution as recommended by the engine manufacturer.

Inspect the exterior of the radiator for obstructions and remove all dirt or foreign material. Use care to avoid damaging the radiator fins. If available, use low pressure compressed air or a stream of water in the opposite direction of normal air flow to clean the radiator. Check the operation of the coolant (core) heater by verifying that hot coolant is being discharged from the outlet hose.

### *Fuel System Service*

Diesel fuel is subject to contamination and deterioration over time, and one reason for regular generator set exercise is to use up stored fuel over the course of a year before it degrades. In addition to other fuel system service recommended by the engine manufacturer, the fuel filters should be drained at the interval indicated in the maintenance schedule. Water vapor accumulates and condenses in the fuel tank and must also be periodically drained from the tank along with any sediment present.

House exhaust and makeup air louvers are to be checked for any blockage from dirt or debris or insect nests. These must be completely cleared or the engine generator will be de-rated.

The engine air intake components should be checked at the interval indicated in the table. The frequency of cleaning or replacing air cleaner filter elements is primarily determined by the conditions in which the generator set operates. Air cleaners typically contain a paper cartridge filter element which can be cleaned and reused if not damaged.

### *Starting Batteries*

Weak or undercharged starting batteries are the most common cause of standby power system failures. Even when kept fully charged and maintained, lead-acid starting batteries are subject to deterioration over time and must be periodically replaced when they no longer hold a proper charge. Only a regular schedule of inspection and testing under load can prevent generator starting problems. See the manual for the recommended inspection interval for the batteries and charging system.

### *Testing Batteries*

Checking the output voltage of the batteries is not indicative of their ability to deliver adequate starting power. As batteries age, their internal resistance to

current flow goes up, and the only accurate measure of terminal voltage must be done under load. Use a manual battery load tester to verify the condition of each starting battery.

### *Cleaning Batteries*

Keep the batteries clean by wiping them with a damp cloth whenever dirt appears excessive. If corrosion is present around the terminals, remove the battery cables and wash the terminals with a solution of baking soda and water (1/4-pound baking soda to one quart of water). Be careful to prevent the solution from entering the battery cells, and flush the batteries with clean water when done. After replacing the connections, coat the terminals with a light application of petroleum jelly.

### *Checking Specific Gravity*

Use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell. A fully charged battery will have a specific gravity of 1.260. Charge the battery if the specific gravity reading is below 1.215.

### *Checking Electrolyte Level*

Check the level of the electrolyte in the batteries at least every 200 hours of operation. If low, fill the battery cells to the bottom of the filler neck with distilled water.

### *Generator Set Exercise*

Generator sets on standby must be able to go from a cold start to being fully operational in a matter of seconds. This can impose a severe burden on engine parts. However, regular exercising keeps engine parts lubricated, prevents oxidation of electrical contacts, uses up fuel before it deteriorates, and, in general, helps provide reliable engine starting. Exercise the generator set at least once a month for a minimum of 30 minutes loaded to the maximum extent possible. Operate the bridge hoist a number of times during that period to load the generator and help prevent wet stacking.

For additional technical support, please contact the local Caterpillar distributor. See generator manual on site for further information.

### *2.3.4.3 Automatic Transfer Switch*

The Automatic Transfer Switch is located on the equipment pad furthest from the ferry terminal. The manufacturers' maintenance manual for this equipment is included for reference in the appendix.

Reasonable care in preventive maintenance will ensure high reliability and long life for the ATS. An annual preventive maintenance program is recommended.

The following preventative maintenance should be performed quarterly:

- Clean the ATS enclosure: Brush and vacuum away any excessive dust accumulation. Remove any moisture with a clean cloth. A hair dryer may also help.
- Check the transfer switch contacts: Remove the transfer switch insulating contact covers and check contact condition. Replace the contacts if they become pitted or worn excessively. Reinstall the insulating contact covers carefully.
- Maintain transfer switch lubrication: Renew factory lubrication on all movements and linkages. Re-lubricate the solenoid operator if the transfer switch coil is replaced. Do not use oil; order manufacturer recommended lubrication kit.
- Check all cable connections & retighten them.
- Exercise the ATS monthly with the exercise of the generator.

#### *2.3.4.4 Breaker Panels and Molded Case Circuit Breakers*

Panelboards require inspection that includes removing the cover and breaker retention plate and checking that the breakers are properly seated and that the connections are tight. Also check for connection and conductor overheating and insect and rodent infestation and enclosure corrosion.

Manually actuate each breaker to assure mechanical operation.

In addition to manual operation, molded case breakers should be trip tested every other year. This will typically require hiring a testing company to perform the work with specialized equipment.

#### *2.3.4.5 Flexible Cables and Flexible Conduit*

The bridge is provided with several types of cables. These are exposed flexible cables not carried in any type of conduit or enclosed wireway. They are called droop, trail or festoon cables. Other flexible cables are conductors carried in flexible conduit.

The cables are to be inspected twice per year for jacket fatigue, especially at the minimum bend radius, and fittings, chafing, jacket and insulation hardening and connection condition. The connections must be tight and show no evidence of overheating or oxidation. Also examine flexible conduit for exterior jacket damage and deterioration and internal strength member distortion if possible.

Check the flexible conduit for damage to jacket or armor. Damaged armor, if not protruding through the jacket, will show distortion in the jacket.

Check that flexible cable basket grips are actually supporting the cables. They should not be loose at all on the cable. If it is not possible to get the grip to grab the cable, push the cable up into the grip to provide slack at the entry into the cabinet,

then add a stainless steel hose clamp at the end of the grip farthest from the fitting causing it to grip the cable.

#### *2.3.4.6 Apron and Bridge Hoist Motors*

The machinery is driven by one 10 HP 460 volt 3 phase bridge hoist winch motor and one 0.75 HP 460 volt 3 phase apron drive brake-motor. The NEMA Design letter of the motors are unknown and therefore are assumed to be design B.

The motors should be inspected yearly for bearing condition and lubrication, exterior paint condition, mountings and mounting hardware. The primary (stator) should be given an insulation resistance test and a log produced with that value to determine any deterioration trend in the insulation over time. In the case of low reading, the value must be above 1 megohm or the motor will need to be rehabilitated. In addition, the motor current draw should be recorded for full travel and in both directions for both the bridge and apron motors and compared to that of the previous inspections in order to determine changes in motor condition and also as an indication of change in bridge or apron balance or friction.

The hoist motor and brake are provided with 120 volt winding heaters. These heaters should be tested yearly by measuring the current to them. Note that opening the disconnect switch will not open the circuit to the motor heater nor to the thermal sensor therefore they remain live when the motor disconnect is opened (turned off) and present a shock hazard if working in the motor terminal box. Power for these items must be disconnected at breaker in the control panel before testing.

#### *2.3.4.7 Bridge and Apron Brakes*

Each motor is provided with a solenoid actuated brake. The bridge hoist motor brake is separately actuated while the apron motor brake is powered from the motor leads. It should be noted that the apron motor brake has been disabled. The brakes should be tested for current draw and insulation resistance. These values should be recorded for a year to year comparison. The brake covers should be removed once a year and the solenoid checked for freedom of movement and rust on the armature. Unless stated otherwise by the manufacturer, no lubricant should be used on the armature itself but light machine oil may be used on the remaining mechanism. Any collection of dirt or rust on the armature pole piece faces will cause the solenoid to draw more than design current and may cause it to overheat if not cleaned.

#### *2.3.4.8 Pawl Solenoid Actuated Valve*

The bridge is provided with a pawl system in order to guarantee that the bridge does not lower under gravity and load as it would be if it was only held by the solenoid brake.

The pawl is driven by a hydraulic oil pump and controlled by a solenoid valve. The pump is powered by 120 volts from the RLP and is provided with its own overload relay. The solenoid valve is separately controlled. Energizing the valve withdraws the pawl. De-energizing engages the pawl.

A proximity switch senses the position of the pawl, engaged or disengaged, and is used to drive a white pawl engaged status light.

The hoist hydraulics are provided with a 120VAC heater with thermostat. The heater current should be checked during an inspection.

#### *2.3.4.9 Relays, Contactors, Time Delay Relays and Time Clocks*

Relays, contactors, time delay relays and time clocks should be cleaned by vacuuming. Dirt in the pole pieces can cause the relay coil to burn out prematurely. Compressed air should not be used as it can drive dirt into components. They should be watched in operation for smooth and secure operation and no humming. If possible, contacts should be viewed for possible wear and burning or at least evidence of arcing. The mounting should be checked for security and all terminals checked for tightness. Conductors near the terminations should be checked for evidence of overheating.

The period of operation of timing devices should be checked for accuracy. Time clocks should also be checked for total setting.

#### *2.3.4.10 Enclosures and Boxes*

Inspect enclosures and boxes annually. Inspect boxes for cracks, corrosion, deterioration and damage. Inspect conduit fittings for corrosion and deterioration. Note the condition of paint if applicable. Note condition of covers, hinges and screws and replace if necessary. Assure all boxes are completely closed and secured.

### **2.3.5 Safety Precautions**

Electrical equipment should never be inspected or replaced without first disconnecting the power at the branch circuit disconnecting switch for that device if not also upstream of the device. Also, the bridge and apron motors are provided with the ability to be manually operated. Serious injury can result if the motor energizes while being manually operated and so the local disconnect must be opened (turned off) during manual operation.

### **2.3.6 Maintenance Procedure for Lockout/Tagout System**

#### *2.3.6.1 Overview*

Lockout-tagout (LOTO) or lock and tag is a safety procedure to ensure that dangerous equipment is properly unpowered and not started up again prior to the completion of maintenance or servicing work. "Lock and tag" works in conjunction with a lock and lockbox usually locking the power source disconnect handle, and placing it in such a position that no hazardous power sources can be turned on. The procedure also requires that a tag be affixed to the locked device indicating that it should not be turned on without permission.

The responsibility for seeing that this procedure is followed is binding upon all employees. All employees shall be instructed in the safety significance of the lockout

procedure by (designated individual). Each new or transferred affected employee shall be instructed by (designated individuals) in the purpose and use of the lockout procedure.

Employees authorized to perform lockout shall be certain as to which switch, valve, or other energy isolating devices apply to the equipment being locked out. More than one energy source (electrical, mechanical, or others) may be involved. Any questionable identification of sources shall be cleared by the employees with their supervisors. Before lockout commences, job authorization should be obtained.

## Control of Hazardous Energy Lockout/Tagout

OSHA 3120  
2002 (Revised)

### *2.3.6.2 Sequence of Lockout Procedure*

Notify all affected employees that a lockout is required and the reasons. If the equipment is operating, shut it down by the normal stopping procedure. Operate the switches or other energy isolating devices so that the energy source(s) (electrical, mechanical, hydraulic, and other) is disconnected or isolated from the equipment. Lock out energy isolating devices with an assigned individual lock. Lock out the generator engine starting control or disconnect the starting battery when working on the generator or on equipment that may be energized should the generator turn on. After ensuring that no personnel are exposed and as a check on having disconnected the energy sources, lock out all emergency stop buttons. The equipment is now locked out.

### *2.3.6.3 Restoring Equipment to Service*

When the work is complete and equipment is ready for testing or normal service, check the equipment area to see that no one is exposed. When equipment is clear, remove all locks. The energy isolating devices may be operated to restore energy to equipment.

### *2.3.6.4 Procedure Involving Multiple Persons*

In the preceding steps, if more than one individual is required to lock out equipment, each shall place his/her own personal lock on the energy isolating device(s). One designated individual of a work crew or a supervisor, with the knowledge of the crew, may lock out equipment for the whole crew. In such cases, it may be the responsibility of the individual to carry out all steps of the lockout procedure and inform the crew when it is safe to work on the equipment. Additionally, the designated individual shall not remove a crew lock until it has been verified that all individuals are clear.

### *2.3.6.5 Rules for Using Lockout Procedure*

All equipment shall be locked out to protect against accidental or inadvertent operation when such operation could cause injury to personnel. Do not attempt to operate any switch, or other energy isolating device bearing a lock.

---

## Section 3: Troubleshooting

### 3.1 General Troubleshooting Precautions

**WARNING:** Contacting high voltage components can result in severe personal injury or death. Keep all doors closed and covers in place during troubleshooting, except for those involved in the work.

Don't let familiarity create a careless attitude toward safety. Do not assume that a circuit is deenergized before beginning work. First use a non-contact voltage detector to check for energized circuits. If voltage is detected, deenergize. If not detected, use a digital VOM to contact and check actual circuits as the non-contact unit should be used to just to scan for live circuits and not to determine if a circuit is not live. Consider all voltages to be dangerous. Always follow lockout/tagout procedures.

Always work with a partner and wear personnel protection equipment (PPE), including safety shoes, hard hat, goggles, voltage rated gloves and reflective vest if outdoors. Never leave open enclosures unattended. Keep all unauthorized persons from the active work area. Provide barriers and warning signs.

Upon completion of the work, always apply proper latching and clamping to enclosure covers and doors to prevent water entry. Always check that heating, if present, is available and that breathers and drains are not clogged. Always lock or padlock enclosures to assure protection from vandalism.

### 3.2 Troubleshooting Precautions Related to Generator

Although the bridge may not be running during servicing, 480 volt power is available. It should be noted that the generator may kick on unexpectedly due the action of the automatic transfer switch and because of this the automatic starting of the generator may need to be inhibited during troubleshooting.

**WARNING:** In the generator housing, ignition of explosive battery gasses can cause severe personal injury or death. Arcing at the battery terminals, light switch or other equipment, flame, pilot lights and sparks can ignite battery gas. Do not smoke, or switch trouble light ON or OFF near battery. Discharge static electricity from body before touching batteries by first touching a grounded metal surface. Ventilate battery area before working on or near battery – Wear goggles – Stop genset and disconnect charger before disconnecting battery cables – Disconnect negative (-) cable first and reconnect last.

**WARNING:** Accidental starting of the generator set can cause severe personal injury or death. Prevent accidental starting by disconnecting the negative (-) cable from the battery terminal.

When troubleshooting the generator when it is shut down, make certain the generator set cannot be accidentally re-started as follows:

Check the following on these generators:

1. Move the RUN/OFF-RESET/AUTO switch on the control panel to the OFF position.
2. Turn off or remove AC power from the battery charger.
3. Remove the negative (-) battery cable from the generator set starting battery.

### **3.2.1 Generator Status Indicators**

(See Operators Manual on site)

### 3.3 Troubleshooting Tables

The mechanical systems and electrical systems troubleshooting tables in this section were developed to assist with finding the source of a problem and effecting a repair. Note that maintenance personnel must be thoroughly familiar with the entire mechanical and electrical system before attempting to trace and repair a problem.

The electrical systems troubleshooting tables in this section assume that all wire connections are tight. Control Power available is indicated by the CONTROL POWER ON indicating light at the top of the control panel. This also assumes that the E-Stop buttons have not been activated. In general the electrical systems troubleshooting tables assume that the control power is available.

**TROUBLESHOOTING TABLE - MECHANICAL OPERATION & EQUIPMENT**

<b>Problem</b>	<b>Possible Cause</b>	<b>Corrective Action</b>
<b>Apron will not raise</b>	Brake will not release	There is no manual release incorporated into the brake. Back cover will need to be removed and some method employed to manually release brake. <b>WARNING: Be careful of electrical hazards and unexpected operation of motor shaft.</b>
	Wire rope is broken	Replace wire rope
	Apron out of balance	Apron heavy, check for significant sized objects on movable portion of apron and remove if safe to do so.
	Deflector sheaves do not rotate freely	Inspect deflector sheaves and remove any foreign objects.
	Deflector sheaves do not rotate freely	Lubricate deflector sheave bearings.
	Foreign objects caught in counterweight guides	Inspect counterweight guides and remove any foreign objects.
	Foreign object caught in apron hinge	Inspect the apron hinge for the source of interference and remove any foreign material.
	Deflector sheave bearing is seized	Verify that deflector sheaves busings are free of contaminants and are adequately lubricated.
	Counterweight sheave bearing is seized	Verify that counterweight sheave busings are free of contaminants and are adequately lubricated.
	Gearbox failure	Replace failed component or entire gearbox.
	Apron is already at fully raised position	Visually verify that apron is fully raised, then lower apron if safe to do so.
<b>Apron will not lower</b>	Brakes will not release	There is no manual release incorporated into the brake. Back cover will need to be removed and some method employed to manually release brake. <b>WARNING: Be careful of electrical hazards and unexpected operation of motor shaft.</b>
	Wire rope is broken	Replace wire rope.

**TROUBLESHOOTING TABLE - MECHANICAL OPERATION & EQUIPMENT**

<b>Problem</b>	<b>Possible Cause</b>	<b>Corrective Action</b>
<b>Apron will not lower (Continued)</b>	Counterweights out of balance	Check for large objects on counterweights, removes item if safe to do so.
	Deflector sheaves do not rotate freely.	Inspect deflector sheaves and remove any foreign objects.
		Lubricate deflector sheave bearings.
	Foreign objects caught in counterweight guides	Inspect counterweight guides and remove any foreign objects.
	Foreign object caught in apron hinge	Inspect the apron hinge for the source of interference and remove any foreign material.
	Deflector sheave bearing is seized	Verify that deflector sheavs busings are free of contaminants and are adequately lubricated.
	Counterweight sheave bearing is seized	Verify that counterweight sheave busings are free of contaminants and are adequately lubricated.
	Gearbox failure	Replace failed component or entire gearbox.
Apron is already at fully raised position	Visually verify that apron is fully raised., then lower apron if safe to do so.	
<b>Apron will not rotate in horizontal plane</b>	Apron pivot corroded.	Clean pivot and lubricate.
<b>Transfer bridge will not raise</b>	Brakes will not release	Manually release brake by pulling handle knob on end of brake.
	Wire rope is broken	Replace wire rope.
	Bridge out of balance	Bridge heavy, check for significant sized objects on movable portion of bridge.
	Foreign objects caught in counterweight guides	Inspect counterweight guides and remove any foreign objects.
	Binding at joint between bridge and approach due to excessive thermal expansion	Wait for the temperature of bridge to decrease sufficiently and then eliminate interference.
	Foreign object caught in the joint between bridge and approach	Inspect the joint, locate the source of interference and remove any foreign material.

**TROUBLESHOOTING TABLE - MECHANICAL OPERATION & EQUIPMENT**

<b>Problem</b>	<b>Possible Cause</b>	<b>Corrective Action</b>
<b>Transfer bridge will not raise (Continued)</b>	Deflector sheave bearing is seized	Verify that deflector sheavs busings are free of contaminants and are adequately lubricated.
	Bridge hinge bearing is seized	Verify that hinge busings are free of contaminants and are adequately lubricated.
	Drum bearing is seized	Verify that drum busings are free of contaminants and are adequately lubricated.
	Counterweight sheave bearing is seized	Verify that counterweight sheave busings are free of contaminants and are adequately lubricated.
	Gearbox failure	Replace failed component or entire gearbox.
	Bridge is already at fully raised position	Visually verify that apron is fully raised, then lower bridge if safe to do so.
<b>Transfer bridge will not lower</b>	Brakes will not release	Manually release brake by pulling handle knob on end of brake.
	Pawl is still engaged	Retract pawl by turning bolt clockwise on side of parallel shaft reducer.
	Wire rope is broken	Replace wire rope.
	Counterweights out of balance	Check for large objects on counterweights, removes item if safe to do so.
	Foreign objects beneath bridge	Inspect below bridge and remove any foreign objects.
	Foreign objects caught in counterweight guides	Inspect counterweight guides and remove any foreign objects.
	Binding at joint between bridge and approach due to excessive thermal expansion	Wait for the temperature of bride to decrease sufficiently and then eliminate interference.
	Foreign object caught in the joint between bridge and approach	Inspect the joint, locate the source of interference and remove any foreign material.
	Deflector sheave bearing is seized	Verify that deflector sheavs busings are free of contaminants and are adequately lubricated.

**TROUBLESHOOTING TABLE - MECHANICAL OPERATION & EQUIPMENT**

<b>Problem</b>	<b>Possible Cause</b>	<b>Corrective Action</b>
<b>Transfer bridge will not lower (Continued)</b>	Bridge hinge bearing is seized	Verify that hinge busings are free of contaminants and are adequately lubricated.
	Drum bearing is seized	Verify that drum busings are free of contaminants and are adequately lubricated.
	Counterweight sheave bearing is seized	Verify that counterweight sheave busings are free of contaminants and are adequately lubricated.
	Gearbox failure	Replace failed component or entire gearbox.
	Bridge is already at fully raised position	Visually verify that apron is fully raised, then lower bridge if safe to do so.
<b>Brake is overheating or noisy</b>	Disc pack is dragging	Inspect endplate, hub and discs for dirt, burrs, wiring and other sources of interference preventing disc "float".
	Friction disc excessively worn (disc can wear to 1/2 original thickness)	Replace friction discs.
	Endplate, stationary disc or pressure plate warped	Replace warped or worn component.
<b>Reducer is overheating or noisy</b>	Insufficient amount of oil	Fill with clean oil to proper level.
	Wrong type of oil causing breakdown of lubricant	Drain, flush and fill with proper type of oil.
	Bearings are damaged	Consult a qualified technician for repair.
	Loose or foreign object inside of housing	Open inspection cover and look for loose, broken or foreign object, the remove/repair as necessary.
<b>Bearing is overheating or noisy</b>	Insufficient amount of grease	Pump in additional grease.
	Housing over packed with grease	Bearing will purge excess grease during operation.
	Wrong type of grease causing breakdown of lubricant	Flush and pump in proper type of lubricant.
	Grease passage blocked	Inspect and clean grease ports and fittings, then pump in clean grease.

**TROUBLESHOOTING TABLE - MECHANICAL OPERATION & EQUIPMENT**

<b>Problem</b>	<b>Possible Cause</b>	<b>Corrective Action</b>
<b>Bearing is overheating or noisy (Continued)</b>	Foreign matter or corrosive agent entering bearing	Flush and purge contaminants out, pPump in clean grease.
	Bearing has failed	Replace bearing in-kind.
	Sheave is not rotating at proper speed or is frozen	Inspect snatch blocks for foreign objects or other interferences and remove the interference.
	Also see Bearing "Possible Causes"	Also see Bearing "Corrective Action".
<b>Wire rope is wearing on sides</b>	Sheave groove is worn	Measure groove radius. Replace sheave as required.
<b>Wire rope is not staying in drum groove</b>	Wire rope is misaligned	Check fleet angle of rope and compare to expected fleet angle. Adjust/realign mislocated component as necessary.
<b>Bridge handwheel does not operate machinery</b>	Handwheel will not slide onto right angle reducer input shaft	Wire brush clean reducer shaft and bore of handwheel. Apply lubricant (WD-40) to facilitate installation if needed.
	Handwheel rotates but does not turn input shaft of reducer	Verify that key has been inserted and secured in keyway.
<b>Apron handwheel does not operate machinery</b>	Handwheel will not slide onto right angle reducer input shaft	Wire brush clean reducer shaft and bore of handwheel. Apply lubricant (WD-40) to facilitate installation if needed.
	Handwheel rotates but does not turn input shaft of reducer	Verify that key has been inserted and secured in keyway.
	Handwheel rotates but does not turn input shaft of reducer	Verify that slide coupling is in engaged position.

**TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT**

<b>Problem</b>	<b>Possible Cause</b>	<b>Action</b>
<b>Apron will not raise</b>	Fully raised limit switch tripped or seized	Apron already in the fully raised position or the fully raised limit switch seized in the actuated position. Exercise limit switch if required.
	Tripped overload relay	Reset the overload on DA/UA. If the overload trips again on the next operation, see mechanical binding below, motor winding issue, megger motor windings to check for ground fault. Continuity check motor windings to check for open winding. Check power on load side of overload for single phasing.
	Mechanical binding	Check for binding in the apron machinery and the motor gear reducer.
	Circuit breaker tripped (480V power loss)	Circuit breaker CB-4 tripped. Also check for short in wiring, ground fault in motor and wiring and single phasing of motor. Also check status of CB-M and Disconnect Means #2. Check that ATS (automatic transfer switch) is in normal position with normal power available, or is in emergency position with generator running.
	Contactors or relay coil burned out (UA and Apron Relay)	Check coil continuity. Check applied coil voltage while attempting to operate.

**TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT**

Problem	Possible Cause	Action
	Control switch or control switch wiring failed	Check action of apron control switches at the control stations on the bridge and platform. Check available voltage at control switches.
	Motor disconnect open (off)	Check disconnect in proximity of the motor that its door is closed and secured and the operating handle is on the closed or ON position.
	Control Power Loss	Check if control power is available. Check control power breakers CB-1 and Main Breaker in RLP. If the platform control station functions, but the bridge control station and radio control fail to function, check if safety lockout switch S-1 in control panel is closed.
	Apron operates from control station but not from radio transmitter	Check that the E-stop on transmitter is not depressed. Check batteries in transmitter and verify that receiver is powered and functions properly.
<b>Apron will not lower</b>	Fully lowered limit switch tripped or seized	Apron already in the fully lowered position or the fully lowered limit switch seized in the actuated position. Exercise limit switch if required.

**TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT**

Problem	Possible Cause	Action
	Tripped overload relay	Reset the overload on DA/UA. If the overload trips again on the next operation, see mechanical binding below, motor winding issue, megger motor windings to check for ground fault. Continuity check motor windings to check for open winding. Check power on load side of overload for single phasing.
	Mechanical binding	Check for binding in the apron machinery and the motor gear reducer.
	Circuit breaker tripped (480V power loss)	Circuit breaker CB-4 tripped. Also check for short in wiring, ground fault in motor and wiring and single phasing of motor. Also check status of CB-M and Disconnect Means #2. Check that ATS (automatic transfer switch) is in normal position with normal power available, or is in emergency position with generator running.
	Contactor or relay coil burned out (DA and Apron Relay)	Check coil continuity. Check applied coil voltage while attempting to operate.
	Control switch or control switch wiring failed	Check action of apron control switches at the control stations on the bridge and platform. Check available voltage at control switches.

**TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT**

Problem	Possible Cause	Action
	Motor disconnect open (off)	Check disconnect in proximity of the motor that its door is closed and secured and the operating handle is on the closed or ON position.
	Control Power Loss	Check if control power is available. Check control power breakers CB-1 and Main Breaker in RLP. If the platform control station functions, but the bridge control station and radio control fail to function, check if safety lockout switch S-1 in control panel is closed.
	Apron operates from control station but not from radio transmitter	Check that E-stop on transmitter is not depressed. Check batteries in transmitter and verify that receiver is powered and functions properly.
<b>Transfer bridge will not raise</b>	Fully raised limit switch tripped or seized	Bridge already in the fully raised position or the fully raised limit switch seized in the actuated position. If the switch cannot be accessed or reset, actuate the FULLY RAISED LIMIT SWITCH BYPASS (S-3) switch in the control panel. If the bridge becomes functional, check limit switch and wiring.

**TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT**

Problem	Possible Cause	Action
	Tripped overload relay	Reset the overload on DB/UB. If the overload trips again on the next operation, see mechanical binding below, motor winding issue, check megger motor windings to check for ground fault. Continuity check motor windings to check for open winding. Check power on load side of overload for single phasing.
	Mechanical binding	Check for binding in the bridge machinery and the motor gear reducer.
	Circuit breaker tripped (480V power loss)	Circuit breaker CB-5 tripped. Also check for short in wiring, ground fault in motor and wiring and single phasing of motor. Also check status of CB-M and Disconnect Means #2. Check that ATS (automatic transfer switch) is in normal position with normal power available, or is in emergency position with generator running.
	Contactor or relay coil burned out (UB and BU interposing relay)	Check coil continuity. Check applied coil voltage while attempting to operate.
	Control switch or control switch wiring failed	Check action of control switches in bridge and platform control stations. Check available voltage at control switches.

**TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT**

Problem	Possible Cause	Action
	Brake failed to release	Check that the brake fully releases. Test brake coil for continuity. Check that solenoid is not seized.
	Motor disconnect open (off)	Check disconnect in proximity of the motor that its door is closed and secured and the operating handle is on the closed or ON position.
	Control Power Loss	Check control power is available. Check control power breakers CB-1 and Main Breaker in RLP. If the platform control station functions, but the bridge control station and radio control fail to function, check safety lockout switch S-1 in control panel is closed.
	Bridge operates from control station but not from radio transmitter	Check that the E-stop on transmitter is not depressed. Check batteries in transmitter and verify that receiver is powered and functions properly.
	Motor internal thermal tripped	Motor continuously operating, jammed machinery. Excessive duty cycle. Allow motor to cool for 30 minutes and attempt restart.

**TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT**

Problem	Possible Cause	Action
<p><b>Transfer bridge will not lower</b></p>	<p>Fully lowered limit switch tripped or seized</p>	<p>Bridge already in the fully lowered position or the fully lowered limit switch seized in the actuated position. If the switch cannot be accessed or reset, actuate the S4 bridge fully lowered bypass switch in the control panel. If bridge becomes functional, check limit switch and wiring.</p>
	<p>Tripped overload relay</p>	<p>Reset the overload on DB/UB. If the overload trips again on the next operation, see mechanical binding below, motor winding issue, check megger motor windings to check for ground fault. Continuity check motor windings to check for open winding. Check power on load side of overload for single phasing.</p>
	<p>Mechanical binding</p>	<p>Check for binding in the bridge machinery and the motor gear reducer.</p>
	<p>Circuit breaker tripped (480V power loss)</p>	<p>Circuit breaker CB-5 tripped. Also check for short in wiring, ground fault in motor and wiring and single phasing of motor. Also check status of CB-M and Disconnect Means #2. Check that ATS (automatic transfer switch) is in normal position with normal power available, or is in emergency position with generator running.</p>

**TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT**

Problem	Possible Cause	Action
	Contactor or relay coil burned out (DB and BD interposing relay)	Check coil continuity. Check applied coil voltage while attempting to operate.
	Control switch or control switch wiring failed	Check action of control switches in bridge and platform control stations. Check available voltage at control switches.
	Bridge down delay timer failed	Apply jumper across timer terminals, several seconds after selecting bridge lower to allow pawl to be withdrawn.
	Pawl failed to release as indicated by white pawl indicating light	Check hydraulic pump motor wiring. Verify that brake contactor "BRIDGE CONTACTOR U&D" has been energized and is applying power to motor. Check power at load side of CB-1 in the RLP, at load side of the Main Breaker, at load side of Panelboard RLP Circuit Breaker CB-1 in the control panel, and status of the ATS and generator.
	Brake failed to release	Check that the brake fully releases. Test brake coil for continuity. Check that solenoid is not seized.
	Motor disconnect open (off)	Check disconnect in proximity of the motor that its door is closed and secured and the operating handle is on the closed or ON position.

**TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT**

Problem	Possible Cause	Action
	Control Power Loss	Check control power is available. Check control power breakers CB-1 and Main Breaker in RLP. If the platform control station functions, but the bridge control station and radio control fail to function, check safety lockout switch S-1 in control panel is closed.
	Bridge operates from control station but not from radio transmitter	Check that E-stop on transmitter is not depressed. Check batteries in transmitter and verify that receiver is powered and functions properly.
	Motor internal thermal tripped	Motor continuously operating, jammed machinery. Excessive duty cycle. Allow motor to cool for 30 minutes and attempt restart.

**TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT**

Problem	Possible Cause	Action
<p><b>Bridge motor circuit breaker trips</b></p>	<p>Short circuit in motor</p>	<p>Open (turn off) motor disconnect switch. Check line to line resistance of the motor at the disconnect switch. It should indicate continuity with a very small value. Special equipment would be needed to read the actual value but only continuity is needed here. Check line to ground resistance using a megohm meter and assure that the value compares to that of the previous reading and is at least 1 megohm. If these values are good, check flexible cables for damage, and insulation resistance and interior of flexible cable junction boxes for moisture. Check bridge flexible conduit for damage and conductors within for insulation resistance.</p>
	<p>Water in motor</p>	<p>Open conduit box and examine for water or moisture. It may necessary to unmount motor and inspect the interior for water or moisture. If no moisture is found but motor insulation resistance is below 1 megohm, replace and/or send to shop for rehabilitation.</p>

**TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT**

Problem	Possible Cause	Action
<p><b>Apron motor circuit breaker trips</b></p>	<p>Short circuit in motor</p>	<p>Open (turn off) motor disconnect switch. Check line to line resistance of the motor at the disconnect switch. It should indicate continuity with a very small value. Special equipment would be needed to read the actual value but only continuity is needed here. Note that the brake windings are connected to two of the motor windings. Check line to ground resistance using a megohm meter and assure that the value compares to that of the previous reading and is at least 1 megohm. If these values are good, check flexible cables for damage, and insulation resistance and interior of flexible cable junction boxes for moisture. Check bridge flexible conduit for damage and conductors within for insulation resistance.</p>
	<p>Water in motor</p>	<p>Open conduit box and examine for water or moisture. Remove cover from brake and examine for water or moisture. It may necessary to unmount motor and inspect the interior for water or moisture. If no moisture is found but motor insulation resistance is below 1 megohm, replace and/or send to shop for rehabilitation.</p>

**TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT**

<b>Problem</b>	<b>Possible Cause</b>	<b>Action</b>
<b>Bridge hoist pump motor circuit breaker in RLP</b>	Short circuit in motor, motor starting capacitor or water or oil entry	Open (turn off) motor disconnect switch. Check line to line resistance of the motor at the disconnect switch. It should indicate continuity with a very small value. Special equipment would be needed to read the actual value but only continuity is needed here. Check line to ground resistance using a megohm meter and assure that the value compares to that of the previous reading and is at least 1 megohm. If these values are good, check flexible cables for damage, and insulation resistance and interior of flexible cable junction boxes for moisture. Check bridge flexible conduit for damage and conductors within for insulation resistance.
	Water or oil in motor	See hoist manufacturer's manual
<b>Bridge and/or apron cannot be controlled from the bridge control station</b>	Lockout switch S-1 open	Close switch S-1 when safe to do so.
<b>Bridge and/or apron cannot be controlled from the radio control system</b>	Lockout switch S-1 open	Close switch S-1 when safe to do so.

**TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT**

<b>Problem</b>	<b>Possible Cause</b>	<b>Action</b>
<b>Radio control will not operate the apron, or the bridge, or the ship/sign lights.</b>	Bad battery	Replace battery with unit as called out in the manual.
	Emergency stop depressed	Check if the emergency stop latching button is depressed and if so rotate to release.
	Radio receiver non-functional	Check radio receiver in cabinet in machinery platform by hoist.
	Radio control system locked out	Check that switch S-1 is in the normal position.
<b>White pawl globe light will not illuminate</b>	Bulb is burned out	Check and change bulb if necessary.
	Bad proximity switch	See hoist manufacturer's manual for testing and replacement of the proximity switch.
<b>No utility 480V power</b>	Control panel main breaker CB-M or Disconnect Means #2 open	Check voltage at circuit breakers CB-M and Disconnect Means #2 in the control panel. CB-M is provided with a 150 amp trip, and Disconnect Means #2 is provided with a 70 amp trip. Verify that the breakers are not tripped and that balanced three phase voltage is available. The voltage phase to phase should be between 440 and 490 volts.
<b>Generator does not start on power loss</b>	Generator not in Auto mode	Check that the switch on the control panel of the generator is in the AUTO position.

**TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT**

<b>Problem</b>	<b>Possible Cause</b>	<b>Action</b>
	Automatic Transfer Switch failure	On power loss, the transfer switch is provided with a contact which closes to start the generator. Check the Kohler automatic transfer switch manual for troubleshooting.
<b>Generator does not start by local means</b>	Generator does not start when the control switch is in the RUN position	Check fuel and battery. Otherwise, see generator troubleshooting in generator manual.
<b>Automatic Transfer Switch does not switch from Utility power to Generator power</b>	Generated power does not meet required power parameters programmed into the automatic transfer switch	See ATS manual
	ATS failure	See ATS manual (Note ATS may be switched manually with the manual actuation rod).
<b>Automatic Transfer Switch does not switch from Generator to Utility power</b>	Utility power does not meet required power parameters programmed into the automatic transfer switch	Check CB-M if tripped and check voltage at CB-M.
	ATS failure	See ATS manual (Note ATS may be switched manually with the manual actuation rod).
<b>Flood lights will not illuminate</b>	Bulb burned out	Check other floodlight for illumination.
	Contactors LC non-functional	Check contactor LC coil for continuity. Check power to LC coil.

**TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT**

<b>Problem</b>	<b>Possible Cause</b>	<b>Action</b>
	One or both safety interlock switches (E-Stop)depressed	Determine why the safety lockout switch(s) (E-Stop switches) is depressed and reset if appropriate. (Note that consideration should be given to moving the circuit to a point that is not affected by these switches.
	Control power failure	Check for 120 VAC at circuit breakers RLP ckt-1 and 2CB-M. Check CB-1 for 480V.
	Power failure to fixture	Check breaker RLP Circuit 10/12. Check fixture wiring.
<b>Walkway lights do not illuminate</b>	Bulb burned out	Check other walkway lights for illumination. If illuminated, change bulb. If all lights out, proceed to next step.
	Power failure to fixture	Check RLP ckt-14. Check astronomical timer TC in control panel. Check contact, motor and settings of timeclock TC. The clock circuit can be checked by jumping the timeclock contact. If jumpering turns on the light, check the operation of TC.
<b>Ship lights (platform tower lights) will not illuminate</b>	Bulb burned out	Check other ship light for illumination. If illuminated, change bulb.
	Failed lighting contactor	Operate S-6 bypass switch on the interior of the control cabinet. If the lights illuminate, check contactor RC. Check contacts and coil of RC contactor in the control cabinet for proper operation.

**TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT**

Problem	Possible Cause	Action
	Power failure to fixture	Check RLP ckt-10 and ckt-12 in the panelboard RLP.
	Failed remote control	Recheck operation from the remote control system. If it does not operate the lights, and the contactor is good, check the remote control transmitter and receiver. Check if transmitter operates the apron and bridge. If so, check radio receiver.
<b>Ship-Shore power unavailable</b>	No power available	Check that the Ship-Shore disconnect switch is closed (on). If the Ship-Shore circuit breaker near the control panel is tripped, reset once and test. If the breaker trips again, with the breaker off, test line to line and line to ground insulation resistance. A breaker is located within the receptacle housing. Test here also. Check the primary and secondary voltages at the transformer. Also verify that the ferry did not overload the system.

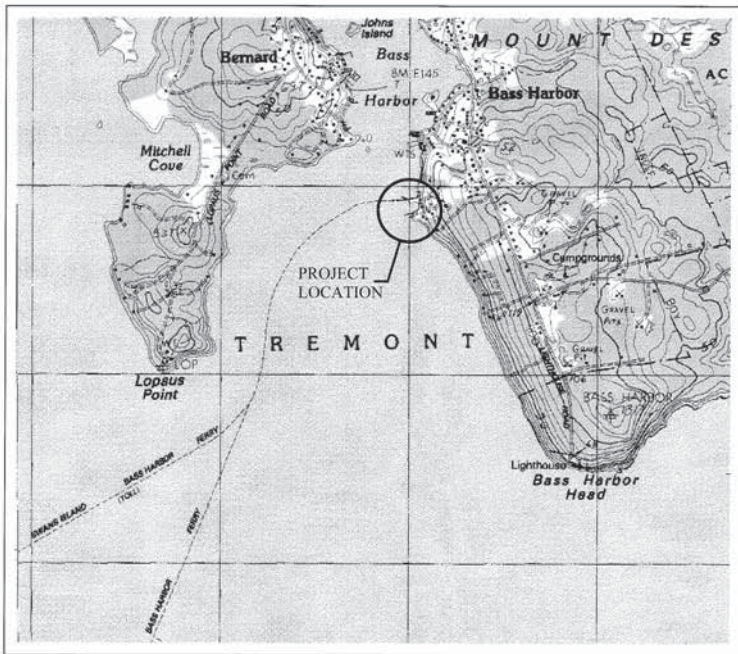
---

## **Section 4: Appendices**

## **APPENDIX 4.1—Ferry Terminal Plans 2010**

# STATE OF MAINE DEPARTMENT OF TRANSPORTATION BASS HARBOR FERRY TERMINAL

## PROJECT NO: PIN 017745.00



### INDEX OF SHEETS

SHEET No.	TITLE
X-01	TITLE SHEET
X-02	BASS HARBOR TERMINAL EXISTING LAYOUT PLAN
X-03	BASS HARBOR TERMINAL SOIL BORING/ROCK CORE DATA TABLES
X-04	BASS HARBOR TERMINAL PROPOSED LAYOUT PLAN
X-05	BASS HARBOR TERMINAL EXISTING DOLPHIN REINFORCING DETAILS
X-06	BASS HARBOR TERMINAL EXISTING FENDER FRAME ASSEMBLY
X-07	BASS HARBOR TERMINAL EXISTING FENDER FACING DETAILS
X-08	BASS HARBOR TERMINAL EXISTING FENDER ATTACHMENT DETAILS
X-09	BASS HARBOR TERMINAL PROPOSED HEAD DOLPHIN MODIFICATIONS AND DETAILS
X-10	BASS HARBOR TERMINAL PROPOSED SIDE AND TURNING DOLPHIN MODIFICATIONS AND DETAILS
X-11	BASS HARBOR TERMINAL TOWER FOUNDATION EXISTING CONDITIONS
X-12	BASS HARBOR TERMINAL TOWER FOUNDATION REPAIR DETAILS
X-13	BASS HARBOR TERMINAL WAVE FENCE AND DETAILS
E-01	BASS HARBOR TERMINAL PROPOSED ELECTRICAL DEMOLITION PLAN
E-02	BASS HARBOR TERMINAL PROPOSED ELECTRICAL SITE PLAN
E-03	BASS HARBOR TERMINAL PROPOSED ELECTRICAL LAYOUT PLAN
E-04	BASS HARBOR TERMINAL PROPOSED ELECTRICAL GENERATOR LAYOUT PLAN



DATE	BY	REVISION

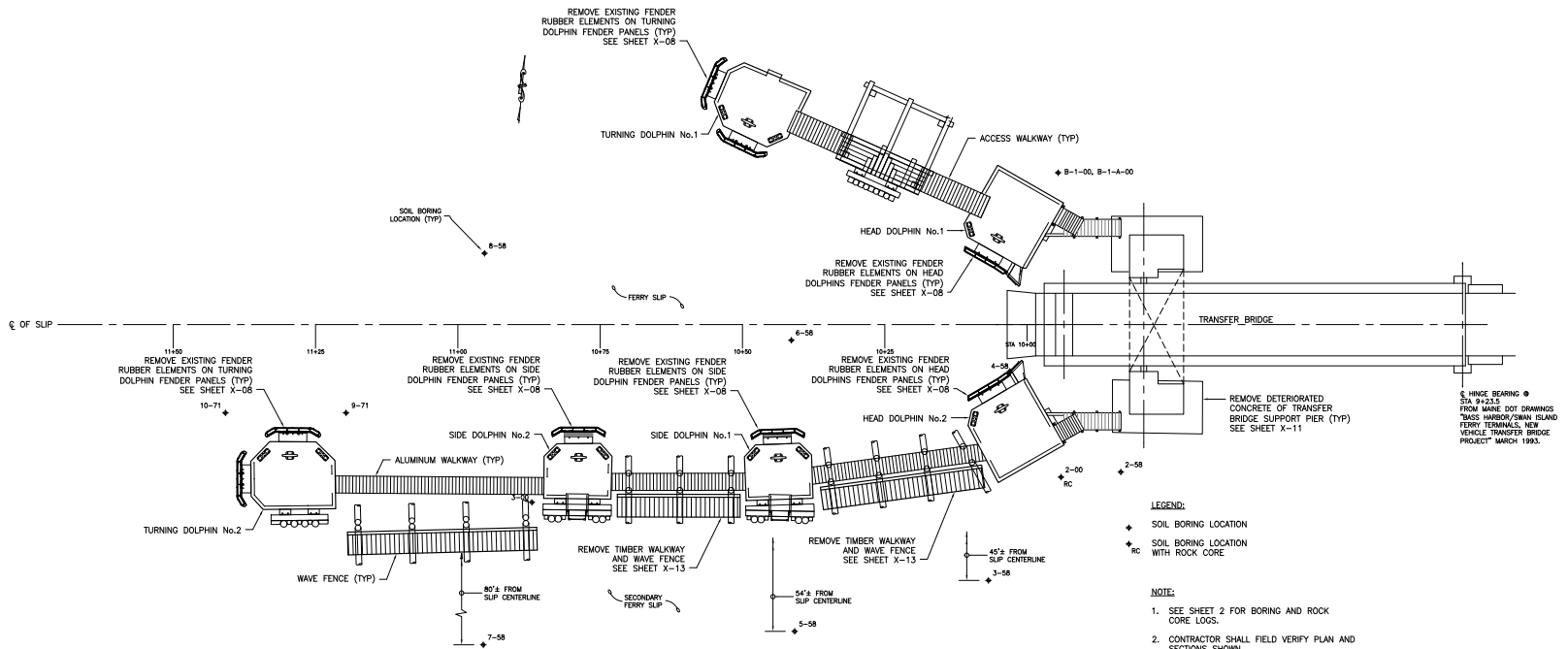
ISSUED BY	ISSUED DATE	REVISION
REV. BY	REV. DATE	

MAINE STATE ENGINEER  
OF TRANSPORTATION  
**TITLE SHEET**

Sheet  
Reference  
Number:  
**X-01**  
Sheet 1 of 17

1 2 3 4 5

D  
C  
B  
A



**EXISTING BASS HARBOR TERMINAL PLAN**  
SCALE: 1"=10'-0"

**LEGEND:**  
 \* SOIL BORING LOCATION  
 \* RC SOIL BORING LOCATION WITH ROCK CORE

**NOTE:**  
 1. SEE SHEET 2 FOR BORING AND ROCK CORE LOGS.  
 2. CONTRACTOR SHALL FIELD VERIFY PLAN AND SECTIONS SHOWN.  
 3. SEE SHEET X-05 THROUGH X-08 FOR ORIGINAL CONSTRUCTION DRAWINGS. MEMBERS AND DIMENSIONS SHALL BE FIELD VERIFIED.

**CHILDS ENGINEERING CORPORATION**  
 BOX 333 WILFORD, MASSACHUSETTS 02068 U.S.A.  
 TEL: (508) 358-9770  
 E-MAIL: info@childseng.com



Date	Drawn	Check

Checked by	Date	RFI	RFI	RFI	RFI
	09/20/10 <td> </td> <td> </td> <td> </td> <td> </td>				

MAINE STATE FERRY SERVICE  
 OF TRANSPORTATION  
**BASS HARBOR TERMINAL**  
 EXISTING LAYOUT PLAN

Sheet reference number:  
**X-02**  
 Sheet 2 of 17



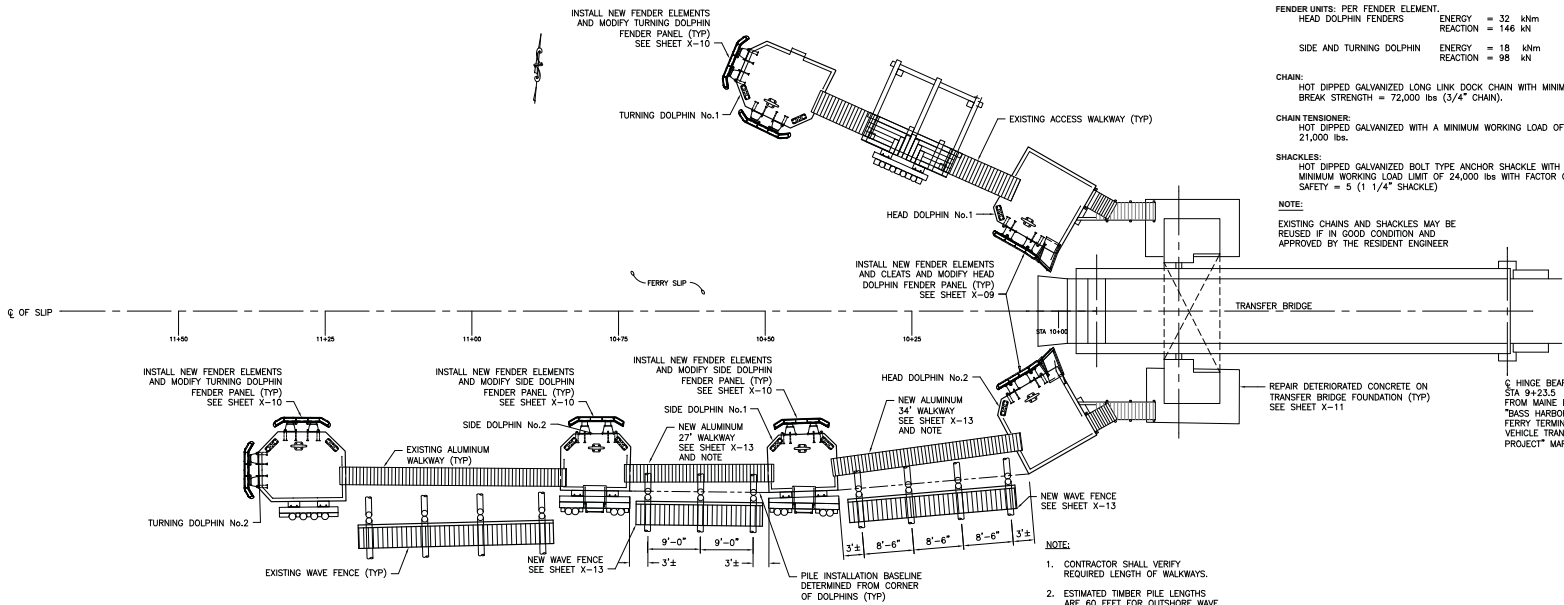
1 2 3 4 5

D

C

B

A



**FENDER CAPACITIES:**  
 FENDER UNITS: PER FENDER ELEMENT.  
 HEAD DOLPHIN FENDERS ENERGY = 32 kNm  
 REACTION = 146 kN  
 SIDE AND TURNING DOLPHIN ENERGY = 18 kNm  
 REACTION = 98 kN

CHAIN:  
 HOT DIPPED GALVANIZED LONG LINK DOCK CHAIN WITH MINIMUM  
 BREAK STRENGTH = 72,000 lbs (3/4" CHAIN).

CHAIN TENSIONER:  
 HOT DIPPED GALVANIZED WITH A MINIMUM WORKING LOAD OF  
 21,000 lbs.

SHACKLES:  
 HOT DIPPED GALVANIZED BOLT TYPE ANCHOR SHACKLE WITH A  
 MINIMUM WORKING LOAD LIMIT OF 24,000 lbs WITH FACTOR OF  
 SAFETY = 5 (1 1/4" SHACKLE)

NOTE:  
 EXISTING CHAINS AND SHACKLES MAY BE  
 REUSED IF IN GOOD CONDITION AND  
 APPROVED BY THE RESIDENT ENGINEER

- NOTE:
1. CONTRACTOR SHALL VERIFY REQUIRED LENGTH OF WALKWAYS.
  2. ESTIMATED TIMBER PILE LENGTHS ARE 60 FEET FOR OUTSHORE WAVE FENCE.
  3. CONTRACTOR SHALL ASSUME 7 EXISTING TIMBER PILES CAN BE REUSED FOR BIDDING PURPOSES.

**PROPOSED BASS HARBOR TERMINAL PLAN**  
 SCALE: 1"=10'-0"

**CHILDS ENGINEERING CORPORATION**  
 BOX 333 WILFIELD, MASSACHUSETTS 02030 U.S.A.  
 TEL: (508) 338-9770  
 E-MAIL: info@childse.com

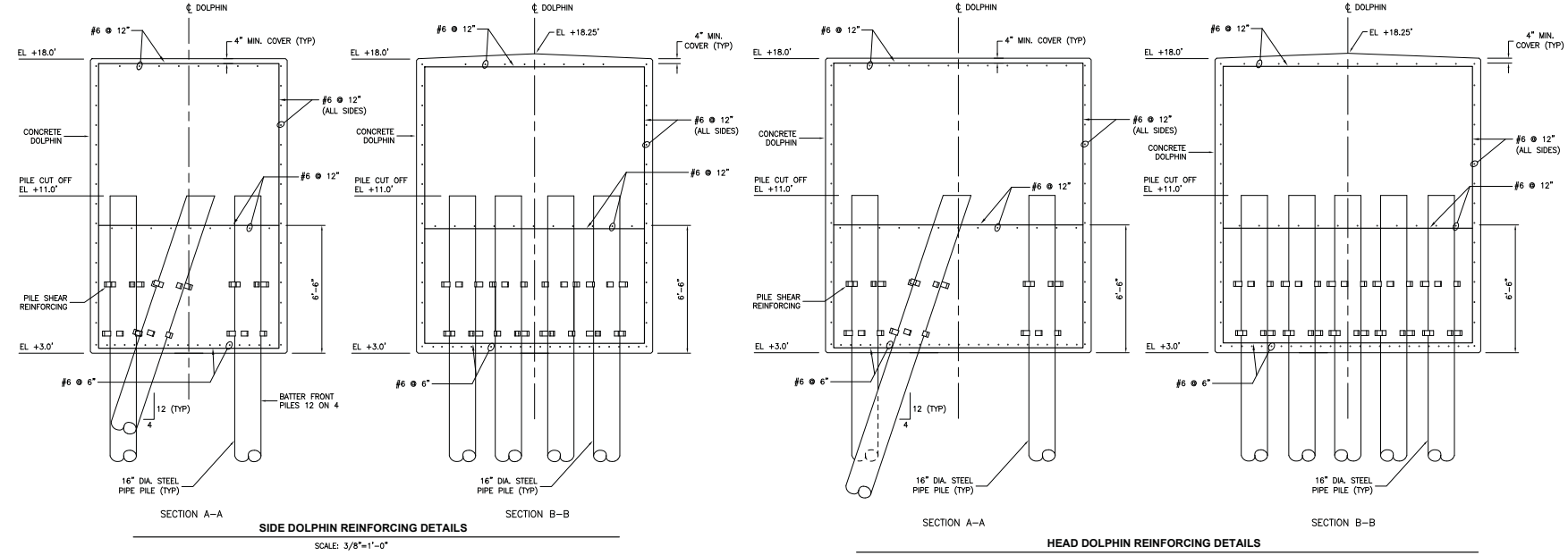
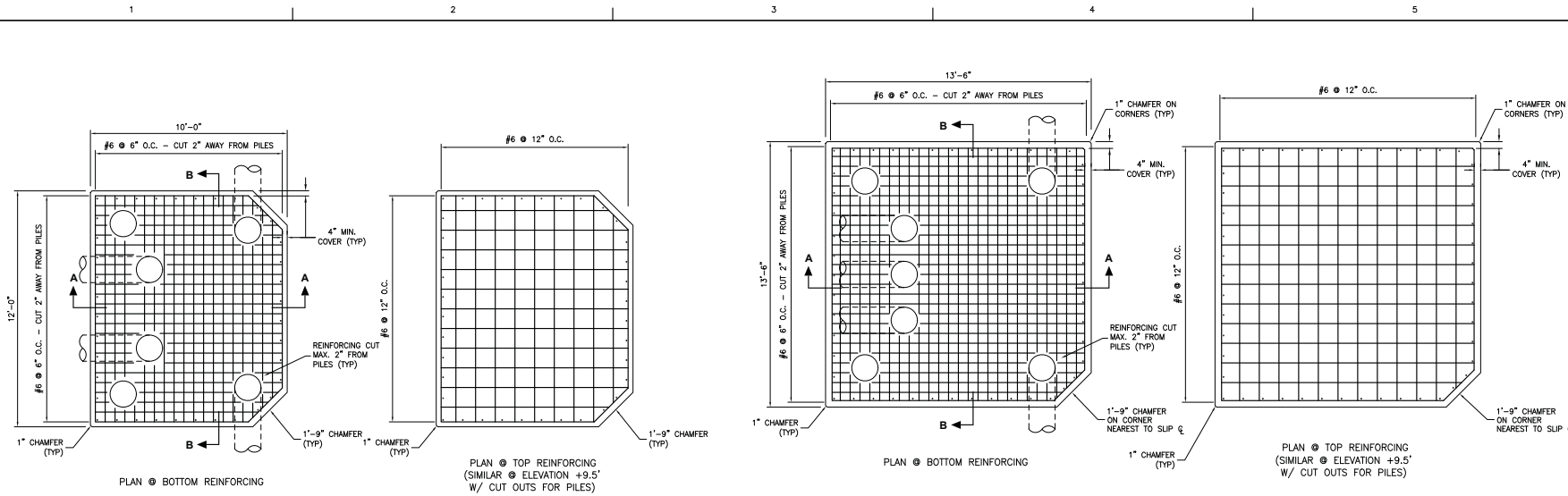


Date	Drawn	Checked

Approved by	Date	RFI	RFI	RFI	RFI
	09/20/10 <td> </td> <td> </td> <td> </td> <td> </td>				

MAINE STATE FERRY SERVICE  
 DEPARTMENT OF TRANSPORTATION  
 BASS HARBOR TERMINAL  
 PROPOSED LAYOUT PLAN

Sheet reference number:  
**X-04**  
 Sheet 4 of 17



SCALE: 3/8"=1'-0"

SCALE: 3/8"=1'-0"

**NOTE:**

THIS DRAWING IS FROM MAINE DOT PROJECT FBD-7826(10) "BASS HARBOR FERRY PIER" 2001. THIS SHEET IS TO BE USED FOR REFERENCE. ALL DIMENSIONS, MATERIAL AND LAYOUTS SHALL BE FIELD VERIFIED.

CHILDS ENGINEERING CORPORATION  
 Box 333, Weymouth, Massachusetts 02092, U.S.A.  
 Phone: (508) 759-7171  
 E-mail: mail@childseng.com

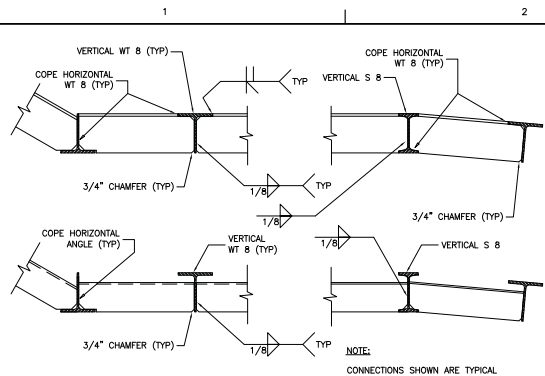


NO.	DATE	DESCRIPTION

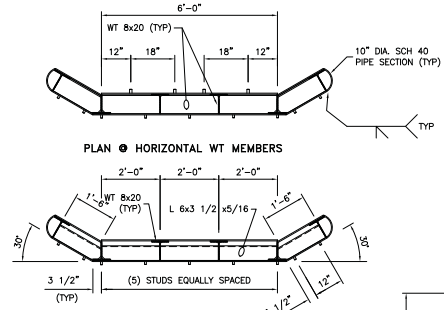
Checked by	RFJ	Date	09/20/10
Drawn by	APL	Drawn on	RFJ 221610-4-05
Reviewed by	RFJ	Per Scale	1"=0'-1"

MAINE STATE FERRY SERVICE  
 OF TRANSPORTATION  
 BASS HARBOR TERMINAL  
 EXISTING DOLPHIN  
 REINFORCING DETAILS

Sheet  
 reference  
 number:  
**X-05**  
 Sheet  
 5 of 17

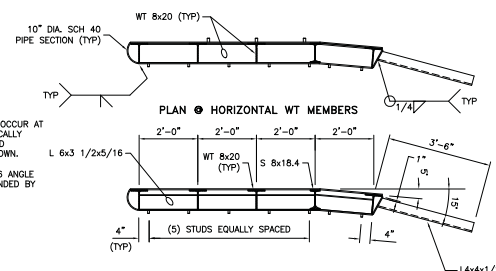


**TYPICAL FRAME CONNECTION DETAILS**  
SCALE: 1"=1'-0"

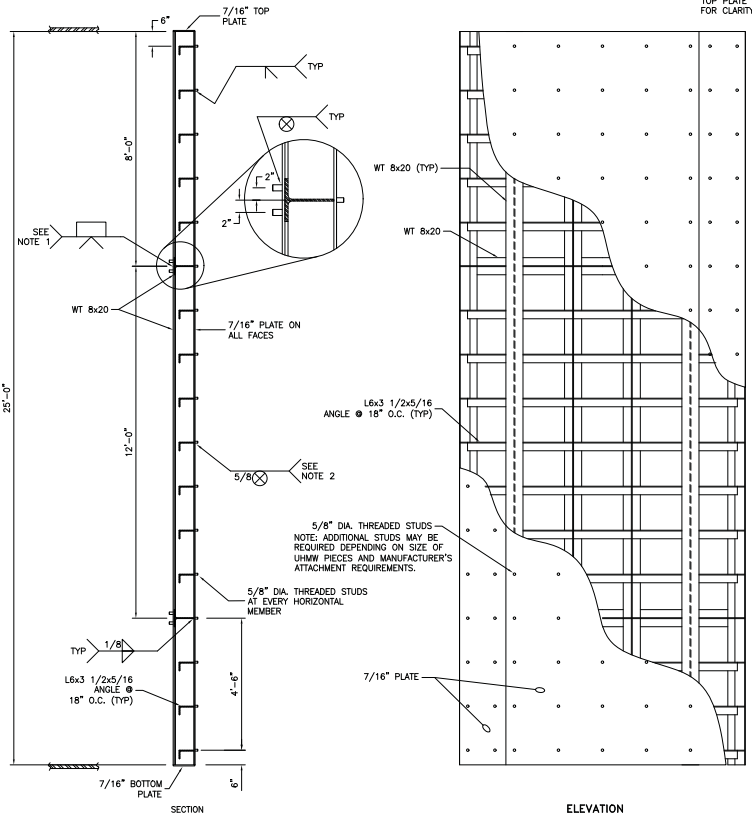


**PLAN ◉ HORIZONTAL WT MEMBERS**  
TOP PLATE NOT SHOWN FOR CLARITY.

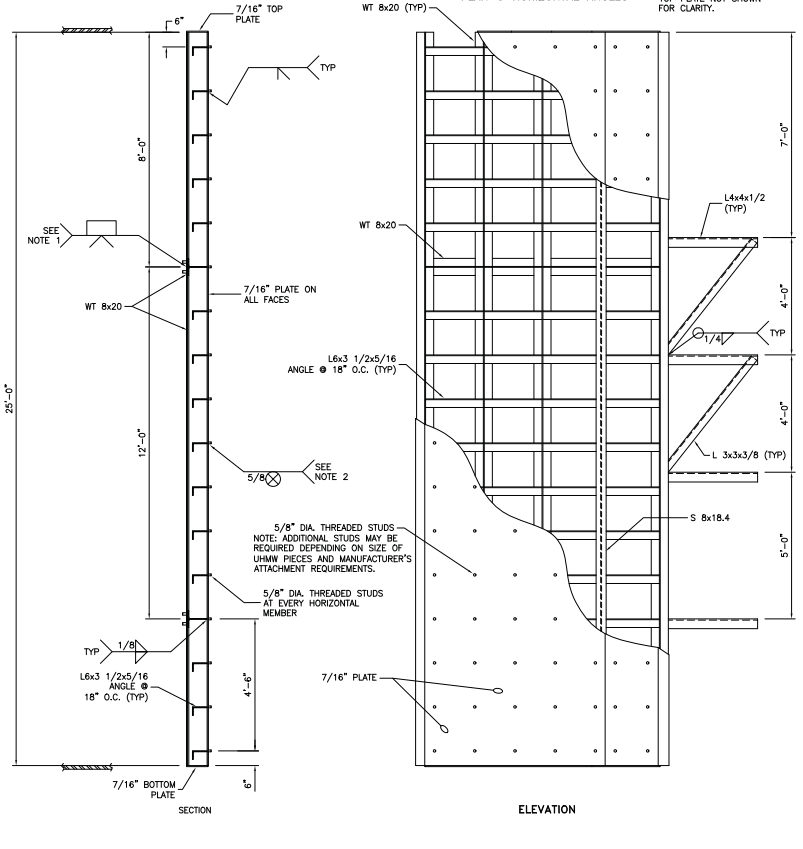
- NOTES:**
- 1.) ATTACH PLATE TO WT 8 FLANGE WITH CONTINUOUS "V" GROOVE WELD. SEAMS TO OCCUR AT EACH WT 8 BOTH HORIZONTALLY AND VERTICALLY ALIGNED WITH THE STEM, EXCEPT AT ANGLED CONNECTIONS WHERE SEAM OCCURS AS SHOWN.
  - 2.) STUD WELDS TO OCCUR ALONG THE L6 ANGLE LEGS, SPACED AS SHOWN OR AS RECOMMENDED BY THE UHMW WEAR SURFACE MANUFACTURER.
  - 3.) FRAMES TO BE WATERTIGHT.



**PLAN ◉ HORIZONTAL ANGLES**  
TOP PLATE NOT SHOWN FOR CLARITY.



**SIDE & TURNING DOLPHIN FENDER FRAME**  
SCALE: 1/2"=1'-0"



**HEAD DOLPHIN FENDER FRAME**  
SCALE: 1/2"=1'-0"

**NOTE:**  
THIS DRAWING IS FROM MAINE DOT PROJECT FBD-7826(10) "BASS HARBOR FERRY PIER" 2001. THIS SHEET IS TO BE USED FOR REFERENCE. ALL DIMENSIONS, MATERIAL AND LAYOUTS SHALL BE FIELD VERIFIED.

**CHILDS ENGINEERING CORPORATION**  
Box 333, Westbrook, Maine 04092-0333, USA  
Tel: (207) 738-9170  
E-mail: info@childseng.com



Date	Issue

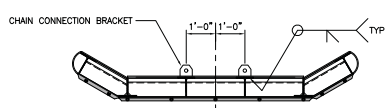
Project No.	RF#	Date	Issue
09/20/10	RF#		
221610-X-06	RF#		

MAINE STATE FERRY SERVICE  
OF TRANSPORTATION  
**BASS HARBOR FERRY PIER  
FENDER FRAME ASSEMBLY**

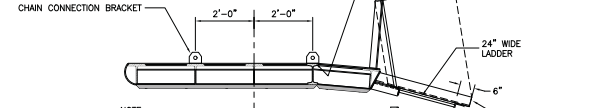
Sheet reference number:  
**X-06**  
Sheet 6 OF 17

1 2 3 4 5

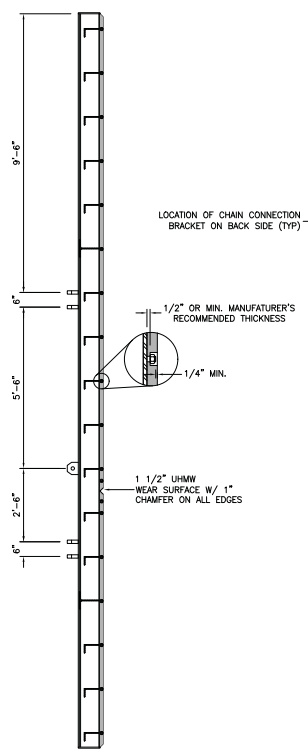
D



NOTE:  
TOP PLATE NOT SHOWN FOR CLARITY.



NOTE:  
TOP PLATE NOT SHOWN FOR CLARITY.

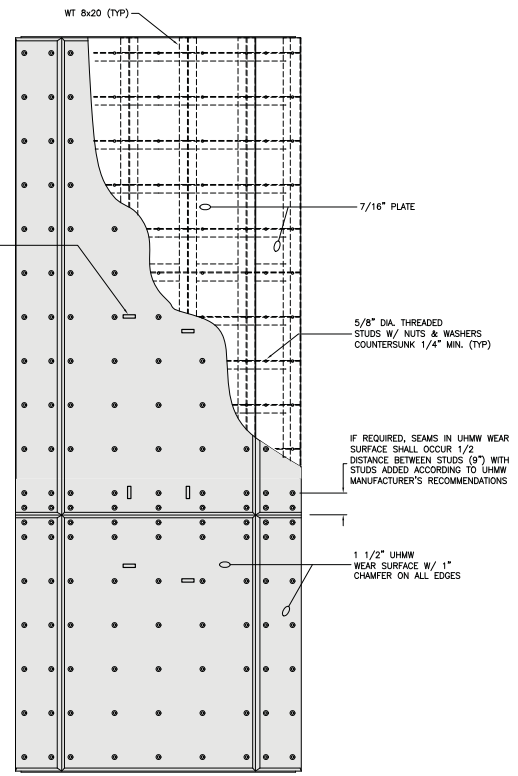


LOCATION OF CHAIN CONNECTION BRACKET ON BACK SIDE (TYP)

1/2" OR MIN. MANUFACTURER'S RECOMMENDED THICKNESS  
1/4" MIN.

1 1/2" UHMW WEAR SURFACE W/ 1" CHAMFER ON ALL EDGES

SECTION



IF REQUIRED, SEAMS IN UHMW WEAR SURFACE SHALL OCCUR 1/2 DISTANCE BETWEEN STUDS (9") WITH STUDS ADDED ACCORDING TO UHMW MANUFACTURER'S RECOMMENDATIONS

1 1/2" UHMW WEAR SURFACE W/ 1" CHAMFER ON ALL EDGES

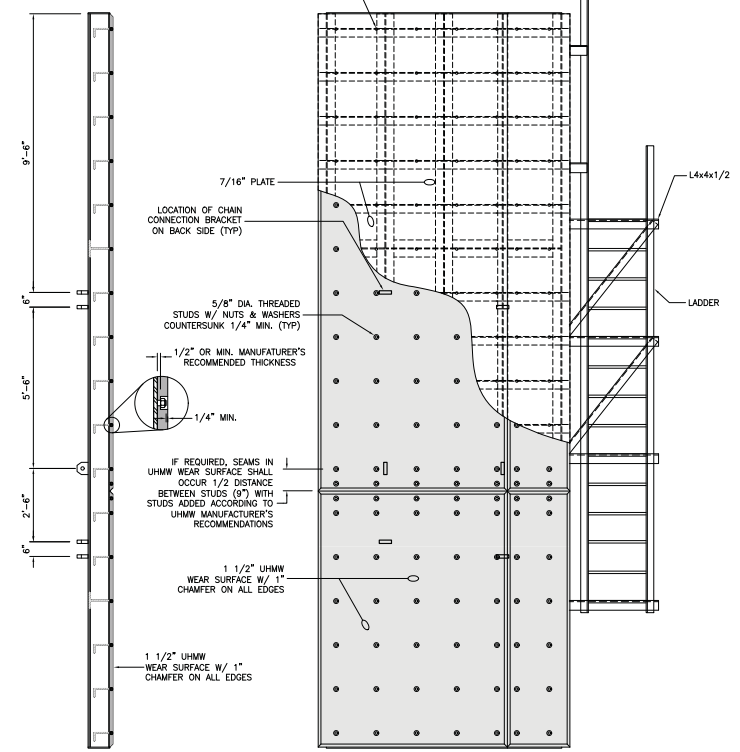
ELEVATION

**SIDE DOLPHIN FENDER FACING**  
SCALE: 1/2"=1'-0"

C

B

A



LOCATION OF CHAIN CONNECTION BRACKET ON BACK SIDE (TYP)

1/2" OR MIN. MANUFACTURER'S RECOMMENDED THICKNESS  
1/4" MIN.

IF REQUIRED, SEAMS IN UHMW WEAR SURFACE SHALL OCCUR 1/2 DISTANCE BETWEEN STUDS (9") WITH STUDS ADDED ACCORDING TO UHMW MANUFACTURER'S RECOMMENDATIONS

1 1/2" UHMW WEAR SURFACE W/ 1" CHAMFER ON ALL EDGES

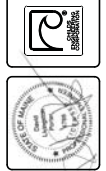
SECTION

ELEVATION

**HEAD DOLPHIN FENDER FACING**  
SCALE: 1/2"=1'-0"

NOTE:  
THIS DRAWING IS FROM MAINE DOT PROJECT FBD-7826(10) "BASS HARBOR FERRY PIER" 2001. THIS SHEET IS TO BE USED FOR REFERENCE. ALL DIMENSIONS, MATERIAL AND LAYOUTS SHALL BE FIELD VERIFIED.

CHILDS ENGINEERING CORPORATION  
Box 333 Weymouth, Massachusetts 02092 U.S.A.  
Tel: (617) 339-3700  
E-mail: info@childseng.com

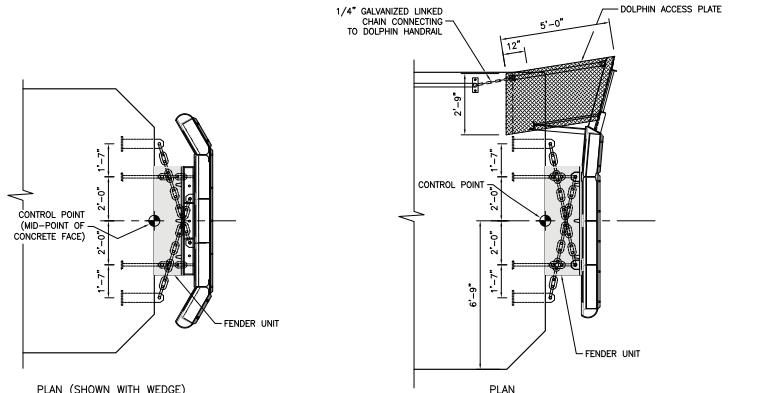


Rev.	Description	Date	By
A	REVISED 2-20-02		

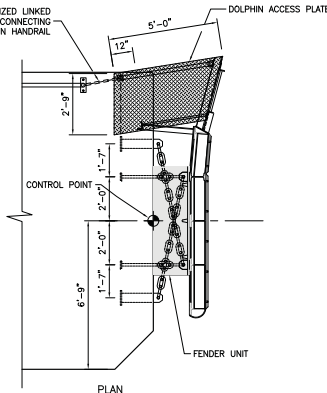
Checked by	Date	RFI	RFI	RFI
APL	09/20/10	RFI	RFI	RFI

MAINE STATE FERRY SERVICE  
OF TRANSPORTATION  
BASS HARBOR FERRY TERMINAL  
EXISTING FENDER FACING DETAILS

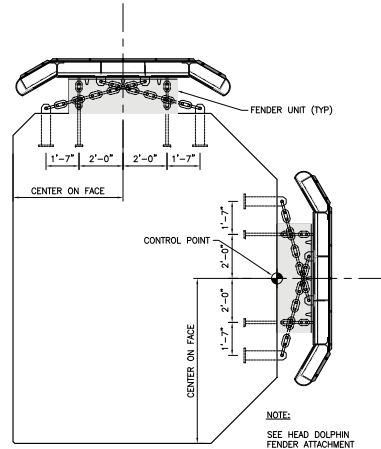
Sheet reference number:  
**X-07**  
Sheet 7 of 17



PLAN (SHOWN WITH WEDGE)

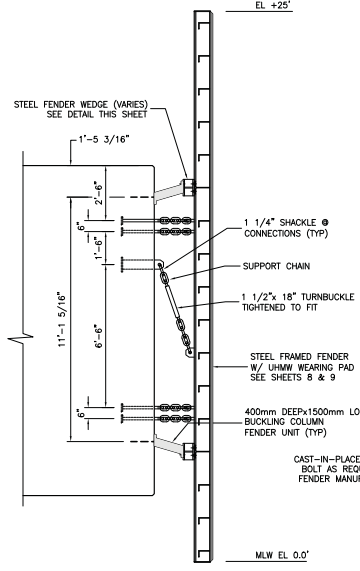


PLAN



TURNING DOLPHIN FENDER ATTACHMENT

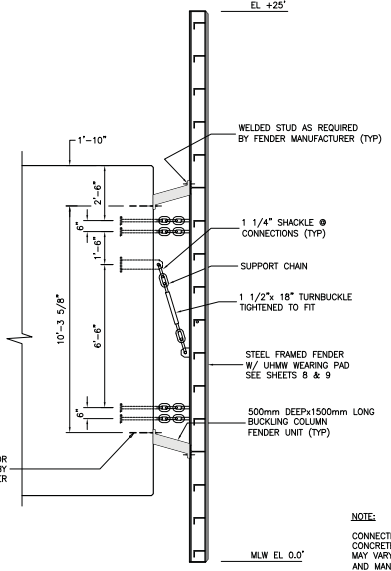
SCALE: 3/8"=1'-0"



SECTION @ DOLPHIN CENTERLINE

SIDE DOLPHIN FENDER ATTACHMENT

SCALE: 3/8"=1'-0"

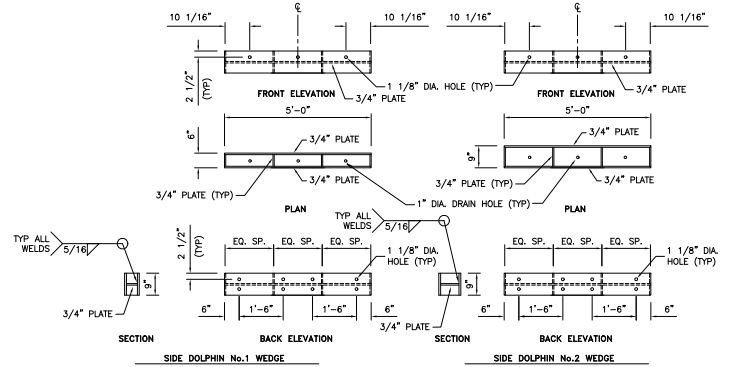


SECTION @ DOLPHIN CENTERLINE

HEAD DOLPHIN FENDER ATTACHMENT

SCALE: 3/8"=1'-0"

NOTE:  
CONNECTION OF FENDER UNITS TO CONCRETE DOLPHIN AND FENDER FRAME MAY VARY DEPENDING ON FENDER SHAPE AND MANUFACTURER'S RECOMMENDATIONS.



STEEL FENDER WEDGE

SCALE: 1/2"=1'-0"

NOTE:  
THIS DRAWING IS FROM MAINE DOT PROJECT FBD-7826(10) "BASS HARBOR FERRY PIER" 2001. THIS SHEET IS TO BE USED FOR REFERENCE. ALL DIMENSIONS, MATERIAL AND LAYOUTS SHALL BE FIELD VERIFIED.

CHILDS ENGINEERING CORPORATION  
Box 333 Weyfield, Massachusetts 02090 U.S.A.  
Tel: (508) 398-2700  
E-mail: info@childseng.com

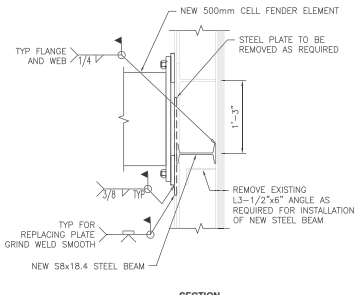
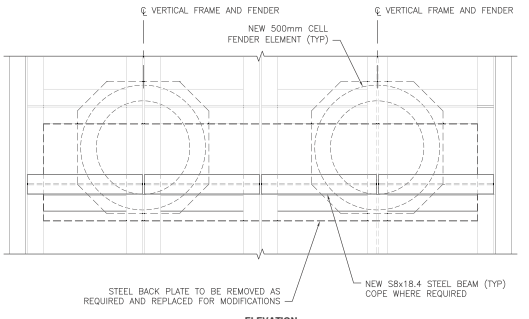
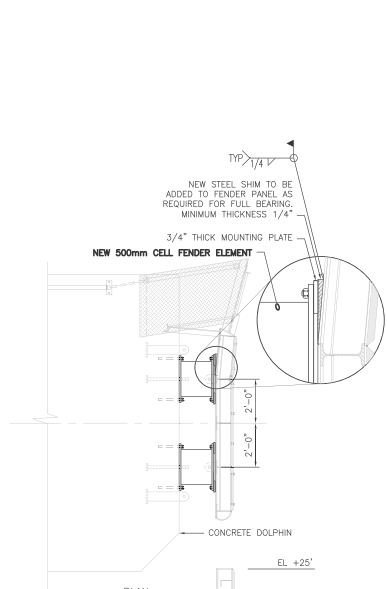


NO.	DATE	DESCRIPTION

NO.	DATE	DESCRIPTION

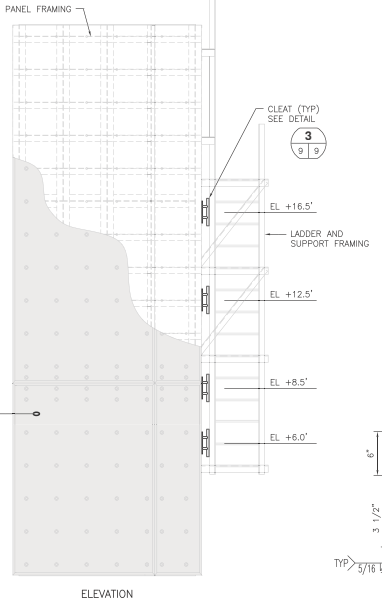
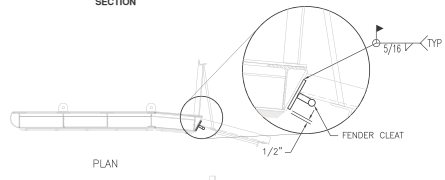
MAINE STATE FERRY SERVICE  
OF TRANSPORTATION  
BASS HARBOR TERMINAL  
EXISTING FENDER  
ATTACHMENT DETAILS

Sheet  
reference  
number:  
X-08  
Sheet  
8 of 17

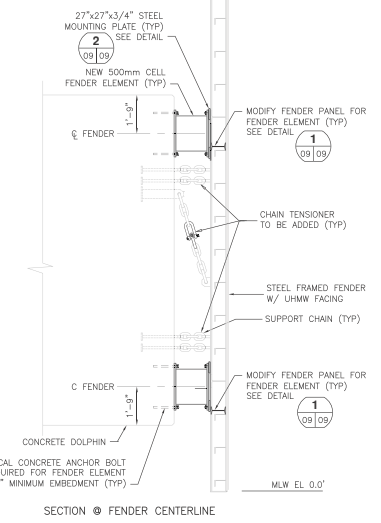


- NOTE:
1. ANY DAMAGED COATING EITHER EXISTING OR DUE TO WELDING OR HANDLING SHALL BE RECOATED ACCORDING TO PROJECT SPECIFICATIONS.
  2. UHMW FACING MATERIAL SHALL BE REMOVED BEFORE WELDING ON ADJACENT STEEL.
  3. SEE SHEET X-05 FOR DOLPHIN REINFORCING.
  4. EXISTING CHAINS AND CONNECTORS SHALL BE REUSED UNLESS DAMAGED OR CORRODED. THE ENGINEER SHALL DETERMINE IF REPLACEMENT IS REQUIRED.

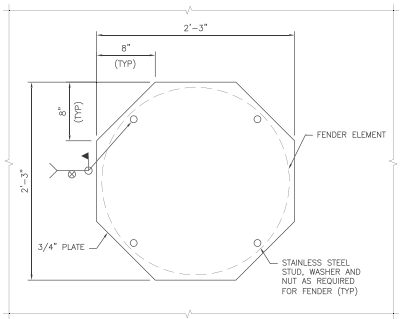
**1** MODIFICATION DETAIL  
09 | 09 SCALE: 1"=1'-0"



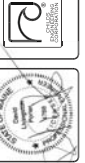
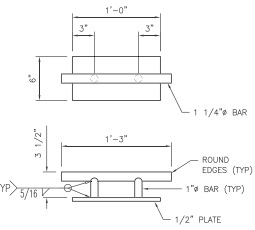
**3** FENDER CLEAT DETAIL  
09 | 09 SCALE: 1 1/2"=1'-0"



**HEAD DOLPHIN FENDER ATTACHMENT**  
SCALE: 3/8"=1'-0"



**2** MOUNTING PLATE DETAIL  
09 | 09 SCALE: 1 1/2"=1'-0"



NO.	DATE	DESCRIPTION

APPROVED BY:	DATE:
RFG	09/20/10
RFG	09/20/10
RFG	09/20/10
RFG	09/20/10
RFG	09/20/10
RFG	09/20/10

MAINE STATE FERRY SERVICE  
OF TRANSPORTATION  
**BASS HARBOR TERMINAL**  
**PROPOSED HEAD DOLPHIN**  
**MODIFICATIONS AND DETAILS**

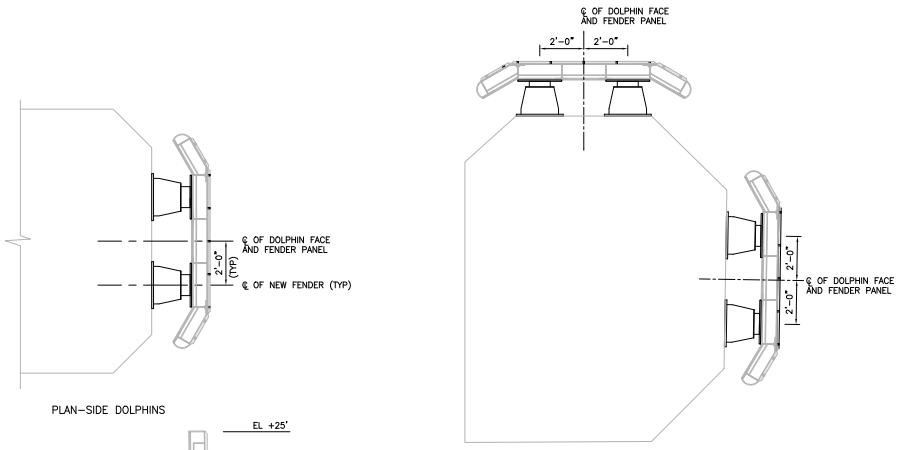
1 2 3 4 5

D

C

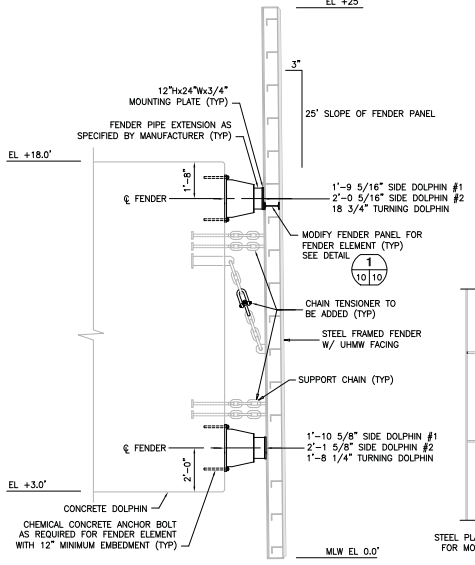
B

A



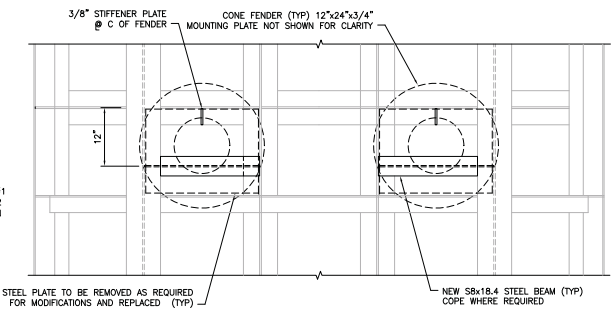
PLAN-SIDE DOLPHINS

PLAN-TURNING DOLPHINS

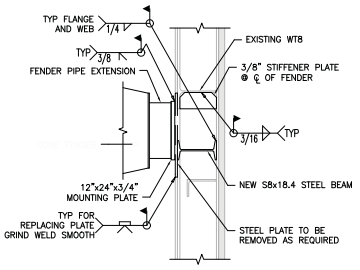


SECTION @ FENDER CENTERLINE  
SIDE AND TURNING DOLPHIN FENDER ATTACHMENT

SCALE: 3/8"=1'-0"



ELEVATION



SECTION

1  
10/10 MODIFICATION DETAIL

SCALE: 1"=1'-0"

- NOTE:
1. ANY DAMAGED COATING EITHER EXISTING OR DUE TO WELDING OR HANDLING SHALL BE RECOATED ACCORDING TO PROJECT SPECIFICATIONS.
  2. UHMW FACING MATERIAL SHALL BE REMOVED BEFORE WELDING ON ADJACENT STEEL.
  3. SEE SHEET X-05 FOR DOLPHIN REINFORCING.
  4. EXISTING CHAINS AND CONNECTORS SHALL BE REUSED UNLESS DAMAGED OR CORRODED. THE ENGINEER SHALL DETERMINE IF REPLACEMENT IS REQUIRED.

CHILDS ENGINEERING CORPORATION  
Box 333 Middlefield, Massachusetts 02042 U.S.A.  
Tel: (508) 558-7170  
E-mail: info@childseng.com

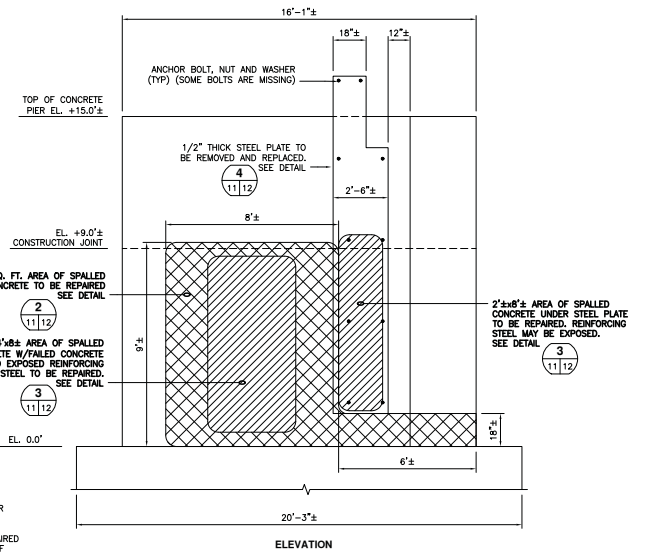
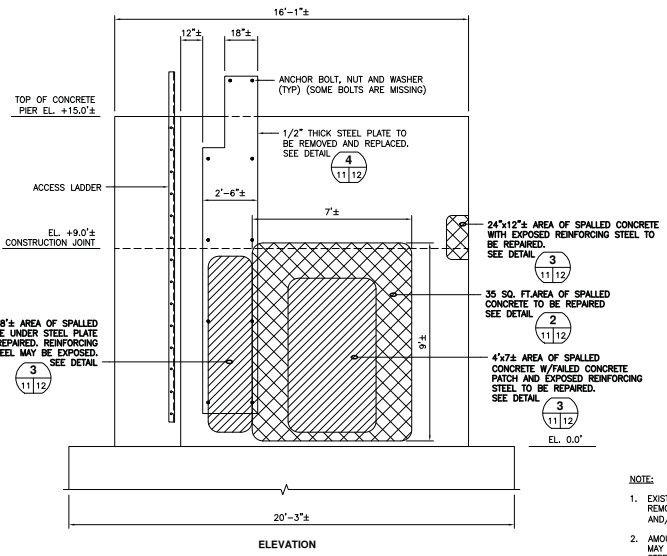
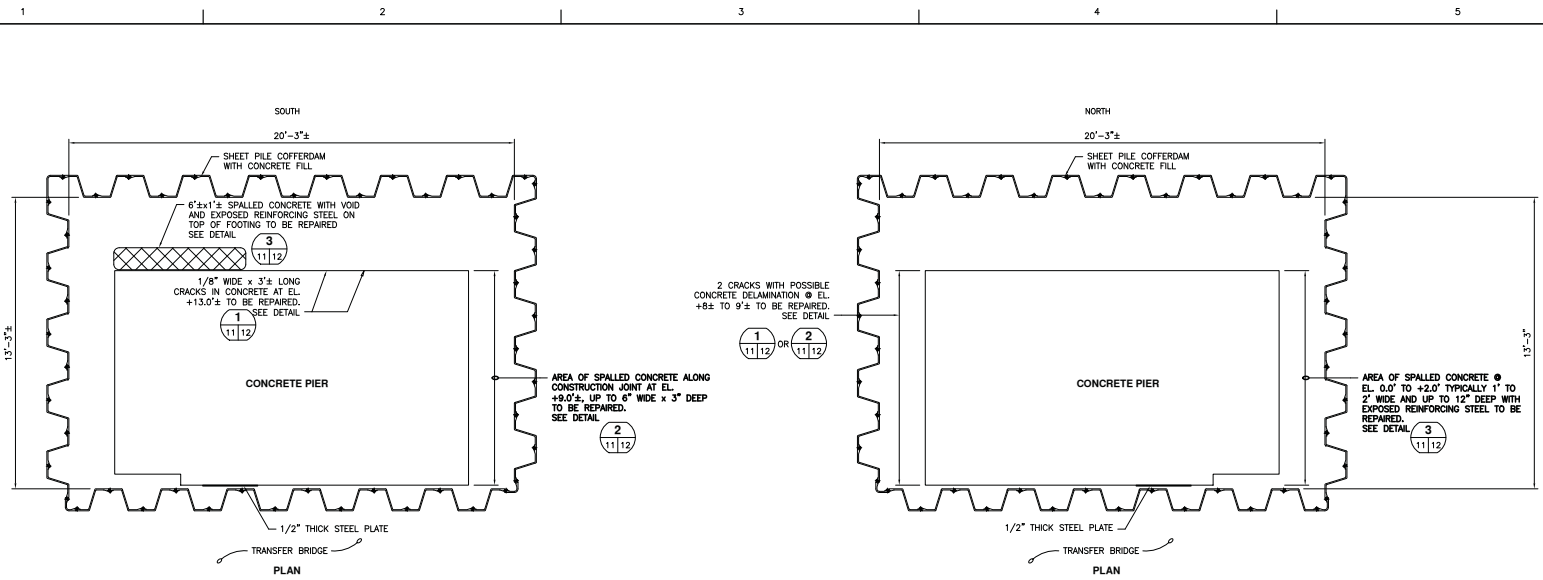


Date	Issue	Description

Checked by	Date	RFI	RFI	RFI	RFI
	09/20/10				

MAINE STATE FERRY SERVICE  
DEPARTMENT OF TRANSPORTATION  
BASIS HARBOR TERMINAL  
PILING AND TURNING DOLPHINS  
MODIFICATIONS AND DETAILS

Sheet reference number:  
X-10  
Sheet 10 of 17



**NOTE:**

- EXISTING MARINE GROWTH TO BE REMOVED BY HIGH PRESSURE WATER AND/OR MECHANICAL MEANS.
- AMOUNT OF CONCRETE TO BE REPAIRED MAY BE REVISED AFTER REMOVAL OF STEEL PLATES AND MARINE GROWTH.

**NORTH FACE - SOUTH PIER HOIST TOWER FOUNDATION**  
SCALE: 3/8"=1'-0"

**SOUTH FACE - NORTH PIER HOIST TOWER FOUNDATION**  
SCALE: 3/8"=1'-0"

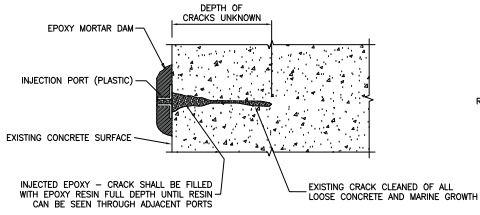
**CHILDS ENGINEERING CORPORATION**  
Box 333 - Weymouth, Massachusetts 02092 U.S.A.  
Tel: (617) 339-9700  
E-mail: info@childseng.com



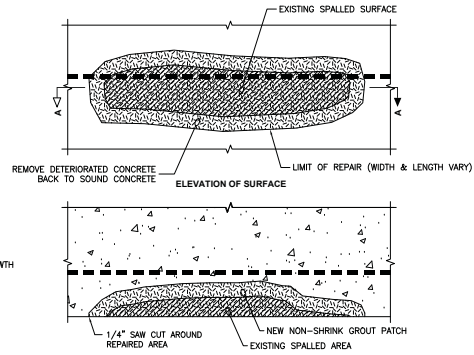
NO.	DATE	DESCRIPTION

Project No.	RF#	Date	09/20/10
Drawn by	APL	Scale	As Shown
Checked by	RF#	Project No.	221610-X-11

MAINE STATE FERRY SERVICE  
OF TRANSPORTATION  
BASS HARBOR TERMINAL  
TOWER FOUNDATION CONDITIONS



**1 CONCRETE CRACK REPAIR**  
 SCALE: NONE



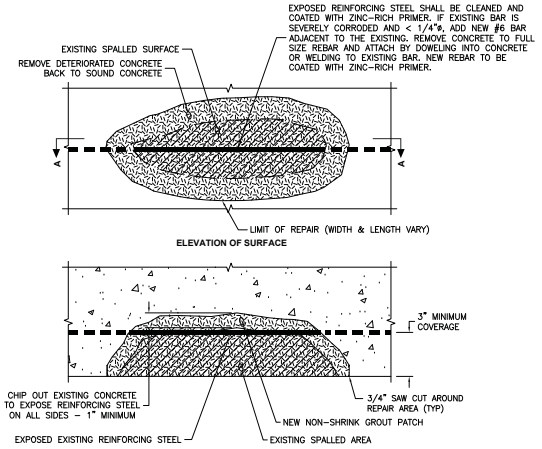
**2 CONCRETE SPALL REPAIR - TYPE 1**  
 SCALE: 3"=1'-0"

**CONCRETE REPAIR QUANTITIES:**

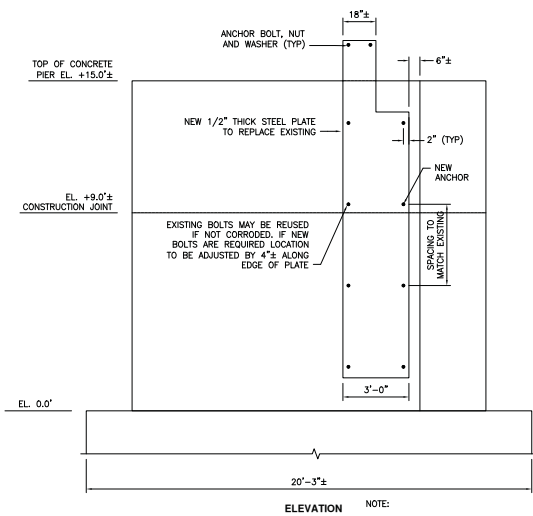
- CONCRETE SPALL REPAIR TYPE 1: 57 SQ.FT. (UP TO 3" DEEP)
- CONCRETE SPALL REPAIR TYPE 1 SUBMERGED: 32 SQ.FT. (UP TO 3" DEEP)
- CONCRETE SPALL REPAIR TYPE 2: 94 SQ.FT. (UP TO 12" DEEP)
- CONCRETE SPALL REPAIR TYPE 2 SUBMERGED: 20 SQ.FT. (UP TO 12" DEEP)
- CONCRETE CRACK REPAIR: 26 LIN.FT.

**NOTE:**

1. EXTENT OF CONCRETE REPAIR MAY BE REVISED AFTER REMOVAL OF STEEL PLATES AND MARINE GROWTH.
2. AREAS OF SPALLED CONCRETE ALWAYS SUBMERGED SHALL BE CLEANED OF MARINE GROWTH AND DETERIORATED CONCRETE AND PATCHED WITH UNDERWATER GROUT.



**3 CONCRETE SPALL REPAIR - TYPE 2**  
 SCALE: 3"=1'-0"



**4 HOIST TOWER FOUNDATION STEEL PLATE REPAIR**  
 SCALE: 3/8"=1'-0"

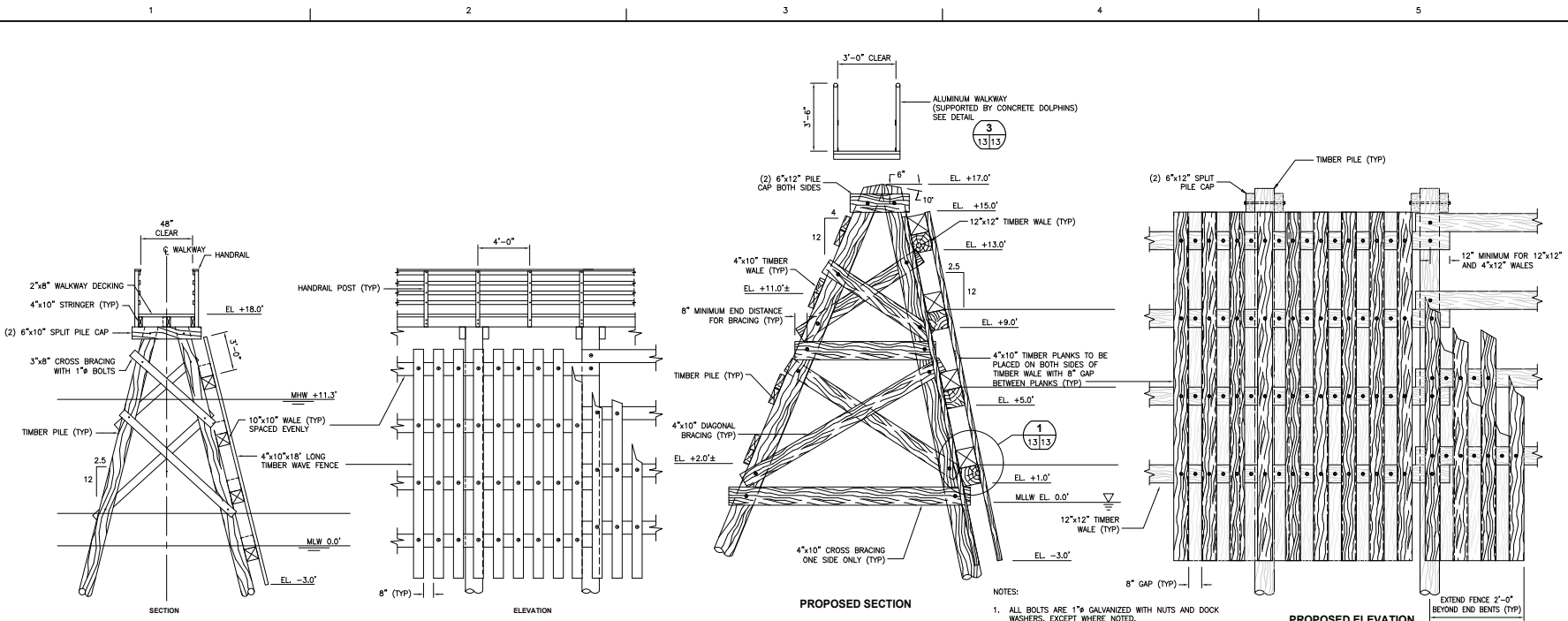


No.	Date	Description

Checked by	Date	RFI No.	RFI Date	RFI No.	RFI Date	RFI No.	RFI Date

MAINE STATE FERRY SERVICE  
 OF TRANSPORTATION  
 BASS HARBOR TERMINAL  
 TOWER FOUNDATION  
 REPAIR DETAILS

Sheet reference number:  
 X-12  
 Sheet 12 of 17



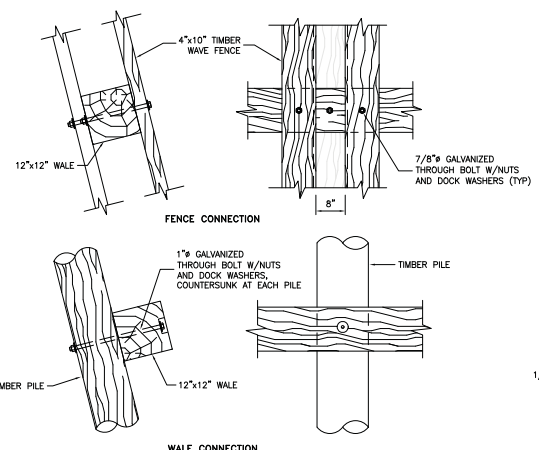
**EXISTING WAVE FENCE/WALKWAY DETAILS**  
SCALE: 1/4"=1'-0"

**PROPOSED SECTION**

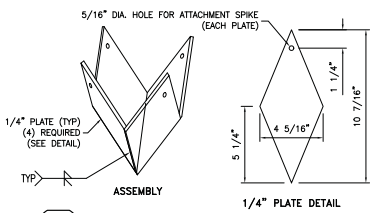
**PROPOSED ELEVATION**

- NOTES:
1. ALL BOLTS ARE 1" GALVANIZED WITH NUTS AND DOCK WASHERS, EXCEPT WHERE NOTED.
  2. ALL TIMBER ASSOCIATED WITH WAVE FENCE SHALL BE 2.5 OCA TREATED.
  3. ALL TIMBER PILE SHALL BE DRIVEN TO A CAPACITY 16 TONS WITH A MINIMUM EMBEDMENT OF 20' UNLESS REFUSED, AS ENCOUNTERED.
  4. ALL TIMBER PILES SHALL HAVE A PILE POINT SEE DETAIL.
  5. EXISTING TIMBER PILES MAY BE REUSED IF NOT DAMAGED, CAN BE DRIVEN TO THE REQUIRED CRITERIA AND APPROVED BY THE ENGINEER. CONTRACTOR SHALL ASSUME 7 PILES CAN BE REUSED FOR BIDDING PURPOSES.

**PROPOSED WAVE FENCE DETAILS**  
SCALE: 3/8"=1'-0"

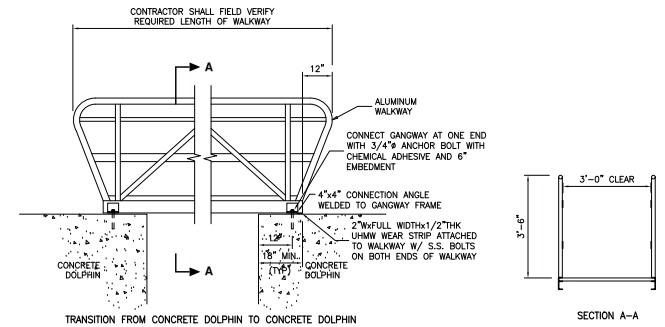


**1 WALE CONNECTIONS**  
SCALE: 3/4"=1'-0"



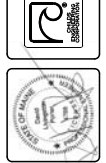
**2 TIMBER PILE POINT**  
SCALE: 3"=1'-0"

NOTE: DIMENSIONS SHOWN SIMILAR TO PILE POINT MANUFACTURED BY ASSOCIATED PILE & FITTING.



**3 WALKWAY TRANSITION DETAILS**  
SCALE: 1/2"=1'-0"

**CHILDS ENGINEERING CORPORATION**  
BOX 333 WAREFIELD, MASSACHUSETTS 02082 U.S.A.  
TEL: (508) 238-7170  
E-MAIL: info@childseng.com

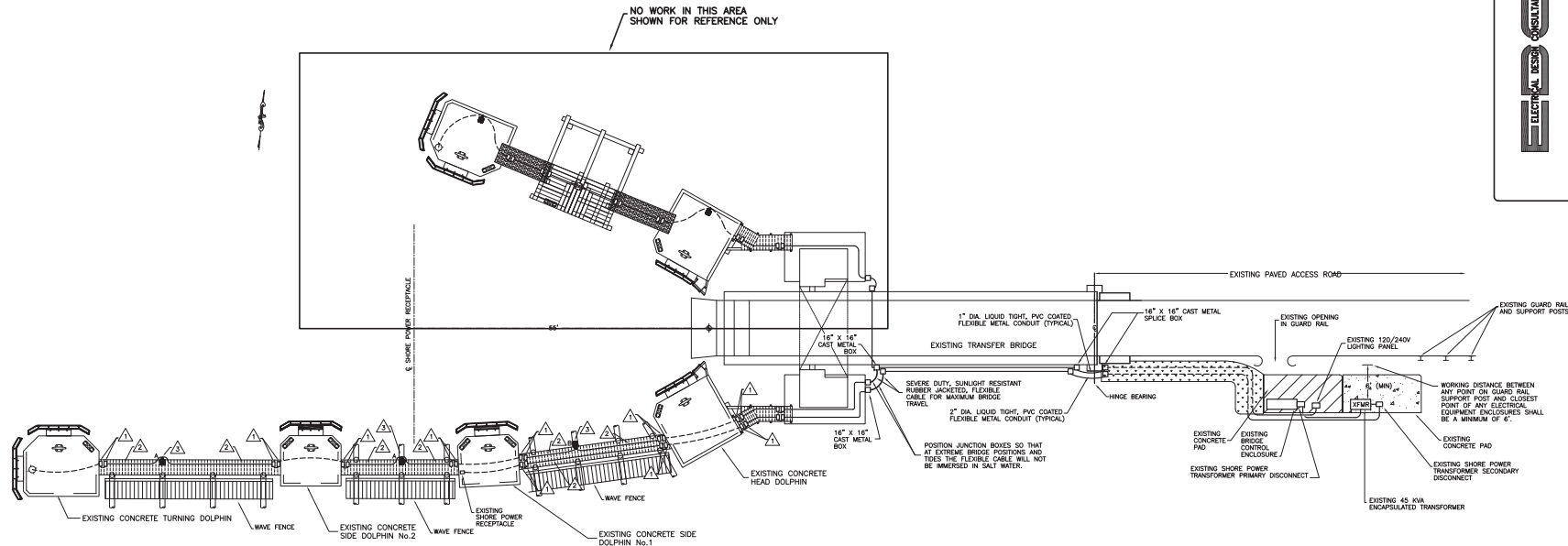


NO.	DATE	DESCRIPTION

DATE	BY	DESCRIPTION
09/20/10 <td>RFJ <td> </td> </td>	RFJ <td> </td>	
22/12/10 <td>APL <td> </td> </td>	APL <td> </td>	

MAINE STATE FERRY SERVICE  
OF TRANSPORTATION  
BASS HARBOR TERMINAL  
WAVE FENCE AND DETAILS

Sheet Reference Number:  
**X-13**  
Sheet 13 OF 17



EXISTING BASS HARBOR TERMINAL - ELECTRICAL DEMOLITION PLAN

SCALE: 3/32"=1'-0"

- DEMOLITION NOTES:**
- △ REMOVE JUNCTION BOX AND WIRING. SEAL MOUNTING HOLES IN CONCRETE DOLPHIN WITH WEATHERPROOF SEALING COMPOUND.
  - △ REMOVE CONDUIT AND WIRING.
  - △ REMOVE LIGHT POLE. SALVAGE FOR INSTALLATION AS SHOWN ON SHEET E-3.



**CHILD'S ENGINEERING CORPORATION**  
 BOX 333, WESTFIELD, MASSACHUSETTS 01095, U.S.A.  
 Phone: (603) 338-8848 Fax: (603) 338-2781  
 E-mail: info@childscorp.com



No.	Description	Date

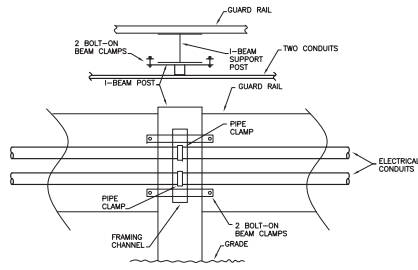
Project No.	108-06-10
Sheet No.	BAS-E1
Scale	3/32"=1'-0"

MAINE STATE FERRY SERVICE  
 MAINE DEPARTMENT  
 OF TRANSPORTATION  
**BASS HARBOR TERMINAL  
 ELECTRICAL  
 DEMOLITION PLAN**

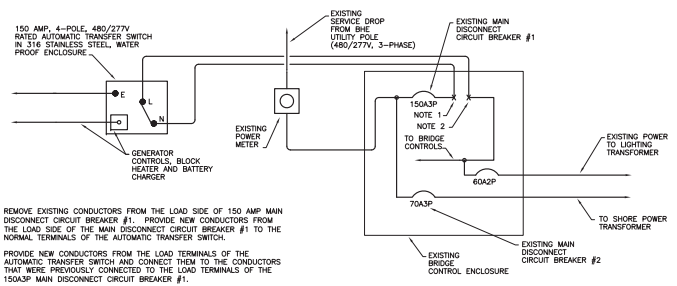
Sheet reference number: **1**  
 Sheet 1 of 4

C:\Program Files\Autodesk\LT 2011\Projects\BAS - HARBOR\BAS-E1.dwg, 9/29/2010 7:54:04 AM, AutoCAD PDF





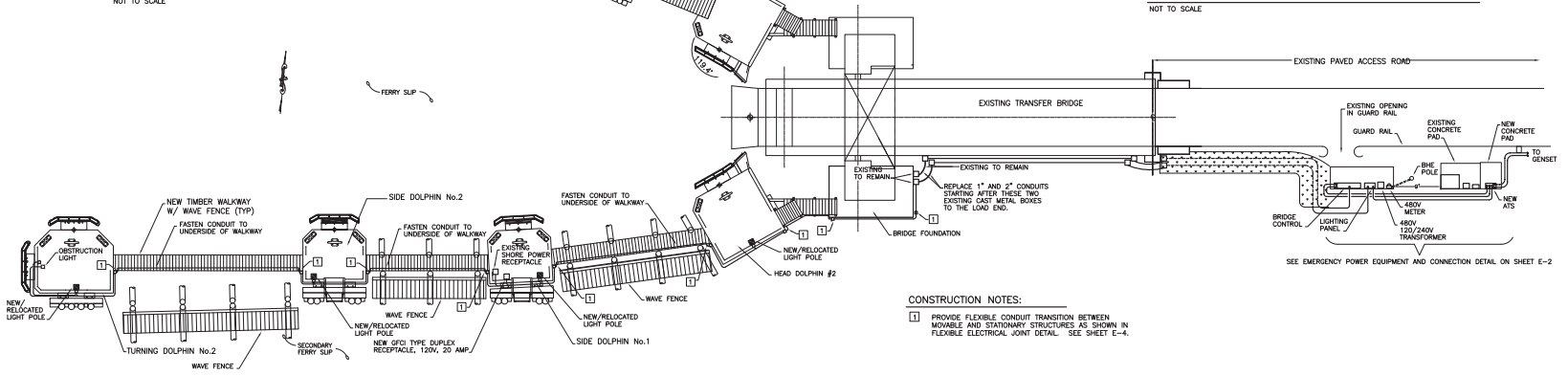
CONDUIT SUPPORT AT GUARD RAIL - I-BEAM POST  
NOT TO SCALE



NOTE 1: REMOVE EXISTING CONDUCTORS FROM THE LOAD SIDE OF 150 AMP MAIN DISCONNECT CIRCUIT BREAKER #1. PROVIDE NEW CONDUCTORS FROM THE LOAD SIDE OF THE MAIN DISCONNECT CIRCUIT BREAKER #1 TO THE NORMAL TERMINALS OF THE AUTOMATIC TRANSFER SWITCH.

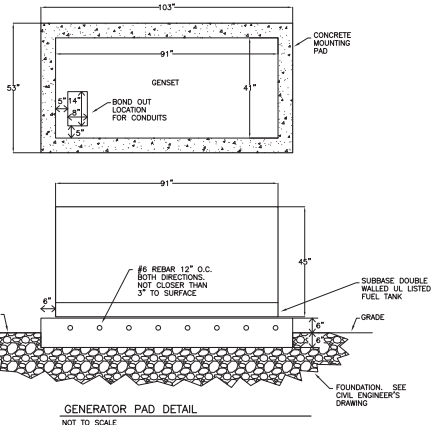
NOTE 2: PROVIDE NEW CONDUCTORS FROM THE LOAD TERMINALS OF THE AUTOMATIC TRANSFER SWITCH AND CONNECT THEM TO THE CONDUCTORS THAT WERE PREVIOUSLY CONNECTED TO THE LOAD TERMINALS OF THE 150AMP MAIN DISCONNECT CIRCUIT BREAKER #1.

MODIFICATION TO EXISTING POWER DISTRIBUTION SYSTEM  
NOT TO SCALE

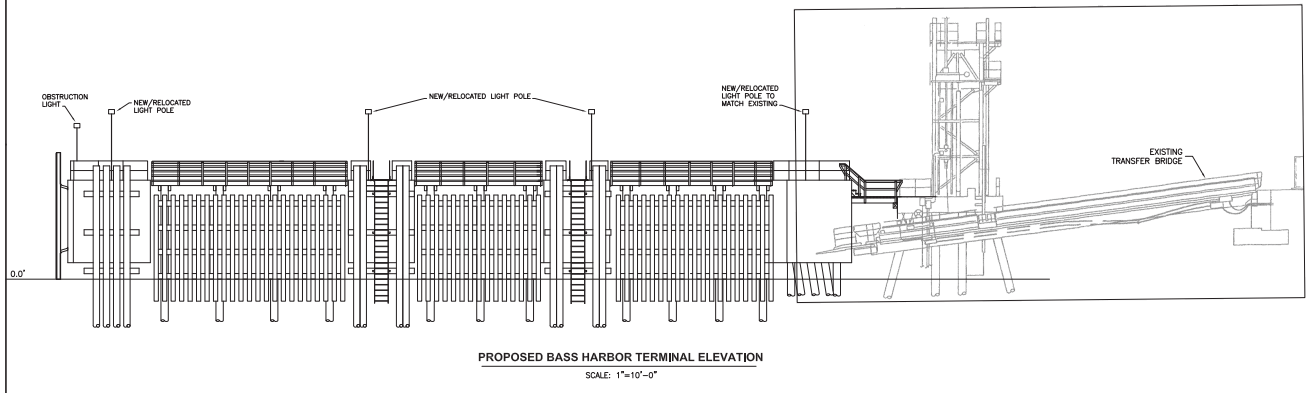


BASS HARBOR TERMINAL PROPOSED ELECTRICAL LAYOUT  
SCALE: 3/32" = 1'-0"

CONSTRUCTION NOTES:  
 1. PROVIDE FLEXIBLE CONDUIT TRANSITION BETWEEN MOVABLE AND STATIONARY STRUCTURES AS SHOWN IN FLEXIBLE ELECTRICAL JOINT DETAIL - SEE SHEET E-4.



GENERATOR PAD DETAIL  
NOT TO SCALE



PROPOSED BASS HARBOR TERMINAL ELEVATION  
SCALE: 1"=10'-0"

**ELECTRICAL DESIGN CONSULTANTS**

**CHILD'S ENGINEERING CORPORATION**  
 BOX 333, WELFIELD, MASSACHUSETTS 02092, U.S.A.  
 Phone: (603) 356-8848 Fax: (603) 356-2781  
 E-mail: info@childseng.com





MAINE STATE FERRY SERVICE  
 MAINE DEPARTMENT OF TRANSPORTATION  
 BASS HARBOR TERMINAL  
 PROPOSED ELECTRICAL LAYOUT PLAN

Sheet reference number: **E-3**  
 Sheet 3 of 4



STATE OF MAINE  
DEPARTMENT OF TRANSPORTATION  
**BASS HARBOR FERRY TERMINAL**

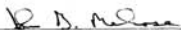
PROJECT NO. : STP-6071(00)X  
OCTOBER 27, 1997

DRAWING LIST

C1 EXISTING CONDITIONS  
C2 SITE PLAN  
C3 SITE DETAILS  
C4 GEOMETRIC  
C5 SEWAGE DISPOSAL SYSTEM DETAILS  
C6 DETAILS  
S1 FOUNDATION & FRAMING PLANS  
S2 FOUNDATION & FRAMING DETAILS  
A1 PLANS  
A2 ELEVATIONS  
A3 SECTIONS/DETAILS  
A4 WINDOW/DOOR SCHEDULES & DETAILS  
A5 INTERIOR ELEVATIONS  
M1 HEATING PLAN/VENTILATING DATA, DETAILS, SCHEDULES & LEGENDS  
P1 PLUMBING PLAN, SCHEDULES, LEGENDS & DETAILS  
E5 ELECTRICAL SITE PLAN  
E1 ELECTRICAL PLAN, ELEVATIONS, SYMBOLS & NOTES  
E2 ELECTRICAL EQUIPMENT, SCHEDULES & DETAILS

DEPARTMENT OF TRANSPORTATION

APPROVED

  
JOHN G. MELROSE - COMMISSIONER

4/1/98  
DATE

  
JOHN E. DORITY - CHIEF ENGINEER

3/30/98  
DATE



TFH ARCHITECTS  
100 COMMERCIAL STREET  
PORTLAND, MAINE 04101  
TELEPHONE: 207 775-6141

ARCHITECTURE PLANNING

SITE DESIGN  
TFC ASSOCIATES

STRUCTURAL ENGINEER:  
PETERHAM AND GLENN

MECHANICAL ENGINEER:  
BROWN AND KIRWAN

ELECTRICAL ENGINEER:  
ELECTRICAL DESIGN CONSULTANTS



© 1996 TTH ARCHITECTS

# FERRY TERMINAL TREMONT, MAINE



TTH ARCHITECTS  
100 COMMERCIAL STREET  
PORTLAND, MAINE 04051  
TELEPHONE: 207-773-6144  
ARCHITECTURE PLANNING

CIVIL/LANDSCAPE:  
TIC ASSOCIATES  
40 SANTER STREET  
SOUTH PORTLAND, ME 04106

STRUCTURAL:  
PROGRAM & GREER  
120 US ROUTE 100  
FAIRBACH, ME 04015

MECHANICAL:  
BISHOP AND JORDAN  
15 MERRY ROAD  
SCARBOROUGH, ME 04074-1362

ELECTRICAL:  
ELECTRICAL DESIGN  
CONSULTANTS  
BERRY POINT ROAD  
LONG ISLAND, ME 04050

REVISIONS:  
AUGUST 1, 1996

DATE: AUGUST 29, 1996

PROJECT NO.: 9614

DRAWN BY: TTB

CHECKED BY: TST

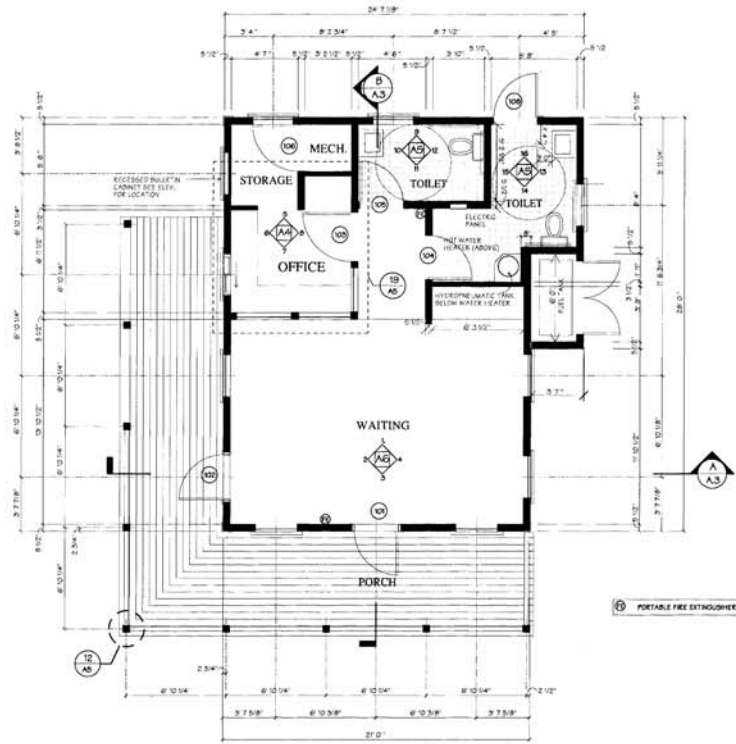
SCALE: 1/4" = 1'-0"

SHEET TITLE:

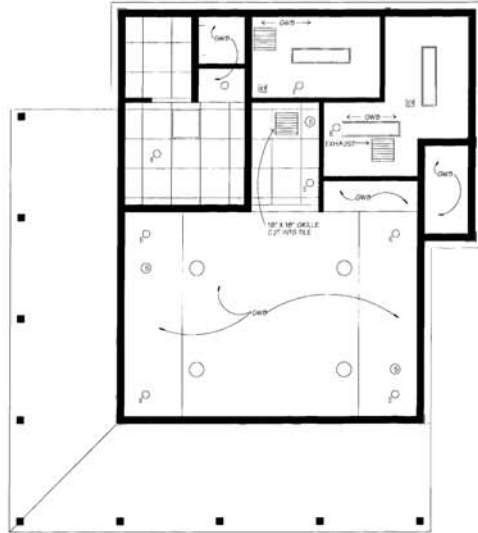
PLANS

SHEET

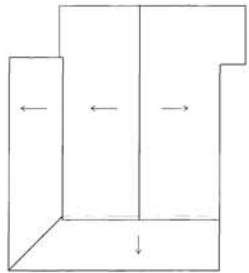
# A-1



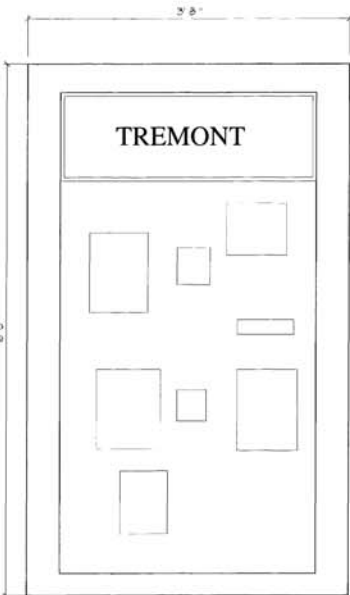
1. FLOOR PLAN  
SCALE: 1/4" = 1'-0"



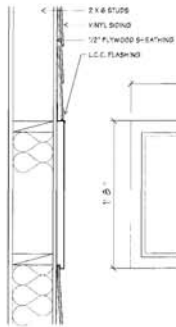
2. REFLECTED CEILING PLAN  
SCALE: 1/4" = 1'-0"



3. ROOF PLAN  
SCALE: 1/4" = 1'-0"



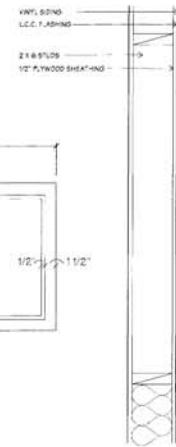
8. BULLETIN BOARD  
SCALE: 1 1/2" = 1'-0"



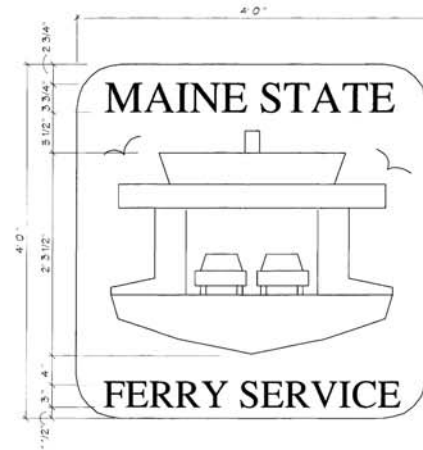
7. SIGN B  
SCALE: 1 1/2" = 1'-0"



6. SIGN A  
SCALE: 1 1/2" = 1'-0"



5. SIGN B  
SCALE: 1 1/2" = 1'-0"



4. SIGN B  
SCALE: 1 1/2" = 1'-0"

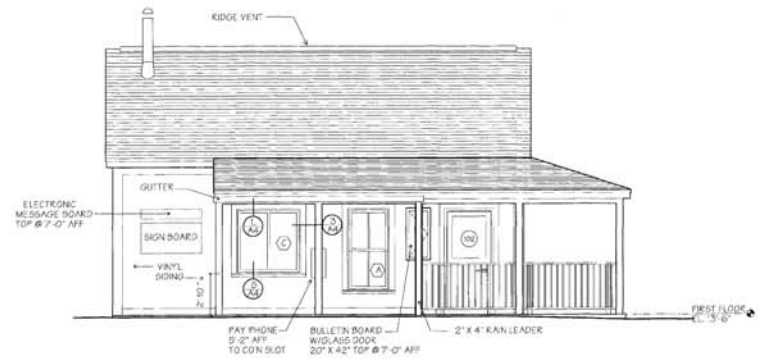


© 1997 TTH ARCHITECTS

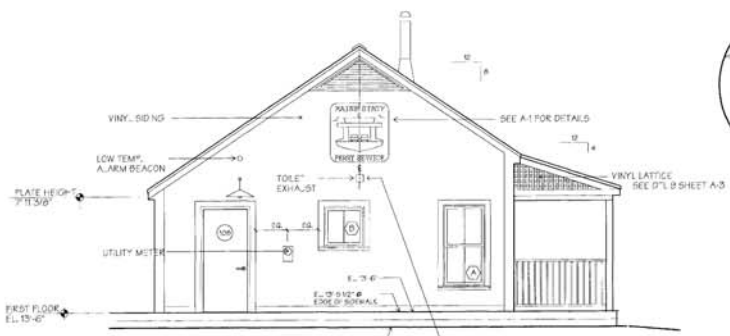
# FERRY TERMINAL BASS HARBOR, MAINE



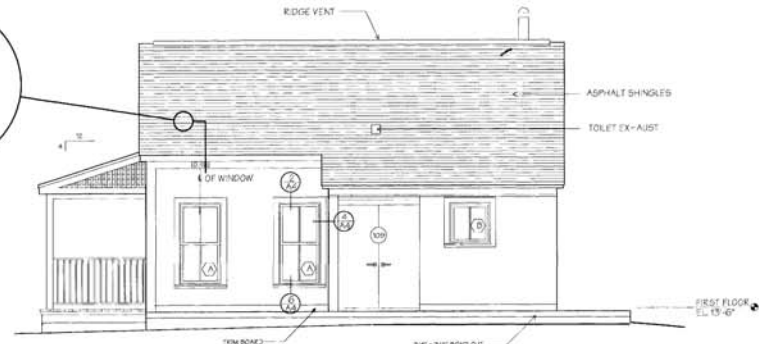
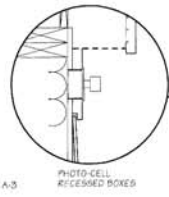
1. WEST ELEVATION  
SCALE: 1/4" = 1'-0"



2. NORTH ELEVATION  
SCALE: 1/4" = 1'-0"



3. EAST ELEVATION  
SCALE: 1/4" = 1'-0"



4. SOUTH ELEVATION  
SCALE: 1/4" = 1'-0"



TTH ARCHITECTS  
100 COMMERCIAL STREET  
PORTLAND, MAINE 04101  
TELEPHONE: 207-751-5441  
ARCHITECTURE PLANNING

CIVIL LANDSCAPE  
THE ASSOCIATES  
48 SANTRY STREET  
SOUTH PORTLAND, ME 04106

STRUCTURAL  
PINDERAM & CREER  
1711 S. ROUTE ONE  
FAIRBETH, ME 04105

MECHANICAL  
BENSON & BERRAN  
14 MUSCOY ROAD  
SCARBOROUGH, ME 04074-1982

ELECTRICAL  
ELECTRICAL DESIGN  
13 SUNDY LANE  
BASS HARBOR ROAD  
LONG ISLAND, ME 04050

REVISIONS:  
AUGUST 5, 1997

DATE:	JANUARY 15, 1997
PROJECT NO.:	3414
DRAWN BY:	TJB
CHECKED BY:	TJT
SCALE:	1/4" = 1'-0"
SHEET TITLE:	

### ELEVATIONS

SHEET

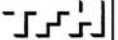
# A-2

GENERAL NOTES:  
1. REFER TO STRUCTURAL DRAWINGS FOR ALL FOUNDATION INFORMATION.  
2. ALL WINDOW HEADS TO ALIGN HORIZONTALLY.



© 1998 TFM ARCHITECTS

# FERRY TERMINAL BASS HARBOR, MAINE



TFM ARCHITECTS  
100 COMMERCIAL STREET  
PORTLAND, MAINE 04108  
TELEPHONE 303 775 4844  
ARCHITECTURE PLANNING

CIVIL ARCHITECTURE  
TECH ASSOCIATES  
100 HAWTHORNE STREET  
SOUTH PORTLAND, ME 04106

STRUCTURAL  
PONDHAM & OSTER  
120 US ROUTE ONE  
FALMOUTH, ME 04105

MECHANICAL  
ROBINSON & JORDAN  
10 MOSEY ROAD  
SCARBOROUGH, ME 04074-1582

ELECTRICAL  
ELECTRICAL DESIGN  
CONSULTANTS  
3007 PINE STREET  
LEWIS ISLAND, ME 04049

REVISIONS:

June 9, 1997  
OCTOBER 27, 1997

DATE: JANUARY 13, 1997

PROJECT NO. 9614

DRAWN BY: ENDSWARD

CHECKED BY: BEB

SCALE: AS NOTED

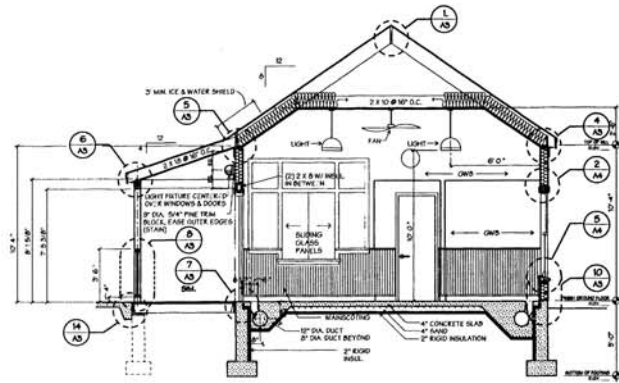
SHEET TITLE:

SECTIONS & DETAILS

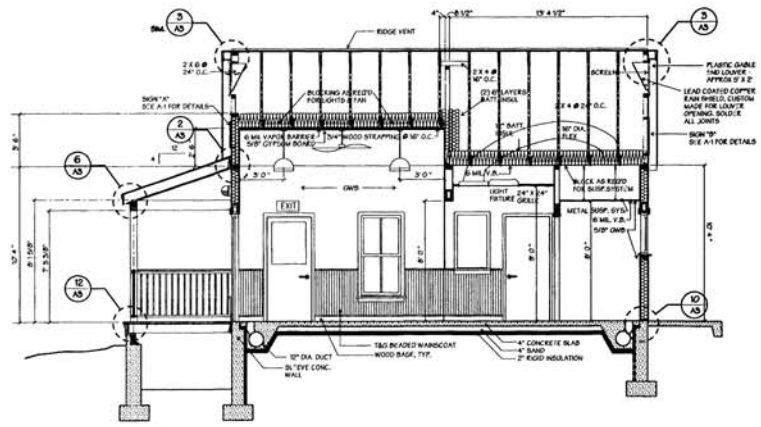
SHEET:

A-3

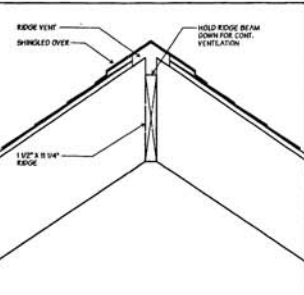
FIGURE



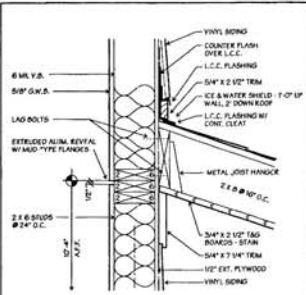
1. SECTION A  
SCALE: 1/4" = 1'-0"



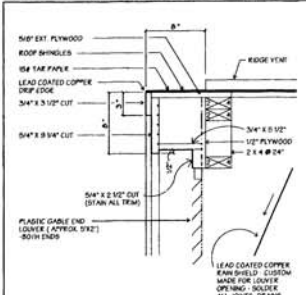
2. SECTION B  
SCALE: 1/4" = 1'-0"



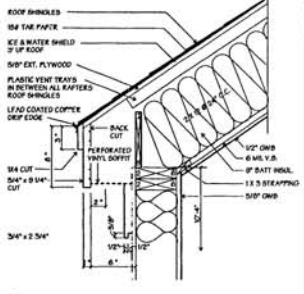
1. GABLE END DETAIL  
SCALE: 1 1/2" = 1'-0"



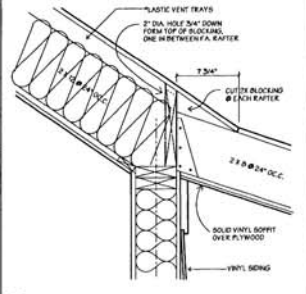
2. PORCH ROOF @ GABLE DETAIL  
SCALE: 1 1/2" = 1'-0"



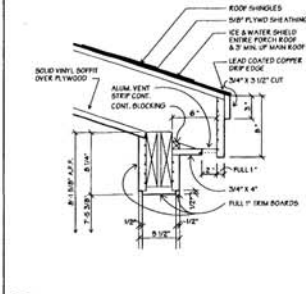
3. LOUVER DETAIL  
SCALE: 1 1/2" = 1'-0"



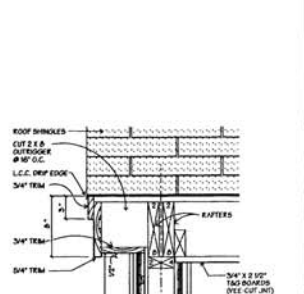
4. TYPICAL EAVE DETAIL  
SCALE: 1 1/2" = 1'-0"



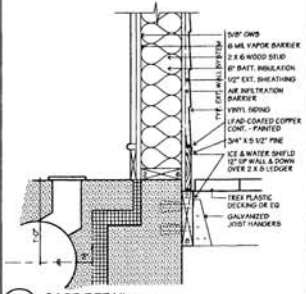
5. PORCH ROOF @ EAVE DETAIL  
SCALE: 1 1/2" = 1'-0"



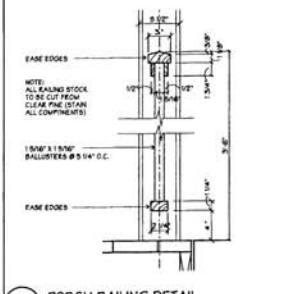
6. EAVE @ PORCH DETAIL  
SCALE: 1 1/2" = 1'-0"



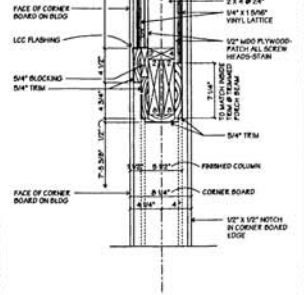
7. BASE DETAIL  
SCALE: 1 1/2" = 1'-0"



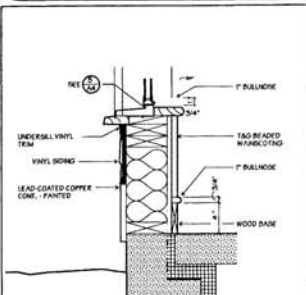
8. PORCH RAILING DETAIL  
SCALE: 1 1/2" = 1'-0"



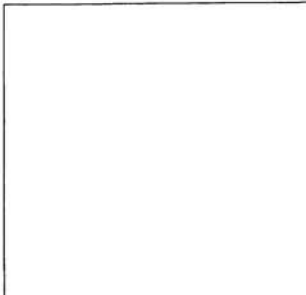
9. OMITTED  
SCALE: 1 1/2" = 1'-0"



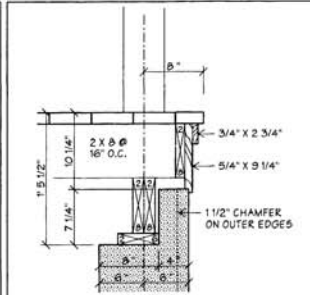
10. DETAIL  
SCALE: 1 1/2" = 1'-0"



11. DETAIL  
SCALE: 1 1/2" = 1'-0"



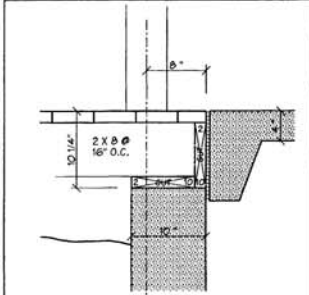
12. BASE @ PORCH DETAIL  
SCALE: 1 1/2" = 1'-0"



13. BASE @ PORCH DETAIL  
SCALE: 1 1/2" = 1'-0"

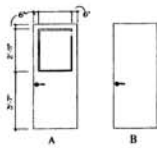


14. BASE @ PORCH DETAIL  
SCALE: 1 1/2" = 1'-0"



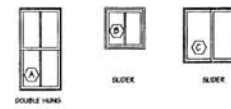
15. BASE @ PORCH DETAIL  
SCALE: 1 1/2" = 1'-0"

DOOR SCHEDULE													
DOOR NO.	DOOR SIZE	DOOR THL.	DOOR			FRAME			LABEL	THRESH.	HWM SET	REMARKS	
			MAT.	ELEV.	FIN.	MAT.	ELEV.	HEAD					JAMB
101	3'-0" x 7'-0"	1 5/8"	HM	A	PTD	HM	2	2	5	3	ALUM.	HW-1	SAFETY GLASS, INSULATED
102	3'-0" x 7'-0"	1 5/8"	HM	A	PTD	HM	2	2	5	3	ALUM.	HW-1	SAFETY GLASS, INSULATED
103	3'-0" x 7'-0"	1 5/8"	WD	B	PTD	HM	2	2	5	3	---	HW-2	
104	3'-0" x 7'-0"	1 5/8"	WD	B	PTD	HM	2	2	5	3	ALUM.	HW-3	
105	2'-4" x 7'-0"	1 5/8"	WD	B	PTD	HM	2	2	5	3	ALUM.	HW-1	
106	3'-0" x 7'-0"	1 5/8"	HM	B	PTD	HM	2	2	5	3	ALUM.	HW-1	1 HOUR RATED
107	3'-0" x 7'-0"	1 5/8"	HM	B	PTD	HM	2	2	5	3	ALUM.	HW-1	
108	3'-0" x 7'-0"	1 5/8"	HM	B	PTD	HM	2	2	5	3	ALUM.	HW-1	INSULATED
109	2 @ 2'-0" x 7'-0"	1 5/8"	HM	B	PTD	HM	2	2	5	3	ALUM.	HW-1	INSULATED



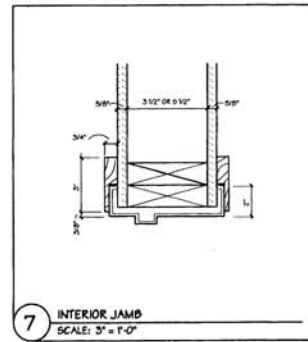
DOOR ELEVATIONS

WINDOW SCHEDULE			
WINDOW TYPE	OPERATION	ROUGH OPENING (W x H)	REMARKS
A	DOUBLE HUNG	2'-10 3/8" x 5'-5 3/4"	FACTORY MUL DOOR UNITS
B	SLIDER	2'-0" x 3'-0 5/8"	
C	SLIDER	4'-6 5/4" x 4'-2 1/2"	

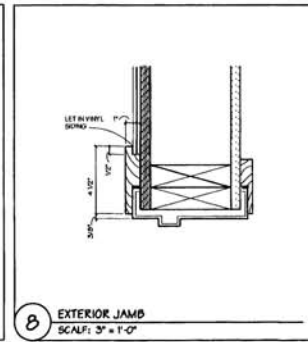


WINDOW ELEVATIONS

ROOM NAME	WALLS				FLOOR	CEILING	REMARKS
	NORTH	EAST	SOUTH	WEST			
WAITING	PAINT	PAINT	PAINT	PAINT	VCT	GWB	PANDED 1&G WANSKOT
CORRIDOR	PAINT	PAINT	PAINT	PAINT	VCT	2-2" ACT	PANDED 1&G WANSKOT
OFFICE	PAINT	PAINT	PAINT	PAINT	CARPET	2-2" ACT	
STORAGE	PAINT	PAINT	PAINT	PAINT	CARPET	2-2" ACT	
MECH.	PAINT	PAINT	PAINT	PAINT	VCT	GWB	
SMALL TOILET	PAINT	PAINT	PAINT	PAINT	CERAMIC TILE	GWB	CERAMIC TILE WANSKOT
LARGE TOILET	PAINT	PAINT	PAINT	PAINT	CERAMIC TILE	GWB	CERAMIC TILE WANSKOT
UTILITY CLOSET	PAINT	PAINT	PAINT	PAINT	VCT	GWB	
OIL TANK SHELTER	INSULATION ONLY				INSULATE	INSULATE	

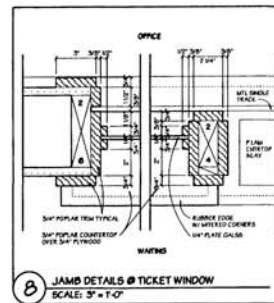


7 INTERIOR JAMB  
SCALE: 3" = 1'-0"

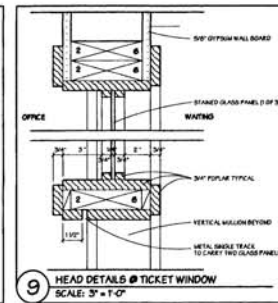


8 EXTERIOR JAMB  
SCALE: 3" = 1'-0"

DOOR DETAILS  
SCALE: 3" = 1'-0"

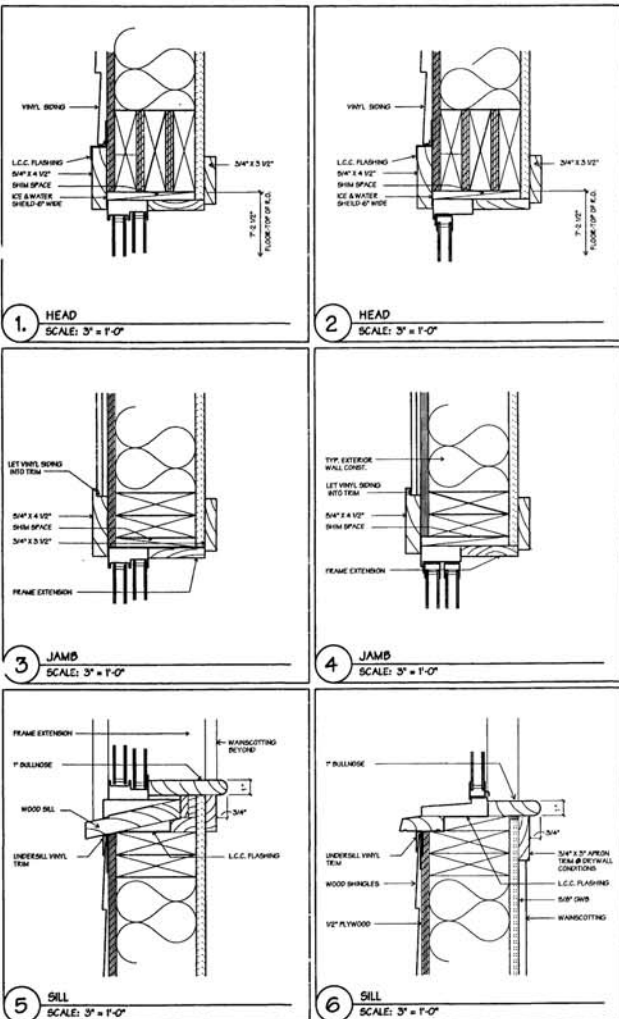


8 JAMB DETAILS @ TICKET WINDOW  
SCALE: 3" = 1'-0"



9 HEAD DETAILS @ TICKET WINDOW  
SCALE: 3" = 1'-0"

TICKET WINDOW DETAILS  
SCALE: 3" = 1'-0"



1 HEAD  
SCALE: 3" = 1'-0"

2 HEAD  
SCALE: 3" = 1'-0"

3 JAMB  
SCALE: 3" = 1'-0"

4 JAMB  
SCALE: 3" = 1'-0"

5 SILL  
SCALE: 3" = 1'-0"

6 SILL  
SCALE: 3" = 1'-0"

WINDOW DETAILS  
SCALE: 3" = 1'-0"



© 1977 TFM ARCHITECTS

FERRY TERMINAL  
BASS HARBOR, MAINE



TFM ARCHITECTS  
400 COMMERCIAL STREET  
PORTLAND, MAINE 04109  
TELEPHONE 301-770-8444  
ARCHITECTURE PLANNING

CIVIL & ARCHITECTURE  
TRUCK ASSOCIATES  
100 PINE STREET  
BOSTON, MASSACHUSETTS 02114

STRUCTURAL  
PROGRAM & DESIGN  
700 US ROUTE 1  
FALMOUTH, MAINE 04103

MECHANICAL  
KROHN & JORDAN  
18 WATER ROAD  
SCARBOROUGH, MAINE 04074-1382

ELECTRICAL  
ELECTRICAL DESIGN  
CONSULTANTS  
BERRY HUNT ROAD  
LEWIS ISLAND, ME 04040

REVISIONS

June 9, 1997  
OCTOBER 27, 1997

DATE: JANUARY 15, 1997

PROJECT NO.: 8616

DRAWN BY: DMYSKO

CHECKED BY: RED

SCALE: AS NOTED

SHEET TITLE:

WINDOW/DOOR DETAILS  
& SCHEDULES

SHEET:

A-4

PTCHL



© 1996 TTH ARCHITECTS

# FERRY TERMINAL

TREMONT, MAINE



TTH ARCHITECTS  
300 COMMERCIAL STREET  
PORTLAND, MAINE 04103  
TELEPHONE: 207-755-6441  
ARCHITECTURE PLANNING

CIVIL ASSOCIATE:  
TEC ASSOCIATES  
26 LAWYER STREET  
SOUTH PORTLAND, ME 04106

STRUCTURAL:  
PONDHAM & CREER  
1755 BOSTON ROAD  
FAIRBANKS, ME 04105

MECHANICAL:  
BUNSON AND JORDAN  
84 BRIDGE ROAD  
SCARBOROUGH, ME 04874-1942

ELECTRICAL:  
ELECTRICAL DESIGN  
CONSULTANTS  
8880 PORT ROAD  
LONG ISLAND, ME 04150

REVISIONS:  
AUGUST 5, 1998

DATE: AUGUST 26, 1998

PROJECT NO.: 9614

DRAWN BY: TJB

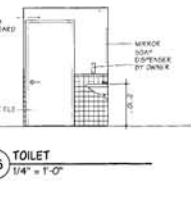
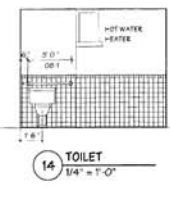
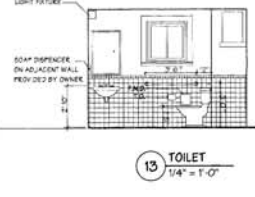
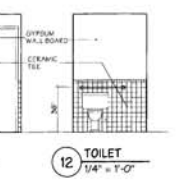
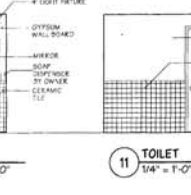
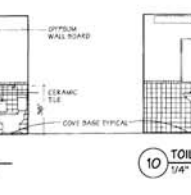
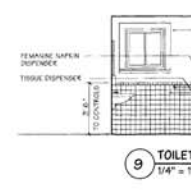
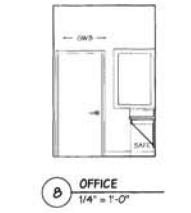
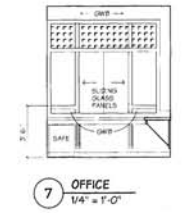
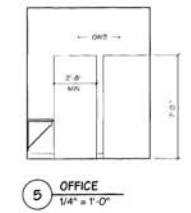
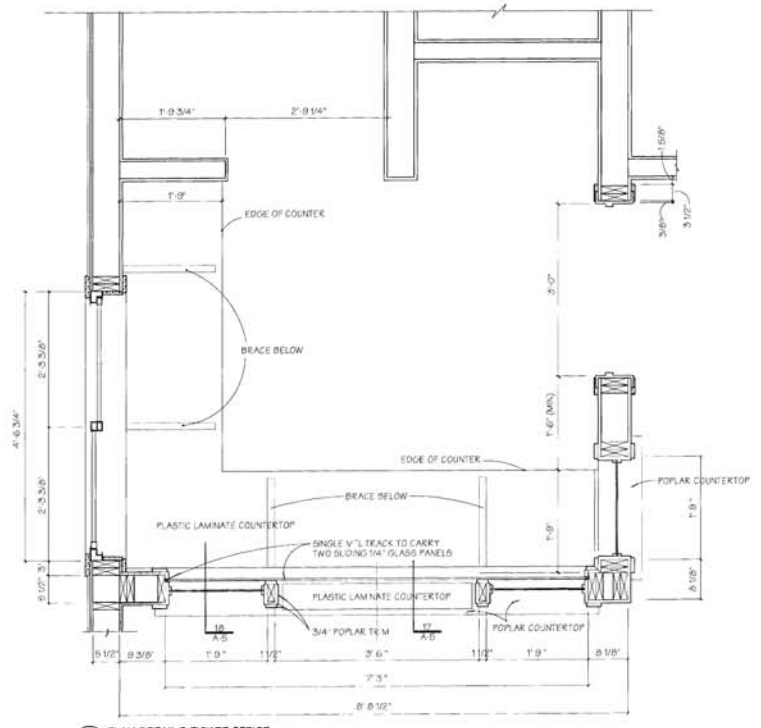
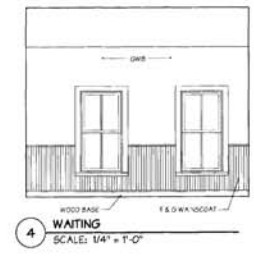
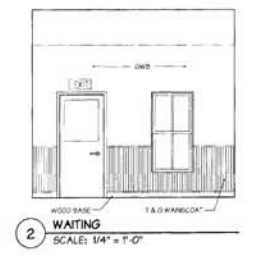
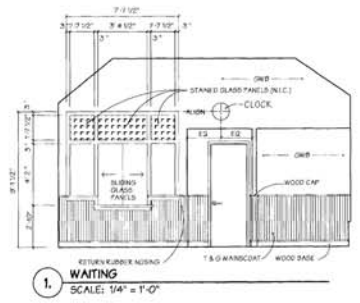
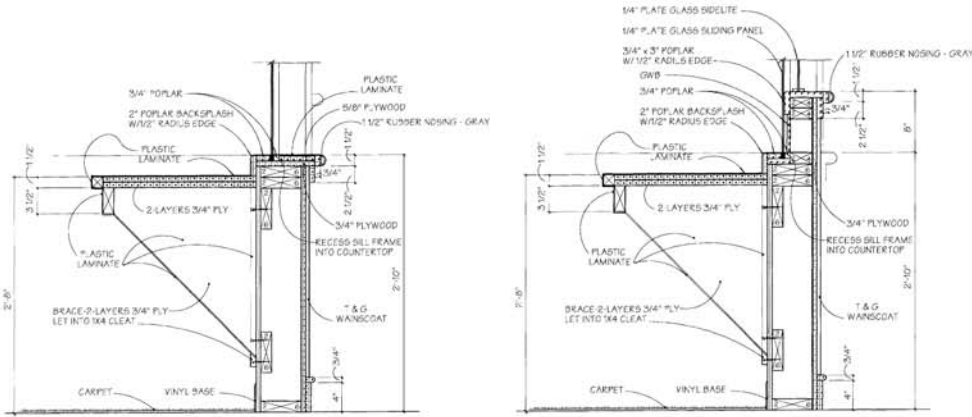
CHECKED BY: TTT

SCALE: 1/4" = 1'-0"

SHEET TITLE:

## INTERIOR ELEVATIONS

SHEET:



**NOTES**

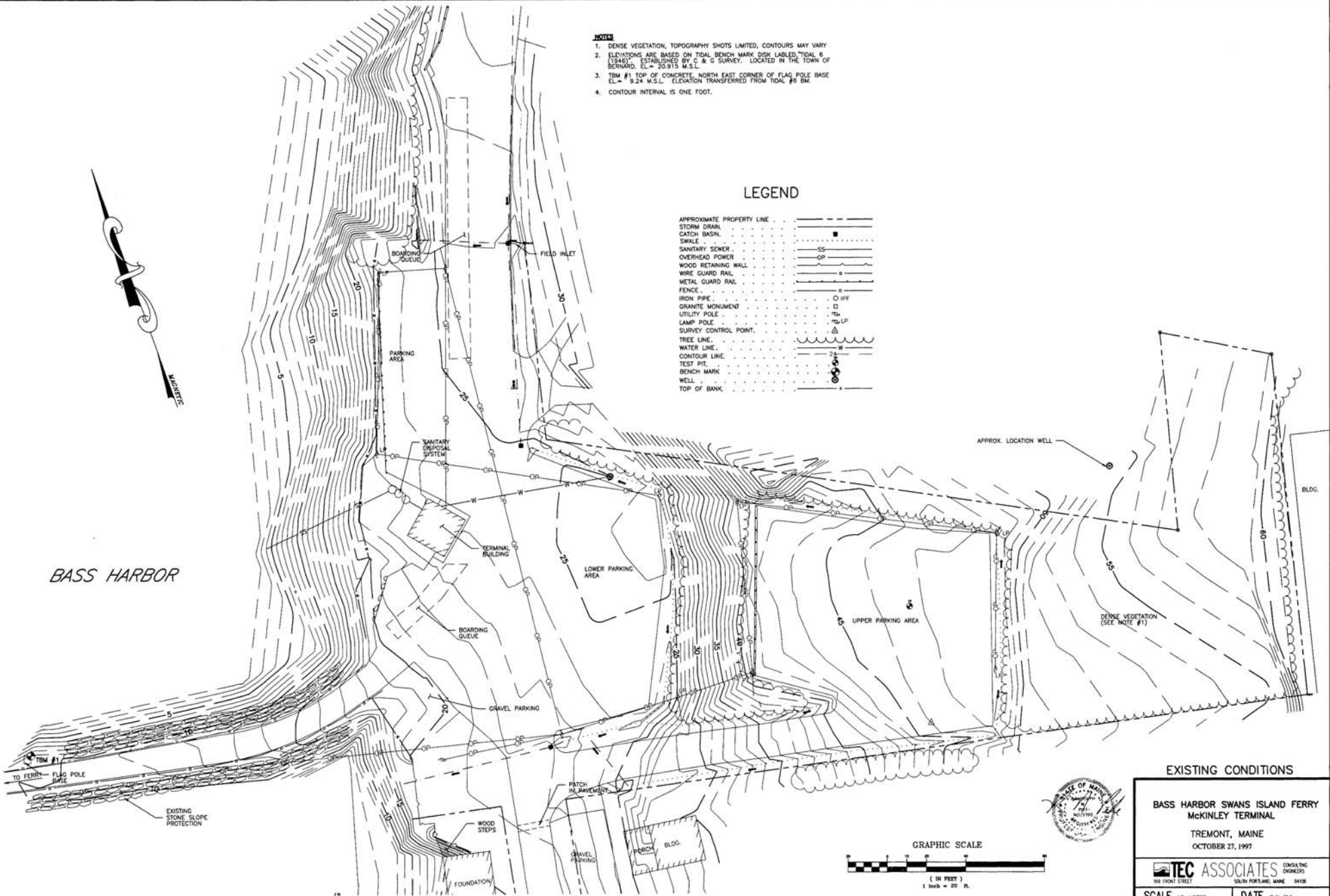
1. DENSE VEGETATION, TOPOGRAPHY SHOTS LIMITED, CONTOURS MAY VARY
2. ELEVATIONS ARE BASED ON TIDAL BENCH MARK DISK LABELED, TIDAL 6 (1940), ESTABLISHED BY C & G SURVEY, LOCATED IN THE TOWN OF BERNARD, EL. = 20.915 M.S.L.
3. TBM #1 TOP OF CONCRETE, NORTH EAST CORNER OF FLAG POLE BASE EL. = 9.24 M.S.L. ELEVATION TRANSFERRED FROM TIDAL #6 BM.
4. CONTOUR INTERVAL IS ONE FOOT.

**LEGEND**

APPROXIMATE PROPERTY LINE	---
STORM DRAIN	---
CATCH BASIN	■
SWALE	---
SANITARY SEWER	SS
OVERHEAD POWER	OP
WOOD RETAINING WALL	---
WIRE GUARD RAIL	---
METAL GUARD RAIL	---
FENCE	---
IRON PIPE	○ IFF
GRANITE MONUMENT	□ D
UTILITY POLE	○ U
LAMP POLE	○ LP
SURVEY CONTROL POINT	△
TREE LINE	---
WATER LINE	---
CONTOUR LINE	---
TEST PIT	○ TP
BENCH MARK	○ BM
WELL	○ W
TOP OF BANK	---



BASS HARBOR



**EXISTING CONDITIONS**

BASS HARBOR SWANS ISLAND FERRY  
 MCKINLEY TERMINAL  
 TREMONT, MAINE  
 OCTOBER 27, 1997



**TEC ASSOCIATES** CONSULTING ENGINEERS  
 169 FRONT STREET SOUTH PORTLAND, MAINE 04106

SCALE AS NOTED	DATE 7/1/98
9623	DESIGNED BY JOL
	CHECKED BY C1

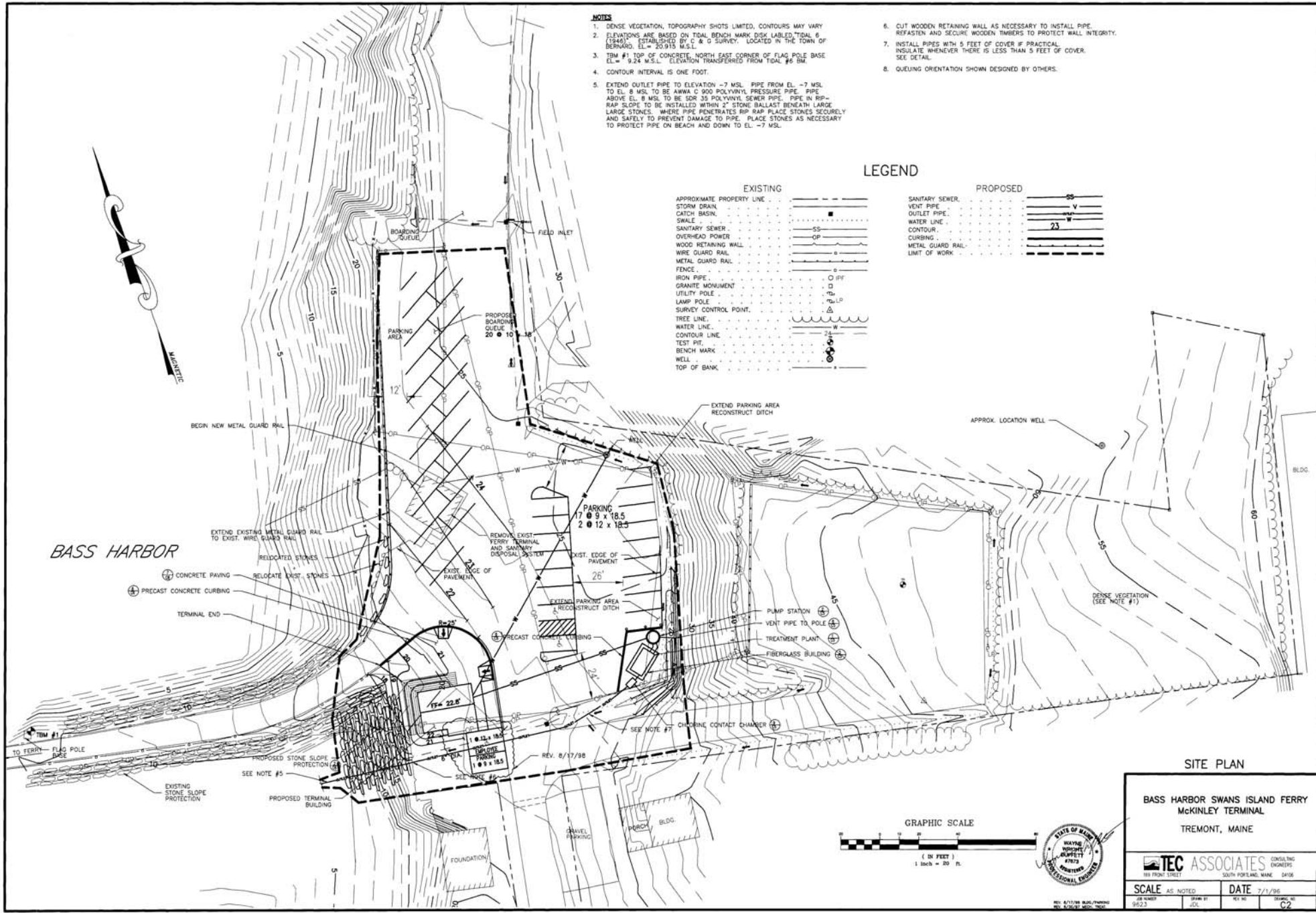
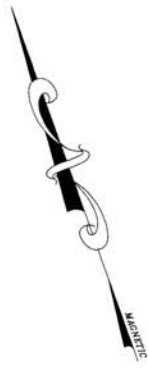
**NOTES**

1. DENSE VEGETATION, TOPOGRAPHY SHOTS LIMITED, CONTOURS MAY VARY
2. ELEVATIONS ARE BASED ON TIDAL BENCH MARK DISK LABELED "TIDAL 6 (1944)" ESTABLISHED BY C & G SURVEY, LOCATED IN THE TOWN OF BERNARD, EL. = 20.915 M.S.L.
3. TBM #1 TOP OF CONCRETE, NORTH EAST CORNER OF FLAG POLE BASE EL. = 9.24 M.S.L. ELEVATION TRANSFERRED FROM TIDAL #6 BM
4. CONTOUR INTERVAL IS ONE FOOT.
5. EXTEND OUTLET PIPE TO ELEVATION -7 MSL. PIPE FROM EL. -7 MSL TO EL. 8 MSL TO BE AWWA C 900 POLYVINYL PRESSURE PIPE. PIPE ABOVE EL. 8 MSL TO BE SDR 35 POLYVINYL SEWER PIPE. PIPE IN RIP- RAP SLOPE TO BE INSTALLED WITHIN 2" STONE BALLAST BENEATH LARGE LARGE STONES. WHERE PIPE PENETRATES RIP RAP PLACE STONES SECURELY AND SAFELY TO PREVENT DAMAGE TO PIPE. PLACE STONES AS NECESSARY TO PROTECT PIPE ON BEACH AND DOWN TO EL. -7 MSL.

6. CUT WOODEN RETAINING WALL AS NECESSARY TO INSTALL PIPE. REFASTEN AND SECURE WOODEN TIMBERS TO PROTECT WALL INTEGRITY.
7. INSTALL PIPES WITH 5 FEET OF COVER IF PRACTICAL. INSULATE WHENEVER THERE IS LESS THAN 5 FEET OF COVER. SEE DETAIL.
8. QUEUING ORIENTATION SHOWN DESIGNED BY OTHERS.

**LEGEND**

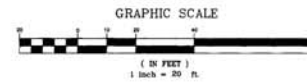
EXISTING	PROPOSED
APPROXIMATE PROPERTY LINE	SANITARY SEWER
STORM DRAIN	VENT PIPE
CATCH BASIN	OUTLET PIPE
SWALE	WATER LINE
SANITARY SEWER	CONTOUR
OVERHEAD POWER	CURBING
WOOD RETAINING WALL	METAL GUARD RAIL
WIRE GUARD RAIL	LIMIT OF WORK
METAL GUARD RAIL	
FENCE	
IRON PIPE	
GRANITE MONUMENT	
UTILITY POLE	
LAMP POLE	
SURVEY CONTROL POINT	
TREE LINE	
WATER LINE	
CONTOUR LINE	
TEST PIT	
BENCH MARK	
WELL	
TOP OF BANK	



**BASS HARBOR**

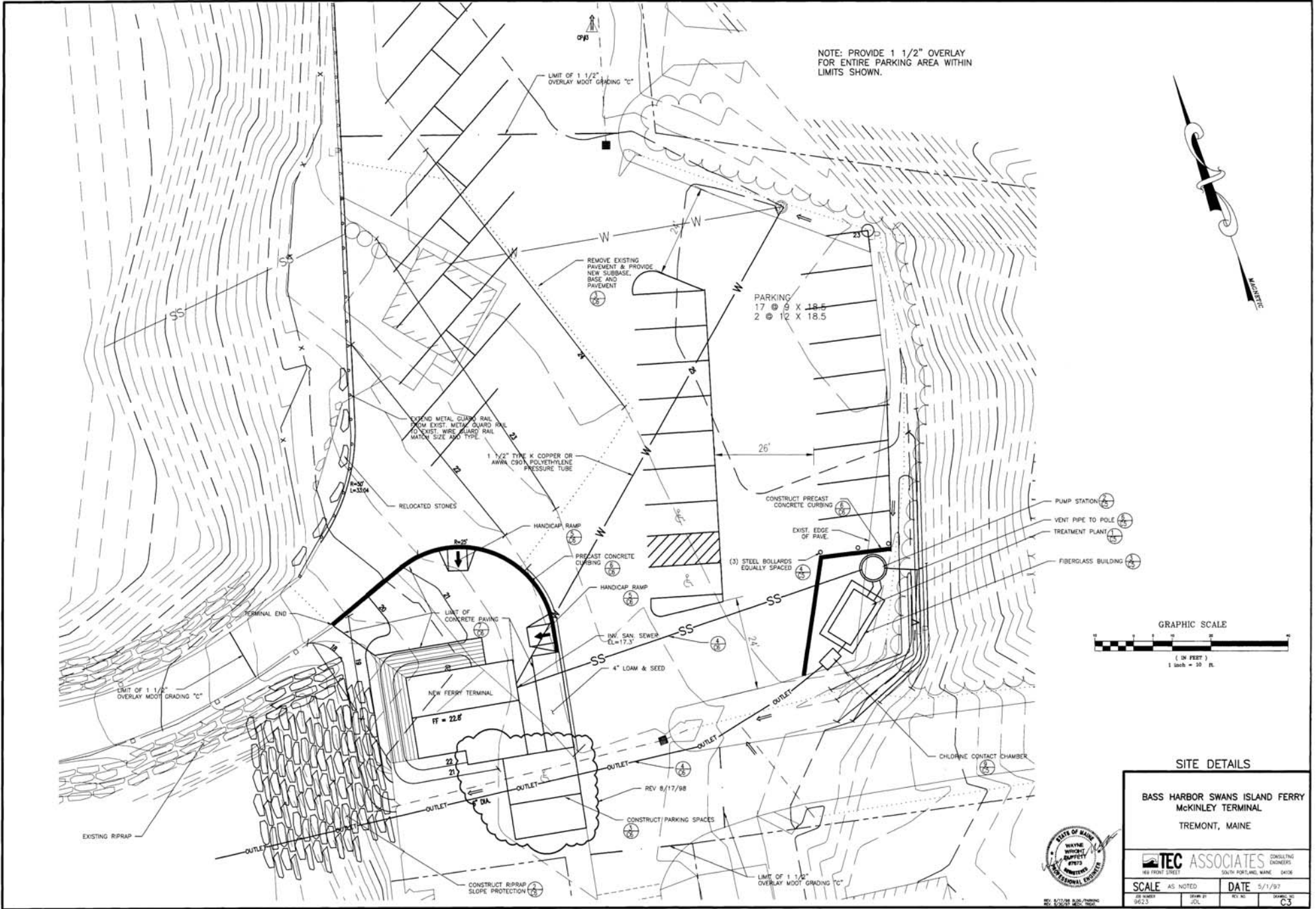
**SITE PLAN**

BASS HARBOR SWANS ISLAND FERRY  
MCKINLEY TERMINAL  
TREMONT, MAINE

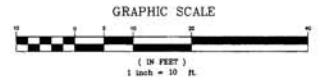


**TEC ASSOCIATES** CONSULTING ENGINEERS  
189 FRONT STREET SOUTH PORTLAND, MAINE 04106


SCALE AS NOTED	DATE 7/1/98
BY JUC	REV. NO. C2



NOTE: PROVIDE 1 1/2" OVERLAY FOR ENTIRE PARKING AREA WITHIN LIMITS SHOWN.

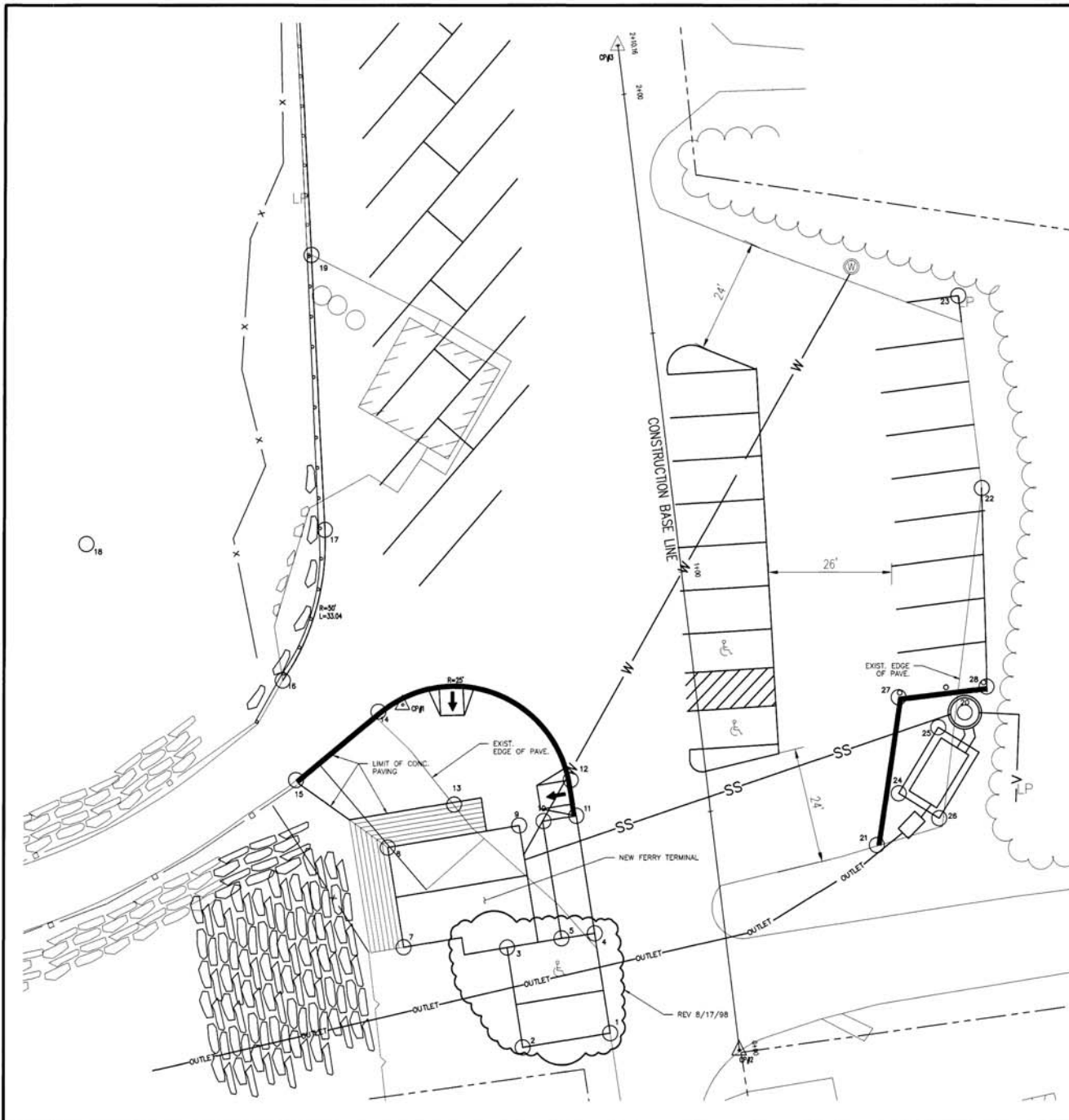


SITE DETAILS

<b>BASS HARBOR SWANS ISLAND FERRY MCKINLEY TERMINAL TREMONT, MAINE</b>			
			
SCALE AS NOTED		DATE 5/11/97	
JOB NO. 9623	DRAW BY JOL	REV NO.	SHEET NO. C-3



© 1997/98/99/00/01/02/03/04/05/06/07/08/09/10/11/12/13/14/15/16/17/18/19/20

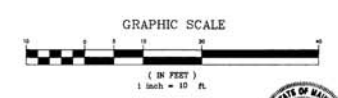


REV. 8/17/98

POINT	STATION	OFFSET	DESCRIPTION
1.	0+6.89	28.45' L.	EP
2.	0+6.27	45.01' LT	EP
3.	0+27.25	45.72' LT	EP
4.	0+27.88	27.16' LT	EP
5.	0+27.70	33.93' LT	CORN. CONC. WALK
6.	0+27.03	67.30' LT	BC
7.	0+51.02	68.11' LT	BC
8.	0+52.09	40.13' LT	BC
9.	0+52.35	34.95' LT	CORN. CONC. WALK
10.	0+52.60	28.00' LT	CORN. CONC. WALK
11.	0+60.12	28.28' LT	RAD. FACE OF CONC. CURB
12.	0+58.15	53.20' LT	CL RAD.
13.	0+79.25	66.61' LT	RAD. FACE OF CONC. CURB
14.	0+67.34	85.84' LT	CORN CONC. END OF CURB
15.	0+88.20	85.71' LT	EP/RAD.
16.	1+18.11	73.17' LT	EP/RAD.
17.	1+21.44	123.08' LT	CL RAD.
18.	1+75.09	69.06' LT	EP
19.	0+63.72	55.28' RT	PUMP STA
20.	0+38.69	33.63' RT	FACE OF CONC. CURB
21.	1+09.54	64.45' RT	EP
22.	1+49.80	64.36' RT	EP
23.	0+48.77	34.46' RT	BC
24.	0+61.33	49.38' RT	BC
25.	0+42.58	47.31' RT	BC
26.	0+68.5	41.87' RT	FACE OF CONC. CURB
27.	0+68.59	60.46' RT	FACE OF CONC. CURB
28.			

CONTROL POINTS

POINT	NORTHING	EASTING	DESCRIPTION
CP#1	4820.47	4881.21	PK NAL
CP#2	4728.79	4923.22	PK NAL
CP#3	4933.69	4969.98	PK NAL



GEOMETRIC

BASS HARBOR SWANS ISLAND FERRY  
MCKINLEY TERMINAL  
TREMONT, MAINE

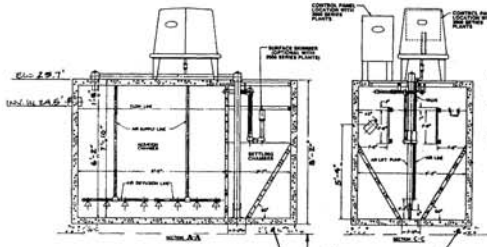
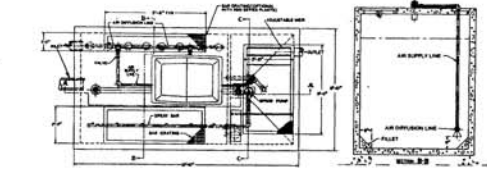
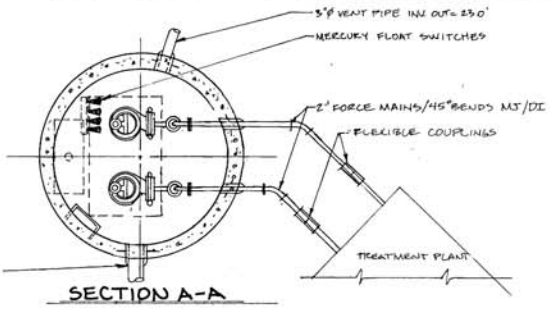
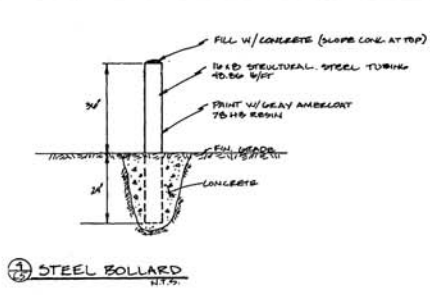
TEC ASSOCIATES ENGINEERS  
100 FRONT STREET  
SOUTH PORTLAND, MAINE 04106

SCALE AS NOTED DATE 5/17/97

REV. 8/17/98 BLOS/PARKING  
REV. 6/27/97 MECH. 10241

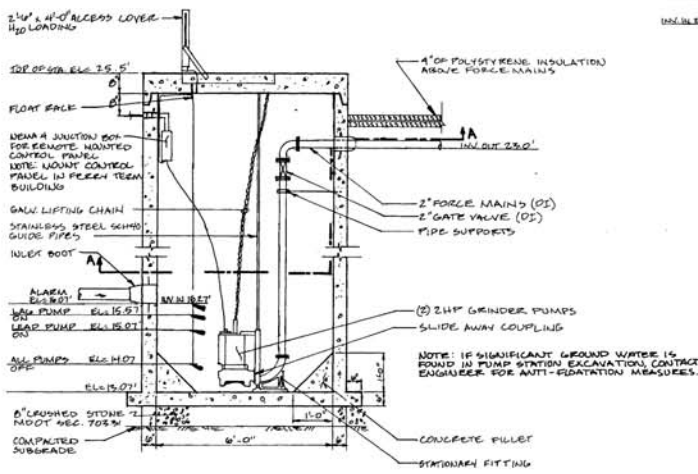
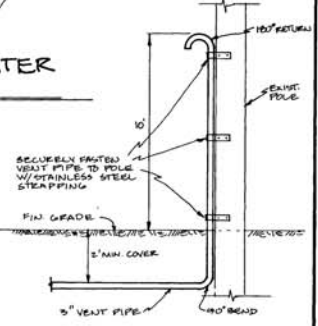
WAYNE WINN/CURFEY P/E  
PROFESSIONAL PROJECT

DATE 5/17/97  
SCALE AS NOTED  
REV. NO. 1  
SHEET NO. 1  
PROJECT NO. C4



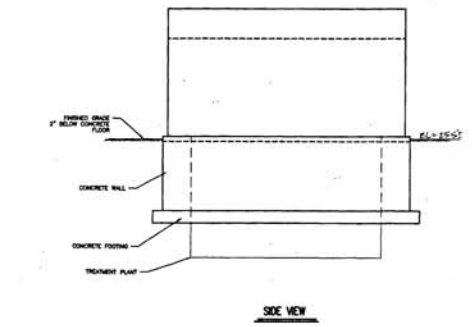
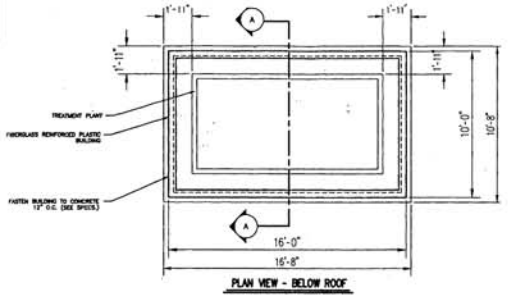
NOTES  
 1. TO MINIMIZE FALL THRU PLANT, LOCATE INLET INVERT 8" ABOVE FLOW LINE.  
 2. IF SIGNIFICANT GROUND WATER IS FOUND IN TREATMENT PLANT EXCAVATION CONTACT ENGINEER FOR ANTI-FLUATATION MEASURES.  
 3. INSTALL 4" OF POLYURETHANE INSULATION BETWEEN PUMP STATION AND TREATMENT PLANT, TREATMENT PLANT AND CHLORINE CONTACT CHAMBER, AND FROM CHLORINE CONTACT CHAMBER UNTIL 4' OF COVER IS REACHED. BEYOND 4 FEET OF COVER, INSTALL 2" OF INSULATION UNTIL 5 FEET OF COVER IS REACHED.

**COMMERCIAL WASTEWATER TREATMENT PLANT**  
 N.T.S.

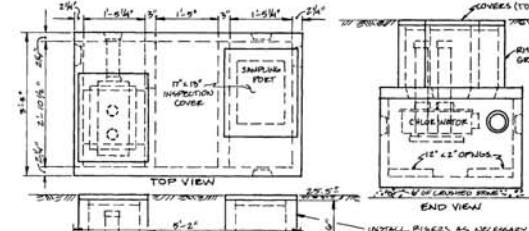
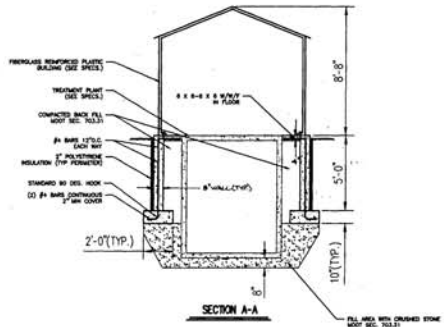


**SECTION VIEWS - SUBMERSIBLE PUMP STATION**  
 1/2" = 1'-0"

**TYPICAL VENT PIPE TERMINUS**  
 N.T.S.

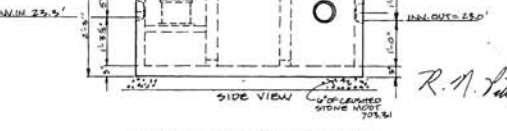


**FIBERGLASS REINFORCED PLASTIC BUILDING**  
 N.T.S.



NOTES  
 1. 1500-1500 GAL/DAY SAN 100 SANITIZ. CHLORINATOR  
 2. CONG. 4000 PSI AFTER 28 DAYS  
 3. ALL STRUCTURES CAPABLE OF SUPPORTING H-20 LOADING  
 4. CHLORINATOR TO BE CHECKED MONTHLY. ADD CHLORINE TABLETS AS NECESSARY

**SEWAGE DISPOSAL SYSTEM DETAILS**

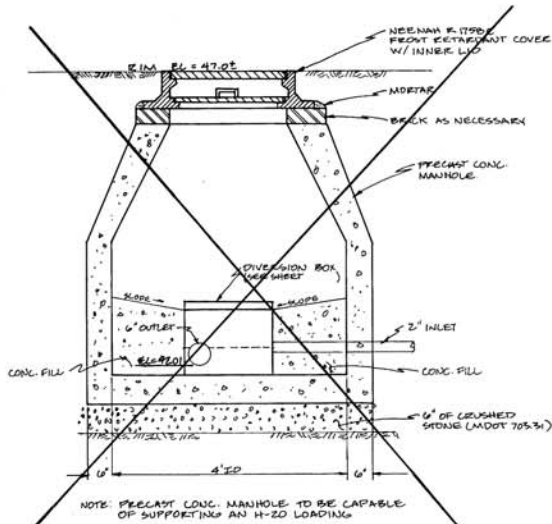


**PRECAST CONCRETE CHLORINE CONTACT CHAMBER**  
 N.T.S.

BASS HARBOR SWANS ISLAND FERRY  
 MCKINLEY TERMINAL

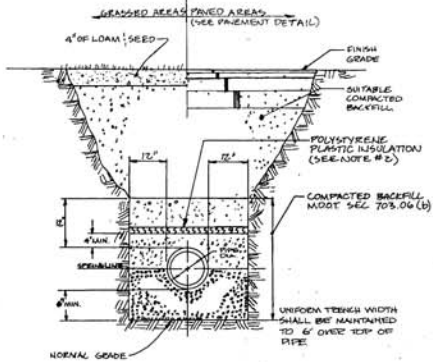
TREMONT, MAINE  
 OCTOBER 27, 1997

**TEC ASSOCIATES** CONSULTING ENGINEERS  
 183 Front Street, South Portland, Maine 04108  
 SCALE AS NOTED DATE 10/7/96  
 DRAWING NO. C-5  
 REV. NO. 1  
 DRAWN BY J.D.L.  
 CHECKED BY R.A.L.  
 DATE 7/2/07

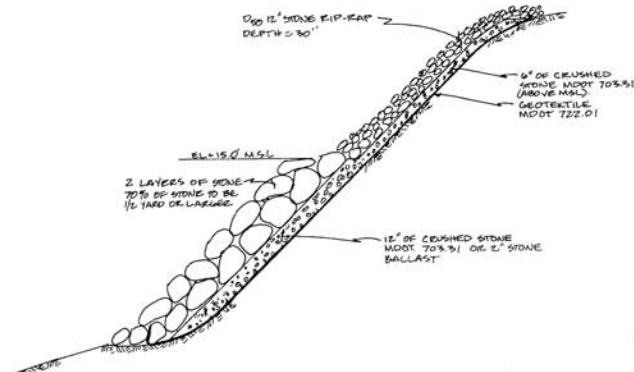


**1 DIVERSION BOX ACCESS MANHOLE**  
N.T.S.

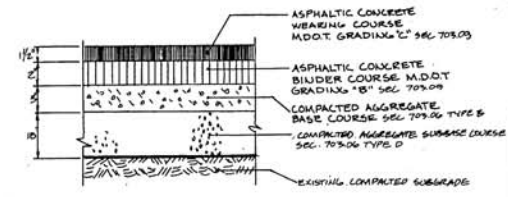
**NOTES**  
 1. SEE PAVEMENT DETAILS FOR PAVING / PATCHING REQUIREMENTS FOR ROAD / PARKING AREAS.  
 2. WHERE DEPTH OF COVER IS LESS THAN 5'-0" BEDDING IS TO BE EXTENDED TO 4" ABOVE THE TOP OF THE PIPE AND 2" OF POLYSTYRENE PLASTIC INSULATION IS TO BE INSTALLED



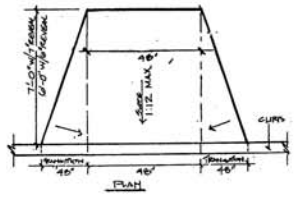
**4 TYPICAL TRENCH SECTION**  
N.T.S.



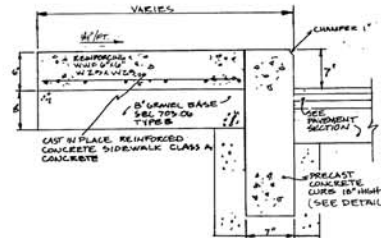
**2 STONE SLOPE PROTECTION**  
N.T.S.



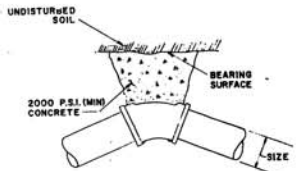
**3 BITUMINOUS CONCRETE PAVEMENT**  
N.T.S.



**5 Sidewalk Ramp Detail**  
N.T.S.

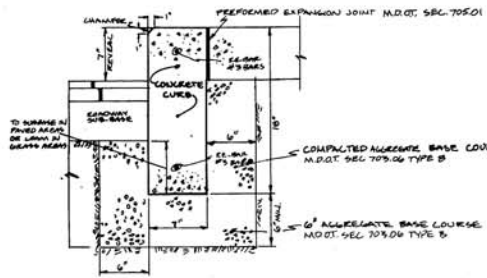


**7 CONCRETE PAVING DETAIL**  
N.T.S.

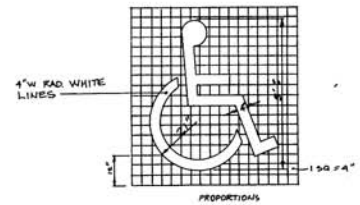


**8 FORCE MAIN THRUST BLOCK DETAIL**  
NO SCALE

SIZE IN	TEE, 90°	45°	22 1/2°	11 1/4°
2	1.0	1.0	1.0	1.0
3	1.0	1.0	1.0	1.0
4	1.2	1.0	1.0	1.0
6	2.6	1.4	1.0	1.0
8	4.6	2.5	1.4	1.0
10	7.2	3.9	2.0	1.0
12	10.4	5.6	2.8	1.5
14	14.2	7.7	3.9	2.0
18	18.5	10.0	5.0	2.5
18	23.4	12.7	6.4	3.3



**6 CONCRETE CURB**  
N.T.S.



**9 HANDICAP SYMBOL**  
N.T.S.

**DETAILS**

BASS HARBOR SWANS ISLAND FERRY  
MCKINLEY TERMINAL

TREMONT, MAINE  
OCTOBER 27, 1997

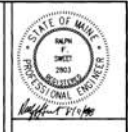
**TEC ASSOCIATES** CONSULTING ENGINEERS  
169 Front Street South Portland, Maine 04106

SCALE AS NOTED DATE 10/7/96  
 JOB NO. 9623 DRAWN BY JDL REV. NO. 0 DRAWING NO. C-6

*R.N. King*

REV. 7/2/07

P-1211



# FERRY TERMINAL FOR BASS HARBOR, MAINE

**T F H ARCHITECTS**  
100 COMMERCIAL STREET  
PORTLAND, MAINE 04101  
TELEPHONE 207 775 8141  
ARCHITECTURE AND PLANNING

**CITY/LANDSCAPE**  
ENGINEERS & ASSOCIATES  
175 S. CLAYTON ST.  
PORTLAND, MAINE 04106  
207-781-1500

**STRUCTURAL ENGINEERS**  
FORRESTER & GREEN  
175 S. CLAYTON ST.  
PORTLAND, MAINE 04106  
207-781-1500

**MECHANICAL ENGINEERS**  
FORRESTER & GREEN  
175 S. CLAYTON ST.  
PORTLAND, MAINE 04106  
207-781-1500

**ELECTRICAL ENGINEERS**  
ELECTRICAL DESIGN CONSULTANTS  
215 Park Ave.  
Long Beach, Maine 04060  
207-788-1643

**REVISIONS**

As of 1998

DATE JAN 28, 1997

FILE NAME BASS-E1

DRAWN BY BMC

SCALE 1" = 4'

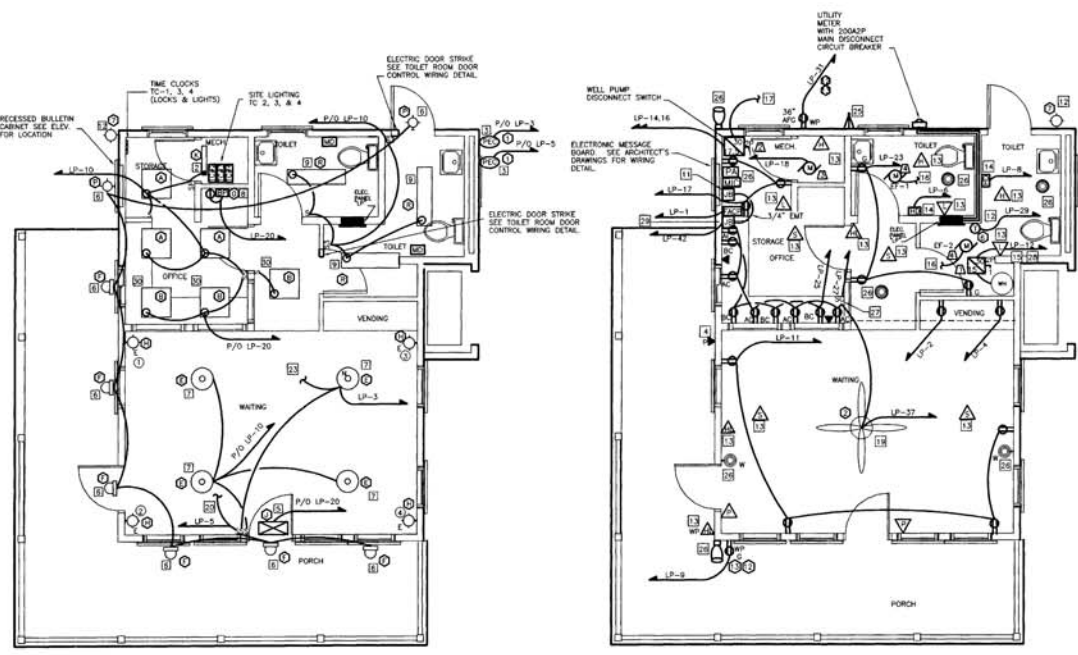
DRAWING TITLE

**ELECTRICAL PLAN AND ELEVATIONS SYMBOLS AND NOTES**

DRAWING NO.

# E1

11/2/98



**LIGHTING PLAN**  
SCALE: 1/4" = 1'

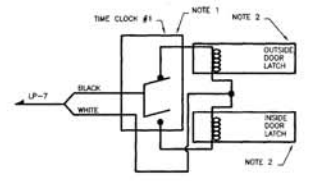
**POWER PLAN**  
SCALE: 1/4" = 1'

**SYMBOLS**

- DUPLEX RECEPTACLE-ABOVE COUNTER
- DUPLEX RECEPTACLE-BELOW COUNTER
- DUPLEX RECEPTACLE-GFCI TYPE
- DUPLEX RECEPTACLE-WEATHER PROOF GFCI TYPE
- SINGLE RECEPTACLE OUTLET
- S SINGLE POLE LIGHT SWITCH
- S3 SINGLE POLE THREE WAY LIGHT SWITCH
- SP LIGHT SWITCH WITH PILOT LIGHT
- LETTER REFERS TO LUMINAIRE SCHEDULE ITEM
- FLUORESCENT LUMINAIRE
- WALL MOUNTED LIGHT FIXTURE
- △ FIRE ALARM SYSTEM STROBE ONLY-30 CANDLEA
- △ FIRE ALARM SYSTEM HEAT DETECTOR
- △ SMOKE DETECTOR
- △ EMERGENCY LIGHTING BATTERY PACK
- E WALL MOUNTED EMERGENCY LIGHT
- MF ABOVE FINISHED FLOOR
- FA FIRE ALARM CONTROL PANEL
- △ FIRE ALARM UNIT-110 CANDLEA
- △ FIRE ALARM HORN/STROBE WEATHERPROOF-110 CANDLEA
- △/G ABOVE FINISHED GRADE
- THERMOSTAT
- FLUSH MOUNTED WALL LIGHT
- CANOPY LUMINAIRE
- ELECTRONIC DOOR STRIKE
- SC PADDLE FAN SPEED CONTROL
- HAND DRIVER
- △ FIRE ALARM PULL STATION
- COIN OPERATED TELEPHONE
- NUMBER REFERS TO ITEM ON MATERIAL LIST
- PHOTO ELECTRIC CONTROL SWITCH
- PENDANT MOUNTED LUMINAIRE
- PENDANT MOUNTED LUMINAIRE - NIGHT LIGHT
- NUMBER REFERS TO CONSTRUCTION NOTE
- EXIT SIGN
- △ NUMBER REFERS TO ITEM ON EQUIPMENT LOAD SCHEDULE
- WATER HEATER
- 240 VOLT BRANCH CIRCUIT
- BRANCH CIRCUIT CONTINUED-SEE NOTES
- FUSED DISCONNECT SWITCH, RATED 30 AMP FUSED AT 15 AMPS, 2-POLE, NEMA-1
- MOTOR OPERATED EQUIPMENT
- TELEPHONE OUTLET
- PAY TELEPHONE OUTLET
- JUNCTION BOX
- THE CLOCK NUMBER 1
- PUBLIC ADDRESS AMPLIFIER, AM/TM TUNER
- FLUSH MOUNTED CEILING SPEAKER UNIT
- WALL MOUNTED PA SPEAKER UNIT
- EXTERIOR SPEAKER-WEATHERPROOF HORN
- DESK MICROPHONE AND CALL SWITCH

**CONSTRUCTION NOTES**

- 1 NOT USED
- 2 WALL MOUNT LIGHT FIXTURE ABOVE DOOR.
- 3 MOUNT PHOTOCELL ON UNDERSIDE OF SOFFIT AIMED AWAY FROM APERTURAL LIGHT SOURCES.
- 4 VERIFY MOUNTING HEIGHT WITH NEW ENGLAND TELEPHONE BEFORE ROUGH-IN. PAY PHONE RECEPTACLE AND POWER OUTLET MUST BE HANDICAPPED ACCESSIBLE.
- 5 EDGE LIT EXIT SIGN HAS RECESSED SELF-CONTAINED BATTERY AND CHARGER. COORDINATE DOOR HEATER CONSTRUCTION TO CENTER EXIT SIGN'S RECESSED BACKBOX. CONNECT TO LINE SIDE OF WAITING AREA LIGHTING BRANCH CIRCUIT.
- 6 REFER TO ARCHITECT'S BUILDING ELEVATION FOR EXACT LOCATION OF EXTERIOR LIGHT FIXTURES.
- 7 REFER TO ARCHITECT'S CONSTRUCTION DETAIL FOR INSTALLATION OF TYPE "Y" PENDANT MOUNTED LUMINAIRES. 2'-0" ABOVE FLOOR.
- 8 MOUNT SINGLE RECEPTACLE FOR EMERGENCY LIGHTING BATTERY PACK ABOVE FILL CABINET.
- 9 CONNECT LIGHT SWITCH SO THAT LIGHT OPERATES AUTOMATICALLY IN EMERGENCY MODE DURING POWER OUTAGE. SEE TOILET ROOM LIGHT CONTROL DETAIL.
- 10 MOUNT THE LIGHT SWITCH IN PARALLEL WITH NIGHT LIGHT PHOTOCELL FOR OPTIONAL MANUAL "ON" CONTROL OF NIGHT LIGHTS DURING SATINNE.
- 11 PROVIDE WATER PROOF, FLUSH MOUNTED JUNCTION BOX BEHIND ELECTRONIC MESSAGE BOARD. SEE EQUIPMENT SHOP DRAWING FOR REQUIREMENTS.
- 12 SEE ARCHITECTURAL ELEVATION DRAWING FOR LOCATION OF LOW TEMPERATURE ROTATING ALARM BEACON. MOUNT THERMOSTAT AT 42° F. SET ALARM TEMPERATURE LEVEL AS DIRECTED BY OWNER. SEE LOW TEMPERATURE ALARM WIRING DETAIL, SHEET E-2.
- 13 SEE FIRE ALARM RISEN DIAGRAM FOR CIRCUITING DETAILS.
- 14 SEE ARCHITECT'S WALL ELEVATION DETAILS FOR EXACT LOCATION OF HAND DRIVERS.
- 15 WATER HEATER IS ON SHELF. SEE ARCHITECT'S DRAWING FOR EXACT LOCATION.
- 16 CONTINUE CIRCUIT TO LIGHT SWITCH SO THAT EXHAUST FAN OPERATES WHEN LIGHT IS "ON".
- 17 CONTINUE CIRCUIT TO SUBVERSIBLE WELL PUMP. SEE SITE DRAWING FOR EXACT LOCATION.
- 18 NOT USED.
- 19 MOUNT CEILING FAN IN ACCORDANCE WITH ARCHITECT'S REFLECTED CEILING PLAN.
- 20 CONTINUE SWITCH WIRING TO PHOTOCELL. SEE CANOPY NIGHT LIGHT CONTROL DIAGRAM.
- 21 NOT USED.
- 22 CONTINUE SWITCH WIRING TO PHOTOCELL. SEE WAITING ROOM NIGHT LIGHT CONTROL DIAGRAM.
- 23 NOT USED.
- 24 CONTINUE SWITCH WIRING TO PHOTOCELL. SEE WAITING ROOM NIGHT LIGHT CONTROL DIAGRAM.
- 25 NOT USED.
- 26 INSTALL OWNER'S ANTENNA 75000 ON BUILDING SIDE WALL AT 8'0". PROVIDE COAX ANTENNA CABLE AS SPECIFIED BY THE OWNER, FROM THE ANTENNA TO THE LOCATION OF THE MARINE RADIO.
- 27 SEE PUBLIC ADDRESS SYSTEM DIAGRAM FOR WIRING DETAIL. INTERCONNECTION BETWEEN SPEAKERS AND AMPLIFIER IS WITH TWO CONDUCTORS AND #16 CABLE.
- 28 PROVIDE PADDLE FAN SPEED CONTROL, GRANGER #4928.
- 29 MOUNT DISCONNECT SWITCHES FOR WATER HEATER ABOVE SHELF. PROVIDE WORKING CLEARANCES IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE.
- 30 PROVIDE FLUSH MOUNTED JUNCTION BOX AT ELECTRONIC MESSAGE BOARD CONTROL CONSOLE. PROVIDE POWER AND TELEPHONE CABLE TO CONTROL CONSOLE.
- 31 CONNECT LIGHT SWITCH SO THAT EMERGENCY BATTERY OPERATES TYPE "B" WHEN UTILITY POWER IS NOT AVAILABLE REGARDLESS OF THE LOCAL SWITCH POSITION.



NOTE 1: PROVIDE TOILET ROOM ELECTRIC DOOR LATCH CONTROL TIME CLOCK PARAGON #4113-500, WIRED AS SHOWN SO THAT ONLY ONE ELECTRIC DOOR LATCH IS UNLOCKED AT THE SAME TIME.

NOTE 2: PROVIDE AN "ELECTRICALLY HELD UNLOCKED" DOOR LATCH SO THAT IF POWER IS REMOVED FROM DOOR LATCH MECHANISM THE LATCH SPRINGS TO THE LOCKED POSITION.

**TOILET ROOM DOOR CONTROL WIRING DETAIL**  
NOT TO SCALE



**NORTH ELEVATION**  
SCALE: 1/8" = 1'



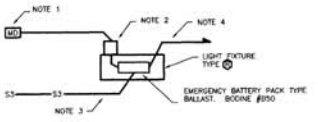
**SOUTH ELEVATION**  
SCALE: 1/8" = 1'



**WEST ELEVATION**  
SCALE: 1/8" = 1'



**EAST ELEVATION**  
SCALE: 1/8" = 1'



**TOILET ROOM LIGHT CONTROL DIAGRAM**  
NOT TO SCALE

- NOTE 1: PROVIDE WATT STOPPER #01-1000 MOTION DETECTOR AT CORNER OF WALL AND CEILING WHERE SHOWN.
- NOTE 2: PROVIDE WATT STOPPER #A120-E POWER PACK AT FIXTURE HOUSING. PROVIDE OPENING IN CEILING ABOVE FIXTURE HOUSING TO ACCEPT POWER PACK. PROVIDE INTERCONNECTING WIRING AS DETAILED IN MANUFACTURER'S INSTALLATION INSTRUCTIONS.
- NOTE 3: PROVIDE THREE WAY SWITCHES AT ENTRY DOOR(S) WITH POWER WIRING CONNECTED SO THAT THESE SWITCHES OVERRIDE MOTION DETECTOR SWITCH.
- NOTE 4: PROVIDE POWER WIRING TO SELF CONTAINED EMERGENCY LIGHT BATTERY PACK/BALLAST SO THAT LIGHT IS CONTROLLED BY THREE WAY SWITCHES AND MOTION DETECTOR SWITCH WHEN NORMAL POWER IS AVAILABLE. THE LIGHT IS TO TURN "ON" AUTOMATICALLY, REGARDLESS OF ANY OTHER SWITCHES IF NORMAL (UTILITY) POWER TO THIS LIGHT IS INTERRUPTED.

THIS DRAWING IS THE PROPERTY OF T. F. H. ARCHITECTS. IT IS TO BE USED ONLY FOR THE PROJECT AND SITE SPECIFICALLY IDENTIFIED HEREON. IT IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM.





**FERRY TERMINAL**  
 FOR  
**TREMONT, MAINE**  
 PER IMPACTMENT, MODIFICATION, IMPROVEMENT, SERVICE CENTER AND ROUTE SERVICE SERVICE

**T F H ARCHITECTS**  
 100 COMMERCIAL STREET  
 PORTLAND, MAINE 04101  
 TELEPHONE 207 775 8141  
 ARCHITECTURE AND PLANNING

**CIVIL/LANDSCAPE ARCHITECTS & ASSOCIATES**  
 PORTLAND & BOSTON  
 175 S. BROAD ST. PORTLAND, MAINE 04101  
 607-761-0400  
**STRUCTURAL ENGINEERS**  
 PORTLAND & BOSTON  
 175 S. BROAD ST. PORTLAND, MAINE 04101  
 607-761-0400  
**MECHANICAL ENGINEERS**  
 PORTLAND & BOSTON  
 175 S. BROAD ST. PORTLAND, MAINE 04101  
 607-761-0400  
**ELECTRICAL ENGINEERS**  
 ELECTRICAL ENGINE CONSULTANTS  
 725 N. BAY ST. LONG BEACH, CALIF. 90801  
 561-798-0801

REVISIONS  
 OCTOBER 27, 1997

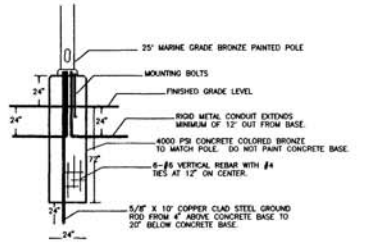
DATE: **JAN. 28, 1997**  
 FILE NAME: **TREM-ES**  
 DRAWN BY: **BMC**  
 SCALE: **1" = 20'**  
 DRAWING TITLE:

**ELECTRICAL SITE PLAN**

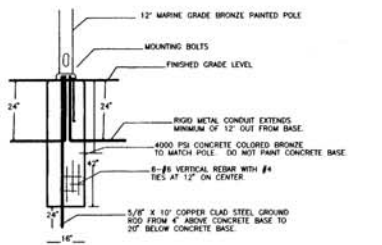
DRAWING NO.

**ES**

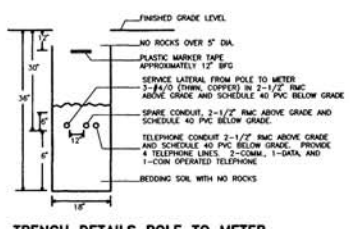
25  
 30  
 35  
 40



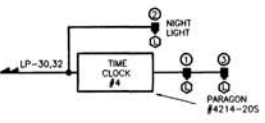
**SQUARE SECTION--CONCRETE POLE BASE DETAIL--TYPE L**  
 NOT TO SCALE



**SQUARE SECTION--CONCRETE POLE BASE DETAIL--TYPE Q**  
 NOT TO SCALE



**TRENCH DETAILS POLE TO METER**  
 NOT TO SCALE

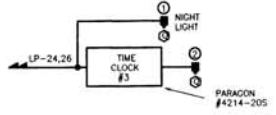
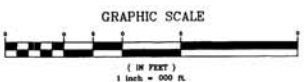
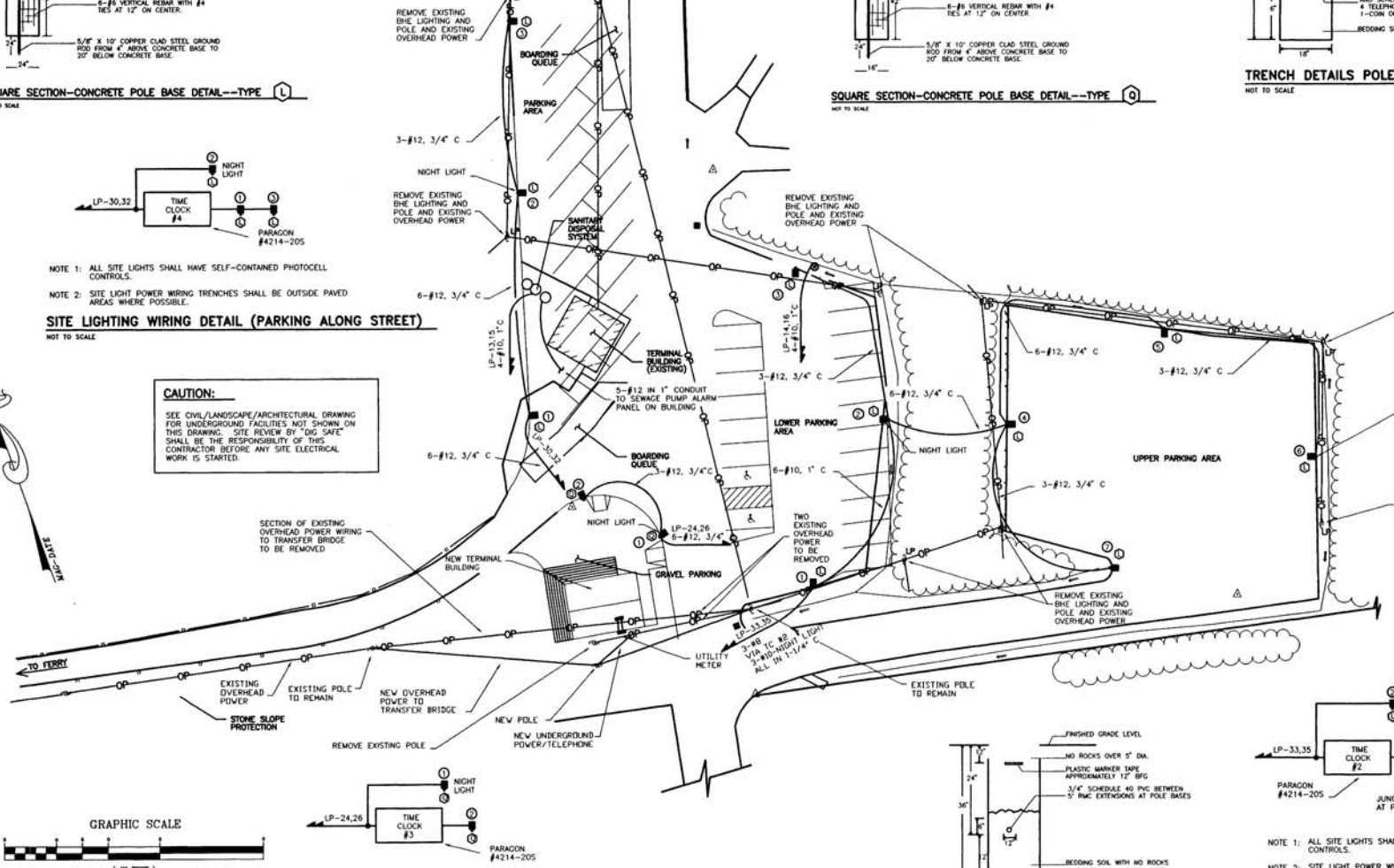


NOTE 1: ALL SITE LIGHTS SHALL HAVE SELF-CONTAINED PHOTOCELL CONTROLS.  
 NOTE 2: SITE LIGHT POWER WIRING TRENCHES SHALL BE OUTSIDE PAVED AREAS WHERE POSSIBLE.

**SITE LIGHTING WIRING DETAIL (PARKING ALONG STREET)**  
 NOT TO SCALE

**CAUTION:**  
 SEE CIVIL/LANDSCAPE/ARCHITECTURAL DRAWING FOR UNDERGROUND FACILITIES NOT SHOWN ON THIS DRAWING. SITE REVIEW BY "DIG SAFE" SHALL BE THE RESPONSIBILITY OF THIS CONTRACTOR BEFORE ANY SITE ELECTRICAL WORK IS STARTED.

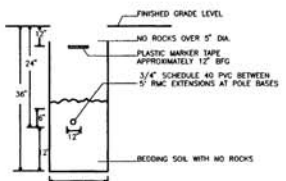
SECTION OF EXISTING OVERHEAD POWER WIRING TO TRANSFER BRIDGE TO BE REMOVED.



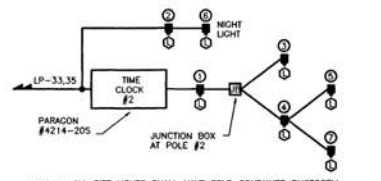
NOTE 1: ALL SITE LIGHTS SHALL HAVE SELF-CONTAINED PHOTOCELL CONTROLS.  
 NOTE 2: SITE LIGHT POWER WIRING TRENCHES SHALL BE OUTSIDE PAVED AREAS WHERE POSSIBLE.

**SITE LIGHTING WIRING DETAIL (FRONT OF BUILDING)**  
 NOT TO SCALE

**ELECTRICAL SITE PLAN**  
 SCALE: 1" = 20'



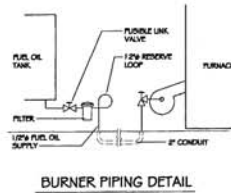
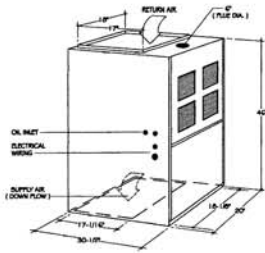
**TRENCH DETAILS SITE LIGHTING**  
 NOT TO SCALE



NOTE 1: ALL SITE LIGHTS SHALL HAVE SELF-CONTAINED PHOTOCELL CONTROLS.  
 NOTE 2: SITE LIGHT POWER WIRING TRENCHES SHALL BE OUTSIDE PAVED AREAS WHERE POSSIBLE.

**SITE LIGHTING WIRING DETAIL (PARKING)**  
 NOT TO SCALE

UNIT DESIGNATION :	
SCHEDULE NO.	FURNACE
MODEL NO.	FURNACE 8330001
PRODUCT DATA	
HEATING PERFORMANCE	
INPUT CAPACITY	80,000 BTU/H
OUTPUT CAPACITY	33,000 BTU/H
SUPPLY AIR BLOWER PERFORMANCE	
TOTAL SUPPLY AIR	1,000 CFM
TOTAL RESISTANCE EXTERNAL TO UNIT	0.5 IN. WG
BLOWER SPEED (CIRCUIT)	0.5 IN. WG
MOTOR EFFICIENCY	0.85
ELECTRICAL DATA	
POWER SUPPLY	115V/60
TOTAL UNIT CAPACITY	1.2 AMP
MAXIMUM OVERCURRENT DEVICE FUSED OR CIRCUIT BREAKER	20 AMP
UNIT WEIGHT	
TOTAL UNIT WEIGHT	162 LBS.



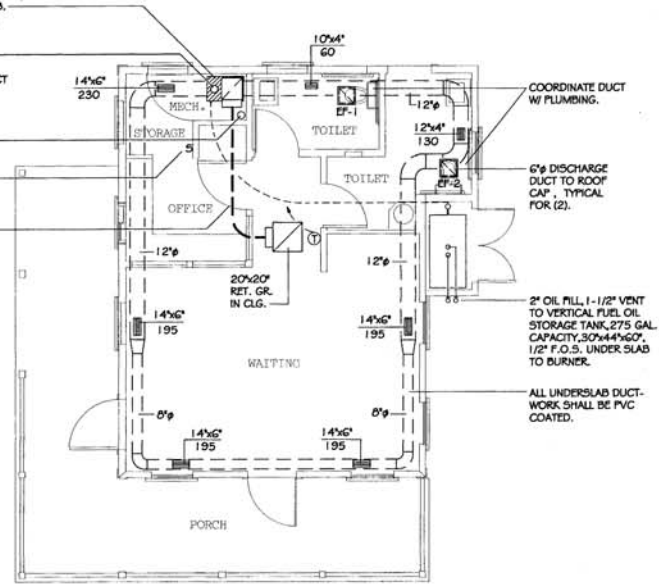
UNIT #1, DOWN FLOW FURNACE, 17x18" DISCHARGE PLENUM (PVC COATED) TO TWO (2) 12" SUPPLY RUNS UNDER SLAB.

6" CHIMNEY THRU ROOF TERMINATE 36" ABOVE ROOF PEAK.

6" COMBUSTION AIR DUCT UP TO ATTIC W/ M.O.D., 6" OPENING AT CEILING ± 12" A.F.F., INTERLOCK M.O.D. W/ BURNER.

BURNER EMERG. SWITCH.

16" FLEX IN ATTIC TO 17x18" RETURN PLENUM.



### HEATING & VENTILATING PLAN

SCALE: 1/4" = 1'-0"

CLEARANCES FROM	
TOP OF FURNACE Casing OR PLENUM	8 INCHES
TOP OF HORIZONTAL WALL/SLAB DUCT WITHIN DUCT OF FURNACE	2 INCHES
FLEX PIPING/INSULATED HORIZONTAL OR BELOW FIVE	4 INCHES
FLEX PIPING/INSULATED VERTICALLY ABOVE FIVE	6 INCHES
NET SIZE OF SUPPLY VOLUME & RETURN AIR DUCT WITHIN DUCT OF FURNACE	8 INCHES
FRONT OF FURNACE	8 INCHES
SEDS OF FURNACE	1 INCH
ROOF OF FURNACE	1 INCH
BOTTOM OF FURNACE	0 INCHES

\* FLOOR SHALL BE NON-COMBUSTIBLE EXCEPT WHEN INSTALLED ON NON-COMBUSTIBLE FLOOR BASE THEN FLOOR MAY BE COMBUSTIBLE AND IF DECREASED TO 2"

### SYMBOLS LEGEND

	SUPPLY DUCT ( UP )
	RETURN DUCT ( UP )
	SUPPLY DUCT ( DN )
	RETURN DUCT ( DN )
	FIRE DAMPER ( TYPE 'B' )
	MANUAL VOLUME DAMPER
	MOTOR OPERATED DAMPER
	ELBOW W/ TURNING VANES
	THERMOSTATS
	OUTLET TYPE
	CFM

### FAN SCHEDULE

SYMBOL	LOCATION	MOD. NO.	CFM	NOISE	T.S.P	RPM	ELEC.	REMARKS
EF-1	TOILET	27	140	3.1	0.375	1640	115V-1PH-60HZ	CEILING MOUNTED
EF-2	H.C. TOILET	27	140	3.1	0.375	1640	115V-1PH-60HZ	CEILING MOUNTED

### AIR DEVICES

FLOOR REGISTERS SHALL BE HART & COOLEY #531 WITH O.B. DAMPER.

RETURN GRILLES SHALL BE HART & COOLEY #A650.



**JOHNSON & JOHNSON**  
MECHANICAL CONTRACTORS  
P.O. BOX 1088  
SEASIDE, MAINE 04088  
TEL. (207) 862-8848 • FAX (207) 862-8919

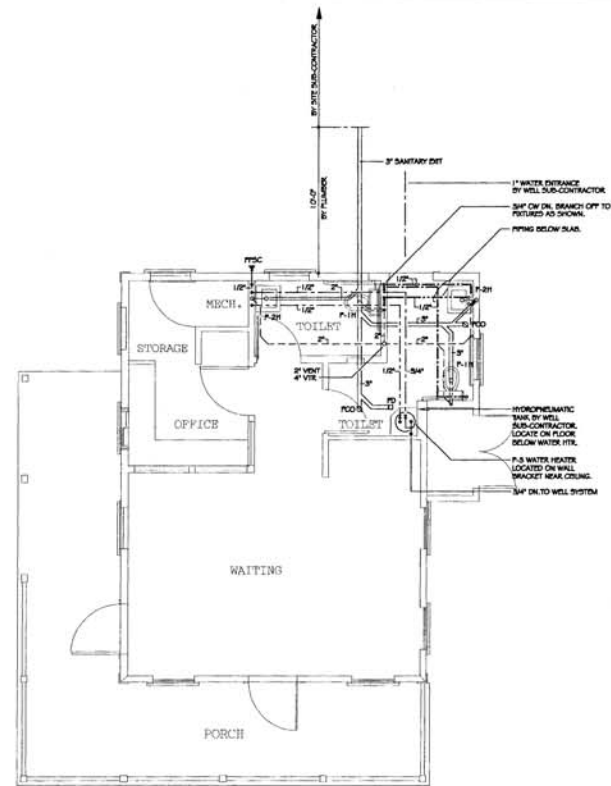
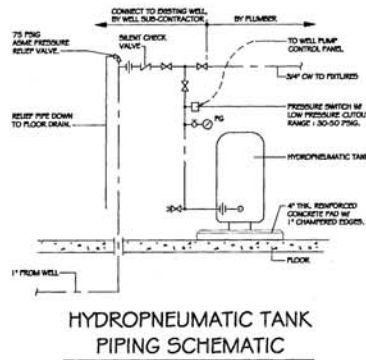
REVISIONS:  
0-96, FLOOR PLAN CHANGE  
1-97, FUEL OIL TANK RELOCATED  
5-97, CHANGED EF-1 & 2 TO THRU ROOF, TEXT CHANGES.  
8-96, FLOOR PLAN CHANGE AS PER ARCHITECT'S DRAWINGS.

DRAWN: [ ] CHECKED: [ ] REVISIONS THIS SHEET:  
FLOOR PLAN / HEATING & VENTILATING DATA, DETAIL, SCHEDULE & LEGEND  
SCALE: 1/4" = 1'-0"  
DATE: 7-18-96  
PROJECT: 96172

TREMONT FERRY TERMINAL  
M-I

# PLUMBING SYMBOLS LEGEND

	SOIL OR WASTE ABOVE FLOOR
	SOIL OR WASTE BELOW FLOOR
	ROOF DRAIN ABOVE FLOOR
	ROOF DRAIN BELOW FLOOR
	VENT ABOVE FLOOR
	VENT BELOW FLOOR
	COLD WATER
	HOT WATER
	HOT WATER RECIRCULATION
	TEMPERED HOT WATER
	TEMPERED HOT WATER RECIRCULATION
	GATE VALVE
	CHECK VALVE
	GLOBE VALVE
	BACKWATER VALVE
	GAS PIPING
	AIR PIPING
	CLEAN-OUT END OF MAIN
	CLEAN-OUT FLUSH WITH FLOOR
	FLOOR DRAIN
	ROOF DRAIN
	SPRINKLER



# PLUMBING FIXTURE SCHEDULE

THE FOLLOWING NUMBERS ARE BASED ON AMERICAN STANDARD - U.R. AND KOHLER ARE ACCEPTABLE.

- P-1, WATER CLOSET : AMERICAN STANDARD 2164 1.5 12" ROUGH ELONGATED WITH BEMIS 1500D SEAT AND CS401DL SUPPLY.  
\* 3" WASTE, 2" VENT, 1/2" COLD WATER \*
- P-1H, HANDICAPPED WATER CLOSET : AMERICAN STANDARD 2108.408 1.5 17" HIGH, 12" ROUGH ELONGATED WITH BEMIS 1500D SEAT AND CS401DL SUPPLY.  
\* 3" WASTE, 2" VENT, 1/2" COLD WATER \*
- P-2, WALL HUNG LAVATORY : AMERICAN STANDARD Q355.012 20x18 WALL HUNG LAVATORY WITH 2385.449 FAUCET, 1-1/2x1-1/4 17 GAUGE CHROME 1" TRAP AND CS400A SUPPLIES.  
\* 1-1/2" WASTE, 1-1/2" VENT, 1/2" HOT & COLD WATER \*
- P-2H, WALL HUNG HANDICAPPED LAVATORY : AMERICAN STANDARD Q355.012 20x18 WALL HUNG LAVATORY WITH 2385.478 FAUCET, 1-1/2x1-1/4 17 GAUGE 1" TRAP AND CS400A SUPPLIES AND TRUBRO INSULATING KIT.  
\* 1-1/2" WASTE, 1-1/2" VENT, 1/2" HOT & COLD WATER \*
- P-3, WATER HEATER : RHEEM MODEL #EG5P-10 COMMERCIAL WATER HEATER, 10 GALLON CAPACITY, 2000 WATT COIL, 240V-1 PH-60HZ, 16" RND x 24" HIGH.

FLOOR CLEAN OUTS : ADJUSTABLE, CAST IRON BODY W/ GAS TIGHT PLUG AND ROUND SCORIATED TOP. ZURN ZN1400 OR EQUAL BY JOSAM, SMITH OR WADE.

FLOOR DRAINS : 5" DIAMETER ZURN ZN415 OR EQUAL BY JOSAM, SMITH OR WADE.

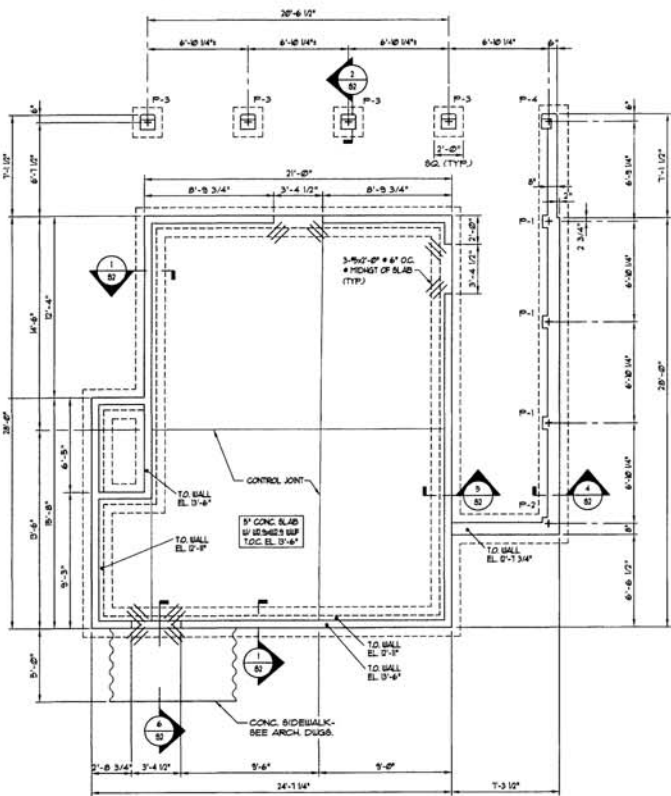
FREEZE-PROOF SILL COCKS : ANTI-SYPHON, NON FREEZE WITH BACKFLOW PREVENTOR, BRONZE BODY, STAINLESS STEEL FACE AND LOOSE KEY. ZURN Z-1310 OR EQUAL BY JOSAM, SMITH OR WADE.



**JOHNSON & JORDAN**  
MECHANICAL CONTRACTORS  
P.O. BOX 1068  
SCARLETT, MI 48157-1068  
TEL: (313) 885-0845 FAX: (313) 885-8819

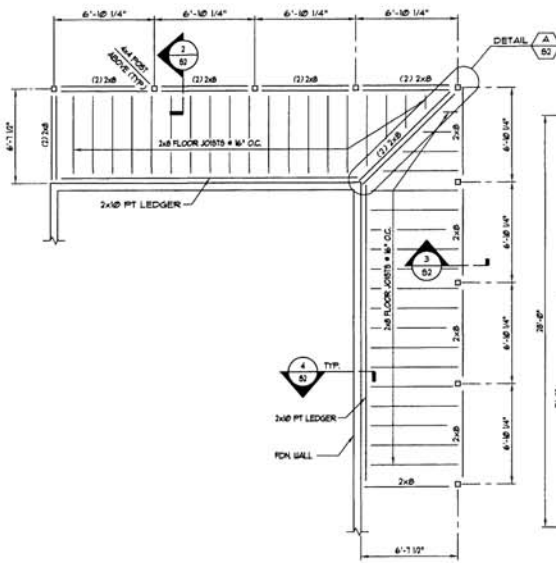
REVISIONS:  
0-96, FLOOR PLAN CHANGE  
1-97, FLOOR PLAN CHANGE  
5-97, TEXT CHANGES  
8-98, FLOOR PLAN CHANGES AS PER ARCHITECT'S DRAWINGS.

DATE:	7-18-96
PROJECT:	96172
DRAWN:	MPJ
CHECKED:	MPJ
DESIGNED:	MPJ
SCALE:	1/4" = 1'-0"
PROJECT: TREMONT FERRY TERMINAL	
SHEET: P-1	



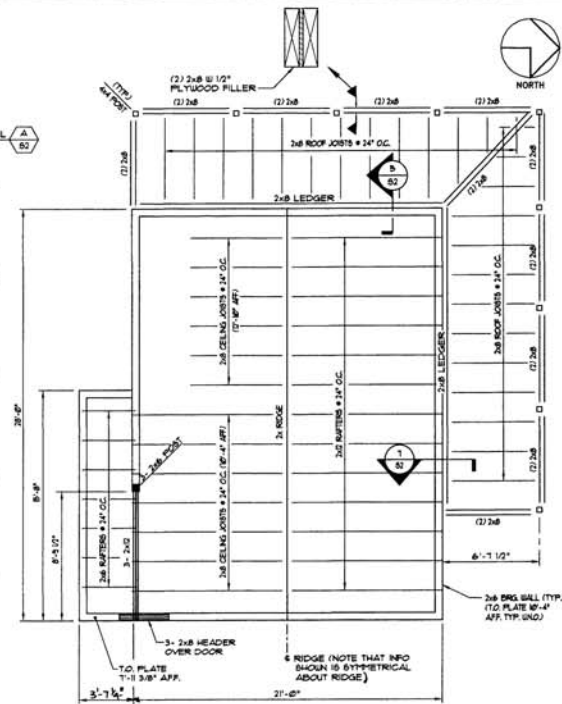
**FOUNDATION PLAN**  
14'-7 1/2\"/>

NOTE: CURE SLAB w/ MOISTURE RETAINING COVER FOR 7 DAYS. CUT SLAB JOINTS AS SOON AS POSSIBLE AFTER FINISHING. DO NOT ALLOW SLAB SURFACE TO DRY DURING CURING PERIOD.



**DECK FLOOR FRAMING PLAN**  
14'-7 1/2\"/>

- NOTES
1. ALL WOOD IS PRESSURE TREATED.
  2. DECKING: TREX WOOD POLYMER LUSPER.



**ROOF FRAMING PLAN**  
14'-7 1/2\"/>

**GENERAL STRUCTURAL NOTES**

1. DESIGN CODE: 1993 BOCA NATIONAL BUILDING CODE.
2. ROOF DESIGN LOADS:  
SNOW LOAD ON GROUND: 80 PSF.  
ROOF SNOW: 33 PSF BALANCED.  
LOAD: 41 PSF UNBALANCED.

**FOUNDATION NOTES**

1. DESIGN BEARING CAPACITY:  
2.5 KSF FOOTINGS ON SOIL.
2. PLACE FOOTINGS ON EXPOSED LEDGE SURFACE WHERE ENCOUNTERED. STRIP SOIL COVER FROM LEDGE AND CLEAN ALL LOOSE MATERIAL FROM LEDGE SURFACE BEFORE CONSTRUCTING FOOTINGS.
3. WHERE FOOTINGS DO NOT BEAR DIRECTLY ON LEDGE PROVIDE MIN. 4\"/>

CRUSHED GRAVEL:

4\"/>	
1/4\"/>	
NO. 40	20-30
0-30	0-30
NO. 200	0-30

**CONCRETE NOTES**

1. DESIGN CODE: ACI 318-89
2. CONCRETE: MORT CLASS A, 4000 PSI.
3. REINFORCEMENT: GRADE 60, ASTM A615
4. MIN. CONCRETE COVER:  
3\"/>

**CONCRETE NOTES CONT.**

5. SPLICE LENGTHS (UNLESS SHOWN OTHERWISE):  
HORIZONTAL BARS IN WALLS, LONGITUDINAL BARS IN FOOTINGS:  
#5 1' - 0\"/>
6. COORDINATE PENETRATIONS WITH MECHANICAL, ELECTRICAL AND CIVIL DRAWINGS.
- WOOD FRAMING NOTES:**
  1. STRUCTURAL LUMBER: NO. 2 SPRUCE-PINE-FIR OR BETTER.
  2. DESIGN CODE: NATIONAL DESIGN SPECIFICATIONS FOR WOOD CONSTRUCTION BY THE NATIONAL FOREST PRODUCTS ASSOCIATION.
  3. FASTENERS: COMPLY WITH RECOMMENDED FASTENING SCHEDULE OF THE BOCA NATIONAL BUILDING CODE/1993, UNLESS SHOWN OTHERWISE ON THE DRAWINGS.
  4. NAILING REQUIREMENTS FOR PLYWOOD, ROOF DECK, AND SHEATHING: PROVIDE 8D NAILS AS FOLLOWS UNLESS SHOWN OTHERWISE:  
8\"/>
  5. SPIKE TOGETHER ALL FRAMING MEMBERS WHICH ARE BUILT-UP USING 2-ROPS OF 1/4\"/>
  6. PROVIDE GALVANIZED METAL JOIST HANGERS AT FLOOR FRAMED CONNECTIONS. IF SIZES ARE NOT SHOWN ON PLANS, PROVIDE HANGERS EQUAL TO SIMPSON L210 OR L2110.
  7. PROVIDE GALVANIZED METAL RAFTER TIES EQUAL TO SIMPSON H 2.5 BETWEEN RAFTERS OR ROOF TRUSSES AND SUPPORTING WALLS OR MEMBERS, UNLESS SHOWN OTHERWISE.
  8. PROVIDE 3-3 X 8 HEADERS OVER ALL OPENINGS IN BEARING WALLS UNLESS SHOWN OTHERWISE.
  9. PROVIDE DOUBLE TOP PLATE IN ALL EXTERIOR WALLS AND ALL BEARING WALLS. STAGGER TOP PLATE SPLICES IN EXTERIOR WALLS 4'-0\"/>
  10. PROVIDE PRESSURE TREATED LUMBER FOR ALL LUMBER IN CONTACT WITH MASONRY OR CONCRETE.
  11. PROVIDE MIN. OF 2-2X STUDS AT ENDS OF ALL BUILT-UP 2X BEAMS UNLESS SHOWN OTHERWISE.
  12. ROOF AND WALL SHEATHING: APA RATED SHEATHING, EXPOSURE 1 OR STRUCTURAL I OR II RATED SHEATHING, EXPOSURE 1. ROOF: 5/8\"/>
  13. POSTS AT CORNERS OF EXT. WALLS: PROVIDE 6X8 OR 3-2X6 MIN.
  14. PROVIDE 1X2 DIAGONAL BRIDGING FOR EACH 8\"/>



**FERRY TERMINAL**  
BASS HARBOR, MAINE



TTH ARCHITECTS  
100 COMMERCIAL STREET  
PORTLAND, MAINE 04101  
TELEPHONE 503-753-8448  
ARCHITECTURE PLANNING

**CLIENTS:**

STRUCTURAL ENGINEER:  
PAUL J. GAUDIN  
LICENSE NO. 811195  
MECHANICAL ENGINEER:  
ELECTRICAL ENGINEER:

REVISION  
OCTOBER, 1993  
AUGUST, 1996

DATE	JAN 97
PROJECT NO.	9306
DRAWN BY	CAH
SCALE	1/4\"/>
SHEET TITLE	FOUNDATION & FRAMING PLANS

FOUNDATION & FRAMING PLANS

SHEET NO.



**FERRY TERMINAL  
BASS HARBOR, MAINE**



ARCHITECTURE PLANNING

CONTRACTOR

MECHANICAL ENGINEER

ELECTRICAL ENGINEER

REVISION: OCTOBER, 1997

AUGUST, 1998

DATE: JUNE, 1997

PROJECT NO.: 8333

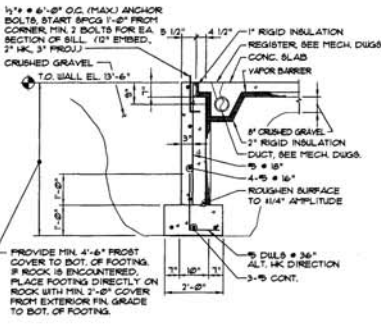
DRAWN BY: CM

SCALE: AS NOTED

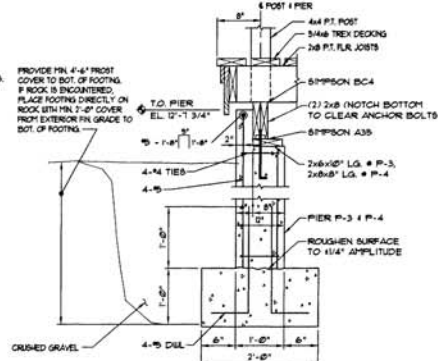
BEST TITLE

FOUNDATION & FRAMING DETAILS

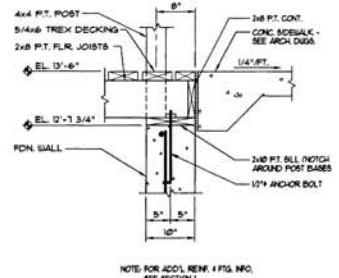
BEST NO.



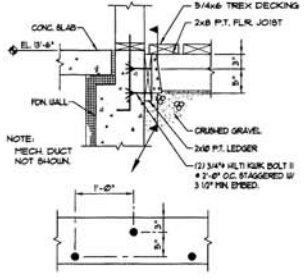
**SECTION 1**  
1/2'-1'-0"



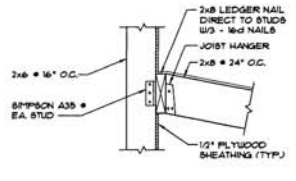
**SECTION 2**  
1/2'-1'-0"



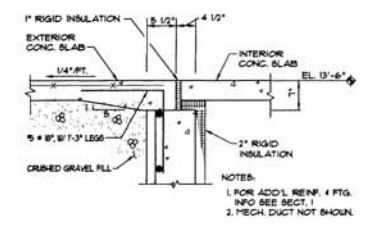
**SECTION 3**  
1'-1'-0"



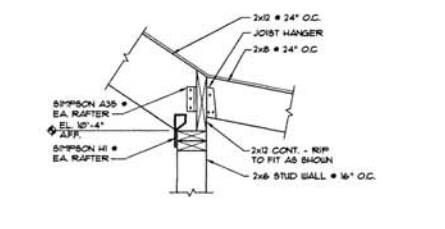
**SECTION 4**  
1'-1'-0"



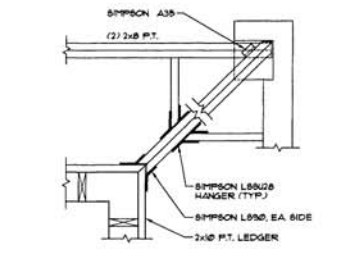
**SECTION 5**  
1'-1'-0"



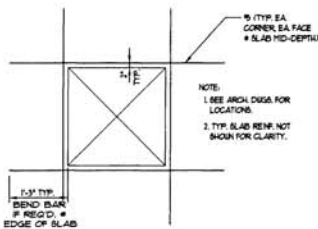
**SECTION 6**  
1'-1'-0"



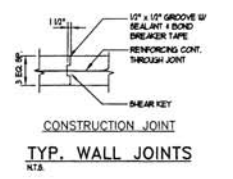
**SECTION 7**  
1'-1'-0"



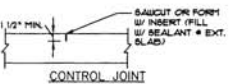
**DETAIL 8**  
1'-1'-0"



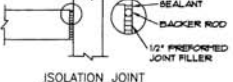
**ADD'L REIN. @ CONCR. SLAB OPNGS**  
NTA



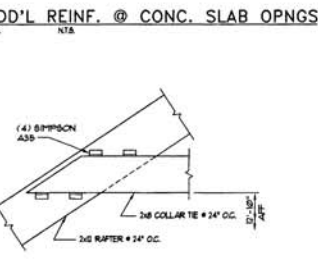
**CONSTRUCTION JOINT TYP. WALL JOINTS**  
NTA



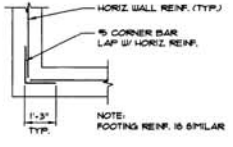
**CONTROL JOINT**



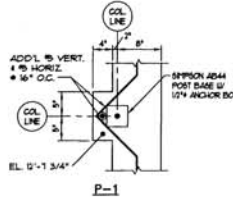
**ISOLATION JOINT TYP. SLAB JOINTS**  
NTA



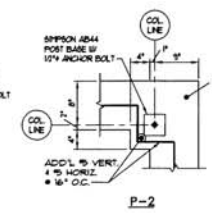
**COLLAR TIE/RAFTER CONNECTION**  
NTA



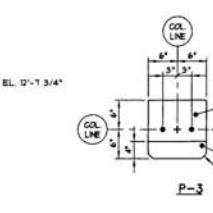
**TYP. CORNER REINFORCING**  
NTA



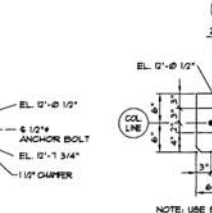
**P-1**



**P-2**



**P-3**



**P-4**

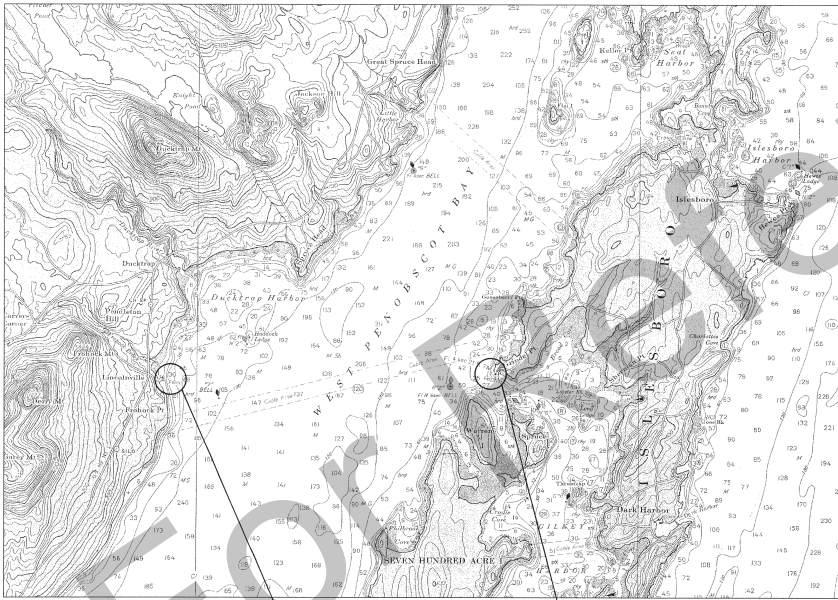
**PIER DETAILS**  
1'-1'-0"  
NOTE: TYP. WALL REIN. NOT SHOWN

NOTE: USE 5/8" REIN. AS PIER P-3

CADD FILE: 8233252B PLOT SCALE: 1/4" = 1'-0" PLOT DATE: 8/10/98

## **APPENDIX 4.2— Selected Lincolnville/Islesboro Ferry Terminal Plans**

STATE OF MAINE  
 DEPARTMENT OF TRANSPORTATION  
 AUGUSTA, MAINE  
**FERRY TERMINALS**  
**LINCOLNVILLE/ISLESBORO, MAINE**  
 PIN NO'S 15615.00 & 15616.00



**LINCOLNVILLE**

**ISLESBORO**

**LOCATION MAP**

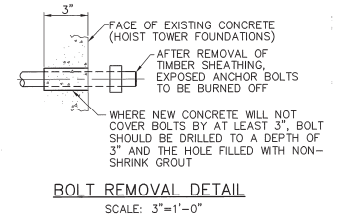
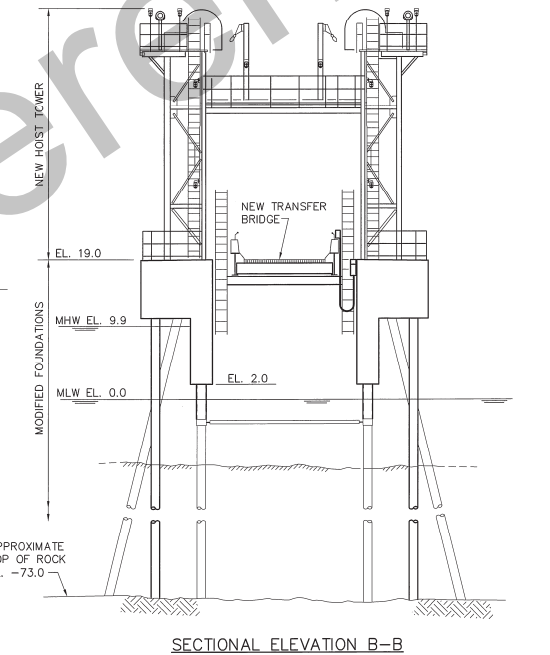
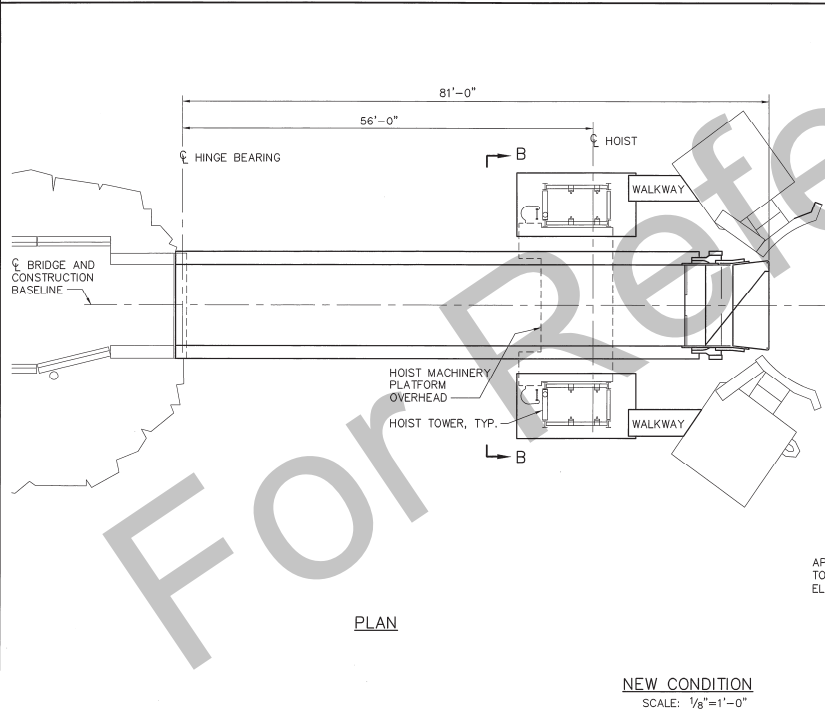
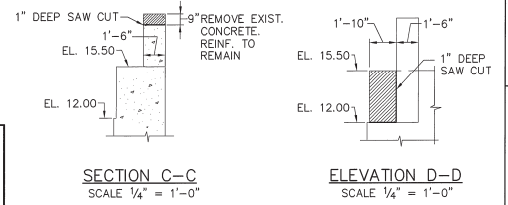
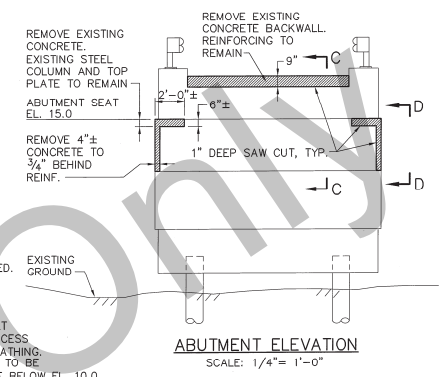
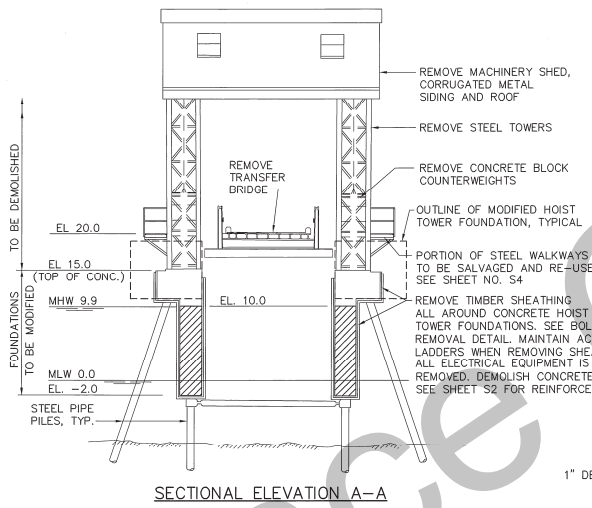
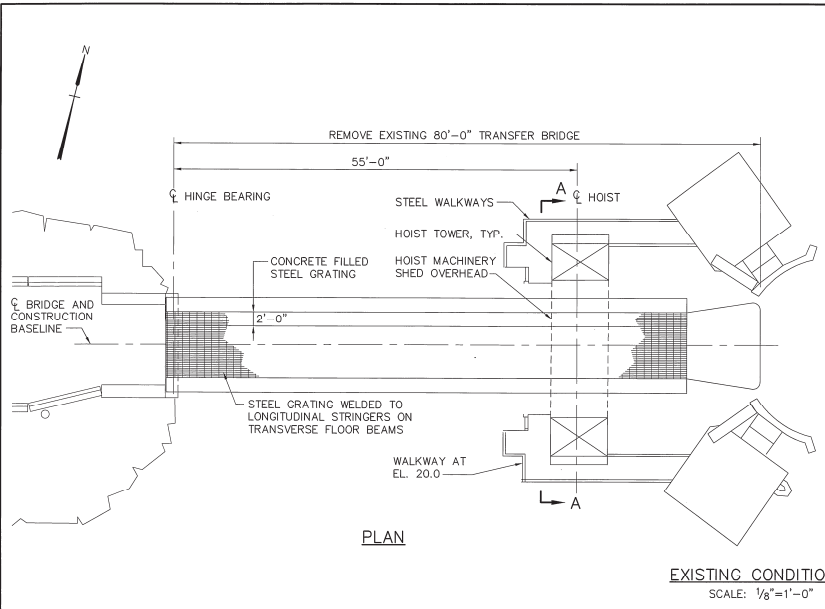
FROM NOAA CHART  
 (NOT TO BE USED FOR  
 NAVIGATION, NOT TO SCALE)

These plans are included for reference purposes only. At the time this manual was created the existing plans were not available. The user should verify that all existing information with field measurements and observations.

**LIST OF DRAWINGS**

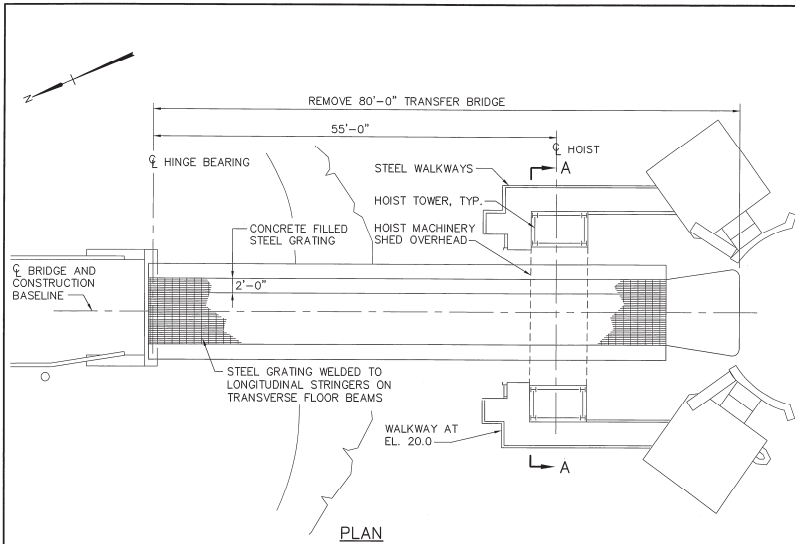
SHEET NO.	DRAWING TITLE
1	G1 TITLE SHEET - LOCATION MAP AND INDEX
2	C1 LINCOLNVILLE - GENERAL PLAN AND NOTES
3	C2 ISLESBORO - GENERAL PLAN
4	C3 CONSTRUCTION STAGING
5	D1 LINCOLNVILLE - TRANSFER BRIDGE DEMOLITION AND MODIFICATIONS
6	D2 ISLESBORO - TRANSFER BRIDGE DEMOLITION AND MODIFICATIONS
7	S1 ABUTMENT MODIFICATIONS AND CONCRETE REPAIRS
8	S2 LINCOLNVILLE - HOIST TOWER FOUNDATION DETAILS
9	S3 ISLESBORO - HOIST TOWER FOUNDATION DETAILS
10	S4 MISCELLANEOUS DETAILS
11	E1 LINCOLNVILLE - ELECTRICAL SITE PLAN
12	E2 LINCOLNVILLE - ELECTRICAL DETAILS
13	E3 LINCOLNVILLE - ELECTRICAL ONE LINE DIAGRAM
14	E4 ISLESBORO - ELECTRICAL SITE PLAN
15	E5 ISLESBORO - ELECTRICAL DETAILS AND ONE LINE DIAGRAM
16	E6 LINCOLNVILLE - TRANSFER BRIDGE / BERTH ELECTRICAL PLAN
17	E7 ISLESBORO - TRANSFER BRIDGE / BERTH ELECTRICAL PLAN
18	TB1 TRANSFER BRIDGE - PLAN, ELEVATION & SECTION
19	TB2 TRANSFER BRIDGE - FRAMING PLAN & DETAILS
20	TB3 TRANSFER BRIDGE - BARRIER AND RAILING DETAILS
21	TB4 TRANSFER BRIDGE - APRON DETAILS - PART 1
22	TB5 TRANSFER BRIDGE - APRON DETAILS - PART 2
23	TB6 TRANSFER BRIDGE - HOIST TOWER DETAILS - PART 1
24	TB7 TRANSFER BRIDGE - HOIST TOWER DETAILS - PART 2
25	TB8 TRANSFER BRIDGE - HOIST TOWER DETAILS - PART 3
26	TB9 TRANSFER BRIDGE - HOIST TOWER DETAILS - PART 4
27	TB10 TRANSFER BRIDGE - REEVING DIAGRAMS AND HOIST MACHINERY DETAILS
28	TB11 TRANSFER BRIDGE - HOIST WIRING AND DETAILS
29	TB12 TRANSFER BRIDGE - POWER ELEMENTARY
30	TB13 TRANSFER BRIDGE - CONTROL AND POWER WIRING
31	TB14 TRANSFER BRIDGE - ELECTRICAL PLANS & DETAILS - PART 1
32	TB15 TRANSFER BRIDGE - ELECTRICAL DETAILS - PART 2
33	RD1 REFERENCE DRAWING NO. 1
34	RD2 REFERENCE DRAWING NO. 2
35	RD3 REFERENCE DRAWING NO. 3
36	RD4 REFERENCE DRAWING NO. 4
37	RD5 REFERENCE DRAWING NO. 5

STATE OF MAINE DEPARTMENT OF TRANSPORTATION	APPROVED	DATE	COMMISSIONER	CHIEF ENGINEER
STATE OF MAINE DEPARTMENT OF TRANSPORTATION REGULATORY DIVISION No. 8721	[Signature]	7/1/08	[Signature]	06/30/08
PROJECT INFORMATION	SIGNATURE	P.E. NUMBER	DATE	PROJECT COMPLETION DATE
PROGRAM PROJECT MANAGER DESIGNER CONSULTANT	MULTIMODAL FAULD PROFILE DWHL	8721	8/27/08	
<b>FERRY TERMINALS LINCOLNVILLE/ISLESBORO, MAINE</b>				
TITLE SHEET LOCATION MAP AND INDEX				
SHEET NUMBER				
G1				
1 OF 37				

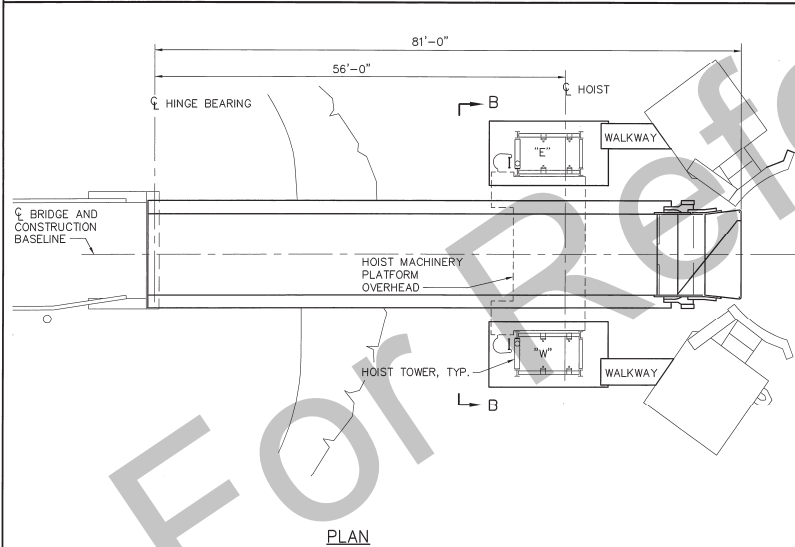
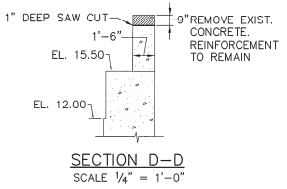
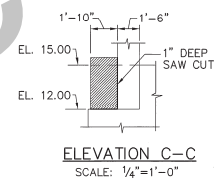
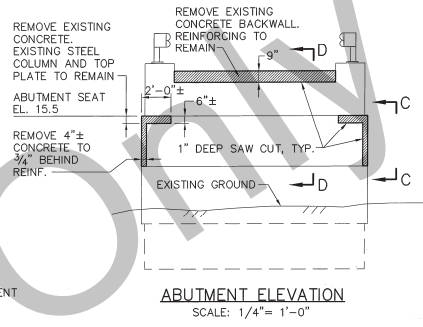
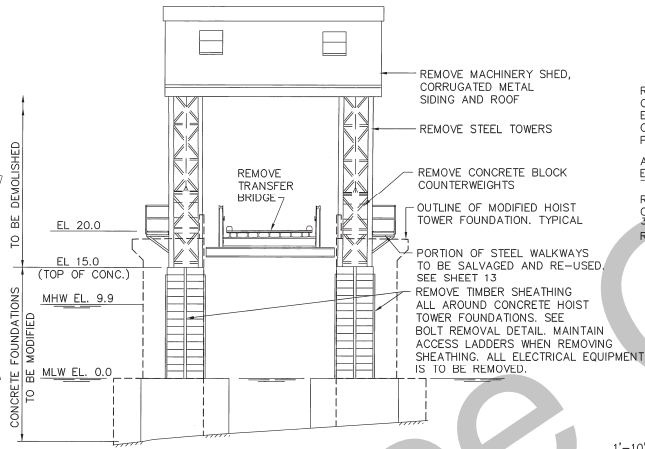


- NOTES:**
- THE FOLLOWING ITEMS ARE TO BE SALVAGED BY THE CONTRACTOR:
1. THE BRONZE PLAQUE LOCATED ON THE TRANSFER BRIDGE.
  2. FOR ELECTRICAL DEMOLITION NOTES, SEE SHEETS E1,3,4,5 & 6.
  3. RADIO CONTROL EQUIPMENT LOCATED IN THE ELECTRICAL CABINET IS TO BE TURNED OVER TO THE DEPARTMENT.

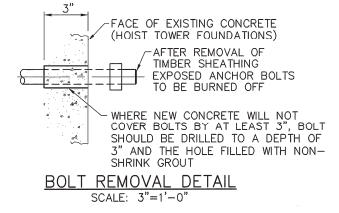
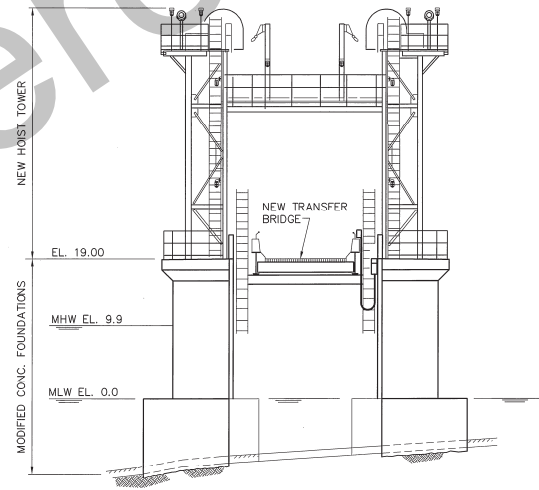
STATE OF MAINE		DEPARTMENT OF TRANSPORTATION	
APPROVED		DATE	
COMMISSIONER:		CHIEF ENGINEER:	
PROJECT INFORMATION		SIGNATURE	
PROGRAM	MULTIMODAL	PAUL POTTE	
PROJECT MANAGER	DWH		
DESIGNER	CONSULTANT	FAY, SPORFORD & THORNDIKE	P.F. NUMBER
			8721
PROJECT RESORT	CONTRACTOR		DATE
			6/27/08
PROJECT COMPLETION DATE		PROJECT COMPLETION DATE	
FERRY TERMINALS		LINCOLNVILLE - TRANSFER BRIDGE	
LINCOLNVILLE/ISLESBORO, MAINE		DEMOLITION AND MODIFICATIONS	
SHEET NUMBER		D1	
5 OF 37			



EXISTING CONDITION  
SCALE: 1/8"=1'-0"

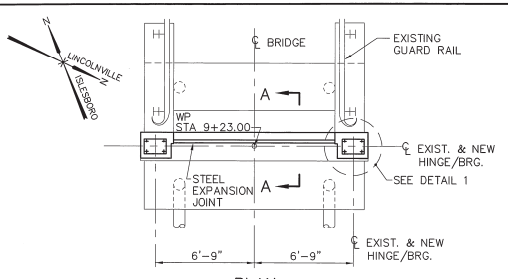


NEW CONDITION  
SCALE: 1/8"=1'-0"

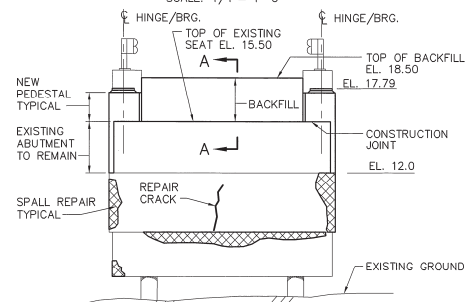


- NOTES:
- THE FOLLOWING ITEMS ARE TO BE SALVAGED BY THE CONTRACTOR:
1. THE BRONZE PLAQUE (APPROX. 20"x24") LOCATED ON TRANSFER BRIDGE.
  2. FOR ELECTRICAL DEMOLITION DETAILS, SEE SHEET E4 AND E5.
  3. RADIO CONTROL EQUIPMENT LOCATED IN THE ELECTRICAL CABINET IS TO BE TURNED OVER TO THE DEPARTMENT.

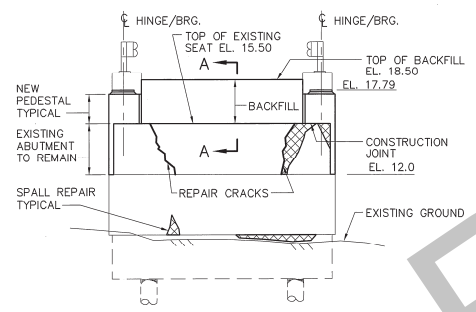
STATE OF MAINE DEPARTMENT OF TRANSPORTATION		APPROVED		DATE	
COMMISSIONER:		CHIEF ENGINEER:			
PROGRAM	MULTIMODAL	SIGNATURE	P.E. NUMBER	DATE	6/27/08
PROJECT MANAGER	PAUL POTLIFF				
DESIGNER	DWH				
CHECKER					
CONSULTANT					
CONTRACTOR					
PROJECT COMPLETION DATE					
FERRY TERMINALS LINCOLNVILLE/ISLESBORO, MAINE ISLESBORO - TRANSFER BRIDGE DEMOLITION AND MODIFICATIONS					
SHEET NUMBER					
D2					
6 OF 37					



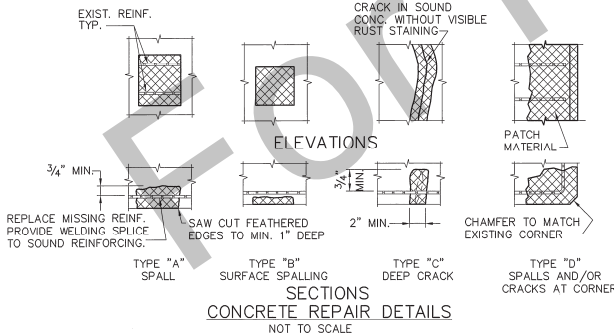
PLAN  
SCALE: 1/4" = 1'-0"



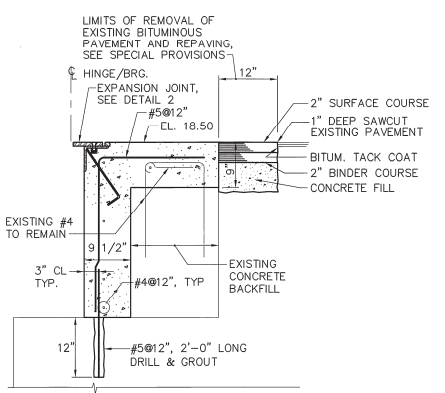
LINCOLNVILLE ABUTMENT ELEVATION  
SCALE: 1/4" = 1'-0"



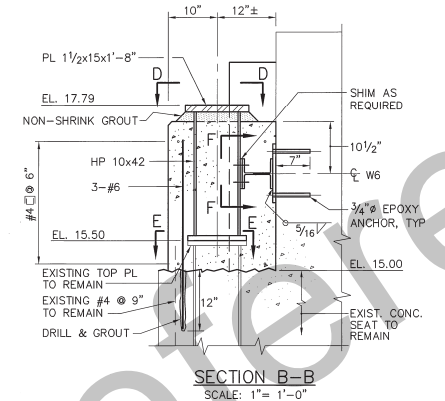
ISLESBORO ABUTMENT ELEVATION  
SCALE: 1/4" = 1'-0"



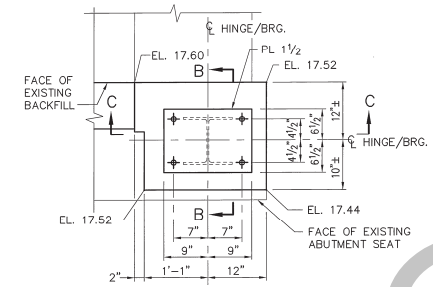
SECTIONS  
CONCRETE REPAIR DETAILS  
NOT TO SCALE



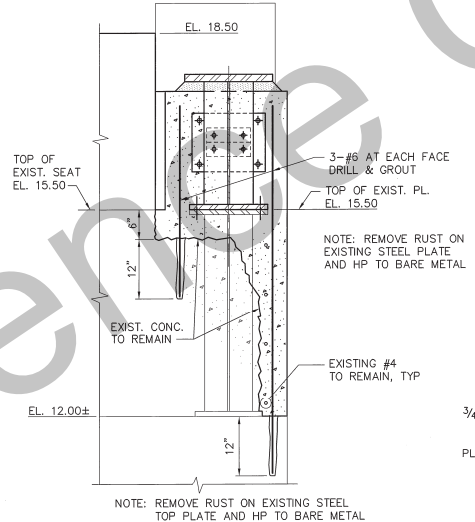
SECTION A-A  
SCALE: 1" = 1'-0"



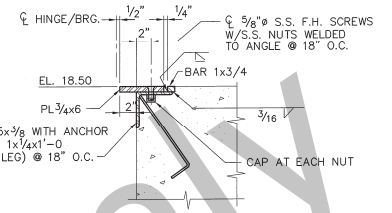
SECTION B-B  
SCALE: 1" = 1'-0"



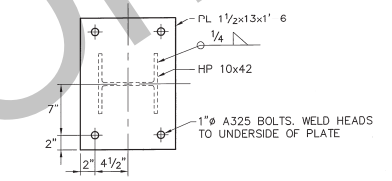
DETAIL 1  
SCALE: 1" = 1'-0"



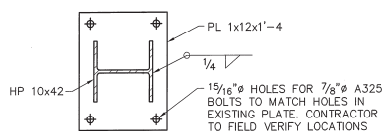
SECTION C-C  
SCALE: 1" = 1'-0"



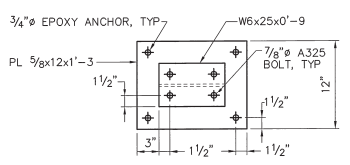
DETAIL 2  
SCALE: 1 1/2" = 1'-0"



PLAN D-D  
SCALE: 1 1/2" = 1'-0"



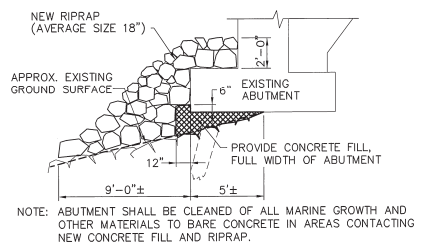
SECTION E-E  
SCALE: 1 1/2" = 1'-0"



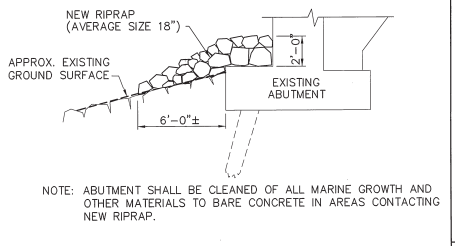
SECTION F-F  
SCALE: 1 1/2" = 1'-0"

SCHEDULE OF REPAIRS (SQ. FT.)				
LOCATION	TYPE A	TYPE B	TYPE C	TYPE D
<b>LINCOLNVILLE</b>				
ABUTMENT	50	50	3	10
<b>SOUTH HOIST TOWER</b>				
CONCRETE FOUNDATION	10	20		
BATTER PILE ENCASEMENT	50	25		
<b>NORTH HOIST TOWER</b>				
CONCRETE FOUNDATION	10	20		
BATTER PILE ENCASEMENT	10	25		
<b>ISLESBORO</b>				
ABUTMENT	10	20	6	
EAST HOIST TOWER	25	25		
WEST HOIST TOWER	25	25		

NOTES:  
1. IF REINFORCING STEEL IS SURROUNDED BY DETEIORATED CONCRETE OR HAS LESS THAN 1" ORIGINAL COVER, THE CONCRETE SHALL BE REMOVED TO A DEPTH OF 3/4" BEHIND THE REBAR.  
2. SEE SECTION 519 "REHABILITATION OF STRUCTURAL CONCRETE" OF THE SPECIAL PROVISIONS.



LINCOLNVILLE ABUTMENT  
SCOUR REPAIR  
SCALE: 1/4" = 1'-0"



ISLESBORO ABUTMENT  
RIPRAP REPAIR  
SCALE: 1/4" = 1'-0"

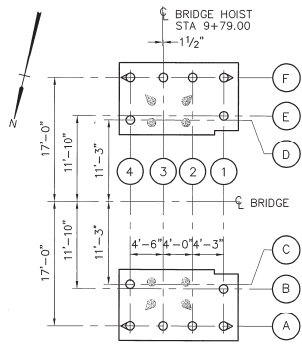
STATE OF MAINE  
DEPARTMENT OF TRANSPORTATION

APPROVED: \_\_\_\_\_ DATE: \_\_\_\_\_  
COMMISSIONER: \_\_\_\_\_ CHIEF ENGINEER: \_\_\_\_\_

PROJECT INFORMATION: PROJECT NUMBER: \_\_\_\_\_ MULTIMODAL: \_\_\_\_\_ PROJECT TITLE: \_\_\_\_\_ DRAWN: \_\_\_\_\_ P.E. NUMBER: 8721  
DESIGNER: \_\_\_\_\_ PROJECT DESIGN: \_\_\_\_\_ PROJECT DESIGN & MODIFIED: 8/27/08  
CONTRACTOR: \_\_\_\_\_ PROJECT CONTRACTOR DATE: 8/27/08

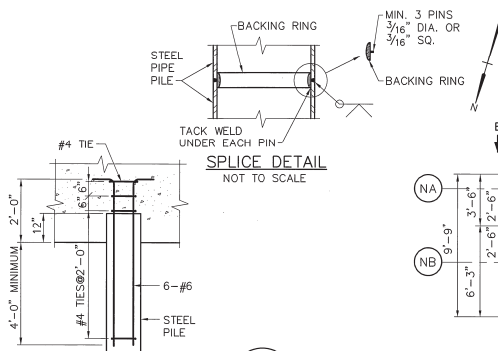
FERRY TERMINALS  
LINCOLNVILLE/ISLESBORO, MAINE  
ABUTMENT MODIFICATIONS  
AND CONCRETE REPAIRS

SHEET NUMBER  
S1  
7 OF 37



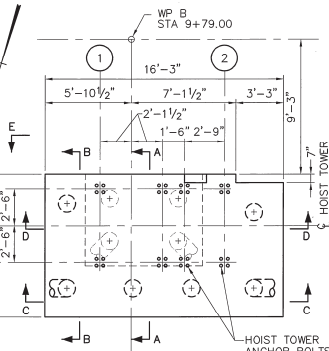
**PILE PLAN**  
SCALE: 1/8"=1'-0"

- PILE LEGEND**
- = PLUMB PILE
  - ◐ = 3:12 BATTER PILE
  - ⊗ = EXISTING PLUMB PILE
  - ⊗ = EXISTING BATTER PILE

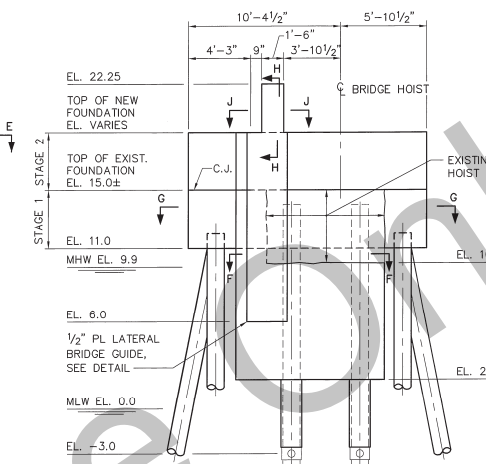


**PILE EMBEDMENT**  
SCALE 1/2" = 1'-0"

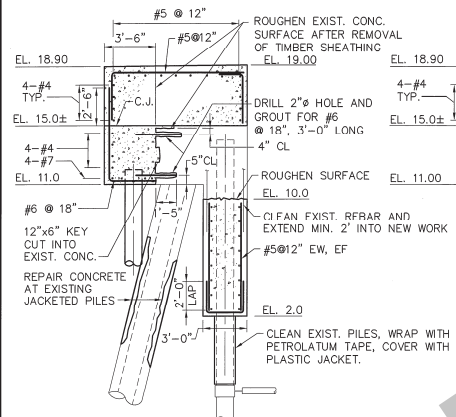
**PILE TIP DETAIL**  
NOT TO SCALE



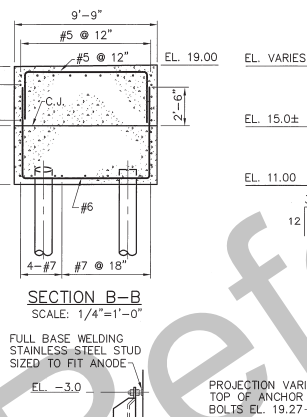
**PLAN - HOIST TOWER FOUNDATION**  
NORTH FOUNDATION SHOWN  
SOUTH FOUNDATION SIMILAR OPP. HAND  
SCALE: 1/4"=1'-0"



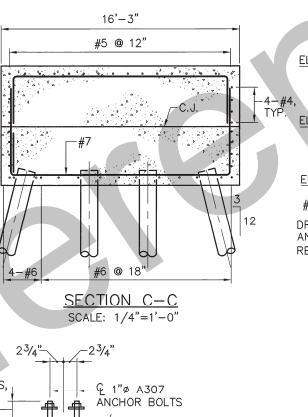
**ELEVATION E-E**  
SCALE: 1/4"=1'-0"



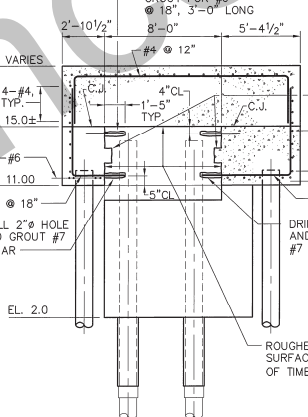
**SECTION A-A**  
SCALE: 1/4"=1'-0"



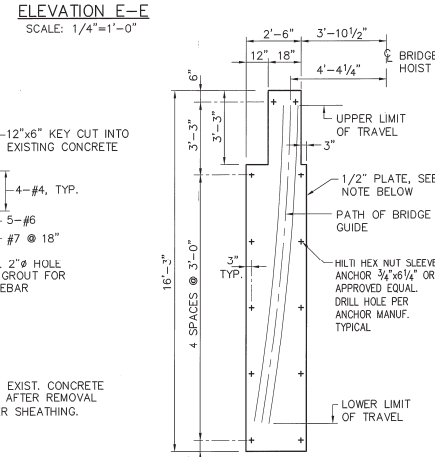
**SECTION B-B**  
SCALE: 1/4"=1'-0"



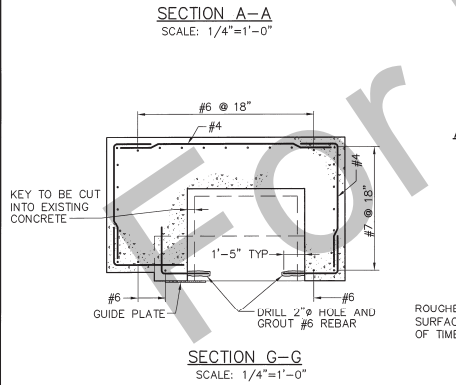
**SECTION C-C**  
SCALE: 1/4"=1'-0"



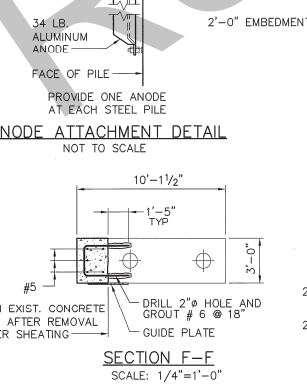
**SECTION D-D**  
SCALE: 1/4"=1'-0"



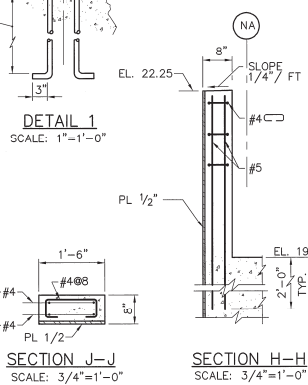
**ELEVATION LATERAL BRIDGE GUIDE**  
SCALE: 3/8"=1'-0"



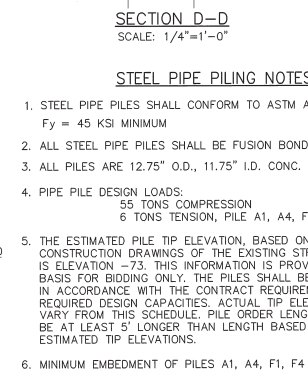
**SECTION G-G**  
SCALE: 1/4"=1'-0"



**SECTION F-F**  
SCALE: 1/4"=1'-0"



**SECTION J-J**  
SCALE: 3/4"=1'-0"



**SECTION H-H**  
SCALE: 3/4"=1'-0"

**STEEL PIPE PILING NOTES**

- STEEL PIPE PILES SHALL CONFORM TO ASTM A252, GRADE 3  
F<sub>y</sub> = 45 KSI MINIMUM
- ALL STEEL PIPE PILES SHALL BE FUSION BONDED EPOXY COATED
- ALL PILES ARE 12.75" O.D., 11.75" I.D. CONC. FILLED STEEL PIPE
- PIPE PILE DESIGN LOADS:  
55 TONS COMPRESSION  
6 TONS TENSION, PILE A1, A4, F1, F4

5. THE ESTIMATED PILE TIP ELEVATION, BASED ON ORIGINAL CONSTRUCTION DRAWINGS OF THE EXISTING STRUCTURE, IS ELEVATION -73. THIS INFORMATION IS PROVIDED AS A BASIS FOR BIDDING ONLY. THE PILES SHALL BE INSTALLED IN ACCORDANCE WITH THE CONTRACT REQUIREMENTS TO THE REQUIRED DESIGN CAPACITIES. ACTUAL TIP ELEVATIONS WILL VARY FROM THIS SCHEDULE. PILE ORDER LENGTHS SHALL BE AT LEAST 5' LONGER THAN LENGTH BASED ON ESTIMATED TIP ELEVATIONS.

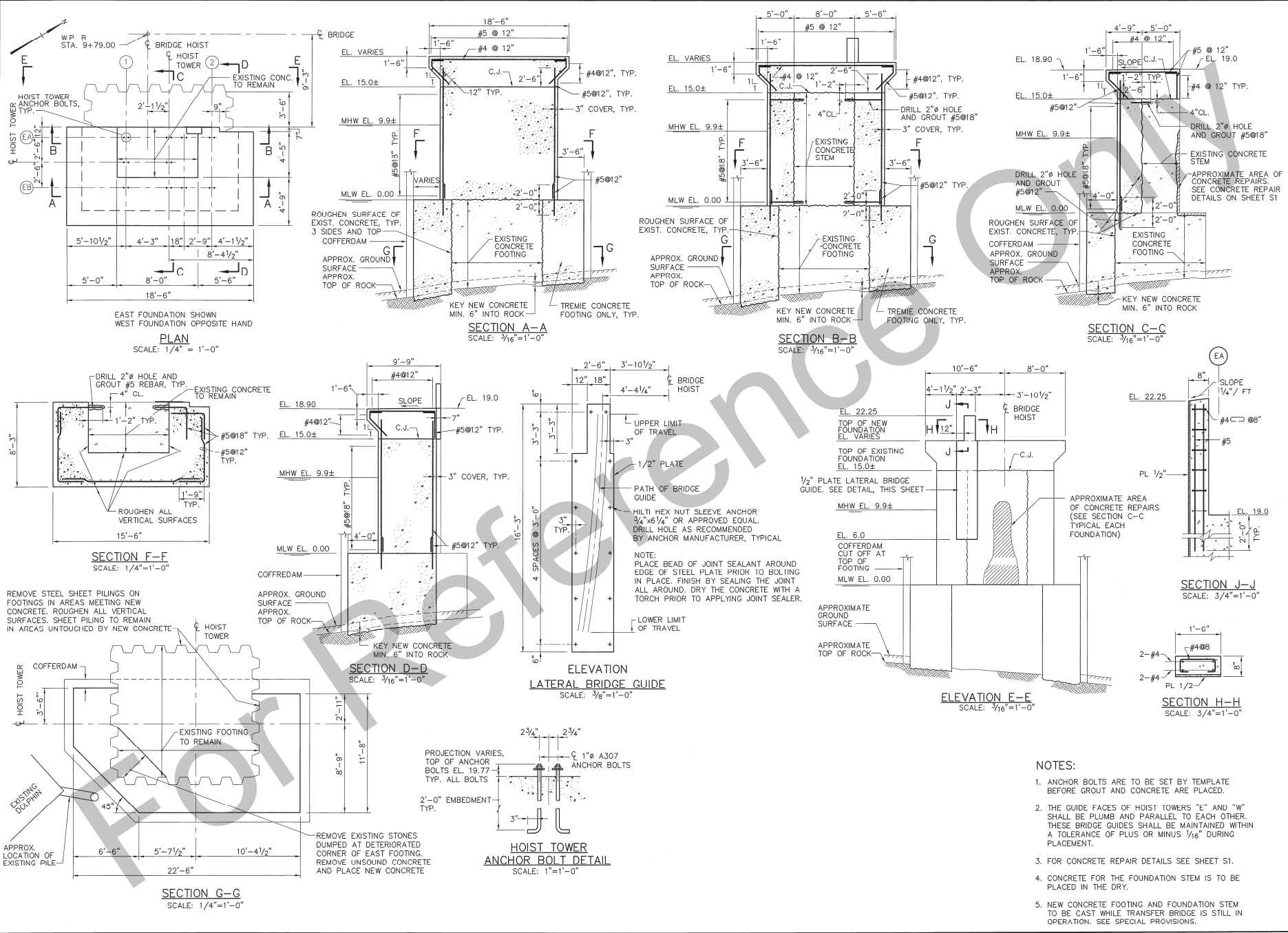
- MINIMUM EMBEDMENT OF PILES A1, A4, F1, F4 SHALL BE 52 FEET.

NOTE: PLACE BEAD OF JOINT SEALANT AROUND EDGE OF STEEL PLATE PRIOR TO BOLTING IN PLACE. FINISH BY SEALING THE JOINT ALL AROUND. DRY THE CONCRETE WITH A TORCH PRIOR TO APPLYING JOINT SEALER.

**NOTES:**

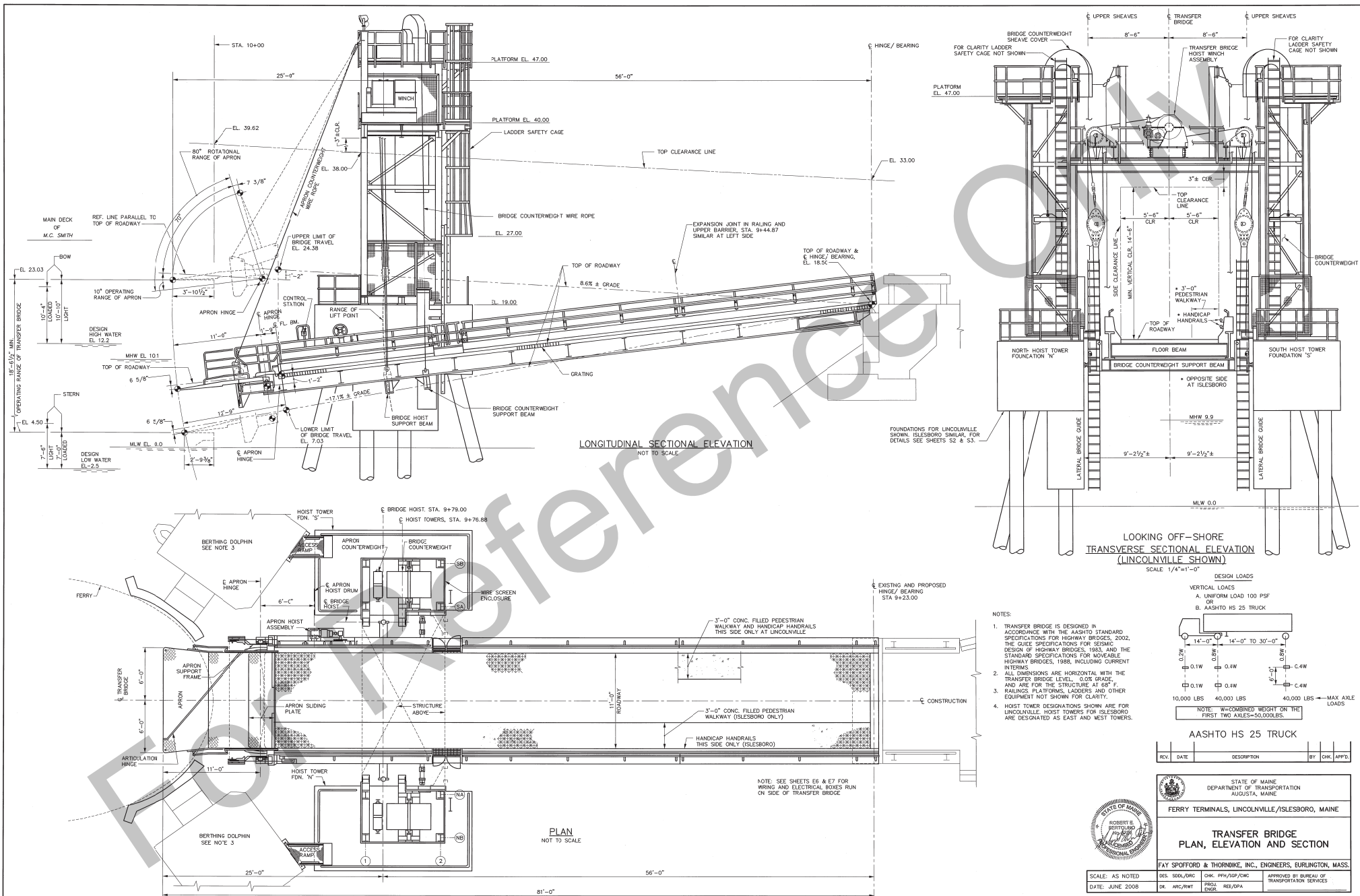
- THE GUIDE FACES OF HOIST TOWERS "N" AND "S" SHALL BE PLUMB AND PARALLEL TO EACH OTHER. THESE BRIDGE GUIDES SHALL BE MAINTAINED WITHIN A TOLERANCE OF PLUS OR MINUS 1/16" DURING PLACEMENT AND CURING
- ANCHOR BOLTS TO BE SET BY TEMPLATE BEFORE GROUT OR CONCRETE IS PLACED.

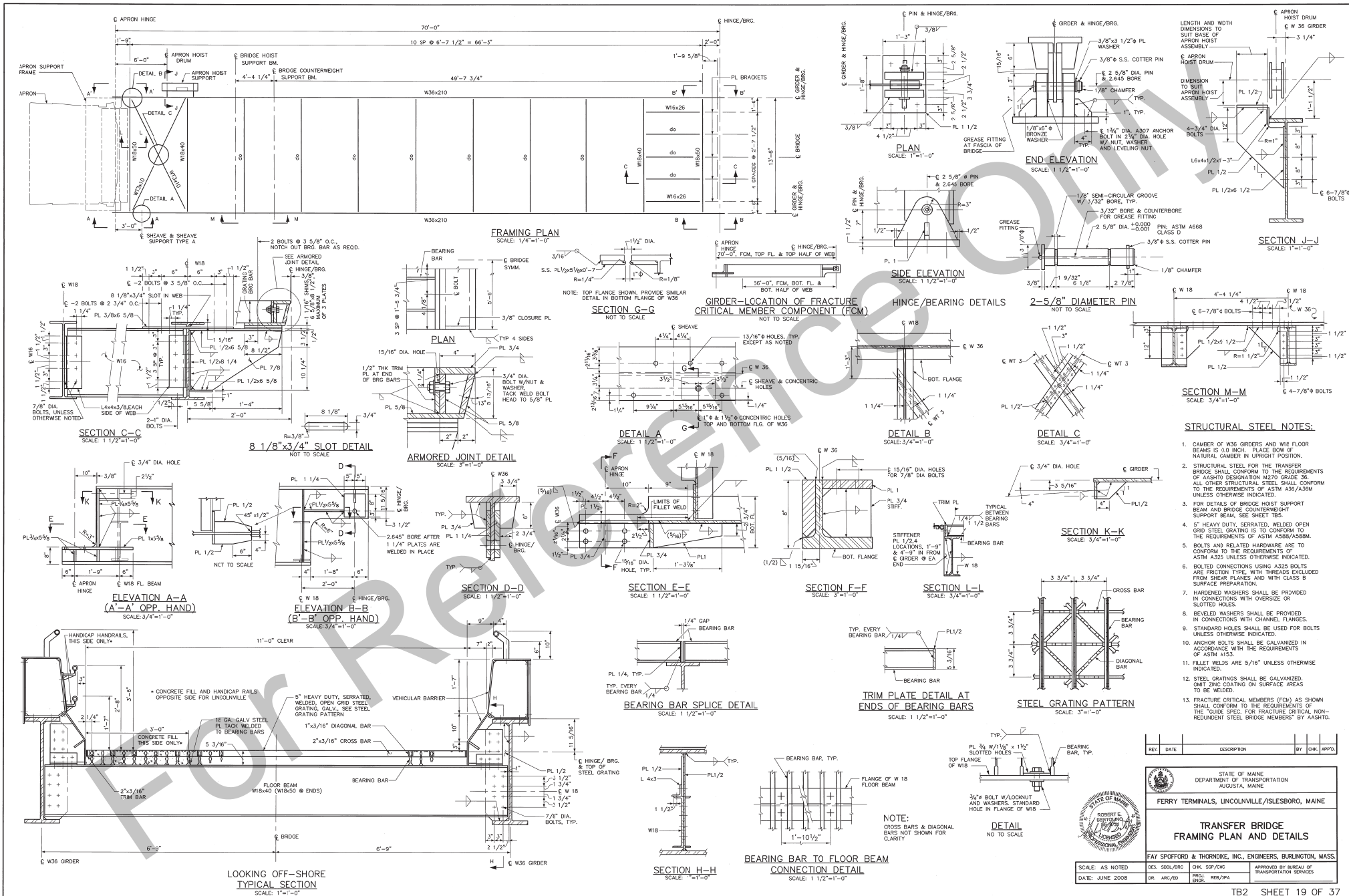
STATE OF MAINE DEPARTMENT OF TRANSPORTATION		APPROVED	DATE
COMMISSIONER:		CHIEF ENGINEER:	
PROJECT INFORMATION	PROJECT MANAGER	DESIGNER	CONSULTANT
MULTIMODAL	PULL PILE	DWH	FAY, SPORFORD & THORNDIKE
FERRY TERMINALS LINCOLNVILLE/ISLESBORO, MAINE LINCOLNVILLE	SIGNATURE	P.F. NUMBER	DATE
HOIST TOWER FOUNDATION DETAILS	8/21	6/27/08	
SHEET NUMBER		8 OF 37	



- NOTES:**
- ANCHOR BOLTS ARE TO BE SET BY TEMPLATE BEFORE GROUT AND CONCRETE ARE PLACED.
  - THE GUIDE FACES OF HOIST TOWERS "E" AND "W" SHALL BE PLUMB AND PARALLEL TO EACH OTHER. THESE BRIDGE GUIDES SHALL BE MAINTAINED WITHIN A TOLERANCE OF PLUS OR MINUS 1/16" DURING PLACEMENT.
  - FOR CONCRETE REPAIR DETAILS SEE SHEET S1.
  - CONCRETE FOR THE FOUNDATION STEM IS TO BE PLACED IN THE DRY.
  - NEW CONCRETE FOOTING AND FOUNDATION STEM TO BE CAST WHILE TRANSFER BRIDGE IS STILL IN OPERATION. SEE SPECIAL PROVISIONS.

STATE OF MAINE DEPARTMENT OF TRANSPORTATION		APPROVED	DATE
COMMISSIONER:		CHIEF ENGINEER:	
PROJECT INFORMATION		SIGNATURE	
PROGRAM	MULTIMODAL	PROJECT MANAGER	PAUL POTTLE
DESIGNER	DWH	CONSOLEMIT	
PROJECT DESIGN	FAV, SPITFORD & THOMPSON	P.E. NUMBER	87721
PROJECT COMPLETION DATE			6/27/08
FERRY TERMINALS LINCOLNVILLE/ISLESBORO, MAINE		HOIST TOWER FOUNDATION DETAILS	
SHEET NUMBER		S3	
9 OF 37			





**STRUCTURAL STEEL NOTES:**

- CAMBER OF W36 GIRDERS AND W18 FLOOR BEAMS TO 10 INCH - PLACE BOW OF NATURAL CAMBER IN UPRIGHT POSITION.
- STRUCTURAL STEEL FOR THE TRANSFER BRIDGE SHALL CONFORM TO THE REQUIREMENTS OF AASHTO DESIGNATION M270 GRADE 50. ALL OTHER STRUCTURAL STEEL SHALL CONFORM TO THE REQUIREMENTS OF ASTM A36/A36M UNLESS OTHERWISE INDICATED.
- TOP DETAILS OF BRIDGE HOIST SUPPORT BEAM AND BRIDGE COUNTERWEIGHT SUPPORT BEAM, SEE SHEET TBS.
- 5" HEAVY DUTY, SEPARATED, WELDED OPEN GRID STEEL GRATING IS TO CONFORM TO THE REQUIREMENTS OF ASTM A495/A495M.
- BOLTS AND RELATED HARDWARE ARE TO CONFORM TO THE REQUIREMENTS OF ASTM A325 UNLESS OTHERWISE INDICATED.
- BOLTED CONNECTIONS USING A325 BOLTS ARE FRICTION TYPE, WITH THREADS EXCLUDED FROM SHEAR PLANES AND WITH CLASS B SURFACE PREPARATION.
- HARDENED WASHERS SHALL BE PROVIDED IN CONNECTIONS WITH OVERSIZE OR SLOTTED HOLES.
- BEVELLED WASHERS SHALL BE PROVIDED IN CONNECTIONS WITH CHANNEL FLANGES.
- STANDARD HOLES SHALL BE USED FOR BOLTS UNLESS OTHERWISE INDICATED.
- ANCHOR BOLTS SHALL BE GALVANIZED IN ACCORDANCE WITH THE REQUIREMENTS OF ASTM A153.
- FILLET WELDS ARE 5/16" UNLESS OTHERWISE INDICATED.
- STEEL GRATINGS SHALL BE GALVANIZED, OBTAIN ZINC COATING ON SURFACE AREAS TO BE WELDED.
- FRACTURE CRITICAL MEMBERS (FCM) AS SHOWN SHALL CONFORM TO THE REQUIREMENTS OF THE "GUIDE SPEC. FOR FRACTURE CRITICAL NON-REDUNDANT STEEL BRIDGE MEMBERS" BY AASHTO.

REV.	DATE	DESCRIPTION	BY	CHK.	APP.

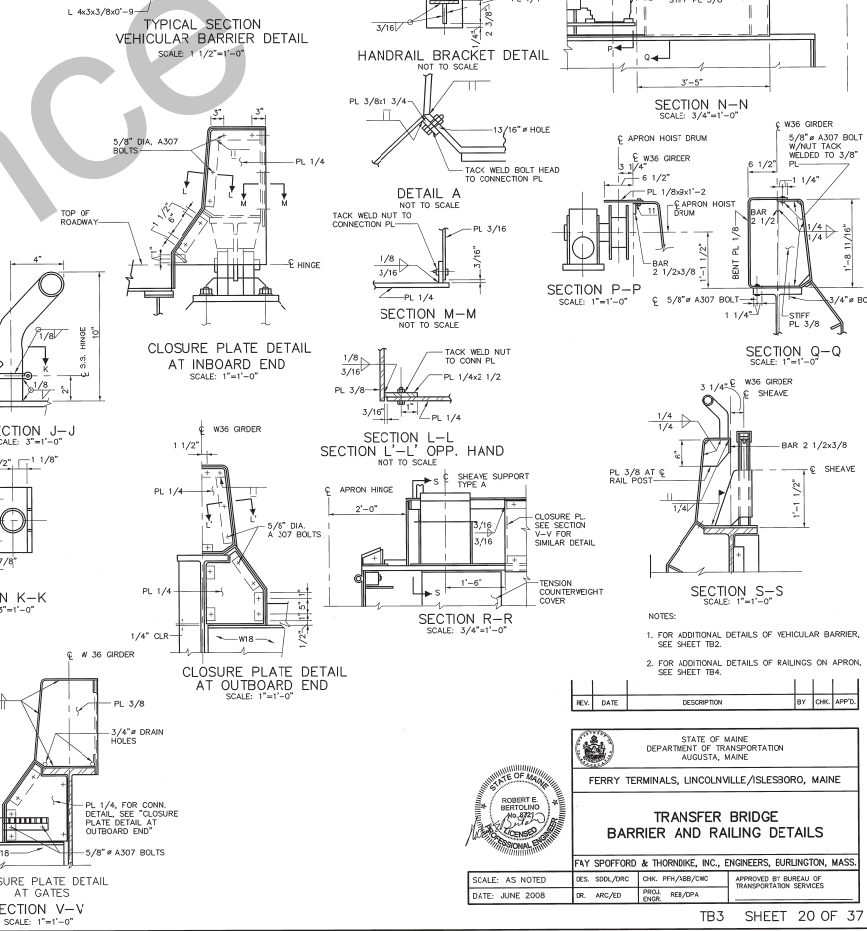
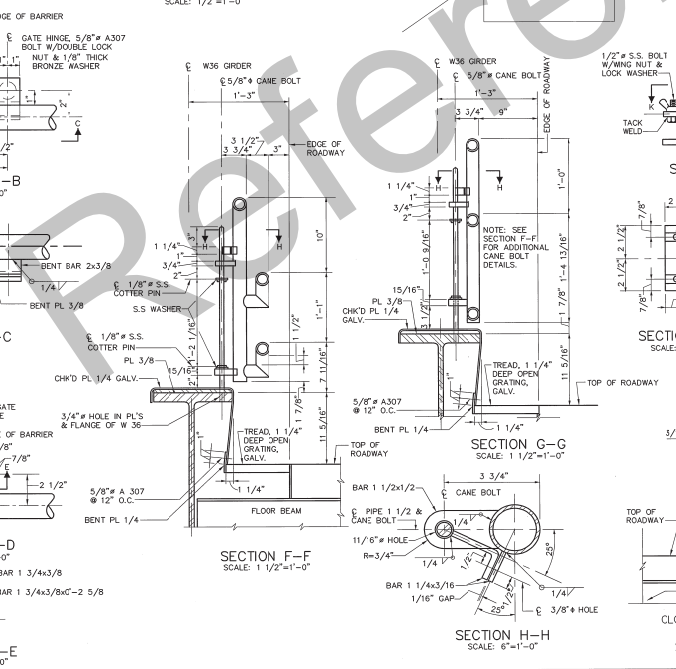
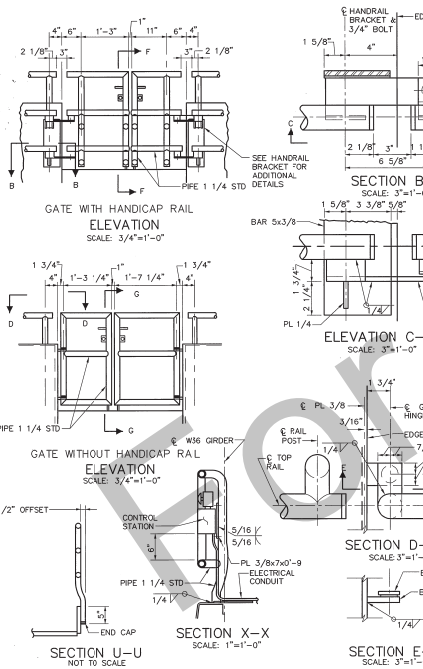
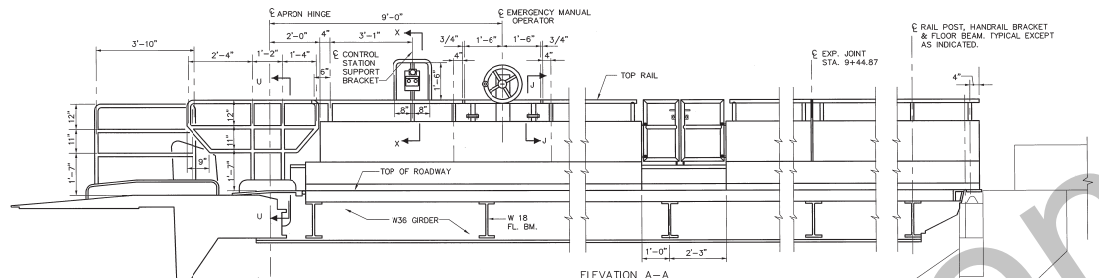
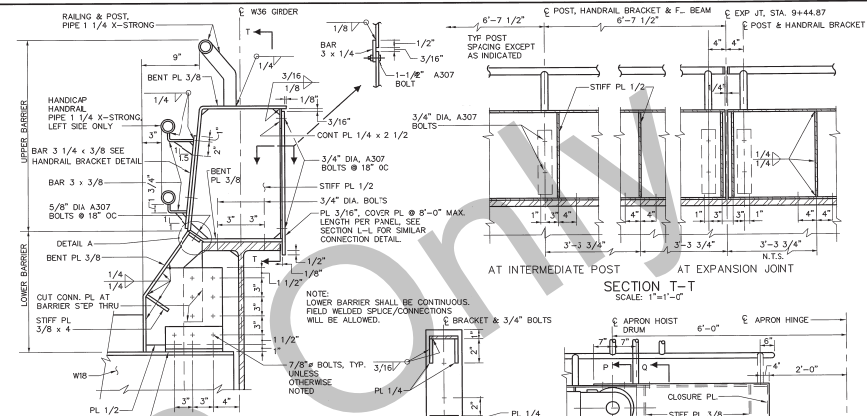
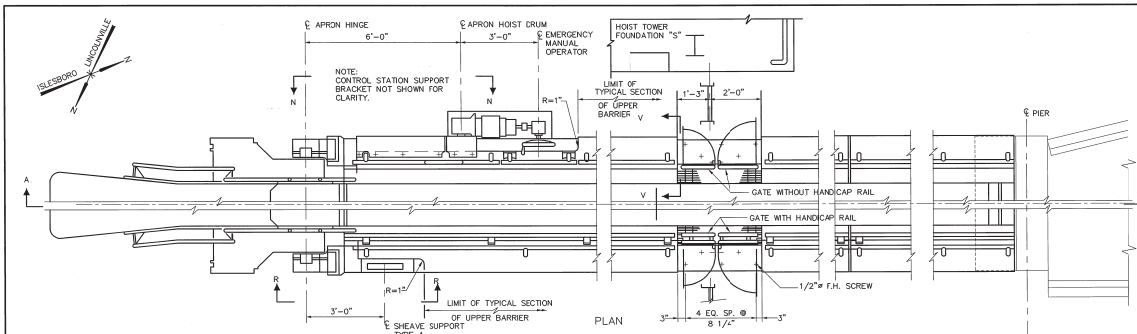
STATE OF MAINE  
DEPARTMENT OF TRANSPORTATION  
AUGUSTA, MAINE

FERRY TERMINALS, UNCONVILLE/SLESBORO, MAINE

**TRANSFER BRIDGE  
FRAMING PLAN AND DETAILS**

FAY SPOTTORD & THORNDIKE, INC., ENGINEERS, BURLINGTON, MASS.

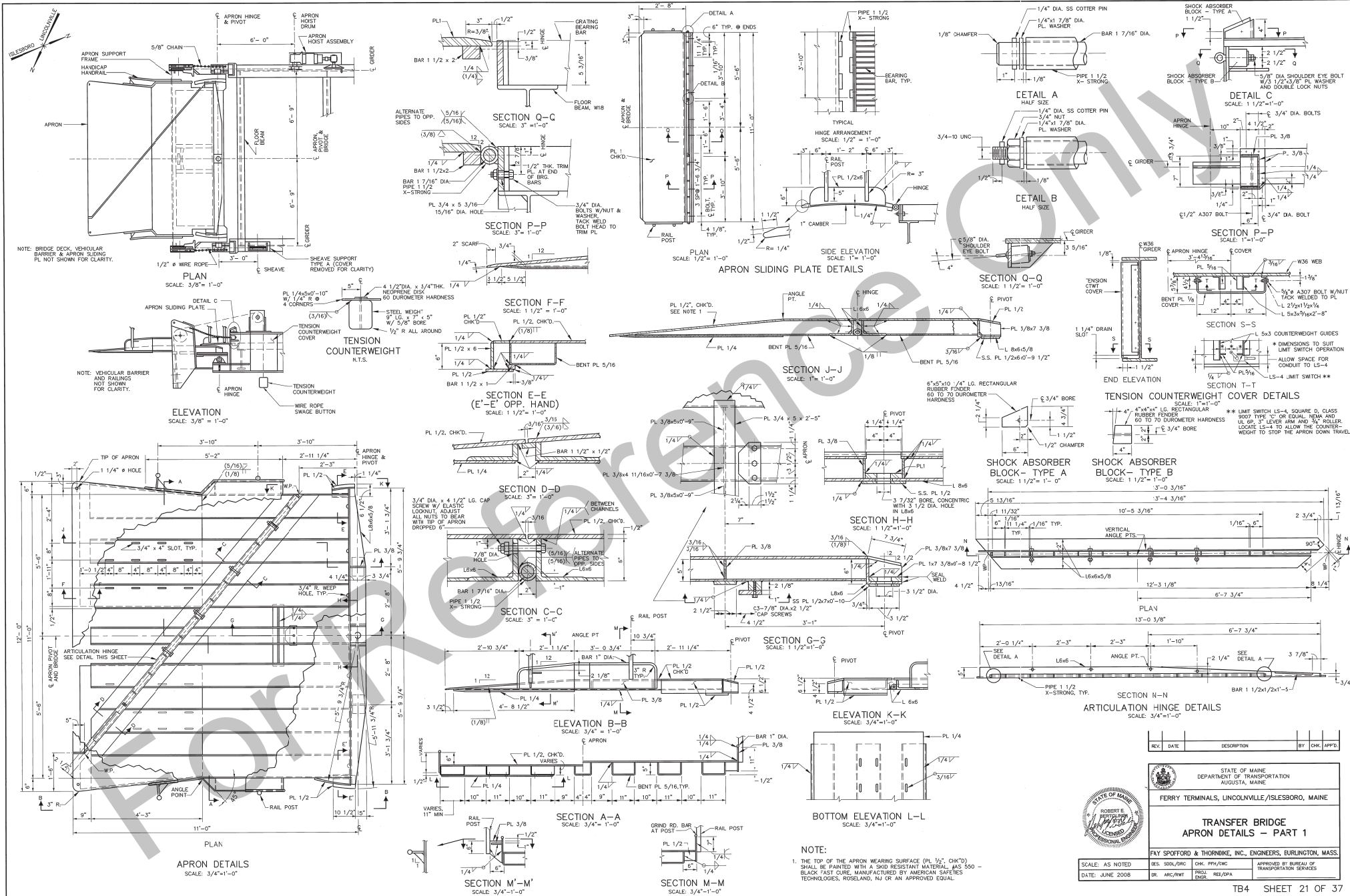
DES. SDD/ARB    CHK. SPJ/FC  
DATE: JUNE 2008    DR. ARC/DG    PROJ. RSB/PA    APPROVED BY ABEAU/OF  
ENGR.    ENGR.



REV.	DATE	DESCRIPTION	BY	CHK.	APP'D.

STATE OF MAINE DEPARTMENT OF TRANSPORTATION AUGUSTA, MAINE		
FERRY TERMINALS, LINCOLNVILLE/ISLESBORO, MAINE		
<b>TRANSFER BRIDGE          BARRIER AND RAILING DETAILS</b>		
FAY SPOFFORD & THORNDIKE, INC., ENGINEERS, BURLINGTON, MASS.		
DES. SDD/LHC	CHK. FFH/AB/CNC	APPROVED BY BUREAU OF TRANSPORTATION SERVICES
DATE: JUNE 2008	DR. ARG/ED	PROJ. REP/DPA DISP



REV.	DATE	DESCRIPTION	BY	CHK.	APP'D.

STATE OF MAINE  
DEPARTMENT OF TRANSPORTATION  
AUGUSTA, MAINE

FERRY TERMINALS, LINCOLNVILLE/SLESBORO, MAINE

**TRANSFER BRIDGE  
APRON DETAILS - PART 1**

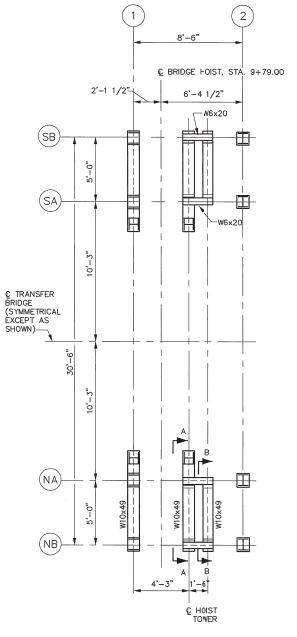
FAY SPOFFORD & THORNIKE, INC., ENGINEERS, BURLINGTON, MASS.

DES. S00L/SRC  
CHK. PFM/VC  
DATE: JUNE 2008

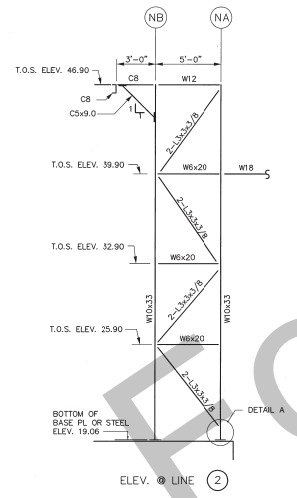
DR. ARG/PWT  
PROJ. RFD/DA  
DSCR.

APPROVED BY BUREAU OF TRANSPORTATION SERVICES

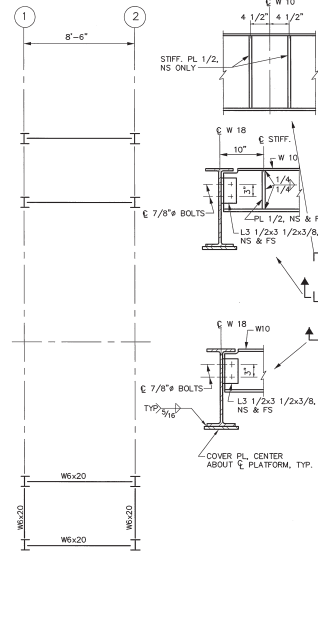




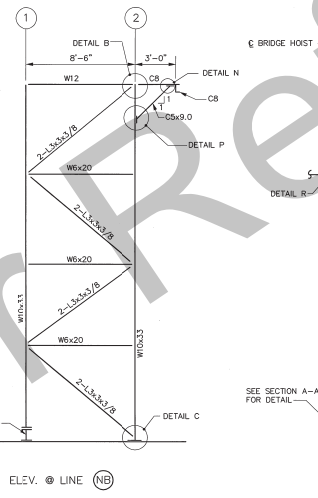
FOUNDATION ELEV. 19.0



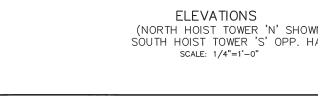
ELEV. @ LINE 2



T.O.S. ELEV. 25.90 & 32.90

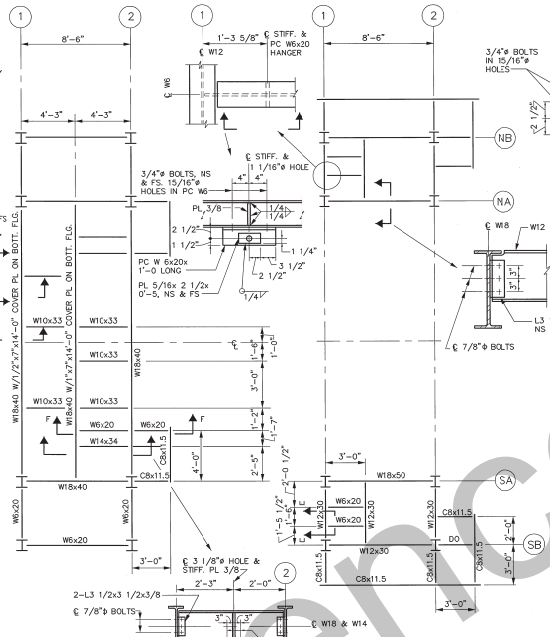


PLATFORM ELEV. 40.0

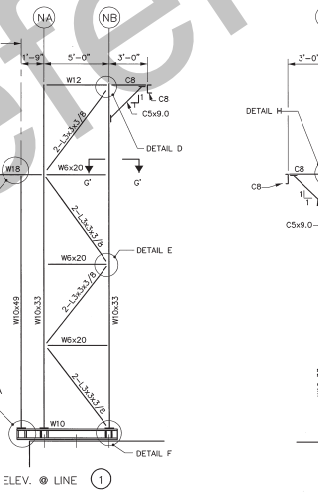


PLATFORM ELEV. 47.0

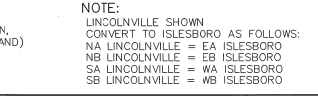
**FRAMING PLANS**  
SCALE: 1/4"=1'-0"



PLATFORM ELEV. 40.0



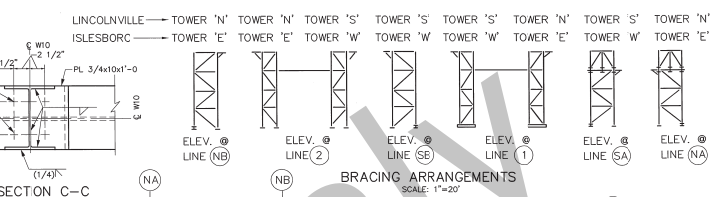
PLATFORM ELEV. 47.0



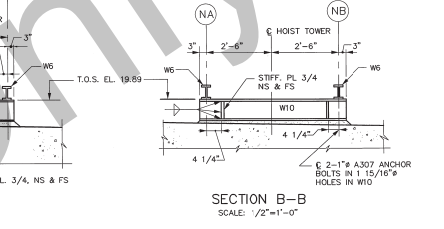
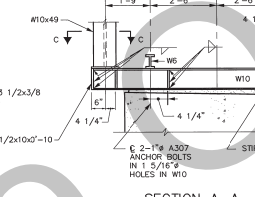
ELEV. @ LINE NA

**ELEVATIONS**  
(NORTH HOIST TOWER 'N' SHOWN,  
SOUTH HOIST TOWER 'S' OPP. HAND)  
SCALE: 1/4"=1'-0"

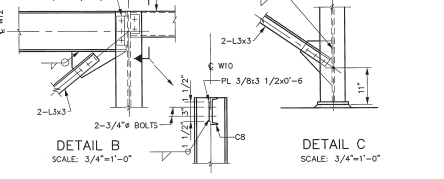
**NOTE:**  
LINCOLNVILLE SHOWN  
CONVERT TO ISLESBORO AS FOLLOWS:  
NA LINCOLNVILLE = EA ISLESBORO  
NB LINCOLNVILLE = EB ISLESBORO  
SA LINCOLNVILLE = WA ISLESBORO  
SB LINCOLNVILLE = WB ISLESBORO



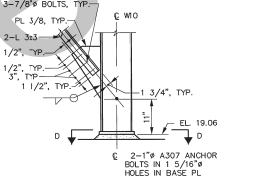
**SECTION C-C**  
SCALE: 1 1/2"=1'-0"



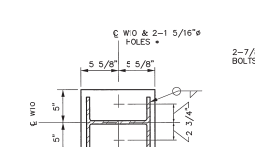
**SECTION A-A**  
SCALE: 1/2"=1'-0"



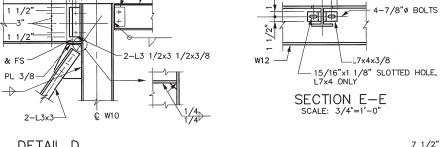
**SECTION A-A**  
SCALE: 1/2"=1'-0"



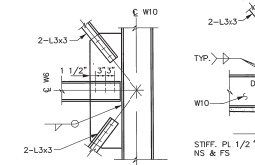
**DETAIL A**  
SCALE: 3/4"=1'-0"



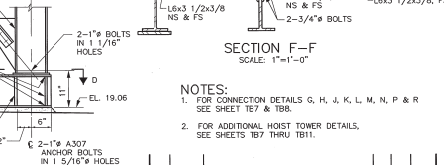
**DETAIL B**  
SCALE: 3/4"=1'-0"



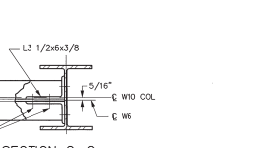
**SECTION D-D**  
SCALE: 1 1/2"=1'-0"



**SECTION E-E**  
SCALE: 3/4"=1'-0"



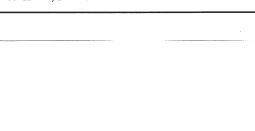
**DETAIL E**  
SCALE: 3/4"=1'-0"



**DETAIL F**  
SCALE: 3/4"=1'-0"



**SECTION G-G**  
SCALE: 1 1/2"=1'-0"



- NOTES:**  
1. FOR CONNECTION DETAILS G, H, J, K, L, M, N, P & R  
SEE SHEET T67 & T68.  
2. FOR ADDITIONAL HOIST TOWER DETAILS,  
SEE SHEETS T67 THRU T611.

REV.	DATE	DESCRIPTION	BY	CHK.	APPD.

STATE OF MAINE  
DEPARTMENT OF TRANSPORTATION  
AUGUSTA, MAINE

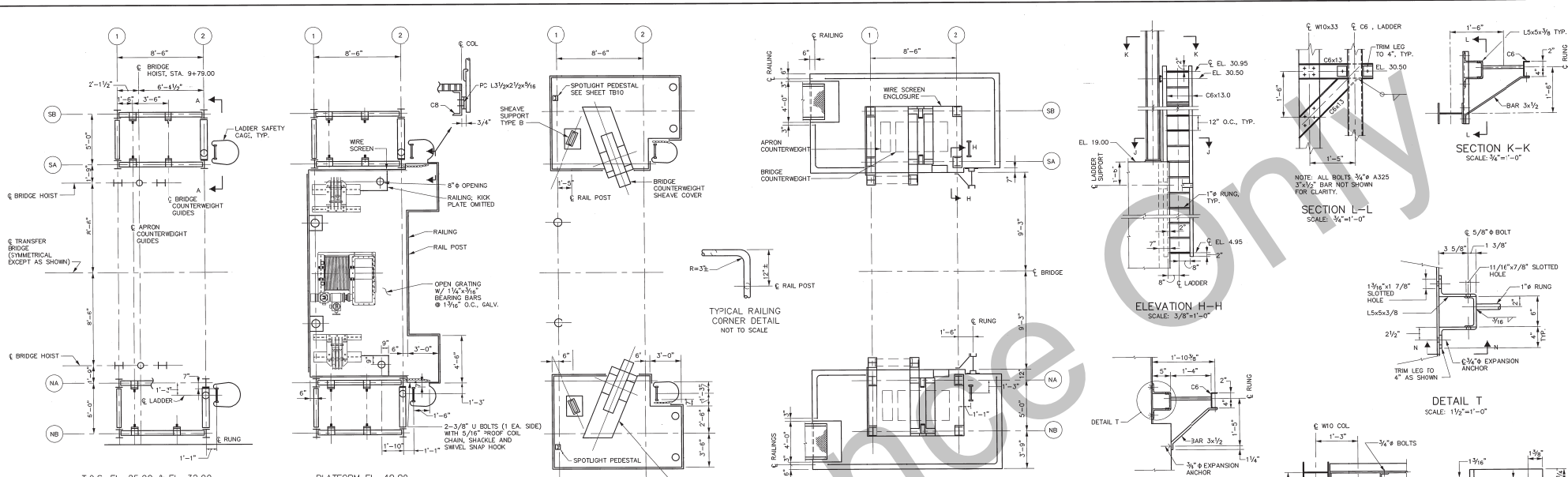
FERRY TERMINALS, LINCOLNVILLE/ISLESBORO, MAINE

**TRANSFER BRIDGE  
HOIST TOWER DETAILS - PART 1**

FAY SPOFFORD & THORNDIKE, INC., ENGINEERS, BURLINGTON, MASS.

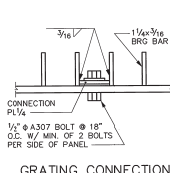
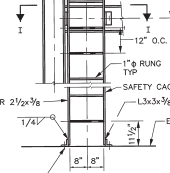
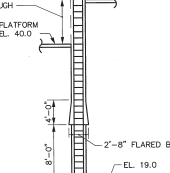
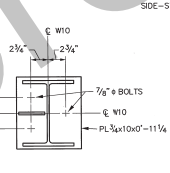
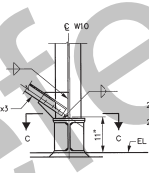
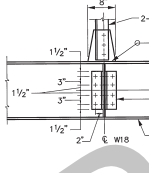
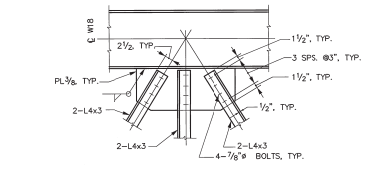
SCALE: AS NOTED  
DES. SIO/LJC  
DATE: JUNE 2008

CHK. PPH/CWC  
PROJ. RIB/DPA  
APP. BY BUREAU OF TRANSPORTATION SERVICES

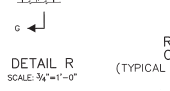
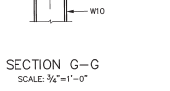
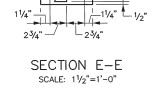
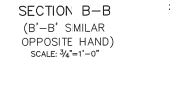
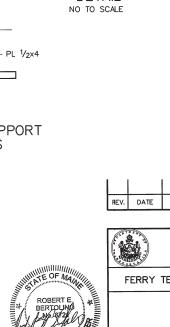
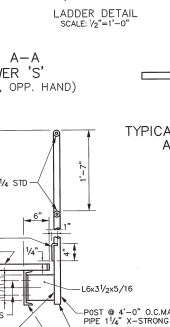
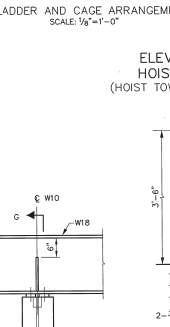
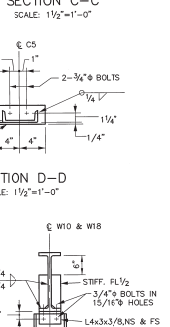
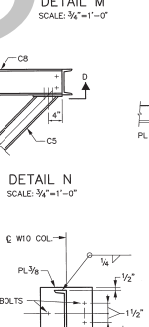
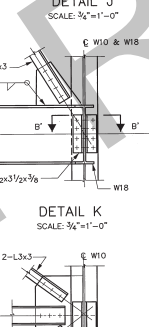
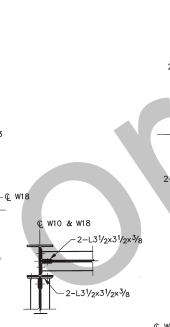
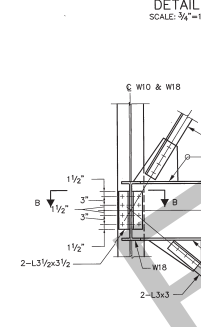


NOTE:  
LINCOLNVILLE SHOWN  
CONVERT TO ISLESBORO AS FOLLOWS:  
NA LINCOLNVILLE = EA ISLESBORO  
NE LINCOLNVILLE = ED ISLESBORO  
SA LINCOLNVILLE = WA ISLESBORO  
SB LINCOLNVILLE = WB ISLESBORO

PLANS  
SCALE: 1/4"=1'-0"



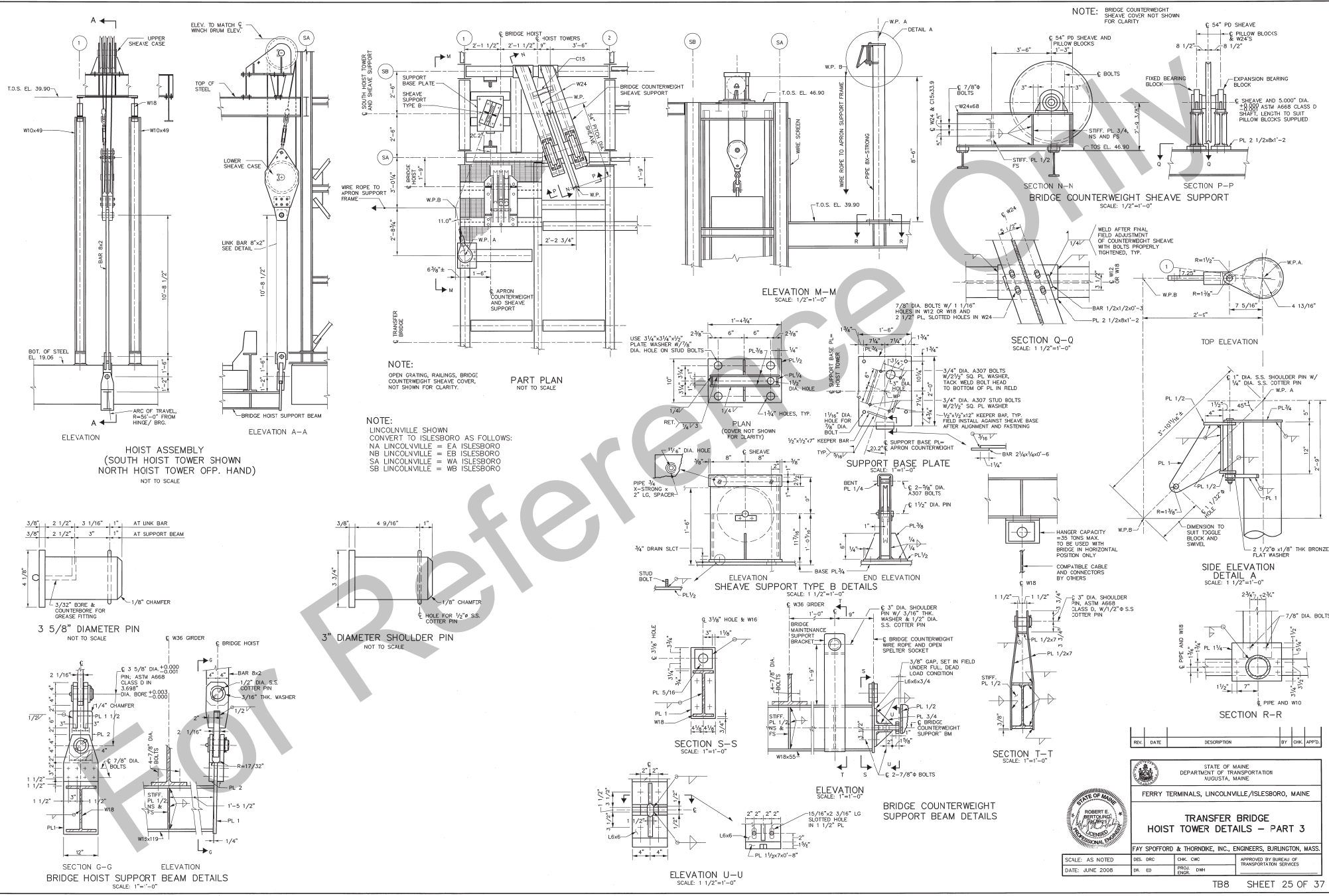
- NOTES:**
- FOR DETAIL OF RAIL POST CONNECTION TO CONCRETE FOUNDATION, SEE TYPICAL PIPE INSERT DETAIL ON SHEET 54.
  - BAND ALL EDGES AND OPENINGS OF OPEN GRATING WITH 1/4"x3/8" BARS.
  - WIRE SCREENS AT PLATFORM ELEVATION 40.0 ALONG COLUMN LINES SA & NA. SEE "WIRE SCREEN ENCLOSURE DETAILS" ON SHEET TBB FOR SIMILAR DETAILS.
  - FOR LADDER SAFETY CAGE DETAILS SEE SHEET TBB.

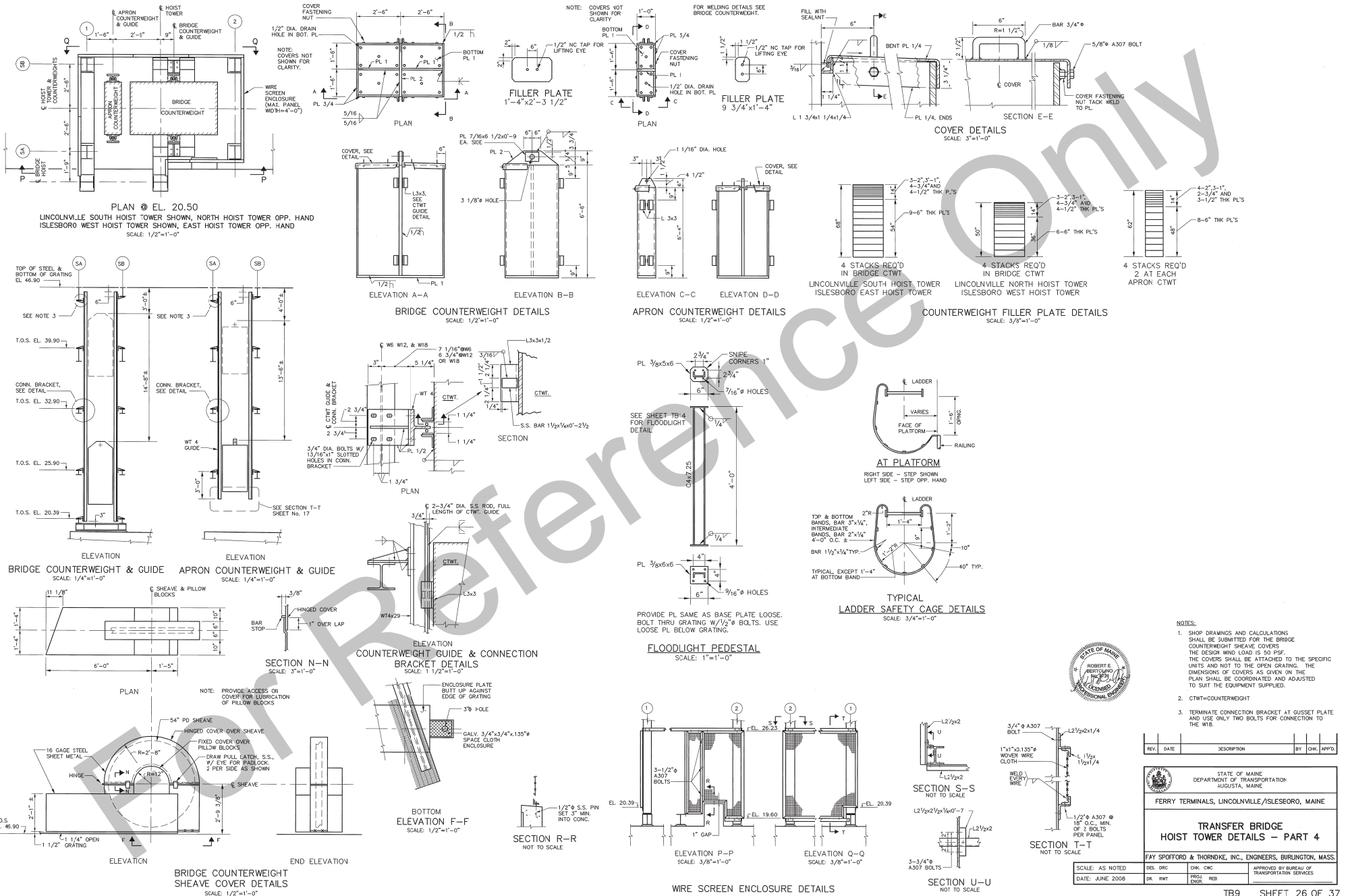


REV.	DATE	DESCRIPTION	BY	CHK.	APPD.

STATE OF MAINE DEPARTMENT OF TRANSPORTATION ALBANY, MAINE	
FERRY TERMINALS, LINCOLNVILLE/ISLESBORO, MAINE	
<b>TRANSFER BRIDGE HOIST TOWER DETAILS - PART 2</b>	
FAY SPOFFORD & THORNDIKE, INC., ENGINEERS, BURLINGTON, MASS.	
SCALE: AS NOTED	CHK. PRP/CWC
DATE: JUNE 2008	BR. RD/RWT
	PROJ. NO. 2008-01
	REV. 001





- NOTES:**
- SHOP DRAWINGS AND CALCULATIONS SHALL BE SUBMITTED FOR THE BRIDGE COUNTERWEIGHT SHEAVE COVERS. THE DESIGN WIND LOAD IS 50 PSF. THE COVERS SHALL BE ATTACHED TO THE SPECIFIC UNITS AND NOT TO THE OPEN GRATING. THE DIMENSIONS OF COVERS AS GIVEN ON THE PLAN SHALL BE COORDINATED AND ADJUSTED TO SUIT THE EQUIPMENT SUPPLIED.
  - CTWT-COUNTERWEIGHT
  - TERMINATE CONNECTION BRACKET AT GUSSET PLATE AND USE ONLY TWO BOLTS FOR CONNECTION TO THE WIRE.

REV.	DATE	DESCRIPTION	BY	CHK.	APP'D.

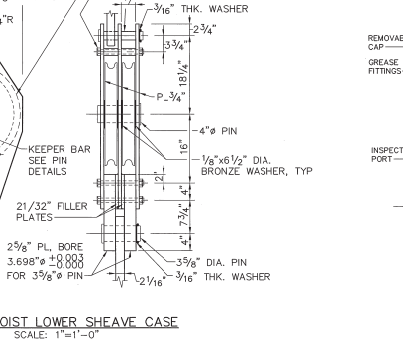
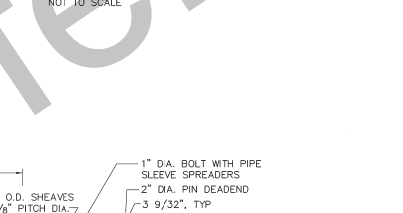
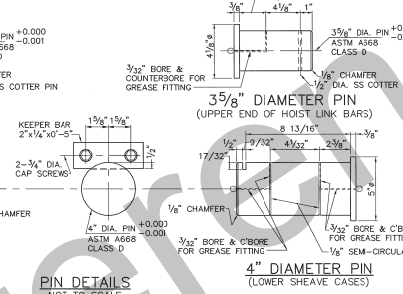
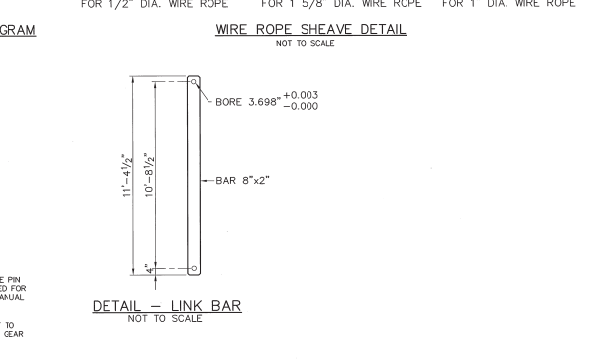
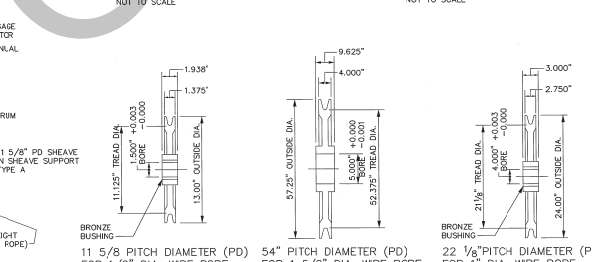
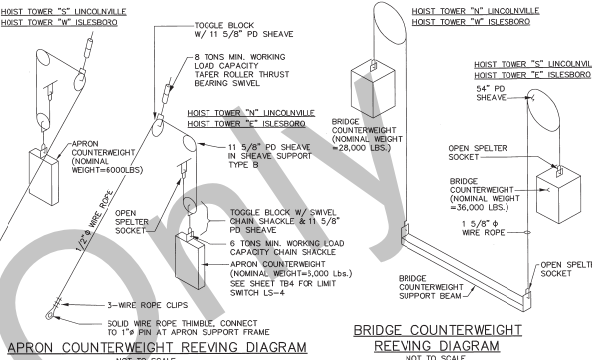
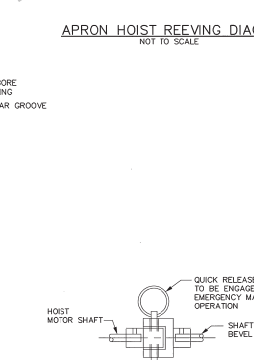
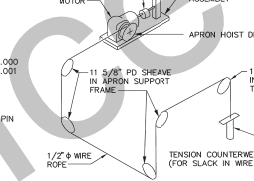
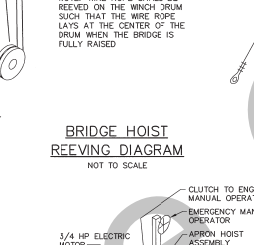
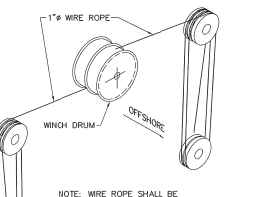
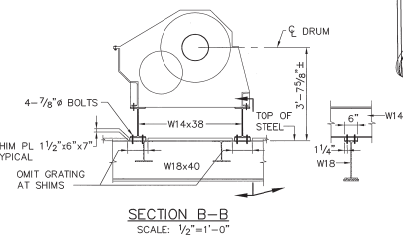
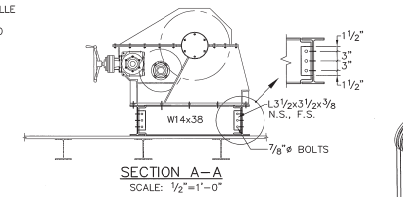
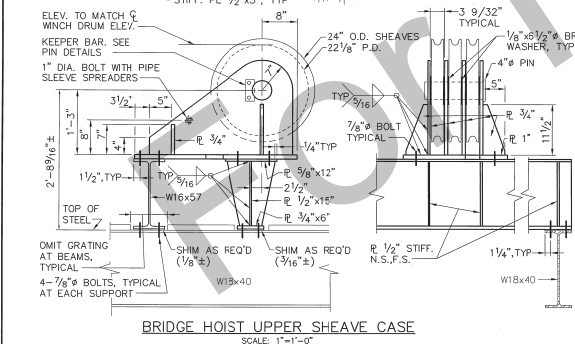
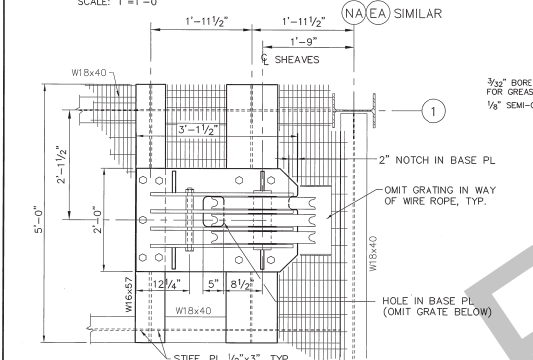
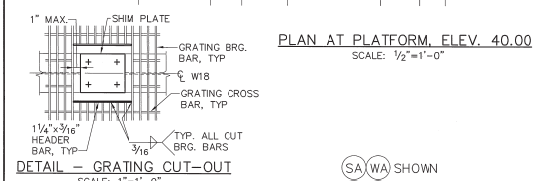
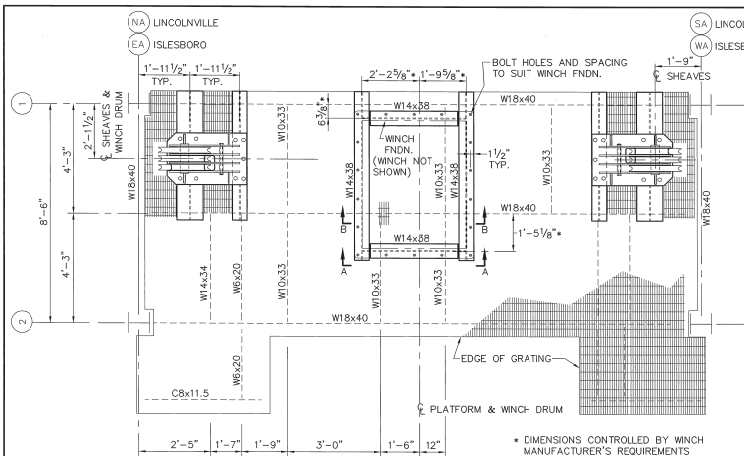
STATE OF MAINE  
DEPARTMENT OF TRANSPORTATION  
AUGUSTA, MAINE

FERRY TERMINALS, LINCOLNVILLE/ISLESEOR, MAINE

**TRANSFER BRIDGE  
HOIST TOWER DETAILS - PART 4**

RAY SPYFFORD & THORNDIKE, INC., ENGINEERS, BURLINGTON, MASS.

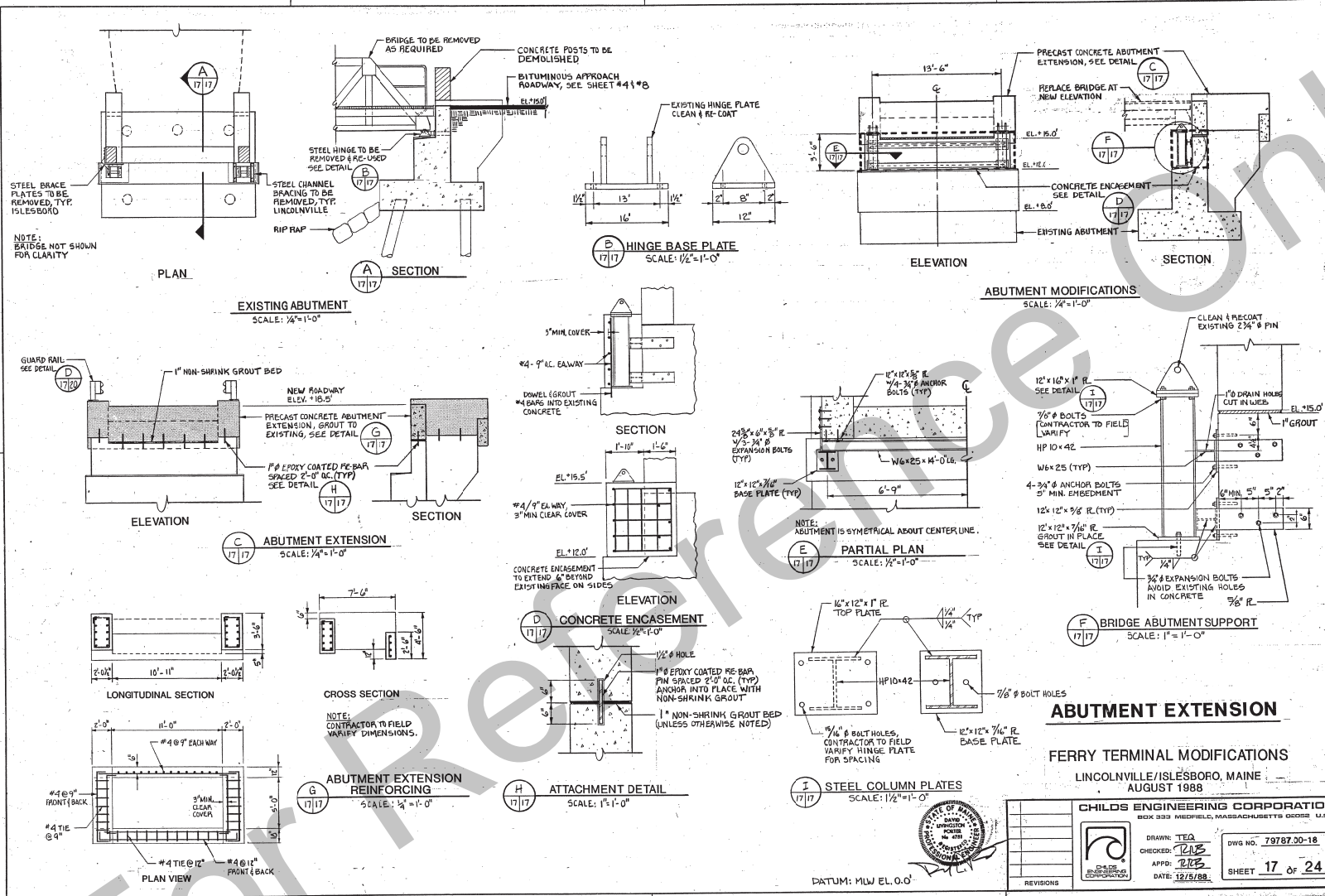
SCALE: AS NOTED	DES. CHK.	CHK. CON.
DATE: JUNE 2008	DRW. WRT.	PROJ. ENG.



REV.	DATE	DESCRIPTION	BY	CHK.	APPD.

STATE OF MAINE DEPARTMENT OF TRANSPORTATION AUGUSTA, MAINE	
FERRY TERMINALS, LINCOLNVILLE/ISLESBORO, MAINE	
TRANSFER BRIDGE - REEVING DIAGRAMS AND HOIST MACHINERY DETAILS	
FAY SPOFFORD & THORNIKE, INC., ENGINEERS, BURLINGTON, MASS.	
SCALE: AS NOTED	APPROVED BY BUREAU OF TRANSPORTATION SERVICES
DATE: JUNE 2008	



**ABUTMENT EXTENSION**

**FERRY TERMINAL MODIFICATIONS**

LINCOLNVILLE/ISLESBORO, MAINE  
AUGUST 1988

CHILDS ENGINEERING CORPORATION  
BOX 333 MEDFIELD, MASSACHUSETTS 02052 U.S.A.

DRAWN: TEA  
CHECKED: TCB  
APPROVED: RLB  
DATE: 12/5/88  
DWG NO. 79787.00-18  
SHEET 17 OF 24



NO.	REVISIONS

REV.	DATE	DESCRIPTION	BY	CHK.	APPRO.

STATE OF MAINE  
DEPARTMENT OF TRANSPORTATION  
AUGUSTA, MAINE

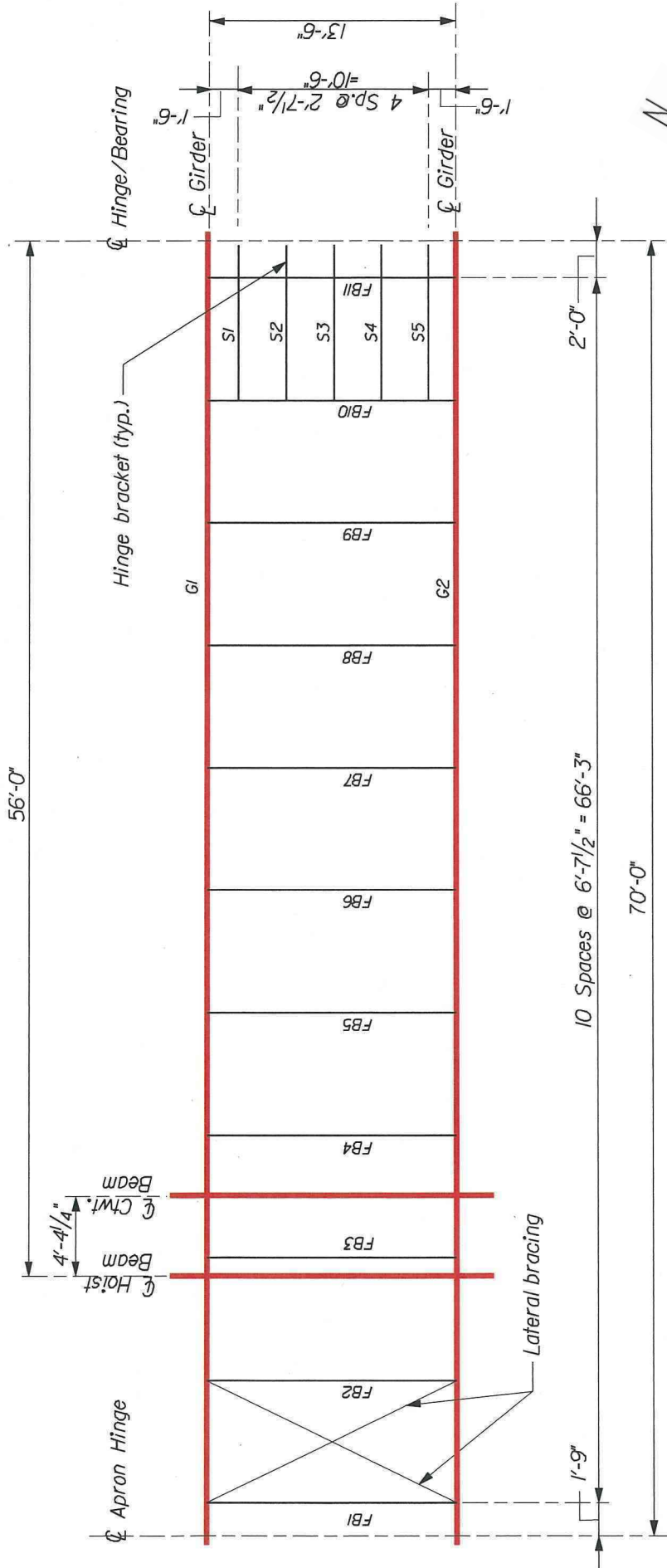
FERRY TERMINALS, LINCOLNVILLE/ISLESBORO, MAINE

REFERENCE DRAWING

FAY SPOFFORD & THORNDIKE, INC., ENGINEERS, BURLINGTON, MASS.  
APPROVED BY BUREAU OF TRANSPORTATION SERVICES

SCALE: NOT TO SCALE  
DATE: JUNE 2008  
DES. OK.  
CHK. PROJ. ENGR.

## **APPENDIX 4.3—Fracture Critical Member Inspection Plan**

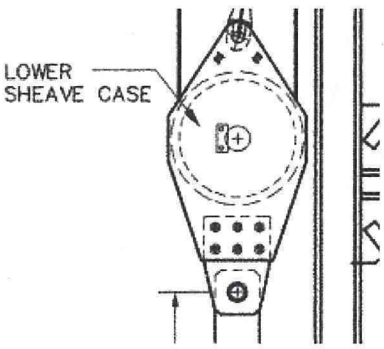
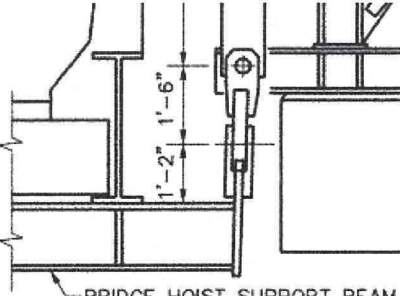
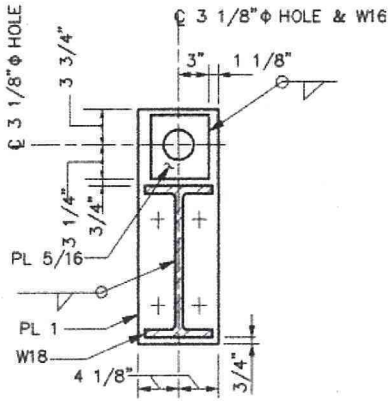


FRAMING PLAN

- LEGEND
- FB = Floor Beam
  - G = Girder
  - S = Stringer
  - █ = Fracture Critical Member

### Fatigue Prone Details

Category reference: AASHTO LRFD Bridge Design Specs Table 6.6.1.2.3-1

Photo or Plan Details	Fatigue Category	Distribution	Description
 <p>LOWER SHEAVE CASE</p>	E	<p>Located above (G1 &amp; G2) at the intersection of Bridge Hoist support beam.</p>	<p>Fracture originating from holes in link bar, sheave case or cable clevis.</p>
 <p>BRIDGE HOIST SUPPORT BEAM</p>	E	<p>Located at intersection of (G1 &amp; G2) with Bridge Hoist Support Beam.</p>	<p>Fracture originating from holes in link bar.</p>
 <p>SECTION S-S SCALE: 1"=1'-0"</p>	E	<p>Located at intersection of (G1 &amp; G2) with Bridge Counterweight Support Beam.</p>	<p>Fracture originating from holes in connection plates or cable clevis.</p>

## **APPENDIX 4.4—Mechanical**

***Appendix 4.4.1—Mechanical Maintenance Check List***

# BASS HARBOR TRANSFER BRIDGE INSPECTION AND MAINTENANCE CHECKLIST (MECHANICAL)

By: \_\_\_\_\_

Date: \_\_\_\_\_

**CAUTION: Use proper lockout/tagout procedures to ensure that maintenance personnel are safe from harm and injury during all inspection and maintenance activities.**

After every maintenance period:

- Restore mechanical systems to their original status.
- Remove all inspection and maintenance equipment from the work area.
- Initiate repair work orders as required.
- Report serious deficiencies to the maintenance supervisor.

Refer to lubrication drawings for equipment locations.

Application Legend	
◇	Oil Reservoir - Check Level and Fill as Required
○	Grease Gun - Remove Plug, Fill and Replace Plug
△	Grease Gun - Alemite Fitting
⬡	Brush or Swab
⇒	Oil Can

Lubricant Legend	
A	Mobilux EP1
B	Mobilux EP2
C	Mobilgear SHC634
D	Mobiltac 275
E	Vitalife 400 or BioLube
F	Mobil DTE-26M
G	Light Oil (WD-40)

NOTES:

Large empty rectangular box for notes.

<h1 style="margin: 0;">BASS HARBOR TRANSFER BRIDGE</h1> <h2 style="margin: 0;">MAINTENANCE CHECKLIST</h2> <h3 style="margin: 0;">(MECHANICAL)</h3>	<h1 style="font-size: 48px; margin: 0;">1</h1> <h2 style="font-size: 24px; margin: 0;">MONTH</h2>
--	---

BRIDGE HOIST MACHINERY	Performed By	Date
<b>RIGHT ANGLE REDUCERS (HUB CITY)</b>		
Inspect for oil leaks.		
Inspect the oil level.		
Inspect oil for contaminants, water and metal particles.		
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.		
<b>PLANETARY REDUCERS (BREVINI)</b>		
Inspect for oil leaks.		
Inspect the oil level.		
Inspect oil for contaminants, water and metal particles.		
Lubricate bearings.		
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.		
<b>PARALLEL SHAFT REDUCERS (JERED)</b>		
Inspect for oil leaks.		
Inspect the oil level.		
Lubricate cartridge and sleeve bearings.		
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.		

<b>HOIST DRUM</b>		
Lubricate drum shaft bearings		
<b>WIRE ROPE AND DEFLECTOR SHEAVES</b>		
Lubricate upper sheave case bushings.		
Lubricate lower sheave case bushings.		
Lubricate link bar upper and lower pin connections.		

<b>BRIDGE COUNTERWEIGHT SYSTEM</b>	Performed By	Date
Lubricate sheave bearings.		

<b>APRON HOIST MACHINERY</b>	Performed By	Date
<b>PEDESTAL REDUCER (JERED)</b>		
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.		
Lubricate slide coupling.		
<b>RIGHT ANGLE REDUCERS (CONE)</b>		
Inspect for oil leaks.		
Check the oil level.		
Lubricate bearings.		
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.		
<b>WIRE ROPE AND DEFLECTOR SHEAVES</b>		
Lubricate deflector sheave bushings.		
<b>MISCELLANEOUS</b>		
Lubricate disconnect coupling.		
Lubricate apron bearings.		
Lubricate apron transverse roller.		

APRON COUNTERWEIGHT SYSTEM	Performed By	Date
Lubricate lower deflector sheave bushings.		
Lubricate upper deflector sheave bushings.		
Lubricate snatch block sheave bushings.		
Lubricate snatch block swivel bushings.		

<h1 style="margin: 0;">BASS HARBOR TRANSFER BRIDGE</h1> <h2 style="margin: 0;">MAINTENANCE CHECKLIST</h2> <h3 style="margin: 0;">(MECHANICAL)</h3>	<h1 style="font-size: 48px; margin: 0;">3</h1> <h2 style="font-size: 24px; margin: 0;">MONTH</h2>
--	---

NOTE: Also include Monthly Maintenance Checklists at the quarterly maintenance interval.

BRIDGE HOIST MACHINERY	Performed By	Date
<b>DISC BRAKES (Stearns)</b>		
Inspect all bolts for rust, corrosion and tightness.		
<b>ELECTRIC MOTORS (Reuland)</b>		
Inspect mounting bolts for rust, corrosion and tightness.		
<b>RIGHT ANGLE REDUCERS (HUB CITY)</b>		
Inspect mounting bolts for rust, corrosion and tightness.		
Inspect all flange, seal carrier and bearing cover bolts for tightness.		
Clean off all corrosion, dirt and oils. Repaint any damaged areas.		
<b>PLANETARY REDUCERS (BREVINI)</b>		
Inspect mounting bolts for rust, corrosion and tightness.		
Inspect all flange, seal carrier and bearing cover bolts for tightness.		
Clean off all corrosion, dirt and oils. Repaint any damaged areas.		
<b>PARALLEL SHAFT REDUCERS (JERED)</b>		
Inspect reducer supports and support members for corrosion and indications of stress.		
Inspect mounting bolts for rust, corrosion and tightness.		
Inspect all flange, seal carrier and bearing cover bolts for tightness.		
Clean off all corrosion, dirt and oils. Repaint any damaged areas.		

<b>HOIST DRUM</b>		
Inspect all external bolts for tightness.		
Inspect drum shaft journal bearing housings and mounting bolts for rust, corrosion and tightness.		
<b>WIRE ROPE AND DEFLECTOR SHEAVES</b>		
Inspect link bar and pin connections for visual damage, as well as any rust or corrosion. Repaint any damaged areas.		
Lubricate turnbuckle threads.		

<b>BRIDGE COUNTERWEIGHT SYSTEM</b>	Performed By	Date
Inspect sheave bearing housings and mounting bolts for rust, corrosion and tightness.		
Lubricate turnbuckle threads.		
Inspect guide rails for straightness and any damaged areas.		
Lubricate guide rails.		
Inspect guide brackets and fasteners for any damage.		
Inspect counterweight box for corrosion or damage.		

<b>APRON HOIST MACHINERY</b>	Performed By	Date
<b>PEDESTAL REDUCER (JERED)</b>		
Inspect mounting bolts for rust, corrosion and tightness.		
Clean off all corrosion, dirt and oils. Repaint any damaged areas.		
Lubricate input and output shaft bearings.		
<b>DISC BRAKES (Stearns)</b>		
Inspect all bolts for rust, corrosion and tightness.		
<b>ELECTRIC MOTORS (Reuland)</b>		
Inspect mounting bolts for rust, corrosion and tightness.		

<b>RIGHT ANGLE REDUCERS (CONE)</b>		
Inspect mounting bolts for rust, corrosion and tightness.		
Inspect all flange and bearing cover bolts for tightness.		
Inspect hoist drum for cracks, damage, corrosion or imprinting.		
<b>WIRE ROPE AND DEFLECTOR SHEAVES</b>		
Inspect wire ropes for damage or breaks, particularly at end connections.		
Inspect deflector sheaves for corrosion or other damage.		
Inspect deflector sheave rope grooves for wear or imprinting damage.		
<b>MISCELLANEOUS</b>		
Inspect apron hinge for any damage and freedom of motion.		
Inspect articulating hinge for any damage and freedom of motion.		
Inspect apron pivot for any damage and freedom of motion.		
Inspect sliding plate for damage or bent edges.		

APRON COUNTERWEIGHT SYSTEM	Performed By	Date
Inspect upper deflector sheave support and mounting bolts for rust, corrosion and tightness.		
Inspect swivel and snatch block for rust and corrosion.		
Inspect swivel and snatch block for freedom of movement.		
Inspect guide rails for straightness and any damaged areas.		
Lubricate guide rails.		
Inspect guide brackets and fasteners for any damage.		
Inspect counterweight box for corrosion or damage.		

<h1 style="margin: 0;">BASS HARBOR TRANSFER BRIDGE</h1> <h2 style="margin: 0;">MAINTENANCE CHECKLIST</h2> <h3 style="margin: 0;">(MECHANICAL)</h3>	<h1 style="font-size: 48px; margin: 0;">6</h1>
	<h2 style="font-size: 24px; margin: 0;">MONTH</h2>

NOTE: Also include Monthly and Quarterly Maintenance Checklists at the semi-annual maintenance interval.

BRIDGE HOIST MACHINERY	Performed By	Date
<b>PARALLEL SHAFT REDUCERS (JERED)</b>		
Remove inspection cover and visually inspect gear teeth for problems.		
Observe inside housing for corrosion or other debris.		
Inspect hydraulic hose for chafing or other damage.		
Inspect pawl assembly for proper operation while inspection cover is removed.		
<b>HOIST DRUM</b>		
Inspect drum rope grooves for wear or imprinting damage.		
<b>WIRE ROPE AND DEFLECTOR SHEAVES</b>		
Lubricate wire ropes.		
Inspect wire ropes for damage or breaks, particularly at end connections.		
Inspect turnbuckle assembly for corrosion or damage.		
Inspect upper sheaves for cracks in hub, web and rim.		
Inspect upper sheaves for cracks in hub, web and rim.		

<b>BRIDGE COUNTERWEIGHT SYSTEM</b>	Performed By	Date
Lubricate wire ropes.		
Inspect wire ropes for damage or breaks, particularly at end connections.		
Inspect turnbuckle assembly for corrosion or damage.		
Inspect sheaves for cracks in hub, web and rim.		
Inspect sheave rope grooves for wear or imprinting damage.		

<b>APRON HOIST MACHINERY</b>	Performed By	Date
<b>PEDESTAL REDUCER (JERED)</b>		
Inspect slide coupling and manually operate it.		
Verify presence of slide coupling engagement pin		
<b>WIRE ROPE AND DEFLECTOR SHEAVES</b>		
Lubricate wire ropes.		

<b>APRON COUNTERWEIGHT SYSTEM</b>	Performed By	Date
Lubricate wire ropes.		
Inspect wire ropes for damage or breaks, particularly at end connections.		
Inspect lower deflector sheaves for damage and rope groove wear.		
Inspect upper deflector sheaves for damage and rope groove wear.		

<h1 style="margin: 0;">BASS HARBOR TRANSFER BRIDGE</h1> <h2 style="margin: 0;">MAINTENANCE CHECKLIST</h2> <h3 style="margin: 0;">(MECHANICAL)</h3>	<h1 style="font-size: 48px; margin: 0;">12</h1> <h2 style="font-size: 24px; margin: 0;">MONTH</h2>
--	--

NOTE: Also include Monthly, Quarterly and Semi-Annual Maintenance Checklists at the annual maintenance interval.

BRIDGE HOIST MACHINERY	Performed By	Date
<b>DISC BRAKES (Stearns)</b>		
Check friction disc clearance, adjust if necessary.		
Inspect condition of friction discs and measure thickness, replace if necessary.		
<b>ELECTRIC MOTORS (Reuland)</b>		
Lubricate motor bearings.		
<b>RIGHT ANGLE REDUCERS (HUB CITY)</b>		
Change oil.		
<b>PLANETARY REDUCERS (BREVINI)</b>		
Change oil.		
<b>PARALLEL SHAFT REDUCERS (JERED)</b>		
Sample and test oil by a qualified test agency. Change oil based on test results.		
Change hydraulic pump oil.		

BRIDGE COUNTERWEIGHT SYSTEM	Performed By	Date
No additional maintenance required this period.		

APRON HOIST MACHINERY	Performed By	Date
<b>DISC BRAKES (Stearns)</b>		
Check friction disc clearance, adjust if necessary.		
Inspect condition of friction discs and measure thickness, replace if necessary.		
<b>ELECTRIC MOTORS (Reuland)</b>		
Lubricate motor bearings.		
<b>RIGHT ANGLE REDUCERS (CONE)</b>		
Change oil.		
<b>APRON COUNTERWEIGHT SYSTEM</b>		
No additional maintenance required this period.		

***Appendix 4.4.2—Mechanical Spare Parts List***

**MECHANICAL SPARE PARTS LIST**

Item	QTY	Manufacturer	Catalog #	Description	Location
RIGHT ANGLE REDUCER	1	HUB CITY	0220-4-015-088	BEVEL GEAR REDUCER, 2:1 RATIO, STYLE AB	BRIDGE HOIST
PLANETARY REDUCER	1	BREVINI	ED2065-MR2	2 STAGE, INLINE REDUCER, 25:1 RATIO, FLANGE MOUNTED	BRIDGE HOIST
PARALLEL SHAFT REDUCER	0	NETEC/JERED	X-2558	CUSTOM REDUCER ASSEMBLY – CONTACT MANUFACTURER	BRIDGE HOIST
PAWL CYLINDER	1	MILWAUKEE	PSH-61	POWER MITE SERIES, 1-1/8" BORE, 1/2" ROD, 1-1/2" STROKE, 2000 PSI, CLEVIS MOUNT	BRIDGE HOIST (INSIDE PARALLEL SHAFT RED.)
PAWL CYLINDER HYDRAULIC HOSE	1	GENERIC	GENERIC	3000PSI WORKING PRESSURE, 3/4" DIA., LENGTH TO SUIT	BRIDGE HOIST (INSIDE PARALLEL SHAFT RED.)
BRIDGE HOIST ROPE ASSEMBLY	1	WIREROPE WORKS	N/A	1" DIA., 6X41 WARRINGTON SEALE, IWRC, RIGHT REGULAR, 56.9 TON NOMINAL STRENGTH**, CLASS B GALVANIZED, SPELTER SOCKET ON ONE END	BRIDGE HOIST

**MECHANICAL SPARE PARTS LIST**

Item	QTY	Manufacturer	Catalog #	Description	Location
BRIDGE COUNTERWEIGHT ROPE ASSEMBLY	1	WIREROPE WORKS	N/A	1-5/8" DIA., 6X41 WARRINGTON SEALE, IWRC, RIGHT REGULAR, 146 TON NOMINAL STRENGTH**, CLASS B GALVANIZED, SPELTER SOCKETS ON BOTH ENDS	BRIDGE COUNTERWEIGHT
WORM REDUCER	1	CONE DRIVE	SMU40-1	DOUBLE ENVELOPING WORM, 1.87 HP @ 1750 RPM INPUT, 200:1 RATIO	APRON HOIST
APRON HOIST ROPE ASSEMBLY	1	WIREROPE WORKS	N/A	1/2" DIA., 6X41 WARRINGTON SEALE, IWRC, RIGHT REGULAR, 14.6 TON NOMINAL STRENGTH**, CLASS B GALVANIZED, SPELTER SOCKET ON ONE END	APRON HOIST
APRON COUNTERWEIGHT ROPE ASSEMBLY	1	WIREROPE WORKS	N/A	1/2" DIA., 6X41 WARRINGTON SEALE, IWRC, RIGHT REGULAR, 14.6 TON NOMINAL STRENGTH**, CLASS B GALVANIZED, SPELTER SOCKET ON ONE END	APRON COUNTERWEIGHT

\*\* WIRE ROPE NOMINAL STRENGTH SHOWN IS BEFORE GALVANIZING

***Appendix 4.4.3—Mechanical Equipment Vendor List***

**MECHANICAL EQUIPMENT VENDOR LIST**

Component	Manufacturer	Vendor
<b>APRON HOIST MACHINERY</b>		
Pedestal Reducer	<b>NETEC</b> (a Division of Jered Industries Inc.) 3000 Sidney Lanier Drive Brunswick, GA 31525 P: (912)262-2000 Website: <a href="http://www.par.com/marine/jered-llc">www.par.com/marine/jered-llc</a>	PaR Marine Services 3000 Sidney Lanier Drive Brunswick, GA 31525 P: (912)262-2000 Website: <a href="http://www.par.com/marine/jered-llc">www.par.com/marine/jered-llc</a>
Motor	<b>See Electrical Section</b>	See Electrical Section
Brake	<b>Stearns (a Division of Rexnord)</b> 5150 S. International Drive Cudahy, WI 53110 P: (414)277-4363 Website: <a href="http://www.rexnord.com">www.rexnord.com</a>	Motion Industries 216 Perry Road Bangor, ME, 04401 P: (207)942-5571 F: (207)942-4738 Website: <a href="http://www.motionindustries.com">www.motionindustries.com</a>
Worm Reducer	<b>Cone Drive Service Center</b> 240 E. 12th Street Traverse City, MI 49685 P: (888)726-2663 Website: <a href="http://www.conedrive.com">www.conedrive.com</a>	Motion Industries 216 Perry Road Bangor, ME, 04401 P: (207)942-5571 F: (207)942-4738 Website: <a href="http://www.motionindustries.com">www.motionindustries.com</a>

**MECHANICAL EQUIPMENT VENDOR LIST**

Component	Manufacturer	Vendor
<b>APRON HOIST MACHINERY - <i>Continued</i></b>		
Operating Rope	<b>Wirerope Works, Inc.</b> 100 Maynard Street Williamsport PA 17701 P: (800)541-7673 P: (570)326-5146 Website: www.wwwwrope.com	I & I Sling 1400 Providence Highway Bldg 3 – Suite 3000 Norwood, MA 02062 P: (781)575-0600 Website: www.iandisling.com
Deflector Sheave	<b>The Crosby Group</b> 2801 Dawson Rd. Tulsa, OK 74110 P: (918) 834-4611 Website: www.thecrosbygroup.com	I & I Sling 1400 Providence Highway Bldg 3 – Suite 3000 Norwood, MA 02062 P: (781)575-0600 Website: www.iandisling.com

Bass Harbor Ferry Terminal Transfer Bridge • Operations & Maintenance Manual

**MECHANICAL EQUIPMENT VENDOR LIST**

Component	Manufacturer	Vendor
<b>APRON COUNTERWEIGHT MACHINERY</b>		
Counterweight Rope	<p><b>Wirerope Works, Inc.</b>                      100 Maynard Street                      Williamsport PA 17701                      P: (800)541-7673                      P: (570)326-5146                      Website: www.wwwwrope.com</p>	<p>I &amp; I Sling                      1400 Providence Highway                      Bldg 3 – Suite 3000                      Norwood, MA 02062                      P: (781)575-0600                      Website: www.iandisling.com</p>
Deflector Sheave (Upper Snatch Block)	<p><b>The Crosby Group</b>                      2801 Dawson Rd.                      Tulsa, OK 74110                      P: (918) 834-4611                      Website: www.thecrosbygroup.com</p>	<p>I &amp; I Sling                      1400 Providence Highway                      Bldg 3 – Suite 3000                      Norwood, MA 02062                      P: (781)575-0600                      Website: www.iandisling.com</p>
Upper Deflector Sheave Rope Swivel	<p><b>The Crosby Group</b>                      2801 Dawson Rd.                      Tulsa, OK 74110                      P: (918) 834-4611                      Website: www.thecrosbygroup.com</p>	<p>I &amp; I Sling                      1400 Providence Highway                      Bldg 3 – Suite 3000                      Norwood, MA 02062                      P: (781)575-0600                      Website: www.iandisling.com</p>
Deflector Sheave (Lower Snatch Block)	<p><b>Yoke USA</b>                      1600 East McFadden Avenue                      Santa Ana, CA 92705                      P: (888)260-7444                      P: (714)545-7444                      Website: www.yokeusa.com</p>	<p>I &amp; I Sling                      1400 Providence Highway                      Bldg 3 – Suite 3000                      Norwood, MA 02062                      P: (781)575-0600                      Website: www.iandisling.com</p>

Bass Harbor Ferry Terminal Transfer Bridge • Operations & Maintenance Manual

**MECHANICAL EQUIPMENT VENDOR LIST**

Component	Manufacturer	Vendor
<b>BRIDGE HOIST MACHINERY</b>		
Motor	<b>See Electrical Section</b>	See Electrical Section
Brake	<b>Stearns (a Division of Rexnord)</b> 5150 S. International Drive Cudahy, WI 53110 P: (414)277-4363 Website: www.rexnord.com	Motion Industries 216 Perry Road Bangor, ME, 04401 P: (207)942-5571 F: (207)942-4738 Website: www.motionindustries.com
Right Angle Reducer	<b>Hub City</b> (a Subsidiary of Regal-Beloit Corp.) 2914 Industrial Ave. Aberdeen, SD 57401 P: (605) 225-0360 Website: www.hubcityinc.com	Motion Industries 216 Perry Road Bangor, ME, 04401 P: (207)942-5571 F: (207)942-4738 Website: www.motionindustries.com
Planetary Reducer	<b>Brevini USA, Inc.</b> 14141 W. Brevini Drive Yorktown, IN 47396 P: (888)BREVINI OR P: (765)759-2300 Website: www.breviniusa.com	Motion Industries 216 Perry Road Bangor, ME, 04401 P: (207)942-5571 F: (207)942-4738 Website: www.motionindustries.com

Bass Harbor Ferry Terminal Transfer Bridge • Operations & Maintenance Manual

**MECHANICAL EQUIPMENT VENDOR LIST**

Component	Manufacturer	Vendor
<b>BRIDGE HOIST MACHINERY - Continued</b>		
Parallel Shaft Reducer	<p><b>NETEC</b>                      (a Division of Jered Industries Inc.)                      3000 Sidney Lanier Drive Brunswick, GA 31525                      P: (912)262-2000                      Website: www.par.com/marine/jered-llc</p>	<p>PaR Marine Services                      3000 Sidney Lanier Drive                      Brunswick, GA 31525                      P: (912)262-2000                      Website: www.par.com/marine/jered-llc</p>
Drum Shaft Bearings	<p><b>Emerson Industrial Automation</b>                      8000 W Florissant Ave.                      St. Louis, MO 63136                      P: (314)533 2000                      Website: www.emersonindustrial.com</p>	<p>Motion Industries                      216 Perry Road                      Bangor, ME, 04401                      P: (207)942-5571                      F: (207)942-4738                      Website: www.motionindustries.com</p>
Operating Rope	<p><b>Wirerope Works, Inc.</b>                      100 Maynard Street                      Williamsport PA 17701                      P: (800)541-7673                      P: (570)326-5146                      Website: www.wirerope.com</p>	<p>I &amp; I Sling                      1400 Providence Highway                      Bldg 3 – Suite 3000                      Norwood, MA 02062                      P: (781)575-0600                      Website: www.iandisling.com</p>
Rope Sockets	<p><b>The Crosby Group</b>                      2801 Dawson Rd.                      Tulsa, OK 74110                      P: (918) 834-4611                      Website: www.thecrosbygroup.com</p>	<p>I &amp; I Sling                      1400 Providence Highway                      Bldg 3 – Suite 3000                      Norwood, MA 02062                      P: (781)575-0600                      Website: www.iandisling.com</p>

Bass Harbor Ferry Terminal Transfer Bridge • Operations & Maintenance Manual

**MECHANICAL EQUIPMENT VENDOR LIST**

Component	Manufacturer	Vendor
<b>BRIDGE HOIST MACHINERY - <i>Continued</i></b>		
Deflector Sheave	<b>The Crosby Group</b> 2801 Dawson Rd. Tulsa, OK 74110 P: (918) 834-4611 Website: www.thecrosbygroup.com	I & I Sling 1400 Providence Highway Bldg 3 – Suite 3000 Norwood, MA 02062 P: (781)575-0600 Website: www.iandisling.com
Lower Sheave Case Turnbuckle	<b>The Crosby Group</b> 2801 Dawson Rd. Tulsa, OK 74110 P: (918) 834-4611 Website: www.thecrosbygroup.com	I & I Sling 1400 Providence Highway Bldg 3 – Suite 3000 Norwood, MA 02062 P: (781)575-0600 Website: www.iandisling.com

Bass Harbor Ferry Terminal Transfer Bridge • Operations & Maintenance Manual

**MECHANICAL EQUIPMENT VENDOR LIST**

Component	Manufacturer	Vendor
<b>BRIDGE COUNTERWEIGHT MACHINERY</b>		
Sheave	<b>The Crosby Group</b> 2801 Dawson Rd. Tulsa, OK 74110 P: (918) 834-4611 Website: www.thecrosbygroup.com	I & I Sling 1400 Providence Highway Bldg 3 – Suite 3000 Norwood, MA 02062 P: (781)575-0600 Website: www.iandisling.com
Sheave Bearings	<b>Cooper Split Roller Bearing Corp.</b> 5365 Robin Hood Road, Suite B Norfolk, VA 23513 P: (757)460-0925 Website: www.cooperbearings.com	Motion Industries 216 Perry Road Bangor, ME, 04401 P: (207)942-5571 F: (207)942-4738 Website: www.motionindustries.com
Counterweight Rope	<b>Wirerope Works, Inc.</b> 100 Maynard Street Williamsport PA 17701 P: (800)541-7673 P: (570)326-5146 Website: www.wwwwrope.com	I & I Sling 1400 Providence Highway Bldg 3 – Suite 3000 Norwood, MA 02062 P: (781)575-0600 Website: www.iandisling.com
Rope Sockets	<b>The Crosby Group</b> 2801 Dawson Rd. Tulsa, OK 74110 P: (918) 834-4611 Website: www.thecrosbygroup.com	I & I Sling 1400 Providence Highway Bldg 3 – Suite 3000 Norwood, MA 02062 P: (781)575-0600 Website: www.iandisling.com

***Appendix 4.4.4—Mechanical Equipment Nameplate Table***

**MECHANICAL EQUIPMENT NAMEPLATE DATA**

**APRON HOIST MACHINERY**

**Pedestal Reducer**

Manufacturer: NETEC  
 Model No.: X2256  
 Serial No.: 26787  
 Ratio: 200:1  
 Input: 18" diameter handwheel (manual)

**Motor**

Manufacturer: Reuland  
 Serial No.: 937026A-1  
 Production No.: 0007H-1BAN-0007  
 HP: 3/4  
 RPM: 600  
 Frame: 184  
 Housing: TENV  
 Insulation: Class BBB  
 Type: COVO  
 Code: L  
 Style: AER  
 Time Rating: 30 Minutes  
 Options: 40W space heater (120V)

**Brake** <sup>ESTIMATED</sup>

Manufacturer: Stearns (Rexnord)  
 Model No.: 105622200008  
 Serial No.: N/A  
 Torque: 6 ft-lb  
 Options: 25W space heater

**Worm Reducer**

Manufacturer: Cone Drive  
 Model No.: SMU40-1  
 Ratio: 200:1  
 Input: 1.87 hp @ 1750 rpm  
 Assembly No.: 09500880-100-2

**Operating Rope** <sup>ESTIMATED</sup>

Manufacturer: Unknown  
 Diameter: 1/2"  
 Description: 6x41 Warrington-Seale construction, galvanized, extra improved plow steel (XIPS), independent wire rope core (IWRC), right regular lay, 13.3 ton minimum breaking strength with one end clamped to drum and tension counterweight installed on free end

**MECHANICAL EQUIPMENT NAMEPLATE DATA**

**Deflector Sheave** <sup>ESTIMATED</sup>

Manufacturer: McKissick  
Model No.: 13BB  
Pitch Diameter: 11-5/8"  
Bore Diameter: 1-1/2" (nominal)  
Rope Diameter: 1/2"

**APRON COUNTERWEIGHT MACHINERY**

**Counterweight Rope**

Manufacturer: Unknown  
Diameter: 1/2"  
Description: 6x41 Warrington-Seale construction, extra improved plow steel (XIPS), independent wire rope core (IWRC), right regular lay, 13.3 ton minimum breaking strength with open spelter socket on counterweight end and thimble with (3) wire rope clips on apron end

**Deflector Sheave (Upper)** <sup>ESTIMATED</sup>

Manufacturer: McKissick  
Model No.: 13BB  
Pitch Diameter: 11-5/8"  
Bore Diameter: 1-1/2" (nominal)  
Rope Diameter: 1/2"

**Snatch Block (above bridge hoist platform)**

Manufacturer: Campbell (Cooper)  
Model No.: 4099BS 733-2520  
Capacity: 8 ton  
Pitch Diameter: 6"  
Rope Diameter: 3/4"

**Snatch Block Swivel**

Manufacturer: Johnson Block  
Model No.: 12JE  
Serial No.: 92-956  
Assembly No.: 471440  
Working Load: 12 metric tons

**Deflector Sheave (Lower)**

Manufacturer: Campbell (Cooper)  
Model No.: 4099BS 733-2520  
Capacity: 8 ton  
Pitch Diameter: 6"  
Rope Diameter: 3/4"

**MECHANICAL EQUIPMENT NAMEPLATE DATA**

**BRIDGE HOIST MACHINERY**

**Motor**

Manufacturer: Reuland  
Serial No.: 99-6684A-4  
Production No.: 0100C-1BAN-0285  
HP: 10  
RPM: 1800  
Frame: 256U  
Housing: TENV  
Insulation: Class HHH  
Style: ABR  
Type: COSO  
Time Rating: 30 Minutes  
Options: Temperature Sensor

**Brake**

Manufacturer: Stearns (Rexnord)  
Model No.: 1081022I2ALF  
Serial No.: 05109D001  
Torque: 175 ft-lb  
Options: space heater, brass pressure plate, brass stationary disc

**Right Angle Reducer**

Manufacturer: Hub City  
Model No.: 88  
Ratio: 2:1  
Style: AB  
Assembly No.: 0220-4-015-088  
Date Code: 9804

**Planetary Reducer**

Manufacturer: Brevini  
Type: ED2065-MR2  
Ratio: 25:1  
Serial No.: V11641  
M.C. 22  
Date: 12/98

**Parallel Shaft Reducer**

Manufacturer: NETEC  
Model No.: X-2558  
Serial No.: 27188  
Options: 40" drum assembly integral with housing frame, 2.5 kW oil bath heater, pawl mechanism (spring actuated - cylinder released)

**MECHANICAL EQUIPMENT NAMEPLATE DATA**

**Parallel Shaft Reducer Optional Equipment**

**Hydraulic Pump**

Manufacturer (Pump): SPX Stone  
Part No.: 2975-BC

Solenoid Valve: Nachi  
Model No.: SS-G01-A5X-R-C115-E50

Manufacturer (Motor): Magnetek (Century AC Motor)  
Part No.: 8-184007-20  
Serial No.: BN10-233  
HP: 1/2  
RPM: 1725  
Frame: K56Y  
Insulation: Class B  
Code: L  
Form: KMA  
Type: CS  
Time: Continuous

**Hydraulic Cylinder**

Manufacturer: Milwaukee Cylinder  
Series: Power Mite  
Model No.: PSH-61  
Serial No.: H9946461  
Bore Dia.: 1.125"  
Rod Dia.: 0.5"  
Stroke: 1.50"  
Working Pressure: 2000 psi max

**Oil Bath Heater**<sup>ESTIMATED</sup>

Manufacturer: Chromalox  
Catalog No.: ARMTO-2255T1  
Part No.: 156-303012-723  
Description: 2.5kW, 120V-1Ph-60Hz

**Operating Rope**

Manufacturer: Unknown  
Diameter: 1"  
Description: 6x41 Warrington-Seale construction, extra improved plow steel (XIPS), independent wire rope core (IWRC), right regular lay, 51.7 ton minimum breaking strength with open spelter socket on counterweight end and thimble with (3) wire rope clips on apron end

**MECHANICAL EQUIPMENT NAMEPLATE DATA**

**Deflector Sheave (Upper Sheave Case)**<sup>ESTIMATED</sup>

Manufacturer: McKissick  
Stock No.: 4100859  
Pattern No.: 42TS8-2  
Pitch Diameter: 21-1/8"  
Bore Diameter: 4" (nominal)  
Rope Diameter: 1"

**Deflector Sheave (Lower Sheave Case)**<sup>ESTIMATED</sup>

Manufacturer: McKissick  
Stock No.: 4100859  
Pattern No.: 42TS8-2  
Pitch Diameter: 21-1/8"  
Bore Diameter: 4" (nominal)  
Rope Diameter: 1"

**BRIDGE COUNTERWEIGHT MACHINERY**

**Sheave**

Manufacturer: McKissick  
Pitch Diameter: 54"  
Bore Diameter: 5" (nominal)  
Rope Diameter: 1-5/8"

**Sheave Bearings**

Manufacturer: Cooper (an SKF Group Company)  
Model Nos.: O2BCP500GR (Expansion Bearing)  
O2BCP500EX (Fixed Bearing)  
Shaft Diameter: 5" (nominal)

**Counterweight Rope**

Manufacturer: Unknown  
Diameter: 1-5/8"  
Description: 6x41 Warrington-Seale construction, extra improved plow steel (XIPS), independent wire rope core (IWRC), right regular lay, 132 ton minimum breaking strength with open spelter socket on each end

***Appendix 4.4.5—Mechanical Manufacturers' Maintenance Manuals***

## **Appendix 4.4.5 - Mechanical Manufacturer's Literature**

### **Bridge Hoist Machinery**

- 4.4.5.1 Brake (Stearns)
- 4.4.5.2 Right Angle Reducer (Hub City)
- 4.4.5.3 Planetary Reducer (Brevini)
- 4.4.5.4 Parallel Shaft Reducer (Jered/NETEC)
- 4.4.5.5 Pawl Hydraulic Pump (SPX Stone)
- 4.4.5.6 Pawl Hydraulic Cylinder (Milwaukee)
- 4.4.5.7 Deflector Sheave (McKissick)

### **Bridge Counterweight System**

- 4.4.5.8 54" Diameter Sheave (McKissick)
- 4.4.5.9 Sheave Bearings (Cooper)
- 4.4.5.10 Turnbuckle (Crosby)

### **Apron Hoist Machinery**

- 4.4.5.11 Brake (Stearns)
- 4.4.5.12 Worm Reducer (Cone Drive)

### **Apron Counterweight System**

- 4.4.5.13 Upper Deflector Sheave (McKissick)
- 4.4.5.14 Upper Snatch Block Swivel (Johnson)
- 4.4.5.15 Upper and Lower Snatch Blocks (Campbell Cooper)

### **Lubricant Data**

- 4.4.5.16 Mobilux EP1 and EP2
- 4.4.5.17 Mobilux SHC634
- 4.4.5.18 Mobiltac 275
- 4.4.5.19 Crosby Vitalife 400
- 4.4.5.20 Mobil DTE-26M

## Appendix 4.4.5.1

System: Bridge Hoist Machinery  
Component: Brake  
Manufacturer: Stearns

# Introduction to Solenoid Actuated Brakes (SAB's)

## Stearns Brakes Set the Standard for Excellence

Stearns offers the most comprehensive line of solenoid actuated brakes (SAB's) on the market today. We have earned the reputation as the industry's quality leader by working closely with you, our customers, understanding your needs and developing products with design features to handle your most challenging applications. We have installed millions of Stearns brakes worldwide since 1935. Many brakes operating today are 40 years old or more; evidence of our product quality and reliability.

Stearns motor brakes can be mounted directly to an electric motor or foot mounted. The compact design delivers high torque in a small size with fast, positive response and no residual drag when released. Our brakes can be mounted directly onto NEMA C-face motors without special alignment procedures. Many motor manufacturers offer a brake kit which will convert a stock fan-cooled motor into a brakemotor. Stearns Solenoid Actuated Brakes feature unitized construction which makes servicing friction discs easy using only a screwdriver and wrench. The Stearns SAB ensures automatic stopping and holding any time power to the brake is interrupted. And, as with ALL Stearns products, the friction material is non-asbestos.

We can produce a brake which meets your specifications, including metric mounting. Chances are, we've already manufactured similar requirements from a long list of pre-engineered options.

### Enclosure Types

Stearns brakes, when properly installed, are provided in a variety of IP enclosure types.

**IP 21** - intended for general purpose, indoor applications, as a ventilated enclosure. Protected against dripping water.

**IP 23** - intended for indoor applications, as a non-ventilated enclosure. It provides protection against falling, non-corrosive dirt and liquid. Protected against spraying water.

**IP 54** - intended for dust protected indoor and outdoor applications. Protected against splashing water.

**IP 55** - intended for dust protected indoor and outdoor applications. Protected against water jets.

**IP 56** - intended for dust protected indoor and outdoor applications. Protected against heavy seas or powerful jets.

**IP 57** - intended for dust protected indoor and outdoor applications. Protected against the effects of immersion.

NOTE: IP 21, 23 & 54 - formerly referred to by Stearns as NEMA 1, 2 & 4 respectively.

IP 55, 56 & 57 - formerly referred to by Stearns as NEMA Type 4X (BISSC Certified with epoxy coating and stainless steel hardware on exterior, or with a stainless steel enclosure).

### Self-Adjusting Disc Brakes

Remote inaccessible locations or high cycling applications require a specially designed, low-maintenance brake that will operate at peak efficiency and provide uniform braking for long periods of time. Stearns exclusive self-adjusting feature helps eliminate the major cause of brake maintenance - friction lining wear. Self-adjusting brakes are also well suited for applications where rapid cycling requires frequent resetting of solenoid air gap. Automatic adjustment also eliminates the errors that can occur with hand adjustment. They can be easily modified to suit your particular application. Depending upon the series you select, these brakes can be direct mounted on motors ranging in size from NEMA 182TC through NEMA 505C.



### Manually Adjusted Disc Brakes with Automatic Reset

It's an unbeatable combination; the features you want most in spring-set disc brakes. Standard features now include: a unique spring design which allows for



universal mounting, an air gap adjustment gauge for visual recognition that the brake needs adjustment, a new patented hub design, and genuine Stearns friction discs which are trademarked and patented. The 56 Series Brakes come in static torque ratings from 1.5 through 25 lb-ft with NEMA C-face mountings 56C, 143TC, 145TC, 182TFC and 184TFC. Ten different housing, endplate, and release configurations, with a wide variety of pre-engineered modifications, you can select from 120,000 possible combinations! In addition, for holding applications where friction disc wear is not a factor, Stearns 87,000 Series Brakes are available with an optional manual adjust. The 87,000 Series Brakes are available in static torque ratings from 6 lb-ft through 105 lb-ft, with NEMA C-face mountings, 182TC through 286TC.

# Series 81,000 and 82,000

Mounting Face NEMA 324 and 326TC, TSC, UC or USC, NEMA 364 and 365TC, TSC, UC or USC  
NEMA 404 and 405 TC, TSC, UC or USC

## 81,000 Series Specifications

Nominal Static Torque	No. of Friction Discs	Coil Size	Maximum Solenoid Cycle Rate <sup>①</sup>	Thermal Capacity <sup>②</sup>	Inertia (Wk <sup>2</sup> )
lb-ft (Nm)			cycles/min	hp-sec/min (watts)	lb-ft <sup>2</sup> (kgm <sup>2</sup> x 10 <sup>-3</sup> )
125 (169)	2	9	15	30 (373)	.192 (8.06)
175 (237)	2	9	15	30 (373)	.192 (8.06)
230 (312)	3	9	15	30 (373)	.280 (11.76)

## 82,000 Series Specifications

Nominal Static Torque	No. of Friction Discs	Coil Size		Maximum Solenoid Cycle Rate <sup>①</sup>		Thermal Capacity <sup>②</sup>	Inertia (Wk <sup>2</sup> )
		AC	DC	cycles/min	hp-sec/min (watts)		
lb-ft (Nm)				AC	DC		lb-ft <sup>2</sup> (kgm <sup>2</sup> x 10 <sup>-3</sup> )
125 (169)	2	9	9	15	15	50 (621)	.490 (20.58)
175 (237)	2	9	9	15	15	50 (621)	.490 (20.58)
230 (312)	3	9	9	15	15	50 (621)	.704 (29.57)
330 (447)	3	K9	9	13	15	50 (621)	.704 (29.57)
440 (597)	4	K9	9	13	15	50 (621)	.918 (38.56)

① Maximum solenoid cycle rate is based on ambient temperature of 72°F (22°C) with 50% duty cycle. Does not relate to brake cycle rate (see Thermal Capacity).

② Thermal capacity rating is based on ambient temperature of 72°F (22°C) stop time of one second or less, with no heat absorbed from motor. Refer to "Selection Procedure" Section. Derate thermal capacity by 25% for vertical mounting.

## Current Ratings (amperes)

Coil Size	Frequency	Voltage	Current	
			Inrush	Holding
9	60 Hz	115	44.0	1.6
		200	25.4	.9
		230	22.0	.8
		400	12.7	.5
		460	11.4	.4
	575	8.8	.3	
	50 Hz	110	32.1	1.2
		220	16.0	.6
		380	11.1	.4
	DC	24	56.4	.7
95		14.9	.2	
115		11.4	.1	
230		5.9	.07	
K9	60 Hz	115	50.0	2.2
		200	28.0	1.3
		230	25.0	1.1
		400	14.0	.6
		460	12.5	.6
	575	10.0	.4	
	50 Hz	110	36.0	1.6
		220	24.0	.9
		380	12.5	.6
	DC	—	—	—
		—	—	—
		—	—	—
		—	—	—
—		—	—	

## Ordering and Identification Information

The following example and tables provide information for selecting the appropriate three-letter suffix when ordering a Stearns Brake.

Example of a complete part number, Series 81,000:

1-081-011-02-NLF — Lead wire position (internal and external, left and right)  
460 Vac  
2-1/8 bore and 1/2 x 1/4 keyway

Example of a complete part number, Series 82,000:

1-082-012-02-NLF — Lead wire position (internal and external, left and right)  
460 Vac  
2-1/8 bore and 1/2 x 1/4 keyway

### 81,000 Series Hub Selection

Character	Bore (in.)	Keyway** (in. x in.)
A	1 1/8	1/4 x 1/8
B*	1 1/4	1/4 x 1/8
C	1 3/8	5/16 x 5/32
D	1 1/2	3/8 x 3/16
E*	1 9/16	3/8 x 3/16
F	1 5/8	3/8 x 3/16
G*	1 11/16	3/8 x 3/16
H	1 3/4	3/8 x 3/16
I*	1 13/16	1/2 x 1/4
J	1 7/8	1/2 x 1/4
K*	1 15/16	1/2 x 1/4
L*	2	1/2 x 1/4
M*	2 1/16	1/2 x 1/4
N*	2 1/8	1/2 x 1/4
O*	2 3/16	1/2 x 1/4
P*	2 1/4	1/2 x 1/4
Q*	2 5/16	5/8 x 5/16
R	2 3/8	5/8 x 5/16
S*	2 7/16	5/8 x 5/16
T	2 1/2	5/8 x 5/16
W	1 1/8	pilot bore

Maximum allowable bore 2.500 in. (76.200 mm) (maximum shaft length not to exceed end of hub).

\*These bores are non-standard. Add \$600.00 to List Price.

\*\*Keyseats made to ANSI B17.1 standard.

### 82,000 Series Hub Selection

Character	Bore (in.)	Keyway** (in. x in.)
A	1 1/8	1/4 x 1/8
B*	1 1/4	1/4 x 1/8
C	1 3/8	5/16 x 5/32
D	1 1/2	3/8 x 3/16
E*	1 9/16	3/8 x 3/16
F	1 5/8	3/8 x 3/16
G*	1 11/16	3/8 x 3/16
H	1 3/4	3/8 x 3/16
I*	1 13/16	1/2 x 1/4
J	1 7/8	1/2 x 1/4
K*	1 15/16	1/2 x 1/4
L*	2	1/2 x 1/4
M*	2 1/16	1/2 x 1/4
N*	2 1/8	1/2 x 1/4
O*	2 3/16	1/2 x 1/4
P*	2 1/4	1/2 x 1/4
Q*	2 5/16	5/8 x 5/16
R	2 3/8	5/8 x 5/16
S*	2 7/16	5/8 x 5/16
T	2 1/2	5/8 x 5/16
U*	2 5/8	5/8 x 5/16
V*	2 3/4	5/8 x 5/16
W	1 1/8	pilot bore
X	2 7/8	3/4 x 3/8
Y*	2 15/16	3/4 x 3/8
Z*	3	3/4 x 3/8

Maximum allowable bore 3.000 in. (76.200 mm) (maximum shaft length not to exceed end of hub).

\*These bores are non-standard. Add \$600.00 to List Price.

\*\*Keyseats made to ANSI B17.1 standard.

### Standard AC Voltage Ratings

Character	Voltage	Hz
B	115	60
D	110	50
E	200	60
F	230 190	60 50
H	220	50
L	460 380	60 50
M	415	50
N	575	60
O	110/220	50
P	115/230	60
Q	230/460 190/380	60 50
R	200/400	60

### Direct Current

Character	Voltage
U	24
V	36
W	48
X	95
Y	115
Z	230

Consult factory if other DC voltage is needed.

Modifications are available- see SAB Modification Section

# Series 81,000 (1-081-0XX)

Mounting Face: NEMA 324 and 326 TC, TSC, UC or USC, NEMA 364 and 365 TC, TSC, UC or USC, NEMA 404 and 405 TC, TSC, UC or USC  
**12.5" AK, 11.0" AJ**

**Static Torque:** 125 through 230 lb-ft

**Enclosure Material:** Cast Iron

**Release Type:** Knob, maintained with automatic reset. Vertical above IP 54 supplied with side release lever.

**Enclosure Protection:** IP 23 and 54 (formerly referred to by Stearns as NEMA Type 2 & 4, respectively).

**Mounting:** Fanguard-mounted brakes requiring IP 54 protection may require additional sealing measures beyond seals provided with the brake - Refer to Installation & Service Instruction sheets.

**Installation, Service and Parts List:** P/N 8-078-921-00

**Specifications, bores/voltages:** Page 22

**Modifications:** Pages 54-63

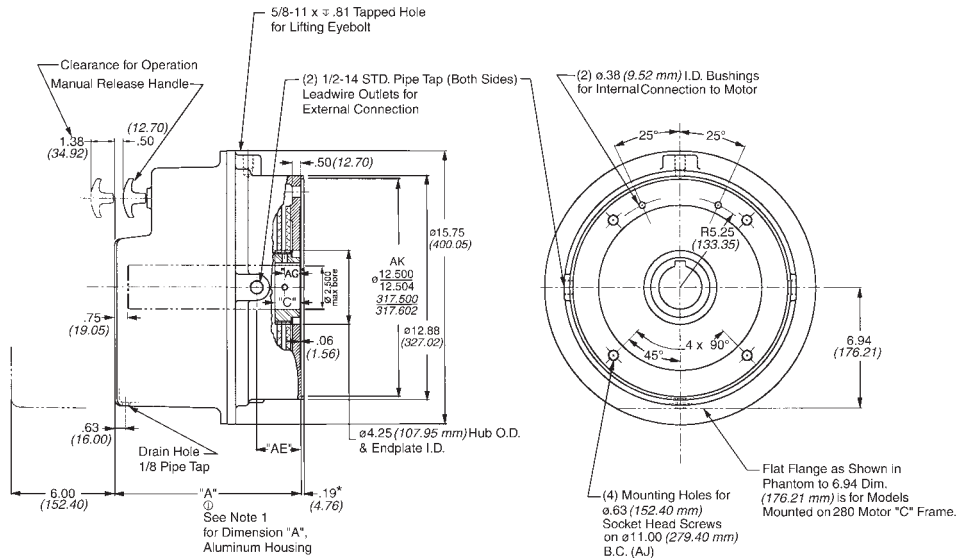
Modification required for vertical mounting. Vertical above IP 54 includes side release. See SAB Modifications for details and list price adders.



- Self-Adjusting Design
- Splined Hub
- Spring-Set Electrically Released
- Lead Wire Length: 36 inches
- Maximum Speed: 3600 Horizontal  
2400 Vertical
- Coil Insulation: Standard Class B  
Optional Class H
- Certified: CSA File LR-6254
- ABS Type Approval Certified

Brake set and release times in milliseconds, when brake and motor are switched separately (for T1/T2 definitions see page 101):

Static Torque	Coil Size	T1	T2
All	9	56	27



## Dimensional Data/Unit Pricing (Discount Symbol C1)

Nominal Static Torque (lb-ft) (Nm)	Enclosure	Type	Basic Model Number and List Price ① ②	Dimensions in Inches (Dimensions in Millimeters)				Cast Iron Wt. lbs (kg) ③
				A ① Cast Iron	AE	AG	C	
125 (169)	IP 23	AC	1-081-011-0X \$4,800.00	10.81 (274.64)	2.56 (65.09)	.94 (23.81)	1.44 (36.51)	148 (67.0)
		DC	1-081-015-0X \$5,850.00					
125 (169)	IP 54	AC	1-081-012-0X 6,250.00	10.88 (276.22)	2.56 (65.09)	.94 (23.81)	1.44 (36.51)	151 (69.0)
		DC	1-081-016-0X 7,300.00					
175 (237)	IP 23	AC	1-081-021-0X 5,150.00	10.81 (274.64)	2.56 (65.09)	.94 (23.81)	1.44 (36.51)	148 (67.0)
		DC	1-081-025-0X 6,200.00					
175 (237)	IP 54	AC	1-081-022-0X 6,600.00	10.88 (276.22)	2.56 (65.09)	.94 (23.81)	1.44 (36.51)	151 (69.0)
		DC	1-081-026-0X 7,650.00					
230 (312)	IP 23	AC	1-081-031-0X 5,700.00	11.31 (287.34)	3.06 (77.79)	1.44 (36.51)	1.94 (49.21)	155 (70.0)
		DC	1-081-035-0X 6,750.00					
230 (312)	IP 54	AC	1-081-032-0X 7,150.00	11.38 (288.92)	3.06 (77.79)	1.44 (36.51)	1.94 (49.21)	158 (72.0)
		DC	1-081-036-0X 8,200.00					

- ① New! 9th digit indicates aluminum or cast iron housing  
2 = Cast Iron  
3 = Aluminum: Add .38" to "A" dimension
- ② Subtract \$100.00 for brake ordered less hub.
- ③ Subtract 21 lbs. for aluminum housing. Foot mounting adds 40 lbs (18.2 kg) to weight.

## Motor Frame Adapters

**WARNING!** Before selecting an adapter to mount a brake on a larger motor frame, the torque and thermal capacity required by the application should be determined as shown in the "Selection Procedure" section. A larger motor may indicate a requirement for greater thermal capacity than the brake is designed for. The brake selection must be matched to the motor and application requirements, before use of an adapter is considered.

To Adapt to NEMA Frame Size	AK Dim.	Reg. No.	Adapter Stock Number	Additional Shaft Length Required
	in (mm)			in. (mm)
182TC, 184TC, 213TC, 215TC, 254TC or 256TC	8.50 (215.90)	-9	5-55-2041-00 List \$1325	.94 (23.81)
284TC or 286TC	10.50 (266.70)	-11	5-55-2043-00 List \$1325	.94 (23.81)
444TSC and 445TSC	16.00 (406.40)	-16	5-55-2045-00 List \$1875	.88 (22.22)

For adapter dimensions, see *Technical Data*.

## Installation and Service Instructions for Self Adjust Brakes 81,000 Series

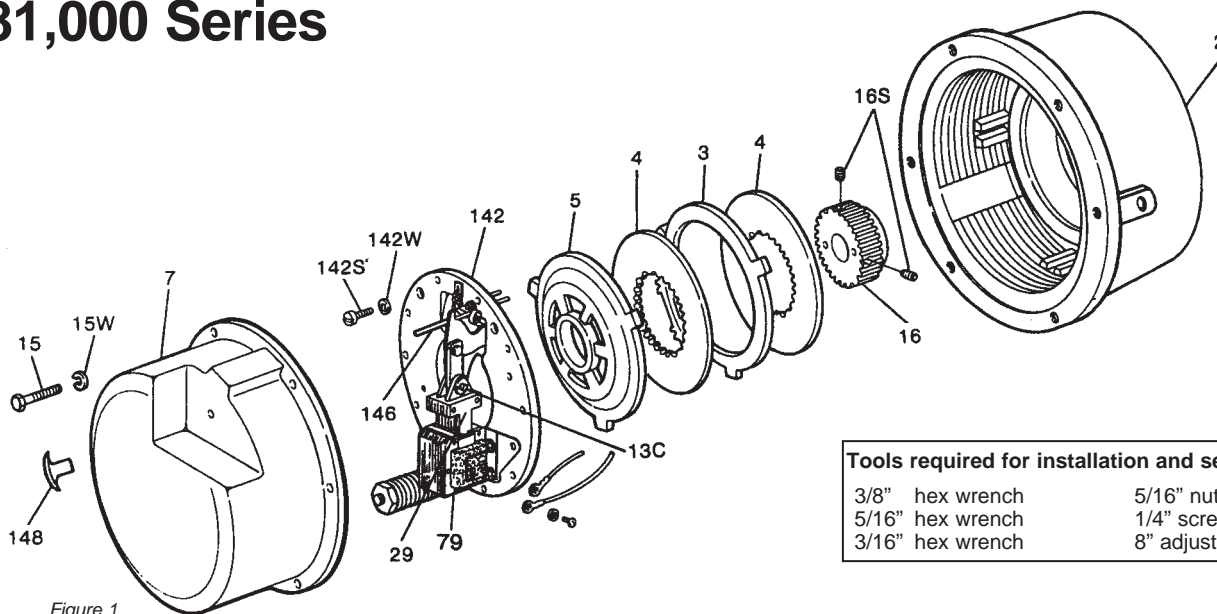
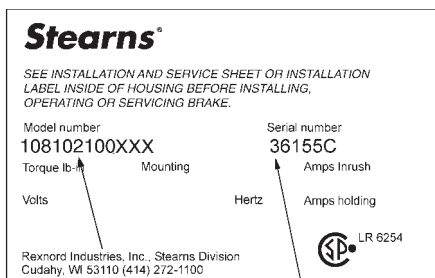


Figure 1

### Tools required for installation and servicing:

3/8" hex wrench	5/16" nut driver
5/16" hex wrench	1/4" screwdriver
3/16" hex wrench	8" adjustable wrench



### Note:

**MODEL NUMBER**  
Refer to actual nameplate on brake for additional information

**SERIAL NUMBER**

### Important

Please read these instructions carefully before installing, operating, or servicing your Stearns Brake. Failure to comply with these instructions could cause injury to personnel and/or damage to property if the brake is installed incorrectly. For definition of limited warranty/liability, contact Rexnord Industries, LLC, Stearns Div., 5150 S. International Dr., Cudahy, WI 53110, (414) 272-1100.

### Caution

- Installation and servicing must be made in compliance with all local safety codes including Occupational Safety and Health Act (OSHA). All wiring and electrical connections must comply with the National Electric Code (NEC) and local electric codes in effect.
- Use of this brake in atmospheres containing explosive gases and dusts must be in accordance with NEC article 501. This brake is not suitable for use in certain atmospheres containing explosive gases and dusts. **HazLoc** inspection authorities are responsible for verifying and authorizing the use of suitably designed and installed **HazLoc** equipment. When questions arise consult local **Authority Having Jurisdiction (AHJ)**.

- To prevent an electrical hazard, disconnect power source before working on the brake. If power disconnect point is out of sight, lock disconnect in the *off* position and tag to prevent accidental application of power.
- Make certain power source conforms to the requirements specified on the brake nameplate.
- Be careful when touching the exterior of an operating brake. Allow sufficient time for brake to cool before disassembly. Surfaces may be hot enough to be painful or cause injury.
- Do not operate brake with housing removed. All moving parts should be guarded.
- Installation and servicing should be performed only by qualified personnel familiar with the construction and operation of the brake.
- For proper performance and operation, only genuine Stearns parts should be used for repairs and replacements.
- After usage, the brake interior will contain burnt and degraded friction material dust into the air or inhaling it, as this may be dangerous to your health.
- DO NOT BLOW OFF DUST** using an air hose. It is important to avoid dispersing dust into the air or inhaling it, as this may be dangerous to your health.
  - Wear a filtered mask or a respirator while removing dust from the inside of a brake.
  - Use a vacuum cleaner or a soft brush to remove dust from the brake. When brushing, avoid causing the dust to become airborne. Collect the dust in a container, such as a bag, which can be sealed off.
- Caution!** While the brake is equipped with a manual release to allow manual shaft rotation, the motor should not be run with the manual

release engaged, to avoid overheating the friction disc(s).

### General Description

This series brake is spring-set, electrically released. They contain two or three rotating friction discs (4) driven by a hub (16) mounted on the motor or other shaft.

**Note:** Fan-guard mounted brakes requiring IP54 & IP55 protection may require additional sealing measures beyond seals provided with this brake. Pressurized sprays aimed at the fan and brake hub surfaces can result in fluid migration along the motor shaft and keyway, and into the brake. The use of an appropriate sealant such as *RTV* or a *forsheda* seal is advised.

### Operating Principle

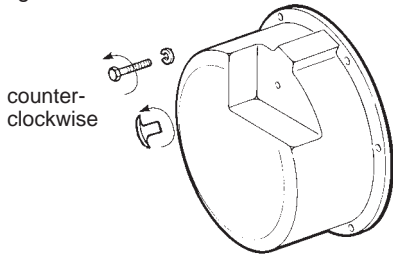
This series contains two or three friction discs (4) assembled alternately between the endplate (2) friction surface, stationary disc(s) (3) and pressure plate (5). The stationary components are restrained from rotating by being keyed into the endplate. With the brake released, all disc pack components are free to slide axially and the friction disc(s) to rotate.

Brake release occurs when the solenoid coil is electrically energized, causing the solenoid plunger to travel a specified distance and through a lever system, overcoming the pressure spring force. This action released the clamping force on the disc pack, thereby allowing the friction disc(s) and brake hub to rotate.

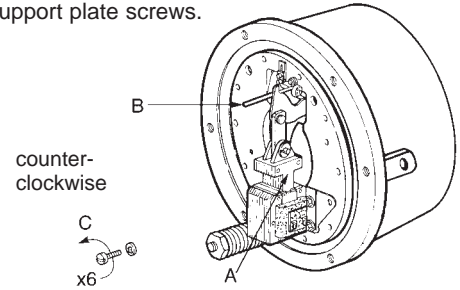
Brake sets and torque is produced when electric current to the solenoid coil is interrupted, thereby collapsing the solenoid magnetic field. The solenoid plunger returns to its original de-energized position allowing the lever arm to move forward by virtue of the compressed torque springs. This action compressed the disc pack components which applies a retarding torque to the brake hub and ultimately restores the brake to a spring-set condition.

# BRAKE MOUNTING

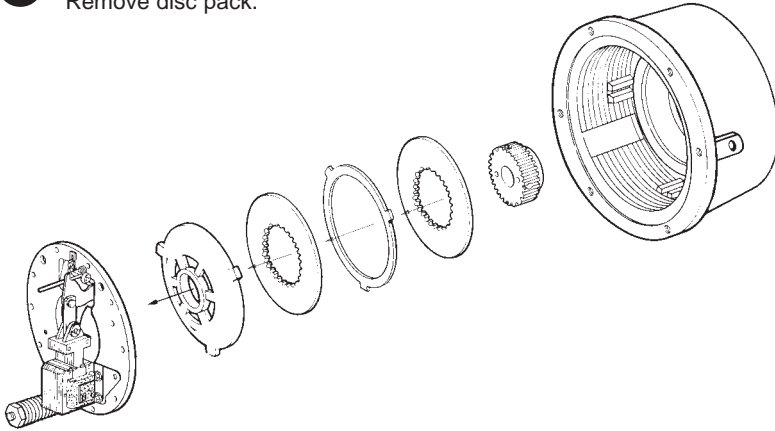
- 1** Remove manual release knob.  
Remove housing screws.  
Remove housing.



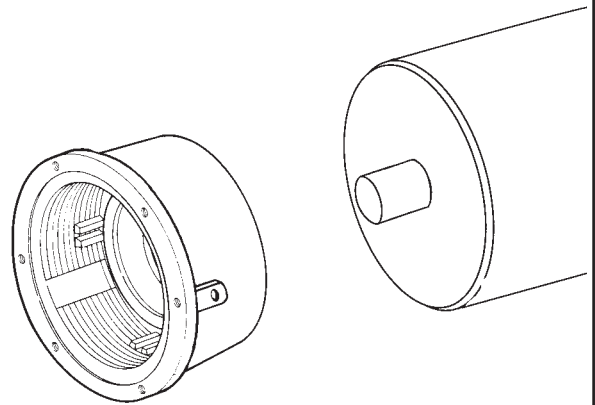
- 2** A. Push plunger down.  
B. Pull manual release to hold plunger.  
C. Remove support plate screws.



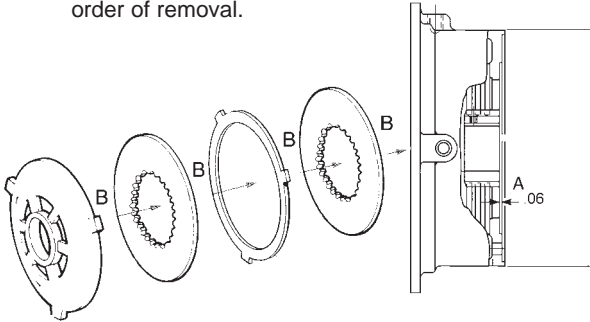
- 3** Lift off support plate.  
Remove disc pack.



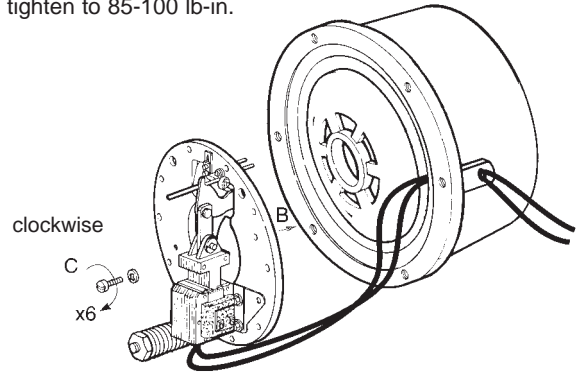
- 4** A. Position endplate on motor register.  
B. Insert four mounting bolts and tighten.  
(Torque per manufacturer specification)



- 5** A. Position hub on shaft as shown.  
Tighten set screws to motor shaft.  
Torque to: 5/16" - 156 lb-in;  
3/8" - 288 lb-in;  
1/2" - 625 lb-in.  
B. Reassemble disc pack in reverse\*  
order of removal.



- 6** A. Route lead wires through conduit hole.  
B. Position support plate on endplate.  
C. Insert six mounting screws with lockwashers;  
tighten to 85-100 lb-in.

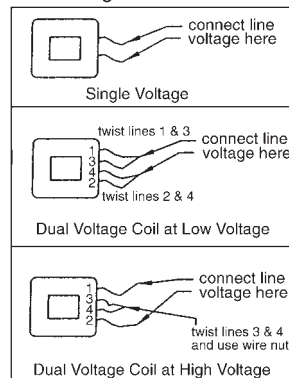


- 7** AC coils are 50/60 hz, single phase rated. Power supply to coil must not have current or frequency limiting output that is less than the coil requirement. Voltage supply to the coil must be within  $\pm 10\%$  of nameplate rating.\*

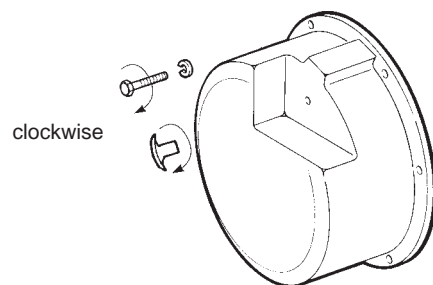
Caution: Keep wiring away from pinch points.

\* For DC voltages see sheet 8-078-950-00.

## Coil Wiring



- 8** Replace housing.  
Tighten housing screws to 130 lb-in and release knob to 50 lb-in.



**General Maintenance**

**Warning!** Any mechanism or load held in position by the brake should be secured to prevent possible injury or damage to equipment before any disassembly of the brake is attempted or the manual release knob or lever is operated on the brake. Observe all cautions listed at the beginning of this manual.

**Note:** Do not lubricate any part of the brake as this may cause a malfunction and/or a loss of torque.

**Troubleshooting**

**A. If brake does not stop properly, coasts or overheats:**

1. Check that manual release knob is not in released mode.
2. Check for excessively worn, charred or broken friction discs.
3. Check that hub has not loosened and shifted on motor shaft.
4. Check that friction discs slide freely over hub. Clean hub and/or file burrs and nicks if required.
5. Check that stationary disc(s) and/or pressure plate can move freely in endplate and that they are not warped from overheating.
6. Check endplate slots for wear in the areas where stationary disc(s) and/or pressure plate make contact. Grooves in slots can prevent free disc movement and result in torque loss, stationary disc or friction disc breakage.
7. On vertically mounted brakes, check that springs are installed correctly and that stationary disc(s) can slide freely over vertical mounting pins. Check for wear on plunger guide bracket.
8. Confirm that the pressure spring nut (19) is properly tightened against the spacer (134) under the nut. Spring length should be measured from the cast surface of the

support plate to the bottom side of the spring nut. Spring lengths are based on the brake fully assembled, using a new disc pack. Spring length will increase as the disc pack wears.

Torque (lb-ft)	Compressed Spring Length
125	4-23/32"
175	4-23/32"
230	4-27/32"

9. Check solenoid air gap (see page 4). Adjust if necessary.
10. Check that solenoid linkage can move freely. It requires approximately 18 lbs of pressure on the 125 lb-ft; 23 lbs on the 175, and 230 lb-ft to seat solenoid plunger correctly functioning brake.
11. Check voltage reading at coil terminals against coil voltage rating.
12. Check that brake coil is energized at the same time as, or prior to, motor and de-energized at the same time, or after, motor.
13. If stopping time exceeds 1 second, or if the application requires more than five stops per minute, check the thermal requirements to stop load against the thermal capacity of the brake.
14. Check for excessive voltage drop in motor line when motor is started. check wire gauge of supply line against motor starting current and solenoid inrush current. Measure voltage drop at solenoid coil terminals during maximum inrush current condition. To accomplish this, insert a block of wood, or other non-magnetic material, between solenoid plunger and frame. Block thickness should approximately equal solenoid air gap. Energize motor and brake simultaneously,

take reading and immediately shut down. This is to prevent motor, brake or solenoid burnup.

**B: If brake hums, solenoid pulls in slowly, or coil burns out:**

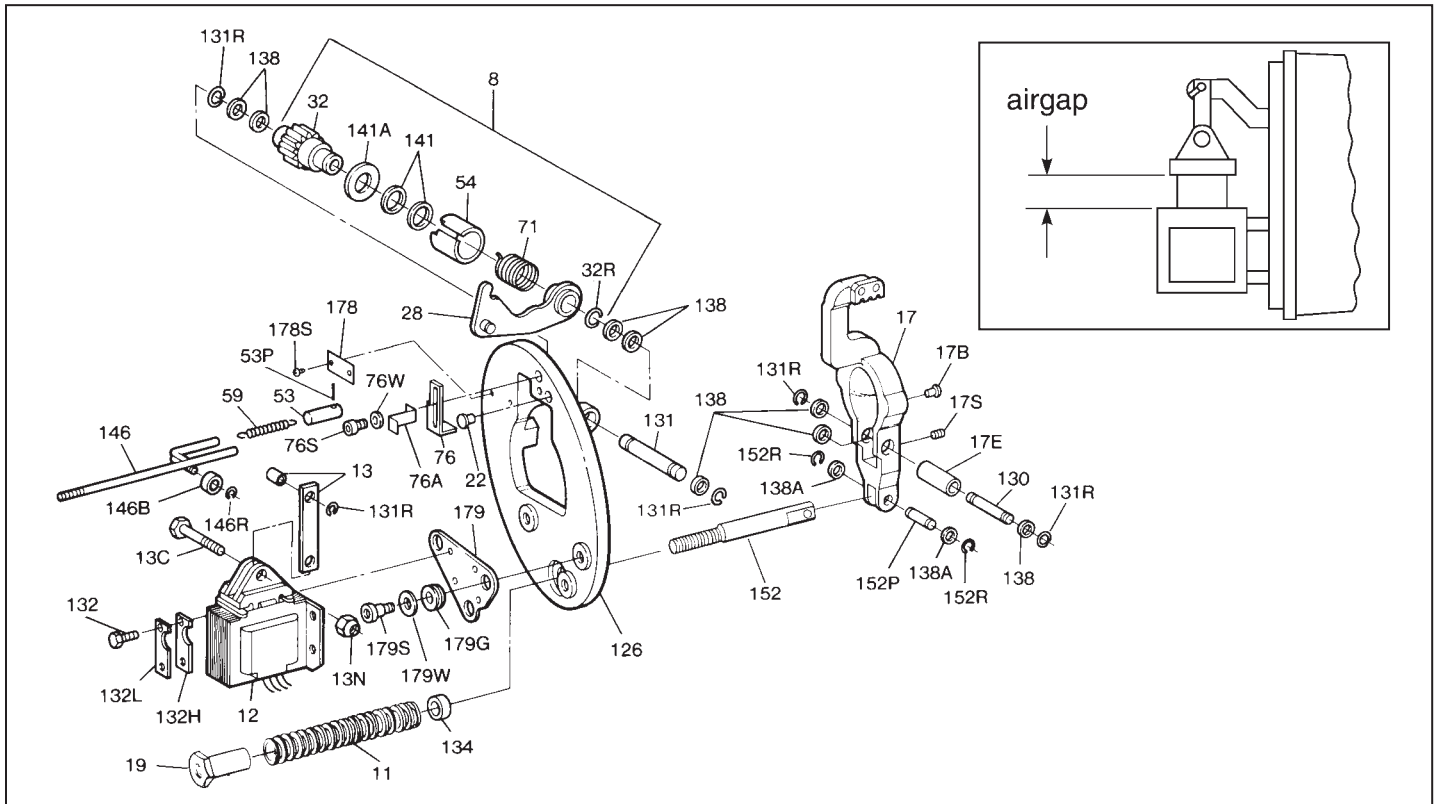
1. Check Items A-7, A-9, A-11 and A-14.
2. Check if shading coils are broken.
3. Check for worn plunger guides or if plunger rubs on solenoid frame laminations.
4. Check for worn solenoid plunger and frame.
5. Check if solenoid is dirty.
6. Check if solenoid mounting screws have loosened.
7. Check for worn or binding linkage. For normal pressure required to seat solenoid plunger to frame see A-10.

**C: If brake is noisy during stopping and/or friction discs shatter:**

1. Check for worn motor bearings allowing shaft runout.
2. On foot mounted brakes, recheck alignment.
3. Check hub position on shaft. The outboard face of hub should protrude 3/32" to 1/8" beyond face of outboard friction disc.
4. Check motor shaft endfloat. It should not exceed 0.020".
5. Check concentricity of endplate and C-face register. Alignment must be within .007" concentricity and face runout. Shaft runout should be within .002" TIR.

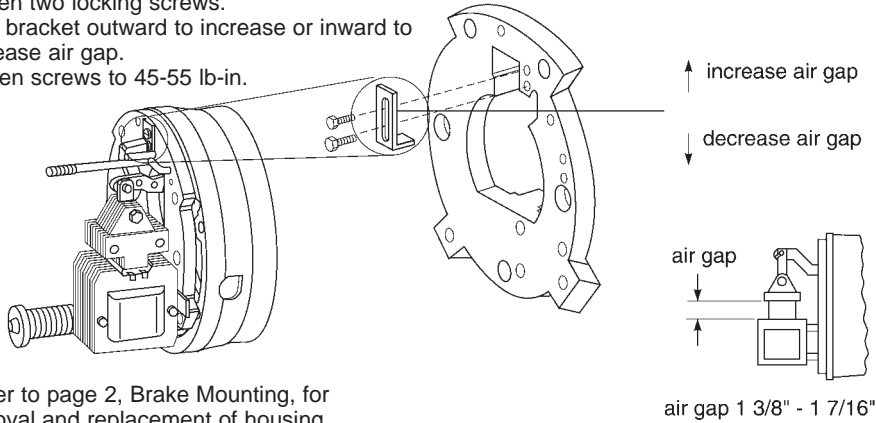
**Vertical Brake Assembly**

Refer to service sheet 8-078-931-05 and 8-078-931-15 for proper spring and spacer positions when brake is assembled for vertical orientation.



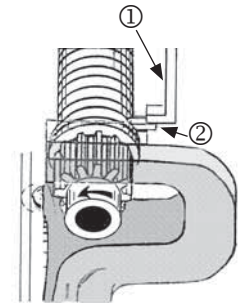
## AIR GAP ADJUSTMENT

- 1** Loosen two locking screws.  
Slide bracket outward to increase or inward to decrease air gap.  
Tighten screws to 45-55 lb-in.



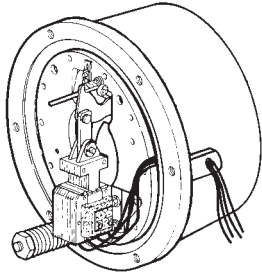
**Note:** Refer to page 2, Brake Mounting, for removal and replacement of housing.

Wrap spring stop ① is positioned above the tang of the wrap spring ②

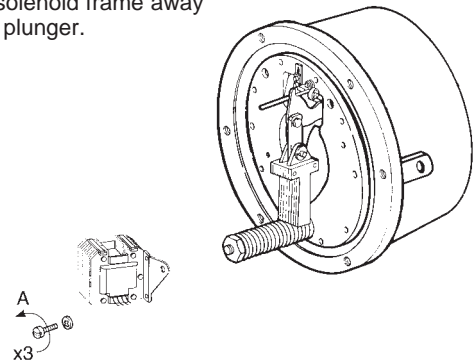


## COIL REPLACEMENT

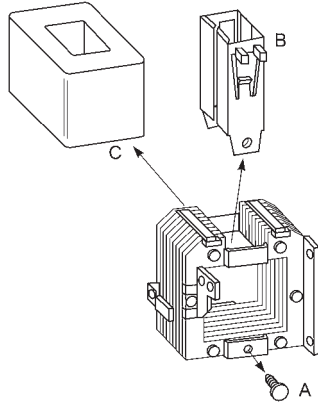
- 1** Disconnect coil lead wires from power source and pull them out of the brake.



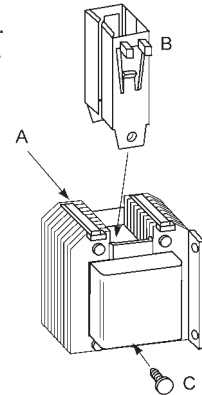
- 2** A. Remove solenoid mounting screws.  
B. Lift solenoid frame away from plunger.



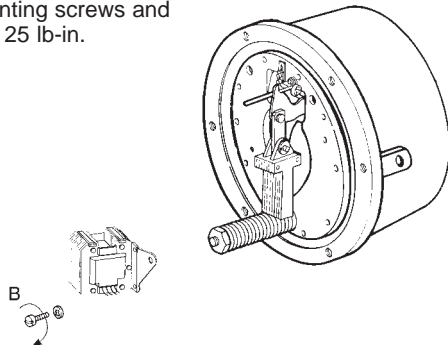
- 3** A. Remove guide screws.  
B. Lift guides out of coil.  
C. Push coil out of frame.



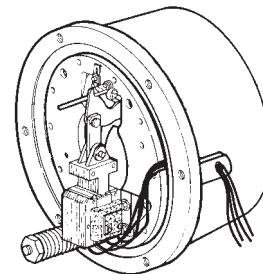
- 4** A. Insert new coil.  
B. Press plunger guides into place.  
C. Insert and tighten guide screws.



- 5** A. Slide coil assembly on to plunger.  
B. Insert mounting screws and tighten to 125 lb-in.

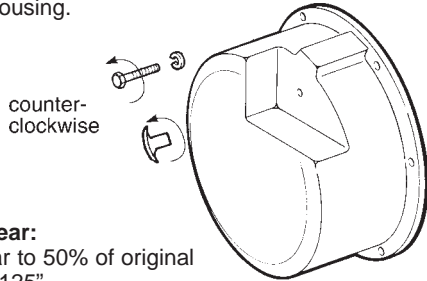


- 6** Reroute coil wires and reconnect to power supply.



# FRICION DISC REPLACEMENT

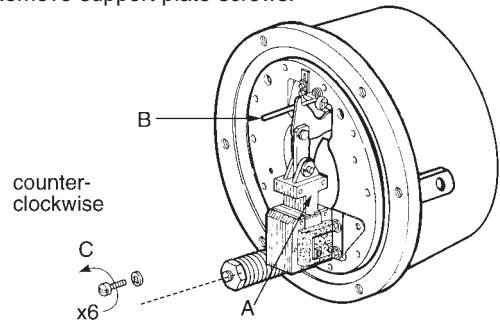
- 1** Remove manual release knob.  
Remove housing screws.  
Remove housing.



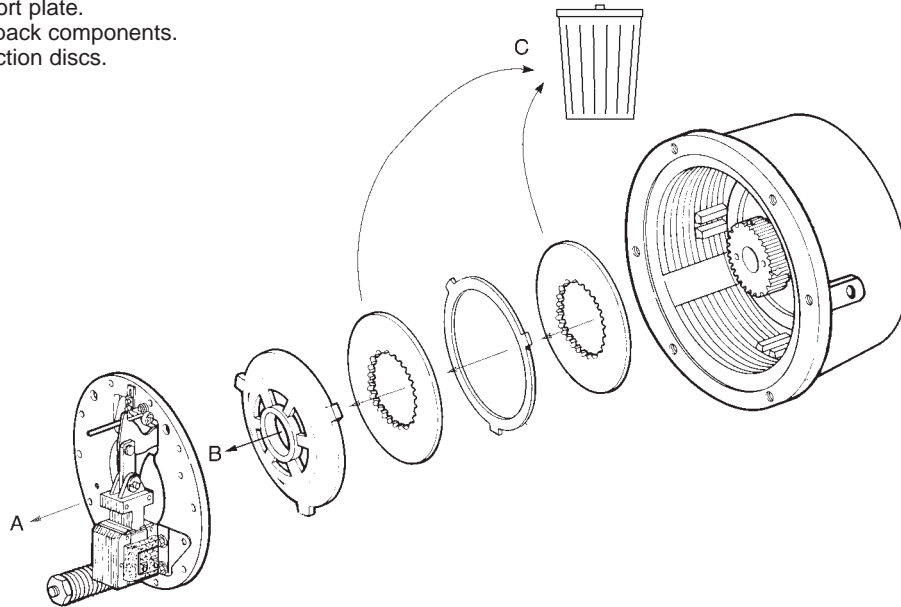
## Friction Disc Wear:

1. Discs can wear to 50% of original thickness, or .125".
2. Entire wear of disc pack cannot exceed the thickness of a new disc, or .250".

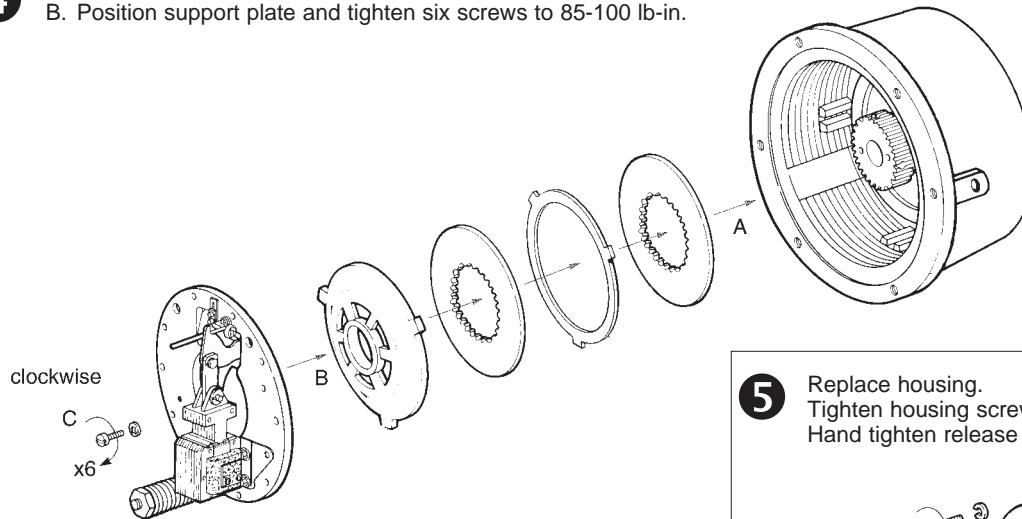
- 2** A. Push plunger down.  
B. Pull manual release to hold plunger.  
C. Remove support plate screws.



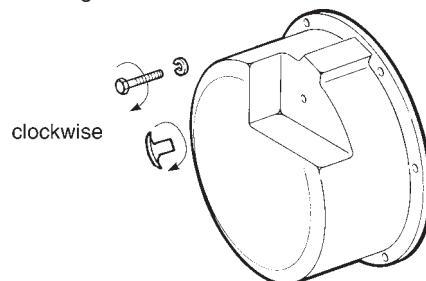
- 3** A. Remove support plate.  
B. Remove disc pack components.  
C. Discard old friction discs.



- 4** A. Install new friction discs and reassemble in reverse order of disassembly.\*  
B. Position support plate and tighten six screws to 85-100 lb-in.



- 5** Replace housing.  
Tighten housing screws to 130 lb-in.  
Hand tighten release knob.



**Information required when ordering replacement parts:**

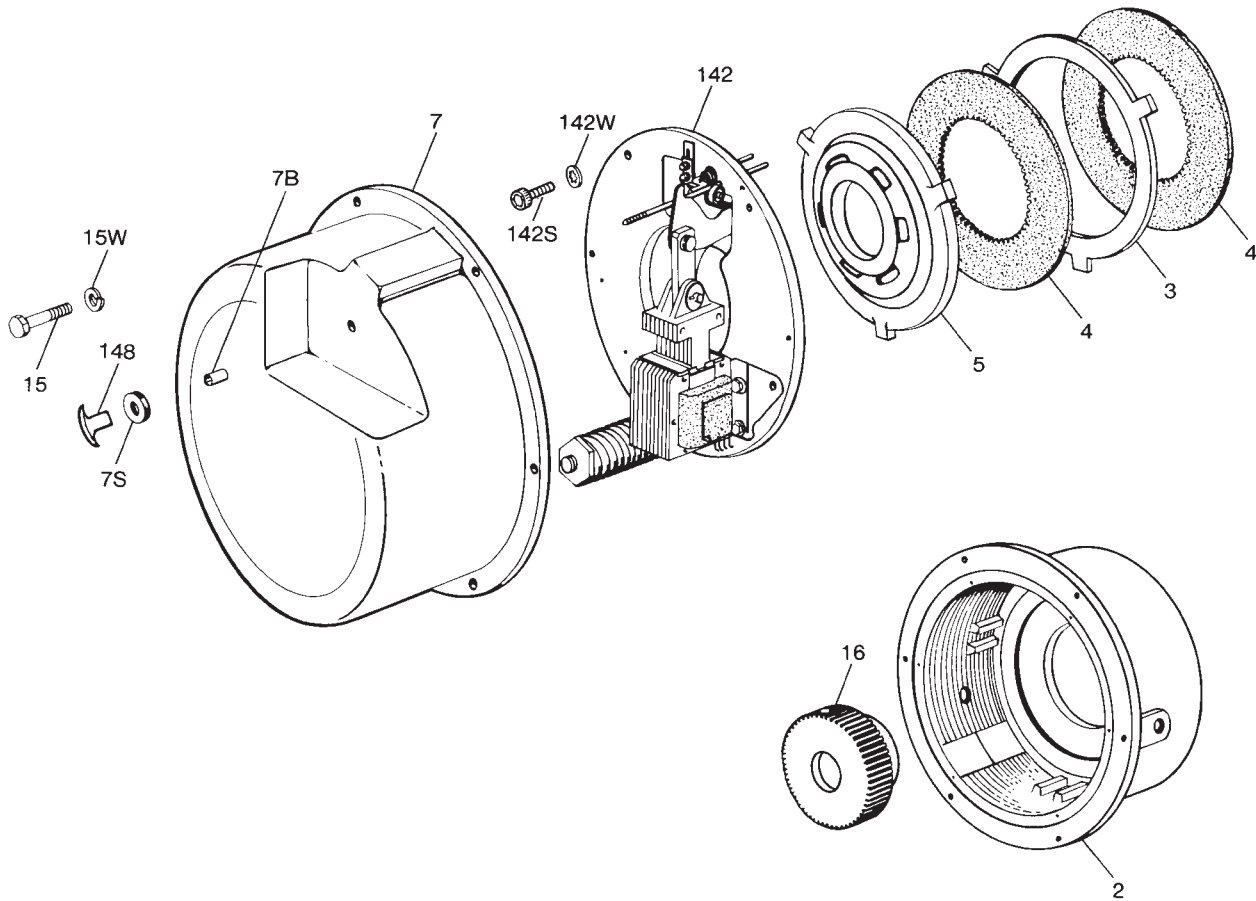
- Give part number of parts needed, brake model number and brake serial number. The brake model and serial number may identify special brakes not covered by this parts list.
- When ordering hubs, specify shaft diameter (hub bore) and keyway.
- Consult factory regarding support plate assembly for vertical and extra items.

- Enclosures are designated as follows:

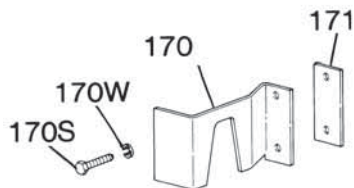
O = Standard  
E - Dust-tight, waterproof (DTWP)

**General Information**

- Vertical details, see P/N 8-078-931-05 and 8-078-962-06.



**Vertical Mounting  
below Motor**



**Vertical Mounting  
above Motor**

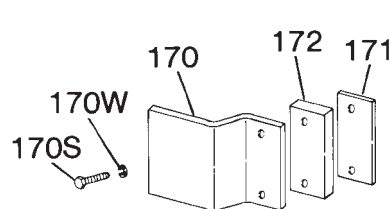


TABLE 1  
Components of Standard Horizontal AC or DC Units and Standard Modifications

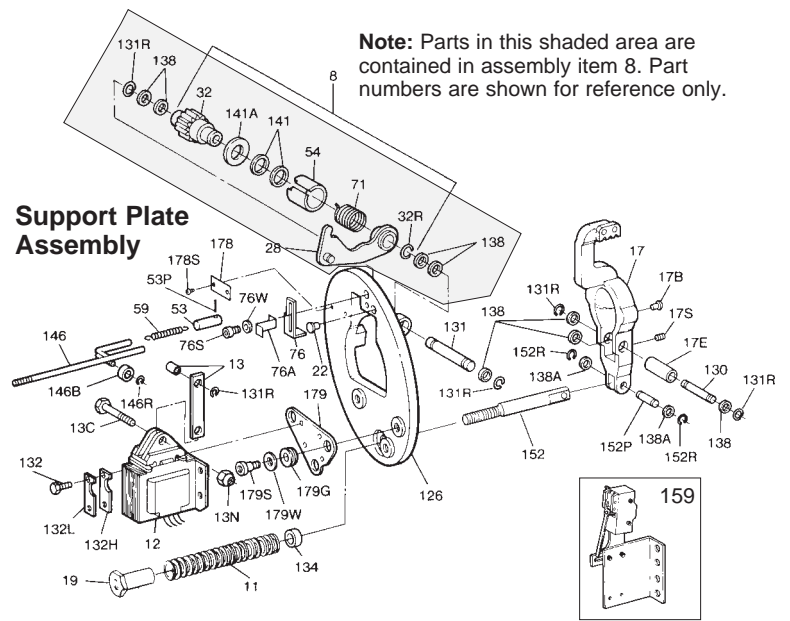
				Torque (lb-ft)		125		175		230					
				Current		AC		DC		AC		DC			
				Enclosure		O	E	O	E	O	E	O	E		
				Brake Model Number→		1-081-011-02		1-081-012-02		1-081-015-02		1-081-016-02			
						1-081-021-02		1-081-022-02		1-081-025-02		1-081-026-02			
						1-081-031-02		1-081-032-02		1-081-035-02		1-081-036-02			
Type of Modification	Item No.	Description	Part Number↓	1-081-011-02	1-081-012-02	1-081-015-02	1-081-016-02	1-081-021-02	1-081-022-02	1-081-025-02	1-081-026-02	1-081-031-02	1-081-032-02	1-081-035-02	1-081-036-02
	2	Endplate Endplate Endplate and oil seal assembly Endplate and oil seal assembly	8-002-226-01 8-002-227-01 5-22-1011-00 5-22-1012-00	1		1		1		1		1		1	
	2S	Seal (component of endplate and seal assembly)	9-02-0014-00		1		1		1		1		1		1
	3	Stationary disc	8-003-211-01	1	1	1	1	1	1	1	1	2	2	2	2
	4	Friction disc	8-004-104-00	2	2	2	2	2	2	2	2	3	3	3	3
	5	Pressure plate	8-005-109-01	1	1	1	1	1	1	1	1	1	1	1	1
	7	Housing, bearing and seal assembly	5-07-2012-00	1	1	1	1	1	1	1	1	1	1	1	1
	7B	Housing bearing (component of Item 7)	9-04-0050-00	1	1	1	1	1	1	1	1	1	1	1	1
	7D	Pipe plug (drain)	9-33-0325-00	1	1	1	1	1	1	1	1	1	1	1	1
	7S	Housing seal (component of Item 7)	9-02-0017-00	1	1	1	1	1	1	1	1	1	1	1	1
	15	Machine screw (housing)	9-17-3216-00	6	6	6	6	6	6	6	6	6	6	6	6
	15W	Lock washer (housing)	9-45-1332-00	6	6	6	6	6	6	6	6	6	6	6	6
	16	Hub and set screw assembly	5-16-1102-00	1	1	1	1	1	1	1	1	1	1	1	1
	69	Hub and set screw assembly Gasket (housing to endplate)	5-16-1104-00 8-069-203-00		1		1		1		1		1		1
	140	Lead wire bushing (endplate) (internal connection only) Lead wire bushing (endplate) (internal connection only)	8-140-002-08 8-140-002-10	1	1	1	1	1	1	1	1	1	1	1	1
	142	Support plate assembly Support plate assembly Support plate assembly Support plate assembly Support plate assembly Support plate assembly	5-42-2071-00 5-42-2072-00 5-42-2073-00 5-42-2074-00 5-42-2075-00 5-42-2076-00	1	1		1		1	1		1	1		1
	142S	Cap screw (support plate)	9-17-5016-00	6	6	6	6	6	6	6	6	6	6	6	6
	142W	Conical spring washer (support plate)	9-46-0006-00	6	6	6	6	6	6	6	6	6	6	6	6
	148	Release knob	8-148-804-00	1	1	1	1	1	1	1	1	1	1	1	1
Components for Standard Modifications (most items not shown)															
Vertical Mounting Above Motor	2	Endplate with pins Endplate with pins Endplate and seal assembly with pins Endplate and seal assembly with pins	5-20-1001-00 5-20-1002-00 5-22-1015-00 5-22-1016-00	1		1		1		1		1		1	
	3	Stationary disc	8-003-211-01	1	1	1	1	1	1	1	1	2	2	2	2
	5	Pressure plate	8-005-109-02	1	1	1	1	1	1	1	1	1	1	1	1
	7	Housing and side release assembly	5-07-1002-00	1	1	1	1	1	1	1	1	1	1	1	1
	Not Shown	Vertical mounting pin Vertical mounting pin Vertical mounting spring kit	8-061-204-00 8-061-205-00 5-96-0102-00	3	3	3	3	3	3	3	3	3	3	3	3
170	Plunger guide bracket	Kit 5-55-2002-00	1	1	1	1	1	1	1	1	1	1	1	1	
170S	Cap screw (bracket)														
170W	Lock washer (bracket)														
171	Shim (bracket)														
172	Spacer														
		Release plate Screw Lock nut Spring pin Release rod	8-170-102-00 9-16-3012-00 9-40-3730-00 9-32-4055-00 8-146-201-01		1		1		1		1		1		1
Components of support plate vertical mounting															
Foot Mounting	34	Foot mounting kit, comprised of:	5-55-2021-00	1	1	1	1	1	1	1	1	1	1	1	1
	34S	Foot mounting bracket	8-034-205-01	4	4	4	4	4	4	4	4	4	4	4	4
	39W	Cap screw Lock washer	9-17-1624-00 9-45-1316-00	4	4	4	4	4	4	4	4	4	4	4	
Vertical Mounting below Motor	3	Stationary disc	8-003-211-01	1	1	1	1	1	1	1	1	2	2	2	2
	5	Pressure plate (less pins)	8-005-109-03	1	1	1	1	1	1	1	1	1	1	1	1
	Not Shown	Vertical mounting pin Vertical mounting pin	8-061-206-00 8-061-207-00	3	3	3	3	3	3	3	3	3	3	3	3
	Not Shown	Vertical spring kit	5-96-0102-00	1	1	1	1	1	1	1	1	1	1	1	1
	170	Plunger guide bracket	8-170-205-00	2	2	1	1	2	2	1	1	2	2	1	1
170S	Cap screw (bracket)	8-350-002-00	2	2	2	2	2	2	2	2	2	2	2	2	
170W	Lock washer (bracket)	9-45-0330-00	2	2	2	2	2	2	2	2	2	2	2	2	
171	Shim (bracket)	8-454-016-00	**	**	**	**	**	**	**	**	**	**	**	**	
Shaft Through Housing	7	Housing, bearing and seal assembly	5-07-2014-00	1	1	1	1	1	1	1	1	1	1	1	
	24	Shaft bushing (specify bore)	8-024-202-01	1	1	1	1	1	1	1	1	1	1	1	
	24L	Set screw (shaft bushing)	9-20-3004-00	2	2	2	2	2	2	2	2	2	2	2	
	24S	Shaft seal (component of item 7)	9-02-0010-00	1	1	1	1	1	1	1	1	1	1	1	
Space Heater	Not Shown	Heater (115 volt circuit) Kit Heater (230 volt circuit) Kit	5-27-2006-00 5-27-2007-00	1	1	1	1	1	1	1	1	1	1	1	

\*See P/N 8-078-931-05 \*\*As required

**Table 2** (see note)  
Components of  
Support Plate Assemblies

Item No.	Description	Part Number	Brake Size Torque (lb-ft)		125		175		230	
			AC	DC	AC	DC	AC	DC		
8	Solenoid lever and pinion assembly (comprised of Items 28, 32, 32R, 54, 71, 141 and 141A)	5-66-7321-00	1	1	1	1	1	1	1	1
11	Pressure spring (green) Pressure spring (yellow)	9-70-4601-00 9-70-6001-00	1	1			1	1	1	1
13	Solenoid link and bearing assembly	5-55-2006-00	1	1	1	1	1	1	1	1
13C	Cap screw (solenoid link)	8-157-703-00	1	1	1	1	1	1	1	1
13N	Nut (solenoid link)	8-40-3732-00	1	1	1	1	1	1	1	1
17	Lever arm assembly	5-17-2001-00	1	1	1	1	1	1	1	1
17B	Pressure button	9-25-1908-00	2	2	2	2	2	2	2	2
17E	Eccentric sleeve (lever arm)	8-054-201-00	1	1	1	1	1	1	1	1
17S	Set screw (lever arm)	9-20-3004-00	2	2	2	2	2	2	2	2
19	Pressure spring nut	8-019-202-01	1	1	1	1	1	1	1	1
22	Solenoid lever stop	8-022-603-00	1	1	1	1	1	1	1	1
53	Manual release spring tube	8-053-201-00	1	1	1	1	1	1	1	1
53P	Roll pin (spring tube)	9-32-4012-00	1	1	1	1	1	1	1	1
59	Release spring	9-71-0004-00	1	1	1	1	1	1	1	1
76	Wrap spring stop	8-076-203-00	1	1	1	1	1	1	1	1
76A	Holding plate (wrap spring stop)	8-076-204-00	1	1	1	1	1	1	1	1
76S	Cap screw (spring stop)	9-17-2812-00	2	2	2	2	2	2	2	2
76W	Lock washer (spring stop)	9-45-1328-00	2	2	2	2	2	2	2	2
126	Support plate and bearing assembly	5-26-2004-00	1	1	1	1	1	1	1	1
130	Pivot pin (lever arm)	8-118-204-00	1	1	1	1	1	1	1	1
131	Pivot pin (solenoid lever)	8-131-201-00	1	1	1	1	1	1	1	1
131R	Retaining ring (pivot pin)	9-03-0020-00	5	5	5	5	5	5	5	5
132	Cap screw (solenoid mounting)	8-350-008-00	4	4	4	4	4	4	4	4
132H	Holding plate (solenoid mounting)	8-076-207-00	2	2	2	2	2	2	2	2
132L	Lock plate (solenoid mounting)	8-076-206-00	2	2	2	2	2	2	2	2
134	Pressure spring spacer	8-134-001-02	1	1	1	1			1	1
	Pressure spring spacer	8-134-001-03							1	1
138	Bearing (washer type)	8-138-201-00	8	8	8	8	8	8	8	8
138A	Bearing (washer type)	8-138-701-00	2	2	2	2	2	2	2	2
146	Release rod	8-146-201-00	1	1	1	1	1	1	1	1
146B	Ball bearing (release rod)	9-01-6801-00	1	1	1	1	1	1	1	1
146R	Retaining ring (release rod)	9-03-0007-00	1	1	1	1	1	1	1	1
152	Pressure spring stud	8-152-201-00	1	1	1	1	1	1	1	1
152P	Pivot pin (spring stud)	8-118-202-00	1	1	1	1	1	1	1	1
152R	Retaining ring (spring stud)	9-03-0019-00	2	2	2	2	2	2	2	2
159	Brake release interlock kit (standard manual release)	5-55-2005-00	1	1	1	1	1	1	1	1
	Brake release interlock kit (side manual release)	5-55-2004-00	1	1	1	1	1	1	1	1
178	Instruction plate	8-078-055-00	1	1	1	1	1	1	1	1
178S	Drivescrew	9-25-1303-00	2	2	2	2	2	2	2	2
179	Solenoid mounting plate	8-179-205-01	1	1	1	1	1	1	1	1
179G	Grommet (mounting plate)	8-147-202-00	3	3	3	3	3	3	3	3
179S	Shoulder screw (mounting plate)	9-26-1108-00	3	3	3	3	3	3	3	3
179W	Washer (mounting plate)	8-138-202-00	3	3	3	3	3	3	3	3

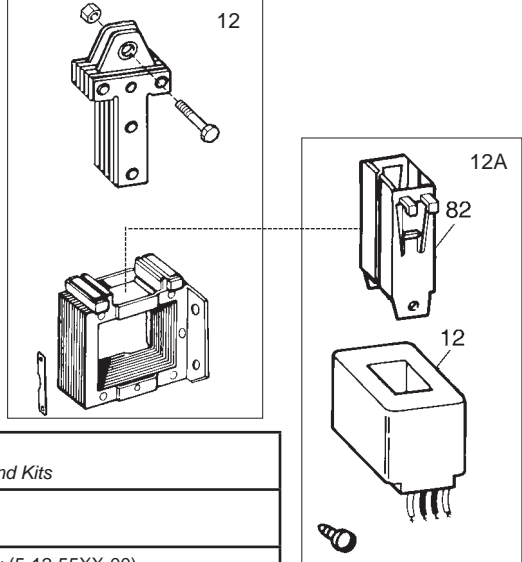
NOTE: Some brakes manufactured prior to the "-20" series had solenoids which were mounted on (4) rubber shock mounts. Conversion kits are available to replace these mounts. Kit 5-12-9595 replaces 1" diameter by 17/32" high mounts with 1/4-20 studs. Kit 5-12-9594 replaces 1-1/4" diameter by 3/4" high mounts with 5/16-18 studs. Kit 5-12-9593 must replace mounts on serial numbers B-960232 through 69 and B-989748.



**Solenoid and Coil Assembly**

**Table 3**  
Components of Solenoid and Coil Assemblies

Item	Description	Part Number	
<b>AC Brakes</b>			
12	Solenoid Assembly (AC)	5-12-5529-00	
12A	No. 9 coil assembly 60 Hz	115 Vac	5-96-6901-33
		230 Vac	5-96-6902-33
		460 Vac	5-96-6904-33
		575 Vac	5-96-6905-33
		115/230 Vac	5-96-6907-33
	230/460 Vac	5-96-6909-33	



**Table 4**  
Contents of Assemblies and Kits

Item No.	Description
12	Solenoid assembly (5-12-55XX-00) 1 - Plunger 1 - Frame 2 - Lock plates 1 - Solenoid link cap screw 1 - Solenoid link nut 1 - Cable clamp and screw (DC only)
12A	Coil assembly (5-96-69XX-33) 1 - Coil 2 - Plunger guides 2 - Plunger guide screws
159	Brake switch kit (5-55-2004-00 or 5-55-2005-00) (brake release interlock switch - N.O.) 1 - Microswitch 1 - Bracket, microswitch 1 - Bracket, mounting 1 - Mounting hardware

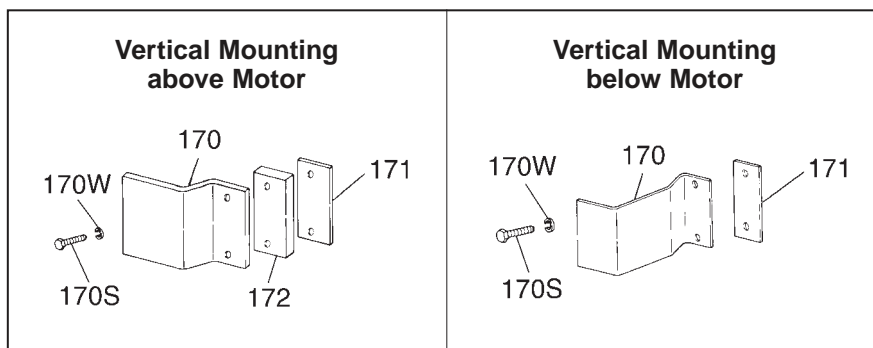
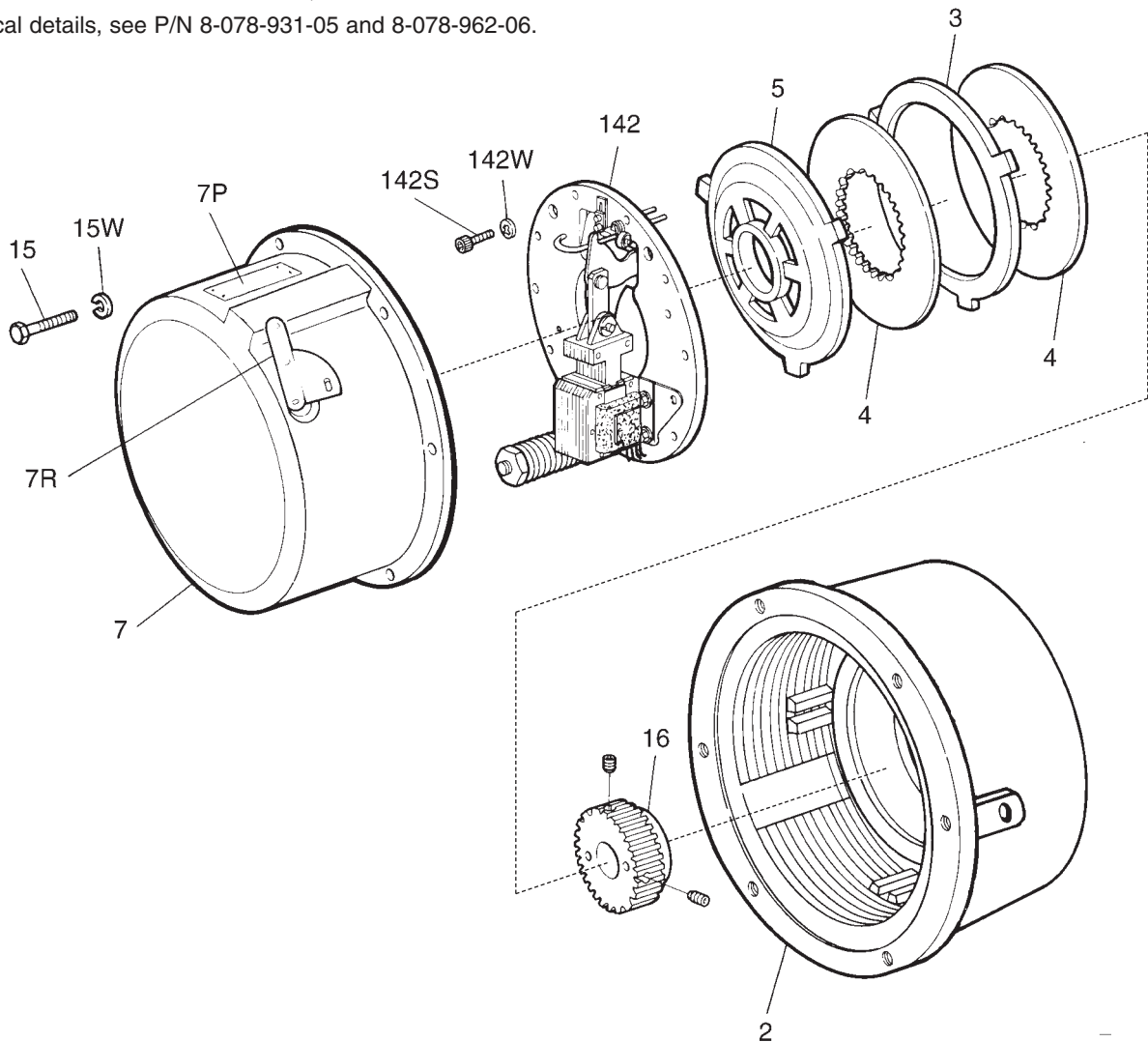
## Parts List for 81,000-02 Series Brakes (Portal Crane)

### Information required when ordering replacement parts:

- Give part number of parts needed, brake model number, and brake serial number. The brake model and serial number may identify special brakes not covered by this parts list.
- When ordering hubs, specify shaft diameter (hub bore) and keyway.
- Consult factory regarding support plate assembly for vertical and extra items.

### General Information

- For installation and service instructions, see P/N 8-078-921-04
- For vertical details, see P/N 8-078-931-05 and 8-078-962-06.



**TABLE 1**  
*Components of Standard Horizontal AC or DC Units  
and Standard Modifications*

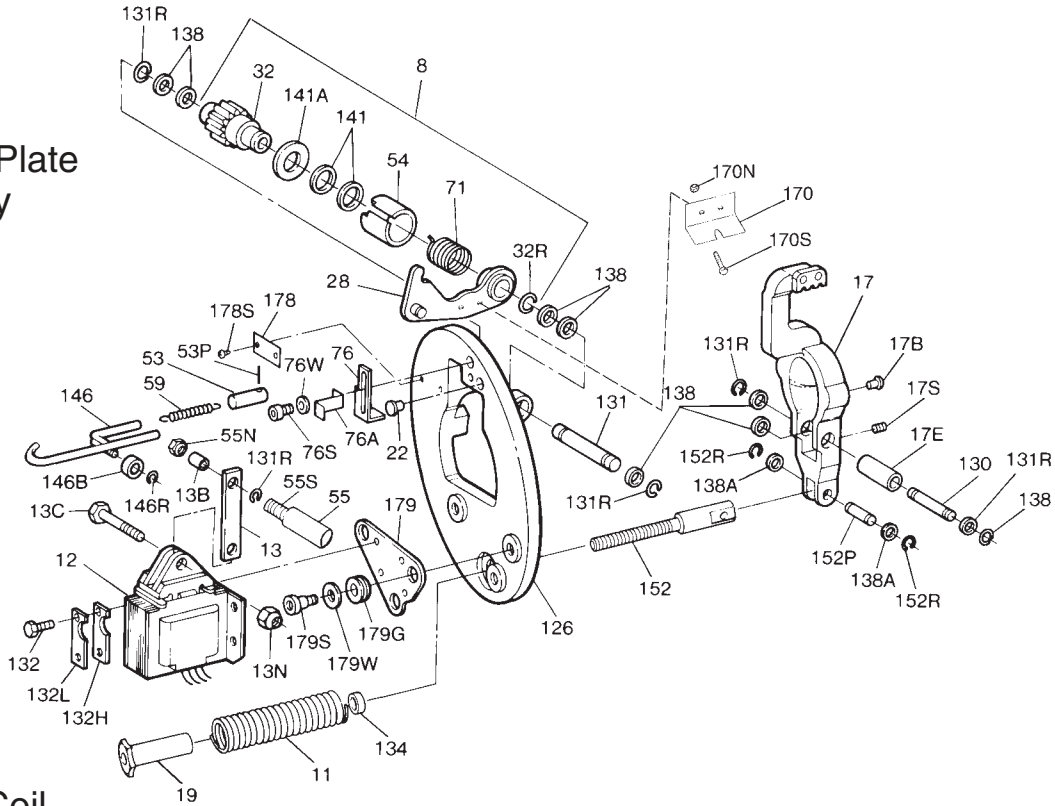
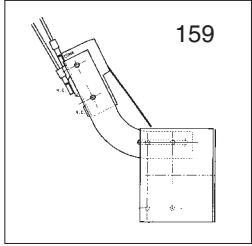
				Torque (lb-ft)		125		175		230	
				Current		AC	DC	AC	DC	AC	DC
				Brake Model Number →		1-081-012-02		1-081-016-02		1-081-036-02	
Type of Modification	Item No.	Description	Part Number ↓	1-081-012-02	1-081-016-02	1-081-022-02	1-081-026-02	1-081-032-02	1-081-036-02		
	2	Endplate and oil seal assembly	5-22-1011-00	1	1	1	1				
	2S	Endplate and oil seal assembly	5-22-1012-00					1	1		
		Seal ( <i>component of endplate and seal assembly</i> )	9-02-0014-00	1	1	1	1	1	1	1	1
	3	Stationary disc	8-003-202-02	1	1	1	1	2	2		
	4	Friction disc	5-66-8414-00	2	2	2	2	3	3		
	5	Pressure plate	8-005-109-01	1	1	1	1	1	1		
	7	Housing, bearing and seal assembly (cast iron)	5-07-2019-00	1	1	1	1	1	1		
		Housing, bearing and seal assembly (aluminum)	5-07-2119-00	1	1	1	1	1	1		
	7R	Release handle	8-148-103-00	1	1	1	1	1	1		
	7D	Pipe plug ( <i>drain</i> )	9-33-0325-01	1	1	1	1	1	1		
	7P	Warning plate	8-078-699-00	1	1	1	1	1	1		
	15	Machine screw ( <i>housing</i> )	9-17-5216-00	6	6	6	6	6	6		
	15W	Lock washer ( <i>housing</i> )	9-45-1352-00	6	6	6	6	6	6		
	<i>not shown</i>	Full release kit	5-55-2007-00	1	1	1	1	1	1	1	
16	Hub and set screw assembly	5-16-1102-00	1	1	1	1					
	Hub and set screw assembly	5-16-1104-00					1	1			
69	Gasket ( <i>housing to endplate</i> )	8-069-206-00	1	1	1	1	1	1			
140	Lead wire bushing ( <i>endplate</i> ) ( <i>internal connection only</i> )	8-140-002-08	1	1	1	1					
	Lead wire bushing ( <i>endplate</i> ) ( <i>internal connection only</i> )	8-140-002-10						1	1		
142	Support plate assembly	5-42-2071-34-09	1	1							
	Support plate assembly	5-42-2073-34-09			1	1					
	Support plate assembly	5-42-2075-34-09						1	1		
142S	Cap screw ( <i>support plate</i> )	9-17-5016-00	6	6	6	6	6	6	6		
142W	Conical spring washer ( <i>support plate</i> ) 1/4 I.D. x 9/16 O.D.	9-46-0006-00	6	6	6	6	6	6	6		
<b>Components for Standard Modifications</b> ( <i>most items not shown</i> )											
Vertical Mounting above Motor	2	Endplate and seal assembly with pins	5-22-1015-00	1	1	1	1				
	3	Endplate and seal assembly with pins	5-22-1016-00					1	1		
	5	Stationary disc	8-003-202-02	1	1	1	1	2	2		
		Pressure plate	8-005-109-02	1	1	1	1	1	1		
	Not Shown	Vertical mounting pin	8-061-204-00	3	3	3	3				
		Vertical mounting pin	8-061-205-00					3	3		
		Vertical mounting spring kit (above)	5-96-0102-00	1	1	1	1	1	1		
	170	Plunger guide bracket	Kit 5-55-2002-00								
	170S	Cap screw ( <i>bracket</i> )									
	170W	Lock washer ( <i>bracket</i> )									
171	Shim ( <i>bracket</i> )										
172	Spacer										
	Release plate	8-170-105-00	1	1	1	1	1	1	1		
	Screw	9-16-3014-00	2	2	2	2	2	2	2		
	Lock nut	9-40-3730-00	2	2	2	2	2	2	2		
	Spring pin	9-32-4055-00	1	1	1	1	1	1	1		
	Release rod	8-146-201-01	1	1	1	1	1	1	1		
Foot Mounting	34	<i>Foot mounting kit, comprised of:</i> Foot mounting bracket Cap screw Lock washer	5-55-2021-00								
34S	Foot mounting bracket		8-034-205-01	1	1	1	1	1	1		
39W	Cap screw		9-17-1624-00	4	4	4	4	4	4		
	Lock washer		9-45-1316-00	4	4	4	4	4	4		
Vertical Mounting below Motor	3	Stationary disc	8-003-202-02	1	1	1	1	2	2		
	5	Pressure plate ( <i>less pins - Item 61</i> )	8-005-109-03	1	1	1	1	1	1		
	61	Vertical mounting pin	8-061-206-00	3	3	3	3				
		Vertical mounting pin	8-061-207-00					3	3		
		Vertical mounting spring kit (below)	5-96-0103-00	1	1	1	1	1	1		
	170	Plunger guide bracket (AC)	8-170-204-00	1	1	1	1	1	1		
170S	Cap screw ( <i>bracket</i> )	8-350-002-00	2	2	2	2	2	2			
170W	Lock washer ( <i>bracket</i> )	9-45-0330-00	2	2	2	2	2	2			
171	Shim ( <i>bracket</i> )	8-454-016-00	*	*	*	*	*	*			
Space Heater	<i>not shown</i>	Heater ( <i>115 volt circuit</i> )	9-62-2058-00	1	1	1	1	1	1		
		Heater ( <i>230 volt circuit</i> )	9-62-2061-00	1	1	1	1	1	1		
		Clamp ( <i>heater</i> )	9-61-0077-00	1	1	1	1	1	1		
		Screw	9-25-7321-00	1	1	1	1	1	1		

**TABLE 2**  
Components of Support Plate Assemblies

			Brake Size Torque (lb-ft)	125	175	230
			Assembly Part Number→	5-42-2071-34-09	5-42-2073-34-09	5-42-2075-34-09
Item No.	Description	Part Number ↓				
8	Solenoid lever and pinion assembly (comprised of Items 28, 32, 32R, 54, 71, 141 and 141A)	5-96-7382-00	1	1	1	
11	Pressure spring (green)	9-70-4601-00	1			
12	Pressure spring (yellow)	9-70-6001-00		1	1	
	Solenoid assembly	see Table 3	1	1	1	
13	Solenoid link	8-013-205-00	1	1	1	
13B	Bearing (solenoid link)	9-04-1001-00	1	1	1	
13C	Cap screw (solenoid link)	8-157-703-00	1	1	1	
13N	Nut (solenoid link)	9-40-3732-00	1	1	1	
17	Lever arm assembly	5-17-2001-00	1	1	1	
17B	Pressure button	9-25-1908-00	2	2	2	
17E	Eccentric sleeve (lever arm)	8-054-201-00	1	1	1	
17S	Set screw (lever arm)	9-20-3004-00	2	2	2	
19	Pressure spring nut	8-019-201-00	1	1	1	
22	Solenoid lever stop	8-022-603-00	1	1	1	
28	Solenoid lever (component of Item 8)		1	1	1	
32	Pinion (component of Item 8)		1	1	1	
32R	Retaining ring (component of Item 8)		1	1	1	
53	Manual release spring tube	8-053-201-00	1	1	1	
53P	Roll pin (spring tube)	9-32-4012-00	1	1	1	
54	Sleeve (component of Item 8)		1	1	1	
55	Actuator (component of Item 159)	8-170-211-00	1	1	1	
55N	Nut (component of Item 159)	9-40-3730-00	1	1	1	
55S	Machine screw (component of Item 159)	9-10-3040-00	1	1	1	
59	Release spring	9-71-0004-00	1	1	1	
71	Wrap spring (component of Item 8)		1	1	1	
76	Wrap spring stop	8-076-203-00	1	1	1	
76A	Holding plate (wrap spring stop)	8-076-204-00	1	1	1	
76S	Cap screw (spring stop)	9-17-2812-00	2	2	2	
76W	Lock washer (spring stop)	9-45-1328-00	2	2	2	
126	Support plate and bearing assembly	5-26-2004-00	1	1	1	
130	Pivot pin (lever arm)	8-118-204-00	1	1	1	
131	Pivot pin (solenoid lever)	8-131-201-00	1	1	1	
131R	Retaining ring (pivot pin)	9-03-0020-00	5	5	5	
132	Cap screw (solenoid mounting)	8-350-008-00	4	4	4	
132H	Holding plate (solenoid mounting)	8-076-207-00	2	2	2	
132L	Lock plate (solenoid mounting)	8-076-206-00	2	2	2	
134	Pressure spring spacer	8-134-001-02	1	1		
	Pressure spring spacer	8-134-001-03			1	
138	Bearing (washer type)	8-138-201-00	8	8	8	
138A	Bearing (washer type)	8-138-701-00	2	2	2	
141	Wrap spring spacer (component of Item 8)		*	*	*	
141A	Wrap spring sleeve spacer (comp. of Item 8)		1	1	1	
146	Release rod	8-146-201-00	1	1	1	
146B	Ball bearing (release rod)	9-01-6801-00	1	1	1	
146R	Retaining ring (release rod)	9-03-0007-00	1	1	1	
152	Pressure spring stud	8-152-201-00	1	1	1	
152P	Pivot pin (spring stud)	8-118-202-00	1	1	1	
152R	Retaining ring (spring stud)	9-03-0019-00	2	2	2	
157	DC switch kit	see Table 3				
159	Brake release interlock kit (side manual release)	5-55-2004-00	1	1	1	
178	Instruction plate	8-078-054-00	1	1	1	
178S	Drivescrew	9-25-1303-00	2	2	2	
179	Solenoid mounting plate	8-179-205-01	1	1	1	
179G	Grommet (mounting plate)	8-147-202-00	3	3	3	
179S	Shoulder screw (mounting plate)	9-26-1108-00	3	3	3	
179W	Washer (mounting plate)	8-138-202-00	3	3	3	
170	Manual release plate	8-170-105-00	1	1	1	
170S	Release plate screw	9-16-3014-01	2	2	2	
170N	Release plate nut	9-40-3730-00	2	2	2	

\*As required

## Support Plate Assembly



## Solenoid and Coil Assembly

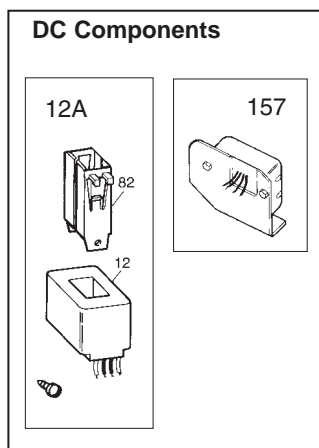
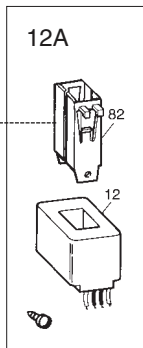
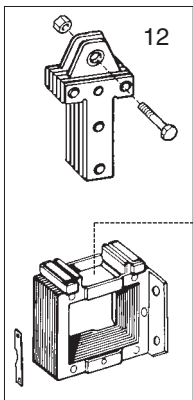
**TABLE 3**

*Components of Solenoid and Coil Assemblies*

Item	Description	Part Number
12	Solenoid assembly	5-12-5529-00
<b>AC Brakes</b>		
12A	No. 9 coil assembly 60 Hz	115 Vac 5-96-6901-33 230 Vac 5-96-6902-33 460 Vac 5-96-6904-33 575 Vac 5-96-6905-33 115/230 Vac 5-96-6907-33 230/460 Vac 5-96-6909-33
159	Brake release interlock switch kit	5-55-2004-00
<b>DC Brakes</b>		
12A	No. 9 coil assembly	115 Vdc 5-96-6916-33 230 Vdc 5-96-6917-33
157	DC switch kit	115 Vdc 5-57-5716-02 230 Vdc 5-57-5717-02

**TABLE 4 – Contents of Assemblies and Kits**

Item No.	Description
12	Solenoid assembly (5-12-5529-00) 1 - Plunger 1 - Frame 2 - Lock plates 1 - Solenoid link cap screw 1 - Solenoid link nut 1 - Cable clamp and screw (DC only)
12A	Coil assembly (5-96-69XX-33) 1 - Coil 2 - Plunger guides 2 - Plunger guide screws
157	DC switch kit (5-57-57XX-02) 1 - DC switch 2 - Mounting screws 2 - Lock washers
159	AC switch kit (5-55-2004-00) (brake release interlock switch - N.O.) 1 - AC switch 2 - Mounting screws 2 - Lock washers
7R	Full Release kit (5-55-2007-00) 1 - Release lever 1 - Spring pin 1 - O - Ring 1 - Release handle 1 - Locking plate 1 - Assembly hardware



## Appendix 4.4.5.2

System: Bridge Hoist Machinery  
Component: Right Angle Reducer  
Manufacturer: Hub City



# BEVEL GEAR DRIVES

Selection of Units, Classes of Service,  
Starting Torque, Thermal Capacity.....D-3

Quick Selection Tables..... D-4, D-5

Rating and Dimensions

- Models AD1, AD2..... D-6, D-7
- Models AD3, AD4, AD5 ..... D-8, D-9
- Model M2 ..... D-10, D-11
- Model M3 ..... D-12, D-13
- Model 44..... D-14, D-15
- Model 11..... D-16, D-17
- Model 150..... D-18, D-19
- Model 165..... D-20, D-21
- Model 175..... D-22, D-23
- Model 66..... D-24, D-25
- Model 65..... D-26, D-27
- Model 600..... D-28, D-29
- Model 88..... D-30, D-31**
- Models 800, 810..... D-32, D-33
- Model 850..... D-34, D-35
- Model 1000..... D-36, D-37
- Model 1010..... D-38, D-39
- Model 1050..... D-40, D-41
- Model 1200..... D-42, D-43
- Model 1250..... D-44, D-45
- Model 1700..... D-46, D-47
- Model 2200..... D-48, D-49
- Model 790..... D-50, D-51
- Model 920..... D-52, D-53
- Model 950..... D-54, D-55
- Metric Bevel Gear Drives..... D-56 to D-58
- RA Series ..... D-59 to D-64
- Accessories & Factory Options ..... D-65 to D-68





## **BEVEL GEAR DRIVES**

Over 40 Standard Models

### **BASIC SPECIFICATIONS**

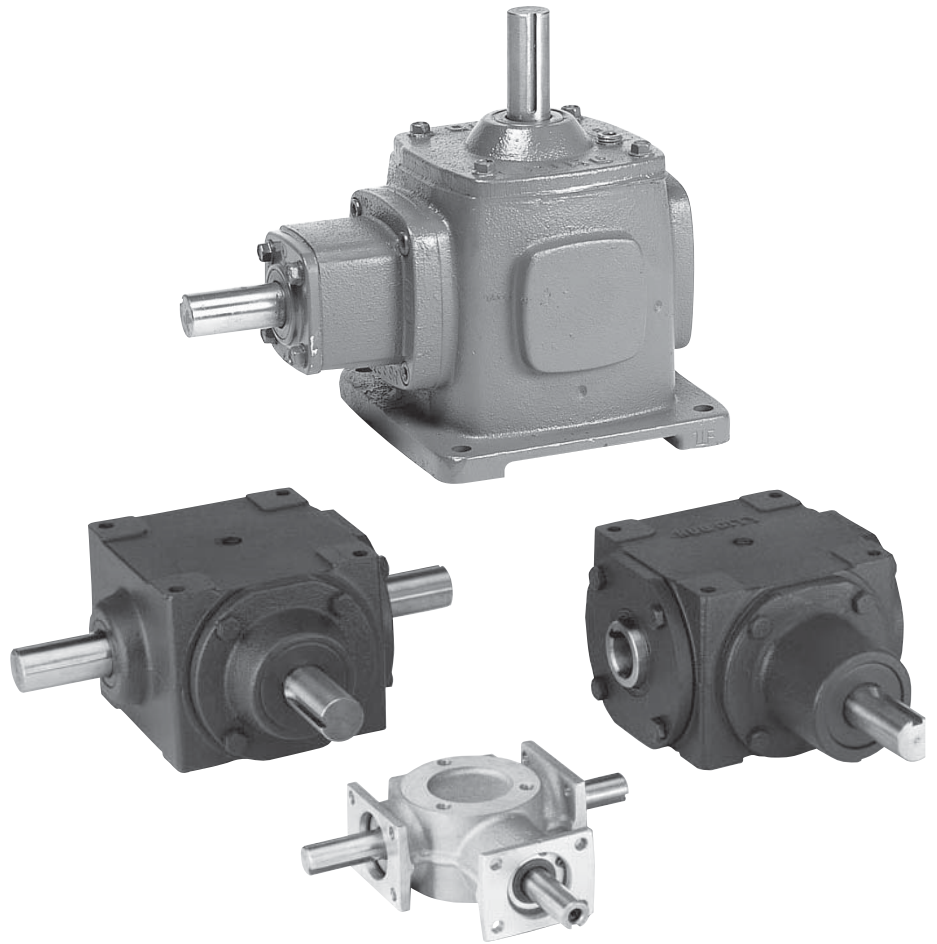
- Power Ratings from .016 to 1250 hp
- Output Torque to 58,000 inch/lbs
- Ratios from 1:1 through 7.33:1
- Operating Speeds to 3600 rpm

### **STANDARD FEATURES**

- Universal Mounting Dimensions Assure Maximum Design Flexibility
- Ductile Iron or Cast Iron Housings Designed for Superior Thermal Conductivity Provides Rigid Gear and Bearing Support.
- Cast Aluminum Housings Provide Corrosion Resistance for Models AD1 through AD5
- Spiral Bevel or Straight Bevel Gearing Provides Efficient Operation and Durability
- Alloy Shafting for Greater Strength.
- Ball or Tapered Roller Bearings for Endurance and Strength
- Heavy-Duty Industrial Seals Keep Contaminants Out

### **OPTIONAL FEATURES**

- Modified Standard and Custom Designs
- C-Face or Hydraulic Motor Mounting Flanges
- Metric Versions to Meet Global Market Demands
- CleanLine Washdown and BISSC Configurations
- Unique or Harsh Environment Adaptations



**For Stainless Steel  
Bevel Gear Drives  
See HUB<sup>®</sup>  
Section O**

**For Higher Ratio Bevel Drives  
See Poweratio<sup>®</sup> 2000  
Helical Bevel  
Section K**



## SELECTION OF BEVEL GEAR DRIVES

Bevel gear drives are selected on the basis of SPEED, RATIO, HORSEPOWER, and TORQUE. The QUICK SELECTION TABLES, page D4 & D-5 are designed to assist you in making a rapid selection of the model to fit your requirements. To use this table, find your required INPUT RPM and RATIO in the table and look across the page for the unit with the proper INPUT HORSEPOWER

for your application. For example, if the application INPUT SPEED is 1750 RPM and you require a 1:1 RATIO capable of transmitting 90 HORSEPOWER, from the chart the proper selection is a Model 88 with spiral bevel gears. The Table of Contents will guide you to the catalog pages containing complete engineering data and specifications for the model you have selected.

TABLE 1 – SERVICE FACTORS

PRIME MOVER	DURATION OF SERVICE PER DAY (1)	DRIVEN MACHINE LOAD CLASSIFICATION		
		UNIFORM	MEDIUM SHOCK	HEAVY SHOCK
Electric Motor	Occasional 1/2 hr.	*	*	1.25
	Intermittent 3 hrs.	*	1.00	1.50
	3 - 10 hours	1.00	1.25	1.75
	Over 10 hours	1.25	1.50	2.00
Electric Motor With Frequent Starts and Stops (2)	Occasional 1/2 hr.	*	1.00	1.50
	Intermittent 3 hrs.	1.00	1.25	1.75
	3 - 10 hours	1.25	1.50	2.00
	Over 10 hours	1.50	1.75	2.25
Multi-Cylinder Internal Combustion Engine	Occasional 1/2 hr.	*	1.00	1.50
	Intermittent 3 hrs.	1.00	1.25	1.75
	3 - 10 hours	1.25	1.50	2.00
	Over 10 hours	1.50	1.75	2.25
Single Cylinder Internal Combustion Engine	Occasional 1/2 hr.	1.00	1.25	1.75
	Intermittent 3 hrs.	1.25	1.50	2.00
	3 - 10 hours	1.50	1.75	2.25
	Over 10 hours	1.75	2.00	2.50
Reversing Service Application		Consult Factory		

\* UNSPECIFIED SERVICE FACTORS SHOULD BE 1.0 OR AS AGREED UPON BY USER AND MANUFACTURER.

### EXPLANATORY NOTES

1. Time specified for intermittent and occasional service refers to total operating time per day.
2. Term "frequent starts and stops" refers to more than 10 starts per hour.

### STARTING TORQUE

Momentary or starting torque should be limited to 200 per cent of rated capacity for Hub City Bevel gear drives.

### THERMAL CAPACITY

The thermal capacity of a unit is the maximum capacity at which the unit will operate at a temperature not exceeding 200° F. Under certain conditions of high load and high RPM the thermal capacity may be somewhat less than the mechanical capacity. If thermal capacity is exceeded, provision must be made for additional cooling of the unit or external recirculation of lubricant. Factory engineers are ready to assist designers with their problems, at all times.

### EFFICIENCY

Bevel Gearing and Ball or Tapered Roller Bearings provide a drive with very high efficiency. The approximate efficiency is 97.5%.

### SERVICE FACTORS

The ratings for gear drives in this manual are based on a service factor of 1.00, for uniform load and uniform power source, up to 10 hours of operation per day. For other operating conditions, the application horsepower or torque must be multiplied by the appropriate service factor, to determine the equivalent gear drive power rating. A gear drive should be selected with a rated capacity equal to or greater than the equivalent rating. Table 1 designates recommended service factors for various conditions of load, power source, and duration of service.

AGMA Service Factors for Drives and Reducers are listed on pages A-7 to A-8.

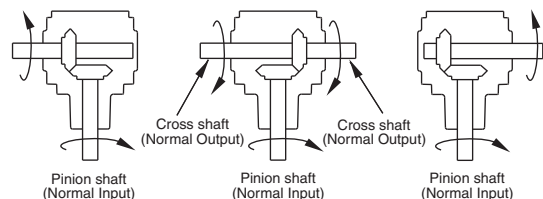
Refer to page A-2 for further information and cautions on the selection of proper service factors.

### APPLICATIONS

Bevel Gear Drives transfer power at 90°. Generally this power transfer is a 1:1 ratio with relation to speed. These gear drives are also capable of increasing or reducing speed.

### SHAFT ROTATION

Shaft rotation is determined by the relative location of the gears. Right hand (clockwise) or left hand (counter-clockwise) rotations are determined by viewing the end of the shaft. Pinion shaft can be rotated in either direction.



The above illustrations show common terms normally used in discussing Bevel Gear Drives.



## QUICK MODEL SELECTION

STRAIGHT BEVEL GEAR DRIVES BY INPUT HORSEPOWER														
INPUT RPM	RATIO	OUTPUT RPM	M2 M3	RA-0	44	11	150	165	66	600	88	800	810	1000
2400	1:1	2400	3.00											
	1.47:1	1644				8.0								
	1.5:1	1600	2.10											
	1.8:1	1333				7.3								
	2:1	1200	1.40				9.0	9.0						
1750	1:1	1750	2.25	2.0	20.0									
	1.43:1	1225			10.1									
	1.47:1	1199				6.1								
	1.5:1	1168	1.57				9.2	9.2	15.0					
	1.8:1	972				5.4								
	2:1	875	1.04	2.5	5.90		6.3	6.3	7.3					
3:1	583		1.7							15.0				
1150	1:1	1150	1.50	1.50	13.8	12.0	12.0	17.0	24.2	34.0				
	1.36:1	852							11.4					
	1.43:1	805			6.9									
	1.47:1	788				4.2								
	1.5:1	767	1.03				6.2	6.2	10.6		39.0	44.0	44.0	
	1.7:1	676										33.0	33.0	
	1.8:1	638				3.6								
	2:1	575	.70	1.9	4.1		4.3	4.3	5.4		22.0			
3:1	383		1.3							9.9				
690	1:1	690	.93	1.0	8.4	7.6	7.6	10.6	16.3	23.9	36.5	56.2	56.2	80.0
	1.21:1	575										40.0	40.0	55.0
	1.33:1	519										37.0	37.0	
	1.36:1	511							7.2					
	1.43:1	483			4.3									
	1.47:1	473				2.6								
	1.5:1	460	.65				3.9	3.9	7.1		24.0	28.0	28.0	
	1.7:1	406										21.6	21.6	
	1.8:1	383				2.2								
	1.87:1	369												39.0
	2:1	345	.43	1.3	2.5			2.7	2.7	3.9		13.8		
	2.21:1	314												26.0
3:1	230		.93							6.5				
100	1:1	100	.14	.25	1.2	1.2	1.2	1.7	2.9	4.3	5.8	9.0	9.0	17.0
	1.21:1	83										6.7	6.7	11.0
	1.33:1	75										6.1	6.1	
	1.36:1	74							1.4					
	1.43:1	70			.71									
	1.47:1	68				.44								
	1.5:1	66	.12				.65	.65	1.4		3.8	4.6	4.6	
	1.7:1	59										3.4	3.4	
	2:1	50		.30	.41			.50	.50	.70		2.3		
	2.2:1	45												4.8
	3:1	33		.20										

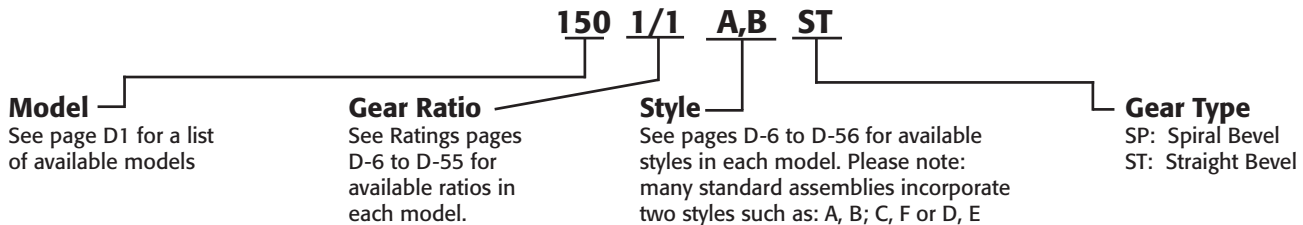


# QUICK MODEL SELECTION

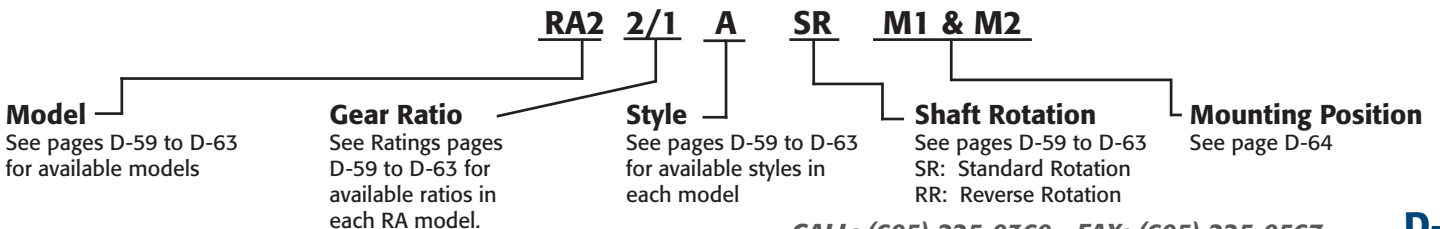
SPIRAL BEVEL GEAR DRIVES BY INPUT HORSEPOWER																			
INPUT RPM	RATIO	OUTPUT RPM	AD1 AD4	AD2 AD5	AD3	RA-1	11 150 165 175	RA-2	65 66	RA-3	600	88	RA-4	800 810 850	1010 1050	1200	1250	1700	2200
3600	1:1	3600	1.81	4.31	10.25														
	2:1	1800	.53	2.12	3.82														
2400	1:1	2400	1.24	2.95	7.10	17.6	21.8	27.3	59.0	51.3	59.0								
	1.29:1	1860									46.3								
	1.53:1	1569							46.0										
	2:1	1200	.36	1.45	2.62	12.8	12.3	19.1	20.7	49.6									
1750	3:1	800					7.0		12.5										
	1:1	1750	.91	2.19	5.27	14.1	16.0	21.9	46.0	41.1	46.0	90.0	52.2	132	251	296	380	701	1250
	1.29:1	1356									34.7								
	1.33:1	1316													195	232		334	491
	1.5:1	1167										69.9		69.9	173	205	205	301	480
	1.53:1	1143							35.0										
1150	2:1	875	.26	1.07	1.96	10.3	9.0	15.3	15.4	39.6		56.0	49.5	56.0	124	235	235	305	
	3:1	583				6.5		13.1	9.2	27.3		30.7	40.2	30.7	55.8	133	133	159	237
	1:1	1150	.61	1.47	3.55	10.5	11.0	16.3	30.5	30.0	30.5	63.0	38.9	90.0	173	204	261	482	868
	1.29:1	891									23.6								
	1.33:1	865													134	164		228	337
	1.5:1	767										47.0		47.0	118	145	145	206	330
690	1.53:1	751							23.0										
	2:1	575	.18	.72	1.32	7.5	6.1	10.9	10.3	27.3		38.0	36.9	38.0	84.4	166	166	210	
	3:1	383				4.5		9.7	6.2	18.7		20.6	30.0	20.6	37.7	93.0	93.0	108	162
	1:1	690	.37	.90	2.19	7.3	6.8	11.4	20.0	18.8	20.0	39.5	27.2	56.0	109	128	165	305	549
	1.29:1	535									14.6								
	1.33:1	519													83.5	112		144	212
100	1.5:1	460										29.5		29.5	73.8	85.0	85.0	130	208
	1.53:1	451							15.0										
	2:1	345	.11	.44	.81	4.7	3.7	6.9	6.3	17.3		23.0	25.8	23.0	52.5	113	113	132	
	3:1	230				2.8		6.1	3.8	11.8		12.6	20.9	12.6	28.4	61.0	61.0	67.0	101
	1:1	100	.06	.14	.34	1.3	1.1	2.2	3.7	3.2	3.7	6.5	5.2	9.0	18.5	21.0	27.0	50.0	92.0
	1.29:1	77									2.3								



### BEVEL GEAR DRIVE NOMENCLATURE EXAMPLES



### RA SERIES



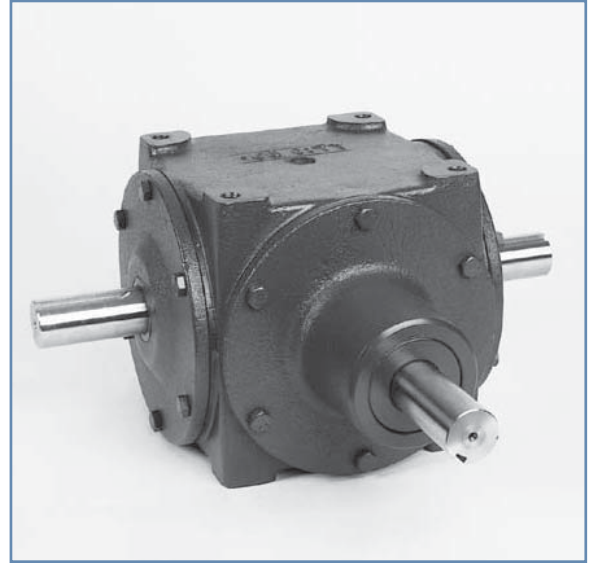
CALL: (605) 225-0360 • FAX: (605) 225-0567



## MODEL 88

### FEATURES

- Rugged cast iron housing designed for rigid gear and bearing support.
- Alloy shafting for greater strength.
- Tapered roller bearings for endurance and strength.
- Choice of thirteen (13) standard gear ratios.
- Heavy-duty industrial seals to keep lubricant in and dirt out.
- Universal mounting assures maximum design flexibility.
- Base and pinion shaft mounting kits available.  
(Refer to pages D-65, D-66)
- Reversing model available as factory option. (Refer to page D-66)
- Hydraulic motor mounting flanges available. (Refer to page D-67)
- Hub City lubricant recommended. (Refer to section R)



### RATING TABLE

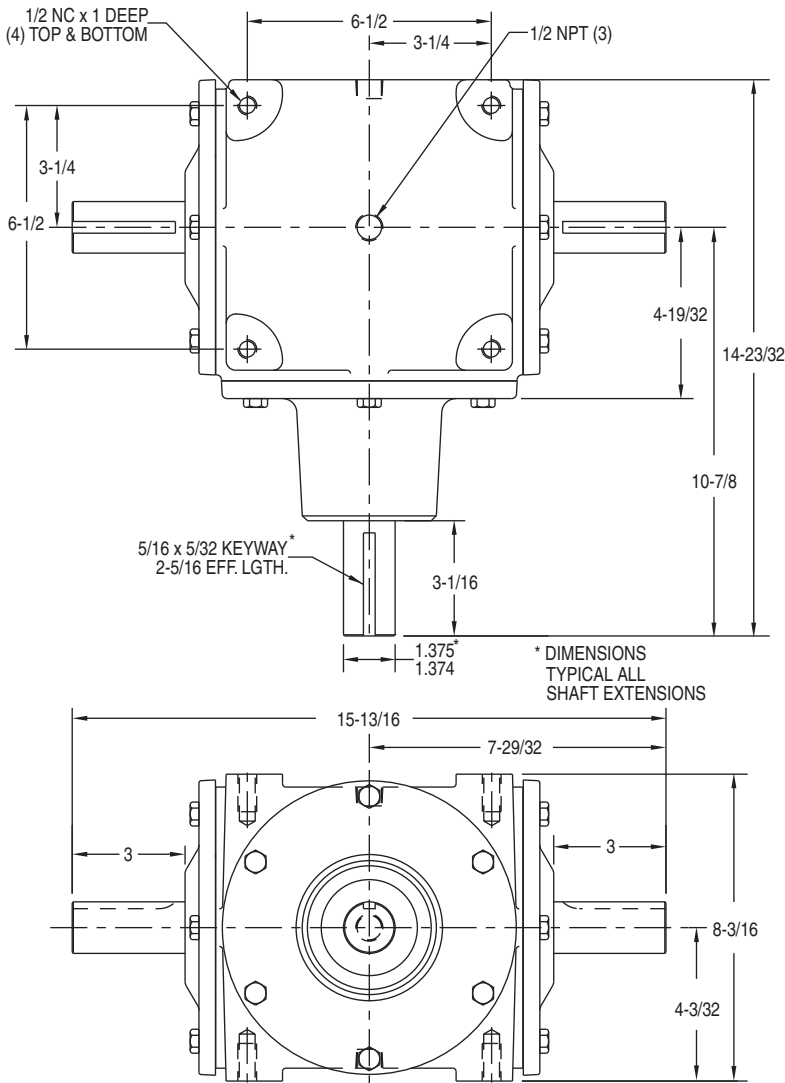
INPUT RPM†		REDUCTION RATIOS								INCREASER RATIOS				
		1:1	SPIRAL 1:1	1.5:1	SPIRAL 1.5:1	2:1	SPIRAL 2:1	3:1	SPIRAL 3:1	1:1.5	SPIRAL 1:1.5	1:2	SPIRAL 1:2	1:3*
1750	INPUT HORSEPOWER		90.00		69.00		56.00	15.00	30.69					
	OUTPUT TORQUE IN. LBS.		3240.00		3720.00		4070.00	1621.00	3316.00					
	‡INPUT O.H.L.		35.00		97.00		85.00	600.00	65.00					
	‡OUTPUT O.H.L.		320.00		475.00		225.00	760.00	400.00					
1150	INPUT HORSEPOWER		63.00	39.00	47.00	22.00	38.00	9.90	20.55		68.00		73.00	
	OUTPUT TORQUE IN. LBS.		3450.00	3200.00	3860.00	2410.00	4169.00	1629.00	3378.70		2480.00		2000.00	
	‡INPUT O.H.L.		202.00	99.00	216.00	330.00	150.00	709.00	175.00		152.00		115.00	
	‡OUTPUT O.H.L.		370.00	570.00	600.00	700.00	275.00	820.00	525.00		219.00		210.00	
850	INPUT HORSEPOWER	44.00	48.00	29.00	35.70	16.50	29.00	7.50	15.39		51.00		55.00	
	OUTPUT TORQUE IN. LBS.	3260.00	3558.00	3220.00	3970.00	2446.00	4230.00	1669.00	3423.40		2520.00		2039.00	
	‡INPUT O.H.L.	103.00	243.00	309.00	234.00	506.00	185.00	793.00	200.00		176.00		145.00	
	‡OUTPUT O.H.L.	385.00	410.00	600.00	625.00	850.00	350.00	900.00	620.00		252.00		225.00	
690	INPUT HORSEPOWER	36.50	39.50	24.00	29.50	13.80	23.00	6.50	12.59	25.00	42.50	26.00	45.00	11.40
	OUTPUT TORQUE IN. LBS.	3330.00	3607.00	3290.00	4040.00	2520.00	4267.00	1780.00	3449.90	1520.00	2585.00	1188.00	2055.00	350.00
	‡INPUT O.H.L.	234.00	308.00	432.00	329.00	602.00	235.00	843.00	240.00	290.00	247.00	373.00	175.00	892.00
	‡OUTPUT O.H.L.	450.00	475.00	685.00	710.00	950.00	400.00	1200.00	700.00	710.00	356.00	603.00	275.00	641.00
400	INPUT HORSEPOWER	21.50	23.50	14.30	17.60	8.50	13.80	3.80	7.43	18.00	26.00	15.40	27.00	7.30
	OUTPUT TORQUE IN. LBS.	3390.00	3702.00	3380.00	4160.00	2680.00	4356.00	1800.00	3512.00	1890.00	2730.00	1210.00	2127.00	380.00
	‡INPUT O.H.L.	514.00	429.00	565.00	546.00	925.00	325.00	1035.00	330.00	612.00	396.00	792.00	244.00	1062.00
	‡OUTPUT O.H.L.	565.00	590.00	910.00	930.00	1170.00	635.00	1400.00	825.00	831.00	498.00	819.00	500.00	778.00
300	INPUT HORSEPOWER	16.40	18.00	10.90	13.50	6.50	10.50	2.90	5.62	15.00	20.00	11.75	20.00	5.70
	OUTPUT TORQUE IN. LBS.	3440.00	3780.00	3435.00	4250.00	2730.00	4394.00	1827.00	3542.00	2020.00	2790.00	1235.00	2101.00	400.00
	‡INPUT O.H.L.	600.00	486.00	794.00	631.00	1038.00	365.00	1147.00	420.00	700.00	452.00	996.00	275.00	1170.00
	‡OUTPUT O.H.L.	630.00	655.00	995.00	1020.00	1250.00	875.00	1475.00	925.00	889.00	514.00	987.00	625.00	860.00
100	INPUT HORSEPOWER	5.80	6.50	3.80	4.80	2.30	3.60	1.00	1.91	5.60	7.10	4.25	7.00	2.00
	OUTPUT TORQUE IN. LBS.	3650.00	4095.00	3590.00	4440.00	2898.00	4511.00	1891.00	3611.30	2350.00	2980.00	1340.00	2206.00	420.00
	‡INPUT O.H.L.	1050.00	843.00	1400.00	1120.00	1400.00	650.00	1400.00	850.00	1235.00	608.00	1400.00	500.00	1400.00
	‡OUTPUT O.H.L.	1075.00	1100.00	1475.00	1500.00	1500.00	1200.00	1500.00	1365.00	1400.00	829.00	1400.00	900.00	1250.00
WR <sup>2</sup> (Lb. In. <sup>2</sup> ) REFERRED TO HIGH SPEED SHAFT	STYLE													
	A, B	31.46	45.53	19.28	22.28	10.72	10.50	6.59	4.67	44.31	51.04	44.56	44.27	NA
	C, D, E, F	31.08	45.15	19.12	22.11	10.63	10.40	6.55	4.63	43.48	50.22	43.09	42.81	NA
	G	45.90	66.96	30.86	35.61	17.18	17.08	11.26	7.44	57.94	67.46	54.75	54.50	72.33
WR <sup>2</sup> (Lb. In. <sup>2</sup> ) REFERRED TO LOW SPEED SHAFT	A, B	31.46	45.53	43.38	50.12	42.87	41.99	59.30	42.01	19.69	22.69	11.14	11.07	NA
	C, D, E, F	31.08	45.15	43.02	49.75	42.51	41.61	58.94	41.64	19.33	22.32	10.78	10.70	NA
	G	45.90	66.96	69.45	80.13	68.73	68.31	101.36	66.93	25.75	29.98	13.69	13.62	8.04
	GG	46.30	67.79	58.56	70.06	55.73	57.92	75.60	58.41	31.71	38.21	18.00	17.96	NA

†FOR HIGHER INPUT SPEEDS CONSULT FACTORY.  
‡OVERHUNG LOAD IN LBS. AT CENTER OF SHAFT EXTENSIONS.

\*AVAILABLE IN STYLE G ONLY



# MODEL 88



**NOTE: STYLE G & GG**

1. DIMENSIONS FOR SHAFTS A, A1, AND A2 ARE IDENTICAL FOR ALL RATIOS.
2. CENTERLINE TO END OF SHAFT DIMENSIONS WILL VARY. REQUEST CERTIFIED DIMENSIONAL PRINTS.

**FOR LUBRICATION AND INSTALLATION INSTRUCTIONS - REFER TO SECTION R**

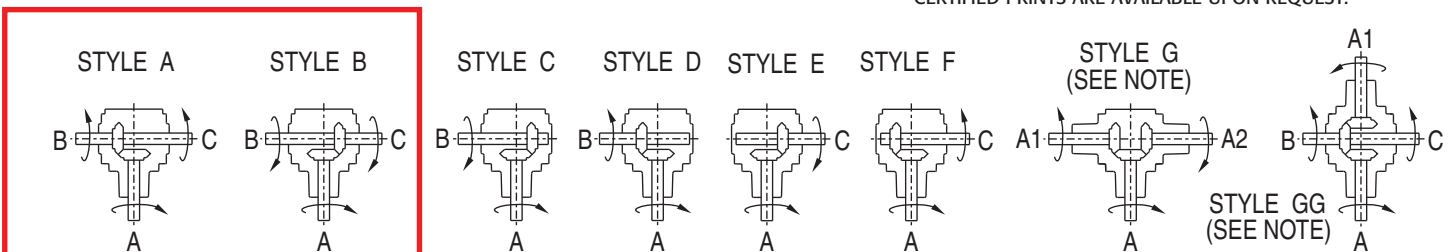
**D**

**RATING AND DIMENSIONS**

**DRY SHIPPING WEIGHTS**

STYLES A, B, C, D, E, F .....	.88 lbs.
STYLES G .....	100 lbs.
STYLES GG .....	112 lbs.

**STANDARD STYLES AVAILABLE**



DIMENSIONS SHOWN ARE FOR REFERENCE ONLY. CERTIFIED PRINTS ARE AVAILABLE UPON REQUEST.

CONSULT FACTORY FOR VERTICAL SHAFT LUBRICATION RECOMMENDATIONS  
INPUT SHAFT CAN BE ROTATED IN EITHER DIRECTION



# PART NUMBERING SYSTEM & NAME PLATE INFO.

## ENCLOSED DRIVE PRODUCTS

**PRODUCT CATEGORY CODE**

02 – Power Transmission Products

03 – Accessory Products

04 – Contract Machine Products

00

00

**NUMERICAL SEQUENCE CODE**

00000

**PRODUCT IDENTIFICATION CODE**

**Power Transmission Products:**

- 20 – Standard Units
- 21 – Modified Standard Units
- 22 – Special Units – Custom Designs
- 23 – Standard Components
- 25 – Special Components
- 27 – Modules – Poweratio, others
- 29 – Accessory Kits
- 50 – High Efficiency Drives - Standard Units
- 51 – High Efficiency Drives - Modified Standard Units
- 53 – High Efficiency Drives - Standard Components
- 55 – High Efficiency Drives - Special Components
- 60 – Standard Electric Motors
- 65 – Modified Standard Electric Motors
- 70 – Powertorque® Shaft Mount & Spartan Aluminum Worm Drives - Standard Units
- 71 – Powertorque® Shaft Mount & Spartan Aluminum Worm Drives - Modified Standard Units
- 72 – Powertorque® Shaft Mount & Spartan Aluminum Worm Drives - Accessory Kits

**Accessory Products:**

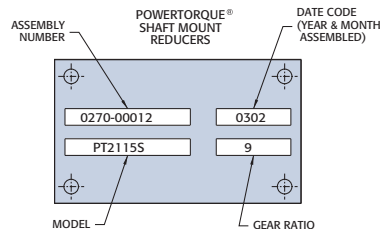
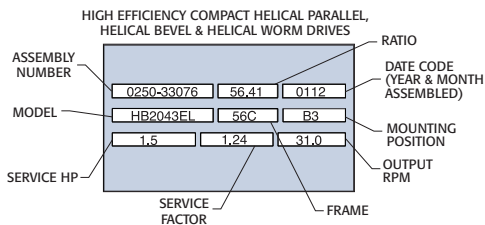
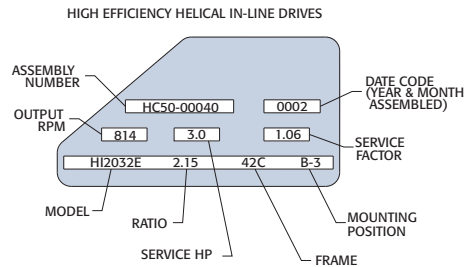
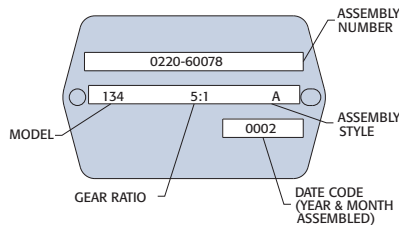
- 31 – Over-running Couplers
- 32 – PTO Adaptors
- 34 – Overhung Load Adaptors
- 35 – Standard Yokes

**Contract Machine Products:**

- 40 – Contract Parts

CleanLine HUB<sup>3</sup>™ Worm Gear Speed Reducers and Bevel Gear Drives do not have an attached name-plate. The information is directly marked on the housing. Bevel Gear Drives have the ASSEMBLY NUMBER, MODEL, GEAR RATIO, STYLE/MOUNTING POSITION, and DATE CODE. Worm Gear Speed Reducers have the ASSEMBLY NUMBER, MODEL, GEAR RATIO, STYLE, and DATE CODE.

### HUB CITY NAME PLATE INFORMATION



## MOUNTED BEARING PRODUCTS

0000

00000

**NUMERICAL SEQUENCE CODE**

**PRODUCT IDENTIFICATION CODE**

BALL BEARING				
1001	Standard	Pillow Blocks	1102 Modified Flange Blocks	1203 Special Flange Cartridges
1002	Standard	Flange Blocks	1103 Modified Flange Cartridges	1204 Special Take-Up Units
1003	Standard	Flange Cartridges	1104 Modified Take-Up Units	1205 Special Accessories
1004	Standard	Take-Up Units	1105 Modified Accessories	1300 Standard Components
1005	Standard	Accessories	1201 Special Pillow Blocks	1500 Special Components
1101	Modified	Pillow Blocks	1202 Special Flange Blocks	
TYPE E – TAPERED ROLLER BEARING (DISCONTINUED)				
1031	Standard	Pillow Blocks	1132 Modified Flange Blocks	1203 Special Flange Cartridges
1032	Standard	Flange Blocks	1133 Modified Flange Cartridges	1330 Standard Components
1033	Standard	Flange Cartridges	1201 Special Pillow Blocks	1530 Special Components
1131	Modified	Pillow Blocks	1202 Special Flange Blocks	



# ALPHA-NUMERIC MODEL INDEX

MODEL	RATINGS	DIMENSIONS	MODEL	RATINGS	DIMENSIONS	MODEL	RATINGS	DIMENSIONS
0331-xxxxx	SEE PAGE Q22		246	B17	B36-B37	1803	B57	B66-B67
0332-xxxxx	SEE PAGE Q22		260V	B18	See pg B93	1804	B57	B70-B71
0334-xxxxx	SEE PAGE Q22		261	B18	B24-B25	1805	B57	B72-B73
0339-xxxxx	SEE PAGE Q22		262	B18	B26-B27	1806	B57	B74-B75
1	F34	F35	263	B18	B28-B29	1809	B57	See pg B93
1T200	NA	M28	264	B18	B32-B33	1810	B57	See pg B93
2	F36	F37	265	B18	B34-B35	2101	B57	B62-B63
3	F38	F39	266	B18	B36-B37	2102	B57	B64-B65
3T200	NA	M28	269V	B18	See pg B93	2103	B57	B66-B67
3T210	NA	M27	280	F16	F17	2104	B57	B70-B71
4	F40	F41	290	F26	F27	2105	B57	B72-B73
5	F42	F43	320V	B18	See pg B93	2106	B57	B74-B75
6	F44	F45	321	B18	B24-B25	2109	B57	See pg B93
6T200	NA	M28	322	B18	B26-B27	2110	B57	See pg B93
6T210	NA	M27	323	B18	B28-B29	2200	D48	D49
8	F48	F49	324	B18	B32-B33	2212	P1	P1
9T200	NA	M28	325	B18	B34-B35	2213	P1	P1
9T210	NA	M27	326	B18	B36-B37	2401	B58	B62-B63
11	D16	D17	327	B18	B40-B41	2402	B58	B64-B65
12T200	NA	M28	328	B18	B42-B43	2403	B58	B66-B67
12T210	NA	M27	329V	B18	See pg B93	2404	B58	B70-B71
18T200	NA	M28	330	Q18	Q19	2405	B58	B72-B73
18T210	NA	M27	380V	B19	See pg B93	2406	B58	B74-B75
22	F10	F11	381	B19	B24-B25	2601	B58	B62-B63
44	D14	D15	382	B19	B26-B27	2602	B58	B64-B65
52	F28	F29	383	B19	B28-B29	2603	B58	B66-B67
65	D26	D27	384	B19	B32-B33	2604	B58	B70-B71
65M	D26	D58	385	B19	B34-B35	2605	B58	B72-B73
66	D24	D25	386	B19	B36-B37	2606	B58	B74-B75
66M	D24	D57	387	B19	B40-B41	2609	B58	See pg B93
75	F46	F47	388	B19	B42-B43	2610	B58	See pg B93
83L&83S	F30	F31	389V	B19	See pg B93	2651	See Page B86	
85L	F18	F19	390	Q20	Q21	2652	See Page B86	
88	D30	D31	450V	B20	B46-B47	2653	See Page B86	
89	F32	F33	451	B20	B24-B25	2654	See Page B86	
95H	F24	F25	452	B20	B26-B27	2655	See Page B86	
95L	F22	F23	453	B20	B30-B31	2656	See Page B86	
101M	D38	D57	454	B20	B32-B33	2659	See Page B86	
105M	D40	D58	455	B20	B34-B35	2660	See Page B86	
120M	D42	D57	456	B20	B38-B39	3201	B58	B62-B63
125M	D44	D58	457	B20	B40-B41	3202	B58	B64-B65
131	B16	B24-B25	458	B20	B42-B43	3203	B58	B66-B67
134	B16	B32-B33	459V	B20	B44-B45	3204	B58	B70-B71
150	D18	D19	520V	B20	B46-B47	3205	B58	B72-B73
165	D20	D21	521	B20	B24-B25	3206	B58	B74-B75
165M	D20	D57	522	B20	B26-B27	3207	B58	B78-B79
175	D22	D23	523	B20	B30-B31	3208	B58	B80-B81
175M	D22	D58	524	B20	B32-B33	3209	B58	See pg B93
180V	B16	See pg B93	525	B20	B34-B35	3210	B58	See pg B93
181	B16	B24-B25	526	B20	B38-B39	3251	See Page B86	
182	B16	B26-B27	527	B20	B40-B41	3252	See Page B86	
183	B16	B28-B29	528	B20	B42-B43	3253	See Page B86	
184	B16	B32-B33	529V	B20	B44-B45	3254	See Page B86	
185	B16	B34-B35	600	D28	D29	3255	See Page B86	
186	B16	B36-B37	790	D50	D51	3256	See Page B86	
189V	B16	See pg B93	800	D32	D33	3257	See Page B86	
200	F20	F21	800M	D32	D57	3258	See Page B86	
210V	B17	See pg B93	810	D32	D33	3259	See Page B86	
211	B17	B24-B25	850	D34	D35	3260	See Page B86	
212	B17	B26-B27	850M	D34	D58	3801	B59	B62-B63
213	B17	B28-B29	920	D52	D53	3802	B59	B64-B65
214	B17	B32-B33	950	D54	D55	3803	B59	B66-B67
215	B17	B34-B35	1000	D36	D37	3804	B59	B70-B71
216	B17	B36-B37	1010	D38	D39	3805	B59	B72-B73
219V	B17	See pg B93	1050	D40	D41	3806	B59	B74-B75
230	F12	F13	1200	D42	D43	3807	B59	B78-B79
240	F14	F15	1250	D44	D45	3808	B59	B80-B81
241	B17	B24-B25	1301	B57	B62-B63	3809	B59	See pg B93
242	B17	B26-B27	1304	B57	B70-B71	3810	B59	See pg B93
243	B17	B28-B29	1700	D46	D47	3851	See Page B86	
244	B17	B32-B33	1801	B57	B62-B63	3852	See Page B86	
245	B17	B34-B35	1802	B57	B64-B65	3853	See Page B86	



## IMPORTANT INFORMATION

PLEASE READ CAREFULLY



The following and information is supplied to you for your protection and to provide you with many years of trouble free and safe operation of your HUB CITY product.

Read ALL instructions prior to operating reducer. Injury to personnel or reducer failure may be caused by improper installation, maintenance or operation.



- Written authorization from HUB CITY is required to operate or use reducers in man lift or people moving devices.
- Check to make certain application does not exceed the allowable load capacities published in the current catalog.
- Buyer shall be solely responsible for determining the adequacy of the product for any and all uses to which Buyer shall apply the product. The application by Buyer shall not be subject to any implied warranty of fitness for a particular purpose.
- For safety, Buyer or User should provide protective guards over all shaft extensions and any moving apparatus mounted thereon. The User is responsible for checking all applicable safety codes in his area and providing suitable guards. Failure to do so may result in bodily injury and/or damage to equipment.
- Hot oil and reducers can cause severe burns. Use extreme care when removing lubrication plugs and vents.
- Make certain that the power supply is disconnected before attempting to service or remove any components. Lock out the power supply and tag it to prevent unexpected application of power.
- Reducers are not to be considered fail safe or self-locking devices. If these features are required, a properly sized, independent holding device should be utilized. Reducers should not be used as a brake.
- Any brakes that are used in conjunction with a reducer must be sized or positioned in such a way so as to not subject the reducer to loads beyond the catalog rating.
- Lifting supports including eyebolts are to be used for vertically lifting the gearbox only and no other associated attachments or motors.
- Use of an oil with an EP additive on units with backstops may prevent proper operation of the backstop. Injury to personnel, damage to the reducer or other equipment may result.
- Overhung loads subject shaft bearings and shafts to stress which may cause premature bearing failure and/or shaft breakage from bending fatigue, if not sized properly.



- Test run unit to verify operation. If the unit tested is a prototype, that unit must be of current production.
- If the speed reducer cannot be located in a clear and dry area with access to adequate cooling air supply, then precautions must be taken to avoid the ingestion of contaminants such as water and the reduction in cooling ability due to exterior contaminants.
- Mounting bolts should be routinely checked to ensure that the unit is firmly anchored for proper operation.

In the event of the resale of any of the goods, in whatever form, Resellers/Buyers will include the following language in a conspicuous place and in a conspicuous manner in a written agreement covering such sale:

The manufacturer makes no warranty or representations, express or implied, by operation of law or otherwise, as to the merchantability or fitness for a particular purpose of the goods sold hereunder. Buyer acknowledges that it alone has determined that the goods purchased hereunder will suitably meet the requirements of their intended use. In no event will the manufacturer be liable for consequential, incidental or other damages. Even if the repair or replacement remedy shall be deemed to have failed of its essential purpose under Section 2-719 of the Uniform Commercial Code, the manufacturer shall have no liability to Buyer for consequential damages.

Resellers/Buyers agree to also include this entire document including the warnings and cautions above in a conspicuous place and in a conspicuous manner in writing to instruct users on the safe usage of the product.

This information should be read together with all other printed information supplied by HUB CITY.



## IMPORTANT INFORMATION

PLEASE READ CAREFULLY



This catalog is not intended to provide operational instructions. Appropriate Marathon Electric instructions provided with the motor and precautions attached to the motor should be read carefully prior to installation, operation and/or maintenance of the equipment. Injury to personnel or motor failure may be caused by improper installation, maintenance or operation.

*The following  and  information is supplied to you for your protection and to provide you with many years of trouble free and safe operation of your Marathon Electric product:*



- Disconnect power and lock out driven equipment before working on a motor.
- Always keep hands and clothing away from moving parts.
- The lifting support on the motor is not to be used to lift the entire machine. Only the motor attached directly to the support may be safely lifted by the support.
- Install and ground per local and national codes.
- Discharge all capacitors before servicing a single phase motor.
- Misapplication of a motor in a hazardous environment can cause fire or an explosion and result in serious injury. Only the end user, local authority having jurisdiction, and/or insurance underwriter are qualified to identify the appropriate class(es), group(s), division and temperature code. Marathon Electric personnel can not evaluate or recommend what motors may be suitable for use in hazardous environments. If a motor is nameplated for hazardous locations, do not operate the motor without all of the grease and drain plugs installed.
- Never attempt to measure the temperature rise of a motor by touch. Temperature rise must be measured by thermometer, resistance, imbedded detector or thermocouple.
- Motors with automatic reset thermal protectors will automatically restart when the protector temperature drops sufficiently. Do not use motors with automatic reset thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.
- Motors with manual reset thermal protectors may start unexpectedly after the protector trips when the surrounding air is at +20°Fahrenheit or lower. If the manual reset protector trips, disconnect motor from its power supply. After the protector cools (five minutes or more), it can be reset and power may be applied to the motor.
- Connect all protective device leads, marked P1, P2, etc., per instructions supplied with the motor.
- Operation of a motor at other than its nameplate rating may result in fire, damage to equipment or serious injury to personnel.
- For safety, Buyer or User should provide protective guards over all shaft extensions and any moving apparatus mounted thereon. The User is responsible for checking all applicable safety codes in his area and providing suitable guards. Failure to do so may result in bodily injury and/or damage to equipment.



- Consult qualified personnel with questions and all electrical repairs must be performed by trained and qualified personnel only.
- For motors nameplated as "belted duty only", do not operate the motor without belts properly installed.
- Motors and/or driven equipment should not be operated faster than their rated speed.
- For inverter applications, follow the inverter manufacturer's installation guidelines.
- Make sure the motor is properly secured and aligned before operation.

In the event of the resale of any of the goods, in whatever form, Resellers/Buyers will include the following language in a conspicuous place and in a conspicuous manner in a written agreement covering such sale:

The manufacturer makes no warranty or representations, express or implied, by operation of law or otherwise, as to the merchantability or fitness for a particular purpose of the goods sold hereunder. Buyer acknowledges that it alone has determined that the goods purchased hereunder will suitably meet the requirements of their intended use. In no event will the manufacturer be liable for consequential, incidental or other damages. Even if the repair or replacement remedy shall be deemed to have failed of its essential purpose under Section 2-719 of the Uniform Commercial Code, the manufacturer shall have no liability to Buyer for consequential damages.

Resellers/Buyers agree to also include this entire document including the warnings and cautions above in a conspicuous place and in a conspicuous manner in writing to instruct users on the safe usage of the product.

This information should be read together with all other printed information supplied by Marathon Electric. For more information contact: **Marathon Electric**, Regal Beloit Manufacturing Corporation, 100 E. Randolph St., Wausau, WI 54401  
Phone: 715-675-3311 or Fax: 715-675-8030.

CALL: (605) 225-0360 • FAX: (605) 225-0567



## GEAR DRIVE WARNINGS & CAUTIONS

### IMPORTANT SELECTION INFORMATION

The system of connected rotating parts must be free from critical speed, torsional, or other type vibration, regardless of how induced. The responsibility for this system analysis lies with the purchaser of the gear unit.

#### WARNING

#### SHIELD ALL ROTATING PARTS

For safety, purchaser or user must provide protective guards over all shaft extensions and any moving apparatus mounted on the unit. The user is responsible for checking and complying with all applicable safety codes in his area and providing suitable guards. Failure to do so may result in bodily injury and/or damage to equipment.

#### WARNING

Wear protective clothing and eye shields when installing or maintaining unit and machine.

#### WARNING

A unit cannot be used as an integral part of a machine superstructure which would impose additional loads on the unit other than those imposed by the torque being transmitted, or by any shaft mounted power transmitting device such as sprockets, pulleys, or couplings.

#### WARNING

Make certain that all tools and other items are clear from rotating parts before starting machine. Stand clear, and start machine slowly to be sure all components are secure and operating properly.

#### WARNING

For safe operation and to continue the unit warranty, when installing, reinstalling, or replacing a factory installed fastener for servicing purpose, or to accommodate the mounting of guards, shields or other light load imposing devices, or for mounting the unit, it becomes the responsibility of the purchaser or user to properly determine the quality, grade of fastener, thread engagement, load carrying capacity, tightening torque, and the means of torque retention.

**COUPLINGS** – Flexible couplings to input and output shafts are recommended because they minimize bearing and gear wear caused by slight misalignment. Follow coupling manufacturer's recommendations for installation and shielding.

**SHEAVES AND SPROCKETS** – When mounting sheaves or sprockets, the center of the load should be located as close to the reducer as possible. Excessive overhung loading could result in early failures of bearing or shaft. Refer to the general catalog or contact Hub City for overhung load ratings. Follow manufacturer's recommendations for installation and shielding.

#### CAUTION

Do not operate the unit without making sure it contains the correct amount of oil. Do not overfill or underfill with oil, or injury to personnel, unit, or other equipment may result.

#### CAUTION

Oil should be changed with greater frequency if unit is used in a severe environment such as dusty or humid or high or low temperatures.

#### CAUTION

Do not mix nonsynthetic and synthetic oil in the unit.

#### CAUTION

If unit is used in the food or drug industry (including animal food) consult the petroleum supplier or HUB CITY for recommendations of lubricants which meet the specifications of FDA, USDA and/or other authoritative bodies having jurisdiction. Standard lubricants are not suitable for these applications or these industries.

#### CAUTION

Inspect shafts and components for paint, burrs, or other imperfections before installing components. Do not use excessive force or pounding to install components onto unit shafts, as this may cause damage to shafts, bearings, or gears.

**PREVENTATIVE MAINTENANCE** – Keep shafts and vent plug clean to prevent foreign particles from entering seals or gear case. Inspect periodically for oil leaks.

#### CAUTION

**STORAGE OF HUB CITY REDUCERS:** A gearbox does not have a definable shelf life. The main points of deterioration are rusting of non-painted surfaces and drying out of the seal lips. Proper storage of drives in a cool dry place in a carton away from exposure to ultraviolet light should permit protection for approximately one year.

If the unit is to be inoperative for a longer period of time, completely fill the gear case with regular lubricant containing rust and oxidation inhibitors, tag the gear case and any connected motor to prevent operation until the proper oil level is obtained. Do not operate a completely filled gear case. Coat external shafts with a rust preventative oil or grease. At least every three months, rotate the input shaft until the output rotates at least one revolution to ensure all internal parts are coated and that the shaft seals are free and the seal journals are coated with oil.

The most sensitive part of the gearbox is the radial lip seals. Even under ideal storage conditions, the seal lips may deteriorate or take a set, losing their sealing effect and reducing service life. Therefore, it may be necessary to replace the seals prior to putting the units in service depending upon the length and conditions of storage.



## BEVEL GEAR DRIVES LUBRICATION

**General Note** – These instructions contain information for the standard Bevel Gear Drive product line. For Instructions specific to the Hub<sup>3™</sup> Bevel Gear Drives and the CleanLine Plus Bevel Gear Drives see the CleanLine Products page R-25.

**BEVEL GEAR DRIVES General Note** – These instructions contain information common to more than one model of Bevel Gear Drive. To simplify reading, similar models have been grouped as follows:

GROUP 1 – Models 44, 11, 150, 165, 165M, 175, 175M, 66, 66M, 65, 65M, 600, 88, 800, 800M, 810, 850, 850M, 1000, 1010, 101M, 1200, 120M, 1700 and 2200.

GROUP 2 – Models 790, 920, 950, 1050, 105M, 1250 and 125M.

GROUP 3 – Models M2, M3 and M3M.

GROUP 4 – Models AD1, AD2, AD3, AD3M, AD4, AD4M, AD5 and AD5M.

GROUP 5 – Models RA0, RA1, RA2, RA3, RA4



GROUP 1, 2, and 3 BEVEL GEAR DRIVES ARE SHIPPED DRY. OIL MUST BE ADDED PRIOR TO OPERATION. GROUP 4 and 5 DRIVES ARE PREFILLED AT FACTORY.

All HUB CITY Bevel Gear Drives are splash lubricated. Typical mounting positions with all shafts in horizontal position are shown in Figures B1 & B2. Fill/breather, level and drain plugs have been provided to meet most mounting requirements. Group 4 Drives may be mounted in any position and are prefilled at factory with a semi-fluid grease designed for a wide variety of applications. Group 5 drives are factory filled with a Lubricant, which has an AGMA Number 4EP and an ISO-ASTM Viscosity Grade 150, for horizontal shaft mounting as shown in figure B1.



**BEVEL GEAR DRIVES:** Review the approved mounting positions and lubrication levels identified in Figures B1 & B2 on this sheet. Do not deviate from the mounting positions or lubrication levels shown without contacting the factory.

**BEFORE OPERATING BEVEL GEAR DRIVES** (Except Group 4 and Group 5 Drives) – Remove Breather and/or fill Plug (1, Figures B1 & B2) and Oil Level Plug (2, Figures B1 & B2). Fill gearbox with a recommended lubricant (see APPROXIMATE OIL CAPACITY CHART in these instructions) and GEAR LUBRICANT page of these instructions) until lubricant starts coming out oil level plug hole. Clean thread on the removed plugs and the plug holes with degreaser. Install plugs securely in gear case. Note – Breather and/or fill Plug (1, Figure B1 & B2) must always be installed in the top of gear case, opposite Drain Plug (3, Figure B1 & B2). Note – Models 790, 920 and 950 have the breather (4, Figure B2) installed in the pinion housing.



Do not change lubricants in Group 4 Bevel Gear Drives unless they are disassembled for service. Groups 1, 2, 3 & 5 Bevel Gear Drives should have lubricant changed as described below.



**CHANGING LUBRICANT** – After the first 500 hours or (4) weeks of operation, drain out initial oil, flush out the bevel gear case with an approved nonflammable, non-toxic solvent, such as Lubriplate Syn Flush, Lubriplate Pure Flush, Whitmore's Flushing Oil (#06802030) or Medallion™ Flushing Oil Kosher (#06812010), and refill. Thereafter, oil should be changed at least every 5,000 operating hours (10,000 for synthetic oil lubricant) or every 12 months (24 months for synthetic oil lubricant), which ever occurs first.

**VARIATIONS FROM NORMAL CONDITIONS** – Bevel Gear Drives: Input speeds that exceed the maximum speeds recommended for a given ratio, which are listed in the general catalog specifications, may require an adjustment in the oil level. Consult HUB CITY for special lubricant recommendations when operating at higher speeds. All HUB CITY Bevel Gear Drives (except Group 4 Drives) are designed for installation with all shafts in a horizontal position.

If either shaft is in a vertical position or mounted on an incline (except Group 4 Drives) zerk fittings may be required to lubricate upper bearings. It may also be necessary to make some oil plug modification. Consult HUB CITY for recommendations.

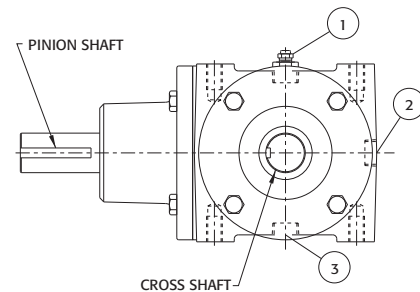


FIGURE B1 - MOUNTING POSITION, GROUP 1, 3 & 5

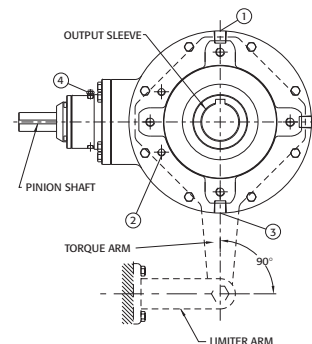


FIGURE B2 - MOUNTING POSITION, GROUP 2





## BEVEL GEAR DRIVES & COOLING TOWER DRIVES

### APPROXIMATE OIL CAPACITIES - BEVEL GEAR DRIVES

MODEL	QUANTITY	MODEL	QUANTITY
<b>GROUP 1</b>			
44	0.50 pint	790	2.75 pints
11	0.40 pint	920	5 pints
150	0.75 pint	950	10 pints
165 & 165M	0.75 pint	1050 & 105M	10 pints
175 & 175M	0.70 pint	1250 & 125M	18 pints
66 & 66M	1.50 pints	<b>GROUP 3</b>	
65 & 65M	1.40 pints	M2	0.25 pints
600	1.50 pints	M3 & M3M	0.25 pints
88	5 pints	<b>GROUP 4 (ALL PRELUBED AT FACTORY)</b>	
800 & 800M	5 pints	AD1	.5 oz
810	5 pints	AD2	1.5 oz
850 & 850M	4.5 pints	AD3 & AD3M	8.0 oz
1000	10 pints	AD4 & AD4M	.5 oz
1010 & 101M	10 pints	AD5 & AD5M	1.5 oz
1200 & 120M	20 pints	<b>GROUP 5 (ALL PRELUBED AT FACTORY)</b>	
1700	10 gallons	RA0	10 oz
2200	14 gallons	RA1	28 oz
		RA2	37 oz
		RA3	75 oz
		RA4	154 oz

### BEVEL GEAR DRIVES INSTALLATION



Power may be applied (drive shaft) to either the cross or pinion shaft providing that the gear reduction does not exceed 3:1. On models that have greater than 3:1 gear ratio, the input must be on the pinion shaft such as Models 790, 920 and 950. Also, input rotation on these models should be clockwise.



**SHAFT MOUNTED BEVEL GEAR DRIVES, Group 2 Drives** – Driven shaft should be supported independently with pillow block bearings, located as close to Bevel Gear Drive as possible. A suitable Torque Arm, shown in dotted line (Figure B2) must be provided (not supplied) to keep unit from rotating. A rigid torque arm will cause bearings to “load up” and cause excessive wear. To prevent this, provide a slight amount of “float” at the pivot point. Note that torque arm must be fastened to all mounting pads.



**BEVEL GEAR DRIVES** configured with the Hub City “Counter Flow” lubrication system. models 1010, 101M, 1050, 105M, 1200, 120M, 1250, 125M, 790, 920 and 950, may require the pinion housing and/or the end caps to be rotated as

part of the installation, depending on the drives mounting position. With the drive in it’s required mounting position, the word “TOP” that appears on the pinion housing and/or end caps must be in a vertically up position, to maintain proper bearing lubrication.

To reposition the pinion housing or cap, remove all capscrews, rotate the housing or cap with out removing it from the main housing. Apply Loctite® to the capscrews, reinstall and torque proper specifications. Units are assembled at the factory with pinion housings and/or end caps positioned for style “A”, “C” and “E” units mounted with all shafts in a horizontal plane.

### COOLING TOWER DRIVES LUBRICATION



**ALL COOLING TOWER DRIVES ARE SHIPPED DRY. OIL MUST BE ADDED PRIOR TO OPERATION.**

All HUB CITY Cooling Tower Drives are splash lubricated. The design of the Cooling Tower Drive permits uniform lubrication of all moving parts and bearing surfaces. After installation, and prior to operation, the gear case must be filled to the proper level with a recommended lubricant (see APPROXIMATE OIL CAPACITY CHART in these instructions and GEAR LUBRICANT page of these instructions).

**INITIAL LUBRICANT FILL** – Clean threads on removed plugs and plug holes with degreaser. Fill gear case with approved lubrication until the oil level is within 1/4 inch from the top of the filling elbow. Allow several minutes for the oil to stabilize at a static level. Coat plugs with thread sealant and replace in gear case.

If a remote oil gage has been installed, be sure that the oil level in the remote oil gage matches the oil level in the Cooling Tower Drive filling elbow.



**CHANGING LUBRICANT** – The initial lubricant should be changed after the first 2 weeks of operation. Drain the original oil, fill the cooling tower gear case to the proper level with an approved nonflammable, non-toxic solvent, such as Lubriplate Syn Flush, Lubriplate Pure Flush, Whitmore’s Flushing Oil (#06802030) or Medallion™ Flushing Oil Kosher (#06812010), start Cooling Tower Drive and allow to reach operating speed, then remove power immediately. Drain flushing oil and refill to proper level with recommended lubricant. Thereafter, oil changes should be every 6 months (12 months for synthetic oil lubricant) unless operating under extreme operating conditions. Extreme operating conditions are described under Variations From Normal Conditions.

The original oil may be strained and replaced. Do not use a strainer finer than 25 micro inches to avoid filtering out oil additives.



## HUB CITY GEAR LUBRICANT

### GEAR LUBRICANT GL-460

**Part No. 8580001024(Qt.)**

**AGMA No: 7 Comp.**

**ISO Viscosity Grade: 460**

A premium quality, heavy bodied lubricant formulated and recommended for enclosed worm gear drives. It is suitable for splash lubrication of worm gearing at moderate to high speeds and temperatures. This highly filtered oil has the following outstanding advantages and benefits:

- Excellent film forming characteristics.
- Superior load carrying capacity.
- Good oxidation stability.
- Minimizes friction and bulk oil temperature rise.
- Ideal for severe service conditions.

For worm gear reducers with ambient temperatures of 40° to 100°F (4° to 38°C) and operating temperatures To 225° F (107°C).

For ambient temperatures below or above these temperatures, or operating temperatures above this temperature, consult the factory.

Lubricants of this type and meeting the above specifications may be substituted where HUB CITY LUBRICANTS are recommended. Lubricant selected must be compatible with bronze gear materials and nitrile rubber seals.



If unit is used in the food or drug industry (including animal food) consult the petroleum supplier or HUB CITY for recommendations of lubricants which meet the specifications of FDA, USDA and/or other authoritative bodies having jurisdiction. Standard lubricants are not suitable for these applications or these industries.

### ALL-TEMPERATURE PAO SYNTHETIC GEAR LUBRICANT

**Part No. 8580001011(Qt.)**

**AGMA No: 7**

**ISO Viscosity Grade: 460**

HUB CITY SYNTHETIC LUBRICANT is premium gearbox lubricant which is recommended for worm gear drives in most applications, especially those subject to low start-up temperature and/or high operating temperature. This lubricant is a synthesized hydrocarbon based material which provides longer lubrication intervals because of its increased resistance to thermal and oxidative degradation. This decreases maintenance costs. Further economy is realized because of the increased efficiency of units lubricated with HUB CITY SYNTHETIC LUBRICANTS.

It provides:

- Excellent wear protection and load carrying ability.
- Outstanding oxidation stability at elevated temperatures.
- Wide temperature range.
- Extended lubricant life, resulting in lower maintenance and lubrication costs.
- Outstanding foam stability.

For worm gear reducers with ambient temperatures of -10° to 125°F (-23° to 52°C) and operating temperatures To 225°F (107°C).

For ambient temperatures below or above these temperatures, or operating temperatures above this temperature, consult the factory.

This lubricant can be operated at temperatures considerably above 225°F (107°C). However, the gear drive manufacturer should always be contacted prior to operating at high temperatures as damage may occur to seals or other gear drive components.

Lubricant manufacturer and HUB CITY should be contacted when substituting a premium lubricant where HUB CITY SYNTHETIC is recommended.

NOTE: Although this synthetic lubricant is fully compatible with conventional lubricants, maximum benefits will be obtained when installed in a system that has been thoroughly cleaned and flushed.

### PAG 460 H1 SYNTHETIC GEAR LUBRICANT

**PART NO. 8580001049 (QT.)**

**ISO Viscosity Grade 460**

HUB CITY PAG 460 H1 SYNTHETIC GEAR LUBRICANT is a Fully Synthetic PolyGlycol, which provides the ultimate efficiency and thermal capacity, and is recommended for worm gear drives in most applications, including lubed-for-life units. The exceptional anti-wear protection, high efficiency, and reduced oil temperature with HUB CITY PAG 460 H1 allow more torque to be transmitted through the reducer, and can often allow downsizing to a smaller, more economical gear drive. This lubricant has very high thermal and oxidative stability to reduce sludge and deposits, which provides longer lubrication intervals. This reduces maintenance costs, and the high efficiency reduces energy consumption and cost.

HUB CITY PAG 460 H1 is approved for USDA/NSF H-1 use in food processing facilities where there is the possibility of incidental contact with food.

HUB CITY PAG 460 H1 SYNTHETIC GEAR LUBRICANT provides:

- Exceptional EP/antiwear protection for gears and bearings.
- High viscosity index of 250 for wide operating temperature range. Viscosity of 460 cSt @ 100° F (40° C) and 77 cSt @ 212° F (100° C). Pour point of - 27° F (33° C).
- Protection against rust and corrosion in service.
- Resistance against foaming.
- Excellent lubricity inherent to this fully synthetic lubricant.
- Low traction coefficient resulting in increased energy efficiency and reduced oil temperature.
- Excellent thermal and oxidative stability to reduce sludge formation and deposits.

NOTE: PAG SYNTHETIC LUBRICANTS ARE NOT COMPATIBLE WITH MINERAL OIL AND OTHER TYPES OF SYNTHETIC LUBRICANTS and must never be mixed. Topping off with the wrong lubricant type could cause unit failure. Converting existing units in service with other lubricants to PAG synthetic is not recommended. If this is done, the housing must be thoroughly flushed out with PAG synthetic before being refilled. Converting existing units from PAG synthetic to other lubricants is not recommended, because the lower efficiency and thermal capacity may cause unit failure.

PAG SYNTHETIC LUBRICANTS are hygroscopic and absorb more water than mineral oils or PAO synthetic lubricants. Water does not drop to the bottom, but stays on top of the lubricant. Therefore, extra care should be taken not to expose the PAG lubricants to excessive moisture.

For Worm Gear Reducers with ambient temperatures of -10° F to 125° F (-23° C to 52° C) and operating temperatures to 225° F (107° C).

For ambient temperatures below or above these temperatures, or operating temperatures above this temperature, consult the factory.

Lubricant manufacturer and HUB CITY should be contacted before substituting any other lubricant. The lubricant must be a PAG synthetic lubricant, with ISO 460 viscosity. If used in a food processing facility, the lubricant must meet USDA/NSF H1 approval. Food grade lubricants must always be stored separately from non-food grade lubricants, to prevent the possibility of using the wrong lubricant. Separate pumps or containers must always be used with food grade lubricants, to prevent contamination.



## HUB CITY GEAR LUBRICANT

### GEAR LUBRICANT

#### GL-90

Part No. 8580001009(Qt.)

AGMA No: 5EP

ISO Viscosity Grade: 220

A non-leaded, heavy-duty industrial gear lubricant designed for spur, helical, and bevel enclosed gear sets operating under severe service conditions. Ideal for both circulation and splash lubrication systems, GL-90 offers:

- Superior load-carrying capacity.
- Outstanding anti-wear properties.
- Excellent rust and corrosion protection.
- Good oxidation stability.
- Minimal friction and bulk oil temperature rise.
- Full protection against foaming.

For ambient temperatures of 15° to 125° F (-10° to 52° C) and operating temperatures To 185° F (85° C).

For ambient temperatures below or above these temperatures, or operating temperatures above this temperature, consult the factory.

### GEAR LUBRICANT

#### SYNTHETIC 75W-90

Part No. 8580001031(Qt.)

AGMA No: 4/5EP

ISO Viscosity Grade: 150/220

Formulated from synthesized hydrocarbon base oils and a sulfur phosphorus gear lubricant additive for severe operating conditions. Recommended for bevel, helical, and spur gear drives. Especially those subject to low startup temperature and/or high operating temperature. It provides the following outstanding advantages and benefits.

- Excellent wear protection and load carrying ability.
- Outstanding oxidation stability at elevated temperatures.
- Wide temperature range.
- Extend lubricant life resulting in lower maintenance and lubrication costs.
- Recommended for year-round lubrication.
- Not recommended for worm gear drives or gear drives with backstops.

The outstanding oxidation and thermal stability of this product results in a considerable extension of lubrication and oil change intervals.






For ambient temperatures of -25° to 125° F (-32° to 52° C) and operating temperatures To 225° F (107° C).

For ambient temperatures below or above these temperatures, or operating temperatures above this temperature, consult the factory.

Hub City synthetic 75W-90 gear lubricant can be operated at temperatures above 225° F however, the gear drive manufacturer should always be contacted prior to operation at high temperatures. As damage may occur to seals or other gear drive components. Although Hub City synthetic 75W-90 lubricant is fully compatible with conventional lubricants, maximum benefits will be obtained when installed in a system which has been thoroughly cleaned and flushed.



## GEAR LUBRICANT

RECOMMENDED LUBRICANTS					
					
HUB CITY UNIT	GL-460 8580001024	PAO SYNTHETIC 8580001011	PAG460 SYNTHETIC 8580001049	GL-90 8580001009	SYNTHETIC 75W-90 8580001031
WORM GEAR SPEED REDUCERS (except Cleanline HUB3™)	X	X	X		
BEVEL GEAR DRIVES (except Group 4, Group 5, Cleanline Plus, and Cleanline HUB3™)				X	X
COOLING TOWER DRIVES				X	X
PARALLEL SHAFT (except Helical Ratio Multipliers)				X	X
POWERTORQUE®				X	X
HELICAL IN-LINE (factory filled)				X	X
COMPACT HELICAL PARALLEL (factory filled)				X	X
HELICAL BEVEL (factory filled)				X	X
HELICAL WORM (factory filled)	X EXCEPT PRIM. UNIT OF QUAD RED. UNITS	X EXCEPT PRIM. UNIT OF QUAD RED. UNITS	X EXCEPT PRIM. UNIT OF QUAD RED. UNITS	X PRIM. UNIT ONLY OF QUAD RED. UNITS	X PRIM. UNIT ONLY OF QUAD RED. UNITS
330 SERIES PTO SPEED CHANGER				X	X
390 SERIES PTO SPEED CHANGER (factory filled)					X do NOT Substitute other lubricants
CLEANLINE HUB3™ WORM GEAR DRIVES SPARTAN WORM AND HELICAL DRIVES RATIO MULTIPLIERS (ARM & RM SERIES) (ALL FACTORY FILLED)			X		

## MOTOR INSTALLATION INSTRUCTIONS

### MOTOR INSTALLATION INSTRUCTIONS:

1. Be sure all of the paint and masking has been removed from the face and pilot of the flange. Check the input bore to be sure it contains a small amount of anti-seize compound. If there isn't any, apply a small amount. This compound will inhibit fretting corrosion between the motor or pump shaft and the unit bore.
2. Install the key (if round bore) to the maximum depth of the keyway provided in the bore.
3. Align keyways or splines of motor or pump and bore of unit and install motor or pump into flange. Do not use excessive force or pounding to install motor or pump into flange, as this may damage shafts or bearings.



4. Hub City "C" flange reducers and Hydraulic Flange Reducers are designed to accept motors with shaft lengths that do not exceed the maximum specified by the N.E.M.A. or SAE standards. If the motor or pump shaft bottoms out before the motor flange seats against the reducer flange face, the motor or pump shaft length must be reduced to N.E.M.A. or SAE standards.
5. Secure the motor or pump to the unit. Capscrews and lockwashers are provided with "C" flange units.
6. Proper tightening torques for mounting bolts are provided in the chart below.

CAPSCREW TIGHTENING TORQUE GRADE 5 CAPSCREWS (DRY, WITHOUT LUBRICANT)	
CAPSCREW SIZE	TIGHTENING TORQUE (FT. LBS.)
1/4-20 NC	8
5/16-18 NC	16
3/8-16 NC	29
1/2-13 NC	71
5/8-11 NC	143
3/4-10 NC	251



A Parts List and Print for your Drive is available upon request. To obtain the proper Parts List and Print, you must accurately furnish the Assembly Number, Model Number, Ratio, Style and Shipping Code as shown on the metal tag attached to the Gear Drive. HUB CITY has Sales Offices and a network of Industrial Power Transmission Distributors that can serve your needs world wide. Check the Yellow Pages for one near you. For assistance, phone or write you Industrial Power Transmission Distributor, or the Hub City Factory Sales Office.



## **IMPORTANT INFORMATION**

### **PLEASE READ CAREFULLY**



**The following  and  information is supplied to you for your protection and to provide you with many years of trouble free and safe operation of your HUB CITY mounted bearing product.**

Read ALL instructions prior to operating reducer. Injury to personnel or reducer failure may be caused by improper installation, maintenance or operation.



- Written authorization from HUB CITY is required to operate or use bearing units in man lift or people moving devices.
- Check to make certain application does not exceed the allowable load capacities published in the current catalog.
- Buyer shall be solely responsible for determining the adequacy of the product for any and all uses to which Buyer shall apply the product. The application by Buyer shall not be subject to any implied warranty of fitness for a particular purpose.
- For safety, Buyer or User should provide protective guards over all shaft extensions and any moving apparatus mounted thereon. The User is responsible for checking all applicable safety codes in his area and providing suitable guards. Failure to do so may result in bodily injury and/or damage to equipment.
- Hot machinery and bearings can cause severe burns. Use extreme care when servicing or lubricating.
- Make certain that the power supply is disconnected before attempting to service or remove any components. Lock out the power supply and tag it to prevent unexpected application of power.
- Lifting supports including eyebolts are to be used for vertically lifting the bearing unit only and no other associated attachments or motors.
- Overhung loads subject shaft bearings and shafts to stress which may cause premature bearing failure and/or shaft breakage from bending fatigue, if not sized properly.



- Test run bearing unit to verify operation. If the unit tested is a prototype, that unit must be of current production.
- If the bearing unit cannot be located in a clear and dry area with access to adequate cooling air supply, then precautions must be taken to avoid the ingestion of contaminants such as water and the reduction in cooling ability due to exterior contaminants.
- Mounting bolts should be routinely checked to ensure that the bearing unit is firmly anchored for proper operation.

In the event of the resale of any of the goods, in whatever form, Resellers/Buyers will include the following language in a conspicuous place and in a conspicuous manner in a written agreement covering such sale:

The manufacturer makes no warranty or representations, express or implied, by operation of law or otherwise, as to the merchantability or fitness for a particular purpose of the goods sold hereunder. Buyer acknowledges that it alone has determined that the goods purchased hereunder will suitably meet the requirements of their intended use. In no event will the manufacturer be liable for consequential, incidental or other damages. Even if the repair or replacement remedy shall be deemed to have failed of its essential purpose under Section 2-719 of the Uniform Commercial Code, the manufacturer shall have no liability to Buyer for consequential damages.

Resellers/Buyers agree to also include this entire document including the warnings and cautions above in a conspicuous place and in a conspicuous manner in writing to instruct users on the safe usage of the product.

This information should be read together with all other printed information supplied by HUB CITY.

# Maintenance Instructions

**General Note** — These instructions contain information common to more than one model of Bevel Gear Drive. To simplify reading, similar models have been grouped as follows:

**GROUP 1** — Models 11, 150, 165, 175, 66 (illustrated), 65, 88, 600, 800, 810, 850, 1000, 1010 and 1200.

**GROUP 2** — Models 790, 920 (illustrated), 950, 1050 and 1250.

**GROUP 3** — Models M2 and M3.

**GROUP 4** — Models AD1, AD2, AD3, AD4 & AD5.

**NOTE:** For PINION SHAFT disassembly instructions for Models 1010 and 1200, follow the Group 2 instructions. For PINION SHAFT disassembly instructions for the Model 790, follow the Group 1 instructions.

It is advisable to periodically inspect your Bevel Gear Drive for any signs of impending service. Spare or replacement parts can often be ordered and obtained before disassembly is necessary, thus minimizing machine down-time. The following symptoms can be inspected visually without disassembly and may, in some cases, indicate extensive maintenance procedures.

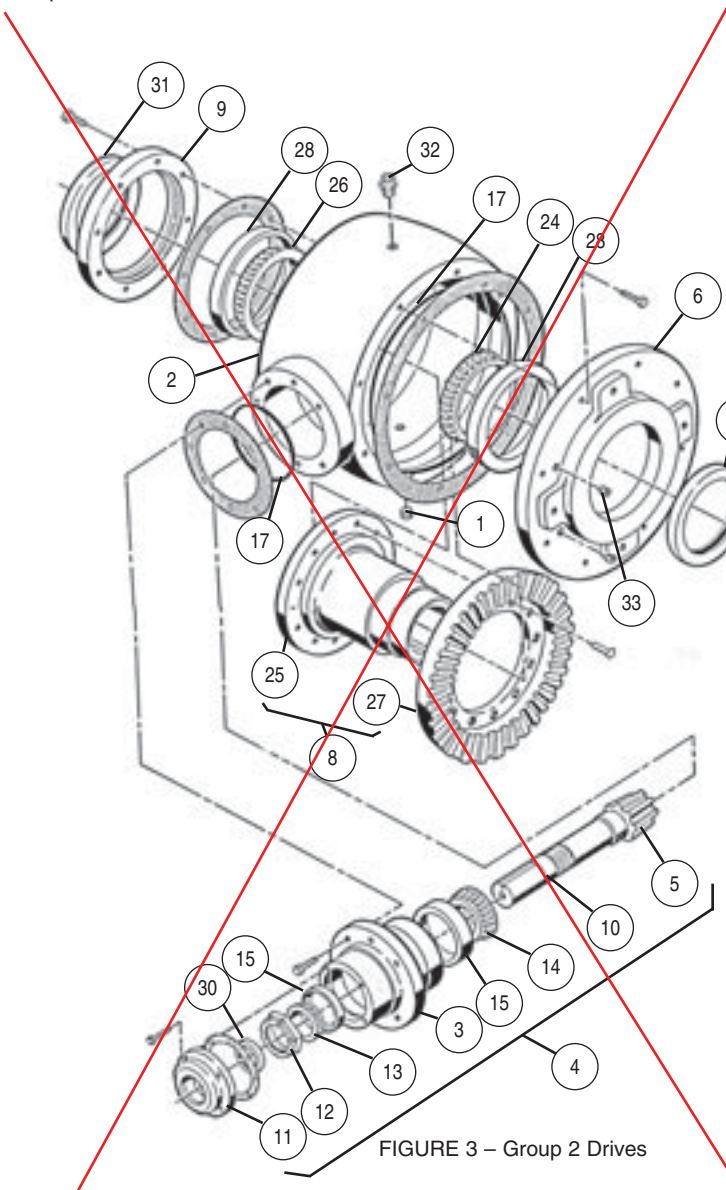


FIGURE 3 – Group 2 Drives

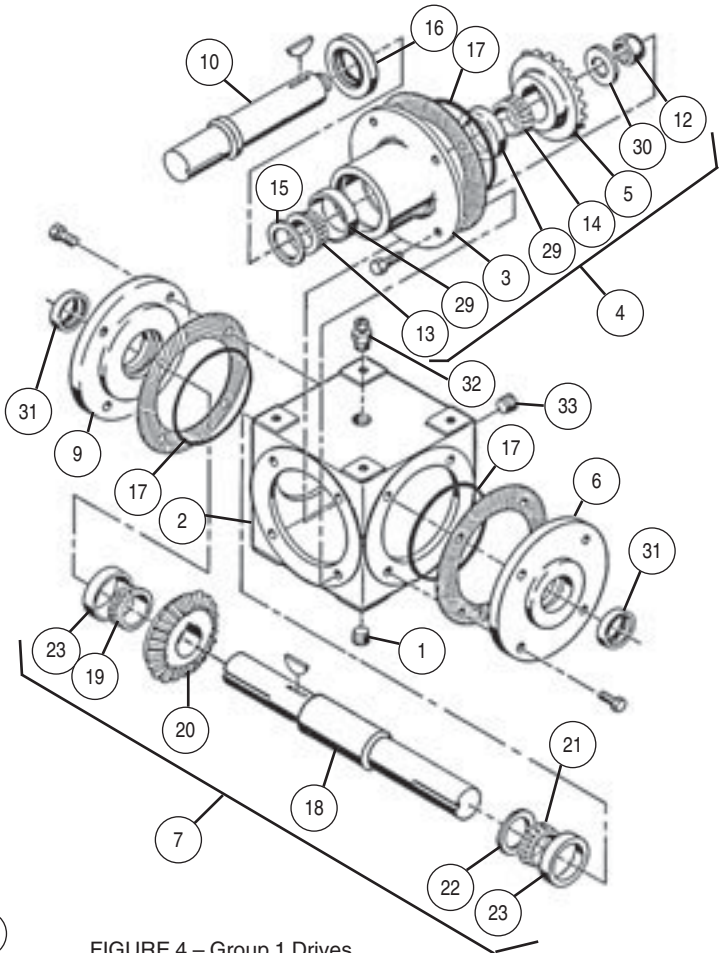


FIGURE 4 – Group 1 Drives

**Oil leaking from pinion housing, caps, cap screws or pipe plugs**—might be corrected by retightening or removal and recoating with pipe sealant before tightening. If this does not correct the leaking condition, disassembly will be necessary to replace O-rings.

**High internal operating temperature (above 200° F.)**—could indicate that unit was being overloaded and should be replaced entirely with a larger capacity unit. Damaged bearings or inadequate oil level can also cause heat build-up.

**Oil leaking from seals**—indicates that shaft and/or seals are worn and need replacing. Keep dirt and foreign particles off shafts in the area of the seals to minimize wear. Note: On initial run of new unit or after a new replacement of seals, some lubricant leakage is normal for the first few hours of running time until seals seat against the shafts. If condition persists, seal replacement will be necessary.

**Excessive end play of shafts**—if there is a noticeable (.005" or more measurable) shaft movement when couplings are removed and shaft is moved back and forth, it is an indication of bearing wear. Removing shims between caps and gear case can usually correct the condition and avoid bearing replacement.

**Excessive backlash**—might indicate worn gears which often may be readjusted, instead of replacing.

**IMPORTANT**

In the initial factory assembly, Loctite® was used on the threads of all cap screws. If any screws are removed, a new application of Loctite® is necessary or lock washers must be installed. Note—Screw threads and threaded hole must be degreased before the application of Loctite®.

# Maintenance Instructions

**⚠ WARNING**

For safe operation and to continue the unit warranty, when installing, reinstalling, or replacing a factory installed fastener for servicing purposes, or to accommodate the mounting guards, shields or other light load imposing devices, or for mounting the unit, it becomes the responsibility of the customer or user to properly determine the quality, grade of fastener, thread engagement, load carrying capacity, tightening torque, and the means of torque retention.

## DISASSEMBLY PROCEDURE

**⚠ CAUTION**

The exterior threaded holes on this drive are for mounting the drive or drive accessories (couplings, sprockets, etc.). They are not to be used for lifting the drive or any driver/driven equipment.

**⚠ WARNING**

Make certain that the power supply is disconnected before attempting to service or install the unit, or remove any components. Lock out the power supply, and tag it to prevent unexpected application of power.

**⚠ WARNING**

Wear protective clothing and eye shields when installing or maintaining unit and machine.

**Group 1, 2 and 3 Drives (Refer to Figures 3 and 4 unless otherwise noted.)**

1. Disconnect Bevel Gear Drive from drive motor, couplings or driven shafts to guard against personal injury. Remove all sprockets, or sheaves from Bevel Gear Drive shafts with a puller tool to prevent accidental damage to shafts. Remove all keys from keyways.
2. Remove Pipe Plug (1) from bottom of Gear Case (2) and drain all lubricant from unit, preferably while unit is warm.

**⚠ WARNING**

Oil, housing, and other components can reach high temperatures during operation, and can cause severe burns. Use extreme care when removing lubrication plugs and vents while servicing the unit.

3. If old seals are to be salvaged, cover keyways with cellophane tape, plastic shim stock or paper. Remove cap screws from Pinion Housing (3) and CAREFULLY remove Pinion Shaft Assembly (4). Be careful to keep bearings clean and not to damage Gear (5) teeth.
4. Remove cap screws from Open Cap (6) which is opposite the gear side of Cross Shaft Assembly (7, Figure 4) and Output Sleeve Assembly (8, Figure 3) and remove, being careful to keep bearings clean and preventing damage to gear teeth. Slip open cap with seal off cross shaft or output sleeve.
5. Remove cap screws from Open Cap (9) on the gear side of Gear Case (2) and remove cap and shims. This completes disassembly of sub-assemblies.

## PINION SHAFT DISASSEMBLY

**Group 1 Drives**—Secure Pinion Shaft (10, Figure 4) with a vise, and remove Lock Nut (12) and washer from shaft. Place pinion assembly in a press with threaded end of shaft up and back side of Bevel Gear (5) supported. Remove gear by pressing out.

Support outer flange surface of Pinion Housing (3) on press anvil and push threaded end of pinion shaft through housing, thereby removing Inner Bearing Cone (14), Outer Bearing Cone (13) Spacer Washer (15), Seal (16) and Shaft (10) from pinion housing. Note—disassembly of the pinion shaft from the housing will cause damage to the seal and seal must be replaced. If bearings are to be replaced, see Group 2 instructions below.

~~**Group 2 Drives**—Secure Pinion Shaft (10, Figure 3) with a vise, on shaft extension and remove cap screws from Seal Carrier (11), and remove it and gasket from Pinion Housing (3). Loosen Lock Nut (12) and remove from pinion shaft. Remove remaining pinion assembly from the vise and place inner flange surface of the Pinion Housing (3) on the anvil of a press. Push shaft through pinion housing, thereby releasing Outer Bearing Cone (13). Whenever gear set is changed, it is recommended that the Inner Bearing Cone (14) be replaced. If bearings are to be replaced, remove Bearing Cups (15) from Pinion Housing (3) with a puller tool or if one is not available, gently tap opposite back sides of the bearing cups with a flat punch so that they are removed evenly and no damage occurs to pinion housing.~~

~~**Group 3 Drives (not illustrated)**—Disassembly of the pinion shaft assembly is essentially the same as Group 1 Drives above except a snap ring must be removed instead of a lock nut so that bevel gear can be removed. M2 and M3 Drives have ball bearings instead of tapered bearings and they may be removed easily from pinion housing after shaft has been pressed out. It is necessary to replace pinion housing seal due to probable damage during disassembly procedure.~~

## CROSS SHAFT DISASSEMBLY

**Group 1 Drives**—Cross Shaft Assembly (7, Figure 4) is disassembled by placing Shaft (18) in a press with sleeve between anvil and gear.

Figure 5 shows the use of a sleeve to support gear at hub. On certain types of bevel gears it is recommended that this tool be used to protect gear teeth. This tool may be obtained from Hub City or machined for the purpose in your shop.

Push shaft through Bearing Cone (19) and Bevel Gear (20). Invert shaft and rest Bearing Cone (21) on sleeve and anvil or, on some models, on Spacer (22) and push shaft through bearing cone. If bearings are to be replaced, remove Bearing Cups (23) from Open Caps (6 and 9) with a puller tool or, if one is not available, gently tap opposite back sides of the bearing cups with a flat punch so that they are removed evenly and no damage occurs to caps.

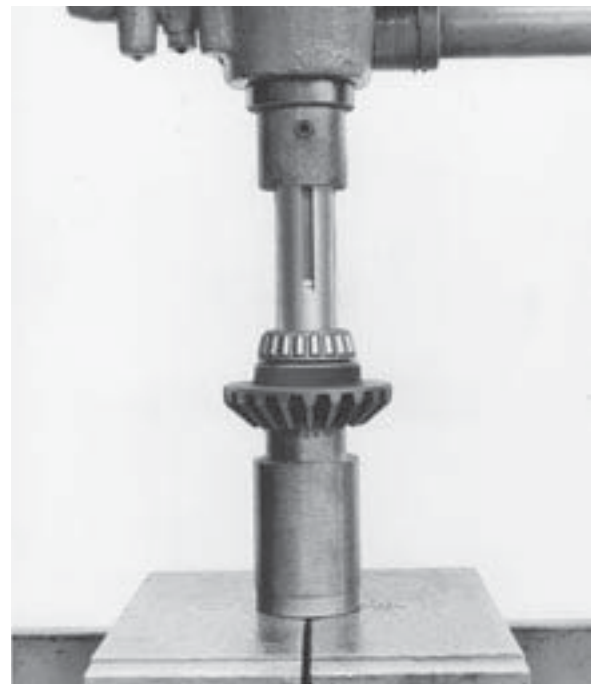


FIGURE 5 – Pressing Shaft out of Bearing and Gear

# Maintenance Instructions

**NOTE:** All cross shafts in Group 1 Drives are shouldered. Bearing Cones and Gears must ALWAYS be removed by moving them away from the shoulder.

~~**Group 3 Drives (not illustrated)**—Disassembly procedure for Models M2 and M3 cross shafts is similar to Group 1 above except that a spacer is located between the bevel gear and the bearing. The spacer is removed with the gear. These models have ball bearings which are easily removed from caps.~~

## OUTPUT SLEEVE DISASSEMBLY

~~**Group 2 Drives**—Bearing (24, Figure 3) is removed from Output Sleeve (25) on the side opposite the gear (G.O. side) by placing inner bearing race on the press anvil and pushing sleeve out of bearing. If Bearing (26) on the gear side needs to be replaced, it can be removed by tearing apart bearing and removing inner bearing race with a gear puller.~~

~~If gear side Bearing (26) is to be salvaged and reused (because of a replacement of ring gear or output sleeve), it must be gently tapped off sleeve with a flat punch after drilling several opposing holes (max. 3/16" dia.) in flange of output sleeve as shown in Figure 6. When enough clearance is obtained between bearing and output sleeve, insert a bearing puller and complete bearing removal. It is good practice to remove the gear side bearing from the output sleeve if Ring Gear (27) has to be replaced because the bearing could easily be contaminated with metal fragments when ring gear rivets are removed.~~

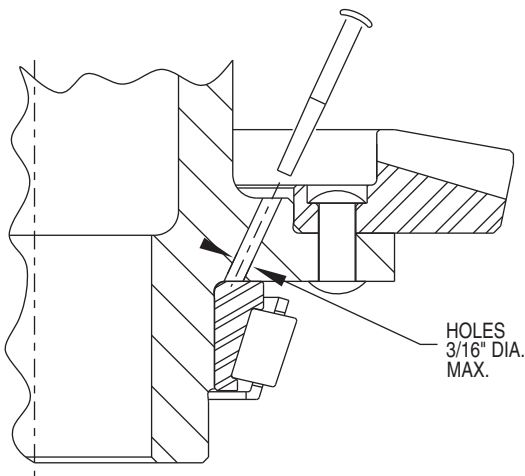


FIGURE 6 – Gear Side Bearing Removal

**Ring Gear Removal**—Rivets must be removed by either drilling through rivet heads on one side and tapping them out or machine off rivet heads in a lathe and then tap them out. Important — extreme care should be taken to prevent damage to output sleeve.

**NOTE:** On model 790 the Ring Gear is keyed to the output sleeve.

## INSPECTION

Examine all seals for wear or damage and press out of open caps, pinion housings and seal carrier if replacement is necessary. Inspect all other part for damage or wear before proceeding to reassembly.

## ASSEMBLY PROCEDURE

1. All parts including the gear case, should be cleaned thoroughly with an approved, non-flammable, non-toxic solvent. Any accumulation of sludge deposits or corruptions should be removed. Whenever pinion housing and caps are removed, it is recommended that seals and gaskets be replaced. These and other miscellaneous items are included in each Drive Repair Kit. (See Parts Lists).

Before reassembly, examine pinion and cross shafts or output sleeve for grooving in the shaft seal areas. If the shafts are to be reused, polish out any imperfections with a fine grade of Emery Cloth. The polishing motion should be circumferential, not axial or spiral in direction.

2. Replace Bearings Cups (15 and 28, Figure 3) and (23 and 29, Figure 4) in pinion housing and open caps being careful to remove any foreign particles in the counterbore. Bearing cup must seat squarely in counterbore (Groups 1 and 2 only). If cup must be tapped into place, use a rubber hammer or piece of wood to protect cup surfaces. Do not insert seals at this time.

3. When reassembling Pinion Shaft Assembly (4, Figures 3 and 4), Cross Shaft Assembly (7, Figure 4) and Output Sleeve Assembly (8, Figure 3), refer to Figures 3 and 4 so that all parts are included in their proper position. Be sure that parts are pressed tightly against one another and that no foreign material is included between them.



FIGURE 7 – Reassembly of Gear and Bearing Cone

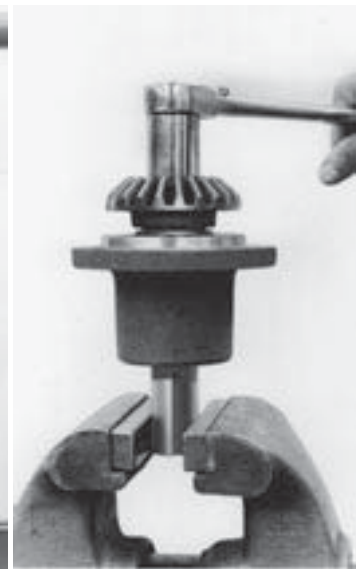


FIGURE 8 – Pinion Assembly Adjustment

Figure 7 shows the recommended method of pressing the Bearing Cone (1) onto Shaft (2). An Inserting Tool (3) is shown pressing evenly on the bearing inner race. This tool may be obtained from Hub City or machined for the purpose in your shop. A substitute inserting tool may also be made from tubing which would have an I.D. sufficient to accept the shaft and an O.D. no larger than the inner bearing race.

### CAUTION

Contact on the cage of the bearing or using the bearing cup to press the bearing on will **damage bearing**. If it is impossible to install the bearings as recommended above, the alternate method would be to heat the bearing (to increase the I.D. temporarily) and gently tap opposite sides of the bearing inner race with a flat punch without damaging bearing.

# Maintenance Instructions

**Group 1 Drives**—Assembly of Cross Shaft Assembly (7, Figure 4) is essentially the reverse of the disassembly procedures except that when installing Bevel Gear (20) on shaft, first insert woodruff key. Gear is then heated in hot oil and then installed on shaft where it will cool and shrink fit.

The Pinion Shaft Assembly (4, Figure 4) is assembled as follows: Insert Spacer (15) on Pinion Shaft (10). Press Outer Bearing Cone (13) on shaft using inserting tool. Place threaded end of shaft into Pinion Housing (3) and press Inner Bearing (14) over shaft and into pinion housing with inserting tool. Install woodruff key and press Pinion Gear (5) on shaft. Assemble Pinion Washer (30) and Lock Nut (12) on shaft. Secure assembly in a vise as shown in Figure 8 and tighten lock nut enough to draw down gear and washer until the bearings bind. Nut is then backed off slightly (approx. 1/4 turn). Release pinion shaft from the vise and rap nut and shaft end sharply with a rubber mallet while supporting pinion housing on vise (see Figure 9). This will free up the bearings so that they will rotate freely with no noticeable end play. Do not install seals at this time. See FINAL ASSEMBLY AND BACKLASH ADJUSTMENT section to complete assembly.



FIGURE 9 – Pinion Assembly Adjustment



FIGURE 10 – Oil Seal Installation

grooves in caps and pinion housings. Apply grease liberally on surface of all O-rings before assembly into housings. Install Open Cap (9, Figures 3 and 4) on the gear side of Case (2, Figures 3 and 4) with 3 shims. Fasten caps and shims to gear case by torquing down cap screws securely. Insert Output Sleeve Assembly (8, Figure 3) or Cross Shaft Assembly (7, Figure 4) carefully through opening in case and into open caps. Install 3 shims and Open Cap (6, Figures 3 and 4) on the case side which is opposite the gear with cap screws and torque down all screws evenly.

Bearings are then adjusted by removing or adding gaskets until the bearings bind and then add one gasket at a time until shaft or sleeve rotates freely, with no end play. Note—Position of gear will be closer to center if the number of shims on each end cap does not vary by more than one.

Insert Pinion Shaft Assembly (4, Figures 3 and 4) carefully into Case (2) using 3 shims and cap screws. Gear backlash is adjusted by moving shims from the cross shaft or output sleeve open cap on the gear side to the side opposite the gear until gears rotate freely, with no noticeable backlash. At this point, move 2 shims back to the gear side end cap and the gears will then be properly adjusted. Note—if there are not enough shims left in open cap opposite gears to move 2 shims back—further gear adjustment must be made by removing 2 shims from between the pinion housing and case and repeat the entire procedure listed in this and two preceding paragraphs.

When bearings and gear backlash have been properly adjusted, remove cap screws a final time, clean threads on screws and in holes with degreaser. Coat threads with Loctite®. If Loctite® or equivalent is not available, use lock washers (not supplied) behind screw heads. Torque down all screws evenly.

## OIL SEAL INSTALLATION

**Group 1, 2 and 3 Drives**—Oil seals (30 and 31, Figures 3 and 4) and (16, Figure 4) can now be installed in open caps and pinion housings. Slip Seal (1, Figure 10) over tapered end of Pilot Sleeve (2, Figure 10), making sure that the spring loaded lip of the seal is facing toward the Bevel Gear Drive. Slip pilot sleeve over shaft and down until end of sleeve is against bearing. Install Seal Driver (1, Figure 11) over pilot sleeve and tap seal down sleeve until it is seated in housing or cap. Remove seal driver and pilot sleeve. These installation tools are available from Hub City.



FIGURE 11 – Oil Seal

~~**Group 2 Drives**—The Output Sleeve Assembly (8, Figure 3) is assembled as follows: Ring Gear (27) must be riveted squarely and firmly to output sleeve. Position ring gear on flange of output sleeve and temporarily fasten with four cap screws and nuts. Position screws 90° apart and tighten in a crisscross sequence until gear is drawn down evenly. Rivet the holes between the cap screws in a crisscross sequence. Remove cap screws and rivet remaining holes. Riveting force must be sufficient to expand the rivet tightly in the holes and form a good rivet head.~~

~~**NOTE:** Model 790 ring gear is keyed to output sleeve.~~

~~Place insertion tool and Bearing (24) on press anvil and press output sleeve into bearing. Reverse sleeve assembly and install Bearing (26).~~

~~Assembly of Pinion Shaft Assembly (4, Figure 3) is essentially the reverse of the disassembly procedure. Use 1 gasket between Seal Carrier (11) and Pinion Housing (3). Bearing adjustment is similar to Group 1 Drives and Figures 8 and 9 should be referred to. Do not install seals at this time. See FINAL ASSEMBLY AND BACKLASH ADJUSTMENT section to complete assembly.~~

~~**Group 3 Drives (not illustrated)**—Assembly of cross shaft and pinion assemblies is essentially the same as Group 1 Drives except a snap ring holds the pinion shaft assembly together instead of a lock nut. No bearing adjustment is necessary on pinion shaft because ball bearings are self adjusting. Assembly of components in their proper order can be checked by referring to the sectional view on the parts list sheet. Do not install seals at this time.~~

## FINAL ASSEMBLY & BACKLASH ADJUSTMENT

**Group 1, 2 and 3 Drives**—Install O-rings (17, Figures 3 and 4) into O-ring

If a pilot sleeve and seal driver (or their equivalent) are not readily available, seal must be installed with a rubber hammer or block of wood to prevent seal damage.



Damage to seals can be avoided by covering the shaft keyways with cellophane tape, plastic shim stock or paper before sliding seals onto shaft.

## REFILLING GEAR CASE WITH LUBRICANT

**Group 1, 2 and 3 Drives**—Clean and recoat Drain Plug (1, Figures 3 and 4) with pipe sealant and replace in bottom of gear case. Remove Fill and Breather Plug (32, Figures 3 and 4) and Oil Level Plug (33, Figures 3 and 4). Fill gear case with recommended lubricant and follow all recommended procedures as detailed in Lubrication and Installation Instructions which are included with each Drive.



Do not operate the unit without making sure it contains the correct amount of lubricant. Do not overfill or underfill, or injury to personnel, unit, or other equipment may result.



Do not mix nonsynthetic and synthetic oil in the unit.



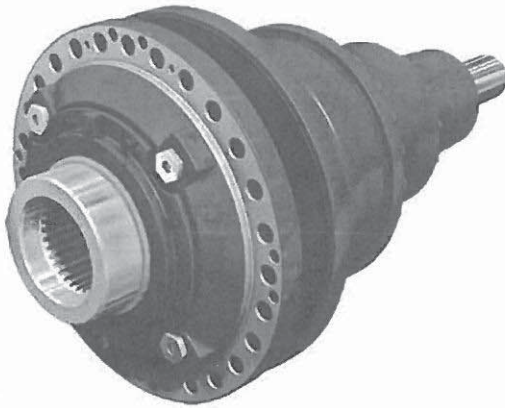
Make certain that all tools and other items are clear from rotating parts before starting machine. Stand clear, and start machine slowly to be sure all components are secure, and operating properly.

## Appendix 4.4.5.3

System: Bridge Hoist Machinery  
Component: Planetary Reducer  
Manufacturer: Brevini

**MANUALE DI INSTALLAZIONE E MANUTENZIONE  
NOTICE D'INSTALLATION ET D'ENTRETIEN  
MANUAL DE INSTALACIÓN Y MANTENIMIENTO**

- **INSTALLATION AND MAINTENANCE MANUAL**  
- **INSTALLATIONS-UND WARTUNGSHANDBUCH**  
- **MANUAL DE INSTALAÇÃO E MANUTENÇÃO**



**RIDUTTORI PER APPLICAZIONI INDUSTRIALI E PER ROTAZIONI**

**GEARBOXES FOR INDUSTRIAL APPLICATIONS AND SLEWING DRIVES**

**GETRIEBE FÜR INDUSTRIELLE ANWENDUNGEN UND SCHWENKANTRIEBE**

**RÉDUCTEURS POUR APPLICATIONS INDUSTRIELLES ET POUR ROTATIONS**

**REDUCTORES PARA APLICACIONES INDUSTRIALES Y DE GIRO**

**REDUTORES PARA APLICAÇÕES INDUSTRIAIS Y DE GIRO**

 **brevini  
riduttori**

## 1. INTRODUCTION:

Brevini Riduttori S.p.A. would like thank you for choosing one of its products and is pleased to include you among its preferred Customers.

The company hopes you will be satisfied when using the gear unit.

### 1.1 How to consult the Manual

It is easy to consult this manual by referring to the table of contents which can be used to find the subject of interest very quickly. The chapters are organized into a hierarchical structure that makes it easier to find the required information.

### 1.2 Scope of the Manual

This manual provides the Gear unit user with all the information necessary to ensure correct installation, use and maintenance in compliance with the safety restrictions set forth by current standards.

To understand this manual even better, we would like to describe the following terms used in the document:

**HAZARDOUS AREA:** area within or in proximity to the machine in which the presence of an exposed person represents a risk to the safety and health of that person.

**EXPOSED PERSON:** any person who is inside all or part of a hazardous area.

**OPERATOR:** person assigned to install, operate, adjust, perform routine maintenance and clean the machine.

**SKILLED TECHNICIAN:** a specialized person who performs unscheduled maintenance or pairs requiring special knowledge of the machine, its operation, safety devices and relative operating methods.



**ATTENTION:** Operator accident-prevention standards



**WARNING:** The machine and/or its parts may be damaged



**PRECAUTION:** Additional information regarding the operation being carried out

**NOTE:** Provides useful information

For any doubts or if the manual has been damaged or lost, please do not hesitate to contact the BREVINI RIDUTTORI S.p.A. Technical Service Department.

### 1.3 Warranty Conditions

BREVINI RIDUTTORI S.p.A. warrants that its products shall be free from defects for a period of 12 months from the date the product is shown to have been placed

in operation by original user and/or in any case for a period of maximum 18 months from the date of shipment.

The warranty shall not be valid if the defect or not conformity will prove to be depending on not correct or not suitable applications of the product, or if the product has been uncorrectly placed in operation.

The warranty by BREVINI RIDUTTORI S.p.A. is expressly limited to the repair or replacement of the defected product, which is returned our factory after notification of failure, and thereafter if the product is found by BREVINI RIDUTTORI S.p.A. to be, in fact, defective.

BREVINI RIDUTTORI S.p.A. shall not be liable for any damages, either material or economic, resulting from or caused by any defects. Brevini Riduttori S.p.A. will only be liable for repair or replacement of the product.

The gearbox is intended to be used in suitable environment and for suitable applications in appliance with what has been

foreseen at the moment the project has been studied.

Improper use of the gearbox is forbidden.

Any change or replacement of machine parts, which has not been authorized by BREVINI RIDUTTORI S.p.A., may represent an accident risk and therefore releases the manufacturer from any civil or penal liabilities, and makes the warranty invalid.

### 1.4 General warnings

Personnel must be informed about the following subjects regarding machine operating safety:

- Accident risks.

- D.P.I. devices designed to ensure operator safety (individual protection devices: goggles, gloves, hard-hat, etc.).

- General accident-prevention rules or those set forth by international directives and by the laws of the country where the machine will be used.

When delivered, check that the Gear unit has not been damaged during transport and that any accessories are complete.

- Before standing to work, the operator must be familiar with machine features and must have read this entire manual.

### 1.5 Reproduction and copyright restrictions

BREVINI RIDUTTORI S.p.A. reserves all rights.

It is prohibited to reproduce all or a portion of the structure and contents of this manual, unless expressly authorized by BREVINI RIDUTTORI S.p.A.. Furthermore, it is prohibited to store such information on any type of support (magnetic, magnetic-optical, microfilm, photocopies, etc.).

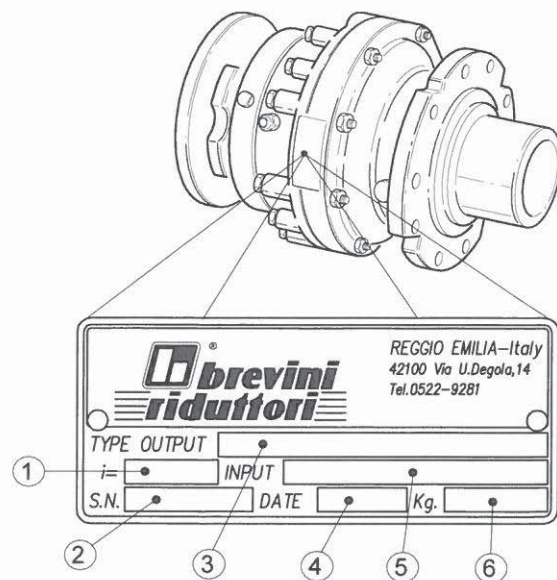
### 1.6 Revisions

Subsequent revisions of the manual will be issued as a result of machine functional changes or replacements.

## 2. TECHNICAL DATA:

Each gear unit is supplied with an identification nameplate and a manufacturer's declaration (as per the enclosure II B) which have been prepared according to EEC directive 392 and subsequent amendments. The identification nameplate contains the main technical data regarding the functional and construction features of the gear unit. Therefore, it must always be visible and undamaged.

- 1) Reduction ratio
- 2) Serial number
- 3) Type or gear unit/Gear unit output
- 4) Year built
- 5) Gear unit input
- 6) Gear unit weight

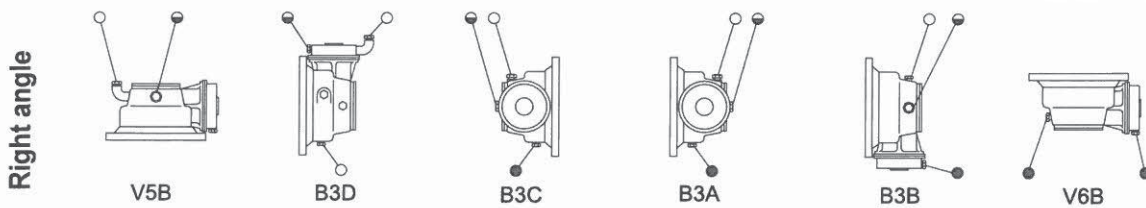


2.1 Code description

<b>ED</b>	<b>2090</b>	<b>MR</b>	<b>20</b>	<b>FL350</b>	<b>B3</b>
Gear unit family	Reduction size	Gear unit output	Reduction ratio	Gear unit input	Construction form

2.2 Configurations

		Horizontal Position		Vertical Position	
		010-091	150-320	010-091	150-320
in line	MN-MR-MN1-MR1				
	FE				
	FS				



- Magnetic drain plug
- ◐ Oil level plug
- Breather and filling plug

ENGLISH

### 3. SUPPLY CONDITION:

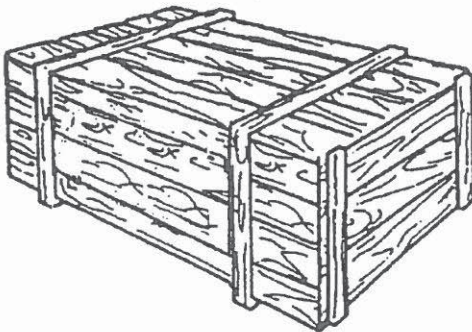
The exterior of the gear units are painted with a synthetic epoxy primer ("RAL 5010" blue), unless otherwise indicated in the contracts. Such protection can withstand normal industrial environments, including outdoor sites, while additional synthetic top coats can also be applied. If the machine will be used under particularly aggressive environmental conditions, special types of paints can also be applied.

The machined external parts of the gear unit, such as the ends of the hollow and non-hollow shafts, support surfaces, spigots, etc. are protected with rust-inhibitor oil (tectyl). The internal parts of the gear unit casings and drives are also protected with rust-inhibitor oil.

All the gear units, unless otherwise indicated in the contracts, are supplied without lubrication **(as indicated by a special adhesive sticker attached to the gear unit to notify the user of such a supply condition).**

### 4. PACKING, HANDLING, RECEIVING, STORAGE:

#### 4.1 Packing

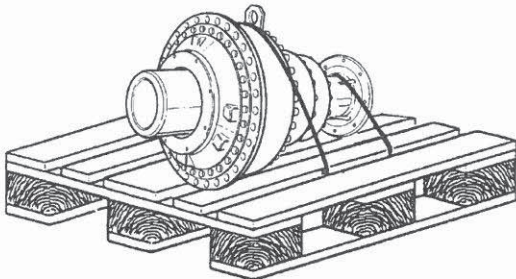


 Brevini Riduttori S.p.A. products are packed and shipped in crates or on pallets, depending on the specific case.

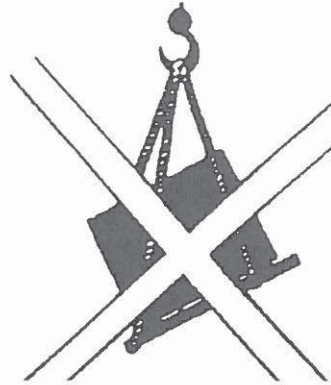
- All Brevini products, unless otherwise indicated in the contracts, **are packed with wrapping that can withstand normal industrial environments.**

#### 4.2 Handling

**Note:** the weight shown on the nameplate does not include any accessories: such as brakes, motor flanges, wheel flanges, etc.; consequently, to obtain the gear unit + accessories total weight, please add, depending on the gear unit size, a max approximate extra weight of 40 kg. for input accessories; for output accessories, please calculate a max value equal to approx. the 8% of the gear unit weight depending on the unit size.



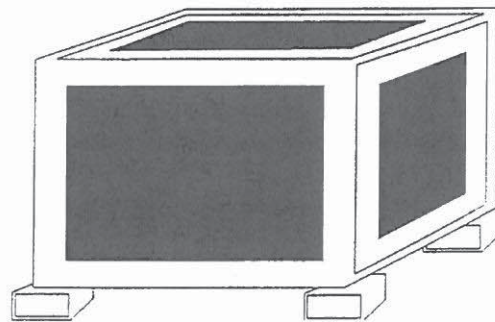
To move packages, use lifting equipment that is suitable for the type of packing and for which the capacity is indicated on such equipment.



Do not tilt or turn the package upside down while lifting or during transport.



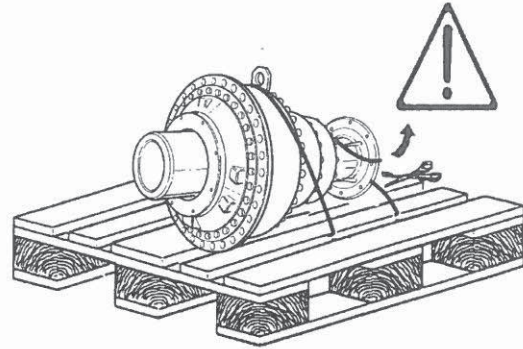
If the packages are unloaded from a fork-lift truck, make sure the weight is balanced on the forks.



If necessary, place wooden wedges under the package to make lifting easier.



If the packages are unloaded with a hoist and, in any case, with a hook, make sure that the load is balanced and for slinging use lifting accessories that are legally certified. For packages shipped on pallets, make sure that the lifting accessories do not damage the machine.

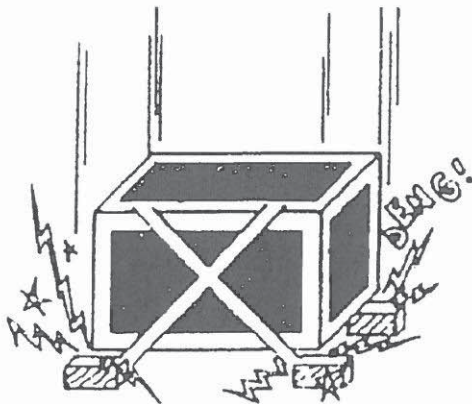


**!** The strap holding the product to the packing is sharp. It may hit the operator while the product is being unloaded. The packing must be eliminated as follows:

- use a pair of shears (**warning: the ends may hit the operator**)
- cut or remove the external packing
- cut the internal strap (**warning: the ends may hit the operator**)
- remove the machine from the pallets.

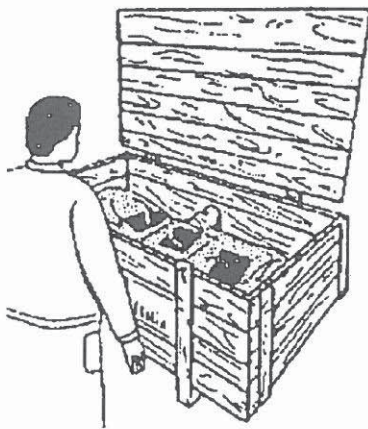
If the machine has been damaged or if there are any defects or missing parts, immediately notify the BREVINI RIDUTTORI S.p.A. Service department: Tel. ++3905229281, Fax ++390522928300.

#### 4.4 Handling the machine without packing

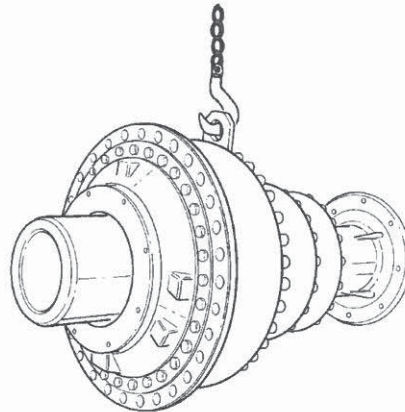


While lifting and positioning the package, avoid any violent impacts or bumps.

#### 4.3 Receiving

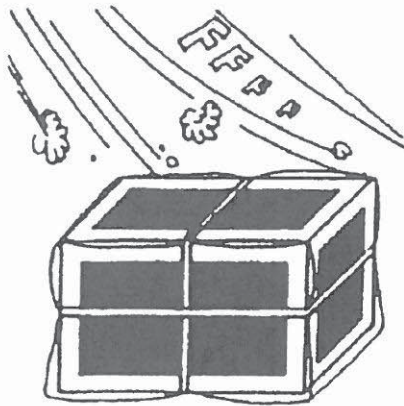


When the Machine is receiving, make sure the supply corresponds to what is specified in the order. Also check that the package and its contents have not been damaged during transport.



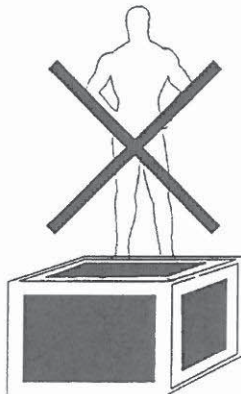
**!** Before removing the machine from its packing make sure it is solidly attached to the lifting accessories so that it cannot slide or flip over. Before handling the machine, remove the wood blocks inserted in the packing to keep it stable during shipment. Lift the machine making sure the load remains balanced during the various operations.

## 4.5 Storage

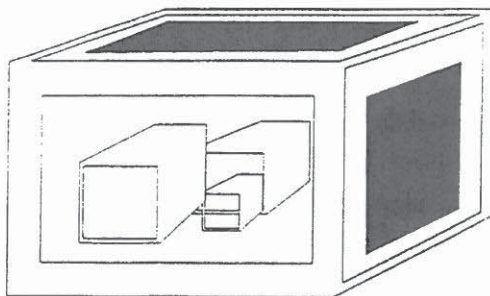


- If the product must be stored for more than 2 months, do the following:
- Protect the shafts and the spigots with a film or grease and/or rust-inhibitor liquids
  - Completely fill the gear unit and any multi-disk brake with suitable oil (see paragraph 7.4)
  - Store the machine in a cool place at a temperature ranging from  $-5^{\circ}\text{C}$  to  $+30^{\circ}\text{C}$
  - Protect the packages against dirt, dust and moisture.

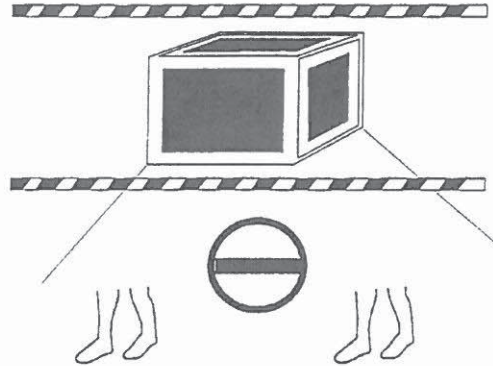
**NOTE:** For extended storage of more than 6 months, the rotating seals will no longer be efficient. It is recommended to check them periodically by turning the internal gears by and rotating the input shaft. For a negative multi-disk brake, release the brake by using a hydraulic pump or similar device (see paragraph 8.1 for the brake opening pressure). It is recommended to replace the gaskets when the machine is started.



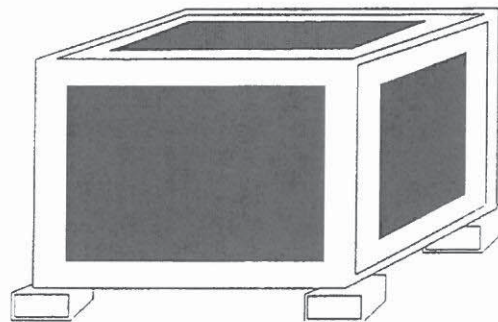
- Do not stack pieces on top of each other
- Do not walk on or place pieces on top of the package.



- Do not store any material inside the package.



- Keep the package away from any passage areas.



- If possible, insert wooden wedges between the package and the floor.

## 5. INSTALLATION:

### 5.1 General instructions

Install the Product carefully following the steps listed below:

- When installing the Gear unit, make sure the oil, breather, level and drain plugs are in the correct position. Their position will vary according to the assembly position (see paragraph 2.2 Configurations).

If the gear unit is supplied in the multi-disk brake configuration, make sure that the brake oil, breather, level and drain plugs are in the correct position. Their position will vary according to the assembly position (see paragraph 2.2 Configurations).

- The brakes in general must be correctly connected to their specific control circuits and, for hydraulically controlled brakes, they must be bled like the hydraulic circuit.

- When installing RPR or MDU series gear units, be very careful not to damage any grease pipes or those used to empty the oil in the gear unit (located on the side of the gear unit support). They should be positioned so that it is easy to access the grease gun and any oil expansion tank (during installation protect the pipes and the tank).

- The Gear unit is normally supplied with a flange for coupling the electric, hydraulic and air motors.

- The customer is responsible for installing suitable guards for the input shafts, as well as couplings, pulleys, belts, etc., according to the current safety standards in force in the country where the machine is used.

- For Gear units installed outdoors, use rust-inhibitor paint and protect the oil guard and relative sliding guides with water-repellent grease and provide protection against bad weather.

**Note:** BREVINI RIDUTTORI S.p.A. advises against filling its products with oil prior to installation

### 5.2 Installation instructions for flange mounted gear unit

- They must be attached to a rigid structure with a clean support surface that is perpendicular to the drive axis.
- The spigots and the coupling surfaces of the gear unit must be clean without any dents. The checks described above are particularly important ensure perfect alignment between the driven shaft and the output shaft of the gear unit. This is even more important for gear units with a splined female output shaft which cannot bear any radial or axial loads.
- Lubricate all the spigots of the gear unit and the housing seat with grease or oil.
- After having inserted the gear unit into its housing and having placed it in the correct position, fit the reference pins in their seats, then tighten the attachment bolts (recommended minimum class 8.8), applying torque as indicated in the table "torque setting" paragraph 8.1, making sure that such torque settings are compatible with the other parts (nuts and/or structure).

**NOTE:** It is recommended to use class 10.9 or 12.9 bolts where the application involves severe impacts, frequent stops, starts, reversals or when it exceeds 70% of the maximum tolerated torque.

**NOTE:** During installation, for right angle gear units with a male input shaft, the input axis may not be in the ideal position. To solve this problem, it is recommended to do the following:

- for connections using couplings which can compensate for the misalignments, measure the existing misalignment, check the acceptable misalignment from the coupling and, if the value is greater, shim the motor to obtain the acceptable clearances
- for a connection with mechanical devices that cannot be used to compensate for the clearances, align the motor using shims.

### 5.3 Installation instructions for a foot mounted gear unit

- Make sure that the assembly feet rest on a flat surface. If not, shim them so that all are level.
- An improper support for the feet may break the unit.
- Attach the unit using bolts with a minimum class 8.8 tightened at the torque settings indicated in paragraph 8.1.

### 5.4 Installation instructions for a shaft mounted gear unit

Particular attention is required when installing these gear units, therefore follow the instructions described below.

#### 5.4.1 Mounting the reaction arm on the gear unit

- Check that spigots of the gear unit and the reaction arm are clean, not dented and that there are no traces of paint.
  - Lubricate the couplings and insert the reaction arm on the gear unit spigot, then insert any dowels.
  - Attach the reaction arm using minimum class 8.8 bolts.
  - It is recommended to use class 10.9 or 12.9 bolts where the application involves severe impacts, frequent stops or starts, reversals or when it exceeds 70% of the maximum gear unit torque.
  - Check that the reaction arm anchor system does not lock the gear unit, but allows it to move freely in space in order to absorb the movements imposed in it by the shaft.
- For torque settings refer to the table "torque setting" paragraph 8.1, making sure that such settings are compatible with the other parts (nuts and/or attachment structures).

#### 5.4.2 Installing the gear unit with an FS output

**NOTE:** the connection couplings are supplied ready for installation, therefore they need not be disassembled prior to the initial installation.

- Slightly unscrew three bolts of the torque coupling located at 120° until the inner ring can just be turned by hand (excessive tightening might deform the inner ring).

- Insert it above the shaft of the gear unit whose external surface was previously lubricated.
- degrease the internal surface of the gear unit shaft and the machine shaft.
- Insert the gear unit on the machine shaft or vice versa (excessive axial force should not be necessary).
- Position the center line of the coupling on the center line of the useful section of the machine shaft (see fig. No. 1). During this operation refer to dimension "a" which will vary according to the size of the coupling, as indicated here in the table No. 1
- Use a torque wrench and gradually tighten all the bolts in the coupling in a circular direction (not diametrically opposed) until they are fully tightened at a torque setting corresponding to the value reported in the table No. 1.

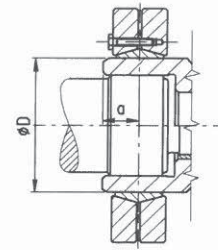


Fig. n. 1

- Check that the 2 rings remain concentric and parallel while tightening, keeping in mind that the maximum tolerated parallelism error is 0.25-0.35% of the external diameter of the couplings.

**NOTE:** Excessive tightening may permanently deform the inner ring, thus refer to the torque settings indicated in the table.

#### 5.4.3 Disassembling the coupling and the gear unit

- Gradually release the attachment bolts in a circular direction. Initially each bolt must be backed off only a quarter of a turn to prevent the attachment elements from seizing and to avoid tilting.
- Remove the gear unit from the driven shaft. To do this a hole on the gear unit shaft can also be used to pump oil under low pressure so that it can be pulled off gradually.
- remove the coupling from the gear unit shaft.

Table No. 1

Disk type	Dimensions			Bolts			a
	d. sh.	d x D	H2	n	Tipo	Ma	
SD 62 M	50	62 x 110	29	10	M6 x 25	12	17
SD 100 M	75	100 x 170	43	12	M8 x 35	29	30
SD 125 M	90	125 x 215	52	12	M10 x 40	58	35
SD 140 M	100	140 x 230	58	10	M12 x 45	100	40
SD 165 M	120	165 x 290	68	8	M16 x 55	240	45
SD 175 M	130	175 x 300	68	8	M16 x 55	240	45
SD 185 M	140	185 x 330	85	10	M16 x 65	240	55
SD 185 H	140	185 x 330	112	15	M16 x 80	240	55
SD 220 H	165	220 x 370	134	20	M16 x 90	240	67
SD 240 H	180	240 x 405	144	15	M20 x 100	490	72
SD 280 H	220	280 x 460	172	20	M20 x 120	490	87
SD 340 H	260	340 x 570	200	20	M24 x 120	820	102
SD 390 H	300	390 x 660	212	24	M24 x 140	820	120

#### 5.4.4 Installing the gear unit with an FP output

- Insert the stop ring, if provided, in its housing on the shaft pos.n°1.
- Grease the seats of the o-rings pos. N°2 and 3 on the cover pos.n°4; then insert the respective o-rings in their seats; then insert the cover on the shaft.
- Insert the other stop ring pos.n°5, then the tongue pos.n°6 in their respective seats on the shaft.
- Assemble the torque arm pos. N°7 on the reduction gear.
- Suitably lubricate both the shaft and its seat (reduction gear female shaft); then carry out coupling of the shaft and the reduction gear (do not force).

fitting holes in phase with the shaft spline, and the only way to set the timing will be by trial and error.

- After fixing the assembly in position, cut off the current to the solenoid valve, disconnect the hand-operated hydraulic pump and refit the 1/4 Gas plug.

## 5.7 Accessory installation instructions

### Motor Assembly:

While assembling the gear unit on the motor, the coupling must be lubricated with a thin layer of grease or with a no-grip lubricant.

Carefully insert the motor shaft in to the coupling and make sure that the motor spigot perfectly matches the gear unit spigot.

After checking that the motor is properly centered, tighten all the attachment bolts applying the torque indicated in the table "torque setting" paragraph 8.1.

### Accessory Assembly:

To mount pinions, pulleys or couplings, use suitable equipment avoid seizing. As an alternative, heat the piece to 80°-100° C.

Lubricate the grooves with a thin layer of grease or a no-grip lubricant and tighten attachment bolts applying the torque indicated in the table "torque setting" paragraph 8.1.

## 6. START-UP OF AUXILIARIES (BRAKES - CLUTCHES- ETC.):

### 6.1 Negative multi-disk brake

NOTE: The negative multi-disk brake is used only as a parking brake, or in special situation as an emergency brake.

- Connect the fittings of the system hydraulic circuit to the brake control hole (see paragraph 2.2 "configuration") of all the gear units with these features installed in the system.

- Pressurize the hydraulic circuit and then bleed all brakes. Slightly unscrew the brake control fitting, and maintain pressure until only oil is expelled without any air. Then re-tighten the fitting.

### 6.2 Disk brake

- Connect the fittings of the system brake circuit to the brake control hole "A" (see fig. No. 2) of the brake clamp located on the gear unit for all the gear units with these features installed in the system.

Bleed The brakes after injecting oil into the circuit (remove the air from the brake circuit).

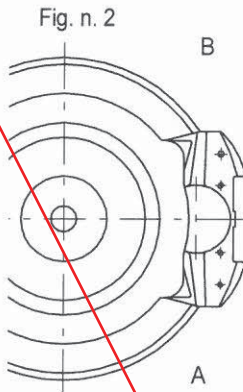
- At least two persons are needed to carry out this operation.

NOTE: For the bleeding operation it is recommended, after having removed the rubber guard of the bleeder valve "B", to attach a piece of rubber hose with a length of about 20 cm to collect any oil into a can (wich should not be dumped in the environment since such oil is a major pollutant).

- Slightly unscrew (1 turn) the bleeder valve "B" and keep activating the brake control until only oil without any air is expelled from the valve. Immediately close the valve and release the brake control.

NOTE: if oil not expelled the first time the brake control is activated close the bleeder valve and release the brake control. Then open the valve again and activate the brake control and continue in this manner until only oil is expelled.

- Repeat this operation for all gear units with these features installed in the system, then top-up the oil in the brake circuit.



## 6.3 Gear unit-coupler assembly with active clutch safety system

- the hydraulic pump used by the power pack is reversible, thus guaranteeing the same constant pressure at all times, regardless of the direction of rotation

**ATTENTION:** the pressure relief valve on the power pack has been pre-set to the right pressure (25.5 ± 2 bar). It is absolutely forbidden to alter this valve setting.

- power up the solenoid valve with direct current (12 Volt) via the socket on the power pack (see chapter 2.2.1 for location of symbol)

- to prime the hydraulic pump (after filling the assembly with lubricating oil), simply start the coupler PTO rotating, as the pump is self-priming.

## 7. LUBRICATION:

### 7.1 Gear unit lubrication

**The Brevini gear units are supplied without oil, therefore the user must the lubricant according to what is indicated in the table shown in paragraph 7.4.**

#### Basic oil specifications

The basic parameters of the selected oil are:

- viscosity at nominal operating conditions
- additives

The oil must lubricate the bearings and the gears and all these components work inside the same box, in different operating conditions. We will look at these parameters one by one.

#### 7.1.1 Viscosity

Nominal viscosity is referred to a temperature of 40 °C, but rapidly decreases with an increase in the temperature of the gear unit.

If the operating temperature is between 50 °C and 70 °C, a nominal viscosity can be chosen according to the following guide table, choosing the highest viscosity if the highest temperature is foreseen.

$n_2$ [rpm]	50 °C	70 °C
>20	VG150	VG220
<5	VG220	VG320
<5	VG320	VG460

#### 7.1.2 Additives

In addition to the normal antifoaming and antioxidant additives, it is important to use lubricating oils with additives that have EP (extreme-pressure) and antiwear properties, according to ISO 6743-6 L-CKC or DIN 51517-3 CLP. Clearly, therefore, products with stronger EP characteristics will have to be found for slower gear unit speeds. It should be remembered that the chemical compounds replacing hydrodynamic lubrication are formed to the detriment of the original EP load. Therefore, with very low speeds and high loads it is important to keep to the maintenance intervals so as not to diminish the lubricating characteristics of the oil excessively.

### Checking the oil with non-forced lubrication

If the gear unit is fitted horizontally, the oil level should be at the centre if proper lubrication is to be guaranteed (see fig. 7).

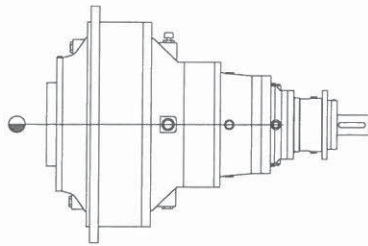


Fig. 7

For applications with a very low output rotation speed ( $n_2 \leq 5$  rpm) it is advisable to fix the level at a value higher than 50-100 mm (see fig. 8).

To check the oil level, simply use a transparent tube, positioning it as shown in fig. 8.

If the output speed is extremely low ( $n_2 \leq 1$  rpm), or if long gear unit downtimes are foreseen, it is advisable to fill the entire casing. In this case, a special "expansion tank" must be fitted.

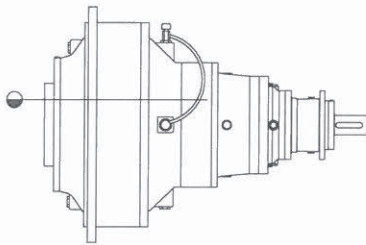


Fig. 8

If a gauge is fitted for checking the level visually (or by means of an electrical signal), this must be fitted as shown in the diagram in fig. 9. Position the breather cap above the level indicator, using a tube of the right length, connecting the upper (empty) part of the gear unit to just below the breather. This will prevent oil from spilling out.

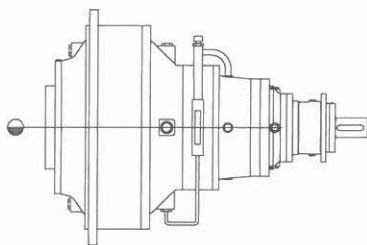


Fig. 9

### Filing and level

- The gear units are equipped with oil level, breather, filler and drain plugs and their position changes according to the installation configuration.
- Check the exact position of the plugs using the diagrams on paragraph 2.2 "configuration".
- Unscrew the level-filler plugs, put oil into the Gear unit and when this oil flows out of the level hole, replace the plugs.
- In the RPR or MDU series, one of the support bearings must be lubricated with grease, using the grease gun located above the gear unit attachment flange, and using a generic type of grease with the features indicated in paragraph 7.3.

- The lubricant oil used in the gear unit-coupler assembly with active clutch safety system is the same as the oil used in the clutch pump.

- Turn the gear unit a few times to eliminate any air pockets and then check the various levels.

### 7.2 Expansion tank

**ATTENTION:** make sure the expansion tank is installed higher than the top part of the gear unit.

For applications with an expansion tank, do the following: (see figure 3).

- Remove the plug "A"
- To enhance gear unit ventilation (only during the filling phase) it is also possible to remove one of the top of the gear unit.

- As the oil rises to the top of the open plug in the top part of the gear unit, replace the plug.

- Continue filling until the oil reaches the min. visual level plug on the tank which should not be exceeded to provide space for the volume of the hot oil to expand.

- Replace the plug.  
- With the gear unit running under steady-state thermal conditions, and the oil at its maximum expansion temperature, never exceed the max. level.

- Run the gear unit for a few minutes to eliminate any air pockets, then check the various levels.

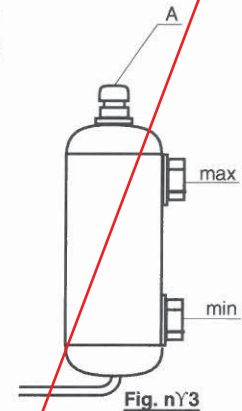
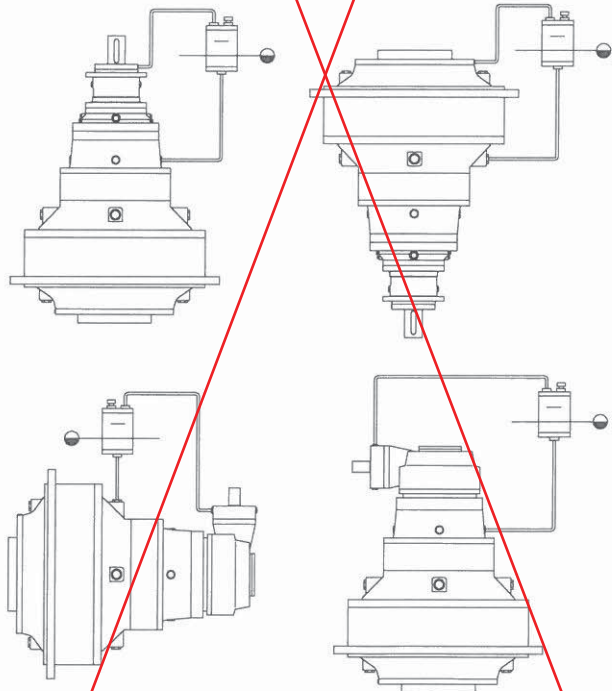


Fig. nY3

### Vertical in-line fitting and right-angled fitting with expansion tank



### 7.3 Brake lubrication

#### Multi-disk brake

- The Brevini multi-disk brakes are supplied without oil.
- The user must select the lubricant features.
- To lubricate the multi-disk brake unit, Brevini Riduttori recommends using mineral oils with enhanced heat and aging

~~resistance and viscosity ISO VG 32, with a viscosity index greater than or equal to 95.~~

~~- Hydraulic oils are suitable, in general.~~

**Multi-disk brake filling and level**

~~- The multi-disk brakes are equipped with oil level, filler and drain plugs and their position changes according to the installation configuration.~~

~~- Check the exact position of the plugs using the diagrams on page 7.~~

~~- Unscrew the level/filler plugs, put oil into the brake and when this oil flows out of the level hole, replace the plugs.~~

~~- Turn the brake a few times to eliminate any air pockets and then check the various levels.~~

**Disk brake**

~~- Disk brake do not require any lubrication.~~

**7.4 Grease features**

Type of soap:     stearate hydroxide lithium 12 or equivalent  
 Consistency:     NLGI No. 2  
 Base Oil:         Mineral oil with viscosity from 100 to 320 cST at 40°C  
 Additives:        Rust inhibitors  
 Viscosity index: 80 Minimum  
 Pour point:       -10° C maximum

**7.4 Lubricant table**

Lubricant	Mineral		
	ISO VG 150	ISO VG 220	ISO VG 320
Agip	Blasia 150	Blasia 220	Blasia 320
Aral	Drgol BG 150	Drgol BG 220	Drgol BG 220
BP	Energol GR-XP 150	Energol GR-XP 220	Energol GR-XP 320
Castrol	Alphamax 150	Alphamax 220	Alphamax 320
Cepsa	Engranajes HP 150	Engranajes HP 220	Engranajes HP 320
Dea	Falcon CLP 150	Falcon CLP 220	Falcon CLP 320
Elf Lubmarine	Epona Z 150	Epona Z 220	Epona Z 320
Esso	Spartan EP 150	Spartan EP 220	Spartan EP 320
Fuchs	Renep Compound 104	Renep Compound 106	Renep Compound 108
Fuchs Lubritech	Gearmaster CLP 150	Gearmaster CLP 220	Gearmaster CLP 320
Klüber	Klüberoil GEM 1-150	Klüberoil GEM 1-220	Klüberoil GEM 1-320
Mobil	Mobilgear XMP 150	Mobilgear XMP 220	Mobilgear XMP 320
Nils	Ripress EP 150	Ripress EP 220	Ripress EP 320
Omv	Gear HST 150	Gear HST 220	Gear HST 320
Optimol	Optigear BM 150	Optigear BM 220	Optigear BM 320
Q8	Goya NT 150	Goya NT 220	Goya NT 320
Repsol	Super Tauro 150	Super Tauro 220	Super Tauro 320
Shell	Omala 150	Omala 220	Omala 320
Texaco	Meropa 150	Meropa 220	Meropa 320
TotalFinaElf	Carter EP 150	Carter EP 220	Carter EP 320
Tribol	1100 - 150	1100 - 220	1100 - 320
Lubricant	Synthetic		
	ISO VG 150	ISO VG 220	ISO VG 320
Agip	-	Blasia SX 220	Blasia SX 320
Aral	Drgol PAS 150	Drgol PAS 220	Drgol PAS 220
BP	Enersyn EXP 150	Enersyn EXP 220	Enersyn EXP 320
Castrol	Alphasyn 150	Alphasyn 220	Alphasyn 320
Cepsa	Engranajes HPX 150	Engranajes HPX 220	Engranajes HPX 320
Dea	Intor HCLP 150	Intor HCLP 220	Intor HCLP 320
Elf Lubmarine	-	Epona SA 220	Epona SA 320
Esso	Spartan SEP 150	Spartan SEP 220	Spartan SEP 320
Fuchs	Renolin unisyn CLP 150	Renolin unisyn CLP 220	Renolin unisyn CLP 320
Fuchs Lubritech	Gearmaster SYN 150	Gearmaster SYN 220	Gearmaster SYN 320
Klüber	Klübersynth EG 4-150	Klübersynth EG 4-220	Klübersynth EG 4-320
Mobil	Mobilgear SHC XMP 150	Mobilgear SHC XMP 220	Mobilgear SHC XMP 320
Nils	-	Ripress EP 220	-
Omv	-	Gear SHG 220	Gear SHG 320
Optimol	Optigear Synthetic A 150	Optigear Synthetic A 220	Optigear Synthetic A 320
Q8	El Greco 150	El Greco 220	El Greco 320
Shell	Omala HD 150	Omala HD 220	Omala HD 320
Texaco	Pinnacle EP 150	Pinnacle EP 220	Pinnacle EP 320
TotalFinaElf	Carter SH 150	Carter SH 220	Carter SH 320
Tribol	1510 - 150	1510 - 220	1510 - 320

**Table of lubricant oils suitable for alimentary use**  
 (Approved according to USDA-H1 and NSF-H1 specifications)

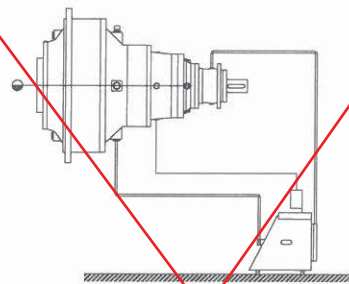
Lubricant	Hydraulic oils		
	ISO VG 32	ISO VG 46	ISO VG 68
Agip	Rocol Foodlube H1 power 32	-	-
Aral	Eural Hyd 32	Eural Hyd 46	Eural Hyd 68
Bel-Ray	No-Tox HD Hydr Oil 32	No-Tox HD Hydr Oil 46	No-Tox HD Hydr Oil 68
BP	Enerpar M 32	Enerpar M 46	Enerpar M 68
Chevron	Lubricating Oil FM 32	Lubricating Oil FM 46	Lubricating Oil FM 68
Esso	Nuto FG 32	Nuto FG 46	Nuto FG 68
Keystone	Nevastane SL 32	Nevastane SL 46	Nevastane SL 68
Klüber	Summit Hysyn FG 32	Summit Hysyn FG 46	Summit Hysyn FG 68
Mobil	DTE FM 32	DTE FM 46	DTE FM 68
Nils	Mizar 32	Mizar 46	Mizar 68
Optimol	Optileb HY 32	Optileb HY 46	Optileb HY 68
Pakelo	No-Tox Oil Hydr. ISO 32	No-Tox Oil Hydr. ISO 46	No-Tox Oil Hydr. ISO 68
Royal Purple	Poly-Guard FDA 32	Poly-Guard FDA 46	Poly-Guard FDA 68
Shell	Cassida Fluid HF 32	Cassida Fluid HF 46	Cassida Fluid HF 68
Texaco	Cygnus Hydraulic Oil 32	Cygnus Hydraulic Oil 46	Cygnus Hydraulic Oil 68
Tribol	Food Proof 1840 - 32	Food Proof 1840 - 46	Food Proof 1840 - 68
Lubricant	Gear Oils		
	ISO VG 150	ISO VG 220	ISO VG 320
Agip	Rocol Foodlube H1 Torque 150	-	Rocol Foodlube H1 Torque 150
Aral	Eural Gear 150	Eural Gear 220	-
Bel-Ray	No-Tox Syn Gear 150	No-Tox Syn Gear 220	No-Tox Syn Gear 320
Chevron	-	Lubricating Oil FM 220	-
Esso	-	Gear Oil 220	-
Keystone	Nevastane EP 150	Nevastane EP 220	Nevastane EP 320
Klüber	Klüberoil 4 UH1 N 150	Klüberoil 4 UH1 N 220	Klüberoil 4 UH1 N 320
Mobil	DTE FM 150	DTE FM 220	DTE FM 320
Nils	Ripress Synt Food 150	Ripress Synt Food 220	Ripress Synt Food 320
Optimol	Optileb GT 150	Optileb GT 220	Optileb GT 320
Pakelo	No-Tox Oil Gear ISO 150	No-Tox Oil Gear ISO 220	No-Tox Oil Gear ISO 320
Royal Purple	Poly-Guard FDA 150	Poly-Guard FDA 220	Poly-Guard FDA 320
Shell	Cassida Fluid GL 150	Cassida Fluid GL 220	Cassida Fluid GL 320
Texaco	Cygnus Gear PAO 150	Cygnus Gear PAO 220	Cygnus Gear PAO 320
Tribol	-	Food Proof 1840 - 220	Food Proof 1840 - 320

ENGLISH

**7.6 Diagrams and oil checking with auxiliary cooling system**

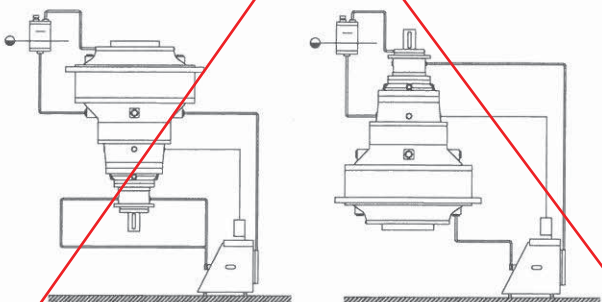
**Horizontal gear unit**

See paragraph 7.1 for levels.



**Vertical gear unit**

See paragraph n° 7.2 for definition of levels, also for right angle gear units



## 8. CHECKS:

### 8.1 First start-up checks

Before starting the machine check the following:

- Check that all the oil plug are in the correct position (see paragraph 2.2 "configuration").
- Check that all oil levels are correct.
- Check that all the grease guns are full of grease.
- Check that the operating pressure (see table on the right) is sufficient to fully open the multi-disk brake to avoid overheating and any premature wear of brake disks.

Type of brake	Opening pressure (bar)		Static torque (Nm)
	Max.	Min.	
FL620/12	21	26	210
FL635/12	12	15	315
FL250.4C	10,24	13,28	181
FL250.6C	10,53	13,28	186
FL350.6C	15,80	19,92	278
FL350.8C	16,20	19,90	381
FL450.6C	20,48	25,59	360
FL450.8C	21,03	25,59	492
FL650.10C	14,20	19,92	428
FL650.12C	14,56	19,92	528
FL650.14C	15,00	19,92	633
FL750.10C	18,40	25,59	556
FL750.12C	18,95	25,59	684
FL750.14C	19,49	25,59	819
FL960.12C	15,56	21,98	1019
FL960.14C	15,56	21,98	1189
FL960.16C	15,56	21,98	1359
FL960.18C	15,56	21,98	1528

**ATTENTION:** Given the type of brake, the operating pressure should never drop below the minimum brake opening pressure to avoid the braking action.

**ATTENTION:** The gear units and any multi-disk brakes are shipped without oil. The customer is responsible for filling such devices (see lubrication chapter paragraph 7).

- Check that all the bolts with ISO metric threads are correctly tightened (see table "torque setting values").

Values Table Torque Setting Bolts

d x p mm.	4.8		5.8		8.8		10.8		12.9	
	kN	Nm	kN	Nm	kN	Nm	kN	Nm	kN	Nm
3x0,5	1.2	0.9	1.5	1.1	2.3	1.8	3.4	2.6	4.0	3
4x0,7	2.1	1.6	2.7	2	4.1	3.1	6.0	4.5	7.0	5.3
5x0,8	3.5	3.2	4.4	4	6.7	6.1	9.8	8.9	11.5	10.4
6x1	4.9	5.5	6.1	6.8	9.4	10.4	13.8	15.3	16.1	17.9
7x1	7.3	9.3	9.0	11.5	13.7	17.2	20.2	25	23.6	30
8x1	9.9	14.5	12.2	18	18.9	27	28	40	32	47
9x1,25	9.3	13.6	11.5	16.8	17.2	25	25	37	30	44
10x1,5	14.5	26.6	18	33	27	50	40	73	47	86
10x1,25	15.8	28	19.5	35	30	53	43	78	51	91
12x1,25	23.8	50	29	62	45	95	65	139	77	163
12x1,75	21.3	46	26	56	40	86	50	127	69	148
14x1,5	32	79	40	96	61	150	90	220	105	257
14x2	29	73	36	90	55	137	80	201	94	235
16x1,5	43	121	54	150	82	229	121	336	141	393
16x2	40	113	50	141	76	214	111	314	130	369
10x2,5	49	157	60	194	95	306	135	435	158	509
18x1,5	57	178	70	220	110	345	157	491	184	575
20x2,5	63	222	77	275	122	432	173	615	203	719
20x1,5	72	248	89	307	140	482	199	687	233	804
22x2,5	78	305	97	376	152	502	216	843	253	987
22x1,5	88	337	109	416	172	654	245	932	266	1090
24x3	90	383	112	474	175	744	250	1080	292	1240
24x2	101	420	125	519	196	814	280	1160	327	1360
27x3	119	568	147	703	230	1100	328	1570	384	1840
27x2	131	615	162	760	225	1200	363	1700	425	1990
30x3,5	144	772	178	955	280	1500	300	2130	467	2500
30x2	165	850	204	1060	321	1670	457	2370	535	2380

d = bolt diameter

p = bolt pitch

kN = axiale pre-loading

Nm = torque setting bolts

### 8.2 No-load tests

- After a brief period of operation (5-10 minutes) check the oil levels under no-load conditions, topping up those levels which have gone down check that nuts and bolts of the various attachments are properly tightened.
- Check that the brakes lock and release at the right time and all operate correctly.

## 9. MAINTENANCE:

### Introduction

Maintenance can be "routine or unscheduled".

**ATTENTION:** All maintenance activities must be carried out under safety conditions.

### 9.1 Routine maintenance:

The operator is responsible for routine maintenance and must carry out the following activities.

- After a brief operating period of about 100 hours (breaking-in), change the oil in the gear unit and the multi-disk brake (if installed) and wash the interior of the unit with cleaning liquid.
- Check that there are no metallic parts with unusual dimension in the magnetic plug of the gear unit and in any multi-disk brake.
- Change the oil in the gear unit while it is hot so that it is easier to drain.

- Subsequent oil changes will be made every 200-2500 hours of operation or, in any case, each year.
- Do not mix different types of oil.
- Periodically check the levels (about once a month) and top up if necessary.

**ATTENTION:** when checking the oil levels in gear units equipped with a multi-disk brake or hydraulic motor or both, if the levels have risen, this means that oil is penetrating either from the brake seals or from the motor rotary seal. Contract the "Brevini Service Department".

- For each unit it is recommended to keep a chart that will be duly filled out and updated each time maintenance is performed.

### 9.2 Oil Change

- Use the diagrams on paragraph 2.2 "configuration" to identify the oil plug according to the gear unit configuration and always paragraph 2.2 for the multi-disk brake configuration. Unscrew the drain plug and the filler plug to help drain the oil from the gear unit. Once the oil has been emptied, replace the drain plug. If the gear unit is equipped with a multi-disk brake, repeat the same operation with the multi-disk brake.
- In the MDU series, starting with size "550", a pipe is supplied to empty the oil in the gear unit, therefore it must be emptied using a suction pump, removing the plug from the emptying pipe located on the flange attaching the gear unit and fitting to it.
- Wash the interior of the gear unit with a suitable cleaning liquid that is recommended by the lubricant manufacturer. If the gear unit is equipped with a multi-disk brake, repeat the same operation with the multi-disk brake, as follows:  
Put liquid into the gear unit and the multi-disk brake (if any), then replace the filter plugs; run the device for a few minutes at a high speed, then remove the cleaning liquid again from the gear unit and the multi-disk brake. (if any).
- See paragraph 7 Lubrication for filling instructions.

### 9.3 Unscheduled maintenance

Brevini Riduttori prohibits the gear unit to be opened to carry out any operation that is not included in routine maintenance procedures. Brevini Riduttori do not undertake any liability for all those operations out of routine maintenance which may have caused damages to people or things. When the need arises, contact the nearest Brevini Service Centres as listed on page 117.

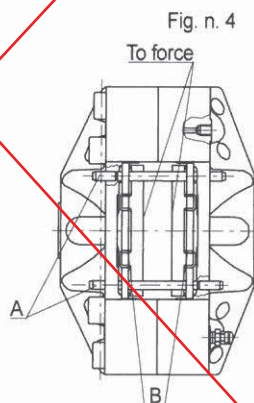
## 10. MAINTENANCE OF AUXILIARIES (BRAKES - CLUTCHES- ETC.):

### 10.1 Procedure to replace disks or seals for multi disk brakes

"Brevini Riduttori S.p.A." prohibits this operation to be performed on its units, therefore if braking action becomes inefficient contact the nearest Brevini Service Centres as listed on page 117.

### 10.2 Procedure to replace pads for disk brakes

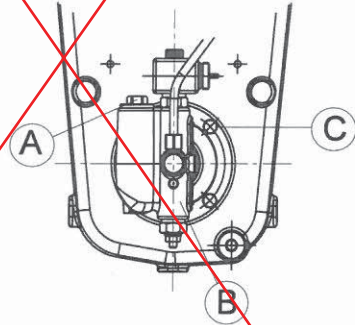
- Use a screwdriver or similar tool to pry between the disk and the pad to make the position of the brake clamp retract up to the start of the stroke. Carry out this operation first on one side and then on the other for both pistons.
- Use a pin remover and hammer to remove one of the two pins "A" from its seat (see fig. 4), remove the two springs "B", then remove the other pin.
- With a mechanical clamp pull out the two worn pads, use



- compressed air to clean away any dust from the pad seats in the brake clamp, then insert the new pads.
- Mount one of the pins "A" in its seat, place the two springs "B" in their position, put them under tension, then mount the other pin in its seat.
- Activate the brake a few times to re-position the pistons of the brake clamp with the new pads.
- Brake a few times to check if bleeding is required.

### 10.3 Maint. proc. for hydr. power pack on gear unit-coupler assembly with active clutch safety system

- The power pack "B" has an inspectable 100 µ bronze filter, upstream of the pressure relief valve.
- With each routine maintenance job (oil change) on the gear unit-coupler assembly you are advised either to change the power pack filter, by unscrewing the cap "A", or at least to regenerate it by washing thoroughly with solvent and blow-cleaning inside the filter with air.
- If the power pack "B" has to be replaced: empty the lubricant oil out of the assembly, cut off the current to the solenoid valve, disconnect the oil delivery tube, unscrew and remove the 4 bolts pos. "C" and then withdraw the power pack for replacement.
- To reassemble, go through the above steps in reverse order; see par. 6.3 for resetting the power pack.



ENGLISH

## 11. SCRAP DISPOSAL:

### 11.1 Machine demolition

- If the machine must be scrapped, it should become non-operational:
- Disassemble the various parts.
- Disconnect any motor unit.
- But first after having completely emptied all the oil from gear unit.

### 11.2 Ecology information

The disposal of gear unit packaging materials, replaced parts, components or the gear unit and lubricants must comply with environmental restrictions, without polluting the soil, water or air. The party receiving the materials is responsible for carrying out the operation in conformity with the current standards in force in the country in which the machine is used.

### Instructions for suitable waste treatment

- Iron, aluminium, copper materials: these are recyclable materials which must be sent to a special authorized collection center.
- Plastic and rubber materials: these materials must be delivered to a dump or to special recycling centers.
- Used oils: deliver to a special C.Di.R.A. (in Italy the Consorzio Obbligatorio Oli Esausti).

## 12. PROBLEMS AND RELATIVE SOLUTIONS:

If malfunctions occur, consult the following table. If the problems continue, contact the nearest Brevini Service Center as listed on page 117.

PROBLEM	POSSIBLE CAUSE	SOLUTION
With motor running the output shaft doesn't turn	1) Incorrect motor assembly 2) Internal malfunction 3) Brake blocked	1) Check coupling between gear unit/motor 2) Contact a Service Center 3) Check hydraulic circuit
Oil leak from breather during operation	1) Level too high 2) Incorrect breather position 3) Possible wear of multidisk brake seals or hydraulic motor	1) Lower oil level 2) Check breather position 3) Contact a Service Center
Oil leak from seals	1) Clogged breather plug 2) Stiffening of seals due to prolonged storage 3) Damaged or worn seals	1) Unscrew and thoroughly clean the plug 2) Clean the area and check for leakage again after a few days 3) Contact a Service Center
Disk brake doesn't brake	1) No pressure to the brake 2) Worn brake pads	1) Check hydraulic circuit 2) Replace brake pads
Excessive vibrations	1) Gear unit incorrectly installed 2) Coupling structure weak 3) Internal malfunction	1) Check the connection and in-line configuration 2) Strengthen the structure 3) Contact a Service Center
Excessive noise	1) Internal malfunction	1) Contact a Service Center
Excessive heating	1) No ventilation 2) High thermal power	1) Remove fairing 2) Insert oil circulation
Multi-disk brake doesn't release	1) No pressure to the brake 2) Internal malfunction 3) No pressure in the circuit	1) Check connection to hydraulic circuit 2) Contact a Service Center 3) Check hydraulic circuit
Multi-disk brake doesn't to look	1) Residual pressure in the hydraulic circuit	1) Check hydraulic circuit
Multi-disk brake doesn't brake	1) Pressure delivered to brake 2) Worn disks	1) Check hydraulic circuit 2) Contact a Service Center

## "S" Serie

### 2.5. INSTALLATION:

#### 2.5.4.2 Installation of gear unit with FS output

- Clean and degrease the internal surface of the gear unit shaft and machine shaft.
- Lubricate the coupling housing (fig. 1 point A).
- If the coupling is new there is no need to disassemble it and grease it.
- If the coupling is being overhauled, disassemble it and grease the zones marked "C" (see fig. 1).
- Remove cap "Z" (see fig. 1) in order to bleed off the air when fitting the shaft.
- Fit the coupling on to the gear unit without tightening the bolts, leaving cap "Z" loose (see fig. 1).

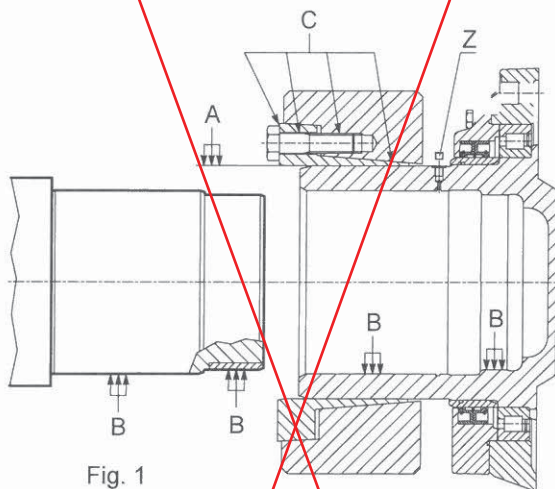


Fig. 1

- If the gear unit is in a vertical working position with the output shaft underneath, make sure the coupling can't come out and fall; in any event, never tighten the coupling bolts before fitting the shaft into its housing.
- Fit the gear unit on to the machine shaft or vice versa (excessive axial force shouldn't be necessary); there should be no interference when assembling, so make sure the shaft and gear unit are properly aligned.
- Refit cap "Z" (see fig. 2), then position the coupling (see fig. 2 point A).
- Using a torque wrench, tighten all the bolts gradually in a circular sequence (i.e. not in a diametrically opposite sequence) until they are all tightened to torque value "T" in table N° 1.
- Set the torque wrench to 3 - 5% above the setting given in table N° 1, then tighten the coupling bolts to the new setting.

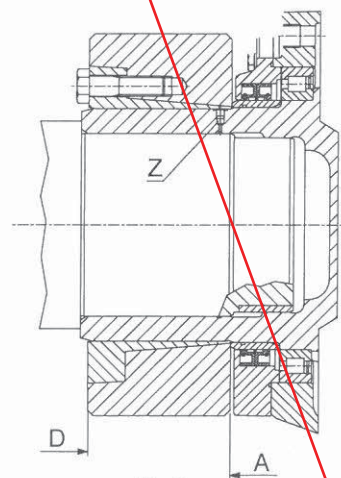
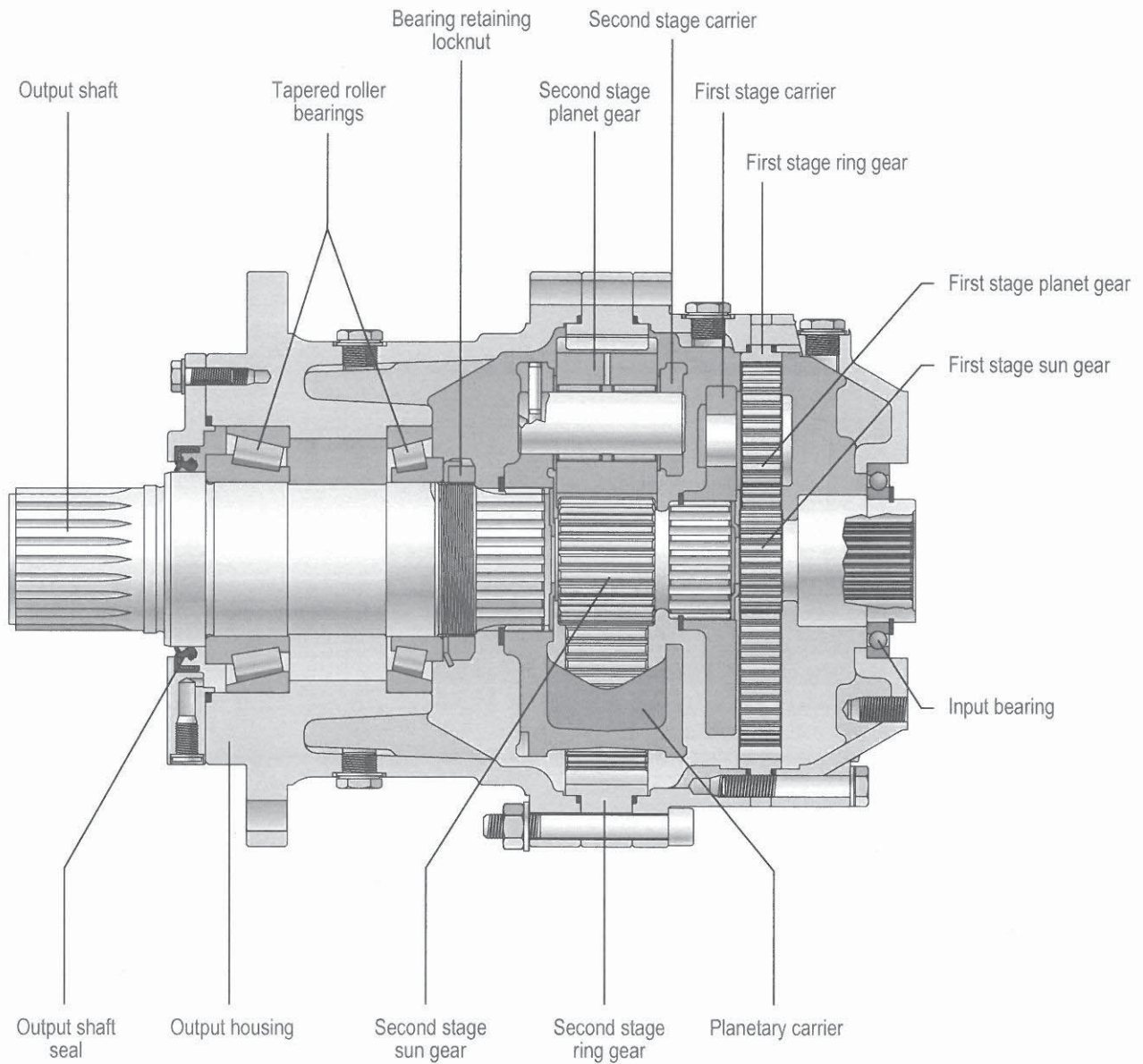


Fig. 2

# Planetary Shaft Drives

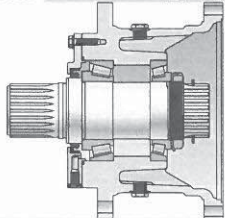
## > CUTAWAY DRAWING OF A TYPICAL TWO STAGE IN LINE SHAFT DRIVE



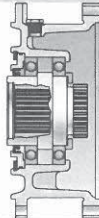
4

**brevini**  
**riduttori**

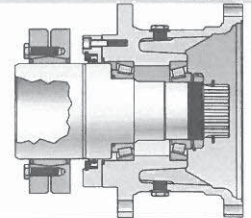
Output shaft  
MR version



Output shaft  
FE version



Output shaft  
FS version

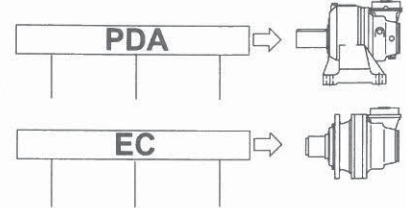
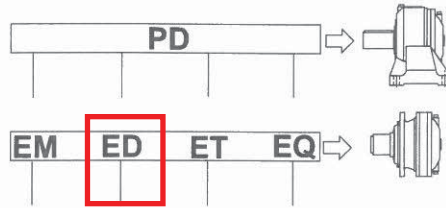


# Ordering Code

## MODEL CODE

**EM**

Version



**1020**

Size

1020, 2020, 3020, 4020

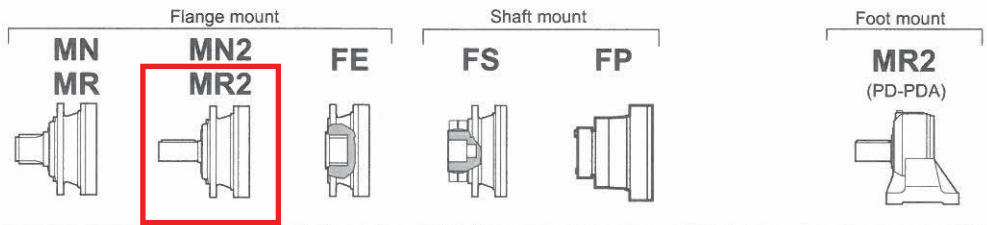
1 stage 2 stages (highlighted) 3 stages 4 stages

2020, 3020, 4020

2 stages 3 stages 4 stages

**MR**

Shaft configuration



**3.08**

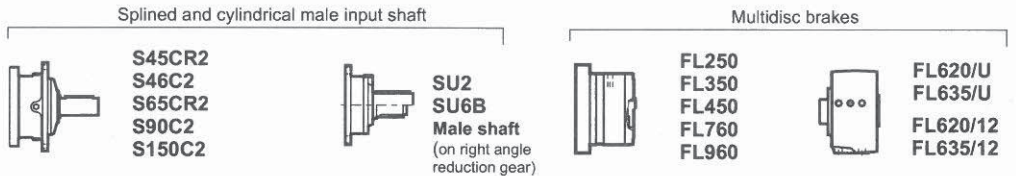
Effective ratio

↓ See data sheet (ieff)

$i_{eff}$	$n_1$ [rpm]												$T_{2MAX}$ [FLb]	$P_1$ [HP]
	1750			1430			1170			870				
	$n_2$ [rpm]	$T_2$ [FLb]	$P_2$ [HP]	$n_2$ [rpm]	$T_2$ [FLb]	$P_2$ [HP]	$n_2$ [rpm]	$T_2$ [FLb]	$P_2$ [HP]	$n_2$ [rpm]	$T_2$ [FLb]	$P_2$ [HP]		
<b>EM 1020</b>														
3.08	568	624	69	464	693	59	390	704	51	282	769	41.5	2050	27
3.60	500	683	65	409	725	57	334	770	49.2	249	842	40.0		

**S45CR2**

Input side accessories



**B3**

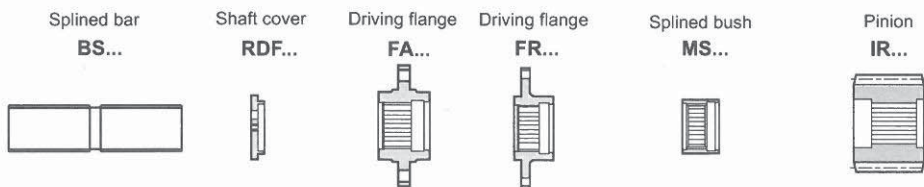
Mounting position

See tables on page 287 - 288

B3 V5A V6A B3D B3A B3B B3C  
 B6 V5B V6B B6C B6A B6B B6D  
 B7 V5C V6C B7A B7B B7C B7D  
 B8 V5D V6D B8B B8A B8C B8D  
 V5  
 V6

**FA020**

Output shaft accessories



Model code example

**EM 1020 MR 3.08 S45CR2 B3 FA020**

# Technical Data

---

## Effective ratio: $i_{\text{eff}}$

Actual reduction ratio provided by our standard gear combination for any size of gear unit. It represents the reduction in speed between input and output gearbox speed. Due to the modularity of the Brevini planetary many more ratios are available than shown. Please consult Brevini for additional ratios.

## Output torque: $T_2$ [FtLb]

Output torque value providing the specified lifetime, calculated according to I.S.O. (D.P. 6336). The values make reference to a theoretically calculated lifetime of 1500 and 10000 hours (application factor  $KA=1$ ) at the relevant speed levels for in line and right angle version. The values take into account both bending and surface strength of the tooth flanks, the latter being (generally) the limiting factor.

## Maximum torque: $T_{2\text{Max}}$ [FtLb]

Maximum allowable intermittent or peak output torque. The specified torque values must be properly reduced in case of installations with many starts or reversals in order to take into consideration gears and shaft strength.

## Nominal Power $P_2$ [HP]

The published values are the combinations of the torque  $T_2$  and speed  $n_2$  for the two lifetime values indicated on the tables.

For right angle units the stated values are related to the universal input versions.

**In cases where actual power exceeds thermal ratings please consult Brevini for application assistance.**

## Thermal Rating $P_T$ [HP]

This is the continuous power transmittable by a gear unit with splash lubrication and max oil temperature of 194 °F.

The values displayed are based on 1430 rpm as input speed, horizontal mount, in open air, ambient temperature of 68 °F, lubrication oil VG 150, continuous duty.

For higher powers, cooling systems may be required.

## Input speed $n_1$ [rpm]

Four levels of input speed have been displayed on the catalogue.

They cover the major range of applications of gearboxes both in industrial and mobile field.

Maximum recommended speed is 1800 rpm. Higher input speeds may be possible please consult Brevini Technical staff in this case.

## Efficiency

The efficiency of the Brevini planetary gearboxes is normally quite high (0.97 - 0.98 for each stage, for middle values of torque and speed), but is reduced at higher speeds and low output torque levels. Particular care should be taken, therefore, on applications involving fractional horse power especially where a right angle drive is concerned (for instance  $P_2 \leq 2\text{-}3$  HP, with  $n_1 \geq 1000$  rpm).

## Application Factor $K_a$

Brevini Planetary gears are designed for rugged service.

However, for proper selection, duty cycle, reversals, frequent starts and stops and load types should be taken into account. In these cases, the actual load should be multiplied by the application factor for the proper sizing of the gearbox.

The table on page 11 provides application factors, taking into account duty and driven load type.

## Allowable temperature

Standard gear units are suitable for oil temperature between  $-4$  °F and 194 °F.

For temperature conditions lower than  $-4$  °F and above 194 °F, special materials and seals may be necessary, which are provided upon request.

## Loads on output shafts

The diagrams on gearbox sections show the allowable radial loads on the output shafts for a ISO L10 bearing life corresponding to:  $n_2 \cdot h = 10^5$  rpm has well as allowable axial loads.

Gear units having female splined output shafts are generally used to transmit pure torque, and are not always suitable to take radial loads.

For any technical question please consult Brevini Technical staff.

## Lubrication oil volume and gear unit weight

In the table on page 284 you can find the relevant average values, for each type of gear unit.

## Start/Stop adjusting factor $C_s$

Factor taking into account frequent starts/stops, reversals.

See page 11.

## Appendix 4.4.5.4

System: Bridge Hoist Machinery  
Component: Parallel Shaft Reducer  
Manufacturer: Jered (NETEC)

# NEW ENGLAND TRAWLER EQUIPMENT Co.

MARINE MACHINERY

SHOCK TESTING EQUIPMENT

INDUSTRIAL MACHINERY



291 EASTERN AVENUE  
CHELSEA, MASSACHUSETTS 02150  
TEL. 617-884-4354

## IMPORTANT NOTICE

THIS INSTRUCTION MANUAL CONTAINS INFORMATION VITAL TO THE SAFETY AND PERFORMANCE OF THE EQUIPMENT DESCRIBED HEREIN. IT IS IMPERATIVE THAT PERSONNEL RESPONSIBLE FOR OPERATION AND MAINTENANCE BE THOROUGHLY FAMILIAR WITH THE CONTENTS OF THIS MANUAL.

FAILURE TO DO SO MAY RESULT IN IMPROPER OPERATION AND/OR MAINTENANCE WHICH WILL DAMAGE THE EQUIPMENT AND VOID OUR WARRANTY.

Date Manuals Shipped 5/ 6/98 QTY.(3)  
Customer CIANBRO CORPORATION, INC.  
Purchase Order No. P.O. 148179RW

**STATE OF MAINE FERRY SYSTEM**

**TECHNICAL MANUAL**

**10 H.P. ELECTRIC  
FERRY RAMP WINCH**

**MODEL X-2558**

SERIAL Nos. 27186, 27187, 27188, & 27189

**FOR**

**CIANBRO CORPORATION**

**P.O. No. 148179RW**

**STATE OF MAINE FERRY SYSTEM**


**NETEC S.O. 9161 - J-8955**

**NETEC, INC.**


291 Eastern Avenue

Chelsea, Massachusetts 02150

TEL. (617) 884-4354 • FAX. (617) 889-5240



**ANY CHANGES OR  
ALTERATIONS MADE  
TO NETEC  
EQUIPMENT AND/OR  
MACHINERY  
WITHOUT THE  
WRITTEN  
AUTHORIZATION OF  
NETEC, INC. AUTO-  
MATICALLY VOIDS  
THE WARRANTY!!!**



## TABLE OF CONTENTS

# SAFETY PRECAUTIONS & WARNINGS

PARAGRAPH	PAGE
GENERAL INFORMATION.....	1
Scope.....	1
Purpose.....	1
Table of Specifications.....	1
Winch Components.....	1
Ratings.....	2
FUNCTIONAL DESCRIPTION .....	2
Introduction.....	2
General Description.....	2
Controls.....	3
Start-Up.....	4
INSTALLATION.....	4
Introduction.....	4
Installation Procedures.....	4
Storage.....	5
Start-Up After Storage.....	6
Reshipment.....	6
OPERATING PROCEDURES.....	6
Introduction.....	6
Operating Procedures.....	7
To Hoist or Lower the Ramp.....	7
To Re-Set th e Automatic Pawl.....	7
Operations Shut-Down.....	8
Emergency Brake Release.....	8
PREVENTIVE MAINTENANCE.....	8
Introduction.....	8
Gear Lubrication.....	8
Initial Oil Change.....	8
Grease Lubrication.....	9
Maintenance Schedule.....	9
Component Maintenance.....	10
Weekly.....	10
General Maintenance.....	10
TROUBLESHOOTING.....	11
Introduction.....	11
Component Troubleshooting.....	12

**TABLE OF CONTENTS**  
**SAFETY PRECAUTIONS & WARNINGS**

PARAGRAPH	PAGE
RECOMMENDED SPARE PARTS LISTS.....	13
Introduction.....	13
Recommended Spare Parts.....	13

**DRAWINGS FOUND IN THE POCKET AT THE REAR OF THIS MANUAL.**

**NETEC E3091200: 10 H.P. Electric Ferry Ramp Winch General Arrangement.**

**NETEC B3299500: Back-Up Brake Control Interface Electrical Schematic**

# **SAFETY PRECAUTIONS**

The following are general safety steps. These should be understood and followed at all times:

- a. All circuits not known to be dead must be considered alive at all times.
- b. Do not wear loose clothing or long hair when working with rotating machines.
- c. Do not use metal tools or objects when working near electricity.
- d. Be certain you are **not** grounded when using test meters or making adjustments.
- e. Shut off power before making any connections.
- f. When using a meter, select a range higher than expected.
- g. Do not use test equipment known to be in poor condition.

---

## **RESUSCITATION**

A high voltage is required to operate deck machinery. Those working with the motor and control(s) should know modern methods of resuscitation.

---

## **WARNING**

The National Safety Council, Accident Prevention Manual for Industrial Operations, 7th Edition and other recognized safety sources make a common point: "All employees working with cranes or hoists or assisting in hooking or arranging a load should be instructed to keep out from under load. From a safety standpoint, one factor is paramount: conduct all lifting operations in such a manner that if there were an equipment failure, no personnel would be injured. This means keep out from under raised load and keep out of the line of force of any load."

**CAUTION AND WARNING NOTES.** Warnings and cautions which appear elsewhere in this manual are repeated here for emphasis.

**WARNING**

**UNDER NO CIRCUMSTANCES SHOULD THE WINCH BE USED TO RAISE OR LOWER PERSONNEL!**

**WARNING**

**BEFORE OPERATING, MAKE CERTAIN ALL PERSONNEL ARE CLEAR OF THE DECK AREA SURROUNDING THE WINCH AND CLEAR OF THE RAMP OPENING. NOTIFY ALL PERSONNEL THAT THE WINCH IS READY FOR USE.**

**WARNING**

**IMPROPER INSTALLATION AND MOUNTING CAN CAUSE PREMATURE WEAR OF WINCH COMPONENTS.**

**WARNING**

**IT IS THE RESPONSIBILITY OF THE CUSTOMER, NOT THE WINCH MANUFACTURER, TO PROPERLY LOCATE AND INSTALL THE WINCH WITH REGARD TO THE SAFETY OF THOSE OPERATING THE MACHINERY. INSTALL THE WINCH IN AN AREA WHERE THERE IS AMPLE ROOM TO OPERATE THE WINCH WITHOUT THE OPERATOR BECOMING ENTANGLED IN THE CABLES, LINES, WINCH MECHANISM, OR OTHER NEARBY EQUIPMENT, OR SO AS TO ENDANGER OTHER PERSONNEL WORKING IN THE VICINITY OF THE WINCH OR AT ADJACENT EQUIPMENT.**

**CAUTION**

**UPON RECEIPT OF THE MACHINERY, IT IS THE RESPONSIBILITY OF THE CUSTOMER/SHIPYARD TO PROPERLY STORE AND PRESERVE THE MACHINERY FROM DAMAGE.**

# 10 H.P. ELECTRIC FERRY RAMP WINCH MODEL X-2558

## GENERAL INFORMATION:

**SCOPE.** This manual covers the NETEC Model X-2558, 10 H.P. Electric Ferry Ramp Winch for 1-inch wire rope. It describes how the winch works and how to operate and maintain it. No special tools or test equipment are required.

**PURPOSE.** By running lines from the winch drum through a series of five sheaves the winch is used to smoothly raise and lower the ferry's boarding ramp.

The General Arrangement and a parts list of the winch is shown on NETEC Model X-2558, General Arrangement Drawing E3091200 enclosed in a pocket in the back of this manual. The Table of Specifications lists the important features of the winch.

<b>TABLE OF SPECIFICATIONS</b>	
Model Number	X-2558
Serial Numbers	27186-27189
Wire Rope Size	1" Wire Rope
Drum Capacity	125 Feet / Section/ 2 Sections / Drum
Line Pull	3,000 Pounds/ Section
Line Speed	50 Feet Per Minute
Total Line Pull	6,000 Pounds
Motor Brake Holding Capacity	31,000 Lb. Minimum
Motor Horsepower	10 H.P.
Voltage/Cycles/Hertz	440/3/60
RPM	1800
Unit Weight	8,925 Lbs.

**WINCH COMPONENTS.** The major components furnished as part of the 10 H.P. Electric Door Hoist Winches:

- Electric Motor
- Electric Brake
- Right Angle Bevel Gear Box
- Planetary Reducer
- Torque Limiter

## GENERAL INFORMATION: Cont'd.

**RATING.** The winch is rated to hold 125 feet of 1-inch wire rope per section of the single, two-section grooved drum. The total rated line pull is 6,000 pounds, at a rate of 50 feet per minute. The effective rate of movement of the ramp will be 10 feet per minute.

Each winch weighs approximately 8,925 pounds.

## FUNCTIONAL DESCRIPTION:

**INTRODUCTION.** Refer to NETEC General Arrangement Drawing E3091200, for reference and for location of part numbers referred to in the following paragraphs describing the winch.

**GENERAL DESCRIPTION.** The NETEC Model X-2558, 10 H.P. Electric Ramp Hoisting winch consists of a single, fabricated steel, grooved, split drum, electrically driven winch for 1-inch wire rope. The split drum is driven by a 10 H.P. 440/3/60V electric motor with a fail-safe electric brake, through a helical-bevel gear box, planetary reducer, and final spur gear reduction. Each portion of the drum is designed to store 125 feet of 1-inch wire.

- a. The winch, as shown on NETEC Dwg. E3091200 consists of a fabricated, split, grooved, steel drum (25) sized to store 125 feet, of 1-inch wire rope. The winch is rated for a line pull of 3,000 pounds per section of the drum with a total of 6,000 pounds of line pull at 50 feet per minute.
- b. The winch is powered by a 10 horsepower, 440/3/60, 1800 RPM, marine duty, electric motor (20) with a spring set, electrically released motor brake (21) , both equipped with space heaters. The right angle helical-bevel gear drive (18), has a second electric brake (19), mounted on the right angle shaft, that is activated by the PLC controls. The output shaft of the helical-bevel gear drive (18) is directly coupled to the planetary reducer (17) which is keyed (41) to a coupling (117), pinned (14) to the primary shaft (12) and enclosed in the gearcase.
- c. The primary pinion (9) is keyed (10) to the primary shaft (12), driving the primary gear (59). The primary gear (59) rides on the friction disc faces of the the torque limiter (60) providing a slip differential. The torque limiter is keyed (64) to the final/intermediate shaft (63) and supports the primary gear (59). Also keyed (66) to the intermediate/ final shaft is the final pinion (67) which drives the final gear (48) with a ratchet welded to the outer flange of the gear. The final gear (48) is keyed (47) to the drum shaft (29).

## **FUNCTIONAL DESCRIPTION Cont'd.:**

d. Welded to the hub of the final gear (48) is a sprocket to chain-drive the pawl clutch sprocket (35) on the pawl shaft (33). A second sprocket (44), keyed (43) to the opposite end of the pawl shaft (33), is chain-driven by a sprocket (46) keyed (54) to the sprocket shaft (53) and supported by a bearing stand (49) with a flanged bushing (50); all located below the final gear. Also keyed (55) to the sprocket shaft (53) is a larger sprocket (56), which is chain-driven by a sprocket (11) keyed (10) to the primary shaft (12). This sprocket and chain system drives the ratchet and pawl mechanical locking system (40) to provide a bi-directional "fail-to-lock" feature. This system is completely enclosed in the gear case.

e. The drum shaft (29) extends through the split drum (25) with the shaft turning on bronze bushings (28 & 32). The drum (25) is keyed (30) to the shaft and is axially contained by bronze thrust washers (32). The drum (4) turns when power is applied to the winch.

f. The pawl operates automatically. The chain drive connected to the primary shaft rotates the pawl shaft at the same speed the chain drive connected to the final gear rotates the friction plate. The friction plate is threaded onto the pawl shaft with an Acme power screw thread. As such, during normal operations, once the friction plate is screwed against the pawl, it will not move away axially during shaft rotation.

On "HAUL-IN" the spring (70), attached to the pawl lever arm, with assistance from the sprag clutch, pulls the pawl into the ratchet. The pawl arm slips along the ratchet teeth during drum rotation and is always engaged. In the event of gear train failure, the pawl falls onto the ratchet, preventing additional drum rotation. During payout, the drag of the friction disk rotates the pawl downward against the spring and holds the pawl out, allowing the drum to rotate. If the drum is overhauled, or a failure in the gear train is detected, the rotation of the drum chain will tend to screw the friction disk out away from the pawl, the spring will overcome the weight and pull the pawl into the ratchet, stopping the drum.

g. The PLC, located in the small control enclosure mounted near the winch, senses the speed of the drum when running. If this exceeds normal running speed, the PLC will set the auxiliary brake and trip the emergency stop circuit, stopping the motor and setting the motor brake. If the drum is still being overhauled, the automatic pawl will engage the drum and stop the winch. See OPERATING PROCEDURES for instructions on resetting the automatic pawl.

**CONTROLS.** The winch requires a separate motor starter and controls to drive the winch that are to be supplied by others.

## FUNCTIONAL DESCRIPTION Cont'd.:

**START-UP.** Before attempting to start the winch, check to see that the gear reducer cases have been properly filled with oil and that the flange bearings have been properly lubricated.

The winch must be wired to the electrical system through the motor starter and control stations according to the manufacturer's instructions. The Back-Up Control Interface NETEC Electrical Schematic B3299500 can be found in the rear of the text section, and in the pocket at the rear of the manual.

## INSTALLATION:

**INTRODUCTION.** Refer to the General Arrangement drawing E3091200 loaded in the pocket at the rear of this manual for the location and identification of parts referenced in the following paragraphs.

### **WARNING**

**IT IS THE RESPONSIBILITY OF THE CUSTOMER, NOT THE WINCH MANUFACTURER, TO PROPERLY LOCATE AND INSTALL THE WINCH WITH REGARD TO THE SAFETY OF THOSE OPERATING THE MACHINERY. INSTALL THE WINCH IN AN AREA WHERE THERE IS AMPLE ROOM TO OPERATE THE WINCH WITHOUT THE OPERATOR BECOMING ENTANGLED IN THE CABLES, LINES, WINCH MECHANISM, OR OTHER NEARBY EQUIPMENT, OR SO AS TO ENDANGER OTHER PERSONNEL WORKING IN THE VICINITY OF THE WINCH OR AT ADJACENT EQUIPMENT.**

**INSTALLATION PROCEDURES.** Lift the winch off its shipping skid using a crane and slings.

- a. Inspect the unit for any signs of damage that may have occurred in transit.
- b. Mount the unit carefully on a suitably prepared foundation, reinforced for the design loading. Shim under the mounting pads as necessary to avoid distortion of the winch frame, and gear alignment.

### **WARNING**

**IMPROPER INSTALLATION AND MOUNTING OF THE WINCH CAN CAUSE PREMATURE WEAR OF WINCH COMPONENTS.**

## **INSTALLATION: Cont'd.**

- c. Make sure the winch is properly aligned with the blocks and sheaves before securing.
- d. Secure the winch with twenty-one (21) 1-inch, Grade 8 Foundation bolts (supplied by others).
- e. Before operating the winch, check the oil level in the gear reducer cases to be sure they are filled to the proper levels; add oil if necessary. The bevel-box reducer should take approximately five (5) pints of oil, and the planetary reducer should hold 2½ quarts of oil. NETEC recommends using Mobil Uptime™ SHC 634 Gear Lubricant, which is for both high and low temperature applications, in all of the winch gear boxes.

The winch gearcase will require approximately 35 gallons of oil.

- f. Mount the Brake Control Interface enclosure in a protected location near the winch, and wire according to NETEC Electrical Schematic B3299500 found at the rear of this text and in the pocket at the rear of the manual.
- g. The winch motor, brakes, and Brake Control Interface must be connected to a motor controller. The motor controller and push-buttons are to be supplied and installed by others.
- h. The geared motors and gear units were lubricated before shipment from the factory and assembly. All grease points on the winch were thoroughly lubricated at the factory prior to shipment, and the winch should be ready for operation. Refer to the manufacturer's bulletins included in this manual for information on oil changes and the LUBRICATION section for re-greasing directions.
- i. Operate the winch in both directions at no load to check for the proper direction of rotation. If the winch does not operate in the proper direction, reverse any two motor leads.
- j. The winch is then ready for use, and to have the wires run from the split drum through the blocks and sheaves and attached to the ramp.

**STORAGE.** If the winch is to be stored for a long period of time, fill the gear reducers completely with oil. Coat all unpainted surfaces with preservative oil. If not stored in an enclosed, heated area, take steps to prevent condensation in the motor, brake and controls. Either supply a heat source, or enclose sufficient packages of silica gel to prevent moisture damage.

## **INSTALLATION: Cont'd.**

### **CAUTION**

**UPON RECEIPT OF THE MACHINERY, IT IS THE RESPONSIBILITY OF THE CUSTOMER/ SHIPYARD, NOT THE MANUFACTURER, TO PROPERLY STORE AND PRESERVE THE MACHINERY FROM DAMAGE.**

**START-UP AFTER STORAGE.** Before starting the unit following a long period of storage, drain the gear reducers to the proper level. If the winch has been stored with a special long term storage oil, the gear reducers will need to be drained and refilled with the proper AGMA 5 lubricant.

**RESHIPMENT.** If the unit must be packed for reshipment, securely bolt the winch to a suitably strong skid, large enough to provide support for the entire unit. Suspended components should be blocked and strapped to the pallet to reduce stress on the components in transit.

---

## **OPERATING PROCEDURES:**

**INTRODUCTION.** This section will outline procedures for the correct operation of the NETEC Model X-2558, 10 HP Electric Ferry Ramp Winch.

**OPERATING PROCEDURES.** After the unit has been properly installed, connected to electric service and checked out (run at no load), it is ready to have the wire rope wound onto the drum sections and through the blocks and sheaves securing it to the ramp. With all connections made, the winch is ready for service.

---

### **WARNING**

**UNDER NO CIRCUMSTANCES SHOULD THE WINCH BE USED TO RAISE OR LOWER PERSONNEL!**

---

### **WARNING**

**BEFORE OPERATING MAKE CERTAIN ALL PERSONNEL ARE CLEAR OF THE AREA SURROUNDING THE WINCH, AND CLEAR OF THE RAMP. NOTIFY ALL PERSONNEL THAT THE WINCH IS READY FOR USE.**

## OPERATING PROCEDURES.

### TO OPERATE THE FERRY RAMP WINCH TO RAISE OR LOWER THE RAMP:

Electrical power must be available.

### TO RAISE THE RAMP:

- a. To raise the ramp, activate the winch in the haul-in direction.
- b. When the ramp has been raised sufficiently by the winch, the operator should stop activating the winch in the haul-in direction. The fail-safe motor brake will stop the winch and hold the load.

### TO LOWER THE RAMP:

- a. To lower the ramp, the operator should activate the winch in the pay-out direction.
- b. When the ramp has been lowered sufficiently by the winch, the operator should stop activating the winch in the lower direction. The fail-safe motor brake will stop the winch and hold the load.

### TO RESET THE AUTOMATIC PAWL:

#### NOTE

**IF THE PAWL HAS SET AUTOMATICALLY, SOMETHING DRASTIC HAS OCCURRED!! UNTIL THE PROBLEM HAS BEEN FOUND AND CORRECTED, DO NOT RE-SET THE WINCH AND RESUME OPERATIONS. BEFORE EXAMINING THE WINCH, SECURE THE MOTOR CONTROLLER, AND ALL WIRES LEADING FROM THE WINCH, OR SERIOUS INJURY COULD OCCUR!**

- a. Remove the protective bronze cover on the right angle gear box.
- b. Set the drum against the pawl such that the winch will not pay-out using the hand wheel. The hand wheel is attached to the gear train at the right angle gear box.
- c. Continue to rotate the hand wheel in the pay-out direction until the friction disc is snug against the pawl. Use shim stock to sense when the disc is close.
- d. Try to haul-in with the hand wheel for approximately  $\frac{1}{16}$  turn of the drum. Then try to pay out. If the pawl moves downward and sets out, allowing the winch to pay-out., the friction disc is set correctly. If the pawl comes back in when paying out, repeat steps 2-4 again.

## **OPERATING PROCEDURES: Cont'd.**

e. Cycle the power to the PLC to re-set the program. The winch is now operational again.

**OPERATIONS SHUT-DOWN:** At the conclusion of winch operations, the winch can be shut-down by doing the following:

a. When the pushbuttons are released, the winch will stop, applying the brakes, to hold the ramp.

b. The electric power to the winch motor starter will be cut by turning the dis-connect handle in the door of the motor starter /controller, setting the brakes.

**EMERGENCY BRAKE RELEASE.** Should it become necessary to release the motor brake on the winch with power unavailable, it is possible to do so using the **EMERGENCY MANUAL BRAKE RELEASE**. (See the **STEARN'S Bulletin** enclosed in this manual.

## **PREVENTIVE MAINTENANCE:**

**INTRODUCTION.** Refer to NETEC Assembly Dwg. E3091200 for the location and identification of part numbers referred to in the following paragraphs.

**GEAR LUBRICATION.** The gears in the helical-bevel reducer and planetary reducer are lubricated from the oil within the case. Fill the reducers with an oil from the manufacturer's recommended list of lubricants in this manual. The helical bevel reducer should take approximately 5 pints of oil. The planetary reducer should require approximately 2½ quarts. NETEC recommends using Mobil Uptime™ SHC 634 Gear Lubricant, which is for both high and low temperature applications, in all of the winch gear boxes. Refer to the manufacturer's instructions as to the location of the drain, level and fill plugs.

The winch gearcase requires approximately 35 gallons

**INITIAL OIL CHANGE.** The oil in the reducer should be drained after the first one hundred (100) hours of operation. Drain the oil from the reducer, preferably while the reducer and oil are still warm. Flush the gear case with an approved non-flammable, non-toxic solvent and refill with an AGMA 5 EP lubricant. Subsequent oil changes should occur after every 2,500 hours of operation or every six months, whichever occurs first. See the Brevini Gear section in the back of this manual.

## PREVENTIVE MAINTENANCE

<b>RECOMMENDED LUBRICANTS</b>	
for use with <b>NETEC DECK MACHINERY</b>	
	<b>JULY 25, 1997</b>
Hydraulic Oil (Open Loop)	Mobil DTE-26M
Spur, Helical Gears	Mobilgear 632
Planetary Reducers	Mobilube HD 80W 90
All Worm Gearing (including Cone Drive)	Mobil 600W Super Cylinder Oil MIL-L-15019C Symbol 6135 Mobil SHC-634 Synthetic Lubricant
Open Gearing (Spray Cans)	MobilTac E Lubriplate Open Gear Shield
Grease Fittings	Mobilax EP #2 Lubriplate Marine Lube "A"
Preservative Treatment	Mobilarma 524
Low Temperature Gear Cases	Mobil "Uptime" SCH634

NOTE: Lubricant manufacturers shown are not exclusive recommendations. Consult your lubricant source for oil selection.

**GREASE LUBRICATION.** Four points on the winch have pressure grease fittings; two on the cartridge bearings, and two fittings on the bronze drum bushings. Lubrication points are marked on the general arrangement drawing with the symbol L. A grease gun lubricant meeting Mobilax EP #2 or equal is recommended.

**MAINTENANCE SCHEDULE.** The table below provides a summary of scheduled maintenance actions.

<b>SCHEDULED MAINTENANCE.</b>		
<b>LOCATION</b>	<b>FREQUENCY</b>	<b>PROCEDURE</b>
Gear Oil	Annually	Drain & refill gearcases.
Electrical Connections	Daily when operating	Inspect all connections for loose wires and correct immediately.
Bolted Connections	Monthly	Check all winch connections and foundation bolts. Retighten as necessary.

## **PREVENTIVE MAINTENANCE**

**COMPONENT MAINTENANCE.** Refer to the manufacturer bulletins in the back of this manual for maintenance instructions on the motor, brakes and reducers and other components of the hoist system.

**WEEKLY.** All exposed moving components and controls on the Winch, including component parts, should be inspected at least weekly for freedom of movement and proper mobility. Each item should be cleaned and lubricated weekly in accordance with the manufacturer bulletins contained in this manual. If it is necessary to disassemble and remove parts such as handles to properly maintain them, disassemble, clean, flush with an appropriate solvent, and lubricate the part and reassemble the component only in accordance with the manufacturer bulletin.

**GENERAL MAINTENANCE.** Prior to shipping, the winch was coated with a marine coating paint system, consisting of inorganic zinc, epoxy tie coating, and silicone alkyd enamel, which should resist deterioration for a long period of time. If the coating becomes damaged, the damaged area should be thoroughly cleaned and resealed with a good quality marine paint.

Periodically, all foundation and connection bolts should be tightened. Maintain oil levels and grease applications in all components.

### **CAUTION**

**UPON RECEIPT OF THE MACHINERY, IT IS THE RESPONSIBILITY OF THE CUSTOMER/SHIPYARD TO PROPERLY STORE AND PRESERVE THE MACHINERY FROM DAMAGE.**

## **TROUBLESHOOTING:**

**INTRODUCTION.** If trouble is encountered during normal operations of the winch, the table below provides a guide for isolating the fault in a logical manner.

<b>TROUBLESHOOTING GUIDE.</b>		
<b>PROBLEM</b>	<b>CAUSES</b>	<b>REMEDY</b>
<b>Oil leakage.</b>	<b>Leakage from reducer.</b>	<b>Replace shaft seals on reducers where oil is leaking. Wipe up spill, &amp; reinspect for additional leakage from housing.</b>
	<b>Leakage from reducer housing cover plates.</b>	<b>Tighten cover bolts, or remove &amp; clean cover plates, apply new sealing compound.</b>
	<b>Too much oil in reducer.</b>	<b>Drain oil to proper level on oil level gauge.</b>
<b>Winch stalls easily.</b>	<b>Motor controller malfunctioning.</b>	<b>Check for a broken leadwire /electrical connection.</b>
		<b>Check for correct voltage. 10%± correct line voltage will cause magnet failure, &amp; coil burn-out.</b>
		<b>Check for charred/burned out coils.</b>
	<b>Motor brake not releasing.</b>	<b>Check for excessive spacing or gap. See Stearn's bulletin.</b>
		<b>Check for broken or damaged brake parts.</b>
		<b>Check for failure of power supply to brake.</b>
<b>Over-heating reducer.</b>	<b>Insufficient oil or too much oil.</b>	<b>Check oil levels in the reducers. Adjust them to the proper levels.</b>
	<b>Locate hot spot.</b>	<b>Check for worn bearings.</b>
	<b>Wrong grade of oil.</b>	<b>Flush &amp; refill reducers with proper grade of oil.</b>

<b>PROBLEM</b>	<b>CAUSES</b>	<b>REMEDY</b>
<b>Noise &amp; vibration.</b>	<b>Loose foundation bolts.</b>	<b>Check &amp; tighten all mounting bolts.</b>
	<b>Overloading.</b>	<b>Reduce the load, check the gears &amp; replace, if worn.</b>
	<b>Insufficient oil.</b>	<b>Check the oil level in the reducer. Adjust the level to between the high/low readings on the sight gauge.</b>
	<b>Loose parts.</b>	<b>Inspect for broken parts, loose bolts, nuts, &amp; screws. Check the keys for size &amp; fit.</b>
	<b>Bad bearing.</b>	<b>Determine the shaft by the noise frequency. Disassemble &amp; replace the bearing.</b>
	<b>Motor loose.</b>	<b>Check &amp; tighten all motor &amp; adapter bolts.</b>
	<b>Motor brake chatters or hums.</b>	<b>Check brake magnetic faces for dirt; to remove the dirt, insert a clean sheet of paper to dislodge the dirt, apply brakes &amp; then remove the paper.</b>
<b>Check for brake disc alignment.</b>		
<b>Winch will not pay-out.</b>	<b>Automatic Pawl may have set.</b>	<b>See Pawl Re-Set in Operations Section.</b>

**COMPONENT TROUBLESHOOTING.** Refer to the manufacturer bulletins in the back of this manual for additional troubleshooting information on the motor brake, gear reducer and other components.

## RECOMMENDED SPARES PARTS LISTS:

INTRODUCTION. This table references parts lists as found on NETEC 10 H.P. Electric Ferry Ramp Winch Drawing E3091200 and on the associated NETEC Drawing: Back-Up Brake Control Interface Electrical Schematic B3299500.

* MANUFACTURER RECOMMENDED SPARE PARTS LIST FOR 1-2 YEARS NORMAL SERVICE PER NETEC GENERAL ARRANGEMENT DWG. E3091200/ PER EACH WINCH.			
ITEM	DESCRIPTION	PART NUMBER	QTY/UNIT
4	GASKET	B3109300	2
5	BEARING CARTRIDGE	B3106600	2
6	CARTRIDGE GASKET	B3107700	2
7	BALL BEARING	05A0228	4
16	REDUCER GASKET	B3111400	1
17	REDUCER 25.98:1	03A0044	1
*	O-RING #8-33/1100	412-3410-0000	1
*	BEARING #15-33/1100	422-1410-0000	1
*	BEARING #16-33/1100	422-1390-0000	1
*	LIP SEAL #18 -33/1100	411-3400-0000	1
*	O-RING #15-00/4108	412-2170-0000	2
*	O-RING #22-00/4043	412-2090-0000	2
*	BEARING #25-00/4043	421-1930-0000	1
*	IN-PUT GASKET #4-611-308J-2500	366-0224-9000	1
*	LIP SEAL #7-611-308J-2500	411-2790-0000	1
18	BEVEL GEAR DRIVE 2:1	03D0012	1
*	CUP,BEARING	8-32-20-58-006	4
*	CONE,BEARING	8-32-20-68-006	4
*	SEAL	8-74-21-25-017	2
*	SEAL	8-74-21-28-902	1
*	O-RING	8-74-80-09-072	3

ITEM	DESCRIPTION	PART NUMBER	QTY/UNIT
19	MOTOR BRAKE, 50#	02A0040	1
*	FRICTION DISC KIT	5-66-8472-00	2
*	SOLENOID KIT	5-66-5061-00	1
*	460 COIL KIT	5-66-6604-33	1
*	SPACE HEATER	9-62-2057-00	1
20	10 HP MOTOR, 1800 RPM	01A0040	1
*	DE BEARING	10-91308-14-5-S	1
*	OE BEARING	9-91306-14-5-S	1
*	SEAL #33	33-93237	1
*	SEAL #33	56-93120	1
21	MOTOR BRAKE, 105#	02A0041	1
*	FRICTION DISC KIT	5-66-8472-00	3
*	SOLENOID KIT	5-66-5081-00	1
*	460 COIL KIT	5-66-6804-33	1
*	SPACE HEATER	9-62-2057-00	1
27	THRUST WASHER	B3080200	1
28	BUSHING	B3095400	1
31	THRUST WASHER	B3068500	1
32	SPLIT BUSHING	B3095500	1
36	CLUTCH FRICTION FACING	B3107100	1
37	RIVETS	11C0101	12
38	BUSHING	A3110300	1
50	FLANGED BUSHING	05A0224	1
51	THRUST WASHER	05A0229	1
58	COVER PLATE GASKET	B3107500	1
61	FLANGE BEARING	05A0180	2
62	CARTRIDGE GASKET	B3107800	1
111	THRUST SPACER	A3113100	1
114	PROXIMITY SENSOR	18G0011	2

NETEC, INC.

4/30/98  
1:08 PM

M E3091200A - E3091200A - X-2558 10 HP RAMP WINCH G.A.  
Quantity 1

**Bill of Material Report**

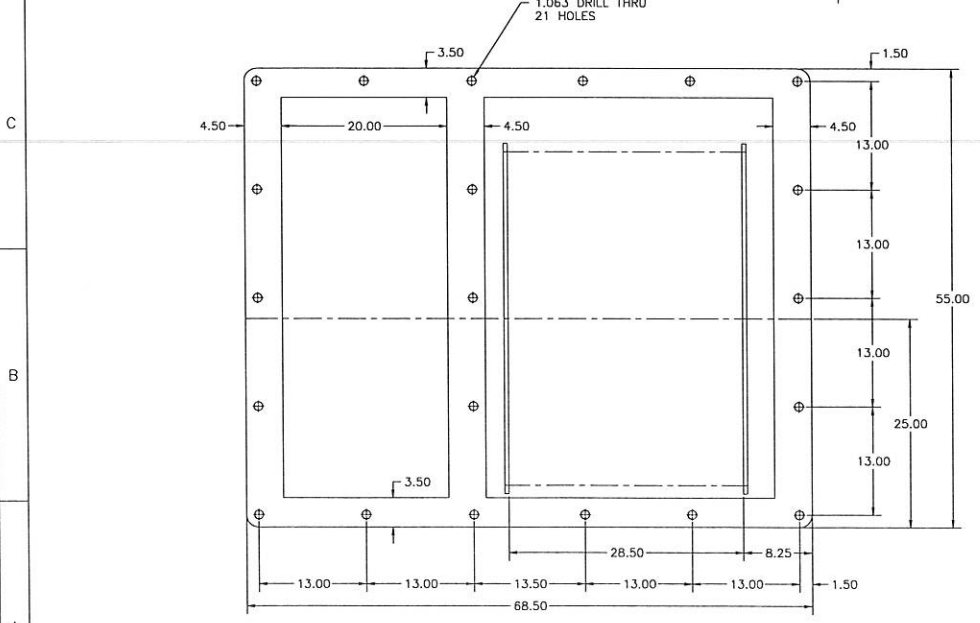
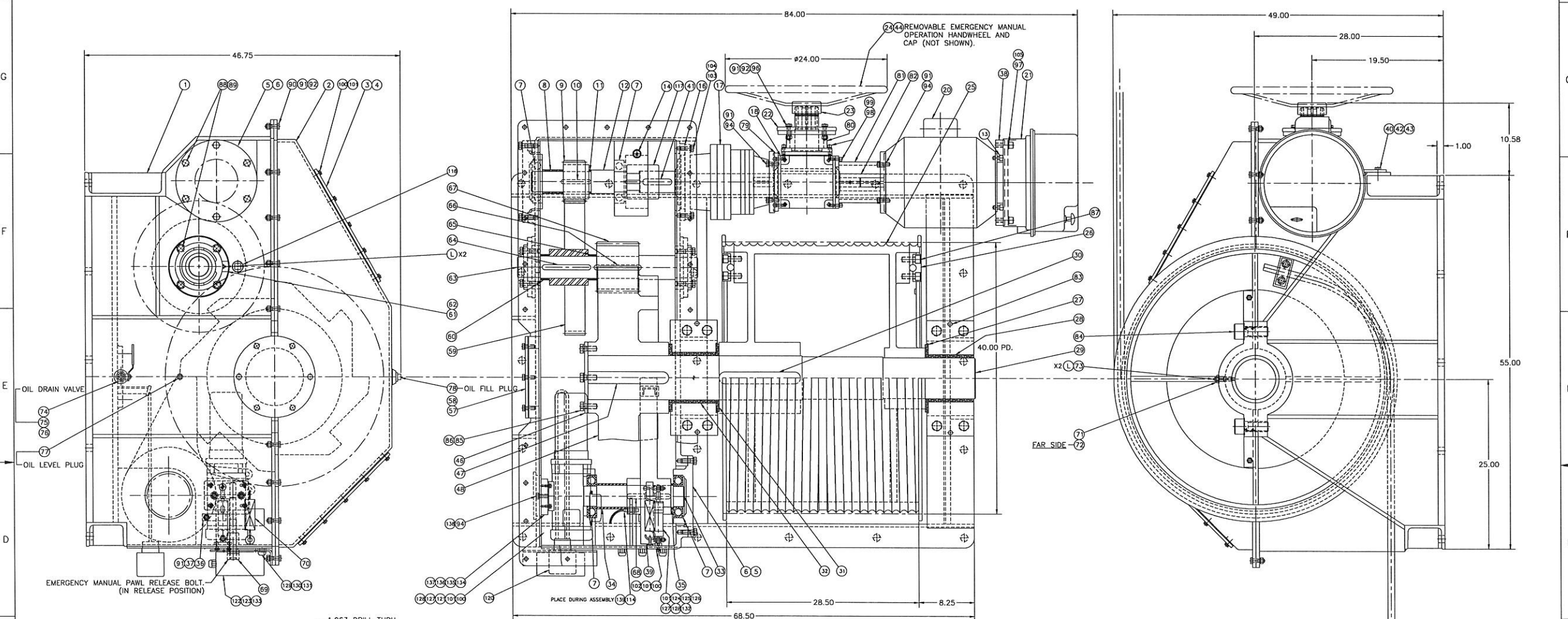
Piece #	Detail	Quantity
1	M E3091200A-1 - H3095700- - BEDFRAME/GEARCASE X-2558	1
2	M E3091200A-2 - D3095800- - GEARCASE COVER X-2558	2
3	M E3091200A-3 - B3109200- - ACCESS COVER X-2558 WINCH	2
4	M E3091200A-4 - B3109300- - ACCESS PLATE GASKET X-2558 WINCH	2
5	M E3091200A-5 - B3106600- - BEARING CARTRIDGE X-2558	2
6	M E3091200A-6 - B3107700- - BEARING CARTRIDGE GASKET 12.00 O/D	2
7	05A0228 BALL BEARING 75mm X 160mm X 37mm	4
8	M E3091200A-8 - A3106000- - SPACER 3.50 O/D X 3.00 I/D X 3.125	1
9	M E3091200A-9 - B3101000- - PINION 19T 3 DP-20PA STUB TOOTH 3.25F	1
10	M E3091200A-10 - B3006440 - KEY ROUND ONE END	1
11	M E3091200A-11 - B3106200- - 30 TOOTH CHAIN SPROCKET	1
12	M E3091200A-12 - B3104400- - PRIMARY SHAFT 3.50 X 16.125	1
13	M E3091200A-58 - A3105800- - SPACER 6.25 O/D X 5.81 I/D X 0.32	1
14	11B0046 PULL-OUT DOWEL PIN 1"DIA X 4.00	1
15	0000000 NOT USED	1
16	M E3091200A-14 - B3111400- - BREVINI 065 GASKET	1
17	03A0044 REDUCER 25.98:1 RATIO	1
18	03D0012 BEVEL GEAR DRIVE 2:1 RATIO	1
19	02A0040 MOTOR BRAKE ELEC 50#' (DBL C) 1.38 SHAFT	1
20	01A0040 MOTOR ELEC 10 HP 1800RPM 460V TENV	1
21	02A0041 MOTOR BRAKE ELEC 105 #'	1
22	M E3091200A-15 - B3108400- - CRANK SHAFT GUARD X-2558	1
23	09D0061 PIPE CAP 3 NPT	1
24	M E3091200A-17 - C3109400- - HANDWHEEL 24.00 DIA (W/HUB)	1
25	M E3091200A-18 - D3094700- - DRUM - 10 HP. RAMP WINCH	1
26	M E3091200A-19 - A3095600- - ROPE CLAMP-10 HP RAMP WINCH	2
27	B3080200- THRUST WASHER 10.0 OD X 6.0 ID X .50	1

Piece #	Detail	Quantity
28	B3095400- BUSHING 6.00 ID X 7.00 OD X 6.75	1
29	M E3091200A-21 - C3095300- - DRUM SHAFT 6.50 X 57.50	1
30	M E3091200A-22 - B3006530 - KEY ROUND BOTH ENDS	1
31	B3068500- THRUST WASHER 6.5 ID X 10.5 OD X .5	2
32	B3095500- SPLIT BUSHING 6.50 ID X 7.50 OD X 6.50	1
33	M E3091200A-23 - B3106700- - PAWL SHAFT X-2558	1
34	M E3091200A-24 - A3107600- - SPACER 3.50 O/D X 3.00 I/D	1
35	M E3091200A-25 - B3107000- - PAWL CLUTCH X-2558	1
36	M E3091200A-26 - B3107100- - FRICTION FACING PAWL CLUTCH	1
37	11C0101 SEMI-TUBE RIVET 9/64 D1A X 0.75	12
38	A3110300- BUSHING 2.955 ID X 3.500 OD X 2.38	1
39	M E3091200A-28 - C3105600- - PAWL 10 HP RAMP WINCH	1
40	05D0002 BACKSTOP w/ TORQUE LIMITER w/ RELEASE	1
41	M E3091200A-29 - B3006448 - KEY ROUND ONE END	1
42	11C0099 EXTERNAL RETAINING RING 2.938 SHAFT DIA	1
43	M E3091200A-30 - B3006442 - KEY ROUND ONE END	1
44	05C0055 CHAIN SPROCKET 32 TEETH (BORED)	1
45	M E3091200A-31 - A3107300- - RETAINER PLATE 2.50 DIA X .25 (1 HOLE)	1
46	M E3091200A-32 - B3107200- - RETAINER PLATE 10.50 DIA X .50 (3 HOLE)	1
47	M E3091200A-33 - B3006447 - KEY ROUND ONE END	1
48	M E3091200A-34 - C3100800- - FINAL GEAR W/RATCHET X-2558	1
49	M E3091200A-35 - B3108000- - BEARING STAND X-2558	1
50	05A0224 FLANGED BUSHING 1.25 ID X 1.50 OD X 1.50	1
51	05A0229 THRUST WASHER 1.25 ID X 1.69 OD X .13	1
52	05C0056 CHAIN SPROCKET 23 TEETH (BORED)	1
53	M E3091200A-37 - A3106800- - SPROCKET SHAFT 1.25 DIA. X 4.531	1
54	M E3091200A-38 - B3006525 - KEY ROUND BOTH ENDS	1
55	M E3091200A-39 - B3006526 - KEY ROUND BOTH ENDS	1
56	M E3091200A-40 - C3106300- - 76 TOOTH CHAIN SPROCKET	1
57	M E3091200A-41 - B3107400- - COVER PLATE A36 .38 X 12.00 DIA	1
58	M E3091200A-42 - B3107500- - COVER PLATE GASKET .13 NEOP	1
59	M E3091200A-43 - C3101100- - GEAR 58T 3 DP-20PA STUB TOOTH 3.00F	1

Piece #	Detail	Quantity
60	05D0003 FRICTION TORQUE LIMITER SIZE 350	1
61	05A0180 4 BOLT FLANGE CART W/C SEAL 3.000 SHAFT	2
62	M E3091200A-44 - B3107800- - MFC 48 GASKET	1
63	M E3091200A-45 - C3104500- - FINAL SHAFT 3.50 X 26.750	1
64	M E3091200A-46 - B3006524 - KEY ROUND BOTH ENDS	1
65	M E3091200A-47 - A3105900- - SPACER 3.75 O/D X 3.28 I/D X 1.50	1
66	M E3091200A-48 - B3006439 - KEY ROUND ONE END	1
67	M E3091200A-49 - B3100900- - PINION 21T 3 DP-20PA STUB TOOTH 6.25F	1
68	M E3091200A-50 - B3108100- - STEPPED KEY 5/8 X 1/2	1
69	M E3091200A-51 - A3108700- - MANUAL PAWL RELEASE BOLT	1
70	11A0093 EXTENSION SPRING 4.5 LG X 1.5 OD X .188	1
71	M E3091200A-52 - B3010406 - RETAINER STUD .625-11 X 2.25	1
72	M E3091200A-53 - B3010405- - RETAINER STUD .625-11 X 2.00	1
73	11C0001 GREASE FITTING 304 ALEMITE #1961-S	2
74	09B0126 CLOSE NIPPLE 3/4 STD PIPE	1
75	07C0001 BALL VALVE 3/4 NPT	1
76	09D0006 SQ HEAD PLUG 3/4 NPT	1
77	09D0009 SQ HEAD PLUG 1/2 NPT	1
78	09D0017 SQ HD PIPE PLUG 1"	1
79	M E3091200A-54 - B3110500- - REDUCER ADAPTER PLATE	1
80	M E3091200A-55 - C3110600- - BRAKE ADAPTER	1
81	M E3091200A-56 - C3110700- - MOTOR ADAPTER	1
82	M E3091200A-57 - A3110400- - SLEEVE COUPLING 1.375 BORE	1
83	14C0001 ROUND BAR 0.625 DIA	4
84	10C0131 SOCKET HD CAP SCREW 1 1/2-6 X 3.50 LG	8
85	10A0002 HEX HD CAP SCREW 1-8 X 2.00	3
86	10A0034 LOCKWASHER 1.00 STD SPLIT	3
87	10D0227 SOCK HD CAP SCREW 5/8-11 X 1.75	4
88	10D0040 HEX HD CAP SCREW 5/8-11 X 1.75	20
89	10D0026 LOCKWASHER 5/8 STD SPLIT	20
90	10D0032 HEX HD CAP SCREW 1/2-13 X 2.00	26
91	10D0025 LOCKWASHER 1/2 STD SPLIT	48

Piece #	Detail	Quantity
92	10D0005 HEX NUT 1/2-13	30
93	10D0049 FLAT WASHER .50 STD	2
94	10D0031 HEX HD CAP SCREW 1/2-13 X 1.50	20
95	10D0029 HEX HD CAP SCREW 1/2-13 X 1.00	8
96	10D0084 SOCK HD CAP SCREW 1/2-13 X 1.75	4
97	10D0195 HI COLLAR LOCKWASHER 1/2 STD SPLIT	10
98	10D0077 SOCK HD CAP SCREW 3/8-16 X 1.50	18
99	10D0197 HI COLLAR LOCKWASHER 3/8 STD SPLIT	18
100	10D0095 HEX HD CAP SCREW 3/8-16 X 1.00	33
101	10D0023 LOCKWASHER 3/8 STD SPLIT	37
102	10C0269 FLAT HD SOCKET CAP SCREW 3/8-16 X 1.00	4
103	10D0230 HEX HEAD CAP SCREW M14 X 40 MM	12
104	10D0231 LOCKWASHER M14 STD SPLIT	12
105	10C0030 SOCKET HD CAP SCREW 1/2-13 X 2.00 LG	10
106	05C0059 CONNECTING LINK #50 ROLLER CHAIN	3
107	05C0058 OFFSET LINK #50 ROLLER CHAIN	3
108	05C0060 #50 ROLLER CHAIN (5/8 PITCH)	1
109	05C0060 #50 ROLLER CHAIN (5/8 PITCH)	1
110	05C0060 #50 ROLLER CHAIN (5/8 PITCH)	1
111	A3113100- THRUST SPACER	1
112	M E3091200A-59 - A3113200- - SPACER 3.38 OD X 3.00 ID X 1.485	1
113	M E3091200A-60 - A3112900- - SPACER 3.50 O/D X 3.00 I/D	1
114	18G0011 PROXIMITY SENSOR 12mm SS 2mm SENS	2
115	M E3091200A-61 - A3113600- - PROXIMITY SENSOR BRACKET	2
116	09D0056 SQ HD PIPE PLUG 1-1/4	1
117	M E3091200A-62 - B3111300A - INTERIM DRIVE COUPLING X-2558	1
118	10D0021 LOCKWASHER 1/4 STD SPLIT	4
119	10D0063 SOCK HD CAP SCREW 1/4-20 X .75	4

CAD DRAWING-NO MANUAL REVISIONS PERMITTED			
REVISIONS			
REV	DESCRIPTION	DATE	BY
A	REVISED TO AS BUILT CONDITION	4-30-98	AJD
B	ADDED POWER UNIT FOR PAWL (GEN. LOC.)	4-30-98	AJD
C	REMOVED SPROCKETS AND CHAINS		
D	MODIFICATION FOR HPU OPERATED PAWL	08/31/98	JMV
E	AS BUILT	07/11/99	PAS
F	CHANGED MOTOR TO 10HP U-FRAME	07/03/00	PAS



FOUNDATION FOOTPRINT

GENERAL NOTES:

- DRUM CAPACITY**  
DRUM IS GROOVED WITH TWO SECTIONS.  
EACH SECTION TO HOLD 125 FT. OF  
1" DIA. WIRE ROPE.
- RATING**  
LINE PULL ON EACH SECTION OF THE  
DRUM = 3,500 LBS. AT 40 FPM.  
(TOTAL LINE PULL = 7,000 LBS.)

<small>© COPYRIGHT NETEC, INC. (New England Trawler Equipment Company) DRAWINGS ARE AND ASSOCIATED HEREIN COMPANY PROPERTY AND NOT TO BE REPRODUCED OR DISTRIBUTED WITHOUT WRITTEN PERMISSION FROM NETEC, INC.</small>	<small>UNLESS OTHERWISE SPECIFIED TOLERANCES ARE: X.X .003 X.XX .0010 X.XXX .0005</small>	<small>DRAWN BY: AJD. CHECKED BY: - APPROVED BY: -</small>	<small>NETEC, NEW ENGLAND TRAWLER EQUIP. CO. 281 EASTERN AVE. CHELSEA, MA. 02150 (617)844-4334 FAX(617)848-3240</small>
	<small>FRACTIONS: 1/16, 1/8, 1/4, 1/2, 3/4 ANGLES: 15°, 30°, 45°, 60°, 75°, 90°, 105°, 120°, 135°, 150°, 165°, 180° FINISH: 1/8" DIMENSIONS ARE IN INCHES</small>	<small>MODEL: X-255B JOB: J-8555 DATE: 01-16-98</small>	<small>TITLE: 10 HP. RAMP WINCH GENERAL ARRANGEMENT</small>

## Appendix 4.4.5.5

System: Bridge Hoist Machinery  
Component: Pawl Hydraulic Pump  
Manufacturer: SPX Stone

**Distributor Power Unit Program**

Model No. 2975-BC

Internet Address:  
<http://www.stonehydraulics.com>**TROUBLE SHOOTING****General**

1. Check to see that the motor is wired correctly with tight connections, and for the proper voltage.
2. Check reservoir oil level.
3. Check relief valve for proper setting with pressure gauge in outlet line.
4. Check for external leakage at cylinders, hoses and power units.

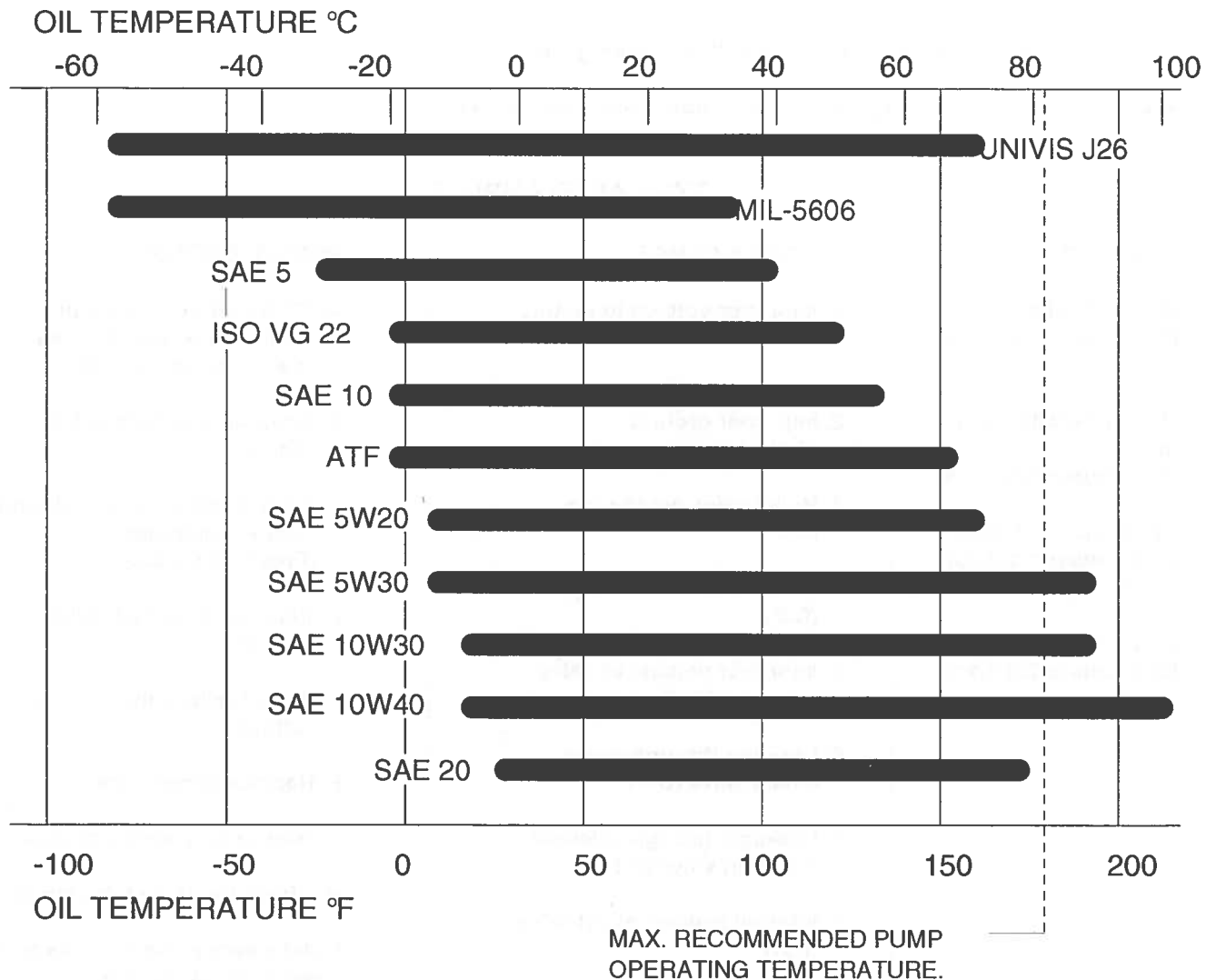
**TYPICAL EXAMPLES**

SYMPTOM	POSSIBLE CAUSE	POSSIBLE SOLUTIONS
Unit will not start (See causes 1,2,3,10)	1. Improper voltage to motor. (A,F,G)	A. Check wiring and insure connections are tight, as well as proper voltage.
Unit drifts with power unit off. (See causes 5,6,7 & 8)	2. Improper ground. (A,H,I)	B. Keep oil reservoir full & clean.
Slow cylinder travel (See causes 1,2,3,7,8,9,10 & 11)	3. Relief valve set too low (C,E)	C. Do not adjust valves without proper equipment (Pressure Gauge)
Unit will not lower (See causes 2,4,5,11)	4. Relief valve set too high (C,E)	D. Flush & clean hydraulic system.
	5. Improper voltage to valve solenoid (A,H)	E. Adjust relief valve to proper setting.
	6. Leakage through pump check valve (D,F)	F. Replace component
	7. Leakage through solenoid lowering valve (D,F)	G. Return for necessary repair
	8. Internal leakage at cylinder. (F,G)	H. Check for clean tight metal to
	9. Insufficient oil to pump (B,D,G)	I. Make sure nut is tight on solenoid valve 15 In.Lbs. Max.
	10. Pump siezed-frozen up. (F,G)	
	11. Cylinder overleaded (C.E.)	

## Distributor Power Unit Program

Internet Address:  
<http://www.stonehydraulics.com>

### RECOMMENDED OILS AT VARIOUS TEMPERATURES

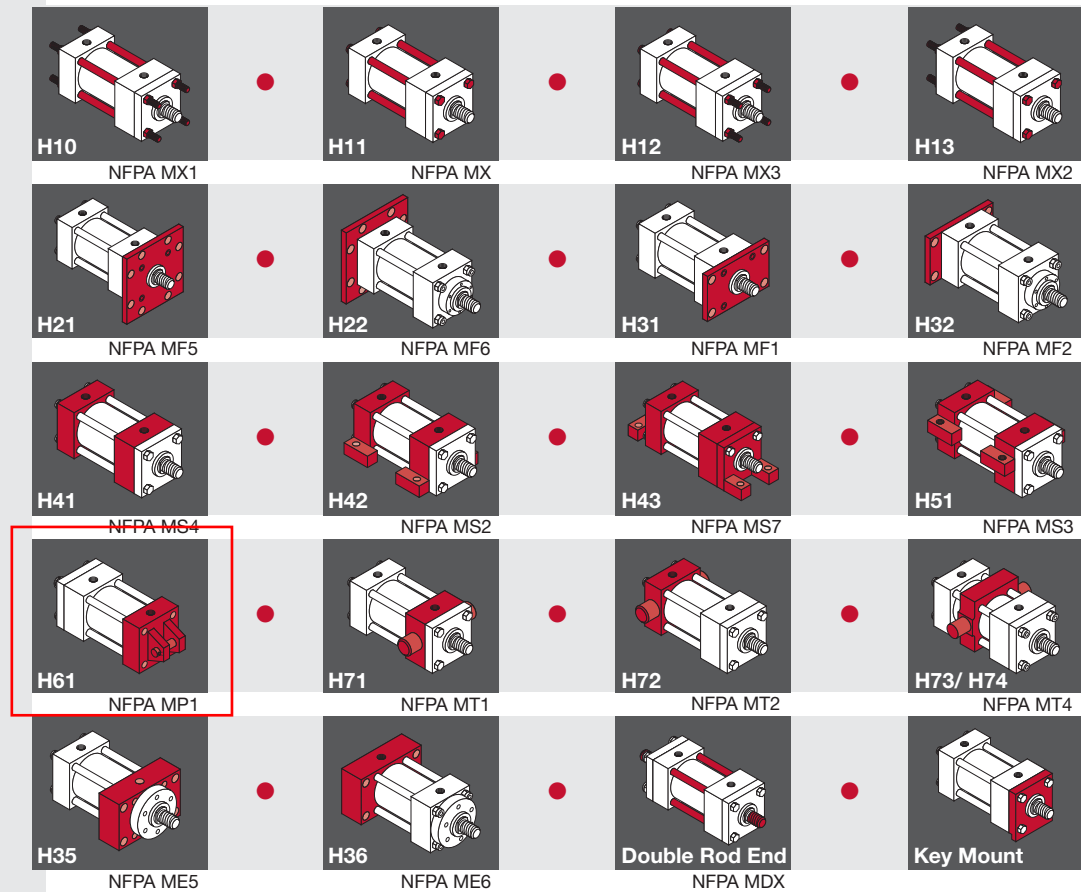


TEMPERATURE LIMITS BASED ON MAXIMUM VISCOSITY OF 1000 CENTISTOKES (5000 SSU) AND MINIMUM VISCOSITY OF 15 CENTISTOKES (80 SSU)

## Appendix 4.4.5.6

System: Bridge Hoist Machinery  
Component: Pawl Hydraulic Cylinder  
Manufacturer: Milwaukee Cylinder

## Series H



**Milwaukee Cylinder Series H Hydraulic Cylinders** are built to perform on the toughest applications. Series H is a complete line of NFPA standard hydraulic tie rod cylinders, with maximum operating pressures up to 3000 psi on all standard bore sizes. If your application requires higher operating pressures, consult our engineers. Incorporating a variety of *Milwaukee Cylinder* exclusive advanced features proven through the years, these cylinders will provide a long, maintenance-free service life.

		Page
<b>General</b>	<i>TABLE 3 - Piston Rod End Styles</i>	<i>Inside Cover page ii</i>
	<i>Standard Specifications and Features</i>	<b>6</b>
	<i>Performance Tested Design Features</i>	<b>7</b>
<b>Mounting Specifications</b>	<i>Tie Rod Mount</i>	<b>8-11</b>
	<i>Flange Mount</i>	<b>12-13</b>
	<i>Side Mount and Lug Mount</i>	<b>14-15</b>
	<i>Pin Mount and Trunnion Mount</i>	<b>16-19</b>
	<i>Solid End Cap Mount Double Rod End Cylinders Key Mount</i>	<b>20-25 26 27</b>
<b>Additional Information</b>	<i>Design Options</i>	<b>28-29</b>
	<i>Stop Tubes / Cylinder Sizing</i>	<b>30-31</b>
	<i>Ordering Information / Replacement Parts</i>	<b>32-33</b>
	<i>Installation / Trouble Shooting / Maintenance</i>	<b>34-35</b>
<b>Accessories</b>	<i>Clevis / Brackets / Pins / Rod Eyes Dimensional Data</i>	<i>Inside Back Cover</i>

## STANDARD SPECIFICATIONS

- Standard construction – square head – tie-rod design
- Nominal pressure – 3000 psi (5000 psi non-shock); see info box below
- Standard fluid-hydraulic oil
- Standard temperature – -20° F to +200° F
- Standard bore sizes – 1½" To 18"
- Standard piston rod diameters ⅝" thru 7"
- Standard mounting styles– 18 standard styles and custom designs to suit your needs
- Strokes – available in any practical stroke length
- Cushions – available at either end or both ends of stroke
- Standard 7 rod end styles and specials designed to order
- Rod end style KK<sub>2</sub> is studded as standard for ⅝" and 1" diameter rods. Studded rod end style is available for all rod sizes

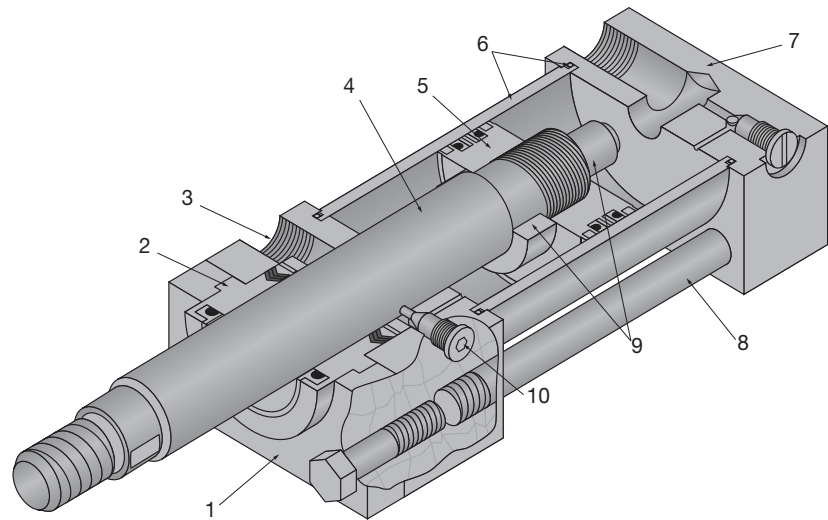


If your hydraulic operating pressure exceeds 3000 psi, send your application data for engineering evaluation and design recommendations.



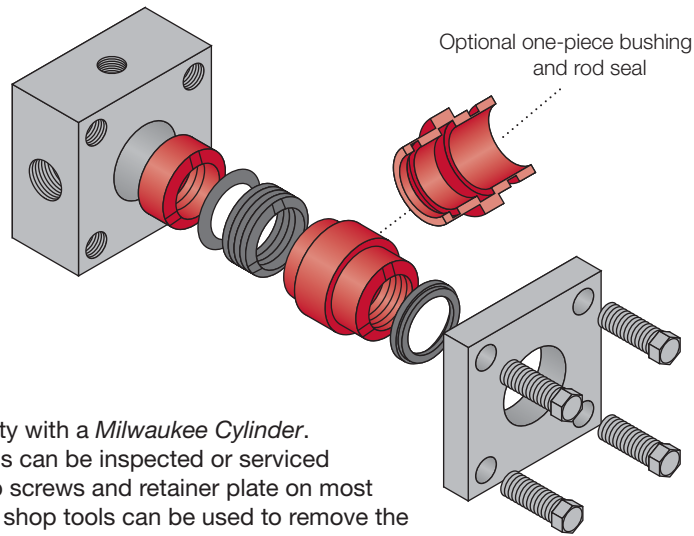
**MilCad Cylinder Configurator**

Visit [milwaukeeecylinder.com](http://milwaukeeecylinder.com) to configure and download CAD files of your cylinders.



## STANDARD FEATURES

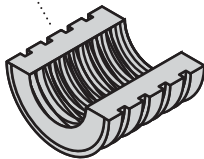
- 1. Removable Retainer Plate**  
 The retainer plate and rod bushing are externally removable without disassembling the cylinder on most standard models. Four capscrews securely hold and lock the retainer plate in place.
- 2. Rod Bushing and Seals**  
 A combination of spring loaded multiple lip vee rings with a supporting bronze bushing is standard in *Milwaukee Cylinder Series H* Cylinders.
- 3. Ports**  
 Large NPTF cylinder ports are standard and can be located to customer requirements. SAE ports optional.
- 4. Piston Rod**  
 The piston rod is of high strength steel, hardened and plated to resist scoring and corrosion, assuring maximum life.
- 5. Piston**  
 The piston is of fine grained alloy iron, incorporating a combination of u-cup seals and cast iron rings, ensuring non-leak Hi-Lo pressure performance. The piston is pilot fitted and threaded to the rod.
- 6. Cylinder Barrel and Seals**  
 The barrel is of steel tubing, honed to a fine finish to assure superior sealing, minimum friction and maximum seal life. It is step cut on the O.D. of both ends for an O-Ring and molded back-up washer. *Milwaukee Cylinder's* unique non-extrusion barrel seal design provides a positive leak tight seal.
- 7. End Caps**  
 End caps and mountings are of high quality steel, precision machined for accurate mounting.
- 8. Tie-Rods and Nuts**  
 The tie-rods are constructed from a high quality medium carbon steel. On most sizes the threads are rolled for rigid engagement of the self-locking nuts.
- 9. Cushions**  
 Cushions are machined to close tolerance to provide positive, smooth deceleration at the end of stroke. On all bore sizes, we provide the longest cushion possible based on the rod size and blind end caps. Longer cushions are available; for further information, consult factory.
- 10. Cushion Needle Adjustment and Ball Check**  
 The cushion needle adjustment valve and cushion-check ball retainer screw are specifically designed to provide full cushion adjustment.



## Simple Maintenance...

Simple maintenance is reality with a *Milwaukee Cylinder*. The rod bushing or rod seals can be inspected or serviced by merely removing the cap screws and retainer plate on most models. Standard available shop tools can be used to remove the rod bushing and seals without disturbing the torque on the tie-rods, assuring performance quality with maintenance ease.

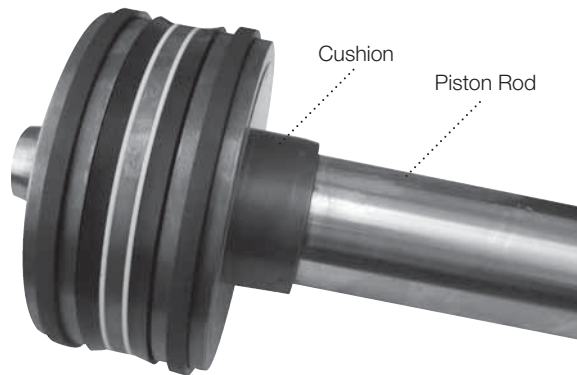
Optional piston design with four cast iron rings



## Cushions...

The cushion is of a high-grade alloy, precision machined and specially tapered to provide smooth deceleration of the piston at the end of stroke.

A standard manufacturing process at *Milwaukee Cylinder* is to assemble the piston, cushion, and the piston rod; placing the assembly between centers and checking the critical diameters for concentricity.



## Piston Rod...

The piston rod is hardened, plated high strength steel, machined and processed to resist scoring and corrosion, assuring maximum life. *Milwaukee Cylinder* offers seven rod end styles as standard. **The style #2 rod end with two wrench flats is furnished as standard** unless otherwise specified. Special rod ends and extra wrench flats are also available. They must be specified at the time of order, giving the dimensional requirements and the location of additional wrench flats.

## COMBINATION ROD SEAL DESIGN...

The Series H cylinder combines spring loaded multiple lip vee rings with a supporting bronze bearing ring bushing and a double lip wiper as a secondary seal. This proven rod seal design combination is effective at both high and low pressures. It affords maximum sealing and an extra long bearing support.

As an optional design, a one-piece rod bushing with a double lip u-cup rod seal and a double lip wiper is available. Metallic rod scrapers may be supplied on request, in place of the double lip wiper with either rod bushing design.

## COMBINATION SEALING ROD

The Series H Cylinder combines two bi-directional sealing cast iron piston rings, with u-cup seals with back-up rings and a fine grained alloy iron piston. This proven piston seal design is effective at both high and low pressures. The design gives the wear and shock absorbing quantities of cast iron and the near zero leakage of the u-cup seals.

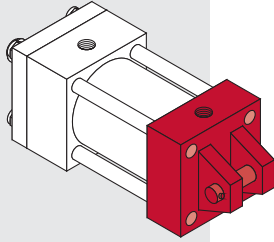
As an optional design, a piston using four low friction cast iron rings is available.

**For Package and Mounting**  
Dimension see  
**Tables 1H and 2H.**

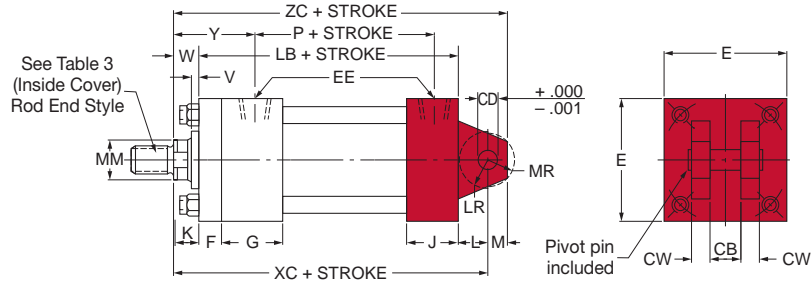
## PIN AND TRUNNION MOUNTED CYLINDERS

All pin and trunnion cylinders need a provision on both ends for pivoting. These types of cylinders are designed to carry shear loads and the trunnion and pivot pins should be carried by bearings that are rigidly held and closely fit for the entire length of the pin.

Shown with square retainer.  
Retainer is circular on bore sizes of  
3/4" and larger.



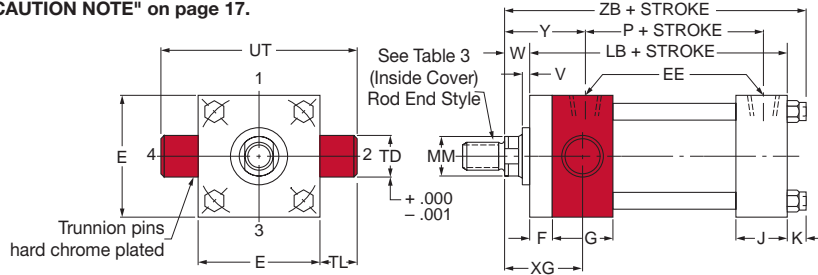
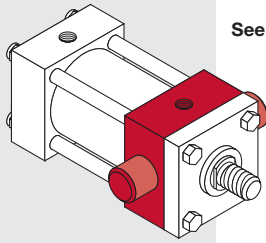
### CLEVIS MOUNT



**MODEL H61**  
**NFPA STYLE MP1**

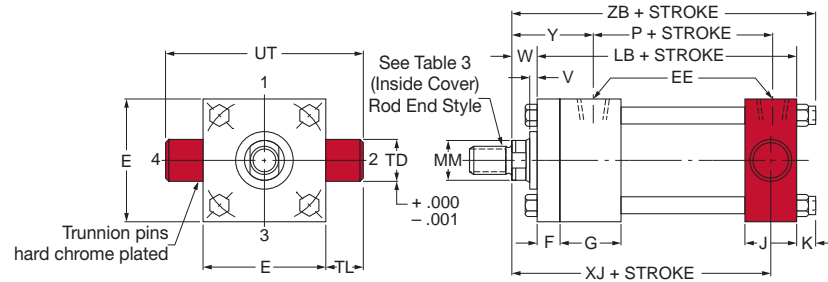
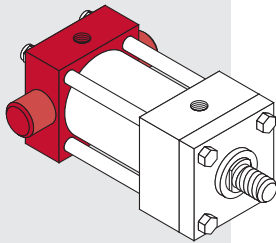
### ROD END TRUNNION MOUNT

See "CAUTION NOTE" on page 17.



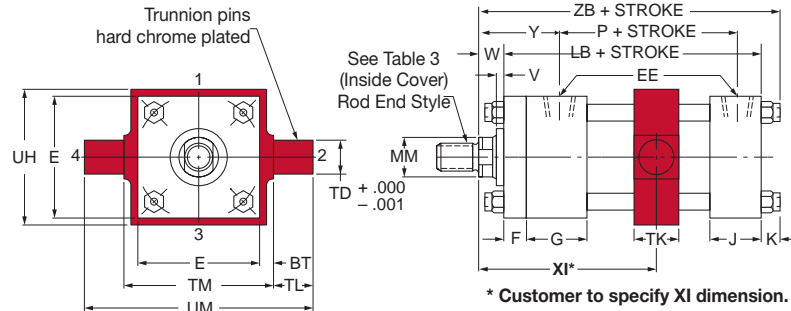
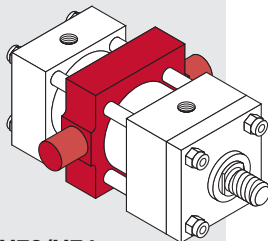
**MODEL H71**  
**NFPA STYLE MT1**

### BLIND END TRUNNION MOUNT



**MODEL H72**  
**NFPA STYLE MT2**

### CENTER TRUNNION MOUNT



**MODEL H73/H74**  
**NFPA STYLE MT4**

H73 is an exclusive Milwaukee Cylinder design.  
H74 is the Industry "Standard" design.

**TABLE 1H**

The dimensions given on this table are affected by the piston rod diameter and the stroke.

Bore Ø	Rod MM	Cylinder Code ↓	P	LB	V	W	XC	XG	XJ	Y	ZB	ZC
1½	5/8	H00151	27/8	5	¼	5/8	63/8	17/8	47/8	2	61/8	67/8
	1*	H00152			½	1	63/4	2¼	5¼	23/8	6½	7¼
2	1	H01510	27/8	5¼	¼	¾	7¼	2¼	5¼	23/8	65/8	8
	13/8*	H01511			3/8	1	7½	2½	5½	25/8	67/8	8¼
2½	1	H01520	3	53/8	¼	¾	73/8	2¼	53/8	23/8	63/4	81/8
	13/8	H01521			3/8	1	73/8	2½	53/8	25/8	7	83/8
	1¾*	H01522			½	1¼	77/8	2¾	57/8	27/8	7¼	83/8
3¼	13/8	H01530	319/32	6¼	¼	7/8	85/8	25/8	6¼	223/32	77/8	95/8
	1¾	H01531			3/8	11/8	87/8	27/8	6½	231/32	81/8	97/8
	2	H01532			3/8	1¼	9	3	65/8	33/32	8¼	10
4	1¾	H01540	37/8	65/8	¼	1	9¾	27/8	6¾	215/16	83/8	111/8
	2	H01541			¼	11/8	97/8	3	67/8	31/16	8½	11¼
	2½	H01542			3/8	13/8	101/8	3¼	71/8	33/16	8¾	11½
5	2	H01550	43/8	71/8	¼	11/8	10½	3	73/8	31/16	9¼	121/8
	2½	H01551			3/8	13/8	10¾	3¼	73/8	33/16	9½	123/8
	3	H01552			3/8	13/8	10¾	3¼	73/8	35/16	9½	123/8
	3½	H01553			3/8	13/8	10¾	3¼	73/8	35/16	9½	123/8
6	2½	H01560	5	83/8	¼	1¼	121/8	33/8	83/8	37/16	10¾	141/8
	3	H01561										
	3½	H01562										
7	3	H01570	5½	9½	¼	1¼	13¾	35/8	93/8	3¾	12	161/8
	3½	H01571										
	4	H01572										
	4½	H01573										
8	4½	H01574	6¼	10½	¼	1¼	15	3¾	10¼	37/8	13¼	17¾
	3½	H01580										
	4	H01581										
	4½	H01582										
10	5	H01583	8½	1313/16	¼	1¼	191/16	4¾	13¼	4¾	1611/16	229/16
	5½	H01584			½	1½	195/16	5	13½	5	1615/16	2213/16
	6	H01590			½	1½	195/16	5	131/2	5	1615/16	2213/16
	6½	H01591			½	1½	195/16	5	131/2	5	1615/16	2213/16
12	5½	H15120	97/8	167/16	¼	1¼	223/16	53/8	15½	5½	199/16	263/16
	7	H15121										

For bore diameter sizes 14" to 18" see next page.

**HOW TO ORDER**

For ordering information refer to Page 32.


**CAUTION NOTES:**

Rod end trunnion mount cylinders in bore sizes 5" through 8" with oversize piston rods, and bore sizes 10" through 18" with all piston rod diameters should not be used over 1500 PSI. If your application requires higher pressure, consult the factory.


**NOTES:**

◆ For double rod end cylinders, add prefix letter D to cylinder code. Example: DHM00151. (Refer to page 26.) Double rod ends are not available on clevis mount Series H cylinders.

\* Removable retainer not available for these bore and rod combinations: H61 and H73/H74 mounting styles.



**Rod End Styles and Dimensions**  
For rod end styles and dimensions see Table 3 in the inside cover of catalog.



**MilCad Cylinder Configurator**  
Visit [milwaukeecylinder.com](http://milwaukeecylinder.com) to configure and download CAD files of your cylinders.

**TABLE 2H**

The dimensions are constant regardless of rod diameter or stroke.

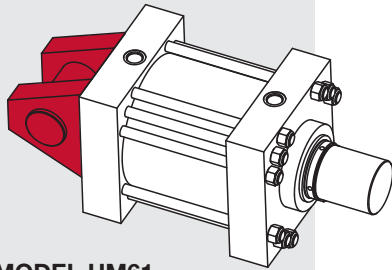
Bore Ø	CB	CD	CW	E	EE NPT	EE SAE	F	G	J	K	L	LR	M	MR	TD	TL	H73				H74				UT
																	TK	TM	UH	UM	TK	TM	UH	UM	
1½	¾	½	½	2½	½	#10	¾	1¾	1½	½	¾	5/8	½	21/32	1	1	1½	4	2½	6	1½	3	3	5	4½
2	1¼	¾	5/8	3	½	#10	5/8	1¾	1½	5/8	1¼	11/8	¾	15/16	13/8	13/8	2	5	33/8	7¼	1¾	3½	3½	6¼	5¾
2½	1¼	¾	5/8	3½	½	#10	5/8	1¾	1½	5/8	1¼	11/8	¾	15/16	13/8	13/8	2	5½	41/8	8¼	1¾	4	4	6¾	6¼
3¼	1½	1	¾	4½	¾	#12	¾	2	1¾	¾	1½	1¼	1	13/16	1¾	1¾	2½	7	5	10½	2¼	5	5	8½	8
4	2	13/8	1	5	¾	#12	7/8	2	1¾	¾	21/8	17/8	13/8	13/8	1¾	1¾	2½	7½	6½	11	2¼	5½	6½	9	8½
5	2½	1¾	1¼	6½	¾	#12	7/8	2	1¾	1	2¼	2	13/8	13/8	1¾	1¾	3	9	7½	12½	3	7	7¼	10½	10
6	2½	2	1¼	7½	1	#16	1	2¼	2¼	11/8	2½	21/16	2	2	2	2	3½	10½	8¾	14½	3¾	8½	8¾	12½	11½
7	3	2½	1½	8½	1¼	#20	1	2¾	2¾	1¼	3	25/8	23/8	23/8	2½	2½	4	12	10	17	3½	9¾	10	14¾	13½
8	3	3	1½	9½	1½	#24	1	3	3	1½	3¼	27/8	2¾	2¾	3	3	4½	13	11	19	4	11	11¾	17	15½
10	4	3½	2	123/8	2	#24	11/16	311/16	311/16	13/8	4	3½	3½	3½	3½	3½	5	171/8	15¼	241/8	5	14	15¼	21	195/8
12	4½	4	2¼	147/8	2½	#32	119/16	47/16	47/16	17/8	4½	4	4	4	4	4	5½	207/8	19¼	287/8	5½	16½	19¼	24½	227/8

Series H Series MH Series LH Series A Series M Series MN Hyd-Pne Devices Cyl Accessories Manipulators Power Units/Valves Design Guide

**For Package and Mounting**  
Dimension see  
**Tables 1H and 2H.**

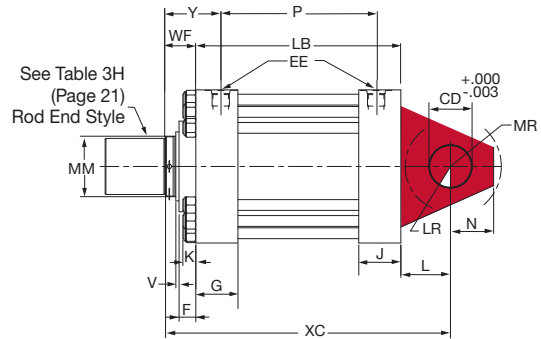
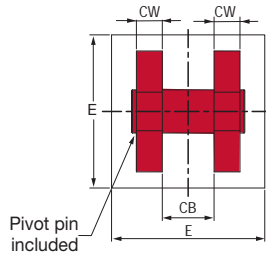
## PIN AND TRUNNION MOUNTED CYLINDERS

All pin and trunnion cylinders need a provision on both ends for pivoting. These types of cylinders are designed to carry shear loads and the trunnion and pivot pins should be carried by bearings that are rigidly held and closely fit for the entire length of the pin.

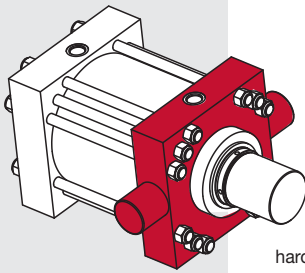


**MODEL HM61**

### CLEVIS MOUNT

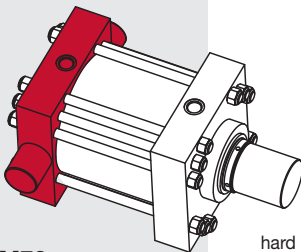
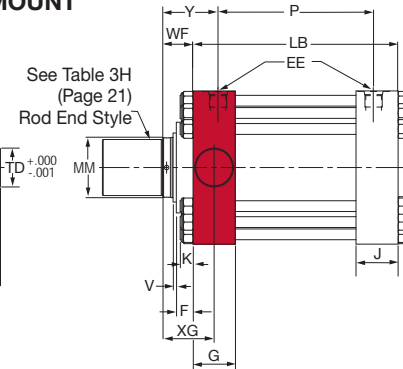
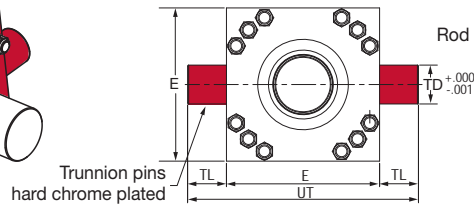


See "CAUTION NOTE" on page 19.



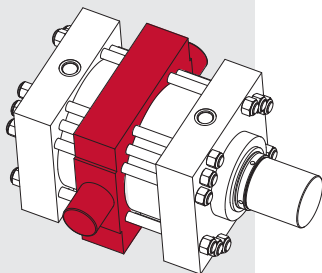
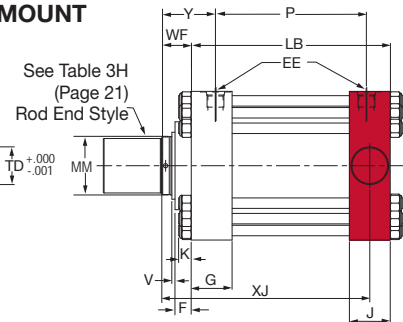
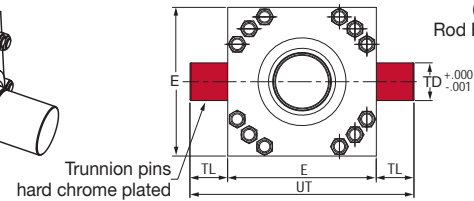
**MODEL HM71**

### ROD END TRUNNION MOUNT



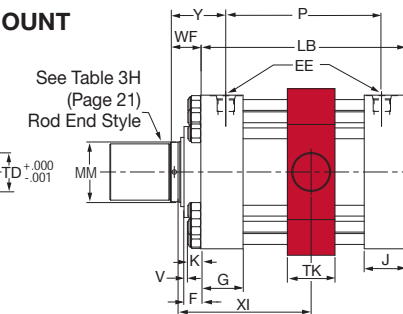
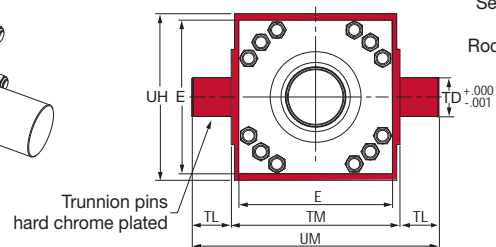
**MODEL HM72**

### BLIND END TRUNNION MOUNT



**MODEL HM73/HM74**

### CENTER TRUNNION MOUNT



HM73 is an exclusive Milwaukee Cylinder design.  
HM74 is the Industry "Standard" design.

**▼ TABLE 1H** The dimensions given on this table are affected by the piston rod diameter and the stroke.

Bore Ø	Rod MM	Cylinder Code ↓	B	LB	P	V	WF	Y	XC	XG	XJ
14	7	HM15140	8			1/4	3 1/2	6	24 7/8	5 15/16	16 1 1/16
	8	HM15141	9	15 5/8	10 5/8	1/4	4	6 1/2	25 3/8	6 7/16	17 3/16
	10	HM15142	-			-	6	8 1/2	27 3/8	8 7/16	19 3/16
16	8	HM15160	9	18 5/8	11 7/8	1/4	4	7 3/8	29 5/8	-	-
	9	HM15161	-			-	5 5/8	9	31 1/4	-	-
	10	HM15162	-			-	6	9 3/8	31 5/8	-	-
18	9	HM15180	-	22	13 3/4	-	5 5/8	9 3/4	35 1/4	-	-
	10	HM15181	-			-	6	10 1/8	35 5/8	-	-

**▼ TABLE 2H** The dimensions are constant regardless of rod diameter or stroke.

Bore Ø	CB	CD	CW	E	EE SAE	G	J	K	L	LR	M	MR	TD	TL	TK	TM	UH	UM	UT
14	6	5	3	17 3/4	#24	4 7/8	4 7/8	1 1/2	5 3/4	4 1/8	5	5 15/32	4 1/2	4 1/2	5 1/2	19 1/2	19 1/4	28 1/2	26 1/8
16	7	6	3 1/2	20 1/4	#24	5 7/8	5 7/8	1 5/8	7	6 1/4	6	6	-	-	-	-	-	-	-
18	8	6 1/2	4	22 1/4	#24	6 7/8	6 7/8	1 7/8	7 5/8	6 3/4	6 1/2	6 1/2	-	-	-	-	-	-	-

**HOW TO ORDER**

For ordering information refer to Page 32.

**CAUTION NOTES:**

Rod end trunnion mount cylinders in bore sizes 5" through 8" with oversize piston rods, and bore sizes 10" through 18" with all piston rod diameters should not be used over 1500 PSI. If your application requires higher pressure, consult the factory.

**NOTES:**

- ◆ For double rod end cylinders, add prefix letter D to cylinder code. Example: DHM15140. (Refer to page 26.) Double rod ends are not available on clevis mount Series H cylinders.



**MilCad Cylinder Configurator**

Visit [milwaukeecylinder.com](http://milwaukeecylinder.com) to configure and download CAD files of your cylinders.

**LARGE BORE CYLINDERS**

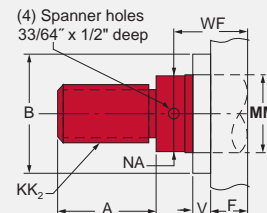
**NOTE:** Large bore Series H cylinders (14", 16" and 18") must use Table 3H for accurate piston rod end dimensions.

**▼ TABLE 3H - Piston Rod Ends**

Bore Ø	Rod MM	Thread KK	A	B +.000 - .005	F	NA	V	WF
14	7	5 1/2-12	7	8	1 15/16	6 7/8	1/4	3 1/2
	8	5 3/4-12	8	9	1 15/16	7 7/8	1/4	4
	10	7 1/4-12	10	-	3 1/2	9 7/8	-	6
16	8	5 3/4-12	8	9	1 15/16	7 7/8	1/4	4
	9	6 1/2-12	9	-	3 3/8	8 7/8	-	5 5/8
	10	7 1/4-12	10	-	3 1/2	9 7/8	-	6
18	9	6 1/2-12	9	-	3 3/8	8 7/8	-	5 5/8
	10	7 1/4-12	10	-	3 1/2	9 7/8	-	6

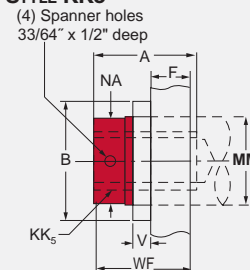
**PISTON ROD END STYLES**

**STYLE KK2**



ROD END STYLE CODE NO. 2

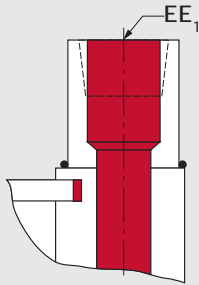
**STYLE KK5**



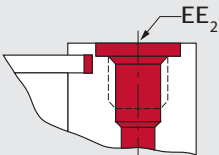
ROD END STYLE CODE NO. 5

Series H Series MH Series LH Series A Series MN Hyd-Pneum Devices Cyl Accessories Manipulators Power Units/Valves Design Guide

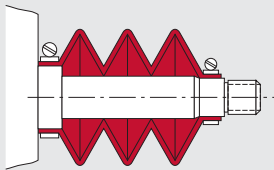
Port Locations



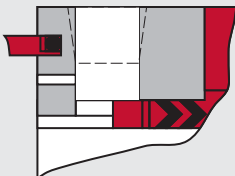
Enlarge Port Welded Boss



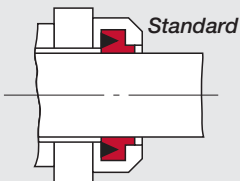
SAE Straight Thread O-ring Port



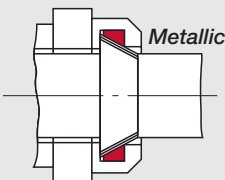
Rod Boots



Automatic Bleed



Standard



Metallic

Metallic Rod Wipers

## DESIGN OPTIONS

### Standard Ports

The Milwaukee Cylinder Series H cylinders are manufactured as standard, with the largest possible NPTF tapered thread ports that will fit in both the rod and blind ends of a given bore size. Upon request, extra ports can be provided on the sides of the end caps not occupied by mountings or cushion adjusters.

### Enlarge Ports

On most bore sizes, welded bosses may be provided for enlarge NPTF ports. These bosses protrude from the sides of the end caps. For information as to the boss height in relation to your bore and port requirements, contact the factory. Also, special heavier end caps can be provided to accommodate enlarge ports without the use of a welded boss.

### Straight Thread Ports

On request, an SAE straight thread O-Ring port can be used on the Series H cylinders. In addition to the standard enlarge NPTF ports, welded bosses may also be used for enlarge SAE straight thread O-Ring ports. For further information contact the factory.

**Note:** Flange and manifold style ports are available.

### Bleeder Ports

Bleeder ports are not regularly furnished with Series H cylinders. Automatic air bleeds are standard on non-cushion cylinders. Bleeder ports are available upon request. They will be placed on either end cap or on the tube.

## ▼ PORT SIZES

Bore Ø	Standard NPTF Port EE	Oversized NPTF Port EE <sub>1</sub>	SAE Straight O-Ring Port	
			EE <sub>2</sub>	SAE Standard Thread Series
1½	½	¾	#10	7/8-14
2	½	¾	#10	7/8-14
2½	½	¾	#10	7/8-14
3¼	¾	1	#12	1¼-12
4	¾	1	#12	1¼-12
5	¾	1	#12	1¼-12
6	1	1¼	#16	1½-12
7	1¼	1½	#20	1¾-12
8	1½	2	#24	1¾-12
10	2	2½	#24	1¾-12
12	2½	3	#32	2½-12

## ▼ 4-Bolt Flange Ports Heavy-duty Hydraulic Cylinders

Bore Ø	Rod Ø	Nominal Flange Size (in)
3¼	1.38	.75
	1.75	.75
	2.00	.75
4	1.75	.75
	2.00	.75
	2.50	.75
5	2.00	.75
	2.50	.75
	3.00	.75
	3.50	.75
6	2.50	1.00
	3.00	1.00
	3.50	1.00
	4.00	1.00
7	3.00	1.25
	35.00	1.25
	4.00	1.25
	4.50	1.25
	5.00	1.25
8	3.50	1.50
	4.00	1.50
	4.50	1.50
	5.00	1.50
	5.50	1.50

**NOTE:** Some flange overhang will occur on heads or caps in most cylinder designs. Overhang may interfere with some end mountings.

### Rod Boots

When cylinders are used in areas of high contamination or where contaminants have an air hardening property, the exposed piston rod should be covered with a rod boot to protect the rod bearing and seals. A rod boot is simply a collapsible cover. It is of sewn construction made from a neoprene coated fabric. The rod boots are impervious to oil, grease and water.

They will operate effectively from 0° F to +200° F without cracking. For additional details on Rod Boots, please see page 186.

### Metallic Rod Wipers

If requested metallic rod wipers will be supplied in place of the standard synthetic rubber wiper. This type of seal is recommended for applications where contaminants would tend to cling to the rod and damage a standard synthetic rubber rod wiper.

## DESIGN OPTIONS FOR SPECIAL CYLINDERS

### Special Rod Ends

Modifications of standard or entirely special rod ends are available from *Milwaukee Cylinder*. When your requirements call for a special rod end style, your order should include a sketch if it is to be an entirely special rod end or note reference as to which letter dimensions you wish to have modified (see inside cover).

### Special Assemblies from Standard Parts

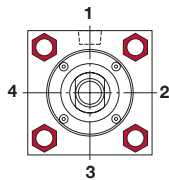
Each style of the various standard cylinder mountings is illustrated, using the commonly recognized cylinder dimensional symbols of the National Fluid Power Association. Each side of the end views are numbered to aid in communication when referring to the relationship between the ports and the mountings. When requesting information or placing an order that requires a dimension other than standard, always make reference to the given dimensional symbol in the catalog and then give your requirements.

### Cushion Adjustment Locations

A ball check and a cushion adjustment needle are supplied as standard in position #2 on most models. The cushion needle and ball check are interchangeable as far as location and may be put in any side not occupied by a port or mounting.

### Port Locations

Ports are located in position #1 as standard unless otherwise specified. By using the position numbers given with the end views in the dimensional data section of this catalog, ports can be arranged in any one of four 90° positions in relation to the cylinder mounting. When ports are relocated on a cushioned cylinder, the cushion needle and ball check are automatically relocated to hold their relationship to the port as on a standard cylinder, unless otherwise specified at the time of the order.



### Removable Trunnion Pins

Removable trunnion pins are available on models H71 and H72 at a nominal extra charge. They can be used on all bore

and rod combinations, except on the largest oversize rods offered with each bore size on all model H71 cylinders.

### Single-Acting Cylinders

Series H cylinders are designed for either single or double action. When used as a single acting cylinder, hydraulic power drives the piston in one direction, only relying on either the load or an external force to return the piston after the pressure is exhausted.

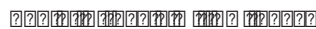
### Single-Acting Spring Cylinders

Single-acting spring return cylinders normally have a spring inside of the cylinder to return the piston to its original position. The application load and friction conditions must be specified when placing an order to properly size the spring. Also specify whether the spring is to return or advance the piston. A spring return cylinder is designed with a stop tube to act as spring guide, which prevents binding of the cylinder due to misalignment of the spring. To accurately determine the cylinder length and mounting dimensions for your application, contact your local *Milwaukee Cylinder* representative or the factory.

### Water Service Cylinders

Series H cylinders can be used with water as an operating fluid with some standard modifications to the types of material and the manufacturing processes used. These modifications will include, at some additional cost, bronze piston, nickel plated end caps, a hard chrome plated cylinder barrel and a chrome plated piston or stainless steel piston rod at extra cost. Due to the increased factors of corrosion, electrolysis and mineral deposits acting within a water fitted cylinder, *Milwaukee Cylinder* cannot warrant or make any guarantees other than a water service cylinder will be free of defects in workmanship or materials.

### Proximity Switches

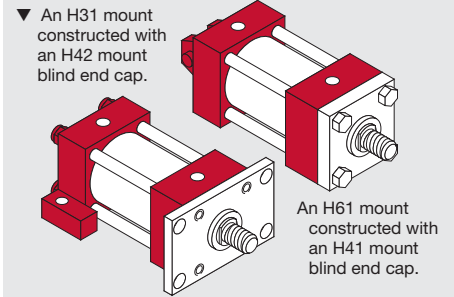


We provide inductive proximity switches for end of stroke sensing. These non-contact switches detect the presence of the spud/cushion bushing. See page 185 for more information.



### Combined Mountings

Standard mountings may be combined when specified by the customer. Some examples of this are:

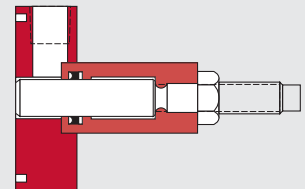


These and other combinations can be readily made from standard parts. If you are unsure of a possible combination or if it will suit your particular needs, consult with your local *Milwaukee Cylinder* representative or contact the factory.

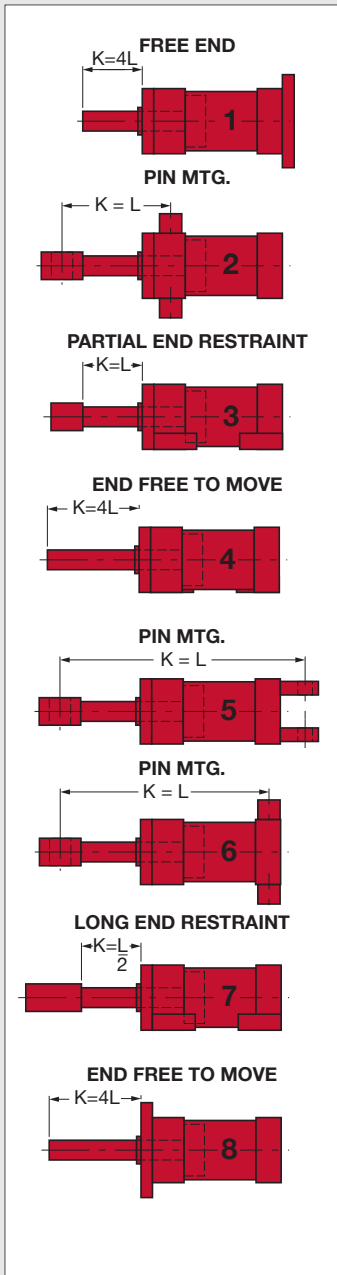
### Adjustable Stroke Cylinders

When a cylinder application requires stroke adjustment, *Milwaukee Cylinder* offers a number of designs, the most common of which is illustrated below. This particular design is externally adjustable, incorporating a threaded rod (of piston rod quality) with the standard hydraulic rod end multiple lip vee seal and bushing design. This provides a proven-effective high and low pressure seal, affording maximum sealing on the stroke adjustment rod.

Further information concerning design limitations, cushioning or alternate designs can be obtained by contacting the factory.



## FIGURE 1



**Stop Tubes**  
 For more information on Stop Tubes, see page 181 in the Design Engineer's Guide.

### STOP TUBES

Stop tubes are used to maintain bearing pressure within acceptable limits and are recommended on cylinders with long strokes or poorly guided rods.

The stop tube is a spacer between the rod end cap and the piston, which provides separation between the piston and the rod bearing. This separation reduces the moment forces developed between the rod bearing and piston when the rod is extended.

To determine if stop tube is necessary for your cylinder requirements, you have to solve for "K" (refer to Figure 1). If your required cylinder has a "K" dimension in excess of 40 inches, stop tube is required. For each 10 inch increment or fraction thereof in excess of 40 inches, one inch of stop tube is recommended. When stop tube is required, the overall length of the cylinder will be increased by the length of the stop tube to be used.

To determine "K" (see to Figure 1)  
 \*Note: W = the rod stick out  
 (refer to pages 8-27)

#### Cylinder #1, #4, #8 – see Figure 1

$$K = 4L = 4(\text{stroke} + W^*)$$

#### Cylinder #2 - see Figure 1

$$K = L = (CA \text{ or } CE) + XG + \text{Stroke}$$

Note:

CA = rod eye dimension (back inside cover)  
 CE = rod clevis dimension (back inside cover)  
 XG = mounting dimension page 18

#### Cylinder #3 – see Figure 1

$$K = L = W^* + \text{Stroke}$$

#### Cylinder #5 – see Figure 1

$$K = L = (CA \text{ or } CE) + XC + (2 \times \text{Stroke})$$

Note:

CA = rod eye dimension (back inside cover)  
 CE = rod clevis dimension (back inside cover)  
 XC = mounting dimension page 18

#### Cylinder #6 – see Figure 1

$$K = L = (CA \text{ or } CE) + XJ + (2 \times \text{Stroke})$$

Note:

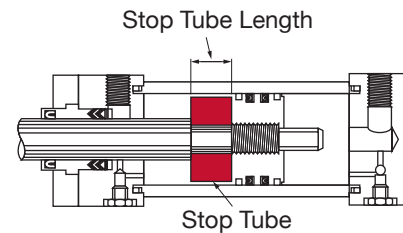
CA = rod eye dimension (back inside cover)  
 CE = rod clevis dimension (back inside cover)  
 XJ = mounting dimension page 18

#### Cylinder #7 – see Figure 1

$$K = L/2 = (W^* + \text{Stroke})/2$$

When mounting long stroke cylinders, care should be taken to assure cylinder alignment over the entire length of stroke. The use of external guides or swivel bushings is recommended to reduce side load conditions and prolong the cylinder's service life.

Note: Stop tube length must be added to "K" factor before making final selection of rod size. This is primarily true in No. 5 long stroke applications.



*The stop tube is located between the piston and the rod end cap. It limits the extended stroke of the cylinder, providing additional strength for less cost and reduced weight than the use of an oversize rod.*

▼ TABLE 1 - VALUE OF "K" IN INCHES

Thrust Force (in-lbs)	Piston Rod Diameter (in)															
	5/8	1	1 1/8	1 1/4	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	7	8	9	10
400	35	84	134	-	-	-	-	-	-	-	-	-	-	-	-	-
700	30	68	119	-	-	-	-	-	-	-	-	-	-	-	-	-
1,000	26	60	105	156	190	-	-	-	-	-	-	-	-	-	-	-
1,400	24	54	93	144	175	244	308	-	-	-	-	-	-	-	-	-
1,800	23	48	84	127	160	230	294	366	-	-	-	-	-	-	-	-
2,400	18	45	75	114	145	214	281	347	-	-	-	-	-	-	-	-
3,200	16	40	68	103	131	196	262	329	398	-	-	-	-	-	-	-
4,000	12	38	63	93	119	174	240	310	373	446	-	-	-	-	-	-
5,000	9	36	60	87	112	163	225	289	359	426	-	-	-	-	-	-
6,000	-	30	56	82	102	152	209	274	342	411	476	-	-	-	-	-
8,000	-	25	51	76	93	136	186	244	310	375	448	-	-	-	-	-
10,000	-	21	45	70	89	125	172	221	279	349	412	-	-	-	-	-
12,000	-	17	41	64	85	117	155	210	270	326	388	455	-	-	-	-
16,000	-	-	35	57	75	110	141	188	233	291	350	421	-	-	-	-
20,000	-	-	28	52	66	103	136	173	218	270	325	385	-	-	-	-
30,000	-	-	-	39	56	87	120	156	190	232	285	330	-	-	-	-
40,000	-	-	-	24	43	75	108	142	177	210	248	293	-	-	-	-
50,000	-	-	-	-	30	66	97	131	165	201	234	268	408	-	-	-
60,000	-	-	-	-	-	57	88	119	154	190	226	256	384	-	-	-
80,000	-	-	-	-	-	36	71	104	136	170	204	240	336	-	-	-
100,000	-	-	-	-	-	-	56	91	120	154	199	224	324	400	-	-
120,000	-	-	-	-	-	-	45	76	108	146	174	207	313	377	-	-
140,000	-	-	-	-	-	-	-	64	98	129	162	194	301	365	-	-
160,000	-	-	-	-	-	-	-	47	87	118	149	182	279	350	421	-
200,000	-	-	-	-	-	-	-	-	65	98	131	160	260	330	402	-
250,000	-	-	-	-	-	-	-	-	-	72	109	143	236	301	375	-
300,000	-	-	-	-	-	-	-	-	-	85	120	154	212	281	351	420
350,000	-	-	-	-	-	-	-	-	-	53	100	131	195	261	328	396
400,000	-	-	-	-	-	-	-	-	-	-	72	182	241	309	374	-
500,000	-	-	-	-	-	-	-	-	-	-	-	152	212	274	341	-
600,000	-	-	-	-	-	-	-	-	-	-	-	-	114	183	247	310
700,000	-	-	-	-	-	-	-	-	-	-	-	-	70	162	221	280

▼ TABLE 2 - DEDUCTIONS FOR PULL STROKE FORCE & DISPLACEMENT

Piston Rod Ø	Piston Rod Area	Cylinder Force in Pounds for Various Pressures							Displacement /in of Stroke	
		500 psi	750 psi	1000 psi	1250 psi	1500 psi	2000 psi	3000 psi	Gallons Oil Displaced	
5/8	.307	154	230	307	384	461	614	921	.00133	
1	.785	393	589	785	981	1178	1570	2355	.00340	
1 1/8	1.485	743	1114	1485	1856	2228	2970	4455	.00643	
1 1/4	2.405	1203	1804	2405	3006	3608	4810	7215	.01041	
2	3.142	1571	2357	3142	3928	4713	6284	9426	.01360	
2 1/2	4.909	2455	3682	4909	6137	7364	9818	14730	.02125	
3	7.069	3535	5302	7069	8836	10600	14140	21210	.03060	
3 1/2	9.621	4811	7216	9621	12026	14430	19240	28860	.04165	
4	12.57	6285	9428	12570	15708	18860	25140	37710	.05442	
4 1/2	15.90	7950	11920	15900	19880	23850	31800	47700	.06883	
5	19.64	9818	14726	19635	24544	29452	39270	58905	.08500	
5 1/2	23.76	11880	17820	23760	29698	35640	47520	71280	.10286	
7	38.48	19240	28860	38480	-	57720	76920	115400	.1668	
8	50.27	25135	37700	50270	-	75400	100500	150810	.2177	
9	63.62	31810	47720	63620	-	95430	127200	190860	.2753	
10	78.54	39270	58900	78540	-	117810	157100	235620	.3396	

▼ TABLE 3 - THRUST FORCE AND DISPLACEMENT

Cylinder Bore Ø	Piston Area	Cylinder Force in Pounds for Various Pressures							Displacement /in of Stroke	
		500 psi	750 psi	1000 psi	1250 psi	1500 psi	2000 psi	3000 psi	Gallons Oil Displaced	
1 1/2	1.767	884	1325	1767	2209	2651	3534	5301	.00765	
2	3.142	1571	2357	3142	3928	4713	6284	9426	.01360	
2 1/2	4.909	2455	3682	4909	6137	7364	9818	14730	.02125	
3 1/4	8.296	4148	6222	8296	10370	12440	16590	24890	.03591	
4	12.57	6285	9428	12570	15708	18860	25140	37710	.05442	
5	19.64	9820	14730	19640	24544	29460	39280	58920	.08502	
6	28.27	14140	21200	28270	35342	42400	56540	84810	.12230	
7	38.49	19240	28870	38490	48106	57740	76980	115500	.16660	
8	50.27	25140	37700	50270	62832	75400	100500	150800	.21760	
10	78.54	39270	58900	78540	98175	117800	157100	235600	.34000	
12	113.1	56550	84820	113100	141375	169600	226200	339300	.48960	
14	153.9	76950	115400	153900	-	230800	307800	461700	.66620	
16	201.1	100600	150800	201100	-	301600	402200	603300	.8706	
18	254.5	127200	190900	254500	-	381800	509000	763500	1.102	
20	314.2	157100	235600	314200	-	471300	628400	942600	1.306	

## CYLINDER SIZING

The selection of the correct rod size is one of the most important factors in sizing a cylinder. The standard rod for each bore size that *Milwaukee Cylinder* manufactures is sufficient to handle the maximum tension force that the cylinder is capable of producing. It is primarily in compression and long stroke, high thrust applications that the column strength needs to be considered.

The following steps should be used to determine the proper rod size for an application:

1. Select the cylinder bore size required from Table 3 based on the required cylinder thrust force and the operating line pressure at the cylinder.
2. Determine the length between mounting points or "L" as shown on Figure 1, page 30.
3. Based on the distance between mounting points ("L"), determine the value of "K" as shown on Figure 1, page 30.
4. Using the thrust force and the developed "K" dimension, refer to Table 1 to select the proper rod size.
5. If an oversized rod is required, re-check the overall length dimension ("K") in Step 1 and confirm your previous rod size selection.

To determine the cylinder pull (tension), stroke force, or displacement, deduct the force or displacement corresponding to the rod size in Table 2 from the force or displacement corresponding to the bore size shown in Table 3.

Series H  
Series MH  
Series LH  
Series A  
Series MN  
Hyd-Pneum Devices  
Cyl Accessories  
Manipulators  
Power Units/Valves  
Design Guide

Feature	Description	Page Number	Code Number	Example
Double Rod End		26	D	
Cylinder Code	Refer to Table 1H	9, 11, 13, 15, 17 19, 21, 23, 25	—	
Mounting Style	Model Number Only	8, 10, 12, 14, 16 18, 20, 22, 24	—	
Rod End Style	Code Number	inside front cover	—	
Cushions	None	—	1	
	Rod End	—	2	
	Blind End	—	3	
	Both Ends	—	4	
Cylinder Modifications	Special		S	
Seals	BUNA-N (-20° to 200° F)		7	
	Viton (-15° to 350° F)		8	
	Special		S	
Stroke	Specify in Inches Including Fractional Requirements		—	

**\*NOTE:** Use "S" if any special design features or seals are required, describe in detail on your order.

**EXAMPLE:** The code for a hydraulic cylinder 4" bore, 2" rod, rod end rectangular flange mounting, Style No. 1 rod end, cushion both ends, standard seals with a 14 3/4" stroke is: **H01541-31-14-7x14 3/4**.



## DUPLICATE CYLINDERS

Duplicate cylinders can

be ordered by giving the serial number from the nameplate of the original cylinder. Factory records supply a quick, positive identification.

## HOW TO ORDER

### Series H Cylinders

Standard Series H Cylinders can be completely and accurately described by a model number. If your requirements are completely standard, select the alphanumeric codes from above that represent your cylinder and place them in the sequence indicated by the example. Use of the cylinder model number will eliminate untimely delays in handling your order.

### General Order Data

1. Bore & Rod Size or the Cylinder Code: (refer to pages 8-27)
2. Mounting Style: (refer to page 8-27)
3. Rod End Style: (refer to inside cover, page ii)
4. Cushion Requirements
5. Length of Stroke

### Application Data

1. : refer to page 28.
2. Series H Cylinders are equipped with seals for use with hydraulic oil. If other than a quality grade hydraulic oil will be used, specify the type of fluid in your order. See page 184 for more details.
3. Series H Hydraulic Cylinders contain seals of Nitrile (Buna-N) suitable to -20° F to +200° F. Specify your operating temperature if your application does not fall within this temperature range.
4. Series H Cylinders are rated for 3000 PSI. If your requirements are in excess of the rated pressure, describe your application in your order.
5. : Specify any accessories you require, using the part numbers given on the inside back cover.
6. If you require special seals, rod material, stop tube, center support, adjustable stroke or any other special requirements not covered, specify in detail on your order.



### MilCad Cylinder Configurator

Visit [milwaukeecylinder.com](http://milwaukeecylinder.com) to configure and download CAD files of your cylinders.

## REPLACEMENT SEALS OR CYLINDER PARTS

For replacement seals or cylinder parts, the serial number of your cylinder, the cylinder model number and the item number of the part you require (below) should appear on your order. To order entire seal kits for your cylinder, simply specify the serial number and the cylinder model number from page 32 on your request for service parts.

## HOW TO ORDER COMPLETE SEAL KITS

When ordering complete seal kits, specify the following information on your order:

1. The serial number of the cylinder the seals will be used on.
2. The bore and rod size.
3. If the cylinder is cushioned.

To eliminate untimely delays in the handling of your order, please use the seal kit code as shown in the example below:

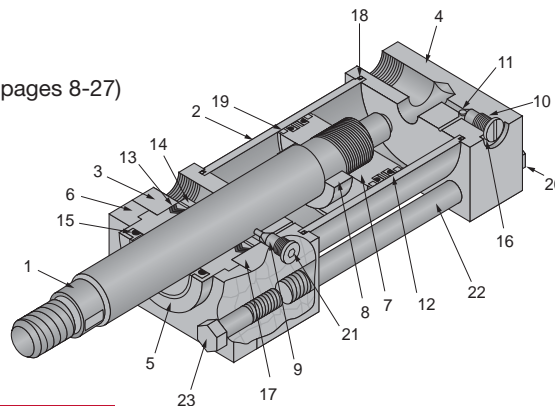
Example:

XXXXXX-7-40

- cylinder code number (refer to pages 8-27)

XXXXXX-8-40

- cylinder code number (refer to pages 8-27)



## STANDARD PARTS LIST

Item No.	Description
1	Piston Rod
2	Cylinder Barrel
3	Head End Cap
4	Cap End Cap
5	Rod Bushing
6	Retainer Plate
7	Piston
8	Cushion Plunger
9	Cushion Adj. Plunger
10	Ball Check Retainer
11	Ball Check
12	U-Cup Seal & Backup Washer for Piston
13	Rod Vee Ring Set
14	Rear Bearing Ring
15	Rod Wiper
16	O-Ring Seal for Ball Check Retainer
17	Wave Spring
18	Cylinder Barrel O-Ring & Backup Washer
19	Cast Iron Piston Ring, Standard
20	Tie Rod Flex Lock Nut
21	O-Ring Seal for Cushion Adj. Needle
22	Tie Rod
23	Self-Locking Cap Screw

## Retainer Plate Cap Screw Torques

### For Square Retainers

Bore Ø	Torque (Ft-lbs)
1½	10
2	20
2½	20
3¼	40
4	40
5	75
6	100

### For Circular Retainers

Bore Ø	Rod	Torque (Ft-lbs)
1½	All	3
2	All	6
2½	1, 1⅜	6
	1¾	10
3¼	All	10
4	All	10
5	All	10
6	2½	10
	3, 3½, 4	30
7	All	30
8	3½ - 5	30
	5½	50
10	4½ - 5	30
	5½	50
12	5½	50
	All	50

## Tie-rod Nut Torques

### Nut Torque Specifications

Bore Ø	Torque (Ft-lbs)
1½	25
2	45
2½	45
3¼	125
4	125
5	300
6	400
7	600
8	900
10	2500
12	3700

When it is necessary to remove the tie-rod nuts on a cylinder, they must be reassembled to the torque specifications given above. To prevent the tie-rods from twisting when tightened, use a vice grip or locking clamp. Note that the torque specification is based on lubricated threads.

## INSTALLATION FOR SERIES H

### General Information

#### Cleanliness

The most important consideration when installing the cylinder. When cylinders are shipped from *Milwaukee Cylinder*, the ports are securely plugged with plastic plugs which should not be removed until the piping is to be installed. All piping should be thoroughly clean, to include the removal of all threading and flaring burrs or chips, before making the connection to the cylinder ports. One chip can cause premature failure of the cylinder or other hydraulic system components.

#### Alignment

Improper alignment will result in excessive cylinder wear. Check to assure rod alignment between the cylinder and its mating component on your machine in both the extended and retracted positions.

#### Environment

Cylinders operating in areas where there is weld splatter, fast drying chemicals, paint, excessive heat or other hazardous conditions, should have covers or shields to prevent damage to the rod and rod seals.

#### Bleeding

Air within the cylinder or system will cause erratic operation of the cylinder. *Milwaukee Cylinders* generally do not require bleed ports if the cylinder ports are mounted in an upright position. Several full strokes of the cylinder will purge air from the cylinder into the circuit piping, where it can be bled off. Bleeder ports are available for applications where the cylinder is the high point of the circuit or where the cylinder does not complete a full stroke during its normal cycle.

## MOUNTING RECOMMENDATIONS

### Foot Mounted Cylinders

The use of high strength alloy steel mounting bolts 1/16" smaller than the hole size is recommended. After final alignment, foot mounted cylinders should be dowel pinned in place.

### Trunnion Mounted Cylinders

Lubricated pillow blocks designed for close tolerance applications should be used. It is important to rigidly mount and align the pillow blocks so that the trunnion pins will not be subjected to any extreme bending moments. The rod end should be pivoted with the pivot pin in line and parallel to the axis of the trunnion pins.

### Flush Mount Cylinders

The use of high strength alloy steel mounting bolts is recommended. Shear keys should be used to reduce the stress on the mounting bolts created by the normal push and pull forces created by the cylinder cycle.

### Flange Mount Cylinders

The controlled diameter rod bushing extension can be used as a pilot to locate the flange mount. Dowel pins should be used after the cylinder is mounted and aligned to prevent shifting.

### Clevis Mount Cylinders

This type of cylinder must be pivoted at both ends and the pins must be in line and parallel to each other. After the cylinder is mounted, the customer should check to assure that the cylinder is free to swing through its working arc without interference from other machined parts.

## STORAGE

Often times, cylinders are delivered before a customer is prepared to install them and must be stored for a period of time. When storage is required:

1. Select an area indoors for storage, which has dry and non-corrosive atmosphere. Take caution to protect the cylinder from both internal and external corrosion.
2. Cylinders to be stored should be kept in a vertical position (piston rod up) whenever possible.
3. Port protector plugs should be kept in the cylinder ports until the time of installation.

## CYLINDER TROUBLE SHOOTING

### 1. External leakage

If leaking occurs between the end cap and barrel, check tie-rod torque. Do not over torque. If the torque is correct, then replace the barrel seal. When leakage occurs in the rod bushing area, replace the rod seals. If leakage continues or reoccurs in short period of operation, check items 2 thru 5, page 33.

### 2. Cylinder misalignment

Side load is a common problem which occurs when the cylinder application does not allow the piston rod to work in line during the extend and retract motions of the cylinder. Evidence of this is excessive seal failure, bushing wear or galling of the piston rod. Often, bending of the piston rod or complete failure (breakage) of the rod occurs.

### 3. Contamination on the piston rod

Dirt and other material is often picked up when the piston rod is extended. When the rod is retracted in an excessive dirty application, it often carries the dirt back into the rod seal cavity of the cylinder, causing damage to the seals. With a slight modification of the cylinder rod end, a rod boot can be added to protect the rod bushing and seals for most applications.

### 4. Bad mountings

Due to wear of pivot pins or mounting bolts working loose, a cylinder may have side load, even though the rod was in line when the cylinder was first installed. All cylinder mountings should be checked periodically.

### 5. Damaged piston rod

An extended piston rod can be damaged by the impact of a hard object which could burr the rod. If this occurs, the rod should be checked immediately to prevent seal damage.

### 6. Internal leakage

Inside the cylinder, leakage past the piston seals can cause sluggish movement or settling of the cylinder under load conditions. This occurs due to leakage of worn piston seals or rings.

### 7. Creeping cylinder

When a cylinder is stopped in midstroke and it creeps, check for internal leakage. Creeping can also be caused by a worn control valve and this should be checked, even if the cylinder is found to have internal leakage.

### 8. Erratic operation

When a cylinder is erratic or sluggish in operation, this may be caused by a number of problems. The most common cause of sluggish operation is air in the system. Internal leakage could also be a

cause. If the system starts out sluggishly and, as it warms, speeds up, the oil may be of too high viscosity. The whole system should be checked for worn components if after these checks, the cylinder is still operating in a sluggish manner.

## CYLINDER MAINTENANCE

### Rod Seal Replacement

When changing rod seals, extend the piston rod 3" or more if possible, being sure to support the rod at all times. Remove the retainer plate screws (if tie-rod nuts have to be removed, refer to the nut torque specification on this page when reassembling the cylinder), retainer plate and outer bushing. Using an eye hook or thin screwdriver, pry the vees from the end cap cavity (if low pressure air is applied to the rod end port, this will help to force the vees from the cavity). The new set of vees should be assembled into the cavity separately and lubed with the soft vee in the center. Replace the rod wiper in the bushing and reassemble the cylinder.

### Piston Seal Replacement

When changing piston seals, extend the piston rod 3" or more if possible, being sure to support the piston rod and the piston at all times. \*Remove the tie-rod nuts, blind end cap, the barrel and then the piston seals. A light grease, compatible with the system fluid, should be used on the rings and block vee seals for smooth assembly. Install the block vee piston seals, scarf cutting on only the back-up washers. Then install the cast iron rings with the joints in opposite directions. To reassemble, start the piston into the tube, compressing the cast iron rings using twine or a ring compressor. When the piston block vee seal is to the edge of the barrel, use a thin rounded blade to start the lip of the block vee, making sure the entire lip is started before moving the piston further into the tube.

**\*Note:** When a cylinder has been disassembled this far, the barrel seals should at least be inspected, if not replaced.

### Barrel Seal Replacement

When replacing barrel seals, use the same method of disassembling the cylinder as used when replacing piston seals. The barrel seal consists of a backup washer and O-Ring, which is assembled on the first step of both ends of the tube, with the backup washer going on first. The outer diameter of the tube groove on the end caps must be checked for nicks or burrs and then greased. Position the end caps squarely on the tube (check to make sure port location is correct) and firmly force or tap the end cap over the tube until it bottoms. Check to make sure the O-Ring did not shear and then finish assembling the cylinder.

## Nut Torque Specifications

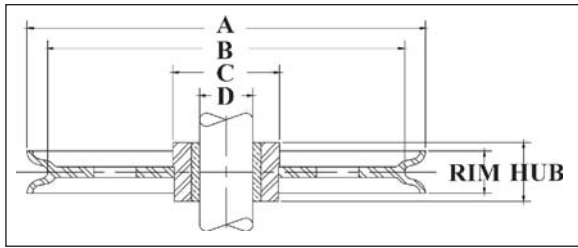
Cylinder Bore	Torque (Ft-lbs)
1½	25
2 - 2½	45
3¼ - 4	125
5	300
6	400
8	900
10	2500
12	3700

When it is necessary to remove the tie-rod nuts on a cylinder, they must be reassembled to the torque specifications given above. To prevent the tie-rods from twisting when tightened, use a vice grip or locking clamp. Note that the torque specification is based on lubricated threads.

## Appendix 4.4.5.7

System: Bridge Hoist Machinery  
Component: Deflector Sheave  
Manufacturer: McKissick

# McKissick® Bronze Bushed Sheaves



**SEE APPLICATION AND WARNING INFORMATION**

Para Español: [www.thecrosbygroup.com](http://www.thecrosbygroup.com)

on Pages 375-382

## Bronze Bushed Sheaves

- Roll-Forged™ sheaves are available in sizes up to 78" in diameter.
- McKissick® Bronze Bushed Sheaves are equipped with S.A.E. 660 Bronze Bushings for cold finished shafts with "Figure 8" oil groove.
- For sizes not listed, McKissick Finished Bore Sheaves can be equipped with bronze bushings at an optional charge.

"A" Nominal Outside Diameter (in.)	Stock Number	Pattern Number	Wire Line Size (in.)	"D" Shaft Size (in.)	Hub Width (in.)	Rim Width (in.)	"C" Nominal Hub Outside Diameter (in.)	"B" Nominal Tread Diameter (in.)	Material	Approx. Weight (lbs.)
2-1/4	907004	1173	1/4	3/8*	5/8	9/16	3/4	1-7/8	B.S.	.75
3	907059	1173	3/16	3/8*	25/32	3/4	1	2-3/8	P.M.	1.00
3	907077	1173	3/16	1/2*	25/32	3/4	1	2-3/8	P.M.	1.00
3	907095	1173	3/16	5/8*	25/32	3/4	1	2-3/8	P.M.	1.00
3	907022	1173	1/4	3/8*	1/2	1/2	1	2-5/8	P.M.	.75
3	907040	1173	1/4	1/2*	1/2	1/2	1	2-5/8	P.M.	.75
3	460165	3X	1/4	1/2*	1-5/16	1-3/16	1-1/8	2-1/16	B.S.	1.00
3	2030896	3-1	5/16	3/4	1	7/8	1-3/4	2-1/4	P.M.	1.50
3	907068	1173	3/8	3/8*	3/4	3/4	1	2-3/8	P.M.	1.00
3	916101	1208	3/8	3/8*	25/32	3/4	1-1/2	2-3/8	B.S.	1.00
3	907086	1173	3/8	1/2*	3/4	3/4	1	2-3/8	P.M.	1.00
3	916110	1208	3/8	1/2*	25/32	3/4	1-1/2	2-3/8	B.S.	1.00
3	460156	3X	3/8	1/2*	1-5/16	1-3/16	1-1/8	2-1/16	B.S.	1.00
3	907102	1173	3/8	5/8*	3/4	3/4	1	2-3/8	P.M.	1.00
3	2030895	3-1	3/8	3/4	1	7/8	1-3/4	2-1/4	P.M.	1.50
3	2023202	3-1	7/16	3/4	1	7/8	1-3/4	2-1/4	P.M.	1.50
3	916129	1208	1/2	3/8*	1-1/4	1-1/8	1-7/8	2	B.S.	1.33
3	916138	1208	1/2	1/2*	1-1/4	1-1/8	1-7/8	2	B.S.	1.50
4	460290	4-1	1/8	1	1	7/8	2	3-1/8	B.S.	2.00
4	907111	1173	3/16	1/2*	3/4	5/8	1-3/8	3-1/2	P.M.	1.00
4	907139	1173	3/16	5/8*	3/4	5/8	1-3/8	3-1/2	P.M.	1.00
4	916147	1208	1/4	1/2*	13/16	3/4	2	3-1/4	B.S.	1.50
4	916165	1208	1/4	3/4*	13/16	3/4	2	3-1/4	B.S.	1.50
4	460307	4-1	1/4	1	1	7/8	2	3-1/8	B.S.	2.00
4	907120	1173	5/16	1/2*	3/4	5/8	1-3/8	3-1/2	P.M.	1.00
4	907148	1173	5/16	5/8*	3/4	5/8	1-3/8	3-1/2	P.M.	1.00
4	907166	1173	3/8	1/2*	13/16	3/4	1-1/2	3-1/4	P.M.	1.25
4	916156	1208	3/8	1/2*	13/16	3/4	2	3-1/4	B.S.	1.50
4	907184	1173	3/8	5/8*	13/16	3/4	1-1/2	3-1/4	P.M.	1.40
4	907200	1173	3/8	3/4*	13/16	3/4	1-1/2	3-1/4	P.M.	1.25
4	460316	4-1	3/8	1	1	7/8	2	3-1/8	B.S.	2.00
4	907228	1173	1/2	1/2*	1-1/16	1	1-5/8	3-3/16	P.M.	1.50
4	916192	1208	1/2	1/2*	1-1/8	1	1-5/8	3-3/16	B.S.	2.00
4	907246	1173	1/2	5/8*	1-1/16	1	1-5/8	3-3/16	P.M.	1.50
4	907264	1173	1/2	3/4*	1-1/16	1	1-5/8	3-3/16	P.M.	1.50
4	2028640	1208	3/8	3/4*	13/16	3/4	2	3-1/4	B.S.	1.50
4-1/8	2023186	4-K	3/8	1	1-1/2	1-3/8	2	3	F.S.	3.50
4-1/8	2029618	4-K	1/2	1	1-1/2	1-3/8	2	3	F.S.	3.50
4-1/8	2023188	4-K	5/8	1	1-1/2	1-3/8	2	3	F.S.	3.50
4-1/4	460450	4E	3/8	5/8*	1-3/16	15/16	2-1/8	3-3/8	B.S.	2.40
4-1/4	460441	4E	1/2	5/8*	1-3/16	15/16	2-1/8	3-3/8	B.S.	2.40
4-3/4	460575	5-2	5/16	5/8	1-9/16	1-3/8	1-1/2	3-5/8	D.I.	3.50
4-3/4	460584	5-2	3/8	5/8	1-9/16	1-3/8	1-1/2	3-5/8	D.I.	3.50
4-3/4	460593	5-2	1/2	5/8	1-9/16	1-3/8	1-1/2	3-5/8	D.I.	3.50

McKissick  
Sheaves

Custom sheaves are available. See page 281 for ordering details.

# McKissick® Bronze Bushed Sheaves

"A" Nominal Outside Diameter (in.)	Stock Number	Pattern Number	Wire Line Size (in.)	"D" Shaft Size (in.)	Hub Width (in.)	Rim Width (in.)	"C" Nominal Hub Outside Diameter	"B" Nominal Tread Diameter (in.)	Material	Approx. Weight (lbs.)
12	914149	1193	3/4	1-1/4	1-5/8	1-1/2	5-1/4	10-1/4	D.I.	25.5
12	914167	1193	3/4	1-1/2*	1-5/8	1-1/2	5-1/4	10-1/4	D.I.	25.5
12	<b>346593</b>	<b>12-2-A</b>	<b>3/4</b>	<b>2-1/4</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>4-1/2</b>	<b>9-3/4</b>	<b>R.F.</b>	<b>26.0</b>
12	<b>4104882</b>	<b>12-9</b>	<b>3/4</b>	<b>2-1/2</b>	<b>1-3/4</b>	<b>1-5/8</b>	<b>4-1/2</b>	<b>9-3/4</b>	<b>R.F.</b>	<b>25.0</b>
12	<b>462449</b>	<b>12-2-A</b>	<b>3/4</b>	<b>2</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>4-1/2</b>	<b>9-3/4</b>	<b>R.F.</b>	<b>26.0</b>
12	<b>4104917</b>	<b>12-2-A</b>	<b>3/4</b>	<b>2-1/2</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>4-1/2</b>	<b>9-3/4</b>	<b>R.F.</b>	<b>25.0</b>
12	<b>462485</b>	<b>12-5</b>	<b>3/4</b>	<b>3</b>	<b>3</b>	<b>1-7/8</b>	<b>5-1/2</b>	<b>9-3/8</b>	<b>R.F.</b>	<b>21.0</b>
12	908227	1173	7/8	1-1/4*	2	1-3/4	3-3/4	10	D.I.	20.3
12	908245	1173	7/8	1-1/2*	2	1-3/4	3-3/4	10	D.I.	20.3
12	<b>462458</b>	<b>12-2-A</b>	<b>7/8</b>	<b>2</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>4-1/2</b>	<b>10-1/4</b>	<b>R.F.</b>	<b>26.0</b>
12	<b>2023554</b>	<b>12-NS-3</b>	<b>7/8</b>	<b>2-1/4</b>	<b>2-1/2</b>	<b>2-3/8</b>	<b>4-1/2</b>	<b>9-3/8</b>	<b>R.F.</b>	<b>28.0</b>
12	<b>4104891</b>	<b>12-9</b>	<b>7/8</b>	<b>2-1/2</b>	<b>1-3/4</b>	<b>1-5/8</b>	<b>4-1/2</b>	<b>10-1/4</b>	<b>R.F.</b>	<b>25.0</b>
12	<b>462467</b>	<b>12-2-A</b>	<b>1</b>	<b>2</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>4</b>	<b>10</b>	<b>R.F.</b>	<b>26.0</b>
12	2023552	12-NS-3	1-1/8	2-1/4	2-1/2	2-3/8	4-1/2	9-3/8	R.F.	26.0
13	<b>462779</b>	<b>13-2</b>	<b>3/8</b>	<b>2</b>	<b>1-1/2</b>	<b>1-1/8</b>	<b>3-1/2</b>	<b>11-5/8</b>	<b>R.F.</b>	<b>14.0</b>
13	<b>462788</b>	<b>13-2</b>	<b>1/2</b>	<b>2</b>	<b>1-1/2</b>	<b>1-1/8</b>	<b>3-1/2</b>	<b>11-5/8</b>	<b>R.F.</b>	<b>14.0</b>
14	<b>463625</b>	<b>14-1</b>	<b>5/8</b>	<b>1-1/2</b>	<b>1-3/4</b>	<b>1-5/8</b>	<b>3-1/4</b>	<b>12-1/8</b>	<b>R.F.</b>	<b>20.0</b>
14	<b>463634</b>	<b>14-1</b>	<b>3/4</b>	<b>1-1/2</b>	<b>1-3/4</b>	<b>1-5/8</b>	<b>3-1/4</b>	<b>11-3/8</b>	<b>R.F.</b>	<b>20.0</b>
14	<b>463643</b>	<b>14-1</b>	<b>7/8</b>	<b>1-1/2</b>	<b>1-3/4</b>	<b>1-5/8</b>	<b>3-1/4</b>	<b>11-3/8</b>	<b>R.F.</b>	<b>20.0</b>
14	<b>463448</b>	<b>14NS-3</b>	<b>7/8</b>	<b>2-1/4</b>	<b>2-1/2</b>	<b>2-3/8</b>	<b>4-1/2</b>	<b>12-1/4</b>	<b>R.F.</b>	<b>28.0</b>
14	<b>463457</b>	<b>14NS-3</b>	<b>1</b>	<b>2-1/4</b>	<b>2-1/2</b>	<b>2-3/8</b>	<b>4-1/2</b>	<b>11-3/8</b>	<b>R.F.</b>	<b>28.0</b>
14	<b>463466</b>	<b>14NS-3</b>	<b>1-1/8</b>	<b>2-1/4</b>	<b>2-1/2</b>	<b>2-3/8</b>	<b>4-1/2</b>	<b>11-3/8</b>	<b>R.F.</b>	<b>28.0</b>
14	<b>**463518</b>	<b>14WL-8</b>	<b>1/2</b>	<b>3-3/4</b>	<b>2-1/2</b>	<b>1-3/8</b>	<b>5-1/16</b>	<b>12-5/8</b>	<b>R.F.</b>	<b>15.0</b>
14	<b>4103552</b>	<b>14-2</b>	<b>5/8</b>	<b>2</b>	<b>1-3/4</b>	<b>1-5/8</b>	<b>4-1/2</b>	<b>12-1/8</b>	<b>R.F.</b>	<b>29.2</b>
14	<b>**908281</b>	1173	3/4	1-1/8*	1-5/8	1-7/16	3-1/4	12-1/4	C.I.	26.5
14	<b>**908307</b>	1173	3/4	1-1/4*	1-5/8	1-1/2	3-1/4	12-1/4	C.I.	26.5
14	<b>917173</b>	<b>1208</b>	<b>3/4</b>	<b>1-1/4*</b>	<b>1-5/8</b>	<b>1-1/2</b>	<b>4</b>	<b>12</b>	<b>R.F.</b>	<b>26.5</b>
14	<b>917191</b>	<b>1208</b>	<b>3/4</b>	<b>1-1/2*</b>	<b>1-5/8</b>	<b>1-1/2</b>	<b>3-1/4</b>	<b>11-3/4</b>	<b>R.F.</b>	<b>26.5</b>
14	<b>4103632</b>	<b>14-2</b>	<b>3/4</b>	<b>2</b>	<b>1-3/4</b>	<b>1-5/8</b>	<b>4-1/2</b>	<b>11-3/4</b>	<b>R.F.</b>	<b>30.0</b>
14	<b>4104828</b>	<b>24S7-A</b>	<b>3/4</b>	<b>2-3/4</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>5-1/2</b>	<b>11-3/4</b>	<b>R.F.</b>	<b>35.0</b>
14	<b>917182</b>	<b>1208</b>	<b>7/8</b>	<b>1-1/4*</b>	<b>1-5/8</b>	<b>1-1/2</b>	<b>4</b>	<b>12</b>	<b>R.F.</b>	<b>26.5</b>
14	<b>917208</b>	<b>1208</b>	<b>7/8</b>	<b>1-1/2*</b>	<b>1-5/8</b>	<b>1-1/2</b>	<b>4</b>	<b>12</b>	<b>R.F.</b>	<b>26.5</b>
14	<b>463484</b>	<b>14PL-8</b>	<b>7/8</b>	<b>2</b>	<b>2-5/16</b>	<b>2-1/8</b>	<b>4-1/2</b>	<b>11-3/8</b>	<b>R.F.</b>	<b>28.0</b>
14	<b>4103641</b>	<b>14-2</b>	<b>7/8</b>	<b>2</b>	<b>1-3/4</b>	<b>1-5/8</b>	<b>4-1/2</b>	<b>12-1/4</b>	<b>R.F.</b>	<b>31.0</b>
16	<b>4101395</b>	<b>16-4</b>	<b>1/2</b>	<b>3-1/2</b>	<b>2-3/4</b>	<b>2-1/2</b>	<b>5-3/4</b>	<b>14-1/4</b>	<b>R.F.</b>	<b>54.0</b>
16	<b>4100047</b>	<b>16-4</b>	<b>3/4</b>	<b>3-1/2</b>	<b>2-3/4</b>	<b>2-1/2</b>	<b>5-3/4</b>	<b>13-3/8</b>	<b>R.F.</b>	<b>47.0</b>
16	<b>4100109</b>	<b>16-17</b>	<b>3/4</b>	<b>3-3/4</b>	<b>2-3/4</b>	<b>2-1/2</b>	<b>5-3/4</b>	<b>13-3/8</b>	<b>R.F.</b>	<b>42.0</b>
16	<b>4103703</b>	<b>16-5</b>	<b>7/8</b>	<b>2-1/2</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>4-1/2</b>	<b>12-15/16</b>	<b>R.F.</b>	<b>35.0</b>
16	<b>4105211</b>	<b>16-5</b>	<b>7/8</b>	<b>2-3/4</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>4-1/2</b>	<b>12-15/16</b>	<b>R.F.</b>	<b>42.0</b>
16	<b>917342</b>	<b>1208</b>	<b>1</b>	<b>1-1/2*</b>	<b>2</b>	<b>1-3/4</b>	<b>4-1/4</b>	<b>13-1/4</b>	<b>R.F.</b>	<b>34.0</b>
16	<b>917360</b>	<b>1208</b>	<b>1</b>	<b>2*</b>	<b>2</b>	<b>1-3/4</b>	<b>4-1/4</b>	<b>13-1/4</b>	<b>R.F.</b>	<b>34.0</b>
16	<b>4100127</b>	<b>16-17</b>	<b>1</b>	<b>3-3/4</b>	<b>2-3/4</b>	<b>2-1/2</b>	<b>5-3/4</b>	<b>13-1/4</b>	<b>R.F.</b>	<b>63.0</b>
18	<b>4105131</b>	<b>18-2</b>	<b>7/8</b>	<b>3</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>5-1/2</b>	<b>14-15/16</b>	<b>R.F.</b>	<b>52.0</b>
18	<b>4105195</b>	<b>26FS-8</b>	<b>7/8</b>	<b>5-1/2</b>	<b>2-7/8</b>	<b>2-5/8</b>	<b>8</b>	<b>14-15/16</b>	<b>R.F.</b>	<b>59.0</b>
18	<b>917468</b>	<b>1208</b>	<b>1</b>	<b>1-1/2*</b>	<b>2</b>	<b>1-7/8</b>	<b>3-1/4</b>	<b>14-7/8</b>	<b>R.F.</b>	<b>55.0</b>
18	<b>917486</b>	<b>1208</b>	<b>1</b>	<b>2*</b>	<b>2</b>	<b>1-7/8</b>	<b>4-1/2</b>	<b>14-7/8</b>	<b>R.F.</b>	<b>55.0</b>
18	<b>914826</b>	<b>1193</b>	<b>1</b>	<b>2*</b>	<b>2</b>	<b>1-3/4</b>	<b>5-3/4</b>	<b>15-3/4</b>	<b>R.F.</b>	<b>62.0</b>
18	<b>4104052</b>	<b>18-2</b>	<b>1</b>	<b>2-3/4</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>5-1/2</b>	<b>14-7/8</b>	<b>R.F.</b>	<b>66.0</b>
18	<b>4105140</b>	<b>18-2</b>	<b>1</b>	<b>3</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>5-1/2</b>	<b>14-7/8</b>	<b>R.F.</b>	<b>52.0</b>
18	<b>4100298</b>	<b>26FS-7</b>	<b>1</b>	<b>4</b>	<b>3</b>	<b>2-3/4</b>	<b>6-1/2</b>	<b>15-1/8</b>	<b>R.F.</b>	<b>81.0</b>
18	<b>4103348</b>	<b>26FS-7</b>	<b>1-1/8</b>	<b>4</b>	<b>3</b>	<b>2-3/4</b>	<b>6-1/2</b>	<b>15-1/8</b>	<b>R.F.</b>	<b>60.0</b>
20	<b>4100341</b>	<b>20-2</b>	<b>3/4</b>	<b>3</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>5-1/2</b>	<b>18</b>	<b>R.F.</b>	<b>68.0</b>
20	<b>4105239</b>	<b>20-2</b>	<b>3/4</b>	<b>3-3/4</b>	<b>2-3/4</b>	<b>2-1/8</b>	<b>6-1/2</b>	<b>18</b>	<b>R.F.</b>	<b>68.0</b>
20	<b>4100350</b>	<b>20-2</b>	<b>7/8</b>	<b>3</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>5-1/2</b>	<b>17-1/8</b>	<b>R.F.</b>	<b>45.0</b>
20	<b>4105266</b>	<b>32-T-8</b>	<b>7/8</b>	<b>5-1/2</b>	<b>2-7/8</b>	<b>2-5/8</b>	<b>8</b>	<b>16-15/16</b>	<b>R.F.</b>	<b>68.0</b>
20	<b>4100369</b>	<b>20-2</b>	<b>1</b>	<b>3</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>5-1/2</b>	<b>17-1/8</b>	<b>R.F.</b>	<b>80.2</b>
20	<b>4105328</b>	<b>20-2</b>	<b>1</b>	<b>3-1/4</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>5-1/2</b>	<b>17-1/8</b>	<b>R.F.</b>	<b>68.0</b>
20	<b>4105257</b>	<b>20-2</b>	<b>1</b>	<b>3-3/4</b>	<b>2-3/4</b>	<b>2-1/8</b>	<b>6-1/2</b>	<b>16-1/2</b>	<b>R.F.</b>	<b>68.0</b>
20	<b>4105275</b>	<b>32-T-8</b>	<b>1</b>	<b>5-1/2</b>	<b>2-7/8</b>	<b>2-5/8</b>	<b>8</b>	<b>17-1/8</b>	<b>R.F.</b>	<b>68.0</b>
24	<b>4105346</b>	<b>24TS-8</b>	<b>9/16</b>	<b>5-3/4</b>	<b>3-3/8</b>	<b>3-1/8</b>	<b>8</b>	<b>22</b>	<b>R.F.</b>	<b>113</b>
24	<b>4105355</b>	<b>24TS-8</b>	<b>7/8</b>	<b>5-3/4</b>	<b>3-3/8</b>	<b>3-1/8</b>	<b>8</b>	<b>21</b>	<b>R.F.</b>	<b>133</b>
24	<b>4100859</b>	<b>42TS8-2</b>	<b>1</b>	<b>4</b>	<b>3</b>	<b>2-3/4</b>	<b>6-1/2</b>	<b>21-1/8</b>	<b>R.F.</b>	<b>80.0</b>

McKissick® Roll-Forged™ sheaves highlighted above in bold italic are available with reduced lead times due to our advanced manufacturing process.

Custom sheaves are available. See page 281 for ordering details.

## Appendix 4.4.5.8

System: Bridge Counterweight System  
Component: 54" Dia. Sheave  
Manufacturer: McKissick

# DO NOT BE FOOLED... into

## The Elements of a Superior Sheave.

Every McKissick® Roll-Forged™ sheave starts as a single piece of AISI C-1035 carbon steel plate. Utilizing a “time proven” proprietary roll forging process that adds extra strength to the critical groove section, the sheave is formed from a precision flame cut blank. The hub is then pressed into place with complete metal-to-metal contact and secured with a deep penetrating weld to ensure proper fit and longer life. Before the McKissick® name is added, each sheave is thoroughly inspected to meet applicable industry and Crosby® quality standards.

**McKissick® Roll-Forged™ sheaves contain the following critical standard features required to meet your demanding applications.**

- 1** Smooth radius at the rim provides superior transition from outside diameter to groove - eliminating sharp corners that can damage rope
- Cold formed split steel sheaves may contain a sharp transition radius at rim of sheave



- 2** Size for size, McKissick® Roll-Forged™ sheaves have a thicker section under the tread of the wire rope groove - providing more substantial support of the wire rope
- Cold formed split steel sheaves are limited to a thinner section thickness under the groove, reducing sheave life in heavy service conditions
  - Thinner sections produce a sharp corner under the tread, resulting in potential stress risers



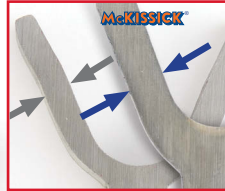
- 3** Thicker web on sheave provides required stiffness to support a stronger sheave that contains thicker flange sections
- The thinner web on cold formed split steel sheaves, inherent to the process, does not support thicker flange sections
  - The sharp, pointed cutter used in forming the groove during the cold formed split steel process may produce a concealed crack in the bottom of the groove

	McKissick®	Cold Formed Split Steel
Smooth Radius Edge - Better fit, less wear on rope	✓	
Thicker Fleet Section - Better support, stronger sheave groove	✓	
Deep Penetrating Weld at Hub - Longer life	✓	
Flame Hardened Groove - Higher Rockwell C rating	35Rc	14Rc
Roll Forging Process - Provides superior grain flow	✓	



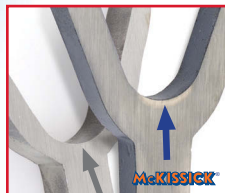
**There is no sheave like a McKissick® Roll-Forged™ Sheave**

# thinking all sheaves produce the same results.



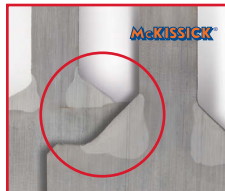
**4** Heavier flange sections - provide a much stronger wire rope groove and maintain proper consistent groove angles, ensuring long term wire rope performance

- Cold formed split steel sheaves tend to have flange sections that are thinner as well as variations in thickness on the same sheave, resulting in less than desired performance during critical applications
- Cold formed split steel sheaves are limited to a maximum flange thickness of 50% of web section



**5** Minimum 35Rc for higher hardness in the bottom of the groove - results in less wear to the sheave, thus extending life of wire rope

- Unless requested at time of order, cold formed split steel sheaves have a much lower hardness rating (approx. 14Rc)
- The standard material used in cold formed split steel process may not allow higher hardness in groove



**6** Precision alignment of hub with blank, then finished with a deep penetrating weld - ensuring proper fit, longer life and confidence during the most extreme of applications

**Cold Formed  
Split Steel  
Sheave**

## Additional Important Features of McKissick® Roll-Forged Sheaves

- The grain flow associated with the McKissick® Roll-Forged™ sheave process results in excellent performance properties.
- Each sheave is permanently marked with “McKissick®”, sheave outside diameter, wire rope size and Product Identification Code (PIC) that provides complete material traceability

**Crosby® and McKissick® Roll-Forged™ Sheaves  
Reliability You Can Depend On**



**theCrosby® group**

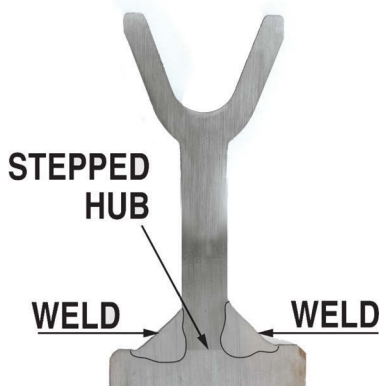
[www.thecrosbygroup.com](http://www.thecrosbygroup.com)

# McKissick® Roll-Forged™ Sheaves

## HEAVY DUTY SHEAVES FROM 12" THROUGH 78"

### Stepped Hub Design Proves Better

The McKissick hub is stepped to eliminate stress failure in the weld, common in traditional hub designs. The hub is pressed into place with complete metal-to-metal contact. This helps ensure an accurate alignment to the hub's axis so there is no wobble or lopping of the rotating sheave. The precision aligned hub/sheave wheel combination adds to the bearing life and keeps the sheave on the job longer.



Full penetration weld is standard on 40" and larger sheaves.

### Closed Die Upset and Roll Forged – Not Split

Upsetting and roll forging forms the groove and flange walls in multiple steps, eliminating the need to split and weaken the groove. This exclusive forging process adds extra strength to the critical groove section. You can count on a McKissick sheave to give maximum life performance, because it's forged to distribute the wire rope forces evenly over an accurately formed load surface. Plus, uniformity of the roll forged groove adds longer wire rope life.

### Full Range of Standard Sheave Sizes

McKissick Roll-Forged™ sheaves are available in a full range of sizes from 12 inches to 78 inches, and bearing styles and prices that best fit your application. Crosby also manufactures custom McKissick sheaves and can make minor modifications to standard sheaves as needed for special applications.

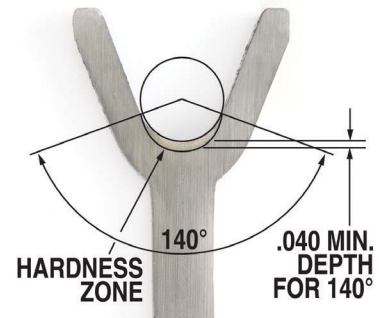


### Solid Steel – No Casting

Every McKissick sheave starts as a single piece of solid carbon steel plate. It's flame-cut from closely checked stock, so there's no inherent web/rim flaw as you find in cast sheaves. There's better balance and better distribution of forces with a McKissick Roll-Forged™ sheave too. Casting can result in groove wall variations – either too thick or too thin – causing uneven stresses and early failure.

### Flame Hardened Groove

Crosby's hardening technique is a science. It provides a precise maximum hardness for wear-resistance across the wire rope contact area. The McKissick sheave groove is flame hardened to a minimum 35 Rockwell C for a 140° contact area with the wire rope (upon special request the McKissick sheave groove can be flame hardened to a minimum 50 rockwell C for a 150° contact area with the wire rope). The solid steel plate provides the ideal surface for flame hardening and a closer tolerance fit to the wire rope to reduce fatigue and wear.



### Bearing Selection to Match Your Job Requirement

The McKissick Roll-Forged™ sheave is available in the following configurations:

- Plain bore
- Bronze bushed
- Roller bearing
- Tapered roller bearing
- Lubrication thru hub
- Key ways
- Set screws
- Full Complement Bearing



Licensed Under  
API Spec 8C-0021

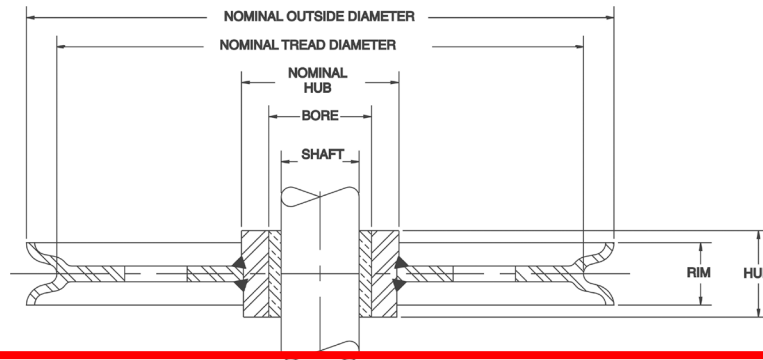
Sheaves are available to API 8C.

Custom sheaves are available. See page 281 for ordering details.

# McKissick® Sheaves Selection Guide

McKissick® sheaves come in a variety of sizes to suit your specific applications. Crosby offers many sheaves as standard and these are shown in the pages that follow.

For applications that require unique specifications, Crosby can make minor modifications to many of the sheaves listed at a reasonable charge. We can also custom design and manufacture sheaves to your exact requirements. Contact Crosby Sales to order McKissick® sheaves and include the stock number and quantity. For help in finding that standard sheave or for help with special requirements or custom designed sheaves, furnish the following important information:



## DIMENSIONAL INFORMATION

Pitch Diameter: \_\_\_\_\_  
~~Nominal Outside Diameter:~~ 54"      Wire Rope Size: 1-5/8"      Rim Width: \_\_\_\_\_  
 + Shaft Size: 5"      \*Hub Width: \_\_\_\_\_  
 Nominal Tread Diameter (Optional): 52-3/8"      Nominal Hub Diameter (Optional): \_\_\_\_\_

\*Hub width is measured over the cone of the Tapered Bearing Sheaves.  
 + Shaft Size is Bore Size on Plain Bore Sheaves.

## BEARING TYPE

Bronze Bushing       ++ Roller Bearing       Tapered Roller Bearing       Finish / Plain Bore  
 Full Complement Cylindrical Roller Bearing       Underwater       Other  
 ++ Requires hardened and ground shaft

## MATERIAL TYPE

Roll-Forged™ (Flame hardened 14" and larger)       Forged Steel       Domed  
 Cast Steel       Fabricated       Other

## APPLICATION INFORMATION

Line Pull: \_\_\_\_\_ Fleet Angle: \_\_\_\_\_ Degree of Wrap: \_\_\_\_\_  
 Line Speed: \_\_\_\_\_ Environment: \_\_\_\_\_ Groove Angle: \_\_\_\_\_

## SPECIAL REQUIREMENTS

Special Testing: \_\_\_\_\_  
 Finish: \_\_\_\_\_  
 Third Party Inspection / Approval: \_\_\_\_\_

In USA: Crosby's Special Engineered Product Group at 1-800-777-1555, fax (918) 834-5035, specials@thecrosbygroup.com  
 In Canada: Crosby Canada at (905) 451-9261  
 In Europe: N.V. Crosby Europe at 32 15 757125(26).

## Appendix 4.4.5.9

System: Bridge Counterweight System  
Component: Sheave Bearing  
Manufacturer: Cooper

## Lubrication

### P10 Series Bearing 5" Dia. Shaft

#### Fittings

Lubrication points are tapped 1/4" NPT or 1/8" NPT depending on size and series, and fitted with nipples for grease lubrication as standard. Grease nipples may be removed and replaced with other fittings or pipes. Pipework must be flexible to allow swivel cartridges to function correctly.

BSP fittings may be used, but care must be taken to avoid blocking off the lubricant cross-drilling as these fittings generally screw in further than NPT fittings.

#### Lubricant type

Cooper bearings and housings are designed for grease lubrication. Grease is easier to retain in the housing than oil, offering reduced lubricant loss and improved sealing. It also offers better protection against corrosion to the rolling surfaces.

Greases of NLGI No.2 designation are recommended for most applications. For centrally pumped systems a No.1 grease may be used for increased 'pumpability'.

Greases with extreme pressure (EP) additives are recommended.

For speeds over 200,000mm dn, greases with synthetic base oils are recommended.

Grease with a lithium complex thickener is usually used for normal applications operating at temperatures between 0°C and 80°C. When water resistance is required a grease with aluminium complex thickener can be used. Aluminium complex greases are not compatible with some other types of grease. The bearing must therefore be solvent cleaned of other greases before adding an aluminium complex based grease.

For extreme temperatures, speeds and loads always obtain a lubricant recommendation from our technical department.

#### Selection of Base Oil Viscosity (ISO-VG)

Grease selected for bearing lubrication must have a base oil of sufficiently high viscosity to adequately separate the rolling elements and race parts under operating conditions, in order for the bearing to provide a long service life. The same comment applies for the viscosity of the oil if oil lubrication is used.

The charts on page 3 recommended operating ranges for three common oil viscosities, for bearings under normal loading (for radial loads up to Cr/10).

In order to use these charts, the 'geometry factor' for the bearing in question must be found from the tables opposite and on page 2, and this geometry factor multiplied by the bearing speed (in thousands of rpm) in order to obtain the 'velocity factor'.

For example, if an 01E B 65M bearing is to be run at 1800rpm:

The geometry factor is 48.2 from the table.

Velocity factor =  $48.2 \times 1800/1000 = 86.76$

To determine the suitability of one of these oils, draw a vertical line from the horizontal axis at the calculated velocity factor, and draw a horizontal line from vertical axis at the operating temperature.

If the lines intersect in the shaded area the viscosity of the oil is suitable.

If the lines intersect above the shaded area a higher viscosity oil is required.

If the lines intersect below the shaded area the bearing may operate satisfactorily, but it is suggested that a lower viscosity oil is used.

The use of these charts is subject to the operating conditions being within the recommended ranges for the lubricant as specified by the lubricant manufacturer:

For conditions not covered by these charts, please contact our technical department.

Note that the lubricant film thickness is not particularly sensitive to load, so for heavier loading the lubricant selection as provided by these charts is usually sufficient provided that the lines drawn on the chart as explained above do not intersect at the upper edge of the shaded area.

It is recommended that our technical department is contacted with details of the application if extremes of load, speed or temperature are expected.

### GEOMETRY FACTORS OF STANDARD CYLINDRICAL BEARINGS

Shaft Diameter d	Bearing Reference	Geometry factor	Shaft Diameter d	Bearing Reference	Geometry factor
35	01 B 35M	27.3	110	100 B 110M	104
40	01 B 40M	27.3		01 B 110M	112
45	01E B 45M	37.6		02 B 110M	120
50	01E B 50M	37.6	115	03 B 110M	127
	02 B 50M	39.0		01 B 115M	112
55	01E B 55M	48.2		02 B 115M	120
60	01E B 60M	48.2	120	100 B 120M	124
	02 B 60M	53.2		01 B 120M	129
65	01E B 65M	48.2		125	02 B 120M
	02 B 65M	53.2	03 B 120M		127
70	01E B 70M	61.4	130		01 B 125M
	02 B 70M	67.1		02 B 125M	139
75	100 B 75M	57.5		135	01 B 130M
	01E B 75M	61.4	01 B 130M		129
80	02 B 75M	67.1	140		02 B 130M
	01E B 80M	77.2		03 B 130M	143
85	02 B 80M	83.7		145	01 B 135M
	100 B 85M	71.5	150		100 B 140M
90	01E B 85M	77.2			01 B 140M
	02 B 85M	83.7		02 B 140M	158
95	01E B 90M	77.2	155	03 B 140M	160
	02 B 90M	83.7		02 B 145M	158
100	01E B 95M	92.8		100	100 B 150M
	100 B 100M	87.9	01 B 150M		164
105	01E B 100M	92.8	02 B 150M		176
	02 B 100M	101	03 B 150M	181	
110	03 B 100M	112	105	01 B 155M	164
	01E B 105M	92.8		02 B 155M	176
115	02 B 105M	101			

## GEOMETRY FACTORS OF STANDARD CYLINDRICAL BEARINGS

Shaft Diameter d	Bearing Reference	Geometry factor
160	01 B 600-160M	164
	01 B 160M	183
	02 B 600-160M	176
	02 B 160M	198
	03 B 160M	212
170	01 B 608-170M	183
	01 B 170M	200
	02 B 170M	198
175	01 B 175M	200
	02 B 175M	216
180	01 B 180M	200
	02 B 180M	216
	03 B 180M	232
190	01 B 190M	237
	02 B 190M	258
	03 B 190M	277
200	01 B 200M	237
	02 B 200M	258
	03 B 200M	277
220	01 B 220M	277
	02 B 220M	297
	03 B 220M	328
230	01 B 230M	277
	02 B 230M	297

Shaft Diameter d	Bearing Reference	Geometry factor
240	01 B 240M	323
	02 B 240M	343
	03 B 240M	359
250	01 B 250M	323
	02 B 250M	343
	03 B 250M	359
260	01 B 1000-260M	323
	01 B 260M	364
	02 B 260M	343
270	01 B 270M	364
	01 B 275M	364
	01 B 280M	364
280	02 B 280M	386
	03X B 280M	413
	03E B 280M	397
290	01 B 290M	413
	03 B 290M	463
300	01 B 300M	413
	02 B 300M	435
	03 B 300M	463
320	01 B 320M	455
	02 B 320M	484
	03 B 320M	527
330	01 B 330M	455
	02 B 330M	484

Shaft Diameter d	Bearing Reference	Geometry factor
340	01 B 1300-340M	455
	01 B 340M	501
	02 B 340M	536
	03E B 340M	551
350	01 B 350M	501
	02 B 350M	536
360	01 B 1400-360M	501
	01 B 360M	551
	02 B 360M	536
	03E B 360M	551
380	03X B 360M	576
	01 B 380M	551
	02 B 380M	579
390	03 B 380M	631
	01 B 390M	600
400	01 B 400M	600
	02 B 400M	631
	03 B 400M	631
420	01 B 420M	650
	02 B 420M	685
	03E B 420M	701
440	01 B 440M	701
	02 B 440M	730
	03E B 440M	701

Shaft Diameter d	Bearing Reference	Geometry factor
460	01 B 460M	701
	02 B 460M	730
	03E B 460M	759
	03X B 460M	807
480	01 B 480M	757
	02 B 480M	790
	03X B 480M	807
500	01 B 500M	810
	02 B 500M	837
	03 B 500M	917
530	01 B 530M	879
	02 B 530M	903
	03 B 530M	917
560	01 B 560M	934
	02 B 560M	966
	03E B 560M	995
580	01 B 580M	995
	02 B 580M	1031
600	01 B 600M	1053
	02 B 600M	1075
	03E B 600M	1053

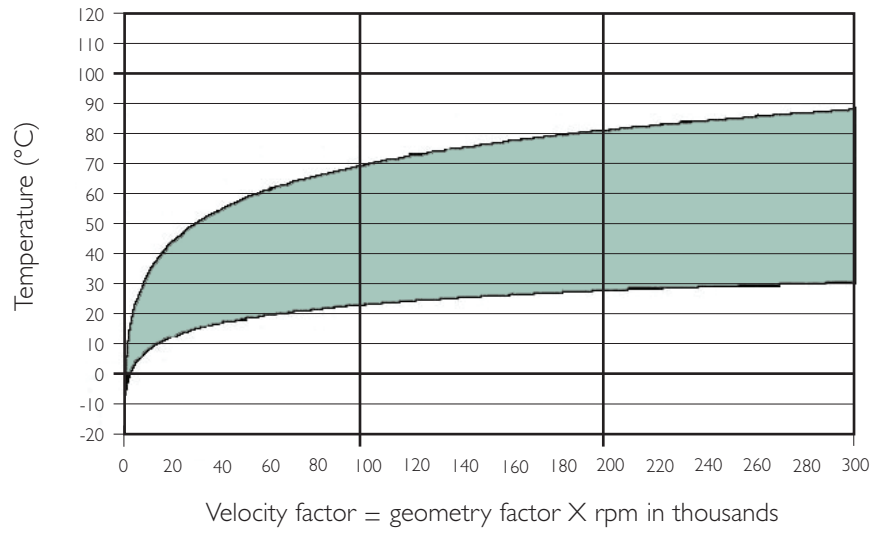
## GEOMETRY FACTORS OF 08 SERIES BEARINGS

Shaft Diameter (mm)	Bearing Reference	Geometry factor
150	08 B 150M EX	176
	08 B 150M GR	
160	08 B 160M EX	176
	08 B 160M GR	
200	08 B 200M EX	258
	08 B 200M GR	
220	08 B 220M EX	297
	08 B 220M GR	
240	08 B 240M EX	343
	08 B 240M GR	

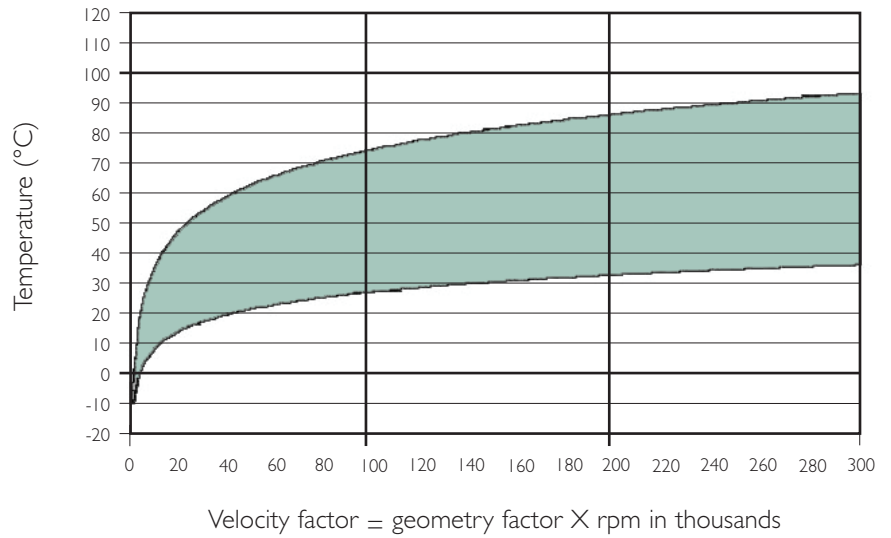
## GEOMETRY FACTORS OF IDTB SERIES BEARINGS

Shaft Diameter d (mm)	Bearing Reference	Geometry factor
75	IDTB75M	63
80	IDTB80M	69
90	IDTB90M	78
100	IDTB100M	96
110	IDTB110M	110
120	IDTB120M	118
140	IDTB140M	144
160	IDTB160M	169
180	IDTB180M	196

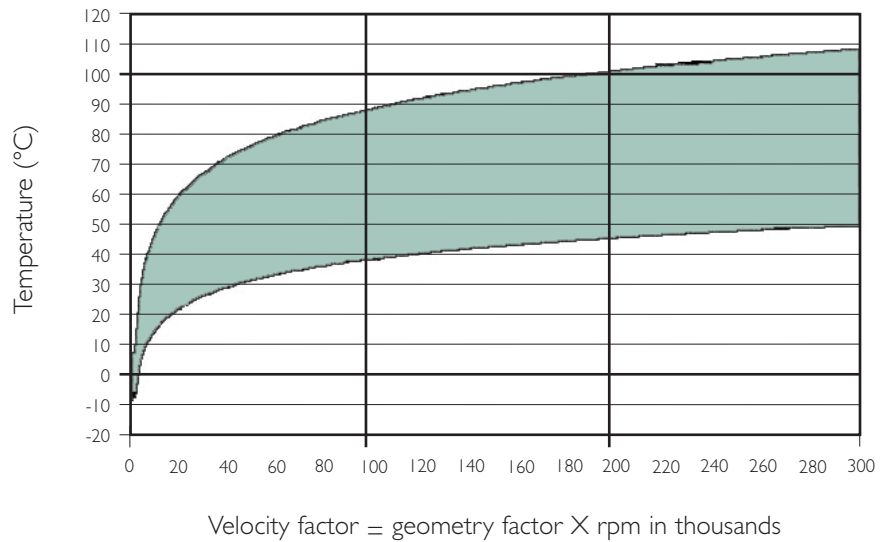
Cooper Bearing recommended speed and temperature range for VG 150 grease and oils



Cooper Bearing recommended speed and temperature range for VG 220 grease and oils



Cooper Bearing recommended speed and temperature range for VG 460 grease and oils



## Grease quantity for initial lubrication

The quantity of grease required on initial lubrication is dependent upon operating speed and temperature.

If the operating temperature is below 80°C the quantity of grease may be determined directly according to the bearing reference and operating speed from the table below. If the operating temperature is above 80°C a 25% pack of grease should be used regardless of operating speed (refer to the right hand column of the table).

With a 'full pack' of grease the space within the housing (i.e. surrounding the bearing components) in the assembled unit is completely filled with grease.

The table assumes normal density grease (about 0.85 g/cm<sup>3</sup>).

### INITIAL GREASE QUANTITIES FOR STANDARD CYLINDRICAL BEARINGS

Shaft Diameter d (mm)	Bearing Reference	Speed (rpm) up to	Grease (full pack) (kg)	Speed (rpm)		Grease (75% full pack) (kg)	Speed (rpm)		Grease (50% full pack) (kg)	Speed (rpm)		Grease (33% full pack) (kg)	Speed (rpm) over	Grease (25% full pack) (kg)
				from	to		from	to		from	to			
35	01 B 35M	1312	0.06	1312	2625	0.05	2625	3937	0.03	3937	5249	0.02	5249	0.02
40	01 B 40M	1312	0.06	1312	2625	0.05	2625	3937	0.03	3937	5249	0.02	5249	0.02
45	01E B 45M	984	0.09	984	1969	0.07	1969	2953	0.05	2953	3937	0.03	3937	0.02
50	01E B 50M	984	0.09	984	1969	0.07	1969	2953	0.05	2953	3937	0.03	3937	0.02
	02 B 50M	984	0.15	984	1969	0.11	1969	2953	0.08	2953	3937	0.05	3937	0.04
55	01E B 55M	787	0.15	787	1575	0.11	1575	2362	0.08	2362	3150	0.05	3150	0.04
60	01E B 60M	787	0.15	787	1575	0.11	1575	2362	0.08	2362	3150	0.05	3150	0.04
	02 B 60M	787	0.21	787	1575	0.16	1575	2362	0.11	2362	3150	0.07	3150	0.05
65	01E B 65M	787	0.15	787	1575	0.11	1575	2362	0.08	2362	3150	0.05	3150	0.04
	02 B 65M	787	0.21	787	1575	0.16	1575	2362	0.11	2362	3150	0.07	3150	0.05
70	01E B 70M	656	0.18	656	1312	0.14	1312	1969	0.09	1969	2625	0.06	2625	0.05
	02 B 70M	656	0.30	656	1312	0.23	1312	1969	0.15	1969	2625	0.10	2625	0.08
75	100 B 75M	656	0.15	656	1312	0.11	1312	1969	0.08	1969	2625	0.05	2625	0.04
	01E B 75M	656	0.18	656	1312	0.14	1312	1969	0.09	1969	2625	0.06	2625	0.05
	02 B 75M	656	0.30	656	1312	0.23	1312	1969	0.15	1969	2625	0.10	2625	0.08
80	01E B 80M	562	0.30	562	1125	0.23	1125	1687	0.15	1687	2250	0.10	2250	0.08
	02 B 80M	562	0.45	562	1125	0.34	1125	1687	0.23	1687	2250	0.15	2250	0.11
85	100 B 85M	573	0.22	573	1145	0.17	1145	1718	0.11	1718	2291	0.07	2291	0.06
	01E B 85M	562	0.30	562	1125	0.23	1125	1687	0.15	1687	2250	0.10	2250	0.08
	02 B 85M	562	0.45	562	1125	0.34	1125	1687	0.23	1687	2250	0.15	2250	0.11
90	01E B 90M	562	0.30	562	1125	0.23	1125	1687	0.15	1687	2250	0.10	2250	0.08
	02 B 90M	562	0.45	562	1125	0.34	1125	1687	0.23	1687	2250	0.15	2250	0.11

## INITIAL GREASE QUANTITIES FOR STANDARD CYLINDRICAL BEARINGS

Shaft Diameter d (mm)	Bearing Reference	Speed (rpm) up to	Grease (full pack) (kg)	Speed (rpm)		Grease (75% full pack) (kg)	Speed (rpm)		Grease (50% full pack) (kg)	Speed (rpm)		Grease (33% full pack) (kg)	Speed (rpm) over	Grease (25% full pack) (kg)
				from	to		from	to		from	to			
95	01E B 95M	492	0.36	492	984	0.27	984	1476	0.18	1476	1969	0.12	1969	0.09
100	100 B 100M	492	0.36	492	984	0.27	984	1476	0.18	1476	1969	0.12	1969	0.09
	01E B 100M	492	0.36	492	984	0.27	984	1476	0.18	1476	1969	0.12	1969	0.09
	02 B 100M	492	0.60	492	984	0.45	984	1476	0.30	1476	1969	0.20	1969	0.15
	03 B 100M	492	1.20	492	984	0.90	984	1476	0.60	1476	1969	0.40	1969	0.30
105	01E B 105M	492	0.36	492	984	0.27	984	1476	0.18	1476	1969	0.12	1969	0.09
	02 B 105M	492	0.60	492	984	0.45	984	1476	0.30	1476	1969	0.20	1969	0.15
110	100 B 110M	437	0.36	437	875	0.27	875	1312	0.18	1312	1750	0.12	1750	0.09
	01 B 110M	437	0.51	437	875	0.38	875	1312	0.26	1312	1750	0.17	1750	0.13
	02 B 110M	437	0.90	437	875	0.68	875	1312	0.45	1312	1750	0.30	1750	0.23
	03 B 110M	437	1.40	437	875	1.05	875	1312	0.70	1312	1750	0.46	1750	0.35
115	01 B 115M	437	0.51	437	875	0.38	875	1312	0.26	1312	1750	0.17	1750	0.13
	02 B 115M	437	0.90	437	875	0.68	875	1312	0.45	1312	1750	0.30	1750	0.23
120	100 B 120M	394	0.49	394	787	0.37	787	1181	0.25	1181	1575	0.16	1575	0.12
	01 B 120M	394	0.60	394	787	0.45	787	1181	0.30	1181	1575	0.20	1575	0.15
	02 B 120M	394	1.20	394	787	0.90	787	1181	0.60	1181	1575	0.40	1575	0.30
	03 B 120M	437	1.40	437	875	1.05	875	1312	0.70	1312	1750	0.46	1750	0.35
125	01 B 125M	394	0.60	394	787	0.45	787	1181	0.30	1181	1575	0.20	1575	0.15
	02 B 125M	394	1.20	394	787	0.90	787	1181	0.60	1181	1575	0.40	1575	0.30
130	100 B 130M	394	0.49	394	787	0.37	787	1181	0.25	1181	1575	0.16	1575	0.12
	01 B 130M	394	0.60	394	787	0.45	787	1181	0.30	1181	1575	0.20	1575	0.15
	02 B 130M	394	1.20	394	787	0.90	787	1181	0.60	1181	1575	0.40	1575	0.30
	03 B 130M	394	1.40	394	787	1.05	787	1181	0.70	1181	1575	0.46	1575	0.35
135	01 B 135M	358	0.78	358	716	0.59	716	1074	0.39	1074	1432	0.26	1432	0.20
140	100 B 140M	358	0.64	358	716	0.48	716	1074	0.32	1074	1432	0.21	1432	0.16
	01 B 140M	358	0.78	358	716	0.59	716	1074	0.39	1074	1432	0.26	1432	0.20
	02 B 140M	358	1.40	358	716	1.05	716	1074	0.70	1074	1432	0.46	1432	0.35
	03 B 140M	358	2.00	358	716	1.50	716	1074	1.00	1074	1432	0.66	1432	0.50
145	02 B 145M	358	1.40	358	716	1.05	716	1074	0.70	1074	1432	0.46	1432	0.35

## INITIAL GREASE QUANTITIES FOR STANDARD CYLINDRICAL BEARINGS

Shaft Diameter d (mm)	Bearing Reference	Speed (rpm) up to	Grease (full pack) (kg)	Speed (rpm)		Grease (75% full pack) (kg)	Speed (rpm)		Grease (50% full pack) (kg)	Speed (rpm)		Grease (33% full pack) (kg)	Speed (rpm) over	Grease (25% full pack) (kg)
				from	to		from	to		from	to			
150	100 B 150M	328	1.02	328	656	0.77	656	984	0.51	984	1312	0.34	1312	0.26
	01 B 150M	328	0.90	328	656	0.68	656	984	0.45	984	1312	0.30	1312	0.23
	02 B 150M	328	1.40	328	656	1.05	656	984	0.70	984	1312	0.46	1312	0.35
	03 B 150M	328	2.70	328	656	2.03	656	984	1.35	984	1312	0.89	1312	0.68
155	01 B 155M	328	0.90	328	656	0.68	656	984	0.45	984	1312	0.30	1312	0.23
	02 B 155M	328	1.40	328	656	1.05	656	984	0.70	984	1312	0.46	1312	0.35
160	01 B 600-160M	328	0.90	328	656	0.68	656	984	0.45	984	1312	0.30	1312	0.23
	01 B 160M	303	1.00	303	606	0.75	606	909	0.50	909	1211	0.33	1211	0.25
	02 B 600-160M	328	1.40	328	656	1.05	656	984	0.70	984	1312	0.46	1312	0.35
	02 B 160M	303	1.40	303	606	1.05	606	909	0.70	909	1211	0.46	1211	0.35
	03 B 160M	303	3.60	303	606	2.70	606	909	1.80	909	1211	1.19	1211	0.90
170	01 B 608-170M	303	1.00	303	606	0.75	606	909	0.50	909	1211	0.33	1211	0.25
	01 B 170M	281	1.20	281	562	0.90	562	844	0.60	844	1125	0.40	1125	0.30
	02 B 170M	303	2.00	303	606	1.50	606	909	1.00	909	1211	0.66	1211	0.50
	03 B 170M	303	3.60	303	606	2.70	606	909	1.80	909	1211	1.19	1211	0.90
175	01 B 175M	281	1.20	281	562	0.90	562	844	0.60	844	1125	0.40	1125	0.30
	02 B 175M	281	2.00	281	562	1.50	562	844	1.00	844	1125	0.66	1125	0.50
180	01 B 180M	281	1.20	281	562	0.90	562	844	0.60	844	1125	0.40	1125	0.30
	02 B 180M	281	2.00	281	562	1.50	562	844	1.00	844	1125	0.66	1125	0.50
	03 B 180M	281	4.20	281	562	3.15	562	844	2.10	844	1125	1.39	1125	1.05
190	01 B 190M	246	1.40	246	492	1.05	492	738	0.70	738	984	0.46	984	0.35
	02 B 190M	246	2.70	246	492	2.03	492	738	1.35	738	984	0.89	984	0.68
	03 B 190M	246	5.40	246	492	4.05	492	738	2.70	738	984	1.78	984	1.35
200	01 B 200M	246	1.40	246	492	1.05	492	738	0.70	738	984	0.46	984	0.35
	02 B 200M	246	2.70	246	492	2.03	492	738	1.35	738	984	0.89	984	0.68
	03 B 200M	246	5.40	246	492	4.05	492	738	2.70	738	984	1.78	984	1.35
220	01 B 220M	219	1.40	219	437	1.05	437	656	0.70	656	875	0.46	875	0.35
	02 B 220M	219	3.60	219	437	2.70	437	656	1.80	656	875	1.19	875	0.90
	03 B 220M	219	6.90	219	437	5.18	437	656	3.45	656	875	2.28	875	1.73
230	01 B 230M	219	1.40	219	437	1.05	437	656	0.70	656	875	0.46	875	0.35
	02 B 230M	219	3.60	219	437	2.70	437	656	1.80	656	875	1.19	875	0.90

## INITIAL GREASE QUANTITIES FOR STANDARD CYLINDRICAL BEARINGS

Shaft Diameter d (mm)	Bearing Reference	Speed (rpm) up to	Grease (full pack) (kg)	Speed (rpm)		Grease (75% full pack) (kg)	Speed (rpm)		Grease (50% full pack) (kg)	Speed (rpm)		Grease (33% full pack) (kg)	Speed (rpm) over	Grease (25% full pack) (kg)
				from	to		from	to		from	to			
240	01 B 240M	197	2.00	197	394	1.50	394	591	1.00	591	787	0.66	787	0.50
	02 B 240M	197	4.20	197	394	3.15	394	591	2.10	591	787	1.39	787	1.05
	03 B 240M	197	8.10	197	394	6.08	394	591	4.05	591	787	2.67	787	2.03
250	01 B 250M	197	2.00	197	394	1.50	394	591	1.00	591	787	0.66	787	0.50
	02 B 250M	197	4.20	197	394	3.15	394	591	2.10	591	787	1.39	787	1.05
	03 B 250M	197	8.10	197	394	6.08	394	591	4.05	591	787	2.67	787	2.03
260	01 B 1000-260M	197	2.00	197	394	1.50	394	591	1.00	591	787	0.66	787	0.50
	01 B 260M	179	2.00	179	358	1.50	358	537	1.00	537	716	0.66	716	0.50
	02 B 260M	197	4.20	197	394	3.15	394	591	2.10	591	787	1.39	787	1.05
	03 B 260M	197	8.10	197	394	6.08	394	591	4.05	591	787	2.67	787	2.03
270	01 B 270M	179	2.00	179	358	1.50	358	537	1.00	537	716	0.66	716	0.50
275	01 B 275M	179	2.00	179	358	1.50	358	537	1.00	537	716	0.66	716	0.50
280	01 B 280M	179	2.00	179	358	1.50	358	537	1.00	537	716	0.66	716	0.50
	02 B 280M	179	4.80	179	358	3.60	358	537	2.40	537	716	1.58	716	1.20
	03X B 280M	179	10.00	179	358	7.50	358	537	5.00	537	716	3.30	716	2.50
	03E B 280M	179	10.00	179	358	7.50	358	537	5.00	537	716	3.30	716	2.50
290	01 B 290M	164	2.00	164	328	1.50	328	492	1.00	492	656	0.66	656	0.50
	03 B 290M	164	11.00	164	328	8.25	328	492	5.50	492	656	3.63	656	2.75
300	01 B 300M	164	2.00	164	328	1.50	328	492	1.00	492	656	0.66	656	0.50
	02 B 300M	164	5.40	164	328	4.05	328	492	2.70	492	656	1.78	656	1.35
	03 B 300M	164	11.00	164	328	8.25	328	492	5.50	492	656	3.63	656	2.75
320	01 B 320M	151	2.76	151	303	2.07	303	454	1.38	454	606	0.91	606	0.69
	02 B 320M	151	6.60	151	303	4.95	303	454	3.30	454	606	2.18	606	1.65
	03 B 320M	151	12.00	151	303	9.00	303	454	6.00	454	606	3.96	606	3.00
330	01 B 330M	151	2.76	151	303	2.07	303	454	1.38	454	606	0.91	606	0.69
	02 B 330M	151	6.60	151	303	4.95	303	454	3.30	454	606	2.18	606	1.65
340	01 B 1300-340M	151	2.76	151	303	2.07	303	454	1.38	454	606	0.91	606	0.69
	01 B 340M	141	3.00	141	281	2.25	281	422	1.50	422	562	0.99	562	0.75
	02 B 340M	141	7.20	141	281	5.40	281	422	3.60	422	562	2.38	562	1.80
	03E B 340M	141	15.00	141	281	11.25	281	422	7.50	422	562	4.95	562	3.75

## INITIAL GREASE QUANTITIES FOR STANDARD CYLINDRICAL BEARINGS

Shaft Diameter d (mm)	Bearing Reference	Speed (rpm) up to	Grease (full pack) (kg)	Speed (rpm)		Grease (75% full pack) (kg)	Speed (rpm)		Grease (50% full pack) (kg)	Speed (rpm)		Grease (33% full pack) (kg)	Speed (rpm) over	Grease (25% full pack) (kg)
				from	to		from	to		from	to			
350	01 B 350M	141	3.00	141	281	2.25	281	422	1.50	422	562	0.99	562	0.75
	02 B 350M	141	7.20	141	281	5.40	281	422	3.60	422	562	2.38	562	1.80
360	01 B 1400-360M	141	3.00	141	281	2.25	281	422	1.50	422	562	0.99	562	0.75
	01 B 360M	131	3.00	131	262	2.25	262	394	1.50	394	525	0.99	525	0.75
	02 B 360M	141	7.20	141	281	5.40	281	422	3.60	422	562	2.38	562	1.80
	03E B 360M	141	15.00	141	281	11.25	281	422	7.50	422	562	4.95	562	3.75
	03X B 360M	141	15.00	141	281	11.25	281	422	7.50	422	562	4.95	562	3.75
380	01 B 380M	131	3.00	131	262	2.25	262	394	1.50	394	525	0.99	525	0.75
	02 B 380M	131	7.80	131	262	5.85	262	394	3.90	394	525	2.57	525	1.95
	03 B 380M	131	16.20	131	262	12.15	262	394	8.10	394	525	5.35	525	4.05
390	01 B 390M	123	3.60	123	246	2.70	246	369	1.80	369	492	1.19	492	0.90
400	01 B 400M	123	3.60	123	246	2.70	246	369	1.80	369	492	1.19	492	0.90
	02 B 400M	123	9.00	123	246	6.75	246	369	4.50	369	492	2.97	492	2.25
	03 B 400M	131	16.20	131	262	12.15	262	394	8.10	394	525	5.35	525	4.05
420	01 B 420M	116	4.20	116	232	3.15	232	347	2.10	347	463	1.39	463	1.05
	02 B 420M	116	9.60	116	232	7.20	232	347	4.80	347	463	3.17	463	2.40
	03E B 420M	116	21.60	116	232	16.20	232	347	10.80	347	463	7.13	463	5.40
440	01 B 440M	109	4.20	109	219	3.15	219	328	2.10	328	437	1.39	437	1.05
	02 B 440M	109	9.60	109	219	7.20	219	328	4.80	328	437	3.17	437	2.40
	03E B 440M	116	21.60	116	232	16.20	232	347	10.80	347	463	7.13	463	5.40
460	01 B 460M	109	4.20	109	219	3.15	219	328	2.10	328	437	1.39	437	1.05
	02 B 460M	109	9.60	109	219	7.20	219	328	4.80	328	437	3.17	437	2.40
	03E B 460M	109	24.60	109	219	18.45	219	328	12.30	328	437	8.12	437	6.15
	03X B 460M	104	24.60	104	207	18.45	207	311	12.30	311	414	8.12	414	6.15
480	01 B 480M	104	4.80	104	207	3.60	207	311	2.40	311	414	1.58	414	1.20
	02 B 480M	104	10.20	104	207	7.65	207	311	5.10	311	414	3.37	414	2.55
	03X B 480M	109	24.60	109	219	18.45	219	328	12.30	328	437	8.12	437	6.15
500	01 B 500M	98	4.80	98	197	3.60	197	295	2.40	295	394	1.58	394	1.20
	02 B 500M	98	10.80	98	197	8.10	197	295	5.40	295	394	3.56	394	2.70
	03 B 500M	98	30.00	98	197	22.50	197	295	15.00	295	394	9.90	394	7.50

### INITIAL GREASE QUANTITIES FOR STANDARD CYLINDRICAL BEARINGS

Shaft Diameter d (mm)	Bearing Reference	Speed (rpm) up to	Grease (full pack) (kg)	Speed (rpm)		Grease (75% full pack) (kg)	Speed (rpm)		Grease (50% full pack) (kg)	Speed (rpm)		Grease (33% full pack) (kg)	Speed (rpm) over	Grease (25% full pack) (kg)
				from	to		from	to		from	to			
530	01 B 530M	94	5.40	94	187	4.05	187	281	2.70	281	375	1.78	375	1.35
	02 B 530M	94	11.40	94	187	8.55	187	281	5.70	281	375	3.76	375	2.85
	03 B 530M	98	30.00	98	197	22.50	197	295	15.00	295	394	9.90	394	7.50
560	01 B 560M	89	5.40	89	179	4.05	179	268	2.70	268	358	1.78	358	1.35
	02 B 560M	89	11.40	89	179	8.55	179	268	5.70	268	358	3.76	358	2.85
	03E B 560M	89	36.00	89	179	27.00	179	268	18.00	268	358	11.88	358	9.00
580	01 B 580M	86	6.00	86	171	4.50	171	257	3.00	257	342	1.98	342	1.50
	02 B 580M	86	12.60	86	171	9.45	171	257	6.30	257	342	4.16	342	3.15
600	01 B 600M	82	6.00	82	164	4.50	164	246	3.00	246	328	1.98	328	1.50
	02 B 600M	82	12.60	82	164	9.45	164	246	6.30	246	328	4.16	328	3.15
	03E B 600M	86	38.40	86	171	28.80	171	257	19.20	257	342	12.67	342	9.60

### INITIAL GREASE QUANTITIES FOR 08 SERIES BEARINGS

Shaft Diameter (mm)	Pedestal Reference	Speed (rpm) up to	Grease (full pack) kg	Speed (rpm)		Grease (75% full pack) kg	Speed (rpm)		Grease (50% full pack) kg	Speed (rpm)		Grease (33% full pack) kg	Speed (rpm) over	Grease (25% full pack) kg
				from	to		from	to		from	to			
150	08 SDC3134	328	2.10	328	656	1.57	656	984	1.05	984	1312	0.69	1312	0.53
160	08 SDC3136	328	2.04	328	656	1.53	656	984	1.02	984	1312	0.67	1312	0.50
200	08 SDC3144	246	3.50	246	492	2.63	492	738	1.75	738	max.	1.16	-	0.88
220	08 SDC3148	219	3.62	219	437	2.72	437	656	1.81	656	max.	1.20	-	0.90
240	08 SDC3152	197	5.17	197	394	3.88	394	591	2.59	591	max.	1.71	-	1.30

### INITIAL GREASE QUANTITIES FOR IDTB SERIES BEARINGS

Shaft Diameter d (mm)	Bearing Reference	Speed (rpm) up to	Grease (full pack) (Kg)	Speed (rpm)		Grease (75% full pack) (Kg)	Speed (rpm)		Grease (50% full pack) (Kg)	Speed (rpm)		Grease (33% full pack) (Kg)	Speed (rpm) over	Grease (25% full pack) (Kg)
				from	to		from	to		from	to			
75	IDTB75M	667	0.19	667	1333	0.14	1333	2000	0.10	2000	2667	0.06	2667	0.05
80	IDTB80M	625	0.23	625	1250	0.17	1250	1875	0.12	1875	2500	0.08	2500	0.06
90	IDTB90M	556	0.25	556	1111	0.19	1111	1667	0.12	1667	2222	0.08	2222	0.06
100	IDTB100M	500	0.41	500	1000	0.31	1000	1500	0.20	1500	2000	0.13	2000	0.10
110	IDTB110M	455	0.44	455	909	0.33	909	1364	0.22	1364	1818	0.14	1818	0.11
120	IDTB120M	417	0.50	417	833	0.38	833	1250	0.25	1250	1667	0.17	1667	0.13
140	IDTB140M	357	0.65	357	714	0.48	714	1071	0.32	1071	1429	0.21	1429	0.16
160	IDTB160M	313	0.63	313	625	0.47	625	938	0.32	938	1250	0.21	1250	0.16
180	IDTB180M	278	0.77	278	556	0.58	556	833	0.39	833	1111	0.25	1111	0.19

## Routine greasing

### General (all Series)

Routine greasing frequency depends on temperature, speed and environment. Grease quantities depend on bearing size. Excessive quantities of lubricant should not be used. Particularly at high speeds, this may result in excessive churning and overheating.

Automatic lubrication systems should be metered to deliver grease at an average rate equivalent to the routine greasing periods and quantities specified.

If it can be done safely, routine greasing should occur while the shaft is rotating to help distribute the grease. Do not mix different types of grease in the bearing.

## Standard cylindrical bearings

The table below specifies routine greasing intervals. The shortest greasing interval should be selected to which one or more of the conditions in the table apply. If operating conditions fall outside those listed please contact our technical department for a recommended lubrication interval.

The following table specifies the required quantity of grease at each routine greasing. Note that 2ml is approximately one shot from a conventional side-lever grease gun. Smaller quantities may be delivered using a push-type gun.

Routine greasing frequency	Operating conditions		
	Temperature	Speed dn (mm)	Environment (3)
100 hours	80°C to 175°C	200,000 to 300,000 (1)	Very dirty/submerged
200 hours	60°C to 80°C	100,000 to 200,000	Dusty/splashed
400 hours (2)	Below 60°C	Up to 100,000	Clean/dry

(1) Up to bearing maximum in case of 100 Series bearings

(2) For EX bearings and GR bearings used for location only (i.e. no nominal thrust load) this may be extended to 1000 hours. For applications where temperature and operating speed allow for a full pack of grease this may be extended to one year for EX bearings and GR bearings used for location only.

(3) For applications where operating speed and temperature allow for a full pack of grease, regreasing can occur every 400 hours regardless of the working environment.

\* May be increased to 2 if speed is less than 100,000dn (mm), or up to 200,000dn (mm) if operating temperature is less than 80°C.

Shaft Diam. d	Bearing Reference	Routine Grease Volume (ml)
35	01 B 35M	4
40	01 B 40M	4
45	01E B 45M	4
50	01E B 50M	4
	02 B 50M	4
55	01E B 55M	4
60	01E B 60M	4
	02 B 60M	4
65	01E B 65M	4
	02 B 65M	4
70	01E B 70M	4
	02 B 70M	4
75	100 B 75M	1*
	01E B 75M	4
	02 B 75M	4
80	01E B 80M	4
	02 B 80M	4
85	100 B 85M	1*
	01E B 85M	4
	02 B 85M	4
90	01E B 90M	4
	02 B 90M	4
95	01E B 95M	4
100	100 B 100M	2
	01E B 100M	4
	02 B 100M	4
	03 B 100M	4

Shaft Diam. d	Bearing Reference	Routine Grease Volume (ml)
105	01E B 105M	4
	02 B 105M	4
110	100 B 110M	2
	01 B 110M	4
	02 B 110M	4
	03 B 110M	4
115	01 B 115M	4
	02 B 115M	4
120	100 B 120M	4
	01 B 120M	4
	02 B 120M	4
	03 B 120M	4
125	01 B 125M	4
	02 B 125M	4
130	100 B 130M	4
	01 B 130M	4
	02 B 130M	4
	03 B 130M	4
135	01 B 135M	4
140	100 B 140M	4
	01 B 140M	4
	02 B 140M	4
	03 B 140M	8
145	02 B 145M	4
150	100 B 150M	4
	01 B 150M	4
	02 B 150M	4
	03 B 150M	8

Shaft Diam. d	Bearing Reference	Routine Grease Volume (ml)
155	01 B 155M	4
	02 B 155M	4
160	01 B 600-160M	4
	01 B 160M	4
	02 B 600-160M	4
	02 B 160M	8
170	03 B 160M	8
	01 B 608-170M	4
	01 B 170M	4
175	02 B 170M	8
	03 B 170M	8
180	01 B 175M	4
	02 B 175M	8
190	01 B 180M	4
	02 B 180M	8
	03 B 180M	8
200	01 B 190M	4
	02 B 190M	8
	03 B 190M	16
220	01 B 200M	4
	02 B 200M	8
	03 B 200M	16
230	01 B 220M	4
	02 B 220M	8
	03 B 220M	16
230	01 B 230M	4
	02 B 230M	8

Shaft Diam. d	Bearing Reference	Routine Grease Volume (ml)
240	01 B 240M	8
	02 B 240M	8
	03 B 240M	16
260	01 B 1000-260M	8
	01 B 260M	8
	02 B 260M	8
	03 B 260M	16
270	01 B 270M	8
275	01 B 275M	8
280	01 B 280M	8
	02 B 280M	16
	03X B 280M	16
	03E B 280M	16
290	01 B 290M	8
300	03 B 290M	16
	01 B 300M	8
	02 B 300M	16
320	03 B 300M	16
	01 B 320M	8
	02 B 320M	16
330	03 B 320M	24
	01 B 330M	8
	02 B 330M	16
340	01 B 1300-340M	8
	01 B 340M	8
	02 B 340M	16
	03E B 340M	24
350	01 B 350M	8
	02 B 350M	16

Shaft Diam. d	Bearing Reference	Routine Grease Volume (ml)
360	01 B 1400-360M	8
	01 B 360M	8
	02 B 360M	16
	03E B 360M	24
380	03X B 360M	24
	01 B 380M	8
	02 B 380M	16
390	03 B 380M	24
	01 B 390M	16
400	01 B 400M	16
	02 B 400M	16
	03 B 400M	24
420	01 B 420M	16
	02 B 420M	16
	03E B 420M	24
440	01 B 440M	16
	02 B 440M	24
	03E B 440M	32
460	01 B 460M	16
	02 B 460M	24
	03E B 460M	32
	03X B 460M	32
480	01 B 480M	16
	02 B 480M	24
	03X B 480M	32
500	01 B 500M	16
	02 B 500M	24
	03 B 500M	32

Shaft Diam. d	Bearing Reference	Routine Grease Volume (ml)
530	01 B 530M	16
	02 B 530M	24
	03 B 530M	32
560	01 B 560M	16
	02 B 560M	24
	03E B 560M	32
580	01 B 580M	16
	02 B 580M	24
600	01 B 600M	16
	02 B 600M	24
	03E B 600M	32

### 08 SDC Series

**Expansion bearings (EX):** Lubricate every 400 hours. This frequency may be increased to weekly if desired. For 150mm and 160mm sizes use approximately 4ml of grease (generally 2 shots of grease from a conventional grease gun) For larger sizes use approximately 8ml of grease (generally 4 shots).

**Fixed bearing (GR):** Lubricate the bearing weekly (i.e. approximately every 150hours operation). For 150mm and 160mm sizes use approximately 4ml of grease (generally 2 shots of grease from a conventional grease gun). For larger sizes use approximately 8ml of grease (generally 4 shots). If the bearing is used for location only (i.e. there is no nominal axial load) it may be treated as per the expansion bearing of the same size for lubrication purposes.

### IDTB Series

Relubricate the bearing weekly or every 150 hours of operation. Sizes up to and including 120mm bore size: Use 2ml of fresh grease. Sizes over 120mm bore size: Use 4ml of fresh grease.

The following is a typical assembly sequence of a pedestal or flange mounted bearing and is included to allow engineers using this catalogue to understand the assembly process of the Cooper bearing and to allow them to produce relevant documentation for their own machines, which may require this information. A full set of assembly instructions is usually packaged with each standard bearing, for use by the fitters. If non-standard bearings are to be used, and/or a different assembly sequence is required for the application, specific assembly instructions can be supplied on request.

The illustrations use a pedestal mounted unit as an example.

## Preliminary Notes

Bearings must be disassembled before assembling into position.

Unwrap the bearing parts, remove the outer race halves (if supplied assembled around other parts), and separate the halves of the cage (if required). Various cage jointing methods are used depending on size and series of bearing. Undo the clamping ring screws and remove the clamping rings from the inner race.

Remove the preservative from all surfaces of all the parts.

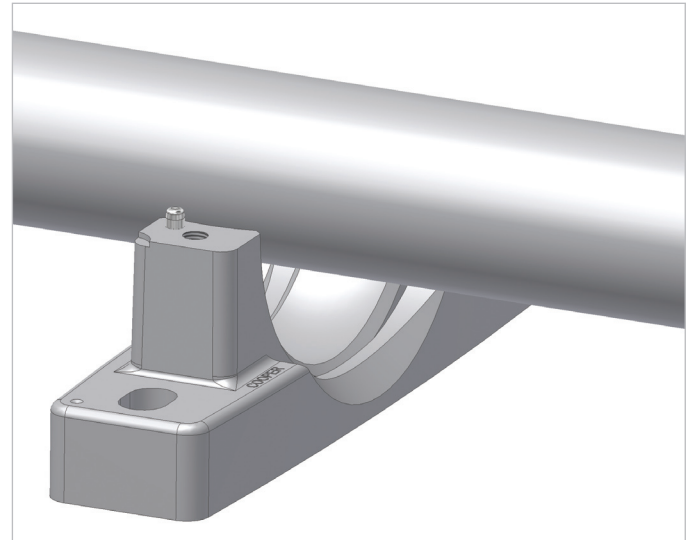
All bearing and housing components (with the exception of pressed steel-, die cast- and plastic cages) are marked with matching numbers or letters on each half. Ensure that the match marks on the halves are the same and are placed together on each component when the bearing is assembled.

Even though cage halves are not necessarily match-marked, they must not be mixed, as the rollers are graded into sets.

Complete roller bearings are interchangeable between similar Cooper cartridges. Individual parts should not be interchanged. Cartridges are interchangeable between standard outer housings provided that standard clearances are specified.

## Step 1 – Housing Base

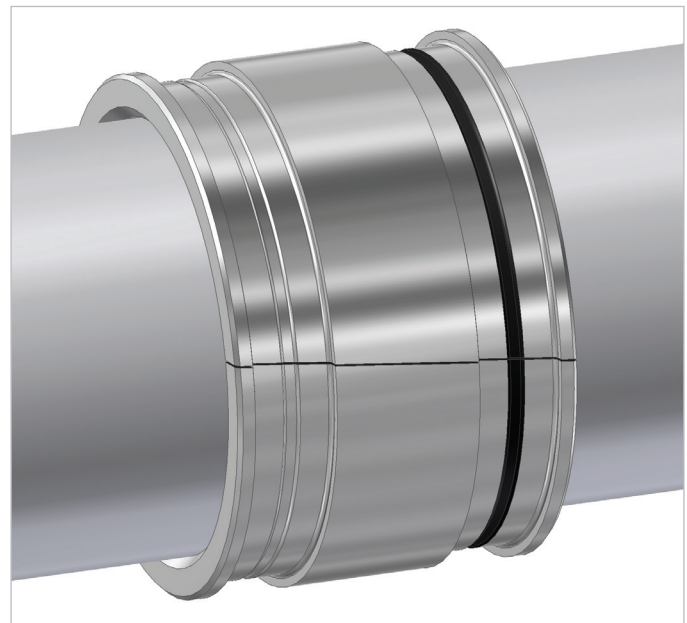
Place the pedestal base or flange lower half into position. If the precise location of the housing is predetermined it may be bolted into position. Generally, pedestal bases may require slight movement at a later stage in order to accurately position the shaft.



*Note: The pedestal base is not shown in most of the illustrations that follow, for clarity of other details.*

## Step 2 – Inner Race

Lightly oil the shaft with thin machine oil, then remove the excess with a clean wiper. Place the inner race at the correct position on the cleaned shaft. Soft packing on the joint faces, or feeler gauges, should be used to ensure that the joint gaps are approximately equal. Inner races of expansion bearings are usually set centrally with the outer race, but in cases of significant axial expansion there may be a deliberate offset. (This is usually up to a maximum of 10% of the roller length, but may be more in the case of special types of bearing).

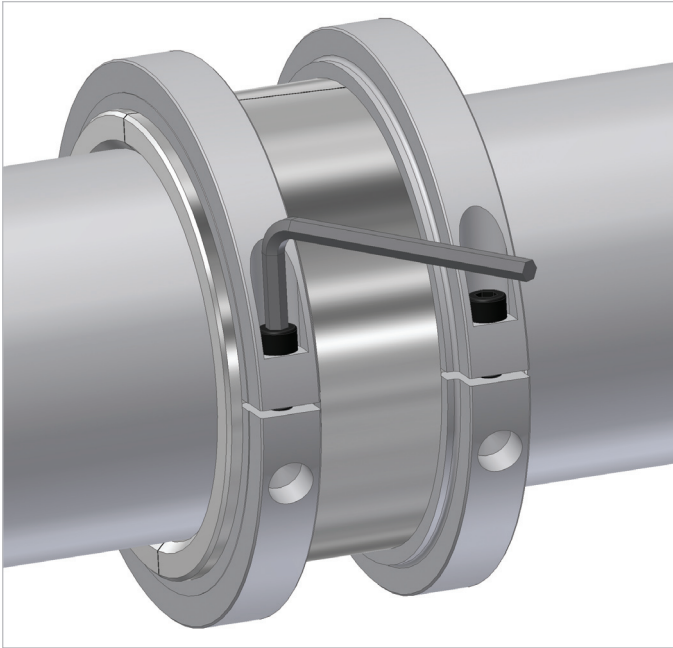


# INSTALLATION AND ASSEMBLY

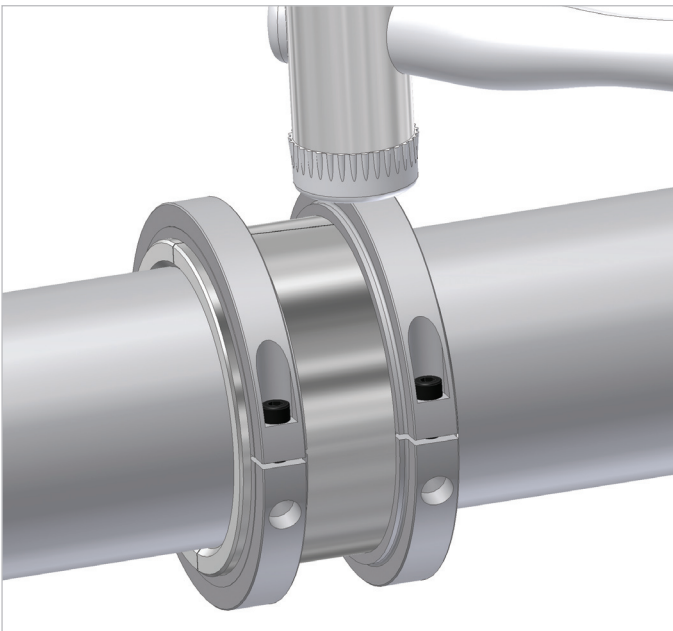
## ASSEMBLY INSTRUCTIONS

### Step 3 – Clamping Rings

Fit the clamping rings with joints at approximately 90° to the inner race joints (45° in the case of large bearings with 4-part clamping rings). Progressively tighten all clamping ring screws.



Tap down each half of the inner race and clamping rings all around the shaft using a soft-faced hammer, or insert a hardwood block between a steel hammer and the bearing parts. Retighten the clamping ring screws. Repeat until screws remain fully tight. Tightening torques are listed on pages 156 to 160.



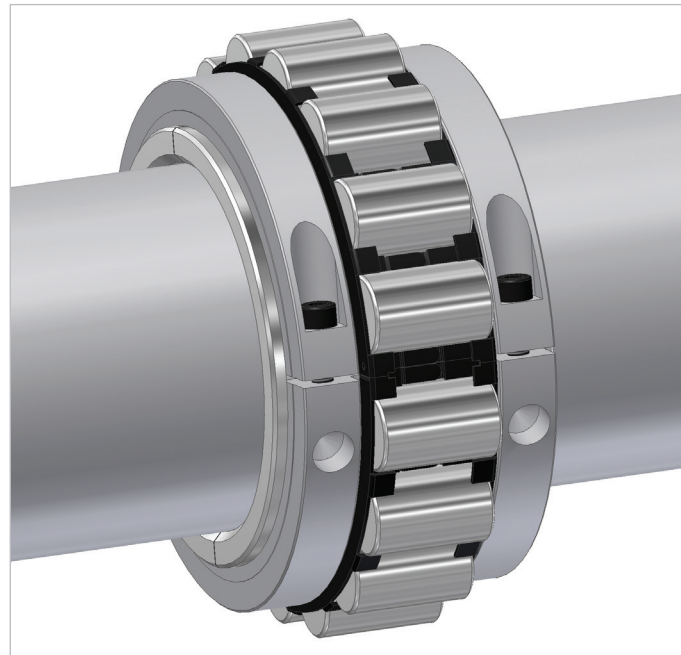
Check that there are approximately equal gaps at both joints of the inner race.

Check that there are approximately equal joints at both (or all 4) joints of each clamping ring.

### Step 4 – Cage and Rollers

Coat the bore of the cage and roller assembly with grease and lightly cover the inner race assembly (fitted to the shaft) all over with grease for protection.

Assemble the cage (complete with rollers) around the inner race. The two halves of the cage are fixed together by various means depending on size and series of bearing. (Further details are to be found in the assembly leaflets supplied with the bearing, or details of the joint of a particular size and series of cage can be supplied on request).



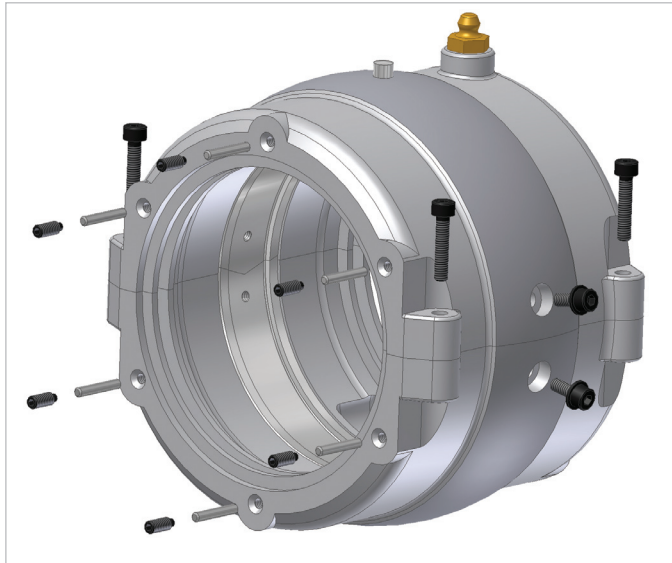
### Step 5 – Cartridge and Outer Race Sub-Assembly

Place the half outer race with the lubrication hole in the top half of the cartridge and the second half outer race into the lower half of the cartridge. Ensure that the ends of the outer race project from the cartridge joint face by equal amounts.

All lipped outer races must be clamped axially. Side screws 'A' are fitted to all GR cartridges. Side rods 'B' are fitted to some sizes only.



Radial screws 'C' and washers are fitted to both EX and GR cartridges of larger sizes only.



#### EX Cartridges:

Just enter radial screws 'C' (where fitted, complete with washers) into the corresponding outer race holes, but do not tighten. Place the two half cartridges together, complete with half outer races, and fully tighten the joint screws 'D'. Fully tighten the radial screws 'C'.

#### Cartridges for Lipped Outer Races (GR and Special Types):

Just enter radial screws 'C' (where fitted, complete with washers) into the corresponding outer race holes, but do not tighten. Place the two half cartridges together, complete with outer races, and fully tighten the joint screws 'D'. Enter the side rods 'B' (where fitted) and side screws 'A'. Progressively and fully tighten the side screws 'A' and radial screws 'C' (where fitted).

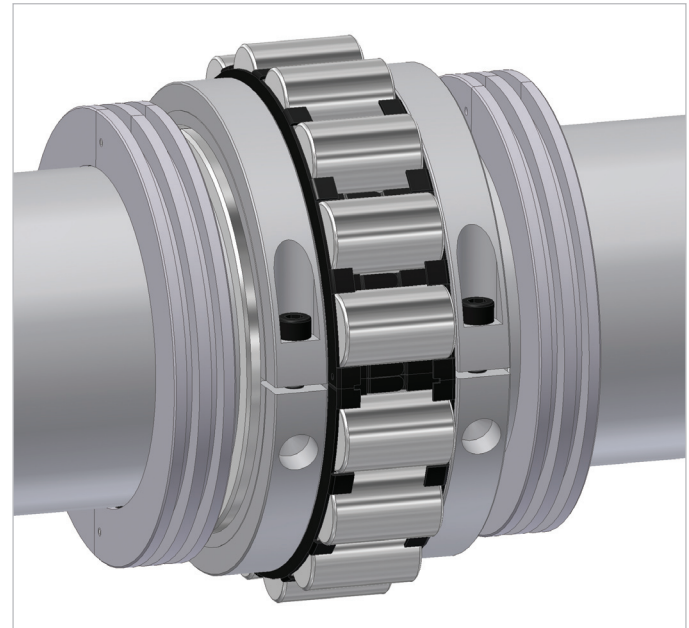
#### All types:

Inject grease to fill the grease passages. Remove joint screws 'D' and separate cartridge halves, taking care that the outer race halves do not fall out of position in their respective half-cartridges.

## Step 6 – Seals

If the unit is to be fitted with aluminium triple labyrinth (ATL) seals, fit them onto the shaft as follows:

Separate the ATL seal halves by driving out the two jointing pins. Lubricate the 'O' rings in the bore with grease. Reassemble on the shaft by compressing the 'O' rings of both halves sufficiently to allow the jointing pins to be reinserted, and reinsert the pins. Note: ATL seals are able to slide along the shaft once assembled.



Felt seals should be soaked in oil before fitting into the cartridge end bores. Most types of seal other than triple labyrinth seals and SRSRP seals are fitted into the cartridge end bores before assembling the cartridge into position.

## Step 7 – Lubrication

Coat the inside of the cartridge, cage and rollers and all seals with grease (See page 161 for correct quantity). For speeds over 150,000mm dn (shaft diameter in mm multiplied by shaft speed in rpm) approximately 40% of the grease used should be applied to the bearing parts and the remainder applied to the inside of the cartridge. This is to avoid excessive churning of grease when running at high speed.

# INSTALLATION AND ASSEMBLY

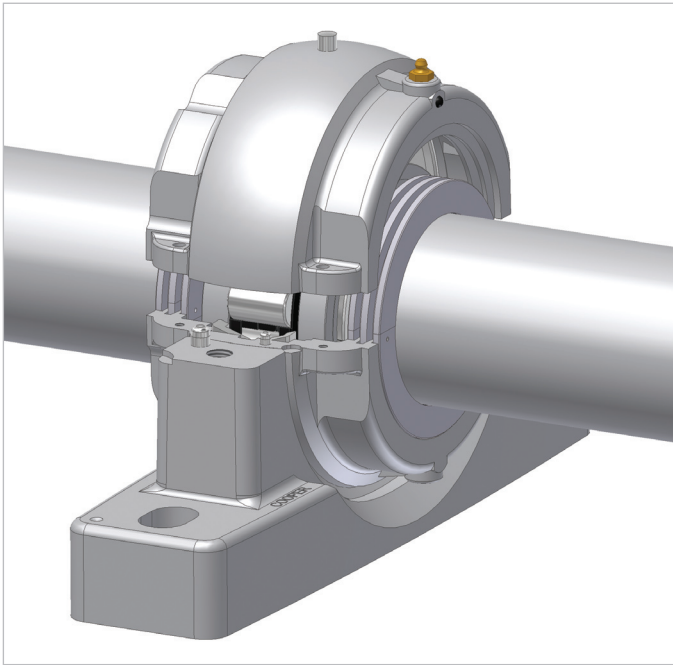
## ASSEMBLY INSTRUCTIONS

### Step 8 – Cartridge

Lubricate the spherical seating of the bottom half of the cartridge with grease.

Place the bottom half of the cartridge on top of the bearing and rotate 180° into the pedestal base or half-flange.

Place the top half of the cartridge on top of the bottom half, close the cartridge and fully tighten the joint screws. Lubricate the spherical seating with grease.

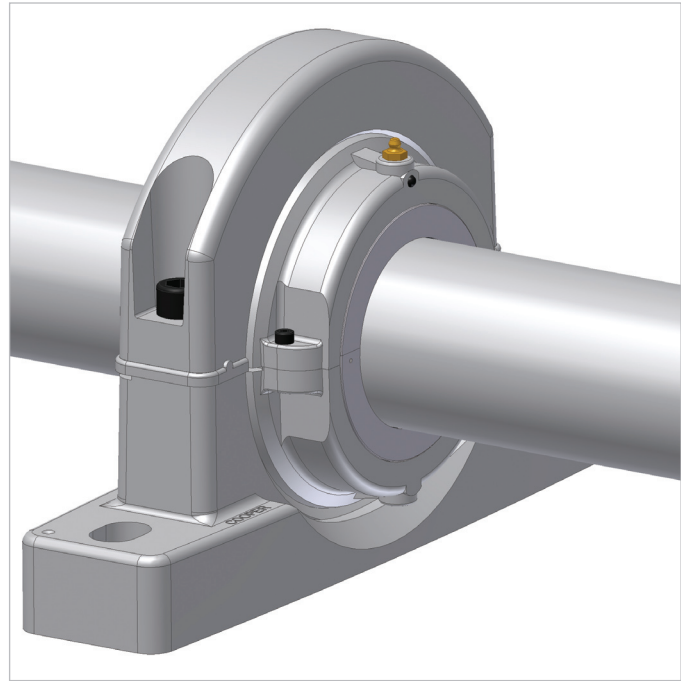


### Step 9 – Housing

If not already done, tighten the bolts fixing the pedestal base or lower flange half into position.

Place the pedestal cap or flange top half into position. If it is safe to do so, running the shaft for a time without the outer housing joint screws fully tightened will help the bearing to accurately align.

Fully tighten the joint screws.



Shaft Diameter d (mm)	Bearing reference	Clamping ring screw (1)			Cartridge joint screw (1)			Cartridge radial screw (1)			Side screw (1)			Pedestal joint screw (1)			Flange joint screw (1)		
		Screw size	Key size A/F (mm)	Torque (2) (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)
35	01 B 35M	M4x20	3	4.5	M4x25	3	3.5	-	-	-	M4x10	2	2.0	M8x45	6	26	M8x40	6	26
40	01 B 40M	M4x20	3	4.5	M4x25	3	3.5	-	-	-	M4x10	2	2.0	M8x45	6	26	M8x40	6	26
45	01E B 45M	M4x20	3	4.5	M4x25	3	3.5	-	-	-	M4x10	2	2.0	M8x45	6	26	M8x40	6	26
50	01E B 50M	M4x20	3	4.5	M4x25	3	3.5	-	-	-	M4x10	2	2.0	M8x45	6	26	M8x40	6	26
	02 B 50M	M5x25	4	8.5	M5x25	4	6.5	-	-	-	M4x10	2	2.0	M10x55	8	52.5	M10x45	8	52.5
55	01E B 55M	M4x20	3	4.5	M4x25	3	3.5	-	-	-	M4x10	2	2.0	M10x55	8	52.5	M10x45	8	52.5
60	01E B 60M	M4x20	3	4.5	M4x25	3	3.5	-	-	-	M4x10	2	2.0	M10x55	8	52.5	M10x45	8	52.5
	02 B 60M	M5x25	4	8.5	M5x25	4	6.5	-	-	-	M4x10	2	2.0	M12x65	10	90	M12x55	10	90
65	01E B 65M	M4x20	3	4.5	M4x25	3	3.5	-	-	-	M4x10	2	2.0	M10x55	8	52.5	M10x45	8	52.5
	02 B 65M	M5x25	4	8.5	M5x25	4	6.5	-	-	-	M4x10	2	2.0	M12x65	10	90	M12x55	10	90
70	01E B 70M	M4x20	3	4.5	M4x25	3	3.5	-	-	-	M4x10	2	2.0	M12x65	10	90	M12x55	10	90
	02 B 70M	M6x25	5	15	M6x25	5	11	-	-	-	M4x10	2	2.0	M16x65	14	225	M12x55	10	90
75	100 B 75M	M3x16	2.5	2	M4x25	3	3.5	-	-	-	M4x10	2	2.0	M10x55	8	52.5	M10x45	8	52.5
	01E B 75M	M4x20	3	4.5	M4x25	3	3.5	-	-	-	M4x10	2	2.0	M12x65	10	90	M12x55	10	90
	02 B 75M	M6x25	5	15	M6x25	5	11	-	-	-	M4x10	2	2.0	M16x65	14	225	M12x55	10	90
80	01E B 80M	M5x25	4	8.5	M5x25	4	6.5	-	-	-	M4x10	2	2.0	M16x65	14	225	M12x55	10	90
	02 B 80M	M6x25	5	15	M6x25	5	11	-	-	-	M4x10	2	2.0	M16x65	14	225	M16x65	14	225
85	100 B 85M	M4x20	3	4.5	M4x25	3	3.5	-	-	-	M4x10	2	2.0	M12x65	10	90	M12x55	10	90
	01E B 85M	M5x25	4	8.5	M5x25	4	6.5	-	-	-	M4x10	2	2.0	M16x65	14	225	M12x55	10	90
	02 B 85M	M6x25	5	15	M6x25	5	11	-	-	-	M4x10	2	2.0	M16x65	14	225	M16x65	14	225
90	01E B 90M	M5x25	4	8.5	M5x25	4	6.5	-	-	-	M4x10	2	2.0	M16x65	14	225	M12x55	10	90
	02 B 90M	M6x25	5	15	M6x25	5	11	-	-	-	M4x10	2	2.0	M16x65	14	225	M16x65	14	225
95	01E B 95M	M6x25	5	15	M6x25	5	11	-	-	-	M4x10	2	2.0	M16x65	14	225	M16x65	14	225
100	100 B 100M	M4x20	3	4.5	M5x25	4	6.5	-	-	-	M4x10	2	2.0	M16x65	14	225	M12x55	10	90
	01E B 100M	M6x25	5	15	M6x25	5	11	-	-	-	M4x10	2	2.0	M16x65	14	225	M16x65	14	225
	02 B 100M	M6x25	5	15	M6x25	5	11	-	-	-	M4x10	2	2.0	M20x80	17	420	M16x65	14	225
	03 B 100M	M10x45	8	70	M10x45	8	52.5	-	-	-	M6x10	3	7.8	M16x75	14	225	-	-	-
105	01E B 105M	M6x25	5	15	M6x25	5	11	-	-	-	M4x10	2	2.0	M16x65	14	225	M16x65	14	225
	02 B 105M	M6x25	5	15	M6x25	5	11	-	-	-	M4x10	2	2.0	M20x80	17	420	M16x65	14	225

(1) All screws are metric coarse thread, grade 12.9

(2) For vertical shaft or high thrust applications the clamping ring screw torque should be increased by up to 20%

# INSTALLATION AND ASSEMBLY

## SCREW SIZES, WRENCH SIZES AND TORQUES

Shaft Diameter (mm)	Bearing reference	Clamping ring screw (1)			Cartridge joint screw (1)			Cartridge radial screw (1)			Side screw (1)			Pedestal joint screw (1)			Flange joint screw (1)		
		Screw size	Key size A/F (mm)	Torque (2) (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)
110	100 B 110M	M5x25	4	8.5	M6x25	5	11	-	-	-	M4x10	2	2.0	M16x65	14	225	M16x65	14	225
	01 B 110M	M6x25	5	15	M6x25	5	11	-	-	-	M6x10	3	7.8	M20x80	17	420	M16x65	14	225
	02 B 110M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M20x80	17	420	M20x80	17	420
	03 B 110M	M10x45	8	70	M10x45	8	52.5	M10x30	8	35	M6x10	3	7.8	M16x75	14	225	-	-	-
115	01 B 115M	M6x25	5	15	M6x25	5	11	-	-	-	M6x10	3	7.8	M20x80	17	420	M16x65	14	225
	02 B 115M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M20x80	17	420	M20x80	17	420
120	100 B 120M	M6x25	5	15	M6x25	5	11	-	-	-	M6x10	3	7.8	M20x80	17	420	M16x65	14	225
	01 B 120M	M6x25	5	15	M6x25	5	11	-	-	-	M6x10	3	7.8	M20x80	17	420	M20x80	17	420
	02 B 120M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M20x100	17	420	M20x100	17	420
	03 B 120M	M10x45	8	70	M10x45	8	52.5	M10x30	8	35	M6x10	3	7.8	M16x75	14	225	-	-	-
125	01 B 125M	M6x25	5	15	M6x25	5	11	-	-	-	M6x10	3	7.8	M20x80	17	420	M20x80	17	420
	02 B 125M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M20x100	17	420	M20x100	17	420
130	100 B 130M	M6x25	5	15	M6x25	5	11	-	-	-	M6x10	3	7.8	M20x80	17	420	M16x65	14	225
	01 B 130M	M6x25	5	15	M6x25	5	11	-	-	-	M6x10	3	7.8	M20x80	17	420	M20x80	17	420
	02 B 130M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M20x100	17	420	M20x100	17	420
	03 B 130M	M10x45	8	70	M10x45	8	52.5	M10x25	8	35	M10x16	5	30	M16x75	14	225	-	-	-
135	01 B 135M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M20x80	17	420	M20x80	17	420
140	100 B 140M	M6x25	5	15	M6x25	5	11	-	-	-	M6x10	3	7.8	M20x80	17	420	M20x80	17	420
	01 B 140M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M20x80	17	420	M20x80	17	420
	02 B 140M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M20x100	17	420	M24x100	19	712
	03 B 140M	M10x45	8	70	M10x45	8	52.5	M10x25	8	35	M10x16	5	30	M20x100	17	420	-	-	-
145	02 B 145M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M20x100	17	420	M24x100	19	712
150	100 B 150M	M6x25	5	15	M8x30	6	26	-	-	-	M6x10	3	7.8	M20x80	17	420	M20x80	17	420
	01 B 150M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M20x100	17	420	M20x100	17	420
	02 B 150M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M20x100	17	420	M24x100	19	712
	03 B 150M	M10x45	8	70	M10x45	8	52.5	M10x30	8	35	M10x16	5	30	M20x100	17	420	-	-	-
155	01 B 155M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M20x100	17	420	M20x100	17	420
	02 B 155M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M20x100	17	420	M24x100	19	712



Shaft Diameter d (mm)	Bearing reference	Clamping ring screw (1)			Cartridge joint screw (1)			Cartridge radial screw (1)			Side screw (1)			Pedestal joint screw (1)			Flange joint screw (1)		
		Screw size	Key size A/F (mm)	Torque (2) (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)
160	01 B 600-160M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M20x100	17	420	M20x100	17	420
	01 B 160M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M16x65	14	225	M20x100	17	420
	02 B 600-160M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M20x100	17	420	M24x100	19	712
	02 B 160M	M10x45	8	70	M10x45	8	52.5	-	-	-	M6x10	3	7.8	M20x100	17	420	M24x120	19	712
	03 B 160M	M12x55	10	120	M12x55	10	90	M12x35	10	60	M10x16	5	30	M20x100	17	420	-	-	-
170	01 B 608-170M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M16x65	14	225	M20x100	17	420
	01 B 170M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M16x65	14	225	M20x100	17	420
	02 B 170M	M10x45	8	70	M10x45	8	52.5	-	-	-	M6x10	3	7.8	M20x100	17	420	M24x120	19	712
	03 B 170M	M12x55	10	120	M12x55	10	90	M12x35	10	60	M10x16	5	30	M20x100	17	420	-	-	-
175	01 B 175M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M16x65	14	225	M20x100	17	420
	02 B 175M	M10x45	8	70	M10x45	8	52.5	M10x25	8	35	M6x10	3	7.8	M20x100	17	420	M24x120	19	712
180	01 B 180M	M8x30	6	35	M8x30	6	26	-	-	-	M6x10	3	7.8	M16x65	14	225	M20x100	17	420
	02 B 180M	M10x45	8	70	M10x45	8	52.5	M10x25	8	35	M6x10	3	7.8	M20x100	17	420	M24x120	19	712
	03 B 180M	M12x55	10	120	M12x55	10	90	M12x35	10	60	M10x16	5	30	M20x100	17	420	-	-	-
190	01 B 190M	M8x30	6	35	M8x30	6	26	M10x20	8	35	M6x10	3	7.8	M16x65	14	225	M24x100	19	712
	02 B 190M	M12x55	10	120	M12x55	10	90	M10x30	8	35	M6x10	3	7.8	M20x100	17	420	M24x120	19	712
	03 B 190M	M12x55	10	120	M12x55	10	90	M12x40	10	60	M10x16	5	30	M24x100	19	712	-	-	-
200	01 B 200M	M8x30	6	35	M8x30	6	26	M10x20	8	35	M6x10	3	7.8	M16x65	14	225	M24x100	19	712
	02 B 200M	M12x55	10	120	M12x55	10	90	M10x30	8	35	M6x10	3	7.8	M20x100	17	420	M24x120	19	712
	03 B 200M	M12x55	10	120	M12x55	10	90	M12x40	10	60	M10x16	5	30	M24x100	19	712	-	-	-
220	01 B 220M	M10x45	8	70	M10x45	8	52.5	M10x20	8	35	M6x10	3	7.8	M16x65	14	225	M24x100	19	712
	02 B 220M	M12x55	10	120	M12x55	10	90	M10x30	8	35	M6x10	3	7.8	M20x100	17	420	M24x120	19	712
	03 B 220M	M16x65	14	300	M16x75	14	225	M12x40	10	60	M10x16	5	30	M20x100	17	420	-	-	-
230	01 B 230M	M10x45	8	70	M10x45	8	52.5	M10x20	8	35	M6x10	3	7.8	M16x65	14	225	M24x100	19	712
	02 B 230M	M12x55	10	120	M12x55	10	90	M10x30	8	35	M6x10	3	7.8	M20x100	17	420	M24x120	19	712
240	01 B 240M	M10x45	8	70	M10x45	8	52.5	M10x20	8	35	M6x10	3	7.8	M20x80	17	420	M24x100	19	712
	02 B 240M	M12x55	10	120	M12x55	10	90	M10x30	8	35	M10x16	5	30	M20x100	17	420	M24x100	19	712
	03 B 240M	M16x65	14	300	M16x75	14	225	M12x40	10	60	M10x16	5	30	M20x100	17	420	-	-	-
250	01 B 250M	M10x45	8	70	M10x45	8	52.5	M10x20	8	35	M6x10	3	7.8	M20x80	17	420	M24x100	19	712
	02 B 250M	M12x55	10	120	M12x55	10	90	M10x30	8	35	M10x16	5	30	M20x100	17	420	M24x100	19	712
	03 B 250M	M16x65	14	300	M16x75	14	225	M12x40	10	60	M10x16	5	30	M20x100	17	420	-	-	-

(1) All screws are metric coarse thread, grade 12.9

(2) For vertical shaft or high thrust applications the clamping ring screw torque should be increased by up to 20%

# INSTALLATION AND ASSEMBLY

## SCREW SIZES, WRENCH SIZES AND TORQUES

Shaft Diameter (mm)	Bearing reference	Clamping ring screw (I)			Cartridge joint screw (I)			Cartridge radial screw (I)			Side screw (I)			Pedestal joint screw (I)			Flange joint screw (I)		
		Screw size	Key size A/F (mm)	Torque (2) (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)
260	01 B 1000-260M	M10x45	8	70	M10x45	8	52.5	M10x20	8	35	M6x10	3	7.8	M20x80	17	420	M24x100	19	712
	01 B 260M	M10x45	8	70	M10x45	8	52.5	M10x25	8	35	M10x16	5	30	M20x100	17	420	M24x120	19	712
	02 B 260M	M12x55	10	120	M12x55	10	90	M10x30	8	35	M10x16	5	30	M20x100	17	420	M24x100	19	712
	03 B 260M	M16x65	14	300	M16x75	14	225	M12x40	10	60	M10x16	5	30	M20x100	17	420	-	-	-
270	01 B 270M	M10x45	8	70	M10x45	8	52.5	M10x25	8	35	M10x16	5	30	M20x100	17	420	M24x120	19	712
275	01 B 275M	M10x45	8	70	M10x45	8	52.5	M10x25	8	35	M10x16	5	30	M20x100	17	420	M24x120	19	712
280	01 B 280M	M10x45	8	70	M10x45	8	52.5	M10x25	8	35	M10x16	5	30	M20x100	17	420	M24x120	19	712
	02 B 280M	M16x65	14	300	M16x75	14	225	M10x30	8	35	M10x16	5	30	M20x100	17	420	M24x100	19	712
	03X B 280M	M20x80	17	560	M20x100	17	420	M12x40	10	60	M10x16	5	30	M20x100	17	420	-	-	-
	03E B 280M	M20x80	17	560	M20x100	17	420	M12x35	10	60	M10x16	5	30	M20x100	17	420	-	-	-
290	01 B 290M	M10x45	8	70	M10x45	8	52.5	M10x25	8	35	M10x16	5	30	M20x100	17	420	M24x120	19	712
	03 B 290M	M20x80	17	560	M20x100	17	420	M12x55	10	60	M10x16	5	30	M20x100	17	420	-	-	-
300	01 B 300M	M10x45	8	70	M10x45	8	52.5	M10x25	8	35	M10x16	5	30	M20x100	17	420	M24x120	19	712
	02 B 300M	M16x65	14	300	M16x75	14	225	M10x30	8	35	M10x16	5	30	M20x100	17	420	M24x100	19	712
	03 B 300M	M20x80	17	560	M20x100	17	420	M12x55	10	60	M10x16	5	30	M20x100	17	420	-	-	-
320	01 B 320M	M12x55	10	120	M12x55	10	90	M10x25	8	35	M10x16	5	30	M20x100	17	420	M24x120	19	712
	02 B 320M	M16x65	14	300	M16x75	14	225	M10x30	8	35	M10x16	5	30	M20x100	17	420	M24x120	19	712
	03 B 320M	M20x80	17	560	M20x100	17	420	M12x55	10	60	M10x16	5	30	M24x120	19	712	-	-	-
330	01 B 330M	M12x55	10	120	M12x55	10	90	M10x25	8	35	M10x16	5	30	M20x100	17	420	M24x120	19	712
	02 B 330M	M16x65	14	300	M16x75	14	225	M10x30	8	35	M10x16	5	30	M20x100	17	420	M24x120	19	712
340	01 B 1300-340M	M12x55	10	120	M12x55	10	90	M10x25	8	35	M10x16	5	30	M20x100	17	420	M24x120	19	712
	01 B 340M	M12x55	10	120	M12x55	10	90	M10x25	8	35	M10x16	5	30	M20x100	17	420	M24x120	19	712
	02 B 340M	M16x65	14	300	M16x75	14	225	M12x30	10	60	M10x16	5	30	M20x100	17	420	-	-	-
	03E B 340M	M24x100	19	950	M20x100	17	420	M12x40	10	60	M16x25	8	125	M24x100	19	712	-	-	-
350	01 B 350M	M12x55	10	120	M12x55	10	90	M10x25	8	35	M10x16	5	30	M20x100	17	420	M24x120	19	712
	02 B 350M	M16x65	14	300	M16x75	14	225	M12x30	10	60	M10x16	5	30	M20x100	17	420	-	-	-
360	01 B 1400-360M	M12x55	10	120	M12x55	10	90	M10x25	8	35	M10x16	5	30	M20x100	17	420	M24x120	19	712
	01 B 360M	M12x55	10	120	M12x55	10	90	M10x25	8	35	M10x16	5	30	M20x100	17	420	M24x100	19	712
	02 B 360M	M16x65	14	300	M16x75	14	225	M12x30	10	60	M10x16	5	30	M20x100	17	420	-	-	-
	03E B 360M	M24x100	19	950	M20x100	17	420	M12x40	10	60	M16x25	8	125	M24x100	19	712	-	-	-
	03X B 360M	M24x100	19	950	M20x100	17	420	M12x55	10	60	M10x16	5	30	M24x120	19	712	-	-	-



# INSTALLATION AND ASSEMBLY

## SCREW SIZES, WRENCH SIZES AND TORQUES

Shaft Diameter d (mm)	Bearing reference	Clamping ring screw (1)			Cartridge joint screw (1)			Cartridge radial screw (1)			Side screw (1)			Pedestal joint screw (1)			Flange joint screw (1)		
		Screw size	Key size A/F (mm)	Torque (2) (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)	Screw size	Key size A/F (mm)	Torque (Nm)
380	01 B 380M	M12x55	10	120	M12x55	10	90	M10x25	8	35	M10x16	5	30	M20x100	17	420	M24x100	19	712
	02 B 380M	M16x65	14	300	M16x75	14	225	M12x30	10	60	M10x16	5	30	M20x100	17	420	-	-	-
	03 B 380M	M24x100	19	950	M20x100	17	420	M12x55	10	60	M10x16	5	30	M24x120	19	712	-	-	-
390	01 B 390M	M12x55	10	120	M12x55	10	90	M10x25	8	35	M10x16	5	30	M20x100	17	420	M24x100	19	712
400	01 B 400M	M12x55	10	120	M12x55	10	90	M10x25	8	35	M10x16	5	30	M20x100	17	420	M24x100	19	712
	02 B 400M	M16x65	14	300	M16x75	14	225	M12x35	10	60	M10x16	5	30	M20x100	17	420	-	-	-
	03 B 400M	M24x100	19	950	M20x100	17	420	M12x55	10	60	M10x16	5	30	M24x120	19	712	-	-	-
420	01 B 420M	M12x55	10	120	M12x55	10	90	M12x25	10	60	M10x16	5	30	M20x80	17	420	-	-	-
	02 B 420M	M16x65	14	300	M16x75	14	225	M12x35	10	60	M10x16	5	30	M20x100	17	420	-	-	-
	03E B 420M	M24x100	19	950	M20x100	17	420	M12x40	10	60	M16x25	8	125	M24x120	19	712	-	-	-
440	01 B 440M	M12x55	10	120	M12x55	10	90	M12x25	10	60	M10x16	5	30	M20x80	17	420	-	-	-
	02 B 440M	M16x65	14	300	M16x75	14	225	M12x35	10	60	M10x16	5	30	M20x100	17	420	-	-	-
	03E B 440M	M24x100	19	950	M20x100	17	420	M12x40	10	60	M16x25	8	125	M24x120	19	712	-	-	-
460	01 B 460M	M12x55	10	120	M12x55	10	90	M12x25	10	60	M10x16	5	30	M20x80	17	420	-	-	-
	02 B 460M	M16x65	14	300	M16x75	14	225	M12x35	10	60	M10x16	5	30	M20x100	17	420	-	-	-
	03E B 460M	M24x100	19	950	M20x100	17	420	M12x55	10	60	M16x25	8	125	M24x120	19	712	-	-	-
	03X B 460M	M24x100	19	950	M20x100	17	420	M16x65	14	150	M10x16	5	30	M24x120	19	712	-	-	-
480	01 B 480M	M12x55	10	120	M12x55	10	90	M12x25	10	60	M10x16	5	30	M20x100	17	420	-	-	-
	02 B 480M	M20x80	17	560	M20x100	17	420	M12x35	10	60	M10x16	5	30	M24x120	19	712	-	-	-
	03X B 480M	M24x100	19	950	M20x100	17	420	M16x65	14	150	M10x16	5	30	M24x120	19	712	-	-	-
500	01 B 500M	M16x65	14	300	M16x75	14	225	M12x30	10	60	M10x16	5	30	M20x100	17	420	-	-	-
	02 B 500M	M20x80	17	560	M20x100	17	420	M12x35	10	60	M10x16	5	30	M24x120	19	712	-	-	-
	03 B 500M	M24x100	19	950	M20x100	17	420	M16x65	14	150	M10x16	5	30	M24x120	19	712	-	-	-
530	01 B 530M	M16x65	14	300	M16x75	14	225	M12x30	10	60	M10x16	5	30	M20x100	17	420	-	-	-
	02 B 530M	M20x80	17	560	M20x100	17	420	M12x35	10	60	M10x16	5	30	M24x120	19	712	-	-	-
	03 B 530M	M24x100	19	950	M20x100	17	420	M16x65	14	150	M10x16	5	30	M24x120	19	712	-	-	-
560	01 B 560M	M16x65	14	300	M16x75	14	225	M12x30	10	60	M10x16	5	30	M20x100	17	420	-	-	-
	02 B 560M	M20x80	17	560	M20x100	17	420	M12x35	10	60	M10x16	5	30	M24x120	19	712	-	-	-
	03E B 560M	M24x100	19	950	M20x100	17	420	M12x55	10	60	M16x25	8	125	M24x120	19	712	-	-	-
580	01 B 580M	M16x65	14	300	M16x75	14	225	M12x30	10	60	M10x16	5	30	M20x100	17	420	-	-	-
	02 B 580M	M20x80	17	560	M20x100	17	420	M12x35	10	60	M10x16	5	30	M24x120	19	712	-	-	-
600	01 B 600M	M16x65	14	300	M16x75	14	225	M12x30	10	60	M10x16	5	30	M20x100	17	420	-	-	-
	02 B 600M	M20x80	17	560	M20x100	17	420	M12x35	10	60	M10x16	5	30	M24x120	19	712	-	-	-
	03E B 600M	M24x100	19	950	M20x100	17	420	M12x55	10	60	M16x25	8	125	M24x120	19	712	-	-	-

(1) All screws are metric coarse thread, grade 12.9

(2) For vertical shaft or high thrust applications the clamping ring screw torque should be increased by up to 20%

# INSTALLATION AND ASSEMBLY

## GREASE QUANTITIES FOR INITIAL LUBRICATION

### GREASE QUANTITIES FOR INITIAL LUBRICATION

The quantity of grease required on initial assembly is dependent upon operating speed and temperature.

If the operating temperature is below 80°C the quantity of grease may be determined directly according to bearing reference and operating speed from the following table.

If the operating temperature is above 80°C, a 25% pack of

grease should be used regardless of speed (refer to the right hand column of the table).

With a 'full pack' of grease the space within the cartridge (i.e. surrounding the bearing components) in the assembled unit is completely filled with grease.

The table assumes normal density grease (about 0.85g/cm<sup>3</sup>).

Shaft Diameter d (mm)	Bearing Reference	Speed (rpm) up to	Grease (full pack) (kg)	Speed (rpm)		Grease (75% full pack) (kg)	Speed (rpm)		Grease (50% full pack) (kg)	Speed (rpm)		Grease (33% full pack) (kg)	Speed (rpm) over	Grease (25% full pack) (kg)
				from	to		from	to		from	to			
35	01 B 35M	1312	0.06	1312	2625	0.05	2625	3937	0.03	3937	5249	0.02	5249	0.02
40	01 B 40M	1312	0.06	1312	2625	0.05	2625	3937	0.03	3937	5249	0.02	5249	0.02
45	01E B 45M	984	0.09	984	1969	0.07	1969	2953	0.05	2953	3937	0.03	3937	0.02
50	01E B 50M	984	0.09	984	1969	0.07	1969	2953	0.05	2953	3937	0.03	3937	0.02
	02 B 50M	984	0.15	984	1969	0.11	1969	2953	0.08	2953	3937	0.05	3937	0.04
55	01E B 55M	787	0.15	787	1575	0.11	1575	2362	0.08	2362	3150	0.05	3150	0.04
60	01E B 60M	787	0.15	787	1575	0.11	1575	2362	0.08	2362	3150	0.05	3150	0.04
	02 B 60M	787	0.21	787	1575	0.16	1575	2362	0.11	2362	3150	0.07	3150	0.05
65	01E B 65M	787	0.15	787	1575	0.11	1575	2362	0.08	2362	3150	0.05	3150	0.04
	02 B 65M	787	0.21	787	1575	0.16	1575	2362	0.11	2362	3150	0.07	3150	0.05
70	01E B 70M	656	0.18	656	1312	0.14	1312	1969	0.09	1969	2625	0.06	2625	0.05
	02 B 70M	656	0.30	656	1312	0.23	1312	1969	0.15	1969	2625	0.10	2625	0.08
75	100 B 75M	656	0.15	656	1312	0.11	1312	1969	0.08	1969	2625	0.05	2625	0.04
	01E B 75M	656	0.18	656	1312	0.14	1312	1969	0.09	1969	2625	0.06	2625	0.05
	02 B 75M	656	0.30	656	1312	0.23	1312	1969	0.15	1969	2625	0.10	2625	0.08
80	01E B 80M	562	0.30	562	1125	0.23	1125	1687	0.15	1687	2250	0.10	2250	0.08
	02 B 80M	562	0.45	562	1125	0.34	1125	1687	0.23	1687	2250	0.15	2250	0.11
85	100 B 85M	573	0.22	573	1145	0.17	1145	1718	0.11	1718	2291	0.07	2291	0.06
	01E B 85M	562	0.30	562	1125	0.23	1125	1687	0.15	1687	2250	0.10	2250	0.08
	02 B 85M	562	0.45	562	1125	0.34	1125	1687	0.23	1687	2250	0.15	2250	0.11
90	01E B 90M	562	0.30	562	1125	0.23	1125	1687	0.15	1687	2250	0.10	2250	0.08
	02 B 90M	562	0.45	562	1125	0.34	1125	1687	0.23	1687	2250	0.15	2250	0.11



Shaft Diameter d (mm)	Bearing Reference	Speed (rpm) up to	Grease (full pack) (kg)	Speed (rpm)		Grease (75% full pack) (kg)	Speed (rpm)		Grease (50% full pack) (kg)	Speed (rpm)		Grease (33% full pack) (kg)	Speed (rpm) over	Grease (25% full pack) (kg)
				from	to		from	to		from	to			
95	01E B 95M	492	0.36	492	984	0.27	984	1476	0.18	1476	1969	0.12	1969	0.09
100	100 B 100M	492	0.36	492	984	0.27	984	1476	0.18	1476	1969	0.12	1969	0.09
	01E B 100M	492	0.36	492	984	0.27	984	1476	0.18	1476	1969	0.12	1969	0.09
	02 B 100M	492	0.60	492	984	0.45	984	1476	0.30	1476	1969	0.20	1969	0.15
	03 B 100M	492	1.20	492	984	0.90	984	1476	0.60	1476	1969	0.40	1969	0.30
105	01E B 105M	492	0.36	492	984	0.27	984	1476	0.18	1476	1969	0.12	1969	0.09
	02 B 105M	492	0.60	492	984	0.45	984	1476	0.30	1476	1969	0.20	1969	0.15
110	100 B 110M	437	0.36	437	875	0.27	875	1312	0.18	1312	1750	0.12	1750	0.09
	01 B 110M	437	0.51	437	875	0.38	875	1312	0.26	1312	1750	0.17	1750	0.13
	02 B 110M	437	0.90	437	875	0.68	875	1312	0.45	1312	1750	0.30	1750	0.23
	03 B 110M	437	1.40	437	875	1.05	875	1312	0.70	1312	1750	0.46	1750	0.35
115	01 B 115M	437	0.51	437	875	0.38	875	1312	0.26	1312	1750	0.17	1750	0.13
	02 B 115M	437	0.90	437	875	0.68	875	1312	0.45	1312	1750	0.30	1750	0.23
120	100 B 120M	394	0.49	394	787	0.37	787	1181	0.25	1181	1575	0.16	1575	0.12
	01 B 120M	394	0.60	394	787	0.45	787	1181	0.30	1181	1575	0.20	1575	0.15
	02 B 120M	394	1.20	394	787	0.90	787	1181	0.60	1181	1575	0.40	1575	0.30
	03 B 120M	437	1.40	437	875	1.05	875	1312	0.70	1312	1750	0.46	1750	0.35
125	01 B 125M	394	0.60	394	787	0.45	787	1181	0.30	1181	1575	0.20	1575	0.15
	02 B 125M	394	1.20	394	787	0.90	787	1181	0.60	1181	1575	0.40	1575	0.30
130	100 B 130M	394	0.49	394	787	0.37	787	1181	0.25	1181	1575	0.16	1575	0.12
	01 B 130M	394	0.60	394	787	0.45	787	1181	0.30	1181	1575	0.20	1575	0.15
	02 B 130M	394	1.20	394	787	0.90	787	1181	0.60	1181	1575	0.40	1575	0.30
	03 B 130M	394	1.40	394	787	1.05	787	1181	0.70	1181	1575	0.46	1575	0.35
135	01 B 135M	358	0.78	358	716	0.59	716	1074	0.39	1074	1432	0.26	1432	0.20
140	100 B 140M	358	0.64	358	716	0.48	716	1074	0.32	1074	1432	0.21	1432	0.16
	01 B 140M	358	0.78	358	716	0.59	716	1074	0.39	1074	1432	0.26	1432	0.20
	02 B 140M	358	1.40	358	716	1.05	716	1074	0.70	1074	1432	0.46	1432	0.35
	03 B 140M	358	2.00	358	716	1.50	716	1074	1.00	1074	1432	0.66	1432	0.50
145	02 B 145M	358	1.40	358	716	1.05	716	1074	0.70	1074	1432	0.46	1432	0.35



# INSTALLATION AND ASSEMBLY

## GREASE QUANTITIES FOR INITIAL LUBRICATION

Shaft Diameter d (mm)	Bearing Reference	Speed (rpm) up to	Grease (full pack) (kg)	Speed (rpm)		Grease (75% full pack) (kg)	Speed (rpm)		Grease (50% full pack) (kg)	Speed (rpm)		Grease (33% full pack) (kg)	Speed (rpm) over	Grease (25% full pack) (kg)
				from	to		from	to		from	to			
150	100 B 150M	328	1.02	328	656	0.77	656	984	0.51	984	1312	0.34	1312	0.26
	01 B 150M	328	0.90	328	656	0.68	656	984	0.45	984	1312	0.30	1312	0.23
	02 B 150M	328	1.40	328	656	1.05	656	984	0.70	984	1312	0.46	1312	0.35
	03 B 150M	328	2.70	328	656	2.03	656	984	1.35	984	1312	0.89	1312	0.68
155	01 B 155M	328	0.90	328	656	0.68	656	984	0.45	984	1312	0.30	1312	0.23
	02 B 155M	328	1.40	328	656	1.05	656	984	0.70	984	1312	0.46	1312	0.35
160	01 B 600-160M	328	0.90	328	656	0.68	656	984	0.45	984	1312	0.30	1312	0.23
	01 B 160M	303	1.00	303	606	0.75	606	909	0.50	909	1211	0.33	1211	0.25
	02 B 600-160M	328	1.40	328	656	1.05	656	984	0.70	984	1312	0.46	1312	0.35
	02 B 160M	303	1.40	303	606	1.05	606	909	0.70	909	1211	0.46	1211	0.35
	03 B 160M	303	3.60	303	606	2.70	606	909	1.80	909	1211	1.19	1211	0.90
170	01 B 608-170M	303	1.00	303	606	0.75	606	909	0.50	909	1211	0.33	1211	0.25
	01 B 170M	281	1.20	281	562	0.90	562	844	0.60	844	1125	0.40	1125	0.30
	02 B 170M	303	2.00	303	606	1.50	606	909	1.00	909	1211	0.66	1211	0.50
	03 B 170M	303	3.60	303	606	2.70	606	909	1.80	909	1211	1.19	1211	0.90
175	01 B 175M	281	1.20	281	562	0.90	562	844	0.60	844	1125	0.40	1125	0.30
	02 B 175M	281	2.00	281	562	1.50	562	844	1.00	844	1125	0.66	1125	0.50
180	01 B 180M	281	1.20	281	562	0.90	562	844	0.60	844	1125	0.40	1125	0.30
	02 B 180M	281	2.00	281	562	1.50	562	844	1.00	844	1125	0.66	1125	0.50
	03 B 180M	281	4.20	281	562	3.15	562	844	2.10	844	1125	1.39	1125	1.05
190	01 B 190M	246	1.40	246	492	1.05	492	738	0.70	738	984	0.46	984	0.35
	02 B 190M	246	2.70	246	492	2.03	492	738	1.35	738	984	0.89	984	0.68
	03 B 190M	246	5.40	246	492	4.05	492	738	2.70	738	984	1.78	984	1.35
200	01 B 200M	246	1.40	246	492	1.05	492	738	0.70	738	984	0.46	984	0.35
	02 B 200M	246	2.70	246	492	2.03	492	738	1.35	738	984	0.89	984	0.68
	03 B 200M	246	5.40	246	492	4.05	492	738	2.70	738	984	1.78	984	1.35
220	01 B 220M	219	1.40	219	437	1.05	437	656	0.70	656	875	0.46	875	0.35
	02 B 220M	219	3.60	219	437	2.70	437	656	1.80	656	875	1.19	875	0.90
	03 B 220M	219	6.90	219	437	5.18	437	656	3.45	656	875	2.28	875	1.73
230	01 B 230M	219	1.40	219	437	1.05	437	656	0.70	656	875	0.46	875	0.35
	02 B 230M	219	3.60	219	437	2.70	437	656	1.80	656	875	1.19	875	0.90



Shaft Diameter d (mm)	Bearing Reference	Speed (rpm) up to	Grease (full pack) (kg)	Speed (rpm)		Grease (75% full pack) (kg)	Speed (rpm)		Grease (50% full pack) (kg)	Speed (rpm)		Grease (33% full pack) (kg)	Speed (rpm) over	Grease (25% full pack) (kg)
				from	to		from	to		from	to			
240	01 B 240M	197	2.00	197	394	1.50	394	591	1.00	591	787	0.66	787	0.50
	02 B 240M	197	4.20	197	394	3.15	394	591	2.10	591	787	1.39	787	1.05
	03 B 240M	197	8.10	197	394	6.08	394	591	4.05	591	787	2.67	787	2.03
250	01 B 250M	197	2.00	197	394	1.50	394	591	1.00	591	787	0.66	787	0.50
	02 B 250M	197	4.20	197	394	3.15	394	591	2.10	591	787	1.39	787	1.05
	03 B 250M	197	8.10	197	394	6.08	394	591	4.05	591	787	2.67	787	2.03
260	01 B 1000-260M	197	2.00	197	394	1.50	394	591	1.00	591	787	0.66	787	0.50
	01 B 260M	179	2.00	179	358	1.50	358	537	1.00	537	716	0.66	716	0.50
	02 B 260M	197	4.20	197	394	3.15	394	591	2.10	591	787	1.39	787	1.05
	03 B 260M	197	8.10	197	394	6.08	394	591	4.05	591	787	2.67	787	2.03
270	01 B 270M	179	2.00	179	358	1.50	358	537	1.00	537	716	0.66	716	0.50
275	01 B 275M	179	2.00	179	358	1.50	358	537	1.00	537	716	0.66	716	0.50
280	01 B 280M	179	2.00	179	358	1.50	358	537	1.00	537	716	0.66	716	0.50
	02 B 280M	179	4.80	179	358	3.60	358	537	2.40	537	716	1.58	716	1.20
	03X B 280M	179	10.00	179	358	7.50	358	537	5.00	537	716	3.30	716	2.50
	03E B 280M	179	10.00	179	358	7.50	358	537	5.00	537	716	3.30	716	2.50
290	01 B 290M	164	2.00	164	328	1.50	328	492	1.00	492	656	0.66	656	0.50
	03 B 290M	164	11.00	164	328	8.25	328	492	5.50	492	656	3.63	656	2.75
300	01 B 300M	164	2.00	164	328	1.50	328	492	1.00	492	656	0.66	656	0.50
	02 B 300M	164	5.40	164	328	4.05	328	492	2.70	492	656	1.78	656	1.35
	03 B 300M	164	11.00	164	328	8.25	328	492	5.50	492	656	3.63	656	2.75
320	01 B 320M	151	2.76	151	303	2.07	303	454	1.38	454	606	0.91	606	0.69
	02 B 320M	151	6.60	151	303	4.95	303	454	3.30	454	606	2.18	606	1.65
	03 B 320M	151	12.00	151	303	9.00	303	454	6.00	454	606	3.96	606	3.00
330	01 B 330M	151	2.76	151	303	2.07	303	454	1.38	454	606	0.91	606	0.69
	02 B 330M	151	6.60	151	303	4.95	303	454	3.30	454	606	2.18	606	1.65
340	01 B 1300-340M	151	2.76	151	303	2.07	303	454	1.38	454	606	0.91	606	0.69
	01 B 340M	141	3.00	141	281	2.25	281	422	1.50	422	562	0.99	562	0.75
	02 B 340M	141	7.20	141	281	5.40	281	422	3.60	422	562	2.38	562	1.80
	03E B 340M	141	15.00	141	281	11.25	281	422	7.50	422	562	4.95	562	3.75

# INSTALLATION AND ASSEMBLY

## GREASE QUANTITIES FOR INITIAL LUBRICATION

Shaft Diameter d (mm)	Bearing Reference	Speed (rpm) up to	Grease (full pack) (kg)	Speed (rpm)		Grease (75% full pack) (kg)	Speed (rpm)		Grease (50% full pack) (kg)	Speed (rpm)		Grease (33% full pack) (kg)	Speed (rpm) over	Grease (25% full pack) (kg)
				from	to		from	to		from	to			
350	01 B 350M	141	3.00	141	281	2.25	281	422	1.50	422	562	0.99	562	0.75
	02 B 350M	141	7.20	141	281	5.40	281	422	3.60	422	562	2.38	562	1.80
360	01 B 1400-360M	141	3.00	141	281	2.25	281	422	1.50	422	562	0.99	562	0.75
	01 B 360M	131	3.00	131	262	2.25	262	394	1.50	394	525	0.99	525	0.75
	02 B 360M	141	7.20	141	281	5.40	281	422	3.60	422	562	2.38	562	1.80
	03E B 360M	141	15.00	141	281	11.25	281	422	7.50	422	562	4.95	562	3.75
	03X B 360M	141	15.00	141	281	11.25	281	422	7.50	422	562	4.95	562	3.75
380	01 B 380M	131	3.00	131	262	2.25	262	394	1.50	394	525	0.99	525	0.75
	02 B 380M	131	7.80	131	262	5.85	262	394	3.90	394	525	2.57	525	1.95
	03 B 380M	131	16.20	131	262	12.15	262	394	8.10	394	525	5.35	525	4.05
390	01 B 390M	123	3.60	123	246	2.70	246	369	1.80	369	492	1.19	492	0.90
400	01 B 400M	123	3.60	123	246	2.70	246	369	1.80	369	492	1.19	492	0.90
	02 B 400M	123	9.00	123	246	6.75	246	369	4.50	369	492	2.97	492	2.25
	03 B 400M	131	16.20	131	262	12.15	262	394	8.10	394	525	5.35	525	4.05
420	01 B 420M	116	4.20	116	232	3.15	232	347	2.10	347	463	1.39	463	1.05
	02 B 420M	116	9.60	116	232	7.20	232	347	4.80	347	463	3.17	463	2.40
	03E B 420M	116	21.60	116	232	16.20	232	347	10.80	347	463	7.13	463	5.40
440	01 B 440M	109	4.20	109	219	3.15	219	328	2.10	328	437	1.39	437	1.05
	02 B 440M	109	9.60	109	219	7.20	219	328	4.80	328	437	3.17	437	2.40
	03E B 440M	116	21.60	116	232	16.20	232	347	10.80	347	463	7.13	463	5.40
460	01 B 460M	109	4.20	109	219	3.15	219	328	2.10	328	437	1.39	437	1.05
	02 B 460M	109	9.60	109	219	7.20	219	328	4.80	328	437	3.17	437	2.40
	03E B 460M	109	24.60	109	219	18.45	219	328	12.30	328	437	8.12	437	6.15
	03X B 460M	104	24.60	104	207	18.45	207	311	12.30	311	414	8.12	414	6.15
480	01 B 480M	104	4.80	104	207	3.60	207	311	2.40	311	414	1.58	414	1.20
	02 B 480M	104	10.20	104	207	7.65	207	311	5.10	311	414	3.37	414	2.55
	03X B 480M	109	24.60	109	219	18.45	219	328	12.30	328	437	8.12	437	6.15
500	01 B 500M	98	4.80	98	197	3.60	197	295	2.40	295	394	1.58	394	1.20
	02 B 500M	98	10.80	98	197	8.10	197	295	5.40	295	394	3.56	394	2.70
	03 B 500M	98	30.00	98	197	22.50	197	295	15.00	295	394	9.90	394	7.50



# INSTALLATION AND ASSEMBLY

## GREASE QUANTITIES FOR INITIAL LUBRICATION

Shaft Diameter d (mm)	Bearing Reference	Speed (rpm) up to	Grease (full pack) (kg)	Speed (rpm)		Grease (75% full pack) (kg)	Speed (rpm)		Grease (50% full pack) (kg)	Speed (rpm)		Grease (33% full pack) (kg)	Speed (rpm) over	Grease (25% full pack) (kg)
				from	to		from	to		from	to			
530	01 B 530M	94	5.40	94	187	4.05	187	281	2.70	281	375	1.78	375	1.35
	02 B 530M	94	11.40	94	187	8.55	187	281	5.70	281	375	3.76	375	2.85
	03 B 530M	98	30.00	98	197	22.50	197	295	15.00	295	394	9.90	394	7.50
560	01 B 560M	89	5.40	89	179	4.05	179	268	2.70	268	358	1.78	358	1.35
	02 B 560M	89	11.40	89	179	8.55	179	268	5.70	268	358	3.76	358	2.85
	03E B 560M	89	36.00	89	179	27.00	179	268	18.00	268	358	11.88	358	9.00
580	01 B 580M	86	6.00	86	171	4.50	171	257	3.00	257	342	1.98	342	1.50
	02 B 580M	86	12.60	86	171	9.45	171	257	6.30	257	342	4.16	342	3.15
600	01 B 600M	82	6.00	82	164	4.50	164	246	3.00	246	328	1.98	328	1.50
	02 B 600M	82	12.60	82	164	9.45	164	246	6.30	246	328	4.16	328	3.15
	03E B 600M	86	38.40	86	171	28.80	171	257	19.20	257	342	12.67	342	9.60



# ROUTINE GREASING

Routine greasing frequency depends on temperature, speed and environment. Grease quantities depend on bearing size. Excessive quantities of lubricant should not be used. Particularly at high speeds, this may result in excessive churning and overheating.

Automatic lubrication systems should be metered to deliver grease at an average rate equivalent to the routine greasing periods and quantities specified.

If it can be done safely, routine greasing should occur while the shaft is rotating to help distribute the grease. Do not mix different types of grease in the bearing.

The table below specifies routine greasing intervals. The shortest greasing interval should be selected to which one or more of the conditions in the table apply. If operating conditions fall outside those listed please contact our technical department for a recommended lubrication interval.

Routine greasing frequency	Operating conditions		
	Temperature	Speed dn (mm)	Environment (3)
100 hours	80°C to 175°C	200,000 to 300,000 (1)	very dirty/ submerged
200 hours	60°C to 80°C	100,000 to 200,000	dusty/splashed
400 hours (2)	Below 60°C	up to 100,000	clean/dry

The following table specifies the required quantity of grease at each routine greasing. Note that 2ml is approximately one shot from a conventional side-lever grease gun. Smaller quantities may be delivered using a push-type gun.

Shaft Diam. d	Bearing Reference	Routine Grease Volume (ml)
35	01 B 35M	4
40	01 B 40M	4
45	01E B 45M	4
50	01E B 50M	4
	02 B 50M	4
55	01E B 55M	4
60	01E B 60M	4
	02 B 60M	4
65	01E B 65M	4
	02 B 65M	4
70	01E B 70M	4
	02 B 70M	4
75	100 B 75M	1*
	01E B 75M	4
80	02 B 75M	4
	01E B 80M	4
85	02 B 80M	4
	100 B 85M	1*
90	01E B 85M	4
	02 B 85M	4
95	01E B 90M	4
	02 B 90M	4
100	01E B 95M	4
	100 B 100M	2
	01E B 100M	4
	02 B 100M	4
105	03 B 100M	4
	01E B 105M	4
110	02 B 105M	4
	100 B 110M	2
115	01 B 110M	4
	02 B 110M	4
	03 B 110M	4
120	01 B 115M	4
	02 B 115M	4
125	100 B 120M	4
	01 B 120M	4
	02 B 120M	4
130	03 B 120M	4
	01 B 125M	4
135	02 B 125M	4
	100 B 130M	4
140	01 B 130M	4
	02 B 130M	4
	03 B 130M	4
145	01 B 135M	4
	100 B 140M	4
	01 B 140M	4
150	02 B 140M	4
	03 B 140M	8
	02 B 145M	4
155	100 B 150M	4
	01 B 150M	4
	02 B 150M	4
	03 B 150M	8

Shaft Diam. d	Bearing Reference	Routine Grease Volume (ml)
105	01E B 105M	4
	02 B 105M	4
110	100 B 110M	2
	01 B 110M	4
	02 B 110M	4
115	03 B 110M	4
	01 B 115M	4
	02 B 115M	4
120	100 B 120M	4
	01 B 120M	4
	02 B 120M	4
125	03 B 120M	4
	01 B 125M	4
	02 B 125M	4
130	100 B 130M	4
	01 B 130M	4
	02 B 130M	4
135	03 B 130M	4
	01 B 135M	4
	100 B 140M	4
140	01 B 140M	4
	02 B 140M	4
	03 B 140M	8
145	02 B 145M	4
	100 B 150M	4
150	01 B 150M	4
	02 B 150M	4
	03 B 150M	8
	03 B 150M	8

(1) Up to bearing maximum in case of 100 Series bearings

(2) For EX bearings and GR bearings used for location only (i.e. no nominal thrust load) this may be extended to 1000 hours. For applications where temperature and operating speed allow for a full pack of grease this may be extended to one year for EX bearings and GR bearings used for location only.

(3) For applications where operating speed and temperature allow for a full pack of grease, regreasing can occur every 400 hours regardless of the working environment.

\* May be increased to 2 if speed is less than 100,000dn (mm), or up to 200,000dn (mm) if operating temperature is less than 80°C.



# ROUTINE GREASING

Shaft Diam. d	Bearing Reference	Routine Grease Volume (ml)
155	01 B 155M	4
	02 B 155M	4
160	01 B 600-160M	4
	01 B 160M	4
	02 B 600-160M	4
	02 B 160M	8
170	03 B 160M	8
	01 B 608-170M	4
	01 B 170M	4
	02 B 170M	8
175	03 B 170M	8
	01 B 175M	4
	02 B 175M	8
180	01 B 180M	4
	02 B 180M	8
	03 B 180M	8
190	01 B 190M	4
	02 B 190M	8
	03 B 190M	16
200	01 B 200M	4
	02 B 200M	8
	03 B 200M	16
220	01 B 220M	4
	02 B 220M	8
	03 B 220M	16
230	01 B 230M	4
	02 B 230M	8

Shaft Diam. d	Bearing Reference	Routine Grease Volume (ml)
240	01 B 240M	8
	02 B 240M	8
	03 B 240M	16
260	01 B 1000-260M	8
	01 B 260M	8
	02 B 260M	8
	03 B 260M	16
270	01 B 270M	8
275	01 B 275M	8
280	01 B 280M	8
	02 B 280M	16
	03X B 280M	16
	03E B 280M	16
290	01 B 290M	8
	03 B 290M	16
300	01 B 300M	8
	02 B 300M	16
	03 B 300M	16
320	01 B 320M	8
	02 B 320M	16
	03 B 320M	24
330	01 B 330M	8
	02 B 330M	16
340	01 B 1300-340M	8
	01 B 340M	8
	02 B 340M	16
	03E B 340M	24
350	01 B 350M	8
	02 B 350M	16

Shaft Diam. d	Bearing Reference	Routine Grease Volume (ml)
360	01 B 1400-360M	8
	01 B 360M	8
	02 B 360M	16
	03E B 360M	24
	03X B 360M	24
380	01 B 380M	8
	02 B 380M	16
	03 B 380M	24
390	01 B 390M	16
400	01 B 400M	16
	02 B 400M	16
	03 B 400M	24
420	01 B 420M	16
	02 B 420M	16
	03E B 420M	24
440	01 B 440M	16
	02 B 440M	24
	03E B 440M	32
460	01 B 460M	16
	02 B 460M	24
	03E B 460M	32
	03X B 460M	32
480	01 B 480M	16
	02 B 480M	24
	03X B 480M	32
500	01 B 500M	16
	02 B 500M	24
	03 B 500M	32

Shaft Diam. d	Bearing Reference	Routine Grease Volume (ml)
530	01 B 530M	16
	02 B 530M	24
	03 B 530M	32
560	01 B 560M	16
	02 B 560M	24
	03E B 560M	32
580	01 B 580M	16
	02 B 580M	24
600	01 B 600M	16
	02 B 600M	24
	03E B 600M	32



# WHAT TO DO WITH YOUR USED BEARING

When a bearing reaches the end of its working life, it doesn't have to be discarded without providing further value. Three options for dealing with end-of-life bearings are outlined below.

## Reconditioning

Cooper offer a reconditioning service for larger bearings. A used bearing is thoroughly cleaned and a detailed report prepared on its condition and the required work required to bring it back to an as-new functional condition. Generally a reconditioned bearing will consist of a combination of remachined components of the original bearing and new components to give the correct clearances.

Reconditioning is generally more economical than manufacture of new bearings, depending upon the amount of work required to the subject bearing, for the following bearings:

<b>01 Series:</b>	320mm/13" bore size and over
<b>02 Series:</b>	320mm/13" bore size and over
<b>03 Series:</b>	160mm/6½" bore size and over
<b>04 Series:</b>	all sizes
<b>Thrust bearings:</b>	all sizes

Cooper are also able to recondition radial and thrust cylindrical bearings of non-Cooper manufacture.

## Failure Analysis

Cooper offer a failure analysis service for all sizes of bearing, of any age. Where appropriate, we will offer advice on fitting practices, lubrication regime, or modifications to the mounting arrangements to help improve future bearing life.

Bearings sent for analysis may be reconditioned, recycled or returned as appropriate.

Please inform Cooper if you wish to use this service, before returning bearings to one of our sites. A small charge may be made depending on requirements.

## Recycling

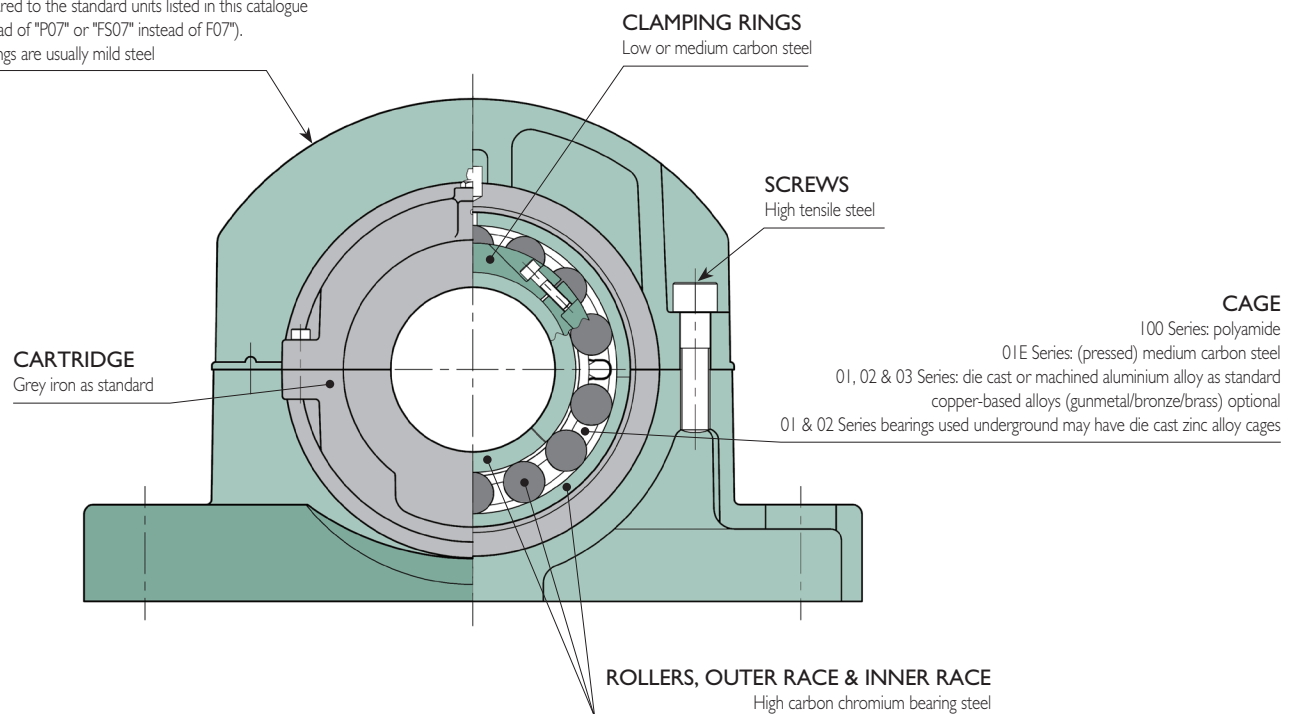
The materials used in a Cooper bearing unit are almost completely recyclable. The diagram below helps to identify the various materials used in standard and popular optional versions of Cooper bearings so that they can be segregated as required.

### OUTER HOUSING

Grey iron or ductile iron as standard.

Cast steel housings will usually have the letter 'S' inserted into their reference compared to the standard units listed in this catalogue (e.g. "PS07" instead of "P07" or "FS07" instead of "F07").

Fabricated housings are usually mild steel



## PROBLEM: OVERHEATING

Possible Cause	Solution
Shaft oversize. Bearing running tight	Provide shaft with correct tolerance. Contact Cooper technical department.
Aluminum triple labyrinth seal rubbing	Seal bore and labyrinth should be greased during installation.
Housing overpacked with grease or oil level too high	Bearing will purge excess grease through seals. Oil lubrication - reduce level to just below cage.
Wrong type of grease or oil causing lubricant breakdown.	Consult reliable lubricant manufacturer for proper type of lubricant or contact Cooper technical department.
Low oil level. Insufficient grease.	Oil level should be just below cage outside diameter. Add proper grease.
Inner race rubbing against seals.	Check clamping ring screws to make sure inner race is tight on the shaft. Make sure the expansion bearing is mounted properly with rollers positioned centrally on outer race.
Incorrect shaft alignment	Recheck alignment.
Bearing selected with inadequate internal clearance for high temperature operation.	Contact Cooper technical department.
Oil lubrication hole blocked. Grease passage blocked.	Inspect and clean holes. Refill to proper level.
Two fixed bearings on common shaft.	Remove one bearing and replace with an expansion bearing.
Pinching of bearing.	Make sure entire area of pedestal base is supported.
Bearing cartridge not aligned.	Lubricate cartridge spherical with anti-seize compound. With pedestal cap in place and cap bolts loose, rotate or run shaft a few revolutions while under load. Re-tighten cap bolts.

## PROBLEM: NOISY BEARING

Possible Cause	Solution
Foreign matter or corrosive agent entering bearing.	Remove and inspect bearing and seals. Clean and re-lubricate bearing and seals.
Pinching of bearing.	Make sure entire area of pedestal base is supported.
Undersize shaft.	Measure shaft for proper fit. Refer to page 14.
Inner race rubbing against seals.	Check clamping ring screws to make sure the inner race is tight on shaft. Make sure the expansion bearing is mounted correctly with roller positioned centrally on the outer race.
Improper mounting of bearing.	Inspect bearing. Check that all match marks coincide. If parts are damaged, replace with new bearing.
Aluminum triple labyrinth seal rubbing	Seal bore and labyrinth should be greased during installation.
Low oil level. Insufficient grease.	Oil levels should be just below cage outside diameter. Add correct grease.

## PROBLEM: NOISY BEARING (CONTINUED)

Possible Cause	Solution
Wrong type of grease or oil causing lubricant breakdown.	See lubrication section or contact Cooper technical department.
Bearing selected with incorrect internal clearance.	Contact Cooper technical department.
Shaft does not contain a fixed bearing.	Remove one expansion bearing and replace with fixed bearing.
Two fixed bearings on common shaft.	Remove one and replace with an expansion bearing.
Unbalanced load.	Re-balance machine.
Bearing exposed to vibration while machine is idle.	Examine bearing for brinelling separated by the distance equal to spacing of rollers. Replace bearing. Rotate shaft at least once every two weeks to prevent brinelling.

## PROBLEM: VIBRATION

Possible Cause	Solution
Foreign matter or corrosive agent entering bearing.	Remove and inspect bearing and seals. Clean and re-lubricate bearing and seals.
Pinching of bearing.	Make sure the entire area of the pedestal base is supported.
Shaft undersize.	Measure shaft for proper fit. Refer to page 14.
Unbalanced load.	Re-balance machine.
Flat on roller due to skidding.	Replace bearing. Consult Cooper technical department if problem persists.
Improper mounting of bearing.	Inspect bearing. Check that all match marks coincide. If parts are damaged, replace with new bearing.
Bearing cartridge not aligned.	Lubricate cartridge spherical with anti-seize compound. With pedestal cap in place and cap bolts loose, rotate or run shaft a few revolutions while under load. Re-tighten cap bolts.
Excessive clearance in bearing resulting in vibration.	Use bearing with recommended internal clearance.
Failure to clean bearing before assembly.	Remove and carefully clean bearing and re-assemble with correct lubrication.

## PROBLEM: BEARING LOOSE ON SHAFT

Possible Cause	Solution
Clamping rings not tightened sufficiently.	Make sure clamping rings are fully tightened. Refer to assembly procedure.
Undersize shaft.	Measure shaft for proper fit. Refer to page 14.
Shaft out of round or not parallel.	Measure shaft. Refer to page 14.



## Appendix 4.4.5.10

System: Bridge Counterweight System  
Component: Turnbuckle  
Manufacturer: Crosby



## CROSBY TURNBUCKLES



HG-223 Hook & Hook

Meets the performance requirements of Federal Specifications FF-T791b, Type 1, Form 1 - Class 5, and ASTM F-1145, except for those provisions required of the contractor.



HG-225 Hook & Eye

Meets the performance requirements of Federal Specifications FF-T791b, Type 1, Form 1 - Class 6, and ASTM F-1145, except for those provisions required of the contractor.



HG-226 Eye & Eye

Meets the performance requirements of Federal Specifications FF-T791b, Type 1, Form 1 - Class 4, and ASTM F-1145, except for those provisions required of the contractor.



HG-227 Jaw & Eye

Meets the performance requirements of Federal Specifications FF-T791b, Type 1, Form 1 - Class 8, and ASTM F-1145, except for those provisions required of the contractor.



HG-228 Jaw & Jaw

Meets the performance requirements of Federal Specifications FF-T791b, Type 1, Form 1 - Class 7, and ASTM F-1145, except for those provisions required of the contractor.

- Turnbuckle assembly combinations include: Eye and Eye, Hook and Hook, Hook and Eye, Jaw and Jaw, Jaw and Eye.
- End fittings are Quenched and Tempered, bodies heat treated by normalizing.
- Crosby's Quenched and Tempered end fittings and normalized bodies have enhanced impact properties for greater toughness at all temperatures.
- Hot Dip galvanized.
- Hooks are forged with a greater cross sectional area that results in a stronger hook with better fatigue properties.
- Modified UNJ thread on end fittings for improved fatigue properties. Body has UNC threads.
- Turnbuckle eyes are forged elongated, by design, to maximize easy attachment in system and minimize stress in the eye. For turnbuckle sizes 1/4" through 2-1/2", a shackle one size smaller can be reeved through eye.
- Forged jaw ends are fitted with bolts and nuts on sizes 1/4" through 5/8", and pins and cotters on sizes 3/4" through 2-3/4".
- TURNBUCKLES RECOMMENDED FOR STRAIGHT OR IN-LINE PULL ONLY.
- Lock Nuts available for all sizes.
- Typical hardness levels, Tensile Strengths and Ductility Properties are available for all sizes.
- Turnbuckles can be furnished proof tested or magnaflux inspected with certificates if requested at time of order.
- Crosby products meet or exceed all the requirements of ASME B30.26 including identification, ductility, design factor, proof load and temperature requirements. Importantly, Crosby products meet other critical performance requirements including fatigue life, impact properties and material traceability, not addressed by ASME B30.26.



Modified thread: Note stress relieving radii in this unretouched photo enlargement of the supabuckle.



Standard thread: Note stress building sharp V in this unretouched photo enlargement.



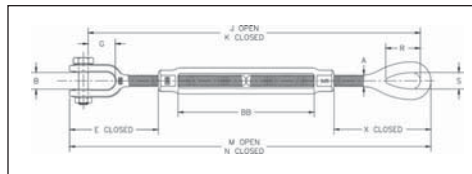
## HG-227 JAW AND EYE TURNBUCKLES

- End fittings are Quenched and Tempered, bodies heat treated by normalizing.
- Hot Dip galvanized steel.
- Turnbuckles eyes are forged and elongated, by design, to maximize easy attachment in system and minimize stress in the eye. For turnbuckles size 1/4" through 2-1/2", a shackle one size smaller can be reeved through eye.
- Forged jaw ends are fitted with bolts and nuts for 1/4" through 5/8", and pins and cotters on 3/4" through 2-3/4" sizes.
- Modified UNJ thread on end fittings for improved fatigue properties.
- Body has UNC threads.
- Crosby products meet or exceed all the requirements of ASME B30.26 including identification, ductility, design factor, proof load and temperature requirements. Importantly, Crosby products meet other critical performance requirements including fatigue life, impact properties and material traceability, not addressed by ASME B30.26.
- TURNBUCKLES RECOMMENDED FOR STRAIGHT OR IN-LINE PULL ONLY.
- Fatigue Rated.



HG-227 Jaw & Eye

Meets the performance requirements of Federal Specifications FF-T791b, Type 1, Form 1 - Class 8, and ASTM F-1145, except for those provisions required of the contractor.



## HG-227 JAW & EYE

THREAD DIA. & TAKE UP (IN.)	HG-227 STOCK NO.	WORKING LOAD LIMIT (LBS.*)*	WEIGHT EACH (LBS.)	DIMENSIONS (IN.)												
				A	B	E CLOSED	G	J OPEN	K CLOSED	M OPEN	N CLOSED	R	S	X CLOSED	BB	
1/4 x 4	1031877	500	.30	.25	.45	1.58	.62	11.35	7.35	12.07	8.07	.78	.34	1.75	4.00	
5/16 x 4-1/2	1031895	800	.50	.31	.50	1.98	.87	13.71	8.71	14.01	9.51	.94	.44	2.09	4.50	
3/8 x 6	1031911	1,200	.80	.38	.54	2.12	.87	16.81	10.81	17.77	11.77	1.12	.53	2.52	6.00	
1/2 x 6	1031939	2,200	1.51	.50	.55	2.75	1.06	19.29	12.29	20.48	13.48	1.44	.72	3.23	6.00	
1/2 x 9	1031957	2,200	1.71	.50	.55	2.75	1.06	25.29	15.29	26.48	16.48	1.44	.72	3.23	9.00	
1/2 x 12	1031975	2,200	2.08	.50	.55	2.75	1.06	31.29	18.29	32.48	19.48	1.44	.72	3.23	12.00	
5/8 x 6	1031993	3,500	2.35	.63	.82	3.50	1.31	20.99	13.74	22.53	15.28	1.75	.88	3.90	6.00	
5/8 x 9	1032019	3,500	3.17	.63	.82	3.50	1.31	26.99	16.74	28.53	18.28	1.75	.88	3.90	9.00	
5/8 x 12	1032037	3,500	3.61	.63	.82	3.50	1.31	32.99	19.74	34.53	21.28	1.75	.88	3.90	12.00	
3/4 x 6	1032055	5,200	4.00	.75	1.03	4.18	1.50	22.69	15.19	24.61	17.11	2.09	1.00	4.69	6.00	
3/4 x 9	1032073	5,200	4.75	.75	1.03	4.18	1.50	28.69	18.19	30.61	20.11	2.09	1.00	4.69	9.00	
3/4 x 12	1032091	5,200	5.93	.75	1.03	4.18	1.50	34.69	21.19	36.61	23.11	2.09	1.00	4.69	12.00	
3/4 x 18	1032117	5,200	7.00	.75	1.03	4.18	1.50	46.69	27.19	48.61	29.11	2.09	1.00	4.69	18.00	
7/8 x 12	1032135	7,200	8.36	.88	1.23	4.85	1.75	36.09	22.34	38.32	24.57	2.38	1.25	5.10	12.00	
7/8 x 18	1032153	7,200	9.75	.88	1.23	4.85	1.75	48.09	28.34	50.32	30.57	2.38	1.25	5.10	18.00	
1 x 6	1032171	10,000	8.92	1.00	1.31	5.53	2.06	26.34	18.34	28.89	20.89	3.00	1.44	6.36	6.00	
1 x 12	1032199	10,000	11.20	1.00	1.31	5.53	2.06	38.34	24.34	40.89	26.89	3.00	1.44	6.36	12.00	
1 x 18	1032215	10,000	13.30	1.00	1.31	5.53	2.06	50.34	30.34	52.89	32.89	3.00	1.44	6.36	18.00	
1 x 24	1032233	10,000	17.00	1.00	1.31	5.53	2.06	62.34	36.34	64.89	38.89	3.00	1.44	6.36	24.00	
1-1/4 x 12	1032251	15,200	19.42	1.25	1.86	7.21	2.81	41.32	26.82	44.55	30.05	3.56	1.81	7.72	12.00	
1-1/4 x 18	1032279	15,200	24.18	1.25	1.86	7.21	2.81	53.32	32.82	56.05	36.05	3.56	1.81	7.72	18.00	
1-1/4 x 24	1032297	15,200	28.50	1.25	1.86	7.21	2.81	65.32	38.82	68.55	42.05	3.56	1.81	7.72	24.00	
1-1/2 x 12	1032313	21,400	28.99	1.50	2.25	7.88	2.81	43.50	28.50	47.25	32.25	4.06	2.12	8.62	12.00	
1-1/2 x 18	1032331	21,400	35.00	1.50	2.25	7.88	2.81	55.50	34.50	59.25	38.25	4.06	2.12	8.62	18.00	
1-1/2 x 24	1032359	21,400	39.18	1.50	2.25	7.88	2.81	67.50	40.50	71.25	44.25	4.06	2.12	8.62	24.00	
1-3/4 x 18	1032395	28,000	53.75	1.75	2.60	9.40	3.38	55.38	37.38	59.78	41.78	4.62	2.38	10.00	18.00	
1-3/4 x 24	1032411	28,000	60.68	1.75	2.60	9.40	3.38	67.38	43.38	71.78	47.78	4.62	2.38	10.00	24.00	
2 x 24	1032439	37,000	89.00	2.00	2.62	11.86	3.69	72.62	48.62	77.95	53.95	5.75	2.69	13.09	24.00	
2-1/2 x 24	1032457	60,000	150.00	2.50	3.06	13.56	4.44	75.80	51.80	82.40	58.40	6.50	3.12	13.78	24.00	
2-3/4 x 24	1032475	75,000	183.00	2.75	3.68	15.22	4.19	77.88	53.88	85.50	61.50	7.00	3.25	15.22	24.00	

\* Proof Load is 2.5 times the Working Load Limit. Ultimate Load is 5 times the Working Load Limit. Mechanical Galvanized.

## Appendix 4.4.5.11

System: Apron Hoist Machinery  
Component: Brake  
Manufacturer: Stearns

# Introduction to Solenoid Actuated Brakes (SAB's)

## Stearns Brakes Set the Standard for Excellence

Stearns offers the most comprehensive line of solenoid actuated brakes (SAB's) on the market today. We have earned the reputation as the industry's quality leader by working closely with you, our customers, understanding your needs and developing products with design features to handle your most challenging applications. We have installed millions of Stearns brakes worldwide since 1935. Many brakes operating today are 40 years old or more; evidence of our product quality and reliability.

Stearns motor brakes can be mounted directly to an electric motor or foot mounted. The compact design delivers high torque in a small size with fast, positive response and no residual drag when released. Our brakes can be mounted directly onto NEMA C-face motors without special alignment procedures. Many motor manufacturers offer a brake kit which will convert a stock fan-cooled motor into a brakemotor. Stearns Solenoid Actuated Brakes feature unitized construction which makes servicing friction discs easy using only a screwdriver and wrench. The Stearns SAB ensures automatic stopping and holding any time power to the brake is interrupted. And, as with ALL Stearns products, the friction material is non-asbestos.

We can produce a brake which meets your specifications, including metric mounting. Chances are, we've already manufactured similar requirements from a long list of pre-engineered options.

### Enclosure Types

Stearns brakes, when properly installed, are provided in a variety of IP enclosure types.

**IP 21** - intended for general purpose, indoor applications, as a ventilated enclosure. Protected against dripping water.

**IP 23** - intended for indoor applications, as a non-ventilated enclosure. It provides protection against falling, non-corrosive dirt and liquid. Protected against spraying water.

**IP 54** - intended for dust protected indoor and outdoor applications. Protected against splashing water.

**IP 55** - intended for dust protected indoor and outdoor applications. Protected against water jets.

**IP 56** - intended for dust protected indoor and outdoor applications. Protected against heavy seas or powerful jets.

**IP 57** - intended for dust protected indoor and outdoor applications. Protected against the effects of immersion.

NOTE: IP 21, 23 & 54 - formerly referred to by Stearns as NEMA 1, 2 & 4 respectively.

IP 55, 56 & 57 - formerly referred to by Stearns as NEMA Type 4X (BISSC Certified with epoxy coating and stainless steel hardware on exterior, or with a stainless steel enclosure).

### Self-Adjusting Disc Brakes

Remote inaccessible locations or high cycling applications require a specially designed, low-maintenance brake that will operate at peak efficiency and provide uniform braking for long periods of time. Stearns exclusive self-adjusting feature helps eliminate the major cause of brake maintenance - friction lining wear. Self-adjusting brakes are also well suited for applications where rapid cycling requires frequent resetting of solenoid air gap. Automatic adjustment also eliminates the errors that can occur with hand adjustment. They can be easily modified to suit your particular application. Depending upon the series you select, these brakes can be direct mounted on motors ranging in size from NEMA 182TC through NEMA 505C.



### Manually Adjusted Disc Brakes with Automatic Reset

It's an unbeatable combination; the features you want most in spring-set disc brakes. Standard features now include: a unique spring design which allows for



universal mounting, an air gap adjustment gauge for visual recognition that the brake needs adjustment, a new patented hub design, and genuine Stearns friction discs which are trademarked and patented. The 56 Series Brakes come in static torque ratings from 1.5 through 25 lb-ft with NEMA C-face mountings 56C, 143TC, 145TC, 182TFC and 184TFC. Ten different housing, endplate, and release configurations, with a wide variety of pre-engineered modifications, you can select from 120,000 possible combinations! In addition, for holding applications where friction disc wear is not a factor, Stearns 87,000 Series Brakes are available with an optional manual adjust. The 87,000 Series Brakes are available in static torque ratings from 6 lb-ft through 105 lb-ft, with NEMA C-face mountings, 182TC through 286TC.

## 56 Series

### Mounting Face: NEMA 56C, 143TC and 145TC

#### The 56,X00 Series have the following design features:

- Spring-Set Electrically Released
- Static Torque 1.5 through 25 lb-ft
- Adjustable Torque, down to 50% of rated nameplate torque
- Manual Wear Adjustment
- Airgap Adjust Gage
- Splined Hub
- IP 21, 23 & 54 (formerly referred to by Stearns as NEMA type 1, 2 & 4 respectively)
- IP 55, 56, & 57 (formerly referred to by Stearns as NEMA Type 4X (BISSC Certified with epoxy coating and stainless steel hardware on exterior, or with a stainless steel enclosure)
- Universal mounting through 15 lb-ft. The 20 and 25 lb-ft are supplied with springs for vertical modification.

#### Specifications:

- Lead Wire Length: 24 inches
- Maximum Speed:  
Horizontal 5000 rpm  
Vertical 3600 rpm
- Coil Insulation: Standard Class B  
Optional Class H  
(56,800 Series Class H standard)
- Certified: CSA File LR-6254
- ABS Type Approval Certified

### Product Overview

#### 56000 Series

Designed for industrial applications requiring high performance in a compact lightweight package.

##### Construction:

Die cast aluminum endplate with stamped steel housing

##### Available Enclosures:

IP 23, 54 & 55

##### Release Type:

External knob manual release with or without automatic reset

Through Shaft Capability: Yes (IP 23 only)



#### 56700 Series

Units designed for industrial applications that fit between a standard C-Face motor and gear reducer. Can also be used to retrofit installed units without braking capability.

Construction: Die cast aluminum endplate and housing

##### Available Enclosures:

IP 23, 54, 55 & 56

Release Type: External knob manual release with automatic reset

C-face brake has output shaft



#### 56200 Series

Designed for industrial applications requiring the protection of a heavy duty cast iron enclosure.

##### Construction:

Cast iron endplate and housing.

##### Available Enclosures:

IP 56 & 57

##### Release Type:

External side lever release with automatic reset

Through Shaft Capability: Yes



#### Also Available . . .

#### 56100 Series

Full die cast aluminum endplate and housing with internal release lever

##### Available Enclosures:

IP 23, 56 & 57



#### 56500 Series

Same as 56000 Series with 182TC / 184TC mounting.

##### Construction:

Cast iron endplate with stamped steel housing

(Direct mount to 182TC / 184TC)

##### Available Enclosures:

IP 23, 54 & 55

##### Release Type:

External knob manual release with or without automatic reset

Through Shaft Capability: Yes (IP 23 only)



#### 56300 Series

Die cast aluminum endplate with stamped steel housing and external maintained release, IP 21



#### 56400 Series

Cast iron endplate with stamped steel housing and external knob release

##### Available Enclosures:

IP 23 & 54



#### 56900 Series

For use in severe environments found in process industries such as food, pulp and paper mills and chemical plants.

Construction: Stainless steel

##### Release Type:

Side lever with automatic reset

##### Available Enclosures:

IP 56 & IP 57

Through Shaft Capability: with IP43 rating only



#### 56600 Series

Cast iron endplate and housing with internal release lever

##### Available Enclosures:

IP 23, 56 & 57



# Series 56,000; 56,100; **56,200** 56,300; 56,400; 56,500; 56,600; 56,700; and 56,900

Mounting Face: NEMA 56C, 143TC and 145TC

## Engineering Specifications

Maximum Solenoid Cycle Rate: ① Thermal Capacity: ②  
 AC 36 cycles/min Horizontal 9 hp-sec/min (112 watts)  
 DC 10 cycles/min Vertical 6.5 hp-sec/min (80 watts)

- ① Maximum solenoid cycle rate is based on ambient temperature of 72°F (22°C) with 50% duty cycle. Does not relate to brake cycle rate (see Thermal Capacity).
- ② Thermal capacity rating is based on ambient temperature of 72°F (22°C), stop time of one second or less, with no heat absorbed from motor. Refer to Selection Procedure Section.

### Series 56,000; 56,100; 56,300; 56,500; and 56,700

Nominal Static Torque	Number of Friction Discs	Coil Size		Inertia (WK <sup>2</sup> )
		AC	DC	
1.5-3 (2-4)	1	4	4+	.008 (3.36)
6 (8)	1	K4	K4+	.008 (3.36)
10 (14)	2	K4	K4+	.014 (5.88)
15 (20)	2	K4+	M4+	.014 (5.88)
20 (27)	3	K4+	M4+	.020 (8.40)
25 (34)	3	M4+	P4+	.020 (8.40)

### Series 56,200; 56,400; 56,600; and 56,900

Nominal Static Torque	No. of Friction Discs	Coil Size		Inertia (WK <sup>2</sup> )
		AC	DC	
3-6 (4-8)	2	4	4+	.014 (5.88)
10 (14)	2	K4	K4+	.014 (5.88)
15 (20)	2	K4+	M4+	.014 (5.88)
20 (27)	3	K4+	M4+	.020 (8.40)
25 (34)	3	M4+	P4+	.020 (8.40)

## Current Ratings (amperes)

Solenoid Coil Size*	AC Current	Voltage: 60 Hz						Voltage: 50 Hz			Voltage: DC			
		115	200	230	400	460	575	110	220	380	24	95	115	230
4	Inrush	3.6	2.1	1.8	1.1	.9	.7	4.1	2.1	.9	13.3	3.6	2.8	1.5
	Holding	.3	.2	.2	.08	.08	.06	.3	.2	.08	.3	.1	.05	.03
4+	Inrush	-	-	-	-	-	-	-	-	-	12.0	4.7	3.7	2.0
	Holding	-	-	-	-	-	-	-	-	-	.4	.1	.08	.04
K4	Inrush	4.3	2.5	2.2	1.3	1.1	.9	3.8	1.9	1.1	17.5	4.7	3.7	2.0
	Holding	.3	.2	.2	.1	.08	.07	.4	.2	.08	.4	.1	.08	.04
K4+	Inrush	4.6	2.5	2.3	1.2	1.0	.9	4.9	2.0	1.0	20.5	7.5	5.5	2.0
	Holding	.4	.2	.2	.1	.1	.08	.4	.2	.1	.5	.1	.08	.04
M4	Inrush	3.0	1.7	1.5	.9	.8	.6	-	-	.8	-	-	-	-
	Holding	.6	.3	.3	.2	.1	.21	-	-	.1	-	-	-	-
M4+	Inrush	4.6	2.5	2.3	1.2	1.0	.9	4.1	2.0	1.3	30.3	7.9	5.5	2.0
	Holding	.4	.2	.2	.1	.1	.08	.4	.2	.1	.5	.1	.1	.04
P4+	Inrush	-	-	-	-	-	-	-	-	-	30.3	11.3	8.4	3.0
	Holding	-	-	-	-	-	-	-	-	-	.5	.1	.08	.04

## Motor Frame Adapters: Series 56,000 through 56,600

**WARNING!** Before selecting an adapter to mount a brake on a larger motor frame, the torque and thermal capacity required by the application should be determined as shown in the "Selection Procedure" section. A larger motor may indicate a requirement for greater thermal capacity than the brake is designed for. The brake selection must be matched to the motor and application requirements, before use of an adapter is considered.

To Adapt to NEMA Frame Size	AK Dim.	Reg. No.	Brake Enclosure ①	Brake Torque	Adapter Stock Number	Additional Shaft Length Required
	in. (mm)					in. (mm)
182TC 184TC 213TC 215TC 254TC 256TC	8.50 (215.90)	-9	IP 23	1.5-15	5-55-5041-00 List \$700.00	.94 (23.81)
	8.50 (215.90)	-9	IP 54	1.5-6	5-55-5041-00 List \$700.00	.94 (23.81)
	8.50 (215.90)	-9	IP 23	20 & 25	5-55-5043-00 List \$700.00	.94 (23.81)
	8.50 (215.90)	-9	IP 54	10-25	5-55-5043-00 List \$700.00	.94 (23.81)

① 56,300 Series have NEMA 1 enclosure. For adapter dimensions, see Technical Data

Brake set and release times in milliseconds, when brake and motor are switched separately (for T1/T2 definitions, see page 101):

Static Torque lb-ft	Coil Size	T1	T2
1.5 - 25	4, K4, K4+, M4+	25	14

## Ordering and Identification Information

The following example and tables provide information for selecting the appropriate three-letter suffix when ordering a Stearns Brake.

Example of a complete part number:

1-056-034-00-BFF — Lead wire position (internal and external, left and right) standard  
 Series — Torque — Enclosure — 230 Vac — 5/8 bore and 3/16 x 3/32 keyway

## Hub Selection

Character	Bore (in.)	Keyway** (in. x in.)
A*	5/8	1/8 x 1/16
B	5/8	3/16 x 3/32
C	3/4	3/16 x 3/32
D	7/8	3/16 x 3/32
E	1-1/8	1/4 x 1/8
F*	1-1/4	1/4 x 1/8
K	1/2	1/8 x 1/16
L*	1	1/4 x 1/8
N*	9/16	1/8 x 1/16
O*	11/16	3/16 x 3/32
P*	1-1/16	1/4 x 1/8
R*	13/16	3/16 x 3/32
S*	15/16	1/4 x 1/8
Z	.460	pilot bore

Minimum bore is .500. Maximum allowable bore is 1.25. (maximum shaft length not to exceed end of hub). For through-shaft applications, .875 is maximum

\*These bores are non-standard. Add \$225.00 to list price.

\*\*Keyseats made to ANSI B17.1 Standard.

## Standard AC Voltage Ratings

Character	Voltage	Hertz
B	115	60
D	110	50
E	200	60
F	230	60
	190	50
H	220	50
L	460	60
	380	50
M	415	50
N	575	60
O	110/220	50
P	115/208-230	60
Q	208-230/460	60
	190/380	50
R	200/400	60

## Direct Current

Character	Voltage
T	12
U	24
V	36
W	48
X	95
Y	115
Z	230

Consult factory if other DC voltage is needed.

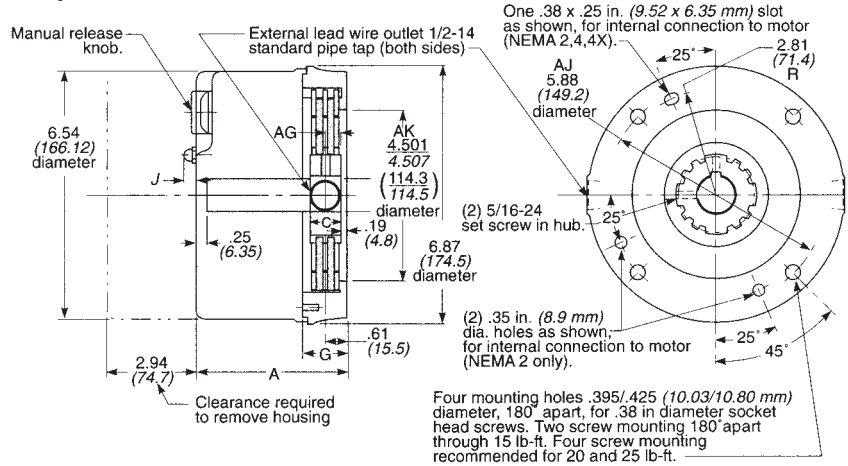
Voltages below 70VDC are polarity sensitive.

Modifications are available—see SAB Modification Section

Dimensional Drawings are on the pages following.

**Series 56,000 (1-056-0XX-00) &  
Series 56,000-80 (1-056-0XX-80)**

**Mounting Face: NEMA 56C,  
143TC and 145TC  
4.5" AK, 5.88" AJ**



**Series 56,000 Pricing (Discount Symbol B4)**

Nominal Static Torque lb-ft (Nm)	Enclosure	Basic Model Number and List Price**			
		AC	AC List Price**	DC	DC List Price**
1.5 (2)	IP 23	1-056-001-00	\$430.00	1-056-005-00	\$730.00
	IP 54	1-056-002-00	565.00	1-056-006-00	865.00
	IP 55	1-056-004-00	640.00	1-056-008-00	940.00
3 (4)	IP 23	1-056-011-00	450.00	1-056-015-00	750.00
	IP 54	1-056-012-00	585.00	1-056-016-00	885.00
	IP 55	1-056-014-00	660.00	1-056-018-00	960.00
6 (8)	IP 23	1-056-021-00	515.00	1-056-025-00	815.00
	IP 54	1-056-022-00	650.00	1-056-026-00	950.00
	IP 55	1-056-024-00	725.00	1-056-028-00	1,025.00
10 (14)	IP 23	1-056-031-00	615.00	1-056-035-00	915.00
	IP 54	1-056-032-00	755.00	1-056-036-00	1,055.00
	IP 55	1-056-034-00	830.00	1-056-038-00	1,130.00
15 (20)	IP 23	1-056-041-00	715.00	1-056-045-00	1,015.00
	IP 54	1-056-042-00	855.00	1-056-046-00	1,155.00
	IP 55	1-056-044-00	930.00	1-056-048-00	1,230.00
20 (27)	IP 23	1-056-051-00	805.00	1-056-055-00	1,105.00
	IP 54	1-056-052-00	940.00	1-056-056-00	1,240.00
	IP 55	1-056-054-00	1,015.00	1-056-058-00	1,315.00
25 (34)	IP 23	1-056-061-00	900.00	1-056-065-00	1,200.00
	IP 54	1-056-062-00	1,035.00	1-056-066-00	1,335.00
	IP 55	1-056-064-00	1,110.00	1-056-068-00	1,410.00

**Series 56,000- 80\* Pricing (Discount Symbol B4)**

Nominal Static Torque lb-ft (Nm)	Enclosure	Basic Model Number and List Price**			
		AC	AC List Price**	DC	DC List Price**
1.5 (2)	IP 54	1-056-002-80*	\$500.00	1-056-006-80*	\$800.00
3 (4)	IP 54	1-056-012-80*	520.00	1-056-016-80*	820.00
6 (8)	IP 54	1-056-022-80*	585.00	1-056-026-80*	885.00
10 (14)	IP 54	1-056-032-80*	690.00	1-056-036-80*	990.00
15 (20)	IP 54	1-056-042-80*	790.00	1-056-046-80*	1,090.00
20 (27)	IP 54	1-056-052-80*	875.00	1-056-056-80*	1,175.00
25 (34)	IP 54	1-056-062-80*	970.00	1-056-066-80*	1,270.00

Dimensions for estimating only.

For installation purposes request certified prints.

**Enclosure:** Lightweight Steel Housing, Aluminum Endplate

**Enclosure Protection:** IP 23, 54 & 55  
(formerly referred to by Stearns as NEMA 2, 4 & 4X\* respectively)  
(\*BISSC certified)

**Mounting:** Fanguard mounted brakes requiring IP 54 or IP 55 protection may require additional sealing measures beyond seals provided with the brake. Refer to Installation & Service Instruction sheets.

**Installation and Service:** P/N 8-078-905-60

**Parts List:** P/N 8-078-906-00

**Modifications:** Pages 54-63

**IP 23 Dimensions**

Nominal Static Torque lb-ft (Nm)	Dimensions in Inches (Dimensions in Millimeters)					Wt lbs (Kg)
	A	AG	C Hub Width	G	J	
1.5 (2)	4.06 (103.1)	.52 (13.2)	.81 (20.6)	1.23 (31.2)	.31 (7.9)	8 (3.6)
3 (4)						8 (3.6)
6 (8)						8 (3.6)
10 (14)						8 (3.6)
15 (20)						8 (3.6)
20 (27)						9 (4.0)
25 (34)	4.50 (114.3)	.52 (13.2)	1.18 (30.0)	1.66 (42.2)	.31 (7.9)	9 (4.0)

**IP 54 / 55 Dimensions**

Nominal Static Torque lb-ft (Nm)	Dimensions in Inches (Dimensions in Millimeters)					Wt lbs (Kg)					
	A	AG	C Hub Width	G	J						
1.5 (2)	4.06 (103.1)	.47 (11.9)	.81 (20.6)	1.21 (30.7)	.37 (9.4)	8 (3.6)					
3 (4)						8 (3.6)					
6 (8)						8 (3.6)					
10 (14)						9 (4.0)					
15 (20)						4.51 (114.6)	.59 (15.0)	1.18 (30.0)	1.66 (42.2)	.37 (9.4)	9 (4.0)
20 (27)						9 (4.0)					
25 (34)	9 (4.0)										

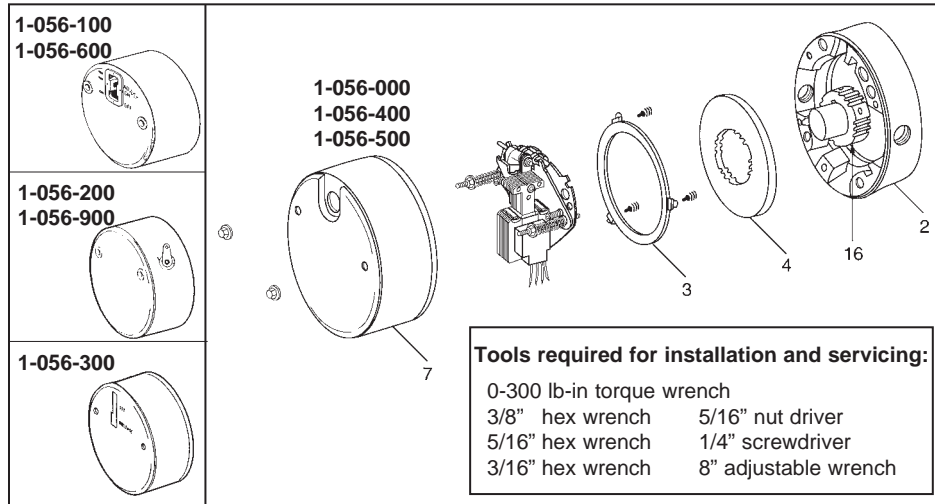
\* 56,000-80 Series includes a C-face gasket only, no hub seal.

\*\* Subtract \$30.00 for brake ordered less hub.

## Installation & Service Instructions for 1-056-X00\* Series (all revisions) Manual Adjust Brakes

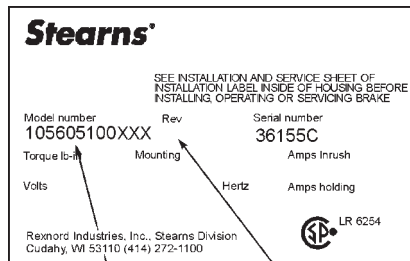
\*This sheet includes Series 1-056,000; 1-056,100; 1-056,200; 1-056,300; 1-056,400; 1-056,500; 1-056,600 and 1-056,900.

For other series consult factory.



**Tools required for installation and servicing:**  
0-300 lb-in torque wrench  
3/8" hex wrench      5/16" nut driver  
5/16" hex wrench      1/4" screwdriver  
3/16" hex wrench      8" adjustable wrench

### Typical Nameplate



Note:  
MODEL NUMBER  
Refer to actual nameplate on  
brake for additional information

REVISION CONTROL  
(if applicable) and  
brake serial number

### Important

Please read these instructions carefully before installing, operating, or servicing your Stearns Brake. Failure to comply with these instructions could cause injury to personnel and/or damage to property if the brake is installed or operated incorrectly. For definition of limited warranty/liability, contact Rexnord Industries, LLC, Stearns Division, 5150 S. International Dr., Cudahy, WI 53110, (414) 272-1100.

### Caution

1. Installation and servicing must be made in compliance with all local safety codes including Occupational Safety and Health Act (OSHA). All wiring and electrical connections must comply with the National Electric Code (NEC) and local electric codes in effect.
2. Use of this brake in atmospheres containing explosive gases and dusts must be in accordance with NEC article 501. This brake is not suitable for use in certain atmospheres containing explosive gases and dusts. **HazLoc** inspection authorities are responsible for verifying and authorizing

the use of suitably designed and installed **HazLoc** equipment. When questions arise consult local **Authority Having Jurisdiction (AHJ)**.

3. To prevent an electrical hazard, disconnect power source before working on the brake. If power disconnect point is out of sight, lock disconnect in the *off* position and tag to prevent accidental application of power.
4. Make certain power source conforms to the requirements specified on the brake nameplate.
5. Be careful when touching the exterior of an operating brake. Allow sufficient time for brake to cool before disassembly. Surfaces may be hot enough to be painful or cause injury.
6. Do not operate brake with housing removed. All moving parts should be guarded.
7. Installation and servicing should be performed only by qualified personnel familiar with the construction and operation of the brake.
8. For proper performance and operation, only genuine Stearns parts should be used for repairs and replacements.
9. After usage, the brake interior will contain burnt and degraded friction material dust. This dust must be removed before servicing or adjusting the brake.

DO NOT BLOW OFF DUST using an air hose. It is important to avoid dispersing dust into the air or inhaling it, as this may be dangerous to your health.

- a) Wear a filtered mask or a respirator while removing dust from the inside of a brake.
- b) Use a vacuum cleaner or a soft brush to remove dust from the brake. When brush-

For replacement parts refer to sheets:

Series	Sheet Part No.
1-056-000	8-078-906-00
1-056-100	8-078-906-01
1-056-200	8-078-906-02
1-056-300	8-078-906-03
1-056-400	8-078-906-04
1-056-500	8-078-906-05
1-056-600	8-078-906-06
1-056-900	8-078-906-09

Also available at [www.stearns.rexnord.com](http://www.stearns.rexnord.com)

ing, avoid causing the dust to become airborne. Collect the dust in a container, such as a bag, which can be sealed off.

10. **Caution!** While the brake is equipped with a manual release to allow manual shaft rotation, the motor should not be run with the manual release engaged, to avoid overheating the friction disc(s).

### General Description

These series of brakes are spring-set, electrically released. They contain one or more rotating friction discs (4) driven by a hub (16) mounted on the motor or other shaft.

**Note:** Fan-guard mounted brakes requiring IP54 & IP55 protection may require additional sealing measures beyond seals provided with this brake. Pressurized sprays aimed at the fan and brake hub surfaces can result in fluid migration along the motor shaft and keyway, and into the brake. The use of an appropriate sealant such as *RTV* or a *forsheda* seal is advised.

### Operating Principle

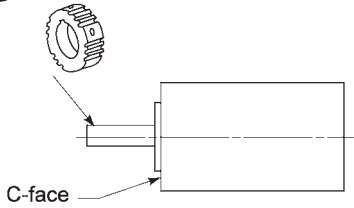
These series contain one or more friction discs (4) assembled alternately between the endplate (2) friction surface, stationary disc(s) (3) and pressure plate (also called stationary disc) (3). The stationary disc(s) are restrained from rotating by being keyed into the endplate. With the brake released, all disc pack components are free to slide axially and the friction disc(s) to rotate.

Brake release occurs when the solenoid coil is electrically energized, causing the solenoid plunger to travel a specified distance and through a lever system, overcoming the pressure spring force. This action releases the clamping force on the disc pack, thereby allowing the friction disc(s) and brake hub to rotate.

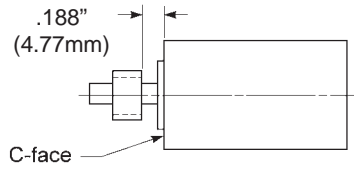
Brake sets and torque is produced when electric current to the solenoid coil is interrupted, thereby collapsing the solenoid magnetic field. The solenoid plunger returns to its original de-energized position allowing the lever arm to move forward by virtue of the compressed torque springs. This action compresses the disc pack components which applies a retarding torque to the brake hub and ultimately restores the brake to a spring-set static condition.

## BRAKE MOUNTING (Manual Adjust) 1-056-X00

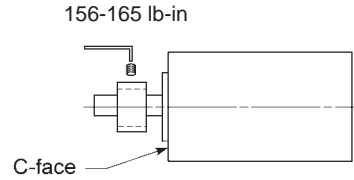
**1** Place hub on motor shaft.



**2** Position hub on shaft as shown.

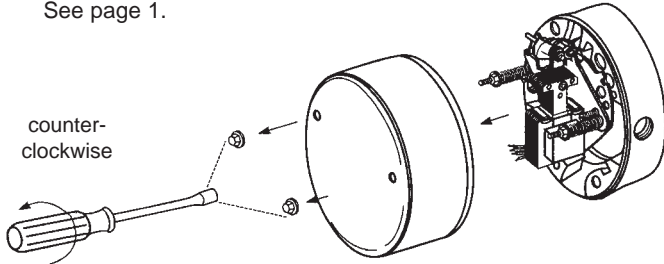


**3** Tighten set screws to motor shaft.

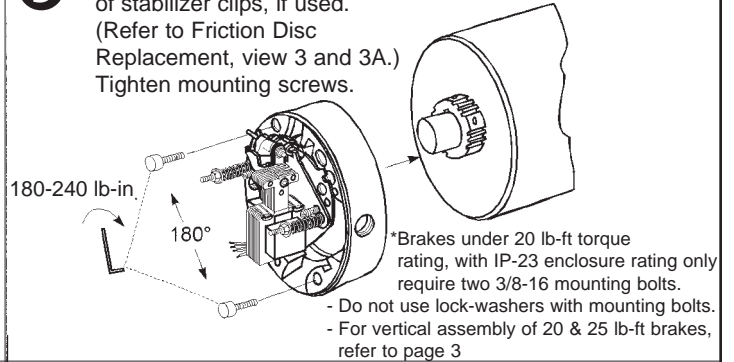


**4** Remove brake housing.

Housings vary by series number. See page 1.



**5** Slide endplate over hub noting position of stabilizer clips, if used. (Refer to Friction Disc Replacement, view 3 and 3A.) Tighten mounting screws.

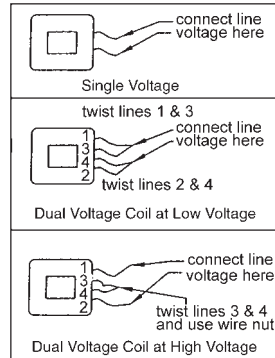


**6** AC coils are 50/60 Hz, single phase rated. Power supply to coil must not have current or frequency limiting output that is less than the coil requirement.

- Connect leadwires to power source. Verify voltage rating\* per nametag on coil.
- Keep wiring away from pinch points and moving components.

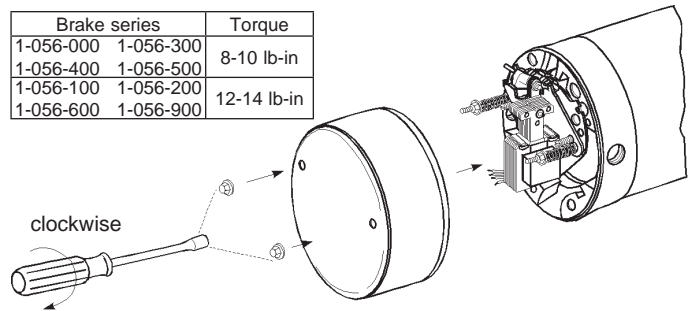
\* For DC voltages see sheet 8-078-950-00.

### Coil Wiring



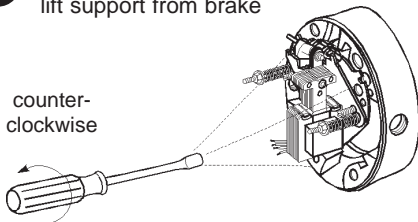
**7** Replace brake housing and tighten to torque specified below:

Brake series		Torque
1-056-000	1-056-300	8-10 lb-in
1-056-400	1-056-500	
1-056-100	1-056-200	12-14 lb-in
1-056-600	1-056-900	

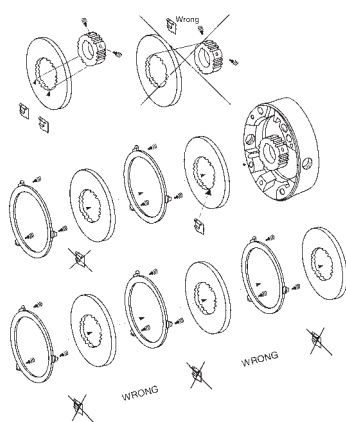


## FRICTION DISC REPLACEMENT SERIES 1-056-X00

**1** Remove support plate screws and lift support from brake



**3** Install new friction disc(s) and stationary disc(s) as shown.



**Note:** Stabilizer clips should never be located over the set screws of the hub.

Single disc brakes always use two stabilizer clips, locate at 90° from each other.

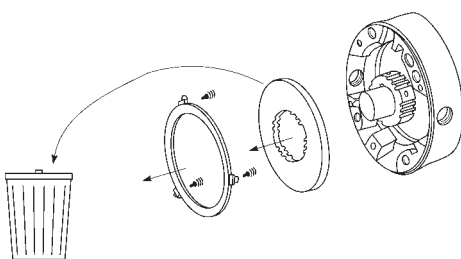
Double disc brakes typically will not require stabilizer clips, however there are some special modifications that will use them.

**Rev A & B** may have these clips may have these clips located 1 per disc, and should never be positioned in line with each other.

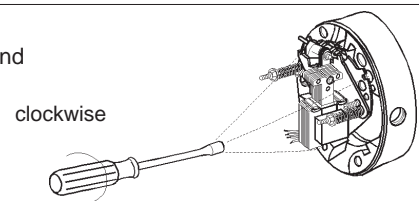
**Rev C** will have only one clip, used on the inner-most disc. No clip will be used on the outer-most disc.

Three disc brakes will never use stabilizer clips on friction discs.

**2** Remove and discard old friction disc.



**4** Reposition support plate on endplate and tighten mounting screws to 55-58 lb-in.



**Note:** Friction discs can wear to 1/2 their original thickness, or .093"

## AIR GAP ADJUSTMENT 1-056-X00

As friction disc wear the air gap will increase. When plunger gets to the reset position, the air gap must be adjusted.

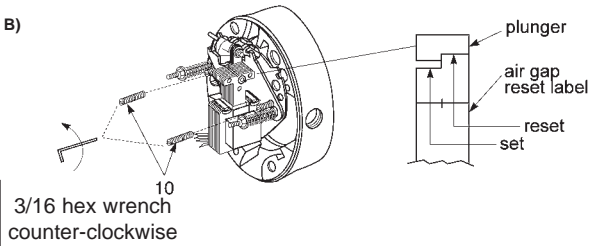
- 1** To **increase** air gap, turn both adjusting screws (10) counterclockwise. Use 3/16 hex wrench, or flat screwdriver on older models.

### 56,X00 Series Air Gap (REV A & B)

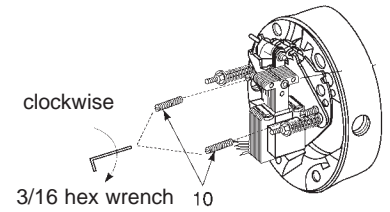
Disc	Torque	Min/Max
1	1.5, 3 & 6	.38" - .69"
2	10 & 15	.45" - .69"
3	20 & 25	.50" - .69"

### 56,X00 Series Air Gap (REV C)

Disc	Torque	Min/Max
2	3, 6, 10 & 15	.45" - .69"
3	20 & 25	.50" - .69"



- 2** To **decrease** air gap, turn both adjusting screws (10) clockwise.

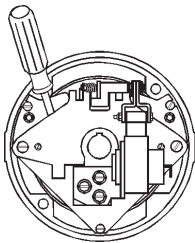


Maximum gap should not exceed .69"

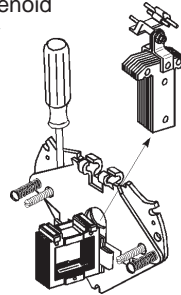
## COIL REPLACEMENT SERIES 1-056-X00

Remove housing and disconnect power and wiring to coil.

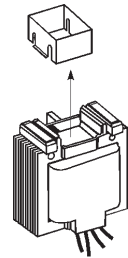
- 1** Insert screwdriver between support plate and lever arm and pry forward.



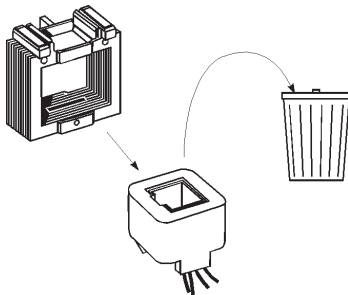
- 2** Lift plunger/solenoid lever assembly out of coil.



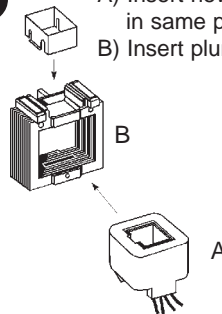
- 3** Remove plunger guide.



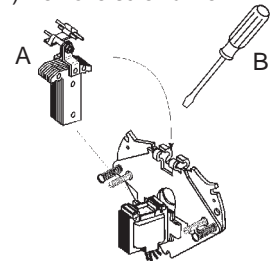
- 4** Discard coil.



- 5** A) Insert new coil. (Lead wires in same position as old coil.)  
B) Insert plunger guide.



- 6** A) Re-insert plunger into coil; drop pivot pin into cradle of support plate.  
B) Remove screwdriver.



Reconnect coil and replace housing per installation instructions, page 2.

## VERTICAL SPRING ASSEMBLY 1-056-X00

### Vertical Brake Assembly

Single disc brakes are universal mount and do not require separator springs. Double disc brakes are universal mount but require separator springs which are preassembled to the stationary disc. These discs are inserted spring first into the brake. Refer to figure 5A below.

#### 2 Friction Disc

Vertical Above  
Vertical Below

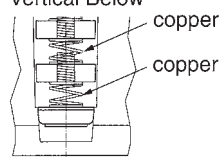


Figure 5A

**Installation Procedure for 20 and 25 lb-ft brakes if mounted vertical to motor shaft** (These brakes are factory assembled for horizontal operation.)

Remove support plate by loosening the three mounting screws. Remove stationary discs and friction discs. Using the spring kit provided with this brake, insert three springs of identical color into each stationary disc hole. Springs are inserted from the side opposite the indent mark (see Figure 5B). Stationary disc should be placed on a clean flat surface with a clearance hole to allow the tip of the spring to extend through the bottom side of the stationary plate. Using the 1/8" pin provided and a hammer, drive the spring until the large coil diameter bottoms out against the disc.

Reassemble the disc pack with the stationary discs in the proper arrangement shown in Figure 5C.

Mount support plate and torque screws evenly to 55-58 lb-in.

#### 20, 25 lb-ft Horizontal

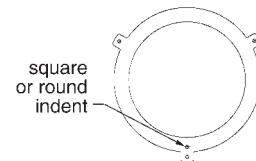


Figure 5B

#### 3 Friction Disc

Vertical Above

Vertical Below

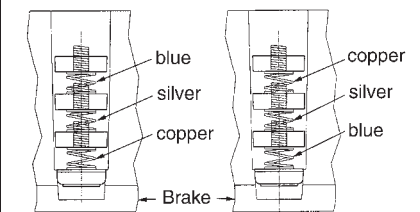


Figure 5C

# TORQUE ADJUSTMENT

## Torque Adjustment

Brake is factory set for nominal rated static torque which is maximum torque. Torque may be decreased up to 50% for increased stopping times up to 2 second stop time.

The torque on the 1-1/2 lb-ft brake may not be reduced.

Turn both spring adjustment screws (11), Figure 6, equal amounts counterclockwise to decrease torque. See Table A for torque reduction permissible amounts.

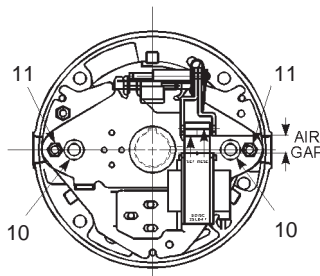


Figure 6

TABLE A

Nominal Static Torque (lb-ft)	Original Spring Height (inches)	Maximum Counterclockwise Turns	% Torque Reduction per Turn
1-1/2	1.69"	-	-
3	1.47"	7	7%
6	1.47"		
10	1.53"		
15	1.53"		
20	1.53"		
25	1.47"		

# TROUBLESHOOTING

## COIL FAILURE

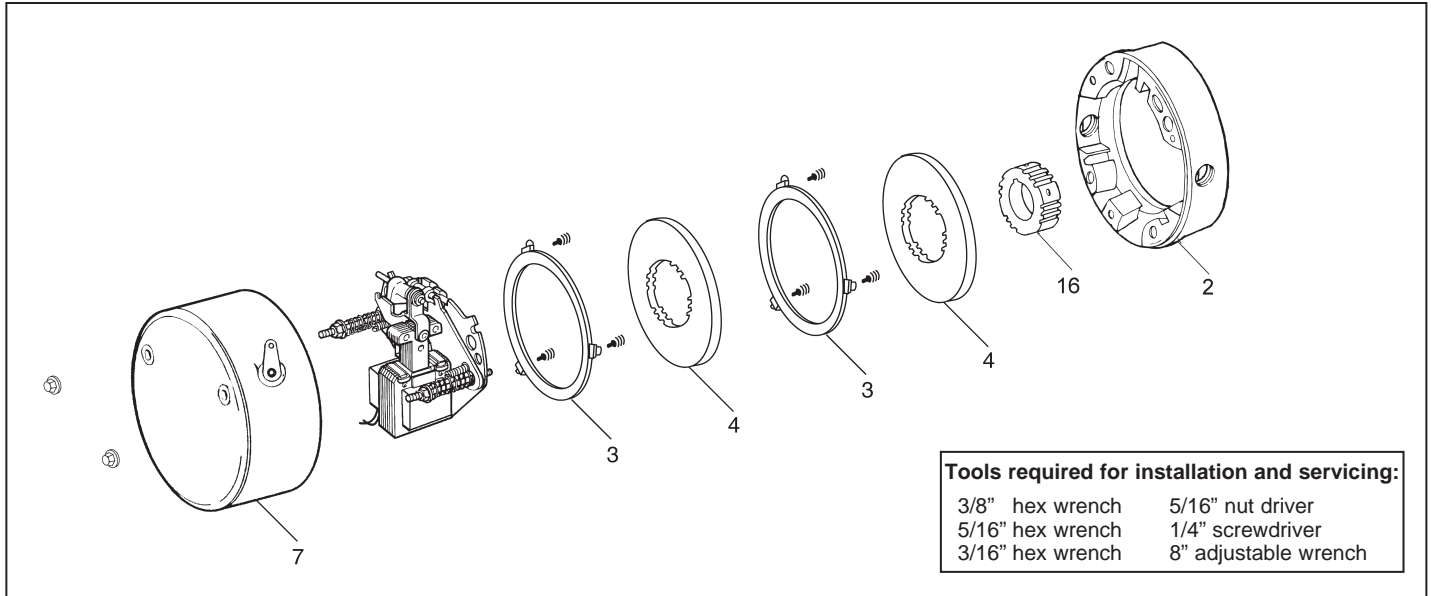
SUPPLY VOLTAGE CAUSE	SUPPLY VOLTAGE CORRECTION
Line voltage >110% of coil rating	Reduce voltage or replace with proper rated coil
AC input on a DC coil	Replace rectifier or replace with proper rated coil.
Excessive voltage drop during inrush time	Increase current rating of power supply.
WIRING CAUSE	WIRING CORRECTION
Leadwires interfering with plunger pull-in	Reroute wiring away from plunger and other moving components.
Excessive voltage drop during inrush time	Increase leadwires size from power supply
Coil leadwire shorted to ground	Replace coil or leadwire and protect with wire sleeving
SOLENOID ASSEMBLY CAUSE	SOLENOID ASSEMBLY CORRECTION
Plunger not seating flush against solenoid frame	Loosen solenoid mounting screws and reposition frame to allow full face contact
Plunger cocked in coil preventing pull-in	Realign solenoid frame
Excessive solenoid/plunger wear at mating surface	Replace solenoid assembly
Broken shading coils	Replace solenoid assembly
WORN PARTS CAUSE	WORN PARTS CORRECTION
Excessive wear of solenoid link arm and/or shoulder bolt	Replace link arm and link bolt; also inspect plunger thru-hole for elongation
Plunger guides worn down and interfering with plunger movement	Replace guides
APPLICATION CAUSE	APPLICATION CORRECTION
Machinery cycle rate is exceeding brake rating	Reduce brake cycle rate or use alternate control method
High ambient temperature (>110%) and thermal load exceeding coil insulation rating	Use Class H rated coil and /or find alternate method of cooling brake
Brake coil wired with windings of an Inverter motor or other voltage/current limiting device	Wire coil to dedicated power source with instantaneous coil rated voltage
MISCELLANEOUS CAUSE	MISCELLANEOUS CORRECTION
Wrong or over tightened torque	Replace with proper spring or refer to Installation section for proper spring height
Excessive air gap	Reset, refer to Installation Section 4

## EXCESSIVE WEAR / OVERHEATING

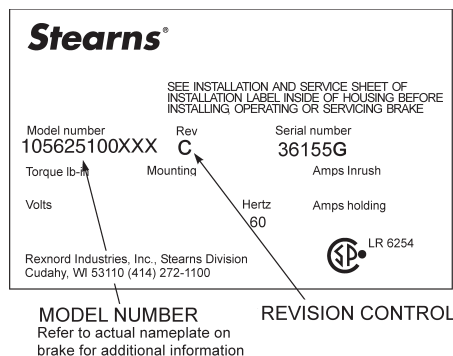
AIR GAP CAUSE	AIR GAP CORRECTION
Low solenoid air gap	Reset air gap (refer to Air Gap Adjustment)
Disc pack dragging	Inspect endplate, hub and discs for dirt, burrs, wiring and other sources of interference preventing disc "float"
CYCLE RATE CAUSE	CYCLE RATE CORRECTION
Brake "jogging" exceeding coil cycle rate	Reduce cycle rate or consider alternate control method
Thermal capacity is being exceeded	Reduce cycle rate, use alternate control method or increase brake size
ALIGNMENT CAUSE	ALIGNMENT CORRECTION
Broke endplate not concentric to motor C-Face	Motor register must be within .004" on concentricity.
Motor shaft runout is excessive	Must be within .002"; runout; consult motor manufacturer
Brake is being operated on a incline greater than 15° above or below horizontal	Vertical separator springs must be used to prevent discs from becoming cocked
WORN PARTS CAUSE	WORN PARTS CORRECTION
Friction disc excessively worn (disc can wear to 1/2 original thickness or .093")	Replace friction discs.
Endplate, stationary disc or pressure plate warped	Replace warped or worn component
Linkages and/or pivot pins worn	Replace all worn components
Motor shaft endfloat excessive	Endfloat must not exceed .020"; consult motor manufacturer
HUB CAUSE	HUB CORRECTION
Burr on hub interfering with disc "float"	File off burr
Set screw backed out and interfering with disc	Retighten set screw; use Loctite® 242 to help secure
MISCELLANEOUS	MISCELLANEOUS
Solenoid plunger not pulling completely	Check line voltage (±10% of nameplate rating) or replace worn solenoid assembly
Wiring is restricting disc pack movement	Reroute wiring
Excessive stop time (2 seconds or greater)	Increase brake size/torque or use alternate control method
High Ambient temperature (in excess of 110°F)	Reduce cycle rate or use alternate method of cooling

## Parts List for 1-056-200 Series (rev. C) Manual Adjust Brakes

For Installation and Service Instructions refer to sheet part number 8-078-905-60. Instructions and parts list also available at [www.stearns.rexnord.com](http://www.stearns.rexnord.com).



### Typical Nameplate



### IMPORTANT

Please read these instructions carefully before installing, operating, or servicing your Stearns Brake. Failure to comply with these instructions could cause injury to personnel and/or damage to property if the brake is installed or operated incorrectly. For definition of limited warranty/liability, contact Rexnord Industries, LLC, Stearns Division, 5150 S. International Dr., Cudahy, WI 53110, (414) 272-1100.

### Caution

1. Installation and servicing must be made in compliance with all local safety codes including Occupational Safety and Health Act (OSHA). All wiring and electrical connections must comply with the National Electric Code (NEC) and local electric codes in effect.

2. Do not operate the brake in atmospheres containing explosive gases or dusts.
3. To prevent an electrical hazard, disconnect power source before working on the brake. If power disconnect point is out of sight, lock disconnect in the *off* position and tag to prevent accidental application of power.
4. Make certain power source conforms to the requirements specified on the brake nameplate.
5. Be careful when touching the exterior of an operating brake. Allow sufficient time for brake to cool before disassembly. Surfaces may be hot enough to be painful or cause injury.
6. Do not operate brake with housing removed. All moving parts should be guarded.
7. Installation and servicing should be performed only by qualified personnel familiar with the construction and operation of the brake.
8. For proper performance and operation, only genuine Stearns parts should be used for repairs and replacements.
9. After usage, the brake interior will contain burnt and degraded friction material dust. This dust must be removed before servicing or adjusting the brake.

DO NOT BLOW OFF DUST using an air hose. It is important to avoid dispersing dust into the air or inhaling it, as this may be dangerous to your health.

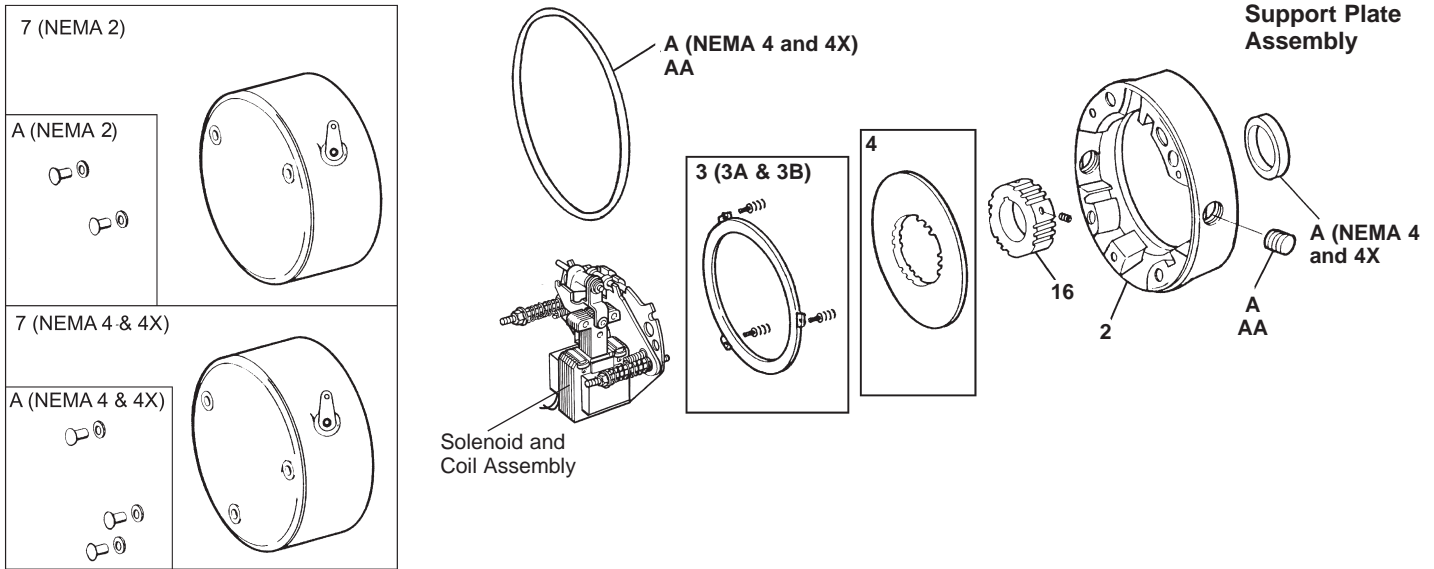
- a) Wear a filtered mask or a respirator while removing dust from the inside of a brake.
- b) Use a vacuum cleaner or a soft brush to remove dust from the brake. When brushing, avoid causing the dust to become airborne. Collect the dust in a container, such as a bag, which can be sealed off.

**Information required when ordering replacement parts:**

- Give Part Number of parts or kits needed, Brake Model Number, and Brake Serial Number. The Brake Model and Serial Number may identify special brakes not covered by this parts list
- When ordering hubs, specify shaft diameter (hub bore) and keyway.

- Enclosure is specified as follows:

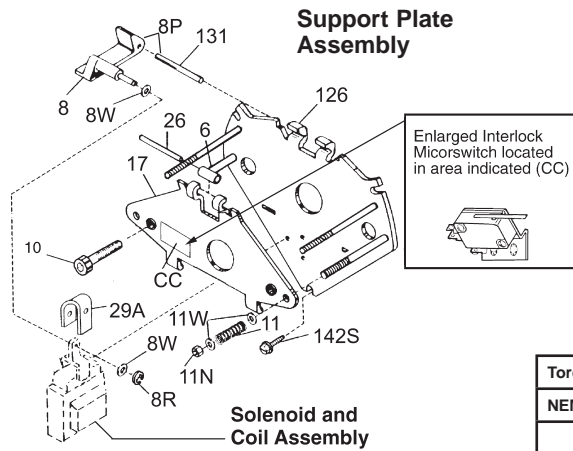
NEMA 2 (formerly referred to as standard)  
 NEMA 4 (formerly referred to as DTWP dust-tight waterproof)  
 NEMA 4X (formerly referred to as BISSC washdown)



**TABLE 1**  
 Components of Standard AC or DC Brake

Item	Description	Part Number ↓	Torque (lb-ft)			3			6			10			15			20 and 25		
			NEMA Enclosure			2	4	4X	2	4	4X	2	4	4X	2	4	4X	2	4	4X
			Brake Model Number →			1-056-211-00	1-056-212-00	1-056-214-00	1-056-221-00	1-056-222-00	1-056-224-00	1-056-231-00	1-056-232-00	1-056-234-00	1-056-241-00	1-056-242-00	1-056-244-00	1-056-251-00 & -261-00	1-056-252-00 & -262-00	1-056-254-00 & -264-00
A	Hardware kit - NEMA 2 (all revisions) Hardware kit - NEMA 4 (revision C) Hardware kit - NEMA 4X (revision C)	5-66-1014-00 5-66-1019-00 5-66-1020-00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
AA	Plug/Gasket kit **Close couple	— NEMA 4 — NEMA 4X — NEMA 4 3 disc — NEMA 4X 3 disc	5-63-0532-00 5-63-0533-00 5-63-0534-00 5-63-0537-00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
7	Housing & release knob kit — NEMA 2 Housing & release knob kit — NEMA 4 Housing & release knob kit — NEMA 4X	5-07-5040-00 5-07-5041-00 5-07-5043-00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
3	Stationary disc kit (1 disc universal, 3 disc horizontal)	5-66-8354-00													3	3	3			
3A	Stationary disc kit (2 disc universal)	5-66-8355-00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
3B	Stationary disc kit (3 disc universal)	5-66-8356-00													1	1	1			
Not Shown	Vertical spring kit (3 disc)	5-63-0525-00													1	1	1			
4	Friction disc kit	5-66-8462-00	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3			
DP	Disc pack kit — 2 disc Disc pack kit — 3 disc	5-66-8602-00 5-66-8603-00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
16	Hub and set screw assembly	5/8 bore 7/8 bore 1-1/8 bore	5-16-5153-00-01B 5-16-5153-00-01D 5-16-5153-00-01E	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
2	Endplate Seal assembly Seal Assembly	2 & 3 disc (NEMA 2) 2 & 3 disc (NEMA 4) 2 & 3 disc (NEMA 4X)	8-002-582-01-30F 5-02-5044-00 5-02-5046-00	1	1	1	1	1	1	1	1	1	1	1	1	1	1			

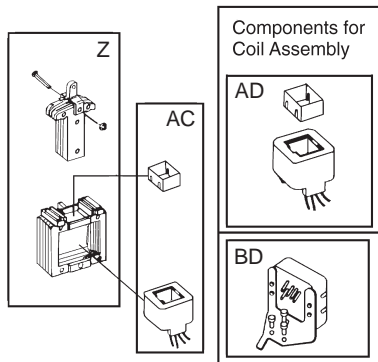
\*\* Close coupled brakes are identified by an 8 in the 8th digit. Example: 1-056-XXX-8X.



**TABLE 2**  
Components of Support Plate and Coil Assembly

			Torque (lb-ft)		3		6		10		15		20		25		
			NEMA Enclosure		2	4/4X	2	4/4X	2	4/4X	2	4/4X	2	4/4X	2	4/4X	
			Support Plate Assy. (Items 6 through 131 and Z)→		5-42-5601-00-44	5-42-5601-00-34	5-42-5605-00-44	5-42-5605-00-34	5-42-5607-00-44	5-42-5607-00-34	5-42-5609-00-44	5-42-5609-00-34	5-42-5611-00-44	5-42-5611-00-34	5-42-5611-00-44	5-42-5611-00-34	
Item	Description	Part Number↓															
6	Bearing	8-006-501-00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
8	Solenoid lever	8-008-504-01			1	1	1	1	1	1	1	1	1	1	1	1	
8P	Solenoid lever & pin assembly	8-008-507-00	1	1													
8R	Retaining ring	9-03-0057-00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
8W	Spacer	9-45-0168-00	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
11N	Torque adjustment nut	9-40-3928-00	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
10	Wear adjustment screw	9-17-8420-00	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
11	Pressure spring	9-70-1215-00	2	2													
	Pressure spring	9-70-1523-00			2	2	2	2									
	Pressure spring	9-70-1524-00							2	2							
11W	Spring washer	9-46-0010-00			4	4	4	4	4	4	4	4	4	4	4	4	
17	Lever arm and stop nut assy.	5-17-5011-00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
26	Bearing pin	9-29-4826-00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
29A	Plunger stop	8-094-503-00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
126	Support plate and spring stud assembly (2 housing studs)	5-26-5019-00	1		1				1				1				
	Support plate and spring stud assembly (3 housing studs)	5-26-5020-00		1			1			1				1		1	
131	Pivot pin	9-29-4836-00			1	1	1	1	1	1	1	1	1	1	1	1	
142S	Mounting screws	9-25-9013-00	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
<b>AC Brakes</b>																	
Z	No. 4 solenoid kit	5-96-5047-01			1	1			1			1			1		
AC	No. 4 coil kit 60 Hz	115/230 Vac	5-66-6407-33			1	1										
		230/460 Vac	5-66-6409-33			1	1										
		115 Vac	5-66-6401-33			1	1										
		230 Vac	5-66-6402-33			1	1										
		460 Vac	5-66-6404-33			1	1										
		575 Vac	5-66-6405-33			1	1										
	No. K4 coil kit 60 Hz	115/230 Vac	5-66-6457-33							1							
		230/460 Vac	5-66-6459-33							1							
		115 Vac	5-66-6451-33							1							
		230 Vac	5-66-6452-33							1							
		460 Vac	5-66-6454-33							1							
		575 Vac	5-66-6455-33							1							
	No. K4+ coil kit 60 Hz	115/230 Vac	5-66-6407-23										1		1		
		230/460 Vac	5-66-6409-23										1		1		
		115 Vac	5-66-6401-23										1		1		
		230 Vac	5-66-6402-23										1		1		
460 Vac		5-66-6404-23										1		1			
575 Vac		5-66-6405-23										1		1			
No. M4+ coil kit 60 Hz	115/230 Vac	5-66-6457-23														1	
	230/460 Vac	5-66-6459-23														1	
	115 Vac	5-66-6451-23														1	
	230 Vac	5-66-6452-23														1	
	460 Vac	5-66-6454-23														1	
	575 Vac	5-66-6455-23														1	
CC	Brake release interlock switch (opt)	5-57-5526-00			1	1			1			1		1		1	
<b>DC Brakes</b>																	
AD	No. 4 + coil assembly	115 Vdc	5-96-6416-43			1	1										
		230 Vdc	5-96-6417-43			1	1										
	No. K4 + coil assembly	115 Vdc	5-96-6416-23							1							
		230 Vdc	5-96-6417-23							1							
No. M4 + coil assembly	115 Vdc	5-96-6466-23										1		1			
	230 Vdc	5-96-6467-23										1		1			
BD	Electronic DC switch kit	24/28 Vdc	5-57-5712-15			1	1			1		1		1		1	
		115 Vdc	5-57-5716-15			1	1			1		1		1		1	
		230 Vdc	5-57-5717-15			1	1			1		1		1		1	

## Solenoid and Coil Assembly



**Table 3**  
Contents of Kits and Assemblies

Item	Kit Description
A	Hardware kit - NEMA 2 (5-66-1014-00) 2 - Housing acorn nuts 2 - Conduit plugs
	Hardware kit - NEMA 4 (5-66-1019-00) Hardware kit - NEMA 4X (5-66-1-20-00) 3 - Housing nuts 3 - Housing nut gaskets 1 - Endplate oil seal 2 - Endplate hole plugs 1 - Housing to endplate gasket or o-ring 2 - Endplate conduit pipe plugs
3	Stationary disc kit (5-66-8354-00) 1 - Stationary disc
3A	Stationary disc kit (5-66-8355-00) 2 - Stationary discs with springs
3B	Stationary disc kit (5-66-8356-00) 3 - Stationary discs with springs
4	Friction disc kit (5-66-8462-00) 1 - Friction disc
DP	Disc pack kit (5-66-860X-00) 2 or 3 - Friction disc(s) 2 or 3 - Stationary disc(s) 6 or 9 - Stationary disc separator springs
16	Hub and screw assembly - all types, all bores (5-16-5153-00-01*) 1 - Brake hub 2 - Set screws
Z	No. 4 solenoid kit (5-66-5047-00) (5-96-5047-01) 1 - Plunger 1 - Solenoid link 1 - Frame (including mounting bracket) 1 - Solenoid link cap screw 1 - Solenoid link nut 3 - Solenoid mounting screws
AC	No. 4 AC coil kit (5-66-64-XX-X3) and DC coil assembly (5-96-64XX-X3)
AD	Coil / Top Plunger guide / Wire nut
BD	DC switch kit (5-57-571X-15) 1 - Electronic switch 1 - Mounting bracket 3 - Bracket mounting screws 4 - Switch mounting screws 4 - Nuts 4 - Lock washers 5 - Crimp connectors
CC	Brake release interlock switch (5-57-5526-00) 1 - Microswitch 1 - Mounting bracket 2 - Bracket mounting screws 2 - Switch mounting screws 2 - Lock washers 2 - Nuts 2 - Leadwire assembly

## Optional Modification Kits

**TABLE 4**

Catalog Mod Number	Description	Part Number↓	Torque (lb-ft)		
			3 & 6	10 & 15	20 & 25
			Brake Model Number→		
			1-056-21X 1-056-22X	1-056-23X 1-056-24X	1-056-25X 1-056-26X
M4	Brass stationary disc	8-003-513-02	2	2	2
M13	Space heater 115 Vac 230 Vac	5-27-2004-00	1	1	1
		5-27-2005-00	1	1	1
M17	Terminal strip	5-63-0524-00	1	1	1
M21	Vertical spring kit (2-disc) (3 disc)	5-63-0539-00	1	1	
		5-63-0525-00			1

Catalog Mod Number	Description	Part Number↓	Torque (lb-ft)				
			3 & 6	10	15 & 20	25	
			Brake Model Number→				
			1-056-211-00 1-056-221-00	1-056-231-00	1-056-241-00 1-056-251-00	1-056-261-00	
M6	No. 4 Class 'H' coil kit	115/230 Vac	5-96-6407-05	1			
		230/460 Vac	5-96-6409-05	1			
		115 Vac	5-96-6401-05	1			
		230 Vac	5-96-6402-05	1			
		460 Vac	5-96-6404-05	1			
	No. K4 Class 'H' coil kit	115/230 Vac	5-96-6457-05		1		
		230/460 Vac	5-96-6459-05		1		
		115 Vac	5-96-6451-05		1		
		230 Vac	5-96-6452-05		1		
		460 Vac	5-96-6454-05		1		
	No. K4+ Class 'H' coil kit	115/230 Vac	5-96-6407-25			1	
		230/460 Vac	5-96-6409-25			1	
115 Vac		5-96-6401-25			1		
230 Vac		5-96-6402-25			1		
460 Vac		5-96-6404-25			1		
No. M4+ Class 'H' coil kit	115/230 Vac	5-96-6457-25				1	
	230/460 Vac	5-96-6459-25				1	
	115 Vac	5-96-6451-25				1	
	230 Vac	5-96-6452-25				1	
	460 Vac	5-96-6454-25				1	
	575 Vac	5-96-6455-25				1	

Rexnord Industries, LLC  
Stearns Division  
5150 S. International Drive  
Cudahy, Wisconsin 53110  
(414) 272-1100 Fax: (414) 277-4364  
www.stearns.rexnord.com



## Appendix 4.4.5.12

System: Apron Hoist Machinery  
Component: Worm Reducer  
Manufacturer: Cone Drive



Gearsets



Single Reduction



Multiple Reduction



Custom Design



# PRODUCTS IN THE RANGE

Serving an entire spectrum of mechanical drive applications from food, energy, mining and metal; to automotive, aerospace and marine propulsion, we are here to make a positive difference to the supply of drive solutions.



**Model HP**

Worm Gear units with double enveloping worm gearing. Available in single, double and triple reductions.



**Series A**

Universal metric housing featuring double enveloping gearing & drywell feature



**Series B**

Industrial Duty worm gear unit featuring Conex gearing



**DuoDrive**

Dual gears on parallel output shafts



**Extruder Drive**

Rugged duty reducer takes high screw pressure



**Series G**

Helical parallel shaft & bevel helical right angle drive gear units



**Series W**

Precision right angle servo gearboxes



**Model RG**

Moderate precision right angle servo gearboxes



**Series S**

Value Engineered right angle servo gearboxes



**Series P**

Precision planetary servo gearboxes



**Series E**

Economical planetary servo gearboxes



**Series LE**

Economical planetary servo gearboxes

We can create custom engineered transmission solutions of any size and configuration.

## How To Order

When you order or request a quotation for a Cone Drive unit, you will need to provide some basic information. Please provide complete information.

How to Order Example:	SHU	40 - 2	15 to 1	1800 RPM	87086660010
Model _____					
Size _____					
Assembly, Mounting No. _____					
Overall Ratio _____					
Input Speed* _____					
Serial No. (if available for replacement or rebuild) _____					

If you require an Application Review, you may wish to provide...

1. Input power (HP)
2. Output torque requirement
3. Service factor (duty cycle)
4. Application data
5. Special requirements
6. Sketch or drawing
7. Hollow shaft bore size (when required)

\*Standard units are set up for 1750 RPM. If input is to be other than 1750, the information should be made to Cone Drive to ensure proper bearing and oil level settings are defined.

## Making a selection for your application

We look forward to serving you. Please phone us at 1-888-994-2663 for help specifying gear ratio, speed, duty cycle, and backlash. Or tell us about your application by faxing us the information below to 1-888-907-2663. Our dedicated teams are waiting for your call.

1. Application:
  - General type of application or machine.
  - Specific consideration; eg. positioning accuracy, shock loading, or self-locking.
2. Duty cycle:
  - Continuous or intermittent
    - If continuous:
      - Hours per week
    - If intermittent:
      - How many starts and stops per hour.
      - Average “on” time per hour.
3. Ratio and operating speed:
  - Variable or continuous speed input.
  - Preferred input speed.
  - Desired output speed.
4. Loading:
  - Horsepower or torque available or required for starting, running, and stopping.
  - General type of driving motor; eg. AC motor, servo motor, or hydraulic motor.
  - Special load classification; eg. shock loading, reversing, potential for emergency stops.
  - Unusually high inertia loading at the input or output shaft.
  - Overhung and/or thrust loading on shafts.
5. Environmental:
  - Any unusual environmental conditions such as high or low temperature, grit or other contaminants, or wet or spray exposure.
6. Configuration:
  - With or without a Cone Drive supplied drive motor.
  - Flange mounting provisions for the drive motor.
  - Solid or hollow output shaft.
  - Special modifications, dimensions, or features desired.

---

If Cone Drive is to provide the motor, please provide the following information:

1. Horsepower (HP)
2. RPM
3. Frame Size
4. Phase
5. Cycle (Hertz)
6. Voltage
7. Enclosure
8. Type
9. Design
10. Duty
11. Percent slip
12. Brake rating
13. Conduit box location when exact location is required (see view)

If customer is to furnish and mount the motor, please provide the following information so that the correct motor adaptor and coupling will be provided.

1. Horsepower (HP)
2. Frame size
3. Speed
4. Motor pilot diameter
5. Motor shaft dimensions
6. Brake rating (when units or motors are to be equipped with brakes having a torque rating that exceeds the unit or motor rating, the brake rating must be used to select unit size.
7. Complete coupling information (if alternate coupling is required and is not being furnished by Cone Drive)

## Selection Procedure

### The Procedure for Determining Speed Reducer Load Capacity is as Follows:

- Determine the proper service factor by matching your duty requirements with the "Service Factor" chart in this section.
- Determine the actual input horsepower required to drive the reducer. In case of operating worm speed under 100 RPM, use only output torque ratings. Multiply this horsepower or torque value by the appropriate service factor rather than adjust the ratings in the Catalog. This will give you the adjusted horsepower or torque required.
- Find the ratio by dividing the speed of the input shaft by the speed of the output shaft.
- Referring to the Selection guide in this section or the mechanical horsepower ratings charts in the Traditional Products Section, select a unit, at the given worm RPM and ratio, having a corresponding mechanical rating (or one slightly in excess) to the adjusted horsepower or torque.
- Check the actual input horsepower to be transmitted (horsepower before applying service factor) against the thermal rating listed in the same table as in 4 above. The thermal rating defines the maximum horsepower which can be transmitted continuously (30 minutes or longer). This is based on an oil sump temperature rise of 100°F above ambient, and must not exceed 200°F. If the thermal rating is a lower value than the mechanical rating, choose the unit on the basis of the thermal rating. Exceptions to this rule are applications, where operation is intermittent and does not permit thermal build-up. For applications involving multiple cycles the average horsepower required should be compared with the thermal rating of the reducer. Where water-cooled units are used, thermal ratings can be obtained from our Traverse City, Michigan office; where fan cooled units are used, use the fan cooled thermal ratings shown on the fan cooled pages in the Traditional Products Section.
- If either input or output shaft is connected to driver or driven mechanism other than by direct shaft coupling, calculate overhung load requirements (Chain Pull) by dividing the torque demand by the pitch radius of the sprocket, sheave, spur or helical gear used. Multiply by the following factor:

Type of Drive	Overhung Load Factor
Chain Sprocket	1.00
Spur or helical gearing	1.25
"V" belt sheave	1.50
Flat belt sheave	2.50

As modified by the applicable service factor, this load may not exceed the overhung load rating listed under Chain Pull in the HP. and Torque Ratings Tables. The Chain Pull figures are based on the center of the load being no further from the center line of the reducer than one-half the keyway length on the output shaft extension. When Chain Pull approaches full rated capacity as listed, use heat-treated foundation bolts (150,000 PSI tensile strength).

- Cone Drive's Application Engineering Department is available to assist you with selection of the reducer for your application. Computer programs and technical personnel are available to discuss your application. We invite you to forward all pertinent data to Cone Drive's Traverse City, Michigan office or your local representative for our full review and selection assistance.

Horsepower, Speed and Torque Relationship	
Formula 1: P =	$\frac{T_w n}{63,000}$
Formula 2: T <sub>w</sub> =	$\frac{P \cdot 63,000}{n}$
Formula 3: T <sub>G</sub> =	T <sub>w</sub> • m <sub>G</sub> • η
Definitions	
M <sub>G</sub> = gear ratio	$\frac{N_G}{N_w}$
n =	rotational speed of worm (rpm)
P =	power input to worm (Horsepower)
T <sub>w</sub> =	input torque (inch pounds)
T <sub>G</sub> =	output torque (inch pounds)
η =	efficiency (percent)

**HELICAL / WORM REDUCER, 1750 RPM  
 GEARMOTOR & DOUBLE REDUCTION REDUCER**  
 MINIMUM REDUCER SIZE FOR INPUT HORSEPOWER SHOWN BASED ON MECHANICAL H. P. RATING\*

Output Speed	Ratio		Motor Horsepower											
			1	2	3	5	7.5	10	15	20	25	30	50	70
350	5	1 x 5	25	25	25	25	30	30	35	35	50	50	50	70
233.3	7.5	1.5 x 5	25	25	25	25	30	35	35	40	50	50	70	70
194.4	9	1.8 x 5	25	5	25	25	30	35	35	50	50	50	70	70
175	10	1 x 10	25	25	25	30	35	35	50	50	50	50	70	80
140	12.5	2.5 x 5	25	25	25	30	35	35	50	50	50	50	70	80
116.7	15	1.5 x 10	25	25	25	30	35	35	40	50	50	60	70	80
97.2	18	1.8 x 10	25	25	25	30	35	35	50	50	50	60	70	80
87.5	20	4 x 5	25	25	30	30	35	40	50	60	60	70	80	
77.8	22.5	1.5 x 15	25	25	30	35	35	40	50	50	60	70	80	
70	25	2.5 x 10	25	25	30	35	35	40	50	50	60	60		
58.3	30	1.5 x 20	25	25	30	35	40	50	50	60	70	70		
48.6	36	1.8 x 20	25	30	30	35	40	50	60	60	70	70		
43.8	40	4 x 10	25	30	30	35	40	50	50	60	70	70		
38.9	45	1.8 x 25	25	30	35	40	50	50	60	70	70	80		
35	50	2.5 x 20	25	30	35	40	50	50	60	70	70	80		
29.2	60	4 x 15	25	30	35	40	50	50	60	70	70	80		
24.3	72	1.8 x 40	30	35	40	50	60	60	70	80				
23.3	75	2.5 x 30	25	35	35	50	50	60	70	80	80			
		5 x 15	20-30	20-30	20-35	25-40	30-60	30-60	35-70	35-70	40-80	50-100	60-120	70-150
21.9	80	4 x 20	25	35	35	50	50	60	70	70	80			
19.4	90	1.8 x 50	30	35	40	50	60	70	80					
17.5	100	4 x 25	30	35	40	50	60	60	70	80				
		5 x 20	20-30	20-35	25-70	25-50	30-60	30-60	35-70	40-80	40-80	50-100	60-120	70-150
14.6	120	4 x 30	30	35	40	50	60	70	80					
14	125	5 x 25	20-30	20-35	25-40	25-50	30-60	30-70	40-80	40-80	50-100	50-100	60-120	70-150
11.7	150	10 x 15	20-30	20-35	25-40	30-60	30-60	35-70	40-80	50-100	50-100	50-100	70-150	70-150
10.9	160	4 x 40	35	40	50	60	70	70	80					
10	175	2.5 x 70	50	50	50	60	70	80						
8.8	200	4 x 50	35	50	50	60	70	80						
		10 x 20	20-35	25-40	25-50	30-60	35-70	35-70	40-80	50-100	50-100	60-120	70-150	80-180
7.8	225	15 x 15	20-35	25-40	25-50	30-60	35-70	40-70	50-100	50-100	60-120	60-120	70-150	
7.3	240	4 x 60	35	50	50	70	80	80						
7	250	10 x 25	20-35	25-50	30-60	30-70	30-70	40-80	50-100	50-100	60-120	60-120	70-150	80-180
6.3	280	4 x 70	50	50	60	70	80							

**Note:** Sizes shown not shaded are for helical/worm reducers and gear motors. Sizes shaded are for double reduction worm gear speed reducers.

## Lubrication Data

Lubrication is very important for successful operation of Cone Drive gearsets and speed reducers. Inadequate lubrication can result in increased power consumption, added maintenance and gearset failure. Please review the following recommendations and the "Approved List of Lubricants" shipped with all Cone Drive gearsets and speed reducers. Cone Drive recommends only those lubricants listed or any lubricant which meets all the requirements of AGMA (American Gear Manufacturers Association) 9004-D94 "Lubrication of Industrial Enclosed Gear Drives" as it applies to double enveloping worm gearing. Use of other lubricants can result in gearset failure which will not be covered under warranty. See reducers nameplate for the recommended lubricant.

### Type of Oil

Lubricating oils for use in gear units should be high quality well refined steam cylinder petroleum oils. They must not be corrosive to gears, to ball, roller or sleeve bearings; they must be neutral in reaction; free from grit or abrasives; and have good defoaming properties. As they may be subject to high operating temperatures, they must have good resistance to oxidation.

For worm-gears additions of 3 percent to 10 percent of acidless tallow or similar animal fats are desirable.

### Ambient Temperature

The oils shown in the table on the following page are for use in an ambient temperature range of approximately 15° to 125°F with the low end of the range depending on the pour point of the specific oil used. If the ambient temperature will be below or above this range please contact Cone Drive for specific recommendations on proper lubricant as well as proper oil seal and shim materials.

### Oil Sump Temperatures

The maximum recommended oil sump temperature is 200°F. Where reducers will be used at maximum ambient and full catalog rating. Contact Cone Drive for lubrication recommendations.

### Sludge

It is necessary that the oil be clean and free from sludge at all times to obtain long life from a gear unit.

Sludge in gear units may be caused by excessive heat, from dust and dirt and other contaminants and by the presence of moisture or chemical fumes. Therefore, every precaution should be taken to prevent water and foreign particles from entering the gear case.

### Cone Drive Reducers are Shipped without Oil.\*

At assembly all reducers are treated with a rust inhibitor. This treatment coats all internal parts and will protect the reducer for a period of 30 days. If the unit is to be stored longer than 30 days, see long term storage instructions.

### Oil Change

If an approved synthetic lubricant is used, it should be changed after 5000 hours of operation or once per year, whichever occurs first. If a recommended steam cylinder oil is used, the change interval should be after 2500 hours of operation or every six months, whichever occurs first. These change intervals are recommended for units operating under favorable conditions. Where operating conditions are severe, such a rapid rise and fall in temperature of the gear case with accompanied sweating of the inside walls and resulting formation of sludge, or where operation is in moist or dusty atmospheres, or in the presence of chemical fumes or extended running at sump temperatures in excess of 180° F, it may be necessary to change the oil at intervals of one to three months. It is recommended a sampling program be established with your lubricant manufacturer where reducers are exposed to the severe operating conditions, mentioned above.

### Oil Level

Cone Drive reducers are furnished with a bronze colored hex head pipe plug to indicate oil level. An oil level tag is affixed to the unit near the oil level indicator. Oil level should always be checked with the unit stopped. Estimated oil capacities for standard reducers, are listed in this section.

### Attachable Helical Primary, Double and Triple Reductions Reducers.

These units utilize separate housings and are furnished with separate oil sumps. It is important that all sumps are filled to the proper oil level.

### Grease Packed Bearings

Bearings that are at least partially submerged in oil or oiled by internal oil scoops do not require special maintenance. However, bearings that are not lubricated as above require grease lubrication. Grease fittings and internal retainers are furnished when required. They should be greased with a high quality lithium base NLGI #2 or NLGI #3 bearing grease at normal maintenance intervals depending on the duty cycle of the reducer.

### Extreme Pressure (E.P.) Lubricants

Extreme Pressure (E.P.) lubricants or cylinder oils with sulphur-phosphorus additives are not acceptable and should not be used in Cone Drive Speed reducers or worm gearing.

## Lubrication Data

### Viscosity

Oils recommended for AGMA 7 comp., 8 comp., and 8A comp. must have a minimum viscosity index of 90.

AGMA Lubricant Number	VISCOSITY RANGE		
	ASTM System		
	SUS @210°F	SUS @100°F	CST @ 40°C
7 COMP*	125 - 150	1919 - 2346	ISO460 (414-506)
8 COMP*	150 - 190	2837 - 3467	ISO680 (612-748)
8A COMP*	190 - 250	2236	ISO460
SHC634	215	2236	ISO460

\*Compounded with 3 to 10 percent of acidless tallow or other suitable animal fats. Refer to Cone Drive approved list of lubricants for specific oils that meet the above specifications.

RECOMMENDED LUBRICANTS							
REDUCER SIZES	Worm Speed Up To RPM	AMBIENT TEMPERATURE °F		WORM SPEED ABOVE RPM	AMBIENT TEMPERATURE °F		AGMA Standard Specification of Industrial Enclosed Gearing (9005). *Pour Point of the oil used should be less than the minimum ambient temperature expected. These lubricants are satisfactory for sump temperatures up to 200°F.
		*14-50	50-125		*14-50	50-125	
20 thru 60	700	8 comp.	8A comp.	700	8 comp.	8 comp.	
70 thru 120	450	8 comp.	8A comp.	450	8 comp.	8 comp.	
150 thru 180	300	8 comp.	8A comp.	300	8 comp.	8 comp.	
220 thru 240	250	8 comp.	8A comp.	250	8 comp.	8 comp.	
280	200	8 comp.	8A comp.	200	8 comp.	8 comp.	

### Limiting Speeds for Splash Type Lubrication

The maximum sliding velocity for splash lubrication is 2000 ft. per minute. If the gear set sliding velocity exceeds this value special lubrication provisions are required. Please contact Cone Drive Engineering for specific recommendations.

The ratings charts in the following section are blocked to indicate acceptable operating speeds with splash lubrication for standard reducers and gear sets.

The sliding velocity for standard reducers or gear sets is determined by multiplying the factor from the table by the speed of the worm in RPM.

Sliding Velocity - "V" in ft. per min.
<b>Example:</b> 4.000 C.D. 20:1 Ratio at 3000 RPM:
"V" = Sliding Velocity (Ft/Min.)
"V" = .489 x 3000
"V" = 1467 Ft/Min.

SLIDING VELOCITY FACTOR											
RATIO											
Size	C.D.	5:1	10:1	15:1	20:1	25:1	30:1	40:1	50:1	60:1	70:1
20	2.000	.291	.261	.253	.250	.249	.248	.247	.247	.246	.246
25	2.500	.377	.334	.324	.249	.320	.319	.318	.318	.317	
30	3.000	.457	.382	.369	.363	.362	.361	.360	.359	.359	.359
35	3.500	.533	.453	.439	.433	.431	.430	.429	.428	.428	.428
40	4.000	.613	.512	.495	.489	.486	.485	.484	.483	.483	.482
50	5.000	.722	.632	.612	.605	.600	.598	.597	.596	.595	.595
60	6.000	.888	.763	.740	.731	.726	.724	.723	.722	.722	.722
70	7.000	1.050	.860	.827	.818	.812	.809	.807	.806	.805	.805
80	8.000	1.180	.920	.882	.870	.863	.860	.857	.856	.855	.855
100	10.000	1.468	1.138	1.095	1.080	1.070	1.070	1.070	1.060	1.060	1.060
120	12.000	1.760	1.362	1.308	1.292	1.282	1.278	1.273	1.271	1.270	1.270
150	15.000	2.200	1.635	1.565	1.542	1.530	1.528	1.522	1.518	1.516	
180	18.000	2.535	1.865	1.775	1.743	1.728	1.720	1.715	1.711	1.706	

## Oil Capacities

Approximate Quantities in Quarts & Gallons

### Single Reduction Reducers - Floor Mounted Position

UNIT SIZE		20	25	30	35	40	50	60	70	80	100	120	150	180
WORM OVER GEAR	HO	1 Qt.	1 1/2 Qt.	2 1/2 Qt.	1 Gal.	1 1/2 Gal.	2 1/2 Gal.	3 3/4 Gal.	6 1/2 Gal.	10 1/2 Gal.	19 Gal.	45 Gal.		
	SHO ALT OIL LEVEL	1/2 Qt.	1 Qt.	1 1/2 Qt.	2 1/2 Qt.	1 Gal.	1 3/4 Gal.	2 1/2 Gal.	4 Gal.	6 1/2 Gal.	12 1/2 Gal.	26 Gal.		
WORM UNDER GEAR	HU SHU	1/2 Qt.	1 Qt.	1 1/2 Qt.	3 1/2 Qt.	1 1/2 Gal.	2 1/4 Gal.	3 1/4 Gal.	5 1/4 Gal.	7 3/4 Gal.	15 Gal.	30 Gal.	45 Gal.	70 Gal.
VERTICAL HV OUTPUT SHAFT SHV		1 Qt.	1 Qt.	1 1/2 Qt.	2 1/2 Qt.	1 Gal.	1 3/4 Gal.	2 3/4 Gal.	5 Gal.	6 1/2 Gal.	14 Gal.	26 Gal.	50 Gal.	80 Gal.

### Double Reduction Reducers - Floor Mounted Position

UNIT SIZE	20/30	20/35	25/40	25/50	30/60	30/70	35/70	40/70	40/80	50/100	60/120	70/150	80/180
OO-UO-VO OOS-UOS-VOS	3 Qt.	1 1/2 Qt.	1 3/4 Gal.	2 3/4 Gal.	4 1/4 Gal.	7 Gal.	7 1/4 Gal.	7 1/2 Gal.	11 1/2 Gal.	20 3/4 Gal.	47 1/2 Gal.		
OU-UU-VU	2 1/2 Qt.	1 Gal.	1 3/4 Gal.	2 1/2 Gal.	4 Gal.	5 1/4 Gal.	5 1/2 Gal.	6 Gal.	8 1/2 Gal.	16 Gal.	30 Gal.	50 Gal.	76 Gal.
OUS-UUS-VUS			1 1/4 Gal.	2 Gal.	3 1/4 Gal.	6 1/4 Gal.	6 1/2 Gal.	7 Gal.	9 3/4 Gal.	18 1/2 Gal.	34 Gal.		
OV-UV-VV OVS-UVS-VVS	2 Qt.	2 Qt.	1 1/4 Gal.	2 Gal.	3 1/4 Gal.	6 1/4 Gal.	6 1/2 Gal.	7 Gal.	9 3/4 Gal.	18 1/2 Gal.	34 Gal.		

### Gearmotors & Helical/Worm Reducers - All Positions

UNIT SIZE		25	30	35	40	50	60	70	80
ALL MODELS MOUNTED WITH WORM UNDER GEAR	STANDARD SHAFT HOLLOW SHAFT	2 Qt.	2 1/2 Qt.	1 1/4 Gal.	2 1/4 Gal.	3 Gal.	4 1/4 Gal.	7 Gal.	8 1/2 Gal.
ALL MODELS MOUNTED WITH WORM OVER GEAR		1 1/2 Qt.	1 1/4 Gal.	2 Gal.	2 1/4 Gal.	4 Gal.	5 Gal.	9 Gal.	11 Gal.
ALL MODELS MOUNTED WITH VERTICAL OUTPUT SHAFT		2 1/2 Qt.	3 1/2 Qt.	1 1/2 Gal.	2 1/4 Gal.	3 Gal.	3 3/4 Gal.	8 Gal.	10 1/4 Gal.
ALL MODELS MOUNTED WITH INPUT END UP		4 Qt.	1 1/4 Gal.	2 1/4 Gal.	3 Gal.	5 1/4 Gal.	6 3/2 Gal.	13 1/2 Gal.	16 Gal.
ALL MODELS MOUNTED WITH INPUT END DOWN		3 1/2 Qt.	1 Gal.	1 3/4 Gal.	2 1/2 Gal.	3 1/2 Gal.	4 3/4 Gal.	8 3/4 Gal.	10 1/2 Gal.

**Important:** Do not overfill units. Fill to center line of oil gauge or to pipe plug identified with oil level sticker. Oil capacities will vary due to mounting positions or type of gearshaft mounting used, such as solid shaft, hollow shaft or spread bearings. Each reducer is built and oil levels are set at the factory for a specific mounting position.

## Approved List of Lubricants for Cone Drive Double-Enveloping Worm Gear Speed Reducers & Gear Sets

WORM SPEED (RPM)	† AMBIENT TEMPERATURE		(±) WORM SPEED ABOVE (RPM)	† AMBIENT TEMPERATURE -10 °C to +50 °C (14 °F to 125 °F)	AGMA LUBRICANT NUMBER	VISCOSITY RANGE		
	-10 °C to +10 °C (14 °F to 50 °F)	-10 °C to +50 °C (50 °F to 125 °F)				ASTM SYSTEM		ISO GRADE
						SUS@210 °F	SUS@100 °F	CST@40 °F
0-700	8 Comp.	8A Comp.	700	8 Comp.	7 Comp.	125-150	1919-2346	ISO460 (414-506)
0-450	8 Comp.	8A Comp.	450	8 Comp.	8 Comp.	150-190	2837-3467	ISO680 (612-748)
0-300	8 Comp.	8A Comp.	300	8 Comp.	8A Comp.	190-250	4171-5098	ISO1000(900-1100)
0-200	8 Comp.	8A Comp.	200	8 Comp.				

MANUFACTURER	AGMA #8 COMPOUND (NON-E.P)			AGMA #8 COMPOUND (NON-E.P)		
	BRAND NAME	P.P.F.	SUS@210°F	BRAND NAME	P.P.F.	SUS@210°F
Mobil Oil Corp.	600W Super Cylinder Oil	10	155	Extra Hecla Super Cylinder Oil	20	198
Amoco	Cylinder Oil 680	15	200	Cylinder Oil 1000	15	243
BP Oil NOT AVAILABLE IN THE U.S				Energ DC-C 1000	6	1000 CST
Behnke Lubricants Inc.	Jax Super Cylinder	30	190	Jax Super Cylinder	15	243
<b>Bel-Ray Company, Inc.</b>	Stream Cylinder Oil 150	5	167	Steam Cylinder Oil 250	10	205
Bel-Ray Company, Inc.	No-Tox worm Gear Lube (FOOD GRADE H1) Oil ISO 680	5	216	No-Tox Worm Gear Lube (FOOD GRADE H1) OIL ISO 1000	5	292
Cato Oil and Grease Corp.	Mystik Power Lube #680	5	212	Mystik Power Lube #1000	5	315
Century Lubricating Oils, Inc.	Garwal #680	35	183			
Chevron Products Comp.	Cylinder Oil W-ISO #680	10	191	Cylinder Oil W-ISO #1000	10	252
Citgo Petroleum Corp.	Cylinder Oil #680-7	15	193			
Conoco Inc.	Inca Oil #680	30	165	Inca Oil #1000	35	211
Dryden Oil Company Inc.	Worm Gear Oil #680	20	180	Worm Gear #1000	20	222
Engineered Lubricants	Enlubol SCO-3400	15	685CST	Enlubol SCO-193 Comp.	15	916CST
Exxon Company	Cylesstic TK 680	20	184	Cylesstic TK 1000	30	227
Fina Oil Company	Cylan Steam Cyl. Oil 680	20	175			
Fiske Brothers Refining	Lubriplate CP-8	22	160	Lubriplate CP-8A	35	230
Fiske Brothers Refining	*Lubriplate SPO-288	20	173			
Huls	PQ-AGMA#8	10	175			
Imperial/Esso Oil	Cylesso TK 680	37	680 CST	Cylesso TK 1000	37	925 CST
Kendall Motor Oil Company	Kendco 155 Comp.	25	177	Kendco 206 Comp.	35	229
Lubrication Engineers	680 Almasol	15	191			
Lyndell Lubricants	Modoc #175	30	190			
Mobil Oil Corp.	600W Super Cyl. Oil	20	155	Extra Hecla Super Cyl.Oil	30	200
Pennzoil Products Company	Cylinder Oil #680	30	680 CST	Cylinder Oil #1000	30	1000 CST
Pennzoil Products Company	Cylinder Oil #6-NR	36	680 CST			
Philips 66 Company	Hector 630-S	10	172			
Primrose Oil Company				243 Cylinder Oil #8A	15	220
Schaeffer Mfg. Company	#147 Steam Cylinder Oil	10	190			
Shell Oil Products Company	Valvata J-680	20	650 CST			
Sunoco	Sun Gear Oil 8c	10	677			
Texaco Lubricants Company	Vanguard 680	20	190	Vanguard 1000	25	220

APPROVED SYNTHETIC LUBRICANTS:	
MANUFACTURER	BRAND NAME
Henkel Corp./Emery Group	*Emery-2843 Synthetic Lubricant
Keystone / Atochem	*Keystone KSL-367 Synthetic Lubricant
Mobil Oil Corp.	*Mobil SH634 Synthetic Lubricant
Texaco Lubricants Co.	*Pinnacle 460Synthetic Lubricant

**BEARING GREASE:** High quality lithium base NLGI #2 or NLGI #3

**NOTES:**

- Note #1.....The listed synthetic lubricants are acceptable for use as an AGMA #7, AGMA #8 and AGMA #8A. AGMA #7 lubricants are primarily used in force feed lubrication systems or other special applications.
- Note #2.....Worm gears operating at a sliding velocity in excess of 10 m/s (2,000 ft. per min.) may require force feed lubrication. For force feed lubrication recommendations. see Cone Drive Product Catalog or contact Cone Drive Engineering.
- Note #3.....Major oil companies, not on the above list, do not have products which meet the requirements of AGMA. #9005-D94
- Note #4.....Manufacturers listed above, in bold print, have product available world wide. Contact a listed manufacturer for availability in your area.
- Note #5.....All lubricants are listed per the manufacturers recommendation.
- Note #6.....(\*)This is a special lubricant, not an AGMA compound
- Note #7.....Centistoke viscosity values are at 40 centigrade
- Note #8.....If a Cone Drive reducer is to be operated at an input rpm other than that shown on the name plate, contact Cone Drive Engineering Department for recommendations.
- Note #9.....For double and triple reduction reducers an ISO 1000 (AGMA #8A) lubricant can be used in the primary as well as the final reduction stages.
- Note #10.....Pour point of the oil used should be 5 C (9 F) less than the minimum ambient temperature expected. For special temperature or operating conditions, contact Cone Drive Engineering Department for the proper lubrication selection.
- Note #11.....AGMA specifications require a viscosity index (VI) of 90 (min.). However, lubricants listed with a VI of less than 90 may be used if a recommended lubricant with a VI of 90 (min.) is not available.

## Material Specifications

### Gears

For normal worm speeds up to 3600 rpm, or 2000 feet per minute sliding velocity, Cone Drive gear units rated in accordance with our standard formulae, we recommend our standard gear bronze. Gears are chill or centrifugally cast bronze according to the following specifications.

#### Chemical:

Tin .....	10.00% to 12.00 %
Impurities .....	.50% Max.
Phosphorus .....	.05% - .25%
Copper .....	Remainder

#### Mechanical:\*

Tensile strength .....	45,000 Lbs./ Sq.In.Min
Yield Point .....	25,000 Lbs./ Sq. In. Min.
Elongation in 2" .....	14% Min.

\*Gear mechanical properties are test bar values.

\*\*Worm mechanical properties are typical for 1" rounds having 32 Rc surface hardness.

### Worms

Worm threads are cut integral with the worm shaft from #4150 resulfurized steel within the limitations of the chemical specifications shown below.

#### Chemical:

Carbon .....	.48% - 53%
Manganese .....	.75% - 1.30%
Phosphorus .....	.035% Max
Sulphur .....	.06% - .10%
Silicon.....	.15% - .35%
Chromium.....	.60% - 1.10%
Molybdenum .....	.15% - .25%

#### Mechanical:\*\*

Tensile strength .....	140,000 Lbs./ Sq. In. Min.
Yield Point .....	120,000 Lbs./ Sq. In. Min.
Reduction in area....	40%
Elongation in 2" .....	12%

### Housing, Caps & Carriers

Housing, Caps & Carriers size 1.5 through size 120 are generally supplied in cast iron. Larger sizes are supplied in welded steel or cast iron at our option.

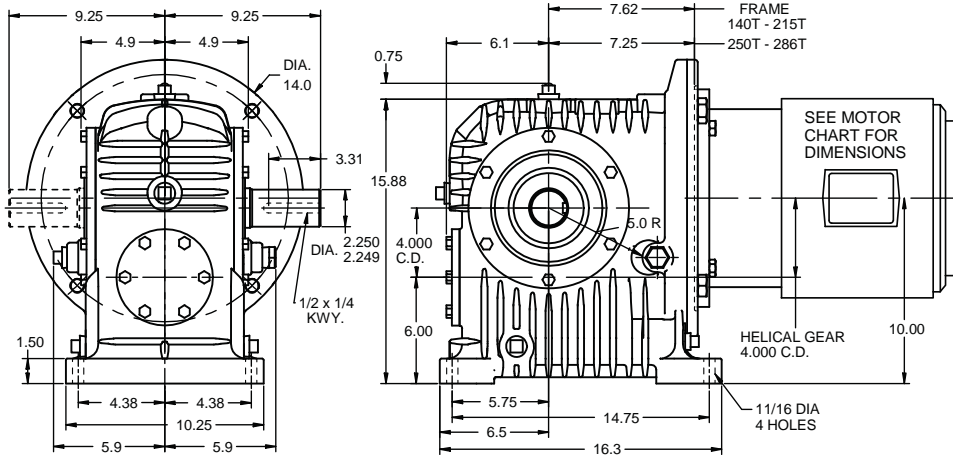
### Solid Output Shafts

Output shafts for size 1.5 through size 60 are cold drawn steel. Size 70 and greater are heat treated alloy steel, the same as the worm material in the listing above.

# Cone Drive Helical/Worm D-Flange Gearhead - 4.000" C.D.

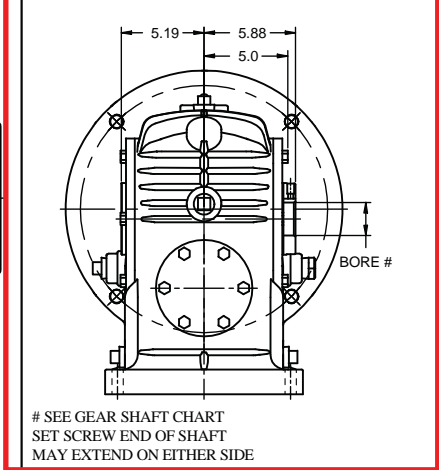
## Size 40 Solid Shaft

**Model MU** est. wt. 230 lbs less motor

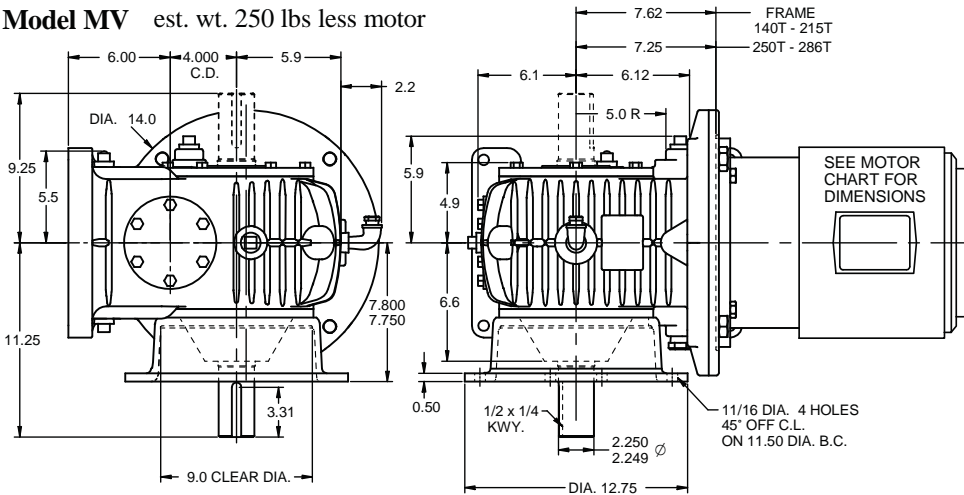


## Hollow Shaft

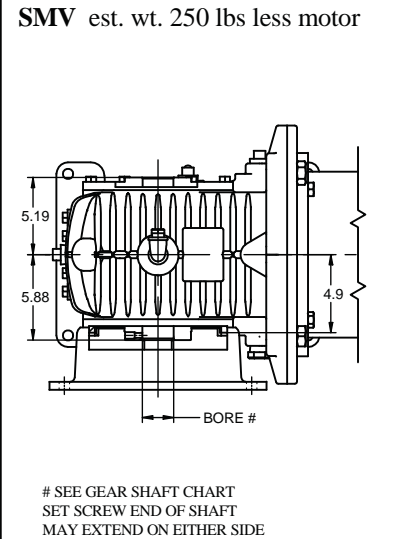
**SMU** est. wt. 230 lbs less motor



**Model MV** est. wt. 250 lbs less motor



**SMV** est. wt. 250 lbs less motor

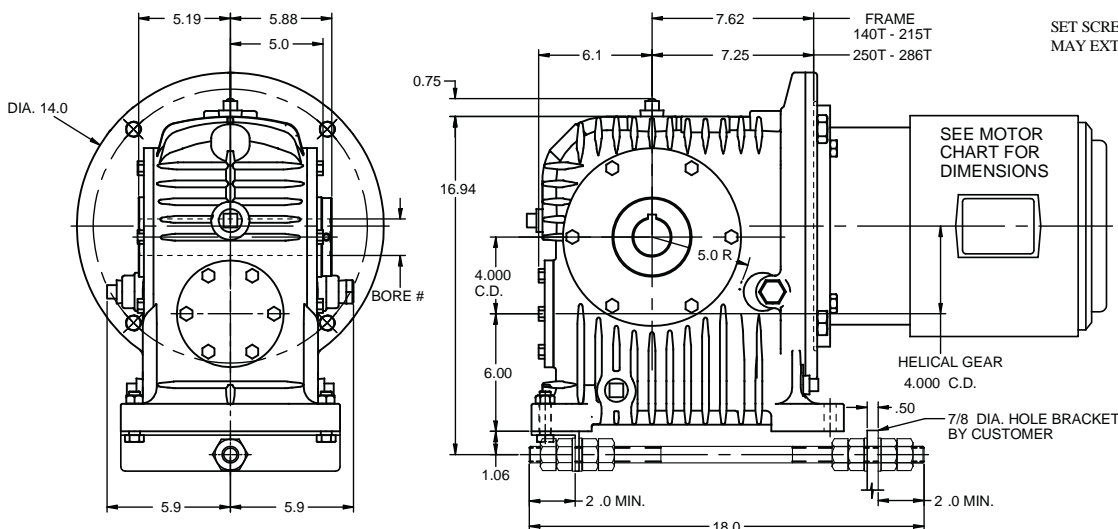


SOLID OUTPUT SHAFT MAY EXTEND ON EITHER SIDE OR BE DOUBLE EXTENDED.

**Model SM** est. wt. 230 lbs less motor

# SEE GEAR SHAFT CHART

SET SCREW END OF SHAFT  
 MAY EXTEND ON EITHER SIDE



UNIT CAN BE SUPPLIED WITH  
 SOLID SHAFT, CONTACT CONE DRIVE

# Cone Drive Helical/Worm D-Flange Gearhead

Size 40 4.000" C.D. HELICAL PRI./4.000" C.D. WORM GEAR SEC.

## AGMA HORSEPOWER & OUTPUT TORQUE RATINGS FOR 1.0 SERVICE FACTOR

TOTAL RATIO PRIMARY X SECONDARY		INPUT RPM				
		100	580	870	1150	1750
5:1 1 x 5	Me.HP	1.66	8.93	13.1	16.9	24.9
	Th.HP	1.66	8.93	13.1	16.9	18.7
	O.T.	4670	4430	4340	4270	4140
7.5:1 1.5 x 5	Me.HP	1.38	7.45	10.9	14.2	20.9
	Th.HP	1.38	7.45	10.9	14.2	18.7
	O.T.	5710	5520	5410	5330	5190
9:1 1.8 x 5	Me.HP	1.20	6.50	9.53	12.4	18.3
	Th.HP	1.20	6.50	9.53	12.4	17.9
	O.T.	5920	5770	5660	5580	5440
10:1 1 x 10	Me.HP	1.66	8.93	13.1	15.3	19
	Th.HP	1.66	8.93	13.1	15.3	15.4
	O.T.	8730	8520	8400	7490	6190
12.5:1 2.5 x 5	Me.HP	0.96	5.26	7.72	10.0	14.8
	Th.HP	0.96	5.26	7.72	10.0	14.8
	O.T.	6520	6450	6350	6260	6110
15:1 1.5 x 10	Me.HP	1.38	7.45	10.3	12.3	15.4
	Th.HP	1.38	7.45	10.3	12.3	15.2
	O.T.	10700	10500	9860	8910	7440
18:1 1.8 x 10	Me.HP	1.20	6.50	9.13	11.0	13.9
	Th.HP	1.20	6.50	9.13	11.0	13.9
	O.T.	11100	11000	10400	9580	8050
20:1 4 x 5	Me.HP	1.30	5.62	7.17	8.34	10.4
	Th.HP	1.30	5.62	7.17	8.34	10.4
	O.T.	12400	10100	8720	7710	6380
22.5:1 1.5 x 15	Me.HP	1.15	5.43	7.33	8.70	10.9
	Th.HP	1.15	5.43	7.33	8.70	10.9
	O.T.	12800	11100	10200	9300	7790
25:1 2.5 x 10	Me.HP	0.96	5.04	7.07	8.80	11.6
	Th.HP	0.96	5.04	7.07	8.80	11.6
	O.T.	12200	11700	11100	10500	9240
27:1 1.8 x 15	Me.HP	0.97	4.69	6.45	7.82	9.91
	Th.HP	0.97	4.69	6.45	7.82	9.91
	O.T.	12800	11400	10700	9920	8460
30:1 1.5 x 20	Me.HP	0.88	4.16	5.62	6.68	8.4
	Th.HP	0.88	4.16	5.62	6.68	8.4
	O.T.	12400	10900	10100	9190	7670
36:1 1.8 x 20	Me.HP	0.74	3.59	4.94	5.99	7.62
	Th.HP	0.74	3.59	4.94	5.99	7.62
	O.T.	12400	11100	10500	9840	8300
37.5:1 2.5 x 15	Me.HP	0.70	3.54	4.99	6.21	8.26
	Th.HP	0.70	3.54	4.99	6.21	8.26
	O.T.	12800	11800	11200	10800	9620
40:1 4 x 10	Me.HP	0.61	3.18	4.60	5.91	8.47
	Th.HP	0.61	3.18	4.60	5.91	8.47
	O.T.	12100	11700	11400	11100	10600
45:1 1.8 x 25	Me.HP	0.60	2.89	3.99	4.84	6.15
	Th.HP	0.60	2.89	3.99	4.84	6.15
	O.T.	11900	11100	10400	9730	8330
50:1 2.5 x 20	Me.HP	0.54	2.71	3.82	4.76	6.35
	Th.HP	0.54	2.71	3.82	4.76	6.35
	O.T.	12400	11500	11000	10600	9530
54:1 1.8 x 30	Me.HP	0.50	2.42	3.34	4.06	5.16
	Th.HP	0.50	2.42	3.34	4.06	5.16
	O.T.	11400	10400	9740	9190	8010
60:1 4 x 15	Me.HP	0.45	2.35	3.35	4.25	5.98
	Th.HP	0.45	2.35	3.35	4.25	5.98
	O.T.	12800	12300	11900	11600	10900
62.5:1 2.5 x 25	Me.HP	0.44	2.19	3.08	3.84	5.13
	Th.HP	0.44	2.19	3.08	3.84	5.13
	O.T.	11900	11300	11000	10500	9450
72:1 1.8 x 40	Me.HP	0.38	1.82	2.52	3.05	3.88
	Th.HP	0.38	1.82	2.52	3.05	3.88
	O.T.	10300	9790	9360	8840	7650
75:1 2.5 x 30	Me.HP	0.37	1.83	2.58	3.22	4.30
	Th.HP	0.37	1.83	2.58	3.22	4.30
	O.T.	11400	10700	10300	9830	8990

Me.HP = Mechanical horsepower      Th.HP = Thermal horsepower  
 O.T. = Output torque in Lb. in.

TOTAL RATIO PRIMARY X SECONDARY		INPUT RPM				
		100	580	870	1150	1750
80:1 4 x 20	Me.HP	0.35	1.80	2.56	3.26	4.58
	Th.HP	0.35	1.80	2.56	3.26	4.58
	O.T.	12400	12000	11500	11200	10700
90:1 1.8 x 50	Me.HP	0.31	1.46	2.02	2.45	3.12
	Th.HP	0.31	1.46	2.02	2.45	3.12
	O.T.	9240	9360	9110	8620	7380
100:1 4 x 25	Me.HP	0.28	1.45	2.06	2.63	3.70
	Th.HP	0.28	1.45	2.06	2.63	3.70
	O.T.	11900	11600	11400	11200	10600
108:1 1.8 x 60	Me.HP	0.26	1.22	1.68	2.05	2.60
	Th.HP	0.26	1.22	1.68	2.05	2.60
	O.T.	9100	9010	8640	8180	7110
120:1 4 x 30	Me.HP	0.24	1.21	1.73	2.20	3.10
	Th.HP	0.24	1.21	1.73	2.20	3.10
	O.T.	11400	11000	10700	10500	9920
125:1 2.5 x 50	Me.HP	0.23	1.10	1.56	1.94	2.60
	Th.HP	0.23	1.10	1.56	1.94	2.60
	O.T.	9240	9370	9330	9150	8380
150:1 2.5 x 60	Me.HP	0.20	0.92	1.30	1.62	2.17
	Th.HP	0.20	0.92	1.30	1.62	2.17
	O.T.	9100	9150	8950	8700	7990
160:1 4 x 40	Me.HP	0.18	0.91	1.30	1.66	2.33
	Th.HP	0.18	0.91	1.30	1.66	2.33
	O.T.	10300	10000	9770	9800	9490
200:1 4 x 50	Me.HP	0.15	0.73	1.04	1.33	1.87
	Th.HP	0.15	0.73	1.04	1.33	1.87
	O.T.	9240	9320	9360	9380	9200
240:1 4 x 60	Me.HP	0.13	0.61	0.87	1.11	1.56
	Th.HP	0.13	0.61	0.87	1.11	1.56
	O.T.	9100	9160	9170	9030	8760

**CAUTION:**  
 It is the purchaser's or user's responsibility to guard all shafting in accordance with current local, state or federal requirements.

**Notes:**

- For motor data refer to pages 71 and 72.
- VM & SVM units supplied with special footbrackets which provides a vertical input and a horizontal output shaft reducer follow in this section.
- All MV units having shaft extended thru base side will be supplied with a steep bearing mounting on base side, unless otherwise specified.
- Steep bearing arrangements follow in this section.
- All units can be supplied with fan cooling.
- When specified each unit can be supplied with a worm shaft extension located opposite the input end.
- When specified, units can be supplied with water cooling coils in oil sump.
- Set screw end of hollow shaft is considered the extension end.
- Unless otherwise specified, all reducers are supplied with a right hand helix worm gear set.
- Reducers are designed for shaft rotation in either direction.
- For cap and carrier dimensions not shown see mounting section.
- For output shaft chain pull capacity, see single reduction rating chart for size unit required. Determine worm speed by dividing input speed by helical gear ratio.
- Refer to page 26 for lubrication information, efficiency, and service factors.
- Reducers may be used in floor, ceiling, or wall mounted positions, however, they must be ordered for the position required so that suitable oil level, grease fittings, filler and drains are provided.
- Hand of assembly and mounting position diagrams follow in this section.

STANDARD HOLLOW GEAR SHAFTS		
BORE INCHES	GEAR SHAFT NUMBER	KEYWAY SIZE
2.9375*	40-S60-215	5/8 X 5/16
2.6875*	40-S60-211	5/8 X 5/16
2.4375*	40-S60-207	5/8 X 5/16
2.1875*	40-S60-203	5/8 X 5/16

Special hollow gear shaft bore sizes are available at additional cost.  
 \*AGMA Standard Bore Tolerance: +.003, -.000  
 2 set screws at long end of shaft.

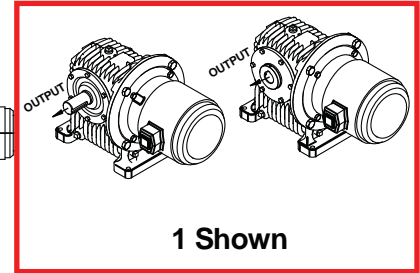
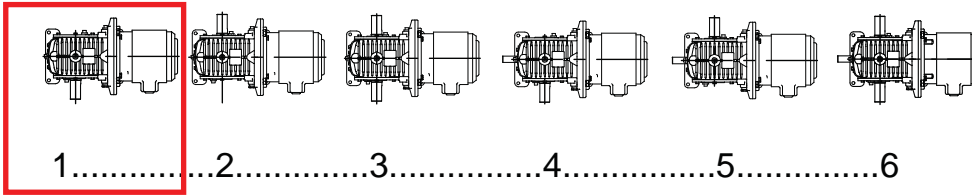
**Important:** In any applications of Cone Drive products where breakage, damage, disconnection, any other malfunction of any drive train component, or excessive wear could result in personal injury or property damage, a fail-safe device capable of stopping and holding the load in the event of such an occurrence must be incorporated after the drive train.

# Assembly & Mounting Position Numbers for Cone Drive Helical/Worm D Flange Gearhead

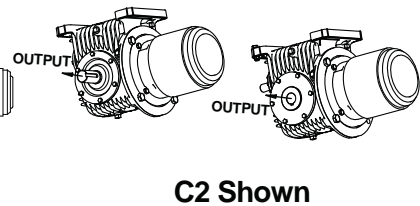
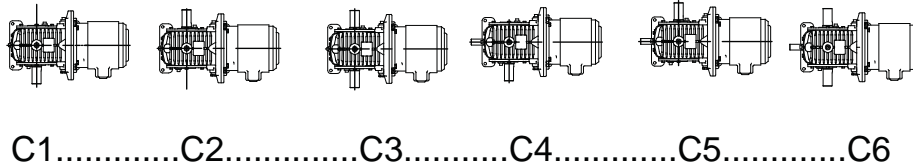
Models MU, SMU, MV, SMV, SM, Solid & Hollow Shaft

ALL DIAGRAMS SHOW REDUCER WITH FEET ON FAR SIDE

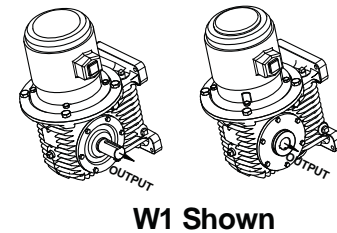
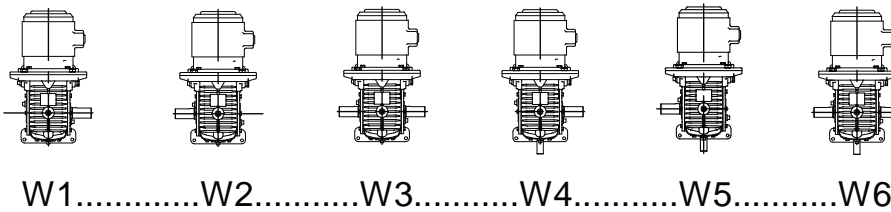
## Top View, Floor Mounted



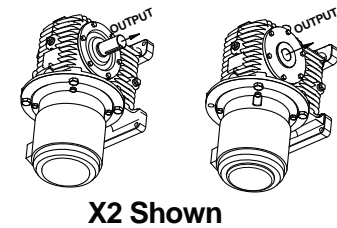
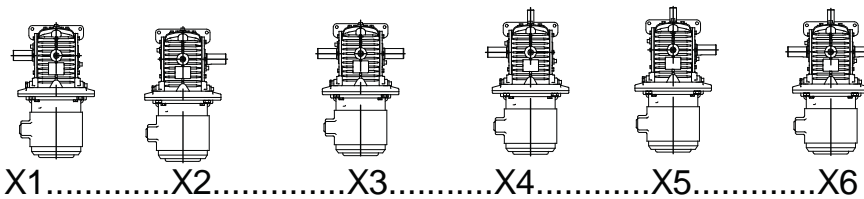
## Ceiling Mounted\*



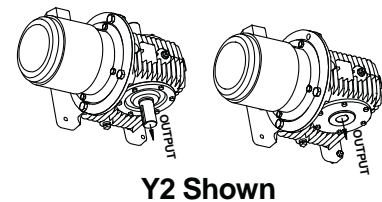
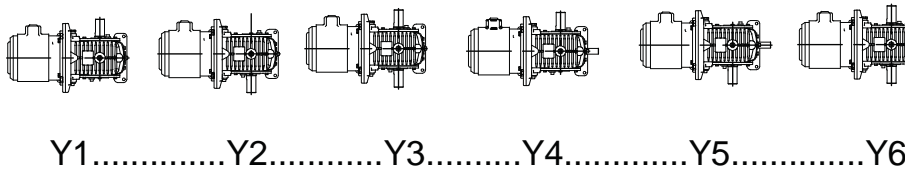
## Wall Mounted, Motor Up



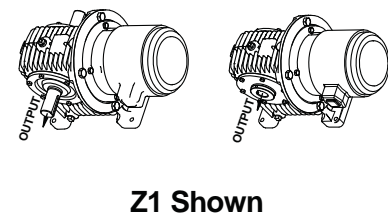
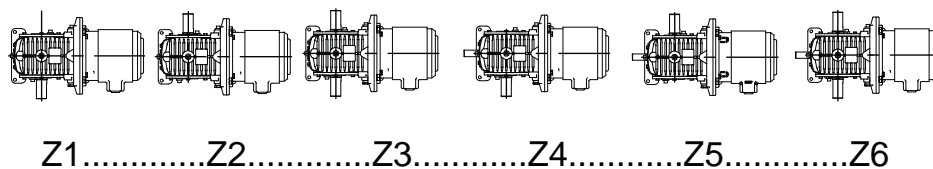
## Wall Mounted, Motor Down\*



## Wall Mounted, Motor To Left\*



## Wall Mounted, Motor To Right

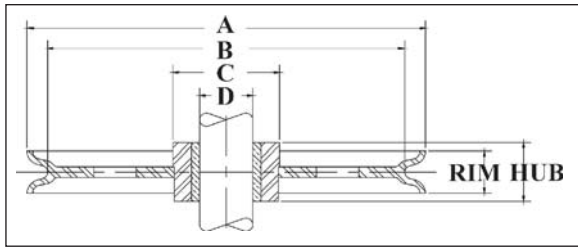


\*Motor face may be submerged in oil. Contact motor supplier regarding shaft seal requirements.

## Appendix 4.4.5.13

System: Apron Counterweight System  
Component: Upper Deflector Sheave  
Manufacturer: McKissick

# McKissick® Bronze Bushed Sheaves



**SEE APPLICATION AND WARNING INFORMATION**

Para Español: [www.thecrosbygroup.com](http://www.thecrosbygroup.com)

on Pages 375-382

## Bronze Bushed Sheaves

- Roll-Forged™ sheaves are available in sizes up to 78" in diameter.
- McKissick® Bronze Bushed Sheaves are equipped with S.A.E. 660 Bronze Bushings for cold finished shafts with "Figure 8" oil groove.
- For sizes not listed, McKissick Finished Bore Sheaves can be equipped with bronze bushings at an optional charge.

"A" Nominal Outside Diameter (in.)	Stock Number	Pattern Number	Wire Line Size (in.)	"D" Shaft Size (in.)	Hub Width (in.)	Rim Width (in.)	"C" Nominal Hub Outside Diameter (in.)	"B" Nominal Tread Diameter (in.)	Material	Approx. Weight (lbs.)
2-1/4	907004	1173	1/4	3/8*	5/8	9/16	3/4	1-7/8	B.S.	.75
3	907059	1173	3/16	3/8*	25/32	3/4	1	2-3/8	P.M.	1.00
3	907077	1173	3/16	1/2*	25/32	3/4	1	2-3/8	P.M.	1.00
3	907095	1173	3/16	5/8*	25/32	3/4	1	2-3/8	P.M.	1.00
3	907022	1173	1/4	3/8*	1/2	1/2	1	2-5/8	P.M.	.75
3	907040	1173	1/4	1/2*	1/2	1/2	1	2-5/8	P.M.	.75
3	460165	3X	1/4	1/2*	1-5/16	1-3/16	1-1/8	2-1/16	B.S.	1.00
3	2030896	3-1	5/16	3/4	1	7/8	1-3/4	2-1/4	P.M.	1.50
3	907068	1173	3/8	3/8*	3/4	3/4	1	2-3/8	P.M.	1.00
3	916101	1208	3/8	3/8*	25/32	3/4	1-1/2	2-3/8	B.S.	1.00
3	907086	1173	3/8	1/2*	3/4	3/4	1	2-3/8	P.M.	1.00
3	916110	1208	3/8	1/2*	25/32	3/4	1-1/2	2-3/8	B.S.	1.00
3	460156	3X	3/8	1/2*	1-5/16	1-3/16	1-1/8	2-1/16	B.S.	1.00
3	907102	1173	3/8	5/8*	3/4	3/4	1	2-3/8	P.M.	1.00
3	2030895	3-1	3/8	3/4	1	7/8	1-3/4	2-1/4	P.M.	1.50
3	2023202	3-1	7/16	3/4	1	7/8	1-3/4	2-1/4	P.M.	1.50
3	916129	1208	1/2	3/8*	1-1/4	1-1/8	1-7/8	2	B.S.	1.33
3	916138	1208	1/2	1/2*	1-1/4	1-1/8	1-7/8	2	B.S.	1.50
4	460290	4-1	1/8	1	1	7/8	2	3-1/8	B.S.	2.00
4	907111	1173	3/16	1/2*	3/4	5/8	1-3/8	3-1/2	P.M.	1.00
4	907139	1173	3/16	5/8*	3/4	5/8	1-3/8	3-1/2	P.M.	1.00
4	916147	1208	1/4	1/2*	13/16	3/4	2	3-1/4	B.S.	1.50
4	916165	1208	1/4	3/4*	13/16	3/4	2	3-1/4	B.S.	1.50
4	460307	4-1	1/4	1	1	7/8	2	3-1/8	B.S.	2.00
4	907120	1173	5/16	1/2*	3/4	5/8	1-3/8	3-1/2	P.M.	1.00
4	907148	1173	5/16	5/8*	3/4	5/8	1-3/8	3-1/2	P.M.	1.00
4	907166	1173	3/8	1/2*	13/16	3/4	1-1/2	3-1/4	P.M.	1.25
4	916156	1208	3/8	1/2*	13/16	3/4	2	3-1/4	B.S.	1.50
4	907184	1173	3/8	5/8*	13/16	3/4	1-1/2	3-1/4	P.M.	1.40
4	907200	1173	3/8	3/4*	13/16	3/4	1-1/2	3-1/4	P.M.	1.25
4	460316	4-1	3/8	1	1	7/8	2	3-1/8	B.S.	2.00
4	907228	1173	1/2	1/2*	1-1/16	1	1-5/8	3-3/16	P.M.	1.50
4	916192	1208	1/2	1/2*	1-1/8	1	1-5/8	3-3/16	B.S.	2.00
4	907246	1173	1/2	5/8*	1-1/16	1	1-5/8	3-3/16	P.M.	1.50
4	907264	1173	1/2	3/4*	1-1/16	1	1-5/8	3-3/16	P.M.	1.50
4	2028640	1208	3/8	3/4*	13/16	3/4	2	3-1/4	B.S.	1.50
4-1/8	2023186	4-K	3/8	1	1-1/2	1-3/8	2	3	F.S.	3.50
4-1/8	2029618	4-K	1/2	1	1-1/2	1-3/8	2	3	F.S.	3.50
4-1/8	2023188	4-K	5/8	1	1-1/2	1-3/8	2	3	F.S.	3.50
4-1/4	460450	4E	3/8	5/8*	1-3/16	15/16	2-1/8	3-3/8	B.S.	2.40
4-1/4	460441	4E	1/2	5/8*	1-3/16	15/16	2-1/8	3-3/8	B.S.	2.40
4-3/4	460575	5-2	5/16	5/8	1-9/16	1-3/8	1-1/2	3-5/8	D.I.	3.50
4-3/4	460584	5-2	3/8	5/8	1-9/16	1-3/8	1-1/2	3-5/8	D.I.	3.50
4-3/4	460593	5-2	1/2	5/8	1-9/16	1-3/8	1-1/2	3-5/8	D.I.	3.50

McKissick  
Sheaves

Custom sheaves are available. See page 281 for ordering details.

# McKissick® Bronze Bushed Sheaves

"A" Nominal Outside Diameter (in.)	Stock Number	Pattern Number	Wire Line Size (in.)	"D" Shaft Size (in.)	Hub Width (in.)	Rim Width (in.)	"C" Nominal Hub Outside Diameter	"B" Nominal Tread Diameter (in.)	Material	Approx. Weight (lbs.)
12	914149	1193	3/4	1-1/4	1-5/8	1-1/2	5-1/4	10-1/4	D.I.	25.5
12	914167	1193	3/4	1-1/2*	1-5/8	1-1/2	5-1/4	10-1/4	D.I.	25.5
12	<b>346593</b>	<b>12-2-A</b>	<b>3/4</b>	<b>2-1/4</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>4-1/2</b>	<b>9-3/4</b>	<b>R.F.</b>	<b>26.0</b>
12	<b>4104882</b>	<b>12-9</b>	<b>3/4</b>	<b>2-1/2</b>	<b>1-3/4</b>	<b>1-5/8</b>	<b>4-1/2</b>	<b>9-3/4</b>	<b>R.F.</b>	<b>25.0</b>
12	<b>462449</b>	<b>12-2-A</b>	<b>3/4</b>	<b>2</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>4-1/2</b>	<b>9-3/4</b>	<b>R.F.</b>	<b>26.0</b>
12	<b>4104917</b>	<b>12-2-A</b>	<b>3/4</b>	<b>2-1/2</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>4-1/2</b>	<b>9-3/4</b>	<b>R.F.</b>	<b>25.0</b>
12	<b>462485</b>	<b>12-5</b>	<b>3/4</b>	<b>3</b>	<b>3</b>	<b>1-7/8</b>	<b>5-1/2</b>	<b>9-3/8</b>	<b>R.F.</b>	<b>21.0</b>
12	908227	1173	7/8	1-1/4*	2	1-3/4	3-3/4	10	D.I.	20.3
12	908245	1173	7/8	1-1/2*	2	1-3/4	3-3/4	10	D.I.	20.3
12	<b>462458</b>	<b>12-2-A</b>	<b>7/8</b>	<b>2</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>4-1/2</b>	<b>10-1/4</b>	<b>R.F.</b>	<b>26.0</b>
12	<b>2023554</b>	<b>12-NS-3</b>	<b>7/8</b>	<b>2-1/4</b>	<b>2-1/2</b>	<b>2-3/8</b>	<b>4-1/2</b>	<b>9-3/8</b>	<b>R.F.</b>	<b>28.0</b>
12	<b>4104891</b>	<b>12-9</b>	<b>7/8</b>	<b>2-1/2</b>	<b>1-3/4</b>	<b>1-5/8</b>	<b>4-1/2</b>	<b>10-1/4</b>	<b>R.F.</b>	<b>25.0</b>
12	<b>462467</b>	<b>12-2-A</b>	<b>1</b>	<b>2</b>	<b>2-5/16</b>	<b>2-3/16</b>	<b>4</b>	<b>10</b>	<b>R.F.</b>	<b>26.0</b>
12	2023552	12-NS-3	1-1/8	2-1/4	2-1/2	2-3/8	4-1/2	9-3/8	R.F.	26.0
<b>13</b>	<b>462779</b>	<b>13-2</b>	<b>3/8</b>	<b>2</b>	<b>1-1/2</b>	<b>1-1/8</b>	<b>3-1/2</b>	<b>11-5/8</b>	<b>R.F.</b>	<b>14.0</b>
<b>13</b>	<b>462788</b>	<b>13-2</b>	<b>1/2</b>	<b>2</b>	<b>1-1/2</b>	<b>1-1/8</b>	<b>3-1/2</b>	<b>11-5/8</b>	<b>R.F.</b>	<b>14.0</b>
14	463625	14-1	5/8	1-1/2	1-3/4	1-5/8	3-1/4	12-1/8	R.F.	20.0
14	463634	14-1	3/4	1-1/2	1-3/4	1-5/8	3-1/4	11-3/8	R.F.	20.0
14	463643	14-1	7/8	1-1/2	1-3/4	1-5/8	3-1/4	11-3/8	R.F.	20.0
14	463448	14NS-3	7/8	2-1/4	2-1/2	2-3/8	4-1/2	12-1/4	R.F.	28.0
14	463457	14NS-3	1	2-1/4	2-1/2	2-3/8	4-1/2	11-3/8	R.F.	28.0
14	463466	14NS-3	1-1/8	2-1/4	2-1/2	2-3/8	4-1/2	11-3/8	R.F.	28.0
14	<b>**463518</b>	<b>14WL-8</b>	<b>1/2</b>	<b>3-3/4</b>	<b>2-1/2</b>	<b>1-3/8</b>	<b>5-1/16</b>	<b>12-5/8</b>	<b>R.F.</b>	<b>15.0</b>
14	4103552	14-2	5/8	2	1-3/4	1-5/8	4-1/2	12-1/8	R.F.	29.2
14	<b>**908281</b>	1173	3/4	1-1/8*	1-5/8	1-7/16	3-1/4	12-1/4	C.I.	26.5
14	<b>**908307</b>	1173	3/4	1-1/4*	1-5/8	1-1/2	3-1/4	12-1/4	C.I.	26.5
14	917173	1208	3/4	1-1/4*	1-5/8	1-1/2	4	12	R.F.	26.5
14	917191	1208	3/4	1-1/2*	1-5/8	1-1/2	3-1/4	11-3/4	R.F.	26.5
14	4103632	14-2	3/4	2	1-3/4	1-5/8	4-1/2	11-3/4	R.F.	30.0
14	4104828	24S7-A	3/4	2-3/4	2-5/16	2-3/16	5-1/2	11-3/4	R.F.	35.0
14	917182	1208	7/8	1-1/4*	1-5/8	1-1/2	4	12	R.F.	26.5
14	917208	1208	7/8	1-1/2*	1-5/8	1-1/2	4	12	R.F.	26.5
14	463484	14PL-8	7/8	2	2-5/16	2-1/8	4-1/2	11-3/8	R.F.	28.0
14	4103641	14-2	7/8	2	1-3/4	1-5/8	4-1/2	12-1/4	R.F.	31.0
16	4101395	16-4	1/2	3-1/2	2-3/4	2-1/2	5-3/4	14-1/4	R.F.	54.0
16	4100047	16-4	3/4	3-1/2	2-3/4	2-1/2	5-3/4	13-3/8	R.F.	47.0
16	4100109	16-17	3/4	3-3/4	2-3/4	2-1/2	5-3/4	13-3/8	R.F.	42.0
16	4103703	16-5	7/8	2-1/2	2-5/16	2-3/16	4-1/2	12-15/16	R.F.	35.0
16	4105211	16-5	7/8	2-3/4	2-5/16	2-3/16	4-1/2	12-15/16	R.F.	42.0
16	917342	1208	1	1-1/2*	2	1-3/4	4-1/4	13-1/4	R.F.	34.0
16	917360	1208	1	2*	2	1-3/4	4-1/4	13-1/4	R.F.	34.0
16	4100127	16-17	1	3-3/4	2-3/4	2-1/2	5-3/4	13-1/4	R.F.	63.0
18	4105131	18-2	7/8	3	2-5/16	2-3/16	5-1/2	14-15/16	R.F.	52.0
18	4105195	26FS-8	7/8	5-1/2	2-7/8	2-5/8	8	14-15/16	R.F.	59.0
18	917468	1208	1	1-1/2*	2	1-7/8	3-1/4	14-7/8	R.F.	55.0
18	917486	1208	1	2*	2	1-7/8	4-1/2	14-7/8	R.F.	55.0
18	914826	1193	1	2*	2	1-3/4	5-3/4	15-3/4	R.F.	62.0
18	4104052	18-2	1	2-3/4	2-5/16	2-3/16	5-1/2	14-7/8	R.F.	66.0
18	4105140	18-2	1	3	2-5/16	2-3/16	5-1/2	14-7/8	R.F.	52.0
18	4100298	26FS-7	1	4	3	2-3/4	6-1/2	15-1/8	R.F.	81.0
18	4103348	26FS-7	1-1/8	4	3	2-3/4	6-1/2	15-1/8	R.F.	60.0
20	4100341	20-2	3/4	3	2-5/16	2-3/16	5-1/2	18	R.F.	68.0
20	4105239	20-2	3/4	3-3/4	2-3/4	2-1/8	6-1/2	18	R.F.	68.0
20	4100350	20-2	7/8	3	2-5/16	2-3/16	5-1/2	17-1/8	R.F.	45.0
20	4105266	32-T-8	7/8	5-1/2	2-7/8	2-5/8	8	16-15/16	R.F.	68.0
20	4100369	20-2	1	3	2-5/16	2-3/16	5-1/2	17-1/8	R.F.	80.2
20	4105328	20-2	1	3-1/4	2-5/16	2-3/16	5-1/2	17-1/8	R.F.	68.0
20	4105257	20-2	1	3-3/4	2-3/4	2-1/8	6-1/2	16-1/2	R.F.	68.0
20	4105275	32-T-8	1	5-1/2	2-7/8	2-5/8	8	17-1/8	R.F.	68.0
24	4105346	24TS-8	9/16	5-3/4	3-3/8	3-1/8	8	22	R.F.	113
24	4105355	24TS-8	7/8	5-3/4	3-3/8	3-1/8	8	21	R.F.	133
24	4100859	42TS8-2	1	4	3	2-3/4	6-1/2	21-1/8	R.F.	80.0

McKissick® Roll-Forged™ sheaves highlighted above in bold italic are available with reduced lead times due to our advanced manufacturing process.

Custom sheaves are available. See page 281 for ordering details.

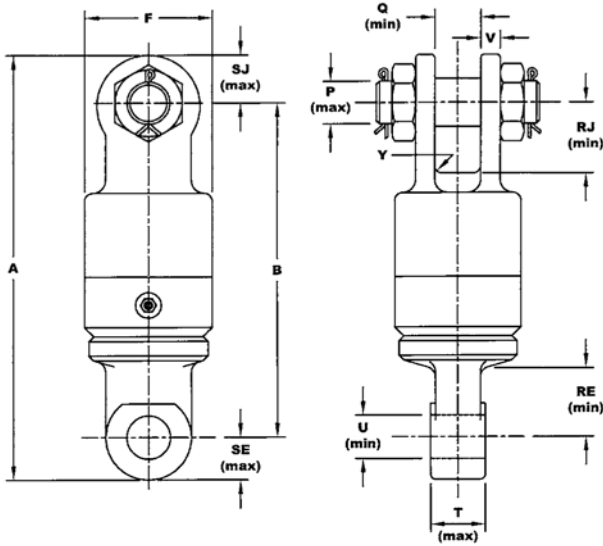
## Appendix 4.4.5.14

System: Apron Counterweight System  
Component: Upper Snatch Block Swivel  
Manufacturer: Johnson Block

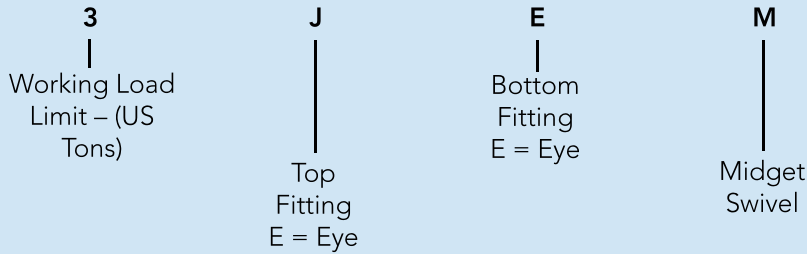
# Swivels Jaw/Eye

3 through 19 ton capacities  
4 to 1 design factor

For product warnings and inspection instructions, see pages 120-122



## Key to Jaw/Eye Swivel model numbers



To order, please specify:

- Model number

## Jaw & Eye Swivels

Model No	Wt.	A Overall Length	B Net Length	F Swivel Dia.	P Pin Dia.	Q Width Between Ears	RE Hole to Obstruction	RJ Pin to Obstruction	SE Hole to End of Fitting	SJ Pin to End of Fitting	T Thickness of Eye	U Hole Dia.	V Thickness of Ear	Y Jaw Radius
3JEM	8	7.96	5.65	2.63	1.00	0.97	1.23	1.08	1.22	1.22	0.91	1.03	0.50	0.09
4JE	18	12.15	9.46	3.25	1.25	1.44	1.55	2.07	1.34	1.44	1.03	1.31	0.56	0.25
7JF	18	12.15	9.46	3.25	1.25	1.44	1.55	2.07	1.34	1.44	1.03	1.31	0.56	0.25
12JE	35	15.30	11.30	4.00	1.75	1.69	2.24	2.69	2.03	2.06	1.28	1.78	0.75	0.25
19JE	41	15.77	11.77	4.44	1.75	1.94	2.43	2.94	2.03	2.06	1.28	1.78	0.75	0.25

## Appendix 4.4.5.15

System: Apron Counterweight System  
Component: Upper and Lower Snatch Blocks  
Manufacturer: Campbell (Cooper)



**Apex Tool Group 14600 York Rd. | Suite A Sparks, Maryland 21152**  
**Toll Free: (800) 621-8814**

Catalog Number: 7332520  
4099BS, 6" Steel Drop Side Snatch Block, Bronze Bushed, Galvanized

UPC	020418124976
Block Size	6 in
Wire Rope Diameter	3/4 in
Sheave Size - OD	6 in
Sheave Size - Center Pin Diameter	1-1/2 in
Working Load Limit Metric Ton	8 t
Weight Each (lbs.)	27.00 lb
Made in USA	Yes

Model 4099  
For Wire Rope  
Steel Shells with Steel Sheaves  
Drop-Forged Fittings  
Grooved Bronze Bushings with Pressure Grease Lubrication  
Galvanized Finish  
Special Feature: the Bolt Cannot Be Lost When the Block is Opened  
Connections Are Easily Interchangeable  
Working Loads are Resultant Working Loads  
**DO NOT EXCEED THE WORKING LOAD LIMIT**

## Appendix 4.4.5.16

Mobilux EP1 and EP2



## Mobilux™ EP 0, 1, 2, 3, 004 and 023

### Grease

#### Product Description

Mobilux™ EP 0, 1, 2, 3, 004 and 023 products are a high performance family of five general-purpose industrial greases and two special-duty semi-fluid greases. These lithium hydroxystearate greases are formulated to provide extra protection against wear, rusting and water washout. They are available in NLGI grades ranging from 00 to 3, with base oil viscosities ISO VG 150 and 320.

Mobilux EP 0, 1, 2 and 3 greases are recommended for most types of industrial applications including heavy-duty applications where high unit pressures or shock loads are present. These greases provide excellent protection against rust and corrosion and resist water wash-out which makes them particularly suitable for equipment where moist or wet conditions are common. Mobilux EP 0 and 1 are suitable for centralised systems. Mobilux EP 2 and 3 are general-purpose greases. The recommended operating temperature range is from -20°C to 130°C but they may be used at higher temperatures if the lubrication frequency is increased accordingly.

Mobilux EP 004 and Mobilux EP 023 are particularly suitable for the lubrication of enclosed gears and bearings in poorly sealed gear cases they can also be used in many other industrial applications where conventional gear oils cannot be retained in gear cases, chain cases, etc. because of leakage due to worn or missing seals. The recommended operating temperature range is -25 to 120°C for Mobilux EP 004 and -15 to 120°C for Mobilux EP 023.

#### Features and Benefits

Mobilux EP greases have a long history of proven performance and have demonstrated good performance in the areas of corrosion protection, low temperature pumpability and high temperature service life. A Timken OK load of 40 lb illustrates their load carrying and extreme pressure capability.

- Reduced wear under heavy or shock loading and vibration for good equipment reliability and availability
- Protection against rust and corrosion and resistance to water washout for equipment protection and good lubrication even in presence of water
- Extended bearing life potential in wet environments for reduced bearing costs and unanticipated downtime
- Good pumpability in centralised systems (Mobilux EP 0 and 1)
- Effective leakage control (Mobilux EP 004 and Mobilux EP 023)

#### Applications

- Mobilux EP 0 and EP 1 provide good low temperature pumpability and are suitable for centralised lubrication systems and other applications where low temperature performance is required.
- Mobilux EP 2 is recommended for multipurpose applications in antifriction and plain bearings, bushings and pins under normal operating conditions.
- Mobilux EP 3 is a stiffer NLGI grade 3 grease recommended for applications where maximum protection against penetration of water or solid contaminants is required.
- Mobilux EP 004 and Mobilux EP 023 are particularly suitable for the lubrication of enclosed gears and bearings in poorly sealed gear cases on most underground mining machinery with the exception of electric motor gearings. Mobilux EP 004 and Mobilux EP 023 can also be used in many other industrial applications where conventional gear

oils cannot be retained in equipment such as gear cases, chain cases, because of leakage due to worn or missing seals. Mobilux EP 004 passes the SEW 1008 hour gear test requirement DR.EM.203 mod.

## Specifications and Approvals

Mobilux EP meets or exceeds the requirements of:	Mobilux EP 0	Mobilux EP 1	Mobilux EP 2	Mobilux EP 3	Mobilux EP 004	Mobilux EP 023
DIN 51825: (2004-06)		KP1K-30	KP2K-30	KP3K-20		
DIN 51826: (2005-01)	GP0G-20				GP00G-20	GP000G-20

Mobilux EP has the following builder approvals	Mobilux EP 0	Mobilux EP 1	Mobilux EP 2	Mobilux EP 3	Mobilux EP 004	Mobilux EP 023
SEW Eurodrive/ PS C Gears					X	

## Typical Properties

	Mobilux EP 0	Mobilux EP 1	Mobilux EP 2	Mobilux EP 3	Mobilux EP 004	Mobilux EP 023
NLGI Grade	0	1	2	3	00	000
Thickener Type	Lithium	Lithium	Lithium	Lithium	Lithium	Lithium
Color, Visual	Brown	Brown	Brown	Brown	Brown	Brown
Penetration, Worked, 25°C, ASTM D 217	370	325	280	235	415	460
Viscosity of Oil, ASTM D 445						
cSt @ 40°C	160	160	160	160	160	320
Timken OK Load, ASTM D 2509, lb	40	40	40	40	40	40
4-Ball Wear, ASTM D 2266, Scar, mm	0.4	0.4	0.4	0.4	0.5	0.4
4-Ball Weld Load, ASTM D 2596, Kg	250	250	250	250	250	250
Dropping Point, D 2265, C	190	190	190	190		
Rust Protection, ASTM D 6138, Distilled Water	0-0	0-0	0-0	0-0	0-0	0-0

## Health and Safety

Based on available information, this product is not expected to produce adverse effects on health when used for the intended application and the recommendations provided in the Material Safety Data Sheet (MSDS) are followed. MSDS's are available upon request through your sales contract office, or via the Internet. This product should not be used for purposes other than its intended use. If disposing of used product, take care to protect the environment.

The Mobil logotype, the Pegasus design and Mobilux are trademarks of Exxon Mobil Corporation, or one of its subsidiaries.

8-2014

Exxon Mobil Corporation  
3225 Gallows Road  
Fairfax, VA 22037

1-800-ASK MOBIL (275-6624)

Typical Properties are typical of those obtained with normal production tolerance and do not constitute a specification. Variations that do not affect product performance are to be expected during normal manufacture and at different blending locations. The information contained herein is subject to change without notice. All products may not be available locally. For more information, contact your local ExxonMobil contact or visit [www.exxonmobil.com](http://www.exxonmobil.com). ExxonMobil is comprised of numerous affiliates and subsidiaries, many with names that include Esso, Mobil, or ExxonMobil. Nothing in this document is intended to override or supersede the corporate separateness of local entities. Responsibility for local action and accountability remains with the local ExxonMobil-affiliate entities.

Copyright © 2001-2014 Exxon Mobil Corporation. All rights reserved.

## Appendix 4.4.5.17

Mobilux SHC634



## Mobil SHC Gear Series

### Next-generation supreme-performance gear lubricants



**Engineered to deliver optimum equipment protection and oil life in the most extreme conditions.**

Enhance your productivity with Mobil SHC Gear Series supreme-performance, fully synthetic industrial gear oils — next-generation technology providing excellent protection and oil life in some of the most extreme conditions. This enhanced industrial gear oil formulation features the latest Mobil SHC technology, which offers exceptional oxidation resistance and thermal properties, naturally high viscosity index, and outstanding low-temperature fluidity.

**Helps drive productivity with energy efficiency up to 3.6 percent.**

Mobil SHC Gear Series' high viscosity index and low traction coefficient combine to provide a significant reduction in energy consumption in many gear drives. Mobil SHC Gear Series exhibited energy savings of up to 3.6 percent versus conventional oils in statistically validated laboratory tests.\* This is one more way Mobil SHC Gear Series can help contribute to an increase in your productivity.

**Excellent wear protection and resistance to micropitting.**

Mobil SHC Gear Series lubricants contain advanced proprietary additive technology designed to provide industrial gearboxes with excellent protection against conventional wear modes, such as scuffing, and a high level of resistance against micropitting fatigue. Additionally, compared with conventional gear oil chemistries, Mobil SHC Gear Series offers the potential for improved lubrication of gearbox rolling-element bearings. Mobil SHC Gear Series products offer excellent rust and corrosion protection, show no tendency to plug fine filters even when wet — and have excellent compatibility with ferrous and nonferrous metals even at elevated temperatures.

## High-Performance Benefits

### Excellent water-handling properties

Easily separates from water and will not plug filters, potentially improving filter life.

### Outstanding seal compatibility

Meets or exceeds stringent Freudenberg seal testing requirements, potentially reducing seal leakage and avoiding related oil consumption. Approved by Siemens for use in Flender gearboxes.

### Robust shear stability

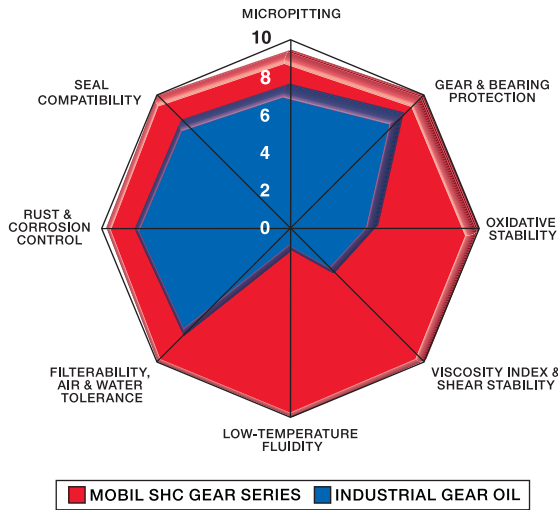
Shows excellent resistance to viscosity loss even under the high shear conditions found in severe industrial gearboxes and bearings, ensuring long lubricant life in service.

### 6x oxidation resistance

Extends oil life up to 6x versus standard mineral gear oil, especially at elevated operating temperatures — extending drain intervals and reducing lubricant costs.

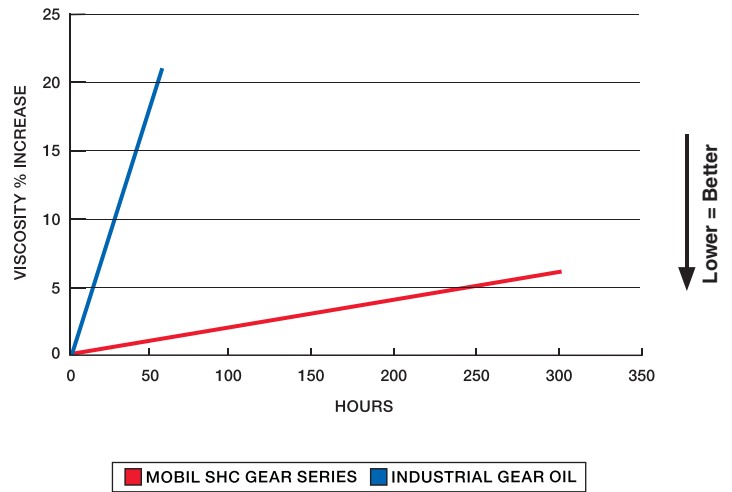
# Mobil SHC Gear Series — Performance

## Balanced Formulation



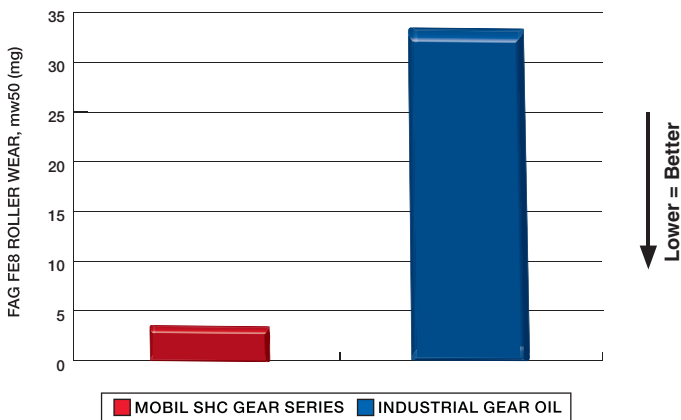
A technical survey of conventional industrial gear oils shows Mobil SHC Gear Series delivers significantly better performance in nearly every dimension.

## Thermal and Oxidative Stability



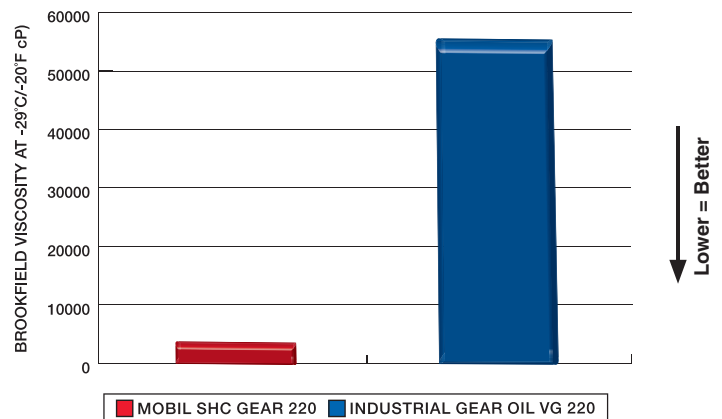
In an ASTM D 5704 mod., L-60-1 test, Mobil SHC Gear Series' viscosity rose only 6 percent during an extended-length 300-hour test compared with conventional industrial gear oil's 21 percent viscosity rise during a standard-length 50-hour test.

## Bearing Wear Protection



In a standard FAG FE8 Stage 1 bearing test, Mobil SHC Gear Series protected bearings significantly better than conventional industrial gear oil.

## Low-Temperature Fluidity



ASTM D 2983 testing of Brookfield Viscosity shows that Mobil SHC Gear 220 Series offers better low-temperature performance compared with conventional industrial gear oil, providing the opportunity for extended temperature range for start-up and operation.



\*Energy efficiency relates solely to the fluid performance when compared with conventional reference oils of the same viscosity grade in gear applications. The technology used allows up to 3.6% efficiency compared with the reference when tested in a worm gearbox under controlled conditions. Efficiency improvements will vary based on operating conditions and application.

For more information on Mobil SHC Gear Series and other Mobil Industrial lubricants and services, please contact your local company representative, the Mobil technical help line at 1-800-662-4525, or visit [www.mobilindustrial.com](http://www.mobilindustrial.com).



## Mobil SHC™ 600 Series

### Exceptional Performance Gear and Bearing Oils

#### Product Description

Mobil SHC™ 600 Series lubricants are exceptional performance gear and bearing oils designed to provide outstanding service in terms of equipment protection, oil life and problem-free operation helping to enable increased customer productivity. These scientifically engineered oils are formulated using the latest proprietary and patent pending Mobil SHC technology to provide outstanding and balanced performance in demanding applications at high and low temperatures. Mobil SHC 600 products feature excellent low temperature properties, as well as improved air release performance in the lower viscosity grades. These products are resistant to mechanical shear, even in heavily loaded gear and high shear bearing applications, so that there is virtually no loss of viscosity.

Mobil SHC 600 Series products have low traction coefficients relative to mineral oils which derive from the molecular structure of the base stocks used. This results in low fluid friction in the load zone of non-conforming surfaces such as gears and rolling contact bearings. Low fluid friction produces lower operating temperatures and improved gear efficiency, which translates into reduced power consumption. Mobil SHC 600 Series products have demonstrated up to 3.6% improvement in energy efficiency in controlled laboratory testing(\*). Mobil SHC 600 Series formulation also provides excellent resistance to oxidation and deposit formation at elevated temperatures, as well as exceptional resistance to rusting and corrosion, antiwear, demulsibility, foam control and air release properties, and multi-metal compatibility. Mobil SHC 600 Series oils maintain good compatibility with seals and other materials used in equipment normally lubricated with mineral oils.

Mobil SHC 600 Series lubricants are suitable for use in a wide range of equipment, not only as high temperature problem solvers, but also because of the other benefits they offer.

(\*). Energy efficiency relates solely to the performance of Mobil SHC 600 when compared to conventional (mineral) reference oils of the same viscosity grade in circulating and gear applications. The technology used allows up to 3.6% efficiency compared to the reference when tested in a worm gearbox under controlled conditions. Efficiency improvements will vary based on operating conditions and application.

#### Features and Benefits

The Mobil SHC brand of lubricants are recognized and appreciated around the world for their innovation and outstanding performance. These synthetic products, molecularly designed and pioneered by our research scientists, embody the continuing commitment to using advanced technology to provide outstanding lubricant products. The development of Mobil SHC 600 Series was preceded by close contacts between our scientists and application specialists with key Original Equipment Manufacturers (OEMs) to ensure that the products provide exceptional performance in the continually evolving industrial equipment designs.

Our work with key equipment builders has helped confirm the results from our own laboratory and rig tests showing the exceptional performance of Mobil SHC 600 Series lubricants. Not least among the benefits, shown in work with OEMs, is the potential for energy efficiency improvements up to 3.6% relative to mineral oils (\*). These benefits are particularly evident in equipment with a high level of mechanical losses, such as high ratio worm gears.

To develop the latest Mobil SHC technology for Mobil SHC 600 Series oils, our product formulation scientists chose select base oils because of their exceptional thermal/oxidative resistance potential and combined them with a balanced additive system, which complements the inherent benefits of the base oils to provide excellent oil life, deposit control and resistance to thermal/oxidative and chemical degradation. This formulation approach provides low temperature fluidity characteristics

exceeding that of many conventional mineral products and is a key benefit for remote, low ambient temperature applications. Mobil SHC 600 Series oils offer the following features and potential benefits:

Features	Advantages and Potential Benefits
Superb high temperature thermal/oxidation resistance	Helps extend equipment high temperature operating capability Long oil life, helps reduce maintenance costs Helps minimize deposits to enable trouble-free operation and long filter life
High Viscosity Index and absence of wax	Maintains viscosity and film thickness at high temperatures Helps enable exceptional low temperature performance, including start-up
Low traction coefficient	Helps reduce friction and increase efficiency in sliding mechanisms such as gearing, with potential for reduced power consumption and lower steady-state operating temperatures. Helps minimize the effects of micro slip in rolling contact bearings to potentially extend rolling-element life
High load carrying capability	Helps protect equipment and extends life; helps minimize unexpected downtime and extends service periods
Balanced additive combination	Provides excellent performance in terms of rust and corrosion prevention, water separability, foam control and air release performance enabling problem-free operation in a wide range of industrial applications, and reduced operating costs

(\*) Energy efficiency relates solely to the performance of Mobil SHC 600 when compared to conventional (mineral) reference oils of the same viscosity grade in circulating and gear applications. The technology used allows up to 3.6% efficiency compared to the reference when tested in a worm gearbox under controlled conditions. Efficiency improvements will vary based on operating conditions and application.

## Applications

While Mobil SHC 600 Series are generally compatible with mineral oil based products, admixture may detract from their performance. Consequently it is recommended that before changing a system to one of Mobil SHC 600 Series products, it should be thoroughly cleaned out and flushed to achieve the maximum performance benefits. Mobil SHC 600 Series oils are compatible with most NBR, FKM and most other elastomeric seal materials that are used with mineral oils. There is the potential for substantial variations in the elastomers. For best results, consult your equipment supplier, seal manufacturer, or your local company representative to verify compatibility.

Mobil SHC 600 Series lubricants are recommended for use in a wide variety of gear and bearing applications where high or low temperatures are encountered or where operating temperatures or bulk oil temperatures are such that conventional lubricants give unsatisfactory life, or where improved efficiency is desired. They are particularly effective in applications where the maintenance costs of component replacement, system cleaning and lubricant changes are high. Specific applications require selection of the appropriate viscosity grade and include:

- Filled for life gearboxes, especially high ratio/ low-efficiency worm gears
- Remotely located gearboxes, where oil change-out is difficult
- Low temperature applications, such as ski lifts where seasonal oil changes can be avoided
- Mixer roll bearings and roll neck bearings where high temperatures are encountered
- Plastic calendars



Mobil SHC 600 Series	624	625	626	627	629	630	632	634	636	639
TOST, ASTM D 943 mod, hours	10,000+	10,000+	10,000+	10,000+	10,000+	10,000+	10,000+	10,000+	10,000+	10,000+
RPVOT, ASTM D 2722, minutes	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
Rust protection, ASTM D665B, Synthetic Sea Water	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Water Separability, ASTM D1401,Min. to 37 ml water @ 54° C	10	15	15	-	-	-	-	-	-	-
Water Separability, ASTM D1401,Min. to 37 ml water @ 82° C	-	-	-	15	20	20	20	20	20	25
Copper Corrosion, ASTM D130, 24 hrs @ 121° C	1B	1B	1B	1B	1B	1B	1B	1B	1B	1B
Foam Test, ASTM D892, Seq I,II,IIITendency / Stability, ml/ml	15/0, 20/0, 25/0	10/0, 30/0, 10/0	10/0, 20/0, 10/0	0/0, 10/0, 0/0	0/0, 0/0,0/0	0/0, 10/0, 0/0	0/0,0/0,0/0	0/0,0/0,0/0	0/0,0/0,0/0	0/0, 0/0, 0/0
FZG gear scuffing test, A/8.3/90, ISO 14635-1 (mod), Failure Stage	11	12	12	12	13	13+	13+	13+	13+	13+
FAG FE8 Bearing Wear Test 7.5/80-80 ((DIN 51819-3) Roller Wear (mg)	-	-	-	2	2	2	2	2	2	2

## Health and Safety

Based on available information, this product is not expected to produce adverse effects on health when used for the intended application and the recommendations provided in the Material Safety Data Sheet (MSDS) are followed. MSDS's are available upon request through your sales contract office, or via the Internet. This product should not be used for purposes other than its intended use. If disposing of used product, take care to protect the environment.

All products may not be available locally.

Note for Canadian users: Mobil SHC 600 Series is not controlled under Canadian WHMIS legislation.

All trademarks used herein are trademarks or registered trademarks of Exxon Mobil Corporation or one of its subsidiaries unless indicated otherwise.

9-2014

Exxon Mobil Corporation  
3225 Gallows Road  
Fairfax, VA 22037

1-800-ASK MOBIL (275-6624)

Typical Properties are typical of those obtained with normal production tolerance and do not constitute a specification. Variations that do not affect product performance are to be expected during normal manufacture and at different blending locations. The information contained herein is subject to change without notice. All products may not be available locally. For more information, contact your local ExxonMobil contact or visit [www.exxonmobil.com](http://www.exxonmobil.com). ExxonMobil is comprised of numerous affiliates and subsidiaries, many with names that include Esso, Mobil, or ExxonMobil. Nothing in this document is intended to override or supersede the corporate separateness of local entities. Responsibility for local action and accountability remains with the local ExxonMobil-affiliate entities.

Copyright © 2001-2014 Exxon Mobil Corporation. All rights reserved.

## Appendix 4.4.5.18

Mobiltac 275



## Mobiltac 375 NC, 325 NC and 275 NC

### Gear Oils

#### Product Description

Mobiltac 375 NC, 325 NC and 275 NC extra high performance non-leaded, diluent-type, heavy-bodied open gear lubricants designed for a wide variety of open gear and mining applications. They contain a non-chlorinated, volatile solvent that ensures fluidity during application, even at low temperatures. Once applied, the diluent evaporates and the lubricants take on a flexible, adhesive, high-strength consistency that is maintained throughout their service life. Mobiltac 375 NC, 325 NC and 275NC adhere strongly to gear teeth and other machine elements to resist excessive throw-off, thereby providing a wear-resistant, viscous, continuous film that lubricates well under boundary conditions. Mobiltac 275 NC also contains solid phase EP/anti-wear additive for added equipment protection

Mobiltac 375 NC, 325 NC and Mobiltac 275NC will not harden, chip, or flake in cold weather, are self-healing, and do not form a hard-packed buildup in gear-tooth roots. Dripping and throw-off are minimal, and the lubricants are easily cleaned up with a solvent-soaked rag. The lubricants provide resistance to rain, snow, and process water washing. Their flash points minimise the risk of fire. These new generation gear and mining lubricants are applied easily by hand or by automatic dispensers. Mobiltac NC technology has rapidly become a firm favourite among many open gear users and mine operators around the world

#### Features and Benefits

The Mobiltac NC Series of products are the most recent technology advance for the Mobiltac brand of products that have been used with great success in open gear and other mining applications for several decades. These new technology products provide significantly improved environmental and performance benefits over older diluent-type technologies. They offer the following features and potential benefits:

Features	Advantages and Potential Benefits
Excellent protection of gear teeth and other machine elements under boundary lubrication conditions	Less equipment wear and breakdown; lower replacement, downtime and maintenance costs
Excellent low-temperature pumpability	Easy start-up at low ambient and avoids cost of preheating
Excellent resistance to water washing	Maintains superb protection in wet environments; less unanticipated downtime
Minimal throw-off and dripping	Less product waste and new product cost
No chipping or flaking at low temperatures	Maintains protective lubricating film at low temperatures
Easy to clean up with rags and conventional solvents or cleaning fluids	Improved safety and reduced maintenance costs

#### Applications

Mobiltac 375 NC, 325 NC and Mobiltac 275NC are designed for use in a wide variety of open gear and mining applications:

- Mobiltac 375 NC, containing a high-viscosity base oil, is recommended for the lubrication of highly loaded open gears, including those that operate at high temperature, for example, ring gears on cement kilns and large gears on ore-processing mills
- Mobiltac 325 NC is recommended for the same applications as Mobiltac 375 NC. It contains more diluent and has a lower viscosity for ease of application at cooler temperatures
- Mobiltac 275 NC is designed for service as a lubricant for mine and quarry shovels, draglines, and related equipment; also open gears, racks and pinions, swing gears, booms and sticks

- Minimum operating temperature for Mobiltac 325 NC is -18 C, 375 NC is -1 C and 275 NC is -9 C

**Typical Properties**

<b>Mobiltac NC</b>	<b>Mobiltac375 NC</b>	<b>Mobiltac325 NC</b>	<b>Mobiltac275 NC</b>
Appearance	Viscous, semi-fluid, black	Viscous, semi-fluid, black	Viscous, semi-fluid, black
Viscosity, ASTM D 445			
cSt @ 40° C, with diluent	5000	1500	-
cSt @ 100° C, without diluent	1260	1000	-
Flash Point, °C, ASTM D 92	135	110	150
Specific Gravity, °C kg/l, ASTM D 1298	0.96	0.95	0.99
Maximum Temperature Use, °C	121	93	-

**Health and Safety**

Based on available information, this product is not expected to produce adverse effects on health when used for the intended application and the recommendations provided in the Material Safety Data Sheet (MSDS) are followed. MSDS's are available upon request through your sales contract office, or via the Internet. This product should not be used for purposes other than its intended use. If disposing of used product, take care to protect the environment.

The Mobil logotype, the Pegasus design are trademarks of Exxon Mobil Corporation, or one of its subsidiaries.

9-2013

Exxon Mobil Corporation  
 3225 Gallows Road  
 Fairfax, VA 22037

1-800-ASK MOBIL (275-6624)

Typical Properties are typical of those obtained with normal production tolerance and do not constitute a specification. Variations that do not affect product performance are to be expected during normal manufacture and at different blending locations. The information contained herein is subject to change without notice. All products may not be available locally. For more information, contact your local ExxonMobil contact or visit [www.exxonmobil.com](http://www.exxonmobil.com) ExxonMobil is comprised of numerous affiliates and subsidiaries, many with names that include Esso, Mobil, or ExxonMobil. Nothing in this document is intended to override or supersede the corporate separateness of local entities. Responsibility for local action and accountability remains with the local ExxonMobil-affiliate entities.

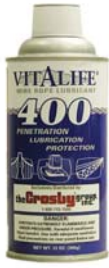
Copyright © 2001-2014 Exxon Mobil Corporation. All rights reserved.

## Appendix 4.4.5.19

Crosby Vitalife 400

# Wire Rope Lubricant

## VITALIFE®



## VITALIFE® 400



## VITALIFE® 410 BIO-LUBE



## VITALIFE® 5 GALLON



## VITALIFE® 55 GALLON

Vitalife® products are the preferred wire rope lubricants in the industry because of their ability to penetrate into wire rope and displace water and contaminants, thus reducing wear and corrosion throughout the rope.

- Available in a variety of container sizes.
- Provides inner strand preservation and lubricity.
- Allows for easy visual inspection of the ropes.
- Reduces the friction between the strands of the wire rope, thus extending rope life.
- Adheres to surface of strands, forming an outer film which provides excellent corrosive protection.
- Non-tacky (will not attract dust)
- Vitalife® in aerosol form is a regulated dangerous good. See MSDS sheet for shipping instructions.
- Vitalife® Bio-Lube has been developed especially for environmentally friendly applications.
- Vitalife® 500 has been developed exclusively for ski lifts and tramways.
- Vitalife® 600 has been developed exclusively for elevator applications.

Vitalife® Type	Container Size	Vitalife® Stock No.	Weight Each (lbs)
Vitalife® 400 (Standard)	12 Ounce	1038946	1.00
	5 Gallon	1038955	41.0
	55 Gallon	1038964	420
Vitalife® 410 BIO-LUBE (Environmentally Friendly)	12 Ounce	1039004	1.00
	5 Gallon	1039013	41.0
	55 Gallon	1039022	420
<del>Vitalife® 500 (Ski Lifts and Tramways)</del>	<del>5 Gallon</del>	<del>1038973</del>	<del>41.0</del>
	<del>55 Gallon</del>	<del>1038982</del>	<del>420</del>
Vitalife® 600 (Elevator Cables)	<del>1 Quart</del>	<del>1039034</del>	<del>2.00</del>
	<del>1 Gallon</del>	<del>1039037</del>	<del>8.20</del>
	<del>5 Gallon</del>	<del>1039040</del>	<del>41.0</del>
	<del>55 Gallon</del>	<del>1039043</del>	<del>420</del>

## VSP Vitalife® Spray Applicators

- Designed and manufactured to work in the rugged field conditions of the construction industry.
- All applicator seals are specially designed to work with Vitalife® 400 and BIO-LUBE products.

Description	VSP Stock No.	Weight Each (lbs.)
4 Gallon Backpack Sprayer	1039092	11.8

## BACKPACK MODEL (4 GALLON)



### Product Description

**Vitalife® # 400** is a unique light-bodied wire rope lubricant and protector. For field application it offers outstanding lubrication, penetration, and preservation of wire ropes. The consistency of **Vitalife® # 400** is suitable for manual and automatic application. It can be applied with relative ease even under the most severe climatic conditions.

**Vitalife® # 400** is produced from the highest quality petroleum fractions. In addition to having excellent lubricating properties, they contain selected additives to obtain acid and alkali resistance, water displacing properties, excellent rust prevention, oxidation stability and penetration. The high polarity of **Vitalife® # 400** enables it to creep and "wet" the metal surface forming an adhesive and protective film.

### Product Benefits and Features

Light-bodied oil · provides the ability to penetrate to the core of wire rope · wire ropes are cleaner and easy to inspect · penetrates the interstices between wires and strands · high film strength · prevents wear · resists oxidation and corrosion · self-healing film former · excellent in acid or alkali and pollutants' environment · high polarity promotes creeping and re-lubrication of areas forced dry of oil.

### Major Applications

Field lubrication for wire ropes in service. All sizes of standing and running ropes as used on suspension and lift bridges, tramways and cableways. All types of cranes, escalators, derricks, masts and chimneys. Also on hoist ropes, draglines, conveyors and material handling equipment. Major industries served include surface and underground mining, construction, towing, marine, gas and petroleum, on and off shore drilling, to name a few.

### Methods of Application

**Vitalife® #400** has been tested and proven directly compatible with Crosby **Vitalife®** Spray Applicators (see Crosby Catalog). The use of **Vitalife® #400** in Crosby **Vitalife®** Spray Applicators is recommended. Other methods of application include manual by brush, swab, drip, pour, automatic drip or spray systems and automatic pressure wire rope lubricators. This product is also available in an aerosol can.

### Typical Properties

<b>Appearance</b>	Turbid, Brown
<b>Viscosity, SUS @100°F</b>	275/300
<b>Flash Point, COC °F (°C)</b>	330 (166)
<b>Pour Point, °F (°C)</b>	-15 (-26)
<b>Gravity, °API</b>	21.6
<b>Shell Four Ball Wear Scar, MM</b>	0.68
<b>Corrosion Protection</b>	90 Days Maximum
(Accelerated humidity testing 100% R.H. @120°F)	
<b>Weight Per Gallon, Pound</b>	7.696

The information furnished herein is based on observations believed to be reliable, but American Oil & Supply Co. does not guarantee the results to be accurate and makes no warranties, expressed or implied. **Vitalife®** is a registered trademark of American Oil & Supply Co.



American Oil & Supply International, LLC

**MATERIAL SAFETY DATA SHEET**

**Section 1: Chemical Product and Company Identification**

**Vitalife® 400**

**Wire Rope Lubricant**

**Product Code: 50007**

**Manufacturer:**  
American Oil & Supply International LL  
4445 N A1A, Suite 247  
Vero Beach, FL 32963

**Emergency Telephone Numbers**  
1-732-389-5514 M-F 9am—5PM  
1-732-539-7717 After Hours

**Supplier:**  
Crosby Group Inc.  
PO Box 3128  
Tulsa, OK 74101

**Information: 918/834-4611**  
**24 Hr Emergency Telephone:**  
Domestic: 1-800-451-8346  
Intl: 00-1-703-527-3887

**Section 2: Composition, Information on Ingredients**

Hydrotreated Heavy Naphthenic Distillate	CAS Registry #
00840600 # 5005P	64742-52-5
	(Trade Secret)
00840600 # 5006P	(Trade Secret)

**OSHA HAZARDOUS COMPONENTS (29 CFR 1910.1200)**

Based on the data available to American Oil & Supply Co., this product is not considered a hazard under OSHA Hazard Communication Standard 29 CFR 1910.1200.

Exposure limit for oil mist in air: **TWA**

- |  |                  |   |
|--|------------------|---|
| • Chemical Family: Petroleum Hydrocarbon | ACGIH, TLV(ppm)  | 5 |
| • Hazardous Ingredients: None Known      | OSHA,PELS (ppm)  | 5 |
|  | NIOSH, TWA (ppm) | 5 |

**Section 3: Hazards Identification**

**Overview**

Dark amber, turbid liquid with slight odor. Can burn in a fire

**Potential Health Effects:**

**Inhalation:** Will not produce vapors unless heated to temperatures of 300 F.

**Eye Contact:** Irritating, but will not permanently injure eye tissue.

**Skin Contact:** Prolonged or repeated contact may cause skin irritation.

**Ingestion:** Small amounts (Tablespoonful) swallowed are not likely to cause injury. Larger amounts may cause nausea and Vomiting. Consult a physician promptly.

**Chronic (Cancer) Information:** IARC Monographs state that when laboratory animals are exposed to severely hydrotreated oil, such as these products, there is insufficient evidence for cancer. Thus, these oils are Unlabeled in accordance with 29 CFR 1910.1200.

**Section 4: First Aid Measures**

- **Eye Contact:** Flush eyes with plenty of water for several minutes. Get medical attention if irritation persists.
- **Skin:** Wash skin with plenty of soap and water for several minutes. Get medical attention if irritation persists
- **Ingestion:** If more than several mouthfuls have been swallowed, give two glasses of water (16oz). Get medical attention.
- **Inhalation:** If irritation, headache, nausea, or drowsiness occurs, remove to fresh air. Get medical attention if breathing becomes difficult or symptoms persist.

**Section 5: Fire Fighting Measures**

Flashpoint & Method: 330° F/166°C (COC), 395°F/202°C (CC)

Flammable Limits: LFL & UFL are not available

Autoignition Temperature: Not Available

NFPA	
Fire	1
Health	1
Reactivity	0
Spec. Haz.	No

HMIS	
Health	1
Flammability	1
Reactivity	0
PPI	B

According to NFPA Guide, use water spray, dry chemical, foam, or carbon dioxide. Water or foam may cause frothing. Use water to cool fire exposed containers. If a leak or spill has not ignited, use water spray to disperse the vapors and to provide protection for persons attempting to stop the leak.

**Section 6: Accidental Release Measures**

- Notify the appropriate authorities immediately. Contain spill, if possible. Avoid breathing vapor. Use self contained breathing apparatus or supplied air for large spills or in confined areas. Wipe up or use suitable absorbent material and shovel into appropriate container for disposal. Prevent entry into sewers of waterways. Avoid contact with skin, eyes or clothing.

**Section 7: Handling and Storage**

- Minimum feasible handling temperatures should be maintained. Periods of exposure to high temperature should be minimized. Water contamination should be avoided.

**Section 8: Exposure Controls, Personal Protection**

**Protective Equipment:**

**EYE/FACE PROTECTION:** Chemical type goggles or face shield recommended to prevent eye exposure.

**SKIN PROTECTION:** Workers should wash exposed skin several times daily with soap and water. Soiled clothing should be laundered or dry cleaned at least weekly.

**Respiratory Protection:** Airborne concentrations should be kept to lowest levels. If vapor is generated, use respirator approved by OSHA or NIOSH as appropriate. Supplied air respiratory protection should be used for cleaning large spills or upon entry into tanks, vessels, or other confined spaces.

**Ventilation:** Must be adequate to meet exposure limits below.

**Exposure Limit:** (Total Product) 5 mg/m3 for mineral oil mist over an 8 hour daily exposure (ACGIH)

**Section 9: Physical and Chemical Properties**

Vapor Pressure torr @ 24 C:	<7 x 10 <sup>-3</sup>	Vapor Density:	>8.0 (Air=1)
Specific Gravity:	0.910 (H <sub>2</sub> O=1)	Evaporation Rate:	<0.001 (butyl acetate=1)
Solubility in Water:	Insoluble	Freezing Point:	Not applicable
pH:	Not relevant	Odor:	Slight
Boiling Point:	>400°F/>148°C	Appearance:	Dark amber, turbid liquid
Viscosity:	275/300 SUS at 100°F	Weight Per Pound	7.696

**Section 10: Stability and Reactivity**

General: Vitalife 400 is stable; hazardous polymerization will not occur.

Materials & Conditions to Avoid: Strong oxidants; acid or alkali. Will react with strong oxidizers

Hazardous Decomposition Products: Carbon Monoxide in case of incomplete combustion.

**Section 11: Toxicological Information**

(Animal Toxicity Data)

Median Lethal Dose (LD50 LC50)

Oral

Inhalation

Dermal

Irritation Index:

Skin:

Eyes:

Sensitization

Other:

(Species)

Believed to be >5g/kg (rat): Practically non-toxic

Not Determined

Believed to be >3g/kg (rat) Practically non-toxic

Estimation of Irritation (Species)

Believed to be <0.5/8.0 (rabbit); no appreciable effect

Believed to be <15/110 (rabbit); no appreciable effects

Not Applicable

None

**Section 12: Ecological Information**

No data is available on the adverse effects of this material on the environment. A film or sheen will cause discoloration of the water surface or adjoining shoreline.

**Section 13: Disposal Information**

This product has been evaluated for RCRA characteristics and does not meet the criteria of a hazardous waste if discarded in its purchased form. Under RCRA it is the responsibility of the user of the product to determine at the time of disposal, whether the product meets RCRA criteria for hazardous waste. This product is subject in service to chemical alteration, which may render the resulting material hazardous. Purchaser must follow all local, state and federal laws and should check with local governmental office for disposal information.

**Section 14: Transport Information**

DOT, ICAO/IATA and IMO – Not Regulated

**Section 15: Regulatory Information**

**TSCA:** All components of this material are listed in the U.S. TSCA Inventory.

**OSHA:** IARC Monographs state that when laboratory animals are exposed to severely hydrotreated oils such as these products, there is insufficient evidence for cancer. Thus, these oils are unlabeled in accordance with 29 CFR 1910.1200

**SARA Title III:** Section 302/304 Extremely Hazardous Substance (**NONE**) Section 313 Toxic Chemicals (**NONE**)

**CERCLA:** Section 102 (a) Hazardous Substance (**No Reportable Quantity (RQ) Substances**)

**CALIFORNIA PROPOSTION # 65** (NOT LISTED)

**Canadian Domestic Substances List:** (All components are listed)

- The information herein is presented in good faith and believed to be accurate as of the revision date shown above. However, no warranty, expressed or implied, is given. It is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws.

# VITALIFE® BIO-LUBE



# VITALIFE®

WIRE ROPE LUBRICANT



## Product Description

**Vitalife® BIO LUBE** is for environmentally sensitive applications. **Vitalife® BIO-LUBE** is a unique light-bodied wire rope lubricant and protector built from environmentally safe base fluids. For field application it offers outstanding lubrication, penetration, and preservation of wire ropes. The consistency of **Vitalife® BIO-LUBE** makes it suitable for manual and automatic application. It can be applied with relative ease even under the most severe climatic conditions.

**Vitalife® BIO-LUBE** is produced from the highest quality readily biodegradable oil base stocks. In addition to having excellent lubricating properties, they contain selected additives to obtain acid and alkali resistance; water displacing properties; excellent rust prevention, oxidation stability and penetration. The high polarity of **Vitalife® BIO-LUBE** enables it to creep and “wet” the metal surface forming an adhesive and protective film.

## Product Benefits and Features

Light-bodied oil · provides the ability to penetrate to the core of wire rope · wire ropes are cleaner and easy to inspect · penetrates the interstices between wires and strands · high film strength · prevents wear · resists oxidation and corrosion · self-healing film former · excellent in acid or alkali and pollutants' environmentally friendly · bio-degradable · high polarity promotes creeping and re-lubrication of areas forced dry of oil.

## Major Applications

Field lubrication for wire ropes in service. All sizes of standing and running ropes as used on suspension and lift bridges, tramways and cableways. All types of cranes, escalators, derricks, masts and chimneys. Also on hoist ropes, draglines, conveyors and material handling equipment. Major industries served include surface and underground mining, construction, towing, marine, gas and petroleum, on and off shore drilling, to name a few.

## Methods of Application

**Vitalife® BIO-LUBE** has been tested and proven directly compatible with Crosby **Vitalife®** Spray Applicators (see Crosby Catalog). The use of **Vitalife® BIO-LUBE** in Crosby **Vitalife®** Spray Applicators is recommended. Other methods of application include manual by brush, swab, drip, pour, automatic drip or spray systems and automatic pressure wire rope lubricators. This product is also available in an aerosol can.

## Typical Properties

<b>Appearance</b>	Amber Liquid
<b>Viscosity, SUS @ 100 °C</b>	9.70
<b>@ 40 °C</b>	48.31
<b>Flash Point, COC °F (°C)</b>	550 (288)
<b>Pour Point, °F (°C)</b>	-38.2 (-36)
<b>Gravity, °API</b>	
<b>Corrosion Protection</b>	No Corrosion after 168 Hours
(Accelerated humidity testing 100% R.H. @ 120°F)	
<b>Weight Per Gallon, Pound</b>	

The information furnished herein is based on observations believed to be reliable, but American Oil & Supply Co. does not guarantee the results to be accurate and makes no warranties, expressed or implied. **Vitalife®** is a registered trademark of American Oil & Supply Co.



American Oil & Supply International, LLC

phone: 732.345.8213 | fax: 732.345.8216 | 766 Shrewsbury Avenue, Tinton Falls, NJ 07757 | [www.americanoil1895.com](http://www.americanoil1895.com)

**MATERIAL SAFETY DATA SHEET**

**Section 1: Chemical Product and Company Identification**

**Vitalife® BIO-LUBE**  
**Wire Rope Lubricant**  
**Product Code: 50008JG**

**Manufacturer:**  
American Oil & Supply International LL  
4445 N A1A, Suite 247  
Vero Beach, FL 32963

**Emergency Telephone Numbers**  
1-732-389-5514 M-F 9am—5PM  
1-732-539-7717 After Hours

**Supplier:**  
Crosby Group Inc.  
PO Box 3128  
Tulsa, OK 74101

**Information: 918/834-4611**  
**24 Hr Emergency Telephone:**  
Domestic: 1-800-451-8346  
Intl: 00-1-703-527-3887

**Section 2: Composition, Information on Ingredients**

INGREDIENT	CAS NUMBER	OSHA TWA	NIOSH TWA	ACGIH TWA	IDHL	% WT
Rapeseed Oil	120962-03-0	N/E	N/E	N/W	N/E	

**Section 3: Hazards Identification**

Emergency Overview

CONTENEN FLAMMABLE AND UNDER PRESSURE. STORE BELOW 120°F, OUT OF SUNLIGHT AND AWAY FROM HEAT SOURCES. DO NOT PUNCTURE OR INCENERATE. AVOID CONTACT WITH SKIN AND EYES. VAPOR HARMVUL. INTENTIONAL MISUSE BY DELIVERABLY CONCENTRAING AND INHALING THE CONTENTS MAY BE HARMFUL OR FATAL

Potential Health Effects:

**Inhalation: Prolonged or repeated overexposure is anesthetic. May cause irritation of the respiratory tract, or acute nervous system depression characterized by headache, dizziness, staggering gait or confusion**

**Eye Contact:** liquid or vapors may cause redness, burning, tearing, swelling, and/or pain.

**Skin Contact:** Frequent or prolonged contact can result in defatting and drying of the skin, which may result in skin irritation and dermatitis.

**Ingestion:** Due to being an aerosol, the product does not lend itself to ingestion. Should ingestion occur, it may cause irritation to membranes of the mouth, throat, and gastrointestinal tract resulting in vomiting and/or cramps.

**Chronic (Cancer) Information:** Antimony Oxide is listed with IARC as Class 2B (Possible Human Carcinogen) and with ACGIH as Class A2 (Suspected Human Carcinogen). It is not listed with OSHA or NTP as being carcinogenic. None of the other ingredients in this product are listed with OSHA, ACGIH, IARC, OR NTP as being carcinogenic.

Medical Conditions Aggravated: Skin contact may aggravate an existing dermatitis. Other conditions unknown.

Primary Hazards: Sinsory Irritation.

**Section 4: First Aid Measures**

- **Eye Contact:** Immediately flush with clear water for at least 15 minutes. Make sure to flush under the eyelids. Consult a physician for definitive treatment.
- **Skin:** Remove with soap and water. Consult a physician if irritation continues.
- **Ingestion: Unlikely due to being in aerosol form. Should actual ingestion occur, do not induce vomiting! Drink a glass of water or milk to dilute. Contact a physician. Never give anything by mouth to an unconscious person.**
- **Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is disscult, give oxygen. Seek medical attention if symptoms persist or if unconscious.**

**Section 5: Fire Fighting Measures**

Flashpoint: <95 F (>35C) Closed Cup flammable Limits: Lower (LEL): 1.8% Upper (UEL): 9.5%

Extinguishing Media: For warehouse and storage conditions, use NFPA Class B extinguishers (CO<sub>2</sub> dry chemical, or universal aqueous film forming foam)>

Special Fire Fighting Procedures: Use water spray to cool fire exposed aerosol containers, for contents can reapture violently from heat developed pressure. Firemen should wear self-contained breathing apparatus.

Unusual Fire and Explosion Hazards: Contents extremely flammable and under pressure. In addition, when liquid or vapor comes into contact with flames or red hot metal, products of combustion may be created.

**Section 6: Accidental Release Measures**

Containment Procedure: Product is an aerosol, therefore spills and leaks are unlikely. In case of rupture, released content should be contained as any other solvent spill.

Spill Cleanup: Spills from aerosol cans are unlikely and are generally of small volume. Large spills are therefore not normally considered a problem. In case of actual rupture, avoid breathing vapors and ventilate area well. Remove sources of ignition and use non-sparking equipment. Soak up material with inert absorbent and place in safty containers for proper disposal.

Special Instructions: Aerosol products represent a limited hazard and will not spill or leak unless reaptured. In case of rupture contents are generally evacuated from the can rapidly. Area should be ventilated immediately and continuous ventilation provided until all fumes and vapors have been removed. Aerosol cans should never be incinerated or burned. See Section 13 for disposal considerations.

Reporting Requirements: Spills due to the rupture of a single aerosol can are generally below and regulatory reporting requirements. However, if larger spill somehow result, the reporting requirements of the EPA and other local, state and federal agencies should be observed.

**Section 7: Handling and Storage**

**Handling:** Avoid prolonged or repeated skin contact. Avoid breathing of vapors. Do not incinerate (burn) containers. Always replace overcap when not in use. **Storage:** Storage of individual cans should be in an area below 120°F and away from heat sources. Assure can is in a secure place to prevent knocking over and accidental rupture. For storage of pallet quantities compliance with NFPA 30B (Manufacture and Storage of Aerosol Products) is recommended. This product is classified as a Level 3 Aerosol.

**Section 8: Exposure Controls, Personal Protection**

**Eye Protection:** Safety glasses with side shields are recommended as a minimum for any type of industrial chemical handling. Where eye contact with the material could occur, chemical splash proof goggles are recommended.

**Skin Protection:** For brief contact, no precautions other than clean body-covering clothing should be needed. When prolonged or repeated contact could occur, use protective clothing impervious to the ingredients listed in Section 2.

**Respiratory Protection:** Atmospheric levels should be maintained below the exposure guideline. When respiratory protection is required, an appropriate NIOSH approved respirator for organic vapor should be worn. If respirators are needed, compliance with OSHA standard 29 CFR 1910.134 is necessary.

**Engineering Controls:** General ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. Local exhaust ventilation or an enclosed handling system may be necessary to control air contamination below that of the lowest TLV/PEL rated ingredient from Section 2.

**Section 9: Physical and Chemical Properties**

Boiling Point:	Propellant <0°F	Freezing Point	Not established
Specific Gravity (H <sub>2</sub> O=1)	Below 1.0	Vapor Pressure	Not established
Vapor Density (Air=1)	Above 1.0	Water Solubility	Negligible
Percent Volative	93.0% Wt Max	Evaporation Rate	Not established
Appearance	Clear liquid	Odor	Minimal

**Section 10: Stability and Reactivity**

Stability:	Stable	Incompatibilities:	Strong oxidizing materials
Hazard polymerization	Will not occur	Decomposition products	Oxides of carbon
Conditions to avoid:	Heat, sparks, flame, red hot metal		

**Section 11: Toxicological Information**

INGREDIENT	ORAL LD50	DERMAL LD50	INHALATION LC50
Liquified Petroleum Gas	No Date	No Date	No Date
Botanical Base Fluids	No Date	No Date	No Date

**Section 12: Ecological Information**

No data is available on the adverse effects of this material on the environment.

**Section 13: Disposal Information**

An aerosol container that does not contain a significant amount of liquid would meet the definition of scrap metal (40 CFR 261.1(c)(6)) and would be exempt from RCRA regulation under 40 CFR 261.6(a)(3)(iv) if it is to be recycled. If containers are to be disposed of (not recycled) they must be managed under applicable RCRA and state regulations.

**Section 14: Transport Information**

NMFC Description: Oils other than Petroleum, Rapeseed Oils, NOI Item 155250 Sub 1, Class 65

DOT Hazardous Materials Description: Consumer Commodity, ORM-D

UN and ICAO/IATA Dangerous Goods Description: Consumer Commodity, 9, ID8000

IMDG Dangerous Goods Description: Aerosol, 2, UN1950, Limited Quantity EmS No. 2-13 MFAG No. 620  
(Limited quantity provisions apply as shipped by supplier and may not apply if repacked for subsequent re-shipment)

**Section 15: Regulatory Information**

United States – Federal		CAS No.	TSCA	RCRA	CERCLA	SARA 313	CAA	CWA	
Ingredient									
Liquified Petroleum Gas		68476-85-7	**	-	-	-	-	-	
Hydrotreated Heavy Naphthenic Distillate		64742-52-5	**	-	-	-	-	-	
United States – States		CA	FL	MA	PA	MN	NJ	NY	WA
Ingredient									
Liquefied Petroleum Gas		-	-	2,4	-	-	-	-	-
Hydrotreated Heavy Naphthenic Distillate		-	-	-	-	-	-	-	-

**Section 16: Other Information**

National Fire Protection Association/Hazardous Materials Identification System Rating

	Health	Fire	Reactivity	Special
NFPA	1	3	0	-
HMIS	1	3	0	B

- The information herein is presented in good faith and believed to be accurate as of the revision date shown above. However, no warranty, expressed or implied, is given. It is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws.

## Appendix 4.4.5.20

Mobil DTE-26M



## Mobil DTE™ 20 Series

### Hydraulic Oils

#### Product Description

Mobil DTE™ 20 Series oils are supreme performance anti-wear hydraulic oils designed to satisfy a wide range of hydraulic equipment requirements. They provide long oil/filter life and optimum equipment protection reducing both maintenance costs and product disposal costs. They were developed in conjunction with the major builders to meet the stringent requirements of severe hydraulic systems using high pressure, high output pumps as well as handling the critical requirements of other hydraulic system components such as close clearance servo-valves and the high accuracy numerically controlled (NC) machine tools. These products meet the most rigorous performance requirements of a wide range of hydraulic system and component manufacturers using various multi-metallurgy designs allowing a single product with outstanding performance characteristics.

The DTE 20 Series oils are formulated with high quality base oils and a super-stabilised additive system that neutralises the formation of corrosive materials. They are designed to work with systems operating under severe conditions where high levels of antiwear and film strength protection are needed, yet they are formulated to work where non-antiwear hydraulic oils are generally recommended.

#### Features and Benefits

The Mobil DTE 20 Series hydraulic oils provide outstanding oxidation resistance allowing extension of oil and filter change intervals. Their high level of anti-wear properties and excellent film strength characteristics result in exceptional equipment performance that not only results in fewer breakdowns but helps improve production capacity. Their detergency and keep clean properties offer service over a wide range of system cleanlinesses while their controlled demulsibility permits the oils to work well in systems contaminated with small amounts of water yet readily separate large amounts of water.

Features	Advantages and Potential Benefits
Anti-wear	Helps reduce wear Protects systems using various metallurgy
Quality Reserve	Maintains performance features even under severe service conditions and extended drain intervals Helps improve system cleanliness
Oxidation Stability	Provides long oil and equipment life Helps extend filter life
Corrosion Protection	Prevents internal hydraulic system corrosion Helps reduce the negative effects of moisture in systems Provides corrosion protection of multi-metallurgy component designs
Meets a Wide Range of equipment requirements	One product can replace several products, minimizing inventory requirements Helps reduce potential for product misapplication
Air Separation Characteristics	Reduces foaming potential and it's negative effects
Water Separation	Protects systems where small quantities of moisture are present Readily separates larger quantities of water



<b>Mobil DTE 20 Series</b>	<b>21</b>	<b>22</b>	<b>24</b>	<b>25</b>	<b>26</b>	<b>27</b>	<b>28</b>
Pour Point, °C, ASTM D 97	-30	-30	-27	-27	-21	-21	-15
Flash Point, °C, ASTM D 92	174	200	220	232	236	248	276
FZG 4-Square Load Support, DIN 51354, Fail Stage	-	-	12	12	12	12	12
Foam Sequence I, II, III, ASTM D 892 , ml	20/0	20/0	20/0	20/0	20/0	20/0	20/0

## Health and Safety

Based on available information, this product is not expected to produce adverse effects on health when used for the intended application and the recommendations provided in the Material Safety Data Sheet (MSDS) are followed. MSDS's are available upon request through your sales contract office, or via the Internet. This product should not be used for purposes other than its intended use. If disposing of used product, take care to protect the environment.

All trademarks used herein are trademarks or registered trademarks of Exxon Mobil Corporation or one of its subsidiaries unless indicated otherwise.

9-2014

Exxon Mobil Corporation  
3225 Gallows Road  
Fairfax, VA 22037

1-800-ASK MOBIL (275-6624)

Typical Properties are typical of those obtained with normal production tolerance and do not constitute a specification. Variations that do not affect product performance are to be expected during normal manufacture and at different blending locations. The information contained herein is subject to change without notice. All products may not be available locally. For more information, contact your local ExxonMobil contact or visit [www.exxonmobil.com](http://www.exxonmobil.com). ExxonMobil is comprised of numerous affiliates and subsidiaries, many with names that include Esso, Mobil, or ExxonMobil. Nothing in this document is intended to override or supersede the corporate separateness of local entities. Responsibility for local action and accountability remains with the local ExxonMobil-affiliate entities.

Copyright © 2001-2014 Exxon Mobil Corporation. All rights reserved.

## MATERIAL SAFETY DATA SHEET

### SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

#### PRODUCT

**Product Name:** MOBIL DTE 26  
**Product Description:** Base Oil and Additives  
**Product Code:** 201560102030, 602649-00, 970101  
**Intended Use:** Hydraulic fluid

#### COMPANY IDENTIFICATION

**Supplier:** EXXON MOBIL CORPORATION  
3225 GALLOWS RD.  
FAIRFAX, VA. 22037 USA

**24 Hour Health Emergency** 609-737-4411  
**Transportation Emergency Phone** 800-424-9300  
**ExxonMobil Transportation No.** 281-834-3296  
**Product Technical Information** 800-662-4525, 800-947-9147  
**MSDS Internet Address** <http://www.exxon.com>, <http://www.mobil.com>

### SECTION 2 COMPOSITION / INFORMATION ON INGREDIENTS

No Reportable Hazardous Substance(s) or Complex Substance(s).

### SECTION 3 HAZARDS IDENTIFICATION

This material is not considered to be hazardous according to regulatory guidelines (see (M)SDS Section 15).

#### POTENTIAL HEALTH EFFECTS

Excessive exposure may result in eye, skin, or respiratory irritation. High-pressure injection under skin may cause serious damage.

<b>NFPA Hazard ID:</b>	Health: 0	Flammability: 1	Reactivity: 0
<b>HMIS Hazard ID:</b>	Health: 0	Flammability: 1	Reactivity: 0

**NOTE:** This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

### SECTION 4 FIRST AID MEASURES

#### INHALATION

Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use

Product Name: MOBIL DTE 26

Revision Date: 12 Oct 2012

Page 2 of 9

adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

#### SKIN CONTACT

Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

#### EYE CONTACT

Flush thoroughly with water. If irritation occurs, get medical assistance.

#### INGESTION

First aid is normally not required. Seek medical attention if discomfort occurs.

### SECTION 5 FIRE FIGHTING MEASURES

#### EXTINGUISHING MEDIA

**Appropriate Extinguishing Media:** Use water fog, foam, dry chemical or carbon dioxide (CO<sub>2</sub>) to extinguish flames.

**Inappropriate Extinguishing Media:** Straight Streams of Water

#### FIRE FIGHTING

**Fire Fighting Instructions:** Evacuate area. Prevent runoff from fire control or dilution from entering streams, sewers, or drinking water supply. Firefighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

**Unusual Fire Hazards:** Pressurized mists may form a flammable mixture.

**Hazardous Combustion Products:** Smoke, Fume, Aldehydes, Sulfur oxides, Incomplete combustion products, Oxides of carbon

#### FLAMMABILITY PROPERTIES

**Flash Point [Method]:** >204°C (399°F) [ASTM D-92]

**Flammable Limits (Approximate volume % in air):** LEL: 0.9 UEL: 7.0

**Autoignition Temperature:** N/D

### SECTION 6 ACCIDENTAL RELEASE MEASURES

#### NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations. US regulations require reporting releases of this material to the environment which exceed the applicable reportable quantity or oil spills which could reach any waterway including intermittent dry creeks. The

Product Name: MOBIL DTE 26

Revision Date: 12 Oct 2012

Page 3 of 9

---

National Response Center can be reached at (800)424-8802.

## PROTECTIVE MEASURES

Avoid contact with spilled material. See Section 5 for fire fighting information. See the Hazard Identification Section for Significant Hazards. See Section 4 for First Aid Advice. See Section 8 for advice on the minimum requirements for personal protective equipment. Additional protective measures may be necessary, depending on the specific circumstances and/or the expert judgment of the emergency responders. For emergency responders: Respiratory protection: respiratory protection will be necessary only in special cases, e.g., formation of mists. Half-face or full-face respirator with filter(s) for dust/organic vapor or Self Contained Breathing Apparatus (SCBA) can be used depending on the size of spill and potential level of exposure. If the exposure cannot be completely characterized or an oxygen deficient atmosphere is possible or anticipated, SCBA is recommended. Work gloves that are resistant to hydrocarbons are recommended. Gloves made of polyvinyl acetate (PVA) are not water-resistant and are not suitable for emergency use. Chemical goggles are recommended if splashes or contact with eyes is possible. Small spills: normal antistatic work clothes are usually adequate. Large spills: full body suit of chemical resistant, antistatic material is recommended.

## SPILL MANAGEMENT

**Land Spill:** Stop leak if you can do it without risk. Recover by pumping or with suitable absorbent.

**Water Spill:** Stop leak if you can do it without risk. Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist before using dispersants.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

## ENVIRONMENTAL PRECAUTIONS

Large Spills: Dike far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

<b>SECTION 7</b>
------------------

<b>HANDLING AND STORAGE</b>
-----------------------------

## HANDLING

Prevent small spills and leakage to avoid slip hazard. Material can accumulate static charges which may cause an electrical spark (ignition source). When the material is handled in bulk, an electrical spark could ignite any flammable vapors from liquids or residues that may be present (e.g., during switch-loading operations). Use proper bonding and/or ground procedures. However, bonding and grounds may not eliminate the hazard from static accumulation. Consult local applicable standards for guidance. Additional references include American Petroleum Institute 2003 (Protection Against Ignitions Arising out of Static, Lightning and Stray Currents) or National Fire Protection Agency 77 (Recommended Practice on Static Electricity) or CENELEC CLC/TR 50404 (Electrostatics - Code of practice for the avoidance of hazards due to static electricity).

**Static Accumulator:** This material is a static accumulator.

## STORAGE

The container choice, for example storage vessel, may effect static accumulation and dissipation. Do not store in open or unlabelled containers.

## SECTION 8

## EXPOSURE CONTROLS / PERSONAL PROTECTION

**Exposure limits/standards for materials that can be formed when handling this product:** When mists/aerosols can occur the following are recommended: 5 mg/m<sup>3</sup> - ACGIH TLV (inhalable fraction), 5 mg/m<sup>3</sup> - OSHA PEL.

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

### ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

No special requirements under ordinary conditions of use and with adequate ventilation.

### PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

**Respiratory Protection:** If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

No special requirements under ordinary conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapor warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

**Hand Protection:** Any specific glove information provided is based on published literature and glove manufacturer data. Glove suitability and breakthrough time will differ depending on the specific use conditions. Contact the glove manufacturer for specific advice on glove selection and breakthrough times for your use conditions. Inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

No protection is ordinarily required under normal conditions of use.

**Eye Protection:** If contact is likely, safety glasses with side shields are recommended.

**Skin and Body Protection:** Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

No skin protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid skin contact.

**Specific Hygiene Measures:** Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practice good housekeeping.

Product Name: MOBIL DTE 26

Revision Date: 12 Oct 2012

Page 5 of 9

## ENVIRONMENTAL CONTROLS

Comply with applicable environmental regulations limiting discharge to air, water and soil. Protect the environment by applying appropriate control measures to prevent or limit emissions.

## SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

**Note:** Physical and chemical properties are provided for safety, health and environmental considerations only and may not fully represent product specifications. Contact the Supplier for additional information.

### GENERAL INFORMATION

**Physical State:** Liquid

**Color:** Brown

**Odor:** Characteristic

**Odor Threshold:** N/D

### IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

**Relative Density (at 15.6 °C):** 0.881

**Flash Point [Method]:** >204°C (399°F) [ASTM D-92]

**Flammable Limits (Approximate volume % in air):** LEL: 0.9 UEL: 7.0

**Autoignition Temperature:** N/D

**Boiling Point / Range:** > 316°C (600°F)

**Vapor Density (Air = 1):** > 2 at 101 kPa

**Vapor Pressure:** < 0.013 kPa (0.1 mm Hg) at 20 °C

**Evaporation Rate (n-butyl acetate = 1):** N/D

**pH:** N/A

**Log Pow (n-Octanol/Water Partition Coefficient):** > 3.5

**Solubility in Water:** Negligible

**Viscosity:** 68 cSt (68 mm<sup>2</sup>/sec) at 40 °C

**Oxidizing Properties:** See Hazards Identification Section.

### OTHER INFORMATION

**Freezing Point:** N/D

**Melting Point:** N/A

**Pour Point:** -18°C (0°F)

**DMSO Extract (mineral oil only), IP-346:** < 3 %wt

## SECTION 10 STABILITY AND REACTIVITY

**STABILITY:** Material is stable under normal conditions.

**CONDITIONS TO AVOID:** Excessive heat. High energy sources of ignition.

**MATERIALS TO AVOID:** Strong oxidizers

**HAZARDOUS DECOMPOSITION PRODUCTS:** Material does not decompose at ambient temperatures.

**HAZARDOUS POLYMERIZATION:** Will not occur.

Product Name: MOBIL DTE 26

Revision Date: 12 Oct 2012

Page 6 of 9

<b>SECTION 11</b>	<b>TOXICOLOGICAL INFORMATION</b>
-------------------	----------------------------------

**ACUTE TOXICITY**

Route of Exposure	Conclusion / Remarks
<b>Inhalation</b>	
Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Irritation: No end point data for material.	Negligible hazard at ambient/normal handling temperatures. Based on assessment of the components.
<b>Ingestion</b>	
Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
<b>Skin</b>	
Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Irritation: No end point data for material.	Negligible irritation to skin at ambient temperatures. Based on assessment of the components.
<b>Eye</b>	
Irritation: No end point data for material.	May cause mild, short-lasting discomfort to eyes. Based on assessment of the components.

**CHRONIC/OTHER EFFECTS**

**Contains:**

Base oil severely refined: Not carcinogenic in animal studies. Representative material passes IP-346, Modified Ames test, and/or other screening tests. Dermal and inhalation studies showed minimal effects; lung non-specific infiltration of immune cells, oil deposition and minimal granuloma formation. Not sensitizing in test animals.

Additional information is available by request.

The following ingredients are cited on the lists below: None.

--REGULATORY LISTS SEARCHED--

1 = NTP CARC

2 = NTP SUS

3 = IARC 1

4 = IARC 2A

5 = IARC 2B

6 = OSHA CARC

<b>SECTION 12</b>	<b>ECOLOGICAL INFORMATION</b>
-------------------	-------------------------------

The information given is based on data available for the material, the components of the material, and similar materials.

**ECOTOXICITY**

Material -- Not expected to be harmful to aquatic organisms.

**MOBILITY**

Base oil component -- Low solubility and floats and is expected to migrate from water to the land. Expected to partition to sediment and wastewater solids.

**PERSISTENCE AND DEGRADABILITY**

**Biodegradation:**

---

Base oil component -- Expected to be inherently biodegradable

#### BIOACCUMULATION POTENTIAL

Base oil component -- Has the potential to bioaccumulate, however metabolism or physical properties may reduce the bioconcentration or limit bioavailability.

#### OTHER ECOLOGICAL INFORMATION

VOC: 0 G/L [ASTM E1868-10]

<b>SECTION 13</b>	<b>DISPOSAL CONSIDERATIONS</b>
-------------------	--------------------------------

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

#### DISPOSAL RECOMMENDATIONS

Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products. Protect the environment. Dispose of used oil at designated sites. Minimize skin contact. Do not mix used oils with solvents, brake fluids or coolants.

#### REGULATORY DISPOSAL INFORMATION

RCRA Information: The unused product, in our opinion, is not specifically listed by the EPA as a hazardous waste (40 CFR, Part 261D), nor is it formulated to contain materials which are listed as hazardous wastes. It does not exhibit the hazardous characteristics of ignitability, corrosivity or reactivity and is not formulated with contaminants as determined by the Toxicity Characteristic Leaching Procedure (TCLP). However, used product may be regulated.

**Empty Container Warning** Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. **DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.**

<b>SECTION 14</b>	<b>TRANSPORT INFORMATION</b>
-------------------	------------------------------

**LAND (DOT):** Not Regulated for Land Transport

**LAND (TDG):** Not Regulated for Land Transport

**SEA (IMDG):** Not Regulated for Sea Transport according to IMDG-Code

**AIR (IATA):** Not Regulated for Air Transport

Product Name: MOBIL DTE 26  
 Revision Date: 12 Oct 2012  
 Page 8 of 9

<b>SECTION 15</b>	<b>REGULATORY INFORMATION</b>
-------------------	-------------------------------

**OSHA HAZARD COMMUNICATION STANDARD:** When used for its intended purposes, this material is not classified as hazardous in accordance with OSHA 29 CFR 1910.1200.

**Complies with the following national/regional chemical inventory requirements::** AICS, DSL, ENCS, IECSC, KECI, PICCS, TSCA

**EPCRA SECTION 302:** This material contains no extremely hazardous substances.

**SARA (311/312) REPORTABLE HAZARD CATEGORIES:** None.

**SARA (313) TOXIC RELEASE INVENTORY:** This material contains no chemicals subject to the supplier notification requirements of the SARA 313 Toxic Release Program.

The following ingredients are cited on the lists below:

Chemical Name	CAS Number	List Citations
ZINC ALKYL DITHIOPHOSPHATE	68649-42-3	15

--REGULATORY LISTS SEARCHED--

- |               |                  |                   |             |
|---------------|------------------|-------------------|-------------|
| 1 = ACGIH ALL | 6 = TSCA 5a2     | 11 = CA P65 REPRO | 16 = MN RTK |
| 2 = ACGIH A1  | 7 = TSCA 5e      | 12 = CA RTK       | 17 = NJ RTK |
| 3 = ACGIH A2  | 8 = TSCA 6       | 13 = IL RTK       | 18 = PA RTK |
| 4 = OSHA Z    | 9 = TSCA 12b     | 14 = LA RTK       | 19 = RI RTK |
| 5 = TSCA 4    | 10 = CA P65 CARC | 15 = MI 293       |             |

Code key: CARC=Carcinogen; REPRO=Reproductive

<b>SECTION 16</b>	<b>OTHER INFORMATION</b>
-------------------	--------------------------

N/D = Not determined, N/A = Not applicable

**THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:**

- Revision Changes:
- Section 09: Boiling Point C(F) was modified.
  - Section 08: Comply with applicable regulations phrase was modified.
  - Section 09: Vapor Pressure was modified.
  - Section 07: Handling and Storage - Storage Phrases was modified.
  - Hazard Identification: Health Hazards was modified.
  - Section 11: Dermal Lethality Test Data was modified.
  - Section 11: Dermal Lethality Test Comment was modified.
  - Section 11: Oral Lethality Test Data was modified.
  - Section 11: Inhalation Lethality Test Data was modified.
  - Section 11: Dermal Irritation Test Data was modified.

Product Name: MOBIL DTE 26

Revision Date: 12 Oct 2012

Page 9 of 9

---

Section 11: Eye Irritation Test Data was modified.  
Section 11: Oral Lethality Test Comment was modified.  
Section 11: Inhalation Lethality Test Comment was modified.  
Section 11: Dermal Irritation Test Comment was modified.  
Section 11: Eye Irritation Test Comment was modified.  
Section 11: Inhalation Irritation Test Data was modified.  
Section 09: Relative Density - Header was modified.  
Section 09: Flash Point C(F) was modified.  
Section 09: Viscosity was modified.  
Section 14: LAND (TDG) - Header was modified.  
Section 15: National Chemical Inventory Listing was modified.  
Section 15: Community RTK - Header was modified.  
Section 12: Other Ecological Information - Header was added.  
Section 12: California VOC was added.  
Section 12: California VOC was added.

-----  
-----  
The information and recommendations contained herein are, to the best of ExxonMobil's knowledge and belief, accurate and reliable as of the date issued. You can contact ExxonMobil to insure that this document is the most current available from ExxonMobil. The information and recommendations are offered for the user's consideration and examination. It is the user's responsibility to satisfy itself that the product is suitable for the intended use. If buyer repackages this product, it is the user's responsibility to insure proper health, safety and other necessary information is included with and/or on the container. Appropriate warnings and safe-handling procedures should be provided to handlers and users. Alteration of this document is strictly prohibited. Except to the extent required by law, re-publication or retransmission of this document, in whole or in part, is not permitted. The term, "ExxonMobil" is used for convenience, and may include any one or more of ExxonMobil Chemical Company, Exxon Mobil Corporation, or any affiliates in which they directly or indirectly hold any interest.

-----  
Internal Use Only

MHC: 0B, 0B, 0, 0, 0, 0

PPEC: A

DGN: 2007812XUS (546747)

-----  
Copyright 2002 Exxon Mobil Corporation, All rights reserved

## **APPENDIX 4.5—Electrical**

***Appendix 4.5.1—Electrical Maintenance Check List***

# BASS HARBOR TRANSFER BRIDGE INSPECTION AND MAINTENANCE CHECKLIST (ELECTRICAL)

By: \_\_\_\_\_

Date: \_\_\_\_\_

**CAUTION: Use proper lockout/tagout procedures to ensure that maintenance personnel are safe from harm and injury during all inspection and maintenance activities.**

**CAUTION: Electrical components may be live and can cause serious injuries or death. Electrical safety equipment is highly recommended to individuals performing work on open cabinets or enclosures.**

**CAUTION: The engine generator may start automatically at any time. It is provided with a remote control in the automatic transfer switch. Prior to any work on this unit, turn off the automatic control.**

After every maintenance period:

- Restore electrical systems to their original status.
- Remove all inspection and maintenance equipment from the work area.
- Initiate repair work orders as required.
- Report serious deficiencies to the maintenance supervisor.

NOTES:

<h1 style="margin: 0;">BASS HARBOR TRANSFER BRIDGE</h1> <h2 style="margin: 0;">MAINTENANCE CHECKLIST</h2> <h3 style="margin: 0;">(ELECTRICAL)</h3>	<h1 style="font-size: 48px; margin: 0;">1</h1> <h2 style="font-size: 24px; margin: 0;">MONTH</h2>
--	---

<b>ELECTRICAL INSPECTION AND MAINTENANCE</b>	Performed By	Date
Inspect and exercise standby generator operation		
Inspect and test automatic/remote transfer switches		
Inspect flexible cables, conduit and cabinets for damage, corrosion and moisture build-up		
Inspect exterior lighting & photocells		
Inspect and test radio control system		
Inspect and test control switches		
Inspect and test pawl indication lights		
Exercise all limit switches		
<b>GENERATOR INSPECTION AND MAINTENANCE</b>	Performed By	Date
Inspect for leaking fluids		
Check coolant heater		
Check coolant level		
Check oil level		
Check fuel level		

<h1 style="margin: 0;">BASS HARBOR TRANSFER BRIDGE MAINTENANCE CHECKLIST (ELECTRICAL)</h1>	<h1 style="font-size: 48px; margin: 0;">3</h1>
	<h2 style="font-size: 24px; margin: 0;">MONTH</h2>

NOTE: Also include Monthly Maintenance Checklists at the quarterly maintenance interval.

<b>ELECTRICAL INSPECTION AND MAINTENANCE</b>	Performed By	Date
Inspect and test control equipment		
Inspect and test marine horn and radio		
Inspect panel heating		
<b>GENERATOR MAINTENANCE</b>	Performed By	Date
Check/clean air cleaner		
Check battery charger		
Drain fuel filter		
Drain water from fuel tank		
Trim surrounding vegetation		

<h1 style="margin: 0;">BASS HARBOR TRANSFER BRIDGE</h1> <h2 style="margin: 0;">MAINTENANCE CHECKLIST</h2> <h3 style="margin: 0;">(ELECTRICAL)</h3>	<h1 style="font-size: 48px; margin: 0;">6</h1> <h2 style="font-size: 24px; margin: 0;">MONTH</h2>
--	---

NOTE: Also include Monthly and Quarterly Maintenance Checklists at the semi-annual maintenance interval.

<b>ELECTRICAL INSPECTION AND MAINTENANCE</b>	Performed By	Date
Inspect and test bridge and apron hoist motors		
Inspect and test brakes and pawl operation		
Inspect and clean contactors and overload relays		
Inspect and clean control relays and timers		
Inspect and test limit switches and actuators		
Inspect operator control devices		
Test limit switch and lighting bypass switches		
Inspect all enclosure door and cover latches for tightness		
Inspect conduit and wiring systems for corrosion, evidence of water entry and terminal tightness		
Inspect GFI receptacles		
<b>GENERATOR MAINTENANCE</b>	Performed By	Date
Check coolant concentration		
Check drive belt tension		
Drain exhaust condensate		
Check starting batteries		
Check and clean louvers		

<h1 style="margin: 0;">BASS HARBOR TRANSFER BRIDGE</h1> <h2 style="margin: 0;">MAINTENANCE CHECKLIST</h2> <h3 style="margin: 0;">(ELECTRICAL)</h3>	<h1 style="font-size: 48px; margin: 0;">12</h1> <h2 style="font-size: 24px; margin: 0;">MONTH</h2>
--	--

NOTE: Also include Monthly, Quarterly and Semi-Annual Maintenance Checklists at the annual maintenance interval.

<b>ELECTRICAL INSPECTION AND MAINTENANCE</b>	Performed By	Date
Molded case circuit breakers – trip test (Biennially)		
Inspect breaker panels for water entry and hand actuate all breakers		
Inspect transformers for corrosion and evidence of overheating		
Inspect fuses for blown units and wiring termination tightness		
Inspect motor disconnect switches for water entry, door clasp tightness and exercise from external handle		
Inspect for corrosion, water entry and door clasp tightness		
Inspect surge arrestors for termination tightness		
<b>GENERATOR MAINTENANCE</b>	Performed By	Date
Check battery charger		
Change oil and filter		
Clean crankcase breather		
Change air cleaner element		
Check radiator hoses		
Change fuel filter		
Clean cooling system (Biennially)		

***Appendix 4.5.2—Electrical Spare Parts List***

**ELECTRICAL SPARE PARTS LIST**

Item	QTY	Manufacturer	Catalog #	Description	Location
CB-1	1	SIEMENS	ED42B060	2P, 480V, 60AT BREAKER – PANELBOARD RLP CIRCUIT BREAKER	CONTROL PANEL
CB-2	1	SIEMENS	ED41B020	1P, 480V, 20AT BREAKER – FLOODLIGHT CIRCUIT BREAKER	CONTROL PANEL
CB-3	0	SIEMENS	ED42B060	2P, 480V, 60AT BREAKER – SHIP- SHORE POWER CIRCUIT BREAKER	CONTROL PANEL
CB-4	1	SIEMENS	ED43B015	3P, 480V, 15AT BREAKER – APRON HOIST MOTOR CIRCUIT BREAKER	CONTROL PANEL
CB-5	1	SIEMENS	ED43B040	3P, 480V, 40AT BREAKER – BRIDGE HOIST MOTOR CIRCUIT BREAKER	CONTROL PANEL
CB-6	1	SIEMENS	ED42B015	2P, 480V, 15AT BREAKER – TOWER MAINTENANCE LIGHTING CIRCUIT BREAKER?	CONTROL PANEL
CB-M	1	SIEMENS	FXD63B150	3P, 600V, 150AT BREAKER – UTILITY SERVICE BREAKER	CONTROL PANEL

**ELECTRICAL SPARE PARTS LIST**

Item	QTY	Manufacturer	Catalog #	Description	Location
DISCONNECT MEANS #2	1	GE	GENERAL ELECTRIC TED134070WL	3P, 480V, 70A CIRCUIT BREAKER – SERVICE POWER DISCONNECT #2	
POWER DISTRIBUTION BLOCK	1	SQUARE D	9080LBC363206	3P, 600V POWER DISTRIBUTION BLOCK	CONTROL PANEL
DA-UA	1	SIEMENS	3TF4422-0A	120V COIL, 20A, 5 HP REVERSING CONTACTOR WITH 2NO & 2NC AUX CONTACTS -- APRON MOTOR STARTER	CONTROL PANEL
APRON MOTOR OVERLOAD RELAY	1	SIEMENS	3UA54 00-1G	3P, 6.3A OVERLOAD RELAY – APRON HOIST MOTOR OVERLOAD RELAY	CONTROL PANEL
APRON RELAY	1	SIEMENS	3TH4022-0A	120V COIL, INTERPOSING RELAY WITH 2NO AND 2NC CONTACTS – APRON MOTOR STARTER INTERPOSING RELAY	CONTROL PANEL
DB-UB	1	SIEMENS	3TF4222-0A	SIZE 1 120VAC COIL, 22.5A, 10 HP REVERSING CONTACTOR WITH 2NO & 2NC AUX CONTACTS -- HOIST MOTOR STARTER	CONTROL PANEL

**ELECTRICAL SPARE PARTS LIST**

Item	QTY	Manufacturer	Catalog #	Description	Location
HOIST MOTOR OVERLOAD RELAY	1	GE	CR324C WITH C151B HEATERS	SIZE 1, 3 POLE OVERLOAD RELAY – BRIDGE HOIST MOTOR STARTER	CONTROL PANEL
BU	1	SIEMENS	3TH4022-0A	120V COIL, INTERPOSING RELAY WITH 2NO AND 2NC CONTACTS – BRIDGE UP INTERPOSING RELAY	CONTROL PANEL
BD	1	SIEMENS	3TH4022-0A	120V COIL, INTERPOSING RELAY WITH 2NO AND 2NC CONTACTS – BRIDGE DOWN INTERPOSING RELAY	CONTROL PANEL
BRIDGE CONTACTOR U&D	0	SQUARE D	CLASS 8903 LIGHTING CONTACTOR	BRIDGE MOTOR STARTER INTERPOSING RELAY	CONTROL PANEL
SURGE ARRESTOR	1	DELTA	LA603	3PH 480V SURGE ARRESTOR	CONTROL PANEL
ENCLOSURE HEATER	1	HOFFMAN	D-AH8001B	120V, 800W ENCLOSURE HEATER	CONTROL PANEL
DOWN BR TDR	1	IDEC	RR2P-UL-AC120	120VAC DPDT RELAY – DOWN BRIDGE TIME DELAY RELAY	CONTROL PANEL
PAWL RELAY	1	CARLO GAVAZZI	RCP8 002	120VAC, 10A DPDT RELAY – PAWL RELAY	CONTROL PANEL

**ELECTRICAL SPARE PARTS LIST**

Item	QTY	Manufacturer	Catalog #	Description	Location
SOLID STATE TIMER	1	SSAC	TDUL3000A	BRIDGE DOWN FUNCTION RELAY (PAWL RELEASE) TIME DELAY RELAY	CONTROL PANEL
LIGHTING CONTACTOR	1	ASCO	92023030	2 POLE, 30A MECHANICALLY HELD REMOTE CONTROL SWITCH – “BASS HARBOR” SIGN LIGHTS	CONTROL PANEL
S1	1	GE	CR104PSG21B91	TOGGLE SWITCH -- "LOCKOUT REMOTE. BRIDGE CONTROL" LOCKS OUT BRIDGE CONTROL STATION AND RADIO CONTROL	CONTROL PANEL
S2	0	GE	CR104PSG21B91	TOGGLE SWITCH -- "BYPASS CABLE TENSION L.S." BYPASSES APRON CABLE TENSION LIMIT SWITCH	CONTROL PANEL
S3	0	GE	CR104PSG21B91	TOGGLE SWITCH -- "BYPASS BRIDGE RAISE L.S." – BYPASSES BRIDGE FULLY RAISED LIMIT SWITCH	CONTROL PANEL

**ELECTRICAL SPARE PARTS LIST**

Item	QTY	Manufacturer	Catalog #	Description	Location
S4	0	GE	CR104PSG21B91	TOGGLE SWITCH -- "BYPASS BRIDGE LOWER L.S." – BYPASSES BRIDGE FULLY LOWERED LIMIT SWITCH	CONTROL PANEL
S6	0	GE	CR104PSG21B91	TOGGLE SWITCH – "BYPASS REMOTE CONTROL LIGHTS" – BYPASSES REMOTE CONTROL FOR LIGHTING	CONTROL PANEL
CONTROL PANEL RECEPTACLE	1		LOCAL PURCHASE	GFI RECEPTACLE	CONTROL PANEL
MAIN BREAKER	1	SIEMENS	Q280H	MAIN RLP BREAKER	RLP PANEL
CB (1)	1	SIEMENS	Q120H	BRIDGE CONTROL POWER	RLP PANEL
CB (2)	1	SIEMENS	Q120H	PLATFORM LIGHTS	RLP PANEL
CB (3)	1	SIEMENS	Q120H	CABINET HEATER	RLP PANEL
CB (4)	0	SIEMENS	Q120H	PLATFORM RECEPTACLE	RLP PANEL
CB (5)	0	SIEMENS	Q120H	CABINET RECEPTACLE	RLP PANEL
CB (6)	0	SIEMENS	Q120H	RADIO RECEIVER	RLP PANEL
CB (7)	0	SIEMENS	Q120H	SPARE	RLP PANEL
CB (8)	0	SIEMENS	Q120H	RADIO RECEIVER HEATER, APRON H&R	RLP PANEL
CB (9)	1	SIEMENS	Q120H	SPARE	RLP PANEL
CB (10)	1	SIEMENS	Q120H	FLOODLIGHTS	RLP PANEL
CB (11)	1	SIEMENS	Q120H	SPARE	RLP PANEL
CB (12)	0	SIEMENS	Q120H	FLOODLIGHTS	RLP PANEL
CB (13, 15)	1	SIEMENS	Q230H	UNKNOWN BREAKER	RLP PANEL

**ELECTRICAL SPARE PARTS LIST**

Item	QTY	Manufacturer	Catalog #	Description	Location
CB (14, 16)	0	SIEMENS	Q220H	TIME CLOCK & DOCK LIGHTS	RLP PANEL
CB (18)	0	SIEMENS	Q110	PHOTOELECTRIC HAZARD LIGHTS	RLP PANEL
CB (20, 22)	0	SIEMENS	Q230H	GENERATOR BLOCK HEATER & GENERATOR BATTERY CHARGER	RLP PANEL
AUTOMATIC TRANSFER SWITCH	0	KOHLER	K3018502	480V, 50A, 3PH AUTOMATIC TRANSFER SWITCH	ENCLOSURE ADJACENT TO DOLPHIN LIGHT TIMER
DOLPHIN LIGHT TIMER	1	PARAGON ELECTRICAL PRODUCTS	EC4005PC/120/208-240V	DOLPHIN LIGHT TIMER	ENCLOSURE ADJACENT TO AUTOMATIC TRANSFER SWITCH AND SHIP-SHORE POWER CIRCUIT BREAKER
SHIP-SHORE POWER DISCONNECT CIRCUIT BREAKER	1	GE	THED136125	600V, 125A CIRCUIT BREAKER -- SHIP SHORE RECEPTACLE TRANSFORMER SECONDARY CIRCUIT BREAKER	ENCLOSURE ADJACENT TO DOLPHIN LIGHT TIMER AND SHIP-SHORE POWER TRANSFORMER
SHIP-SHORE POWER TRANSFORMER	0	(UNLABELED)	(UNLABELED)	480/240V STEP-DOWN TRANSFORMER – SHIP-SHORE POWER TRANSFORMER	ENCLOSURE ADJACENT TO SHIP-SHORE POWER CIRCUIT BREAKER

**ELECTRICAL SPARE PARTS LIST**

Item	QTY	Manufacturer	Catalog #	Description	Location
EMERGENCY GENERATOR	0	KOHLER	50RE0ZJC	3PH, 50KW, 63KVA GENERATOR – EMERGENCY GENERATOR	ENCLOSURE NEXT TO TERMINAL HOUSE
RADIO CONTROL RECEIVER	0	MAGNETEK	MODEL FLEX-6EX SER#044806	RADIO CONTROL RECEIVER	ON MACHINERY PLATFORM
SHIP-SHORE POWER RECEPTACLE	0	RUSSEL STOLL	DBRS1404100K0	480V, 100A POWER RECEPTACLE – SHIP SHORE POWER	WEST DOLPHIN WALKWAY
BRIDGE HOIST MOTOR	0	REULAND	SER#99-6684A-3 PROD#0100C-1BAN-0285	10HP, 460V, 1800RPM NEMA DESIGN B MOTOR – BRIDGE HOIST	ON MACHINERY PLATFORM
BRIDGE HOIST BRAKE	0	STEARNS	1081022I2ALF	460V, 11.1A, 175 LB-FT MOTOR DISC BRAKE – BRIDGE HOIST MOTOR	MOUNTED ON BRIDGE HOIST MOTOR
BRIDGE HOIST DISCONNECT	0	SQUARE D	HU363DS	3P, 100A, 600V SINGLEDISCONNECT SWITCH – BRIDGE HOIST MOTOR	ON MACHINERY PLATFORM
APRON MOTOR	0	REULAND	SERIAL NO. 937028A-1 PRODUCT NO. 0007H-1BAN-0007	0.75HP, 460V, 600RPM NEMA DESIGN B MOTOR – APRON	ON BRIDGE BY TOWER
APRON MOTOR DISCONNECT	0	SQUARE D	HU361DS	3P, 30A, 600V SINGLE THROW DISCONNECT SWITCH IN NEMA 4X ENCLOSURE – APRON MOTOR	NEAR APRON MOTOR ON BRIDGE

**ELECTRICAL SPARE PARTS LIST**

Item	QTY	Manufacturer	Catalog #	Description	Location
PAWL HPU PUMP MOTOR	0	MAGNETEK	PART NO. 8-184007-20	230V, 0.5HP, 1725 RMP PAWL HYDRAULIC PUMP MOTOR	MACHINERY PLATFORM
SL1/SL2	1	SQUARE D	9001SKR9R	MUSHROOM HEAD MAINTAINED OIL TIGHT PUSHBUTTON -- SAFETY LOCKOUT - "EMR ALL STOP" PLATFORM/RAMP CONTROL STATIONS	PLATFORM CONTROL STATION/ RAMP CONTROL STATION
PAWL INDICATION RELAY (ON HOIST)	1	ALLEN- BRADLEY	700-HA32A1-1-4 SERIES B	120V RELAY – PAWL RELAY	PAWL RELAY JUNCTION BOX
EAST TOWER RECEPTACLE	1		LOCAL PURCHASE	GFI RECEPTACLE	EAST TOWER
FULLY RAISED AND FULLY LOWERED LIMIT SWITCHES (BRIDGE AND APRON)	1	SQUARE D	D9007C54B2	LIMIT SWITCH	BRIDGE—ON COUNTERWEIGHT TOWER; APRON— AT APRON PIVOT
MACHINERY PLATFORM LIGHTING SWITCH	1		LOCAL PURCHASE	TOGGLE SWITCH – AREA LIGHTING	WEST TOWER

**ELECTRICAL SPARE PARTS LIST**

Item	QTY	Manufacturer	Catalog #	Description	Location
SS1, SS3 (PLATFORM); SS2, SS4 (BRIDGE)	1	SQUARE D	9001SKS53FB	HEAVY DUTY OIL TIGHT 3 POS SEL SW SPRING RETURN TO CENTER IN PLATFORM AND RAMP CONTROL STATIONS - "RAISE- OFF-LOWER" APRON AND BRIDGE	PLATFORM CONTROL STATION / RAMP CONTROL STATION
RED/GREEN INDICATIONS	1 EA	ALLEN- BRADLEY	800H-QRH2G  800H-QRH2R	120VAC NEMA 4X INDICATOR LIGHTS – PAWL INDICATOR PROXIMITY DRIVEN THROUGH PAWL INDICATION RELAY	TOWER
TRAIL CABLE (BASED ON VINALHAVEN)	1	CAROL	3/8 TYPE SOOW	BRIDGE HOIST MOTOR	
TRAIL CABLE (BASED ON VINALHAVEN)	1	CAROL	26/10 TYPE SOOW	HOIST BRAKE	
TRAIL CABLE (BASED ON VINALHAVEN)	1	CAROL	3/3 TYPE SOOW	SHIP POWER	
TRAIL CABLE (BASED ON VINALHAVEN)	1	CAROL	8/10 TYPE SOOW	PLATFORM LIGHTING	
TRAIL CABLE (BASED ON VINALHAVEN)	1	CAROL	20/12 TYPE SOOW	BRIDGE/APRON CONTROL	

***Appendix 4.5.3—Electrical Equipment Vendor List***

Bass Harbor Ferry Terminal Transfer Bridge • Operations & Maintenance Manual

**ELECTRICAL EQUIPMENT VENDOR LIST**

<b>Component</b> <i>(See Electrical Spare Parts List)</i>	<b>Manufacturer</b>	<b>Vendor</b>
	<b>General Electric</b> GE Lighting Systems Nela Park East Cleveland, OH 44112 800-435-4448 www.gelighting.com	Grainger 425 Warren Ave Portland, ME 04103-1287 207-797-7693
	<b>Emerson Network Power (ASCO Power Technologies)</b> ASCO Power Technologies Florham Park, NJ 07932 800-800-2726 www.emersonnetworkpower.com	
	<b>SSAC</b> Phoenix, NY 13135 Contact: Dave Eastwood Cell: (315) 720-2849 DEastwood@Littelfuse.com	Industrial Automation Supply 75 Industrial Way Portland, ME 04103 207-797-2345 www.iasinc.com email: jwitham@iasinc.com
	<b>Pentair (Hoffman)</b> Hoffman New England District Sales Office 321 Main Street Farmington, CT 06032 860-678-4464 www.hoffmanonline.com dan.riccio@pentair.com	
	<b>Delta</b> Delta Lightning Arrestors Big Spring, TX 79721 432-267-1000 www.deltala.com/	
	<b>Allen Bradley</b> Rockwell Automation 700 Lanidex Plaza Parsippany, NJ 07054 973-526-3901 www.rockwellautomation.com	Horizon Solutions LLC 293 Target Industrial Circle Bangor, ME 04401 207-942-7357

Bass Harbor Ferry Terminal Transfer Bridge • Operations & Maintenance Manual

**ELECTRICAL EQUIPMENT VENDOR LIST**

<b>Component</b> <i>(See Electrical Spare Parts List)</i>	<b>Manufacturer</b>	<b>Vendor</b>
	<p><b>Kohler Power</b> 800-544-2444 www.kohlerpower.com</p>	<p>Gowen Power Systems 41 Evergreen Drive (Rear) P.O. Box 3542 Portland, ME 04103 800-564-6936</p>
	<p><b>Reuland Electric</b> 4500 East Grand River Avenue Howell, MI 48843-8516 888-540-7350 www.reuland.com parts@reuland.com</p>	<p>Rodgers Power Transmission Sales PO Box 425 Wilmont, NH 03287-0425 603-526-2209</p>
	<p><b>Square D</b> Schneider Electric 800 Federal St, Boston ONE Campus Andover, MA 01810 978-794-0800 www.schneider-electric.com</p>	<p>Grainger 425 Warren Ave Portland, ME 04103-1287 207-797-7693</p>
	<p><b>Rexnord (Stearns)</b> Rexnord Corporation Stearns Division 5150 S. Internation Dr. Cudahy, WI 53110 414-272-1100 www.rexnord.com</p>	<p>Motion Industries 437 Sennebec Road Union, ME 04862 207-785-4666</p>
	<p><b>Magnetek</b> Magnetek Enrange 70 Abele Road, Suite 1201 Bridgeville, PA 15017 sales@magnetek.com</p>	
	<p><b>Carlo Gavazzi, Inc</b> 750 Hastings Lane Buffalo Grove, Illinois 60089-6904 847-465-6100 www.carlogavazzi.com sales@carlogavazzi.com</p>	

Bass Harbor Ferry Terminal Transfer Bridge • Operations & Maintenance Manual

**ELECTRICAL EQUIPMENT VENDOR LIST**

<b>Component</b> <i>(See Electrical Spare Parts List)</i>	<b>Manufacturer</b>	<b>Vendor</b>
	<b>General Cable (Carol Cable)</b> 4 Tesseneer Dr Highland Heights, KY 41076 859-572-8000 www.generalcable.com	
	<b>IDEC Corporation</b> 1175 Elko Drive Sunnyvale, CA 94089-2209 800-262-4332 opencontact@idec.com www.idec.com	LEEN Company (I Power Distribution Group) 257 Perry Rd Bangor, ME 04401 207-942-7475
	<b>Caterpillar, Inc. (Olympian)</b> 501 SW Jefferson Ave Peoria, IL 61630 888-614-4328 www.caterpillar.com	Milton Cat 79 Robertson Blvd Brewer, ME 04412-2246 207-989-1890 info@miltoncat.com www.miltoncat.com
	<b>Thomas &amp; Betts (Russellstoll)</b> 8155 T&B Boulevard Memphis, TN 38125 901-252-5000 www.russellstoll.com	Powertech Controls 909 Motor Pkwy Hauppauge, NY 11788 800-938-6678 info@powertechcontrols.com
	<b>Siemens</b> 300 New Jersey Avenue Suite 1000 Washington, D.C. 20001 800-743-6367 usa.siemens.com	Grainger 425 Warren Ave Portland, ME 04103-1287 207-797-7693