



## Colonel Patrick O'Rorke Memorial Bridge

Final Report - Operation and Maintenance Analysis Strategy

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### FINAL REPORT

March 23, 2021  
WJE No. 2019.8583

### PREPARED FOR:

Genesee Transportation Council  
50 West Main St., Suite 8112  
Rochester, NY 14614

### PREPARED BY:

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A handwritten signature in black ink, appearing to read 'Ryan Kanagy'.

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Ryan Kanagy, PE  
Associate Principal

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### EXECUTIVE SUMMARY

The Colonel Patrick O'Rorke Memorial Bridge (BIN 3317120) is a critical link in the regional transportation system linking Pattonwood Drive directly to the eastern end of the Lake Ontario State Parkway. The movable portion of the bridge is a double leaf rolling lift bascule bridge, with an average of 566 operations per year, that has had a history of operational issues dating back to the 2004 installation, resulting in significant disruptions to local and regional traffic.

This study, conducted by WJE Engineers and Architects, P.C., provided a review of the mechanical and electrical systems associated with the movable bridge to provide an asset management strategy to maintain the systems in a state of good repair for a desired service life of 75 years. The study included a review of the current operating status of the systems, recent operating issues, existing documentation, and a review of practices related to the maintenance and operation of the bridge.

An inspection of the mechanical and electrical systems yielded numerous recommended repairs including, but not limited to, adjustments to positively seat the bridge in relay operating mode, a repair for the manual operating mechanism at the southeast tail lock, replacement of the seized over-travel limit switches and adjustments to the rotary cam limit switches, repairs to address motor overspeed faults, adjustments to the bumper blocks, repairs to the heavily corroded machinery room floors and sealing the decks to prevent water intrusion.

An inventory of the available reference drawings and literature raises questions about the status of the electrical installation, as there were numerous copies of electrical shop drawings, some with hand mark-ups. Future repair efforts may be complicated by the need to review and verify the accuracy of the installations prior to making any changes to the system.

The bridge was provided with operation and maintenance materials at the time of construction. Copies of these materials remain at the bridge though bridge maintenance and operation personnel use separate abbreviated electronic copies that include mechanical maintenance (primarily lubrication) and operation procedures. Note, however, that the existing manuals and separate electronic materials do not provide good guidance on utilizing bypasses or for manual operation. In addition, at the time of this study, periodic preventative maintenance for the electrical systems is no longer being performed.

Revised operation and maintenance manuals have been provided, as part of this study, to address noted shortcomings in the operation and maintenance materials. These may be used by maintenance and operation personnel for future reference. Apart from these revised materials, recommendations are provided for mechanical and electrical near-term repairs, training of personnel, maintenance, and for capital repairs.

The results of the study are intended to be used to address near term issues including the elimination of operational failures and to minimize long term capital requirements. With improvements to maintenance and by providing near and long term repairs, it is expected that the bridge can be maintained in a reliable condition for the target 75 year life. The provided costs may be utilized by the owner as part of their planning for near term and long term expenditures required to maintain the bridge mechanical and electrical systems in a state of good repair.

## ABBREVIATIONS

Table 1 defines a list of abbreviations that are used in the report.

Table 1. Abbreviations

<b>Abbreviation</b>	<b>Description</b>
AASHTO	American Association of State Highway Transportation Officials
ATS	Automatic Transfer Switch
BIN	Bridge Identification Number
BX	Bearing Identification (B1, B2, etc.)
CCTV	Closed-Circuit Television
cSt	Centistoke (Kinematic Oil Viscosity)
CX	Coupling Identification (C1, C2, etc.)
EP	Extreme Pressure (EP Oils)
hp	Horsepower
HVAC	Heating, Ventilation, and Air Conditioning
ISO	International Organization for Standardization
kW	Kilowatt
LED	Light-Emitting Diode
MCC	Motor Control Center
NE	Northeast
NW	Northwest
NYSDOT	New York State Department of Transportation
O&M	Operation and Maintenance
PLC	Programmable Logic Controller
PVC	Polyvinyl Chloride
RCLS	Rotary Cam Limit Switch
RPM	Revolutions Per Minute
SCR	Silicone Controlled Rectifier
SE	Southeast
SW	Southwest
UPS	Uninterruptible Power Supply
V	Volt

## **INTRODUCTION**

The Colonel Patrick O'Rorke Memorial Bridge (BIN 3317120) carries Pattonwood Drive over the Genesee River in Rochester, New York. The O'Rorke Bridge is a critical link in the regional transportation system linking Pattonwood directly to the eastern end of the Lake Ontario State Parkway. The bridge carries four 11-foot wide travel lanes, two five-foot wide shoulders that also serve as bike lanes, and two seven-foot wide sidewalks. The entire bridge is about 920 feet long; the moveable span is 243 feet long, the eastern approach is 530 feet long, and the western approach is 148 feet long. In the closed position, the bridge's clearance is about 45 feet above the river, which is sufficient to allow the passage of most recreational watercraft, though operations remain a requirement for some vessels.

The movable portion of the bridge is a double leaf rolling lift bascule bridge that was opened to traffic in October 2004. The movable bridge is owned by the New York State Department of Transportation and provided with operation and maintenance by Monroe County. The bridge has had a history of operational issues dating back to the original installation, resulting in significant disruptions to local and regional traffic. The bridge differs from others in the region as it requires specific maintenance practices to maintain the reliability of the mechanical and electrical systems.

This report summarizes a study of the mechanical and electrical systems associated with the movable bridge, including the condition of the machinery, and a review of practices related to the maintenance and operation of the bridge. The study has been conducted by WJE Engineers and Architects, P.C. (WJE) for the Genesee Transportation Council. The report provides recommendations for best maintenance and operation practices to achieve a desired service life of 75 years. The recommendations also include proposed schedules and costs for routine maintenance, necessary repairs, and for anticipated future capital requirements (rehabilitations). The results of this study, including all recommendations, constitute an asset management strategy, outlining the necessary steps and costs to ensure reliability for the life of the bridge.

## DESCRIPTION OF SYSTEMS

### Mechanical Components

Mechanical machinery includes span drive machinery, span stabilizing machinery, and traffic warning gates. The schematic provided in Figure 1 identifies the location of the mechanical components.

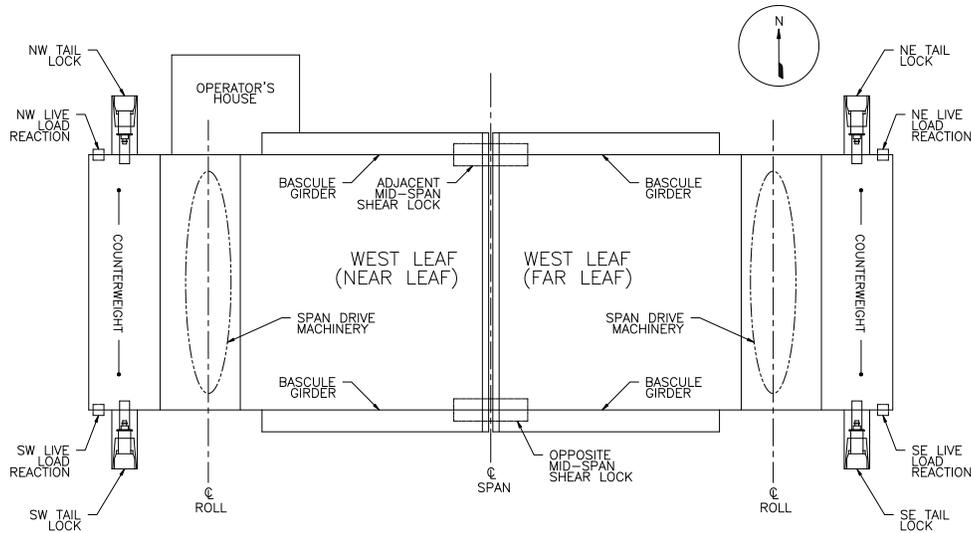


Figure 1: Bridge Layout with Mechanical System Locations

The span drive operating machinery for each bascule leaf is identical. Figure 2 is a schematic of the span drive machinery with component designations. The machinery is located in a machinery room below the roadway level. The machinery rooms are accessible through doors in the bascule girders. Normal power for each span drive is provided by one of the two 75hp, 900 RPM electric motors in each machinery room (Reuland, See Figure 3). Each motor is connected to an input shaft of the primary reducer via a double engagement grid coupling. On both input shafts is a brake wheel for a spring set, thrustor released shoe type motor brake (Link Controls, Figure 4). On the counterweight side of the primary reducer is an emergency drive input shaft at which a power drill can be coupled for emergency operation. In the case when the electric motors cannot be used, personnel can operate the leaf using the power drill.

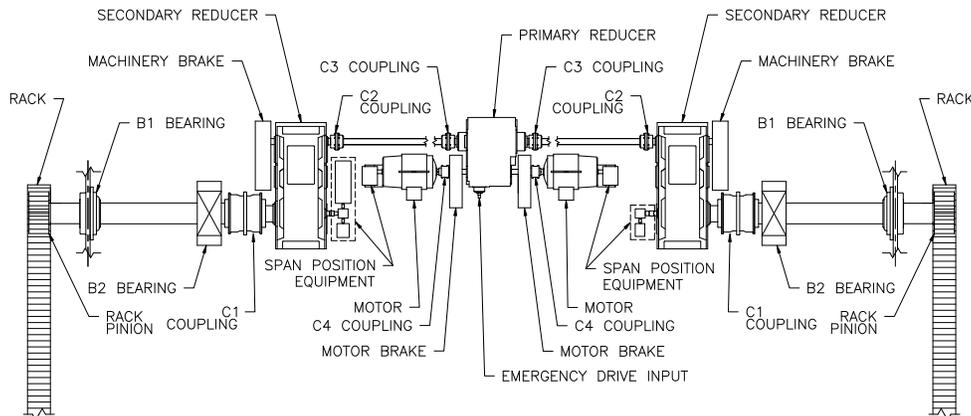


Figure 2: Span Drive Machinery



Figure 3: Span Drive Motor



Figure 4: Motor Brake

The primary reducer (Prager LTD2225-S Differential Reducer, Figure 5) has two output shafts, and a differential integrated within the primary reducer to ensure even load sharing. The primary reducer output shafts are connected to the secondary reducers' input shafts using floating shafts and single engagement gear type couplings (Falk 1035G51, Figure 7). The secondary reducers (Prager LT5100, Figure 6) have an additional input shaft, each of which has a brake wheel for a spring set, thrustor released shoe type machinery brake installed on it. The output shafts of the secondary reducers are coupled to the rack pinion shafts with double engagement gear type couplings (Falk 1120G20, Figure 8). The pinion shaft is supported by a spherical roller bearing in a pillow block housing and a spherical roller bearing flange mounted to the bascule girder (Figure 9 and Figure 10). The rack pinion is cantilevered off the end of the pinion shaft outboard of the bascule girder. The mating horizontal spur gear rack is located above the pinion and is mounted on a fixed structural support.



Figure 5: Primary Reducer



Figure 6: Secondary Reducer



Figure 7: Floating Shaft Coupling (C2 and C3)



Figure 8: C1 Coupling



Figure 9: B1 Bearing



Figure 10: B2 Bearing

The rack pinions (Figure 11) are located at the center of the arc of the curved tread castings (Figure 12) that support the movable span. Rotation of the electric motors causes the rack pinions to rotate and travel along the fixed racks, exerting a force at the rack and pinion gear mesh.



Figure 11: Rack and Pinion Gear Set



Figure 12: Curved and Flat Treads

The curved tread castings roll along fixed horizontal flat tread castings maintaining the position of the rack pinion at the center of roll. The bridge opens and closes for marine traffic as a result of rotary and translational movement.

The movable leaves are fitted with a series of devices to stabilize and support the span in the closed position. One lock bar type tail lock is provided at the tail end of each bascule girder to limit span movement when it is engaged. The lock bar is driven by an electro-mechanical linear actuator (RACO Size 7, LBR K1N7 ZMZAAlZ) and is supported by a front and rear guide. When driven, the lock bar engages a strike plate attached to the bascule girder. When retracted, the lock bar is pulled outboard of the bascule girder and allows the leaf to open. See Figure 13 and Figure 14 for a schematic and photo of the tail lock machinery. See

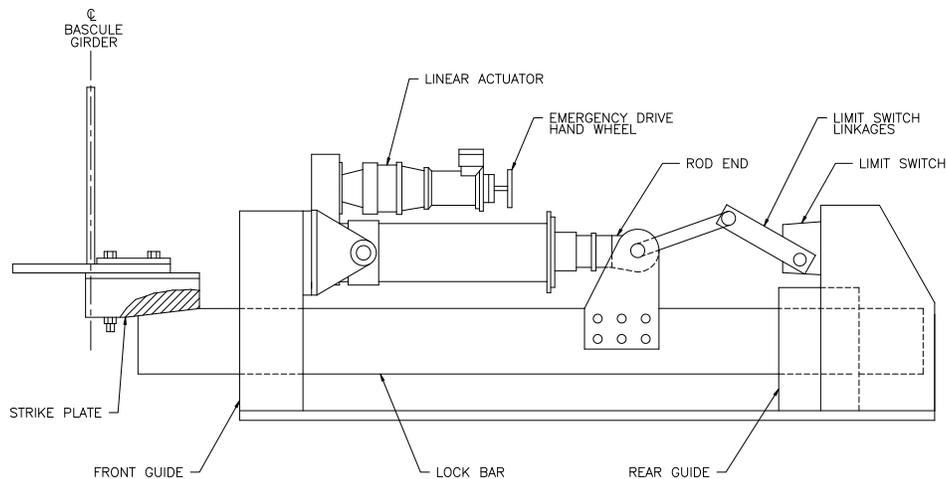


Figure 13: Tail Lock Arrangement



Figure 14: Tail Lock Assembly, Including Actuator in a Sheet Metal Enclosure

The mid-span shear locks are a jaw lock system to allow the leaves to share live load shear forces. The jaw lock consists of a diaphragm on each side of the far leaf and a corresponding jaw on each side of the near

leaf. Synchronized operation of the leaves is required during opening and closing for smooth engagement and disengagement of the jaw lock system. As the leaves are closing, they are both rotating and translating and the diaphragm slides into the gap of the jaw. See Figure 15 and Figure 16.



Figure 15: Shear Lock Assembly Jaw on the Near Leaf



Figure 16: Shear Lock Assembly Diaphragm on the Far Leaf

Live load reactions are provided to prevent over-travel of the span during closing and provide stability to the span in the fully closed position. There are two live load reactions for each leaf. The reactions are located on top of the approach end of each bascule girder and are intended to support the loads resulting from imbalance and the live load of traffic. Identification and location of the live load reactions are shown in Figure 1 and a photograph is provided in Figure 17.

The bridge is equipped with four traffic warning gates. A pair of gates are located on each approach to the movable span outboard of the sidewalks. When the gates are lowered, they meet in the middle of the roadway to block vehicular and pedestrian traffic prior to opening the movable span. See Figure 18 for a photo of the machinery within one of the gate enclosures.



Figure 17: Live Load Reaction Assembly with Bridge Closed



Figure 18: Traffic Gate Machinery, View of Reducer, Lower Crank and Connecting Rod

## Electrical Components

The bridge operator's control room, electrical room, and generator room are all located on different floors inside the operator's house at the northwest corner of the movable span. The location of the operator's control room is on the top floor of the operator's house and provides a clear view of the navigable channel and both bridge roadway approaches. A closed-circuit television (CCTV) system provides the operator additional view of the bridge approaches and the navigational channel.

Operation of the bridge is achieved using wound rotor motors with a form of motor stator adjustable voltage torque/speed control. Each leaf is provided with two 75 hp Reuland motors, configured as redundant units. The motors are shown in Figure 2 and Figure 3. Power is provided for the bridge by the local utility in the form of a 480/277 volt, 3-phase, 4-wire, solidly grounded service, derived from a utility pad mounted transformer located at the northwest approach. A 250 kW Cummins standby generator is provided as backup in the event of a utility outage. See Figure 19.



Figure 19. Standby Generator



Figure 20: Emergency Span Drive Drill

A third option for operation of the bridge is provided with a hand drive input to the operating system primary reducer, a 120V DeWalt DW138 hand drill (Figure 20) is used as the hand drive. Power for the drill can be provided from a mobile generator that can be connected to a receptacle mounted on the utility main disconnect switch enclosure.

The bridge drive system is powered and controlled from a motor control center (MCC) and silicone-controlled rectifier (SCR) drive cabinets located in the electrical room (Figure 21). The bridge main power feed is bottom entry into the MCC (Figure 22) main feeder breaker. The motor control starters are all located in the MCC and a lighting panel is also provided in the MCC for powering the bridge auxiliary loads.



Figure 21. SCR Drive Cabinet



Figure 22: MCC

The bridge control system consists of a programmable logic controller (PLC) as the primary form of control for the bridge operating system. Backup hard-wired relay logic is also provided at the bridge and used in the event of PLC failure. Bridge interlocking is achieved through the use of either the installed PLC or relay logic control. The PLC controller is located in the operator's control console and the relay logic is located in the bridge relay cabinet within the control room of the operator's house. An uninterruptible power supply (UPS) is provided as a temporary backup source of power for the bridge control system.

Traffic gates and traffic lights are provided for vehicular and pedestrian traffic control at each of the bridge approaches.

Control of the operation of the bridge leaves includes feedback from a variety of field feedback devices for input to the bridge PLC and relay control logic and for control, interlocking and status indication for the bridge operator. To indicate and control span position, a leaf position rotary cam limit switches (RCLS; Figure 23), Selsyn span position transmitters (Figure 24), inclinometers (Figure 25), span seated limit switches (Figure 26), over-travel limit switches (Figure 27), tachometers and speed switches (Figure 28) are utilized. Other field feedback devices include switches associated with the tail locks and the traffic gates.



Figure 23. Span Drive RCLS



Figure 24. Selsyn Transmitter at Span Drive



Figure 25. Inclinometer



Figure 26. Span Seated Limit Switch



Figure 27. Span Over-Travel Limit Switch at Flat Treads



Figure 28. Tachometer and Speed Switch

The electrical system also includes submarine cables to provide electric power and control functionality between the east and west leaves. Additionally, aids for marine navigation, an intercom system, and a fire alarm system are provided to satisfy marine safety and bridge fire life safety requirements.

## INVENTORY OF STRUCTURE AND OPERATIONS

An inventory of the current bridge systems and the state of operations was conducted as part of this study. This inventory included a review of existing documentation including maintenance documentation, operating procedures, a review of the bridge mechanical and electrical installations, and a review of the current operation status.

A site visit was performed on August 6, 2020 to assess the condition of the bridge, review available documentation on site, and to interview county and state personnel with an understanding of the history of the bridge and the current operation and maintenance practices. The following personnel were interviewed:

- Bruce Hutchinson - Bridge Operator
- Brian Richard - Maintenance Foreman, Monroe County
- Kevin Cannan - NYSDOT Engineering, Region 4 Construction

Each of the three provided valuable insight into current bridge operation and maintenance practices and into the history of maintenance and operational issues. Findings from the conversations are incorporated into this document where appropriate.

**Duty Cycle**

The duty cycle for bridge operation is relatively modest for a movable bridge, with an operating season from April to December and an average of 566 operations per year. The operator maintains electronic records of operations in electronic files on the control room desktop computer. A summary of the number of operations dating back to 2006 is provided in Table 2.

Table 2. Summary of Operations by Year

Year	Commercial	Recreational	Maintenance	Training	Total
2020 (YTD)	103	17	72	9	201
2019	343	98	17	62	520
2018	156	81	16	113	366
2017	166	122	48	47	383
2016	122	132	78	267	599
2015	144	96	35	307	582
2014	324	184	56	14	578
2013	158	234	17	190	599
2012	184	203	18	38	443
2011	129	257	51	0	437
2010	132	343	27	0	502
2009	182	312	81	15	590
2008	442	390	64	76	972
2007	242	431	30	114	817
2006	194	330	40	339	903
<b>Average</b>	<b>201</b>	<b>215</b>	<b>43</b>	<b>106</b>	<b>566</b>

Source: Bridge Operator's Electronic Records

Note that the records indicate a significant disparity in the number of training operations from year to year. The variation reflects the challenge in maintaining the bridge workforce. In years where there had been significant turnover in personnel, the number of training operations was necessarily higher.

**Current Operating Status, History, and Record of Issues**

An operation of the bridge was performed during the site visit. No unusual behaviors or conditions were noted that would indicate a mechanical or electrical problem.

The interviewed personnel noted that the bridge has a history of operational issues dating back to the original installation in the early 2000's. Electrical problems are understood to be the primary source of reliability issues. The tail locks have also been a source of issues in the recent past. Apart from the tail locks, the mechanical machinery has operated reliably and without significant issues.

Operational issues date back to initial installation. The operator notes that previous records of operational problems were tracked through the "Hansen" system, a computerized maintenance system. It appears that these were also referred to as "Daily Report Forms" and folders with records from 2006 to 2015, are kept in folders on site.

Since that time, issues are tracked with operator reports which are maintained electronically in the desktop computer located in the control room. These files document routine maintenance, minor operation interruptions including drive faults, incident reports, and unexpected repairs. Many of the forms document issues where a temporary drive fault was acknowledged, cleared, then operation continued without issue. For some issues, contractors were called to the bridge for troubleshooting and repairs. A review of the daily report forms shows that common failures include:

- Intermittent drive faults. Many were addressed through either acknowledging/resetting the fault or restarting the console by the Operator with no requirement for additional assistance. "Motor Low Overspeed", "Resolver" were common faults. Many of the faults occurred with the bridge near the seated position.
- Interrupted operations without an error message or apparent causes. These issues were generally addressed by the operators and the source of the issues, if they were determined, were not described in the reports.
- Miscellaneous electrical repairs that are considered to be typical maintenance.
- General maintenance reports for miscellaneous issues related to water damage, lighting, HVAC systems, fire alarm, security, computer systems, and CCTV systems.
- Occasional traffic gate faults or issues, some requiring manual operation of the gates and some minor traffic gate machinery repairs.
- Multiple tail lock operational issues in 2019 and 2020.

A limited list of known recent issues and their status are provided in the Table 3 for the record.

Table 3. O'Rorke History of Recent Issues

Component	Issue	Status	Resolution
Seating	Bridge not seated with load (per AASHTO requirements)	Repaired in 2020	The PLC has been updated to provide seating load per AASHTO in June of 2020. These changes were made by WJE with assistance from the Panatrol Corporation. Additional changes are required to seat with load on the backup relay system.
Tail Locks	SE Tail Lock (#4) - overtravel and failure to operate electrically	Repaired in 2020	The issue hasn't returned after the following changes in June 2020: <ul style="list-style-type: none"> <li>■ PLC changes to seat bridge with load (WJE and Panatrol)</li> <li>■ Shimming of live load reactions (CP Ward)</li> <li>■ Cleaning of lock bars and of receivers (CP Ward)</li> </ul>
Traffic Warning Gates	Failure of machinery fasteners at SE gate	Repaired in 2020	Bolts replaced April 2020. No issue when checked at 8/6/20 site visit. Should monitor in future.

Component	Issue	Status	Resolution
UPS	The original UPS was not operating properly; it was bypassed and, as a result, the generator would not start automatically with power loss	Partially Repaired in 2020	New UPS installed and generator/ATS were tested and operated successfully in June 2020. The replacement was performed by CP Ward electricians with oversight by WJE.
Drive Relay	Intermittent drive faults due to overcurrent at drive relay	Repaired in 2017	Replaced instantaneous overcurrent relays with new overload relays.
Terminal Blocks	Failures of surge protecting terminal blocks at submarine cable junction boxes taking bridge out of service	Repaired in 2021	Terminal blocks replaced in 2021 with no issues.
Tail Locks	SE Tail Lock (#4) - failed manual operating mechanism; CP Ward felt that the manual operation engagement mechanism (key) likely sheared during the work to retract the lock bar during the previously noted failure (above)	Repair Required	The manual operating mechanism should be repaired to restore functionality.
Motor Overspeed	Periodic fault due to indication of motor low overspeed	Repair Required	Drive parameters should be tuned to allow proper coordination between speed references and bridge positions.

Since the shimming of load reactions and the changes to the PLC to positively seat the leaves, the tail locks have been operating reliably. The reliability issues related to the electrical installation have been reduced, though some installation deficiencies may continue to cause issues that will require attention in the future.

**Inventory of Existing Documentation**

Existing documents were found in the operator’s house in the control room (top floor). Documents were found located in the flat file along the west wall of the room and on the shelves that surround the computer desk on the north wall. Other electronic information was provided by the operator from the computer located on the desk of the north wall. The documents relevant to the mechanical and electrical systems are summarized in the tables that follow. For the purpose of this inventory, the flat file drawers are numbered sequentially starting from one for the top drawer to number ten for the bottom drawer.

**Drawings**

The inventory of drawings is summarized in Table 4.

Table 4. Bridge Drawing Inventory

Year	Description	Author	Location	Comments
2000	Record Design Drawings	Bergmann Associates	On top of Flat File	Bound 11x17 drawings, volumes 1 and 2
2000	Mechanical and Electrical Design Drawings	Bergmann Associates	Flat File Drawers 1, 2	Bound 11x17 drawings in Drawer 1 Several loose as-built drawings in Drawer 2

Year	Description	Author	Location	Comments
2001 to 2005	Electrical Shop Drawings (as-built control schematics)	Link Control Systems, Inc.	Flat File Drawers 1, 2, 3	11x17 drawings, bound set in Drawer 1 Loose sheets in Drawers 2 and 3 Numerous copies with hand mark-ups - accuracy is questionable Loose sheets with markups of panel directories
2001 to 2004	Electrical Shop Drawings (general location, installation, conduit runs, etc.)	O'Connell Electric Co.	Flat File Drawer 1, 3, 4	Full size drawings, sketches, layouts in Drawer 1 Laminated full size drawings, sketches, and installation details in Drawer 3 Two as-built shop drawings in Drawer 4 (apparent replicates)
2004	PLC Ladder Logic Prints	PLC Program Details	-	Existing prints that show PLC ladder logic. Located in Control House, but exact location not verified.
2001 to 2002	Mechanical Shop Drawings	JC Industrial Manufacturing Corporation	Flat File Drawer 4, 5	Includes machinery arrangements and part details, includes curved and flat treads
2001 to 2002	Mechanical Shop Drawings (reducers)	Prager	Flat File Drawer 5	Primary and secondary reducer shop drawings
2001	Structural Shop Drawings	PDM Bridge	Flat File Drawer 8, 9	Full size structural shop drawings, may be relevant for mechanical connections
2001 to 2005	Other Shop Drawings	Various	Flat File	Architectural, structural, and ornamental component shop drawings in various drawers, most not relevant to mechanical and electrical systems

Our review of the mechanical shop drawings found them to be current and relatively complete.

A review of the electrical installation shop drawings resulted in questions about the completeness and accuracy of the records. There are multiple copies of the O'Connell installation drawings and the Link Control Systems (Link) shop drawings. Of the numerous copies of individual Link drawings, there are multiple copies with hand mark-ups that have not been verified. Future repair efforts may be complicated by the need to review and verify the accuracy of the installation prior to making any changes to the system.

### Maintenance Literature

The inventory of maintenance literature is summarized in Table 5.

Table 5. Bridge Maintenance Literature Inventory

Year	Description	Author	Location	Comments
2005 to Current	Mechanical Maint. Lubrication	Monroe Cty DOT, Original Manuals	Monroe County Files; Flat File Drawer 2; Machinery Maint. Manual Binder on Top of Flat File	Current lubrication table provided by County at time of interview; Table in Drawer 2 is out-of-date; The original maintenance manual binder appears to include lubricants

Year	Description	Author	Location	Comments
				similar to the current lubrication table; The updated maintenance manual includes a revised lubrication table. See Appendix E.
2005	Mechanical Maintenance Other Requirements	Original Contractor	Machinery Maint. Manual Binder on Top of Flat File	Appears to provide a maintenance routine that is common for the movable bridge industry.
2005	Mechanical Maintenance Traffic Gates	B&B Roadway	Traffic Gate Maintenance Manual Binder on Control Room Shelves	Gate installation and maintenance materials are provided by the manufacturer.
2005	Electrical Owner and Operator Manuals	O'Connell Electric Co.	Control Room Shelves	Manuals from original installation. Separate binders for: generator; hand drive system; conduit and cables; traffic signals and utility; spare parts inventory; submarine cables; panelboards, switchgear, and disconnects; security system; façade lighting; marine radio; UPS system; street lighting; devices and fixtures; fire alarm system; loudspeaker / intercom
2019	Generator Inspection Checklist	Power Generation Systems Specialists	Flat File Drawer 3	2019 generator inspection checklist (3rd party inspection)
2016	Electrical Preventative Maintenance Checklist	Unclear	Flat File Drawer 3	Completed checklists from 2016, presumably O'Connell Electric Co. as they reportedly performed routine inspections in the past

## Operating Procedures

The inventory of materials related to the operating sequence is summarized in Table 6.

Table 6. Bridge Operating Procedure Inventory

Year	Description	Author	Location	Comments
2011	PLC Operation Sequence (BT- )	County	Electronic Files	This current operating procedure is in the files on the desktop computer
2011	Relay Operation Sequence (BT- )	County	Electronic Files	This current operating procedure is in the files on the desktop computer
2009	PLC Operation Sequence (BT-07.02)	County	Flat File Drawer 3	Procedure for operation from the PLC - not current
2009	Relay Operation Sequence (BT-07.03)	County	Flat File Drawer 3	Procedure for operation from the Relay - not current
2005	Operator's Manual	O'Connell Electric Co.	Flat File Drawer 3	Detailed procedures, including PLC and relay operation, from Contractor. Procedures not current.

Year	Description	Author	Location	Comments
Undated	Informal Operation Sequence	Unknown	Flat File Drawer 4	Handwritten procedure for operation, presume with PLC, on large sheet, in color
Undated	Informal Operation Sequence	Unknown	Flat File Drawer 3	Simplified procedure for operation, presume with PLC - mark-ups of procedure written by hand

The most current operating procedures for PLC and Relay operation were provided by the Operator from the files on the control room desktop computer. There are multiple older, separate copies of operating procedures located in the flat file and the original Operation Manual. Based on a limited review, the procedures appear to include only minor changes, but it is good practice to maintain a single copy of each procedure for the bridge. Old copies of procedures should be marked obsolete and removed from the bridge for archival.

At the time of the site visit, the operator was well-trained and experienced, the risk of an issue with operation was very low. For newer operators, the risk would depend on their training. It is recommended that a single copy of current procedures be provided in an updated Operation Manual or other location for use and reference by personnel. This is good practice and would help to limit risk of operational issues that may occur with inexperienced operators.

There did not appear to be written procedures or guidelines for operating equipment utilizing bypasses. The operation of the bridge or of individual machinery components using bypass features eliminates interlocks that prevent out of sequence operation that can cause damage to components or to the structure. Care should be taken to ensure that operator and maintenance training provides an understanding of these features, their purpose, and the risks associated with bypass operation. Consideration should be given to creating written procedures and training for bypass procedures to be used by maintenance or operating personnel. These procedures should clearly identify circumstances and criteria for use of bypasses given the risk to damage to components.

A revised Operation Manual has been created as part of this report. The manual is provided in 0 for review and it includes operation procedures and guidance on the utilization of bypasses.

Review of the Full Open Position

When operating the bridge using the PLC, the controls stop the bridge before the full-open position of 71 degrees listed on the 2000 design drawings. Based on previous inspections, there was a risk that operation to the full-open position would result in contact between the rack pinions and the structure, as evidence of damage was found at the structure and rack pinion teeth at all locations. It was not clear if the damage was a current or past issue. The cause was thought to be that the full open limit switches and over-travel limit switches were incorrectly set, not properly functioning, or were not properly integrated into the bridge control systems. In addition, the noted damage is an indication that the bumper blocks may be improperly set, as they should be positioned to prevent structural damage.

The full open position was investigated on site on February 4, 2021. The investigation included operations of each leaf to the full open position using Relay mode and PLC mode. Leaf position was recorded from

the control console position analog meter and by independent measurements using a clinometer (AccuStar clinometer through a data acquisition unit).

For each operation, with the leaf at the full open position, the following measurements were taken:

- Clearance between the rack pinions and the structure (where evidence of contact had been noted)
- Clearance between the over-travel limit switch lever (located at the treads) and its triggering mechanism
- Clearance between the counterweight and the bumper block assemblies located in the counterweight pits

Note that, physical measurement of the clearances at the bumper blocks was not possible due to their location (a significant height above the bascule pier pit). Clearances at the bumper blocks were assessed visually. The measurements are summarized in the Table 7.

Table 7. Full Open Investigation Measurements

	Measurement	Near (West) Leaf	Far (East) Leaf
PLC	Angle at Console	63°	66°
	Angle at Clinometer	67.5°	67.4°
	North Pinion	10.5"	11"
	South Pinion	10.5"	11"
Relay	Angle at Console	67°	69°
	Angle at Clinometer	71°	70.7°
	North Pinion	3"	4-1/4"
	South Pinion	3"	4"
	Over-Travel Switch	Contact <sup>1</sup>	Contact <sup>1</sup>
	North Bumpers	1" to 1-1/2"	Contact <sup>2</sup>
	South Bumpers	1/2" to 1"	1 to 2"

1. The over-travel limit switch for each leaf was found to be seized and not mechanically functional.
2. The northeast bumper block assembly is damaged.

The following issues were noted as part of the investigation:

- The northeast bumper blocks were displaced/damaged.
- Both over-travel limit switches were properly positioned but were heavily corroded and mechanically seized. No indication of over-travel switch contact was noted at the control console. This did not affect operation in relay mode as the position of the leaves was controlled by the span drive rotary cam limit switches.
- The span drive rotary cam limit switch position for full open in Relay mode is very close to the triggering location for the over-travel limit switch. Adjustments may be warranted to ensure that the over-travel limit switches are triggered just past the Relay full open position.

- The console position indication is mis-calibrated compared to the physical measurement of the position using a clinometer.

The bumper block clearances were compared to the pinion and structure clearances. At the east leaf, the contact at the bumper blocks is a clear indication that the rack pinion should not contact the structure steel. However, the damaged north bumper blocks should be repaired, and the southeast bumper blocks should be shimmed out to provide contact at the same time as the north.

At the west leaf, the estimated clearances at the bumper blocks would allow the bridge to travel an additional 2.06" linearly should the leaf open further to come into contact with the bumper blocks. At this position, the final clearance between the pinion and the structure would be approximately 15/16". This clearance should be sufficient to ensure that the pinion and structure do not come into contact. However, this only a small margin and may not be sufficient if the blocks compress on contact; this is a risk as the installation is comprised of multiple stacked blocks. Consideration may be given to reducing the gaps at the blocks or to modifying the arrangements to reduce the number of blocks by adding a steel weldment as a spacer. In the near term, the damaged areas near the rack pinions should be cleaned and painted, and maintenance personnel should monitor the areas for future evidence of contact in the future. Other recommendations are provided in the Needs Assessment section of this report.

**Maintenance Practices**

The existing mechanical maintenance practices were reviewed with Brian Richard, the Monroe County maintenance foreman. A summary of the mechanical lubrication practices and other maintenance practices is provided in this section along with comparisons to industry standards or best practices. A summary of the status of electrical maintenance is similarly provided.

**Mechanical Component Lubrication**

A current lubrication chart for the machinery components was provided at the time of the site visit. The lubrication type and frequency were reviewed for each of the components and compared with common industry practice and with the existing Maintenance Manual. A brief review of the lubrication chart compared with industry standards is summarized in Table 8. Specific recommendations related to the lubrication practices are provided below the table.

Table 8. Existing Machinery Lubrication Review

<b>Component</b>	<b>Lubricant</b>	<b>Frequency</b>	<b>Industry Std. / Comments</b>
Motor Bearings	Mobil XHP 222	One pump at 5 years	A small amount of grease periodically is appropriate; change to 5 pumps annually. Change lube to Mobil Polyrex EM to match original packing from Reuland.
Brake Thrusters	Mobil Velocite 10	6 months - level check and top off	Check and top-off is typical for industry; thrusters are sealed-for-life; Manufacturer's data indicates Chevron Spindle Oil #10.
Pinion Shaft Bearings	Mobilith SHC 1500	6 months	Grease and frequency are appropriate
Pinion Shaft Coupling	Falk LTG	3 years	Lubricant appropriate; more frequent is typical - adjust to yearly

Component	Lubricant	Frequency	Industry Std. / Comments
Floating Shaft Coupling	Falk LTG	3 years	Lubricant appropriate; more frequent is typical - adjust to yearly
Motor Coupling	Falk LTG	1 year	Lubricant and frequency appropriate
Primary Reducer	Mobil 600 XP 220	6 months - level check and top off	Oil viscosity lower viscosity than manufacturer's requirements; change oil
Secondary Reducer	Mobil 600 XP 220	6 months - level check and top off	Oil viscosity lower viscosity than manufacturer's requirements; change oil
Instrument Reducers	Mobil 600 XP 220	6 months - level check and top off	Appropriate frequency. Consider changing oil periodically (5 yrs, though low risk)
Racks and Pinions	Castle Muscle Grease	6 months	Recommend change to an open gear lubricant and frequency adjustment, if necessary, to ensure teeth remain lubricated between maintenance cycles
Tail Lock - Rod Eye and Actuator	Mobil Grease XHP 222	6 months	Rod End - frequency and lubricant OK Actuator - Mobilith SHC 460 per mftr. literature
Tail Lock - Lock Bar	Castle Muscle Grease	6 months	Recommend change to a lubricant suited to exposed sliding surfaces and adjust frequency to ensure lubricated
Traffic Gate - Bearings	Mobil Grease XHP 222	6 months	Appropriate lubricant and frequency
Traffic Gate - Chain	Castle Muscle Grease	6 months	Appropriate lubricant and frequency
Shear Lock Jaws	Mobilith AW-0	6 months	Appropriate lubricant, adjust to monthly lubrication

*Source: Existing Lubricant and Frequency Provided by County Personnel*

In general, the maintenance personnel's attention to lubrication is conscientious. Some of the lubricants and lubrication schedules are consistent with typical industry practice, but there are some lubrications and frequencies that warrant review. In addition, some of the lubricants do not match the directions provided in the Maintenance Manual literature located on site. All of the lubricants and their frequencies were reviewed. Note the following review comments related to the lubrication practices.

- Review Motor Bearing Lubricant. The selected motor bearing lubricant is a grease that includes a lithium complex thickener. Reuland, the motor manufacturer, has indicated that the motor bearings were packed with Mobil Polyrex EM. This is a polyurea thickened grease. There are compatibility issues with using the lithium based grease in these bearings. It is recommended that the Mobil Polyrex EM be used to match the manufacturer's recommendations.
- Review Motor Bearing Lubrication Frequency. Shaft bearings for motors typically only require small amounts of lubricant periodically to replenish the old lubricant. A yearly lubrication frequency is recommended.
- Brake Thrustor Oil. The brakes are "sealed for life" and should only need minor additions over time. The lubricant shown on the existing lube chart is Mobile Velocite 10. A review of Mobile literature shows this to be an ISO Grade 22. The thrustor manufacturer's literature recommends Chevron Spindle

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Oil #10. This is an ISO Grade 10 oil. It is recommended that Chevron Spindle Oil #10 be used in the future and that the Velocite 10 be discarded.

- Coupling Lubrication Practice. An appropriate re-lubrication practice for couplings is to install one lube fitting and to remove an opposite plug, then to flush old lubrication to the extent possible. Maintenance is aware of this recommendation. Notes have been added to the lubrication schedule to outline the procedure.
- Reducer Lubrication.
  - Per the provided lubrication table, the current gear oil at the reducers is Mobil 600 XP 220. This is a 5EP oil (ISO 220) with a 220 cSt at 40°C viscosity.
  - The reducer data plates call out a 6EP oil for the primary reducers and a 6S-EP (this is a synthetic) for the secondary reducers.
  - The shop drawing and manufacturer's literature in the existing O&M manual calls out a 6S(EP) (288-352 cSt at 40°C. Texaco Pinnacle EP320.

The current oil viscosity does not fall within the recommended range per the reducer literature and per the reducer housing data plates (288 to 352 cSt at 40°C). This may not be a significant issue as there were no indications of unusual gear wear or damage due to the use of the current lubricant and there were no signs of an issue with the oil sample analysis performed as part of the 2020 inspection. However, it is recommended that the lubricant be changed to match the manufacturer's requirements. Synthetic oils are recommended for both the primary and secondary reducers as it will provide more consistent oil viscosity with temperature fluctuations and provide a longer service life.

- Reducer Oil Changes. Current maintenance practice is to check the oil level and top off as necessary. The oil should be tested annually and replaced base on the sample testing results.
- Rack and Pinion Lubricant. The 2020 inspection report documents signs of inadequate lubrication at the racks and pinions. The lubricant used for the rack and pinion gear tooth lubrication is Castle Muscle Grease. The manufacturer lists the following uses for this aluminum complex grease: "fifth wheels, cables, electric motor shafts, pulleys, and hinges." This lubricant is not comparable with lubricants designed for open gears such as Lubriplate Gear Shield Heavy or Chevron Open Gear Lube. In addition, the frequency of lubrication, listed at 6 months, should be reduced as required to maintain adequate lubricant coverage at all times. The recommendation is to provide monthly lubrication with an open gear grease during the operational season.
- Tail Lock - RACO Actuator Lubrication. The manufacturer's literature indicates that the actuator is packed with a synthetic lubricant (Mobilith SHC 460) and recommends periodic lubrication with an equivalent lubricant.
- Tail Lock - Lock Bar Lubricant and Lubrication Procedures. The Castle Muscle Grease is currently used at the lock bars. There was some corrosion on the lock bars noted during the 2020 inspection. The lubrication and frequency should be upgraded to ensure no corrosion. It is recommended that the lubrication practice include the removal of old grease and any debris from the lock bars and from the receivers (at span) when lubricating; this will help to limit built-up of old grease and debris to help prevent future operation issues.

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- Shear Lock Jaw Lubrication Frequency. The lubrication was inadequate at the time of the 2020 inspection. The frequency of the shear lock lubrication should be increased to try to maintain lubricant on the jaws to the extent possible. It is recommended that a monthly lubrication schedule be maintained, with an increase of the frequency based on inspection.
  - Traffic Warning Gates. The provided lubrication chart includes bearing grease for the pivots and rod ends in the traffic warning gate housings. The list did not include oil for the two enclosed reducers that are included in the gate drive train. An appropriate lubricant and frequency has been added to the lubrication chart.

The provided recommendations have been incorporated into a revised copy of the lubrication schedule, which is provided as part of the Mechanical Maintenance Manual shown in Appendix E.

### Other Mechanical Component Maintenance

The lubrication chart included a number of non-lubrication maintenance items that the County personnel address periodically. The noted maintenance items are listed below with some commentary.

- Check tension and pads on the brakes at six-month intervals. The brake torque and pads are important to check. Another important detail is to maintain the brake wheel friction surface free of corrosion or debris. At the time of the 2020 inspection, the brakes were noted to be in good condition.
- Clean and visually inspect the flat and curved treads on a six-month interval. The treads must be kept clear of debris. The amount of debris varies by bridge. It is recommended that this frequency be increased, if necessary, to ensure the flat and curved treads remain clear of debris.
- Visual inspection of the rigid couplers associated with the electrical control equipment. This is an appropriate inspection for the couplers.

The following additional maintenance efforts were also discussed:

- Periodic replacement of the span drive machinery reducer desiccant breathers.
- Periodic cleaning of the counterweight pits.
- General removal of debris and excess lubricant. Maintenance personnel were aware of this and appear to include this in their efforts.
- Maintenance of paint on all machinery surfaces. Corrosive deterioration is the most common source of deterioration for movable bridge machinery components. During the meeting, the importance of addressing deterioration was emphasized. The O'Rorke Scope of Work document reproduced in APPENDIX A notes that painting to address corrosive deterioration of mechanical components is the responsibility of the stand-by contractor, under the direction of the DOT. It is recommended that small touch-up painting repairs be performed by Monroe County personnel as part of their typical lubrication and inspection maintenance practices. This may help to limit corrosive deterioration in the long-term.
- Corrosion of machinery room floor. This is a known issue with the bridge and, given the extent of deterioration, may require a repair contract.
- Check fastener tightness (although fasteners shouldn't loosen if properly tensioned).

- Traffic Warning Gates. One of the common issues with traffic warning gates is the loosening of the fasteners that secure the reducer base plate to the reducer, the reducer base plate to the support channel, and the support channel to the gate housing. Maintenance personnel were generally aware that this can be an issue though they noted that maintenance of the gates is state DOT responsibility. Note that a O'Rorke Scope of Work document reproduced in APPENDIX A lists the gates as the responsibility of Monroe County.
- Curved and Flat Treads. The lugs and pockets on rolling lift bridges often wear. Where the wear is severe, some owners elect to lubricate the wearing surfaces, even though the lubricant can trap debris. For this bridge, the wear is light, and lubrication is not recommended at this time.

The existing Mechanical Maintenance Manual provides maintenance direction on a number of components. A revised Mechanical Maintenance Manual has been created as part of this report. The manual is provided in Appendix E. This manual includes specific recommendations for maintenance for all mechanical components, and it includes a revised lubrication chart to address the issues noted above.

### **Electrical Component Maintenance**

There are no current routine electrical maintenance practices for the bridge. The operator noted past routine inspection efforts by O'Connell Electric Co. (the electrical installer), dating back to 2017. Since construction, O'Connell also was involved with numerous electrical repairs. A copy of a Preventative Maintenance checklist, dated 2016, and presumably completed by O'Connell Electric Co., was found in the flat file located in drawer 3. The preventative maintenance checklist included visual inspections, fastener checks, and other routine inspection items.

It is important that maintenance efforts include the electrical systems. Examples of industry standard electrical maintenance are provided in the list that follows. Recommended tasks and frequencies have been reviewed and provided in a revised Electrical Maintenance Manual, attached in Appendix D.

- Insulation resistance testing (Megger resting) for major electrical power equipment including motor feeders, motor windings and submarine cable conductors
- Removal of accumulated dust and debris from around electrical components and from within cabinets and panels
- Routine maintenance and test of the generator/Automatic Transfer Switch (ATS)
- Inspection of cables and conduits for deterioration
- Physical inspection and functionality checks for limit switches and interlocks
- Review of terminal block fasteners and other electrical connections for tightness
- Visual inspection of fuses
- Visual inspection and continuity checks at circuit breakers
- Test operation of UPS
- Lamp and indicator light tests
- Inspection for the mechanical integrity of electrical installations
- Inspection of contacts and/or blades for switches

- Exercise active components such as breakers, switches, etc.
- Review components during operation
- Test all emergency light fixtures

The existing maintenance manuals provide maintenance direction on a number of electrical components. A revised Electrical Maintenance Manual has been created as part of this report and is provided in Appendix C. This manual includes specific recommendations for maintenance for the electrical components, and it includes a proposed checklist for use by maintainers.

## **NEEDS ASSESSMENT**

The purpose of the Needs Assessment is to summarize the gaps in documentation and training for bridge maintenance and operation personnel, and the required repair efforts based on the current condition of the mechanical and electrical systems.

### **Mechanical Drawings**

- There are no updates recommended for drawings related to the mechanical components. The on-site records of mechanical machinery accurately match the installation. Minimal duplicate drawings and no modified drawings were noted in this review. In addition, documents within the existing Operation and Maintenance manual literature are consistent with the installation and remain applicable.

### **Routine Mechanical Maintenance**

- The current lubrication table provided by the County does not match other documents, including the original maintenance manual. In addition, some of the lubricants and lubrication frequencies require modifications to meet industry standards. An updated Mechanical Maintenance Manual with a revised lubrication table is provided in APPENDIX E. Out-of-date lubrication schedules should be marked to identify them as obsolete. The obsolete documents should then be archived offsite.
- It is recommended that mechanical maintenance items be updated in a current document. This has been performed as part of this study. Updated maintenance recommendations are provided within the Mechanical Maintenance Manual in APPENDIX E. Some additions include periodically removing debris from the tail lock receivers and the live load reactions, addressing corrosive and paint deterioration as it occurs, and checking that traffic gate reducers remain securely mounted.
- Consider providing a wall-mounted lubrication chart in the machinery spaces. This is a practice sometimes used to ensure proper maintenance, even if there are changes to maintenance personnel. Consideration may be given to providing photographs that will be cross referenced to the lubrication charts.

### **Electrical Drawings**

- Consolidate and update as-built control schematics (Link Control Systems, Inc. shop drawings). Remove out-of-date drawings for archival or mark to indicate obsolete. Confirm accuracy of hand mark-ups as part of the review and create current as-builts. It may be cost-effective to include this activity as part of a future rehabilitation to modernize the drives and PLC. If a rehabilitation is not

pursued in the near-term then this work should be prioritized as it will facilitate future troubleshooting and repairs.

- Consolidate copies of O'Connell Electric Company electrical installation shop drawings. Remove duplicates, check for discrepancies between duplicated sheets, and ensure accuracy of installations. This would likely take weeks of site time to trace out the installation and is beyond the scope of the current work. It is recommended that this be performed as part of any future rehabilitation. If a rehabilitation is not pursued in the near-term then this work should be prioritized as it will facilitate future troubleshooting and repairs.

### **Routine Electrical Maintenance**

- Provide requirements for routine maintenance for all components. A detailed list of recommendations by component is provided in the Electrical Maintenance Manual provided in Appendix D.

### **Operation Support and Training**

A revised Operation Manual has been provided as part of this study. The document is provided in APPENDIX C. This document was provided to address the following needs:

- Operating Procedure. Due to duplicate and obsolete records, it was recommended that an operating procedure(s) be consolidated and updated. Remove out-of-date procedures for archival and clearly mark them to indicate that they are obsolete.
- Manual Operation Procedure. There were no noted records of procedures for manual operation using the provided hand drills at the span drive machinery. A detailed procedure for operation using the hand drills been provided. Note that, with this additional review of the system, it is clear that manual operation using the hand drills poses significant safety concerns. Operation with the drills should be avoided if possible.
- Bypass Procedures. The provided operation manual includes guidance on the use of the different bypasses that have been provided with the electrical installation. Note that, given the risks associated with bypassing control system interlocks, it strongly recommended that bypasses be used only by trained personnel.
- It is recommended that bridge operation and maintenance personnel be provided with training to understand any revisions to operating and maintenance procedures. It is especially important, that all personnel be fully trained on bypass procedures and the procedure for drill operation. Note that this training is not included as part of this scope.

### **Miscellaneous Repairs to Address Current Conditions**

There are numerous mechanical and electrical repairs that are recommended for the bridge machinery. The following is a summary of repairs recommended based on recent experience at the bridge. The list includes findings as part of this review, and it includes many of the recommendations from the February 2020 detailed mechanical and electrical inspection. Costs are provided for these repairs as part of the Asset Management section of this report.

## Electrical Repairs and Rehabilitation

- The PLC logic has been updated to positively seat both leaves with load prior to driving the tail locks. These changes were performed by WJE personnel with the assistance of the Panatrol Corporation in June, 2020. Changes are still required to seat the bridge with load using the backup relay system.
  - The PLC drive parameters should be tuned to allow proper coordination between speed references and bridge positions to address the nuisance "motor overspeed" failures.
  - Consider replacement of the existing PLC with a modern PLC. This change would provide improved functionality compared to the existing PLC. The change would also be an opportunity to review, update and replace as required the existing as-built controls schematics (by Link Controls) to ensure an accurate set of drawings.
  - Replace the frozen over-travel limit switches with switches suitable for the prevailing environment.
  - Adjust the span drive rotary cam limit switches' full open position to be before the over-travel limit switches are triggered. Calibrate the control console span position indication.
  - Change the control logic (both PLC and relay logic) for the traffic gate interlock such that both oncoming gates must be lowered before the off-going gate can be lowered and vice versa. This work should be performed by a PLC systems specialist vendor.
  - Furnish and install an interlock limit switch for the emergency hand drive system. This should be wired back to the bridge control system to prevent operation of the main drive system of both leaves when the hand drive is engaged to ensure safe operation of the emergency hand drive system.
  - The bridge is provided with a selsyn transmitter and receiver to indicate the position of the span. This device is obsolete and replacement parts will be difficult to obtain in the future. This device should be replaced with a modern span position indicating system.
  - The released and set limit switches for all brakes have been installed incorrectly. The released switches actuate as soon as the brakes begin to release but before the brakes are fully released. The set switches actuate as the brakes are released and not as the brakes set. The limit switches should be adjusted for proper indication of the set and released positions.
  - Furnish and install pedestrian traffic signals at each bridge approach to provide advanced warning and enhance safety for pedestrians.
  - Furnish and install emergency lighting in the electrical room. Replace failed emergency lighting fixtures and/or their battery packs at other locations on the bridge.
  - Clean and paint, or provide a protective coating, at all components where there is corrosion. The touch-up of deteriorated paint or coating is an important maintenance tool to extend the life of the components and, if done in a timely fashion, will limit costly rehabilitative efforts in the future.
  - Consider replacing corroded conduits that are within the machinery space with PVC coated conduits.
  - Monitor the electrical insulation resistance for the motor/feeder assemblies where the resistance to ground was found to be low. Monitor the motors for the traffic gates, one west tail lock (#1) and the SE tail lock (#4). If maintenance does not have this capability, it is recommended that this be included in annual inspections by qualified personnel.
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- Provide a protective cover for all traffic gate rotary cam limit switch assemblies.
- Investigate the path of ingress of water into the traffic gate enclosures. Seal any water entrance points to ensure the interior of the gate housings stay dry.
- The wire-nut splices located inside the brake disconnect switches are not permitted per AASHTO. Replace the splices with a code compliant method of splicing.
- When replacing failed light bulbs, replace the existing with LED light bulbs. Provide new fixtures where required to make this change.

#### Mechanical Repairs and Rehabilitation

- As part of past troubleshooting for an operational issue at the SE Tail Lock (#4), the manual operation mechanism failed. The manual operation mechanism should be repaired. As part of this work, verify that all tail lock manual operating mechanisms are functional. If repairs require shipment to the manufacturer, procure and install spare tail lock assemblies as required. Note that the tail lock assemblies are discussed in the asset management plan as they are short life items relative to the other mechanical machinery. Their replacement in the coming years will likely be recommended as a form of preventative maintenance.
- The access to the tail lock actuators is poor and it hinders maintenance. It is recommended that access platforms be provided to facilitate safe mechanical and electrical maintenance of these components. Repairs should also include a redesign or replacement of the tail lock covers to facilitate maintenance.
- Stop water leakage into the machinery rooms or provide a means of controlling the damage due to the water. Clean the existing floors and ensure their integrity. If they are adequate, clean and paint them to mitigate future damage. If necessary, replace the corroded machinery room floors to ensure their structural integrity. Consider a floor design or materials that would limit future degradation.
- The brake wheel at the northeast motor brake showed signs of a previous over-heat. The brake shoes may have been damaged if they were overheated. Check the surface of the shoes on Motor Brake-FA for glazing or cracking due to overheating and replace as required.
- Adjust the bumper blocks to prevent over-travel of the leaves and replace the damaged portions of the bumper blocks. Shim out the southeast bumper blocks to provide contact at the same position as at the northeast bumper blocks. Given the given the marginal clearances between the pinions and the structures, reduce gaps in the bumper block installations by reducing the number of blocks and providing welded steel spacers.
- Replace the missing clamping bolts on the northeast tail lock actuator rod end.
- Tighten reducer mounting plate bolts at near leaf traffic gates.
- Clean and paint all components where there is paint deterioration and corrosion. The touch-up of deteriorated paint is an important maintenance tool to extend the life of the components and, if done in a timely fashion, will limit costly rehabilitative efforts in the future. This is especially important for critical support items such as the curved and flat tread plates. These curved and flat treads are more exposed than many of the machinery components, and a rehabilitation to correct significant corrosive deterioration would incur significant costs.

- There is leakage at the input shaft seals for the far primary reducer. These seals should be replaced to limit this leakage. In the near term, additional maintenance effort should include monitoring and containing any leakage.
- Re-align the encoder assembly at the non-driven shaft for the southwest span drive motor.
- Shim to realign the span position equipment at the output of the secondary reducers. Consideration may be given to replacing the existing rigid couplings with couplings that can accommodate parallel and angular misalignment.
- There are leaks at the input shaft seals for the southwest and northeast right-angle gearboxes at the secondary reducers' output shafts. In the near term, contain leaked oil and monitor the oil levels in the gearboxes. In the long term, consider replacing the assemblies.
- There are cracks in the concrete that supports the open end of the flat tread plates. These should be sealed or otherwise repaired to prevent further degradation.

## **ASSET MANAGEMENT SCHEDULE AND COSTS**

A long term plan for asset management requires an understanding of the near-term and long-term costs associated with the maintenance of the mechanical and electrical systems for the bridge. A list of repairs, a schedule, and costs have been provided as part of this study. Estimated costs include routine maintenance activities, near-term replacements/repairs, and anticipated long-term capital costs to maintain the bridge mechanical and electrical systems in a state of good repair. Note that this study did not include costs for structural systems, HVAC, plumbing, or any other costs that are not directly related to the mechanical and electrical systems associated with bridge operation.

## **METHODOLOGY**

The summarized costs have been estimated based on experience with bids and repair costs from similar work in the movable bridge industry. Repair costs are based on required materials and labor. Where applicable, costs also include engineering support for significant design repairs, though construction services and other owner management costs are not included. In addition, operating costs for utilities are also not included.

Often life cycle cost analyses will be used as part of a cost benefit analysis to compare alternatives for repairs or new design for infrastructure. When these comparisons are made, the life cycle analyses often will include a discount rate to translate future dollars into current dollars for the sake of evaluating options. The discount rate allows for comparisons of costs from different points of time in present day dollars, and it is typically a reduction in cost based on the "opportunity value" of time. In other words, if one sets aside dollars for future investment, with those dollars' earning power over time, the cost of future work in present day dollars is less.

The O'Rorke Bridge cost analysis, however, does not present costs for comparison for alternatives, but is provided to outline expected costs for near-term and long-term maintenance of the bridge. For this reason, a discount rate is not included in the cost analyses. All costs have been provided in 2021 dollars. Costs in future years may then be increased by an estimated inflation rate to provide expected costs.

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The estimated repairs and the costs associated with them have been established based on a target life of 75 years for the bridge, targeting reliable bridge operation approximately through 2080 based on the bridge commissioning in 2004.

### Cost of Near-Term Repairs

A list of recommended near-term mechanical and electrical repairs was provided in the section titled Miscellaneous Repairs to Address Current Conditions. A summary of the near-term mechanical and electrical repairs and their associated costs is provided in Table 9 and Table 10.

- For minor repairs, the costs include estimated hours for Monroe County maintenance personnel, assuming a labor cost of \$100 per hour.
- For more significant repairs, the costs include assumed contractor labor at \$150 per hour.
- Engineering costs are included where applicable.
- Additional detail is provided in expanded tables in APPENDIX B.

Table 9: Cost for Near-Term Mechanical Repairs

System	Component	Repair Description	Purpose	Estimated Cost 2021 \$
Tail Locks	SE Tail Lock	Verify that all manual operation mechanisms work. Assume replace SE Tail Lock.	Ensure manual operation mechanism remains functional	\$47,200
Tail Locks	NE Tail Lock	Replace the missing clamping bolts on the tail lock actuator rod end .	Ensure integrity of actuator rod end connection	\$1,600
Span Drive Machinery	Machinery Rooms	Clean the corroded floors and ensure their integrity. If they are adequate, clean and paint them to mitigate future damage.	Extend the life and ensure integrity of the machinery room floors	\$41,500
Span Drive Machinery	Machinery Rooms	Determine source of water infiltration into machinery areas. Seal the deck or make other repairs as required to direct water.	Extend the life and ensure integrity of the machinery room floors	\$170,000
Span Drive Machinery	NE Motor Brake	The brake wheel shows signs of a previous over-heat; inspect the surface of the shoes for glazing or cracking due to overheating and replace as required.	Ensure the integrity of the Far Adjacent Motor Brake	\$2,100
Bumper Blocks	East Bumper Blocks	Replace damaged bumper blocks; shim out blocks to equal position at NE and SE	Ensure functionality of bumper blocks	\$5,800
Traffic Control	Traffic Gates	Gate maintenance repairs: Tighten the reducer mounting plate bolts at the near leaf traffic gates; Remove water and seal gate housings; Adjust far adjacent gate drive linkages.	Ensure operational integrity of the gates	\$4,800
Painting	Mechanical Installations	Clean and paint, or provide a protective coating, at all components where there is corrosion.	Limit corrosion to extend the life of the components	\$42,000
Span Drive Machinery	Far Primary Reducer	Replace the leaking input shaft seals; monitor and maintain until replaced.	Limit leakage and maintenance efforts	\$16,200
Span Drive Machinery	SW Motor Encoder Assembly	Re-align the encoder assembly with the motor shaft.	Limit risk of damage of bearings due to misalignment	\$2,000
Span Drive Machinery	Span Position Equipment at Output of Secondary Reducers	Re-align the span position equipment and replace the couplings to provide misalignment capacity.	Limit risk of damage of bearings due to misalignment	\$12,700
Span Drive Machinery	Span Position Equipment at Output of SW and NE Secondary Reducers	Replace the leaking right-angle gearboxes that are coupled to the reducer output shafts.	Elinminate leakage of reducers	\$7,800
Span Support Components	Concrete at Flat Tread Installations	Seal or repair cracks in concrete near the open end of the flat tread plate installations.	Prevent further degradation of the concrete	\$2,900
General	All Components	General engineering assistance for those items without engineering costs	Assist and expedite repairs	\$20,000
<b>Total Cost, Near Term Mechanical Repairs</b>				<b>\$376,600</b>

Table 10: Cost for Near-Term Electrical Repairs

System	Component	Repair Description	Purpose	Total Cost 2021 \$
Control System	Relay Logic	Modify relay logic to positively seat the bridge.	Positively seat bridge under backup control	\$43,900
Control System	SCR Drives	Adjust drive parameters to coordinate speed references for different bridge positions.	Eliminate nuisance "motor overspeed" failures	\$23,100
Control System	PLC and Relay Logic	Change the control logic (both PLC and relay logic) for the traffic gate interlocks such that both oncoming gates must be lowered before the off-going gates can be lowered and vice versa.	Ensure proper sequence of operation for safety and AASHTO compliance	\$13,800
Electrical Installation	Brake Disconnect Switches	Replace wire-nut splices with code compliant terminals.	Wire-nut splices are not permissible per AASHTO	\$3,600
Field Devices	Full Open Switch and Over-Travel Limit Switch	Adjust full open switch, over-travel switch, RCLS, and bumper blocks for revised full open.	Modify overtravel switches, RCLS, and bumper blocks to ensure no damage to structure; calibrate control console position indication	\$21,700
Field Devices	Over-Travel Limit Switch	Replace the over-travel limit switches with ones suitable for prevailing environment.	Ensure functionality of over-travel limit switches	\$3,400
Field Devices	Span Drive Brake Set and Released Limit Switches	Adjust the limit switches for proper indication of the set and released positions.	Proper indication of the brake positions will help to ensure safe operation of the bridge	\$17,900
Field Devices / Control System	Emergency Hand Drive System	Furnish and install an interlock limit switch for the emergency hand drive system. This should be wired back to the bridge control system to prevent operation of the main drive system of both leaves when the hand drive is engaged.	Ensure safe operation of the emergency hand drive system	\$47,100
Traffic Control	Pedestrian Traffic Signals	Furnish and install pedestrian traffic signals at each bridge approach.	Provide advanced warning to / enhance the safety of pedestrians	\$52,900
Traffic Control	Traffic Gates	Provide a protective cover for all rotary cam limit switches.	Protect rotary cam switches from debris and corrosion	\$1,500
Bridge Lighting	Emergency Lighting	Furnish and install emergency lighting in the electrical room; replace failed emergency lighting fixtures and/or their battery packs at other locations on the bridge.	Allow for safe access to areas in the event of utility failure	\$5,000
Bridge Lighting	Lighting	Change existing light bulbs to LED bulbs. Replace fixtures as needed for LED lights.	Reduce cost and maintenance associated with the lights	\$20,000
Painting	Electrical Installation	Clean and paint, or provide a protective coating, at all components where there is corrosion.	Limit corrosion to extend the life of the components	\$17,000

**Total Cost, Near Term Electrical Repairs \$270,900**

### Capital Costs for Life Cycle

The estimated capital costs are provided using conservative estimates of the life cycle for the components that comprise the mechanical and electrical systems for the bridge. A summary of mechanical and electrical capital costs is provided in Table 11 and Table 12. Note the following:

- The estimated life of each component is provided based on our experience at similar structures. For this exercise, the service life of components has been conservatively estimated assuming capital investments are required to ensure reliable systems. The life estimates also assume that the components will be provided with routine maintenance to ensure a state of good repair.
- Capital costs are provided assuming a target life of 2080 for the machinery, to achieve an approximate service life of 75 years from the commissioning of the bridge.
- Where practical, and to minimize the number of contracts over the life of the bridge, repairs have been combined.

Table 11: Mechanical Capital Costs

System	Component	2020 Condition	Capital Required for Service Life to 2080				
			Notes	Repair Year	Cost (2021 \$)	Year	Cost (2021 \$)
Span Drive Machinery	Drivetrain, including shafts, couplings, reducers, bearings, gears	Good	Assume 1 rehab. to achieve target life.	2060	\$5,010,000	None	-
Span Support Assemblies	Curved and flat tread assemblies	Good	Assume 1 rehab. to achieve target life.	2060	\$2,312,000	None	-
Span Support Assemblies	Live load reactions	Fair	Assume 2 rehabs. to achieve target life.	2040	\$66,000	2060	\$66,000
Span Support Assemblies	Tail lock assemblies	NA	Provide platforms for access to the tail lock assemblies.	2022	\$143,000	None	-
Span Drive Machinery	Machinery Room Floors	Poor condition due to corrosive deterioration	Seal the deck and replace the floors with corrosion resistant material	2022	\$146,000	None	-
Span Support Assemblies	Tail lock assemblies	Fair	Costs included with electrical costs .	-	-	-	-

Table 12: Electrical Capital Costs

System	Component	2020 Condition	Capital Required for Service Life to 2080						
			Notes	Year	Cost (2021 \$)	Year	Cost (2021 \$)	Year	Cost (2021 \$)
Main Electrical Service	Main Electrical Service Unit Substation	As-New	Assume 1 rehab. to achieve target life. (Includes feeder cables to bridge)	2060	\$50,000	None	-	None	-
Bridge Standby Power	Generator with Automatic Transfer Switch and Load Bank	Very Good	Assume 1 rehab. to achieve target life. Includes load bank.	2050	\$176,000	None	-	None	-
Span Drive Motors and Drives	Main Span Drive Motors and SCR Drives	Very Good, but Drives are Obsolete and Provide Inferior Control	Replace motors and drives: VFDs and squirrel cage induction motors, with modern PLCs. Assume 2 rehabs to achieve target life.	2022	\$2,164,333	2050	\$2,089,333	None	-
Bridge Control System and PLC	Bridge Control System and PLC	Fair, but Obsolete SCR Drives and Aging PLC	Rehabilitate at same time as motors and drives. Assume 2 rehabs to achieve target life.			2050		None	-
Span Drive Brakes	Span Drive Motor and Machinery Brakes	Good	Replace when replace motors and drives. Assume 2 rehabs to achieve target life.			2050		None	-
Field Devices	Bridge Position: Selsyns, Rotary Cam Limit Switches, Inclometers, Speed Switches, and Others	RCLS for Bridge Position- Fair Selsyn for Bridge Position - Obsolete Inclinometer for Bridge Position - Good Bridge Seated Plunger Switches - Good Bridge Over-Travel Lever Switches - Poor Speed Switches - Good Tachometers - Good	Rehabilitate at same time as motors and drives. Assume 2 rehabs to achieve target life. (Excluding maintenance costs... costs for full replacement shown).			2050		None	-
	Tail Locks: Rotary Cam Limit Switches and Position Switches	Tail Lock RCLS - Fair Tail Lock Position Switches - Fair	Included with Tail Lock Assemblies.			-		None	-
	Traffic Warning Gates: Rotary Cam Limit Switches and Enclosure Door Switches	Fair	Included with Gate Assemblies			-		None	-
Operator's Control Console	Operator's Control Console	Very Good	Assume replacement for 1st replacement motors and drives. Should last to target life.	None	-	None	-		
Tail Locks	Tail Locks (Mechanical and Electrical Included)	Fair due to Significant Corrosion. Past Operation Issues, and Insulation Resistance for Some Motors	Assume 3 rehabs. to achieve target life. Assume approx. 20 year life.	2022	\$192,080	2050	\$192,080	2070	\$192,080
Droop Cables	Droop Cables	Very Good	Assume replace 2 times.	2030	\$37,920	2060	\$37,920	None	-
Emergency Span Drive System	Hand Drive Drill Driven with Portable Generator Receptacle	Good (Moderate Corrosion at Local Disconnect Covered Elsewhere)	Assume 1 rehab. Recommend replacement of existing with a more sophisticated auxiliary drive system, driven by existing generator, control from operator's console, and including brakes and limits of operation.	2030	\$242,200	None	-	None	-
Aids to Navigation	Navigation Lights	Good - Minor Corrosion and Operation Issues	Assume 3 rehabs. to achieve target life.	2030	\$93,600	2050	\$93,600	2070	\$93,600
	Marine Horn	Good	Assume 3 rehabs. to achieve target life.	2030	\$21,200	2050	\$21,200	2070	\$21,200
CCTV	CCTV System	Good	Assume 3 rehabs. to achieve target life. Assume approx. 20 year life.	2030	\$109,800	2050	\$109,800	2070	\$109,800
Fire Alarm System	Fire Alarm System	As-New	Assume 3 rehabs. to achieve target life.	2030	\$113,600	2050	\$113,600	2070	\$113,600
Traffic Control	Warning Gates (Mechanical and Electrical Included)	Fair Condition due to Corrosion, Some Mechanical Operational Issues, and Insulation Resistance for Some Motors	Assume 3 rehabs. to achieve target life.	2030	\$247,021	2050	\$247,021	2070	\$247,021
	Traffic Lights	Good	Assume 1 rehab. to achieve target life.	2070	\$57,000	None	-	None	-
MCCs	MCCs	Good	Assume 1 rehab. to achieve target life.	2040	\$259,800	None	-	None	-
Submarine Cables	Submarine Cables	Very Good	Assume 1 rehab. to achieve target life.	2050	\$259,000	None	-	None	-
Electrical Installation (Conduit, Junction Boxes, etc.)	Conduit, Junction Boxes, & Cable Trays, Disconnect Switches, Lighting Fixtures, Space Heaters, Switches and Receptacles	Fair due to Corrosion in Spots	Assume 1 rehab. to achieve target life. Combine with other electrical rehabilitation in date shown.	2050	\$1,253,600	None	-	None	-
Intercom	Intercom System	Very Good	Assume 1 rehab. to achieve target life.	2050	\$90,200	None	-	None	-

**Maintenance Costs**

Maintenance costs are provided based on an assumed standard of care that is consistent with good practice within the movable bridge industry, with adjustments as necessary given the duty cycle for this bridge. The costs are provided in Table 13. Note the following assumptions that impact the maintenance costs.

- Normal maintenance is based on an estimated effort in terms of number of personnel and hours for Monroe County maintenance personnel, assuming a labor cost of \$100 per hour. The estimated effort includes an approximate number of hours per month for maintenance personnel plus additional time for troubleshooting call-outs.
- The estimates also include some emergency call-outs for mechanical and electrical personnel to troubleshoot operational issues. The effort for this work is estimated at an inflated rate of \$150 per hour.
- Maintenance material estimates include lubricants and other materials (rags, light bulbs, reducer breathers, scrapers, etc.) associated with general maintenance.

Table 13: Cost for Annual Mechanical and Electrical Maintenance

Task	Component	Annual Cost 2021 \$
Mechanical Maintenance	Routine Mechanical Maintenance Costs Assuming Hours per Month and Cost of Lubricants and Other Consumables Included	\$71,500
Mechanical Maintenance	Non-Routine Mechanical Repairs Beyond Normal Maint Efforts; Assumed Hours and Parts.	\$21,600
Mechanical Maintenance	Assumed Emergency Mechanical Call-Out for Maint. Personnel	\$39,200
Electrical Maintenance	Routine Electrical Maintenance Costs Assuming Hours per Month and Cost of Consumables Included	\$34,000
Electrical Maintenance	Non-Routine Electrical Repairs Beyond Normal Maint Efforts. Assumed Hours and Parts.	\$24,600
Electrical Maintenance	Assumed Emergency Electrical Call-Out for Maint. Personnel (bridge operational issues, etc.)	\$29,200
Inspection	Biannual Mechanical & Electrical Inspection and Reports (scope of recent inspections but with the addition of remote access from systems vendor for control system testing)	\$52,500

**Total Cost, Annual Mechanical and Electrical Maint. \$272,600**

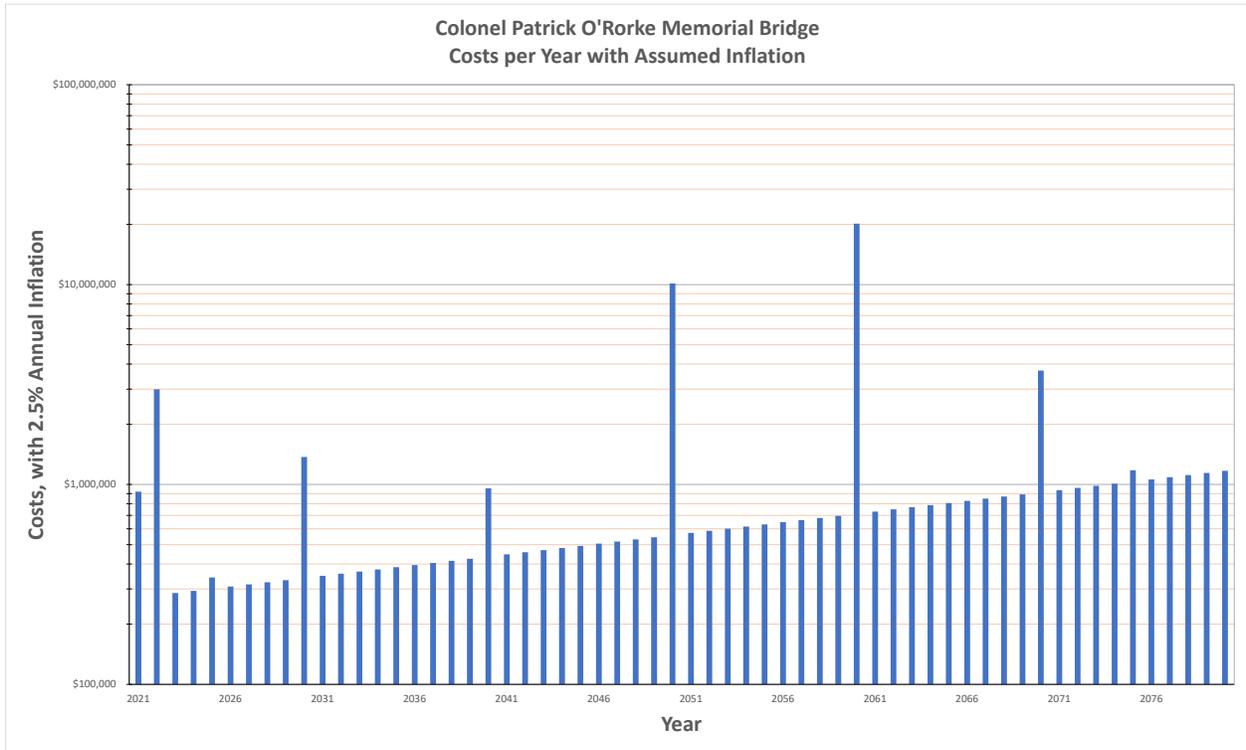
**SUMMARY OF FUTURE COSTS**

The anticipated costs per year are summarized in the Table 14 and in Figure 29. Costs estimates have been compiled from the estimates provided above and increased by an assumed inflation rate of 2.5% per year. Again, note that a discount rate has not been applied as is sometimes done for life cycle analyses.

Table 14. Total Mechanical and Electrical Cost per Year, Inflated at 2.5%

Year	Maint.	Repairs	Capital	Total Cost	Year	Maint.	Repairs	Capital	Total Cost
2021	\$272,600	\$647,500	\$0	\$920,100	2051	\$571,797	\$0	\$0	\$571,797
2022	\$279,415	\$0	\$2,711,548	\$2,990,963	2052	\$586,092	\$0	\$0	\$586,092
2023	\$286,400	\$0	\$0	\$286,400	2053	\$600,744	\$0	\$0	\$600,744
2024	\$293,560	\$0	\$0	\$293,560	2054	\$615,763	\$0	\$0	\$615,763
2025	\$300,899	\$0	\$41,857	\$342,756	2055	\$631,157	\$0	\$0	\$631,157
2026	\$308,422	\$0	\$0	\$308,422	2056	\$646,936	\$0	\$0	\$646,936
2027	\$316,132	\$0	\$0	\$316,132	2057	\$663,109	\$0	\$0	\$663,109
2028	\$324,036	\$0	\$0	\$324,036	2058	\$679,687	\$0	\$0	\$679,687
2029	\$332,137	\$0	\$0	\$332,137	2059	\$696,679	\$0	\$0	\$696,679
2030	\$340,440	\$0	\$1,033,335	\$1,373,775	2060	\$714,096	\$0	\$19,484,395	\$20,198,491
2031	\$348,951	\$0	\$0	\$348,951	2061	\$731,948	\$0	\$0	\$731,948
2032	\$357,675	\$0	\$0	\$357,675	2062	\$750,247	\$0	\$0	\$750,247
2033	\$366,617	\$0	\$0	\$366,617	2063	\$769,003	\$0	\$0	\$769,003
2034	\$375,782	\$0	\$0	\$375,782	2064	\$788,228	\$0	\$0	\$788,228
2035	\$385,177	\$0	\$0	\$385,177	2065	\$807,934	\$0	\$0	\$807,934
2036	\$394,806	\$0	\$0	\$394,806	2066	\$828,132	\$0	\$0	\$828,132
2037	\$404,676	\$0	\$0	\$404,676	2067	\$848,836	\$0	\$0	\$848,836
2038	\$414,793	\$0	\$0	\$414,793	2068	\$870,057	\$0	\$0	\$870,057
2039	\$425,163	\$0	\$0	\$425,163	2069	\$891,808	\$0	\$0	\$891,808
2040	\$435,792	\$0	\$520,840	\$435,792	2070	\$914,103	\$0	\$2,797,642	\$3,711,745
2041	\$446,687	\$0	\$0	\$446,687	2071	\$936,956	\$0	\$0	\$936,956
2042	\$457,854	\$0	\$0	\$457,854	2072	\$960,380	\$0	\$0	\$960,380
2043	\$469,300	\$0	\$0	\$469,300	2073	\$984,389	\$0	\$0	\$984,389
2044	\$481,033	\$0	\$0	\$481,033	2074	\$1,008,999	\$0	\$0	\$1,008,999
2045	\$493,059	\$0	\$0	\$493,059	2075	\$1,034,224	\$0	\$143,866	\$1,178,090
2046	\$505,385	\$0	\$0	\$505,385	2076	\$1,060,080	\$0	\$0	\$1,060,080
2047	\$518,020	\$0	\$0	\$518,020	2077	\$1,086,582	\$0	\$0	\$1,086,582
2048	\$530,970	\$0	\$0	\$530,970	2078	\$1,113,746	\$0	\$0	\$1,113,746
2049	\$544,245	\$0	\$0	\$544,245	2079	\$1,141,590	\$0	\$0	\$1,141,590
2050	\$557,851	\$0	\$9,584,050	\$557,851	2080	\$1,170,129	\$0	\$0	\$1,170,129

Figure 29: Total Mechanical and Electrical Cost per Year, Inflated at 2.5%



## **SUMMARY**

The movable portion of the Colonel Patrick O'Rorke Memorial Bridge is a double leaf rolling lift bascule bridge that was opened to traffic in October 2004. The bridge has had a history of operational issues dating back to the original installation, resulting in significant disruptions to local and regional traffic.

This report summarizes a study of the mechanical and electrical systems associated with the movable bridge. The study included a review of the current operating status of the systems, recent operating issues, the existing documentation, and a review of practices related to the maintenance and operation of the bridge. This study yields a list of recommendations which include mechanical and electrical repairs, updates to maintenance and operation literature, training of personnel, and capital repairs estimated to maintain the systems in a state of good repair for a desired service life of 75 years.

As part of the work, upgrades to the existing operation and maintenance, including updated machinery lubrication requirements, have been outlined in revised operation and maintenance manuals. The maintenance manuals include maintenance checklists for and schedules for routine maintenance of the mechanical and electrical systems. The operation manual includes updated operating procedures, including guidance for manual operation and for the use of control system bypass features.

The results of the study are intended to be used to address near term issues including the elimination of operational failures and to minimize long term capital requirements. With improvements to maintenance and by providing near and long term repairs, it is expected that the bridge can be maintained in a reliable condition for the target 75 year life. The provided costs may be utilized by the owner as part of their planning for near term and long term expenditures required to maintain the bridge mechanical and electrical systems in a state of good repair.



**APPENDIX A. SCOPE OF WORK RESPONSIBILITY DOCUMENT**

PIN 4T3920

**D034678 - O'Rorke\_Schedule B**

SLA# \_\_\_\_\_

ITEM	SCOPE OF WORK	RESPONSIBILITY	
		Monroe County	NYS DOT
<b>MAINTENANCE (Routine and Capital)</b>			
M1	Bridge vehicular and pedestrian traffic control - - Signal and gate bulbs, - lighting and signal lenses, - Signal controller timing, - bell, and - traffic gates	X	
M2	Bridge navigation lights – - bulbs, lenses, and photocel	X	
M3	Street and façade lighting on the Bridge – - bulbs, lenses, and photocel	X	
M4	Control house, including: - Doors, keyless entry, windows, flooring, wall covering, ceiling - Computer system, security CCTV system, telephone, PA system - Light bulbs and lenses - Audible horn, - HVAC, and - Interior janitorial cleaning	X	
M5	Plumbing, including: - bathrooms, - floor drains, - condensate lines, - hot/cold water lines, - hot water tank	X	
M6	Electric and data recepticals	X	
M7	Fire alarm testing and annual drill	X	
M8	Lubrication of all moving parts and bearings	X	
M8.5	Painting of Mechanical Equipment corrosion		Stand-By
M9	Mechanical pit cleaning	X	
M10	Generator Maintenance - Annual oil change and filter - fuel additive - twice a year load test, before and after navigation season		FA
M11	Annual training and simulated power failure operation, lift up/down (NYS DOT Lead, MC Assist)	X	FA, BR
M12	Drainage scuppers and curb drainage on the bridge	X	
M13	Small tools	X	
M14	Safety Repairs of: - Sidewalk, curb, fascia, structural concrete, joint sealant, bridge deck, approach slabs, bridge rail, approach rail, steel superstructure, offensive graffiti, and associated MP&T		BR. Maint.
M15	Capital planning and programming for maintenace, restoration, rehabilitation contracts - Bridge washing - Bridge painting - Bridge Joint - Deck Sealing		Planning
M16	Non-Emergency electrical wiring and breakers (not lift control breakers or fuses)		Gen. Mech
M17	Any non-emergency, non-impedance to maritime, vehicle, or pedestrian work orders	X	



PIN 4T3920

**D034678 - O'Rorke\_Schedule B**

SLA# \_\_\_\_\_

ITEM	SCOPE OF WORK	RESPONSIBILITY	
		Monroe County	NYSDOT

OPERATION			
O1	Bridge operator pre-shift inspection on foot	X	
O2	Bridge bascule span operation, up, down, per procedure sequence	X	
O3	Bridge navigation lights operable during navigation season from sunset to sunrise CFR335118.6	X	
O4	Bridge vehicular traffic control - - signals, - bell, and - pedestrian/vehicle traffic gates	X	
O5	Street and facade lighting on the bridge	X	
O6	Bridge control house, controls, and audible horn	X	
O7	Bridge failure/closure notification procedures	X	

ITEMS PROVIDED BY			
P1	Electricity, water, refuse removal, and communications services	X	
P2	Commercial services that include: - Floor mats - Uniforms - Exterior window cleaning - Janitorial service	X	
P3	Incidental supplies, including: - office supplies, batteries, flashlight, mechanical paint, cleaning supplies, clothing - PPE for County staff, including safety harness	X	
P4	Traffic closure devices from <b>initial notice up to two hours</b> (Short Duration) - Cones/Barrels, Sawhorse (Items stored in control house, operator setup) - Bridge closed sign (Items stored in control house, operator setup)	X	
P9	Traffic closure devices from <b>two hours and longer</b> (Short-Term Stationary) - Cones/Barrels, Type III Barricades, MP&T - Flaggers - Signs and Detour Signs		Residency
P5	Insurance	X	
P6	Motor oil and lubricants	X	
P7	Hiring, training, and employing seasonal operators, floaters, and backups	X	
P8	Public Involvement - - brochures - public notices - press releases - Government stakeholder inquires	MC to assist NYSDOT	NYSDOT PIO
P10	Construction supplies - lumber, steel, welding, and bolts		BR Maint.
P11	Equipment or Equipment rentals (not small tools, portable generators, or pumps)		BR Maint.

EMERGENCY			
E1	Emergency stand-by contractor - Electrical wiring failures and fuses - Mechanical failures - Gate Arm repairs - pro-logic controls and control panel circuit components - Mechanical/Electrical switch contacts - Positioning or seating of the bridge - Manual raising/lowering of bridge		Emergency Stand-by Contractor



APPENDIX B. EXPANDED NEAR TERM REPAIR COST TABLES

Table 15: Expanded Table for Mechanical Near Term Repair Costs

System	Component	Repair Description	Purpose	Engineering Cost	Contractor Cost	Monroe County Maint Cost	Estimated Cost 2021 \$
Tail Locks	SE Tail Lock	Verify that all manual operation mechanisms work. Assume replace SE Tail Lock.	Ensure manual operation mechanism remains functional.	\$5,000	\$42,200	No Monroe County costs	\$47,200
Tail Locks	NE Tail Lock	Replace the missing clamping bolts on the tail lock actuator rod end.	Ensure integrity of actuator rod and connection.	\$0	\$0	Minor costs for 1 day, 2 workers to procure and replace fasteners.	\$1,600
Span Drive Machinery	Machinery Rooms	Clean the corroded floors and ensure their integrity. If they are adequate, clean and paint them to mitigate future damage.	Extend the life and ensure integrity of the machinery room floors.	\$4,500	\$37,000	No Monroe County costs	\$41,500
Span Drive Machinery	Machinery Rooms	Determine source of water infiltration into machinery areas. Seal the deck or make other repairs as required to direct water.	Extend the life and ensure integrity of the machinery room floors.	\$40,000	\$130,000	No Monroe County costs	\$170,000
Span Drive Machinery	NE Motor Brake	The brake wheel shows signs of a previous overheating. Inspect the surface of the shoe for glazing or cracking due to overheating and replace as required.	Ensure the integrity of the Fair Adjacent Motor Brake.	\$0	\$0	Assume 1 day for metal to remove shoes and inspect; include cost of 1 added day for replacement, and shoe replacement costs.	\$2,100
Bumper Blocks	East Bumper Blocks	Replace damaged bumper blocks; shim out blocks to equal position at NE and SE.	Ensure functionality of bumper blocks.	\$0	\$0	No Monroe County costs	\$5,800
Traffic Control	Traffic Gates	Gate maintenance repairs. Tighten the reducer mounting plate bolts at the near leaf traffic gates. Remove water and seal gate housings. Adjust fair adjacent gate drive linkages.	Ensure operational integrity of the gates.	\$0	\$0	Assume 2 days for 2 maintenance personnel to make this repair	\$4,800
Painting	Mechanical Installations	Clean and paint, or provide a protective coating at all components where there is corrosion.	Limit corrosion to extend the life of the components.	\$0	\$0	Assume 5 weeks for 2 workers to hand clean and paint corroded areas; include nominal \$2K for prep and painting materials	\$42,000
Span Drive Machinery	Far Primary Reducer	Replace the leaking input shaft seals; monitor and maintain until replaced.	Limit leakage and maintenance efforts.	\$6,400	\$9,800	No Monroe County costs	\$16,200
Span Drive Machinery	SW Motor Encoder Assembly	Re-align the encoder assembly with the motor shaft.	Limit risk of damage of bearings due to misalignment.	\$0	\$0	Assume 1 day for 2 workers to align and shim. Assume nominal \$60 materials cost.	\$2,000
Span Drive Machinery	Span Position Equipment at Output of Secondary Reducers	Re-align the span position equipment and replace the couplings to provide misalignment capacity.	Limit risk of damage of bearings due to misalignment.	\$6,400	\$6,300	No Monroe County costs	\$12,700
Span Drive Machinery	Span Position Equipment at Output of SW and NE Secondary Reducers	Replace the leaking right-angle gearboxes that are coupled to the reducer output shafts.	Eliminate leakage of reducers.	\$0	\$7,800	Assume 2 days for 2 workers to align and shim new assemblies. Assume nominal \$3,000 materials cost for new couplings, shims, reducers.	\$7,800
Span Support Components	Concrete at Fair Tread Installations	Seal fair tread cracks in concrete near the span end of the fair tread using sealant.	Prevent further degradation of the concrete.	\$0	\$0	Assume 1 day for 2 workers to prepare then seal concrete.	\$2,900
General	All Components	General engineering assistance for those items without engineering costs.	Assist and expedite repairs.	\$20,000	\$0	No Monroe County costs	\$20,000
<b>Total Cost, Near Term Mechanical Repairs</b>							<b>\$376,600</b>



Table 16: Expanded Table for Electrical Near Term Cost

System	Component	Repair Description	Purpose	Engineering Cost	Contractor Cost	Monroe County Maint Cost	Total Cost 2021 \$
Control System	Relay Logic	Modify relay logic to positively seat the bridge.	Positively seat bridge under backup control	\$37,900	Assume 1 week on site for one worker	\$0	\$43,900
Control System	SCR Drives	Adjust drive parameters to coordinate speed references for different bridge positions.	Eliminate nuisance "motor overspeed" failures	\$18,300	Assume 4 days on site for one worker	\$0	\$23,100
Control System	PLC and Relay Logic	Change the control logic (both PLC and relay logic) for the traffic gate interlocks such that opening gates must be lowered before the off-ramps can be lowered and vice versa.	Ensure proper sequence of operation for safety and AASHTO compliance	\$10,800	Assume 1 day in field for Contractor PLC calls, 1 day in field for relay calls	\$0	\$13,800
Electrical Installation	Brake Disconnect Switches	Replace wire-nut splices with code compliant terminals.	Wire-nut splices are not permissible per AASHTO	\$0	No Contractor costs	\$1,800	\$3,800
Field Devices	Full Open Switch and Over-Travel Limit Switch	Adjust full open switch, over-travel switch, RCLS, and bumper blocks for revised full open.	Modify overtravel switches, RCLS, and bumper blocks to ensure no damage to structure; calibrate control console position indication	\$9,500	Assume 2 workers for 3 days	\$0	\$21,700
Field Devices	Over-Travel Limit Switch	Replace the over-travel limit switches with ones suitable for prevailing environment.	Ensure functionality of over-travel limit switches	\$0	Installation of new over-travel switch and testing. Assume 1 day for 2 workers, includes costs for switches	\$0	\$3,400
Field Devices	Span Drive Brake Set and Released Limit Switches	Adjust the limit switches for proper indication of the set and released drive's engaged.	Proper indication of the brake operation of the bridge	\$13,100	Cost for 2 workers in field for 2 days	\$0	\$17,900
Field Devices / Control System	Emergency Hand Drive System	Furnish and install an interlock limit switch for the emergency hand drive system. This should be wired back to the bridge control system to prevent operation of the main drive system of both leaves when the hand drive is engaged.	Ensure safe operation of the emergency hand drive system	\$33,000	Includes \$2,500 materials, 4 days in field for 2 contractor personnel, and 2 days in field for Controls specialist	\$0	\$47,100
Traffic Control	Pedestrian Traffic Signals	Furnish and install pedestrian traffic signals at each bridge approach.	Provide advanced warning to / enhance the safety of pedestrians	\$8,900	2 weeks for installation for 2 personnel; \$20k materials	\$0	\$52,900
Traffic Control	Traffic Gates	Provide a protective cover for all rotary cam limit switches.	Protect rotary cam switches from debris and corrosion	\$0	No Contractor costs	\$1,500	\$1,500
Bridge Lighting	Emergency Lighting	Furnish and install emergency lighting in the electrical room; replace failed emergency lighting fixtures and/or their battery packs at other locations on the bridge.	Allow for safe access to areas in the event of utility failure	\$0	No Contractor costs	\$5,000	\$5,000
Bridge Lighting	Lighting	Change existing light bulbs to LED bulbs. Replace fixtures as needed for LED lights.	Reduce cost and maintenance associated with the lights	\$0	No Contractor costs	\$5,000	\$20,000
Painting	Electrical Installation	Clean and paint, or provide a protective coating, at all components where there is corrosion.	Limit corrosion to extend the life of the components	\$0	No Contractor costs	\$17,000	\$17,000
<b>Total Cost, Near Term Electrical Repairs</b>							<b>\$270,900</b>



**APPENDIX C. OPERATION MANUAL**

# COLONEL PATRICK O’RORKE MEMORIAL BRIDGE

## OPERATION MANUAL



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Submitted: March 19, 2021

# OPERATION MANUAL

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## 1. General Information

### 1.1. Introduction

The purpose of the Operation Manual is to provide operating requirements for the bridge. The Operation Manual is not intended as a substitute for training and any existing requirements provided by the owner of the bridge, the U.S. Coast Guard, or any other entity.

### 1.2. Safety

There are inherent safety risks associated with the operating electrical equipment and machinery for movable bridges. Notable safety hazards include dangers from electric potentials, high speed rotating mechanical parts, high temperature of equipment, fall hazards, and slipping hazards from spilled fluids.

Maintenance must be performed by competent, qualified, and certified personnel experienced in the maintenance and operation of electrical systems and equipment and with heavy machinery. Personnel must be familiar with the specific systems associated with the bridge. Refer to appropriate Monroe County or NY state documents for detailed safety procedures and regulations, including any lockout / tagout requirements.

All maintenance personnel must, at all times, maintain a line of communications with the bridge operator and all other personnel that are working on the bridge when performing bridge maintenance. Ensure that all parties are notified and in a safe position prior to bridge, traffic control or any bridge electrical or machinery operation. Similarly, ensure that the operator is aware of any maintenance activities that may delay the operation of the bridge. Communication is essential to ensure safe coordination of operation and maintenance activities.

## 2. Systems Description

### 2.1. Introduction

The following describes in general terms of those electrical systems and equipment associated with the operation of the bridge. This system information is intended to explain the general functionality of the furnished electrical equipment and how they are integrated into the various bridge operating systems. The layout of the movable bridges and machinery is provided in Figure 1.

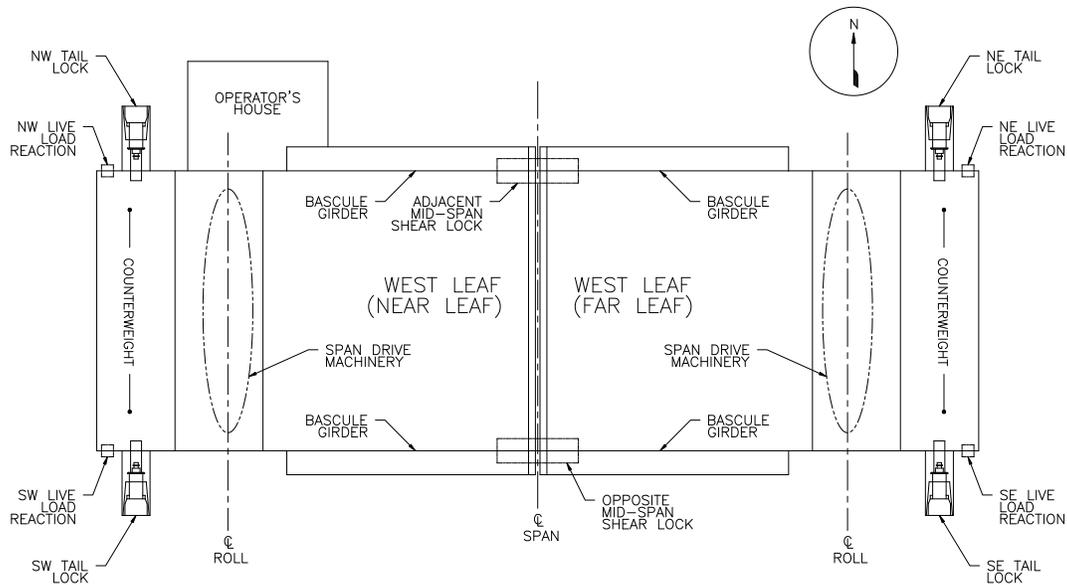


Figure 1: Bridge Layout with Machinery System Locations

## 2.2. Normal Power System

The electric utility service consists of a 480/277 volt, 3-phase, 4-wire, solidly grounded system, which is derived from a utility pad mounted transformer located at the northwest approach. The utility metering equipment is mounted on the low voltage section of the step down transformer. The utility service is provided with a service disconnect switch on the load side of the step down transformer to interrupt power to the bridge for maintenance and troubleshooting.

## 2.3. Standby Power System

The bridge is provided with a standby generator for backup power. is model DFAC-5629306 manufactured by Cummins Power Generation, and is rated at 250kW, 277/480 volts. The generator is capable of operating the bridge for all identified modes of operation. The generator is provided with 125kW load bank mounted on the generator. The load bank is used to exercise the generator under load during maintenance. The system is provided with an automatic transfer switch (ATS), which automatically switches to standby power in the event of a utility power failure. The ATS is located in the generator room in a wall mounted enclosure.

## 2.4. Emergency Hand Drive System

An emergency hand drive system is provided for the bridge that is used in the event of the main drive system failure or both utility and generator outage. The hand drive consists of a 120V DeWalt DW138 drill that can be plugged into a receptacle that is fed by a mobile generator receptacle and a local disconnect switch. The mobile generator receptacle is mounted on the utility main disconnect switch enclosure located in the utility compounded area.

## 2.5. Span Drive System

The span drive system consists of two (2) span drive motors, two (2) thruster motor brakes and two (2) thruster machinery brake. See Figure 2 for span drive machinery arrangement.

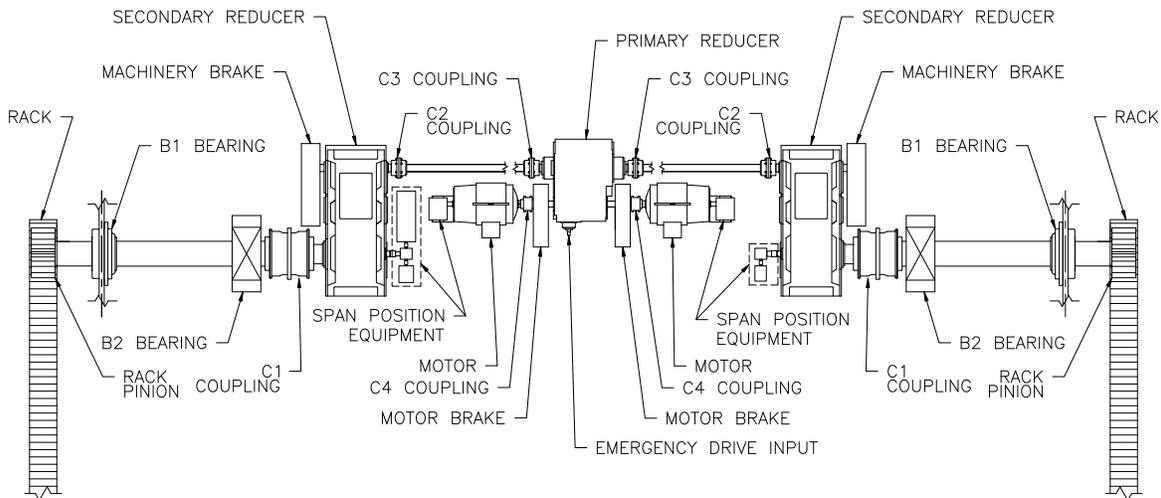


Figure 2: Span Drive Machinery

The span drive motors are Reuland wound rotor induction motors rated for 75HP at 900 RPM. The motors are configured as redundant units and are controlled from respective SCR drive controllers for torque and speed control. Each SCR drive controller is provided with a combination of tachometer and speed switch unit. Each tachometer/speed switch is mounted on an extension shaft of each drive motor. These units provide the necessary feedback to the SCR drive controller for speed control of their respective span drive motor. They also provide an over speed trip function to trip the drive controller in the event that set speeds are exceeded.

## 2.6. Tail Lock System

The bridge is provided with four (4) tail locks. The lock bar-type tail lock is provided at the tail end of each bascule girder to limit span movement when it is engaged. The lock bar is driven by an electro-mechanical linear actuator and is supported by a front and rear guide. When driven, the lock bar engages a strike plate attached to the bascule girder. When retracted, the lock bar is pulled outboard of the bascule girder and allows the leaf to open. See Figure 3 for the tail lock machinery arrangement.

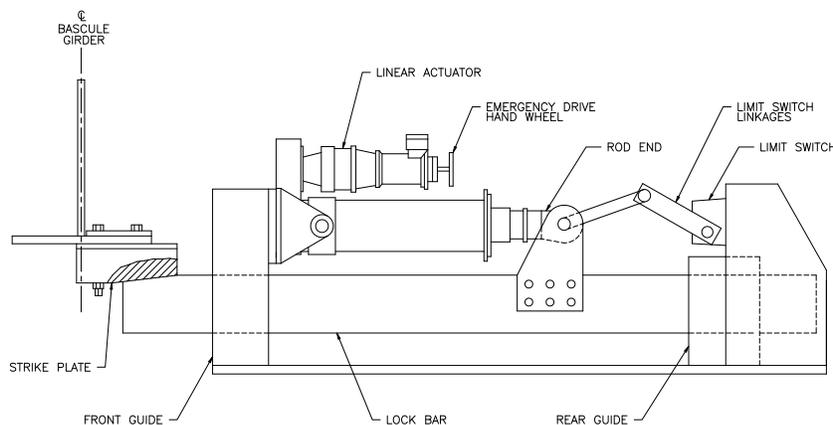


Figure 3: Tail Lock Arrangement

The lock system is provided with an electrically operated linear actuator, limit switches, and an emergency drive hand wheel mechanism. Lock bar control is an integrated part of the bridge operating system and its operation is interlocked with the span seated limit switches to ensure that the span is seated prior to operation.

The lock bar is capable of being operated manually with the emergency drive hand wheel in the event of electric operating failure or for maintenance and troubleshooting.

Each tail lock bar arrangement includes two limit switches: a rotary cam limit switch (RCLS) for end of travel control and a positive indication limit switch used for interlocking and indication.

## 2.7. Traffic Control System

The bridge traffic control system consists of a combination of traffic lights, warning gates, and pedestrian control that are integrated into the bridge control system.

Traffic lights consist of two sets of three aspect traffic lights suspended over each approach roadway from a pole mounted cantilevered arm.

Two (2) warning gates are provided at each of the bridge approaches and, when lowered, straddle the full width of the approach roadway. Each warning gate consists of a gate arm with steady and flashing lights. The warning gate enclosures include the operating mechanisms used for raising and lowering the warning gate arm. Each operating mechanism is provided with a hand crank mechanism for manual operation in the event of electrical failure or for maintenance and troubleshooting. Each gate mechanism is also provided with a set of limit switches that are used in the control system.

## 2.8. Drive Operating System

The bridge drive system is powered and controlled from a motor control center (MCC) and silicone controlled rectifier (SCR) drive cabinets located in the electrical room.

The bridge main power feed is through a bottom entry into the MCC main feeder breaker. The incoming feed is protected with transient voltage surge suppressors (TVSS) located at the bottom left compartment of the MCC. The motor control starters are all located in the MCC and a lighting panel is also provided in the MCC for powering the bridge auxiliary loads. The bridge drive motors are powered and controlled by SCR drives. Each SCR drive controller is provided with a combination of tachometer and speed switch unit, mounted on an extension shaft of each drive motor. These units provide the necessary feedback to the SCR drive controller for speed control of their respective span drive motor. The feeder breakers for the SCR drives are located in the MCC and are Kirk-Key interlocked to only allow single motor operation per leaf

## 2.9. Control Logic System

The bridge control system consists of a PLC controller as the primary form of control. Backup hard-wired relay logic is also provided at the bridge and used in the event of PLC failure. Bridge interlocking is achieved through the use of either form of the logic control. The PLC controller is located in the operator's control console and the relay logic is located in the bridge relay cabinet within the control room of the operator's house.

The bridge control, safety and sequencing interlocks utilize inputs from field located limit switches and PLC / relay logic to ensure that the bridge is only operated in a specific sequence and ensures safety for the traveling public, bridge operating staff and the bridge physical structure and machinery.

As configured, the operator has complete control of the bridge from the operator's control desk. Additionally, the control system is provided with bypass functionality to enable continued operation in the event of one or more field device failures.

## 2.10. Overspeed Protection

The bridge control system is provided with overspeed protection based on feedback from speed switches installed at each leaf machinery. The switch is used to provide the following trip functions:

- Span drive system overspeed when operating at full speed. This trip function trips the drive when the rated speed of the driven machinery exceeds 110% of its rated speed. It ensures that no damage can occur to the bridge or its machinery due to excessive speed of operation.
- Span drive reduced speed setting overspeed. This trip function trips the drive when the low speed of the driven machinery exceeds 110% of its rated speed. It ensures

that the drive is reducing speed at the nearly open or closed to stop the moving span in a controlled manner.

### 2.11. Navigational Aids

Navigation aids include fender lights, navigation lights, and a marine air horn.

The bridge is provided with three pedestal type fender navigation lights on each fender for channel marking. The fender navigation lights are manual or automatic photocell controlled. A relay cabinet is provided for the navigation lighting system to allow for auto/manual operation. Additionally, the navigation lighting system is provided with a battery bank and an inverter to ensure uninterrupted service for the navigation lighting system.

There are four navigation lights which are used for marine traffic signaling. The lights are pivot type green over red lights mounted at the toe end on the outboard sides of each leaf.

A marine air horn is provided to signal marine traffic prior to a bridge opening and closing. The air horn compressor is located at the west counterweight pit area and the horn is located at the fender level directly facing the navigable channel.

### 2.12. Intercom System

The bridge is provided with an intercom system for communications between different areas throughout the bridge. Table 1 provides the intercom directory.

*Table 1: Intercom Directory*

Station #	Location
10	Control Room
11	Storage / Locker Room
12	Motor Control Room (Electrical Room)
13	Generator Room
14	Pier 1 North Catwalk
15	Pier 1 East Catwalk
16	Pier 1 South Catwalk
17	Pier 1 Machine Room
18	East Submarine Cabinet
19	Pier 2 North Catwalk
20	Pier 3 West Catwalk
21	Pier 2 South Catwalk
22	Pier 2 Machine Room

The bridge is also provided with a public address (PA) system. The PA controller is located in the generator room. See Figure 4.



Figure 4: Bridge PA System



Figure 5: Bridge Fire Alarm Panel

### 2.13. Other Systems

The bridge has been provided with a fire alarm system. The system consists of smoke detectors, pull stations, and a fire alarm control panel located on the first floor of the operator's house. A smoke detector and a pull station are also provided in the machinery space. See Figure 5.

The bridge is provided with a CCTV system. The CCTV cameras have been strategically located throughout the bridge to monitor the bridge, roadway approaches, and waterway approaches. The operator can monitor these locations from the office space inside the bridge control room.

Thermostatically controlled heat tracing is provided for sanitary and water lines. The control panel is located in the bascule pier area. See Figure 6 and Figure 7.



Figure 6: Heat Trace Control Panel



Figure 7: Open Heat Trace Control Panel  
with Thermostats

### 2.14. Operator's Control Console Details

The control console layout is shown in Figure 8. The control console is where the operator performs the normal leaf operations. The console includes indication lights, pushbutton switches, indication lights, selector switches, and indication meters for the operator's use.



Figure 8. Control Console

Control console switches, pushbuttons, indication lights, and other feedback devices are summarized in Table 2 through Table 6.

Table 2: Control Console - Switches

Switch	Description
Control Power	2 position keyed switch for control console power - Off / On
Control Mode	2 position switch for mode of operation - PLC / Relay
Leaf Speed	2 position switch for leaf speed - Normal / Reduced
Traffic Signals	2 position switch to operate traffic signals - Stop / Go
Traffic Gates (4 Switches)	3 position switches used to operate the gates - Raise / Lower / Stop
All Gates	2 position switch controls all gates - Raise / Stop
Tail Locks (4 Switches)	3 position switches to operate each tail lock individually - Pull/Stop/Drive
All Tail Locks	3 position switch operates all tail locks as a group - Pull/Stop/Drive
Generator	4 position switch - Auto/Test/Run/Off
Nav. Lights	3 position switch for navigation lights - Auto/Off/Manual
Channel Spot Light	2 position switch for the channel spot light - Off / On

Manual Control East Leaf	Manual operation drum switch. The "B" positions release the brakes prior to raising.
Manual Control West Leaf	Manual operation drum switch. The "B" positions release the brakes prior to raising.

Table 3: Control Console - Pushbuttons

Pushbutton	Description
Horn	Push to warn of bridge movement
Raise	Push to raise the leaves
Lower	Push to lower the leaves
Emergency Stop	Push to stop leaf operation in an emergency All span drive brakes will set
Normal Stop	Push to stop leaf operation in a non-emergency The drives will decelerate and stop
Alarm Acknowledge	Acknowledge alarm generated by the PLC (when alarm shows on PLC display). Will need to acknowledge and reset to continue PLC mode operation.
Reset Alarm	Reset alarm generated by the PLC. Alarm message on the display will disappear if the alarm no longer exists.

Table 4: Control Console - Indication Lights

Light	Color	Illumination Condition
Control Power On	Red	The control console is powered in the ON position
Relay	Red	Relay mode is selected
PLC	White	PLC system is active
Drive Fault	Red	The drive has faulted
Utility Power Available	Red	ATS indicates that normal power is available
Transfer Switch - Utility	Green	ATS in the utility position
Transfer Switch - Gen	Red	ATS in the generator position
Clear Position	Green	Indicates that the bridge is at full open (both RCLS switches need to be set to activate the channel clear light)
Heat Trace - Energize	White	This indicates that the heat tracing is operating
Heat Trace - Failure	Red	This indicates a failure in the heat tracing system
Phases Clear	White	Indicates no fault with the supply power phases
Phases Fault	Red	Indicates that one of the supply power phases has faulted
Generator - Auto	Green	Power automatically switches to gen. if utility failure
Generator - Normal	Green	Generator is running
Generator - Test	Green	Generator start and running in test mode. Will not transfer power.
Leaf Position (1 light each leaf)		
Over Travel	Red	Over travel reached (lever switch at treads)

Full Open	Green	Full open position reached (RCLS)
Near Open	Orange	Nearly open position reached (RCLS)
Near Closed	Orange	Nearly closed position reached (RCLS)
3 Touch Position	Green	Light indicates the "touch position" when the two leaves' center locks begin engagement
Full Closed	Green	Fully closed position (seated limit switches )
Traffic Signals		
Allow Traffic	Green	Traffic signals are set to green
Caution Traffic	Amber	Traffic signals are amber, as part of change to red
Halt Traffic	Red	Traffic signals are set to red
Traffic Gates		
Gate Up	Green	Gate raised (1 light for each gate, 4 total)
Gate Down	Red	Gate lowered (1 light for each gate, 4 total)
Tail Locks		
Lock Pulled	Red	Lock pulled (1 light for each lock, 4 total)
Lock Driven	Green	Lock driven (1 light for each lock, 4 total)
Span Drive Brakes		
Brakes Set	Green	All leaf brakes are set (1 light for each leaf, 2 total)
Brakes Released	Red	All leaf brakes are released (1 light for each leaf, 2 total)
Brakes Hand Released	Red	When <i>any</i> of the leaf brakes are hand released (1 light for each leaf, 2 total)

Table 5: Control Console - Keyed Bypass Switches

Switch	Description
Traffic Signals	In the event of traffic signal failure, this bypass switch could be used to simulate traffic signal RED permissive and proceed to the next step of the operating sequence.
Traffic Gates Up	In the event of any traffic gates up limit switch(es) failure, this bypass switch could be used to simulate all traffic gates UP permissive and proceed to the next step of the operating sequence.
Traffic Gates Down	In the event of any traffic gates down limit switch(es) failure, this bypass switch could be used to simulate all traffic gates DOWN permissive and proceed to the next step of the operating sequence.
Locks Driven	In the event of any tail lock driven limit switch(es) failure, this bypass switch could be used to simulate all tail locks DRIVEN permissive and proceed to the next step of the operating sequence.
Locks Pulled	In the event of any tail lock pulled limit switch(es) failure, this bypass switch could be used to simulate all tail locks PULLED

	permissive and proceed to the next step of the operating sequence.
Brake Set Bypass	In the event of any brake set limit switch(es) failure, this bypass switch could be used to simulate all brakes SET permissive and proceed to the next step of the operating sequence (PLC only, not included in Relay mode).
Brake Release Bypass	In the event of any brake released limit switch(es) failure, this bypass switch could be used to simulate all brakes RELEASED permissive and proceed with span movement (PLC only, not included in Relay mode).
Brake Hand Release Bypass	The bridge control system prohibits the leaf operation if any brake is hand released for the respective leaf. This bypass switch allows span operation in the event of the brake being hand released (PLC only, not included in Relay mode).
Span Seated Bypass	In the event of span seated limit switch(es) failure, this bypass switch could be used to simulate both leaves are SEATED permissive and proceed to the next step of the operating sequence.

*Table 6: Control Console - Meters and Other Feedback*

<b>Device</b>	<b>Description</b>
East Leaf Position	Angular position indication
West Leaf Position	Angular position indication
Motor Ammeter	Motor current measurement - 1 for each motor
PLC Display	A display on the console used to provide feedback from PLC for faults, etc.

### 2.15. MCC Control Functionality (Bypass Modes)

The motor control center (MCC), located in the electrical room, includes the bridge main power feed into the MCC main feeder breaker, a lighting panel, motor control starters, and local control functionality for the locks, gates, and span drive brakes. See Figure 9.



*Figure 9. Motor Control Center (MCC)*

A brief description of the functionality of the MCC controls follows. Operation of any of motors from the MCC is considered operation in bypass mode as it would circumvent interlocks used within the control system to ensure the safety of the bridge, structure, maintenance personnel, and the traveling public.

Operation of the any of the components in bypass mode must be done by trained personnel and with absolute certainty that the structure and machinery will not be damaged and ensuring the safety of maintenance personnel and the traveling public. See Section 3.6f or notes on operation utilizing bypasses.



- The 2 position key switch should be set for REMOTE for normal operation from the console. The switch should be set to LOCAL for control from the MCC. Note that the LOCAL mode of operation will bypass all interlocks.
- Use the 3 position switch (Pull/Off/Drive) to control the lock when in LOCAL mode. The provided lights will illuminate when pulling / driving the locks.

	<b>WARNING – Bypassing the interlocks places the bridge structures, tail lock machinery, maintenance personnel, pedestrians, and vehicular traffic at risk. Operation of the locks in LOCAL mode must be done by trained personnel and with absolute certainty that machinery will not be damaged and that the bridge leaf will not move with the locks pulled.</b>
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- Warning Gate Local Control. The warning gates may be operated individually from the MCC. See Figure 13.
  - The 2 position key switch should be set for REMOTE for normal operation from the console. The switch should be set to LOCAL for control from the MCC. Note that the LOCAL mode of operation will bypass all interlocks.
  - Use the 3 position switch (Raise/Off/Lower) to control the gate when in LOCAL mode.



Figure 13. Warning Gate Controls at the MCC

	<b>WARNING – Bypassing the interlocks places the bridge structures, gate machinery, maintenance personnel, pedestrians, and vehicular traffic at risk. Operation of the gates in LOCAL mode must be done by trained personnel and with absolute certainty that the gates can be operated without harm to the machinery, pedestrians, or to vehicular traffic.</b>
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- Span Drive Motor and Machinery Brake Local Control. The brakes may be operated individually from the MCC. Note that the LOCAL mode of operation will bypass all interlocks.

- Release pushbutton. The release pushbutton releases the brake when in LOCAL mode. An indication light illuminates when the brake starter energizes.
- Set pushbutton. The set pushbutton sets the brake when in LOCAL mode. The indication light turns off when the brake starter de-energizes.

	<p><b>WARNING</b> – Bypassing the interlocks places the bridge structures, span drive machinery, maintenance personnel, pedestrians, and vehicular traffic at risk. Operation of the brakes in LOCAL mode must be done by trained personnel and with absolute certainty that the gates can be operated without harm to the machinery, pedestrians, or to vehicular traffic.</p>
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### 3. Operating Sequences

#### 3.1. General Notes on Operation

Operation of the movable leaves may be performed under the following scenarios.

- PLC mode under utility or standby generator power
- Relay mode under utility or standby generator power
- Manual operation using the emergency hand drills

Note the following operation limitations:

- The minimum operation angle is 20 degrees to ensure that the mid-span shear locks disengage (press normal stop to halt operation past this point).
- Hours of operation. With the exception of commercial vessels, no lifts between 7AM to 9AM, 12PM to 1PM, and 4PM to 6PM.
- The operator should note weather conditions during operation and other factors that may affect operation. High winds, snow accumulation, or other external loads may impact the operation of the bridge. Note the following wind restrictions:
  - Use NORMAL speed of operation for wind speeds < 35 mph.
  - Use REDUCED speed of operation for wind speeds greater than 35 mph, but less than 65 mph.
  - Do not operate the bridge when winds exceed 65 mph.

Note the following during operation:

- Activation of the e-stop pushbutton on the desk will prevent initiation of a bridge operation. Following an e-stop, the button will need to be pulled to the UP position and the Reset Alarm pushbutton must be pressed.
- Drive faults are addressed using the Reset Alarm pushbutton. If an issue continues, current practice is to switch the drives until the issue can be addressed.
- All operational issues and drive faults should be recorded within the County's electronic records.

### 3.2. PLC Operation on Utility Power

#### Starting Conditions

- a. Control console navigation light switch in AUTO position
- b. Control console e-stop pushbutton in the UP position

#### 1. Energize the control console.

Turn the control console key to the ON position. Verify that the following status indication lights are illuminated:

- a. Control Power On – RED
- b. Utility Power Available – RED
- c. Transfer Switch - Utility Power Selected – GREEN
- d. Generator - Auto – GREEN
- e. Phases Clear - WHITE

Verify that the following lights are illuminated GREEN

- a. Traffic Lights – indicating 'go'
- b. Traffic Gates – East and West on-coming and off-going indicating 'up'
- c. Tail Locks, East and West #1, 2, 3, 4 – indicating 'driven'
- d. Brakes, East and West – indicating 'set'

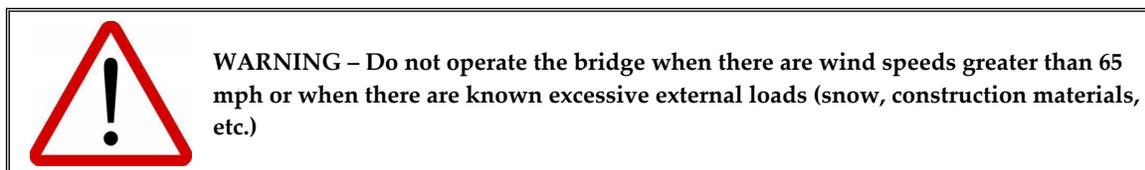
#### 2. Select the Operating Mode

Turn the Control Mode switch to PLC.

The PLC indication light illuminates WHITE

#### 3. Select Leaf Speed

- a. NORMAL Speed. Use normal speed for most operations unless there are high loads due to wind (> 35 mph), snow, or other external loads.
- b. REDUCED Speed. Use with winds >35 to <65 mph winds, or heavy bridge load conditions.



#### 4. Announce lift intention

Use the internal intercom system to announce the intention to lift.

Note: press and release '7,' then press and hold 'T' while announcing intention.

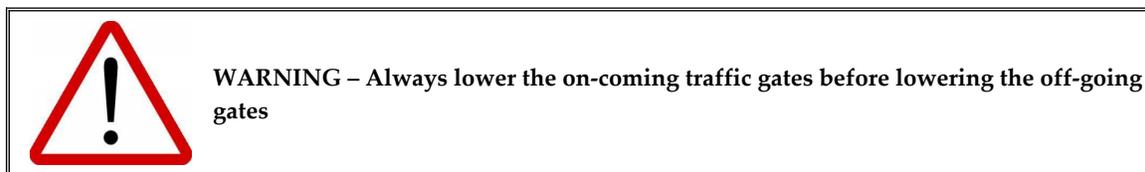
Press, then release 'X' to end broadcast.

#### 5. Change Traffic Signals to RED

- a. Change the signals from GREEN to RED by turning the 'traffic signals' control switch from 'go' to 'stop.'  
The red light will illuminate.

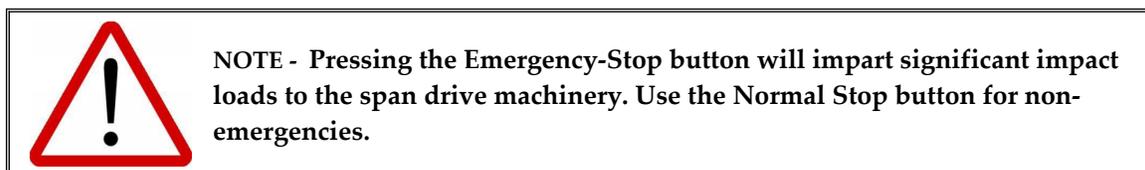
- b. As traffic signals change from GREEN, to YELLOW, to RED, the gate lights begin to flash, and the traffic/pedestrian alarm begins to sound.
6. Verify that traffic has stopped. Visually check in both directions.
7. Sound the marine horn once by depressing and holding down the Horn button for approximately three (3) seconds.
8. Verify that traffic and pedestrians are behind the gates.
  - a. Use monitors and visual checks.
  - b. Use microphone, if necessary, to communicate with pedestrians.
9. Lower the on-coming traffic gates.

Lower the oncoming traffic gates by turning and holding the East and West Oncoming Warning Gates switches to the LOWER position until the gates are fully lowered.



10. Lower the off-going traffic gates.

Lower the off going traffic gates by turning and holding the East and West Off Going Warning Gates switch to the LOWER position until the gates are fully lowered.
11. Verify traffic has stopped using the monitors and visually check in both directions.
12. Pull the tail locks.
  - a. Operate as a group. To pull all tail locks as a group, turn and hold the All Locks switch to the PULL position. When a lock reaches its fully pulled position, its pulled light illuminates.
  - b. Operate individually. To pull the tail locks individually, turn each lock switch (1, 2, 3, & 4) to the PULL position.
13. Raise the span by pressing the Raise pushbutton.
  - a. The system will automatically release brakes before raising the span, accelerate to creep speed then to full speed after touching position is cleared, slow span speed to creep at near open, de-energize drive system, and set brakes at full open.
  - b. The navigation lights change from red to green at full open.
  - c. To stop in a non-emergency, at an intermediate position, press the Normal Stop pushbutton.



14. Visually confirm that marine traffic has cleared the channel.
15. Sound the marine horn once by depressing and holding down the Horn button for approximately three (3) seconds.
16. Begin to lower the span by pressing the Lower pushbutton.
  - a. Note: The system will automatically release the brakes before lowering movement begins, the west leaf begins lowering followed by the east leaf. When each leaf enters the near closed position, the span system stops each leaf and sets the brakes.
  - b. The system will automatically release brakes before lowering the span.
  - c. The west leaf begins lowering followed by the east leaf.
  - d. When each leaf enters the nearly closed position, the system stops each leaf and sets the brakes.
  - e. The navigation lights change from green to red once the angle is reduced from full open.
  - f. To stop in a non-emergency, at an intermediate position, press the Normal Stop pushbutton.
17. Finish lowering the span by pressing the foot switch to lower the spans at creep speed from the touch position.
  - a. Note: the system will automatically release brakes and lower spans to the seated position. At seated, the brakes set and the drives de-energize.
18. Drive the tail locks.
  - a. Group drive the tail locks by turning and holding the All Locks switch to the DRIVE position.
  - b. As a lock begins driving, its Pulled light turns off. When a lock reaches its fully driven position, its Driven light illuminates. When the first lock begins driving, the gong begins sounding.
  - c. *Note: Moving the switch to the STOP position causes all lock movement to stop.*
19. Raise all traffic gates.
  - a. Group raise the traffic gates by turning and holding the All Gates switch to the RAISE position.
  - b. As a gate begins raising, its lowered light turns off. When a gate reaches its fully raised position, its raised light illuminates.
    - a. *Note: Moving the switch to the STOP position causes all gate movement to stop.*
20. Change the traffic lights to green.

Change traffic signals from red to green by turning the Traffic Light Selection switch to the GO position. Traffic signals and control console traffic signal light illuminates and the gongs stop sounding.
21. De-energize the control console by turning the control power selector switch to the OFF position.

### 3.3. Relay Operation on Utility Power

#### Starting Conditions

- a. Control console navigation light switch in AUTO position
- b. Control console e-stop pushbutton in the UP position

#### 1. Energize the control console.

Turn the control console key to the ON position. Verify that the following status indication lights are illuminated:

- a. Control Power On – RED
- b. Utility Power Available – RED
- c. Transfer Switch - Utility Power Selected – GREEN
- d. Generator - Auto – GREEN
- e. Phases Clear - WHITE

Verify that the following lights are illuminated GREEN

- e. Traffic Lights – indicating 'go'
- f. Traffic Gates – East and West on-coming and off-going indicating 'up'
- g. Tail Locks, East and West #1, 2, 3, 4 – indicating 'driven'
- h. Brakes, East and West – indicating 'set'

#### 2. Select the Operating Mode

Turn the Control Mode switch to RELAY.

The RELAY indication light illuminates RED

#### 3. Select Leaf Speed to REDUCED



#### 4. Announce lift intention.

Use the internal intercom system to announce the intention to lift.

Note: press and release '7,' then press and hold 'T' while announcing intention.

Press, then release 'X' to end broadcast.

#### 5. Change traffic signals to RED

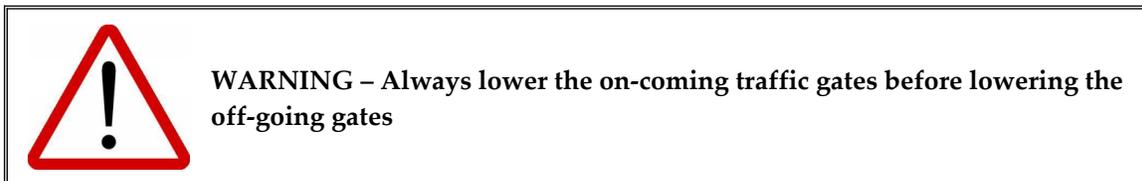
- c. Change the signals from GREEN to RED by turning the 'traffic signals' control switch from 'go' to 'stop.'

The red light will illuminate.

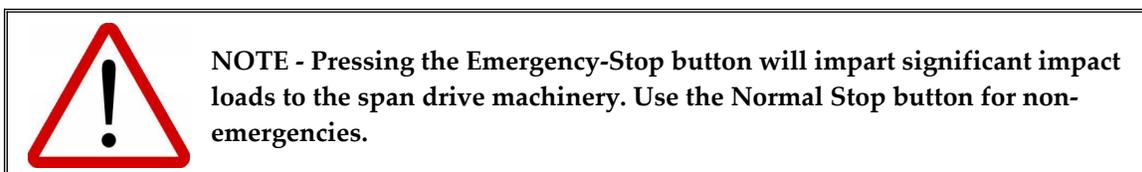
- d. As traffic signals change from GREEN, to YELLOW, to RED, the gate lights begin to flash, and the traffic/pedestrian alarm begins to sound.

#### 6. Verify that traffic has stopped. Visually check in both directions.

7. Sound the marine horn once by depressing and holding down the Horn button for approximately three (3) seconds.
8. Verify that traffic and pedestrians are behind the gates.
  - c. Use monitors and visual checks.
  - d. Use microphone, if necessary, to communicate with pedestrians.
9. Lower the on-coming traffic gates.  
Lower the oncoming traffic gates by turning and holding the East and West Oncoming Warning Gates switches to the LOWER position until the gates are fully lowered.



10. Lower the off-going traffic gates  
Lower the off going traffic gates by turning and holding the East and West Off Going Warning Gates switch to the LOWER position until the gates are fully lowered.
11. Verify traffic has stopped using the monitors and visually check in both directions.
12. Pull the tail locks.
  - a. Operate as a group. To pull all tail locks as a group, turn and hold the All Locks switch to the PULL position. When a lock reaches its fully pulled position, its pulled light illuminates.
  - b. Operate individually. To pull the tail locks individually, turn each lock switch (1, 2, 3, & 4) to the PULL position.
13. Raise the span by pressing the Raise pushbutton.
  - d. The system will automatically release brakes before raising the span, accelerate to creep speed then to full speed after touching position is cleared, slow span speed to creep at near open, de-energize drive system, and set brakes at full open.
  - e. The navigation lights change from red to green at full open.
  - f. To stop in a non-emergency, at an intermediate position, press the Normal Stop pushbutton.



14. Sound the marine horn once by depressing and holding down the Horn button for approximately three (3) seconds.
15. Visually confirm that marine traffic has cleared the channel.
16. Begin to lower the span by pressing the Lower pushbutton.
  - a. Note: The system will automatically release the brakes before lowering movement begins, the west leaf begins lowering followed by the east leaf. When each leaf enters the near closed position, the span system stops each leaf and sets the brakes.
  - b. The system will automatically release brakes before lowering the span.
  - c. The west leaf begins lowering followed by the east leaf.
  - d. When each leaf enters the nearly closed position, the system stops each leaf and sets the brakes.
  - e. The navigation lights change from green to red once the angle is reduced from full open.
  - f. To stop in a non-emergency, at an intermediate position, press the Normal Stop pushbutton.
17. Finish lowering the span by pressing the foot switch to lower the spans at creep speed from the touch position.
  - a. Note: the system will automatically release brakes and lower spans to the seated position. At seated, the brakes set and the drives de-energize.
18. Drive the tail locks
  - a. Group drive the tail locks by turning and holding the All Locks switch to the DRIVE position.
  - b. As a lock begins driving, its Pulled light turns off. When a lock reaches its fully driven position, its Driven light illuminates. When the first lock begins driving, the gong begins sounding.
  - c. *Note: Moving the switch to the STOP position causes all lock movement to stop.*
19. Raise all gates
  - a. Group raise the traffic gates by turning and holding the All Gates switch to the RAISE position.
  - b. As a gate begins raising, its lowered light turns off. When a gate reaches its fully raised position, its raised light illuminates.
  - b. *Note: Moving the switch to the STOP position causes all gate movement to stop.*
20. Change the traffic lights to green.

Change traffic signals from red to green by turning the Traffic Light Selection switch to the GO position. Traffic signals and control console traffic signal light illuminates and the gongs stop sounding.
21. De-energize the control console by turning the Control Power selector switch to the OFF position.

### 3.4. Operation on Standby (Generator Power)

The operation sequence when using standby generator power is the same as for utility power. In the event of a utility failure, the ATS will automatically transfer power to the generator.

Note the following changes to control console indication with the control console in the ON position:

- a. Control Power On – RED
- b. Transfer Switch - Generator Power Selected - RED
- c. Generator - Run - GREEN
- d. Phases Clear - WHITE

### 3.5. Manual Operation Sequence Using Emergency Drive Drills

An emergency hand drive system is provided for manual operation of the bridge which may be used in the event of the main drive system failure or both utility and generator outage. See Figure 14.



*Figure 14. Emergency Drive Hand Drive Drill*



**WARNING - Operation of the leaves with the emergency hand drills poses significant safety risks as positional control and safety interlocks are excluded. Operation with the hand drills should only be performed in an emergency and with personnel trained in their safe usage.**

### Starting Conditions

- Manual operation using the emergency drive may be desired if there is a loss in utility power and if the standby generator is out of service.
- A properly sized mobile generator is provided at the utility substation receptacle.
- Provide a marine radio for contact with marine vessels.
- Assume start from seated position and that the leaves are span heavy throughout operation.
- 2020 imbalance testing indicated that both leaves should be span heavy throughout operation. The emergency drive system must only be used when the bridge is balanced and there are no significant external loads.



**WARNING – The emergency drive must not be operated when temporary construction materials are on the bridge, or with significant snow or ice loads, or with wind loads. Emergency drive operation with external loads may result in loss of control of the leaves.**

- Provided adequate safety procedures are in place, opening a span heavy bridge using the emergency drive drills is possible. It is unlikely that the drills can accommodate overhauling torque when lowering the span heavy leaves. Attempts at closing the bridge using the drill may not be successful and may result in loss of control of the bridge. Lowering should be performed by carefully hand releasing and setting the motor brakes to incrementally lower the leaves.
- This procedure assumes that workers can access the motor brakes to set them, with the bridge at full open, from the emergency drill access platform.

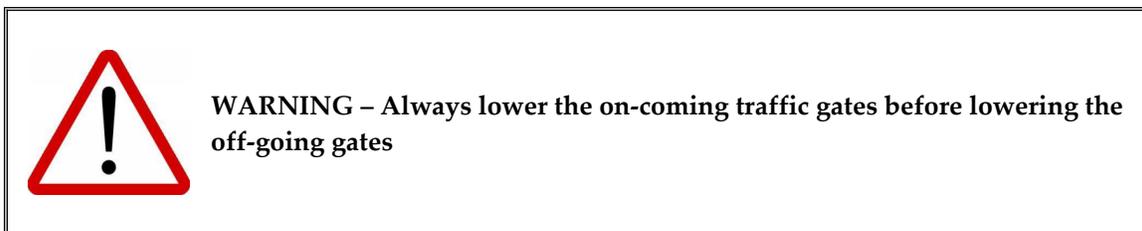
### Safety

- For emergency drive operation, provide lock out / tag out to ensure that none of the motors (span drive, gates, brakes, tail locks) can be energized during manual operation.
- All personnel shall be in close radio contact throughout the operation process.
- All span drive brakes shall be set until ready to operate.
- This procedure assumes that the motor brakes are accessible and operable, using the hand release levers, from the emergency drive platforms that provide access to the drills. This must be verified before operation with the emergency drives.

### Personnel Required

- Manual operation using the emergency drive will require significant personnel to ensure the safety of the workers, the bridge, and the traveling public.
- A suggested minimum number of workers includes
  - 5 workers per leaf (10 workers total):
    - 1 worker to operate the drill

- 2 workers to operate the brakes
  - 2 workers to operate the tail locks (one for each lock)
  - 1 worker in the control house monitoring vehicular and pedestrian traffic visually.
  - 1 worker at each approach to flag vehicular traffic (2 workers total).
  - 1 worker at each approach to manually operate the traffic gates (2 workers total).
  - 1 worker to monitor the mobile generator at the utility substation.
1. Start the mobile generator to supply power to the hand drive drills.
  2. Release stored energy and connect the hand drive drill to the span drive machinery at each leaf. On a given leaf:
    - Slowly release span drive brakes one-at-a-time and allow stored mechanical energy (wind-up) to come out of the machinery.
    - Reset the brakes.
    - Plug in the hand drive drill to the emergency power receptacle and test to ensure operable.
    - Connect the hand drive drill to the primary reducer right angle shaft extension.
  3. Provide flagging to halt traffic at both approaches.
  4. Verify that traffic has stopped. Visually check in both directions. Verify that traffic and pedestrians are behind the gates.
  5. Lower the on-coming traffic gates manually.  
Lower oncoming traffic gates by using the manual hand cranks at the motor shaft extensions.



6. Lower off-going traffic gates  
Lower oncoming traffic gates by using the manual hand cranks at the motor shaft extensions.
7. Verify traffic has stopped both directions.
8. Pull the tail locks.  
Manually pull the tail locks one at a time, using their emergency drive hand wheels, ensuring no movement at the leaves while pulling the locks.
9. Hand release the span drive brakes.

- Hand release brakes one at a time. Start with the machinery brakes. The motor brakes should be the final brakes released, with personnel ready on the emergency drive platform for operation.
  - Watch for sudden movement of the machinery. If there is unusual movement, set the brakes and investigate / resolve the issue.
10. With all brakes hand released, use the emergency drive drill to operate the leaves.
    - Personnel should be prepared to set the motor brakes if there are any operational issues, such as loss of control of the leaf (e.g., the leaf begins to lower while trying to raise it).
    - At the start of operation, verify the correct direction of machinery rotation.
    - Coordinate operation between the two leaves; they need to be operated together to free up the mid-span shear locks.
    - Slowly raise the two leaves to the desired opening position. Operation in increments is recommended, setting the motor brakes whenever the drills are not driving. The opening angle should be limited to the extent possible.
    - Set the brakes whenever the leaves are at the desired position.
  11. Communicate to the marine vessel that the channel is clear for travel.
  12. Confirm that the marine traffic has cleared the channel visually and using radio contact with the vessel.
  13. Notify all personnel that the bridge will be closed.

Note. For closing, it is assumed that the leaves are span heavy beyond friction, and that they may be drifted down slowly by “feathering” the span drive motor brakes.

	<p><b>WARNING – It is unlikely that the drills can accommodate overhauling torque when lowering the span heavy leaves. Attempts at closing the bridge using the drills may not be successful and may result in loss of control of the bridge. Lowering should be performed incrementally by carefully and safely hand releasing / setting the motor brakes.</b></p>
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14. Release one of the two span drive motor brakes and check for movement.
15. Assuming no movement, slowly hand release the second motor brake to allow the leaf to lower.
16. Set and release one of the two motor brakes to allow the leaf to lower in small increments. Ensure that the motor brake wheel does not overheat during this process. If it is hot to the touch, halt the operation until the brake wheel cools.
17. Provide radio coordination between the two leaves to coordinate leaf position.
18. Use visual inspection and close radio coordination to ensure that the two shear locks properly engage when approaching the lowered position.
19. Continue to set and release one of the two motor brakes to lower the leaf to the seated position, taking care not to allow the brake wheel to overheat.

20. Once seated, use the emergency drive drills to drive the leaves into the seated position. Set the motor brakes while holding drill torque.
21. Set all span drive brakes.
22. Manually drive all tail locks using their emergency drive hand wheels.
23. Raise the off-going traffic gates by using the manual hand cranks at the motor shaft extensions.
24. Raise the on-coming traffic gates by using the manual hand cranks at the motor shaft extensions.
25. Release the traffic.

### 3.6. Bypass Operations

Bypass functionality is provided with keyed switches at the control console and at the MCC. See Table 5 in Section 2.14 and see Section 2.15 for a list of bypass switches. A description of available bypasses is provided in Table 7.

	<p><b>WARNING – Bypassing the interlocks places the bridge structures, machinery, maintenance personnel, pedestrians, and vehicular traffic at risk. Operation of any of the systems in bypass mode must be done by trained personnel and with certainty of the safety for personnel, the public, the structure, and the machinery.</b></p>
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*Table 7: List of Bypasses*

Bypass	Location	Description
Traffic Signals	Control Console	In the event of traffic signal failure, this bypass switch could be used to simulate traffic signal RED permissive and proceed to the next step of the operating sequence.
Traffic Gates Up	Control Console	In the event of any traffic gates up limit switch(es) failure, this bypass switch could be used to simulate all traffic gates UP permissive and proceed to the next step of the operating sequence.
Traffic Gates Down	Control Console	In the event of any traffic gates down limit switch(es) failure, this bypass switch could be used to simulate all traffic gates DOWN permissive and proceed to the next step of the operating sequence.
Locks Driven	Control Console	In the event of any tail lock driven limit switch(es) failure, this bypass switch could be used to simulate all tail locks DRIVEN permissive and proceed to the next step of the operating sequence.
Locks Pulled	Control Console	In the event of any tail lock pulled limit switch(es) failure, this bypass switch could be used to simulate all tail locks PULLED permissive and proceed to the next step of the operating sequence.
Brake Set	Control Console	In the event of any brake set limit switch(es) failure, this bypass switch could be used to simulate all brakes SET permissive and proceed to the next step of the operating sequence (PLC only, not included in Relay mode).

Brake Release	Control Console	In the event of any brake released limit switch(es) failure, this bypass switch could be used to simulate all brakes RELEASED permissive and proceed with span movement (PLC only, not included in Relay mode).
Brake Hand Release	Control Console	The bridge control system prohibits the leaf operation if any brake is hand released for the respective leaf. This bypass switch allows span operation in the event of the brake being hand released (PLC only, not included in Relay mode).
Span Seated	Control Console	In the event of span seated limit switch(es) failure, this bypass switch could be used to simulate both leaves are SEATED permissive and proceed to the next step of the operating sequence.
Tail Locks	MCC	In the event of a switch failure, the switches may be bypassed and the individual locks may be pulled or retracted from MCC LOCAL control.
Gates	MCC	In the event of a switch failure, the switches may be bypassed and the individual gates may be raised or lowered from MCC LOCAL control.
Brakes	MCC	In the event of a switch failure, the switches may be bypassed. The brakes may be released or set from MCC LOCAL control.

The control system utilizes limit switch feedback as part of a coordinated sequence of operation to ensure the safety of the bridge and of the traveling public. Limit switch feedback would, for example, ensure that the traffic signals are red before lowering the gates, and that the gates are down before pulling the locks or raising the leaves. There are inherent risks in bypassing these safety features.

To properly use bypasses, maintenance and operation personnel *must* act as a substitute for the switch feedback and provide physical verifications in place of failed switches and/or provide a substitute service in place of a failed component.

Generally, bypasses would be used by trained maintenance personnel to operate the bridge or a machinery component when there is a limit switch issue, or as part of troubleshooting of a failed component. It is not practical to provide detailed procedures to cover all circumstances where bypasses may be utilized. Selected circumstances where bypasses may be utilized are provided below as an example and for consideration for future bypass usage.

### 3.6.1 Example use of Traffic Gates Down Bypass at Console

<i>Issue:</i>	<i>During an operating sequence, all four of the gates physically lowered, but the control console shows one of the four gates to be raised.</i>
<i>Possible Cause:</i>	<i>Failed or incorrectly adjusted gate limit switch.</i>
<i>Procedure:</i>	<i>1. Verify that all four gates are lowered.</i>

	<p>2. Use the Control Console Traffic Gates Down keyed bypass switch to continue the operating sequence from the console.</p> <p>3. Troubleshoot and repair the issue after the desired operation.</p>
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### 3.6.2 Example use of Traffic Signal Bypass at Console

<i>Issue:</i>	<i>All or some of the traffic signals have failed. A desired operation has failed as the console indicators show that vehicular traffic has a green light.</i>
<i>Possible Cause:</i>	<i>Failure of the control system to command operation of the light or failure of the traffic light control power.</i>
<i>Procedure:</i>	<p>1. Provide flaggers to ensure that traffic is stopped.</p> <p>2. Once traffic is physically confirmed to have stopped, use the Control Console Traffic Signals keyed bypass switch to continue the operating sequence from the console.</p> <p>3. Troubleshoot and repair the failed component after the desired operation.</p>

### 3.6.3 Example use of Locks Driven Bypass at Console

<i>Issue:</i>	<i>An operating sequence from the console has failed after closing. The console indication lights show that one of the four locks has not driven.</i>
<i>Possible Cause:</i>	<i>Failure of the operation of the lock or failed or incorrectly adjusted limit switch.</i>
<i>Procedure:</i>	<p>1. Physically inspect the lock. If it has not driven fully, manually drive the lock to its driven position using its emergency drive hand wheel. If it is driven fully, the issue may be related to a limit switch.</p> <p>2. Once all locks are verified to be fully driven, if the console still does not provide the proper indication, use the Control Console Locks Driven keyed bypass switch to conclude the operating sequence from the console.</p> <p>3. Troubleshoot and repair the issue after the desired operation.</p>

### 3.6.4 Example use of Locks Pulled Bypass at Console

<i>Issue:</i>	<i>An operating sequence from the console has failed near the start of the operating sequence. The console indication lights show that one of the four locks has not pulled.</i>
<i>Possible Cause:</i>	<i>Failure of the operation of the lock or failed or incorrectly adjusted limit switch.</i>
<i>Procedure:</i>	<p>1. Physically inspect the lock. If it has not pulled fully, manually pull the lock to its pulled position using its emergency drive hand wheel. If it pulled fully, the issue may be related to a limit switch.</p> <p>2. Once all locks are verified to be fully pulled, if the console still does not provide the proper indication, use the Control Console Locks Pulled keyed bypass switch to conclude the operating sequence from the console.</p> <p>3. Troubleshoot and repair the issue after the desired operation.</p>

### 3.6.5 Example use of Brake Set Bypass at Console

<i>Issue:</i>	<i>An operating sequence from the console has failed. The console indication lights show that one of brakes on the west leaf is released.</i>
<i>Possible Cause:</i>	<i>The limit switch has failed.</i>
<i>Procedure:</i>	<ol style="list-style-type: none"> <li>1. <i>Physically inspect the brakes and confirm that all brakes for the leaf are set.</i></li> <li>2. <i>Verify that all brakes on the leaf set when required and release when required.</i></li> <li>3. <i>Once it is confirmed that the brakes are set, use the Control Console Brake Set keyed bypass switch to conclude the operating sequence from the console.</i></li> <li>4. <i>Troubleshoot and repair the issue after the desired operation.</i></li> </ol>

### 3.6.6 Example use of Span Seated Bypass at Console

<i>Issue:</i>	<i>An operating sequence from the console has failed at the end of the operation. The console indication lights show that one of the leaves is not fully seated.</i>
<i>Possible Cause:</i>	<i>A span seated limit switch has failed.</i>
<i>Procedure:</i>	<ol style="list-style-type: none"> <li>1. <i>Physically inspect the seated limit switch and confirm the proper position of the leaf so that the locks can be safely driven.</i></li> <li>2. <i>Once it is confirmed that the leaf is seated, use the Control Console Span Seated keyed bypass switch to conclude the operating sequence from the console.</i></li> <li>3. <i>Troubleshoot and repair the issue after the desired operation.</i></li> </ol>

### 3.6.7 Bypasses at the MCC

Bypass functionality is provided for the locks, gates, and brakes from the MCC. The locks and gates may be individually operated from the MCC by setting a switch to LOCAL control at the MCC enclosure. Operation from the MCC will bypass interlocks but will retain end of travel limits.

Operation from the MCC should generally only be pursued for maintenance and troubleshooting purposes. When any of the components are operated from the MCC, personnel must ensure safe operation:

- Driving locks from MCC. Ensure that the span is seated for driving locks. If there is a physical issue driving the locks, consider inspecting the live load reactions and the tail lock receivers to check alignment and for debris or other obstructions that may inhibit operation.
- Pulling locks from the MCC. The locks are safety devices to prevent movement of the span under traffic. Ensure that traffic is halted before pulling locks.
- Raising gates from MCC. Ensure that the leaves are seated and that the tail locks are engaged before raising the gates from the MCC.

- Lowering gates from MCC. Ensure that vehicular traffic has been halted. A flagger is recommended for unusual circumstances where a single gate would be raised and lowered.
- Releasing or setting brakes from MCC. Individual brakes may be released or set from the MCC as part of maintenance repairs. Care should be taken to ensure that the bridge is closed and that the tail locks are driven as releasing brakes may result in movement of the leaves.

### 3.7. Startup After Shutdowns

Additional precautions should be taken when putting the bridge back into service after extended shutdowns or after significant maintenance efforts. Minimum recommended action items are provided below. Qualified personnel should provide additional requirements as necessary based on the nature and cause of the shutdown and the scope of work of any repairs.

- Mechanical maintenance personnel should inspect the mechanical machinery components for suitability for operation. Typical inspections would include ensuring that equipment and structural items are positively secured, components are lubricated, brakes are operational, etc. See the mechanical maintenance manual for typical maintenance and inspection requirements for each machinery component.
- Electrical maintenance personnel should inspect the electrical components for suitability for operation. See the electrical maintenance manual for typical maintenance and inspection requirements for the electrical components.
- Perform a visual inspection and ensure that there are no obstructions for bridge operation over the full range of travel. This includes a review of the flat treads to ensure that they are free of debris.
- Ensure that there are no loose components or other items on the bascule span that could move when the bridge is operated.
- Evaluate the effect of any shutdown changes to the movable leaf that would affect the imbalance of the leaf. Ensure that the operating loads will be within the capacity of the span drive machinery.
- Remove accumulated ice loads and snow loads to minimize start-up loads.
- Test and ensure that the control console indication lights are all functional.
- Test and ensure that field feedback devices are functional.
- Ensure that the all control console inputs (switches, etc.) are properly positioned.



**APPENDIX D. ELECTRICAL MAINTENANCE MANUAL**

# COLONEL PATRICK O’RORKE MEMORIAL BRIDGE

## ELECTRICAL MAINTENANCE MANUAL



Prepared by:

**WJE** Beasley, Chin &  
Hunderman, P.C.

Submitted: March 19, 2021

# ELECTRICAL MAINTENANCE MANUAL

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## 1. General Information

### 1.1. Introduction

The following describes in general terms those electrical systems and equipment associated with the operation of the bridge. This system information is intended to explain the general functionality of the furnished electrical equipment and how they are integrated into the various bridge operating systems.

### 1.2. Safety

There are inherent safety risks associated with the operating electrical equipment and machinery for movable bridges. Notable safety hazards include dangers from electric potentials, high speed rotating mechanical parts, high temperature of equipment, fall hazards, and slipping hazards from spilled fluids.

Maintenance must be performed by competent, qualified, and certified personnel experienced in the maintenance and operation of electrical systems and equipment and with heavy machinery. Personnel must be familiar with the specific systems associated with the bridge. Refer to appropriate Monroe County or NY state documents for detailed safety procedures and regulations, including any lockout / tagout requirements.

All maintenance personnel must, at all times, maintain a line of communications with the bridge operator and all other personnel that are working on the bridge when performing bridge maintenance. Ensure that all parties are notified and in a safe position prior to bridge, traffic control or any bridge electrical or machinery operation. Similarly, ensure that the operator is aware of any maintenance activities that may delay the operation of the bridge. Communication is essential to ensure safe coordination of operation and maintenance activities.

## 2. Systems Description

### 2.1. Introduction

The following describes in general terms of those electrical systems and equipment associated with the operation of the bridge. This system information is intended to explain the general functionality of the furnished electrical equipment and how they are integrated into the various bridge operating systems. The layout of the movable bridges and machinery is provided in Figure 1.

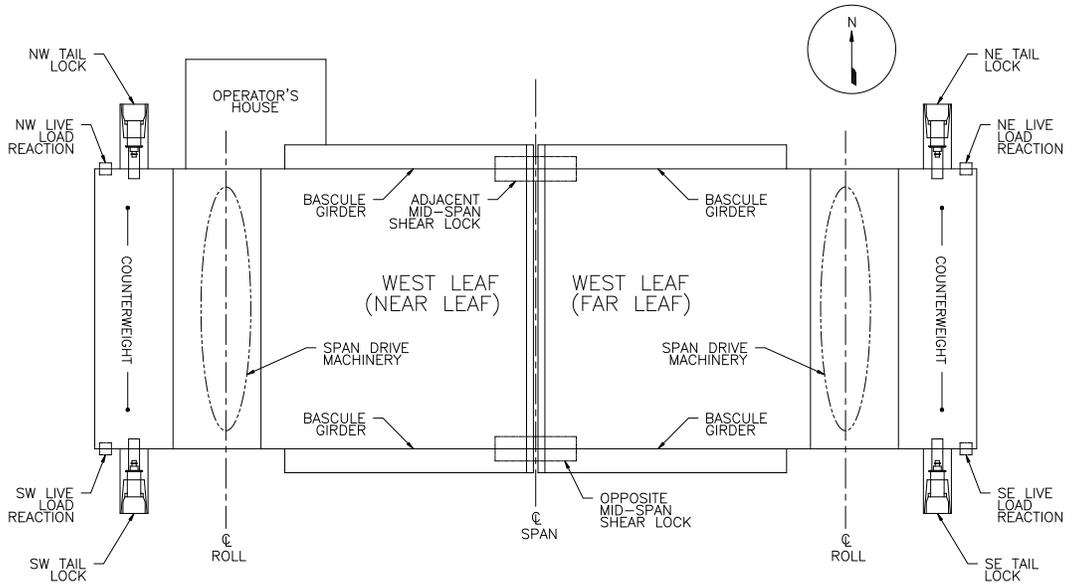


Figure 1: Bridge Layout with Machinery System Locations

## 2.2. Normal Power System

The electric utility service consists of a 480/277 volt, 3-phase, 4-wire, solidly grounded system, which is derived from a utility pad mounted transformer located at the northwest approach. The utility metering equipment is mounted on the low voltage section of the step down transformer. The utility service is provided with a service disconnect switch on the load side of the step down transformer to interrupt power to the bridge for maintenance and troubleshooting.

## 2.3. Standby Power System

The bridge is provided with a standby generator for backup power. is model DFAC-5629306 manufactured by Cummins Power Generation, and is rated at 250kW, 277/480 volts. The generator is capable of operating the bridge for all identified modes of operation. The generator is provided with 125kW load bank mounted on the generator. The load bank is used to exercise the generator under load during maintenance. The system is provided with an automatic transfer switch (ATS), which automatically switches to standby power in the event of a utility power failure. The ATS is located in the generator room in a wall mounted enclosure.

## 2.4. Emergency Span Drive System

An emergency hand drive system is provided for the bridge that is used in the event of the main drive system failure or both utility and generator outage. The hand drive consists of a 120V DeWalt DW138 drill that can be plugged into a receptacle that is fed by a portable generator receptacle and a local disconnect switch. The portable generator receptacle is mounted on the utility main disconnect switch enclosure located in the utility compounded area.

## 2.5. Span Drive System

The span drive system consists of two (2) span drive motors, two (2) thruster motor brakes and two (2) thruster machinery brake. See Figure 2 for span drive machinery arrangement.

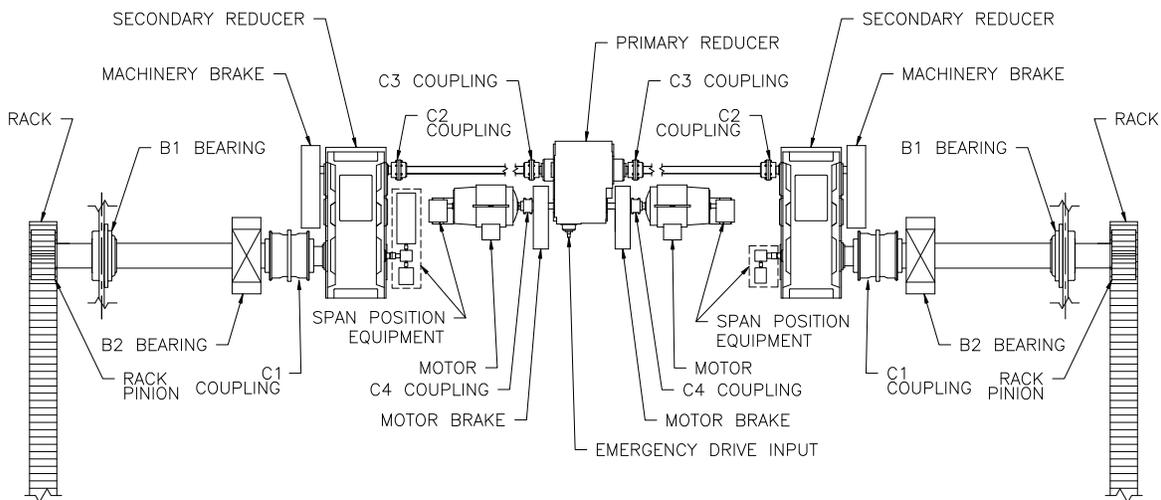


Figure 2: Span Drive Machinery

The span drive motors are Reuland wound rotor induction motors rated for 75HP at 900 RPM. The motors are configured as redundant units and are controlled from respective SCR drive controllers for torque and speed control. Each SCR drive controller is provided with a combination of tachometer and speed switch unit. Each tachometer/speed switch is mounted on an extension shaft of each drive motor. These units provide the necessary feedback to the SCR drive controller for speed control of their respective span drive motor. They also provide an over speed trip function to trip the drive controller in the event that set speeds are exceeded.

## 2.6. Tail Lock System

The bridge is provided with four (4) tail locks. The lock bar-type tail lock is provided at the tail end of each bascule girder to limit span movement when it is engaged. The lock bar is driven by an electro-mechanical linear actuator and is supported by a front and rear guide. When driven, the lock bar engages a strike plate attached to the bascule girder. When retracted, the lock bar is pulled outboard of the bascule girder and allows the leaf to open. See Figure 3 for the tail lock machinery arrangement.

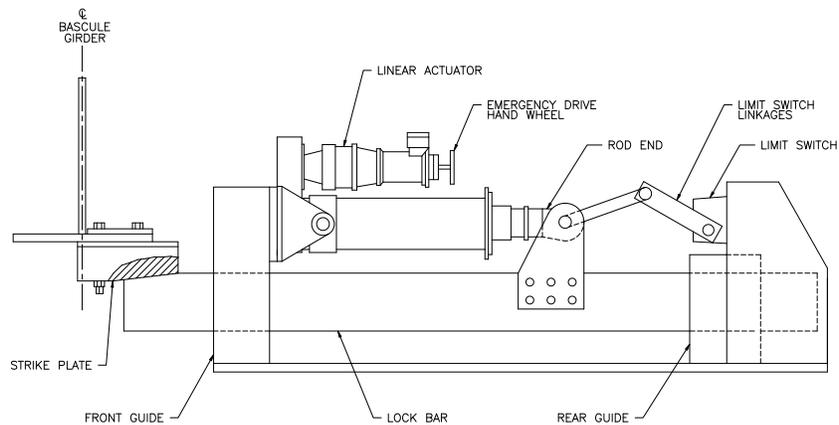


Figure 3: Tail Lock Arrangement

The lock system is provided with an electrically operated linear actuator, limit switches, and an emergency drive hand wheel mechanism. Lock bar control is an integrated part of the bridge operating system and its operation is interlocked with the span seated limit switches to ensure that the span is seated prior to operation.

The lock bar is capable of being operated manually with the emergency drive hand wheel in the event of electric operating failure or for maintenance and troubleshooting.

Each tail lock bar arrangement includes two limit switches: a rotary cam limit switch (RCLS) for end of travel control and a positive indication limit switch used for interlocking and indication.

## 2.7. Traffic Control System

The bridge traffic control system consists of a combination of traffic lights, warning gates, and pedestrian control that are integrated into the bridge control system.

Traffic lights consist of two sets of three aspect traffic lights suspended over each approach roadway from a pole mounted cantilevered arm.

Two (2) warning gates are provided at each of the bridge approaches and, when lowered, straddle the full width of the approach roadway. Each warning gate consists of a gate arm with steady and flashing lights. The warning gate enclosures include the operating mechanisms used for raising and lowering the warning gate arm. Each operating mechanism is provided with a hand crank mechanism for manual operation in the event of electrical failure or for maintenance and troubleshooting. Each gate mechanism is also provided with a set of limit switches that are used in the control system.

## 2.8. Drive Operating System

The bridge drive system is powered and controlled from a motor control center (MCC) and silicone controlled rectifier (SCR) drive cabinets located in the electrical room.

The bridge main power feed is through a bottom entry into the MCC main feeder breaker. The incoming feed is protected with transient voltage surge suppressors (TVSS) located at the bottom left compartment of the MCC. The motor control starters are all located in the MCC and a lighting panel is also provided in the MCC for powering the bridge auxiliary loads. The bridge drive motors are powered and controlled by SCR drives. Each SCR drive controller is provided with a combination of tachometer and speed switch unit, mounted on an extension shaft of each drive motor. These units provide the necessary feedback to the SCR drive controller for speed control of their respective span drive motor. The feeder breakers for the SCR drives are located in the MCC and are Kirk-Key interlocked to only allow single motor operation per leaf

## 2.9. Control Logic System

The bridge control system consists of a PLC controller as the primary form of control. Backup hard-wired relay logic is also provided at the bridge and used in the event of PLC failure. Bridge interlocking is achieved through the use of either form of the logic control. The PLC controller is located in the operator's control console and the relay logic is located in the bridge relay cabinet within the control room of the operator's house.

The bridge control, safety and sequencing interlocks utilize inputs from field located limit switches and PLC / relay logic to ensure that the bridge is only operated in a specific sequence and ensures safety for the traveling public, bridge operating staff and the bridge physical structure and machinery.

As configured, the operator has complete control of the bridge from the operator's control desk. Additionally, the control system is provided with bypass functionality to enable continued operation in the event of one or more field device failures.

## 2.10. Overspeed Protection

The bridge control system is provided with overspeed protection based on feedback from speed switches installed at each leaf machinery. The switch is used to provide the following trip functions:

- Span drive system overspeed when operating at full speed. This trip function trips the drive when the rated speed of the driven machinery exceeds 110% of its rated speed. It ensures that no damage can occur to the bridge or its machinery due to excessive speed of operation.
- Span drive reduced speed setting overspeed. This trip function trips the drive when the low speed of the driven machinery exceeds 110% of its rated speed. It ensures

that the drive is reducing speed at the nearly open or closed to stop the moving span in a controlled manner.

### 2.11. Navigational Aids

Navigation aids include fender lights, navigation lights, and a marine air horn.

The bridge is provided with three pedestal type fender navigation lights on each fender for channel marking. The fender navigation lights are manual or automatic photocell controlled. A relay cabinet is provided for the navigation lighting system to allow for auto/manual operation. Additionally, the navigation lighting system is provided with a battery bank and an inverter to ensure uninterrupted service for the navigation lighting system.

There are four navigation lights which are used for marine traffic signaling. The lights are pivot type green over red lights mounted at the toe end on the outboard sides of each leaf.

A marine air horn is provided to signal marine traffic prior to a bridge opening. The air horn compressor is located at the west counterweight pit area and the horn is located at the fender level directly facing the navigable channel.

### 2.12. Intercom System

The bridge is provided with an intercom system for communications between different areas throughout the bridge. Table 1 provides the intercom directory.

*Table 1: Intercom Directory*

Station #	Location
10	Control Room
11	Storage / Locker Room
12	Motor Control Room (Electrical Room)
13	Generator Room
14	Pier 1 North Catwalk
15	Pier 1 East Catwalk
16	Pier 1 South Catwalk
17	Pier 1 Machine Room
18	East Submarine Cabinet
19	Pier 2 North Catwalk
20	Pier 3 West Catwalk
21	Pier 2 South Catwalk
22	Pier 2 Machine Room

The bridge is also provided with a public address (PA) system. The PA controller is located in the generator room.

### 2.13. Other Systems

The bridge has been provided with a fire alarm system. The system consists of smoke detectors, pull stations, and a fire alarm control panel located on the first floor of the operator's house. A smoke detector and a pull station are also provided in the machinery space.

The bridge is provided with a CCTV system. The CCTV cameras have been strategically located throughout the bridge to monitor the bridge, roadway approaches, and waterway approaches. The operator can monitor these locations from the office space inside the bridge control room.

## 3. Electrical Equipment

### 3.1. Bridge Standby Generator

The bridge is provided with a standby generator for backup power. See Figure 4. The generator is model DFAC-5629306 manufactured by Cummins Power Generation, and is rated at 250kW, 277/480 volts. Operation and maintenance requirements are provided in an Owner and Operator's binder located in the Operator's Control Room.

### 3.2. Automatic Transfer Switch

The electric service to the bridge is normally provided by the electric utility with the installed standby generator being used as back up. The transfer from electric utility to standby generator occurs automatically in the event of utility power failure with the Automatic Transfer Switch (ATS). See Figure 5. The transfer switch is of Cummins manufacture.



Figure 4. Standby Generator



Figure 5. Automatic Transfer Switch



*Figure 6: Motor Control Center*

### 3.3. Motor Control Center (MCC)

The MCC is a Cutler-Hammer Series 2100, sized for 600A, 480V. See Figure 6.

### 3.4. SCR Drives

Hubbel silicone controlled rectifier (SCR) drives, located cabinets in the electrical room, power and control the span drive motors. See Figure 7. The feeder breakers for the SCR drives are located in the MCC and are Kirk-Key interlocked to only allow single motor operation per leaf. See Figure 8. Normal motor operating combinations for operation of the two leaves are motor 1 and 3 paired or motor 2 and 4 paired.



*Figure 7. Drive Cabinets*



*Figure 8. Drive Breakers at MCC*

### 3.5. Submarine Cable

The bridge is provided with a submarine cable installation that provides electric power and control functionality between the east and west leaves. The power feed that emanates

from the MCC is run in submarine cable to the east side of the bridge to serve the bridge east side operating equipment. The submarine cables also carry signal feedback from the field devices located on the east side back to the bridge control system located in the operator's control house at the west approach. Both east and west leaves are provided with a submarine cable termination cabinet.

### 3.6. Droop Cables

The bridge is provided with a droop cable installation that provides electric power and control functionality between the fixed and moving structures for each leaf. See Figure 9. Each leaf is provided with two (2) droop cable termination cabinets, one located on the fixed structure and one in the machinery space on the moving structure.



*Figure 9: Droop Cables*

### 3.7. Lighting and Small Power

Lighting is provided in the operator's house and in the machinery space. Emergency lights and exit lights have also been provided throughout the operator's house. The operator's house and the machinery spaces are provided with electric space heaters.

### 3.8. CCTV System

A CCTV system provides visibility for the bridge operator during bridge raising and lowering, as well as providing additional bridge security and safety for the bridge and the general public. The CCTV system consists of strategically located PTZ cameras to view the bridge approaches and the navigable channel in both directions. The CCTV cameras are monitored from two (2) ceiling mounted CCTV monitors located in the bridge control room.

### 3.9. Span Drive Motors

Each leaf is provided with two (2) Reuland manufactured 75 HP wound rotor span drive motors. See Figure 10. The two drive motors are coupled in parallel to the span drive machinery and configured as redundant units.



Figure 10: Span Drive Motor

### 3.10. Span Drive Brakes

Each leaf machinery system is provided with four spring set, thruster released brakes including two motor brakes and two machinery brakes. See Figure 11 and Figure 12. Each brake is provided with a brake set, brake released, and a brake hand released limit switch in accordance with the requirements of AASHTO. The brakes are provided with brake local disconnect switches as per the NEC. See Table 2 and Table 3 for brake data plate information.

Table 2: Motor Brake Manufacturer Information

Specification	Motor Brake Motor
Manufacturer	EMG
Prod. No.	02/466178
Phase	3
Hz	60
Volts	265 / 460
Amps	0.69 / 0.40
Power	200W
NEMA	IP65

Table 3: Machinery Brake Manufacturer Information

Specification	Machinery Brake Motor
Manufacturer	EMG
Prod. No.	02/52474
Phase	3
Hz	60
Volts	265/460
Amps	2.0 / 1.15
Power	330W
NEMA	IP65



Figure 11. Span Drive Motor Brake



Figure 12. Span Drive Machinery Brake

### 3.11. Emergency Span Drive Drill

The emergency span drive includes a drive that can be plugged into a receptacle fed by a portable generator. See Figure 13.

The drill manufacturer's details are as follows:

- DeWalt Model DW138, Reversible Spade-Handle Drill
- 3/4" Drive
- 120V, 60 Hz, 10 Amps
- 375 RPM



Figure 13: Emergency Span Drive Drill

### 3.12. Tail Lock Actuators

The tail lock assembly includes an electro-mechanical actuator shown in Figure 14. Manufacturer details are provided in Table 4.



*Figure 14: Tail Lock Assembly, Including Actuator in a Sheet Metal Enclosure.*

*Table 4: Tail Lock Actuator Manufacturer Information*

<b>Specification</b>	<b>Details</b>
Manufacturer	RACO International, Inc.
Model	Size 7 Electric Actuator, C-Design with Trunnion Brackets, Brake, and Handwheel
Type	MA7 Ball Screw Actuator
Type Code	LBR K1N7 ZMZA AIZ
Thrust	8800 lbs.
Stroke	Special 12.6"
Motor Voltage	230/460/3 Ph/60
Motor Data	1.7 kW, 3.5 FL Amps
Temp Range	-40 deg C to 100 deg C
Weight	315 lb.
Raco Drawing	GANQD001

### 3.13. Field Feedback Devices

The following field feedback devices are used as part of the control system:

Position and Control for the Moving Leaves:

- RCLS - used to indicate leaf position, end of travel limits, and over-travel limits. See Figure 15.
- Selsyn Transmitter - provides feedback to the Selsyn receiver at the control console to determine leaf angle measurement. See Figure 16.



Figure 15. Span Drive RCLS



Figure 16. Selsyn Transmitter at Span Drive

- Inclinometer - used to provide leaf angle measurement. See Figure 17.
- Span Seated Limit Switch - plunger type limit switch used to indicate seated position and used for interlocks between the moving span and tail locks. See Figure 18.



Figure 17. Inclinometer



Figure 18. Span Seated Limit Switch

- Over-Travel Limit Switch - lever type switch used as a safety in the event of a leaf over-travel. See Figure 19.
- Tachometer - used to record motor speed. See Figure 20.
- Speed Switch - used to trip the drives when leaf speed exceeds rated speed. See Figure 20.



*Figure 19. Span Over-Travel Limit Switch at Flat Treads*



*Figure 20. Tachometer and Speed Switch at Span Drive Motor*

Tail Lock Feedback Devices:

- RCLS for end of travel.
- Position switch for interlocking and indication. See Figure 14.

Gates (See Figure 21) :

- Rotary Cam Limit Switch - for end of travel
- Door limit switches for interlocking.
- Hand crank interlock switch.



*Figure 21: Traffic Gate Assembly*

### 3.14. Traffic Warning Gates

The gates are B&B Roadway model VT-40 assemblies. See Figure 21. Each warning gate consists of a code compliant arm with steady and flashing lights that straddle half the width of the roadway when lowered. The traffic gate operating mechanisms used to raise and lower the warning gate arms are located in freestanding weatherproof enclosures.

Each gate is provided with a hand crank mechanism and limit switches to prevent electrical operation of the gates when the gates are being manually operated.

### 3.1. Traffic Signals

The traffic signal installation consists of two (2) sets of three aspect traffic lights cantilevered over the roadway from a pole mounted cantilevered arm.

### 3.2. Navigation Lighting

The bridge is provided with fender pedestal type navigation lights for channel marking and clearance; three fender navigation lights have been provided on each fender. This configuration is in accordance with U.S. Coast Guard requirements. The fender navigation lights are manual or automatic photocell controlled. A relay cabinet is provided for the navigation lighting system to allow for auto/manual operation. Additionally, the navigation lighting system is provided with a battery bank and an inverter to ensure uninterrupted service for the navigation lighting system. See Figure 22. The bridge is also provided with pivot type green over red navigation lights mounted at the toe end on the outboard side of each leaf for marine traffic signaling. See Figure 23.



Figure 22. Fender Navigation Light



Figure 23. Toe End Navigation Lights

### 3.3. Motor and Brake Disconnects

Disconnect switches are provided in the machinery space and at the tail lock assemblies to disconnect the motors locally. See Figure 24 and Figure 25.

2



Figure 24. Span Drive Machinery Brake Disconnect Switch



Figure 25. Tail Lock Disconnect Switch at Base of Tail Lock Support Frame

### 3.1. Intercom and PA System

The bridge is provided with an intercom system for communications between different areas throughout the bridge and a public address (PA) system. The PA controller is located in the generator room. See Figure 26.

### 3.2. Fire Alarm

The bridge has been provided with a fire alarm system. Fire alarm monitoring devices have been installed throughout the bridge. Each floor of the operator's house and the electrical and generator rooms are provided with smoke detectors and pull stations. Additionally, smoke detectors, heat detectors and pull stations are provided at each of the machinery spaces. The main fire alarm control panel FACP is located at the first floor of the operator's house. See Figure 27.



Figure 26. Bridge PA System



Figure 27. Bridge Fire Alarm Panel

### 3.3. Cables, Conduits, and Junction Boxes

The bridge indoor electrical installation generally consists of RGS conduits and termination junction boxes. The bridge outdoor electrical installation consists of numerous runs of PVC coated conduits. The junction boxes are stainless steel.

## 4. Scheduled Inspection, Testing, and Maintenance

### 4.1. General

Electrical inspection and maintenance of the bridge systems shall generally follow the following recommendations and practices:

- All manufacturers' recommendations.
- General recommendations and guidelines from in accordance with AASHTO.
- Specific recommendations noted in this manual.
- Additional maintenance deemed necessary based on the history of operation and maintenance of this bridge, as determined by trained maintenance personnel.

### 4.2. Scheduled Electrical Inspection, Testing, and Maintenance

#### 4.2.1. General

The integrity of the electrical installation throughout the bridge shall be verified a minimum of every year through visual inspection and insulation resistance testing of the major feeder cables and action taken as necessary to mitigate corrosion, ingress of moisture and reduction in feeder cable insulation.

The visual inspection shall be in sufficient depth to locate any corrosion, nicks to cable insulation, loose fittings, and terminations as well as the ingress of moisture into pull and junction boxes.

The insulation resistance testing of major electrical power equipment including motor feeders, motor windings and submarine cable conductors and shall be performed using a "Megger" of an appropriate test voltage for the insulation being tested in accordance with code. The testing shall be performed with the cables disconnected at both ends and each conductor being Meggered to ground. The motor windings shall be Meggered at the motor disconnect switch with the disconnect switch open. The Megger readings shall be recorded along with date and weather conditions to create an historic record of insulation resistance of each feeder cable.

#### 4.2.2. Bridge Operation Controls Verification through Operation

##### 4.2.2.1. Suggested Maintenance

Operate the bridge and verify control elements including: the sequence of operation, interlocks, and permissives associated with the operation of the bridge and traffic control systems.

##### 4.2.2.2. Schedule

Operation with verification of sequence, interlocks, and permissives should be performed every two years.

### 4.2.3. Span Drive Motors

#### 4.2.3.1. Suggested Maintenance

- De-energize the equipment and follow appropriate Lockout/Tagout procedures.
- Remove accumulated dust and dirt.
- Inspect all terminations at motor assembly. Tighten connections as necessary.
- Inspect all wiring for deterioration of insulation.
- Grease motor bearings in accordance with manufacturer's recommendations. See the mechanical maintenance manual for details.
- "Megger" the motor stator windings to ground.

#### 4.2.3.2. Schedule

The motors should be inspected and maintained as noted, including the Meggering, at least once annually. See the mechanical maintenance manual for bearing grease frequency.

### 4.2.4. Tail Lock Actuator

#### 4.2.4.1. Suggested Maintenance

- De-energize the equipment and follow appropriate Lockout/Tagout procedures.
- Remove accumulated dust and dirt.
- Inspect all terminations at motor assembly. Tighten connections as necessary.
- Inspect all wiring for deterioration of insulation.
- Grease in accordance with manufacturer's recommendations. See the mechanical maintenance manual for details.
- "Megger" the motor stator windings to ground.

#### 4.2.4.2. Schedule

The motors should be inspected and maintained as noted at least once annually. Note that the meggering of the motors is only required once annually. See the mechanical maintenance manual for bearing grease frequency.

### 4.2.5. Span Drive Thrustor Brakes

#### 4.2.5.1. Suggested Maintenance

- Inspect all terminations. Tighten connections as necessary.
- Inspect all wiring for deterioration of insulation.
- Check the functionality of the brake limit switches.
- "Megger" the brake motor windings to ground.

#### 4.2.5.2. Schedule

The brakes should be inspected and maintained as noted at least once annually.

#### 4.2.6. Standby Generator

The standby generator is maintained by a third party in accordance with the manufacturer's recommendations. A list of general maintenance requirements is replicated here for the County maintainer's reference.

##### 4.2.6.1. Suggested Maintenance

Generator maintenance should be scheduled as recommended by the manufacture. Refer to the manufacturer's literature in the control house for additional details. A summary of minimum maintenance items is provided as a reference. The maintainer should keep records and logs for any generator runs, maintenance, and other services.

- Ensure that the generator is de-energized following the appropriate Lockout/Tagout procedure(s) for any maintenance done on the generator.
- Observe generator during the operation for abnormal vibrations, sounds and any other abnormal operational conditions.
- At the time of this maintenance run, the generator should be inspected for oil, fuel, or coolant leakage.
- Check all fluids and replenish or replace as necessary.
- Perform coolant and oil changes as required by the manufacturer.
- Replace fluid filters.
- Visually inspect all status indicators.
- Inspect all cables and connections for deterioration.
- Clean the assembly and ensure proper enclosure water seal against water ingress.
- Megger the armature windings.
- Inspection and replace air filters as-needed.
- Inspect all belts and adjust / replace as necessary.
- Inspect hoses and hose clamps and replace as necessary.
- Clean the radiator.

##### 4.2.6.2. Schedule

- Operate the bridge under load using the generator at least monthly.
- The inspection of the conductors and the enclosure should be performed at least once every six months.
- Meggering the armature windings should be performed annually.
- Follow the manufacturer's Service Schedule in the Generator's Operation Manual for other suggested maintenance frequencies for all required tasks.

#### 4.2.7. Automatic Transfer Switch (ATS)

##### 4.2.7.1. Suggested Maintenance

- De-energize the equipment and follow the appropriate Lockout/Tagout procedures.
- Inspect ATS contacts and other hardware for wear.
- Inspect cables and connections for deterioration.
- Inspect for mechanical integrity of the enclosure.
- Replace damaged or failed components.
- Check for required area clearances.
- Remove accumulated dust and dirt. Use brush, soft cloth, or vacuum cleaners.
- Refer to manufacturer's literature for additional service and maintenance requirements.
- Throw the main power disconnect at the MCC to simulate a utility power failure and verify ATS operation to transfer power to the standby generator.

##### 4.2.7.2. Schedule

The ATS maintenance activities should be performed at least once annually.

#### 4.2.8. MCC

##### 4.2.8.1. Suggested Maintenance

- De-energize the main power that feeds the MCC's and follow the appropriate Lockout/Tagout procedures.
- Remove accumulated dust and dirt. Use brush, soft cloth, or vacuum cleaner.
- Inspect all terminal block screws and tighten all connections as necessary.
- Inspect all starter contactor contacts and replace as necessary.
- Inspect all wiring for deterioration of insulation.
- Exercise all active components, including starters, circuit breakers, control switches, disconnecting devices, fuses, and mechanical interlocks.
- Inspect for mechanical integrity of the enclosure and its anchorage.
- Check for required area clearances.
- Replace damaged or failed components.
- Inspect all circuit breakers. Verify with multi-meter that continuity is broken on trip or switched off condition.
- Check in the buckets with overloads and TVSS and confirm that there are no overloads.
- Inspect all fuses with multimeter and verify continuity. If fuse replacement is necessary, always install the same type and rating fuses furnished. Evolution in fuse design has produced fuses that are mechanically equivalent but not electrically equivalent. They may not have the same short-circuit withstand ability and current limiting ability.

#### 4.2.8.2. Schedule

The MCC maintenance activities should be performed at least once annually.

#### 4.2.9. UPS

##### 4.2.9.1. Suggested Maintenance

- Remove accumulated dust and dirt.
- Visually inspect all conductors and their terminations.
- Test batteries in accordance with the manufacturer's recommendations and replace as necessary.
- Perform a test operation of the UPS (disconnect normal power).
- Refer to manufacturer's literature for additional maintenance and testing information.

##### 4.2.9.2. Schedule

The UPS maintenance activities should be performed at least once annually.

#### 4.2.10. Silicon Controlled Rectifier Drives (SCRs)

##### 4.2.10.1. Suggested Maintenance

- De-energize the equipment and follow the appropriate Lockout/Tagout procedures.
- Remove accumulated dust and dirt. Use brush, soft cloth, or vacuum cleaner.
- Visually inspect drive components and wiring for discoloration and evidence of overheating, or other deterioration to wiring insulation.
- Inspect all terminal block screws and tighten all connections as necessary.
- Inspect and verify functionality of all relays, contactors, and control and indication devices.
- Inspect for mechanical integrity of the enclosure and its anchorage.
- Test operate the bridge using each drive and motor.

##### 4.2.10.2. Schedule

The maintenance activities for the drive cabinets should be performed at least once annually.

#### 4.2.11. Control Console

##### 4.2.11.1. Suggested Maintenance

- With the Control Power On, check that each indication light is functional by pressing to test. Verify proper operation of all switches and pushbuttons.
- De-energize the equipment at the MCC breaker and follow the appropriate Lockout/Tagout procedures.

- Visually inspect drive components and wiring for discoloration and evidence of overheating.
- Check for required area clearances.
- Replace damaged or failed components.
- Remove accumulated dust and dirt. Use brush, soft cloth, or vacuum cleaner.
- Inspect all terminal block screws and tighten all connections as necessary.
- Inspect enclosure lamps.

#### 4.2.11.2. Schedule

The control console maintenance and inspection should be performed at least once annually.

### 4.2.12. Control Relays in Relay Cabinet

#### 4.2.12.1. Suggested Maintenance

- All power and control power feed to the relay cabinet should be de-energized when checking the terminal cabinets. Follow the appropriate Lockout/Tagout procedures.
- Remove accumulated dust and dirt. Use brush, soft cloth, or vacuum cleaner.
- Inspect all wiring for deterioration of insulation.
- Inspect all terminal screws and tighten all connections as necessary.
- Inspect all breakers, fuses, relays, and contacts inside the cabinet for proper operation.
- Inspect for mechanical integrity of the enclosure and its anchorage.
- Check for required area clearances.
- Replace damaged or failed components.

#### 4.2.12.2. Schedule

Control relays inspection and maintenance should be performed at least once annually.

### 4.2.13. Limit Switches and Rotary Cam Limit Switches

#### 4.2.13.1. Suggested Maintenance

- Remove accumulated dust, dirt, and moisture on housing. Use brush, soft cloth, or vacuum cleaner.
- Inspect cover gaskets and bolts to ensure proper seal of housing.
- Clean the limit switch assembly and its associated target(s).
- Inspect the switches for wear.
- Where applicable, inspect the rollers for wear.
- Where applicable, inspect the cams for wear. The cams are made of a harder material than the rollers, thus should last even longer. The longevity of the cams is based on the number of cycles, and typically these do not need to be replaced for several hundred thousand cycles. Based on the number of cycles per year of this bridge, the cams should never have to be replaced.

- Inspect all fasteners and tighten connections as necessary.
- Where applicable, inspect coupling for deterioration.
- Replace or repair damaged or failed components.
- Test and verify proper operation, feedback control, and indication.

#### 4.2.13.2. Schedule

Limit switch inspection and maintenance should be performed at least once annually. The over-travel limit switch should be exercised monthly. This may be performed concurrent with mechanical maintenance work.

### 4.2.14. CCTV System

#### 4.2.14.1. Suggested Maintenance

- Check that nothing is obscuring the field of view of camera lenses and adjust as necessary.
- Verify that the cameras are properly focused and adjust if necessary.
- Check the operation of the pan tilt and zoom focus.
- Check wiring and cable harnesses for wear.
- Check connections for loose wiring.
- Ensure that monitors are operational.
- Clean monitor screens.
- Check all cable and wiring connections to the monitors.

#### 4.2.14.2. Schedule

Inspection to ensure functionality of the CCTV components at least once a month. Provide visual inspection of all cable and wiring connections, and cleaning of screens at least once every six months.

### 4.2.15. Safety Disconnect Switches

#### 4.2.15.1. Suggested Maintenance

- Visually inspect all conductors and their terminations.
- Inspect switch blades and replace switch or switch blades as necessary.
- Exercise the switch.
- Clean the assembly and ensure properly sealed against water ingress.
- Inspect for mechanical integrity of the enclosure and its anchorage.
- Check for required area clearances.
- Replace damaged or failed components.

#### 4.2.15.2. Schedule

Safety disconnect switch inspection and maintenance should be performed at least once annually.

## 4.2.16. Conduits and Electrical Boxes

### 4.2.16.1. Suggested Maintenance

- Inspect conduit and repair or replace broken or detached conduits.
- Clean electrical box assemblies and ensure properly sealed against water ingress.
- Inspect the mechanical integrity of the enclosures and their anchorages.
- Remove accumulated debris from around the conduit runs and spot clean and paint corroded areas.

### 4.2.16.1. Schedule

Maintenance and inspection for conduits and electrical boxes should be performed at least once annually.

## 4.2.17. Warning Gates

The gate enclosures are provided with doors to allow for access to the machinery for maintenance. The doors are limit switch protected to prevent operation of the gates when the doors are opened.

### 4.2.17.1. Suggested Maintenance

- De-energize the equipment and follow the appropriate Lockout/Tagout procedures.
- Remove accumulated dust and dirt on surface and inside the enclosure. Use brush, soft cloth, or vacuum cleaner.
- Inspect all wiring and connections for deterioration.
- Remove any corrosion from limit switch contacts.
- Visually inspect hardware, power, and control equipment for proper operation.
- Spot clean and paint corroded areas on the gate assemblies.
- Check the gate arm lights and confirm that they are operational.
- Inspect the gate arm leveling and make adjustment if needed.
- Inspect all hardware mountings and tighten all loose bolts.
- Observe the gate operation, including control interlock permissives and gate end-of-travel limits.
  - Verify the gongs are operational during gate operation.
  - Verify the gate arm lights are on, and flash in the correct sequence.
  - Investigate any abnormal sounds or behavior during the operation.
- Inspect gasket on both doors on each gate to ensure weatherproof integrity for the gate housing.
- Megger the gate motor windings.
- Refer to manufacturer's literature for additional information regarding the electrical and mechanical maintenance requirements.

#### 4.2.17.2. Schedule

Inspection and maintenance for the gates should be performed at least once every six months, with the exception of meggering the motor windings, which should be performed at least once annually.

#### 4.2.18. Warning Gongs

##### 4.2.18.1. Suggested Maintenance

- Verify proper function and operation of gongs and control interlocks.
- Replace or repair damaged or failed components.
- Inspect the mechanical integrity of the assemblies and their anchorages.

##### 4.2.18.2. Schedule

Inspection to verify the function and operation of the gongs, and any required repairs, should be performed at least once every month. Check the integrity of the assemblies at least once every six months.

#### 4.2.19. Fire Alarm

##### 4.2.19.1. Suggested Maintenance

- Inspection, testing and maintenance of the fire alarm systems must be performed in accordance with local, state, and national regulations.
- Correct any trouble condition or malfunction immediately.

##### 4.2.19.2. Schedule

A fire alarm system testing, and maintenance schedule should be in accordance with local, and national fire codes and other codes that might apply. As a minimum, test the system once every 3 months.

#### 4.2.20. Traffic Lights, Marine Navigation Lights, and Fender Lights

##### 4.2.20.1. Suggested Maintenance

- Verify proper function and operation of traffic lights and control interlocks.
- Replace or repair damaged or failed components.
- Inspect the mechanical integrity of the assemblies and their anchorages.

##### 4.2.20.2. Schedule

Inspection to verify the function and operation of the lights, and any required repairs, should be performed at least once every month. Check the integrity of the assemblies at least once every six months.

#### 4.2.21. General Lighting

##### 4.2.21.1. Suggested Maintenance

- Visually inspect lighting circuits, feeder breakers, and wiring.
- Immediately report a failed light bulb and prioritize its replacement to remove the hazard of reduced illumination.
- Inspect mechanical integrity of installations and make repairs as necessary.

##### 4.2.21.2. Schedule

Inspect for failed bulbs and replace as necessary on a monthly basis as a minimum. Perform other detailed maintenance and inspection at least once annually.

#### 4.2.22. Emergency Lighting

##### 4.2.22.1. Suggested Maintenance

- Perform maintenance and testing of the emergency lighting installation in accordance with local, state, and national regulations and as herein described.
- Remove accumulated dust and dirt on lenses and inside the fixture housing. Use brush, soft cloth, or vacuum cleaner.
- Test the functionality of the emergency lighting.
- Inspect all bulbs and batteries. Replace if needed.
- Inspect all wiring and connections for deterioration.
- Provide written record of each test results and repairs.
- If provided, refer to manufacturer's literature for additional information regarding the maintenance requirement.

##### 4.2.22.2. Schedule

Each emergency lighting fixture should be tested and repaired to ensure functional at least once every month. Perform detailed inspection and maintenance at least once annually.

## 5. Manufacturer's Literature

## 5.1. Brakes



# LINK CONTROL SYSTEMS, INC.

ELECTRICAL CONTROL SYSTEMS MANUFACTURER

16 COLT COURT, RONKONKOMA, N.Y. 11779

PHONE No. (631) 471-3950    FAX No. (631) 471-2390

## MOTOR OPERATED SHOE BRAKES

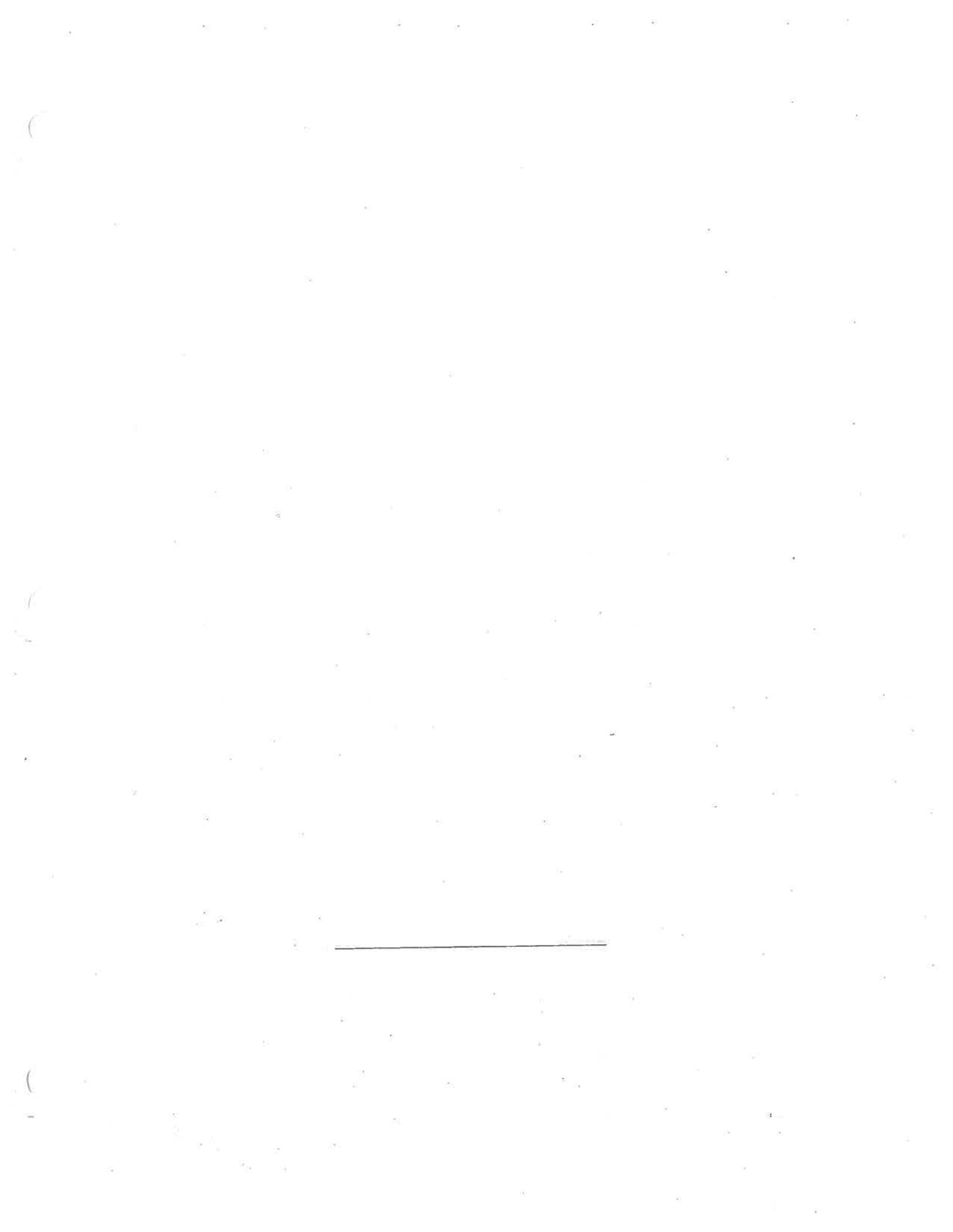
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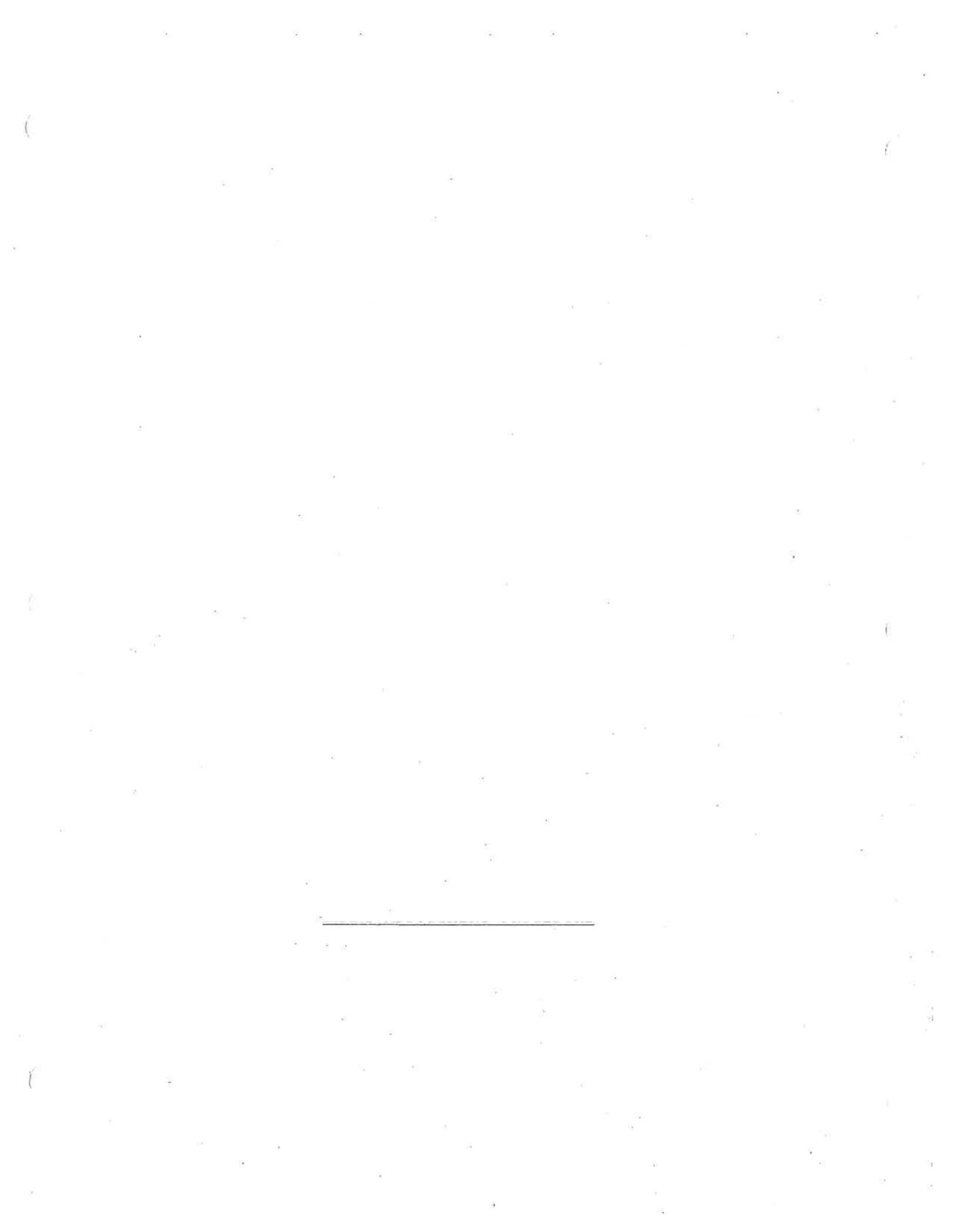














## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

adjustment independent of the electrical system.

See figures below for location of valves on thruster motor type.

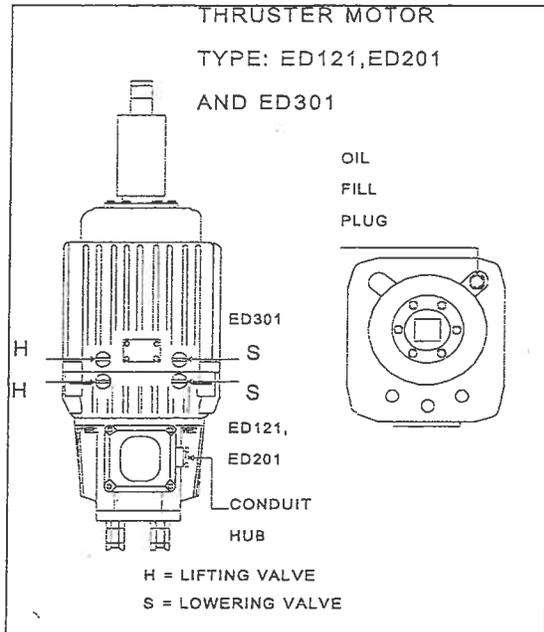


FIGURE 4

Remove protective covers to expose valves.

Clockwise (cw) turn on valve increases operating time and counter clockwise (ccw) turn on valve decreases operating time.

Valve "H" controls the time it takes to fully release the brake. The average time value should be about 1 second.

Valve "S" controls the time it takes to fully set the brake. The average time value should be about 2 -5 seconds. Review the project requirements or specifications for the actual times required.

### TESTING PROCEDURE

**IMPORTANT:**

PERFORM BRAKING TESTS GOVERNED BY CONSIDERATION  
OF SAFETY REGULATIONS AND ACCIDENT AVOIDANCE.

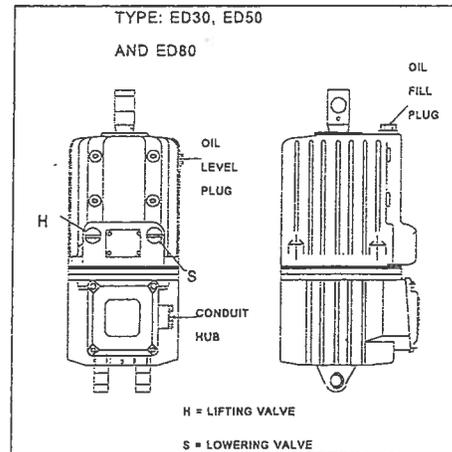


FIGURE 5

## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

Do not perform any load testing until the brake has been adjusted properly. See brake adjustment procedure in this booklet.

- 1 - Engage the mechanical and electrical drive system at reduced speed.
- 2 - First apply emergency braking at partial speeds, then further emergency braking at increasing speeds until maximum speed has been reached. This will wear in the brake pads to the drum.
- 3 - Reliability of the brake system can only be properly achieved according to the braking time required to stop the load.

### BRAKE MAINTENANCE

The maintenance and inspection periods depend on the degree of service. It is recommended that the brake be inspected about every 100 operating hours or three (3) months.

\* Check lining wear regularly. If lining wear (or brake drum wear) occurs, re-adjust brake. Bonded brake linings can be worn down to a minimum thickness of about 0.0787 in. or 2 mm, rivet brake linings to about 0.1969 in. or 5mm before having to be replaced.

\* Brakes with automatic wear compensation have been designed

## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

---

in such a way that the reserve stroke "SR" is automatically set at the thruster. In case of a failure, check whether the automatic adjustment has seized, Catch (2) is not properly seated or the adjustment pinion has become contaminated.

- \* Brakes without automatic wear compensation must be adjusted as soon as the minimum reserve stroke "SR-min" is reached.
- \* All joints must be kept clean. NO GREASING IS REQUIRED.
- \* Keep automatic wear compensation device and main spindle "A" clean and slightly greased.
- \* Use resin free grease only.
- \* Remove oil fill plug, check fluid level. fluid level should be slightly below fill plug opening. If necessary replenish fluid. Always use replacement fluid type " CHEVRON SPINDLE OIL #10".

If the brake is not to be used for a prolonged period of time, all movable parts must be preserved by means of a suitable agent. This is mainly true for the brake drum surface. When placing the brake back in service it is recommended to re-adjust the brake as described in the "BRAKE ADJUSTMENT PROCEDURES" covered in this booklet.

### BRAKE LINING REPLACEMENT

\*\*\*\*\*  
\* Important: Prior to repairing, make sure that the mechanical \*  
\* and electrical drive system components cannot be activated. \*  
\* The bridge should be in the fully seated position and secured \*  
\* from any movement. \*  
\*\*\*\*\*

Bonded brake linings can be worn down to a minimum thickness of about 0.1181 in. or 3mm, rivet brake linings to about 0.1969 in. or 5mm before having to be replaced.

- \* Loosen brake lock nut (18) and brake stop screw (17).
- \* Loosen FAN (10) at adjusting nut (11) (after removing tappet "9") or nut until the brake is completely open.
- \* Remove cotter pins (3). Release the tension brake shoe

## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

- spring (4), extract the bolts (3).
- \* Bring the brake shoes to the position of disassembly (overhead of brake drum).
  - \* Clean friction surface of new linings.
  - \* Mount and fasten new brake shoes in the opposite sequence.
  - \* Adjust the brake as specified and proceed with testing.

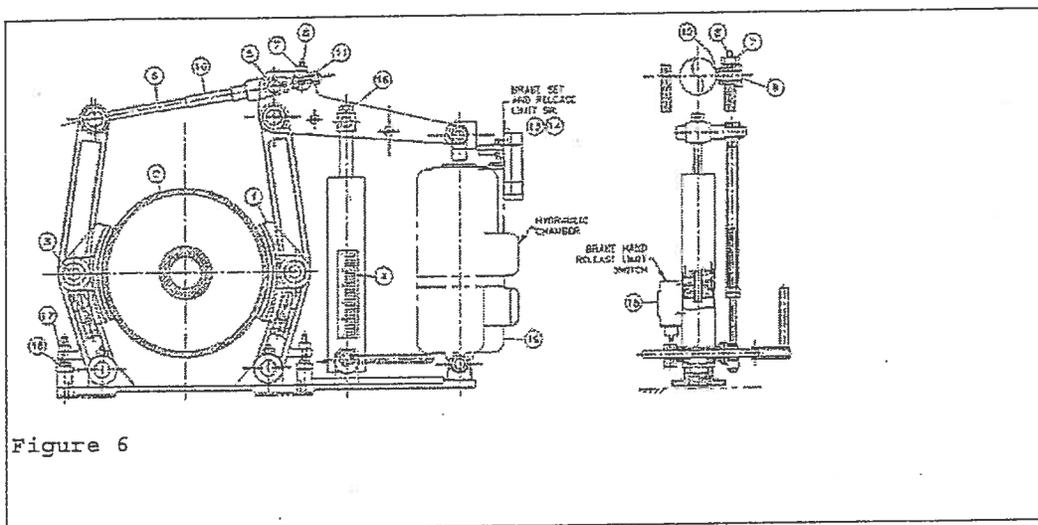


Figure 6

NOTE: USE ORIGINAL REPLACEMENT PARTS ONLY.  
HYDRAULIC THRUSTER UNIT

### BRAKE SPRING LENGTH

BRAKE #	UNCOMPRESSED SPRING LENGTH (INCHES)
72-308-23/30-EBN	8.27 ± 0.11
72-310-23/30-EBN	8.27 ± 0.11
72-310-50-EBN	9.45 ± 0.12
72-312-23/30-EBN	8.27 ± 0.11
72-312-50/80-EBN	13.78 ± 0.18
72-316-50/80-EBN	13.78 ± 0.18
72-316-121-EBN	16.54 ± 0.18

## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

### STANDARD SPECIFICATIONS:

The basic version of the thruster complies with the following national and international standards:

NEMA-U.S.A. ASA-U.S.A.  
CSA-Canada SEN-Sweden  
NF-France NEK-NORWAY  
BS 2613-Great Britain  
IEC Publication 72-Europe  
CEI-Italy NBN-Belgium  
IS-India SEV-Switzerland  
VDE 0530 Part 1-Germany

### OPERATION:

The important components of the thruster are the electric motor, centrifugal pump and the servo-cylinder, all of which are mounted axially. The working fluid which the unit is filled with provides the operating medium.

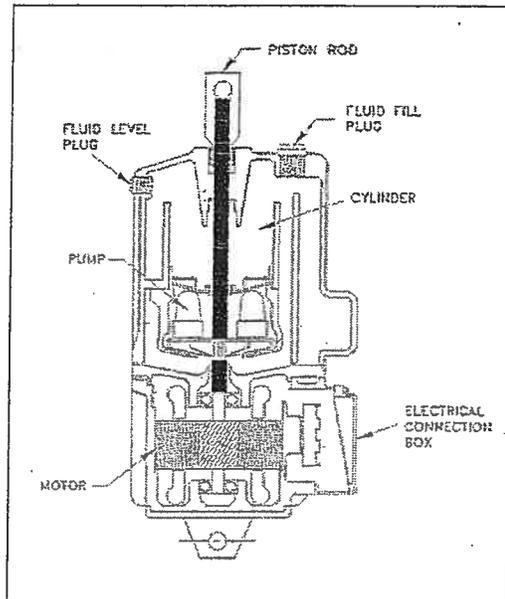
When the motor is switched off, the piston is at its lower limit. The working fluid is carried under the piston by the motor driven pump impeller.

Cross section of THRUSTER shown in SET (de-energized) position.

### HYDRAULIC THRUSTER UNIT

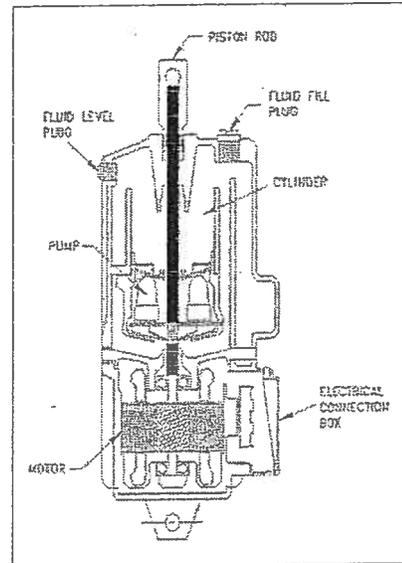
Since this impeller has radial vanes, the direction of rotation of the motor has no effect on the operation of the thruster.

As a result of the pressure produced, the piston travels along its path against the built in brake spring or against an external load. The power resulting from the product "force x distance" is transmitted via the piston rod and pressure pushes to the device to be operated. Thus the piston can either travel the total stroke distance or externally limited parts of the stroke. At the end of piston travel the power taken by the motor, because of the motor and pump characteristics, reduces to approximately half that required during stroke movement. The pressure however, reaches its highest value at this point - which, depending on the unit, lies between 25% and 45% above the rated value. Thus load on the motor is reduced at the limit of travel.



## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

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### HYDRAULIC THRUSTER UNIT

When the motor has been switched off, the piston under the influence of an external force (brake spring or weight) returns to its original position. With the exception of the starting phase, the lifting and lowering speed is linear. The setting time will vary with the size of the external load.

The thruster is not susceptible to mechanical or electrical failure resulting from a restriction of travel to the lifting shaft. This feature is important should the device being operated jam.

Cross section of THRUSTER

**BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES**

TECHNICAL DATA									
TYPE	LIFTING	STROKE	THRUST	BRAKING		POWER	CURRENT	DUTY RATING	WEIGHT
	FORCE			SPRING FORCE	CONSUMPTION	CONSUMPTION	AT S3 - 60%		
	N	mm	N cm	(C-SPRING) N	W	AT 400 V A	DUTY CYCLE c/h	kg	
<b>SHORT STROKE UNIT</b>									
ED 23/6	220	50	1100	180	165	0.5	2000	10	
ED 30/6	300	50	1500	270	200	0.5	2000	14	
ED 50/6	500	60	3000	450	210	0.5	2000	23	
ED 80/6	800	60	4800	750	330	1.2	2000	24	
ED 121/6	1250	60	7500	1200	390	1.2	2000	39	
ED 185/6	1850	60	11100	1900	450	1.3	2000	39	
ED 201/6	2000	60	12000	1900	450	1.3	2000	39	
ED 301/6	3000	60	18000	2700	550	1.4	1500	40	
<b>LONG STROKE UNIT</b>									
ED 50/12	500	120	6000	-	210	0.5	1200	26	
ED 80/12	800	120	9500	-	330	1.2	1200	27	
ED 121/12	1250	120	15000	-	390	1.2	1200	39	
ED 201/12	2000	120	24000	-	450	1.3	1200	39	
ED 301/12	3000	120	35000	-	550	1.4	900	40	
ED 185/16	1850	155	29600	-	450	1.3	400	40	
ED 301/15	3000	150	45000	-	550	1.4	400	50	
ED 350/20	3500	200	70000	-	550	1.4	400	50	
UNITS UP TO 6300 N LIFTING FORCE AND 200 mm STROKE ON REQUEST									
TYPE OF OIL: CHEVRON SPINDLE OIL #10									

All values are approximate, consult factory with specific requirements.

Technical

Data "Thruster"

**HYDRAULIC THRUSTER UNIT**

**MOTOR:** All thrusters are fitted with a two pole AC squirrel cage induction motor. Construction type is a V3 standard to DIN 42950.

**VOLTAGE AND FREQUENCY:** Standard version is wound to operate on voltages with 5% variation at 60hz. The motor windings are arranged for dual voltage and can be reconfigured at time of installation. Thrusters can be supplied to operate on specific voltages and frequency. Please consult the factory for more information.

## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

### MOTOR CONNECTION:

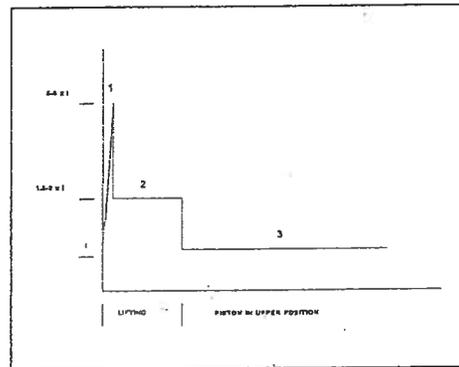
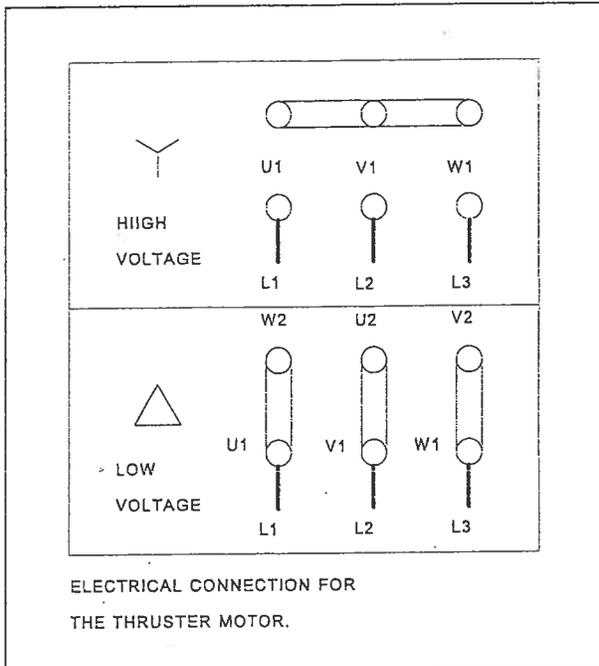
The operation of the thruster is not dependent on the direction of rotation of the motor. The source can be wired in any sequence to the U1, V1 and W1 terminals. The motor winding arrangement at the terminal block can be wired for star or delta depending on the voltage being applied. The unit will normally leave the factory configured for the higher voltage.

Inside the conduit box where the U1, V1, and W1 terminals are located are two loose wires. These wires are connected to a 120 volt source to power the interior heater within the thruster casing.

### SELECTION OF MOTOR PROTECTION:

Due to the electro hydraulic regularities, the thruster can be operated without protective motor switch and thermal overload. If however, protective wiring is required, we ask you to consider the following guidelines. The curve of current consumption is represented by the diagram to the right.

- 1=Turn on (inrush current).
- 2=Current during lifting.
- 3=Current at end of lift.



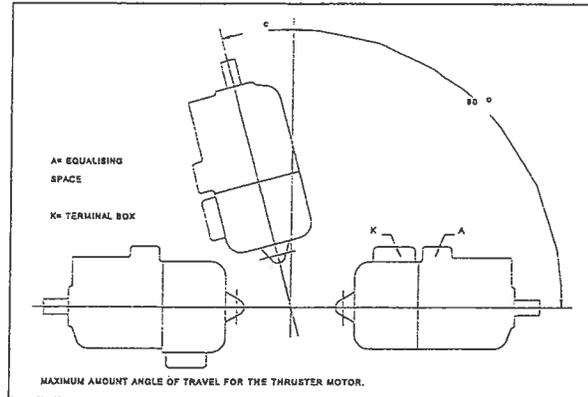
### HYDRAULIC

### THRUSTER UNIT

## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

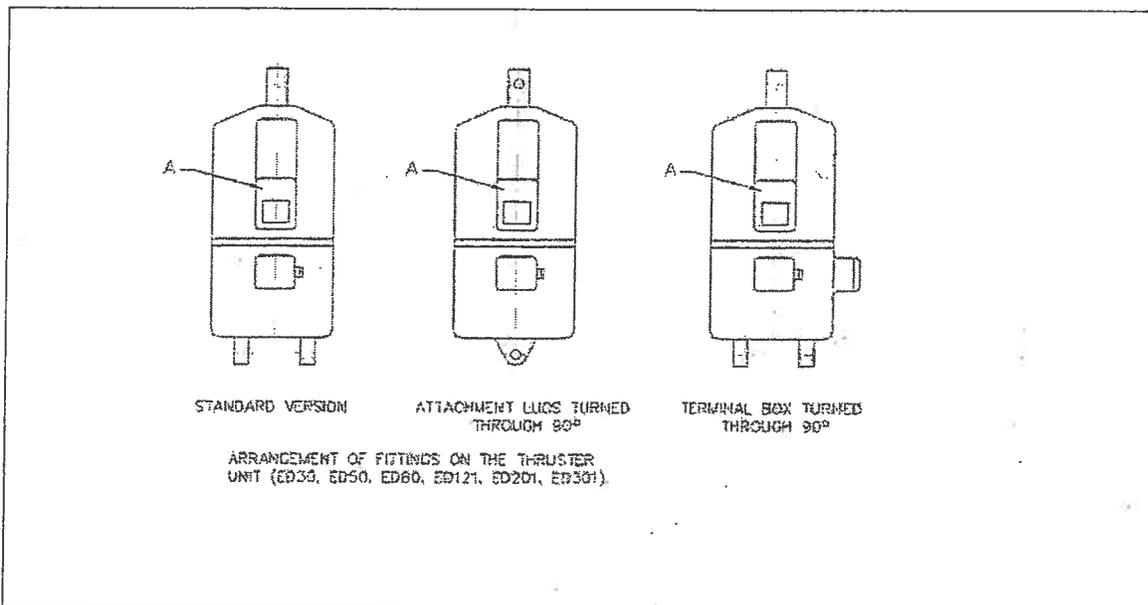
### MOUNTING:

Thrusters can be mounted vertically, at an angle and horizontally as shown in the drawing at the right. Care must be taken to ensure that the equalizing space "A" lies upper most.



### MOUNTING POSITION (TERMINAL CONNECTION BOX):

The terminal connection box on the thruster can also be located at 90 degrees or 180 degrees to the equalizing space "A" which must always lie uppermost when a thruster is mounted horizontally or at a steep angle from the vertical position. The thruster can be supplied with the fixing lugs turned through 90 degrees.



## HYDRAULIC THRUSTER UNIT

### PRECAUTIONS TO BE TAKEN:

**BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES**

Care must be taken to ensure that the angular movement of the thruster is not hindered and that no transverse forces act on the piston rod which could cause friction losses and jamming in the piston rod channel. In addition, care should be taken that the piston rod surface is not damaged or, for example, splashed with paint or the piston rod sealing rings will be destroyed (leakage).

**MAINTENANCE:**

The thruster unit requires no maintenance. For trouble free operation the thruster must always be filled with the type of fluid as specified in the table of "TECHNICAL DATA". Screw plug size for filling or draining hole, M22 x 1.5.

**OIL QUANTITY FOR THRUSTER:**

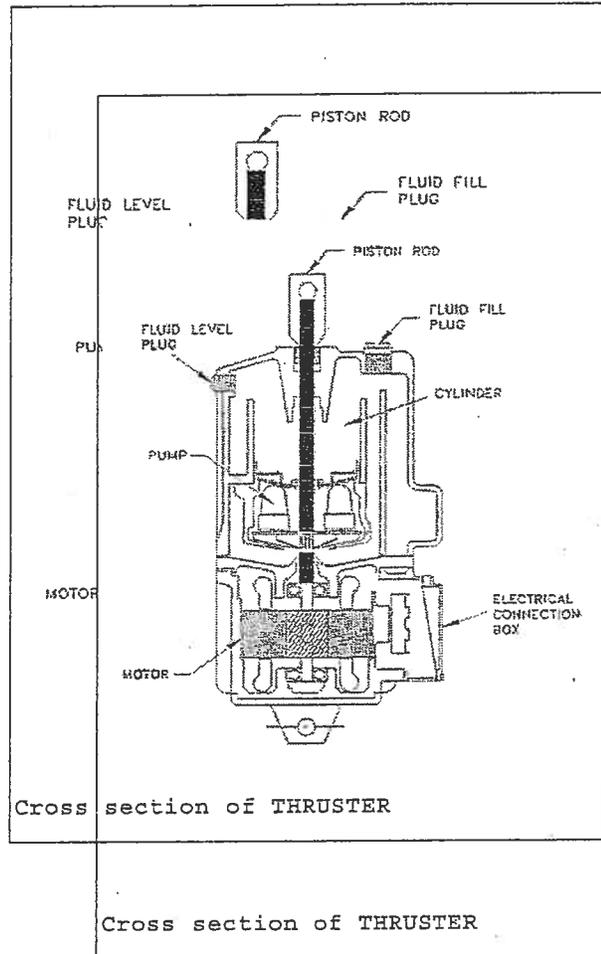
TYPE	OZ.
ED23/5	27.6
ED30/5	32
ED50/6	71
ED80/6	71
ED121/6	158
ED201/6	158
ED301/6	155

The above values are average values, they are lower for thrusters with valves and/or springs.

**HYDRAULIC THRUSTER UNIT**

**OPERATING FLUID / MAINTENANCE:**

The thruster is supplied for a temperature range from -13 degrees Fahrenheit to 122 degrees Fahrenheit and filled



## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

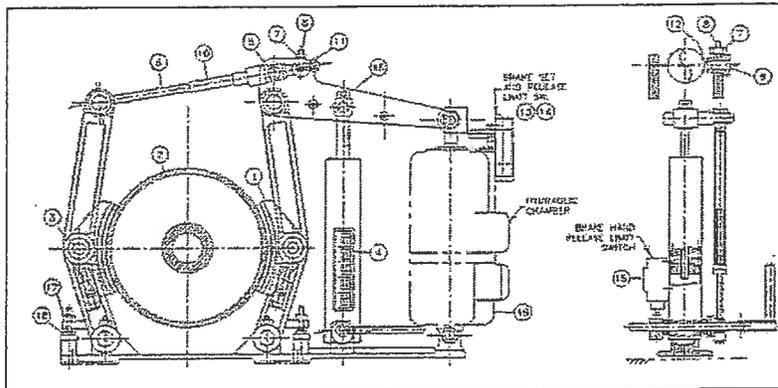
with hydraulic oil "CHEVRON SPINDLE OIL #10". This long life filling is not subject to wear or contamination during operation as long as the thruster maintains its original condition. All bearings in the thruster casing receives an original lubrication of grease. A long life grease Shell Alvania R3 is used.

### **\*IMPORTANT\***

When refilling, the thruster must be filled in the vertical position up to the overflow screw or to the filling limit of the charging connection, depending on the type of thruster. In order to prevent inclusions of air, run the unit through several strokes. Then check the oil level again, add fluid as needed, tighten charging connection and overflow screw.

RENEWAL PARTS, SERIES 72-300-EBN SHOE BRAKES:

**BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES**



BRAKE WHEEL  
DIAMETER

DEVICE	8"	10"	12"	16"	20"
1) SHOES	308-1	310-1	312-1	316-1	320-1
2) BRAKE WHEEL	308-2	310-2	312-2	316-2	320-2
3) SHOES BOLTS	308-3	310-3	312-3	316-3	320-3
4) BRAKE SPRING	308-4	310-4	312-4	316-4	320-4
5) YOKE BUSHINGS	308-5	310-5	312-5	316-5	320-5
6) SPINDLE	308-6	310-6	312-6	316-6	320-6
7) LOCK NUT	308-7	310-7	312-7	316-7	320-7
8) SET SCREW	308-8	310-8	312-8	316-8	320-8
9) TAPPET	308-9	310-9	312-9	316-9	320-9
10) FAN	308-10	310-10	312-10	316-10	320-10
11) ADJUSTING NUT	308-11	310-11	312-11	316-11	320-11
12) CATCH PIN	308-12	310-12	312-12	316-12	320-12
13) SET LIMIT SWITCH	308-13	310-13	312-13	316-13	320-13
14) REL. LIMIT SWITCH	308-14	310-14	312-14	316-14	320-14
15) HAND RE. LIMIT SWITCH	308-15	310-15	312-15	316-15	320-15
16) HEXAGON NUT	308-16	310-16	312-16	316-16	320-16
17) BRAKE STOP SCREW	308-17	310-17	312-17	316-17	320-17
18) BRAKE LOCK NUT	308-18	310-18	312-18	316-18	320-18
19) THRUSTER UNIT	**** ORDER BY NUMBER ON UNIT ****				

(NOTE: ADD "72-" PREFIX WHEN ORDERING REPLACEMENT PARTS.)

Link Control Systems, Inc.  
Specification Sheet for Link Control Systems Shoe Brake

## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

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Each brake shall be a spring set, thruster released, shoe type brake. The brake shall have a continuous duty rating as shown on the plans. In addition, it shall be factory set for the retarding torque as shown. The brake shall be provided with corrosion resisting fittings as well as an indicator for reading the set torque in foot pounds. This indicator shall be mounted behind clear Plexiglas and will give the correct reading throughout the adjustment span.

The brake shall be equipped with a hand release which will not change the torque setting. The hand release shall be operable without removing the brake cover if specified. Each hand release shall also be equipped with a heavy duty lever limit switch for interlocking purposes.

The brake shall be designed so that the lining has automatic wear compensation. This wear compensation will automatically adjust the shoes as they wear to maintain the proper distance from the brake drum. If required a limit switch shall be provided that will indicate less than minimum lining.

In addition, limit switches are supplied to indicate when the brake is in the released position (electrically or mechanically) and in the set position (electrically or mechanically). These limit switches shall have a minimum of one normally open and one normally closed contact.

All brake wheels shall be supplied by the brake manufacturer. They shall have a pilot bore and be shipped to the machinery manufacturer for final boring and seating on the shafts.

Enclosures where required shall be of NEMA 3 type rain tight. This enclosure shall have a vertical split cover for ease of maintenance and inspection. The thruster unit shall be totally enclosed with built in adjustable time delays for setting. The enclosure shall be of a watertight construction with a cast conduit box. The hydraulic fluid shall be capable of year round service with a temperature range of -13 degrees Fahrenheit to 122 degrees Fahrenheit.

The brake shall be capable of rotating 90 degrees from horizontal without any harmful effect to the operation of the thruster unit.

Brakes shall be LINK CONTROL SYSTEMS 72-300-EBN SERIES or APPROVED EQUAL.

## 5.2. RACO Actuator

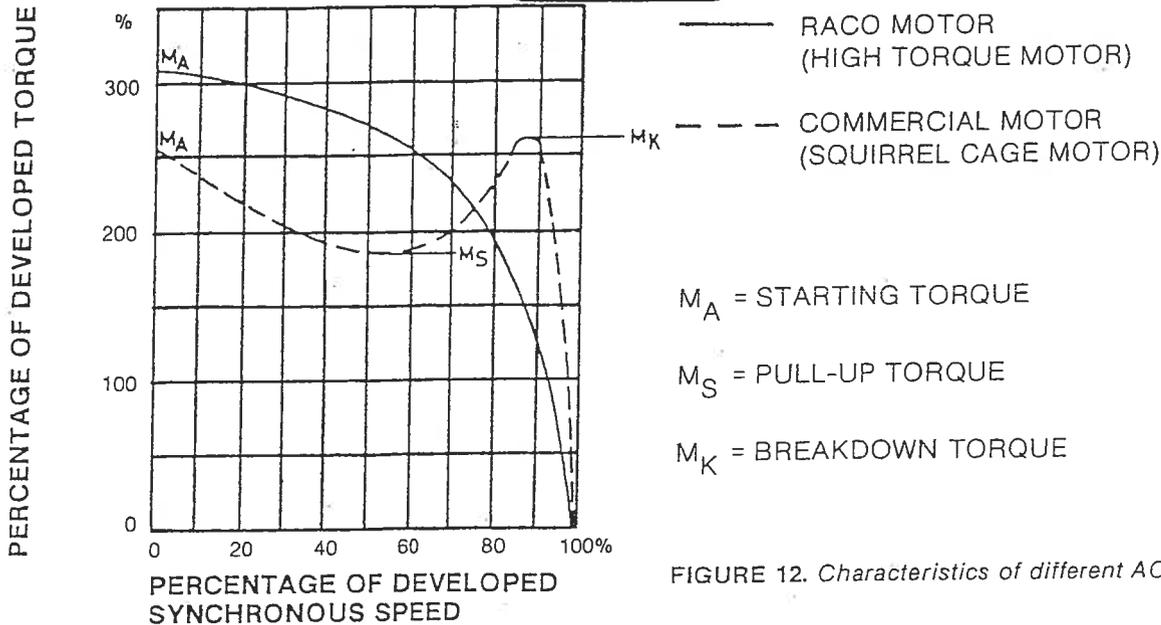


FIGURE 12. Characteristics of different AC motors.

### RACO MOTOR VS. COMMERCIAL MOTOR

Commercial motors, such as the standard NEMA squirrel cage motor, are designed and wound to deliver a constant speed, regardless of the torque demanded by the load. The speed should not drop off noticeably in case of overload, unless the overload gets too high, and then the motor should stall. High frequency of reversals can lead to severe overheating and to structural damage in the windings.

The RACO MOTOR, developed specifically for actuator duty or similar applications, is wound for the opposite criteria. It must start easily and fast and must develop the maximum torque within the shortest possible time. In addition to the very high starting torque the RACO MOTOR also has the feature of a uniformly decreasing torque versus speed (see Fig. 12).

The RACO MOTOR has a low starting current and inertia so that rapid and repeated jogging and plugging service, which might be destructive to a commercial motor, does not affect a RACO MOTOR.

The housing of a RACO MOTOR is made of aluminum, which will, due to the high thermal conductivity, conduct the heat developed by the motor. A RACO MOTOR is always type TENV (totally enclosed - non-ventilated) as it does not need the additional protection of a fan.

Contrary to commercial motors, which have insulation Class "B" (266° F) as standard, all RACO MOTORS come with insulation Class "F" (311° F) as standard and without extra charge. Commercial motors with higher insulation Classes "F" or "H" (356° F) are available upon request, also the RACO MOTOR is available in Class "H".

### BREAKAWAY THRUST AND BREAKDOWN TORQUE

Fig. 12 shows the comparison of characteristics of a RACO MOTOR and a typical NEMA motor. It shows very clearly that the starting torque of a RACO MOTOR is much higher than any commercial motor due to the special design features of the RACO MOTOR. This means it also has a higher breakaway force than any commercial motor.

In case of an overload situation, the commercial motor will slow down in speed until the breakdown torque is reached at approximately 85% to 90% of the rated speed. At speeds lower than 85%, the commercial motor's torque output starts to drop drastically, causing it to become weaker as more load is applied to it. After passing the breakdown torque, the commercial motor will burn out quickly if load is not removed or motor de-energized.

The RACO MOTOR does not have a breakdown torque. It develops an ever increasing amount of torque as more and more load is applied to it, making it perfectly suitable for actuator duty since very seldom do the load demands remain constant. Since the RACO MOTOR is designed to operate (i.e., develop maximum torques) over its full RPM range, overloading will not damage it. It will also burn out eventually — as any AC motor — if the motor is allowed to remain energized during a locked rotor or stalled condition, unless it is equipped with our electronic thrust overload protection which will shut off the actuator automatically.

All RACO MOTORS are available with a warranty of 4 years when equipped with the thermistor protection and the optional electronic thrust overload protection RPM.

600E701

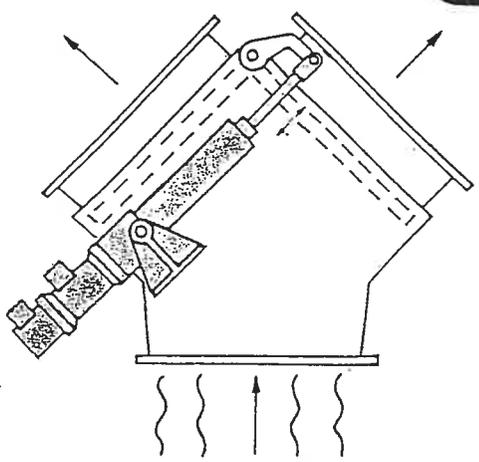


FIGURE 15. Electric actuator to operate diverter valve.

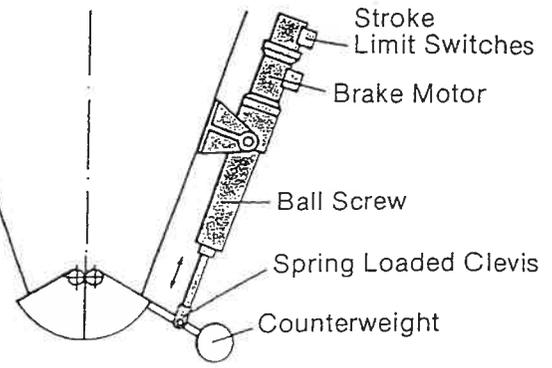


FIGURE 16. Safety application for bin gate. Counterweight closes gate automatically in case of power failure.

### ACME THREAD VS. BALL SCREW

RACO Electric Actuators can be equipped with ball screws instead of the standard Acme thread. These ball screws, totally made in our own factory, consist of a high precision, hardened, threaded rod with ultra-precision ground balls held in a custom-made nut.

RACO Ball Screw Actuators have an efficiency of at least 90% which is approximately three times higher than actuators with an Acme thread. A brake motor has to be used to ensure high accuracy of positioning and to maintain the selected position of the actuator.

Due to the low friction of the ball screw, the lifetime of an actuator can be increased up to 10 times.

	Actuator with Acme Thread	Actuator with Ball Screw
Life Expectancy	100%	1,000%
Starts per minute	100%	300%
Efficiency	100%	225%
Energy consumption	100%	40%
Capacity drive motor	100%	33%
Lubrication requirement	100%	10%
Preventive maintenance	100%	10%

For high-duty cycles, increased accuracy in positioning, increased life, reduced overall costs, reduced energy costs, and considerable savings in maintenance, select RACO Ball Screw Actuators.

### SAFETY ACTUATORS - BRAKES

Actuators equipped with a ball screw can be used as safety actuators, such as opening or closing a gate in case of a power failure. Ball screw actuators normally have to be equipped with a brake.

Our power release brake "L" applies braking force when power is off. Power is required to release the brake. The brake can also be released manually if equipped with a manual release. Application: moving heavy loads vertically.

Brake "B" is a power set brake which is released when power is off. A counterweight system provided by the customer or a spring incorporated into the actuator can be used to retract or extend the actuator to open or close a device if power is lost.

All brakes are DC brakes, however, a rectifier is built into the motor terminal box to convert AC into DC current, if necessary. Brakes are available for different AC input voltages, such as 24, 110, or 220 volts.

Fig. 16 shows a safety application of a ball screw actuator for a bin gate.

RACO

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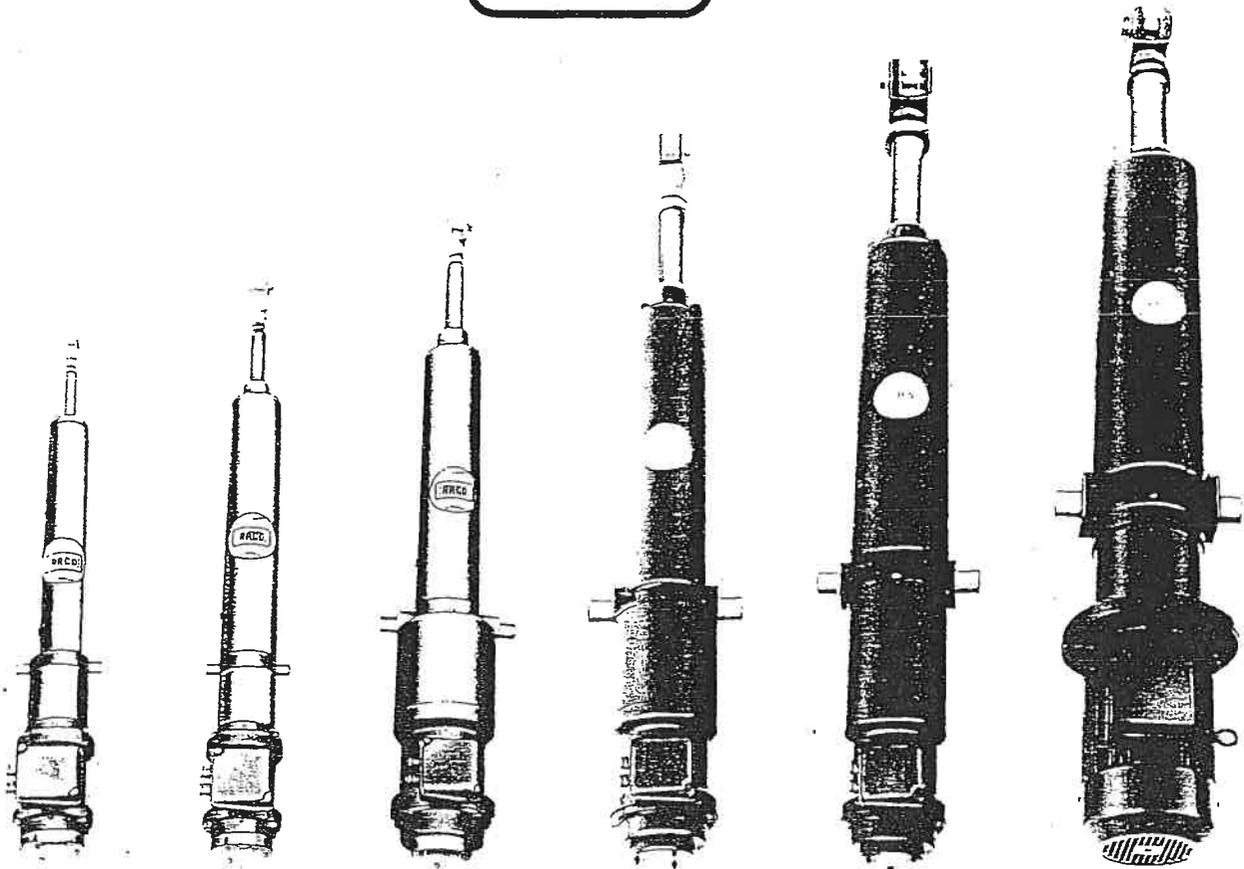


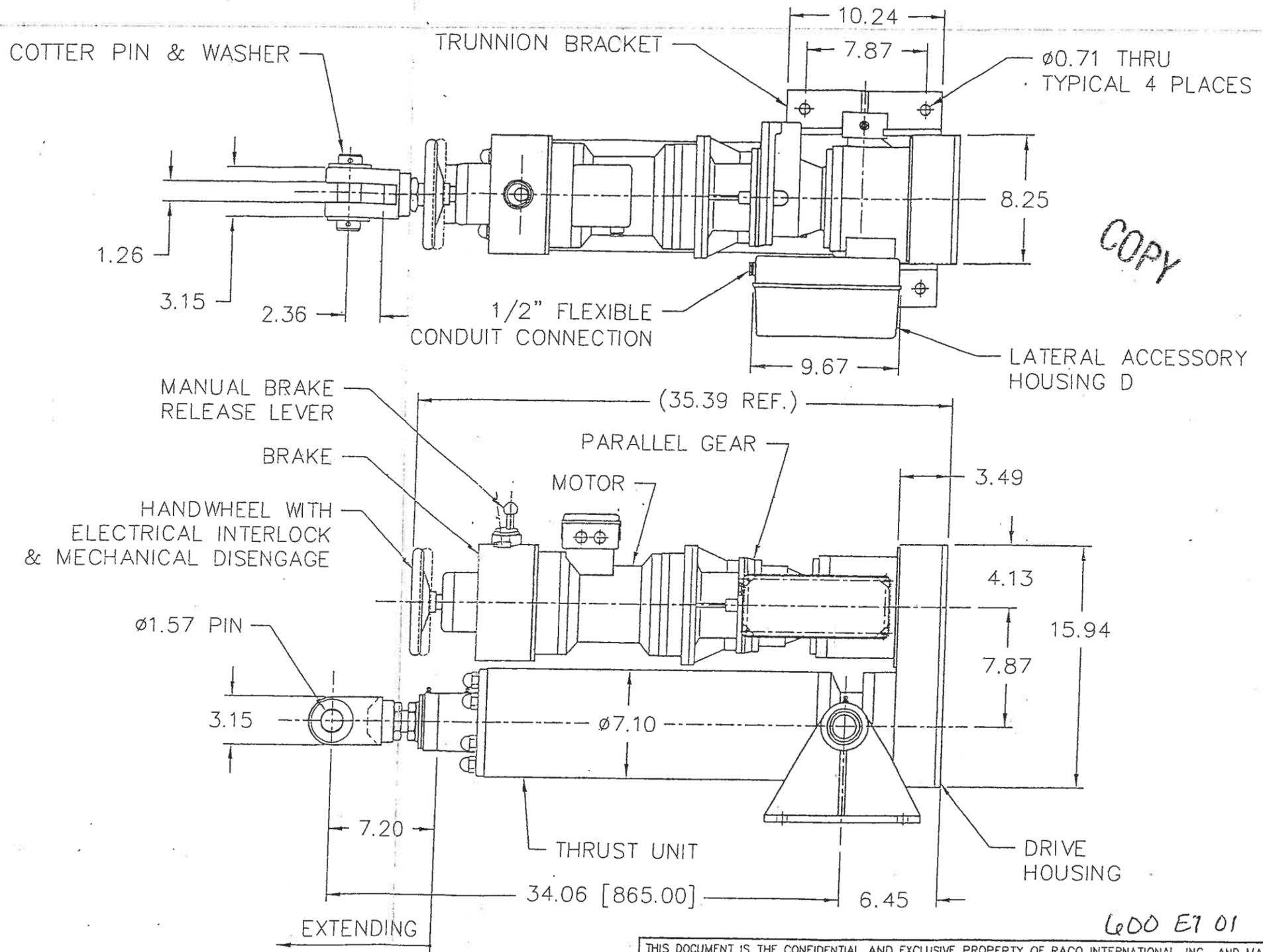
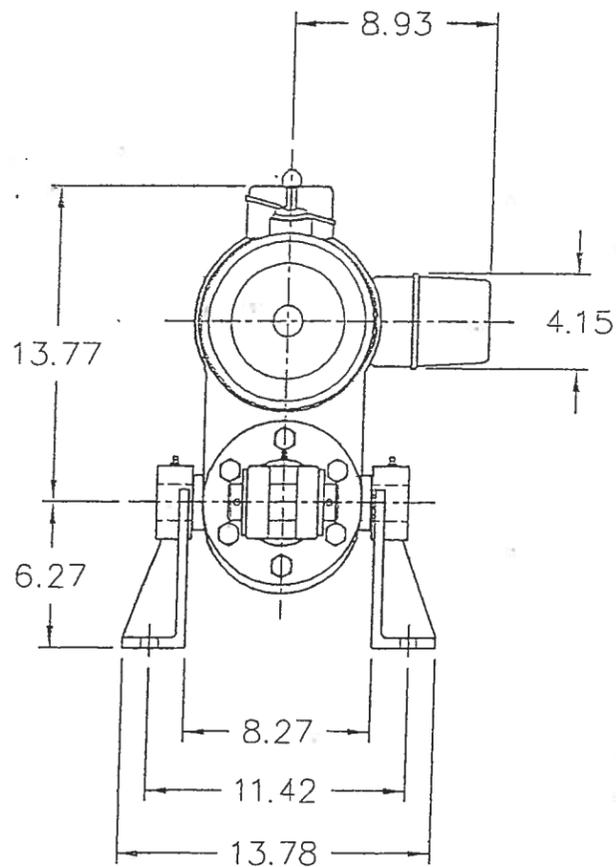
FIGURE 1. RACO electric actuators, sizes 3-8, basic actuators without accessories.

## ADVANTAGES OF RACO ELECTRIC LINEAR ACTUATORS

- Modular system allows custom-built units
- 2 year warranty for thrust unit
- 4 year motor warranty available
- Totally weatherproof
- Explosion-proof actuators available
- Reliable repeatability in positioning with brake or servo motors
- Holds position accurately & indefinitely
- Noiseless
- Precise positioning within 0.0004" possible
- Suitable for high duty cycles
- Safety applications possible
- Can be equipped with servo-motors
- Tested for minimum of 1 million strokes with ballscrews
- Suitable for computer controlled operation
- Electronic thrust overload protection available
- Standard thrusts up to 200,000 lbs.
- Standard strokes up to 78.7"
- Standard rod speeds up to 11.3 in./sec.
- Maximum thrusts up to 200% higher than rated thrust
- Static loads higher than rated thrust
- Non-contaminating - environmentally safe
- Suitable for corrosive environments
- Controls and accessories are field expandable
- Electronic remote control possible
- Radio remote control possible

**TECHNICAL DATA**

TYPE: MA7 BALLSCREW ACTUATOR  
 TYPE CODE: LBR K1N7 ZMZAAIZ  
 THRUST: 8800 LBS. (40000 N)  
 ROD SPEED: 0.7 IN/SEC  
 STROKE: SPECIAL 12.6 (320mm)  
 MOTOR VOLTAGE: 230/460/3 Ph/60  
 MOTOR DATA: 1.7 KW, 3.5 FL AMPS  
 TEMP RANGE: -40°C TO 100°C  
 APPROX. WEIGHT: 315 LBS  
 APPLICATION: STUTSON ST BRIDGE - REAR LOCK



COPY

600 E7 01

**NOTES:**

1. ALL DIMENSIONS ARE IN INCHES UNLESS [NOTED].
2. ACTUATOR IS SHOWN IN RETRACTED POSITION.
3. THRUST TUBE DIAMETER 2.4"

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REVISIONS		
1	ADDED TECHNICAL DATA ON 06-04-02 BY C.McKOWN	

RACO

**RACO INTERNATIONAL, INC.**

P.O. BOX 151 BETHEL PARK, PA 15102

TITLE: GENERAL ARRANGEMENT OF A SIZE 7 ELECTRIC ACTUATOR, C-DESIGN WITH TRUNNION BRACKETS, BRAKE AND HANDWHEEL: SPECIAL STROKE = 12.6 [320]		
SCALE 1/8	DR. BY C.McKOWN	DRAWING NO.
DATE 03-21-02	CK'D. BY WCM02	GANQD001

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## **Section 1 General Information**

This manual contains mechanical and electrical installation, operating and maintenance instructions for sizes 2, and 4 to 11 **MA** series **Modular Actuators** manufactured and distributed by RACO International, L.P. The instruction manual may be updated from time to time without prior notification and may be supplemented by additional vendor information as it deemed to be necessary by the supplier. A requirement of fault free operation and fulfillment of any rights to claim under guarantee is that you read, understand and adhere to the entire information in the installation, operating and maintenance instructions before you start to install and operate the equipment.

The installation, operating and maintenance instructions contain important information about the unit and its functionality and are intended for users having technical expertise and are thoroughly familiar with the machinery or the environment in which the actuator(s) is (are) integrated. Please keep this manual accessible for further use and for your fellow co-workers. They will thank you.

### **Intended Use**

The equipment described in this manual is intended for industrial applications only and should not be used to lift, support, or otherwise transport personnel unless you have written approval from RACO International, L.P. which authorizes the specific actuator unit, as used in your application, as suitable for moving personnel. It is important that you analyze all aspects of your application and review the information concerning the product or system in the current product offer. Due to the variety of operating conditions and applications for the product or system, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

Take a moment to analyze your present environmental conditions and potential hazardous locations in regards to areas containing flammable vapors, liquids, gases or combustible dusts or fibers. Refer to the NFPA 70E or NEC article 500 guidelines for hazardous area and zone classifications. Make sure that the delivered actuator fulfills the requirements of your local jurisdictions. Do not use in highly corrosive or extremely wet or submersible environments without prior written approval from RACO International, L.P.

Do not use in applications involving extended exposure to temperatures below -14deg F or above 120 deg F without prior written approval from RACO International, L.P.

### **Safety Notes**

If the electrical control and power system is not supplied by RACO it is the responsibility of the user to select, install, maintain the appropriate actuator motor circuit protection. This includes, but is not limited to, the selection of the branch breaker or fuses and the overload selection. If variable frequency drives (VFD) or servo drives (SD) are used, the appropriate parameters have to be set in that way that the actuator is adequately protected from overloading in dynamic and static conditions. Make sure that the thermal over temperature protection devices are integrated and connected into the control circuit.

Make sure that all interconnecting wiring circuits are complying with the most recent National Electric Code (NEC) guidelines, local jurisdictions and/or your plant regulations.

Make sure that the nameplate voltage and frequency for the motor, brake and control equipment matches with your supply voltage and frequency. Double check the star/delta jumper setting in the motor terminal housing in accordance with your supply power.

Observe all applicable Occupational Safety and Health Act (OSHA) requirements during installation, operation, maintenance and/or service of the supplied RACO electrical actuators. In particular, observe the lockout and tag out procedures. All electrical power must be securely disconnected before performing any work on the actuator. Please be reminded that stored energy may be present. Secure all hanging, spring loaded or otherwise possible shifting equipment. Failure to do so can cause harm, injuries or death and/or damage to the equipment.

All RACO actuators are shipped with clearance to the end of the design stroke limit to allow for testing upon initial start-up for proper electrical phase connection and confirmation of proper travel direction. These clearances are critical to prevent accidental over-stroke damage in the event of initial wiring errors. Make sure that the designated end of stroke limit switches are wired into the correct reversing starter coil circuit.

RACO electrical Actuators are usually supplied with, and always recommended to be used with, end of stroke limit switches. In this configuration two normally closed switches are set in a way, that each switch is monitoring respectively, each end of the design stroke. When properly connected into the motor control circuit, the limit switch will open up when the design stroke limit is reached and will disconnect control voltage to the respective starter coil, which will disconnect power from the motor. Over stroking of the actuator in either direction can cause binding, jamming or even destruction of the actuator and/or the attached equipment. Make sure that the physical limits of the attached equipment are beyond the setting of the design stroke limits of the actuator.

Be aware the motor supplied with your RACO product MAY be capable of delivering more torque than is required for your particular application, and indeed may be capable of delivering a higher torque than the maximum rating of the RACO product. In the event of unforeseen interference or higher than designed force or loads, the LOCKED ROTOR or stall torque capability of the motor may cause damage to the RACO product or the surrounding equipment. If the motor control selected does not provide maximum thrust or power limiting capability, install separate, RACO recommended current, power or RPM monitor protection devices with trip points selected not to exceed the nominal thrust rating of the actuator.

## **Precautions**

During and after operation carefully check all device surfaces for high temperature when touching any part. Always allow sufficient time for surfaces to cool down before maintenance, service, disassembly, or any other work or inspection is performed. Surfaces may be hot enough to cause pain and injury.

Installation, maintenance, and service should be performed only by qualified, trained personnel, who are familiar with the installation, construction and operation of the device and the surrounding machinery. Use only genuine RACO parts for repairs and maintenance to ensure safe, proper performance and operation. If you have any doubt in the qualification of the intended repair facility, do yourself a favor and send the actuator to RACO'S qualified in-house repair shop to guarantee proper repair.

## **Section 2 Receiving of Shipment**

### **Inspection**

Immediately upon receipt of any RACO product, inspect the entire shipment including the packaging for evidence of damages of any kind. Compare the received goods with the itemized packing list and account for all items. There may be smaller items in the crate or packing container as well. All RACO products are inspected prior to shipment and are released for shipment confirmed in good condition. RACO products are shipped FCA from the RACO factory in Bethel Park, Pennsylvania. It is the responsibility of the receiving party to recognize damage on receipt and process claims for any damage with your freight carrier.

### **Unpacking and Lifting Information**

Small actuators are packaged in cardboard boxes with internal support and/or filling material. Larger actuators are packaged on a wooden skid or in a wooden crate. If strapping band material is used be advised that the band is under tension and may have sharp edges or corners. Wooden crates are constructed with nails, staples and/or screws. Always wear OSHA approved gear, like safety glasses, gloves, hardhats, back support as required if unpacking or handling the equipment.

### **Lifting Points**

Small actuators can be lifted and handled without any lifting devices. Make sure that the actuator is placed in a secure fashion onto a solid surface since the center of gravity may not be obvious. Larger actuators have to be lifted and handled with an overhead crane. Make sure that all bracing which holds the actuator securely in the crate is removed. Use appropriate rated rigging slings. Fasten the slings securely on multiple points on the actuator. Do not use lifting lugs on the motor or gearbox, these lifting points are designed by the gear box or motor supplier to lift the respective part only. Lift slowly and observe any shifting or rotating of the actuator. Never position yourself under any hanging load. After the actuator is removed from the shipping container make sure that the actuator is placed in a secure fashion, V-blocks or bracing may be required, onto a solid surface since the center of gravity may not be obvious.

### **Disposal of Packing Material**

All packing material should be disposed in accordance with the local regulations. Be environmentally responsible since you just unpacked an environmentally friendly actuator which does not contain any hazardous hydraulic fluids and enables low electrical energy consumption.

### **Extended Storage**

If the actuator is not mounted immediately after arrival at the job site, the actuator should be stored in a dry and vibration free area in a horizontal orientation. Make sure the actuator is well supported and the thrust tube is in the retracted position. Non painted surfaces should be treated with a light oil or grease film. If the actuator is stored with the trunnion brackets attached lubricate the trunnion pins via the zerk fitting. The storage temperature should not exceed a range of 14 degrees to 104 degrees Fahrenheit (10 to 40 degrees Celsius). If storage exceeds 2 years it is recommended to completely replace all lubrications

## Section 3 Installation

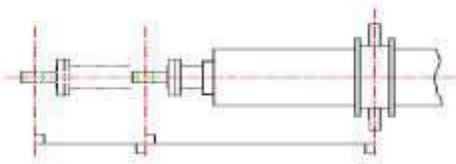
### Mechanical Installation

Before starting the mechanical installation make yourself familiar with the conditions in regards to location, the physical space where the actuator will be installed, environmental conditions, type of foundation as far as concrete pad, steel structure and or steel beams. Check mounting bolt pattern, bolt sizes and SAE grade strength of bolts with the installation drawings. Most actuators are supplied with front end clevises or spherical rod ends. Check the engagement of the forks and or the pin size with the mating piece. All RACO Actuators are delivered with the thrust tube extended around one inch to allow for checking of movement in the anticipated direction. Have a plan for lifting and rigging of the actuator into its final mounting position. Confirm weight of the actuator, lifting points and center of gravity. Never install eye bolts on motors and or gearboxes. These lifting positions were installed by the motor or gearbox manufacturer to lift the individual item only.

### Alignment

Proper alignment of the actuator is essential to guarantee a long and trouble free operation of the actuator. Even though the actuator can tolerate a side loading of up to 10% of its nominal thrust rating, premature wear of the front bushing, thrust tube, nut and screw assembly and an increase in power consumption are the result. In cases where side loads or bending forces are extremely high, jamming or stalling of the actuator may occur or bending of the thrust tube, screw and or attached equipment. Make sure that the actuator is mounted firmly to the foundation. Use shims or other means to ensure level and parallel mounting of the trunnion pin brackets. The center line of the actuator should be on the center line of the attached equipment which should be moved, rotated, pushed and pulled or otherwise agitated. Make sure that over the full stroke of the actuator the attached equipment performs a movement which follows the centerline of the actuator in horizontal and vertical direction. An easy way to check the linear alignment in the field is by connecting the load to the actuator in the retracted position. Observe the mounting position between the two connected pieces. Disconnect the load from the actuator.

### Trunnion Pin Mount



With the trunnion pin mount one dimension of freedom of movement can be achieved. The freedom of movement is exactly  $90^\circ$  to the centerline of the trunnion pins. Make sure that over the full stroke of the actuator the clevis or spherical rod eye, as well as all other parts of the actuator, can pivot freely around the circular movement on the trunnion pins. All RACO supplied trunnion pins are manufactured out of stainless steel. Dependent on the customers, design of the trunnion pin receptacle may be lined with a bushing, which may or may not require lubrication. Ensure that a good fit and sufficient surface area is provided to transfer the thrust forces into the equipment foundation.

### Bracket Mount

RACO trunnion brackets are designed for the individual sizes of Actuators out of the RACO Modular Actuator program and provide easy installation with one dimension of freedom of movement. Make sure that the mounting hole pattern of the trunnion bracket is transferred to the foundation and a flat and smooth surface is provide to ensure a plum an secure connection between both surfaces. Check for angular and or height misalignments between the trunnion brackets and the centerline of the actuator. Shims may be used to correct that problem. The standard RACO trunnion brackets are manufactured out of cast iron with machined surfaces

for the trunnion pin hole and the foundation surface to guarantee true angular alignment and adequate clearances with defined tolerances. The trunnion pin hole is equipped with a center grease relief groove and a connecting zerk fitting. After the trunnion brackets are installed on the trunnion pins of the actuator during the initial installation the grease relief grooves and the trunnion pin hole has to be filled with grease. See 3.11 for grease type. Apply grease until it becomes visible between the trunnion pin and the trunnion bracket hole. Periodic re-greasing is required. The time interval depends on the angular movement, the duty cycle and ambient conditions.

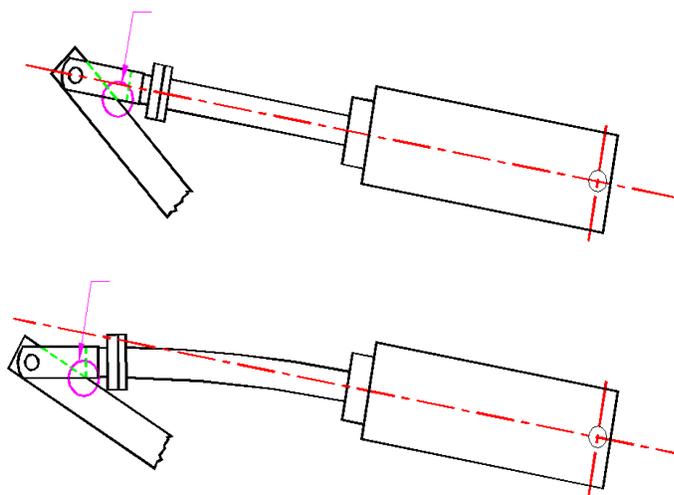
Recommended Interval & Amount:

Bracket Size	Amount in ounces	Interval
4 / 5	0.125	Six months
6 / 7	0.15	Six months
8	0.2	Six months
9 / 10 / 11	0.3	Six months

Trunnion brackets for actuators sizes 9 to 11 are steel fabrications with machined surfaces for the trunnion pin hole and the foundation surface.

If self-lubricating DU bushings are used the zerk fitting is removed and replaced with a plug. No greasing is required.

## Clearance



## Electrical Installation

Before starting the electrical installation make yourself familiar with the installation conditions in regards to location, temperature conditions, distance between the actuator and the Motor Control Center (MCC) installation method cable; tray, ridged conduit, underground, race way etc. Study the electrical drawings and compare the nameplate information of the actuator, in particular, voltage and power requirement with the installation drawings. Wiring and installation should be performed in accordance with the most recent National Electric Code (NEC) regulations as well as any applicable local ordinances and/or plant specifications. In particular observe Article 310-15b and Article 215-2b in regards to wire size, voltage drop and distance. In most installation cases the actuator is rotating at least in one dimension at the trunnion brackets. RACO recommends the use of flexible cable to wire to the motor terminal housing and the accessories. Power and control cable should be separated from each other.

## Section 4 Motor Power

### Reversing Motor Starter

The UL 489 branch circuit breaker or fuse, reversing motor contactors and motor overload relay should be sized in accordance with the NEC guidelines. It is recommended to use either mechanically interlocking reversing motor contactors or install electrical interlocking contacts in the control circuit. The normally closed actuator switches should be directly hard wired into the control circuit to interrupt independently from other control equipment as well as the control power to the starter coils. Please be advised that in most cases the branch circuit breaker and/or motor overload relay are designed and sized to protect and limit short circuit faults and/or, long term overloading of the motor. These devices may not protect the motor or actuator from damage due to mid stroke obstructions. Always install the thermal temperature switch or thermistor device into the control circuit for additional protection.

### Motor Brake

Electrical motor brakes are available in a variety of different functions, forms, and electrical connection schemes. The most common function is the type L holding brake. If no power is applied to the brake coil a spring loaded package will apply holding forces to the brake disk and securely hold the actuator in place up to the nominal thrust rating of the actuator. The opposite function is the type B or power applied holding brake. If power is applied to the brake, the magnetic field of the brake coil will overcome the spring forces and securely clamp the brake disk and hold the actuator in place. Most motor brakes are designed with a DC coil. The DC power is generated via a half wave or full wave rectifier. The following table shows the relationship between supply voltage, rectifier connection and rectifier type in a three phase five wire circuit:

Supply Voltage	Rectifier Connection	Rectifier Type	Resulting DC Coil Voltage
460V AC	Phase/Phase	Full Wave	414V DC
460V AC	Phase/Phase	Half Wave	207V DC
460V AC	Phase/ MP	Full Wave	240V DC
460V AC	Phase/ MP	Half Wave	120V DC
230V AC	Phase/Phase	Full Wave	207V DC
230V AC	Phase/Phase	Half Wave	103V DC
230V AC	Phase/ MP	Full Wave	133V DC
230V AC	Phase/ MP	Half Wave	60V DC

MP = middle point or star point

Some brakes are equipped with a manual brake release lever. Before operating the manual brake release lever ensure that no stored energy is present or the load is sufficiently blocked, especially if the actuator is equipped with a ball screw. Due to the high efficiency of the power screw the load will back drive the actuator. If unit is equipped with a hand operator it is possible to use it after releasing the brake. To speed up the reaction time of the brake circuit, different wiring schemes may be utilized as follows:

- Separate contacts out of the starter to control the brake
- Contacts on the DC side of the rectifier
- Diode snubber circuit
- Two coil brake
- SEW Eurodrive type quick brake wiring

Please consult RACO International L.P. before implementing above designs since life expectancy of the brake and the dynamic behavior of the actuator may be affected. Since brake pads are a wear item, please refer to the maintenance section of this manual.

## **VFD**

The UL 489 branch circuit breaker or fuse should be sized in accordance with the NEC guidelines and the Variable Frequency Drive (VFD) manufacturer's installation manual. Additional contactors may be required if the actuator is equipped with a motor brake. If the VFD is purchased from RACO International, L.P. in conjunction with the actuator, unless otherwise specified, all drive parameters are preset to operate the drive. Fine tuning of overload, thrust limits, acceleration and deceleration times and optional dynamic DC braking may be required.

Please refer to the VFD manufacturer's installation manual for the maximum cable length between the drive and the actuator motor and the type and size of wire before performing the installation.

During start-up, if possible, start out with a low frequency setting to observe the movement of the actuator in slow linear speed motion and to verify intended direction, setting of end of stroke limits and or other possible interferences.

## **Thrust Overload Protection**

As mentioned above the overload relay in a conventional motor control center is not designed to fully protect the motor from overheating and burn out, especially at mid stroke obstructions and/or sudden overloading of the actuator. For complete protection, special thrust overload devices can be added to protect the motor as well as the actuator and the attached equipment from damage, up to destruction. Different methods are available at RACO's disposal to achieve that goal:

- Motor current monitoring
- Motor power [ $P = U \cdot I \cdot \cos(\phi)$ ] monitoring
- Motor RPM monitoring
- Load cell feedback monitoring

RACO recommends installing a thrust overload device in a form of an external current or power monitoring relay in the motor control starter bucket. Motor RPM monitoring is achieved with RACO's electronic position system EPS 06 in combination with limit switches and analog feedback signal mounted on the actuator in A, B, C or D housing or as part of RACO's VFD package.

## Section 5 Limit Switches & Auxiliary Equipment

### Electronic Limit Switch

The **EPS02** and **EPS06** are the newest additions in the line of RACO Limit Switches. The rotation of the motor or screw shaft will be transmitted in a non-contact form via a magnetic field to the circuit board. Here it will be converted into 512 pulses per revolution. The pulses will be counted, processed and stored in non-volatile memory. Even under loss of power the absolute position will be retained.



The **EPS02** is the basic version with two independent tiers of end of stroke limit settings connected to relay output contacts (250VAC, 5A). Single or multiple stop points can be defined on each tier. A serial RS232 communication interface allows easy configuration and setup of the limit switches.

The **EPS06** is the advanced version, utilizing the components of the **EPS02**, by connecting the expansion board via a ribbon cable. The expansion board enhances the **EPS06** functions to include a scalable analogue output signal 4-20mA and or 0-10VDC, a pulse width modulation output signal and up to three additional pairs of limit switches. Rotational speed supervision is also possible. The expansion board provides a USB interface port.

The EPS 02 and 06 are a direct replacement for the classical RACO mechanical limit switches and can be mounted in the same accessory housings.

For installation of the RACO Setup PC Tool software, interface connection and parameter setting please refer to the EPS software manual.

[http://www.racointernational.com/PDF\\_DS/RACOTool\\_V1.8.7.zip](http://www.racointernational.com/PDF_DS/RACOTool_V1.8.7.zip)

#### Technical Data:

Board level supply voltage: 24V DC,

Required supply current:

EPS 02 100mA

EPS 06 600mA

Ambient temperature range: -40F to 185F

Accuracy: +/- 1% of full range

Hysteresis: < 0.004" (0.1mm) stroke

Protection class: IP 54, optional IP 65

#### EPS 02

Relay Output, two channels: 250V AC / 5A; 30V DC / 5A

Input signals; two channels: 24V DC

#### EPS 06

Relay Output, two channels: 250V AC / 5A; 30V DC / 5A

Open collector, four channels: 24V DC / 100mA each

Input signals; four channels: 24V DC

Analog output: 0(4)-20mA, 0-10V DC

Digital output: Pulse width modulation, 24V DC

## Section 6 Maintenance

### Lubrication



Trunnion brackets should be lubricated immediately upon installation.



Before performing any maintenance on any RACO actuator follow the lockout and tag out procedure and/or any site specific safety procedures. Secure all attached loads. Please be reminded that stored energy may be present. All RACO actuators are initially factory lubricated. Based on the type of actuator, environmental condition and duty cycle develop a maintenance schedule based on the below parameters and stick to it. Purchase the recommended grease type and a grease gun to be ready whenever your first maintenance routine starts.



### Grease Type

If not otherwise specified, the actuators are lubricated with Conoco Phillips Dynalife L-EP 1. It is a lithium 12-hydroxystearate soap thickened grease compounded with lead free, extreme pressure agents which provide excellent load carrying and anti-wear properties in both steel on steel and steel on bronze applications. In addition, the grease effectively inhibits oxidation and rust.

### Conoco Phillips Dynalife L-EP 1

Typical Properties:	
Soap Type	Lithium 12-Hydroxystearate
Penetration @ 77.F W 60	325
Usable Temperature Range	-18°C to124°C, 0°F to255°F
Color	Amber
Texture	Smooth
4-Ball E.P. Test	275 kgf
Timken Test	40 lbs
Steel Corrosion	Pass
Dropping Point	177°C , 350°F
Viscosity @ 40 deg C	175cST
Viscosity @ 100 deg C	13.0cST
Flash Point	220 °C, 428°F°

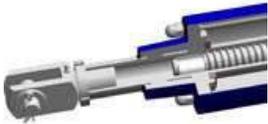
For demanding outdoor applications and applications close to marine environments Exxon Mobilith SHC460 grease will be used.

It combines the unique feature of a polyalphaolefin (PAO) synthetic base fluid with those of a high quality lithium complex thickener. The lithium complex thickener contributes excellent adhesion, structural stability and resistance to water in addition to extended high and low temperature performance.

## Exxon Mobilith SHC460

Typical Properties:	
Soap Type	Lithium complex
Penetration @ 77.F W 60	305
Usable Temperature Range	-50°C to 230°C, -58°F to 446°F
Color	Red
Texture	Smooth
4-Ball E.P. Test	250 kgf
Timken Test	50 lbs
Steel Corrosion	Pass
Dropping Point	255°C , 491°F
Viscosity @ 40 deg C	460cST
Water Washout ASTM D 1264	3
Loss at 79°C, % wt	
Flash Point	204 °C, 400°F°

### Lubrication Points



Dependent upon the type, size, configuration and accessories of your particular actuator, there may be multiple lubrication points on the actuator. In general all lubrication points are equipped with a zerk fitting for easy connection to a grease gun. If no zerk fitting is installed no lubrication is required. If a rod cover is installed, lubrication points may be obscured by the rod cover and or the fastener band. The most common lubrication points are located at the clevis on size 4 and 5 MA actuators, and at the stop plate on our size 6 actuator and all trunnion brackets if equipped. The thrust bearing, motor bearings and gearbox are considered permanently lubricated. Most maintenance free applications are equipped with DU bushings at the front cap as well as stainless steel to PTFE fabric on sliding surfaces as installed on the radial spherical bearing at the rod end.

### ACME Screw

The ACME screw and nut system must be re-lubricated approximately every 10,000 strokes or after one year, whatever comes first. Please refer to below chart for the re-lubrication quantity. After the prescribed amount of grease is injected into the clevis or stop plate zirk fitting, the actuator should be retracted into the complete end position and then cycled for a full stroke. This procedure ensures that the new grease is distributed over the entire length of the ACME screw. It may be required to disconnect the actuator from the load or readjust the limit switches to achieve the full stroke cycle. Secure load as required.

### Ball Screw

The ball screw and nut system must be re-lubricated approximately every 100,000 strokes or after one year, whatever comes first. Please refer to below chart for the re-lubrication quantity. After the prescribed amount of grease is injected into the clevis or stop plate zerk fitting the actuator should be retracted into the complete end position and than cycled for a full stroke. This procedure ensures that the new grease is distributed over the entire length of the Ball screw. It may be required to disconnect the actuator from the load or readjust the limit switches to achieve the full stroke cycle. Secure load as required.

## Brackets

Trunnion brackets should be lubricated immediately upon installation.



If the actuator is supplied with RACO trunnion brackets, the same Conoco Phillips Dynalife L-EP1 or Exxon Mobilith SHC460 should be used. Attach the grease gun to the zerk fitting and apply grease into the fitting until the old grease is forced out of the trunnion pin hole and the grease relief groove. Wipe off the old and excess grease from the trunnion pin and bracket. Periodic re-greasing is required at least once per year. The time interval depends on the angular movement, duty cycle and ambient condition. Dispose of old grease and used rags in accordance to your local environmental guidelines.

## Front Cap

If the front cap is supplied with a zerk grease fitting the type of grease specified on the lubrication sticker found on your actuator shield tube should be used. Attach the grease gun to the zerk fitting and apply grease into the fitting until back pressure builds up. During operation of the actuator a light grease film should be present on the thrust tube to protect the surface from adverse environmental impact and protect the seal in the front cap from dry rot. Dispose of old grease and used rags in accordance to your local environmental guidelines. If the front cap is not equipped with a zerk fitting apply a light coat of grease to the exposed part of the thrust tube.

## Clevis, Spherical Rod End, Junction Pieces

RACO supplies a range of front end adapters to accommodate the connection between the RACO actuator and the customer's equipment. These connection points may allow the actuator to pivot or rotate during the stroke. Periodic re-greasing is required at least once per year. The time interval depends on the angular movement, duty cycle and ambient conditions. Visually inspect connections, for example, clevis, through holes for wear and surface damage. Replace these items as required.

## Lubrication Quantity Chart

The below re-lubrication chart applies to the ACME screw and ball screw actuators. The lubrication quantity is dependent upon the nominal stroke length of the actuator. Make sure that after each re-lubrication interval the actuator is cycled over the entire stroke length to allow the new lubricant to be distributed over the entire nut / spindle system.

### Re-lubrication Quantity in Ounces

Actuator Size	Stroke in inch													
	3.9	7.9	11.8	15.7	19.7	23.6	31.5	39.4	47.2	55.1	63.0	70.9	78.7	
2	0.35	0.35	0.35											
4	0.53	0.53	0.53	0.71	0.71	0.88	0.88	1.06						
5	0.71	0.71	0.71	1.06	1.06	1.41	1.41	1.76						
6	0.71	0.71	0.71	1.06	1.06	1.41	1.41	1.76	2.12	2.12	2.47	2.47	2.47	
7	1.06	1.06	1.06	1.41	1.41	1.76	1.76	2.12	2.82	2.82	3.53	3.53	3.53	
8	1.41	1.41	1.41	1.76	1.76	2.12	2.12	2.47	3.17	3.17	3.88	3.88	3.88	
9	7.05	7.05	7.05	7.05	8.82	8.82	8.82	8.82	10.58	10.58	10.58	10.58	10.58	
10	8.82	8.82	8.82	8.82	10.58	10.58	10.58	10.58	12.35	12.35	12.35	12.35	12.35	
11	8.82	8.82	8.82	8.82	10.58	10.58	10.58	10.58	12.35	12.35	12.35	12.35	12.35	

## **Motor / Gearbox Lubrication**

RACO Motors and most commercial motors are considered permanently lubricated. RACO supplied gearboxes are filled with mineral or synthetic oil and do not require any maintenance under normal operating conditions. Nord and SEW gearboxes are filled in most cases with synthetic oil such as Mobil SHC 630. Bockwoldt gearboxes are typically filled with a CLP mineral oil, viscosity class VG 320. All gearboxes that are not vented are max filled to allow for universal mounting conditions on the actuator.

From time to time, a visual inspection of the gearbox should be performed. If signs of oil leaks at the gearbox are observed, appropriate action should be taken or consult factory for specific information.

## **Exchange of Grease**



It is recommended that a complete exchange of grease on the ball screw or ACME screw should be performed after 4 to 6 years. If the duty cycle is very low, the grease should be exchanged completely no later than 8 to 10 years.

We recommend during the lubrication change to replace all seal and gasket materials.

## **SECTION 7 BIND RELIEF (UN-JAMMING) INSTRUCTIONS FOR RACO MA TYPE ACTUATORS 4, 5, 6, 7 & 8**

RACO Electric Linear Actuators are normally equipped with one pair of adjustable limit switches. When properly adjusted they will shut the motor off when the motor reaches the fully extended or retracted positions. If the actuator is operated without the connection of limit switches to the circuit, or if the limit switches are readjusted incorrectly, it can happen that the unit will jam, since the motor does not shut off in time. To unjam the actuator mechanically, please follow these instructions:

### **Jammed in Retracted Position**

You will want to gain access to the motor coupling;

For MA type 4 actuators, the coupling (4.10) can be accessed by removing the motor and gear box, if equipped. Remove bolts (4.3) and the flange and the coupling housing will now separate from the unit.

For MA type 6 actuators it is not necessary to access the coupling by removing the motor. Instead remove the clevis, remove the first jam nut (1.7), and loosen the second jam nut until it is relieved.

For MA type 5, 7 & 8 actuators, the coupling (4.10) can be accessed by removing the 6 seal nuts (4.4) on the bearing block and removing the motor assembly and gear box, if equipped.

Using care not to damage any parts, exert force on the coupling in a counter-clockwise position (as viewed from the motor end) using an appropriate lever until jam loosens.

Note: In the event that excessive force is required to unjam the actuator, it is advisable to return the unit to RACO for complete disassembly.

### **Jammed in Extended Position**

Carefully loosen the cap nuts (2.17) on the front cap (2.1) approximately three turns.

**WARNING** - Loosen one turn at a time. Do not remove completely as spring pressure on large units can be dangerously high.

Jog the reverse button on the motor control. If necessary, loosen the cap nuts (2.17) more until jogging causes the thrust tube to retract. If necessary, you may also choose to remove the motor and gear box, if equipped to access the coupling. In this instance you would then exert force in a clockwise position (as viewed from the motor end).

### **“C” Design Actuators**

Unjamming MA actuators of the “C” design is the same if a jam occurs in the extended position.

For a jam in the retracted position you must access the lower belt wheel (12.7) by removing the rear belt cover (12.2). Exert a counterclockwise force on the lower belt wheel until the jam loosens.

For actuators that have a “D” or “E” accessory housing, removal of the housing BEFORE removal of the motor is necessary. Take off the cover to remove the switches and the belt, and then you may proceed with disassembly. When reassembling the accessory housing be sure to follow the instructions on the timing belt and tracking details planes of alignment data sheet

## Section 8 Disassembly Instructions

### Prior to disassembly



You must observe all cautions and warnings posted on all device labels and as listed in this manual. Failure to do so may result in serious personal injury or death.



***Warning!*** Do not attempt to install, perform maintenance, or service any RACO product until you have read thoroughly and understand completely all instructions, safety rules, cautions, warnings, and dangers contained in this manual. Failure to comply can result in accidents involving fire, electric shock, and serious personal injury or death. Save this manual and review frequently for continuing safe operation, and for instructing others who may use RACO products.

Read and closely follow all Warnings, Cautions, and Instructions in this manual. Failure to do so may result in voiding the RACO Warranty.

***CAUTION!*** You MUST check with RACO prior to any disassembly or maintenance procedures not specifically recommended in this Manual in order to preserve the RACO Warranty. If unauthorized or non-recommended practices or procedures are performed, RACO reserves the right to deny warranty claims for any defect at the sole discretion of RACO.



***CAUTION!*** Disassembly is not recommended under any circumstance. However, under extreme conditions, if there is no other opportunity to return the unit to RACO, the following instructions may be used as alternative guidelines.

Fully and independently support the cylinder and the attached load. If possible, disconnect the front attachment mechanism from the load.

### Disassembly of Thrust Unit Only

- Remove clevis and / or stop plate assembly.
- Remove front cap.
- Remove shield tube.
- Remove guide rods.
- Remove thrust tube. (remove set screw or heat Loctite to break loose)
- Remove front screw guide.
- Remove nut housing and bronze nut assembly.
- Disassemble nut housing after removing stop screw. (heat may be required)
- Remove end plates from nut housing. Note orientation of pressure plates and springs for re-assembly.

*For ball screw actuators **do not** remove the ball nut. Re-assembly of the nut is difficult and the loss of bearings is likely.*

## Disassembly of Motor

- Remove 6 seal nuts on the trunnion bearing housing.
- This will allow separation of the bearing housing and the coupling housing. If an accessory housing is attached please see the instructions for accessory housings.
- Any accessories installed on the rear of the motor must be removed first.
- Remove the front bearing housing from the stator housing. The rotor will also come out.
- Remove snap rings and bearings as required.

## Disassembly of the Screw and Bearing Block Assembly

- Remove couplings.
- Remove bearing cover nut or preload locknut. (setscrews)
- Press the screw to the front of the bearing block.
- Remove bearing seals, bearings and spacer as required. Note orientation for re-assembly.

## Disassembly of Actuators

- Turn off and lock out the main power and control circuit power to the actuator.
- Support the load if necessary and remove the electrical connections from the actuator.
- Remove actuator to a clean work environment.
- If the actuator is jammed in the extreme extended or retracted position, refer to the un-jamming instructions first.

(Loctite Gasket eliminator 515 is used on all metal to metal exposed surfaces, and Loctite 271 is used on all thread locking. 271 requires heat to break it loose.)

## DISASSEMBLY INSTRUCTIONS FOR ACCESSORIES



You must observe all cautions and warnings posted on all device labels and as listed in this manual. Failure to do so may result in serious personal injury or death.



***Warning!*** Do not attempt to install, perform maintenance, or service any RACO product until you have read thoroughly and understand completely all instructions, safety rules, cautions, warnings, and dangers contained in this manual. Failure to comply can result in accidents involving fire, electric shock, and serious personal injury or death. Save this manual and review frequently for continuing safe operation, and for instructing others who may use RACO products.

Read and closely follow all Warnings, Cautions, and Instructions in this manual. Failure to do so may result in voiding the RACO Warranty.



***CAUTION!*** You **MUST** check with RACO prior to any disassembly or maintenance procedures not specifically recommended in this Manual in order to preserve the RACO Warranty. If unauthorized or non-recommended practices or procedures are performed, RACO reserves the right to deny warranty claims for any defect at the sole discretion of RACO.

**CAUTION!** Disassembly is not recommended under any circumstance. However, under extreme conditions, if there is no other opportunity to return the unit to RACO, the following instructions may be used as alternative guidelines.

Fully and independently support the cylinder and the attached load. If possible, disconnect the front attachment mechanism from the load.

Read and closely follow all Warnings, Cautions, and Instructions in this manual. Failure to do so may result in voiding the RACO Warranty.

**CAUTION!** You **MUST** check with RACO prior to any disassembly or maintenance procedures not specifically recommended in this Manual in order to preserve the RACO Warranty. If unauthorized or non-recommended practices or procedures are performed, RACO reserves the right to deny warranty claims for any defect at the sole discretion of RACO.

### **DISASSEMBLY OF ACCESSORIES “D” or “E” Lateral Accessory Housings**

1. Remove the cover (9.35).
2. Remove RPM Pulse Generator if so equipped to allow clearance for belt removal.
3. Remove two socket screws (9.66) from the bearing block supporting the driven shaft.  
Note any shims used to tension the belt.
4. Tilt the bearing block to allow removal of the belt

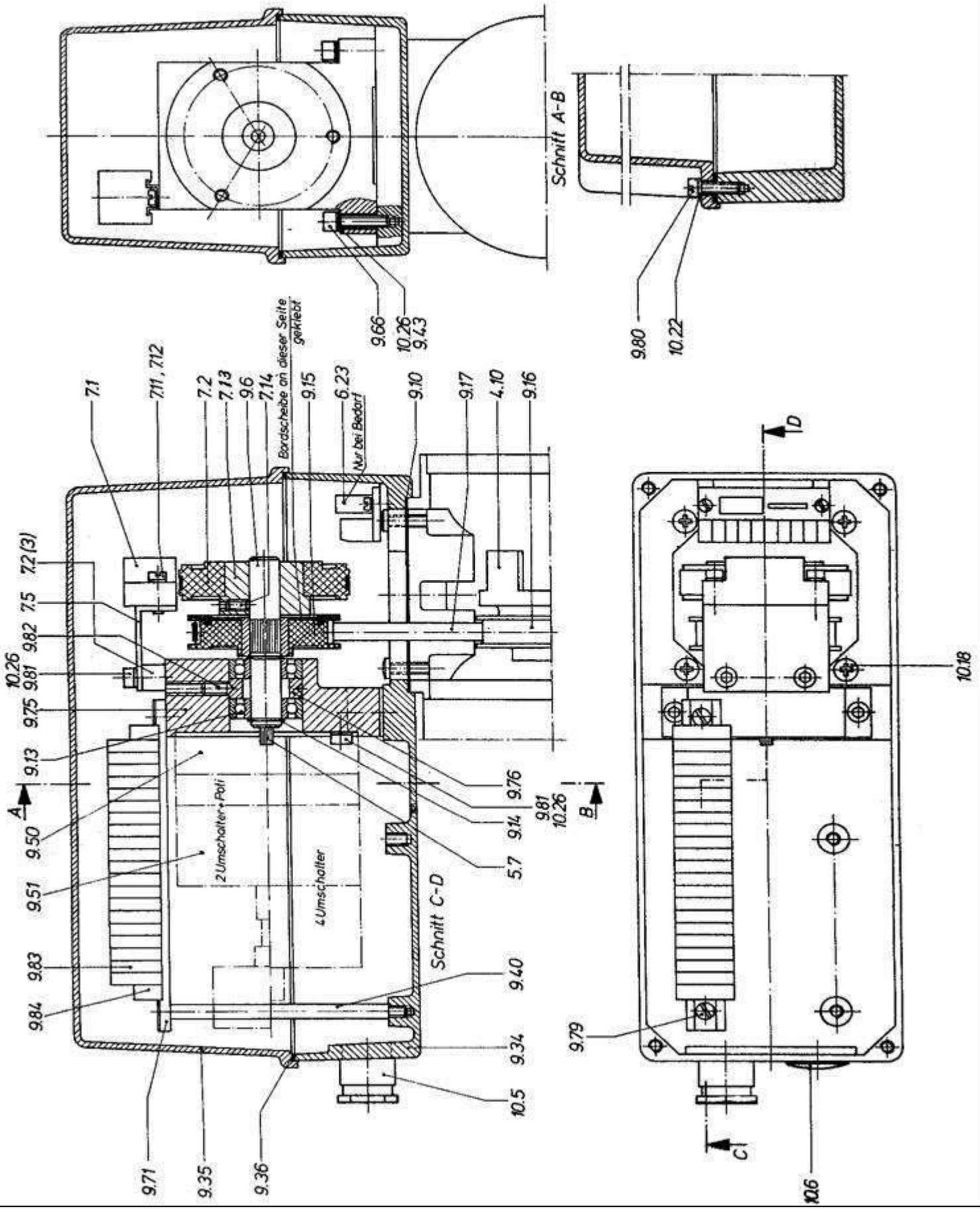
### **ATTENTION**

These instructions are for emergency repairs only. If your actuator is still under warranty, you will void this warranty by opening the unit. We strongly recommend having all repairs done by RACO International, Inc. and using RACO spare parts only.



## Accessory Housing D-E Parts List

<u>Pos. – No.</u>	<u>Description</u>
9.6	Shaft
9.10	Screw
9.13	Ball Bearing
9.14	Snap Ring
9.17	Timing Belt
9.30	Plug
9.34	Housing
9.35	Housing Cover
9.36	Gasket
9.40	Cap Screw
9.43	Washer
9.50	Gearing
9.51	Switching
9.66	Screw
9.71	Pin Rail
9.75	Bearing Block
9.76	Spacer
9.79	Bolt
9.79.1	Washer
9.81	Screw
9.81.1	Washer
9.82	Set Screw
9.83	Terminals
9.83.1	Terminal End Cover
9.84	Clip
10.18	Screw
10.26	Washer
10.29	Rail



# MANAGEMENT SYSTEM CERTIFICATE

Certificate No:  
100027-2011-AQ-GER-DAkKS

Initial certification date:  
20. March 1996

Valid:  
01. April 2018 - 31. March 2021

This is to certify that the management system of



International

## RACO Elektro Maschinen GmbH

Jesinghauser Str. 56-64, 58332 Schwelm, Germany

has been found to conform to the Quality Management System standard:

**ISO 9001:2015**

This certificate is valid for the following scope:

**Development, Design, Manufacturing, Sales and Service of Electric Mechanical Drive Units, Electric Actuators, Linear Drives, Brake Systems, Ball Screws and Electronic Control and Positioning Components**

Place and date:  
Essen, 27. February 2018

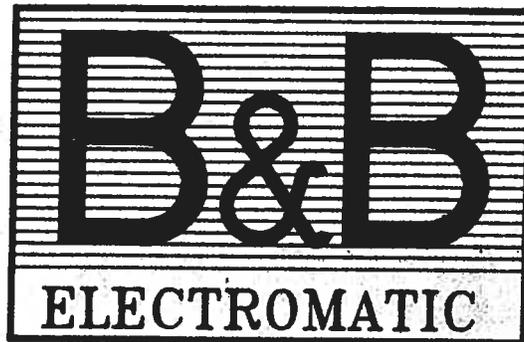


For the issuing office:  
DNV GL - Business Assurance  
Schnieringshof 14, 45329 Essen, Germany

A handwritten signature in blue ink, appearing to read "T. Beck".

**Thomas Beck**  
Technical Manager

### 5.3. Traffic Gates



Handbook  
for  
Gates & Barriers

STUTSON STREET BRIDGE  
VT-40 TRAFFIC GATES  
SERIAL #5525-5528  
B&B FACTORY ORDER #00-8512

Quality Manufacturing since 1925

# VT-40 HANDBOOK

## Stutson Street Bridge

B&B FACTORY ORDER #00-8512

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Warranty

Certification of Testing

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VT-40 Warning Gate Installation Instructions

VT-40 Warning Gate Start up Instructions

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*(See Dwg. "Shear\_Pin\_Mount" in Section 3 for additional information)*

## **SECTION 2: Specifications**

VT 40 Warning Gate Specifications

VT- 40 Operator Assembly (Dwg. 0040DA0002)

**B&B Electromatic, Inc.**  
14113 Main Street, P. O. Box 99  
Norwood, LA 70761  
225-629-5234 or 800-367-0387

### **SECTION 3: Accessories and Major Components**

BM-122 Arm Light Specifications & Drawing (Dwg.#0122DM0009)

AW25-500 (12V) Flasher Specifications & Drawing (Dwg.#9200BD0540)

Z-555 Gong Specifications & Drawing (Dwg.#0555DA0531)

Brake Assembly, Universal (Dwg.#0040BA0023)

RDC-15-12 Limit Switch (Dwg.#0040BA0666)

Motor, Leeson Electric Corporation (Dwg.#033764)

Cross Member – Rigid Base (Dwg.#01100-0707-A1)

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VT-40 Warning Gate – Installation Drawing  
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Dwg.#WI8712B1, #WI8712B2, #WI8712B3

VT-40 Warning Gate – Wiring Diagram  
Stutson Street Bridge  
Dwg.#WE8712C1, #WE8712C2, #WE8712C3 & #WE8712C4

## LIMITED WARRANTY

B&B Electromatic, in connection with apparatus sold, warrants same to be free from defects in material and workmanship under normal use and service. B&B will, at its option, repair or replace any part which, upon inspection by B&B, appears to be defective.

This warranty shall not apply if the article has been subjected to abuse in handling or installation, or has been misused or misapplied, or has been disassembled, repaired, altered, neglected or used in any way which, in the opinion of B&B, adversely affects the products.

For components such as motors, tanks, controllers, fuses, and power cords, supplied but not manufactured by B&B, B&B reserves the right to limit the warranty period to the warranty period of the component manufacturer.

VT-40 traffic warning gate operators, navigation lights, and XL series hydraulic slide gate operators are warranted for 5 full years against all part failures due to defective materials or workmanship. B&B 5-year (20,000 hour) navigation lamps are also warranted for 5 years against burnout.

All other B&B products are warranted for 2 full years against all part failures due to defective materials or workmanship.

The warranty period begins on the date of shipment from B&B facility. In order to receive the warranty, the purchaser must return the defective part, prepaid, to B&B. B&B will ship, prepaid, a replacement at no cost. Maximum liability will in no case exceed the value of the B&B unit involved. Costs associated with removing and replacing defective materials or parts are not covered by this warranty.

B&B maintains original shipment records to help you determine the warranty status of your products.

B&B reserves the right to change specifications and designs without notice, and assumes no responsibilities for making these modifications on any equipment previously sold.

*This warranty is in lieu of all other warranties, expressed or implied. B&B disclaims any warranties of merchantability or fitness for a particular purpose, and expressly disclaims all responsibility for special, incidental or consequential damages.*



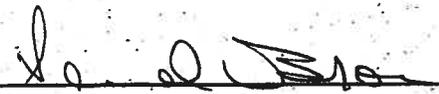
14113 MAIN STREET  
P.O. BOX 99  
NORWOOD, LA 70761  
(225)629-5234 • FAX:(225)629-5727

## CERTIFICATION OF TESTING

Product: VT-40  
Job Name: Stutson Street Bridge  
B&B Factory Order #: 00-8512

Model Number	Serial Number
VT-40 (S.E. Off-going)	5525
VT-40 (N.E. On-coming)	5526
VT-40 (S.W. On-coming)	5527
VT-40 (N.W. Off-going)	5528

Each gate has been completely assembled, lubricated and test run through 24 complete cycles under full power at our factory without failure or problems.

  
Signature

Samuel Brown, General Foreman  
Name & Title

3-21-03  
Date

# SECTION: 1

## Installation, Adjustment and Maintenance



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## VT-40 WARNING GATE INSTALLATION INSTRUCTIONS

**NOTE 1: Failure to install your gate properly could cause damage to the operating mechanism.**

1. Read the instructions and review the drawings thoroughly. If you do not understand any part of these instructions, please contact the manufacturer.
2. Check the anchor bolt locations and prepare the foundation for the gate. Set the gate operator and be sure to seal the bottom with duct seal. Housing must be level. Anchor bolts must be tightened evenly.
3. Make sure the local power supply for the motor and control circuit are correct.  
\*Reference the enclosed electrical drawing in the back of the handbook.

**IMPORTANT: All conduit must be sealed and the housing grounded.**

4. Using the hand crank, rotate the main arm shaft 45 degrees noting rotation arrow on brake drum.
5. Open main disconnect switch (S1) and connect the power. Connect the control circuit if separate. If power is supplied from the motor circuit, check the connections at the terminals.

**NOTE 2: At this point in the installation, no sidearm channels, counterweights or arms should have been installed.**

**NOTE 3: If sidearm channels were installed at the factory, they need not be removed for the previous instructions.**

6. "Bump" test gate operator for correct motor rotation. Motor rotation and gate arm motion should match the rotation arrow on the brake drum. Reverse power leads if necessary to get proper motor rotation.
7. Run gate operator (without sidearm channels, arms or counterweights) through several complete cycles. Leave the gate operator in the closed to traffic position and open the main disconnect switch.

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**NOTE 4:** This gate has been completely assembled, lubricated and test run through 24 complete cycles under full power at the factory. If satisfactory operation is not displayed in step #10, recheck all electrical connections carefully. **CONSULT FACTORY IF PROBLEM IS NOT FOUND.**

8. Now install sidearm channels, the arm and the counterweights. Support the outer end of the arm until counterweights are all installed. Attach any lights, signs or other fixtures. Install counterweight in position marked on sidearm channels.
9. Make sure rotation of motor with hand crank lowers or raises arm as indicated on brake drum.
10. Close the main disconnect switch (S1) and operate the control circuit. If all connections are made correct, gate arm will operate correctly. The limit switch will automatically stop the motor at the extreme 90 degree movement of the arm.

**IMPORTANT:** If the power connections to the motor are reversed, the limit switch will automatically disconnect the motor when it reaches about 93 degrees either open or closed, depending upon the position of the controls, ie, open or closed. The limit switch has been set at the factory and should not require adjustment. Arm should be raised or lowered by lengthening or shortening the connecting rod, **NOT BY ADJUSTMENT OF THE LIMIT SWITCH CAMS.**

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## **VT-40 WARNING GATE START-UP INSTRUCTIONS**

**NOTE:** These instructions assume installation has been completed. If necessary, refer to the enclosed installation instructions.

1. Open the operator door.
2. Connect power by flipping the disconnect switch to the "ON" position.
3. Test operate the gate to be sure it is functioning properly.

## **VT-40 WARNING GATE SHUT-DOWN INSTRUCTIONS**

1. Open the operator door.
2. Disconnect power by flipping the disconnect switch to the "OFF" position.

## **VT-40 WARNING GATE EMERGENCY OPERATION INSTRUCTIONS**

1. Open the operator door.
2. Disconnect power by flipping the disconnect switch to the "OFF" position.
3. Locate the hand-crank mounted inside the housing.
4. Slip the hand-crank onto the shaft extending through the brake. The brake will automatically release.
5. Turn the hand-crank to raise or lower the gate, as needed. A tag on the brake indicates crank direction for opening or closing the gate.
6. Remove the hand-crank.
7. Flip the disconnect switch back to the "ON" position to resume powered operation.



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## VT-40 LUBRICATION INSTRUCTIONS

Mechanism lubrication should be checked at least once per month.

**Transmission (Item 4 on Assembly drawing):**

Ref. Dwg. #0040DA002

**First gear drive box ( High speed housing):**

1. Open the back door of the housing (opposite roadway).
2. Check oil by removing the oil level plug located on the left hand vertical surface of the transmission a few inches below the motor.  
*Note: Some gates may have site glasses.*
  - a. If oil is visible, oil level is adequate - replace plug and go to next section.
  - b. If oil is not visible, go to step 3.
3. Remove fill plug on top of first gear box.
4. Fill the case to the level plug or site glass (removed in step two) with multi-grade Mobil SHC 629 or a direct replacement. (see recommended replacement oils on the following page.)
5. Replace plugs.

**Final drive gear box (Low speed housing):**

1. Check the oil level by removing the oil level plug located near the bottom of the transmission on the right hand side of the gate (item 4). The plug will be located on the front of the transmission. *Note: Some gates may have site glasses.*
  - a. If oil is visible, oil level is adequate - replace the plug and go to next section.
  - b. If oil is not visible, go to step 2.
2. Remove oil fill plug on top of final gear box.
3. Fill the case to the level plug or site glass (removed in step one) with multi-grade Mobil SHC 629 or a direct replacement. (see recommended replacement oils on the following page)
4. Replace plugs.

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**Arm Shaft Bearing (Item 7):**

1. Grease with Texaco Marfak 2 or equal.
2. Wipe off excess.

**Connecting Rod Ends (Items 5 & 6):**

1. Grease with Texaco Marfak 2 or equal.
2. Wipe off excess.

**Limit Switch Drive Chain (Item 9):**

1. Spray chain with any good aerosol chain lube.
2. Wipe off excess.

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## VT-40 LUBRICATION REPLACEMENT INSTRUCTIONS

Lubricate mechanism every 12 months with a manufacturer approved lubricant.

### First gear drive box ( High speed housing):

1. Standing behind the operator open the left housing door.
2. Locate drain plug on the bottom horizontal surface of the gear change box directly under the motor.
3. Position catch pan under drain plug.
4. Remove the oil fill hole on the top surface of the gear change box directly beside the motor.
5. Remove the drain plug until the oil is completely drained, then replace plug.
6. Remove the oil level plug.
7. Refill gear change box until oil flows from the oil level hole. Replug the oil fill hole and the oil level hole.

### Final drive gear box (Low speed housing):

1. Open the right housing door.
2. Located drain plug on the vertical surface of the final output box directly behind the limit switch.
3. Position catch pan under drain plug.
4. Remove the oil fill hole on the top surface of the final output box directly above the drain plug.
5. Remove the drain plug until the oil is completely drained, then replace plug.
6. Remove the oil level plug.
7. Refill final output box until oil flows from the oil level hole. Replug the oil fill hole and the oil level hole.



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## RECOMMENDED REPLACEMENT OILS FOR VT-40 GATE OPERATORS

Direct replacement of oils is very complicated and should be considered carefully when doing so. The following oils are recommended by the manufacturer of the transmissions on both the Warning Gates and Barrier Gates.

The multi-grade **Mobil SHC 629** synthetic oil is the manufacturers first choice. If this oil is not available, **Exxon Terrestrial SHP 150** can be used as a direct replacement. The temperature range is -30°F to 165°F.

If neither of the two above mentioned oils is available, almost any **ISO Grade 150** or **AGMA Lubricant #4** with a pour point of -40°F or less & a viscosity of approx. 726 (SUS@100°F) is acceptable.

The following grease is recommended by the manufacturer of the flange type bearings used on both the Warning Gates and Barrier Gates.

Texaco Marfax or Texaco Starplex grease is the manufacturers first choice. If this grease is not available, consult your local supplier for an equivalent.

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## UNIVERSAL VT BRAKE ASSEMBLY REPLACEMENT INSTRUCTIONS

\*Refer to Drawing #0040BA0023

**IMPORTANT:** Unless specified, the replacement brake assembly does not include a solenoid or a brake drum. If these items are required, they must be requested separately, please specify the motor voltage.

**WARNING: DISCONNECT GATE POWER BY THROWING THE MAIN POWER SWITCH (S1) OFF BEFORE REMOVING THE OLD BRAKE ASSEMBLY.**

Item numbers refer to the brake drawing included in the major components section of this handbook.

### To remove the old assembly:

1. Remove the Brake Release Stub (item 9) from its bracket.
2. Remove the Brake Drum (item 2) set screw. The set screw is located on the side of the brake drum, even with the key in its center.
3. Pull the drum off of its shaft.
4. Disconnect the wires from the brake release solenoid (item 5).
5. Remove the brake assembly mounting bolts, and lift off the brake assembly.

### To mount the new assembly:

1. Place the new brake assembly on top of the motor, align the mounting holes, and tighten the mounting bolts.
2. Unless a new solenoid was requested, the brake solenoid from the old brake assembly will need to be re-mounted on the new assembly.
  - Disconnect the solenoid arm from the solenoid release rod (item 7).
  - Remove the solenoid mounting screws.

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- Place the solenoid (item 5) on the new brake assembly, align the holes and replace the mounting bolts.
  - Reconnect the solenoid plunger to the solenoid release rod.
  - Reconnect power wires to the solenoid.
3. Insert the brake drum onto the keyed shaft and tighten the set-screw.
  4. Re-install the manual release stub onto its mounting bracket.
  5. Re-apply power to the gate, and test the brake by running the operator.
  6. If the solenoid makes a loud buzzing sound, it is binding and needs to be adjusted.
    - Loosen the mounting bolts and activate the operator. The solenoid should seat itself properly.
    - Re-tighten the mounting bolts.

If the solenoid continues to buzz, the solenoid release rod may be out of alignment. Loosening the screw between the solenoid plunger and release rod (item 7) should alleviate this. If the problem persists, contact the manufacturer.

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## MOTOR REPLACEMENT INSTRUCTIONS FOR VT-40 GATE OPERATORS

**IMPORTANT:** Before replacing the motor, check that the new motor is identical to the old in voltage, phase and horsepower.

**WARNING: DISCONNECT GATE POWER BY THROWING THE MAIN POWER SWITCH (S1) OFF BEFORE CHANGING MOTORS.**

1. Remove the brake assembly (see previous instructions)
2. Have a qualified electrician disconnect the motor wires from the junction box on the side of the motor.
3. Remove the four motor mounting bolts located at the base of the motor.
4. Pull the motor up, out of the transmission, making sure the feather key comes out with the motor shaft.
5. Mount the new motor, inserting the keyed shaft into the transmission and aligning the mounting holes.
6. Have a qualified electrician reconnect the motor wires at the junction box on the side of the motor.
7. Re-mount the brake assembly (see previous instructions).
8. Re-apply power to the operator and run the gate several times. If the gate does not run satisfactorily, contact the manufacturer.

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## **LIMIT SWITCH REPLACEMENT INSTRUCTIONS FOR VT-40 GATE OPERATORS**

**WARNING: DISCONNECT GATE POWER BY THROWING THE MAIN POWER SWITCH (S1) OFF BEFORE BEGINNING.**

1. Remove the old limit switch from the gate limit switch assembly by removing the mounting screws and connecting wires.
2. Install the new limit switch by aligning the mounting holes, replacing the mounting screws and re-connecting wires as removed from defective switch.
3. Apply power to the gate and run it several times. Limit switches are pre-adjusted and should not require additional adjustment. If the gate does not operate satisfactorily, contact the manufacturer.

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## FIELD BALANCING INSTRUCTIONS FOR VT OPERATORS

**IMPORTANT: EVERY VT WARNING GATE IS BALANCED AT THE FACTORY BEFORE IT IS SHIPPED. IF ANY ADDITIONS OR CHANGES ARE MADE TO THE GATE ARM IN THE FIELD, THE GATE MAY REQUIRE RE-BALANCING. AN UNBALANCED ARM MAY DAMAGE THE OPERATOR.**

If any additions or changes are made to the VT operator, the following guidelines will help you determine what changes, if any, need to be made to the gate balance:

1. Make the desired changes to the gate arm.
2. Secure the tip end of the arm to prevent injury or accident.
3. Disconnect the connecting rod which runs between the upper and lower cranks, this will free the arm to be balanced.

INDICATIONS	PROBLEM	SOLUTION
<u>Gate arm tends to raise</u> Requires more than 20 lbs. to keep it closed to traffic.	Gate is counterweight heavy.	1. Counterweights can be pushed closer to the pivot. 2. Counterweights can be removed.
<u>Gate arm tends to lower</u> Requires more than 20 lbs. to keep it open to traffic.	Gate is arm heavy.	1. Counterweights can be pushed further from the pivot. 2. Counterweights can be added.

A properly balanced gate can be manually operated by one person pushing on the end of the counterweight mounting channel. It should require only 20 lbs. of force to manually operate the gate. For detailed instructions on balancing the operator with weights, refer to the next page.

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## GATE ARM BALANCING

These adjustments are set at the manufacturing facility and should not need to be adjusted in the field unless the arms have been modified, causing the weight of the arm to change.

### Calculating Counterweight Requirements

1. Disconnect arm drive by removing top connecting rod bolt located in the gate housing.
2. Mark any place on the gate arm and attach a weighing scale to the arm at that point.
3. Measure how much weight, in pounds, it takes to start raising the gate arm. (arm lbs.)
4. Measure, in inches, the distance from the weight point to the center of the pivot point (arm distance).
5. Measure, in inches, the distance from center of pivot point to center of counterweight (counterweight distance).
6. Follow this formula to get the proper amount of counterweight to add to gate.

$$\frac{\text{arm lbs. x arm dist.}}{\text{cw dist.}}$$

### COUNTERWEIGHT SIZES

18"X36"X1" THICK	= 182 POUNDS
18"X36"X.5" THICK	= 91 POUNDS
12"X24"X1" THICK	= 82 POUNDS
12"X24"X.5" THICK	= 41 POUNDS
12"X12"X1" THICK	= 41 POUNDS
12"X12"X.5" THICK	= 20 POUNDS

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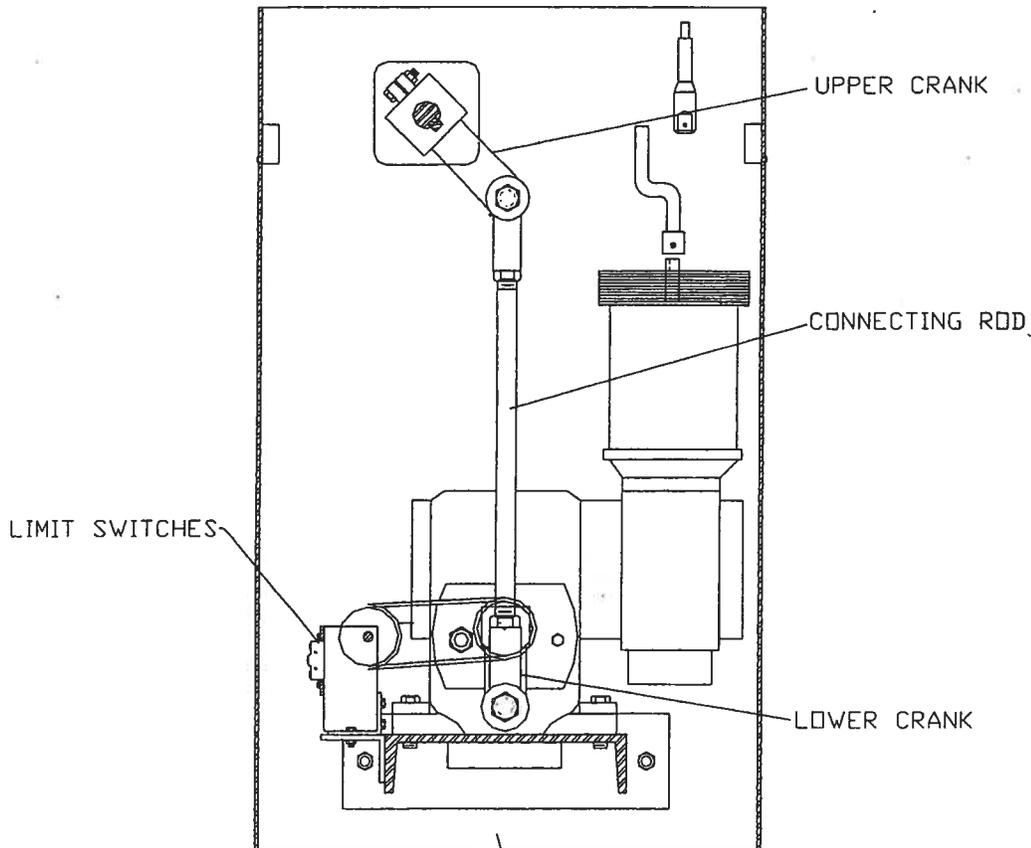
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## ADJUSTING THE VT GATE MOVEMENT

When installing or maintaining a VT warning or barrier gate, setting the limit switches and connecting rod length properly can be confusing at times. The following instructions are intended to clarify this process. The steps can be broken into two sections, setting crank orientation, and setting gate starting and stopping points.



### SECTION 1: SETTING THE CRANK ORIENTATION AND ROTATION USING THE LIMIT SWITCHES

A standard VT gate operator with 90 degrees of travel is designed so that the gate arm accelerates and decelerates smoothly as it pivots. This is achieved through the lengths of the two crank arms. In order to optimize this "sinusoidal" movement, the following steps should be followed when installing the operator.

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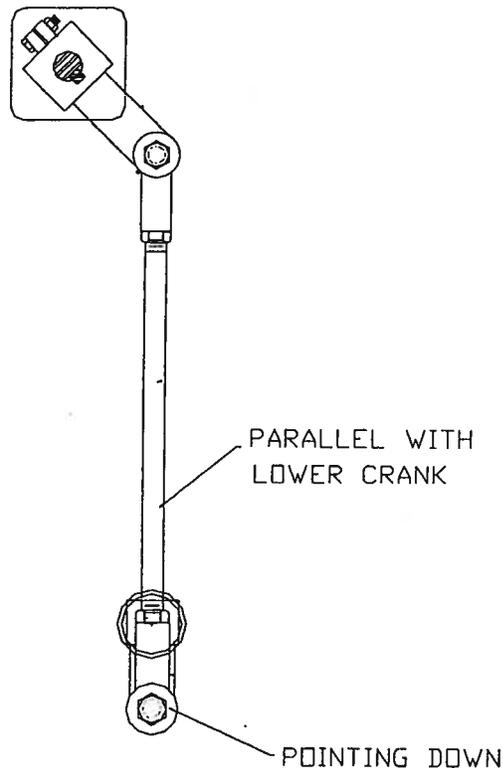
1) Determine the direction of rotation of the cranks. In a standard installation, the cranks pivot toward the motor, away from the roadway.

The limit switch cams rotate the same direction that the pivot rotates. Cam 1 is always the raise stop, Cam 2 is always the lower stop, Cam 3 generally controls the arm lights if there are any, and Cam 4 generally controls the bell if there is one.

**IMPORTANT: Disconnect the power at the main switch before adjusting the limit switches.**

2) Manually rotate the gate into its fully open to traffic (raised) position by inserting the manual crank onto the shaft extending from the top of the motor and turning it until the gate reaches the desired position.

**Note:** At fully open, the connecting rod should be parallel with the sides of the operator and with the lower drive crank. The lower drive crank should be pointing straight down.



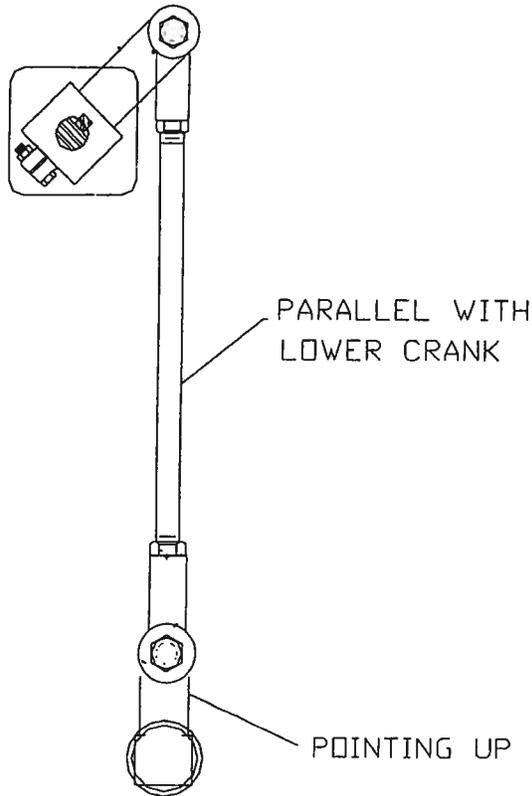
3) With an Allen wrench loosen the limit switch cams just enough so that they will turn, but not so much that they are loose.

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4) Rotate Cam 1 until the limit switch follower just falls off of the edge of the cam. Keep the direction of rotation of the cam in mind as you set it to ensure that when the gate rotates, the limit switch follower will move back onto the cam.

5) Manually rotate the gate into its fully closed to traffic position.



**Note:** At fully closed, the lower drive crank should have rotated through 180 degrees, and should be pointing straight up. The connecting rod should be parallel with the sides of the housing and the lower drive crank.

6) Rotate Cam 2 until the limit switch follower just falls off of the edge of the cam. Keep the direction of rotation of the cam in mind as you set it to ensure that when the gate rotates, the limit switch follower will move back onto the cam.

7) Re-apply power and run the gate open and closed. If the cams require more adjustment it is important to disconnect power before moving the limit switch cams. Be sure to re-tighten the limit switch cams once they have been properly set.

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**NOTE:** At this point in the adjustment, the crank orientation is more important than the gate position. At the fully open and fully closed positions, the connecting rod should be parallel with the sides of the housing, and the drive crank should point directly up or directly down.

## **STEP TWO: ADJUSTING THE STOPPING AND STARTING POINTS OF THE GATE ARM**

If the starting and stopping points of the gate arm need to be adjusted, this will be done using the connecting rod. This should only be done if the crank and connecting rod positions are correct as described above..

8) With the gate in the fully raised or lowered position, loosen the lock nuts on the connecting rod and turn the rod to increase or decrease its length. Adjust the rod until the gate arm is in the desired position.

**NOTE:** Adjusting the connection rod changes both the raised and lowered position by the same amount.

9) Run the gate through several cycles to ensure proper starting and stopping points.

10) If the gate panel travels slightly too far in either the open or closed direction, this can be adjusted using the limit switches. It is important to note that adjusting the limit switch at this point will stop the gate arm before it has fully decelerated.

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## **SECTION: 2**

# **VT-40 Operator Specifications**

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Stutson Street Bridge  
B&B Factory Order #00-8512  
VT-40 Specs., 4 Pages (Page 1 of 4)  
(4) Four Units Required



## Model VT-40

### GENERAL

The safety gate will be B & B type VT-40. These specifications are the minimum that will be acceptable. The gate will be of the standard vertical to horizontal arm type, will have a weatherproof housing and operating mechanism and will include such controls, accessories and modifications as specified.

### APPLICATIONS

The VT-40 Automatic Safety Gate will typically be used as a warning, traffic control and access control gate. Typical applications will include moveable bridge traffic warning gate, parking lot access control gate and any medium to heavy-duty traffic control or warning installation.

- **HOUSING**

The housing will be fabricated from 1/4-inch **5052-H32** aluminum. The aluminum housing will receive a primer finish. Formed, channel shaped side plates will be used to produce a strong configuration without welded corners.

Front and rear access doors will be hung on bronze, full-cross hinges with stainless steel hinge pins. Hinges will be of the slip-off type. Doors will be held in place with two bronze wing nuts and stainless steel swing bolts and will be sealed with neoprene strip gaskets. Top will be held in place with corrosion resistant hex head bolts. Openings for arm shafts will be equipped with "O" ring seals. Padlockable doors will be a standard feature (padlock by others).

The housing base will provide four 1-inch holes for mounting on the customer's foundation. Anchor bolts and templet will be supplied by the gate manufacturer. Standard anchor bolt size will be 3/4 - 10 x 12 + 4 hot dip galvanized.

- **ARM**

The arm will be constructed according to the customer's specifications and will be a *Wooden wishbone* - This arm, with aluminum articulating fence, will be fabricated from extra clear vertical grain fir in a wishbone shape (*Refer to installation drawings for actual dimensions*).

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VT-40 Specs., 4 Pages (Page 2 of 4)  
(4) Four Units Required

Double stainless steel truss cables and a spring loaded roadway bumper will be furnished with all arms.

Roadway arm lengths (dimension "A") will be measured from the centerline of the gate housing to the tip of the arm. (*Refer to installation drawings for actual dimensions*).

Gate arms will be covered on both sides with 16-inch alternating red and white engineering grade reflectorized sheeting.

- **ARM BASE**  
A rigid mounting will be furnished.
- **ARM MOUNTING CHANNELS**  
Arm mounting channels will be fabricated from carbon steel, hot dip galvanized. The roadway arm shaft will be 44 inches above the base line of the gate housing.
- **COUNTERWEIGHTS**  
Each gate will be equipped with suitable hot dip galvanized steel counterweights of the sectional, bolt-on type. Counterweights will have a maximum 10% adjustment.
- **ARM SHAFTS**  
The main arm shaft will be mounted in heavy-duty ball bearings and will be lubricated from the inside. The main arm shaft will be not less than 2 inches in diameter. Shaft material will be ASTM A311 Class B high strength, stressproof steel.
- **TRANSMISSION**  
The transmission will be a fully enclosed, all gear, direct drive unit running in an oil bath. The drive train will not use belts or chains and will be connected to the arm shaft with a connecting rod having self-aligning ball ends. The connecting rod will be constructed of ASTM A311 Class B high strength stressproof steel.

During the opening and closing cycles, the gate arm will begin with zero velocity and accelerate smoothly reaching maximum velocity at mid-stroke (45 degrees). The arm will then decelerate smoothly to zero velocity at full stroke (90 degrees) preventing bounce or whip of the arm. Operating time to open or close the gate will be 13 seconds.

The standard connecting rod assembly will be designed to move the gate through a 90-degree travel.

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VT-40 Specs., 4 Pages (Page 3 of 4)  
(4) Four Units Required

- **MOTOR**

A 480V, 3PH, 1HP motor will be provided. The motor will be of the flange-mounted type, attached to the transmission case with not less than four bolts. The motor will be of the instant reversing type to permit reversing movement of the arms at any point of travel. Motor data will appear in the manual.

- **BRAKING MECHANISM**

A solenoid release, automatic motor brake will be furnished as part of the gate drive mechanism. The brake will automatically release when the handcrank is inserted to manually operate the gate.

- **HANDCRANK**

A handcrank and drill crank will be included with each gate to operate the gate during power failure. Door safety switches will automatically disconnect the control circuit power when the door is opened to allow for manual operation.

- **LIMIT SWITCH**

The gate limit switch will be a unit assembly containing eight individual switches having one set of normally open and one set of normally closed contacts each. Contacts will be totally enclosed and will have U.L. rating of not less than 15 amperes at 220 volts AC. Limit switch will be readily accessible and easily replaced with normal hand tools. Each individual switch will be controlled by an independent cam, which will be adjustable with a hex socket cap screw. The limit switch body, shafts and cams will be of corrosion resistant non-ferrous materials.

- **SAFETY SWITCHES, TERMINAL BLOCKS AND WIRING**

To protect operating and maintenance personnel from injury during service or installation, a manual disconnect switch will be furnished, installed and fully wired in the main motor leads.

Automatic disconnect switches will be arranged to break the control circuit when either door is opened. Pressure type terminal blocks will be provided and installed inside the housing on the roadway side. All control wires will terminate on these blocks. Each terminal will be clearly labeled and all conductors will be color coded and/or numbered. The wiring diagram will reflect such colors or numbers. A GFI receptacle will be supplied in the gate housing. No conductor will be smaller than #16 AWG stranded. Each housing will contain a laminated electrical schematic secured to the inside of the housing for reference by service personnel.

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B&B Factory Order #00-8512  
VT-40 Specs., 4 Pages (Page 4 of 4)  
(4) Four Units Required

- **QUALITY ASSURANCE**

Manufacturer of the traffic control gate operator will have a minimum of five years experience in the manufacture of industrial gate operators and barriers, and will make available replacement parts for ten years. All gates are individually inspected at time of final assembly and test. Each gate will be tagged "ACCEPTED" upon completion of inspection and a "Certification of Testing" will be supplied in the handbook for validation of meeting internal Quality Assurance standards.

# **SECTION 3:**

## **VT-40**

### **Accessories and Major Components**



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BM-122 Specs., 1 Page  
\*Supplied on VT-40 Traffic Gates



## **Model BM122 Warning Light**

### **General**

The BM122 warning light will be a 2-way warning light, visible on opposing sides of the light. The warning light will be shock and corrosion resistant, built to withstand severe use. It will be used in applications requiring a 2-way optical system, such as marker lights for warning gates.

### **Housing**

The housing will be a two-piece, cast aluminum, accurately machined. The top section will be fitted to the base with a gasket seal and held securely in place with two stainless steel, drawbolts. The base section will provide field wiring entrance through a 3/4-inch NPS conduit entrance. The top section and base will be primed with one coat of chromate oxide primer and two coats of black alkyd enamel.

### **Lens**

The lens will be red, 4-inch diameter acrylic, having a beam spread of 30. The lens will be held in place by four non-corrosive fasteners. The lens will be fitted into the top section, and gasketed with neoprene gaskets.

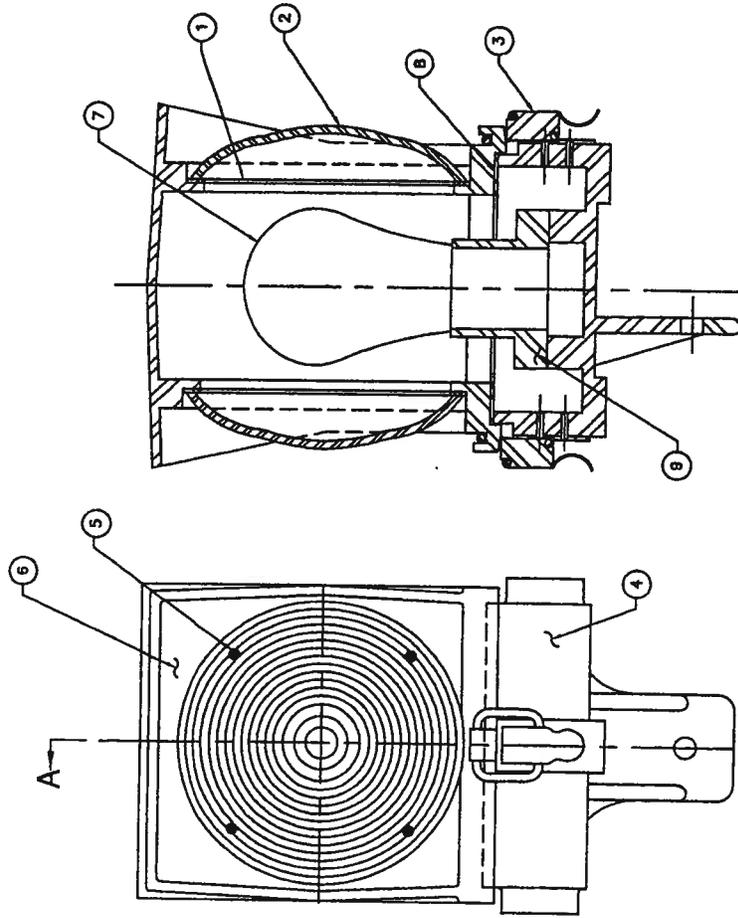
### **Receptacle and Lamps**

The standard lamp receptacle will be a medium brass base, 250 volt, 660 watt, with porcelain shell. The receptacle will be designed to resist lamp seizing. A 67-watt, 120 volt, 8,000 hour lamp with brass base will be included.

### **Quality Assurance**

Manufacturer of the warning lights will have a minimum of five years experience in the manufacture of warning lights and will make available replacement parts for ten years. All warning lights are individually tested and inspected at time of final assembly.

ZONE REV	BY	DATE	DESCRIPTION
0	94308-1	JRR 2-11-85	ORIGINAL ISSUE
1	84214-1	JES 12-18-85	CORRECTED TO NEW DWG. STANDARDS



SECTION AA

ITEM NO	IDENTIFYING NO	DESCRIPTION	QUANTITY	UNIT	REVISION	DATE
1	0122-7824	BASE GASKET	1	EA	0122AD0007	
2	0177-50718-B	RECEPTACLE BRASS BASE	1	EA		
3	0122-1007	LIGHT BULB 67W	1	EA		
4	0122-8448	HOUSING, BARRIER LT	1	EA	0122DM0008	
5	111-0808SS-C	6-32 UNC-2A X .625 SER	8	EA		
6	0122-8438	BASE, BARRIER LT	1	EA	0122BM0504	
7	0122-2100	DRAW BOLTS	2	EA		
8	0122-3128	LENS, MODEL M-87	1	EA	AD-87844-M	
9	0122-9508	LENS GASKET	1	EA	0122AD0008	

ITEM NO	IDENTIFYING NO	DESCRIPTION	QUANTITY	UNIT	REVISION	DATE
1	0122-0002	PRODUCT USED ON	1	EA		
2	JRR	2-85				
3	RED	2-85				

PARTS LIST	
PRODUCT USED ON	B&B ELECTROMATIC NORWOOD, LA
REVISION	BARRIER LIGHT ASSY EM-122
DATE	2-85
BY	JRR
CHECKED	RED
DATE	2-85

B&B ELECTROMATIC  
NORWOOD, LA

BARRIER LIGHT ASSY  
EM-122

REV	BY	DATE	DESCRIPTION
1	JRR	2-85	
2	RED	2-85	

Stutson Street Bridge  
B&B Factory Order #00-8512  
AW25-500 Specs., 1 Page  
\*Supplied on VT-40 Traffic Gates



## **Model AW25-500 (120V) Warning Light Flashers**

### **General**

The flasher will be B&B model AW25-500. It will be a solid state flasher having two alternately flashing circuits and one steady burn circuit. The flasher will be designed for heavy-duty applications including traffic control gates and barriers.

### **Construction**

The flasher assembly will include mounting hardware as required, solid state flasher circuitry, a terminal block and a transformer when required. The flasher assembly will be fully wired at the factory. All components will be corrosion resistant. The entire transfer relay assembly, including all electronic circuitry, will be encapsulated in weatherproof, shock-resistant plastic enclosure to prevent possible damage from condensation or water buildup within the flasher.

### **Flash Rate**

The standard flash rate for the two alternately flashing circuits will be .50 second on & .50 second off. An additional steady burn circuit will also be provided.

### **Input Voltage/Current Draw**

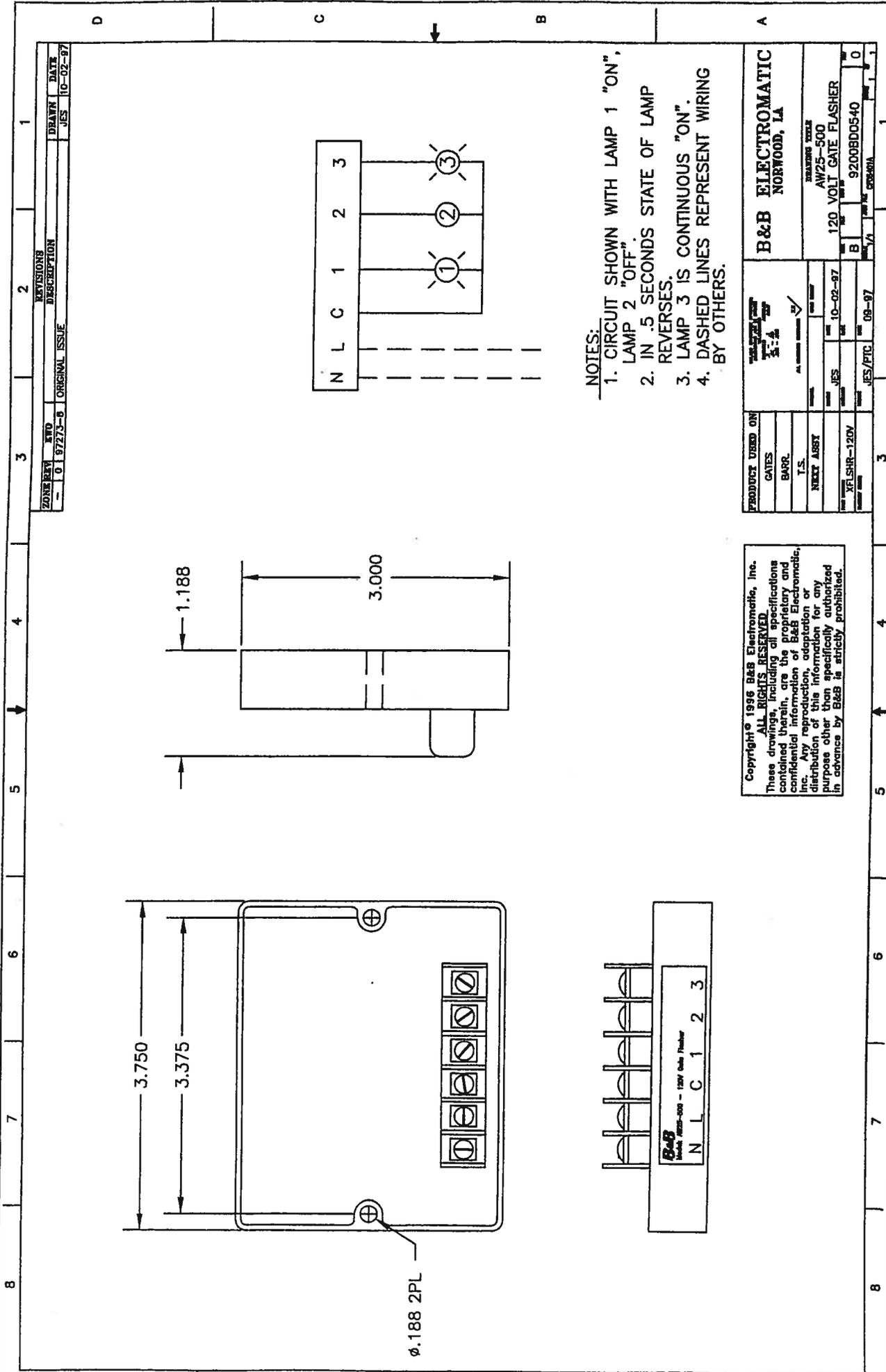
The standard input voltage is 120VAC  $\pm 10\%$ . The maximum current draw will be 10 amperes per flashing circuit.

### **Shipping Weight**

Approximate shipping weight for the AW25-500 is 3 pounds.

### **Quality Assurance**

Manufacturer of the flasher will have a minimum of five years experience in the manufacture of flashers and will make available replacement parts for ten years. All flashers are individually inspected at time of final assembly and test. Each flasher will be tagged "ACCEPTED" upon completion of inspection for validation of meeting internal Quality Assurance standards.



ZONE KEY	REV	DESCRIPTION	DATE
0	97273-8	ORIGINAL ISSUE	JES 10-02-97

- NOTES:**
1. CIRCUIT SHOWN WITH LAMP 1 "ON", LAMP 2 "OFF".
  2. IN .5 SECONDS STATE OF LAMP REVERSES.
  3. LAMP 3 IS CONTINUOUS "ON".
  4. DASHED LINES REPRESENT WIRING BY OTHERS.

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PRODUCT USED ON	DATE	BY	REV
GATES			
BARR.			
T.S.			
NEXT ASST			
JES	10-02-97		
JES/PTC	08-97		

<b>B&amp;B ELECTROMATIC</b>		<b>NORWOOD, IA</b>	
AW25-500		120 VOLT GATE FLASHER	
B	92008D05-40	0	0

Stutson Street Bridge  
B&B Factory Order #00-8512  
Z-555 Gong Specs., 1 Page  
\*Supplied on SW & NE On-Coming VT-40 Traffic Gates



## **Model Z-555 (bronze) Gong**

### **General**

The Model Z-555 gong will be a heavy duty, motor driven industrial quality warning bell. It will be suitable for a variety of traffic control applications, including mounting on traffic control gates and barriers as an audible warning to both pedestrians and motor traffic.

### **Housing**

The housing and door will be cast aluminum. The door will hinge on stainless steel hinge pins and have a swing bolt with provision for padlock (padlock by others). All joints will be sealed with neoprene gasket and non-hardening sealer. The housing and door assembly will be weather-proof.

### **Gear Train**

All gears in the gear train will be journaled in oil-impregnated bronze bearings for long life and minimal service. The electric motor will drive the gear train which in turn drives a cam and hammer to strike the gong shell approximately one hundred times per minute.

### **Motor**

The electric motor will be 115 volt, 60Hz, drawing 2.3 amps. The motor will be TEFC, continuous duty for long life and dependable service.

### **Gong Shell**

The gong shell will be 12-inch O.D., cast bronze. A stainless steel, tamper resistant stud will hold the shell in place. The shell will be protected by a cast aluminum weather guard.

### **Mounting**

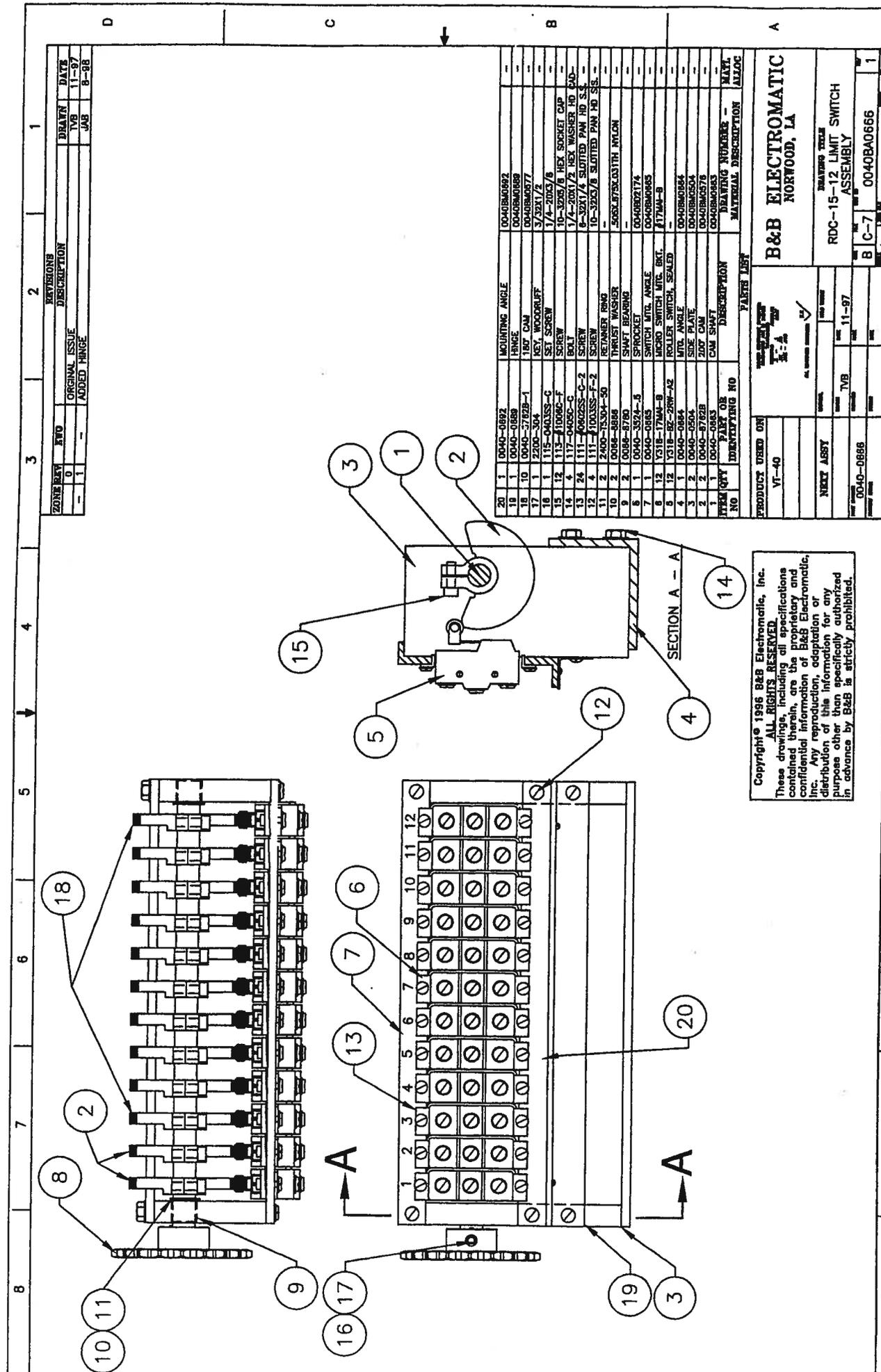
The housing will be drilled for mounting to a horizontal plate surface with the use of a tri-stud mounting arrangement.

### **Quality Assurance**

Manufacturer of the gongs will have a minimum of five years experience in the manufacture of gongs and will make available replacement parts for 10 years. All gongs are individually tested and inspected at time of final assembly. Each gong will be tagged "ACCEPTED" upon completion of inspection for validation of meeting internal Quality Assurance standards.







ZONE REV	EVO	DESCRIPTION	DATE
0	1	ORIGINAL ISSUE	11-87
1	1	ADDED HINGE	8-88

ITEM NO	QUANTITY	IDENTIFYING NO	DESCRIPTION	UNIT	REMARKS
20	1	0040-0892	MOUNTING ANGLE		
18	1	0040-0868	HINGE		
16	10	0040-2782B-1	18° CAM		
17	1	2200-304	KEY WOODRUFF		
15	1	115-0403SS-C	SET SCREW		
14	4	117-0405-C	SCREW		
13	4	117-0405-C	BOLT		
12	4	111-0402SS-C-2	SCREW		
11	2	111-0402SS-F-2	SCREW		
10	2	2400-15304-50	RETAINER RING		
9	2	0040-4804	THRUST WASHER		
8	2	0040-8780	SHAFT BEARING		
7	1	0040-3924-5	SPROCKET		
6	12	V318-17MM-8	SWITCH MTL ANGLE		
5	12	V318-EZ-288-A2	MICRO SWITCH MTR. RKT.		
4	1	0040-0844	ROLLER SWITCH, SEALED		
3	2	0040-0844	MTL ANGLE		
2	2	0040-8782B	SIDE PLATE		
1	1	0040-0863	200° CAM		
			CAM SHAFT		

ITEM NO	QUANTITY	IDENTIFYING NO	DESCRIPTION	UNIT	REMARKS
1	1	0040-0863	CAM SHAFT		
2	2	0040-8782B	SIDE PLATE		
3	2	0040-0844	MTL ANGLE		
4	1	0040-0844	ROLLER SWITCH, SEALED		
5	12	V318-EZ-288-A2	MICRO SWITCH MTR. RKT.		
6	12	V318-17MM-8	SWITCH MTL ANGLE		
7	1	0040-3924-5	SPROCKET		
8	2	0040-8780	SHAFT BEARING		
9	2	0040-4804	THRUST WASHER		
10	2	2400-15304-50	RETAINER RING		
11	2	111-0402SS-F-2	SCREW		
12	4	111-0402SS-C-2	SCREW		
13	4	117-0405-C	BOLT		
14	4	117-0405-C	SCREW		
15	1	115-0403SS-C	SET SCREW		
16	10	0040-2782B-1	18° CAM		
17	1	2200-304	KEY WOODRUFF		
18	1	0040-0868	HINGE		
19	1	0040-0868	HINGE		
20	1	0040-0892	MOUNTING ANGLE		

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**B&B ELECTROMATIC**  
 NORWOOD, LA

PRODUCT USED ON: VT-40

DATE: 11-87

BY: NEXY ASSY

0040-0868

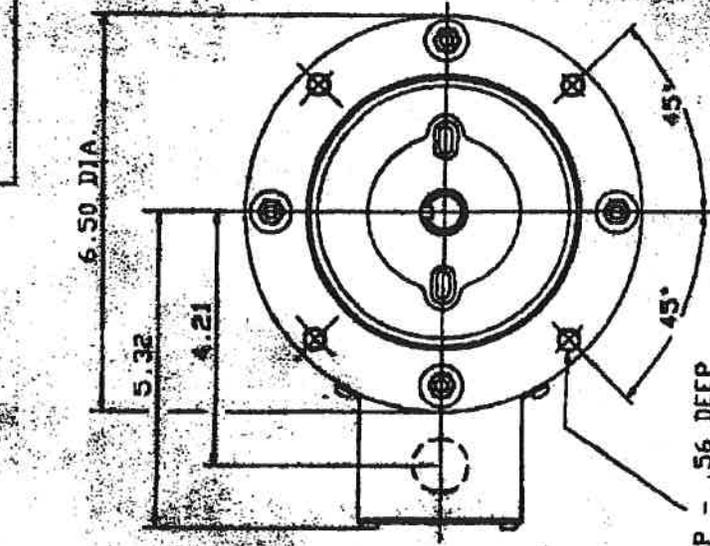
REVISIONS

DATE: 11-87

ASSEMBLY

0040BA0666

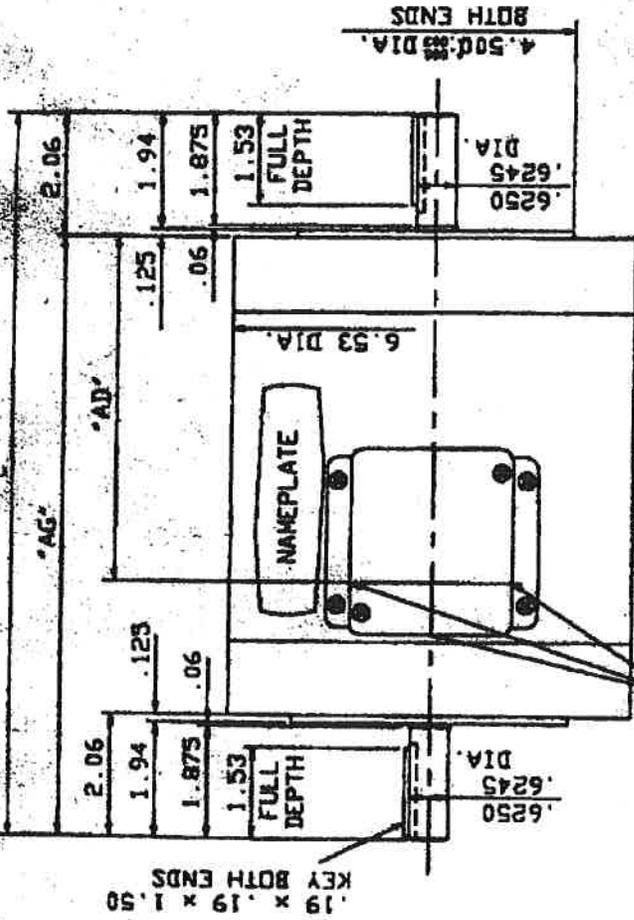
033764



3/8"-16 TAP - .56 DEEP  
4 REQ'D. ON A 5.875  
DIA. B.C. - BOTH ENDS.



MOUNTING HOLES ON BOTH  
ENDS TO BE ALIGNED ± 2°.



GASKETS THROUGHOUT

.88 DIA  
KNOCKOUTS  
3-REDD

MAXIMUM FACE RUNOUT TO BE .004 T.I.R.  
MAXIMUM PILOT ECCENTRICITY .004 T.I.R.  
PERMISSIBLE SHAFT RUNOUT .002 T.I.R.

FRAME	'C'	'AG'	'AD'
B56	11.13	9.06	4.75
C56	11.63	9.56	5.25
D56	12.13	10.06	5.75
E56	12.63	10.56	6.25
F56	13.13	11.06	6.75

TOLERANCES UNLESS OTHERWISE SPECIFIED		DECIMALS	
		.08	± .01
		.000	± .005
		.0000	± .0005
		FRACTIONS	± 1/64
		ANGLES	± 1/2°
		FINISH	3/F

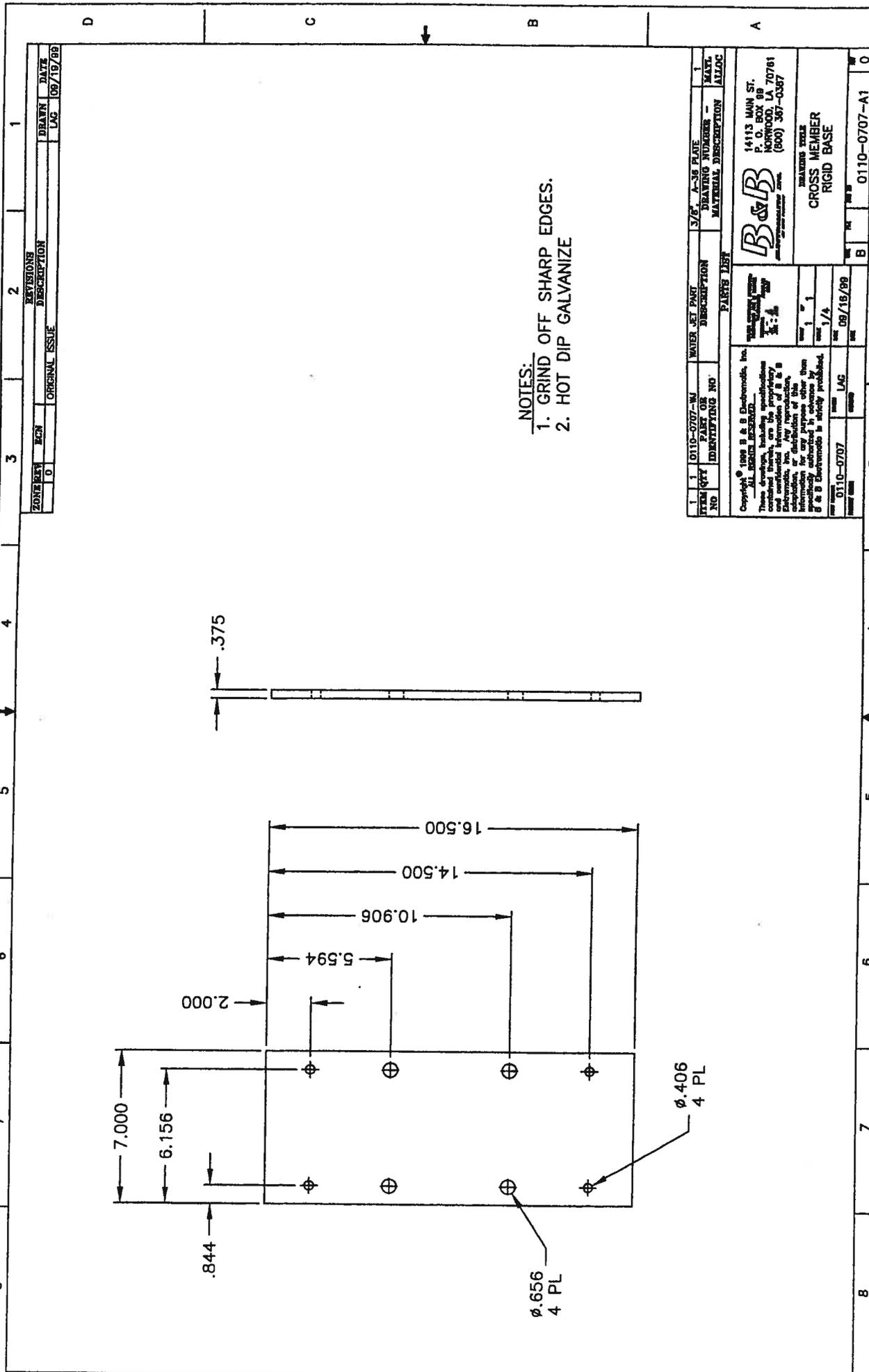
  

3	ADDED C-FACE ALIGNMENT NOTE PER ECR 50624SAM	08/16/94	BRARR	RT	2/15/98	TITLE	OUTLINE - 56 FR.
2	ADDED 'B' FRAME TO TABLE	2/18/91	RJP	DL	2/12/90		OPEN 'C' FACE
1	KEYWAY WAS 3.41. KEY WAS 1.38 PER C.H.	3/30/90	RT				
MR.	REVISION	BY	DATE				

THIS DRAWING IS DESIGN AND RETAIL IS OUR PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH OUR WORK ALL RIGHTS OF DESIGN AND INVENTION ARE RESERVED		FINISH	B & B	SIZE	BRANDING NO.
		ELECTRIC	A	A	033764

LEESON ELECTRIC CORPORATION



NOTES:  
 1. GRIND OFF SHARP EDGES.  
 2. HOT DIP GALVANIZE

ZONE	REV	ECN	ORIGINAL ISSUE	REVISIONS DESCRIPTION	DRAWN	DATE
0					LAG	06/19/89

ITEM NO	QTY	0110-0707-WJ BASE OR IDENTIFYING NO	WATER SET PART DESCRIPTION	3/8" A-36 PLATE DRAWING NUMBER - MATERIAL DESCRIPTION	MATL ALLOC
1	1	0110-0707	CROSS MEMBER RIGID BASE	0110-0707-A1	0

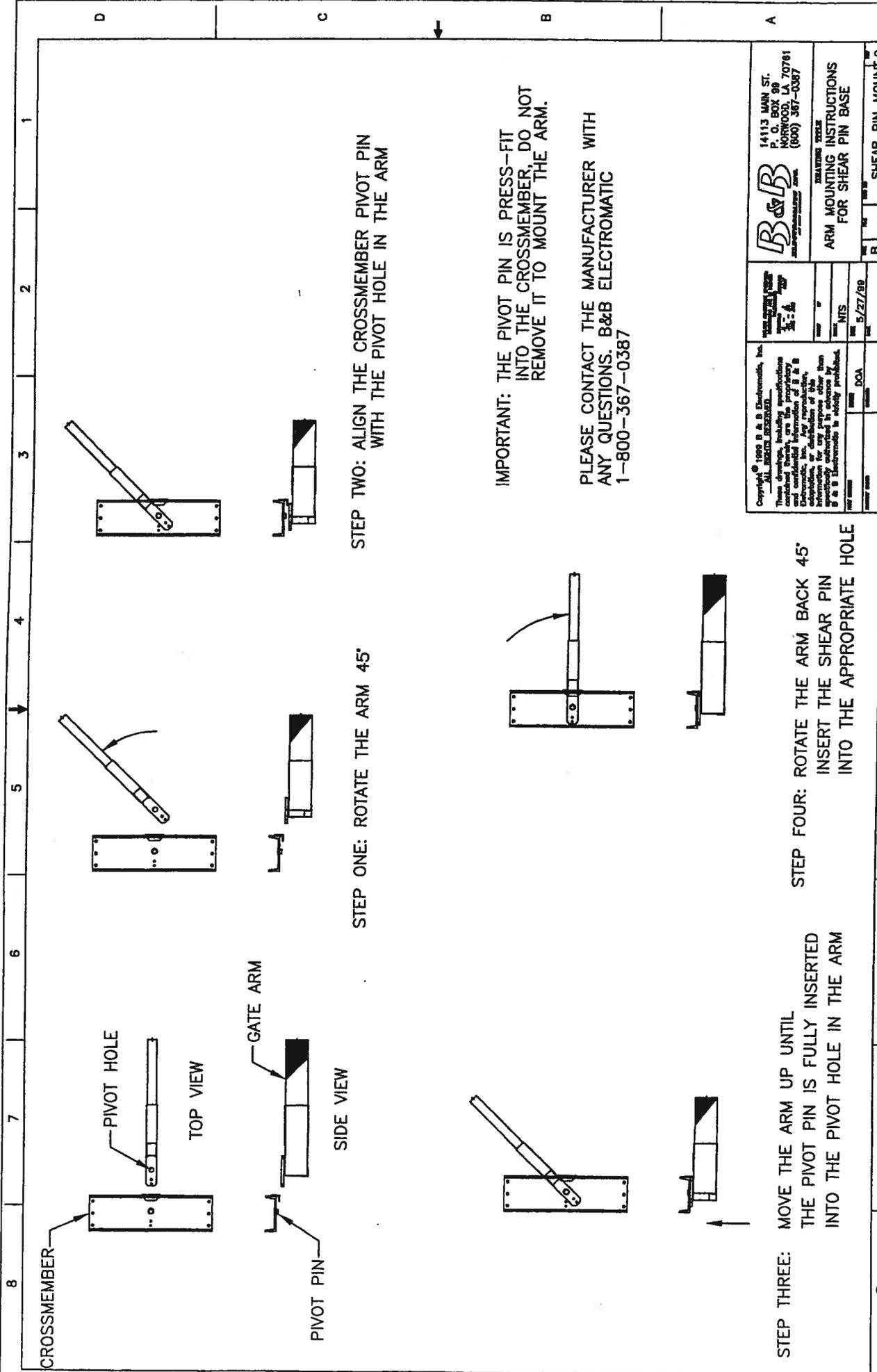
  

DATE	BY	CHKD	APP'D	DESCRIPTION
06/16/89	LAG			CROSS MEMBER RIGID BASE

<b>B&amp;B</b> 14113 MAIN ST. P. O. BOX 18 NORTHWOOD, N.H. 07070 (800) 367-0387	
DRAWING TITLE CROSS MEMBER RIGID BASE	

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STEP ONE: ROTATE THE ARM 45°

STEP TWO: ALIGN THE CROSSMEMBER PIVOT PIN WITH THE PIVOT HOLE IN THE ARM

IMPORTANT: THE PIVOT PIN IS PRESS-FIT INTO THE CROSSMEMBER, DO NOT REMOVE IT TO MOUNT THE ARM.

PLEASE CONTACT THE MANUFACTURER WITH ANY QUESTIONS. B&B ELECTROMATIC 1-800-367-0387

STEP THREE: MOVE THE ARM UP UNTIL THE PIVOT PIN IS FULLY INSERTED INTO THE PIVOT HOLE IN THE ARM

STEP FOUR: ROTATE THE ARM BACK 45° INSERT THE SHEAR PIN INTO THE APPROPRIATE HOLE

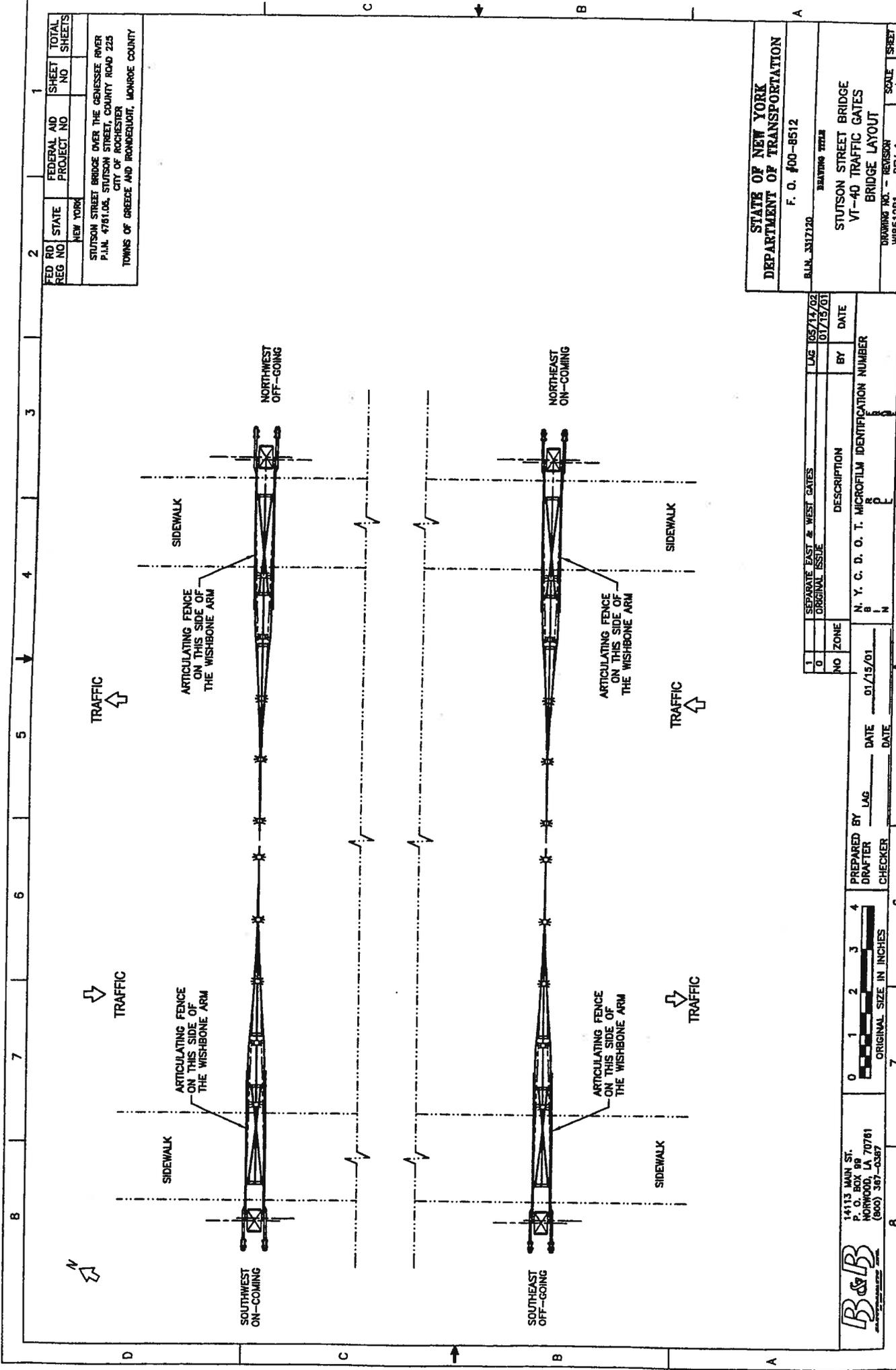
		14113 MAIN ST. P. O. BOX 99 MONROE, LA 70781 (800) 367-0387	
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# SECTION: 4

## VT-40 Drawings

**B&B**

An ISSI Company  
14113 Main Street  
Norwood, Louisiana 70761  
(225)629-5234 ~ Fax (225)629-5727  
BBENG@BBGATES.COM  
© 1997 B&B



FED RD REG NO	STATE	FEDERAL PROJECT NO	SHEET NO	TOTAL SHEETS
	NEW YORK			
STUTSON STREET BRIDGE OVER THE GENESSEE RIVER P.L.M. 4781.06, STUTSON STREET, COUNTY ROAD 225 CITY OF ROCHESTER TOWNS OF GREECE AND IRONDEQUOIT, MONROE COUNTY				

STATE OF NEW YORK DEPARTMENT OF TRANSPORTATION	
F. O. #00-8512	BRIDGE TITLE
B.L.M. 3317120	STUTSON STREET BRIDGE VT-40 TRAFFIC GATES BRIDGE LAYOUT
DRAWING NO. - REVISION	SCALE
W1851981 - REV. 4	

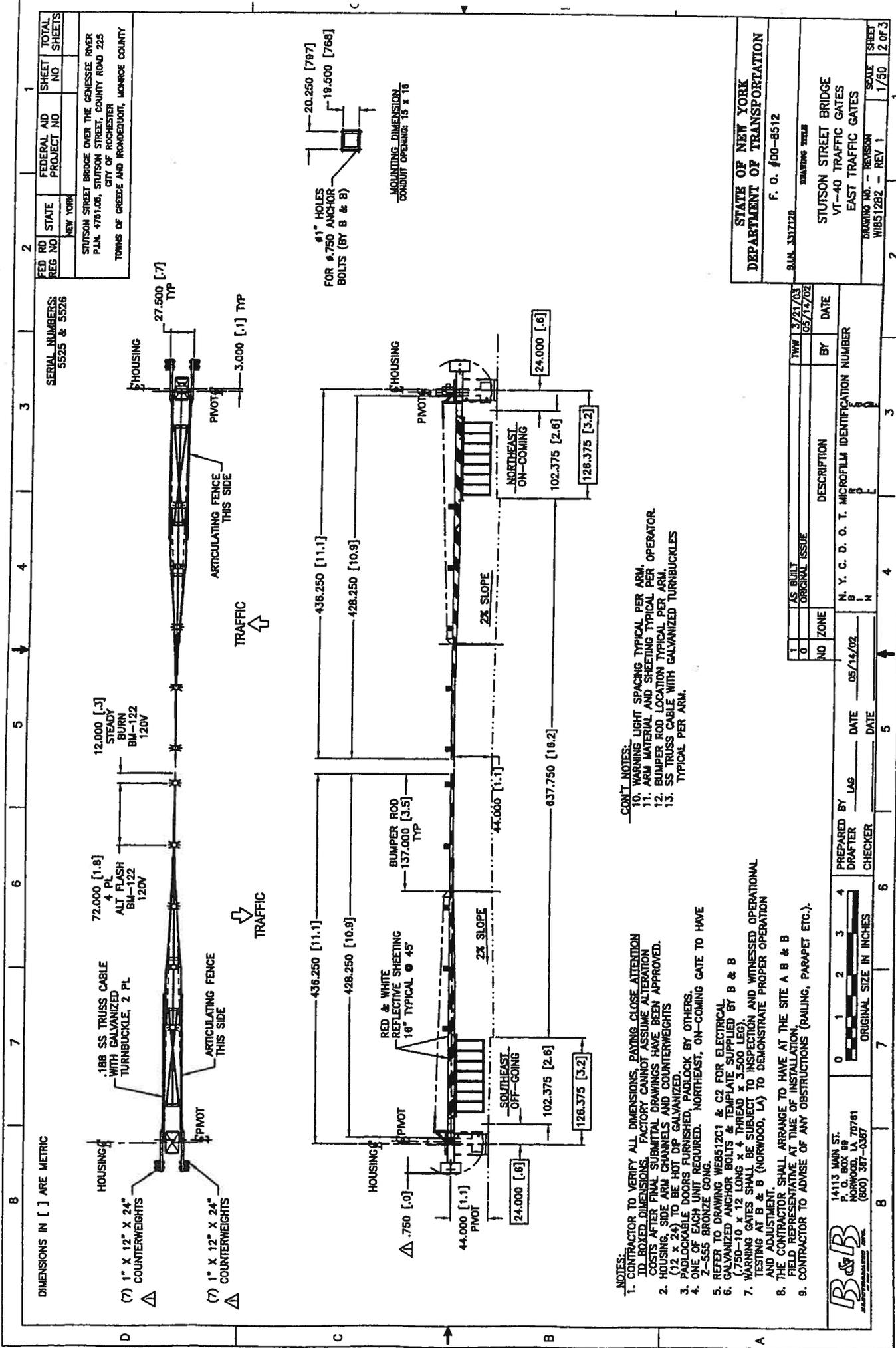
SEPARATE EAST & WEST GATES	LAG	05/14/02	BY	DATE
ORIGINAL ISSUE		01/15/01		
NO ZONE	DESCRIPTION	N. Y. C. D. O. T. MICROFILM IDENTIFICATION NUMBER		
		8	6	6
		8	6	6
		8	6	6

PREPARED BY	LAG	DATE	DATE
DRAFTER		01/15/01	
CHECKER			



14113 MAIN ST.  
P. O. BOX 98  
HORWOOD, LA 70761  
(800) 387-0387

**B&B**  
ENGINEERS



SERIAL NUMBERS:  
5525 & 5526

FED RD STATE  
REG NO NEW YORK

FEDERAL AID  
PROJECT NO

SHEET NO

TOTAL SHEETS

STUTSON STREET BRIDGE OVER THE GENESSEE RIVER  
P.O. BOX 4791,06, STUTSON STREET, COUNTY ROAD 225  
CITY OF ROCHESTER  
TOWNS OF GREECE AND IRONDEQUOT, MONROE COUNTY

STATE OF NEW YORK  
DEPARTMENT OF TRANSPORTATION

F. O. #00-8512

STUTSON STREET BRIDGE  
VT-40 TRAFFIC GATES  
EAST TRAFFIC GATES

SCALE  
DRAWING NO. - REVISION  
1/50  
2 OF 3

NO	AS BUILT	ORIGINAL	ISSUE	DATE
1				3/21/03
2				05/13/02

NO	ZONE	DESCRIPTION	BY	DATE
1		N. Y. C. D. O. T. MICROFILM IDENTIFICATION NUMBER		

PREPARED BY	LAG	DATE	DATE
DRAFTER		05/14/02	
CHECKER			

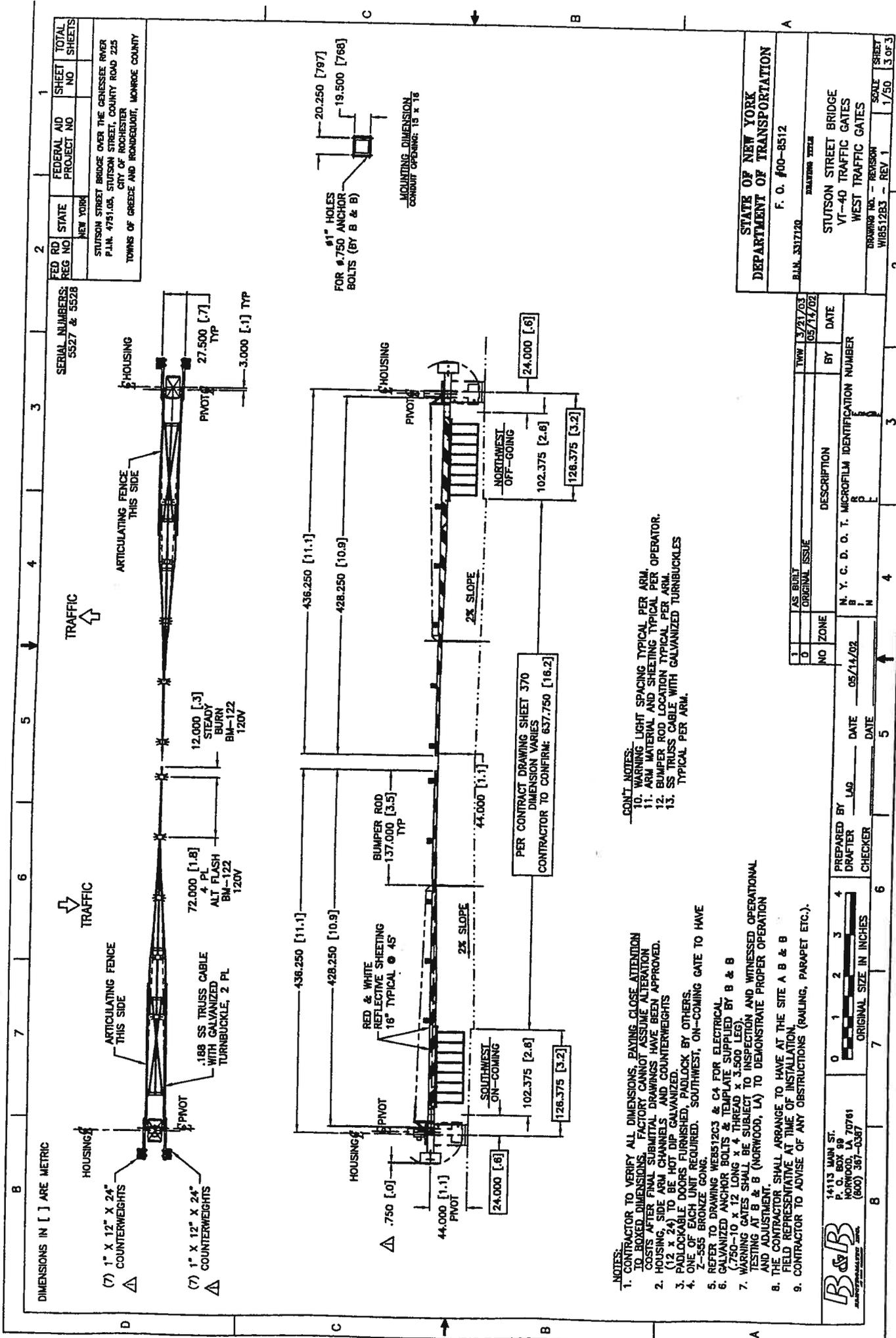
14113 MAIN ST.  
PO BOX 4791,06  
ROCHESTER, NY 14616  
(800) 387-0387

ORIGINAL SIZE IN INCHES  
0 1 2 3 4  
7

- NOTES:
- CONTRACTOR TO VERIFY ALL DIMENSIONS, PAYING CLOSE ATTENTION TO BOXED DIMENSIONS. FACTORY CANNOT ASSUME ALTERATION COSTS AFTER FINAL SUBMITTAL DRAWINGS HAVE BEEN APPROVED.
  - HOUSING SIDE BEB CHANNELS AND COUNTERWEIGHTS (12) LOCKING DOORS BE HOT DIP GALVANIZED.
  - PADLOCKS TO BE PROVIDED, PADLOCK ON-COMING GATE. ONE OF EACH REQUIRED. NORTHWEST, ON-COMING GATE TO HAVE 7-555 BRONZE COING.
  - REFER TO DRAWING WEBS12C1 & C2 FOR ELECTRICAL.
  - GALVANIZED ANCHOR BOLTS & TEMPLATE SUPPLIED BY B & B.
  - 7/16" TO 1/2" LONG x 4" THREAD x 3.500 LEG.
  - WARNING GATES SHALL BE SUBJECT TO INSPECTION AND WITNESSED OPERATIONAL TESTING AT B & B (NORWOOD, LA) TO DEMONSTRATE PROPER OPERATION AND ADJUSTMENT.
  - THE CONTRACTOR SHALL ARRANGE TO HAVE AT THE SITE A B & B FIELD REPRESENTATIVE AT TIME OF INSTALLATION.
  - CONTRACTOR TO ADVISE OF ANY OBSTRUCTIONS (RAILING, PARAPET ETC.).

- CONT. NOTES:
- WARNING LIGHT SPACING TYPICAL PER ARM.
  - ARM MATERIAL AND SHEETING TYPICAL PER OPERATOR.
  - BUMPER ROD LOCATION TYPICAL PER ARM.
  - SS TRUSS CABLE WITH GALVANIZED TURNBUCKLES TYPICAL PER ARM.





1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50		
SERIAL NUMBERS: 5527 & 5528		FED. RD. STATE PROJECT NO. NEW YORK		FED. AID PROJECT NO.		SHEET NO.		TOTAL SHEETS		STUTSON STREET BRIDGE OVER THE KENNESSEE RIVER P.L.M. 4781.05, STUTSON STREET, COUNTY ROAD 225 CITY OF ROCHESTER TOWNS OF GREEDE AND IRANDQUOIT, MONROE COUNTY		FED. RD. STATE PROJECT NO. NEW YORK		FED. AID PROJECT NO.		SHEET NO.		TOTAL SHEETS		STUTSON STREET BRIDGE OVER THE KENNESSEE RIVER P.L.M. 4781.05, STUTSON STREET, COUNTY ROAD 225 CITY OF ROCHESTER TOWNS OF GREEDE AND IRANDQUOIT, MONROE COUNTY		FED. RD. STATE PROJECT NO. NEW YORK		FED. AID PROJECT NO.		SHEET NO.		TOTAL SHEETS		STUTSON STREET BRIDGE OVER THE KENNESSEE RIVER P.L.M. 4781.05, STUTSON STREET, COUNTY ROAD 225 CITY OF ROCHESTER TOWNS OF GREEDE AND IRANDQUOIT, MONROE COUNTY		FED. RD. STATE PROJECT NO. NEW YORK		FED. AID PROJECT NO.		SHEET NO.		TOTAL SHEETS		STUTSON STREET BRIDGE OVER THE KENNESSEE RIVER P.L.M. 4781.05, STUTSON STREET, COUNTY ROAD 225 CITY OF ROCHESTER TOWNS OF GREEDE AND IRANDQUOIT, MONROE COUNTY		FED. RD. STATE PROJECT NO. NEW YORK		FED. AID PROJECT NO.		SHEET NO.		TOTAL SHEETS		STUTSON STREET BRIDGE OVER THE KENNESSEE RIVER P.L.M. 4781.05, STUTSON STREET, COUNTY ROAD 225 CITY OF ROCHESTER TOWNS OF GREEDE AND IRANDQUOIT, MONROE COUNTY	

STATE OF NEW YORK  
DEPARTMENT OF TRANSPORTATION  
F. O. #00-8512  
B.U.M. 3317120  
STUTSON STREET BRIDGE  
VI-40 TRAFFIC GATES  
WEST TRAFFIC GATES

AS BUILT ORIGINAL ISSUE  
NO ZONE  
N. Y. C. D. O. T. MICROFILM IDENTIFICATION NUMBER  
DATE 05/14/02  
DATE 05/14/02

PREPARED BY  
DRAFTER  
CHECKER  
DATE 05/14/02  
DATE 05/14/02

14113 MAIN ST.  
ROCHESTER, N.Y. 14609  
(518) 387-0387

ORIGINAL SIZE IN INCHES  
SCALE 1/50

DESIGNING NO. - REV 1  
SCALE 1/50  
SHEET 3 OF 3

CONTRACTOR TO VERIFY ALL DIMENSIONS, PAYING CLOSE ATTENTION TO BOXED DIMENSIONS. FACTORY CANNOT ASSUME ALTERATION COSTS AFTER FINAL SUBMITTAL DRAWINGS HAVE BEEN APPROVED.

NOTES:  
1. CONTRACTOR TO VERIFY ALL DIMENSIONS, PAYING CLOSE ATTENTION TO BOXED DIMENSIONS. FACTORY CANNOT ASSUME ALTERATION COSTS AFTER FINAL SUBMITTAL DRAWINGS HAVE BEEN APPROVED.  
2. HOUSING SIDE RAIL CHANNELS AND COUNTERWEIGHTS (12 x 24) TO BE HOT DIP GALVANIZED.  
3. PADLOCKABLE DOOR FURNISHED, PADLOCK BY OTHERS.  
4. ONE OF EACH UNIT REQUIRED. SOUTHWEST, ON-COMING GATE TO HAVE 2-555 BRONZE COAT.  
5. REFER TO DRAWING WEBS1203 & C4 FOR ELECTRICAL.  
6. GALVANIZED ANCHOR BOLTS & TEMPLATE SUPPLIED BY B & B (750-10 x 12 LONG x 4 THREAD x 3.500 LEG).  
7. WARNING AT B & B (NORWOOD, LA) TO DEMONSTRATE PROPER OPERATION AND ADJUSTMENT.  
8. THE CONTRACTOR SHALL ARRANGE TO HAVE AT THE SITE A B & B FIELD REPRESENTATIVE AT TIME OF INSTALLATION.  
9. CONTRACTOR TO ADVISE OF ANY OBSTRUCTIONS (RAILING, PARAPET ETC.).

TRAFFIC

TRAFFIC

TRAFFIC

PER CONTRACT DRAWING SHEET 370  
DIMENSION VARIES  
CONTRACTOR TO CONFIRM: 637.750 [16.2]

44.000 [1.1] PIVOT

44.000 [1.1] PIVOT

44.000 [1.1] PIVOT

44.000 [1.1] PIVOT

137.000 [3.5] TYP  
BUMPER ROD

128.375 [3.2]  
102.375 [2.6]  
NORTHWEST OFF-GOING

128.375 [3.2]  
102.375 [2.6]  
NORTHWEST OFF-GOING

128.375 [3.2]  
102.375 [2.6]  
SOUTHWEST ON-COMING

128.375 [3.2]  
102.375 [2.6]  
SOUTHWEST ON-COMING

24.000 [.6]

24.000 [.6]

24.000 [.6]

24.000 [.6]

436.250 [11.1]

436.250 [11.1]

436.250 [11.1]

436.250 [11.1]

428.250 [10.9]

428.250 [10.9]

428.250 [10.9]

428.250 [10.9]

20.250 [.7] TYP  
HOUSING

20.250 [.7] TYP  
HOUSING

20.250 [.7] TYP  
HOUSING

20.250 [.7] TYP  
HOUSING

19.500 [.768]  
#1" HOLES FOR #750 ANCHOR BOLTS (BY B & B)

19.500 [.768]  
#1" HOLES FOR #750 ANCHOR BOLTS (BY B & B)

19.500 [.768]  
#1" HOLES FOR #750 ANCHOR BOLTS (BY B & B)

19.500 [.768]  
#1" HOLES FOR #750 ANCHOR BOLTS (BY B & B)

3.000 [-.1] TYP

3.000 [-.1] TYP

3.000 [-.1] TYP

3.000 [-.1] TYP

12.000 [.3] STEADY BURN  
BM-122 120V

72.000 [1.8] ALT FLASH  
BM-122 120V

ARTICULATING FENCE THIS SIDE

ARTICULATING FENCE THIS SIDE

ARTICULATING FENCE THIS SIDE

ARTICULATING FENCE THIS SIDE

188 SS TRUSS CABLE WITH GALVANIZED TURNBUCKLE, 2 PL

188 SS TRUSS CABLE WITH GALVANIZED TURNBUCKLE, 2 PL

188 SS TRUSS CABLE WITH GALVANIZED TURNBUCKLE, 2 PL

188 SS TRUSS CABLE WITH GALVANIZED TURNBUCKLE, 2 PL

1" x 12" x 24" COUNTERWEIGHTS

HOUSING

HOUSING

HOUSING

HOUSING

2% SLOPE

2% SLOPE

2% SLOPE

2% SLOPE

RED & WHITE REFLECTIVE SHEETING 18" TYPICAL @ 45'

RED & WHITE REFLECTIVE SHEETING 18" TYPICAL @ 45'

RED & WHITE REFLECTIVE SHEETING 18" TYPICAL @ 45'

RED & WHITE REFLECTIVE SHEETING 18" TYPICAL @ 45'

ARTICULATING FENCE THIS SIDE

ARTICULATING FENCE THIS SIDE

ARTICULATING FENCE THIS SIDE

ARTICULATING FENCE THIS SIDE

TRAFFIC

TRAFFIC

TRAFFIC

TRAFFIC

TRAFFIC

TRAFFIC

TRAFFIC

TRAFFIC



# O'Connell Electric Co.

ELECTRICAL CONTRACTORS

Since 1911

Industrial & Commercial

Powerline & Substation

Signal & Street Lighting

TEGG Service

## TABLE OF CONTENTS

- 1) Traffic Gates
- 2) Maintenance
- 3) Pier Lights
- 4) Marine Air Horn
- 5) Gauge Light

### MAIN OFFICE

830 Phillips Road  
Victor, NY 14564-9747  
585-924-2176 Fax 585-924-4973

### BUFFALO OFFICE

929B Ransom Road  
Lancaster, NY 14086  
716-675-9010 Fax 716-686-0586

### SYRACUSE OFFICE

301 Stoutenger Street  
East Syracuse, NY 13057  
315-437-1453 Fax 315-437-7431

Stutson Street Bridge  
B&B Factory Order #00-8512  
VT-40 Specs., 4 Pages (Page 1 of 4)  
(4) Four Units Required



## Model VT-40

### GENERAL

The safety gate will be B & B type VT-40. These specifications are the minimum that will be acceptable. The gate will be of the standard vertical to horizontal arm type, will have a weatherproof housing and operating mechanism and will include such controls, accessories and modifications as specified.

### APPLICATIONS

The VT-40 Automatic Safety Gate will typically be used as a warning, traffic control and access control gate. Typical applications will include moveable bridge traffic warning gate, parking lot access control gate and any medium to heavy-duty traffic control or warning installation.

- **HOUSING**

The housing will be fabricated from 1/4-inch **5052-H32** aluminum. The aluminum housing will receive a primer finish. Formed, channel shaped side plates will be used to produce a strong configuration without welded corners.

Front and rear access doors will be hung on bronze, full-cross hinges with stainless steel hinge pins. Hinges will be of the slip-off type. Doors will be held in place with two bronze wing nuts and stainless steel swing bolts and will be sealed with neoprene strip gaskets. Top will be held in place with corrosion resistant hex head bolts. Openings for arm shafts will be equipped with "O" ring seals. Padlockable doors will be a standard feature (padlock by others).

The housing base will provide four 1-inch holes for mounting on the customer's foundation. Anchor bolts and templet will be supplied by the gate manufacturer. Standard anchor bolt size will be 3/4 - 10 x 12 + 4 hot dip galvanized.

- **ARM**

The arm will be constructed according to the customer's specifications and will be a *Wooden wishbone* - This arm, with aluminum articulating fence, will be fabricated from extra clear vertical grain fir in a wishbone shape (*Refer to installation drawings #WI8512A2 & WI8512A3 for actual dimensions*).

**Stutson Street Bridge**  
**B&B Factory Order #00-8512**  
**VT-40 Specs., 4 Pages (Page 2 of 4)**  
**(4) Four Units Required**

Double stainless steel truss cables and a spring loaded roadway bumper will be furnished with all arms.

Roadway arm lengths (dimension "A") will be measured from the centerline of the gate housing to the tip of the arm. (*Refer to installation drawings #WI8512A2 & WI8512A3 for actual dimensions*).

Gate arms will be covered on both sides with 16-inch alternating red and white engineering grade reflectorized sheeting.

- **ARM BASE**

A rigid mounting will be furnished.

- **ARM MOUNTING CHANNELS**

Arm mounting channels will be fabricated from carbon steel, hot dip galvanized. The roadway arm shaft will be 44 inches above the base line of the gate housing.

- **COUNTERWEIGHTS**

Each gate will be equipped with suitable hot dip galvanized steel counterweights of the sectional, bolt-on type. Counterweights will have a maximum 10% adjustment.

- **ARM SHAFTS**

The main arm shaft will be mounted in heavy-duty ball bearings and will be lubricated from the inside. The main arm shaft will be not less than 2 inches in diameter. Shaft material will be ASTM A311 Class B high strength, stressproof steel.

- **TRANSMISSION**

The transmission will be a fully enclosed, all gear, direct drive unit running in an oil bath. The drive train will not use belts or chains and will be connected to the arm shaft with a connecting rod having self-aligning ball ends. The connecting rod will be constructed of ASTM A311 Class B high strength stressproof steel.

During the opening and closing cycles, the gate arm will begin with zero velocity and accelerate smoothly reaching maximum velocity at mid-stroke (45 degrees). The arm will then decelerate smoothly to zero velocity at full stroke (90 degrees) preventing bounce or whip of the arm. Operating time to open or close the gate will be 13 seconds.

The standard connecting rod assembly will be designed to move the gate through a 90-degree travel.

- **MOTOR**

A 480V, 3PH, 1HP motor will be provided. The motor will be of the flange-mounted type, attached to the transmission case with not less than four bolts. The motor will be of the instant reversing type to permit reversing movement of the arms at any point of travel. Motor data will appear in the manual.

- **BRAKING MECHANISM**

A solenoid release, automatic motor brake will be furnished as part of the gate drive mechanism. The brake will automatically release when the handcrank is inserted to manually operate the gate.

- **HANDCRANK**

A handcrank and drill crank will be included with each gate to operate the gate during power failure. Door safety switches will automatically disconnect the control circuit power when the door is opened to allow for manual operation.

- **LIMIT SWITCH**

The gate limit switch will be a unit assembly containing eight individual switches having one set of normally open and one set of normally closed contacts each. Contacts will be totally enclosed and will have U.L. rating of not less than 15 amperes at 220 volts AC. Limit switch will be readily accessible and easily replaced with normal hand tools. Each individual switch will be controlled by an independent cam, which will be adjustable with a hex socket cap screw. The limit switch body, shafts and cams will be of corrosion resistant non-ferrous materials.

- **SAFETY SWITCHES, TERMINAL BLOCKS AND WIRING**

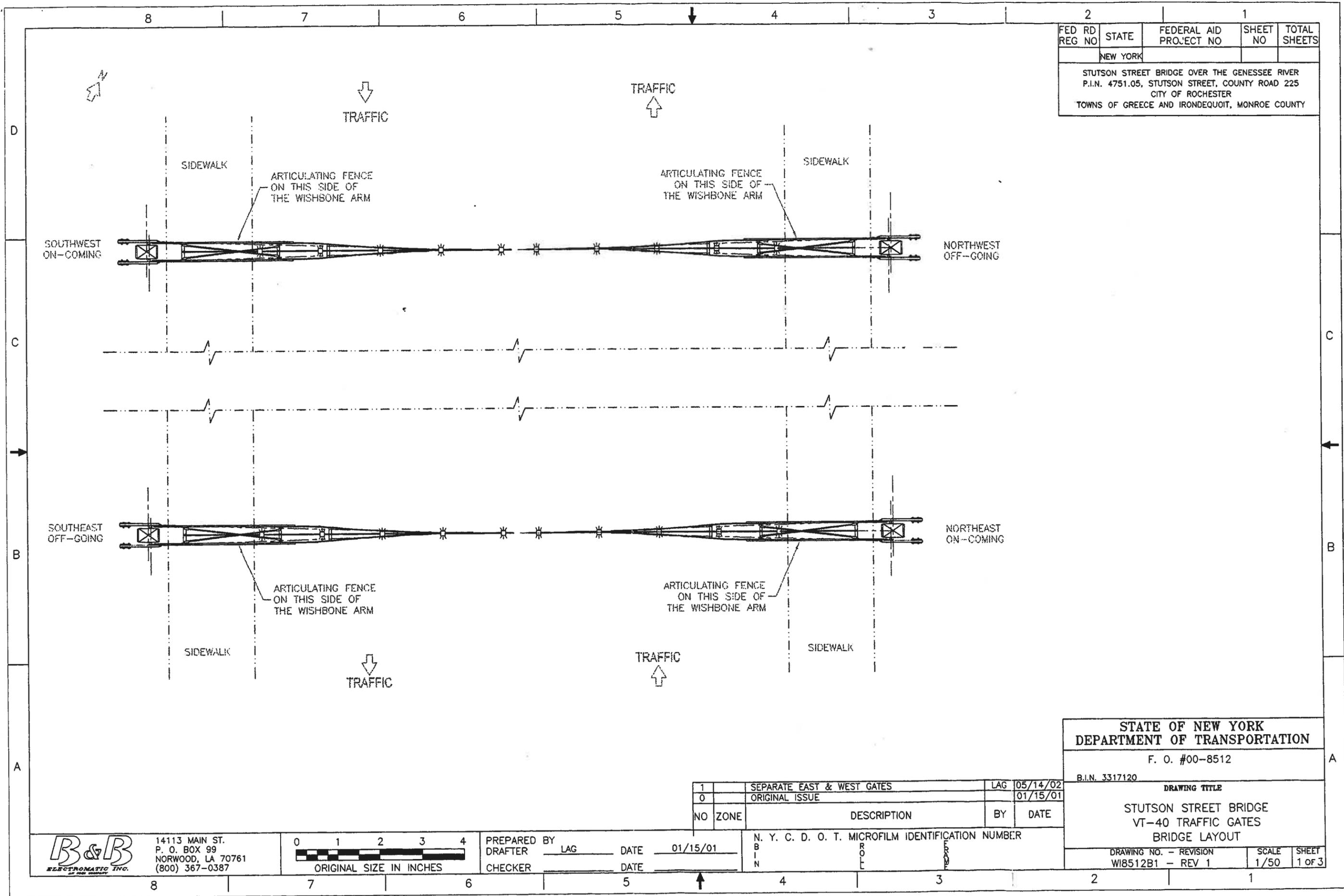
To protect operating and maintenance personnel from injury during service or installation, a manual disconnect switch will be furnished, installed and fully wired in the main motor leads. Automatic disconnect switches will be arranged to break the control circuit when either door is opened. Pressure type terminal blocks will be provided and installed inside the housing on the roadway side. All control wires will terminate on these blocks. Each terminal will be clearly labeled and all conductors will be color coded and/or numbered. The wiring diagram will reflect such colors or numbers. A GFI receptacle will be supplied in the gate housing. No conductor will be smaller than #16 AWG stranded. Each housing will contain a laminated electrical schematic secured to the inside of the housing for reference by service personnel.

**Stutson Street Bridge**  
**B&B Factory Order #00-8512**  
**VT-40 Specs., 4 Pages (Page 4 of 4)**  
**(4) Four Units Required**

- **QUALITY ASSURANCE**

Manufacturer of the traffic control gate operator will have a minimum of five years experience in the manufacture of industrial gate operators and barriers, and will make available replacement parts for ten years. All gates are individually inspected at time of final assembly and test. Each gate will be tagged "ACCEPTED" upon completion of inspection and a "Certification of Testing" will be supplied in the handbook for validation of meeting internal Quality Assurance standards.

FED RD REG NO	STATE	FEDERAL AID PROJECT NO	SHEET NO	TOTAL SHEETS
	NEW YORK			
STUTSON STREET BRIDGE OVER THE GENESSEE RIVER P.I.N. 4751.05, STUTSON STREET, COUNTY ROAD 225 CITY OF ROCHESTER TOWNS OF GREECE AND IRONDEQUOIT, MONROE COUNTY				



STATE OF NEW YORK  
DEPARTMENT OF TRANSPORTATION

F. O. #00-8512

B.I.N. 3317120

DRAWING TITLE

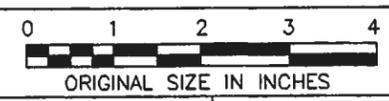
STUTSON STREET BRIDGE  
VT-40 TRAFFIC GATES  
BRIDGE LAYOUT

DRAWING NO. - REVISION	SCALE	SHEET
W18512B1 - REV 1	1/50	1 OF 3

1	SEPARATE EAST & WEST GATES	LAG	05/14/02	
0	ORIGINAL ISSUE		01/15/01	
NO	ZONE	DESCRIPTION	BY	DATE

N. Y. C. D. O. T. MICROFILM IDENTIFICATION NUMBER

**B&B**  
ELECTROMATIC INC.  
14113 MAIN ST.  
P. O. BOX 99  
NORWOOD, LA 70761  
(800) 367-0387



PREPARED BY  
DRAFTER LAG DATE 01/15/01  
CHECKER DATE

8 7 6 5 4 3 2 1

D

C

B

A

TRAFFIC

TRAFFIC

TRAFFIC

TRAFFIC

SIDEWALK

SIDEWALK

SIDEWALK

SIDEWALK

ARTICULATING FENCE ON THIS SIDE OF THE WISHBONE ARM

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ARTICULATING FENCE ON THIS SIDE OF THE WISHBONE ARM

SOUTHWEST ON-COMING

NORTHWEST OFF-GOING

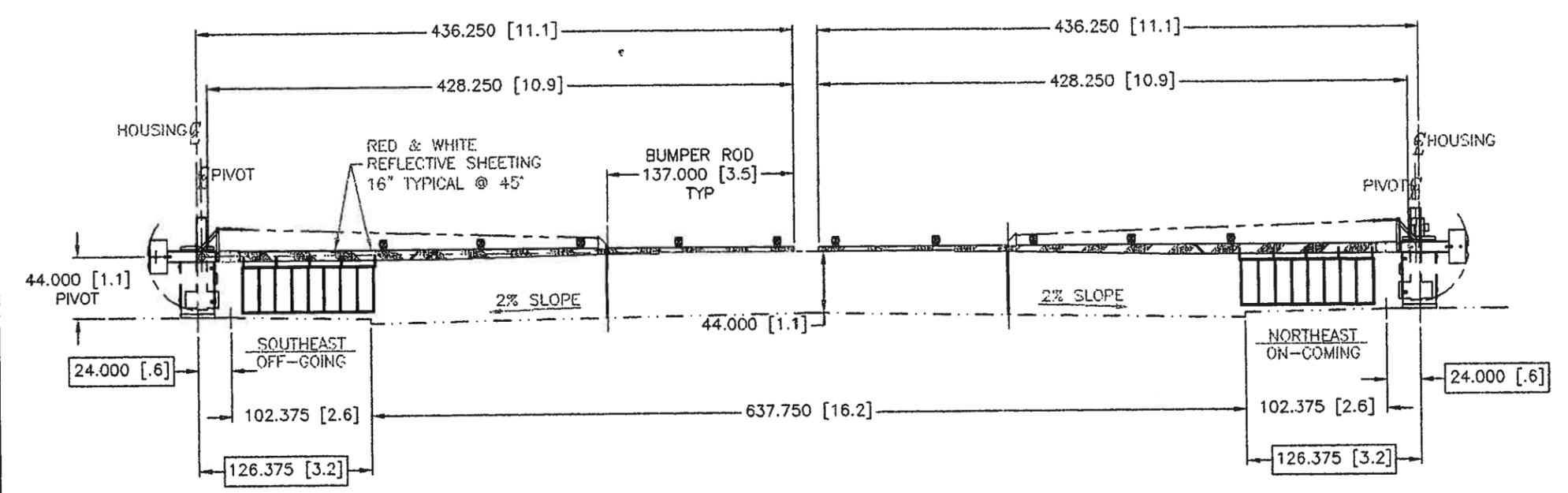
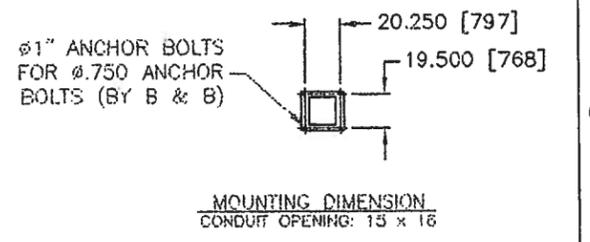
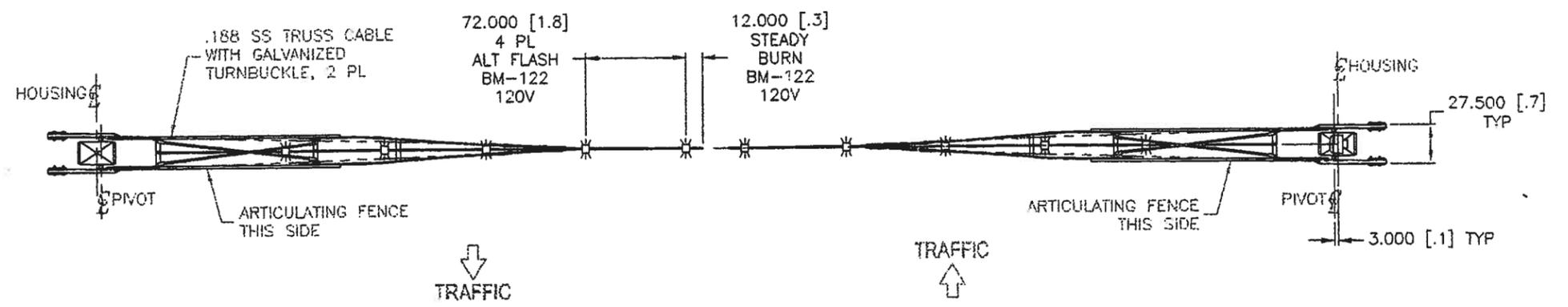
SOUTHEAST OFF-GOING

NORTHEAST ON-COMING

FED RD REG NO	STATE	FEDERAL AID PROJECT NO	SHEET NO	TOTAL SHEETS
	NEW YORK			

STUTSON STREET BRIDGE OVER THE GENESSEE RIVER  
P.I.N. 4751.05, STUTSON STREET, COUNTY ROAD 225  
CITY OF ROCHESTER  
TOWNS OF GREECE AND IRONDEQUOIT, MONROE COUNTY

DIMENSIONS IN [ ] ARE METRIC



- NOTES:**
- CONTRACTOR TO VERIFY ALL DIMENSIONS, PAYING CLOSE ATTENTION TO BOXED DIMENSIONS. FACTORY CANNOT ASSUME ALTERATION COSTS AFTER FINAL SUBMITTAL DRAWINGS HAVE BEEN APPROVED.
  - HOUSING, SIDE ARM CHANNELS/TUBES AND COUNTERWEIGHTS (12 x 24) TO BE HOT DIP GALVANIZED.
  - PADLOCKABLE DOORS FURNISHED, PADLOCK BY OTHERS.
  - ONE OF EACH UNIT REQUIRED. NORTHEAST, ON-COMING GATE TO HAVE Z-555 BRONZE GONG.
  - REFER TO DRAWING WE8512B1 & B2 FOR ELECTRICAL.
  - GALVANIZED ANCHOR BOLTS & TEMPLATE SUPPLIED BY B & B (.750-10 x 12 LONG x 4 THREAD x 3.500 LEG).
  - WARNING GATES SHALL BE SUBJECT TO INSPECTION AND WITNESSED OPERATIONAL TESTING AT B & B (NORWOOD, LA) TO DEMONSTRATE PROPER OPERATION AND ADJUSTMENT.
  - THE CONTRACTOR SHALL ARRANGE TO HAVE AT THE SITE A B & B FIELD REPRESENTATIVE AT TIME OF INSTALLATION.
  - CONTRACTOR TO ADVISE OF ANY OBSTRUCTIONS (RAILING, PARAPET ETC.).

- CON'T NOTES:**
- WARNING LIGHT SPACING TYPICAL PER ARM.
  - ARM MATERIAL AND SHEETING TYPICAL PER OPERATOR.
  - BUMPER ROD LOCATION TYPICAL PER ARM.
  - SS TRUSS CABLE WITH GALVANIZED TURNBUCKLES TYPICAL PER ARM.

STATE OF NEW YORK  
DEPARTMENT OF TRANSPORTATION

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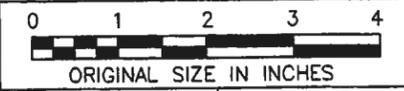
DRAWING TITLE  
STUTSON STREET BRIDGE  
VT-40 TRAFFIC GATES  
EAST TRAFFIC GATES

NO	ZONE	DESCRIPTION	BY	DATE
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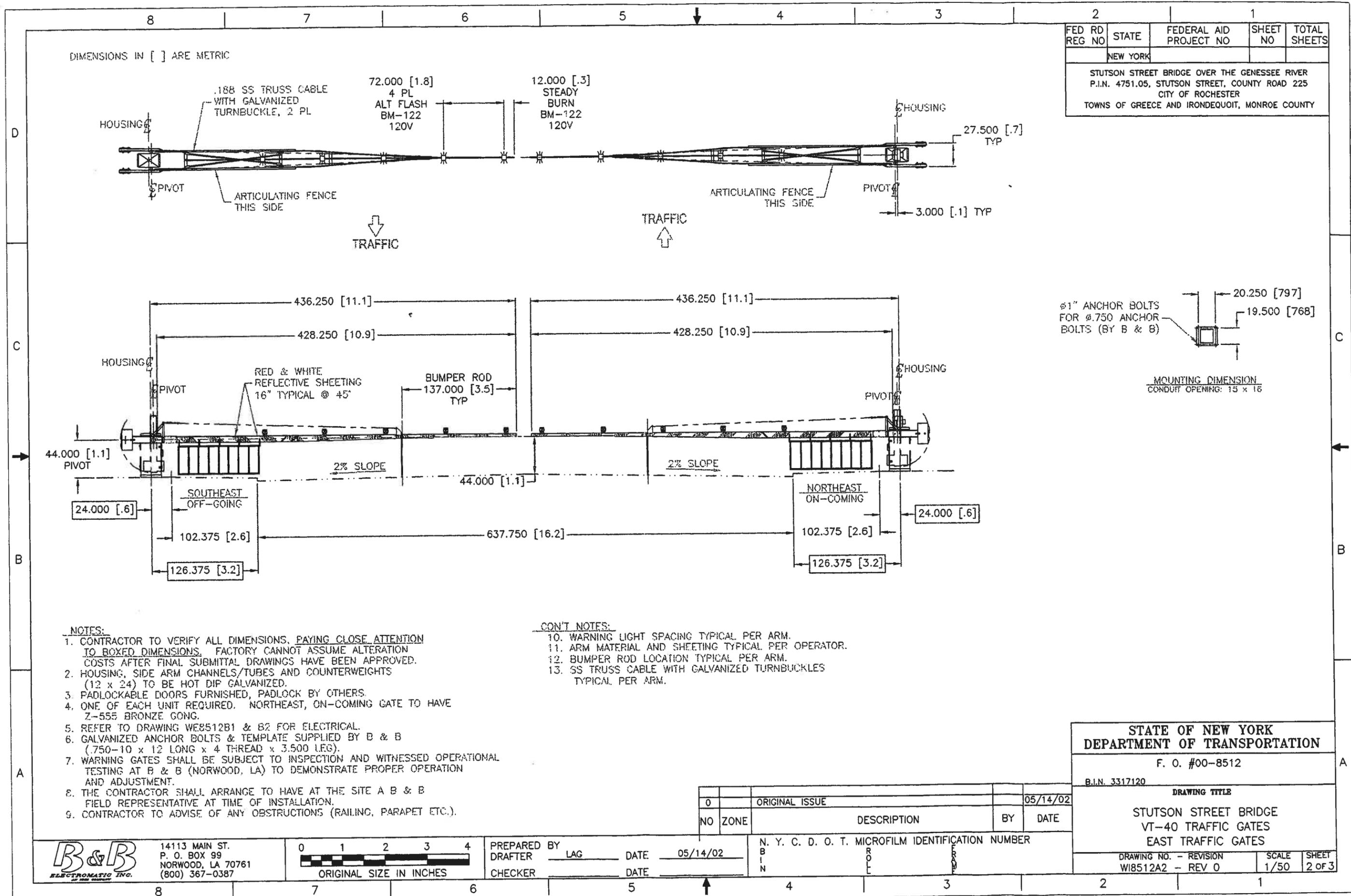
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DRAWING NO. - REVISION	SCALE	SHEET
W8512A2 - REV 0	1/50	2 OF 3

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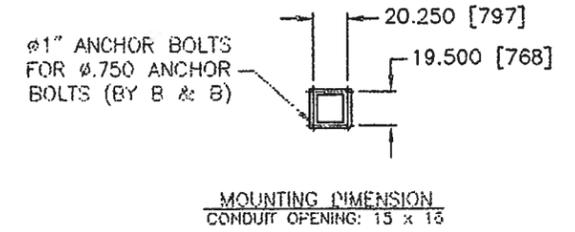
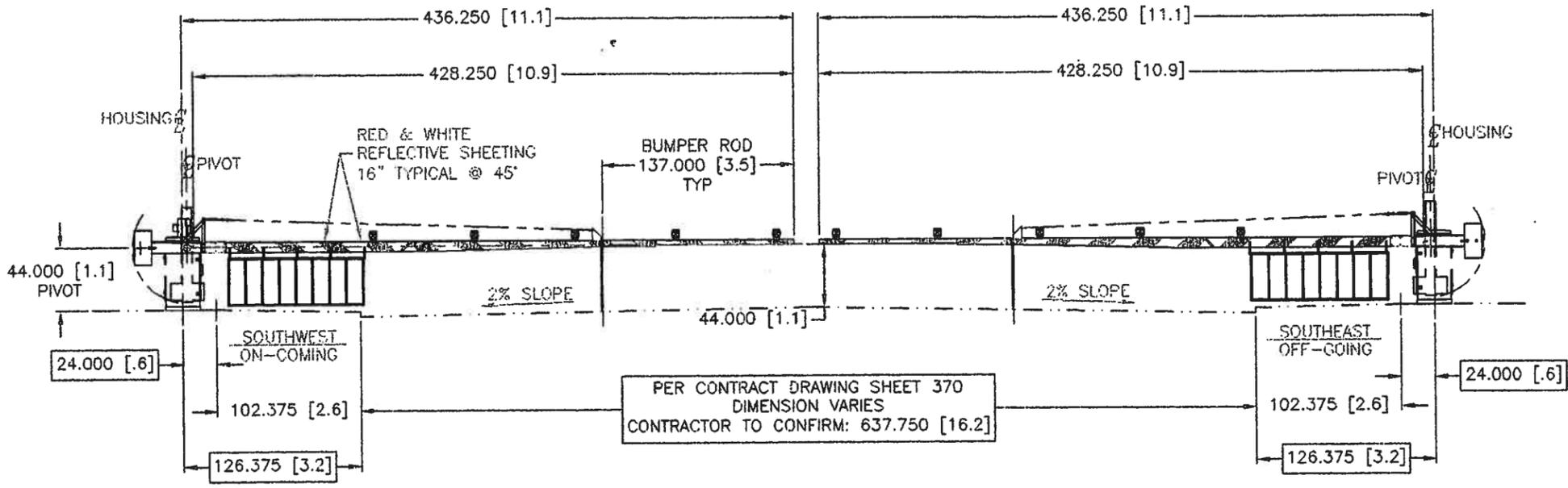
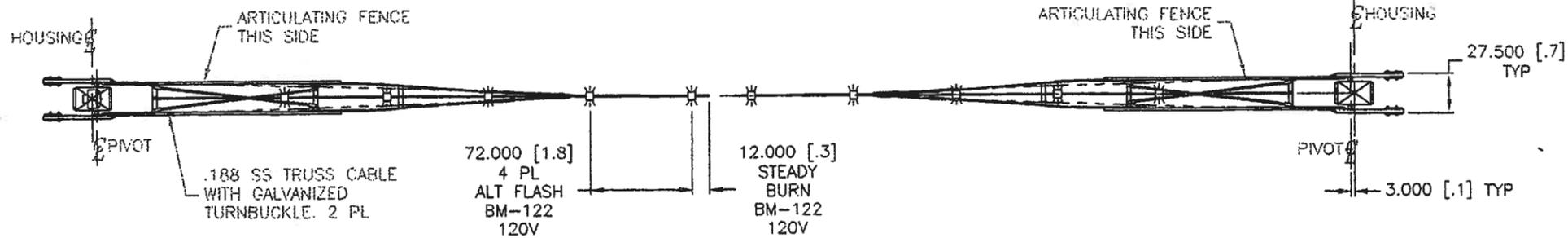


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CHECKER DATE



FED RD REG NO	STATE	FEDERAL AID PROJECT NO	SHEET NO	TOTAL SHEETS
	NEW YORK			
STUTSON STREET BRIDGE OVER THE GENESSEE RIVER P.I.N. 4751.05, STUTSON STREET, COUNTY ROAD 225 CITY OF ROCHESTER TOWNS OF GREECE AND IRONDEQUOIT, MONROE COUNTY				

DIMENSIONS IN [ ] ARE METRIC



NOTES:

- CONTRACTOR TO VERIFY ALL DIMENSIONS, PAYING CLOSE ATTENTION TO BOXED DIMENSIONS. FACTORY CANNOT ASSUME ALTERATION COSTS AFTER FINAL SUBMITTAL DRAWINGS HAVE BEEN APPROVED.
- HOUSING, SIDE ARM CHANNELS/TUBES AND COUNTERWEIGHTS (12 x 24) TO BE HOT DIP GALVANIZED.
- PADLOCKABLE DOORS FURNISHED, PADLOCK BY OTHERS.
- ONE OF EACH UNIT REQUIRED. SOUTHWEST, ON-COMING GATE TO HAVE Z-555 BRONZE GONG.
- REFER TO DRAWING W8512B5 & B4 FOR ELECTRICAL.
- GALVANIZED ANCHOR BOLTS & TEMPLATE SUPPLIED BY B & B (.750-10 x 12 LONG x 4 THREAD x 3.500 LEG).
- WARNING GATES SHALL BE SUBJECT TO INSPECTION AND WITNESSED OPERATIONAL TESTING AT B & B (NORWOOD, LA) TO DEMONSTRATE PROPER OPERATION AND ADJUSTMENT.
- THE CONTRACTOR SHALL ARRANGE TO HAVE AT THE SITE A B & B FIELD REPRESENTATIVE AT TIME OF INSTALLATION.
- CONTRACTOR TO ADVISE OF ANY OBSTRUCTIONS (RAILING, PARAPET ETC.).

CONT. NOTES:

- WARNING LIGHT SPACING TYPICAL PER ARM.
- ARM MATERIAL AND SHEETING TYPICAL PER OPERATOR.
- BUMPER ROD LOCATION TYPICAL PER ARM.
- SS TRUSS CABLE WITH GALVANIZED TURNBUCKLES TYPICAL PER ARM.

STATE OF NEW YORK  
DEPARTMENT OF TRANSPORTATION

F. O. #00-8512

B.I.N. 3317120

DRAWING TITLE

STUTSON STREET BRIDGE  
VT-40 TRAFFIC GATES  
WEST TRAFFIC GATES

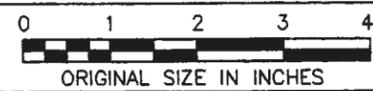
DRAWING NO. - REVISION	SCALE	SHEET
W8512A3 - REV 0	1/50	3 OF 3

NO	ZONE	DESCRIPTION	BY	DATE
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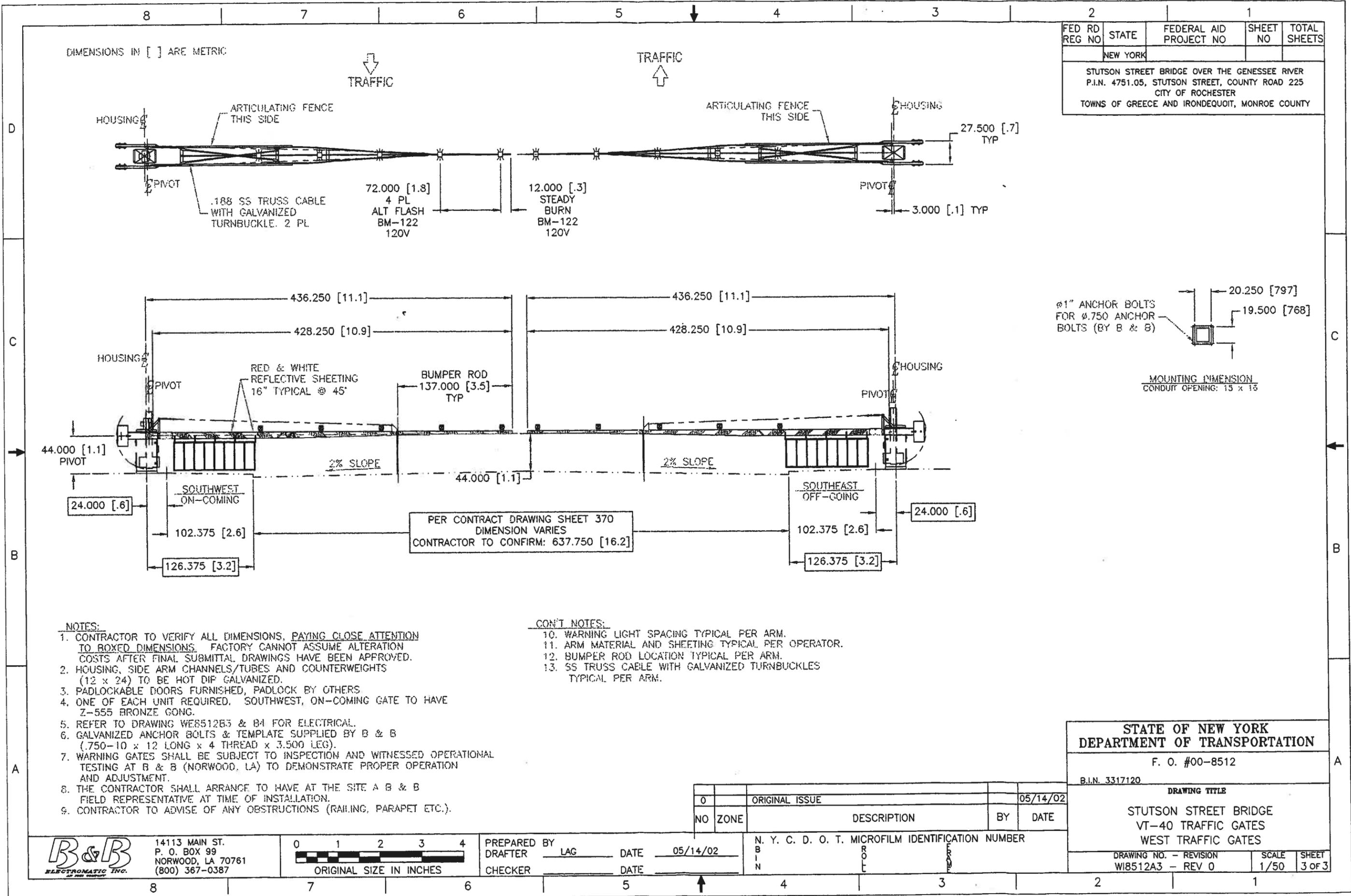
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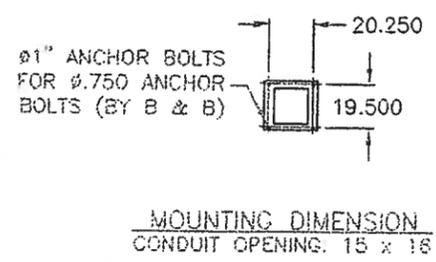
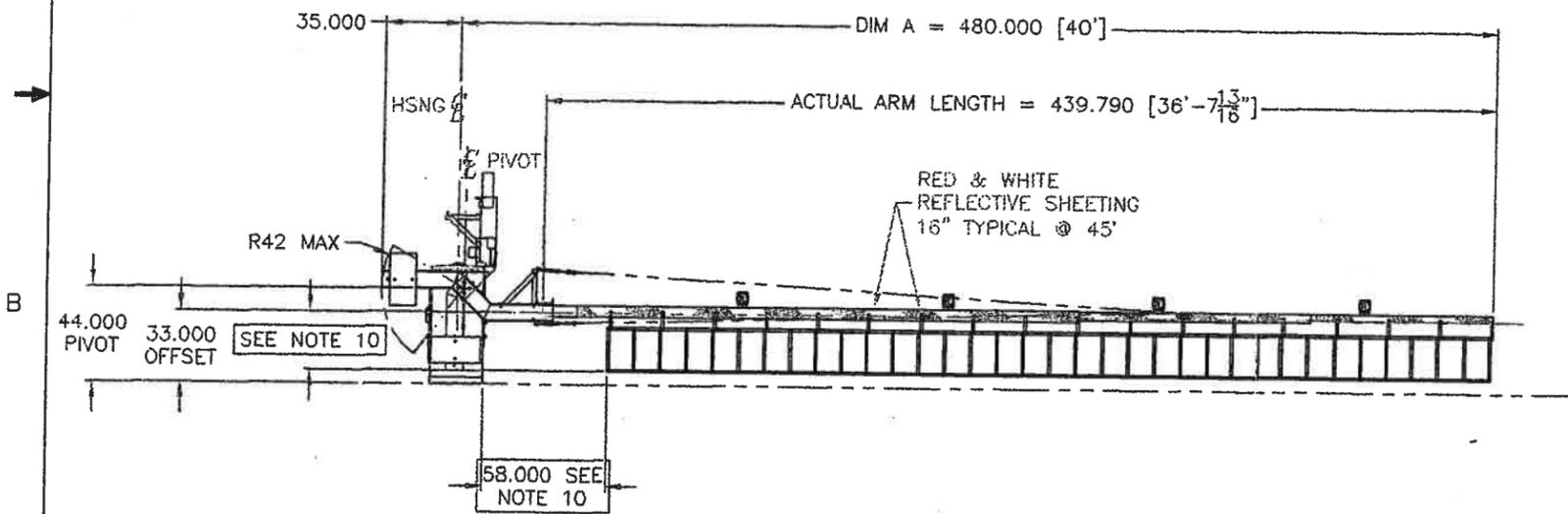
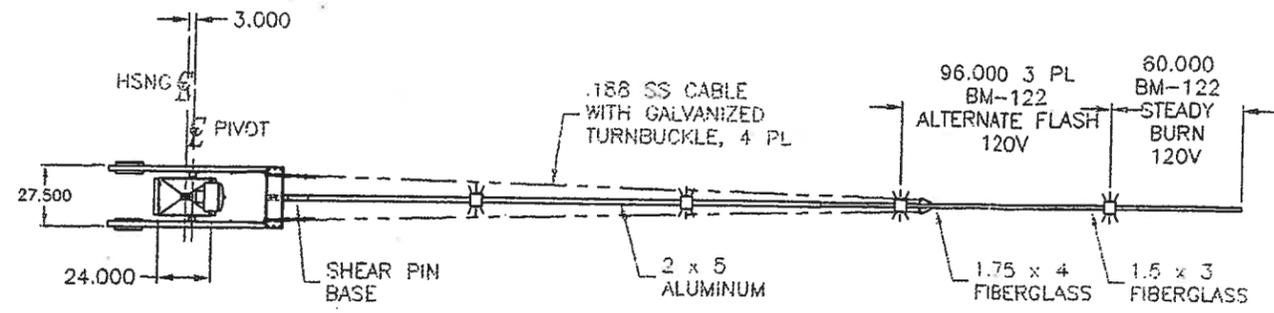
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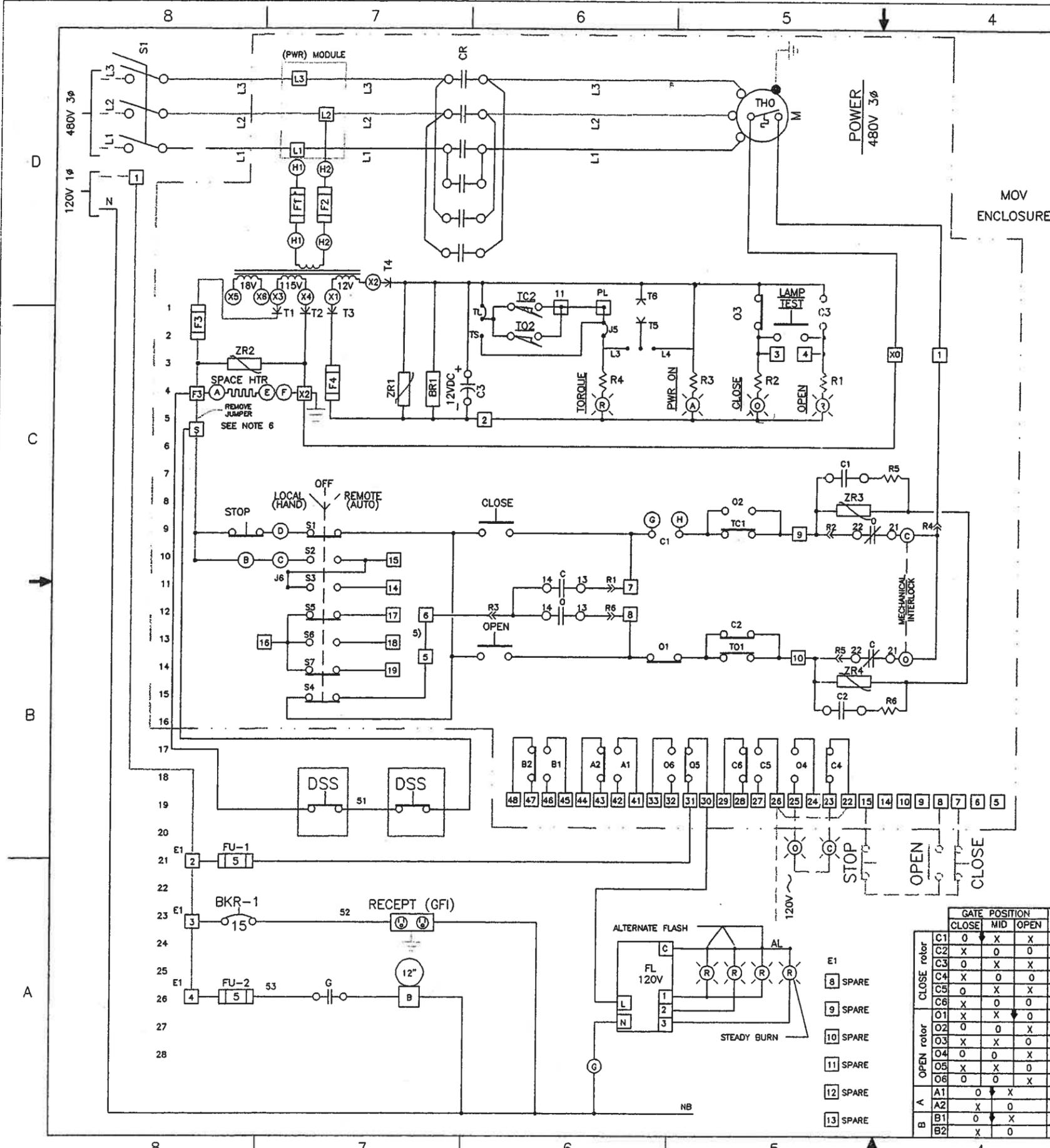
ZONE REV		ECN	REVISIONS		DRAWN	DATE
			DESCRIPTION			
0			ORIGINAL ISSUE		LAG	01/15/01



**NOTES:**

1. CONTRACTOR TO VERIFY ALL DIMENSIONS. FACTORY CANNOT ASSUME ALTERATION COSTS AFTER FINAL SUBMITTAL DRAWINGS HAVE BEEN APPROVED.
2. HOUSING TO BE ALUMINUM.
3. SIDE ARM CHANNELS AND COUNTERWEIGHTS (12 x 24) TO BE HOT DIP GALVANIZED.
4. PADLOCKABLE DOORS FURNISHED, PADLOCK BY OTHERS.
5. FOUR UNITS REQUIRED, FOUR WITH BRONZE Z-555 GONC.
6. REFER TO DRAWING WE8512A1 FOR ELECTRICAL.
7. ANCHOR BOLTS & TEMPLATE SUPPLIED BY B & B. (.750-10 x 12 LONG x 4 THREAD x 3.500 LEG).
8. WARNING GATES SHALL BE SUBJECT TO INSPECTION AND WITNESSED OPERATIONAL TESTING AT B & B (NORWOOD, LA) TO DEMONSTRATE PROPER OPERATION AND ADJUSTMENT.
9. THE CONTRACTOR SHALL ARRANGE TO HAVE AT THE SITE A B & B FIELD REPRESENTATIVE AT TIME OF INSTALLATION.
10. CONTRACTOR TO ADVISE OF ANY OBSTRUCTIONS (RAILING, PARAPET ETC.).

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PART NUMBER	DRAWN	DATE	DRAWING TITLE	
00-8512	LAG	01/15/01	STUTSON STREET BRIDGE VT-40A WARNING GATE DIM A = 40'-0" ALUM/FBG ARM	
FACTORY ORDER	CHECKED	DATE	SIZE	REV
			D FO	0



ZONE		REV	ECN	REVISIONS DESCRIPTION	DRAWN	DATE
0				ORIGINAL ISSUE	LAG	01/15/01

- NOTES:
- CONTACTS SHOWN: GATE CLOSED, VOLTAGE: OFF, S/S: HAND.
  - CUSTOMER WIRES TO TERMINALS ON PWR AND TBM MODULES.
    - ⊙ M2CP INTERNAL TERMINAL INTERCONNECT WIRING POINTS.
    - - - FIELD CONNECTED WIRING BY OTHERS.
    - INTERCONNECT WIRING BETWEEN E1 & MOV INTERNAL TERMINALS.
  - TORQUE SWITCH TC1 & TO1 NC CONTACTS OPEN, AND TC2 & TO2 CONTACTS MAKE ON FIELD ADJUSTABLE MECHANICAL OVERLOAD IN CLOSE C, OR OPEN O, DIRECTION.
  - TO TORQUE GATE CLOSED: INSTALL JUMPER G TO H ON LSM.
  - FOR MAINTAINED PB CONTROL: REMOVE 5 TO 6 JUMPER ON TBM.
  - FOR REMOTE STOP PE OR RELAY: REMOVE F3 TO 5 TBM JUMPER.
  - O & C (21-22) REVERSING CONTACTOR N.C. INTERLOCK CONTACTS. O & C (13-14) MOMENTARY PUSHBUTTON N.O. SEAL-IN CONTACTS.
  - MOTOR THERMAL CONTACTS OPEN WITH EXCESSIVE TEMPERATURE.
  - POSITION INDICATOR PILOT LIGHTS: LED SOLID-STATE  
 OPEN INDICATES: FULL OPEN (RED)  
 CLOSE INDICATES: FULL CLOSED (GREEN)  
 MID-POSITION: BOTH OPEN AND CLOSE ILLUMINATED.  
 PWR ON AND TORQUE INDICATORS ARE ONLY VISIBLE WITH COVER OPEN FOR CONVENIENCE DURING MAINTENANCE PROCEDURES.
  - ALL CONTROL CONDUCTORS SHALL BE #14 AWG MINIMUM STRANDED WIRE.
  - NUMBER ALL CONDUCTORS, BOTH ENDS.
  - ALL DASHED LINES REPRESENTS WIRING BY OTHERS.
  - ALL POWER CONDUCTORS SHALL BE #10 AWG MINIMUM STRANDED WIRE.

\*PARTS LIST PER GATE

ITEM NO	QTY	PART NUMBER	NOMENCLATURE/DESCRIPTION
S1	1	YS304-KG-2	MAIN DISCONNECT SWITCH, 2 POLE
	1	X797-4A238	GFI DUPLEX SOCKET BOX
RECEPT:	1	YR322-1591-F1	GFI DUPLEX SOCKET, 120V, 15A
NB	1	YB323-0001	NEUTRAL BUSS
MOV	1	0040-Q7T2-3	ELECT. ACT. AND CONT. 480V, 3φ, 1/12HP, 13 SEC.
	1	0040-O713	BRACKET, HAND CRANK SAFETY SWITCH
G	1	YR797-5X838	RELAY, GONG ACTIVATION
	1	YF304-9080GH10	CHANNEL END CLAMP
	1	YF304-9080GH148	TERMINAL BLOCK CHANNEL
	1	YF304-9080GF1	FUSE END SECTION
	2	YF304-9080GF6B	FUSE HOLDER
FU-2	1	YF315-FNM-5	FUSE, 5A, GONG
FU-1	1	YF315-FNM-5	FUSE, 5A, FLASHER
FL	1	9200-O540	AW25-500, SOLID STATE FLASHER, 120 Vout
	1	YT304-9080GM6B	END SECTION
E1	13	YT304-9080GR1	SINGLE SECTION STD BUCANNAN TERMINAL
DSS	2	YS646-E19-00M	DOOR SAFETY SWITCH, DPDT
B	1	0555-0000/B	Z555 GONG W/ BRONZE SHELL
BKR-2	1	YB304-Q0U115	CIRCUIT BREAKER, SINGLE POLE, 15A
BKR-1	1	YB304-Q0U115	CIRCUIT BREAKER, SINGLE POLE, 15A
AL	4	0122-0002	WARNING LIGHT, BM-122, 120V

\*\*SS TABLE

	HAND	OFF	AUTO
S1	X	O	O
S2	O	X	X
S3	O	X	X
S4	X	X	O
S5	O	O	O
S6	O	X	X
S7	X	X	O

	GATE POSITION			CONTACT FUNCTION
	CLOSE	MID	OPEN	
C1	0	X	X	CLOSE COIL
C2	X	0	0	BYPASS TO 1
C3	0	X	X	OPEN LAMP
C4	X	0	0	CLOSE IND.
C5	0	X	X	SPARE
C6	X	0	0	SPARE
O1	X	X	0	OPEN COIL
O2	0	0	X	BYPASS TC1
O3	X	X	0	CLOSE LAMP
O4	0	0	X	OPEN IND.
O5	X	X	0	FLASHER
O6	0	0	X	SPARE
A1	0	X	X	SPARE
A2	X	0	0	SPARE
B1	0	X	X	SPARE
B2	X	0	0	SPARE

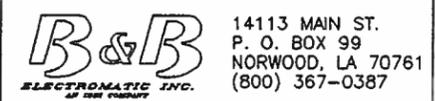
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SHEET 1 OF 1  
SCALE NTS

PART NUMBER 00-8512  
CHECKED LAG  
DATE 01/15/01



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DRAWING TITLE  
STUTSON STREET BRIDGE  
VT-40A WARNING GATE  
480V 3φ

SIZE	FILE	DWG NO	REV
D	FO	WE8512A1	0

## 6. Sample Maintenance Checklists

The following sample checklists are provided as example lists that may be used to "check off" work items. These are provided as a suggested baseline for reference only. They should be expanded upon and updated as necessary to be consistent with maintenance personnel work practices, and to ensure that all systems are properly maintained for reliable operation of the bridge.

# O'Rorke Machinery Electrical Maintenance Chart

Part	Qty.	Frequency	Maintainer Notes	Year:												
				April	May	June	July	Aug	Sept	Oct	Nov	Dec				
<b>Operation Controls Verification</b>	-															
Sequence of operation - interlocks and permissives	-	Biennial														
<b>Electric Motors</b>	4															
Remove debris	-	Annual														
Check conductors and terminations	-															
Megger stator windings to ground	-															
<b>Brakes</b>	8															
Remove debris	-	Annual														
Check terminations	-															
Inspect wiring	-															
Check limit switch functionality	-															
Megger brake motor windings to ground	-															
<b>Tail Lock Actuator</b>	4															
Remove debris	-	Annual														
Check conductors and terminations	-															
Megger motor windings to ground	-															
<b>Standby Generator</b>	1															
Operation check	-	Monthly														
Fluid checks	-	6 months														
Check status indicators	-															
Check cables and connections	-															
Check air filters	-															
Replace fluid filters	-															
Fuel check	-															
Check belts	-															
Check hoses and hose clamps	-	Annual														
Clean radiator	-															
Megger armature windings	-															
<b>Automatic Transfer Switch</b>	1															
Remove debris	-	Annual														
Check for wear	-															
Check conductors and terminations	-															
Enclosure integrity	-															
Area clearances	-															
Simulate power failure to use ATS	-															
<b>Motor Control Center</b>	1															
Remove debris	-	Annual														
Check conductors and terminations	-															
Exercise starters, circuit breakers, etc.	-															
Enclosure integrity	-															
Area clearances	-															
Continuity checks at circuit breakers	-															
Continuity checks at fuses	-															
Overloads and TVSS checks	-															

Note:

1. Electrical maintenance by trained personnel only.
2. Use lockout/tagout procedures to de-energize components to ensure safety during maintenance procedures.

## O'Rorke Machinery Electrical Maintenance Chart

Part	Qty.	Frequency	Maintainer Notes	Year:												
				April	May	June	July	Aug	Sept	Oct	Nov	Dec				
<b>Uninterruptible Power Supply</b>	<b>1</b>															
Remove debris	-	Annual														
Check conductors and terminations	-															
Battery test	-															
Test operation	-															
<b>SCR Drives</b>	<b>4</b>															
Remove debris	-	Annual														
Check conductors and terminations	-															
Verify functionality of relays, contractors	-															
Verify functionality of control and indication	-															
Enclosure integrity	-															
Test operate using each drive and motor	-															
<b>Control Console</b>	<b>1</b>															
Test indication lights	-	Annual														
Test switches and pushbuttons	-															
Check conductors and terminations	-															
Remove debris	-															
Enclosure lamps	-															
<b>Control Relays</b>	<b>1</b>															
Remove debris	-	Annual														
Check conductors and terminations	-															
Check breakers, fuses, relays, and contacts	-															
Enclosure integrity	-															
Area clearances	-															
<b>Liimit Switches and RCLS</b>	<b>-</b>															
Exercise limit switch levers	-	Monthly														
Verify proper operation	-															
Remove debris	-	Annual														
Check fasteners	-															
Clean assemblies and targets	-															
Inspect for wear	-															
Check gaskets	-															
Where applicable, review couplings	-															
Exercise limit switch levers	-															
Verify proper operation	-															
<b>CCTV</b>	<b>1</b>															
Check for obstructed views	-	Monthly														
Check focus	-															
Check operation of pan tilt and zoom focus	-															
Monitors opreational	-	Annual														
Inspect wiring and terminations	-															
Clean monitors	-															

Note:

1. Electrical maintenance by trained personnel only.
2. Use lockout/tagout procedures to de-energize components to ensure safety during maintenance procedures.

## O'Rorke Machinery Electrical Maintenance Chart

Part	Qty.	Frequency	Maintainer Notes	Year:												
				April	May	June	July	Aug	Sept	Oct	Nov	Dec				
<b>Disconnect Switches</b>	-															
Check conductors and terminations	-	Annual														
Switch blades	-															
Exercise switch	-															
Enclosure integrity and seal	-															
Area clearances	-															
Remove debris	-															
<b>Conduits and Electrical Boxes</b>	-															
Inspect and repair failed or detached conduit	-	Annual														
Check box integrity and seal	-															
Remove debris	-															
Paint touch-up	-															
<b>Traffic Warning Gates</b>	4															
Remove debris	-	6 months														
Check conductors and terminations	-															
Remove corrosion from limit switch contacts	-															
Inspect for proper operation	-															
Gate arm light illumination and sequence	-															
Gate arm level and height	-															
Door gaskets	-	Annual														
Paint touch-up	-															
Megger gate motor windings to ground	-															
<b>Warning Gongs</b>	2															
Verify operational	-	6 months														
Installation integrity	-															
<b>Fire Alarm</b>	1															
Test in accordance with fire codes	-	3 months														
<b>Traffic Lights, Nav Lights, Fender Lights</b>	-															
Visually inspect for proper function	-	Monthly'														
Installation integrity	-															
<b>General Lighting</b>	-															
Visually inspect for proper function	-	Annual														
Replace bulbs and fixtures as necessary	-															
Inspect circuits, feeder breakers, wiring	-															
Installation integrity	-															
<b>Emergency Lighting</b>	-															
Remove debris	-	Annual														
Test	-															
Check bulbs / batteries	-															
Inspect wiring and terminations	-															
Provide written record of test and repairs	-															

Note:

1. Electrical maintenance by trained personnel only.
2. Use lockout/tagout procedures to de-energize components to ensure safety during maintenance procedures.



**APPENDIX E. MECHANICAL MAINTENANCE MANUAL**

# COLONEL PATRICK O’RORKE MEMORIAL BRIDGE

## MECHANICAL MAINTENANCE AND LUBRICATION MANUAL



Prepared by:

**WJE** Beasley, Chin &  
Hunderman, P.C.

Submitted: March 19, 2021

# MECHANICAL MAINTENANCE AND LUBRICATION MANUAL

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## 1. General Information

### 1.1. Introduction

The purpose of this manual is to summarize maintenance requirements for the mechanical machinery associated with the bridge. Provided details include general system descriptions, scheduled maintenance and inspection, and lubrication information.

### 1.2. Safety

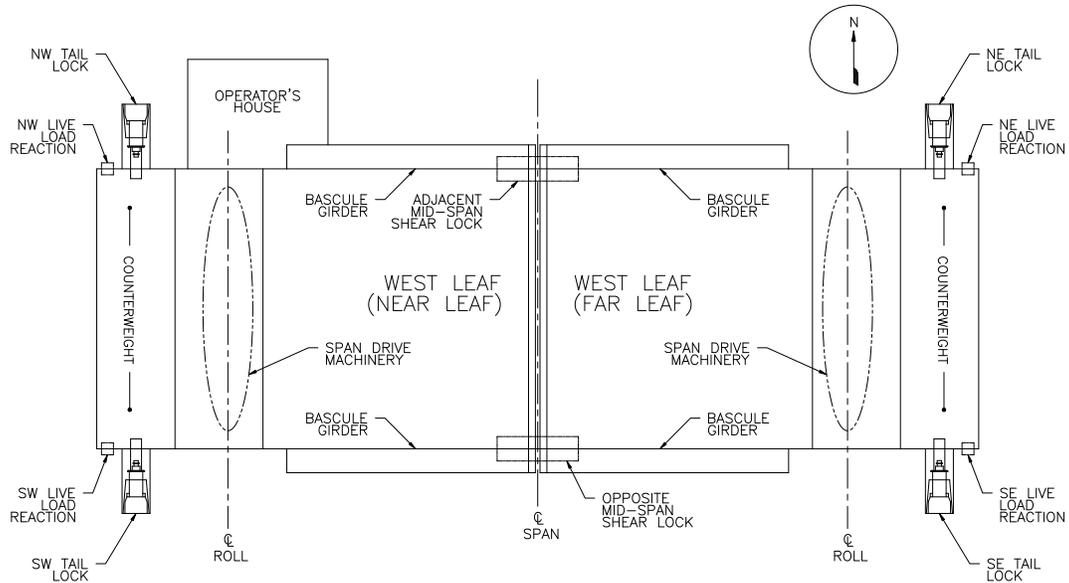
There are inherent safety risks associated with the mechanical machinery for movable bridges. Notable safety hazards include dangers from rotating mechanical parts, high temperature of equipment, fall hazards, pinch points and slipping hazards from spilled fluids or rainwater.

Maintenance must be done in accordance with local, state and federal regulations including the requirements of Occupational Safety and Health Administration (OSHA) and the American Association of State Highway and Transportation Officials (AASHTO). Maintenance must be done by competent personnel experienced in heavy machinery and familiar with the systems on this bridge. Personnel should refer all questions to their supervisor for guidance on proper procedures.

Always maintain a line of communication with the bridge operator and all other personnel that are working on the bridge. Ensure that all parties are notified and in a safe position prior to bridge operation. Similarly, ensure that the operator is aware of any maintenance activities that may delay operation. Communication is essential to ensure safe coordination of operation and maintenance activities.

## 2. Operational Description

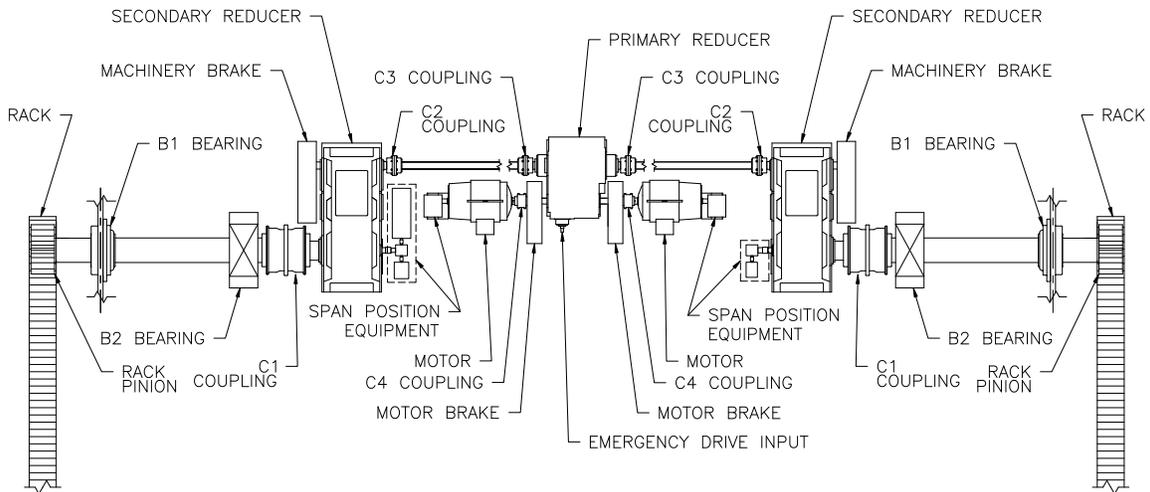
The machinery for the bridge consists of span drive machinery, span stabilizing machinery, tail locks, and traffic warning gates. See Figure 1 for the location of the machinery components (excluding the traffic warning gates).



**Figure 1: Plan View of Span**

### 2.1. Span Drive Machinery

The span drive machinery is located in the machinery room below the roadway level. The span drive operating machinery for each bascule leaf is identical. See Figure 2 for a schematic of the span drive machinery with component designations.



**Figure 2: Plan View of Span Drive Machinery**

The normal power for each span drive is provided by one of the two 75 HP, 900 RPM electric live motors in each machinery room. Each motor is connected to an input shaft of the primary reducer via a double engagement grid coupling. On both input shafts is a brake wheel for a spring set, thrustor released shoe type motor brake. On the counterweight side of the primary reducer is an emergency drive input shaft at which a power drill can

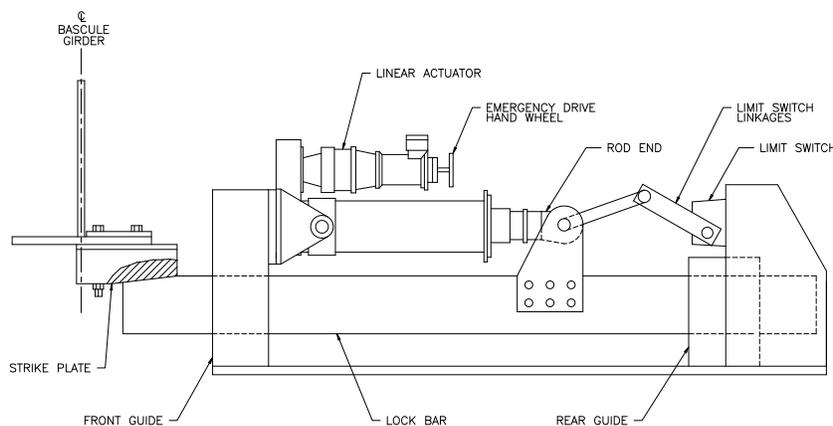
be coupled for emergency operation. In the case when the electric motors cannot be used, personnel can operate the leaf using the power drill.

The primary reducer has two output shafts, and a differential integrated into the primary reducer ensures even load sharing. The primary reducer output shafts are connected to the secondary reducers' input shafts using floating shafts and single engagement gear type couplings. The secondary reducers have an additional input shaft, each of which has a brake wheel for a spring set, thrustor released shoe type machinery brake installed on it. The output shafts of the secondary reducers are coupled to the rack pinion shafts with double engagement gear type couplings. The pinion shaft is supported by a spherical roller bearing in a pillow block housing and a spherical roller bearing flange mounted to the bascule girder. The rack pinion is cantilevered off the end of the pinion shaft outboard of the bascule girder. The mating horizontal spur gear rack is located above the pinion and is mounted on a fixed structural support.

The rack pinions are located at the center of the arc of the curved tread castings that support the movable span. Rotation of the electric motors causes the rack pinions to rotate and travel along the fixed racks, exerting a force at the rack and pinion gear mesh. The curved tread castings roll along fixed horizontal flat tread castings maintaining the position of the rack pinion at the center of roll. The bridge opens and closes for marine traffic as a result of rotary and translational movement.

## 2.2. Span Stabilizing Machinery

The movable leaves are fitted with a series of devices to stabilize and support the span in the closed position. One lock bar type tail lock is provided at the tail end of each bascule girder to limit span movement when it is engaged. The lock bar is driven by an electro-mechanical linear actuator and is supported by a front and rear guide. When driven, the lock bar engages a strike plate attached to the bascule girder. When retracted, the lock bar is pulled outboard of the bascule girder and allows the leaf to open. See Figure 3 for a schematic of the tail lock machinery.



**Figure 3: Tail Lock Machinery**

The mid-span shear locks are a jaw lock system to allow the leaves to share live load shear forces. The jaw lock consists of a diaphragm on each side of the far leaf and a corresponding jaw on each side of the near leaf. Synchronized operation of the leaves is required for both opening and closing for smooth engagement and disengagement of the jaw lock system. As the leaves are closing, they are both rotating and translating and the diaphragm slides into the gap of the jaw.

Live load reactions are provided to prevent over-travel of the span during closing and provide stability to the span in the fully closed position. There are two live load reactions for each leaf. The reactions are located on top of the approach end of each bascule girder and are intended to support the loads resulting from imbalance and the live load of traffic.

### 2.3. Traffic Warning Gate Machinery

The bridge is equipped with four traffic warning gates. A pair of gates are located on each approach to the movable span outboard of the sidewalks and provide visual indication to traffic when the bridge is operated as a part of the traffic control system. When the gates are lowered, they meet in the middle of the roadway to block vehicular and pedestrian traffic prior to opening the movable span. The warning gates do not function as a physical barrier, and no resistance barriers are provided.

## 3. Functional Description

### 3.1. Motors

There are two span drive motors in each machinery room. Both motors are 75 HP, 900 RPM AC electric motors of the same make and model. The electric motors are fitted with a shaft extension at the rear of the motor and an encoder. The motor is foot mounted on a weldment. Shims for the motor feet are provided to enable adjustments for alignment. See Figure 4.



**Figure 4: Span Drive Motor**

### 3.2. Brakes

There are four brakes in each machinery room. Two motor brakes are located on each of the primary reducer input shafts, and one machinery brake is located on the outboard end of each secondary reducer input shaft. See Figures 5 and 6.



Figure 5: Motor Brake



Figure 6: Machinery Brakes

The span drive brake assemblies are spring-set thrustor released drum brakes with additional manual release levers. The design brake torque settings are as follows:

Torque Settings (per brake, as shown on design plans)

Motor Brake: 448 Nm (540 Nm max brake capacity)

Machinery Brake: 1730 Nm (2650 Nm max brake capacity)

### 3.3. Reducers

#### 3.3.1. Primary Reducer

Each leaf is supplied with one primary reducer. The primary reducer is a parallel shaft, triple reduction, triple input and double output, differential reducer with a ratio of 7.595:1. On the counterweight side of the primary reducer is an emergency drive input shaft at which a power drill can be coupled for emergency operation. The emergency drive ratio is 30.38:1. Shims are provided at the mounting of the reducer to allow for alignment adjustments. There are shaft seals at all the reducer input and



Figure 7: Primary Reducer

output shafts to mitigate oil leakage from these sites. See Figure 7.

### 3.3.2. Secondary Reducer

Each leaf is supplied with one secondary reducer. The secondary reducers is a parallel shaft, triple reduction, double input, and single output differential reducer with a ratio of 90.801:1. There are shaft seals at all the reducer input and output shafts to mitigate oil leakage from these sites. See Figure 8.



Figure 8: Secondary Reducer

### 3.4. Bearings

There are four bearings located in each machinery room. The two B1 bearings are grease lubricated spherical roller bearings flange mounted to each bascule girder. See Figure 9. The B2 bearings are grease lubricated spherical roller bearings in a pillow block housing. See Figure 10.



Figure 9: B1 Bearing



Figure 10: B2 Bearing

### 3.5. Couplings

There are eight couplings located in each machinery room. The two C1 couplings are double engagement gear type couplings. See Figure 11. The two C2 and the two C3 couplings are single engagement gear type couplings that support the floating shafts between the primary reducer and the secondary reducers. See Figures 12 and 13. The two C4 couplings, or motor couplings, are double engagement grid type couplings. See Figure 13 and Figure 14.



**Figure 11: C1 Coupling**



**Figure 12: Floating Shaft Coupling (C2 and C3 Couplings)**



**Figure 13: C4 Motor Coupling**



**Figure 14: C4 Motor Coupling with Cover Removed Showing Grids**

### 3.6. Open Gearing

There are two open spur gearsets in each machinery room. See Figure 15.

The two flat racks and are mounted on a fixed structural support. The two pinions mate with the racks from below and are cantilevered off the end of the pinion shaft. The gearsets are located outboard of the bascule girder.



**Figure 15: Rack and Pinion Gear Set**

### 3.1. Curved and Flat Treads

There are two curved and flat tread assemblies supplied for each movable leaf. One curved tread is mounted to each bascule girder and its mating flat tread is anchored to the pier. The curved treads utilize opposing wedges between tread sections to ensure strength at the joint. Restraining blocks are provided at these wedges. The curved treads are supplied with pockets which engage lugs on the flat treads during operation. See Figure 16.



**Figure 16: Curved and Flat Treads**

### 3.2. Tail Lock Machinery

One lock bar type tail lock is provided at the tail end of each bascule girder to limit span movement when it is engaged. The lock bar is driven by an electro-mechanical linear actuator and is supported by a front and rear guide. When driven, the lock bar engages a strike plate attached to the bascule girder. When retracted, the lock bar is pulled outboard of the bascule girder and allows the leaf to open.

#### 3.2.1. Tail Lock Linear Actuator

Each tail lock assembly includes one tail lock linear actuator. The tail lock linear actuator utilizes a gear motor, timing belt, and an acme screw to provide thrust to the cylinder rod. Each motor is supplied with an emergency hand crank. See Figure 17.

#### 3.2.2. Tail Lock Guides and Strike Plate

One rear guide and one front guide are supplied with each tail lock assembly. The guides are fixed and are mounted to the pier. The guides are fitted with lubricated bronze shoes. Additionally, one steel strike plate is supplied with each tail lock assembly and is mounted to the counterweight end of each bascule girder. See Figure 18 and Figure 19. Figure 18: Tail Lock Assembly

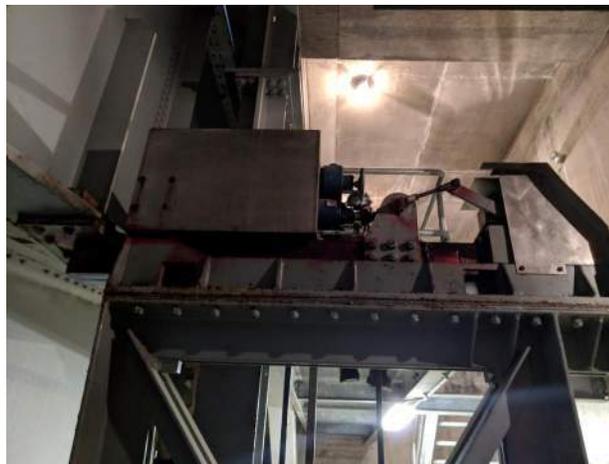


Figure 17: Tail Lock Assembly



Figure 18: Tail Lock Assembly



Figure 19: Tail Lock Assembly, Receiver  
(Lock Bar Retracted)

### 3.3. Shear Lock Assembly

The shear lock assemblies consist of one diaphragm on each end of the far leaf and a corresponding jaw on each end of the near leaf. The contact surfaces of these items are lubricated. See Figure 20 and Figure 21.



**Figure 20: Shear Lock Assembly Jaw on the Near Leaf**



**Figure 21: Shear Lock Assembly Diaphragm on the Far Leaf**

### 3.4. Live Load Reactions

There are two live load reactions for each leaf. The live load reactions consist of a strike plate mounted to the top of the counterweight end of each bascule girder and mate with a strike plate mounted to the approach. The strike plates are provided with shims to enable adjustments. See Figure 22.

### 3.5. Bumper Blocks

Wooden bumper blocks are installed against the bascule pier and should be set to limit the spans over-travel in the event of a loss of control at full open. See Figure 23.



**Figure 22: Live Load Reaction Assembly with Bridge Closed**



**Figure 23: Bumper Block Assembly, with Bridge Near Full Open**

### 3.6. Warning Gates

There are four warning gates, two at each approach to the bridge. All four gates consist of similar mechanisms. The gates consist of gate arms which straddle half the width of the roadway and the pedestrian walkway. The operating machinery at each gate consists of a motor that is face mounted to a right-angle reducer, which then outputs a crank. A connecting rod with rod eyes at each end connects the reducer output crank to a crank mounted to the gate arm support shaft which is the center of rotation of the gate arms. The gate arm support shaft is mounted through the gate enclosure through a pair of grease lubricated face mounted spherical bearings and connects to the gate arm support bracket. There are two additional bearings that support the crankshafts, one at each shaft. See Figure 24 and Figure 25.



**Figure 24: Traffic Gate Machinery, View of Reducer, Lower Crank and Connecting Rod**



**Figure 25: Traffic Gate Machinery, View of Connecting Rod and Gate Arm Shaft**

### 3.7. Span Position Indication Equipment

Each leaf is provided with span position indication equipment driven by the secondary reducer output shafts. The span position indication equipment at each leaf consists of two right angle gearboxes, two position transmitters, and a rotary cam limit switch, all coupled with rigid couplings. Shims are provided to enable adjustments to alignment.

## 4. Scheduled Maintenance

### 4.1. General

Mechanical inspection and maintenance of the bridge systems shall generally follow the following recommendations and practices:

- All manufacturers' recommendations.
- General recommendations and guidelines from in accordance with AASHTO.
- Specific recommendations noted in this manual.
- Additional maintenance deemed necessary based on the history of operation and maintenance of this bridge, as determined by trained maintenance personnel.

### 4.2. Scheduled Maintenance and Inspection

Maintenance tasks listed in this section shall be performed according to the schedules presented in Section 8, with updates as required to ensure properly maintained equipment.

#### 4.2.1. Grease Purging

The maintenance efforts include periodic purging of old lubricant from sleeve bearings and couplings. When components are being purged, maintenance personnel should take care to capture all extruded grease to prevent it from falling on the ground or in the water. In some cases, depending on the location, personnel may be able to install drop cloths to capture any purged grease. In other cases, this won't be practical, and personnel will have to capture purging excess grease by hand as it comes out of the bearings.

#### 4.2.2. Checking Fasteners

It is recommended that fasteners be checked in the following manner. An initial check would be performed by visual and tactile inspection. Loose bolts may be apparent where there are gaps under bolt heads or under nuts, or where there are signs of movement (removal of paint, lines in excess grease, etc.). A second check should be performed, where practical, by feeling for movement of the fastener when the component is loaded during operation.

### 4.3. Lubrication Table

The lubrication schedule for all applicable components is provided in the table in Section 7. Update lubrication frequency as necessary to ensure that components are always lubricated. Other maintenance, apart from lubrication, is listed in the following sections.

#### 4.4. Span Drive Motors

##### 4.4.1.1. Suggested Maintenance

- Check the mounting bolts.
- Monitor the motor during operation of the machinery to detect the presence of abnormal vibration or noise.
- Clean and spot paint exterior surfaces to address deterioration.

##### 4.4.1.2. Schedule

- Inspect at 6 month intervals.
- Cleaning and painting to be performed annually.

#### 4.5. Brakes

##### 4.5.1.1. Suggested Maintenance

- The brakes should be checked for wear and satisfactory operation.
- Check and adjust the thruster reserve stroke to meet manufacturer requirements.
- Check torque setting.
- The brake assemblies and friction surface should be kept clean and free of debris.
- Check brake wheels for corrosion and remove as necessary with emery cloth.
- The brake thruster seals should be inspected for signs of leaks. Any leaks should be addressed immediately with the consultation of both the engineering staff and the manufacturer.
- Check brake shoes for appropriate thickness.
- Inspect the integrity of the brake linkage assembly.
- Inspect the brake hand release mechanism to ensure that it is functional.
- Check the safety interlock limit switches for proper function.
- Check brake wheel/brake pad clearance with brake hand released using feeler gages
- Check brake wheel/brake pad clearance with brake set using feeler gages. There should be zero clearance.
- Clean and spot paint exterior surfaces to address deterioration.

##### 4.5.1.2. Schedule

- Inspect and adjust at 6 month intervals.
- Cleaning and painting to be performed annually.

## 4.6. Reducers

### 4.6.1.1. Suggested Maintenance

- The reducers should be checked for wear (internal inspection) and satisfactory operation.
- The reducers should be kept clean and free of debris.
- Clean and spot paint exterior surfaces to address deterioration.

### 4.6.1.2. Schedule

- Clean at 6 month intervals.
- Cleaning and painting and internal inspection to be performed annually.

## 4.7. Bearings

### 4.7.1. Suggested Maintenance

- Check condition of the cap and/or mounting bolts and tighten if required.
- If there are indications of abnormal wear or if the bearing is not accepting grease, schedule internal inspection.
- Remove any accumulated debris from in and around all bearings. Clean debris and excess lubricant from these areas at the start and end of the operation season as a minimum. Adjust the frequency based on the amount of debris accumulation.
- Monitor the bearings during operation of the machinery to detect the presence of abnormal vibration or noise.
- Inspect desiccant breather and replace if necessary.
- Clean and spot paint exterior surfaces to address deterioration.
- Perform oil sample analysis to determine if oil change is necessary.

### 4.7.2. Schedule

- Inspection and maintenance at 6 month intervals.
- Cleaning and painting to be performed annually.
- Perform oil sample analysis annually.

## 4.8. Couplings

### 4.8.1. Suggested Maintenance

- Check for loose fasteners and torque fasteners per manufacturer's recommendations if necessary.
- For smaller couplings, such as at the position equipment, check that the set screws (that secure the coupling hubs to shafts) are tight.
- Inspect keys and keyways for cracks.
- Listen for abnormal noises from the couplings during operation.

- If there are indications of an issue with the couplings, then disassemble them for inspection. This requires supporting the floating shafts by other means.
- Inspect seals and gaskets for damage or leakage.
- Clean any excess grease.
- Clean and spot paint exterior surfaces to address deterioration.

#### 4.8.2. Schedule

- Inspection and maintenance at 6 month intervals.
- Cleaning and painting to be performed annually.

### 4.9. Open Gearing

#### 4.9.1. Suggested Maintenance

- Visually check the condition of the gear teeth. Observe for broken teeth or signs of abnormal wear to the teeth.
- Remove any accumulated debris from in and around all gears. Clean debris and excess lubricant from these areas at the start and ends of the season as a minimum. Adjust the frequency based on the amount of debris accumulation.
- Remove any old/dried lubricant in the roots of the gears.
- Monitor the gears during operation of the machinery to detect the presence of abnormal sounds or movement.
- Clean and spot paint non-wearing exterior surfaces to address deterioration.

#### 4.9.2. Schedule

- Inspection and maintenance at 6 month intervals.
- Cleaning and painting non-wearing surfaces to be performed annually.

### 4.10. Tread Assemblies

#### 4.10.1. Suggested Maintenance

- Remove any accumulated debris from in and around the treads. Clean debris from these areas at the start and ends of the season as a minimum. Adjust the frequency based on the amount of debris accumulation.
- Monitor the treads during operation of the machinery to detect the presence of abnormal sounds or movement.
- Clean and spot paint non-wearing exterior surfaces to address deterioration.

#### 4.10.2. Schedule

- Remove debris monthly.
- Monitor for abnormal sounds and clean and paint annually.

#### 4.11. Tail Lock Assembly

##### 4.11.1. Suggested Maintenance

- Remove any accumulated debris from on and around the linkages, lock bars, guides, and receivers.
- Observe the tail locks during operation of the machinery to detect the presence of abnormal vibration or noise.
- Check the condition of the lock bar guide and receiver mounting bolts.
- Clean the lock receiver plate of all debris.
- Clean and spot paint non-wearing surfaces to address deterioration.

##### 4.11.2. Schedule

- Inspection and maintenance at 6 month intervals.
- Clean and paint annually.

#### 4.12. Mid-Span Shear Lock Assembly

##### 4.12.1. Suggested Maintenance

- Remove any accumulated debris from on and around the shear locks.
- Check for loose fasteners and tighten as necessary.
- Clean and spot paint non-wearing surfaces to address deterioration.

##### 4.12.2. Schedule

- Inspection and maintenance at 6 month intervals.
- Clean and paint annually.

#### 4.13. Bumper Blocks

##### 4.13.1. Suggested Maintenance

- Check the condition of the mounting bolts.
- Check for damage or wear of the bumper blocks.

##### 4.13.2. Schedule

- Inspect annually.

#### 4.14. Live Load Reactions

##### 4.14.1. Suggested Maintenance

- Check for loose mounting bolts at the strike plates and shoes.
- Remove debris.
- Clean and spot paint to address deterioration.

#### 4.14.2. Schedule

- Remove debris from live load reactions every monthly.
- Check for loose fasteners every 6 months.
- Clean and paint annually.

### 4.15. Traffic Warning Gates

#### 4.15.1. Suggested Maintenance

- Observe gates during operation for abnormal sounds and movement.
- Remove any accumulated debris from the interior and exterior of the gate housing.
- Check for loose mounting bolts. It is recommended that the inspector check for movement at the reducer mounting interfaces while rocking the gate arm.
- Check for set screw tightness at the chain sprockets and pulleys.
- Inspect the gate arms for wear or damage.
- Check for signs of leakage from the reducer. If leakage is noted, check oil level and add oil as necessary, monitor for further leakage and repair as necessary.

#### 4.15.2. Schedule

- Inspect and maintain every 3 months.
- Clean and paint annually.

### 4.16. Position Indication Equipment

#### 4.16.1. Suggested Maintenance

- Observe all position indication equipment during operation for abnormal sounds and movement.
- Exercise lever arm limit switches.
- Remove any accumulated debris from on or around the assemblies or targets.
- Check for loose mounting bolts or connections.

#### 4.16.2. Schedule

- Exercise lever arm limit switches every 3 months.
- Perform other maintenance activities every 6 months.

## 5. Manufacturers' Maintenance Literature

## 5.1. Brakes

***Machinery Brakes (qty. 4) (400 E5 10)***

The machinery brakes are Link Controls Motor Operated Shoe Brake model #72-316-121-EBN. These brakes are located on the machinery brake shaft of the secondary reducer.

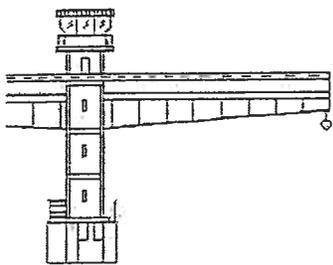
# LINK CONTROL SYSTEMS, INC.

ELECTRICAL CONTROL SYSTEMS MANUFACTURER

16 COLT COURT, RONKONKOMA, N.Y. 11779

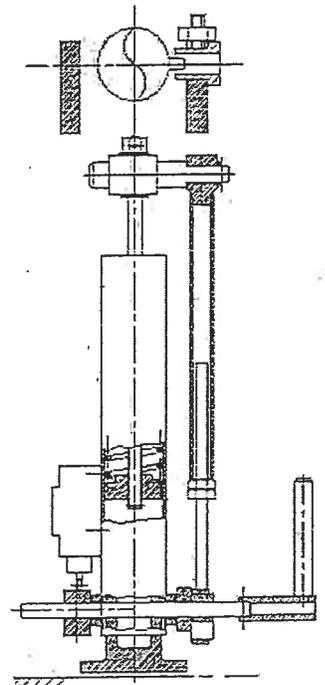
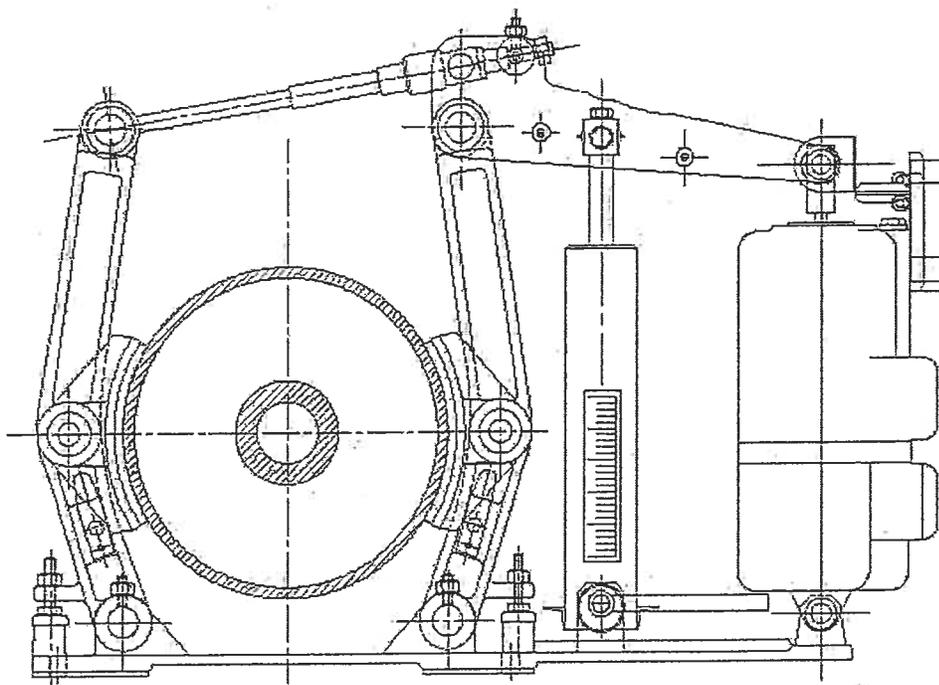
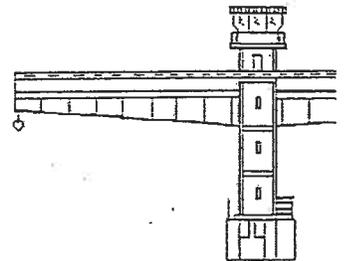
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## MOTOR OPERATED SHOE BRAKES



BRIDGE CONTROL DIVISION

Series 72-300-EBN



SET-UP, TESTING, MAINTENANCE &  
RENEWAL PART LIST MANUAL

(BOOKLET "LINK 72-2001.0")

BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

LINK CONTROL SYSTEMS, INC.  
16 COLT COURT  
RONKONKOMA, N.Y. 11779  
Phone (631) 471-3950 FAX (631) 471-2390

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INTRODUCTION TO LINK CONTROL SYSTEMS SHOE BRAKE

The base plate is constructed of welded flat steel. The brake shoe levers are designed as a double web lever, flame cut from a

## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

---

single piece. Uniform shoe operation is set by the adjustable stops located on the brake levers. The spacing of the shoes on the brake wheel is adjusted by an eccentric stop on the brake lever. This prevents the shoe from rubbing at the tip and assures uniform application over the entire shoe area. A threaded spindle serves as a means of transmitting the braking force between the two brake shoe levers.

The desired braking torque is set by means of adjusting a variable compression spring, in a square guide tube. The torque setting is read on a scale on the side of the guide tube protected by a plexiglas cover. Adjustments in brake torque are made without loosening any lock nuts or other lock devices. Due to the vertical brake spring and the automatic brake shoe adjusting device, the braking torque will be nearly uniform over the lining life.

All hinge points are equipped with maintenance free bushings; all pins and bare parts are electro-galvanized. Little maintenance is required, other than periodic inspection.

With the automatic brake lining wear compensation device no manual adjustment need be made to maintain torque setting. Lining wear should be watched and shoes replaced when necessary. A brake lining wear limit switch for remote indication is available as an option.

The electro-hydraulic mechanism is designed to give protection against wear and corrosion by providing double seal for dust protection and double seal in the hydraulic system in the oil chamber. Built-in lifting and lowering valves are provided as standard material, for step less adjustment of the lifting and lowering times up to 5 seconds. Maximum operating ambient's are -13 degrees Fahrenheit to +122 degrees Fahrenheit. A low temperature oil is provided as standard.

Brakes can be mounted with motor vertical or at any angle to horizontal provided the unit is mounted with the motor terminal box on top.

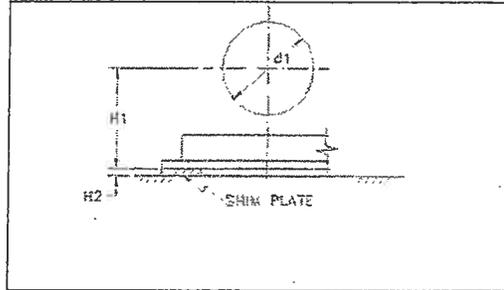
### BRAKE INSTALLATION ALIGNMENT

Before mounting the brake assembly, check brake drum rotation for correct circular motion. Any lateral run out (wobbly movement) will cause uneven wear to the brake linings and reduce overall brake performance. [Refer to the chart on page 4 for maximum allowable tolerance for all brakes]. Thoroughly inspect brake drum surface for fine ground flat finish. Remove any dirt on the brake

## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

drum surface that may have accumulated during installation. Never use a mineral-based solvent such as paint thinner. Instead, use a denatured (isopropyl) alcohol for this purpose.

Prior to installation parts on the movement that all paint and



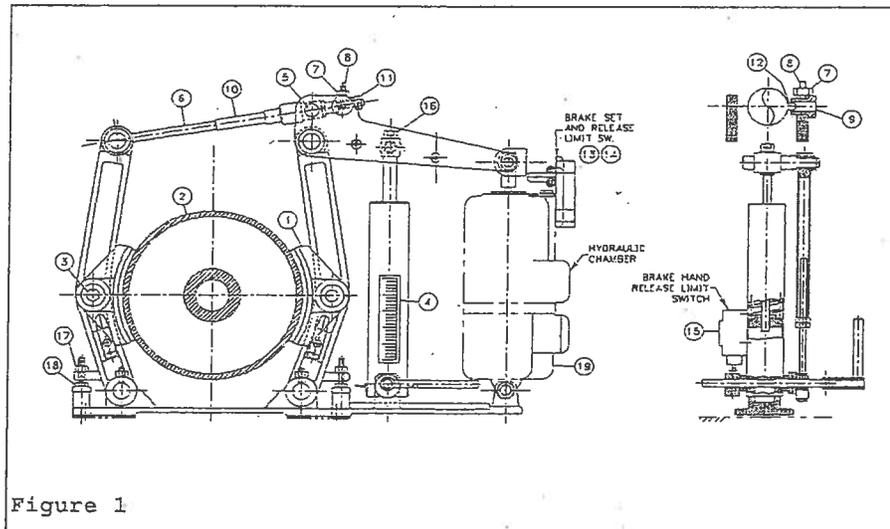
brake final check all moving brake for free. Take special care joints are free of debris.

**ATTENTION:** When painting the brake before or after the installation avoid contaminating the joints, main spindle (A), piston rod (lifting shaft on thruster motor), brake drum and brake linings with paint. Never paint the thruster motor. Total layer of paint should never exceed 150 mils thickness.

Align the brake assembly so that the brake shoe linings and the brake drum surface are in alignment with each other both square and center. Engage the brake shoes to the brake drum and fasten the brake assembly stationary with the proper bolts.

**NOTE:** Refer to page 20 for reference number descriptions.

### MAXIMUM ALLOWABLE TOLERANCE FOR ALL BRAKES



## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

ALL DIMENSIONS ARE IN INCHES. DRUM BRAKE DIMENSIONS AS PER GERMAN STANDARD (DIN 15435)

DRUM DIAMETER - d1	H1	H2	TOLERANCE ( Related to d1 and H1)
8"	6.1	0.197	0.019
10"	7.28	0.197	0.019
12"	8.86	0.197	0.019
16"	10.63	0.394	0.019
20"	13	0.394	0.032
25"	16.14	0.394	0.032
28"	18.11	0.394	0.032

### BRAKE ADJUSTMENT PROCEDURE

**BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES**

**Note:** The following "BRAKE ADJUSTMENT PROCEDURE" and "TEST PROCEDURE" must be completed properly. The effectiveness of the brake depends on these procedures being followed.

Reserve Stroke (Thruster Motor) Adjustment STEP #1

- \*\*\*\*\*  
 \* **Important:** Prior to adjusting, make sure that the mechanical \*  
 \* and electrical drive system components cannot be activated. \*  
 \* The bridge should be in the fully seated position and secured \*  
 \* from any movement. \*  
 \*\*\*\*\*  
 1- Unscrew locknut (7) and turn back set screw (8). Pull the tappet (9) to the outside till the FAN (10) can be rotated freely at lock nut (7).

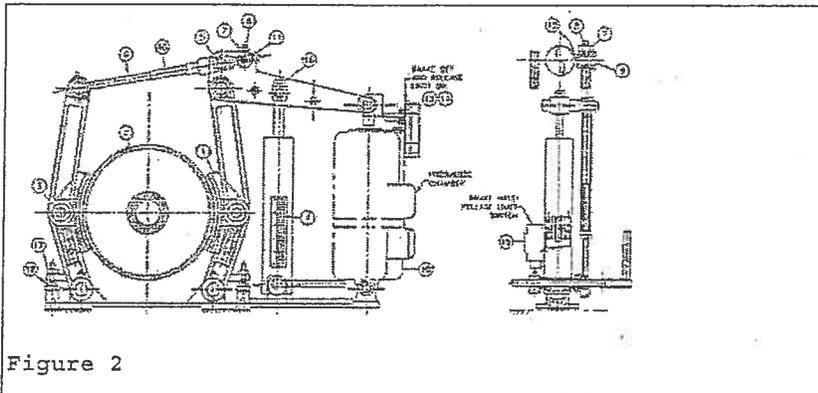


Figure 2

- 2- Tighten FAN (10) at lock nut (7) until level "SR" is reached at the actuator. Turn back nut (7) until the catch pin (12) is in the range of tappet (9).

	Brake Set-SR	Brake Released-SL
EMG ELDRO - THRUSTERS	INCHES	INCHES
ED 23/5	1.89	3.46
ED 30/5	2.32	3.90
ED 50/6 - ED 80/6	2.52	4.49
ED 121/6 TO ED 301/6	6.10	8.07

BRAKE ADJUSTMENT PROCEDURE

- 3- Insert tappet (9) in the lever so that the catch pin (12) is inside of the tappet hole. Tighten set screw (8) and lock nut

## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

(7).

- 4- Operate actuator several times till the reserve stroke "SR" +/- 3mm is reached. spindle "A" stops rotating. See figure 1.

### NOTE

\* For brakes without automatic wear compensator the reserve stroke "SR" has to be adjusted by turning lock nut (7) at main spindle (6) to maintain the adjusted brake torque. See step 2.

### BRAKING TORQUE ADJUSTMENT STEP #2

- 1- Tense the brake spring by turning the hexagon nut (16) clockwise, decreasing torque is performed by loosening hexagon nut (16) counter clockwise. Loosening lock nuts is not required. The brake torque is read on the brake moment scale (4) at the upper edge of the spring plate. See figure 1.

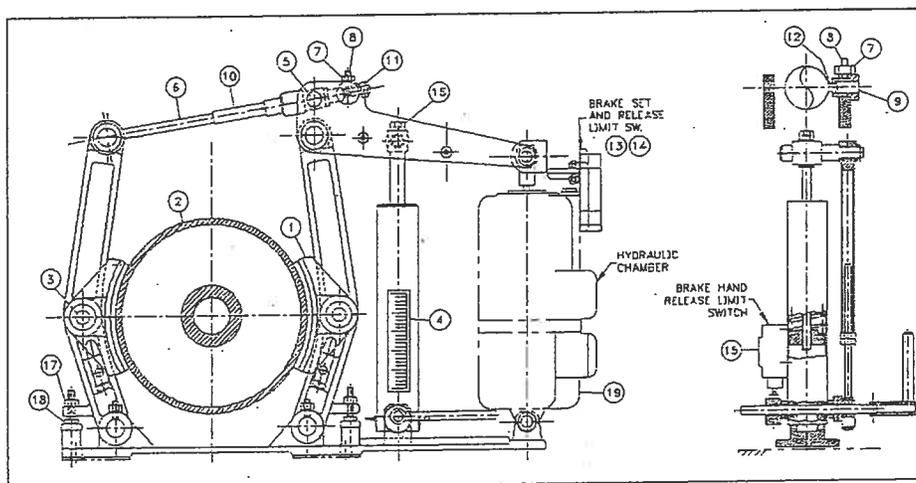
### NOTE

\*\*SR" adjustment must be re-verified after torque is set. See chart on page 5.

FIGURE 1

### BRAKE ADJUSTMENT PROCEDURE

### UNIFORM SHOE LIFT-OFF ADJUSTMENT STEP #3



- 1 - Open brake via lifting device

BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

---

- 2 - Upon unscrewing the brake lock nut (17) adjust brake stop screw (18) in a way so as to ensure uniform brake shoe lift-off.
- 3 - Tighten brake lock nut (17).

BRAKE ADJUSTMENT PROCEDURE

MANUAL RELEASE MECHANISM STEP #4

## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

(TUBE-TYPE ADJACENT TO BRAKE DRUM)

### CAUTION:

The manual release mechanism is intended for use only in case of a power failure and/or maintenance purposes. It allows the braking torque to be manually reduced to lower the load safely to the ground.

The mechanism IS NOT FINAL-ADJUSTED by the manufacturer. Final adjustment must be done during INSTALLATION on site!

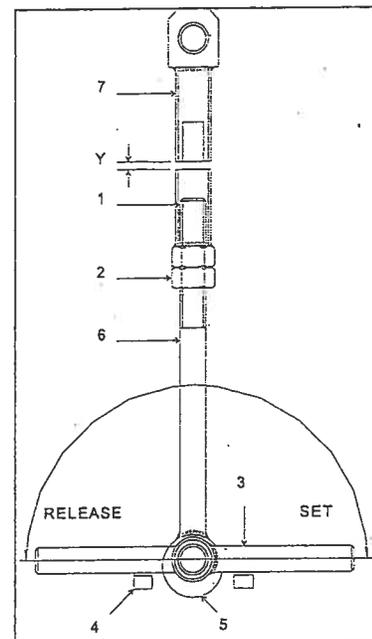
IMPROPER ADJUSTMENT OF THE MANUAL RELEASE MECHANISM CAN CAUSE BRAKE FAILURE BY REDUCING BRAKING TORQUE BEING APPLIED TO THE BRAKE DRUM

To adjust the mechanism these steps must be followed:

- 1- Lower the cam (5) by operating the lever (3) to engage (set) the brake.
- 2- Loosen nut (2) to obtain the gap (Y) 4-5 mm or .16-.20 inches between the push rod sleeve (1) and the tube (7).
- 3- Secure the sleeve (1) by tightening nut (2) against sleeve (1).
- 4- Swing lever (3) approximately 180 degrees and check the function of the mechanism. The shoes will move away from the brake drum.
- 5- Swing the lever (3) back to engage (set) the brake.

- (1) PUSH ROD SLEEVE
- (2) LOCK NUT
- (3) LEVER
- (4) STOP
- (5) CAM
- (6) PUSH ROD
- (7) TUBE

FIGURE 3



### BRAKE ADJUSTMENT PROCEDURE

#### ADJUSTMENT FOR LIFTING & LOWERING TIME STEP #5 (THRUSTER MOTOR ADJUSTMENT VALVES)

The lifting and lowering valves (H,S) are a built-in feature allowing for step less control of normal lifting and lowering time, independent of each other. This allows for a mechanical time

## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

adjustment independent of the electrical system.

See figures below for location of valves on thruster motor type.

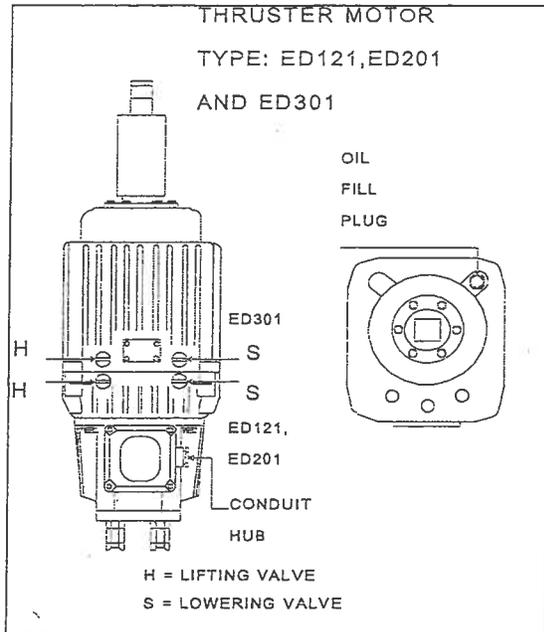


FIGURE 4

Remove protective covers to expose valves.

Clockwise (cw) turn on valve increases operating time and counter clockwise (ccw) turn on valve decreases operating time.

Valve "H" controls the time it takes to fully release the brake. The average time value should be about 1 second.

Valve "S" controls the time it takes to fully set the brake. The average time value should be about 2 -5 seconds. Review the project requirements or specifications for the actual times required.

### TESTING PROCEDURE

**IMPORTANT:**

PERFORM BRAKING TESTS GOVERNED BY CONSIDERATION  
OF SAFETY REGULATIONS AND ACCIDENT AVOIDANCE.

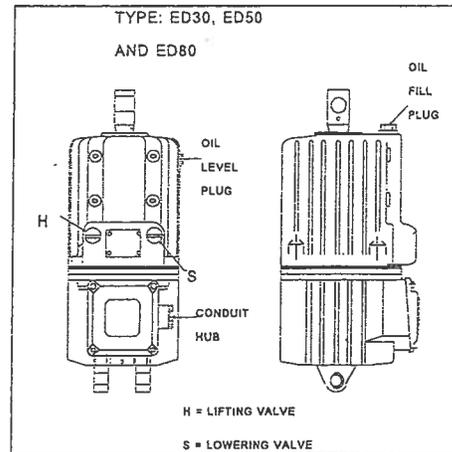


FIGURE 5

## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

Do not perform any load testing until the brake has been adjusted properly. See brake adjustment procedure in this booklet.

- 1 - Engage the mechanical and electrical drive system at reduced speed.
- 2 - First apply emergency braking at partial speeds, then further emergency braking at increasing speeds until maximum speed has been reached. This will wear in the brake pads to the drum.
- 3 - Reliability of the brake system can only be properly achieved according to the braking time required to stop the load.

### BRAKE MAINTENANCE

The maintenance and inspection periods depend on the degree of service. It is recommended that the brake be inspected about every 100 operating hours or three (3) months.

\* Check lining wear regularly. If lining wear (or brake drum wear) occurs, re-adjust brake. Bonded brake linings can be worn down to a minimum thickness of about 0.0787 in. or 2 mm, rivet brake linings to about 0.1969 in. or 5mm before having to be replaced.

\* Brakes with automatic wear compensation have been designed

BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

---

in such a way that the reserve stroke "SR" is automatically set at the thruster. In case of a failure, check whether the automatic adjustment has seized, Catch (2) is not properly seated or the adjustment pinion has become contaminated.

- \* Brakes without automatic wear compensation must be adjusted as soon as the minimum reserve stroke "SR-min" is reached.
- \* All joints must be kept clean. NO GREASING IS REQUIRED.
- \* Keep automatic wear compensation device and main spindle "A" clean and slightly greased.
- \* Use resin free grease only.
- \* Remove oil fill plug, check fluid level. fluid level should be slightly below fill plug opening. If necessary replenish fluid. Always use replacement fluid type " CHEVRON SPINDLE OIL #10".

If the brake is not to be used for a prolonged period of time, all movable parts must be preserved by means of a suitable agent. This is mainly true for the brake drum surface. When placing the brake back in service it is recommended to re-adjust the brake as described in the "BRAKE ADJUSTMENT PROCEDURES" covered in this booklet.

BRAKE LINING REPLACEMENT

\*\*\*\*\*  
\* Important: Prior to repairing, make sure that the mechanical \*  
\* and electrical drive system components cannot be activated. \*  
\* The bridge should be in the fully seated position and secured \*  
\* from any movement. \*  
\*\*\*\*\*

Bonded brake linings can be worn down to a minimum thickness of about 0.1181 in. or 3mm, rivet brake linings to about 0.1969 in. or 5mm before having to be replaced.

- \* Loosen brake lock nut (18) and brake stop screw (17).
- \* Loosen FAN (10) at adjusting nut (11) (after removing tappet "9") or nut until the brake is completely open.
- \* Remove cotter pins (3). Release the tension brake shoe

BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

- spring (4), extract the bolts (3).
- \* Bring the brake shoes to the position of disassembly (overhead of brake drum).
  - \* Clean friction surface of new linings.
  - \* Mount and fasten new brake shoes in the opposite sequence.
  - \* Adjust the brake as specified and proceed with testing.

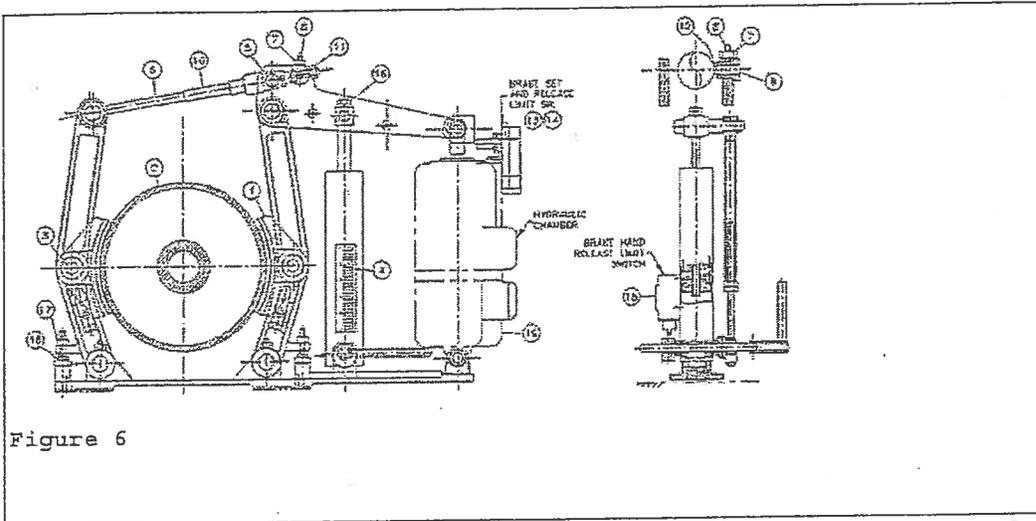


Figure 6

NOTE: USE ORIGINAL REPLACEMENT PARTS ONLY.  
HYDRAULIC THRUSTER UNIT

BRAKE SPRING LENGTH

BRAKE #	UNCOMPRESSED SPRING LENGTH (INCHES)
72-308-23/30-EBN	8.27 ± 0.11
72-310-23/30-EBN	8.27 ± 0.11
72-310-50-EBN	9.45 ± 0.12
72-312-23/30-EBN	8.27 ± 0.11
72-312-50/80-EBN	13.78 ± 0.18
72-316-50/80-EBN	13.78 ± 0.18
72-316-121-EBN	16.54 ± 0.18

## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

### STANDARD SPECIFICATIONS:

The basic version of the thruster complies with the following national and international standards:

NEMA-U.S.A. ASA-U.S.A.  
CSA-Canada SEN-Sweden  
NF-France NEK-NORWAY  
BS 2613-Great Britain  
IEC Publication 72-Europe  
CEI-Italy NBN-Belgium  
IS-India SEV-Switzerland  
VDE 0530 Part 1-Germany

### OPERATION:

The important components of the thruster are the electric motor, centrifugal pump and the servo-cylinder, all of which are mounted axially. The working fluid which the unit is filled with provides the operating medium.

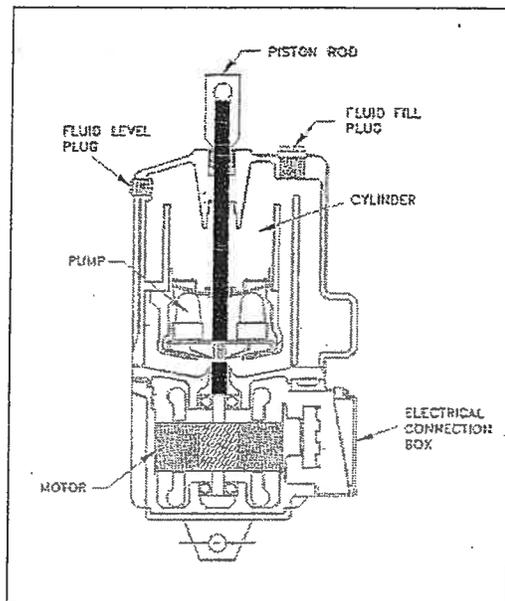
When the motor is switched off, the piston is at its lower limit. The working fluid is carried under the piston by the motor driven pump impeller.

Cross section of THRUSTER shown in SET (de-energized) position.

### HYDRAULIC THRUSTER UNIT

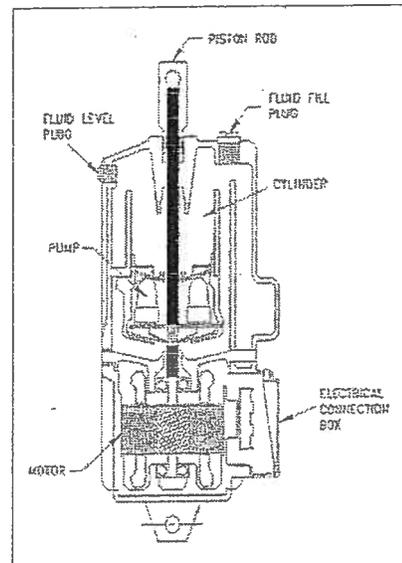
Since this impeller has radial vanes, the direction of rotation of the motor has no effect on the operation of the thruster.

As a result of the pressure produced, the piston travels along its path against the built in brake spring or against an external load. The power resulting from the product "force x distance" is transmitted via the piston rod and pressure pushes to the device to be operated. Thus the piston can either travel the total stroke distance or externally limited parts of the stroke. At the end of piston travel the power taken by the motor, because of the motor and pump characteristics, reduces to approximately half that required during stroke movement. The pressure however, reaches its highest value at this point - which, depending on the unit, lies between 25% and 45% above the rated value. Thus load on the motor is reduced at the limit of travel.



## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

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### HYDRAULIC THRUSTER UNIT

When the motor has been switched off, the piston under the influence of an external force (brake spring or weight) returns to its original position. With the exception of the starting phase, the lifting and lowering speed is linear. The setting time will vary with the size of the external load.

The thruster is not susceptible to mechanical or electrical failure resulting from a restriction of travel to the lifting shaft. This feature is important should the device being operated jam.

Cross section of THRUSTER

**BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES**

TECHNICAL DATA								
TYPE	LIFTING	STROKE	THRUST	BRAKING		CURRENT	DUTY RATING	WEIGHT
	FORCE			SPRING FORCE	CONSUMPTION	CONSUMPTION		
	N	mm	N cm	(C-SPRING) N	W	AT 400 V A	DUTY CYCLE c/h	kg
<b>SHORT STROKE UNIT</b>								
EO 23/6	220	50	1100	180	165	0.5	2000	10
ED 30/6	300	50	1500	270	200	0.5	2000	14
ED 50/6	500	60	3000	450	210	0.5	2000	23
ED 80/6	800	60	4800	750	330	1.2	2000	24
ED 121/6	1250	60	7500	1200	330	1.2	2000	39
ED 185/6	1850	60	11100	1900	450	1.3	2000	39
EO 201/6	2000	60	12000	1900	450	1.3	2000	39
ED 301/6	3000	60	18000	2700	550	1.4	1500	40
<b>LONG STROKE UNIT</b>								
ED 50/12	500	120	6000	-	210	0.5	1200	26
ED 80/12	800	120	9500	-	330	1.2	1200	27
ED 121/12	1250	120	15000	-	330	1.2	1200	39
ED 201/12	2000	120	24000	-	450	1.3	1200	39
ED 301/12	3000	120	35000	-	550	1.4	900	40
ED 185/16	1850	155	29500	-	450	1.3	400	40
ED 301/15	3000	150	45000	-	550	1.4	400	50
ED 350/20	3500	200	70000	-	550	1.4	400	50
UNITS UP TO 6300 N LIFTING FORCE AND 200 mm STROKE ON REQUEST								
TYPE OF OIL: CHEVRON SPINOLE OIL #10								

All values are approximate, consult factory with specific requirements.

Technical

Data "Thruster"

HYDRAULIC THRUSTER UNIT

**MOTOR:** All thrusters are fitted with a two pole AC squirrel cage induction motor. Construction type is a V3 standard to DIN 42950.

**VOLTAGE AND FREQUENCY:** Standard version is wound to operate on voltages with 5% variation at 60hz. The motor windings are arranged for dual voltage and can be reconfigured at time of installation. Thrusters can be supplied to operate on specific voltages and frequency. Please consult the factory for more information.

## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

### MOTOR CONNECTION:

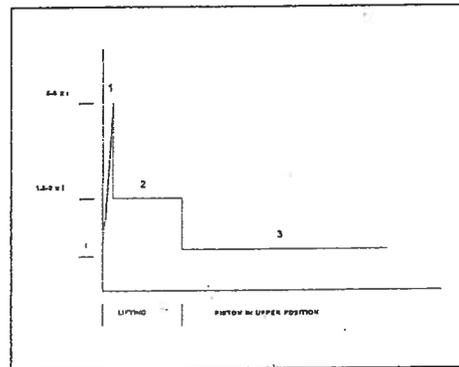
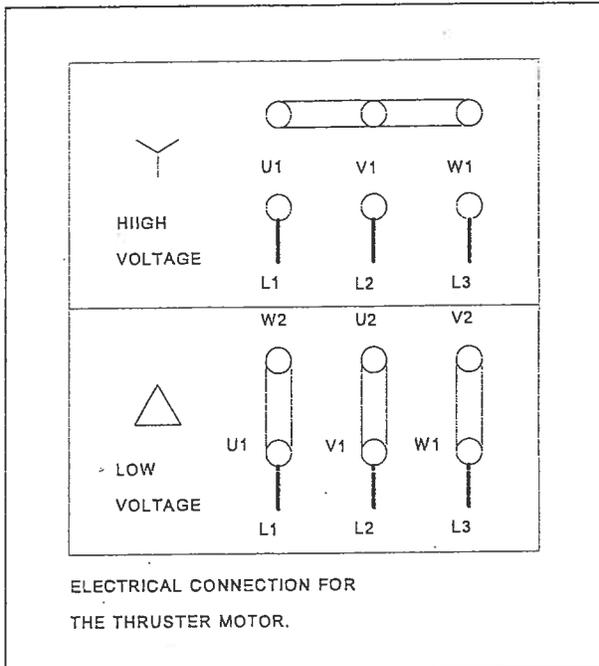
The operation of the thruster is not dependent on the direction of rotation of the motor. The source can be wired in any sequence to the U1, V1 and W1 terminals. The motor winding arrangement at the terminal block can be wired for star or delta depending on the voltage being applied. The unit will normally leave the factory configured for the higher voltage.

Inside the conduit box where the U1, V1, and W1 terminals are located are two loose wires. These wires are connected to a 120 volt source to power the interior heater within the thruster casing.

### SELECTION OF MOTOR PROTECTION:

Due to the electro hydraulic regularities, the thruster can be operated without protective motor switch and thermal overload. If however, protective wiring is required, we ask you to consider the following guidelines. The curve of current consumption is represented by the diagram to the right.

- 1=Turn on (inrush current).
- 2=Current during lifting.
- 3=Current at end of lift.



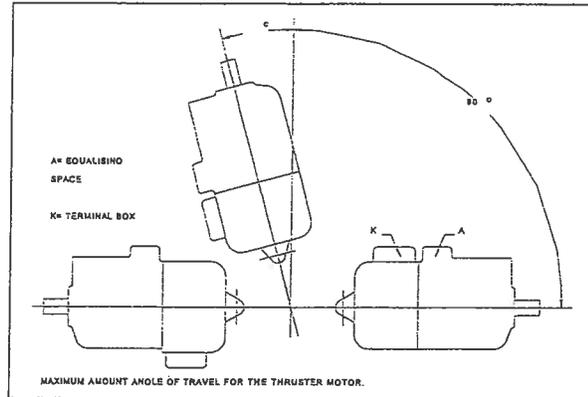
### HYDRAULIC

### THRUSTER UNIT

## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

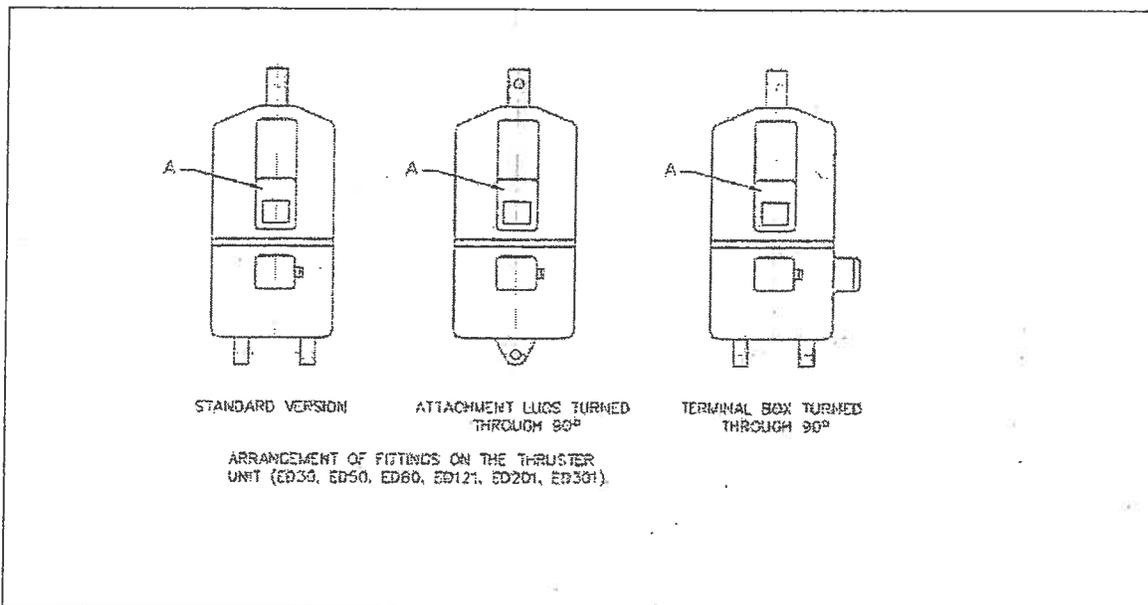
### MOUNTING:

Thrusters can be mounted vertically, at an angle and horizontally as shown in the drawing at the right. Care must be taken to ensure that the equalizing space "A" lies upper most.



### MOUNTING POSITION (TERMINAL CONNECTION BOX):

The terminal connection box on the thruster can also be located at 90 degrees or 180 degrees to the equalizing space "A" which must always lie uppermost when a thruster is mounted horizontally or at a steep angle from the vertical position. The thruster can be supplied with the fixing lugs turned through 90 degrees.



## HYDRAULIC THRUSTER UNIT

### PRECAUTIONS TO BE TAKEN:

**BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES**

Care must be taken to ensure that the angular movement of the thruster is not hindered and that no transverse forces act on the piston rod which could cause friction losses and jamming in the piston rod channel. In addition, care should be taken that the piston rod surface is not damaged or, for example, splashed with paint or the piston rod sealing rings will be destroyed (leakage).

**MAINTENANCE:**

The thruster unit requires no maintenance. For trouble free operation the thruster must always be filled with the type of fluid as specified in the table of "TECHNICAL DATA". Screw plug size for filling or draining hole, M22 x 1.5.

**OIL QUANTITY FOR THRUSTER:**

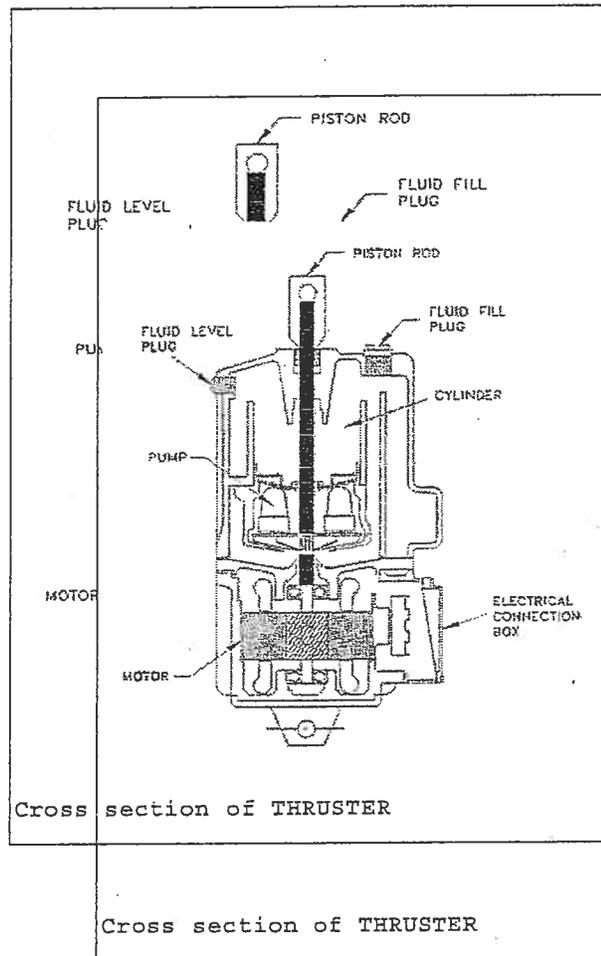
TYPE	OZ.
ED23/5	27.6
ED30/5	32
ED50/6	71
ED80/6	71
ED121/6	158
ED201/6	158
ED301/6	155

The above values are average values, they are lower for thrusters with valves and/or springs.

**HYDRAULIC THRUSTER UNIT**

**OPERATING FLUID / MAINTENANCE:**

The thruster is supplied for a temperature range from -13 degrees Fahrenheit to 122 degrees Fahrenheit and filled



## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

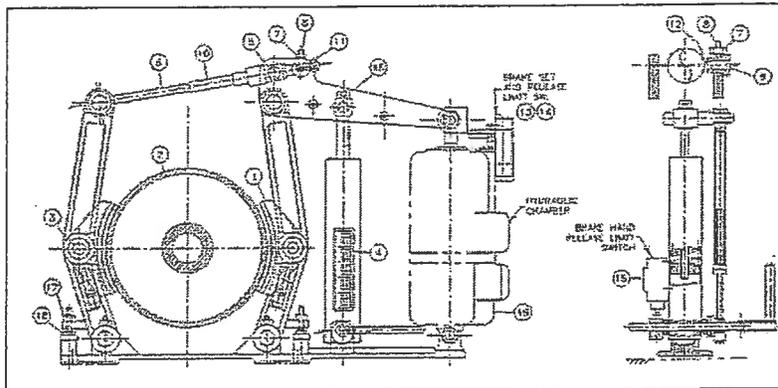
with hydraulic oil "CHEVRON SPINDLE OIL #10". This long life filling is not subject to wear or contamination during operation as long as the thruster maintains its original condition. All bearings in the thruster casing receives an original lubrication of grease. A long life grease Shell Alvania R3 is used.

### **\*IMPORTANT\***

When refilling, the thruster must be filled in the vertical position up to the overflow screw or to the filling limit of the charging connection, depending on the type of thruster. In order to prevent inclusions of air, run the unit through several strokes. Then check the oil level again, add fluid as needed, tighten charging connection and overflow screw.

RENEWAL PARTS, SERIES 72-300-EBN SHOE BRAKES:

**BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES**



BRAKE WHEEL  
DIAMETER

DEVICE	8"	10"	12"	16"	20"
1) SHOES	308-1	310-1	312-1	316-1	320-1
2) BRAKE WHEEL	308-2	310-2	312-2	316-2	320-2
3) SHOES BOLTS	308-3	310-3	312-3	316-3	320-3
4) BRAKE SPRING	308-4	310-4	312-4	316-4	320-4
5) YOKE BUSHINGS	308-5	310-5	312-5	316-5	320-5
6) SPINDLE	308-6	310-6	312-6	316-6	320-6
7) LOCK NUT	308-7	310-7	312-7	316-7	320-7
8) SET SCREW	308-8	310-8	312-8	316-8	320-8
9) TAPPET	308-9	310-9	312-9	316-9	320-9
10) FAN	308-10	310-10	312-10	316-10	320-10
11) ADJUSTING NUT	308-11	310-11	312-11	316-11	320-11
12) CATCH PIN	308-12	310-12	312-12	316-12	320-12
13) SET LIMIT SWITCH	308-13	310-13	312-13	316-13	320-13
14) REL. LIMIT SWITCH	308-14	310-14	312-14	316-14	320-14
15) HAND RE. LIMIT SWITCH	308-15	310-15	312-15	316-15	320-15
16) HEXAGON NUT	308-16	310-16	312-16	316-16	320-16
17) BRAKE STOP SCREW	308-17	310-17	312-17	316-17	320-17
18) BRAKE LOCK NUT	308-18	310-18	312-18	316-18	320-18
19) THRUSTER UNIT	**** ORDER BY NUMBER ON UNIT ****				

(NOTE: ADD "72-" PREFIX WHEN ORDERING REPLACEMENT PARTS.)

Link Control Systems, Inc.  
Specification Sheet for Link Control Systems Shoe Brake

## BRAKE SET-UP, TESTING AND MAINTENANCE PROCEDURES

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Each brake shall be a spring set, thruster released, shoe type brake. The brake shall have a continuous duty rating as shown on the plans. In addition, it shall be factory set for the retarding torque as shown. The brake shall be provided with corrosion resisting fittings as well as an indicator for reading the set torque in foot pounds. This indicator shall be mounted behind clear Plexiglas and will give the correct reading throughout the adjustment span.

The brake shall be equipped with a hand release which will not change the torque setting. The hand release shall be operable without removing the brake cover if specified. Each hand release shall also be equipped with a heavy duty lever limit switch for interlocking purposes.

The brake shall be designed so that the lining has automatic wear compensation. This wear compensation will automatically adjust the shoes as they wear to maintain the proper distance from the brake drum. If required a limit switch shall be provided that will indicate less than minimum lining.

In addition, limit switches are supplied to indicate when the brake is in the released position (electrically or mechanically) and in the set position (electrically or mechanically). These limit switches shall have a minimum of one normally open and one normally closed contact.

All brake wheels shall be supplied by the brake manufacturer. They shall have a pilot bore and be shipped to the machinery manufacturer for final boring and seating on the shafts.

Enclosures where required shall be of NEMA 3 type rain tight. This enclosure shall have a vertical split cover for ease of maintenance and inspection. The thruster unit shall be totally enclosed with built in adjustable time delays for setting. The enclosure shall be of a watertight construction with a cast conduit box. The hydraulic fluid shall be capable of year round service with a temperature range of -13 degrees Fahrenheit to 122 degrees Fahrenheit.

The brake shall be capable of rotating 90 degrees from horizontal without any harmful effect to the operation of the thruster unit.

Brakes shall be LINK CONTROL SYSTEMS 72-300-EBN SERIES or APPROVED EQUAL.

## 5.2. Reducers

### 5.2.1. Primary Reducer

***Primary Reducer (qty. 2) (400 E7 01)***

The Primary Reducers are Prager LTD2225-S Differential Reducers. The design gear ratio is 7.593:1 with a 30.370:1 emergency drive ratio.



REPAIR SERVICES • GEARS • GEARBOXES

*A Rexnord Geared Products Company*

# **LOW SPEED RIGHT ANGLE/PARALLEL SHAFT SPEED REDUCER INSTRUCTION MANUAL**



REPAIR SERVICES • GEARS • GEARBOXES

*A Rexnord Geared Products Company*

J.C. MACHINE COMPANY  
O'Rorke Bridge  
(formerly Stutson St. Bridge)

REFERENCE: P.O. NO. CH02  
PRAGER ORDER NO. 52129

### SPECIFICATIONS

GEAR DRIVE TYPE	TRIPLE REDUCTION DIFFERENTIAL
GEAR DRIVE SIZE	LTD2225-S
SERIAL NO.	
INPUT SPEED	870 RPM
OUTPUT SPEED	114.6 RPM
RATIO	7.59:1
EMERGENCY DRIVE RATIO	30.37:1
SERVICE RATING	112 HP
SERVICE FACTOR	1.0
LUBRICATING OIL	AGMA NO. 6S (288-352 cSt @ 40°C) TEXACO PINNACLE EP320
OUTPUT TORQUE RATING	30,798 IN-LBS PER OUTPUT SHAFT

**AT YOUR SERVICE SINCE 1897**

1113 Howard St. • Deer Park, TX 77536  
TELEPHONE: (281) 542-1822 • FAX: (281) 542-1897

**SCOPE:** The objective of this manual is to give general information on Installation-Lubrication-Maintenance-Disassembly and Reassembly of PRAGER INCORPORATED medium and low speed right angle shaft speed reducers. In addition, there is some supplementary information on coupling alignment, oil characteristics, and storage information.

**EQUIPMENT DESCRIPTION:** The types of reducers include: double, triple and quadruple reduction units with a combination of straight or spiral bevel and helical gears. This covers many different types of reducers with a great range of ratio and horsepower capacities. Always mount these reducers in a horizontal plane. A horizontal mounting position is necessary for the proper functioning of the oil distribution system. In some instances, due to thermal horsepower limitations, the box may be furnished with an oil pump and cooler. Much of the information included in this manual is valid for various special reducers or increasers, and it may be distributed as a general help for such special boxes.

The people at PRAGER INCORPORATED have made every effort to provide the customer with a high quality long lasting piece of equipment which will give trouble-free service over an extended period of time if it is operated within its designed capacity with the proper oil and reasonable conditions of maintenance.

On one end of the surface of the housing, is a stainless steel name plate giving: model designation, serial number, and order number. This information is needed to furnish any spare parts or any kind of technical information on the operating characteristics of the reducer.

If major repairs should be needed on this reducer, it is best to return it to the factory.

If time is not available for factory repairs, PRAGER has available capable field servicemen who can go to the job site. If the customer desires to repair the equipment himself, it is suggested that he study carefully the parts list furnished with the reducer and the information in this manual; in particular, Disassembly and Reassembly.

Any work done on PRAGER equipment during the warranty period without the approval of PRAGER and /or a PRAGER representative being present could void the warranty.

PRAGER wants very much for this equipment to give its normal expected long life. If there are any questions concerning the operation or repair of equipment, the customer should contract our head sales office in New Orleans.

**STORAGE:** PRAGER uses a specially formulated break-in oil which leaves a residual film on all interior surfaces. With reasonable exterior conditions, this film will last 6 months. The film will be compatible with the lubricating oil added by the customers.

Should the reducer remain inoperative at its installation site over 6 months, special care needs to be taken to protect the interior surfaces. After once starting operation, and the reducer is "down" for an extended period of time, it is desirable to operate the equipment for a few minutes once a week during the shut-down periods. This would assure a redistribution of oil and help prevent interior corrosion. See Addendum B for additional information.

**INSTALLATION:** Normally the coupling halves which go on the reducer slow speed and high speed shafts will be installed at PRAGER, prior to the reducer being shipped to the field site.

If a coupling half must be installed, check the coupling bore, shaft end and key way edges for any bruises or burrs. Mic shaft and bore of coupling half cold. The bore of the coupling must be expanded until it is at least .0005 in. per in. of diameter over the shaft diameter. Lightly grease shaft surface, heat carefully, slowly, and evenly the coupling half ( not over 300 degrees F.) until bore is sufficiently expanded. Install coupling cover. Place coupling half on shaft in its proper axial position keeping key-ways in line, it should move into place easily. If necessary, tap lightly with raw-hide mallet.

A properly fitted key will go against the bottom of the key way in the shaft with the sides of the key fitting "metal to metal" in the key way opening. There should be a clearance at the top of the key so that it does not make any contact against the outer part of the key way in the coupling half. It is possible to put a severe hoop stress in a coupling half if the key is improperly fitted.

Any reducer needs to be mounted on a substantial foundation. One system uses a concrete base, then a sole plate on the top of the concrete, about 1/16 in. shim space, then the reducer. The sole plate has tapped holes already in place so that cap screws can be used to clamp down the flanges of the reducer (with the proper shims in place) at all positions. Once a general elevation is established above the concrete, the sole plate is grouted into place, leaving a space of about 1/16" between the top of the sole plate and the bottom of the reducer pads. This shim space allows proper positioning of the reducer as to its slow speed and high speed coupling alignment, and space for shims so that the reducer can be bolted down flat. The housing must not be in a twist or bind as this will adversely affect tooth contact and will cause bearing edge loading. Use an adequate "area" of shims under all tie down bolts or cap screws. In "making up" the shim pack use as few shims as possible so pack will not be "soft". For example, a group of shims could be made up of a .060 in. plate plus .005 in. shim plus .002 in. shim, .067 in. total.

Another system is to use a base plate (sometimes called a bedplate) which is a rigid weldment or casting which supports two or more of the components in the package. For instance, a motor-reducer-pump might be installed on one base plate. This base might be installed on one base plate. This base plate is designed and made sufficiently rigid to support the various components. It is best to remove the reducer and other components from the base plate prior to its installation. At the job site, the base plate would be mounted in concrete. It is good practice for the concrete to be poured up into the inside of base plate to achieve optimum stability. The initial alignment for this design system is normally done by PRAGER or the package supplier, and the needed shims are already in place. Final checks should be made for possible twist in the housing and possible misalignment of the couplings. See "Start Up".

Flexible couplings need to be aligned both radially and axially. It is obvious that heavily loaded rotating shafts which are misaligned relative to one another will cause an abnormal and irregular overhung load. This condition in turn can cause abnormally high bearing loads and even irregular tooth contact. This latter condition could occur as the coupling misalignment takes up the clearance space within the bearings with a subsequent relative axial misalignment of the gear tooth surfaces. Addendum A gives procedures for both cold check and hot check coupling alignments.

If the box has an oil pump and cooler, it will be necessary to complete any piping for the cooling water. It is essential that all the studs, cap screws, and bolts in the system be adequately and properly tightened. Properly tightened bolting in which the "grip" (the parts being clamped between the bolt head and nut) is metal-to-metal will not fail in fatigue. After final hot check, install two substantial tapered dowels in line with high speed pinion between sole plate and reducer.

**START-UP:** Viscosity information on the proper oil to use in the reducer is given on the name plate. The box should be filled while the equipment is "at rest" and the level should be checked while the equipment is "at rest". The level of lubricant is established by a dip stick type gage, or sight glass. Initially, the oil should be filled to the top of the sight glass. As it is distributed during operation, the level will fall somewhat.

Prior to start-up, check the oil distribution system in the box. This can be done through the inspection cover opening to insure that the oil wipers, troughs, and feed holes are all open and in operating condition. The oil pump, if one is present, should be primed through the available opening.

Obviously, the coupling working parts should be properly greased with the lubricant specified by the manufacturer. The grease for the coupling should be

worked thoroughly into the working parts prior to installing the cover as centrifugal force tends to throw grease out against the coupling cover.

Tooth contact checks are made by PRAGER during assembly and after run-in to assure a quality reducer leaving our plant. However, a field tooth contact check should be made after alignment is completed and prior to start-up. Carefully clean oil from several meshing teeth on both the gear and pinion, and apply a thin coat of high spot blue to the clean pinion teeth. Apply a drag to the slow speed shaft and mesh the blue teeth by rotating the pinion back and forth several times through the blued area. Inspect the marks left by the high spot blue on both the gear and its removal on the pinion. Tooth contact on the loaded sides should be over at least 70% of the face. Normally, contact on a new set of gear elements would be intermittent, such that after some wearing and possibly some initial pitting, the contact will be virtually 100% across the face.

If the amount of contact is too low, it is possible that the housing is tied down in a bind. Progressively loosen tie down cap screws, check with feeler for space beneath the flange at the loosened cap screw. Re-shim as needed, tighten hold down cap screws, and then re-check tooth contact.

On most reducers, restraint from axial movement is achieved by the tapered roller bearings on the low speed shaft. It is essential that there not be any additional axial restraint in the system causing any kind of bind. A possible source of axial bind is the end of the shaft on the driving equipment bearing against the end of the high speed pinion shaft.

The reducer should be spun at a relatively low speed once or twice while the system is being observed for any possible abnormality. With full speed start-up, one must of course watch for any abnormal vibration, noise, leakage, flake collection on filter, or hot bearings. See Installation and Addendum A for alignment procedures.

**LUBRICATION:** As mentioned above the required viscosity of oil use in this reducer is given on the name plate. We recommend a premium, mineral oil with rust and oxidation inhibitors and an anti-foam agent. Some customers, when there are difficult operational situations, desire an extreme pressure (EP) oil and at times, an EP oil can add to the life of the equipment by helping to prevent scoring under conditions of marginal lubrication. PRAGER sales offices can furnish specific trade names of oils, if desired, once the customer has selected an oil supplier. Addendum B gives further information on oil lubricants.

After two weeks operation on a new reducer, the oil should be drained from the housing, the interior flushed out, and the box re-filled with fresh oil. Keep installed filter, if present, clean. The original oil may be used if it is filtered through a nominal 5 micron mechanical filter. Do not use an adsorptive type filter, it may remove oil additives.

Once every month check oil for possible contamination. The sample should be obtained from near the bottom of the gear case. This is also a good time to relubricate any grease lubricated bearings.

Every 6 months the old oil should be removed and interior of the box flushed out. If a filter is provided, it should be cleaned at each oil change. At this time, the interior gear elements should be visually inspected carefully through the inspection cover openings. Add new oil.

**MAINTENANCE:** The lubricant change interval and care mentioned above is, of course a vital segment of maintenance. Proper lubrication can help greatly to obtain long life for this type equipment. Keep filter clean.

It is recommended to maintain records of the coupling alignment hot check on a reducer. Changes in the alignment can indicate possible shift in foundation or some type of difficulty within the box.

An operator should always "listen" for possible changes in the noise level of the reducer which can be an indication of some sort problem.

It can be an indication of trouble if one of the bearings or the oil were to get too hot. On a premium straight mineral oil, the absolute peak of operating temperature would be 200 degrees F. With most extreme pressure oils, the operating peak is 160 degrees F. When lead naphthanate is the primary extreme pressure ingredient, and the temperature gets much above 160 degrees F, the life of the oil will be greatly reduced.

Should the temperature of the oil get too high, it may be simply an indication that the level of the oil is too high or possibly that the viscosity of the oil is too great for that particular application.

**DISASSEMBLY:** The sequence given will be for complete disassembly. Quite possibly visual inspection of the interior of the box will give information as to the basic cause of the problem, and may influence disassembly techniques. Obviously, it is desirable to order from PRAGER any replacement parts needed, and such an order should be placed as soon as possible if spare parts are not on hand. When the time and expense of disassembly and reassembly is considered, it is always best to obtain new sets of gaskets, shims and roller bearings. In ordering, parts, PRAGER must have the model designation, the serial number, and the order number which are given on the name plate on the exterior part of the housing.

Throughout the disassembly sequence, it is good to observe carefully what may have occurred inside the box and to keep a record of the position of any of the failed components. For instance, if there should be a straight roller

bearing failure, make a record of the position in the box that the failure tool place and which side of the bearing is toward the outside. A white marker can be used to identify these positions. One other precaution: a better analysis can be made of failed components if they are left dirty in their failed condition.

Disassembly procedure:

(1) Remove bolts, stud nuts, and dowels at the parting line of the reducer. Mark positions of all carriers and seals as guides for reassembly.

Should the oil pump, if present, be disassembled mark significant parts for correct reassembly. On some pumps the suction is changed by only switching the back plate 180 degrees.

(2) If the housing is split through the bearing bores, loosen several turns all of the cap screws, bearing retainers to housing in the lower half of the housing, and remove completely all the cap screws in the housing cover.

(3) If the housing consists of a main housing and a cover, the bearing retainers can be removed completely from the cover, and then the cover can be removed.

(4) Check the wiper location, if furnished, and the oil distribution system to be sure that they are functioning properly. Remove wiper assembly.

(5) By crane, lift the housing cover from the housing. Use considerable care in doing this by attaching a crane hook in a center position and lifting equally as near possible. A cable sling to the box corners may be necessary. Some sharp blows with a rawhide hammer at the corner positions and possibly some prying with a large screw driver in some areas would help to break loose the parting line joint.

(6) Separate the high speed and slow speed coupling covers and disassemble the load carrying members of the couplings.

(7) Remove all cap screws from the lower section of all seal and bearing retainers where they go into the lower portion of the housing.

(8) Remove the high speed shaft cartridge, if so equipped, and remove the lock nut and bevel pinion and the high speed bearing retainer.

(9) If needed, remove the coupling half from the high speed pinion shaft extension. Loosen set screw in coupling and use pullers with careful application of heat. Never let a torch flame remain in place too long. Slip off any remaining retainer. If it is necessary to remove oil slinger, note the axial position so it can be replaced in its proper location.

- (10) Lift out the intermediate assembly (if any,) the high speed gear-low speed pinion, along with the bearing retainers.
- (11) Slip off bearing retainers.
- (12) Lift out the low speed gear--low speed shaft--tapered roller bearings, the low speed bearing retainers, and the oil seal.
- (13) If necessary, remove the coupling half from the end of the low speed shaft. Note Item (9) above.
- (14) Lift off the bearing retainers and bearing cups.
- (15) Remove both tapered roller bearing cone assemblies using pullers.
- (16) Obtain, if desired, a representative full quart sample of oil from the sump.

REASSEMBLY: Clean all the interior parts of the housing and housing cover as well as all components which may be reused. Parting line surfaces must be clean and smooth, scrape surfaces if necessary. If there are slight amounts of corrosion in places, these can be cleaned by using a fine emery cloth, rubbing any shaft member in a rotative or circumferential direction. Do not rub shaft with emery cloth in a length-wise direction as it may introduce seal leaks. On certain rare occasions, if the oil inside the box had been allowed to get unusually acid, it might attack the paint on the interior surfaces of the housing and housing cover. If this should happen, the loose paint and rust must be cleaned off thoroughly and the interior re-painted. It is normally assumed that the base or lower part of the housing was never removed from its foundation support, which in turn assumes that the original positioning and coupling alignments were proper.

To obtain a minimum amount of face run-out of the slow speed gear relative to the slow speed shaft axis, and other gear face run-out relative to their shaft axes, the gears should be assembled on their respective "shafts" at PRAGER rather than at the equipment site.

In a double reduction reducer which has an intermediate of a low speed pinion -high speed gear, in almost all instances the high speed gear blank would have to be pressed on the low speed pinion shaft prior to the teeth being cut on the high speed gear. This gives optimum condition of face run-out as well as pitch diameter run-out.

For the discussion that follows, it is assumed that the low speed gear is pressed in its proper position on the slow speed shaft and that the high speed gear is already in position on the slow speed pinion shaft.

A light oil on all parts would help the assembly procedure as well as preventing corrosion on the various internal components during their exposure to the atmosphere.

#### REASSEMBLY SEQUENCE:

**The following applies strictly to the assembly of the bevel gear and pinion and should be performed during the assembly process as dictated by the unit configuration.**

**MOUNTING DISTANCE:** The axial position of a bevel gear or pinion in assembly is given by a dimension called the mounting distance. This is the linear dimension from the axial locating surface of a given member to the intersection point of its axis with the axis of its mate. The surface is usually the back face of the pinion or gear.

Frequently, it is more convenient to make measurements in assembly to the front of the pinion. In such cases, a flat reference surface is provided at the front for measuring purposes. The mounting distance is etched on the end of the pinion and on a smooth surface on the perimeter of the gear.

**BACKLASH:** Bevel gears are cut to have a definite amount of backlash which varies according to the pitch and operating conditions. This backlash is necessary for the safe and proper running of the gears. If there is insufficient backlash, the gears will be noisy, wear excessively, and possibly score on the tooth surfaces or even break. The amount of backlash required is usually etched or stamped on one or both members of a pair.

Normal backlash, that is, backlash in a direction perpendicular to the tooth surface should be measured at the tightest point. In order to make this measurement, hold the pinion solidly against rotation, rigidly mount a dial indicator against a gear tooth, being sure that the indicator stem is perpendicular to the tooth surface at the extreme heel.

The normal backlash will be shown by the indicator when the gear is turned back and forth. In the case of fine pitch gears, it is often easier to check the backlash by means of a boom arrangement attached to the gear shaft. The indicator reading is taken at the radius approximately equal to the pitch radius of the gear. This method gives a direct reading of backlash in the plane of rotation.

This checking of the backlash is an important step in the mounting of the gears. When the requisite backlash is not obtained, the gear should be adjusted axially until it is obtained.

**INSTALLING THE GEARS:** Before assembling a pair of bevel gears, look them over, observe all markings and read any tags which may be attached. The mounting distance is indicated as "M.D." followed by the dimension. Backlash is indicated as "lash" followed by the amount.

The tooth bearing should always be checked before putting in the lubricant and running under load. The mounting is correct only when the proper tooth bearing and required amount of backlash are obtained. To check the gears, paint the teeth with a mixture of marking compound and a few drops of light oil and run the gears under a light load. The tooth bearing will show contact near the center of the teeth.

**MARKED TEETH:** Spiral bevel gears of exactly even or multiple ratios, which have been lapped, have certain teeth marked "X". These gears should always be assembled with the marked teeth together. This should be done whenever such gears are put together after having been disengaged.

**LOCATING THE PINION:** The position for mounting the pinion should be determined by measuring from the shaft of the mating gear. The distance from the locating surface on the pinion to the gear shaft will be equal to the mounting distance minus the radius of the gear shaft.

The measurement may be made by means of micrometer gages, gage blocks or by special gages prepared for that purpose. It is often more convenient to measure to the front of the mounted pinion rather than to its back.

In this way the mounting distance can be readily checked, after the pinion is in place.

**LOCATING THE GEAR:** After the pinion is in place, the correct position of the gear may be accurately determined by moving the gear along its shaft and into mesh with the pinion until the specified backlash is obtained, as previously explained. It is then locked in place.

**CHECKING THE INSTALLATION:** When both gear and pinion are fastened in place, the tooth bearing should be checked as already mentioned. Inaccuracies in mounting or assembling will change the location of the tooth bearing on properly cut bevel gears. The deviation from the proper tooth bearing indicates the nature of the error.

When the bearing is too high on the pinion and too low on the gear, the pinion is too near the center of the gear. This is corrected by increasing the pinion mounting distance. In the opposite case, with the bearing low on the pinion and high on the gear, the pinion mounting distance should be decreased.

If the shafts are not accurately located in the same plane, a cross bearing will result -- the contact will be concentrated at one end of the tooth on one side and the opposite end on the other side. The shafts must be lined up to correct this.

**TOOTH BEARING:** Spiral bevel gears are produced to run with a localized tooth bearing. Since the area of contact does not cover the whole tooth, a slight tolerance in positioning the gears in assembly and some displacement under operating loads is possible. Without concentration of the load on the ends of the teeth.

The ideal tooth bearing is slightly high on the pinion and low on the gear. Its length under light load is usually about one-half of the tooth length so as to provide sufficient adjustability consistent with smoothness. Moreover, since the tooth bearing under heavy load will generally shift toward the heel (outer end of the tooth), the gears are cut so as to place the bearing, with the gears mounted in correct position, slightly near the toe (inner end of the tooth). The resulting bearing is called a central toe bearing.

#### **INSTALLING SPIRAL BEVEL GEARS:**

1. Always keep matched or lapped gear in their original sets or pairs.
2. Always replace both members of a pair.
3. Assemble lapped gears of even ratio with the teeth marked "X" together.
4. See that gears are a close fit on shaft.
5. Make sure that there is the correct amount of backlash.
6. Check the tooth bearing.
7. Make sure that lock nuts, bolts, etc., are tight. In the case of spiral bevel, be sure that both pinion and gear are locked against axial thrust in both directions.
8. Lubricate gears properly before operating under power.

**The remainder of the assembly process is similar to that specified for parallel shaft gear reducers.**

(1) Heat both cone roller assemblies which go on the slow speed shaft in an oil bath not to exceed 250 degrees F. Be certain that the surfaces on which the bearing cones will be placed are clean and free from any kind of burr. It would normally take about 1-1/2 hours in 250 degrees F oil for the bearing to adequately expand. It should drop into place. Be sure the cone shoulder is firmly against the part of the shaft or hub on which it makes axial contact.

Using similar procedures, install the low speed slinger(s). The axial position of the slinger must be correct for it to properly deflect oil.

On some of the larger fabricated reducers spherical roller bearings may be used on the low speed shaft, and possibly the high speed shafts. To

maintain an axial position, one of the outer races on the slow speed shaft is clamped, axially into place. In these applications, spherical roller bearings have an interference fit on inside diameter.

(2) Prior to placing the low speed coupling half on the low speed shaft end, install bearing retainer, low speed labyrinth seal, and, if needed, the coupling cover. The coupling half can be heated to not over 300 degrees F and then placed on the shaft end. Be careful that coupling half does not go on too far and then partially shrink into place. A piece of key stock or something clamped to the shaft for coupling to bump against would be helpful to prevent this.

(3) As needed, install high speed oil slinger and the inner races of the straight roller bearings. The inner races should have the number side "out" and the radiused bore corner "in". Normally, inner races will be positioned axially with the outer edge adjacent to where the shaft chamfer intersects the shaft outside diameter. The slingers and inner races should be expanded in hot oil not to exceed 250 degrees F, and placed in their proper axial position on the appropriate shaft ends. When the inner races are completely cooled in position, it is desirable to check the tightness of the race against the shaft. This can be done by tapping with a plastic hammer several times against race edge see if there is any axial movement from an insufficient interference fit. Ordinarily, it is quite difficult to move a properly fitted inner race with the plastic hammer.

(4) The tapered roller bearing cups are tapped into their bearing retainers. The low speed gear, low speed shaft, low speed bearing-retainer assemblies and a typical shim pack are placed in position in bottom half of the housing. Insert and tighten cap screws which hold retainers. It is essential to adjust, via shims, the tapered roller bearings to obtain the proper end movement of the slow speed shaft. When working equipment heats up under load, parts will expand, and could excessively increase the thrust loading on the tapered roller bearings if the initial end movement has been too small (pre-load too high). If bearing settings are not specified on the assembly drawing, we recommend that the clearance between an upper roller and the cup be .0015" to .002" for slow speed shaft bearings. This can be checked easily with a feeler gage. Change shims at the blind end retainer until the adjustment is correct.

(5) The appropriate outer race-roller assemblies used on the pinion (and where applicable the intermediate assembly). are now tapped into their bearing retainers. Snap rings should be install in the grooves of the bearing retainers which would prevent the outer races from moving axially out of position. Install the appropriate (new) gaskets on all bearings retainers. It is more convenient to use a bit of gasket compound to attach or lightly glue each gasket to its carrier flange.

- (6) As applicable on the high speed pinion and possibly the intermediate assembly, the bearing retainers would be positioned on the ends of the shaft and then this sub-assembly lowered into the appropriate bore of the housing.
- (7) The high speed coupling half is installed on the shaft extension end similar to the procedure on (2).
- (8) With all bearing carriers and retainers in their proper axial positions in the lower half of the housing, hand rotate the gear elements to be sure everything is in this proper position.
- (9) When the exposed gear elements are properly positioned, a tooth contact check should be made. A thin coating of high spot blue can be put on 3 or 4 cleaned pinion teeth. These coated teeth are then turned into contact against 6 or 8 cleaned gear teeth. Contact along both face halves should be 60 or 70% on the loaded sides. For further statements on tooth contact checks, check the fourth and fifth paragraphs under START-UP.
- (10) If the amount of contact is too low, and no satisfactory explanation can be found, it is best to contact a PRAGER sales office for their suggestions and help.
- (11) Move the bearing carriers and bearing retainers out about 1/8" to give clearance space for the housing cover installation.
- (12) Check again that the parting line surfaces are clean and smooth. These surfaces must come together metal-to-metal. Put a thin strip of sealing compound to make a seal at this joint. It is necessary that this line of sealing compound encircle the studs at the slow speed shaft and cover any area through which a leak might occur.
- (13) Lower the housing cover into position. This needs to be done very slowly and carefully as the part can bind at times on the studs around the slow speed shaft. Install the dowel pins on the ends of the housing to be sure that the relative position of the housing and housing cover are correct. Then insert all bolts and loosely tighten.
- (14) Tap the bearing retainers against the housing. Insert and tighten all bolts, caps screws, and stud nuts.
- (15) Insert and bolt into place the oil wiper assembly. Wiper blades should have only .010 to .020 clearance between the blade lip and slow speed gear face edge. If there is excessive clearance, oil may not be "wiped" from the gear and the bearings may not have enough oil.

- (16) Install oil pump if one is present. Check for adequate clearance between the end of the pump coupling and the gear shaft (driver). This space should be packed with grease to reduce wear.
- (17) Fill reducer with appropriate oil as mentioned in START-UP.
- (18) It is desirable to spin the unit with no load if this is possible. This involves completing attachment of the high speed pinion coupling, (if coupling has match marks, be sure they line up correctly,) greasing coupling, and installing cover. This is done simply to check any apparent abnormality.
- (19) Re-attach the slow speed coupling. Re-grease coupling, and install covers.
- (20) Even though coupling alignment check has been previously made, it is desirable to go through the complete procedure as outlined in the Addendum A. Record the results.
- (21) Follow the START-UP procedures given above.

## Viscosity Ranges for AGMA Lubricants

Rust and oxidation inhibited gear oils	Viscosity range <sup>1</sup> mm <sup>2</sup> /s (cSt) at 40°C	Equivalent ISO grade <sup>1</sup>	Extreme pressure gear lubricants <sup>2</sup>	Synthetic gear lubricants
AGMA Lubricant No. No. _____			AGMA Lubricant No.	AGMA Lubricant
0	28.8 to 35.2	32		0S
1	41.4 to 50.6	46		1S
2	61.2 to 74.8	68	2 EP	2S
3	90 to 110	100	3 EP	3S
4	135 to 165	150	4 EP	4S
5	198 to 242	220	5 EP	5S
6	288 to 352	320	6 EP	6S
7, 7 Comp <sup>3</sup>	414 to 506	460	7 EP	7S
8, 8 Comp <sup>3</sup>	612 to 748	680	8 EP	8S
8A Comp <sup>3</sup>	900 to 1100	1000	8A EP	

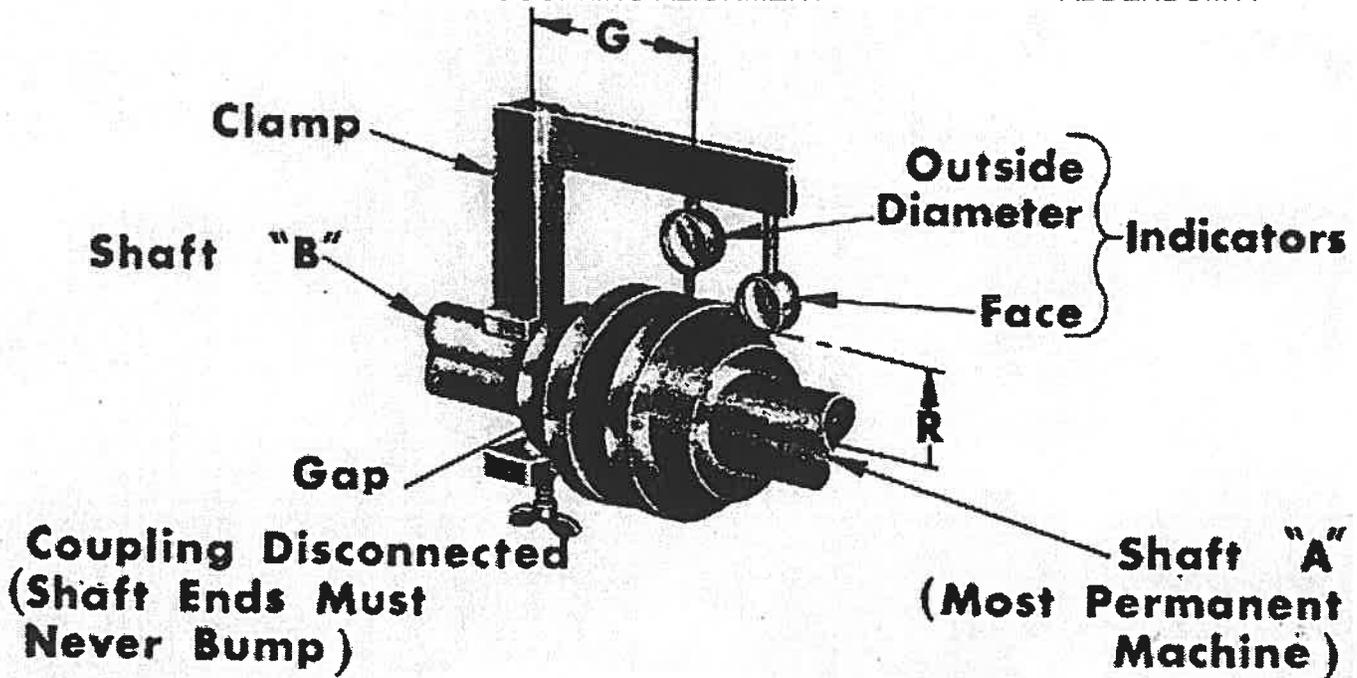
<sup>1</sup>) Per ISO 3448, Industrial Liquid Lubricants - ISO Viscosity Classification. Also ASTM D 2422 and British Standards Institution B.S. 4231.

<sup>2</sup>) Extreme pressure lubricants should be used only when recommended by the gear manufacturer.

<sup>3</sup>) Oils marked Comp are compounded with 3% to 10% fatty or synthetic fatty oils.

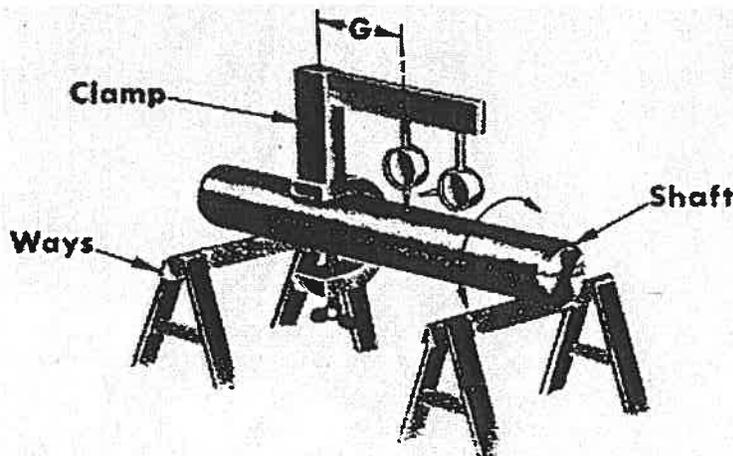
COUPLING ALIGNMENT

ADDENDUM A



OBJECTIVE: Align Shaft "B" to Shaft "A"

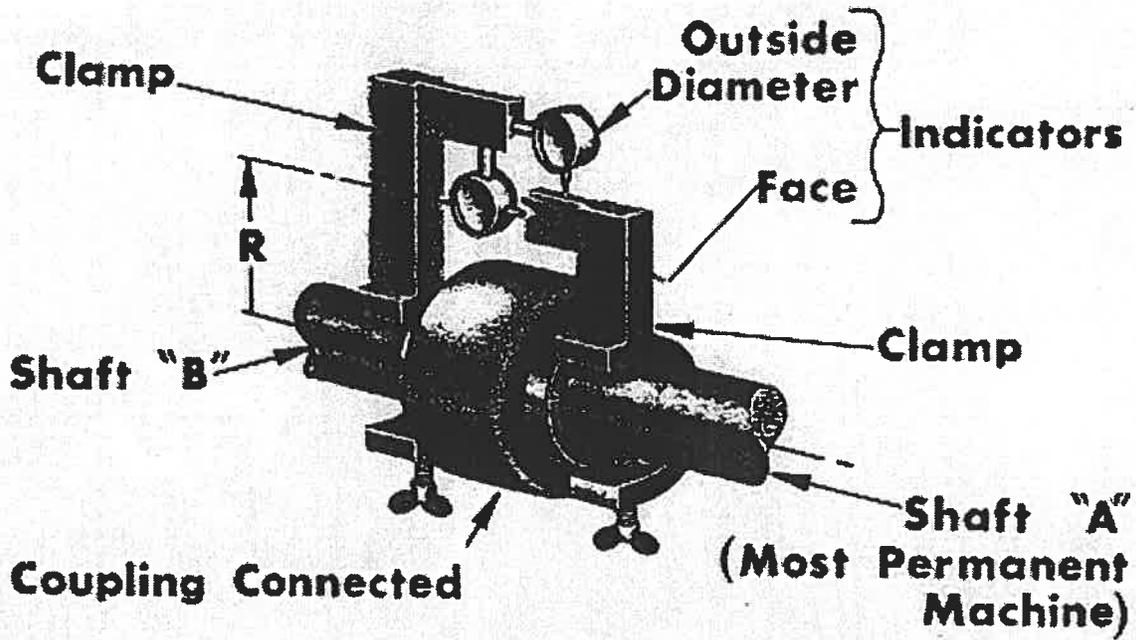
1. Check for arm sag (see Note 1, below).
2. Record approximate "R" dimension.
3. Hand rotate shaft "B" around Shaft "A" (see Note 2, below).
4. Record the outside diameter and face indicator readings at 12 o'clock, 3 o'clock, 6 o'clock, and 9 o'clock. Shift shaft "B" into the same relative axial position prior to each face reading (that is, with prize bar, move shaft axially in one direction until all axial clearance is gone).
5. Correct alignment as needed. Consider also the anticipated thermal changes. For 50° F. Temperature rise the housing will expand about .00033 inch per inch of height or center distance.



NOTE 1. Technique for checking gravity sag in radial indicator

- (a) Rotate clamp while attached to shaft, observe change in outside diameter indicator reading at 90 positions.
- (b) To reduce sag: Keep "G" short, use light weight indicators, use one indicator at a time.

NOTE 2. With the illustrated position of the dial indicators, rotating shaft "A" relative to shaft "B" would only give the internal eccentricity of the "A" shaft relative to its axis.



OBJECTIVE: Check Alignment, while Hot, Shaft "B" and Shaft "A"

Work machinery until operating temperatures are stabilized, then:

- (1) Quickly install clamps and indicators at both couplings.
- (2) Hand rotate shafts.
- (3) Record the approximate "R" dimension and the outside diameter and face readings at 12 o'clock, 3 o'clock, 6 o'clock, and 9 o'clock.
- (4) Correct alignment as needed.
- (5) Maximum allowable runout, total indicator reading (TIR) inches:

Shaft Surface Velocity	Outside Diameter	Face, TIR
5000 fpm and up	.002	.0004 per inch of R
3000 to 5000 fpm	.004	.0005 per inch of R
1500 to 3000 fpm	.006	.0006 per inch of R
500 to 1500 fpm	.008	.0008 per inch of R
500 to fpm and down	.010	.0010 per inch of R

COUPLING ALIGNMENT (Work Sheet)

ADDENDUM A

	<u>DRIVER</u>	<u>COUPLING</u>	<u>COUPLING</u>	<u>DRIVEN</u>
Mfg.	_____	_____	_____	_____
Model	_____	_____	_____	_____
Serial	_____	_____	_____	_____

COLD CHECK

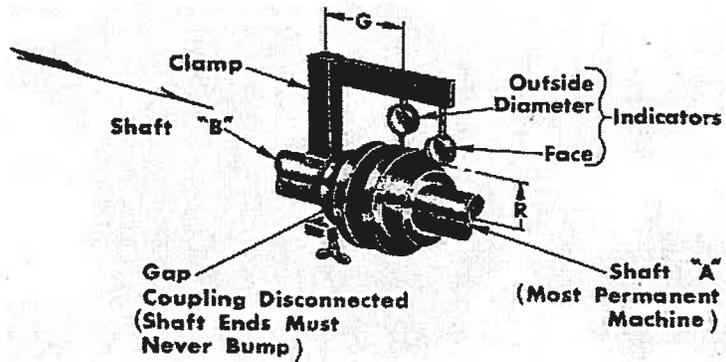
Temperature \_\_\_\_\_°F. Ambient

Rotate Shaft "B" around Shaft "A"  
Viewed from Left End of Illustration:

<u>Position</u>	<u>*Outside Diameter</u>	<u>*Face</u>
12 o'clock	_____	_____
3 o'clock	_____	_____
6 o'clock	_____	_____
9 o'clock	_____	_____

\*plus or minus

Record arm "R" \_\_\_\_\_



HOT CHECK

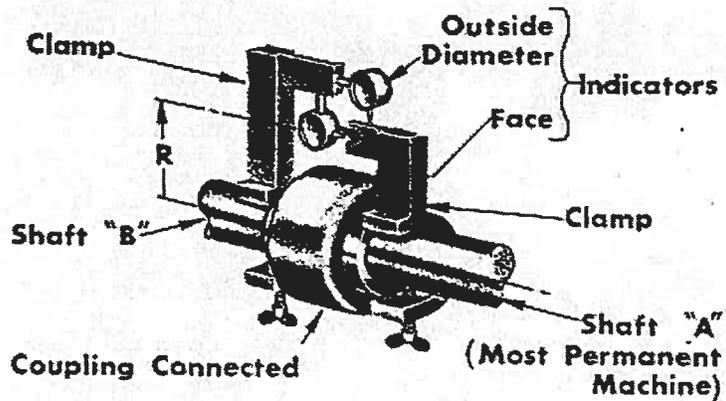
Temperature \_\_\_\_\_°F. Ambient, \_\_\_\_\_°F. Sump Oil

Rotate Shaft "B" around Shaft "A"

<u>Position</u>	<u>*Outside Diameter</u>	<u>*Face</u>
12 o'clock	_____	_____
3 o'clock	_____	_____
6 o'clock	_____	_____
9 o'clock	_____	_____

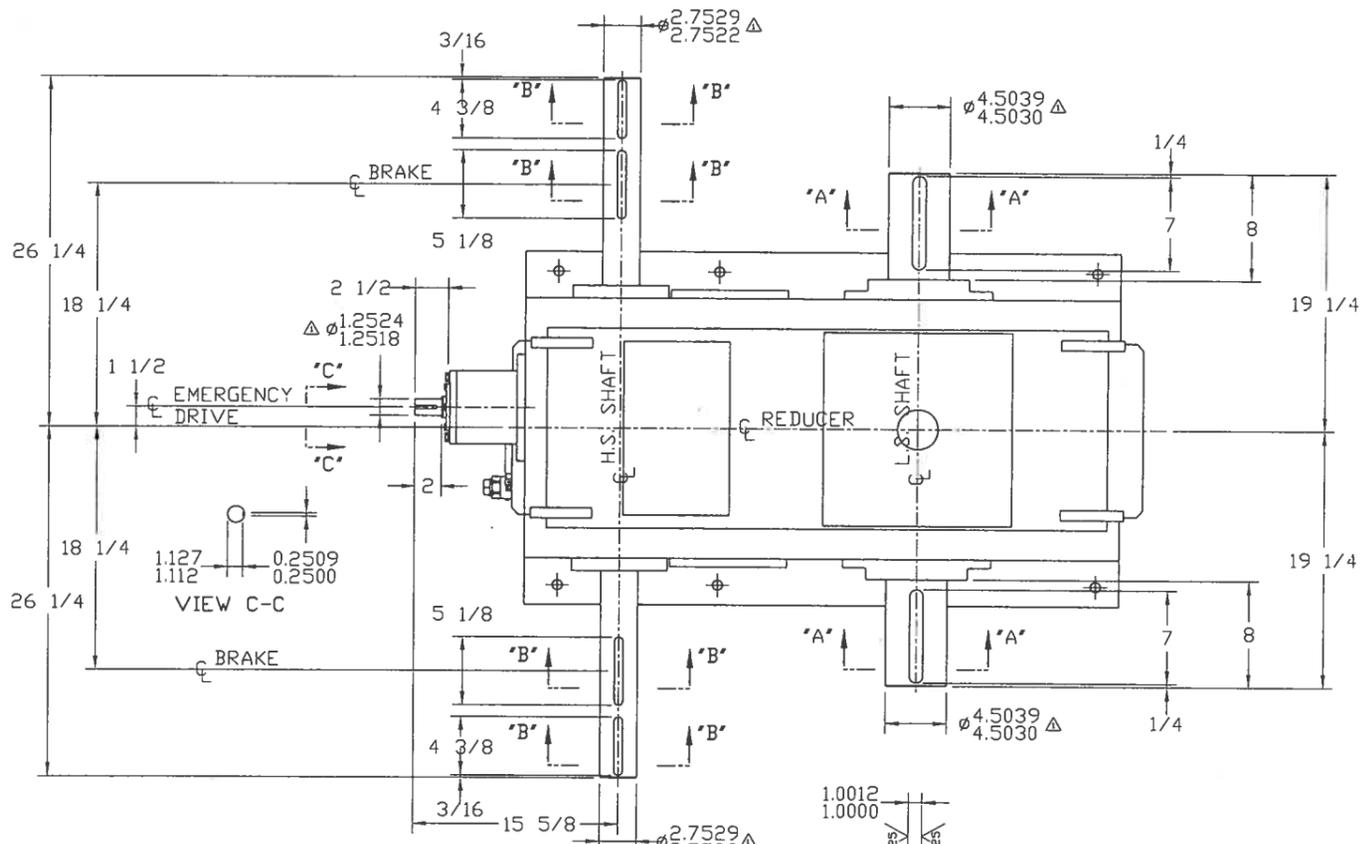
\*plus or minus

Record arm "R" \_\_\_\_\_



## RECOMMENDED PRACTICE FOR PRESERVING GEAR TEETH AND BEARINGS IN REDUCERS DURING INOPERATIVE PERIODS

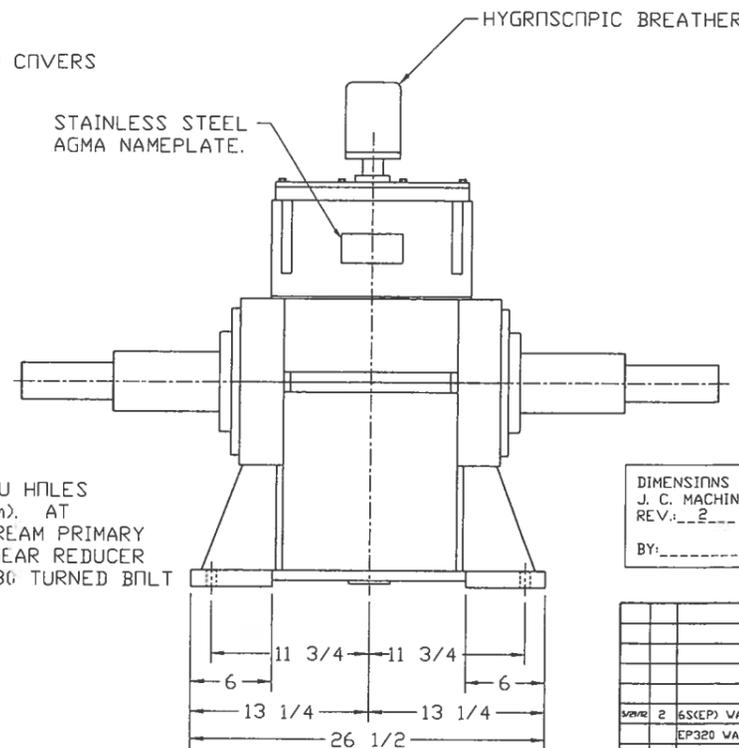
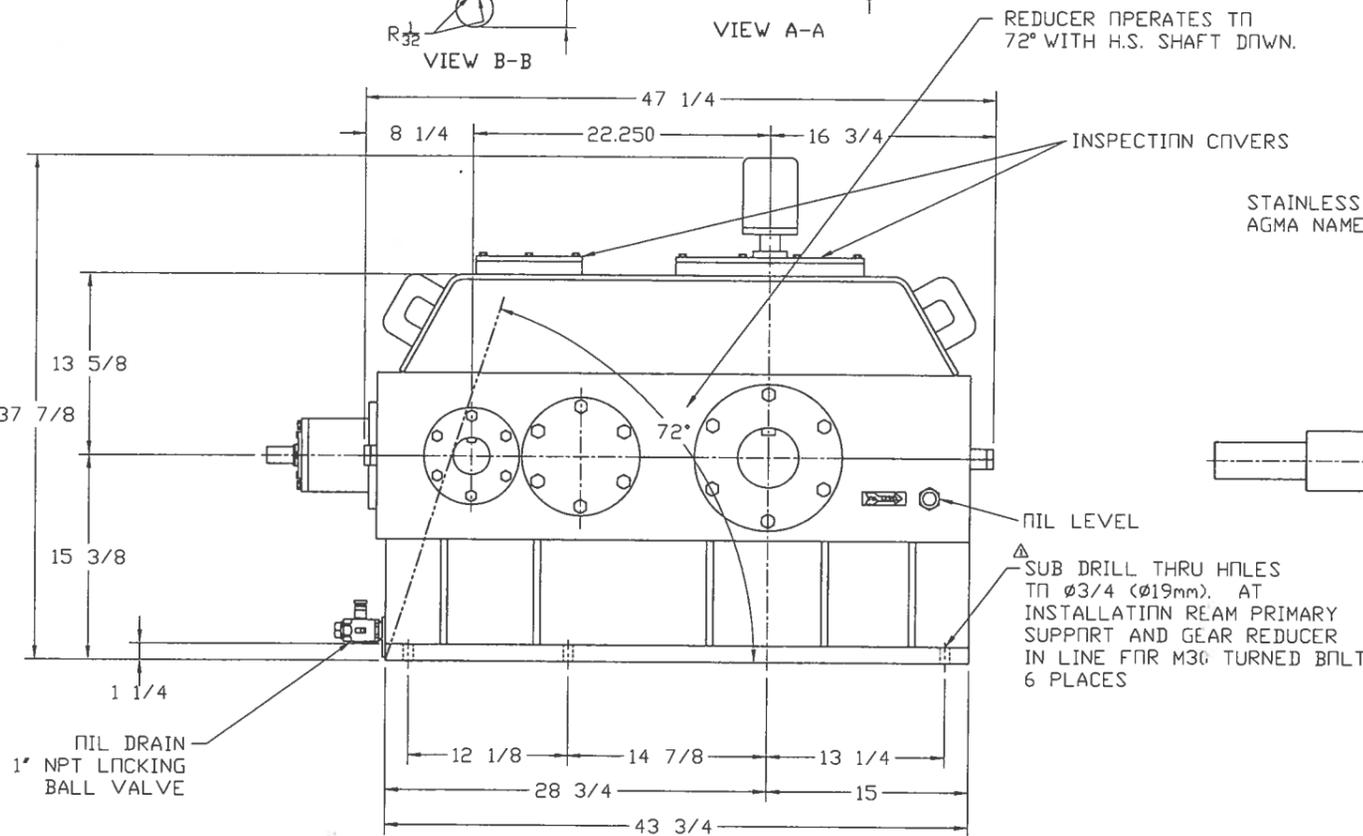
1. On new gear reducers shipped from our plant, the residual break-in oil adhering to exposed surfaces should prevent corrosion of interior parts for the least six months.
2. When the user adds the recommended lubricating oil and the reducer is operated for period of time, the oil should protect interior parts for inoperative periods up to 30 days.
3. If additional down time is needed, the customer should spin the reducer every 30 days to redistribute the oil to the non-submerged parts and gain another 30 days protection.
4. If extended down time is expected and it is impractical to spin the reducer, a rust preventive type oil should be brushed or sprayed on the gear teeth and bearings. Any quality rust preventive oil should give 12 months protection against corrosion. This oil should be compatible with the operating oil, and it should be unnecessary to remove the rust preventive oil when the reducer is started again.
5. Fill seal openings completely with oil. The oil can be the normal operating lubricant. When the equipment is to be used, the seals must be removed and the oil level dropped to the proper operating level.



NOTE:

1. GEARS AND PINIONS TO BE DESIGNED AND MANUFACTURED IN ACCORDANCE WITH ANSI/AGMA 6010-E88 TO AGMA QUALITY Q9.
2. HUSING TO BE FABRICATED FROM A-36 STEEL PLATE AND THERMALLY STRESS RELIEVED BEFORE MACHINING.
3. GEAR MATERIAL TO BE HEAT TREATED ALLLOY STEEL.
4. PINION MATERIAL TO BE HEAT TREATED ALLLOY STEEL.
5. SHAFT MATERIAL TO BE HEAT TREATED ALLLOY STEEL.
6. B10 LIFE OF ALL BEARINGS GREATER THAN 40,000 HOURS.
7. STRESSES ON GEAR & PINION TEETH DO NOT EXCEED 75% OF YIELD STRENGTH WITH 285% OF FULL LOAD MOTOR TORQUE.
8. SEE J.C. MACHINE SHOP DRAWING 400 E7 FOR GEAR REDUCER MOUNTING DETAILS AND J.C. MACHINE SHOP PART NO. 400 D6 04 FOR THE TURNED MOUNTING BOLT DETAILS

NAME PLATE DATA  
 UNIT SIZE: LTD2225-S DIFFERENTIAL REDUCER  
 RATIO: 7.593:1  
 EMERGENCY DRIVE RATIO: 30.370:1  
 INPUT SPEED: 870 RPM  
 OUTPUT SPEED: 114.6 RPM  
 SERVICE RATING: 112.0 HP  
 SERVICE FACTOR: 1.00  
 LUBRICANT: AGMA NO. 6S(EP)<sup>Δ</sup>  
 (288-352 cSt @ 40°C)  
 FURNISH 24 GAL. OF TEXACON  
<sup>Δ</sup>PINNACLE EP320 GEAR LUBRICANT.  
 OUTPUT TORQUE RATING: 30,798 IN-LBS/SHAFT  
 ESTIMATED WEIGHT = 3000 LBS.



DIMENSIONS CERTIFIED CORRECT FOR  
 J. C. MACHINE CO. P.O. NO. CH02  
 REV: 2  
 BY: \_\_\_\_\_ DATE: \_\_\_\_\_

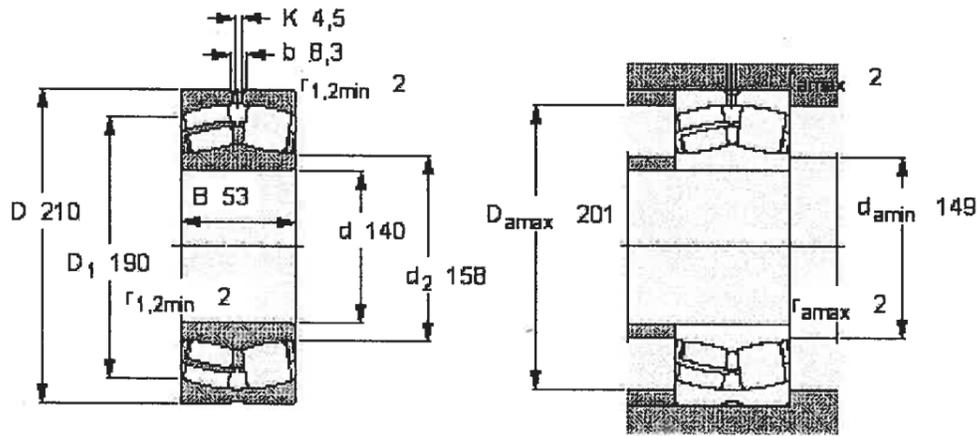
REF.: STUTSON STREET BRIDGE  
 OVER THE GENESEE RIVER  
 MONROE COUNTY  
 STATE OF NEW YORK

TOLERANCES (except as noted)		PRAGER	
DECIMAL	FRACTIONAL	Customer:	Job No.
+/- SEE NOTE	+/- SEE NOTE	J. C. MACHINE COMPANY	32129
ANGULAR	ANGULAR	MIAMI, FL	Drawn: GAD
+/- 1/2°	+/- 1/2°	Subject:	Date: 2/22/01
		PRAGER LTD2225-S DIFFERENTIAL SPEED REDUCER	Checked:
		INSTALLATION OUTLINE	Approved:
		Scale: 1" = 6"	Drawing No. D-35806
DATE	SYM	DESCRIPTION	DR. CH.

**Spherical roller bearings, cylindrical and tapered bore**

Principal dimensions			Basic load ratings		Fatigue load limit Pu	Speed ratings		Mass lb	Designation
d	D	B	dynamic	static		Reference speed	Limiting speed		
in			lbf		lbf	r/min			* - SKF Explorer bearing
5,5118	8,2677	2,0866	105000	153000	15300	2600	3400	14,4	23028 CC/W33 *

22



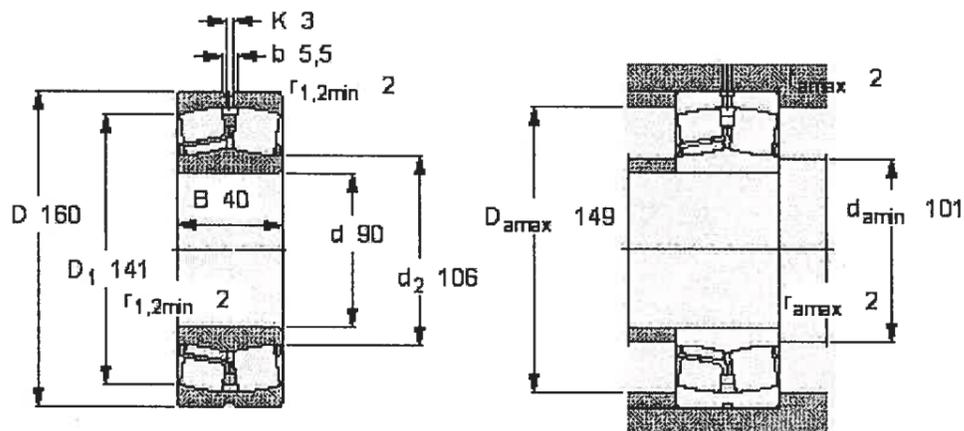
**Calculation factors**

- e 0,22
- Y<sub>1</sub> 3
- Y<sub>2</sub> 4,6
- Y<sub>0</sub> 2,8

**Spherical roller bearings, cylindrical and tapered bore**

Principal dimensions			Basic load ratings		Fatigue load limit Pu	Speed ratings		Mass lb	Designation
d	D	B	dynamic	static		Reference speed	Limiting speed		
in			lbf	C0	lbf	r/min	lb	-	
3,5433	6,2992	1,5748	73100	84300	8770	3800	5300	7,5	22218 E *

2.3



**Calculation factors**

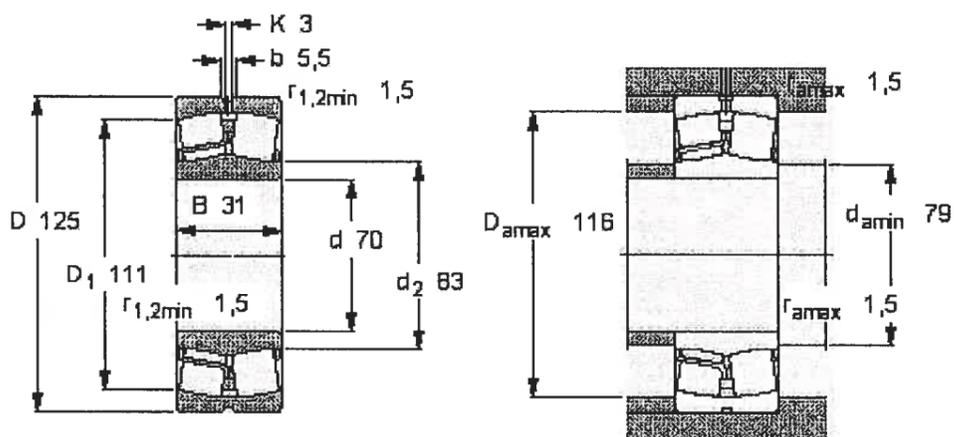
- e 0,24
- Y<sub>1</sub> 2,8
- Y<sub>2</sub> 4,2
- Y<sub>0</sub> 2,8

This part replaces 22218CC/W33 per SKF 10/16/06

**Spherical roller bearings, cylindrical and tapered bore**

Principal dimensions			Basic load ratings		Fatigue load limit	Speed ratings		Mass	Designation
d	D	B	C	C0	Pu	Reference speed	Limiting speed		
in			lbf		lbf	r/min		lb	
2,7559	4,9213	1,2205	46800	51300	5730	5000	6700	3,42	22214 E *

70



**Calculation factors**

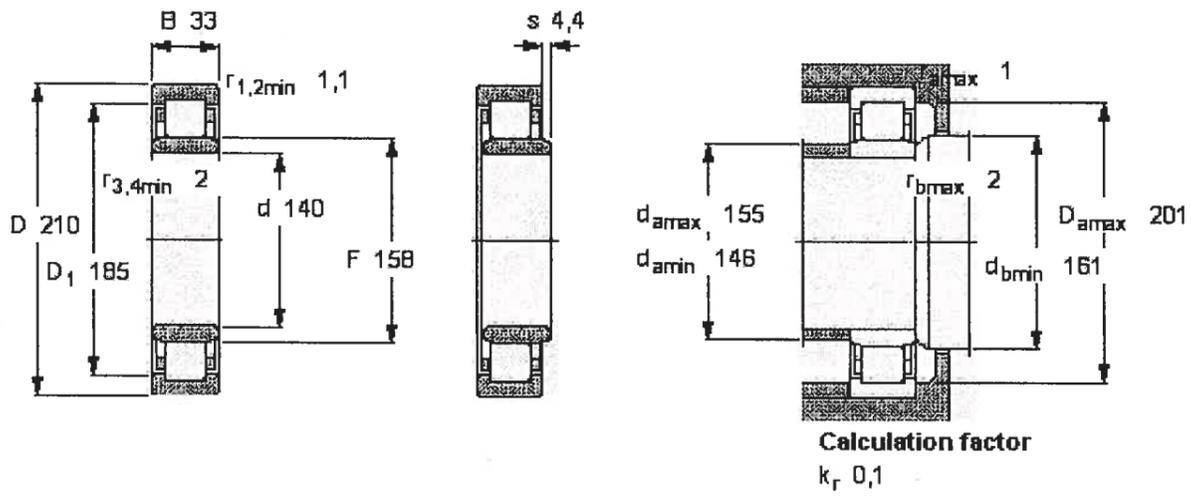
- e 0,23
- Y<sub>1</sub> 2,9
- Y<sub>2</sub> 4,4
- Y<sub>0</sub> 2,8

This part replaces 22214CC/W33 per SKF 10/16/06

**Cylindrical roller bearings, single row**

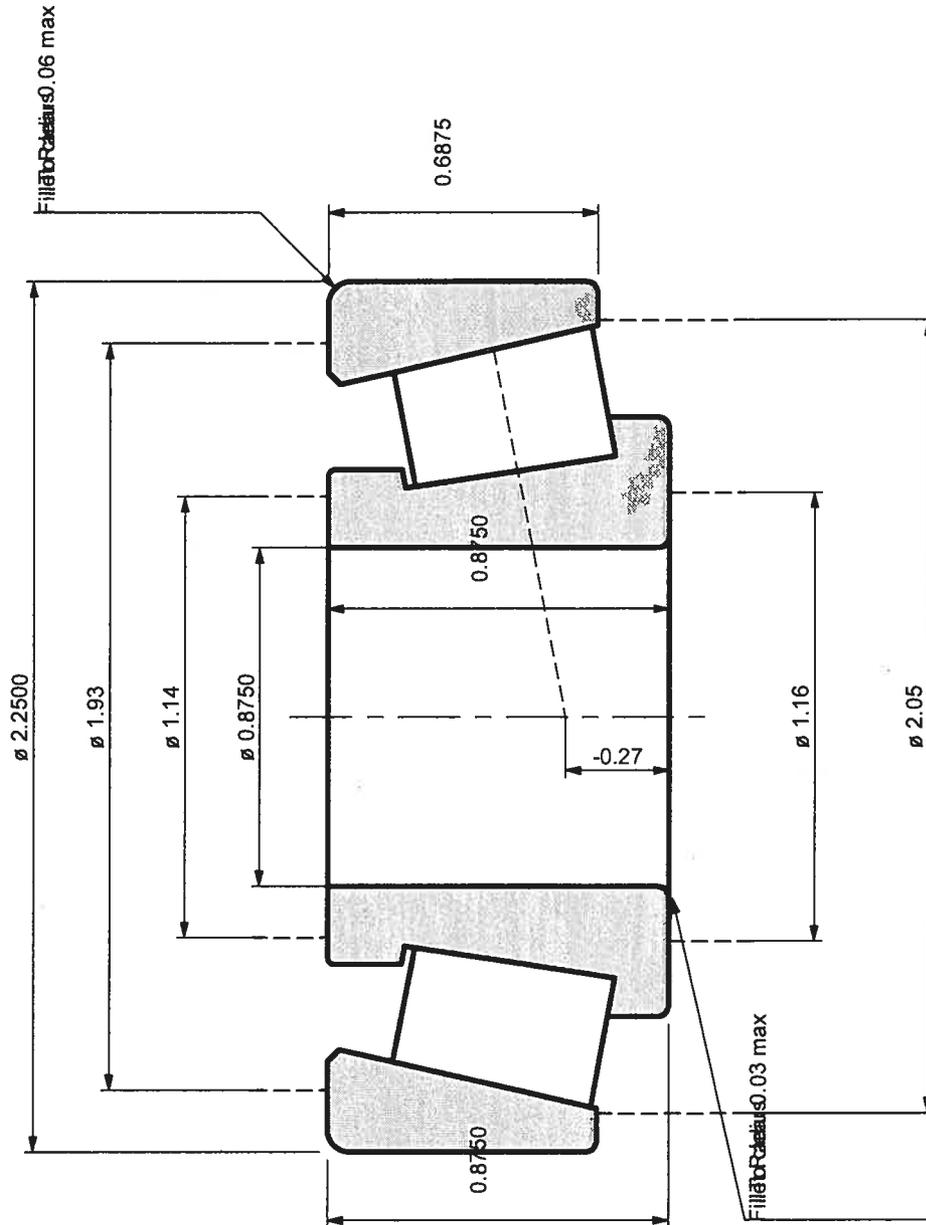
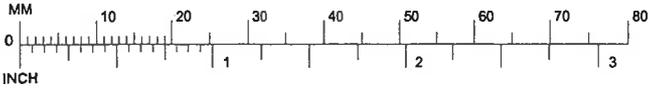
Principal dimensions			Basic load ratings		Fatigue load limit	Speed ratings		Mass	Designation	Angle ring Designation
d	D	B	C	C0	Pu	Reference speed	Limiting speed	lb	* - SKF Explorer bearing	-
in			lbf		lbf	r/min				
5,5118	8,2677	1,2992	38700	55100	6070	3600	3600	8,93	NU 1028 M	-

25









**IMPERIAL UNITS**

SUPERSEDES



ORIGINAL SCALE

2 : 1

Max Shaft Fillet Radius - R	0.03	inch
Max Housing Fillet Radius - r	0.06	inch
ISO Factor - e	0.35	
ISO Factor - Y	1.73	
Bearing weight (with cage)	0.63	lb
Number of Rollers per Row	13	
Effective Center a / Cone Back Face	-0.27	inch

**TIMKEN**

**THE TIMKEN COMPANY**  
CANTON, OHIO USA

**1280 - 1220**

TS BEARING ASSEMBLY  
Prager Services, Inc.  
Kinzel

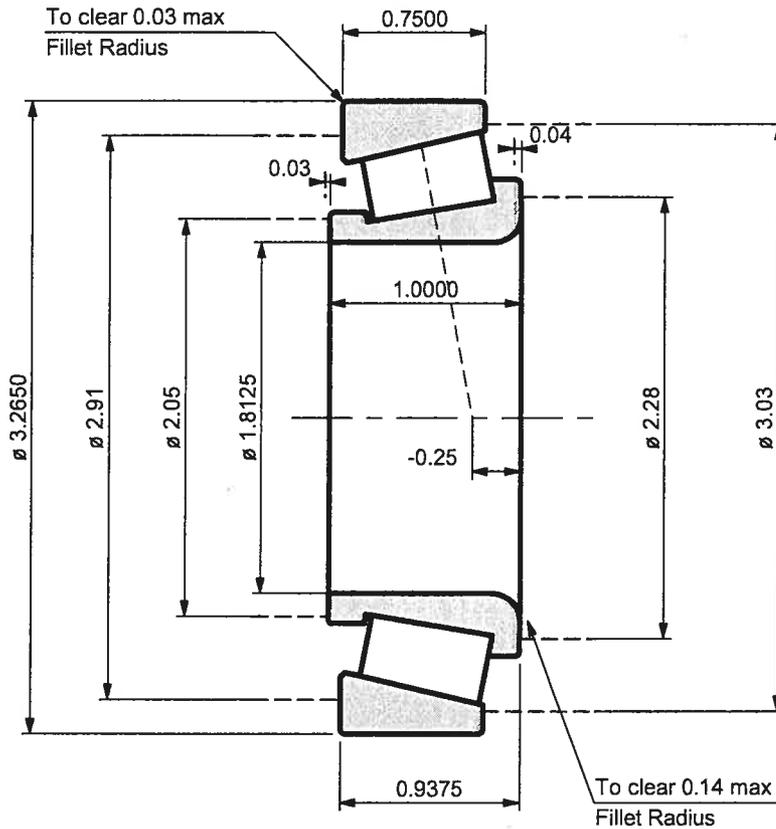
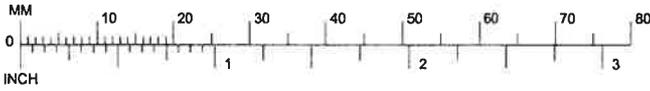
K factor	1.69
Dynamic Radial Rating, C90	2990 lbf
Dynamic Thrust Rating, Ca90	1770 lbf
Static Radial Rating, C0	12400 lbf
Radial Rating (1E6 Rev.), C1	11500 lbf

DRAWN Trbsg V 2.1.0	CHECKED	APPROVED	DATE 10/16/2006
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**\* COMPUTER GENERATED \***

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THE TIMKEN COMPANY

**FOR DISCUSSION ONLY**



**IMPERIAL UNITS**

SUPERSEDES

PROJECTION



ORIGINAL SCALE

1 : 1

Max Shaft Fillet Radius - R	0.14	inch
Max Housing Fillet Radius - r	0.03	inch
ISO Factor - e	0.33	
ISO Factor - Y	1.79	
Bearing weight (with cage)	1.17	lb
Number of Rollers per Row	18	
Active Center a / Cone Back Face	-0.25	inch

**THE TIMKEN COMPANY**

CANTON, OHIO USA

**25592 - 25520**

TS BEARING ASSEMBLY

Prager Services, Inc.  
Kinzel

K factor	1.74
Dynamic Radial Rating, C90	4880 lbf
Dynamic Thrust Rating, Ca90	2800 lbf
Static Radial Rating, C0	24900 lbf
Radial Rating (1E6 Rev.), C1	18800 lbf

DRAWN  
Trbgs V 2.1.0

CHECKED

APPROVED

DATE

10/16/2006

\* COMPUTER GENERATED \*

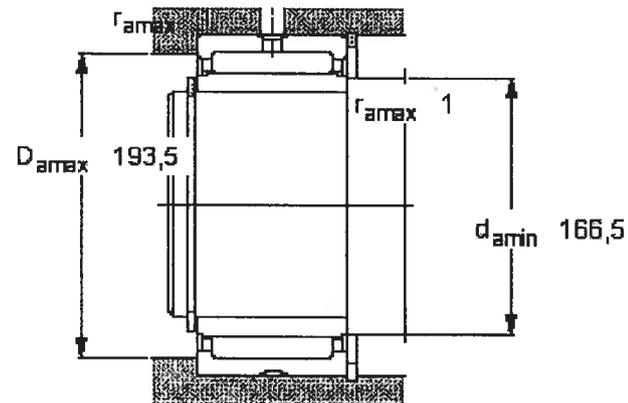
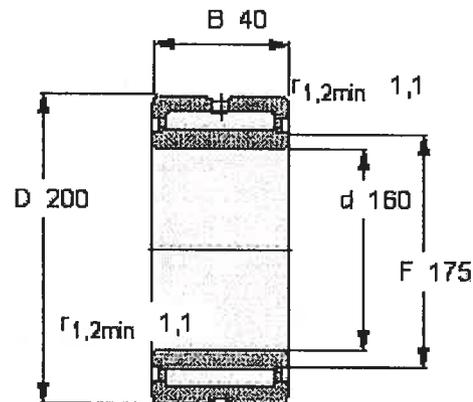
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WITHOUT THE CONSENT OF  
THE TIMKEN COMPANY

**FOR DISCUSSION ONLY**

### Needle roller bearings, with flanges, with an inner ring

Principal dimensions			Basic load ratings		Fatigue load limit	Speed ratings		Mass	Designation
d	D	B	dynamic	static	Pu	Reference speed	Limiting speed		
in			lbf		lbf	r/min		lb	-
6,2992	7,874	1,5748	35300	101000	11200	2200	2600	6,39	NA 4832

21



Permissible axial displacement from normal position of one bearing ring in relation to the other:  
 $s = 1,5$

Stock Number **44968**  
Description **LDS & SMALL BORE SEAL**  
Lip Code **Nitrile (Lip Code: R)**  
Type/Style **CRWHA1**



	Inches
Shaft	<b>4.5</b>
Bore	<b>5.501</b>
OD	<b>5.506</b>
Width	<b>0.438</b>
Weight	<b>0.424</b>

UPC	<b>00085311035934</b>
Speedi-Sleeve	<b>99450</b>
WastWatcher	<b>44959</b>
Bore-Tite on O.D.	<b>Y</b>

Product Images:

Note: photos are representative of construction.

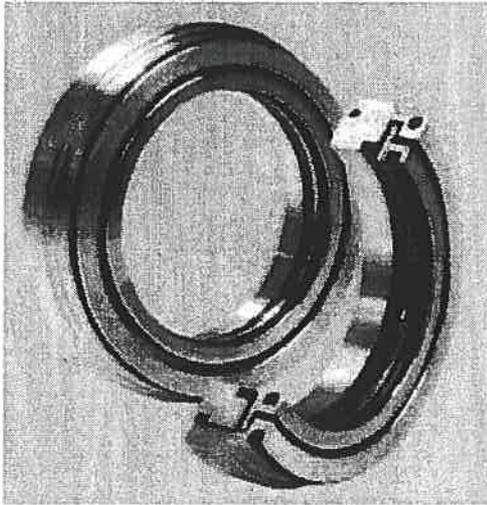




# MAGNUM - S

DURABLE BY DESIGN

CARTRIDGE BEARING SEAL

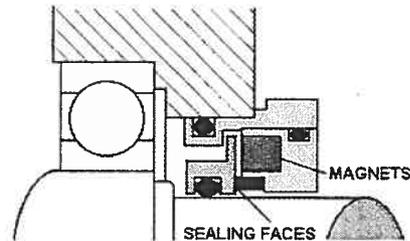


The new **ISOMAG MAGNUM-S** finally resolves the long-standing issues of leakage and installation that have plagued flooded bearing seals.

The **MAGNUM-S** cartridge seal will fit into narrow cross section and short axial length applications that previously prevented the use of precision flat face seals.

Unitized cartridge design correctly sets the seal forever. Axial rotor movement is contained within the cobalt magnetic field for the life of the seal ... Even if you move the shaft.

**MAGNUM-S** is a precision contact mechanical seal designed to completely seal your power frame, gearbox, motor, turbine, blower and more. The "S" features precision lapped faces and O.D. hydraulic loading to assure sealing in flooded applications. All these features are in a compact unitized assembly that installs as easy as a lip seal.



**MAGNUM-S**  
Patent Pending

**OIL FLOODED  
OIL MIST  
OIL SPLASH  
GREASE**

**CUSTOM SIZES  
BUILT TO FIT**

**HORIZONTAL  
VERTICAL UP  
VERTICAL DOWN**



ISOMAG Corp.  
11871 Dunlay Ave.  
Baton Rouge, LA 70809

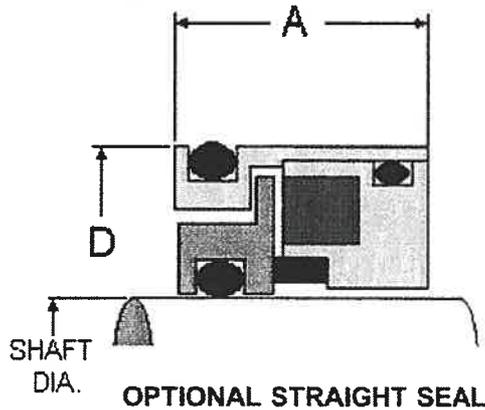
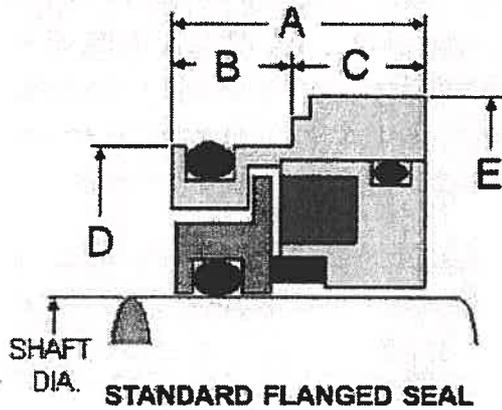
Phone: 225-752-0926  
Fax: 225-756-3141  
Website: isomag.com



DURABLE BY DESIGN

# MAGNUM - S

## CARTRIDGE BEARING SEAL



### INCH SIZE SEALS

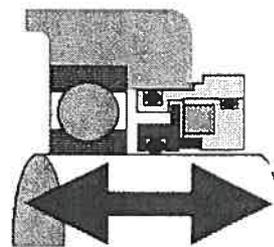
SHAFT DIA.	A	B	C	D min. bore	E
.750" to 2.000"	.685	.310	.375	SHAFT + .750	BORE + .200
2.062" to 2.500"	.740	.340	.400	SHAFT + .750	BORE + .200
2.562" to 10.000"	.900	.500	.400	SHAFT + 1.000	BORE + .200
10.062" to 13.000"	1.125	.500	.625	SHAFT + 1.500	BORE + .200

### METRIC SIZE SEALS

SHAFT DIA.	A	B	C	D min. bore	E
20 to 50 mm	17.4	7.9	9.5	SHAFT + 19.05	BORE + 5.08
51 to 63 mm	18.8	8.6	10.2	SHAFT + 19.05	BORE + 5.08
64 to 255 mm	22.9	12.8	10.2	SHAFT + 25.40	BORE + 5.08
256 to 330 mm	28.6	12.8	15.9	SHAFT + 38.10	BORE + 5.08

### SPECIFICATIONS

ROTARY FACE	: HT 17-4 PH
STATIONARY FACE	: TFE COMPOSITE
STATOR	: BRONZE std.
ADAPTER	: BRONZE std.
ELASTOMERS	: VITON std.
MAGNETS	: RARE EARTH
<i>Optional materials available</i>	
MAX OPERATING CONDITIONS	
OPERATING TEMP	: 300 F
PRESSURE	: 20 PSIG
SPEED Lubricated	: 12,000 FPM
SPEED Dry	: 4,000 FPM



**HANDLES AXIAL  
SHAFT MOVEMENT**

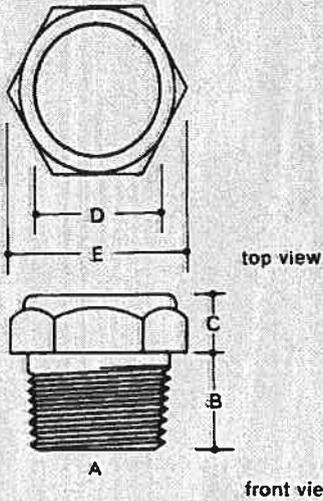
**Multi - National Distribution**



ISOMAG Corp.  
11871 Dunlay Ave.  
Baton Rouge, LA 70809

Phone: 225-752-0926  
Fax: 225-756-3141  
Website: isomag.com

**PORTHOLE LIQUID LEVEL GAUGES**



**BW-10 CLEAR WINDOW WITH OPEN BACK  
BW-20 CLEAR WINDOW AND REFLECTOR**

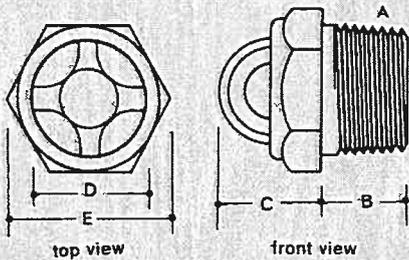


steel, zinc plated

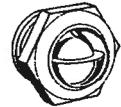
PSI	a.	b.	c.	d.	e.	BW-10	BW-20
						Item Number	Item Number
75	3/8-18	1/2	11/32	15/32	1	04040	
75	1/2-14	17/32	7/16	37/64	1 1/4	04041	04052
50	3/4-14	17/32	7/16	3/4	1 1/2	04042	04053
25	1-11 1/2	11/16	1/2	1	1 13/16	04043	04054
10	1 1/4-11 1/2	11/16	1/2	1 9/32	2 1/4	04044	04055
10	1 1/2-11 1/2	11/16	1/2	1 9/16	2 1/2	04045	04056
2.5	2-11 1/2	11/16	1/2	2	3 1/8	04046	04057

Maximum temperature 250°F

Not for air service



**BW-40 OBSERVA-DOME**



steel, zinc plated

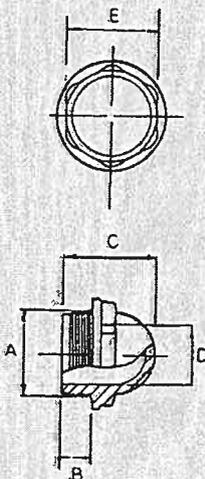
a.	b.	c.	d.	e.	Item Number
3/4-14	17/32	13/16	15/16	1 1/2	04119
1-11 1/2	11/16	13/16	15/16	1 13/16	04120
1 1/4-11 1/2	11/16	1	1 1/4	2 1/4	04121
1 1/2-11 1/2	11/16	1 3/16	1 11/16	2 1/2	04122

Maximum recommended conditions:

Not for air service

10 psi to 100°F

2 psi to 160°F



**PLASTIC DOME THREADED, POLYCARBONATE**

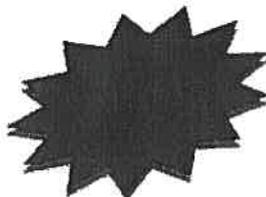
a.	b. mm	c. mm	d. mm	e. mm	Item Number
1/2 BSP	10	30	14	24	6301-1
3/4 BSP	12	34	20	30	6302-1
1 BSP	12	36	23	36	6303-1
1 1/4 BSP	13	41	28	41	6304-1
M20x1.5	10	30	14	24	6305-1
M27x105	13	34	16	30	6306-1
M33x1.5	12	36	22	36	6307-1
M35x1.5	13	33	25	45	6308-1
M42x1.5	13	41	28	41	6309-1

Maximum working pressure 45 PSI

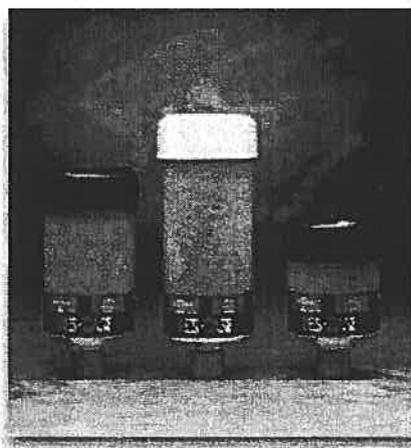
Not for air service

Maximum working temperature 160°F

## DISPOSABLE *Breathers*

[About Des-Case](#)[Breathers](#)[Tech Notes](#)[Case Studies](#)[Distributors](#)[How It Works](#)[Tools](#)[Newsroom](#)

The new Des-Case® Disposable Steel Breather is the ideal desiccant breather for mobile equipment. With 1 micron filtration and a rugged metal housing, this breather is durable, resistant to vibration and can withstand a greater range of temperatures.



**"Industry spends billions of dollars annually treating the negative effects of oil contamination."**

Des-Case attacks the cause as opposed to treating the problem of contamination. Designed and developed by filtration engineers the Des-Case hygroscopic breather is a unique, patented air filter and water vapor removal system. It will virtually eliminate moisture and particulate contamination in industrial equipment reservoirs such as hydraulic tanks and gear boxes.

### *Change To Des-Case For Maximum Performance*

Des-Case hygroscopic breather elements are state-of-the-art in design and function, and are industry's best choice for assuring maximum machine performance. Des-Case

### *Resilient Construction*

Moisture and particulate accumulation are major factors of oil contamination in industrial equipment. Neglected, these detriments restrict equipment efficiency, causing machine downtime and significant expense in replacement oil, parts and repair labor. Des-Case breathers incorporate a proven, field-tested design. They prevent water and contaminants from entering fluid reservoirs as differential pressures occur through thermal expansion and contraction of the fluid, or during the filling or emptying process. Des-Case breathers utilize the entire area of the patented polyester filter media to remove solid particulate material as small as 3-microns. Accompanying water vapor is then removed by the hygroscopic agent. A final filter ensures that only clean dry air enters the system. [See how it works!](#)

### *Unique Filtration Process*

Every Des-Case hygroscopic breather is manufactured in a durable, shock-absorbing clear plastic casing with resilient qualities to withstand the customary abuse associated with heavy manufacturing equipment. The units are disposable, and are manufactured entirely of environmentally safe components. Des-Case disposable hygroscopic breathers are manufactured in three sizes, DC-2, DC-3, and DC-4 to accommodate different mounting space requirements. All three models are rated for 20 cfm of air in and out of the tank or

- offers these cost-saving benefits:
- ⑤ Elimination of water-contaminated oil which leads to additive stripping
  - ⑤ Elimination of rust-forming condensation
  - ⑤ Elimination of sludge deposits
  - ⑤ Less abrasive particles to prolong machine operating life
  - ⑤ Longer oil and oil filter life

reservoir (the equivalent of 150 gpm fluid level change in the tank).  
 The Des-Case Sizing Wizard will help you determine the best product for your application.

**Models, Accessories & Installation Methods**

Des-Case disposable breathers retain particulate as small as 0.5-micron (73.5% efficiency) or 3-micron absolute, are rated for 20 cfm and feature a 1" standpipe.

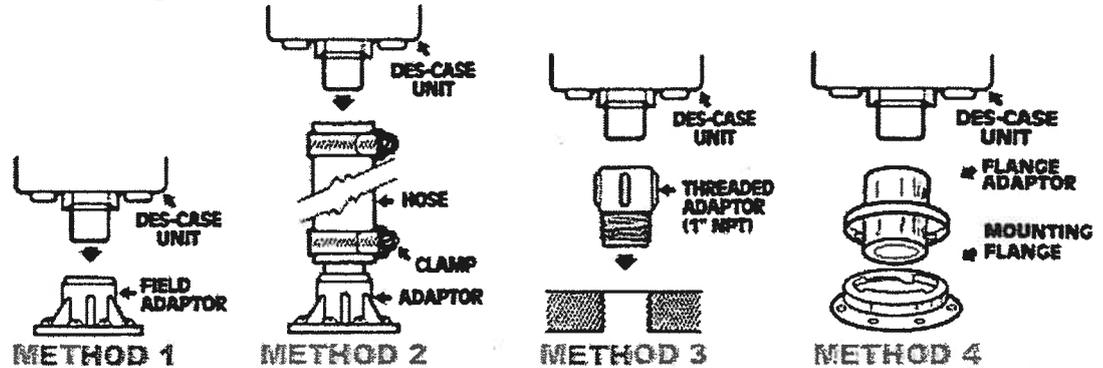
Model#	Diameter	Height	Water Adsorption
DC-2	4in/10.16cm	4.5in/11.43cm	5.25oz/155ml
DC-3	4in/10.16cm	6.5in/16.51cm	8.16oz/240ml
DC-4	4in/10.16cm	8.5in/21.59cm	11.66oz/345ml

**Optional Accessories**

Threaded Adaptors	DC-10
Clamps	DC-11
Field Adaptors	DC-12
Flange Adaptors	DC-15
Flexhose	DC-16

\* All adsorption rates are approximate and do not factor in the positive effects of regeneration.

Des-Case hygroscopic breathers are designed for installation on most equipment regardless of location. For installation in difficult areas, Des-Case offers accessories enabling breather placement to be several feet away from an oil reservoir or gearbox.



[Breathers](#) | [Tech Notes](#) | [Case Studies](#) | [Distributors](#) | [How It Works](#) | [Sizing Wizard](#)  
[Home](#) | [About Des-Case](#) | [Newsroom](#) | [Contact Us](#)

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## *inPHorm* Brass Products Selection Report

Last Change: 10-4-2005 9:59  
 Report Date: 10-4-2005 10:15

Software Version: 1.1

### Customer Identification

Company Name:  
 Contact Name:  
 Contact Title:  
 Company Address:  
 City:  
 State:  
 Zip Code:  
 Phone:  
 FAX:

### Brass Products Valve Specifications

PART NUMBER: XVP500P-16  
 Product Line: Ball Valves  
 Type of Valve: Inline  
 Type of Actuator: Manual Handle  
 Parker Division: Brass Products Division  
 Body Material: Brass  
 Cv.: 54  
 Connector Ends: 1" Female PTF special short  
 1" Female PTF special short

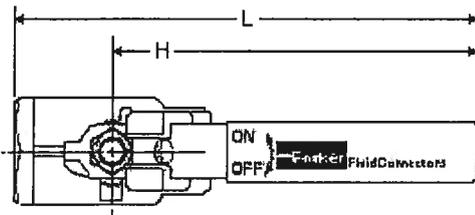
### Choose Sizing Method

Entered Connection Size: 1"  
 Max. Operating Pressure: 20 psia  
 Max. Operating Temperature: 150 °F

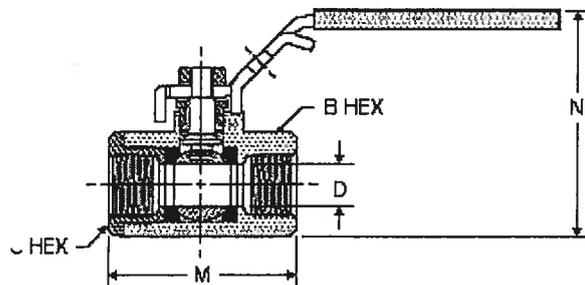
### Details

Vent Options:  - No Vent  
 Stem Options:  - Brass Ball and Stem  
 Handle Options: P - Steel Padlocking Lever Handle  
 Handle Cover:  - Yellow with Marked Parker Logo

### Brass Products Valves Dimensions



B (Hex) = 1 1/2  
 C (Hex) = 1 9/16  
 D (Flow) = 0.875  
 H = 3.96  
 L = 5.34  
 M = 2.75  
 N = 3.08



### Warnings and Additional Information

#### Warnings

This software provides you with options for your further investigation. Before using any product, it is important that you analyze all

### 5.2.2. Secondary Reducer

***Secondary Reducer (qty. 4) (400 E5 01)***

The Secondary Reducers are Prager LT5100 Triple Reduction Speed Reducers. The design gear ratio is 90.8:1.



REPAIR SERVICES • GEARS • GEARBOXES

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# LOW SPEED PARALLEL SHAFT SPEED REDUCER

## INSTRUCTION MANUAL

**AT YOUR SERVICE SINCE 1897**

1113 Howard St. • Deer Park, TX 77536  
TELEPHONE: (281) 542-1822 • FAX: (281) 542-1897



REPAIR SERVICES • GEARS • GEARBOXES

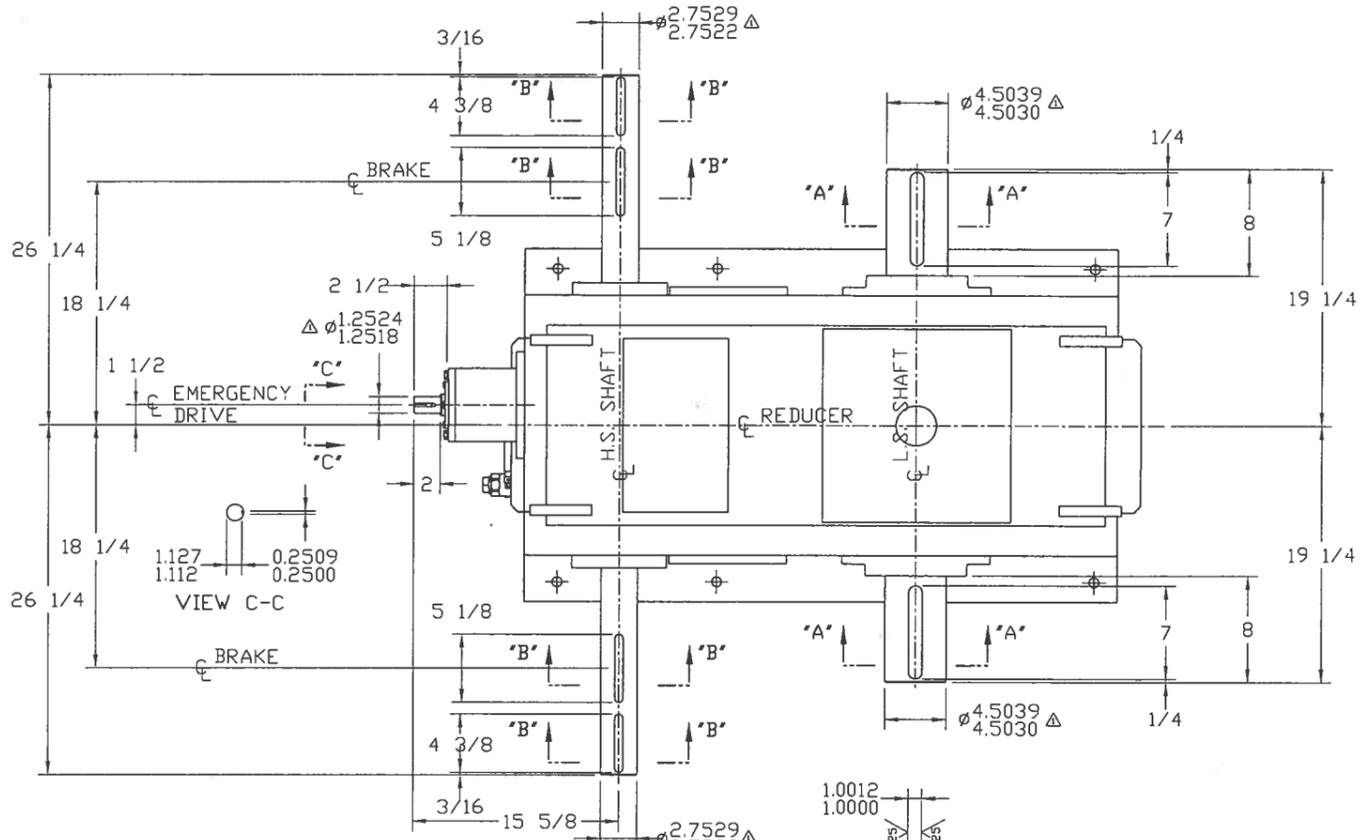
*A Rexnord Geared Products Company*

J.C. MACHINE COMPANY  
O'Rorke Bridge  
(formerly Stutson St. Bridge)

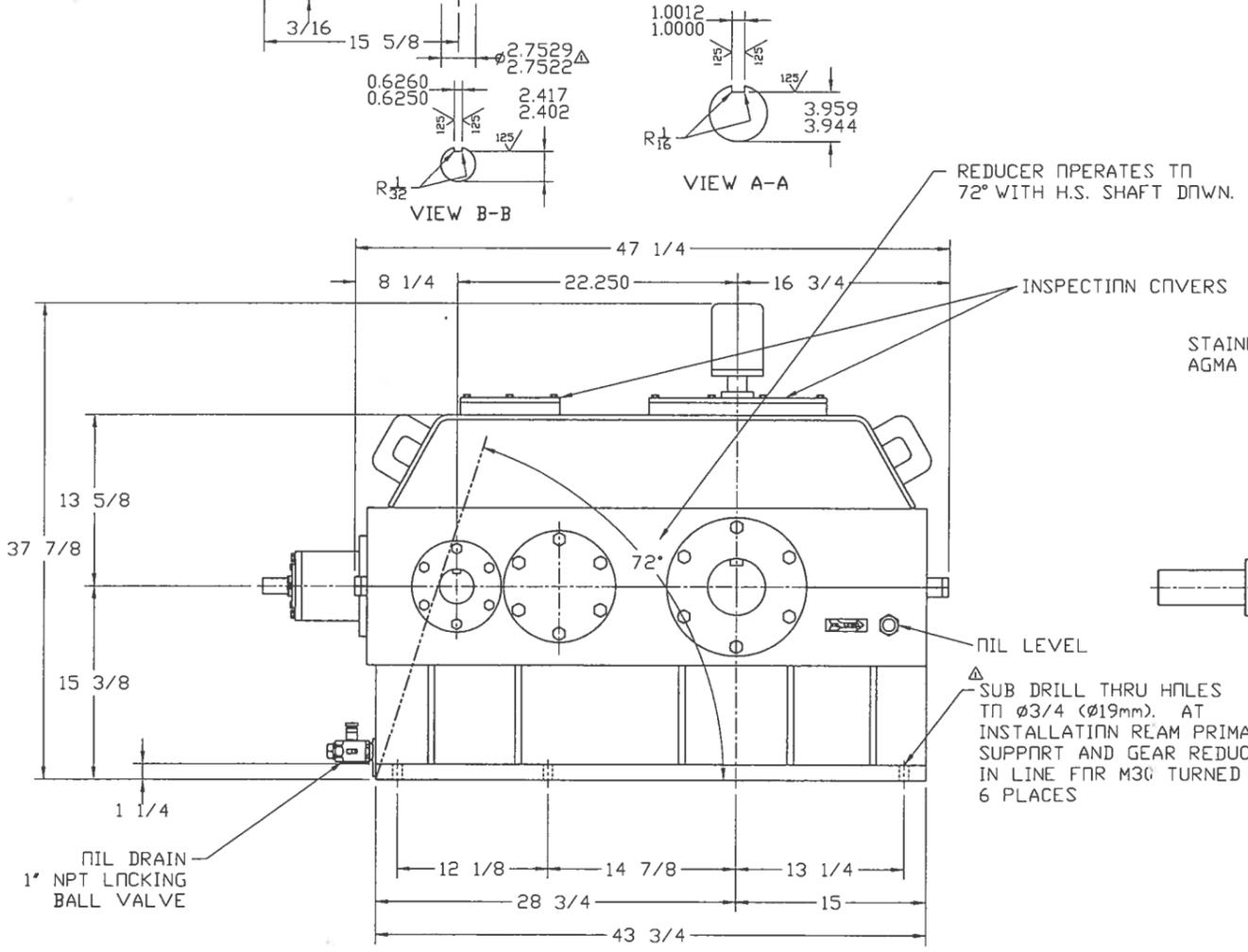
REFERENCE: P.O. NO. CH02  
PRAGER ORDER NO. 52129

#### SPECIFICATIONS

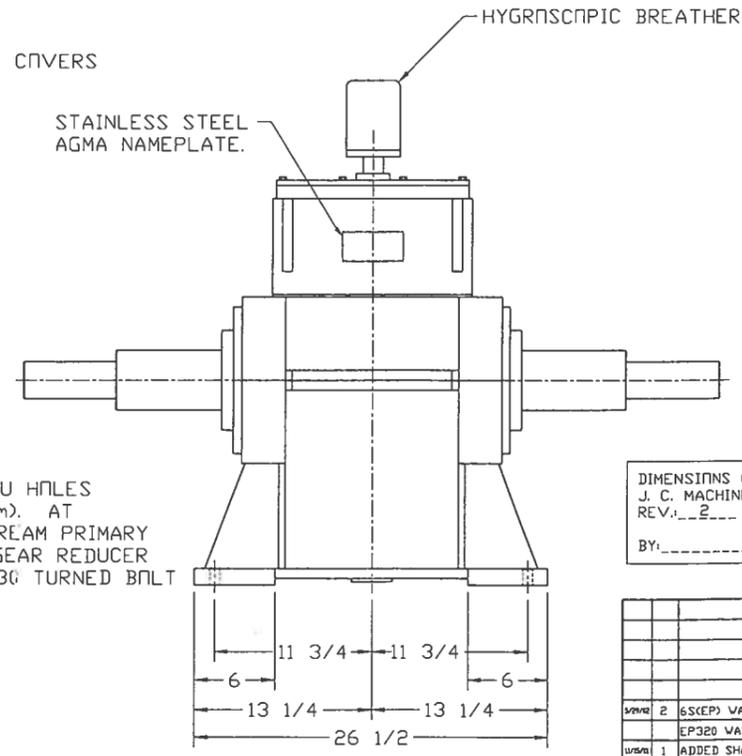
GEAR DRIVE TYPE	TRIPLE REDUCTION
GEAR DRIVE SIZE	LT5100
SERIAL NO.	
INPUT SPEED	115 RPM
OUTPUT SPEED	1.27RPM
RATIO	90.8:1
SERVICE RATING	55 HP
SERVICE FACTOR	1.0
LUBRICATING OIL	AGMA NO. 6S (288-352 cSt @ 40°C) TEXACO PINNACLE EP320



- NOTE:
1. GEARS AND PINIONS TO BE DESIGNED AND MANUFACTURED IN ACCORDANCE WITH ANSI/AGMA 6010-E88 TO AGMA QUALITY Q9.
  2. HOUSING TO BE FABRICATED FROM A-36 STEEL PLATE AND THERMALLY STRESS RELIEVED BEFORE MACHINING.
  3. GEAR MATERIAL TO BE HEAT TREATED ALLPLY STEEL.
  4. PINION MATERIAL TO BE HEAT TREATED ALLPLY STEEL.
  5. SHAFT MATERIAL TO BE HEAT TREATED ALLPLY STEEL.
  6. B10 LIFE OF ALL BEARINGS GREATER THAN 40,000 HOURS.
  7. STRESSES ON GEAR & PINION TEETH DO NOT EXCEED 75% OF YIELD STRENGTH WITH 285% OF FULL LOAD MOTOR TORQUE.
  8. SEE J.C. MACHINE SHOP DRAWING 400 E7 FOR GEAR REDUCER MOUNTING DETAILS AND J.C. MACHINE SHOP PART NO. 400 D6 04 FOR THE TURNED MOUNTING BOLT DETAILS



NAME PLATE DATA  
 UNIT SIZE: LTD2225-S DIFFERENTIAL REDUCER  
 RATIO: 7.593:1  
 EMERGENCY DRIVE RATIO: 30.370:1  
 INPUT SPEED: 870 RPM  
 OUTPUT SPEED: 114.6 RPM  
 SERVICE RATING: 112.0 HP  
 SERVICE FACTOR: 1.00  
 LUBRICANT: AGMA NP. 6S(EP) (288-352 cSt @ 40°C)  
 FURNISH 24 GAL. OF TEXAC P  
 Pinnacle EP320 GEAR LUBRICANT.  
 OUTPUT TORQUE RATING: 30,798 IN-LBS/SHAFT  
 ESTIMATED WEIGHT = 3000 LBS.



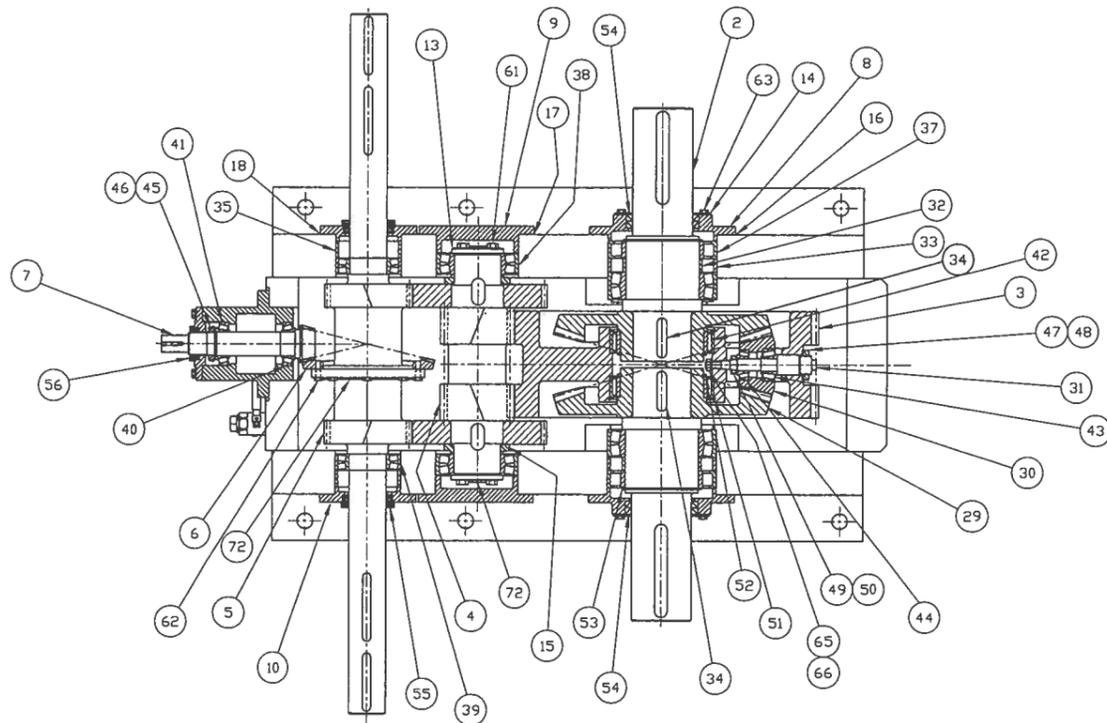
DIMENSIONS CERTIFIED CORRECT FOR  
 J. C. MACHINE CO P.O. NO. CH02  
 REV: 2  
 BY: \_\_\_\_\_ DATE: \_\_\_\_\_

REF.: STUTSON STREET BRIDGE  
 OVER THE GENESEE RIVER  
 MONROE COUNTY  
 STATE OF NEW YORK

TOLERANCES (except as noted)		PRAGER	
DECIMAL	FRACTIONAL	A Rexnord Geared Products Company NEW ORLEANS, LA	
+/- SEE NOTE	+/- SEE NOTE	Customer:	J. C. MACHINE COMPANY
ANGULAR +/- 1/2°	ANGULAR +/- 1/2°	Job No:	52129
		Drawn:	GAD
		Date:	2/22/01
		Checked:	
		Approved:	
DATE	SYN	DESCRIPTION	DR. CH

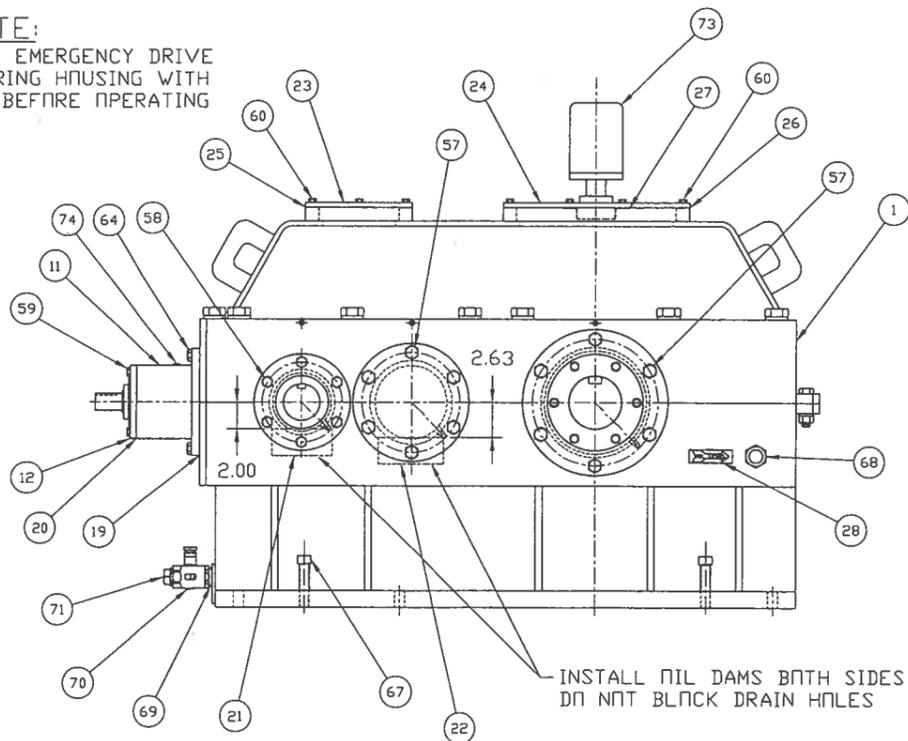
Rev:	2
Scale:	1" = 6"
Drawing No.:	D-35806



LIST OF PARTS			
CUSTOMER: J. C. MACHINE COMPANY MIAMI, FL.	PURCHASE ORDER NO. CHO2	SHOP ORDER NO. 52129	
UNIT DESCRIPTION: PRAGER LTD2225-S DIFFERENTIAL REDUCER 7.593:1 RATIO	INSTALLATION PLAN 0-35806	DATE: 28 FEB 01 SHEET 1 OF 2	
ITEM	QUAN.	DESCRIPTION	DRAWING NO.
1	1	ASSEMBLY, GEAR HOUSING AND COVER	D-36139
2	2	L.S. SHAFT	B-36142
3	1	L.S. GEAR-82 TEETH	C-36143
4	1	L.S. PINION & H.S. GEAR ASSEMBLY (CONSISTS OF)	B-36144
	(1)	L.S. PINION-18 TEETH	B-36144A
	(1)	H.S. GEAR-45 TEETH, LH	B-36145
	(1)	H.S. GEAR-45 TEETH, RH	B-36146
	(2)	KEY	B-36147
5	1	H.S. PINION-27 TEETH	B-36148
6	1	EMERGENCY DRIVE BEVEL GEAR - 60 TEETH	C-36149B
7	1	EMERGENCY DRIVE BEVEL PINION - 20 TEETH	C-36149A
8	2	SEAL RETAINER-L.S. SHAFT	B-36150
9	2	BRG. RETAINER-L.S. PINION SHAFT	B-34193
10	2	SEAL RETAINER-H.S. SHAFT	B-36151
11	1	BEARING HOUSING - BEVEL PINION	B-36152
12	1	SEAL RETAINER - EMERGENCY DRIVE	B-36153
13	2	BEARING RETAINER PLATE - L.S. SHAFT	B-30543
14	2	SEAL RETAINER PLATE - L.S. SHAFT	B-36154
15	2	SPACER - H.S. GEAR	B-30540
16	2	GASKET, L.S. SHAFT-GARLOCK 3000, 1/32 THICK	B-36157
17	2	GASKET, L.S. SHAFT-GARLOCK 3000, 1/32 THICK	B-36158
18	2	GASKET, H.S. PINION-GARLOCK 3000, 1/32 THICK	B-36159
19	1	SHIM, PLASTIC, THICKNESS AS REQUIRED	B-36180
20	1	GASKET, EMER. DR.-GARLOCK 3000, 1/32 THICK	B-36181
21	2	OIL DAM - H.S.	B-36182
22	2	OIL DAM - L.S.	B-36183
23	1	INSPECTION COVER-PLAIN	B-36164
24	1	INSPECTION COVER-BREATHER	B-36165
25	1	GASKET, INSP. COVER-GARLOCK 3000, 1/32 THICK	B-36166
26	1	GASKET, INSP. COVER-GARLOCK 3000, 1/32 THICK	B-36167
27	1	BAFFLE, BREATHER	B-30029
28	1	OIL LEVEL INDICATOR	B-31769
29	2	STRAIGHT BEVEL GEAR - 57 TEETH	B-34187
30	3	STRAIGHT BEVEL PINION - 17 TEETH	B-34188
31	3	PIN - BEVEL PINION	B-36168
32	2	SPACER, INNER - L.S. BEARING	B-34197
33	2	SPACER, OUTER - L.S. BEARING	B-34194
34	2	KEY	B-36169
35	2	SPACER - H.S. BEARING	B-30541
36	2	BEARING, SPHERICAL ROLLER, SKF 23028CC/W33	
37	2	BEARING, CYLINDRICAL ROLLER, SKF NU102B	

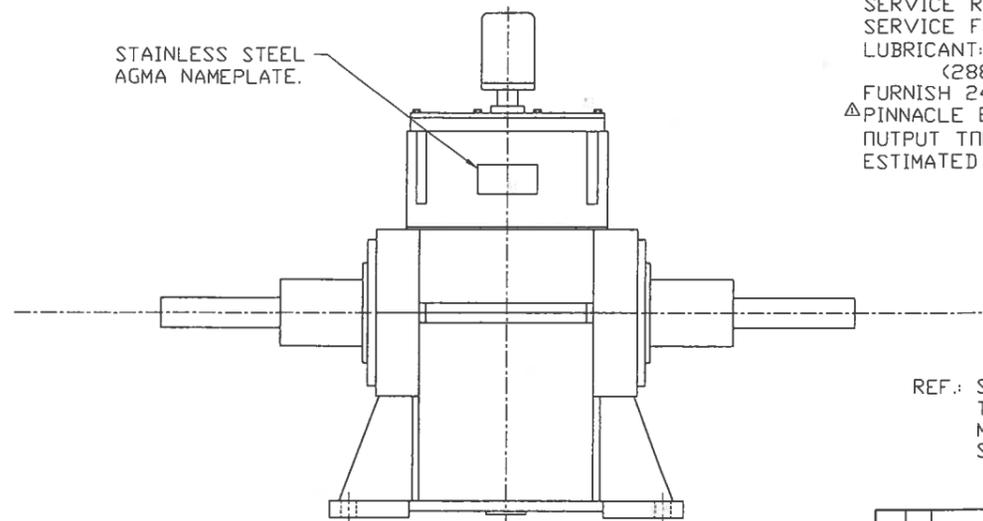
LIST OF PARTS			
CUSTOMER: J. C. MACHINE COMPANY MIAMI, FL.	PURCHASE ORDER NO. CHO2	SHOP ORDER NO. 52129	
UNIT DESCRIPTION: PRAGER LTD2225-S DIFFERENTIAL REDUCER 7.593:1 RATIO	INSTALLATION PLAN 0-35806	DATE: 28 FEB 01 SHEET 2 OF 2	
ITEM	QUAN.	DESCRIPTION	DRAWING NO.
38	2	BEARING, SPHERICAL ROLLER, SKF 22218CC/W33	
39	2	BEARING, SPHERICAL ROLLER, SKF 22214CC/W33	
40	1	BEARING, TAPERED RLR., TIMKEN 25582/25520	
41	1	BEARING, TAPERED RLR., TIMKEN 25584/25520	
42	2	BEARING, NEEDLE, SKF NA4832	
43	3	BEARING, TAPERED RLR., TIMKEN 3659/3620	
44	3	BEARING, TAPERED RLR., TIMKEN 1280/1220	
45	1	LOCK NUT, SKF N 09	
46	1	LOCK WASHER, SKF W 09	
47	3	LOCK NUT, SKF N 07	
48	3	LOCK WASHER, SKF W 07	
49	3	LOCK NUT, SKF N 04	
50	3	LOCK WASHER, SKF W 04	
51	2	RETAINING RING, SPIROLOX RR-787	
52	2	RETAINING RING, SPIROLOX RS-829	
53	2	RETAINING RING, SPIROLOX RSN-550	
54	4	OIL SEAL, L.S., G/R NO. 44888 (4.50 X 5.50 X 4.38)	
55	2	OIL SEAL, H.S., ISOMAG MODEL MAGNUM-S (2.75 I.D. X 3.75 O.D.)	
56	1	OIL SEAL, EMER. DR., ISOMAG MAGNUM-S (1.825 I.D. X 2.375 O.D.)	
57	24	HEX HD. CAP. SCREW, 5/8-11 UNC X 1.75 LG., ASTM A325	
58	12	HEX HD. CAP. SCREW, 1/2-13 UNC X 1.50 LG., ASTM A325	
59	8	HEX HD. CAP. SCREW, 3/8-16 UNC X 1.25 LG., ASTM A325	
60	72	HEX HD. CAP. SCREW, 3/8-16 UNC X 1.00 LG., ASTM A325	
61	8	DRILLED HD. CAP. SCREW, 1/2-13 UNC X 1.25 LG., ASTM A325	
62	8	DRILLED HD. CAP. SCREW, 3/8-16 UNC X 1.25 LG., ASTM A325	
63	12	HEX HD. CAP. SCREW, 3/8-16 UNC X .75 LG., ASTM A325	
64	8	HEX HD. CAP. SCREW, 1/2-13 UNC X 1.75 LG., ASTM A325	
65	3	HEX NUT, FULL 1/2-13 UNC	
66	3	LOCK WASHER, HELICAL SPRING, 1/2"	
67	4	SQUARE HD. SET SCREW, 3/4-10 UNC X 3.00 LG.	
68	1	SIGHT GAUGE, GITS BW-10, ITEM NO. 04043, 1" N.P.T.	
69	1	CLOSE PIPE NIPPLE, STD. BLK., 1" N.P.T.	
70	1	BALL VALVE, LOCKING, 1" NPT FEMALE, PARKER-HANNIFIN, XVP, JOP-16	
71	1	PIPE PLUG, 1" NPT SD, HD.	
72	3	WIRE LOCK	
73	1	BREATHER, DFS-CASE DC-2 WITH DC-10 ADAPTER	
74	9	PIPE PLUG, 1/8" NPT SOCKET HD.	
75	2	L.S. BEARING SPACER ANTI-ROTATION ROLL PIN, 1/4" X 5/8" LONG	

NOTE:  
FILL EMERGENCY DRIVE  
BEARING HOUSING WITH  
OIL BEFORE OPERATING



INSTALL OIL DAMS BOTH SIDES  
ON NPT BLOCK DRAIN HOLES

STAINLESS STEEL  
AGMA NAMEPLATE.



NAME PLATE DATA  
UNIT SIZE: LTD2225-S DIFFERENTIAL REDUCER  
RATIO: 7.593:1  
EMERGENCY DRIVE RATIO: 30.370:1  
INPUT SPEED: 870 RPM  
OUTPUT SPEED: 114.6 RPM  
SERVICE RATING: 112.0 HP  
SERVICE FACTOR: 1.00  
LUBRICANT: AGMA NP. 6S(EP)<sup>Δ</sup>  
(288-352 cSt @ 40 C)  
FURNISH 24 GAL. PF TEXACON  
<sup>Δ</sup>PINNACLE EP320 GEAR LUBRICANT.  
OUTPUT TORQUE RATING: 30,798 IN-LBS/SHAFT  
ESTIMATED WEIGHT = 3000 LBS.

REF.: STUTSON STREET OVER  
THE GENESEE RIVER  
MORRIS COUNTY  
STATE OF NEW YORK

TOLERANCES (except as noted)		PRAGER A Rexnord Geared Products Company NEW ORLEANS, LA
DECIMAL ±/- SEE NOTE		
FRACTIONAL ±/- SEE NOTE		Customer: J. C. MACHINE COMPANY MIAMI, FL.
ANGULAR ±/- 1/2°		
DATE		Job No. 52129
SYN		Drawn: GAD
DESCRIPTION		Date: 2/22/01
		Checked: SLK
		Approved: GAD
		Scale: 1" = 6"
		Drawing No. D-35806A
		Rev. 1



*A Rexnord Geared Products Company*

**SCOPE:** The objective of this manual is to give general information on Installation-Lubrication-Maintenance-Disassembly and Reassemble of PRAGER INCORPORATED medium and low speed parallel shaft speed reducers. In addition, there is some supplementary information on coupling alignment, oil characteristics, and storage information.

**EQUIPMENT DESCRIPTION:** The types of parallel shaft speed reducers include: single reduction, Type HSG, HS, LS and MS; double reduction, Type HDG, HD, LD and MD; triple reduction, Type HT, MT and LT; and quadruple reduction, Type LQ. This covers many different types of reducers with a great range of ratio and horsepower capacities. Always mount these reducers in a horizontal plane. A horizontal mounting position is necessary for the proper functioning of the oil distribution system. In some instances, due to thermal horsepower limitations, the box may be furnished with an oil pump and cooler much of the information included in this manual is valid for various special reducers or increasers, and it may be distributed as a general help for such special boxes.

The people at PRAGER INCORPORATED have made every effort to provide the customer with a high quality long lasting piece of equipment which will give trouble-free service over an extended period of time if it is operated within its designed capacity with the proper oil and reasonable conditions of maintenance.

On one end of the surface of the housing, is a stainless steel name plate giving: model designation, serial number, and order number. This information is needed to furnish any spare parts or any kind of technical information on the operating characteristics of the reducer.

If major repairs should be needed on this reducer, it is best to return it to the factory. If time is not available for factory repairs, PRAGER has available capable field servicemen who can go to the job site. If the customer desires to repair the equipment himself, it is suggested that he study carefully the parts list furnished with the reducer and the information in this manual; in particular, Disassembly and Reassembly.

Any work done on PRAGER equipment during the warranty period without the approval of PRAGER and /or a PRAGER representative being present could void the warranty.

PRAGER wants very much for this equipment to give its normal expected long life. If there are any questions concerning the operation or repair of equipment, the customer should contract our head sales office in New Orleans.

**STORAGE:** PRAGER uses a specially formulated break-in oil which leaves a residual film on all interior surfaces. With reasonable exterior conditions, this film will last 6 months. The film will be compatible with the lubricating oil added by the customers.

Should the reducer remain inoperative at its installation site over 6 months, special care needs to be taken to protect the interior surfaces. After once starting operation, and the reducer is



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"down" for an extended period of time, it is desirable to operate the equipment for a few minutes once a week during the shut-down periods. This would assure a redistribution of oil and help prevent interior corrosion. See addendum B for additional information.

**INSTALLATION:** Normally the coupling halves which go on the reducer slow speed and high speed shafts will be installed at PRAGER, prior to the reducer being shipped to the field site.

If a coupling half must be installed, check the coupling bore, shaft end and key way edges for any bruises or burrs. Mic shaft and bore of coupling half cold. The bore of the coupling must be expanded until it is at least .0005 in. per in. of diameter over the shaft diameter. Lightly grease shaft surface, heat carefully, slowly, and evenly the coupling half (not over 300 degrees F.) until bore is sufficiently expanded. Install coupling cover. Place coupling half on shaft in its proper axial position keeping key-ways in line, it should move into place easily. If necessary, tap lightly with raw-hide mallet.

A properly fitted key will go against the bottom of the key way in the shaft with the sides of the key fitting "metal to metal" in the key way opening. There should be a clearance at the top of the key so that it does not make any contact against the outer part of the key way in the coupling half. It is possible to put a severe hoop stress in a coupling half if the key is improperly fitted.

Any reducer needs to be mounted on a substantial foundation. One system uses a concrete base, then a sole plate on the top of the concrete, about 1/16 in. shim space, then the reducer. The sole plate has tapped holes already in place so that cap screws can be used to clamp down the flanges of the reducer (with the proper shims in place) at all positions. Once a general elevation is established above the concrete, the sole plate is grouted into place, leaving a space of about 1/16" between the top of the sole plate and the bottom of the reducer pads. This shim space allows proper positioning of the reducer as to its slow speed and high speed coupling alignment, and space for shims so that the reducer can be bolted down flat. The housing must not be in a twist or bind as this will adversely affect tooth contact and will cause bearing edge loading. Use an adequate "area" of shims under all tie down bolts or cap screws. In "making up" the shim pack use as few shims as possible so pack will not be "soft". For example, a group of shims could be made up of a .060 in. plate plus .005 in. shim plus .002 in. shim, .067 in. total.

Another system is to use a base plate (sometimes called a bedplate) which is a rigid weldment or casting which supports two or more of the components in the package. For instance, a motor-reducer-pump might be installed on one base plate. This base might be installed on one base plate. This base plate is designed and made sufficiently rigid to support the various components. It is best to remove the reducer and other components from the base plate prior to its installation. At the job site, the base plate would be mounted in concrete. It is good practice for the concrete to be poured up into the inside of base plate to achieve optimum stability. The



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initial alignment for this design system is normally done by PRAGER or the package supplier, and the needed shims are already in place. Final checks should be made for possible twist in the housing and possible misalignment of the couplings. See "Start Up".

Flexible couplings need to be aligned both radially and axially. It is obvious that heavily loaded rotating shafts which are misaligned relative to one another will cause an abnormal and irregular overhung load. This condition in turn can cause abnormally high bearing loads and even irregular tooth contact. This latter condition could occur as the coupling misalignment takes up the clearance space within the bearings with a subsequent relative axial misalignment of the gear tooth surfaces. Addendum A gives procedures for both cold check and hot check coupling alignments.

If the box has an oil pump and cooler, it will be necessary to complete any piping for the cooling water. It is essential that all the studs, cap screws, and bolts in the system be adequately and properly tightened. Properly tightened bolting in which the "grip" (the parts being clamped between the bolt head and nut) is metal-to-metal will not fail in fatigue. After final hot check, install two substantial tapered dowels in line with high speed pinion between sole plate and reducer.

**START-UP:** Viscosity information on the proper oil to use in the reducer is given on the name plate. The box should be filled while the equipment is "at rest" and the level should be checked while the equipment is "at rest". The level of lubricant is established by a dip stick type gage, or sight glass. Initially, the oil should be filled to the top of the sight glass. As it is distributed during operation, the level will fall somewhat.

Prior to start-up, check the oil distribution system in the box. This can be done through the inspection cover opening to insure that the oil wipers, troughs, and feed holes are all open and in operating condition. The oil pump, if one is present, should be primed through the available opening.

Obviously, the coupling working parts should be properly greased with the lubricant specified by the manufacturer. The grease for the coupling should be worked thoroughly into the working parts prior to installing the cover as centrifugal force tends to throw grease out against the coupling cover.

Tooth contact checks are made by PRAGER during assembly and after run-in to assure a quality reducer leaving our plant. However, a field tooth contact check should be made after alignment is completed and prior to start-up. Carefully clean oil from several meshing teeth on both the gear and pinion, and apply a thin coat of high spot blue to the clean pinion teeth. Apply a drag to the slow speed shaft and mesh the blue teeth by rotating the pinion back and forth several times through the blued area. Inspect the marks left by the high spot blue on both the gear and its removal on the pinion. Tooth contact on the loaded sides should be over at least 70% of the face.



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Normally, contact on a new set of gear elements would be intermittent, such that after some wearing and possibly some initial pitting, the contact will be virtually 100% across the face.

If the amount of contact is too low, it is possible that the housing is tied down in a bind. Progressively loosen tie down cap screws, check with feeler for space beneath the flange at the loosened cap screw. Re-shim as needed, tighten hold down cap screws, and then re-check tooth contact.

On most reducers, restraint from axial movement is achieved by the tapered roller bearings on the low speed shaft. It is essential that there not be any additional axial restraint in the system causing any kind of bind. A possible source of axial bind is the end of the shaft on the driving equipment bearing against the end of the high speed pinion shaft.

The reducer should be spun at a relatively low speed once or twice while the system is being observed for any possible abnormality. With full speed start-up, one must of course watch for any abnormal vibration, noise, leakage, flake collection on filter, or hot bearings. See Installation and Addendum A for alignment procedures.

**LUBRICATION:** As mentioned above the required viscosity of oil use in this reducer is given on the name plate. We recommend a premium, turbine type, mineral oil with rust and oxidation inhibitors and an anti-foam agent. Some customers, when there are difficult operational situations, desire an extreme pressure (EP) oil and at times, an EP oil can add to the life of the equipment by helping to prevent scoring under conditions of marginal lubrication. PRAGER sales offices can furnish specific trade names of oils, if desired, once the customer has selected an oil supplier. Addendum B gives further information on oil lubricants.

After two weeks operation on a new reducer, the oil should be drained from the housing, the interior flushed out, and the box re-filled with fresh oil. Keep installed filter, if present, clean. The original oil may be used if it is filtered through a nominal 5 micron mechanical filter. Do not use an adsorptive type filter, it may remove oil additives.

Once every month check oil for possible contamination. The sample should be obtained from near the bottom of the gear case.

Every 6 months the old oil should be removed and interior of the box flushed out. If a filter is provided, it should be cleaned at each oil change. At this time, the interior gear elements should be visually inspected carefully through the inspection cover openings. Add new oil.

**MAINTENANCE:** The lubricant change interval and care mentioned above is, of course a vital segment of maintenance. Proper lubrication can help greatly to obtain long life for this type equipment. Keep filter clean.



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It is recommended to maintain records of the coupling alignment hot check on a reducer. Changes in the alignment can indicate possible shift in foundation or some type of difficulty within the box.

An operator should always "listen" for possible changes in the noise level of the reducer which can be an indication of some sort problem.

It can be an indication of trouble if one of the bearings or the oil were to get too hot. On a premium straight mineral oil, the absolute peak of operating temperature would be 200 degrees F. With most extreme pressure oils, the operating peak is 160 degrees F. When lead naphthanate is the primary extreme pressure ingredient, and the temperature gets much above 160 degrees F, the life of the oil will be greatly reduced.

Should the temperature of the oil get too high, it may be simply an indication that the level of the oil is too high or possibly that the viscosity of the oil is too great for that particular application.

**DISASSEMBLY:** The sequence given will be for complete disassembly. Quite possibly visual inspection of the interior of the box will give information as to the basic cause of the problem, and may influence disassembly techniques. Obviously, it is desirable to order from PRAGER any replacement parts needed, and such an order should be placed as soon as possible if spare parts are not on hand. When the time and expense of disassembly and reassembly is considered, it is always best to obtain new sets of gaskets, shims and roller bearings. In ordering parts, PRAGER must have the model designation, the serial number, and the order number which are given on the name plate on the exterior part of the housing.

Throughout the disassembly sequence, it is good to observe carefully what may have occurred inside the box and to keep a record of the position of any of the failed components. For instance, if there should be a straight roller bearing failure, make a record of the position in the box that the failure took place and which side of the bearing is toward the outside. A white marker can be used to identify these positions. One other precaution: a better analysis can be made of failed components if they are left dirty in their failed condition.

Disassembly procedure:

- (1) Remove bolts, stud nuts, and dowels at the parting line of the reducer. Mark positions of all carriers and seals as guides for reassembly. Should the oil pump, if present, be disassembled mark significant parts for correct reassembly. On some pumps the suction is changed by only switching the back plate 180 degrees.
- (2) Loosen several turns all of the cap screws, bearing retainers to housing in the lower half of the housing, and remove completely all the cap screws in the housing cover.



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- (3) Use some of the removed cap screws as jack screws to push the retainers outward about 1/8" to 1/4" such that the housing cover will be free to come off.
- (4) Check the wiper location, if furnished, and the oil distribution system to be sure that they are functioning properly. Remove wiper assembly.
- (5) By crane, lift the housing cover from the housing. Use considerable care in doing this by attaching a crane hook in a center position and lifting equally as near possible. A cable sling to the box corners may be necessary. Some sharp blows with a rawhide hammer at the corner positions and possibly some prying with a large screw driver in some areas would help to break loose the parting line joint.
- (6) Separate the high speed and slow speed coupling covers and disassemble the load carrying members of the couplings.
- (7) Remove all cap screws from the lower section of all seal and bearing retainers where they go into the lower portion of the housing.
- (8) Lift out the high speed pinion along with its bearings, and both the high speed bearing retainer on the extension end. Remove the blind end bearing retainer along with the outer race, from the blind end of the high speed pinion.
- (9) If needed, remove the coupling half from the high speed pinion shaft extension. Loosen set screw in coupling and use pullers with careful application of heat. Never let a torch flame remain in place too long. Slip off remaining retainer. If it is necessary to remove oil slinger, note the axial position so it can be replaced in its proper location.
- (10) Lift out the intermediate assembly (if any,) the high speed gear-low speed pinion, along with the bearing retainers.
- (11) Slip off both bearing retainers.
- (12) Lift out the low speed gear--low speed shaft--tapered roller bearings, the low speed bearing retainers, and the oil seal.
- (13) If necessary, remove the coupling half from the end of the low speed shaft. Note Item (9) above.
- (14) Lift off the bearing retainers (and bearing cups) from both ends.
- (15) Remove both tapered roller bearing cone assemblies using pullers.
- (16) Obtain, if desired, a representative full quart sample of oil from the sump.

**REASSEMBLY:** Clean all the interior parts of the housing and housing cover as well as all components which may be reused. Parting line surfaces must be clean and smooth, scrape surfaces if necessary. If there are slight amounts of corrosion in places, these can be cleaned by using a fine emery cloth, rubbing any shaft member in a rotative or circumferential direction. Do not rub shaft with emery cloth in a length-wise direction as it may introduce seal leaks. On certain rare occasions, if the oil inside the box had been allowed to get unusually acid, it might attack the paint on the interior surfaces of the housing and housing cover. If this should happen, the loose paint and rust must be cleaned off thoroughly and the interior re-painted. It is normally assumed that the base or lower part of the housing was never removed from its foundation support, which in turn assumes that the original positioning and coupling alignments were proper.

To obtain a minimum amount of face run-out of the slow speed gear relative to the slow speed shaft axis, and the high speed gear face run-out relative to the low speed pinion shaft axis, both the slow speed gear and the high speed gear should be assembled on their respective "shafts" at PRAGER rather than at the equipment site.

In a double reduction reducer which has an intermediate of a low speed pinion -high speed gear, in almost all instances the high speed gear blank would have to be pressed on the low speed pinion shaft prior to the teeth being cut on the high speed gear. This gives optimum condition of face run-out as well as pitch diameter run-out.

For the discussion that follows, it is assumed that the low speed gear is pressed in its proper position on the slow speed shaft and that the high speed gear is already in position on the slow speed pinion shaft.

A light oil on all parts would help the assembly procedure as well as preventing corrosion on the various internal components during their exposure to the atmosphere.

#### REASSEMBLY SEQUENCE:

(1) Heat both cone roller assemblies which go on the slow speed shaft in an oil bath not to exceed 250 degrees F. Be certain that the surfaces on which the bearing cones will be placed are clean and free from any kind of burr. It would normally take about 1-1/2 hours in 250 degrees F oil for the bearing to adequately expand. It should drop into place. Be sure the cone shoulder is firmly against the part of the shaft or hub on which it makes axial contact.

Using similar procedures, install the low speed slinger(s). The axial position of the slinger must be correct for it to properly deflect oil.



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On some of the larger fabricated reducers spherical roller bearings may be used on the low speed shaft, and possibly the high speed shafts. To maintain an axial position, one of the outer races on the slow speed shaft is clamped, axially into place. In these applications, spherical roller bearings have an interference fit on inside diameter.

(2) Prior to placing the low speed coupling half on the low speed shaft end, install bearing retainer, low speed labyrinth seal, and, if needed, the coupling cover. The coupling half can be heated to not over 300 degrees F and then placed on the shaft end. Be careful that coupling half does not go on too far and then partially shrink into place. A piece of key stock or something clamped to the shaft for coupling to bump against would be helpful to prevent this.

(3) As needed, install high speed oil slinger and the inner races of the straight roller bearings. The inner races should have the number side "out" and the radiused bore corner "in". Normally, inner races will be positioned axially with the outer edge adjacent to where the shaft chamfer intersects the shaft outside diameter. The slingers and inner races should be expanded in hot oil not to exceed 250 degrees F, and placed in their proper axial position on the appropriate shaft ends. When the inner races are completely cooled in position, it is desirable to check the tightness of the race against the shaft. This can be done by tapping with a plastic hammer several times against race edge see if there is any axial movement from an insufficient interference fit. Ordinarily, it is quite difficult to move a properly fitted inner race with the plastic hammer.

(4) The tapered roller bearing cups are tapped into their bearing retainers. The low speed gear, low speed shaft, low speed bearing-retainer assemblies and a typical shim pack are placed in position in bottom half of the housing. Insert and tighten cap screws which hold retainers.

It is essential to adjust, via shims, the tapered roller bearings to obtain the proper end movement of the slow speed shaft. When working equipment heats up under load, parts will expand, and could excessively increase the thrust loading on the tapered roller bearings if the initial end movement has been too small (pre-load too high). On most tapered roller bearings used on low speed shafts, we recommend that the clearance between an upper roller and the cup be .0015" to .002". This can be checked easily with a feeler gage. Change shims at the blind end retainer until the adjustment is correct.

(5) The appropriate outer race-roller assemblies used on the pinion (and where applicable the intermediate assembly). are now tapped into their bearing retainers. Snap rings should be install in the grooves of the bearing retainers which would prevent the outer races from moving axially out of position. Install the appropriate (new) gaskets on all bearings retainers. It is more convenient to use a bit of gasket compound to attach or lightly glue each gasket to its carrier flange.

(6) As applicable on the high speed pinion and possibly the intermediate assembly, the bearing retainers would be positioned on the ends of the shaft and then this sub-assembly lowered into the appropriate bore of the housing.

- (7) The high speed coupling half is installed on the shaft extension end similar to the procedure on (2).
- (8) With all bearing carriers and retainers in their proper axial positions in the lower half of the housing, hand rotate the gear elements to be sure everything is in this proper position.
- (9) When the exposed gear elements are properly positioned, a tooth contact check should be made. A thin coating of high spot blue can be put on 3 or 4 cleaned pinion teeth. These coated teeth are then turned into contact against 6 or 8 cleaned gear teeth. Contact along both face halves should be 60 or 70% on the loaded sides. For further statements on tooth contact checks, check the fourth and fifth paragraphs under START-UP.
- (10) If the amount of contact is too low, and no satisfactory explanation can be found, it is best to contact a PRAGER sales office for their suggestions and help.
- (11) Move the bearing carriers and bearing retainers out about 1/8" to give clearance space for the housing cover installation.
- (12) Check again that the parting line surfaces are clean and smooth. These surfaces must come together metal-to-metal. Put a thin strip of sealing compound to make a seal at this joint. It is necessary that this line of sealing compound encircle the studs at the slow speed shaft and cover any area through which a leak might occur.
- (13) Lower the housing cover into position. This needs to be done very slowly and carefully as the part can bind at times on the studs around the slow speed shaft. Install the dowel pins on the ends of the housing to be sure that the relative position of the housing and housing cover are correct. Then insert all bolts and loosely tighten.
- (14) Tap the bearing retainers against the housing. Insert and tighten all bolts, caps screws, and stud nuts.
- (15) Insert and bolt into place the oil wiper assembly. Wiper blades should have only .010 to .020 clearance between the blade lip and slow speed gear face edge. If there is excessive clearance, oil may not be "wiped" from the gear and the bearings may not have enough oil.
- (16) Install oil pump if one is present. Check for adequate clearance between the end of the pump coupling and the gear shaft (driver). This space should be packed with grease to reduce wear.
- (17) Fill reducer with appropriate oil as mentioned in START-UP.



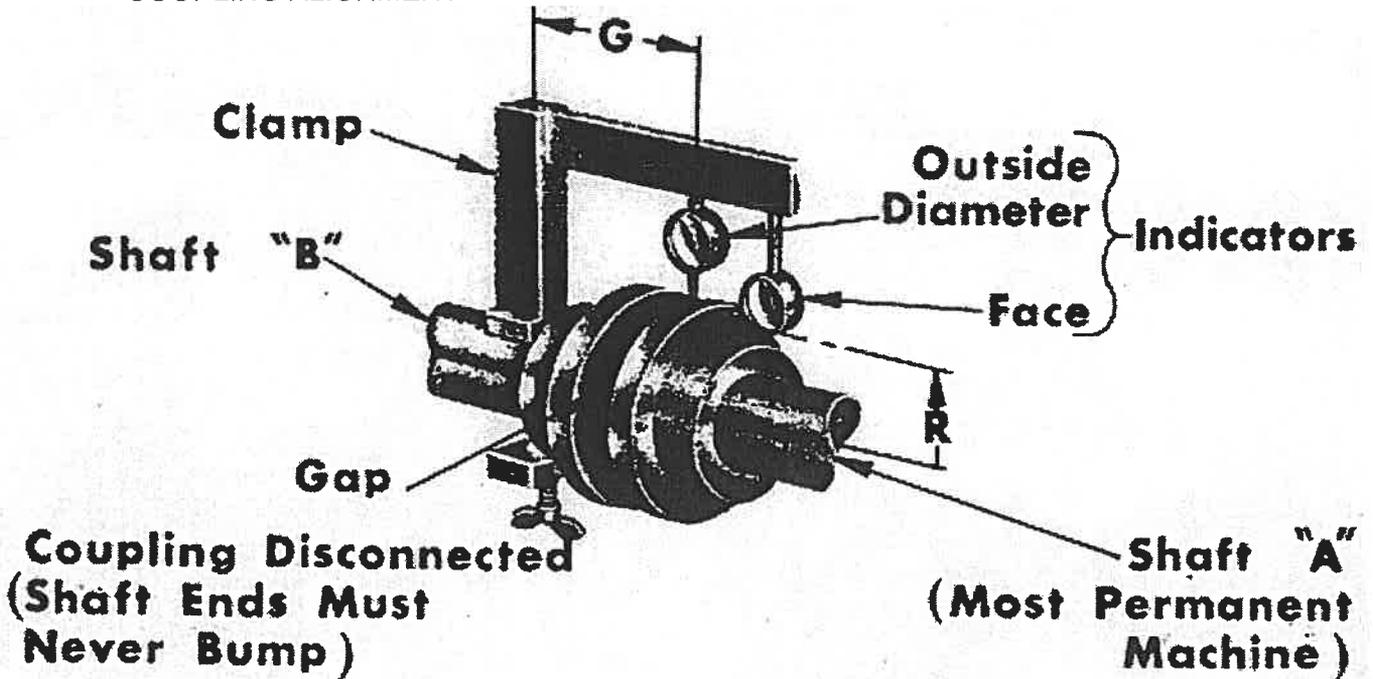
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- (18) It is desirable to spin the unit with no load if this is possible. This involves completing attachment of the high speed pinion coupling, (if coupling has match marks, be sure they line up correctly,) greasing coupling, and installing cover. This is done simply to check any apparent abnormality.
- (19) Re-attach the slow speed coupling. Re-grease coupling, and install covers.
- (20) Even though coupling alignment check has been previously made, it is desirable to go through the complete procedure as outlined in the Addendum A. Record the results.
- (21) Follow the START-UP procedures given above.

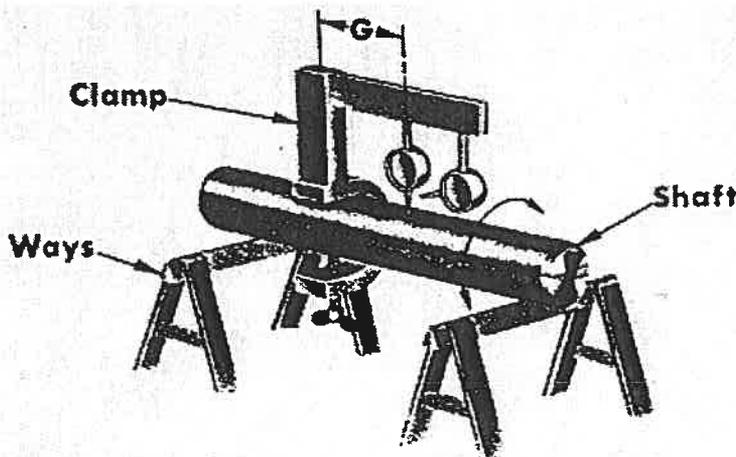
## COUPLING ALIGNMENT

ADDENDUM A



OBJECTIVE: Align Shaft "B" to Shaft "A"

1. Check for arm sag (see Note 1, below).
2. Record approximate "R" dimension.
3. Hand rotate shaft "B" around Shaft "A" (see Note 2, below).
4. Record the outside diameter and face indicator readings at 12 o'clock, 3 o'clock, 6 o'clock, and 9 o'clock. Shift shaft "B" into the same relative axial position prior to each face reading (that is, with prize bar, move shaft axially in one direction until all axial clearance is gone).
5. Correct alignment as needed. Consider also the anticipated thermal changes. For 50° F. Temperature rise the housing will expand about .00033 inch per inch of height or center distance.

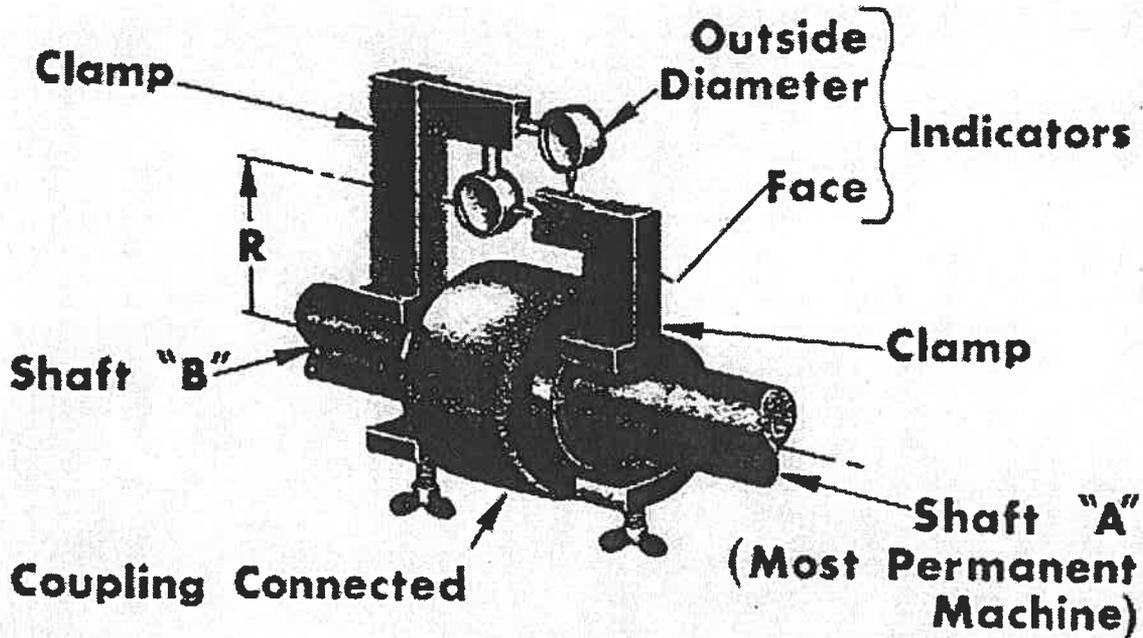


NOTE 1. Technique for checking gravity sag in radial indicator

(a) Rotate clamp while attached to shaft, observe change in outside diameter indicator reading at 90 positions.

(b) To reduce sag: Keep "G" short, use light weight indicators, use one indicator at a time.

NOTE 2. With the illustrated position of the dial indicators, rotating shaft "A" relative to shaft "B" would only give the internal eccentricity of the "A" shaft relative to its axis.



OBJECTIVE: Check Alignment, while Hot, Shaft "B" and Shaft "A"

Work machinery until operating temperatures are stabilized, then:

- (1) Quickly install clamps and indicators at both couplings.
- (2) Hand rotate shafts.
- (3) Record the approximate "R" dimension and the outside diameter and face readings at 12 o'clock, 3 o'clock, 6 o'clock, and 9 o'clock.
- (4) Correct alignment as needed.
- (5) Maximum allowable runout, total indicator reading (TIR) inches:

Shaft Surface Velocity	Outside Diameter	Face, TIR
5000 fpm and up	.002	.0004 per inch of R
3000 to 5000 fpm	.004	.0005 per inch of R
1500 to 3000 fpm	.006	.0006 per inch of R
500 to 1500 fpm	.008	.0008 per inch of R
500 to fpm and down	.010	.0010 per inch of R



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COUPLING ALIGNMENT

(Work Sheet)

ADDENDUM A

DRIVER      COUPLING                      COUPLING    DRIVEN

Mfg. \_\_\_\_\_  
 Model \_\_\_\_\_  
 Serial \_\_\_\_\_

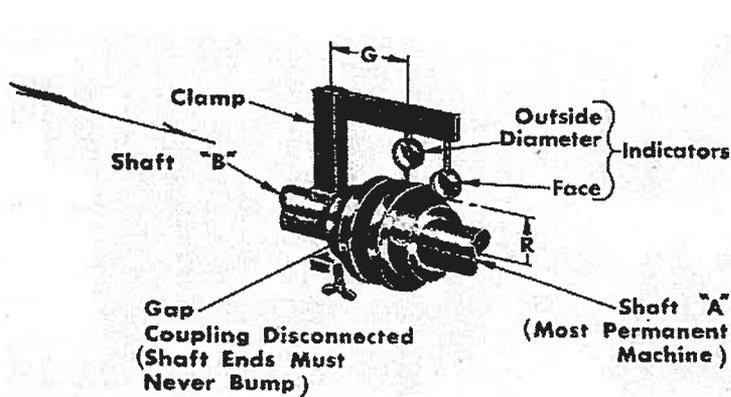
COLD CHECK      Temperature \_\_\_\_\_ °F. Ambient

Rotate Shaft "B" around Shaft "A"  
 Viewed from Left End of Illustration:

	*Outside Diameter	*Face
12 o'clock	_____	_____
3 o'clock	_____	_____
6 o'clock	_____	_____
9 o'clock	_____	_____

\*plus or minus

Record arm "R" \_\_\_\_\_



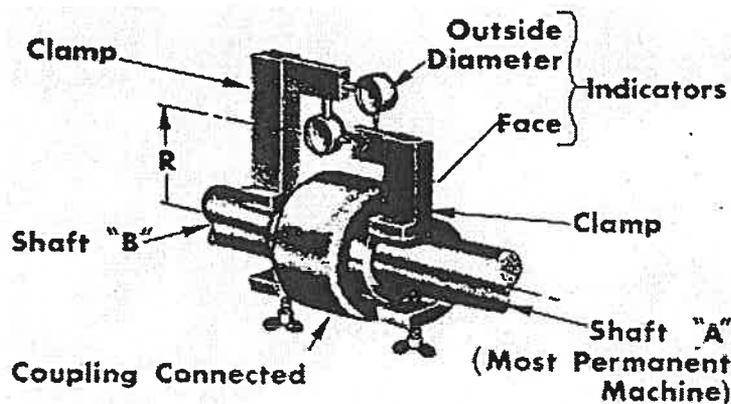
HOT CHECK      Temperature \_\_\_\_\_ °F. Ambient, \_\_\_\_\_ °F. Sump Oil

Rotate Shaft "B" around Shaft "A"

	*Outside Diameter	*Face
12 o'clock	_____	_____
3 o'clock	_____	_____
6 o'clock	_____	_____
9 o'clock	_____	_____

\*plus or minus

Record arm "R" \_\_\_\_\_





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## ADDENDUM B

### RECOMMENDED PRACTICE FOR PRESERVING GEAR TEETH AND BEARINGS IN REDUCERS DURING INOPERATIVE PERIODS

1. On new gear reducers shipped from our plant, the residual break-in oil adhering to exposed surfaces should prevent corrosion of interior parts for the least six months.
2. When the user adds the recommended lubricating oil and the reducer is operated for period of time, the oil should protect interior parts for inoperative periods up to 30 days.
3. If additional down time is needed, the customer should spin the reducer every 30 days to redistribute the oil to the non-submerged parts and gain another 30 days protection.
4. If extended down time is expected and it is impractical to spin the reducer, a rust preventive type oil should be brushed or sprayed on the gear teeth and bearings. Any quality rust preventive oil should give 12 months protection against corrosion. This oil should be compatible with the operating oil, and it should be unnecessary to remove the rust preventive oil when the reducer is started again.
5. Fill seal openings completely with oil. The oil can be the normal operating lubricant. When the equipment is to be used, the seals must be removed and the oil level dropped to the proper operating level.



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ADDENDUM C

Viscosity Ranges for AGMA Lubricants

Rust and oxidation inhibited gear oils 40°C AGMA Lubricant No.	Viscosity range <sup>1</sup> mm <sup>2</sup> /s	Equivalent ISO grade <sup>1</sup>	Extreme pressure gear lubricants <sup>2</sup>	Synthetic gear lubricants (cSt) at AGMA Lubricant No. _____
0	28.8 to 35.2	32		0S
1	41.4 to 50.6	46		1S
2	61.2 to 74.8	68	2 EP	2S
3	90 to 110	100	3 EP	3S
4	135 to 165	150	4 EP	4S
5	198 to 242	220	5 EP	5S
6	288 to 352	320	6 EP	6S
7, 7 Comp <sup>3</sup>	414 to 506	460	7 EP	7S
8, 8 Comp <sup>3</sup>	612 to 748	680	8 EP	8S
8A Comp <sup>3</sup>	900 to 1100	1000	8A EP	

<sup>1</sup>) Per ISO 3448, Industrial Liquid Lubricants - ISO Viscosity Classification. Also ASTM D 2422 and British Standards Institution B.S. 4231.

<sup>2</sup>) Extreme pressure lubricants should be used only when recommended by the gear manufacturer.

<sup>3</sup>) Oils marked Comp are compounded with 3% to 10% fatty or synthetic fatty oils.

## Purging Lip Seals

If the reducer has a dual seal design with a grease purge, regular maintenance should include purging the grease between the seals. A grease fitting is located between the inner and outer seal (see fig. 1). Opposite the grease fitting is either a relief valve or a solid pipe plug. If a solid pipe plug is present, remove it before adding grease. As new grease is added between the seals, old grease should be expelled through the relief valve (or unplugged hole). Add new grease until all old grease has been purged.

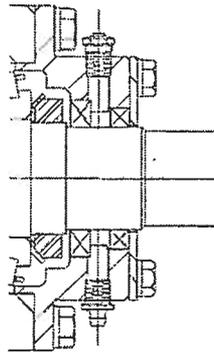


Figure 1

## General Troubleshooting

### Noise/Vibration

Noise as defined by AGMA299.01 Part I Section 3:

*3.1 The differentiation between sound and noise can be defined simply: sound is a variation in pressure; noise is undesired sound. Noise also implies undesired frequencies which tend to mask useful information, causing possible misrepresentation of actual sound characteristics. Examples of noises extraneous to gear sound measurement are lubrication pump noise, air-drill noise, 60cycle hum, instrumentation, electrical noise, etc.*

Due to the dynamics of the gear mesh gear teeth will generate sound, even in 100% theoretically accurate gearing. Because of this it is very important to note the noise and vibration characteristics of a gear unit during operation when it is first installed. A change in noise or vibration may be an indication of changing conditions in the system.

Irregularities in the tooth profile or tooth spacing may generate noise at the frequency of the irregularities. Improper lubrication is another possible cause for noise generated in the gear mesh. Usually any gear mesh sounds generated will be at the gear mesh frequency (the frequency of rotation times the number of teeth on the rotating member), harmonics of the mesh frequency or at sideband frequencies (mesh frequency plus and minus the pinion or gear rotational frequencies).

Sometimes irregularities in the tooth profile (i.e. wear or damage) can be repaired depending upon the severity. Repairing the tooth profile can be accomplished by either recutting or regrinding the teeth. If profile damage is not severe and contained to a small portion of the tooth it may be possible to “dress” the area. Note that this does not actually repair the tooth but may reduce the chances of the damage propagating. It is likely that noise will still be generated by the “dressed” area.

Bearings also may generate noise. Irregularities in bearing elements, deflection, misalignment, loose cages and races, roller skewing and/or skidding may generate bearing noise. Deflections under load and misalignment are common causes of anti-friction bearing noise.

Couplings may also be a source of noise due to windage. System resonance and critical speeds also generate sound in gear units. Resonant frequencies of the casing and/or baseplate can be excited by internally generated frequencies such as tooth mesh. In some instances equipment external to the gear unit (cooling fans, pumps, motors, valves) may also be the source of noise that can appear to be generated by the gear unit.

## **Temperature**

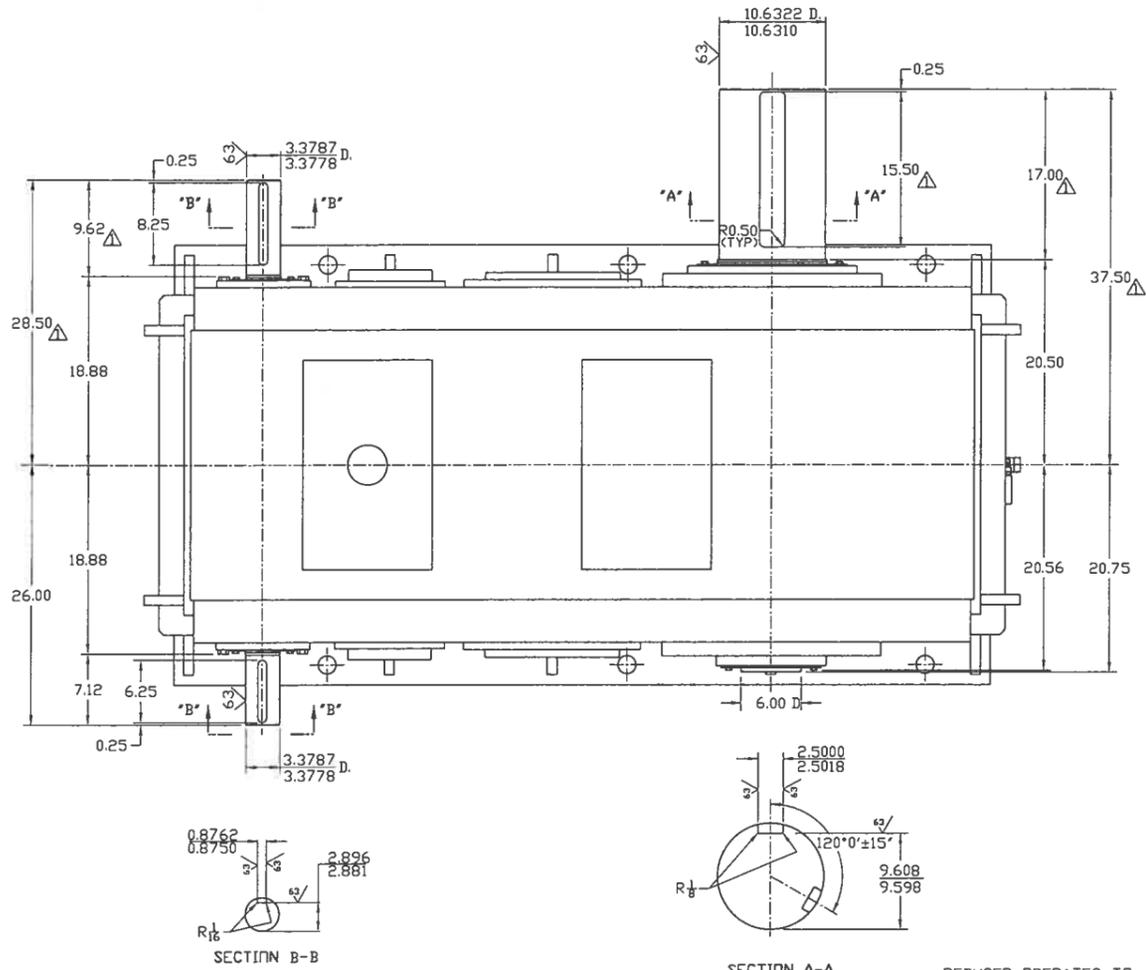
Per ANSI/AGMA9005-D94 the maximum oil sump temperature for petroleum based oils is 95°C (203°F) and for synthetic oils is 107°C (225°F). Ideally the oil temperature during operation should be below 93°C (200°F). An elevated temperature may be an indication of several possible conditions.

The oil level may either be too high or too low to provide adequate lubrication. If the oil level is too low, then it is possible that the components of the gear unit are not receiving enough lubrication to facilitate cooling. If the oil level is too high, then it is possible that the over abundance of oil is not allowing proper circulation of the oil. In order to properly cool the components of a gear unit, the oil must

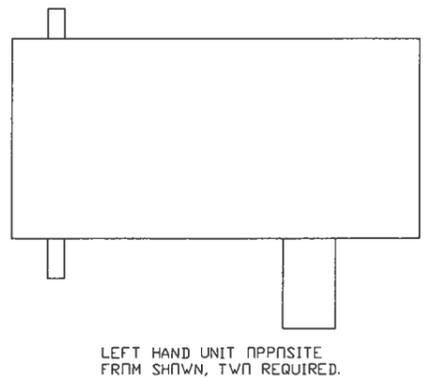
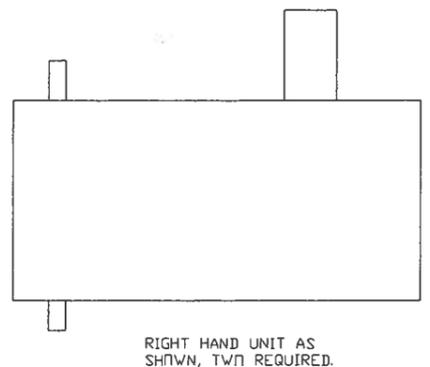
come into contact with them and then be allowed to circulate away to “carry” the heat away and allow it to dissipate.

Elevated temperatures may also be an indication of possible problems with a bearing. In most applications bearings require a certain amount of clearance for proper operation. If bearing clearances are too large then rollers (in anti-friction bearings) may be “skidding” instead of rolling. If the clearances are too small the additional loading may be causing excessive heat generation. In gear units with sleeve bearings, improper clearances may cause an insufficient lubrication film that could lead to metal to metal contact between the bearing and shaft. This may cause additional heat generation.

It is also possible that elevated temperatures may be an indication that the oil is not sufficient for the application. This can be caused by using oil with the incorrect viscosity or oil that is beyond its service life. Regular sampling of oil is a very useful tool for monitoring a gear unit and insuring that the oil’s properties are sufficient. Over time oil can be degraded by a number of things including contamination and chemical changes occurring within the oil during normal operation.



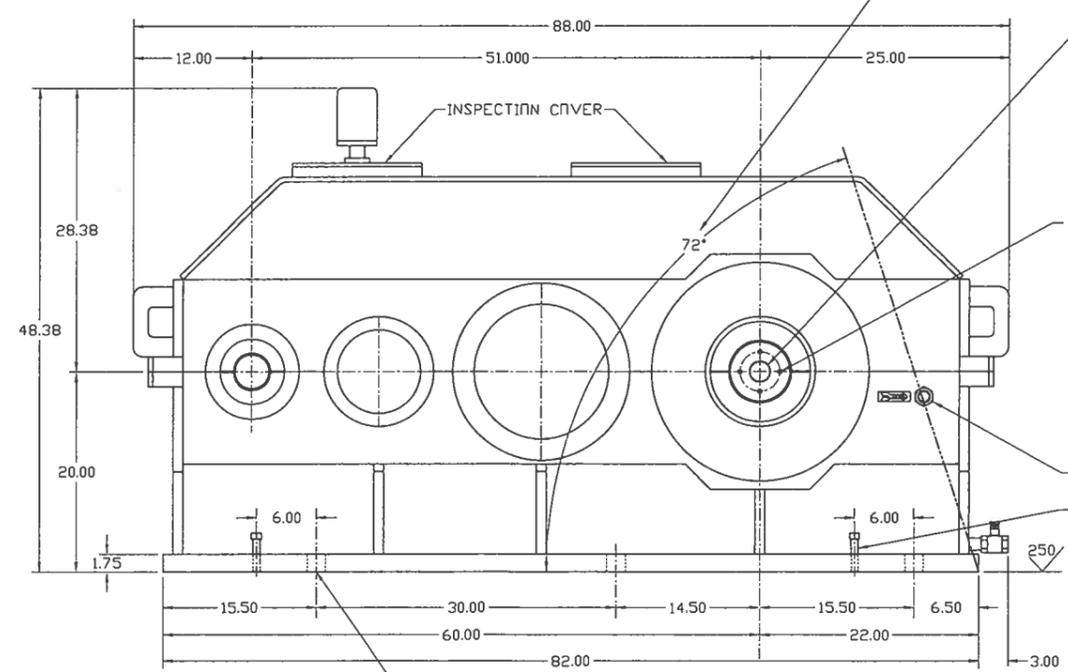
- NOTE:
- REDUCER TO BE FACTORY FINISHED INTERNALLY & EXTERNALLY WITH SHERWIN-WILLIAMS CO. #61RN30 SHOP COAT PRIMER.
  - EXTERIOR PAINTING FINISH COAT PERFORMED BY OTHERS.
  - REDUCER TO BE TESTED AS REQUIRED BY SPECIFICATION ITEM 99599.0801 M-OPERATING MACHINERY.
  - HOUSING TO BE FABRICATED FROM A-36 STEEL PLATE AND THERMALLY STRESS RELIEVED BEFORE MACHINING.
  - B10 LIFE OF ALL BEARINGS GREATER THAN 40,000 HOURS.
  - GEARS AND PINIONS TO BE DESIGNED AND MANUFACTURED IN ACCORDANCE WITH AGMA 2001-C95, AGMA QUALITY Q11.
  - INPUT AND OUTPUT COUPLINGS MOUNTED BY PRAGER.
  - SEE J.C. MACHINE SHOP DRAWING 400 E5 FOR SPEED REDUCER MOUNTING DETAILS AND JCMS PART NO. 400 D6 03 FOR THE TURNED MOUNTING BOLT DETAILS.



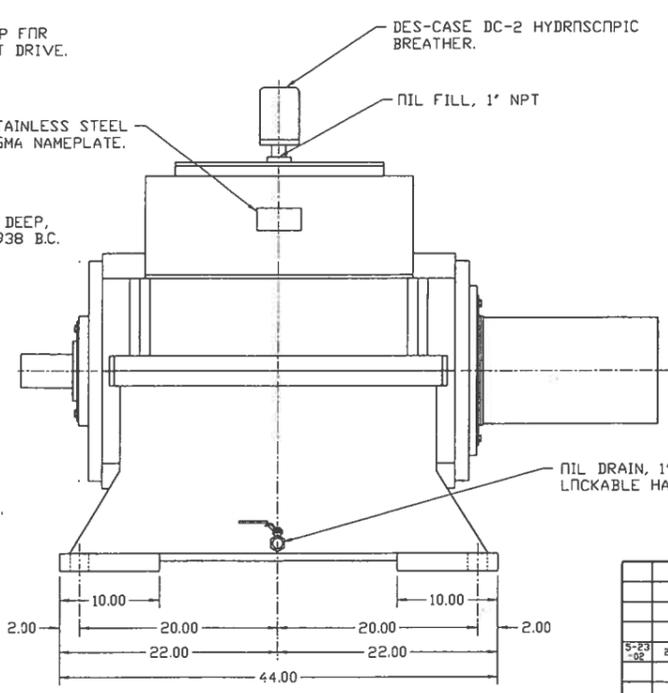
SECTION B-B

SECTION A-A

REDUCER OPERATES TO 72° WITH L.S. SHAFT DOWN.



△ SUB DRILL THRU HOLES 1 1/2" (38 MM). AT INSTALLATION REAM REDUCER AND SECONDARY SUPPORT IN LINE FOR M42 TURNED BOLTS, 6 PLACES.

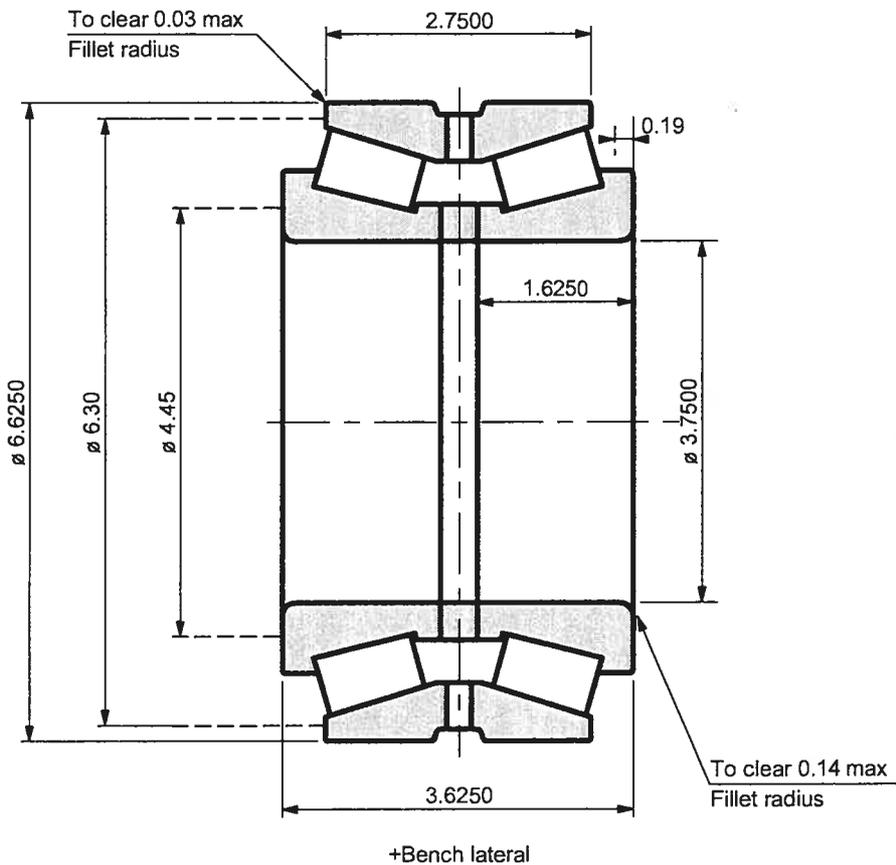
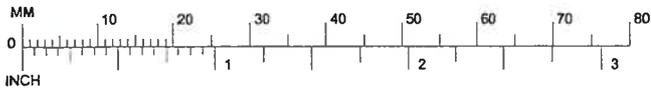


NAME PLATE DATA  
 UNIT SIZE: LT5100 SPEED REDUCER  
 TRIPLE REDUCTION  
 RATIO: 90.8:1  
 INPUT SPEED: 115 RPM  
 OUTPUT SPEED: 1.27 RPM  
 SERVICE RATING: 55.0 HP  
 SERVICE FACTOR: 1.00  
 OUTPUT TORQUE RATING  
 = 2,727,886 IN-LBS.  
 EFFICIENCY = 95% AT FULL  
 SPEED AND LOAD.  
 LUBRICANT: AGMA NO. 6S(EP) △  
 (288-352 cst @ 40°C)  
 FURNISH 125 GALS. TEXACO  
 △ PINNACLE EP320 GEAR LUBRICANT.  
 ESTIMATED WEIGHT = 16200 LBS.

DIMENSIONS CERTIFIED CORRECT FOR  
 J. C. MACHINE CO. P.L. NO. CH02  
 REV. R  
 BY: S.D. GRIFFITH DATE: 5-23-02

REF.: STUTSON STREET BRIDGE  
 OVER THE GENESEE RIVER  
 MONROE COUNTY  
 STATE OF NEW YORK

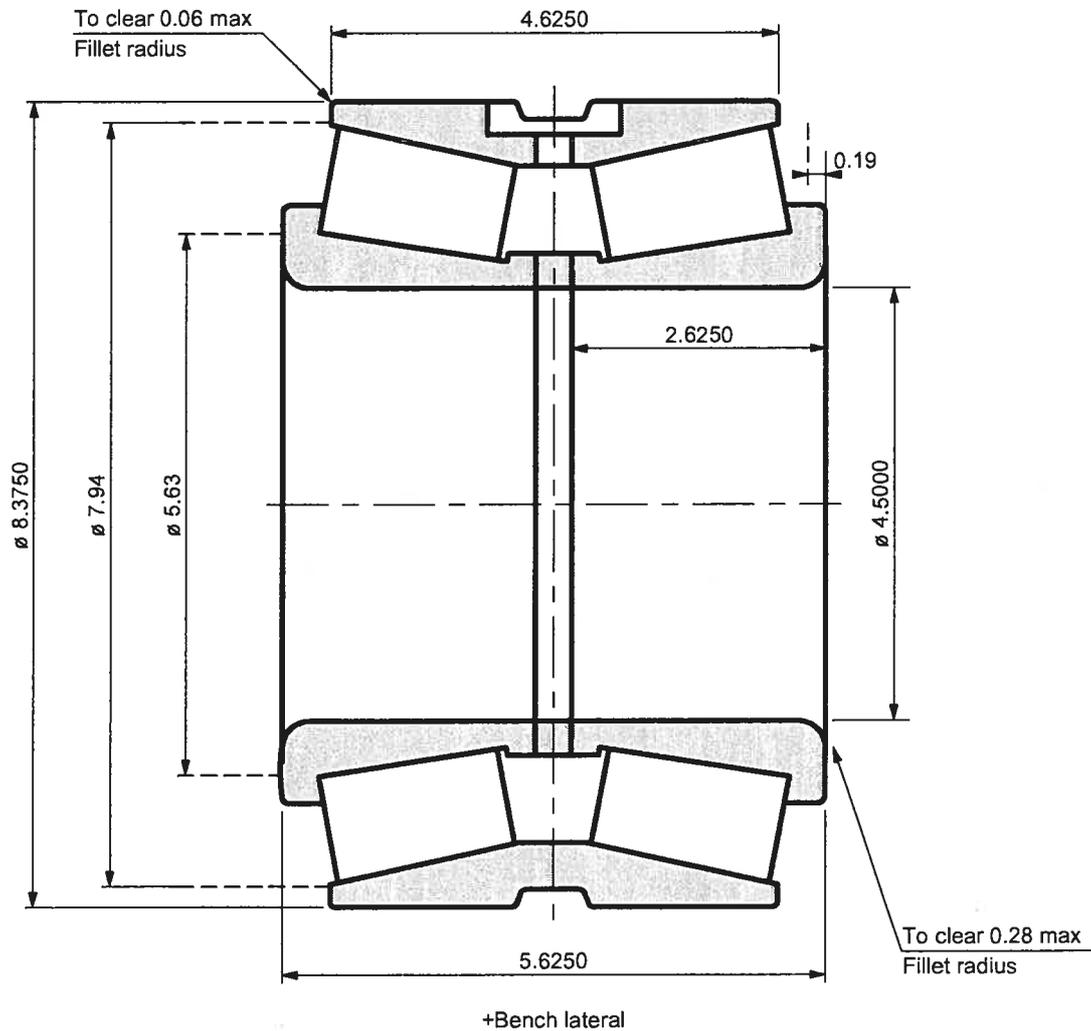
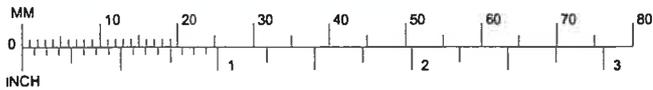
TOLERANCES (except as noted)		PRAGER	
DECIMAL	XXX	A Division of Brook Hansen NEW ORLEANS, LA	
FRACTIONAL	±	Customer: J C MACHINE COMPANY MIAMI, FL	
HERPRA 320	SDG	Job No.	52129
NOTE 8 ADDED.	SDG	Drawn	SDG
DATE	SYN	Checked	SLK
11-18-01	1	Scale:	1 1/2"=1'-0"
15.50 WAS 16.00, 28.50 WAS 28.00, 9.62		Approved	GAD
37.50 WAS 39.00, 17.00 WAS 17.50,		DR. CLK.	
15.50		Drawing No.	D-35805
		Rev.	2



8 Oil Holes Ø 0.250 inches equally spaced

IMPERIAL UNITS

		SUPERSEDES			
		PROJECTION		ORIGINAL SCALE	1 : 2
Max shaft fillet radius - R	0.14	inch	<p><b>683 - 672D - X1S-683</b>          TDO BEARING ASSEMBLY  <b>Prager Services, Inc.</b>          Kinzel</p> <p>K factor 1.24          Dynamic Radial Rating, C90 14300 lbf          Dynamic Thrust Rating, Ca90 11500 lbf          Dynamic Radial Rating (2 rows), C90(2) 24900 lbf          Radial Rating (1E6 Rev.), C1 (1) 55100 lbf</p>		
Max housing fillet radius - r	0.03	inch			
ISO factor - e	0.47				
ISO factor - Y1	1.43				
ISO factor - Y2	2.14				
Bearing weight (with cage)	18.06	lb	<p><b>THE TIMKEN COMPANY</b>          CANTON, OHIO USA</p>		
Number of rollers per row	23				
* COMPUTER GENERATED *		THIS DRAWING MUST NOT BE COPIED OR REPRODUCED WITHOUT THE CONSENT OF THE TIMKEN COMPANY		DRAWN Trbsg V 2.1.0	CHECKED
				APPROVED	DATE 10/16/2006
				<b>FOR DISCUSSION ONLY</b>	



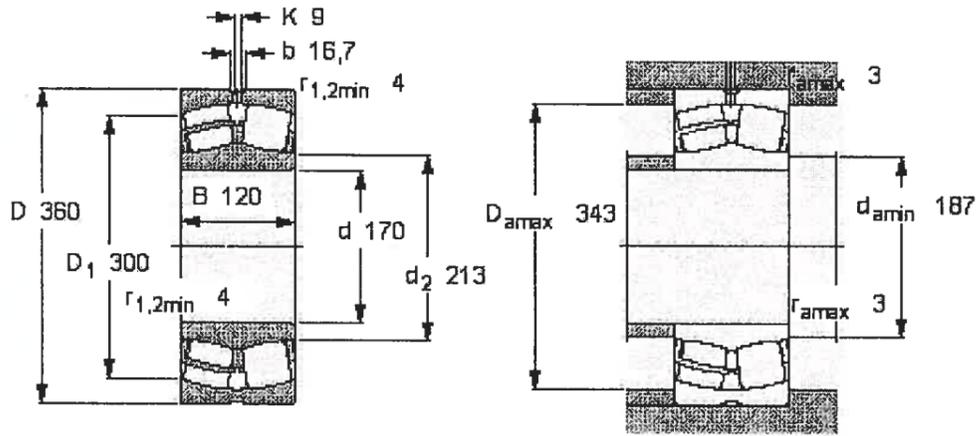
Maximum Pin Diameter,  $K_a = 1.00$  in.  
 Maximum Pin Depth into Cup,  $K_b = 0.31$  in.  
 9 Oil Holes  $\phi 0.375$  inches equally spaced

**IMPERIAL UNITS**

		SUPERSEDES			
		PROJECTION	ORIGINAL SCALE	H H 2 2 4 3 4 6 - H H 2 2 4 3 1 0 C D - H H 2 2 4 3 4 6	
			1 : 2		
Max shaft fillet radius - R	0.28	inch	<b>TDO BEARING ASSEMBLY</b> <b>Prager Services, Inc.</b> <b>Kinzel</b>  K factor 1.79 Dynamic Radial Rating, C90 36700 lbf Dynamic Thrust Rating, Ca90 20500 lbf Dynamic Radial Rating (2 rows), C90(2) 63900 lbf Radial Rating (1E6 Rev.), C1 (1) 142000 lbf		
Max housing fillet radius - r	0.06	inch			
ISO factor - e	0.33				
ISO factor - Y1	2.07				
ISO factor - Y2	3.09				
Bearing weight (with cage)	47.41	lb	<b>THE TIMKEN COMPANY</b>  CANTON, OHIO USA		
Number of rollers per row	17				
		DATE	CHECKED	APPROVED	DATE
		10/16/2006			10/16/2006
* COMPUTER GENERATED *		THIS DRAWING MUST NOT BE COPIED OR REPRODUCED WITHOUT THE CONSENT OF THE TIMKEN COMPANY		FOR DISCUSSION ONLY	

Spherical roller bearings, cylindrical and tapered bore

Principal dimensions			Basic load ratings		Fatigue load limit Pu	Speed ratings		Mass	Designation
d	D	B	dynamic	static		Reference speed	Limiting speed		
in			lbf	C0	lbf	r/min	lb		* - SKF Explorer bearing
6,6929	14,1732	4,7244	396000	486000	39600	1400	1800	135	22334 CC/W33 *

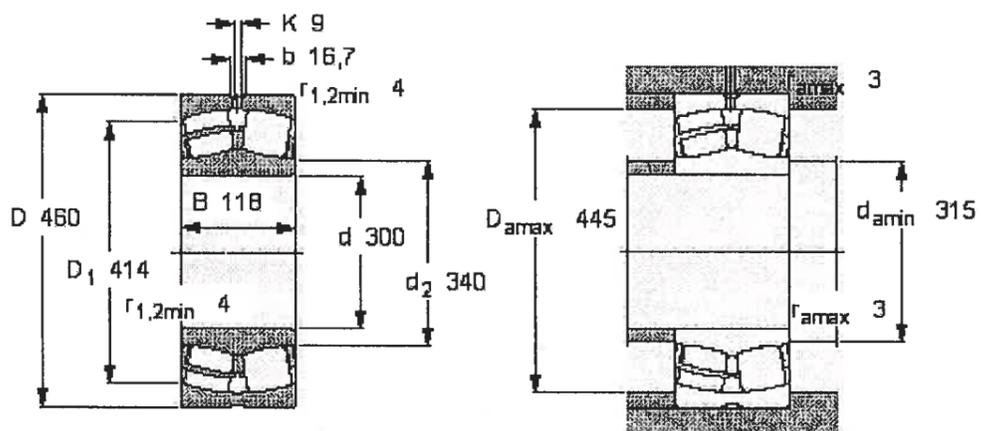


Calculation factors

- e 0,33
- $Y_1$  2
- $Y_2$  3
- $Y_0$  2

### Spherical roller bearings, cylindrical and tapered bore

Principal dimensions			Basic load ratings		Fatigue load limit Pu	Speed ratings		Mass lb	Designation
d	D	B	dynamic	static		Reference speed	Limiting speed		
in			lbf	C0	lbf	r/min			* - SKF Explorer bearing
11,811	18,1102	4,6457	477000	776000	59600	1200	1500	158	23060 CC/W33 *



**Calculation factors**

- e 0,23
- Y<sub>1</sub> 2,9
- Y<sub>2</sub> 4,4
- Y<sub>0</sub> 2,8

7C

**Stock Number**      **60028**  
**Description**        **LDS & SMALL BORE SEAL**  
**Lip Code**            **Nitrile (Lip Code: R)**  
**Type/Style**         **CRWHA1**

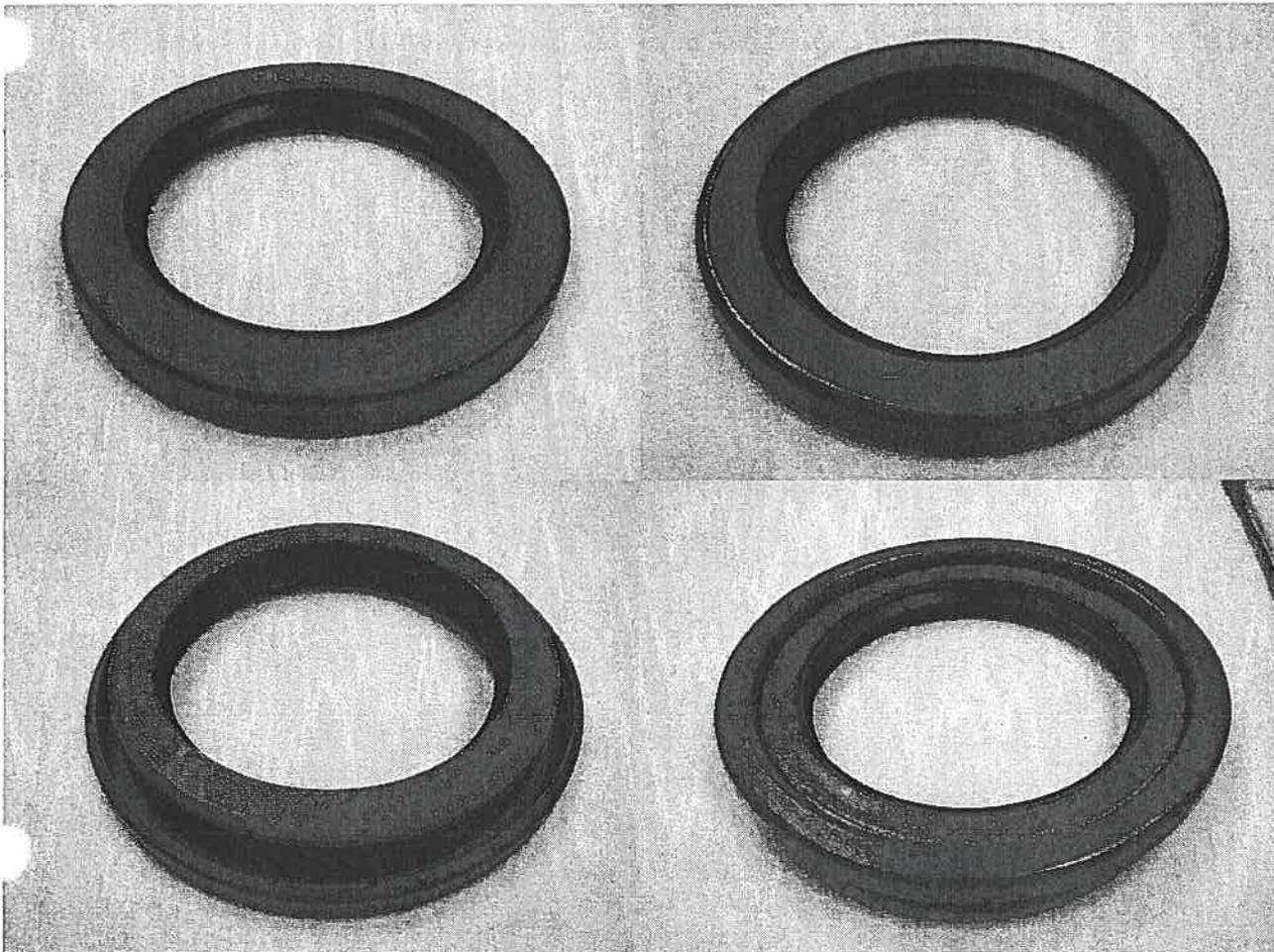


	Inches
Shaft	<b>6</b>
Bore	<b>7.5</b>
OD	<b>7.506</b>
Width	<b>0.5</b>
Weight	<b>0.827</b>

UPC	<b>00085311038836</b>
Speedi-Sleeve	<b>99599</b>
Bore-Tite on O.D.	<b>Y</b>

**Product Images:**

Note: photos are representative of construction.



**Stock Number**      **34868**  
**Description**        **LDS & SMALL BORE SEAL**  
**Lip Code**            **Nitrile (Lip Code: R)**  
**Type/Style**         **CRWHA1**

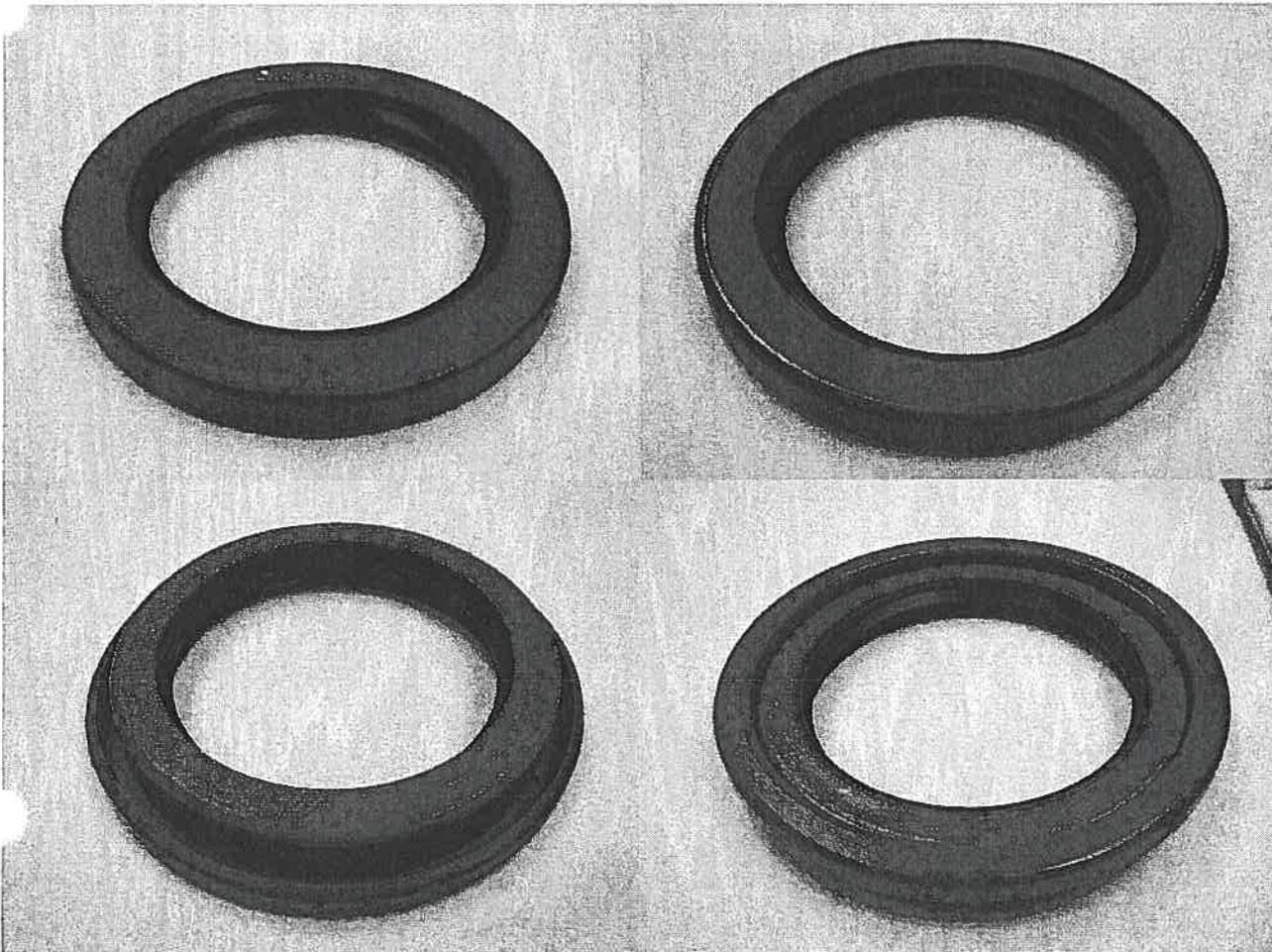


	Inches
Shaft	<b>3.5</b>
Bore	<b>4.376</b>
OD	<b>4.381</b>
Width	<b>0.438</b>
Weight	<b>0.28</b>

UPC	<b>00085311032179</b>
Speedi-Sleeve	<b>99350</b>
WastWatcher	<b>34860</b>
Bore-Tite on O.D.	<b>Y</b>

**Product Images:**

Note: photos are representative of construction.



**Stock Number**      **110030**  
**Description**        **LDS & SMALL BORE SEAL**  
**Lip Code**            **Nitrile (Lip Code: R)**  
**Type/Style**         **CRWHA1**

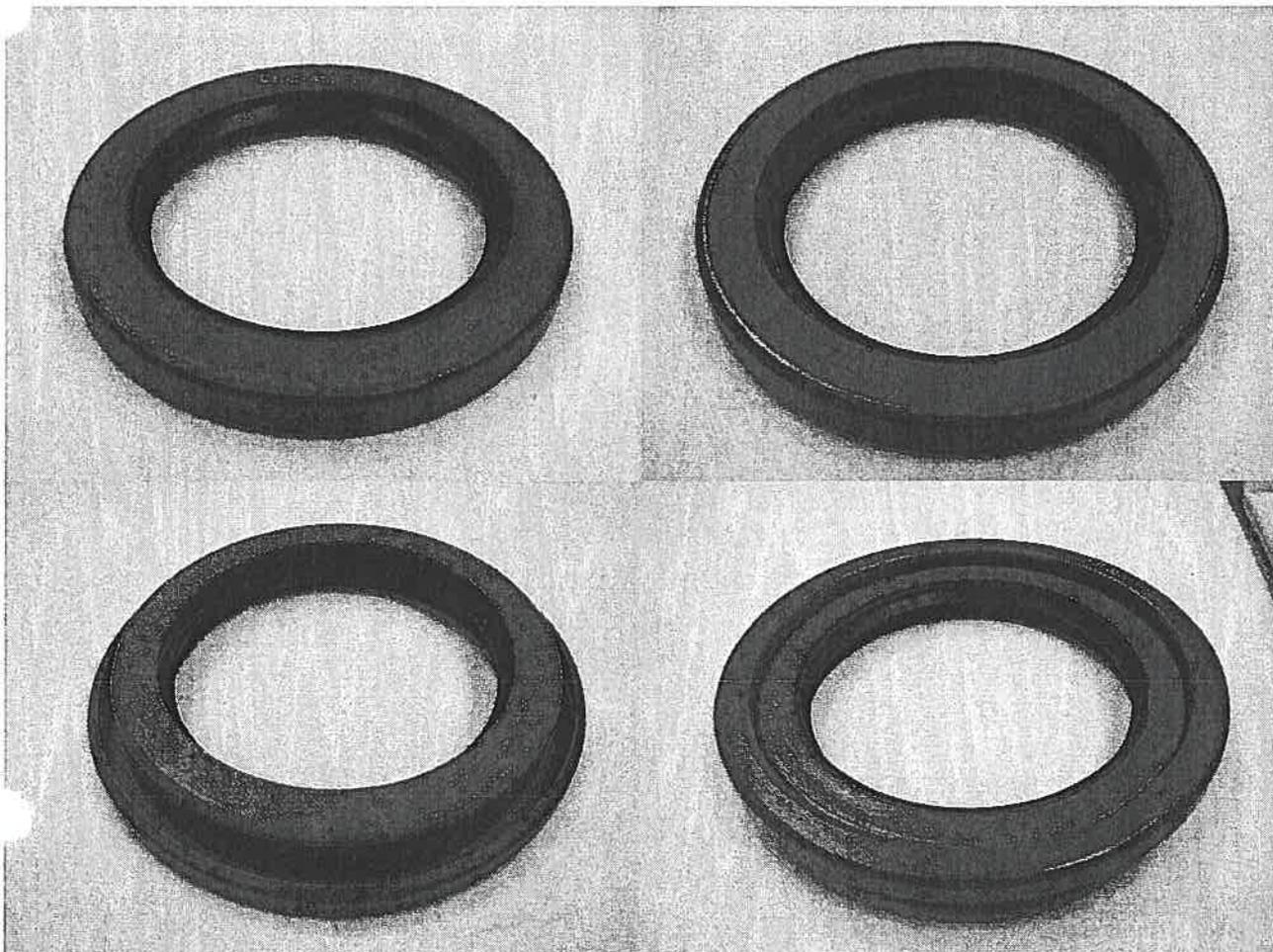


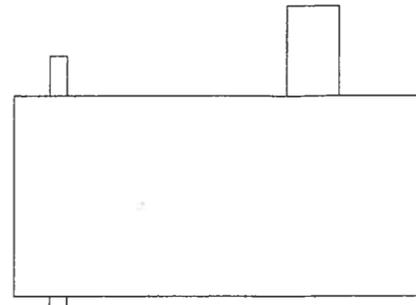
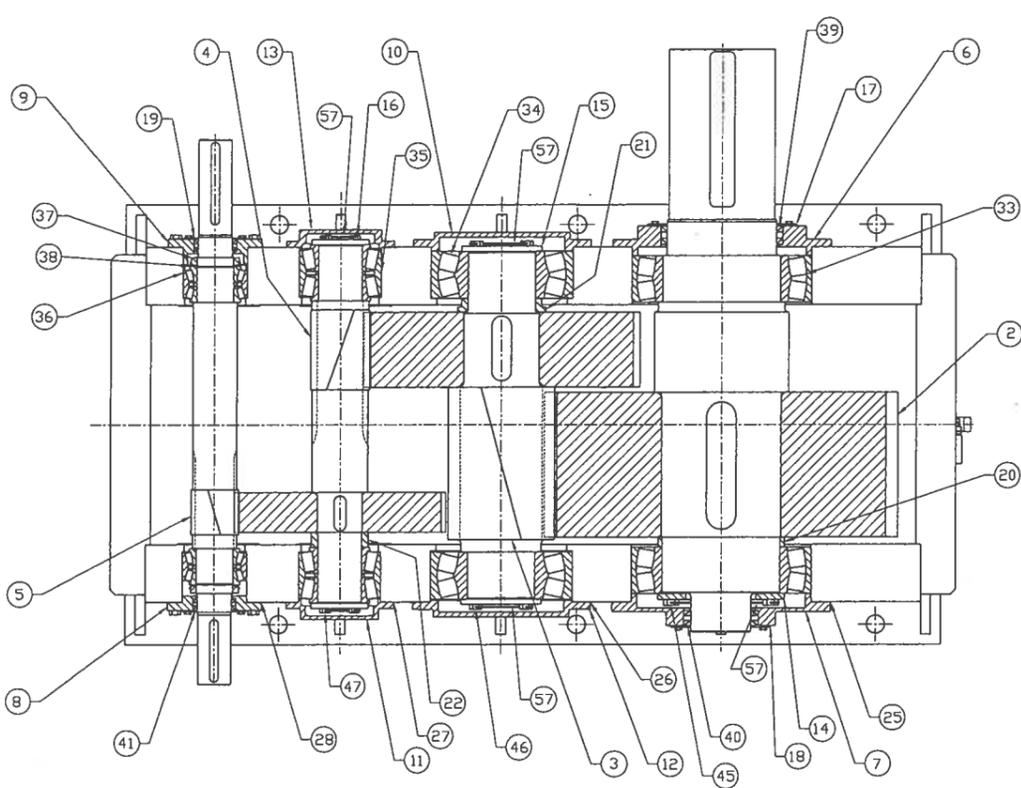
	Inches
Shaft	<b>11</b>
Bore	<b>12.25</b>
OD	<b>12.258</b>
Width	<b>0.625</b>
Weight	<b>2.249</b>

**UPC**                                **00085311043526**  
**Speedi-Sleeve**  
**WastWatcher**                 **110030**  
**Bore-Tite on O.D.**             **N**

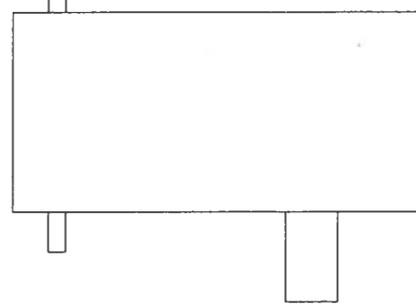
Product Images:

Note: photos are representative of construction.

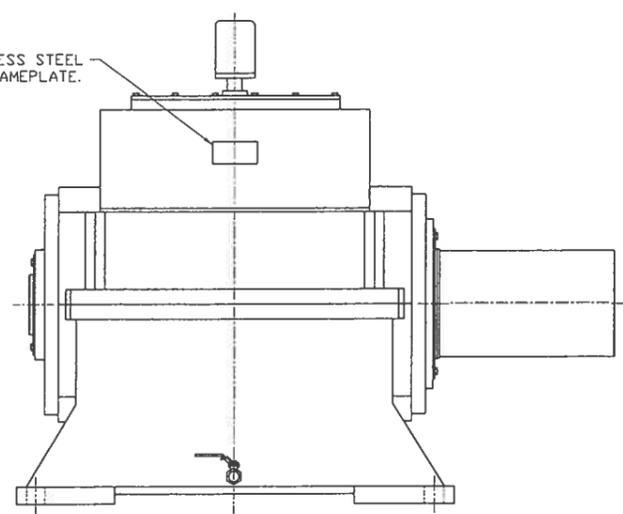
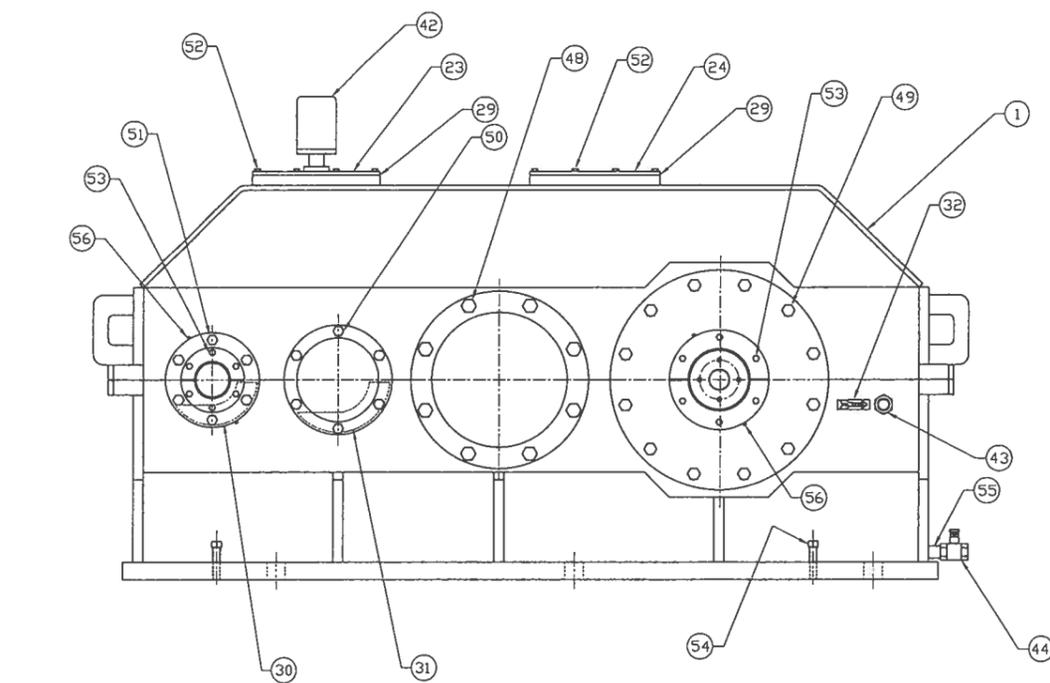




RIGHT HAND UNIT AS SHOWN, TWO REQUIRED.



LEFT HAND UNIT OPPOSITE FROM SHOWN, TWO REQUIRED.



STAINLESS STEEL AGMA NAMEPLATE.

LIST OF PARTS

CUSTOMER:		PURCHASE ORDER NO.		SHOP ORDER NO.		
J. C. MACHINE COMPANY MIAMI, FL		CH02		S2129		
UNIT DESCRIPTION:			INSTALLATION PLAN		DATE:	
PRAGER LT5100 SPEED REDUCER 90.8:1 RATIO			0-35805		28 FEB 01	
ITEM	QUAN.	DESCRIPTION	DRAWING NO.			
1	1	ASSEMBLY, GEAR HOUSING AND COVER	D-36041			
2	1	L.S. GEAR & SHAFT ASSEMBLY (CONSISTS OF)	B-36044			
	(1)	L.S. GEAR-87 TEETH	B-36043			
	(1)	L.S. SHAFT	B-36042			
	(2)	KEY	B-36042A			
3	1	L.S. PINION & L.S. GEAR ASSEMBLY (CONSISTS OF)	B-36046			
	(1)	L.S. PINION-18 TEETH	B-36045			
	(1)	L.S. GEAR-92 TEETH	B-36047			
	(2)	KEY	B-36045A			
4	1	L.S. PINION & H.S. GEAR ASSEMBLY (CONSISTS OF)	B-36048			
	(1)	L.S. PINION-18 TEETH	B-36048			
	(1)	H.S. GEAR-105 TEETH	B-36050			
	(2)	KEY	B-36048A			
5	1	H.S. PINION-22 TEETH	B-36051			
6	1	SEAL RETAINER-L.S. SHAFT	B-36052			
7	1	SEAL RETAINER-L.S. SHAFT	B-36053			
8	1	SEAL RETAINER-H.S. SHAFT	B-36054			
9	1	SEAL & BRG. RETAINER-H.S. SHAFT	B-36055			
10	1	BRG. RETAINER-L.S. PINION SHAFT	B-36056			
11	1	BRG. RETAINER-L.S. PINION SHAFT	B-36057			
12	1	ENO CAP-L.S. PINION	B-36058			
13	1	ENO CAP-L.S. PINION	B-36059			
14	2	BRG. RETAINER PLATE-L.S. SHAFT	B-36060			
15	2	BRG. RETAINER PLATE-L.S. PINION SHAFT	B-36061			
16	2	BRG. RETAINER PLATE-L.S. PINION SHAFT	B-36062			
17	1	SEAL RETAINER PLATE-L.S. SHAFT	B-36063			
18	1	SEAL RETAINER PLATE-L.S. SHAFT	B-36064			
19	2	SEAL RETAINER PLATE-H.S. SHAFT	B-36065			
20	1	SPACER, L.S. GEAR	B-36066			
21	1	SPACER, L.S. GEAR	B-36067			
22	1	SPACER, H.S. GEAR	B-36068			
23	1	INSPECTION COVER-BREATHER	B-36069			
24	1	INSPECTION COVER-PLAIN	B-36070			
25	2	GASKET, L.S. SHAFT-GARLOCK 3000, 1/32 THICK	B-36052A			
26	2	GASKET, L.S. PINION-GARLOCK 3000, 1/32 THICK	B-36058A			
27	2	GASKET, L.S. PINION-GARLOCK 3000, 1/32 THICK	B-36057A			
28	2	GASKET, H.S. PINION-GARLOCK 3000, 1/32 THICK	B-36054A			
29	2	GASKET, INSP. COVER-GARLOCK 3000, 1/32 THICK	B-36069A			

LIST OF PARTS

CUSTOMER:		PURCHASE ORDER NO.		SHOP ORDER NO.		
J. C. MACHINE COMPANY MIAMI, FL		CH02		S2129		
UNIT DESCRIPTION:			INSTALLATION PLAN		DATE:	
PRAGER LT5100 SPEED REDUCER 90.8:1 RATIO			0-35805		28 FEB 01	
ITEM	QUAN.	DESCRIPTION	DRAWING NO.			
30	2	OIL OAM-H.S.	B-36073			
31	2	OIL DAM-L.S.	B-36074			
32	1	OIL LEVEL INDICATOR	B-31785			
33	2	BEARING, SPHERICAL ROLLER, SKF 23060CC/W33 EXPLORER				
34	2	BEARING, SPHERICAL ROLLER, SKF 22334CC/W33 EXPLORER				
35	2	BEARING, TAPERED RLR., TIMKEN HH224346-90078 TDO ASM., .016 BEP				
36	2	BEARING, TAPERED RLR., TIMKEN 683-90042 TDO ASM., .012 BEP				
37	2	LOCK NUT, SKF AN 19				
38	2	LOCK WASHER, SKF W 19				
39	2	OIL SEAL, L.S., C/R NO. 110030 (11.00 X 12.25 X .625)				
40	2	OIL SEAL, L.S., C/R NO. 60028 (6.00 X 7.50 X .50)				
41	4	OIL SEAL, H.S., C/R NO. 34868 (3.50 X 4.37 X .438)				
42	1	BREATHER DES-CASE DC-2 WITH DC-10 ADAPTER				
43	1	SIGHT GAUGE, GTS BW-10, ITEM NO. 04043, 1" N.P.T.				
44	1	BALL VALVE, LOCKING, 1" NPT FEMALE PARKER-HANNIFIN XVPSOOP-16				
45	6	DRILLED HD. CAP SCREW, 7/8-9 UNC X 2.00 LG., ASTM A325				
46	12	DRILLED HD. CAP SCREW, 3/4-10 UNC X 1.75 LG., ASTM A325				
47	8	DRILLED HD. CAP SCREW, 5/8-11 UNC X 1.50 LG., ASTM A325				
48	16	HEX HD. CAP SCREW, 7/8-9 UNC X 2.00 LG., ASTM A325				
49	24	HEX HD. CAP SCREW, 3/4-10 UNC X 2.00 LG., ASTM A325				
50	12	HEX HD. CAP SCREW, 5/8-11 UNC X 1.50 LG., ASTM A325				
51	12	HEX HD. CAP SCREW, 1/2-13 UNC X 1.50 LG., ASTM A325				
52	32	HEX HD. CAP SCREW, 3/8-16 UNC X 1.00 LG., ASTM A325				
53	26	HEX HD. CAP SCREW, 3/8-16 UNC X 0.75 LG., ASTM A325				
54	4	SQUARE HD. SET SCREW, 3/4-10 UNC X 3.00 LG.				
55	1	PIPE NIPPLE, STD. BLK., 1" N.P.T. X 2.5 LG.				
56	8	PIPE PLUG, 1/8 NPT				
57	5	WIRE LOCK				

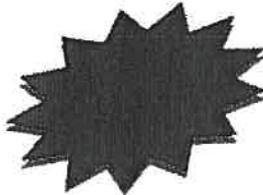
NAME PLATE DATA  
 UNIT SIZE: LT5100 SPEED REDUCER  
 TRIPLE REDUCTION  
 RATIO: 90.8:1  
 INPUT SPEED: 115 RPM  
 OUTPUT SPEED: 1.27 RPM  
 SERVICE RATING: 55.0 HP  
 SERVICE FACTOR: 1.00  
 OUTPUT TORQUE RATING  
 = 2,727,886 IN.-LBS.  
 EFFICIENCY = 95% AT FULL  
 SPEED AND LOAD.  
 LUBRICANT: AGMA NO. 6S(EP)  $\Delta$   
 (288-352 cSt @ 40°C)  
 $\Delta$  FURNISH 125 GALS. TEXACO  
 $\Delta$  PINNACLE EP320 GEAR LUBRICANT.  
 ESTIMATED WEIGHT = 16200 LBS.

REF.: STUTSON STREET BRIDGE  
 OVER THE GENESEE RIVER  
 MINNIE COUNTY  
 STATE OF NEW YORK

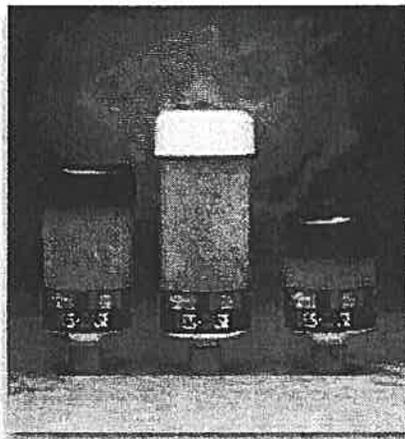
TOLERANCES except as noted:		PRAGER	
DECIMAL	XXX	A Division of Brook Hansen NEW ORLEANS, LA	
+	0.02	Customer: J. C. MACHINE COMPANY	
FRACTIONAL	1/16	MIAMI, FL	
+	1/2°	Subject: PRAGER LT5100 SPEED REDUCER	
ANGULAR	1/2°	Drawn: SDG	
+	1/2°	Date: 12-14-00	
Job No.	S2129	Details: PARTS LIST	
Drawn	SDG	Scale: 1 1/2"=1'-0"	
EP320 VAS HERIPA 320	SDG	Drawing No. D-35805A	
6S(EP) VAS GEP, PINNACLE	Checked: SLK	Rev. 1	
DATE SYN	DESCRIPTION	DR. CH	Approved: GAD

20

## DISPOSABLE *Breathers*

[About Des-Case](#)[Breathers](#)[Tech Notes](#)[Case Studies](#)[Distributors](#)[How It Works](#)[Tools](#)[Newsroom](#)

The new Des-Case® Disposable Steel Breather is the ideal desiccant breather for mobile equipment. With 1 micron filtration and a rugged metal housing, this breather is durable, resistant to vibration and can withstand a greater range of temperatures.



**"Industry spends billions of dollars annually treating the negative effects of oil contamination."**

Des-Case attacks the cause as opposed to treating the problem of contamination. Designed and developed by filtration engineers the Des-Case hygroscopic breather is a unique, patented air filter and water vapor removal system. It will virtually eliminate moisture and particulate contamination in industrial equipment reservoirs such as hydraulic tanks and gear boxes.

### *Change To Des-Case For Maximum Performance*

Des-Case hygroscopic breather elements are state-of-the-art in design and function, and are industry's best choice for assuring maximum machine performance. Des-Case

### *Resilient Construction*

Moisture and particulate accumulation are major factors of oil contamination in industrial equipment. Neglected, these detriments restrict equipment efficiency, causing machine downtime and significant expense in replacement oil, parts and repair labor. Des-Case breathers incorporate a proven, field-tested design. They prevent water and contaminants from entering fluid reservoirs as differential pressures occur through thermal expansion and contraction of the fluid, or during the filling or emptying process. Des-Case breathers utilize the entire area of the patented polyester filter media to remove solid particulate material as small as 3-microns. Accompanying water vapor is then removed by the hygroscopic agent. A final filter ensures that only clean dry air enters the system. [See how it works!](#)

### *Unique Filtration Process*

Every Des-Case hygroscopic breather is manufactured in a durable, shock-absorbing clear plastic casing with resilient qualities to withstand the customary abuse associated with heavy manufacturing equipment. The units are disposable, and are manufactured entirely of environmentally safe components. Des-Case disposable hygroscopic breathers are manufactured in three sizes, DC-2, DC-3, and DC-4 to accommodate different mounting space requirements. All three models are rated for 20 cfm of air in and out of the tank or

offers these cost-saving benefits:

- ⑤ Elimination of water-contaminated oil which leads to additive stripping
- ⑤ Elimination of rust-forming condensation
- ⑤ Elimination of sludge deposits
- ⑤ Less abrasive particles to prolong machine operating life
- ⑤ Longer oil and oil filter life

reservoir (the equivalent of 150 gpm fluid level change in the tank).  
The Des-Case Sizing Wizard will help you determine the best product for your application.

### Models, Accessories & Installation Methods

Des-Case disposable breathers retain particulate as small as 0.5-micron (73.5% efficiency) or 3-micron absolute, are rated for 20 cfm and feature a 1" standpipe.

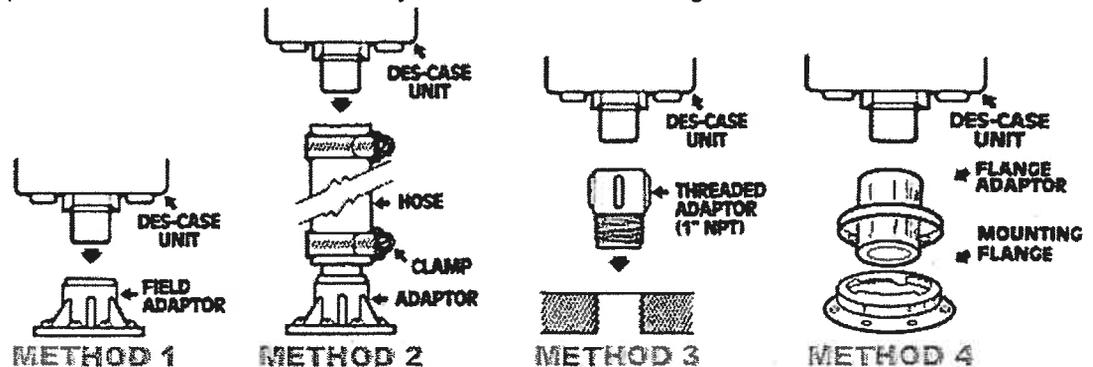
Model#	Diameter	Height	Water Adsorption
DC-2	4in/10.16cm	4.5in/11.43cm	5.25oz/155ml
DC-3	4in/10.16cm	6.5in/16.51cm	8.16oz/240ml
DC-4	4in/10.16cm	8.5in/21.59cm	11.66oz/345ml

#### Optional Accessories

Threaded Adaptors	DC-10
Clamps	DC-11
Field Adaptors	DC-12
Flange Adaptors	DC-15
Flexhose	DC-16

*\* All adsorption rates are approximate and do not factor in the positive effects of regeneration.*

Des-Case hygroscopic breathers are designed for installation on most equipment regardless of location. For installation in difficult areas, Des-Case offers accessories enabling breather placement to be several feet away from an oil reservoir or gearbox.



[Breathers](#) | [Tech Notes](#) | [Case Studies](#) | [Distributors](#) | [How It Works](#) | [Sizing Wizard](#)  
[Home](#) | [About Des-Case](#) | [Newsroom](#) | [Contact Us](#)

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### inPHorm Brass Products Selection Report

Last Change: 10-4-2005 9:59  
Report Date: 10-4-2005 10:15

Software Version: 1.1

#### Customer Identification

Company Name:  
Contact Name:  
Contact Title:  
Company Address:  
City:  
State:  
Zip Code:  
Phone:  
FAX:

#### Brass Products Valve Specifications

PART NUMBER: XVP500P-16  
Product Line: Ball Valves  
Type of Valve: Inline  
Type of Actuator: Manual Handle  
Parker Division: Brass Products Division  
Body Material: Brass  
Series: 500  
CV: 54  
Connector Ends: 1" Female PTF special short  
1" Female PTF special short

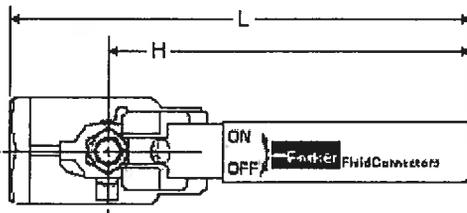
#### Choose Sizing Method

Entered Connection Size: 1"  
Max. Operating Pressure: 20 psia  
Max. Operating Temperature: 150 °F

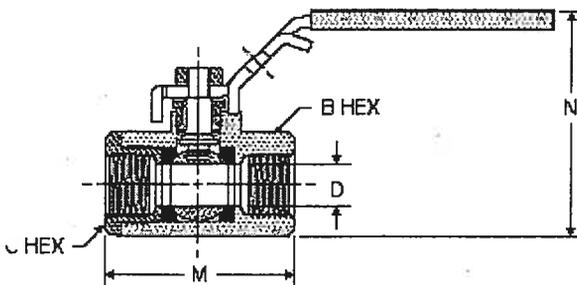
#### Details

Vent Options: \_ - No Vent  
Stem Options: \_ - Brass Ball and Stem  
Handle Options: P - Steel Padlocking Lever Handle  
Handle Cover: \_ - Yellow with Marked Parker Logo

#### Brass Products Valves Dimensions



- B (Hex) = 1 1/2
- C (Hex) = 1 9/16
- D (Flow) = 0.875
- H = 3.96
- L = 5.34
- M = 2.75
- N = 3.08

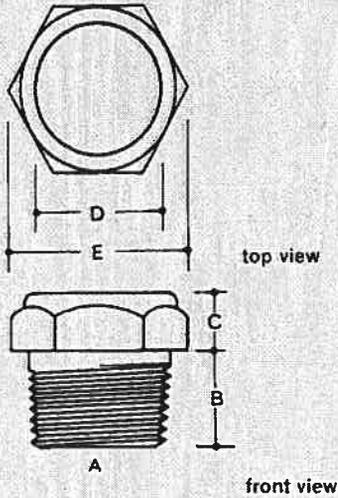


#### Warnings and Additional Information

##### Warnings

This software provides you with options for your further investigation. Before using any product, it is important that you analyze all

**PORTHOLE LIQUID LEVEL GAUGES**



**BW-10 CLEAR WINDOW WITH OPEN BACK  
BW-20 CLEAR WINDOW AND REFLECTOR**



steel, zinc plated

PSI	a.	b.	c.	d.	e.	BW-10	BW-20
						Item Number	Item Number
75	3/8-18	1/2	11/32	15/32	1	04040	
75	1/2-14	17/32	7/16	37/64	1 1/4	04041	04052
50	3/4-14	17/32	7/16	3/4	1 1/2	04042	04053
25	1-11 1/2	11/16	1/2	1	1 13/16	04043	04054
10	1 1/4-11 1/2	11/16	1/2	1 9/32	2 1/4	04044	04055
10	1 1/2-11 1/2	11/16	1/2	1 9/16	2 1/2	04045	04056
2.5	2-11 1/2	11/16	1/2	2	3 1/8	04046	04057

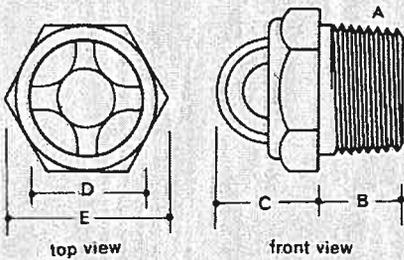
Maximum temperature 250°F

Not for air service

**BW-40 OBSERVA-DOME**



steel, zinc plated



a.	b.	c.	d.	e.	Item Number
3/4-14	17/32	13/16	15/16	1 1/2	04119
1-11 1/2	11/16	13/16	15/16	1 13/16	04120
1 1/4-11 1/2	11/16	1	1 1/4	2 1/4	04121
1 1/2-11 1/2	11/16	1 3/16	1 11/16	2 1/2	04122

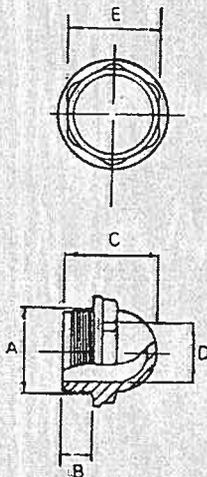
Maximum recommended conditions:

10 psi to 100°F

2 psi to 160°F

Not for air service

**PLASTIC DOME THREADED, POLYCARBONATE**



a.	b. mm	c. mm	d. mm	e. mm	Item Number
1/2 BSP	10	30	14	24	6301-1
3/4 BSP	12	34	20	30	6302-1
1 BSP	12	36	23	36	6303-1
1 1/4 BSP	13	41	28	41	6304-1
M20x1.5	10	30	14	24	6305-1
M27x105	13	34	16	30	6306-1
M33x1.5	12	36	22	36	6307-1
M35x1.5	13	33	25	45	6308-1
M42x1.5	13	41	28	41	6309-1

Maximum working pressure 45 PSI

Maximum working temperature 160°F

Not for air service

### 5.3. Couplings

***Motor Couplers (qty. 4) (400 E7 19)***

The motor couplers are Falk Steelflex Couplings, Type T10, Size 1090. The motor couplers are used to connect the drive motors to the primary reducer. These couplers are located under the guard between each drive motor and the primary reducer.

## How To Use This Manual

This manual provides detailed instructions on maintenance, lubrication, installation, and parts identification. Use the table of contents below to locate required information.

## Table of Contents

Introduction . . . . .	Page 1
Lube Fittings . . . . .	Page 1
Limited End Float . . . . .	Page 1
Lubrication . . . . .	Pages 1-2
Installation & Alignment Instructions. . . . .	Pages 2-4
Annual Maintenance, Relube & Disassembly . . . . .	Page 4
Installation & Alignment Data . . . . .	Page 5
Parts Identification & Parts Interchangeability . . . . .	Page 6

**CAREFULLY FOLLOW THE INSTRUCTIONS IN THIS MANUAL FOR OPTIMUM PERFORMANCE AND TROUBLE FREE SERVICE.**

## INTRODUCTION

This manual applies to Sizes 1020T thru 1140T and 20T thru 140T10 Falk Steelflex Tapered Grid Couplings. Unless otherwise stated, information for Sizes 1020T thru 1140T applies to Sizes 20T thru 140T respectively, e.g. 1020T = 20T, 1100T = 100T, etc. These couplings are designed to operate in either the horizontal or vertical position without modification. Beginning in year 1994 through 2003, these couplings were being supplied with one set of inch series fasteners and one set of Metric fasteners. Beginning in year 2004 only Metric fasteners are being supplied. Refer to Page 6 for part interchangeability.

The performance and life of the couplings depend largely upon how you install and service them.

**CAUTION:** Consult applicable local and national safety codes for proper guarding of rotating members. Observe all safety rules when installing or servicing couplings.

**WARNING:** Lockout starting switch of prime mover and remove all external loads from drive before installing or servicing couplings.

## LUBE FITTINGS

Cover halves have 1/8" NPT lube holes. Use a standard grease gun and lube fitting as instructed on Page 4.

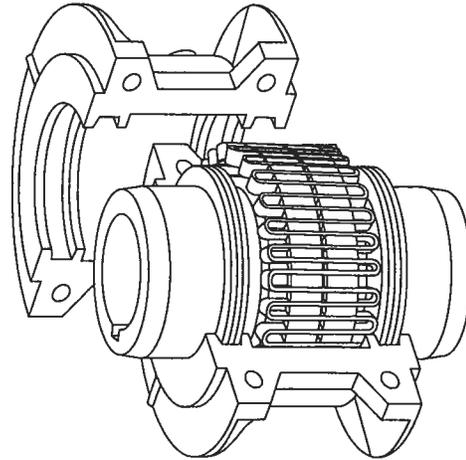
## LIMITED END FLOAT

When electric motors, generators, engines, compressors and other machines are fitted with sleeve or straight roller bearings, limited axial end float kits are recommended for protecting the bearings. Falk Steelflex couplings are easily modified to limit end float; refer to Manual 428-820 for instructions.

## LUBRICATION

Adequate lubrication is essential for satisfactory operation. Page 2 provides a list of typical lubricants and specifications for general purpose and long term greases. Because of its

## TYPE T10 STEELFLEX COUPLING



superior lubricating characteristics and low centrifuge properties, Falk Long Term Grease (LTG) is highly recommended. Sizes 1020T to 1090T10 are furnished with a pre-measured amount of grease for each coupling. The grease can be ordered for larger size couplings.

The use of general purpose grease requires re-lubrication of the coupling at least annually.

## Long Term Grease (LTG)

The high centrifugal forces encountered in couplings separate the base oil and thickener of general purpose greases. Heavy thickener, which has no lubrication qualities, accumulates in the grid-groove area of Steelflex couplings resulting in premature hub or grid failure unless periodic lubrication cycles are maintained.

Falk Long Term Grease (LTG) was developed specifically for couplings. It resists separation of the oil and thickener. The consistency of Falk LTG changes with operating conditions. As manufactured it is an NLGI #1/2 grade. Working of the lubricant under actual service conditions causes it to become semifluid while the grease near the seals will set to a heavier grade, helping to prevent leakage.

LTG is highly resistant to separation, easily out performing all other lubricants tested. The resistance to separation allows the lubricant to be used for relatively long periods of time.

- Steelflex couplings initially lubricated with LTG will not require re-lubrication until the connected equipment is stopped for servicing. If a coupling leaks grease, is exposed to extreme temperatures, excessive moisture, or experiences frequent reversals, more frequent lubrication may be required.

Although LTG grease is compatible with most other coupling greases, the mixing of greases may dilute the benefits of LTG.

## USDA Approval

LTG has the United States Department of Agriculture Food Safety & Inspection Service approval for applications where there is no possibility of contact with edible products. (H-2 ratings).

**CAUTION:** Do not use LTG in bearings.

### Specifications — Falk LTG

The values shown are typical and slight variations are permissible.

AMBIENT TEMPERATURE RANGE — -20°F (-29°C) to 250°F (121°C). Min. Pump = 20° F (-7° C).

MINIMUM BASE OIL VISCOSITY — 3300SSU (715cST) @ 100°F (38°C).

THICKENER — Lithium & soap/polymer.

CENTRIFUGE SEPARATION CHARACTERISTICS — ASTM #D4425 (Centrifuge Test) — K36 = 2/24 max., very high resistance to centrifuging.

NLGI GRADE (ASTM D-217) — 1/2

CONSISTENCY (ASTM D-217) — 60 stroke worked penetration value in the range of 315 to 360 measured at 77°F (25°C)

MINIMUM DROPPING POINT — 350°F (177°C) minimum

MINIMUM TIMKEN O.K. LOAD — 40 lbs.

ADDITIVES — Rust and oxidation inhibitors that do not corrode steel or swell or deteriorate synthetic seals.

### Packaging

14 oz. (0,4 kg ) CARTRIDGES — Individual or case lots of 10 or 30.

35 lb. (16 kg )PAIL, 120 lb. (54 kg ) KEG & 400 lb. (181 kg) DRUMS.

### General Purpose Grease

Annual Lubrication — The following specifications and lubricants for general purpose grease apply to Falk Steelflex couplings that are lubricated annually and operate within ambient temperatures of 0°F to 150°F (-18°C to 66°C). For temperatures beyond this range (see Table 1), consult the Factory.

If a coupling leaks grease, is exposed to extreme temperatures, excessive moisture or experiences frequent reversals, more frequent lubrication may be required.

### Specifications — General Purpose Coupling Lubricants

The values shown are typical and slight variations are permissible.

DROPPING POINT — 300°F (149°C) or higher.

CONSISTENCY — NLGI No. 2 with 60 stroke worked penetration value in the range of 250 to 300.

SEPARATION AND RESISTANCE — Low oil separation rate and high resistance to separation from centrifuging.

LIQUID CONSTITUENT — Possess good lubricating properties equivalent to a high quality, well refined petroleum oil.

INACTIVE — Must not corrode steel or cause swelling or deterioration of synthetic seals.

CLEAN — Free from foreign inclusions.

### General Purpose Greases Meeting Falk Specifications

Lubricants listed below are typical products only and should not be construed as exclusive recommendations.

TABLE 1 — General Purpose Greases <sup>H</sup>

Ambient Temperature Range	0°F to 150°F (-18°C to 66°C)	-30°F to 100°F (-34°C to 38°C)
Manufacturer	Lubricant †	Lubricant †
Amaco Oil Co.	Amolith Grease #2	Amolith Grease #2
BP Oil Co.	Energrease LS-EP2	Energrease LS-EP1
Chevron U.S.A. Inc.	Duro-Lith EP2	Duro-Lith EP1
Citgo Petroleum Corp.	Premium Lithium Grease EP2	Premium Lithium Grease EP1
Conoco Inc.	EP Conolith Grease #2	EP Conolith Grease #2
Exxon Company, USA	Unirex EP2	Unirex EP2
E.F. Houghton & Co.	Cosmolube 2	Cosmolube 1
Imperial Oil Ltd.	Unirex EP2	Unirex EP2
Kendall Refining Co.	Lithium Grease L421	Lithium Grease L421
Keystone Div. (Pennwalt)	81 EP-2	81 EP-1
Lyondell Petrochemical (ARCO)	Litholine H EP 2 Grease	Litholine H EP 2 Grease
Mobil Oil Corp.	Mobilux EP111	Mobilith AW1
Petra-Canada Products	Multipurpose EP2	Multipurpose EP1
Phillips 66 Co.	Philube Blue EP	Philube Blue EP
Shell Oil Co.	Alvania Grease 2	Alvania Grease 2
Shell Canada Ltd.	Alvania Grease 2	Alvania Grease 2
Sun Oil Co.	Ultra Prestige 2EP	Ultra Prestige 2EP
Texaco Lubricants	Starplex HD2	Multifok EP2
Unocal 76 (East & West)	Unoba EP2	Unoba EP2
Valvoline Oil Co.	Multilube Lithium EP Grease	...

\* Grease application or re-lubrication should be done at temperatures above 20°F (-7°C). If grease must be applied below 20°F (-7°C), consult The Falk Corporation.

† Lubricants listed may not be suitable for use in the food processing industry; check with lube manufacturer for approved lubricants.

### INSTALLATION OF TYPE T10 STEELFLEX TAPERED GRID COUPLINGS

#### Installation

Only standard mechanics tools, wrenches, a straight edge and feeler gauges are required to install Falk Steelflex couplings. Coupling Sizes 1020T thru 1090T are generally furnished for CLEARANCE FIT with setscrew over the keyway. Sizes 1100T and larger are furnished for an INTERFERENCE FIT without a setscrew.

CLEARANCE FIT HUBS — Clean all parts using a non-flammable solvent. Check hubs, shafts and keyways for burrs. Do not heat clearance fit hubs. Install keys, mount hubs with flange face flush with shaft ends or as otherwise specified and tighten setscrews.

INTERFERENCE FIT HUBS — Furnished without setscrews. Heat hubs to a maximum of 275°F (135°C) using an oven, torch, induction heater or an oil bath. To prevent seal damage, DO NOT heat hubs beyond a maximum temperature of 400°F (205°C).

When an oxy-acetylene or blow torch is used, use an excess acetylene mixture. Mark hubs near the center of their length in several places on hub body with a temperature sensitive crayon, 275°F (135°C) melt temperature. Direct flame towards hub bore using constant motion to avoid overheating an area.

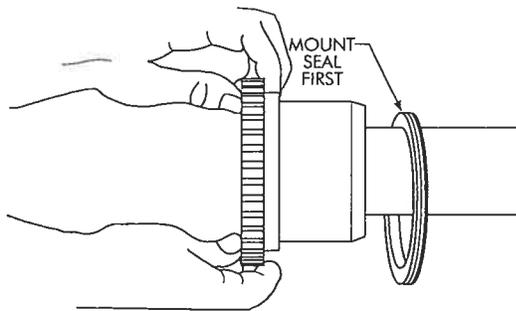
**WARNING:** If an oil bath is used, the oil must have a flash point of 350°F (177°C) or higher. Do not rest hubs on the bottom of the container. Do not use an open flame in a combustible atmosphere or near combustible materials.

Heat hubs as instructed above. Mount hubs as quickly as possible with hub face flush with shaft end. Allow hubs to cool before proceeding. Insert setscrews (if required) and tighten.

**Maximize Performance And Life**

The performance and life of couplings depend largely upon how you install and maintain them. Before installing couplings, make certain that foundations of equipment to be connected meet manufacturers' requirements. Check for soft foot. The use of stainless steel shims is recommended. Measuring misalignment and positioning equipment within alignment tolerances is simplified with an alignment computer. These calculations can also be done graphically or mathematically.

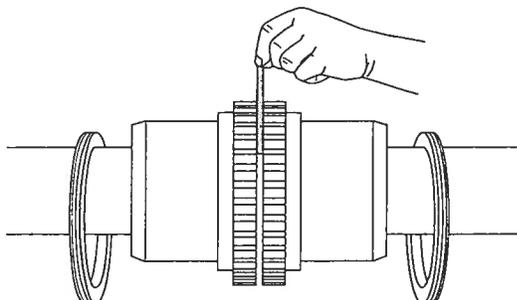
Alignment is shown using spacer bar and straight edge. This practice has proven to be adequate for many industrial applications. However, for superior final alignment, the use of dial indicators (see Manual 458-834 for instructions), lasers, alignment computers or graphical analysis is recommended.



**1 — Mount Seals And Hubs**

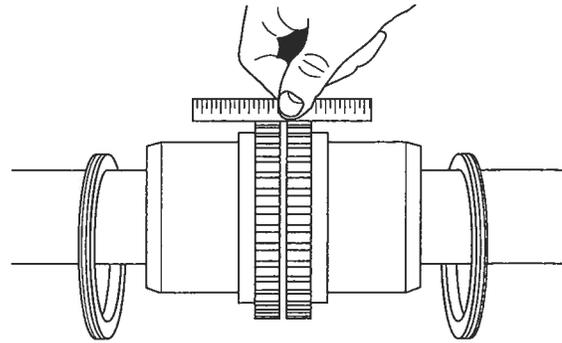
Lock out starting switch of prime mover. Clean all metal parts using a non-flammable solvent. Lightly coat seals with grease and place on shafts BEFORE mounting hubs. Heat interference fit hubs as previously instructed. Seal keyways to prevent leakage. Mount hubs on their respective shafts so the hub face is flush with the end of its shaft unless otherwise indicated. Tighten setscrews when furnished.

**2 — Gap and Angular Alignment**



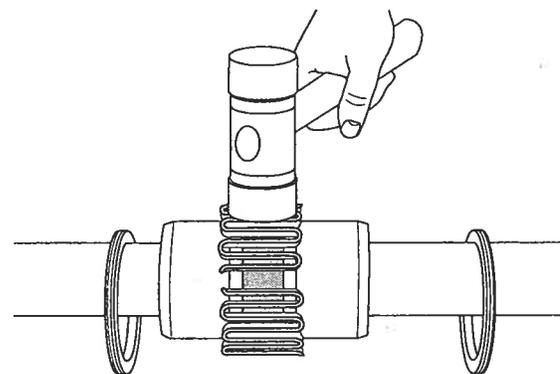
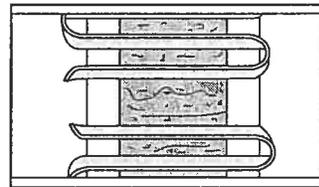
Use a spacer bar equal in thickness to the gap specified in Table 2, Page 5. Insert bar as shown below left, to same depth at 90° intervals and measure clearance between bar and hub face with feelers. The difference in minimum and maximum measurements must not exceed the ANGULAR installation limits specified in Table 2.

**3 — Offset Alignment**



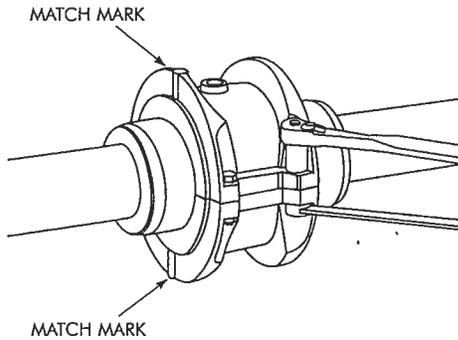
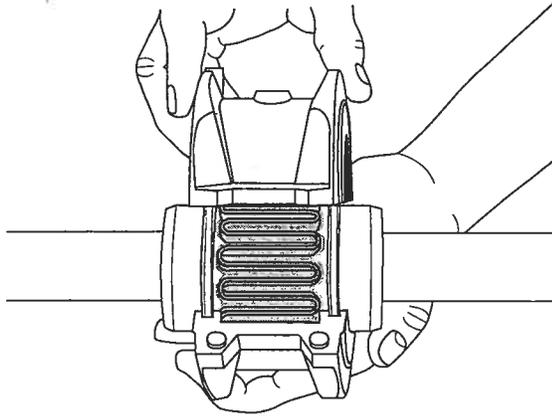
Align so that a straight edge rests squarely (or within the limits specified in Table 2) on both hubs as shown above and also at 90° intervals. Check with feelers. The clearance must not exceed the PARALLEL OFFSET installation limits specified in Table 2. Tighten all foundation bolts and repeat Steps 2 and 3. Realign coupling if necessary.

**4 — Insert Grid**

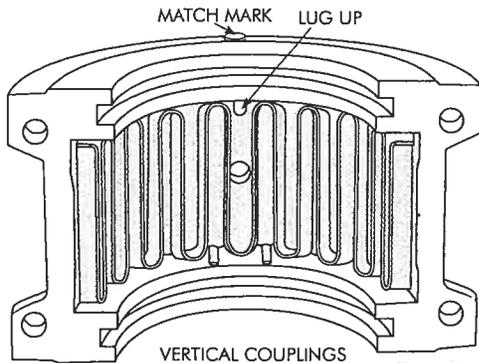


Pack gap and grooves with specified lubricant before inserting grid. When grids are furnished in two or more segments, install them so that all cut ends extend in the same direction (as detailed in the exploded view picture above); this will assure correct grid contact with non-rotating pin in cover halves. Spread the grid slightly to pass over the coupling teeth and seat with a soft mallet.

5 — Pack With Grease And Assemble Covers



Pack the spaces between and around the grid with as much lubricant as possible and wipe off excess flush with top of grid. Position seals on hubs to line up with grooves in cover. Position gaskets on flange of lower cover half and assemble covers so that the match marks are on the same side (see above). If shafts are not level (horizontal) or coupling is to be used vertically, assemble cover halves with the lug and match



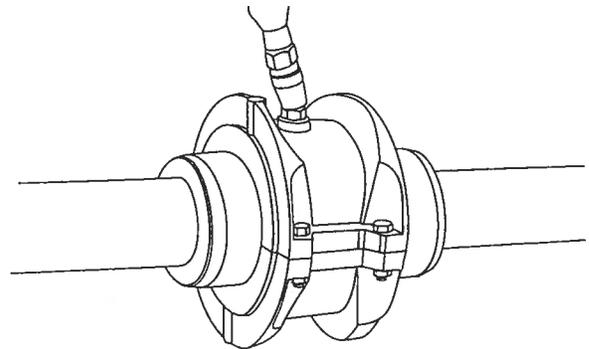
mark UP or on the high side. Push gaskets in until they stop against the seals and secure cover halves with fasteners, tighten to torque specified in Table 2. Make sure gaskets stay in position during tightening of fasteners. **CAUTION:** Make certain lube plugs are installed before operating.

ANNUAL MAINTENANCE

For extreme or unusual operating conditions, check coupling more frequently.

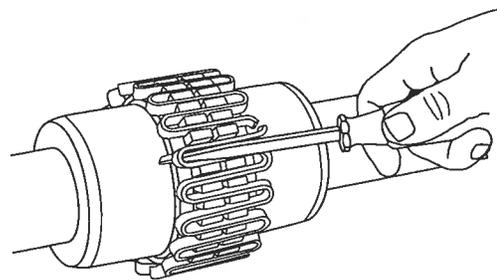
1. Check alignment per steps on Page 3. If the maximum operating misalignment limits are exceeded, realign the coupling to the recommended installation limits. See Table 2 for installation and operating alignment limits.
2. Check tightening torques of all fasteners.
3. Inspect seal ring and gasket to determine if replacement is required. If leaking grease, replace.
4. When connected equipment is serviced, disassemble the coupling and inspect for wear. Replace worn parts. Clean grease from coupling and repack with new grease. Install coupling using new gasket as instructed in this manual.

Periodic Lubrication



The required frequency of lubrication is directly related to the type of lubricant chosen, and the operating conditions. Steelflex couplings lubricated with common industrial lubricants, such as those shown in Table 1, should be relubed annually. The use of Falk Long Term Grease (LTG) will allow relube intervals to be extended to beyond five years. When relubing, remove both lube plugs and insert lube fitting. Fill with recommended lubricant until an excess appears at the opposite hole. **CAUTION:** Make certain all plugs have been inserted after lubricating.

Coupling Disassembly And Grid Removal



Whenever it is necessary to disconnect the coupling, remove the cover halves and grid. A round rod or screwdriver that will conveniently fit into the open loop ends of the grid is required. Begin at the open end of the grid section and insert the rod or screwdriver into the loop ends. Use the teeth adjacent to each loop as a fulcrum and pry the grid out radially in even, gradual stages, proceeding alternately from side to side.

**TYPE T COUPLING INSTALLATION & ALIGNMENT DATA**

Maximum life and minimum maintenance for the coupling and connected machinery will result if couplings are accurately aligned. Coupling life expectancy between initial alignment and maximum operating limits is a function of load, speed and lubrication. Maximum operating values listed in Table 2 are based on cataloged allowable rpm.

Values listed are based upon the use of the gaps listed, standard coupling components, standard assemblies and cataloged allowable speeds.

Values may be combined for an installation or operating condition.

Example: 1060T max. operating misalignment is .016" parallel plus .018" angular.

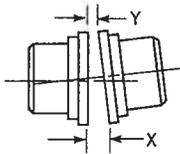
NOTE: For applications requiring greater misalignment, refer application details to Falk.

Angular misalignment is dimension X minus Y as illustrated below.

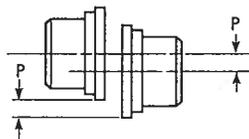
Parallel misalignment is distance P between the hub center lines as illustrated below.

End float (with zero angular and parallel misalignment) is the axial movement of the hubs(s) within the cover(s) measured from "O" gap.

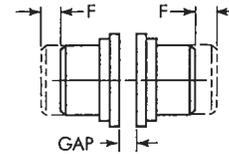
ANGULAR MISALIGNMENT



PARALLEL OFFSET MISALIGNMENT



END FLOAT



**TABLE 2 — Misalignment & End Float**

SIZE	Installation Limits						Operating Limits						Cover Fastener Tightening Torque Values Inch or Metric Series Fasteners		Allow Speed (rpm)	Lube Wt	
	Parallel Offset-P		Angular (x-y)		Hub Gap 10%		Parallel Offset-P		Angular (x-y)		End Float Physical Limit (Min) 2 x F		(lb-in)	(Nm)		lb	kg
	Max Inch	Max mm	Max Inch	Max mm	Inch	mm	Max Inch	Max mm	Max Inch	Max mm	Inch	mm					
1020T	.006	0,15	.003	0,08	.125	3	.012	0,30	.010	0,25	.210	5,33	100	11,3	4500	.06	0,03
1030T	.006	0,15	.003	0,08	.125	3	.012	0,30	.012	0,30	.198	5,03	100	11,3	4500	.09	0,04
1040T	.006	0,15	.003	0,08	.125	3	.012	0,30	.013	0,33	.211	5,36	100	11,3	4500	.12	0,05
1050T	.008	0,20	.004	0,10	.125	3	.016	0,41	.016	0,41	.212	5,38	200	22,6	4500	.15	0,07
1060T	.008	0,20	.005	0,13	.125	3	.016	0,41	.018	0,46	.258	6,55	200	22,6	4350	.19	0,09
1070T	.008	0,20	.005	0,13	.125	3	.016	0,41	.020	0,51	.259	6,58	200	22,6	4125	.25	0,11
1080T	.008	0,20	.006	0,15	.125	3	.016	0,41	.024	0,61	.288	7,32	200	22,6	3600	.38	0,17
1090T	.008	0,20	.007	0,18	.125	3	.016	0,41	.028	0,71	.286	7,26	200	22,6	3600	.56	0,25
1100T	.010	0,25	.008	0,20	.188	5	.020	0,51	.033	0,84	.429	10,90	312	35	2440	.94	0,43
1110T	.010	0,25	.009	0,23	.188	5	.020	0,51	.036	0,91	.429	10,90	312	35	2250	1.1	0,51
1120T	.011	0,28	.010	0,25	.250	6	.022	0,56	.040	1,02	.556	14,12	650	73	2025	1.6	0,74
1130T	.011	0,28	.012	0,30	.250	6	.022	0,56	.047	1,19	.551	14,00	650	73	1800	2.0	0,91
1140T	.011	0,28	.013	0,33	.250	6	.022	0,56	.053	1,35	.571	14,50	650	73	1650	2.5	1,14

**TABLE 3 — Coupling Cover Fastener Identification**

SIZE	Inch Series Fasteners				METRIC FASTENERS	
	Old Style		New Style			
1020-1070T10		SAE Grade 8 ★		SAE Grade 8		Property Class 10.9
1080-1090T10		SAE Grade 8		SAE Grade 8		Property Class 10.9
1100-1140T10		SAE Grade 5		SAE Grade 5		Property Class 8.8

★ Older style covers, Sizes 1020T10 thru 1070T10 must utilize socket head cap screws and locknuts held by the cover.

**PARTS IDENTIFICATION**

All coupling parts have identifying part numbers as shown below. Parts 3 and 4 (Hubs and Grids), are the same for both Type T10 and T20 couplings. All other coupling parts are unique to Type T10. When ordering parts, always SPECIFY SIZE and TYPE shown on the COVER.

**PARTS INTERCHANGEABILITY**

Parts are interchangeable between Sizes 20T and 1020T, 30T and 1030T, etc. except as noted.

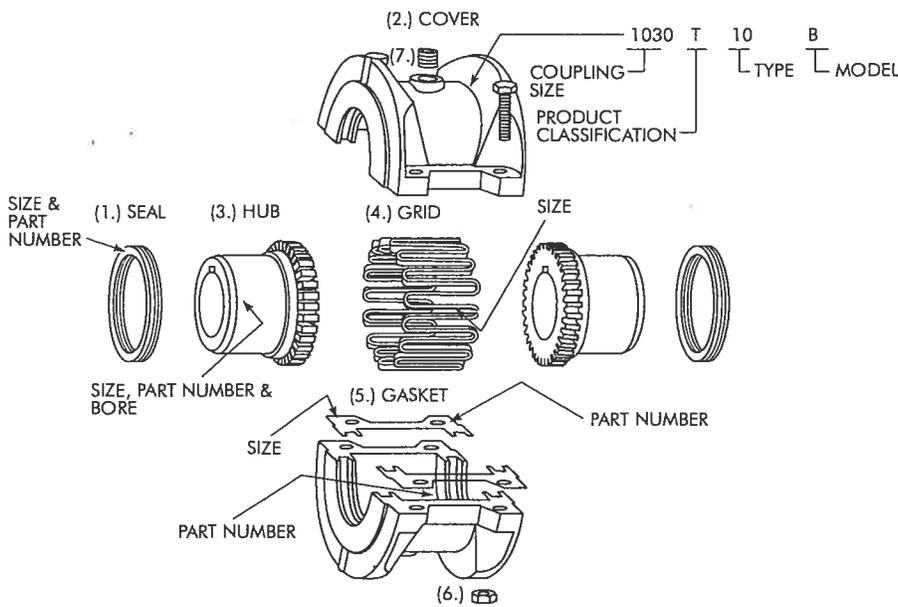
**GRIDS** — Size 1020T thru 1140T Steelflex couplings use blue or non-painted grids. Older models, 20T thru 140T, use orange grids.

**CAUTION:** Blue or non-pointed grids may be used in all applications, but **DO NOT** substitute orange grids for blue or nonpointed.

**COVERS** — **CAUTION:** **DO NOT** mix cover halves of different designs. Sizes 1020T thru 1070T10 covers have been manufactured in several different two-rib designs and 80T thru 140T covers have been manufactured with two and three ribs.

**HARDWARE** — Older style covers, Sizes 1020T10 thru 1070T10, utilized socket head cap screws with captured locknuts. The new style covers use hex head cap screws (either inch or metric from year 1994 through 2003 and only Metric beginning in 2004). Specify the style cover when ordering replacement parts.

**PART NUMBER LOCATION**



**PART DESCRIPTION**

1. Seal (T10)
2. Cover (T10)
3. Hub (Specify bore and keyway)
4. Grid
5. Gasket (T10)
6. Metric Fasteners (T10).
7. Lube Plug

**ORDER INFORMATION**

1. Identify part(s) required by name above.
2. Furnish the following information.

**EXAMPLE:**

Coupling Size: 1030  
Coupling Type: T10  
Model: B  
Bore: 1.375  
Keyway: .375 x .187

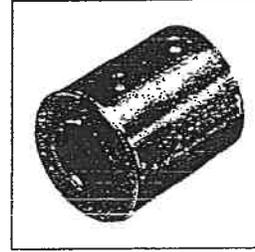
3. Contact your Falk Distributor or Falk for price and availability.

# Specialty Couplings

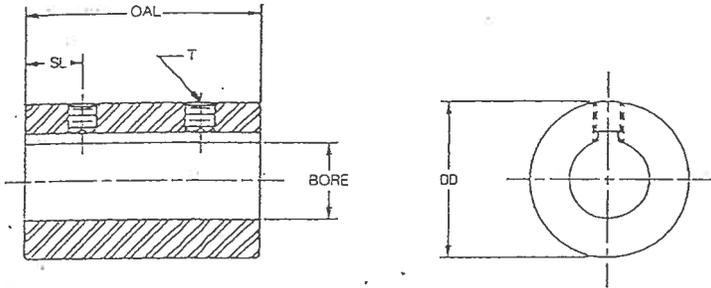


## Rigid Sleeve Couplings

Lovejoy Rigid Sleeve couplings fit the standards of the industry. These couplings, the simplest type, provide a fixed union between two shafts which are precisely aligned. They are suitable for use in joining any two shafts when flexibility is not required, shaft alignment is maintained and proper bearing support is provided. The rigid sleeve couplings come with a black oxide finish.



RIGID SLEEVE COUPLING



### Rigid Sleeve Couplings Dimensional Data

Size	Item (UPC) No.	OD in	OAL in	SL in	Set Screw T in	Bore	
						in	mm
SC-250	14322	0.50	0.75	0.19	8-32 x 1/8	0.25*	6.4*
SC-312	14324	0.62	1.00	0.25	8-32 x 1/8	0.31*	7.9*
SC-375	14326	0.75	1.00	0.25	10-24 x 3/16	0.38*	9.5*
SC-500	14330	1.00	1.50	0.38	1/4-20 x 3/16	0.50	12
SC-625	14332	1.25	2.00	0.50	5/16-18 x 1/4	0.62	15
SC-750	14335	1.50	2.00	0.50	5/16-18 x 3/16	0.75	17
SC-875	14338	1.75	2.00	0.50	5/16-18 x 3/16	0.88	20
SC-1000	14343	2.00	3.00	0.75	3/8-16 x 3/8	1.00	24
SC-1125	14346	2.12	3.00	0.75	3/8-16 x 3/8	1.12	27
SC-1250	14349	2.25	4.00	1.00	3/8-16 x 3/8	1.25	30
SC-1375	14352	2.50	4.50	1.00	3/8-16 x 3/8	1.38	35

Note: \* indicates that these sizes do not have keyways

***Floating Shaft Couplers (qty. 8) (400 E5 09)***

The floating shaft couplers are Falk Lifelign Gear Couplings, Type G51, Size 1035. The floating shaft couplers are used to connect the primary reducer to the floating shaft and the floating shaft to the secondary reducer. These couplers are located under the guards at each end of the floating shaft.

JCM # 400 E5 09

**How To Use This Manual**

This manual provides detailed instructions on installation, maintenance, and parts identification for Falk Lifelign® gear couplings, Types G & GF10, 20, 31, 32, 51, 52, & GP20 & GP52. Use the table of contents below to locate required information.

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 Lubrication . . . . . Pages 1-2  
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 Bi-Annual & Annual Maintenance . . . . . Page 3  
 Installation & Alignment Instructions . . . . . Pages 3-6 & 7  
 Installation & Alignment Data . . . . . Page 6  
 Ports Identification & Parts Interchangeability . . . . . Page 7-8

**CAREFULLY FOLLOW THE INSTRUCTIONS IN THIS MANUAL FOR OPTIMUM PERFORMANCE AND TROUBLE FREE SERVICE.**

**INTRODUCTION**

This manual applies to standard coupling Types G & GF10, 31 and 51 with shrouded bolts, and G & GF20, 32, 52, and GP20 & GP52 with exposed bolts. For couplings furnished with special features, refer to assembly drawing furnished with coupling for proper assembly arrangement and any additional installation or maintenance requirements. Refer to the specific manuals for GV vertical gear couplings installation and maintenance.

**IMPORTANT:** Use G/GF51 & 52 couplings for floating shaft assemblies or as the fourth bearing in three bearing systems. When gear couplings are mounted on a horizontal floating shaft, use a gap disc in each coupling. Where limited end float is required or where sleeve bearing motors are used, consult Falk. Type GP52 couplings are recommended for horizontal application only. Refer Type GP52 floating shaft applications to Falk.

**CAUTION:** Consult applicable local and national safety codes for proper guarding of rotating members. Observe all safety rules when installing or servicing couplings.

**WARNING:** Lockout starting switch of prime mover and remove all external loads from drive before installing or servicing couplings.

**LUBE FITTINGS**

Sleeves have 1/8" NPT lube holes for sizes 1010G20 - 1035G20, 1GF20 - 7GF20, 1025G10 - 1035G10, and 2 1/2 GF10 - 5 1/2 GF10. (Sizes 1010G10 - 1020G10 and 1GF10 - 2GF10 use 1/4"-28 SAE LT automotive plugs and fittings.) Sizes 1040G thru 1070G have 1/4" NPT holes. Use a standard grease gun and lube fittings.

**LIMITED END FLOAT**

Where limited end float is required or where sleeve bearing motors are used, consult Falk.

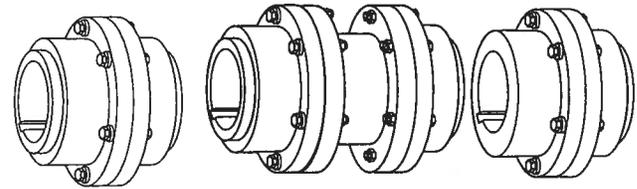
**LUBRICATION**

Adequate lubrication is essential for satisfactory operation. Because of its superior lubricating characteristics and low centrifuge properties, Falk Long Term Grease (LTG) is

Type G/GP/GF20

Type G/GF32

Type G/GP/GF52



1000G Series Pictured

highly recommended.

Gear couplings initially lubricated with Falk Long Term Grease (LTG) will not require re-lubrication for up to three years.

The use of general purpose grease requires re-lubrication of the coupling at least once every six months. If coupling leaks grease, is exposed to extreme temperatures, excessive moisture, experiences frequent reversals or axial movements; more frequent lubrication may be required.

**USDA Approval**

LTG has the United States Department of Agriculture Food Safety & Inspection Service approval for applications where there is a possibility of contact with edible products. (H-2 ratings.)

**Long Term Grease (LTG)**

The high centrifugal forces encountered in couplings separate the base oil and thickener of general purpose greases. Heavy thickener, which has no lubrication qualities, accumulates in the tooth mesh area of gear couplings resulting in premature mesh failure unless periodic lubrication cycles are maintained.

Falk Long Term Grease (LTG) was developed specifically for couplings. It resists separation of the oil and thickener. The consistency of Falk LTG changes with operating conditions. As manufactured, it is an NLGI #1/2 grade. Working of the lubricant under actual service conditions causes it to become semifluid, while the grease near the seals will set to a heavier grade, helping to prevent leakage.

LTG is highly resistant to separation, easily out performing all other lubricants tested. The resistance to separation allows the lubricant to be used for relatively long periods of time.

Although LTG grease is compatible with most other coupling greases, the mixing of greases may dilute the benefits of LTG.

**CAUTION:** Do not use LTG in bearings. Do not use LTG for low speed applications. Refer to Table 4, Page 6 for coupling speed range of LTG grease.

**Packaging**

14 oz. (0,4 Kg) CARTRIDGES — Individual or case lots of 10 or 60.

35 lb. (16 Kg) PAILS, 120 lb. (54 Kg) KEG & 400 lb. DRUMS.

**Specifications — Falk LTG (Long Term Grease)**

TEMPERATURE RANGE — -20°F (-29°C) to 250°F (121°C).  
 Minimum pump = 20°F (-7°C).

MINIMUM BASE OIL VISCOSITY — 3300SSU (715cSt) @ 100°F (38°C).

THICKENER — Lithium soap/polymer.

**CENTRIFUGE SEPARATION CHARACTERISTICS** — ASTM #D4425-84 (Centrifuge Test) — K36 = 2/24 max., very high resistance to centrifuging.

**NLGI GRADE** (ASTM D-217) — 1/2

**CONSISTENCY** (ASTM D-217) — 60 stroke worked penetration value in the range of 315 to 360 measured @ 77°F (25°C).

**DROPPING POINT** — 350°F (177°C) minimum.

**MINIMUM TIMKEN EP O.K. LOAD** — 40 lb. (18 kg).

**ADDITIVES** — Rust and oxidation inhibitors that do not corrode steel or swell or deteriorate synthetic seals.

**General Purpose Grease**

**Bi-annual Lubrication** — The following specifications and lubricants for general purpose grease apply to Falk gear couplings that are lubricated bi-annually and operate within ambient temperatures of -30°F (-34°C) to 200°F (93°C). For temperatures beyond this range, consult Falk. For normal service, use a NLGI #1 extreme pressure (EP) grease EXCEPT when the coupling speed is less than the minimum specified in Table 4, Page 6. At these lower speeds, use a NLGI #0 extreme pressure (EP) grease. When one or more gear couplings in an application require NLGI #0 grease, the same grease may be used in all of the couplings. DO NOT use cup grease.

If coupling leaks grease, is exposed to extreme temperatures, excessive moisture or experiences frequent reversals or axial movements; more frequent lubrication may be required.

Lubricants listed in Tables 1, 2 & 3 are typical products only and should not be construed as exclusive recommendations.

**Specifications — General Purpose Coupling Lubricants**

**COUPLING SPEED RANGE** — See Table 4, Page 6.

**TEMPERATURE RANGE** — -30°F to +200°F (-34°C to +93°C)

**WORKED PENETRATION AT 77°F(25°C)** —

NLGI #1 . . . . . 310-340 (See Table 1)

NLGI #0 . . . . . 355-385 (See Table 2)

**DROPPING POINT** — 300°F(149°C) or higher

**TEXTURE** — Smooth or fibrous

**MINIMUM TIMKEN O.K. LOAD** — 30 lb.

**SEPARATION AND RESISTANCE** — Low oil separation rate and high resistance to separation from centrifuging.

**LIQUID CONSTITUENT** — Possess good lubricating properties . . . equivalent to a high quality, well refined petroleum oil with EP additives.

**INACTIVE** — Must not corrode steel or cause swelling or deterioration of synthetic seals.

**Oil Lubrication**

EP oils may be a more effective lubricant than grease when the required coupling speed is one half of the minimum speed range of NLGI #1 grease listed in Table 4, Page 6 (Minimum rpm = 2). Oil lubricated couplings must be sealed to prevent leakage, i.e. keyways, etc. Couplings must be drained and refilled with new oil every six months for operating temperatures up to 160°F (71°C) and every three months for couplings operating at temperatures of 160°F (71°C) up to 200°F (93°C).

For temperatures beyond this range, consult Falk. The minimum operating temperature must not be lower than the pour point of the oil. The specified amount of grease listed in Table 4, Page 6, is in pounds and also applies to the volume of oil in pints.

**Specifications**

**Type:** Mild EP gear oil that meets AGMA Specifications 250.04.

**Grade:** AGMA #8EP (ISO VG 680).

**Viscosity:** 612-748 cSt @ 104°F (40°C).

**Pour Point:** 20°F (-7°C) Maximum.

Must not corrode steel or swell or deteriorate synthetic seals.

**TABLE 1 — NLGI #1 Grease**

Manufacturer	Lubricant *
Amoco Oil Co.	Rykon Grease #1 EP
BP Oil Co.	Energrease LS-EP1
Chevron U.S.A., Inc.	Dura-Lith EP1
Citgo Petroleum Corp	Premium Lithium Grease EP1
Conoco Inc.	EP Conolith Grease #1
Exxon Company, U.S.A.	Lidok EP1
Imperial Oil Ltd.	Ronex EP1
Kendall Refining Co.	Lithium Grease L-416
Keystone Div., Pennwalt Corp.	Zeniplex-1
Lyondell Lubricants	Litholine Complex EP1
Mobil Oil Corp.	Mobilux EP1
Petro-Canada Products	Multipurpose EP1
Phillips 66 Co.	Philube Blue EP
Shell Oil Co.	Alvania EP Grease 1
Shell Canada Ltd.	Alvania Grease EP1
Sun Oil Co.	Sun Prestige 741 EP
Texaco Lubricants	Multifok EP1
Unocal 76 (East & West)	Unoba EP1

**TABLE 2 — NLGI #0 EP Grease**

Manufacturer	Lubricant *
Amoco Oil Co.	Rykon Premium Grease 0 EP
BP Oil Co.	Energrease LS-EP 0
Chevron U.S.A., Inc.	Dura-Lith EP 0
Citgo Petroleum Corp	Premium Lithium Grease EP 0
Conoco Inc.	EP Conolith Grease #0
Imperial Oil Ltd.	Unirex EP0
Exxon Company, U.S.A.	Lidok EP 0
Kendall Refining Co.	Lithium Grease L-406
Keystone Div., Pennwalt Corp.	Zeniplex-0
Mobil Oil Corp.	Mobilux EP 0
Petro-Canada Products	Multipurpose Lotemp EP Grease
Phillips 66 Co.	Philube Blue EP
Shell Oil Co.	Alvania EP Grease RO
Shell Canada Ltd.	Alvania Grease EPW
Sun Oil Co.	Sun Prestige 740 EP
Texaco Lubricants	Multifok EP 0
Unocal 76 (East & West)	Unoba EP 0

**TABLE 3 — Oil Lubricants**

Manufacturer	Lubricant *
Amoco	Permagear EP 160
Chevron, U.S.A.	NL Gear Compound 680
Exxon Co., U.S.A.	Sparton EP680
Gulf Oil Co.	EP Lubricant HD 680
Mobil Oil Co.	Mobilgear 636
Shell Oil Co.	Omola Oil 680
Texaco Inc.	Meropa 680
Union Oil Co. of Calif.	Extra Duty NL Gear Lube 8EP

\* Lubricants listed may not be suitable for use in the food processing industry; check with lube manufacturer for approved lubricants.

## HORIZONTAL COUPLING INSTALLATION, ALL TYPES

Only standard mechanics tools, torque wrenches, inside micrometer, dial indicator, straight edge, spacer bar, and feeler gauges are required to install Falk gear couplings. Clean all parts using a non-flammable solvent. Check hubs, shafts, and keyways for burrs. DO NOT heat clearance fit hubs. Use a lubricant that meets the specifications on Page 2. Pack sleeve teeth with grease and lightly coat seals with grease BEFORE assembly. The required amount of grease is listed in Table 4. Make certain flange fasteners are tightened to the required torque listed in Table 4.

**Interference Fit Hubs** — Unless otherwise specified, Falk gear couplings are furnished for an interference fit without setscrews. Heat hubs to 275°F (135°C) using an oven, torch, induction heater, or an oil bath.

**CAUTION:** To prevent seal damage DO NOT heat hubs beyond a maximum temperature of 400°F (205°C) for Type G and 500°F (260°C) for Type GF.

When an oxy-acetylene or blow torch is used, use an excess acetylene mixture. Mark hubs near the center of their length in several places on hub body with a temperature sensitive crayon, 275°F (135°C) melt temperature. Direct flame towards hub bore using constant motion to avoid overheating an area.

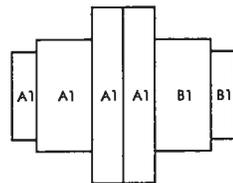
**WARNING:** If an oil bath is used, the oil must have a flash point of 350°F (177°C) or higher. Do not rest hubs on the bottom of the container. Do not use an open flame in a combustible atmosphere or near combustible materials.

## Maximize Performance & Life

The performance and life of couplings depend largely upon how you install and maintain them. Before installing couplings, make certain that foundations of equipment to be connected meet manufacturers' requirements. Check for soft foot. The use of stainless steel shims is recommended. Measuring misalignment and positioning equipment within alignment tolerances is simplified with an alignment computer. These calculations can also be done graphically or mathematically, and allow the incorporation of "cold offsets", which will compensate for shaft position changes due to thermal growth.

## Balanced Couplings

The fasteners provided are matched sets and must not be mixed or substituted. Assembly balanced couplings are match marked and must be assembled with mating match marks aligned. In some sizes, the flanges are not match marked. Coupling flanges must be assembled with O.D.'s aligned to within .002" (0.05 mm). Component parts of assembly balanced couplings must not be replaced without re-balancing the complete assembly.



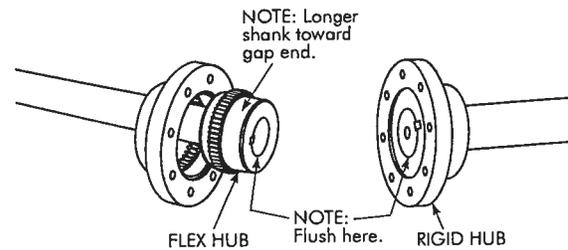
## BI-ANNUAL MAINTENANCE

Re-lubricate coupling if using general purpose grease. If coupling leaks grease, is exposed to extreme temperatures, excessive moisture or frequent reversals; more frequent lubrication may be required.

## ANNUAL MAINTENANCE

For extreme or unusual operating conditions, check coupling more frequently.

1. Check alignment per Step 7, Page 7. If the maximum operating misalignment values are exceeded, realign the coupling to the recommended installation values. See Table 4, for installation and maximum operating misalignment values.
2. Check tightening torques of all fasteners.
3. Inspect seal ring and gasket to determine if replacement is required.
4. Re-lubricate coupling if using general purpose grease.



## ALL TYPES G/GF/GP HORIZONTAL COUPLING INSTALLATION

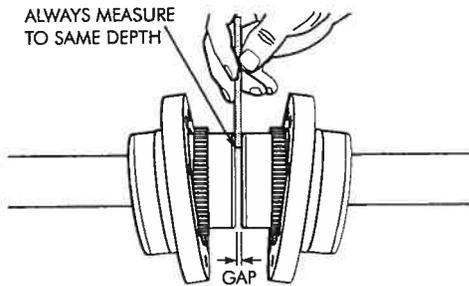
### 1 — Mount Flanged Sleeves, Seals & Hubs

Place the flanged sleeves WITH seal rings on shafts BEFORE mounting flex hubs. Mount flex or rigid hubs on their respective shafts, as shown above, so that each face is flush with the end of its shaft. Allow hubs to cool before proceeding. Seal keyways to prevent leakage. Insert setscrews (if required) and tighten. Position equipment in approximate alignment with approximate hub gap.

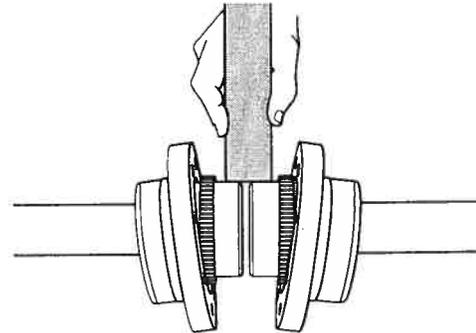
For Type G/GF10 & 20 and GP20, position equipment in approximate alignment with gap equal to that given in Table 4. For Type G/GF31 & 32 spacer and G/GF/GP51 & 52 floating shaft, with rigid hubs on floating shaft, position equipment in approximate alignment with approximate distance between shafts per Step 4A, Figure 2 on Page 5.

For G/GF/GP51 & 52 with flex hubs on the floating shaft, refer to Step 4A, Figure 1 on Page 5, to determine distance between shafts.

**2 — Gap & Angular Alignment for Close Coupled, Spacer, Short Floating Shaft, and Insulated Couplings**

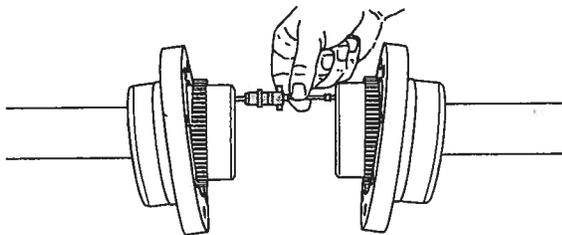


**3 — Offset Alignment for Close Coupled, Spacer, Short Floating Shaft, and Insulated Couplings**



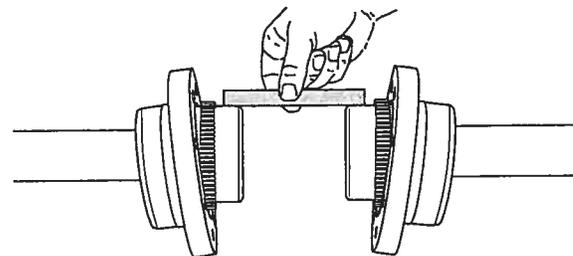
**2A — Type G/GF10 & 20 & GP20**

Use a spacer bar equal in thickness to gap specified in Table 4. Insert bar, as shown above, to same depth at 90° intervals and measure clearance between bar and hub face with feelers. The difference in minimum and maximum measurements must not exceed the INSTALLATION ANGULAR limit specified in Table 4.



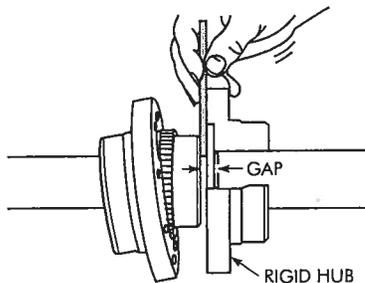
**3A — Type G/GF10 & 20 & GP20**

Align so that a straight edge rests squarely on both hubs as shown above and also at 90° intervals. Check with feelers. The clearance should not exceed the INSTALLATION OFFSET limit specified in Table 4. Tighten foundation bolts and repeat Steps 2A and 3A. Realign coupling if necessary. Use a dial indicator if hub extension is too short for accurate use of a straight edge.



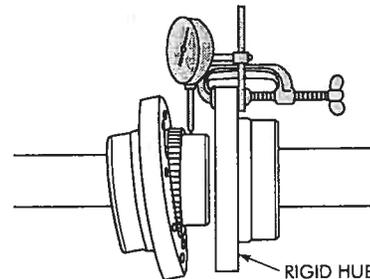
**2B — G/GF31 & 32 (Spacer), and Type G/GF51 & 52 (Short Floating Shaft, See Step 4 for Long Floating Shaft)**

Use an inside micrometer as shown above and at 90° intervals to measure the distance between hubs. The difference in minimum and maximum measurements should not exceed the INSTALLATION ANGULAR limit specified in Table 4.



**3B — Type G/GF31 & 32 (Spacer), and Type G/GF51 & 52 (Short Floating Shaft, See Step 4 for Long Floating Shaft)**

Align so that a straight edge rests squarely (or within the limits specified in Table 4) on both hubs as shown above and also at 90° intervals. Check with feelers. The clearance should not exceed the INSTALLATION OFFSET limit specified. Tighten all foundation bolts and repeat Steps 2B and 3B. Realign coupling if necessary.



**2C — G/GF51 & 52 & GP52 (As Fourth Bearing in Three Bearing System)**

Use a spacer bar equal in thickness to the "X" dimension specified in Table 4. Insert bar, as shown above to same depth at 90° intervals and measure clearance between bar and hub face with feelers. The difference in minimum and maximum measurements must not exceed the INSTALLATION ANGULAR limit specified in Table 4.

**3C — Type G/GF51 & 52 & GP52 (As Fourth Bearing in Three Bearing System)**

Clamp a dial indicator to the rigid hub as shown and rotate the rigid hub one complete turn. The total indicator reading DIVIDED by two must not exceed the INSTALLATION OFFSET limit specified in Table 4. Tighten all foundation bolts and repeat

specified in Table 4. Tighten all foundation bolts and repeat Steps 2C and 3C. Realign coupling if necessary.

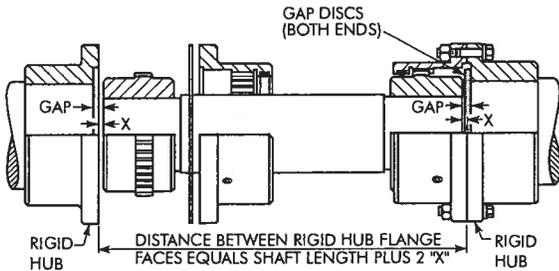


Figure 1

**4 — Type G/GF/GP51 & 52 With Long Floating Shaft**

**4A — Determine Distance Between Shafts**

For Figure 1 above, measure the length of the floating shaft

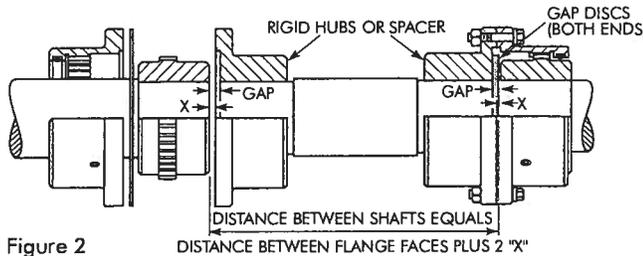


Figure 2

and add 2 times the gap dimension from Table 4 to get the distance between the shafts to be coupled.

For Figure 2 above, measure the overall floating shaft or spacer assembly length from flange to flange and add 2 times the "X" dimension from Table 4 to get the distance between the shafts to be coupled.

**4B — Position First Drive & Floating Shaft**

Set the drive most difficult to move to true level and bolt it in place. Set the floating shaft on V-blocks. Then align coupling on

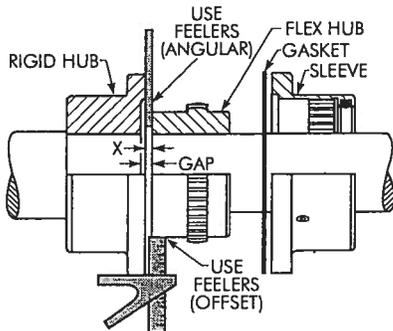


Figure 3

fixed drive as follows:

**4B1 — Refer to Figure 3**

Use a spacer bar equal in thickness to the "X" dimension specified in Table 4. Insert the bar to the same depth at 90° intervals and measure the clearance between the bar and hub face with feelers as shown. The difference in minimum and maximum measurements should not exceed the INSTALLATION

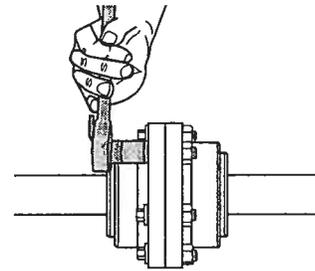
ANGULAR limit specified in Table 4.

**4B2 — Refer to Figure 3**

Align coupling & floating shaft so that, with the square head (or depth micrometer) resting squarely on the flange, equal clearance measurements are obtained between flange and the hub O.D. in four places 90° apart. The difference between minimum and maximum feeler readings should not exceed the INSTALLATION OFFSET limit in Table 4 divided by 2. The above measurement is TIR.

**4C — Position Second Drive**

Position second drive for the correct "X" dimension and align per Steps 4B1 & 4B2. DO NOT move the floating shaft. Bolt drive in place and recheck alignment and gap. Realign if necessary. For greater accuracy, check alignment with a depth micrometer or dial indicator.

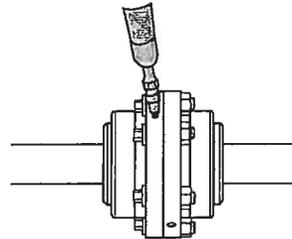


**5 — Assemble Coupling — G and GF Only**

Insert gasket between flanges and gap disc into counterbore of each rigid hub for floating shaft assemblies and bolt flanges together. Use only the fasteners furnished with the coupling. IMPORTANT: Tighten fasteners to torque specified in Table 4.

**5A — Assemble Coupling — Insert Insulator Parts and Join Flanged Sleeves (GP20 & GP52)**

Clean flange faces and coat with Permatex #2 or equivalent. DO NOT install gaskets. Insert insulator bushings into flanged holes. Draw one sleeve onto hub and position insulator center plate on flange face. Draw other sleeve onto hub and assemble fasteners with insulator washers. Use only fasteners furnished with coupling. IMPORTANT: Tighten fasteners to torque specified in Table 4.



**6 — Lubricate**

Remove all grease plugs and fill with recommended grease until an excess appears at an open hole; then insert plug. Continue procedure until all plugs have been inserted. **CAUTION:** Remove grease fitting and make certain all plugs are inserted after lubricating.

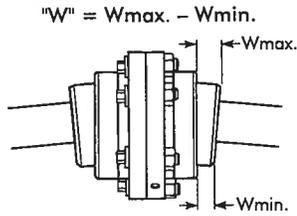
**TABLE 4 — Installation & Alignment Data For Types G/GF10, 20, 31, 32, 51, 52 & GP20 & GP52**  
★ — Dimensions — Inches (Metric — mm)

COUPLING SIZE			1010G 1GF	1015G 1-½GF	1020G 2GF	1025G 2-½GF	1030G 3GF	1035G 3-½GF	1040G 4GF	1045G 4-½GF	1050G 5GF	1055G 5-½GF	1060G 6GF	1070G 7GF	
Gap	G/GF10 & 20		.125 (.3)	.125 (.3)	.125 (.3)	.188 (.5)	.188 (.5)	.250 (.6)	.250 (.6)	.312 (.8)	.312 (.8)	.312 (.8)	.312 (.8)	.375 (.10)	
	GP20		...	...	...	.325 (.8)	.325 (.8)	.385 (.10)	.385 (.10)	.450 (.11)	.450 (.11)	.450 (.11)	.450 (.11)	.510 (.13)	
	→	G/GF51 & 52	.156 (.4)	.156 (.4)	.156 (.4)	.188 (.5)	.188 (.5)	.218 (.6)	.281 (.7)	.312 (.8)	.344 (.9)	.344 (.9)	.406 (.10)	.500 (.13)	
	GP52		...	...	...	.325 (.8)	.325 (.8)	.350 (.9)	.420 (.11)	.450 (.11)	.480 (.12)	.480 (.12)	.540 (.14)	.635 (.16)	
"X" Dimension	→ G/GF51 & 52		.056 (.1)	.056 (.1)	.056 (.1)	.088 (.2)	.088 (.2)	.118 (.3)	.121 (.3)	.152 (.4)	.144 (.4)	.144 (.4)	.146 (.4)	.170 (.4)	
	GP52		...	...	...	.215 (.5)	.215 (.5)	.245 (.6)	.246 (.6)	.280 (.7)	.270 (.7)	.270 (.7)	.270 (.7)	.295 (.8)	
Installation Limits	G/GF10, 20, 31, 32, 51 & 52 & GP20 & GP52		Angular	.006 (.015)	.007 (.019)	.009 (.023)	.011 (.028)	.013 (.033)	.015 (.039)	.018 (.046)	.020 (.051)	.022 (.055)	.024 (.061)	.026 (.066)	.031 (.078)
	G/GF10 & 20 & GP20		Offset	.002 (.005)	.003 (.007)	.003 (.008)	.004 (.010)	.005 (.013)	.006 (.015)	.007 (.018)	.008 (.020)	.009 (.023)	.010 (.026)	.011 (.028)	.013 (.033)
	→ G/GF51 & 52 & GP52		Offset	.001 (.003)	.001 (.003)	.001 (.003)	.002 (.004)	.002 (.005)	.002 (.005)	.003 (.006)	.003 (.008)	.003 (.008)	.003 (.008)	.004 (.010)	.005 (.011)
	G/GF31 & 32		Offset	.006 (.014)	.006 (.016)	.007 (.017)	.008 (.020)	.009 (.023)	.011 (.028)	.012 (.030)	.013 (.032)	.015 (.038)	.016 (.041)	.017 (.043)	.017 (.044)
"W"†	Installation Check		All Types	.006 (.015)	.007 (.019)	.009 (.023)	.011 (.028)	.013 (.033)	.015 (.039)	.018 (.046)	.020 (.051)	.022 (.055)	.024 (.061)	.026 (.066)	.031 (.078)
	Operating Limit Check		All Types	.035 (.90)	.045 (1.13)	.054 (1.38)	.067 (1.71)	.079 (2.00)	.092 (2.33)	.108 (2.74)	.121 (3.08)	.131 (3.33)	.144 (3.66)	.157 (3.99)	.183 (4.66)
Coupling Speed Range (rpm)	→ G10, 20, 51, 52 & GP20 & GP52	NLGI #0 Grease-Max. ‡	7000	6000	5000	4750	4400	3900	3600	3200	2900	2650	2450	2150	
		Falk LTG or NLGI #1 Grease	Min.	1030	700	550	460	380	330	290	250	230	210	190	160
			Allow.	8000	6500	5600	5000	4400	3900	3600	3200	2900	2650	2450	2150
	G31 & 32	NLGI #0 Grease-Max. ‡	7000	5500	4600	4000	3600	3100	2800	2600	2400	2200	2100	1800	
		Falk LTG or NLGI #1 Grease	Min.	1030	700	550	460	380	330	290	250	230	210	190	160
			Allow.	7000	5500	4600	4000	3600	3100	2800	2600	2400	2200	2100	1800
Grease - pounds (kg)	→ G10 & 20		.09 (0.041)	.16 (0.073)	.25 (0.11)	.50 (0.23)	.80 (0.36)	1.20 (0.54)	2.00 (0.91)	2.30 (1.0)	3.90 (1.8)	4.90 (2.2)	7.00 (3.2)	9.60 (4.4)	
	G51 & 52		.05 (0.023)	.09 (0.041)	.15 (0.068)	.26 (0.12)	.40 (0.18)	.60 (0.27)	1.03 (0.47)	1.25 (0.57)	2.00 (0.91)	2.50 (1.1)	3.75 (1.7)	5.00 (2.3)	
	G31 & 32 per in. Spacer Length		....	....	.03 (0.014)	.06 (0.027)	.06 (0.027)	.12 (0.054)	.20 (0.091)	.20 (0.091)	.20 (0.091)	.20 (0.091)	.20 (0.091)	.20 (0.091)	
	G31 & 32 Less Spacer		.09 (0.041)	.16 (0.073)	.25 (0.11)	.50 (0.23)	.80 (0.36)	1.20 (0.54)	2.00 (0.91)	2.30 (1.0)	3.90 (1.8)	4.90 (2.2)	7.00 (3.2)	9.60 (4.4)	
	GF10 & 20		.09 (0.039)	.15 (0.068)	.27 (0.12)	.47 (0.21)	.74 (0.33)	.88 (0.40)	1.48 (0.67)	2.62 (1.2)	2.87 (1.3)	4.44 (2.0)	4.95 (2.2)	6.79 (3.1)	
	GP20		...	...	...	.50 (0.227)	.80 (0.363)	1.20 (0.544)	2.00 (0.907)	2.30 (1.04)	3.90 (1.77)	4.90 (2.22)	7.00 (3.18)	9.60 (4.35)	
	→ GF51 & 52		.06 (0.025)	.09 (0.042)	.15 (0.070)	.27 (0.12)	.41 (0.19)	.50 (0.23)	.87 (0.40)	1.46 (0.66)	1.66 (0.75)	2.47 (1.1)	2.93 (1.3)	4.27 (1.9)	
	GP52		...	...	...	.26 (0.118)	.40 (0.181)	.60 (0.272)	1.03 (0.467)	1.25 (0.567)	2.00 (0.907)	2.50 (1.13)	3.75 (1.70)	5.00 (2.27)	
	GF31 & 32 per in. Spacer Length		.06 (0.027)	.07 (0.032)	.07 (0.032)	.08 (0.037)	.02 (0.009)	.16 (0.072)	.21 (0.095)	.12 (0.053)	.13 (0.059)	.14 (0.065)	.71 (0.322)	.91 (0.413)	
	GF31 & 32 Less Spacer		.09 (0.039)	.15 (0.068)	.27 (0.12)	.47 (0.21)	.74 (0.33)	.88 (0.40)	1.48 (0.67)	2.62 (1.2)	2.87 (1.3)	4.44 (2.0)	4.95 (2.2)	6.97 (3.2)	
Flange Bolt Torque - lb-in. (Nm)	→ G/GF10, 31 & 51		108 (12)	372 (42)	372 (42)	900 (102)	900 (102)	1800 (203)	1800 (203)	1800 (203)	3000 (339)	3000 (339)	3000 (339)	3000 (339)	
	G/GF20, 32 & 52		108 (12)	372 (42)	900 (102)	1800 (203)	1800 (203)	3000 (339)							
	GP20 & GP52		...	...	...	420 (47.5)	420 (47.5)	840 (94.9)	840 (94.9)	840 (94.9)	1440 (162.7)	1440 (162.7)	1440 (162.7)	1800 (203.4)	

\* Refer to Selection Guide for maximum bores and Manual 427-108 for re boring instructions.

† Flexible couplings are designed to accommodate changes in operating conditions. Coupling life expectancy between initial alignment and maximum operating limits is a function of load, speed and lubrication. Application requirements in excess of 3/4° misalignment per flex half coupling should be referred to Falk for review.

‡ Couplings with NLGI #0 grease may be operated at any speed between zero and the maximum shown.



Check "W" at each flexible hub.

### 7 — Assembled Coupling Alignment Check – All Styles

The alignment can be checked without disassembling the coupling as shown at left. Determine "W" by measuring distances "W" max. and "W" min. between flex hub and sleeve using a depth micrometer or feeler gauges. The difference between "W" max. and "W" min. must not exceed the "W" value given in Table 4. Check "W" at each coupling end.

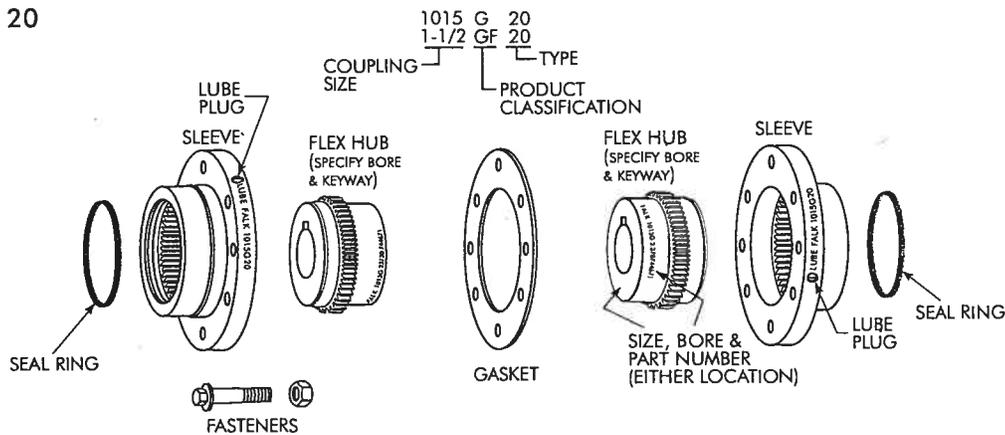
### PARTS IDENTIFICATION AND PART NUMBER LOCATION

Coupling parts have identifying size and part numbers as illustrated below. When ordering parts, always SPECIFY SIZE, TYPE, HUB BORE, KEYWAY, and PART NUMBER found on each item.

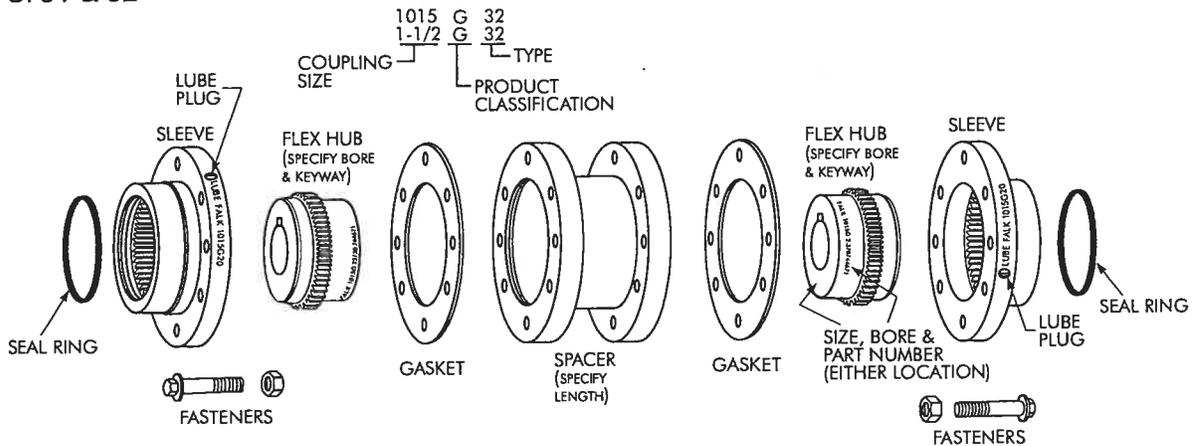
Contact your Falk Distributor or Falk for price and availability.

- EXAMPLE:**  
 Complete 1050G20 Gear Coupling  
 Consisting of:  
 2 – 1050G20 Sleeves  
 (Includes: Gasket & Seal)  
 2 – 1050G Flex Hubs  
 Bore: 6.750 Keyway: 1.750 x .750  
 Bore: 7.375 Keyway: 1.750 x .750  
 1 – Fastener Set

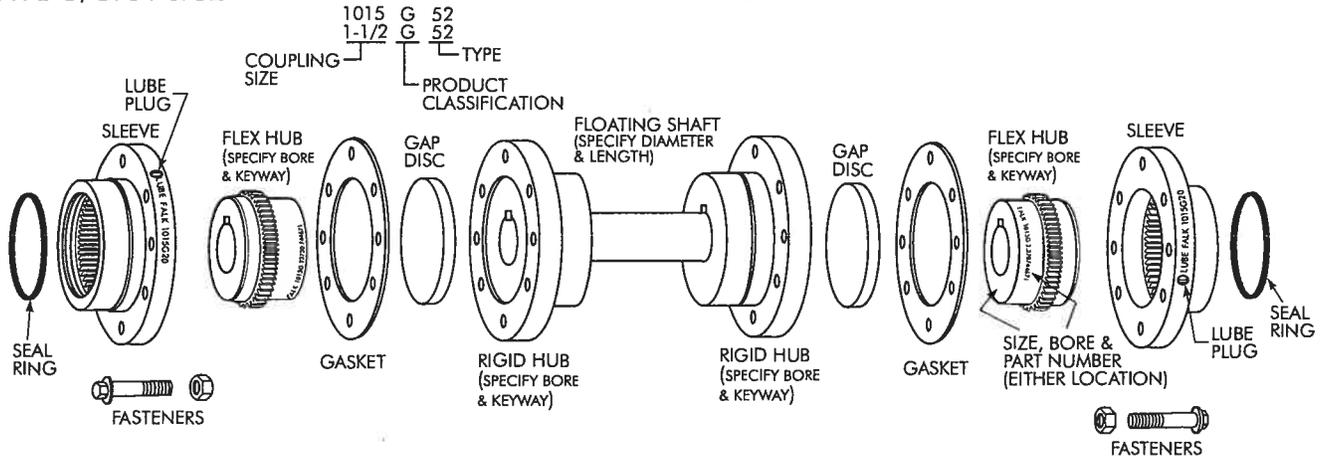
#### TYPE G/GF10 & 20



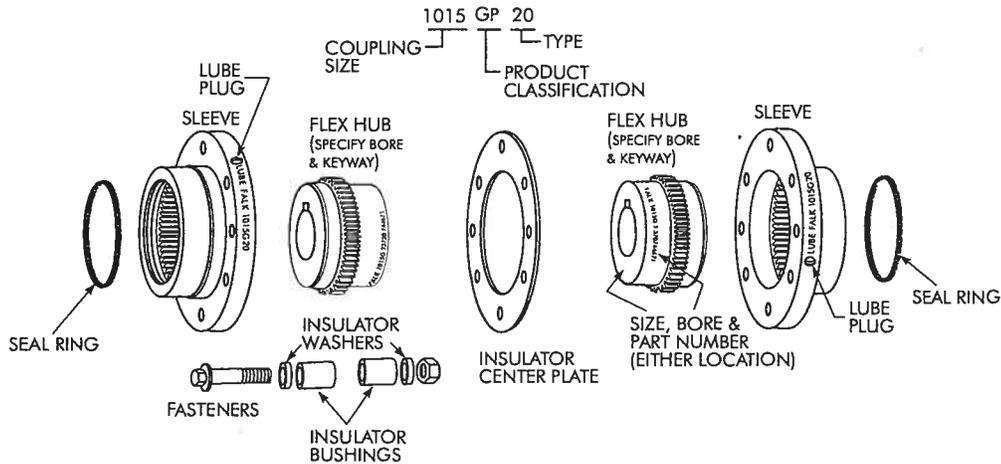
#### TYPE G/GF31 & 32



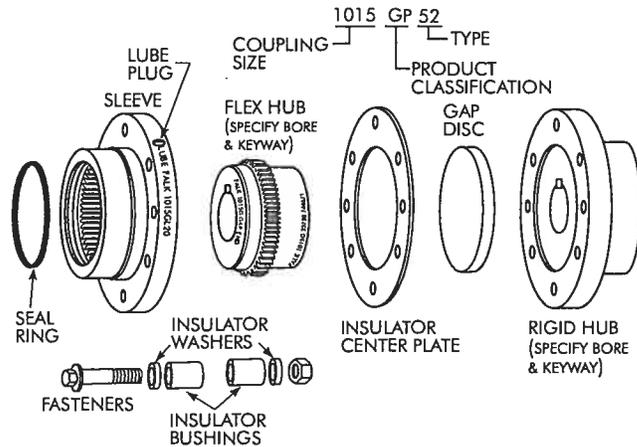
**TYPE G/GF51 & 52**



**TYPE GP20**



**TYPE GP52**



***Pinion Shaft Couplers (qty. 4) (400 E3 14)***

The pinion shaft couplers are Falk Lifelign Gear Couplings, Type G20, Size 1120. The pinion shaft couplers are used to connect the secondary reducer to the pinion shaft. These couplers are located under the guards at the secondary reducer end of the pinion shaft.

JCM # 400 E 3 14

### How To Use This Manual

This manual provides detailed instructions on installation, maintenance and parts identification for Falk Lifelign gear couplings, Types G20, G32, and G52. Use the table of contents below to locate required information.

### Table of Contents

Introduction . . . . .	Page 1
Lube Fittings . . . . .	Page 1
Limited End Float . . . . .	Page 1
Lubrication . . . . .	Pages 1-2
Installation & Alignment Instructions . . . . .	Pages 3-7
Maintenance . . . . .	Page 7
Installation & Alignment Data . . . . .	Page 8
Parts Identification & Order Information . . . . .	Pages 9-10

**CAREFULLY FOLLOW THE INSTRUCTIONS IN THIS MANUAL FOR OPTIMUM PERFORMANCE AND TROUBLE FREE SERVICE.**

### INTRODUCTION

This manual applies to standard coupling Types G20, G32, and G52 with exposed bolts. For couplings furnished with special features, refer to assembly drawing furnished with coupling for proper assembly arrangement and any additional installation or maintenance requirements.

Type G couplings are recommended for horizontal application only. Use Type GV couplings for vertical applications, or for inclinations over 10° from horizontal. Do not use GV couplings for thrust applications, refer to Falk.

**CAUTION:** Consult applicable local and national safety codes for proper guarding of rotating members. Observe all safety rules when installing or servicing couplings.

**WARNING:** Lockout starting switch of prime mover and remove all external loads from drive before installing or servicing couplings.

### LUBE FITTINGS

Flanged sleeves and end plates have 1/2 NPT lube holes for size 1080 (2080) thru 1110 (2110) and 3/4 NPT for size 1120 (2120) thru 1300 (2300). Use standard grease pumping equipment and lube fittings.

### LIMITED END FLOAT

When electric motors are fitted with sleeve bearings, the use of a gap disc is recommended to limit coupling end float to protect the motor bearings. **NOTE:** HUB GAP increase is required. Refer to 458-820 for instructions.

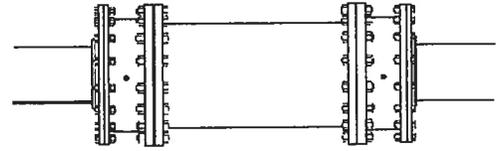
### LUBRICATION

Adequate lubrication is essential for satisfactory operation. Because of its superior lubricating characteristics and low centrifuge properties, Falk Long Term Grease (LTG) is highly recommended.

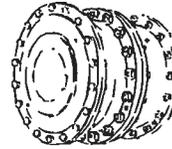
Gear couplings initially lubricated with Falk Long Term Grease (LTG) will not require re-lubrication for up to three years.

The use of general purpose grease requires re-lubrication of the coupling at least once every six months. If a coupling leaks grease, is exposed to extreme temperatures, excessive

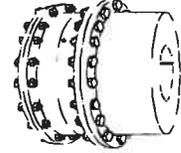
TYPE G32



TYPE G20



TYPE G52



moisture, experiences frequent reversals or axial movements; more frequent lubrication may be required.

### USDA Approval

LTG has the United States Department of Agriculture Food Safety & Inspection Service approval for applications where there is no possibility of contact with edible products. (H-2 ratings.)

### Long Term Grease (LTG)

The high centrifugal forces encountered in couplings separate the base oil and thickener of general purpose greases. Heavy thickener, which has no lubrication qualities, accumulates in the tooth mesh area of gear couplings resulting in premature mesh failure unless periodic lubrication cycles are maintained.

Falk Long Term Grease (LTG) was developed specifically for couplings. It resists separation of the oil and thickener. The consistency of Falk LTG changes with operating conditions. As manufactured it is an NLGI #1/2 grade. Working of the lubricant under actual service conditions causes it to become semifluid while the grease near the seals will set to a heavier grade, helping to prevent leakage.

LTG is highly resistant to separation, easily out performing all other lubricants tested. The resistance to separation allows the lubricant to be used for relatively long periods of time.

Although LTG grease is compatible with most other coupling greases, the mixing of greases may dilute the benefits of LTG.

**CAUTION:** Do not use LTG in bearings. Do not use LTG for low speed applications. Refer to Table 4, Page 8 for coupling speed range of LTG grease.

### Packaging

14 oz. (0,4 Kg) CARTRIDGES — Individual or case lots of 10 or 60.

35 lb. (16 Kg) PAILS, 120 lb. (54 Kg) KEG & 400 lb. (181 kg.) DRUMS.

### Specifications — Falk LTG (Long Term Grease)

TEMPERATURE RANGE — -20°F (-29°C) to 250°F (121°C). Minimum pump = 20°F (-7°C).

MINIMUM BASE OIL VISCOSITY — 3300SSU (715cSt) @ 100°F (38°C).

THICKENER — Lithium soap/polymer.  
 CENTRIFUGE SEPARATION CHARACTERISTICS — ASTM #D4425-84 (Centrifuge Test) — K36 = 2/24 max., very high resistance to centrifuging.  
 NLGI GRADE (ASTM D-217) — 1/2  
 CONSISTENCY (ASTM D-217) — 60 stroke worked penetration value in the range of 315 to 360 measured @ 77°F (25°C).  
 DROPPING POINT — 350°F (177°C) minimum.  
 MINIMUM TIMKEN EP O.K. LOAD — 40 lbs. (18 kg).  
 ADDITIVES — Rust and oxidation inhibitors that do not corrode steel or swell or deteriorate synthetic seals.

### General Purpose Grease

**Bi-annual Lubrication** — The following specifications and lubricants for general purpose grease apply to Falk gear couplings that are lubricated bi-annually and operate within ambient temperatures of -30°F (-34°C) to 200°F (93°C). For temperatures beyond this range, refer to Falk. For normal service, use a NLGI #1 extreme pressure (EP) grease EXCEPT when the coupling speed is less than the minimum specified in Table 4 on Page 8. At these lower speeds, use a NLGI #0 extreme pressure (EP) grease. When one or more gear couplings in an application require NLGI #0 grease, the same grease may be used in all of the couplings.

If coupling leaks grease, is exposed to extreme temperatures, excessive moisture or experiences frequent reversals or axial movements; more frequent lubrication may be required.

Lubricants listed in Tables 1, 2 & 3 are typical products only and should not be construed as exclusive recommendations.

### Specifications — General Purpose Coupling Lubricants

COUPLING SPEED RANGE — See Table 4, Page 8.  
 TEMPERATURE RANGE — -30°F to +200°F(-34°C to +93°C)  
 WORKED PENETRATION AT 77°F(25°C) —  
     NLGI #1 . . . . . 310-340 (See Table 1)  
     NLGI #0 . . . . . 355-385 (See Table 2)  
 DROPPING POINT — 300°F(149°C) or higher  
 TEXTURE — Smooth or fibrous  
 MINIMUM TIMKEN O.K. LOAD — 30 lbs.  
 SEPARATION AND RESISTANCE — Low oil separation rate and high resistance to separation from centrifuging.  
 LIQUID CONSTITUENT — Passess good lubricating properties . . . equivalent to a high quality, well refined petroleum oil with EP additives.  
 INACTIVE — Must not corrode steel or cause swelling or deterioration of synthetic seals.

### Oil Lubrication

EP oils may be a more effective lubricant than grease when the required coupling speed is one half of the minimum speed range of NLGI #1 grease listed in Table 4, Page 8 (Minimum rpm ÷ 2). Oil lubricated couplings must be sealed to prevent leakage, i.e. keyways, etc. Couplings must be drained and refilled with new oil every six months for operating temperatures up to 160°F (71°C) and every three months for

couplings operating at temperatures of 160°F (71°C) up to 200°F (93°C). For temperatures beyond this range, refer to Falk. The minimum operating temperature must not be lower than the pour point of the oil. The specified amount of grease listed in Table 4, Page 8, in pounds, also applies to the volume of oil in pints.

### Specifications

**Type:** Mild EP gear oil that meets AGMA Specifications 250.04.  
**Grade:** AGMA #8EP (ISO VG 680).  
**Viscosity:** 612-748 cSt @ 104°F (40°C).  
**Pour Point:** 20°F (-7°C) Maximum.  
 Must not corrode steel or swell or deteriorate synthetic seals.

TABLE 1 — NLGI #1 EP Grease

Manufacturer	Lubricant *
Amoco Oil Co.	Rykan Grease #1 EP
BP Oil Co.	Energrease LS-EP1
Chevron U.S.A., Inc.	Dura-Lith EP1
Citgo Petroleum Corp	Premium Lithium Grease EP1
Canoca Inc.	EP Conolith Grease #1
Exxon Company, U.S.A..	Lidok EP1
Imperial Oil Ltd.	Ronek EP1
Kendall Refining Co.	Lithium Grease L-416
Keystone Div., Pennwalt Corp.	Zeniplex-1
Lyandell Lubricants	Lithaline Complex EP1
Mobil Oil Corp..	Mabilux EP1
Petro-Canada Products	Multipurpose EP1
Phillips 66 Co.	Philube Blue EP
Shell Oil Co.	Alvania EP Grease 1
Shell Canada Ltd.	Alvania Grease EP1
Sun Oil Co.	Sun Prestige 741 EP
Texaco Lubricants	Multifak EP1
Unocal 76 (East & West)	Unaba EP1

TABLE 2 — NLGI #0 EP Grease

Manufacturer	Lubricant *
Amoco Oil Co.	Rykan Premium Grease 0 EP
BP Oil Co.	Energrease LS-EP 0
Chevron U.S.A., Inc.	Dura-Lith EP 0
Citgo Petroleum Corp	Premium Lithium Grease EP 0
Conaca Inc.	EP Conolith Grease #0
Exxon Company, U.S.A..	Lidok EP 0
Kendall Refining Co.	Lithium Grease L-406
Keystone Div., Pennwalt Corp.	Zeniplex-0
Mobil Oil Corp..	Mabilux EP 0
Petro-Canada Products	Multipurpose Lotemp EP Grease
Shell Oil Co.	Alvania EP Grease RO
Shell Canada Ltd.	Alvania Grease EPW
Sun Oil Co.	Sun Prestige 740 EP
Texaco Lubricants	Multifak EP 0
Unocal 76 (East & West)	Unoba EP 0

TABLE 3 — Oil Lubricants

Manufacturer	Lubricant *
Amoco	Permagear EP 680
Chevron, U.S.A.	NL Gear Compound 680
Exxon Co., U.S.A.	Spartan EP680
Gulf Oil Co.	EP Lubricant HD 680
Mobil Oil Co.	Mabilgear 636
Shell Oil Co.	Omala Oil 680
Texaco Inc.	Meropa 680
Union Oil Co. of Calif.	Extra Duty NL Gear Lube 8EP

\* Lubricants listed may not be suitable for use in the food processing industry; check with lube manufacturer for approved lubricants.

### COUPLING INSTALLATION, ALL TYPES

Only standard mechanics tools, torque wrenches, straight edge, spacer bar and feeler gauges are required to install Falk gear couplings. Clean all parts using a non-flammable solvent. Check hubs, shafts and keyways for burrs. DO NOT heat clearance fit hubs. Use a lubricant that meets the specifications on Page 1 or 2. Pack sleeve teeth with grease and lightly coat seals with grease BEFORE assembly. The required amount of grease is listed in Table 4, Page 8. Make certain flange fasteners are tightened to the required torque listed in Tables 4.

**Interference Fit Hubs** — Unless otherwise specified, Falk gear couplings are furnished for an interference fit without set screws. Heat hubs to 275°F (135°C) using an oven, torch, induction heater or an oil bath.

**CAUTION:** To prevent seal damage, DO NOT heat hubs beyond a maximum temperature of 400°F (205°C).

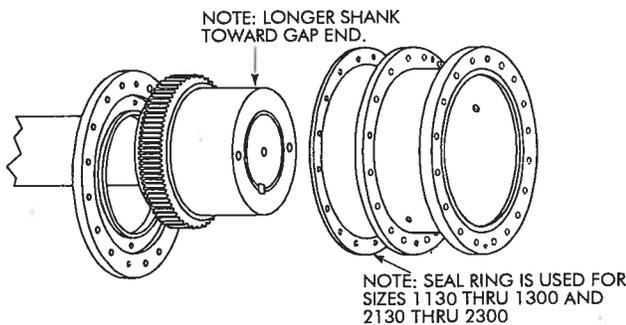
When an oxy-acetylene or blow torch is used, use an excess acetylene mixture. Mark hubs near the center of their length in several places on hub body with a temperature sensitive crayon, 275°F (135°C) melt temperature. Direct flame towards hub bore using constant motion to avoid overheating an area.

**WARNING:** If an oil bath is used, the oil must have a flash point of 350°F (177°C) or higher. Do not rest hubs on the bottom of the container. Do not use an open flame in a combustible atmosphere or near combustible materials.

### Maximize Performance & Life

The performance and life of couplings depend largely upon how you install and maintain them. Before installing couplings, make certain that foundations of equipment to be connected meet manufacturers' requirements. Check for soft foot. The use of stainless steel shims is recommended. Measuring misalignment and positioning equipment within alignment tolerances is simplified with an alignment computer, and allow the incorporation of "cold offsets", which will compensate for shaft position changes due to thermal growth. Alignment calculations can also be done graphically or mathematically.

### TYPE G HORIZONTAL COUPLING INSTALLATION



**NOTE:** For Types G32 and G52, Steps 1 through 5 apply when the flex hubs are mounted on the shaft extensions of the connected equipment. For G52 with flex hubs on the short floating shaft, refer to Steps A through C on Page 5.

### 1 — Mount Coupling Parts

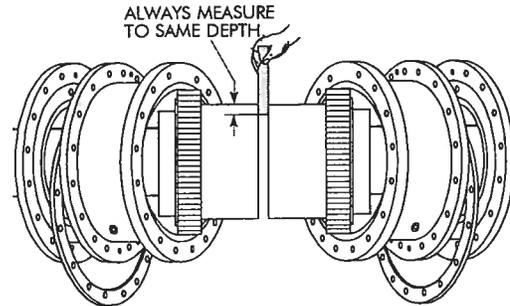
Place the end plates WITH seal rings and end plate gaskets on the shafts BEFORE mounting flex hubs. Mount flex hubs on their respective shafts, as shown above, so that each hub face is flush with the end of its shaft. Allow hubs to cool before proceeding. Seal keyways to prevent leakage. Insert set screws (if required) and tighten. Mount flanged sleeves with end plate gaskets or seal rings.

Position equipment in approximate alignment with approximate gap specified in Table 4, Page 8.

For Types G32 and G52, determine the distance between shafts to be connected per Step 5A, Figure 2, Page 6, or Step 5B, Figure 3, Page 7, and position equipment in approximate alignment. Set the unit most difficult to move to true level and bolt in place.

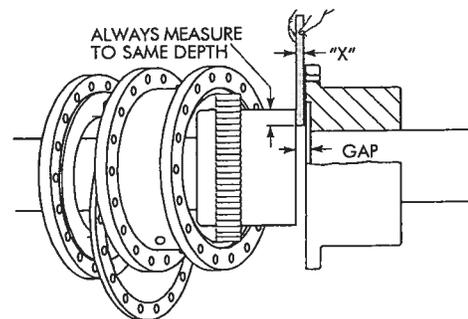
### 2 — Gap & Angular Alignment for Single and Double Engagement and Spacer or Floating Shaft Couplings

#### 2A — Type G20 – Double Engagement



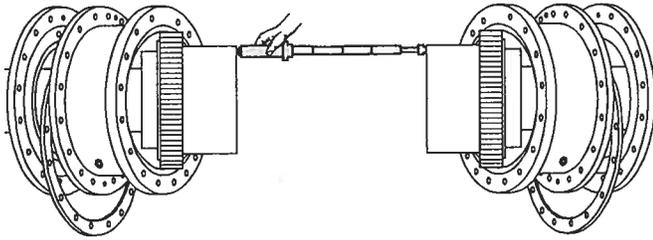
Use a spacer bar equal in thickness to gap specified in Table 4. Insert bar, as shown above, to same depth at 90° intervals and measure clearance between bar and hub face with feelers. The difference in minimum and maximum measurements must not exceed the INSTALLATION ANGULAR limit specified in Table 4.

#### 2B — Type G52 – Single Engagement



Use a spacer bar equal in thickness to the "X" dimension specified in Table 4, Page 8. Insert the bar, as shown above to the same depth at 90° intervals and measure the clearance between the bar and hub face with feelers. The difference in minimum and maximum measurements should not exceed the ANGULAR limit specified in Table 4.

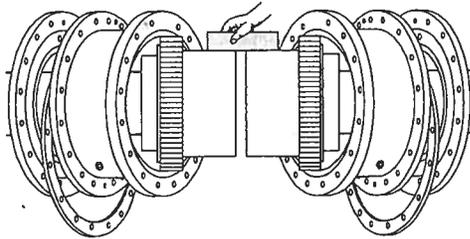
**2C — G32/G52 Short Spacer or Floating Shaft**



Use an inside micrometer as shown above and at 90° intervals to measure the distance between hubs. The difference in minimum and maximum measurements should not exceed the ANGULAR limit specified in Table 4, Page 8.

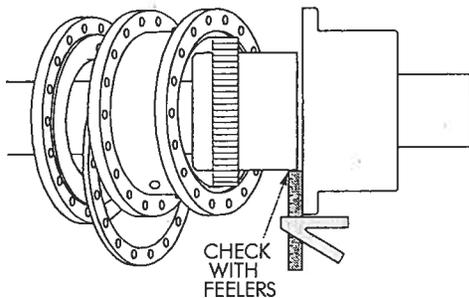
**3 — Parallel Offset Alignment**

**3A — Type G20 – Double Engagement**



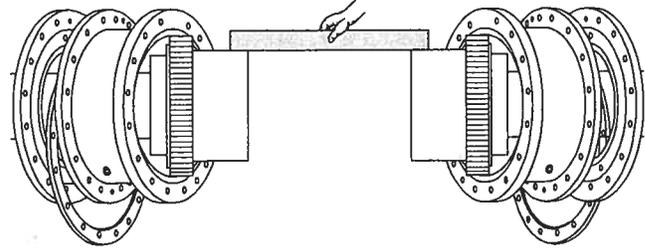
Align so that a straight edge rests squarely (or within the limits specified in Table 4) on both hubs as shown above and also at 90° intervals. Check with feelers. The clearance should not exceed the INSTALLATION PARALLEL OFFSET limit specified in Table 4. Tighten foundation bolts and repeat Steps 2 and 3. Realign coupling if necessary. **IMPORTANT:** Grease the hub teeth.

**3B — Type G52 –Single Engagement**



Position a square on the rigid hub flange as shown above at 6 to 8 equally spaced points. Measure the clearance between the hub and square blade at each point with feelers and reposition units until the DIFFERENCE in feeler readings is as near zero as possible. Tighten all foundation bolts and repeat Steps 2 and 3. Realign coupling if necessary. Grease the hub teeth.

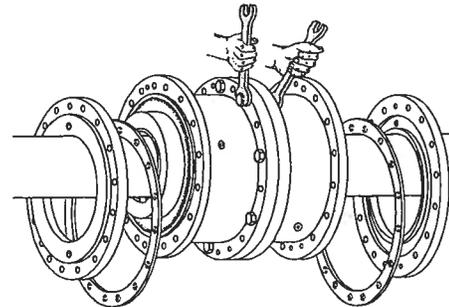
**3C — G32/G52 Short Spacer or Floating Shaft**



Align so that a straight edge rest squarely (or within the limits specified in Table 4) on both hubs as shown above and also at 90° intervals. Check with feelers. The clearance should not exceed the PARALLEL OFFSET limit specified. Tighten all foundation bolts and repeat Steps 2 and 3. Realign coupling if necessary. Grease the hub teeth.

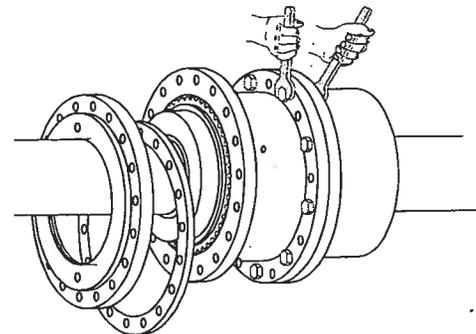
**4 — Assemble Couplings**

**4A — Type G20 – Double Engagement**



Insert gasket or seal ring between flanges. Position flanged sleeves with lube holes at about 90° and then carefully draw flanged sleeves into register. Use only the fasteners furnished with the coupling. Bolt end plates with gaskets or seal rings to sleeves. Position end plate lube holes at about 90° from holes in adjacent sleeve. **IMPORTANT:** Tighten flange fasteners to torque specified in Table 4, Page 8.

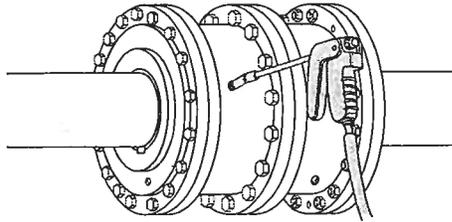
**4B — Type G32/G52 – Single Engagement**



Insert gasket or seal ring between flanged sleeve and rigid hub. Carefully draw flanged sleeve into register with rigid hub. Use only bolts furnished with the coupling. **IMPORTANT:** Tighten flange or seal ring sleeve bolts to torque specified in Table 4, Page 8. Bolt end plate with gasket to sleeve. Position end plate lube holes at about 90° from holes in sleeve.

## 5 — Lubricate

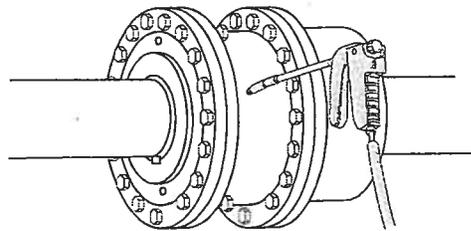
### 5A — Type G20 – Double Engagement



Remove all lube plugs from sleeves and end plates and fill with recommended grease until an excess appears at an open lube hole; then insert plug. Continue procedure until lubricant has flowed through each hole and all plugs have been inserted. **CAUTION:** Remove grease fitting and make certain all plugs are inserted after lubricating.

**NOTE:** For disassembly, jack-screw holes are provided on all sleeve flanges except the female center flange. End plate fasteners may be used as jack-screws.

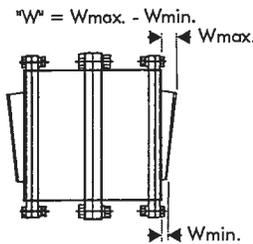
### 5B — G32/G52 Short Spacer or Floating Shaft



Refer to Table 4, Page 8, for amount of grease required. Remove all lube plugs from sleeves and end plates and fill with recommended grease until an excess appears at an open lube hole; then insert plug. Continue procedure until lubricant has flowed through each hole and all plugs have been inserted. **CAUTION:** Remove grease fitting and make certain all plugs are inserted after lubricating.

**NOTE:** For disassembly, jack-screw holes are provided on sleeve flanges. End plate fasteners may be used as jack-screws.

## 6 — Assembled Coupling Alignment Check

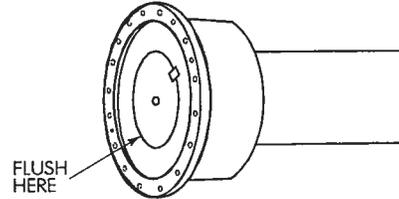


Check "W" at each flexible hub.

The alignment can be checked without disassembling or rotating the coupling as shown above. Determine "W" by measuring distances "W"max. and "W"min. between flex hub and end plate using a depth micrometer or feeler gages. The difference between "W"max. and "W"min. must not exceed the "W" value given in Table 4, Page 8. Check "W" at each coupling end.

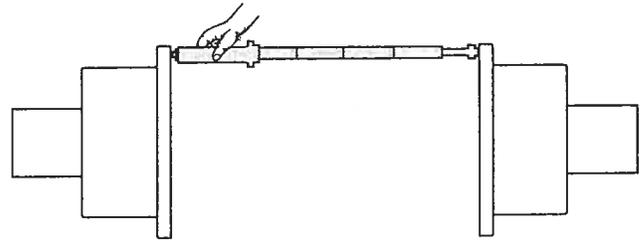
## COUPLING WITH SHORT SPACER OR FLOATING SHAFT — Rigid Hubs on Shaft Extensions

### A — Mount Rigid Hubs



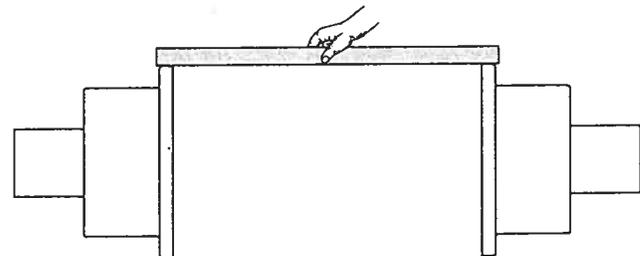
Refer to Step 1 on Page 3. **NOTE:** Mount rigid hub so that the hub counterbore face is flush with the shaft ends as illustrated above. Seal keyway to prevent leakage.

### B — Gap and Angular Alignment



Determine correct distance between rigid hub flange faces from Step 5A, Figure 2 on Page 6, and position machines. Use an inside micrometer at 90° intervals between the rigid hub faces to obtain correct distance and angular alignment. The difference between the minimum and maximum measurements should not exceed the ANGULAR limit specified in Table 4.

### C — Parallel Offset Alignment



Align so that a straight edge rests squarely (or within limits specified in Table 4, Page 8) on both hubs as shown above and also at 90° intervals. Check with feelers. Fasten foundation bolts, and repeat Steps B and C. Realign if necessary. Assemble and lubricate per Steps 4B and 5B on Pages 4 and 5.

## COUPLING WITH LONG FLOATING SHAFT — Rigid or Flex Hubs on Shaft Extensions

### 1 — Mount Coupling Parts

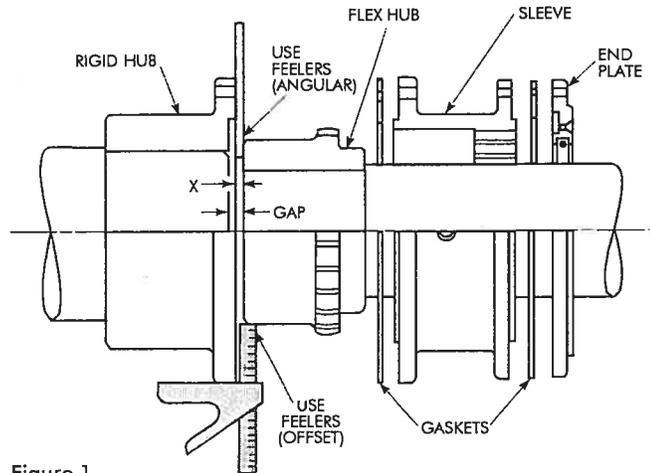


Figure 1

Mount hubs, sleeves, gaskets, end plates and seals per Step 1 on Page 3 or A on Page 5.

### 2 — Position First Unit and Floating Shaft

Set the unit most difficult to move to true level and bolt it in place. Set the floating shaft or spacer on V-blocks and align coupling on fixed unit.

### 3 — Gap and Angular Alignment

Refer to Figure 1. Use a spacer bar equal in thickness to the "X" dimension specified in Table 4 on Page 8. Insert the bar to the same depth at 90° intervals and measure the clearance between the bar and hub face with feelers as shown. The difference in minimum and maximum measurements should not exceed the ANGULAR limit specified in Table 4, Page 8.

### 4 — Parallel Offset Alignment

Refer to Figure 1 and align coupling and floating shaft so that, with the square head resting squarely on the flange, equal clearance measurements are obtained between flange and the hub O.D. in four places 90° apart. The difference between minimum and maximum feeler readings should not exceed the PARALLEL OFFSET limit in Table 4 on Page 8.

### 5A — Determine Distance Between Rigid Hub Flange Faces

For Figure 2 below, measure the length of the floating shaft and add 2 times the "X" dimension from Table 4 on Page 8 to get the distance between the rigid hub flange faces.

### 5B — Determine Distance Between Flex Hub Faces

For Figure 3, Page 7, measure the overall floating shaft or spacer assembly length from flange to flange and add 2 times the "X" dimension from Table 4 on Page 8 to get the distance between the shafts to be coupled.

### 6 — Position Second Unit

Position second unit for the correct "X" dimension and align per Steps 3 and 4 above. DO NOT move the floating shaft. Bolt unit in place and recheck alignment and gap, realign if necessary. For greater accuracy, check alignment with a depth micrometer or dial indicator as outlined on Page 7.

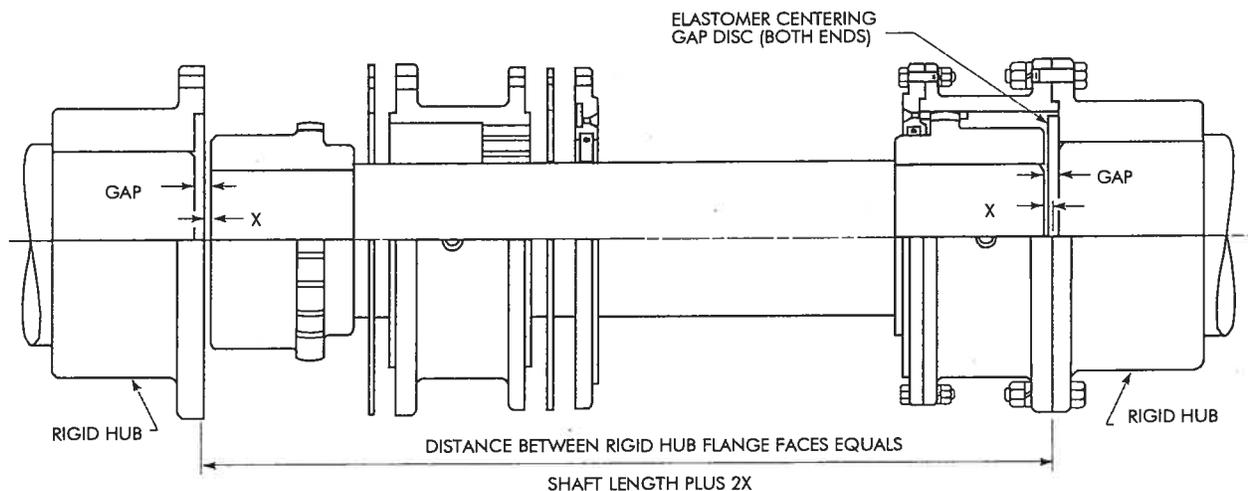


Figure 2

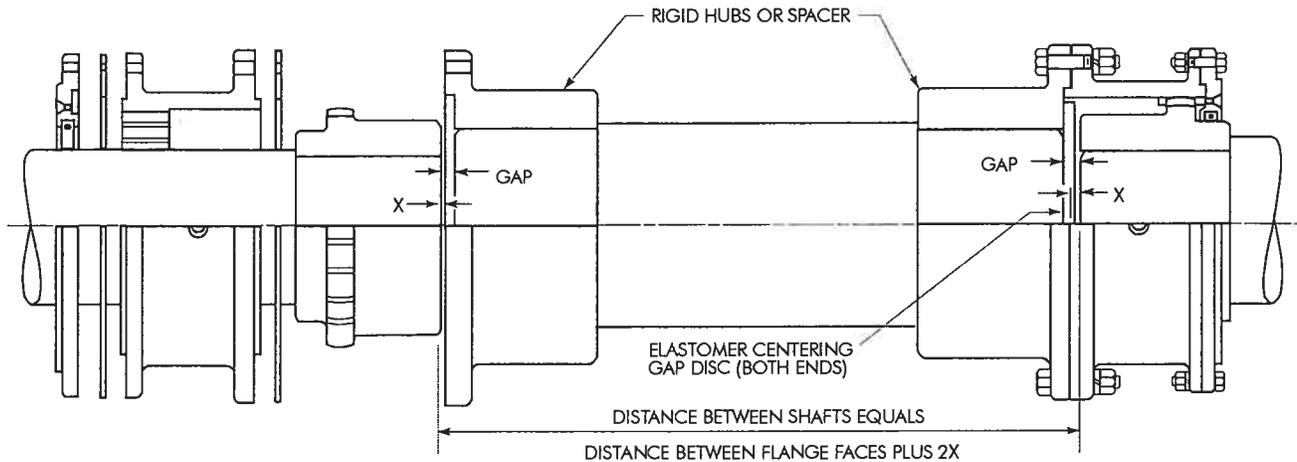


Figure 3

**NOTE:** Dimension "X" in Figures 2 and 3 is the same as in Figure 1. Refer to Table 4, Page 8 for "X".

### 7 — Alignment Check with Dial Indicator

A dial indicator may be used if the driving and driven hubs can be rotated. Mount dial indicators on the driving and driven hubs. For the parallel offset check, sweep the O.D. of the floating shaft hubs through one complete 360° turn. The total dial indicator reading, divided by two, should not exceed the parallel offset limit in Table 4. For the parallel offset check with a depth micrometer, use the same procedure as outlined in Step 4, Page 6 when a square head is used.

For angular check with flex hubs on the floating shaft, sweep the face of either end of the flex hubs for 360°. The TIR should not exceed the angular limit shown in Table 4. For angular check with rigid hubs on the floating shaft, sweep the gasket flange for 360°. The TIR should not exceed the angular limit shown in Table 4.

### 8 — Assemble and Lubricate

Grease hub teeth. Assemble and lubricate coupling per Steps 4B on Page 4 and 5B on Page 5.

### BI-ANNUAL MAINTENANCE

Re-lubricate coupling if using general purpose greases. If coupling leaks grease, is exposed to extreme temperatures, excessive moisture or frequent reversals; more frequent lubrication may be required.

### ANNUAL MAINTENANCE

For extreme or unusual operating conditions, check coupling more frequently.

1. Check alignment per Step 6, Page 5. If the maximum operating misalignment values are exceeded, realign the coupling to the recommended installation values. See Table 4, Page 8, for installation and maximum operating misalignment values.
2. Check tightening torques of all fasteners.
3. Inspect seal ring and gasket to determine if replacement is required.
4. Re-lubricate coupling if using general purpose grease.



TABLE 4 — Installation & Alignment Data for Types G20/G32/G52 ★ — Dimensions — Inches (Metric — mm)

COUPLING SIZE		1080 2080	1090 2090	1100 2100	1110 2110	1120 2120	1130 2130	1140 2140	1150 2150	1160 2160	1180 2180	1200 2200	1220 2220	1240 2240	1260 2260	1280 2280	1300 2300	
Gap (Hub Separation) ± 10%	G20	.375 (10)	.500 (13)	.500 (13)	.500 (13)	.500 (13)	.750 (19)	.750 (19)	.750 (19)	1.000 (25)	1.000 (25)	1.000 (25)	1.000 (25)	1.000 (25)	1.000 (25)	1.000 (25)	1.000 (25)	
	G32/G52	.500 (13)	.562 (14)	.625 (16)	.625 (16)	.625 (16)	.750 (19)	.750 (19)	.750 (19)	1.000 (25)	1.000 (25)	1.000 (25)	1.125 (29)	1.125 (29)	1.125 (29)	1.125 (29)	1.125 (29)	
"X" Dimension	G32/G52	.188 (5)	.250 (6)	.250 (6)	.250 (6)	.250 (6)	.375 (10)	.375 (10)	.375 (10)	.500 (13)	.500 (13)	.500 (13)	.500 (13)	.500 (13)	.500 (13)	.500 (13)	.500 (13)	
Installation Limits	G20, G32, & G52	Parallel Offset Max	.016 (0.406)	.017 (0.432)	.019 (0.483)	.022 (0.559)	.023 (0.584)	.024 (0.610)	.025 (0.635)	.027 (0.686)	.028 (0.711)	.029 (0.737)	.035 (0.889)	.039 (0.991)	.042 (1.07)	.046 (1.17)	.047 (1.19)	.048 (1.22)
		Angular Max	.032 (0.813)	.036 (0.914)	.040 (1.02)	.045 (1.14)	.049 (1.2)	.052 (1.32)	.057 (1.45)	.061 (1.55)	.063 (1.6)	.072 (1.83)	.080 (2.03)	.087 (2.21)	.097 (2.46)	.106 (2.69)	.115 (2.92)	.123 (3.12)
"W"†	Installation Check		.032 (0.813)	.036 (0.914)	.040 (1.02)	.045 (1.14)	.049 (1.2)	.052 (1.32)	.057 (1.45)	.061 (1.55)	.063 (1.6)	.072 (1.83)	.080 (2.03)	.087 (2.21)	.097 (2.46)	.106 (2.69)	.115 (2.92)	.123 (3.12)
	Operating Limit Check		.092 (2.33)	.101 (2.58)	.115 (2.91)	.128 (3.24)	.141 (3.57)	.151 (3.82)	.164 (4.16)	.177 (4.49)	.190 (4.82)	.216 (5.49)	.239 (6.07)	.262 (6.65)	.291 (7.40)	.317 (8.06)	.344 (8.73)	.370 (9.39)
Coupling Speed Range with Falk LTG or NLG1 #1 Grease — rpm ‡	Min	140	120	110	100	94	88	82	76	72	64	58	52	48	44	40	38	
	Allow.	1750	1550	1450	1330	1200	1075	920	770	650	480	370	290	270	250	230	220	
Grease — pounds (kg)	G20	21 (9.53)	27 (12.2)	33 (15.0)	39 (17.7)	46 (20.9)	72 (32.7)	73 (33.1)	90 (40.8)	95 (43.1)	110 (49.9)	150 (68.0)	235 (107)	240 (109)	270 (122)	300 (136)	330 (150)	
	G32 & G52	11 (5)	14 (6.4)	17 (7.7)	20 (9.1)	24 (10.9)	37 (16.8)	38 (17.2)	46 (20.9)	48 (21.8)	56 (25.4)	76 (34.5)	120 (54.4)	125 (56.7)	135 (61.2)	155 (70.3)	170 (77.1)	
Tightening Torque — lb-ft (Nm)	Center Flange	740 (1 003)	1050 (1 424)	1050 (1 424)	1840 (2 495)	1840 (2 495)	1840 (2 495)	1980 (2 685)	1980 (2 685)	3080 (4 176)	3080 (4 176)	4340 (5 885)	4340 (5 885)	8250 (11 186)	8250 (11 186)	10900 (14 778)	10900 (14 778)	
	End Plate	120 (163)	180(244)			260 (353)	360(488)			640(868)								
Fastener Size — UNC Thread — Inches	Center Flange	1.125 x 4.12	1.25 x 4.75	1.25 x 5.25	1.50 x 6.00	1.50 x 6.25		1.75 x 6.50		2.00 x 7.00		2.25 x 7.75		2.75 x 9.75		3.00 x 10.50		
	End Plate	.875 x 3.25	1.00 x 3.50			1.125 x 3.50	1.25 x 4.50				1.50 x 5.00							
Wrench Size — Inches	Center Flange	1.687	1.875		2.250			2.625		3.000		3.375		4.250		4.625		
	End Plate	1.312	1.50			1.687	1.875				2.25							
Puller Bolt Size (UNC Thread) — Inches		1-8	1.25-7	1.5-6	1.5-6	1.5-6	1.5-6	1.5-6	1.5-6	1.5-6	1.5-6	2-4.5	2-4.5	2-4.5	2-4.5	2-4.5	2-4.5	

★ Refer to Selection Guide for maximum bores and Manual 427-108 for re boring instructions.

† Flexible couplings are designed to accommodate changes in operating conditions. Coupling life expectancy between initial alignment and maximum operating limits is a function of load, speed, and lubrication. Application requirements in excess of 3/8" misalignment per flex-half coupling should be referred to Falk for review.

‡ NGL1 #0 grease MUST be used when speeds are BELOW minimum shown.

### PARTS IDENTIFICATION AND ORDER INFORMATION

Coupling parts have identifying size and part description as illustrated below. When ordering parts, always SPECIFY SIZE, TYPE, HUB BORE, KEYWAY, PART DESCRIPTION, and PART NUMBER found on each item.

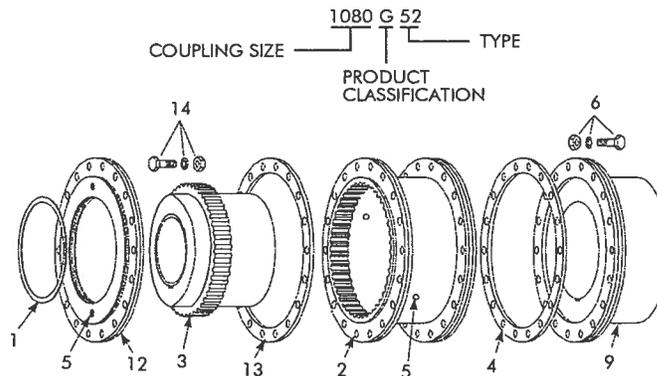
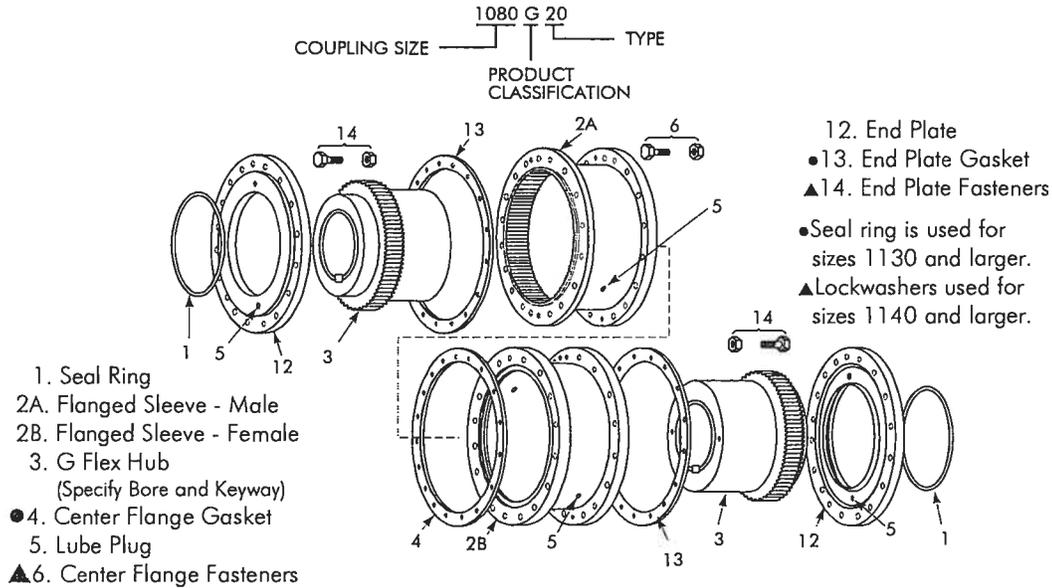
Contact your Falk Distributor or Falk for price and availability.

#### EXAMPLE:

Complete 1080G20 Gear Coupling

Bore: 8.750 Keyway: 2.000 x .750

Bore: 9.500 Keyway: 2.500 x .750



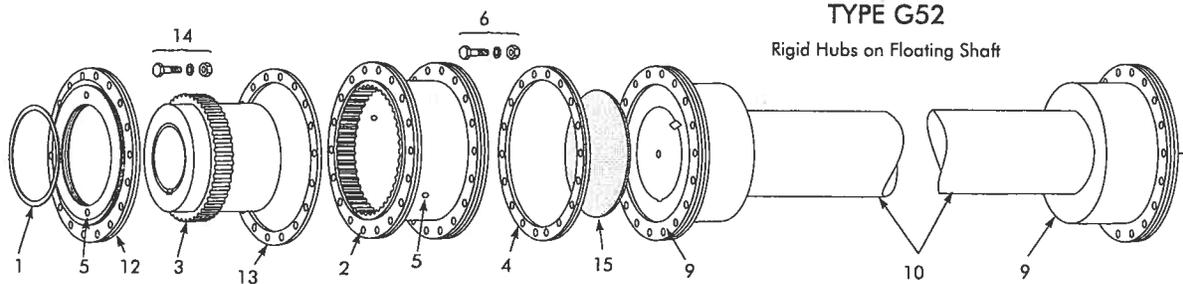
- 1. Seal Ring
- 2. Flanged Sleeve
- 3. G Flex Hub  
(Specify Bore and Keyway)

- † 4. Sleeve Gasket
- 5. Lube Plug
- 6. Sleeve Bolt, Nut, Lockwasher
- 9. Rigid Hub

- 12. End Plate
- † 13. End Plate Gasket
- 14. End Plate Bolt, Nut, Lockwasher

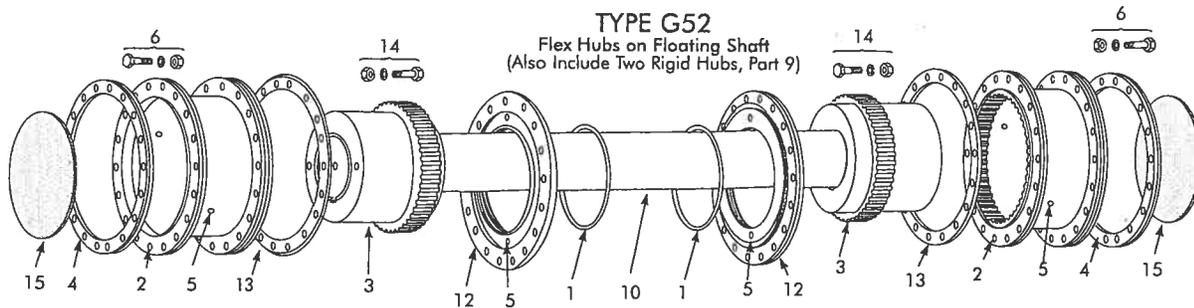
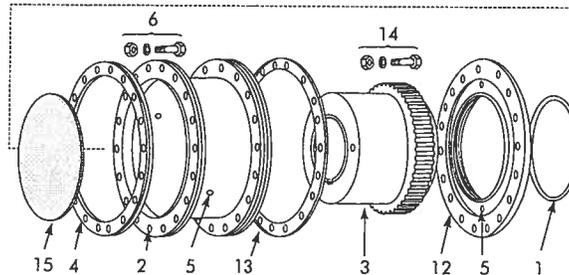
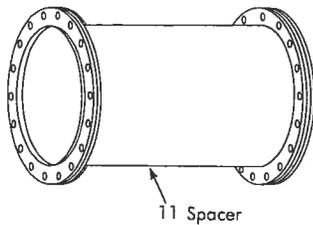
† O-Ring is used for Sizes 1130 thru 1300 and 2130 thru 2300.

## FLOATING SHAFT AND SPACER COUPLINGS



### TYPE G32

Parts 1 thru 14 shown above for Type G52 (delete 9 and 10) complete the balance of the spacer coupling.



- |                   |                                 |                                     |              |
|-------------------|---------------------------------|-------------------------------------|--------------|
| 1. Seal Ring      | 5. Lube Plug                    | 11. Spacer (specify length)         | 15. Gap Disc |
| 2. Flanged Sleeve | 6. Sleeve Bolt, Nut, Lockwasher | 12. End Plate                       |              |
| 3. G Flex Hub *   | 9. Rigid Hub *                  | †13. End Plate Gasket               |              |
| †4. Sleeve Gasket | 10. Floating Shaft              | 14. End Plate Bolt, Nut, Lockwasher |              |

\* Always specify bore and keyway. † O-Ring is used for Sizes 1130 thru 1300 and 2130 thru 2300.

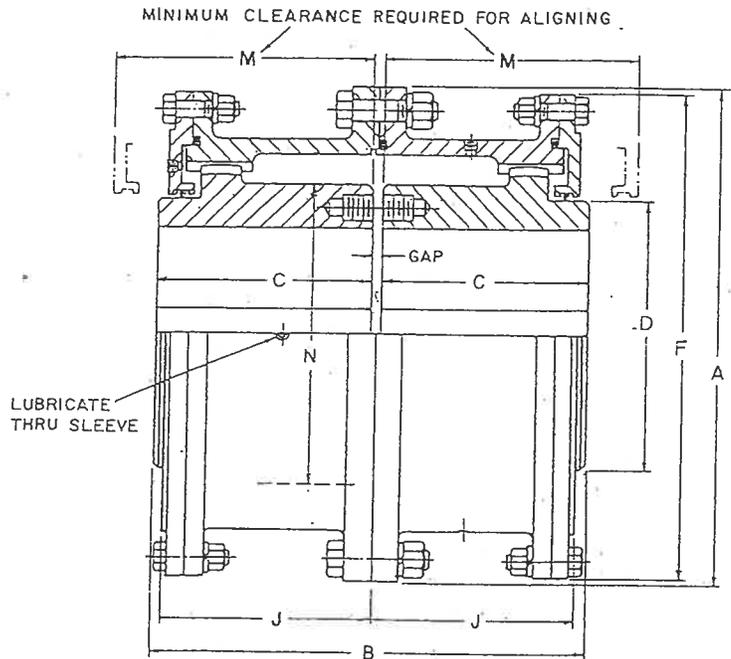
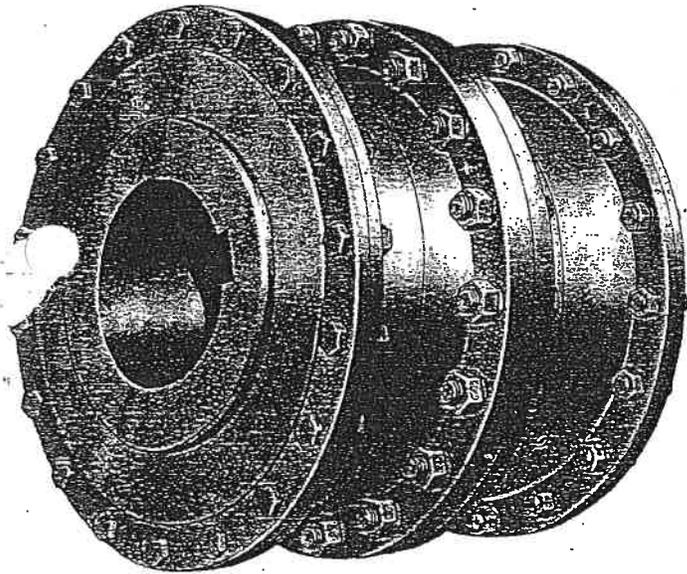
# Double Engagement Couplings

400E314

A series of gear couplings are offered, identical in configuration and dimensions, but different in construction material. Standard hubs and sleeves for the 1000 series are machined from carbon steel; alloy heat treated steel is used for the 2000 series.

Other features for both series include extra heavy end plates with thru bolt construction for steel mill service, end plate vent holes to permit flow-thru lubrication, controlled diameter Grade 5 center flange fasteners, extra thick hub shank diameters, and a large lubrication reservoir. Keyless hub fits with straight or tapered shafts, with or without provisions for hydraulic removal are available when specified.

## Type G20 Exposed Bolts



SIZE *	Torque Rating lb.-in. (millions)		Allow. * Speed rpm	Max † Bore One Rect. Key	Min. Bore ‡	Cplg Wt With No Bore-lb	Lube Wt lb	DIMENSIONS—INCHES								
	1000 Series	2000 Series						A	B	C	D	F	J	M	N	GAP
1080/2080G	1.323	2.070	1750	10.000	4.000	1550	21	23.25	20.00	9.81	14.00	22.50	9.56	11.81	14.50	.375
1090/2090G	1.795	2.791	1550	11.000	4.500	2170	27	26.00	22.25	10.88	15.50	25.25	10.44	12.88	16.50	.500
1100/2100G	2.520	3.919	1450	12.000	5.000	2870	33	28.00	24.50	12.00	17.50	27.50	11.56	14.00	18.50	.500
1110/2110G	3.465	5.393	1330	13.750	5.500	3700	39	30.50	26.75	13.12	19.50	29.50	12.69	15.12	20.50	.500
1120/2120G	4.410	6.880	1200	15.000	6.000	4660	46	33.00	28.25	13.88	21.50	32.50	13.44	15.88	22.50	.500
1130/2130G	5.261	8.190	1075	16.000	6.500	5720	72	35.88	30.00	14.62	23.00	34.88	14.25	17.12	24.00	.750
1140/2140G	6.426	10.080	920	17.000	7.000	6850	73	38.00	31.75	15.50	25.00	37.00	14.88	18.00	26.00	.750
1150/2150G	7.749	11.970	770	19.000	7.500	8300	90	40.50	33.75	16.50	27.00	39.50	16.06	19.00	28.00	.750
1160/2160G	9.450	14.490	650	21.000▲	10.000	10380	95	43.75	35.75	17.38	29.00	42.75	16.50	19.75	30.00▲	1.000
1180/2180G	12.600	18.900	480	24.000▲	11.250	13800	110	48.00	37.00	18.00	33.00	47.00	17.12	20.50	34.00▲	1.000
1200/2200G	17.010	25.200	370	27.000▲	12.500	18920	150	53.50	43.25	21.12	36.50	51.50	20.25	25.00	38.00▲	1.000
1220/2220G	21.420	31.500	290	30.000▲	13.750	25760	235	59.50	47.00	23.00	40.00	58.00	22.25	27.00	42.00▲	1.000
1240/2240G	26.460	39.690	270	33.000▲	15.000	32200	240	64.25	50.50	24.75	44.50	62.25	23.88	28.50	46.00▲	1.000
1260/2260G	32.760	48.510	250	35.250▲	16.250	39240	270	68.75	54.00	26.50	48.50	66.75	25.50	30.50	50.00▲	1.000
80G	39.060	59.850	230	38.000▲	17.500	46720	300	73.50	55.50	27.25	52.50	71.00	26.25	31.25	54.00▲	1.000
300G	47.250	72.450	220	41.000▲	18.750	54690	330	77.75	57.00	28.00	56.50	75.25	27.00	31.50	58.00▲	1.000

- Dimensions are for reference only and are subject to change without notice, unless certified. Gaskets are used of flange joints for Sizes 1120/2120 and smaller. DO NOT use 1000 series parts in 2000 series couplings. Sizes 1080/2080 thru 1130/2130G use all metal locknuts.  
 \* Consult Factory for higher speeds.  
 † Maximum bores listed are based on recommended keys shown in Table 5 on Page 18. For other maximum bore-key combinations that can be manufactured to order, refer to Table 6 on Page 18.  
 ▲ Reduced shank diameter hubs are available where required bore permits. See Table 12, Page 20, for selections.  
 ‡ Minimum bore is the smallest bore to which a RSB (rough stock bore) hub can be bored. Depending upon coupling size, rough stock bore hubs have only a blind centering hole or a small through hole that will permit remachining of the hubs to the minimum bores specified.

# Single Engagement Couplings

400 E 3 14

Standard single engagement couplings accommodate angular misalignment only.

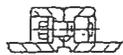
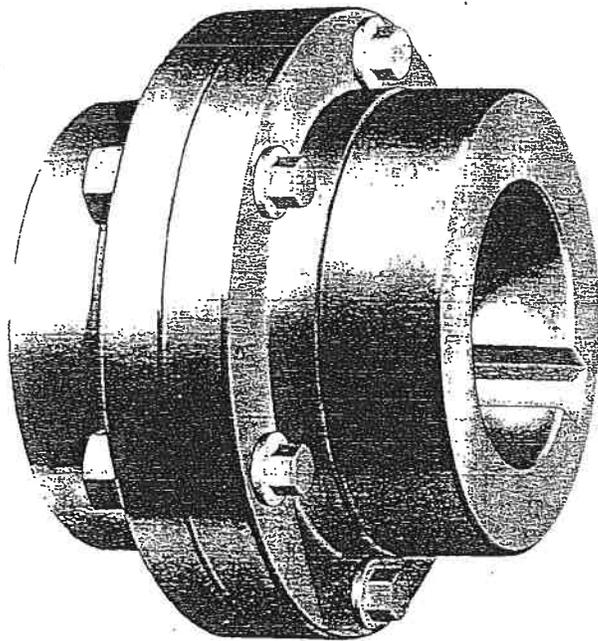
Used primarily with floating shaft assemblies as shown on Pages 12 and 13 but are also suitable for radial support of connected equipment. Consult Factory for radial load capacity.

For inclinations over 10°, use a Type GV52 coupling as shown on Page 15.

The Type G52 exposed bolt design allows the use of either open end or socket wrenches which makes it the preferred design for most industrial applications.

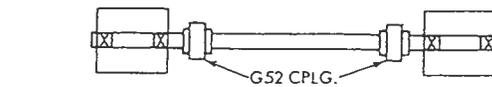
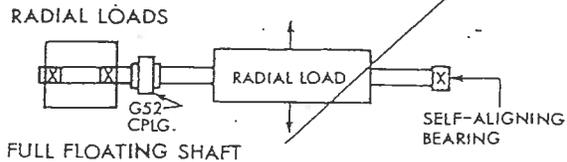
NOTE: When couplings are mounted on a floating shaft, use a gap disc in each coupling to center the floating assembly.

## Type G52 Exposed Bolts

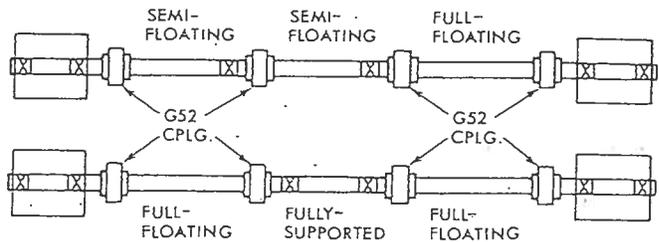


Type G51 Shrouded Bolts furnished only when specified on order

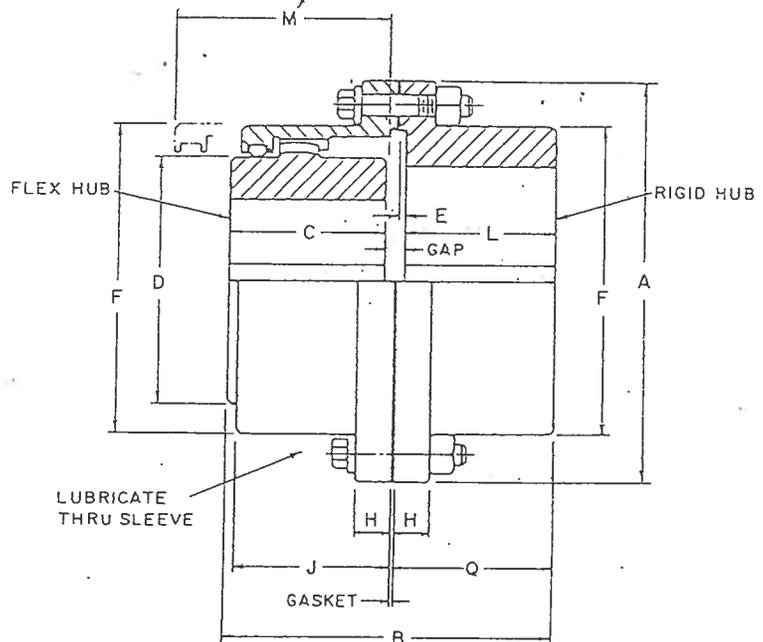
## Typical Applications



### COMBINATIONS



### MINIMUM CLEARANCE REQUIRED FOR ALIGNING



SIZE ★	Torque Rating lb.-in.	Allow. * Speed rpm	Max Bore†		Min Bore ‡	Cplg Wt With No Bore—lb		Lube Wt lb	DIMENSIONS—INCHES											SIZE ★	
			Flex Hub	Rigid Hub		G51	G52		A	B	C	D	E	F	H	J	L	M	Q		GAP
1010G	7,560	8000	1.875	2.375	.50	9	10	.05	4.56	3.41	1.69	2.70	.10	3.30	.55	1.53	1.56	2.00	1.66	.156	1010G
1015G	17,010	6500	2.375	2.938	.75	18	20	.09	6.00	3.92	1.94	3.40	.10	4.14	.75	1.88	1.82	2.40	1.92	.156	1015G
1020G	31,500	5600	2.875	3.625	1.00	30	35	.15	7.00	4.90	2.44	4.14	.10	4.98	.75	2.34	2.30	3.00	2.40	.156	1020G
1025G	56,700	5000	3.625	4.375	1.25	55	60	.26	8.38	6.12	3.03	5.14	.10	6.10	.86	2.82	2.90	3.60	3.00	.188	1025G
1030G	94,500	4400	4.125	5.125	1.50	85	95	.40	9.44	7.24	3.59	6.00	.10	7.10	.86	3.30	3.46	4.20	3.56	.188	1030G
1035G	144,900	3900	4.875	5.875	2.00	135	150	.60	11.00	8.43	4.19	7.00	.10	8.32	1.12	3.84	4.02	5.10	4.12	.218	1035G
1040G	220,500	3600	5.750	7.250	2.50	200	220	1.03	12.50	9.56	4.75	8.25	.16	9.66	1.12	4.38	4.54	5.70	4.70	.281	1040G
1045G	302,400	3200	6.750	8.125	3.00	285	300	1.25	13.62	10.75	5.31	9.25	.16	10.79	1.12	4.84	5.14	6.50	5.30	.312	1045G
1050G	409,500	2900	7.375	9.000	3.50	400	430	2.00	15.31	12.17	6.03	10.00	.20	12.04	1.50	5.54	5.80	7.20	6.00	.344	1050G
1055G	535,500	2650	8.250	10.000	4.00	555	580	2.50	16.75	13.76	6.62	11.00	.20	13.16	1.50	6.22	6.80	8.00	7.00	.344	1055G
1060G	693,000	2450	9.125	11.000	4.50	...	715	3.75	18.00	15.16	7.41	12.00	.26	14.41	1.00	6.65	7.34	9.00	7.60	.406	1060G
1070G	1,008,000	2150	10.875	13.000	5.00	...	1120	5.00	20.75	17.86	8.69	14.00	.33	16.73	1.12	7.70	8.67	10.50	9.00	.500	1070G

★ All sizes will be furnished as Type G52 unless otherwise specified on order. Sizes 1060 and 1070G available only as Type G52. For larger sizes, refer to Bulletin 451-120.

‡ Balancing may allow up to 50% increase in speeds shown, refer to Factory.

† Maximum bores listed are based on recommended keys shown in Table 8 on

Dimensions are for reference only and are subject to change without notice unless certified.

‡ Minimum bore is the smallest bore to which a RSB (rough stock bore) hub can be bored. Depending upon coupling size, rough stock bore hubs have only a blind centering hole or a small through hole that will permit remachining of the

#### 5.4. RACO Actuator

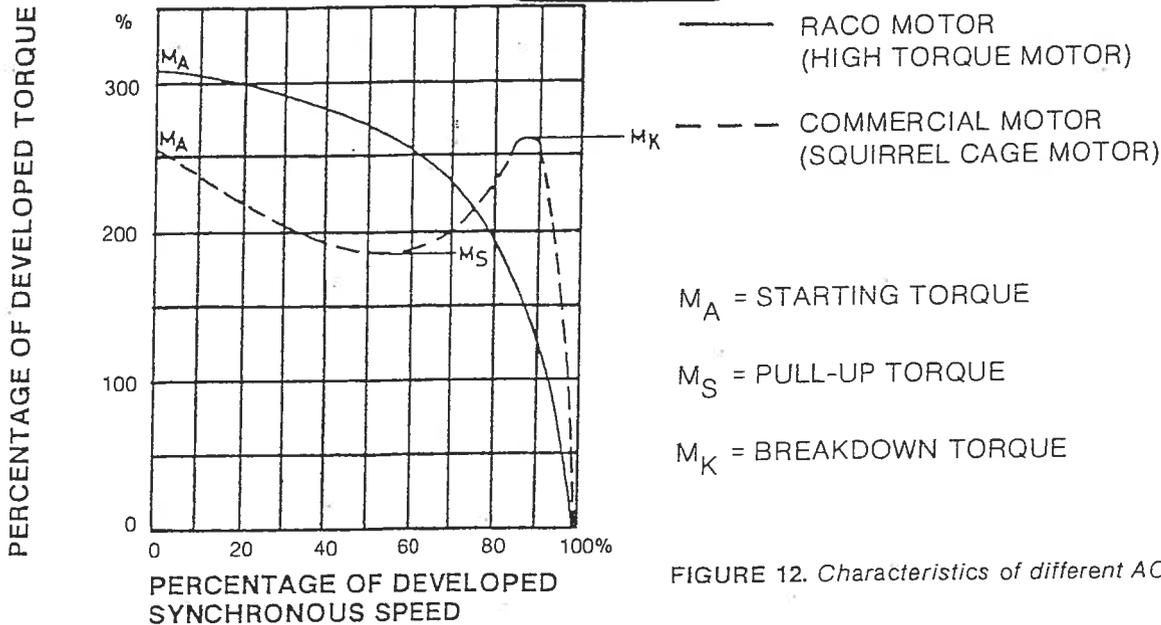


FIGURE 12. Characteristics of different AC motors.

### RACO MOTOR VS. COMMERCIAL MOTOR

Commercial motors, such as the standard NEMA squirrel cage motor, are designed and wound to deliver a constant speed, regardless of the torque demanded by the load. The speed should not drop off noticeably in case of overload, unless the overload gets too high, and then the motor should stall. High frequency of reversals can lead to severe overheating and to structural damage in the windings.

The RACO MOTOR, developed specifically for actuator duty or similar applications, is wound for the opposite criteria. It must start easily and fast and must develop the maximum torque within the shortest possible time. In addition to the very high starting torque the RACO MOTOR also has the feature of a uniformly decreasing torque versus speed (see Fig. 12).

The RACO MOTOR has a low starting current and inertia so that rapid and repeated jogging and plugging service, which might be destructive to a commercial motor, does not affect a RACO MOTOR.

The housing of a RACO MOTOR is made of aluminum, which will, due to the high thermal conductivity, conduct the heat developed by the motor. A RACO MOTOR is always type TENV (totally enclosed - non-ventilated) as it does not need the additional protection of a fan.

Contrary to commercial motors, which have insulation Class "B" (266° F) as standard, all RACO MOTORS come with insulation Class "F" (311° F) as standard and without extra charge. Commercial motors with higher insulation Classes "F" or "H" (356° F) are available upon request, also the RACO MOTOR is available in Class "H".

### BREAKAWAY THRUST AND BREAKDOWN TORQUE

Fig. 12 shows the comparison of characteristics of a RACO MOTOR and a typical NEMA motor. It shows very clearly that the starting torque of a RACO MOTOR is much higher than any commercial motor due to the special design features of the RACO MOTOR. This means it also has a higher breakaway force than any commercial motor.

In case of an overload situation, the commercial motor will slow down in speed until the breakdown torque is reached at approximately 85% to 90% of the rated speed. At speeds lower than 85%, the commercial motor's torque output starts to drop drastically, causing it to become weaker as more load is applied to it. After passing the breakdown torque, the commercial motor will burn out quickly if load is not removed or motor de-energized.

The RACO MOTOR does not have a breakdown torque. It develops an ever increasing amount of torque as more and more load is applied to it, making it perfectly suitable for actuator duty since very seldom do the load demands remain constant. Since the RACO MOTOR is designed to operate (i.e., develop maximum torques) over its full RPM range, overloading will not damage it. It will also burn out eventually — as any AC motor — if the motor is allowed to remain energized during a locked rotor or stalled condition, unless it is equipped with our electronic thrust overload protection which will shut off the actuator automatically.

All RACO MOTORS are available with a warranty of 4 years when equipped with the thermistor protection and the optional electronic thrust overload protection RPM.

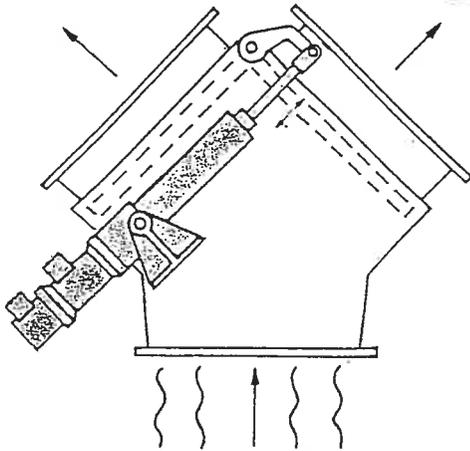


FIGURE 15. Electric actuator to operate diverter valve.

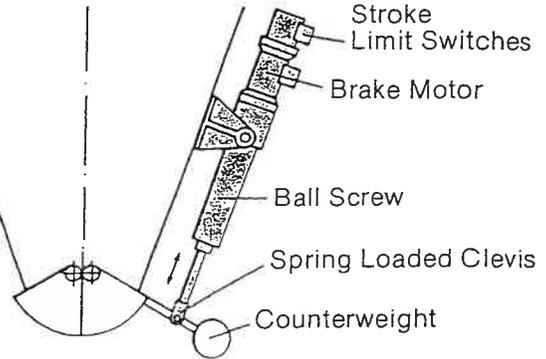


FIGURE 16. Safety application for bin gate. Counterweight closes gate automatically in case of power failure.

### ACME THREAD VS. BALL SCREW

RACO Electric Actuators can be equipped with ball screws instead of the standard Acme thread. These ball screws, totally made in our own factory, consist of a high precision, hardened, threaded rod with ultra-precision ground balls held in a custom-made nut.

RACO Ball Screw Actuators have an efficiency of at least 90% which is approximately three times higher than actuators with an Acme thread. A brake motor has to be used to ensure high accuracy of positioning and to maintain the selected position of the actuator.

Due to the low friction of the ball screw, the lifetime of an actuator can be increased up to 10 times.

	Actuator with Acme Thread	Actuator with Ball Screw
Life Expectancy	100%	1,000%
Starts per minute	100%	300%
Efficiency	100%	225%
Energy consumption	100%	40%
Capacity drive motor	100%	33%
Lubrication requirement	100%	10%
Preventive maintenance	100%	10%

For high-duty cycles, increased accuracy in positioning, increased life, reduced overall costs, reduced energy costs, and considerable savings in maintenance, select RACO Ball Screw Actuators.

### SAFETY ACTUATORS - BRAKES

Actuators equipped with a ball screw can be used as safety actuators, such as opening or closing a gate in case of a power failure. Ball screw actuators normally have to be equipped with a brake.

Our power release brake "L" applies braking force when power is off. Power is required to release the brake. The brake can also be released manually if equipped with a manual release. Application: moving heavy loads vertically.

Brake "B" is a power set brake which is released when power is off. A counterweight system provided by the customer or a spring incorporated into the actuator can be used to retract or extend the actuator to open or close a device if power is lost.

All brakes are DC brakes, however, a rectifier is built into the motor terminal box to convert AC into DC current, if necessary. Brakes are available for different AC input voltages, such as 24, 110, or 220 volts.

Fig. 16 shows a safety application of a ball screw actuator for a bin gate.

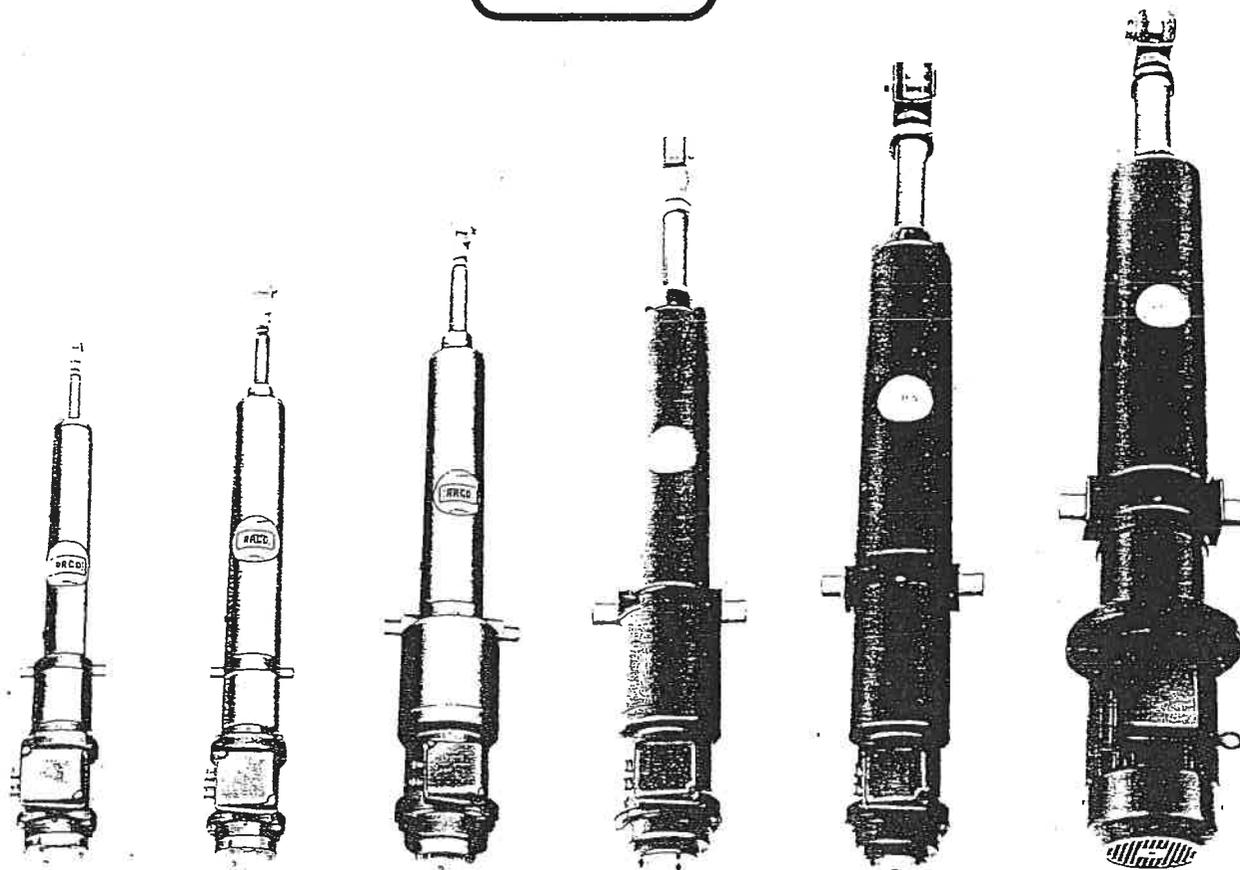


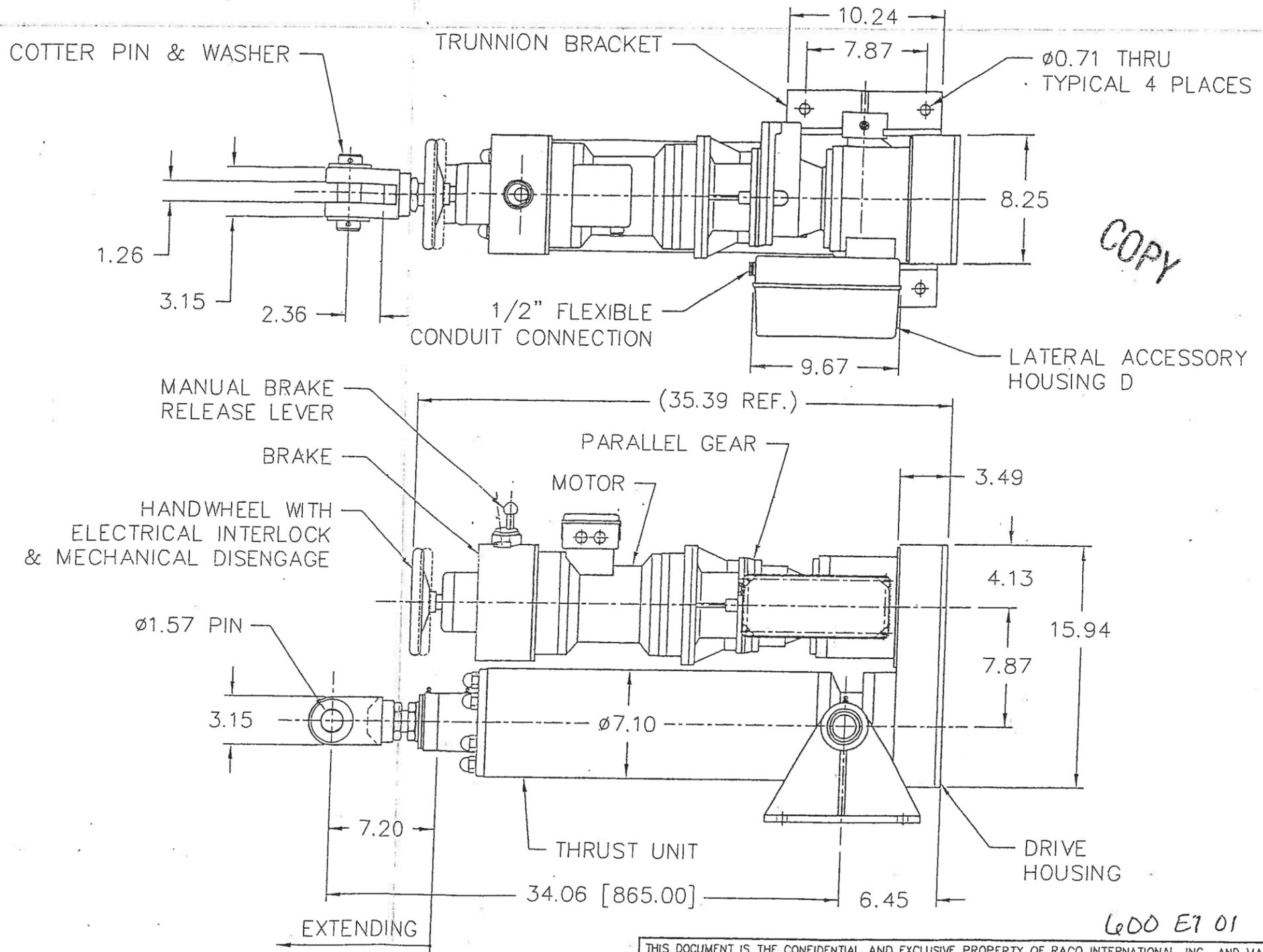
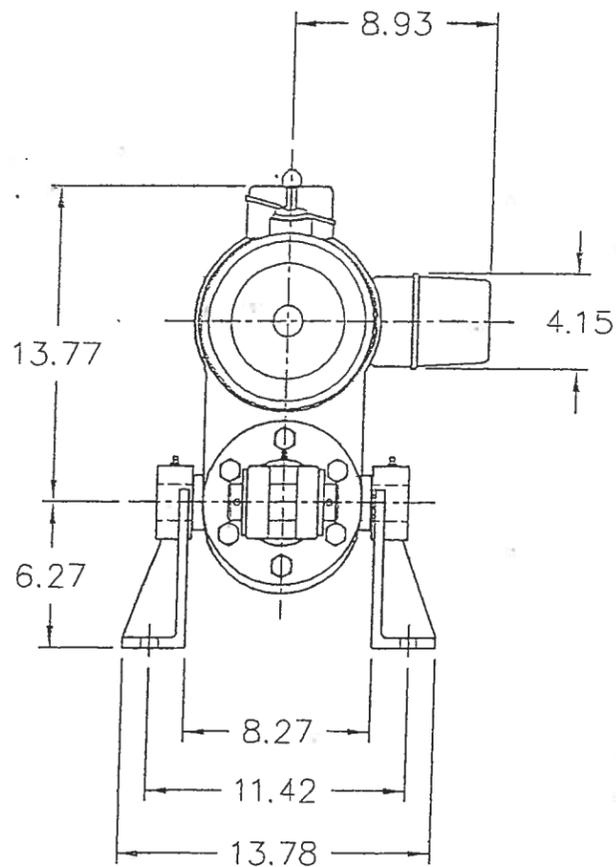
FIGURE 1. RACO electric actuators, sizes 3-8, basic actuators without accessories.

## ADVANTAGES OF RACO ELECTRIC LINEAR ACTUATORS

- Modular system allows custom-built units
- 2 year warranty for thrust unit
- 4 year motor warranty available
- Totally weatherproof
- Explosion-proof actuators available
- Reliable repeatability in positioning with brake or servo motors
- Holds position accurately & indefinitely
- Noiseless
- Precise positioning within 0.0004" possible
- Suitable for high duty cycles
- Safety applications possible
- Can be equipped with servo-motors
- Tested for minimum of 1 million strokes with ballscrews
- Suitable for computer controlled operation
- Electronic thrust overload protection available
- Standard thrusts up to 200,000 lbs.
- Standard strokes up to 78.7"
- Standard rod speeds up to 11.3 in./sec.
- Maximum thrusts up to 200% higher than rated thrust
- Static loads higher than rated thrust
- Non-contaminating - environmentally safe
- Suitable for corrosive environments
- Controls and accessories are field expandable
- Electronic remote control possible
- Radio remote control possible

**TECHNICAL DATA**

TYPE: MA7 BALLSCREW ACTUATOR  
 TYPE CODE: LBR K1N7 ZMZAAIZ  
 THRUST: 8800 LBS. (40000 N)  
 ROD SPEED: 0.7 IN/SEC  
 STROKE: SPECIAL 12.6 (320mm)  
 MOTOR VOLTAGE: 230/460/3 Ph/60  
 MOTOR DATA: 1.7 KW, 3.5 FL AMPS  
 TEMP RANGE: -40°C TO 100°C  
 APPROX. WEIGHT: 315 LBS  
 APPLICATION: STUTSON ST BRIDGE - REAR LOCK



COPY

600 E7 01

**NOTES:**

1. ALL DIMENSIONS ARE IN INCHES UNLESS [NOTED].
2. ACTUATOR IS SHOWN IN RETRACTED POSITION.
3. THRUST TUBE DIAMETER 2.4"

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REVISIONS			<b>RACO INTERNATIONAL, INC.</b> P.O. BOX 151 BETHEL PARK, PA 15102
1	ADDED TECHNICAL DATA ON 06-04-02 BY C.McKOWN		
TITLE: GENERAL ARRANGEMENT OF A SIZE 7 ELECTRIC ACTUATOR, C-DESIGN WITH TRUNNION BRACKETS, BRAKE AND HANDWHEEL: SPECIAL STROKE = 12.6 [320]			
SCALE 1/8	DR. BY C.McKOWN	DRAWING NO.	
DATE 03-21-02	CK'D. BY WCM02	GANQD001	

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## **Section 1 General Information**

This manual contains mechanical and electrical installation, operating and maintenance instructions for sizes 2, and 4 to 11 **MA** series **Modular Actuators** manufactured and distributed by RACO International, L.P. The instruction manual may be updated from time to time without prior notification and may be supplemented by additional vendor information as it deemed to be necessary by the supplier. A requirement of fault free operation and fulfillment of any rights to claim under guarantee is that you read, understand and adhere to the entire information in the installation, operating and maintenance instructions before you start to install and operate the equipment.

The installation, operating and maintenance instructions contain important information about the unit and its functionality and are intended for users having technical expertise and are thoroughly familiar with the machinery or the environment in which the actuator(s) is (are) integrated. Please keep this manual accessible for further use and for your fellow co-workers. They will thank you.

### **Intended Use**

The equipment described in this manual is intended for industrial applications only and should not be used to lift, support, or otherwise transport personnel unless you have written approval from RACO International, L.P. which authorizes the specific actuator unit, as used in your application, as suitable for moving personnel. It is important that you analyze all aspects of your application and review the information concerning the product or system in the current product offer. Due to the variety of operating conditions and applications for the product or system, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

Take a moment to analyze your present environmental conditions and potential hazardous locations in regards to areas containing flammable vapors, liquids, gases or combustible dusts or fibers. Refer to the NFPA 70E or NEC article 500 guidelines for hazardous area and zone classifications. Make sure that the delivered actuator fulfills the requirements of your local jurisdictions. Do not use in highly corrosive or extremely wet or submersible environments without prior written approval from RACO International, L.P.

Do not use in applications involving extended exposure to temperatures below -14deg F or above 120 deg F without prior written approval from RACO International, L.P.

### **Safety Notes**

If the electrical control and power system is not supplied by RACO it is the responsibility of the user to select, install, maintain the appropriate actuator motor circuit protection. This includes, but is not limited to, the selection of the branch breaker or fuses and the overload selection. If variable frequency drives (VFD) or servo drives (SD) are used, the appropriate parameters have to be set in that way that the actuator is adequately protected from overloading in dynamic and static conditions. Make sure that the thermal over temperature protection devices are integrated and connected into the control circuit.

Make sure that all interconnecting wiring circuits are complying with the most recent National Electric Code (NEC) guidelines, local jurisdictions and/or your plant regulations.

Make sure that the nameplate voltage and frequency for the motor, brake and control equipment matches with your supply voltage and frequency. Double check the star/delta jumper setting in the motor terminal housing in accordance with your supply power.

Observe all applicable Occupational Safety and Health Act (OSHA) requirements during installation, operation, maintenance and/or service of the supplied RACO electrical actuators. In particular, observe the lockout and tag out procedures. All electrical power must be securely disconnected before performing any work on the actuator. Please be reminded that stored energy may be present. Secure all hanging, spring loaded or otherwise possible shifting equipment. Failure to do so can cause harm, injuries or death and/or damage to the equipment.

All RACO actuators are shipped with clearance to the end of the design stroke limit to allow for testing upon initial start-up for proper electrical phase connection and confirmation of proper travel direction. These clearances are critical to prevent accidental over-stroke damage in the event of initial wiring errors. Make sure that the designated end of stroke limit switches are wired into the correct reversing starter coil circuit.

RACO electrical Actuators are usually supplied with, and always recommended to be used with, end of stroke limit switches. In this configuration two normally closed switches are set in a way, that each switch is monitoring respectively, each end of the design stroke. When properly connected into the motor control circuit, the limit switch will open up when the design stroke limit is reached and will disconnect control voltage to the respective starter coil, which will disconnect power from the motor. Over stroking of the actuator in either direction can cause binding, jamming or even destruction of the actuator and/or the attached equipment. Make sure that the physical limits of the attached equipment are beyond the setting of the design stroke limits of the actuator.

Be aware the motor supplied with your RACO product MAY be capable of delivering more torque than is required for your particular application, and indeed may be capable of delivering a higher torque than the maximum rating of the RACO product. In the event of unforeseen interference or higher than designed force or loads, the LOCKED ROTOR or stall torque capability of the motor may cause damage to the RACO product or the surrounding equipment. If the motor control selected does not provide maximum thrust or power limiting capability, install separate, RACO recommended current, power or RPM monitor protection devices with trip points selected not to exceed the nominal thrust rating of the actuator.

## **Precautions**

During and after operation carefully check all device surfaces for high temperature when touching any part. Always allow sufficient time for surfaces to cool down before maintenance, service, disassembly, or any other work or inspection is performed. Surfaces may be hot enough to cause pain and injury.

Installation, maintenance, and service should be performed only by qualified, trained personnel, who are familiar with the installation, construction and operation of the device and the surrounding machinery. Use only genuine RACO parts for repairs and maintenance to ensure safe, proper performance and operation. If you have any doubt in the qualification of the intended repair facility, do yourself a favor and send the actuator to RACO'S qualified in-house repair shop to guarantee proper repair.

## **Section 2 Receiving of Shipment**

### **Inspection**

Immediately upon receipt of any RACO product, inspect the entire shipment including the packaging for evidence of damages of any kind. Compare the received goods with the itemized packing list and account for all items. There may be smaller items in the crate or packing container as well. All RACO products are inspected prior to shipment and are released for shipment confirmed in good condition. RACO products are shipped FCA from the RACO factory in Bethel Park, Pennsylvania. It is the responsibility of the receiving party to recognize damage on receipt and process claims for any damage with your freight carrier.

### **Unpacking and Lifting Information**

Small actuators are packaged in cardboard boxes with internal support and/or filling material. Larger actuators are packaged on a wooden skid or in a wooden crate. If strapping band material is used be advised that the band is under tension and may have sharp edges or corners. Wooden crates are constructed with nails, staples and/or screws. Always wear OSHA approved gear, like safety glasses, gloves, hardhats, back support as required if unpacking or handling the equipment.

### **Lifting Points**

Small actuators can be lifted and handled without any lifting devices. Make sure that the actuator is placed in a secure fashion onto a solid surface since the center of gravity may not be obvious. Larger actuators have to be lifted and handled with an overhead crane. Make sure that all bracing which holds the actuator securely in the crate is removed. Use appropriate rated rigging slings. Fasten the slings securely on multiple points on the actuator. Do not use lifting lugs on the motor or gearbox, these lifting points are designed by the gear box or motor supplier to lift the respective part only. Lift slowly and observe any shifting or rotating of the actuator. Never position yourself under any hanging load. After the actuator is removed from the shipping container make sure that the actuator is placed in a secure fashion, V-blocks or bracing may be required, onto a solid surface since the center of gravity may not be obvious.

### **Disposal of Packing Material**

All packing material should be disposed in accordance with the local regulations. Be environmentally responsible since you just unpacked an environmentally friendly actuator which does not contain any hazardous hydraulic fluids and enables low electrical energy consumption.

### **Extended Storage**

If the actuator is not mounted immediately after arrival at the job site, the actuator should be stored in a dry and vibration free area in a horizontal orientation. Make sure the actuator is well supported and the thrust tube is in the retracted position. Non painted surfaces should be treated with a light oil or grease film. If the actuator is stored with the trunnion brackets attached lubricate the trunnion pins via the zerk fitting. The storage temperature should not exceed a range of 14 degrees to 104 degrees Fahrenheit (10 to 40 degrees Celsius). If storage exceeds 2 years it is recommended to completely replace all lubrications

## Section 3 Installation

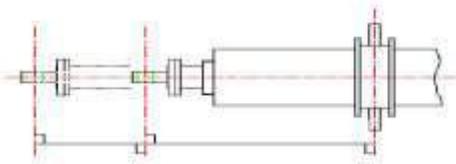
### Mechanical Installation

Before starting the mechanical installation make yourself familiar with the conditions in regards to location, the physical space where the actuator will be installed, environmental conditions, type of foundation as far as concrete pad, steel structure and or steel beams. Check mounting bolt pattern, bolt sizes and SAE grade strength of bolts with the installation drawings. Most actuators are supplied with front end clevises or spherical rod ends. Check the engagement of the forks and or the pin size with the mating piece. All RACO Actuators are delivered with the thrust tube extended around one inch to allow for checking of movement in the anticipated direction. Have a plan for lifting and rigging of the actuator into its final mounting position. Confirm weight of the actuator, lifting points and center of gravity. Never install eye bolts on motors and or gearboxes. These lifting positions were installed by the motor or gearbox manufacturer to lift the individual item only.

### Alignment

Proper alignment of the actuator is essential to guarantee a long and trouble free operation of the actuator. Even though the actuator can tolerate a side loading of up to 10% of its nominal thrust rating, premature wear of the front bushing, thrust tube, nut and screw assembly and an increase in power consumption are the result. In cases where side loads or bending forces are extremely high, jamming or stalling of the actuator may occur or bending of the thrust tube, screw and or attached equipment. Make sure that the actuator is mounted firmly to the foundation. Use shims or other means to ensure level and parallel mounting of the trunnion pin brackets. The center line of the actuator should be on the center line of the attached equipment which should be moved, rotated, pushed and pulled or otherwise agitated. Make sure that over the full stroke of the actuator the attached equipment performs a movement which follows the centerline of the actuator in horizontal and vertical direction. An easy way to check the linear alignment in the field is by connecting the load to the actuator in the retracted position. Observe the mounting position between the two connected pieces. Disconnect the load from the actuator.

### Trunnion Pin Mount



With the trunnion pin mount one dimension of freedom of movement can be achieved. The freedom of movement is exactly  $90^\circ$  to the centerline of the trunnion pins. Make sure that over the full stroke of the actuator the clevis or spherical rod eye, as well as all other parts of the actuator, can pivot freely around the circular movement on the trunnion pins. All RACO supplied trunnion pins are manufactured out of stainless steel. Dependent on the customers, design of the trunnion pin receptacle may be lined with a bushing, which may or may not require lubrication. Ensure that a good fit and sufficient surface area is provided to transfer the thrust forces into the equipment foundation.

### Bracket Mount

RACO trunnion brackets are designed for the individual sizes of Actuators out of the RACO Modular Actuator program and provide easy installation with one dimension of freedom of movement. Make sure that the mounting hole pattern of the trunnion bracket is transferred to the foundation and a flat and smooth surface is provide to ensure a plum an secure connection between both surfaces. Check for angular and or height misalignments between the trunnion brackets and the centerline of the actuator. Shims may be used to correct that problem. The standard RACO trunnion brackets are manufactured out of cast iron with machined surfaces

for the trunnion pin hole and the foundation surface to guarantee true angular alignment and adequate clearances with defined tolerances. The trunnion pin hole is equipped with a center grease relief groove and a connecting zerk fitting. After the trunnion brackets are installed on the trunnion pins of the actuator during the initial installation the grease relief grooves and the trunnion pin hole has to be filled with grease. See 3.11 for grease type. Apply grease until it becomes visible between the trunnion pin and the trunnion bracket hole. Periodic re-greasing is required. The time interval depends on the angular movement, the duty cycle and ambient conditions.

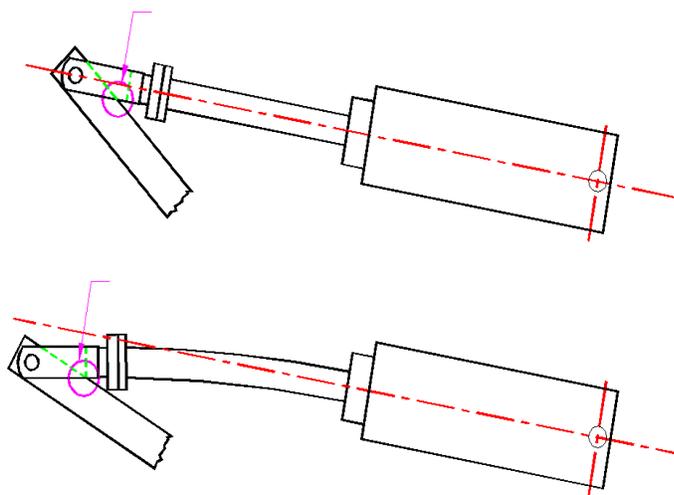
Recommended Interval & Amount:

Bracket Size	Amount in ounces	Interval
4 / 5	0.125	Six months
6 / 7	0.15	Six months
8	0.2	Six months
9 / 10 / 11	0.3	Six months

Trunnion brackets for actuators sizes 9 to 11 are steel fabrications with machined surfaces for the trunnion pin hole and the foundation surface.

If self-lubricating DU bushings are used the zerk fitting is removed and replaced with a plug. No greasing is required.

## Clearance



## Electrical Installation

Before starting the electrical installation make yourself familiar with the installation conditions in regards to location, temperature conditions, distance between the actuator and the Motor Control Center (MCC) installation method cable; tray, ridged conduit, underground, race way etc. Study the electrical drawings and compare the nameplate information of the actuator, in particular, voltage and power requirement with the installation drawings. Wiring and installation should be performed in accordance with the most recent National Electric Code (NEC) regulations as well as any applicable local ordinances and/or plant specifications. In particular observe Article 310-15b and Article 215-2b in regards to wire size, voltage drop and distance. In most installation cases the actuator is rotating at least in one dimension at the trunnion brackets. RACO recommends the use of flexible cable to wire to the motor terminal housing and the accessories. Power and control cable should be separated from each other.

## Section 4 Motor Power

### Reversing Motor Starter

The UL 489 branch circuit breaker or fuse, reversing motor contactors and motor overload relay should be sized in accordance with the NEC guidelines. It is recommended to use either mechanically interlocking reversing motor contactors or install electrical interlocking contacts in the control circuit. The normally closed actuator switches should be directly hard wired into the control circuit to interrupt independently from other control equipment as well as the control power to the starter coils. Please be advised that in most cases the branch circuit breaker and/or motor overload relay are designed and sized to protect and limit short circuit faults and/or, long term overloading of the motor. These devices may not protect the motor or actuator from damage due to mid stroke obstructions. Always install the thermal temperature switch or thermistor device into the control circuit for additional protection.

### Motor Brake

Electrical motor brakes are available in a variety of different functions, forms, and electrical connection schemes. The most common function is the type L holding brake. If no power is applied to the brake coil a spring loaded package will apply holding forces to the brake disk and securely hold the actuator in place up to the nominal thrust rating of the actuator. The opposite function is the type B or power applied holding brake. If power is applied to the brake, the magnetic field of the brake coil will overcome the spring forces and securely clamp the brake disk and hold the actuator in place. Most motor brakes are designed with a DC coil. The DC power is generated via a half wave or full wave rectifier. The following table shows the relationship between supply voltage, rectifier connection and rectifier type in a three phase five wire circuit:

Supply Voltage	Rectifier Connection	Rectifier Type	Resulting DC Coil Voltage
460V AC	Phase/Phase	Full Wave	414V DC
460V AC	Phase/Phase	Half Wave	207V DC
460V AC	Phase/ MP	Full Wave	240V DC
460V AC	Phase/ MP	Half Wave	120V DC
230V AC	Phase/Phase	Full Wave	207V DC
230V AC	Phase/Phase	Half Wave	103V DC
230V AC	Phase/ MP	Full Wave	133V DC
230V AC	Phase/ MP	Half Wave	60V DC

MP = middle point or star point

Some brakes are equipped with a manual brake release lever. Before operating the manual brake release lever ensure that no stored energy is present or the load is sufficiently blocked, especially if the actuator is equipped with a ball screw. Due to the high efficiency of the power screw the load will back drive the actuator. If unit is equipped with a hand operator it is possible to use it after releasing the brake. To speed up the reaction time of the brake circuit, different wiring schemes may be utilized as follows:

- Separate contacts out of the starter to control the brake
- Contacts on the DC side of the rectifier
- Diode snubber circuit
- Two coil brake
- SEW Eurodrive type quick brake wiring

Please consult RACO International L.P. before implementing above designs since life expectancy of the brake and the dynamic behavior of the actuator may be affected. Since brake pads are a wear item, please refer to the maintenance section of this manual.

## **VFD**

The UL 489 branch circuit breaker or fuse should be sized in accordance with the NEC guidelines and the Variable Frequency Drive (VFD) manufacturer's installation manual. Additional contactors may be required if the actuator is equipped with a motor brake. If the VFD is purchased from RACO International, L.P. in conjunction with the actuator, unless otherwise specified, all drive parameters are preset to operate the drive. Fine tuning of overload, thrust limits, acceleration and deceleration times and optional dynamic DC braking may be required.

Please refer to the VFD manufacturer's installation manual for the maximum cable length between the drive and the actuator motor and the type and size of wire before performing the installation.

During start-up, if possible, start out with a low frequency setting to observe the movement of the actuator in slow linear speed motion and to verify intended direction, setting of end of stroke limits and or other possible interferences.

## **Thrust Overload Protection**

As mentioned above the overload relay in a conventional motor control center is not designed to fully protect the motor from overheating and burn out, especially at mid stroke obstructions and/or sudden overloading of the actuator. For complete protection, special thrust overload devices can be added to protect the motor as well as the actuator and the attached equipment from damage, up to destruction. Different methods are available at RACO's disposal to achieve that goal:

- Motor current monitoring
- Motor power [ $P = U \cdot I \cdot \cos(\phi)$ ] monitoring
- Motor RPM monitoring
- Load cell feedback monitoring

RACO recommends installing a thrust overload device in a form of an external current or power monitoring relay in the motor control starter bucket. Motor RPM monitoring is achieved with RACO's electronic position system EPS 06 in combination with limit switches and analog feedback signal mounted on the actuator in A, B, C or D housing or as part of RACO's VFD package.

## Section 5 Limit Switches & Auxiliary Equipment

### Electronic Limit Switch

The **EPS02** and **EPS06** are the newest additions in the line of RACO Limit Switches. The rotation of the motor or screw shaft will be transmitted in a non-contact form via a magnetic field to the circuit board. Here it will be converted into 512 pulses per revolution. The pulses will be counted, processed and stored in non-volatile memory. Even under loss of power the absolute position will be retained.



The **EPS02** is the basic version with two independent tiers of end of stroke limit settings connected to relay output contacts (250VAC, 5A). Single or multiple stop points can be defined on each tier. A serial RS232 communication interface allows easy configuration and setup of the limit switches.

The **EPS06** is the advanced version, utilizing the components of the **EPS02**, by connecting the expansion board via a ribbon cable. The expansion board enhances the **EPS06** functions to include a scalable analogue output signal 4-20mA and or 0-10VDC, a pulse width modulation output signal and up to three additional pairs of limit switches. Rotational speed supervision is also possible. The expansion board provides a USB interface port.

The EPS 02 and 06 are a direct replacement for the classical RACO mechanical limit switches and can be mounted in the same accessory housings.

For installation of the RACO Setup PC Tool software, interface connection and parameter setting please refer to the EPS software manual.

[http://www.racointernational.com/PDF\\_DS/RACOTool\\_V1.8.7.zip](http://www.racointernational.com/PDF_DS/RACOTool_V1.8.7.zip)

#### Technical Data:

Board level supply voltage: 24V DC,

Required supply current:

EPS 02 100mA

EPS 06 600mA

Ambient temperature range: -40F to 185F

Accuracy: +/- 1% of full range

Hysteresis: < 0.004" (0.1mm) stroke

Protection class: IP 54, optional IP 65

#### EPS 02

Relay Output, two channels: 250V AC / 5A; 30V DC / 5A

Input signals; two channels: 24V DC

#### EPS 06

Relay Output, two channels: 250V AC / 5A; 30V DC / 5A

Open collector, four channels: 24V DC / 100mA each

Input signals; four channels: 24V DC

Analog output: 0(4)-20mA, 0-10V DC

Digital output: Pulse width modulation, 24V DC

## Section 6 Maintenance

### Lubrication



Trunnion brackets should be lubricated immediately upon installation.



Before performing any maintenance on any RACO actuator follow the lockout and tag out procedure and/or any site specific safety procedures. Secure all attached loads. Please be reminded that stored energy may be present. All RACO actuators are initially factory lubricated. Based on the type of actuator, environmental condition and duty cycle develop a maintenance schedule based on the below parameters and stick to it. Purchase the recommended grease type and a grease gun to be ready whenever your first maintenance routine starts.



### Grease Type

If not otherwise specified, the actuators are lubricated with Conoco Phillips Dynalife L-EP 1. It is a lithium 12-hydroxystearate soap thickened grease compounded with lead free, extreme pressure agents which provide excellent load carrying and anti-wear properties in both steel on steel and steel on bronze applications. In addition, the grease effectively inhibits oxidation and rust.

### Conoco Phillips Dynalife L-EP 1

Typical Properties:	
Soap Type	Lithium 12-Hydroxystearate
Penetration @ 77.F W 60	325
Usable Temperature Range	-18°C to124°C, 0°F to255°F
Color	Amber
Texture	Smooth
4-Ball E.P. Test	275 kgf
Timken Test	40 lbs
Steel Corrosion	Pass
Dropping Point	177°C , 350°F
Viscosity @ 40 deg C	175cST
Viscosity @ 100 deg C	13.0cST
Flash Point	220 °C, 428°F°

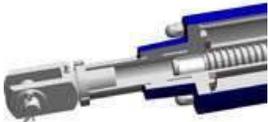
For demanding outdoor applications and applications close to marine environments Exxon Mobilith SHC460 grease will be used.

It combines the unique feature of a polyalphaolefin (PAO) synthetic base fluid with those of a high quality lithium complex thickener. The lithium complex thickener contributes excellent adhesion, structural stability and resistance to water in addition to extended high and low temperature performance.

## Exxon Mobilith SHC460

Typical Properties:	
Soap Type	Lithium complex
Penetration @ 77.F W 60	305
Usable Temperature Range	-50°C to 230°C, -58°F to 446°F
Color	Red
Texture	Smooth
4-Ball E.P. Test	250 kgf
Timken Test	50 lbs
Steel Corrosion	Pass
Dropping Point	255°C , 491°F
Viscosity @ 40 deg C	460cST
Water Washout ASTM D 1264	3
Loss at 79°C, % wt	
Flash Point	204 °C, 400°F°

### Lubrication Points



Dependent upon the type, size, configuration and accessories of your particular actuator, there may be multiple lubrication points on the actuator. In general all lubrication points are equipped with a zerk fitting for easy connection to a grease gun. If no zerk fitting is installed no lubrication is required. If a rod cover is installed, lubrication points may be obscured by the rod cover and or the fastener band. The most common lubrication points are located at the clevis on size 4 and 5 MA actuators, and at the stop plate on our size 6 actuator and all trunnion brackets if equipped. The thrust bearing, motor bearings and gearbox are considered permanently lubricated. Most maintenance free applications are equipped with DU bushings at the front cap as well as stainless steel to PTFE fabric on sliding surfaces as installed on the radial spherical bearing at the rod end.

### ACME Screw

The ACME screw and nut system must be re-lubricated approximately every 10,000 strokes or after one year, whatever comes first. Please refer to below chart for the re-lubrication quantity. After the prescribed amount of grease is injected into the clevis or stop plate zirk fitting, the actuator should be retracted into the complete end position and then cycled for a full stroke. This procedure ensures that the new grease is distributed over the entire length of the ACME screw. It may be required to disconnect the actuator from the load or readjust the limit switches to achieve the full stroke cycle. Secure load as required.

### Ball Screw

The ball screw and nut system must be re-lubricated approximately every 100,000 strokes or after one year, whatever comes first. Please refer to below chart for the re-lubrication quantity. After the prescribed amount of grease is injected into the clevis or stop plate zerk fitting the actuator should be retracted into the complete end position and than cycled for a full stroke. This procedure ensures that the new grease is distributed over the entire length of the Ball screw. It may be required to disconnect the actuator from the load or readjust the limit switches to achieve the full stroke cycle. Secure load as required.

## Brackets

Trunnion brackets should be lubricated immediately upon installation.



If the actuator is supplied with RACO trunnion brackets, the same Conoco Phillips Dynalife L-EP1 or Exxon Mobilith SHC460 should be used. Attach the grease gun to the zerk fitting and apply grease into the fitting until the old grease is forced out of the trunnion pin hole and the grease relief groove. Wipe off the old and excess grease from the trunnion pin and bracket. Periodic re-greasing is required at least once per year. The time interval depends on the angular movement, duty cycle and ambient condition. Dispose of old grease and used rags in accordance to your local environmental guidelines.

## Front Cap

If the front cap is supplied with a zerk grease fitting the type of grease specified on the lubrication sticker found on your actuator shield tube should be used. Attach the grease gun to the zerk fitting and apply grease into the fitting until back pressure builds up. During operation of the actuator a light grease film should be present on the thrust tube to protect the surface from adverse environmental impact and protect the seal in the front cap from dry rot. Dispose of old grease and used rags in accordance to your local environmental guidelines. If the front cap is not equipped with a zerk fitting apply a light coat of grease to the exposed part of the thrust tube.

## Clevis, Spherical Rod End, Junction Pieces

RACO supplies a range of front end adapters to accommodate the connection between the RACO actuator and the customer's equipment. These connection points may allow the actuator to pivot or rotate during the stroke. Periodic re-greasing is required at least once per year. The time interval depends on the angular movement, duty cycle and ambient conditions. Visually inspect connections, for example, clevis, through holes for wear and surface damage. Replace these items as required.

## Lubrication Quantity Chart

The below re-lubrication chart applies to the ACME screw and ball screw actuators. The lubrication quantity is dependent upon the nominal stroke length of the actuator. Make sure that after each re-lubrication interval the actuator is cycled over the entire stroke length to allow the new lubricant to be distributed over the entire nut / spindle system.

### Re-lubrication Quantity in Ounces

Actuator Size	Stroke in inch													
	3.9	7.9	11.8	15.7	19.7	23.6	31.5	39.4	47.2	55.1	63.0	70.9	78.7	
2	0.35	0.35	0.35											
4	0.53	0.53	0.53	0.71	0.71	0.88	0.88	1.06						
5	0.71	0.71	0.71	1.06	1.06	1.41	1.41	1.76						
6	0.71	0.71	0.71	1.06	1.06	1.41	1.41	1.76	2.12	2.12	2.47	2.47	2.47	
7	1.06	1.06	1.06	1.41	1.41	1.76	1.76	2.12	2.82	2.82	3.53	3.53	3.53	
8	1.41	1.41	1.41	1.76	1.76	2.12	2.12	2.47	3.17	3.17	3.88	3.88	3.88	
9	7.05	7.05	7.05	7.05	8.82	8.82	8.82	8.82	10.58	10.58	10.58	10.58	10.58	
10	8.82	8.82	8.82	8.82	10.58	10.58	10.58	10.58	12.35	12.35	12.35	12.35	12.35	
11	8.82	8.82	8.82	8.82	10.58	10.58	10.58	10.58	12.35	12.35	12.35	12.35	12.35	

## **Motor / Gearbox Lubrication**

RACO Motors and most commercial motors are considered permanently lubricated. RACO supplied gearboxes are filled with mineral or synthetic oil and do not require any maintenance under normal operating conditions. Nord and SEW gearboxes are filled in most cases with synthetic oil such as Mobil SHC 630. Bockwoldt gearboxes are typically filled with a CLP mineral oil, viscosity class VG 320. All gearboxes that are not vented are max filled to allow for universal mounting conditions on the actuator.

From time to time, a visual inspection of the gearbox should be performed. If signs of oil leaks at the gearbox are observed, appropriate action should be taken or consult factory for specific information.

## **Exchange of Grease**



It is recommended that a complete exchange of grease on the ball screw or ACME screw should be performed after 4 to 6 years. If the duty cycle is very low, the grease should be exchanged completely no later than 8 to 10 years.

We recommend during the lubrication change to replace all seal and gasket materials.

## **SECTION 7 BIND RELIEF (UN-JAMMING) INSTRUCTIONS FOR RACO MA TYPE ACTUATORS 4, 5, 6, 7 & 8**

RACO Electric Linear Actuators are normally equipped with one pair of adjustable limit switches. When properly adjusted they will shut the motor off when the motor reaches the fully extended or retracted positions. If the actuator is operated without the connection of limit switches to the circuit, or if the limit switches are readjusted incorrectly, it can happen that the unit will jam, since the motor does not shut off in time. To unjam the actuator mechanically, please follow these instructions:

### **Jammed in Retracted Position**

You will want to gain access to the motor coupling;

For MA type 4 actuators, the coupling (4.10) can be accessed by removing the motor and gear box, if equipped. Remove bolts (4.3) and the flange and the coupling housing will now separate from the unit.

For MA type 6 actuators it is not necessary to access the coupling by removing the motor. Instead remove the clevis, remove the first jam nut (1.7), and loosen the second jam nut until it is relieved.

For MA type 5, 7 & 8 actuators, the coupling (4.10) can be accessed by removing the 6 seal nuts (4.4) on the bearing block and removing the motor assembly and gear box, if equipped.

Using care not to damage any parts, exert force on the coupling in a counter-clockwise position (as viewed from the motor end) using an appropriate lever until jam loosens.

Note: In the event that excessive force is required to unjam the actuator, it is advisable to return the unit to RACO for complete disassembly.

### **Jammed in Extended Position**

Carefully loosen the cap nuts (2.17) on the front cap (2.1) approximately three turns.

**WARNING** - Loosen one turn at a time. Do not remove completely as spring pressure on large units can be dangerously high.

Jog the reverse button on the motor control. If necessary, loosen the cap nuts (2.17) more until jogging causes the thrust tube to retract. If necessary, you may also choose to remove the motor and gear box, if equipped to access the coupling. In this instance you would then exert force in a clockwise position (as viewed from the motor end).

### **“C” Design Actuators**

Unjamming MA actuators of the “C” design is the same if a jam occurs in the extended position.

For a jam in the retracted position you must access the lower belt wheel (12.7) by removing the rear belt cover (12.2). Exert a counterclockwise force on the lower belt wheel until the jam loosens.

For actuators that have a “D” or “E” accessory housing, removal of the housing BEFORE removal of the motor is necessary. Take off the cover to remove the switches and the belt, and then you may proceed with disassembly. When reassembling the accessory housing be sure to follow the instructions on the timing belt and tracking details planes of alignment data sheet

## Section 8 Disassembly Instructions

### Prior to disassembly



You must observe all cautions and warnings posted on all device labels and as listed in this manual. Failure to do so may result in serious personal injury or death.



***Warning!*** Do not attempt to install, perform maintenance, or service any RACO product until you have read thoroughly and understand completely all instructions, safety rules, cautions, warnings, and dangers contained in this manual. Failure to comply can result in accidents involving fire, electric shock, and serious personal injury or death. Save this manual and review frequently for continuing safe operation, and for instructing others who may use RACO products.

Read and closely follow all Warnings, Cautions, and Instructions in this manual. Failure to do so may result in voiding the RACO Warranty.

***CAUTION!*** You MUST check with RACO prior to any disassembly or maintenance procedures not specifically recommended in this Manual in order to preserve the RACO Warranty. If unauthorized or non-recommended practices or procedures are performed, RACO reserves the right to deny warranty claims for any defect at the sole discretion of RACO.



***CAUTION!*** Disassembly is not recommended under any circumstance. However, under extreme conditions, if there is no other opportunity to return the unit to RACO, the following instructions may be used as alternative guidelines.

Fully and independently support the cylinder and the attached load. If possible, disconnect the front attachment mechanism from the load.

### Disassembly of Thrust Unit Only

- Remove clevis and / or stop plate assembly.
- Remove front cap.
- Remove shield tube.
- Remove guide rods.
- Remove thrust tube. (remove set screw or heat Loctite to break loose)
- Remove front screw guide.
- Remove nut housing and bronze nut assembly.
- Disassemble nut housing after removing stop screw. (heat may be required)
- Remove end plates from nut housing. Note orientation of pressure plates and springs for re-assembly.

For ball screw actuators **do not** remove the ball nut. Re-assembly of the nut is difficult and the loss of bearings is likely.

## Disassembly of Motor

- Remove 6 seal nuts on the trunnion bearing housing.
- This will allow separation of the bearing housing and the coupling housing. If an accessory housing is attached please see the instructions for accessory housings.
- Any accessories installed on the rear of the motor must be removed first.
- Remove the front bearing housing from the stator housing. The rotor will also come out.
- Remove snap rings and bearings as required.

## Disassembly of the Screw and Bearing Block Assembly

- Remove couplings.
- Remove bearing cover nut or preload locknut. (setscrews)
- Press the screw to the front of the bearing block.
- Remove bearing seals, bearings and spacer as required. Note orientation for re-assembly.

## Disassembly of Actuators

- Turn off and lock out the main power and control circuit power to the actuator.
- Support the load if necessary and remove the electrical connections from the actuator.
- Remove actuator to a clean work environment.
- If the actuator is jammed in the extreme extended or retracted position, refer to the un-jamming instructions first.

(Loctite Gasket eliminator 515 is used on all metal to metal exposed surfaces, and Loctite 271 is used on all thread locking. 271 requires heat to break it loose.)

## DISASSEMBLY INSTRUCTIONS FOR ACCESSORIES



You must observe all cautions and warnings posted on all device labels and as listed in this manual. Failure to do so may result in serious personal injury or death.



***Warning!*** Do not attempt to install, perform maintenance, or service any RACO product until you have read thoroughly and understand completely all instructions, safety rules, cautions, warnings, and dangers contained in this manual. Failure to comply can result in accidents involving fire, electric shock, and serious personal injury or death. Save this manual and review frequently for continuing safe operation, and for instructing others who may use RACO products.

Read and closely follow all Warnings, Cautions, and Instructions in this manual. Failure to do so may result in voiding the RACO Warranty.



***CAUTION!*** You **MUST** check with RACO prior to any disassembly or maintenance procedures not specifically recommended in this Manual in order to preserve the RACO Warranty. If unauthorized or non-recommended practices or procedures are performed, RACO reserves the right to deny warranty claims for any defect at the sole discretion of RACO.

**CAUTION!** Disassembly is not recommended under any circumstance. However, under extreme conditions, if there is no other opportunity to return the unit to RACO, the following instructions may be used as alternative guidelines.

Fully and independently support the cylinder and the attached load. If possible, disconnect the front attachment mechanism from the load.

Read and closely follow all Warnings, Cautions, and Instructions in this manual. Failure to do so may result in voiding the RACO Warranty.

**CAUTION!** You **MUST** check with RACO prior to any disassembly or maintenance procedures not specifically recommended in this Manual in order to preserve the RACO Warranty. If unauthorized or non-recommended practices or procedures are performed, RACO reserves the right to deny warranty claims for any defect at the sole discretion of RACO.

### **DISASSEMBLY OF ACCESSORIES “D” or “E” Lateral Accessory Housings**

1. Remove the cover (9.35).
2. Remove RPM Pulse Generator if so equipped to allow clearance for belt removal.
3. Remove two socket screws (9.66) from the bearing block supporting the driven shaft.  
Note any shims used to tension the belt.
4. Tilt the bearing block to allow removal of the belt

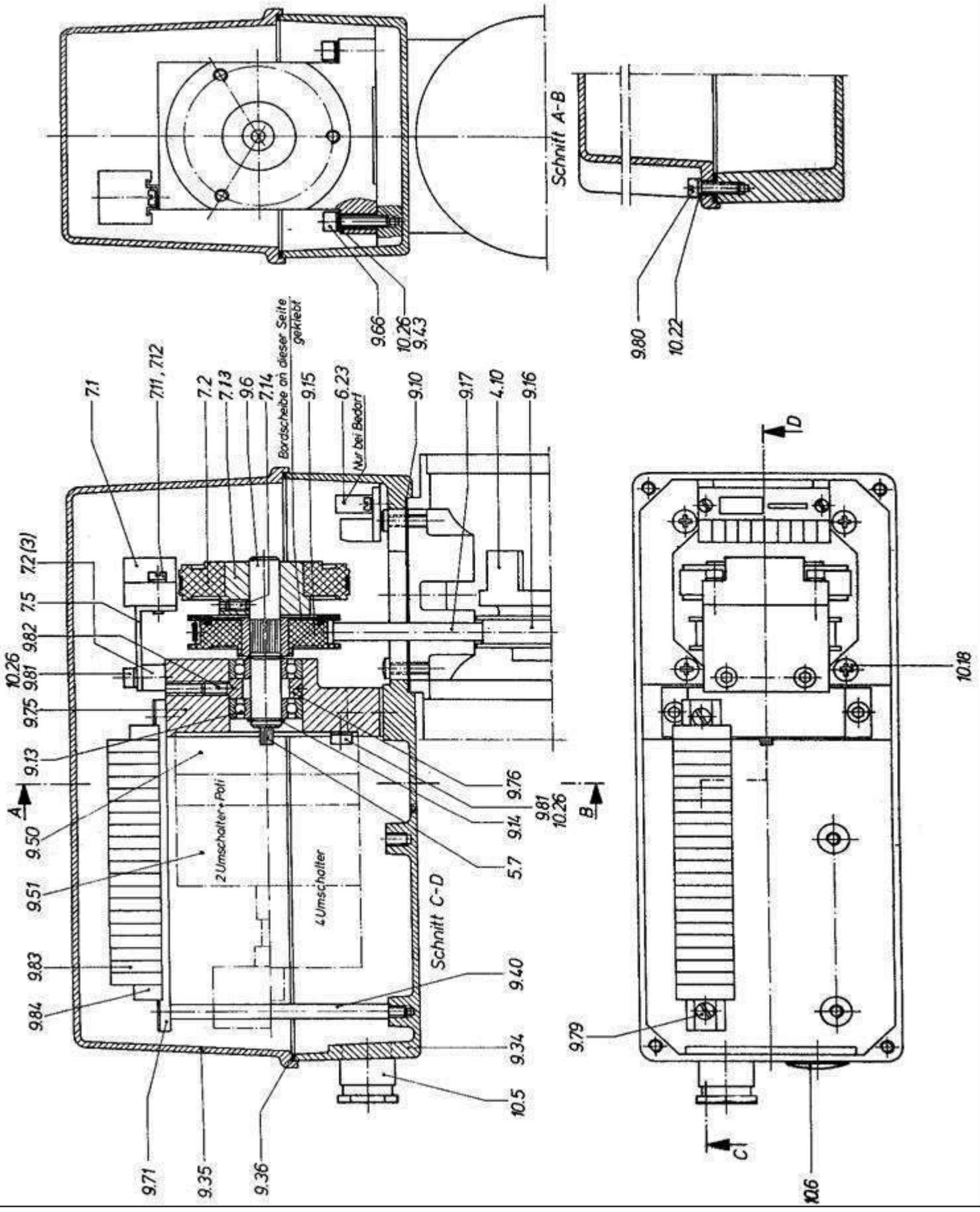
### **ATTENTION**

These instructions are for emergency repairs only. If your actuator is still under warranty, you will void this warranty by opening the unit. We strongly recommend having all repairs done by RACO International, Inc. and using RACO spare parts only.



## Accessory Housing D-E Parts List

<u>Pos. – No.</u>	<u>Description</u>
9.6	Shaft
9.10	Screw
9.13	Ball Bearing
9.14	Snap Ring
9.17	Timing Belt
9.30	Plug
9.34	Housing
9.35	Housing Cover
9.36	Gasket
9.40	Cap Screw
9.43	Washer
9.50	Gearing
9.51	Switching
9.66	Screw
9.71	Pin Rail
9.75	Bearing Block
9.76	Spacer
9.79	Bolt
9.79.1	Washer
9.81	Screw
9.81.1	Washer
9.82	Set Screw
9.83	Terminals
9.83.1	Terminal End Cover
9.84	Clip
10.18	Screw
10.26	Washer
10.29	Rail



# MANAGEMENT SYSTEM CERTIFICATE

Certificate No:  
100027-2011-AQ-GER-DAkKS

Initial certification date:  
20. March 1996

Valid:  
01. April 2018 - 31. March 2021

This is to certify that the management system of



International

## RACO Elektro Maschinen GmbH

Jesinghauser Str. 56-64, 58332 Schwelm, Germany

has been found to conform to the Quality Management System standard:

**ISO 9001:2015**

This certificate is valid for the following scope:

**Development, Design, Manufacturing, Sales and Service of Electric Mechanical Drive Units, Electric Actuators, Linear Drives, Brake Systems, Ball Screws and Electronic Control and Positioning Components**

Place and date:  
Essen, 27. February 2018



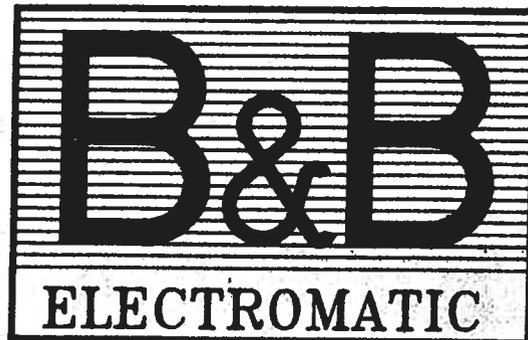
For the issuing office:  
DNV GL - Business Assurance  
Schnieringshof 14, 45329 Essen, Germany

A handwritten signature in blue ink, appearing to read "T. Beck".

**Thomas Beck**  
Technical Manager

## 5.5. Traffic Gates

Partial information due to scan quality.  
See O&M literature in operator's house for  
complete details, including additional drawings



# Handbook

for

# Gates & Barriers

STUTSON STREET BRIDGE  
VT-40 TRAFFIC GATES  
SERIAL #5525-5528  
B&B FACTORY ORDER #00-8512

Quality Manufacturing since 1925

# VT-40 HANDBOOK

## Stutson Street Bridge

B&B FACTORY ORDER #00-8512

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*(See Dwg. "Shear\_Pin\_Mount" in Section 3 for additional information)*

## **SECTION 2: Specifications**

VT 40 Warning Gate Specifications

VT- 40 Operator Assembly (Dwg. 0040DA0002)

**B&B Electromatic, Inc.**  
14113 Main Street, P. O. Box 99  
Norwood, LA 70761  
225-629-5234 or 800-367-0387

### **SECTION 3: Accessories and Major Components**

BM-122 Arm Light Specifications & Drawing (Dwg.#0122DM0009)

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Brake Assembly, Universal (Dwg.#0040BA0023)

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### **SECTION 4: Drawings**

VT-40 Warning Gate – Installation Drawing  
Stutson Street Bridge  
Dwg.#WI8712B1, #WI8712B2, #WI8712B3

VT-40 Warning Gate – Wiring Diagram  
Stutson Street Bridge  
Dwg.#WE8712C1, #WE8712C2, #WE8712C3 & #WE8712C4

## LIMITED WARRANTY

B&B Electromatic, in connection with apparatus sold, warrants same to be free from defects in material and workmanship under normal use and service. B&B will, at its option, repair or replace any part which, upon inspection by B&B, appears to be defective.

This warranty shall not apply if the article has been subjected to abuse in handling or installation, or has been misused or misapplied, or has been disassembled, repaired, altered, neglected or used in any way which, in the opinion of B&B, adversely affects the products.

For components such as motors, tanks, controllers, fuses, and power cords, supplied but not manufactured by B&B, B&B reserves the right to limit the warranty period to the warranty period of the component manufacturer.

VT-40 traffic warning gate operators, navigation lights, and XL series hydraulic slide gate operators are warranted for 5 full years against all part failures due to defective materials or workmanship. B&B 5-year (20,000 hour) navigation lamps are also warranted for 5 years against burnout.

All other B&B products are warranted for 2 full years against all part failures due to defective materials or workmanship.

The warranty period begins on the date of shipment from B&B facility. In order to receive the warranty, the purchaser must return the defective part, prepaid, to B&B. B&B will ship, prepaid, a replacement at no cost. Maximum liability will in no case exceed the value of the B&B unit involved. Costs associated with removing and replacing defective materials or parts are not covered by this warranty.

B&B maintains original shipment records to help you determine the warranty status of your products.

B&B reserves the right to change specifications and designs without notice, and assumes no responsibilities for making these modifications on any equipment previously sold.

*This warranty is in lieu of all other warranties, expressed or implied. B&B disclaims any warranties of merchantability or fitness for a particular purpose, and expressly disclaims all responsibility for special, incidental or consequential damages.*



14113 MAIN STREET  
P.O. BOX 99  
NORWOOD, LA 70761  
(225)629-5234 • FAX:(225)629-5727

## CERTIFICATION OF TESTING

Product: VT-40  
Job Name: Stutson Street Bridge  
B&B Factory Order #: 00-8512

Model Number	Serial Number
VT-40 (S.E. Off-going)	5525
VT-40 (N.E. On-coming)	5526
VT-40 (S.W. On-coming)	5527
VT-40 (N.W. Off-going)	5528

Each gate has been completely assembled, lubricated and test run through 24 complete cycles under full power at our factory without failure or problems.

  
Signature

Samuel Brown, General Foreman  
Name & Title

3-21-03  
Date

# **SECTION: 1**

## **Installation, Adjustment and Maintenance**

***B&B***

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Norwood, Louisiana 70761  
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## VT-40 WARNING GATE INSTALLATION INSTRUCTIONS

**NOTE 1: Failure to install your gate properly could cause damage to the operating mechanism.**

1. Read the instructions and review the drawings thoroughly. If you do not understand any part of these instructions, please contact the manufacturer.
2. Check the anchor bolt locations and prepare the foundation for the gate. Set the gate operator and be sure to seal the bottom with duct seal. Housing must be level. Anchor bolts must be tightened evenly.
3. Make sure the local power supply for the motor and control circuit are correct.  
\*Reference the enclosed electrical drawing in the back of the handbook.

**IMPORTANT: All conduit must be sealed and the housing grounded.**

4. Using the hand crank, rotate the main arm shaft 45 degrees noting rotation arrow on brake drum.
5. Open main disconnect switch (S1) and connect the power. Connect the control circuit if separate. If power is supplied from the motor circuit, check the connections at the terminals.

**NOTE 2: At this point in the installation, no sidearm channels, counterweights or arms should have been installed.**

**NOTE 3: If sidearm channels were installed at the factory, they need not be removed for the previous instructions.**

6. "Bump" test gate operator for correct motor rotation. Motor rotation and gate arm motion should match the rotation arrow on the brake drum. Reverse power leads if necessary to get proper motor rotation.
7. Run gate operator (without sidearm channels, arms or counterweights) through several complete cycles. Leave the gate operator in the closed to traffic position and open the main disconnect switch.

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**NOTE 4:** This gate has been completely assembled, lubricated and test run through 24 complete cycles under full power at the factory. If satisfactory operation is not displayed in step #10, recheck all electrical connections carefully. **CONSULT FACTORY IF PROBLEM IS NOT FOUND.**

8. Now install sidearm channels, the arm and the counterweights. Support the outer end of the arm until counterweights are all installed. Attach any lights, signs or other fixtures. Install counterweight in position marked on sidearm channels.
9. Make sure rotation of motor with hand crank lowers or raises arm as indicated on brake drum.
10. Close the main disconnect switch (S1) and operate the control circuit. If all connections are made correct, gate arm will operate correctly. The limit switch will automatically stop the motor at the extreme 90 degree movement of the arm.

**IMPORTANT:** If the power connections to the motor are reversed, the limit switch will automatically disconnect the motor when it reaches about 93 degrees either open or closed, depending upon the position of the controls, ie, open or closed. The limit switch has been set at the factory and should not require adjustment. Arm should be raised or lowered by lengthening or shortening the connecting rod, **NOT BY ADJUSTMENT OF THE LIMIT SWITCH CAMS.**

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## **VT-40 WARNING GATE START-UP INSTRUCTIONS**

**NOTE:**      **These instructions assume installation has been completed. If necessary, refer to the enclosed installation instructions.**

1.      Open the operator door.
2.      Connect power by flipping the disconnect switch to the "ON" position.
3.      Test operate the gate to be sure it is functioning properly.

## **VT-40 WARNING GATE SHUT-DOWN INSTRUCTIONS**

1.      Open the operator door.
2.      Disconnect power by flipping the disconnect switch to the "OFF" position.

## **VT-40 WARNING GATE EMERGENCY OPERATION INSTRUCTIONS**

1.      Open the operator door.
2.      Disconnect power by flipping the disconnect switch to the "OFF" position.
3.      Locate the hand-crank mounted inside the housing.
4.      Slip the hand-crank onto the shaft extending through the brake. The brake will automatically release.
5.      Turn the hand-crank to raise or lower the gate, as needed. A tag on the brake indicates crank direction for opening or closing the gate.
6.      Remove the hand-crank.
7.      Flip the disconnect switch back to the "ON" position to resume powered operation.



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## VT-40 LUBRICATION INSTRUCTIONS

Mechanism lubrication should be checked at least once per month.

**Transmission (Item 4 on Assembly drawing):**

Ref. Dwg. #0040DA002

**First gear drive box ( High speed housing):**

1. Open the back door of the housing (opposite roadway).
2. Check oil by removing the oil level plug located on the left hand vertical surface of the transmission a few inches below the motor.  
*Note: Some gates may have site glasses.*
  - a. If oil is visible, oil level is adequate - replace plug and go to next section.
  - b. If oil is not visible, go to step 3.
3. Remove fill plug on top of first gear box.
4. Fill the case to the level plug or site glass (removed in step two) with multi-grade Mobil SHC 629 or a direct replacement. (see recommended replacement oils on the following page.)
5. Replace plugs.

**Final drive gear box (Low speed housing):**

1. Check the oil level by removing the oil level plug located near the bottom of the transmission on the right hand side of the gate (item 4). The plug will be located on the front of the transmission. *Note: Some gates may have site glasses.*
  - a. If oil is visible, oil level is adequate - replace the plug and go to next section.
  - b. If oil is not visible, go to step 2.
2. Remove oil fill plug on top of final gear box.
3. Fill the case to the level plug or site glass (removed in step one) with multi-grade Mobil SHC 629 or a direct replacement. (see recommended replacement oils on the following page)
4. Replace plugs.

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**Arm Shaft Bearing (Item 7):**

1. Grease with Texaco Marfak 2 or equal.
2. Wipe off excess.

**Connecting Rod Ends (Items 5 & 6):**

1. Grease with Texaco Marfak 2 or equal.
2. Wipe off excess.

**Limit Switch Drive Chain (Item 9):**

1. Spray chain with any good aerosol chain lube.
2. Wipe off excess.



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## VT-40 LUBRICATION REPLACEMENT INSTRUCTIONS

Lubricate mechanism every 12 months with a manufacturer approved lubricant.

### First gear drive box ( High speed housing):

1. Standing behind the operator open the left housing door.
2. Locate drain plug on the bottom horizontal surface of the gear change box directly under the motor.
3. Position catch pan under drain plug.
4. Remove the oil fill hole on the top surface of the gear change box directly beside the motor.
5. Remove the drain plug until the oil is completely drained, then replace plug.
6. Remove the oil level plug.
7. Refill gear change box until oil flows from the oil level hole. Replug the oil fill hole and the oil level hole.

### Final drive gear box (Low speed housing):

1. Open the right housing door.
2. Located drain plug on the vertical surface of the final output box directly behind the limit switch.
3. Position catch pan under drain plug.
4. Remove the oil fill hole on the top surface of the final output box directly above the drain plug.
5. Remove the drain plug until the oil is completely drained, then replace plug.
6. Remove the oil level plug.
7. Refill final output box until oil flows from the oil level hole. Replug the oil fill hole and the oil level hole.



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## RECOMMENDED REPLACEMENT OILS FOR VT-40 GATE OPERATORS

Direct replacement of oils is very complicated and should be considered carefully when doing so. The following oils are recommended by the manufacturer of the transmissions on both the Warning Gates and Barrier Gates.

The multi-grade **Mobil SHC 629** synthetic oil is the manufacturers first choice. If this oil is not available, **Exxon Terrestic SHP 150** can be used as a direct replacement. The temperature range is -30°F to 165°F.

If neither of the two above mentioned oils is available, almost any **ISO Grade 150** or **AGMA Lubricant #4** with a pour point of -40°F or less & a viscosity of approx. 726 (SUS@100°F) is acceptable.

The following grease is recommended by the manufacturer of the flange type bearings used on both the Warning Gates and Barrier Gates.

Texaco Marfax or Texaco Starplex grease is the manufacturers first choice. If this grease is not available, consult your local supplier for an equivalent.

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## UNIVERSAL VT BRAKE ASSEMBLY REPLACEMENT INSTRUCTIONS

\*Refer to Drawing #0040BA0023

**IMPORTANT:** Unless specified, the replacement brake assembly does not include a solenoid or a brake drum. If these items are required, they must be requested separately, please specify the motor voltage.

**WARNING: DISCONNECT GATE POWER BY THROWING THE MAIN POWER SWITCH (S1) OFF BEFORE REMOVING THE OLD BRAKE ASSEMBLY.**

Item numbers refer to the brake drawing included in the major components section of this handbook.

### To remove the old assembly:

1. Remove the Brake Release Stub (item 9) from its bracket.
2. Remove the Brake Drum (item 2) set screw. The set screw is located on the side of the brake drum, even with the key in its center.
3. Pull the drum off of its shaft.
4. Disconnect the wires from the brake release solenoid (item 5).
5. Remove the brake assembly mounting bolts, and lift off the brake assembly.

### To mount the new assembly:

1. Place the new brake assembly on top of the motor, align the mounting holes, and tighten the mounting bolts.
2. Unless a new solenoid was requested, the brake solenoid from the old brake assembly will need to be re-mounted on the new assembly.
  - Disconnect the solenoid arm from the solenoid release rod (item 7).
  - Remove the solenoid mounting screws.

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- Place the solenoid (item 5) on the new brake assembly, align the holes and replace the mounting bolts.
  - Reconnect the solenoid plunger to the solenoid release rod.
  - Reconnect power wires to the solenoid.
3. Insert the brake drum onto the keyed shaft and tighten the set-screw.
  4. Re-install the manual release stub onto its mounting bracket.
  5. Re-apply power to the gate, and test the brake by running the operator.
  6. If the solenoid makes a loud buzzing sound, it is binding and needs to be adjusted.
    - Loosen the mounting bolts and activate the operator. The solenoid should seat itself properly.
    - Re-tighten the mounting bolts.

If the solenoid continues to buzz, the solenoid release rod may be out of alignment. Loosening the screw between the solenoid plunger and release rod (item 7) should alleviate this. If the problem persists, contact the manufacturer.

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## MOTOR REPLACEMENT INSTRUCTIONS FOR VT-40 GATE OPERATORS

**IMPORTANT:** Before replacing the motor, check that the new motor is identical to the old in voltage, phase and horsepower.

**WARNING: DISCONNECT GATE POWER BY THROWING THE MAIN POWER SWITCH (S1) OFF BEFORE CHANGING MOTORS.**

1. Remove the brake assembly (see previous instructions)
2. Have a qualified electrician disconnect the motor wires from the junction box on the side of the motor.
3. Remove the four motor mounting bolts located at the base of the motor.
4. Pull the motor up, out of the transmission, making sure the feather key comes out with the motor shaft.
5. Mount the new motor, inserting the keyed shaft into the transmission and aligning the mounting holes.
6. Have a qualified electrician reconnect the motor wires at the junction box on the side of the motor.
7. Re-mount the brake assembly (see previous instructions).
8. Re-apply power to the operator and run the gate several times. If the gate does not run satisfactorily, contact the manufacturer.

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## LIMIT SWITCH REPLACEMENT INSTRUCTIONS FOR VT-40 GATE OPERATORS

**WARNING: DISCONNECT GATE POWER BY THROWING THE MAIN POWER SWITCH (S1) OFF BEFORE BEGINNING.**

1. Remove the old limit switch from the gate limit switch assembly by removing the mounting screws and connecting wires.
2. Install the new limit switch by aligning the mounting holes, replacing the mounting screws and re-connecting wires as removed from defective switch.
3. Apply power to the gate and run it several times. Limit switches are pre-adjusted and should not required additional adjustment. If the gate does not operate satisfactorily, contact the manufacturer.

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## FIELD BALANCING INSTRUCTIONS FOR VT OPERATORS

**IMPORTANT: EVERY VT WARNING GATE IS BALANCED AT THE FACTORY BEFORE IT IS SHIPPED. IF ANY ADDITIONS OR CHANGES ARE MADE TO THE GATE ARM IN THE FIELD, THE GATE MAY REQUIRE RE-BALANCING. AN UNBALANCED ARM MAY DAMAGE THE OPERATOR.**

If any additions or changes are made to the VT operator, the following guidelines will help you determine what changes, if any, need to be made to the gate balance:

1. Make the desired changes to the gate arm.
2. Secure the tip end of the arm to prevent injury or accident.
3. Disconnect the connecting rod which runs between the upper and lower cranks, this will free the arm to be balanced.

INDICATIONS	PROBLEM	SOLUTION
<u>Gate arm tends to raise</u> Requires more than 20 lbs. to keep it closed to traffic.	Gate is counterweight heavy.	1. Counterweights can be pushed closer to the pivot. 2. Counterweights can be removed.
<u>Gate arm tends to lower</u> Requires more than 20 lbs. to keep it open to traffic.	Gate is arm heavy.	1. Counterweights can be pushed further from the pivot. 2. Counterweights can be added.

A properly balanced gate can be manually operated by one person pushing on the end of the counterweight mounting channel. It should require only 20 lbs. of force to manually operate the gate. For detailed instructions on balancing the operator with weights, refer to the next page.

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## GATE ARM BALANCING

These adjustments are set at the manufacturing facility and should not need to be adjusted in the field unless the arms have been modified, causing the weight of the arm to change.

### Calculating Counterweight Requirements

1. Disconnect arm drive by removing top connecting rod bolt located in the gate housing.
2. Mark any place on the gate arm and attach a weighing scale to the arm at that point.
3. Measure how much weight, in pounds, it takes to start raising the gate arm. (arm lbs.)
4. Measure, in inches, the distance from the weight point to the center of the pivot point (arm distance).
5. Measure, in inches, the distance from center of pivot point to center of counterweight (counterweight distance).
6. Follow this formula to get the proper amount of counterweight to add to gate.

$$\frac{\text{arm lbs.} \times \text{arm dist.}}{\text{cw dist.}}$$

### COUNTERWEIGHT SIZES

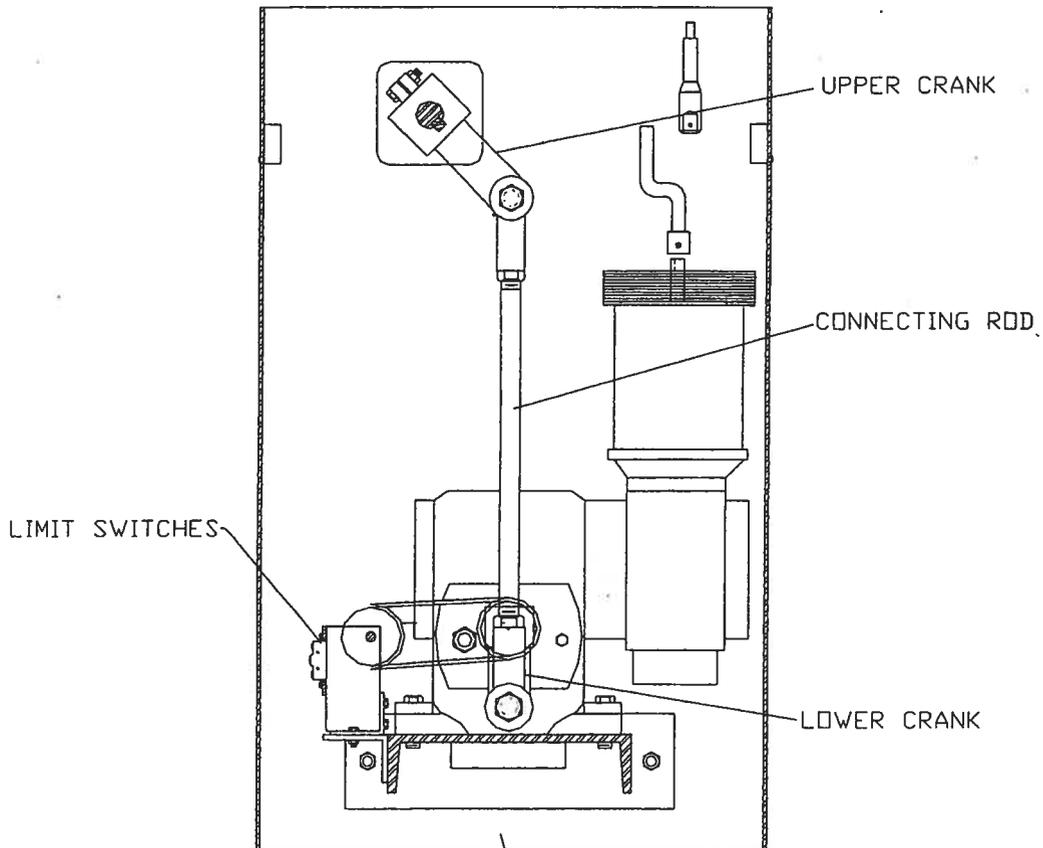
18"X36"X1" THICK	= 182 POUNDS
18"X36"X.5" THICK	= 91 POUNDS
12"X24"X1" THICK	= 82 POUNDS
12"X24"X.5" THICK	= 41 POUNDS
12"X12"X1" THICK	= 41 POUNDS
12"X12"X.5" THICK	= 20 POUNDS

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## ADJUSTING THE VT GATE MOVEMENT

When installing or maintaining a VT warning or barrier gate, setting the limit switches and connecting rod length properly can be confusing at times. The following instructions are intended to clarify this process. The steps can be broken into two sections, setting crank orientation, and setting gate starting and stopping points.



### SECTION 1: SETTING THE CRANK ORIENTATION AND ROTATION USING THE LIMIT SWITCHES

A standard VT gate operator with 90 degrees of travel is designed so that the gate arm accelerates and decelerates smoothly as it pivots. This is achieved through the lengths of the two crank arms. In order to optimize this “sinusoidal” movement, the following steps should be followed when installing the operator.

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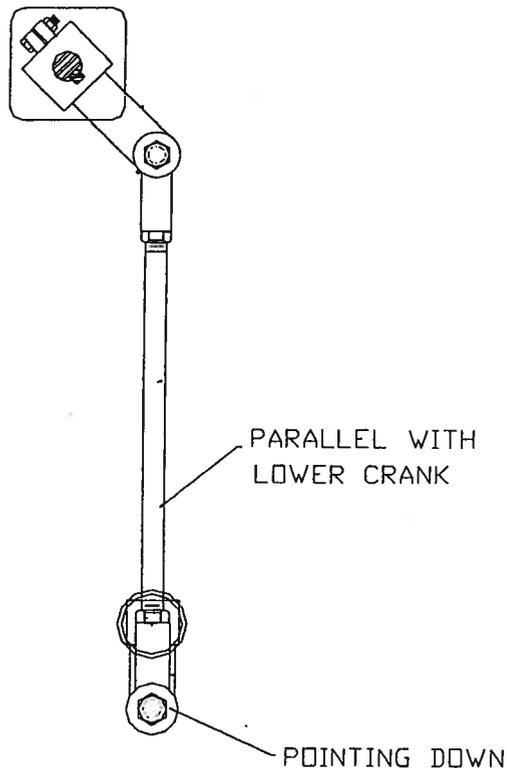
1) Determine the direction of rotation of the cranks. In a standard installation, the cranks pivot toward the motor, away from the roadway.

The limit switch cams rotate the same direction that the pivot rotates. Cam 1 is always the raise stop, Cam 2 is always the lower stop, Cam 3 generally controls the arm lights if there are any, and Cam 4 generally controls the bell if there is one.

**IMPORTANT: Disconnect the power at the main switch before adjusting the limit switches.**

2) Manually rotate the gate into its fully open to traffic (raised) position by inserting the manual crank onto the shaft extending from the top of the motor and turning it until the gate reaches the desired position.

**Note:** At fully open, the connecting rod should be parallel with the sides of the operator and with the lower drive crank. The lower drive crank should be pointing straight down.



3) With an Allen wrench loosen the limit switch cams just enough so that they will turn, but not so much that they are loose.

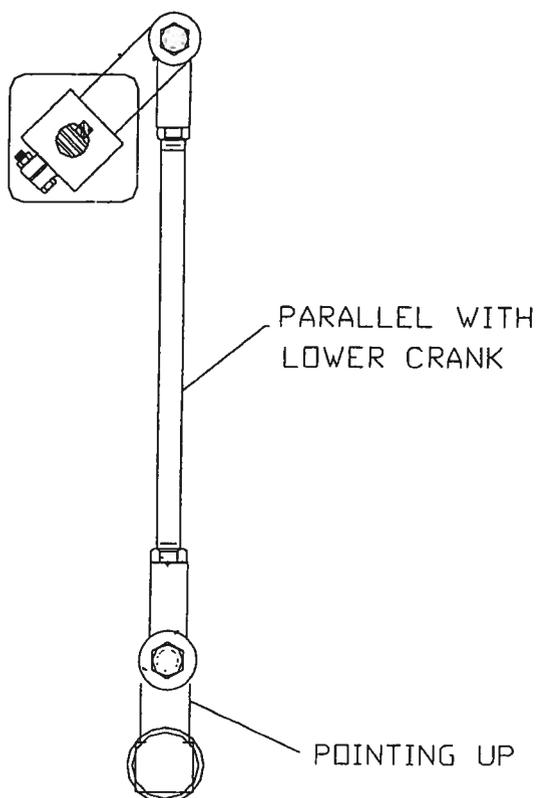
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4) Rotate Cam 1 until the limit switch follower just falls off of the edge of the cam. Keep the direction of rotation of the cam in mind as you set it to ensure that when the gate rotates, the limit switch follower will move back onto the cam.

5) Manually rotate the gate into its fully closed to traffic position.



**Note:** At fully closed, the lower drive crank should have rotated through 180 degrees, and should be pointing straight up. The connecting rod should be parallel with the sides of the housing and the lower drive crank.

6) Rotate Cam 2 until the limit switch follower just falls off of the edge of the cam. Keep the direction of rotation of the cam in mind as you set it to ensure that when the gate rotates, the limit switch follower will move back onto the cam.

7) Re-apply power and run the gate open and closed. If the cams require more adjustment it is important to disconnect power before moving the limit switch cams. Be sure to re-tighten the limit switch cams once they have been properly set.

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**NOTE:** At this point in the adjustment, the crank orientation is more important than the gate position. At the fully open and fully closed positions, the connecting rod should be parallel with the sides of the housing, and the drive crank should point directly up or directly down.

## **STEP TWO: ADJUSTING THE STOPPING AND STARTING POINTS OF THE GATE ARM**

If the starting and stopping points of the gate arm need to be adjusted, this will be done using the connecting rod. This should only be done if the crank and connecting rod positions are correct as described above..

8) With the gate in the fully raised or lowered position, loosen the lock nuts on the connecting rod and turn the rod to increase or decrease its length. Adjust the rod until the gate arm is in the desired position.

**NOTE:** Adjusting the connection rod changes both the raised and lowered position by the same amount.

9) Run the gate through several cycles to ensure proper starting and stopping points.

10) If the gate panel travels slightly too far in either the open or closed direction, this can be adjusted using the limit switches. It is important to note that adjusting the limit switch at this point will stop the gate arm before it has fully decelerated.

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## **SECTION: 2**

# **VT-40 Operator Specifications**

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B&B Factory Order #00-8512  
VT-40 Specs., 4 Pages (Page 1 of 4)  
(4) Four Units Required



## Model VT-40

### GENERAL

The safety gate will be B & B type VT-40. These specifications are the minimum that will be acceptable. The gate will be of the standard vertical to horizontal arm type, will have a weatherproof housing and operating mechanism and will include such controls, accessories and modifications as specified.

### APPLICATIONS

The VT-40 Automatic Safety Gate will typically be used as a warning, traffic control and access control gate. Typical applications will include moveable bridge traffic warning gate, parking lot access control gate and any medium to heavy-duty traffic control or warning installation.

- **HOUSING**

The housing will be fabricated from 1/4-inch **5052-H32** aluminum. The aluminum housing will receive a primer finish. Formed, channel shaped side plates will be used to produce a strong configuration without welded corners.

Front and rear access doors will be hung on bronze, full-cross hinges with stainless steel hinge pins. Hinges will be of the slip-off type. Doors will be held in place with two bronze wing nuts and stainless steel swing bolts and will be sealed with neoprene strip gaskets. Top will be held in place with corrosion resistant hex head bolts. Openings for arm shafts will be equipped with "O" ring seals. Padlockable doors will be a standard feature (padlock by others).

The housing base will provide four 1-inch holes for mounting on the customer's foundation. Anchor bolts and templet will be supplied by the gate manufacturer. Standard anchor bolt size will be 3/4 - 10 x 12 + 4 hot dip galvanized.

- **ARM**

The arm will be constructed according to the customer's specifications and will be a *Wooden wishbone* - This arm, with aluminum articulating fence, will be fabricated from extra clear vertical grain fir in a wishbone shape (*Refer to installation drawings for actual dimensions*).

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B&B Factory Order #00-8512  
VT-40 Specs., 4 Pages (Page 2 of 4)  
(4) Four Units Required

Double stainless steel truss cables and a spring loaded roadway bumper will be furnished with all arms.

Roadway arm lengths (dimension "A") will be measured from the centerline of the gate housing to the tip of the arm. (*Refer to installation drawings for actual dimensions*).

Gate arms will be covered on both sides with 16-inch alternating red and white engineering grade reflectorized sheeting.

- **ARM BASE**  
A rigid mounting will be furnished.
- **ARM MOUNTING CHANNELS**  
Arm mounting channels will be fabricated from carbon steel, hot dip galvanized. The roadway arm shaft will be 44 inches above the base line of the gate housing.
- **COUNTERWEIGHTS**  
Each gate will be equipped with suitable hot dip galvanized steel counterweights of the sectional, bolt-on type. Counterweights will have a maximum 10% adjustment.
- **ARM SHAFTS**  
The main arm shaft will be mounted in heavy-duty ball bearings and will be lubricated from the inside. The main arm shaft will be not less than 2 inches in diameter. Shaft material will be ASTM A311 Class B high strength, stressproof steel.
- **TRANSMISSION**  
The transmission will be a fully enclosed, all gear, direct drive unit running in an oil bath. The drive train will not use belts or chains and will be connected to the arm shaft with a connecting rod having self-aligning ball ends. The connecting rod will be constructed of ASTM A311 Class B high strength stressproof steel.

During the opening and closing cycles, the gate arm will begin with zero velocity and accelerate smoothly reaching maximum velocity at mid-stroke (45 degrees). The arm will then decelerate smoothly to zero velocity at full stroke (90 degrees) preventing bounce or whip of the arm. Operating time to open or close the gate will be 13 seconds.

The standard connecting rod assembly will be designed to move the gate through a 90-degree travel.

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VT-40 Specs., 4 Pages (Page 3 of 4)  
(4) Four Units Required

- **MOTOR**

A 480V, 3PH, 1HP motor will be provided. The motor will be of the flange-mounted type, attached to the transmission case with not less than four bolts. The motor will be of the instant reversing type to permit reversing movement of the arms at any point of travel. Motor data will appear in the manual.

- **BRAKING MECHANISM**

A solenoid release, automatic motor brake will be furnished as part of the gate drive mechanism. The brake will automatically release when the handcrank is inserted to manually operate the gate.

- **HANDCRANK**

A handcrank and drill crank will be included with each gate to operate the gate during power failure. Door safety switches will automatically disconnect the control circuit power when the door is opened to allow for manual operation.

- **LIMIT SWITCH**

The gate limit switch will be a unit assembly containing eight individual switches having one set of normally open and one set of normally closed contacts each. Contacts will be totally enclosed and will have U.L. rating of not less than 15 amperes at 220 volts AC. Limit switch will be readily accessible and easily replaced with normal hand tools. Each individual switch will be controlled by an independent cam, which will be adjustable with a hex socket cap screw. The limit switch body, shafts and cams will be of corrosion resistant non-ferrous materials.

- **SAFETY SWITCHES, TERMINAL BLOCKS AND WIRING**

To protect operating and maintenance personnel from injury during service or installation, a manual disconnect switch will be furnished, installed and fully wired in the main motor leads.

Automatic disconnect switches will be arranged to break the control circuit when either door is opened. Pressure type terminal blocks will be provided and installed inside the housing on the roadway side. All control wires will terminate on these blocks. Each terminal will be clearly labeled and all conductors will be color coded and/or numbered. The wiring diagram will reflect such colors or numbers. A GFI receptacle will be supplied in the gate housing. No conductor will be smaller than #16 AWG stranded. Each housing will contain a laminated electrical schematic secured to the inside of the housing for reference by service personnel.

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(4) Four Units Required

- **QUALITY ASSURANCE**

Manufacturer of the traffic control gate operator will have a minimum of five years experience in the manufacture of industrial gate operators and barriers, and will make available replacement parts for ten years. All gates are individually inspected at time of final assembly and test. Each gate will be tagged "ACCEPTED" upon completion of inspection and a "Certification of Testing" will be supplied in the handbook for validation of meeting internal Quality Assurance standards.

# **SECTION 3:**

## **VT-40**

### **Accessories and Major Components**

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BM-122 Specs., 1 Page  
\*Supplied on VT-40 Traffic Gates



## **Model BM122 Warning Light**

### **General**

The BM122 warning light will be a 2-way warning light, visible on opposing sides of the light. The warning light will be shock and corrosion resistant, built to withstand severe use. It will be used in applications requiring a 2-way optical system, such as marker lights for warning gates.

### **Housing**

The housing will be a two-piece, cast aluminum, accurately machined. The top section will be fitted to the base with a gasket seal and held securely in place with two stainless steel, drawbolts. The base section will provide field wiring entrance through a 3/4-inch NPS conduit entrance. The top section and base will be primed with one coat of chromate oxide primer and two coats of black alkyd enamel.

### **Lens**

The lens will be red, 4-inch diameter acrylic, having a beam spread of 30. The lens will be held in place by four non-corrosive fasteners. The lens will be fitted into the top section, and gasketed with neoprene gaskets.

### **Receptacle and Lamps**

The standard lamp receptacle will be a medium brass base, 250 volt, 660 watt, with porcelain shell. The receptacle will be designed to resist lamp seizing. A 67-watt, 120 volt, 8,000 hour lamp with brass base will be included.

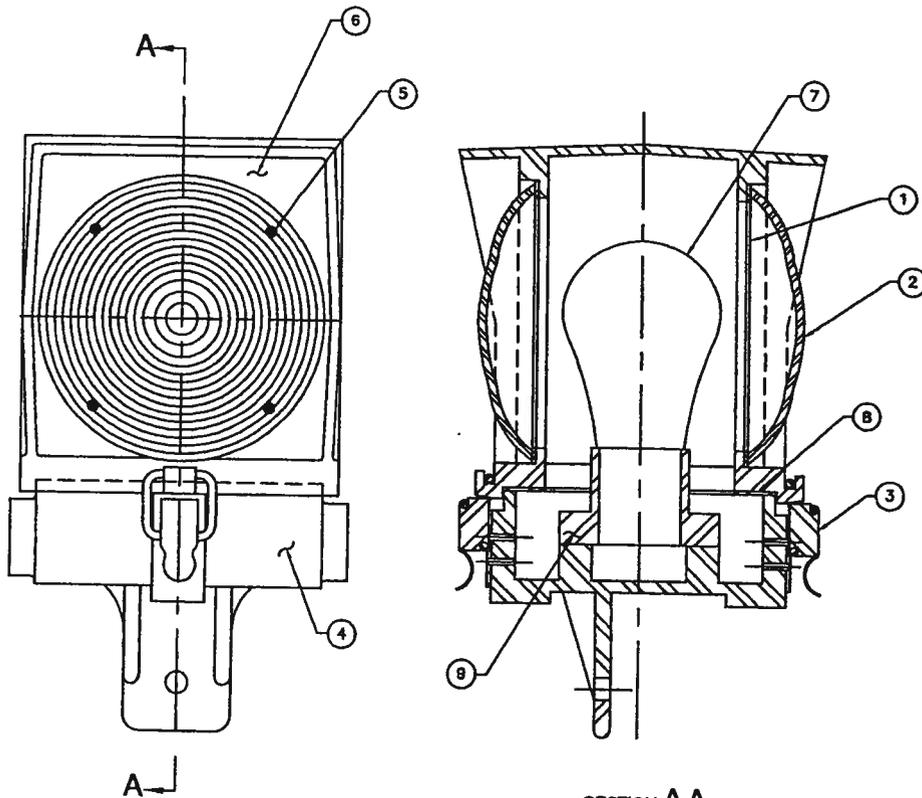
### **Quality Assurance**

Manufacturer of the warning lights will have a minimum of five years experience in the manufacture of warning lights and will make available replacement parts for ten years. All warning lights are individually tested and inspected at time of final assembly.

Partial information due to scan quality.  
See O&M literature in operator's house for  
complete details

8 7 6 5 4 3 2

ZONE	REV	BY	DATE	DESCRIPTION
0				ORIGINAL ISSUE
1				CORRECTED TO NEW DWG.



SECTION A-A

QTY	PART OR IDENTIFYING NO	DESCRIPTION
1	0122-7924	BASE GASKET
1	0177-50715-B	RECEPTACLE, BRASS
1	0122-1007	LIGHT BULB, 67W
1	0122-9449	HOUSING, BARRIER
8	111-0808SS-C	6-32 UNC-2A x
1	0122-8436	BASE, BARRIER LT.
2	0122-2100	DRAW BOLTS
2	0122-3128	LENS, MODEL M-67
2	0122-9508	LENS GASKET

ITEM NO	QTY	PART OR IDENTIFYING NO	DESCRIPTION
PARTS LIST			
PRODUCT USED ON			
NEXT ASSY		<input checked="" type="checkbox"/>	
0122-0002		JRR	2-85
		RED	2-85

8 7 6 5 4 3 2

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B&B Factory Order #00-8512  
AW25-500 Specs., 1 Page  
\*Supplied on VT-40 Traffic Gates



## **Model AW25-500 (120V) Warning Light Flashers**

### **General**

The flasher will be B&B model AW25-500. It will be a solid state flasher having two alternately flashing circuits and one steady burn circuit. The flasher will be designed for heavy-duty applications including traffic control gates and barriers.

### **Construction**

The flasher assembly will include mounting hardware as required, solid state flasher circuitry, a terminal block and a transformer when required. The flasher assembly will be fully wired at the factory. All components will be corrosion resistant. The entire transfer relay assembly, including all electronic circuitry, will be encapsulated in weatherproof, shock-resistant plastic enclosure to prevent possible damage from condensation or water buildup within the flasher.

### **Flash Rate**

The standard flash rate for the two alternately flashing circuits will be .50 second on & .50 second off. An additional steady burn circuit will also be provided.

### **Input Voltage/Current Draw**

The standard input voltage is 120VAC  $\pm$  10%. The maximum current draw will be 10 amperes per flashing circuit.

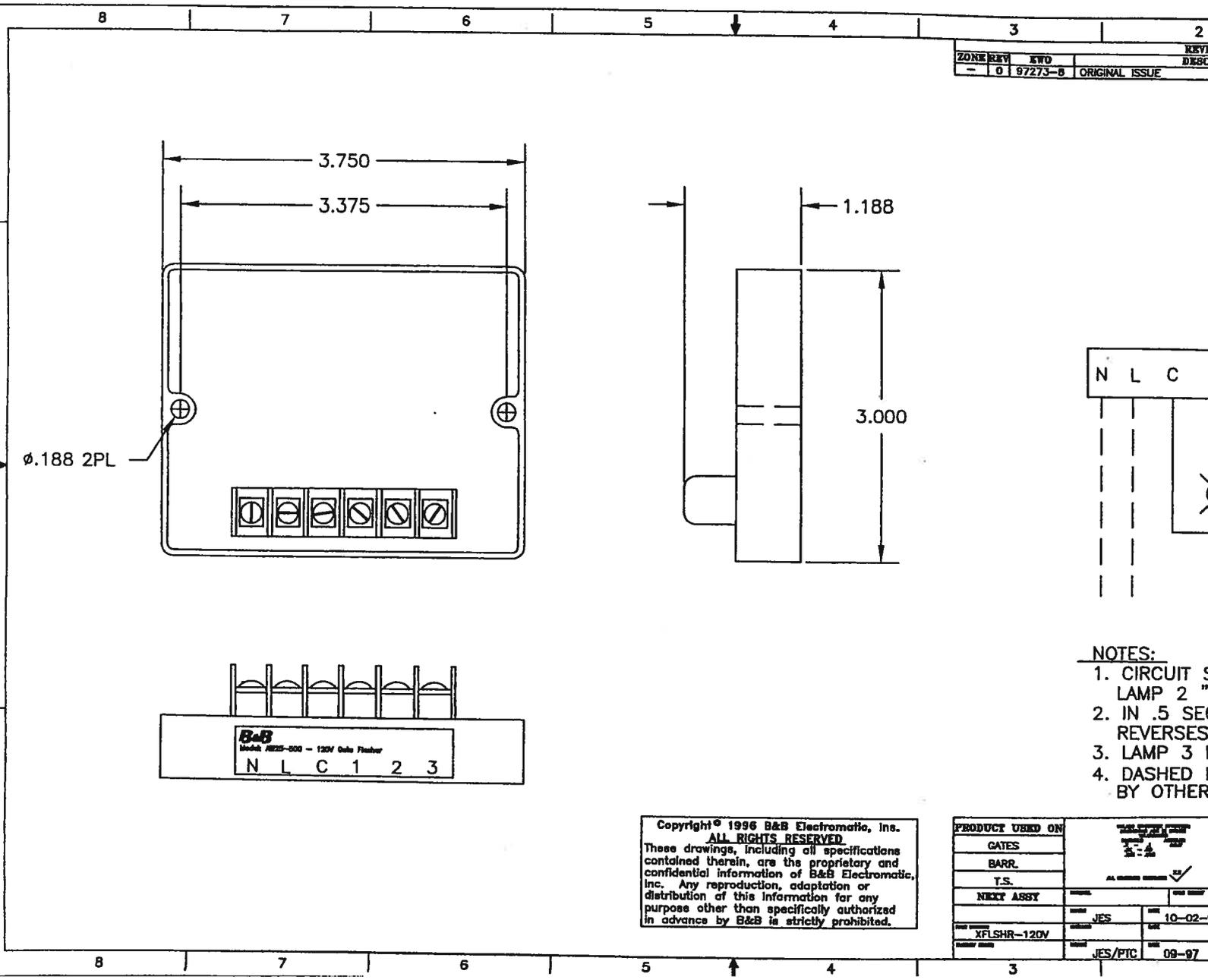
### **Shipping Weight**

Approximate shipping weight for the AW25-500 is 3 pounds.

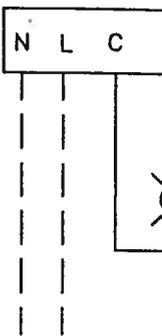
### **Quality Assurance**

Manufacturer of the flasher will have a minimum of five years experience in the manufacture of flashers and will make available replacement parts for ten years. All flashers are individually inspected at time of final assembly and test. Each flasher will be tagged "ACCEPTED" upon completion of inspection for validation of meeting internal Quality Assurance standards.

Partial information due to scan quality.  
See O&M literature in operator's house for complete details



ZONE	REV	KWD	REVISED	DESCR
-	01	97273-B	ORIGINAL ISSUE	



- NOTES:**
1. CIRCUIT S
  2. LAMP 2 "C
  3. IN .5 SEC REVERSES.
  4. LAMP 3 IS
  5. DASHED L
  6. BY OTHERS

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PRODUCT USED ON		DATE	BY
GATES			
BARR.			
T.S.			
NEXT ASSY			
XFLSHR-120V	JES	10-02-9	
	JES/PTC	09-97	

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B&B Factory Order #00-8512  
Z-555 Gong Specs., 1 Page  
\*Supplied on SW & NE On-Coming VT-40 Traffic Gates



## **Model Z-555 (bronze) Gong**

### **General**

The Model Z-555 gong will be a heavy duty, motor driven industrial quality warning bell. It will be suitable for a variety of traffic control applications, including mounting on traffic control gates and barriers as an audible warning to both pedestrians and motor traffic.

### **Housing**

The housing and door will be cast aluminum. The door will hinge on stainless steel hinge pins and have a swing bolt with provision for padlock (padlock by others). All joints will be sealed with neoprene gasket and non-hardening sealer. The housing and door assembly will be weather-proof.

### **Gear Train**

All gears in the gear train will be journaled in oil-impregnated bronze bearings for long life and minimal service. The electric motor will drive the gear train which in turn drives a cam and hammer to strike the gong shell approximately one hundred times per minute.

### **Motor**

The electric motor will be 115 volt, 60Hz, drawing 2.3 amps. The motor will be TEFC, continuous duty for long life and dependable service.

### **Gong Shell**

The gong shell will be 12-inch O.D., cast bronze. A stainless steel, tamper resistant stud will hold the shell in place. The shell will be protected by a cast aluminum weather guard.

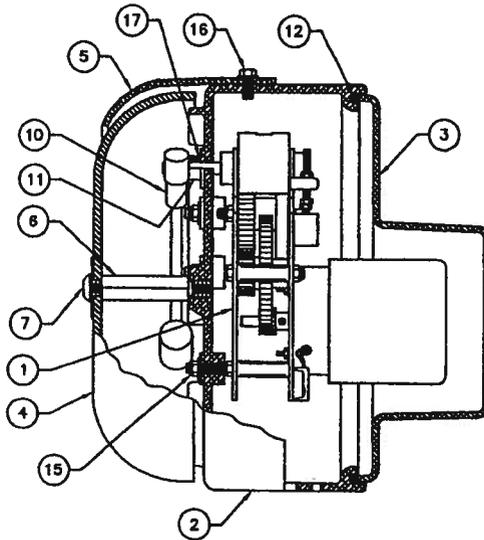
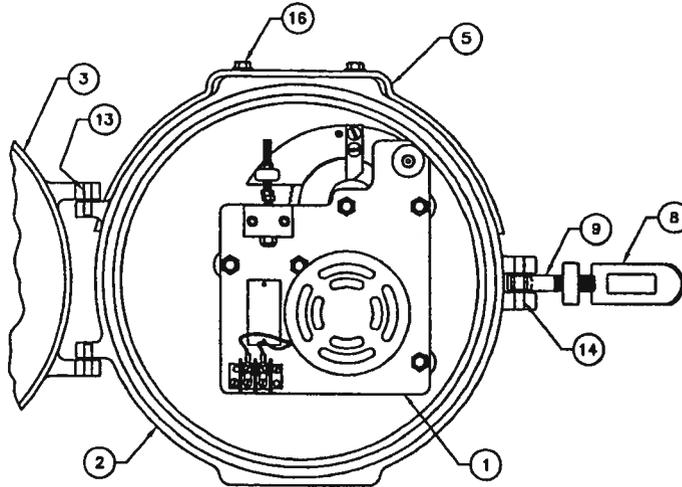
### **Mounting**

The housing will be drilled for mounting to a horizontal plate surface with the use of a tri-stud mounting arrangement.

### **Quality Assurance**

Manufacturer of the gongs will have a minimum of five years experience in the manufacture of gongs and will make available replacement parts for 10 years. All gongs are individually tested and inspected at time of final assembly. Each gong will be tagged "ACCEPTED" upon completion of inspection for validation of meeting internal Quality Assurance standards.

Partial information due to scan quality.  
See O&M literature in operator's house for  
complete details



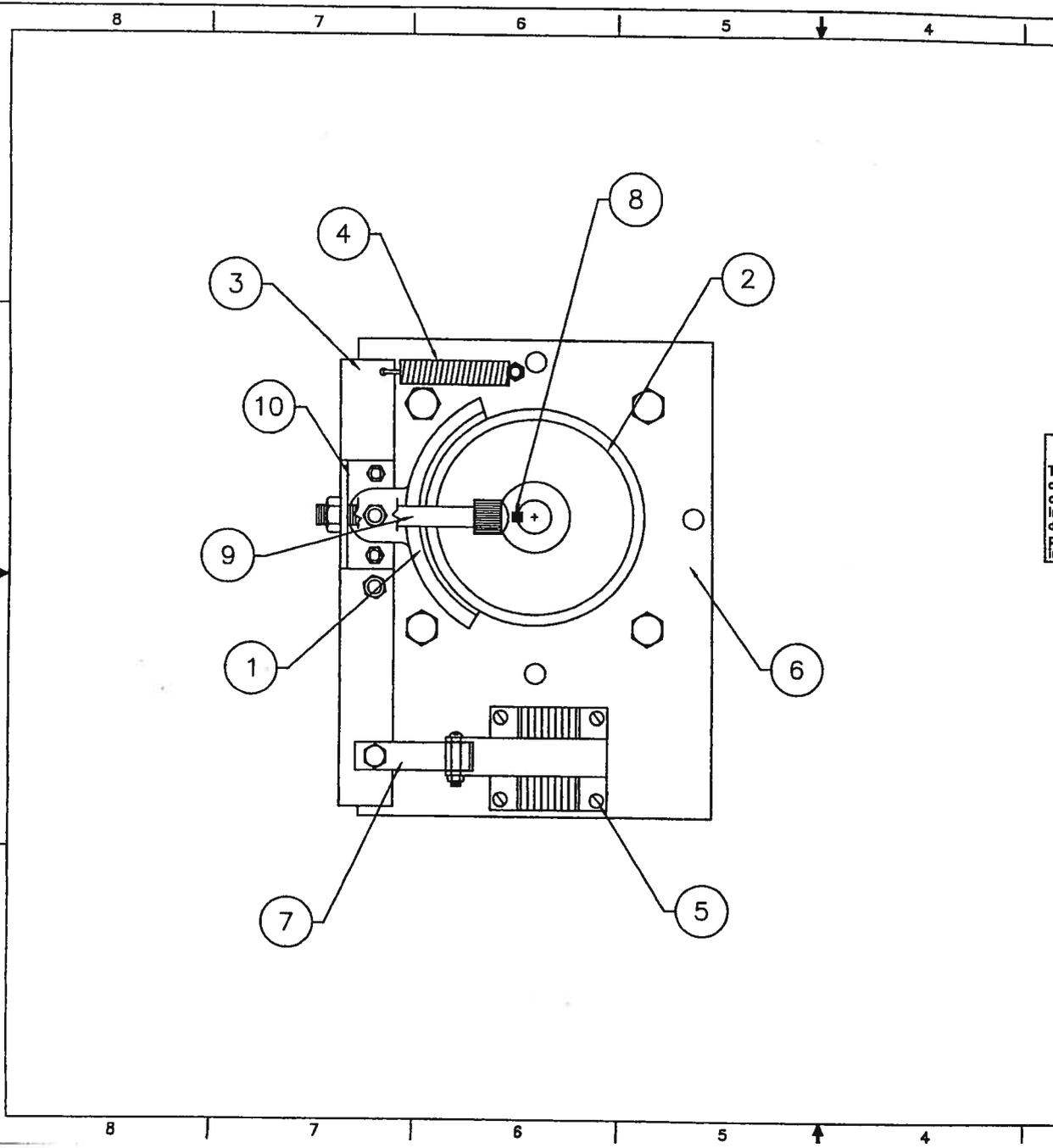
ZONE	REV	BY	DATE	REVISION
-	0	-	-	REDRAWN ON CAD

NOTES:  
1. REPLACES HAND DRAWING #BUL-637779-SPL

ITEM NO	QTY	PART OR IDENTIFYING NO	DESCRIPTION
17	1	2600-568-110	RING, O
16	2	-	BOLT, HEX HEAD
15	3	-	NUT, NYLOCK HEX
14	1	2302-0512	PIN, ROLL
13	2	2302-0410	PIN, ROLL
12	1	0200-1908	CASKET
11	1	0555-8076	COLLAR, WEATHER
10	1	0555-8081	ASSEMBLY, HAMMER
9	1	0555-7888	BOLT, SWING
8	1	0555-8078	ASSEMBLY, HASP
7	1	0555-1737	STUD, TAMPER-PR
6	1	0555-7904	STUD, GONG SHEI
5	1	0555-0507	SHELL, RAIN
4	1	0555-8142B	SHELL, BRONZE
3	1	0555-7883	DOOR
2	1	0555-7883	HOUSING, MAIN
1	1	-	ASSEMBLY, GONG

PRODUCT USED ON	DATE	BY	REVISION
0555-0000/B	BAD	04-97	

Partial information due to scan quality.  
See O&M literature in operator's house for  
complete details



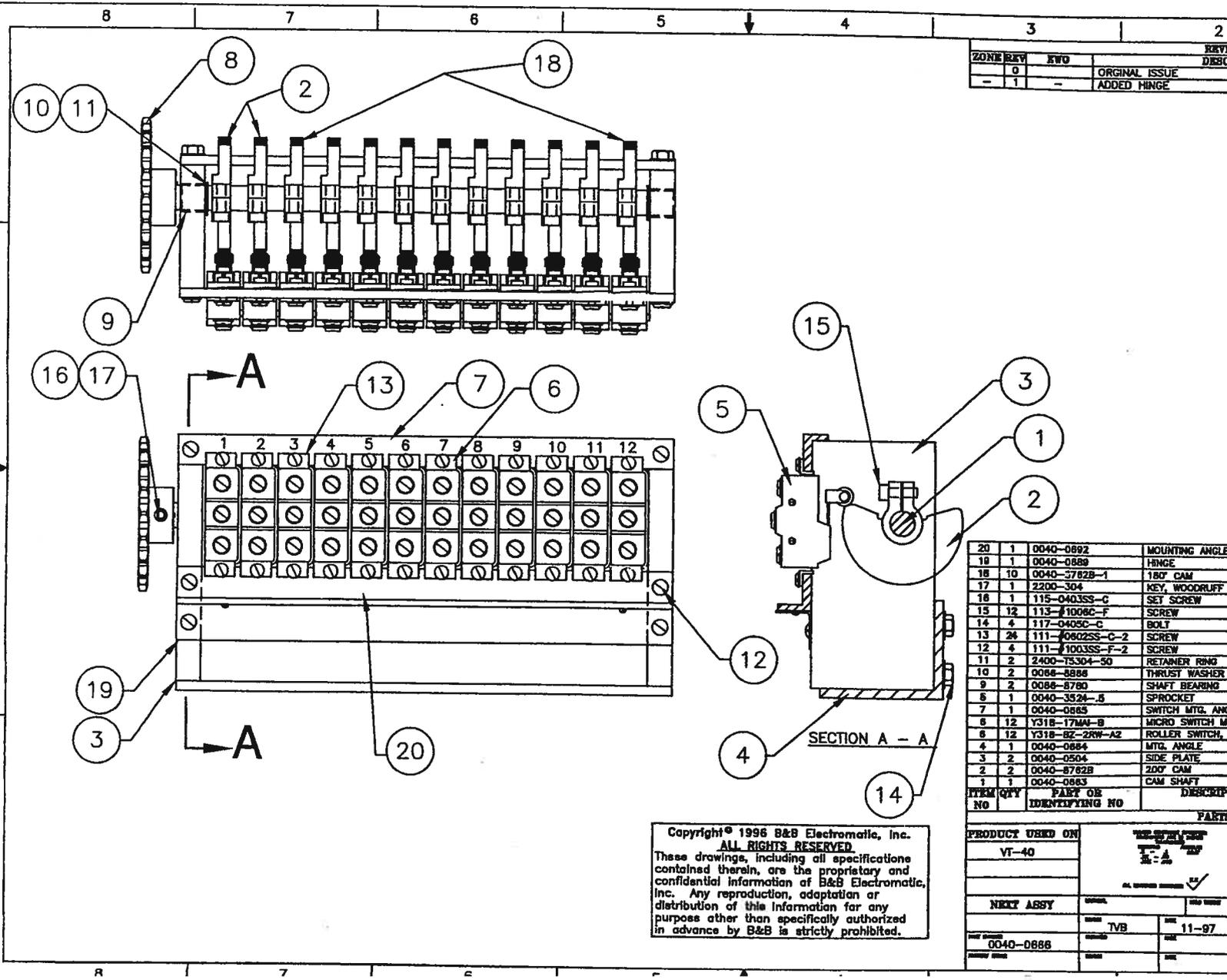
ZONE	REV	EYO	REVISION	DESCR
--	0	--	ORIGINAL ISSUE	
--	1	--	REVISION	
--	2	--	REDRAWN TO NEW STAND	

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Inc. Any reproduction, adaptation or  
distribution of this information for any  
purpose other than specifically authorized  
in advance by B&B is strictly prohibited.

ITEM	QTY	PART OR IDENTIFYING NO	DESCRIPTION
10	1	0040-0532	BRKT, MAN. RELE
9	1	0040-0518	STUD ASSY. BRAKE
8	1	2201-0310	KEY, FEATHER
7	1	0040-0521	BAR, PLUNGER
6	1	0040-0519	PLATE, BRAKE MOU
5	1	5K	BRAKE, RELEASE
4	1	X785-1ED37DED4M	BRAKE SPRING
3	1	0040-0520	BRAKE BEAM
2	1	0086-0357/C	DRUM BRAKE ALI
1	1	0086-1660	BRAKE SHOE, HAC

PRODUCT USED ON		PARTS	
VT'S			
HZ'S			
NEKY ASSY			
0040DA0002	RDC		03-88
0040-0003	RDC		03-88

Partial information due to scan quality.  
See O&M literature in operator's house for complete details

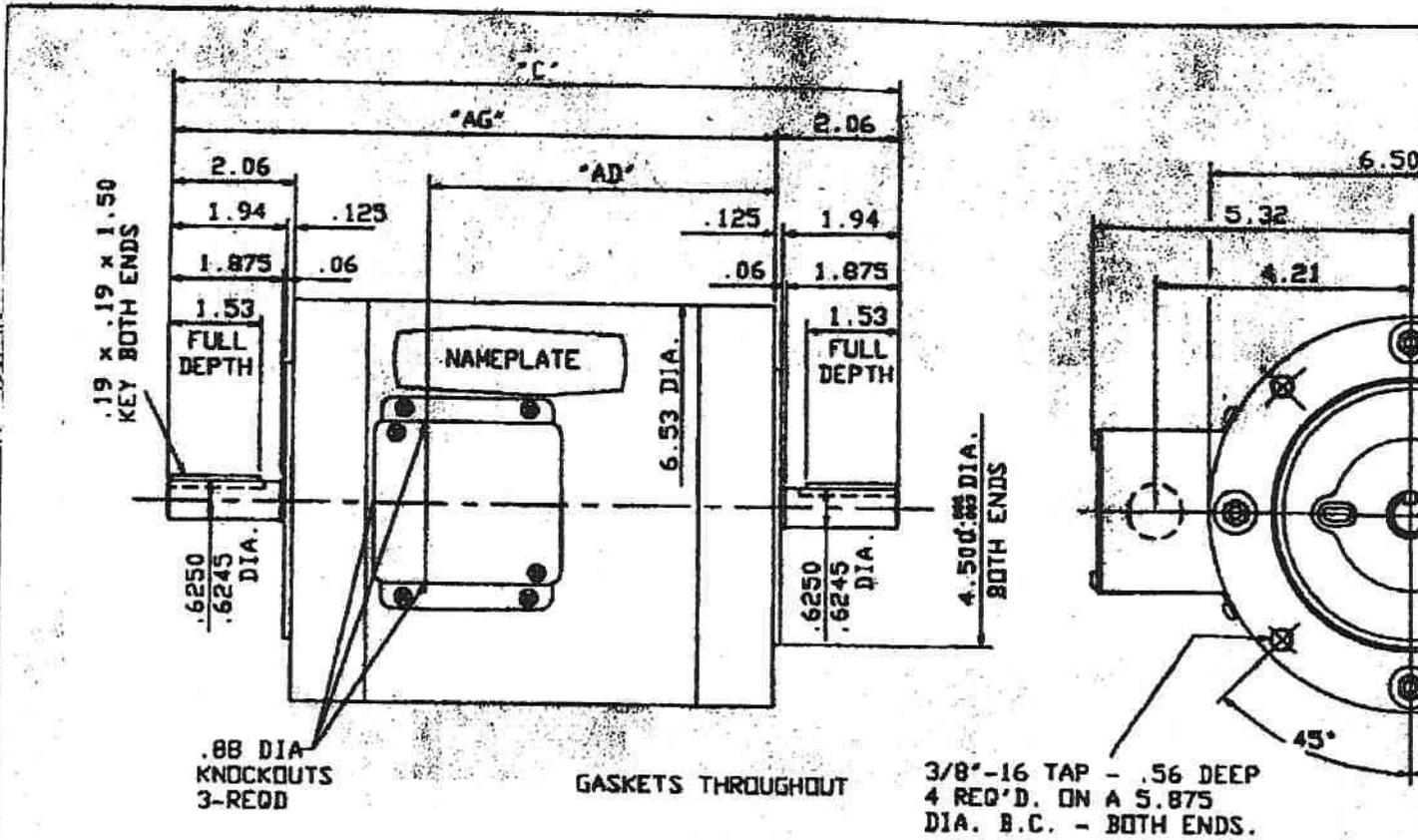


ZONE	REV	EVO	REV
0			ORIGINAL ISSUE
-	1	-	ADDED HINGE

ITEM NO	QTY	PART OR IDENTIFYING NO	DESCRIPTION
20	1	0040-0882	MOUNTING ANGLE
19	1	0040-0889	HINGE
18	10	0040-3782B-1	180° CAM
17	1	2200-304	KEY, WOODRUFF
16	1	115-0403SS-C	SET SCREW
15	12	113-11006C-F	SCREW
14	4	117-0405C-C	BOLT
13	24	111-0602SS-C-2	SCREW
12	4	111-1003SS-F-2	SCREW
11	2	2400-75304-50	RETAINER RING
10	2	0086-0886	THRUST WASHER
9	2	0086-8780	SHAFT BEARING
8	1	0040-3524-5	SPROCKET
7	1	0040-0863	SWITCH MTD. ANGLE
6	12	Y318-17MA-B	MICRO SWITCH MT
5	12	Y318-82-2RW-A2	ROLLER SWITCH, MTD. ANGLE
4	1	0040-0884	MTD. ANGLE
3	2	0040-0504	SIDE PLATE
2	2	0040-8762B	200° CAM
1	1	0040-0863	CAM SHAFT

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PRODUCT USED ON	DATE	REV	BY
VT-40			
NEKT ASSY			
DATE	TVB	REV	11-97
0040-0886			



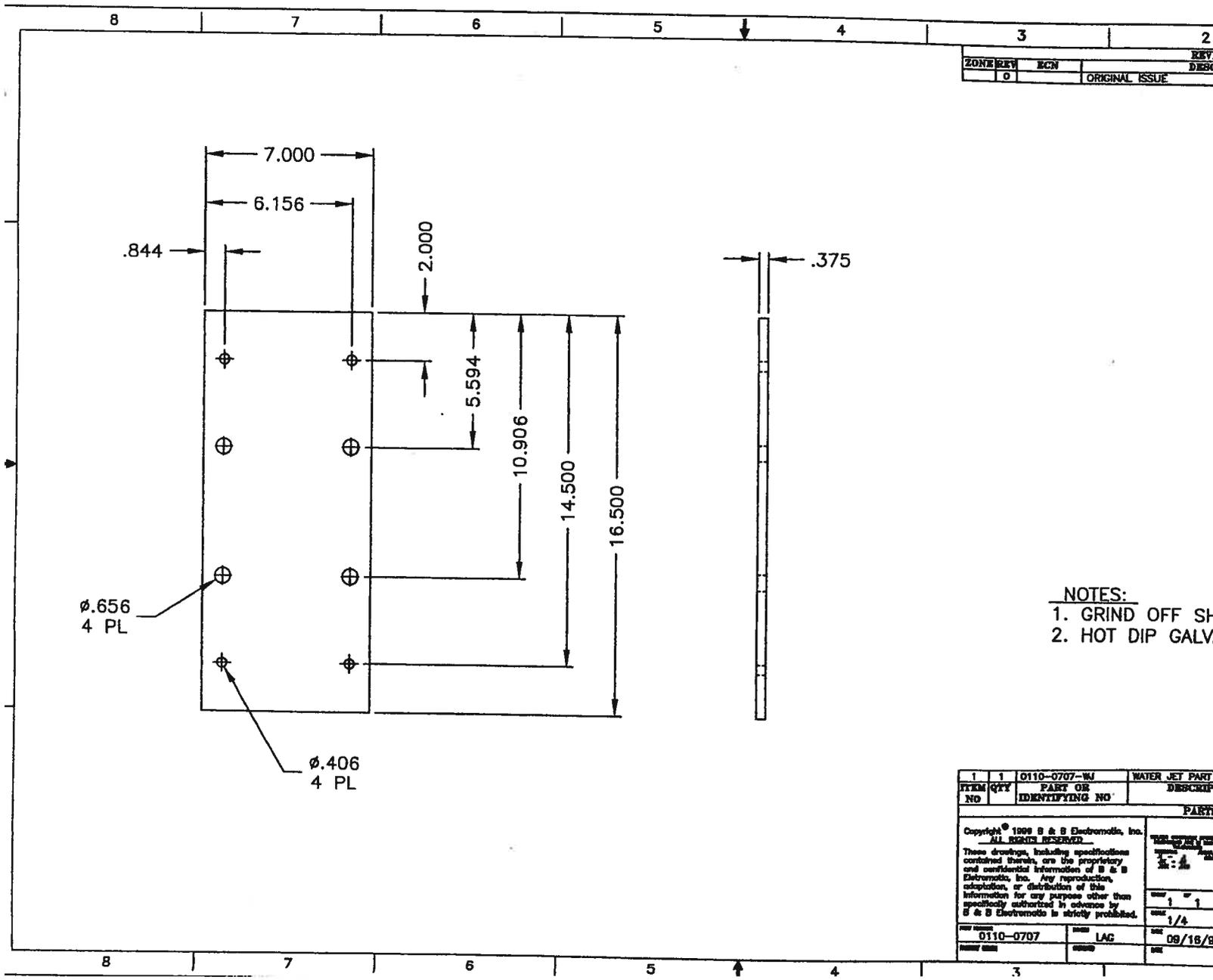
MAXIMUM FACE RUNDOUT TO BE .004 T.I.R.  
MAXIMUM PILDOT ECCENTRICITY .004 T.I.R.  
PERMISSIBLE SHAFT RUNDOUT .002 T.I.R.

FRAME	'C'	'AG'	'AD'
B56	11.13	9.06	4.75
C56	11.63	9.56	5.25
D56	12.13	10.06	5.75
E56	12.63	10.56	6.25
F56	13.13	11.06	6.75

**△**  
MOUNTING H  
ENDS TO BE

				TOLERANCES UNLESS OTHERWISE SPECIFIED		LEESON ELECTRIC	
				DECIMALS			
3	ADDED C-FACE ALIGNMENT NOTE PER ECR 5045/ASAM	4SAM	08/16/94	.00	± .01	DRAWN	RT 2/15/90
2	ADDED 'B' FRAME TO TABLE	RLP DL	2/18/91	.000	± .005	CHK'D	BL 2/12/90
1	KEYWAY WAS 1.41, KEY WAS 1.38 PER C.H.	RT	3/30/90	.0000	± .0005	APPR.	DJA 2/15/90
NO.	REVISION	BY	DATE	FRACTIONS	± 1/64	SCALE	3/8
THIS DRAWING IN DESIGN AND DETAIL IS OUR PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH OUR WORK. ALL RIGHTS OF DESIGN AND INVENTION ARE RESERVED.				HOLES	± 1/2°	REF.	FINISH
				INCH/WH		THE	GP170CS
							OUTLINE
							OPEN
							MAT'L.
							FINISH
							B & B
							ELECTRIC
							SIZE
							A

Partial information due to scan quality.  
See O&M literature in operator's house for complete details



ZONE	REV	ECN	REVISION
	0		ORIGINAL ISSUE

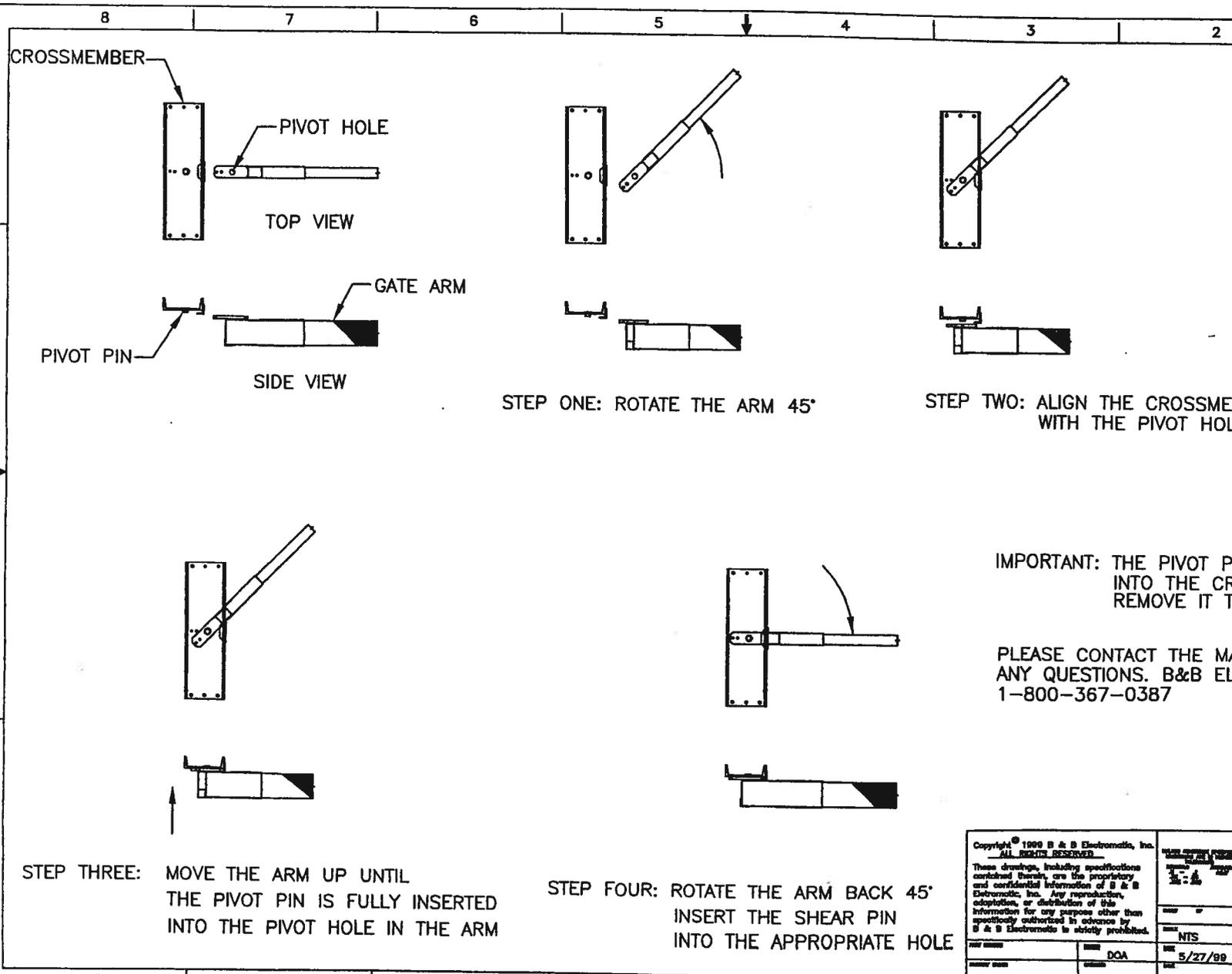
- NOTES:
1. GRIND OFF SH
  2. HOT DIP GALV

ITEM NO	QTY	PART OR IDENTIFYING NO	DESCRIPTION
1	1	0110-0707-WJ	WATER JET PART

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DATE	0110-0707	DESIGN	LAG	DATE	08/18/99
SCALE		SCALE		SCALE	

Partial information due to scan quality.  
See O&M literature in operator's house for complete details



IMPORTANT: THE PIVOT PIN  
GOES INTO THE CROSSMEMBER.  
REMOVE IT FROM THE ARM.

PLEASE CONTACT THE MANUFACTURER FOR  
ANY QUESTIONS. B&B ELECTRONIC  
1-800-367-0387

Copyright © 1999 B & B Electronic, Inc. ALL RIGHTS RESERVED		DATE	5/27/99
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REV	DCA	DATE	5/27/99

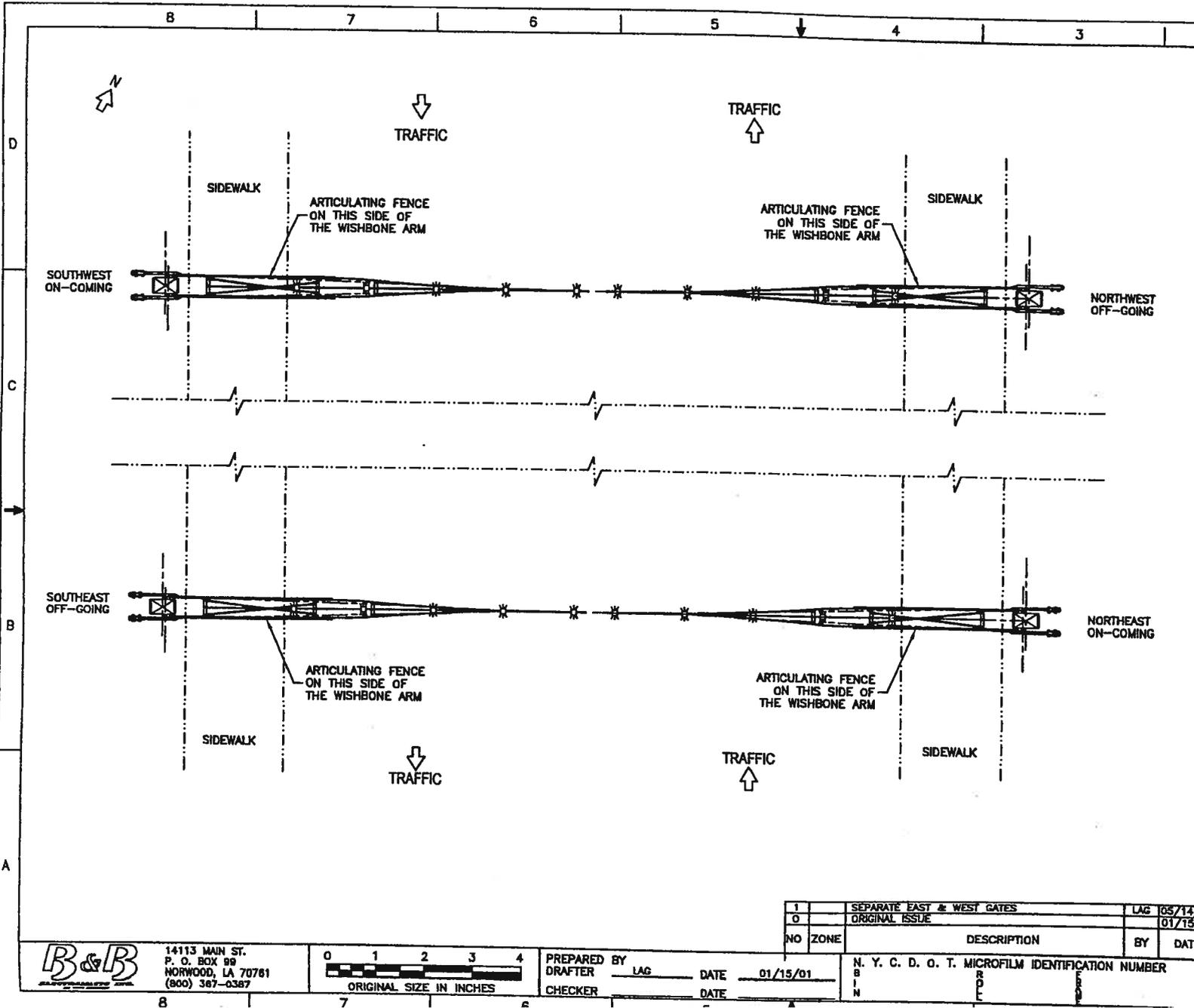
# **SECTION: 4**

## **VT-40 Drawings**

***B&B***

An ISSI Company  
14113 Main Street  
Norwood, Louisiana 70761  
(225)629-5234 ~ Fax (225)629-5727  
BBENG@BBGATES.COM  
© 1997 B&B

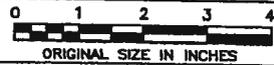
Partial information due to scan quality.  
See O&M literature in operator's house for complete details



1	SEPARATE EAST & WEST GATES	LAG	05/14/01
0	ORIGINAL ISSUE		01/15/01
NO	ZONE	DESCRIPTION	BY
			DATE
N. Y. C. D. O. T. MICROFILM IDENTIFICATION NUMBER			



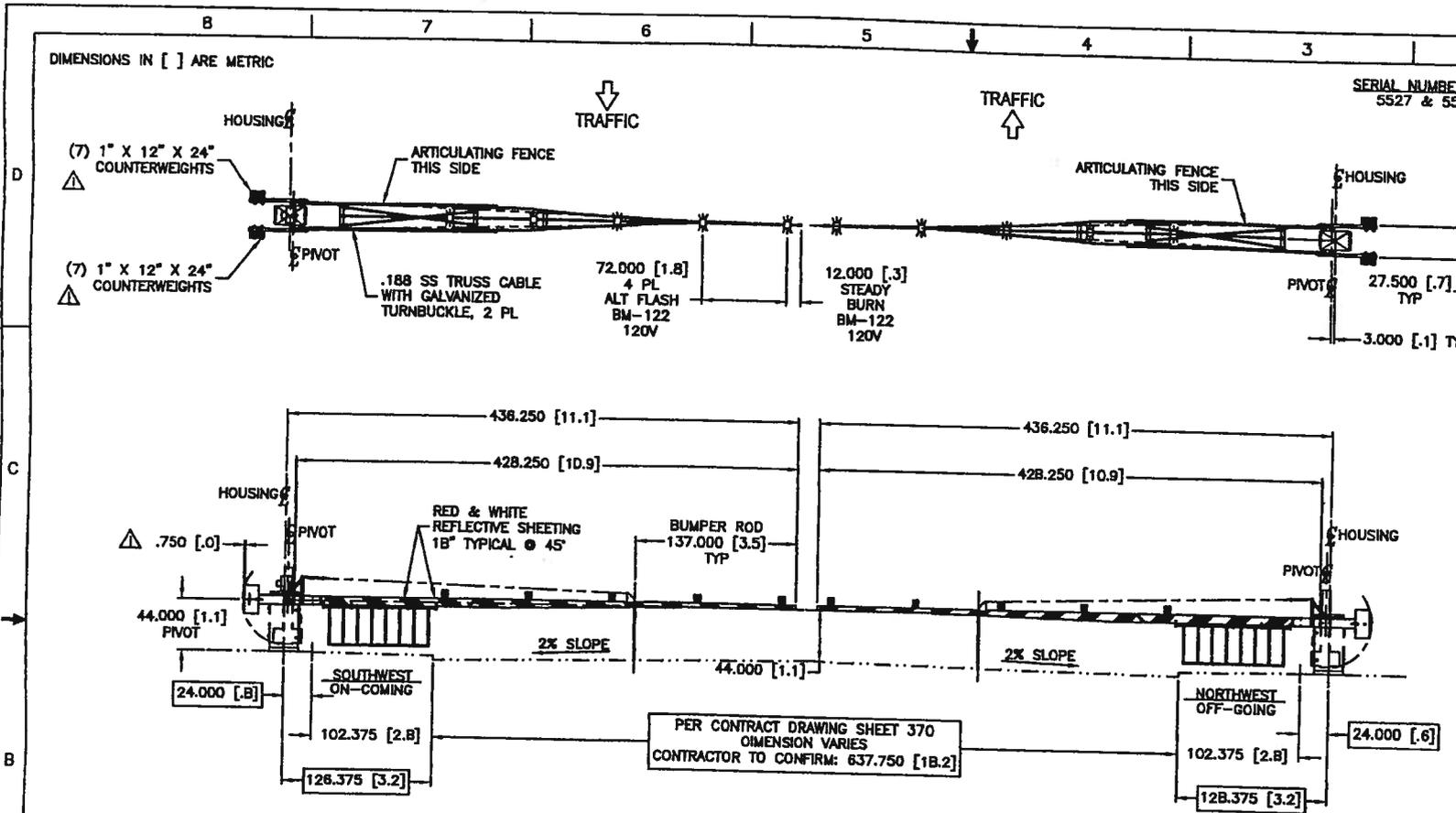
14113 MAIN ST.  
P. O. BOX 88  
NORWOOD, LA 70761  
(800) 367-0387



PREPARED BY \_\_\_\_\_ DATE 01/15/01  
DRAFTER LAG  
CHECKER \_\_\_\_\_ DATE \_\_\_\_\_



Partial information due to scan quality.  
See O&M literature in operator's house for  
complete details



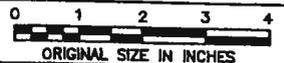
**NOTES:**

1. CONTRACTOR TO VERIFY ALL DIMENSIONS, PAYING CLOSE ATTENTION TO BOXED DIMENSIONS. FACTORY CANNOT ASSUME ALTERATION COSTS AFTER FINAL SUBMITTAL DRAWINGS HAVE BEEN APPROVED.
2. HOUSING, SIDE ARM CHANNELS AND COUNTERWEIGHTS (12 x 24) TO BE HOT OIP GALVANIZED.
3. PADLOCKABLE DOORS FURNISHED, PADLOCK BY OTHERS.
4. ONE OF EACH UNIT REQUIRED. SOUTHWEST, ON-COMING GATE TO HAVE Z-555 BRONZE CONG.
5. REFER TO DRAWING WE8512C3 & C4 FOR ELECTRICAL.
6. GALVANIZED ANCHOR BOLTS & TEMPLATE SUPPLIED BY B & B (.750-10 x 12 LONG x 4 THREAD x 3.500 LEG).
7. WARNING GATES SHALL BE SUBJECT TO INSPECTION AND WITNESSED OPERATIONAL TESTING AT B & B (NORWOOD, LA) TO DEMONSTRATE PROPER OPERATION AND ADJUSTMENT.
8. THE CONTRACTOR SHALL ARRANGE TO HAVE AT THE SITE A B & B FIELD REPRESENTATIVE AT TIME OF INSTALLATION.
9. CONTRACTOR TO ADVISE OF ANY OBSTRUCTIONS (RAILING, PARAPET ETC.).

**CONT. NOTES:**

10. WARNING LIGHT SPACING TYPICAL PER ARM.
11. ARM MATERIAL AND SHEETING TYPICAL PER OPERATOR.
12. BUMPER ROD LOCATION TYPICAL PER ARM.
13. SS TRUSS CABLE WITH GALVANIZED TURNBUCKLES TYPICAL PER ARM.

**B & B**  
14113 MAIN ST.  
P. O. BOX 88  
NORWOOD, LA 70761  
(800) 387-0387



PREPARED BY LAG  
CHECKER  
DATE 05/14/02  
GATE

1	AS BUILT	TWW	3/21/02
0	ORIGINAL ISSUE		05/14/02
NO	ZONE	DESCRIPTION	BY DATE

N. Y. C. O. O. T. MICROFILM IDENTIFICATION NUMBER

B

7

6

5

4

3



# O'Connell Electric Co.

ELECTRICAL CONTRACTORS

Since 1911

Industrial & Commercial

Powerline & Substation

Signal & Street Lighting

TEGG Service

## TABLE OF CONTENTS

- 1) Traffic Gates
- 2) Maintenance
- 3) Pier Lights
- 4) Marine Air Horn
- 5) Gauge Light

### MAIN OFFICE

830 Phillips Road  
Victor, NY 14564-9747  
585-924-2176 Fax 585-924-4973

### BUFFALO OFFICE

929B Ransom Road  
Lancaster, NY 14086  
716-675-9010 Fax 716-686-0586

### SYRACUSE OFFICE

301 Stoutenger Street  
East Syracuse, NY 13057  
315-437-1453 Fax 315-437-7431



## Model VT-40

### GENERAL

The safety gate will be B & B type VT-40. These specifications are the minimum that will be acceptable. The gate will be of the standard vertical to horizontal arm type, will have a weatherproof housing and operating mechanism and will include such controls, accessories and modifications as specified.

### APPLICATIONS

The VT-40 Automatic Safety Gate will typically be used as a warning, traffic control and access control gate. Typical applications will include moveable bridge traffic warning gate, parking lot access control gate and any medium to heavy-duty traffic control or warning installation.

- **HOUSING**

The housing will be fabricated from 1/4-inch **5052-H32** aluminum. The aluminum housing will receive a primer finish. Formed, channel shaped side plates will be used to produce a strong configuration without welded corners.

Front and rear access doors will be hung on bronze, full-cross hinges with stainless steel hinge pins. Hinges will be of the slip-off type. Doors will be held in place with two bronze wing nuts and stainless steel swing bolts and will be sealed with neoprene strip gaskets. Top will be held in place with corrosion resistant hex head bolts. Openings for arm shafts will be equipped with "O" ring seals. Padlockable doors will be a standard feature (padlock by others).

The housing base will provide four 1-inch holes for mounting on the customer's foundation. Anchor bolts and templet will be supplied by the gate manufacturer. Standard anchor bolt size will be 3/4 - 10 x 12 + 4 hot dip galvanized.

- **ARM**

The arm will be constructed according to the customer's specifications and will be a **Wooden wishbone** - This arm, with aluminum articulating fence, will be fabricated from extra clear vertical grain fir in a wishbone shape (*Refer to installation drawings #WI8512A2 & WI8512A3 for actual dimensions*).

**Stutson Street Bridge**  
**B&B Factory Order #00-8512**  
**VT-40 Specs., 4 Pages (Page 2 of 4)**  
**(4) Four Units Required**

Double stainless steel truss cables and a spring loaded roadway bumper will be furnished with all arms.

Roadway arm lengths (dimension "A") will be measured from the centerline of the gate housing to the tip of the arm. (*Refer to installation drawings #WI8512A2 & WI8512A3 for actual dimensions*).

Gate arms will be covered on both sides with 16-inch alternating red and white engineering grade reflectorized sheeting.

- **ARM BASE**

A rigid mounting will be furnished.

- **ARM MOUNTING CHANNELS**

Arm mounting channels will be fabricated from carbon steel, hot dip galvanized. The roadway arm shaft will be 44 inches above the base line of the gate housing.

- **COUNTERWEIGHTS**

Each gate will be equipped with suitable hot dip galvanized steel counterweights of the sectional, bolt-on type. Counterweights will have a maximum 10% adjustment.

- **ARM SHAFTS**

The main arm shaft will be mounted in heavy-duty ball bearings and will be lubricated from the inside. The main arm shaft will be not less than 2 inches in diameter. Shaft material will be ASTM A311 Class B high strength, stressproof steel.

- **TRANSMISSION**

The transmission will be a fully enclosed, all gear, direct drive unit running in an oil bath. The drive train will not use belts or chains and will be connected to the arm shaft with a connecting rod having self-aligning ball ends. The connecting rod will be constructed of ASTM A311 Class B high strength stressproof steel.

During the opening and closing cycles, the gate arm will begin with zero velocity and accelerate smoothly reaching maximum velocity at mid-stroke (45 degrees). The arm will then decelerate smoothly to zero velocity at full stroke (90 degrees) preventing bounce or whip of the arm. Operating time to open or close the gate will be 13 seconds.

The standard connecting rod assembly will be designed to move the gate through a 90-degree travel.

Stutson Street Bridge  
B&B Factory Order #00-8512  
VT-40 Specs., 4 Pages (Page 3 of 4)  
(4) Four Units Required

- **MOTOR**

A 480V, 3PH, 1HP motor will be provided. The motor will be of the flange-mounted type, attached to the transmission case with not less than four bolts. The motor will be of the instant reversing type to permit reversing movement of the arms at any point of travel. Motor data will appear in the manual.

- **BRAKING MECHANISM**

A solenoid release, automatic motor brake will be furnished as part of the gate drive mechanism. The brake will automatically release when the handcrank is inserted to manually operate the gate.

- **HANDCRANK**

A handcrank and drill crank will be included with each gate to operate the gate during power failure. Door safety switches will automatically disconnect the control circuit power when the door is opened to allow for manual operation.

- **LIMIT SWITCH**

The gate limit switch will be a unit assembly containing eight individual switches having one set of normally open and one set of normally closed contacts each. Contacts will be totally enclosed and will have U.L. rating of not less than 15 amperes at 220 volts AC. Limit switch will be readily accessible and easily replaced with normal hand tools. Each individual switch will be controlled by an independent cam, which will be adjustable with a hex socket cap screw. The limit switch body, shafts and cams will be of corrosion resistant non-ferrous materials.

- **SAFETY SWITCHES, TERMINAL BLOCKS AND WIRING**

To protect operating and maintenance personnel from injury during service or installation, a manual disconnect switch will be furnished, installed and fully wired in the main motor leads. Automatic disconnect switches will be arranged to break the control circuit when either door is opened. Pressure type terminal blocks will be provided and installed inside the housing on the roadway side. All control wires will terminate on these blocks. Each terminal will be clearly labeled and all conductors will be color coded and/or numbered. The wiring diagram will reflect such colors or numbers. A GFI receptacle will be supplied in the gate housing. No conductor will be smaller than #16 AWG stranded. Each housing will contain a laminated electrical schematic secured to the inside of the housing for reference by service personnel.

**Stutson Street Bridge**  
**B&B Factory Order #00-8512**  
**VT-40 Specs., 4 Pages (Page 4 of 4)**  
**(4) Four Units Required**

- **QUALITY ASSURANCE**

Manufacturer of the traffic control gate operator will have a minimum of five years experience in the manufacture of industrial gate operators and barriers, and will make available replacement parts for ten years. All gates are individually inspected at time of final assembly and test. Each gate will be tagged "ACCEPTED" upon completion of inspection and a "Certification of Testing" will be supplied in the handbook for validation of meeting internal Quality Assurance standards.

## 6. Lubricants



## Mobilith SHC™ Series

Mobil Grease , United States

Grease

### Product Description

Mobilith SHC™ Series greases are superior performance products designed for a wide variety of applications at extremes of temperature. They combine the unique features of synthetic base fluids with those of a high quality lithium complex thickener. The wax-free nature of synthetic fluids and the low coefficient of traction (compared with mineral oils), provide excellent low temperature pumpability and very low starting and running torque. These products offer the potential for energy savings and can reduce operating temperatures in the load zone of spherical roller and ball bearings. The lithium complex thickener contributes excellent adhesion, structural stability and resistance to water. The greases have a high level of chemical stability and are formulated with special additive combinations to provide excellent protection against wear, rust and corrosion, and providing operating viscosity at high and low temperatures. Mobilith SHC Series greases are available in seven grades, varying in base oil viscosity from ISO VG 100 to 1500 and in NLGI grade from 2 to 00.

Mobilith SHC Series greases have become the products of choice for many users, in many industries worldwide. Their reputation is based on their exceptional quality, reliability, versatility and the performance benefits they deliver.

### Features and Benefits

The Mobil SHC brand of oils and greases are recognized and appreciated around the world for their innovation and outstanding performance. The Mobilith SHC series symbolizes ExxonMobil's continued commitment to using advanced technology to provide outstanding products. A key factor in the development of the Mobilith SHC Series were the close contacts between our scientists and application specialists with key Original Equipment Manufacturers (OEMs) to ensure that our product offerings would provide exceptional performance in the continually evolving industrial equipment designs.

Our work with equipment builders has helped confirm the results from our own laboratory tests showing the exceptional performance of the Mobilith SHC Series lubricants. These benefits include longer grease life, enhanced bearing protection and bearing life, wide temperature range of application, and the potential for improved mechanical efficiency and energy savings.

To combat high thermal exposure of the oil our product formulation scientists chose proprietary synthetic base oils for Mobilith SHC Series oils because of their exceptional thermal/oxidative resistance potential. Our scientists developed a state-of-the-art lithium complex thickener technology and used specific additives to enhance the performance of each grade of the Mobilith SHC Series product family. The Mobilith SHC Series greases offer the following features and benefits:

Features	Advantages and Potential Benefits
Outstanding high temperature and low temperature performance	Wide application temperature ranges, with excellent protection at high temperatures and low torque, easy start-up at low temperatures
Excellent protection against wear, rust and corrosion	Reduced downtime and maintenance costs because of reduced wear, rust and corrosion
Excellent thermal stability and oxidation resistance	Extended service life with longer intervals between relubrication and improved bearing life
Low traction coefficient	Potential to improve mechanical life and reduced energy consumption
Includes both high and low viscosity grades	Options for outstanding protection of slow speed, heavily loaded bearings, and options for good low temperature performance
Outstanding structural stability in the presence of water	Retains excellent grease performance in hostile aqueous environments

Features	Advantages and Potential Benefits
Low volatility	Helps resist viscosity increase at high temperatures to maximize relubrication intervals and bearing life

**Applications**

Application Considerations: While Mobilith SHC Series greases are compatible with most mineral oil based products, admixture may detract from their performance. Consequently it is recommended that before changing a system to one of the Mobilith SHC Series, it should be thoroughly cleaned out to achieve the maximum performance benefits. While the Mobilith SHC Series greases share many performance benefits, their applications are best described in terms of each product grade:

- Mobilith SHC 100 is an antiwear and extreme pressure grease primarily recommended for higher speed applications such as electric motors, where reduced friction, low wear and long service life are required. It is an NLGI 2 Grade / ISO VG 100 grease with a synthetic base fluid. Its operating temperature range is -40° C\* to 150° C.
- Mobilith SHC 220 is a multi-purpose, NLGI 2 extreme pressure grease recommended for heavy-duty automotive and industrial applications. It uses an ISO VG 220 synthetic base fluid. Mobilith SHC 220 has a recommended operating temperature range of -40° C\* to 150° C.
- Mobilith SHC 221 is a multi-purpose, extreme pressure grease recommended for heavy-duty automotive and industrial applications, particularly where centralized grease systems are utilized. It uses an ISO VG 220 synthetic base fluid. Mobilith SHC 221 has a recommended operating temperature range of -40° C to 150° C.
- Mobilith SHC 460 is an NLGI 1.5 Grade grease with ISO VG 460 synthetic base fluid and is an extreme pressure grease recommended for tough industrial and marine applications. It provides outstanding bearing protection under heavy loads at low-to-moderate speeds and in applications where water resistance is a critical factor. Mobilith SHC 460 has demonstrated outstanding performance in steel mills, paper mills and marine applications. The recommended operating temperature range is -30° C\* to 150° C.
- Mobilith SHC 1000 Special is an NLGI 2 Grade grease with ISO VG 1000 synthetic base fluid and strongly fortified with solid lubricants including 11% graphite and 1% molybdenum disulphide for maximum protection of plain or rolling element bearings operating under boundary lubrication regimes. This product is designed to extend bearing life under conditions of extremely slow speeds, sliding contacts, and high temperatures. Mobilith SHC 1000 Special has a recommended operating temperature of -30°C\* to 150 °C with appropriate relubrication intervals.
- Mobilith SHC 1500 is an NLGI 1.5 Grade / ISO VG 1500 grease with a synthetic base fluid. It is intended for use in plain and rolling element bearings operating at extremely slow speeds, under heavy loads and high temperatures. Mobilith SHC 1500 has a recommended operating temperature range of -30 °C\* to 150 °C with appropriate relubrication intervals. Continuous lubrication with Mobilith SHC 1500 has been very effective in prolonging bearing life in a severe roll press application. Mobilith SHC 1500 has also provided excellent performance in rotary kiln roller bearings and in slag transfer rail car bearings.
- Mobilith SHC 007 is an NLGI 00 Grade / ISO VG 460 grease with a synthetic base fluid; it has a recommended operating temperature range of -50° C to 150 ° C with appropriate relubrication intervals. Its primary uses are in grease filled industrial gear cases subject to high temperatures, where conventional semi fluid greases will not provide acceptable lubricant life and in non-driven heavy-duty truck trailer wheel hubs.

\*Low temperature claims based on ASTM D 1478 results vs. maximum limits of 10,000 / 1000 gcm @ startup and 1 hour respectively.

**Specifications and Approvals**

This product has the following approvals:	007	100	1000 SPECIAL	1500	220	221	460
AAR-M942		X				X	

This product is recommended for use in applications requiring:	007	100	1000 SPECIAL	1500	220	221	460
CEN EN 12081:2017		X					

This product meets or exceeds the requirements of:	007	100	1000 SPECIAL	1500	220	221	460

This product meets or exceeds the requirements of:	007	100	1000 SPECIAL	1500	220	221	460
DIN 51825:2004-06 - KPF HC 2 N-30			X				
DIN 51825:2004-06 - KP HC 1-2 N -30				X			
DIN 51825:2004-06 - KP HC 1-2 N -40							X
DIN 51825:2004-06 - KP HC 2 N -30					X		
DIN 51825:2004-06 - KP HC 2 N -40		X					
DIN 51826:2005-01 - GP HC 00 K -30	X						

Properties and Specifications

Property	007	100	1000 SPECIAL	1500	220	221	460
Grade	NLGI 00	NLGI 2	NLGI 2	NLGI 1.5	NLGI 2	NLGI 1	NLGI 1.5
Thickener Type	Lithium Complex						
Color, Visual	Red	Red	Grey Black	Red	Red	Light Tan	
Corrosion Preventive Properties, Rating, ASTM D1743		PASS	PASS	PASS	PASS		PASS
Dropping Point, °C, ASTM D2265		265	265	265	265	265	265
Four-Ball Extreme Pressure Test, Weld Load, kgf, ASTM D2596	250	250	620	250	250	250	250
Four-Ball Wear Test, Scar Diameter, mm, ASTM D2266		0.5		0.50	0.50		0.50
Four-Ball Wear Test, Scar Diameter, 40 kg, 1200 rpm, 1 h, 75 C, mm, ASTM D2266	0.5		0.50			0.50	
Penetration, 60X, 0.1 mm, ASTM D217	415	280	280	305	280	325	305
Rust, Rating, ASTM D1743						PASS	
SKF Emcor Rust Test, Distilled Water, ASTM D6138						0,0	
SKF Emcor Rust Test, Distilled Water, Bearing 1, ASTM D6138		0	0	0	0		0
SKF Emcor Rust Test, Distilled Water, Bearing 2, ASTM D6138		0	0	0	0		
US Steel Mobility @ -18 C, g/min, AMS 1390		20.0		3.0	11.0		5.0

Property	007	100	1000 SPECIAL	1500	220	221	460
Viscosity @ 100 C, Base Oil, mm <sup>2</sup> /s, ASTM D445	55.6	16.3	83.7	149	30.3	28.8	55.6
Viscosity @ 40 C, Base Oil, mm <sup>2</sup> /s, ASTM D445	460	100	1000	1500	220	220	460
Viscosity Index, ASTM D2270	188	175	164	212	179	169	188
Water Washout, Loss @ 79 C, wt%, ASTM D1264		6	2.6	2.5	3	4	3

### Health and Safety

Health and Safety recommendations for this product can be found on the Material Safety Data Sheet (MSDS) @ <http://www.msds.exxonmobil.com/psims/psims.aspx>

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10-2020

### Exxon Mobil Corporation

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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)

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### Benefits for Your Application

- Increased coupling life
- Significantly extended re-lubrication intervals
- Reduced maintenance costs
- Reduced downtime
- Superior lubrication
- High load-carrying capabilities
- Usable up to 250 degrees Fahrenheit (F) (121 C)
- Extended warranty

### USDA Approval

Falk LTG has the United States Department of Agriculture (USDA) Food Safety & Inspection Service approval for applications where there is no possibility of contact with edible products (H-2 rating).

### Packaging Options

Falk LTG is packaged to suit every need:

- **Polybags** — included with Sizes 1020T-1090T couplings for initial hand packing at installation
- **14-ounce (.4 kg) cartridges** — for use in standard industrial lubrication guns
- **35-pound (15.9 kg) pails**
- **120-pound (54.5 kg) kegs** — for plants with many small couplings or large size couplings, best for hand packing
- **400-pound (181.8 kg) drums** — for plants with a pressurized lubrication system
- **A 10 pack of 14-ounce (.4 kg) cartridges**

## Falk Long Term Grease

### Falk Long Term Grease (LTG) for flexible shaft couplings.

Our engineers have spent years measuring the wear rates on coupling components using various lubricants and coatings. Virtually every common industrial lubricant has been centrifuged under laboratory conditions per American Society for Testing and Materials (ASTM) standard test methods for "Oil Separation from Lubricating Grease by Centrifuging." The results of extensive research indicated that greases with high viscosities and low bleed rates produce the longest life. Falk® LTG is specially formulated to provide superior lubrication for flexible shaft couplings.

### How LTG works

The consistency of Falk LTG changes with operating conditions. As manufactured it is a National Lubricating Grease Institute (NLGI) #1 grade. Working of the lubricant under actual service conditions causes it to become semifluid while the grease near the seals will set to a heavier grade, helping to prevent leakage. Falk LTG is highly resistant to separation, easily outperforming all other lubricants tested. The resistance to separation allows the lubricant to be used for relatively long periods of time.

### Compatibility

Falk LTG is compatible with most coupling lubricants. For optimum performance it is recommended that couplings be cleaned of old grease before packing with Falk LTG.

### Extended maintenance intervals

**Falk Steelflex® Grid Couplings** — when Falk Steelflex Grid Couplings are initially lubricated with Falk LTG, scheduled periodic maintenance is not needed. You can now get the superior protective features of these couplings, plus the toughness of steel, and eliminate periodic maintenance expense. Rexnord recommends

that such couplings be inspected and re-lubed only when the connected equipment is being serviced or the coupling is opened for alignment checks.

**Falk Lifelign® Gear Couplings** — re-lube intervals for sensitive gear couplings have been extended from six months to three years.

### Warranties

When a new coupling is aligned, installed, lubricated and operated within the limits specified in the Falk Lifelign Gear Coupling or Falk Steelflex Grid Coupling installation instructions, the following warranties apply from date of purchase.

Falk Steelflex Grid Couplings are warranted for five years and Falk Lifelign Gear Couplings for three years when LTG is used. If other approved coupling greases are used, our standard one-year warranty applies to both coupling designs.



**Lubrication facts**

**Separation** — grease is a blend of oil and a thickener or soap. These compounds are not very stable and will eventually bleed or separate under the high centrifugal forces generated in many coupling applications. Once a grease begins to separate, the thickener accumulates in the areas where lubrication is required, and rapid wear of the contacting surfaces occurs. The oil is now free to leak out of the coupling past the seals, causing premature failure of the coupling.

**Service intervals for all-purpose greases** — it is common practice to lubricate all rotating equipment with one or two all-purpose greases.

Most greases that are used as coupling lubricants were initially developed as bearing lubricants.

Bearing greases have a low viscosity and high bleed rate which is desirable to avoid heat caused by rolling friction. However, rolling friction is not present in couplings where the only movement is a sliding action caused by misalignment of shafts or thermal growth.

**Maintenance and downtime** — in today’s industrial plants the cost of equipment downtime for servicing can easily exceed thousands of dollars per hour. So rather than shutting down this critical equipment, the connecting shaft couplings are frequently allowed to run until failure occurs or until the more expensive drive components in the system require maintenance.

In an attempt to hold the line of high maintenance costs, some users have switched to non lubricated coupling designs. This switch seldom works out for the best because many elastomer designs have a short life expectancy and they induce problems elsewhere in the drive system. When they do fail, the connected equipment often has to be moved to replace the element.

**Falk LTG specifications**

- **NLGI Grade:** #1
- **Thickener Type:** Lithium/Polymer
- **Color, Visual:** Dark Brown
- **Penetration, Worked, 25 Celsius (C), ASTM D 217:** 325
- **Dropping Point, C, ASTM D 2265:** 215
- **cSt @ 40 C:** 680
- **Centrifugal Bleed, ASTM D 4425, K36, 24 hrs, 38 C, vol %:** 0
- **Penetration Change, ASTM D 217, from 60X to 10,000X, mm/10:** 25
- **Bomb Oxidation, ASTM D 942, Pressure drop at 100 hrs, kPa:** 35
- **Four-ball Wear Test, ASTM D 2266:** 0.35
- **Four-ball EP Test, ASTM D 2596, Weld Point, Kg Load Wear Index, Kgf:** 315 51
- **Timken OK Load, ASTM D 2509, lb:** 60
- **Corrosion Prevention, ASTM D 1743:** Pass
- **Copper Strip Corrosion, ASTM D 4048:** 1A
- **Operating Range:** -20 F (-29 C) to 250 F (121 C)
- **Minimum Pump:** 20 F (-6 C)
- **Operating Speed Range**
  - **Falk Steelflex Grid Couplings:** All speeds
  - **Falk Lifelign Gear Couplings:** Minimum speed per Table 1. See service manual 458-110, 458-112 or 458-120 for more information.

**Table 1**

Falk Steelflex Grid Coupling		Falk Lifelign Gear Coupling				
Size***	Required Lube wt-lbs (kg)	Flanged Sleeve		Continuous Sleeve		Minimum Speed with LTG or NLGI #1 Grease**
		Size*	Required Lube wt-lbs (kg)	Size	Required Lube wt-lbs (kg)	
1020T	.06 (.027)	1010G	.09 (.041)	1010GC	.025 (.011)	1,030
1030T	.09 (.041)	1015G	.16 (.073)	1015GC	.063 (.028)	700
1040T	.12 (.055)	1020G	.25 (.113)	1020GC	.094 (.042)	550
1050T	.15 (.068)	1025G	.50 (.23)	1025GC	.144 (.065)	460
1060T	.19 (.086)	1030G	.80 (.36)	1030GC	.201 (.093)	380
1070T	.25 (.113)	1035G	1.20 (.54)	1035GC	.269 (.122)	330
1080T	.38 (.173)	1040G	2.00 (.91)	—	—	290
1090T	.56 (.255)	1045G	2.30 (1.04)	—	—	250
1100T	.94 (.427)	1050G	3.90 (1.77)	—	—	230
1110T	1.12 (.509)	1055G	4.90 (2.22)	—	—	210
1120T	1.62 (.736)	1060G	7.00 (3.18)	—	—	190
1130T	2.0 (.909)	1070G	9.60 (4.35)	—	—	160
1140T	2.5 (1.136)	1080G	21 (9.55)	—	—	140
1150T	4.3 (1.955)	1090G	27 (12.24)	—	—	120
1160T	6.2 (2.818)	1100G	33 (15)	—	—	110
1170T	7.7 (3.5)	1110G	39 (17.7)	—	—	100
1180T	8.3 (3.773)	1120G	46 (21.8)	—	—	94
1190T	9.7 (4.409)	1130G	72 (32.6)	—	—	88
1200T	12.4 (5.636)	1140G	73 (33.1)	—	—	82
1210T	23.2 (10.55)	1150G	90 (40.8)	—	—	76
1220T	35.4 (16.09)	1160G	95 (43.1)	—	—	72
1230T	53.0 (24.09)	1180G	110 (49.9)	—	—	64
1240T	74.5 (33.86)	1200G	150 (68)	—	—	58
1250T	110.5 (50.23)	—	—	—	—	—
1260T	148.1 (67.32)	—	—	—	—	—

\* Refer to the Falk Lifelign Gear Couplings catalog (458-112) for larger sizes.  
 \*\* For Falk Lifelign Gear Coupling speeds below these values, use NLGI #0 grease. For coupling speeds less than half of these values use an EP (extreme pressure) oil. When using oil lubrication, be sure to seal keyways and flange connection to prevent leakage.  
 \*\*\* Falk Steelflex Grid Couplings use Falk LTG Grease or equivalent for all speeds.

# Mobil Polyrex EM Series

## Electric-Motor Bearing Grease

### Product Description

Super-premium Mobil Polyrex EM Series grease is specially formulated for electric-motor bearings. The advanced thickener formulation and proprietary manufacturing techniques provide improved bearing performance and protection for long electric motor life.

### Features & Benefits

Mobil Polyrex EM and Mobil Polyrex EM 103 offer the following features and benefits:

Features	Advantages and Potential Benefits
Outstanding grease life	Outstanding long-life, high-temperature lubrication of ball and roller bearings, particularly in sealed-for-life applications
Advanced polyurea thickener	Increased durability versus conventional polyurea greases when subjected to mechanical shear forces
Excellent corrosion resistance	Mobil Polyrex EM and Mobil Polyrex EM 103 provide protection against rust and corrosion. Mobil Polyrex EM provides additional protection under mild salt-water wash conditions versus Polyrex EM 103
Low-noise properties	Mobil Polyrex EM is suitable for lubrication of ball bearings in many noise-sensitive applications

### Applications

Mobil Polyrex EM greases are recommended by many major bearing and electric motor manufacturers for long-life lubrication of electric motor ball and roller bearings.

Mobil Polyrex EM 103 is more specifically recommended for applications such as vertically mounted bearings, or very large motors where a stiffer grease consistency may be required by the OEM, and low noise properties are not required.

Mobil Polyrex EM greases have been shown to be compatible with a number of ExxonMobil lithium complex greases, as well as competitive electric motor mineral polyurea products, as determined by the methodology of ASTM D6185. For specific questions about grease compatibility, contact your Mobil representative.

Key applications include:

- Electric-motor bearings
- Fin-fan bearings
- High-temperature pump bearings
- Factory-filled, sealed-for-life ball bearings
- Ball or roller bearings operating at high temperatures where low oil separation is required
- Polyrex EM for ball or roller bearings operating in noise sensitive environments



## Typical Properties

	Mobil Polyrex EM	Mobil Polyrex EM 103
NLGI Grade	2	3
Color	Blue	Blue
Base Oil Viscosity, ASTM D 445		
cSt @ 40°C	115	115
cSt @ 100°C	12.2	12.2
Mineral Oil Viscosity Index, ASTM D 2270	95	95
Penetration, ASTM D217 worked, 60x, mm/10	285	250
Penetration Change after 100.000 strokes, ASTM D217, mm/10	40	40
Dropping Point, ASTM D 2265, °C	260	270
Oil separation test, ASTM D 1742, %	0.5	0.1
High Temperature Grease Life, ASTM D 3336, Hours @ 177°C	750+	750+
4-Ball Wear Scar, ASTM D 2266, @ 40kg, 1200 rpm, 75°C, 1 hr, mm	0.41	0.6
Low Temperature Torque, ASTM D 1478, g-cm @ -29°C		
Starting	7500	9300
Running	800	1000
EMCOR Corrosion Performance, 10% Synthetic Sea Water ASTM D 6138 (Prepared As Per ASTM D 665B)	0,1 (No Rust)	-
Rust Protection, ASTM D 1743, Distilled Water	Pass	Pass
Copper Corrosion Resistance, ASTM D 4048	1A	1A
Water Washout, ASTM D 1264, %	1.9	0.8

## Health & 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.

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# Mobilgear™ 600 XP

Extra-high-performance gear lubricants



Energy lives here.

### Product features

Mobilgear 600 XP gear oil can offer:

- Exceptional protection against wear and micropitting
- Long bearing life
- Excellent seal compatibility

# 15X

the industry  
requirement for  
wear protection\*

### Meets or exceeds the requirements of:

- AGMA 9005-EO2
- DIN 51517-3: 2009-04
- ISO 12925

### Potential benefits

Mobilgear 600 XP oil can help:

- 1 Limit equipment replacement costs
- 2 Boost productivity by limiting maintenance downtime and minimising bearing replacement costs
- 3 Minimise leaks, oil consumption and contamination through excellent seal compatibility

### Product overview

Today's smaller gearboxes with higher power density create greater demands on lubricants. That's why Mobilgear 600 XP Series oils are formulated to offer exceptional extreme pressure and load-carrying properties. These capabilities can help minimise unplanned equipment and maintenance downtime, boost productivity through trouble-free operation and limit repair and replacement costs.

### Builder approvals\*

SIEMENS AG Flender gear units, T 7300, Table A-a, Flender Code No.	✓
SIEMENS AG Flender gear units, T 7300, Table E-am, Flender Code No.	✓
Mueller Weingarten DT 55 005	✓

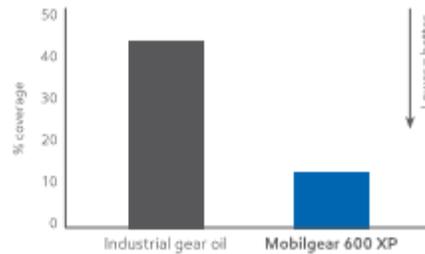
\*As measured by the industry standard FAG HL 8 test.

See Product Data Sheet (PDS) at [mobilind.com](http://mobilind.com) for which oils have these approvals.

# Mobilgear™ 600 XP

## Micropitting protection

In controlled laboratory testing illustrating micropitting formation on gear teeth, Mobilgear 600 XP Series oils provided outstanding protection compared to generic oils. This capability can help enhance equipment life to save you repair and replacement costs.



## Typical properties

Mobilgear 600 XP	68	100	150	220	320	460	680
ISO Viscosity Grade	68	100	150	220	320	460	680
Viscosity, ASTM D 445							
mm <sup>2</sup> /s @ 40°C	68	100	150	220	320	460	680
mm <sup>2</sup> /s @ 100°C	8.8	11.2	14.7	19.0	24.1	30.6	39.2
Viscosity Index, ASTM D 2270	101	97	97	97	97	96	90
Pour Point, °C, ASTM D 97	-27	-24	-24	-24	-24	-15	-9
Flash Point, °C, ASTM D 92	230	230	230	240	240	240	285
Density @15.6 °C, ASTM D 4052, kg/l	0.88	0.88	0.89	0.89	0.90	0.90	0.91
FZG Micropitting, FVA 54, Fail Stage/Rating		10 / High					
FE 8 wear test, DIN 51819-3, D7,5/80-80, Roller wear, mg	2	2	2	2	2	2	2
Timken OK Load, ASTM D 2782, lb	65	65	65	65	65	65	65
4-Ball EP test, ASTM D 2783,							
Weld Load, kg	200	200	250	250	250	250	250
Load Wear Index, kgf	47	47	47	48	48	48	48
FZG Scuffing, Fail Stage							
A/8.3/90	12+	12+	12+	12+	12+	12+	12+
A/16.6/90		12+	12+	12+	12+	12+	12+
Rust protection, ASTM D 665, Seawater	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Copper Strip Corrosion, ASTM D 130, 3 hrs @ 100°C	1B	1B	1B	1B	1B	1B	1B
Demulsibility, ASTM D 1401, Time to 3ml emulsion, minutes @ 82°C	30	30	30	30	30	30	30
Foam Test, ASTM D 892, Tendency/Stability, ml/ml Sequence 1	0/0	0/0	0/0	0/0	0/0	0/0	0/0
Sequence 2	30/0	30/0	30/0	30/0	30/0	30/0	



## Mobil SHC™ 600 Series

Mobil Industrial, United States

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

Features	Advantages and Potential Benefits
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 calenders
- Severe centrifuge applications, including marine centrifuges
- Railroad A/C Traction Drives
- Mobil SHC 626, 627, 629 and 630 are suitable for Oil Flooded Rotary Screw Compressors compressing natural gas, field gas gathering, CO<sub>2</sub> and other process gasses used in the natural gas industry
- Mobil SHC 629, 630, 632, 634, 636, and 639 are approved by Siemens AG for use in Flender gearboxes

## Specifications and Approvals

Mobil SHC 600 Series meets or exceeds the requirements of:	624	625	626	627	629	630	632	634	636	639
AGMA 9005 E02	X	X	X	X	X	X	X	X	X	X
DIN 51517-3 CLP				X	X	X	X	X	X	X
ISO 12925-1 CKB	X									
ISO 12925-1 CKD		X	X	X	X	X	X	X	X	X

Mobil SHC 600 Series has the following builder approvals:	624	625	626	627	629	630	632	634	636	639
Fives Cincinnati			P-63 P-80	P-76	P-77				P-34	P-78

Mobil SHC 600 Series has the following builder approvals:	624	625	626	627	629	630	632	634	636	639
SIEMENS AG Flender gear units, T 7300, Table A-c, Flender Code No.					A36	A35	A34	A33	A32	A31
SEW Eurodrive: SEW IG CLP HC SEW SG CLP HC	32 32		68 68		150 150	220 220	320	460 460	680	1000

## Typical Properties

Mobil SHC 600 Series	624	625	626	627	629	630	632	634	636	639
ISO Viscosity Grade	32	46	68	100	150	220	320	460	680	1000
Viscosity, ASTM D 445										
cSt @ 40°C	32	46	68	100	150	220	320	460	680	1000
cSt @ 100°C	6.3	8.5	11.6	15.3	21.1	28.5	38.5	50.7	69.0	98.8
Viscosity Index, ASTM D2270	148	161	165	162	166	169	172	174	181	184
Pour Point, °C, ASTM D5950	-57	-54	-51	-45	-39	-36	-33	-30	-30	-27
Flash Point, °C, ASTM D 92	236	225	225	235	220	220	225	228	225	222
Density @ 15°C (60°F) (g/cc) ASTM D4052	0.85	0.85	0.86	0.86	0.86	0.87	0.87	0.87	0.87	0.87
Appearance, visual	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange
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 2272, 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,III Tendency / 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

Mobil SHC 600 Series	624	625	626	627	629	630	632	634	636	639
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.

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08-2018

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## Spindle Oil Textile Machine Oil

Product Data Sheet



### Customer benefits

- **Maximizes equipment life**  
Anti-wear additive package protects bearing surfaces from wear when increasing load and temperature can cause breakdown of the oil film.
- **Reduces maintenance costs**  
Oxidation inhibitors help prevent formation of damaging deposits and varnish at elevated temperatures. Effective rust and corrosion inhibitors protect equipment under humid operating conditions.
- **Extended service life**  
Highly refined base oils and effective oxidation inhibitor system provide excellent resistance to degradation and thickening of the oil in service.

### Applications

- Textile machine spinning frame spindles.
- Automated machine tools requiring low viscosity oil
- High speed, lightly loaded spindles, or where the use of higher viscosity oils leads to unacceptably high temperatures
- Lightly loaded high speed industrial machine bearings.
- Industrial circulating oil systems requiring low viscosity oil.
- Hydraulic systems where lower viscosity, anti-wear fluids are recommended.

### Product features:

Low viscosity spindle bearing oil formulated from highly refined mineral oil, anti-wear agents and rust and oxidation inhibitors. Designed for the lubrication of high speed textile machines and automated machine tools.

A **Chevron** company product

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## Product Specifications

SPINDLE OIL KEY PROPERTIES	TEST METHOD (ASTM)	RESULTS
ISO Grade		10
Product Code		544436
Flash Point, COC, °C	D92	146
Pour Point, °C	D97	-9
Viscosity, mm <sup>2</sup> /s @ 40°C	D445	10.0
mm <sup>2</sup> /s @ 100°C	D445	2.66
Viscosity Index	D2270	100

This bulletin was prepared in good faith from the best information available at the time of issue. While the values and characteristics are considered representative, some variation, not affecting performance, can be expected. It is the responsibility of the user to ensure that the products are used in the applications for which they are intended.

Produced by Chevron Lubricants; Africa, Middle East and Pakistan.

**Environment, Health and Safety** Information is available on this product in the Material Safety Data Sheet (MSDS) and Customer Safety Guide. Customers are encouraged to review this information, follow precautions and comply with laws and regulations concerning product use and disposal. To obtain a MSDS for this product, visit [www.caltecoils.com](http://www.caltecoils.com).

For more information, go to [www.chevronlubricants.com](http://www.chevronlubricants.com)

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## PRODUCT DATA

# LUBRIPLATE GEAR SHIELDS

## DESCRIPTION

LUBRIPLATE Gear Shields are available in three different thickness densities (N.L.G.I.) These lubricants are applied as received – THEY DO NOT HAVE TO BE HEATED for application.

## ADVANTAGES

- ⇒ Complete series covering user needs for different film thickness
- ⇒ Waterproof, corrosion resistant
- ⇒ Strong adhesive and stay-put properties
- ⇒ Solid fillers for extra wear protection under heavy load

## APPLICATIONS

**LUBRIPLATE Gear Shield** is an NLGI No. 1 grade. **LUBRIPLATE Gear Shield Heavy** is an NLGI No. 2 grade. Both lubricants are recommended for normal gear coating applications.

**LUBRIPLATE Gear Shield Extra Heavy** is a NLGI No. 3 grade very thick, adhesive and tacky grease designed especially for heavy duty applications. LUBRIPLATE Gear Shield Extra Heavy has proven itself an outstanding lubricant on a wide variety of applications. A leading heavy construction firm found it so successful in lubricating the dipper sticks, racks and pinions on their shovels handling blast furnace slag, that they adopted its use on all their shovel operations including strip mining, stone quarrying and highway construction. A leading manufacturer of heavy duty fork-lift trucks found that this lubricant was the only one that successfully lubricated the slides on some large vehicles designed for the Armed Services. Likewise, chemical and other processors using large open gear drives have found that LUBRIPLATE Gear Shield Extra Heavy has lubricated the gears more satisfactorily and prolonged the gear life considerably over that previously experienced using other gear compounds. It is also an outstanding fifth wheel grease.

## Typical Test Data

PROPERTY	TEST METHOD	TYPICAL RESULTS*		
		GEAR SHIELD	HEAVY	EXTRA HEAVY
Type of Base		Lithium	Lithium	Lithium
NLGI No.		1	2	3
Worked Penetration	ASTM D-217	310/ 340	265/ 295	235/ 260
Dropping Point	ASTM D-566	350°F/ 177°C	365°F/ 185°C	370°F/ 188°C
<b>Viscosity:</b>				
SUS @ 210°F	ASTM D-2161	90	150	200+
cSt @ 100°C	ASTM D-445	17	31	40+
Approximate Cold Test		-20°F/ -29°C	-10°F/ -23°C	0°F/ -18°C

### PACKAGING AVAILABLE

Carton, 4/6 lb. Plastic Tubs  
35 lb. Pail  
120 lb. Quarter Size Drum  
425 lb. Full Size Drum

### GEAR SHIELD

L0150-005  
L0150-035  
\*\*\*  
L0150-040

### HEAVY

L0151-005  
L0151-035  
L0151-039  
L0151-040

### PACKAGING AVAILABLE

Carton, 40/10.5 oz. Caulk Cartridges  
35 lb. Pail  
120 lb. Quarter Size Drum  
425 lb. Full Size Drum  
Carton, 12/11 Oz. Aerosol Cans

### EXTRA HEAVY

L0152-000  
L0152-035  
L0152-039  
L0152-040  
L0152-063





## Mobilgrease XHP™ 220 Series

Mobil Grease , United States

### Product Description

Mobilgrease XHP™ 220 greases are extended service lithium complex greases intended for a wide variety of applications and severe operating conditions. These greases were designed to outperform conventional products by applying cutting edge, proprietary, lithium complex manufacturing technology. They are formulated to provide excellent high temperature performance with superb adhesion, structural stability and resistance to water contamination. These greases have a high level of chemical stability and offer excellent protection against rust and corrosion. These greases feature high dropping points and maximum recommended operating temperature of 140° C (284°F). Mobilgrease XHP 220 greases are available in NLGI grades 00, 0, 1, 2 and 3 with an ISO VG 220 base oil viscosity.

Mobilgrease XHP 220 greases are designed for a wide range of applications including the industrial, automotive, construction and marine sectors. Their performance features make them ideal choices for operating conditions including high temperature, water contamination, shock loading and extended re-lubrication operations. Mobilgrease XHP 222 Special is an extreme pressure grease fortified with 0.75% molybdenum disulfide that provides protection from wear under conditions pivoting and other conditions that lead to loss of oil film.

### Features and Benefits

Mobilgrease XHP 220 greases are leading members of the Mobilgrease brand of products, which have gained a reputation for innovation and performance excellence. Mobilgrease XHP 220 greases are high performance products designed by our formulation technologists and backed by our world-wide technical support staff.

A key factor in the excellent adhesion and cohesion properties and high drop point of Mobilgrease XHP 220 greases is the proprietary manufacturing technology developed at our research facilities and adopted by our modern manufacturing facilities. These products use specially selected additives to provide excellent oxidation stability, rust and corrosion control, resistance to water contamination as well as anti-wear and EP protection. Mobilgrease XHP 220 Series products offer the following features and potential benefits:

Features	Advantages and Potential Benefits
Superb resistance to water washout and spray-off	Helps assure proper lubrication and protection even in the most severe water exposure conditions
Highly adhesive and cohesive structure	Excellent grease tenacity, helps reduce leakage and extend re-lubrication intervals for reduced maintenance requirements
Excellent rust and corrosion resistance	Protection of lubricated parts even in hostile aqueous environments
Very good resistance to thermal, oxidative and structural degradation at high temperature	Helps extend grease life and enhance bearing protection in high temperature applications helping to reduce maintenance and replacement costs
Very good anti-wear and EP performance	Reliable protection of lubricated equipment, even under conditions of high sliding with potential for extended equipment life and reduced unanticipated downtime
Broad multi-purpose application	Provides potential for inventory rationalization and reduced inventory costs

### Applications

Mobilgrease XHP 220 greases are used in a wide range of equipment including industrial, automotive, construction and marine applications. Their blue color enables easy verification of application:

Mobilgrease XHP 005 and 220 are softer, high-temperature greases recommended by ExxonMobil for centralized grease application systems, gear lubrication, and where extreme-cold-temperature pumpability is important.

Mobilgrease XHP 221 is recommended by ExxonMobil for use in industrial and marine applications, chassis components and farm equipment. It provides excellent low temperature performance.

Mobilgrease XHP 222 is recommended by ExxonMobil for industrial and marine applications, chassis components and farm equipment. Its sticky formulation stays in applications longer.

Mobilgrease XHP 223 is recommended by ExxonMobil for applications where good high temperature and anti-leakage properties are required. It is particularly recommended for severe truck wheel bearing applications or for rolling element bearings subject to vibration, or where higher speeds require a grease with higher consistency to provide channeling characteristics.

Mobilgrease XHP 222 Special contains 0.75% molybdenum disulfide, is grey in color and is recommended by ExxonMobil for moderate duty service in industrial applications, chassis components and farm equipment. It also finds application in king pins, U-joints, fifth wheels and bucket pins.

### Specifications and Approvals

<b>This product has the following builder approvals:</b>	<b>220</b>	<b>221</b>	<b>222</b>
Fives Cincinnati P-64			X
Fives Cincinnati P-72		X	
Fives Cincinnati P-79	X		

<b>This product meets or exceeds the requirements of:</b>	<b>220</b>	<b>221</b>	<b>222</b>
DIN 51825:2004-06 - KP 1 N -20		X	
DIN 51825:2004-06 - KP 2 N -20			X

### Properties and Specifications

<b>Property</b>	<b>005</b>	<b>220</b>	<b>221</b>	<b>222</b>	<b>222 SPECIAL</b>	<b>223</b>
Grade	NLGI 00	NLGI 0	NLGI 1	NLGI 2	NLGI 2	NLGI 3
Thickener Type	Lithium Complex	Lithium Complex				
Base Oil Viscosity of Greases @ 40 C, mm <sup>2</sup> /s, AMS 1697	220	220	220	220	220	220
Bomb Oxidation, Pressure Drop, 100 h, kPa, ASTM D942	35	35	35	35	35	35
Color, Visual	Dark blue	Dark blue	Dark blue	Dark blue	Grey-black	Dark blue
Copper Strip Corrosion, Rating, ASTM D4048	1B	1B	1B	1B	1B	1B

Property	005	220	221	222	222 SPECIAL	223
Corrosion Preventive Properties, Rating, ASTM D1743	PASS	PASS	PASS	PASS	PASS	PASS
Dropping Point, °C, ASTM D2265		270	280	280	280	280
Four-Ball Extreme Pressure Test, Weld Load, kgf, ASTM D2596	315	315	315	315	400	315
Four-Ball Wear Test, Scar Diameter, mm, ASTM D2266	0.5	0.5	0.5	0.5	0.5	0.5
Molybdenum Disulfide Content, wt %, CALCULATED					0.75	
Penetration, 60X, 0.1 mm, ASTM D217	415	370	325	280	280	235
Roll Stability, Penetration Consistency Change, 0.1 mm, ASTM D1831		-15	-15	0	0	0
SKF Emcor Rust Test, Distilled Water, ASTM D6138	0,0	0,0	0,0	0,0	0,0	0,0
Timken OK Load, kg, ASTM D2509	40	40	40	40	40	40

### Health and Safety

Health and Safety recommendations for this product can be found on the Material Safety Data Sheet (MSDS) @ <http://www.msds.exxonmobil.com/psims/psims.aspx>

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07-2020

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# Mobilith AW Series

## Grease

### Product Description

The Mobilith AW Series products are high performance lithium-complex greases. They are formulated with antiwear agents to provide excellent service under the severe operating conditions of heavy and shock loading. Oxidation inhibitors enhance the ability of Mobilith AW Series greases to withstand operating temperatures up to 175° C with minimum breakdown or leakage. Rust inhibitors protect lubricated components from rust and corrosion. Mobilith AW Series greases are available in NLGI grades from 00 to 3 with base oil viscosity ISO VG 150, except for Mobilith AW 00 which is ISO VG 100.

Mobilith AW Series greases have excellent handling and dispensing properties at temperatures down to -40° C, which means they are superior to most high-temperature greases that generally have poorer low-temperature consistency and pumpability. The Mobilith AW Series greases provide superior lubrication under thin film conditions, and resist displacement from highly loaded components encountered in industrial applications. Their excellent resistance to water and protection against rust make the greases well suited to applications requiring maximum protection over extended periods.

### Features & Benefits

Mobilith AW Series greases are important members of the Mobilith brand of lithium-complex based greases that have earned a solid reputation for high performance capability, excellent equipment protection and long life. Mobilith AW Series are backed by ExxonMobil's worldwide team of technical and application experts to ensure that the best choice of product is used in customers' applications. The reliable high quality of Mobilith AW Series greases results from the state-of-the-art facilities used in their manufacture.

Features and potential benefits for Mobilith AW Series greases include:

Features	Advantages and Potential Benefits
Excellent antiwear protection under heavy and shock loads	Excellent protection of lubricated equipment with the potential for extended life and reduced maintenance
Excellent protection against rust and corrosion	Outstanding operating temperature range: -40° C to 175° C Highly reliable equipment protection, even in hostile environments, with less unanticipated downtime
High dropping point: 260° C	Excellent high temperature performance with long grease life and reduced maintenance potential
Very good low temperature properties	Series includes products capable of handling, dispensing and lubricating down to -40° C



## Applications

Application Considerations: In order to maintain the performance characteristics of the Mobilith AW Series greases, completely clean or purge previously used greases from the system.

Mobilith AW Series greases are heavy-duty products designed for multi-purpose industrial applications covering a wide range of operating conditions. Specific applications include:

- Mobilith AW 1, 2, and 3 greases are recommended for the lubrication of bearings operating with heavy or shock loads, and at temperatures up to 175° C. They are suitable for lubricating cams, ways, and other sliding elements. Other applications include vehicles and greased components in paper mills, where both water and high temperatures are encountered.
- Mobilith AW 0 and 00 are softer, high-temperature greases recommended for centralised grease application systems, gear lubrication, and where extreme-cold-temperature pumpability is important.

## Specifications & Approvals

Mobilith AW Series meets or exceeds the following industry specifications:	00	0	1	2	3
Quality Level USDA H2	X	X	X	X	X

Mobilith AW Series meets or exceeds the following builder approvals:	00	0	1	2	3
Cincinnati Machine, P-64				X	

## Typical Properties

Mobilith AW Series	00	0	1	2	3
NLGI Grade	00	0	1	2	3
Thickener Type	Li-complex	Li-complex	Li-complex	Li-complex	Li-complex
Color, Visual	Green	Green	Green	Green	Green
Penetration, Worked, 25° C, ASTM D 217	415	370	325	280	235
Dropping Point, °C, ASTM D 2265	--	--	260	260	260
Viscosity of Oil, ASTM D 445					
cSt @ 40° C	100	150	150	150	150
4-Ball Wear Test, ASTM D 2266, Scar, mm	0.5	0.5	0.5	0.5	0.5
4-Ball Weld Load, ASTM D 2509, Kg		250	250	250	250
Timken OK Load, ASTM D 2509, lb	30+	40+	40+	40+	40+
Bomb Oxidation, ASTM D 942, Pressure drop at 100 hrs, kPa	35	35	35	35	35
Corrosion Prevention, ASTM D 1743	Pass	Pass	Pass	Pass	Pass
Rust Protection, IP 220, Distilled Water	0-0	0-0	0-0	0-0	0-0
Copper Strip Corrosion, ASTM D 4048	1A	1A	1A	1A	1A



## Health & 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.

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## 7. Lubrication Table

### O'Rorke Machinery Lubrication Chart

Machinery Lube	Qty.	Lubricant	Equipment	Frequency	Notes	Year:												
						April	May	June	July	Aug	Sept	Oct	Nov	Dec				
<b>B-1 Bearings</b>	4	Mobilith SHC 1500	Grease gun	6 months														
<b>B-2 Bearings</b>	4	Mobilith SHC 1500	Grease gun	6 months														
<b>Pinion Shaft Cplgs</b>	4	Falk LTG	Grease gun	Annually	1. Pull 2 lube port plugs 2. Install fitting at one port 3. Pump to flush old lube out open port 4. Re-install plugs													
<b>Floating Shaft Cplgs</b>	8	Falk LTG	Grease gun	Annually														
<b>Motor Cplgs</b>	4	Falk LTG	Grease gun	Annually														
<b>Electric Drive Motors</b>	4	Mobil Grease Polyrex EM	Grease gun	Annually		1. 5 pumps per year 2. Do not over grease.												
<b>Instrument Reducers</b>	4	Mobil Gear 600 XP 220	Pour	6 mo. 5 yrs*	* For all reducers: 1. Check oil level and top off as necessary at 6 month interval. 2. Est. oil replacement at 5 years, but recommend annual oil sample analysis to determine frequency. 3. Synthetic oil would extend time b/w oil replacements.													
<b>Primary Reducers</b>	2	(ISO 320) Mobil Gear 600 XP 320 or Mobil SHC 632	Pour	6 mo. 5 yrs*														
<b>Secondary Reducers</b>	4	(ISO 320) Mobil Gear 600 XP 320 or Mobil SHC 632	Pour	6 mo. 5 yrs*														
<b>Machinery Brakes</b>	4	Chevron Spindle Oil #10	5 Gallon Pail	6 months	Thrustors are "sealed for life" Monitor and top off as necessary. Replace thrustor if significant leakage.													
<b>Motor Brakes</b>	4	Chevron Spindle Oil #10	5 Gallon Pail	6 months														
<b>Pinions &amp; Racks</b>	4	Lubriplate Gear Shield Heavy	Can	Monthly	Rmve existing lube and debris and apply new													
<b>Tail Locks</b>	4																	
<b>Rod Eye</b>	-	Mobil Grease XHP 222	Grease gun	6 months														
<b>Lock Bar</b>	-	Mobil Grease XHP 222	Gun, brush or swab	Monthly	Rmve existing lube and debris and apply new													
<b>Guides</b>	-	Mobilith SHC 1500	Gun	Monthly														
<b>Trunnion Bearings</b>	-	Mobilith SHC 460	Gun	6 months	Remove cover to access													
<b>Actuator Housing</b>	-	Mobilith SHC 460	Gun	Annually	Remove cover to access													
<b>VT 40 Warning Gates</b>	4																	
<b>Shaft Bearings</b>	-	Mobil Grease XHP 222	Grease gun	6 months														
<b>Connecting Rod Ends</b>	-	Mobil Grease XHP 222	Grease gun	6 months														
<b>Chain</b>	-	Castle Muscle Grease	Can	6 months														
<b>Reducers</b>	-	Mobil SHC 629	Pour	6 months	Check and top-off oil. Change oil if discolored or milky.													
<b>Center Jaw Locks</b>	4	Mobilith AW-0	Paint Roller or Brush	Monthly														

Note:

1. Lubrication frequencies are suggested starting points. Adjust as necessary to ensure that wearing surfaces are always lubricated.
2. Use caution when changing lubricants. Incompatible lubricants may result in failure of the lubricant. When replacing one lubricant with another, flush old lubricant to the extent possible.

## 8. Sample Maintenance Checklists

# O'Rorke Machinery Mechanical Maintenance Chart

Part	Qty.	Frequency	Maintainer Notes	Year:				Leaf:					
				April	May	June	July	Aug	Sept	Oct	Nov	Dec	
<b>Electric Motors</b>	<b>2</b>												
Bolts	-	6 months											
Operation noise / vibration	-												
Paint touch-up	-	Annual											
<b>Brakes</b>	<b>4</b>												
Bolts	-	6 months											
Thrustor stroke	-												
Friction surface debris / corrosion	-												
Torque setting	-												
Thrustor seals	-												
Pad wear	-												
Pad contact / clearance when set / released	-												
Manual operation	-												
Switch functions	-												
Paint touch-up	-	Annual											
<b>Reducers</b>	<b>3</b>												
Bolts	-	6 months											
Operation check	-												
Internal inspection	-												
Debris removal	-												
Paint touch-up	-	Annual											
Oil sample	-												
<b>Bearings</b>	<b>4</b>												
Bolts	-	6 months											
Operation check	-												
Debris removal	-												
Paint touch-up	-	Annual											
<b>Couplings</b>	<b>8</b>												
Bolts	-	6 months											
Keys and keyways	-												
Noise check	-												
Seals and gaskets	-												
Remove excess grease	-												
Set screws (limit switch couplings)	-												
Paint touch-up	-	Annual											
Internal inspection		As needed											
<b>Racks and Pinions</b>	<b>2</b>												
Tooth condition	-	6 months											
Remove debris	-												
Remove old lubricant from roots	-												
Operation check	-												
Paint touch-up	-	Annual											

## O'Rorke Machinery Mechanical Maintenance Chart

Part	Qty.	Frequency	Maintainer Notes	Year:				Leaf:				
				April	May	June	July	Aug	Sept	Oct	Nov	Dec
<b>Position Indic. and Lim Switches</b>												
Exercise limit switches	-	3 months										
Bolts	-											
remove debris	-											
Paint touch-up	-	Annual										
<b>Curved and Flat Treads</b>												
Remove debris	-	Monthly										
Operation check, wear review	-	Annual										
Paint touch-up	-											
<b>Tail Lock</b>												
Bolts	-	6 months										
Remove debris	-											
Operation check	-											
Paint touch-up	-	Annual										
<b>Live Load Reactions</b>												
Bolts	-	6 months										
Remove debris	-											
Paint touch-up	-		Annual									
<b>Bumper Blocks</b>												
Bolts	-	Annual										
Timber damage check	-											
<b>Mid Span Shear Jaw Locks</b>												
Bolts	-	6 months										
Remove debris	-											
Paint touch-up	-	Annual										
<b>VT 40 Warning Gates</b>												
Bolts	-	3 months										
Operation check	-											
Remove debris	-											
Gate arm inspection	-											
Reducer bolts when rock gate arm	-											
Sprocket and pulley set screws	-											
Reducer leakage check	-	Annual										
Paint touch-up	-											