OPERATIONS AND MAINTENANCE MANUAL

Frenchboro Ferry Terminal Transfer Bridge No. 6340 Frenchboro, Maine



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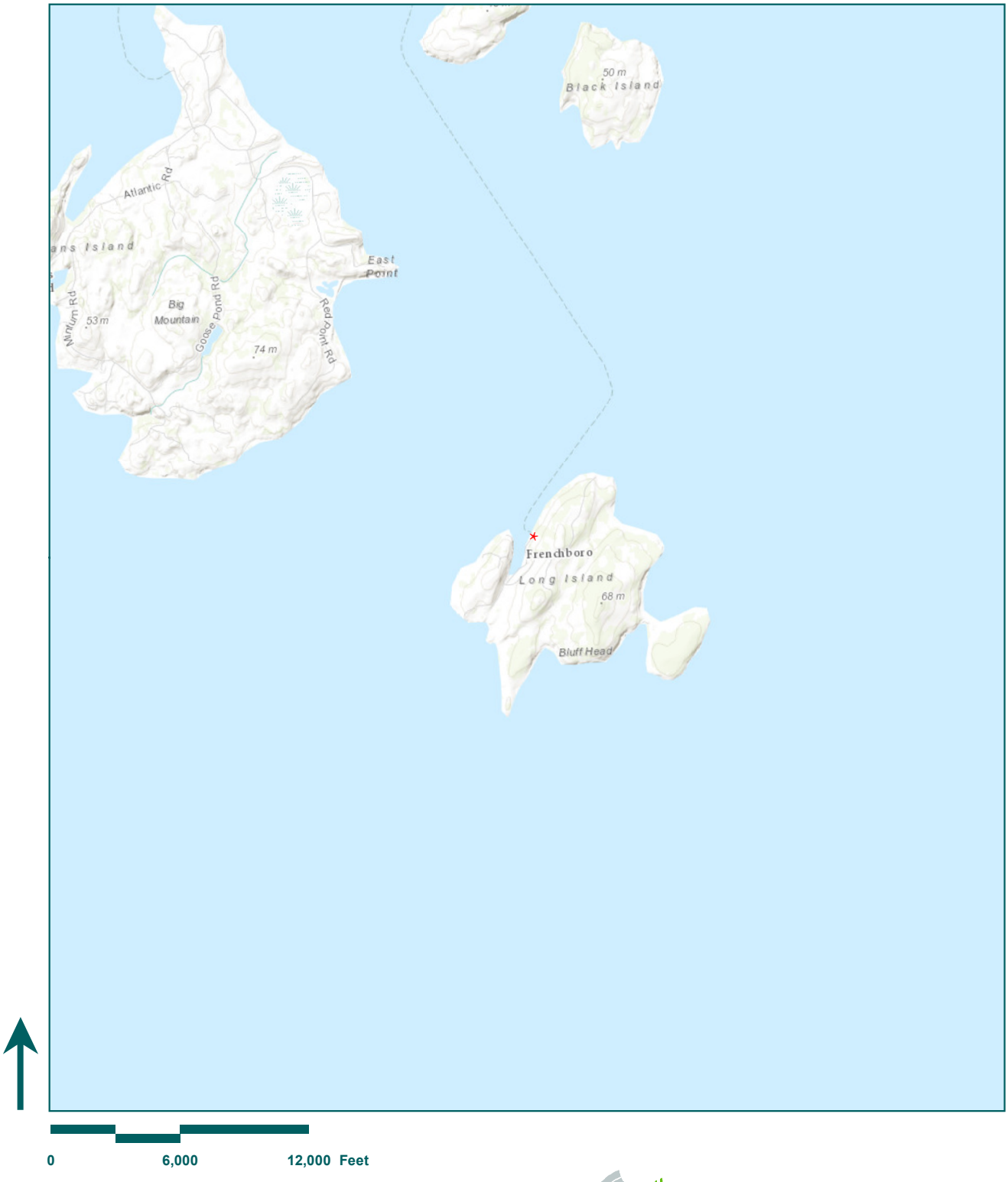
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Location Map



44.07.17 N. Latitude, 68.21.43 W. Longitude

vhb
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Figure 1 – Site Location Map
Ferry Terminal
Frenchboro, Maine

Introduction

The movable transfer bridge at the Frenchboro Ferry Terminal in Frenchboro, Maine allows pedestrian and vehicular traffic to load onto the Captain Henry Lee Ferry. The transfer bridge is adjustable for varying tides and various loading conditions. The ferry runs from Frenchboro to Bass Harbor twice a week. The ferry terminal was originally constructed in 1988 and was rehabilitated in 2014.

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

Bridge Description

Deck: Open steel grid deck, with a 2'-4.5" wide concrete-filled section for pedestrians.

Transfer Bridge Superstructure: A single bascule span comprised of four galvanized steel girders with metal grated decking supported by floor beams.

Transfer Bridge Substructure: Tower and transfer bridge are supported on a large wharf made up of granite blocks. Three dolphins supported on piles. One dolphin made up of timber piles.

Original Construction: 1988

Rehabilitation: 2014

Design Loading: HS 25

Appendix 4.1 contains design drawings from the 1988 original construction. Note that these plans do exactly match the actual structure. Noting this VHB created a fracture critical framing plan for this bridge, which should be included in the Maine Department of Transportation records. The field measurement notes can be found in Appendix 4.2, and the fracture critical framing plan can be found in Appendix 4.3. Key plan and elevation figures are included at the end of this section.

Transfer Bridge

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

The hoists for the bridge and apron are operated by separate brake motors. A dog and ratchet bar system mechanically locks the bridge in position and prevents it from dropping if the brake were to slip.

The transfer bridge is a redundant four through girder type. It is supported by a hoist system containing components that are non-redundant. These members are steel and primarily in tension and are therefore considered to be fracture critical members (FCMs). A sketch plan identifying the fracture critical members and components is included in Appendix 4.2. The transfer bridge consist of four W18 x76 girders supported on the land side by hinge bearings resting on the abutment. At 38 feet from the hinge bearings, the four girders intersect with the transverse hoist beam. The transfer bridge bears on the W18x76 hoist beam and cantilevers an additional 2'-6" beyond to an adjustable apron. The transfer bridge needle beam framing consists of sixteen W4x13 and at 2'-3" on center that support the steel grid decking above. The main girders and needle beams are galvanized steel beams. The grid decking is galvanized steel with a 2'-4.5" wide section filled with concrete for pedestrian use.

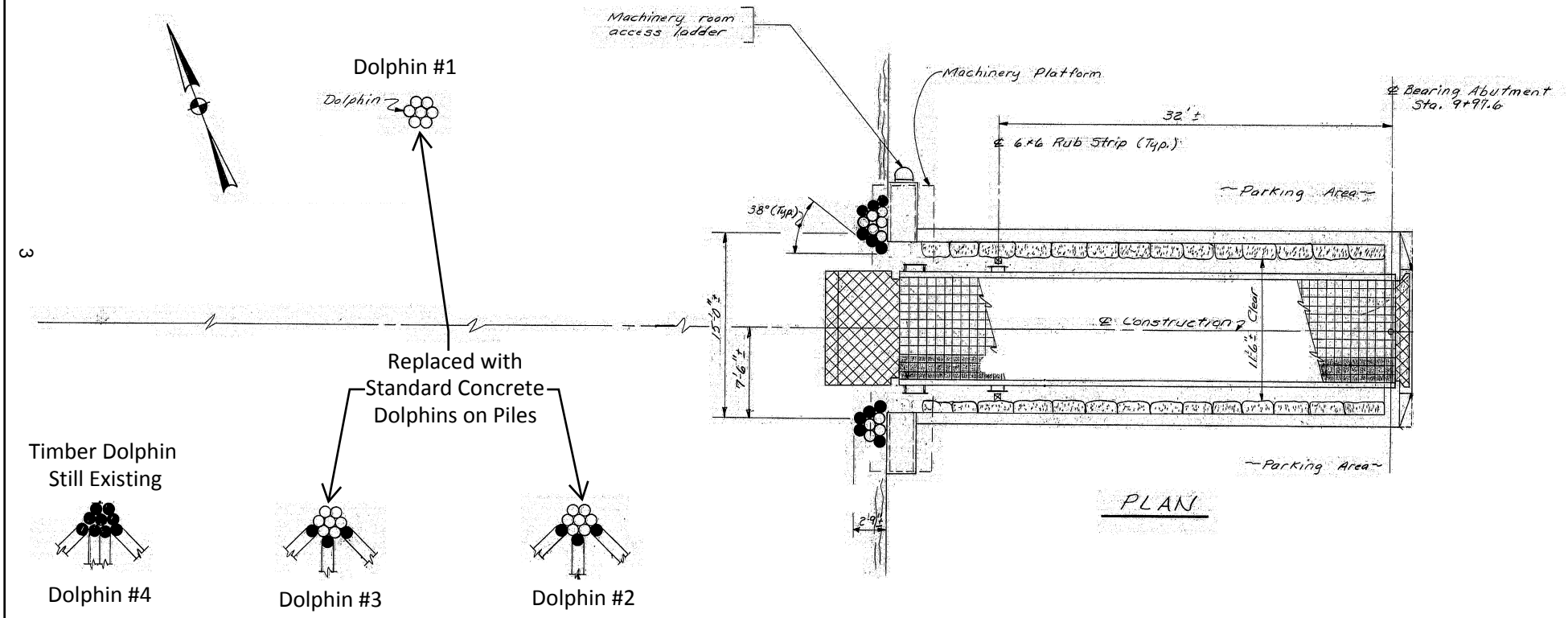
Hoist Towers

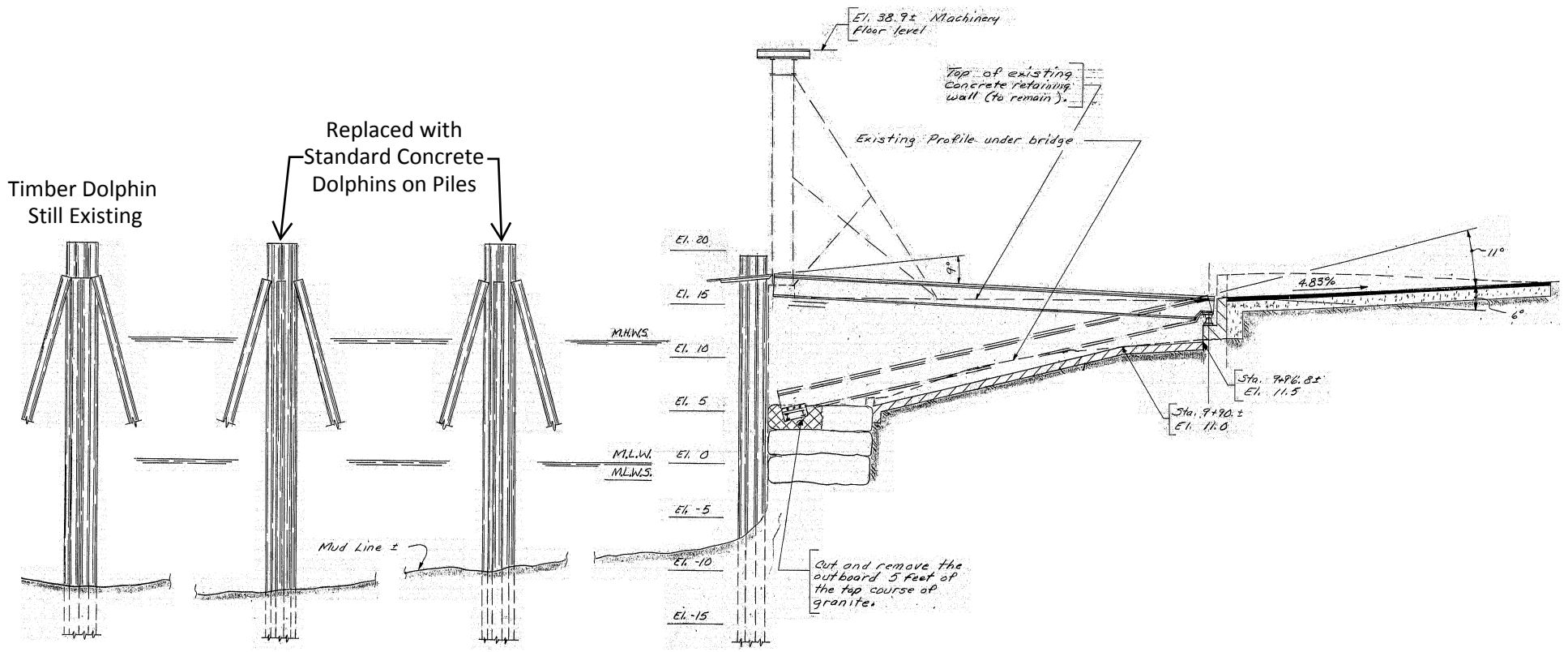
The hoists towers are located near the west edge of the wharf and support the free end of the transfer bridge. The towers are approximately 19 feet tall and are steel framed. The hoist towers support the main hoist and transfer bridge counterweight. The hoist and counter weight cables connect to either side of the structure at the hoist and counter weight beam. The hoist beam and counterweight beam are integral components framed into the transfer bridge.

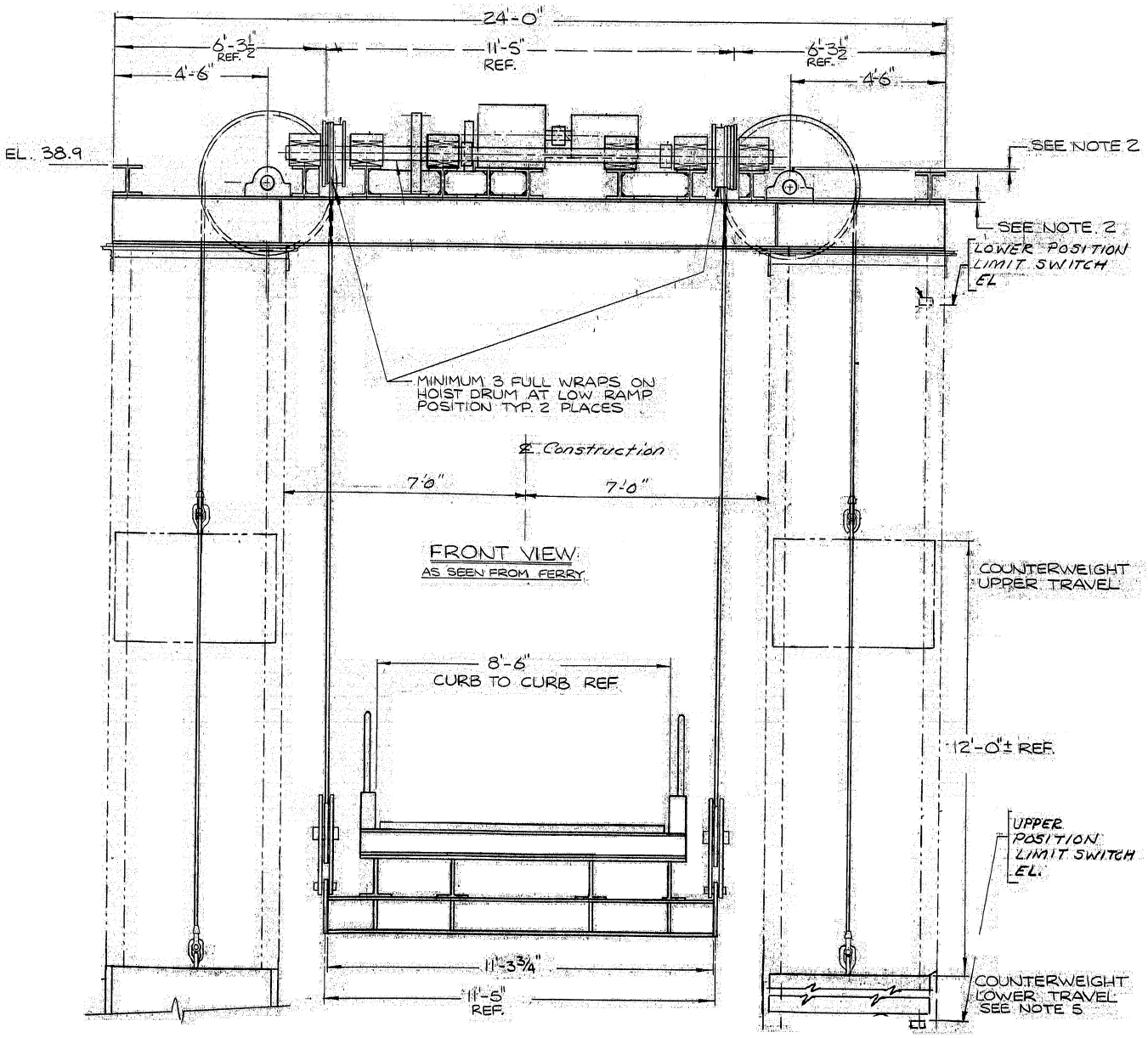
Dolphin System

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

There is one access walkway connecting Dolphin #2 to the wharf.


Machinery room access ladder
Machinery Platform
℄ Bearing Abutment Sta. 9+97.6
32'±
℄ 6.46 Rub Strip (Typ.)
Parking Area
38° (Typ.)
℄ Construction
Clear
Parking Area
PLAN
Dolphin #1
Dolphin
Replaced with Standard Concrete Dolphins on Piles
Timber Dolphin Still Existing
Dolphin #4
Dolphin #3
Dolphin #2


Timber Dolphin
Still Existing
Replaced with
Standard Concrete
Dolphins on Piles
El. 38.9± Machinery
Floor level
Top of existing
Concrete retaining
wall (to remain).
Existing Profile under bridge
El. 20
El. 15
El. 10
El. 5
El. 0
El. -5
El. -10
El. -15
M.H.W.S.
M.L.W.
M.L.W.S.
Mud Line ±
6°
4.83%
11°
6°
Sta. 9+96.8±
El. 11.5
Sta. 9+90.±
El. 11.0
Cut and remove the
outboard 5 feet of
the top course of
granite.


24'-0"
6'-3½" REF.
11'-5" REF.
6'-3½" REF.
4'-6"
4'-6"
EL. 38.9
SEE NOTE 2
SEE NOTE 2
LOWER POSITION LIMIT SWITCH EL.
MINIMUM 3 FULL WRAPS ON HOIST DRUM AT LOW RAMP POSITION TYP. 2 PLACES
℄ Construction
7'-0"
7'-0"
FRONT VIEW
AS SEEN FROM FERRY
COUNTERWEIGHT UPPER TRAVEL
8'-6"
CURB TO CURB REF.
12'-0"± REF.
UPPER POSITION LIMIT SWITCH EL.
11'-3¾"
11'-5" REF.
COUNTERWEIGHT LOWER TRAVEL SEE NOTE 5

Section 1: Operating Procedures

1.1 General Operation of Transfer Bridge

The transfer bridge is operated from either a control station located adjacent to the control panel or a hand held radio transmitting controller. All of the designated operators of the bridge need to review this manual and be thoroughly trained in all procedures required to properly operate and adjust the bridge and apron positions. The transfer bridge and apron must be positioned so that a smooth transition from the land to the ferry and from the ferry to the land is achieved. Improper positioning of either component may unevenly load and/or induce dynamic loads into the structural components, causing the vehicle to bottom out or present a tripping hazard to pedestrians. Adjustments will also need to be made as the loading changes on the ferry. Below is an outline of the general operating procedures.

1.2 Operating Procedures

The following is a simplified operating procedure:

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

The following is a detailed operating procedure:

1. Ferry enters the slip and achieves proper position to load or unload vehicles and pedestrians.

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2. The operator climbs onto the bridge or if the bridge is in accessible, onto the ladder and over a walkway, to the control station.

3. The operator unlocks the control station enclosure and positions the bridge using the BRIDGE RAMP CONTROL raise and lower pushbuttons to a height at which the apron can be lowered onto the deck of the ferry. After the operator positions the transfer bridge, he/she places the apron in contact with the deck using the RAMP APRON CONTROL RAISE and LOWER directions. He/she then adjusts the position of the transfer bridge and apron to provide as close to a straight line as possible. The E-stop can be used at any time to stop the bridge or apron motion. When the bridge is lowering, the pawls are held in the withdrawn position with the red pawl position indicating light illuminated. When the bridge reaches the appropriate height, lowering should be halted. The operator should then jog the bridge up until the pawls engage by raising the transfer bridge slightly until the green light illuminates showing that both pawls have engaged. With both pawls engaged, the transfer bridge is locked into position and ready to safely unload or load vehicles and pedestrians. Note that if the bridge is lowered too far, its motion will be halted by the BRIDGE FULLY LOWERED cam limit switch. If the bridge is raised too far its motion will be halted by the BRIDGE FULLY RAISED cam limit switch.

4. Using the control in the control station, the operator lowers the apron onto the deck by depressing and holding the RAMP APRON CONTROL LOWER pushbutton. The angle of the pivot from the apron to the bridge should then be observed to assure that vehicles can pass over it without bottoming out. Readjustment may be needed. When the vehicles are unloaded, the able ferry seaman signals the passengers to begin off-loading, allowing the vehicles to off-load first, then the pedestrians. When the ferry is empty, the able ferry seaman signals the passengers to begin on-loading, allowing the pedestrians to load first, then the vehicles.

5. The operator monitors the unloading and loading of vehicles and pedestrians. Monitoring assures that vehicles do not bottom out and that the apron is in full contact with the deck and prevents the creation of a tripping hazard for the pedestrians.

6. The operator views the type of each vehicle and makes adjustments as needed.

7. Upon completing the transfer of vehicles and pedestrians, the apron is raised to a predefined angle using the APRON RAISE pushbutton in the control station. Should the apron be raised too high, the apron fully raised cam limit switch will trigger and stop the apron.

8. Upon completing the raising of the apron, the bridge is raised to a predefined angle using the BRIDGE RAMP CONTROL RAISE pushbutton in the control station. As the bridge raises, the red and green pawl position indicating lights

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will alternate, indicating that the pawls are engaged (green) or withdrawn (red). Should the bridge be raised too high, the BRIDGE FULLY RAISED cam limit switch will be triggered, stopping the travel.

9. The operator then closes and locks the control station.

10. The operator leaves the control station and climbs onto the ferry.

1.3 Operating with Radio Control

The transfer bridge system is also provided with remote controls. The remote transmitter is carried on the ferry while the receiver is mounted adjacent to the control station.

The remote is provided with the same controls that the control station provides, including operation of the bridge, apron and emergency-stop.

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

1.4 Backup Operating Procedures

1.4.1 Loss of Power

Should utility service fail, the generator will first need to be plugged in by connecting the power cable from the SINGLE PHASE 120/240V output on the generator to the receptacle adjacent to the utility meter outside the generator trailer. Next, the generator will need to be started manually by turning the keyed switch to the START position and then releasing the switch. In case the generator battery is dead, a jumper cable is provided in the trailer. After about 15 seconds to stabilize, the HERTZ (frequency) meter will show 60 and the manual transfer switch may be switched to the GENERATOR mode by the use of the manual controls in the manual transfer switch enclosure.

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Section 2: Maintenance Procedures

2.1 Facility Maintenance and Structural Inspection

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

2.1.1 Daily

The following maintenance items should be performed each day:

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

2.1.2 Monthly

The following maintenance items should be performed each month:

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

2.1.3 Seasonal

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

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

2.1.4 Annual

The following maintenance items should be performed once per year:

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

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

2.1.5 Biennial

The following maintenance items should be performed every two years:

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

2.1.6 Quinquennial

The following maintenance items should be performed every five years:

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

2.2 Mechanical Maintenance

2.2.1 Mechanical Equipment/Systems

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

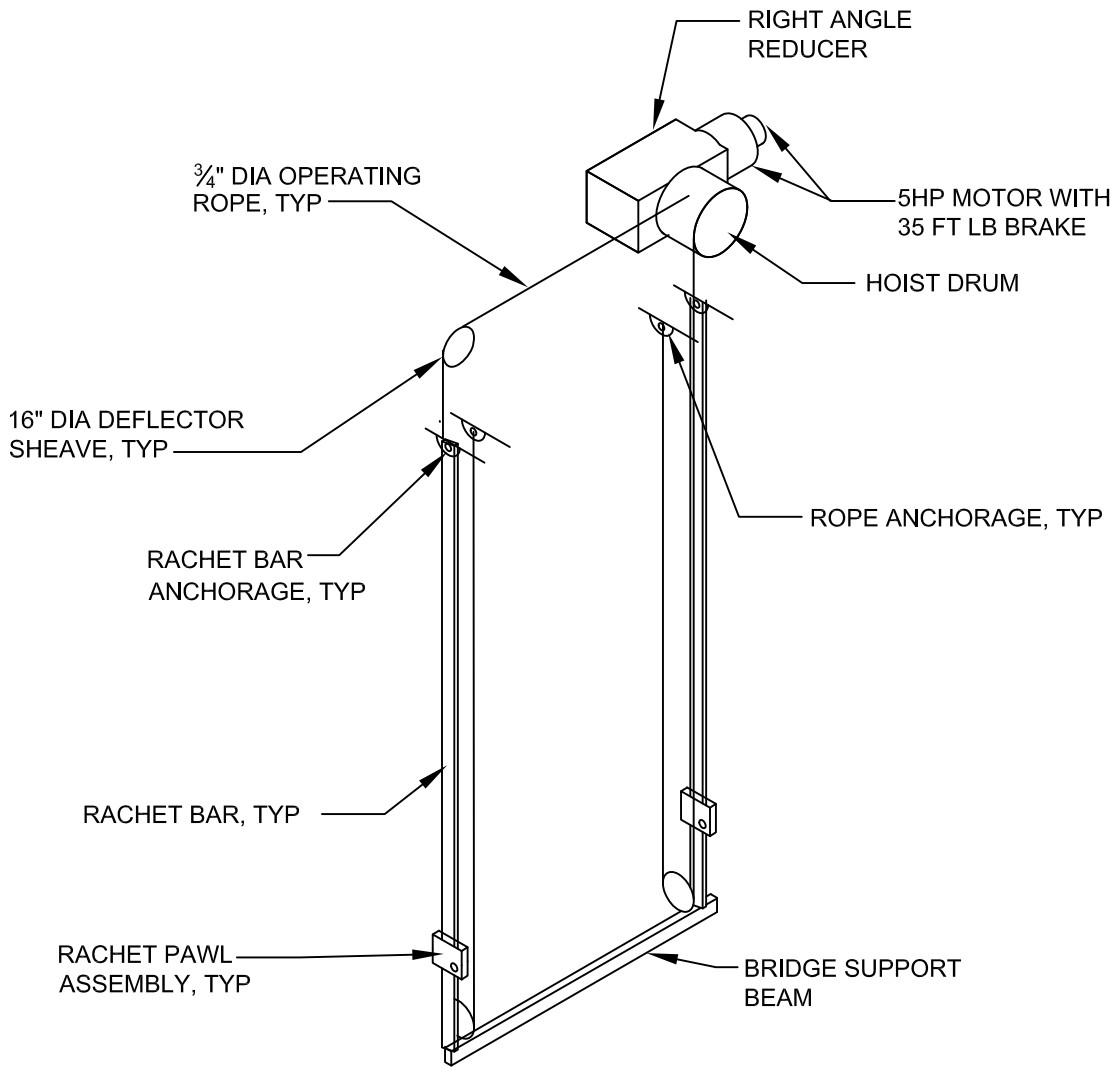
2.2.1.1 Bridge Hoist System

Refer to the Bridge Hoist Machinery Schematic on the following page for a graphic presentation of the system. The machinery for the bridge hoist system is mostly located on a fixed platform above the bridge, spanning between the two counterweight towers. The drive consists of a motorbrake face mounted to the primary input shaft side of a right angle worm gear reducer. The main hoist drum is mounted directly onto the output shaft of the reducer. The drum is supported by the output bearing of the reducer on its west end and by an external, sleeve type, journal bushing on its east end.

As the drum rotates, the three quarter (3/4) inch diameter operating ropes raise and/or lower the bridge, depending on the direction of the drum's rotation. There are two operating ropes, one for each side of the bridge. The north operating rope pays off of the hoist drum vertically downward to a deflector sheave that is anchored to the bridge counterweight support beam. This north rope wraps 180 degrees around this deflector sheave and up to an anchorage on the bottom of the machinery platform above. The south operating rope pays off of the hoist drum horizontally (more or less) across the machinery platform and over the top of a deflector sheave anchored on the machinery platform. The rope wraps 90 degrees around this sheave and travels vertically downward to a deflector sheave that is anchored to the bridge counterweight support beam. This south rope, similar to the north rope, wraps 180 degrees around this deflector sheave and up to an anchorage on the bottom of the machinery platform above.

A ratchet bar system is located adjacent to each operating rope. The tops of the ratchet bars are pinned to anchor points beneath the machinery platform. The bottom of each ratchet bar passes through a pawl assembly anchored to the tower frame. As the bridge is raise, a spring-loaded pawl pin travels along the ratchet bar, engaging the teeth on the ratchet bars. These bars provide a fixed support point for the bridge as vehicles and persons load/unload from the ferry. To lower the bridge, an electrically actuated piston retracts each pawl pin to disengage it from the ratchet bar teeth.

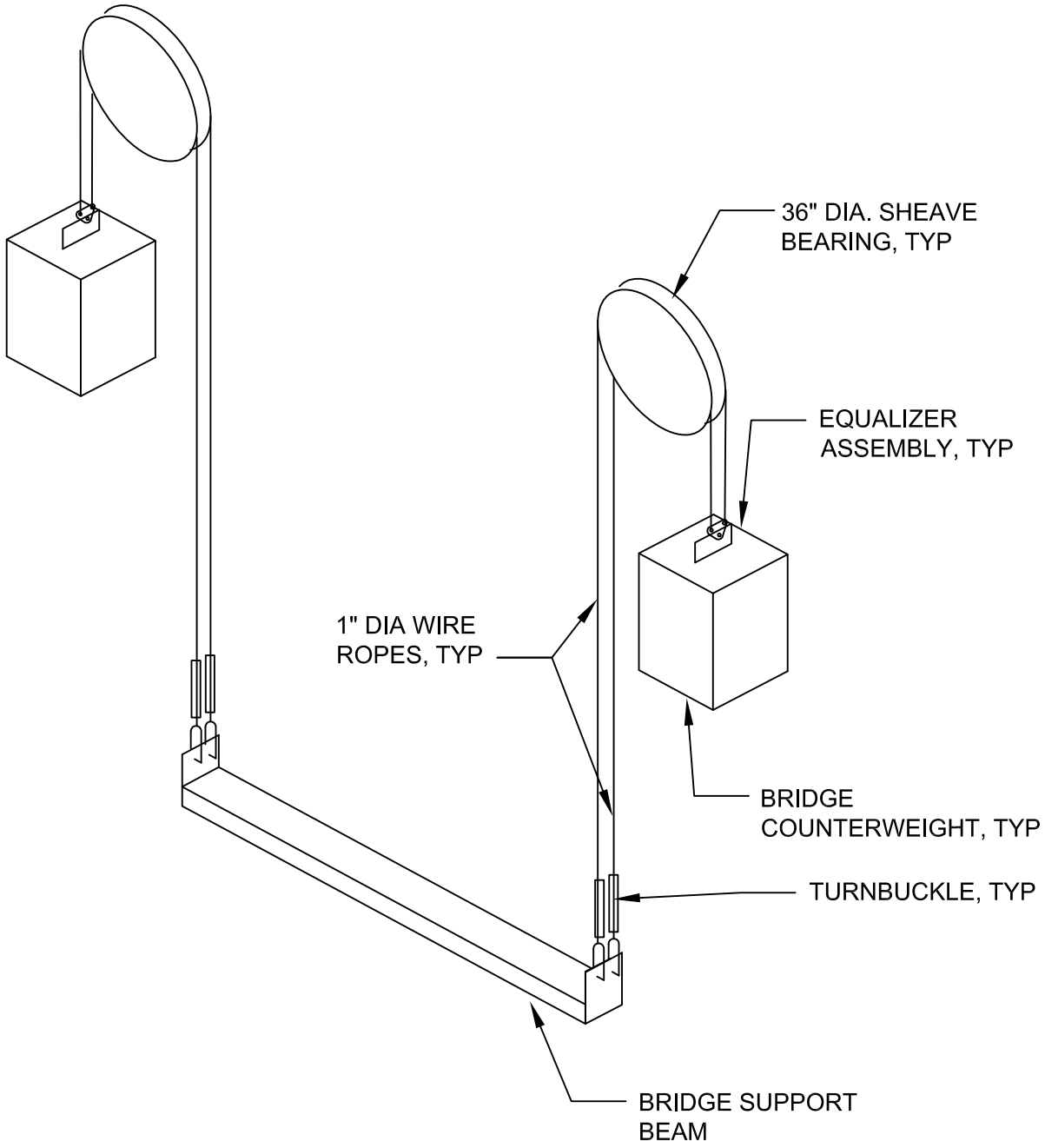
There is no means provided for manual operation of the bridge in the event of a power failure.



BRIDGE HOIST SYSTEM SCHEMATIC

2.2.1.2 Bridge Counterweight System

Refer to the Bridge Counterweight System Schematic on the following page for a graphic presentation of the system. The bridge counterweight system is comprised of two separate counterweights, one located in at each side of the tower. The system is simple and straight-forward. Two 45” diameter, single groove sheaves are supported on a common shaft at each end of the machinery platform by a pair of bronze sleeve bearings. For each counterweight, two 1” diameter counterweight wire ropes are anchored to a bridge support beam beneath the roadway. The pair of ropes passes up over the 45” diameter sheaves and down to an equalizing clevis assembly connected to the top of the counterweight. The counterweights travel inside the structural tower frame, and are guided by guide rails at each corner running the full height of the tower. There is one counterweight system at each the north and south sides of the bridge.



BRIDGE COUNTERWEIGHT SYSTEM SCHEMATIC

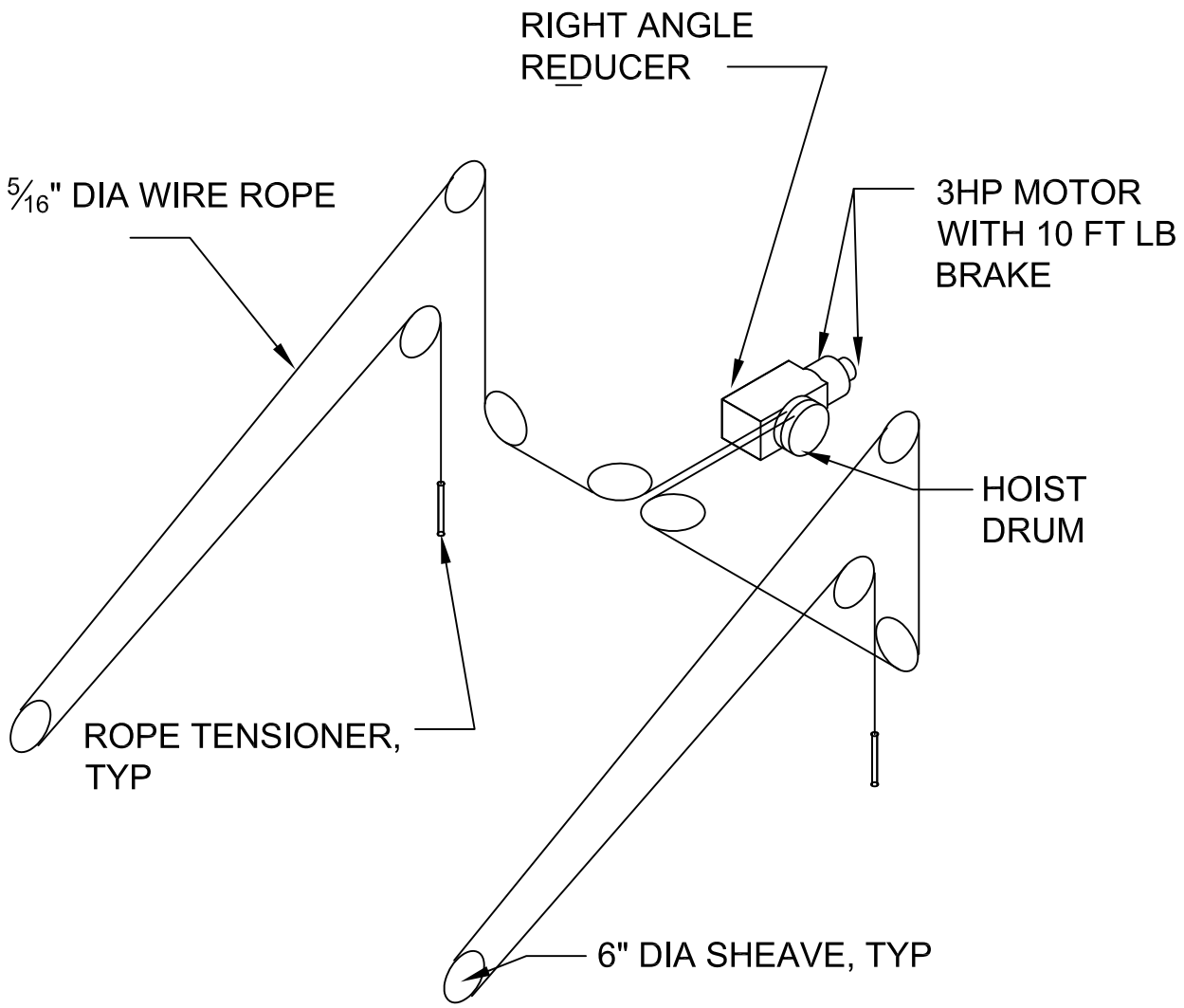
2.2.1.3 Apron Hoist Machinery

Refer to the Apron Hoist Machinery Schematic on the following page for a graphic presentation of the system.

The drive machinery for the apron hoist system is located beneath the roadway level of the bridge. Access is difficult for maintenance personnel. It requires removal of a piece of the bridge deck or the machinery can be reached with the use of a boat beneath the bridge. The apron drive is of a similar arrangement, albeit smaller, to the bridge drive machinery. A 3 horsepower motorbrake assembly is face mounted to a right angle, worm reducer. This reducer is a hollow output shaft style. This hollow output supports one end of the apron hoist drum shaft whose other end is supported in a pillow block mounted bearing.

As the drum rotates, two 5/16” diameter wire ropes spool on/off the drum, thereby raising or lowering the apron, depending on the direction of the drum’s rotation. Each apron rope passes through a reeving system. There are deflector sheaves mounted horizontally (flat) at the toe of the bridge that send the ropes to the north or south sides of the bridge. A steel enclosure on each side of the bridge houses additional apron deflector sheaves. The apron ropes pass up over the lower sheave in this enclosure and out to the toe of the apron. The ropes then wrap nearly 180 degrees around these sheaves and pass back to the steel enclosures where the ropes pass over their final deflector sheaves and travel vertically downward to their anchorage points on the tension counterweights. The tension counterweights ride vertically up and down inside of a steel tubes. The purpose of the tension counterweights is two-fold. The first is to provide a positive anchorage point for the rope as the apron is raised. The tension counterweight bears against a plate inside of the steel tube. The second purpose is to maintain tension in the rope as the apron is lowered.

There is no means provided for manual operation of the apron in the event of a power failure. There is no separate apron counterweight system as is common on the other ferry terminal bridges.



APRON HOIST SYSTEM SCHEMATIC

2.2.2 Mechanical Inspection and Maintenance Schedule

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

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

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

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

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

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

MECHANICAL INSPECTION AND MAINTENANCE SCHEDULE

Equipment	Monthly	Quarterly	Semi-Annually	Annually
BRIDGE HOIST MACHINERY				
Disc Brake (Stearns)				
Inspect all bolts for rust, corrosion and tightness.		X	X	X
Check friction disc clearance, adjust if necessary.				X
Inspect condition of friction discs and measure thickness, replace if necessary.				X
Electric Motor (Reuland)				
Inspect mounting bolts for rust, corrosion and tightness.		X	X	X
Lubricate motor bearings.				X
Reducer (Cone)				
Inspect mounting bolts for rust, corrosion and tightness.		X	X	X
Inspect all flange and bearing cover bolts for tightness.		X	X	X
Inspect for oil leaks.	X	X	X	X
Check the oil level.	X	X	X	X
Change oil.				X
Lubricate bearings.	X	X	X	X
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.	X	X	X	X

Equipment	Monthly	Quarterly	Semi-Annually	Annually
BRIDGE HOIST MACHINERY - *Continued*				
Hoist Drum and Bearing				
Inspect all external bolts for tightness.		X	X	X
Inspect drum rope grooves for wear or imprinting damage.			X	X
Inspect drum shaft journal bearing housing and mounting bolts for rust, corrosion and tightness.		X	X	X
Lubricate drum shaft bearing	X	X	X	X
Wire Rope and Deflector Sheaves				
Lubricate wire ropes.			X	X
Inspect wire ropes for damage or breaks, particularly at end connections.			X	X
Inspect deflector sheaves for cracks in hub, spokes and rim.			X	X
Lubricate deflector sheave bearings.	X	X	X	X
Inspect anchor assemblies for corrosion or damage.			X	X

Equipment	Monthly	Quarterly	Semi-Annually	Annually
BRIDGE HOIST MACHINERY - *Continued*				
Ratchet Bar Assembly				
Inspect ratchet bars for deformation or other damage to teeth.			X	X
Inspect ratchet bar connection pins and cotters.			X	X
Lubricate pawl shaft bearings.	X	X	X	X
Open access cover and inspect ratchet mechanism internal operating components.				X

Equipment	Monthly	Quarterly	Semi-Annually	Annually
BRIDGE COUNTERWEIGHT MACHINERY				
Lubricate wire ropes.			X	X
Inspect wire ropes for damage or breaks, particularly at end connections.			X	X
Inspect sheaves for cracks in hub, spokes and rim.			X	X
Inspect sheave rope grooves for wear or imprinting damage.			X	X
Inspect sheave bearing housings and mounting bolts for rust, corrosion and tightness.		X	X	X
Lubricate sheave bearings.	X	X	X	X
Inspect equalizer pin assemblies for visual damage, as well as any rust or corrosion. Repaint any damaged areas.		X	X	X
Lubricate equalizer pins.		X	X	X
Inspect counterweight for plumbness and clearance with tower during travel. Adjust balance plate arrangement to eliminate excessive interferences.		X	X	X
Inspect counterweight box for corrosion or damage.		X	X	X

Equipment	Monthly	Quarterly	Semi-Annually	Annually
APRON HOIST MACHINERY				
Disc Brake (Stearns)				
Inspect all bolts for rust, corrosion and tightness.		X	X	X
Check friction disc clearance, adjust if necessary.				X
Inspect condition of friction discs and measure thickness, replace if necessary.				X
Electric Motor (Reuland)				
Inspect mounting bolts for rust, corrosion and tightness.		X	X	X
Lubricate motor bearings.				X
Reducer (Cone)				
Inspect mounting bolts for rust, corrosion and tightness.		X	X	X
Inspect all flange and bearing cover bolts for tightness.		X	X	X
Inspect for oil leaks.	X	X	X	X
Check the oil level.	X	X	X	X
Change oil.				X
Lubricate bearings.	X	X	X	X
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.	X	X	X	X
Inspect hoist drum for cracks, damage, corrosion or imprinting.		X	X	X

Equipment	Monthly	Quarterly	Semi-Annually	Annually
APRON HOIST MACHINERY - *Continued*				
Wire Rope and Deflector Sheaves				
Lubricate wire ropes.			X	X
Inspect wire ropes for damage or breaks, particularly at end connections.		X	X	X
Inspect deflector sheaves for corrosion or other damage.		X	X	X
Inspect deflector sheave rope grooves for wear or imprinting damage.		X	X	X
Lubricate deflector sheave bushings.	X	X	X	X
Miscellaneous				
Inspect apron hinge for any damage and freedom of motion.		X	X	X
Lubricate apron hinge bearings.	X	X	X	X

MECHANICAL LUBRICATION LEGENDS

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

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

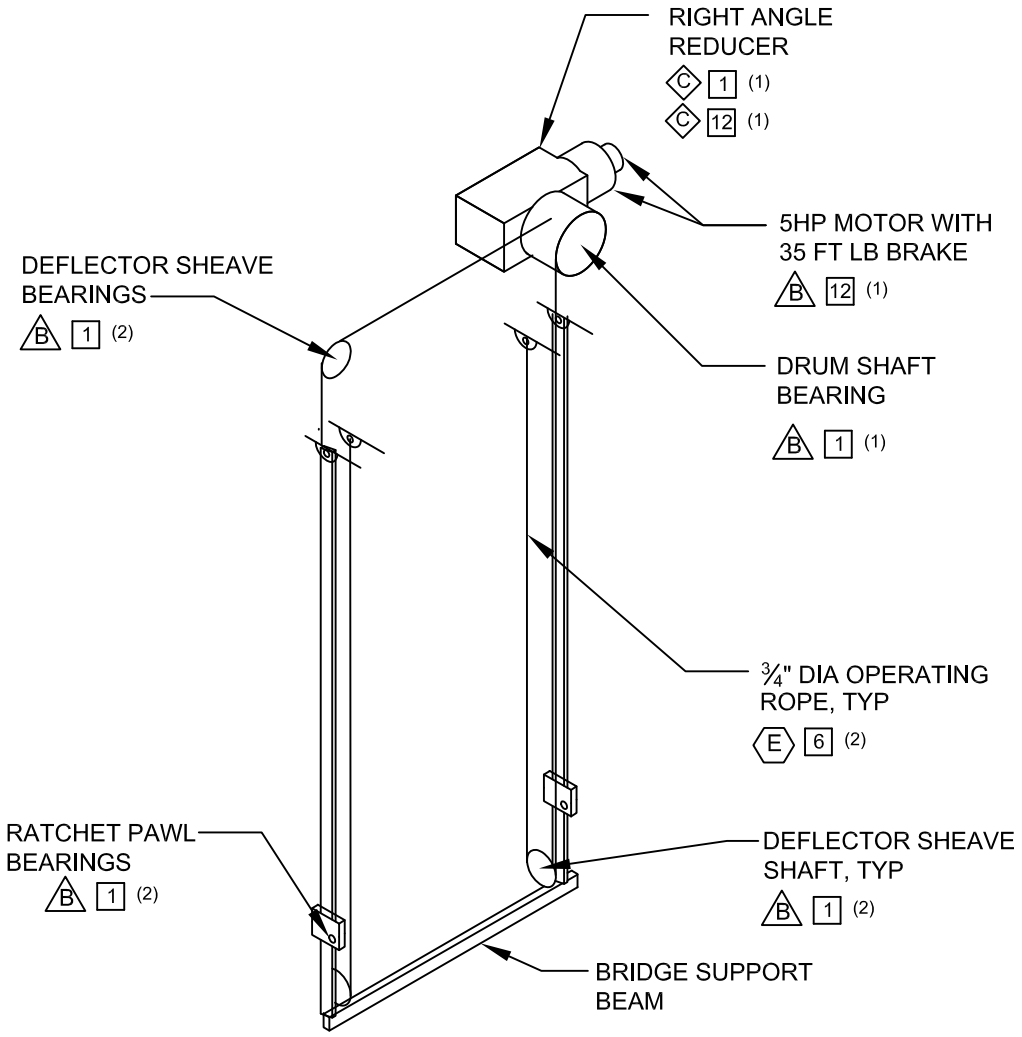
**Lubricant type not used on this transfer bridge.

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

MECHANICAL LUBRICATION SCHEDULES

Equipment	Locations	Frequency	Qty.	Type	Application
BRIDGE HOIST MACHINERY					
Motor (Reuland)	1	A		B	
Reducer (Cone)	1	A	8.5 Gal	C	
Drum Shaft Bearings	1	M		B	
Hoist Ropes	2	S		E	
Deflector Sheave Bearings (on machinery platform)	2	M		B	
Ratchet Pawl Bearings	2	M		B	
Deflector Sheave Shafts (attached to bridge counterweight support beam)	2	M		B	
Turnbuckle Threads	2	Q		G	
Bridge Hinge Bearing	4	M		A	
BRIDGE COUNTERWEIGHT MACHINERY					
Sheave Shaft Bearings	4	M		B	
Counterweight Ropes	4	S		E	
Turnbuckle Threads	4	Q		G	
Equalizer Pins	2	Q		G	

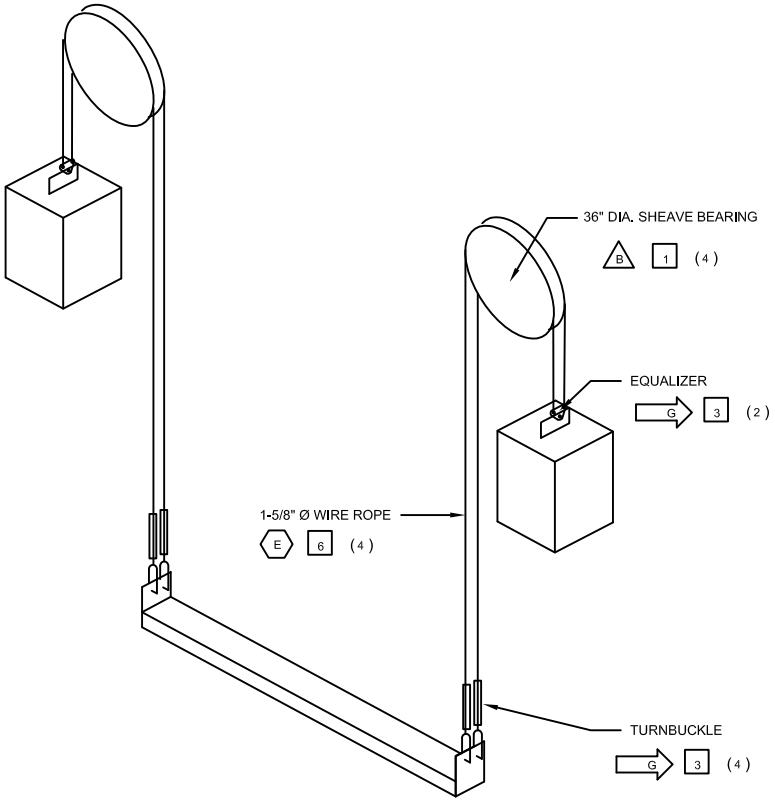
Equipment	Locations	Frequency	Qty.	Type	Application
APRON HOIST MACHINERY					
Worm Reducer (Cone)	1	A	1.25 Gal	C	
Motor (Reuland)	1	A		B	
Hoist Ropes	2	S		E	
Deflector Sheaves	10	M		B	
Apron Hinge Bearings	2	M		A	



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

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

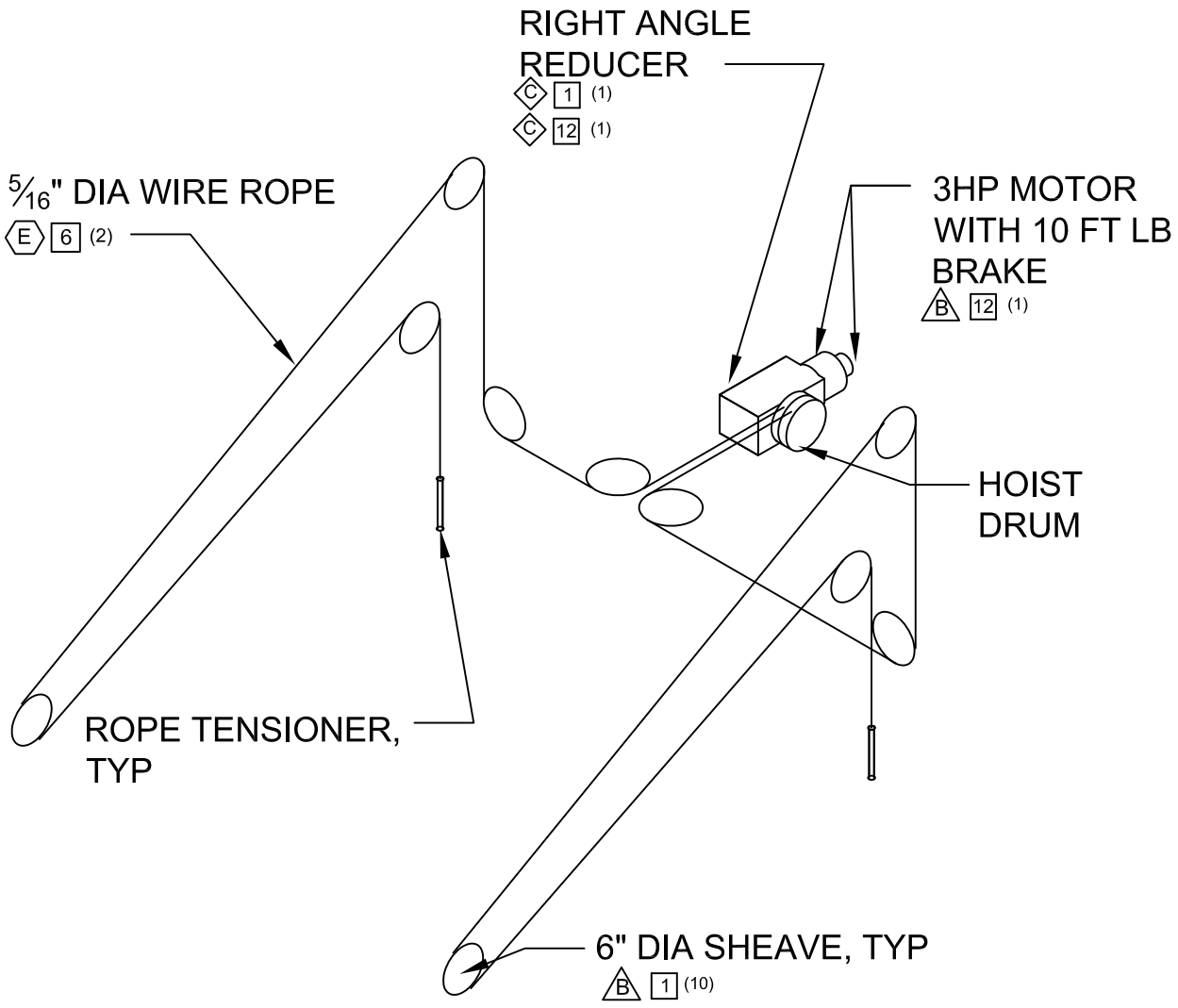
BRIDGE HOIST SYSTEM LUBRICATION DIAGRAM



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

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

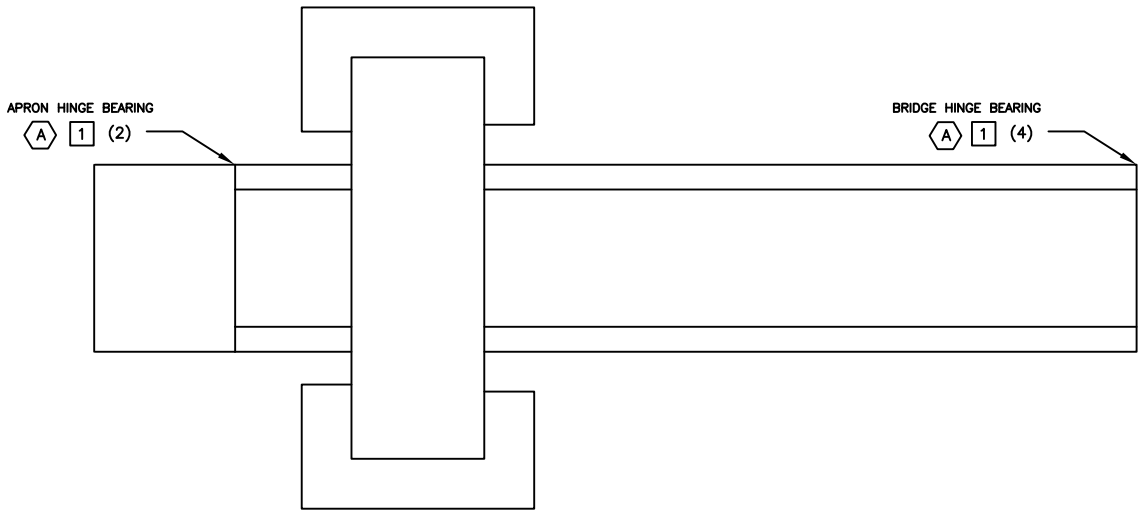
BRIDGE COUNTERWEIGHT SYSTEM LUBRICATION DIAGRAM



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

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

APRON HOIST SYSTEM LUBRICATION DIAGRAM



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

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

BRIDGE AND APRON LUBRICATION DIAGRAM

2.2.3 Inspection and Maintenance Equipment

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

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

2.2.4 Inspection and Maintenance Procedures

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

2.2.4.1 Bridge Hoist Machinery

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

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

- Brake
- Motor
- Reducer
- Hoist drum
- Hoist drum shaft and bearings
- Drive machinery support
- Operating ropes
- Deflector sheaves
- Ratchet bar assemblies

2.2.4.2 Bridge Counterweight System

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

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

- Bridge counterweight sheaves
- Bridge counterweight sheave shaft and bearings
- Bridge counterweight ropes
- Bridge counterweight rope equalizer assemblies
- Bridge counterweight and balance plates
- Bridge counterweight support beam

2.2.4.3 Apron Hoist Machinery

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

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

- Motorbrake
- Reducer
- Limit switch
- Hoist drum
- Drive machinery support
- Operating ropes
- Operating rope tension counterweights
- Deflector sheaves

2.2.5 Safety Precautions

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

There are no machinery guards present to protect personnel from inadvertent contact with the machinery when it is operating. Serious injury can result if the system is operated, whether intentional or unintentional, during an inspection or maintenance procedure.

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

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

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

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

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

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

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

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

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

2.3 Electrical Maintenance

2.3.1 Introduction

General Description

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

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

The motors are powered from across the line starters in a control panel on shore. The control system and interlocking are provided within the control panel also. The actuation of both the apron and bridge takes place from a control station mounted adjacent to the control panel.

Utility power is provided from a 240 VAC single phase transformer in close proximity to the bridge.. The utility supplies the primary power for drive components, and is transformed from single phase to 3 phase power by use of a rotary phase converter. Power is brought from the utility pole to the south tower via aerial cables. In case of utility power failure, an emergency generator system has been parked next to the utility pole as a temporary source of power.

In addition, the flood lighting is powered from the control panel.

2.3.2 Electrical Inspection and Maintenance Schedule

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

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

The electrical equipment inspection includes a cursory examination for smooth operation, uniform and regular movement, proper and secured mounting, evidence of vibration or overheating, wear, cracking, rust, moisture, loose terminations, alignment, spring tension, evidence of arcing, dirt accumulation, grounding and

bonding, safety interlocks, weather tightness and paint condition. Also perform insulation resistance and motor current draw testing.

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

TABLE 2.3.2-1 ELECTRICAL INSPECTION AND MAINTENANCE SCHEDULE

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

Equipment Security				X	
Panel Heating			X		
Conduit and Wiring Systems				X	
Terminations				X	
Enclosures and Boxes					X
Control switches		X			
Pawl indication	X				
Receptacles				X	
Surge arrestors					X

Monthly

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

Seasonally

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

Annually

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

2.3.3 Inspection and Test Equipment

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

- Screw driver and wrench sets
- Flashlight
- Circuit tester
- VOM
- Recording VOM
- Clamp-on ammeter
- Megohm meter
- Receptacle tester including GFI trip test

- Electricians toolkit
- Battery load tester (Generator starting battery)
- Battery hydrometer
- Personal Protective Equipment

2.3.4 Inspection and Maintenance Procedures

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

2.3.4.1 Control Equipment

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

The controls are made up of the following components:

- Standby Power Generator
- Manual transfer switch
- Circuit breakers – 277V rated
- Starters
- Contactors
- Overload relays
- Time delay relays
- Photocells
- Power distribution blocks
- Grounding box, grounding bar and ground bonding
- Utility service disconnect

In addition, the system is provided with:

- Bridge fully raised and fully lowered cam limit switches
- Apron fully raised and fully lowered cam limit switches
- Pawl micro switches
- Control station
- Radio control transmitter and receiver
- Lighting and lighting control

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

2.3.4.2 Standby Generator

The Emergency Generator is a portable unit located in a trailer currently parked adjacent to the utility service pole. Manufacturers' maintenance manuals for this equipment are included for reference in Appendix 4.5.3.

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

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

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

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

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

GENERATOR MAINTENANCE SCHEDULE

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

General Inspection

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

Exhaust System

With the generator set operating, inspect the entire exhaust system including the exhaust manifold, muffler and exhaust pipe. Check for leaks at all connections, welds, gaskets and joints, and make sure that the exhaust pipes are not heating surrounding areas excessively. Repair any leaks immediately. NOTE: ALL DOORS IN THE TRAILER MUST BE OPENED AND LEFT OPEN DURING OPERATION TO PROPERLY VENTILATE THE GENERATOR TRAILER.

Fuel System

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

DC Electrical System

Check the terminals on the starting batteries for clean and tight connections. Loose or corroded connections create resistance which can hinder starting.

Engine

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

Lubrication Service

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

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

Cooling System Service

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

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

Fuel System Service

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

Trailer exhaust is to be checked for any blockage from dirt or debris or insect nests. These must be completely cleared or the engine generator will be de-rated.

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

Starting Batteries

Weak or undercharged starting batteries are the most common cause of emergency power system failures. Even when kept fully charged and maintained, lead-acid starting batteries are subject to deterioration over time and must be periodically replaced when they no longer hold a proper charge. Only a regular schedule of inspection and testing under load can prevent generator starting problems. See the manual for the recommended inspection interval for the batteries and charging system. As no battery charger has been provided, it is assumed that the battery will be dead. If the battery is dead, a jumper cable is provided in the trailer for jumping.

Testing Batteries

Checking the output voltage of the batteries is not indicative of their ability to deliver adequate starting power. As batteries age, their internal resistance to current flow goes up, and the only accurate measure of terminal voltage must be

done under load. Use a manual battery load tester to verify the condition of each starting battery.

Cleaning Batteries

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

Checking Specific Gravity

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

Checking Electrolyte Level

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

Generator Set Exercise

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

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

2.3.4.3 Manual Transfer Switch

The Manual Transfer Switch is located on the adjacent to the utility meter at the base of the utility service pole.

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

The following preventative maintenance should be performed annually:

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

2.3.4.4 Molded Case Circuit Breakers

Checking that the breakers are properly seated and that the connections are tight.

Manually actuate each breaker to assure mechanical operation.

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

2.3.4.5 Conductors and Flexible Conduit

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

2.3.4.6 Apron and Bridge Hoist Motors

The machinery is driven by one 5 HP 230 volt 3 phase bridge hoist brake-motor and one 3 HP 230 volt 3 phase apron winch brake-motor.

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

2.3.4.7 Bridge and Apron Brakes

Each motor is provided with a solenoid actuated brake, both simultaneously actuated with the motors and powered through the motor leads. The brakes should be tested for current draw and insulation resistance. These values should be recorded for a year to year comparison. The brake covers should be removed once

a year and the solenoid checked for freedom of movement and rust on the armature. Unless stated otherwise by the manufacturer, no lubricant should be used on the armature itself but light machine oil may be used on the remaining mechanism. Any collection of dirt or rust on the armature pole piece faces will cause the solenoid to draw more than design current and may cause it to overheat if not cleaned.

2.3.4.8 Solenoid-Actuated Pawls

The bridge is provided with a pawl system (2 pawls, one on each side of the bridge) in order to guarantee that the bridge does not lower under gravity and load as it would be if it was only held by the solenoid brake.

Each pawl is driven by a separate solenoid. The solenoids are powered by 12-24 volts from the power conditioners in the right control panel. Energizing the solenoids withdraws the pawls. De-energizing allows the engagement of the pawls by the actuation of the springs.

A micro switch senses the position of the pawl, engaged or disengaged, and is used to drive the red/green pawl position indicator lights.

2.3.4.9 Relays, Contractors, and Time Delay Relays

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

2.3.4.10 Enclosures and Boxes

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

2.3.5 Safety Precautions

Electrical equipment should never be inspected or replaced without first disconnecting the power at the branch circuit disconnecting switch for that device if not also upstream of the device. Also verify that the rotary phase converter is off.

2.3.6 Maintenance Procedure for Lockout/Tagout System

2.3.6.1 Overview

Lockout-tagout (LOTO) or lock and tag is a safety procedure to ensure that dangerous equipment is properly unpowered and not started up again prior to the completion of maintenance or servicing work. "Lock and tag" works in conjunction with a lock and lockbox usually locking the power source disconnect handle, and

placing it in such a position that no hazardous power sources can be turned on. The procedure also requires that a tag be affixed to the locked device indicating that it should not be turned on without permission.

The responsibility for seeing that this procedure is followed is binding upon all employees. All employees shall be instructed in the safety significance of the lockout procedure by (designated individual). Each new or transferred affected employee shall be instructed by (designated individuals) in the purpose and use of the lockout procedure.

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

Control of Hazardous Energy
Lockout/Tagout

OSHA 3120
2002 (Revised)

2.3.6.2 Sequence of Lockout Procedure

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

2.3.6.3 Restoring Equipment to Service

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

2.3.6.4 Procedure Involving Multiple Persons

In the preceding steps, if more than one individual is required to lock out equipment, each shall place his/her own personal lock on the energy isolating device(s). One designated individual of a work crew or a supervisor, with the knowledge of the crew, may lock out equipment for the whole crew. In such cases, it may be the responsibility of the individual to carry out all steps of the lockout procedure and

inform the crew when it is safe to work on the equipment. Additionally, the designated individual shall not remove a crew lock until it has been verified that all individuals are clear.

2.3.6.5 Rules for Using Lockout Procedure

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

Section 3: Troubleshooting

Section 3: Troubleshooting

3.1 General Troubleshooting Precautions

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

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

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

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

3.2 Troubleshooting Precautions Related to Generator

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

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

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

Check the following on these generators:

1. Move the HEAT/OFF/ON/START switch on the control panel to the OFF position and remove the key.
2. Remove the negative (-) battery cable from the generator set starting battery.

3.2.1 Generator Status Indicators

(See Operators Manual)

3.3 Troubleshooting Tables

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

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

TROUBLESHOOTING TABLE - MECHANICAL OPERATION & EQUIPMENT

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

TROUBLESHOOTING TABLE - MECHANICAL OPERATION & EQUIPMENT

Problem	Possible Cause	Corrective Action
Apron will not lower (continued)	Gearbox failure	Replace failed component or entire gearbox.
	Apron is already at fully lowered position	Visually verify that apron is fully lowered position, then raise apron if safe to do so.
Transfer Bridge (Ramp) will not raise	Brakes will not release	Manually release brake by rotating handle on side of brake.
	Wire rope is broken	Replace wire rope.
	Ratchet bar is bent or broken	Visually inspect both ratchet bars for any signs of damage.
	Bridge out of balance	Bridge heavy, check for significant sized objects on movable portion of bridge.
	Foreign objects caught in counterweight guides	Inspect counterweight guides and remove any foreign objects.
	Binding at joint between bridge and approach due to excessive thermal expansion	Wait for the temperature of bridge to decrease sufficiently and then eliminate interference.
	Foreign object caught in the joint between bridge and approach	Inspect the joint, locate the source of interference and remove any foreign material.
	Deflector sheave bearing is seized	Verify that deflector sheavs busings are free of contaminants and are adequately lubricated.
	Bridge hinge bearing is seized	Verify that hinge busings are free of contaminants and are adequately lubricated.
	Drum bearing is seized	Verify that drum busings are free of contaminants and are adequately lubricated.
	Counterweight sheave bearing is seized	Verify that counterweight sheave busings are free of contaminants and are adequately lubricated.
	Gearbox failure	Replace failed component or entire gearbox.
	Bridge is already at fully raised position	Visually verify that apron is fully raised, then lower bridge if safe to do so.
Transfer Bridge (Ramp) will not lower	Brakes will not release	Manually release brake by rotating handle on side of brake.
	Pawl is still engaged	Disengage pawl by operating lever on side of pawl housing.

TROUBLESHOOTING TABLE - MECHANICAL OPERATION & EQUIPMENT

Problem	Possible Cause	Corrective Action
Transfer Bridge (Ramp) will not lower (continued)	Ratchet bar is bent or broken	Visually inspect both ratchet bars for any signs of damage.
	Wire rope is broken	Replace wire rope.
	Counterweights out of balance	Check for large objects on counterweights, removes item if safe to do so.
	Foreign objects beneath bridge	Inspect below bridge and remove any foreign objects.
	Foreign objects caught in counterweight guides	Inspect counterweight guides and remove any foreign objects.
	Binding at joint between bridge and approach due to excessive thermal expansion	Wait for the temperature of bride to decrease sufficiently and then eliminate interference.
	Foreign object caught in the joint between bridge and approach	Inspect the joint, locate the source of interference and remove any foreign material.
	Deflector sheave bearing is seized	Verify that deflector sheavs busings are free of contaminants and are adequately lubricated.
	Bridge hinge bearing is seized	Verify that hinge busings are free of contaminants and are adequately lubricated.
	Drum bearing is seized	Verify that drum busings are free of contaminants and are adequately lubricated.
	Counterweight sheave bearing is seized	Verify that counterweight sheave busings are free of contaminants and are adequately lubricated.
	Gearbox failure	Replace failed component or entire gearbox.
	Bridge is already at fully lowered position	Visually verify that apron is fully lowered, then raise bridge if safe to do so.
Brake is overheating or noisy	Disc pack is dragging	Inspect endplate, hub and discs for dirt, burrs, wiring and other sources of interference preventing disc “float”.
	Friction disc excessively worn (disc can wear to 1/2 original thickness)	Replace friction discs.
	Endplate, stationary disc or pressure plate warped	Replace warped or worn component.

TROUBLESHOOTING TABLE - MECHANICAL OPERATION & EQUIPMENT

Problem	Possible Cause	Corrective Action
Reducer is overheating or noisy	Insufficient amount of oil	Fill with clean oil to proper level.
	Wrong type of oil causing breakdown of lubricant	Drain, flush and fill with proper type of oil.
	Bearings are damaged	Consult a qualified technician for repair.
	Loose or foreign object inside of housing	Open inspection port and look for loose, broken or foreign object, the remove/repair as necessary. A borescope may be required due to limited access.
Bearing is overheating or noisy	Insufficient amount of grease	Pump in additional grease.
	Housing over packed with grease	Bearing will purge excess grease during operation.
	Wrong type of grease causing breakdown of lubricant	Flush and pump in proper type of lubricant.
	Grease passage blocked	Inspect and clean grease ports and fittings, then pump in clean grease.
	Foreign matter or corrosive agent entering bearing	Flush and purge contaminants out, pump in clean grease.
	Bearing has failed	Replace bearing in-kind.
	Sheave is not rotating at proper speed or is frozen	Inspect sheaves for foreign objects or other interferences and remove the interference.
Wire rope is wearing on sides	Sheave groove is worn	Measure groove radius. Replace sheave as required.
Wire rope is not staying in drum groove	Wire rope is misaligned	Check fleet angle of rope and compare to expected fleet angle. Adjust/realign mislocated component as necessary.

TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT

Problem	Possible Cause	Action
Apron will not raise	Rotary Cam Switch failure or rollover	Apron already in the fully raised position or the fully raised limit switch on the cam seized in the actuated position or the cam has rolled over or bad connection on limit switch or water entry into limit switch. Turn the RAMP APRON CONTROL LIMIT SWITCH BYPASS to the RAISE position and attempt to operate. If the apron operates, it will indicate a bad limit switch or circuit wiring.
	Tripped overload relay	Reset the overload relay on APRON RAISE/LOWER starter. If the overload relay trips again on the next operation, see mechanical binding below, motor winding issue, megger motor windings to check for ground fault. Continuity check motor windings at the overload relay to check for open winding or feeder conductor. Check power on load side of overload relay for single phasing.
	Mechanical binding	Check for binding in the apron machinery and the motor gear reducer. Check for failure of brake to release.
	Circuit breaker tripped or transfer switch open (240V power loss)	Check if apron motor circuit protector or main circuit breaker is tripped. If tripped check for short in wiring, ground fault in motor and wiring and single phasing of motor. Also check status of the Service Breaker. Check that Manual Transfer Switch is in utility position with utility power available, or is in generator position with generator running.
	Rotary Phase Converter Failure	Check if rotary phase converter is running and producing proper voltage on all three phases. If not, check the circuit breaker. Check the fuses. Spare AJT50 fuses are in the base of the control panel. Check that the 230V roto phase disconnect switch is closed (on). Check the contactor (unlabeled) for operation.
	Contactor coil burned out	Check coil continuity on the APRON RAISE contactor. Check applied coil voltage while attempting to operate.

TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT

Problem	Possible Cause	Action
	Control pushbutton or control pushbutton wiring failed	Check action of apron control pushbuttons at the control station. Check available voltage at control pushbuttons.
	Control Power Loss	Check if control power is available. Check control power breaker in the circuit breaker stack. If the ramp hoist functions but the apron does not, it is not the control circuit breaker.
	Apron operates from control station but not from radio transmitter	Check that the E-stop on transmitter is not depressed. Check that the transmitter has been properly turned on. Check batteries in transmitter and verify that receiver is powered and functions properly.
Apron will not lower	Rotary Cam Switch failure or rollover	Apron already in the fully raised position or the fully raised limit switch on the cam seized in the actuated position or the cam has rolled over or bad connection on limit switch or water entry into limit switch. Turn the RAMP APRON CONTROL LIMIT SWITCH BYPASS to the LOWER position and attempt to operate. If the apron operates, it will indicate a bad limit switch or circuit wiring.
	Tripped overload relay	Reset the overload relay on APRON RAISE/LOWER starter. If the overload relay trips again on the next operation, see mechanical binding below, motor winding issue, megger motor windings to check for ground fault. Continuity check motor windings at the overload relay to check for open winding or feeder conductor. Check power on load side of overload relay for single phasing.
	Mechanical binding	Check for binding in the apron machinery and the motor gear reducer. Check for failure of brake to release.
	Circuit breaker tripped or transfer switch open (240V power loss)	Check if apron motor circuit protector or main circuit breaker is tripped. If tripped check for short in wiring, ground fault in motor and wiring and single phasing of motor. Also check status of the Service Breaker. Check that Manual Transfer Switch is in utility position with utility power available, or is in generator position with generator running.

TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT

Problem	Possible Cause	Action
	Rotary Phase Converter Failure	Check if rotary phase converter is running and producing proper voltage on all three phases. If not, check the circuit breaker. Check the fuses. Spare AJT50 fuses are in the base of the control panel. Check that the 230V roto phase disconnect switch is closed (on). Check the contactor (unlabeled) for operation.
	Contactor coil burned out	Check coil continuity on the APRON LOWER contactor. Check applied coil voltage while attempting to operate.
	Control pushbutton or control pushbutton wiring failed	Check action of apron control pushbuttons at the control station. Check available voltage at control pushbuttons.
	Control Power Loss	Check if control power is available. Check control power breaker in the circuit breaker stack. If the ramp hoist functions but the apron does not, it is not the control circuit breaker.
	Apron operates from control station but not from radio transmitter	Check that the E-stop on transmitter is not depressed. Check that the transmitter has been properly turned on. Check batteries in transmitter and verify that receiver is powered and functions properly.
Transfer Bridge (Ramp) will not raise	Rotary Cam Switch failure or rollover	Ramp already in the fully raised position or the fully raised limit switch on the cam seized in the actuated position or the cam has rolled over or bad connection on limit switch or water entry into limit switch. Turn the BRIDGE RAMP CONTROL LIMIT SWITCH BYPASS to the RAISE position and attempt to operate. If the apron operates, it will indicate a bad limit switch or circuit wiring.
	Tripped overload relay	Reset the overload relay on RAMP RAISE/LOWER starter. If the overload relay trips again on the next operation, see mechanical binding below, motor winding issue, megger motor windings to check for ground fault. Continuity check motor windings at the overload relay to check for open winding or feeder conductor. Check power on load side of overload relay for single phasing.

TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT

Problem	Possible Cause	Action
	Mechanical binding	Check for binding in the ramp machinery and the motor gear reducer. Check for failure of brake to release.
	Circuit breaker tripped or transfer switch open (240V power loss)	Check if apron motor circuit protector or main circuit breaker is tripped. If tripped check for short in wiring, ground fault in motor and wiring and single phasing of motor. Also check status of the Service Breaker. Check that Manual Transfer Switch is in utility position with utility power available, or is in generator position with generator running.
	Rotary Phase Converter Failure	Check if rotary phase converter is running and producing proper voltage on all three phases. If not, check the circuit breaker. Check the fuses. Spare AJT50 fuses are in the base of the control panel. Check that the 230V roto phase disconnect switch is closed (on). Check the contactor (unlabeled) for operation.
	Contactor coil burned out	Check coil continuity on the RAMP RAISE contactor. Check applied coil voltage while attempting to operate.
	Control pushbutton or control pushbutton wiring failed	Check action of apron control pushbuttons at the control station. Check available voltage at control pushbuttons.
	Control Power Loss	Check if control power is available. Check control power breaker in the circuit breaker stack. If the apron winch functions but the bridge hoist does not, it is not the control circuit breaker.
	Ramp operates from control station but not from radio transmitter	Check that the E-stop on transmitter is not depressed. Check that the transmitter has been properly turned on. Check batteries in transmitter and verify that receiver is powered and functions properly.

TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT

Problem	Possible Cause	Action
Transfer Bridge (Ramp) will not lower	Rotary Cam Switch failure or rollover	Ramp already in the fully lowered position or the fully lowered limit switch on the cam seized in the actuated position or the cam has rolled over or bad connection on limit switch or water entry into limit switch. Turn the BRIDGE RAMP CONTROL LIMIT SWITCH BYPASS to the LOWER position and attempt to operate. If the apron operates, it will indicate a bad limit switch or circuit wiring.
	Tripped overload relay	Reset the overload relay on RAMP RAISE/LOWER starter. If the overload relay trips again on the next operation, see mechanical binding below, motor winding issue, megger motor windings to check for ground fault. Continuity check motor windings at the overload relay to check for open winding or feeder conductor. Check power on load side of overload relay for single phasing.
	Mechanical binding	Check for binding in the ramp machinery and the motor gear reducer. Check for failure of brake to release.
	Circuit breaker tripped or transfer switch open (240V power loss)	Check if apron motor circuit protector or main circuit breaker is tripped. If tripped check for short in wiring, ground fault in motor and wiring and single phasing of motor. Also check status of the Service Breaker. Check that Manual Transfer Switch is in utility position with utility power available, or is in generator position with generator running.
	Rotary Phase Converter Failure	Check if rotary phase converter is running and producing proper voltage on all three phases. If not, check the circuit breaker. Check the fuses. Spare AJT50 fuses are in the base of the control panel. Check that the 230V roto phase disconnect switch is closed (on). Check the contactor (unlabeled) for operation.
	Contactor coil burned out	Check coil continuity on the RAMP LOWER contactor. Check applied coil voltage while attempting to operate.

TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT

Problem	Possible Cause	Action
	Control pushbutton or control pushbutton wiring failed	Check action of apron control pushbuttons at the control station. Check available voltage at control pushbuttons.
	Control Power Loss	Check if control power is available. Check control power breaker in the circuit breaker stack. If the apron winch functions but the bridge hoist does not, it is not the control circuit breaker.
	Ramp operates from control station but not from radio transmitter	Check that the E-stop on transmitter is not depressed. Check that the transmitter has been properly turned on. Check batteries in transmitter and verify that receiver is powered and functions properly.
Transfer Bridge (Ramp) motor circuit breaker trips	Short circuit in motor	Open (turn off) main breaker at the control panel. Verify that the Rotary Phase Converter is not running. Check line to line resistance of the motor at the overload relay load terminals. It should indicate continuity with a very small value. Special equipment would be needed to read the actual value but only continuity is needed here. Check line to ground resistance using a megohm meter and assure that the value compares to that of the previous reading and is at least 1 megohm. If these values are not good, re-check motor at the conduit box with all motor leads disconnected from their feeders. With the brake leads disconnected from the motor leads, check the motor leads then check the brake leads. If good, check all feeders to the motor.
	Water in motor or brake	Open conduit box and examine for water or moisture. It may necessary to unmount brake-motor motor and inspect the interior for water or moisture. If no moisture is found but motor insulation resistance is below 1 megohm, replace and/or send to shop for rehabilitation.

TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT

Problem	Possible Cause	Action
Apron motor circuit breaker trips	Short circuit in motor	Open (turn off) main breaker at the control panel. Verify that the Rotary Phase Converter is not running. Check line to line resistance of the motor at the overload relay load terminals. It should indicate continuity with a very small value. Special equipment would be needed to read the actual value but only continuity is needed here. Check line to ground resistance using a megohm meter and assure that the value compares to that of the previous reading and is at least 1 megohm. If these values are not good, re-check motor at the conduit box with all motor leads disconnected from their feeders. With the brake leads disconnected from the motor leads, check the motor leads then check the brake leads. If good, check all feeders to the motor.
	Water in motor or brake	Open conduit box and examine for water or moisture. It may necessary to unmount brake-motor motor and inspect the interior for water or moisture. If no moisture is found but motor insulation resistance is below 1 megohm, replace and/or send to shop for rehabilitation.
Rotary Phase Converter circuit breaker trips	Short circuit in motor, motor starting capacitor or water or oil entry	Open (turn off) main breaker at the control panel. Open (turn off) the 230V ROTO PHASE CONVERTER disconnect and verify that the Rotary Phase Converter is not running. Check line to line resistance of the motor at the disconnect switch. It should indicate continuity with a very small value. Special equipment would be needed to read the actual value but only continuity is needed here. Check line to ground resistance using a megohm meter and assure that the value compares to that of the previous reading and is at least 1 megohm. The capacitors in the upper compartment of the unit will need to be disconnected for this test. If these values are good, disconnect the motor and check the feeder conductors for insulation resistance. Check the converter and boxes for water or moisture.

TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT

Problem	Possible Cause	Action
	Water or oil in motor	See rotary phase converter manufacturer's manual.
Ramp and/or apron cannot be controlled from the control station	OPERATOR CONTROL SELECTOR SWITCH in RADIO mode	Turn selector switch to LOCAL mode.
Ramp and/or apron cannot be controlled from the radio control system	OPERATOR CONTROL SELECTOR SWITCH in LOCAL mode	Turn selector switch to RADIO mode.
Radio control will not operate the apron or the bridge	Bad battery or radio not turned on or EMERGENCY STOP depressed	Replace battery with unit as called out in the manual. Release E-stop button if depressed. Turn on radio if off (see below).
Radio control is not turned on	Failure to RESET	Turn the radio control from the OFF to the ON position then turn to the RESET position for 1 second and release. Verify that the proper indicating light is on.
	Emergency stop depressed	Check if the emergency stop latching button is depressed and if so rotate to release.
	Radio receiver non-functional	Check radio receiver adjacent to the control station for functionality.
	Radio control system locked out	Check that OPERATOR CONTROL SELECTOR SWITCH is in RADIO mode.
Red/green pawl position indicating light(s) will not illuminate	Bulb is burned out	Check and change bulb if necessary.
	Bad micro switch or bad 1CR light control relay.	Operate pawls manually and observe the lights. Note that both pawls must be engaged to received a green light. Check the ratchet light relay 1CR for operation. If it fails to operate, check for power at the coil. If power is present and the relay does not actuate check coil and replace if necessary. If no power is present, check the micro switch in the ratchet assembly and replace if necessary.

TROUBLESHOOTING TABLE - ELECTRICAL OPERATION & EQUIPMENT

Problem	Possible Cause	Action
No utility 240V power	Control panel SERVICE BREAKER	Check voltage at SERVICE BREAKER in the control panel. It is provided with a 100 amp trip. Verify that the breaker is not tripped. The single phase voltage should be approximately 240V.
Generator does not start	Generator does not start when the control switch is switched to the START position	Check battery for a charge and fuel level. Otherwise, see generator troubleshooting in generator manual.
Flood lights will not illuminate	Bulb burned out	Check other floodlight for illumination.
	LIGHTING contactor non-functional	Check contactor (labeled as LIGHTING RELAY) coil for continuity. Check power to coil. Check latch function. Check connections.
	Control power failure	Check for 120 VAC to neutral at the control power circuit breaker.
	Power failure to fixture	Check breaker appropriate floodlight circuit breaker for trip.

Section 4: Appendices

APPENDIX 4.1—Ferry Terminal Design Plans

U.S.R.A. Adm. No.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
-	MAINE	003002.00	1	24

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

CONVENTIONAL SIGNS

COUNTY LINES		TRAVELLED WAY - PROPOSED	
TOWN LINES		UNDERGROUND UTILITIES - EXISTING	
PROPERTY LINES		UNDERGROUND UTILITIES - PROPOSED	
R/W LINES - EXISTING		RAILROAD - SINGLE TRACK	
R/W LINES - NEW - ACCESS CONTROL		RAILROAD - DOUBLE TRACK	
R/W LINES - NEW - NO ACCESS CONTROL		UTILITY POLE - EXISTING	
CULVERT - EXISTING		UTILITY POLE - JOINT OCCUPANCY	
CULVERT - PROPOSED		PROPOSED UTILITY POLE - TEMPORARY	X
CURBING - EXISTING		PROPOSED UTILITY POLE - PERMANENT	
CURBING - PROPOSED		TREES	Ø hardwood, ✱ softwood
TRAVELLED WAY - EXISTING		WOODS	

SPECIFICATIONS

DESIGN: Load Factor Design per AASHTO Standard Specifications for Highway Bridges 1983 and Interim Specifications 1984 and 1985.

CONTRACT: State of Maine, Department of Transportation, Standard Specifications, Highways and Bridges, Revisions of January 1984.

DESIGN LOADING

LIVE LOAD: ..... HS 20

MATERIALS

CONCRETE: ..... Class A
REINFORCING STEEL: ..... ASTM A615 Grade 60
STRUCTURAL STEEL: ..... All materials ASTM A36 (GALVANIZED) except as noted
High Strength Bolts ..... ASTM A325 (Galvanized)

BASIC DESIGN STRESSES

CONCRETE: ..... f'_c = 3000 psi
REINFORCING STEEL: ..... fy = 60,000 psi
STRUCTURAL STEEL: ..... ASTM A36 fy = 36,000 psi
ASTM A325 fv = 25,000 psi

TRANSFER BRIDGE
FRENCHBORO
LONG ISLAND
HANCOCK COUNTY

PROJECT NO. 003002.00



LOCATION MAP

scale :

NOTE

All work contemplated under this contract to be governed by and in conformity with the STANDARD SPECIFICATIONS (revision of January 1984) and supplements thereto, except as modified on the plans and in the special provisions.

INDEX OF SHEETS

SHEET NO.	DESCRIPTION
1	TITLE SHEET
2	ESTIMATED QUANTITIES
3	GENERAL PLAN
4	FENDER & DOLPHIN MODIFICATIONS
5	CROSS SECTIONS
6	ABUTMENT
7-12	BRIDGE
13	TOWER MODIFICATIONS
14	ACCESS LADDER
15	MACHINERY HOUSE
16-24	MECHANICAL-ELECTRICAL

APPROVED:

COMMISSIONER

CHIEF ENGINEER

97-114

ESTIMATED QUANTITIES

ITEM NO.	DESCRIPTION	QUANTITY	UNIT

PROJECT: BRIDGE NUMBER 3162 | BY | DATE
PLANS | DESIGN - DETAIL | drf | 10/97
CHECKED | drf | 10/97
QUANTITIES | drf | 10/97
FIELD CHANGES

F.A.P. REG. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
1	MAINE	003002.00	2	24

GENERAL CONSTRUCTION NOTES

1.---Item 202.10, Removal of Existing Superstructure- Property of Contractor shall include removal of the transfer bridge, assorted members, hardware, and equipment as directed by the Engineer. The towers, retaining walls, most of the machinery, and the machinery house are to remain.

2.---Payment for the 6"x6" rub strips, shims, anchors and 12"x12" header block shall be considered as incidental to Item 501.19, Timber Piles, Untreated

3.---The transfer bridge will remain open to traffic during construction except when the new bridge is being erected. The Contractor shall conduct his operation to limit the length of time the facility is closed to traffic. All components of the bridge; ie, structural, mechanical, or electrical must be at the job site prior to closing the facility and removing the existing bridge to minimize the length of time the facility is closed to traffic, unless otherwise approved by the Engineer. A temporary detour will not be required.

The Contractor shall notify appropriate town officials, the county sheriff's department and the Maine State Ferry Service in Rockland of the anticipated closing date 2 weeks prior to the closing. The facility shall not be closed until after the last scheduled trip of the ferry for the week of the closing.

A Public Notice shall be published in a local newspaper to inform the public of the anticipated closing and re-opening dates of the facility. A radio station covering the area shall carry the announcement. All cost of closure signing and newspaper and radio announcements will be considered as incidental to contract items.

The Contractor shall conduct his work such that the facility is closed for no longer than 4 weeks. The Contractor shall notify appropriate town officials, the county sheriff's department and the Maine State Ferry Service in Rockland when the facility is open for use.

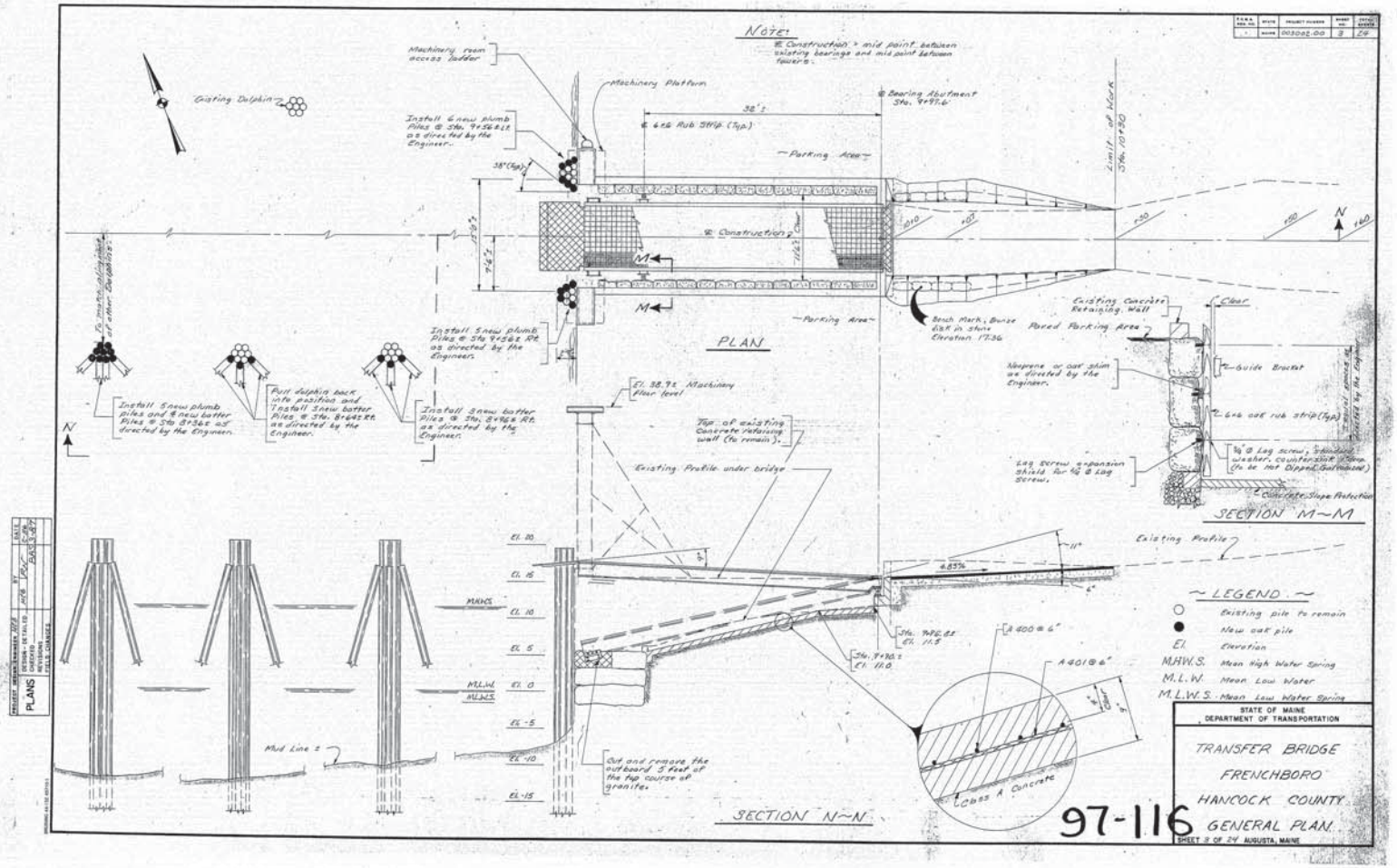
4.---All new structural steel, bolts, and hardware shall be hot-dipped galvanized in accordance with ASTM A123 and A153 Except as noted. All damaged areas and field welding areas shall be repaired by the Contractor using a method recommended by the galvanizer and approved by the Engineer. Payment for galvanizing will be considered as incidental to Item 504.70, Structural Steel Fabricated and Delivered. No extra payment will be made for repairs to the galvanizing, nuts and any holes as required must be re-tapped after hot dipped galvanizing. Alternatively, bolts, and hardware, as approved by the Engineer, may be mechanically galvanized. The mechanically coated bolts and hardware shall conform to the coating thickness, adherence and quality requirements of hot-dipped galvanizing. Mechanically coated nuts for assembly bolts mechanically coated bolts shall be tapped oversize prior to coating and need not be re-tapped afterwards.

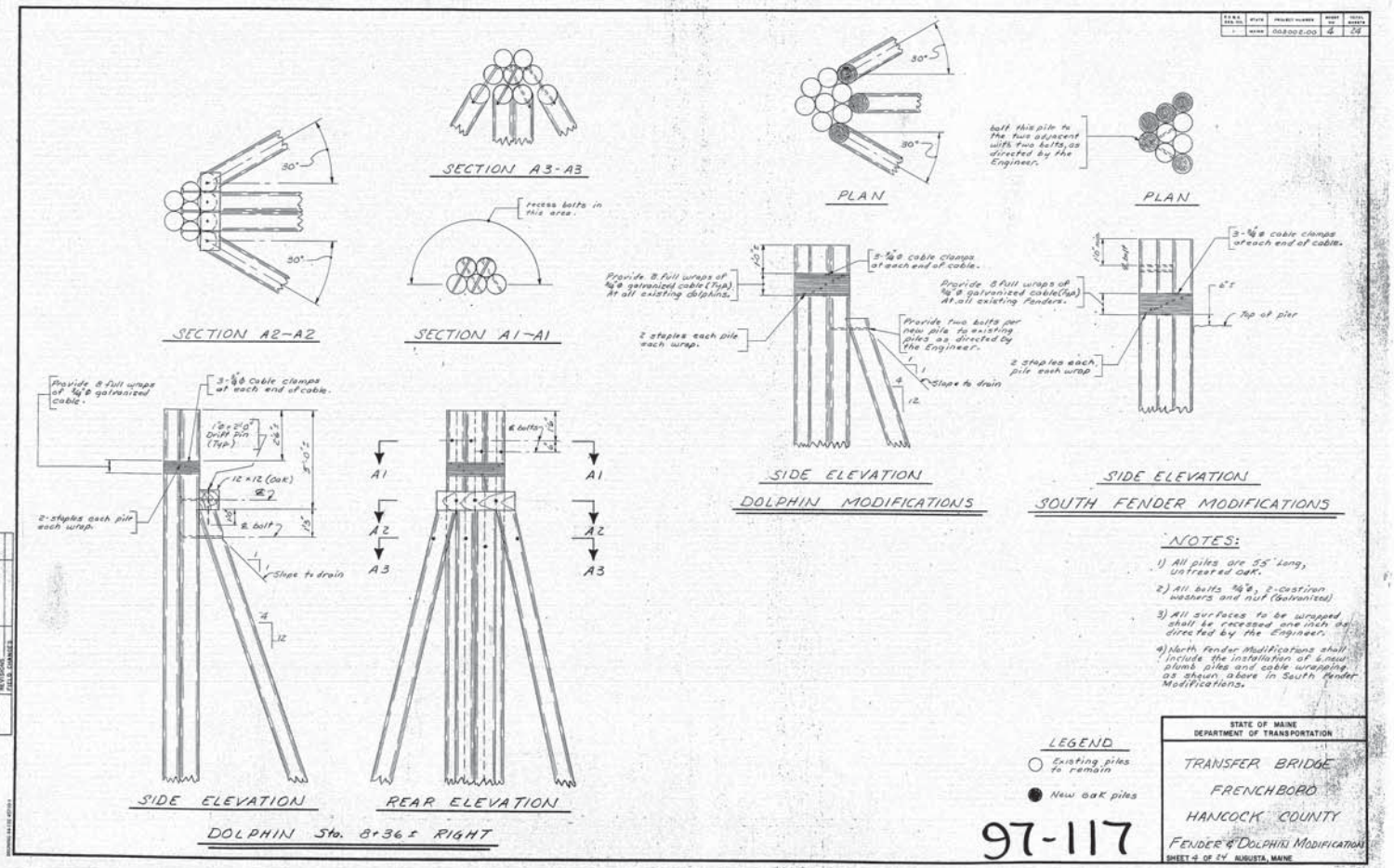
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY
ESTIMATED QUANTITIES

SHEET 2 OF 24 AUGUSTA, MAINE

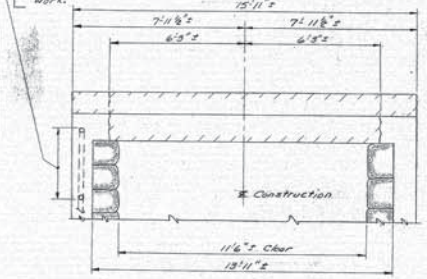
97-115


NOTE:
℄ Construction = mid point between existing bearings and mid point between towers.
Machinery room access ladder
Machinery Platform
Existing Dolphin
Install 6 new plumb Piles @ Sta. 9+58 Lt. as directed by the Engineer.
32'±
℄ 6x6 Rub Strip (Typ.)
Bearing Abutment Sta. 9+97.6
Limit of Work Sta. 10+30
38'(Typ.)
Parking Area
℄ Construction
Clear
+30
+10
+50
+60
N
M
Install 3 new plumb Piles @ Sta. 9+56 Rt. as directed by the Engineer.
Bench Mark: Bronze disk in shore Elevation 17.36
Paved Parking Area
Existing Concrete Retaining Wall
PLAN
To matter of interest to other Dolphins
Install 3 new plumb piles and 3 new batter Piles @ Sta. 8+36 Lt. as directed by the Engineer.
Pull dolphin back into position and Install 3 new batter Piles @ Sta. 8+42 Rt. as directed by the Engineer.
Install 3 new batter Piles @ Sta. 8+48 Rt. as directed by the Engineer.
El. 38.7± Machinery floor level
Top of existing Concrete retaining wall (to remain)
Existing Profile under bridge
Neoprene or oak shim as directed by the Engineer.
Guide Bracket
6x6 oak rub strip (Typ.)
5/8" ø Lag screw; Standard washer, Countersink (Typ. of 16 not Shown) Surround
Lag screw expansion shield for 5/8 ø Lag Screw.
Concrete Slope Protection
SECTION M-M
Existing Profile
11"
4.85%
6"
El. 20.
El. 15.
MHWS
El. 10.
El. 5.
M.L.W.
M.L.W.S.
El. 0
El. -5
El. -10
El. -15
Mud Line
Sta. 9+85.6± El. 11.5
Sta. 9+90.1± El. 11.0
A 400 @ 6"
A 401 @ 6"
4" Clear
4"
Class A Concrete
Cut and remove the outboard 5 feet of the top course of granite.
SECTION N-N
~ LEGEND ~
Existing pile to remain
New oak pile
El. Elevation
M.H.W.S. Mean High Water Spring
M.L.W. Mean Low Water
M.L.W.S. Mean Low Water Spring
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY
GENERAL PLAN
SHEET 3 OF 24 AUGUSTA, MAINE
97-116
PROJECT
PLANS
DESIGN DETAILED
CHECKED
REVISIONS
STEEL CHANGES
BY
DATE
2-26
5-4-97

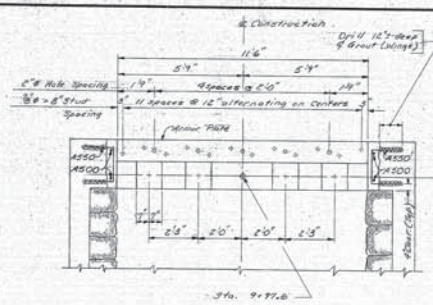

30°
30°
SECTION A2-A2
SECTION A3-A3
recess bolts in this area.
SECTION A1-A1
PLAN
30°
30°
bolt this pile to the two adjacent with two bolts, as directed by the Engineer.
PLAN
Provide 8 full wraps of ¾"ø galvanized cable (Typ). At all existing dolphins.
3-⅞"ø cable clamps at each end of cable.
2 staples each pile each wrap.
Provide two bolts per new pile to existing piles, as directed by the Engineer.
Slope to drain
4
12
SIDE ELEVATION
DOLPHIN MODIFICATIONS
3-⅞"ø cable clamps at each end of cable.
Provide 8 full wraps of ¾"ø galvanized cable (Typ). At all existing Fenders.
6"±
Top of pier
2 staples each pile each wrap
SIDE ELEVATION
SOUTH FENDER MODIFICATIONS
Provide 8 full wraps of ¾"ø galvanized cable.
3-⅞"ø Cable clamps at each end of cable.
12"x 2'-0" Drift pin (Typ)
5'-0"±
12 x 12 (oak)
2 staples each pile each wrap.
⅞"ø bolt
1'-6"
Slope to drain
4
12
SIDE ELEVATION
⅞"ø bolts
A1
A2
A3
A1
A2
A3
REAR ELEVATION
DOLPHIN Sta. 8+36± RIGHT
NOTES:
1) All piles are 35' long, untreated oak.
2) All bolts ¾"ø, 2-castiron washers and nut (Galvanized)
3) All surfaces to be wrapped shall be recessed one inch as directed by the Engineer.
4) North fender Modifications shall include the installation of 6 new plumb piles and cable wrapping as shown above in South fender Modifications.
LEGEND
Existing piles to remain
New oak piles
97-117
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY
FENDER & DOLPHIN MODIFICATIONS
SHEET 4 OF 24 AUGUSTA, MAINE
PROJECT MANAGER
PROJECT ENGINEER
PLANS
CHECKED
REVISIONS
DATE
BY
F.A.P. NO.
STATE
PROJECT NUMBER
SHEET NO.
TOTAL SHEETS
003002-00
4
24

TYPICAL ROADWAY SECTION
97-118
~ FRENCHBORO ~

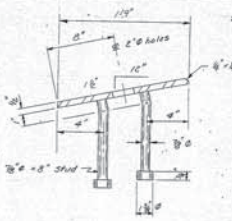
NOTE: Repair first section of existing 2" threaded pipe handrail as directed by the Engineer. Payment will be made under Subsection 109.06 Extra and Force Account Work.



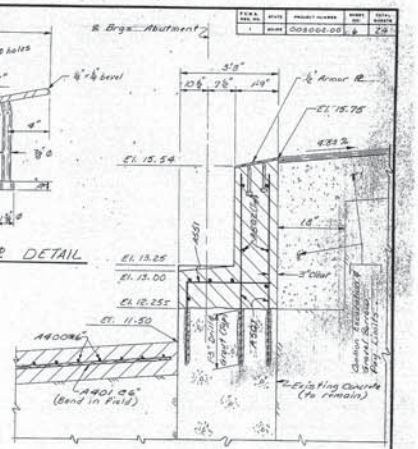
PLAN EXISTING ABUTMENT



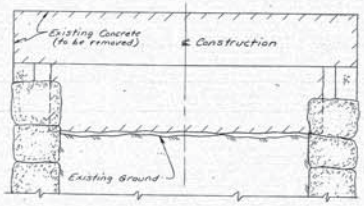
PLAN MODIFIED ABUTMENT



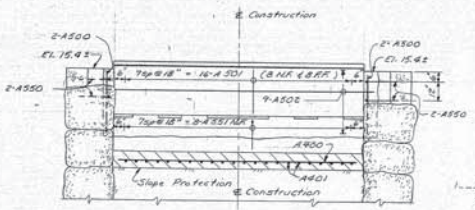
ARMOR ℞ DETAIL



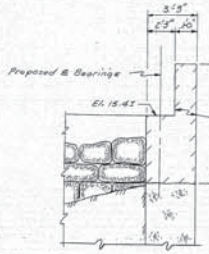
TYPICAL MODIFIED ABUTMENT SECTION



ELEVATION EXISTING ABUTMENT



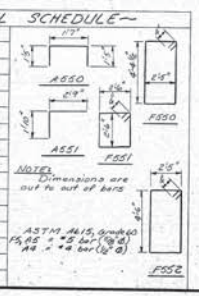
ELEVATION MODIFIED ABUTMENT



TYPICAL ABUTMENT SECTION EXISTING

~ REINFORCING STEEL SCHEDULE ~

Mark	Quantity	Length	Location
-STRAIGHT BARS-			
A400	63	11'0"	Slope Protection
A401	23	31'0"	Slope Protection
A500	4	6'8"	Wing Vertical
A501	16	4'5"	Abutment Vertical
A502	9	12'0	Abutment Horizontal
-BENT BARS-			
A550	4	4'5"	Wing Horizontal
A551	8	4'-9"	Breastwall
F550	4	14'3"	Dowel bend
F551	8	10'8"	" "
F552	4	14'6"	" "



NOTE: Dimensions are out to out of bars

ASTM A615, Grade 60
#5/#5 = #5 bar (16'-0")
#4 = #4 bar (12'-0")

ABUTMENT NOTES

1. Reinforcing steel shall have 3 inches cover unless otherwise indicated.
2. Protective coating for Concrete Surfaces shall be applied to all exposed concrete surfaces, new and old.
3. Remove the existing concrete backwall and bridge seat as shown on the plans. Payment will be made under Item 202.121 Removal of Existing Concrete.
4. All existing reinforcing steel shall be bent to fit into the new concrete as directed by the Engineer. Payment for this work will be considered incidental to Item 503.13, Reinforcing steel Placing.
5. Existing reinforcing steel that has been exposed from concrete removal that will be on a finished surface shall be removed to 2 inches below the finished surface and the holes shall be filled with an approved Non-Shrink grout. Payment for this work will be considered incidental to Item 503.13, Reinforcing Steel Placing.
6. All concrete for Abutment and Slope Protection will be paid for under Item 502.21, Structural Concrete Abutment and Retaining Walls.
7. Holes, for grouting reinforcing steel shall be 1½" to 2" diameter, Holes shall be filled with water for a minimum of two hours before grouting at which time all of the water shall be removed. The grouted areas shall be kept wet from time of initial set for a minimum of twelve hours, with burlap or other suitable means. The grout shall be used in accordance with the manufacturer's recommendations and shall be listed on the department's list of approved Non-Shrink Grouts. No seperate payment will be made for drilling and grouting, and all such work will be considered incidental to Item 503.13, Reinforcing Steel Placing.

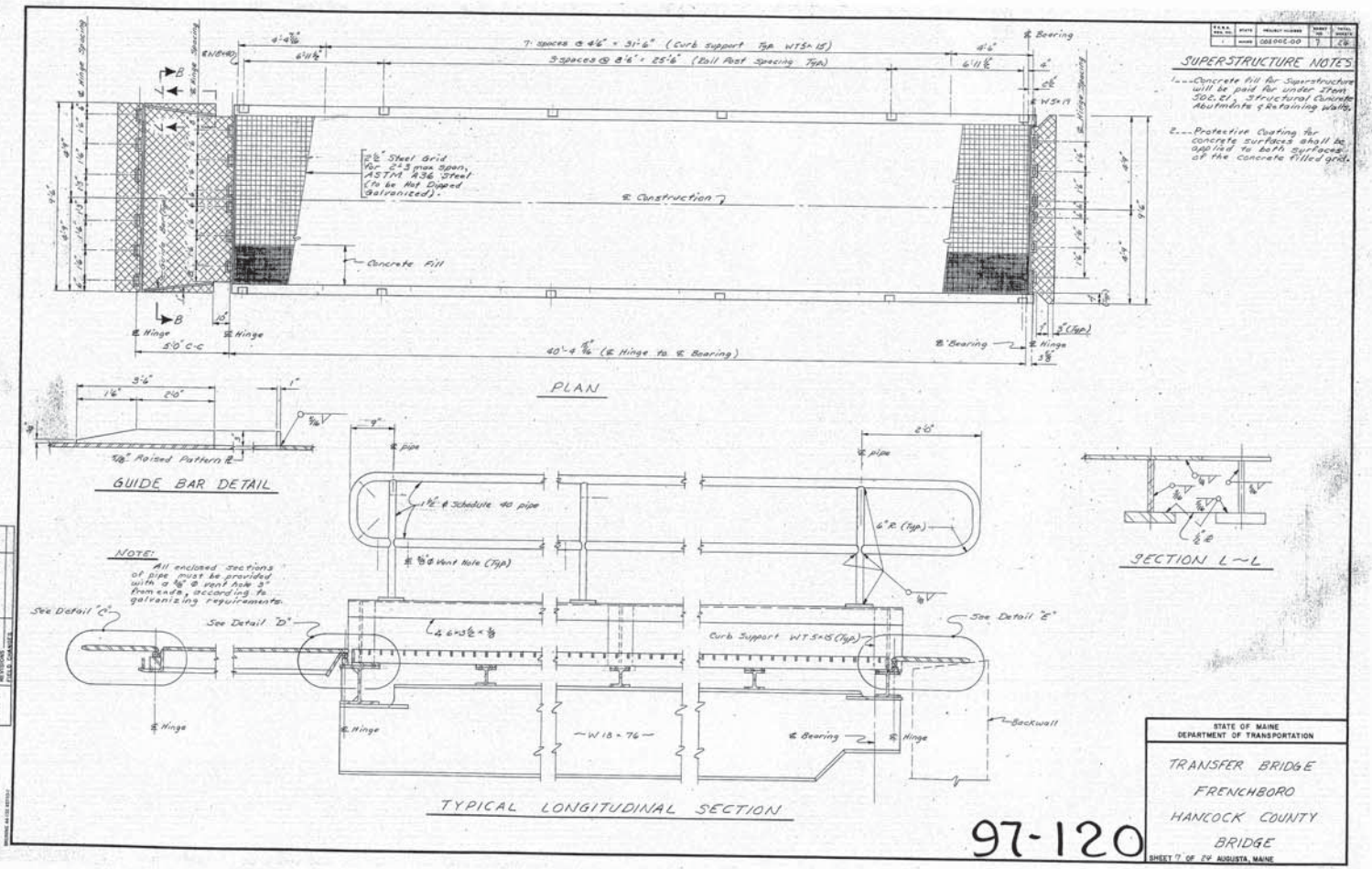
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

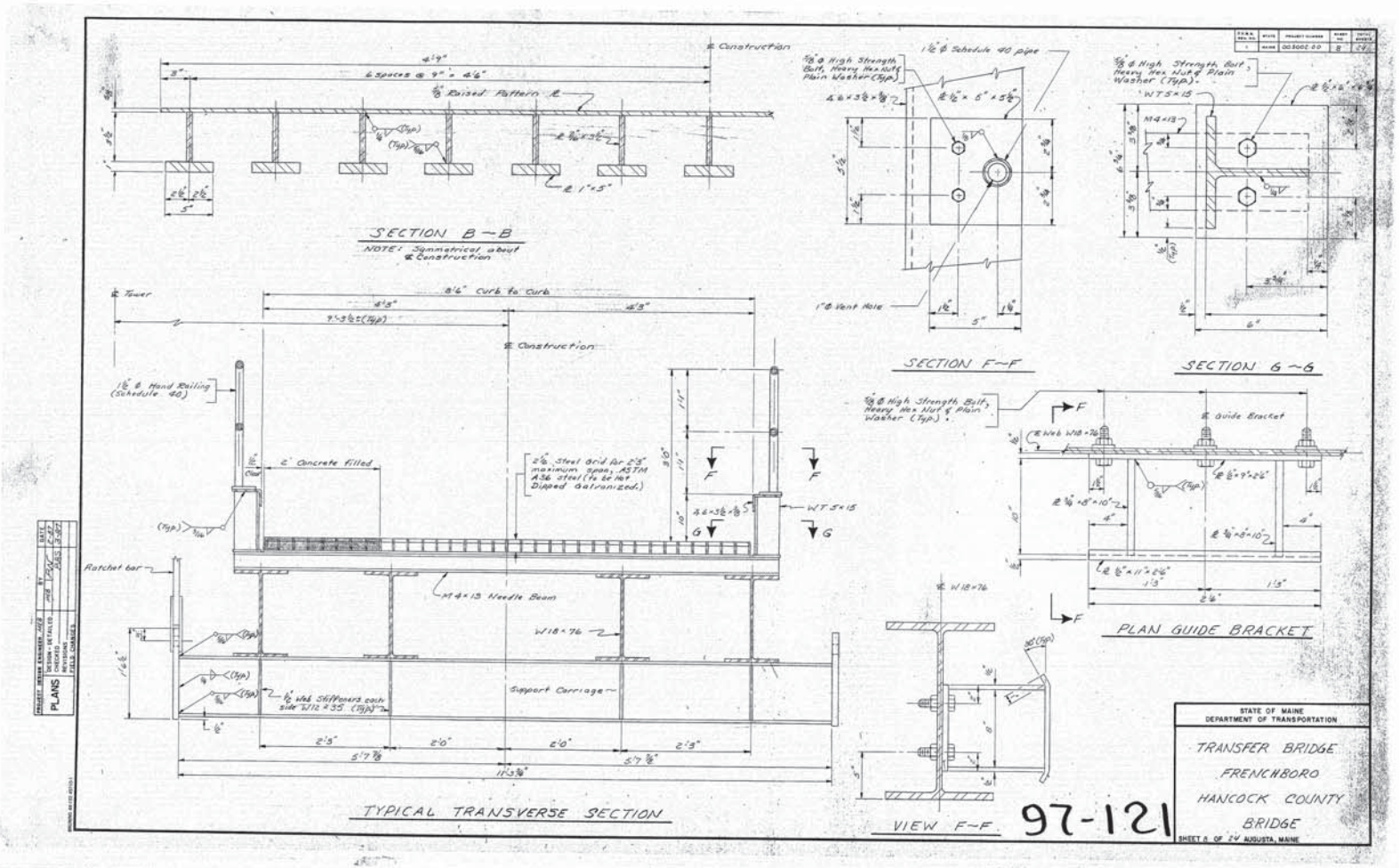
TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY
ABUTMENT

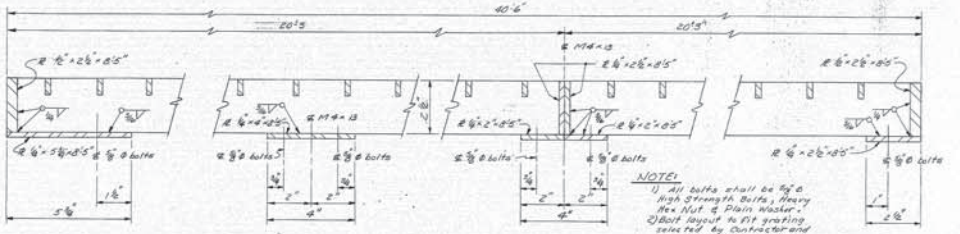
SHEET 6 OF 24 AUGUSTA, MAINE

97-119

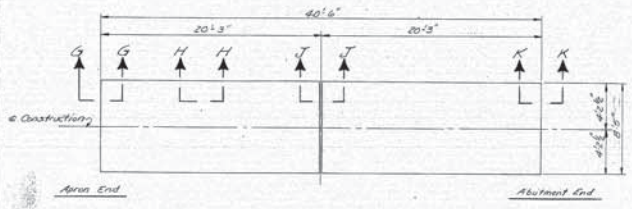
PROJECT: MEGA ENGINEER, INC.
PLANS
DESIGN - DETAILED
CHECKED
REVISIONS
FIELD CHANGES
BY
DATE


7 spaces @ 4'6" = 31'-6" (Curb support Typ. WT5x15)
3 spaces @ 8'6" = 25'-6" (Rail Post Spacing Typ.)
℄ Bearing
℄ Hinge Spacing
(ENGLAND)
2½" Steel Grid for 2'-3 max span, ASTM A36 Steel (To be Hot Dipped Galvanized).
℄ Construction
Concrete Fill
℄ Hinge
5'0" C-C
40'-4 7/16" (℄ Hinge to ℄ Bearing)
PLAN
SUPERSTRUCTURE NOTES
1.---Concrete fill for Superstructure will be paid for under Item 502.21, "Structural Concrete Abutments & Retaining Walls."
2.---Protective Coating for concrete surfaces shall be applied to both surfaces of the concrete filled grid.
GUIDE BAR DETAIL
1½" ø Schedule 40 pipe
⅝" ø Vent Hole (Typ)
NOTE: All enclosed sections of pipe must be provided with a ⅝" ø vent hole 3" from ends, according to galvanizing requirements.
See Detail "C"
See Detail "D"
See Detail "E"
L 6"x3½"x⅜
Curb Support WT5x18 (Typ)
W18 - 76
Backwall
℄ Hinge
℄ Bearing
TYPICAL LONGITUDINAL SECTION
SECTION L-L
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY
BRIDGE
SHEET 7 OF 29 AUGUSTA, MAINE
97-120


SECTION B–B
NOTE: Symmetrical about ℄ Construction
SECTION F–F
SECTION G–G
PLAN GUIDE BRACKET
TYPICAL TRANSVERSE SECTION
VIEW F–F
℄ Construction
℄ Tower
8'6" Curb to Curb
2" Concrete Filled
Ratchet bar
M4×13 Needle Beam
W18×76
Support Carriage
WT5×15
℄ Guide Bracket
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY
BRIDGE
97-121
SHEET 8 OF 24 AUGUSTA, MAINE



NOTE:
1) All bolts shall be ⅞" ø High Strength Bolts, Heavy Hex Nut & Plain Washer.
2) Bolt layout to fit grating selected by Contractor and approved by the Engineer.



PLAN GRID FLOOR LAYOUT

NOTE: Other panel arrangements may be used, with the Engineer's approval.

P.I.N. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
-	MAINE	004902.00	9	24

PROJECT ENGINEER ____ DATE
DESIGN DETAILED ____ BY ____ DATE 2-99
CHECKED ____ BY ____ DATE 2-99
REVISIONS
ITEMS CHANGED

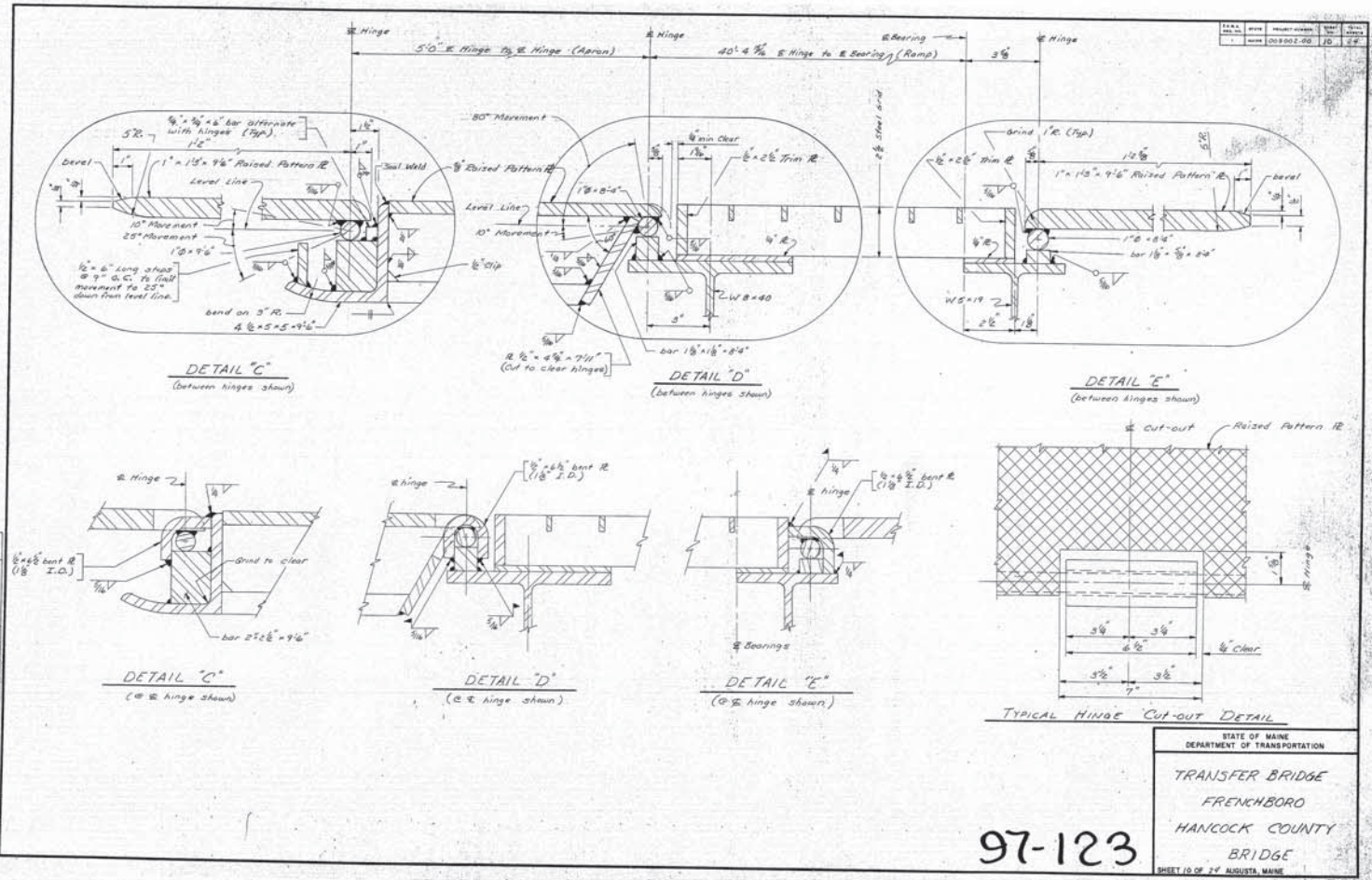
PLANS

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY
BRIDGE

SHEET 9 OF 24 AUGUSTA, MAINE

97-122



PROJECT ENGINEER	PLANS	DESIGN - DETAILS	CHECKED	REVISIONS	TITLE CHANGES	BY	DATE

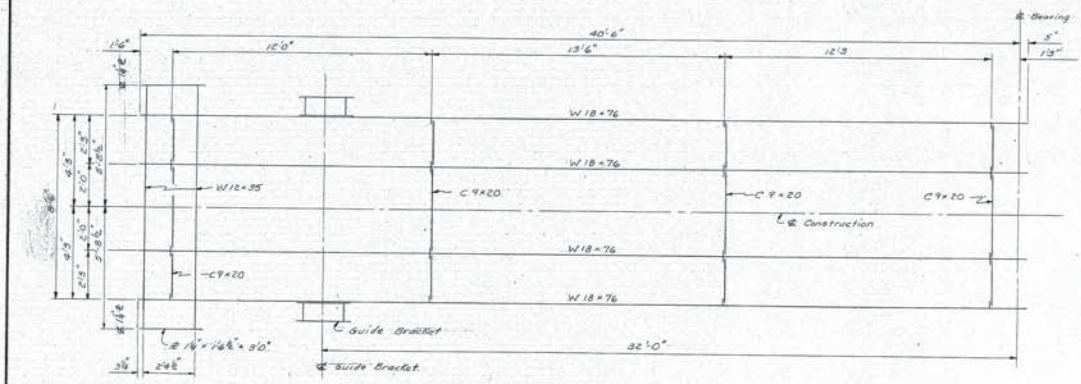
F.A.P. REG. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
-	MAINE	003002.00	10	24

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY
BRIDGE

SHEET 10 OF 24 AUGUSTA, MAINE

97-123



FABRICATION NOTES

1. All bolts shall be ⅞" ø H.S. Bolts. Holt sizes for bolts shall conform to Section 504.23 of the Standard Specifications, and edge distances shall be 1⅛" min. unless otherwise noted.
2. Diaphragm connection plate shall be normal to the top flange.

SPECIFICATIONS

MATERIALS

STRUCTURAL STEEL:

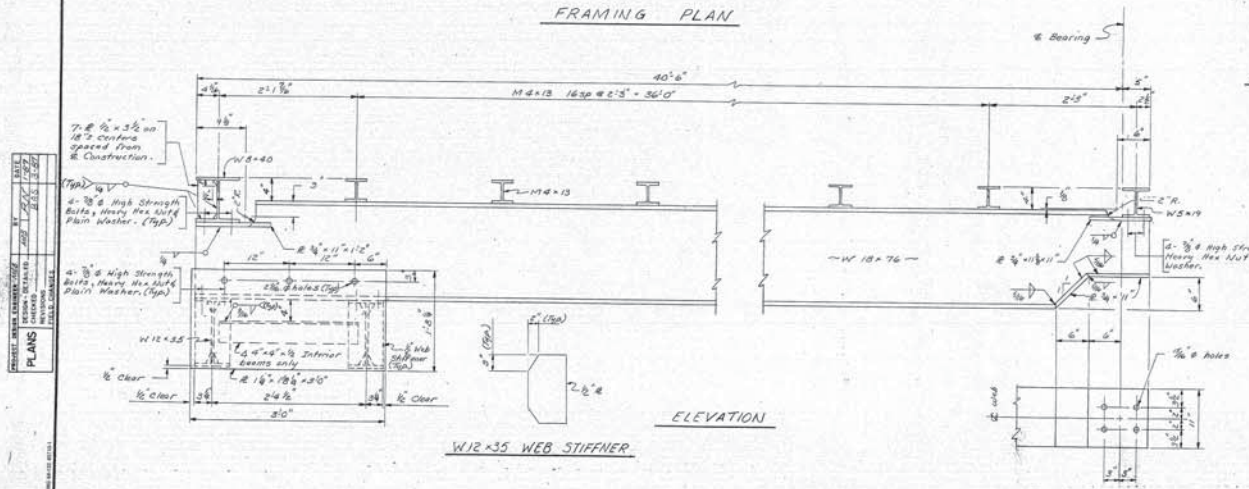
All ASTM A36 (Hot Dipped Galvanized) unless otherwise specified.

Bolts ASTM A325 (Galvanized)

BASIC DESIGN STRESSES

ASTM A36 Fy = 36,000 psi

ASTM A325 Fv = 25,000 psi



PROJECT AREA IDENTIFICATION: 202.1 F.A.P. 1997 S.P. 3.00

PLANS — DESIGN DETAILED / CHECKED / QUANTITIES / FIELD CHANGES

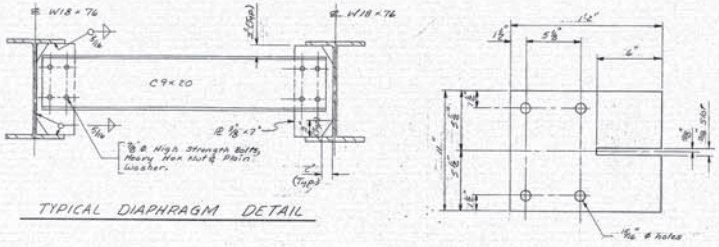
F.A.P. REF. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
1	MAINE	003002.00	11	24

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STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

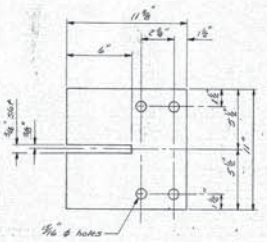
TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY
BRIDGE

SHEET 11 OF 24 AUGUSTA, MAINE



TYPICAL DIAPHRAGM DETAIL

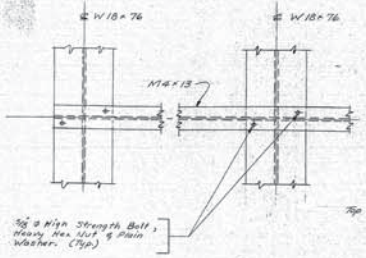
W.B. x 90 BEARING PLATE



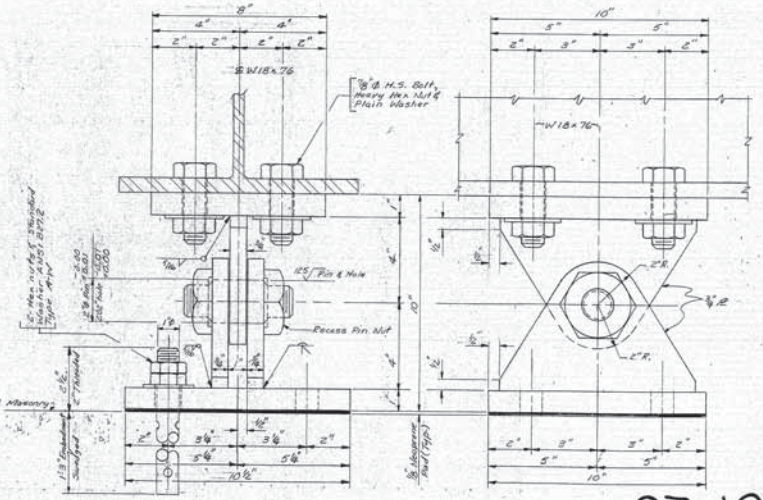
W5 x 9 BEARING PLATE

FABRICATION NOTES

1. All steel including anchor bolts, shall be ASTM A36 and Hot Dipped Galvanized except for contact surfaces.
2. Coat all surfaces with 125 micro-inch finish with NEVER-SIEZE or approved equal.
3. All areas of galvanizing damaged during assembly or field welding, shall be touched up with a Zinc coating as recommended by the galvanizer and as approved by the Engineer.
4. Upset threads on bearing pins and anchor bolts after assembly.



M4 x 13 BOLT LAYOUT DETAIL



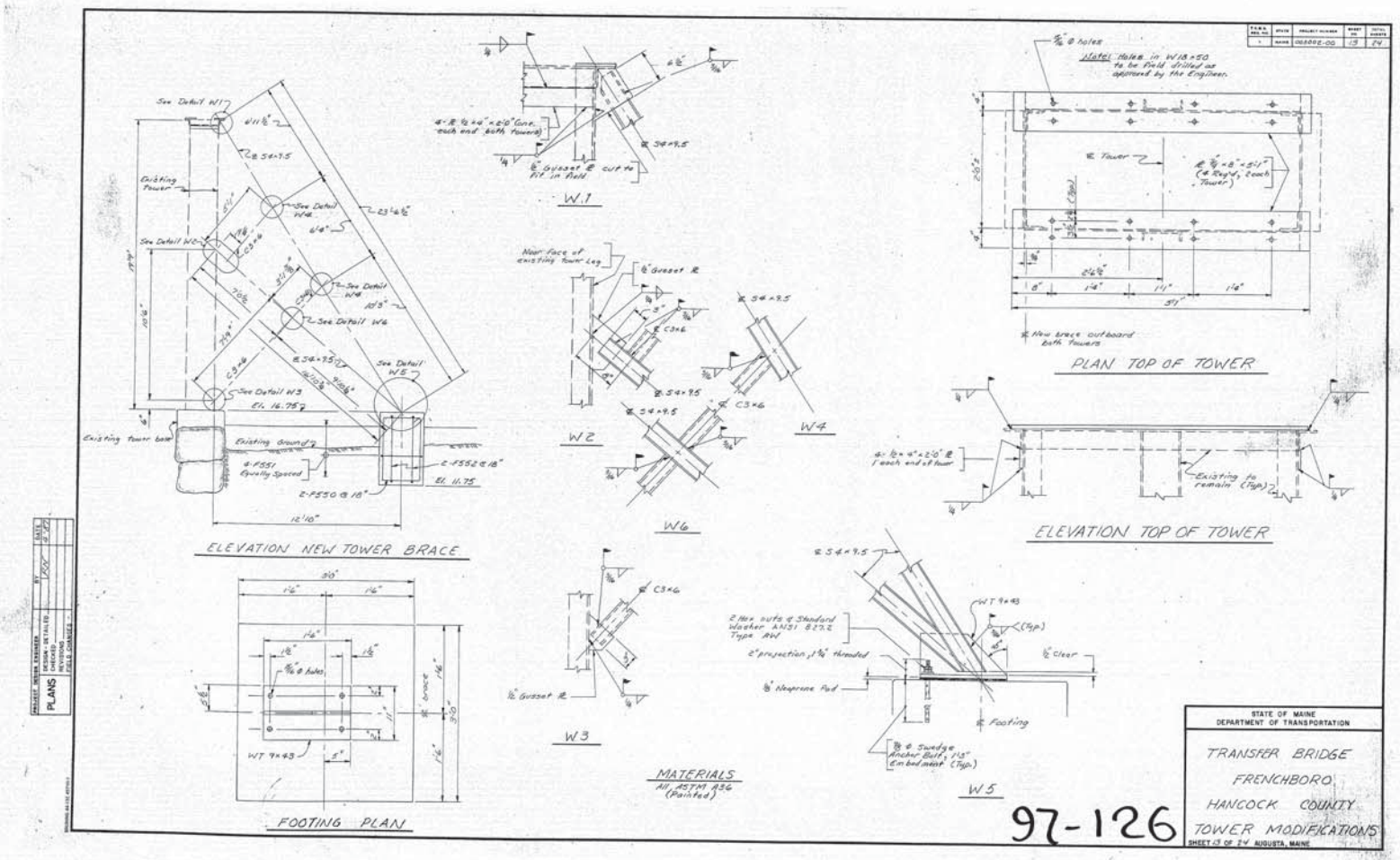
BEARING PEDESTAL

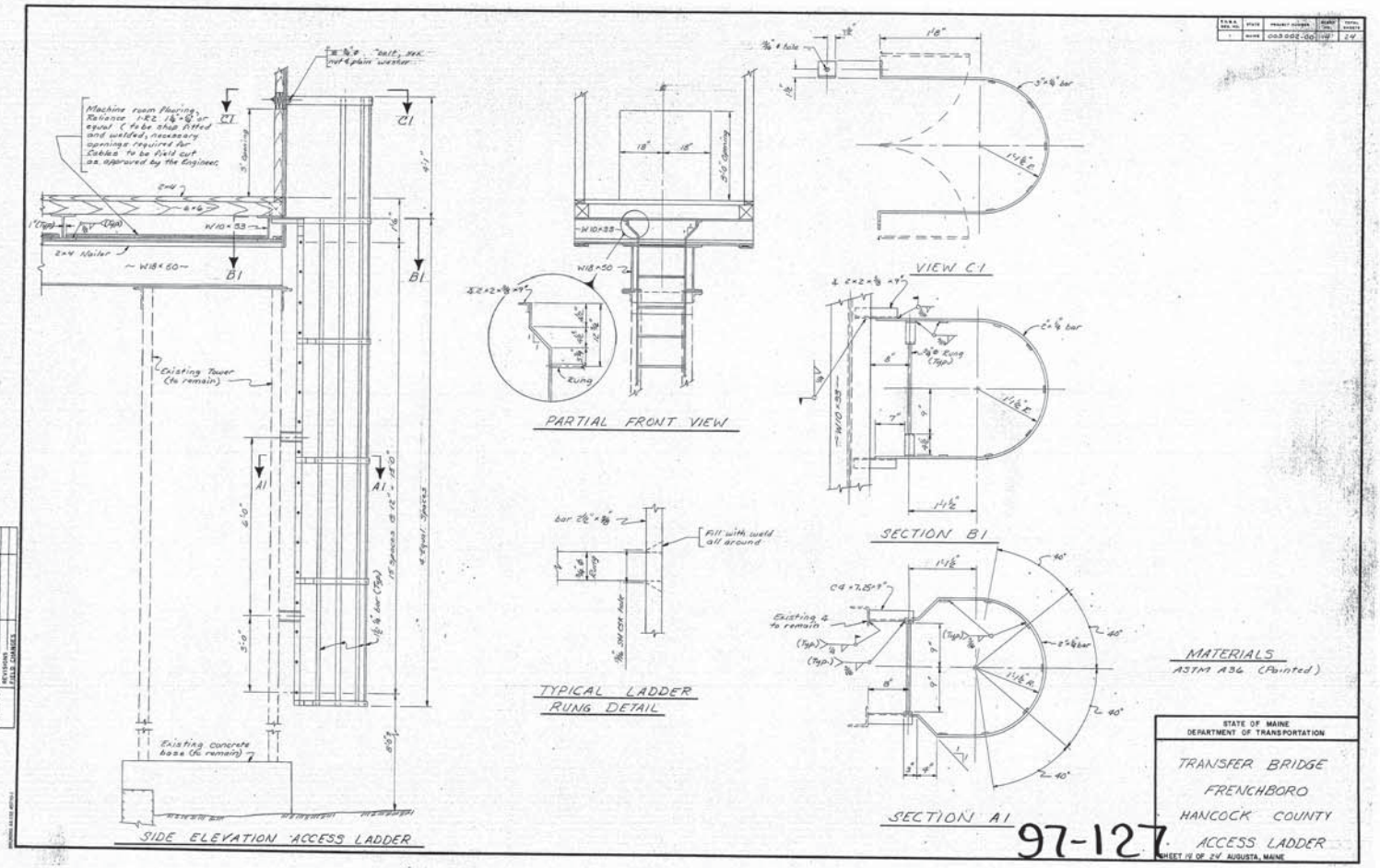
97-125

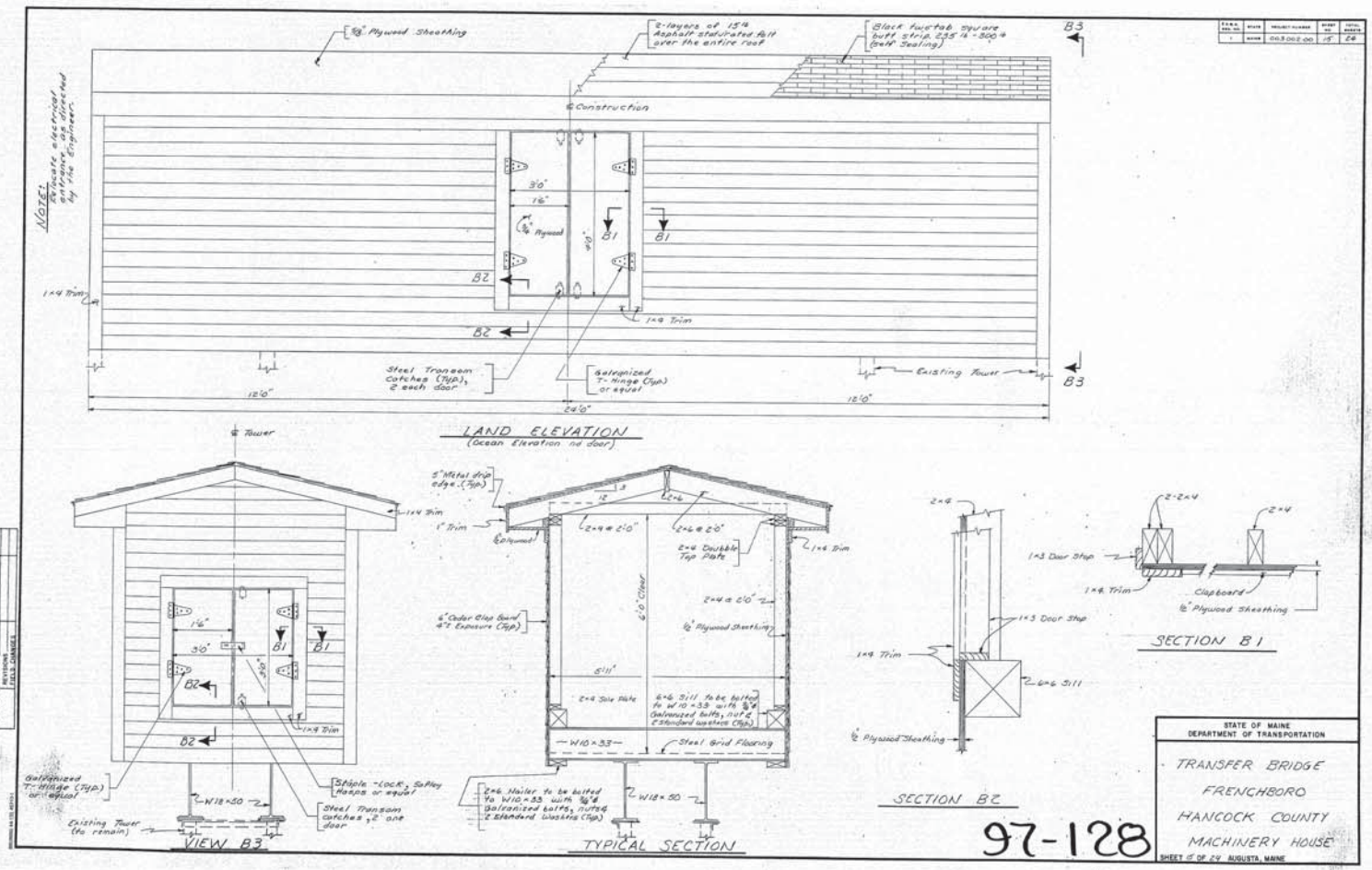
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

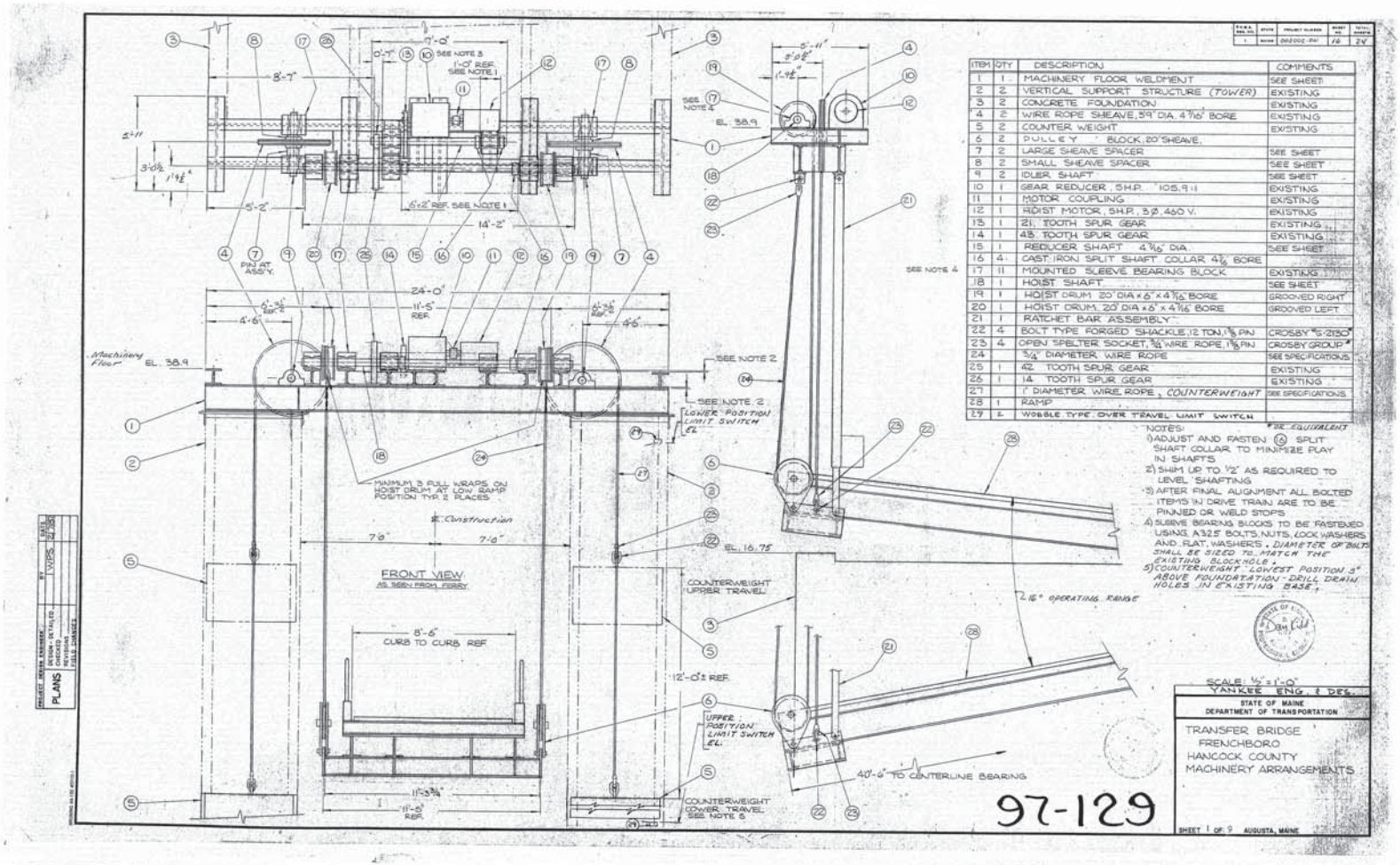
TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY
BRIDGE

SHEET 12 OF 24 AUGUSTA, MAINE


See Detail W17
W11 6"
L8 54×9.5
Existing Tower
See Detail W14
23'4 6"
64"
See Detail W2
C3×6
See Detail W1
10'3"
See Detail W6
C3×6
See Detail W5
See Detail W3
El. 16.75
Existing tower base
Existing Ground
4-F551 Equally Spaced
E-F552 @ 18"
E-F550 @ 18"
El. 11.75
12'10"
ELEVATION NEW TOWER BRACE
4-1" ø ½ x 4" x 2'0" Conc. each end both towers
6" Gusset PL cut to fit in field
W.1
Near face of existing tower Leg
6" Gusset PL
C3×6
W2
W4
W6
½" Gusset PL
W3
MATERIALS
All ASTM A36 (Painted)
⅞" ø holes
Note: Holes in W18 x 50 to be field drilled as approved by the Engineer.
℄ Tower
⅞" ø x 8" x 5'-1" (4 Req'd, Each Tower)
2'6½"
8"
14"
14"
16"
37'
℄ New brace outboard both towers
PLAN TOP OF TOWER
4-1" ø x 4" x 2'0" PL (1 each end of tower)
Existing to remain (Typ.)
ELEVATION TOP OF TOWER
2 Hex nuts & Standard Washer ANSI B27.2 Type AW
2" projection, 1¾" threaded
1" Neoprene Pad
WT 9×43
(Typ.)
1" Clear
Footing
1" ø Swedge Anchor Bolt, 15" Embedment (Typ.)
W5
30"
16"
16"
14"
18"
18"
⅞" ø holes
2'6"
℄ brace
16"
3'0"
16"
WT 9×43
5"
FOOTING PLAN
PROJECT WORK ENDEAVOR
PLANS
DESIGN - DETAILED
CHECKED
REVISED
FIELD CHANGES
BY
DATE
STATE
PROJECT NUMBER
SHEET NO.
TOTAL SHEETS
0658002-00
13
14
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY
TOWER MODIFICATIONS
SHEET 13 OF 14 AUGUSTA, MAINE
97-126


Machine room flooring Reliance 1-82 1⅛"-6½" or equal (to be shop fitted and welded, necessary openings required for cables to be field cut as approved by the Engineer.
Existing Tower (to remain)
Existing concrete base (to remain)
SIDE ELEVATION ACCESS LADDER
PARTIAL FRONT VIEW
TYPICAL LADDER RUNG DETAIL
VIEW C1
SECTION B1
SECTION A1
MATERIALS
ASTM A36 (Painted)
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY
ACCESS LADDER
SHEET 19 OF 24 AUGUSTA, MAINE
97-127


5/8" Plywood Sheathing
2-layers of 15# Asphalt saturated felt over the entire roof
Black fiberglass square butt strip. 235 lb - 300 lb (Self Sealing)
B3
NOTE: Evaluate electrical entrance as directed by the Engineer.
Construction
36"
16"
3/4" Plywood
6'0"
B1
B2
1x4 Trim
Steel Transom catches (Typ.), 2 each door
Galvanized T- Hinge (Typ.) or equal
Existing Tower
12'0"
24'0"
LAND ELEVATION
(Ocean Elevation no door)
Tower
5" Metal drip edge. (Typ.)
1" Trim
Plywood
2x4 @ 2'0"
2x4 Double Top Plate
1x6 Trim
6" Cedar Clap Board 4" Exposure (Typ.)
1/2" Plywood Sheathing
6'0" Clear
5'11"
2x4 Sole Plate
6x6 Sill to be bolted to W10 x 33 with 3/4" Galvanized bolts, nuts & 2 Standard washers (Typ.)
W10 x 33
Steel Grid Flooring
2x6 Nailer to be bolted to W10 x 33 with 3/4" Galvanized bolts, nuts & 2 Standard Washers (Typ.)
W18 x 50
TYPICAL SECTION
Galvanized T- Hinge (Typ.) or equal
Staple - LOCK, Safety Hasps or equal
Steel Transom catches, 2 one door
Existing Tower (to remain)
VIEW B3
2x6
1x3 Door Stop
1x4 Trim
6x6 Sill
SECTION B2
2-2x4
2x4
Clapboard
1/2" Plywood Sheathing
SECTION B1
PROJECT: BRIDGE TRANSFER
PLANS
DESIGN DETAILED
CHECKED
QUANTITIES
FIELD CHANGES
SCALE: 1"=20'
DATE: 5-97
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY
MACHINERY HOUSE
97-128
SHEET 15 OF 24 AUGUSTA, MAINE



ITEM	QTY	DESCRIPTION	COMMENTS
1	1	MACHINERY FLOOR WELDMENT	SEE SHEET
2	2	VERTICAL SUPPORT STRUCTURE (TOWER)	EXISTING
3	2	CONCRETE FOUNDATION	EXISTING
4	2	WIRE ROPE SHEAVE, 39" DIA. 4 7/16" BORE	EXISTING
5	2	COUNTER WEIGHT	EXISTING
6	2	PULLEY BLOCK, 20" SHEAVE,	
7	2	LARGE SHEAVE SPACER	SEE SHEET
8	2	SMALL SHEAVE SPACER	SEE SHEET
9	2	IDLER SHAFT	SEE SHEET
10	1	GEAR REDUCER, 5 H.P. 105.9:1	EXISTING
11	1	MOTOR COUPLING	EXISTING
12	1	HOIST MOTOR, 5 H.P., 3 Ø, 460 V.	EXISTING
13	1	21 TOOTH SPUR GEAR	EXISTING
14	1	48 TOOTH SPUR GEAR	EXISTING
15	1	REDUCER SHAFT 4 7/16" DIA.	SEE SHEET
16	4	CAST IRON SPLIT SHAFT COLLAR 4 7/16" BORE	
17	11	MOUNTED SLEEVE BEARING BLOCK	EXISTING
18	1	HOIST SHAFT	SEE SHEET
19	1	HOIST DRUM 20" DIA x 6" x 4 7/16" BORE	GROOVED RIGHT
20	1	HOIST DRUM, 20" DIA x 6" x 4 7/16" BORE	GROOVED LEFT
21	1	RATCHET BAR ASSEMBLY	
22	4	BOLT TYPE FORGED SHACKLE, 12 TON, 1 1/8" PIN	CROSBY "S-2130"
23	4	OPEN SPELTER SOCKET, 3/4" WIRE ROPE, 1 1/8" PIN	CROSBY GROUP #
24		3/4" DIAMETER WIRE ROPE	SEE SPECIFICATIONS
25	1	42 TOOTH SPUR GEAR	EXISTING
26	1	14 TOOTH SPUR GEAR	EXISTING
27		1" DIAMETER WIRE ROPE, COUNTERWEIGHT	SEE SPECIFICATIONS
28	1	RAMP	
29	2	WOBBLE TYPE OVER TRAVEL LIMIT SWITCH	

OR EQUIVALENT

NOTES:
1) ADJUST AND FASTEN (6) SPLIT SHAFT COLLAR TO MINIMIZE PLAY IN SHAFTS.
2) SHIM UP TO 1/2" AS REQUIRED TO LEVEL SHAFTING.
3) AFTER FINAL ALIGNMENT ALL BOLTED ITEMS IN DRIVE TRAIN ARE TO BE PINNED OR WELD STOPS.
4) SLEEVE BEARING BLOCKS TO BE FASTENED USING A325 BOLTS, NUTS, LOCK WASHERS AND FLAT WASHERS. DIAMETER OF BOLTS SHALL BE SIZED TO MATCH THE EXISTING BLOCK HOLE.
5) COUNTERWEIGHT "LOWEST POSITION" ABOVE FOUNDATION - DRILL DRAIN HOLES IN EXISTING BASE.

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

YANKEE ENG. & DES.

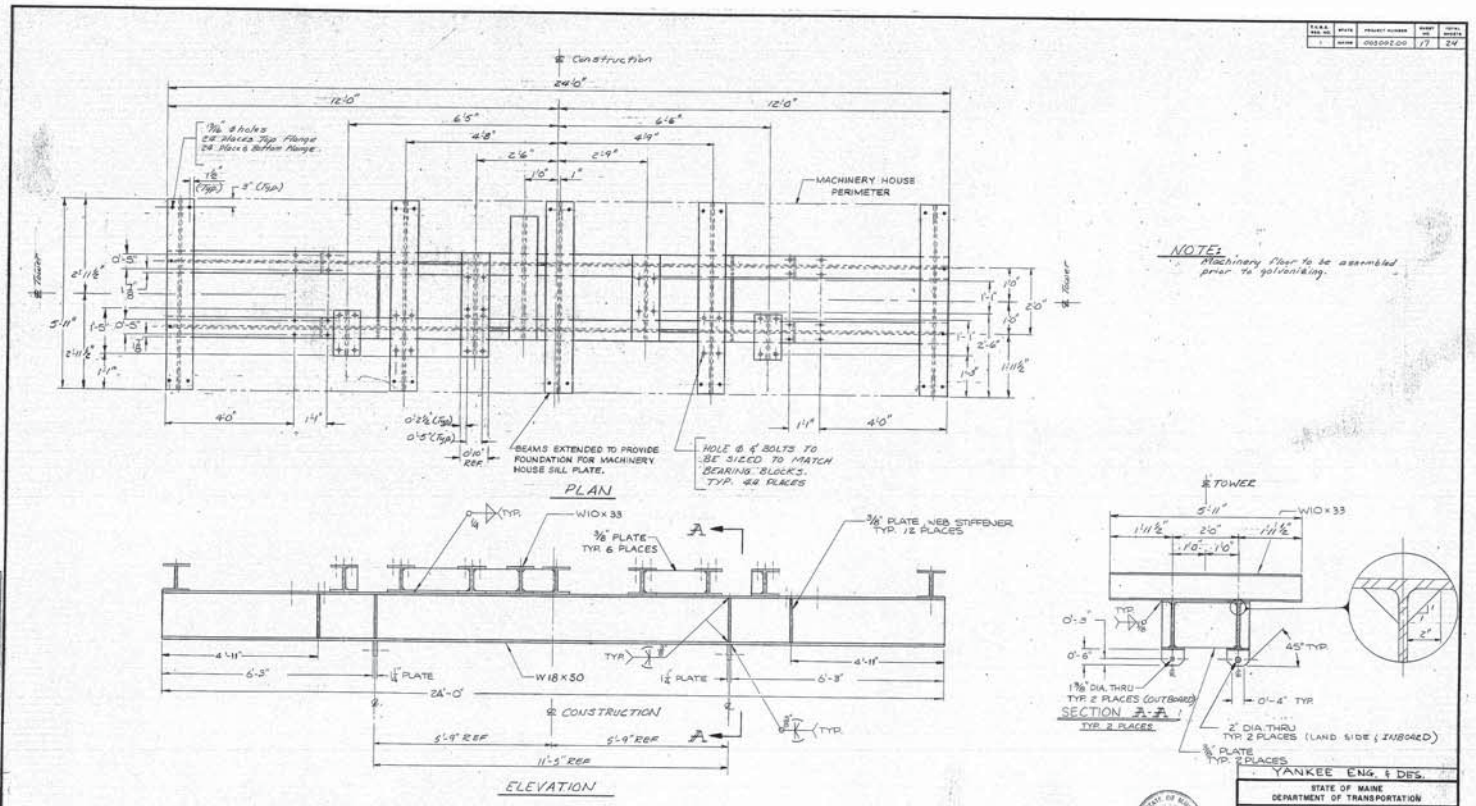
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY
MACHINERY ARRANGEMENTS

97-129

SHEET 1 OF 9 AUGUSTA, MAINE

PROJECT ENGR. ENGINEER: PLANS
DESIGN DETAILED: CHECKED: REVISIONS: FIELD CHANGES:
BY: WPS DATE: 2/98



T.I.N. & Seq. No.	State	Project Number	Sheet No.	Total Sheets
1	Maine	003092.00	17	24

PROJECT BEING REVIEWED
PLANS
DESIGN DETAILED
CHECKED
QUANTITIES
FIELD CHANGES
DATE
10/25/96

YANKEE ENG. & DES.

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY

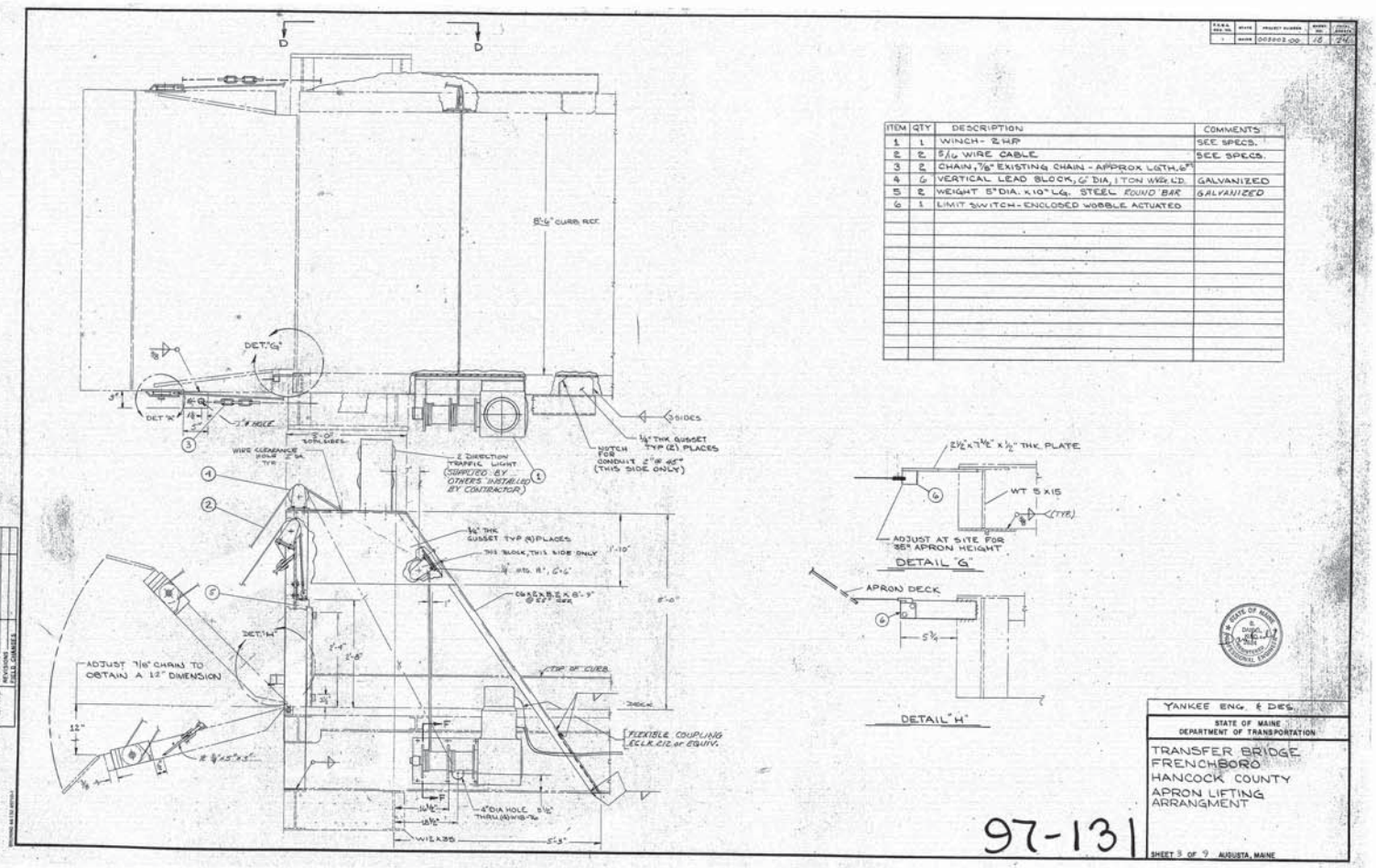
MACHINERY FLOOR
WELDMENT

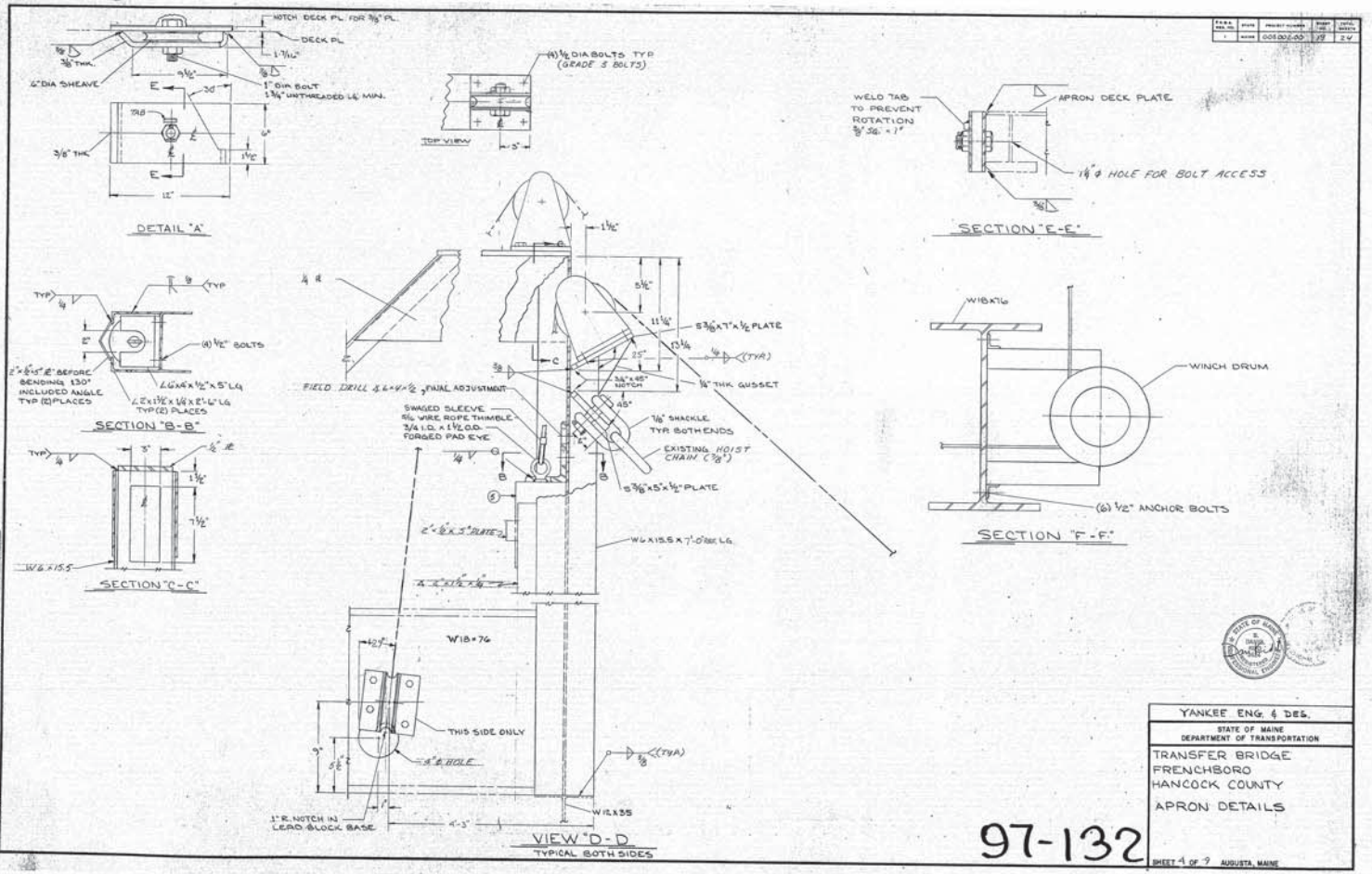
97-130

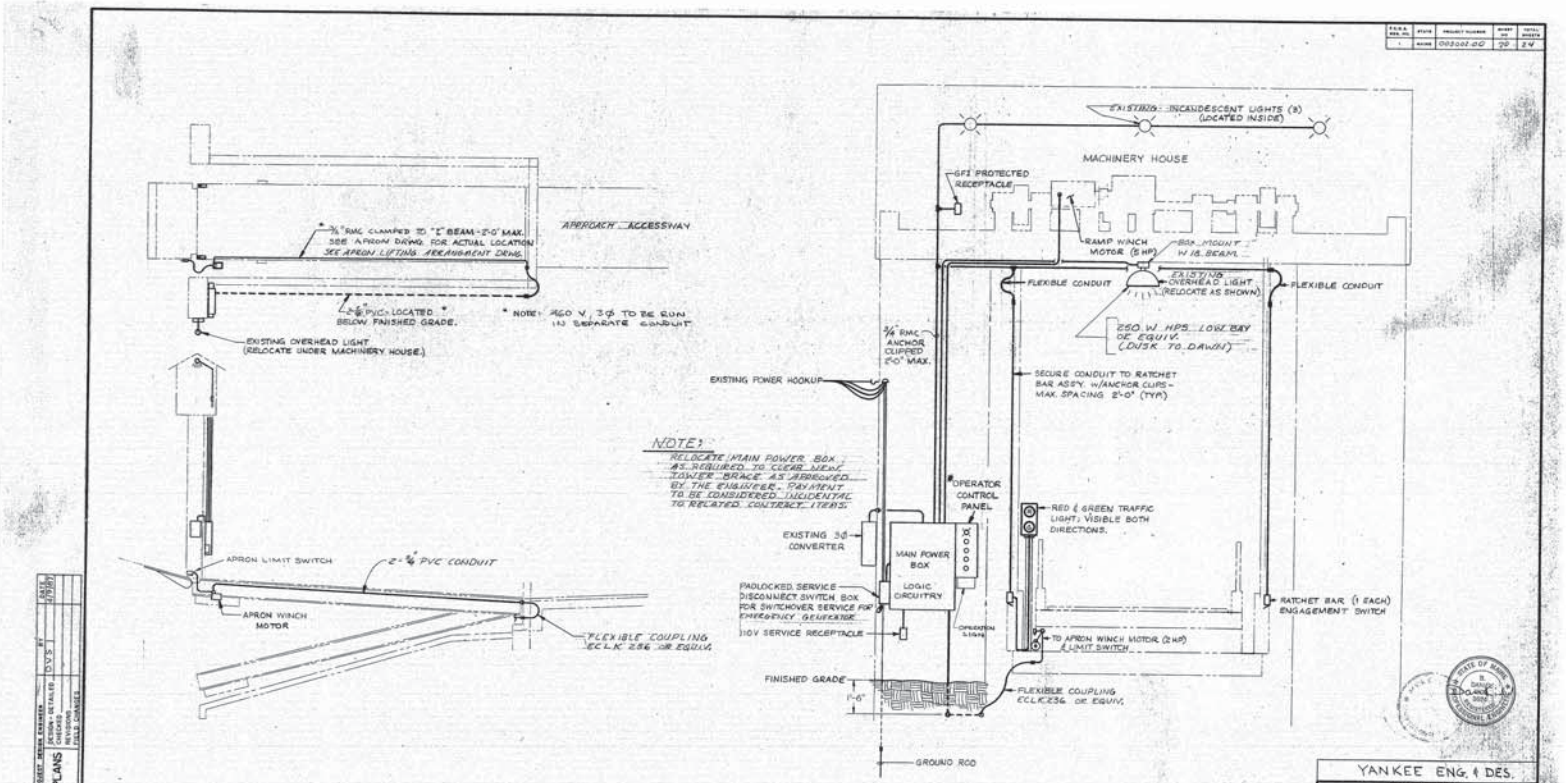
SCALE: ¾" = 1'-0"

SHEET 2 OF 9 AUGUSTA, MAINE

NOTE:
Machinery floor to be assembled prior to galvanizing.


D
D
8'-6" CURB REF.
DET. 'G'
DET. 'H'
SIDES
WIRE CLEARANCE PIPE 2" DIA.
2 DIRECTION TRAFFIC LIGHT (SUPPLIED BY OTHERS INSTALLED BY CONTRACTOR)
NOTCH FOR CONDUIT 2" Ø 45° (THIS SIDE ONLY)
½" THK GUSSET TYP (2) PLACES
½" THK GUSSET TYP (4) PLACES
THIS BLOCK, THIS SIDE ONLY
ADJUST 7/16" CHAIN TO OBTAIN A 12" DIMENSION
12"
TOP OF CURB
FLEXIBLE COUPLING (CLARK-REA or EQUIV.)
4" DIA HOLE 5½" THRU (6) W18-76
WIDTH
5'-3"
8'-0"
1'-10"
2'-4"
2'-8"
2'-6"
2½"
2½"
2½


NOTCH DECK PL. FOR 3/8" PL.
DECK PL.
6" DIA SHEAVE
1" DIA BOLT 1 3/4" UNTHREADED LG MIN.
3/8" THK.
DETAIL "A"
(4) 1/2 DIA BOLTS TYP (GRADE 5 BOLTS)
TOP VIEW
WELD TAB TO PREVENT ROTATION 3/8" SQ. x 1"
APRON DECK PLATE
1 1/8" ø HOLE FOR BOLT ACCESS
SECTION "E-E"
(4) 1/2" BOLTS
L6X4 x 1/2" x 5" LG
L 2" x 1 1/2" x 1/4" x 2'-6" LG TYP (2) PLACES
SECTION "B-B"
W6 x 15.5
SECTION "C-C"
FIELD DRILL & ø 1/2" FINAL ADJUSTMENT
SWAGED SLEEVE
5/8" WIRE ROPE THIMBLE
3/4 I.D. x 1 1/2 O.D. FORGED PAD EYE
5 3/8" x T" x 1/2 PLATE
3/4" x 45° NOTCH
1/8" THK. GUSSET
7/8" SHACKLE TYP BOTH ENDS
EXISTING HOIST CHAIN (7/8")
5 3/8" x 5" x 1/2" PLATE
W6 x 15.5 x 7'-0" LG.
W18 x 76
THIS SIDE ONLY
1" ø HOLE
1" R. NOTCH IN LEAD BLOCK BASE
W12 x 35
VIEW "D-D"
TYPICAL BOTH SIDES
W18x76
WINCH DRUM
(6) 1/2" ANCHOR BOLTS
SECTION "F-F"
PROJECT: MEDIA ENGINEER
DESIGN - DETAILED
CHECKED
REVISIONS
FIELD CHANGES
PLANS
YANKEE ENG. & DES.
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY
APRON DETAILS
97-132
SHEET 4 OF 9 AUGUSTA, MAINE



* OPERATOR CONTROL PANEL ; AS FOLLOWS:
1- GREEN INDICATOR LAMP (RATCHETS ENGAGED)
2- RAMP UP SWITCH
3- RAMP DOWN SWITCH
4- APRON UP SWITCH
5- APRON DOWN SWITCH
6. RATCHET RELEASE BUTTON
7. RED "WARN" BUTTON
8. GREEN "PROCEED" BUTTON

PROJECT REVIEW STAMPED BY: DVS
PLANS — DESIGN - DETAILED: DVS; CHECKED: ; REVISED: ; FIELD CHANGES: ; AS BUILT: 2/98

YANKEE ENG. & DES.

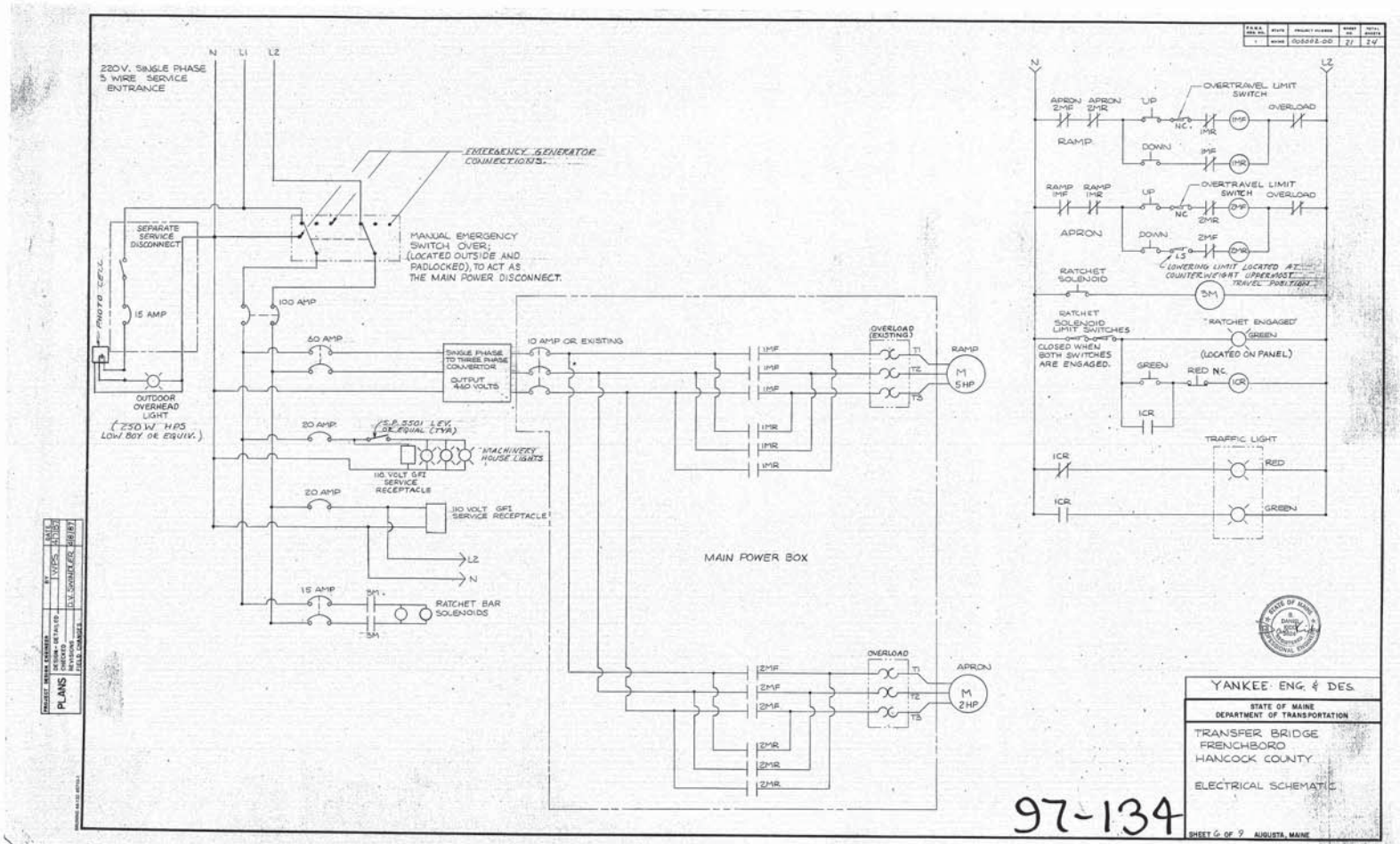
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY

ELECTRICAL LAYOUT PLAN

SHEET 5 OF 9 AUGUSTA, MAINE

97-133



PROJECT: MEDIA NUMBER
PLANS
DESIGN-DETAILED
CHECKED
QUANTITIES
FIELD CHANGES
BY: VOPS
DATE: 5/1/00
D.V. SCHNEIDER, 5/8/97

FHWA REG. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
1	MAINE	0058S2.00	21	24

YANKEE ENG. & DES.

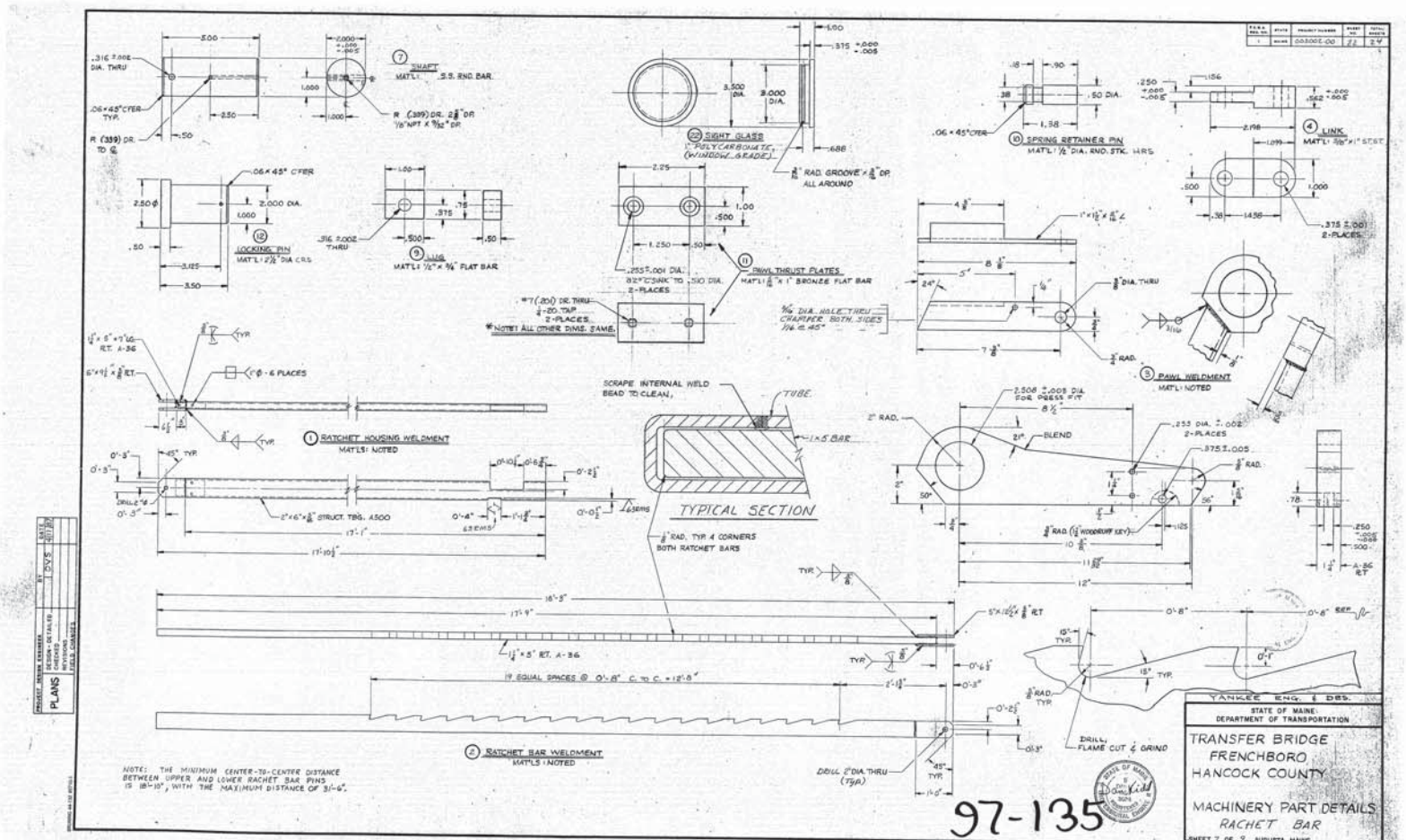
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

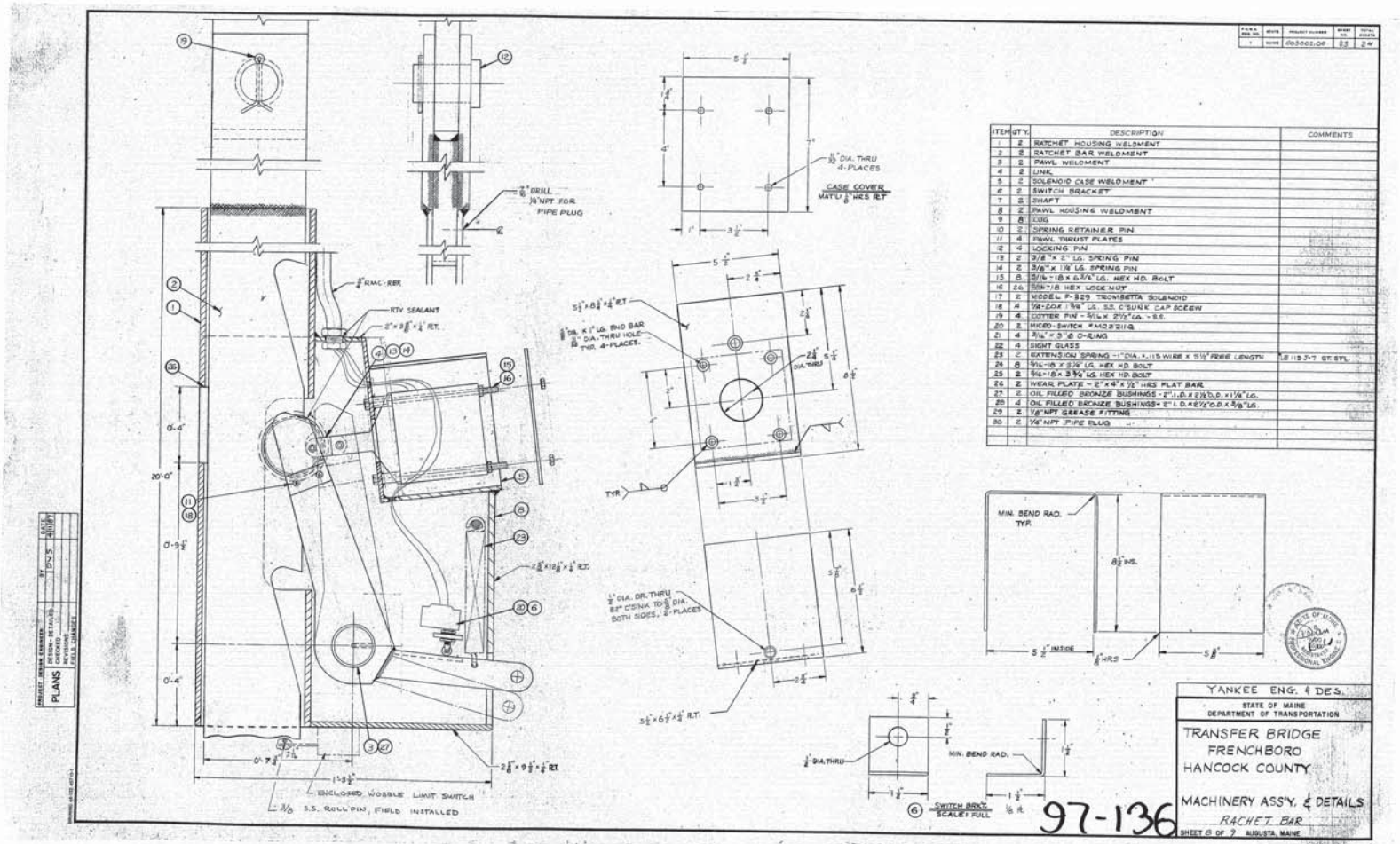
TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY

ELECTRICAL SCHEMATIC

97-134

SHEET 6 OF 9 AUGUSTA, MAINE


7 SHAFT MAT'L: S.S. RND. BAR.
20 SIGHT GLASS 1/4" POLYCARBONATE (WINDOW GRADE)
10 SPRING RETAINER PIN MAT'L: 1/2" DIA. RND. STK. HRS.
4 LINK MAT'L: 3/8" x 1" ST.ST.
12 LOCKING PIN MAT'L: 2 1/2" DIA CRS
9 LUG MAT'L: 1/2" x 3/4" FLAT BAR
11 PAWL THRUST PLATES MAT'L: 1/4" x 1" BRONZE FLAT BAR
3 PAWL WELDMENT MAT'L: NOTED
1 RATCHET HOUSING WELDMENT MAT'L'S: NOTED
TYPICAL SECTION
2 RATCHET BAR WELDMENT MAT'L'S NOTED
NOTE: THE MINIMUM CENTER-TO-CENTER DISTANCE BETWEEN UPPER AND LOWER RACHET BAR PINS IS 18'-10", WITH THE MAXIMUM DISTANCE OF 31'-6".
YANKEE ENG. & DES.
STATE OF MAINE: DEPARTMENT OF TRANSPORTATION
TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY
MACHINERY PART DETAILS
RACHET BAR
SHEET 7 OF 9 AUGUSTA, MAINE
97-135



ITEM	QTY.	DESCRIPTION	COMMENTS
1	2	RATCHET HOUSING WELDMENT	
2	2	RATCHET BAR WELDMENT	
3	2	PAWL WELDMENT	
4	2	LINK	
5	2	SOLENOID CASE WELDMENT	
6	2	SWITCH BRACKET	
7	2	SHAFT	
8	2	PAWL HOUSING WELDMENT	
9	8	CAM	
10	2	SPRING RETAINER PIN	
11	4	PAWL THRUST PLATES	
12	4	LOCKING PIN	
13	2	3/8" x 2" LG. SPRING PIN	
14	2	3/8" x 1 1/8" LG. SPRING PIN	
15	8	5/16"-18 x 6 3/4" LG. HEX HD. BOLT	
16	24	5/16"-18 HEX LOCK NUT	
17	2	MODEL P-329 TRONXBETTA SOLENOID	
18	4	1/4"-20 x 1 3/4" LG. S.S. C'SUNK CAP SCREW	
19	4	COTTER PIN - 5/16 x 2 1/2" LG. - S.S.	
20	2	MICRO-SWITCH #MD2211Q	
21	4	3 1/4" x 3 1/8" O-RING	
22	4	SIGHT GLASS	
23	2	EXTENSION SPRING - 1" DIA. x .115 WIRE x 5 1/2" FREE LENGTH	LE 113.7-T ST. STL.
24	8	5/16-18 x 2 3/8" LG. HEX HD. BOLT	
25	2	5/8-11 x 3 3/4" LG. HEX HD. BOLT	
26	2	WEAR PLATE - 8" x 4" x 1/2" HRS FLAT BAR	
27	2	OIL FILLED BRONZE BUSHINGS - 2" I.D. x 2 1/2 O.D. x 1 1/8" LG.	
28	4	OIL FILLED BRONZE BUSHINGS - 2" I.D. x 2 1/2 O.D. x 5/8" LG.	
29	2	1/8" NPT GREASE FITTING	
30	2	1/8" NPT PIPE PLUG	

P.W.N. REG. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
1	MAINE	005002.00	23	24

PROJECT: MEDIA ENGINEER — DESIGN: DETAILED — CHECKED — REVISIONS — FIELD CHANGES — DATE: 4/1/97 — BY: T.W.S.

PLANS

YANKEE ENG. & DES.

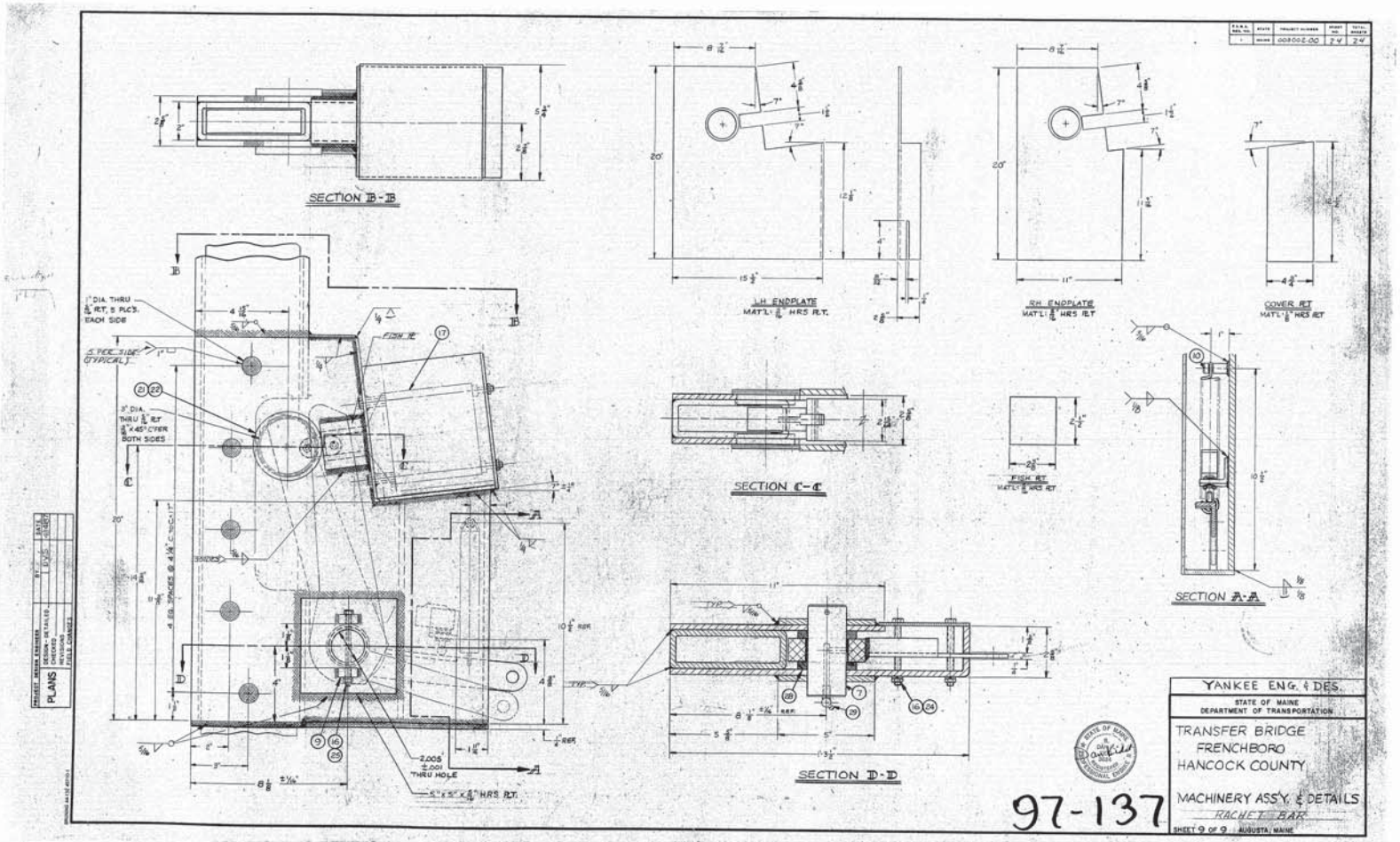
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY

MACHINERY ASS'Y. & DETAILS
RACHET BAR

SHEET 8 OF 9 AUGUSTA, MAINE

97-136


SECTION B-B
LH ENDPLATE
MAT'L 1/2 HRS PLT.
RH ENDPLATE
MAT'L 1/2 HRS PLT
COVER PLT
MAT'L 1/4 HRS PLT
SECTION C-C
FISH PLT
MAT'L 1/2 HRS PLT
SECTION A-A
SECTION D-D
1" DIA. THRU 5/8 PLT, 5 PLCS. EACH SIDE
5 PCS. SIDE (TYPICAL)
1" DIA. THRU 5/8 PLT 5/8"x45° CSK'R BOTH SIDES
4 EQ. SPACES @ 4 1/2" C TO C
2.005 ± .001 THRU HOLE
5"x5"x5/8" HRS PLT
PROJECT DESIGN ENGINEER
DESIGN - DETAILED
CHECKED
PLANS
FIELD CHANGES
YANKEE ENG. & DES.
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY
MACHINERY ASS'Y. & DETAILS
RACHET BAR
SHEET 9 OF 9 AUGUSTA, MAINE
97-137

APPENDIX 4.2— Field Measurements

Project Maine DOT LR's | Project # 55088.00
Location Frenchboro ME | Sheet 1 of 1
Calculated by TJC | Date 12/1/15
Checked by | Date
Title Site Visit Notes

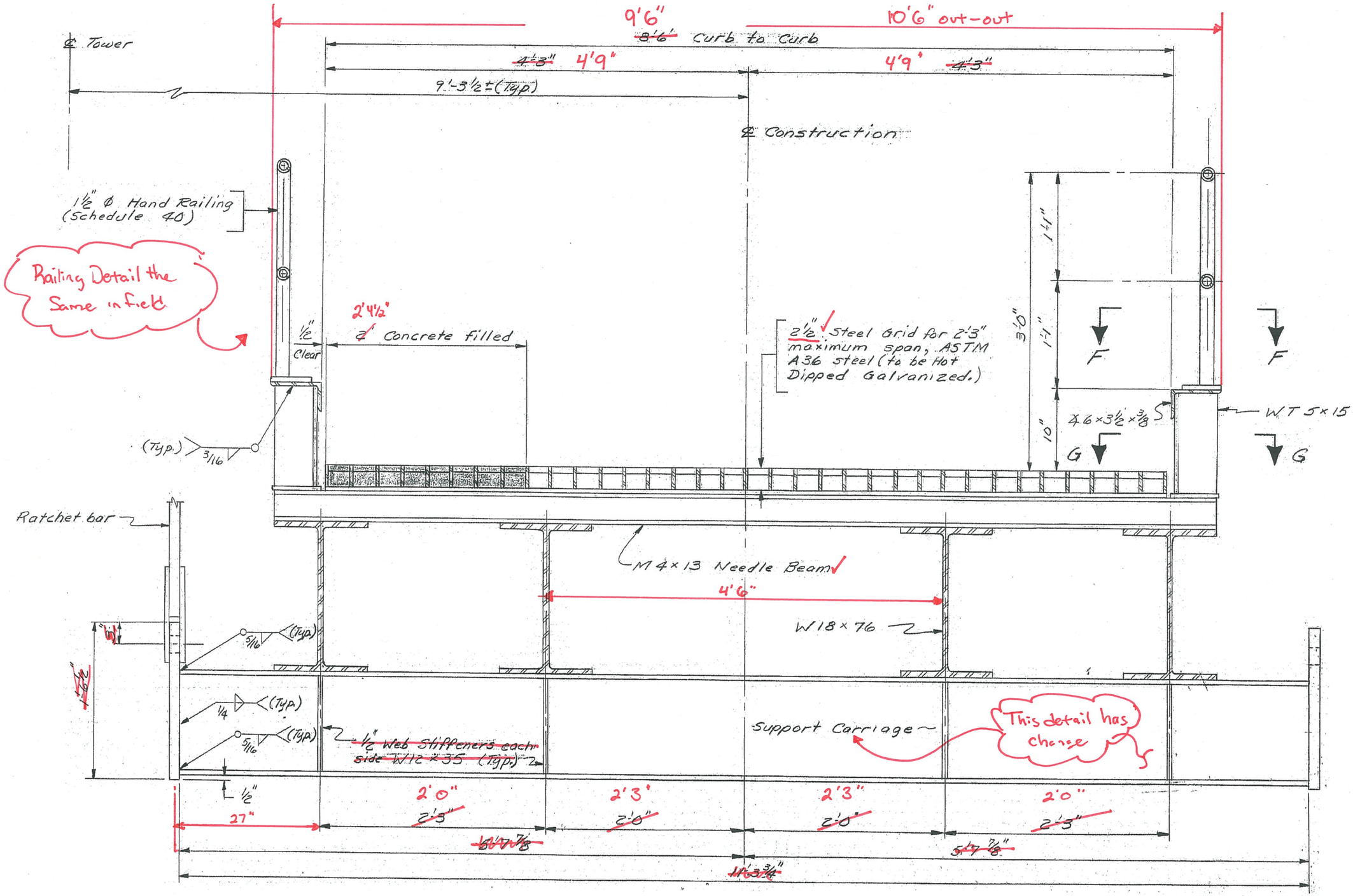
vhb Computations

Site Visit: 11/30/15

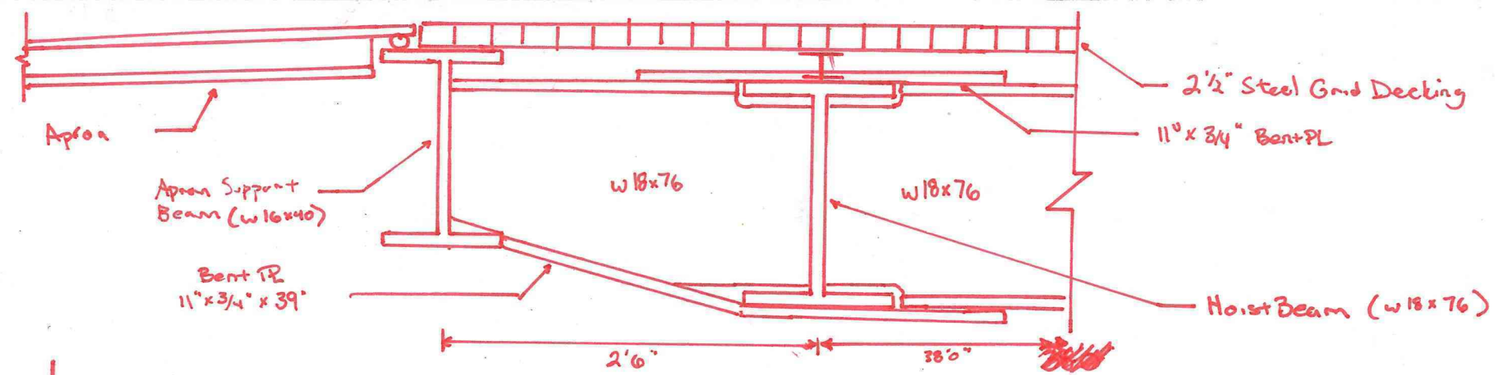
Frenchboro Ferry Transfer Bridge

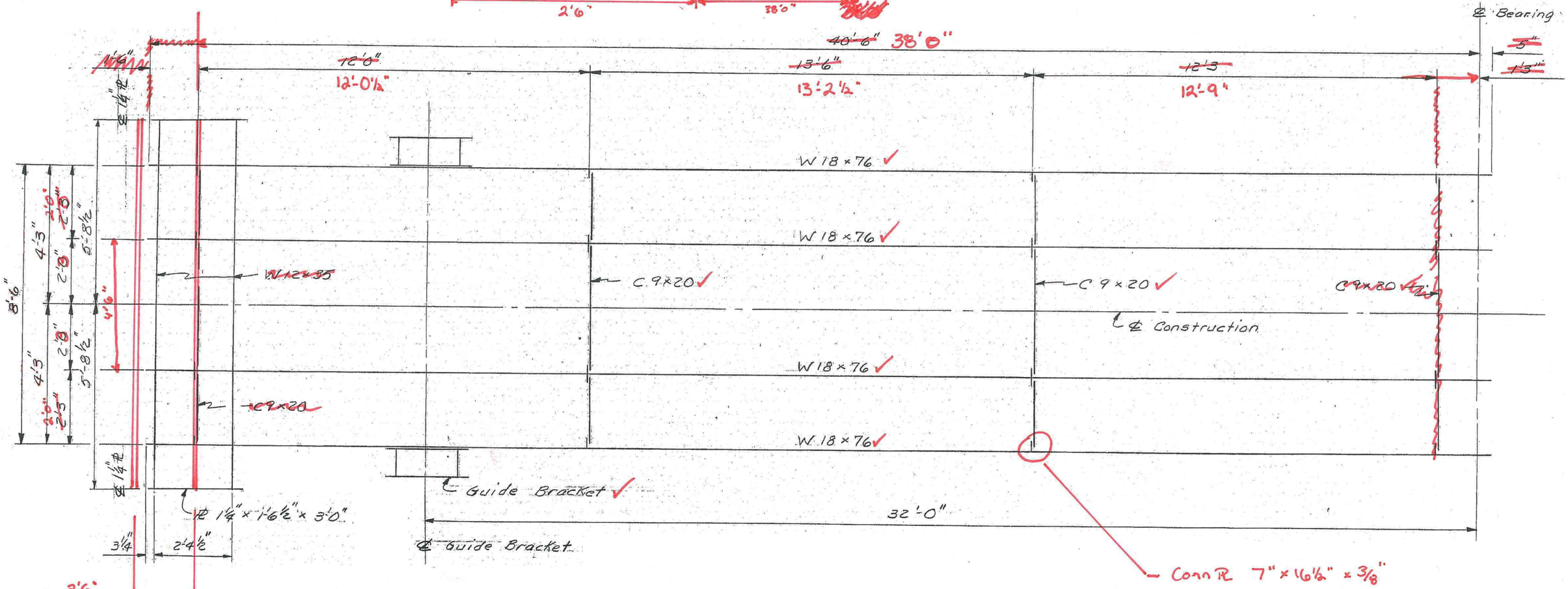
Notes & Observations:

- The main girder spacing and length no longer matches the design plans
- The girder length is now 38' and no longer rests directly at top of a hoist beam but instead connects directly to the Hoist Beam web
- The curb-to-curb is now 9'6"
- The "Jigsaw" support mechanism remains the same as design plans
- There is now an Apron Support beam which is supported by both the extension of girders from hoist beam and a 1¼" ℄ at the ends of the beam which also connects into the end of the hoist beam
- The Apron is 60'0" from hinge to hinge
- The main girders, diaphragms, needle beams all remain the same as the plans but the hoist beam & Apron Supp. beams are new
- The diaphragm spacing does not match plans
- The End Support at the bearings does not match plans but will have no effect on the Rating
- The Railing detail & curbing Remain the same
- The needle beam spacing remains the same



TYPICAL TRANSVERSE SECTION





FRAMING PLAN

Main Girder:
- $d = 18\frac{1}{8}", 18\frac{3}{32}"$
- $t_f = .709", .689", 11/16"$
- $b_f = 11"$
- $t_w = .54", .55"$

Assume W18x76 ✓

Needle Beam:
- $d = 4\frac{1}{4}"$
- $b_f = 4"$
- $t_f = 5/16", 3/8"$

Assume: W4x13 ✓

Hoist Beam:
- $d = 18\frac{3}{16}"$
- $b_f = 11"$
- $t_f = 5/8", 11/16"$

Assume: W18x76 ✓

Apron Supp. Beam:
- $d = 16"$
- $b_f = 7"$
- $t_f = ½"$

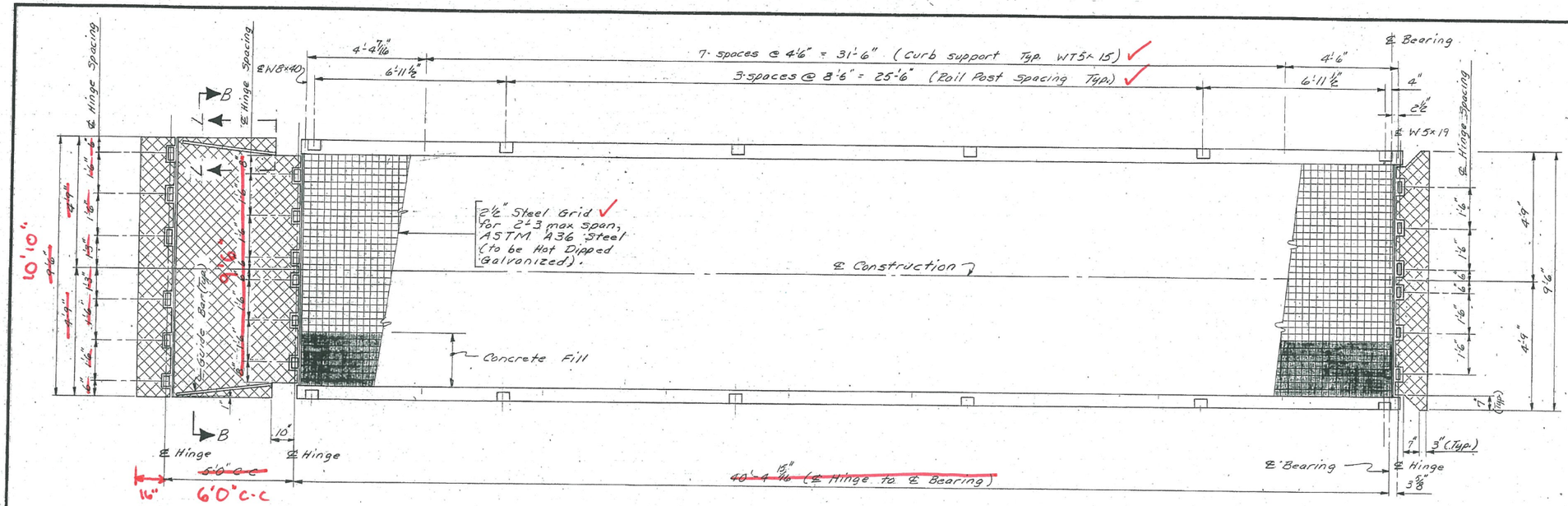
Assume: W16x40 ✓

F.H.W.A. REG. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
1	MAINE	003002.00	7	24

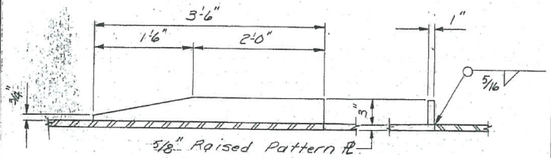
SUPERSTRUCTURE NOTES

1---Concrete fill for Superstructure will be paid for under Item 502.21, Structural Concrete Abutments & Retaining Walls.

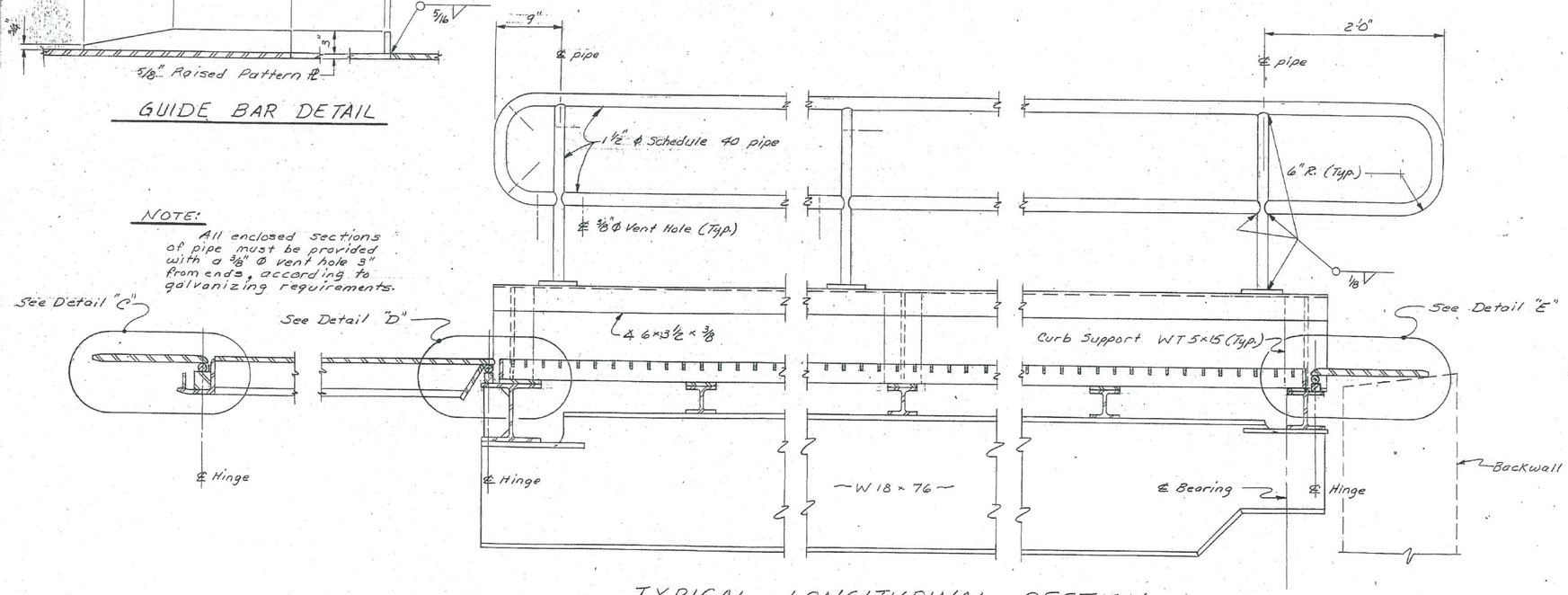
2---Protective Coating for concrete surfaces shall be applied to both surfaces of the concrete filled grid.



PLAN

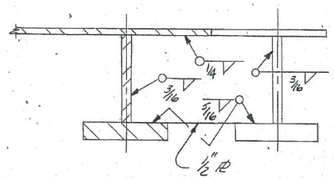


GUIDE BAR DETAIL



TYPICAL LONGITUDINAL SECTION

NOTE:
All enclosed sections of pipe must be provided with a 3/8" ϕ vent hole 3" from ends, according to galvanizing requirements.



SECTION L~L

PROJECT DESIGN ENGINEER	BY	DATE
DESIGN - DETAILED	MEB	1-87
CHECKED	RAC	3-87
REVISIONS	EAS	
FIELD CHANGES		

PLANS

BRUNING 44-132-45710-1

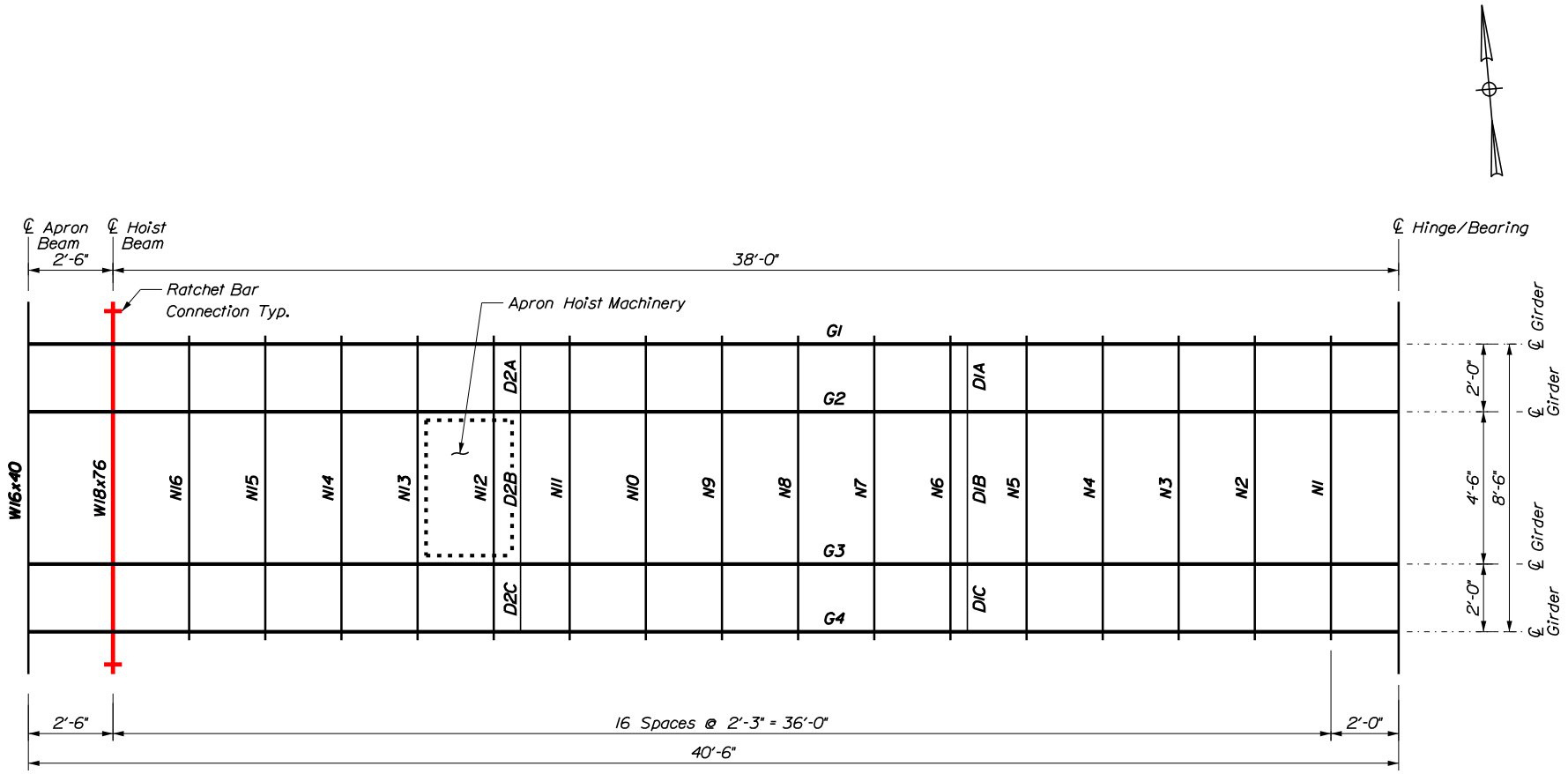
97-120

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

TRANSFER BRIDGE
FRENCHBORO
HANCOCK COUNTY
BRIDGE

SHEET 7 OF 24 AUGUSTA, MAINE

APPENDIX 4.3—Fracture Critical Member Inspection Plan



LEGEND

G = Girder (W18x76)
D = Diaphragm (C9x20)
N = Needle Beam (W4x13)
= Fracture Critical Member

FRAMING PLAN

N.T.S.

vhb

MAINE DEPARTMENT of TRANSPORTATION

BRIDGE No. 6340
Ferry Terminal
Frenchboro, Maine

FRACTURE CRITICAL MEMBER (FCM) IDENTIFICATION

Sheet: 1 of 1	Drawn: DPD	Checked: KJB	Date: 12/15/15

APPENDIX 4.4—Mechanical

Appendix 4.4.1—Mechanical Maintenance Check List

FRENCHBORO TRANSFER BRIDGE INSPECTION AND MAINTENANCE CHECKLIST (MECHANICAL)

By: _____ Date: _____

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

After every maintenance period:

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

Refer to lubrication drawings for equipment locations.

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

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

NOTES:

FRENCHBORO TRANSFER BRIDGE MAINTENANCE CHECKLIST (MECHANICAL)

1
MONTH

BRIDGE HOIST MACHINERY	Performed By	Date
REDUCER (CONE)		
Inspect for oil leaks.		
Inspect the oil level.		
Lubricate bearings.		
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.		
HOIST DRUM AND BEARING		
Lubricate drum shaft bearings		
WIRE ROPE AND DEFLECTOR SHEAVES		
Lubricate deflector sheave bearings.		
Ratchet Bar Assembly		
Lubricate pawl shaft bearings.		

BRIDGE COUNTERWEIGHT SYSTEM	Performed By	Date
Lubricate sheave bearings.		

APRON HOIST MACHINERY	Performed By	Date
REDUCER (CONE)		
Inspect for oil leaks.		

Inspect the oil level.		
Lubricate bearings.		
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.		
WIRE ROPE AND DEFLECTOR SHEAVES		
Lubricate deflector sheave bushings.		
MISCELLANEOUS		
Lubricate apron bearings.		

FRENCHBORO TRANSFER BRIDGE MAINTENANCE CHECKLIST (MECHANICAL)	3
	MONTH

BRIDGE HOIST MACHINERY	Performed By	Date
DISC BRAKES (Stearns)		
Inspect all bolts for rust, corrosion and tightness.		
ELECTRIC MOTORS (Reuland)		
Inspect mounting bolts for rust, corrosion and tightness.		
REDUCER (CONE)		
Inspect mounting bolts for rust, corrosion and tightness.		
Inspect all flange, seal carrier and bearing cover bolts for tightness.		
Inspect for oil leaks.		
Inspect the oil level.		
Lubricate bearings.		
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.		
HOIST DRUM AND BEARING		
Inspect all external bolts for tightness.		
Inspect drum shaft journal bearing housings and mounting bolts for rust, corrosion and tightness.		
Lubricate drum shaft bearings		
WIRE ROPE AND DEFLECTOR SHEAVES		
Lubricate deflector sheave bearings.		

Ratchet Bar Assembly		
Lubricate pawl shaft bearings.		

BRIDGE COUNTERWEIGHT SYSTEM	Performed By	Date
Inspect sheave bearing housings and mounting bolts for for rust corrosion and tightness.		
Lubricate sheave bearings.		
Inspect equalizer pin assemblies for visual damage, as well as any rust or corrosion. Repaint any damaged areas.		
Lubricate equalizer pins.		
Inspect counterweight for plumbness and clearance with tower during travel. Adjust balance plate arrangement to eliminate excessive interference.		
Inspect counterweight box for corrosion or damage.		

APRON HOIST MACHINERY	Performed By	Date
DISC BRAKES (Stearns)		
Inspect all bolts for rust, corrosion and tightness.		
ELECTRIC MOTORS (Reuland)		
Inspect mounting bolts for rust, corrosion and tightness.		
REDUCER (CONE)		
Inspect mounting bolts for rust, corrosion and tightness.		
Inspect all flange and bearing cover bolts for tightness.		
Inspect for oil leaks.		
Inspect the oil level.		
Lubricate bearings.		
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.		

Inspect hoist drum for cracks, damage, corrosion or imprinting.		
WIRE ROPE AND DEFLECTOR SHEAVES		
Inspect wire ropes for damage or breaks, particularly at end connections.		
Inspect deflector sheaves for corrosion or other damage.		
Inspect deflector sheave rope grooves for wear or imprinting damage.		
Lubricate deflector sheave bushings.		
MISCELLANEOUS		
Inspect apron hinge for any damage and freedom of motion.		
Lubricate apron bearings.		

FRENCHBORO TRANSFER BRIDGE MAINTENANCE CHECKLIST (MECHANICAL)

6

MONTH

BRIDGE HOIST MACHINERY	Performed By	Date
DISC BRAKES (Stearns)		
Inspect all bolts for rust, corrosion and tightness.		
ELECTRIC MOTORS (Reuland)		
Inspect mounting bolts for rust, corrosion and tightness.		
REDUCER (CONE)		
Inspect mounting bolts for rust, corrosion and tightness.		
Inspect all flange, seal carrier and bearing cover bolts for tightness.		
Inspect for oil leaks.		
Inspect the oil level.		
Lubricate bearings.		
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.		
HOIST DRUM AND BEARING		
Inspect all external bolts for tightness.		
Inspect drum rope grooves for wear or imprinting damage.		
Inspect drum shaft journal bearing housings and mounting bolts for rust, corrosion and tightness.		
Lubricate drum shaft bearings		

WIRE ROPE AND DEFLECTOR SHEAVES		
Lubricate wire ropes.		
Inspect wire ropes for damage or breaks, particularly at end connections.		
Inspect deflector sheaves for cracks in hub, spokes and rim.		
Lubricate deflector sheave bearings.		
Inspect anchor assemblies for corrosion or damage.		
Ratchet Bar Assembly		
Inspect ratchet bars for deformation or other damage to teeth.		
Inspect ratchet bar connection pins and cotters.		
Lubricate pawl shaft bearings.		

BRIDGE COUNTERWEIGHT SYSTEM	Performed By	Date
Lubricate wire ropes.		
Inspect wire ropes for damage or breaks, particularly at end connections.		
Inspect sheaves for cracks in hub, spokes and rim.		
Inspect sheave rope grooves for wear or imprinting damage.		
Inspect sheave bearing housings and mounting bolts for for rust corrosion and tightness.		
Lubricate sheave bearings.		
Inspect equalizer pin assemblies for visual damage, as well as any rust or corrosion. Repaint any damaged areas.		
Lubricate equalizer pins.		
Inspect counterweight for plumbness and clearance with tower during travel. Adjust balance plate arrangement to eliminate excessive interference.		
Inspect counterweight box for corrosion or damage.		

APRON HOIST MACHINERY	Performed By	Date
DISC BRAKES (Stearns)		
Inspect all bolts for rust, corrosion and tightness.		
ELECTRIC MOTORS (Reuland)		
Inspect mounting bolts for rust, corrosion and tightness.		
REDUCER (CONE)		
Inspect mounting bolts for rust, corrosion and tightness.		
Inspect all flange and bearing cover bolts for tightness.		
Inspect for oil leaks.		
Inspect the oil level.		
Lubricate bearings.		
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.		
Inspect hoist drum for cracks, damage, corrosion or imprinting.		
WIRE ROPE AND DEFLECTOR SHEAVES		
Lubricate wire ropes.		
Inspect wire ropes for damage or breaks, particularly at end connections.		
Inspect deflector sheaves for corrosion or other damage.		
Inspect deflector sheave rope grooves for wear or imprinting damage.		
Lubricate deflector sheave bushings.		
MISCELLANEOUS		
Inspect apron hinge for any damage and freedom of motion.		
Lubricate apron bearings.		

FRENCHBORO TRANSFER BRIDGE MAINTENANCE CHECKLIST (MECHANICAL)

12

MONTH

BRIDGE HOIST MACHINERY	Performed By	Date
DISC BRAKES (Stearns)		
Inspect all bolts for rust, corrosion and tightness.		
Check friction disc clearance, adjust if necessary.		
Inspect condition of friction discs and measure thickness, replace if necessary.		
ELECTRIC MOTORS (Reuland)		
Inspect mounting bolts for rust, corrosion and tightness.		
Lubricate motor bearings.		
REDUCER (CONE)		
Inspect mounting bolts for rust, corrosion and tightness.		
Inspect all flange, seal carrier and bearing cover bolts for tightness.		
Inspect for oil leaks.		
Inspect the oil level.		
Change oil. *Note: Send oil sample for testing, change per test recommendations*		
Lubricate bearings.		
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.		
HOIST DRUM AND BEARING		
Inspect all external bolts for tightness.		

Inspect drum rope grooves for wear or imprinting damage.		
Inspect drum shaft journal bearing housings and mounting bolts for rust, corrosion and tightness.		
Lubricate drum shaft bearings		
WIRE ROPE AND DEFLECTOR SHEAVES		
Lubricate wire ropes.		
Inspect wire ropes for damage or breaks, particularly at end connections.		
Inspect deflector sheaves for cracks in hub, spokes and rim.		
Lubricate deflector sheave bearings.		
Inspect anchor assemblies for corrosion or damage.		
Ratchet Bar Assembly		
Inspect ratchet bars for deformation or other damage to teeth.		
Inspect ratchet bar connection pins and cotters.		
Lubricate pawl shaft bearings.		
Open access cover and inspect ratchet mechanism internal operating components.		

BRIDGE COUNTERWEIGHT SYSTEM	Performed By	Date
Lubricate wire ropes.		
Inspect wire ropes for damage or breaks, particularly at end connections.		
Inspect sheaves for cracks in hub, spokes and rim.		
Inspect sheave rope grooves for wear or imprinting damage.		
Inspect sheave bearing housings and mounting bolts for for rust corrosion and tightness.		
Lubricate sheave bearings.		
Inspect equalizer pin assemblies for visual damage, as well as any rust or corrosion. Repaint any damaged areas.		
Lubricate equalizer pins.		

Inspect counterweight for plumbness and clearance with tower during travel. Adjust balance plate arrangement to eliminate excessive interference.		
Inspect counterweight box for corrosion or damage.		

APRON HOIST MACHINERY	Performed By	Date
DISC BRAKES (Stearns)		
Inspect all bolts for rust, corrosion and tightness.		
Check friction disc clearance, adjust if necessary.		
Inspect condition of friction discs and measure thickness, replace if necssary.		
ELECTRIC MOTORS (Reuland)		
Inspect mounting bolts for rust, corrosion and tightness.		
Lubricate motor bearings.		
REDUCER (CONE)		
Inspect mounting bolts for rust, corrosion and tightness.		
Inspect all flange and bearing cover bolts for tightness.		
Inspect for oil leaks.		
Inspect the oil level.		
Change oil. *Note: Send oil sample for testing, change per test recommendations*		
Lubricate bearings.		
Critically observe the reducer through several operational cycles. Look for unintentional movements and listen for abnormal noises.		
Inspect hoist drum for cracks, damage, corrosion or imprinting.		
WIRE ROPE AND DEFLECTOR SHEAVES		
Lubricate wire ropes.		
Inspect wire ropes for damage or breaks, particularly at end connections.		

Inspect deflector sheaves for corrosion or other damage.		
Inspect deflector sheave rope grooves for wear or imprinting damage.		
Lubricate deflector sheave bushings.		
MISCELLANEOUS		
Inspect apron hinge for any damage and freedom of motion.		
Lubricate apron bearings.		

Appendix 4.4.2—Mechanical Spare Parts List

MECHANICAL SPARE PARTS LIST

Item	QTY	Manufacturer	Catalog #	Description	Location
WORM REDUCER	1	CONE DRIVE	MU80-1	DOUBLE ENVELOPING WORM, 5 HP @ 900 RPM INPUT, ???:1 RATIO	BRIDGE HOIST
BRIDGE HOIST ROPE ASSEMBLY	1	WIREROPE WORKS	N/A	3/4” DIA., 6X41 WARRINGTON SEALE, IWRC, RIGHT REGULAR, 23.8 TON NOMINAL STRENGTH**, CLASS B GALVANIZED, SPELTER SOCKET ON ONE END	BRIDGE HOIST
BRIDGE COUNTERWEIGHT ROPE ASSEMBLY	1	WIREROPE WORKS	N/A	1” DIA., 6X41 WARRINGTON SEALE, IWRC, RIGHT REGULAR, 511.7 TON NOMINAL STRENGTH**, CLASS B GALVANIZED, SPELTER SOCKETS ON BOTH ENDS	BRIDGE COUNTERWEIGHT
WORM REDUCER	1	CONE DRIVE	SMU40-1	DOUBLE ENVELOPING WORM, 1.87 HP @ 1750 RPM INPUT, 200:1 RATIO	APRON HOIST
APRON HOIST ROPE ASSEMBLY	1	WIREROPE WORKS	N/A	5/16” DIA., 6X41 WARRINGTON SEALE, IWRC, RIGHT REGULAR, 5.27 TON NOMINAL STRENGTH**, CLASS B GALVANIZED, SPELTER SOCKET ON ONE END	APRON HOIST

** WIRE ROPE NOMINAL STRENGTH SHOWN IS BEFORE GALVANIZING

Appendix 4.4.3—Mechanical Equipment Vendor List

MECHANICAL EQUIPMENT VENDOR LIST

Component	Manufacturer	Vendor
APRON HOIST MACHINERY		
Reducer	**Cone Drive Service Center** 240 E. 12th Street Traverse City, MI 49685 P: (888)726-2663 Website: www.conedrive.com	Motion Industries 216 Perry Road Bangor, ME, 04401 P: (207)942-5571 F: (207)942-4738 Website: www.motionindustries.com
Brake	**Stearns (a Division of Rexnord)** 5150 S. International Drive Cudahy, WI 53110 P: (414)277-4363 Website: www.rexnord.com	Motion Industries 216 Perry Road Bangor, ME, 04401 P: (207)942-5571 F: (207)942-4738 Website: www.motionindustries.com
Operating Rope	**Wirerope Works, Inc.** 100 Maynard Street Williamsport PA 17701 P: (800)541-7673 P: (570)326-5146 Website: www.wwwrope.com	I & I Sling 1400 Providence Highway Bldg 3 – Suite 3000 Norwood, MA 02062 P: (781)575-0600 Website: www.iandisling.com
Deflector Sheave	**The Crosby Group** 2801 Dawson Rd. Tulsa, OK 74110 P: (918) 834-4611 Website: www.thecrosbygroup.com	I & I Sling 1400 Providence Highway Bldg 3 – Suite 3000 Norwood, MA 02062 P: (781)575-0600 Website: www.iandisling.com

MECHANICAL EQUIPMENT VENDOR LIST

Component	Manufacturer	Vendor
BRIDGE HOIST MACHINERY		
Reducer	**Cone Drive Service Center** 240 E. 12th Street Traverse City, MI 49685 P: (888)726-2663 Website: www.conedrive.com	Motion Industries 216 Perry Road Bangor, ME, 04401 P: (207)942-5571 F: (207)942-4738 Website: www.motionindustries.com
Brake	**Stearns (a Division of Rexnord)** 5150 S. International Drive Cudahy, WI 53110 P: (414)277-4363 Website: www.rexnord.com	Motion Industries 216 Perry Road Bangor, ME, 04401 P: (207)942-5571 F: (207)942-4738 Website: www.motionindustries.com
Drum Shaft Bearing	**Custom Fabrication**	Machine Shop
Operating Rope	**Wirerope Works, Inc.** 100 Maynard Street Williamsport PA 17701 P: (800)541-7673 P: (570)326-5146 Website: www.wwwrope.com	I & I Sling 1400 Providence Highway Bldg 3 – Suite 3000 Norwood, MA 02062 P: (781)575-0600 Website: www.iandisling.com

MECHANICAL EQUIPMENT VENDOR LIST

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

MECHANICAL EQUIPMENT VENDOR LIST

Component	Manufacturer	Vendor
BRIDGE COUNTERWEIGHT MACHINERY		
Sheave	**The Crosby Group** 2801 Dawson Rd. Tulsa, OK 74110 P: (918) 834-4611 Website: www.thecrosbygroup.com	I & I Sling 1400 Providence Highway Bldg 3 – Suite 3000 Norwood, MA 02062 P: (781)575-0600 Website: www.iandisling.com
Sheave Bearings	**Custom Fabrication**	Machine Shop
Counterweight Rope	**Wirerope Works, Inc.** 100 Maynard Street Williamsport PA 17701 P: (800)541-7673 P: (570)326-5146 Website: www.wwwrope.com	I & I Sling 1400 Providence Highway Bldg 3 – Suite 3000 Norwood, MA 02062 P: (781)575-0600 Website: www.iandisling.com
Rope Sockets	**The Crosby Group** 2801 Dawson Rd. Tulsa, OK 74110 P: (918) 834-4611 Website: www.thecrosbygroup.com	I & I Sling 1400 Providence Highway Bldg 3 – Suite 3000 Norwood, MA 02062 P: (781)575-0600 Website: www.iandisling.com

Appendix 4.4.4—Mechanical Equipment Nameplate Table

MECHANICAL EQUIPMENT NAMEPLATE DATA

APRON HOIST MACHINERY

Reducer ESTIMATED

Manufacturer:	Cone Drive
Model No.:	MU35
Remarks:	Embossed on main casting is "35G3V", Embossed on back cover is "35-71"

Motor

Manufacturer:	Baldor
Serial No.:	F0701300253
Spec. No.:	35L615T098H2
HP:	3
RPM:	1750
Frame:	145TDZ
Housing:	TEFC
Power Factor:	78
Code:	M
Design:	A
Time Rating:	40°C Continuous
S.F.:	1.0

Brake

Manufacturer:	Stearns (Rexnord)
Model No.:	1056132Q0B0F
Serial No.:	04791H001-00001-0307
Torque:	10 ft-lb
Rev.:	B
Mounting:	Universal

Operating Rope ESTIMATED

Manufacturer:	Unknown
Diameter:	5/16"
Description:	6x41 Warrington-Seale construction, galvanized, extra improved plow steel (XIPS), independent wire rope core (IWRC), right regular lay, 5.27 ton minimum breaking strength with one end clamped to drum and tension counterweight installed on free end

Deflector Sheave ESTIMATED

Manufacturer:	Unknown
Pitch Diameter:	6"
Bore Diameter:	1" (nominal)
Bore Type:	Bronze with Oil Grooves
Rope Diameter:	5/16"

MECHANICAL EQUIPMENT NAMEPLATE DATA

BRIDGE HOIST MACHINERY

Motor

Manufacturer:	Reuland
Serial No.:	898295A-1
Production No.:	0050F-1BAB-2
HP:	5
RPM:	900
Frame:	254U
Housing:	TENV
Code:	K
Insulation:	B
Style:	AEL
Time Rating:	30 Minutes

Brake

Manufacturer:	Reuland
Model No.:	29B6
Serial No.:	N0H050407A-1
Type:	OLDA
Torque:	35 ft-lb
Power:	203-3-60, 0.8 Amps
Ins.:	B
Product No.:	0LDA-H16N10BB30

Reducer ESTIMATED

Manufacturer:	Cone Drive (Supplied by Thern, Inc. - See Drum Support Frame Info)
Model No.:	MU80-1
Remarks:	Embossed on main casting is "80G3", Embossed on front plate casting is "87-G32", Embossed on bearing seal and cover is "80-70" Embossed on worm cap is "80-27B"

Drum Support Frame

Manufacturer:	Thern Inc. 5712 Industrial Park Rd. Winona, MN 55987 507-454-2996
Model No.:	4HW80-S70
Serial No.:	40900691
Code:	MT89-143
Load Rating:	First layer 5,900 pounds

Limit Switch on Drum

Manufacturer:	Furnas
Cat. No.:	54BB23EE
Ratio:	18:01
Enclosure:	4
	2SPDT

MECHANICAL EQUIPMENT NAMEPLATE DATA

Operating Rope[ESTIMATED]

Manufacturer:	Unknown
Diameter:	3/4"
Description:	6x41 Warrington-Seale construction, extra improved plow steel (XIPS), independent wire rope core (IWRC), right regular lay, 23.8 ton minimum breaking strength with open spelter socket on counterweight end and thimble with (3) wire rope clips on apron end

Deflector Sheave[ESTIMATED]

Manufacturer:	Unknown
Pitch Diameter:	16"
Bore Diameter:	2" (nominal)
Bore Type:	Bronze with Oil Grooves
Hub Length:	1-1/2"
Rope Diameter:	3/4"

BRIDGE COUNTERWEIGHT MACHINERY

Sheave[ESTIMATED]

Note: Replace in pairs to ensure that both sheaves have same pitch dia.
(Pair = Two North Sheaves or Two South Sheaves)

Manufacturer:	Unknown
Pitch Diameter:	36"
Bore Diameter:	4-1/2" (nominal)
Bore Type:	Plain
Hub Length:	7"
Rope Diameter:	1"

Counterweight Rope[ESTIMATED]

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

Appendix 4.4.5—Mechanical Manufacturers' Maintenance Manuals

Appendix 4.4.5 - Mechanical Manufacturer's Literature

Bridge Hoist Machinery

4.4.5.1 Reducer (Cone)
4.4.5.2 Drum Support Frame (Thern)
4.4.5.3 Deflector Sheave (McKissick)

Bridge Counterweight System

4.4.5.4 36" Diameter Sheave (McKissick)

Apron Hoist Machinery

4.4.5.5 Brake (Stearns)
4.4.5.6 Reducer (Cone)
4.4.5.7 Deflector Sheave (McKissick)

Lubricant Data

4.4.5.8 Mobilux EP2
4.4.5.9 Mobilux SHC634
4.4.5.10 Crosby Vitalife 400

Appendix 4.4.5.1

System: Bridge Hoist Machinery
Component: Reducer
Manufacturer: Cone Drive

Helical/Worm Illustrations

Shown below are two Cone Drive helical/worm configurations

Helical/Worm Speed Reducer



Helical/Worm D-Flange Gearhead

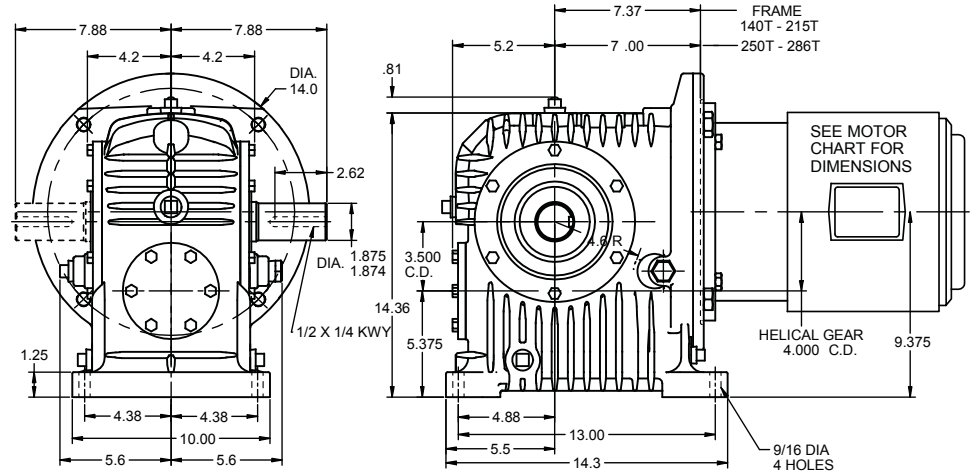


Cone Drive Helical/Worm D-Flange Gearhead - 3.500" C.D.

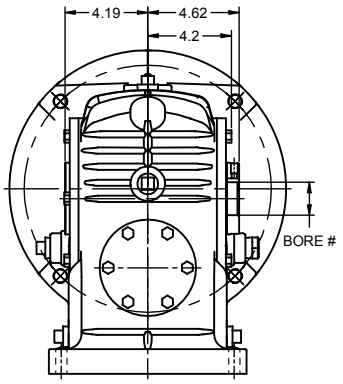
Size 35 Solid Shaft

Hollow Shaft

Model MU est. wt. 180 lbs less motor

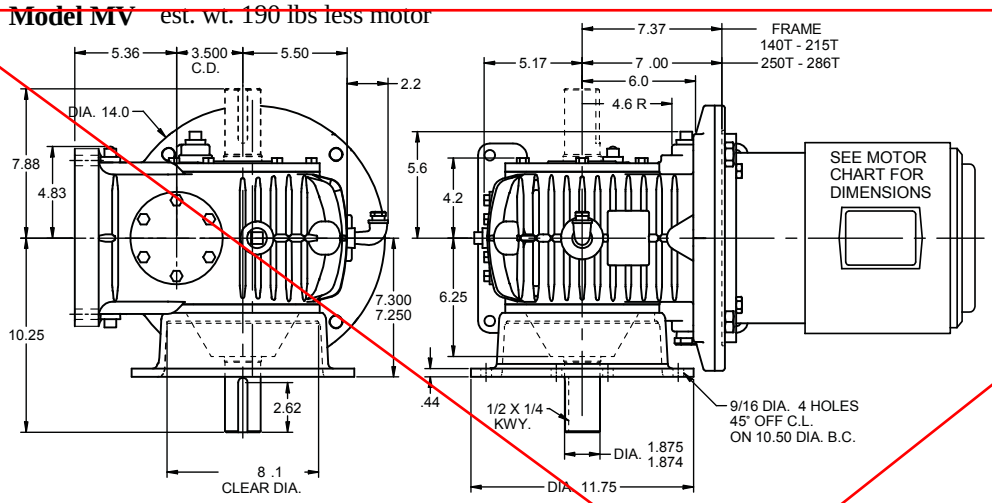


SMU est. wt. 180 lbs less motor



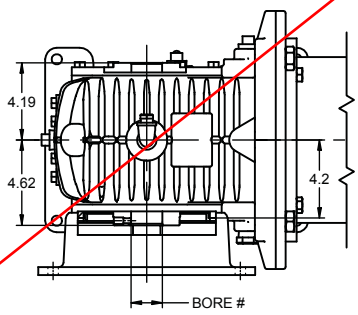
SEE GEAR SHAFT CHART
SET SCREW END OF SHAFT
MAY EXTEND ON EITHER SIDE

Model MV est. wt. 190 lbs less motor



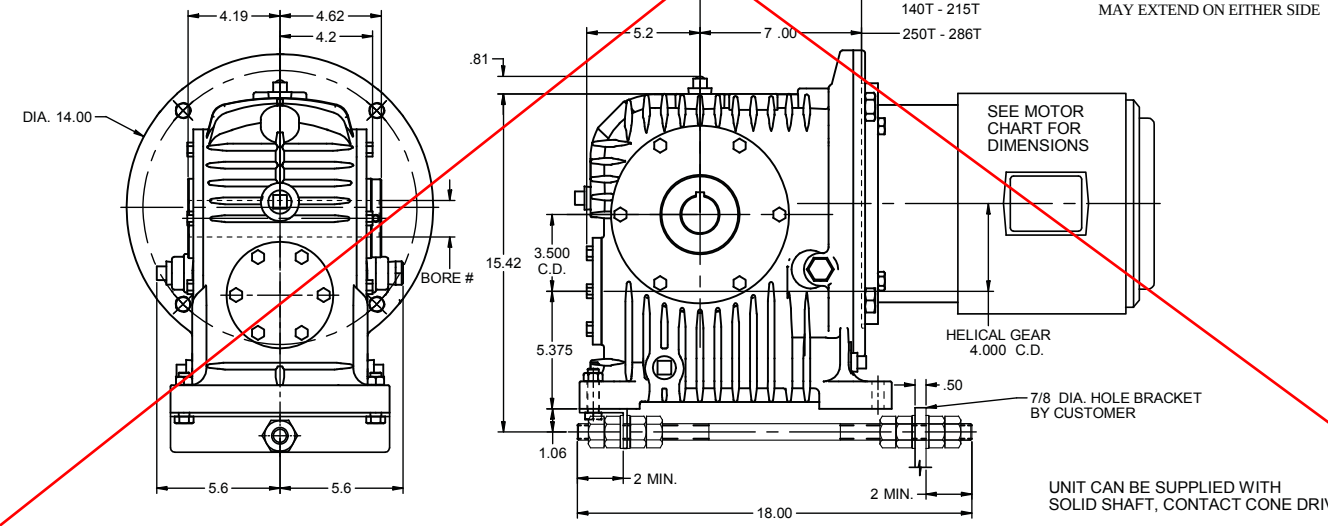
SOLID OUTPUT SHAFT MAY EXTEND ON EITHER SIDE OR BE DOUBLE EXTENDED.

SMV est. wt. 190 lbs less motor



SEE GEAR SHAFT CHART
SET SCREW END OF SHAFT
MAY EXTEND ON EITHER SIDE

Model SM est. wt. 180 lbs less motor



SEE GEAR SHAFT CHART

SET SCREW END OF SHAFT
MAY EXTEND ON EITHER SIDE

UNIT CAN BE SUPPLIED WITH SOLID SHAFT, CONTACT CONE DRIVE

Cone Drive reserves the right to improve or change product design and specifications without notice.

Cone Drive Helical/Worm D-Flange Gearhead

Size 35 4.000" C.D. HELICAL PRI./3.500" C.D. WORM GEAR SEC.

AGMA HORSEPOWER & OUTPUT TORQUE RATINGS FOR 1.0 SERVICE FACTOR

TOTAL RATIO PRIMARY X SECONDARY		INPUT RPM				
		100	580	870	1150	1750
5:1 1 x 5	Me.HP	1.66	8.93	13.1	16.4	20.3
	Th.HP	1.66	8.93	11.7	11.9	12.2
	O.T.	4520	4290	4200	4000	3280
7.5:1 1.5 x 5	Me.HP	1.38	7.45	10.9	13.2	16.5
	Th.HP	1.38	7.45	10.1	10.7	12.2
	O.T.	5520	5340	5240	4800	3970
9:1 1.8 x 5	Me.HP	1.20	6.50	9.53	11.9	15.0
	Th.HP	1.20	6.50	9.53	10.2	12.2
	O.T.	5720	5580	5480	5180	4310
10:1 1 x 10	Me.HP	1.66	7.37	9.50	11.1	13.8
	Th.HP	1.66	7.37	9.30	10.2	10.3
	O.T.	8430	6790	5910	5250	4360
12.5:1 2.5 x 5	Me.HP	0.96	5.26	7.68	9.52	12.5
	Th.HP	0.96	5.26	7.68	9.20	10.4
	O.T.	6300	6240	6110	5750	4980
15:1 1.5 x 10	Me.HP	1.14	5.40	7.37	8.84	11.1
	Th.HP	1.14	5.40	7.37	8.84	10.2
	O.T.	8510	7370	6790	6220	5210
18:1 1.8 x 10	Me.HP	0.96	4.65	6.44	7.87	10.1
	Th.HP	0.96	4.65	6.44	7.87	10.1
	O.T.	8510	7580	7080	6600	5640
20:1 4 x 5	Me.HP	0.90	3.99	5.18	6.04	7.55
	Th.HP	0.90	3.99	5.18	6.04	7.55
	O.T.	8270	6950	6080	5390	4480
22.5:1 1.5 x 15	Me.HP	0.80	3.80	5.21	6.28	7.92
	Th.HP	0.80	3.80	5.21	6.28	7.92
	O.T.	8540	7490	7000	6480	5460
25:1 2.5 x 10	Me.HP	0.70	3.50	4.96	6.20	8.36
	Th.HP	0.70	3.50	4.96	6.20	8.36
	O.T.	8510	7840	7500	7150	6420
27:1 1.8 x 15	Me.HP	0.67	3.27	4.54	5.57	7.18
	Th.HP	0.67	3.27	4.54	5.57	7.18
	O.T.	8540	7650	7250	6830	5920
30:1 1.5 x 20	Me.HP	0.61	2.91	3.99	4.82	6.08
	Th.HP	0.61	2.91	3.99	4.82	6.08
	O.T.	8270	7340	6950	6390	5360
36:1 1.8 x 20	Me.HP	0.51	2.50	3.48	4.28	5.52
	Th.HP	0.51	2.50	3.48	4.28	5.52
	O.T.	8270	7450	7150	6770	5810
37.5:1 2.5 x 15	Me.HP	0.49	2.46	3.49	4.37	5.92
	Th.HP	0.49	2.46	3.49	4.37	5.92
	O.T.	8540	7920	7600	7310	6660
40:1 4 x 10	Me.HP	0.45	2.32	3.31	4.22	5.96
	Th.HP	0.45	2.32	3.31	4.22	5.96
	O.T.	8510	8210	7890	7680	7220
45:1 1.8 x 25	Me.HP	0.42	2.02	2.81	3.45	4.46
	Th.HP	0.42	2.02	2.81	3.45	4.46
	O.T.	7950	7440	7070	6690	5820
50:1 2.5 x 20	Me.HP	0.38	1.88	2.67	3.35	4.54
	Th.HP	0.38	1.88	2.67	3.35	4.54
	O.T.	8270	7660	7420	7200	6580
54:1 1.8 x 30	Me.HP	0.35	1.69	2.35	2.89	3.73
	Th.HP	0.35	1.69	2.35	2.89	3.73
	O.T.	7600	6950	6590	6300	5590
60:1 4 x 15	Me.HP	0.31	1.63	2.33	2.97	4.20
	Th.HP	0.31	1.63	2.33	2.97	4.20
	O.T.	8540	8270	7970	7780	7360
62.5:1 2.5 x 25	Me.HP	0.31	1.52	2.16	2.70	3.66
	Th.HP	0.31	1.52	2.16	2.70	3.66
	O.T.	7950	7580	7390	7120	6520
72:1 1.8 x 40	Me.HP	0.27	1.27	1.77	2.18	2.81
	Th.HP	0.27	1.27	1.77	2.18	2.81
	O.T.	6830	6540	6320	6050	5330
75:1 2.5 x 30	Me.HP	0.26	1.27	1.81	2.26	3.07
	Th.HP	0.26	1.27	1.81	2.26	3.07
	O.T.	7600	7120	6900	6640	6180
80:1 4 x 20	Me.HP	0.24	1.25	1.78	2.27	3.22
	Th.HP	0.24	1.25	1.78	2.27	3.22
	O.T.	8270	8010	7710	7520	7250
90:1 1.8 x 50	Me.HP	0.22	1.02	1.42	1.75	2.26
	Th.HP	0.22	1.02	1.42	1.75	2.26
	O.T.	6070	6240	6140	5900	5130
100:1 4 x 25	Me.HP	0.20	1.01	1.43	1.83	2.60
	Th.HP	0.20	1.01	1.43	1.83	2.60
	O.T.	7950	7770	7610	7510	7180
108:1 1.8 x 60	Me.HP	0.18	0.85	1.19	1.46	1.88
	Th.HP	0.18	0.85	1.19	1.46	1.88
	O.T.	5970	5990	5810	5580	4940
120:1 4 x 30	Me.HP	0.17	0.84	1.20	1.53	2.17
	Th.HP	0.17	0.84	1.20	1.53	2.17
	O.T.	7600	7360	7150	7010	6690
125:1 2.5 x 50	Me.HP	0.16	0.77	1.09	1.37	1.85
	Th.HP	0.16	0.77	1.09	1.37	1.85
	O.T.	6070	6210	6240	6160	5740
150:1 2.5 x 60	Me.HP	0.14	0.64	0.91	1.14	1.55
	Th.HP	0.14	0.64	0.91	1.14	1.55
	O.T.	5970	6050	5980	5840	5460
160:1 4 x 40	Me.HP	0.13	0.64	0.90	1.15	1.64
	Th.HP	0.13	0.64	0.90	1.15	1.64
	O.T.	6830	6650	6480	6530	6390
200:1 4 x 50	Me.HP	0.10	0.51	0.73	0.93	1.31
	Th.HP	0.10	0.51	0.73	0.93	1.31
	O.T.	6070	6160	6200	6240	6180
240:1 4 x 60	Me.HP	0.09	0.43	0.61	0.77	1.10
	Th.HP	0.09	0.43	0.61	0.77	1.10
	O.T.	5970	6040	6070	5990	5870

Me.HP - Mechanical horsepower Th.HP - Thermal horsepower

O.T. - Output torque in Lb. in.

CAUTION: It is the purchaser's or user's responsibility to guard all shafting in accordance with current local, state or federal requirements.

Notes:

For motor data refer to pages 71 and 72.

VM & SVM units supplied with special footbrackets which provides a vertical input and a horizontal output shaft reducer follow in this section.

All MV units having shaft extended thru base side will be supplied with a steeple bearing mounting on on base side, unless otherwise specified.

Steeple bearing arrangements follow in this section.

All units can be supplied with fan cooling.

When specified each unit can be supplied with a worm shaft extension located opposite the input end.

When specified, units can be supplied with water cooling coils in oil sump.

Unless otherwise specified, all reducers are supplied with a right hand helix worm gear set.

Reducers are designed for shaft rotation in either direction.

For cap and carrier dimensions not shown see mounting section.

For output shaft chain pull capacity, see single reduction rating chart for size unit required. Determine worm speed by dividing input speed by helical gear ratio.

Refer to page 26 for lubrication information, efficiency, and service factors.

Reducers may be used in floor, ceiling, or wall mounted positions, however, they must be ordered for the position required so that suitable oil level, grease fittings, filler and drains are provided.

Hand of assembly and mounting position diagrams follow in this section.

STANDARD HOLLOW GEAR SHAFTS		
BORE INCHES	GEAR SHAFT NUMBER	KEYWAY SIZE
2.7500	35-S60-212	3/8 x 3/16
2.6875*	35-S60-211	3/8 x 3/16
2.500	35-S60-208	3/8 x 3/16
2.4375*	35-S60-207	5/8 x 5/16
2.1875*	35-S60-203	1/2 x 1/4
1.9375*	35-S60-115	1/2 x 1/4
1.6875*	35-S60-111	3/8 x 3/16

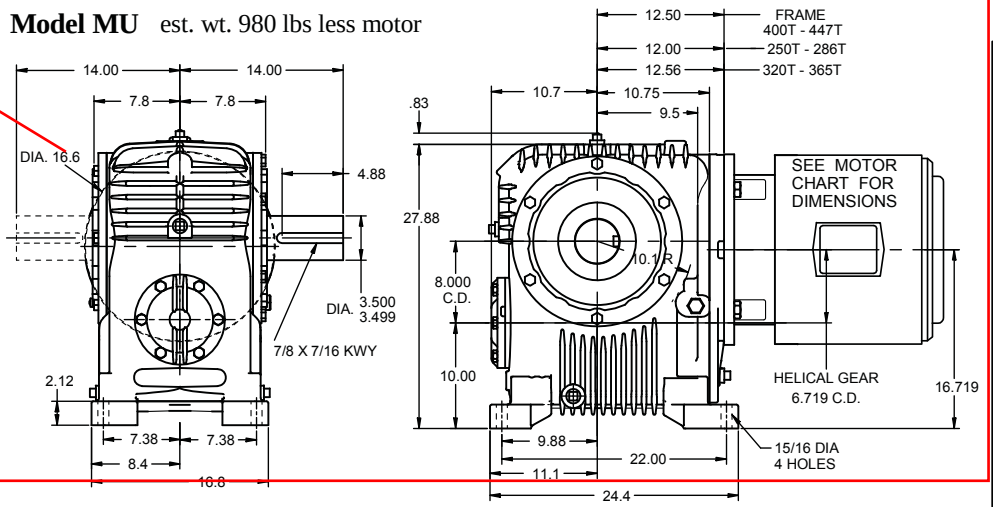
Special hollow gear shaft bore sizes are available at additional cost.
*AGMA Standard Bore Tolerance: +.002, -.000
2 set screws at long end of shaft.

Important: In any applications of Cone Drive products where breakage,damage, disconnection, any other malfunction of any drive train component, or excessive wear could result in personal injury or property damage, a fail-safe device capable of stopping and holding the load in the event of such an occurrence must be incorporated after the drive train.

Cone Drive Helical/Worm D-Flange Gearhead - 8.000" C.D.

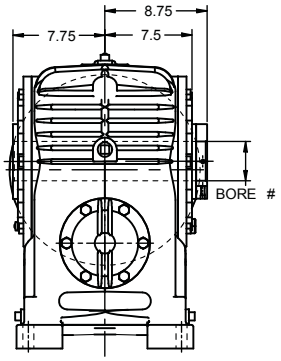
Size 80 Solid Shaft

Model MU est. wt. 980 lbs less motor



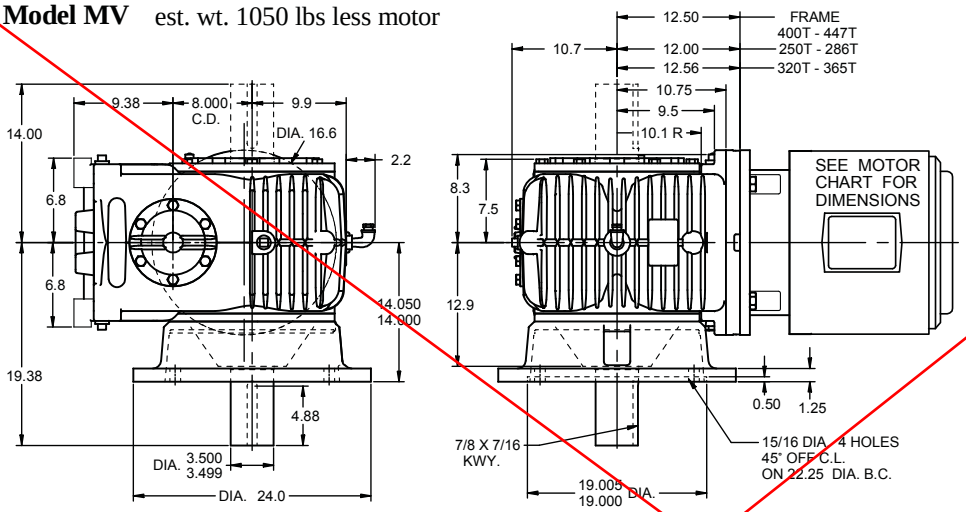
Hollow Shaft

SMU est. wt. 980 lbs less motor



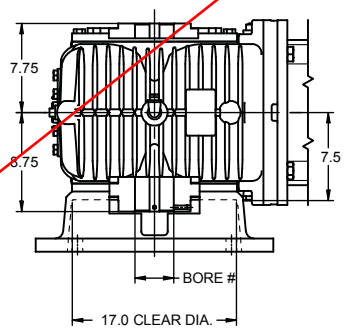
SEE GEAR SHAFT CHART
SET SCREW END OF SHAFT
MAY EXTEND ON EITHER SIDE

Model MV est. wt. 1050 lbs less motor



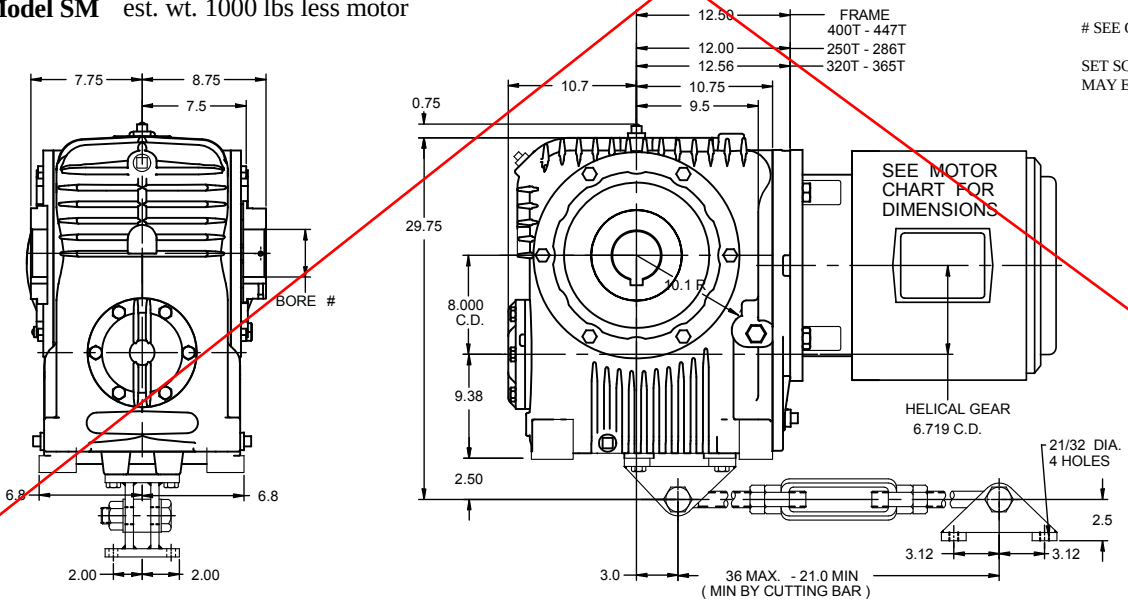
SOLID OUTPUT SHAFT MAY EXTEND ON EITHER SIDE OR BE DOUBLE EXTENDED.

SMV est. wt. 1050 lbs less motor



SEE GEAR SHAFT CHART
SET SCREW END OF SHAFT
MAY EXTEND ON EITHER SIDE

Model SM est. wt. 1000 lbs less motor



SEE GEAR SHAFT CHART

SET SCREW END OF SHAFT
MAY EXTEND ON EITHER SIDE

UNIT CAN BE SUPPLIED
WITH SOLID SHAFT,
CONTACT CONE DRIVE

Cone Drive reserves the right to improve or change
product design and specifications without notice.

Cone Drive Helical/Worm D-Flange Gearhead

Size 80 6.719" C.D. HELICAL PRI./8.000" C.D. WORM GEAR SEC.

AGMA HORSEPOWER & OUTPUT TORQUE RATINGS FOR 1.0 SERVICE FACTOR

TOTAL RATIO PRIMARY X SECONDARY		INPUT RPM				
		100	580	870	1150	1750
5:1 1 x 5	Me.HP	9.23	48.8	70.9	91.4	134
	Th.HP	8.77	33.4	39.2	40.0	41.0
	O.T.	25900	24200	23600	23100	22300
7.5:1 1.5 x 5	Me.HP	7.24	38.6	56.2	72.6	106
	Th.HP	7.03	29.9	33.5	35.3	41.0
	O.T.	30000	28500	27900	27300	26400
9:1 1.8 x 5	Me.HP	6.67	35.7	52.0	67.2	98.6
	Th.HP	5.61	26.4	31.0	33.9	41.0
	O.T.	33000	31600	30900	30300	29400
10:1 1 x 10	Me.HP	9.23	48.8	70.9	87.8	102
	Th.HP	8.77	25.0	30.1	33.3	33.9
	O.T.	48500	46500	45600	43100	33200
12.5:1 2.5 x 5	Me.HP	5.37	28.9	42.3	54.2	77.1
	Th.HP	5.37	21.5	27.5	30.4	34.5
	O.T.	36400	35500	34700	33800	31800
15:1 1.5 x 10	Me.HP	7.24	38.6	56.2	71.9	88.3
	Th.HP	6.84	21.0	24.5	29.4	33.4
	O.T.	56100	54500	53500	52300	42700
18:1 1.8 x 10	Me.HP	6.67	35.7	52.0	65.2	81.0
	Th.HP	4.48	18.7	22.6	25.9	32.7
	O.T.	61600	60100	59200	56600	46800
20:1 4 x 5	Me.HP	9.23	34.0	42.2	48.5	56.4
	Th.HP	6.88	19.7	20.6	22.2	23.9
	O.T.	88000	61300	51200	44900	34600
22.5:1 1.5 x 15	Me.HP	7.24	35.4	44.2	51.4	63.4
	Th.HP	6.04	17.7	21.3	23.6	27.9
	O.T.	80400	72100	61500	54900	45200
25:1 2.5 x 10	Me.HP	5.37	28.9	42.3	54.2	68.5
	Th.HP	3.85	15.6	19.0	22.1	28.3
	O.T.	67900	67100	66200	64800	54400
27:1 1.8 x 15	Me.HP	6.67	31.4	40.1	46.6	58.0
	Th.HP	4.10	14.7	18.1	21.5	26.7
	O.T.	88300	76200	66300	59100	49500
30:1 1.5 x 20	Me.HP	6.29	27.1	34.0	39.5	48.8
	Th.HP	5.30	15.3	18.9	19.8	21.7
	O.T.	88500	70900	61300	54200	44500
36:1 1.8 x 20	Me.HP	5.29	24.1	30.8	35.8	44.5
	Th.HP	3.43	12.5	15.7	21.0	22.0
	O.T.	88500	74400	65600	58700	48600
37.5:1 2.5 x 15	Me.HP	5.02	24.7	33.1	39.0	48.9
	Th.HP	3.42	12.3	15.4	17.6	22.0
	O.T.	91200	82400	74500	67600	57000
40:1 4 x 10	Me.HP	3.36	17.1	24.6	31.3	44.9
	Th.HP	2.58	11.8	14.4	17.2	20.2
	O.T.	66600	62700	60700	59000	56300
45:1 1.8 x 25	Me.HP	4.29	19.5	24.9	28.9	36.0
	Th.HP	3.04	11.8	15.4	16.3	19.5
	O.T.	85200	74500	65100	58100	48800
50:1 2.5 x 20	Me.HP	3.86	18.9	25.4	30.0	37.6
	Th.HP	2.89	10.5	12.9	15.2	18.7
	O.T.	88500	79900	73000	66900	56400
54:1 1.8 x 30	Me.HP	3.60	16.3	20.9	24.3	30.2
	Th.HP	2.75	9.44	11.1	13.2	15.6
	O.T.	81600	69800	60900	55000	47000
60:1 4 x 15	Me.HP	3.19	16.8	23.5	29	37.9
	Th.HP	2.15	8.6	11	12.9	17.1
	O.T.	91200	88100	83400	78800	68900
62.5:1 2.5 x 25	Me.HP	3.15	15.3	20.5	24.2	30.4
	Th.HP	2.54	9.37	11.8	13.9	16.2
	O.T.	85200	79200	72900	66300	56000
72:1 1.8 x 40	Me.HP	2.74	12.3	15.7	18.3	22.8
	Th.HP	2.30	7.90	9.80	11.9	13.5
	O.T.	73800	65900	58600	52900	44900
75:1 2.5 x 30	Me.HP	2.64	12.8	17.2	20.3	25.5
	Th.HP	1.98	8.20	10.0	11.10	14.4
	O.T.	81600	74600	68300	62100	53300
80:1 4 x 20	Me.HP	2.46	12.8	18.0	22.3	29.1
	Th.HP	1.69	7.20	9.20	10.3	14.6
	O.T.	88500	85500	80900	76500	68000
90:1 1.8 x 50	Me.HP	2.21	9.86	12.6	14.7	18.3
	Th.HP	1.62	6.90	9.00	10.6	12.1
	O.T.	65900	63100	57000	51600	43300
100:1 4 x 25	Me.HP	2.02	10.4	14.5	18.0	23.5
	Th.HP	1.39	6.10	8.30	9.70	13.1
	O.T.	85200	83100	80000	76500	67600
108:1 1.8 x 60	Me.HP	1.87	8.24	10.6	12.3	15.3
	Th.HP	1.31	5.68	7.72	9.08	10.5
	O.T.	64900	60700	54100	49000	41700
120:1 4 x 30	Me.HP	1.69	8.68	12.2	15.1	19.8
	Th.HP	1.23	5.40	7.1	8.30	10.6
	O.T.	81600	78900	75400	71800	63300
125:1 2.5 x 50	Me.HP	1.64	7.72	10.4	12.3	15.4
	Th.HP	1.54	5.45	7.07	8.42	10.8
	O.T.	65900	65500	62100	57800	49700
150:1 2.5 x 60	Me.HP	1.40	6.45	8.66	10.3	12.9
	Th.HP	1.31	4.64	6.35	7.39	9.46
	O.T.	64900	63900	59600	55000	47400
160:1 4 x 40	Me.HP	1.31	6.53	9.15	11.3	14.9
	Th.HP	0.96	4.00	5.40	6.50	9.00
	O.T.	73800	71600	68700	67100	60600
175:1 2.5 x 70	Me.HP	1.2	5.53	7.43	8.8	11.1
	Th.HP	1.15	4.20	6.20	7.20	9.3
	O.T.	63800	63000	58600	54200	46800
200:1 4 x 50	Me.HP	1.06	5.24	7.34	9.10	11.9
	Th.HP	0.79	3.20	4.50	5.60	7.80
	O.T.	65900	66600	65800	64200	58700
240:1 4 x 60	Me.HP	0.92	4.37	6.13	7.6	9.97
	Th.HP	0.72	2.70	3.80	4.70	6.90
	O.T.	64900	65400	64500	61800	55900
280:1 4 x 70	Me.HP	0.79	3.75	5.26	6.52	8.56
	Th.HP	0.69	2.30	3.20	4.20	6.30
	O.T.	63800	64400	63500	60900	55000

Me.HP - Mechanical horsepower Th.HP - Thermal horsepower

O.T. - Output torque in Lb. in.

CAUTION: It is the purchaser's or user's responsibility to guard all shafting in accordance with current local, state or federal requirements.

Notes:

For motor data refer to pages 71 and 72.

VM & SVM units supplied with special footbrackets which provides a vertical input and a horizontal output shaft reducer follow in this section.

All MV units having shaft extended thru base side will be supplied with a steeple bearing mounting on base side, unless otherwise specified. Steeple bearing arrangements follow in this section.

All units can be supplied with fan cooling.

When specified each unit can be supplied with a worm shaft extension located opposite the input end.

When specified, units can be supplied with water cooling coils in oil sump.

Unless otherwise specified, all reducers are supplied with a right hand helix worm gear set.

Reducers are designed for shaft rotation in either direction.

For cap and carrier dimensions not shown see mounting section.

For output shaft chain pull capacity, see single reduction rating chart for size unit required. Determine worm speed by dividing input speed by helical gear ratio.

Refer to page 26 for lubrication information, efficiency, and service factors.

Reducers may be used in floor, ceiling, or wall mounted positions, however, they must be ordered for the position required so that suitable oil level, grease fittings, filler and drains are provided.

Hand of assembly and mounting position diagrams follow in this section.

STANDARD HOLLOW GEAR SHAFTS		
BORE INCHES	GEARSHAFT NUMBER	KEYWAY SIZE
4.4375*	80-S60-407	1 X 1/2
3.9375*	80-S60-315	1 X 1/2

Special hollow gear shaft bore sizes are available at additional cost.

*AGMA Standard

Bore Tolerance: +.003, -.000

2 set screws at long end of shaft.

Important: In any applications of Cone Drive products where breakage,damage, disconnection, any other malfunction of any drive train component, or excessive wear could result in personal injury or property damage, a fail-safe device capable of stopping and holding the load in the event of such an occurrence must be incorporated after the drive train.

Fan Cooling for Cone Drive Helical/Worm D Flange Gearhead

MODEL NUMBERS FMU, FMV, FSM, FSMU, FSMV

Cone Drive fan-cooled helical worm double reduction gearmotors are available in all models size 40 through 100. (see note below.) They are identical with standard models except for the use of an extended worm shaft, fan and air-flow control cover.

The control cover directs air over the lower portion of the reducer housing and the fins on the housing guide the air for maximum cooling efficiency.

Thermal horsepower ratings are naturally increased with fan cooling

All size 40 fan-cooled models have thermal horsepower ratings equal to mechanical horsepower ratings, regardless of ratio. In the rating table on this page are shown thermal horsepower ratings for certain ratios of size 50 through size 80 models. Any ratio and speed not listed is limited to the maximum thermal ratings found on ratings page of this section.

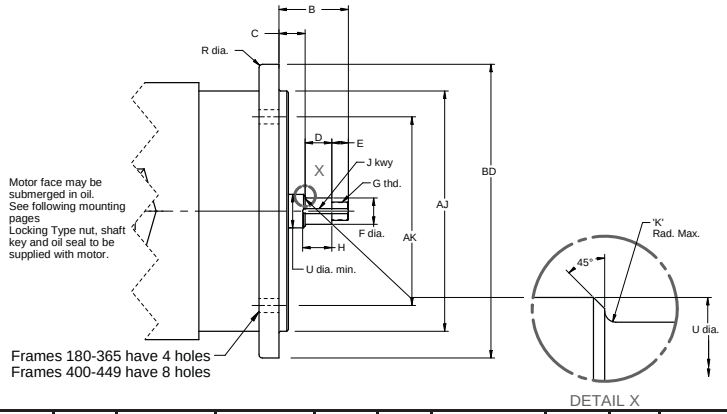
CLEARANCE DIMENSION FROM CENTERLINE OF UNIT OVER FAN COVER						
SIZE	40	50	60	70	80	100
DIM.	8.0	9.5	10.2	12.9	14.3	16.5

Thermal Ratings
of Fan Cooled Gearmotors

UNIT SIZE	TOTAL RATIO	INPUT RPM		
		870	1150	1750
40	ALL RATINGS ARE EQUAL TO MECHANICAL RATING OF SIZE 40 HELICAL/WORM D-FLANGE GEARHEAD IN THIS SECTION			
50	5:1	29.0	36.3	49.6
	7.5:1	23.3	25.7	37.0
	9:1	21.6	24.7	33.3
	10:1	23.8	28.0	34.4
	12.5:1		20.2	24.6
	15:1	17.1	21.4	28.3
60	5:1	29.0	37.5	53.0
	7:5:1	24.6	27.4	38.4
	9:1	22.1	26.3	35.8
	10:1	25.4	32.3	43.8
	12.5:1		21.6	26.8
	15:1	18.1	22.8	31.3
	18:1	16.9	20.0	28.5
70	5:1	47.6	56.0	76.4
	7.5:1	35.9	39.5	55.4
	9:1	33.2	38.0	51.6
	10:1	36.5	46.7	63.2
	12.5:1		31.1	38.6
	15:1	26.3	32.9	45.1
	18:1	24.3	28.9	41.2
	22.5:1	22.9	26.4	37.7
	25:1		22.6	31.7
	30:1	20.2	22.1	29.4
	36:1	16.8	22.1	26.5
	45:1	16.4	18.2	24.6
	50:1		15.6	20.9
	54:1	11.9	14.8	19.6
	72:1	10.8	12.5	15.6
80	5:1	51.0	60.0	82.0
	7.5:1	38.5	42.4	59.5
	9:1	35.7	40.7	55.4
	10:1	39.1	50.0	67.8
	12.5:1		33.4	41.4
	15:1	28.1	35.3	48.4
	18:1	26.0	31.1	44.1
	20:1	26.8	33.3	47.8
	22.5:1	24.5	28.3	40.5
	25:1		24.3	34.0
	30:1	21.7	23.8	31.5
	36:1	18.1	25.2	29.7
	37.5:1		19.3	26.4
	45:1	17.7	19.6	26.3
	50:1		16.7	22.4
	54:1	12.8	15.8	21.1
	72:1	11.3	14.3	18.2
100	CONTACT CONE DRIVE ENGINEERING FOR RATINGS			

Cone Drive Helical/Worm D Flange Gearhead

Dimensions for Mounting NEMA 'D' Flange Motor
Standard Helical Stocked Ratios are: 1:1, 1.5:1, 1.8:1, 2.5:1, and 4:1. Other ratios are also available. For information Contact Cone Drive.
2.5:1 and 4:1 ratios are not available with all motor shaft sizes. See chart below.



FRAME	AK	AJ	BD	B	C	D	E	F +.0000 -.0005	G	H	K	J	U	R	RATIOS	HELICAL PINION DET.
REDUCER SIZES: 25 & 30, HELICAL C.D. 3.000																
180DZ-210DZ 140TDZ-184TDZ*	9.00	10.00	11.00	2.375	.968	.968	.44	.6697	1/2 - 20	1.00	.06	3/16 x 3/32	.88	.53	all ratios	30-700
210TDZ-215TDZ*	9.00	10.00	11.00	2.688	.875	1.062	.75	.9847	7/8 - 14	1.12	.06	3/16 x 3/32	1.38	.53	all ratios but 2.5:1,4:1	30-710
210TDZ-215TDZ*	9.00	10.00	11.00	2.375	.968	.968	.44	.6697	1/2 - 20	1.00	.06	3/16 x 3/32	.88	.53	for ratios 2.5:1,4:1	30-700
REDUCER SIZES: 35 & 40, HELICAL C.D 4.000																
180DZ-210DZ 140TDZ-184TDZ	9.00	10.00	11.00	2.375	.968	.968	.44	.6697	1/2 - 20	1.00	.06	3/16 x 3/32	.88	.53	all ratios	40-700
210TDZ-215TDZ	9.00	10.00	11.00	2.688	.875	1.062	.75	.9847	7/8 - 14	1.12	.06	3/16 x 3/32	1.38	.53	all ratios	40-710
254UDZ-286UDZ 250TDZ-256TDZ*	11.00	12.50	14.00	3.094	1.281	1.218	.59	.9847	7/8 - 14	1.31	.06	3/16 x 3/32	1.50	.81	all ratios	40-710
REDUCER SIZES: 50 & 60, HELICAL C.D 5.375																
180DZ-210DZ 140TDZ-184TDZ	9.00	10.00	11.00	2.375	.968	.968	.44	.6697	1/2-20	1.00	.06	3/16 x 3/32	.88	.53	all ratios	53-700
210TDZ-215TDZ	9.00	10.00	11.00	2.688	.875	1.062	.75	.9847	7/8-14	1.12	.06	3/16 x 3/32	1.38	.53	all ratios	53-710
254UDZ-286UDZ 250TDZ-256TDZ	11.00	12.50	14.00	3.094	1.281	1.218	.59	.9847	7/8-14	1.31	.06	3/16 x 3/32	1.50	.81	all ratios	53-710
280TDZ-286TDZ	11.00	12.50	14.00	3.875	.968	1.593	1.31	1.5013	1 1/4-12	1.68	.12	3/8 x 3/16	1.88	.81	all ratios but 4:1	53-720
320UDZ-360UDZ 320TDZ-326TDZ	14.00	16.00	18.00	4.750	1.875	1.562	1.31	1.5013	1 1/4 - 12	1.75	.12	3/8 x 3/16	1.88	.81	all ratios but 4:1	53-720
280TDZ-286TDZ	11.00	12.50	14.00	3.094	1.281	1.218	.59	.9847	7/8-14	1.31	.06	3/16 x 3/32	1.50	.81	for 4:1 ratios	53-710
320UDZ-360UDZ 320TDZ-326TDZ	14.00	16.00	18.00	3.906	2.093	1.218	.59	.9847	7/8-14	1.31	.06	3/16 x 3/32	1.50	.81	for 4:1 ratio	53-710
REDUCER SIZES: 70 & 80, 100L HELICAL C.D 6.719																
210TDZ-215TDZ	9.00	10.00	11.00	2.688	.875	1.062	.75	.9847	7/8-14	1.12	.06	3/16 x 3/32	1.38	.53	all ratios	67-715
254UDZ-286UDZ 250TDZ-256TDZ	11.00	12.50	14.00	3.094	1.281	1.218	.59	.9847	7/8-14	1.31	.06	3/16 x 3/32	1.50	.81	all ratios	67-715
280TDZ-286TDZ	11.00	12.50	14.00	3.875	.968	1.593	1.31	1.5013	1 1/4-12	1.68	.12	3/8 x 3/16	1.88	.81	all ratios	67-725
320UDZ-360UDZ 320TDZ-326TDZ	14.00	16.00	18.00	4.750	1.875	1.562	1.31	1.5013	1 1/4 -12	1.75	.12	3/8 x 3/16	1.88	.81	all ratios	67-725
360TDZ-365TDZ	14.00	16.00	18.00	5.000	1.875	1.687	1.44	1.875	1 1/2-12	1.88	.12	1/2 x 1/4	2.38	.81	all ratios but 4:1	67-730
400UDZ-445UDZ 400TDZ-445TDZ	18.00	20.00	22.00	5.000	1.812	1.687	1.50	1.875	1 1/2 -12	1.88	.12	1/2 x 1/4	2.38	.81	all ratios but 4:1	67-730
360TDZ-365TDZ	14.00	16.00	18.00	4.750	1.875	1.562	1.31	1.5013	1 1/4-12	1.75	.12	3/8 x 3/16	1.88	.81	for 4:1	67-725
400UDZ-445UDZ 400TDZ-445TDZ	18.00	20.00	22.00	4.688	1.812	1.562	1.31	1.5013	1 1/4 -12	1.75	.12	3/8 x 3/16	1.88	.81	for 4:1	67-725
REDUCER SIZE: 100, HELICAL C.D. 9.750																
324UDZ-365UDZ 324TDZ-365TDZ	14.00	16.00	18.00	4.75	1.250	2.687	.75	1.875	1.767-18 1.731P.D.	2.87	.06	1/2 x 1/4	2.38	.81	all ratios	97-735
400UDZ-445UDZ 400TDZ-449TDZ	18.00	20.00	22.00	5.375	1.875	2.687	.81	2.375	2.360-18 2.324P.D.	2.87	.06	5/8 x 5/16	2.81	.81	all ratios but 4:1	97-740
400UDZ-445UDZ 400TDZ-449TDZ	18.00	20.00	22.00	5.312	1.875	2.687	.75	1.875	1.767-18 1.731P.D.	2.87	.06	1/2 x 1/4	2.38	.81	all ratios	97-735

APRON

BRIDGE

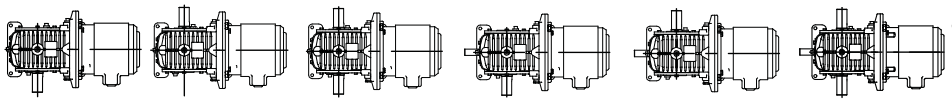
*Reducers marked with asterisk do not require motor adapters.

Assembly & Mounting Position Numbers for Cone Drive Helical/Worm D Flange Gearhead

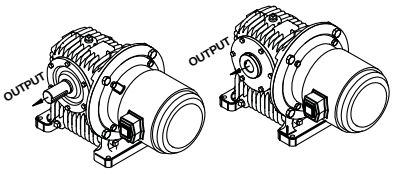
Models MU, SMU, MV, SMV, SM, Solid & Hollow Shaft

ALL DIAGRAMS SHOW REDUCER WITH FEET ON FAR SIDE

Top View, Floor Mounted

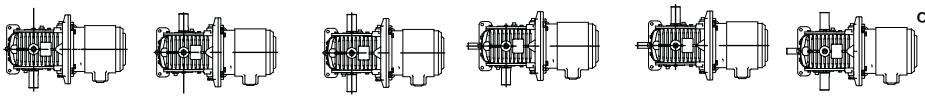


1.....2.....3.....4.....5.....6

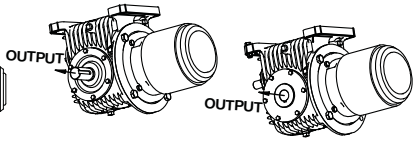


1 Shown

Ceiling Mounted*

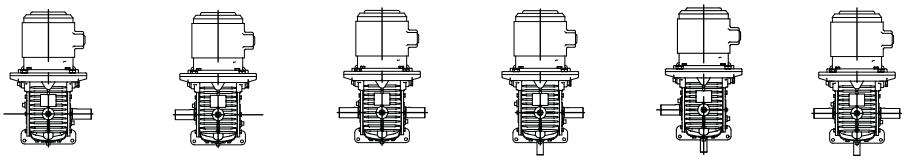


C1.....C2.....C3.....C4.....C5.....C6

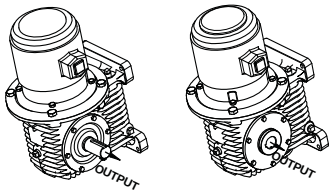


C2 Shown

Wall Mounted, Motor Up

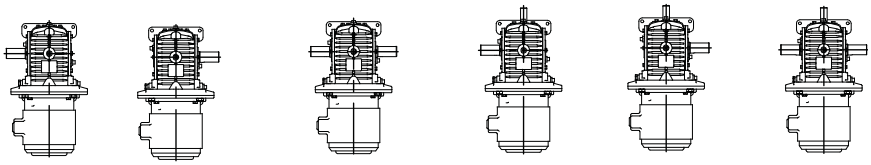


W1.....W2.....W3.....W4.....W5.....W6

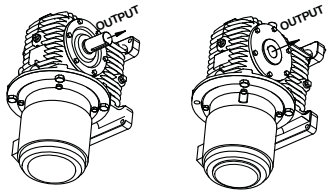


W1 Shown

Wall Mounted, Motor Down*

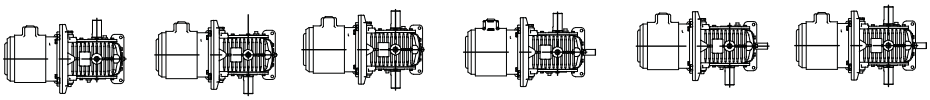


X1.....X2.....X3.....X4.....X5.....X6

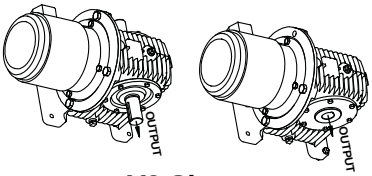


X2 Shown

Wall Mounted, Motor To Left*

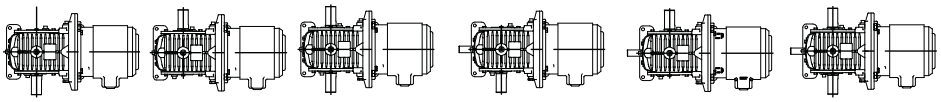


Y1.....Y2.....Y3.....Y4.....Y5.....Y6

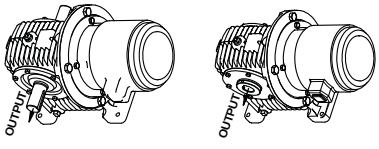


Y2 Shown

Wall Mounted, Motor To Right



Z1.....Z2.....Z3.....Z4.....Z5.....Z6



Z1 Shown

*Motor face may be submerged in oil. Contact motor supplier regarding shaft seal requirements.

Cone Drive reserves the right to improve or change product design and specifications without notice.

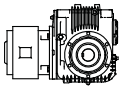
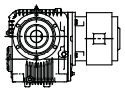
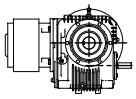
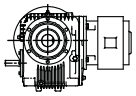
Assembly & Mounting Position Numbers for Cone Drive Helical/Worm D Flange Gearhead

Models MV, SMV - Solid & Hollow Shaft

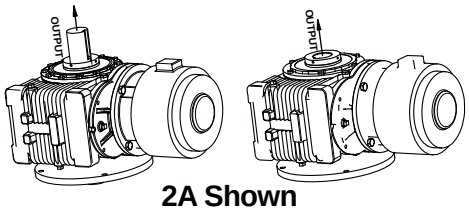
ALL DIAGRAMS SHOW REDUCER WITH BASE ON FAR SIDE

RV	SRV	
A	A	Gearshaft Extended Opposite Base
BR	B	Gearshaft Extended Through Base
SD	C	Gearshaft Double Extended

Floor Mounted - Top View*

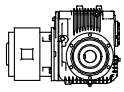
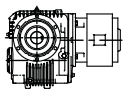
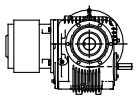
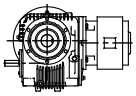





MV	SMV	MV	SMV	MV	SMV	MV	SMV
1A	1A	2A	2A	3A	3A	4A	4A
1BR	1B	2BR	2B	3BR	3B	4BR	4B
1SD	1C	2SD	2C	3SD	3C	4SD	4C

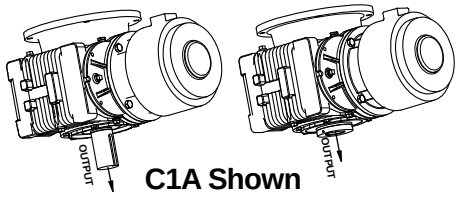


2A Shown

Ceiling Mounted*

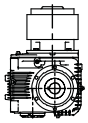
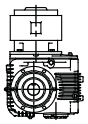
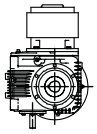
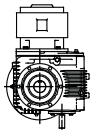





MV	SMV	MV	SMV	MV	SMV	MV	SMV
C1A	C1A	C2A	C2A	C3A	C3A	C4A	C4A
C1BR	C1B	C2BR	C2B	C3BR	C3B	C4BR	C4B
C1SD	C1C	C2SD	C2C	C3SD	C3C	C4SD	C4C

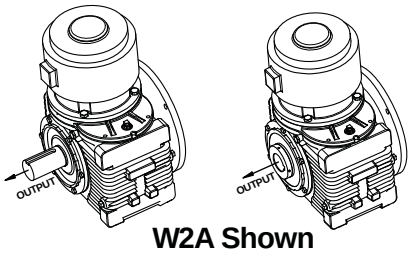


C1A Shown

Wall Mounted - Motor Up

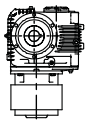
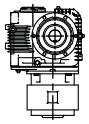
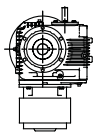
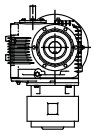





MV	SMV	MV	SMV	MV	SMV	MV	SMV
W1A	W1A	W2A	W2A	W3A	W3A	W4A	W4A
W1BR	W1B	W2BR	W2B	W3BR	W3B	W4BR	W4B
W1SD	W1C	W2SD	W2C	W3SD	W3C	W4SD	W4C

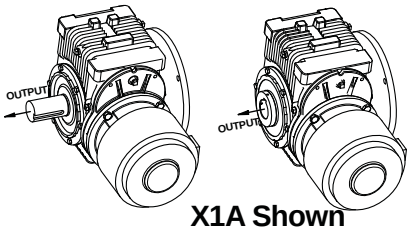


W2A Shown

Wall Mounted - MotorDown*

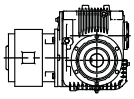
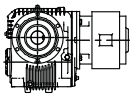
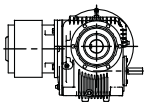
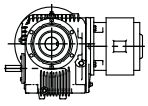





MV	SMV	MV	SMV	MV	SMV	MV	SMV
X1A	X1A	X2A	X2A	X3A	X3A	X4A	X4A
X1BR	X1B	X2BR	X2B	X3BR	X3B	X4BR	X4B
X1SD	X1C	X2SD	X2C	X3SD	X3C	X4SD	X4C

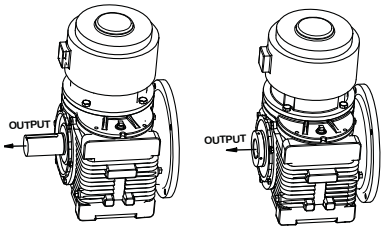


X1A Shown

Wall Mounted - Worm Under

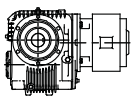
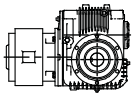
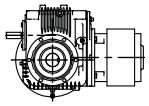
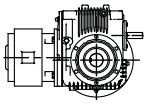





MV	SMV	MV	SMV	MV	SMV	MV	SMV
Y1A	Y1A	Y2A	Y2A	Y3A	Y3A	Y4A	Y4A
Y1BR	Y1B	Y2BR	Y2B	Y3BR	Y3B	Y4BR	Y4B
Y1SD	Y1C	Y2SD	Y2C	Y3SD	Y3C	Y4SD	Y4C

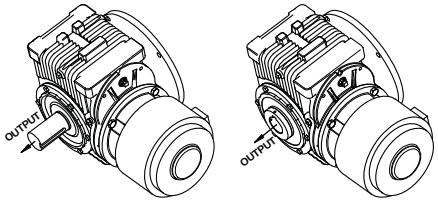


Y2A Shown

Wall Mounted - Worm Over

MV	SMV	MV	SMV	MV	SMV	MV	SMV
Z1A	Z1A	Z2A	Z2A	Z3A	Z3A	Z4A	Z4A
Z1BR	Z1B	Z2BR	Z2B	Z3BR	Z3B	Z4BR	Z4B
Z1SD	Z1C	Z2SD	Z2C	Z3SD	Z3C	Z4SD	Z4C



Z1A Shown

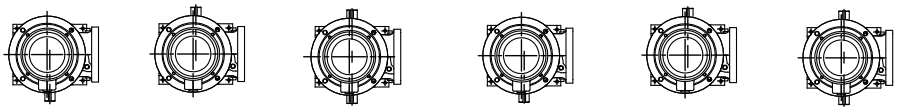
*Motor face may be submerged in oil. Contact motor supplier regarding shaft seal requirements.

Assembly & Mounting Position Numbers for Cone Drive Helical/Worm D Flange Gearhead

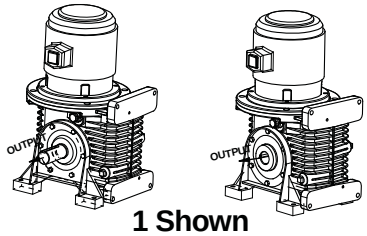
Models VM, SVM - Solid & Hollow Shaft

ALL DIAGRAMS SHOW REDUCER WITH FEET ON FAR SIDE. DIAGRAMS 4-6 HAVE SHAFT EXTENSION OPPOSITE MOTOR END.

Top View, Floor Mounted

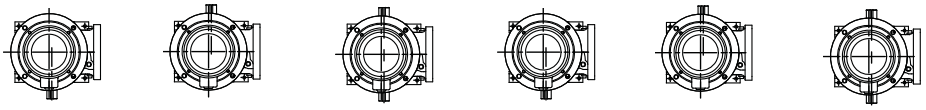


1.....2.....3.....4.....5.....6

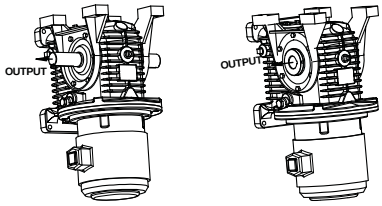


1 Shown

Ceiling Mounted*

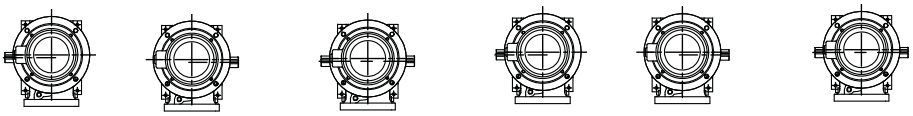


C1.....C2.....C3.....C4.....C5.....C6

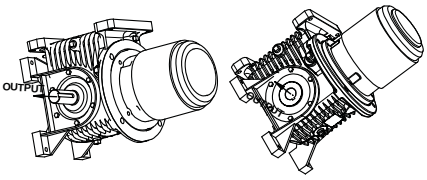


C2 Shown

Wall Mounted, Worm Under Horizontal Gearshaft

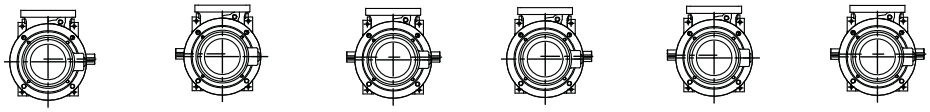


W1.....W2.....W3.....W4.....W5.....W6

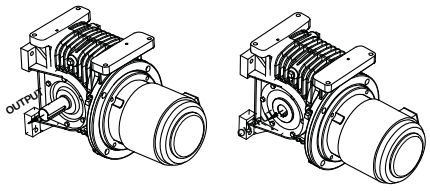


W1 Shown

Wall Mounted, Worm Over Horizontal Gearshaft*

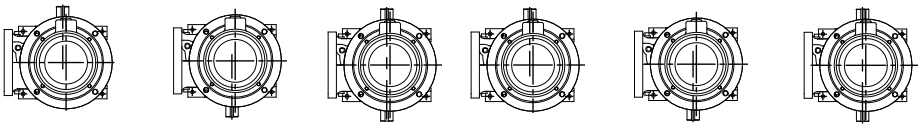


X1.....X2.....X3.....X4.....X5.....X6

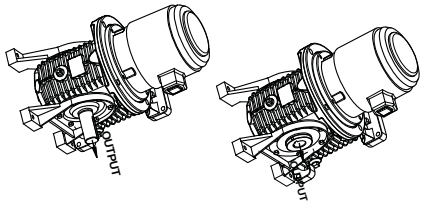


X2 Shown

Wall Mounted, Worm Left Vertical Gearshaft*

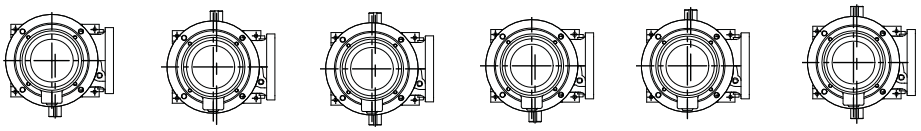


Y1.....Y2.....Y3.....Y4.....Y5.....Y6

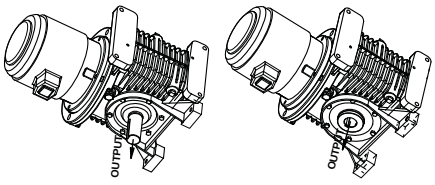


Y2 Shown

Wall Mounted, Worm Right Vertical Gearshaft*



Z1.....Z2.....Z3.....Z4.....Z5.....Z6



Z1 Shown

*Motor face may be submerged in oil. Contact motor supplier regarding shaft seal requirements.

CONEDRIVE™
GEARING SOLUTIONS

23169revMAY2012

Approved List of Lubricants

For Cone Drive Double Enveloping Worm Speed Reducers & Gearsets

RECOMMENDED

	AGMA #7S SYNTHETIC (ISO Viscosity Grade 460)[5]			
MANUFACTURER	**BRAND NAME**	**POUR POINT** °F (°C)	**KIN. VISCOSITY** cSt @ 100°C	**Food Grade (Note 3)**
Chevron	Chevron Clarity Synthetic Machine Oil	-33 (-36)	46.1	
Exxon Mobil Oil Corp.	Mobil SHC 634 Synthetic Lubricant	-40 (-40)	46.5	
Exxon Mobil Oil Corp.	Mobil Glygoyle 460 (Note 6)	-27 (-33)	77.2	X
Exxon Mobil Oil Corp.	Mobil SHC Cibus 460	-44 (-42)	43.6	X
Total Lubricants	Carter SE 460	-40 (-40)	49.6	
Kluber Lubrication	Kluberoil 4 UH1 460 N	-22 (-30)	47.0	X
Royal Purple, Ltd.	Thermyl-Glyde Worm Gear 680 (Note 4)	-27 (-33)	43.0	
Shell	Shell Morlina S4 B	-44 (-42)	45.5	
LUBRIPLATE Lubricants Co.	Lubriplate PGO-FGL 460 Synthetic Gear Oil	-33 (-36)	83.0	X
LUBRIPLATE Lubricants Co.	Lubriplate SFGO Ultra 460 Synthetic Gear Oil	-40 (-40)	46.0	X

	AGMA #8 COMPOUND (NON-E.P.) (ISO Viscosity Grade 680)			AGMA #8A COMPOUND (NON-E.P.) (ISO Viscosity Grade 1000)			
MANUFACTURER	**BRAND NAME**	**POUR POINT** °F (°C)	**KiN. VISCOSITY** cSt @ 100°C	**BRAND NAME**	**POUR POINT** °F (°C)	**KIN. VISCOSITY** cSt @ 100°C	**Food Grade (Note 3)**
BP Oil NOT AVAILABLE IN THE U.S.				Energol DC-C 1000	21 (-6)	45.3	
Bel-Ray Company	HP Worm Gear Oil		37.2				
Bel-Ray Company	No-Tox HD Oil 680	9 (-13)	50.2	No-Tox HD Oil 1000	9 (-13)	66.8	X
Chevron	Cylinder Oil W-ISO #680	10 (-12)	39.3				
Citgo	Cylinder Oil #680-7	5 (-15)	40				
Castrol	Worm Gear Oil #680	-7 (20)	37	Worm Gear Oil #1000	-7 (20)	45.5	
Imperial	Cylesstic TK 680	-7 (20)	37.8	Cylesstic TK 1000	-1 (30)	46.7	
Total Lubricants	Cylan WG 680	-7 (20)	36				
Fiske Brothers Refining				Lubriplate CP-8A	35 (2)	47	
Fiske Brothers Refining	Lubriplate SPO-288	10 (-12)	38				
Imperial/Esso Oil	Cylesso TK 680	-7 (20)	37.8				
Lubrication Engineers	680 Almasol	-6 (-21)	48.3				
Mobil Oil	Extra Hecla Super Cylinder Oil	32 (0)	35.8	Extra Hecla Super Cylinder Oil Mineral	37 (3)	43.0	
Schaeffer Manufacturing	#147 Steam Cylinder Oil	-10 (-12)	27-30				
Shell Oil	Valvata J-680	27 (-3)	38.44				

NOTES:

1... The listed synthetic lubricants are acceptable for use as an AGMA #7, #8 or #8A. AGMA #7 lubricants are primarily used in force feed lubrication systems or other special applications.
2... Manufacturers listed in bold print have product available worldwide. Contact a listed manufacturer for availability in your area.
3... For specific food grade approval type, refer to manufacturer for details.
4... Thermyl-Glyde Worm Gear 680 is an ISO grade 680 and AGMA 8S lubricant
5... Synthetic lubricants with viscosity grades other than those shown may be recommended by Cone Drive Engineering in some cases.
6... This is a polyalkylene glycol (PAG) based product. See supplier for compatibility guidelines and other specifications unique to this PAG lubricant.

Cone Drive Operations, Inc.
240 E. 12th Street, P.O. Box 272, Traverse City, MI 49685-0272 USA
Phone: 231-946-8410, Fax 231-933-8600
www.conedrive.com Sales Phone: 888-994-2663 Sales Fax: 888-907-2663

CONEDRIVE™
GEARING SOLUTIONS

23169revMAY2012

Lubrication Information

For Cone Drive Double Enveloping Worm Speed Reducers & Gearsets

AGMA Lubricant Number Guidelines

CENTER DISTANCE	WORM SPEED (RPM)	AMBIENT TEMPERATURE		WORM SPEED ABOVE (RPM)	AMBIENT TEMPERATURE
		-10°C to +10°C (14°F to 50°F)	+10°C to +50°C (50°F to 125°F)		-10°C to +50°C (14°F to 125°F)
Up to 6" inclusive	0-700	AGMA 7S or AGMA 8 comp	AGMA 7S or AGMA 8A comp	700-up	AGMA 7S or AGMA 8 comp
Over 6" to 12"	0-450			450-up	
Over 12" to 18"	0-300			300-up	
Over 18" & above	0-200			200-up	

Viscosity Ranges

AGMA NO.	ASTM SYSTEM		ISO VISC.
	SUS @210°F	SUS @100°F	CST @40°C
7S Synthetic		1919-2346	414-506
7 Compound	125-150	1919-2346	414-506
8 Compound	150-190	2837-3467	612-748
8A Comp.	190-250	4171-5098	900-1100

IMPORTANT: In any applications of Cone Drive Products where breakage, damage, disconnection, any other malfunction of any drive train component, or excessive wear could result in personal injury or property damage, a fail safe device capable of stopping and holding the load in the event of such an occurrence must be incorporated after the drive train.

Lubrication and Maintenance Notes:

1 **Type of Oil.** For Cone Drive double enveloping worm gear speed reducers use the lubricant information on the nameplate and this *Approved List of Lubricants* to select the proper lubricant. For Cone Drive gear sets used in other assemblies, use this document to select a lubricant. Contact Cone Drive if in doubt.

2 **Ambient Temperature.** The lubricants in this list are for use in an ambient temperature range of approximately 15°F to 125°F with the low end of the range depending on the pour point of the specific oil used. The lubricant Pour Point must be at least 5°C (9°F) less than the minimum startup temperature expected. If the ambient temperature will be below or above this range please contact Cone Drive for specific recommendations on proper lubricant as well as proper oil seal and shim materials.

3 **Sludge.** It is necessary that the oil be clean and free from sludge at all times to obtain long life from the gear unit. Sludge in gear units may be caused by excessive heat, from dust and dirt and other contaminates and by the presence of moisture or chemical fumes. Therefore, every precaution should be taken to prevent water and foreign particles from entering the gear case.

4 **Oil Change.** If an approved synthetic lubricant is used, it should be changed after 5000 hours of operation or once per year, whichever occurs first. If a recommended steam cylinder oil is used, the change interval should be after 2500 hours of operation or every six months, whichever occurs first. These change intervals are recommended for units operating under favorable conditions. Where operating conditions are severe, such as a rapid rise and fall in temperature of the gear case with accompanied sweating of the inside wall and resulting formation of sludge, or where operation is in moist or dusty atmospheres, or in the presence of chemical fumes or extended running at sump temperatures in excess of 180°F, it may be necessary to change the oil at intervals of one to three months. It is recommended a sampling program be established with your lubricant manufacturer where reducers are exposed to the severe operating conditions, mentioned above.

5 **Oil Level.** Oil level should always be checked with the unit stopped.

6 **Extreme Pressure (EP) Lubricants.** Extreme Pressure (EP) lubricants or cylinder oils with sulfur-phosphorus additives are not acceptable and should not be used with worm gearing.

7 **High Speed Applications.** Double enveloping worm gears operating at a sliding velocity in excess of 10 m/s (2,000 ft/min) may require force-feed lubrication. For force feed lubrication recommendations, contact Cone Drive Engineering.

8 **Greased Bearings.** High quality lithium base NLGI #2 or NLGI #3 grease should be applied to fittings at normal maintenance intervals depending on duty cycle. Only bearings requiring added grease will have fittings.

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OIL CAPACITIES

APPROXIMATE CAPACITIES IN QUARTS AND GALLONS

SINGLE REDUCTION REDUCERS - FLOOR MOUNTED POSITION

UNIT SIZE		20	25	30	35	40	50	60	70	80	100	120
WORM OVER GEAR	HO SHO	1 Qt.	1 ½ Qt.	2 ½ Qt.	1 Gal.	1 ½ Gal.	2 ½ Gal.	3 ¾ Gal.	6 ½ Gal.	10 ½ Gal.	19 Gal.	45 Gal.
	ALT OIL LEVEL	½ Qt.	1 Qt.	1 ½ Qt.	2 ½ Qt.	1 ½ Gal.	1 ¾ Gal.	2 ½ Gal.	4 Gal.	6 ½ Gal.	12 ½ Gal.	26 Gal.
WORM UNDER GEAR	HU	½ Qt.	1 Qt.	1 ½ Qt.	3 ½ Qt.	1 ½ Gal.	2 ¼ Gal.	3 ½ Gal.	5 ¼ Gal.	7 ¾ Gal.	15 Gal.	30 Gal.
	SHU											
VERTICAL OUTPUT SHAFT	HV SHV	1 Qt.	1 Qt.	1 ½ Qt.	2 ½ Qt.	1 Gal.	1 ¾ Gal.	2 ¾ Gal.	5 Gal.	6 ½ Gal.	14 Gal.	26 Gal.

DOUBLE REDUCTION REDUCERS - FLOOR MOUNTED POSITION

UNIT SIZE	20 30	20 35	25 40	25 50	30 60	30 70	35 70	40 70	40 80	50 100	60 120
OO-UO-VO OOS-UOS-VOS	3 Qt.	1 ½ Gal.	1 ¾ Gal.	2 ¾ Gal.	4 ¼ Gal.	7 Gal.	7 ¼ Gal.	7 ½ Gal.	11 ½ Gal.	20 ¾ Gal.	47 ½ Gal.
OU-UU-VU	2 ½ Qt.	1 Gal.	1 ¾ Gal.	2 ½ Gal.	4 Gal.	5 ¼ Gal.	5 ½ Gal.	6 Gal.	8 ½ Gal.	16 Gal.	30 Gal.
OUS-UUS-VUS			1 ¼ Gal.	2 Gal.	3 ¼ Gal.	6 ¼ Gal.	6 ½ Gal.	7 Gal.	9 ¾ Gal.	18 ½ Gal.	34 Gal.
OV-UV-VV OVS-UVS-VVS	2 Qt.	2 Qt.									

APRON

BRIDGE

GEARMOTORS & HELICAL/WORM REDUCERS - ALL POSITIONS

UNIT SIZE		25	30	35	40	50	60	70	80
ALL MODELS MOUNTED WITH WORM UNDER GEAR	STANDARD SHAFT	2 Qt.	2 ½ Qt.	1 ¼ Gal.	2 ¼ Gal.	3 Gal.	4 ½ Gal.	7 Gal.	8 ½ Gal.
	HOLLOW SHAFT								
ALL MODELS MOUNTED WITH WORM OVER GEAR		1 ½ Qt.	1 ¼ Gal.	2 Gal.	2 ¼ Gal.	4 Gal.	5 Gal.	9 Gal.	11 Gal.
ALL MODELS MOUNTED WITH VERTICAL OUTPUT SHAFT		2 ½ Qt.	3 ½ Qt.	1 ½ Qt.	2 ¼ Gal.	3 Gal.	3 ¾ Gal.	8 Gal.	10 ½ Gal.
ALL MODELS MOUNTED WITH INPUT END UP		4 Qt.	1 ¼ Gal.	2 ¼ Gal.	3 Gal.	5 ¼ Gal.	6 ¾ Gal.	13 ½ Gal.	16 Gal.
ALL MODELS MOUNTED WITH INPUT END DOWN		3 ½ Qt.	1 Gal.	1 ¾ Gal.	2 ½ Gal.	3 ½ Gal.	4 ¾ Gal.	8 ¾ Gal.	10 ½ Gal.

BEARING GREASE:
High quality lithium base NLGI #2 or NLGI #3

NOTES:

Note #1 - For a complete list of approved synthetic and mineral based oils please see our "Approved List of Lubricants" file available at www.conedrive.com/iandm/approvedlubrication.pdf. You can also contact Cone Drive by calling 888-994-2663.

Note #2 - Worm gears operating at a sliding velocity in excess of 10 m/s (2,000 ft. per min.) may require force feed lubrication. For force feed lubrication recommendations, see our Product Catalog or contact our Application Engineers.

Note #3 - If a reducer is to be operated at an input rpm other than that shown on the name plate, contact our Application Engineers for recommendations.

Note #4 - Pour point of the oil used should be 5° C (9° F) less than the minimum ambient temperature expected. For special temperature or operating conditions, contact our Application Engineers for the proper lubrication selection.

IMPORTANT: Do not overfill units. Fill to center line of oil gauge or to pipe plug identified with oil level sticker. Oil capacities will vary due to mounting positions or type of gearshaft mounting used, such as solid shaft, hollow shaft or spread bearings. Each reducer is built and oil levels are set at the factory for a specific mounting position.

CONEDRIVE®
GEARING SOLUTIONS

LUBRICATION, INSTALLATION, OPERATION & MAINTENANCE INSTRUCTIONS FOR CONE DRIVE SPEED REDUCERS

Cone Drive double-enveloping worm gear speed reducers are used throughout Industry to provide smooth and quiet speed reduction. When properly selected, applied and maintained, they will provide optimum performance.

IMPORTANT: In any applications of Cone Drive Products where breakage, damage, disconnection, any other malfunction of any drive train component, or excessive wear could result in personal injury or property damage, a fail safe device capable of stopping and holding the load in the event of such an occurrence must be incorporated after the drive train.

THE FOLLOWING INFORMATION IS FOR YOUR PROTECTION. PLEASE READ CAREFULLY.

1. Do not attempt to install or operate this reducer until all of these instructions are read and thoroughly understood. If you have any questions, please contact Cone Drive.
2. The horsepower or output torque capacity of this reducer and the service factor (maximum allowable operating cycle) are stamped on the reducer nameplate. These values are not to be exceeded as overloading can result in reducer failure. Exceeding the rating and duty cycle will void the warranty. Please contact Cone Drive with any questions regarding rating and service factors.
3. Each reducer is specifically arranged to operate at the input speed specified on the nameplate. If the input speed is not specified by the customer, it is set up for 1750 RPM and service factor 1.0. Do not operate the reducer at speeds or under service other than specified on the nameplate without contacting Cone Drive for specific instructions on oil level location and bearing settings.
4. Do not alter the reducer without approval from Cone Drive.
5. This reducer has moving mechanical components and connected electrical devices, operating under high voltage to achieve its intended purpose. Operation and repair should only be done by qualified personnel.
6. Before servicing a speed reducer, the main electrical disconnect must be moved to and locked in the off-position. The person performing the work should post on that disconnect a warning to others not to turn on the power.
7. It is normal for the reducer to operate at a housing temperature of up to 200° F. To prevent burns, proper guards or shields must be provided by the purchaser or user to prevent personnel from touching the reducer.
8. Cone Drive products are furnished without guard covers. It is the responsibility of the purchase or user to provide guards for all exposed shafting, couplings, sprockets, sheaves, belts, chains, clutches, and any other moving parts in accordance with current local, state and federal requirements.
9. Failure to follow the instructions contained in this bulletin may result in unit failure, property damage or personal injury.

FINISH COAT PAINTING

Cone Drive speed reducers are furnished with a prime coat of paint on exterior housing surfaces. The reducer should be painted with a finish coat to protect the housing exterior, particularly if subjected to outdoor service, periodic washdown or harsh environments. Mask all shafts, oil seals, tags, name plates, oil level stickers, breathers, gauges etc. before painting. (Painting seal lips can result in oil leakage.)

INSTALLATION

IMPORTANT: Unless otherwise specified on the reducer or in accompanying documentation, all Cone Drive speed reducers are shipped without oil and must be filled to the oil level gage or plug with the proper oil before start-up. See the following section on lubrication.

1. The speed reducer must be securely mounted to a rigid flat foundation or base plate. If necessary, shim under the reducer feet to provide a flat mounting surface.
2. Bolt the reducer to the foundation or mounting base using the largest diameter bolt that will fit through the foot holes of the reducer. Be sure to use a bolt in all available mounting feet holes. If the reducer will be subjected to heavy chain pull or thrust loading, heat treated mounting bolts must be used to prevent stretching and loosening of the bolts.
3. The input and output shafts of the reducer should be coupled to the motor and driven shafts with flexible couplings and the reducer aligned with these shafts within +.001". Solid or rigid couplings should be avoided. Failure to properly align shafts and the use of solid couplings can result in excessive coupling and bearing wear, shaft deflection and eventual failure of one (1) or more of the components.
4. Couplings, sheaves and sprockets should be mounted on the reducer shafts carefully. Do not pound or hammer them onto the shafts as this will damage bearings and oil seals.

5. Sprockets and sheaves should be mounted as close to the reducer as possible and "V" belts and chains adjusted to the proper tension to keep bearing loading and shaft deflection to a minimum. Too much tension in belts and improper location of sheaves and sprockets will lead to excessive chain pull, bearing wear and shaft deflection. For specific information on chain pull capacity, shaft stress and bearing life please contact Cone Drive.
6. NOTE: Exposed metal parts are coated with a commercial rust inhibitor. This rust inhibitor must be removed prior to installation. Failure to do so may result in difficulty in assembling close tolerance mating components.
6. Before starting motor review motor rotation, reducer rotation and required direction of driven machine to insure that the motor is wired for proper direction of rotation. In many instances a machine must run in one direction and failure to wire the motor properly can result in damage to the driven machine
7. **IMPORTANT:** Fill unit to proper level with recommended oil. Grease all fittings with recommended grease (see section on lubrication). In the case of double or triple reduction reducers, be sure to fill each reduction stage to the proper oil level. Note: Some reducers may have been factory filled. Read all tags.

NOTE: All reducers are built for one mounting position, i.e.; floor mounted or wall mounted with worm vertical up or ceiling mounted, etc. If the reducer is to be mounted in any position other than the position for which it was furnished, contact Cone Drive for information on relocating oil level, grease packing bearings, etc., before start-up. If a reducer is operated in a mounting position other than the position for which it was assembled, reducer failure may occur from improper oil level or grease fitting location resulting in lack of lubrication to the gearset and bearings.

START-UP

1. After the reducer has been properly mounted, aligned and lubricated, it is ready for start-up.
2. Make sure driven machine is clear of all obstructions and all safety guards and covers are in place, according to appropriate local, state and federal requirements. If possible, turn motor shaft by hand to confirm drive system is operating freely and in correct direction of rotation.
3. Jog motor to confirm proper rotation.
4. Operate reducer with minimum load for approximately 15 minutes (in both directions if applicable) to seat gears, bearings, and oil seals

OPERATION

1. All reducers require a few hours of "run-in" under load to achieve optimum efficiency. During this initial run-in the reducer will probably run warmer than normal and draw more current than after the run-in period. Reducers operating at a very low load or speed will take much longer to run-in and even if operated continuously at low load or speed may never achieve the efficiency that they would if operated at or near their catalog rating.
2. **IMPORTANT:** Normal reducer operating temperature measured on the oil sump area of the housing should not exceed 100º F above ambient temperature or 200º F. If the reducer operating temperature exceeds 200º F, shut down the unit and contact Cone Drive. Excessive oil sump temperature is indicative of overloading, misalignment, or improper or marginal lubrication. Continuous operation of the reducer with the oil sump temperature above 200º F will result in breakdown of the oil and failure of the reducer.

MAINTENANCE

1. The reducer oil levels should be checked weekly and the recommended oil added as required to maintain the proper oil level.
2. Oil should be changed as outlined in the lubrication section.
3. All grease fittings should be lubricated with the recommended grease once per month.
4. The reducer, particularly finned areas and fan covers, should be kept clean to allow maximum heat dissipation.
5. All reducers and foundation bolts should be checked for tightness after three (3) months of service and annually thereafter.
6. If a reducer is to be repaired, contact Cone Drive for detailed instructions, blueprints, parts lists, etc. If it is necessary field service is available.
7. If a reducer is to be returned, contact Cone Drive for instructions and a returned material authorization (RMA) number.

STORAGE RECOMMENDATIONS FOR CONE DRIVE SPEED REDUCERS

If a reducer is to be stored or shut down for more than 30 days, it should be protected from water condensation and corrosion as follows:

Any enclosed system of gearing is subject to water condensation on the inside of the reducer caused by fluctuating ambient temperatures. This condensation can cause severe rusting of the worm and bearings which could lead to premature failure of the reducer. However, this condition can be easily prevented by following the recommendations outlined for various storage conditions. If the reducer is furnished with a motor, follow the motor manufacturers recommendations for motor preservation.

1. **Standard Shipping Procedure - Protection for Maximum Storage Duration of 30 Days.** Cone Drive speed reducers are treated inside using a rust inhibitor, the exterior is painted with one coat of primer, and all exposed shafting coated with a rust preventative prior to shipment. This procedure is intended to protect the reducers during shipment and short term inside storage for a maximum period of thirty (30) days after shipment.
2. **Long Term Storage (Indoors) for Periods up to One Year.** (a) Fill the reducer completely full with one of the lubricants shown on our approved list of lubricants. A copy of this lubricant list is shipped with each unit. (b) Rotate the wormshaft and gearshaft at least once per month to keep the seals from sticking to the wear rings and/or shafts. (c) If it is not practical to rotate the wormshaft periodically we recommend purchasing a spare set of oil seals to have on hand in the event of seal leakage at start-up. (d) Before putting the reducer into service, lower the oil in the reducer to the proper operating oil level.
3. **Long Term Storage (Outdoors) for Periods Up to One Year.** Proceed as in (2) with the following additions. (a) After filling the unit with oil, plug the breather hole with a pipe plug and wire the breather to the unit. (b) Paint the outside of the unit with a finish coat of paint. (Reducer from the factory is prime coated only.) (c) Coat all exposed shafting with a long term rust preventative.
4. **Extended Storage Periods Exceeding One Year.** (a) Immediately after receipt of the reducer treat the inside of the reducer with "Olin Chemicals Corp. - Dichan® 100 Vapor-Phase Corrosion Inhibitor for Ferrous Metals" by adding an amount specified by Olin Chemical, through the breather. Observe all Olin Chemicals Corp. cautions and warnings when handling this material. Plug the reducer and wire the breather to the unit. (b) Paint the exterior of the unit with a finish coat of paint. (c) Coat all exposed shafting with a long term rust preventative. (d) Place the unit in a heavy plastic bag treated with Dichan® 100 powder. Seal the bag air tight. (e) Crate the unit and cover the crate to keep out water. (f) Purchase a spare set of oil seals to have on hand at start-up

LUBRICATION DATA

Lubrication is very important for successful operation of Cone Drive gearsets and speed reducers. Inadequate lubrication can result in increased power consumption, added maintenance and gear-set failure. Please review the following recommendations and the "Approved List of Lubricants" shipped with all Cone Drive gearsets and speed reducers. Cone Drive recommends only those lubricants listed or any lubricant which meets all the requirements of AGMA (American Gear Manufacturers Association) 9004-D94 "Lubrication of Industrial Enclosed Gear Drives" as it applies to double enveloping worm gearing. Use of other lubricants can result in gearset failure which will not be covered under warranty. See reducers nameplate for the recommended lubricant.

TYPE OF OIL

Performance is based on synthetic lubricants. Using a mineral oil will reduce the mechanical power and output torque ratings by 25%.

AMBIENT TEMPERATURE

The oils shown in the table on the following page are for use in an ambient temperature range of approximately 15° to 125°F with the low end of the range depending on the pour point of the specific oil used. If the ambient temperature will be below or above this range please contact Cone Drive for specific recommendations on proper lubricant as well as proper oil seal and shim materials.

OIL SUMP TEMPERATURES

The maximum recommended oil sump temperature is 200°F. Where reducers will be used at maximum ambient and full catalog rating. Contact Cone Drive for lubrication recommendations.

SLUDGE

It is necessary that the oil be clean and free from sludge at all times to obtain long life from a gear unit. Sludge in gear units may be caused by excessive heat, from dust and dirt and other contaminates and by the presence of moisture or chemical fumes. Therefore, every precaution should be taken to prevent water and foreign particles from entering the gear case.

CONE DRIVE REDUCERS ARE SHIPPED WITHOUT OIL.

At assembly all reducers are treated with a rust inhibitor. This treatment coats all internal parts and will protect the reducer for a period of 30 days. If the unit is to be stored longer than 30 days, see long term storage instructions.

OIL CHANGE

If an approved synthetic lubricant is used, it should be changed after 5000 hours of operation or once per year, whichever occurs first. These change intervals are recommended for units operating under favorable conditions. Where operating conditions are severe, such a rapid rise and fall in temperature of the gear case with accompanied sweating of the inside walls and resulting formation of sludge, or where operation is in moist or dusty atmospheres, or in the presence of chemical fumes or extended running at sump temperatures in excess of 180° F, it may be necessary to change the oil at intervals of one to three months. It is recommended a sampling program be established with your lubricant manufacturer where reducers are exposed to the severe operating conditions, mentioned above.

OIL LEVEL

Cone Drive reducers are furnished with a bronze colored hex head pipe plug to indicate oil level. An oil level tag is affixed to the unit near the oil level indicator. Oil level should always be checked with the unit stopped. Estimated oil capacities for standard reducers, are listed in this section.

DOUBLE AND TRIPLE REDUCTIONS REDUCERS.

These units utilize separate housings and are furnished with separate oil sumps. It is important that all sumps are filled to the proper oil level.

GREASE PACKED BEARINGS

Bearings that are at least partially submerged in oil do not require special maintenance. However, bearings that are not submerged in oil require grease lubrication. Grease fittings and internal retainers are furnished when required. They should be greased with a high quality lithium base NLGI #2 or NLGI #3 bearing grease at normal maintenance intervals depending on the duty cycle of the reducer.

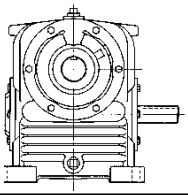
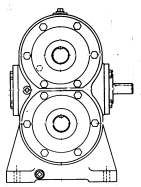
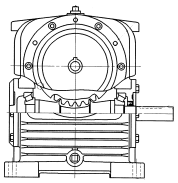
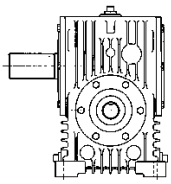
EXTREME PRESSURE (E.P.) LUBRICANTS

Extreme Pressure (E.P.) lubricants or cylinder oils with sulphurphosphorus additives are not acceptable and should not be used in Cone Drive Speed reducers or worm gearing.

Sizes 15 - 80
Single Reduction Speed Reducer
Assembly Instructions



Cone Drive Double Enveloping Worm Gear Units

TEXTRON

Power Transmission

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Introduction

This specification covers the assembly and disassembly of Cone Drive standard worm gear speed reducers and gearsets. It applies to single reduction reducers and standard or low backlash gearsets.

This manual assumes the person performing the assembly and disassembly has experience with servicing transmission equipment. Always use lifting equipment with heavy lifting capability. Standard tools used for the assembly and disassembly of reducers may be used to perform the instructions in this manual. A bearing press will also be necessary to install bearings and gears.

CALL CONE DRIVE TOLL FREE:
Sales Phone: 888-99-4 Cone
Sales Fax: 888-907-Cone
Parts & Service: 888-726-Cone
Parts Fax: 888-916-Cone

Cone Drive

Cone Drive Parts & Service Options

Field Service

Experienced Cone Drive personnel are available to make sure that your Cone Drive reducer is ready to give you the reliable duty for which it was designed.

To arrange for service, please call us toll free at 888-726-Cone, or ask for the field service extension.

Remanufacturing Center

Cone Drive's Remanufacturing Center at our Traverse City manufacturing facility is capable of any level of rebuild. For information, please call us toll free at 888-726-Cone, or ask for the rebuild service extension.

Technical Information

Assembly drawings of your reducer or technical assistance is available from Cone Drive.

Maintenance Workshops

Cone Drive's workshops are the most comprehensive technical educational program in the worm gear industry. We offer a variety of hands-on experience with double-enveloping worm gear speed reducers and gearsets, and teach valuable assembly, repair, and installation techniques.

At an advanced level, field simulation is balanced with classroom instruction at the Cone Drive Training Center and Dynamometer Test Facility. We can provide intensive training and individual attention is provided by Cone Drive engineers, technicians, and field service personnel.

Our programs focus on assembly, repair and installation, lubrication, reducer selection and rating, bearing setting, trouble shooting, and failure analysis.

The Controlling Dimensions

The controlling dimensions for the proper assembly of Cone Drive gearsets are: worm end position, gear side position and center distance. Since these dimensions are held during the manufacture of gearsets, these same dimensions should be maintained within the specified limits to properly locate the worm and gear in the housing at assembly.

Variations in housing flange face dimensions affect the end position of the worm and side position of the gear. We compensate for these variations by inserting shims between the bearing cap or carrier flange face and the housing bore face. The shims are adjusted to centralize the worm and gear in the housing.

Tolerances

The recommended tolerance limits for the controlling dimensions, (worm end position, gear side position, and center distance) are shown.

center distance	tolerances (+/-)
up to 6"	.001
6" to 8"	.002

figure 1

Errors In Angularity

Errors in angularity between the worm and gearshaft, beyond permissible limits, cannot be corrected by altering any of the locating dimensions. Care should be taken that the housing bores for the worm shaft and gear shaft are machined square with each other within .004" per linear foot.

Shims and Shim Sets

Shims are used in Cone Drive gear units both to properly position the worm and gear within the gear housing (see "Assembly Instructions"), and to set the desired bearing end-play or pre-load (see Recommended Tapered Roller Bearing Settings).

The shims also serve as gaskets for the bearing caps and carriers. As spare or replacement parts, the shims are packaged as "shim sets".

Each shim set includes an assortment of shims which are color coded according to thickness as shown in figure 2.

color	*thickness*	*color*	*thickness*
Yellow	.020"	Blue	.005"
Brown	.010"	Green	.003"

figure 2

Grease Packed Bearings

Bearings that are at least partially submerged in oil or oiled by internal oil scoops do not require special maintenance. However, bearings that are not lubricated as above require grease lubrication. Grease fittings and internal retainers are furnished when required, see figure 6. They should be greased with a high quality lithium base NLGI #2 or NLGI #3 bearing grease at normal maintenance intervals depending on the duty cycle of the reducer.

Adjustment of Bearing Settings

Opposed mounted single row tapered roller bearings require adjustment for end play. Select proper worm bearing setting according to RPM from figure 3.

Recommended Tapered Roller Bearing Settings

Single Reduction Reducer Worm Bearing Settings

Reducer Size (center distance)	***Worm Speed (1,000 - 2,000 RPM)***	***Worm Speed (2,001 - 3,600 RPM)***
15 to 35 (1.500" to 3.500")	.003 +/- .001	.005 +/- .001
40 to 60 (4.000" to 6.000")	.004 +/- .001	.006 +/- .001
70 to 80 (7.000" to 8.000")	.006 +/- .001	.007 +/- .001

figure 3

Notes:

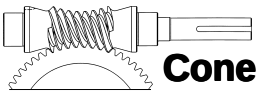
a. Settings shown in figure 3 are axial looseness.

b. All gear bearings up to and including 8.000" C.D. are set to a pre-load of (-).001+/-.001 for output speeds of 350 RPM or less. Contact Application Engineering for gear bearing settings for speeds in excess of 350 RPM.

c. 7.000" and 8.000" C.D. prior to 1980 have preset worm bearings.

d. These bearing settings are for standard and special reducers unless otherwise specified on the assembly drawing.

e. If low backlash is critical, some applications may require reduced settings. Contact Cone Drive Application Engineering for review.



Cone Drive

"O" Markings

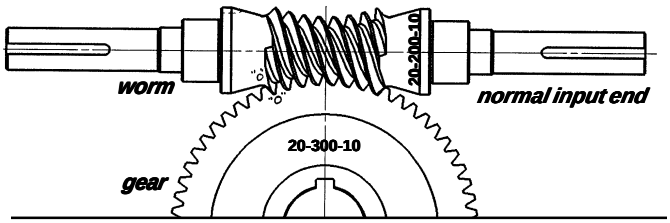
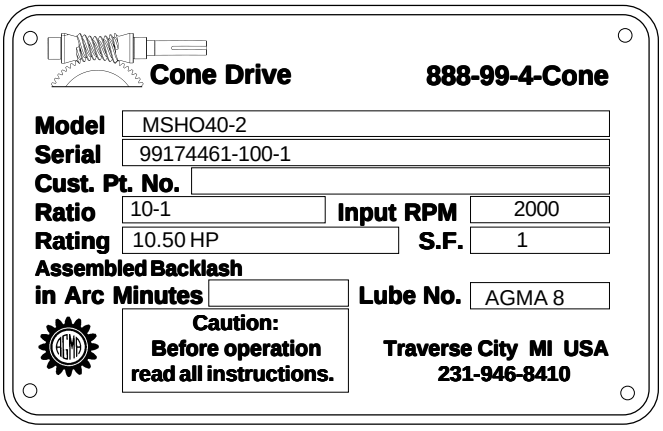


figure 4

"O markings will appear on all multiple threaded worm gearsets that have been lapped and all multiple threaded worm gearsets with low backlash. When "O" markings are present, care should be taken during assembly to ensure that the "O" marks are properly aligned. As indicated in figure 4, when properly aligned, the "O" stamped worm thread will pass through the "O" stamped space between two gear teeth.

Preparation for Rebuild

Applies to 1.5" through 8.0" Center Distance Single Reduction Speed Reducers.
When calling for parts, please reference reducer model number and serial number.
To properly identify a Cone Drive speed reducer we must have the reducer model number and serial number.



Cone Drive Reducer Nameplate
Line #1 -Reducer Model Number
example: MSH040-2.
Line #2 -Serial Number
example: 99174461-100-1.
year manufactured (99)
Cone Drive order number (174461)
order item number (100)
item sequence number (1)
Line #3 -Customer Part Number when required.
Line #4 -Ratio and Input Speed
Line #5 -Reducer Rating and Service Factor
Line #6 -Assembled Backlash and Lubricant No.

Drawings and Parts Lists
Assembly drawings, detail drawings, and parts lists for all units are available from Cone Drive. An assembly drawing is required to rebuild the reducer. Note positions of input and output shafts, breather and oil level plug. A photograph of the reducer before disassembly will be helpful.

Lubrication

Contact Cone Drive for lubrication list.

CALL CONE DRIVE TOLL FREE:
Sales Phone: 888-99-4 Cone
Sales Fax: 888-907-Cone
Parts & Service: 888-726-Cone
Parts Fax: 888-916-Cone

Oil Level

Cone Drive reducers are furnished with a bronze colored hex head pipe plug to indicate oil level. An oil level tag is affixed to the unit near the oil level indicator. Oil level should always be checked with the unit stopped. **Cone Drive reducers are all shipped without oil**. However, WhisperDrive units and Model RG units are shipped with oil**.**

Disassembly Instructions

1. Remove reducer from machine.
Caution: follow machine manufacturer's recommendations, making sure to remove all load from the reducer before removing reducer from machine.
2. Drain oil
3. Clean outside of housing
4. Position reducer on bench with gearshaft up.
5. Remove one (1) gear carrier making sure the shim packs stay with the carrier for determining the amount of new shims to use as a starting point when reassembling reducer.
6. Lift gearshaft assembly out of housing.
7. Wipe off excess oil.
8. Reposition housing so worm is pointing up.
9. Remove one (1) worm bearing carrier making sure shim pack stays with the carrier for determining the amount of new shims to use as a starting point when reassembling the reducer.

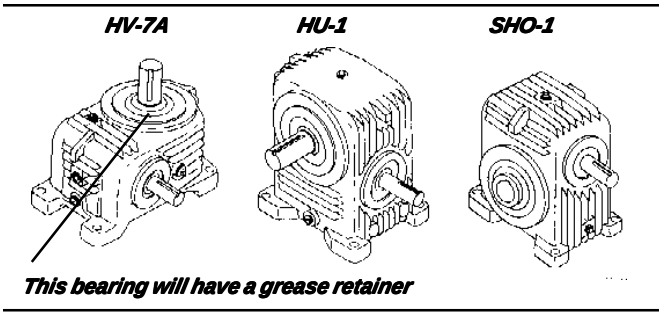


figure 5

10. Lift worm out of housing.
11. Remove remaining worm and gear carriers from housing making sure shims stay with carriers.
12. Remove bearing cups from all carriers.
13. Remove oil seals from open caps and carriers.
14. Clean inside of housing and carriers.
15. Discard old parts, i.e. bearings, seals, and gearset.

Assembly Instructions

Applies to 1.5" through 8.0" Center Distance Single Reduction Speed Reducers.
1. Refer to prints and parts lists for parts breakdown.
2. Check gearset for matched set numbers. The worm and gear must have the same set number.
3. Determine the hand of assembly of the speed reducer which is the relationship between the input and output shaft. This can be found on the name tag as part of the model number (see figure 5), the assembly drawing or from the reducer to be rebuilt.
4. All speed reducers 3" C.D. and larger with a vertical worm or gearshaft will have a grease retainer under the upper bearing cone on the shaft. The grease retainer must be installed with the rim toward the bearing cone, as shown in figure 6. When a grease retainer is used under a bearing, you must add .024" shims to the carrier on that bearing.
5. A 10 ton press will be required for installing the bearings and gear for reducers as large as 3.5" C.D. and a 50 ton press for reducers as large as 8.0" C.D. Press the bearing cups into the worm and gear carriers. Press the grease

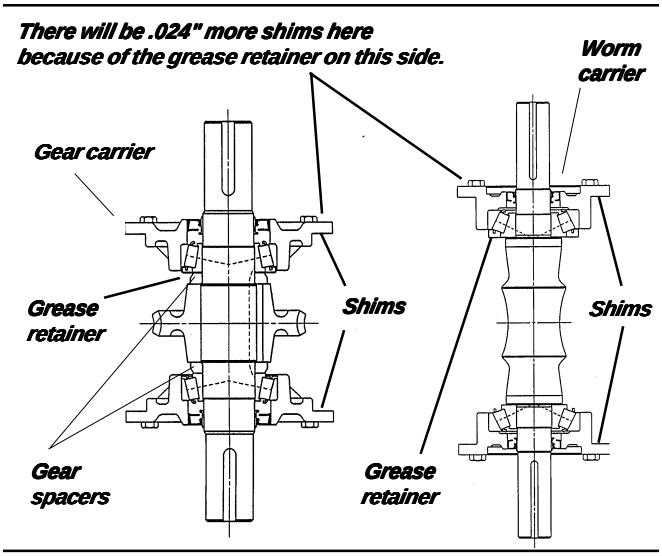


figure 6

retainer (if required) and bearing cones onto the worm. Press the gear, gear spacers (if required), grease retainer (if required), and bearing cones onto the gearshaft.

Bearing Settings

1. The first step for checking bearing settings is to assemble one (1) gear carrier starting with the same number of shims as with old reducer or the nomimal shim thickness caled for on the assembly drawing. Install the gearshaft assembly and bolt the remaining gear carrier and shims into the housing. Rotate the shaft while tapping on the end to seat the bearing rollers. Check the gear bearing setting with an indicator as shown in figure 7. With the dial indicator set at zero, pull up on the shaft while watching the dial indicator. Add or subtract shims as necessary to achieve the proper bearing setting shown in figure 3. The shims should be equal under both carriers so that the worm and gear are centered in the housing, unless there is a grease retainer being used.

2. Remove one (1) gear carrier and the gear shaft assembly from the housing. Note: Keep track of the amount of shims needed under the carrier.

3. The next step is to install the worm assembly into the housing and check the bearing settings in the same manner as the gear assembly. The recommended bearing settings can be found in figure 3, paying attention to reducer size and worm speed. When finished with the bearing settings the worm should be left in the speed reducer.

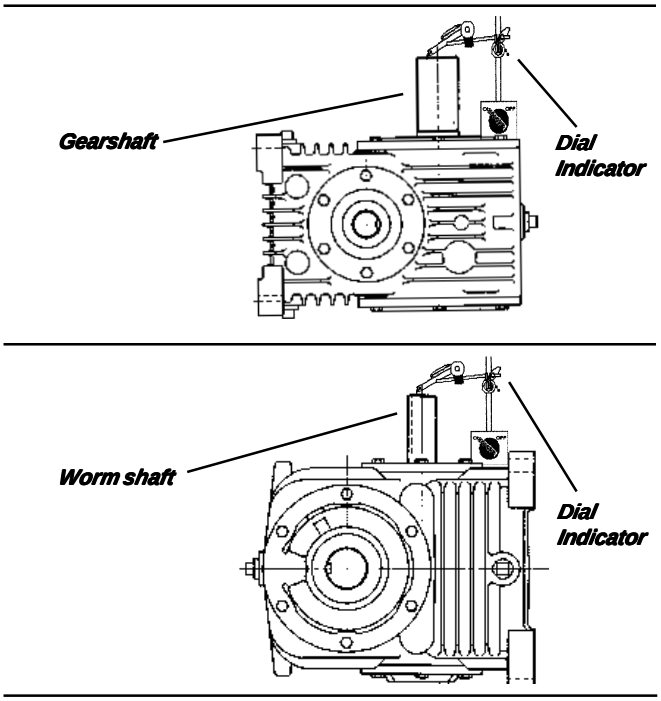


figure 7

Contact Pattern

1. Coat gear teeth and worm threads with a nondrying contact paste. Caution: On some multiple threaded worms, a zero marking will be on the worm and gear. These must be matched during the assembly of the gear and the worm. (refer to "O" marking in figure 4).

2. Install gearshaft assembly into the housing. Replace gear carrier and shims.

3. Rotate the worm shaft by hand until the gear has made one or more revolutions in each direction. Remove gear shaft assembly from the housing to observe the pattern on both the worm and gear.

4. The gearset must be positioned properly at assembly to obtain the desired contact between the worm threads and gear teeth. If the gearset is properly aligned, contact will be approximately as shown by the shaded portions in figures 9 or 13, depending on ratio. The correct pattern is symmetrical with respect to the centerline of the worm and the gear but will vary with ratio. The correct pattern for ratios 5:1 to 25:1 are shown in figures 9 and 10, and for ratios 30:1 to 70:1 see figures 13 and 14.

(discussion continues on page 10)

Sample Contact Patterns for 5:1 - 25:1 Ratios

Correct contact pattern for 5:1 - 25:1 ratio before running-in.

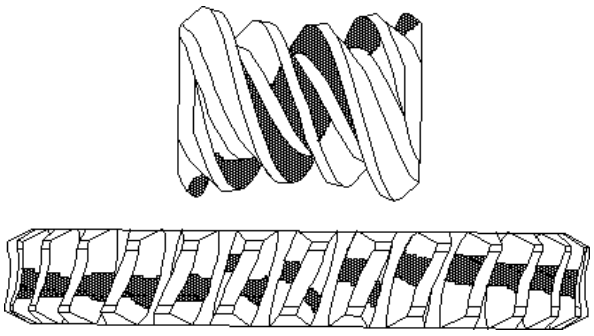


figure 9

Correct contact for 5:1 - 25:1 ratio pattern after running-in.

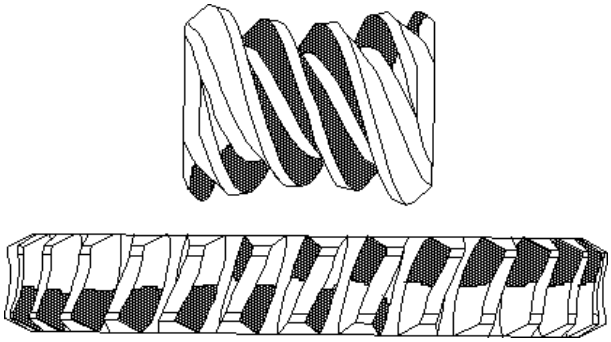


figure 10

How to correct 5:1 - 25:1 ratio for worm off end position.

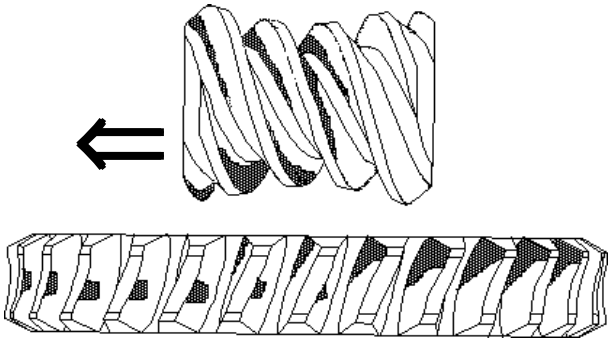


figure 11

How to correct 5:1 - 25:1 ratio for gear off side position.

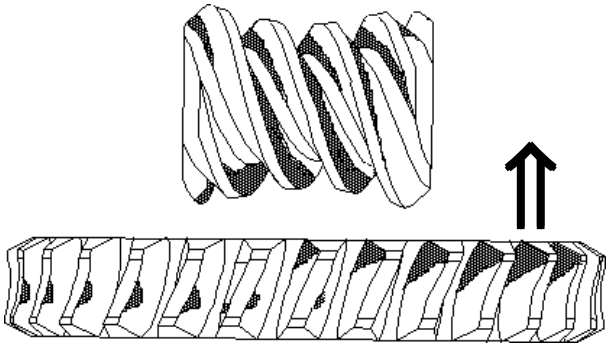


figure 12

Sample Contact Patterns for 30:1 - 70:1 Ratios

Correct contact pattern for 30:1 - 70:1 ratio before running-in.

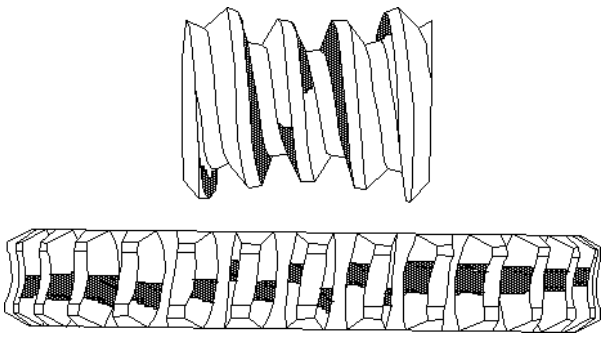


figure 13

Correct contact for 30:1 - 70:1 ratio pattern after running-in.

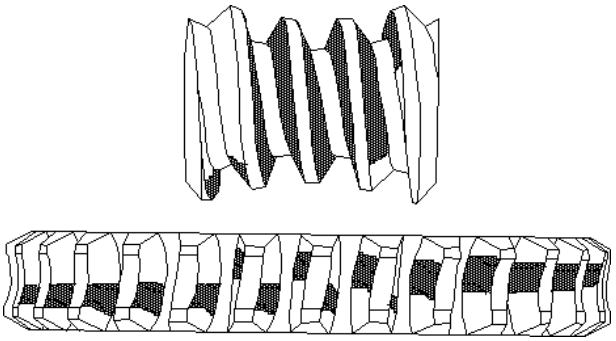


figure 14

How to correct 30:1 - 70:1 ratio for worm off end position.

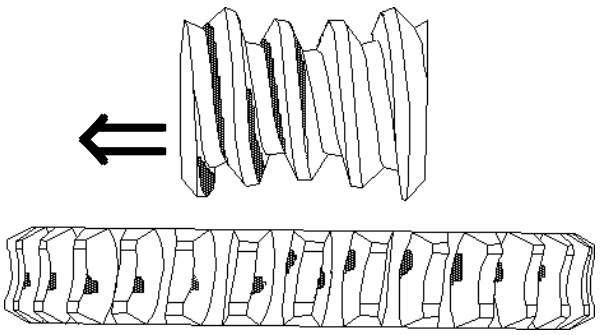


figure 15

How to correct 30:1 - 70:1 ratio for gear off side position.

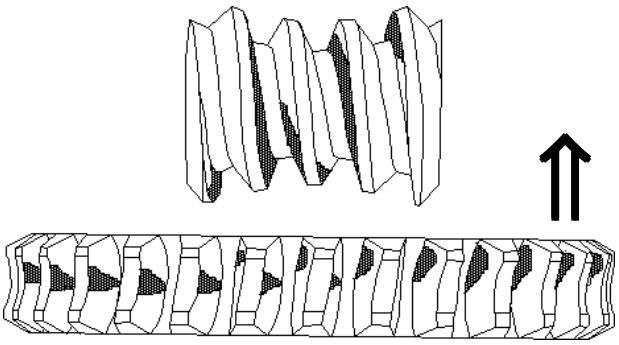


figure 16

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Contact Pattern (continued)

5. All of the illustrations, figures 11, 12, 15, and 16, show a misalignment of the gear set.

6. Correct any misalignment by removing shims from one bearing cap or carrier and adding an equal amount to the opposite cap or carrier. See figure 6.

7. If contact is similar to figures 11 or 15, the worm is out of position. Move the worm in the direction indicated by the arrow. If the contact pattern is opposite to that shown move the worm in the opposite direction.

8. If contact is similar to figures 12 or 16, the gear is off side position. Move the gear in the direction indicated by the arrow. If the contact pattern is opposite to that shown, move the gear in the opposite direction.

9. Install pipe plugs, oil level indicator, all bolts, and grease fittings if applicable. Bolt, torque settings can be found on the print or contact Cone Drive.

10. Install wear ring type oil seals. The wear ring should be assembled onto the shaft by tapping against the flange. A piece of round tubing works well as an assembly tool. Note: Tubing must clear the sealing surface of the wear ring which will expand up to .007" when pressed onto the shaft. Tap the oil seal into the cap or carrier and thus onto the wear ring using a liberal amount of grease on the lip of the seal and the wear ring.

Note: Be sure the outer lip of the seal is completely onto the sealing surface of the wear ring. See drawing, figure 8, for position of wear ring. The dimension for positioning the wear ring is indicated on the reducer assembly drawing.

11. Fill the speed reducer to the proper oil level with a recommended lubricant from the Cone Drive Approved List of Lubricants.

12. Special applications and older style speed reducers may use different assembly techniques.

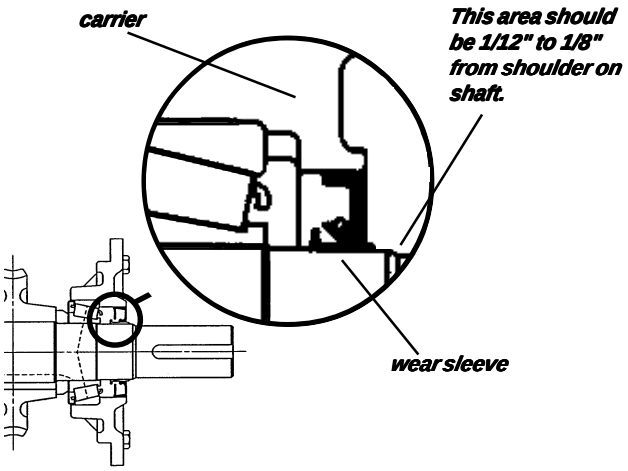
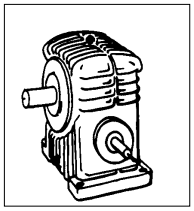


figure 8

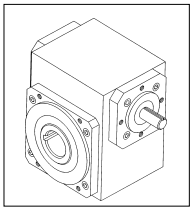
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Trouble Shooting Guide

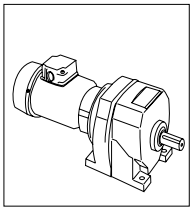
PROBLEM	***EFFECT***	***CAUSE***	***SOLUTION***
Decrease in efficiency	Wear & scoring of worm threads and gear teeth	Improper lubricant	Replace gearset, bearings and oil seals. Select correct lubricant from approved lube list.
Decrease in efficiency	Wear & scoring of worm threads and gear teeth	External torque overload	Eliminate overload, replace gearset, bearings and oil seals or select larger reducer.
Reducer runs hot	Wear & scoring of worm threads and gear teeth	Improper or insufficient lubricant	Replace gearset, bearings and oil seals. Select correct lubricant from approved lube list.
Reducer runs hot	Wear & scoring of worm threads and gear teeth	Input power exceeds thermal rating	Replace gearset, bearings and oil seals. Add Auxillary cooling or select larger reducer.
Reducer seizes up	Gearset and/or bearings running hot	Oil seal leaks	Check condition of gearset and bearings, replace if necessary. Replace oil seals.
Reducer seizes up	Bearings run hot	Tight bearings	Check condition of bearings, replace if needed. Shim bearings per bearing setting instructions.
Reducer seizes up	Bent worm or swedged gear teeth	External torque overload	Eliminate overload, replace gearset, bearings and oil seals or select larger reducer.
Loss of ratio	Broken worm threads or gear teeth	External torque overload	Eliminate overload, replace gearset, bearings and oil seals or select larger reducer.
Reducer comes loose from mounting	Broken reducer feet or foot bolts	External overload	Eliminate overload and replace reducer, if necessary, with same size or larger reducer.
Knocking noise from reducer	Bent gear tooth	External torque overload	Eliminate overload, replace gearset, bearings and oil seals or select larger reducer.
Squealing noise from reducer	Damaged bearing	Improper installation or inadequate lube	Replace bearings and oil seals.



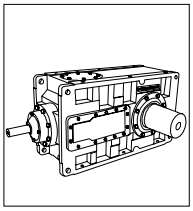
Cone Drive
Double Enveloping design in single, double, and triple reduction types.



WhisperDrive
Servo Precision Gearhead in three precision levels.



Series M
In Line Helical Geared Motors and Reducers.



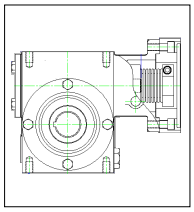
Series G
Helical parallel shaft and Bevel Helical right angle drive gear units.

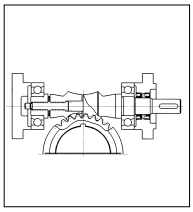
Model RG
Right Angle Gearhead in two precision levels.

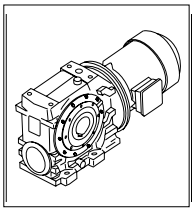
AccuDrive
Zero Backlash Gearing for positive rotational positioning.

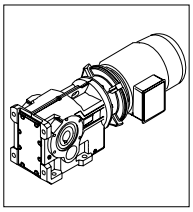
Series C
Right angle drive Helical Worm Geared Motors and Reducers.

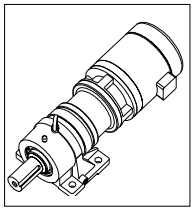
Series K
Right angle Helical Bevel Helical Geared Motors and Reducers.



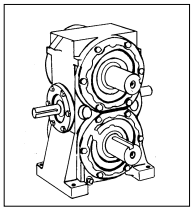




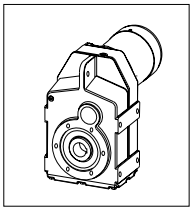




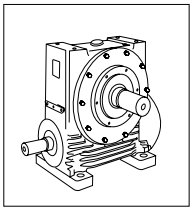
Series Q
In Line Planetary Geared Motors and Reducers.



DuoDrive
Dual Gears on parallel output shafts.



Series F
Parallel Helical shaft mounted geared motors and reducers.



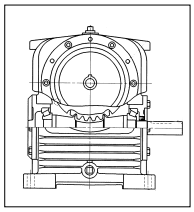
Series A
Worm Gear units and geared motors in single and double reduction types.

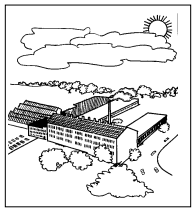
Extruder Drive
Rugged duty reducer takes high screw pressure.

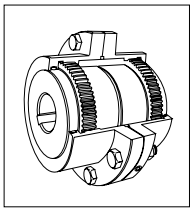
Remanufacturing Center
Fast turnarounds on rebuilds or preventative maintenance, warranteed service.

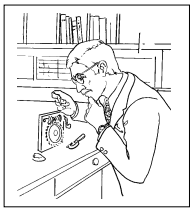
Series X
Nylicon and Cone Ring Type flexible coupling, Gear Type rigid and flexible couplings.

Gear Institute
Gearing's most comprehensive technical educational programs.







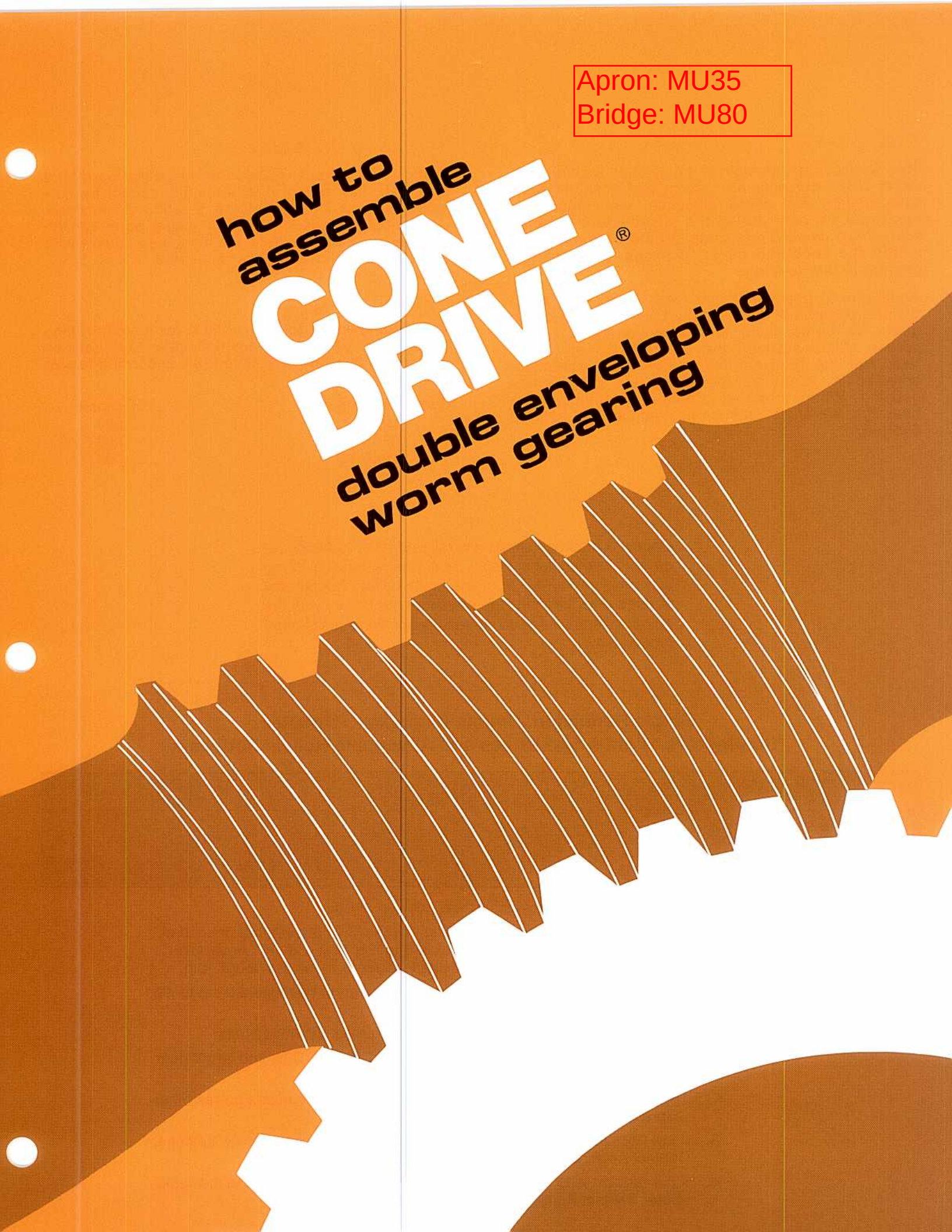


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888-Radicon -Toll Free Sales, 800-295-3749 -Parts & Service

Apron: MU35
Bridge: MU80

how to assemble CONE DRIVE® double enveloping worm gearing



The Controlling Dimensions:

The controlling dimensions for proper assembly of Cone Drive gearsets are: worm end-position, gear side-position and center distance. Since these dimensions are held during the manufacture of gearsets, these same dimensions should be maintained within the specified limits to properly locate the gearing in the housing.

Variations in housing flange face dimensions affect the end-position of the worm and side position of the gear. We compensate for these variations by inserting shims between the bearing cap or carrier face and the housing flange face. The shims are adjusted to centralize the worm and gear in the housing. Where opposed single-row tapered roller bearings are used, shims also adjust the bearing end-play.

Errors in Angularity:

Errors in the angular relation between the worm and gearshaft, beyond permissible limits, cannot be corrected by altering any of the locating dimensions. Care should be taken that the housing bores for the worm shaft and gear shaft are machined square with each other within .004″ per linear foot.

Tolerances:

The recommended tolerance limits for the controlling dimensions, (Worm end-position, gear side-position and center distance) are as follows, according to size (center distance):

Center Distance:	Tolerance
Up to 6″	± .001
6″ to 12″	± .002
over 12″	± .003

MU35

MU80

Adjustment of Bearing Play or Looseness:

Opposed mounted single-row tapered roller bearings require adjustment for end-play. Select proper bearing setting according to R.P.M. from the chart below. Double-row tapered roller bearings are pre-set at the factory with the proper clearance and do not require additional adjustment for end-play.

RECOMMENDED BEARING SETTINGS

Single Reduction, Double Reduction Primaries, Gearmotors, Right Angle Drives and Attachable Helical Reducers

MU35

REDUCER SIZE (CENTER DISTANCE)	WORM SPEED (1000-2000 RPM)	WORM SPEED (2001-3600 RPM)
15 to 35 (1.500" to 3.500")	.003 ± .001	.005 ± .001
40 to 60 (4.000" to 6.000")	.004 ± .001	.006 ± .001
70 to 80 (7.000" to 8.000")	.006 ± .001	.007 ± .001

MU80

NOTE:

A. Settings shown in above chart are axial looseness.

B. All gear bearings up to and including 12.000" C.D. are set to a preload of (-) .001 ± .001 for output speeds of 350 rpm or less. Contact Application Engineering for gear bearing settings for speeds in excess of 350 rpm.

C. For all double worm reducers, the secondary worm bearings are set to .001 ± .001 (loose).

D. 7.000" and 8.000" C.D. prior to 1980 have preset worm bearings.

E. 10.000" C.D. and larger worm bearings and 15.000" C.D. and larger gear bearings are preset.

F. These bearing settings are for standard and special reducers unless otherwise specified on the assembly drawing.

G. If low backlash is critical, some applications may require reduced settings. Contact Application Engineering for review.

H. If the reducer is to be operated at input speeds other than those indicated above, contact Application Engineering for review.

Running-in:

An advantage of Cone Drive gearing is that the manufacturing methods inherently reduce the amount of running-in required to obtain the desired contact. The worm and gear are regenerative (ie: they tend to regenerate themselves if assembled in a misaligned position). However, the more accurate the alignment of the worm gear, the less "running-in" required to obtain maximum efficiency and performance.

"O" Marking:

"O" markings will appear on some, but not all gear sets with multiple threaded worms. In the past, all Cone Drive multiple threaded worms had "O" markings, but today, due to new manufacturing processes, "O" markings are not always used. When "O" markings are present, care should be taken during assembly to ensure that the "O" marks are properly aligned. As indicated in the sketch below, when properly aligned, the "O" stamped worm thread will pass through the "O" stamped space between two gear teeth. See sketch at lower left.

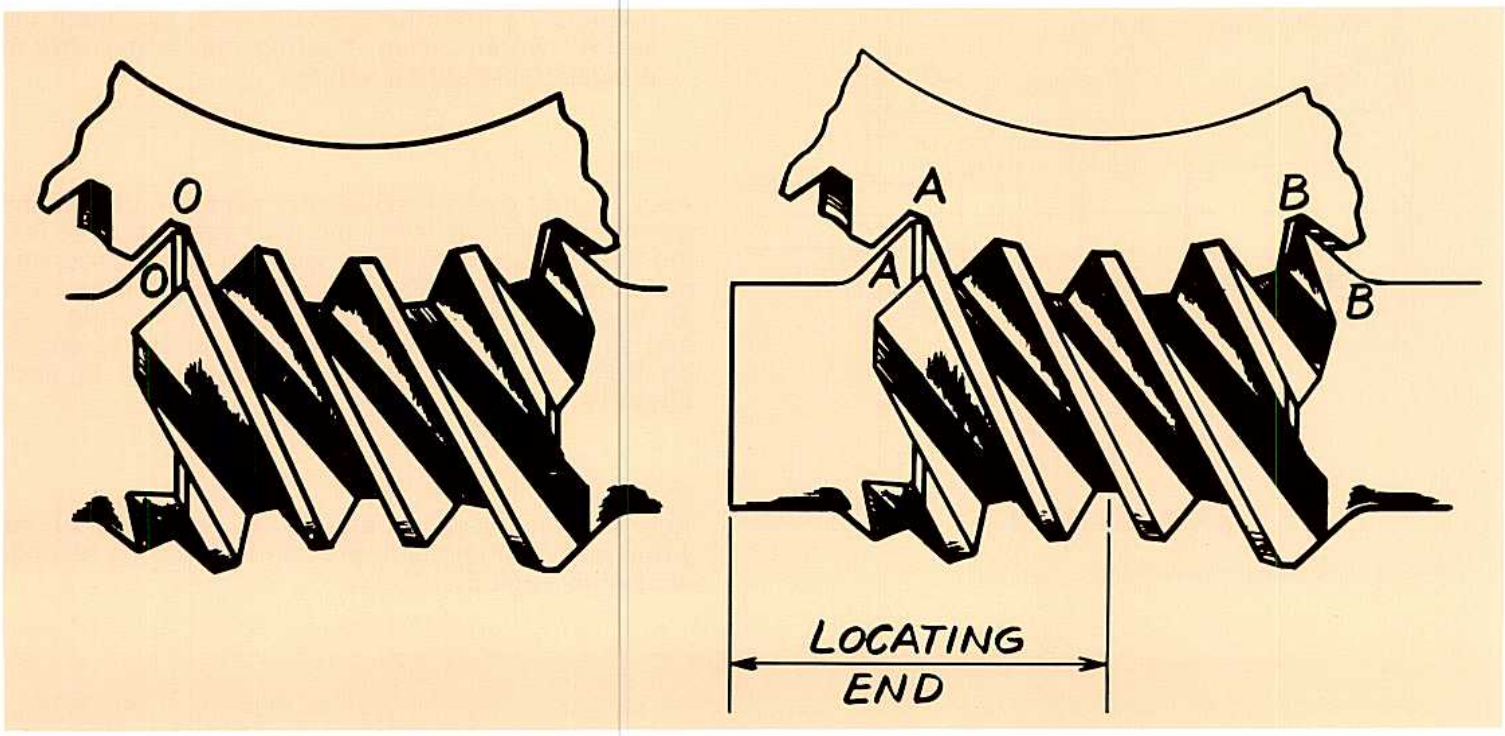
Single worm thread designs and self-indexing gearsets will not show "O" markings.

Matching Relationship:

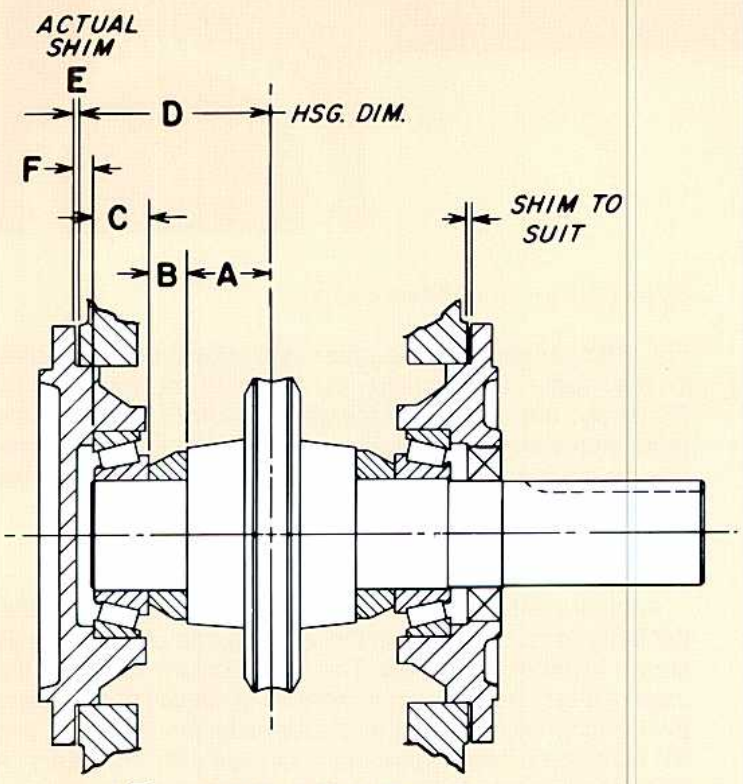
For optimum performance, gear sets should be assembled in the same relationship as matched at the factory. Generally, the matching note on the worm drawing would read "with worm on top (over gear) looking into the extension or drive-end of the worm, the gear marking is to the right (or left)".

Another method used is "A" and "B" marking. In this case, the letter "A" is stamped on the locating end of the worm as shown in the sketch below. This is particularly helpful in the case of a symmetrical worm, where it is difficult to determine the locating-end. At the time of assembly, the letters "A" and "B" stamped on the worm must coincide with the letters "A and "B" stamped on the gear. See sketch at lower right.

See worm print for proper matching relationship. Most standard gear sets are matched "with the worm on top (over gear), looking into the worm extension or drive-end, the gear marking is to the left.

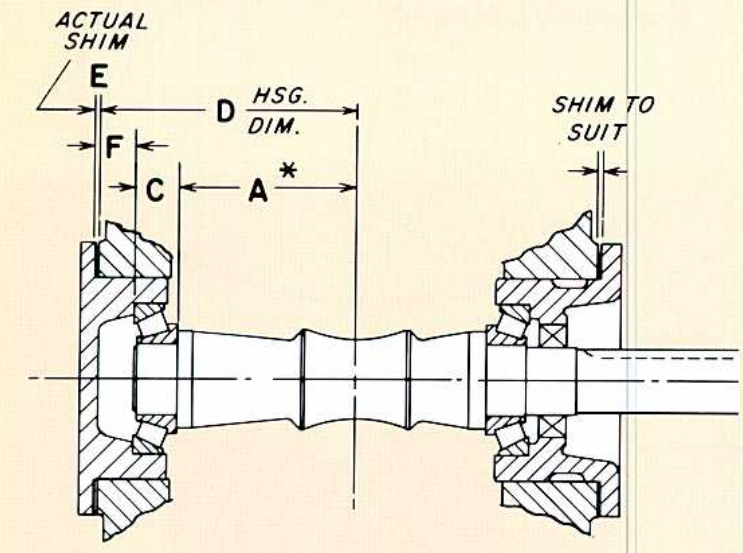


OPPOSED BEARINGS



E= A+B+C+F −D

SKETCH No. 1



E= A+C+F −D

SKETCH No. 2

*Dimension held exact in manufacturing.

Measuring:

Since there are numerous combinations of mounting arrangements, it would be virtually impossible to describe the measurement of each. However, by selecting one or a combination of the following methods, the measurement of any type of mounting arrangement can be accomplished.

Gear Assembly

1. Make the required measurements as shown in Sketch #1 and determine shim thickness E. If a grease retainer is required on the locating end add the thickness of the retainer to Dimension A.
2. Press the gear on the gearshaft being sure to observe the matching relationship discussed on Page 3. Add gear spacers and grease retainers (if required) and press the gear bearings onto the shaft.
3. Assemble one carrier, bearing cup, and shims (E thickness), to the housing. Drop the gearshaft sub-assembly into the housing from the opposite side and assemble the second gear bearing carrier and bearing cup with sufficient shims to provide .000 bearing setting.
4. Remove 1 carrier and remove the gearshaft sub-assembly from the housing. Keep the shim pack with the removed carrier.

Worm Assembly

1. Make the required measurements as shown in Sketch #2 and determine shim thickness E. If a grease retainer is required on the locating end, add the thickness of the retainer to Dimension A.
2. Press the worm bearing cones on the worm. If a grease retainer is required, it must be positioned between the bearing and the worm shoulder.
3. Assemble one carrier, bearing cup, and shims (E thickness) to the housing and drop the worm into the housing from the opposite side. Assemble the second worm carrier, bearing cup and shims to provide .000 bearing setting.

Check Contact

Apply a light coat of red lead or prussian blue to the worm and carefully lower the gear sub-assembly into the housing and into mesh with the worm observing match markings and 0 marking if required (See Page 3). Assemble the gear bearing carrier, bearing cup, and shims and check the contact pattern as shown on Pages 6 and 7 by rotating the worm in each direction.

Adjust Bearing Settings

Add or remove shims **equally** at each end of the worm and gear shafts to provide the bearing settings shown on Page 2.

DOUBLE ROW THRUST BEARINGS

General

The worm is assembled into the housing before the gear on Model HV up to and including 10.000" C.D. and on all Model HU and HO reducers with split type housing. On Model HV 12.000" C.D. and larger the worm is assembled last using an eccentric thrust bearing carrier to bring the worm into mesh with the gear.

Worm

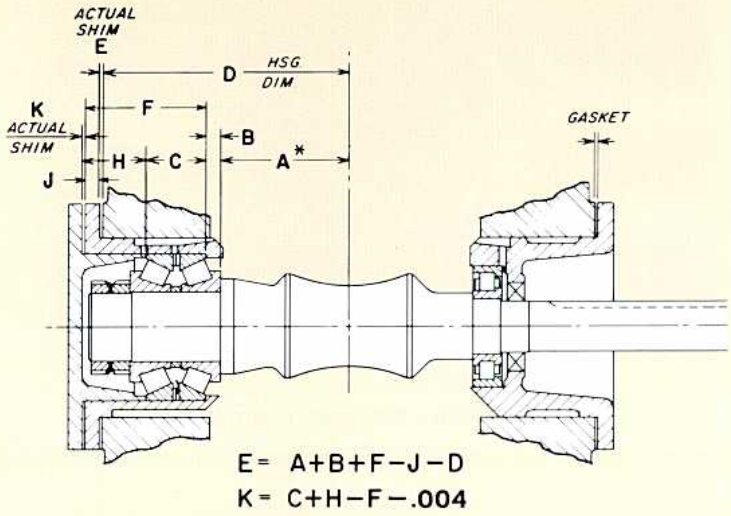
1. Make the required measurements as shown in Sketch #3 and determine shim thickness E. If a grease retainer is required on the locating end, add the thickness of the retainer to Dimension A.
2. Press all worm bearings on the worm. If a grease retainer is required, it must be positioned between the bearing and the worm shoulder. Assemble the locknuts and lock washers.
3. Assemble the worm into the housing using E shim thickness between the thrust bearing carrier and the housing. Lock the thrust bearing in place by installing K shim thickness between the bearing cap and the thrust bearing carrier. This should provide a .003-.005 clamp on the bearing cups.

Gear

1. Make the required measurements as shown in Sketch #4 and determine the spacer width J. If a grease retainer is required on the locating end, add the thickness of the retainer to Dimension A. Grind the thrust bearing spacer to J dimension and assemble the spacer, grease retainer (if required), and the thrust bearing to the shaft.
2. Press the gear on the gearshaft being sure to observe the matching relationship discussed on Page 3. Add the radial gear spacer and grease retainer (if required) and press the radial bearing into place. Assemble the locknuts and lock washers.

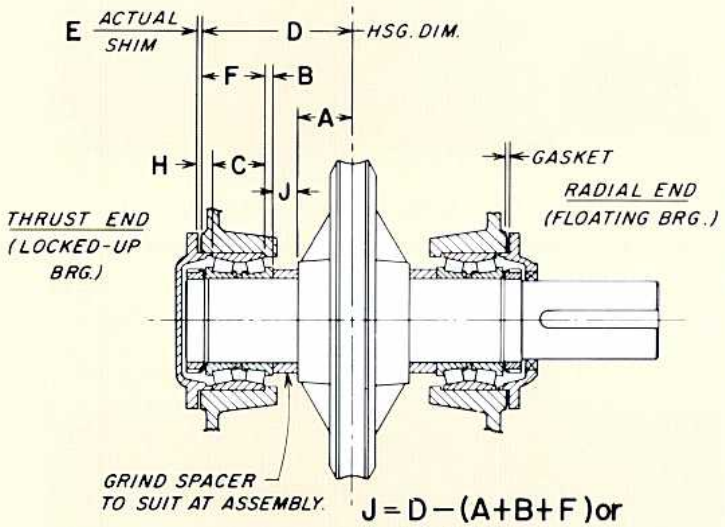
Check Contact

1. Apply a light coat of prussian blue or red lead to the worm.
2. Assemble the gearshaft sub-assembly into the housing and lock the thrust bearing in place by installing E shim thickness between the gear bearing cap and the housing. This should provide a .003-.005 clamp on the bearing cups.
3. Check the gearset contact patterns as shown on Pages 6 and 7 by rotating the worm in both directions.
4. No bearing adjustment is required on double row thrust bearings. The endplay is preset at the factory.



SKETCH No. 3

*Dimension held exact in manufacturing



SKETCH No. 4

FAST RATIOS (5:1–25:1)

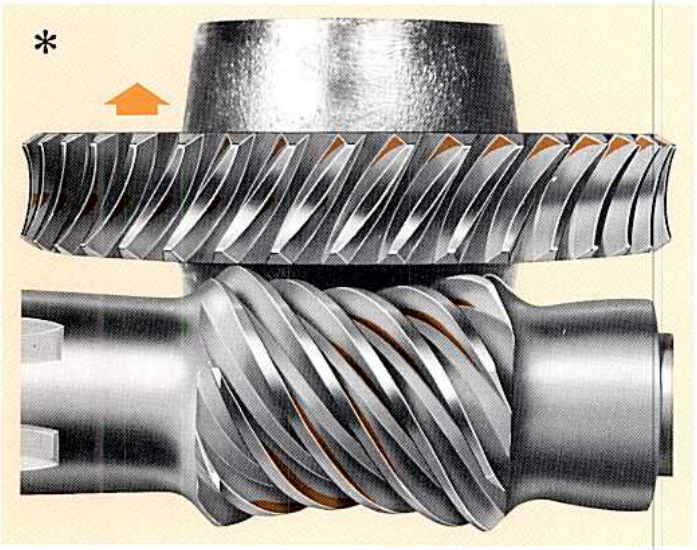


5:1 RATIO — CORRECT POSITION

GEAR SET

After the worm and gear have been assembled in the housing to the correct relative position, the assembly should be checked as follows: Brush a light even coat of red lead or prussian blue on the entire worm thread portion. Rotate the worm in both directions against a light retarding load on the gearshaft until a clear contact pattern is obtained on the worm thread and gear teeth. If the gear set is properly aligned, the contact should be approximately as shown by the shaded portion in the photographs on the top of this and the following page.

The ends of the worm thread are relieved slightly to provide a smooth entry into the gear teeth. After a short run-in under load the worm and gear will seat themselves and show increased contact on both members.



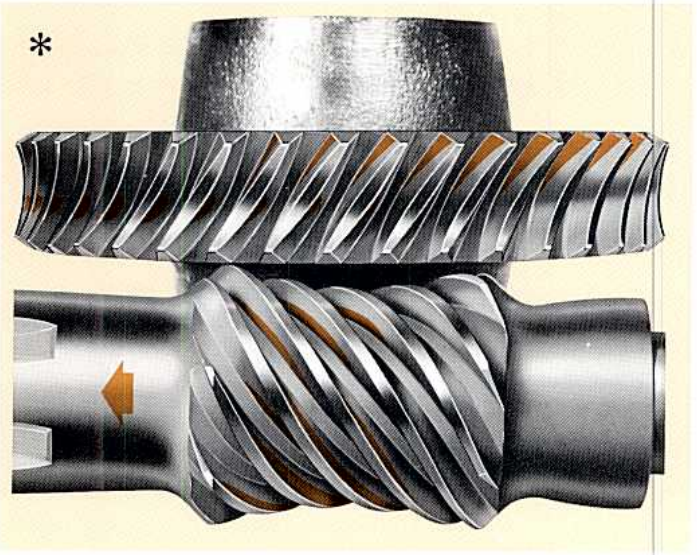
5:1 RATIO — GEAR OFF SIDE POSITION

GEAR OFF

Note that the contact pattern on the gear shows that the worm is making contact with the gear too soon on the left side of the gear teeth and too late on the right side of the gear teeth. This is corrected by moving the gear up to make the contact pattern symmetrical on both sides of the gear.

HOW TO CORRECT "GEAR OFF SIDE POSITION"

If the contact pattern on the gear teeth is similar to the illustrations shown at the left or right, the gear should be moved up a few thousandths as shown



5:1 RATIO — WORM OFF END POSITION

WORM OFF

Note that the left end of the worm shows full contact on the threads and the right end of the worm shows no contact. This is corrected by moving the worm to the left which will centralize the contact pattern.

HOW TO CORRECT "WORM OFF END POSITION"

If the contact pattern on the worm threads is similar to the illustrations shown on the left or right, the worm should be moved a few thousandths to the left as shown by the arrow. If the contact is opposite that shown, the worm should be moved to the right.

* *For illustration purposes only, the above 4 photographs show extreme conditions of off-positioning. Normal care at assembly will produce contact patterns more closely resembling the "correct positioning shown above."*

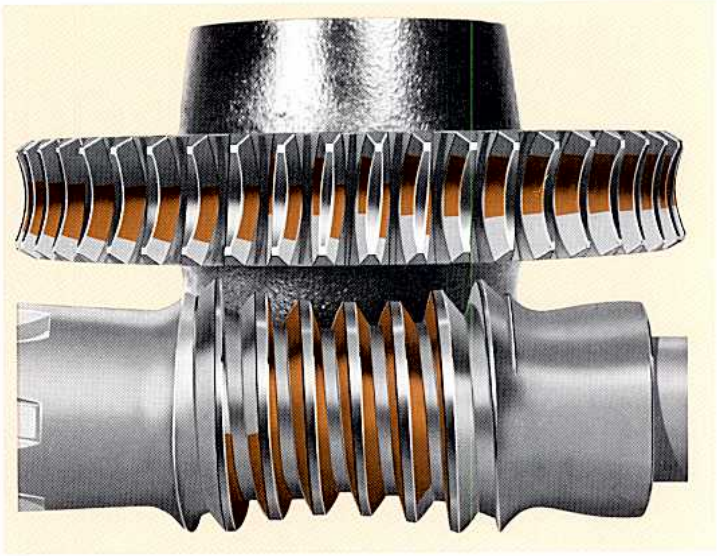
CONTACT

If the preceeding instructions have been followed accurately, the gearset should be positioned properly. However, minor inaccuracies in the housing, bearings or mountings may require a slight adjustment to the worm or gear to obtain proper gearset contact.

The most important objective when assembling worm gearing is to obtain a contact pattern that is symmetrical about the centerline of the worm and gear. The length and area of contact will vary with ratio, but regardless of ratio, the contact pattern should be symmetrical.

These illustrations represent optimum contact which may not be achieved at initial assembly. Lesser contact is acceptable providing it is relatively equal on either side of the worm and gear centerline.

SLOW RATIOS (30:1-70:1)



50:1 RATIO – CORRECT POSITION

SIDE POSITION

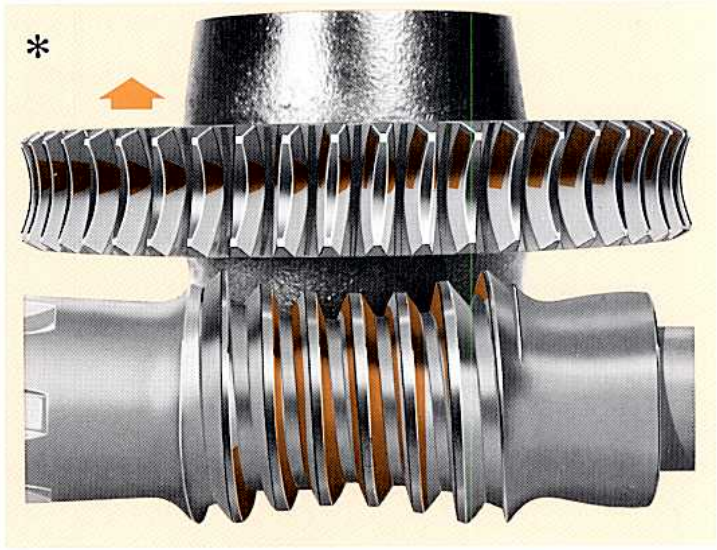
by the arrow. If the contact is opposite that shown, the gear must be moved down.

OPPOSED BEARINGS

The gear is moved by removing shims from under one gear carrier and putting the **same amount of shims** under the opposite gear carrier. (E shim as shown in Sketch #1, Page 4.)

DOUBLE ROW THRUST BEARINGS

The gear is moved by grinding the spacer between the locked up bearing and the gear.



50:1 RATIO – GEAR OFF SIDE POSITION

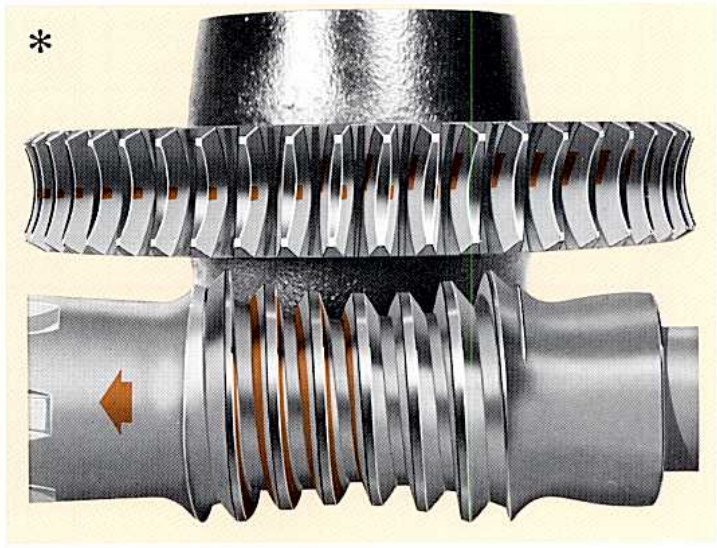
END POSITION

OPPOSED BEARINGS

The worm is moved by removing shims from under one worm carrier and putting the **same amount of shims** under the opposite worm carrier. (E shim as shown in Sketch #2, Page 4.)

DOUBLE ROW THRUST BEARINGS

The worm is moved by adding or removing shims between the thrust bearing carrier and the housing. (E shim as shown in Sketch #3, Page 5.)



50:1 RATIO – WORM OFF END POSITION

LUBRICATION CHART

AGMA STANDARD SPECIFICATION FOR LUBRICATION OF INDUSTRIAL ENCLOSED GEARING (250)

LIMITATIONS

Gear drives operating in normal ambient temperatures, -10°C (15°F) to 40°C (100°F), and at or below their thermal horsepower ratings (continuous duty), should have a maximum sump temperature not exceeding 93°C (200°F). Those operating in ambient temperatures less than -10°C (15°F) or greater than 40°C (100°F), or those operating in extremely humid, chemical, or dust laden atmosphere, should be referred to Cone drive Application Engineering for recommendations.

NOTE: 200°F max operating sump temperature

TYPE OF OIL

Lubricating oils for use in gear units should be high quality well refined petroleum oils. They must not be corrosive to gears, to ball, roller, or sleeve bearings; they must be neutral in reaction; free from grit or abrasives; and have good defoaming properties. They may be subject to high operating temperatures, so they must have good resistance to oxidation. Extreme Pressure (E.P.) lubricants or cylinder oils with sulphur-phosphorus additives are not acceptable and should not be used with Cone Drive worm gearing.

Worm gears generally require steam cylinder oils with additions of 3 percent to 10 percent of acidless tallow or similar animal fats.

VISCOSITY

Oils recommended for AGMA 7 comp, 8 comp and 8A comp must have a minimum viscosity index of 90.

LUBRICATION RECOMMENDATIONS

Pour Point of the oil used should be less than the minimum ambient temperature expected.

BEARING GREASE RECOMMENDATIONS

Reducers supplied with grease fittings are to be greased with a high quality lithium base NLGI #2 or NLGI #3 grease.

SLUDGE

It is necessary that the oil be clean and free from sludge at all times to obtain long life from a gear unit.

Sludge in gear units may be caused by metallic particles ground off the gears, from dust and dirt and by the presence of moisture or chemical fumes. Therefore, every precaution should be taken to prevent water and foreign particles from entering the gear case.

OIL CHANGE

If an approved synthetic lubricant is used, it should be changed after 5,000 hours of operation or once per year, whichever occurs first. If a recommended steam cylinder oil is used, the change interval should be after 2,500 hours of operation or every six months, whichever occurs first. This is recommended for units operating under favorable conditions. Where operating conditions are severe, such as a rapid rise and fall in temperature of the gear case with accompanied sweating of the inside walls and resulting formation of sludge, or where operation is in moist or dusty atmospheres, or in the presence of chemical fumes, or extended running at sump temperatures in excess of 180°F., it may be necessary to change the oil at intervals of one to three months.

VISCOSITY RANGE FOR VARIOUS AGMA LUBRICANTS

AGMA LUBRICANT NUMBER	VISCOSITY RANGE		
	ASTM SYSTEM		ISO GRADE
	SUS @ 210°F	SUS @ 100°F	CST @ 40°C
7 COMP.	125-150	1919-2346	414-506
8 COMP.	150-190	2837-3467	612-748
8A COMP.	190-250	4171-5098	900-1100

Above oils are compounded with 3 to 10 percent of acidless tallow or other suitable animal fats.

Refer to Cone Drive **"Approved List of Lubricants"** for specific oils that meet the above specifications. Cone Drive recommends only those lubricants listed or any lubricant which meets all the requirements of AGMA 250 "Lubrication of Industrial Enclosed Gear Drives" as it applies to double enveloping worm gearing. Use of other lubricants can result in gearset failure which will not be covered under warranty.

DOUBLE-ENVELOPING WORMGEAR UNITS

CENTER DISTANCE	Worm Speed Up to rpm	AMBIENT TEMP. -10°C to 10°C / 15°F to 50°F	AMBIENT TEMP. 10°C to 40°C / 50°F to 100°F	Worm Speed* Above rpm	AMBIENT TEMP. -10°C to 40°C / 15°F to 100°F
Up to 6 in. inclusive	0-700	8 comp	8A comp	700	8 comp
Over 6 in. to 12 in.	0-450	8 comp	8A comp	450	8 comp
Over 12 in. to 18 in.	0-300	8 comp	8A comp	300	8 comp
Over 18 in. to 24 in.	0-250	8 comp	8A comp	250	8 comp
Over 24 in.	0-200	8 comp	8A comp	200	8 comp

MU35

MU80

*Wormgears operating at speeds above 2400 rpm or 2000 feet per minute rubbing speed may require force feed lubrication. In general, an AGMA #7 lubricant of lower viscosity than recommended in the above table may be used with a force feed system.

Cone Drive Operations Inc./
Subsidiary of Textron Inc.
240 E. 12th Street, P.O. Box 272
Traverse City, MI 49685-0272
Phone: 616-946-8410
FAX: 616-946-0235

MEMBER AGMA

Appendix 4.4.5.2

System: Bridge Hoist Machinery
Component: Drum Support Frame
Manufacturer: Thern, Inc.

Model #: 4HW80-70S

ELECTRIC WINCHES — DIRECT DRIVE

4HW SERIES

NOT FOR LIFTING PEOPLE, OR THINGS OVER PEOPLE

NOTE: USE EXTREME CAUTION IN ALL WINCHING OPERATIONS. READ OWNER'S MANUAL.



STANDARD FEATURES

- GENERAL — The helical/worm gearing of the 4HW Series winch allows for smooth and quiet operation. The winch is compact, and with modification it may be mounted in any position (horizontal, vertical, diagonal, or inverted). Wire rope may leave the winch drum at any angle (barring winch frame interference) simplifying load hook-up.
- DRIVE — Power is transmitted from the motor to the winch drum through a two stage speed reducer. The primary stage is helical gearing. The secondary stage is double enveloping worm gearing. Speed reducer housing is cast iron and all shafts are supported by tapered roller bearings.
- CONSTRUCTION — The winch frame and the winch drum are welded steel construction. The drum, with recessed cable anchor, is attached directly to the output shaft of the speed reducer. The other drum end is supported by a spherical roller bearing pillow block with cast steel housing. The brake motor is integrally mounted to the speed reducer.
- MOTOR — Continuous duty, Totally Enclosed Fan Cooled (TEFC), fully reversible, squirrel cage induction brake-motors are standard equipment. They are class F insulated, IEEE 45 marine duty (above deck) approved, UL and CSA recognized, three phase, 200/230/460 volt. Motor brakes are spring set/electrically released disc type.



Model 4HW35 with Thern magnetic reversing motor controls with 50' electric remote cord-pendant control.

OPTIONS

SPECIAL DRUMS —
- Grooved
- Center Flange
- Non-Standard Drum Sizes

MOTORS — For special environments

MAGNETIC REVERSING MOTOR CONTROLS — For remote operation in many environments.

WEATHERPROOF BRAKES

SPECIAL LINE SPEEDS

LIMIT SWITCHES — Available for limiting load travel

SPECIAL MOUNTING ARRANGEMENTS



Model 4HW50 with magnetic reversing motor controls and a grooved drum.

DIMENSIONS and SPECIFICATIONS

HELICAL/WORM GEAR SERIES 4HW

NOT FOR LIFTING PEOPLE, OR THINGS OVER PEOPLE

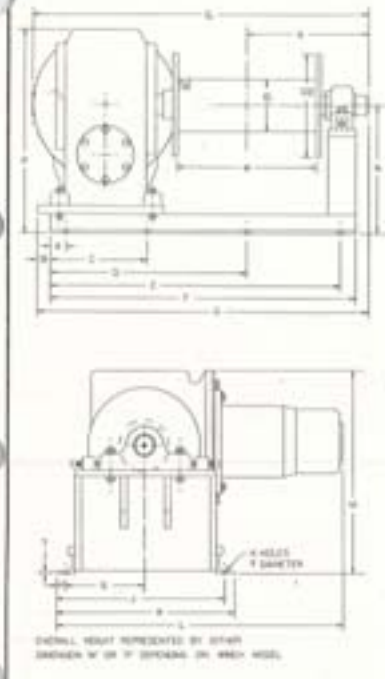


TABLE 1 — STANDARD SPECIFICATIONS

	MODEL NO.	4HW 25	4HW 30	4HW 35	4HW 40	4HW 50	4HW 60	4HW 70	4HW 80
	MOTOR H.P.	1.0	1.5	2.0	3.0	5.0	5.0	7.5	7.5
	DRUM RPM	21.75	17.35	14.38	14.38	10.44	8.70	8.70	7.25
	WIRE ROPE SIZE (min.)	.219	.250	.312	.375	.437	.500	.562	.625
1ST LAYER	LOAD RATING (lbs.) Continuous Duty	1033	1400	2100	2700	4600	5100	6720	7100
	Semi-continuous Duty	1200	1730	2300	3000	5500	6000	7500	8100
	Intermittent Duty	—	—	—	5500	6300	6700	8200	8900
	DRUM CAPACITY (ft.)	45	60	75	75	70	70	75	70
	LINE SPEED (fpm)	24.0	21.6	23.1	26.4	22.5	20.7	24.1	21.6
2ND LAYER	LOAD RATING (lbs.) Continuous Duty	895	1260	1800	2430	3600	4080	5070	6390
	Semi-continuous Duty	1080	1560	2070	2700	4950	5400	6719	7290
	Intermittent Duty	—	—	—	3150	5670	6030	7410	8010
	DRUM CAPACITY (ft.)	95	125	155	155	150	150	155	150
	LINE SPEED (fpm)	26.5	23.8	24.4	29.2	25.0	23.0	26.6	23.9
3RD LAYER	LOAD RATING (lbs.) Continuous Duty	805	1150	1750	2220	3270	4000	5040	5850
	Semi-continuous Duty	990	1425	1990	2450	4500	4950	6160	6840
	Intermittent Duty	—	—	—	2880	5150	5520	6750	7290
	DRUM CAPACITY (ft.)	150	200	245	245	240	240	245	240
	LINE SPEED (fpm)	29.0	26.1	26.8	32.1	27.5	25.3	29.2	26.4
4TH LAYER	LOAD RATING (lbs.) Continuous Duty	790	1050	1600	2050	3050	3650	5100	5350
	Semi-continuous Duty	910	1300	1700	2250	4150	4510	5700	6100
	Intermittent Duty	—	—	—	2650	4750	5050	6200	6700
	DRUM CAPACITY (ft.)	210	275	345	340	335	335	340	335
	LINE SPEED (fpm)	31.5	28.4	29.2	35.0	30.0	27.6	31.8	28.7
	ANCHOR BOLT SIZE (dia.)	3/8	7/16	1/2	5/8	7/8	7/8	1	1
	APPROX. WEIGHT (lbs.)	320	380	575	550	825	1000	1600	1800

TABLE 2 — STANDARD DIMENSIONS

	DRUM			ALL DIMENSIONS IN INCHES																		HOLES	
MODEL	W	I.D.	O.D.	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	X	Y
4HW25	9.0	4.50	7.0	1.0	2.0	5.0	—	19.25	19.5	22.50	.88	12.12	13.0	25.5	15.12	9.12	14.12	23.88	8.50	5.62	.38	.5	.437
4HW30	12.0	4.50	8.5	1.0	2.0	7.0	—	23.19	24.44	27.38	.88	14.12	15.0	29.5	15.75	10.25	14.75	26.94	8.50	5.62	.38	.5	.500
4HW35	15.0	5.50	10.0	1.0	2.0	9.0	—	29.88	30.38	33.88	.88	15.12	16.0	30.88	16.88	11.38	15.88	33.38	11.50	7.12	.38	.5	.562
4HW40	15.0	6.62	11.0	1.5	2.0	9.5	—	31.12	32.88	35.62	1.25	16.75	20.0	34.12	20.62	13.62	16.09	36.12	12.12	8.75	.50	.5	.687
4HW50	15.0	7.38	12.0	1.5	2.0	10.1	20.1	33.19	35.19	38.38	1.25	24.75	26.0	40.00	23.19	15.62	23.19	37.88	12.88	11.75	.50	.5	.937
4HW60	15.0	8.62	14.0	1.5	2.0	11.3	22.3	35.38	37.38	40.75	1.25	26.75	28.0	41.75	23.75	17.50	25.38	39.12	12.88	12.75	.50	.5	.937
4HW70	15.0	10.00	16.0	1.5	2.0	10.3	27.0	36.75	41.00	44.00	1.75	31.25	33.0	47.00	30.62	21.88	30.75	43.75	14.00	14.75	.50	.5	1.062
4HW80	15.0	10.75	17.0	1.5	2.0	10.3	27.5	36.75	42.00	45.00	1.75	33.25	35.0	49.00	33.75	23.88	32.75	45.75	14.00	15.75	.50	.5	1.062

DIMENSIONS ARE FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE WITHOUT NOTICE. FOR CONSTRUCTION, REQUEST FACTORY CERTIFIEDS.

Thern, Inc.
5712 Industrial Park Rd,
Winona, MN 55987
(507) 454-2996

Note: Obsolete model. Manufacturer has no information available for this series. This information is for reference only.
See "Nameplate Data" in Section 4.4.4 of this manual and contact manufacturer for information.

Appendix 4.4.5.3

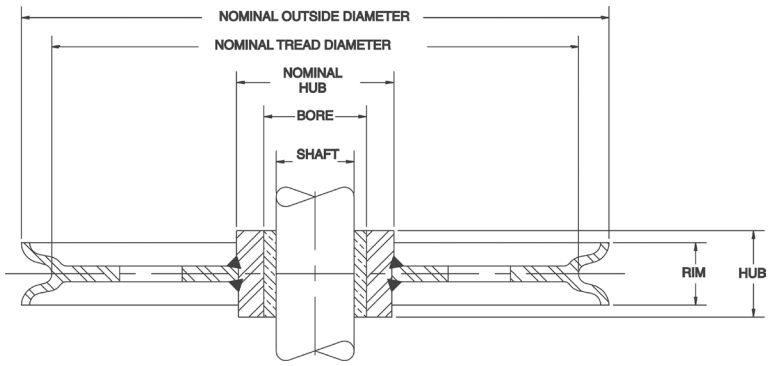
System: Bridge Hoist Machinery
Component: Deflector Sheave
Manufacturer: McKissick

McKissick® Sheaves Selection Guide

McKissick® sheaves come in a variety of sizes to suit your specific applications. Crosby offers many sheaves as standard and these are shown in the pages that follow.

For applications that require unique specifications, Crosby can make minor modifications to many of the sheaves listed at a reasonable charge. We can also custom design and manufacture sheaves to your exact requirements. Contact Crosby Sales to order McKissick® sheaves and include the stock number and quantity. For help in finding that standard sheave or for help with special requirements or custom designed sheaves, furnish the following important information:

NOTE
Bore in hub should produce a running clearance fit with shaft. This is 0.003" to 0.007" clearance.



DIMENSIONAL INFORMATION

Nominal Outside Diameter: 18" **Wire Rope Size:** 3/4" **Rim Width:** _____

+ Shaft Size: 2" (nominal) ***Hub Width:** _____

Nominal Tread Diameter (Optional): _____ **Nominal Hub Diameter (Optional):** _____

*Hub width is measured over the cone of the Tapered Bearing Sheaves.
+ Shaft Size is Bore Size on Plain Bore Sheaves.

BEARING TYPE

☒ Bronze Bushing ☐ ++ Roller Bearing ☐ Tapered Roller Bearing ☐ Finish / Plain Bore
☐ Full Complement Cylindrical Roller Bearing ☐ Underwater ☐ Other

++ Requires hardened and ground shaft

MATERIAL TYPE

☒ Roll-Forged™ (Flame hardened 14" and larger) ☒ Forged Steel ☐ Domed
☒ Cast Steel ☐ Fabricated ☐ Other

APPLICATION INFORMATION

Line Pull: _____ **Fleet Angle:** 0 **Degree of Wrap:** 180

Line Speed: <50 fpm **Environment:** Outdoor **Groove Angle:** 30 to 35 degrees

SPECIAL REQUIREMENTS

Special Testing: _____

Finish: _____

Third Party Inspection / Approval: _____

In USA: Crosby's Special Engineered Product Group at 1-800-777-1555, fax (918) 834-5035, specials@thecrosbygroup.com
In Canada: Crosby Canada at (905) 451-9261
In Europe: N.V. Crosby Europe at 32 15 757125(26).

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Appendix 4.4.5.4

System: Bridge Counterweight System
Component: 36" Diameter Sheave
Manufacturer: McKissick

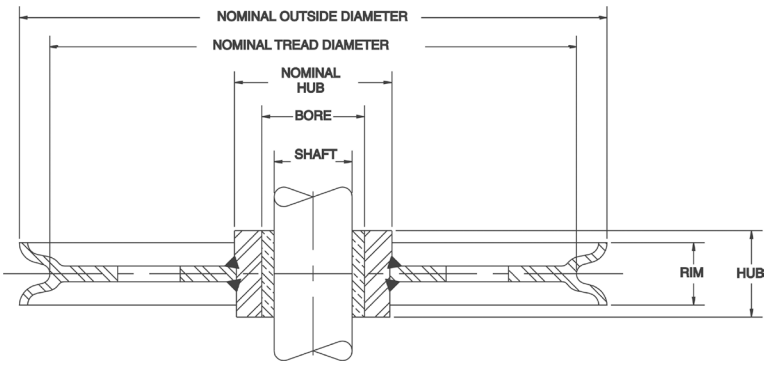
BRIDGE COUNTERWEIGHT SHEAVE (CUSTOM)

McKissick® Sheaves Selection Guide

McKissick® sheaves come in a variety of sizes to suit your specific applications. Crosby offers many sheaves as standard and these are shown in the pages that follow.

For applications that require unique specifications, Crosby can make minor modifications to many of the sheaves listed at a reasonable charge. We can also custom design and manufacture sheaves to your exact requirements. Contact Crosby Sales to order McKissick® sheaves and include the stock number and quantity. For help in finding that standard sheave or for help with special requirements or custom designed sheaves, furnish the following important information:

NOTE
Bore in hub should produce a medium interference fit with shaft. This is 0.002" to 0.004" interference.



DIMENSIONAL INFORMATION

~~Nominal Outside Diameter:~~ Pitch Diameter 36" **Wire Rope Size:** 1" **Rim Width:** _____

+ Shaft Size: 4-1/2" (nominal) ***Hub Width:** 7"

Nominal Tread Diameter (Optional): _____ **Nominal Hub Diameter (Optional):** _____

***Hub width is measured over the cone of the Tapered Bearing Sheaves.**
+ Shaft Size is Bore Size on Plain Bore Sheaves.

BEARING TYPE

☐ Bronze Bushing ☐ ++ Roller Bearing ☐ Tapered Roller Bearing ☒ Finish / Plain Bore

☐ Full Complement Cylindrical Roller Bearing ☐ Underwater ☐ Other

++ Requires hardened and ground shaft

MATERIAL TYPE

☒ Roll-Forged™ (Flame hardened 14" and larger) ☒ Forged Steel ☐ Domed

☒ Cast Steel ☐ Fabricated ☐ Other

APPLICATION INFORMATION

Line Pull: _____ **Fleet Angle:** 0 **Degree of Wrap:** 180

Line Speed: <50 fpm **Environment:** Outdoor **Groove Angle:** 30 to 35 degrees

SPECIAL REQUIREMENTS

Special Testing: _____

Finish: _____

Third Party Inspection / Approval: _____

In USA: Crosby's Special Engineered Product Group at 1-800-777-1555, fax (918) 834-5035, specials@thecrosbygroup.com
In Canada: Crosby Canada at (905) 451-9261
In Europe: N.V. Crosby Europe at 32 15 757125(26).

McKissick Sheaves

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Appendix 4.4.5.5

System: Apron Hoist Machinery
Component: Brake
Manufacturer: Stearns

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NEMA Frame	**Series**	**Torque (lb-ft)**	**Nm**	**Enclosure**	
48C	48,100	1.5 - 6	2-8	IP 23	9
56C - 145TC	56,X00	1.5 - 25	2-34	IP 21, 23, 54, 55, 56, 57	10-15
182TC - 256TC/UC	56,600	10 - 25	14-34	IP 23, 54, 55	16
	87,000	6 - 105	8-142	IP 23, 54, 55	17-20
284TC/UC - 286TC/UC	87,100	50 - 105	68-142	IP 23, 54	21
324 - 405TC/TSC/UC/USC	81,000	125 - 230	169-312	IP 23, 54	22-23
	82,000	125 - 440	169-597	IP 23, 54	22, 24
444 - 445TC/TSC/UC/USC	86,000	500 - 1,000	678-1356	IP 23, 54	25-26
505TC/TSC/UC/USC	86,100	500 - 1,000	678-1356	IP 23, 54	25-26
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324 - 405 TC/TSC/UC/USC	82,300	125 - 330	169-447	IP 56 NEMA 7, 9	38-39
Foot Mounted	87,300	10 - 105	14-142	IP 23 NEMA 7, 9	36-37
Foot Mounted	82,300	125 - 330	169-447	IP 23 NEMA 7, 9	39
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56C - 145TC	56,800	1.5 - 25	2-34	IP 55	40-41
182TC - 256TC/UC	87,800	6 - 105	8-142	IP 55	42-43
DOUBLE C-FACE COUPLER BRAKES					
56C - 145TC	56,700	1.5 - 25	2-34	IP 23, 54, 55, 56	44-45
182TC - 256TC/UC	87,700	10 - 105	14-142	IP 23, 54, 55	46-47
FOOT MOUNTED WITH BEARING SUPPORTED THRU-SHAFT					
Foot Mounted	56,700	1.5 - 25	2-34	IP 23	48
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Series	**Description**		**Torque (lb-in)**	***Nm***	
310	High Torque Holding Only-Servo Motor Brake		8 - 350 lb-in	*.9 - 39.5*	67-68
311	High Torque Holding Only-Servo Motor Brake		75 - 400 lb-in	*8 - 45*	69-70
320	Commercial Duty-Small Gear Motors		3 - 50 lb-in	*.34 - 5.6*	71-72
321/322	Totally-Enclosed Non-Ventilated (TENV) Commercial Duty		3 - 72 lb-in	*.34 - 8.1*	73-76
321 NEMA C	Totally-Enclosed Non-Ventilated (TENV) C-Face Mount		1.5 - 25 lb-ft	*2-34*	77-78
331 & 333	European Style Metric Mounting		3 - 300 lb-ft	*4 - 400*	79-81, 84
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350	European Style Portal Crane Duty - Pressure Plate Mount		75 - 300 lb-ft	*102 - 400*	85-86
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Performance Parameters and Limited Warranty

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The performance of Stearns brakes, clutches, clutch-brake combinations, solenoids, and controls depends upon the proper application of the product, adequate run in, installation and maintenance procedures, and reasonable care in operation.

All torque values listed in our bulletins are nominal and are subject to the variations normally associated with friction devices. The purchaser should take into consideration all variables shown in the applicable specification sheets. Although our application engineers are available for consultation, final selection and performance assurance on the purchaser's machine is the responsibility of the purchaser. Careful purchaser selection, adequate testing at time of installation, operation and maintenance of all products of Rexnord Industries, LLC, Stearns Division are required to obtain effective performance.

Stearns warrants to its purchasers that all its products will be free from defects in material and workmanship at the time of shipment to the purchaser for a period of one (1) year from the date of shipment. All warranty claims must be submitted in writing to Stearns within the warranty period, or shall be deemed waived. As to products or parts thereof which Stearns finds to have been defective at the time of shipment, its sole responsibility hereunder shall be to repair, correct or replace (whichever Stearns deems advisable) such defective products or parts without charge, FOB Stearns factory. In the alternative, Stearns may, at its option, either before or after attempting a different remedy, refund the purchase price upon return of the product or parts.

This warranty shall not apply to any product which has been subjected to misuse: misapplication: neglect (including but not limited to improper maintenance and storage); accident: improper installation; modification (including but not limited to use of other than genuine Stearns replacement parts or attachments); adjustment; or repair.

THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING THAT OF MERCHANTABILITY AND OF FITNESS FOR A PARTICULAR PURPOSE, AND OF ANY OTHER OBLIGATION OR LIABILITY ON OUR PART OF ANY KIND OR NATURE WHATSOEVER.

No Stearns representative has any authority to waive, alter, vary or add to the terms hereof without prior approval in writing, to our purchaser, signed by an officer of Rexnord Industries, LLC.

Stearns liability for its products, whether for breach of contract, negligence, strict liability in tort, or otherwise, shall be limited to the repair, correction, or replacement of the products or parts thereof, or to the refund of the purchase price of such products or parts. Stearns will not be liable for any other injury, loss, damage or expense, whether direct or consequential, including but not limited to loss of use, income, profit or production, or increased cost of operation, or spoilage of or damage to material, arising in connection with the sale, installation, use of, inability to use, or the repair or replacement of, or late delivery of, Stearns products.

Any cause of action for breach of the foregoing warranty must be brought within one (1) year from the date the alleged breach occurs.

Note on Special (Nuclear) Applications:

"Rexnord Industries, LLC, Stearns Division products are designed for standard industrial and commercial applications. Operating requirements, environments and required tolerances in nuclear and aircraft applications may be beyond the commercial standards of the Stearns Divisions products. Rexnord Industries, LLC, Stearns Division will assume absolutely no responsibility for the use of and/or resale of Rexnord Industries, LLC, Stearns Division products for such applications unless approved in writing in advance by Rexnord Industries, LLC, Stearns Division."

Introduction to Solenoid Actuated Brakes (SAB's)

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Stearns Brakes Set the Standard for Excellence

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

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

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

Enclosure Types

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

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

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

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

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

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

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

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

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

Self-Adjusting Disc Brakes



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

Manually Adjusted Disc Brakes with Automatic Reset

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



Introduction to Stearns Solenoid Actuated Brakes (SAB's)

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Brakes for Hazardous Locations



Although rugged Stearns Brakes are built to withstand rigorous industrial environments, many applications require additional protection from explosive gases or ignitable dusts. Stearns manufactures a complete line of disc brakes designed from the hazardous locations defined in the *National Electric Code (NEC)*. Each brake is labeled to show the Class, Group, and maximum operating temperature of the brake enclosure. We offer both motor-mounted and foot-mounted designs, and all Stearns Hazardous Location Brakes are UL Listed and CUL or CSA certified.

Double C-Face Disc Brake Couplers



Stearns Disc Brake Couplers provide maximum versatility, allowing you to add a brake to a C-face motor with a single shaft extension. Using these reliable products, you can couple a C-face motor to a C-face gear reducer.

Washdown Brakes

Stearns Washdown Brakes include the 56,000 and 87,000 Series brake models. These brakes meet BISSC Standards, AAA Dairy Standards, and other food industry washdown requirements. They feature stainless steel hardware, neoprene gasketing, and FDA-approved white epoxy paint or stainless steel enclosure.



Solenoid Actuated Brakes versus Armature Actuated Brakes

Solenoid Actuated Brakes	Armature Actuated Brakes
Simple wear adjustment	Complex wear adjustment
Easy coil exchange for different voltages	Difficult to change out complete magnet assembly
Maintained manual release with automatic reset for brake release during set-up	Non-maintained release (deadman) requires constant external force to operate
Add on options easily assembled to standard unit	Options require complete brake in most units
Rapid set and release times.	Response time is slower due to required magnetic field build-up in magnet-style coil
Connection can be made directly to AC power source	Direct connection to AC power source requires an optional electric control

Marine Applications

Brakes used in marine applications are customized to meet specific standards. These standards are established to provide various levels of corrosion resistance and performance standards under specific conditions.



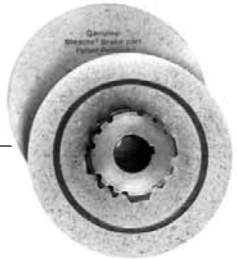
Maritime and Naval Brakes are designed for U.S. Navy and Coast Guard military specifications. These units conform to MIL-B-16392C or 46CFR 110.10-1 and IEEE Standard 45. Special material components help prevent corrosion due to shipboard environments. SAB's used in marine environments can be custom built to meet the specifications. In addition, all Stearns SAB's are "Type Approval Certified" by the American Bureau of Shipping.

Today, Stearns is focused on being your worldwide, value-added supplier. Our factory-trained field sales force is available to work with you in person to determine your application needs, as well as provide training and support to your engineers and maintenance staff. Our extensive network of more than 900 distributor branches is your assurance of quality service after the sale.

Stearns is a division of Rexnord Industries, LLC, a world leader in power transmission products. We have the resources, experience and dedication to meet your industrial brake, clutch and solid-state electronic centrifugal switch needs.

Trademarked and Patented Friction Discs

Now you can rely on identifying genuine Stearns Friction Discs which assure continuous, reliable performance backed by the Stearns name.
A molded ring in the Stearns friction discs makes it easy to visually identify a Stearns disc. The new splined discs are trademarked and patented by Stearns Division, Rexnord Industries, LLC.



Manually Adjusted Solenoid Actuated Brakes

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Stearns manually-adjusted disc brakes are available from .5 to 105 lb-ft static torque. They feature spring-set, electrically released designs having simple adjustments to compensate for friction lining wear. All have simple 2-wire motor connection.

Series 48,100 Disc Brakes

Mount directly to NEMA 48C motor frames. Static torque ratings are 1½, 3 and 6 lb-ft.

Quality Design Features:

- Spring-set, electrically released
- Single-disc caliper design
- Simple wear adjustment for easy maintenance
- Knock-out plug on housing for through-shaft applications
- Maintained manual release with automatic reset
- Mount in any position without modification

All Series 56,X00 Disc Brakes

Mount directly to NEMA 56C, 143TC, 145TC, 182TC and 184TC motor frames. Static torque ratings from 1½ to 25 lb-ft.

The 56 Series family is an unbeatable combination: the features you want most in spring-set disc brakes, at a low price. We took a fresh look at the brake itself as well as your needs and designed a comprehensive line of spring-set brakes that set new standards for quality, reliability and customer convenience. Here's a sampling of the features we've built into the Stearns 56 Series brakes:

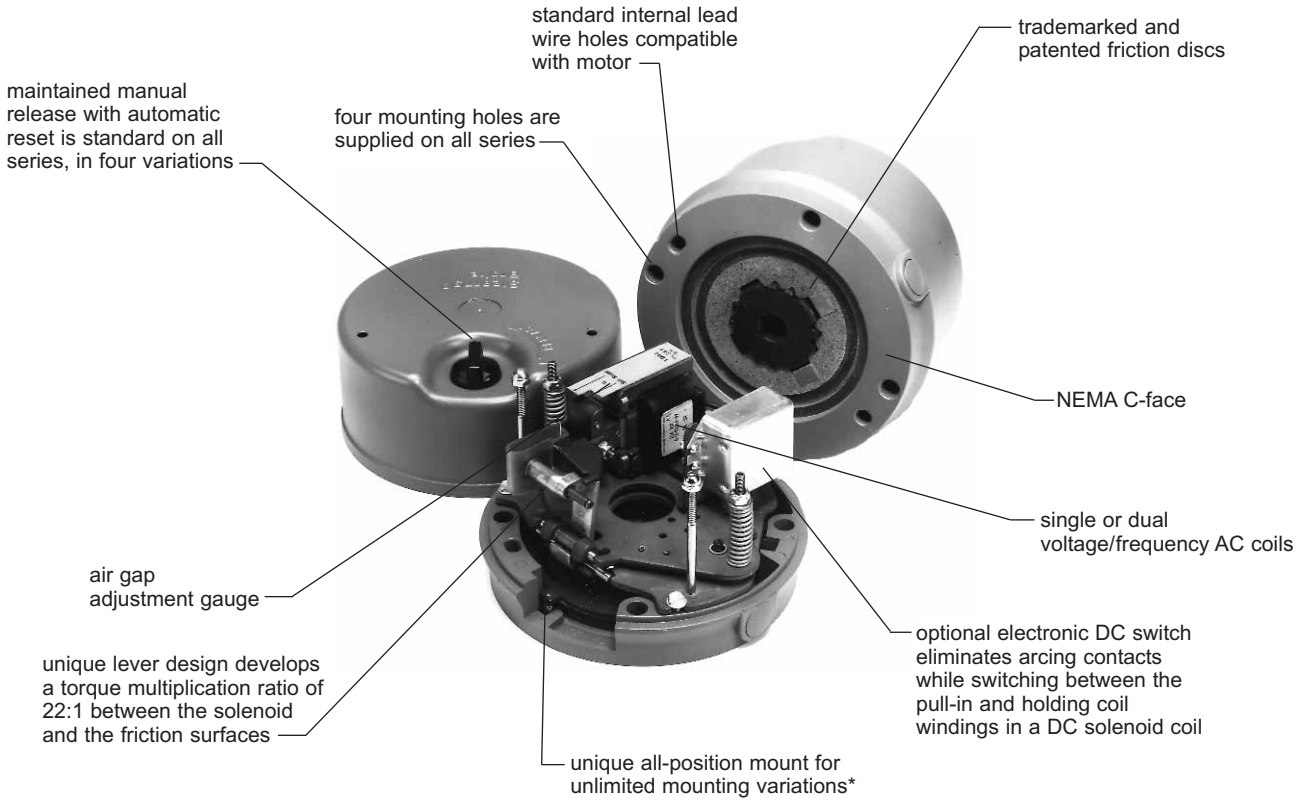
- A Stearns-exclusive spring design permits all-position mount for unlimited mounting possibilities.
- Trademarked and patented friction discs
- Patented splined hub that increases friction disc working area, runs quieter, and offers enhanced heat dissipating capability
- ABS Type Approval Certified

The 56 Series come in static torque ratings from 1.5 through 25 lb-ft with NEMA C-face mountings 56C, 143TC, 145TC, 182TFC, and 184TFC. Ten different housing, endplate, and release configurations accommodate IP 23, IP 54, IP 55, IP 56 and IP 57 enclosures. With a wide variety of pre-engineered modifications, you can select from 120,000 possible combinations!

87,000 Series Disc Brakes

An optional manual adjust mechanism can be provided on 87,000 Series Brakes (does not include 87,300 and 87,800 Series Brakes). Mounted directly to NEMA 182TC through 256TC frames. Includes all the other features of the Series 87,000.

Series 56,000 Design Features

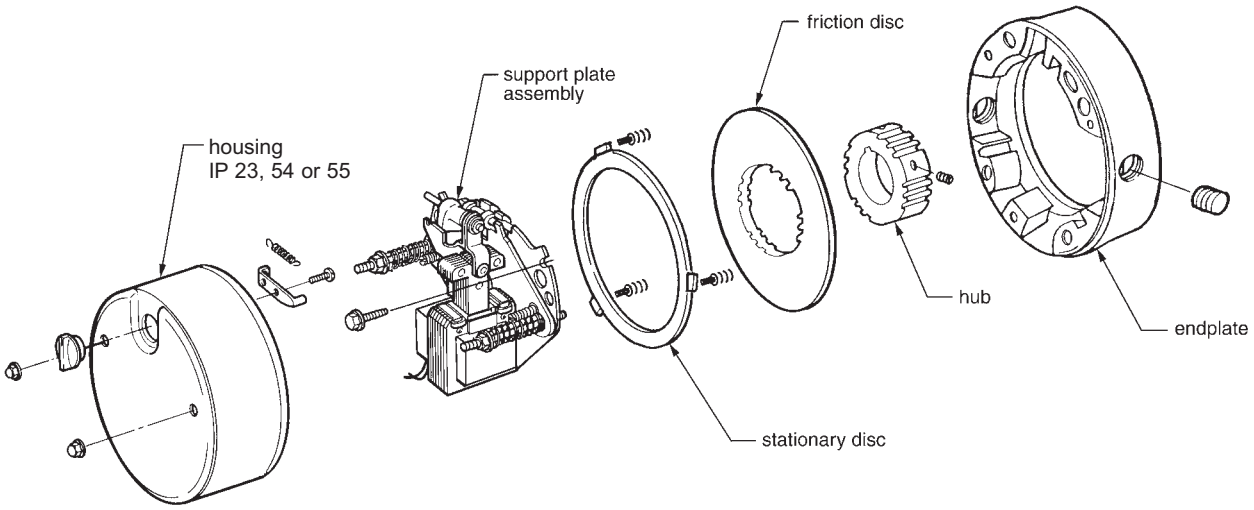


*20 and 25 lb-ft brakes are easily adapted for vertical applications (kit included)

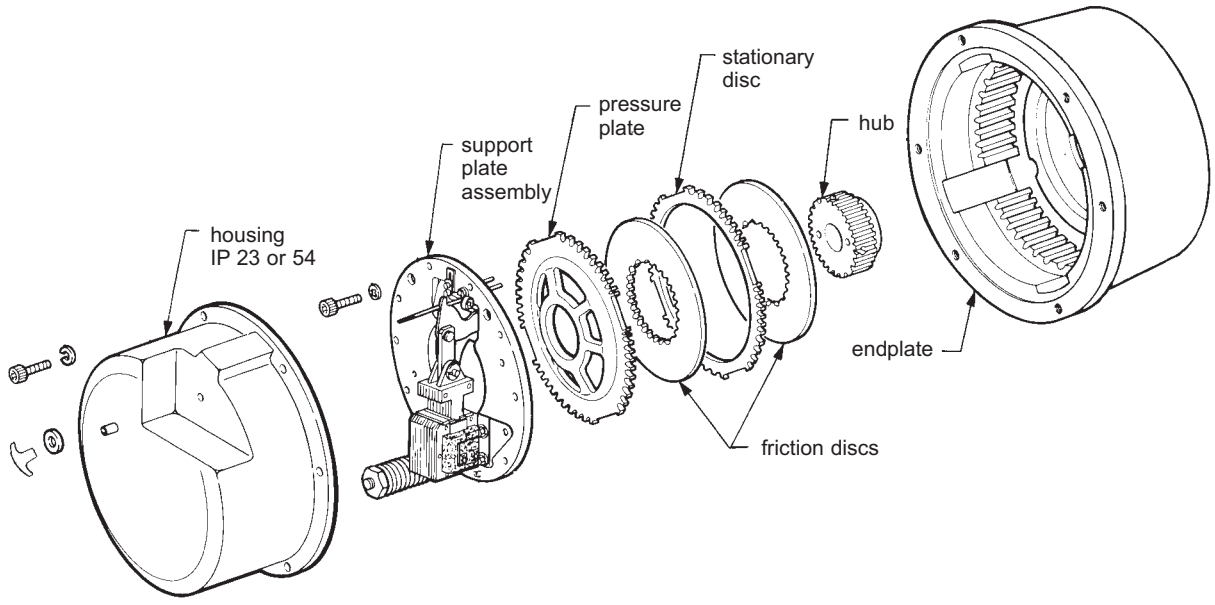
Exploded View- Part Indentification

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Series 56,000 Manually-Adjusted Solenoid Actuated Brake



Self-Adjusting Disc Brakes - Main Components

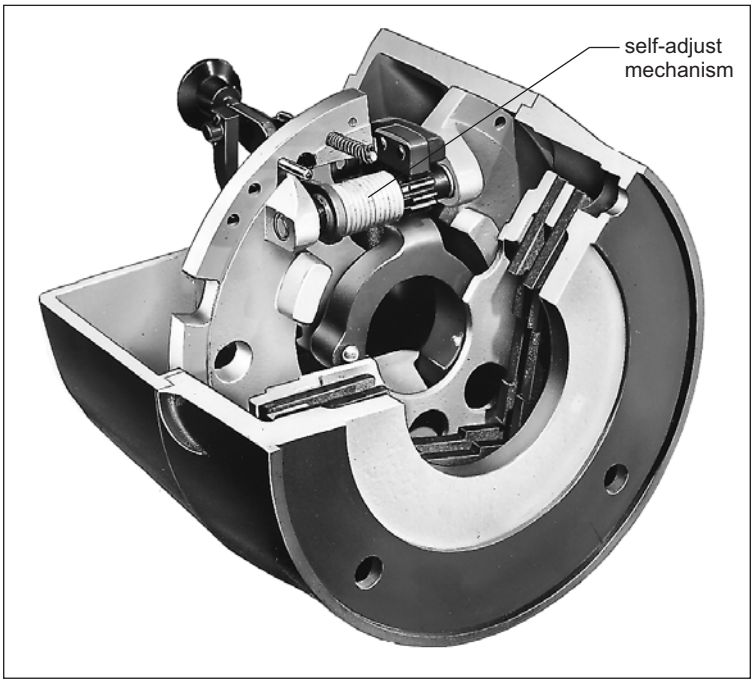


Self-Adjusting Solenoid Actuated Brakes

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Stearns self-adjusting disc brakes feature an exclusive, automatic adjusting device that eliminates the major cause of brake maintenance – adjustment to compensate for friction lining wear. This feature makes Stearns self-adjusting brakes ideal for remote or inaccessible locations, and for applications where rapid cycling requires frequent wear adjustment of manual adjustable brakes.

The self-adjust mechanism is a simple wrap-spring clutch that automatically adjusts the brake's solenoid air gap to compensate for wear of the friction discs. Automatic adjustment occurs every time the brake is operated, eliminating the errors that can occur with hand adjustment. The self-adjust feature means Stearns motor brakes always operate at peak efficiency, providing more uniform braking, longer disc life, less maintenance time and smooth, quiet operation.



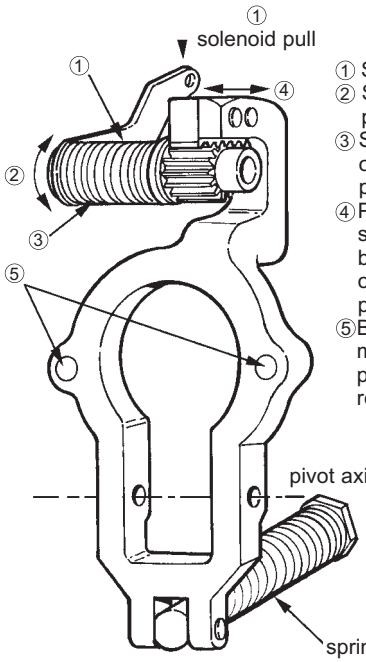
There are nine series of Stearns self-adjusting brakes to select from:

- Series 81,000 brakes for direct mounting to NEMA 324TC through 365TC motor frames. Static torque ratings from 125 to 230 lb-ft.
- Series 82,000 brakes for direct mounting to NEMA 324TC through 405TSC motor frames. Static torque ratings from 125 to 440 lb-ft.
- Series 86,X00 brakes for direct mounting to NEMA 444TSC through 505TSC motor frames. Static torque ratings from 500 to 1,000 lb-ft.
- Series 87,X00 brakes for direct mounting to NEMA 182TC through 286TC motor frames. Static torque ratings from 6 to 105 lb-ft.
- Series 87,200 for floor mounted, double shaft output with bearing support. Static torque ratings from 10 to 105 lb-ft.
- Series 87,300 hazardous location brakes for UL Listed Division I applications, which mount directly to NEMA 182TC through 256TC motor frames. Static torque ratings from 10 to 105 lb-ft.
- Series 82,300 hazardous location brakes for UL listed Division I applications, for mounting directly to NEMA 324TC through 405TSC. Static torque ratings 125 to 330 lb-ft.
- Series 87,700 brakes for in-line applications, to couple the motor and gear box. For direct mounting to NEMA 182TC through 256TC motor frames. Torque Rating of 10 to 105 lb-ft.
- Series 87,800 brakes hazardous location brake for UL Listed Division 2 applications, which mount directly to NEMA 182TC through 256TC motor frames. Static torque ratings of 10 to 105 lb-ft.

Quality Design Features

- Spring-set, electrically released.
- Self-adjusting mechanism minimizes maintenance by automatically compensating for lining wear.
- Unitized construction for easy friction disc replacement.
- Maintained manual release with automatic reset.
- Simple 2-wire motor connection.
- Standard or dust-tight, waterproof enclosures available.
- Many modifications for special application requirements.
- Models for marine and maritime applications.
- Models in accordance with Military Specification B16392-C for Navy applications.
- ABS Type Approval Certified.

Lever Arm and Self-Adjusting Mechanism



① Solenoid is energized.
② Solenoid arm and pinion rotate.
③ Spring clutch tightens on hubs and turns pinion.
④ Pinion moves rack section of lever arm back above pivot axis, overcoming force of pressure spring.
⑤ Buttons on lever arm move away from pressure plate, releasing brake.

SELECTION - Solenoid Actuated Brakes

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NOTE: For overhauling/high inertia loads, to stop in a specified time/distance, or for brakes combined with variable frequency drives, please refer to *Application Engineering* Section.

Stearns Solenoid Actuated Brakes can be easily selected from Table 1 and 2.

Given motor data:
1. Horsepower (hp)
2. Speed (RPM)
3. NEMA C-face frame size

Determine:
1. Static torque rating of the brake (lb-ft)
2. Brake series

Step 1 – Given the motor horsepower and speed, select the brake torque from Table 1. Torque in table 1 is calculated using formula:

$$T_S = \frac{5{,}252 \times P}{N} \times SF$$

Where, T_S = Static torque, lb-ft

P = Motor horsepower, hp

N = Motor full load speed, rpm

SF = Service Factor

5,252 = constant

Example: Given a 5 hp, 1800 RPM motor, the selected brake is 20 or 25 lb-ft.

Step 2 – Given the NEMA C-face motor frame size, select the brake series from Table 2.

Example: Given the 5 hp, 1800 RPM motor in Step 1 with a NEMA 184TC frame, Series 87,000; 87,300 or 87,700 Brakes can be selected to mount directly to the motor.

Table 1 – Torque Selection

In this table, brake torque ratings are no less than 140% of the motor full load torque.

Motor hp	Brakemotor Shaft Speed (RPM)						
	700	900	1200	1500	1800	3000	3600
	Static Torque Rating of Brake (lb-ft)						
1/6	3	1.5	1.5	1.5	0.75	0.5	0.5
1/4	3	3	3	1.5	1.5	0.75	0.5
1/3	6	3	3	3	1.5	1.5	0.75
1/2	6	6	3	3	3	1.5	1.5
3/4	10	6	6	6	6	3	3
1	15	10	6	6	6	3	3
1-1/2	20	15	10	10	10	6	3
2	25	20	15	10	10	6	6
3	35	25	20	15	15	10	6
5	75	50	35	25	20 or 25	15	10
7-1/2	105	75	50	50	35	25	15
10	105	105	75	50	50	25	25
15	175	125	105	75	75	50	35
20	230	175	125	105	105	50	50
25	330	230	175	125	105	75	50
30	330	330	230	175	125	75	75
40	440	330	330	230	175	105	105
50	550	440	330	330	230	*	*
60	750	500	440	330	330	*	*
75	1000	750	500	440	330	*	*
100	—	1000	750	500	440	*	*
125	—	1000	1000	750	500	*	*
150	—	—	1000	750	750	*	*
200	—	—	—	1000	1000	*	*
250	—	—	—	—	1000	*	*

*See catalog pages for maximum rpm by series. Thermal capacity must be considered in load stops over 1800 rpm.

Table 2 – Brake Series Selection by NEMA Frame Size

Torque Range (lb-ft)	Brake Series	C-Face Motor Frame Size											
		48C	56C	143TC 145TC	182TC 184TC	213TC 215TC	254TC 254UC 256TC 256UC	284TC 284UC 286TC 286UC	324TC 324UC 326TC 326UC	364TC 364UC 365TC 365UC	404TC 404UC 405TC 405UC	444TC 444UC 445TC 445UC	504UC 504SC 505C 505SC
Manually-Adjusted Brakes (require periodic adjustment to compensate for friction disc wear)													
1.5-6	48,100	①											
1.5-25	56,X00		①	①	② ①	②	②						
10-25	56,500												
Self-Adjusting Brakes (automatically compensate for friction disc wear)													
6-105	87,X00		③	③	①	①	①	② ①	②	②	②		
50-105	87,100												
125-230	81,000				② ②	② ②	② ②	② ②	① ①	① ①	① ①	② ②	
125-440	82,000												
500-1000	86,000								②	②	②	①	
500-1000	86,100												①
Division I Hazardous Location Brakes (for atmospheres containing explosive gases or ignitable dusts) / Motor Mounted													
1.5-15	65,300		①	①	② ①	② ①	② ①						
10-105	87,300							②	②	②	②		
125-330	82,300				②	②	②	②	①	①	①	②	
Division I Hazardous Location Brakes (for atmospheres containing explosive gases or ignitable dusts) / Foot Mounted													
10-105	87,300				④	④	④						
125-330	82,300								④	④	④		
Division 2 Hazardous Location Brakes													
1.5-25	56,800		① ③	① ③	② ①	② ①	② ①	②	②	②	②		
6-105	87,800												
Double C-Face Brake Couplers (for direct coupling a C-face motor to a C-face gear reducer)													
1.5-25	56,700		①	①									
10-105	87,700				①	①	①						

① Brake mounts directly to motor C-face.
② Adapter required to mount brake to motor C-face. Refer to brake specifications for adapter information.
③ Brake endplate modified for direct mounting to motor C-face without an adapter.
④ Brake is foot mounted for coupling to a hazardous-location motor.

56 Series
Mounting Face: NEMA 56C, 143TC and 145TC

The 56,X00 Series have the following design features:

- Spring-Set Electrically Released
- Static Torque 1.5 through 25 lb-ft
- Adjustable Torque, down to 50% of rated nameplate torque
- Manual Wear Adjustment
- Airgap Adjust Gage
- Splined Hub
- IP 21, 23 & 54 (formerly referred to by Stearns as NEMA type 1, 2 & 4 respectively) IP 55, 56, & 57 (formerly referred to by Stearns as NEMA Type 4X (BISSC Certified with epoxy coating and stainless steel hardware on exterior, or with a stainless steel enclosure)
- Universal mounting through 15 lb-ft. The 20 and 25 lb-ft are supplied with springs for vertical modification.

Specifications:

- Lead Wire Length: 24 inches
- Maximum Speed: Horizontal 5000 rpm Vertical 3600 rpm
- Coil Insulation: Standard Class B Optional Class H (56,800 Series Class H standard)
- Certified: CSA File LR-6254
- ABS Type Approval Certified

Product Overview

56000 Series

Designed for industrial applications requiring high performance in a compact lightweight package.

Construction:
Die cast aluminum endplate with stamped steel housing

Available Enclosures:
IP 23, 54 & 55

Release Type:
External knob manual release with or without automatic reset

Through Shaft Capability: Yes (IP 23 only)



56200 Series

Designed for industrial applications requiring the protection of a heavy duty cast iron enclosure.

Construction:
Cast iron endplate and housing.

Available Enclosures: IP 56 & 57

Release Type:
External side lever release with automatic reset

Through Shaft Capability: Yes



56500 Series

Same as 56000 Series with 182TC / 184TC mounting.

Construction:
Cast iron endplate with stamped steel housing
(Direct mount to 182TC / 184TC)

Available Enclosures:
IP 23, 54 & 55

Release Type:
External knob manual release with or without automatic reset

Through Shaft Capability: Yes (IP 23 only)



56900 Series

For use in severe environments found in process industries such as food, pulp and paper mills and chemical plants.

Construction: Stainless steel

Release Type:
Side lever with automatic reset

Available Enclosures: IP 56 & IP 57

Through Shaft Capability: with IP43 rating only



56700 Series

Units designed for industrial applications that fit between a standard C-Face motor and gear reducer. Can also be used to retrofit installed units without braking capability.

Construction: Die cast aluminum endplate and housing

Available Enclosures:
IP 23, 54, 55 & 56

Release Type: External knob release with automatic reset

C-face brake has output shaft



Also Available . . .

56100 Series

Full die cast aluminum endplate and housing with internal release lever

Available Enclosures:
IP 23, 56 & 57



56300 Series

Die cast aluminum endplate with stamped steel housing and external maintained release, IP 21



56400 Series

Cast iron endplate with stamped steel housing and external knob release

Available Enclosures:
IP 23 & 54



56600 Series

Cast iron endplate and housing with internal release lever

Available Enclosures: IP 23, 56 & 57



Series 56,000; 56,100; 56,200; 56,300; 56,400; 56,500; 56,600; 56,700; and 56,900
Mounting Face: NEMA 56C, 143TC and 145TC

Engineering Specifications

Maximum Solenoid Cycle Rate: ①
AC 36 cycles/min
DC 10 cycles/min

Thermal Capacity: ②
Horizontal 9 hp-sec/min *(112 watts)*
Vertical 6.5 hp-sec/min *(80 watts)*

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

② Thermal capacity rating is based on ambient temperature of 72°F *(22°C)*, stop time of one second or less, with no heat absorbed from motor. Refer to *Selection Procedure* Section.

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

Static Torque lb-ft	Coil Size	T1	T2
1.5 - 25	4, K4, K4+, M4+	25	14

Series 56,000; 56,100; 56,300; 56,500; and 56,700

Nominal Static Torque lb-ft *(Nm)*	Number of Friction Discs	Coil Size AC	Coil Size DC	Inertia (WK^2) lb-ft² *($kgm^2 \times 10^{-4}$)*
1.5-3 *(2-4)*	1	4	4+	.008 *(3.36)*
6 *(8)*	1	K4	K4+	.008 *(3.36)*
10 *(14)*	2	K4	K4+	.014 *(5.88)*
15 *(20)*	2	K4+	M4+	.014 *(5.88)*
20 *(27)*	3	K4+	M4+	.020 *(8.40)*
25 *(34)*	3	M4+	P4+	.020 *(8.40)*

Series 56,200; 56,400; 56,600; and 56,900

Nominal Static Torque lb-ft *(Nm)*	No. of Friction discs	Coil Size AC	Coil Size DC	Inertia (WK^2) lb-ft² *($kgm^2 \times 10^{-4}$)*
3-6 *(4-8)*	2	4	4+	.014 *(5.88)*
10 *(14)*	2	K4	K4+	.014 *(5.88)*
15 *(20)*	2	K4+	M4+	.014 *(5.88)*
20 *(27)*	3	K4+	M4+	.020 *(8.40)*
25 *(34)*	3	M4+	P4+	.020 *(8.40)*

Current Ratings (amperes)

Solenoid Coil Size*	AC Current	Voltage: 60 Hz 115	200	230	400	460	575	Voltage: 50 Hz 110	220	380	Voltage: DC 24	95	115	230
4	Inrush	3.6	2.1	1.8	1.1	.9	.7	4.1	2.1	.9	13.3	3.6	2.8	1.5
	Holding	.3	.2	.2	.08	.08	.06	.3	.2	.08	.3	*.1*	*.05*	*.03*
4+	Inrush	–	–	–	–	–	–	–	–	–	12.0	4.7	3.7	2.0
	Holding										*.4*	*.1*	*.08*	*.04*
K4	Inrush	4.3	2.5	2.2	1.3	1.1	.9	3.8	1.9	1.1	17.5	4.7	3.7	2.0
	Holding	*.3*	*.2*	*.2*	*.1*	*.08*	*.07*	*.4*	*.2*	*.08*	*.4*	*.1*	*.08*	*.04*
K4+	Inrush	4.6	2.5	2.3	1.2	1.0	.9	4.9	2.0	1.0	20.5	7.5	5.5	2.0
	Holding	*.4*	*.2*	*.2*	*.1*	*.1*	*.08*	*.4*	*.2*	*.1*	*.5*	*.1*	*.08*	*.04*
M4	Inrush	3.0	1.7	1.5	.9	.8	.6	–	–	.8	–	–	–	–
	Holding	*.6*	*.3*	*.3*	*.2*	*.1*	*.21*			*.1*				
M4+	Inrush	4.6	2.5	2.3	1.2	1.0	.9	4.1	2.0	1.3	30.3	7.9	5.5	2.0
	Holding	*.4*	*.2*	*.2*	*.1*	*.1*	*.08*	*.4*	*.2*	*.1*	*.5*	*.1*	*.1*	*.04*
P4+	Inrush	–	–	–	–	–	–	–	–	–	30.3	11.3	8.4	3.0
	Holding										*.5*	*.1*	*.08*	*.04*

Motor Frame Adapters: Series 56,000 through 56,600

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

To Adapt to NEMA Frame Size	AK Dim. in. *(mm)*	Reg. No.	Brake Enclosure ①	Brake Torque	Adapter Stock Number	Additional Shaft Length Required in. *(mm)*
182TC 184TC 213TC 215TC 254TC 256TC	8.50 *(215.90)*	-9	IP 23	1.5-15	5-55-5041-00 List $700.00	.94 *(23.81)*
	8.50 *(215.90)*	-9	IP 54	1.5-6	5-55-5041-00 List $700.00	.94 *(23.81)*
	8.50 *(215.90)*	-9	IP 23	20 & 25	5-55-5043-00 List $700.00	.94 *(23.81)*
	8.50 *(215.90)*	-9	IP 54	10-25	5-55-5043-00 List $700.00	.94 *(23.81)*

① 56,300 Series have NEMA 1 enclosure. For adapter dimensions, see *Technical Data*

1-056-132-00-BQF

Ordering and Identification Information

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

Example of a complete part number:

1-056-034-00-BFF
- Series
- Torque
- Enclosure
- Lead wire position (internal and external, left and right) standard
- 230 Vac
- 5/8 bore and 3/16 x 3/32 keyway

Hub Selection

Character	Bore (in.)	Keyway** (in. x in.)
A*	5/8	1/8 x 1/16
B	5/8	3/16 x 3/32
C	3/4	3/16 x 3/32
D	7/8	3/16 x 3/32
E	1-1/8	1/4 x 1/8
F*	1-1/4	1/4 x 1/8
K	1/2	1/8 x 1/16
L*	1	1/4 x 1/8
N*	9/16	1/8 x 1/16
O*	11/16	3/16 x 3/32
P*	1-1/16	1/4 x 1/8
R*	13/16	3/16 x 3/32
S*	15/16	1/4 x 1/8
Z	.460	pilot bore

Minimum bore is .500. Maximum allowable bore is 1.25. (maximum shaft length not to exceed end of hub).
For through-shaft applications, .875 is maximum

*These bores are non-standard. Add $225.00 to list price.

**Keyseats made to ANSI B17.1 Standard.

Standard AC Voltage Ratings

Character	Voltage	Hz
B	115	60
D	110	50
E	200	60
F	230 190	60 50
H	220	50
L	460 380	60 50
M	415	50
N	575	60
O	110/220	50
P	115/208-230	60
Q	208-230/460 190/380	60 50
R	200/400	60

Direct Current

Character	Voltage
T	12
U	24
V	36
W	48
X	95
Y	115
Z	230

Consult factory if other DC voltage is needed.

Voltages below 70VDC are polarity sensitive.

Modifications are available- see SAB Modification Section

Dimensional Drawings are on the pages following.

Series 56,100 (1-056-1XX) Die Cast Aluminum & Series 56,600 (1-056-6XX) Cast Iron

Mounting Face: NEMA 56C, 143TC and 145TC , 4.5" AK, 5.88" AJ



Release Type: Internal Lever, Non-Maintained

Installation and Service: P/N 8-078-905-60

Modifications: Pages 54-63

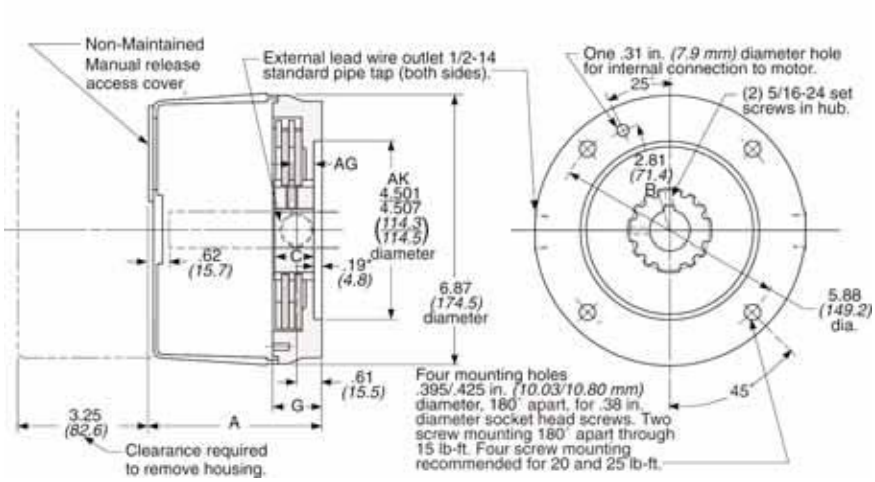
Enclosure Protection: IP 23; 56 & 57 (formerly referred to by Stearns as NEMA 2, 4 & 4X respectively)

Visual Wear Indicator

Mounting: Fanguard-mounted brakes requiring IP 56 or IP 57 protection may require additional sealing measures beyond seals provided with the brake - Refer to Installation & Service Instruction sheets

56,100 Series: Die Cast aluminum enclosure
Parts List: P/N 8-078-906-01

56,600 Series: Cast iron enclosure
Parts List: P/N 8-078-906-06



Series 56,100 Dimensions

Nominal Static Torque lb-ft (Nm)	Enclosure	Dimensions in Inches *(mm)*				Wt lbs (Kg)
		A	AG	C Hub Width	G	
1.5-15 *(2-20)*	IP 23	4.41 *(112.0)*	.59 *(15.0)*	.81 *(20.6)*	1.21 *(30.7)*	8 *(3.6)*
20-25 *(27-34)*		4.86 *(123.4)*		1.18 *(30.0)*	1.66 *(42.2)*	10 *(4.5)*
1.5-6 *(2-8)*	IP 56/57	4.50 *(114.3)*	.47 *(11.9)*	.81 *(20.6)*	1.21 *(30.7)*	8 *(3.6)*
10-25 *(14-34)*		4.95 *(125.7)*	.59 *(15.0)*	1.18 *(30.0)*	1.66 *(42.2)*	10 *(4.5)*

Series 56,600 Dimensions

Nominal Static Torque lb-ft (Nm)	Enclosure	Dimensions in Inches *(mm)*				Wt lbs (Kg)
		A	AG	C Hub Width	G	
3-25 *(4-34)*	IP 23	4.95 *(125.7)*	.59 *(15.0)*	1.18 *(30.0)*	1.66 *(42.2)*	21 *(9.5)*
3-25 *(4-34)*	IP 56/57	5.05 *(128.3)*				

Series 56,100 Pricing (Discount Symbol B4)

Nominal Static Torque lb-ft (Nm)	Enclosure	Basic Model Number and List Price*			
		AC	AC List Price*	DC	DC List Price*
1.5 *(2)*	IP 23	1-056-101-00	$505.00	1-056-105-00	$805.00
	IP 56	1-056-102-00	640.00	1-056-106-00	940.00
	IP 57	1-056-104-00	715.00	1-056-108-00	1,015.00
3 *(4)*	IP 23	1-056-111-00	525.00	1-056-115-00	825.00
	IP 56	1-056-112-00	660.00	1-056-116-00	960.00
	IP 57	1-056-114-00	735.00	1-056-118-00	1,035.00
6 *(8)*	IP 23	1-056-121-00	590.00	1-056-125-00	890.00
	IP 56	1-056-122-00	725.00	1-056-126-00	1,025.00
	IP 57	1-056-124-00	800.00	1-056-128-00	1,100.00
10 *(14)*	IP 23	1-056-131-00	690.00	1-056-135-00	990.00
	IP 56	1-056-132-00	830.00	1-056-136-00	1,130.00
	IP 57	1-056-134-00	905.00	1-056-138-00	1,205.00
15 *(20)*	IP 23	1-056-141-00	790.00	1-056-145-00	1,090.00
	IP 56	1-056-142-00	930.00	1-056-146-00	1,230.00
	IP 57	1-056-144-00	1,005.00	1-056-148-00	1,305.00
20 *(27)*	IP 23	1-056-151-00	880.00	1-056-155-00	1,180.00
	IP 56	1-056-152-00	1,015.00	1-056-156-00	1,315.00
	IP 57	1-056-154-00	1,090.00	1-056-158-00	1,390.00
25 *(34)*	IP 23	1-056-161-00	975.00	1-056-165-00	1,275.00
	IP 56	1-056-162-00	1,110.00	1-056-166-00	1,410.00
	IP 57	1-056-164-00	1,185.00	1-056-168-00	1,485.00

Series 56,600 Pricing (Discount Symbol B4)

Nominal Static Torque lb-ft (Nm)	Enclosure	Basic Model Number and List Price*			
		AC	AC List Price*	DC	DC List Price*
3 *(4)*	IP 23	1-056-611-00	1,200.00	1-056-615-00	1,500.00
	IP 56	1-056-612-00	1,335.00	1-056-616-00	1,635.00
	IP 57	1-056-614-00	1,410.00	1-056-618-00	1,710.00
6 *(8)*	IP 23	1-056-621-00	1,265.00	1-056-625-00	1,565.00
	IP 56	1-056-622-00	1,400.00	1-056-626-00	1,700.00
	IP 57	1-056-624-00	1,475.00	1-056-628-00	1,775.00
10 *(14)*	IP 23	1-056-631-00	1,365.00	1-056-635-00	1,665.00
	IP 56	1-056-632-00	1,505.00	1-056-636-00	1,805.00
	IP 57	1-056-634-00	1,580.00	1-056-638-00	1,880.00
15 *(20)*	IP 23	1-056-641-00	1,465.00	1-056-645-00	1,765.00
	IP 56	1-056-642-00	1,605.00	1-056-646-00	1,905.00
	IP 57	1-056-644-00	1,680.00	1-056-648-00	1,980.00
20 *(27)*	IP 23	1-056-651-00	1,555.00	1-056-655-00	1,855.00
	IP 56	1-056-652-00	1,690.00	1-056-656-00	1,990.00
	IP 57	1-056-654-00	1,765.00	1-056-658-00	2,065.00
25 *(34)*	IP 23	1-056-661-00	1,650.00	1-056-665-00	1,950.00
	IP 56	1-056-662-00	1,785.00	1-056-666-00	2,085.00
	IP 57	1-056-664-00	1,860.00	1-056-668-00	2,160.00

* Subtract $30.00 for brake ordered less hub.

Information Needed for Modifications

Stearns is dedicated to providing you with the most comprehensive selection of modified spring-set disc brakes on the market today. We have included a list of our more popular modifications complete with descriptions, pictures and graphics when applicable and list price adders along with their representative series. Note that modification list prices are subject to the same discounts as apply to the complete brake assembly.

Below please find examples of how the modifications are called out with a letter in the 8th position of the 12 digit model number. Note that these listings are not complete, but represent our more popular selections. For any special applications and modification requirements not found here, please contact your Stearns representative.

IMPORTANT – The modification letter will appear in the *8th position* to call out the modification.

Examples:

1-056-XXX-__X
8th position

1-087-XXX-__X
8th position

1-08X-XXX-__X
8th position

See specific tables for some of the available options of the series required.

If two or more letter modifications are required, the 8th position of the part number will remain zero and position 10, 11 and 12 will be assigned by Stearns as a special part number.

All Series

Modification	Letter
Vertical Mounting - Above Motor	A
Class H Insulation	H
Space Heater (115 Volt Circuit)	I
Space Heater (115 Volt Circuit), Brass Pressure Plate and Stationary Disc	J
Brass Pressure Plate and Stationary Disc	K
Vertical Mounting - Below Motor	L
Thru-Shaft Housing (Standard)	Q
Vertical Mounting - Above Motor and Class H Insulation	T
Electrical Release Indicator Switch, N.O. contacts	W
Side Manual Release with Shaft Through Housing Stamped Steel	Z
Series 87,X00 Only	
Vertical Mounting - Above Motor, Brass Pressure Plate and Stationary Disc	N
Series 81,X00, 82,X00 87,000 and 87,100	
Side Manual Release	Y

Solenoid Actuated Brakes Modification Index

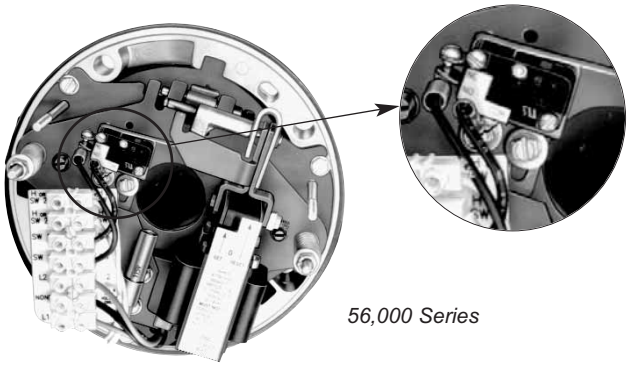
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Category	Description	Modification Number (M___)	Page
Coils	Class H Insulation	M6	56
	DC Coil Option	M9	57
	Non-Standard Voltage AC	M25	60
	Non-Standard Voltage DC	M9	57
	Special Leadwire Length	M31	61
Corrosion Resistance	Brass Pressure Plate	M3	55
	Brass Stationary Disc	M4	55
	Breather Drain	M5	56
	Space Heater (115 or 230 volt)	M13	57
	Special Paint	M14	58
	Stainless Steel Self-Adjust	M15	58
	Stainless Steel Hardware	M16	58
	Corrosion-Resistant Endplate	M39	62
	Stainless Steel Hub	M42	62
Endplates	Special Internal Leadwire Hole	M35	61
	Corrosion-Resistant Endplate	M39	62
	Special Milling: Flat Bottom on Housing & Endplate	M40	62
Friction Discs	Special Material Friction Disc	M44	63
	Carrier Ring Disc (Steel or Zinc Aluminum)	M46	63
	Carrier Ring Disc (Bronze)	M47	63
Gaskets	Motor Gasket	M38	62
	Viton® Gasket	M43	63
Hubs/ Brake Shaft	Non-Standard Bore or Keyway	M11	57
	Special Shaft - Coupler Brakes	M29	60
	Taper-Lock Hubs	M30	61
	Stainless Steel Hub	M42	62
	Splined Hub and Friction Disc	M45	63
Machining Options	Encoder/Tach Machining	M7	56
	Metric Machining	M33	61
	Special Milling: Flat Bottom on Housing & Endplate	M40	62
Manual Adjust	Manual Adjust for 87,000 Series	M48	63
Manual Release	Side Manual Release	M12	57
	Non-Maintained (Deadman)	M32	61
	Internal Release	M37	62
Mounting	Vertical	M21, M23, M24	59-60
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Nameplates	Mylar or Metal	M10	57
	Brass Nameplate	M41	62
Paint/ Special Finish or Material	Brass Pressure Plate	M3	55
	Brass Stationary Disc	M4	55
	Special Paint	M14	58
	Stainless Self-Adjust	M15	58
	Stainless Steel Hardware	M16	58
	Corrosion-Resistant Endplate	M39	62
	Stainless Steel Hub	M42	62
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	Electrical Release Indicator Proximity Switch	M2	55
	Thermal Switch	M18	58
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Tach Mounting	Tach Machining	M7	56
	Thru-Shaft NEMA 2	M19	59
	Thru-Shaft NEMA 4 and 4X	M20	59
Torque Derating	Brass Pressure Plate	M3	55
	Brass Stationary Disc	M4	55
	Special Derating of Torque	M34	61
Wiring Options	Conduit Box with Terminal Strip	M8	56
	Terminal Strip	M17	58
	Special Length Leadwires	M31	61
	Internal Leadwire Hole	M35	61

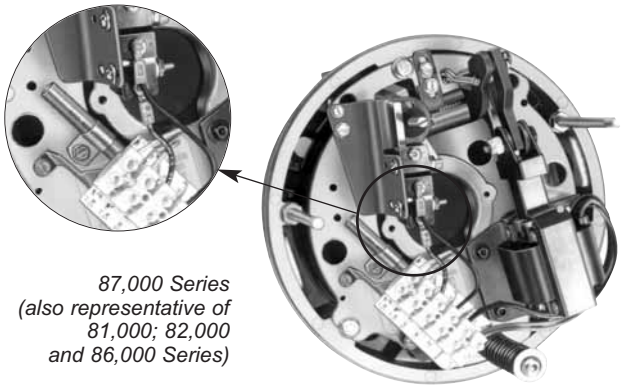
M1 Electrical Release Indicator Switch

This switch is used to indicate when the brake is in a released, non-holding position. This mechanism utilizes a mechanical limit switch.

Series	List Price Adder
56,X00 & 65,300	$450.00
81,000; 82,000; 87,X00	450.00
86,X00	900.00



56,000 Series



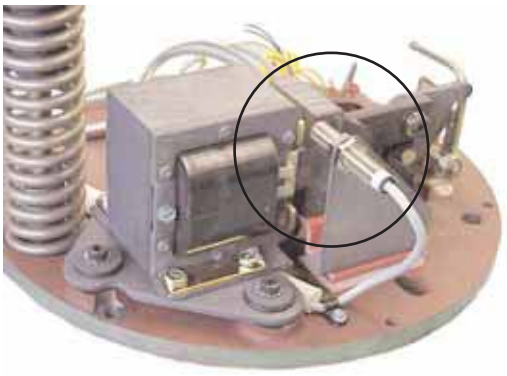
87,000 Series (also representative of 81,000; 82,000 and 86,000 Series)

Not available on 56,800 or 87,800 Series Brakes.

M2 Electrical Release Indicator Proximity Switch

Same function as the switch in M1 above; except, M2 uses an electronic proximity sensor.

Series	List Price Adder
81,000 82,000 87,X00	$1375.00
86,X00	2750.00

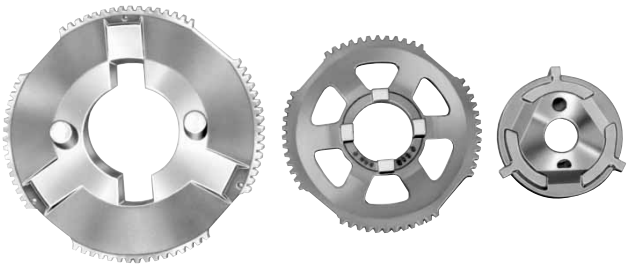


Not available on 56,800 or 87,800 Series Brakes.

M3 Brass Pressure Plate

Typically used in marine applications or in applications where the potential for sparks need to be eliminated. Brass can also be used to reduce torque.

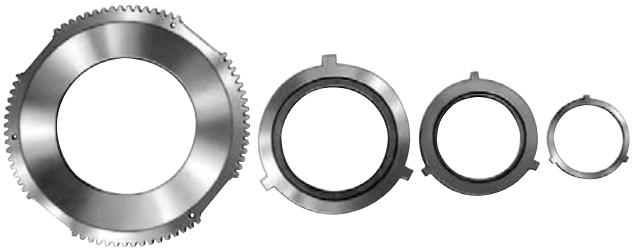
Series	List Price Adder
56,X00	See M4
65,X00	$250.00
81,000; 82,000	800.00
86,X00	1050.00
87,X00	600.00



M4 Brass Stationary Discs

Used with brass pressure plate (List per disc).

Series	List Price Adder
56,X00	$250.00
65,X00	250.00
87,X00	450.00
81,000; 82,000	600.00
86,X00	750.00



M5 Breather Drain

A drain plug is tapped into the bottom of the housing to let moisture escape. This option is only available on brakes with cast aluminum or cast iron housings.

Series	List Price Adder
56,X00	$380.00
65,X00	500.00
81,000 82,000 86,X00 87,X00	380.00



M6 Class H Insulation

Brake is provided with an epoxy encapsulated coil, rated for NEMA Class H designation.

These Class H coils are standard on hazardous location brakes.

Series	List Price Adder
56,X00	$145.00
87,X00	175.00
81,000 82,000	285.00
86,X00	570.00



M7 Housing Machining for Encoder/Tach Mounting

Series	Standard Machining[1]				Close Tolerance[2]			Tether Mount [3]	
	Bolt Circle & Register		Bolt Circle - but no Register		Bolt Circle & Register			A Single Bolt Hole	
	Open[4] Enclosure List Price Adder	Enclosed[5] List Price Adder	Open[4] Enclosure List Price Adder	Enclosed[5] List Price Adder	Open[4] Enclosure List Price Adder	Enclosed[5] List Price Adder	Maximum Thru-Shaft Dia. (inch)	Open[4] Enclosure List Price Adder	Enclosed[5] List Price Adder
56,X00 (except N/A for 56,800)	N/A	N/A	N/A	N/A	N/A	N/A		$350	$460
87,000 - 87,100	$700	$1,200	$80	$350	$2,450	$2,750	1.63	$240	$350
87,M00 - 87,500 - 87,600	N/A	$1,200	N/A	$350	N/A	$2,750		N/A	$350
81,000 - 82,000[6]	$1,100	$1,375	$305	$580	$2,550	$2,825	2.5	$465	$740
86,000	$1,100	$1,375	$380	$780	$2,550	$2,950		$540	$940

[1]**Standard Machining:** The housing is machined for a thru shaft, and to allow for an encoder or tach to be mounted. This option is only available on brakes with cast aluminum or cast iron housings. Consult factory for availability.

[2]**Close tolerance:** The housing and endplate are assembled and dowel pinned together - then machined as a matched set for a through shaft and encoder mounting. This option is only available on brakes with cast aluminum or cast iron housings. This option is recommended for Series 81,000; 82,000; and 86,X00 due to the long distance between the motor and encoder.

[3]**Tether Mount:** The housing is machined for a through shaft, and a single tapped hole for a bolt to secure a tether arm. (56,X has a through hole and tach-welded nut on inside of housing, instead of a tapped hole).

[4]Referred to on the product pages in the catalog as IP23

[5]Referred to on the product pages as IP54/55 (these enclosure ratings no longer apply when the housing is machined for this modification - the customer is responsible for meeting any specific enclosure rating when assembling the encoder.

[6]M7 Modification for Series 81,000 and 82,000 will also require the M12 Modification; the side manual release.



M8 Conduit Box with Terminal Strip

A terminal strip is located inside the conduit box. It allows for easy connection and identification of lead wires.

Series	List Price Adder
All series except hazardous location *(not available for the 48,100 series)*	$300.00 (IP 23) $600.00 (IP 54)
All hazardous location brakes	$600.00



M9 DC Coil Option

For DC voltage applications. Operates with an electronic DC switch module.

Series	List Price Adder	Additional Adder for Non-Standard Voltage
56,X00	$ 300.00	$ 250.00
87,X00	570.00	250.00
81,000	1050.00	250.00
82,000	1565.00	250.00
86,X00	2625.00	500.00

For standard voltage listing, see the ordering information section for the specific brake.

Not available on Hazardous Location Brakes.

M10 Nameplates

To order new brake nameplates, the serial number of the brake is required. A loose nameplate shipped from Stearns Division without being attached to a brake must have all agency markings removed (UL, CSA, etc.). In order to have a brake renameplated with the appropriate agency markings, it must be returned to Stearns Division for product verification.

List Price:	First Nameplate	$150.00
Net Price:	Additional Mylar Nameplates	1.50
	Additional Metal Nameplates	4.00

M11 Nonstandard Hub or Keyway

For standard bore diameter and keyway specifications, see specific brake selection page. For taper bores, consult factory for pricing.

Description	List Price Adder					
	48,100	56,X00	65,X00	81,000 82,000 86,000	87,000 87,100 87,800	87,700
All Quantities and Enclosures	$225.00	225.00	325.00	600.00	250.00	250.00

M12 Side Manual Release

Side release not available on the 1-065-300 or the 1-086-000

Sheet Metal Housing (IP 23 Only)	List Price Adder
56,000; 56,400; 56,500	$50.00
87,000; 87,100	$50.00

Cast Iron Housing	List Price Adder
87,000 IP 23	$385.00 includes casti iron housing adder of $110
87,000 IP 54	$275.00
81,000 82,000	$350.00



M13 Space Heater (115 or 230 Volt Only)

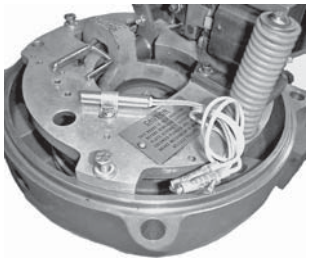
A space heater cartridge is used to prevent moisture build-up inside the brake housing.

Series	Wattage	List Price Adder
56,X00*	15	$210.00
81,000; 82,000; 86,X00	50 and 75	275.00
87,X00**	25 to 30	225.00
Hazardous Duty Brakes	25 to 50	750.00

*Not available on 56,800 or 87,800 Series Brakes
**Not available in 87,800 Class I



56,000 Series



87,000 Series (also representative of 81,000; 82,000 & 86,000 Series)

M14 Special Paint



The standard paint for all brake series (except BISSC Certified & Maritime/Navy) is a red, water-base primer, painted inside and out.

For additional corrosion protection, a special (green) zinc chromate primer can be provided (painted inside and out) in place of the standard red primer. List price adders as shown.

Series	List Price Adder
56,X00	$210.00
65,X00	300.00
81,000; 82,000; 86,X00	550.00
87,000	525.00

Other Special Paint options are available - either primers, a white epoxy finish coat, or clean finish (exterior primer removed). Consult factory for pricing.

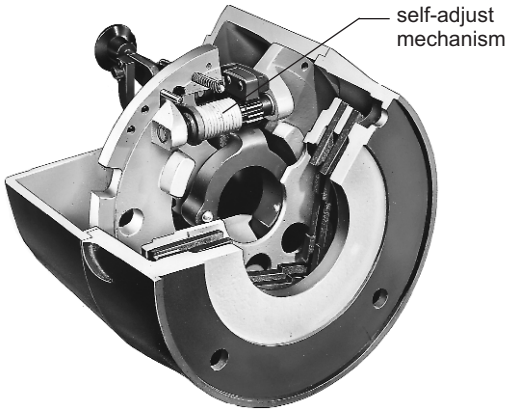
BISSC Certified paint (white epoxy exterior paint) is standard for brake series with IP55 and IP57 enclosure ratings - and the prices are included in the standard list prices.

Maritime and Navy brakes have their own specified paints, with pricing included in the standard list prices.

M15 Stainless Steel Self-Adjust Mechanism

For severe duty applications. This option includes a stainless steel pinion and plated wrap spring in the auto-adjust mechanism. It is only available on the 81,000; 82,000; 86,000 and 87,000 Series Brakes

Series	List Price Adder
81,000; 82,000; 87,000	$350.00
86,X00	$700.00



M16 Stainless Steel Hardware

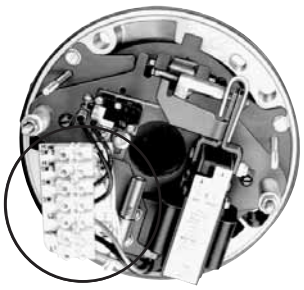
All external hardware is provided in stainless steel.

Series	List Price Adder
48,100	$125.00
56,X00, 87,X00	$150.00
81,000, 82,000 86,000	$275.00

M17 Terminal Strip

A terminal strip is located in the inside of the brake, on the support plate. It allows for easy connection and identification of lead wires.

Series	List Price Adder
ALL	$150.00



56,000 Series



87,000 Series (also representative of 81,000; 82,000 & 86,000 Series)

M18 Thermostat (thermal switch)

This switch is used to indicate when a brake is overheating. Thermostats are standard in 8X,300 and 65,X00 Series. This option is for NON-UL brakes only.

Series	Switch Operation Specificatons	List Price Adder
87,X00	Normally Closed: Opens at 295°F, Closes at 255°F	$400.00
81,000, 82,000 86,X00	Normally Closed: Opens at 210°F, Closes at 180°F	400.00
56,X00	Normally Closed: Opens at 195°F, Closes at 175°F	400.00



M19 Through-Shaft Enclosure

This configuration allows for the motor shaft to extend beyond the housing of the brake.

This modification lowers the brake enclosure rating to IP10.

Series	List Price Adder
56,000, 56,400	N/C
56,100, 56,200	$110.00
56,600	110.00
81,000, 82,000	225.00
86,000	300.00
87,000, 87,100 sheet metal	N/C*
87,000, 87,100 with cast iron housing	225.00 (adder for cast iron housing is $210.00 additional)

*Up to 1-5/16".
Above 1-5/16", add $80.00.



M20 Through-Shaft Cast Iron Enclosure with Lip Seal

This configuration allows the motor shaft to extend beyond the housing of the brake with a bushing to use with a housing lip seal.

This modification lowers the brake enclosure rating to IP10.

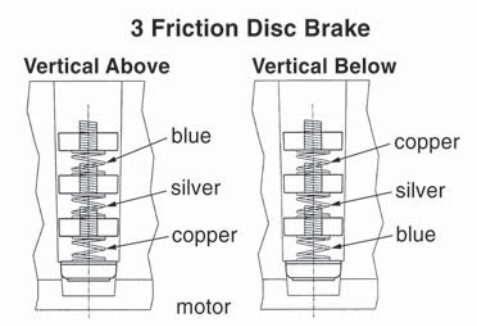
Series	List Price Adder
56,100, 56,200 56,600	$220.00
81,000, 82,000	500.00
86,000	700.00
87,000, 87,100	300.00



M21 Vertical Mounting for 56,000 Series & 65,300 Series

The 56,000 20 and 25 lb-ft Series Brakes are shipped with spring kits. Vertical modification at 15° from horizontal. Read installation and service instructions for details on its use.

Description	List Price Adder
Factory assembly for three disc configuration.	$20.00



Example of 56,000 Series spring requirements for vertical above and below mounting.

M23 Vertical Mounting for 87,X00 Series

For factory modification to vertical above or below application. Vertical modification at 15° from horizontal.

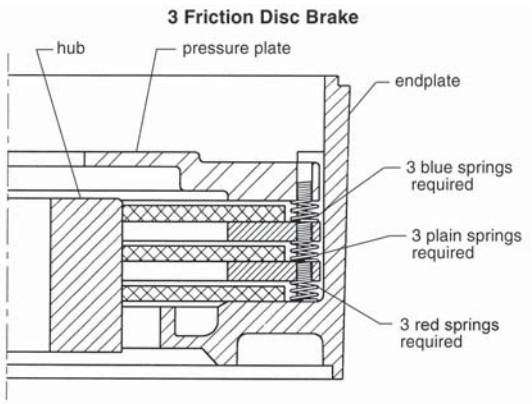
Series 87,000 & 87,100

Torque Value (lb-ft)	IP 23 & IP 54 steel hsg Above	IP 23 & IP 54 steel hsg Below	IP 54/55 cast iron Above	IP 54/55 cast iron Below
6, 10, 15, 25 & 35	$95.00	no mod req'd	$370.00*	no mod req'd
50 & 75	$105.00	$105.00	$380.00*	$105.00
105	$135.00	$135.00	$410.00*	$135.00

*Includes adder for side manual release

Series 87,300; 87,800; 87,700

Torque Value (lb-ft)	Vertical Above	Vertical Below
6, 10, 15, 25 & 35	$95.00	no mod req'd
50 & 75	$105.00	$105.00
105	$135.00	$135.00



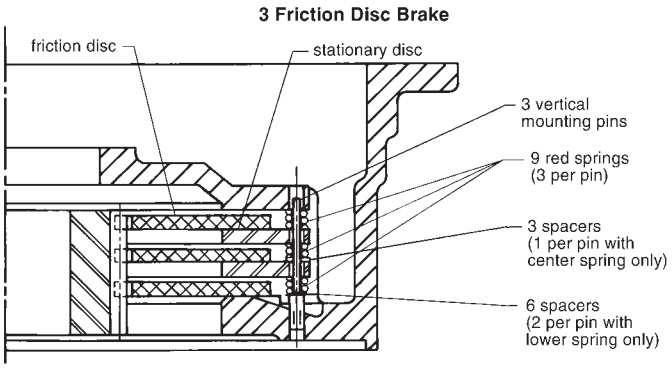
Example of 87,000 Series spring requirements for vertical above mounting.

M24 Vertical Mounting for 81,000; 82,000 and 86,000 Series

These brakes require factory modifications for vertical applications. Vertical modification at 15° from horizontal.

Series	Torque Value (lb-ft)	IP 23 Above & Below	IP 54 Above	IP 54 Below
81,000 & 82,X00	125 & 175	$250.00	$575.00*	$250.00
81,000 & 82,X00	230	300.00	650.00*	300.00
82,X00	330	300.00	650.00*	300.00
82,X00	440	500.00	850.00*	500.00
86,000	500 & 750	750.00	750.00*	750.00

*Includes adder for side manual release

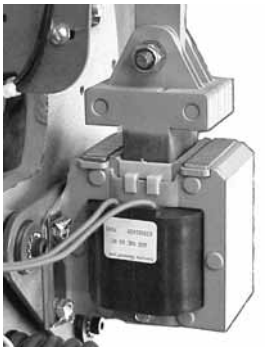


Example of 81,000 Series pin, spring and spacer requirements for vertical above mounting.

M25 Voltage Non-Standard (AC)

For standard voltage listing, see the ordering information section for the specific brake.

Series	List Price Adder
48,100	$165.00
65,X00	165.00
56,000	165.00
81,000; 82,X00	200.00
86,X00	400.00
87,X00	175.00

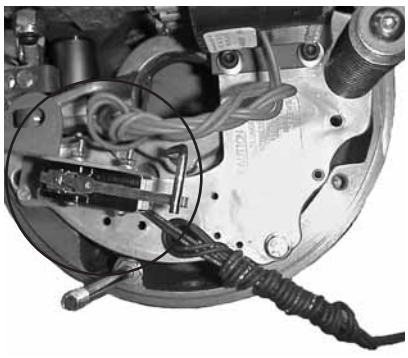


M27 Wear Indicator (Friction Disc) Switch

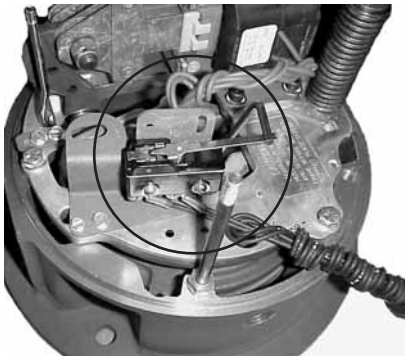
A mechanical switch is installed to indicate when the friction disc requires replacement.

Series	List Price Adder
81,000; 82,X00	$225.00
86,000	225.00
87,X00*	225.00

**Switch supplied with leads (Switches N/A on Series 87,800)*



87,000 Assembly



87,000 Assembly

M29 Special Shaft-Coupler Brake and Foot Mount Brake

Any non-standard input or output shaft on a 56,700, 87,200 or 87,700 Series Brake.

Series	List Price Adder
56,700	$325.00
87,200; 87,700	325.00



M30 Taper-Lock Hubs

For use in severe duty applications and reversing application to secure the brake hub to the motor shaft.

Series	Series	List Price Adder
87,000; 87,100 IP 23 only	10 to 35 lb-ft	$200.00
	50 to 75 lb-ft	225.00
	105 lb-ft	250.00
81,000	125 & 175 lb-ft	225.00
	230 lb-ft	325.00
82,000	125 & 175 lb-ft	375.00
	230 & 330 lb-ft	550.00
	440 lb-ft	675.00





M31 Special Length Lead Wires

Up to 5’	Series	List Price Adder
	All	$65.00

Over 5’	Series	List Price Adder
	All	$130.00

M32 Non-Maintained (Deadman) Manual Release

The brake is mechanically released while the release is pulled into a release position. Once released, the brake sets.

Series*	List Price Adder
56,200, 56,700, 56,800 & 56,900	$110.00
56,000, 56,400 & 56,500	185.00
81,000; 82,000 & 87,000	125.00
86,000	250.00

**N/A on 56,300.*
Standard on 56,100 and 56,600.



M33 Metric Machining Including Cast Iron Endplate

Stearns SAB’s can be used with metric motor frames. The following table indicates standard frame capabilities for an IEC B14 Face mount.

Series	IEC Frame Sizes	List Price Adder
56,200; 56,400; 56,600 & 56,900	B14 flange in sizes 80; 90 & 100 B5 flange in sizes D63 & D71	$340.00
56,500	B14 flange in sizes 112; 132 & 160 B5 flange in sizes D71; D80; D90; D100 & D112	$340.00
87,000	B14 flange in sizes 112; 132 & 160 B5 flange in sizes D71; D80; D90; D100 & D112	$340.00

M34 Derating of Torque

Stearns industrial SAB’s can be custom built to meet your specific torque requirements.

Series	List Price Adder	Derate To
56,500	$315.00	6 lb-ft
87,100	315.00	20 or 30 lb-ft
81,000 & 82,000	460.00	To be approved with application engineering

M35 Special Internal Lead Wire Hole with Bushing

Any non-standard, internal lead wire hole in the endplate.

Series	List Price Adder
All brakes except hazardous location brakes	$175.00



M36 Housing Split

SAB's can be provided with a split housing.

Series	List Price Adder
81,000; 82,000 & 86,000	$725.00
81,000; 82,000 & 86,000 gasketed	$1,000.00
87,000; 87,100 sheet metal	$200.00
87,000; 87,100 cast iron gasketed	$250.00



M37 Internal Release

An internal manual release requires that the housing be removed before the brake can be released by hand.

**N/A for hazardous location brakes*

Series	List Price Adder
87,0XX; 81,0XX; 82,0XX; 86,0XX	N/C

M38 Motor Gasket

The brake is provided with an additional C-Face gasket to be placed between the brake and motor.

Series*	List Price Adder
81,000; 82,000; 86,000	$100.00
56,X00 & 87,000	75.00

**N/A for hazardous location brakes*

M39 Corrosion-Resistant Endplate

Rust preventative treatment applied to brake endplate.

Series	List Price Adder
56,200, 56,400, 56,500, 56,800 & 65,300	$425.00
81,000; 82,X00 & 86,000	575.00
87,X00	475.00



M40 Special Milling: Flat Bottom on Housing & Endplate

This modification is provided in the event the flange between the endplate and housing interfere with the mounting configuration.

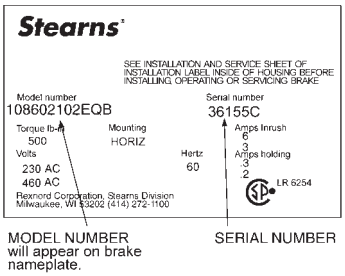
Series	List Price Adder
81,000; 82,000 & 86,000	$650.00



M41 Brass Nameplate with Special Engraving

Brass nameplates offer greater durability in outdoor applications.

Series	List Price Adder
81,000; 82,000 & 86,000	$75.00



M42 Stainless Splined Hub

Stainless steel splined hubs are available for extreme outdoor applications, to prevent corrosion on the disc and hub interface.

Series	List Price Adder
81,000; 82,000 & 86,000	$1060.00
87,000	800.00



M43 Viton® Gasket

Gaskets and o-rings in brakes can be provided in Viton® (flourocarbon) material, in place of the standard neoprene. However, the V-wiper steel-backed seals that are used on pull rod manual releases are not available in Viton® and remain as neoprene.

Viton® is a registered trademark name of DuPont.

Series	List Price Adder
81,000; 82,000; 86,000	$1,300.00
87,000*	$1,125.00
56,000	$950.00

*Viton® gaskets and o-rings are standard for 87,X00 series, except for hazardous location brakes where Viton® seals are N/A.

***Except series 56,200; 56,700; & 56,900 - where Viton gaskets are standard.*

M44 Special Friction Disc (per Disc)

Any non-standard friction disc in a brake. Cost is per disc.

Non-standard discs include: hi-inertia friction discs and heavy duty friction discs. Does not include carrier ring friction discs (see M46 and M47).

Series	List Price Adder
87,000	$50.00
56,000	45.00



M45 Splined Hub and Friction Disc

Standard on most models. Used for severe duty and reversing applications.

Series	List Price Adder
87,300	No Charge

Series	Torque (lb-ft)	List Price Adder
87,X00*	6-35 lb-ft	190.00
	50 & 75 lb-ft	290.00
	105 lb-ft	390.00

** Spline is standard on this series. Adder is for pre-revision 24-tooth spline.*

M46 Carrier Ring Friction Disc

The friction material is bonded to a steel or zinc/aluminum alloy ring.
This is used for severe duty applications and applications where people are being moved.

Series	Carrier ring material	List Price Adder (per disc)
Horizontal Use Only		
81,000	Steel	700.00
82,000	Steel	700.00
Horizontal or Vertical Use		
87,X00** (not available on 87,300 or 87,800 series	Zinc aluminum alloy	550.00



M47 Carrier Ring Friction Disc (Bronze)

The friction material is bonded to a bronze ring.
This is used for severe duty applications and applications where people are being moved.

Horizontal applications only

*** Only available with pre-revision design, 24-tooth splined hub, which is included in this price*

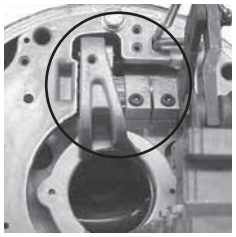
Series	List Price Adder (per disc)
81,000	N/A
82,000	$1050.00
86,000	1250.00
87,X00**	
6-35 lb-ft	925.00
50 & 75 lb-ft	1850.00
105 lb-ft	2775.00



M48 1,08X,000 Series Manual Adjust Mechanism

Excellent for holding applications when disc wear is not a concern. (Not available on hazardous location brakes.)

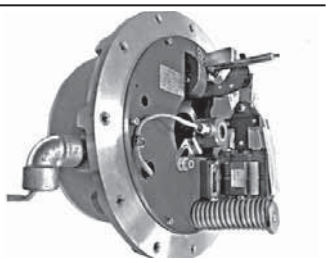
Series	List Price Adder
87,000	Subtract $50 List
81,000 82,000 86,000	No Charge



M60 Encoders

Internally mounted encoders are available in some series brakes, including some hazardous location brakes. See pages 52-53 for series availability and additional information.

Maximum Encoder Diameter (in.)	
1-056	N/A
1-087-E00	2.0”
1-081 & 1-082	2.5”
1-086	3.5”



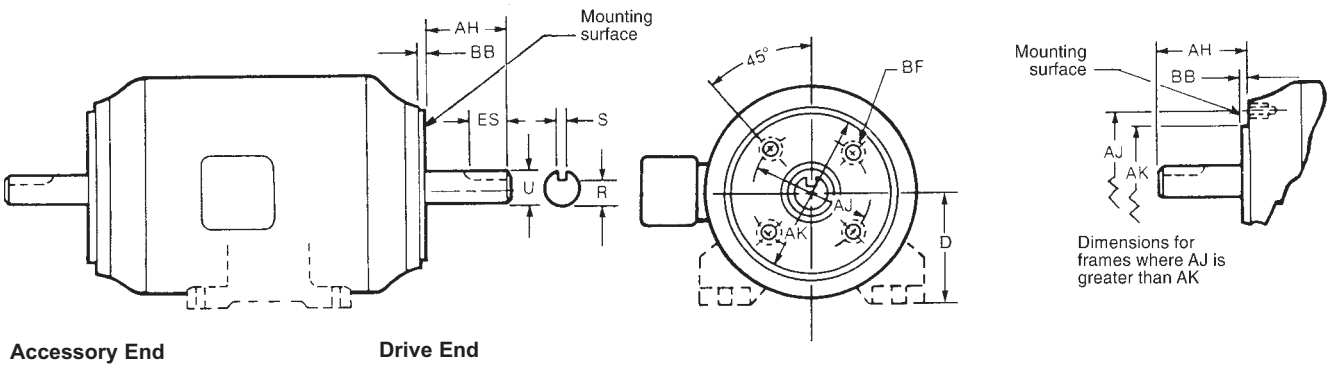
Dimensions for C-Face Brake Motor Systems

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Brakes Externally Wired to Motor

C-face motor with double shaft extension.

Stearns Disc Brakes are designed to mount on standard C-face motors having the same dimensions and tolerances on the accessory end as on the drive end. They also mount on foot mounting brackets and machine mounting faces having the same mounting dimensions and tolerances. Some motor accessory end C-face may differ from the drive end.



Accessory End **Drive End**

Drive End Dimensions (Inches)

Frame Designation	AJ	AK	BB Min.	BF Hole			U	AH	Keyseat			Base to Centerline D
				Number	Tap Size	Bolt Penetration Allowance			R	ES Min.	S	
42C	3.750	3.000	0.16	4	1/4-20	. . .	0.375	1.312	0.328	. . .	flat	2.62
48C	3.750	3.000	0.16	4	1/4-20	. . .	0.500	1.69	0.453	. . .	flat	3.00
56C	5.875	4.500	0.16	4	3/8-16	. . .	0.625	2.06	0.517	1.41	0.188	3.50
143TC and 145TC	5.875	4.500	0.16	4	3/8-16	0.56	0.875	2.12	0.771	1.41	0.188	3.50
182TC and 184TC	7.250	8.500	0.25	4	1/2-13	0.75	1.125	2.62	0.986	1.78	0.250	4.50
182TCH and 184TCH	5.875	4.500	0.16	4	3/8-16	0.56	1.125	2.62	0.986	1.78	0.250	4.50
213TC and 215TC	7.250	8.500	0.25	4	1/2-13	0.75	1.375	3.12	1.201	2.41	0.312	5.25
254TC and 256TC	7.250	8.500	0.25	4	1/2-13	0.75	1.625	3.75	1.416	2.91	0.375	6.25
284TC and 286TC	9.000	10.500	0.25	4	1/2-13	0.75	1.875	4.38	1.591	3.28	0.500	7.00
284TSC and 286TSC	9.000	10.500	0.25	4	1/2-13	0.75	1.625	3.00	1.416	1.91	0.375	7.00
324TC and 326TC	11.000	12.500	0.25	4	5/8-11	0.94	2.125	5.00	1.845	3.91	0.500	8.00
324TSC and 326TSC	11.000	12.500	0.25	4	5/8-11	0.94	1.875	3.50	1.591	2.03	0.500	8.00
364TC and 365TC	11.000	12.500	0.25	8	5/8-11	0.94	2.375	5.62	2.021	4.28	0.625	9.00
364TSC and 365TSC	11.000	12.500	0.25	8	5/8-11	0.94	1.875	3.50	1.591	2.03	0.500	9.00
404TC and 405TC	11.000	12.500	0.25	8	5/8-11	0.94	2.875	7.00	2.450	5.65	0.750	10.00
404TSC and 405TSC	11.000	12.500	0.25	8	5/8-11	0.94	2.125	4.00	1.845	2.78	0.500	10.00
444TC and 445TC	14.000	16.000	0.25	8	5/8-11	0.94	3.375	8.25	2.880	6.91	0.875	11.00
444TSC and 445TSC	14.000	16.000	0.25	8	5/8-11	0.94	2.375	4.50	2.021	3.03	0.625	11.00
500 Frame Series	14.500	16.500	0.25	4	5/8-11	0.94	. . .	. . .	. . .	. . .	. . .	12.50

Tolerances (Inches)

AK Dimension, Face Runout, Permissible Eccentricity of Mounting Rabbet

AK Dimension	Tolerance on AK Dimension		Maximum Face Runout	Maximum Permissible Eccentricity of Mounting Rabbet
	Plus	Minus		
Less than 12	0.000	0.003	0.004	0.004
12 and Larger	0.000	0.005	0.007	0.007

Shaft Extension Diameters

Shaft Diameter	Tolerances	
	Plus	Minus
0.2500 to 1.5000, inclusive	0.000	0.0005
Over 1.5000 to 6.500, inclusive	0.000	0.001

Width of Shaft Extension Keyseats

Width of Keyseat	Tolerances	
	Plus	Minus
0.188 to 0.750, inclusive	0.002	0.000
Over 0.750 to 1.500, inclusive	0.003	0.000

Shaft Runout

Shaft Diameter	Maximum Permissible Shaft Runout
0.3750 to 1.625, inclusive	0.002
Over 1.625 to 6.500, inclusive	0.003

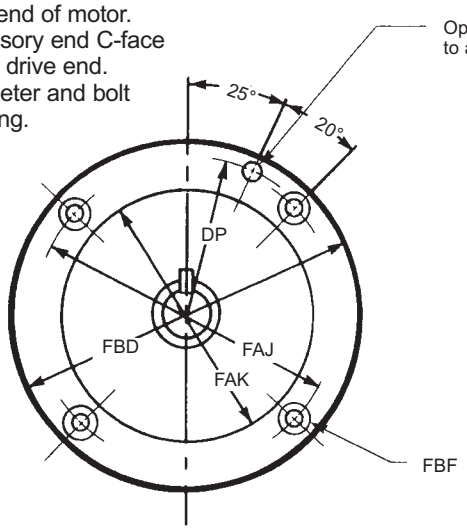
SOURCE: ANSI/NEMA Standards Publication No. MG 1-1987; Part 4 and Part 11.

Dimensions for C-Face AC Brake Motor System (cont.)

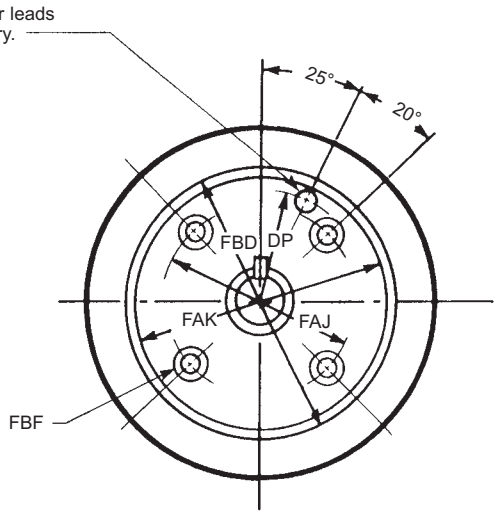
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Accessory End

FC face mounting for accessories, including brakes, on the end opposite the drive end of motor. Some motor accessory end C-face may differ from the drive end. Confirm shaft diameter and bolt circle before ordering.



143TFC to 184TFC Frames, Inclusive



213TFC to 326TFC Frames, Inclusive

Dimensions (Inches)

Frame Designation	FAJ	FAK	FBD Max.	FBF Hole			Hole for Accessory Leads	
				Number	Tap Size	Bolt Penetration Allowance	DP	Diameter
143TFC and 145TFC	5.875	4.500	6.50	4	3/8-16	0.56	2.81	0.41
182TFC and 184TFC	5.875	4.500	6.50	4	3/8-16	0.56	2.81	0.41
213TFC and 215TFC	7.250	8.500	9.00	4	1/2-13	0.75	3.81	0.62
254TFC and 256TFC	7.250	8.500	10.00	4	1/2-13	0.75	3.81	0.62
284TFC and 286TFC	9.000	10.500	11.25	4	1/2-13	0.75	4.50	0.62
324TFC and 326TFC	11.000	12.500	14.00	4	5/8-11	0.94	5.25	0.62

NOTE: Standards have not been developed for the shaft extenison diameter and length, and keyseat dimensions.

Tolerances* (Inches)

FAK Dimension, Face Runout, Permissible Eccentricity of Mounting Rabbet

FAK Dimension	Tolerance on FAK Dimension		Maximum Face Runout	Maximum Permissible Eccentricity of Mounting Rabbet
	Plus	Minus		
Less than 12	0.000	0.003	0.004	0.004
12 and Larger	0.000	0.005	0.007	0.007

* Tolerance requirement on 56,X00 and 87,000 Series Brake kits is .015 T.I.R. (total indicated runout shaft to motor register face).

Shaft Runout

Shaft Diameter	Maximum Permissible Shaft Runout
0.3750 to 1.625, inclusive	0.002
Over 1.625 to 6.500, inclusive	0.003

SOURCE: ANSI/NEMA Standards Publication No. MG 1-1987; Part 4 and Part 11.

Stearns Recommended Minimum Shaft Diameter by Torque

Minimum recommended shaft size considers a keyed C1045 steel shaft under *dynamic* use in a typical spring set brake application.

Torque ft-lb	Minimum Shaft (inches)
0.50	0.250
0.75	0.250
1.5	0.375
3	0.500
6	0.500
10	0.625
15	0.750
25	0.875
35	1.000
50	1.125

Torque ft-lb	Minimum Shaft (inches)
75	1.250
105	1.375
125	1.375
175	1.625
230	1.750
330	2.000
440	2.125
500	2.375
750	2.500
1000	2.750

Torque Nm	Minimum Shaft (mm)
4 Nm	ø10 mm
8 Nm	ø13 mm
16 Nm	ø16 mm
32 Nm	ø20 mm
60 Nm	ø25 mm
80 Nm	ø28 mm
150 Nm	ø34 mm
240 Nm	ø39 mm
400 Nm	ø47 mm

Set and Release Times

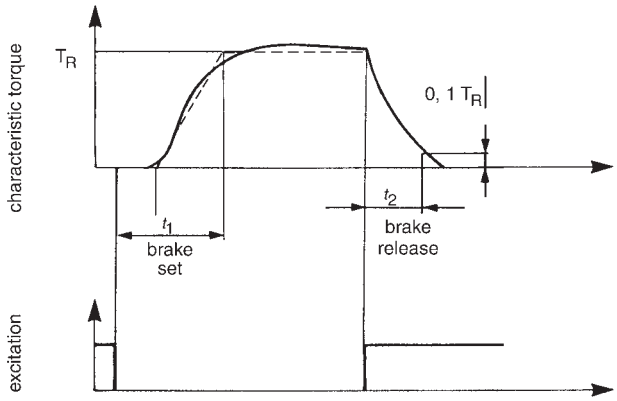
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The models listed below were tested for typical set and release times. Times listed below are defined as follows:

T1 = Total set time to 80% of rated static torque

T2 = Release time, measured as the time from when the power is applied to the brake to the time that the solenoid plunger or armature is fully seated.

NOTE: Times will vary with the motor used, and brakes tested with factory-set air gap. The times shown should be used as a guide only.



SAB T1/T2 Time in Milliseconds

Series	Static Torque lb-ft	Coil Size	T1 AC	T2 AC
56,000	1 1/2 – 25	K4, K4, K4+, M4+	25	14
87,000	10,15, 25,50	5 & 6	42	20
87,000	35,75,105	8	48	20
81,000 82,000	All	9	56	27

Brake and motor are switched separately.
All brakes tested in horizontal position.
Coil is energized for >24 hours before testing.
Ambient temperature 70°F at time of test.

AAB Series 310/311/320/321 Times in Milliseconds

Series	310 DC Side Switching					
Size	**1.79**	**2.0**	**2.87**	**3.35**	**4.25**	**5.0**
T1	3	6	9	14	13	22
T2	20	43	48	110	120	195
Series	**311 DC Side Switching**					
Size	**3.38**	**4.75**	**5.0**			
T1	43	48	96			
T2	12	74	35			
Series	**320 DC Side Switching**					
Size	**1.2**	**1.8**	**2.0**	**2.8**		
T1	14	43	16	27		
T2	24	26	35	34		
Series	**320 Full wave rectifier/AC Side Switching**					
Size	**1.2**	**1.8**	**2.0**	**2.8**		
T1	31	97	52	78		
T2	27	29	40	42		
Series	**321 DC Side Switching**			**321 AC Side Switching**		
Size	**1.2**	**1.8**	**2.8**	**1.2**	**1.8**	**2.8**
T1	13	16	20	45	77	131
T2	18	27	49	16	25	26

AAB Series 333 Times in Milliseconds

Size	Applied Voltage/Type of Switching	T1	T2
72	DC side switching	23	35
	230 Vac/ac side switching/full wave	103	39
	460 Vac/ac side switching/half wave	98	34
90	DC side switching	19	73
	230 Vac/ac side switching/full wave	113	72
	460 Vac/ac side switching/half wave	114	73
	230 Vac connected across motor full wave	357	72
	230 Vac connected across motor /quickset	42	72
112	DC side switching	155	39
	230 Vac/ac side switching/full wave	547	43
	460 Vac/ac side switching/half wave	501	54
132	DC side switching	119	100
	230 Vac/ac side switching/full wave	833	101
	460 Vac/ac side switching/half wave	803	106
145	DC side switching	185	186
	230 Vac/ac side switching/full wave	999	192
	460 Vac/ac side switching/half wave	1007	209
	230 Vac connected across motor full wave	1689	192
	230 Vac connected across motor /quickset	368	192
	460 Vac/ac side switching/half wave/With air gap shim	629	223
170	DC side switching	129	163
	230 Vac/ac side switching/full wave	1130	174
	460 Vac/ac side switching/half wave	1140	175
196	DC side switching	96	263
	230 Vac/ac side switching/full wave	920	264
	460 Vac/ac side switching/half wave	957	274
230	DC side switching	131	264
	230 Vac/ac side switching/full wave	1299	236
	460 Vac/ac side switching/half wave	1303	276
	Tor-Ac 230 Vac/ac side switching/full wave	169	295
	Tor-Ac 230 Vac/ac side switching/full wave/ With air gap shim	122	327
	230 Vac connected across motor quickset/quickrelease/with air gap shim	122	145
278	DC side switching	182	388
	230 Vac/ac side switching/full wave	1807	389
	460 Vac/ac side switching/half wave	1689	366

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CLOSE COUPLED

NEMA Frame	Series	Torque (lb-ft)	Nm	Enclosure	
48C	48,100	1.5 - 6	2-8	IP 23	9
56C - 145TC	56,X00	1.5 - 25	2-34	IP 21, 23, 54, 55, 56, 57	10-15
182TC - 256TC/UC	56,600	10 - 25	14-34	IP 23, 54, 55	16
	87,000	6 - 105	8-142	IP 23, 54, 55	17-20
284TC/UC - 286TC/UC	87,100	50 - 105	68-142	IP 23, 54	21
324 - 405TC/TSC/UC/USC	81,000	125 - 230	169-312	IP 23, 54	22-23
	82,000	125 - 440	169-597	IP 23, 54	22, 24
444 - 445TC/TSC/UC/USC	86,000	500 - 1,000	678-1356	IP 23, 54	25-26
505TC/TSC/UC/USC	86,100	500 - 1,000	678-1356	IP 23, 54	25-26

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56C - 145TC	65,300	1.5 - 15	2-20	IP 23, 56	NEMA 7, 9	29-31
182TC - 256TC/UC	87,300	10 - 105	14-142	IP 23, 55	NEMA 7, 9	32-37
324 - 405 TC/TSC/UC/USC	82,300	125 - 330	169-447	IP 56	NEMA 7, 9	38-39
Foot Mounted	87,300	10 - 105	14-142	IP 23	NEMA 7, 9	36-37
Foot Mounted	82,300	125 - 330	169-447	IP 23	NEMA 7, 9	39

DIVISION 2 HAZARDOUS LOCATION

56C - 145TC	56,800	1.5 - 25	2-34	IP 55	40-41
182TC - 256TC/UC	87,800	6 - 105	8-142	IP 55	42-43

DOUBLE C-FACE COUPLER BRAKES

56C - 145TC	56,700	1.5 - 25	2-34	IP 23, 54, 55, 56	44-45
182TC - 256TC/UC	87,700	10 - 105	14-142	IP 23, 54, 55	46-47

FOOT MOUNTED WITH BEARING SUPPORTED THRU-SHAFT

Foot Mounted	56,700	1.5 - 25	2-34	IP 23	48
Foot Mounted	87,200	10 - 105	14-142	IP 23, 54	49

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Armature Actuated Brakes (AAB)

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Series	Description	Torque (lb-in)	*Nm*	
310	High Torque Holding Only-Servo Motor Brake	8 - 350 lb-in	*.9 - 39.5*	67-68
311	High Torque Holding Only-Servo Motor Brake	75 - 400 lb-in	*8 - 45*	69-70
320	Commercial Duty-Small Gear Motors	3 - 50 lb-in	*.34 - 5.6*	71-72
321/322	Totally-Enclosed Non-Ventilated (TENV) Commercial Duty	3 - 72 lb-in	*.34 - 8.1*	73-76
321 NEMA C	Totally-Enclosed Non-Ventilated (TENV) C-Face Mount	1.5 - 25 lb-ft	*2-34*	77-78
331 & 333	European Style Metric Mounting	3 - 300 lb-ft	*4 - 400*	79-81, 84
331 & 333	European Style-NEMA C-Face Mount	3 - 300 lb-ft	*4 - 400*	82-84
350	European Style Portal Crane Duty - Pressure Plate Mount	75 - 300 lb-ft	*102 - 400*	85-86
360	European Style Portal Crane Duty - Mag Body Mount	60 - 300 lb-ft	*80 - 400*	87-88

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Performance Parameters and Limited Warranty

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The performance of Stearns brakes, clutches, clutch-brake combinations, solenoids, and controls depends upon the proper application of the product, adequate run in, installation and maintenance procedures, and reasonable care in operation.

All torque values listed in our bulletins are nominal and are subject to the variations normally associated with friction devices. The purchaser should take into consideration all variables shown in the applicable specification sheets. Although our application engineers are available for consultation, final selection and performance assurance on the purchaser's machine is the responsibility of the purchaser. Careful purchaser selection, adequate testing at time of installation, operation and maintenance of all products of Rexnord Industries, LLC, Stearns Division are required to obtain effective performance.

Stearns warrants to its purchasers that all its products will be free from defects in material and workmanship at the time of shipment to the purchaser for a period of one (1) year from the date of shipment. All warranty claims must be submitted in writing to Stearns within the warranty period, or shall be deemed waived. As to products or parts thereof which Stearns finds to have been defective at the time of shipment, its sole responsibility hereunder shall be to repair, correct or replace (whichever Stearns deems advisable) such defective products or parts without charge, FOB Stearns factory. In the alternative, Stearns may, at its option, either before or after attempting a different remedy, refund the purchase price upon return of the product or parts.

This warranty shall not apply to any product which has been subjected to misuse: misapplication: neglect (including but not limited to improper maintenance and storage); accident: improper installation; modification (including but not limited to use of other than genuine Stearns replacement parts or attachments); adjustment; or repair.

THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING THAT OF MERCHANTABILITY AND OF FITNESS FOR A PARTICULAR PURPOSE, AND OF ANY OTHER OBLIGATION OR LIABILITY ON OUR PART OF ANY KIND OR NATURE WHATSOEVER.

No Stearns representative has any authority to waive, alter, vary or add to the terms hereof without prior approval in writing, to our purchaser, signed by an officer of Rexnord Industries, LLC.

Stearns liability for its products, whether for breach of contract, negligence, strict liability in tort, or otherwise, shall be limited to the repair, correction, or replacement of the products or parts thereof, or to the refund of the purchase price of such products or parts. Stearns will not be liable for any other injury, loss, damage or expense, whether direct or consequential, including but not limited to loss of use, income, profit or production, or increased cost of operation, or spoilage of or damage to material, arising in connection with the sale, installation, use of, inability to use, or the repair or replacement of, or late delivery of, Stearns products.

Any cause of action for breach of the foregoing warranty must be brought within one (1) year from the date the alleged breach occurs.

Note on Special (Nuclear) Applications:

"Rexnord Industries, LLC, Stearns Division products are designed for standard industrial and commercial applications. Operating requirements, environments and required tolerances in nuclear and aircraft applications may be beyond the commercial standards of the Stearns Divisions products. Rexnord Industries, LLC, Stearns Division will assume absolutely no responsibility for the use of and/or resale of Rexnord Industries, LLC, Stearns Division products for such applications unless approved in writing in advance by Rexnord Industries, LLC, Stearns Division."

Introduction to Solenoid Actuated Brakes (SAB's)

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Stearns Brakes Set the Standard for Excellence

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

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

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

Enclosure Types

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

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

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

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

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

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

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

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

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

Self-Adjusting Disc Brakes



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

Manually Adjusted Disc Brakes with Automatic Reset

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



Introduction to Stearns Solenoid Actuated Brakes (SAB's)

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Brakes for Hazardous Locations



Although rugged Stearns Brakes are built to withstand rigorous industrial environments, many applications require additional protection from explosive gases or ignitable dusts. Stearns manufactures a complete line of disc brakes designed from the hazardous locations defined in the *National Electric Code (NEC)*. Each brake is labeled to show the Class, Group, and maximum operating temperature of the brake enclosure. We offer both motor-mounted and foot-mounted designs, and all Stearns Hazardous Location Brakes are UL Listed and CUL or CSA certified.

Double C-Face Disc Brake Couplers



Stearns Disc Brake Couplers provide maximum versatility, allowing you to add a brake to a C-face motor with a single shaft extension. Using these reliable products, you can couple a C-face motor to a C-face gear reducer.

Washdown Brakes

Stearns Washdown Brakes include the 56,000 and 87,000 Series brake models. These brakes meet BISSC Standards, AAA Dairy Standards, and other food industry washdown requirements. They feature stainless steel hardware, neoprene gasketing, and FDA-approved white epoxy paint or stainless steel enclosure.



Solenoid Actuated Brakes versus Armature Actuated Brakes

Solenoid Actuated Brakes	Armature Actuated Brakes
Simple wear adjustment	Complex wear adjustment
Easy coil exchange for different voltages	Difficult to change out complete magnet assembly
Maintained manual release with automatic reset for brake release during set-up	Non-maintained release (deadman) requires constant external force to operate
Add on options easily assembled to standard unit	Options require complete brake in most units
Rapid set and release times.	Response time is slower due to required magnetic field build-up in magnet-style coil
Connection can be made directly to AC power source	Direct connection to AC power source requires an optional electric control

Marine Applications

Brakes used in marine applications are customized to meet specific standards. These standards are established to provide various levels of corrosion resistance and performance standards under specific conditions.



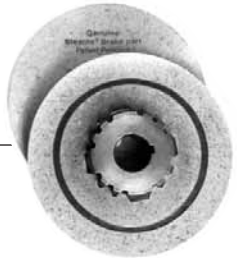
Maritime and Naval Brakes are designed for U.S. Navy and Coast Guard military specifications. These units conform to MIL-B-16392C or 46CFR 110.10-1 and IEEE Standard 45. Special material components help prevent corrosion due to shipboard environments. SAB's used in marine environments can be custom built to meet the specifications. In addition, all Stearns SAB's are "Type Approval Certified" by the American Bureau of Shipping.

Today, Stearns is focused on being your worldwide, value-added supplier. Our factory-trained field sales force is available to work with you in person to determine your application needs, as well as provide training and support to your engineers and maintenance staff. Our extensive network of more than 900 distributor branches is your assurance of quality service after the sale.

Stearns is a division of Rexnord Industries, LLC, a world leader in power transmission products. We have the resources, experience and dedication to meet your industrial brake, clutch and solid-state electronic centrifugal switch needs.

Trademarked and Patented Friction Discs

Now you can rely on identifying genuine Stearns Friction Discs which assure continuous, reliable performance backed by the Stearns name.
A molded ring in the Stearns friction discs makes it easy to visually identify a Stearns disc. The new splined discs are trademarked and patented by Stearns Division, Rexnord Industries, LLC.



Manually Adjusted Solenoid Actuated Brakes

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Stearns manually-adjusted disc brakes are available from .5 to 105 lb-ft static torque. They feature spring-set, electrically released designs having simple adjustments to compensate for friction lining wear. All have simple 2-wire motor connection.

Series 48,100 Disc Brakes

Mount directly to NEMA 48C motor frames. Static torque ratings are 1½, 3 and 6 lb-ft.

Quality Design Features:

- Spring-set, electrically released
- Single-disc caliper design
- Simple wear adjustment for easy maintenance
- Knock-out plug on housing for through-shaft applications
- Maintained manual release with automatic reset
- Mount in any position without modification

All Series 56,X00 Disc Brakes

Mount directly to NEMA 56C, 143TC, 145TC, 182TC and 184TC motor frames. Static torque ratings from 1½ to 25 lb-ft.

The 56 Series family is an unbeatable combination: the features you want most in spring-set disc brakes, at a low price. We took a fresh look at the brake itself as well as your needs and designed a comprehensive line of spring-set brakes that set new standards for quality, reliability and customer convenience. Here's a sampling of the features we've built into the Stearns 56 Series brakes:

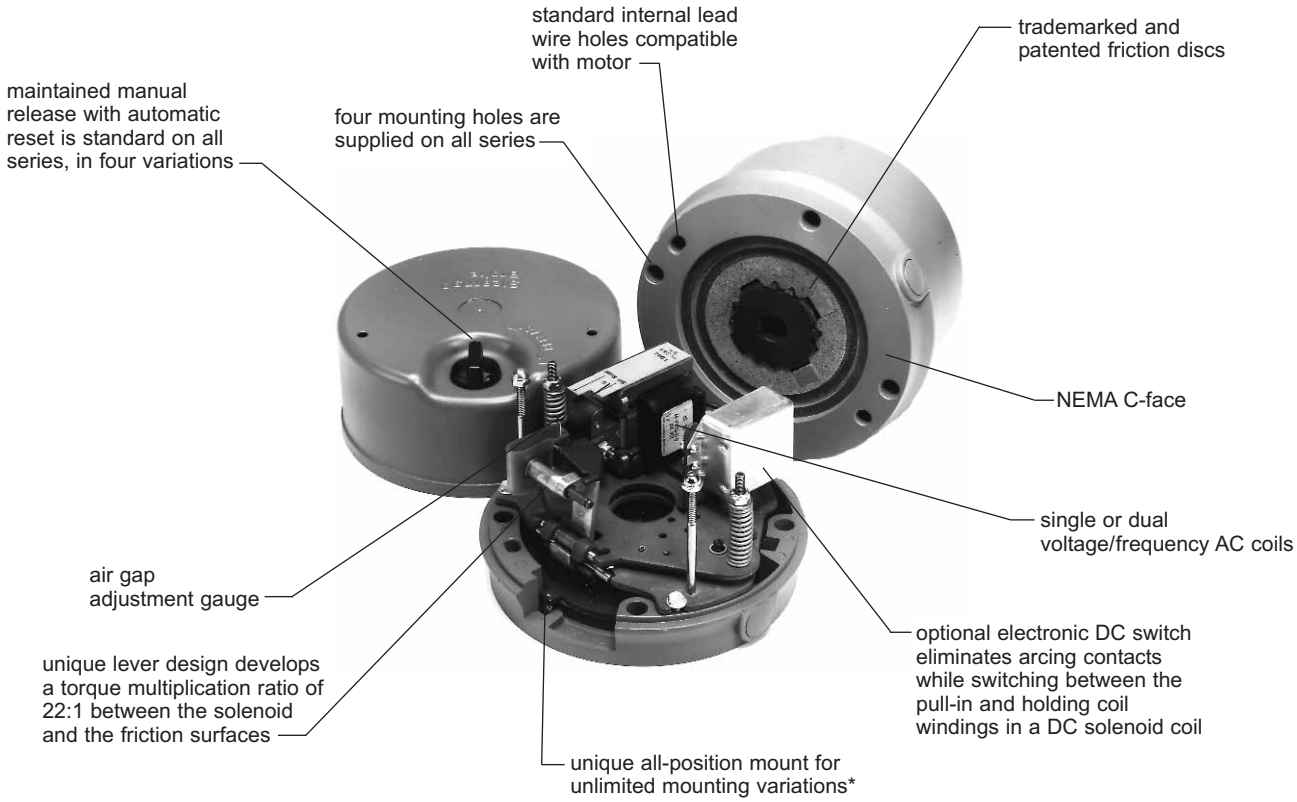
- A Stearns-exclusive spring design permits all-position mount for unlimited mounting possibilities.
- Trademarked and patented friction discs
- Patented splined hub that increases friction disc working area, runs quieter, and offers enhanced heat dissipating capability
- ABS Type Approval Certified

The 56 Series come in static torque ratings from 1.5 through 25 lb-ft with NEMA C-face mountings 56C, 143TC, 145TC, 182TFC, and 184TFC. Ten different housing, endplate, and release configurations accommodate IP 23, IP 54, IP 55, IP 56 and IP 57 enclosures. With a wide variety of pre-engineered modifications, you can select from 120,000 possible combinations!

87,000 Series Disc Brakes

An optional manual adjust mechanism can be provided on 87,000 Series Brakes (does not include 87,300 and 87,800 Series Brakes). Mounted directly to NEMA 182TC through 256TC frames. Includes all the other features of the Series 87,000.

Series 56,000 Design Features

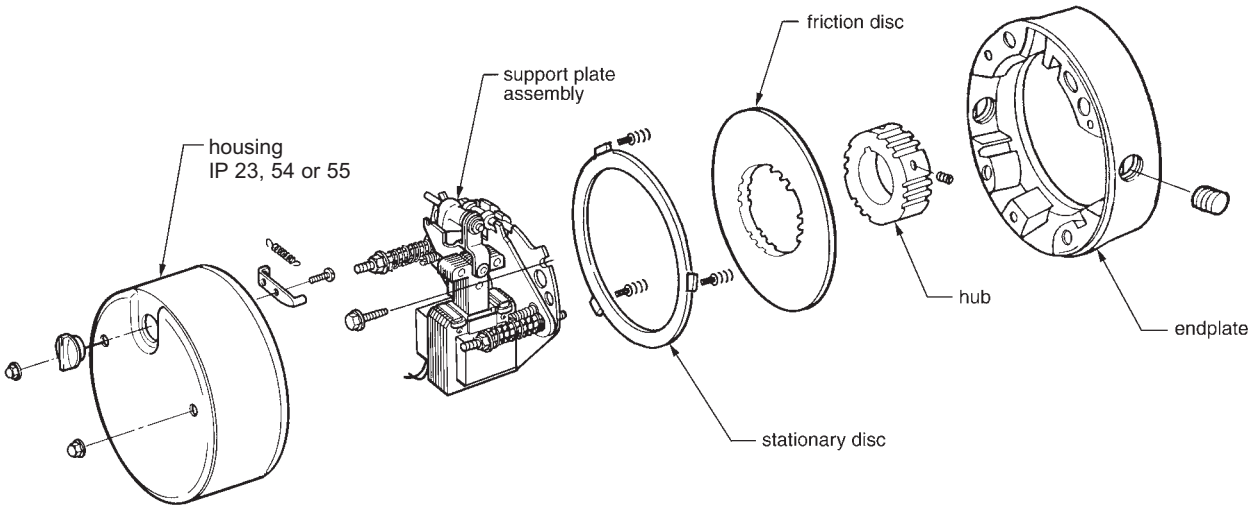


*20 and 25 lb-ft brakes are easily adapted for vertical applications (kit included)

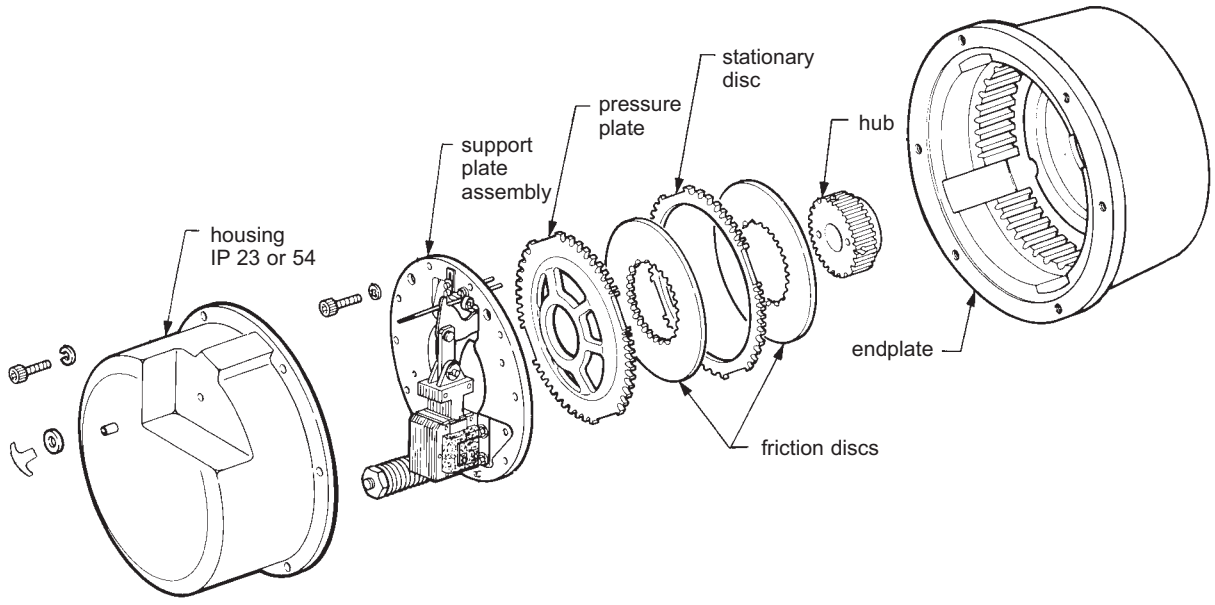
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Series 56,000 Manually-Adjusted Solenoid Actuated Brake



Self-Adjusting Disc Brakes - Main Components

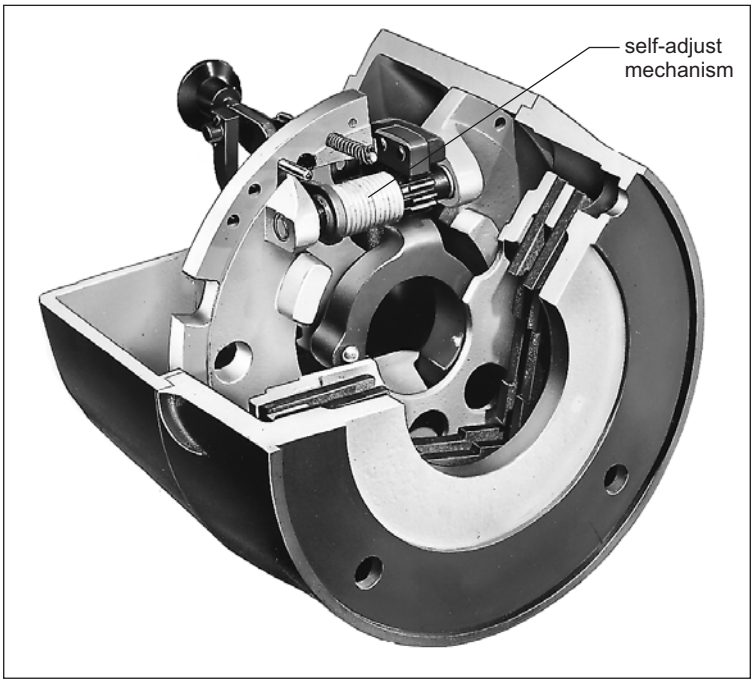


Self-Adjusting Solenoid Actuated Brakes

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Stearns self-adjusting disc brakes feature an exclusive, automatic adjusting device that eliminates the major cause of brake maintenance – adjustment to compensate for friction lining wear. This feature makes Stearns self-adjusting brakes ideal for remote or inaccessible locations, and for applications where rapid cycling requires frequent wear adjustment of manual adjustable brakes.

The self-adjust mechanism is a simple wrap-spring clutch that automatically adjusts the brake's solenoid air gap to compensate for wear of the friction discs. Automatic adjustment occurs every time the brake is operated, eliminating the errors that can occur with hand adjustment. The self-adjust feature means Stearns motor brakes always operate at peak efficiency, providing more uniform braking, longer disc life, less maintenance time and smooth, quiet operation.



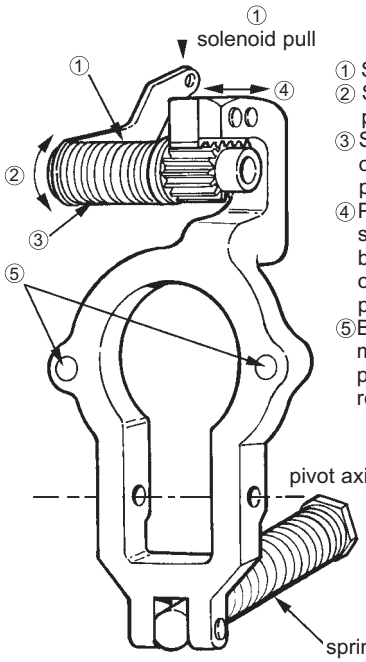
There are nine series of Stearns self-adjusting brakes to select from:

- Series 81,000 brakes for direct mounting to NEMA 324TC through 365TC motor frames. Static torque ratings from 125 to 230 lb-ft.
- Series 82,000 brakes for direct mounting to NEMA 324TC through 405TSC motor frames. Static torque ratings from 125 to 440 lb-ft.
- Series 86,X00 brakes for direct mounting to NEMA 444TSC through 505TSC motor frames. Static torque ratings from 500 to 1,000 lb-ft.
- Series 87,X00 brakes for direct mounting to NEMA 182TC through 286TC motor frames. Static torque ratings from 6 to 105 lb-ft.
- Series 87,200 for floor mounted, double shaft output with bearing support. Static torque ratings from 10 to 105 lb-ft.
- Series 87,300 hazardous location brakes for UL Listed Division I applications, which mount directly to NEMA 182TC through 256TC motor frames. Static torque ratings from 10 to 105 lb-ft.
- Series 82,300 hazardous location brakes for UL listed Division I applications, for mounting directly to NEMA 324TC through 405TSC. Static torque ratings 125 to 330 lb-ft.
- Series 87,700 brakes for in-line applications, to couple the motor and gear box. For direct mounting to NEMA 182TC through 256TC motor frames. Torque Rating of 10 to 105 lb-ft.
- Series 87,800 brakes hazardous location brake for UL Listed Division 2 applications, which mount directly to NEMA 182TC through 256TC motor frames. Static torque ratings of 10 to 105 lb-ft.

Quality Design Features

- Spring-set, electrically released.
- Self-adjusting mechanism minimizes maintenance by automatically compensating for lining wear.
- Unitized construction for easy friction disc replacement.
- Maintained manual release with automatic reset.
- Simple 2-wire motor connection.
- Standard or dust-tight, waterproof enclosures available.
- Many modifications for special application requirements.
- Models for marine and maritime applications.
- Models in accordance with Military Specification B16392-C for Navy applications.
- ABS Type Approval Certified.

Lever Arm and Self-Adjusting Mechanism



① Solenoid is energized.
② Solenoid arm and pinion rotate.
③ Spring clutch tightens on hubs and turns pinion.
④ Pinion moves rack section of lever arm back above pivot axis, overcoming force of pressure spring.
⑤ Buttons on lever arm move away from pressure plate, releasing brake.

SELECTION - Solenoid Actuated Brakes

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NOTE: For overhauling/high inertia loads, to stop in a specified time/distance, or for brakes combined with variable frequency drives, please refer to *Application Engineering* Section.

Stearns Solenoid Actuated Brakes can be easily selected from Table 1 and 2.

Given motor data:
1. Horsepower (hp)
2. Speed (RPM)
3. NEMA C-face frame size

Determine:
1. Static torque rating of the brake (lb-ft)
2. Brake series

Step 1 – Given the motor horsepower and speed, select the brake torque from Table 1. Torque in table 1 is calculated using formula:

$$T_S = \frac{5{,}252 \times P}{N} \times SF$$

Where, T_S = Static torque, lb-ft

P = Motor horsepower, hp

N = Motor full load speed, rpm

SF = Service Factor

5,252 = constant

Example: Given a 5 hp, 1800 RPM motor, the selected brake is 20 or 25 lb-ft.

Step 2 – Given the NEMA C-face motor frame size, select the brake series from Table 2.

Example: Given the 5 hp, 1800 RPM motor in Step 1 with a NEMA 184TC frame, Series 87,000; 87,300 or 87,700 Brakes can be selected to mount directly to the motor.

Table 1 – Torque Selection

In this table, brake torque ratings are no less than 140% of the motor full load torque.

Motor hp	Brakemotor Shaft Speed (RPM)						
	700	900	1200	1500	1800	3000	3600
	Static Torque Rating of Brake (lb-ft)						
1/6	3	1.5	1.5	1.5	0.75	0.5	0.5
1/4	3	3	3	1.5	1.5	0.75	0.5
1/3	6	3	3	3	1.5	1.5	0.75
1/2	6	6	3	3	3	1.5	1.5
3/4	10	6	6	6	6	3	3
1	15	10	6	6	6	3	3
1-1/2	20	15	10	10	10	6	3
2	25	20	15	10	10	6	6
3	35	25	20	15	15	10	6
5	75	50	35	25	20 or 25	15	10
7-1/2	105	75	50	50	35	25	15
10	105	105	75	50	50	25	25
15	175	125	105	75	75	50	35
20	230	175	125	105	105	50	50
25	330	230	175	125	105	75	50
30	330	330	230	175	125	75	75
40	440	330	330	230	175	105	105
50	550	440	330	330	230	*	*
60	750	500	440	330	330	*	*
75	1000	750	500	440	330	*	*
100	—	1000	750	500	440	*	*
125	—	1000	1000	750	500	*	*
150	—	—	1000	750	750	*	*
200	—	—	—	1000	1000	*	*
250	—	—	—	—	1000	*	*

*See catalog pages for maximum rpm by series. Thermal capacity must be considered in load stops over 1800 rpm.

Table 2 – Brake Series Selection by NEMA Frame Size

Torque Range (lb-ft)	Brake Series	C-Face Motor Frame Size											
		48C	56C	143TC 145TC	182TC 184TC	213TC 215TC	254TC 254UC 256TC 256UC	284TC 284UC 286TC 286UC	324TC 324UC 326TC 326UC	364TC 364UC 365TC 365UC	404TC 404UC 405TC 405UC	444TC 444UC 445TC 445UC	504UC 504SC 505C 505SC
Manually-Adjusted Brakes (require periodic adjustment to compensate for friction disc wear)													
1.5-6	48,100	①											
1.5-25	56,X00		①	①	②	②	②						
10-25	56,500				①								
Self-Adjusting Brakes (automatically compensate for friction disc wear)													
6-105	87,X00		③	③	①	①	①	②	②	②	②		
50-105	87,100							①					
125-230	81,000				②	②	②	②	①	①	①	②	
125-440	82,000				②	②	②	②	①	①	①	②	
500-1000	86,000								②	②	②	①	
500-1000	86,100												①
Division I Hazardous Location Brakes (for atmospheres containing explosive gases or ignitable dusts) / Motor Mounted													
1.5-15	65,300		①	①	②	②	②						
10-105	87,300				①	①	①	②	②	②	②		
125-330	82,300				②	②	②	②	①	①	①	②	
Division I Hazardous Location Brakes (for atmospheres containing explosive gases or ignitable dusts) / Foot Mounted													
10-105	87,300				④	④	④						
125-330	82,300								④	④	④		
Division 2 Hazardous Location Brakes													
1.5-25	56,800		①	①	②	②	②						
6-105	87,800		③	③	①	①	①	②	②	②	②		
Double C-Face Brake Couplers (for direct coupling a C-face motor to a C-face gear reducer)													
1.5-25	56,700		①	①									
10-105	87,700				①	①	①						

① Brake mounts directly to motor C-face.
② Adapter required to mount brake to motor C-face. Refer to brake specifications for adapter information.
③ Brake endplate modified for direct mounting to motor C-face without an adapter.
④ Brake is foot mounted for coupling to a hazardous-location motor.

56 Series
Mounting Face: NEMA 56C, 143TC and 145TC

The 56,X00 Series have the following design features:

- Spring-Set Electrically Released
- Static Torque 1.5 through 25 lb-ft
- Adjustable Torque, down to 50% of rated nameplate torque
- Manual Wear Adjustment
- Airgap Adjust Gage
- Splined Hub
- IP 21, 23 & 54 (formerly referred to by Stearns as NEMA type 1, 2 & 4 respectively) IP 55, 56, & 57 (formerly referred to by Stearns as NEMA Type 4X (BISSC Certified with epoxy coating and stainless steel hardware on exterior, or with a stainless steel enclosure)
- Universal mounting through 15 lb-ft. The 20 and 25 lb-ft are supplied with springs for vertical modification.

Specifications:

- Lead Wire Length: 24 inches
- Maximum Speed: Horizontal 5000 rpm Vertical 3600 rpm
- Coil Insulation: Standard Class B Optional Class H (56,800 Series Class H standard)
- Certified: CSA File LR-6254
- ABS Type Approval Certified

Product Overview

56000 Series

Designed for industrial applications requiring high performance in a compact lightweight package.

Construction:
Die cast aluminum endplate with stamped steel housing

Available Enclosures:
IP 23, 54 & 55

Release Type:
External knob manual release with or without automatic reset

Through Shaft Capability: Yes (IP 23 only)



56200 Series

Designed for industrial applications requiring the protection of a heavy duty cast iron enclosure.

Construction:
Cast iron endplate and housing.

Available Enclosures: IP 56 & 57

Release Type:
External side lever release with automatic reset

Through Shaft Capability: Yes



56500 Series

Same as 56000 Series with 182TC / 184TC mounting.

Construction:
Cast iron endplate with stamped steel housing
(Direct mount to 182TC / 184TC)

Available Enclosures:
IP 23, 54 & 55

Release Type:
External knob manual release with or without automatic reset

Through Shaft Capability: Yes (IP 23 only)



56900 Series

For use in severe environments found in process industries such as food, pulp and paper mills and chemical plants.

Construction: Stainless steel

Release Type:
Side lever with automatic reset

Available Enclosures: IP 56 & IP 57

Through Shaft Capability: with IP43 rating only



56700 Series

Units designed for industrial applications that fit between a standard C-Face motor and gear reducer. Can also be used to retrofit installed units without braking capability.

Construction: Die cast aluminum endplate and housing

Available Enclosures:
IP 23, 54, 55 & 56

Release Type: External knob release with automatic reset

C-face brake has output shaft



Also Available . . .

56100 Series

Full die cast aluminum endplate and housing with internal release lever

Available Enclosures:
IP 23, 56 & 57



56300 Series

Die cast aluminum endplate with stamped steel housing and external maintained release, IP 21



56400 Series

Cast iron endplate with stamped steel housing and external knob release

Available Enclosures:
IP 23 & 54



56600 Series

Cast iron endplate and housing with internal release lever

Available Enclosures: IP 23, 56 & 57



Series 56,000; 56,100; 56,200; 56,300; 56,400; 56,500; 56,600; 56,700; and 56,900
Mounting Face: NEMA 56C, 143TC and 145TC

Engineering Specifications

Maximum Solenoid Cycle Rate: ①
AC 36 cycles/min
DC 10 cycles/min

Thermal Capacity: ②
Horizontal 9 hp-sec/min *(112 watts)*
Vertical 6.5 hp-sec/min *(80 watts)*

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

② Thermal capacity rating is based on ambient temperature of 72°F *(22°C)*, stop time of one second or less, with no heat absorbed from motor. Refer to *Selection Procedure* Section.

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

Static Torque lb-ft	Coil Size	T1	T2
1.5 - 25	4, K4, K4+, M4+	25	14

Series 56,000; 56,100; 56,300; 56,500; and 56,700

Nominal Static Torque lb-ft *(Nm)*	Number of Friction Discs	Coil Size AC	Coil Size DC	Inertia (WK^2) lb-ft² *($kgm^2 \times 10^{-4}$)*
1.5-3 *(2-4)*	1	4	4+	.008 *(3.36)*
6 *(8)*	1	K4	K4+	.008 *(3.36)*
10 *(14)*	2	K4	K4+	.014 *(5.88)*
15 *(20)*	2	K4+	M4+	.014 *(5.88)*
20 *(27)*	3	K4+	M4+	.020 *(8.40)*
25 *(34)*	3	M4+	P4+	.020 *(8.40)*

Series 56,200; 56,400; 56,600; and 56,900

Nominal Static Torque lb-ft *(Nm)*	No. of Friction discs	Coil Size AC	Coil Size DC	Inertia (WK^2) lb-ft² *($kgm^2 \times 10^{-4}$)*
3-6 *(4-8)*	2	4	4+	.014 *(5.88)*
10 *(14)*	2	K4	K4+	.014 *(5.88)*
15 *(20)*	2	K4+	M4+	.014 *(5.88)*
20 *(27)*	3	K4+	M4+	.020 *(8.40)*
25 *(34)*	3	M4+	P4+	.020 *(8.40)*

Current Ratings (amperes)

Solenoid Coil Size*	AC Current	Voltage: 60 Hz 115	200	230	400	460	575	Voltage: 50 Hz 110	220	380	Voltage: DC 24	95	115	230
4	Inrush	3.6	2.1	1.8	1.1	.9	.7	4.1	2.1	.9	13.3	3.6	2.8	1.5
	Holding	.3	.2	.2	.08	.08	.06	.3	.2	.08	.3	*.1*	*.05*	*.03*
4+	Inrush	–	–	–	–	–	–	–	–	–	12.0	4.7	3.7	2.0
	Holding										*.4*	*.1*	*.08*	*.04*
K4	Inrush	4.3	2.5	2.2	1.3	1.1	.9	3.8	1.9	1.1	17.5	4.7	3.7	2.0
	Holding	*.3*	*.2*	*.2*	*.1*	*.08*	*.07*	*.4*	*.2*	*.08*	*.4*	*.1*	*.08*	*.04*
K4+	Inrush	4.6	2.5	2.3	1.2	1.0	.9	4.9	2.0	1.0	20.5	7.5	5.5	2.0
	Holding	*.4*	*.2*	*.2*	*.1*	*.1*	*.08*	*.4*	*.2*	*.1*	*.5*	*.1*	*.08*	*.04*
M4	Inrush	3.0	1.7	1.5	.9	.8	.6	–	–	.8	–	–	–	–
	Holding	*.6*	*.3*	*.3*	*.2*	*.1*	*.21*			*.1*				
M4+	Inrush	4.6	2.5	2.3	1.2	1.0	.9	4.1	2.0	1.3	30.3	7.9	5.5	2.0
	Holding	*.4*	*.2*	*.2*	*.1*	*.1*	*.08*	*.4*	*.2*	*.1*	*.5*	*.1*	*.1*	*.04*
P4+	Inrush	–	–	–	–	–	–	–	–	–	30.3	11.3	8.4	3.0
	Holding										*.5*	*.1*	*.08*	*.04*

Motor Frame Adapters: Series 56,000 through 56,600

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

To Adapt to NEMA Frame Size	AK Dim. in. *(mm)*	Reg. No.	Brake Enclosure ①	Brake Torque	Adapter Stock Number	Additional Shaft Length Required in. *(mm)*
182TC 184TC 213TC 215TC 254TC 256TC	8.50 *(215.90)*	-9	IP 23	1.5-15	5-55-5041-00 List $700.00	.94 *(23.81)*
	8.50 *(215.90)*	-9	IP 54	1.5-6	5-55-5041-00 List $700.00	.94 *(23.81)*
	8.50 *(215.90)*	-9	IP 23	20 & 25	5-55-5043-00 List $700.00	.94 *(23.81)*
	8.50 *(215.90)*	-9	IP 54	10-25	5-55-5043-00 List $700.00	.94 *(23.81)*

① 56,300 Series have NEMA 1 enclosure. For adapter dimensions, see *Technical Data*

1-056-132-00-BQF

Ordering and Identification Information

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

Example of a complete part number:

1-056-034-00-BFF
- Series
- Torque
- Enclosure
- Lead wire position (internal and external, left and right) standard
- 230 Vac
- 5/8 bore and 3/16 x 3/32 keyway

Hub Selection

Character	Bore (in.)	Keyway** (in. x in.)
A*	5/8	1/8 x 1/16
B	5/8	3/16 x 3/32
C	3/4	3/16 x 3/32
D	7/8	3/16 x 3/32
E	1-1/8	1/4 x 1/8
F*	1-1/4	1/4 x 1/8
K	1/2	1/8 x 1/16
L*	1	1/4 x 1/8
N*	9/16	1/8 x 1/16
O*	11/16	3/16 x 3/32
P*	1-1/16	1/4 x 1/8
R*	13/16	3/16 x 3/32
S*	15/16	1/4 x 1/8
Z	.460	pilot bore

Minimum bore is .500. Maximum allowable bore is 1.25. (maximum shaft length not to exceed end of hub).
For through-shaft applications, .875 is maximum

*These bores are non-standard. Add $225.00 to list price.

**Keyseats made to ANSI B17.1 Standard.

Standard AC Voltage Ratings

Character	Voltage	Hz
B	115	60
D	110	50
E	200	60
F	230 190	60 50
H	220	50
L	460 380	60 50
M	415	50
N	575	60
O	110/220	50
P	115/208-230	60
Q	208-230/460 190/380	60 50
R	200/400	60

Direct Current

Character	Voltage
T	12
U	24
V	36
W	48
X	95
Y	115
Z	230

Consult factory if other DC voltage is needed.

Voltages below 70VDC are polarity sensitive.

Modifications are available- see SAB Modification Section

Dimensional Drawings are on the pages following.

Series 56,100 (1-056-1XX) Die Cast Aluminum & Series 56,600 (1-056-6XX) Cast Iron

Mounting Face: NEMA 56C, 143TC and 145TC , 4.5" AK, 5.88" AJ



Release Type: Internal Lever, Non-Maintained

Installation and Service: P/N 8-078-905-60

Modifications: Pages 54-63

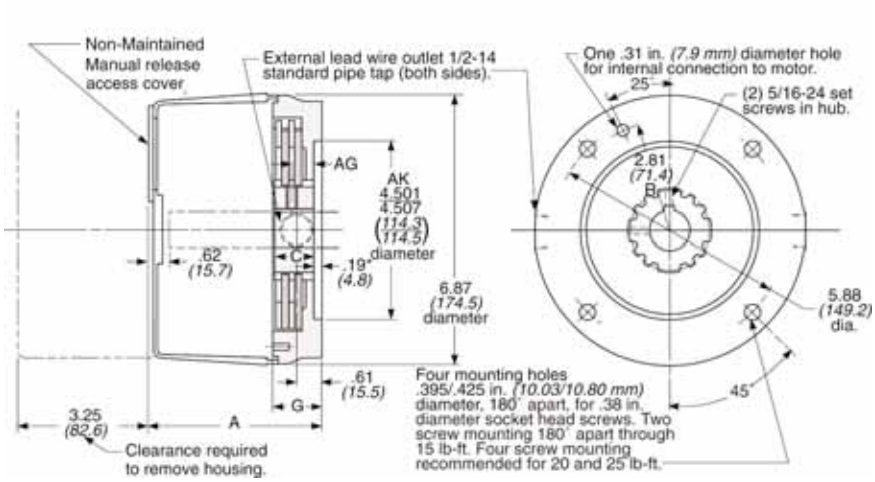
Enclosure Protection: IP 23; 56 & 57 (formerly referred to by Stearns as NEMA 2, 4 & 4X respectively)

Visual Wear Indicator

Mounting: Fanguard-mounted brakes requiring IP 56 or IP 57 protection may require additional sealing measures beyond seals provided with the brake - Refer to Installation & Service Instruction sheets

56,100 Series: Die Cast aluminum enclosure
Parts List: P/N 8-078-906-01

56,600 Series: Cast iron enclosure
Parts List: P/N 8-078-906-06



Series 56,100 Dimensions

Nominal Static Torque lb-ft (Nm)	Enclosure	Dimensions in Inches (mm)				Wt lbs (Kg)
		A	AG	C Hub Width	G	
1.5-15 (2-20)	IP 23	4.41 (112.0)	.59 (15.0)	.81 (20.6)	1.21 (30.7)	8 (3.6)
20-25 (27-34)		4.86 (123.4)		1.18 (30.0)	1.66 (42.2)	10 (4.5)
1.5-6 (2-8)	IP 56/57	4.50 (114.3)	.47 (11.9)	.81 (20.6)	1.21 (30.7)	8 (3.6)
10-25 (14-34)		4.95 (125.7)	.59 (15.0)	1.18 (30.0)	1.66 (42.2)	10 (4.5)

Series 56,600 Dimensions

Nominal Static Torque lb-ft (Nm)	Enclosure	Dimensions in Inches (mm)				Wt lbs (Kg)
		A	AG	C Hub Width	G	
3-25 (4-34)	IP 23	4.95 (125.7)	.59 (15.0)	1.18 (30.0)	1.66 (42.2)	21 (9.5)
3-25 (4-34)	IP 56/57	5.05 (128.3)				

Series 56,100 Pricing (Discount Symbol B4)

Nominal Static Torque lb-ft (Nm)	Enclosure	Basic Model Number and List Price*			
		AC	AC List Price*	DC	DC List Price*
1.5 (2)	IP 23	1-056-101-00	$505.00	1-056-105-00	$805.00
	IP 56	1-056-102-00	640.00	1-056-106-00	940.00
	IP 57	1-056-104-00	715.00	1-056-108-00	1,015.00
3 (4)	IP 23	1-056-111-00	525.00	1-056-115-00	825.00
	IP 56	1-056-112-00	660.00	1-056-116-00	960.00
	IP 57	1-056-114-00	735.00	1-056-118-00	1,035.00
6 (8)	IP 23	1-056-121-00	590.00	1-056-125-00	890.00
	IP 56	1-056-122-00	725.00	1-056-126-00	1,025.00
	IP 57	1-056-124-00	800.00	1-056-128-00	1,100.00
10 (14)	IP 23	1-056-131-00	690.00	1-056-135-00	990.00
	IP 56	1-056-132-00	830.00	1-056-136-00	1,130.00
	IP 57	1-056-134-00	905.00	1-056-138-00	1,205.00
15 (20)	IP 23	1-056-141-00	790.00	1-056-145-00	1,090.00
	IP 56	1-056-142-00	930.00	1-056-146-00	1,230.00
	IP 57	1-056-144-00	1,005.00	1-056-148-00	1,305.00
20 (27)	IP 23	1-056-151-00	880.00	1-056-155-00	1,180.00
	IP 56	1-056-152-00	1,015.00	1-056-156-00	1,315.00
	IP 57	1-056-154-00	1,090.00	1-056-158-00	1,390.00
25 (34)	IP 23	1-056-161-00	975.00	1-056-165-00	1,275.00
	IP 56	1-056-162-00	1,110.00	1-056-166-00	1,410.00
	IP 57	1-056-164-00	1,185.00	1-056-168-00	1,485.00

Series 56,600 Pricing (Discount Symbol B4)

Nominal Static Torque lb-ft (Nm)	Enclosure	Basic Model Number and List Price*			
		AC	AC List Price*	DC	DC List Price*
3 (4)	IP 23	1-056-611-00	1,200.00	1-056-615-00	1,500.00
	IP 56	1-056-612-00	1,335.00	1-056-616-00	1,635.00
	IP 57	1-056-614-00	1,410.00	1-056-618-00	1,710.00
6 (8)	IP 23	1-056-621-00	1,265.00	1-056-625-00	1,565.00
	IP 56	1-056-622-00	1,400.00	1-056-626-00	1,700.00
	IP 57	1-056-624-00	1,475.00	1-056-628-00	1,775.00
10 (14)	IP 23	1-056-631-00	1,365.00	1-056-635-00	1,665.00
	IP 56	1-056-632-00	1,505.00	1-056-636-00	1,805.00
	IP 57	1-056-634-00	1,580.00	1-056-638-00	1,880.00
15 (20)	IP 23	1-056-641-00	1,465.00	1-056-645-00	1,765.00
	IP 56	1-056-642-00	1,605.00	1-056-646-00	1,905.00
	IP 57	1-056-644-00	1,680.00	1-056-648-00	1,980.00
20 (27)	IP 23	1-056-651-00	1,555.00	1-056-655-00	1,855.00
	IP 56	1-056-652-00	1,690.00	1-056-656-00	1,990.00
	IP 57	1-056-654-00	1,765.00	1-056-658-00	2,065.00
25 (34)	IP 23	1-056-661-00	1,650.00	1-056-665-00	1,950.00
	IP 56	1-056-662-00	1,785.00	1-056-666-00	2,085.00
	IP 57	1-056-664-00	1,860.00	1-056-668-00	2,160.00

* Subtract $30.00 for brake ordered less hub.

Information Needed for Modifications

Stearns is dedicated to providing you with the most comprehensive selection of modified spring-set disc brakes on the market today. We have included a list of our more popular modifications complete with descriptions, pictures and graphics when applicable and list price adders along with their representative series. Note that modification list prices are subject to the same discounts as apply to the complete brake assembly.

Below please find examples of how the modifications are called out with a letter in the 8th position of the 12 digit model number. Note that these listings are not complete, but represent our more popular selections. For any special applications and modification requirements not found here, please contact your Stearns representative.

IMPORTANT – The modification letter will appear in the *8th position* to call out the modification.

Examples:

1-056-XXX-__X
8th position

1-087-XXX-__X
8th position

1-08X-XXX-__X
8th position

See specific tables for some of the available options of the series required.

If two or more letter modifications are required, the 8th position of the part number will remain zero and position 10, 11 and 12 will be assigned by Stearns as a special part number.

All Series

Modification	Letter
Vertical Mounting - Above Motor	A
Class H Insulation	H
Space Heater (115 Volt Circuit)	I
Space Heater (115 Volt Circuit), Brass Pressure Plate and Stationary Disc	J
Brass Pressure Plate and Stationary Disc	K
Vertical Mounting - Below Motor	L
Thru-Shaft Housing (Standard)	Q
Vertical Mounting - Above Motor and Class H Insulation	T
Electrical Release Indicator Switch, N.O. contacts	W
Side Manual Release with Shaft Through Housing Stamped Steel	Z
Series 87,X00 Only	
Vertical Mounting - Above Motor, Brass Pressure Plate and Stationary Disc	N
Series 81,X00, 82,X00 87,000 and 87,100	
Side Manual Release	Y

Solenoid Actuated Brakes Modification Index

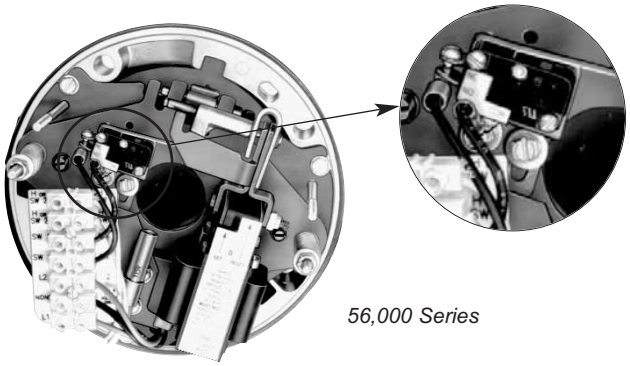
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	Brass Stationary Disc	M4	55
	Breather Drain	M5	56
	Space Heater (115 or 230 volt)	M13	57
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	Corrosion-Resistant Endplate	M39	62
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	Brass Stationary Disc	M4	55
	Special Paint	M14	58
	Stainless Self-Adjust	M15	58
	Stainless Steel Hardware	M16	58
	Corrosion-Resistant Endplate	M39	62
	Stainless Steel Hub	M42	62
Special Housing	Thru-Shaft NEMA 2	M19	59
	Thru-Shaft NEMA 4 and 4X	M20	59
	Split Housing	M36	62
Switches	Electrical Release Indicator	M1	55
	Electrical Release Indicator Proximity Switch	M2	55
	Thermal Switch	M18	58
	Wear Indicator	M27	60
Tach Mounting	Tach Machining	M7	56
	Thru-Shaft NEMA 2	M19	59
	Thru-Shaft NEMA 4 and 4X	M20	59
Torque Derating	Brass Pressure Plate	M3	55
	Brass Stationary Disc	M4	55
	Special Derating of Torque	M34	61
Wiring Options	Conduit Box with Terminal Strip	M8	56
	Terminal Strip	M17	58
	Special Length Leadwires	M31	61
	Internal Leadwire Hole	M35	61

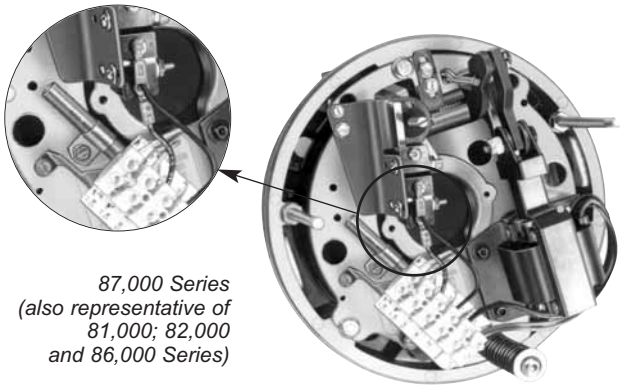
M1 Electrical Release Indicator Switch

Series	List Price Adder
56,X00 & 65,300	$450.00
81,000; 82,000; 87,X00	450.00
86,X00	900.00

This switch is used to indicate when the brake is in a released, non-holding position. This mechanism utilizes a mechanical limit switch.



56,000 Series



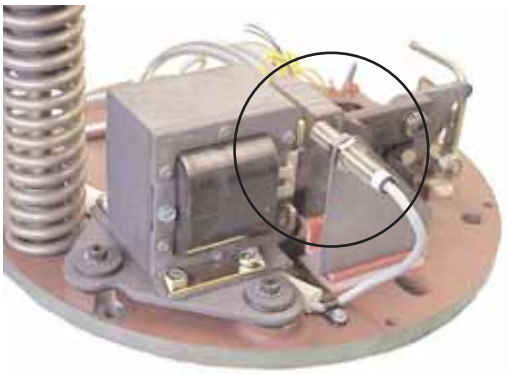
87,000 Series (also representative of 81,000; 82,000 and 86,000 Series)

Not available on 56,800 or 87,800 Series Brakes.

M2 Electrical Release Indicator Proximity Switch

Same function as the switch in M1 above; except, M2 uses an electronic proximity sensor.

Series	List Price Adder
81,000 82,000 87,X00	$1375.00
86,X00	2750.00

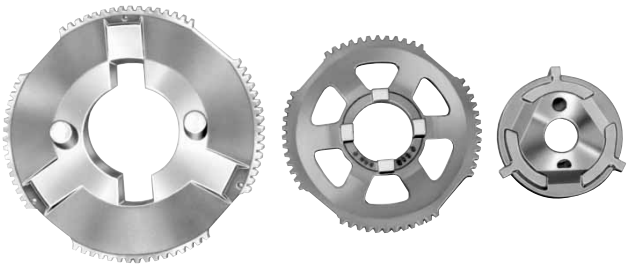


Not available on 56,800 or 87,800 Series Brakes.

M3 Brass Pressure Plate

Typically used in marine applications or in applications where the potential for sparks need to be eliminated. Brass can also be used to reduce torque.

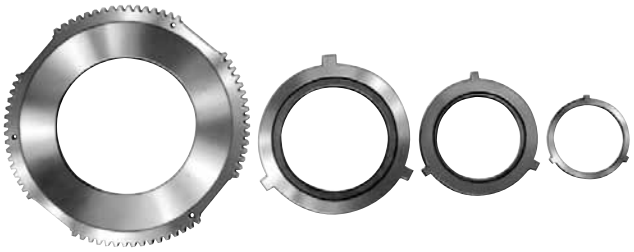
Series	List Price Adder
56,X00	See M4
65,X00	$250.00
81,000; 82,000	800.00
86,X00	1050.00
87,X00	600.00



M4 Brass Stationary Discs

Used with brass pressure plate (List per disc).

Series	List Price Adder
56,X00	$250.00
65,X00	250.00
87,X00	450.00
81,000; 82,000	600.00
86,X00	750.00



M5 Breather Drain

A drain plug is tapped into the bottom of the housing to let moisture escape. This option is only available on brakes with cast aluminum or cast iron housings.

Series	List Price Adder
56,X00	$380.00
65,X00	500.00
81,000 82,000 86,X00 87,X00	380.00



M6 Class H Insulation

Brake is provided with an epoxy encapsulated coil, rated for NEMA Class H designation.

These Class H coils are standard on hazardous location brakes.

Series	List Price Adder
56,X00	$145.00
87,X00	175.00
81,000 82,000	285.00
86,X00	570.00



M7 Housing Machining for Encoder/Tach Mounting

Series	Standard Machining[1]				Close Tolerance[2]			Tether Mount [3]	
	Bolt Circle & Register		Bolt Circle - but no Register		Bolt Circle & Register			A Single Bolt Hole	
	Open[4] Enclosure List Price Adder	Enclosed[5] List Price Adder	Open[4] Enclosure List Price Adder	Enclosed[5] List Price Adder	Open[4] Enclosure List Price Adder	Enclosed[5] List Price Adder	Maximum Thru-Shaft Dia. (inch)	Open[4] Enclosure List Price Adder	Enclosed[5] List Price Adder
56,X00 (except N/A for 56,800)	N/A	N/A	N/A	N/A	N/A	N/A		$350	$460
87,000 - 87,100	$700	$1,200	$80	$350	$2,450	$2,750	1.63	$240	$350
87,M00 - 87,500 - 87,600	N/A	$1,200	N/A	$350	N/A	$2,750		N/A	$350
81,000 - 82,000[6]	$1,100	$1,375	$305	$580	$2,550	$2,825	2.5	$465	$740
86,000	$1,100	$1,375	$380	$780	$2,550	$2,950		$540	$940

[1]**Standard Machining:** The housing is machined for a thru shaft, and to allow for an encoder or tach to be mounted. This option is only available on brakes with cast aluminum or cast iron housings. Consult factory for availability.

[2]**Close tolerance:** The housing and endplate are assembled and dowel pinned together - then machined as a matched set for a through shaft and encoder mounting. This option is only available on brakes with cast aluminum or cast iron housings. This option is recommended for Series 81,000; 82,000; and 86,X00 due to the long distance between the motor and encoder.

[3]**Tether Mount:** The housing is machined for a through shaft, and a single tapped hole for a bolt to secure a tether arm. (56,X has a through hole and tach-welded nut on inside of housing, instead of a tapped hole).

[4]Referred to on the product pages in the catalog as IP23

[5]Referred to on the product pages as IP54/55 (these enclosure ratings no longer apply when the housing is machined for this modification - the customer is responsible for meeting any specific enclosure rating when assembling the encoder.

[6]M7 Modification for Series 81,000 and 82,000 will also require the M12 Modification; the side manual release.



M8 Conduit Box with Terminal Strip

A terminal strip is located inside the conduit box. It allows for easy connection and identification of lead wires.

Series	List Price Adder
All series except hazardous location *(not available for the 48,100 series)*	$300.00 (IP 23) $600.00 (IP 54)
All hazardous location brakes	$600.00



M9 DC Coil Option

For DC voltage applications. Operates with an electronic DC switch module.

Series	List Price Adder	Additional Adder for Non-Standard Voltage
56,X00	$ 300.00	$ 250.00
87,X00	570.00	250.00
81,000	1050.00	250.00
82,000	1565.00	250.00
86,X00	2625.00	500.00

For standard voltage listing, see the ordering information section for the specific brake.

Not available on Hazardous Location Brakes.

M10 Nameplates

To order new brake nameplates, the serial number of the brake is required. A loose nameplate shipped from Stearns Division without being attached to a brake must have all agency markings removed (UL, CSA, etc.). In order to have a brake renameplated with the appropriate agency markings, it must be returned to Stearns Division for product verification.

List Price:	First Nameplate	$150.00
Net Price:	Additional Mylar Nameplates	1.50
	Additional Metal Nameplates	4.00

M11 Nonstandard Hub or Keyway

For standard bore diameter and keyway specifications, see specific brake selection page. For taper bores, consult factory for pricing.

Description	List Price Adder					
	48,100	56,X00	65,X00	81,000 82,000 86,000	87,000 87,100 87,800	87,700
All Quantities and Enclosures	$225.00	225.00	325.00	600.00	250.00	250.00

M12 Side Manual Release

Side release not available on the 1-065-300 or the 1-086-000

Sheet Metal Housing (IP 23 Only)	List Price Adder
56,000; 56,400; 56,500	$50.00
87,000; 87,100	$50.00

Cast Iron Housing	List Price Adder
87,000 IP 23	$385.00 includes casti iron housing adder of $110
87,000 IP 54	$275.00
81,000 82,000	$350.00



M13 Space Heater (115 or 230 Volt Only)

A space heater cartridge is used to prevent moisture build-up inside the brake housing.

Series	Wattage	List Price Adder
56,X00*	15	$210.00
81,000; 82,000; 86,X00	50 and 75	275.00
87,X00**	25 to 30	225.00
Hazardous Duty Brakes	25 to 50	750.00

*Not available on 56,800 or 87,800 Series Brakes
**Not available in 87,800 Class I



56,000 Series



87,000 Series (also representative of 81,000; 82,000 & 86,000 Series)

M14 Special Paint



The standard paint for all brake series (except BISSC Certified & Maritime/Navy) is a red, water-base primer, painted inside and out.

For additional corrosion protection, a special (green) zinc chromate primer can be provided (painted inside and out) in place of the standard red primer. List price adders as shown.

Series	List Price Adder
56,X00	$210.00
65,X00	300.00
81,000; 82,000; 86,X00	550.00
87,000	525.00

Other Special Paint options are available - either primers, a white epoxy finish coat, or clean finish (exterior primer removed). Consult factory for pricing.

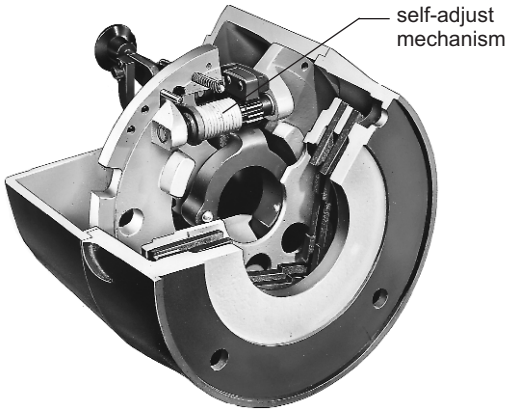
BISSC Certified paint (white epoxy exterior paint) is standard for brake series with IP55 and IP57 enclosure ratings - and the prices are included in the standard list prices.

Maritime and Navy brakes have their own specified paints, with pricing included in the standard list prices.

M15 Stainless Steel Self-Adjust Mechanism

For severe duty applications. This option includes a stainless steel pinion and plated wrap spring in the auto-adjust mechanism. It is only available on the 81,000; 82,000; 86,000 and 87,000 Series Brakes

Series	List Price Adder
81,000; 82,000; 87,000	$350.00
86,X00	$700.00



M16 Stainless Steel Hardware

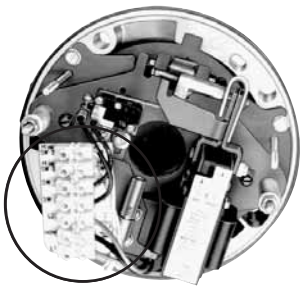
All external hardware is provided in stainless steel.

Series	List Price Adder
48,100	$125.00
56,X00, 87,X00	$150.00
81,000, 82,000 86,000	$275.00

M17 Terminal Strip

A terminal strip is located in the inside of the brake, on the support plate. It allows for easy connection and identification of lead wires.

Series	List Price Adder
ALL	$150.00



56,000 Series



87,000 Series (also representative of 81,000; 82,000 & 86,000 Series)

M18 Thermostat (thermal switch)

This switch is used to indicate when a brake is overheating. Thermostats are standard in 8X,300 and 65,X00 Series. This option is for NON-UL brakes only.

Series	Switch Operation Specificatons	List Price Adder
87,X00	Normally Closed: Opens at 295°F, Closes at 255°F	$400.00
81,000, 82,000 86,X00	Normally Closed: Opens at 210°F, Closes at 180°F	400.00
56,X00	Normally Closed: Opens at 195°F, Closes at 175°F	400.00



M19 Through-Shaft Enclosure

This configuration allows for the motor shaft to extend beyond the housing of the brake.

This modification lowers the brake enclosure rating to IP10.

Series	List Price Adder
56,000, 56,400	N/C
56,100, 56,200	$110.00
56,600	110.00
81,000, 82,000	225.00
86,000	300.00
87,000, 87,100 sheet metal	N/C*
87,000, 87,100 with cast iron housing	225.00 (adder for cast iron housing is $210.00 additional)

*Up to 1-5/16".
Above 1-5/16", add $80.00.



M20 Through-Shaft Cast Iron Enclosure with Lip Seal

This configuration allows the motor shaft to extend beyond the housing of the brake with a bushing to use with a housing lip seal.

This modification lowers the brake enclosure rating to IP10.

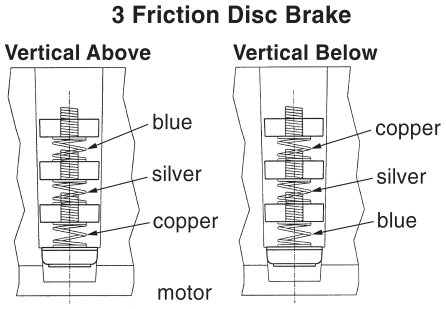
Series	List Price Adder
56,100, 56,200 56,600	$220.00
81,000, 82,000	500.00
86,000	700.00
87,000, 87,100	300.00



M21 Vertical Mounting for 56,000 Series & 65,300 Series

The 56,000 20 and 25 lb-ft Series Brakes are shipped with spring kits. Vertical modification at 15° from horizontal. Read installation and service instructions for details on its use.

Description	List Price Adder
Factory assembly for three disc configuration.	$20.00



Example of 56,000 Series spring requirements for vertical above and below mounting.

M23 Vertical Mounting for 87,X00 Series

For factory modification to vertical above or below application. Vertical modification at 15° from horizontal.

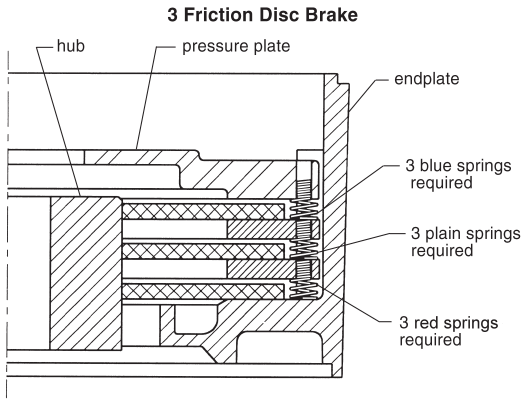
Series 87,000 & 87,100

Torque Value (lb-ft)	IP 23 & IP 54 steel hsg Above	IP 23 & IP 54 steel hsg Below	IP 54/55 cast iron Above	IP 54/55 cast iron Below
6, 10, 15, 25 & 35	$95.00	no mod req'd	$370.00*	no mod req'd
50 & 75	$105.00	$105.00	$380.00*	$105.00
105	$135.00	$135.00	$410.00*	$135.00

*Includes adder for side manual release

Series 87,300; 87,800; 87,700

Torque Value (lb-ft)	Vertical Above	Vertical Below
6, 10, 15, 25 & 35	$95.00	no mod req'd
50 & 75	$105.00	$105.00
105	$135.00	$135.00



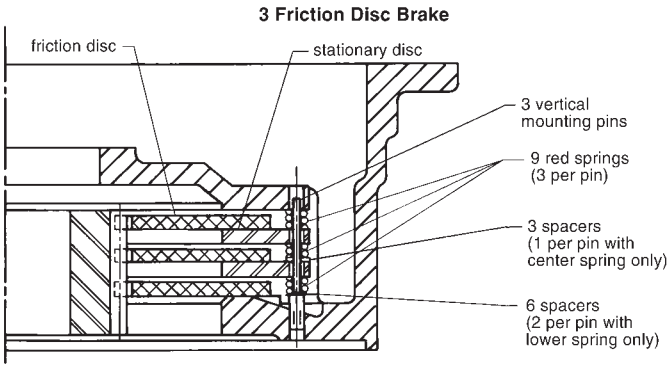
Example of 87,000 Series spring requirements for vertical above mounting.

M24 Vertical Mounting for 81,000; 82,000 and 86,000 Series

These brakes require factory modifications for vertical applications. Vertical modification at 15° from horizontal.

Series	Torque Value (lb-ft)	IP 23 Above & Below	IP 54 Above	IP 54 Below
81,000 & 82,X00	125 & 175	$250.00	$575.00*	$250.00
81,000 & 82,X00	230	300.00	650.00*	300.00
82,X00	330	300.00	650.00*	300.00
82,X00	440	500.00	850.00*	500.00
86,000	500 & 750	750.00	750.00*	750.00

*Includes adder for side manual release

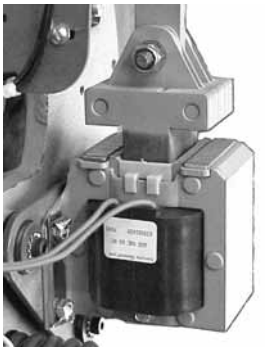


Example of 81,000 Series pin, spring and spacer requirements for vertical above mounting.

M25 Voltage Non-Standard (AC)

For standard voltage listing, see the ordering information section for the specific brake.

Series	List Price Adder
48,100	$165.00
65,X00	165.00
56,000	165.00
81,000; 82,X00	200.00
86,X00	400.00
87,X00	175.00

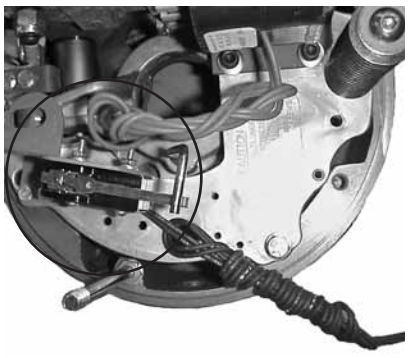


M27 Wear Indicator (Friction Disc) Switch

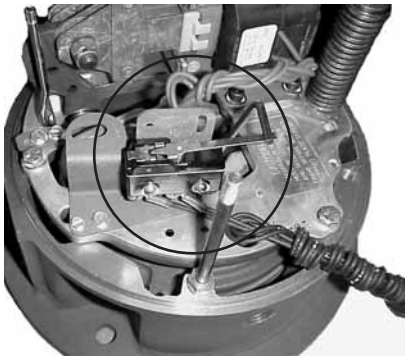
A mechanical switch is installed to indicate when the friction disc requires replacement.

Series	List Price Adder
81,000; 82,X00	$225.00
86,000	225.00
87,X00*	225.00

**Switch supplied with leads (Switches N/A on Series 87,800)*



87,000 Assembly



87,000 Assembly

M29 Special Shaft-Coupler Brake and Foot Mount Brake

Any non-standard input or output shaft on a 56,700, 87,200 or 87,700 Series Brake.

Series	List Price Adder
56,700	$325.00
87,200; 87,700	325.00



M30 Taper-Lock Hubs

For use in severe duty applications and reversing application to secure the brake hub to the motor shaft.

Series	Series	List Price Adder
87,000; 87,100 IP 23 only	10 to 35 lb-ft	$200.00
	50 to 75 lb-ft	225.00
	105 lb-ft	250.00
81,000	125 & 175 lb-ft	225.00
	230 lb-ft	325.00
82,000	125 & 175 lb-ft	375.00
	230 & 330 lb-ft	550.00
	440 lb-ft	675.00





M31 Special Length Lead Wires

Up to 5’	Series	List Price Adder
	All	$65.00

Over 5’	Series	List Price Adder
	All	$130.00

M32 Non-Maintained (Deadman) Manual Release

The brake is mechanically released while the release is pulled into a release position. Once released, the brake sets.

Series*	List Price Adder
56,200, 56,700, 56,800 & 56,900	$110.00
56,000, 56,400 & 56,500	185.00
81,000; 82,000 & 87,000	125.00
86,000	250.00

**N/A on 56,300.*
Standard on 56,100 and 56,600.



M33 Metric Machining Including Cast Iron Endplate

Stearns SAB’s can be used with metric motor frames. The following table indicates standard frame capabilities for an IEC B14 Face mount.

Series	IEC Frame Sizes	List Price Adder
56,200; 56,400; 56,600 & 56,900	B14 flange in sizes 80; 90 & 100 B5 flange in sizes D63 & D71	$340.00
56,500	B14 flange in sizes 112; 132 & 160 B5 flange in sizes D71; D80; D90; D100 & D112	$340.00
87,000	B14 flange in sizes 112; 132 & 160 B5 flange in sizes D71; D80; D90; D100 & D112	$340.00

M34 Derating of Torque

Stearns industrial SAB’s can be custom built to meet your specific torque requirements.

Series	List Price Adder	Derate To
56,500	$315.00	6 lb-ft
87,100	315.00	20 or 30 lb-ft
81,000 & 82,000	460.00	To be approved with application engineering

M35 Special Internal Lead Wire Hole with Bushing

Any non-standard, internal lead wire hole in the endplate.

Series	List Price Adder
All brakes except hazardous location brakes	$175.00



M36 Housing Split

SAB's can be provided with a split housing.

Series	List Price Adder
81,000; 82,000 & 86,000	$725.00
81,000; 82,000 & 86,000 gasketed	$1,000.00
87,000; 87,100 sheet metal	$200.00
87,000; 87,100 cast iron gasketed	$250.00



M37 Internal Release

An internal manual release requires that the housing be removed before the brake can be released by hand.

**N/A for hazardous location brakes*

Series	List Price Adder
87,0XX; 81,0XX; 82,0XX; 86,0XX	N/C

M38 Motor Gasket

The brake is provided with an additional C-Face gasket to be placed between the brake and motor.

Series*	List Price Adder
81,000; 82,000; 86,000	$100.00
56,X00 & 87,000	75.00

**N/A for hazardous location brakes*

M39 Corrosion-Resistant Endplate

Rust preventative treatment applied to brake endplate.

Series	List Price Adder
56,200, 56,400, 56,500, 56,800 & 65,300	$425.00
81,000; 82,X00 & 86,000	575.00
87,X00	475.00



M40 Special Milling: Flat Bottom on Housing & Endplate

This modification is provided in the event the flange between the endplate and housing interfere with the mounting configuration.

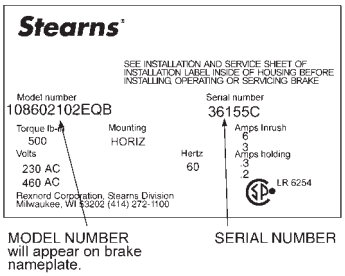
Series	List Price Adder
81,000; 82,000 & 86,000	$650.00



M41 Brass Nameplate with Special Engraving

Brass nameplates offer greater durability in outdoor applications.

Series	List Price Adder
81,000; 82,000 & 86,000	$75.00



M42 Stainless Splined Hub

Stainless steel splined hubs are available for extreme outdoor applications, to prevent corrosion on the disc and hub interface.

Series	List Price Adder
81,000; 82,000 & 86,000	$1060.00
87,000	800.00



M43 Viton® Gasket

Gaskets and o-rings in brakes can be provided in Viton® (flourocarbon) material, in place of the standard neoprene. However, the V-wiper steel-backed seals that are used on pull rod manual releases are not available in Viton® and remain as neoprene.

Viton® is a registered trademark name of DuPont.

Series	List Price Adder
81,000; 82,000; 86,000	$1,300.00
87,000*	$1,125.00
56,000	$950.00

*Viton® gaskets and o-rings are standard for 87,X00 series, except for hazardous location brakes where Viton® seals are N/A.

***Except series 56,200; 56,700; & 56,900 - where Viton gaskets are standard.*

M44 Special Friction Disc (per Disc)

Any non-standard friction disc in a brake. Cost is per disc.

Non-standard discs include: hi-inertia friction discs and heavy duty friction discs. Does not include carrier ring friction discs (see M46 and M47).

Series	List Price Adder
87,000	$50.00
56,000	45.00



M45 Splined Hub and Friction Disc

Standard on most models. Used for severe duty and reversing applications.

Series	List Price Adder
87,300	No Charge

Series	Torque (lb-ft)	List Price Adder
87,X00*	6-35 lb-ft	190.00
	50 & 75 lb-ft	290.00
	105 lb-ft	390.00

** Spline is standard on this series. Adder is for pre-revision 24-tooth spline.*

M46 Carrier Ring Friction Disc

The friction material is bonded to a steel or zinc/aluminum alloy ring.
This is used for severe duty applications and applications where people are being moved.

Series	Carrier ring material	List Price Adder (per disc)
Horizontal Use Only		
81,000	Steel	700.00
82,000	Steel	700.00
Horizontal or Vertical Use		
87,X00** (not available on 87,300 or 87,800 series	Zinc aluminum alloy	550.00



M47 Carrier Ring Friction Disc (Bronze)

The friction material is bonded to a bronze ring.
This is used for severe duty applications and applications where people are being moved.

Horizontal applications only

*** Only available with pre-revision design, 24-tooth splined hub, which is included in this price*

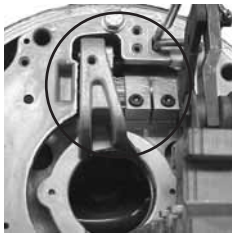
Series	List Price Adder (per disc)
81,000	N/A
82,000	$1050.00
86,000	1250.00
87,X00**	
6-35 lb-ft	925.00
50 & 75 lb-ft	1850.00
105 lb-ft	2775.00



M48 1,08X,000 Series Manual Adjust Mechanism

Excellent for holding applications when disc wear is not a concern. (Not available on hazardous location brakes.)

Series	List Price Adder
87,000	Subtract $50 List
81,000 82,000 86,000	No Charge



M60 Encoders

Internally mounted encoders are available in some series brakes, including some hazardous location brakes. See pages 52-53 for series availability and additional information.

Maximum Encoder Diameter (in.)	
1-056	N/A
1-087-E00	2.0”
1-081 & 1-082	2.5”
1-086	3.5”



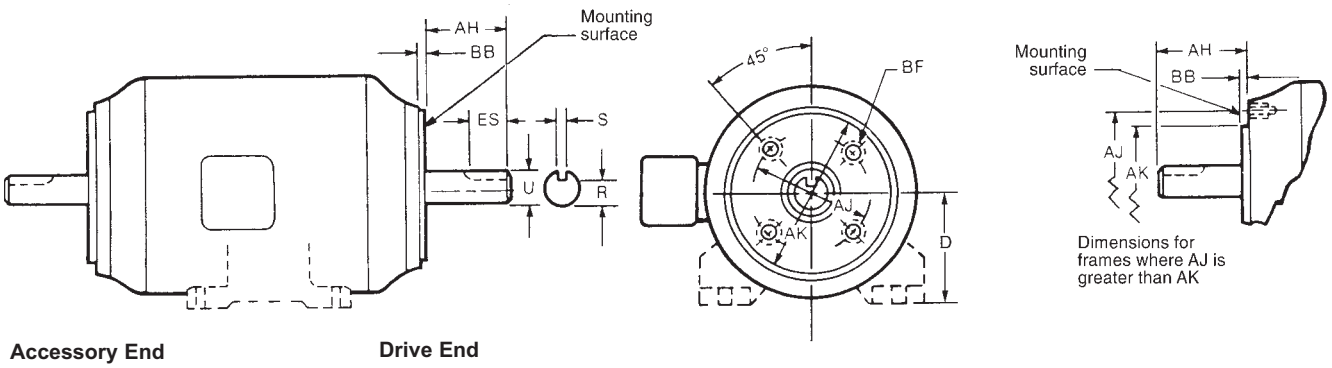
Dimensions for C-Face Brake Motor Systems

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Brakes Externally Wired to Motor

C-face motor with double shaft extension.

Stearns Disc Brakes are designed to mount on standard C-face motors having the same dimensions and tolerances on the accessory end as on the drive end. They also mount on foot mounting brackets and machine mounting faces having the same mounting dimensions and tolerances. Some motor accessory end C-face may differ from the drive end.



Accessory End **Drive End**

Drive End Dimensions (Inches)

Frame Designation	AJ	AK	BB Min.	BF Hole			U	AH	Keyseat			Base to Centerline D
				Number	Tap Size	Bolt Penetration Allowance			R	ES Min.	S	
42C	3.750	3.000	0.16	4	1/4-20	. . .	0.375	1.312	0.328	. . .	flat	2.62
48C	3.750	3.000	0.16	4	1/4-20	. . .	0.500	1.69	0.453	. . .	flat	3.00
56C	5.875	4.500	0.16	4	3/8-16	. . .	0.625	2.06	0.517	1.41	0.188	3.50
143TC and 145TC	5.875	4.500	0.16	4	3/8-16	0.56	0.875	2.12	0.771	1.41	0.188	3.50
182TC and 184TC	7.250	8.500	0.25	4	1/2-13	0.75	1.125	2.62	0.986	1.78	0.250	4.50
182TCH and 184TCH	5.875	4.500	0.16	4	3/8-16	0.56	1.125	2.62	0.986	1.78	0.250	4.50
213TC and 215TC	7.250	8.500	0.25	4	1/2-13	0.75	1.375	3.12	1.201	2.41	0.312	5.25
254TC and 256TC	7.250	8.500	0.25	4	1/2-13	0.75	1.625	3.75	1.416	2.91	0.375	6.25
284TC and 286TC	9.000	10.500	0.25	4	1/2-13	0.75	1.875	4.38	1.591	3.28	0.500	7.00
284TSC and 286TSC	9.000	10.500	0.25	4	1/2-13	0.75	1.625	3.00	1.416	1.91	0.375	7.00
324TC and 326TC	11.000	12.500	0.25	4	5/8-11	0.94	2.125	5.00	1.845	3.91	0.500	8.00
324TSC and 326TSC	11.000	12.500	0.25	4	5/8-11	0.94	1.875	3.50	1.591	2.03	0.500	8.00
364TC and 365TC	11.000	12.500	0.25	8	5/8-11	0.94	2.375	5.62	2.021	4.28	0.625	9.00
364TSC and 365TSC	11.000	12.500	0.25	8	5/8-11	0.94	1.875	3.50	1.591	2.03	0.500	9.00
404TC and 405TC	11.000	12.500	0.25	8	5/8-11	0.94	2.875	7.00	2.450	5.65	0.750	10.00
404TSC and 405TSC	11.000	12.500	0.25	8	5/8-11	0.94	2.125	4.00	1.845	2.78	0.500	10.00
444TC and 445TC	14.000	16.000	0.25	8	5/8-11	0.94	3.375	8.25	2.880	6.91	0.875	11.00
444TSC and 445TSC	14.000	16.000	0.25	8	5/8-11	0.94	2.375	4.50	2.021	3.03	0.625	11.00
500 Frame Series	14.500	16.500	0.25	4	5/8-11	0.94	. . .	. . .	. . .	. . .	. . .	12.50

Tolerances (Inches)

AK Dimension, Face Runout, Permissible Eccentricity of Mounting Rabbet

AK Dimension	Tolerance on AK Dimension		Maximum Face Runout	Maximum Permissible Eccentricity of Mounting Rabbet
	Plus	Minus		
Less than 12	0.000	0.003	0.004	0.004
12 and Larger	0.000	0.005	0.007	0.007

Shaft Extension Diameters

Shaft Diameter	Tolerances	
	Plus	Minus
0.2500 to 1.5000, inclusive	0.000	0.0005
Over 1.5000 to 6.500, inclusive	0.000	0.001

Width of Shaft Extension Keyseats

Width of Keyseat	Tolerances	
	Plus	Minus
0.188 to 0.750, inclusive	0.002	0.000
Over 0.750 to 1.500, inclusive	0.003	0.000

Shaft Runout

Shaft Diameter	Maximum Permissible Shaft Runout
0.3750 to 1.625, inclusive	0.002
Over 1.625 to 6.500, inclusive	0.003

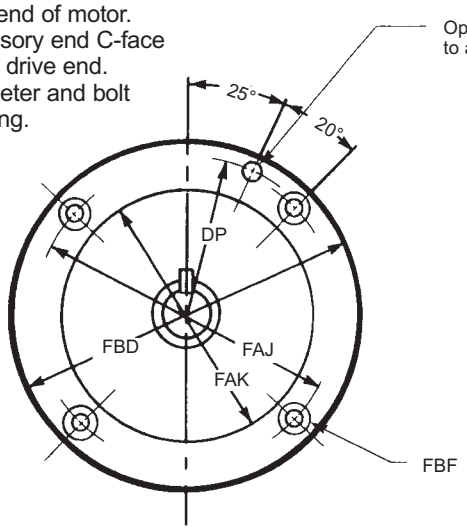
SOURCE: ANSI/NEMA Standards Publication No. MG 1-1987; Part 4 and Part 11.

Dimensions for C-Face AC Brake Motor System (cont.)

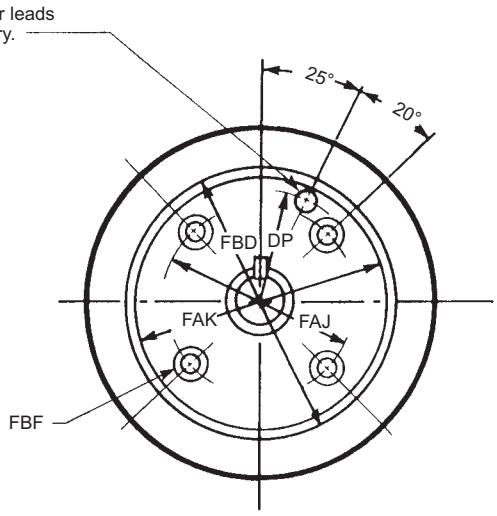
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Accessory End

FC face mounting for accessories, including brakes, on the end opposite the drive end of motor. Some motor accessory end C-face may differ from the drive end. Confirm shaft diameter and bolt circle before ordering.



143TFC to 184TFC Frames, Inclusive



213TFC to 326TFC Frames, Inclusive

Dimensions (Inches)

Frame Designation	FAJ	FAK	FBD Max.	FBF Hole			Hole for Accessory Leads	
				Number	Tap Size	Bolt Penetration Allowance	DP	Diameter
143TFC and 145TFC	5.875	4.500	6.50	4	3/8-16	0.56	2.81	0.41
182TFC and 184TFC	5.875	4.500	6.50	4	3/8-16	0.56	2.81	0.41
213TFC and 215TFC	7.250	8.500	9.00	4	1/2-13	0.75	3.81	0.62
254TFC and 256TFC	7.250	8.500	10.00	4	1/2-13	0.75	3.81	0.62
284TFC and 286TFC	9.000	10.500	11.25	4	1/2-13	0.75	4.50	0.62
324TFC and 326TFC	11.000	12.500	14.00	4	5/8-11	0.94	5.25	0.62

NOTE: Standards have not been developed for the shaft extenison diameter and length, and keyseat dimensions.

Tolerances* (Inches)

FAK Dimension, Face Runout, Permissible Eccentricity of Mounting Rabbet

FAK Dimension	Tolerance on FAK Dimension		Maximum Face Runout	Maximum Permissible Eccentricity of Mounting Rabbet
	Plus	Minus		
Less than 12	0.000	0.003	0.004	0.004
12 and Larger	0.000	0.005	0.007	0.007

* Tolerance requirement on 56,X00 and 87,000 Series Brake kits is .015 T.I.R. (total indicated runout shaft to motor register face).

Shaft Runout

Shaft Diameter	Maximum Permissible Shaft Runout
0.3750 to 1.625, inclusive	0.002
Over 1.625 to 6.500, inclusive	0.003

SOURCE: ANSI/NEMA Standards Publication No. MG 1-1987; Part 4 and Part 11.

Stearns Recommended Minimum Shaft Diameter by Torque

Minimum recommended shaft size considers a keyed C1045 steel shaft under *dynamic* use in a typical spring set brake application.

Torque ft-lb	Minimum Shaft (inches)
0.50	0.250
0.75	0.250
1.5	0.375
3	0.500
6	0.500
10	0.625
15	0.750
25	0.875
35	1.000
50	1.125

Torque ft-lb	Minimum Shaft (inches)
75	1.250
105	1.375
125	1.375
175	1.625
230	1.750
330	2.000
440	2.125
500	2.375
750	2.500
1000	2.750

Torque Nm	Minimum Shaft (mm)
4 Nm	ø10 mm
8 Nm	ø13 mm
16 Nm	ø16 mm
32 Nm	ø20 mm
60 Nm	ø25 mm
80 Nm	ø28 mm
150 Nm	ø34 mm
240 Nm	ø39 mm
400 Nm	ø47 mm

Set and Release Times

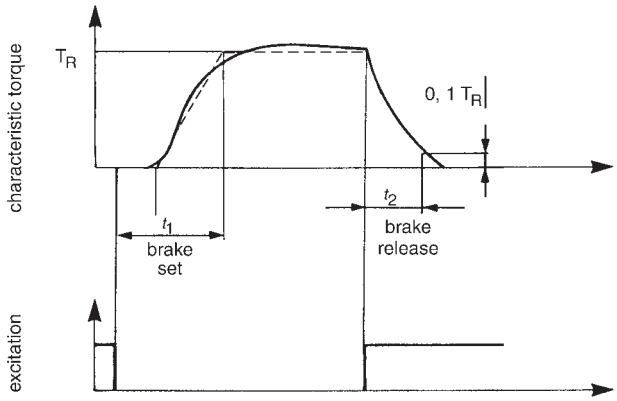
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The models listed below were tested for typical set and release times. Times listed below are defined as follows:

T1 = Total set time to 80% of rated static torque

T2 = Release time, measured as the time from when the power is applied to the brake to the time that the solenoid plunger or armature is fully seated.

NOTE: Times will vary with the motor used, and brakes tested with factory-set air gap. The times shown should be used as a guide only.



SAB T1/T2 Time in Milliseconds

Series	Static Torque lb-ft	Coil Size	T1 AC	T2 AC
56,000	1 1/2 – 25	K4, K4, K4+, M4+	25	14
87,000	10,15, 25,50	5 & 6	42	20
87,000	35,75,105	8	48	20
81,000 82,000	All	9	56	27

Brake and motor are switched separately.
All brakes tested in horizontal position.
Coil is energized for >24 hours before testing.
Ambient temperature 70°F at time of test.

AAB Series 310/311/320/321 Times in Milliseconds

Series	310 DC Side Switching					
Size	**1.79**	**2.0**	**2.87**	**3.35**	**4.25**	**5.0**
T1	3	6	9	14	13	22
T2	20	43	48	110	120	195
Series	**311 DC Side Switching**					
Size	**3.38**	**4.75**	**5.0**			
T1	43	48	96			
T2	12	74	35			
Series	**320 DC Side Switching**					
Size	**1.2**	**1.8**	**2.0**	**2.8**		
T1	14	43	16	27		
T2	24	26	35	34		
Series	**320 Full wave rectifier/AC Side Switching**					
Size	**1.2**	**1.8**	**2.0**	**2.8**		
T1	31	97	52	78		
T2	27	29	40	42		
Series	**321 DC Side Switching**			**321 AC Side Switching**		
Size	**1.2**	**1.8**	**2.8**	**1.2**	**1.8**	**2.8**
T1	13	16	20	45	77	131
T2	18	27	49	16	25	26

AAB Series 333 Times in Milliseconds

Size	Applied Voltage/Type of Switching	T1	T2
72	DC side switching	23	35
	230 Vac/ac side switching/full wave	103	39
	460 Vac/ac side switching/half wave	98	34
90	DC side switching	19	73
	230 Vac/ac side switching/full wave	113	72
	460 Vac/ac side switching/half wave	114	73
	230 Vac connected across motor full wave	357	72
	230 Vac connected across motor /quickset	42	72
112	DC side switching	155	39
	230 Vac/ac side switching/full wave	547	43
	460 Vac/ac side switching/half wave	501	54
132	DC side switching	119	100
	230 Vac/ac side switching/full wave	833	101
	460 Vac/ac side switching/half wave	803	106
145	DC side switching	185	186
	230 Vac/ac side switching/full wave	999	192
	460 Vac/ac side switching/half wave	1007	209
	230 Vac connected across motor full wave	1689	192
	230 Vac connected across motor /quickset	368	192
	460 Vac/ac side switching/half wave/With air gap shim	629	223
170	DC side switching	129	163
	230 Vac/ac side switching/full wave	1130	174
	460 Vac/ac side switching/half wave	1140	175
196	DC side switching	96	263
	230 Vac/ac side switching/full wave	920	264
	460 Vac/ac side switching/half wave	957	274
230	DC side switching	131	264
	230 Vac/ac side switching/full wave	1299	236
	460 Vac/ac side switching/half wave	1303	276
	Tor-Ac 230 Vac/ac side switching/full wave	169	295
	Tor-Ac 230 Vac/ac side switching/full wave/ With air gap shim	122	327
	230 Vac connected across motor quickset/quickrelease/with air gap shim	122	145
278	DC side switching	182	388
	230 Vac/ac side switching/full wave	1807	389
	460 Vac/ac side switching/half wave	1689	366

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CLOSE COUPLED

NEMA Frame	Series	Torque (lb-ft)	Nm	Enclosure	
48C	48,100	1.5 - 6	2-8	IP 23	9
56C - 145TC	56,X00	1.5 - 25	2-34	IP 21, 23, 54, 55, 56, 57	10-15
182TC - 256TC/UC	56,600	10 - 25	14-34	IP 23, 54, 55	16
	87,000	6 - 105	8-142	IP 23, 54, 55	17-20
284TC/UC - 286TC/UC	87,100	50 - 105	68-142	IP 23, 54	21
324 - 405TC/TSC/UC/USC	81,000	125 - 230	169-312	IP 23, 54	22-23
	82,000	125 - 440	169-597	IP 23, 54	22, 24
444 - 445TC/TSC/UC/USC	86,000	500 - 1,000	678-1356	IP 23, 54	25-26
505TC/TSC/UC/USC	86,100	500 - 1,000	678-1356	IP 23, 54	25-26

DIVISION 1 HAZARDOUS LOCATION

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56C - 145TC	65,300	1.5 - 15	2-20	IP 23, 56	NEMA 7, 9	29-31
182TC - 256TC/UC	87,300	10 - 105	14-142	IP 23, 55	NEMA 7, 9	32-37
324 - 405 TC/TSC/UC/USC	82,300	125 - 330	169-447	IP 56	NEMA 7, 9	38-39
Foot Mounted	87,300	10 - 105	14-142	IP 23	NEMA 7, 9	36-37
Foot Mounted	82,300	125 - 330	169-447	IP 23	NEMA 7, 9	39

DIVISION 2 HAZARDOUS LOCATION

56C - 145TC	56,800	1.5 - 25	2-34	IP 55	40-41
182TC - 256TC/UC	87,800	6 - 105	8-142	IP 55	42-43

DOUBLE C-FACE COUPLER BRAKES

56C - 145TC	56,700	1.5 - 25	2-34	IP 23, 54, 55, 56	44-45
182TC - 256TC/UC	87,700	10 - 105	14-142	IP 23, 54, 55	46-47

FOOT MOUNTED WITH BEARING SUPPORTED THRU-SHAFT

Foot Mounted	56,700	1.5 - 25	2-34	IP 23	48
Foot Mounted	87,200	10 - 105	14-142	IP 23, 54	49

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Armature Actuated Brakes (AAB)

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Series	Description	Torque (lb-in)	*Nm*	
310	High Torque Holding Only-Servo Motor Brake	8 - 350 lb-in	*.9 - 39.5*	67-68
311	High Torque Holding Only-Servo Motor Brake	75 - 400 lb-in	*8 - 45*	69-70
320	Commercial Duty-Small Gear Motors	3 - 50 lb-in	*.34 - 5.6*	71-72
321/322	Totally-Enclosed Non-Ventilated (TENV) Commercial Duty	3 - 72 lb-in	*.34 - 8.1*	73-76
321 NEMA C	Totally-Enclosed Non-Ventilated (TENV) C-Face Mount	1.5 - 25 lb-ft	*2-34*	77-78
331 & 333	European Style Metric Mounting	3 - 300 lb-ft	*4 - 400*	79-81, 84
331 & 333	European Style-NEMA C-Face Mount	3 - 300 lb-ft	*4 - 400*	82-84
350	European Style Portal Crane Duty - Pressure Plate Mount	75 - 300 lb-ft	*102 - 400*	85-86
360	European Style Portal Crane Duty - Mag Body Mount	60 - 300 lb-ft	*80 - 400*	87-88

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Performance Parameters and Limited Warranty

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The performance of Stearns brakes, clutches, clutch-brake combinations, solenoids, and controls depends upon the proper application of the product, adequate run in, installation and maintenance procedures, and reasonable care in operation.

All torque values listed in our bulletins are nominal and are subject to the variations normally associated with friction devices. The purchaser should take into consideration all variables shown in the applicable specification sheets. Although our application engineers are available for consultation, final selection and performance assurance on the purchaser's machine is the responsibility of the purchaser. Careful purchaser selection, adequate testing at time of installation, operation and maintenance of all products of Rexnord Industries, LLC, Stearns Division are required to obtain effective performance.

Stearns warrants to its purchasers that all its products will be free from defects in material and workmanship at the time of shipment to the purchaser for a period of one (1) year from the date of shipment. All warranty claims must be submitted in writing to Stearns within the warranty period, or shall be deemed waived. As to products or parts thereof which Stearns finds to have been defective at the time of shipment, its sole responsibility hereunder shall be to repair, correct or replace (whichever Stearns deems advisable) such defective products or parts without charge, FOB Stearns factory. In the alternative, Stearns may, at its option, either before or after attempting a different remedy, refund the purchase price upon return of the product or parts.

This warranty shall not apply to any product which has been subjected to misuse: misapplication: neglect (including but not limited to improper maintenance and storage); accident: improper installation; modification (including but not limited to use of other than genuine Stearns replacement parts or attachments); adjustment; or repair.

THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING THAT OF MERCHANTABILITY AND OF FITNESS FOR A PARTICULAR PURPOSE, AND OF ANY OTHER OBLIGATION OR LIABILITY ON OUR PART OF ANY KIND OR NATURE WHATSOEVER.

No Stearns representative has any authority to waive, alter, vary or add to the terms hereof without prior approval in writing, to our purchaser, signed by an officer of Rexnord Industries, LLC.

Stearns liability for its products, whether for breach of contract, negligence, strict liability in tort, or otherwise, shall be limited to the repair, correction, or replacement of the products or parts thereof, or to the refund of the purchase price of such products or parts. Stearns will not be liable for any other injury, loss, damage or expense, whether direct or consequential, including but not limited to loss of use, income, profit or production, or increased cost of operation, or spoilage of or damage to material, arising in connection with the sale, installation, use of, inability to use, or the repair or replacement of, or late delivery of, Stearns products.

Any cause of action for breach of the foregoing warranty must be brought within one (1) year from the date the alleged breach occurs.

Note on Special (Nuclear) Applications:

"Rexnord Industries, LLC, Stearns Division products are designed for standard industrial and commercial applications. Operating requirements, environments and required tolerances in nuclear and aircraft applications may be beyond the commercial standards of the Stearns Divisions products. Rexnord Industries, LLC, Stearns Division will assume absolutely no responsibility for the use of and/or resale of Rexnord Industries, LLC, Stearns Division products for such applications unless approved in writing in advance by Rexnord Industries, LLC, Stearns Division."

Introduction to Solenoid Actuated Brakes (SAB's)

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Stearns Brakes Set the Standard for Excellence

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

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

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

Enclosure Types

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

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

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

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

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

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

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

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

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

Self-Adjusting Disc Brakes



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

Manually Adjusted Disc Brakes with Automatic Reset

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



Introduction to Stearns Solenoid Actuated Brakes (SAB's)

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Brakes for Hazardous Locations



Although rugged Stearns Brakes are built to withstand rigorous industrial environments, many applications require additional protection from explosive gases or ignitable dusts. Stearns manufactures a complete line of disc brakes designed from the hazardous locations defined in the *National Electric Code (NEC)*. Each brake is labeled to show the Class, Group, and maximum operating temperature of the brake enclosure. We offer both motor-mounted and foot-mounted designs, and all Stearns Hazardous Location Brakes are UL Listed and CUL or CSA certified.

Double C-Face Disc Brake Couplers



Stearns Disc Brake Couplers provide maximum versatility, allowing you to add a brake to a C-face motor with a single shaft extension. Using these reliable products, you can couple a C-face motor to a C-face gear reducer.

Washdown Brakes

Stearns Washdown Brakes include the 56,000 and 87,000 Series brake models. These brakes meet BISSC Standards, AAA Dairy Standards, and other food industry washdown requirements. They feature stainless steel hardware, neoprene gasketing, and FDA-approved white epoxy paint or stainless steel enclosure.



Solenoid Actuated Brakes versus Armature Actuated Brakes

Solenoid Actuated Brakes	Armature Actuated Brakes
Simple wear adjustment	Complex wear adjustment
Easy coil exchange for different voltages	Difficult to change out complete magnet assembly
Maintained manual release with automatic reset for brake release during set-up	Non-maintained release (deadman) requires constant external force to operate
Add on options easily assembled to standard unit	Options require complete brake in most units
Rapid set and release times.	Response time is slower due to required magnetic field build-up in magnet-style coil
Connection can be made directly to AC power source	Direct connection to AC power source requires an optional electric control

Marine Applications

Brakes used in marine applications are customized to meet specific standards. These standards are established to provide various levels of corrosion resistance and performance standards under specific conditions.



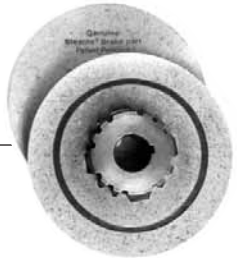
Maritime and Naval Brakes are designed for U.S. Navy and Coast Guard military specifications. These units conform to MIL-B-16392C or 46CFR 110.10-1 and IEEE Standard 45. Special material components help prevent corrosion due to shipboard environments. SAB's used in marine environments can be custom built to meet the specifications. In addition, all Stearns SAB's are "Type Approval Certified" by the American Bureau of Shipping.

Today, Stearns is focused on being your worldwide, value-added supplier. Our factory-trained field sales force is available to work with you in person to determine your application needs, as well as provide training and support to your engineers and maintenance staff. Our extensive network of more than 900 distributor branches is your assurance of quality service after the sale.

Stearns is a division of Rexnord Industries, LLC, a world leader in power transmission products. We have the resources, experience and dedication to meet your industrial brake, clutch and solid-state electronic centrifugal switch needs.

Trademarked and Patented Friction Discs

Now you can rely on identifying genuine Stearns Friction Discs which assure continuous, reliable performance backed by the Stearns name.
A molded ring in the Stearns friction discs makes it easy to visually identify a Stearns disc. The new splined discs are trademarked and patented by Stearns Division, Rexnord Industries, LLC.



Manually Adjusted Solenoid Actuated Brakes

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Stearns manually-adjusted disc brakes are available from .5 to 105 lb-ft static torque. They feature spring-set, electrically released designs having simple adjustments to compensate for friction lining wear. All have simple 2-wire motor connection.

Series 48,100 Disc Brakes

Mount directly to NEMA 48C motor frames. Static torque ratings are 1½, 3 and 6 lb-ft.

Quality Design Features:

- Spring-set, electrically released
- Single-disc caliper design
- Simple wear adjustment for easy maintenance
- Knock-out plug on housing for through-shaft applications
- Maintained manual release with automatic reset
- Mount in any position without modification

All Series 56,X00 Disc Brakes

Mount directly to NEMA 56C, 143TC, 145TC, 182TC and 184TC motor frames. Static torque ratings from 1½ to 25 lb-ft.

The 56 Series family is an unbeatable combination: the features you want most in spring-set disc brakes, at a low price. We took a fresh look at the brake itself as well as your needs and designed a comprehensive line of spring-set brakes that set new standards for quality, reliability and customer convenience. Here's a sampling of the features we've built into the Stearns 56 Series brakes:

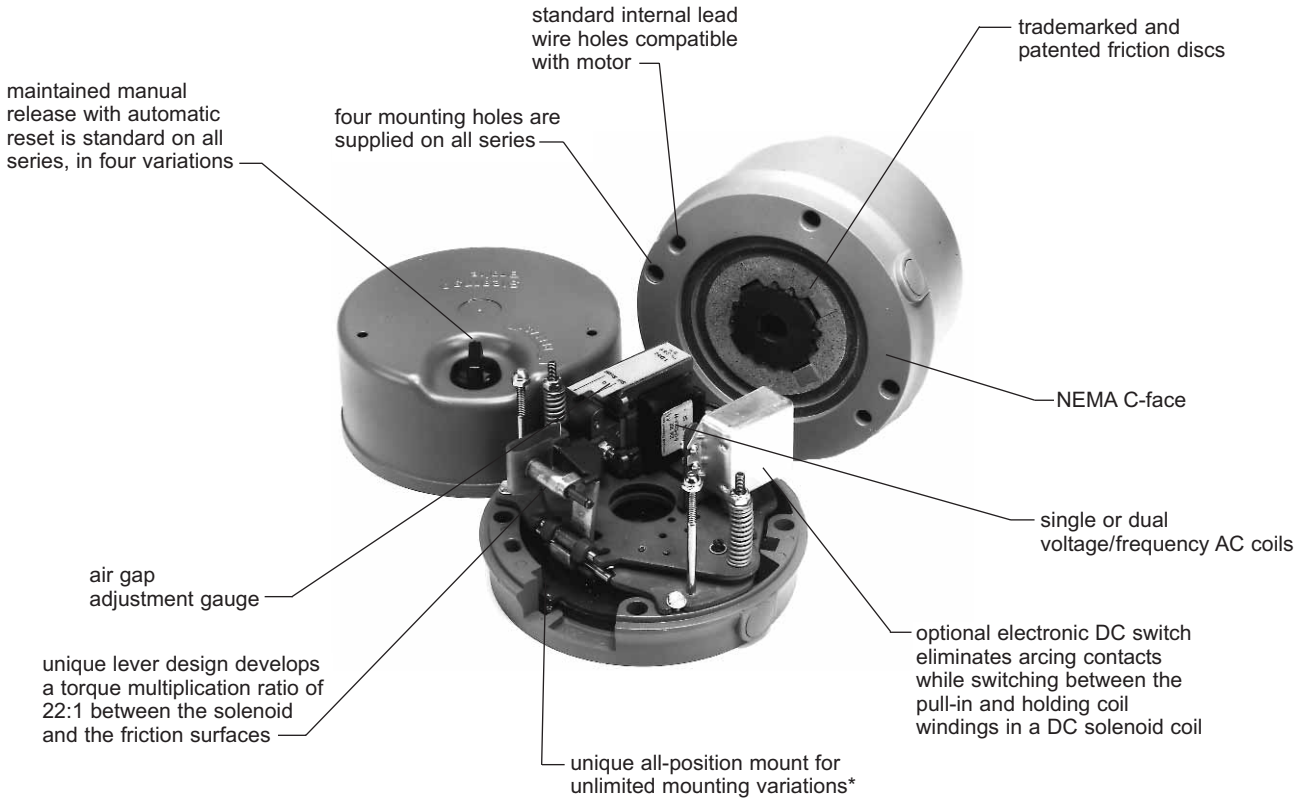
- A Stearns-exclusive spring design permits all-position mount for unlimited mounting possibilities.
- Trademarked and patented friction discs
- Patented splined hub that increases friction disc working area, runs quieter, and offers enhanced heat dissipating capability
- ABS Type Approval Certified

The 56 Series come in static torque ratings from 1.5 through 25 lb-ft with NEMA C-face mountings 56C, 143TC, 145TC, 182TFC, and 184TFC. Ten different housing, endplate, and release configurations accommodate IP 23, IP 54, IP 55, IP 56 and IP 57 enclosures. With a wide variety of pre-engineered modifications, you can select from 120,000 possible combinations!

87,000 Series Disc Brakes

An optional manual adjust mechanism can be provided on 87,000 Series Brakes (does not include 87,300 and 87,800 Series Brakes). Mounted directly to NEMA 182TC through 256TC frames. Includes all the other features of the Series 87,000.

Series 56,000 Design Features

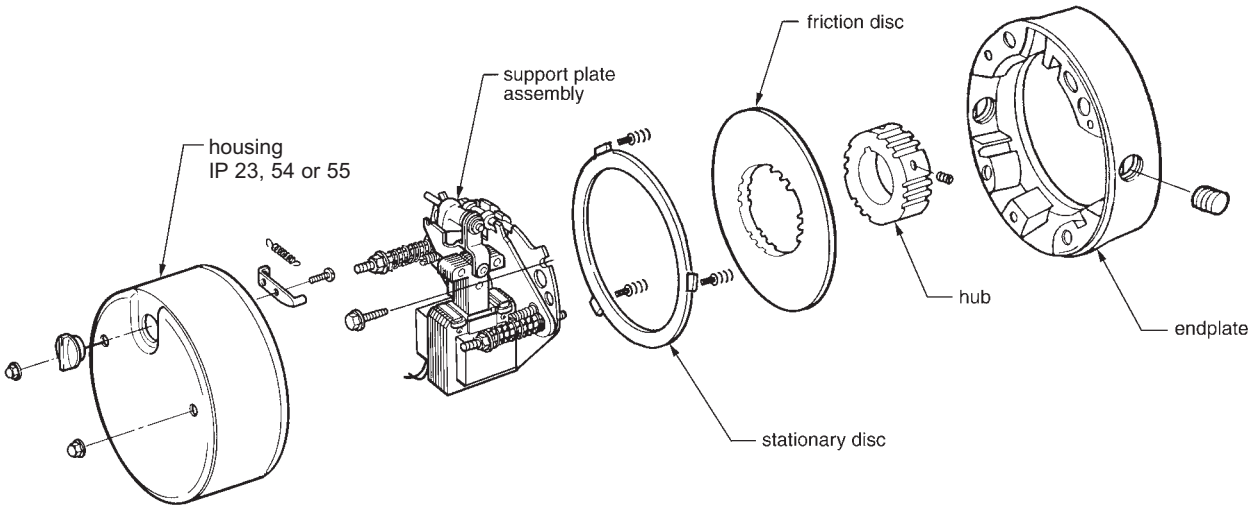


*20 and 25 lb-ft brakes are easily adapted for vertical applications (kit included)

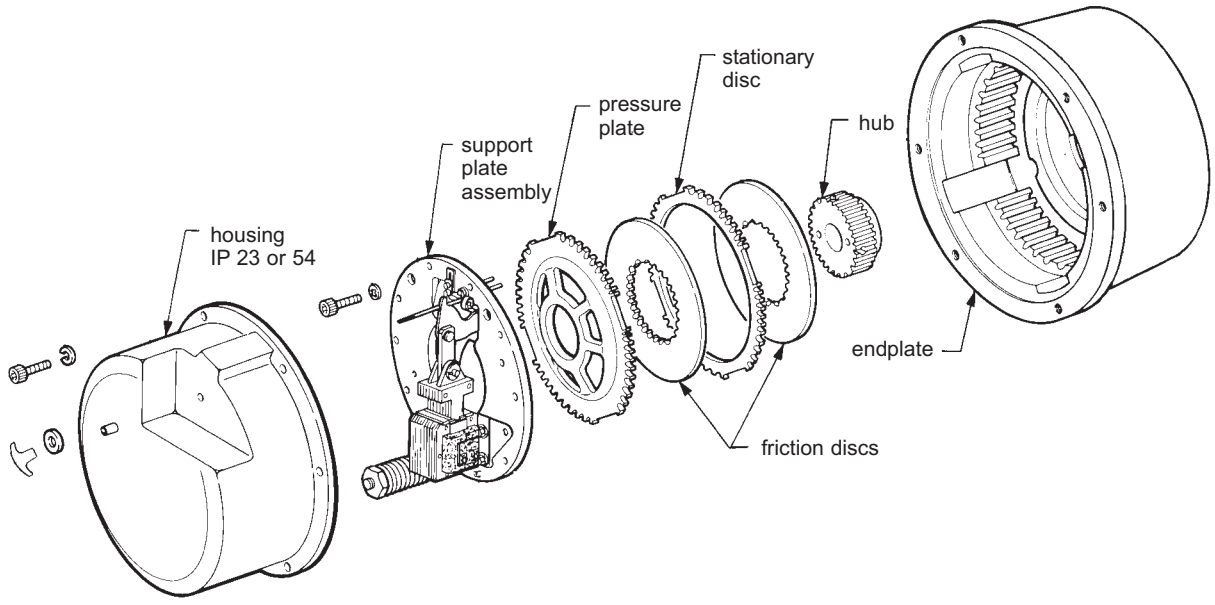
Exploded View- Part Indentification

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Series 56,000 Manually-Adjusted Solenoid Actuated Brake



Self-Adjusting Disc Brakes - Main Components

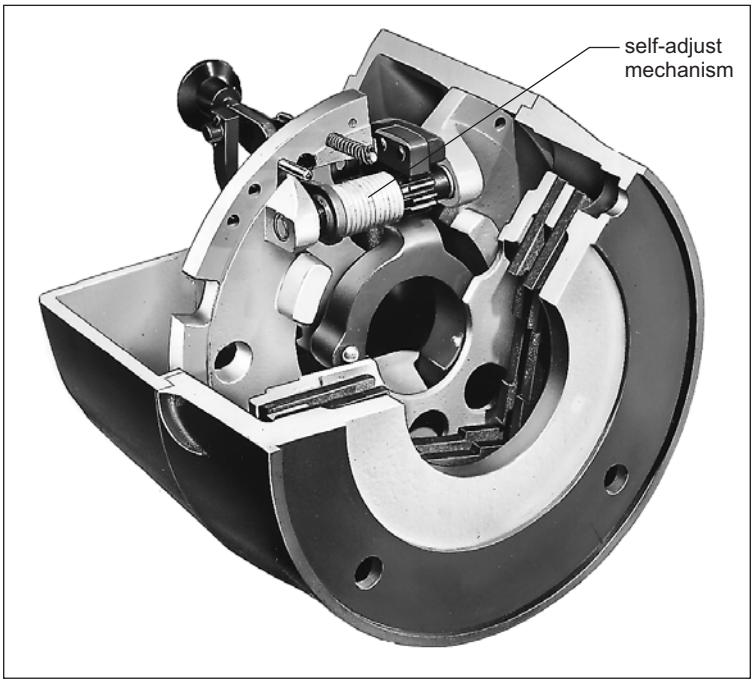


Self-Adjusting Solenoid Actuated Brakes

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Stearns self-adjusting disc brakes feature an exclusive, automatic adjusting device that eliminates the major cause of brake maintenance – adjustment to compensate for friction lining wear. This feature makes Stearns self-adjusting brakes ideal for remote or inaccessible locations, and for applications where rapid cycling requires frequent wear adjustment of manual adjustable brakes.

The self-adjust mechanism is a simple wrap-spring clutch that automatically adjusts the brake's solenoid air gap to compensate for wear of the friction discs. Automatic adjustment occurs every time the brake is operated, eliminating the errors that can occur with hand adjustment. The self-adjust feature means Stearns motor brakes always operate at peak efficiency, providing more uniform braking, longer disc life, less maintenance time and smooth, quiet operation.



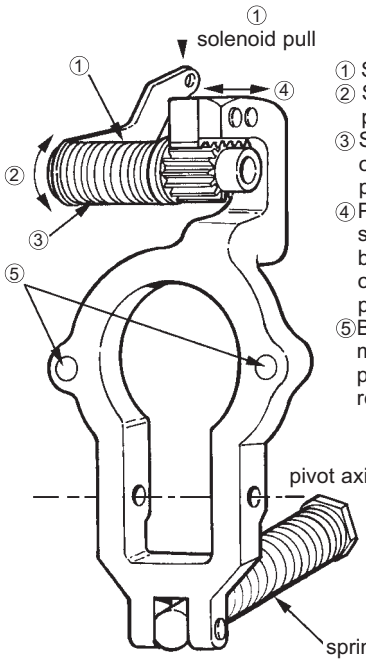
There are nine series of Stearns self-adjusting brakes to select from:

- Series 81,000 brakes for direct mounting to NEMA 324TC through 365TC motor frames. Static torque ratings from 125 to 230 lb-ft.
- Series 82,000 brakes for direct mounting to NEMA 324TC through 405TSC motor frames. Static torque ratings from 125 to 440 lb-ft.
- Series 86,X00 brakes for direct mounting to NEMA 444TSC through 505TSC motor frames. Static torque ratings from 500 to 1,000 lb-ft.
- Series 87,X00 brakes for direct mounting to NEMA 182TC through 286TC motor frames. Static torque ratings from 6 to 105 lb-ft.
- Series 87,200 for floor mounted, double shaft output with bearing support. Static torque ratings from 10 to 105 lb-ft.
- Series 87,300 hazardous location brakes for UL Listed Division I applications, which mount directly to NEMA 182TC through 256TC motor frames. Static torque ratings from 10 to 105 lb-ft.
- Series 82,300 hazardous location brakes for UL listed Division I applications, for mounting directly to NEMA 324TC through 405TSC. Static torque ratings 125 to 330 lb-ft.
- Series 87,700 brakes for in-line applications, to couple the motor and gear box. For direct mounting to NEMA 182TC through 256TC motor frames. Torque Rating of 10 to 105 lb-ft.
- Series 87,800 brakes hazardous location brake for UL Listed Division 2 applications, which mount directly to NEMA 182TC through 256TC motor frames. Static torque ratings of 10 to 105 lb-ft.

Quality Design Features

- Spring-set, electrically released.
- Self-adjusting mechanism minimizes maintenance by automatically compensating for lining wear.
- Unitized construction for easy friction disc replacement.
- Maintained manual release with automatic reset.
- Simple 2-wire motor connection.
- Standard or dust-tight, waterproof enclosures available.
- Many modifications for special application requirements.
- Models for marine and maritime applications.
- Models in accordance with Military Specification B16392-C for Navy applications.
- ABS Type Approval Certified.

Lever Arm and Self-Adjusting Mechanism



① Solenoid is energized.
② Solenoid arm and pinion rotate.
③ Spring clutch tightens on hubs and turns pinion.
④ Pinion moves rack section of lever arm back above pivot axis, overcoming force of pressure spring.
⑤ Buttons on lever arm move away from pressure plate, releasing brake.

SELECTION - Solenoid Actuated Brakes

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NOTE: For overhauling/high inertia loads, to stop in a specified time/distance, or for brakes combined with variable frequency drives, please refer to *Application Engineering* Section.

Stearns Solenoid Actuated Brakes can be easily selected from Table 1 and 2.

Given motor data:
1. Horsepower (hp)
2. Speed (RPM)
3. NEMA C-face frame size

Determine:
1. Static torque rating of the brake (lb-ft)
2. Brake series

Step 1 – Given the motor horsepower and speed, select the brake torque from Table 1. Torque in table 1 is calculated using formula:

$$T_S = \frac{5{,}252 \times P}{N} \times SF$$

Where, T_S = Static torque, lb-ft

P = Motor horsepower, hp

N = Motor full load speed, rpm

SF = Service Factor

5,252 = constant

Example: Given a 5 hp, 1800 RPM motor, the selected brake is 20 or 25 lb-ft.

Step 2 – Given the NEMA C-face motor frame size, select the brake series from Table 2.

Example: Given the 5 hp, 1800 RPM motor in Step 1 with a NEMA 184TC frame, Series 87,000; 87,300 or 87,700 Brakes can be selected to mount directly to the motor.

Table 1 – Torque Selection

In this table, brake torque ratings are no less than 140% of the motor full load torque.

Motor hp	Brakemotor Shaft Speed (RPM)						
	700	900	1200	1500	1800	3000	3600
	Static Torque Rating of Brake (lb-ft)						
1/6	3	1.5	1.5	1.5	0.75	0.5	0.5
1/4	3	3	3	1.5	1.5	0.75	0.5
1/3	6	3	3	3	1.5	1.5	0.75
1/2	6	6	3	3	3	1.5	1.5
3/4	10	6	6	6	6	3	3
1	15	10	6	6	6	3	3
1-1/2	20	15	10	10	10	6	3
2	25	20	15	10	10	6	6
3	35	25	20	15	15	10	6
5	75	50	35	25	20 or 25	15	10
7-1/2	105	75	50	50	35	25	15
10	105	105	75	50	50	25	25
15	175	125	105	75	75	50	35
20	230	175	125	105	105	50	50
25	330	230	175	125	105	75	50
30	330	330	230	175	125	75	75
40	440	330	330	230	175	105	105
50	550	440	330	330	230	*	*
60	750	500	440	330	330	*	*
75	1000	750	500	440	330	*	*
100	—	1000	750	500	440	*	*
125	—	1000	1000	750	500	*	*
150	—	—	1000	750	750	*	*
200	—	—	—	1000	1000	*	*
250	—	—	—	—	1000	*	*

*See catalog pages for maximum rpm by series. Thermal capacity must be considered in load stops over 1800 rpm.

Table 2 – Brake Series Selection by NEMA Frame Size

Torque Range (lb-ft)	Brake Series	C-Face Motor Frame Size											
		48C	56C	143TC 145TC	182TC 184TC	213TC 215TC	254TC 254UC 256TC 256UC	284TC 284UC 286TC 286UC	324TC 324UC 326TC 326UC	364TC 364UC 365TC 365UC	404TC 404UC 405TC 405UC	444TC 444UC 445TC 445UC	504UC 504SC 505C 505SC
Manually-Adjusted Brakes (require periodic adjustment to compensate for friction disc wear)													
1.5-6	48,100	①											
1.5-25	56,X00		①	①	②	②	②						
10-25	56,500				①								
Self-Adjusting Brakes (automatically compensate for friction disc wear)													
6-105	87,X00		③	③	①	①	①	②	②	②	②		
50-105	87,100							①					
125-230	81,000				②	②	②	②	①	①	①	②	
125-440	82,000				②	②	②	②	①	①	①	②	
500-1000	86,000								②	②	②	①	
500-1000	86,100												①
Division I Hazardous Location Brakes (for atmospheres containing explosive gases or ignitable dusts) / Motor Mounted													
1.5-15	65,300		①	①	②	②	②						
10-105	87,300				①	①	①	②	②	②	②		
125-330	82,300				②	②	②	②	①	①	①	②	
Division I Hazardous Location Brakes (for atmospheres containing explosive gases or ignitable dusts) / Foot Mounted													
10-105	87,300				④	④	④						
125-330	82,300								④	④	④		
Division 2 Hazardous Location Brakes													
1.5-25	56,800		①	①	②	②	②						
6-105	87,800		③	③	①	①	①	②	②	②	②		
Double C-Face Brake Couplers (for direct coupling a C-face motor to a C-face gear reducer)													
1.5-25	56,700		①	①									
10-105	87,700				①	①	①						

① Brake mounts directly to motor C-face.
② Adapter required to mount brake to motor C-face. Refer to brake specifications for adapter information.
③ Brake endplate modified for direct mounting to motor C-face without an adapter.
④ Brake is foot mounted for coupling to a hazardous-location motor.

56 Series
Mounting Face: NEMA 56C, 143TC and 145TC

The 56,X00 Series have the following design features:

- Spring-Set Electrically Released
- Static Torque 1.5 through 25 lb-ft
- Adjustable Torque, down to 50% of rated nameplate torque
- Manual Wear Adjustment
- Airgap Adjust Gage
- Splined Hub
- IP 21, 23 & 54 (formerly referred to by Stearns as NEMA type 1, 2 & 4 respectively) IP 55, 56, & 57 (formerly referred to by Stearns as NEMA Type 4X (BISSC Certified with epoxy coating and stainless steel hardware on exterior, or with a stainless steel enclosure)
- Universal mounting through 15 lb-ft. The 20 and 25 lb-ft are supplied with springs for vertical modification.

Specifications:

- Lead Wire Length: 24 inches
- Maximum Speed: Horizontal 5000 rpm Vertical 3600 rpm
- Coil Insulation: Standard Class B Optional Class H (56,800 Series Class H standard)
- Certified: CSA File LR-6254
- ABS Type Approval Certified

Product Overview

56000 Series

Designed for industrial applications requiring high performance in a compact lightweight package.

Construction:
Die cast aluminum endplate with stamped steel housing

Available Enclosures:
IP 23, 54 & 55

Release Type:
External knob manual release with or without automatic reset

Through Shaft Capability: Yes (IP 23 only)



56200 Series

Designed for industrial applications requiring the protection of a heavy duty cast iron enclosure.

Construction:
Cast iron endplate and housing.

Available Enclosures: IP 56 & 57

Release Type:
External side lever release with automatic reset

Through Shaft Capability: Yes



56500 Series

Same as 56000 Series with 182TC / 184TC mounting.

Construction:
Cast iron endplate with stamped steel housing
(Direct mount to 182TC / 184TC)

Available Enclosures:
IP 23, 54 & 55

Release Type:
External knob manual release with or without automatic reset

Through Shaft Capability: Yes (IP 23 only)



56900 Series

For use in severe environments found in process industries such as food, pulp and paper mills and chemical plants.

Construction: Stainless steel

Release Type:
Side lever with automatic reset

Available Enclosures: IP 56 & IP 57

Through Shaft Capability: with IP43 rating only



56700 Series

Units designed for industrial applications that fit between a standard C-Face motor and gear reducer. Can also be used to retrofit installed units without braking capability.

Construction: Die cast aluminum endplate and housing

Available Enclosures:
IP 23, 54, 55 & 56

Release Type: External knob release with automatic reset

C-face brake has output shaft



Also Available . . .

56100 Series

Full die cast aluminum endplate and housing with internal release lever

Available Enclosures:
IP 23, 56 & 57



56300 Series

Die cast aluminum endplate with stamped steel housing and external maintained release, IP 21



56400 Series

Cast iron endplate with stamped steel housing and external knob release

Available Enclosures:
IP 23 & 54



56600 Series

Cast iron endplate and housing with internal release lever

Available Enclosures: IP 23, 56 & 57



Series 56,000; 56,100; 56,200; 56,300; 56,400; 56,500; 56,600; 56,700; and 56,900
Mounting Face: NEMA 56C, 143TC and 145TC

Engineering Specifications

Maximum Solenoid Cycle Rate: ①
AC 36 cycles/min
DC 10 cycles/min

Thermal Capacity: ②
Horizontal 9 hp-sec/min *(112 watts)*
Vertical 6.5 hp-sec/min *(80 watts)*

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

② Thermal capacity rating is based on ambient temperature of 72°F *(22°C)*, stop time of one second or less, with no heat absorbed from motor. Refer to *Selection Procedure* Section.

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

Static Torque lb-ft	Coil Size	T1	T2
1.5 - 25	4, K4, K4+, M4+	25	14

Series 56,000; 56,100; 56,300; 56,500; and 56,700

Nominal Static Torque lb-ft *(Nm)*	Number of Friction Discs	Coil Size AC	Coil Size DC	Inertia (WK^2) lb-ft² *($kgm^2 \times 10^{-4}$)*
1.5-3 *(2-4)*	1	4	4+	.008 *(3.36)*
6 *(8)*	1	K4	K4+	.008 *(3.36)*
10 *(14)*	2	K4	K4+	.014 *(5.88)*
15 *(20)*	2	K4+	M4+	.014 *(5.88)*
20 *(27)*	3	K4+	M4+	.020 *(8.40)*
25 *(34)*	3	M4+	P4+	.020 *(8.40)*

Series 56,200; 56,400; 56,600; and 56,900

Nominal Static Torque lb-ft *(Nm)*	No. of Friction discs	Coil Size AC	Coil Size DC	Inertia (WK^2) lb-ft² *($kgm^2 \times 10^{-4}$)*
3-6 *(4-8)*	2	4	4+	.014 *(5.88)*
10 *(14)*	2	K4	K4+	.014 *(5.88)*
15 *(20)*	2	K4+	M4+	.014 *(5.88)*
20 *(27)*	3	K4+	M4+	.020 *(8.40)*
25 *(34)*	3	M4+	P4+	.020 *(8.40)*

Current Ratings (amperes)

Solenoid Coil Size*	AC Current	Voltage: 60 Hz 115	200	230	400	460	575	Voltage: 50 Hz 110	220	380	Voltage: DC 24	95	115	230
4	Inrush	3.6	2.1	1.8	1.1	.9	.7	4.1	2.1	.9	13.3	3.6	2.8	1.5
	Holding	.3	.2	.2	.08	.08	.06	.3	.2	.08	.3	*.1*	*.05*	*.03*
4+	Inrush	–	–	–	–	–	–	–	–	–	12.0	4.7	3.7	2.0
	Holding										*.4*	*.1*	*.08*	*.04*
K4	Inrush	4.3	2.5	2.2	1.3	1.1	.9	3.8	1.9	1.1	17.5	4.7	3.7	2.0
	Holding	*.3*	*.2*	*.2*	*.1*	*.08*	*.07*	*.4*	*.2*	*.08*	*.4*	*.1*	*.08*	*.04*
K4+	Inrush	4.6	2.5	2.3	1.2	1.0	.9	4.9	2.0	1.0	20.5	7.5	5.5	2.0
	Holding	*.4*	*.2*	*.2*	*.1*	*.1*	*.08*	*.4*	*.2*	*.1*	*.5*	*.1*	*.08*	*.04*
M4	Inrush	3.0	1.7	1.5	.9	.8	.6	–	–	.8	–	–	–	–
	Holding	*.6*	*.3*	*.3*	*.2*	*.1*	*.21*			*.1*				
M4+	Inrush	4.6	2.5	2.3	1.2	1.0	.9	4.1	2.0	1.3	30.3	7.9	5.5	2.0
	Holding	*.4*	*.2*	*.2*	*.1*	*.1*	*.08*	*.4*	*.2*	*.1*	*.5*	*.1*	*.1*	*.04*
P4+	Inrush	–	–	–	–	–	–	–	–	–	30.3	11.3	8.4	3.0
	Holding										*.5*	*.1*	*.08*	*.04*

Motor Frame Adapters: Series 56,000 through 56,600

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

To Adapt to NEMA Frame Size	AK Dim. in. *(mm)*	Reg. No.	Brake Enclosure ①	Brake Torque	Adapter Stock Number	Additional Shaft Length Required in. *(mm)*
182TC 184TC 213TC 215TC 254TC 256TC	8.50 *(215.90)*	-9	IP 23	1.5-15	5-55-5041-00 List $700.00	.94 *(23.81)*
	8.50 *(215.90)*	-9	IP 54	1.5-6	5-55-5041-00 List $700.00	.94 *(23.81)*
	8.50 *(215.90)*	-9	IP 23	20 & 25	5-55-5043-00 List $700.00	.94 *(23.81)*
	8.50 *(215.90)*	-9	IP 54	10-25	5-55-5043-00 List $700.00	.94 *(23.81)*

① 56,300 Series have NEMA 1 enclosure. For adapter dimensions, see *Technical Data*

1-056-132-00-BQF

Ordering and Identification Information

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

Example of a complete part number:

1-056-034-00-BFF
- Series
- Torque
- Enclosure
- Lead wire position (internal and external, left and right) standard
- 230 Vac
- 5/8 bore and 3/16 x 3/32 keyway

Hub Selection

Character	Bore (in.)	Keyway** (in. x in.)
A*	5/8	1/8 x 1/16
B	5/8	3/16 x 3/32
C	3/4	3/16 x 3/32
D	7/8	3/16 x 3/32
E	1-1/8	1/4 x 1/8
F*	1-1/4	1/4 x 1/8
K	1/2	1/8 x 1/16
L*	1	1/4 x 1/8
N*	9/16	1/8 x 1/16
O*	11/16	3/16 x 3/32
P*	1-1/16	1/4 x 1/8
R*	13/16	3/16 x 3/32
S*	15/16	1/4 x 1/8
Z	.460	pilot bore

Minimum bore is .500. Maximum allowable bore is 1.25. (maximum shaft length not to exceed end of hub).
For through-shaft applications, .875 is maximum

*These bores are non-standard. Add $225.00 to list price.

**Keyseats made to ANSI B17.1 Standard.

Standard AC Voltage Ratings

Character	Voltage	Hz
B	115	60
D	110	50
E	200	60
F	230 190	60 50
H	220	50
L	460 380	60 50
M	415	50
N	575	60
O	110/220	50
P	115/208-230	60
Q	208-230/460 190/380	60 50
R	200/400	60

Direct Current

Character	Voltage
T	12
U	24
V	36
W	48
X	95
Y	115
Z	230

Consult factory if other DC voltage is needed.

Voltages below 70VDC are polarity sensitive.

Modifications are available- see SAB Modification Section

Dimensional Drawings are on the pages following.

Series 56,100 (1-056-1XX) Die Cast Aluminum & Series 56,600 (1-056-6XX) Cast Iron

Mounting Face: NEMA 56C, 143TC and 145TC , 4.5" AK, 5.88" AJ



Release Type: Internal Lever, Non-Maintained

Installation and Service: P/N 8-078-905-60

Modifications: Pages 54-63

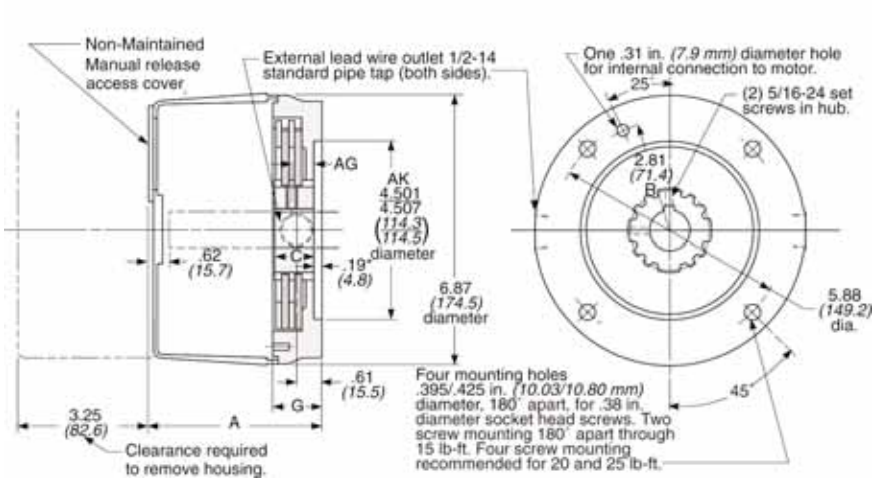
Enclosure Protection: IP 23; 56 & 57 (formerly referred to by Stearns as NEMA 2, 4 & 4X respectively)

Visual Wear Indicator

Mounting: Fanguard-mounted brakes requiring IP 56 or IP 57 protection may require additional sealing measures beyond seals provided with the brake - Refer to Installation & Service Instruction sheets

56,100 Series: Die Cast aluminum enclosure
Parts List: P/N 8-078-906-01

56,600 Series: Cast iron enclosure
Parts List: P/N 8-078-906-06



Series 56,100 Dimensions

Nominal Static Torque lb-ft (Nm)	Enclosure	Dimensions in Inches (mm)				Wt lbs (Kg)
		A	AG	C Hub Width	G	
1.5-15 (2-20)	IP 23	4.41 (112.0)	.59 (15.0)	.81 (20.6)	1.21 (30.7)	8 (3.6)
20-25 (27-34)		4.86 (123.4)		1.18 (30.0)	1.66 (42.2)	10 (4.5)
1.5-6 (2-8)	IP 56/57	4.50 (114.3)	.47 (11.9)	.81 (20.6)	1.21 (30.7)	8 (3.6)
10-25 (14-34)		4.95 (125.7)	.59 (15.0)	1.18 (30.0)	1.66 (42.2)	10 (4.5)

Series 56,600 Dimensions

Nominal Static Torque lb-ft (Nm)	Enclosure	Dimensions in Inches (mm)				Wt lbs (Kg)
		A	AG	C Hub Width	G	
3-25 (4-34)	IP 23	4.95 (125.7)	.59 (15.0)	1.18 (30.0)	1.66 (42.2)	21 (9.5)
3-25 (4-34)	IP 56/57	5.05 (128.3)				

Series 56,100 Pricing (Discount Symbol B4)

Nominal Static Torque lb-ft (Nm)	Enclosure	Basic Model Number and List Price*			
		AC	AC List Price*	DC	DC List Price*
1.5 (2)	IP 23	1-056-101-00	$505.00	1-056-105-00	$805.00
	IP 56	1-056-102-00	640.00	1-056-106-00	940.00
	IP 57	1-056-104-00	715.00	1-056-108-00	1,015.00
3 (4)	IP 23	1-056-111-00	525.00	1-056-115-00	825.00
	IP 56	1-056-112-00	660.00	1-056-116-00	960.00
	IP 57	1-056-114-00	735.00	1-056-118-00	1,035.00
6 (8)	IP 23	1-056-121-00	590.00	1-056-125-00	890.00
	IP 56	1-056-122-00	725.00	1-056-126-00	1,025.00
	IP 57	1-056-124-00	800.00	1-056-128-00	1,100.00
10 (14)	IP 23	1-056-131-00	690.00	1-056-135-00	990.00
	IP 56	1-056-132-00	830.00	1-056-136-00	1,130.00
	IP 57	1-056-134-00	905.00	1-056-138-00	1,205.00
15 (20)	IP 23	1-056-141-00	790.00	1-056-145-00	1,090.00
	IP 56	1-056-142-00	930.00	1-056-146-00	1,230.00
	IP 57	1-056-144-00	1,005.00	1-056-148-00	1,305.00
20 (27)	IP 23	1-056-151-00	880.00	1-056-155-00	1,180.00
	IP 56	1-056-152-00	1,015.00	1-056-156-00	1,315.00
	IP 57	1-056-154-00	1,090.00	1-056-158-00	1,390.00
25 (34)	IP 23	1-056-161-00	975.00	1-056-165-00	1,275.00
	IP 56	1-056-162-00	1,110.00	1-056-166-00	1,410.00
	IP 57	1-056-164-00	1,185.00	1-056-168-00	1,485.00

Series 56,600 Pricing (Discount Symbol B4)

Nominal Static Torque lb-ft (Nm)	Enclosure	Basic Model Number and List Price*			
		AC	AC List Price*	DC	DC List Price*
3 (4)	IP 23	1-056-611-00	1,200.00	1-056-615-00	1,500.00
	IP 56	1-056-612-00	1,335.00	1-056-616-00	1,635.00
	IP 57	1-056-614-00	1,410.00	1-056-618-00	1,710.00
6 (8)	IP 23	1-056-621-00	1,265.00	1-056-625-00	1,565.00
	IP 56	1-056-622-00	1,400.00	1-056-626-00	1,700.00
	IP 57	1-056-624-00	1,475.00	1-056-628-00	1,775.00
10 (14)	IP 23	1-056-631-00	1,365.00	1-056-635-00	1,665.00
	IP 56	1-056-632-00	1,505.00	1-056-636-00	1,805.00
	IP 57	1-056-634-00	1,580.00	1-056-638-00	1,880.00
15 (20)	IP 23	1-056-641-00	1,465.00	1-056-645-00	1,765.00
	IP 56	1-056-642-00	1,605.00	1-056-646-00	1,905.00
	IP 57	1-056-644-00	1,680.00	1-056-648-00	1,980.00
20 (27)	IP 23	1-056-651-00	1,555.00	1-056-655-00	1,855.00
	IP 56	1-056-652-00	1,690.00	1-056-656-00	1,990.00
	IP 57	1-056-654-00	1,765.00	1-056-658-00	2,065.00
25 (34)	IP 23	1-056-661-00	1,650.00	1-056-665-00	1,950.00
	IP 56	1-056-662-00	1,785.00	1-056-666-00	2,085.00
	IP 57	1-056-664-00	1,860.00	1-056-668-00	2,160.00

* Subtract $30.00 for brake ordered less hub.

Information Needed for Modifications

Stearns is dedicated to providing you with the most comprehensive selection of modified spring-set disc brakes on the market today. We have included a list of our more popular modifications complete with descriptions, pictures and graphics when applicable and list price adders along with their representative series. Note that modification list prices are subject to the same discounts as apply to the complete brake assembly.

Below please find examples of how the modifications are called out with a letter in the 8th position of the 12 digit model number. Note that these listings are not complete, but represent our more popular selections. For any special applications and modification requirements not found here, please contact your Stearns representative.

IMPORTANT – The modification letter will appear in the *8th position* to call out the modification.

Examples:

1-056-XXX-__X
8th position

1-087-XXX-__X
8th position

1-08X-XXX-__X
8th position

See specific tables for some of the available options of the series required.

If two or more letter modifications are required, the 8th position of the part number will remain zero and position 10, 11 and 12 will be assigned by Stearns as a special part number.

All Series

Modification	Letter
Vertical Mounting - Above Motor	A
Class H Insulation	H
Space Heater (115 Volt Circuit)	I
Space Heater (115 Volt Circuit), Brass Pressure Plate and Stationary Disc	J
Brass Pressure Plate and Stationary Disc	K
Vertical Mounting - Below Motor	L
Thru-Shaft Housing (Standard)	Q
Vertical Mounting - Above Motor and Class H Insulation	T
Electrical Release Indicator Switch, N.O. contacts	W
Side Manual Release with Shaft Through Housing Stamped Steel	Z
Series 87,X00 Only	
Vertical Mounting - Above Motor, Brass Pressure Plate and Stationary Disc	N
Series 81,X00, 82,X00 87,000 and 87,100	
Side Manual Release	Y

Solenoid Actuated Brakes Modification Index

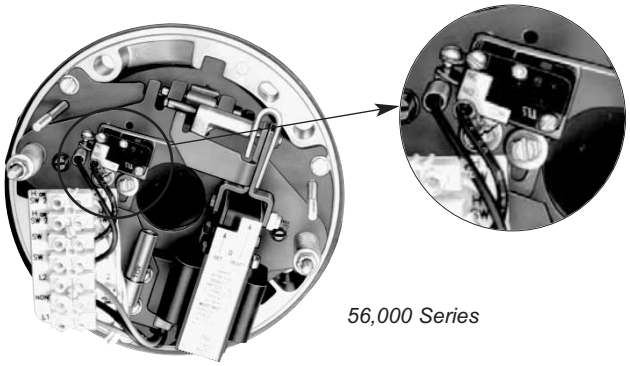
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	Special Leadwire Length	M31	61
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	Brass Stationary Disc	M4	55
	Breather Drain	M5	56
	Space Heater (115 or 230 volt)	M13	57
	Special Paint	M14	58
	Stainless Steel Self-Adjust	M15	58
	Stainless Steel Hardware	M16	58
	Corrosion-Resistant Endplate	M39	62
	Stainless Steel Hub	M42	62
Endplates	Special Internal Leadwire Hole	M35	61
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	Special Milling: Flat Bottom on Housing & Endplate	M40	62
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	Brass Stationary Disc	M4	55
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	Stainless Self-Adjust	M15	58
	Stainless Steel Hardware	M16	58
	Corrosion-Resistant Endplate	M39	62
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	Thru-Shaft NEMA 2	M19	59
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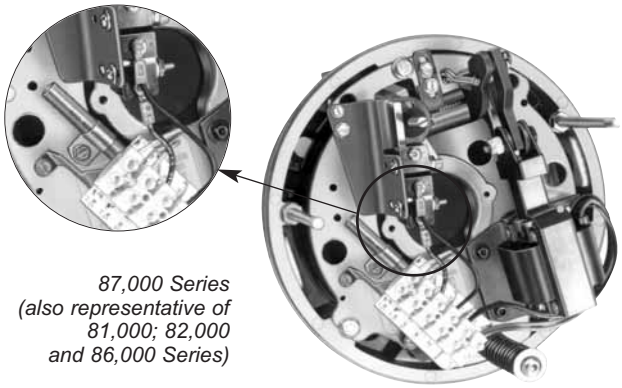
M1 Electrical Release Indicator Switch

Series	List Price Adder
56,X00 & 65,300	$450.00
81,000; 82,000; 87,X00	450.00
86,X00	900.00

This switch is used to indicate when the brake is in a released, non-holding position. This mechanism utilizes a mechanical limit switch.



56,000 Series



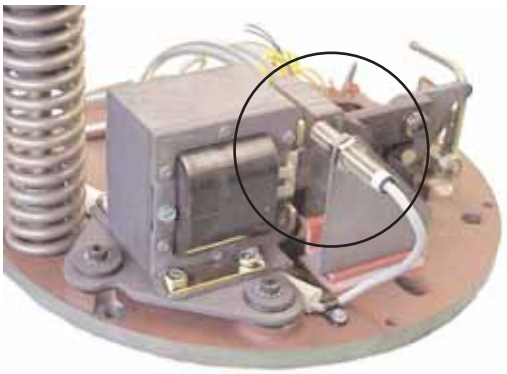
87,000 Series (also representative of 81,000; 82,000 and 86,000 Series)

Not available on 56,800 or 87,800 Series Brakes.

M2 Electrical Release Indicator Proximity Switch

Same function as the switch in M1 above; except, M2 uses an electronic proximity sensor.

Series	List Price Adder
81,000 82,000 87,X00	$1375.00
86,X00	2750.00

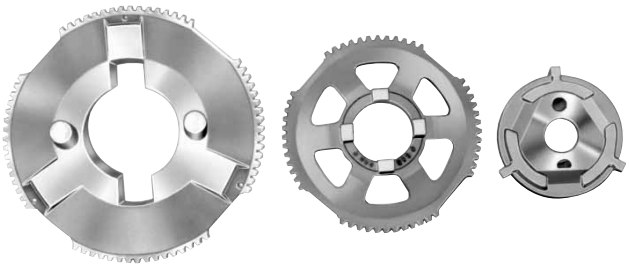


Not available on 56,800 or 87,800 Series Brakes.

M3 Brass Pressure Plate

Typically used in marine applications or in applications where the potential for sparks need to be eliminated. Brass can also be used to reduce torque.

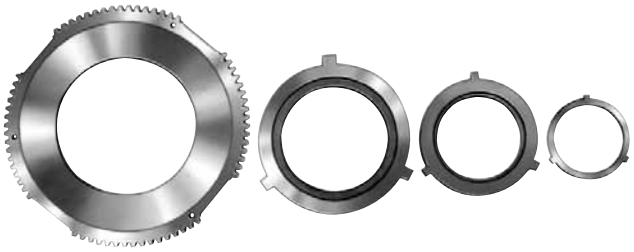
Series	List Price Adder
56,X00	See M4
65,X00	$250.00
81,000; 82,000	800.00
86,X00	1050.00
87,X00	600.00



M4 Brass Stationary Discs

Used with brass pressure plate (List per disc).

Series	List Price Adder
56,X00	$250.00
65,X00	250.00
87,X00	450.00
81,000; 82,000	600.00
86,X00	750.00



M5 Breather Drain

A drain plug is tapped into the bottom of the housing to let moisture escape. This option is only available on brakes with cast aluminum or cast iron housings.

Series	List Price Adder
56,X00	$380.00
65,X00	500.00
81,000 82,000 86,X00 87,X00	380.00



M6 Class H Insulation

Brake is provided with an epoxy encapsulated coil, rated for NEMA Class H designation.

These Class H coils are standard on hazardous location brakes.

Series	List Price Adder
56,X00	$145.00
87,X00	175.00
81,000 82,000	285.00
86,X00	570.00



M7 Housing Machining for Encoder/Tach Mounting

Series	Standard Machining[1]				Close Tolerance[2]			Tether Mount [3]	
	Bolt Circle & Register		Bolt Circle - but no Register		Bolt Circle & Register			A Single Bolt Hole	
	Open[4] Enclosure List Price Adder	Enclosed[5] List Price Adder	Open[4] Enclosure List Price Adder	Enclosed[5] List Price Adder	Open[4] Enclosure List Price Adder	Enclosed[5] List Price Adder	Maximum Thru-Shaft Dia. (inch)	Open[4] Enclosure List Price Adder	Enclosed[5] List Price Adder
56,X00 (except N/A for 56,800)	N/A	N/A	N/A	N/A	N/A	N/A		$350	$460
87,000 - 87,100	$700	$1,200	$80	$350	$2,450	$2,750	1.63	$240	$350
87,M00 - 87,500 - 87,600	N/A	$1,200	N/A	$350	N/A	$2,750		N/A	$350
81,000 - 82,000[6]	$1,100	$1,375	$305	$580	$2,550	$2,825	2.5	$465	$740
86,000	$1,100	$1,375	$380	$780	$2,550	$2,950		$540	$940

[1]**Standard Machining:** The housing is machined for a thru shaft, and to allow for an encoder or tach to be mounted. This option is only available on brakes with cast aluminum or cast iron housings. Consult factory for availability.

[2]**Close tolerance:** The housing and endplate are assembled and dowel pinned together - then machined as a matched set for a through shaft and encoder mounting. This option is only available on brakes with cast aluminum or cast iron housings. This option is recommended for Series 81,000; 82,000; and 86,X00 due to the long distance between the motor and encoder.

[3]**Tether Mount:** The housing is machined for a through shaft, and a single tapped hole for a bolt to secure a tether arm. (56,X has a through hole and tach-welded nut on inside of housing, instead of a tapped hole).

[4]Referred to on the product pages in the catalog as IP23

[5]Referred to on the product pages as IP54/55 (these enclosure ratings no longer apply when the housing is machined for this modification - the customer is responsible for meeting any specific enclosure rating when assembling the encoder.

[6]M7 Modification for Series 81,000 and 82,000 will also require the M12 Modification; the side manual release.



M8 Conduit Box with Terminal Strip

A terminal strip is located inside the conduit box. It allows for easy connection and identification of lead wires.

Series	List Price Adder
All series except hazardous location *(not available for the 48,100 series)*	$300.00 (IP 23) $600.00 (IP 54)
All hazardous location brakes	$600.00



M9 DC Coil Option

For DC voltage applications. Operates with an electronic DC switch module.

Series	List Price Adder	Additional Adder for Non-Standard Voltage
56,X00	$ 300.00	$ 250.00
87,X00	570.00	250.00
81,000	1050.00	250.00
82,000	1565.00	250.00
86,X00	2625.00	500.00

For standard voltage listing, see the ordering information section for the specific brake.

Not available on Hazardous Location Brakes.

M10 Nameplates

To order new brake nameplates, the serial number of the brake is required. A loose nameplate shipped from Stearns Division without being attached to a brake must have all agency markings removed (UL, CSA, etc.). In order to have a brake renameplated with the appropriate agency markings, it must be returned to Stearns Division for product verification.

List Price:	First Nameplate	$150.00
Net Price:	Additional Mylar Nameplates	1.50
	Additional Metal Nameplates	4.00

M11 Nonstandard Hub or Keyway

For standard bore diameter and keyway specifications, see specific brake selection page. For taper bores, consult factory for pricing.

Description	List Price Adder					
	48,100	56,X00	65,X00	81,000 82,000 86,000	87,000 87,100 87,800	87,700
All Quantities and Enclosures	$225.00	225.00	325.00	600.00	250.00	250.00

M12 Side Manual Release

Side release not available on the 1-065-300 or the 1-086-000

Sheet Metal Housing (IP 23 Only)	List Price Adder
56,000; 56,400; 56,500	$50.00
87,000; 87,100	$50.00

Cast Iron Housing	List Price Adder
87,000 IP 23	$385.00 includes casti iron housing adder of $110
87,000 IP 54	$275.00
81,000 82,000	$350.00



M13 Space Heater (115 or 230 Volt Only)

A space heater cartridge is used to prevent moisture build-up inside the brake housing.

Series	Wattage	List Price Adder
56,X00*	15	$210.00
81,000; 82,000; 86,X00	50 and 75	275.00
87,X00**	25 to 30	225.00
Hazardous Duty Brakes	25 to 50	750.00

*Not available on 56,800 or 87,800 Series Brakes
**Not available in 87,800 Class I



56,000 Series



87,000 Series (also representative of 81,000; 82,000 & 86,000 Series)

M14 Special Paint



The standard paint for all brake series (except BISSC Certified & Maritime/Navy) is a red, water-base primer, painted inside and out.

For additional corrosion protection, a special (green) zinc chromate primer can be provided (painted inside and out) in place of the standard red primer. List price adders as shown.

Series	List Price Adder
56,X00	$210.00
65,X00	300.00
81,000; 82,000; 86,X00	550.00
87,000	525.00

Other Special Paint options are available - either primers, a white epoxy finish coat, or clean finish (exterior primer removed). Consult factory for pricing.

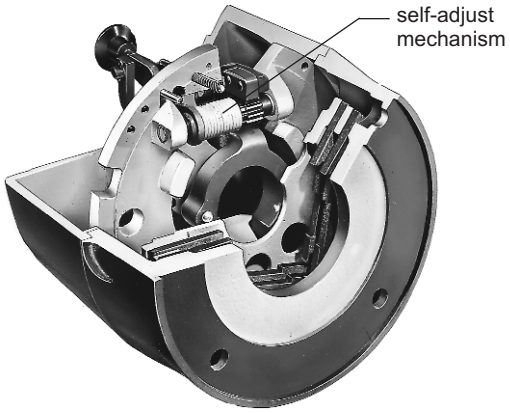
BISSC Certified paint (white epoxy exterior paint) is standard for brake series with IP55 and IP57 enclosure ratings - and the prices are included in the standard list prices.

Maritime and Navy brakes have their own specified paints, with pricing included in the standard list prices.

M15 Stainless Steel Self-Adjust Mechanism

For severe duty applications. This option includes a stainless steel pinion and plated wrap spring in the auto-adjust mechanism. It is only available on the 81,000; 82,000; 86,000 and 87,000 Series Brakes

Series	List Price Adder
81,000; 82,000; 87,000	$350.00
86,X00	$700.00



M16 Stainless Steel Hardware

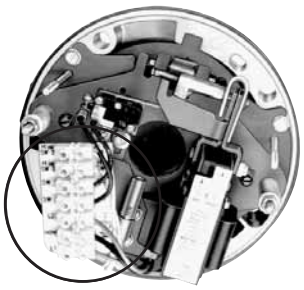
All external hardware is provided in stainless steel.

Series	List Price Adder
48,100	$125.00
56,X00, 87,X00	$150.00
81,000, 82,000 86,000	$275.00

M17 Terminal Strip

A terminal strip is located in the inside of the brake, on the support plate. It allows for easy connection and identification of lead wires.

Series	List Price Adder
ALL	$150.00



56,000 Series



87,000 Series (also representative of 81,000; 82,000 & 86,000 Series)

M18 Thermostat (thermal switch)

This switch is used to indicate when a brake is overheating. Thermostats are standard in 8X,300 and 65,X00 Series. This option is for NON-UL brakes only.

Series	Switch Operation Specificatons	List Price Adder
87,X00	Normally Closed: Opens at 295°F, Closes at 255°F	$400.00
81,000, 82,000 86,X00	Normally Closed: Opens at 210°F, Closes at 180°F	400.00
56,X00	Normally Closed: Opens at 195°F, Closes at 175°F	400.00



M19 Through-Shaft Enclosure

This configuration allows for the motor shaft to extend beyond the housing of the brake.

This modification lowers the brake enclosure rating to IP10.

Series	List Price Adder
56,000, 56,400	N/C
56,100, 56,200	$110.00
56,600	110.00
81,000, 82,000	225.00
86,000	300.00
87,000, 87,100 sheet metal	N/C*
87,000, 87,100 with cast iron housing	225.00 (adder for cast iron housing is $210.00 additional)

*Up to 1-5/16".
Above 1-5/16", add $80.00.



M20 Through-Shaft Cast Iron Enclosure with Lip Seal

This configuration allows the motor shaft to extend beyond the housing of the brake with a bushing to use with a housing lip seal.

This modification lowers the brake enclosure rating to IP10.

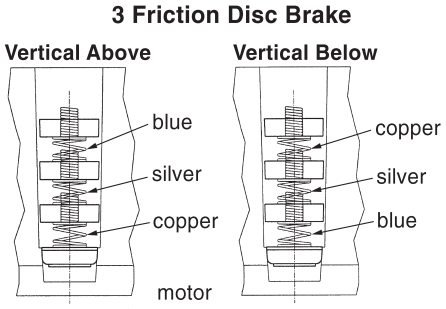
Series	List Price Adder
56,100, 56,200 56,600	$220.00
81,000, 82,000	500.00
86,000	700.00
87,000, 87,100	300.00



M21 Vertical Mounting for 56,000 Series & 65,300 Series

The 56,000 20 and 25 lb-ft Series Brakes are shipped with spring kits. Vertical modification at 15° from horizontal. Read installation and service instructions for details on its use.

Description	List Price Adder
Factory assembly for three disc configuration.	$20.00



Example of 56,000 Series spring requirements for vertical above and below mounting.

M23 Vertical Mounting for 87,X00 Series

For factory modification to vertical above or below application. Vertical modification at 15° from horizontal.

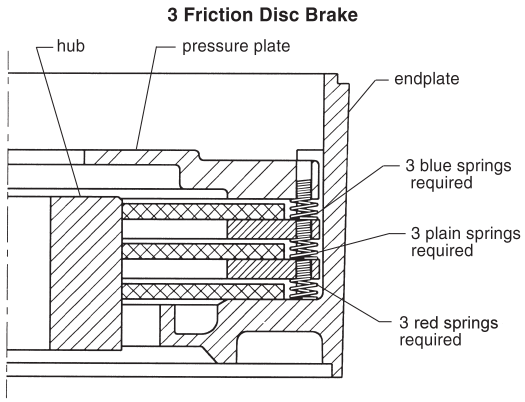
Series 87,000 & 87,100

Torque Value (lb-ft)	IP 23 & IP 54 steel hsg Above	IP 23 & IP 54 steel hsg Below	IP 54/55 cast iron Above	IP 54/55 cast iron Below
6, 10, 15, 25 & 35	$95.00	no mod req'd	$370.00*	no mod req'd
50 & 75	$105.00	$105.00	$380.00*	$105.00
105	$135.00	$135.00	$410.00*	$135.00

*Includes adder for side manual release

Series 87,300; 87,800; 87,700

Torque Value (lb-ft)	Vertical Above	Vertical Below
6, 10, 15, 25 & 35	$95.00	no mod req'd
50 & 75	$105.00	$105.00
105	$135.00	$135.00



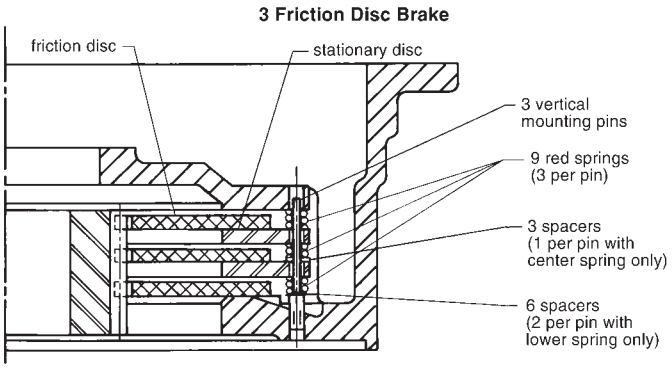
Example of 87,000 Series spring requirements for vertical above mounting.

M24 Vertical Mounting for 81,000; 82,000 and 86,000 Series

These brakes require factory modifications for vertical applications. Vertical modification at 15° from horizontal.

Series	Torque Value (lb-ft)	IP 23 Above & Below	IP 54 Above	IP 54 Below
81,000 & 82,X00	125 & 175	$250.00	$575.00*	$250.00
81,000 & 82,X00	230	300.00	650.00*	300.00
82,X00	330	300.00	650.00*	300.00
82,X00	440	500.00	850.00*	500.00
86,000	500 & 750	750.00	750.00*	750.00

*Includes adder for side manual release

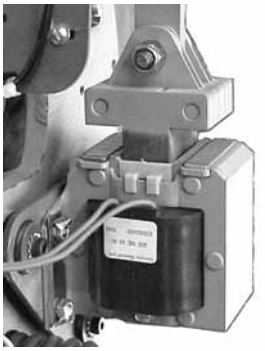


Example of 81,000 Series pin, spring and spacer requirements for vertical above mounting.

M25 Voltage Non-Standard (AC)

For standard voltage listing, see the ordering information section for the specific brake.

Series	List Price Adder
48,100	$165.00
65,X00	165.00
56,000	165.00
81,000; 82,X00	200.00
86,X00	400.00
87,X00	175.00

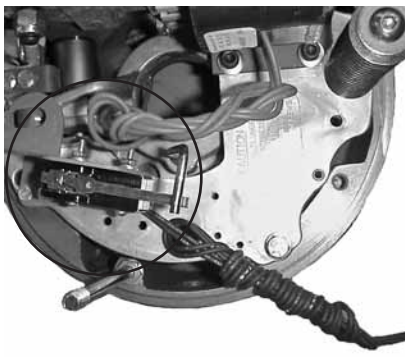


M27 Wear Indicator (Friction Disc) Switch

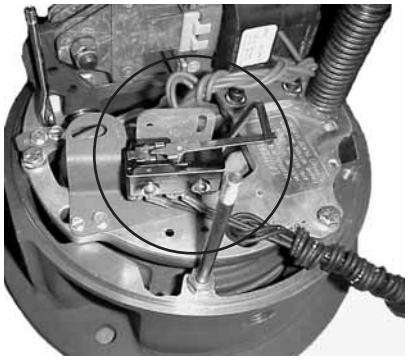
A mechanical switch is installed to indicate when the friction disc requires replacement.

Series	List Price Adder
81,000; 82,X00	$225.00
86,000	225.00
87,X00*	225.00

**Switch supplied with leads (Switches N/A on Series 87,800)*



87,000 Assembly



87,000 Assembly

M29 Special Shaft-Coupler Brake and Foot Mount Brake

Any non-standard input or output shaft on a 56,700, 87,200 or 87,700 Series Brake.

Series	List Price Adder
56,700	$325.00
87,200; 87,700	325.00



M30 Taper-Lock Hubs

For use in severe duty applications and reversing application to secure the brake hub to the motor shaft.

Series	Series	List Price Adder
87,000; 87,100 IP 23 only	10 to 35 lb-ft	$200.00
	50 to 75 lb-ft	225.00
	105 lb-ft	250.00
81,000	125 & 175 lb-ft	225.00
	230 lb-ft	325.00
82,000	125 & 175 lb-ft	375.00
	230 & 330 lb-ft	550.00
	440 lb-ft	675.00





M31 Special Length Lead Wires

Up to 5’	Series	List Price Adder
	All	$65.00

Over 5’	Series	List Price Adder
	All	$130.00

M32 Non-Maintained (Deadman) Manual Release

The brake is mechanically released while the release is pulled into a release position. Once released, the brake sets.

Series*	List Price Adder
56,200, 56,700, 56,800 & 56,900	$110.00
56,000, 56,400 & 56,500	185.00
81,000; 82,000 & 87,000	125.00
86,000	250.00

**N/A on 56,300.*
Standard on 56,100 and 56,600.



M33 Metric Machining Including Cast Iron Endplate

Stearns SAB’s can be used with metric motor frames. The following table indicates standard frame capabilities for an IEC B14 Face mount.

Series	IEC Frame Sizes	List Price Adder
56,200; 56,400; 56,600 & 56,900	B14 flange in sizes 80; 90 & 100 B5 flange in sizes D63 & D71	$340.00
56,500	B14 flange in sizes 112; 132 & 160 B5 flange in sizes D71; D80; D90; D100 & D112	$340.00
87,000	B14 flange in sizes 112; 132 & 160 B5 flange in sizes D71; D80; D90; D100 & D112	$340.00

M34 Derating of Torque

Stearns industrial SAB’s can be custom built to meet your specific torque requirements.

Series	List Price Adder	Derate To
56,500	$315.00	6 lb-ft
87,100	315.00	20 or 30 lb-ft
81,000 & 82,000	460.00	To be approved with application engineering

M35 Special Internal Lead Wire Hole with Bushing

Any non-standard, internal lead wire hole in the endplate.

Series	List Price Adder
All brakes except hazardous location brakes	$175.00



M36 Housing Split

SAB's can be provided with a split housing.

Series	List Price Adder
81,000; 82,000 & 86,000	$725.00
81,000; 82,000 & 86,000 gasketed	$1,000.00
87,000; 87,100 sheet metal	$200.00
87,000; 87,100 cast iron gasketed	$250.00



M37 Internal Release

An internal manual release requires that the housing be removed before the brake can be released by hand.

**N/A for hazardous location brakes*

Series	List Price Adder
87,0XX; 81,0XX; 82,0XX; 86,0XX	N/C

M38 Motor Gasket

The brake is provided with an additional C-Face gasket to be placed between the brake and motor.

Series*	List Price Adder
81,000; 82,000; 86,000	$100.00
56,X00 & 87,000	75.00

**N/A for hazardous location brakes*

M39 Corrosion-Resistant Endplate

Rust preventative treatment applied to brake endplate.

Series	List Price Adder
56,200, 56,400, 56,500, 56,800 & 65,300	$425.00
81,000; 82,X00 & 86,000	575.00
87,X00	475.00



M40 Special Milling: Flat Bottom on Housing & Endplate

This modification is provided in the event the flange between the endplate and housing interfere with the mounting configuration.

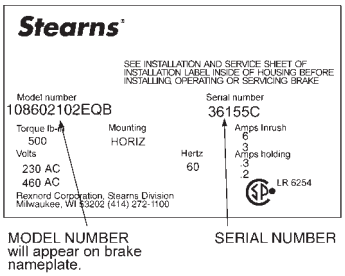
Series	List Price Adder
81,000; 82,000 & 86,000	$650.00



M41 Brass Nameplate with Special Engraving

Brass nameplates offer greater durability in outdoor applications.

Series	List Price Adder
81,000; 82,000 & 86,000	$75.00



M42 Stainless Splined Hub

Stainless steel splined hubs are available for extreme outdoor applications, to prevent corrosion on the disc and hub interface.

Series	List Price Adder
81,000; 82,000 & 86,000	$1060.00
87,000	800.00



M43 Viton® Gasket

Gaskets and o-rings in brakes can be provided in Viton® (flourocarbon) material, in place of the standard neoprene. However, the V-wiper steel-backed seals that are used on pull rod manual releases are not available in Viton® and remain as neoprene.

Viton® is a registered trademark name of DuPont.

Series	List Price Adder
81,000; 82,000; 86,000	$1,300.00
87,000*	$1,125.00
56,000	$950.00

*Viton® gaskets and o-rings are standard for 87,X00 series, except for hazardous location brakes where Viton® seals are N/A.

***Except series 56,200; 56,700; & 56,900 - where Viton gaskets are standard.*

M44 Special Friction Disc (per Disc)

Any non-standard friction disc in a brake. Cost is per disc.

Non-standard discs include: hi-inertia friction discs and heavy duty friction discs. Does not include carrier ring friction discs (see M46 and M47).

Series	List Price Adder
87,000	$50.00
56,000	45.00



M45 Splined Hub and Friction Disc

Standard on most models. Used for severe duty and reversing applications.

Series	List Price Adder
87,300	No Charge

Series	Torque (lb-ft)	List Price Adder
87,X00*	6-35 lb-ft	190.00
	50 & 75 lb-ft	290.00
	105 lb-ft	390.00

** Spline is standard on this series. Adder is for pre-revision 24-tooth spline.*

M46 Carrier Ring Friction Disc

The friction material is bonded to a steel or zinc/aluminum alloy ring.
This is used for severe duty applications and applications where people are being moved.

Series	Carrier ring material	List Price Adder (per disc)
Horizontal Use Only		
81,000	Steel	700.00
82,000	Steel	700.00
Horizontal or Vertical Use		
87,X00** (not available on 87,300 or 87,800 series	Zinc aluminum alloy	550.00



M47 Carrier Ring Friction Disc (Bronze)

The friction material is bonded to a bronze ring.
This is used for severe duty applications and applications where people are being moved.

Horizontal applications only

*** Only available with pre-revision design, 24-tooth splined hub, which is included in this price*

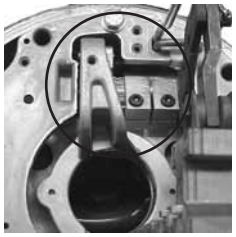
Series	List Price Adder (per disc)
81,000	N/A
82,000	$1050.00
86,000	1250.00
87,X00**	
6-35 lb-ft	925.00
50 & 75 lb-ft	1850.00
105 lb-ft	2775.00



M48 1,08X,000 Series Manual Adjust Mechanism

Excellent for holding applications when disc wear is not a concern. (Not available on hazardous location brakes.)

Series	List Price Adder
87,000	Subtract $50 List
81,000 82,000 86,000	No Charge



M60 Encoders

Internally mounted encoders are available in some series brakes, including some hazardous location brakes. See pages 52-53 for series availability and additional information.

Maximum Encoder Diameter (in.)	
1-056	N/A
1-087-E00	2.0”
1-081 & 1-082	2.5”
1-086	3.5”



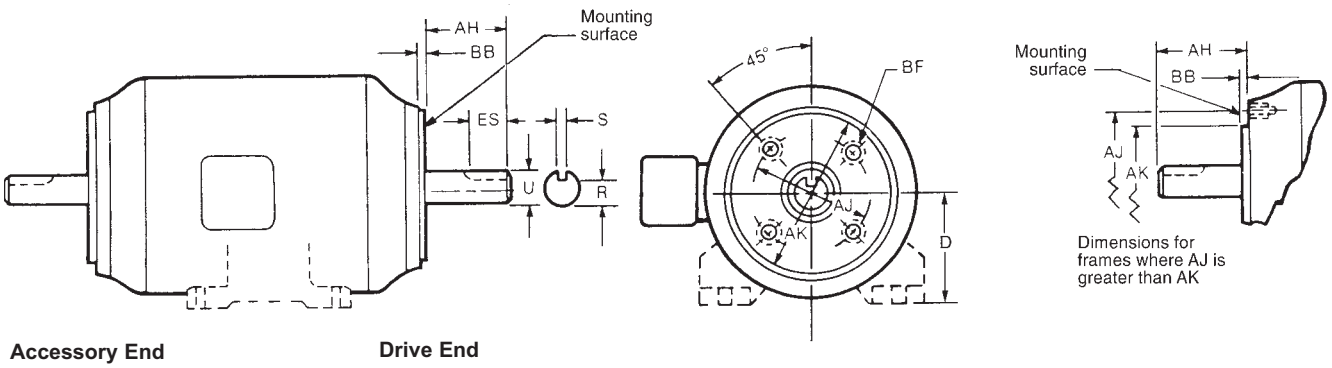
Dimensions for C-Face Brake Motor Systems

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Brakes Externally Wired to Motor

C-face motor with double shaft extension.

Stearns Disc Brakes are designed to mount on standard C-face motors having the same dimensions and tolerances on the accessory end as on the drive end. They also mount on foot mounting brackets and machine mounting faces having the same mounting dimensions and tolerances. Some motor accessory end C-face may differ from the drive end.



Accessory End **Drive End**

Drive End Dimensions (Inches)

Frame Designation	AJ	AK	BB Min.	BF Hole			U	AH	Keyseat			Base to Centerline D
				Number	Tap Size	Bolt Penetration Allowance			R	ES Min.	S	
42C	3.750	3.000	0.16	4	1/4-20	. . .	0.375	1.312	0.328	. . .	flat	2.62
48C	3.750	3.000	0.16	4	1/4-20	. . .	0.500	1.69	0.453	. . .	flat	3.00
56C	5.875	4.500	0.16	4	3/8-16	. . .	0.625	2.06	0.517	1.41	0.188	3.50
143TC and 145TC	5.875	4.500	0.16	4	3/8-16	0.56	0.875	2.12	0.771	1.41	0.188	3.50
182TC and 184TC	7.250	8.500	0.25	4	1/2-13	0.75	1.125	2.62	0.986	1.78	0.250	4.50
182TCH and 184TCH	5.875	4.500	0.16	4	3/8-16	0.56	1.125	2.62	0.986	1.78	0.250	4.50
213TC and 215TC	7.250	8.500	0.25	4	1/2-13	0.75	1.375	3.12	1.201	2.41	0.312	5.25
254TC and 256TC	7.250	8.500	0.25	4	1/2-13	0.75	1.625	3.75	1.416	2.91	0.375	6.25
284TC and 286TC	9.000	10.500	0.25	4	1/2-13	0.75	1.875	4.38	1.591	3.28	0.500	7.00
284TSC and 286TSC	9.000	10.500	0.25	4	1/2-13	0.75	1.625	3.00	1.416	1.91	0.375	7.00
324TC and 326TC	11.000	12.500	0.25	4	5/8-11	0.94	2.125	5.00	1.845	3.91	0.500	8.00
324TSC and 326TSC	11.000	12.500	0.25	4	5/8-11	0.94	1.875	3.50	1.591	2.03	0.500	8.00
364TC and 365TC	11.000	12.500	0.25	8	5/8-11	0.94	2.375	5.62	2.021	4.28	0.625	9.00
364TSC and 365TSC	11.000	12.500	0.25	8	5/8-11	0.94	1.875	3.50	1.591	2.03	0.500	9.00
404TC and 405TC	11.000	12.500	0.25	8	5/8-11	0.94	2.875	7.00	2.450	5.65	0.750	10.00
404TSC and 405TSC	11.000	12.500	0.25	8	5/8-11	0.94	2.125	4.00	1.845	2.78	0.500	10.00
444TC and 445TC	14.000	16.000	0.25	8	5/8-11	0.94	3.375	8.25	2.880	6.91	0.875	11.00
444TSC and 445TSC	14.000	16.000	0.25	8	5/8-11	0.94	2.375	4.50	2.021	3.03	0.625	11.00
500 Frame Series	14.500	16.500	0.25	4	5/8-11	0.94	. . .	. . .	. . .	. . .	. . .	12.50

Tolerances (Inches)

AK Dimension, Face Runout, Permissible Eccentricity of Mounting Rabbet

AK Dimension	Tolerance on AK Dimension		Maximum Face Runout	Maximum Permissible Eccentricity of Mounting Rabbet
	Plus	Minus		
Less than 12	0.000	0.003	0.004	0.004
12 and Larger	0.000	0.005	0.007	0.007

Shaft Extension Diameters

Shaft Diameter	Tolerances	
	Plus	Minus
0.2500 to 1.5000, inclusive	0.000	0.0005
Over 1.5000 to 6.500, inclusive	0.000	0.001

Width of Shaft Extension Keyseats

Width of Keyseat	Tolerances	
	Plus	Minus
0.188 to 0.750, inclusive	0.002	0.000
Over 0.750 to 1.500, inclusive	0.003	0.000

Shaft Runout

Shaft Diameter	Maximum Permissible Shaft Runout
0.3750 to 1.625, inclusive	0.002
Over 1.625 to 6.500, inclusive	0.003

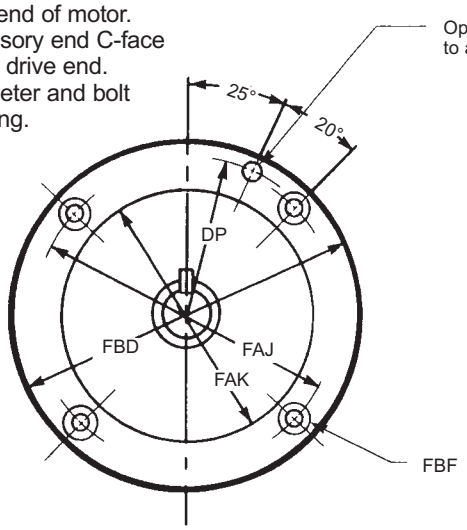
SOURCE: ANSI/NEMA Standards Publication No. MG 1-1987; Part 4 and Part 11.

Dimensions for C-Face AC Brake Motor System (cont.)

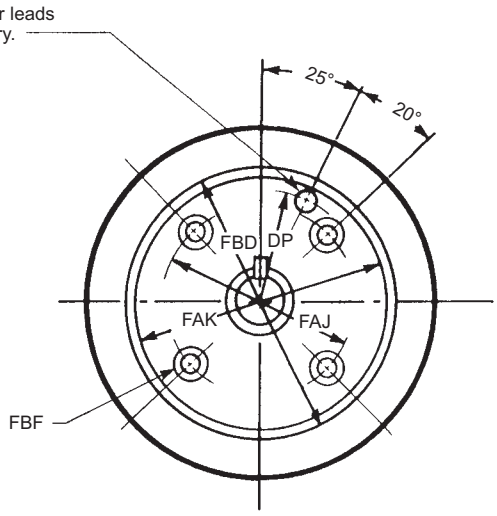
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Accessory End

FC face mounting for accessories, including brakes, on the end opposite the drive end of motor. Some motor accessory end C-face may differ from the drive end. Confirm shaft diameter and bolt circle before ordering.



143TFC to 184TFC Frames, Inclusive



213TFC to 326TFC Frames, Inclusive

Dimensions (Inches)

Frame Designation	FAJ	FAK	FBD Max.	FBF Hole			Hole for Accessory Leads	
				Number	Tap Size	Bolt Penetration Allowance	DP	Diameter
143TFC and 145TFC	5.875	4.500	6.50	4	3/8-16	0.56	2.81	0.41
182TFC and 184TFC	5.875	4.500	6.50	4	3/8-16	0.56	2.81	0.41
213TFC and 215TFC	7.250	8.500	9.00	4	1/2-13	0.75	3.81	0.62
254TFC and 256TFC	7.250	8.500	10.00	4	1/2-13	0.75	3.81	0.62
284TFC and 286TFC	9.000	10.500	11.25	4	1/2-13	0.75	4.50	0.62
324TFC and 326TFC	11.000	12.500	14.00	4	5/8-11	0.94	5.25	0.62

NOTE: Standards have not been developed for the shaft extenison diameter and length, and keyseat dimensions.

Tolerances* (Inches)

FAK Dimension, Face Runout, Permissible Eccentricity of Mounting Rabbet

FAK Dimension	Tolerance on FAK Dimension		Maximum Face Runout	Maximum Permissible Eccentricity of Mounting Rabbet
	Plus	Minus		
Less than 12	0.000	0.003	0.004	0.004
12 and Larger	0.000	0.005	0.007	0.007

* Tolerance requirement on 56,X00 and 87,000 Series Brake kits is .015 T.I.R. (total indicated runout shaft to motor register face).

Shaft Runout

Shaft Diameter	Maximum Permissible Shaft Runout
0.3750 to 1.625, inclusive	0.002
Over 1.625 to 6.500, inclusive	0.003

SOURCE: ANSI/NEMA Standards Publication No. MG 1-1987; Part 4 and Part 11.

Stearns Recommended Minimum Shaft Diameter by Torque

Minimum recommended shaft size considers a keyed C1045 steel shaft under *dynamic* use in a typical spring set brake application.

Torque ft-lb	Minimum Shaft (inches)
0.50	0.250
0.75	0.250
1.5	0.375
3	0.500
6	0.500
10	0.625
15	0.750
25	0.875
35	1.000
50	1.125

Torque ft-lb	Minimum Shaft (inches)
75	1.250
105	1.375
125	1.375
175	1.625
230	1.750
330	2.000
440	2.125
500	2.375
750	2.500
1000	2.750

Torque Nm	Minimum Shaft (mm)
4 Nm	ø10 mm
8 Nm	ø13 mm
16 Nm	ø16 mm
32 Nm	ø20 mm
60 Nm	ø25 mm
80 Nm	ø28 mm
150 Nm	ø34 mm
240 Nm	ø39 mm
400 Nm	ø47 mm

Set and Release Times

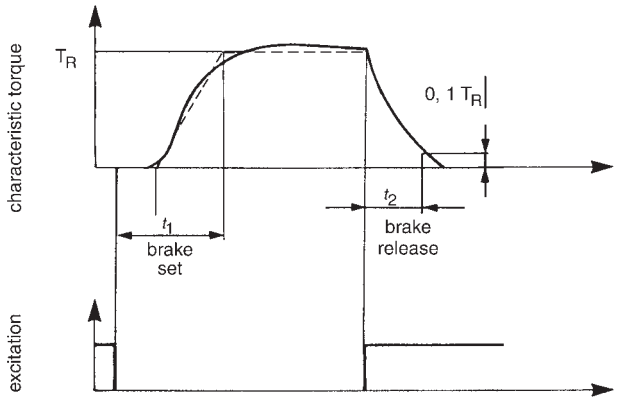
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The models listed below were tested for typical set and release times. Times listed below are defined as follows:

T1 = Total set time to 80% of rated static torque

T2 = Release time, measured as the time from when the power is applied to the brake to the time that the solenoid plunger or armature is fully seated.

NOTE: Times will vary with the motor used, and brakes tested with factory-set air gap. The times shown should be used as a guide only.



SAB T1/T2 Time in Milliseconds

Series	Static Torque lb-ft	Coil Size	T1 AC	T2 AC
56,000	1 1/2 – 25	K4, K4, K4+, M4+	25	14
87,000	10,15, 25,50	5 & 6	42	20
87,000	35,75,105	8	48	20
81,000 82,000	All	9	56	27

Brake and motor are switched separately.
All brakes tested in horizontal position.
Coil is energized for >24 hours before testing.
Ambient temperature 70°F at time of test.

AAB Series 310/311/320/321 Times in Milliseconds

Series	310 DC Side Switching					
Size	**1.79**	**2.0**	**2.87**	**3.35**	**4.25**	**5.0**
T1	3	6	9	14	13	22
T2	20	43	48	110	120	195
Series	**311 DC Side Switching**					
Size	**3.38**	**4.75**	**5.0**			
T1	43	48	96			
T2	12	74	35			
Series	**320 DC Side Switching**					
Size	**1.2**	**1.8**	**2.0**	**2.8**		
T1	14	43	16	27		
T2	24	26	35	34		
Series	**320 Full wave rectifier/AC Side Switching**					
Size	**1.2**	**1.8**	**2.0**	**2.8**		
T1	31	97	52	78		
T2	27	29	40	42		
Series	**321 DC Side Switching**			**321 AC Side Switching**		
Size	**1.2**	**1.8**	**2.8**	**1.2**	**1.8**	**2.8**
T1	13	16	20	45	77	131
T2	18	27	49	16	25	26

AAB Series 333 Times in Milliseconds

Size	Applied Voltage/Type of Switching	T1	T2
72	DC side switching	23	35
	230 Vac/ac side switching/full wave	103	39
	460 Vac/ac side switching/half wave	98	34
90	DC side switching	19	73
	230 Vac/ac side switching/full wave	113	72
	460 Vac/ac side switching/half wave	114	73
	230 Vac connected across motor full wave	357	72
	230 Vac connected across motor /quickset	42	72
112	DC side switching	155	39
	230 Vac/ac side switching/full wave	547	43
	460 Vac/ac side switching/half wave	501	54
132	DC side switching	119	100
	230 Vac/ac side switching/full wave	833	101
	460 Vac/ac side switching/half wave	803	106
145	DC side switching	185	186
	230 Vac/ac side switching/full wave	999	192
	460 Vac/ac side switching/half wave	1007	209
	230 Vac connected across motor full wave	1689	192
	230 Vac connected across motor /quickset	368	192
	460 Vac/ac side switching/half wave/With air gap shim	629	223
170	DC side switching	129	163
	230 Vac/ac side switching/full wave	1130	174
	460 Vac/ac side switching/half wave	1140	175
196	DC side switching	96	263
	230 Vac/ac side switching/full wave	920	264
	460 Vac/ac side switching/half wave	957	274
230	DC side switching	131	264
	230 Vac/ac side switching/full wave	1299	236
	460 Vac/ac side switching/half wave	1303	276
	Tor-Ac 230 Vac/ac side switching/full wave	169	295
	Tor-Ac 230 Vac/ac side switching/full wave/ With air gap shim	122	327
	230 Vac connected across motor quickset/quickrelease/with air gap shim	122	145
278	DC side switching	182	388
	230 Vac/ac side switching/full wave	1807	389
	460 Vac/ac side switching/half wave	1689	366

Appendix 4.4.5.6

System: Apron Hoist Machinery
Component: Reducer
Manufacturer: Cone Drive

Note: Refer to Section 4.4.5.1 for Manufacturer Literature

Appendix 4.4.5.7

System: Apron Hoist Machinery
Component: Deflector Sheave
Manufacturer: McKissick

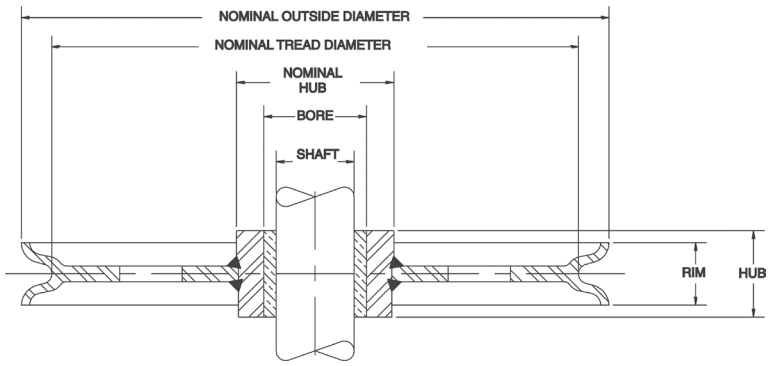
APRON HOIST SHEAVE (CUSTOM)

McKissick® Sheaves Selection Guide

McKissick® sheaves come in a variety of sizes to suit your specific applications. Crosby offers many sheaves as standard and these are shown in the pages that follow.

For applications that require unique specifications, Crosby can make minor modifications to many of the sheaves listed at a reasonable charge. We can also custom design and manufacture sheaves to your exact requirements. Contact Crosby Sales to order McKissick® sheaves and include the stock number and quantity. For help in finding that standard sheave or for help with special requirements or custom designed sheaves, furnish the following important information:

NOTE
Bore in hub should produce a running clearance fit with shaft. This is 0.002" to 0.005" clearance.



DIMENSIONAL INFORMATION

~~Nominal Outside Diameter:~~ Pitch Diameter 6" **Wire Rope Size:** 5/16" **Rim Width:** _____

+ Shaft Size: 1" (nominal) ***Hub Width:** _____

Nominal Tread Diameter (Optional): 5-3/4" (nominal) **Nominal Hub Diameter (Optional):** _____

***Hub width is measured over the cone of the Tapered Bearing Sheaves.**
+ Shaft Size is Bore Size on Plain Bore Sheaves.

BEARING TYPE

☒ **Bronze Bushing** ☐ **++ Roller Bearing** ☐ **Tapered Roller Bearing** ☐ **Finish / Plain Bore**

☐ **Full Complement Cylindrical Roller Bearing** ☐ **Underwater** ☐ **Other**

++ Requires hardened and ground shaft

MATERIAL TYPE

☐ **Roll-Forged™ (Flame hardened 14" and larger)** ☒ **Forged Steel** ☐ **Domed**

☒ **Cast Steel** ☐ **Fabricated** ☐ **Other**

APPLICATION INFORMATION

Line Pull: _____ **Fleet Angle:** 0 **Degree of Wrap:** 180

Line Speed: <50 fpm **Environment:** Outdoor **Groove Angle:** 30 to 35 degrees

SPECIAL REQUIREMENTS

Special Testing: _____

Finish: _____

Third Party Inspection / Approval: _____

In USA: Crosby's Special Engineered Product Group at 1-800-777-1555, fax (918) 834-5035, specials@thecrosbygroup.com
In Canada: Crosby Canada at (905) 451-9261
In Europe: N.V. Crosby Europe at 32 15 757125(26).

McKissick Sheaves

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Appendix 4.4.5.8

Mobilux EP2

Mobil

Mobilux™ EP 0, 1, 2, 3, 004 and 023

Grease

Product Description

Mobilux™ EP 0, 1, 2, 3, 004 and 023 products are a high performance family of five general-purpose industrial greases and two special-duty semi-fluid greases. These lithium hydroxystearate greases are formulated to provide extra protection against wear, rusting and water washout. They are available in NLGI grades ranging from 00 to 3, with base oil viscosities ISO VG 150 and 320.

Mobilux EP 0, 1, 2 and 3 greases are recommended for most types of industrial applications including heavy-duty applications where high unit pressures or shock loads are present. These greases provide excellent protection against rust and corrosion and resist water wash-out which makes them particularly suitable for equipment where moist or wet conditions are common. Mobilux EP 0 and 1 are suitable for centralised systems. Mobilux EP 2 and 3 are general-purpose greases. The recommended operating temperature range is from -20ºC to 130ºC but they may be used at higher temperatures if the lubrication frequency is increased accordingly.

Mobilux EP 004 and Mobilux EP 023 are particularly suitable for the lubrication of enclosed gears and bearings in poorly sealed gear cases they can also be used in many other industrial applications where conventional gear oils cannot be retained in gear cases, chain cases, etc. because of leakage due to worn or missing seals. The recommended operating temperature range is -25 to 120ºC for Mobilux EP 004 and -15 to 120ºC for Mobilux EP 023.

Features and Benefits

Mobilux EP greases have a long history of proven performance and have demonstrated good performance in the areas of corrosion protection, low temperature pumpability and high temperature service life. A Timken OK load of 40 lb illustrates their load carrying and extreme pressure capability.

- Reduced wear under heavy or shock loading and vibration for good equipment reliability and availability
- Protection against rust and corrosion and resistance to water washout for equipment protection and good lubrication even in presence of water
- Extended bearing life potential in wet environments for reduced bearing costs and unanticipated downtime
- Good pumpability in centralised systems (Mobilux EP 0 and 1)
- Effective leakage control (Mobilux EP 004 and Mobilux EP 023)

Applications

- Mobilux EP 0 and EP 1 provide good low temperature pumpability and are suitable for centralised lubrication systems and other applications where low temperature performance is required.
- Mobilux EP 2 is recommended for multipurpose applications in antifriction and plain bearings, bushings and pins under normal operating conditions.
- Mobilux EP 3 is a stiffer NLGI grade 3 grease recommended for applications where maximum protection against penetration of water or solid contaminants is required.
- Mobilux EP 004 and Mobilux EP 023 are particularly suitable for the lubrication of enclosed gears and bearings in poorly sealed gear cases on most underground mining machinery with the exception of electric motor gearings. Mobilux EP 004 and Mobilux EP 023 can also be used in many other industrial applications where conventional gear oils cannot be retained in equipment such as gear cases, chain cases, because of leakage due to worn or missing seals. Mobilux EP 004 passes the SEW 1008 hour gear test requirement DR.EM.203 mod.

Specifications and Approvals

Mobilux EP meets or exceeds the requirements of:	Mobilux EP 0	Mobilux EP 1	Mobilux EP 2	Mobilux EP 3	Mobilux EP 004	Mobilux EP 023
DIN 51825: (2004-06)		KP1K-30	KP2K-30	KP3K-20		
DIN 51826: (2005-01)	GP0G-20				GP00G-20	GP000G-20

Mobilux EP has the following builder approvals	Mobilux EP 0	Mobilux EP 1	Mobilux EP 2	Mobilux EP 3	Mobilux EP 004	Mobilux EP 023
SEW Eurodrive/ PS C Gears					X	

Typical Properties

	Mobilux EP 0	Mobilux EP 1	Mobilux EP 2	Mobilux EP 3	Mobilux EP 004	Mobilux EP 023
NLGI Grade	0	1	2	3	00	000
Thickener Type	Lithium	Lithium	Lithium	Lithium	Lithium	Lithium
Color, Visual	Brown	Brown	Brown	Brown	Brown	Brown
Penetration, Worked, 25ºC, ASTM D 217	370	325	280	235	415	460
Viscosity of Oil, ASTM D 445						
cSt @ 40ºC	160	160	160	160	160	320
Timken OK Load, ASTM D 2509, lb	40	40	40	40	40	40
4-Ball Wear, ASTM D 2266, Scar, mm	0.4	0.4	0.4	0.4	0.5	0.4
4-Ball Weld Load, ASTM D 2596, Kg	250	250	250	250	250	250
Dropping Point, D 2265, C	190	190	190	190		
Rust Protection, ASTM D 6138, Distilled Water	0-0	0-0	0-0	0-0	0-0	0-0

Health and Safety

Based on available information, this product is not expected to produce adverse effects on health when used for the intended application and the recommendations provided in the Material Safety Data Sheet (MSDS) are followed. MSDS's are available upon request through your sales contract office, or via the Internet. This product should not be used for purposes other than its intended use. If disposing of used product, take care to protect the environment.

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9-2015

Exxon Mobil Corporation
22777 Springwoods Village Parkway
Spring TX 77389

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
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Appendix 4.4.5.9

Mobilux SHC634

Mobil SHC Gear Series

Next-generation supreme-performance gear lubricants



Engineered to deliver optimum equipment protection and oil life in the most extreme conditions.

Enhance your productivity with Mobil SHC Gear Series supreme-performance, fully synthetic industrial gear oils — next-generation technology providing excellent protection and oil life in some of the most extreme conditions. This enhanced industrial gear oil formulation features the latest Mobil SHC technology, which offers exceptional oxidation resistance and thermal properties, naturally high viscosity index, and outstanding low-temperature fluidity.

Helps drive productivity with energy efficiency up to 3.6 percent.

Mobil SHC Gear Series' high viscosity index and low traction coefficient combine to provide a significant reduction in energy consumption in many gear drives. Mobil SHC Gear Series exhibited energy savings of up to 3.6 percent versus conventional oils in statistically validated laboratory tests.* This is one more way Mobil SHC Gear Series can help contribute to an increase in your productivity.

Excellent wear protection and resistance to micropitting.

Mobil SHC Gear Series lubricants contain advanced proprietary additive technology designed to provide industrial gearboxes with excellent protection against conventional wear modes, such as scuffing, and a high level of resistance against micropitting fatigue. Additionally, compared with conventional gear oil chemistries, Mobil SHC Gear Series offers the potential for improved lubrication of gearbox rolling-element bearings. Mobil SHC Gear Series products offer excellent rust and corrosion protection, show no tendency to plug fine filters even when wet — and have excellent compatibility with ferrous and nonferrous metals even at elevated temperatures.

High-Performance Benefits

Excellent water-handling properties
Easily separates from water and will not plug filters, potentially improving filter life.

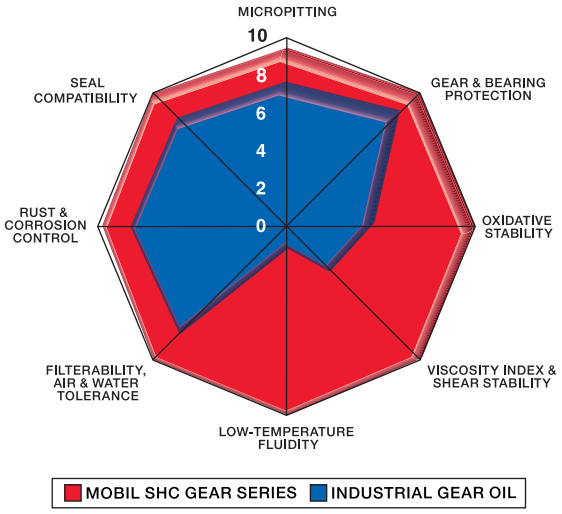
Outstanding seal compatibility
Meets or exceeds stringent Freudenberg seal testing requirements, potentially reducing seal leakage and avoiding related oil consumption. Approved by Siemens for use in Flender gearboxes.

Robust shear stability
Shows excellent resistance to viscosity loss even under the high shear conditions found in severe industrial gearboxes and bearings, ensuring long lubricant life in service.

6x oxidation resistance
Extends oil life up to 6x versus standard mineral gear oil, especially at elevated operating temperatures — extending drain intervals and reducing lubricant costs.

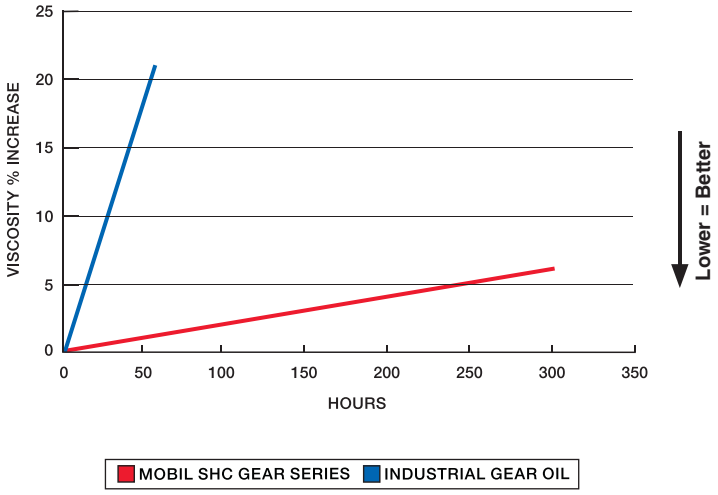
Mobil SHC Gear Series — Performance

Balanced Formulation



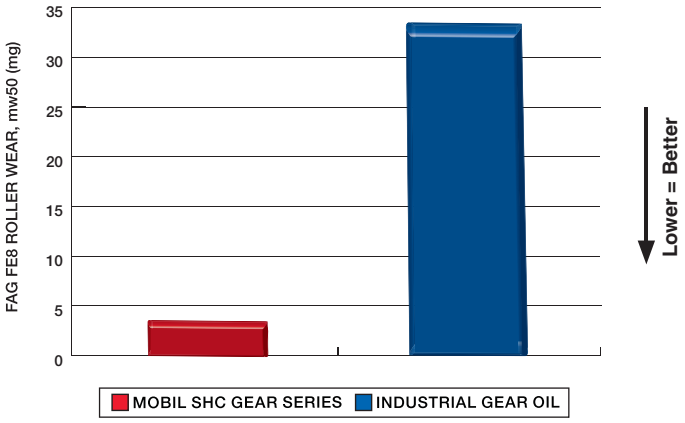
A technical survey of conventional industrial gear oils shows Mobil SHC Gear Series delivers significantly better performance in nearly every dimension.

Thermal and Oxidative Stability



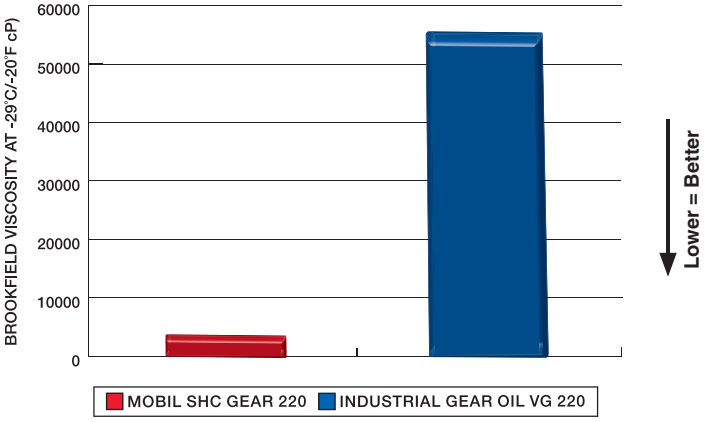
In an ASTM D 5704 mod., L-60-1 test, Mobil SHC Gear Series' viscosity rose only 6 percent during an extended-length 300-hour test compared with conventional industrial gear oil's 21 percent viscosity rise during a standard-length 50-hour test.

Bearing Wear Protection



In a standard FAG FE8 Stage 1 bearing test, Mobil SHC Gear Series protected bearings significantly better than conventional industrial gear oil.

Low-Temperature Fluidity



ASTM D 2983 testing of Brookfield Viscosity shows that Mobil SHC Gear 220 Series offers better low-temperature performance compared with conventional industrial gear oil, providing the opportunity for extended temperature range for start-up and operation.

energy efficiency

*Energy efficiency relates solely to the fluid performance when compared with conventional reference oils of the same viscosity grade in gear applications. The technology used allows up to 3.6% efficiency compared with the reference when tested in a worm gearbox under controlled conditions. Efficiency improvements will vary based on operating conditions and application.

For more information on Mobil SHC Gear Series and other Mobil Industrial lubricants and services, please contact your local company representative, the Mobil technical help line at 1-800-662-4525, or visit www.mobilindustrial.com.

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SYN0757SH

Mobil SHC 600 Series

Supreme Performance Gear and Bearing Oils

Product Description

Mobil SHC 600 Series lubricants are supreme performance gear and bearing oils designed to provide outstanding service in terms of equipment protection, oil life and problem-free operation. They are formulated from synthesised, wax-free hydrocarbon base fluids. The combination of a naturally high viscosity index and a unique, proprietary, additive system enables these products to provide outstanding performance in extreme service applications at high and low temperatures, well beyond the capabilities of mineral oils. 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.

The Mobil SHC 600 Series products have low traction coefficients, 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. It also results in extended parts life and allows for more economical equipment design. The base oils used in the Mobil SHC 600 Series have outstanding response to antioxidant additives resulting in superior resistance to oxidation and sludging, especially at high temperatures. The additive combination used in these oils also provides exceptional resistance to rusting and corrosion, very good antiwear, demulsibility, foam control and air release properties, as well as multimetal compatibility. The Mobil SHC 600 Series oils are also compatible with the same seal and other construction materials used in equipment normally lubricated with mineral oils.

The leading edge technology on which Mobil SHC 600 Series lubricants have always been based has made these the products of choice for operators of a wide range of equipment, worldwide. While initially recognised as a high temperature problem solver, these products are now used in many industrial applications because of the range of benefits they offer.

Features & Benefits

The Mobil SHC brand of lubricants are recognised and appreciated around the world for their innovation and outstanding performance. These molecular designed synthetic products, pioneered by our research scientists, symbolise the continuing commitment to using advanced technology to provide outstanding lubricant products. A key factor in the development of Mobil SHC 600 Series were the close contacts between our scientists and application specialists with key OEMs to ensure that our product offerings will 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 Mobil SHC 600 Series lubricants. Not least among the benefits, shown in work with OEMs, is the potential for significant efficiency improvements in changing from mineral oil. These benefits are particularly evident in equipment which, by design, cannot avoid low overall efficiency, such as high ratio wormgears.

To combat high thermal exposure of the oil, our product formulation scientists chose proprietary base oils for Mobil SHC 600 Series oils because of their exeptional thermal/oxidative resistance potential. Our formulators chose specific additives which would maximize the benefits of the base oils to provide exceptional oil life and deposit control and resistance to thermal/oxidative and chemical degradation, as well as the balance of the performance features. The wax-free nature of the base oil also provides low temperature fluidity

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characteristcs unmatched by mineral products and is a key benefit for remote, low ambient temperature applications. The Mobil SHC 600 Series oils offer the following features and potential benefits:

Features	Advantages and Potential Benefits
Superb high temperature thermal/oxidation resistance	Extends equipment high temperature operating capability
	Long oil life, reduced need and costs for oil change outs
	Minimises sludges and deposits for trouble-free operation and long filter life
High Viscosity Index and absence of wax	Maintains viscosity and film thickness at high temperatures
	Exceptional low temperature performance, including start-up
Low traction coefficient	Reduces overall friction and can increase efficiency in sliding mechanisms such as gearing, with potential for reduced power consumption and lower steady-state operating temperatures.
	Minimises effects of micro slip in rolling contact bearings for longer rolling-element life potential
High load carrying capability	Protects equipment and extends life; minimises unexpected downtime and extends service periods
Balanced additive combination	Provides excellent performance in terms of rust & corrosion prevention, water separability, foam control, air release performance ensuring problem-free operation in a wide range of industrial applications and reduced operating costs

Applications

While Mobil SHC 600 Series are compatible with mineral oil based products, admixture may detract from their performance. Consequently it is recommended that before changing a system to one of the Mobil SHC 600 Series, it should be thoroughly cleaned out and flushed to achieve the maximum performance benefits. The Mobil SHC 600 Series oils are compatible with the following seal materials: fluorocarbon, polyacrylate, polyurethane ether, some silicone, ethylene/acrylic, chlorinated polyethylene, polysulfide, and some nitrile rubbers. There is the potential for substantial variations in the elastomers being used today. For best results, consult your equipment supplier, seal manufacturer, or your local Mobil 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 needed. They are particularly effective in applications where the maintenance costs of component replacement, system cleaning and lubricant changes are high. Specific applications include:

- Filled for life gearboxes, especially high ratio/ low-efficiency worm gears
- Remotely located gearboxes, where oil change-out is difficult
- Low temperature applications, such as ski lifts where seasonal oil changes can be avoided
- Mixer roll bearings and roll neck bearings where high temperatures are encountered
- Plastic calendars
- Severe centrifuge applications, including marine centrifuges
- Railroad A/C Traction Drives
- Mobil SHC 625, 627, 629 and 630 are suitable for Oil Flooded Rotary Screw Compressors compressing natural gas, field gas gathering, CO2 and other process gasses used in the natural gas industry

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Specifications & Approvals

Mobil SHC 600 Series has the following builder approvals	624	625*	626	627	629	630	632	634	636	639
Cone Drive (US)								X		
Boston Gear (US)								X		

** 625 is available only in the USA*

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	32.4	48.0	69.9	99.1	143	216	326	430	664	933
cSt @ 100° C	6.3	7.9	10.9	13.9	18.3	25.2	38.6	48.5	62.8	79.5
Viscosity Index, ASTM D 2270	148	135	146	143	144	152	169	173	165	164
Pour Point, °C, ASTM D 97	-54	-48	-48	-42	-45	-42	-39	-42	-42	-15
Flash Point, °C, ASTM D 92	240	252	236	248	228	235	250	262	236	270
Specific Gravity, ASTM D 4052, 15° C/15° C	0.85	.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, Hours to 2 NN	10,000+	10,000+	10,000+	10,000+	10,000+	10,000+	10,000+	10,000+	10,000+	10,000+
RBOT, ASTM D 2272, min.	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Rust protection, ASTM D665, Sea Water	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Water Seperability, ASTM D 1401, Min. to 3 ml emulsion @ 54° C	10	10	10	-	-	-	-	-	-	-
Water Seperability, ASTM D 1401, Min. to 3 ml emulsion @ 82° C	-	-	-	15	15	15	25	25	30	40
Copper Corrosion, ASTM D130, 24 hrs @ 121° C	1B	1B	1B	1B	1B	1B	1B	1B	1B	1B
Foam Test, ASTM D 892, Seq I,II,III Tendency / Stability, ml/ml										
Seq I	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
Seq II	20/0	0/0	0/0	0/0	0/0	0/0	0/0	20/0	0/0	0/0
Seq III	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
FZG scuffing test, DIN 51534 (mod), A/16.6/90, Failure Stage	10	11	11	13	13	13+	13+	13+	13+	13+

** 625 is available only in the USA*

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Health & Safety

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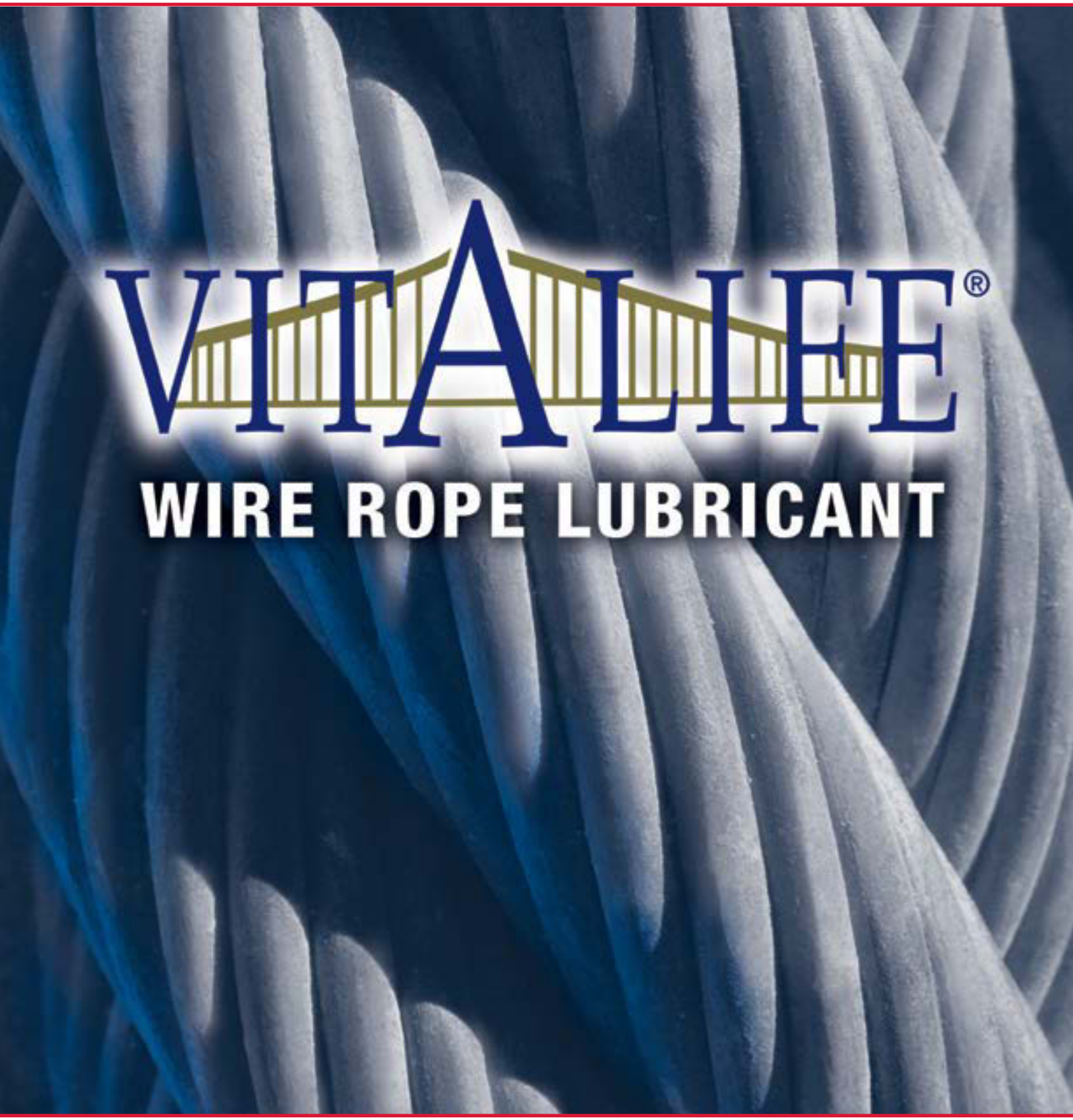
Note for Canadian users: Mobil SHC 600 Series is not controlled under Canadian WHMIS legislation.

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Appendix 4.4.5.10

Crosby Vitalife 400


VITALIFE®
WIRE ROPE LUBRICANT

Vitalife® Wire Rope Lubricants

Wire Rope is a "machine"

A machine is defined as "an apparatus consisting of interrelated parts, both moving and stationary, used in the performance of a function or some kind of work."

Lubricants are the lifeline for all machines, whether simple or complex.

Wire ropes are machines which consist of moving parts (the strands) that, during use, continuously rub against each other, causing friction. Friction causes strand wear and heat. Heat causes oxidation and higher internal core temperatures resulting in accelerated rust and potential premature rope failure.

Like other machine manufacturers, wire rope manufacturers recommend maintenance programs for wire rope which includes inspection and lubrication.

Lubrication is the best way to maintain your wire rope.

The Old Way

Asphaltic, thick, grease-based protective products that only coat the external surface of the ropes are most common. The most important portion of the rope, the "core", does not get lubricated. Expensive application systems are sometimes used in an attempt to "force" these grease-based products into the core of the rope. In addition, grease-based coatings tend to allow airborne dirt particles to adhere to the rope. And finally, thick coatings can also hide dangerous rope damage during visual inspections.

The Vitalife® Way

American Oil and Supply International's (AOSI) theory is "GET INTO THE HEART OF THE ROPE—GET TO THE CORE". After years of applying this message, and through our extensive research into wire rope lubricants, AOSI and The Crosby Group, have made available the finest wire rope lubricants available today

Time-tested Brand

The Vitalife® brand of wire rope lubricants have been utilized since the late 1890's, and is the original standard recognized for it's dependability.

Products of Uncompromising Quality

Quality products begin with quality ingredients, standards, and processes.

Base oil selection

With lubricants, the foundation is the key, and Vitalife® begins with a high quality base oil.

Additives

AOSI uses only top-quality additives (not present in all lubricants) for it's Vitalife® product line. AOSI selects the optimum additive package for the specific Vitalife® product family.

Extensive research and experience allow AOSI manufacturing facilities to provide superior quality control and traceability. They utilize state-of-the-art manufacturing processes to produce lubricants that perform well under a wide variety of environments and applications. AOSI's manufacturing facilities are ISO 9001/2000-certified.

Technical Support Second to None

Crosby provides the highest level of technical support available. Our well trained, and fully equipped Technical Support Team is available to answer any question you have.



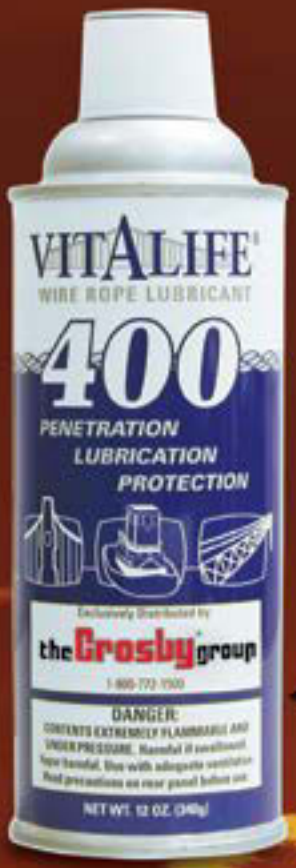
Vitalife® Wire Rope Lubricant Comparison Chart

	Vitalife® 400	Vitalife® BIO-LUBE	Vitalife® 500	Vitalife® 600
Operating temp. Range	-50˚ to 300˚F -46˚ to 148˚C	-32˚ to 550˚F -35˚ to 287˚C	-18˚ to 490˚F -27˚ to 254˚C	-60˚ to 300˚F -51˚ to 148˚C
Typical Use(s)	General purpose; bridges, tramways, cableways, cranes, escalators, derricks, masts, hoist ropes, draglines, conveyors, material handling equipment.	General purpose; environmentally friendly. Same uses as Vitalife 400® product.	Ski-lift ropes; other installations where natural or synthetic rubbers are used in bullrings or sheave liners.	Elevator wire rope cables
Odorless	N	N	N	Y
Color	Clear	Clear	Clear	Clear
Packaging	12 oz. cans 354.9 (ml) cans 5 gallon pails 18.9 (l) pails 55 gallon drums 208.2 (l) drums 275 gallon tote 1,041(l) tote	12 oz. cans 354.9 (ml) cans 5 gallon pails 18.9 (l) pails 55 gallon drums 208.2 (l) drums 275 gallon tote 1,041(l) tote	5 gallon pails 18.9 (l) pails 55 gallon drums 208.2 (l) drums 275 gallon tote 1,041(l) tote	1 Quart 0.9464 (l) 1 Gallon 3.785 (l) 55 gallon drums 208.2 (l) drums 1,041(l) tote 275 gallon tote
Special Order	N	N	Y	Y
MSDS available	Y	Y	Y	Y
Made in USA	Y	Y	Y	Y
Creeps to core of rope	Y	Y	Y	Y
Self healing surface film	Y	Y	Y	Y
Displaces water	Y	Y	Y	Y
Biodegradable	N	Y	N	N
Extends wire rope life	Y	Y	Y	Y
Corrosion protection	Y	Y	Y	Y
Rust protection	Y	Y	Y	Y
Pressure application required	N	N	N	N
Industries served	Surface/underground mining, bridge construction and maintenance, marine, ports, construction, gas petroleum	Surface/underground mining, bridge construction and maintenance, marine, ports, construction, gas petroleum	Ski lift industry, tramway ropes	Elevator maintenance companies, both major and independent

VITALIFE® 400

WIRE ROPE LUBRICANT

Premier Wire Rope Lubricant in the Industry.



Penetrates to the core of the wire

Vitalife® 400 and BIO-LUBE pro

- Inner strand preservation and lubricity.
- Allows for visual inspection of rope.
- Reduces the friction between the strands of the wire rope.
- Extends rope life.

DIAMETER OF WIRE ROPE	Vitalife® 400 or Vitalife® BIO-LUBE (PER 1.000 FT.) (PER 305 m)
1/2 (in) 12.7 (mm)	0.15 Gallon 0.57 (l)
5/8 (in) 15.87 (mm)	0.20 Gallon 0.75 (l)
3/4 (in) 19.05 (mm)	0.30 Gallon 1.14 (l)
7/8 (in) 22.22 (mm)	0.40 Gallon 1.51 (l)
1 (in) 25.4 (mm)	0.45 Gallon 1.70 (l)

Perfect for applications such as bric

NEW

Vitalife® Spray Applicators

The Vitalife® spray applicator is designed and built to make application of Vitalife® products easier and more efficient. The Vitalife® penetrating lubricant is perfect for all wire rope applications, including:

- Wire ropes on drums
- Running ropes
- Slings
- Boom pendant lines
- Loose rigging gear

VITALIFE® BIO-LUBE

WIRE ROPE LUBRICANT

Environmentally Friendly

rope and lubricates every strand.

ducts provide these benefits:

- Adheres to surface of strands forming an outer film, providing excellent corrosive protection.
- Non-tacky (will not attract dust)
- Available in 12 oz. (354.9 ml) spray cans, 5 gallon (18.9 liters) pails and 55 gallon (208.2 liters) drums.



- Non-Toxic; produced from the highest quality biodegradable base fluids.

DIAMETER OF WIRE ROPE	Vitalife® 400 or Vitalife® BIO-LUBE (PER 1,000 FT.) (PER 305 m)
1-1/8 (in) 28.5 (mm)	0.55 Gallon 2.082 (l)
1-1/4 (in) 31.75 (mm)	0.60 Gallon 2.27 (l)
1-3/8 (in) 34.9 (mm)	0.70 Gallon 2.65 (l)
1-1/2 (in) 38.1 (mm)	0.75 Gallon 2.83 (l)
2 (in) 50.8 (mm)	0.90 Gallon 3.40 (l)

dges, cranes, draglines and mining.

Applicator Features

- Vitalife® spray applicator is designed and manufactured to work in the rugged field conditions of the construction industry.
- All applicator seals are specially designed to work with Vitalife® 400 and BIO-LUBE products.
- Each applicator comes complete with various spray nozzles designed for specific applications.



VSP Applicator Available

Backpack Model
4 gallon/15 Liter

Performance to the Extreme
Longer Life. Better Protection.

Unlike most lubricants that stay on the external portion of the wire rope and are greasy, Vitalife® penetrates to the core of the wire rope.

- Provides inner strand preservation to extend rope life
- Allows for visual inspection of rope, reducing down time
- Won't harm rubber, neoprene sheave liners or bull rings
- Non-staining formula adheres to surface without drop off
- Sizes available: Pail: (5 gallon/18.9 liters)
  Drum: (55 gallon/208 liters)
  Tote: (275 gallon/1041 liters)



Developed exclusively for ski lifts and tramways

VITALIFE® 500
WIRE ROPE LUBRICANT

VITALIFE® 600
ELEVATOR CABLE LUBRICANT

Developed Exclusively for Re-lubrication and Maintenance of Elevator Cables

Protects Against Rust, Corrosion and Oxidation

Vitalife® 600 is a light bodied elevator cable lubricant designed to prevent slippage. It creates a self-healing surface film and displaces water, bringing it to the surface where it is detected and able to be removed.



Product Benefits

- Light bodied, colorless and odorless
- Formulated with "slippage" in mind
  - Vitalife® 600 aids the stopping action of an elevator car by breaking the surface lubrication as the brakes are applied.
  - When the car is in motion, the polarity of the lubricant promotes a self healing effect to the surface film of the lubricant.
- Easily penetrates to the core of the cable
- Offers maximum corrosion and oxidation protection

Product Applications

- Use on vertical and horizontal running wire ropes
- Excellent for installations where the control of slippage and or moisture detection is important
- May be applied to wire rope by brush, swab, drip, spray, wick applicators, automatic spray or drip systems and pressure lubricators

Extend Wire Rope Service Life

Available for a wide variety of applications

Vitalife® products are provided in a variety of container sizes. From a 12 oz. (354.9 ml.) spray can to a 275 gallon (1,041 liter) tote, there is a container suitable for your particular application.

Typical applications

- Raising and lowering the boom on power shovels
- Cranes, Port Lifting Equipment, Drag Lines, Derricks
- Tramways
- Coal Mines
- Ski Lifts
- Suspension bridges, guy wires on Antennas and Standing Ropes
- Elevators (mining and buildings)
- Rudders on boats, Fishing Leaders
- Aircraft cables
- Barges, suspension barges
- Tow Trucks
- Factories, Steel Mills, Industrial Plants, Maintenance Facilities
- Automotive, Heavy Duty and Industrial Equipment Builders (OEM manufacturing facilities)

General Vitalife® Benefits

The Vitalife® family of wire rope lubricant products provide many important features required to extend wire rope life (controlled tests & historical records prove the extended life).

- Penetrates to the core
- Dry to the touch; does not attract dust and airborne particles
- Allows easy visual inspection of the rope
- Cleans the wire rope during application
- Oxidation control
- Creeps and wets to the core
- Coats each individual strand
- Water displacement properties
- Rust and corrosion protection
- High polarity of product
- Self-healing
- No expensive, cumbersome applicators are required to lubricate all the way to the core of the rope.







The History of Vitalife® and American Oil Since 1895®

The Vitalife® product has a storied past that dates back to a historic suspension bridge: The Brooklyn Bridge (New York City). J.A. Roebling Company of Trenton, NJ supplied all the wire rope that was used to build the Brooklyn Bridge in the late 1890's. AOSI and Roebling co-developed a lubricant designed to protect the cables of the bridge, and because of this relationship, a new company was born: The Wire Rope Lubricating Company of America. In the 1940's American Oil and Supply acquired The Wire Rope Lubricating Company of America, and the Vitalife® brand of wire rope lubricants. Since then AOSI has taken the original technology and application know how and has improved on the technology, developing the most technically sophisticated wire rope lubricants in the world.

In 2005, Crosby entered into an agreement with AOSI to promote the Vitalife® product lines through our extensive distribution network. With Crosby and AOSI teamed up to provide Vitalife®, it's just another reason to say . . . . .
"When buying Crosby, you're buying more than product, you're buying Quality!"

the Crosby® group

Crosby USA P.O. Box 3128, Tulsa, Oklahoma 74101-3128 U.S.A.
P: (918) 834-4611 F: (918) 832-0940, Email: crosbygroup@thecrosbygroup.com

Crosby Canada 145 Heart Lake Road, Brampton, Ontario, Canada L6W 3K3
P: (905) 451-9261 F: (877) 260-5106, Email: sales@crosby.ca

Crosby Europe Industriepark Zone B n°26, 2220 Heist-op-den-Berg, Belgium
P: (+32) (0)15 75 71 25 F: (+32) (0)15 75 37 64, Email: sales@crosbyeurope.com

www.thecrosbygroup.com

APPENDIX 4.5—Electrical

Appendix 4.5.1—Electrical Maintenance Check List

FRENCHBORO TRANSFER BRIDGE INSPECTION AND MAINTENANCE CHECKLIST (ELECTRICAL)

By: _____ Date: _____

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

CAUTION: Electrical components may be live and can cause serious injuries or death. Electrical safety equipment is highly recommended to individuals performing work on open cabinets or enclosures.

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

After every maintenance period:

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

NOTES:

FRENCHBORO TRANSFER BRIDGE MAINTENANCE CHECKLIST (ELECTRICAL)	1
	MONTH

ELECTRICAL INSPECTION AND MAINTENANCE	Performed By	Date
Inspect and exercise standby generator operation		
Inspect and test automatic/remote transfer switches		
Inspect flexible cables, conduit and cabinets for damage, corrosion and moisture build-up		
Inspect exterior lighting & photocells		
Inspect and test radio control system		
Inspect and test control switches		
Inspect and test pawl indication lights		
Exercise all limit switches		
GENERATOR INSPECTION AND MAINTENANCE	Performed By	Date
Inspect for leaking fluids		
Check coolant heater		
Check coolant level		
Check oil level		
Check fuel level		

FRENCHBORO TRANSFER BRIDGE MAINTENANCE CHECKLIST (ELECTRICAL)	3
	MONTH

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

ELECTRICAL INSPECTION AND MAINTENANCE	Performed By	Date
Inspect and test control equipment		
Inspect and test marine horn and radio		
Inspect panel heating		
GENERATOR MAINTENANCE	Performed By	Date
Check/clean air cleaner		
Check battery charger		
Drain fuel filter		
Drain water from fuel tank		
Trim surrounding vegetation		

FRENCHBORO TRANSFER BRIDGE MAINTENANCE CHECKLIST (ELECTRICAL)	6
	MONTH

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

ELECTRICAL INSPECTION AND MAINTENANCE	Performed By	Date
Inspect and test bridge and apron hoist motors		
Inspect and test brakes and pawl operation		
Inspect and clean contactors and overload relays		
Inspect and clean control relays and timers		
Inspect and test limit switches and actuators		
Inspect operator control devices		
Test limit switch and lighting bypass switches		
Inspect all enclosure door and cover latches for tightness		
Inspect conduit and wiring systems for corrosion, evidence of water entry and terminal tightness		
Inspect GFI receptacles		
GENERATOR MAINTENANCE	Performed By	Date
Check coolant concentration		
Check drive belt tension		
Drain exhaust condensate		
Check starting batteries		
Check and clean louvers		

FRENCHBORO TRANSFER BRIDGE MAINTENANCE CHECKLIST (ELECTRICAL)	12
	MONTH

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

ELECTRICAL INSPECTION AND MAINTENANCE	Performed By	Date
Molded case circuit breakers – trip test (Biennially)		
Inspect breaker panels for water entry and hand actuate all breakers		
Inspect transformers for corrosion and evidence of overheating		
Inspect fuses for blown units and wiring termination tightness		
Inspect motor disconnect switches for water entry, door clasp tightness and exercise from external handle		
Inspect for corrosion, water entry and door clasp tightness		
Inspect surge arrestors for termination tightness		

GENERATOR MAINTENANCE	Performed By	Date
Check battery charger		
Change oil and filter		
Clean crankcase breather		
Change air cleaner element		
Check radiator hoses		
Change fuel filter		
Clean cooling system (Biennially)		

Appendix 4.5.2—Electrical Spare Parts List

ELECTRICAL SPARE PARTS LIST

Item	QTY	Manufacturer	Catalog #	Description	Location
SERVICE BREAKER	1	ALLEN-BRADLEY	140G-I3C3-D10	3PH, 240V, 100AT BREAKER – SERVICE MAIN BREAKER	LEFT CONTROL PANEL
SURGE PROTECTIVE DEVICE	0	EATON	SPV	SEE UNIT	LEFT CONTROL PANEL
POWER DISTRIBUTION BLOCK	1	ALLEN-BRADLEY	1492-PD3263	3P, 350A POWER DISTRUBUTION BLOCK	LEFT/RIGHT CONTROL PANEL
ROTOPHASE SUPPLY CIRCUIT BREAKER	1	ALLEN-BRADLEY	140G-G2C3-C80	1PH, 240V, 60AT BREAKER – ROTOPHASE SUPPLY BREAKER	RIGHT CONTROL PANEL
ROTOPHASE CONTACTOR	1	ALLEN-BRADLEY	300-BOD-930	2 POLE, NEMA SIZE 1, 120V COIL NON-REVERSING CONTACTOR WITH 3NO/NC AUXILIARY CONTACTS – ROTOPHASE CONTACTOR	RIGHT CONTROL PANEL
ROTOPHASE FUSE HOLDER	0	ALLEN-BRADLEY	1492FB1J60-L	2 POLE, 60A, 600V MAX FUSE HOLDER – ROTOPHASE CONVERTER	RIGHT CONTROL PANEL
WELDER CIRCUIT BREAKER	0	ALLEN-BRADLEY	140G-G2C3-C60	3PH, 240V, 60AT BREAKER – WELDER BREAKER	RIGHT CONTROL PANEL

ELECTRICAL SPARE PARTS LIST

Item	QTY	Manufacturer	Catalog #	Description	Location
UTILITY HYDRAULIC PUMP CIRCUIT BREAKER	0	ALLEN-BRADLEY	140U-D6D2	2P, 240V, 30A FRAME, ADJUSTABLE CIRCUIT BREAKER – UTILITY HYDRAULIC PUMP BREAKER	LEFT CONTROL PANEL
LIGHTING RELAY	1	SQUARE D	8903LX020 SER. B 1431	3P, 277V, 20A LIGHTING CONTACTOR – MACHINERY LIGHTING	RIGHT CONTROL PANEL
APRON RAISE/APRON LOWER REVERSING CONTACTOR W/ OVERLOAD RELAY	1	ALLEN-BRADLEY	305-BOD-EEE (NEMA SIZE 1 OVERLOAD)	3 POLE, NEMA SIZE 1, 120V COIL REVERSING CONTACTOR WITH 3NO/NC AUXILIARY CONTACTS AND OVERLOAD – APRON LOWER/RAISE & OVERLOAD	RIGHT CONTROL PANEL
APRON MOTOR CIRCUIT PROTECTOR	1	ALLEN-BRADLEY	140M-F8N-C32	3 POLE, 45A FRAME, 32A MAX TRIP, HIGH BREAK, FIXED MAG ONLY MOTOR CIRCUIT PROTECTOR – APRON MOTOR	RIGHT CONTROL PANEL
RAMP RAISE/APRON LOWER REVERSING CONTACTOR W/ OVERLOAD RELAY	1	ALLEN-BRADLEY	305-COD-EEE (NEMA SIZE 2 OVERLOAD)	3 POLE, NEMA SIZE 2, 120V COIL REVERSING CONTACTOR WITH 3NO/NC AUXILIARY CONTACTS AND OVERLOAD – RAMP LOWER/RAISE & OVERLOAD	RIGHT CONTROL PANEL

ELECTRICAL SPARE PARTS LIST

Item	QTY	Manufacturer	Catalog #	Description	Location
RAMP MOTOR CIRCUIT PROTECTOR	1	ALLEN-BRADLEY	140M-F8N-C45	3 POLE, 45A FRAME, 45A MAX TRIP, HIGH BREAK, FIXED MAG ONLY MOTOR CIRCUIT PROTECTOR – RAMP MOTOR	RIGHT CONTROL PANEL
ENCLOSURE HEATER	1	HOFFMAN	D-AH8001B	120V, 800W ENCLOSURE HEATER	RIGHT CONTROL PANEL
2CR-TD TIME DELAY RELAY	1	ALLEN-BRADLEY	CF 22E W/ ETB30 TIME DELAY MODULE	120VAC RELAY WITH TIME DELAY – ROTOPHASE CONVERTER OFF TIME DELAY RELAY	RIGHT CONTROL PANEL
PAWL SOLENOID CONTACTOR	1	ALLEN-BRADLEY	CF 31E	12VAC COIL CONTACTOR – PAWL SOLENOID CONTACTOR	RIGHT CONTROL PANEL
RSO-1	1	TROMBETTA TYMPANIUM	S500-A300	120VAC TO 108VDC SOLENOID POWER CONDITIONER– PAWL SOLENOID	RIGHT CONTROL PANEL
RSO-2	1	TROMBETTA TYMPANIUM	S500-A300	120VAC TO 108VDC SOLENOID POWER CONDITIONER– PAWL SOLENOID	RIGHT CONTROL PANEL
OPERATOR CONTROL SELECTOR SWITCH	1	ALLEN-BRADLEY	800H-HR2A	2 POS, 1P MAINTAINED SELECTOR SWITCH – OPERATOR CONTROL SELECTOR SWITCH	CONTROL STATION

ELECTRICAL SPARE PARTS LIST

Item	QTY	Manufacturer	Catalog #	Description	Location
LIGHTING CONTROL SELECTOR SWITCH	0	ALLEN-BRADLEY	800H-HR2A	2 POS, MAINTAINED SELECTOR SWITCH – OPERATOR CONTROL SELECTOR SWITCH	CONTROL STATION
EMERGENCY STOP	1	ALLEN-BRADLEY	800T-TFXT6D2	MUSHROOM HEAD EMERGENCY STOP PUSHBUTTON WITH 1 N.C. CONTACT -- EMERGENCY STOP	CONTROL STATION
LOCAL ROTOPHASE CONVERTER RUNNING PILOT LIGHT	1	ALLEN-BRADLEY	800T-QH2A	120VAC, AMBER PILOT LIGHT – ROTOPHASE CONVERTER “RUNNING” PILOT LIGHT	CONTROL STATION
LOCAL ROTOPHASE CONVERTER CONTROL START	1	ALLEN-BRADLEY	800H-R2A	2P, BLACK, BOOTED, MOMENTARY PUSHBUTTON – ROTOPHASE CONVERTER START	CONTROL STATION
LOCAL ROTOPHASE CONVERTER CONTROL STOP	1	ALLEN-BRADLEY	800H-R6A	2P, RED, BOOTED, MOMENTARY PUSHBUTTON – ROTOPHASE CONVERTER START	CONTROL STATION
BRIDGE RAMP CONTROL RAISE	1	ALLEN-BRADLEY	800H-R2A	2P, BLACK, BOOTED, MOMENTARY PUSHBUTTON – BRIDGE RAMP CONTROL RAISE	CONTROL STATION

ELECTRICAL SPARE PARTS LIST

Item	QTY	Manufacturer	Catalog #	Description	Location
BRIDGE RAMP CONTROL LOWER	0	ALLEN-BRADLEY	800H-R2A	2P, BLACK, BOOTED, MOMENTARY PUSHBUTTON – BRIDGE RAMP CONTROL RAISE	CONTROL STATION
APRON CONTROL RAISE	0	ALLEN-BRADLEY	800H-R2A	2P, BLACK, BOOTED, MOMENTARY PUSHBUTTON – BRIDGE RAMP CONTROL RAISE	CONTROL STATION
APRON CONTROL LOWER	0	ALLEN-BRADLEY	800H-R2A	2P, BLACK, BOOTED, MOMENTARY PUSHBUTTON – BRIDGE RAMP CONTROL RAISE	CONTROL STATION
BRIDGE LIMIT SWITCH BYPASS	1	ALLEN-BRADLEY	800H-JR2A	2P, 3 POS, MAINTAINED SELECTOR SWITCH – BRIDGE LIMIT SWITCH BYPASS	CONTROL STATION
APRON LIMIT SWITCH BYPASS	0	ALLEN-BRADLEY	800H-JR2A	2P, 3 POS, MAINTAINED SELECTOR SWITCH – APRON LIMIT SWITCH BYPASS	CONTROL STATION
CB7-LD	0	ALLEN-BRADLEY	1489-M1C200	1P, 20A, 277V, 10kAIC, UNKNOWN CIRCUIT BREAKER	LEFT CONTROL PANEL
CB2-LD	0	ALLEN-BRADLEY	1489-M1C200	1P, 20A, 277V, 10kAIC, UNKNOWN CIRCUIT BREAKER	LEFT CONTROL PANEL

ELECTRICAL SPARE PARTS LIST

Item	QTY	Manufacturer	Catalog #	Description	Location
CB3-LD	0	ALLEN-BRADLEY	1489-M1C200	1P, 20A, 277V, 10kAIC, UNKNOWN CIRCUIT BREAKER	LEFT CONTROL PANEL
CB4-LD	0	ALLEN-BRADLEY	1489-M1C200	1P, 20A, 277V, 10kAIC, PAWL SOLENOID CIRCUIT BREAKER	LEFT CONTROL PANEL
CB5-LD	0	ALLEN-BRADLEY	1489-M1C200	1P, 20A, 277V, 10kAIC, UNKNOWN CIRCUIT BREAKER	LEFT CONTROL PANEL
CB6-LD	0	ALLEN-BRADLEY	1489-M1C200	1P, 20A, 277V, 10kAIC, FLOODLIGHT CIRCUIT BREAKER	LEFT CONTROL PANEL
CB7-L1	0	ALLEN-BRADLEY	1489-M1C200	1P, 20A, 277V, 10kAIC, RIGHT CONTROL PANEL GFI OUTLET CIRCUIT BREAKER	LEFT CONTROL PANEL
CB (8)	0	ALLEN-BRADLEY	1489-M1C200	1P, 20A, 277V, 10kAIC, SPARE CIRCUIT BREAKER	LEFT CONTROL PANEL
CB (9)	0	ALLEN-BRADLEY	1489-M1C200	1P, 20A, 277V, 10kAIC, SPARE CIRCUIT BREAKER	LEFT CONTROL PANEL
CB (10)	0	ALLEN-BRADLEY	1489-M1C200	1P, 20A, 277V, 10kAIC, SPARE CIRCUIT BREAKER	LEFT CONTROL PANEL
CB (11)	0	ALLEN-BRADLEY	1489-M1C200	1P, 20A, 277V, 10kAIC, SPARE CIRCUIT BREAKER	LEFT CONTROL PANEL
CB (12)	0	ALLEN-BRADLEY	1489-M1C200	1P, 20A, 277V, 10kAIC, SPARE CIRCUIT BREAKER	LEFT CONTROL PANEL

ELECTRICAL SPARE PARTS LIST

Item	QTY	Manufacturer	Catalog #	Description	Location
CB (13,14)	1	ALLEN-BRADLEY	1489-M2C150	2P, 15A, 277V, 10KAIC, RATCHET BAR SOLENOID CIRCUIT BREAKER	LEFT CONTROL PANEL
RADIO CONTROL RECEIVER	0	MAGNETEK	MODEL FLEX-6EX SER#44792	RADIO CONTROL RECEIVER	ON CONTROL PANEL
ROTARY PHASE CONVERTER	0	PHASEMASTER	MA1B-254T-300-A	1PH 230V INPUT, 3PH 230V OUTPUT, 60Hz ROTARY PHASE CONVERTER	BEHIND CONTROL PANEL
ROTARY PHASE CONVERTER DISCONNECT SWITCH	0	EATON	(SEE UNIT)	60A, 600V, 60HZ HEAVY DUTY SAFETY SWITCH – ROTARY PHASE CONVERTER	BEHIND CONTROL PANEL
PAWL SOLENOID	1	TROMBETTA	(SEE UNIT)	108VDC SOLENOID – PAWL SOLENOID	PAWL RATCHET BAR HOUSINGS
PAWL MICRO SWITCH	1	HONEYWELL	MD3211Q	120V MICRO SWITCH WITH ROLLER PLUNGER	PAWL RATCHET BAR HOUSINGS
RAMP HOIST MOTOR	0	REULAND	SER#898295A-1 PROD#0050F-1BAB-///2	5HP, 230V, 900RPM NEMA DESIGN B MOTOR – RAMP HOIST	ON MACHINERY PLATFORM
RAMP HOIST BRAKE	0	REULAND	H05-0407A-1	230V, 0.8A, 35 LB-FT MOTOR DISC BRAKE – RAMP HOIST MOTOR BRAKE	MOUNTED ON RAMP HOIST MOTOR
RAMP HOIST DISCONNECT	0	SEE UNIT	SEE UNIT	SEE UNIT	NEXT TO MOTOR ON MACHINERY PLATFORM

ELECTRICAL SPARE PARTS LIST

Item	QTY	Manufacturer	Catalog #	Description	Location
RAMP HOIST LIMIT SWITCH	0	FURNAS	54BB23EE	18 TO 1 RATIO, 2 SPDT SWITCHES, ROTARY CAM LIMIT SWITCH – RAMP HOIST	ON MACHINERY PLATFORM
APRON MOTOR	0	BALDOR	SPEC. 35L615T098H2	3HP, 230V, 1750RPM NEMA DESIGN A MOTOR – APRON WINCH MOTOR	ON RAMP IN HATCH
APRON MOTOR BRAKE	0	STEARNS	105613200BQF REV. B SER. NO. 04791H001-00001-0307	230V, 0.2A, 10 LB-FT MOTOR DISC BRAKE – APRON WINCH MOTOR BRAKE	MOUNTED ON APRON WINCH MOTOR
APRON MOTOR DISCONNECT	0	SEE UNIT	SEE UNIT	SEE UNIT	NEAR APRON MOTOR ON RAMP
APRON WINCH LIMIT SWITCH	0	FURNAS	(SEE UNIT)	(SEE UNIT)	APRON WINCH MOTOR HATCH
STANDBY GENERATOR	0	KUBOTA	GV-3240-60-B	24kVA, 19.2kW, 3PH, 240V GENERATOR – STANDBY GENERATOR	APPROACH IN TRAILER
RED/GREEN INDICATIONS	1 EA	SEE UNIT	SEE UNIT	SEE UNIT	SOUTH TOWER
TRAIL CABLE (BASED ON VINALHAVEN)	1	CAROL	3/8 TYPE SOOW	RAMP HOIST MOTOR	
TRAIL CABLE (BASED ON VINALHAVEN)	1	CAROL	26/10 TYPE SOOW	HOIST BRAKE	
TRAIL CABLE (BASED ON VINALHAVEN)	1	CAROL	3/3 TYPE SOOW	SHIP POWER	

ELECTRICAL SPARE PARTS LIST

Item	QTY	Manufacturer	Catalog #	Description	Location
TRAIL CABLE (BASED ON VINALHAVEN)	1	CAROL	8/10 TYPE SOOW	PLATFORM LIGHTING	
TRAIL CABLE (BASED ON VINALHAVEN)	1	CAROL	20/12 TYPE SOOW	RAMP/APRON CONTROL	

Appendix 4.5.3—Electrical Equipment Vendor List

ELECTRICAL EQUIPMENT VENDOR LIST

Component *(See Electrical Spare Parts List)*	**Manufacturer**	**Vendor**
	Pentair (Hoffman) Hoffman New England District Sales Office 321 Main Street Farmington, CT 06032 860-678-4464 www.hoffmanonline.com dan.riccio@pentair.com	
	Allen Bradley Rockwell Automation 700 Lanidex Plaza Parsippany, NJ 07054 973-526-3901 www.rockwellautomation.com	Horizon Solutions LLC 293 Target Industrial Circle Bangor, ME 04401 207-942-7357
	Reuland Electric 4500 East Grand River Avenue Howell, MI 48843-8516 888-540-7350 www.reuland.com parts@reuland.com	Rodgers Power Transmission Sales PO Box 425 Wilmont, NH 03287-0425 603-526-2209
	Square D Schneider Electric 800 Federal St, Boston ONE Campus Andover, MA 01810 978-794-0800 www.schneider-electric.com	Grainger 425 Warren Ave Portland, ME 04103-1287 207-797-7693
	Mersen 374 Merrimac Street Newburyport, MA 01950 978-462-6662	

ELECTRICAL EQUIPMENT VENDOR LIST

Component *(See Electrical Spare Parts List)*	**Manufacturer**	**Vendor**
	Rexnord (Stearns) Rexnord Corporation Stearns Division 5150 S. Internation Dr. Cudahy, WI 53110 414-272-1100 www.rexnord.com	Motion Industries 437 Sennebec Road Union, ME 04862 207-785-4666
	Cutler-Hammer-Eaton Corp. Eaton Center 111 Superior Avenue Cleveland, OH 44114 216-523-5000	
	Magnetek Magnetek Enrange 70 Abele Road, Suite 1201 Bridgeville, PA 15017 sales@magnetek.com	
	General Cable (Carol Cable) 4 Tesseneer Dr Highland Heights, KY 41076 859-572-8000 www.generalcable.com	
	Hubbell (Furnas) 40 Waterview Drive Shelton, CT 06848-1000 475-882-4000 www.hubbell.com	CED Gilman Electric Supply 323 Bath Road Brunswick, ME 04011 207-729-4155

ELECTRICAL EQUIPMENT VENDOR LIST

Component *(See Electrical Spare Parts List)*	**Manufacturer**	**Vendor**
	Kay Industries (Phasemaster) 604 N. Hill St. South Bend, IN 46617 800-348-5257 www.kayind.com	
	Trombetta-Tympanium 8111 North 87th Street Milwaukee WI, 53224 USA www.trombetta.com	

Appendix 4.5.4—Electrical Manufacturer's Maintenance Manuals

Installation instruction for 140G-G, 140MG-G
Istruzioni di installazione
Installationsanleitung
Instructions pour l'installation
Instrucciones de instalación

Installation - Installazione - Instalación
Instalação - 取付け方法 - 安装

WARNING: To prevent electrical shock, disconnect from power source before installing or servicing. Install in suitable enclosure. Keep free from contaminants. (Follow NFPA70E requirements).

AVVERTENZA: Per prevenire infortuni, togliere tensione prima dell'installazione o manutenzione. Installare in custodia idonea. Tenere lontano da contaminanti. (Seguire i requisiti NFPA70E).

WARNUNG: Vor Installations- oder Servicearbeiten Stromversorgung zur Vermeidung von elektrischen Unfällen trennen. Die Geräte müssen in einem passenden Gehäuse eingebaut und gegen Verschmutzung geschützt werden. (Befolgen Sie die Anforderungen nach NFPA70E).

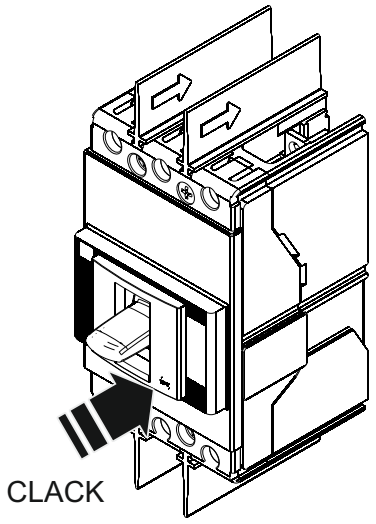
AVERTISSEMENT: Avant le montage et la mise en service, couper l'alimentation secteur pour éviter toute décharge. Prévoir une mise en coffret ou armoire appropriée. Protéger le produit contre les environnements agressifs. (Vous devez respecter la norme NFPA70E).

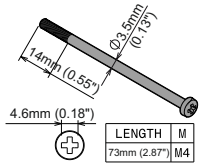
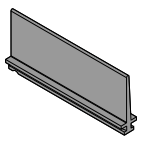
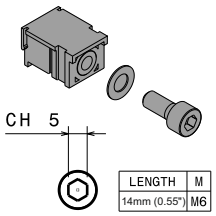
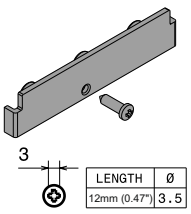
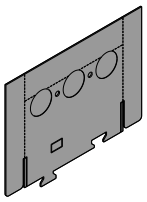
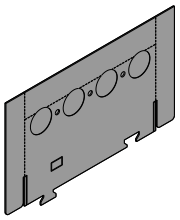
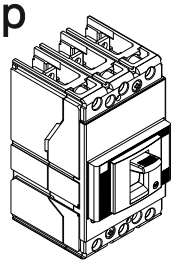
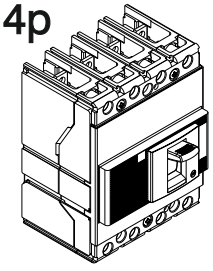
ADVERTENCIA: Desconéctese de la corriente eléctrica, antes de la instalación o del servicio, a fin de impedir sacudidas eléctricas. Instálelo en una caja apropiada. Manténgalo libre de contaminantes. (Cumpla con los requisitos NFPA70E).

ATENÇÃO: Para evitar choques, desconectar da corrente elétrica antes de fazer a instalação ou a manutenção. Instalar em caixa apropriada. Manter livre de contaminantes. (Cumpra as exigências da norma NFPA70E).

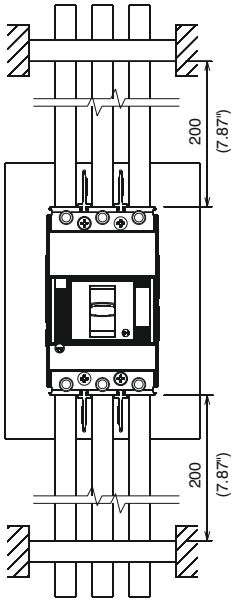
警告:感電事故防止のため、取付けまたは修理の際は電源から取り外してください。適切なケース内に取付けてください。また.汚染物質がないことを確認してください。(NFPA70Eの要件に従ってください)

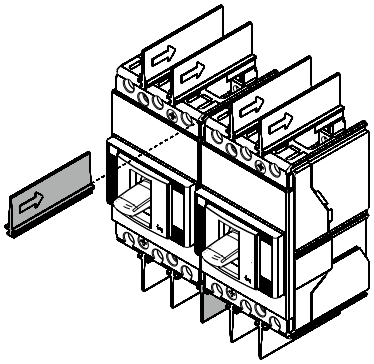
警告:为了防止触电，在安装或维修之前必须先切断电源。安装在合适的设备箱内。防止接触污染物。(符合NFPA70E要求)



						
3p 	x2	x4	x6	x2	x2	—
4p 	x3	x6	x8	x2	—	x2

1 Maximum reccomanded support distance





2

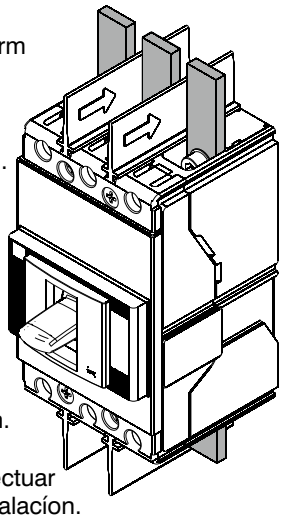
Use cable or insulated busbars/ or perform specific type test on the installation.

Usare cavi o barre isolate/ o eseguire prove di tipo specifiche sull' installazione.

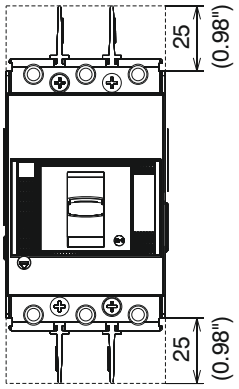
Kabel oder isolierte Sammelschienen verwenden / oder die spezifische Typprüfung auf derInstallation durchführen.

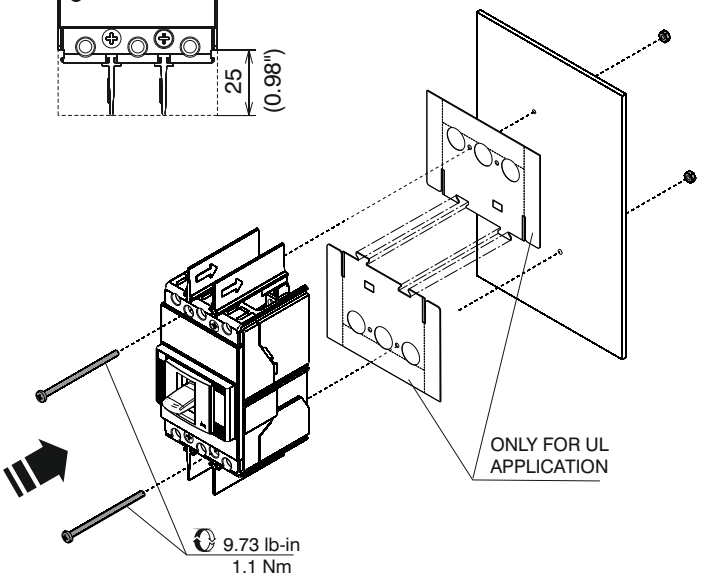
Utiliser un câble ou des barres isolées/ ou réaliser un test de type spécifique sur installation.

Utilizar un cable o barras aisladas / o efectuar una prueba de tipo específico sobre instalacíon.



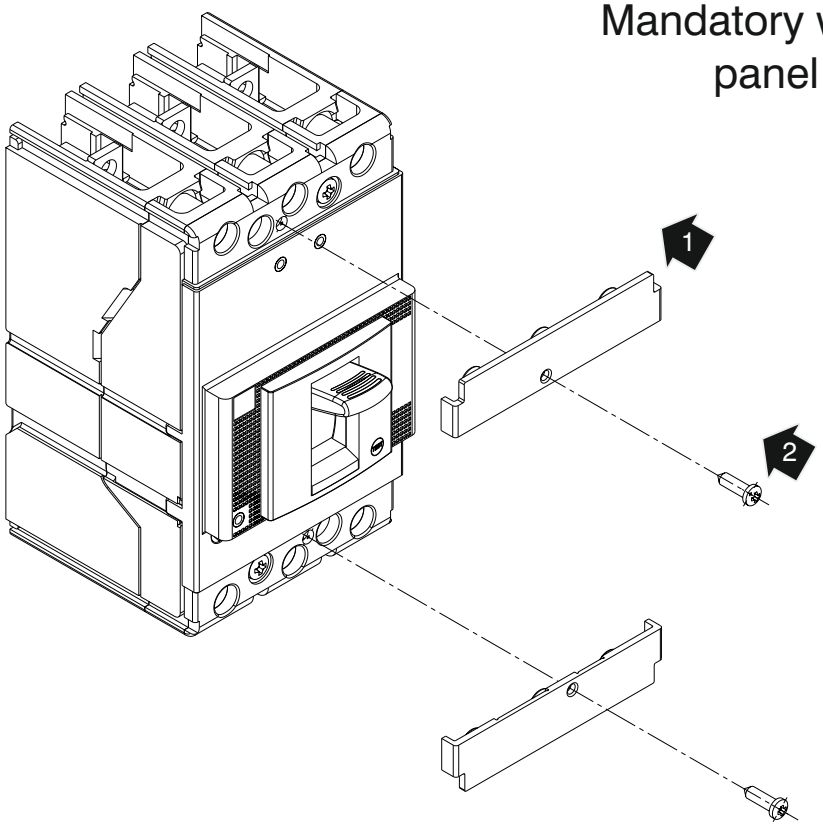
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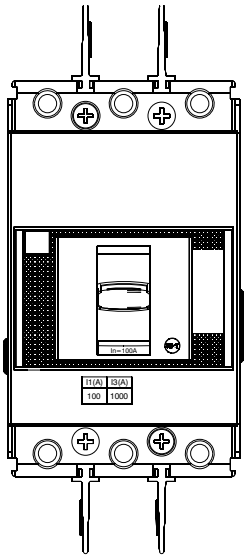
4

Mandatory with door of the panel ⩽ 25mm/0.98" from the front



5

140G-G THERMOMAGNETIC TRIP UNIT



Type	In	I1			I3
Fixed	15	15			500
Fixed	16	16			500
Fixed	20	20			500
Fixed	25	25			500
Fixed	30	30			500
Fixed	32	32			500
Fixed	35	35			500
Fixed	40	40			500
Fixed	50	50			500
Fixed	60	60			600
Fixed	63	63			630
Fixed	70	70			700
Fixed	80	80			800
Fixed	90	90			900
Fixed	100	100			1000
Fixed	110	110			1100
Fixed	125	125			1250
Type	**In**	**Min**	**Med**	**Max**	**I3**
Adjustable	160*	112	136	160	1600

*IEC ONLY

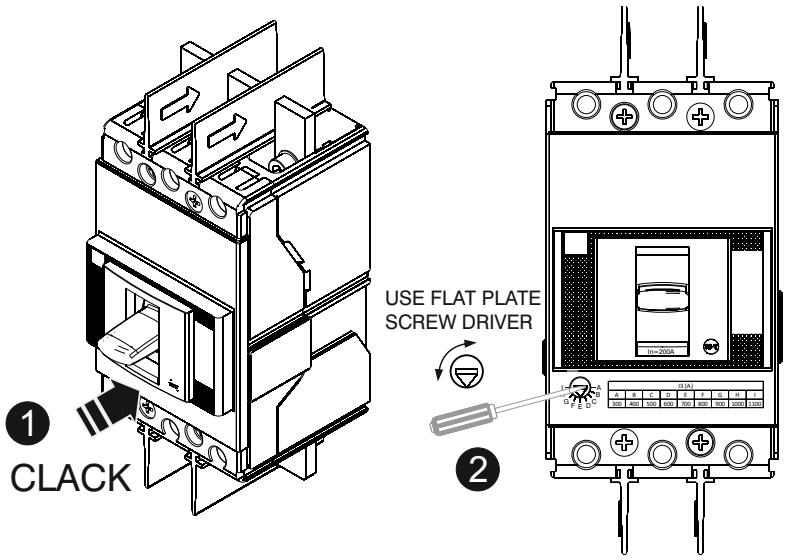
Manually trip the breaker prior to any adjustment of the magnetic trip settings.

E'obbligatorio mettere l'interruttore in posizione Trip test prima di regolare il termomagnetico.

Der Leistungsschalter muss vor Einstellung des thermomagnetischen Auslösers zwingend in die Prüfstellung geschaltet werden.

Il est obligatoire de mettre le disjoncteur en position de Test de Déclenchement avant de régler le déclencheur magnétothermique.

Es obligatorio situar el interruptor en posición "Test de Disparo" antes de realizar el ajuste del relé termomagnético.



I3									
In	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
3	9	12	15	18	21	24	27	30	33
7	21	28	35	42	49	56	63	70	77
15	45	60	75	90	105	120	135	150	165
30	90	120	150	180	210	240	270	300	330
50	150	200	250	300	350	400	450	500	550
70	210	280	350	420	490	560	630	700	770
80	240	320	400	480	560	640	720	800	880
100	300	400	500	600	700	800	900	1000	1100
125	375	500	625	750	875	1000	1125	1250	1375

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Molded Case Circuit Breakers, Motor Protection Circuit Breakers, and Motor Circuit Protectors

Allen-Bradley

Technical Data









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140G Molded Case Circuit Breakers

Introduction to Molded Case Circuit Breakers

What is a Circuit Breaker?

What is a circuit breaker? This is the first question to answer in understanding Molded Case Circuit Breakers. The definition of a circuit breaker varies between the standards organizations, but the most commonly used definitions are:

The National Electrical Manufacturers Association (NEMA) defines circuit breakers as "devices designed to open and close a circuit by non-automatic means, and to open the circuit automatically on a predetermined overcurrent without injury to itself when properly applied within its rating."

The International Electrotechnical Commission (IEC) Standard IEC 60947-2 defines a circuit breaker as "a mechanical switching device, capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specified time and breaking currents under specified abnormal circuit conditions such as those of short-circuit."



There are also similar definitions, that further identify circuit breakers by type of construction and functionality. Within the IEC specification for circuit breakers, there are several distinctions of types of circuit breakers by classification:

Utilization Category

Interrupting medium
- Air break
- Vacuum break
- Gas break

Design
- Open case
- Moulded (molded) case

Method of controlling the operating mechanism
- Dependent manual operation
- Independent manual operation
- Dependent power operation
- Independent power operation
- Stored energy operation

Type of overcurrent release
- Instantaneous
- Definite time delay
- Inverse time delay

In reviewing the attributes just listed, it is understandable that many people are confused about what type of circuit breaker to use, where to use it, and how to select it properly. In this section, the focus will be placed on the definition, application and selection of Molded Case Circuit Breakers (MCCBs) with an inverse time delay as applied to industrial control panels.

This publication will focus on the application and selection of MCCBs, Motor Protection Circuit Breakers (MPCBs) and Motor Circuit Protectors (MCPs). The primary focus will be on products that are packaged in a molded case design, but much of the information can be applied to other circuit breakers that are commonly found in control panels.

Definitions

Each of the product categories we mentioned earlier is packaged in a molded case and confusion develops because of the physical similarity of the products.

The Molded Case Circuit Breaker is a specific type of circuit breaker. NEMA defines circuit breakers as devices designed to open or close a circuit by nonautomatic means, and to open the circuit automatically on a predetermined overcurrent without damage to itself when properly applied within its rating. The term "molded case" simply refers to the construction of the circuit breaker and refers to the fact that the circuit breaker is an assembled unit in a supporting housing of an insulating material.

Within the realm of MCCBs, three distinct product variations exist, each with specific protection properties and uses within the industrial control panel. The main categories are:

Molded Case Circuit Breakers or Feeder Breakers

MCCBs are intended to provide overcurrent protection for conductors and equipment by opening automatically before the current reaches a value and duration that will cause an excessive or dangerous temperature in conductors or conductor insulation. Additionally, these devices can serve as the main disconnecting means for a control panel. This protection pertains to low level overcurrent, and short-circuit current. Traditionally these types of circuit breakers are generically described as thermal magnetic devices, though an increasing number of these devices are also electronic circuit breakers which provide the same type of protection, with the exception that the electronics allow the protection curves to be customized to the specific application. In the United States, the National Electrical Code (NEC) defines how this protection is selected in Sections 240-2, 240-3 and 240-4. In Canada there are similar references in the Canadian Electric Code, C22.1-12. For IEC applications, IEC 60204-1 provides guidance for the construction of industrial control panels.

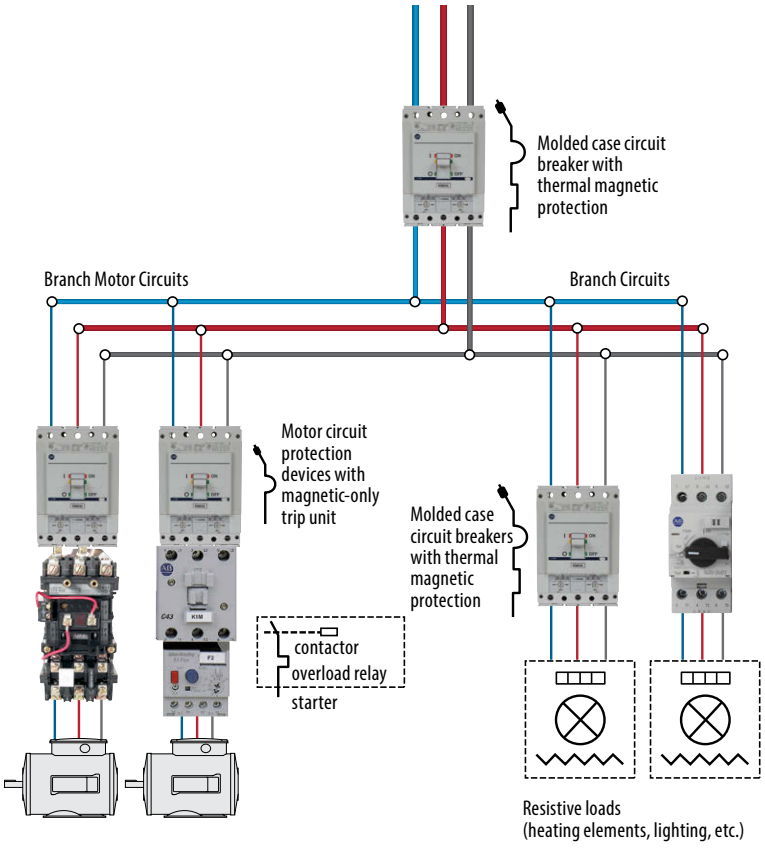
Motor Protection Circuit Breakers

Application-specific variations of the MCCB, these breakers combine the short-circuit and isolation functionality of the MCCB with the motor overcurrent protection of a traditional overload relay. These devices are traditionally used in two-component starter applications, with a contactor to control a motor load. MPCBs are UL 489 Listed as circuit breakers and verified as motor overload relays. Allen-Bradley® MPCBs are UL Listed as 100% breakers, allowing utilization of the full range of motor protection provided. Note: most circuit breakers applied in North America are 80% rated, meaning they can only be used continuously at 80% of their thermal rating. Allen-Bradley MPCBs are 100% rated, allowing full use of the circuit breakers' thermal capacity in motor protection applications.

Motor Circuit Protectors

Another application-specific version of the MCCB, the Motor Circuit Protector (MCP) is a magnetic trip only version of the MCCB. These circuit breakers provide no overload protection and, as a result, when applied in motor circuit need to be applied with a controller in order to provide short-circuit and overcurrent protection. In the United States, the MCP is UL Listed with a controller and together they form a combination starter. The advantage of this combination is the choice in overload protection that can be applied to the starter. Listed combinations can include thermal as well as electronic overload relays, providing users with protection that is customized for their application. The MCP can also be provided in several variations, including high magnetic trip versions that allow them to be used with high-efficiency motors, reducing the chance of nuisance tripping due to the characteristic high inrush currents associated with these motors.

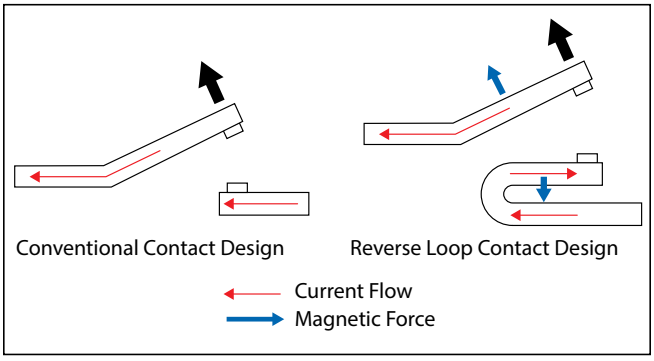
Where are each of these breakers used? The diagram below represents a typical multi-starter control panel. Note that the main disconnecting means is an MCCB, which is acting as both the main disconnect and feeder protection. There are several branches within this control panel. Both MCPs and MPCBs are being used to provide the branch a circuit breaker as a device in the case of the MCP, and branch short-circuit protection as well as overload protection in the case of the MPCB.



Breaker Theory and Construction

When used in an industrial control panel application, the purpose of the MCCB is to provide overcurrent protection. This definition can be divided into short-circuit protection and thermal overcurrent protection. A short circuit can range from hundreds of amps to over 100,000 amps, depending upon the power source and where the short circuit would occur in the circuit.

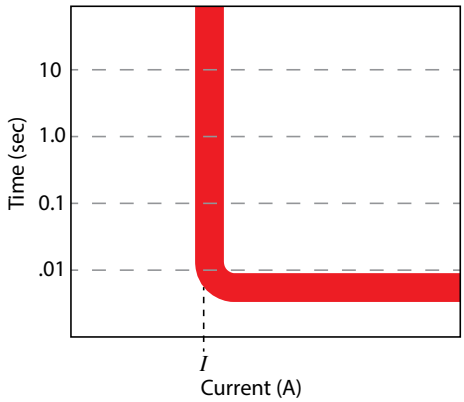
An arc chamber is integral to all MCCBs. This arc chamber will be similar in all forms of the circuit breakers and performs several import functions in providing short-circuit protection. This chamber surrounds the switching contacts within the circuit breaker and the contacts open during a short circuit. The opening of these contacts generates an arc. The arc chamber and its components, the arc chutes and splitter plates, draw the arc away from the contacts, dividing and cooling the arc. Ultimately, this leads to the extinguishing of the arc and the circuit opening and current flow stopping. One of the remarkable elements is that this entire operation occurs in milliseconds, with short-circuit currents that can be 100,000 A or greater, depending upon the available current in the circuit.



Conventional contact design compared to reverse loop contact design.

Depending upon the design of the circuit breaker and intended short-circuit interruption capability, differences in the construction of the contact assemblies exist. The most commonly used contact assemblies are shown here.

The reverse loop design is used in modern circuit breakers as its design uses the magnetic forces created by current flowing in opposite direction to assist in the opening of the contacts under short-circuit conditions. Additionally, the amount of repulsive force generated is proportional to the value of the short-circuit current being experienced by the circuit breaker. This provides for faster interruption time as the short-circuit currents increase.



Example of magnetic time vs. current curve.

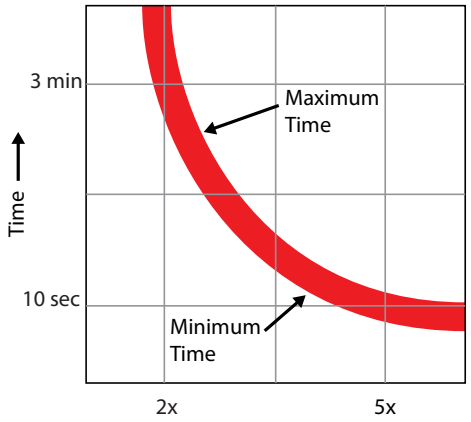
Using these magnetic trip units, we are able to provide short-circuit protection that can be represented in a curve as shown above.

This document is not designed to be a reference to circuit breaker design. However, the construction of the arc chamber is being discussed as it is important to understand that MCCBs with a 25 kA interrupting rating will require fewer arc splitters and smaller arc chutes to interrupt a short circuit than will a comparable device rated for 100 kA of interruption. Therefore, when selecting an MCCB for a specific application, it is very important to take into consideration the amount of short-circuit current available and then select the circuit breaker with an interrupting rating sufficient to meet the requirements of the application.

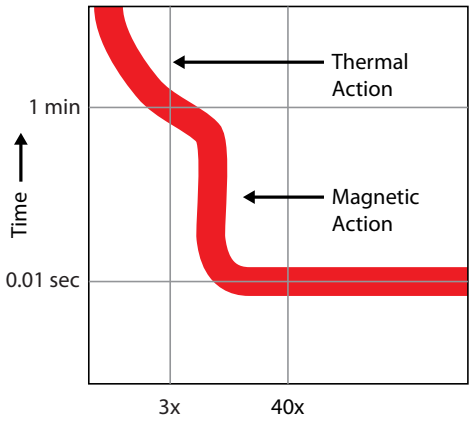
The MCCB also provides thermal protection for the control panel and, as we will see later, the branch circuit. This thermal protection can be provided either through the use of bimetallic heater elements similar to those found in overload relays or through the use of electronics, which simulate the operation of heater element and can provide adjustable overcurrent protection for the application.

Trip Curve for a Thermal Magnetic MCCB

The most commonly selected form of thermal protection is the bimetallic version. This works similarly to a traditional overload relay in which a bimetallic element is heated, causing a deflection, which then exerts pressure on a trip bar and causes the circuit breaker to trip.



Using the bimetallic model, we can provide a thermal protection curve as shown at left.



Combining the short-circuit and overcurrent protection provides us with a protection curve that looks like this.

Trip Curve for an Electronic MCCB

An alternative to using fixed-thermal protection is to use electronic overcurrent protection, which can electronically replicate the function of the mechanical overcurrent device. One of the benefits of using electronic trip units is their ability to tailor the tripping characteristics of the circuit breaker for the application.

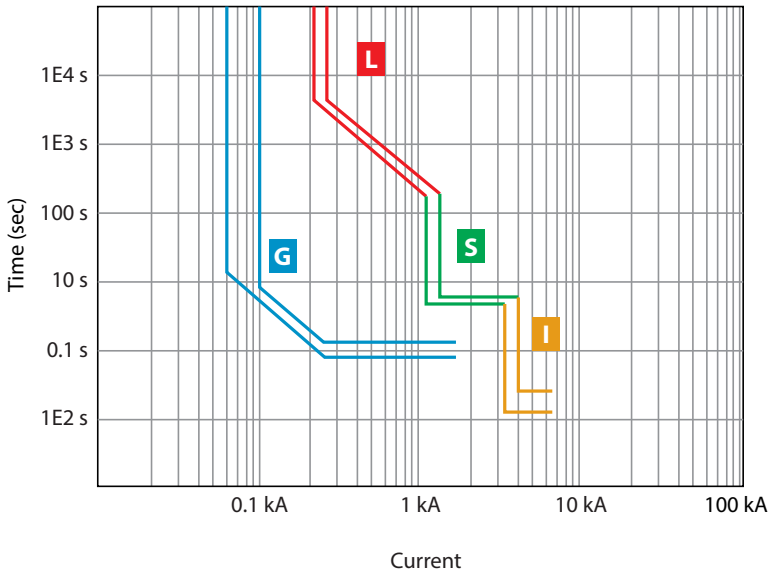
The electronic trip unit has the ability to provide advanced protection in the form of additional trip functionality such as adjustable:

Long Time – Allows the long time between 1.05 and ~1.3 x the thermal rating to be delayed, similar to how an adjustable relay changes classes

Short Time – Adjustable short time between thermal and short-circuit

Instantaneous Trip – Adjustable instantaneous short-circuit trip time

Ground Fault – Adjustable time and value of ground fault tripping



L – Overcurrent Protection **L**ong Time Delay

S – Short-circuit Protection **S**hort Time Delay

I – Short-circuit Protection **I**nstantaneous Trip

G – Ground Fault Protection

In the application section of this introduction we will examine trip curves in greater detail. For now, we are presenting the electronic trip units for the purpose of understanding the scope of a Molded Case Circuit Breaker offering.

Electronic trip units are available in a variety of trip settings. The most common combinations are LSI, LSIG and M-LIV trip settings; therefore a wide variety of options exist for customizing the protection the circuit breaker provide within the control panel.

Rockwell Automation offers a full range of Allen-Bradley Molded Case Circuit Breakers for use in industrial control panel applications. In an effort to simplify the application of MCCBs and their complimentary products, this application guide will help you properly select and apply circuit breakers used in an industrial control panel.

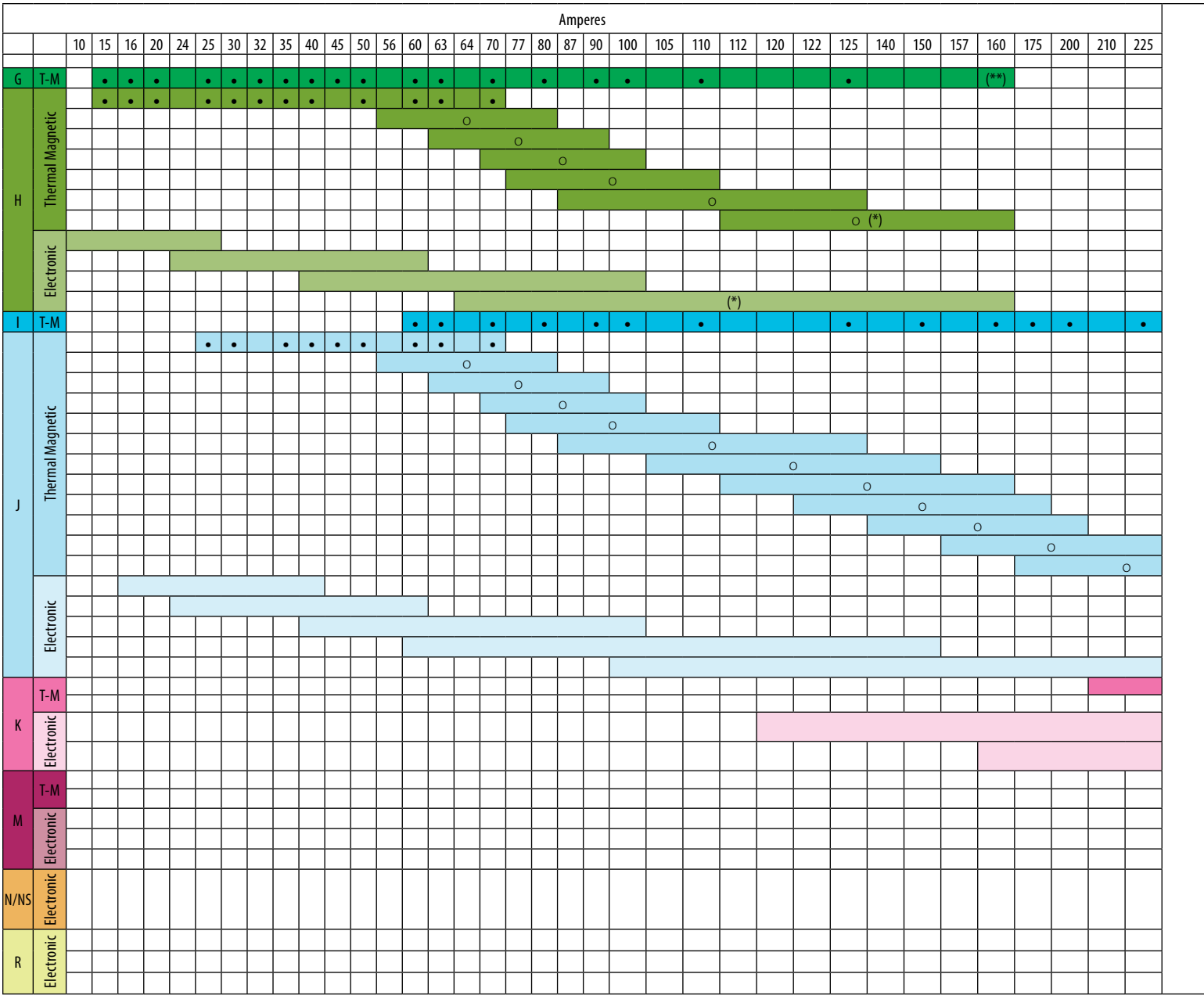
Product Range

140G Molded Case Circuit Breaker Thermal Protection

As previously described, MCCBs provide thermal overcurrent protection in addition to short-circuit protection. MCCBs provide this protection by using mechanical means with heater elements, or by using electronics to detect current flow and model the associated heat generated by the current.

When electronic MCCBs are applied, the ability to adjust the thermal trip rating to shape the trip curve is available and the result is that there are fewer trip units required to cover a wider range of current. Note: while a trip unit may have the capability of protecting the current range, in many cases a rating plug is used to limit the range of adjustability.

The table below illustrates the available thermal magnetic and electronic trip units and adjustment ranges available with the 140G family of MCCBs.



• Denotes Fixed Thermal and Fixed Magnetic.

o Denotes Adjustable Thermal and Adjustable Magnetic.

(*) IEC only.

(**) IEC only. G-Frame is Adjustable Thermal.



| Amperes | | |

Applying Molded Case Circuit Breakers to North American Guidelines

The MCCB is most commonly used as either a feeder breaker or a single circuit breaker where disconnecting, short-circuit, and thermal protection functionality is required. When selecting an MCCB, the following items need to be taken in to consideration:

- Application voltage
- Available short-circuit current
- Amperage of the load or wiring to be protected

Additionally, local code requirements will also need to be taken into consideration and may ultimately affect the type and functionality of the MCCB selected.

MCCB

- Magnetic and Thermal Trip Currents may be fixed or adjustable
- Must be sized per NEC/CEC rules
- May be used for motor circuits, but 140MG (MCP) is first choice
- Motor Current (thermal rating)
  - ≤ 250% motor FLA
  - ≤ 300% for motors ≤ 100 A if the circuit trips on start
  - ≤ 400% for motors ≥ 100 A if the circuit breaker trips on start
- Magnetic Trip Current is generally set at 1000% (10x) of circuit breaker thermal ratings
- May be UL Listed as part of UL 508/UL 60947-4-1
- May also be used for motor control-circuit transformers, but Bulletin 1489 MCBs are the first choice

Motor Protection Circuit Breakers

While globally these devices are considered motor protection circuit breakers, in North America they are defined as manual Type E self-protecting combination motor controllers:

- Sized at 100% of the motor full-load current (FLA)
- Motor current setting is adjustable (thermal rating)
- IEC & UL/CSA calibration requirements require overload to trip at 120 & 125% FLA
- Motor is able to run into the Service Factor when set at 100% of the motor current
- Magnetic Trip Current setting is adjustable (magnetic rating)
- Adjustable at 1300% (13x) highest motor current setting on circuit breaker
- Higher Magnetic Trip Current settings are available if circuit breaker trips on start (140M-C2T-***)
- Example of an MPCB using 140M-C2E-C10:
  - Motor Current is adjustable from 6.3…10 A
  - Set at 100% FLA for proper motor protection
  - Magnetic Trip Current is fixed at 130 A
  - This is where circuit breaker begins to trip in a "short-circuit" condition
- Motor Protection Circuit Breakers are relatively new to the North American market
- NEC/CEC (Canadian Electrical Code) do not specifically recognize this classification of circuit breaker and, therefore, do not describe how to size them (e.g. 100% FLA sizing)

Motor Circuit Protectors

- Motor current setting (thermal) is not specified by NEC/CEC
- MCPs are magnetic only
- Thermal capability should be greater than or equal to motor FLA and less than or equal to overload relay setting
- Motor overload protection must be provided separately
- MCPs are UL Recognized
- Must be tested and listed with specific contactors and overloads
- UL Listing is obtained as part of UL 508/UL 60947-4-1
- Magnetic trip current is adjustable
- Adjustability is required by UL489 standard
- Must be sized per NEC/CEC rules
  - ≤ 800% motor FLA for standard efficiency motors
  - ≤ 1300% motor FLA allowed if motor will not start
  - ≤ 1100% motor FLA for high efficiency motors
  - ≤ 1700% motor FLA allowed if motor will not start
- MCPs are the most popular choice for motor circuits in the North American market
- Used in combination starters and Motor Control Center unit inserts (buckets) for many years
- Provide choice in overload protection

Product Line Overview

Rockwell Automation offers a complete line of Allen-Bradley Molded Case Circuit Breakers, Motor Circuit Protectors and Motor Protection Circuit Breakers.

In the MCCB family there are eight frame sizes of MCCBs, from 15 A through 3000 A, with dual-rated EN/IEC 60947-2 and UL489 breakers in 3- and 4-pole configurations. All frame sizes feature full sets of accessories as well as common accessories, which allows reduced inventory and maximum flexibility.

In the MCP family of products, there are seven frames, ranging from 3 A through 1200 A. The MCPs, like the MCCBs, share the same accessories and provide the same flexibility. In the MPCB range of products there are three frames ranging from 25 A through 150 A, which share the same accessories as MCPs and MCCBs.

MCCB Portfolio Overview

Frame Reference	G	H	I	J	K	M	N/NS	R
Molded Case Circuit Breakers • Bulletin 140G globally rated MCCBs • UL 489, EN 60947-2, CE, CCC • Feeder circuits and disconnects • 3- and 4-pole versions	15…125 A*	15…125 A*	60…225 A	25…250 A	120…400 A	240…800 A	480…1200 A	800…3000 A
Motor Protection Circuit Breakers • Bulletin 140MG globally rated MPCBs • UL 489, EN 60947-2, CE • Branch protection, 2-component starters • 3-pole versions		25…100 A		40…150 A				
Motor Circuit Protectors • Bulletin 140MG globally rated MCPs • UL 489, EN 60947-2, CE • Branch protection, 3-component starters • 3-pole versions	3…125 A	3…125 A	100…150 A	150…250 A	300…400 A	600…800 A	1200 A	

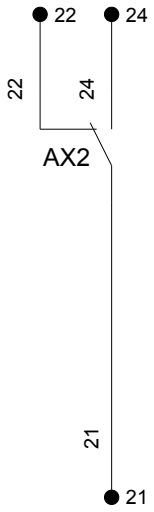
* 160 A IEC only

Auxiliary Contacts (AX)

Auxiliary contacts perform the function of electrically signaling the circuit breaker's operating status. The auxiliary contacts change state when the circuit breaker is opened, closed, or tripped.

Auxiliary contacts indicate the ON/OFF status of the MCCB. The 140G auxiliary contacts are changeover contacts (Form C).





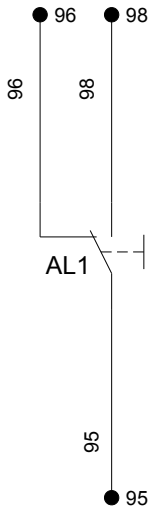
Alarm Contacts (AL)

Alarm Contacts (AL) are a special form of auxiliary contacts that indicate the trip status of the MCCB due to:

- Trip due to overload
- Trip due to short circuit
- Trip due to residual current (if equipped)
- Trip due to shunt trip and/or undervoltage release (if equipped)
- Trip initiated by pressing the "test" button

After initial alarm contact change of state, the Alarm Contacts (AL) change state only when one of the above conditions occur. Manual operation of the breaker to Off does not affect the state of these contacts. The 140G Alarm contacts are changeover contacts (Form C).

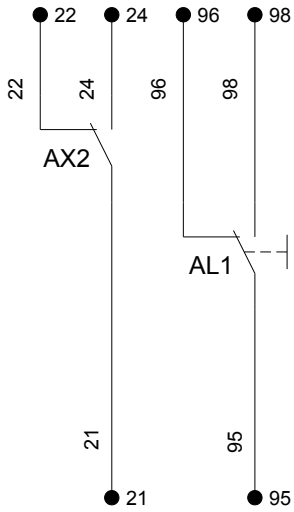




Combination Auxiliary Alarm Contacts

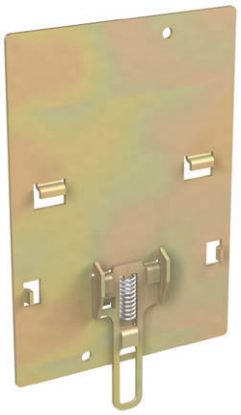
Auxiliary/Alarm contacts include contacts to perform both the Auxiliary Contact (AX) function and the Alarm Contact (AL) function.





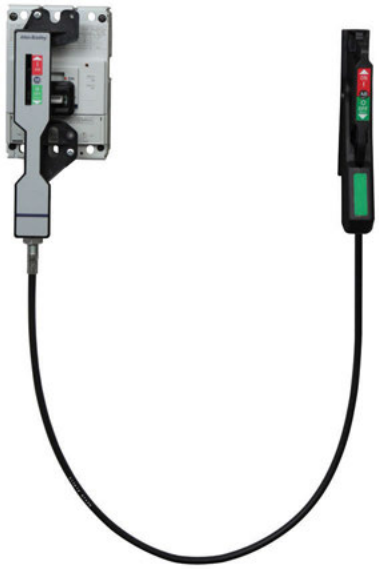
DIN Rail Adapters

In many applications, the ease with which an MCCB can be installed via the use of a DIN Rail adapter. Rockwell Automation provides DIN Rail adapters as accessories for use with its 140G G-, H-, I- and J-Frame breakers.



Flex Cable Operators

Flexible Cable Operators are useful accessories when installing a circuit breaker in a flanged enclosure and the MCCB needs to be controlled externally. Traditionally in North America, flange operators that consist of operating rods or special mounting plates for the breakers have been used. In each case, the circuit breaker must be mounted directly or nearly directly behind the external handle, which is located on the flange. This type of installation is reliable; however, the positioning of the circuit breaker is less than ideal in terms of working room, especially in small enclosures.



The Flexible Cable Operator uses a similar flange-mounted operating handle to control the MCCB; however, rather than operating rods, the breaker is operated by a flexible cable, which provides flexibility in the circuit breaker placement. In many industrial control panels, incoming power to the panel may actually be on the hinged side of the panel and when using traditional flange-mounted operators, the main feeder wires would need to be routed across the panel to the line side of the MCCB. Using a flexible cable-operated MCCB allows the MCCB to be installed closer to the incoming feeder wires and can significantly improve the installation of the control panel.

Another application where Flexible Cable Operators are used is in conjunction with busbar mounting systems installed within an industrial control panel. When an MCCB is being used on the busbar system as the main disconnect or feeder protector, the location of the feeder breaker isn't restricted to the area behind the flange.



End Cap Kits

All 140G MCCBs are furnished with end caps mounted on the circuit breaker as standard. Replacement end cap kits are available.

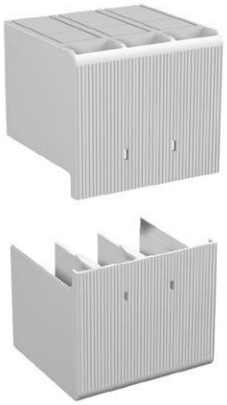
Many customers prefer to use a "crimp-on" ring lug (ring tongue terminal) or forked terminal as the wire termination method to the MCCB. Others prefer wire connection to a terminal lug. A broad selection of terminal lugs are available to meet specific application requirements.

The replacement end cap kit consists of a captive nut and bolt or termination screw, which allows for the termination of wires without the need to use terminal lugs.



Terminal Covers

The terminal shield prevents accidental contact with live parts, they also provide phase to phase insulation.

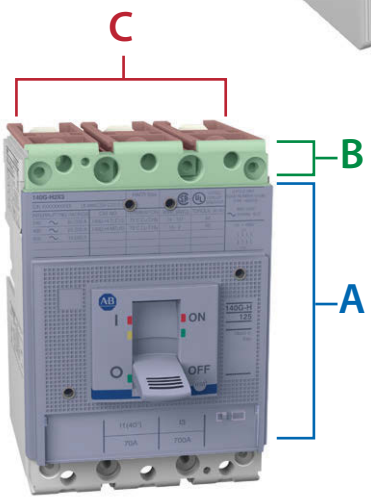


Ingress Protection

The table indicates the degrees of protection against intrusion and accidental contact per IEC 60529 Standard.

Location	Without Terminal Covers	With High Terminal Covers (&)
A	IP40**	–
B	IP20*	IP40*
C	–	IP40†

* G through M frames.
** Also with direct or variable depth rotary operator.
† After installation.
(&) High terminal covers have a height of 60 mm and are designated with a suffix "H" in the catalog number, (i.e. 140G-G-TC3**H**).



Motor Operators

The operating mechanism enables remote opening and closing of the circuit breaker and is particularly suitable for use in power supply network supervisory control systems. It comes complete with a padlock device.

The motor operating mechanism is fitted on the front of the circuit breaker as an alternative to the front flange or rotary operating mechanism. Motor-operated circuit breakers are normally used in applications where switching is done infrequently and generally are not used to replace contactors that are applied in series with the circuit breaker.



Shunt Trip

Shunt trips allow the circuit breaker to be opened using an electric command (opening release). The shunt trip is housed and fitted in a slot within the circuit breaker.

Shunt trips are used in applications where a remote signal to open or isolate a circuit is required.



Undervoltage Release

Undervoltage releases allow the circuit breaker to be opened using a change in the voltage of the power supply to the circuit breaker terminals. The undervoltage release is fitted in a slot within the circuit breaker. Undervoltage releases work when the application voltage is reduced below 75% of the rating of the release unit voltage rating.

Use of undervoltage releases can protect a system against low voltage, particularly when running or starting motors, by removing power to the circuit by opening the circuit breaker in low-voltage situations. In some applications, the undervoltage release can be used to quickly remove power to a machine or machines by opening a push button contact, wired in series with the undervoltage releases.



Rotary Operators

When MCCBs are installed as the main or feeder circuit breaker in an industrial control panel and a non-flanged enclosure is used, a common means for operating the circuit breaker is through the use of a rotary operator mechanism. The use of a rotary operator converts a rotary motion to a vertical motion that "toggles" the MCCB. In this situation, the rotary operator kit would consist of:

- External operating handle
- Operating shaft
- Circuit breaker mounted rotary operating mechanism

Using these kits allows external operation of the circuit breaker with the capability of turning the circuit breaker on/off, and even resetting the circuit breaker without having to open the enclosure. Traditionally, these kits are sold with an operating shaft that allows the customer to use the kit with enclosures of various depths. The operating handles will also provide status indication when the circuit breakers trip.



NFPA 79 Operators

A NFPA 79-compliant Internal Rotary Operating Handle Kit for Bulletin 140G Molded Case Circuit Breakers (MCCBs), Bulletin 140MG Motor Circuit Protectors (MCPs), and Bulletin 140MG Motor Protection Circuit Breakers (MPCBs) is available to address current requirements of the NFPA 79 standard. The NFPA 79 kits are available for G-, H-, I-, J-, K-, M- and N-Frame Circuit Breaker product lines.

Compliance with the current NFPA 79 standard enables operators to maintain control of the main disconnecting means when the door is open; an issue for rotary-operated through-the-door disconnect switches and circuit breakers alike.

This standard requires that the rotary main disconnecting means to be operable without the use of accessory tools or devices (independent of door position) and restates the requirement for an interlocking provision to prevent the closing of the disconnecting means while the enclosure door is open, unless the interlock is operated by a deliberate action. Without this requirement, rotary operated devices may have a shaft protruding from the panel when the door is open. If the panel is powered and it is necessary to turn power off, it is difficult to de-energize the panel by the operating shaft alone. This standard is to reduce the possibility of personnel not being able to turn an energized panel off with the door opened.

Why is This Relatively Simple Product Important to You?

The trend in the market is obviously moving toward building smaller and less-expensive control panels. To achieve this, many panel builders and OEMs have moved toward using rotary operators because they are easier to install and the non-flanged enclosure is significantly less expensive. With the introduction of this internal handle, customers can now comply with the NFPA 79 requirement and use the less-expensive, non-flanged enclosure with circuit breakers.

Applications Where NFPA 79 Compliance is Required as an Upgrade

From an installation perspective, the internal handle replaces the existing operating shaft. Externally, the same 140G handle is used. In the case of an existing 140G installation, installing the kit can be as simple as removing the existing operating shaft, measuring it, and then cutting the new internal operating handle shaft to the same length. It is then installed in place of the existing operating shaft.

Easy to Use, No-Tools-Required Internal Handle Operation

When the door is open, the kit provides an internal handle with a positive grip, allowing users to operate the breaker. If the enclosure were opened using the defeater on the external handle with the circuit breaker on, the user could then turn the breaker off using the internal handle, rather than using a tool to rotate the operating shaft.

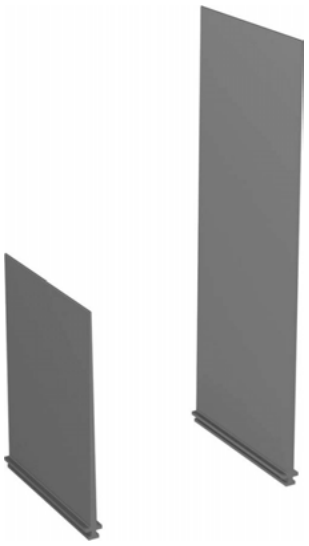
Compliance with "Deliberate Action Required"

Finally, the handle complies with the NFPA 79 requirement to: "Prevent closing of the disconnecting means while the enclosure door is open, unless an interlock is operated by deliberate action." The internal handle must be pulled out before it can be turned, otherwise the handle itself will just ratchet on the shaft.



Phase Barriers

These allow the insulation characteristics between the phases at the connections to be increased. Phase Barriers provide additional electrical clearance between each phase when special connections extend past the circuit breaker housing. They are mounted from the front, even with the circuit breaker already installed.



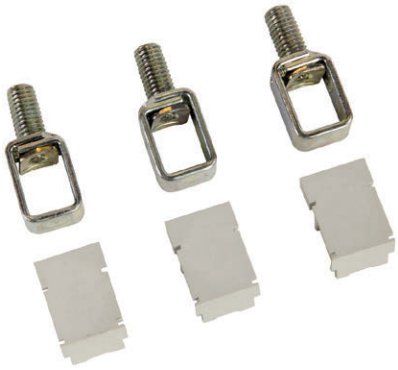
Mechanical Accessories

Terminal Lugs

Mechanical Terminal Lugs may be used to terminate line and load wiring to the MCCB. The 140G product line includes, as standard, the capability to terminate wiring using customer furnished “crimp-on” ring lug (ring tongue) or forked lug termination.

For customers who prefer terminating wiring to Mechanical Terminal Lugs, the 140G line offers a variety of mechanical terminals lugs to match the frame and application wiring.

Multiple tap terminal lugs are available for those customers terminating multiple wires to a MCCB pole, either to line or load connection. Use of a multi-tap connection can save on panel space, making wiring easier due to using (multiple) smaller diameter wire. For applications following the UL guidelines for panel short-circuit current rating (SCCR), the use of multiple wire termination on the load size permits the termination to be rated at the SCCR level of the circuit breaker, which may allow a higher SCCR than may be available using a separate power distribution block.





Padlock Attachments

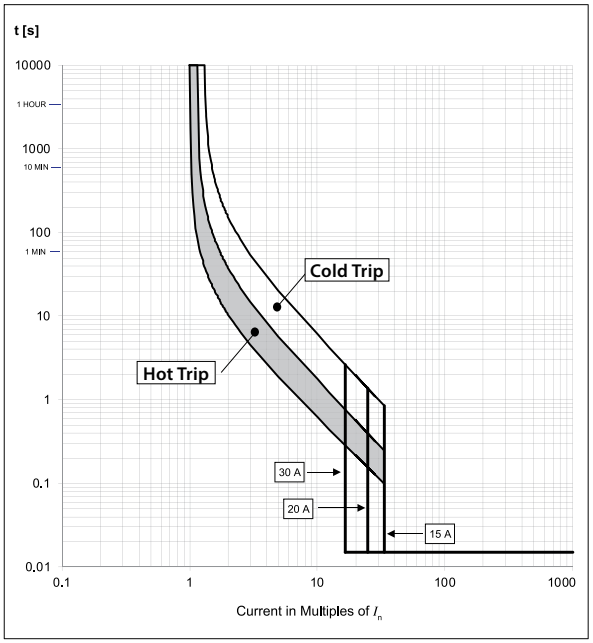
Padlocking hasps are available for the range of MCCB line. This attachment allows the user the ability to padlock the MCCB in the off position. It prevents operation of the circuit breaker when the attachment and a padlock are in place.



Using Trip Curves

One of the most common questions encountered after "How is an MCCB properly sized?" is "How do I interpret the trip curves provided?"

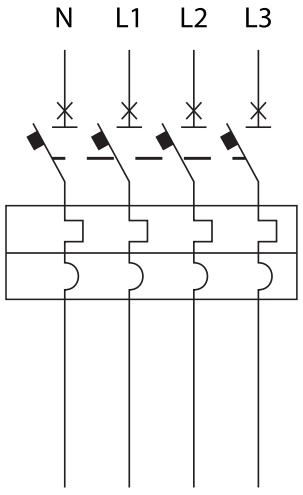
A logical starting point is to explain what the curve actually is. The curve is a representation of how the circuit breaker will react to overcurrents and short-circuit currents. It should be noted that the curve is determined by a specific set of test conditions, and as such, the curve should be used as a guideline; real world deviations from the test criteria may alter the individual results as compared to the curve.



Time-Current Curves for 140G-G thermal magnetic Molded Case Circuit Breakers

Neutral Pole

When applying 4 pole MCCB, the neutral pole is rated at 100% for thermal magnetics, and adjustable 100%, 50% or 0% for electronics.



For all 4 pole 140G MCCB and Molded Case Switches the neutral is the left outside pole, as shown in the illustration.

Reverse-Fed Circuit Breaker

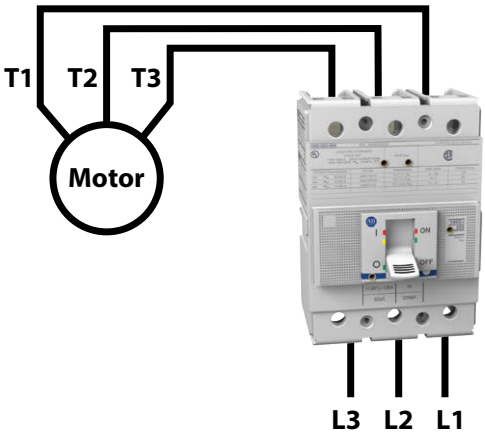
Due to physical equipment arrangements in panelboards, switchboards, and industrial control panels, it is often desirable to reverse feed a molded case circuit breaker. For this application, the circuit breaker must be tested and listed accordingly.

Please note that all Bulletin 140G circuit breakers may be reverse fed. When reverse feeding these devices, the line and load side terminals need to be identified properly.

Note: Maximum voltage for reverse fed.

Reverse Fed		
Bulletin 140G & 140MG	Maximum AC Voltage [V]	
	UL/CSA	IEC
G	600Y/347	690
H	480	480
I	600Y/347	690
J	600	600
K	600	690
M	600	690
N, NS	600	690
R	600	690

Note: The NEC Article 404.7 states "Where these switch or circuit breaker handles are operated vertically rather than rotationally or horizontally, the up position of the handle shall be the (on) position." Refer to applicable codes and standards for specific application requirements.



Interrupting Ratings

The maximum amount of fault current supplied by a system can be calculated at any point in that system. One rule must be followed for applying the correct circuit breaker. The interrupting rating of the breaker must be equal to or greater than the amount of fault current that can be delivered at that point in the system where the breaker is applied. The interrupting rating of the breaker is the maximum amount of fault current it can safely interrupt without damaging itself. A breaker's interrupting rating always decreases as the voltage increases. Interrupting rating is one of the most critical factors in the breaker selection process.



Certifications

To provide customers with third-party assurance that Rockwell Automation® MCCBs meet industry standards, our circuit breakers comply with various global standards. The Bulletin 140G MCCB and 140MG MCP and MPCBs comply with UL, CSA and IEC standards and as such, are UL Listed, CSA Certified, and CCC Certified.

Other certifications exist for the family of MCCBs. The certification of these products is an ongoing process and additional ratings and certifications are continually being pursued. For information about compliance with a particular standard, contact your local Rockwell Automation sales office or Allen-Bradley distributor.

In each of the product sections, the latest certifications at the time of publication are listed for the specific product type.

Selecting a Circuit Breaker, When Application is to Follow U.S. Guidelines

The next step is selecting a breaker for use in an industrial control panel. In the following section we will focus on the MCCB for use as a feeder and as a branch circuit protective device.

Selecting The MCCB for Use as The Main Disconnect or Feeder

A typical industrial control panel is a feeder circuit as defined by the NEC, where a feeder is composed of the wires between the service entrance of the panel or line side of the MCCB and the line side of the branch protective devices.

In many industrial control applications, motor control is involved. In that case, the application must then follow Article 430 of the NEC, which states that breakers for feeders having mixed loads, e.g. heating (lighting and heat appliances) and motors should have ratings suitable for carrying the heating loads, plus the capacity required by the motor loads.

For motor loads, Article 430 states that breakers for motor feeders shall have a rating not greater than the sum of the highest breaker rating of any of its branches and the full-load currents of all other motors served by the feeder.

Feeder Breaker Thermal Rating Selection Example

This assumes that the circuit breaker selected has a voltage rating equal or greater than the application and that the interrupting rating is equal or greater to the available short-circuit current. The panel contains a main feeder breaker supply with three motor branch circuits.

In our application, the feeder is supplying a 3-motor system at a voltage of 480V.

- Motor 1 is 10 Hp. Current value from Table 430.250 of the NEC is 14 A.
- Motor 2 is 5 Hp. Current value from Table 430.250 of the NEC is 7.6 A.
- Motor 1 is 5 Hp. Current value from Table 430.250 of the NEC is 7.6 A.

Calculation of panel wiring includes:

- **For single motors.** Per [430.22], size motor branch circuit conductors no smaller than 125 percent of the motor FLC rating listed in Table 430.147 or 430.148 (Figure 430-4). Size the branch circuit short-circuit and ground-fault protection device per 240.6(A) and 430.52(C)(1) Ex. 1.
- **For multiple motors.** Per [430.24], size multiple motor conductors as follows. First, multiply the full-load current rating of the highest-load motor by 1.25. Then, add up the full-load current ratings of all the other motors in the group. Add these two numbers. That's your motor load for calculating ampacity. Add any other loads on that conductor, to calculate total conductor ampacity.

Current Calculation is:

Motor 1 (14 A* 1.25)	17.5 A
Motor 2	7.6 A
Motor 3	7.6 A
Total	32.7 A

Since the total load comes to 32.7 A and there is not a commercially available breaker available for 32.7 A, the NEC allows the next largest standard-sized breaker to be used. Therefore, a 35 A MCCB could be selected to protect this control panel. Note: each motor branch would also need protection.

Thermal Magnetic Circuit Breakers Used as Branch Short-circuit Devices

It is also possible to use an MCCB as a branch protective device for a motor load, and while we will show the calculation for applying an MCCB in this manner, there are other circuit breakers, such as the MCP and MPCB, that are better suited for this application. After the calculation for sizing is completed, it should be apparent that even though this is technically correct, in some cases, the motor protection and wire protection can be less than ideal.

Per NEC Article 430.52(B), the motor branch circuit short-circuit and ground fault device shall be capable of carrying the starting current of the motor. Further, 430.52(C) indicates that the protective device that has a rating or setting not exceeding the value calculated according to the values given in Table 430.52 shall be used. In the case of an inverse time MCCB, such as the 140G, the calculation for the maximum setting or rating of the protective device is 250% of the motor being protected.

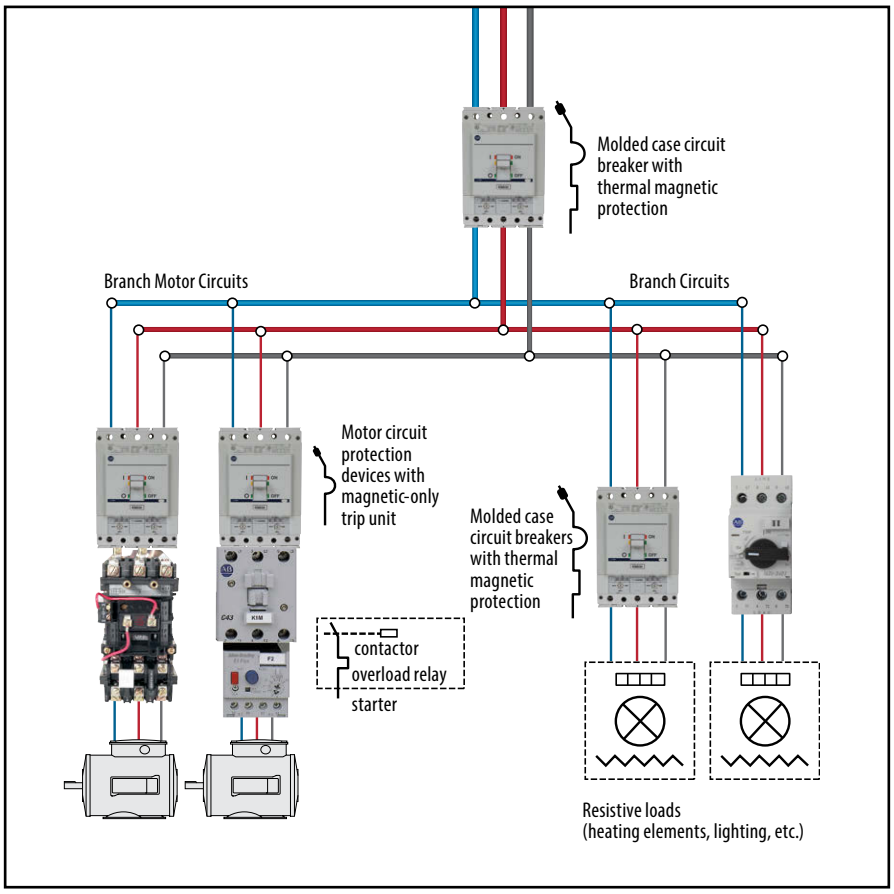
Example

An MCCB is being used to protect a branch motor circuit with a 10 Hp 460V motor. Using Table 430.250 of the NEC, a value of FLC of 14 A is supplied for this motor.

Calculating the maximum branch circuit protective device rating or setting is:

$$14\ A * 250\% = 35\ A$$

Therefore, the maximum size MCCB that could be used in this example is 35 A. This is the maximum rating and therefore smaller devices could be selected for this application. A point to consider is that generally MCCBs have a magnetic trip of approximately 10X the rating of the MCCB. When starting, motors usually exhibit an inrush characteristic of 6 to 10 times the full load rating of the motor, depending on the type of motor being used. In this case, the circuit breaker trip point is approximately 350 A and the motor starting current of locked rotor current is approximately 140 A if a 10x ratio of running to starting current is assumed. A smaller breaker could be selected without concern for nuisance tripping. In that case, there may be more concern about the thermal protection provided by the circuit breaker being based on a 35 A breaker with only a 14 A load. The motor and the wiring may not be adequately protected if larger wire isn't selected or if a motor overload relay is not used.



MCCB Application and Sizing

The Bulletin 140G MCCBs are traditionally used for protection of branch and feeder circuit in an industrial control application. In the role of a feeder circuit breaker, the MCCB provides isolation and short-circuit protection for the panel and thermal protection for the feeder wires and as a branch circuit breaker provides the same protection for the branch wires in the panel. For illustrative purposes, the feeder will be shown at the wiring from the load side of the main or feeder MCCB to the line connection of the branch short-circuit protective devices to which the feeder is supplying power.

The following example is a generic interpretation of the US National Electrical Code (NEC), and should be used only as a reference for applying the MCCB. Final authority regarding the sizing and components used is governed by local and/or national electrical standards and the Jurisdiction Having Authority. Consult these standards before installing or designing any electrical system using short-circuit protective devices (SCPDs).

While this discussion is not intended to be a comprehensive guidebook to designing industrial control panels, we will present several categories of typical applications where a feeder SCPD device will be applied:

- A panel where only motor loads are being fed by the breaker
- A panel where fixed loads are being fed by the breaker
- A panel where mixed loads are being protected by the feeder breaker

In all cases, the examples given here are for reference and users should reference their local electrical code requirements, as they may vary from location to location. The applier should verify that their selection and installation complies with local codes, regulations, and/or standards.

A feeder is composed of the conductors of a wiring system between the service equipment or the generator switchboard of an isolated plant and the branch circuit overcurrent device.

NEC Article 220 states:

> *Where a feeder supplies continuous loads or any combination of continuous and noncontinuous loads, the rating of the overcurrent device shall not be less than the noncontinuous load plus 125% of the continuous load. Exception: Where the assembly including the overcurrent devices protecting the feeder(s) are listed for operation at 100% of their rating, neither the ampere rating of the overcurrent device nor the ampacity of the feeder conductors shall be less than the sum of the continuous load plus the noncontinuous load. Only breakers listed for 100% application, and so labeled can be applied under the exception (for example N Frame and R Frame 140G's that are specifically marked and rated 100%). Breakers without a 100% application listing and label are applied at 80% of rating.*

NEC Article 430 states:

> *Breakers for feeders having mixed loads; e.g., heating (lighting and heat appliances) and motors, should have ratings suitable for carrying the heating loads plus the capacity required by the motor loads…breakers for motor feeders shall have a rating not greater than the sum of the highest breaker rating of any of its branches and the full load currents of all other motors served by the feeder.*

A molded case circuit breaker is rated in rms amperes at a specific ambient temperature. This ampere rating is the maximum continuous current it may carry in the ambient temperature for which it is calibrated. To minimize the need for derating, Allen-Bradley thermal magnetic breakers are calibrated for an ambient temperature of 40 °C (104 °F), which is the average temperature within an enclosure. If the enclosure ambient temperature is known to exceed 40 °C, the breaker used should either be specially calibrated for that temperature, or be derated accordingly.

80% Continuous Rated

All 140G Molded Case Circuit Breakers are rated for 80% continuous load unless marked for 100% loads. The NEC requires that only 100% rated continuous load be marked special with the load designation. In all general applications the unmarked circuit breaker is to be applied at no more than 80% continuous load of its rated current (I_n). Typically 100% rated current MCCBs are devices with electronic trip units. The 140G product line has 100% rated electronic trip MCCBs. Visit www.rockwellautomation.com for specific devices.

Cable Selection

UL Listed circuit breakers rated 125 A or less shall be marked as being suitable for 60 °C (140 °F), 75 °C (167 °F) only or 60/75 °C (140/167 °F) wire. All Allen-Bradley breakers rated 125 A or less are marked for 60/75 °C wire. All UL Listed circuit breakers rated over 125 A are suitable for 75 °C conductors. Conductors rated for higher temperatures may be used, but must not be loaded to carry more current than the 75 °C ampacity of that size conductor for equipment marked or rated 75 °C, or the 60 °C ampacity of that size conductor for equipment marked or rated 60 °C. However, the full 90 °C (194 °F) ampacity may be used when applying derating factors, so long as the actual load does not exceed the lower of the derated ampacity or the 75 °C or 60 °C ampacity that applies.

Unusual Operating Conditions

Operation below 0 °C

Bulletin 140G MCCBs may be applied in ambient temperatures (near the MCCB within an enclosure) below 0 °C. Applications below 0 °C must consider the possibility of ice forming within or on the MCCB and interfering with the internal or external operating mechanisms. All ratings below 0 °C are based on the absence of freezing water or other elements.

Trip Unit Temperatures

Thermal magnetic circuit breakers are temperature sensitive. At ambient temperatures below 40 °C (104 °F), circuit breakers may carry more current than their continuous current rating. Nuisance tripping is not a problem under these lower temperature conditions, although consideration should be given to closer protection coordination to compensate for the additional current-carrying capability. In addition, the actual mechanical operation of the breaker could be affected if the ambient temperature is significantly below the 40 °C standard.

For ambient temperatures above 40 °C, breakers should carry less current than their continuous current rating. Under this condition, the circuit breaker should be derated for the higher ambient temperature.

Electronic trip units are insensitive to ambient temperatures within a certain temperature range. The temperature range for most electronic trip units is -25 °C…+70 °C (-13 °F…+158 °F). Allen-Bradley MCCBs are designed to include temperature protective circuits that initiate a tripping operation and provide self-protection, should the internal temperature rise to an unsafe level.

Circuit Breaker Temperatures

The temperature of the air immediately surrounding a circuit breaker is the ambient temperature. All Allen-Bradley standard breakers are calibrated to a 40 °C ambient temperature. For any ambient temperature application significantly above or below 40 °C, it is recommended that rerating of the circuit breaker be considered or Rockwell Automation be consulted about any possible re-rating.

Altitude

Low voltage circuit breakers must be derated for voltage and interrupting rating at altitudes above 2000 m (6560 ft) above sea level. The thinner air at higher altitudes reduces cooling and dielectric characteristics compared to the denser air found at lower altitudes.

Use the following tables to derate as appropriate.

Voltage Rating Operational Voltage U_e [V]				
Altitude	2000 m (6560 ft)	3000 m (9840 ft)	4000 m (13,120 ft)	5000 m (16,400 ft)
All Frames	100%	90%	79%	67%

Current Rating Rated Uninterrupted Current I_u [A]				
Altitude	2000 m (6560 ft)	3000 m (9840 ft)	4000 m (13,120 ft)	5000 m (16,400 ft)
All Frames	100%	98%	93%	90%

Unusual Mounting Configurations

Generally, circuit breakers may be mounted in any position, up or down, horizontal or vertical, without affecting the tripping characteristics or interrupting rating. However, mounting circuit breakers in a vertical position with the ON position other than UP will be in violation of Article 240-81 of the NEC.

Tropicalization

The 140G/MG Circuit breakers are tested in compliance with IEC Standards, making these devices suitable for hot-humid conditions defined in IEC 60721-2-1, climatograph 8. These devices include:

- Moldings of glass fiber reinforced synthetic resins
- Metallic parts treated for anti-corrosion
- Zinc plating protected by a conversion layer (hexavalent-chromium free) (e.g. RoHS compliant)
- Electronic circuits protected for anti-condensation

Electromagnetic Compatibility

The 140G/MG Circuit Breakers electronic trip units and electronic residual current releases are in compliance with EN 60947-2 Appendix B and Appendix F and European Directive No. 2004/108/EC regarding EMC – electromagnetic compatibility.

Maintenance Mode (MM)

Maintenance Mode (MM) offers a preset set of protection parameters. MM allows systems testing when the molded case circuit breaker is energized or ON. This feature is a manual adjustment on the molded case circuit breaker, via a DIP switch. Preset values for Maintenance Mode are indicated in the selection guide for each frame size.

MCCB Performance Characteristics

			G-Frame			H-Frame					I-Frame	
	Maximum Rated Current	[A]	125/160 ⑥			125/160 ⑥					225	
	Rated Insulation Voltage, U_i IEC	[V]	800			1000					800	
NEMA, UL, CSA	Interrupting Rating Code ①		**G2**	**G3**	**G6**	**H2**	**H3**	**H6**	**H0**	**H15**	**I2**	**I3**
	240V 50/60 Hz (AC)	[kA]	50	65	100	65	100	150	200	200	50	65
	480V 50/60 Hz (AC)	[kA]	**25**	**35**	**65**	**25**	**35**	**65**	**100**	**150**	**25**	**35**
	600Y-347V 50/60Hz (AC)	[kA]	10	14	25						10	10
	600V 50/60 Hz (AC)	[kA]				14	18	25	35	42		
	(DC) 250V – 2 Poles in Series ⑤	[kA]	35	42	50	35	50	65	75	85	25	35
	(DC) 500V – 2 Poles in Series ⑤	[kA]										
	(DC) 500V – 3 Poles in Series ⑤	[kA]				35	50	65	75	85		
	(DC) 500V – 4 Poles in Series ⑤	[kA]	35	50	50							
	(DC) 600V – 3 Poles in Series ⑤	[kA]										
IEC 60947-2	Rated Ultimate Short-circuit Breaking Capacity, I_{cu}											
	220-230V 50/60 Hz (AC) ②	[kA]	65	85	100	65	85	100	150	200	50	85
	380V 50/60 Hz (AC)	[kA]	36	50	70	36	50	70	120	150	30	50
	400-415V 50/60 Hz (AC)	[kA]	**36**	**50**	**70**	**36**	**50**	**70**	**120**	**150**	**36**	**50**
	440V 50/60 Hz (AC) ②	[kA]	36	50	65	30	36	50	60	70	20	40
	500V 50/60 Hz (AC)	[kA]	30	36	50	20	25	30	36	50	13	20
	525V 50/60 Hz (AC)	[kA]	22	35	35	10	12	15	18	20	5	6
	690V 50/60 Hz (AC)	[kA]	6	8	10	10	12	15	18	20	5	8
	(DC) 250V – 2 Poles in Series ⑤	[kA]	36	50	70	36	50	70	85	100	36	50
	(DC) 500V – 2 Poles in Series ⑤	[kA]										
	(DC) 500V – 3 Poles in Series ⑤	[kA]	36 ③	50 ③	70 ③	36	50	70	85	100	36	50
	(DC) 750V – 3 Poles in Series ⑤	[kA]										
	Rated Service Short-circuit Breaking Capacity, I_{cs}											
	220-230V 50/60 Hz (AC)	[kA]	75% (50)	75%	75%	100%	100%	100%	100%	100%	75%	50%
	380V 50/60 Hz (AC)	[kA]	100%	100%	75%	100%	100%	100%	100%	100%	75%	50% (27)
	400-415V 50/60 Hz (AC)	[kA]	**100%**	**75%**	**50%**	**100%**	**100%**	**100%**	**100%**	**100%**	**75%**	**50% (27)**
	440V 50/60 Hz (AC)	[kA]	50%	50%	50%	100%	100%	100%	100%	100%	75%	50%
	500V 50/60 Hz (AC)	[kA]	50%	50%	50%	100%	100%	100%	100%	100%	75%	50%
	525V 50/60 Hz (AC)	[kA]	50%	50%	50%	100%	100%	100%	100%	100%	75%	50%
	690V 50/60 Hz (AC)	[kA]	75%	50%	50%	100%	100%	100%	100%	75%	75%	50%
	(DC) 250V – 2 Poles in Series ⑤	[kA]	100%	75%	75%	100%	100%	100%	100%	100%	100%	75%
	(DC) 500V – 2 Poles in Series ⑤	[kA]										
	(DC) 500V – 3 Poles in Series ⑤	[kA]	100%	75%	75%	100%	100%	100%	100%	100%	100%	75%
	(DC) 750V – 3 Poles in Series ⑤	[kA]										
	Mechanical Life	[No. of Operations]	25000			25000					25000	
		[Operations per Hour]	240			240					240	
	Electrical Life @ 415V (AC)	[No. of Operations]	8000			8000					8000	
		[Operations per Hour]	120			120					120	
	Wire Temperature Rating ④	[°C]	Cu 75 °C			Cu 75 °C					Al or Cu 75 °C	
	Ambient Temperature w/out derating	°F [°C]	104 °F [40 °C]			104 °F [40 °C]					104 °F [40 °C]	
	Storage Temperature	°F [°C]	-40...176 °F [-40…+80 °C]			-40...176 °F [-40…+80 °C]					-40...176°F [-40…+80 °C]	
	Dimensions	3 Pole [mm]	76.2x70x130			90x82.5x130					105x70x150	
	[Width/Depth/Height]	4 Pole [mm]	101.6x70x130			120x82.5x130					140x70x150	

① Explanation of Interrupting Code - G2 for example: G=G Frame 2= 25 kA@480V. See table for complete ratings.
② These ratings have not been tested for the CCC listing.
③ 500V DC 4 Poles in series.
④ Wire Temperature Ratings is determined by testing the circuit breaker under full load current with the conductors sized for 75 °C.
⑤ DC rating is applicable for thermal-magnetic trip units only.
⑥ IEC version with a 160 A I_{cu} rating.

J-Frame				K-Frame				M-Frame			N & NS-Frame			R-Frame
250				400				800			1200			2000/2500/3000
1000				1000				1000			1000			
J2	**J3**	**J6**	**J0**	**K3**	**K6**	**K0**	**K15**	**K5**	**K6**	**K0**	**N5**	**N6**	**N0**	**R12**
65	100	150	200	100	150	200	200	100	200	200	65	100	150	125
25	**35**	**65**	**100**	**35**	**65**	**100**	**150**	**50**	**65**	**100**	**50**	**65**	**100**	**125**
14	18	25	35	25	35	65	100	25	35	42	25	50	65	100
35	42	50	85											
				35	50	65	100	35	50	65				
35	50	65	75	25	35	50	65	20	35	50				
65	85	100	150	85	100	200	200	85	100	200	85	100	200	130
36	50	70	120	50	70	120	200	50	70	100	50	70	120	80
36	**50**	**70**	**120**	**50**	**70**	**120**	**200**	**50**	**70**	**100**	**50**	**70**	**120**	**80**
36	50	65	100	40	65	100	180	45	50	80	50	65	100	80
30	36	50	60	30	50	85	150	35	50	65	40	50	85	40
20	25	45	50	25	40	70	100	25	35	42	30	50	65	40
10	12	15	20	25	40	70	100	22	25	30	30	42	50	40
36	50	70	85	50	70	100	150	50	70	100				
36	50	70	85	36	50	70	100	35	50	65				
36	50	70	85											
				25	36	50	70	20	36	50				
100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
100%	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	75%	100%
100%	100%	100%	100%	100%	100%	100%	75%(80 kA)	75% (18 kA)	50% (19 kA)	50% (22.5 kA)	75%(30 kA)	50%(31.5 kA)	50% (37.5 kA)	100%
100%	100%	100%	100%	100%	100%	100%	100%	75%	75%	75%	100%	75%	75%	100%
100%	100%	100%	100%	100%	100%	100%	100%	75%	75%	75%				
100%	100%	100%	100%	100%	100%	100%	100%	75%	75%	75%				
100%	100%	100%	100%											
				100%	100%	100%	100%	75%	75%	75%				
25000				20000				20000			10000			15000
240				120				120			60			60
8000				7000 (400A) – 5000 (600A)				7000 (600 – 630A) – 5000 (800A)			2000			4500(2000A) – 4000 (2500A) – 3000 (3200A)
120				60				60			60			60
Al or Cu 75 °C				Al or Cu 75 °C				Al or Cu 75 °C			Al or Cu 75 °C			Al or Cu 75 °C
104 °F [40 °C]				104 °F [40 °C]				104 °F [40 °C]			104 °F [40 °C]			104 °F [40 °C]
-40...176 °F [-40…+80 °C]				-40...176 °F [-40…+80 °C]				-40...176 °F [-40…+80 °C]			-40...176 °F [-40…+80 °C]			-40...176 °F [-40…+80 °C]
105x82.5x160				140x108.5x205				210x103.5x268			210x154(N)/178(NS)x268			427x282x382
140x82.5x160				185x103.5x205				280x103.5x268			280x154(N)/178(NS)x268			553x282x382

140G-G Frame Specifications

125 A (UL/CSA)

160 A (IEC)



Interrupting Rating/Breaking Capacity – Thermal Magnetic Circuit Breakers (See page 24 for additional voltages – breaking capacities)

Interrupting Rating (50/60 Hz), UL 489/CSA C22.2-5, No. 5 [kA]			EN 60947-2											
			Breaking Capacity (50/60 Hz)								Breaking Capacity (DC)			
			220V*		415V		440V*		690V		250V DC (2-pole in series)		500V DC (3-pole in series)	
240V	480V	600Y/347V	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]
50	25	10	65	75	36	100	36	50	6	75	36	100	36	100
65	35	14	85	75	50	75	50	50	8	50	50	100	50	100
100	65	25	100	75	70	50	65	50	10	50	70	75	70	75

* These ratings have not been tested for the CCC listing.

Watt Loss

Type	Rated Current I_n [A]	Watt Loss [W] 3 Poles	4 Poles
Thermal Magnetic	15	4.0	5.3
	16	4.5	6.0
	20	5.4	7.2
	25	6.0	8.0
	30	5.5	7.4
	32	6.3	8.4
	35	6.0	8.0
	40	7.8	10.4
	45	9.0	12.0
	50	11.1	14.8
	60	11.7	15.6
	63	12.9	17.2
	70	11.0	14.7
	80	14.4	19.2
	90	17.0	22.7
	100	21.0	28.0
	110	24.9	33.1
	125	32.1	42.8
	160(*)	45.0	60.0
Molded Case Switch	25	1.2	1.6
	50	4.9	6.6
	75	11.1	14.8
	100	19.8	26.4
	125	30.9	41.2

* IEC only.

Molded Case Switch

Rated Current I_n [A]	Magnetic Trip I_m [A]
125 (600Y/247V AC)	1500

Dimensions (mm)

Plus Terminals

Height	130
Width (3-pole)	76.2
Width (4-pole)	101.2
Depth (case)	70
Depth (op handle)	101

Weight (kg)

3 Poles	1.1
4 Poles	1.4

Mechanical Endurance

Electrical Life (on-off) at 120 operations per hour	8000
Mechanical (on-off) at 240 operations per hour	25,000

Electrical Specifications

		UL/CSA	IEC
Maximum Rated Current (I_n)	[A]	125	160
Frame Ratings (I_u) Rated Uninterrupted Current	[A]	125	160
Rated Insulation Voltage (U_i)	[V]	800	
Rated Impulse Withstand Voltage (U_{imp})	[kV]	8	
Rated Operational Voltage (U_e) – AC UL/CSA (60 Hz) IEC (50 Hz)	[V]	600Y/347V	690
Number of Poles		3 and 4	

Standards Compliance

UL489	Yes
CSA 22.2 No. 5	Yes
EN 60947-2	Yes
CCC GB 14048.2	Yes

Temperature Specification*

Ambient Operating Temperature Range (based on the absence of freezing water or other elements)	-25…+70 °C (-13…+158 °F)
Storage Temperature	-40…+70 °C (-40…+158 °F)
Calibration Temperature	40 °C (104 °F)

* For use at temperatures other than 40 °C (104 °F), see the Temperature Performances information following.

Temperature Performance

140G-G Frame Thermal Magnetic Circuit Breakers

The G frame thermal magnetic circuit breaker is calibrated at 40 °C (104 °F). For applications at other temperatures there is a variation in the thermal tripping as indicated below.

T amb [°C]	40	50	60	70
I_n [A]	Max. [A]	Max. [A]	Max. [A]	Max. [A]
15	15	14	13	12
16	16	15	14	13
20	20	19	18	16
25	25	23	22	20
30	30	28	26	24
32	32	30	28	26
40	40	38	35	33
45	45	42	40	37
50	50	47	44	41
60	60	56	52	49
63	63	59	55	51
70	70	66	61	57
80	80	75	70	65
90	90	85	79	73
100	100	94	88	81
110	110	103	96	90
125	125	117	109	102
160*	160*	150*	140*	130*

* IEC only.

Molded Case Switch and Motor Circuit Protectors

Molded case switch and motor circuit protectors do not undergo tripping variations due to ambient temperature. However, even though ambient temperature does not affect the tripping characteristic, for temperatures exceeding +40 °C it is advisable to reduce the maximum current to prevent terminal overheating.

The tables below show the maximum current to prevent terminal overheating.

North America

40 °C (104 °F)	50 °C (122 °F)	60 °C (140 °F)	70 °C (158 °F)
I_{max} [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]
3	3	3	3
7	7	7	7
15	15	15	15
30	30	30	30
50	50	50	50
70	70	70	70
80	80	79	79
100	93	84	79
125	112	97	79

IEC

40 °C (104 °F)	50 °C (122 °F)	60 °C (140 °F)	70 °C (158 °F)
I_{max} [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]
3	3	3	3
7	7	7	7
15	15	15	15
30	30	30	30
50	50	50	50
70	70	70	70
80	80	80	80
100	100	100	100
125	125	125	125
160	160	153	136

140G-H Frame Specifications



125 A (UL/CSA)

160 A (IEC)

Interrupting Rating/Breaking Capacity – Thermal Magnetic and Electronic Circuit Breakers

(See page 24 for additional voltages – breaking capacities)

Interrupting Rating (50/60 Hz), UL 489/CSA C22.2-5, No. 5 [kA]			EN 60947-2											
			Breaking Capacity (50/60 Hz)								Breaking Capacity (DC) †			
			220V*		415V		440V*		690V		250V DC (2-pole in series)		500V DC (3-pole in series)	
240V	480V	600V	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]
65	25	14	65	100	36	100	36	100	10	100	36	100	36	100
100	35	18	85	100	50	100	50	100	12	100	50	100	50	100
150	65	25	100	100	70	100	65	100	15	100	70	100	70	100
200	100	35	150	100	120	100	100	100	18	75	85	100	85	100
200	150	42	200	100	150	100	150	100	20	75	100	100	100	100

* These ratings have not been tested for the CCC listing.

† DC rating is applicable for thermal magnetic trip unit only.

Watt Loss

Type	Rated Current I_n [A]	Watt Loss [W] 3 Poles	4 Poles
Thermal Magnetic	15	3.4	4.6
	16	3.9	5.2
	20	4.8	6.4
	25	5.4	7.2
	30	6.9	9.1
	32	7.8	10.4
	35	8.5	11.3
	40	11.1	14.8
	50	12.3	16.4
	60	13.1	17.4
	63	14.4	19.2
	70	13.3	17.8
	80	17.4	23.2
	90	19.7	26.2
	100	24.3	32.4
	110	26.5	35.3
	125	34.2	45.6
	160(*)	48.5	64.6
Electronic	10	0.3	0.4
	25	2.4	3.2
	60	4.5	6.0
	100	12.6	16.8
	125	19.8	26.4
Molded Case Switch	25	0.8	1.1
	50	3.2	4.2
	75	7.1	9.5
	100	12.7	16.9
	125	19.8	26.4

* IEC only.

Molded Case Switch

Rated Current I_n [A]	Magnetic Trip I_m [A]
125	1500

Dimensions (mm)

Plus Terminals

Height	130
Width (3-pole)	90
Width (4-pole)	120
Depth (case)	82.5
Depth (op handle)	101

Weight (kg)

3 Poles	1.2
4 Poles	1.6

Mechanical Endurance

Electrical Life (on-off) at 120 operations per hour	8000
Mechanical (on-off) at 240 operations per hour	25,000

Electrical Specifications

		UL/CSA	IEC
Maximum Rated Current (I_n)	[A]	125	160
Frame Ratings (I_u) Rated Uninterrupted Current	[A]	125	160
Rated Insulation Voltage (U_i)	[V]	1000	
Rated Impulse Withstand Voltage (U_{imp})	[kV]	8	
Rated Operational Voltage (U_e) – AC UL/CSA (60 Hz) IEC (50 Hz)	[V]	600	690
Maximum Reverse Fed Voltage	[V AC]	480	480
Number of Poles		3 and 4	

Standards Compliance

UL489	Yes
CSA 22.2 No. 5	Yes
EN 60947-2	Yes
CCC GB 14048.2	Yes

Temperature Specification*

Ambient Operating Temperature Range (based on the absence of freezing water or other elements)	-25…+70 °C (-13…+158 °F)
Storage Temperature	-40…+70 °C (-40…+158 °F)
Calibration Temperature	40 °C (104 °F)

* For use at temperatures other than 40 °C (104 °F), see the Temperature Performances information following.

Temperature Performance

140G-H Frame Thermal Magnetic Circuit Breakers

The H frame thermal magnetic circuit breaker is calibrated at 40 °C (104 °F). For applications at other temperatures there is a variation in the thermal tripping as indicated below.

T amb [°C]	40	50	60	70
I_n [A]	Max. [A]	Max. [A]	Max. [A]	Max. [A]
15	15	14	13	12
16	16	15	14	13
20	20	19	17	16
25	25	23	22	20
30	30	28	26	24
32	32	30	28	26
40	40	37	35	32
50	50	47	43	40
60	60	56	52	49
63	63	59	55	51
70	70	66	61	57
80	80	75	70	65
90	90	86	78	73
100	100	93	87	81
110	110	103	96	89
125	125	117	109	101
160*	160*	150*	139*	129*

* IEC only.

Electronic Trip Circuit Breakers, Molded Case Switches and Motor Circuit Protectors

The electronic trip circuit breakers do not undergo tripping variations due to ambient temperature. However, even though ambient temperature does not affect the tripping characteristic, for temperatures exceeding +40 °C it is advisable to reduce the maximum current to prevent terminal overheating.

The same considerations are appropriate for molded case switch and motor circuit protectors.

The tables below show the maximum current to prevent terminal overheating.

North America

40 °C (104 °F)	50 °C (122 °F)	60 °C (140 °F)	70 °C (158 °F)
I_{max} [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]
3	3	3	3
7	7	7	7
15	15	15	15
30	30	30	30
50	50	50	50
70	70	70	70
80	80	79	79
100	93	84	79
125	112	97	79

IEC

40 °C (104 °F)	50 °C (122 °F)	60 °C (140 °F)	70 °C (158 °F)
I_{max} [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]
3	3	3	3
7	7	7	7
15	15	15	15
30	30	30	30
50	50	50	50
70	70	70	70
80	80	80	80
100	100	100	100
125	125	125	125
160	160	146	131

140G-I Frame Specifications

225 A (UL/CSA)

225 A (IEC)



Interrupting Rating/Breaking Capacity – Thermal Magnetic Circuit Breakers (See page 24 for additional voltages – breaking capacities)

Interrupting Rating (50/60 Hz), UL 489/CSA C22.2-5, No. 5 [kA]			EN 60947-2											
			Breaking Capacity (50/60 Hz)								Breaking Capacity (DC)			
			220V*		415V		440V*		690V		250V DC (2-pole in series)		500V DC (3-pole in series)	
240V	480V	600Y/ 347V	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]
50	25	10	50	75	36	75	25	75	5	50	36	100	36	100
65	35	10	85	50	50	50	40	50	6	50	50	75	50	75

* These ratings have not been tested for the CCC listing.

Watt Loss

Type	Rated Current I_n [A]	Watt Loss [W] 3 Poles	4 Poles
Thermal Magnetic	60	11.7	15.6
	63	12.9	17.2
	70	11.0	14.7
	80	14.4	19.2
	90	13.6	18.1
	100	16.8	22.4
	110	17.4	23.2
	125	19.8	26.4
	150	20.8	27.8
	160	23.7	31.6
	175	30.3	40.4
	200	39.6	52.8
	225	43.2	57.6
Molded Case Switch	25	0.5	0.7
	50	2.1	2.8
	75	4.8	6.4
	100	8.5	11.4
	125	13.3	17.8
	150	19.2	25.6
	175	26.1	34.8
	200	34.1	45.5
	225	43.2	57.6

Molded Case Switch

Rated Current I_n [A]	Magnetic Trip I_m [A]
225	2700

Dimensions (mm)

Plus Terminals

Height	150
Width (3-pole)	105
Width (4-pole)	140
Depth (case)	70
Depth (op handle)	101

Weight (kg)

3 Poles	1.7
4 Poles	2.1

Mechanical Endurance

Electrical Life (on-off) at 120 operations per hour	8000
Mechanical (on-off) at 240 operations per hour	25,000

Electrical Specifications

		UL/CSA	IEC
Maximum Rated Current (I_n)	[A]	225	225
Frame Ratings (I_u) Rated Uninterrupted Current	[A]	225	225
Rated Insulation Voltage (U_i)	[V]	800	
Rated Impulse Withstand Voltage (U_{imp})	[kV]	8	
Rated Operational Voltage (U_e) – AC UL/CSA (60 Hz) IEC (50 Hz)	[V]	600Y/347V	690
Number of Poles		3 and 4	

Standards Compliance

UL489	Yes
CSA 22.2 No. 5	Yes
EN 60947-2	Yes
CCC GB 14048.2	Yes

Temperature Specification*

Ambient Operating Temperature Range (based on the absence of freezing water or other elements)	-25…+70 °C (-13…+158 °F)
Storage Temperature	-40…+70 °C (-40…+158 °F)
Calibration Temperature	40 °C (104 °F)

* For use at temperatures other than 40 °C (104 °F), see the Temperature Performances information following.

Temperature Performance

140G-I Frame Thermal Magnetic Circuit Breakers

The I frame thermal magnetic circuit breaker is calibrated at 40 °C (104 °F). For applications at other temperatures there is a variation in the thermal tripping as indicated below.

T amb [°C]	40	50	60	70
I_n [A]	Max. [A]	Max. [A]	Max. [A]	Max. [A]
60	60	56	52	49
63	63	59	55	51
70	70	66	60	56
80	80	75	69	64
90	90	84	78	72
100	100	93	87	80
110	110	102	95	88
125	125	116	108	100
150	150	140	130	121
160	160	149	139	129
200	200	186	173	161
225	225	210	196	181

Molded Case Switch and Motor Circuit Protectors

Molded case switch and motor circuit protectors do not undergo tripping variations due to ambient temperature. However, even though ambient temperature does not affect the tripping characteristic, for temperatures exceeding +40 °C it is advisable to reduce the maximum current to prevent terminal overheating.

The tables below show the maximum current to prevent terminal overheating.

North America

40 °C (104 °F)	50 °C (122 °F)	60 °C (140 °F)	70 °C (158 °F)
I_{max} [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]
100	100	100	100
110	110	110	110
125	125	125	125
150	148	153	142
200	181	161	142
225	199	175	142

IEC

40 °C (104 °F)	50 °C (122 °F)	60 °C (140 °F)	70 °C (158 °F)
I_{max} [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]
100	100	100	100
110	110	110	110
125	125	125	125
150	150	150	150
200	200	200	200
225	225	214	204

140G-J Frame Specifications



250 A (UL/CSA)

250 A (IEC)

Interrupting Rating/Breaking Capacity – Thermal Magnetic and Electronic Circuit Breakers

(See page 25 for additional voltages – breaking capacities)

Interrupting Rating (50/60 Hz), UL 489/CSA C22.2-5, No. 5 [kA]			EN 60947-2											
			Breaking Capacity (50/60 Hz)								Breaking Capacity (DC) †			
			220V*		415V		440V*		690V		250V DC (2-pole in series)		500V DC (3-pole in series)	
240V	480V	600V	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]
65	25	14	65	100	36	100	36	100	10	100	36	100	36	100
100	35	18	85	100	50	100	50	100	12	100	50	100	50	100
150	65	25	100	100	70	100	65	100	15	100	70	100	70	100
200	100	35	150	100	120	100	100	100	20	100	85	100	85	100

* These ratings have not been tested for the CCC listing.

† DC rating is applicable for thermal magnetic trip unit only.

Watt Loss

Type	Rated Current I_n [A]	Watt Loss [W] 3 Poles	4 Poles
Thermal Magnetic	25	8.1	10.7
	30	11.6	15.5
	32	13.2	17.6
	35	13.2	17.6
	40	13.5	18.0
	50	14.1	18.8
	60	14.4	19.2
	63	15.9	21.2
	70	16.2	21.6
	80	16.5	22.0
	90	18.0	24.0
	100	18.6	24.8
	110	20.1	26.8
	125	22.2	29.6
	150	23.5	31.3
	160	26.7	35.6
	175	27.3	36.4
	200	35.7	47.6
	225	39.9	53.1
	250	49.2	65.6
Electronic	40	1.8	2.4
	60	3.8	5.1
	63	4.2	5.6
	100	10.5	14.0
	150	23.5	31.4
	225	53.0	70.6
	250	65.4	87.2
Molded Case Switch	25	0.7	0.9
	50	2.6	3.5
	75	5.9	7.8
	100	10.5	14.0
	125	16.4	21.8
	150	23.5	31.4
	175	32.0	42.7
	200	41.9	55.8
	225	53.0	70.6
	250	65.4	87.2

Molded Case Switch

Rated Current I_n [A]	Magnetic Trip I_m [A]
250	3000

Dimensions (mm)

Plus Terminals

Height	160
Width (3-pole)	105
Width (4-pole)	140
Depth (case)	82.5
Depth (op handle)	117

Weight (kg)

3 Poles	2.5
4 Poles	3.5

Mechanical Endurance

Electrical Life (on-off) at 120 operations per hour	8000
Mechanical (on-off) at 240 operations per hour	25,000

Electrical Specifications

		UL/CSA	IEC
Maximum Rated Current (I_n)	[A]	250	250
Frame Ratings (I_u) Rated Uninterrupted Current	[A]	250	250
Rated Insulation Voltage (U_i)	[V]	1000	
Rated Impulse Withstand Voltage (U_{imp})	[kV]	8	
Rated Operational Voltage (U_e) – AC UL/CSA (60 Hz) IEC (50 Hz)	[V]	600	690
Maximum Reverse Fed Voltage	[V AC]	600	600
Number of Poles		3 and 4	

Standards Compliance

UL489	Yes
CSA 22.2 No. 5	Yes
EN 60947-2	Yes
CCC GB 14048.2	Yes

Temperature Specification*

Ambient Operating Temperature Range (based on the absence of freezing water or other elements)	-25…+70 °C (-13…+158 °F)
Storage Temperature	-40…+70 °C (-40…+158 °F)
Calibration Temperature	40 °C (104 °F)

* For use at temperatures other than 40 °C (104 °F), see the Temperature Performances information following.

Temperature Performance

140G-J Frame Thermal Magnetic Circuit Breakers

The J frame thermal magnetic circuit breaker is calibrated at 40 °C (104 °F). For applications at other temperatures there is a variation in the thermal tripping as indicated below.

T amb [°C]	40	50	60	70
I_n [A]	Max. [A]	Max. [A]	Max. [A]	Max. [A]
25	25	23	21	19
30	30	25	23	20
32	32	27	24	21
35	35	32	30	26
40	40	37	34	30
50	50	46	42	39
60	60	56	51	45
63	63	58	53	48
70	70	65	58	51
80	80	74	66	58
90	90	86	77	68
100	100	95	85	75
110	110	101	92	84
125	125	115	105	95
160	160	150	137	140
175	175	166	153	142
200	200	190	175	160
225	225	208	190	170
250	250	240	230	220

Electronic Trip Circuit Breakers, Molded Case Switches and Motor Circuit Protectors

The electronic trip circuit breakers do not undergo tripping variations due to ambient temperature. However, even though ambient temperature does not affect the tripping characteristic, for temperatures exceeding +40 °C it is advisable to reduce the maximum current to prevent terminal overheating.

The same considerations are appropriate for molded case switch and motor circuit protectors.

The tables below show the maximum current to prevent terminal overheating.

North America

40 °C (104 °F)	50 °C (122 °F)	60 °C (140 °F)	70 °C (158 °F)
I_{max} [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]
150	150	150	150
175	175	164	158
200	200	172	158
225	225	180	158
250	250	222	158

IEC

40 °C (104 °F)	50 °C (122 °F)	60 °C (140 °F)	70 °C (158 °F)
I_{max} [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]
150	150	150	150
175	175	175	175
200	200	200	200
225	225	221	213
250	250	238	213

140G-K Frame Specifications

400 A (UL/CSA)

400 A (IEC)



Interrupting Rating/Breaking Capacity – Thermal Magnetic Circuit Breakers (See page 25 for additional voltages – breaking capacities)

Interrupting Rating (50/60 Hz), UL 489/CSA C22.2-5, No. 5 [kA]			EN 60947-2											
					Breaking Capacity (50/60 Hz)								Breaking Capacity (DC)	
			2-pole in series	3-pole in series	220V*		415V		440V*		690V		500V DC (3-pole in series)	
240V	480V	600V	500V DC	600V DC	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]
100	35	25	35	25	85	100	50	100	40	100	25	100	36	100
150	65	35	50	35	100	100	70	100	65	100	40	100	50	100
200	100	65	65	50	200	100	120	100	100	100	70	100	70	100
200	150	100	100	65	200	100	200	100	180	100	80	100	100	100

* These ratings have not been tested for the CCC listing.

Watt Loss

Type	Rated Current I_n [A]	Watt Loss [W] 3 Poles	4 Poles
Thermal Magnetic	300	40.8	54.4
	400	58.5	78.0
Molded Case Switch and Electronic	300	31.8	42.4
	400	49.5	66

Molded Case Switch

Rated Current I_n [A]	Magnetic Trip I_m [A]
400	5000

Dimensions (mm)

Plus Terminals

Height	205
Width (3-pole)	139.5
Width (4-pole)	186
Depth (case)	103.5
Depth (op handle)	139

Weight (kg)

3 Poles	3.25
4 Poles	4.15

Mechanical Endurance

Electrical Life (on-off) at 60 operations per hour	7000
Mechanical (on-off) at 120 operations per hour	20,000

Electrical Specifications

		UL/CSA	IEC
Maximum Rated Current (I_n)	[A]	400	400
Frame Ratings (I_u) Rated Uninterrupted Current	[A]	400	400
Rated Insulation Voltage (U_i)	[V]	1000	
Rated Impulse Withstand Voltage (U_{imp})	[kV]	8	
Rated Operational Voltage (U_e) – AC UL/CSA (60 Hz) IEC (50 Hz)	[V]	600	690
Number of Poles		3 and 4	

Standards Compliance

UL489	Yes
CSA 22.2 No. 5	Yes
EN 60947-2	Yes
CCC GB 14048.2	Yes

Temperature Specification*

Ambient Operating Temperature Range (based on the absence of freezing water or other elements)	-25…+70 °C (-13…+158 °F)
Storage Temperature	-40…+70 °C (-40…+158 °F)
Calibration Temperature	40 °C (104 °F)

* For use at temperatures other than 40 °C (104 °F), see the Temperature Performances information following.

Temperature Performance

140G-K Frame Thermal Magnetic Circuit Breakers

The K frame thermal magnetic circuit breaker is calibrated at 40 °C (104 °F). For applications at other temperatures there is a variation in the thermal tripping as indicated below.

T amb [°C]	40	50	60	70
I_n [A]	Max. [A]	Max. [A]	Max. [A]	Max. [A]
300	300	286	267	247
400	400	380	355	325

Electronic Trip Circuit Breakers, Molded Case Switches and Motor Circuit Protectors

The electronic trip circuit breakers do not undergo tripping variations due to ambient temperature. However, even though ambient temperature does not affect the tripping characteristic, for temperatures exceeding +40 °C it is advisable to reduce the maximum current to prevent terminal overheating.

The same considerations are appropriate for molded case switch and motor circuit protectors.

The tables below show the maximum current to prevent terminal overheating.

North America

	40 °C (104 °F)	50 °C (122 °F)	60 °C (140 °F)	70 °C (158 °F)
I_n [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]
300	300	264	228	189
400	400	352	304	252

IEC

	40 °C (104 °F)	50 °C (122 °F)	60 °C (140 °F)	70 °C (158 °F)
I_n [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]
300	300	300	300	300
400	400	400	400	352

140G-M Frame Specifications

800 A (UL/CSA)

800 A (IEC)



Interrupting Rating/Breaking Capacity – Thermal Magnetic Circuit Breakers (See page 25 for additional voltages – breaking capacities)

Interrupting Rating (50/60 Hz), UL 489/CSA C22.2-5, No. 5 [kA]				EN 60947-2							
				Breaking Capacity (50/60 Hz)						Breaking Capacity (DC)	
			3-pole in series	220V*		415V		690V		500V DC (3-pole in series)	
240V	480V	600V	600V DC	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]
100	50	25	20	85	100	50	100	22	75	16	75
200	65	35	35	100	100	70	100	25	75	36	75
200	100	42	50	200	75	100	75	30	75	50	75

* These ratings have not been tested for the CCC listing.

Watt Loss

Type	Rated Current I_n [A]	Watt Loss [W] 3 Poles	4 Poles
Thermal Magnetic	600	90.0	120.0
	630 (*)	91.8	122.4
	800	93.0	124.0
Molded Case Switch and Electronic	600	86.4	115.2
	630 (*)	90.0	120.0
	800	96.0	128.0

* IEC only

Molded Case Switch

Rated Current I_n [A]	Magnetic Trip I_m [A]
800	10,000

Dimensions (mm)

Plus Terminals

Height	268
Width (3-pole)	210
Width (4-pole)	280
Depth (case)	103.5
Depth (op handle)	159

Weight (kg)

3 Poles	12.1
4 Poles	15.1

Mechanical Endurance

Electrical Life (on-off) at 60 operations per hour	7000 (630 A) 5000 (800 A)
Mechanical (on-off) at 120 operations per hour	20,000

Electrical Specifications

		UL/CSA	IEC
Maximum Rated Current (I_n)	[A]	800	800
Frame Ratings (I_u) Rated Uninterrupted Current	[A]	800	800
Rated Insulation Voltage (U_i)	[V]	1000	
Rated Impulse Withstand Voltage (U_{imp})	[kV]	8	
Rated Operational Voltage (U_e) – AC UL/CSA (60 Hz) IEC (50 Hz)	[V]	600	690
Number of Poles		3 and 4	

Standards Compliance

UL489	Yes
CSA 22.2 No. 5	Yes
EN 60947-2	Yes
CCC GB 14048.2	Yes

Temperature Specification*

Ambient Operating Temperature Range (based on the absence of freezing water or other elements)	-25…+70 °C (-13…+158 °F)
Storage Temperature	-40…+70 °C (-40…+158 °F)
Calibration Temperature	40 °C (104 °F)

* For use at temperatures other than 40 °C (104 °F), see the Temperature Performances information following.

Temperature Performance

140G-M Frame Thermal Magnetic Circuit Breakers

The M frame thermal magnetic circuit breaker is calibrated at 40 °C (104 °F). For applications at other temperatures there is a variation in the thermal tripping as indicated below.

T amb [°C]	40	50	60	70
I_n [A]	Max. [A]	Max. [A]	Max. [A]	Max. [A]
600	600	552	514	476
630*	630	580	540	500
800	800	740	670	610

* IEC only.

Electronic Trip Circuit Breakers, Molded Case Switches and Motor Circuit Protectors

The electronic trip circuit breakers do not undergo tripping variations due to ambient temperature. However, even though ambient temperature does not affect the tripping characteristic, for temperatures exceeding +40 °C it is advisable to reduce the maximum current to prevent terminal overheating.

The same considerations are appropriate for molded case switch and motor circuit protectors.

The tables below show the maximum current to prevent terminal overheating.

North America

	40 °C (104 °F)	50 °C (122 °F)	60 °C (140 °F)	70 °C (158 °F)
I_n [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]
600	600	528	456	378
800	800	704	608	504

IEC

	40 °C (104 °F)	50 °C (122 °F)	60 °C (140 °F)	70 °C (158 °F)
I_n [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]
630	630	630	598.5	567
800	800	800	760	720

140G-N/NS Frame Specifications

1200 A (UL/CSA)

1200 A (IEC)



Interrupting Rating/Breaking Capacity – Electronic Circuit Breakers (See page 25 for additional voltages – breaking capacities)

Interrupting Rating (50/60 Hz), UL 489/CSA C22.2-5, No. 5 [kA]			Breaking Capacity (50/60 Hz), EN 60947-2									
			220V		415V		440V		500V		690V	
240V	480V	600V	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]
65	50	25	85	85	50	50	50	50	40	40	30	30
100	65	50	100	100	70	70	65	65	50	50	42	32
150	100	65	200	200	120	120	100	100	85	64	50	38

Watt Loss – Electronic and Molded Case Switch

Rated Current I_n [A]	Watt Loss [W]	
	3 Poles	4 Poles
1200	252.0	336.0

Molded Case Switch

Rated Current I_n [A]	Magnetic Trip I_m [A]
1200	20,000

Dimensions (mm)

Plus Terminals

Height	268
Width (3-pole)	210
Width (4-pole)	280
Depth (case)	125
Depth (op handle)	225

Weight (kg)

N – 3/4 Poles	9.7/12.5
NS – 3/4 Poles	11/14

Mechanical Endurance

Electrical Life (on-off) at 60 operations per hour	2000
Mechanical (on-off) at 60 operations per hour	10,000

Electrical Specifications

		UL/CSA	IEC
Maximum Rated Current (I_n)	[A]	1200	1200
Frame Ratings (I_u) Rated Uninterrupted Current	[A]	1200	1200
Rated Insulation Voltage (U_i)	[V]	1000	
Rated Impulse Withstand Voltage (U_{imp})	[kV]	8	
Rated Operational Voltage (U_e) – AC UL/CSA (60 Hz) IEC (50 Hz)	[V]	600	690
Number of Poles		3 and 4	

Standards Compliance

UL489	Yes
CSA 22.2 No. 5	Yes
EN 60947-2	Yes
CCC GB 14048.2	Yes

Temperature Specification*

Ambient Operating Temperature Range (based on the absence of freezing water or other elements)	-25…+70 °C (-13…+158 °F)
Storage Temperature	-40…+70 °C (-40…+158 °F)
Calibration Temperature	40 °C (104 °F)

* For use at temperatures other than 40 °C (104 °F), see the Temperature Performances information following.

Temperature Performance

140G-N/NS Frame Electronic Trip Circuit Breakers, Molded Case Switches and Motor Circuit Protectors

The N/NS frame electronic trip circuit breakers do not undergo tripping variations due to ambient temperature. However, even though ambient temperature does not affect the tripping characteristic, for temperatures exceeding +40 °C it is advisable to reduce the maximum current to prevent terminal overheating.

The same considerations are appropriate for molded case switch and motor circuit protectors.

The tables below show the maximum current to prevent terminal overheating.

North America

	40 °C (104 °F)	50 °C (122 °F)	60 °C (140 °F)	70 °C (158 °F)
I_n [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]
1200	1200	1056	815	756

IEC

	40 °C (104 °F)	50 °C (122 °F)	60 °C (140 °F)	70 °C (158 °F)
I_n [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]
1250	1250	1250	1118	980

140G-R Frame Specifications

2000/2500/3000 A (UL/CSA/IEC)



Interrupting Rating/Breaking Capacity – Electronic Circuit Breakers (See page 25 for additional voltages – breaking capacities)

Interrupting Rating (50/60 Hz), UL 489/CSA C22.2-5, No. 5 [kA]			Breaking Capacity (50/60 Hz), EN 60947-2									
			220V		415V		440V		500V		690V	
240V	480V	600V	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]
125	125	100	130	97.5	80	60	80	60	40	40	40	40

Watt Loss – Electronic and Molded Case Switch

Rated Current I_n [A]	Watt Loss [W]	
	3 Poles	4 Poles
2000	138	184
2500	219	292
3000	351	468

Molded Case Switch

Rated Current I_n [A]	Magnetic Trip I_m [A]
2500	40,000

Dimensions (mm)

Plus Terminals

Height	382
Width (3-pole)	428
Width (4-pole)	554
Depth (case)	231
Depth (op handle)	284

Weight (kg)

3 Pole	73

Mechanical Endurance

Electrical Life (on-off) at 60 operations per hour	4500 (2000 A) 4000 (3000 A)
Mechanical (on-off) at 60 operations per hour	15,000

Electrical Specifications

		UL/CSA	IEC
Maximum Rated Current (I_n)	[A]	3000	3000
Frame Ratings (I_u) Rated Uninterrupted Current	[A]	3000	3000
Rated Insulation Voltage (U_i)	[V]	1000	
Rated Impulse Withstand Voltage (U_{imp})	[kV]	12	
Rated Operational Voltage (U_e) – AC UL/CSA (60 Hz) IEC (50 Hz)	[V]	600	690
Number of Poles		3 and 4	

Standards Compliance

UL489	Yes
CSA 22.2 No. 5	Yes
EN 60947-2	Yes
CCC GB 14048.2	Yes

Temperature Specification*

Ambient Operating Temperature Range (based on the absence of freezing water or other elements)	-25…+70 °C (-13…+158 °F)
Storage Temperature	-40…+70 °C (-40…+158 °F)
Calibration Temperature	40 °C (104 °F)

* For use at temperatures other than 40 °C (104 °F), see the Temperature Performances information following.

Temperature Performance

140G-R Frame Electronic Trip Circuit Breakers and Molded Case Switches

The R frame electronic trip circuit breakers do not undergo tripping variations due to ambient temperature. However, even though ambient temperature does not affect the tripping characteristic, for temperatures exceeding +40 °C it is advisable to reduce the maximum setting for external thermal protection against overloads per the following.

The same considerations are appropriate for molded case switches, except instead of a current adjustment, the table should be used to reflect the maximum current at the specific temperature.

The tables below show the maximum adjustment at which the threshold I_1 of the overcurrent protection (L) must be set according to the ambient temperature.

North America

	40 °C (104 °F)	50 °C (122 °F)	60 °C (140 °F)	70 °C (158 °F)
I_n [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]
2000	2000	1760	1520	1260
2500	2500	2200	1900	1575
3000	3000	2640	2280	1890

IEC

	40 °C (104 °F)	50 °C (122 °F)	60 °C (140 °F)	70 °C (158 °F)
I_n [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]	I_{max} [A]
2000	2000	2000	1826	1633
2500	2500	2500	2283	2042
3000	3000	3000	2800	2613

MCP Performance Characteristics

			G-Frame	H-Frame	I-Frame
	Frame Size	[A]	125	125	225
	Poles		3	3	3
	Instantaneous Trip Settings	[A]	3…125	3...125	100…150
	Rated Insulation Voltage, U_i IEC	[V]	800	1000	800
NEMA, UL, CSA	UL 489 Instantaneous Trip Circuit Breaker (Magnetic Only) Max SCCR. **Combination Controller Rating** ②				
	480V AC	[kA]	65	65	35
	600/347V AC	[kA]	25	–	10
	600V AC	[kA]	–	25	
IEC 60947-2 GB14048.2	Rated Ultimate Short-circuit Breaking Capacity, I_{cu}				
	220-230V AC ①	[kA]	65 ⑤	100 ⑥	85
	400-415V AC	[kA]	36 ⑤	70 ⑥	50
	440V AC ①	[kA]	36 ⑤	65 ⑥	40
	500V AC	[kA]	30 ⑤	50 ⑥	30
	525V AC	[kA]	22 ⑤	30 ⑥	20
	690V AC	[kA]	6 ⑤	15 ⑥	6
	(DC) 250V – 2 Poles in Series	[kA]	36 ⑤	36 ⑥	50
	(DC) 500V – 3 Poles in Series	[kA]	–	36 ⑥	50
	Rated Service Short-circuit Breaking Capacity, I_{cs}				
	220-230V AC ①	[kA]	75% ⑤	100% ⑥	50%
	400-415V AC	[kA]	100% ⑤	100% ⑥	50% (27)
	440V AC ①	[kA]	50% ⑤	100% ⑥	50% (27)
	500V AC	[kA]	50% ⑤	100% ⑥	50%
	525V AC	[kA]	50% ⑤	100% ⑥	50%
	690V AC	[kA]	75% ⑤	100% ⑥	50%
	(DC) 250V – 2 Poles in Series	[kA]	100% ⑤	100% ⑥	75%
	(DC) 500V – 3 Poles in Series	[kA]	–	100% ⑥	75%
	Mechanical Life	[No. of Operations]	25000	25000	25000
		[Operations per Hour]	240	240	240
	Electrical Life @ 415V (AC)	[No. of Operations]	8000	8000	8000
		[Operations per Hour]	120	120	120
	Wire Temperature Rating ④	[°C]	Cu 75 °C	Al or Cu 75 °C	Al or Cu 75 °C
	Ambient Temperature w/out derating	°F [°C]	104 °F [40 °C]	104 °F [40 °C]	104 °F [40 °C]
	Operating Temperature	°F [°C]	-13…+158 °F [-25…+70 °C]	-13…+158 °F [-25…+70 °C]	-13…+158 °F [-25…+70 °C]
	Storage Temperature	°F [°C]	-40...158 °F [-40…+70 °C]	-40...158 °F [-40…+70 °C]	-40...158 °F [-40…+70 °C]
	Dimensions	[mm]	76.2x70x130	90x82.5x130	105x70x150
	[Width/Depth/Height]	[inches]	3x2.76x5.12	3.54x3.25x5.12	4.13x2.76x5.9
	Weight (approximate)	lb [kg]	2.4 [1.1]	2.6 [1.2]	3.7 [1.7]

① These ratings have not been tested for the CCC listing.
② The Short Circuit value is based on a combined of MCP, motor contactor and overload relay as a UL60497-4-1 Type D Combination Motor Controller. Refer to the AB Global Short Circuit Current Ratings Tables, or contact your local Allen Bradley Representative.
③ Adjustable between 1…10x motor FLA. Value based on 1200A rating plug.
④ Wire temperature Rating is determined by testing the Motor Circuit Protector under full load current with the conductors sized for 75 °C.

3A–7A, G Frame

		230V	415V	440V	500–525V	690V	250V DC
⑤	I_{cu} [kA]	5	5	3	3	3	5
	I_{cs} [kA]	100%	100%	100%	100%	100%	100%

J-Frame	K-Frame	M-Frame	N-Frame
250	400	800	1200
3	3	3	3
150…250	300 & 400	600 & 800	1200 ③
1000	1000	1000	1000
65	65	65	–
–	–	–	–
25	35	35	–
100	100	100	100
70	70	70	70
65	65	50	65
50	50	50	50
45	40	25	42
15	40	25	42
70	–	–	–
70	–	–	–
100%	100%	100%	100%
100%	100%	100%	100%
100%	100%	100%	100%
100%	100%	100%	100%
100%	100%	75%	75%
100%	100%	75%	75%
100%	–	–	–
100%	–	–	–
25000	20000	20000	10000
240	120	120	60
8000	7000	5000	2000
120	60	60	60
Al or Cu 75 °C	Al or Cu 75 °C	Al or Cu 75 °C	Al or Cu 75 °C
104 °F [40 °C]	104 °F [40 °C]	104 °F [40 °C]	104 °F [40 °C]
-13…+158 °F [-25…+70 °C]	-13…+158 °F [-25…+70 °C]	-13…+158 °F [-25…+70 °C]	-13…+158 °F [-25…+70 °C]
-40...158 °F [-40…+70 °C]	-40...158 °F [-40…+70 °C]	-40...158 °F [-40…+70 °C]	-40...158 °F [-40…+70 °C]
105x82.5x160	140x108.5x205	210x103.5x268	210x154x268
4.13x3.25x6.3	5.51x4.27x8.07	8.27x4.07x10.55	8.27x6.06x10.55
5.5 [2.5]	7.2 [3.25]	21 [9.5]	21.4 [9.7]

3A–7A, H Frame

		230V	415V	440V	500–525V	690V	250V DC	500V DC
⑥	I_{cu} [kA]	5	5	3	3	3	5	5
	I_{cs} [kA]	100%	100%	100%	100%	100%	100%	100%

140MG-G Frame Specifications



	Maximum		
UL Hp Rating @ 60 Hz	230V AC	460V AC	575V AC
	40	100	125
IEC kW Rating @ 50 Hz	230V AC	400/415V AC	690V AC
	22	45	110

Interrupting Rating/Breaking Capacity – Motor Circuit Protector

See page 42 for Interrupting Rating/Breaking Capacity values.

Dimensions (mm)

Plus Terminals

Height	130
Width (3-pole)	76.2
Depth (case)	70
Depth (op handle)	101

Mechanical Endurance

Electrical Life (on-off) at 120 operations per hour	8000
Mechanical (on-off) at 240 operations per hour	25,000

Watt Loss

Rated Current I_n [A]	Watt Loss [W]
3	4.2
7	9.9
15	3.3
30	6.9
50	9.3
70	15.9
80	15.9
100	19.8
125	30.9

Electrical Specifications

			Maximum
Maximum Rated Current [I_n]	[A]		125
Frame Ratings [I_u] Rated Uninterrupted Current	[A]		125
Rated Insulation Voltage [U_i]	[kV]		800
Rated Impulse Withstand Voltage [U_{imp}]	[kV]		8
Rated Operational Voltage [U_e] – AC	[V]	UL/CSA [60 Hz]	600Y/347V
		IEC [50 Hz]	690
Number of Poles			3

Standards Compliance

UL489	Yes
CSA 22.2 No. 5	Yes
EN 60947-2	Yes
CCC GB 14048.2	Yes

Temperature Specification*

Ambient Operating Temperature Range (based on the absence of freezing water or other elements)	-25…+70 °C (-13…+158 °F)
Storage Temperature	-40…+70 °C (-40…+158 °F)
Calibration Temperature	40 °C (104 °F)

* For use at temperatures other than 40 °C (104 °F), see the Temperature Performance information on page 27.

140MG-H Frame Specifications



	Maximum		
UL Hp Rating @ 60 Hz	230V AC	460V AC	575V AC
	40	100	125
IEC kW Rating @ 50 Hz	230V AC	400/415V AC	690V AC
	22	45	110

Interrupting Rating/Breaking Capacity – Motor Circuit Protector

See page 42 for Interrupting Rating/Breaking Capacity values.

Dimensions (mm)

Plus Terminals

Height	130
Width (3-pole)	90
Depth (case)	82.5
Depth (op handle)	101

Mechanical Endurance

Electrical Life (on-off) at 120 operations per hour	8000
Mechanical (on-off) at 240 operations per hour	25,000

Watt Loss

Rated Current I_n [A]	Watt Loss [W]
3	11.1
7	27.9
15	19.2
30	11.4
50	15
70	16.5
80	20.4
100	24.3
125	42

Electrical Specifications

			Maximum
Maximum Rated Current [I_n]	[A]		125
Frame Ratings [I_u] Rated Uninterrupted Current	[A]		125
Rated Insulation Voltage [U_i]	[kV]		1000
Rated Impulse Withstand Voltage [U_{imp}]	[kV]		8
Rated Operational Voltage [U_e] – AC	[V]	UL/CSA [60 Hz]	600
		IEC [50 Hz]	690
Maximum Reverse Fed Voltage	[V AC]	UL/CSA [60 Hz]	480
		IEC [50 Hz]	480
Number of Poles			3

Standards Compliance

UL489	Yes
CSA 22.2 No. 5	Yes
EN 60947-2	Yes
CCC GB 14048.2	Yes

Temperature Specification*

Ambient Operating Temperature Range (based on the absence of freezing water or other elements)	-25…+70 °C (-13…+158 °F)
Storage Temperature	-40…+70 °C (-40…+158 °F)
Calibration Temperature	40 °C (104 °F)

* For use at temperatures other than 40 °C (104 °F), see the Temperature Performance information on page 29.

140MG-I Frame Specifications



	Maximum		
UL Hp Rating @ 60 Hz	230V AC	460V AC	575V AC
	50	100	125
IEC kW Rating @ 50 Hz	230V AC	400/415V AC	690V AC
	22	45	90

Interrupting Rating/Breaking Capacity – Motor Circuit Protector

See page 42 for Interrupting Rating/Breaking Capacity values.

Dimensions (mm)

Plus Terminals

Height	150
Width (3-pole)	105
Depth (case)	70
Depth (op handle)	101

Mechanical Endurance

Electrical Life (on-off) at 120 operations per hour	8000
Mechanical (on-off) at 240 operations per hour	25,000

Watt Loss

Rated Current I_n [A]	Watt Loss [W]
100	13.5
110	9.9
125	12.3
150	19.5

Electrical Specifications

			Maximum
Maximum Rated Current [I_n]	[A]		225
Frame Ratings [I_u] Rated Uninterrupted Current	[A]		225
Rated Insulation Voltage [U_i]	[kV]		800
Rated Impulse Withstand Voltage [U_{imp}]	[kV]		8
Rated Operational Voltage [U_e] – AC	[V]	UL/CSA [60 Hz]	600Y/347V
		IEC [50 Hz]	690
Number of Poles			3

Standards Compliance

UL489	Yes
CSA 22.2 No. 5	Yes
EN 60947-2	Yes
CCC GB 14048.2	Yes

Temperature Specification*

Ambient Operating Temperature Range (based on the absence of freezing water or other elements)	-25…+70 °C (-13…+158 °F)
Storage Temperature	-40…+70 °C (-40…+158 °F)
Calibration Temperature	40 °C (104 °F)

* For use at temperatures other than 40 °C (104 °F), see the Temperature Performance information on page 31.

140MG-J Frame Specifications



	Maximum		
UL Hp Rating @ 60 Hz	230V AC	460V AC	575V AC
	100	200	250
IEC kW Rating @ 50 Hz	230V AC	400/415V AC	690V AC
	55	90	160

Interrupting Rating/Breaking Capacity – Motor Circuit Protector

See page 43 for Interrupting Rating/Breaking Capacity values.

Dimensions (mm)

Plus Terminals

Height	160
Width (3-pole)	105
Depth (case)	82.5
Depth (op handle)	117

Mechanical Endurance

Electrical Life (on-off) at 120 operations per hour	8000
Mechanical (on-off) at 240 operations per hour	25,000

Watt Loss

Rated Current I_n [A]	Watt Loss [W]
150	23.4
175	27.3
200	35.7
225	39.9
250	49.2

Electrical Specifications

			Maximum
Maximum Rated Current [I_n]	[A]		250
Frame Ratings [I_u] Rated Uninterrupted Current	[A]		250
Rated Insulation Voltage [U_i]	[kV]		1000
Rated Impulse Withstand Voltage [U_{imp}]	[kV]		8
Rated Operational Voltage [U_e] – AC	[V]	UL/CSA [60 Hz]	600
		IEC [50 Hz]	690
Maximum Reverse Fed Voltage	[V AC]	UL/CSA [60 Hz]	600
		IEC [50 Hz]	600
Number of Poles			3

Standards Compliance

UL489	Yes
CSA 22.2 No. 5	Yes
EN 60947-2	Yes
CCC GB 14048.2	Yes

Temperature Specification*

Ambient Operating Temperature Range (based on the absence of freezing water or other elements)	-25…+70 °C (-13…+158 °F)
Storage Temperature	-40…+70 °C (-40…+158 °F)
Calibration Temperature	40 °C (104 °F)

* For use at temperatures other than 40 °C (104 °F), see the Temperature Performance information on page 33.

140MG-K Frame Specifications



	Maximum		
UL Hp Rating @ 60 Hz	230V AC	460V AC	575V AC
	100	250	300
IEC kW Rating @ 50 Hz	230V AC	400/415V AC	690V AC
	90	160	250

Interrupting Rating/Breaking Capacity – Motor Circuit Protector

See page 43 for Interrupting Rating/Breaking Capacity values.

Dimensions (mm)

Plus Terminals

Height	205
Width (3-pole)	139.5
Depth (case)	103.5
Depth (op handle)	139

Mechanical Endurance

Electrical Life (on-off) at 60 operations per hour	7000
Mechanical (on-off) at 120 operations per hour	20,000

Watt Loss

Rated Current I_n [A]	Watt Loss [W]
300	31.8
400	49.5

Electrical Specifications

			Maximum
Maximum Rated Current [I_n]	[A]		400
Frame Ratings [I_u] Rated Uninterrupted Current	[A]		400
Rated Insulation Voltage [U_i]	[kV]		1000
Rated Impulse Withstand Voltage [U_{imp}]	[kV]		8
Rated Operational Voltage [U_e] – AC	[V]	UL/CSA [60 Hz]	600
		IEC [50 Hz]	690
Number of Poles			3

Standards Compliance

UL489	Yes
CSA 22.2 No. 5	Yes
EN 60947-2	Yes
CCC GB 14048.2	Yes

Temperature Specification*

Ambient Operating Temperature Range (based on the absence of freezing water or other elements)	-25…+70 °C (-13…+158 °F)
Storage Temperature	-40…+70 °C (-40…+158 °F)
Calibration Temperature	40 °C (104 °F)

* For use at temperatures other than 40 °C (104 °F), see the Temperature Performance information on page 35.

140MG-M Frame Specifications



	Maximum		
UL Hp Rating @ 60 Hz	230V AC	460V AC	575V AC
	200	400	500
IEC kW Rating @ 50 Hz	230V AC	400/415V AC	690V AC
	160	250	500

Interrupting Rating/Breaking Capacity – Motor Circuit Protector

See page 43 for Interrupting Rating/Breaking Capacity values.

Dimensions (mm)

Plus Terminals

Height	268
Width (3-pole)	210
Depth (case)	103.5
Depth (op handle)	159

Mechanical Endurance

Electrical Life (on-off) at 60 operations per hour	7000 (630 A) 5000 (800 A)
Mechanical (on-off) at 120 operations per hour	20,000

Watt Loss

Rated Current I_n [A]	Watt Loss [W]
600	86.4
800	96.0

Electrical Specifications

			Maximum
Maximum Rated Current [I_n]	[A]		800
Frame Ratings [I_u] Rated Uninterrupted Current	[A]		800
Rated Insulation Voltage [U_i]	[kV]		1000
Rated Impulse Withstand Voltage [U_{imp}]	[kV]		8
Rated Operational Voltage [U_e] – AC	[V]	UL/CSA [60 Hz]	600
		IEC [50 Hz]	690
Number of Poles			3

Standards Compliance

UL489	Yes
CSA 22.2 No. 5	Yes
EN 60947-2	Yes
CCC GB 14048.2	Yes

Temperature Specification*

Ambient Operating Temperature Range (based on the absence of freezing water or other elements)	-25…+70 °C (-13…+158 °F)
Storage Temperature	-40…+70 °C (-40…+158 °F)
Calibration Temperature	40 °C (104 °F)

* For use at temperatures other than 40 °C (104 °F), see the Temperature Performance information on page 37.

140MG-N Frame Specifications



	Maximum		
UL Hp Rating @ 60 Hz	230V AC	460V AC	575V AC
	300	600	700
IEC kW Rating @ 50 Hz	230V AC	400/415V AC	690V AC
	200	250	710

Interrupting Rating/Breaking Capacity – Motor Circuit Protector

See page 42 for Interrupting Rating/Breaking Capacity values.

Dimensions (mm)

Plus Terminals

Height	268
Width (3-pole)	210
Depth (case)	125
Depth (op handle)	225

Mechanical Endurance

Electrical Life (on-off) at 60 operations per hour	2000
Mechanical (on-off) at 60 operations per hour	10,000

Watt Loss

Rated Current I_n [A]	Watt Loss [W]
1200	252.0

Electrical Specifications

			Maximum
Maximum Rated Current [I_n]	[A]		1200
Frame Ratings [I_u] Rated Uninterrupted Current	[A]		1200
Rated Insulation Voltage [U_i]	[kV]		1000
Rated Impulse Withstand Voltage [U_{imp}]	[kV]		8
Rated Operational Voltage [U_e] – AC	[V]	UL/CSA [60 Hz]	600
		IEC [50 Hz]	690
Number of Poles			3

Standards Compliance

UL489	Yes
CSA 22.2 No. 5	Yes
EN 60947-2	Yes
CCC GB 14048.2	Yes

Temperature Specification*

Ambient Operating Temperature Range (based on the absence of freezing water or other elements)	-25…+70 °C (-13…+158 °F)
Storage Temperature	-40…+70 °C (-40…+158 °F)
Calibration Temperature	40 °C (104 °F)

* For use at temperatures other than 40 °C (104 °F), see the Temperature Performance information on page 39.

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MPCB Performance Characteristics

			H-Frame	J-Frame
	Maximum Rated Current	[A]	100	150
	Rated Insulation Voltage, U_i IEC	[V]	1000	1000
NEMA, UL, CSA	Interrupting Rating Code ①		H8	J8
NEMA, UL, CSA	240V 50/60 Hz (AC)	[kA]	150	150
NEMA, UL, CSA	480V 50/60 Hz (AC)	[kA]	65	65
NEMA, UL, CSA	600V 50/60 Hz (AC)	[kA]	25	25
IEC 60947-2	Rated Ultimate Short-circuit Breaking Capacity, I_{cu}			
IEC 60947-2	220-230V 50/60 Hz (AC) ②	[kA]	100	100
IEC 60947-2	380V 50/60 Hz (AC)	[kA]	70	70
IEC 60947-2	400-415V 50/60 Hz (AC)	[kA]	70	70
IEC 60947-2	440V 50/60 Hz (AC) ②	[kA]	65	65
IEC 60947-2	525V 50/60 Hz (AC)	[kA]	15	45
IEC 60947-2	550V 50/60 Hz (AC)	[kA]	15	45
IEC 60947-2	690V 50/60 Hz (AC)	[kA]	15	15
IEC 60947-2	Rated Service Short-circuit Breaking Capacity, I_{cs}			
IEC 60947-2	220-230V 50/60 Hz (AC) ②	[kA]	100%	100%
IEC 60947-2	380V 50/60 Hz (AC)	[kA]	100%	100%
IEC 60947-2	400-415V 50/60 Hz (AC)	[kA]	100%	100%
IEC 60947-2	440V 50/60 Hz (AC) ②	[kA]	100%	100%
IEC 60947-2	525V 50/60 Hz (AC)	[kA]	100%	100%
IEC 60947-2	550V 50/60 Hz (AC)	[kA]	100%	100%
IEC 60947-2	690V 50/60 Hz (AC)	[kA]	100%	100%
	Mechanical Life	[No. of Operations]	25000	25000
		[Operations per Hour]	240	240
	Electrical Life @ 415V (AC)	[No. of Operations]	8000	8000
		[Operations per Hour]	120	120
	Wire Temperature Rating ③	[°C]	Cu 75 °C	Al or Cu 75 °C
	Ambient Temperature w/out derating	°F [°C]	104 °F [40 °C]	104 °F [40 °C]
	Operational Temperature	°F [°C]	-13…+158 °F [-25…+70 °C]	-13…+158 °F [-25…+70 °C]
	Storage Temperature	°F [°C]	-40...158 °F [-40…+70 °C]	-40...158 °F [-40…+70 °C]
	Dimensions	[mm]	90x82.5x130	105x82.5x160
	[Width/Depth/Height]	[inches]	3.54x3.25x5.12	4.13x3.25x6.3
	Weight (approximate)	lb [kg]	2.6 [1.2]	5.5 [2.5]

① Explanation of Interrupting Code – H8 for example: H=H Frame & 8=65 kA@480V. See table for complete ratings.
② These ratings have not been tested for the CCC listing.
③ Wire temperature Rating is determined by testing the Motor Circuit Protector under full load current with the conductors sized for 75 °C.

140MG-H Frame Specifications

25 A, 60 A, 100 A



Interrupting Rating/Breaking Capacity – Motor Protection Circuit Breaker (See page 52 for additional voltages – breaking capacities)

Interrupting Rating (50/60 Hz), UL 489/CSA C22.2-5, No. 5-02 [kA]			EN 60947-2											
			Breaking Capacity (50/60 Hz)								Breaking Capacity (DC)			
			220V*		415V		440V*		690V		250V DC (2-pole in series)		500V DC (3-pole in series)	
240V	480V	600V	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]
150	65	25	100	100	70	100	65	100	15	100	70	100	70	100

* These ratings have not been tested for the CCC listing.

Dimensions (mm)

Plus Terminals

Height	130
Width (3-pole)	90
Depth (case)	82.5
Depth (op handle)	101

Mechanical Endurance

Electrical Life (on-off) at 120 operations per hour	8000
Mechanical (on-off) at 240 operations per hour	25,000

Watt Loss

Rated Current I_n [A]	Watt Loss [W]
10	0.3
25	2.4
60	4.5
100	12.6

Electrical Specifications

			Maximum
Maximum Rated Current [I_n]	[A]		100
Frame Ratings [I_u] Rated Uninterrupted Current	[A]		100
Rated Insulation Voltage [U_i]	[kV]		1000
Rated Impulse Withstand Voltage [U_{imp}]	[kV]		8
Rated Operational Voltage [U_e] – AC	[V]	UL/CSA [60 Hz]	600
		IEC [50 Hz]	690
Maximum Reverse Fed Voltage	[V AC]	UL/CSA [60 Hz]	480
		IEC [50 Hz]	480
Number of Poles			3

Standards Compliance

UL489	Yes
CSA 22.2 No. 5	Yes
EN 60947-2	Yes
CCC GB 14048.2	Yes

Temperature Specification*

Ambient Operating Temperature Range (based on the absence of freezing water or other elements)	-25…+70 °C (-13…+158 °F)
Storage Temperature	-40…+70 °C (-40…+158 °F)
Calibration Temperature	40 °C (104 °F)

* For use at temperatures other than 40 °C (104 °F), see the Temperature Performance information on page 29.

140MG-J Frame Specifications

40 A, 60 A, 100 A, 150 A



Interrupting Rating/Breaking Capacity – Motor Protection Circuit Breaker (See page 52 for additional voltages – breaking capacities)

Interrupting Rating (50/60 Hz), UL 489/CSA C22.2-5, No. 5-02 [kA]			EN 60947-2											
			Breaking Capacity (50/60 Hz)								Breaking Capacity (DC)			
			220V*		415V		440V*		690V		250V DC (2-pole in series)		500V DC (3-pole in series)	
240V	480V	600V	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]	I_{cu} [kA]	I_{cs} [% I_{cu}]
150	65	25	100	100	70	100	65	100	15	100	70	100	70	100

* These ratings have not been tested for the CCC listing.

Dimensions (mm)

Plus Terminals

Height	160
Width (3-pole)	105
Depth (case)	82.5
Depth (op handle)	117

Mechanical Endurance

Electrical Life (on-off) at 120 operations per hour	8000
Mechanical (on-off) at 240 operations per hour	25,000

Watt Loss

Rated Current I_n [A]	Watt Loss [W]
40	1.8
60	3.8
63	4.2
100	10.5
150	23.5

Electrical Specifications

			Maximum
Maximum Rated Current [I_n]	[A]		250
Frame Ratings [I_u] Rated Uninterrupted Current	[A]		250
Rated Insulation Voltage [U_i]	[kV]		1000
Rated Impulse Withstand Voltage [U_{imp}]	[kV]		8
Rated Operational Voltage [U_e] – AC	[V]	UL/CSA [60 Hz]	600
		IEC [50 Hz]	690
Maximum Reverse Fed Voltage	[V AC]	UL/CSA [60 Hz]	600
		IEC [50 Hz]	600
Number of Poles			3

Standards Compliance

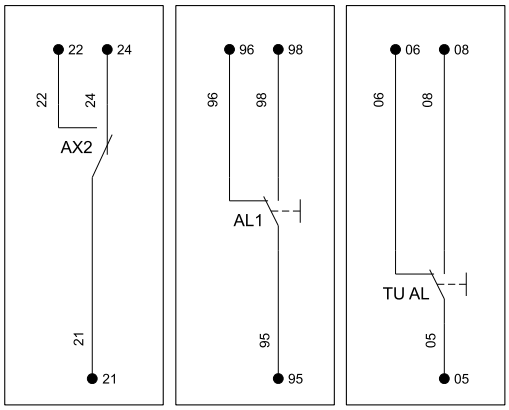
UL489	Yes
CSA 22.2 No. 5	Yes
EN 60947-2	Yes
CCC GB 14048.2	Yes

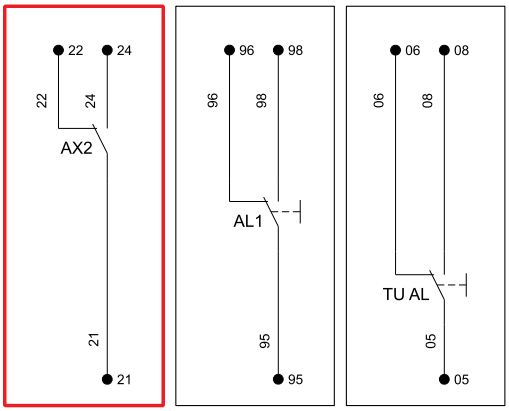
Temperature Specification*

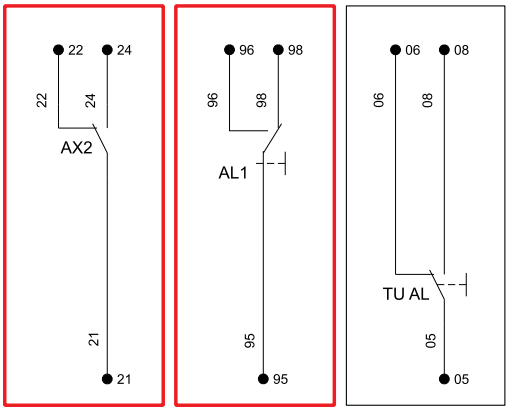
Ambient Operating Temperature Range (based on the absence of freezing water or other elements)	-25…+70 °C (-13…+158 °F)
Storage Temperature	-40…+70 °C (-40…+158 °F)
Calibration Temperature	40 °C (104 °F)

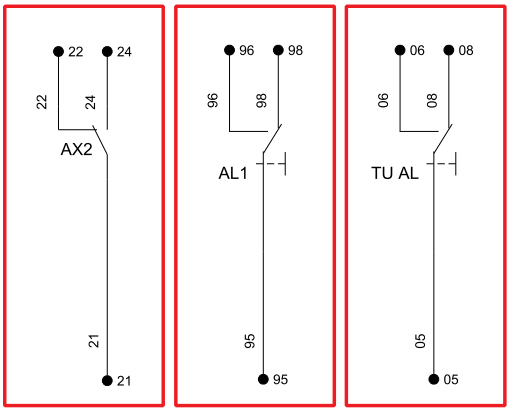
* For use at temperatures other than 40 °C (104 °F), see the Temperature Performance information on page 33.

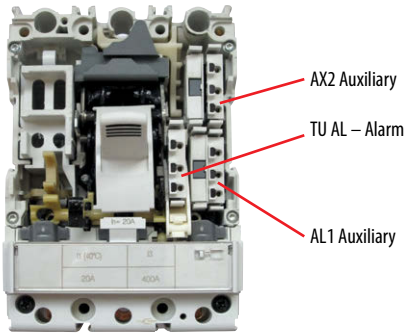
Auxiliary & Alarm Contacts







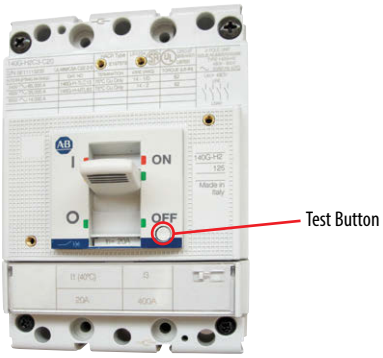




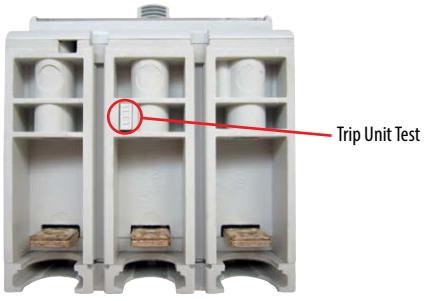
Position of the AX, AL or TU AL Contacts when installed and the Circuit Breaker is ON or the AX contact not installed.



Position of the Contacts when the Circuit Breaker OFF.



Position of the Contacts when the Circuit Breaker is TRIPPED via the TEST Button on the face of the Circuit Breaker or Shunt Trip or Undervoltage Release.



Position of the Contacts when the Circuit Breaker Trip Unit has TRIPPED. This can occur from fault current of thermal overload or via the Test Button on the center pole of TM trip units.

Auxiliary & Alarm Contacts

Application Ratings										Electrical Operating Ratings (Nominal Values)							
		140G Family								Electrical Specifications (&)							
		Frame										Wire Size			IEC Rating		
Order Code	Catalog Number	G	H	I	J	K	M	N, NS	R	Description	Rated Voltage U_e [V]	AWG	mm²	Wire Length	Rated Operational Current (AC)	Rated Operational Current (DC)	UL Rating
AA	**140G-G-EA1R1A**	X	X	X	X	O	O	O	O	(1) Aux - Form C (1) AL - Form C	250V	20	0.5	1 m (39 in.)	6 A @ 250 V AC (#)	5 A @ 24V DC 0.5 A @ 110V DC 0.3 A @ 250V DC (min. 0.03 A DC)	5 A @ 125V AC 3 A @ 250V AC
	140G-K-EA1R1A	O	O	O	O	X	X	O	O	(1) Aux - Form C (1) AL - Form C	250V	20	0.5	1 m (39 in.)	6 A @ 250V AC (#)	5 A @ 24V DC 0.5 A @ 110V DC 0.3 A @ 250V DC (min. 0.03 A DC)	5 A @ 125V AC 6 A @ 250V AC
AB	**140G-H-EA1R1ZB**	O	X	O	X	O	O	O	O	(1) Aux - Form C (1) AL - Form C	400V	17	1	1 m (39 in.)	12 A @ 250V AC 3 A @ 400V AC	0.5 A @ 125V DC 0.3 A @ 250V DC	10 A @ 125V AC 10 A @ 250V AC
	140G-K-EA1R1B	O	O	O	O	X	X	O	O	(1) Aux - Form C (1) AL - Form C	400V	17	1	1 m (39 in.)	12 A @ 250V AC 3 A @ 400V AC	0.5 A @ 125V DC 0.3 A @ 250V DC	12 A @ 125V AC 12 A @ 250V AC
	140G-N-EA1R1B	O	O	O	O	O	O	X (N only)	O	(1) Aux - Form C (1) AL - Form C	400V	17	1	1 m (39 in.)	12 A @ 250V AC 3 A @ 400V AC	0.5 A @ 125V DC 0.3 A @ 250V DC	12 A @ 125V AC 12 A @ 250V AC
AJ	**140G-G-EA1R1J**	X	X	X	X	O	O	O	O	((1) Aux - Form C (1) AL - Form C	24V	20	0.5	1 m (39 in.)	—	Max. – 0.1 A @ 24V DC Min. – 0.01 A @ 5V DC min.	
	140G-N-EA1R1J	O	O	O	O	O	O	X (N only)	O	(1) Aux - Form C (1) AL - Form C	24V	20	0.5	1 m (39 in.)	—	Max. – 0.1 A @ 24V DC Min. – 0.01 A @ 5V DC min.	
BA	**140G-G-EA2R1A**	X	X	X	X	O	O	O	O	(2) Aux - Form C (1) AL - Form C	250V	20	0.5	1 m (39 in.)	6 A @ 250V AC (#)	5 A @ 24V DC 0.5 A @ 110V DC 0.3 A @ 250V DC (min. 0.03 A DC)	5 A @ 125V AC 3 A @ 250V AC
CA	**140G-H-EA3R1A**	O	X	X	X	O	O	O	O	(3) Aux - Form C (1) AL - Form C	250V	20	0.5	1 m (39 in.)	6 A @ 250V AC (#)	5 A @ 24V DC 0.5 A @ 110V DC 0.3 A @ 250V DC (min. 0.03 A DC)	5 A @ 125V AC 3 A @ 250V AC
	140G-K-EA3R1A	O	O	O	O	X	X	O	O	(3) Aux - Form C (1) AL - Form C	250V	20	0.5	1 m (39 in.)	6 A @ 250V AC (#)	5 A @ 24V DC 0.5 A @ 110V DC 0.3 A @ 250V DC (min. 0.03 A DC)	5 A @ 125V AC 6 A @ 250V AC
CJ	**140G-H-EA3R1J**	O	X	X	X	O	O	O	O	(3) Aux - Form C (1) AL - Form C	24V	20	0.5	1 m (39 in.)	—	Max. – 0.1 A @ 24V DC Min. – 0.01 A @ 5V DC min.	
	140G-K-EA3R1J	O	O	O	O	X	X	O	O	(3) Aux - Form C (1) AL - Form C	24V	20	0.5	1 m (39 in.)	—	Max. – 0.1 A @ 24V DC Min. – 0.01 A @ 5V DC min.	
DA	**140G-H-EA1TA**	O	X	O	X	O	O	O	O	(1) TU AL - Form C (Thermal)	250V	20	0.5	1 m (39 in.)	6 A @ 250V AC (#)	5 A @ 24V DC 0.5 A @ 110V DC 0.3 A @ 250V DC (min. 0.03 A DC)	5 A @ 125V AC 3 A @ 250V AC
DJ	**140G-H-EA1TJ**	O	X	O	X	O	O	O	O	(1) TU AL - Form C (Thermal)	24V	20	0.5	1 m (39 in.)	—	Max. – 0.1 A @ 24V DC Min. – 0.01 A @ 5V DC min.	
FB	**140G-H-EA2B**	O	X	O	X	O	O	O	O	(2) Aux - Form C	400V	17	1	1 m (39 in.)	12 A @ 250V AC 3 A @ 400V AC	0.5 A @ 125V DC 0.3 A @ 250V DC	12 A @ 125V AC 12 A @ 250V AC
	140G-K-EA2B	O	O	O	O	X	X	O	O	(2) Aux - Form C	400V	17	1	1 m (39 in.)	12 A @ 250V AC 3 A @ 400V AC	0.5 A @ 125V DC 0.3 A @ 250V DC	10 A @ 125V AC 10 A @ 250V AC
KA	**140G-G-EA1A**	X	X	X	X	O	O	O	O	(1) Aux - Form C	250V	20	0.5	1 m (39 in.)	6 A @ 250V AC (#)	0.5 A @ 110V DC 0.3 A @ 250V DC (min. 0.03 A DC)	5 A @ 125V AC 3 A @ 250V AC
TA	**140G-G-EA1AU**	X	X	X	X	O	O	O	O	(1) Aux - Form C or (1) AL - Form C	250V	20	0.5	1 m (39 in.)	6 A @ 250V AC (#)	5 A @ 24V DC 0.5 A @ 110V DC 0.3 A @ 250V DC (min. 0.03 A DC)	—
—	**140G-G-EA1J**	X	X	X	X	O	O	O	O	(1) Aux - Form C or (1) AL - Form C	24V	20	0.5	1 m (39 in.)	—	Max. – 0.1 A @ 24V DC Min. – 0.01 A @ 5V DC min.	

Application Ratings										Electrical Operating Ratings (Nominal Values)							
		140G Family								Electrical Specifications (&)							
		Frame										Wire Size			IEC Rating		
Order Code	Catalog Number	G	H	I	J	K	M	N, NS	R	Description	Rated Voltage U_e [V]	AWG	mm^2	Wire Length	Rated Operational Current (AC)	Rated Operational Current (DC)	UL Rating
—	**140G-H-EA2R2TA**	O	X	O	X	O	O	O	O	(2) Aux - Form C (2) AL - Form C (Thermal)	250V	20	0.5	1 m (39 in.)	6 A @ 250V AC (#)	5 A @ 24V DC 0.5 A @ 110V DC 0.3 A @ 250V DC (min. 0.03 A DC)	5 A @ 125V AC 3 A @ 250V AC
—	**140G-H-EA3R2A**	O	X	O	X	O	O	O	O	(3) Aux - Form C (2) AL - Form C	250V	20	0.5	1 m (39 in.)	6 A @ 250V AC (#)	5 A @ 24V DC 0.5 A @ 110V DC 0.3 A @ 250V DC (min. 0.03 A DC)	5 A @ 125V AC 3 A @ 250V AC
—	**140G-N-EA1TA**	O	O	O	O	O	O	X	O	(1) AL - Form C (Thermal)	250V	20	0.5	1 m (39 in.)	6 A @ 250V AC (#)	0.5 A @ 110V DC 0.3 A @ 250V DC (min. 0.03 A DC)	—
—	**140G-N-EA2B**	O	O	O	O	O	O	X	O	(2) Aux - Form C	400V	17	1	1 m (39 in.)	12 A @ 250V AC 3 A @ 400V AC	0.5 A @ 125V DC 0.3 A @ 250V DC	12 A @ 125V AC 12 A @ 250V AC
—	**140G-N-EA2J**	O	O	O	O	O	O	X	O	(2) Aux - Form C	24V	20	0.5	1 m (39 in.)	—	Max. – 0.1 A @ 24V DC Min. – 0.01 A @ 5V DC min.	Yes
—	**140G-R-EA1TA**	O	O	O	O	O	O	O	X	(1) AL - Form C (Thermal)	250V	†	†	†	6 A @ 250V AC (#)	0.5 A @ 110V DC 0.3 A @ 250V DC (min. 0.03 A DC)	—
—	**140G-R-EA4A**	O	O	O	O	O	O	O	X	(4) Aux - Form C	400V	†	†	†	12 A @ 250V AC 3 A @ 400V AC	0.5 A @ 125V DC 0.3 A @ 250V DC	15 A @ 125V AC 15 A @ 250V AC
—	**140G-R-EA4J**	O	O	O	O	O	O	O	X	(4) Aux - Form C	24V	†	†	†	—	Max. – 0.1 A @ 24V DC Min. – 0.01 A @ 5V DC min.	Yes
—	**140G-G-EAB1B**	X	X	X	X	O	O	O	O	Quantity 2 Each (1) N.C. Early Break	400 V	17	1	1 m (39 in.)	12 A @ 250V AC 3 A @ 400V AC	0.5 A @ 125V DC 0.3 A @ 250V DC	12 A @ 125V AC 12 A @ 250V AC
		*				—											
—	**140G-G-EAM1B**	X	X	X	X	O	O	O	O	Quantity 2 Each (1) N.O. Early Make	400 V	17	1	1 m (39 in.)	12 A @ 250V AC 3 A @ 400V AC	0.5 A @ 125V DC 0.3 A @ 250V DC	12 A @ 125V AC 12 A @ 250V AC
		*				—											
—	**140G-K-EAM1A**	—				X	O	O	O	Quantity 2 Each (1) N.O. Early Make	250V	20	0.5	1 m (39 in.)	6 A @ 250V AC (#)	0.5 A @ 110V DC 0.3 A @ 250V DC (min. 0.03 A DC)	—
						**											
	140G-M-EAM1A	—				O	X	O	O	Quantity 2 Each (1) N.O. Early Make	250V	20	0.5	1 m (39 in.)	6 A @ 250V AC (#)	0.5 A @ 110V DC 0.3 A @ 250V DC (min. 0.03 A DC)	—
						**											

† Contact Rockwell Automation.

(&) Contacts are wired with 600 V (UL/CSA) insulated wire. No voltage derating of circuit breaker required.

* For use with 140G-G-RMB, -RMY,-RMX 140G-H-RMB, -RMY, RMX handle mechanisms.

** For use with 140G-K-RMB, -RMY, -RMX handle mechanisms.

(#) 250 V AC/DC Expanded Description

Voltage	Class of use	AC	DC
	DC-12	—	0.5 A
110V DC	DC-14	—	0.05 A
125V AC/DC	AC-12, AC-13, AC-14	6 A	—
	AC-15	5 A	—
	AC-12 and DC-12	6 A	0.3 A
	AC-13	6 A	—
	AC-14, DC-14	5 A	0.03 A
250V AC/DC	AC-15	4 A	—

Shunt Trip Devices

Application Ratings					Electrical Operating Ratings (Nominal Values)				
140G Frames G, H, I, J									
Order Code	**Catalog Number**	Rated Voltage U_e [V]	Wire Length – Size		Operation Voltage [V] Min.	Operation Voltage [V] Max.	Inrush Power Consumption AC [VA]	Inrush Power Consumption DC [W]	Opening Time [ms] *
—	**140G-G-SNR**	12V DC	1 m 0.5 mm² 20 AWG	Shunt Open Release	8.4	13.2	—	50	≤ 15
SJ	**140G-G-SNJ**	24…30V AC/DC	1 m 0.5 mm² 20 AWG		16.8	33	50	50	
SK	**140G-G-SNKY**	48…60V AC/DC	1 m 0.5 mm² 20 AWG		33.6	66	60	60	
SD	**140G-G-SND**	110…127V AC 110…125V DC	1 m 0.5 mm² 20 AWG		77	139 AC 137 DC	50	50	
SA	**140G-G-SNA**	220…240V AC 220…250V DC	1 m 0.5 mm² 20 AWG		154	278 AC 274 DC	50	50	
SB	**140G-G-SNB**	380…440V AC	1 m 1 mm² 17 AWG		266	484	55	—	
SC	**140G-G-SNC**	480…525V AC	1 m 1 mm² 17 AWG		336	577	55	—	
140G Frames K, M									
—	**140G-K-SNR**	12V DC	1 m 0.5 mm² 20 AWG	Shunt Open Release	8.4	13.2	—	50	≤ 15
SJ	**140G-K-SNJ**	24…30V AC/DC	1 m 0.5 mm² 20 AWG		16.8	33	50	50	
SK	**140G-K-SNKY**	48…60V AC/DC	1 m 0.5 mm² 20 AWG		33.6	66	60	60	
SD	**140G-K-SND**	110…127V AC 110…125V DC	1 m 0.5 mm² 20 AWG		77	139 AC 137 DC	50	50	
SA	**140G-K-SNA**	220…240V AC 220…250V DC	1 m 0.5 mm² 20 AWG		154	278 AC 274 DC	50	50	
SB	**140G-K-SNB**	380…440V AC	1 m 1 mm² 17 AWG		266	484	55	—	
SC	**140G-K-SNC**	480…525V AC	1 m 1 mm² 17 AWG		336	577	55	—	

All wired with 600V (UL/CSA) insulated wire. No voltage derating required.

* The time it takes to signal the coil and open the power contacts with ***no load***. Under load conditions add 25 ms.

Application Ratings					Electrical Operating Ratings (Nominal Values)				
140G Frames N, NS									
Order Code	**Catalog Number**	Rated Voltage U_e [V]	Wire Length – Size		Operation Voltage [V]		Inrush Power Consumption		Opening Time [ms]
					Min.	Max.	AC [VA]	DC [W]	
SJ	**140G-N-SNJ**	24V AC/DC	1 m 0.5 mm² 20 AWG	Shunt Open Release	16.8	26.4	—	300	≤ 20
SK	**140G-N-SNKY**	48V AC/DC	1 m 0.5 mm² 20 AWG		33.6	52.8	300	300	
SD	**140G-N-SND**	110…120V AC/DC	1 m 0.5 mm² 20 AWG		77	132	300	300	
SA	**140G-N-SNA**	220…240V AC/DC	1 m 0.5 mm² 20 AWG		154	264	300	300	
SB	**140G-N-SNB**	380…400V AC	1 m 1 mm² 17 AWG		266	440	300	—	
RJ	**140G-NS-SNCJ**	24V AC/DC	1 m 0.5 mm² 20 AWG	Shunt Close Release	20.4	26.4	300	300	≤ 80
RK	**140G-NS-SNCKY**	48V AC/DC	1 m 0.5 mm² 20 AWG		40.8	52.8	300	300	
RD	**140G-NS-SNCD**	110…120V AC/DC	1 m 0.5 mm² 20 AWG		93.5	126.5	300	300	
RA	**140G-NS-SNCA**	220…240V AC/DC	1 m 0.5 mm² 20 AWG		187	196.5	300	300	
RB	**140G-NS-SNCB**	380…400V AC	1 m 1 mm² 17 AWG		323	440	300	—	
140G Frame R									
SJ	**140G-R-SNJ**	24V AC/DC	1 m 0.5 mm² 20 AWG	Shunt Open Release	16.8	26.4	—	200	≤ 60
SK	**140G-R-SNKY**	48V AC/DC	1 m 0.5 mm² 20 AWG		33.6	52.8	200	200	
SD	**140G-R-SND**	110…120V AC/DC	1 m 0.5 mm² 20 AWG		77	132	200	200	
SA	**140G-R-SNA**	220…240V AC/DC	1 m 0.5 mm² 20 AWG		154	264	200	200	
SB	**140G-R-SNB**	380…400V AC/DC	1 m 1 mm² 17 AWG		266	440	200	—	
RJ	**140G-R-SNCJ**	24V AC/DC	1 m 0.5 mm² 20 AWG	Shunt Close Release	20.4	26.4	—	200	≤ 80
RK	**140G-R-SNCKY**	48V AC/DC	1 m 0.5 mm² 20 AWG		40.8	52.8	200	200	
RD	**140G-R-SNCD**	110…120V AC/DC	1 m 0.5 mm² 20 AWG		93.5	126.5	200	200	
RA	**140G-R-SNCA**	220…240V AC/DC	1 m 0.5 mm² 20 AWG		187	196.5	200	200	
RB	**140G-R-SNCB**	380…400V AC/DC	1 m 1 mm² 17 AWG		323	440	200	—	

All wired with 600V (UL/CSA) insulated wire. No voltage derating required.

Undervoltage Release

Application Ratings				Electrical Operating Ratings (Nominal Values)					
140G Frames G, H, I, J									
				Electrical Specifications					
				Dropout Voltage [V]		Pickup Voltage	UVR Power Absorbed During Normal Operation		Opening Time
Order Code	**Catalog Number**	Rated Voltage U_e [V]	Wire Length – Size	Min.	Max.	Max. [V]	AC [VA]	DC [W]	
UJ	**140G-G-UVJ**	24…30V AC/DC	1 m 0.5 mm² 20 AWG	8.4	21	25.5	1.5	1.5	≤ 15
UR	**140G-G-UVR**	48V AC/DC	1 m 0.5 mm² 20 AWG	16.8	33.6	40.8	1	1	
—	**140G-G-UVKY**	60V AC/DC	1 m 0.5 mm² 20 AWG	21	42	51	1	1	
UD	**140G-G-UVD**	110…127V AC 110…125V DC	1 m 0.5 mm² 20 AWG	38.5	88.9 AC 87.5 DC	108 AC 106 DC	2	2	
UA	**140G-G-UVA**	220…240V AC 220…250V DC	1 m 0.5 mm² 20 AWG	77	154 AC 175 DC	208 AC 212.5 DC	2.5	2.5	
UB	**140G-G-UVB**	380…440V AC	1 m 1 mm² 17 AWG	133	308	374	3	—	
UC	**140G-G-UVC**	480…525V AC	1 m 1 mm² 17 AWG	168	367.5	446	4	—	
140G Frames K, M									
UJ	**140G-K-UVJ**	24…30V AC/DC	1 m 0.5 mm² 20 AWG	8.4	21	25.5	1.5	1.5	≤ 25
UR	**140G-K-UVR**	48V AC/DC	1 m 0.5 mm² 20 AWG	16.8	33.6	40.8	1	1	
—	**140G-K-UVKY**	60V AC/DC	1 m 0.5 mm² 20 AWG	21	42	51	1	1	
UD	**140G-K-UVD**	110…127V AC 110…125V DC	1 m 0.5 mm² 20 AWG	38.5	88.9 AC 87.5 DC	108 AC 106 DC	2	2	
UA	**140G-K-UVA**	220…240V AC 220…250V DC	1 m 0.5 mm² 20 AWG	77	154 AC 175 DC	208 AC 212.5 DC	2.5	2.5	
UB	**140G-K-UVB**	380…440V AC	1 m 1 mm² 17 AWG	133	308	374	3	—	
UC	**140G-K-UVC**	480…525V AC	1 m 1 mm² 17 AWG	168	367.5	446	4	—	

All wired with 600V (UL/CSA) insulated wire. No voltage derating required.

Application Ratings				Electrical Operating Ratings (Nominal Values)					
140G Frames N, NS									
				Electrical Specifications					
Order Code	**Catalog Number**	Rated Voltage U_e [V]	Wire Length – Size	Dropout Voltage [V]		Pickup Voltage Max. [V]	UVR Power Absorbed During Normal Operation		Opening Time
				Min.	Max.		AC [VA]	DC [W]	
UJ	**140G-N-UVJ**	24V AC/DC	1 m 0.5 mm² 20 AWG	8.4	21	25.5	—	5	≤ 20
—	**140G-N-UVKY**	60V AC/DC	1 m 0.5 mm² 20 AWG	21	42	51	5	5	
UD	**140G-N-UVD**	110…120V AC/DC	1 m 0.5 mm² 20 AWG	38.5	88.9 AC 87.5 DC	108 AC 106 DC	5	5	
UA	**140G-N-UVA**	220…240V AC/DC	1 m 0.5 mm² 20 AWG	77	154 AC 175 DC	208 AC 212.5 DC	5	5	
UB	**140G-N-UVB**	380…400V AC	1 m 1 mm² 17 AWG	133	308	374	5	—	
UC	**140G-N-UVC**	415…440V AC	1 m 1 mm² 17 AWG	168	367.5	446	5	—	
140G Frame R									
UJ	**140G-R-UVJ**	24V AC/DC	1 m 0.5 mm² 20 AWG	8.4	21	25.5	—	5	≤ 30
—	**140G-R-UVKY**	60V AC/DC	1 m 0.5 mm² 20 AWG	21	42	51	5	5	
UD	**140G-R-UVD**	110…120V AC/DC	1 m 0.5 mm² 20 AWG	38.5	88.9 AC 87.5 DC	108 AC 106 DC	5	5	
UA	**140G-R-UVA**	220…240V AC/DC	1 m 0.5 mm² 20 AWG	77	154 AC 175 DC	208 AC 212.5 DC	5	5	
UB	**140G-R-UVB**	380…400V AC	1 m 1 mm² 17 AWG	133	308	374	5	—	
UC	**140G-R-UVC**	415…440V AC	1 m 0.5 mm² 20 AWG	168	367.5	446	5	—	

All wired with 600V (UL/CSA) insulated wire. No voltage derating required.

Motor Operators

Application Ratings							Electrical Operating Ratings (Nominal Values)									
		140G Family					Application Specifications									
		Frame					Operating Voltage						Inrush Power		UVR Power Absorbed During Normal Operation	
Catalog Number	Rated Voltage U_e [V]	G	H	I	J	Wire Length – Size	Min. [V]	Max. [V]	Opening Time [s]	Closing Time [s]	Resetting Time [s]	Min. Control Impulse Time (opening and closing) [ms]	AC [VA]	DC [W]	AC [VA]	DC [W]
140G-G-EOPJ	24 V DC	X	O	X	O	1 m 0.5 mm² 20 AWG	†	†	†	†	†	†	†	†	—	†
140G-H-EOPJ		O	X	O	X		20.4	26.4	0.1	0.1	†	≥ 150	—	500	—	350
140G-G-EOPKY	48…60 V DC	X	O	X	O	1 m 0.5 mm² 20 AWG	†	†	†	†	†	†	—	†	—	350
140G-H-EOPKY		O	X	O	X		40.8	66	0.1	0.1	†	≥ 150	—	500	—	350
140G-G-EOPD	110…125 V AC/DC	X	O	X	O	1 m 0.5 mm² 20 AWG	†	†	†	†	†	†	†	†	†	†
140G-H-EOPD		O	X	O	X		106.3	137	0.1	0.1	†	≥ 150	500	500	350	350
140G-G-EOPA	220…250 V AC/DC	X	O	X	O	1 m 0.5 mm² 20 AWG	†	†	†	†	†	†	†	†	†	†
140G-H-EOPA		O	X	O	X		212.6	275	0.1	0.1	†	≥ 150	500	500	350	350
140G-G-EOPB	380…440 V AC	X	O	X	O	1 m 1 mm² 17 AWG	†	†	†	†	†	†	†	—	†	—
140G-H-EOPB		O	X	O	X		374	484	0.1	0.1	†	≥ 150	500	—	350	—
140G-G-EOPC	480…525 V AC	X	O	X	O	1 m 1 mm² 17 AWG	†	†	†	†	†	†	†	—	†	—
140G-H-EOPC		O	X	O	X		†	†	†	†	†	†	†	†	†	†

		Frame			Operating Voltage						Inrush Power		UVR Power Absorbed During Normal Operation	
Catalog Number	Rated Voltage U_e [V]	K	M		Min. [V]	Max. [V]	Opening Time [s]	Closing Time [s]	Resetting Time [s]	Min. Control Impulse Time (opening and closing) [ms]	AC [VA]	DC [W]	AC [VA]	DC [W]
140G-K-EOPJ	24 V DC	X	O	1 m 0.5 mm² 20 AWG	20.4	26.4	1.5	< 0.1	3	≥ 100	—	300	—	150
140G-M-EOPJ		O	X		20.4	26.4	3	< 0.1	5	≥ 100	—	300	—	150
140G-K-EOPKY	48…60 V DC	X	O	1 m 0.5 mm² 20 AWG	40.8	66	1.5	< 0.1	3	≥ 100	—	300	—	150
140G-M-EOPKY		O	X		40.8	66	3	< 0.1	5	≥ 100	—	300	—	150
140G-K-EOPD	110…125 V AC/DC	X	O	1 m 0.5 mm² 20 AWG	106.3	137	1.5	< 0.1	3	≥ 100	300	300	150	150
140G-M-EOPD		O	X		106.3	137	3	< 0.1	5	≥ 100	300	300	150	150
140G-K-EOPA	220…250 V AC/DC	X	O	1 m 0.5 mm² 20 AWG	212.6	275	1.5	< 0.1	3	≥ 100	300	300	150	150
140G-M-EOPA		O	X		212.6	275	3	< 0.1	5	≥ 100	300	300	150	150
140G-K-EOPB	380 V AC	X	O	1 m 1 mm² 17 AWG	374	484	1.5	< 0.1	3	≥ 100	300	—	150	—
140G-M-EOPB		O	X		374	484	3	< 0.1	5	≥ 100	300	—	150	—

† Contact Rockwell Automation.

All wired with 600V (UL/CSA) insulated wire. No voltage derating required.

Motor Operators

Application Ratings					Electrical Operating Ratings (Nominal Values)				
		140G Family			Application Specifications				
		Frame			Operating Voltage			Inrush Power	
Catalog Number Spring Charging Motor	Rated Voltage U_e [V]	N	NS	Wire Length – Size	Min. [V]	Max. [V]	Charging Time [s]	AC [VA]	DC [W]
140G-NS-SCMJ	24…30 V AC/DC	O	X	1 m 0.5 mm² 20 AWG	20.4	33	8 - 10	≤ 400	≤ 400
140G-NS-SCMKY	48…60 V AC/DC	O	X	1 m 0.5 mm² 20 AWG	40.8	66	8 - 10	≤ 400	≤ 400
140G-NS-SCMD	100…130 V AC/DC	O	X	1 m 0.5 mm² 20 AWG	106.3	143	8 - 10	≤ 400	≤ 400
140G-NS-SCMA	220…250 V AC/DC	O	X	1 m 0.5 mm² 20 AWG	212.6	275	8 - 10	≤ 400	≤ 400
140G-NS-SCMB	380…415 V AC	O	X	1 m 1 mm² 17 AWG	323	456	8 - 10	≤ 400	—

		Frame	Wire	Operating Voltage				Inrush Power	
Catalog Number	Rated Voltage U_e [V]	R	Length – Size	Min. [V]	Max. [V]	Inrush Time [s]	Charging Time [s]	AC [VA]	DC [W]
140G-R-SCMJ	24…30 V AC/DC	X	1 m 0.5 mm² 20 AWG	20.4	33	0.2	4 - 5	500	500
140G-R-SCMKY	48…60 V AC/DC	X	1 m 0.5 mm² 20 AWG	40.8	66	0.2	4 - 5	500	500
140G-R-SCMD	100…130 V AC/DC	X	1 m 0.5 mm² 20 AWG	106.3	143	0.2	4 - 5	500	500
140G-R-SCMA	220…250 V AC/DC	X	1 m 1 mm² 17 AWG	212.6	275	0.2	4 - 5	500	500

† Contact Rockwell Automation.

All wired with 600V (UL/CSA) insulated wire. No voltage derating required.

Residual Current Release Module

Electrical Characteristics	Residual Current Device				
	140G-G-ELP* ②	140G-H-ELP* ③	140G-I-ELP* ②	140G-G-ELP* ②	140G-J-ELP* ③
Primary Power Supply Voltage [V]	85…690	85…690	85…690	85…690	415…690
Operating Frequency [Hz]	45…66	45…66	45…66	45…66	45…66
Fault Frequency [Hz]	50-60	50-60	50-60	50-60	50-60
Test Operating Range [V]	85…690	85…690	85…690	85…690	415…690
Rated Operating Current [A]	160 A Max.	160 A Max.	250 A Max.	250 A Max.	400 A Max.
Adjustable Trip Threshold [A]	0.03-0.05-0.1-0.3-0.5-1-3-5-10	0.03-0.05-0.1-0.3-0.5-1-3-5-10	0.03-0.05-0.1-0.3-0.5-1-3-5-10	0.03-0.05-0.1-0.3-0.5-1-3-5-10	0.03-0.05-0.1-0.3-0.5-1-3-5-10
Selective Type S	√	√	√	√	√
Adjustable NON-trip Time Settings [s] at $2x I\Delta_n$	Instantaneous	Instantaneous	Instantaneous	Instantaneous	Instantaneous
	0.1-0.2-0.3-0.5-1-2-3	0.1-0.2-0.3-0.5-1-2-3	0.1-0.2-0.3-0.5-1-2-3	0.1-0.2-0.3-0.5-1-2-3	0.1-0.2-0.3-0.5-1-2-3
Power Consumption	<5 W at 690V AC	<5 W at 690V AC	<5 W at 690V AC	<5 W at 690V AC	<10 W at 690V AC
Trip Coil with Switch Contact for Trip Signal	√	√	√	√	√
N.O. Contact for Pre-alarm Signal	√	√	√	√	√
N.O. Contact for Alarm Signal	√	√	√	√	√
Pre-alarm Indication from 25% $I\Delta_n$ Steady Yellow LED Light	√	√	√	√	√
Alarm Timing Indication at 75% $I\Delta_n$ Flashing Yellow LED Light ①	√	√	√	√	√
Type A for Pulsating Alternating Current Type AC for Alternating Current	√	√	√	√	√

① Indication of alarm timing at 90% $I\Delta_n$ for 30 mA.
② 3- or 4- pole devices.
③ 4-pole only.

Time-Current Curves

Motor Circuit Protectors
- Bulletin 140MG-G 66
- Bulletin 140MG-H 67
- Bulletin 140MG-I 69
- Bulletin 140MG-J 70
- Bulletin 140MG-K 71
- Bulletin 140MG-M 72
- Bulletin 140MG-N 73
- Bulletin 140MG-H8E 74
- Bulletin 140MG-J8E 75

Thermal Magnetic Molded Case Circuit Protectors
- Bulletin 140G-G 76
- Bulletin 140G-H 82
- Bulletin 140G-I 89
- Bulletin 140G-J 92
- Bulletin 140G-K 98
- Bulletin 140G-M 99

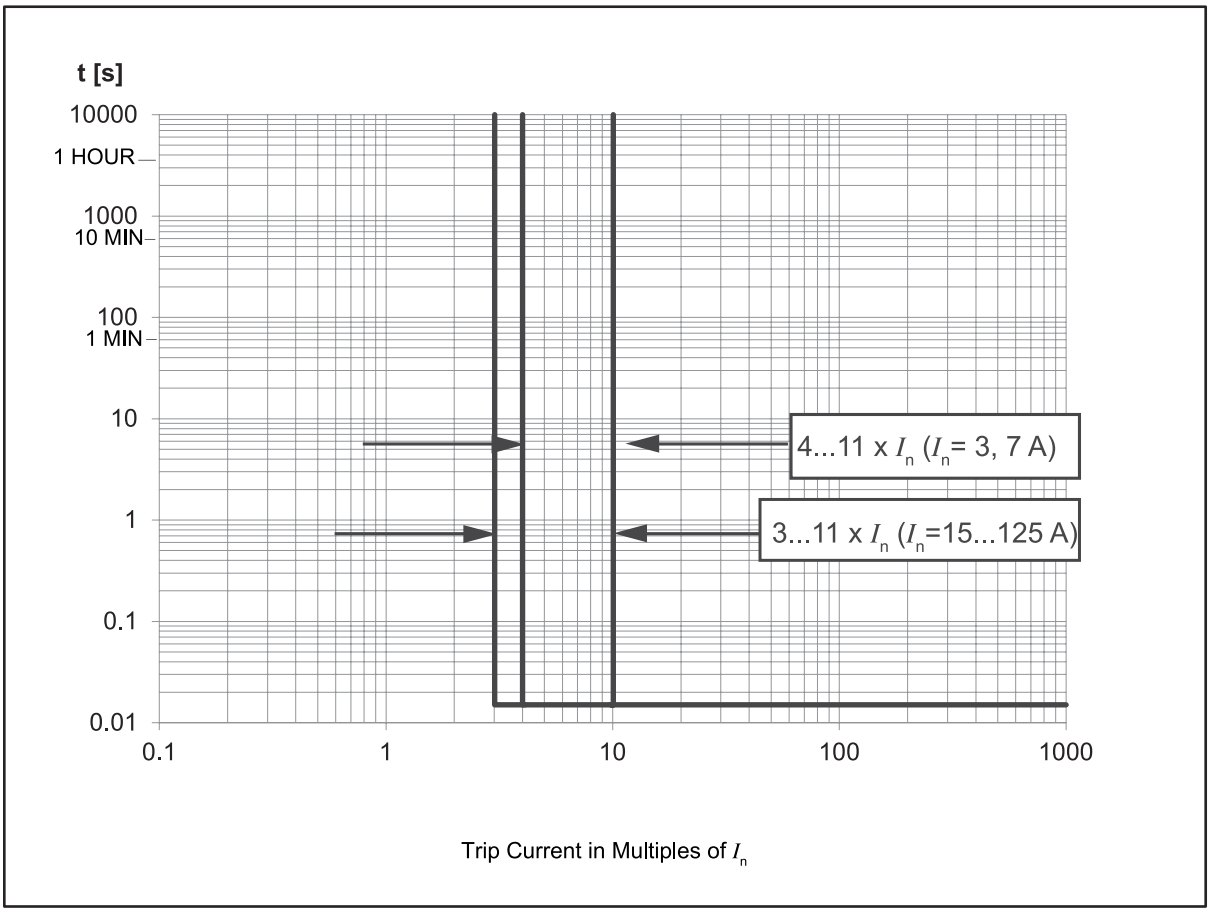
Electronic Molded Case Circuit Protectors
- Bulletin 140G-H 102
- Bulletin 140G-J 104
- Bulletin 140G-K 106
- Bulletin 140G-M 108
- Bulletin 140G-N, -NS 110
- Bulletin 140G-R 114

Let-Through Energy Curves
- I^2t @ 240V 116
- I^2t @ 415V 117
- I^2t @ 480V 118
- I^2t @ 600V 119
- I^2t @ 690V 120

Peak Let-Through Current Curves
- Peak, kA @ 240V 121
- Peak, kA @ 415V 122
- Peak, kA @ 480V 123
- Peak, kA @ 600V 124
- Peak, kA @ 690V 125

Bulletin 140MG-G

Maximum Current: 3…125 A



Instantaneous Pick-up Setting (Amperes)

Catalog Number	A	B	C	D	E	F	G	H	I
140MG-G8P-B30	12	15	17	20	23	25	28	30	33
140MG-G8P-B70	28	34	40	46	53	59	65	71	77
140MG-G8P-C15	45	60	75	90	105	120	135	150	165
140MG-G8P-C30	90	120	150	180	210	240	270	300	330
140MG-G8P-C50	150	200	250	300	350	400	450	500	550
140MG-G8P-C70	210	280	350	420	490	560	630	700	770
140MG-G8P-C80	240	320	400	480	560	640	720	800	880
140MG-G8P-D10	300	400	500	600	700	800	900	1000	1100
140MG-G8P-D12	375	500	625	750	875	1000	1125	1250	1375



Typical Trip Unit Nameplate

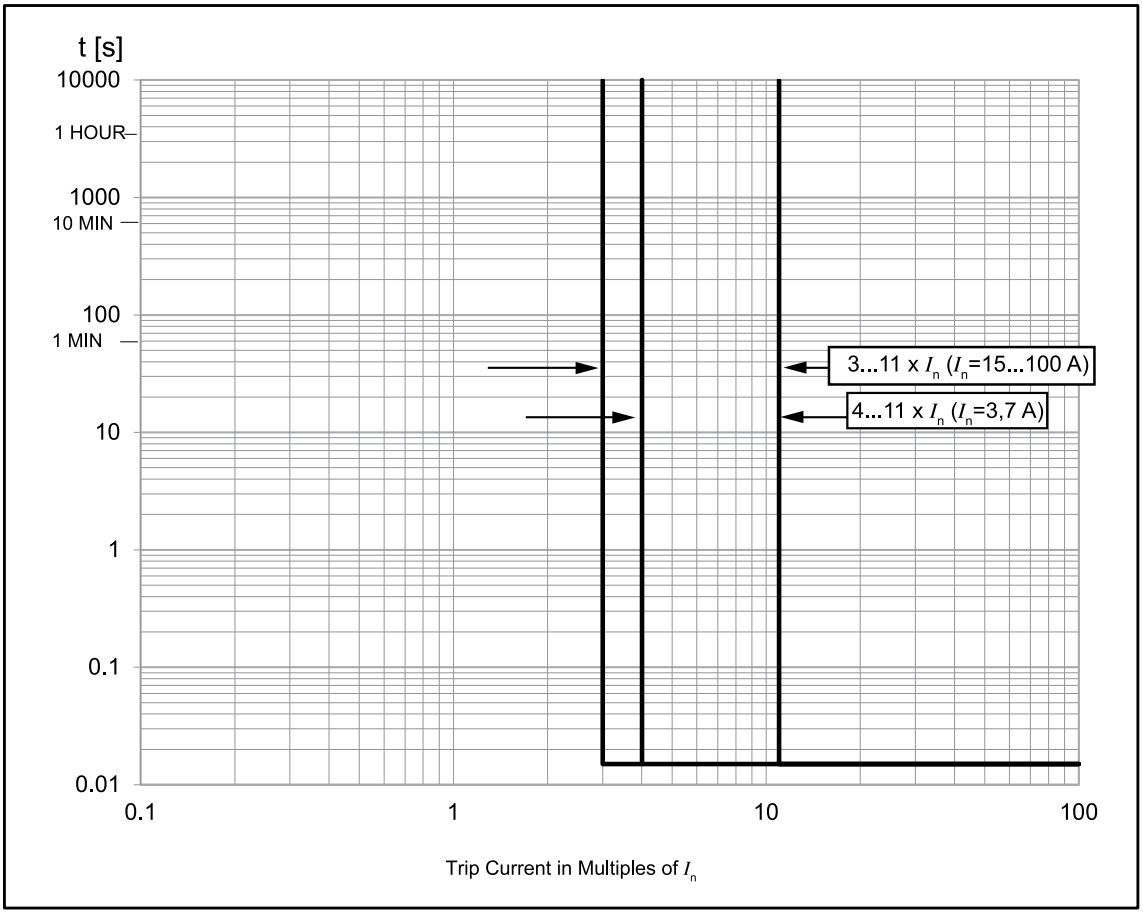
I_3 [A]								
A	B	C	D	E	F	G	H	I
300	400	500	600	700	800	900	1000	1100

See chart on left for trip setting values.

Note: Motor circuit protectors are for use only in combination controllers. For DC applications, pick-up settings are approximately 40% higher.

Bulletin 140MG-H

Maximum Current: 3…100 A



Instantaneous Pick-up Setting (Amperes)

Catalog Number	A	B	C	D	E	F	G	H	I
140MG-H8P-B30	12	15	17	20	23	25	28	30	33
140MG-H8P-B70	28	34	40	46	53	59	65	71	77
140MG-H8P-C15	45	60	75	90	105	120	135	150	165
140MG-H8P-C30	90	120	150	180	210	240	270	300	330
140MG-H8P-C50	150	200	250	300	350	400	450	500	550
140MG-H8P-C70	210	280	350	420	490	560	630	700	770
140MG-H8P-C80	240	320	400	480	560	640	720	800	880
140MG-H8P-D10	300	400	500	600	700	800	900	1000	1100



Typical Trip Unit Nameplate

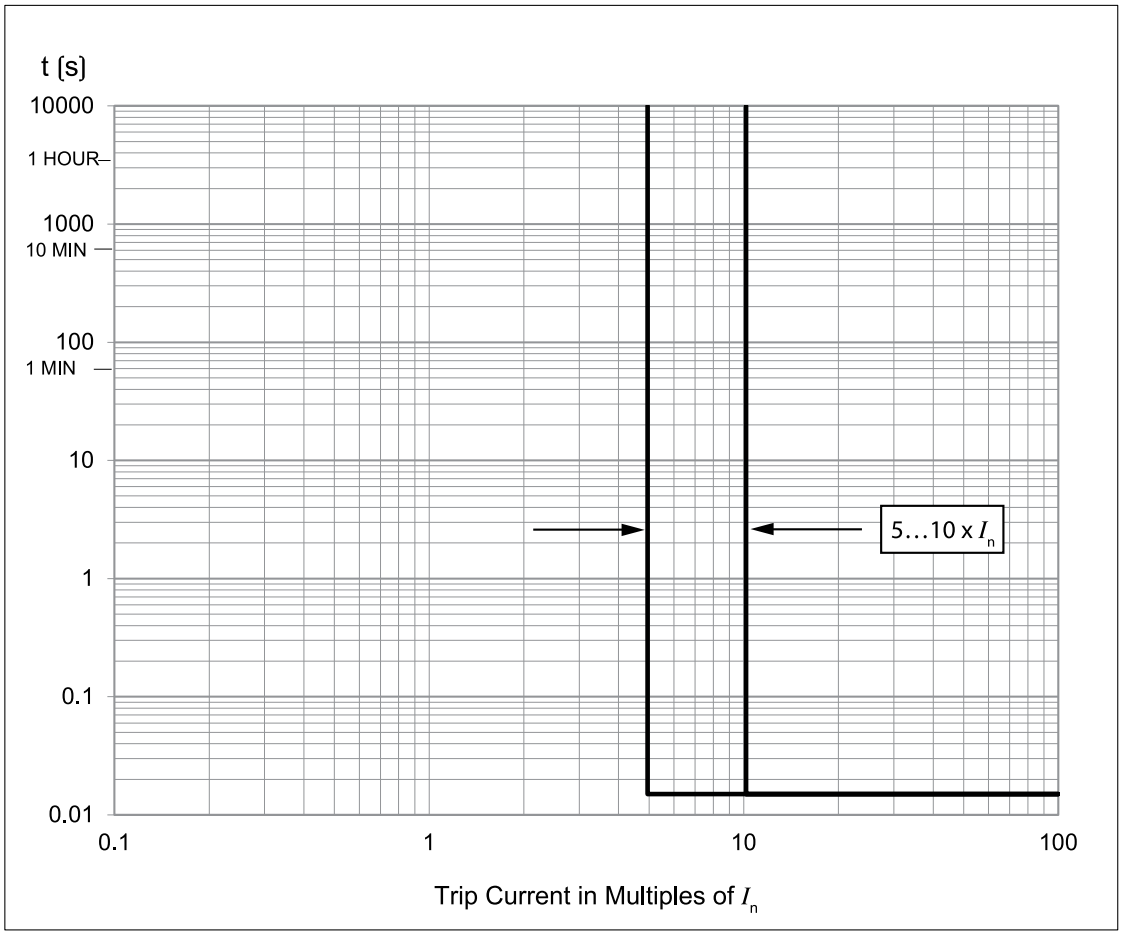
I_3 [A]								
A	B	C	D	E	F	G	H	I
300	400	500	600	700	800	900	1000	1100

See chart on left for trip setting values.

Note: Motor circuit protectors are for use only in combination controllers.
For DC applications, pick-up settings are approximately 40% higher.

Bulletin 140MG-H

Maximum Current: 125 A





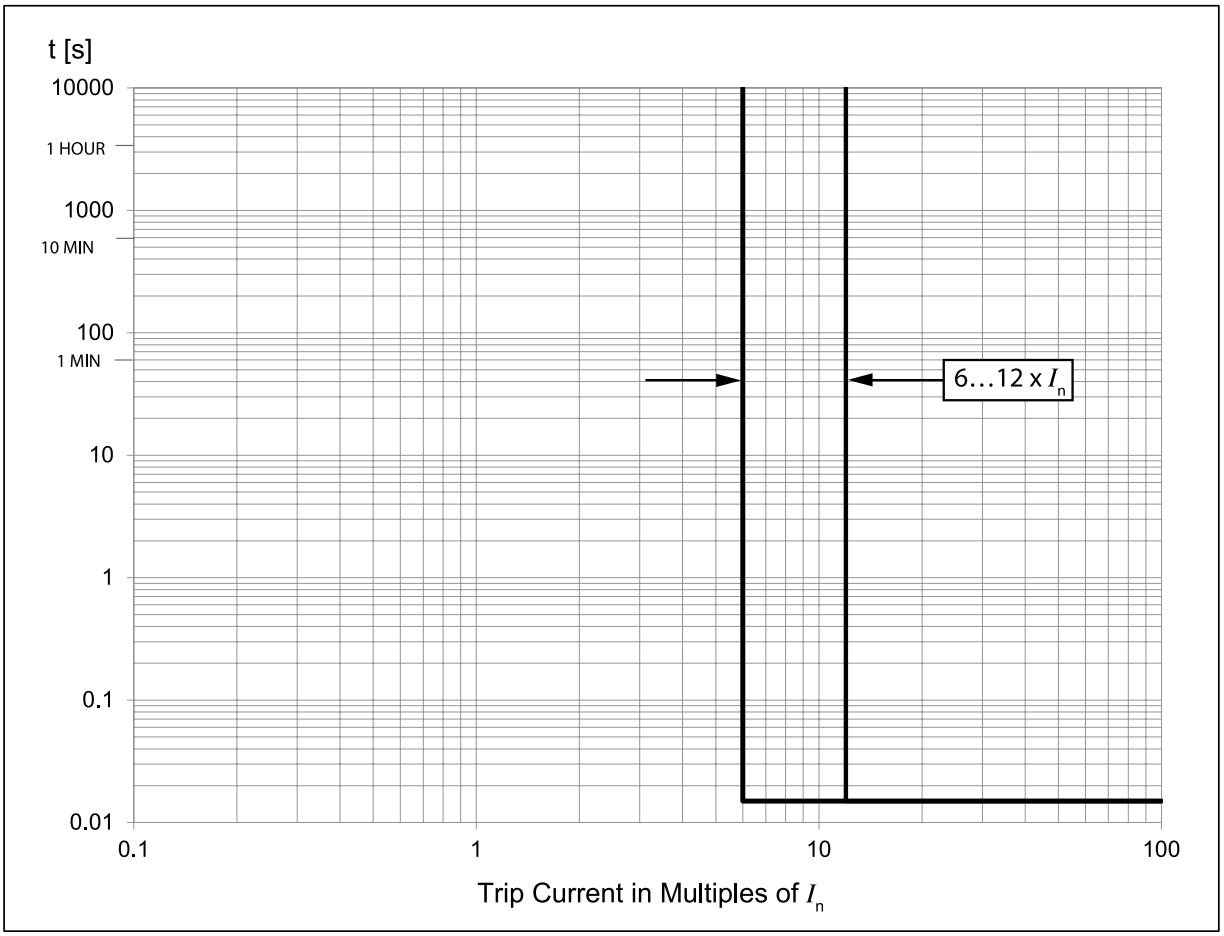
Typical Trip Unit Nameplate

I_3 [A]								
A	B	C	D	E	F	G	H	I
625	703	781	859	938	1016	1094	1172	1250

Note: Motor circuit protectors are for use only in combination controllers.
For DC applications, pick-up settings are approximately 40% higher.

Bulletin 140MG-I

Maximum Current: 100…150 A



Instantaneous Pick-up Setting (Amperes)

Catalog Number	A	B	C	D	E	F	G	H	I
140MG-I8P-D10	600	675	750	825	900	975	1050	1125	1200
140MG-I8P-D11	660	743	825	908	990	1073	1155	1238	1320
140MG-I8P-D12	750	844	938	1031	1125	1219	1313	1406	1500
140MG-I8P-D15	900	1013	1125	1238	1350	1463	1575	1688	1800



Typical Trip Unit Nameplate

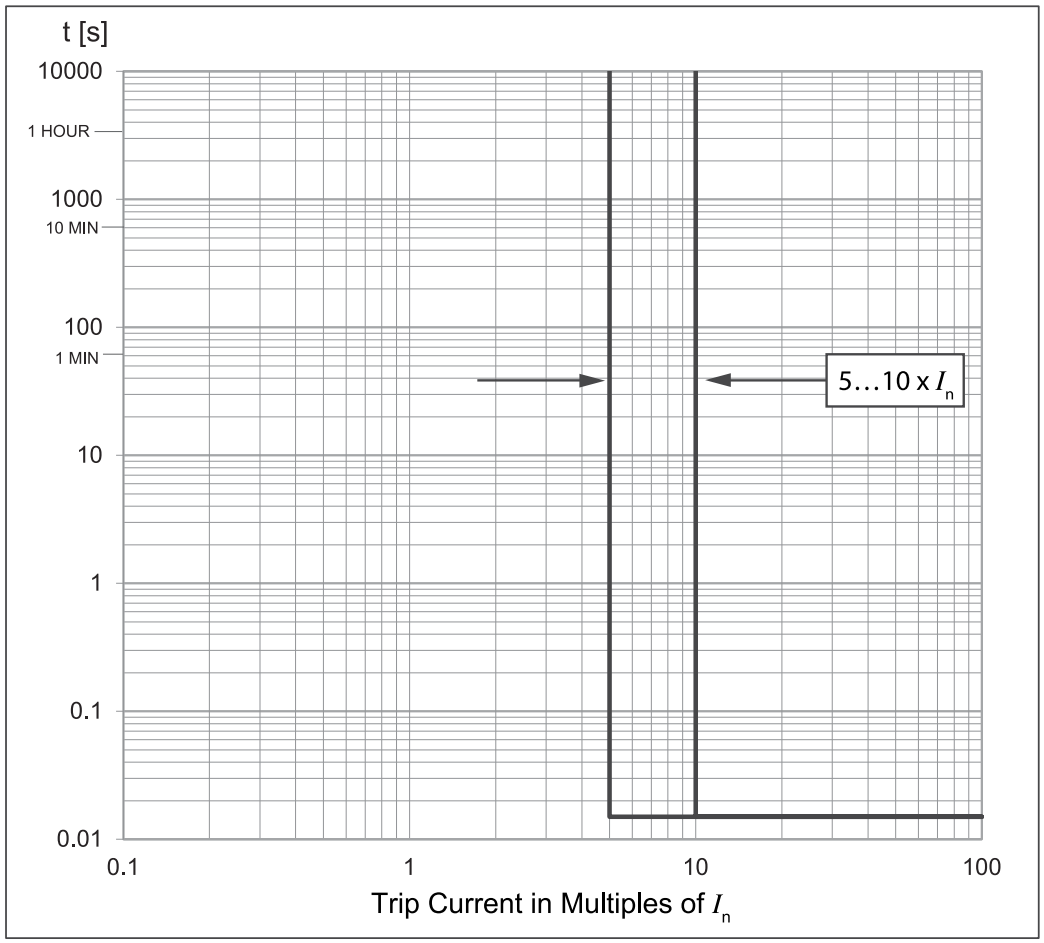
I_3 [A]									
A	B	C	D	E	F	G	H	I
600	675	750	825	900	975	1050	1125	1200

See chart on left for trip setting values.

Note: Motor circuit protectors are for use only in combination controllers. For DC applications, pick-up settings are approximately 40% higher.

Bulletin 140MG-J

Maximum Current: 150…250 A



Instantaneous Pick-up Setting (Amperes)

Catalog Number	A	B	C	D	E	F	G	H	I
140MG-J8P-D15	750	844	938	1031	1125	1219	1313	1406	1500
140MG-J8P-D17	875	984	1094	1203	1313	1422	1531	1641	1750
140MG-J8P-D20	1000	1125	1250	1375	1500	1625	1750	1875	2000
140MG-J8P-D22	1125	1266	1406	1547	1688	1828	1969	2109	2250
140MG-J8P-D25	1250	1406	1563	1719	1875	2031	2188	2344	2500



Typical Trip Unit Nameplate

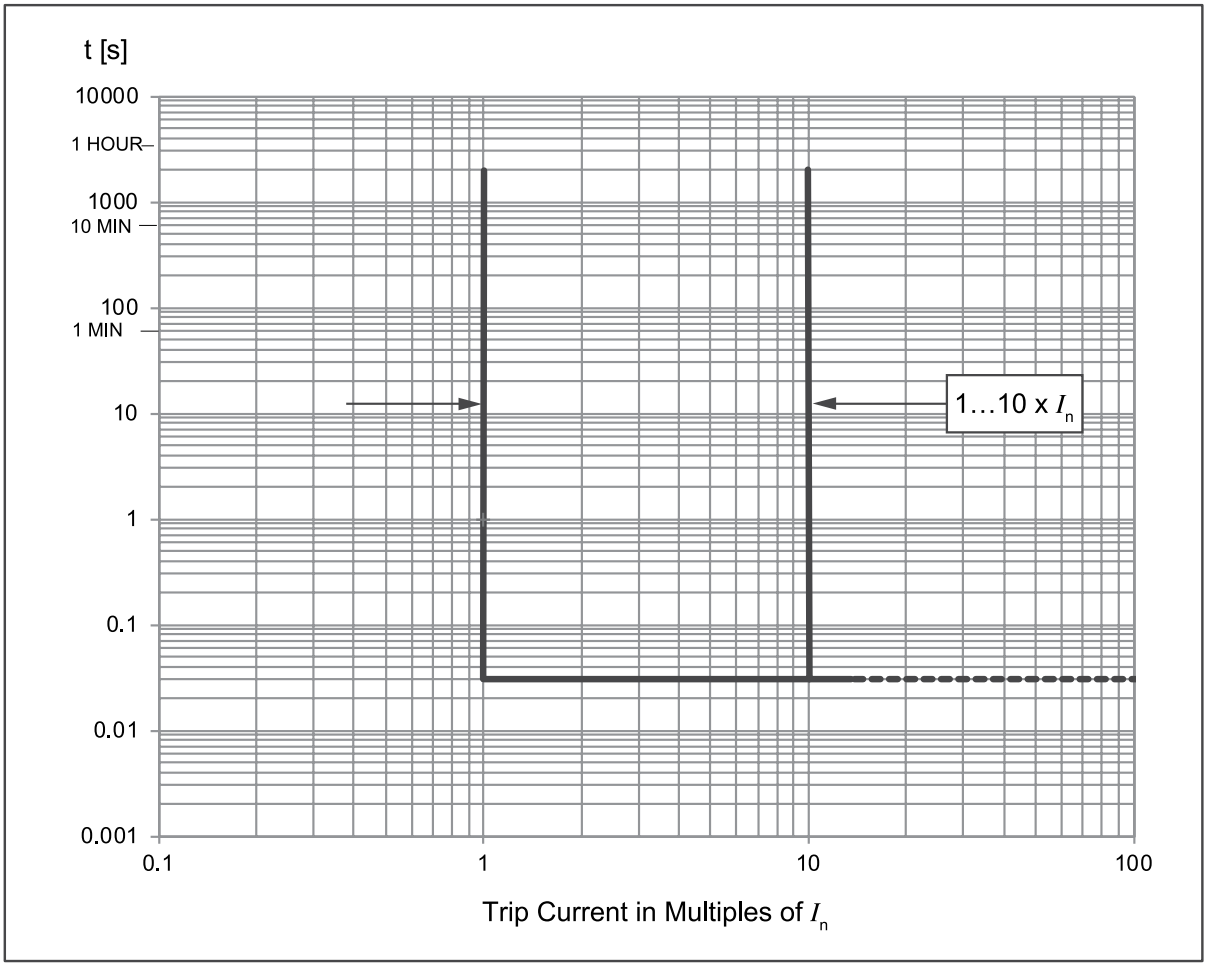
I_3 [A]								
A	B	C	D	E	F	G	H	I
750	844	938	1031	1125	1219	1313	1406	1500

See chart on left for trip setting values.

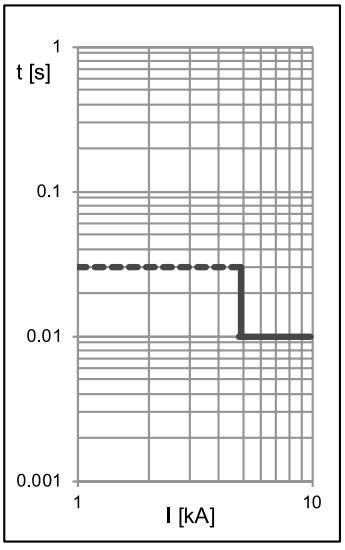
Note: Motor circuit protectors are for use only in combination controllers. For DC applications, pick-up settings are approximately 40% higher.

Bulletin 140MG-K

Maximum Current: 300 A, 400 A

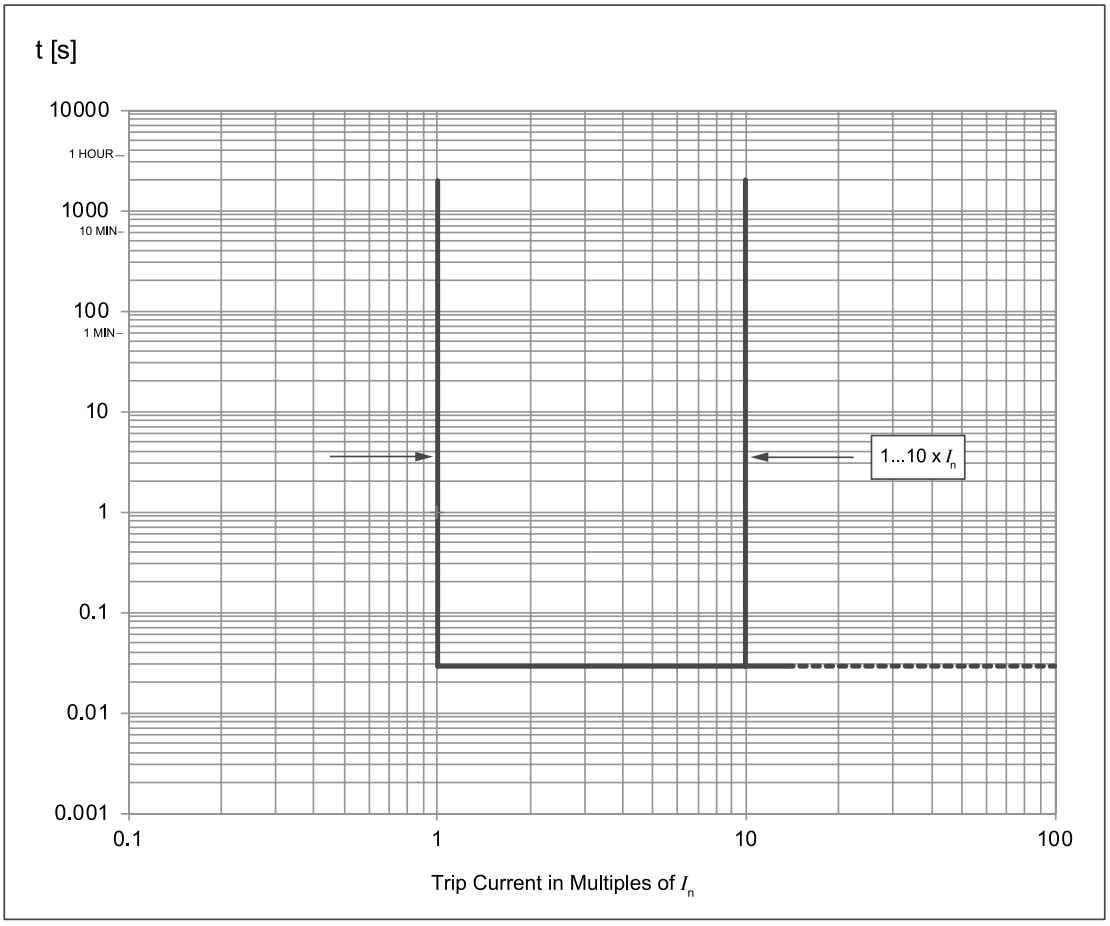


Note: Motor circuit protectors are for use only in combination controllers. For DC applications, pick-up settings are approximately 40% higher.

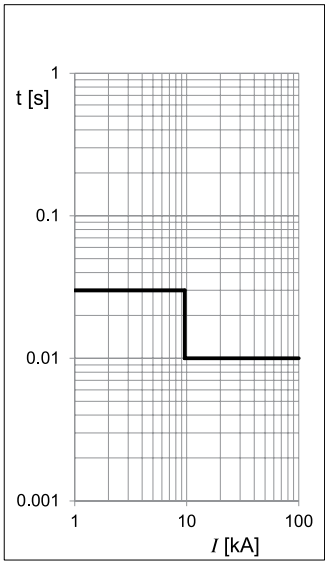


Bulletin 140MG-M

Maximum Current: 600 A, 800 A

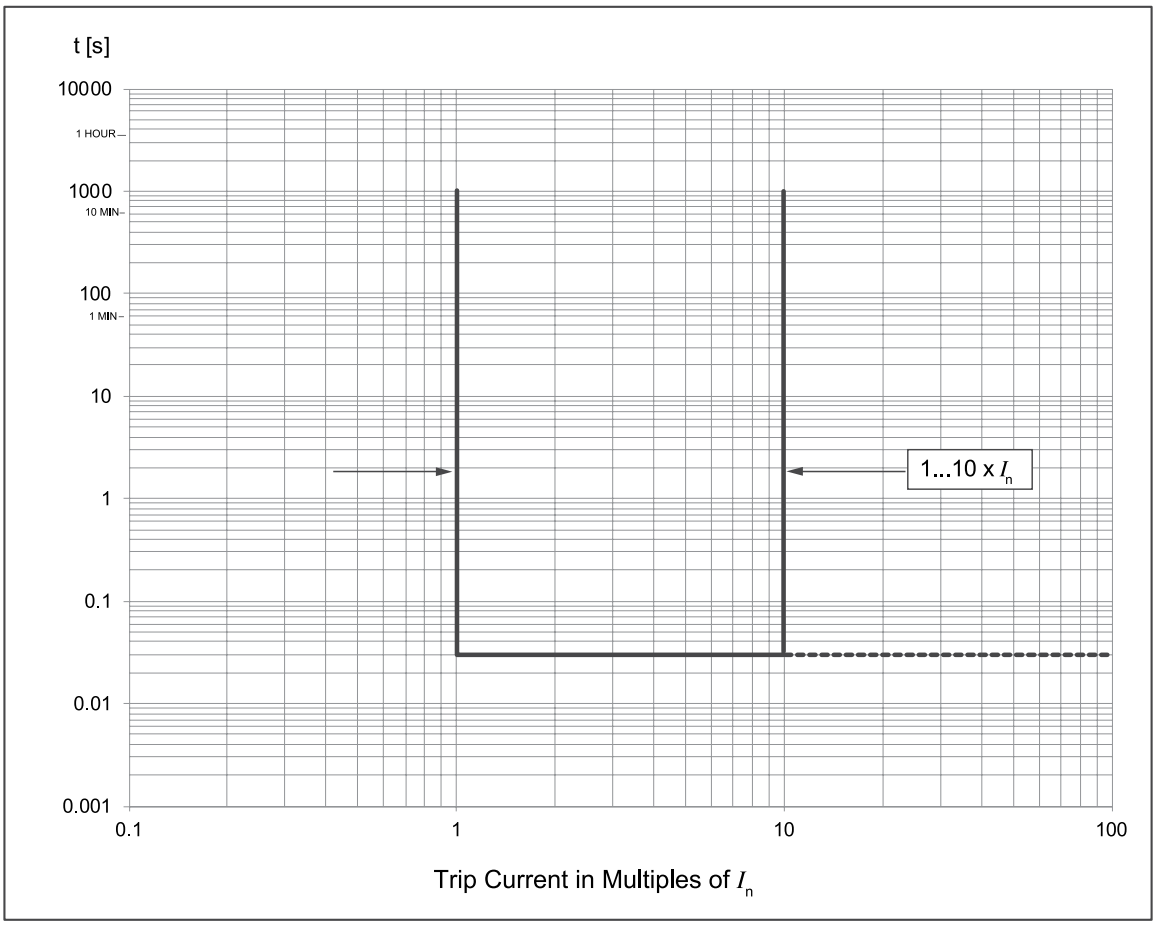


Note: Motor circuit protectors are for use only in combination controllers. For high fault current levels an additional fixed instantaneous override is provided at 9.6 kA.

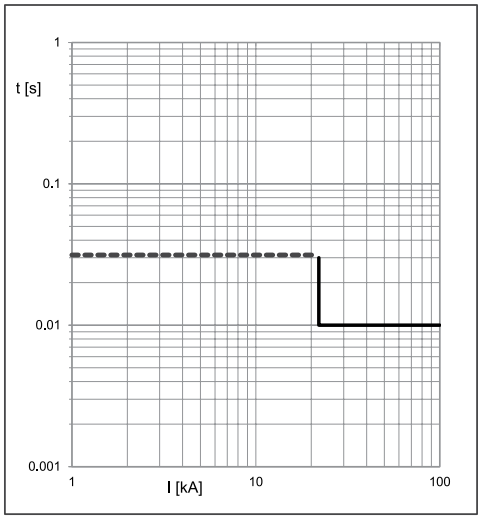


Bulletin 140MG-N

Maximum Current: 1200 A

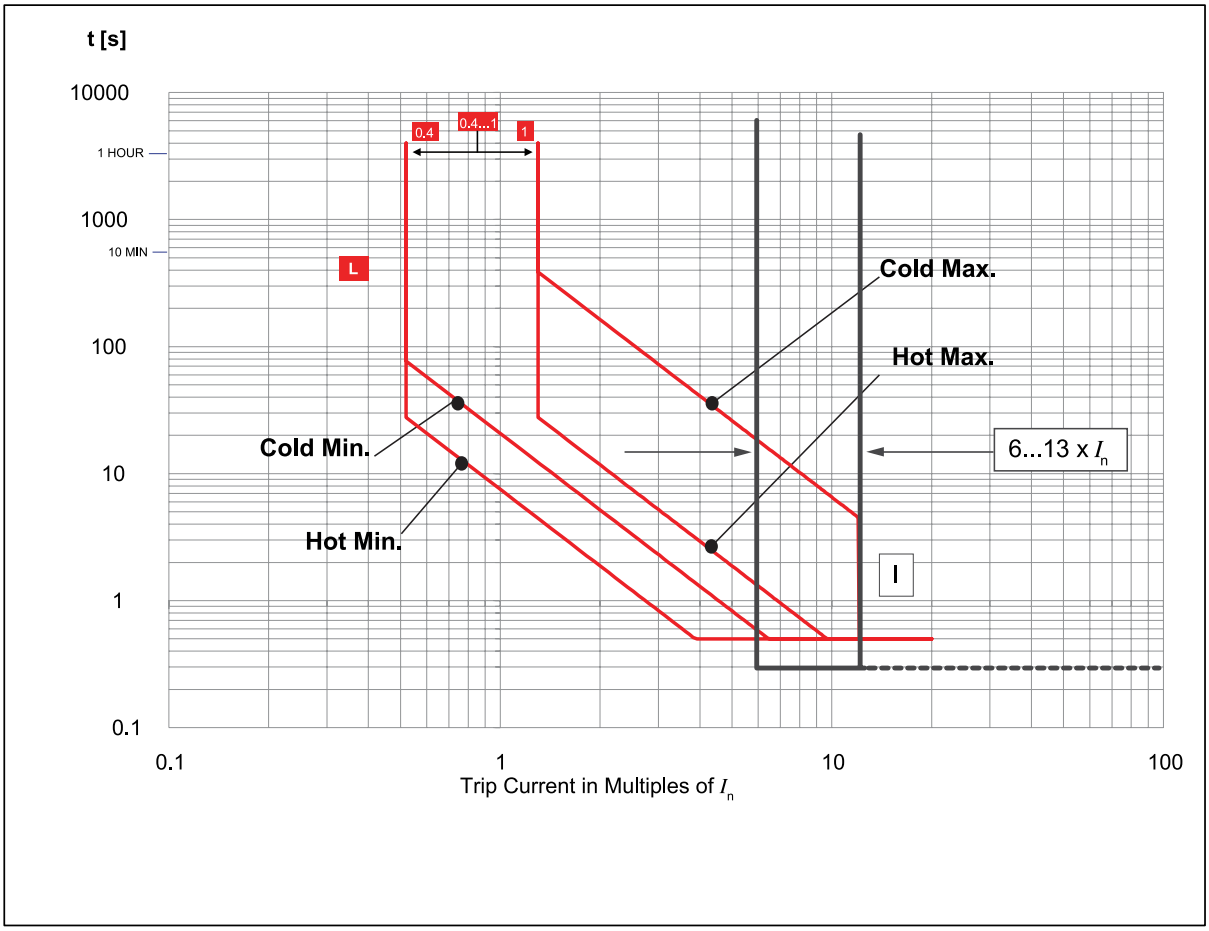


Note: Motor circuit protectors are for use only in combination controllers. For high fault current levels an additional fixed instantaneous override is provided at 22 kA.

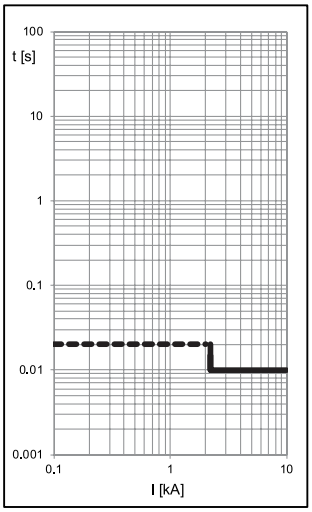


Bulletin 140MG-H8E

Available Current Sensors: 25 A, 60 A, 100 A

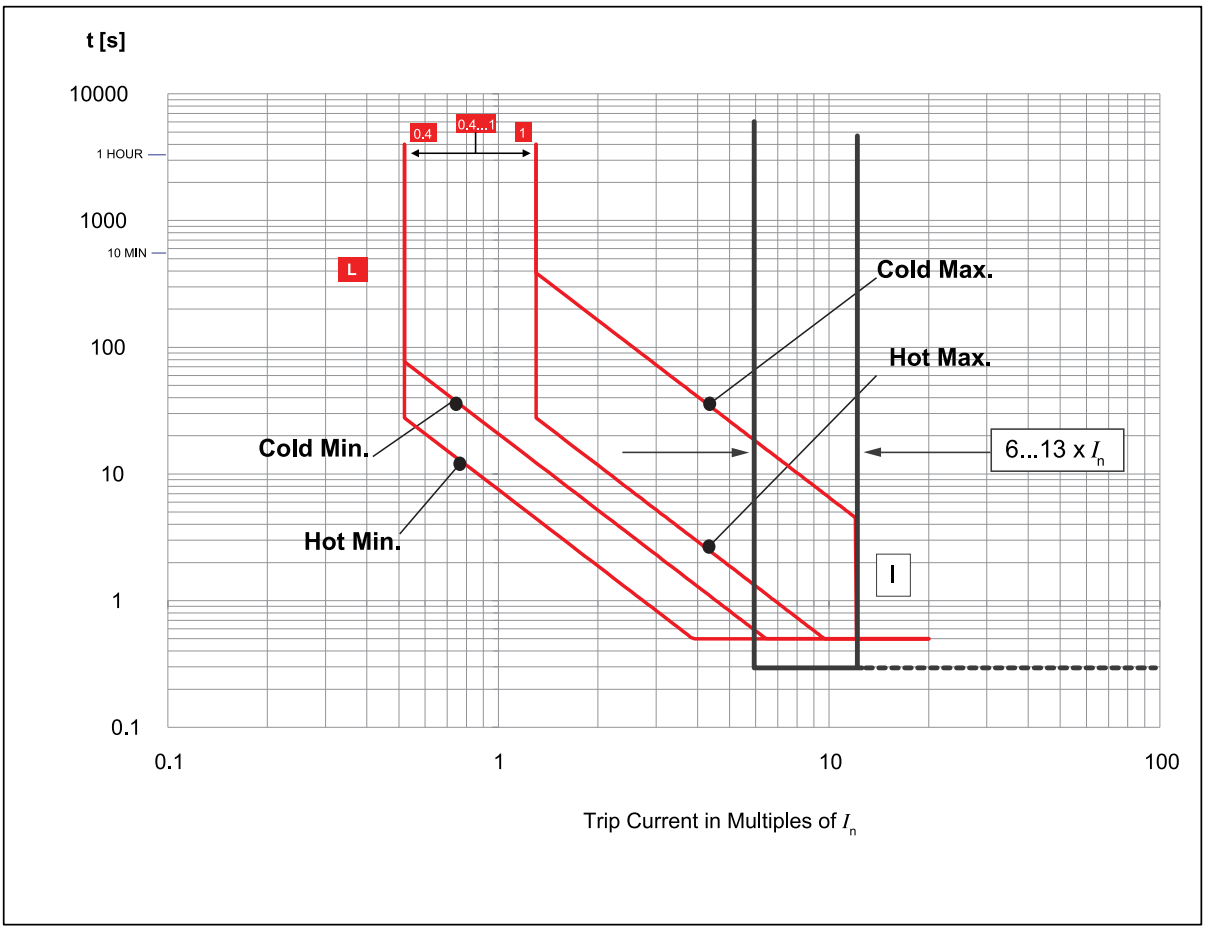


Note: Set L function value equal motor FLA.

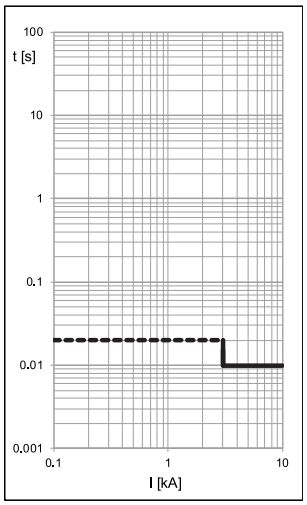


Bulletin 140MG-J8E

Available Current Sensors: 40 A, 60 A, 100 A, 150 A

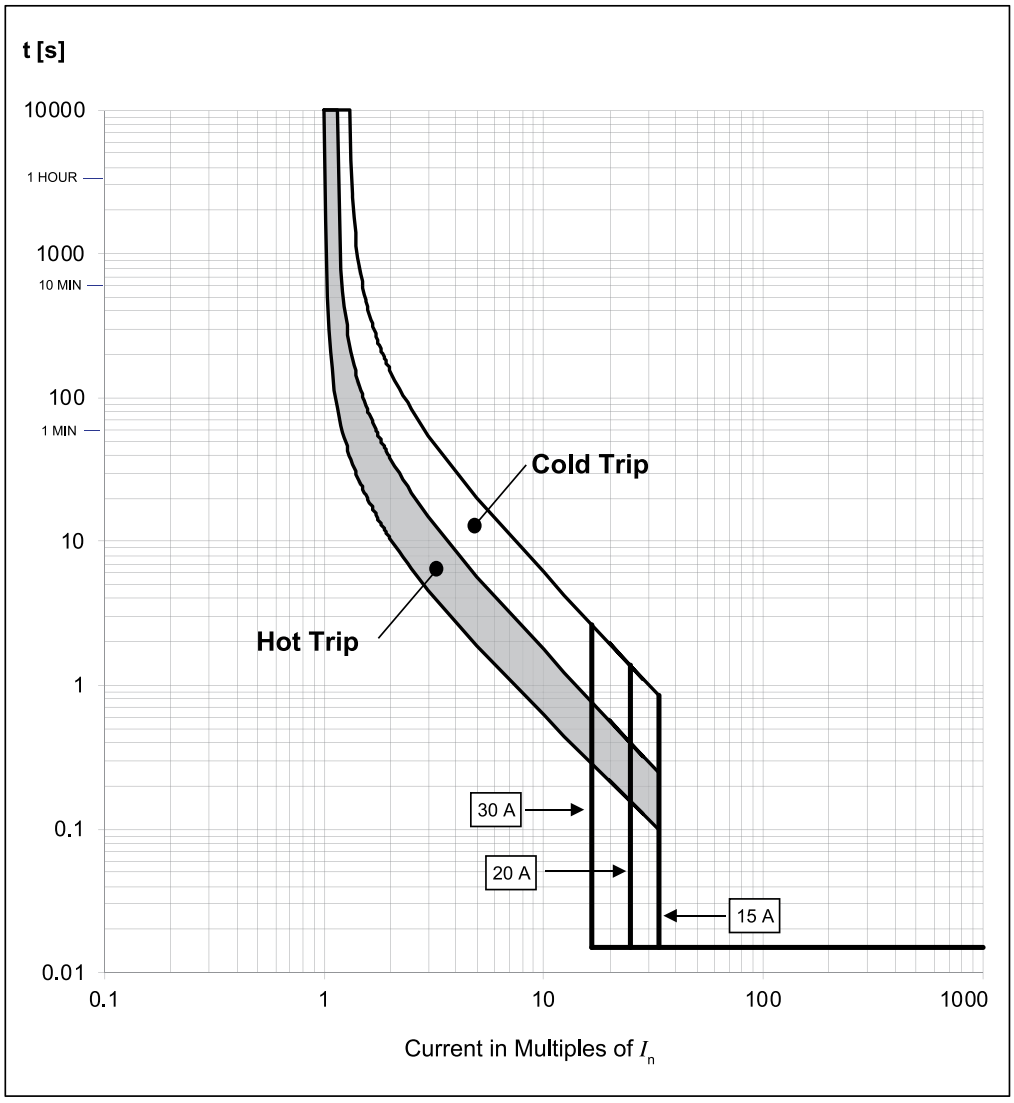


Note: Set L function value equal motor FLA.



Bulletin 140G-G

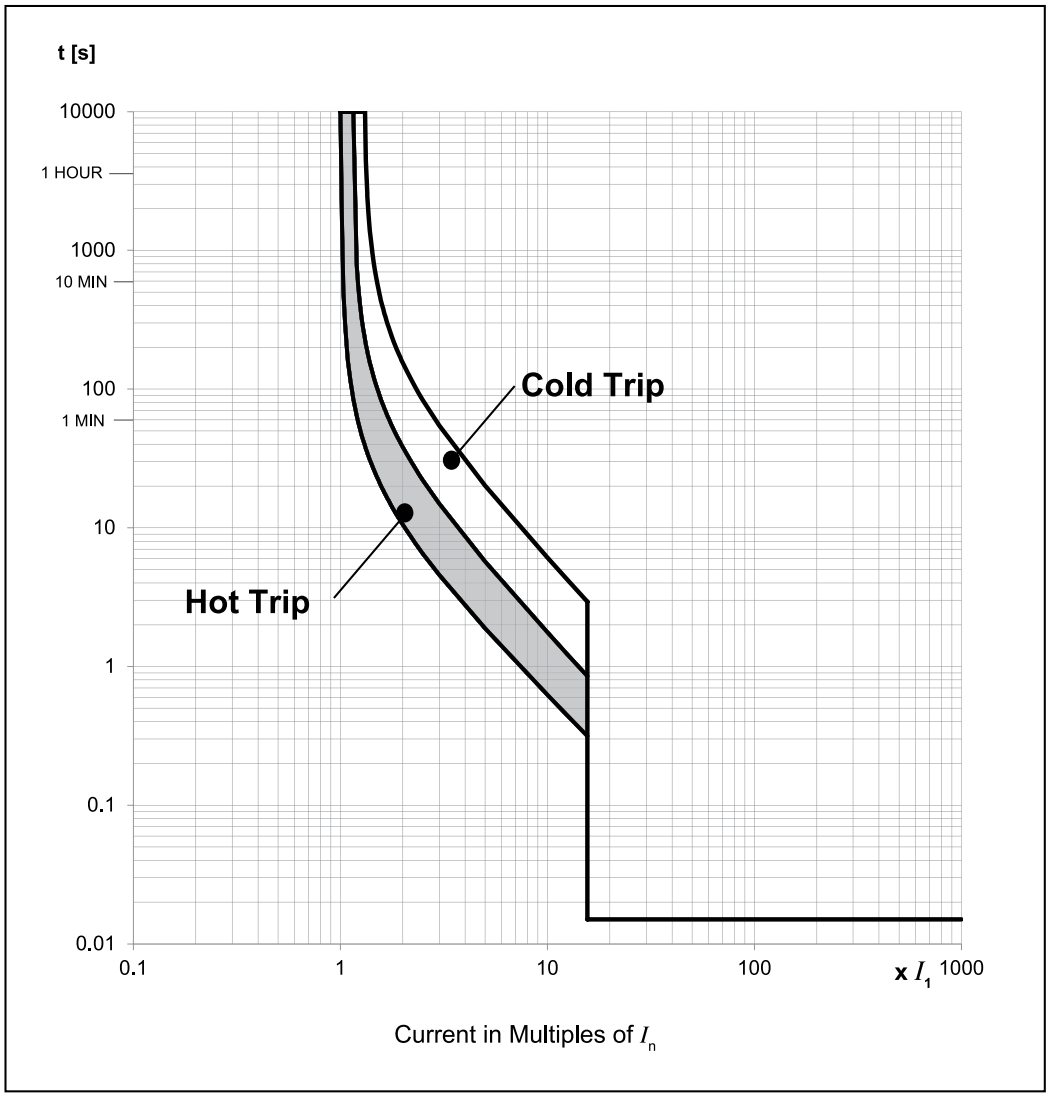
Maximum Current: 15…30 A



Rated Current I_n [A]	Magnetic Trip I_m [A]
15…30	500

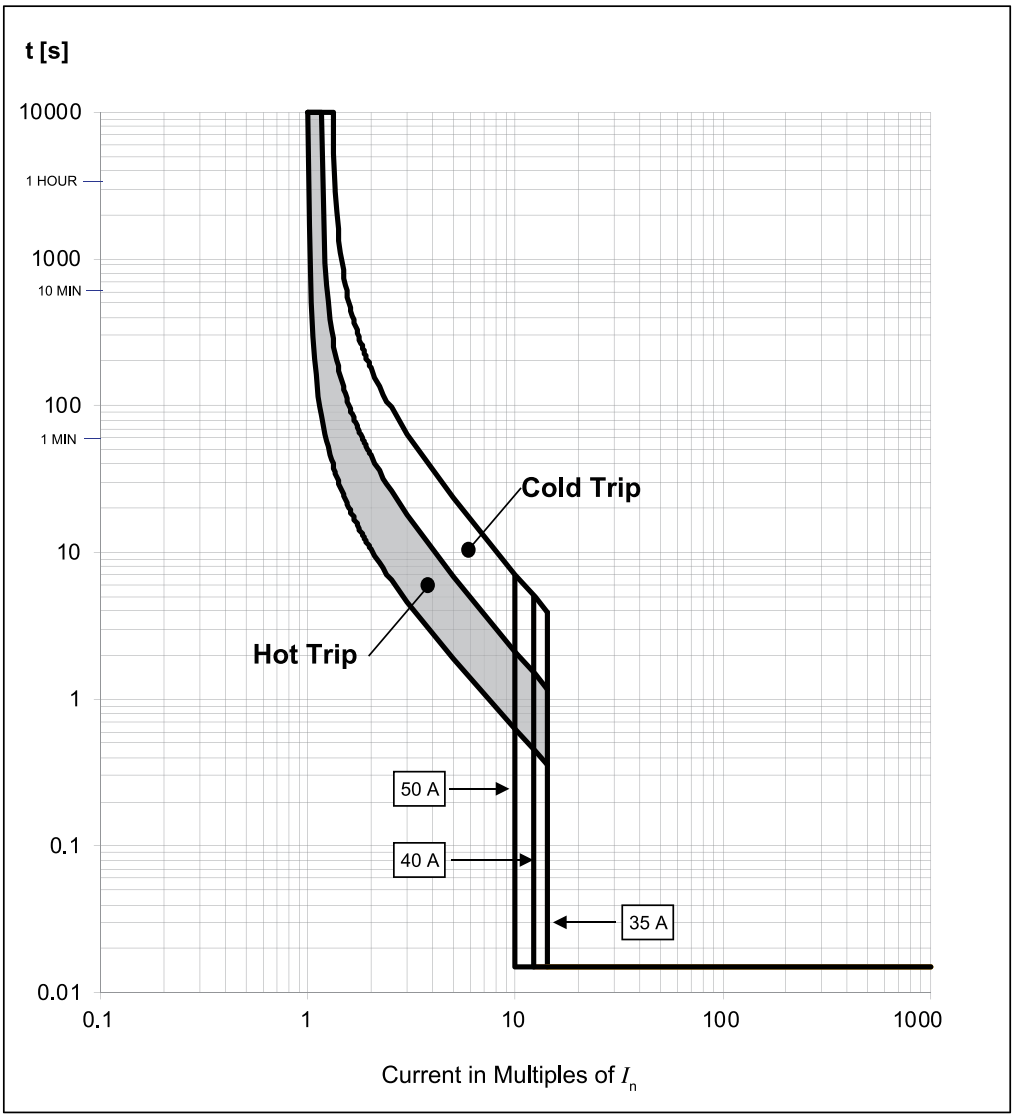
Bulletin 140G-G

Maximum Current: 32 A



Bulletin 140G-G

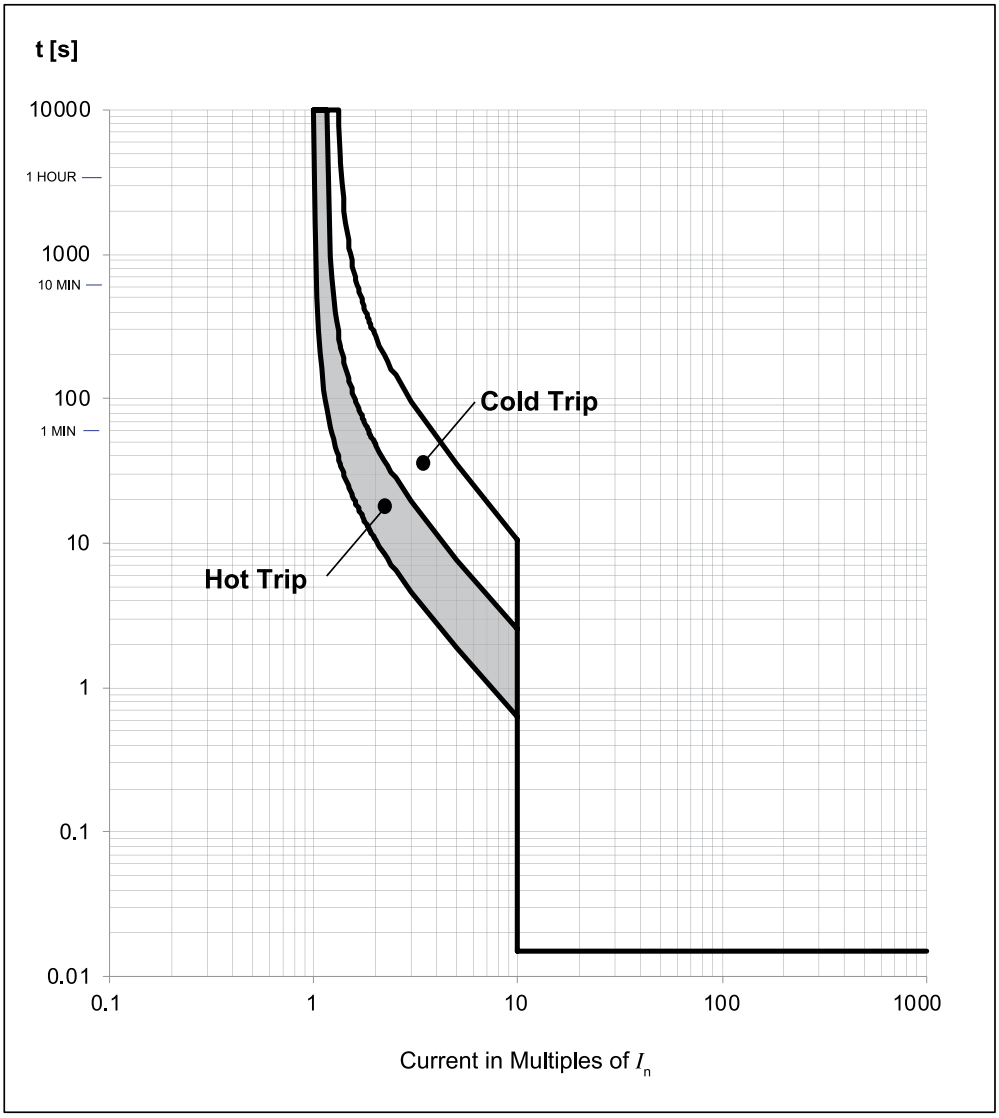
Maximum Current: 35…50 A



Rated Current I_n [A]	Magnetic Trip I_m [A]
35…50	500

Bulletin 140G-G

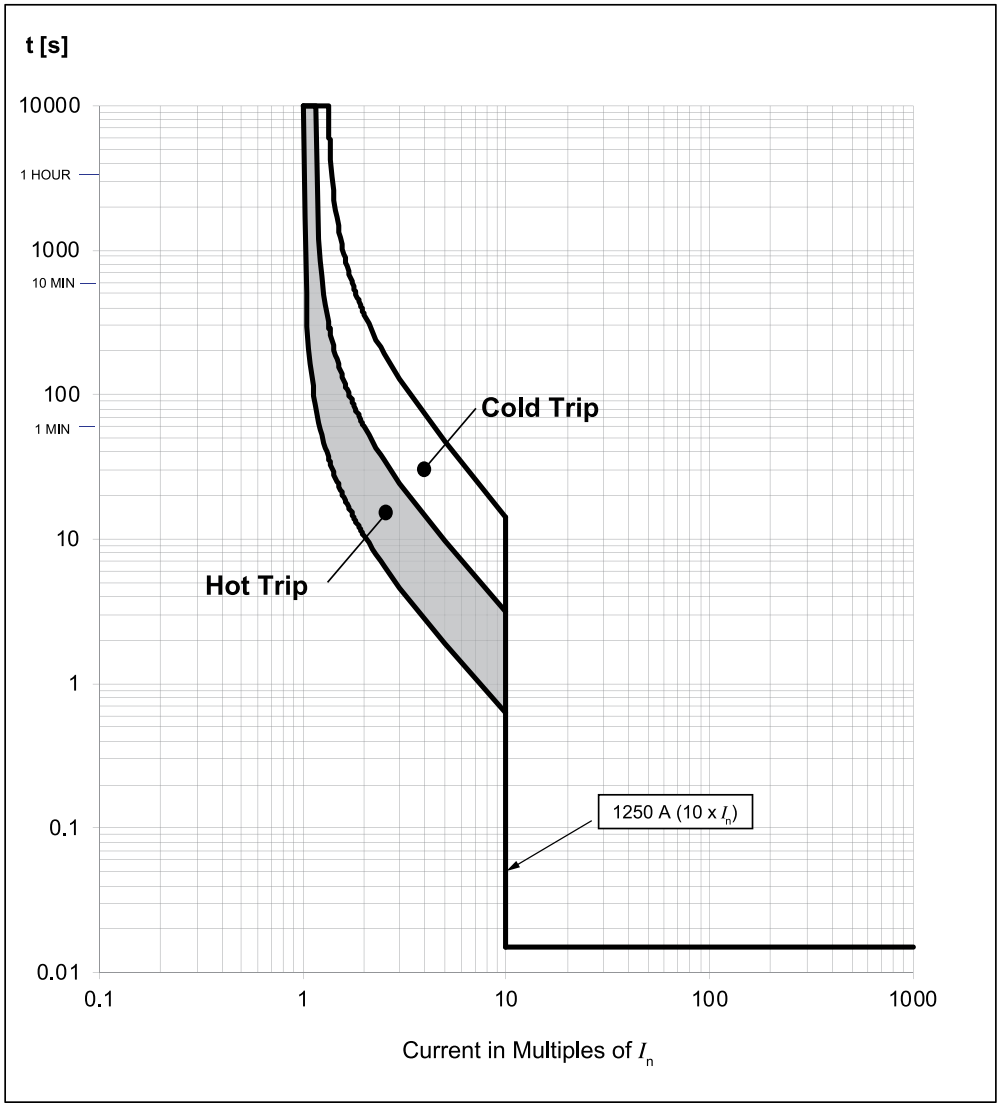
Maximum Current: 60…100 A



Rated Current I_n [A]	Magnetic Trip I_m [A]
60	600
63	630
70	700
80	800
90	900
100	1000

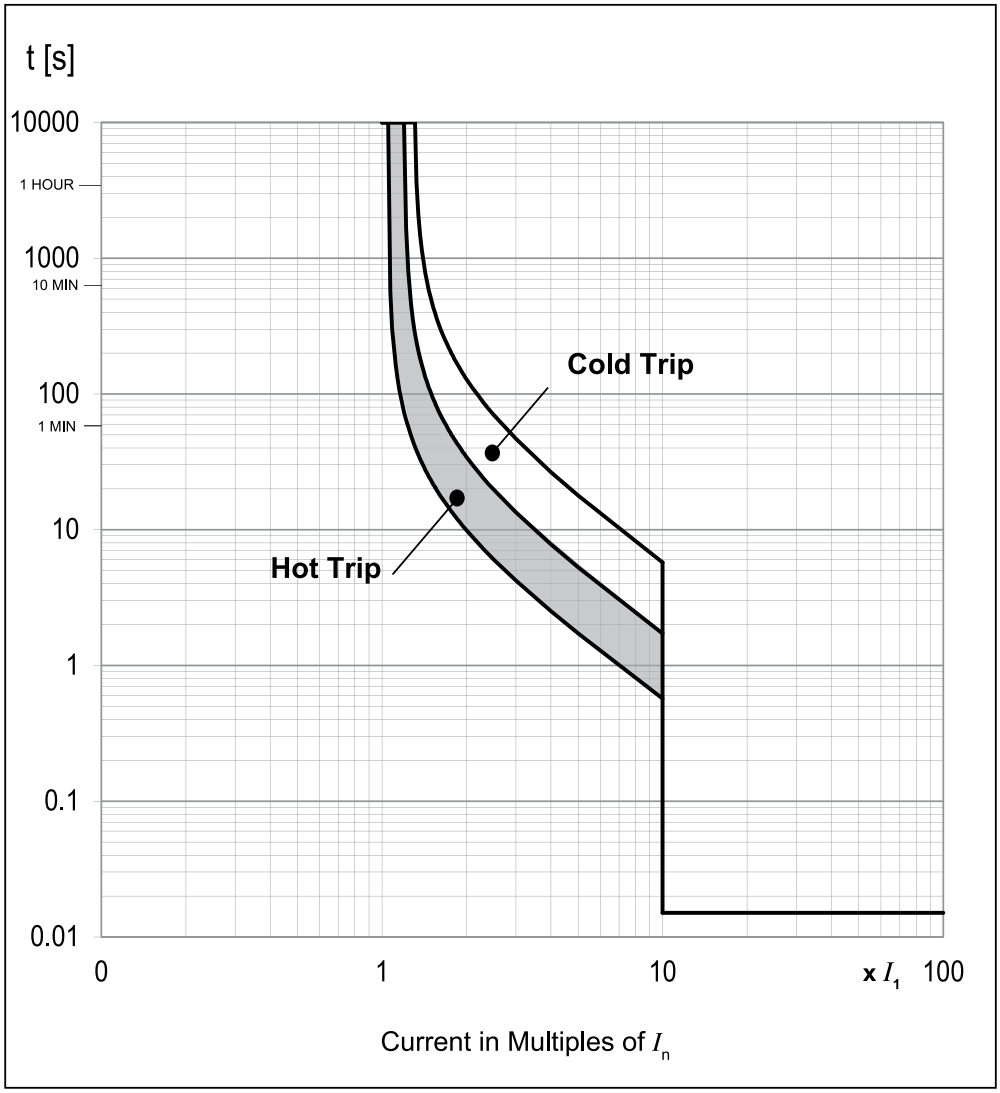
Bulletin 140G-G

Maximum Current: 125 A



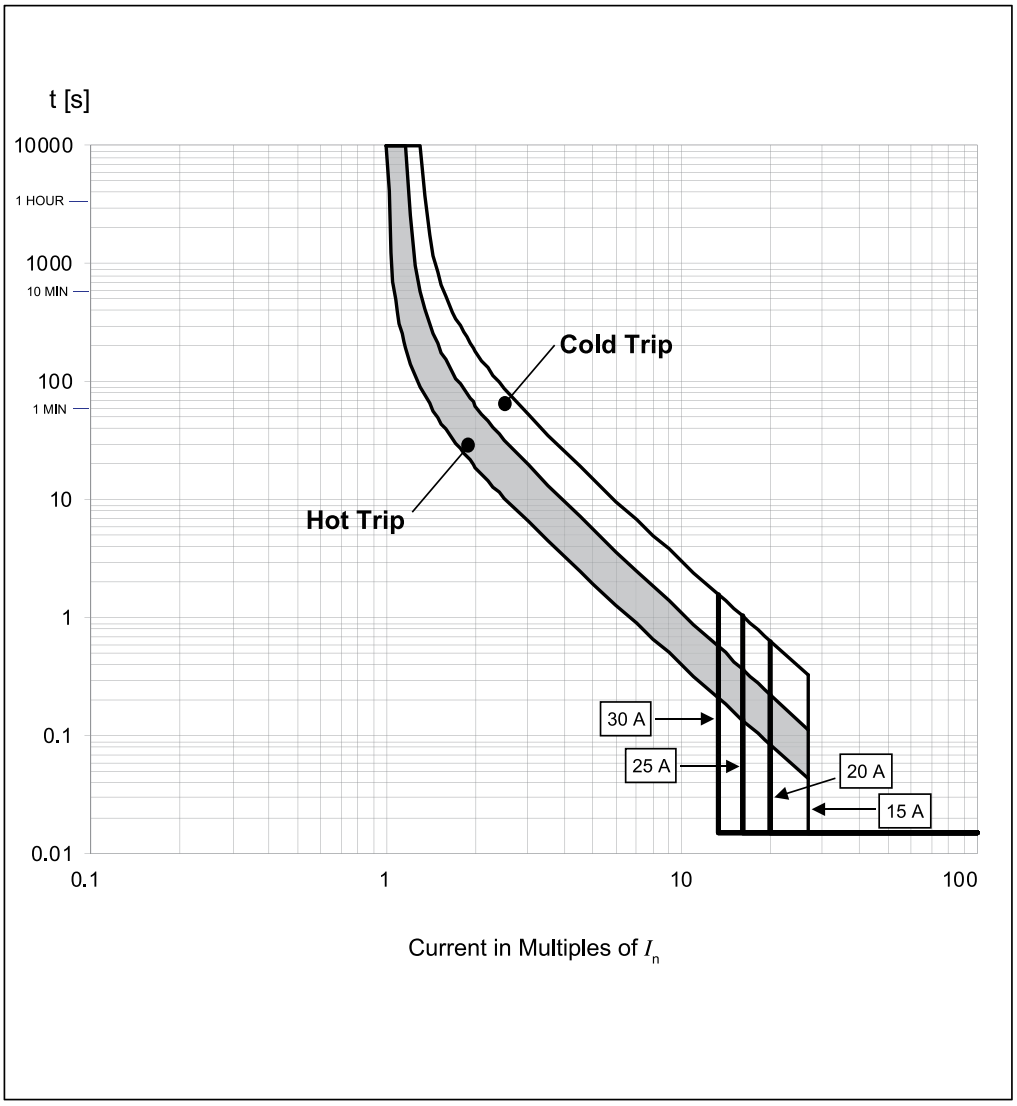
Bulletin 140G-G

Maximum Current: 160 A



Bulletin 140G-H

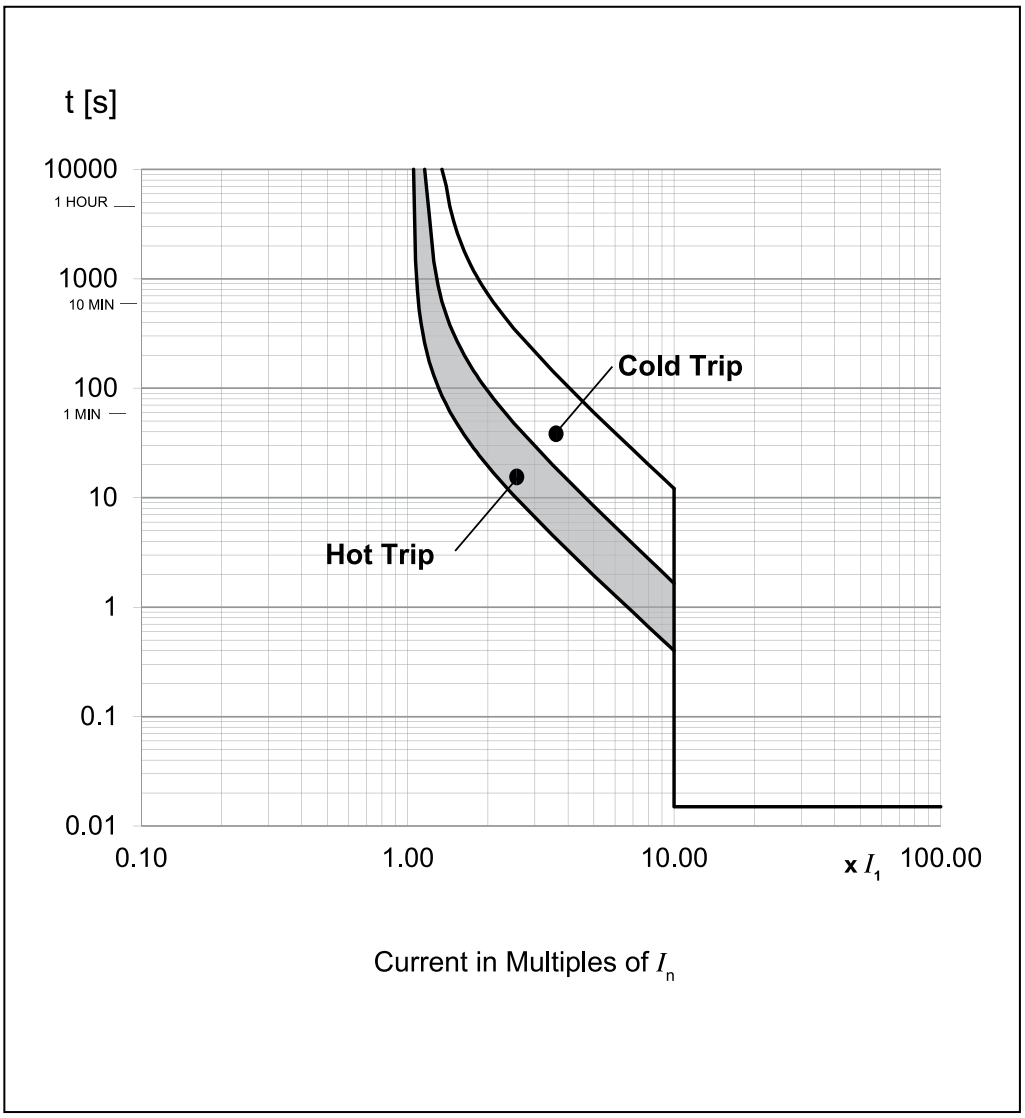
Maximum Current: 15…30 A



Rated Current I_n [A]	Magnetic Trip I_m [A]
15…30	400

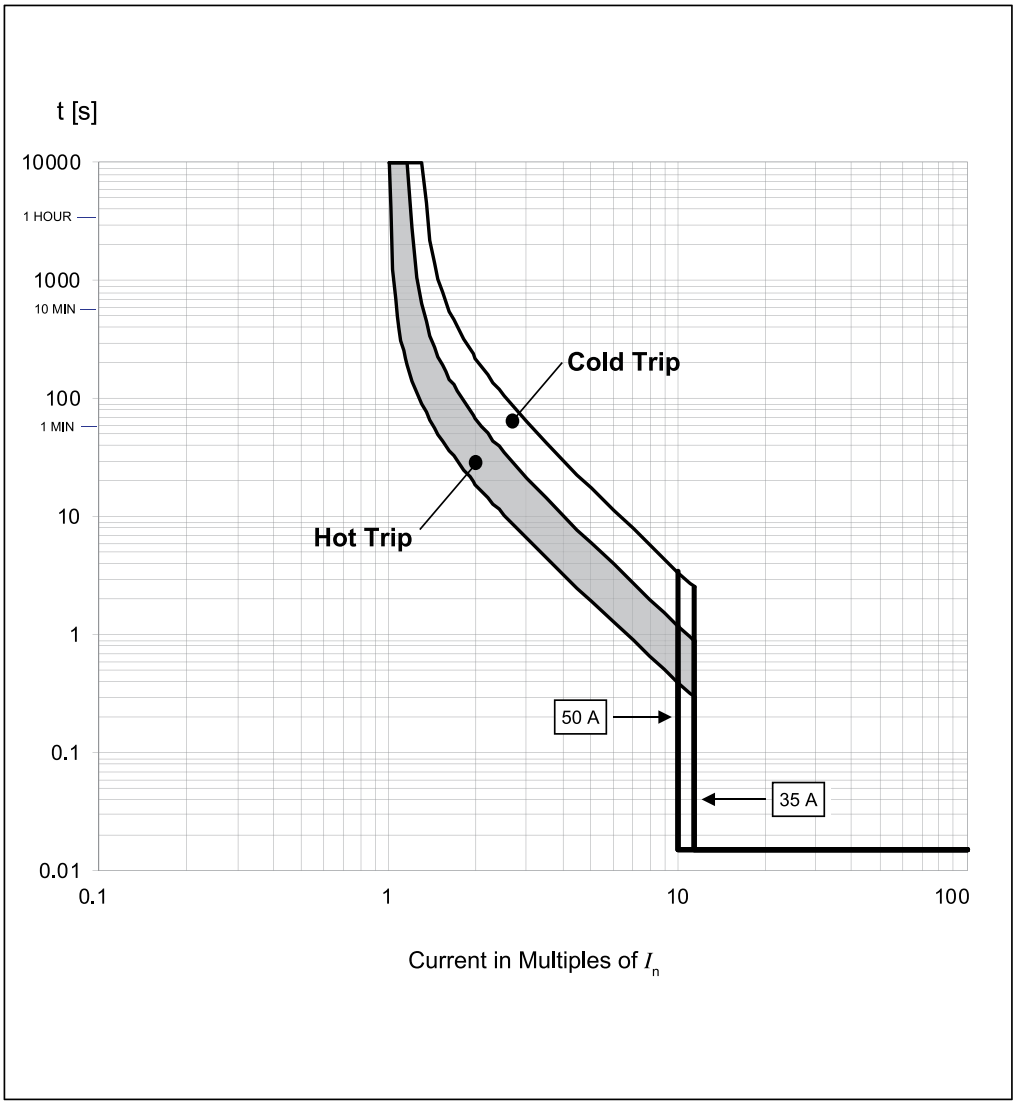
Bulletin 140G-H

Maximum Current: 32 A



Bulletin 140G-H

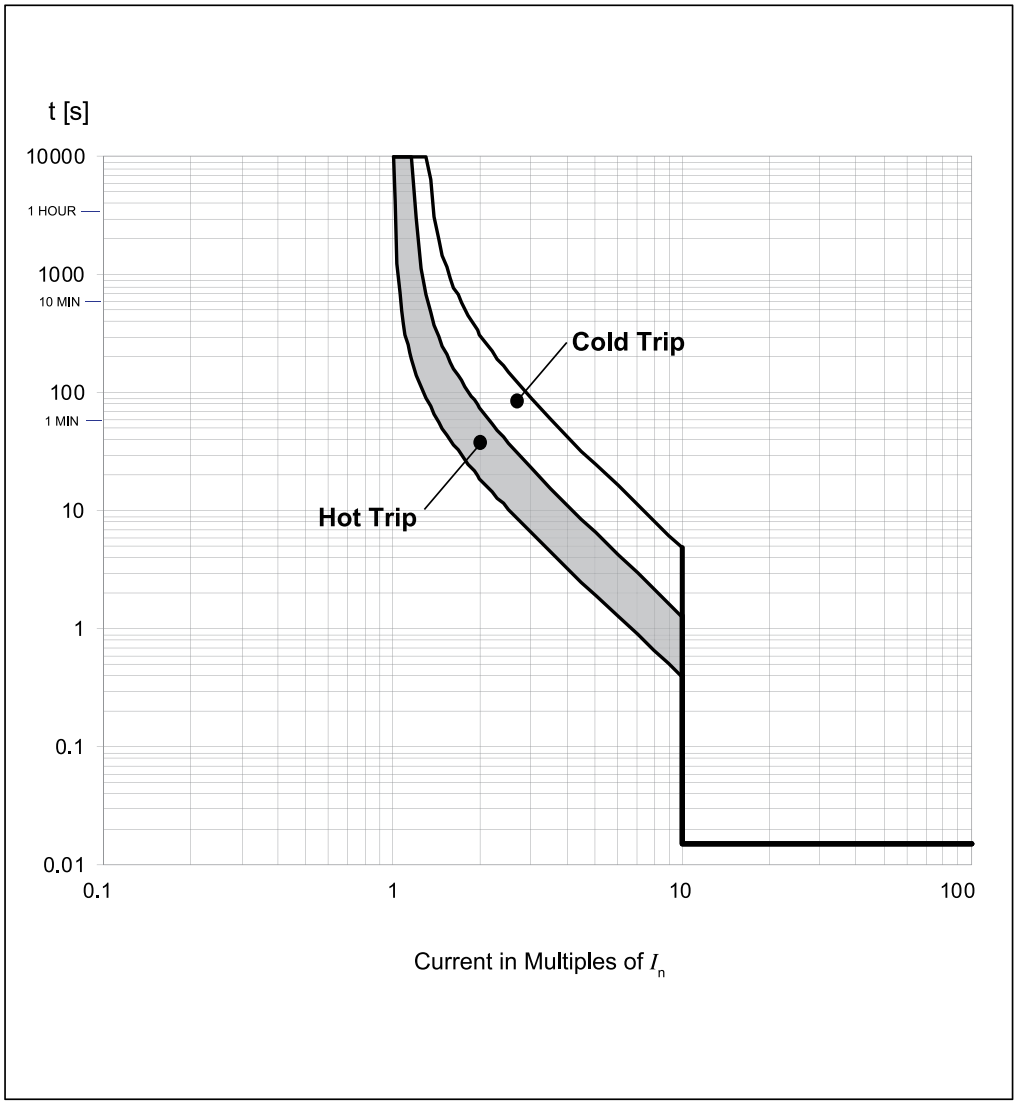
Maximum Current: 35…50 A



Rated Current I_n [A]	Magnetic Trip I_m [A]
35	400
40	400
50	500

Bulletin 140G-H

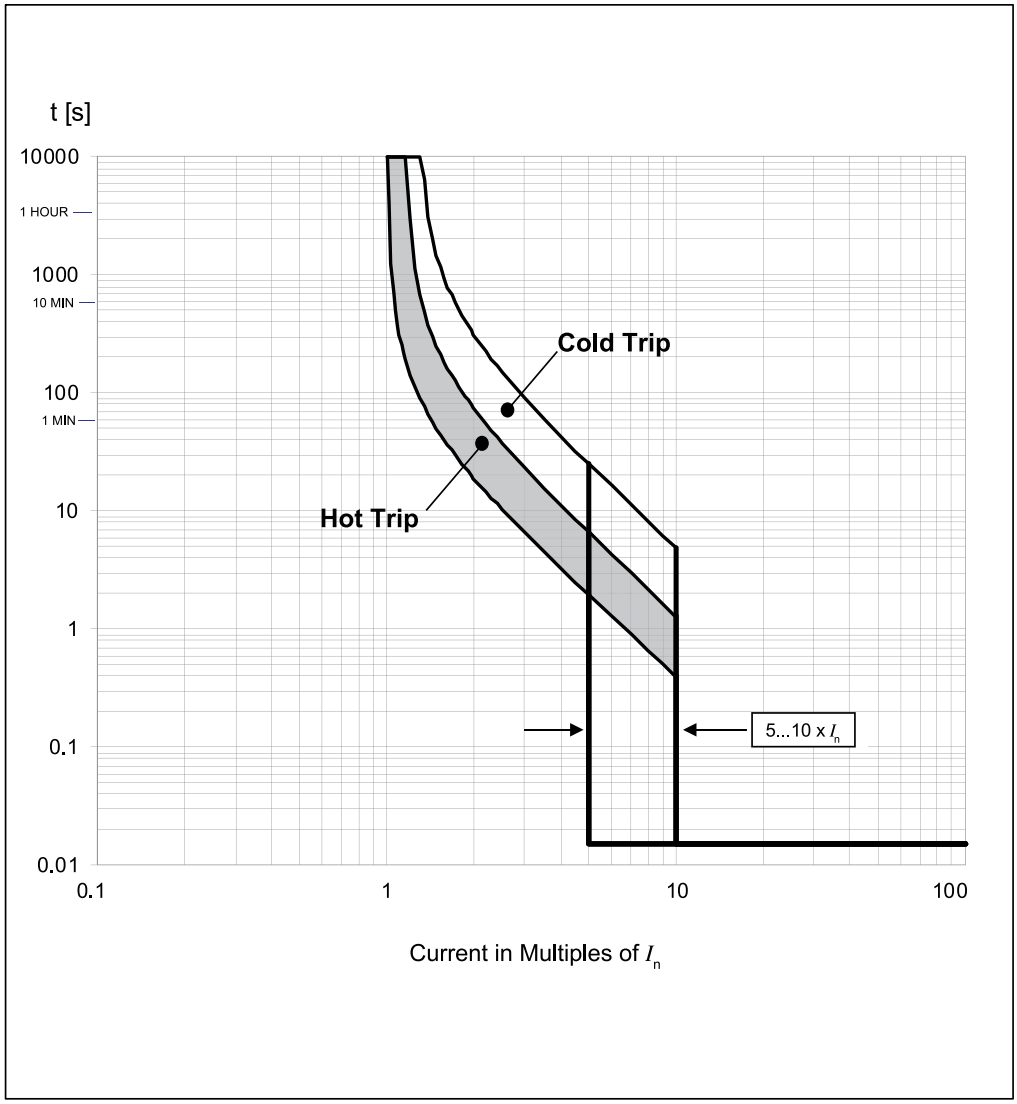
Maximum Current: 60…70 A



Rated Current I_n [A]	Magnetic Trip I_m [A]
60	600
63	630
70	700

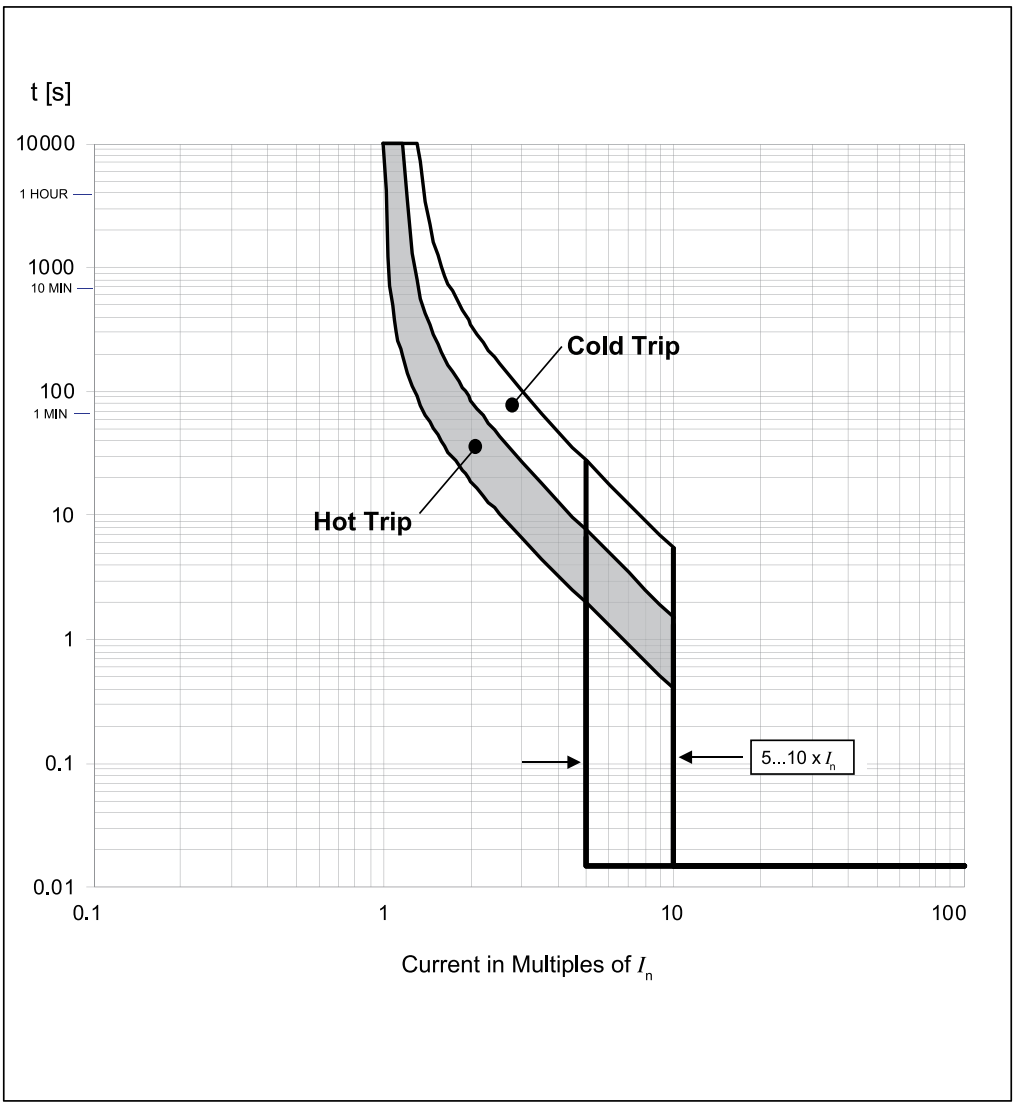
Bulletin 140G-H

Maximum Current: 80…100 A



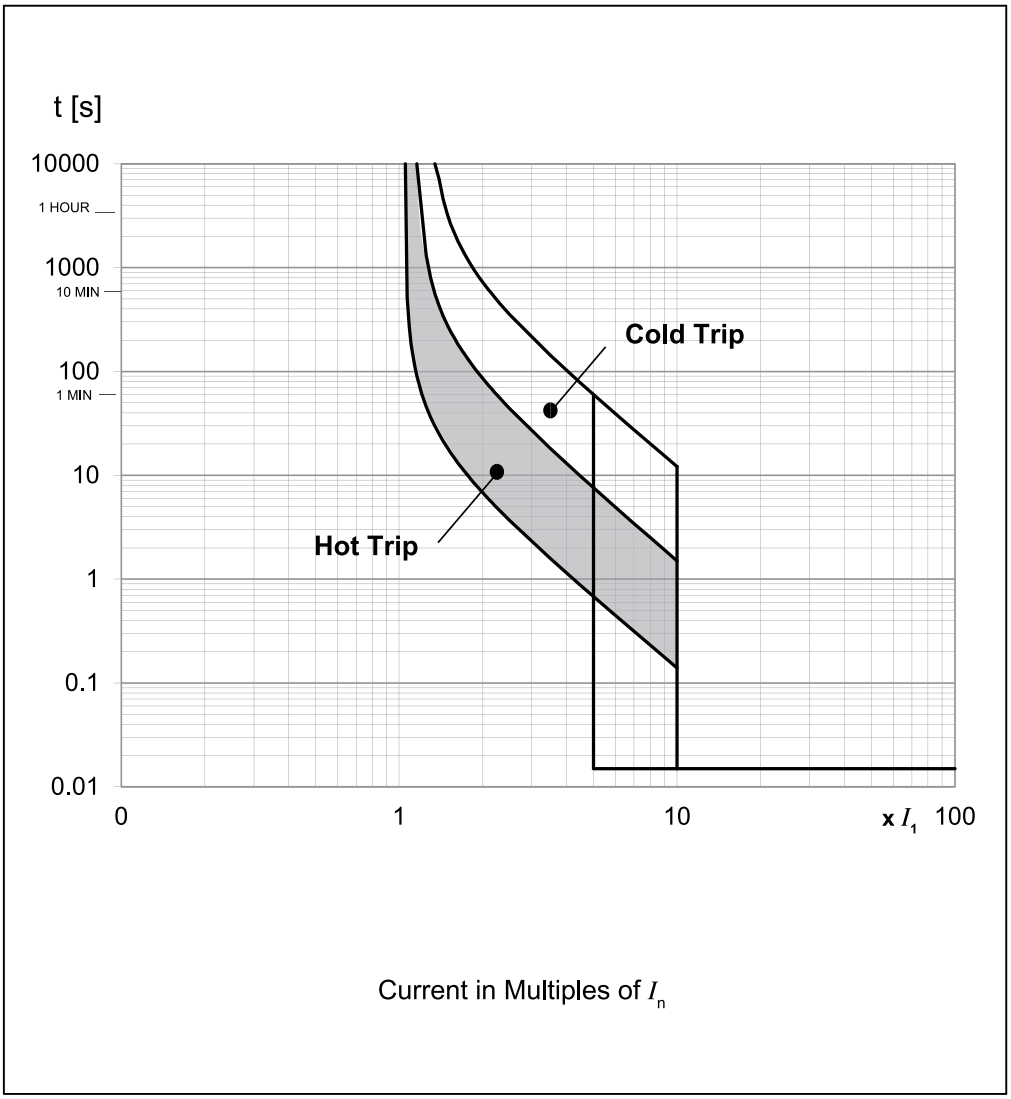
Bulletin 140G-H

Maximum Current: 110…125 A



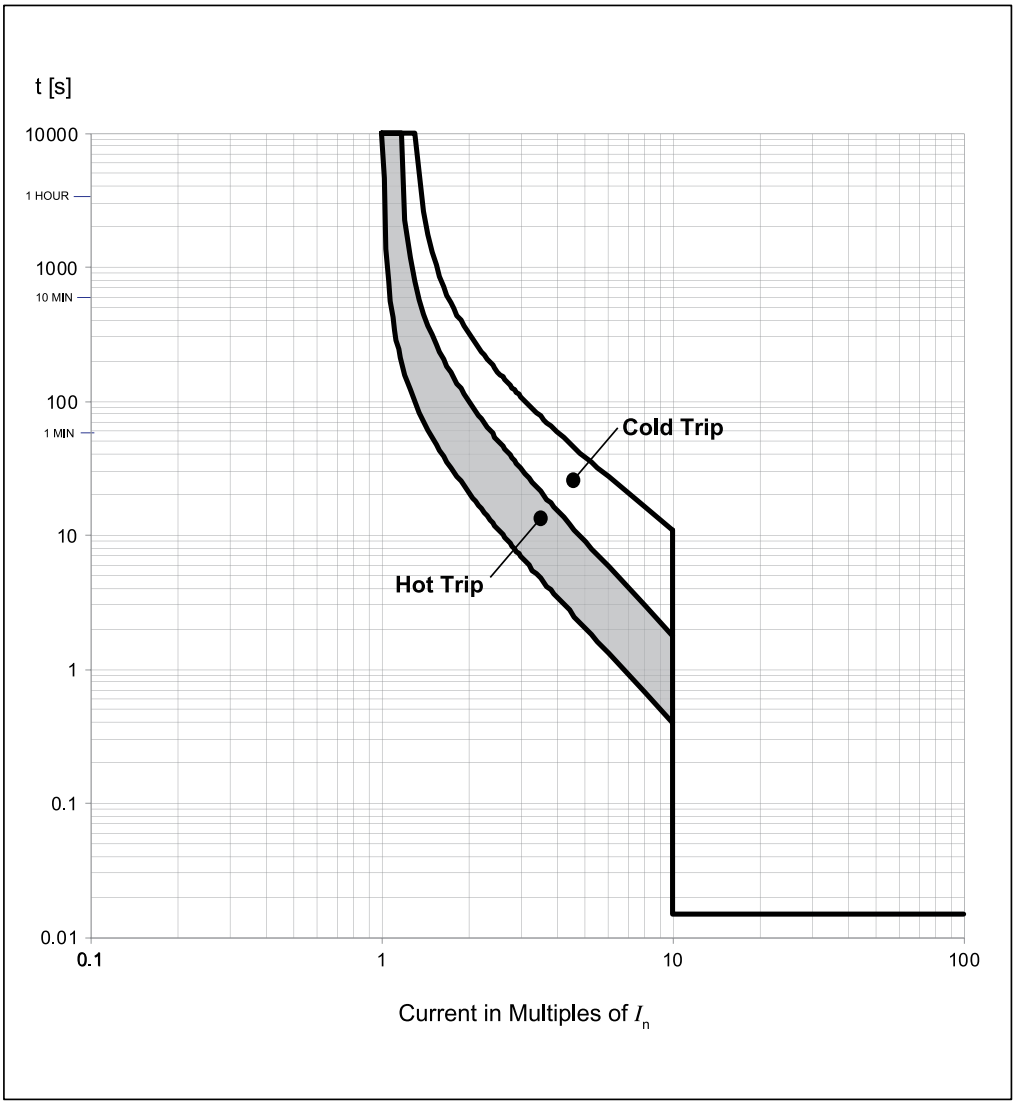
Bulletin 140G-H

Maximum Current: 160 A



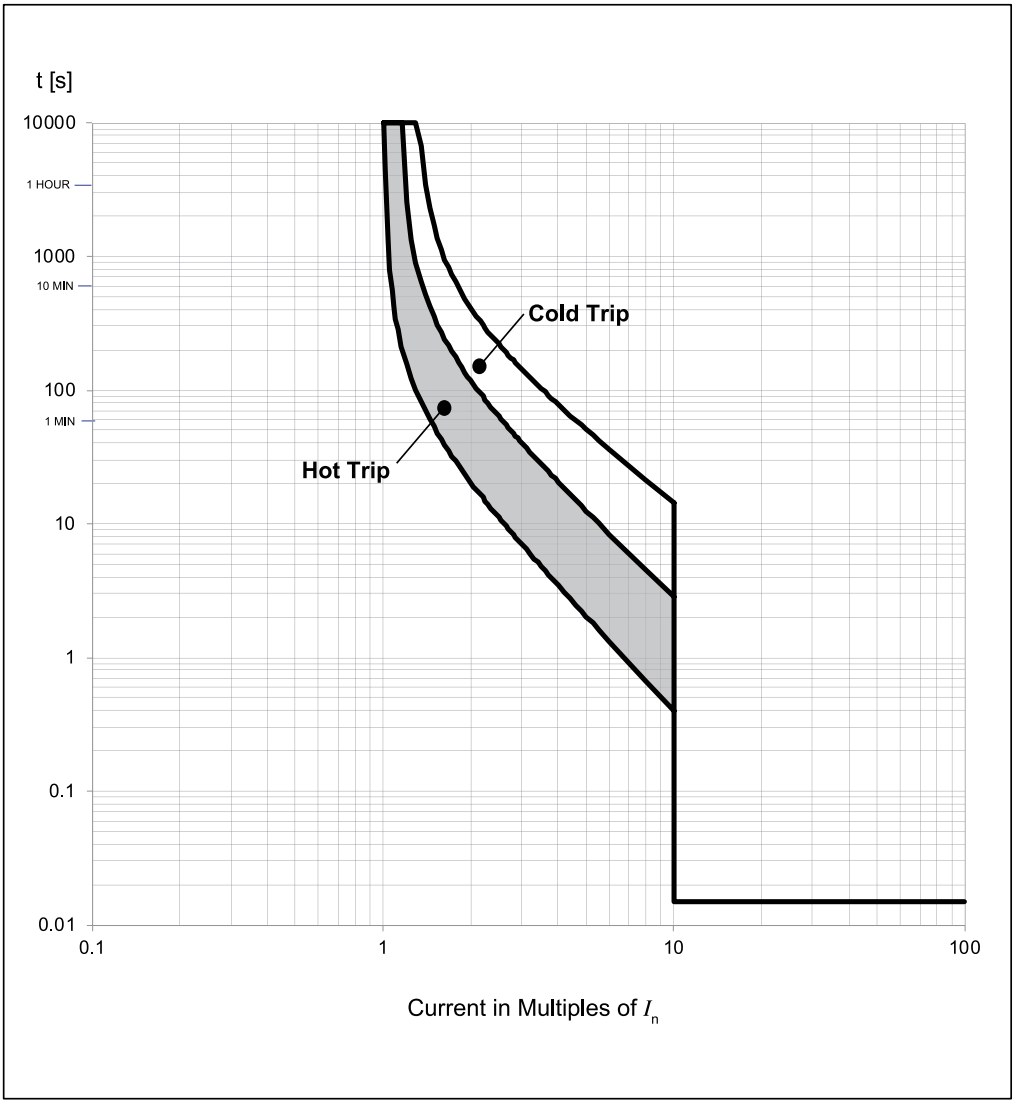
Bulletin 140G-I

Maximum Current: 60…100 A



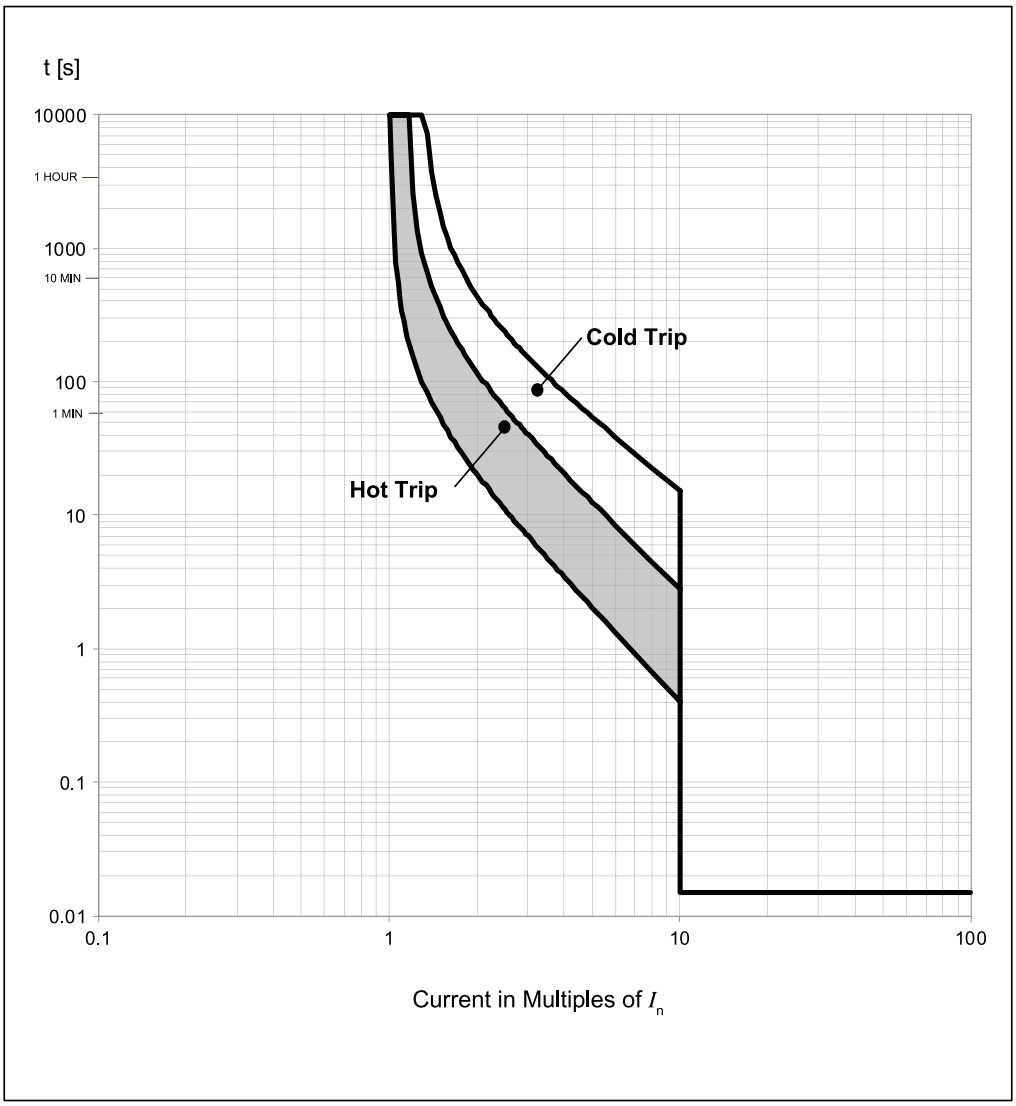
Bulletin 140G-I

Maximum Current: 100…150 A



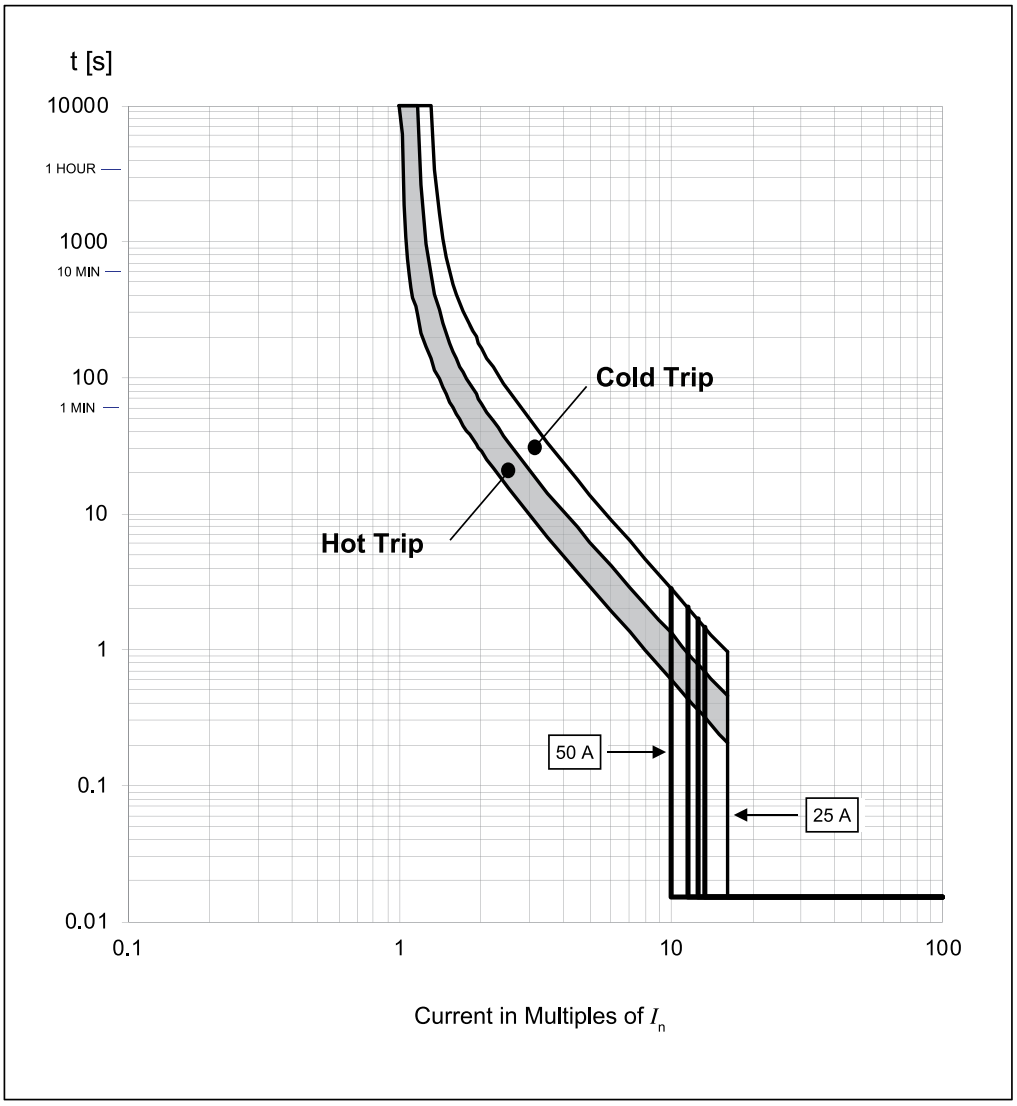
Bulletin 140G-I

Maximum Current: 160…225 A



Bulletin 140G-J

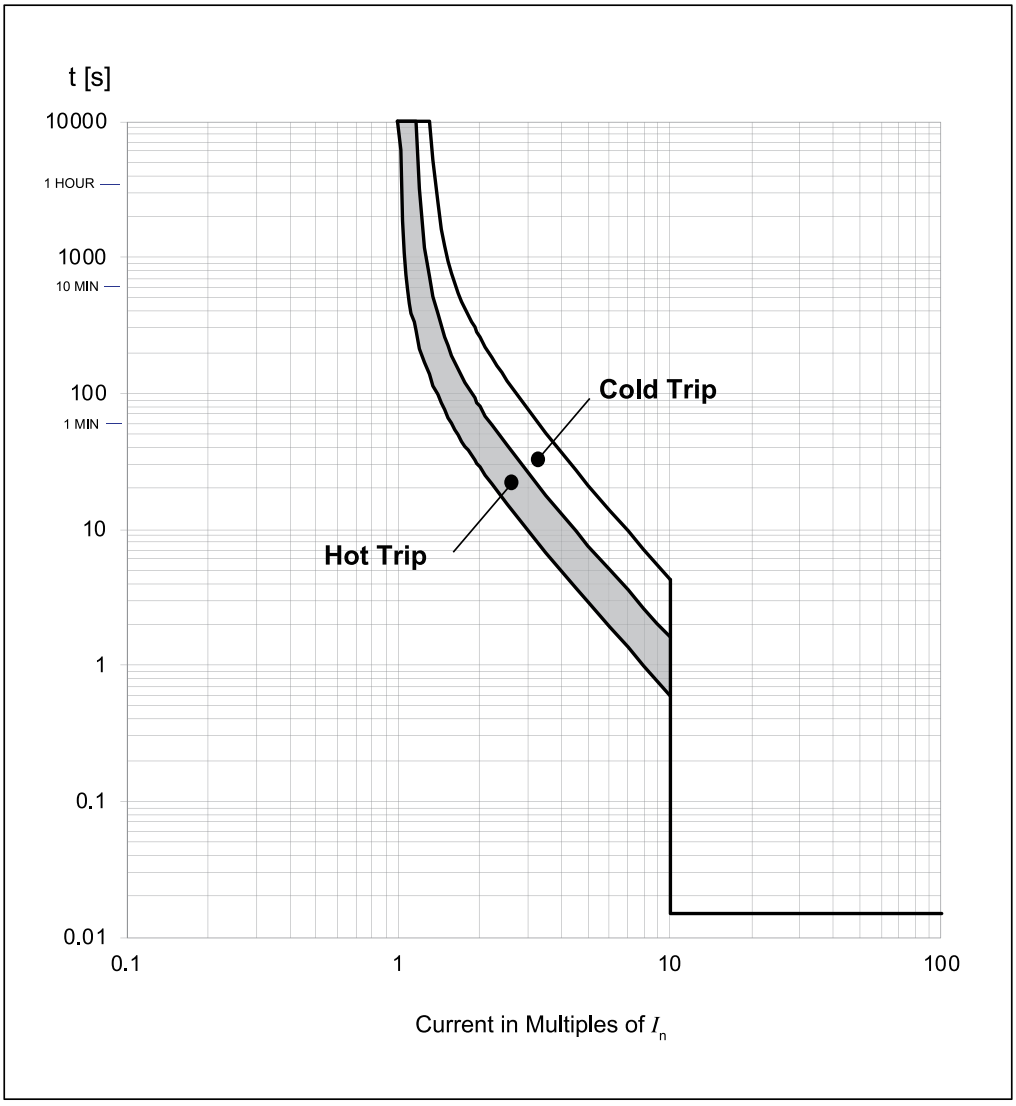
Maximum Current: 25…50 A



Rated Current I_n [A]	Magnetic Trip I_m [A]
25…40	400
50	500

Bulletin 140G-J

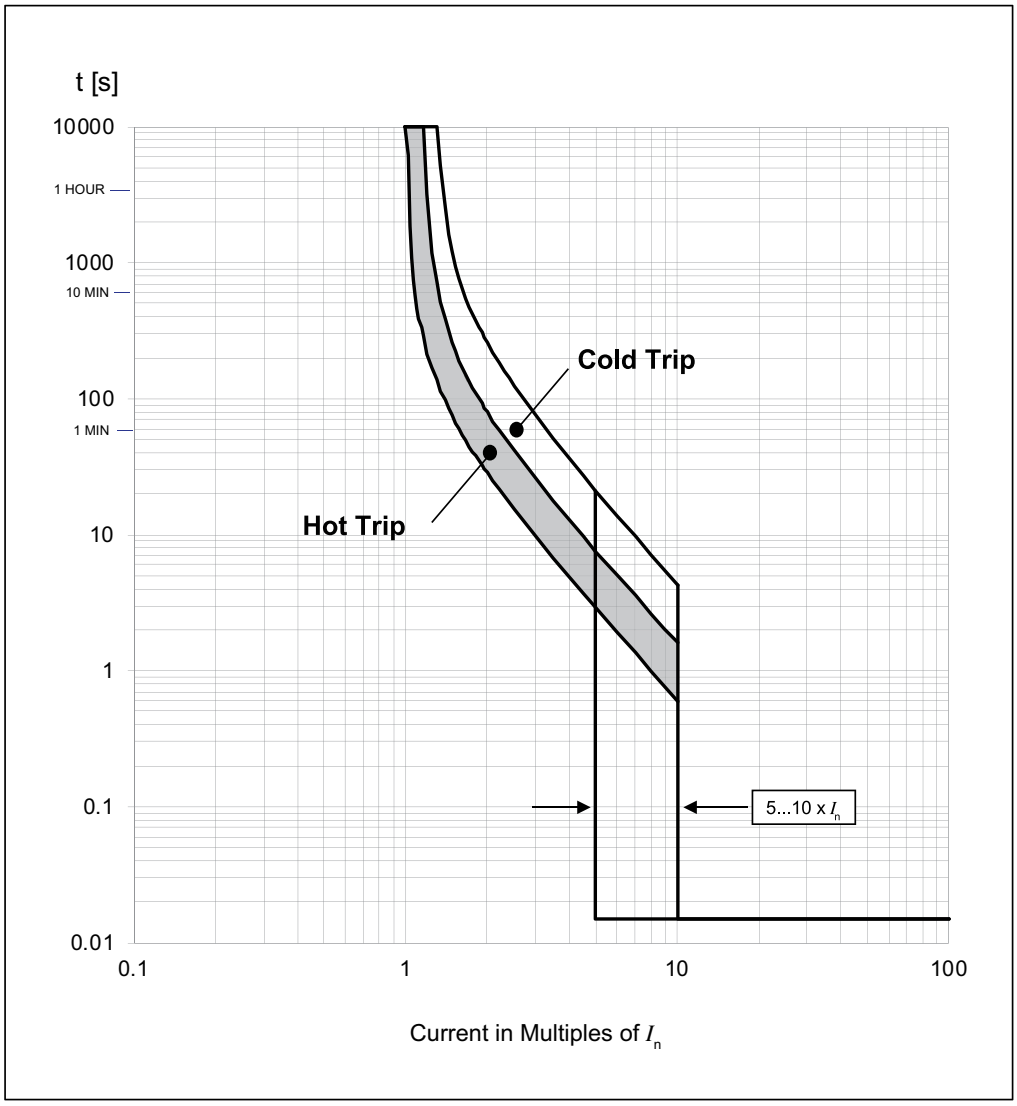
Maximum Current: 60…70 A



Rated Current I_n [A]	Magnetic Trip I_m [A]
60	600
63	630
70	700

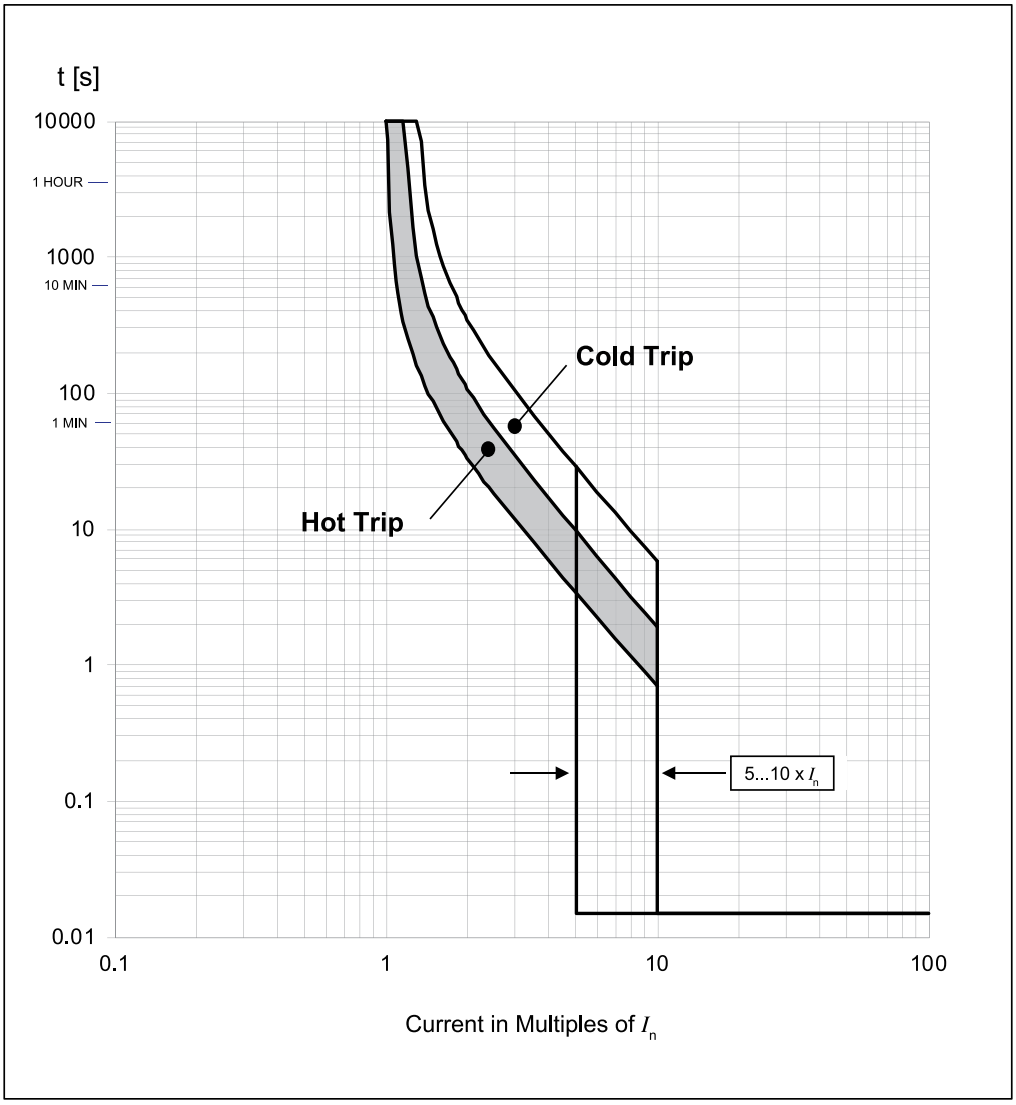
Bulletin 140G-J

Maximum Current: 80…100 A



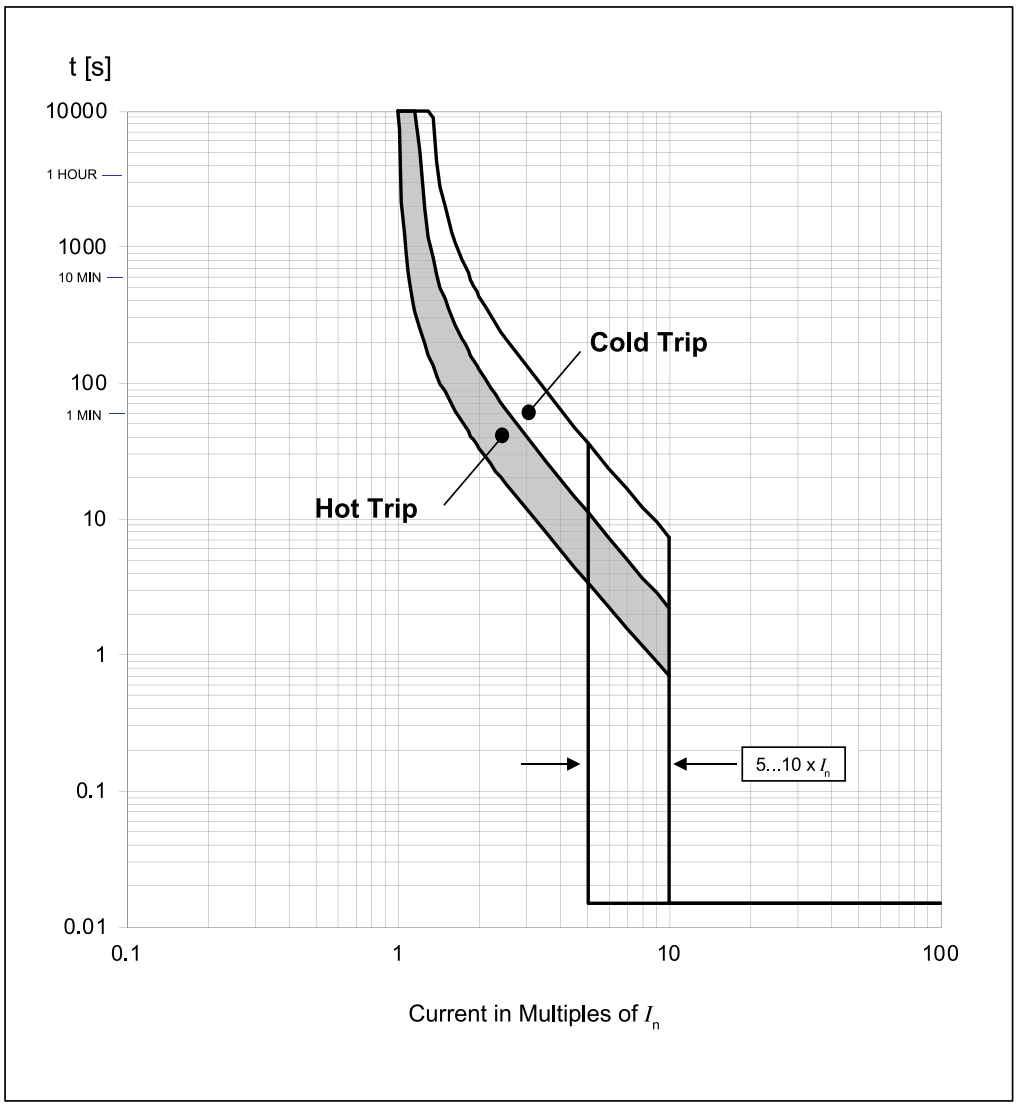
Bulletin 140G-J

Maximum Current: 110…150 A



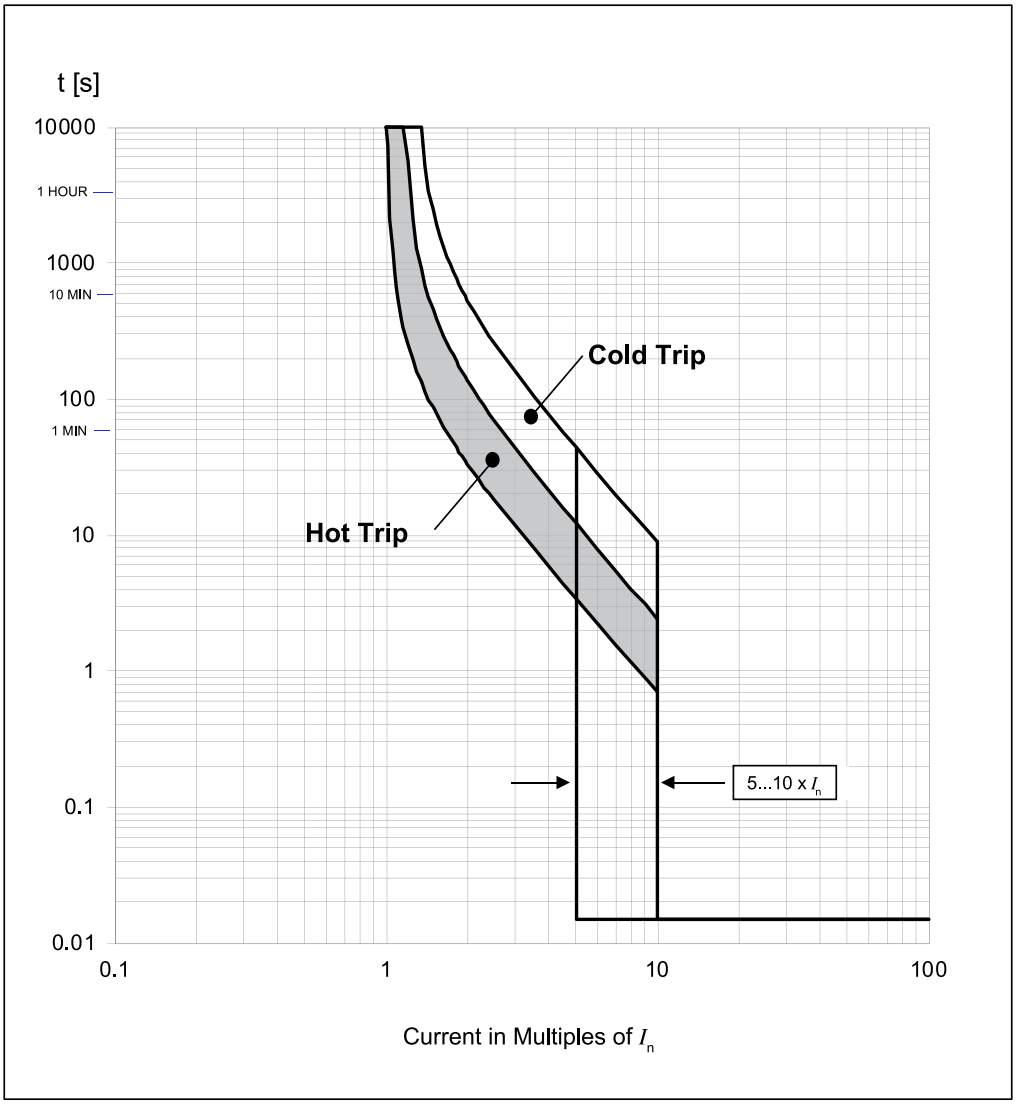
Bulletin 140G-J

Maximum Current: 160…225 A



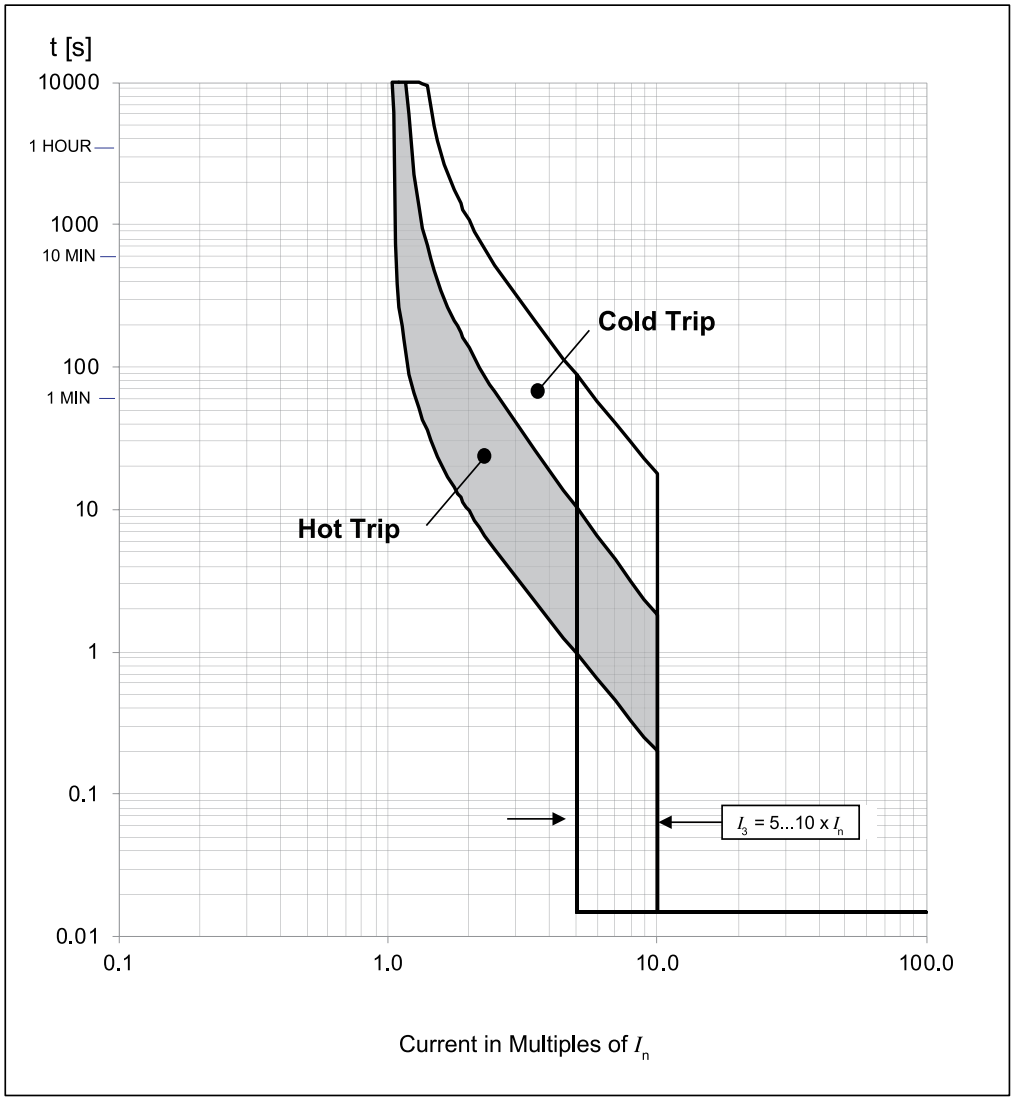
Bulletin 140G-J

Maximum Current: 250 A



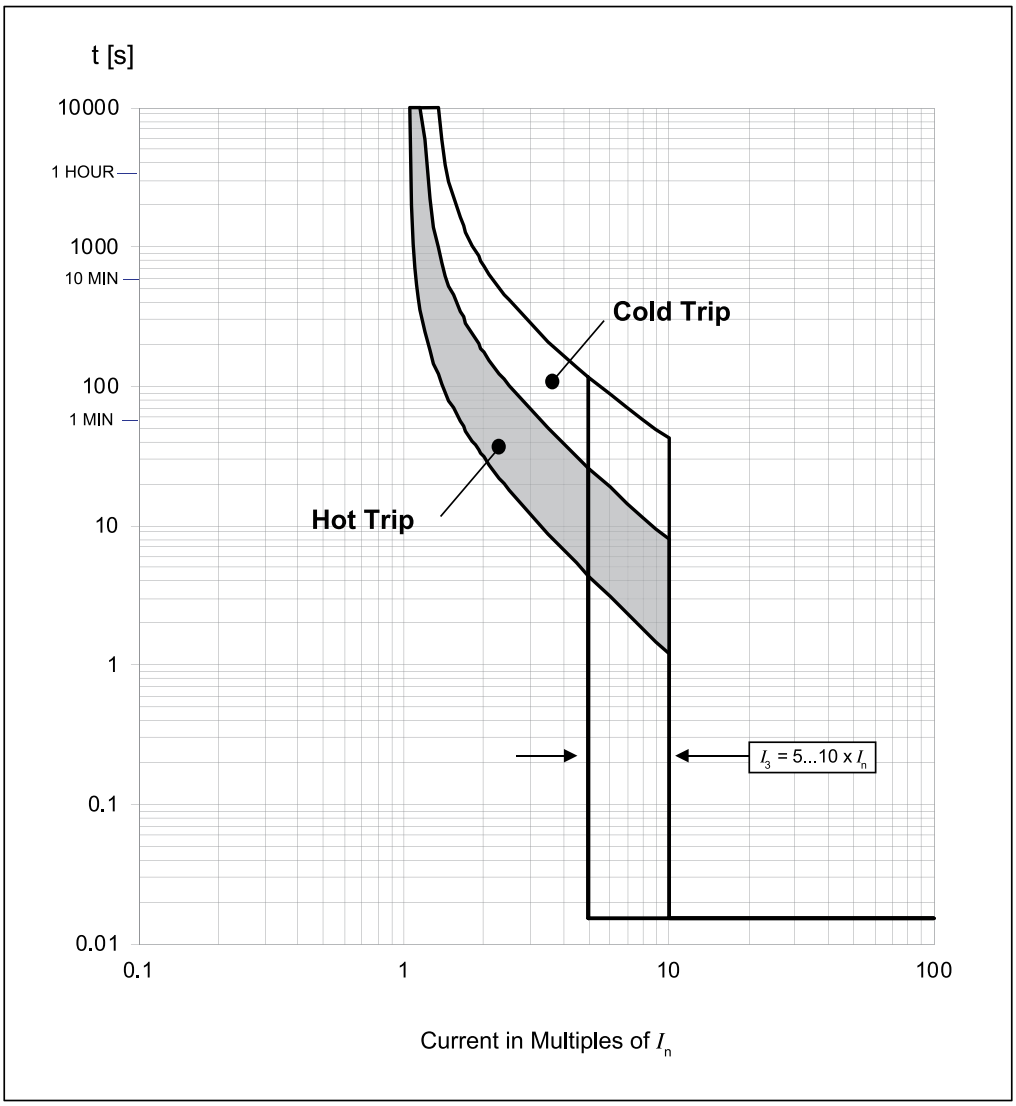
Bulletin 140G-K

Maximum Current: 300 A, 400 A



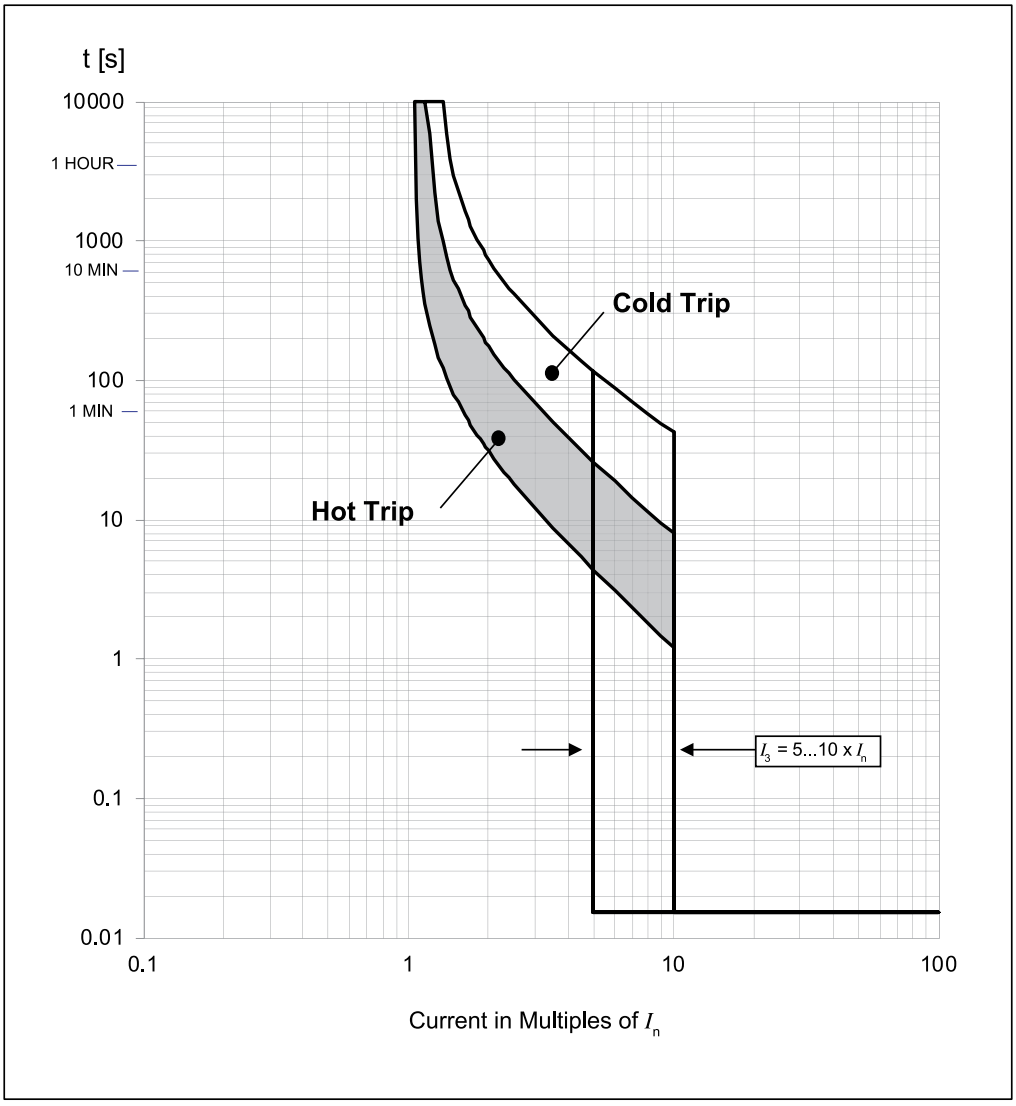
Bulletin 140G-M

Maximum Current: 600 A



Bulletin 140G-M

Maximum Current: 800 A

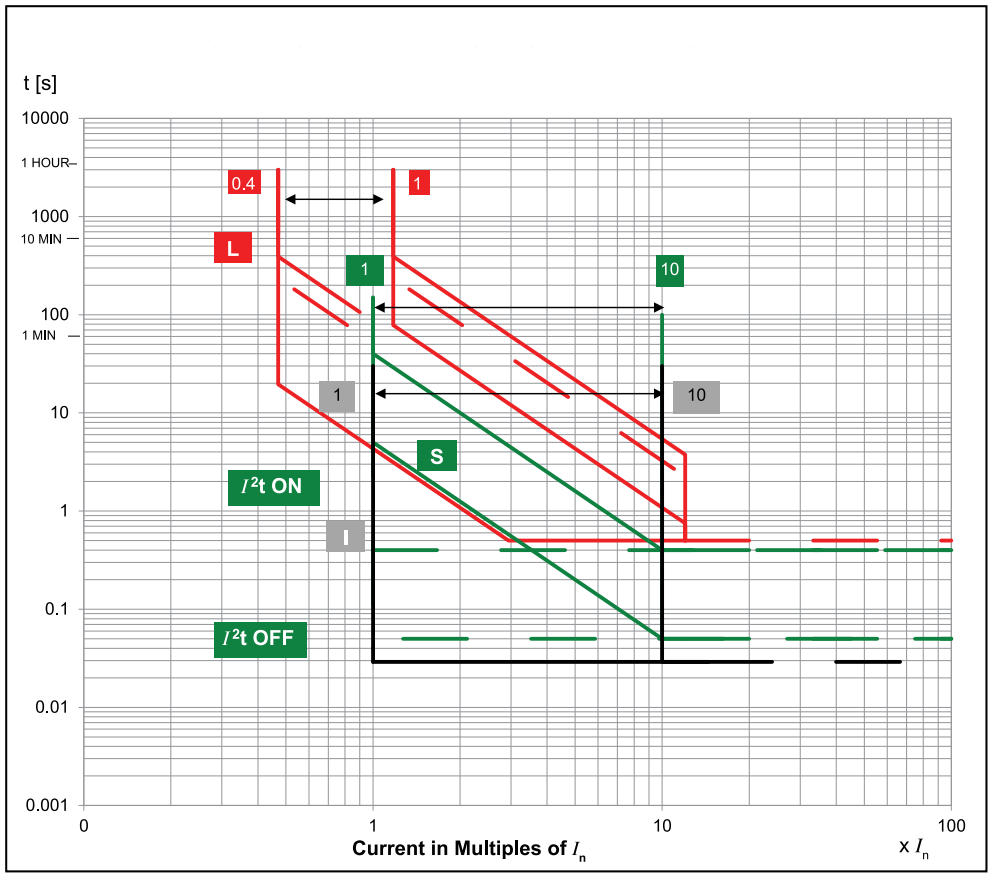


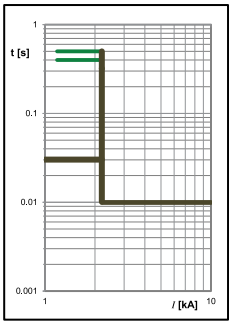
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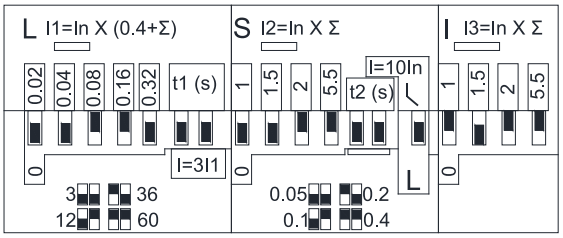
Bulletin 140G-H

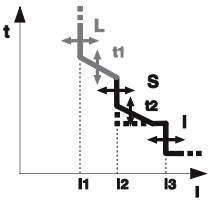
Available Sensors (I_n): 25 A, 60 A, 100 A, 125 A

Electronic Trip Unit. Long Delay Response, Short Delay with I^2t Response, and Instantaneous Curve









Tolerance Values

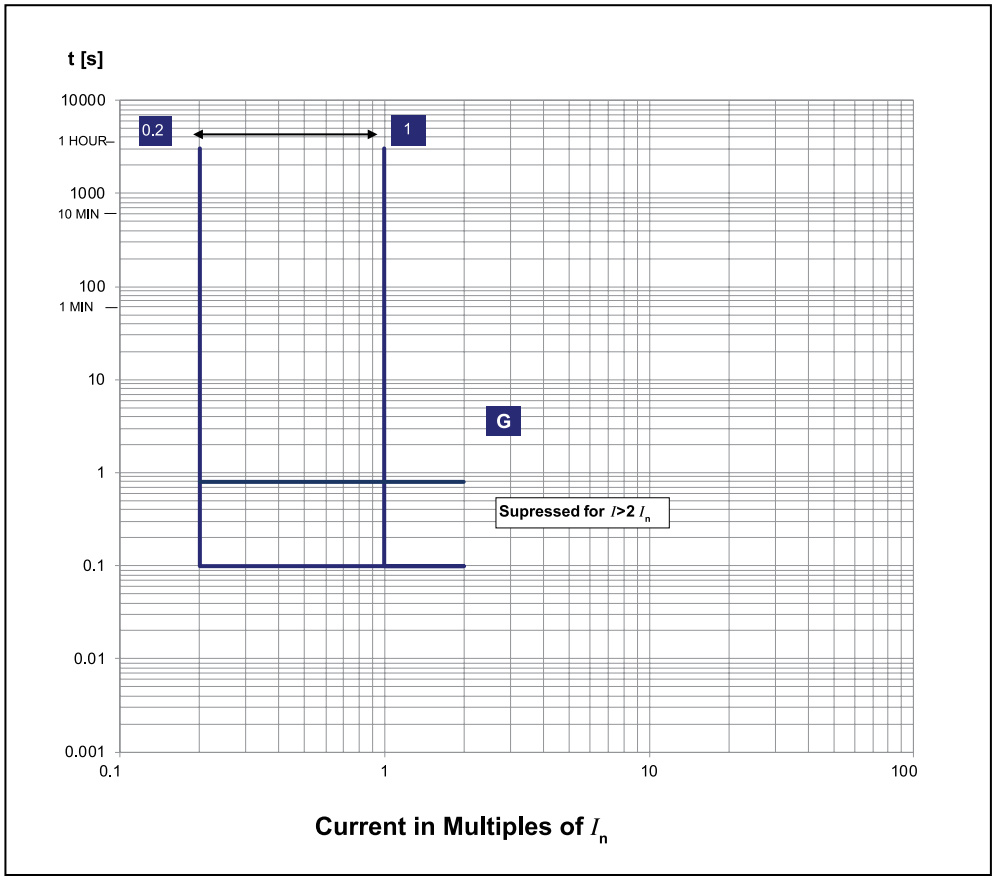
Protection	Trip Threshold	Trip Time
L	1.05 ≤ xI_1 ≤ 1.25	± 20%
S	± 10%	± 20%
I	± 15%	≤ 60 ms
Others	± 20%	

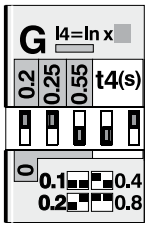
Notes:

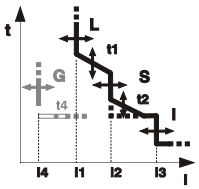
1. Curve accuracy applies from -20 °C to +55 °C (-4 °F to +131 °F) ambient temperature. For possible continuous ampere derating for ambient temperature above 40 °C (104 °F), consult your local Rockwell Automation sales office or Allen-Bradley distributor.
2. The right portion of the curve is determined by the interrupting rating of the circuit breaker.
3. Total clearing times shown include the response times of the trip unit, the breaker opening, and the interruption of the current.
4. For high fault current levels an additional fixed instantaneous hardware override is provided at 2.2 kA.

Bulletin 140G-H

Ground Fault Protection Curve







		I_4 [I_n]						
	I_n [A]	0.2	0.25	0.45	0.55	0.75	0.8	1
140G-H	25	5	6.25	11.3	13.8	18.8	20	25
	60	12	15	27	33	45	48	60
	100	20	25	45	55	75	80	100
	125	25	31.3	56.3	68.8	93.8	100	125
	160*	32	40	72	88	120	128	160

Tolerance Values

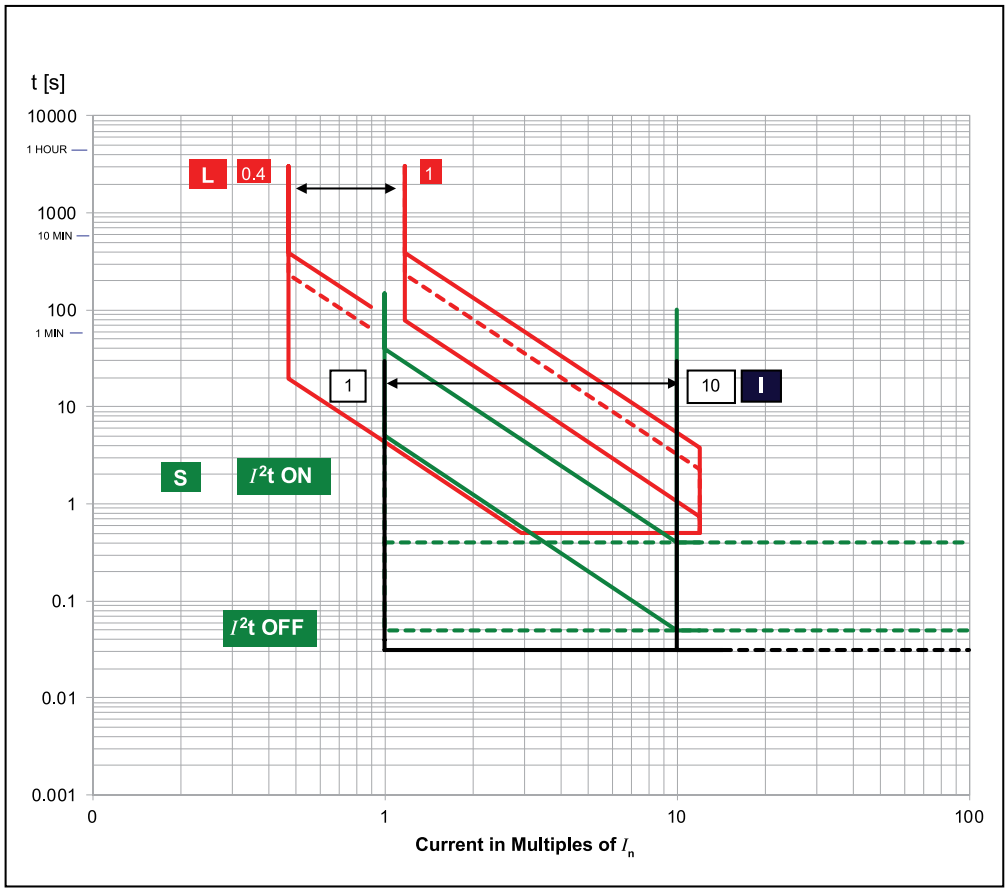
Protection	Trip Threshold	Trip Time
G	± 10%	± 20%

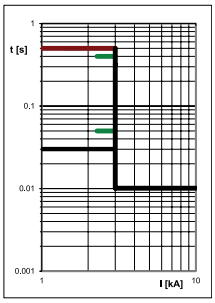
For L-S-I trip curve see Pub. 140G-TD021.

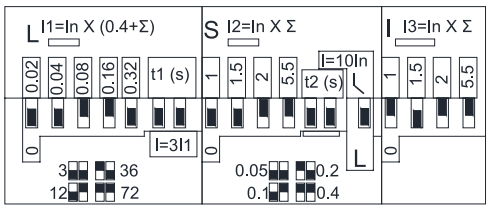
Bulletin 140G-J

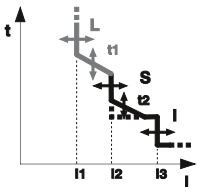
Available Sensors (I_n): 40 A, 60 A, 100 A, 150 A, 250 A

Electronic Trip Unit. Long Delay Response, Short Delay with I^2t Response, and Instantaneous Curve









Tolerance Values

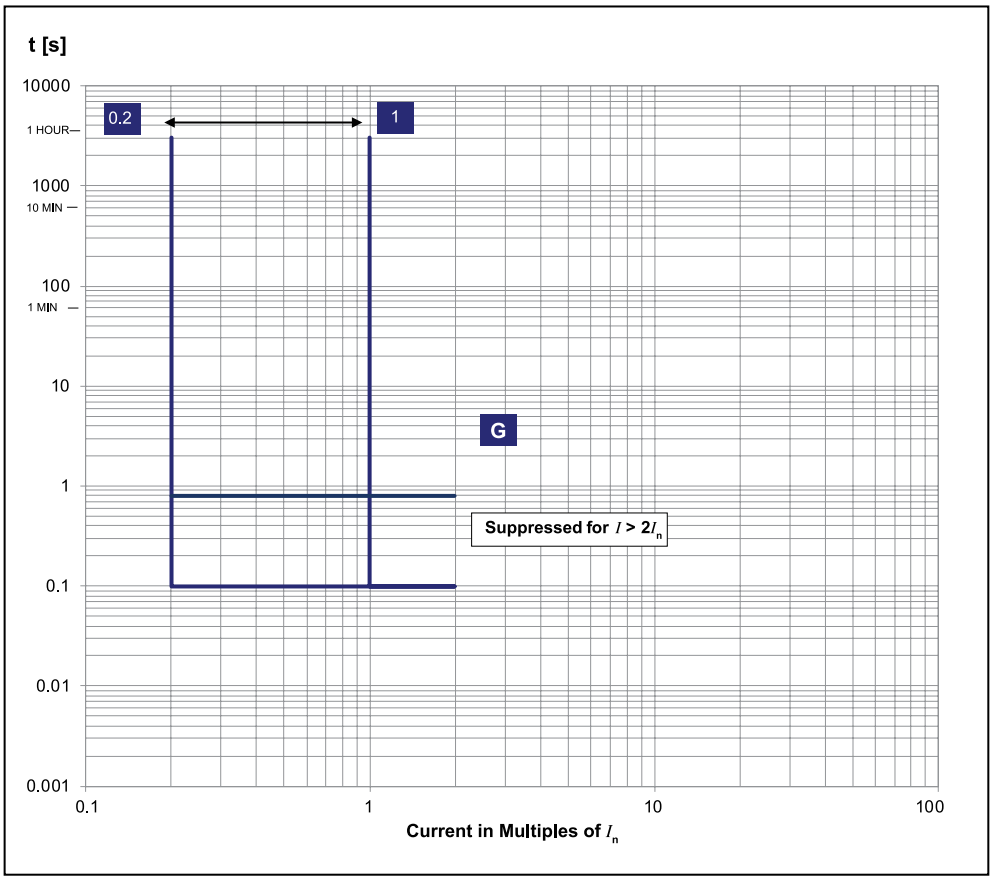
Protection	Trip Threshold	Trip Time
L	$1.05 \le x I_1 \le 1.25$	± 20%
S	± 10%	± 20%
I	± 15%	≤ 60 ms
Others	± 20%	

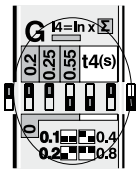
Notes:

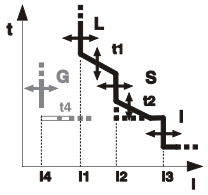
1. Curve accuracy applies from -20 °C to +55 °C (-4 °F to +131 °F) ambient temperature. For possible continuous ampere derating for ambient temperature above 40 °C (104 °F), consult your local Rockwell Automation sales office or Allen-Bradley distributor.
2. The right portion of the curve is determined by the interrupting rating of the circuit breaker.
3. Total clearing times shown include the response times of the trip unit, the breaker opening, and the interruption of the current.
4. For high fault current levels an additional fixed instantaneous hardware override is provided at 3 kA.

Bulletin 140G-J

Ground Fault Protection Curve for LSIG MCCBS







Example:

I_n = 100 A
I_4 = 100 x (0.2 + 0.25) = 45 A
t4 = 0.2 s @ $I > I_4$

		I_4 [I_n]						
	I_n [A]	0.2	0.25	0.45	0.55	0.75	0.8	1
140G-J	40	8	10	18	22	30	32	40
	60	12	15	27	33	45	48	60
	100	20	25	45	55	75	80	100
	150	30	37.5	67.5	82.5	113	120	150
	250	50	62.5	113	138	188	200	250

Tolerance Values

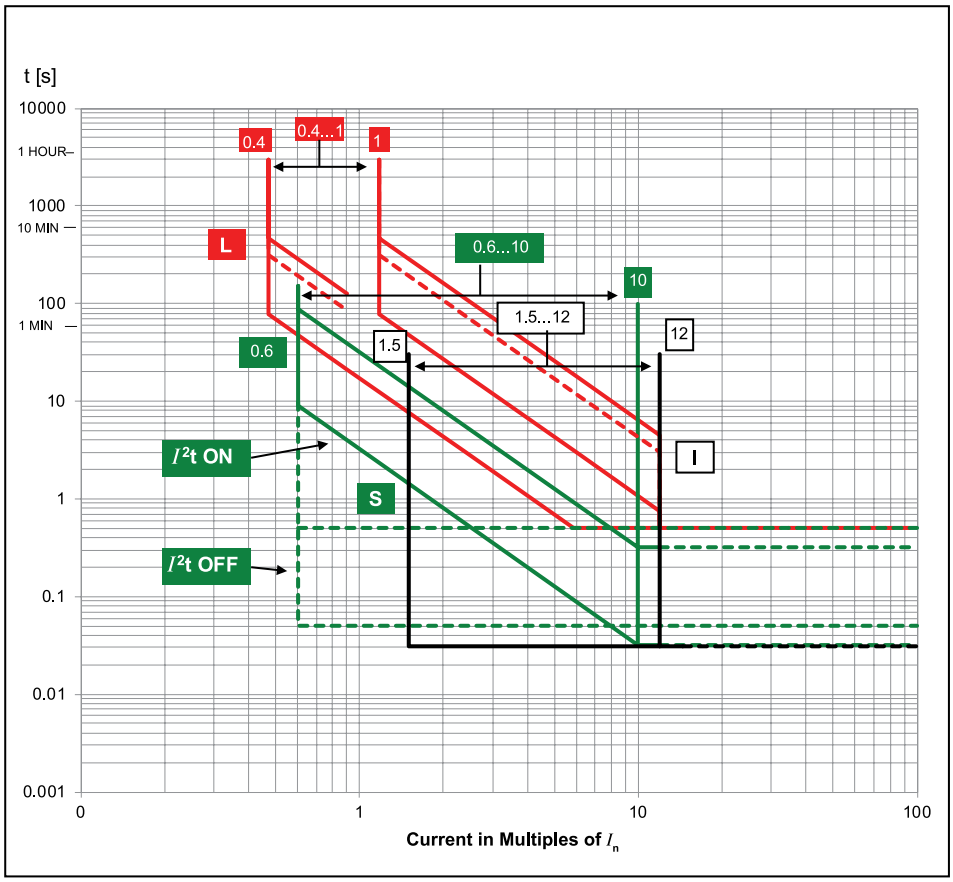
Protection	Trip Threshold	Trip Time
G	± 10%	± 20%

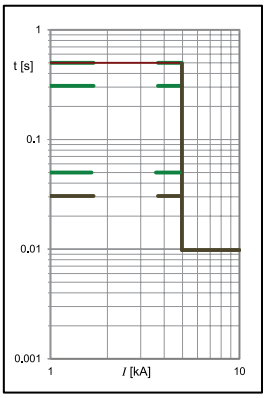
For L-S-I trip curve see Pub. 140G-TD023.

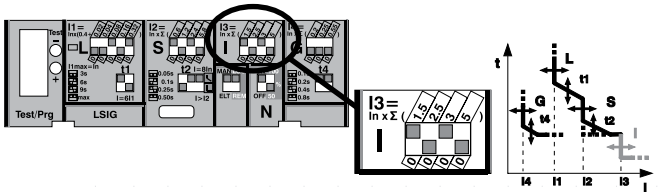
Bulletin 140G-K

Available Sensors (I_n): 300 A, 400 A

Electronic Trip Unit. Long Delay Response, Short Delay with I^2t Response, and Instantaneous Curve







Example:

I_n = 300 A

I_3 = 300 x (1.5 + 3) = 1350 A

	I_3 [I_n]															
I_n [A]	1.5	2.5	3	4	4.5	5	5.5	6.5	7	7.5	8	9	9.5	10.5	12
300	450	750	900	1200	1350	1500	1650	1950	2100	2250	2400	2700	2850	3150	3600
400	600	1000	1200	1600	1800	2000	2200	2600	2800	3000	3200	3600	3800	4200	4800

Tolerance Values

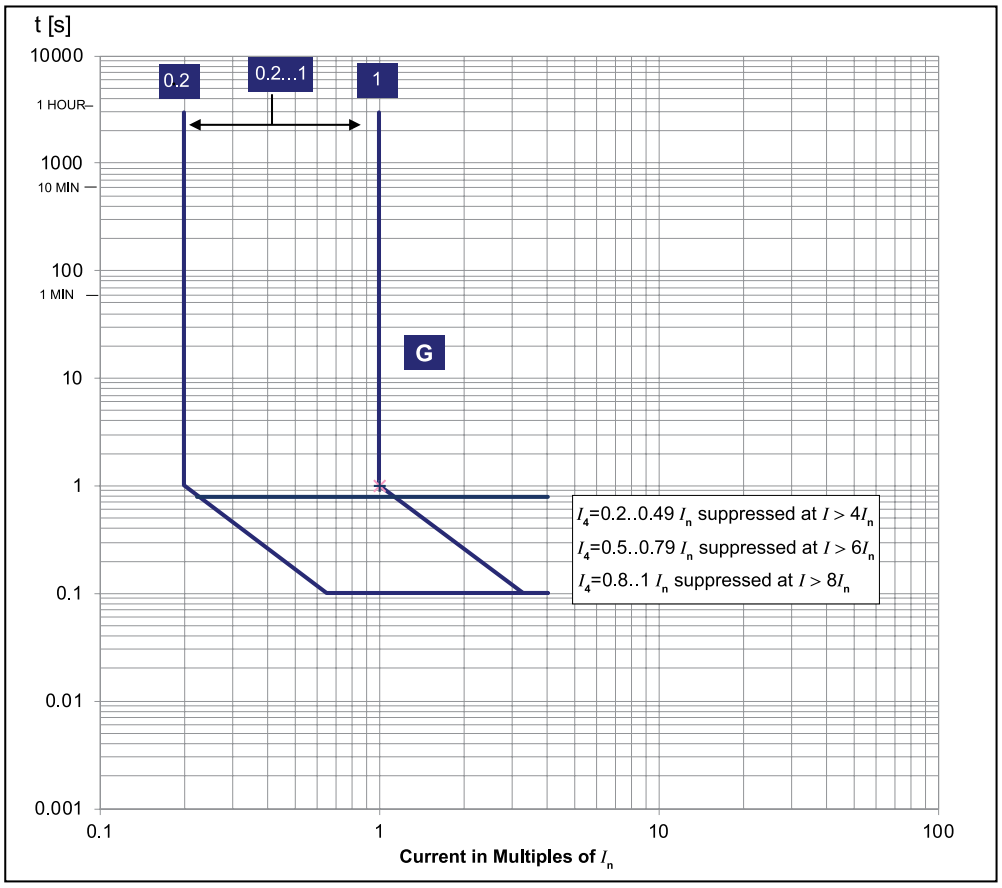
Protection	Trip Threshold	Trip Time
L	1.05 ≤ xI_1 ≤ 1.25	± 20%
S	± 10%	± 20%
I	±1 5%	≤ 60 ms
Others	± 20%	

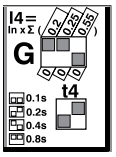
Notes:

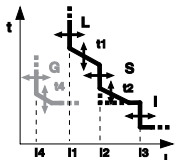
1. Curve accuracy applies from -20 °C to +55 °C (-4 °F to +131 °F) ambient temperature. For possible continuous ampere derating for ambient temperature above 40 °C (104 °F), consult your local Rockwell Automation sales office or Allen-Bradley distributor.
2. The right portion of the curve is determined by the interrupting rating of the circuit breaker.
3. Total clearing times shown include the response times of the trip unit, the breaker opening, and the interruption of the current.
4. For high fault current levels an additional fixed instantaneous hardware override is provided at 5 kA.

Bulletin 140G-K

Ground Fault Protection Curve for LSIG MCCBS







Example:

I_n = 100 A
I_4 = 100 x (0.2 + 0.25) = 45 A
t4 = 0.2 s

	I_4 [I_n]						
I_n [A]	0.2	0.25	0.45	0.55	0.75	0.8	1
300	60	75	135	165	225	240	300
400	80	100	180	220	300	320	400

Tolerance Values

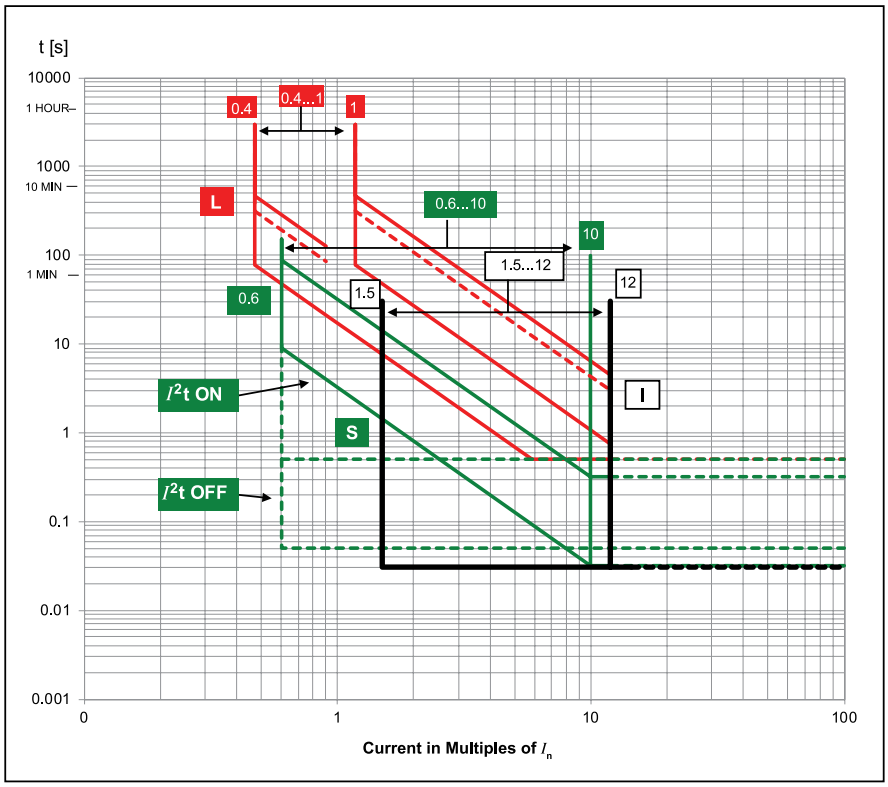
Protection	Trip Threshold	Trip Time
G	± 10%	± 20%

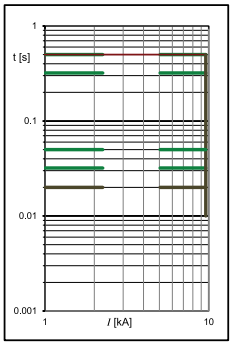
For L-S-I trip curve see Pub. 140G-TD025.

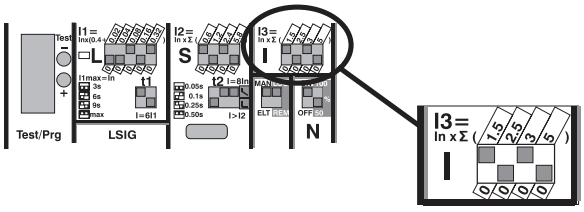
Bulletin 140G-M

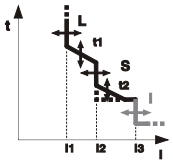
Available Sensors (I_n): 600 A, 800 A

Electronic Trip Unit. Long Delay Response, Short Delay with I^2t Response, and Instantaneous Curve









Example:

I_n = 600 A
I_3 = 600 x (1.5 + 3) = 2700 A

Tolerance Values

Protection	Trip Threshold	Trip Time
L	1.05 ≤ xI_1 ≤ 1.25	± 20%
S	± 10%	± 20%
I	± 15%	≤ 60 ms
Others	± 20%	

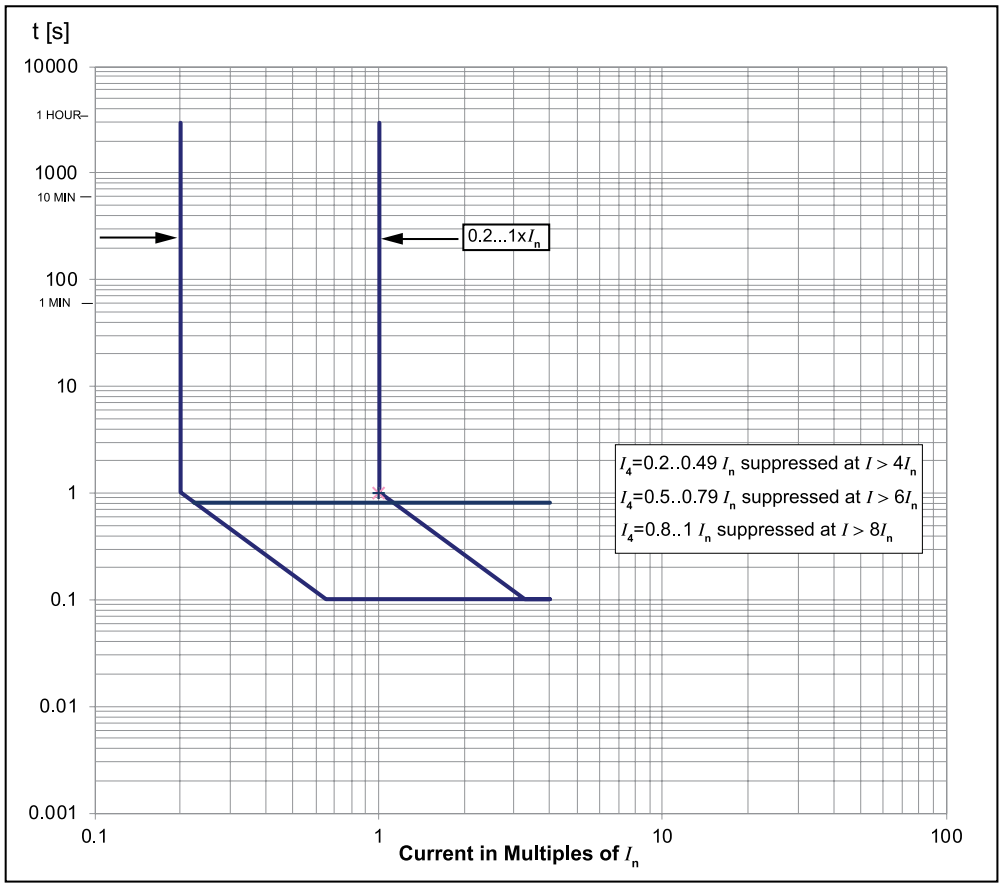
Notes:

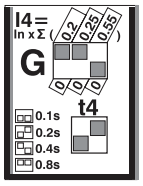
1. Curve accuracy applies from -20 °C to +55 °C (-4 °F to +131 °F) ambient temperature. For possible continuous ampere derating for ambient temperature above 40 °C (104 °F), consult your local Rockwell Automation sales office or Allen-Bradley distributor.
2. The right portion of the curve is determined by the interrupting rating of the circuit breaker.
3. Total clearing times shown include the response times of the trip unit, the breaker opening, and the interruption of the current.
4. For high fault current levels an additional fixed instantaneous hardware override is provided at 9.6 kA.

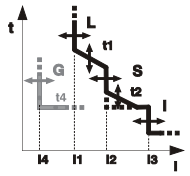
Bulletin 140G-M

Available Sensors (I_n): 600 A, 800 A

Ground Fault Protection Curve for LSIG MCCBS







Tolerance Values

Protection	Trip Threshold	Trip Time
G	± 10%	± 20%

Example:

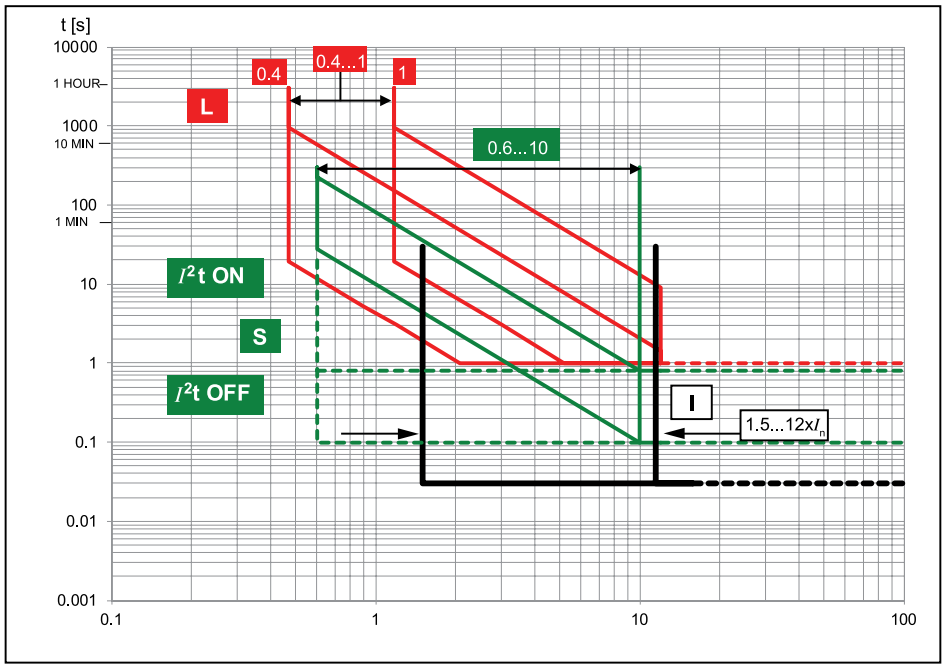
I_n = 600 A
I_4 = 600 x (0.2 + 0.25) = 270 A
t4 = 0.2 s

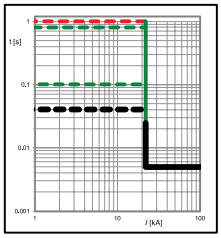
For L-S-I trip curve see Pub. 140G-TD028.

Bulletin 140G-N, -NS

Available Rating Plugs (I_n): 400 A, 800 A, 1000 A, 1200 A, 1250 A (IEC)

LSI





Protection	Disable	Trip Threshold	Trip Time	Trip Threshold Tolerance[2]	Trip Time Tolerance [2]
L (t=k/I^2)		I_1=0.4-0.44-0.48-0.52…1 x I_n	t_1=3-6-12-18 s[1] @ 6I_1	Release between 1.05 and 1.2 x I_1	± 10% $I_f \leq 6 \times I_n$
S (t=k)	✔	I_2=0.6-0.8-1.2-1.8-2.4-3-3.6-4.2-5-5.8-6.6-7.4-8.2-9-10 x I_n	with $I > I_2$ t_2=0.1-0.25-0.5-0.8 s	± 7% $I_f \leq 6 \times I_n$ ± 10% $I_f > 6 \times I_n$	The best of: ± 10% or ± 40 ms
S (t=k/I^2)	✔	I_2=0.6-0.8-1.2-1.8-2.4-3-3.6-4.2-5-5.8-6.6-7.4-8.2-9-10 x I_n	I=10 x I_n t_2=0.1-0.25-0.5-0.8 s	± 7% $I_f \leq 6 \times I_n$ ± 10% $I_f > 6 \times I_n$	± 15% $I_f \leq 6 \times I_n$ ± 20% $I_f > 6 \times I_n$
I (t=k)	✔	I_3=1.5-2.5-3-4-4.5-5-5.5-6.5-7-7.5-8-9-9.5-10.5-12 x I_n	≤ 30 ms	± 10%	

Notes:

1. The minimum value of this trip is 1 s regardless of curve type (self-protection)
2. These tolerances apply under the following conditions:
   - self-powered relay at full power (without start-up)
   - presence of auxiliary power supply
   - two-phase or three-phase power supply
   - preset trip time ≥ 100 ms

For all cases not covered by the above assumptions, the following tolerance values apply:

Protection	Trip Threshold	Trip Time
L	1.05 ≤ xI_1 ≤ 1.25	± 20%
S	± 10%	± 20%
I	± 15%	≤ 60 ms
Others	± 20%	

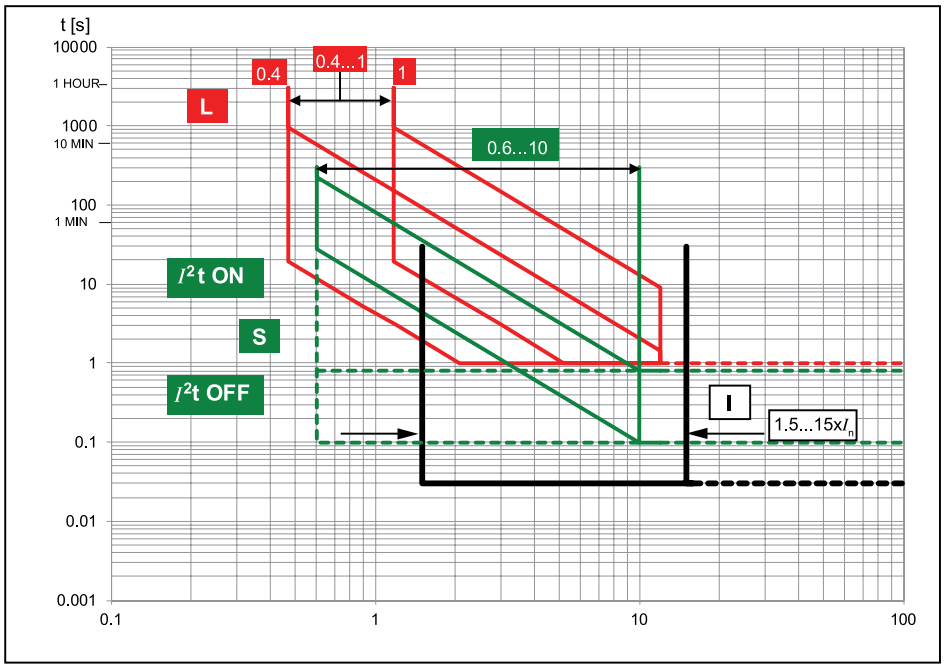
3. Curve accuracy applies from -20 °C to +55 °C ambient. For possible continuous ampere derating for ambient above 40 °C, consult Rockwell Automation.
4. The right portion of the curve is determined by the interrupting rating of the circuit breaker.
5. Total clearing times shown include the response times of the trip unit, the breaker opening, and the interruption of the current.
6. For high fault current levels an additional fixed instantaneous hardware override is provided at 22 kA.

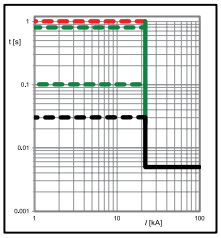
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Bulletin 140G-N, -NS

Available Rating Plugs (I_n): 400 A, 800 A, 1000 A, 1200 A, 1250 A (IEC)

LSIG





Protection	Disable	Trip Threshold	Trip Time	Trip Threshold Tolerance[2]	Trip Time Tolerance [2]
L (t=k/I^2)		I_1=0.4-0.425-0.45-0.475-0.5…-1 x I_n	t_1=3-12-24-36-48-72-108-144 s[1] @ 3I_1	Release between 1.05 and 1.2 x I_1	± 10% $I_f \leq 6 \times I_n$
S (t=k)	✔	I_2=0.6-0.8-1.2-1.8-2.4-3-3.6-4.2-5-5.8-6.6-7.4-8.2-9-10 x I_n	with $I > I_2$ t_2=0.1-0.2-0.3-0.4-0.5-0.6-0.7-0.8 s	± 7% $I_f \leq 6 \times I_n$ ± 10% $I_f > 6 \times I_n$	The best of: ± 10% or ± 40 ms
S (t=k/I^2)	✔	I_2=0.6-0.8-1.2-1.8-2.4-3-3.6-4.2-5-5.8-6.6-7.4-8.2-9-10 x I_n	t_2=0.1-0.2-0.3-0.4-0.5-0.6-0.7-0.8 s @ 10 I_n	± 7% $I_f \leq 6 \times I_n$ ± 10% $I_f > 6 \times I_n$	± 15% $I_f \leq 6 \times I_n$ ± 20% $I_f > 6 \times I_n$
I (t=k)	✔	I_3=1.5-2-3-4-5-6-7-8-9-10-11-12-13-14-15 x I_n	≤ 30 ms	± 10%	

Notes:

1. The minimum value of this trip is 1 s regardless of curve type (self-protection)
2. These tolerances apply under the following conditions:
   - self-powered relay at full power (without start-up)
   - presence of auxiliary power supply
   - two-phase or three-phase power supply
   - preset trip time ≥ 100 ms

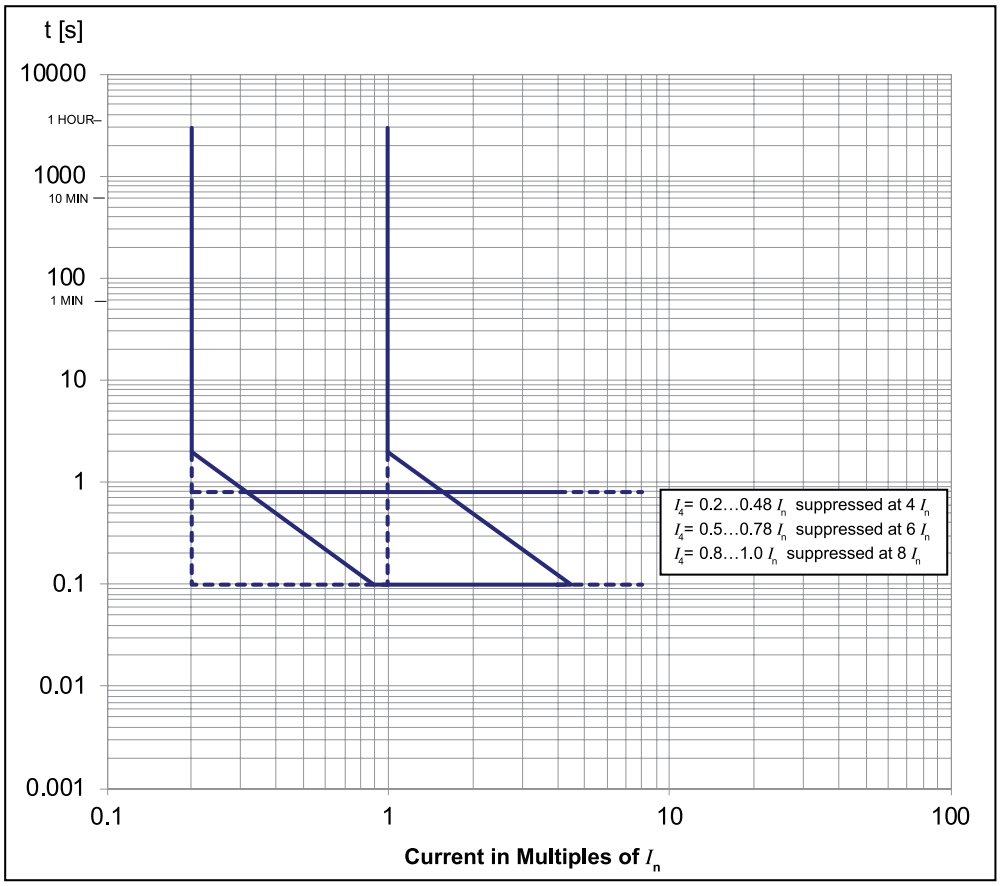
For all cases not covered by the above assumptions, the following tolerance values apply:

Protection	Trip Threshold	Trip Time
L	1.05 ≤ xI_1 ≤ 1.25	± 20%
S	± 10%	± 20%
I	± 15%	≤ 60 ms
Others	± 20%	

3. Curve accuracy applies from -20 °C to +55 °C ambient. For possible continuous ampere derating for ambient above 40 °C, consult Rockwell Automation.
4. The right portion of the curve is determined by the interrupting rating of the circuit breaker.
5. Total clearing times shown include the response times of the trip unit, the breaker opening, and the interruption of the current.
6. For high fault current levels an additional fixed instantaneous hardware override is provided at 22 kA.

Bulletin 140G-N, -NS

Ground Fault Protection Curve for LSIG MCCB



Protection	Disable	Trip Threshold	Trip Time	Trip Threshold Tolerance	Trip Time Tolerance
G (t=k)	✔	I_4=0.2-0.3-0.4-0.6-0.8-0.9-1 x I_n	with $I > I_4$ t_4=0.1-0.2-0.4-0.8 s	± 7%	The best of: ± 10% or ± 40 ms
G (t=k/I^2)	✔	I_4=0.2-0.3-0.4-0.6-0.8-0.9-1 x I_n	t_4=0.1 @ 4.47 I_4 t_4=0.2 @ 3.16 I_4 t_4=0.4 @ 2.24 I_4 t_4=0.8 @ 1.58 I_4	± 7%	± 15%

For all cases not covered by the above assumptions, the following tolerance values apply:

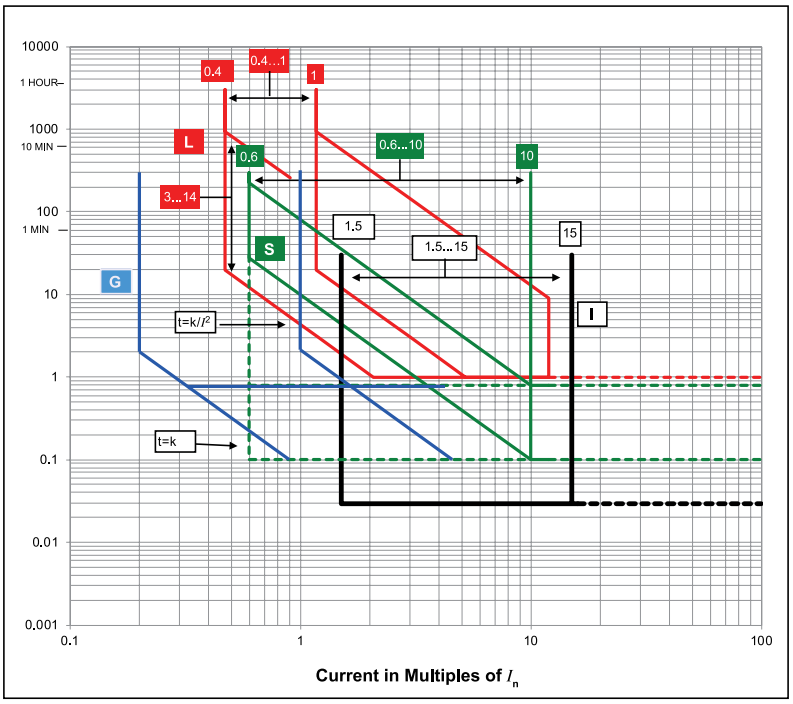
Protection	Trip Threshold	Trip Time
G	± 10%	± 20%
Others	± 20%	

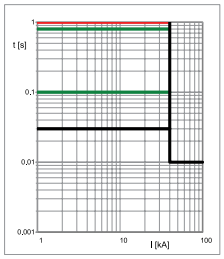
For L-S-I trip curve see Pub. 140G-TD031.

Bulletin 140G-R

Available Sensors (I_n): 2000 A, 2500 A, 3000 A

Electronic Trip Unit. Long Delay Response, Short Delay with I^2t Response, and Instantaneous Curve





Protection	Disable	Trip Threshold	Trip Time	Trip Threshold Tolerance (2)	Trip Time Tolerance (2)
L (t=k/I^2)		I_1=0.4-0.425-0.45-0.475-0.5…-1 x I_n	t_1=3-12-24-36-48-72-108-144 s(1) @ 3I_1	Release between 1.05 and 1.2 x I_1	± 10% I_f ≤ 6 x I_n
S (t=k)	✔	I_2=0.6-0.8-1.2-1.8-2.4-3-3.6-4.2-5-5.8-6.6-7.4-8.2-9-10 x I_n	with $I > I_2$ t_2=0.1-0.2-0.3-0.4-0.5-0.6-0.7-0.8 s	± 7% I_f ≤ 6 x I_n ± 10% I_f > 6 x I_n	The best of: ± 10% or ± 40 ms
S (t=k/I^2)	✔	I_2=0.6-0.8-1.2-1.8-2.4-3-3.6-4.2-5-5.8-6.6-7.4-8.2-9-10 x I_n	t_2=0.1-0.2-0.3-0.4-0.5-0.6-0.7-0.8 s @ 10 I_n	± 7% I_f ≤ 6 x I_n ± 10% I_f > 6 x I_n	± 15% I_f ≤ 6 x I_n ± 20% I_f > 6 x I_n
I (t=k)	✔	I_3=1.5-2-3-4-5-6-7-8-9-10-11-12-13-14-15 x I_n	≤ 30 ms	± 10%	
G (t=k)	✔	I_4=0.2-0.3-0.4-0.6-0.8-0.9-1 x I_n	with I > I_4 t_4=0.1-0.2-0.4-0.8 s	± 7%	The best of: ± 10% or ± 40 ms
G (t=k/I^2)	✔	I_4=0.2-0.3-0.4-0.6-0.8-0.9-1 x I_n	t_4=0.1 @ 4.47 I_4 t_4=0.2 @ 3.16 I_4 t_4=0.4 @ 2.24 I_4 t_4=0.8 @ 1.58 I_4	± 7%	± 15%

Notes:

1. The minimum value of this trip is 1s regardless of curve type (self-protection)
2. These tolerances apply under the following conditions:
   - self-powered relay at full power (without start-up)
   - two-phase or three-phase power supply
   - presence of auxiliary power supply
   - preset trip time ≥ 100 ms
3. Curve accuracy applies from -20 °C to +55 °C (-4 °F to +131 °F) ambient temperature. For possible continuous ampere derating for ambient temperature above 40 °C (104 °F), consult your local Rockwell Automation sales office or Allen-Bradley distributor.
4. The right portion of the curve is determined by the interrupting rating of the circuit breaker.
5. Total clearing times shown include the response times of the trip unit, the breaker opening, and the interruption of the current.
6. For high fault current levels an additional fixed instantaneous hardware override is provided at 40 kA.

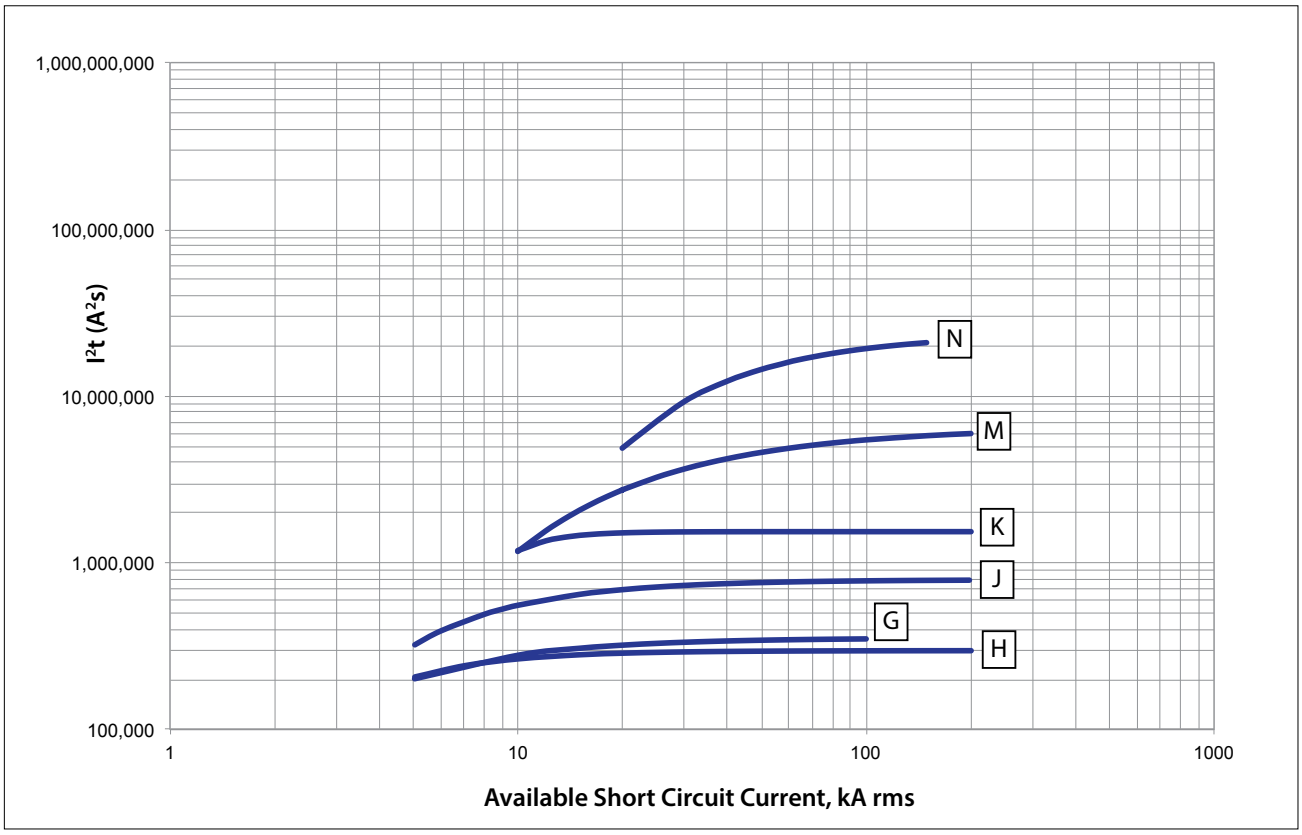
For all cases not covered by the above assumptions, the following tolerance values apply:

Protection	Trip Threshold	Trip Time
L	1.05 ≤ x I_1 ≤ 1.25	± 20%
S	± 10%	± 20%
I	± 15%	≤ 60 ms
G	± 10%	± 20%
Others	± 20%	

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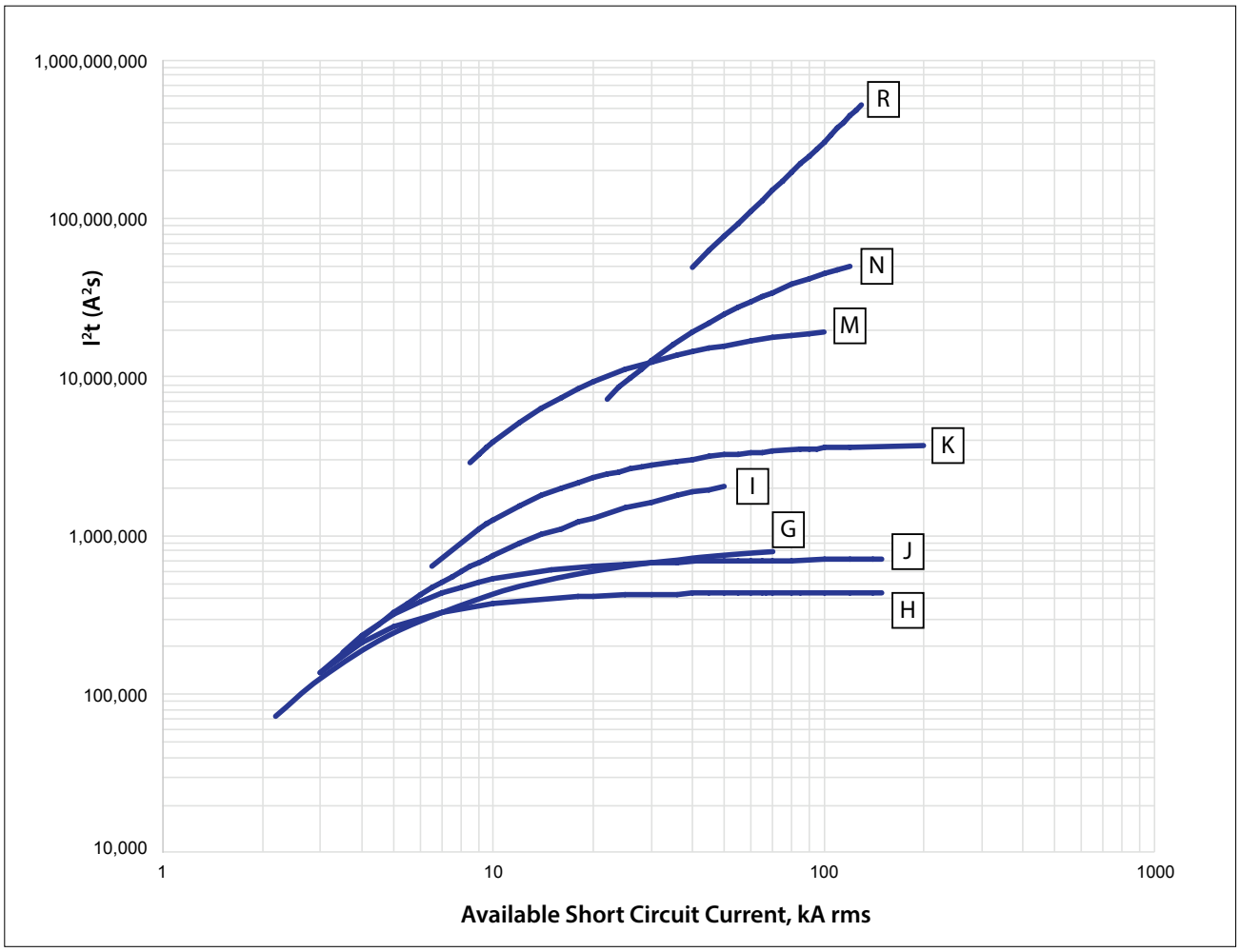
Bulletin 140G

I^2t Let-Through Energy Curve @ 240V



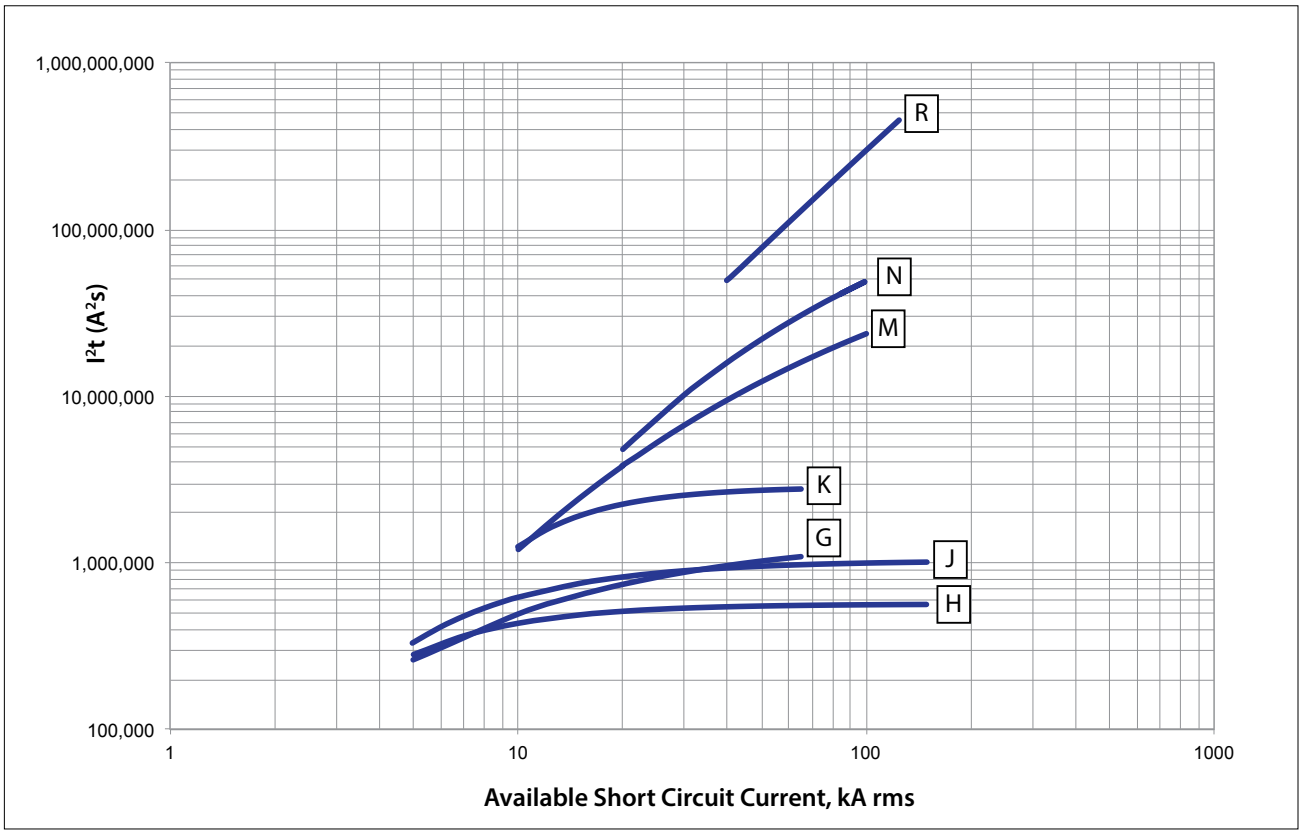
Bulletin 140G

I^2t Let-Through Energy Curve @ 415V



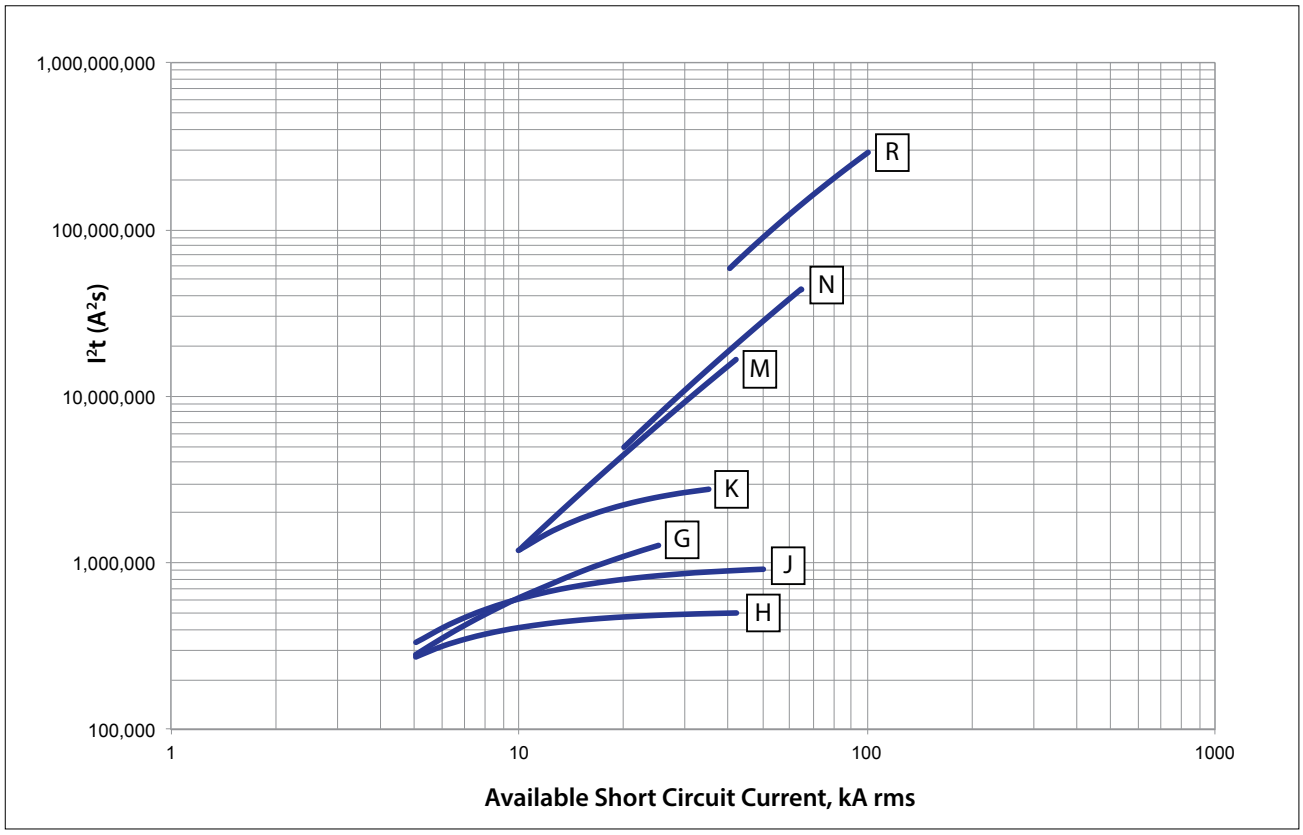
Bulletin 140G

I^2t Let-Through Energy Curve @ 480V



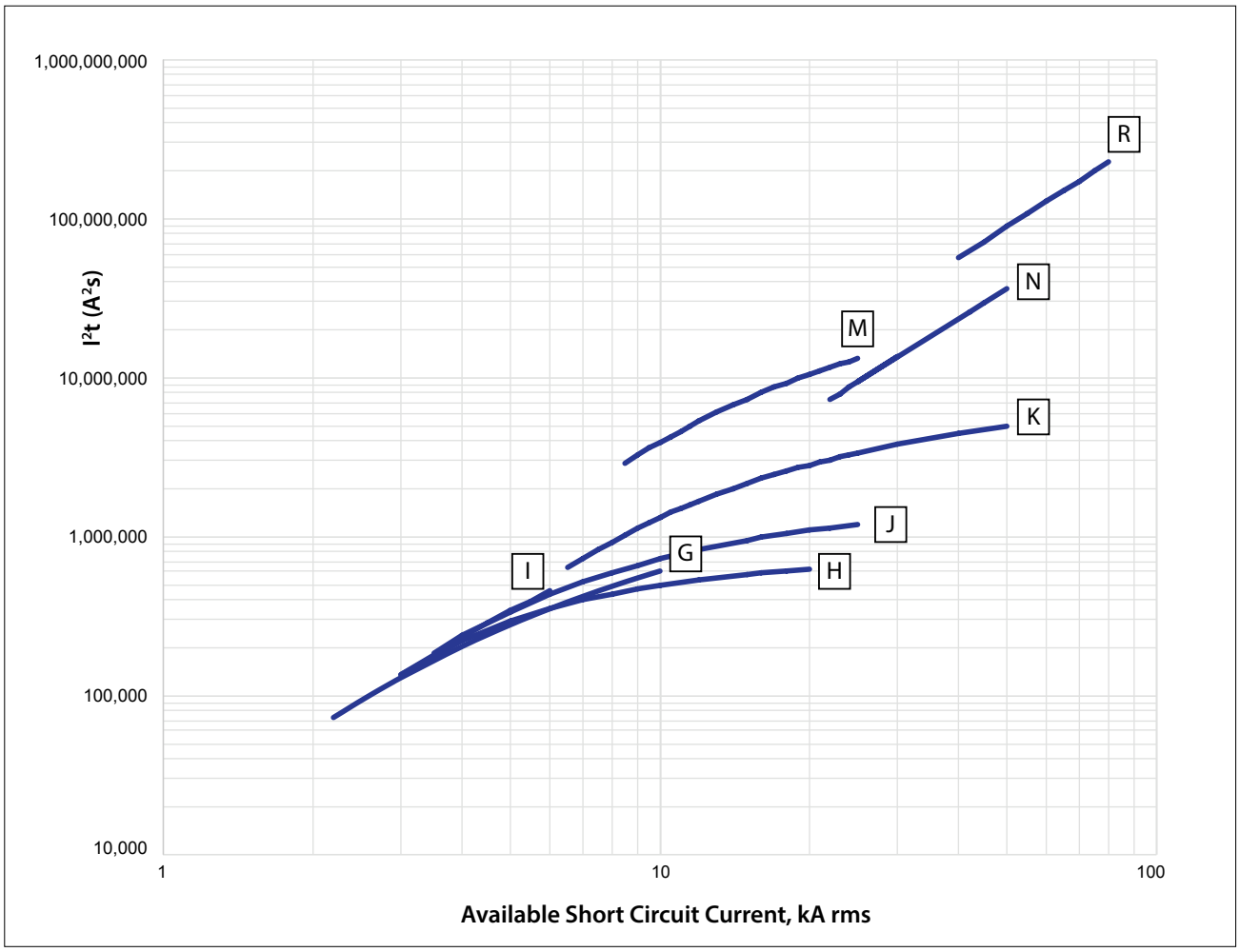
Bulletin 140G

I^2t Let-Through Energy Curve @ 600V



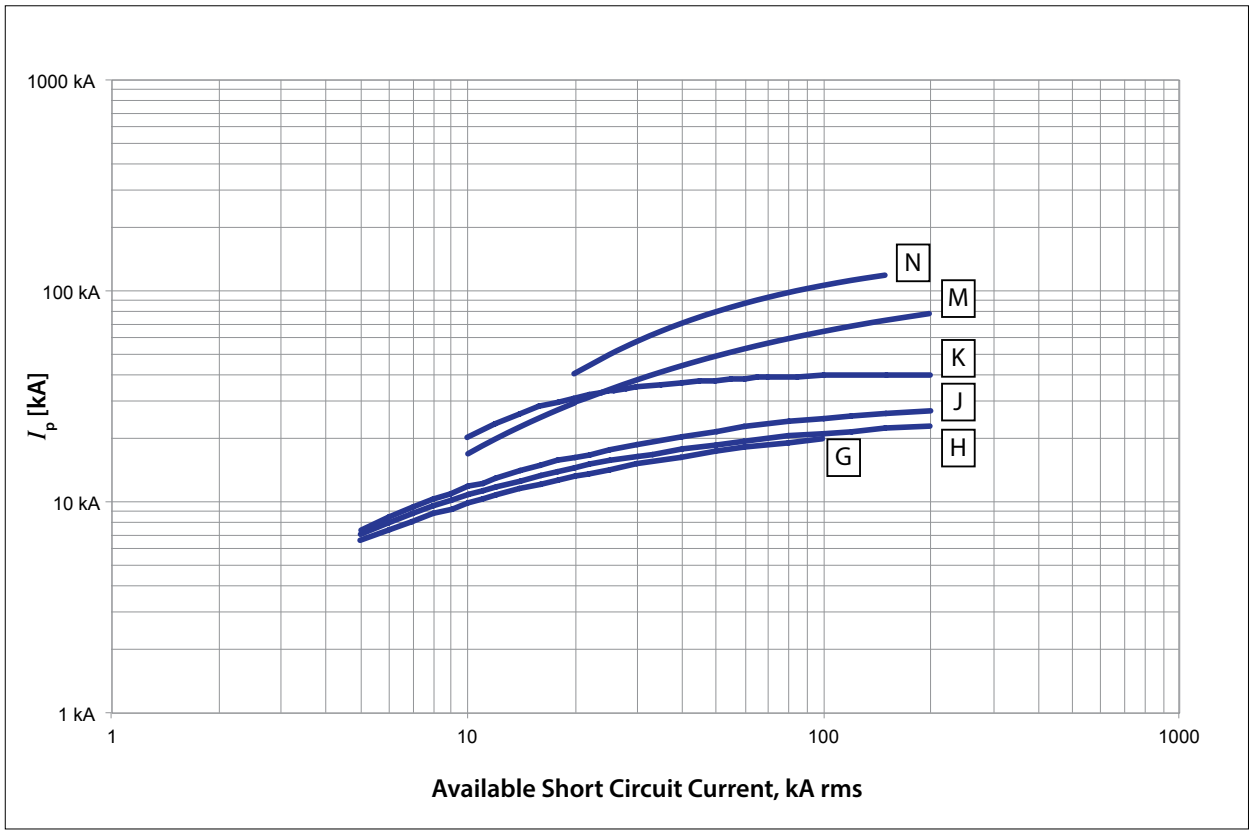
Bulletin 140G

I^2t Let-Through Energy Curve @ 690V



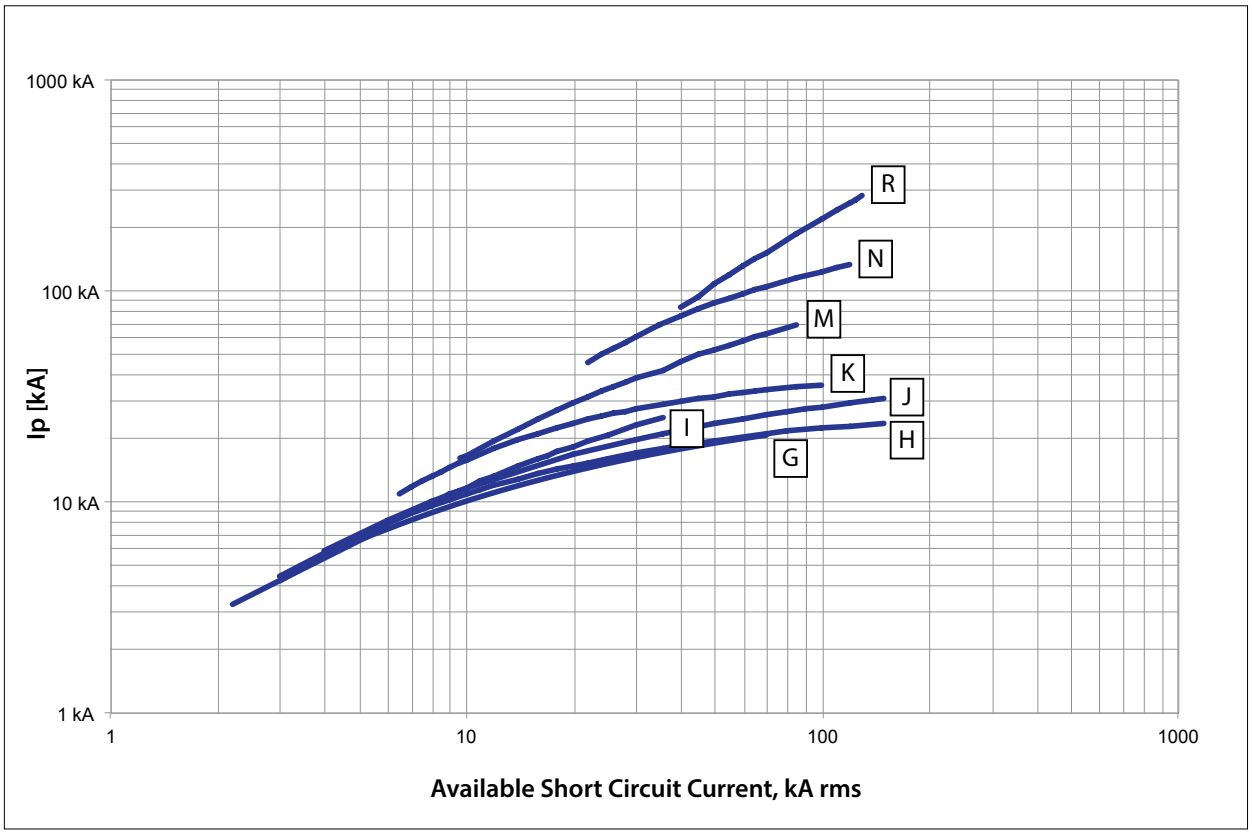
Bulletin 140G

Peak Let-Through Current, kA @ 240V



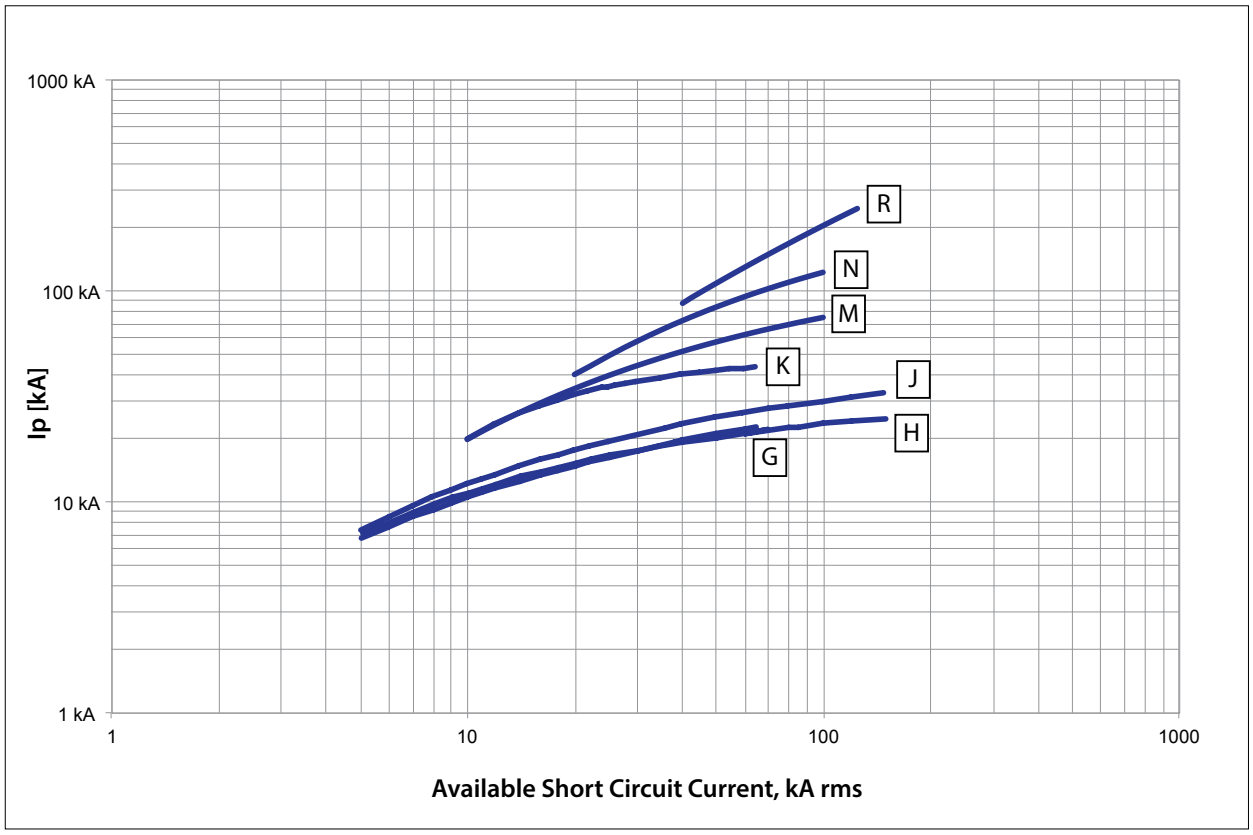
Bulletin 140G

Peak Let-Through Current, kA @ 415V



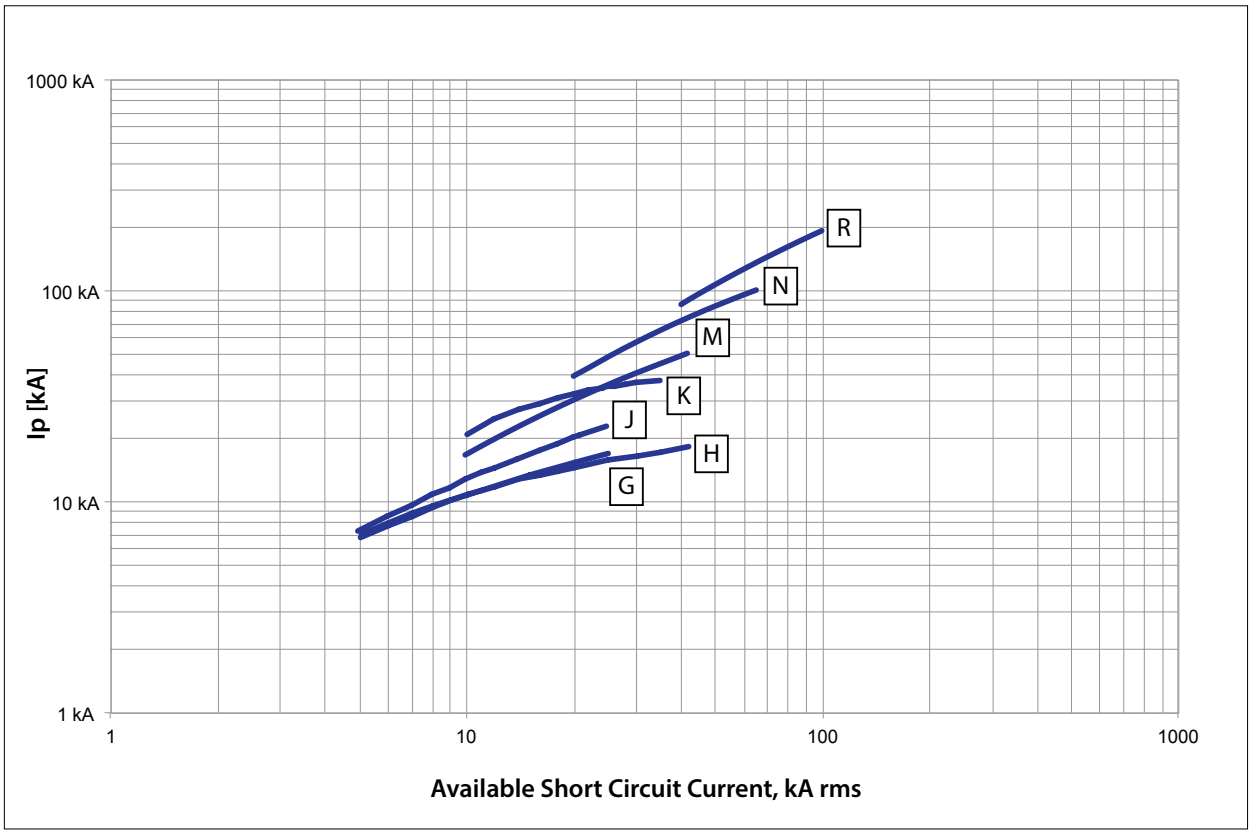
Bulletin 140G

Peak Let-Through Current, kA @ 480V



Bulletin 140G

Peak Let-Through Current, kA @ 600V



Bulletin 140G

Peak Let-Through Current, kA @ 690V

