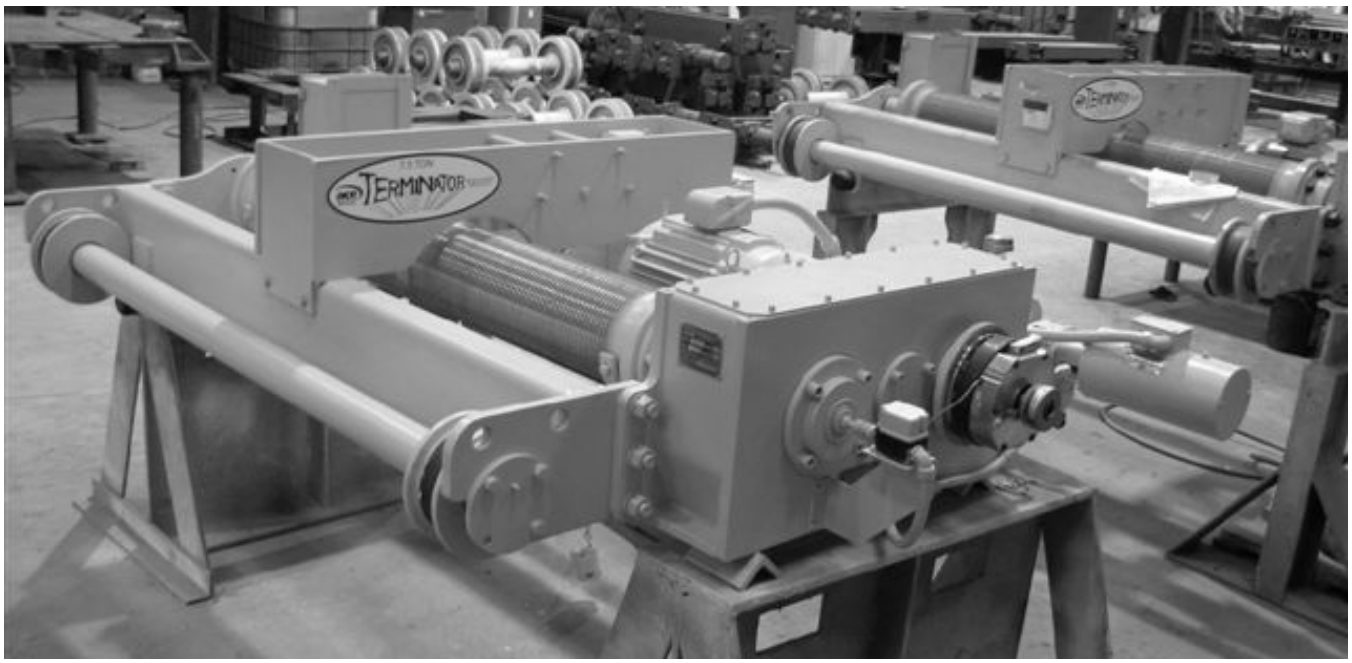
SERVICE & PARTS MANUAL
FOR
T30 TERMINATOR



10200 JACKBORO HWY., FORT WORTH, TX 76135
PH: (817) 237-7700 FAX: (817)237-2777
WEBSITE: WWW.ACEWORLDCOMPANIES.COM

REGISTERED ISO 9001 COMPANY

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INTRODUCTION

This manual contains general installation, operating, maintenance and trouble-shooting instructions for the Gearbox's. These gearboxes are rugged, high quality designed in accordance with standards of the American Gear Manufacturers Association to give many years of trouble-free service. However, optimum performance can be expected only if the procedures in this manual are followed. Should questions arise that are not covered in this guide, additional information may be obtained by contacting Ace World Companies service department.

All inquiries should be accompanied by the following information, which can be obtained from the gearbox nameplate:

Gearbox size and Type
Part number
Serial number

All Orders for renewal parts or replacement parts should include description and part number shown on the parts list supplied in this manual (see section 7).

NOTE

Adequate installation, maintenance, and safety instructions must be given by the User to personnel directly responsible for the operation of the gearbox. In addition, the procedures set forth in the operating instructions must be followed carefully.

HANDLING

When handling the gearbox, care must be taken to avoid supporting or lifting in a manner that would place excess stress on parts that are not designed to support the unit's weight.

Never drag the gearbox. This will mar the machined mounting surfaces and may overstress housing.

Use only lifts that are adequately maintained and that possesses sufficient load carrying capacity for the particular application. Secure and balance the load properly to prevent shifting during suspension.

When attaching slings to the gearbox, attention must be given to the behavior of the sling under load. Do not attach a sling in a manner which will damage any exterior components mounted on the gearbox.

PROLONGED STORAGE

When gearbox is shipped from factory it is filled to cover all gears to prevent rust from forming. At time of installation oil is drained and refilled to the proper level which is determined by the sight gauge as to when it is to its proper level.

When prolonged storage is necessary it should be in-doors and preferably in a dry free area having a relatively constant temperature. When outdoor storage is unavoidable, gearbox should be raised off the ground on skids and covered with a tarp or equivalent covering.

INSTALLATION

GENERAL:

Hoists are tested before being shipped from the factory. To place hoist in service, set on bridge and connect to electrical service.

WARNING
Before attempting installation of hoist/trolley, the main power switch must be locked in the open position.

Perform pre-operation checks and tests before placing in service.

BRIDGE REQUIREMENTS:

The successful operation of the hoist depends upon a properly installed bridge. The bridge should be checked for adequacy of the following:

Size of trolley rail (trolley wheels are arranged to operate on a specific rail size.

Trolley rails are to be solidly fastened to the supporting girder.

The rails shall be straight, parallel, level and at the same elevation. The distance (gage) center to center of bridge rails as well as the rail elevation shall be within a tolerance of plus or minus 1/8” (.32cm).

Rail joints must be smooth and held in tight alignment by properly fitted rail joint bars so that ends are held tightly with no crack or opening.

The bridge should be designed in accordance with specifications outlined by the Crane Manufacturer Association of America for the maximum wheel loads involved.

Size and placement of trolley end stops or bumpers should be checked to insure that they are of the proper height and width to fully contact the trolley wheels and also placed so as to stop the trolley with sufficient clearance between any portion of the trolley and the building.

The trolley is grounded

LUBRICATION:

All hoists are completely lubricated at the factory.

PRE-OPERATION CHECKS:

WARNING

Before energizing the hoist, and prior to running any motion, be certain that you have read this manual in its entirety and you are familiar with your hoist.

Check the main switch serving the runway conductors and also the main disconnect switch on the bridge. Lock both switches in the open position (power off).

Check trolley wheels

Check all connections for tightness of bolts, inclusion of lock washers or other type fasteners, to insure correct material as been used. This check must be made for all connections, mechanical, structural and electrical including both field and factory made connections.

Check to insure that all shipping supports, tie downs, brackets or other items which were used only for shipping or storage purposes are removed from the trolley.

Check alignment of trolley collectors

Check electrical wiring fro conformance to the wiring diagram.

Check all gear cases for oil level, and check all other parts for lubrication.

Check to be certain that the trolley and bridge is clear and free of all obstructions.

PRELIMINARY TESTING

Prior to the start of these tests, make a last minute check to see that loose parts, such as tools, covers, excess hardware, nuts, bolts, etc., have been picked up and safely stored.

Only qualified personal (electricians, etc,) be used for testing unit.

CAUTION
Verify that the trolley furnished has the same voltage, frequency, and phase as the bridge power supply.

Place all master control switches in the OFF position. If trolley is pendant push button operated, check that all buttons are in the OFF (fully released) position. Open power circuit knife switches of each control panel. If the panels are not so equipped, then remove fuses in the motor circuit.

Hoist Test:

a) Test is made prior to reeving the hoist. If your hoist was reeved at the factory then lower the load block manually to a position 8 to 10 feet below the trolley. This can be done by manually releasing the motor brake; some effort will be required to rotate the motor shaft.

b) Close the mainline disconnect switch serving the runway conductors.

c) Using a voltmeter, check all legs of the power leads at the mainline disconnect switch, located on the crane. Determine that power being supplied is of the correct voltage.

d) Close the mainline disconnect switch after checking to see that fuses are is place.

e) Energize the mainline contactor by depressing the START button. De-energize by depressing the STOP button. The action of the contractor in closing and opening the circuit is operating leave circuit with mainline contactor energized.

f) At the hoist control panel, check all legs of the power leads. Determine that power is being supplied at the correct voltage.

g) Check out reversing contactor and accelerating contactor sequencing. Operate the hoist push button on the pendant control, step by step in both directions. At each step, check contactor sequence with sequence shown on panel wiring diagram for proper operation.

h) Open mainline disconnect switch and replace fuses in the hoist motor circuit of the hoist panel.

i) Close mainline disconnect switch and reset mainline contactor by pressing the START button.

j) Jog the hoist master switch or push button in the UP direction, Check to insure that the drum is rotating in a direction which would raise the load block. (Refer to reeving instructions), to determine drum direction for rising). If direction is wrong, correct by interchanging any two leads at motor conduit box. **Be certain main disconnect switch is open (power off) when making this correction.**

k) Operate the hoist several revolutions of the drum in both direction, observing that the motor brake releases properly, and that the gear train and bearings operate without binding.

l) After the hoist is reeved and before placing trolley in service, a confirming load test is recommended under the direction of an appointed qualified person.

Hoist Limit Switch Test: (no load)

After the hoist is completely reeved, the upper and lower (if so equipped) limit switches must be checked for proper operation and safe stopping distance.

a) Set upper and lower limits of load block.

b) Slowly raise the load block. Observe the relationship of the load block to the underside of the trolley. The hoist limit switch should stop the upward travel of the load block with a few inches.

Do not contact or strike trolley frame with load block. If hoist motion is not interrupted by limit switch, stop hoist by depressing the STOP button.

c) If the limit switch does not stop the load block, or if stopping distance exceeds several inches check electrical circuit against wiring diagram, determine cause and correct. Also check brake torque adjustment.

d) Repeat test increasing the speed until test ifs performed at full speed.

WARNING

Distance required to stop the load block after tripping the limit switch increases with speed. Be certain that the limit switch trips soon enough so that the load block will not contact the trolley frame or other obstruction in stopping.

e) If trolley is equipped with a lower limit switch, check switch rip setting by lowering load block until motor stops. With load block in extreme low position, two full wraps of rope must be on the drum.

Trolley Test:

a) At the trolley control panel, check all legs of the power leads. Determine that power is being supplied at the correct voltage.

b) Check reversing contactor and accelerating contactor sequencing by operation of the trolley push button on the pendant control in both directions. Check sequence with panel wiring diagram to determine proper operation.

c) Open mainline disconnect switch and replace fuses in the trolley motor circuit of the trolley panel.

d) Close mainline disconnect switch and reset mainline contactor by pressing the START button.

CAUTION

When operating the trolley motion, place load block in high position and watch out for overhead or side interferences between the building and the crane.

e) Jog trolley master switch in the forward direction (be sure trolley is free to move in either direction). If direction of trolley is incorrect, reverse lead as described under Hoist Test above.

f) Operate the trolley slowly across the entire bridge and slowly contact the end stops. Check contact of bumpers or wheels to end stops. Operate several times back and forth across the bridge avoiding contact with end stops, working the unit up to full speed. Observe that the gear train and bearings operate without binding and that the trolley travels across the bridge without skewing.

LUBRICATION INSTRUCTIONS

LUBRICATION

Lubrication is accomplished by the splash system. The oil level is set high enough to partially submerge all gears, and in some cases, the bearings. In some cases splash feed lubrication fills oil pockets at bearings on all shafts and thereby maintains a reservoir of oil at these points.

TYPE OF LUBRICANT

Use CHEVRON MEROPA ISO 220 or equal.
If ambient temperatures drop below 35^0 F, gearbox oil must be changed to ISO 150 MINERAL GEAR OIL.
If ambient temperatures remain BELOW 0^0 F, an oil heater will have to be installed.

OIL SEALS

Oil seals require a small amount of lubricant to prevent frictional heat and subsequent destruction when the shaft is rotating. Oil seals often permit a slight seepage of oil along the sealing surfaces. This seepage is required to minimize seal friction and heat.

OIL CHANGES

After the initial six (6) months of operation, the original oil should be changed. Very often, due to the wearing-in process, small metal particles will appear in the oil; this is not abnormal. Fill the housing to the indicated level with straight mineral flushing oil which must not contain additives. Start gearbox and bring up to operating speed (preferably without load) and then stop. Drain flushing oil and fill with recommended operating lubricant to proper level.

Unusual environmental or load conditions may necessitate replacement of oil as frequently as one (1) or two (2) month intervals as determined by field inspection. Special attentions must be given to the inspection of lubricants when following conditions exist:

a) High operation temperatures resulting from heavy intermittent loads, causing the temperature of the gear housing to rise rapidly and then cool.

b) Ambient temperature conditions which may cause sweating on the inside wall of the gear housing, contaminating the oil and forming sludge.

Precautions must be taken to prevent any foreign matter from entering the gearbox housing. Dust, dirt, moisture and chemical fumes form a sludge which is detrimental to proper and adequate lubrication. Ace World Companies must be advised before manufacture of gearbox when environmental conditions are anticipated.

OPERATION

3-1 GENERAL

a) The importance of safe handling of overhead hoisting cannot be overstated. The operator should be aware at all time that he is in control of a powerful machine, which if used carelessly, can do a great deal of damage. Correct usage is fundamental to reliable operation and minimum maintenance costs of the trolley. One measuring stick of a good operator is his smoothness of operation. Jumpy of jerky trolley movement, flying starts, quick reversals and sudden stops are the trade marks of the carless operator.

b) Equally important to the safe operation of the trolley is frequent and systematic inspection and maintenance. Mandatory requirements on a national level are detailed in OSHA Part 1910.179. The user should become familiar with those regulations, along with any other state or local codes.

3-2 OPERATOR QUALIFICATIONS

a) Safe and efficient trolley operation requires skill, extreme care, good judgment, alertness, concentration, knowledge of and rigid adherence to proven safety rules and practices. No person should be permitted to operate a trolley:

1) Who is not qualified or has handicaps that could adversely affect such operation.

2) Who has not been properly instructed?

3) Who has not been informed and does not have thorough knowledge of all applicable safe operating practices, including those in this book as well as rigging equipment and practices.

b) The user is also referred to American National Standard ANSI B30.2.0 Section 2-3.1 for qualification and conduct of operators. Additionally, the user should become familiar with National, State or Local safety codes which may apply.

3-3 OPERATING PRECAUTIONS

Equipment covered herein is not designed or suitable as power source for lifting or lowering persons.

Safe operation of an overhead hoist is the operator's responsibility. Listed below are some basic rules that can make an operator aware of dangerous practices to avoid and precautions to take for his own safety and the safety of others. Observance of these rules in addition to frequent examinations and periodic inspection of the equipment may save injury to personnel and damage to equipment.

a) DO

1) Read ANSI B30.2.0 Safety Standard for Overhead and Gantry Cranes.

2) Be familiar with hoist operating controls, procedures and warnings.

3) Make sure lock block travel is in the same directions as shown on controls.

4) Make sure hoist limit switches function properly.

5) Maintain firm footing when operating hoist.

6) Make sure that load slings or other approved single attachments are properly sized and seated in the load block saddle.

7) Make sure that the lock block latch, if used, is closed and not supporting any part of the load.

8) Make sure that load is free to move and will clear all obstructions.

9) Take up slack carefully, check load balance, lift a few inches and check load holding action before continuing.

10) Avoid swinging of load or load hook.

11) Make sure that all persons stay clear of the suspended load.

12) Warn personnel of and approaching load.

13) Protect wire rope from weld spatter or other damaging.

14) Promptly report any malfunction, unusual performance, or damage of the hoist.

15) Use common sense and best judgment whenever operating a hoist.

16) Inspect hoist regularly, replace damaged or worn parts, and keep appropriate records of maintenance.

17) Use the hoist manufacturer's recommended parts when repairing a hoist.

18) Use hook latches wherever possible.

19) Apply lubricant to the wire rope as recommended by the hoist manufacturer.

b) <u>DO NOT</u>

1) Lift more than rated load.

2) Use the hoist load limiting device to measure the load.

3) Operate damaged hoist or hoist that is not working correctly.

4) Operate the host with twisted, kinked, damaged or worn wire ripe.

5) Lift a load unless wire rope is properly seated in its grooves.

6) Use load rope as sling or wrap rope around the load.

7) Lift a load if any binding prevents equal loading on all load supporting ropes.

8) Apply the load to the tip of the hook.

9) Operate unless load is centered under host.

10) Allow your attention to be diverted from operating the hoist.

11) Operate the hoist beyond limits of load rope travel.

12) Use limit switches as routine operating stops unless recommended. They are emergency devices only.

13) Use hoist to lift, support or transport people.

14) Lift loads over people.

15) Leave a suspended load unattended unless specific precautions have been taken.

16) Allow sharp contact between two hoist or between host and obstructions

17) Allow personnel not physically fit or properly qualified to operate the hoist.

18) Allow the rope or hook to be used as a ground for welding.

19) Allow the rope or hook to be touched by a live wilding electrode.

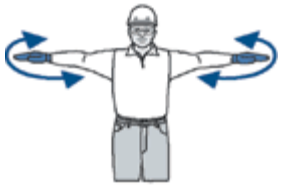
20) Remove or obscure the warnings on the hoist.

21) Adjust or repair a hoist unless qualified to perform hoist maintenance.

22) Attempt to lengthen the load rope or repair damaged load rope.

3-4 HAND SIGNALS

 **HOIST** With forearm vertical, and forefinger pointing up, move hand in small horizontal circle.	 **LOWER** With arm extended downward, forefinger pointing down, move hand in a small horizontal circle.	 **BRIDGE TRAVEL** Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.
 **MULTIPLE TROLLEYS** Hold up one finger for block marked ”1” and two finger for block marked “2”.	 **TROLLEY TRAVEL** Palm up, fingers closed, thumb pointing in direction of motion, jerk hand horizontally.	 **MOVE SLOWLY (i.e. HOIST SLOWLY)** Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal.

 **STOP** Arm extended, palm down,hold position rigidly.	 **EMERGENCY STOP** Arm extended, palm down, move hand rapidly right and left.	 **MAGNET IS DISCONNECTED** Crane operator spreads both hands apart – palms up.

3-5 LEARNING THE CONTROLS

The operator should locate and be familiar with the operation of the runway mainline disconnect switch and for this exercise lock switch in the OPEN (power off) position. The operator should now manipulate the various push buttons to get the “feel” and determine that they do not bind or stick in any position. The operator should become familiar with the location of the buttons or switches for their respective motions, as well as the “START” and “STOP” buttons which operate the mainline contactor. The “STOP” buttons should be used in any emergency since it will shut off power to all motions.

WARNING

If a push button binds or sticks in any position or does not return to the OFF position – do not turn power on – determine the cause of malfunction and correct before operating trolley.

3-6 OPERATING THE CONTROLS (NO LOAD)

3-6.1 Close the mainline disconnect switch. Press the START button. The trolley is now under power and ready to operate. For descriptive purposes assume the trolley is push button controlled with three speed points. Be certain the area is clear of all obstructions and people.

3-6.2 Hoist motion. Depress the “Down” push button to the first speed point. Observe that the load block is moving down slowly.

If the load block does not start down, depress the push button to the second speed point to start the load block in motion, and then back off to the first speed point. This

may occur if the hoist is new or has been idle for a period of time. If the load block still does not move on the first speed point after an initial break-in period, the hoist secondary resistance can be modified. This should be done only after consultation with ACE WORLD COMPANIES electrical department.

With the load block moving downward, push to the 2nd and finally to the 3rd (full speed) point of control observing the increase in speed as the button is depressed. With no load on the load block the speed change may be detectable only by the use of a tachometer.

Release push button and observe distance required to stop load block. The load block may be lowered until two full wraps of cable remain on the drum. Never lower load block below this position.

In the same manner, depress the "UP" push button to the first speed point, then to the 2nd speed point and finally to the 3rd (full speed point. Release push button and observe stopping distance. During this practice be certain to stop the load block several feet below the bottom of the trolley.

At the beginning of each shift the operator must check the hoist upper limit switch with no load. Extreme care must be exercised to avoid accidental damage in the event the switch does not operate. Raise the load block by slow inching. Carefully observe the relationship of the load block and the bottom of the trolley frame. The hoist upper limit switch, when working properly, should cause the host upward motion to stop.

WARNING

Do not contact or strike trolley frame, drum or upper block with load block. If hoist motion is not interrupted by limit switch, stop hoist. Do not attempt further operation. Report condition to proper supervisor for correction.

Repeat upper limit switch test described above several times, each time increasing the hoist speed until switch is tested at full speed. Do not use this upper limit switch as an operating control.

3-6.3 Trolley motion. The operator must develop complete familiarity with response of the trolley motion and direction relative to position of the controls. As with the hoist, the operator should become familiar with each speed point working to full speed ONLY after stopping from each speed point. This practice should continue ling enough so that direction speeds, stopping, distance, hook swing control, etc., become "second nature" to the operator's judgment and reflexes.

3-7 OPERATING THE CONTROLS (WITH LOAD)

The exact same procedures apply with load as given in Para. 3-6 for no load. Start operation using a light load of 10 to 15 percent full load graduating to approximately 50% load and then to full load in three load steps. This will give the operator a feel for control response throughout the load range. The most important effect of a changing load with which the operator must become familiar is the variation of stopping distance required.

Motor torque in the first speed point is limited to approximately 50 percent and therefore the hoist will not raise or lower loads exceeding approximately 50 percent of the rated load while on the first speed point.

OPERATING INSTRUCTIONS

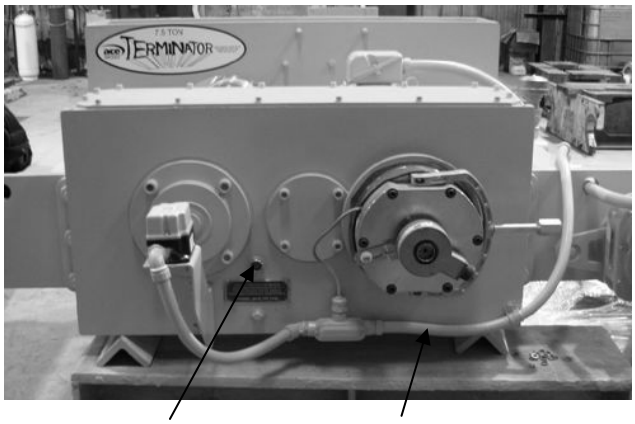


Fig. 3-1,

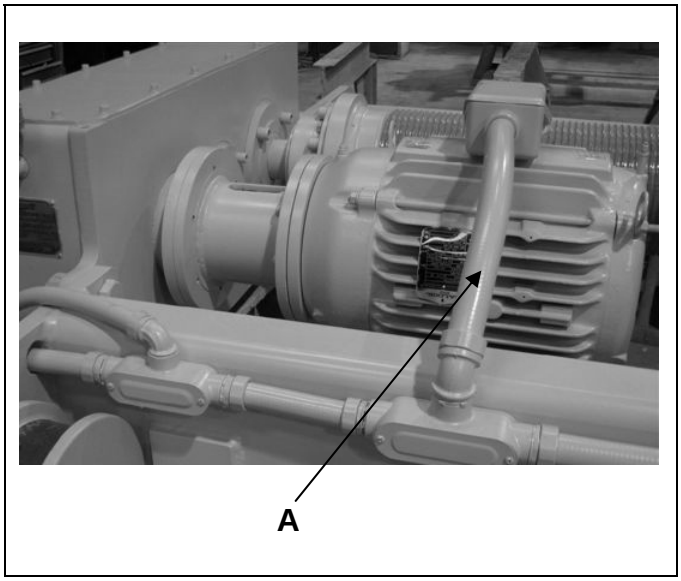


Fig. 3-2

PRELIMINARY CHECKS

When starting up any new equipment, it is best to proceed cautiously. Even though the installation instructions are followed, the existence of errors or omissions is always possible. Before initial start-up, perform the following procedures:

a) Before start-up, check the gearbox to be sure it is filled to the proper oil level with the correct type, grade, and amount of oil specified (Fig 3-1(A).
b) Have required electrical connections been made, gearboxes equipped with an electric motor or control devices must be wired and checked for proper operation (Fig 3-1(B) and Fig 3-2(A).

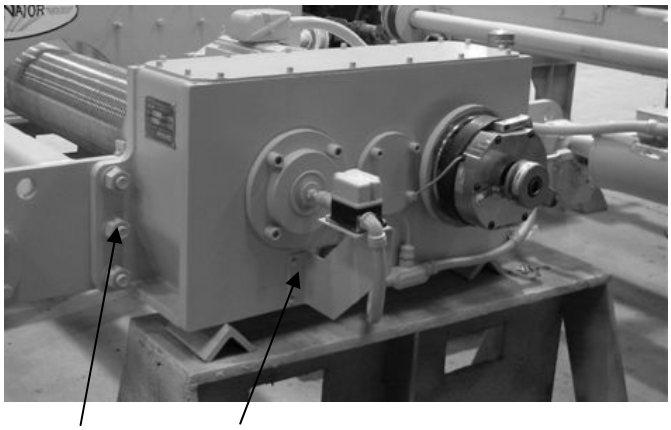


Fig. 3-3

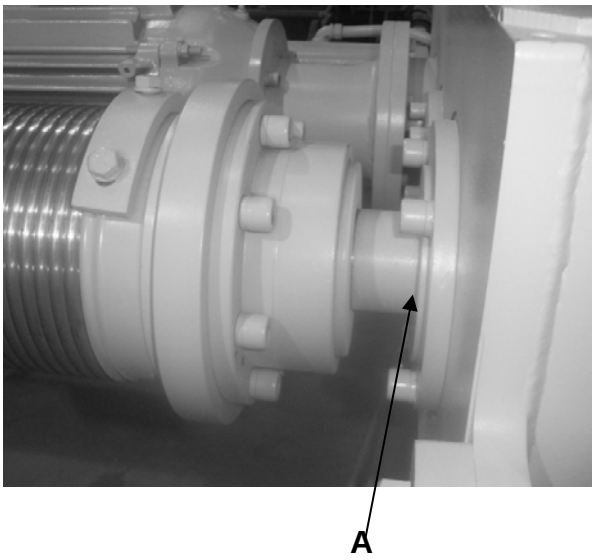


Fig. 3-4

c) Check all mounting bolts for proper torque (Fig 3-3(A).
d) Check all external bolts, screw, accessories and other mounted equipment to ensure they have not loosened during shipment or handling (Fig 3-3(B).

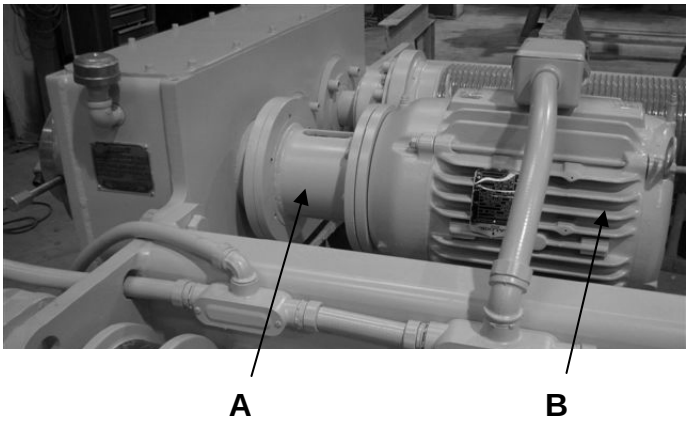


Fig. 3-5,

e) Are all couplings, pinions, or other drive components installed on shaft extensions with keys and fasteners in place? (Fig 3-4(A) and Fig 3-5(A).
f) Check drive motor and make sure it will drive the gearbox unit input shaft in the correct direction (Fig 3-5(B).

START-UP PROCEDURE

The gearbox unit has been test run at the factory; however, during initial start-up, perform the following recommended procedures:

a) Electrical motor starting must be arranged to start gearbox slowly to avoid severe impact loads. Across the line starting of motors must be applied with caution to prevent instantaneous gear loads greatly in excess of rating.
b) If the gearbox is equipped with heaters
c) Starting gearbox slowly and under as light a load as possible.
d) Check for oil leaks.

OPERATIONAL CHECKS

a) As the gearbox is brought up to normal operating speed, it must be checked constantly for unusual sounds, excessive vibration, excessive heat or oil leakage. If any of these problems develop, the gearbox must be stopped immediately and the cause determined and corrected.
b) After start-up the gearbox should be operated until temperatures stabilize.

TROUBLESHOOTING

TROUBLSHOOTING CHART

OVERHEATING		
FIG	**PROBABLE CAUSE**	**CORRECTIVE ACTION**
	a) Gearbox overloaded.	a) Reduce loading or replace with gearbox of sufficient capacity.
	b) Gearbox speed excessive.	b) Consult Ace World Companies.
	c) Recommended oil level exceeded or low.	c) Check oil level indicator and add or drain oil.
	d) Breathers dirty or obstructed.	d) Breathers dirty or obstructed. Clean breathers insolvent.
	e) Improper grade of oil.	e) Drain, flush and fill with proper grade of oil.
	f) Oil oxidized or dirty	f) Drain, flush and fill with clean oil. Clean or replace oil filter. Refer to lube chart.

SHAFT FAILURE		
FIG	**PROBABLE CAUSE**	**CORRECTIVE ACTION**
	a) Gearbox overloaded.	a) Reduce loading. Consult Ace World Companies
	b) Couplings improperly aligned.	b) Consult Ace World Companies
	c) Improper couplings installed.	c) Remove couplings and replace with proper type and size.
	f) Torsional or lateral vibrations.	f) Consult Ace World Companies.

BEARING FAILURE		
	PROBABLE CAUSE	**CORRECTIVE ACTION**
	a) Gearbox overloaded.	a) Reduce loading or replace with gear drive of sufficient capacity.
	b) Bearings improperly lubricated.	b) Check oil level indicator and add or drain oil.

OIL LEAKAGE		
FIG	**PROBABLE CAUSE**	**CORRECTIVE ACTION**
	a) Recommended oil level exceeded.	a) Check oil level indicator and drain excess oil.
	b) Breather dirty or obstructed.	b) Clear breather of obstruction. Clean breathers in solvent.
	c) Oil drain obstructed.	c) Check that drain is clean and allow free flow.
	d) Oil seals defective.	d) Replace oil seals. Consult Ace World Companies
	e) Drain plug, fittings, and connections leaking.	e) Disconnect, apply pipe sealant, and tighten.
	f) Housing and caps leaking.	f) Tighten screw and bolts.

GEAR WEAR		
FIG	**PROBABLE CAUSE**	**CORRECTIVE ACTION**
	a) Gearbox overloaded.	a) Reducing loading and/or consult Ace World Companies.
	b) Recommended oil level exceeded or low.	b) Check oil level indicator and add or drain oil.
	c) Improper grade oil.	c) Drain, flush and fill with proper grade of oil. See lube Chart.
	d) Oil oxidized or dirty.	d) Drain, flush and fill with clean oil. See lube chart.
	e) Gears misaligned.	e) Check gear teeth contact pattern and if tooth contact is inadequate check condition and alignment of bearings. consult Ace World Companies.

UNUSUAL OR INCREASING NOISE AND/OR VIBRATION		
FIG	**PROBABLE CAUSE**	**CORRECTIVE ACTION**
	a) Gearbox overloaded.	a) Reduce loading and/or consult Ace World Companies.

PREVENTIVE MAINTENANCE

GENERAL

The preventive maintenance instructions are presented as scheduled procedures and provide the information necessary for prolonging the life of the gearbox and for the prevention and detection of gearbox failures before actual failure takes place. The majority of gearbox failures can be attributed to improper lubrication, misapplication and misalignment.

Improper lubrication is a prime cause of gear failures. Too frequently, units are started up without a lubricant. Conversely, the unit sometimes has a larger volume of oil than is specified in the mistaken belief that better lubrication is obtained. A higher volume of oil usually results in more of the input power going into churning of the oil, creating excessive temperatures with detrimental results to gears and bearings. Insufficient lubrication causes the same results.

Gear failure due to overload is a broad and varied area of misapplication of the gear train. The nature of load (input torque, output torque, duration of operating cycle, chocks, speed, acceleration, braking, frequent starts and stops, etc.) determines the gear unit size and other design criteria. If there is any question that the actual service conditions may be more severe than originally anticipated, consult Ace World Companies before start-up. Often there are remedies that can be suggested before the gearbox is damaged by overload, but none are effective after severe damage.

The hoist should be analyzed while the gearbox is under a full load condition to determine that the hoist is not overloaded and thus putting out more than rated torque. If it is determined that overload does exist, the unit should be stopped and steps taken to either remove the overload or contact Ace World Companies to determine suitability of the gearbox under observed conditions.

SCHEDULED MAINTENANCE

DAILY:

The gearbox must be routinely inspected for unusual sounds or visible oil leaks. If either occurs, the gearbox must be stopped immediately, and the cause determined and corrected.

After the first 100 hours of operation, all external housing and mounting bolts should be torque to make certain they have not loosened. Check all piping connections and tighten if necessary.

WEEKLY

Check oil level and add oil if necessary.

Check the alignment of the gearbox with connected machinery after initially operating for 4 weeks under load.

a) Are all mounting bolts torque to correct tightness?
b) Is all housing and cap bolts torque to correct tightness.
c) Is gearbox correctly alignment with other equipment.
d) Is any excessive torque or overhung loads placed on gearbox.

TWO MONTHLY INTERVALS

Check oil for contamination.

SIX MONTH OR 2500 HOUR INTERVALS

Change oil in gearbox.

EXTENDED SHUTDOWN PERIODS

If it becomes necessary to shut down for a period longer than 25 weeks, the gearbox must be operated for at least 15 minutes during each week that it is idle. This periodic operation will keep the gears and bearings coated with oil and will prevent rust due to condensation of moisture resulting from temperature changes.

HOIST REDUCER
ASSEMBLY AND DISASSEMBLY PROCEDURES

ASSEMBLY PROCEDURES

Assembly should only be done by qualified personnel experienced with this type of machinery. Before starting work they should review the service manual and familiarize themselves with the assembly, parts list, and drawings. All safety precautions must be observed. Personal injury or equipment damage could result if these precautions are not observed.

TIPS FOR ASSEMBLY

Hoist of sufficient capacity to handle the parts must be available in the area where the unit will be assembled.

Slings should be used when handling machined parts. Clean up the area around the gearbox before assembly to keep parts clean. Sufficient space should be available to lay parts out in proper order for assembly.

Move gearbox to a clean prepared area for assembly when possible. Before starting assembly, carefully review assembly, parts lists, and drawings. Inspect the gearbox.

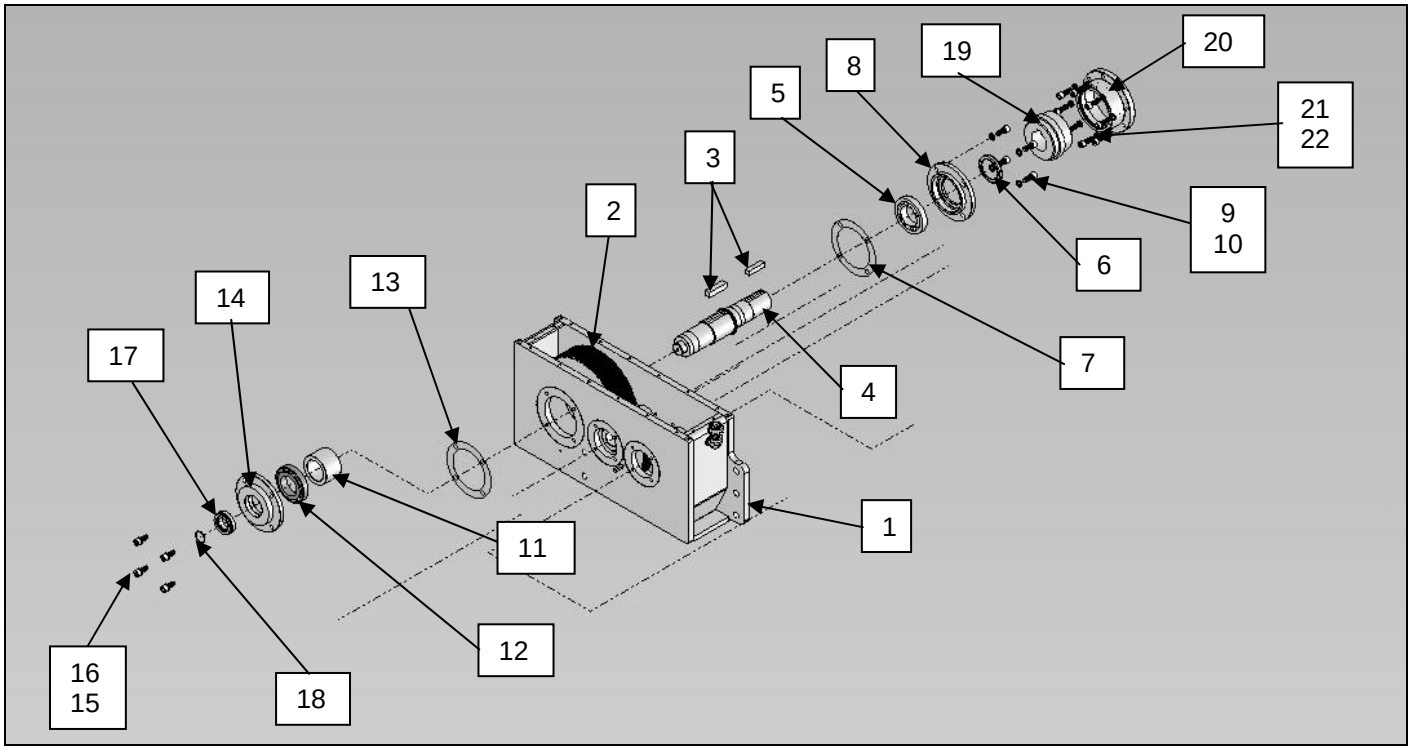


Fig. 6-1, Gearbox Assembly, (Drum Output Shaft)

1. Move Gearbox Housing (1) on a clean table for assembly.
2. Lower (2) Drum Gear in housing (1).
3. Insert (3) Keystock on (4) Output Shaft.
4. Align (4) Output Shaft with (2) Drum Gear in housing and slide through Drum Gear until it stops.
5. Install (5) Bearing on (4) Output Shaft.
6. Install (6) Seal in (8) Capsule.
7. Install (7) Shim on (8) Capsule.
8. Install (8) Capsule to (1) Housing.
9. Secure (8) Capsule to Housing (1) with (9) Soc.Hd. Cpscw and (10) Lockwasher.
10. Install (11) Drum Gear Spacer onto (4) Output Shaft.
11. Install (12) Bearing onto (4) Output Shaft.
12. Install (13) Shim onto (14) Capsule.
13. Install (14) Capsule onto (1) Housing.
14. Secure (14) Capsule to (1) Housing with (15) Soc Hd Cpscw and (16) Lockwasher.
15. Install (17) Bearing into (14) Capsule.
16. Install (18) Snap Ring onto (4) Output Shaft.
17. Install (19) Flex Hub onto (4) Output Shaft and (3) Keyway.
18. Install (20) Sleeve onto (19) Flex Hub.
19. Use (21) (22) to attach Sleeve to Drum.

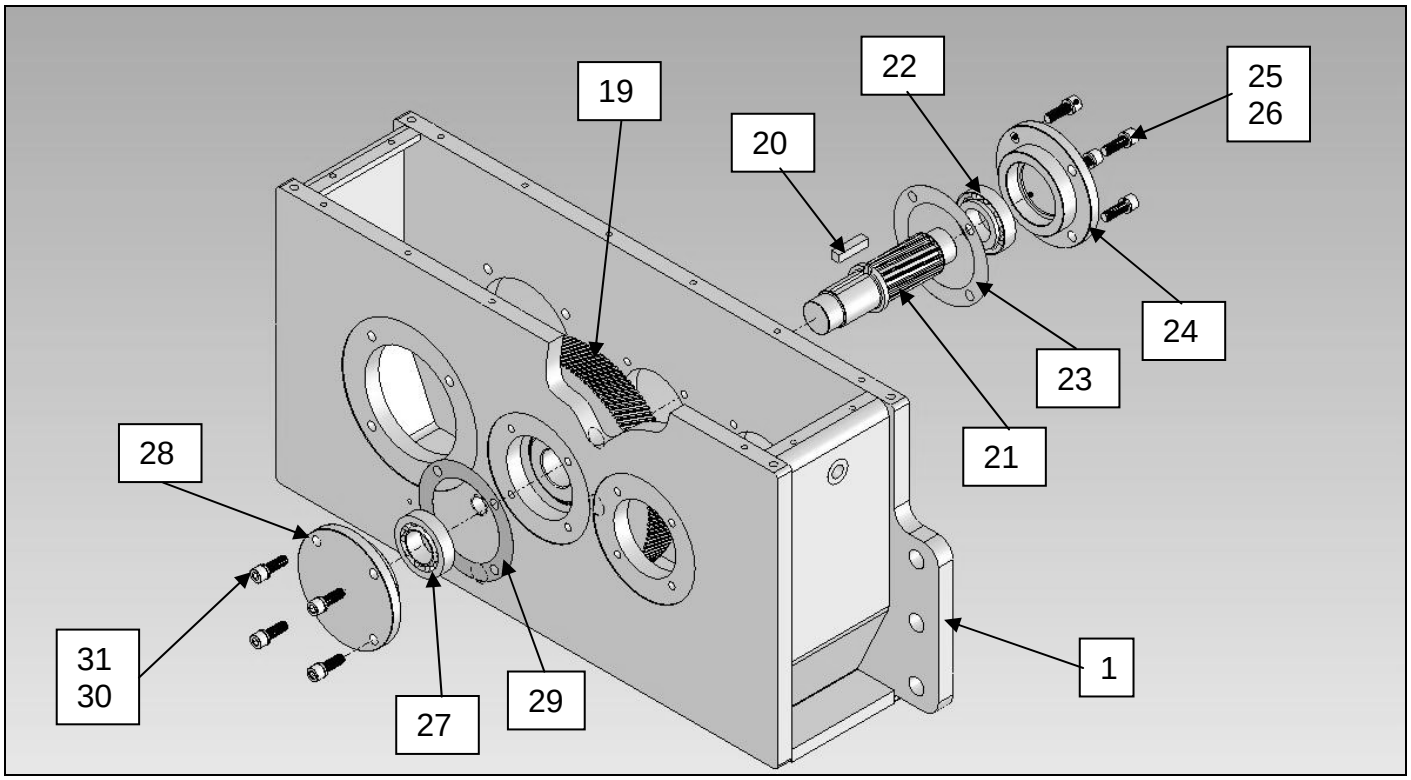


Fig. 6-2, Gearbox Assembly, (Drum Pinion & Shaft)

1. Lower (19) Motor Gear into (1) Housing.
2. Insert (20) Keystock on (21) Drum Pinion Shaft.
3. Insert (21) Drum Pinion Shaft_____
4. Insert (22) Bearing into (24) Capsule.
5. Install (23) Shim onto (24) Capsule.
6. Install (24) Capsule onto (1) Housing.
7. Secure (24) Capsule onto (1) Housing with (25) Soc. Hd. Cpscw and (26) Lockwasher.
8. Install (27) Bearing into (28) Capsule.
9. Install (29) Shim onto (28) Capsule.
10. Install (28) Capsule onto (1) Housing.
11. Secure (28) Capsule to (1) Housing with (30) Soc Hd Cpscw and (31) Lockwasher.

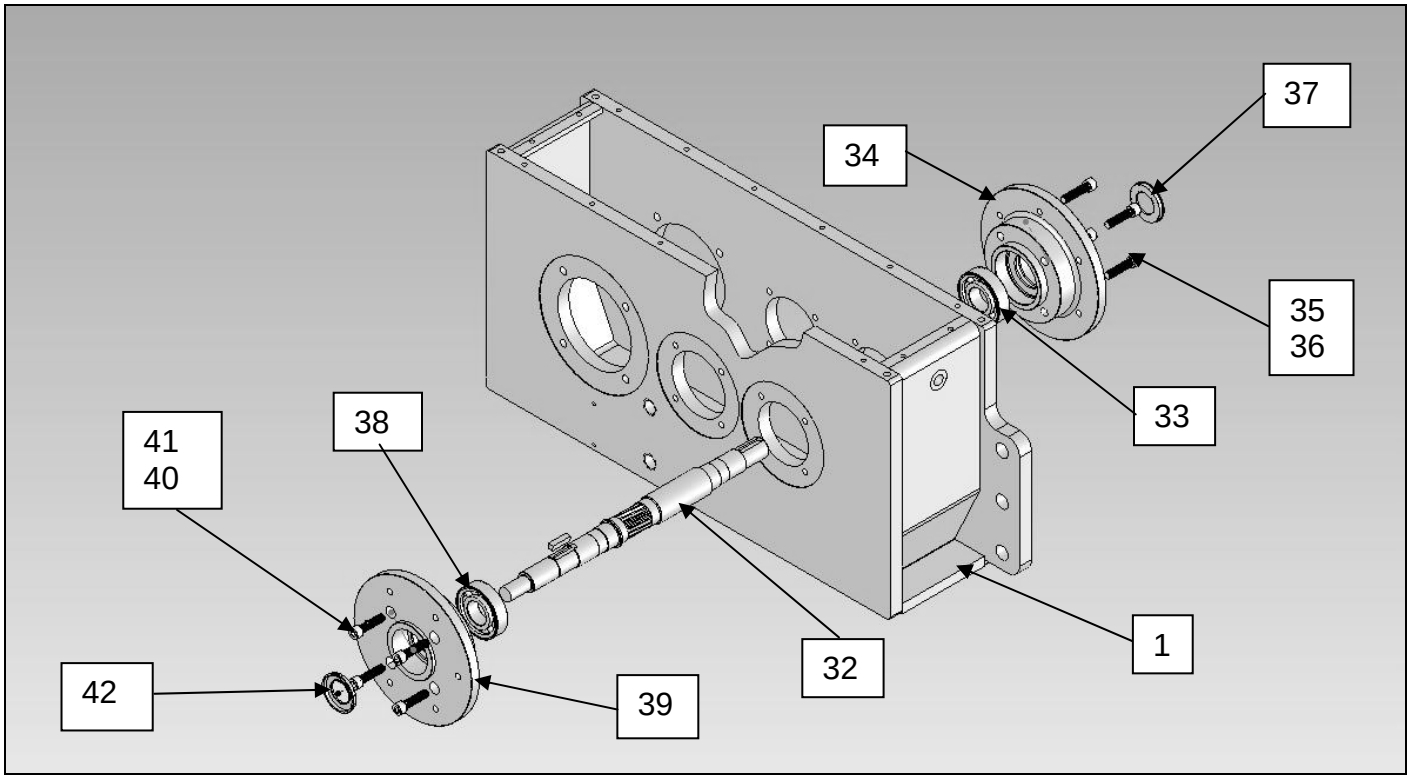


Fig. 6-3, Gearbox Assembly, (Motor Pinion & Shaft)

1. Install (32) Motor Pinion & Shaft into (1) Housing.
2. Insert (33) Bearing into (34) Brake Adaptor/Capsule.
3. Insert (34) Brake Adaptor/Capsule onto (1) Housing.
4. Secure (34) Brake Adaptor/Capsule onto (1) Housing with (35) Soc. Hd. Cpscw & (36) Lockwasher.
5. Install (37) Seal into (34) Brake Adaptor/Capsule.
6. Install (38) Bearing into (39) Brake Adaptor/Capsule.
7. Secure (39) Capsule onto (1) Housing
8. Secure (39) Capsule onto (1) Housing with (40) Soc. Hd. Cpscw and (41) Lockwasher.
9. Install (42) Seal into (39) Brake Adaptor/Capsule.

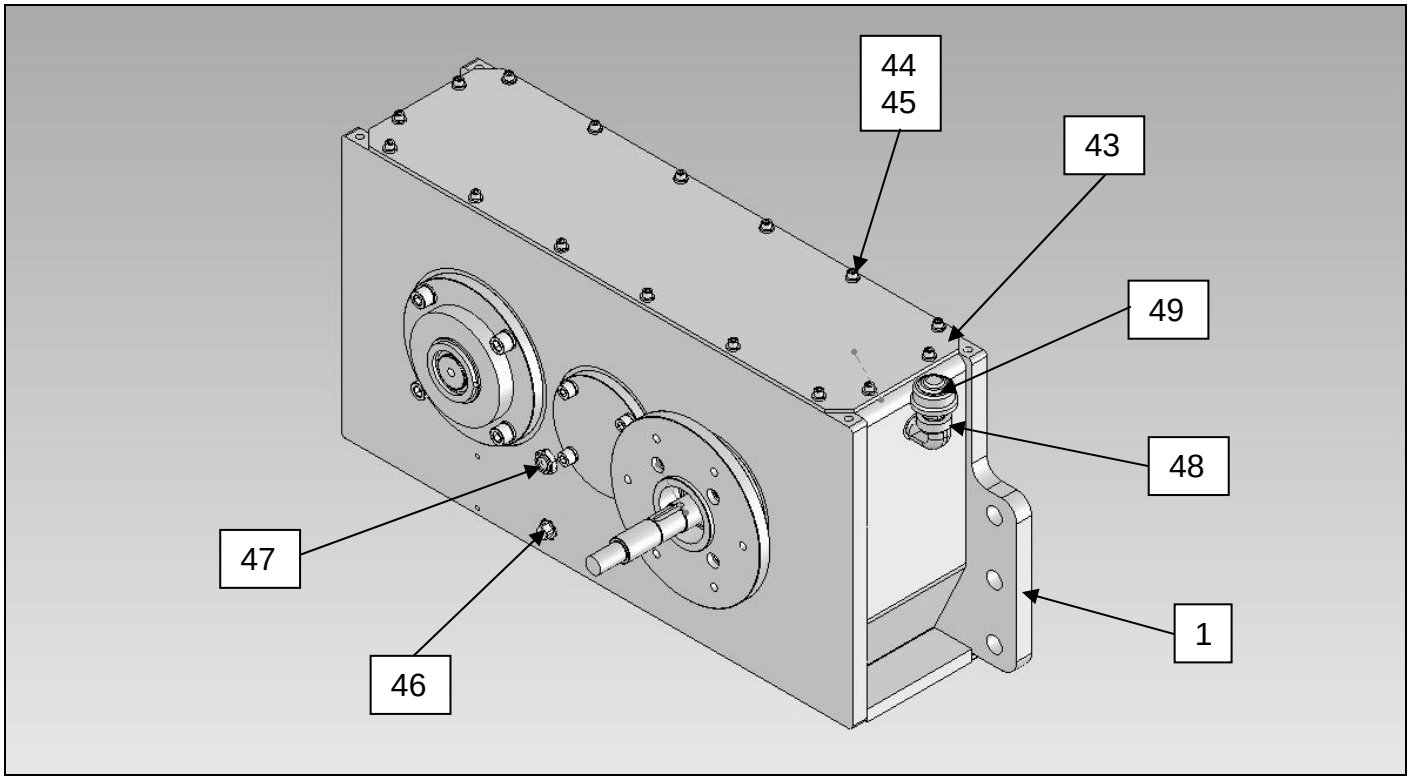


Fig. 6-4, Gearbox Assembly, (Lid, Breather, Sight Gauge and Plug)

1. Set (43) Lid on top of (1) Housing (Match Lid Holes with Housing Holes).
   (Before setting lid on housing put Silicone Sealant around holes and edge of lid)
2. Secure (43) Lid to (1) Housing with (44) Soc Hd Cpscw and (45) Lockwasher.
3. Install (46) Drain Plug into (1) Housing.
4. Install (47) Sight Gauge into (1) Housing.
5. Install (48) Pipe Elbow into (1) Housing.
6. Install (49) Breather onto (48) Pipe Elbow.

DISASSEMBLY PROCEDURES

To disassemble gearbox proceed as follows:

Hoists of sufficient capacity to handle the parts must be available in the area where the unit will be disassembled.

Slings should be used when handling machined parts. Clean up the area around the gearbox before disassembly to keep parts clean. Sufficient space should be available to lay parts out in proper order for assembly. Remember that parts are usually disassembled in reverse order of assembly. Provide wooden blocks or skids for storing machined parts to prevent damage to machined parts.

ILLUSTRATED PARTS MANUAL

FOR

T-30 TERMINATOR

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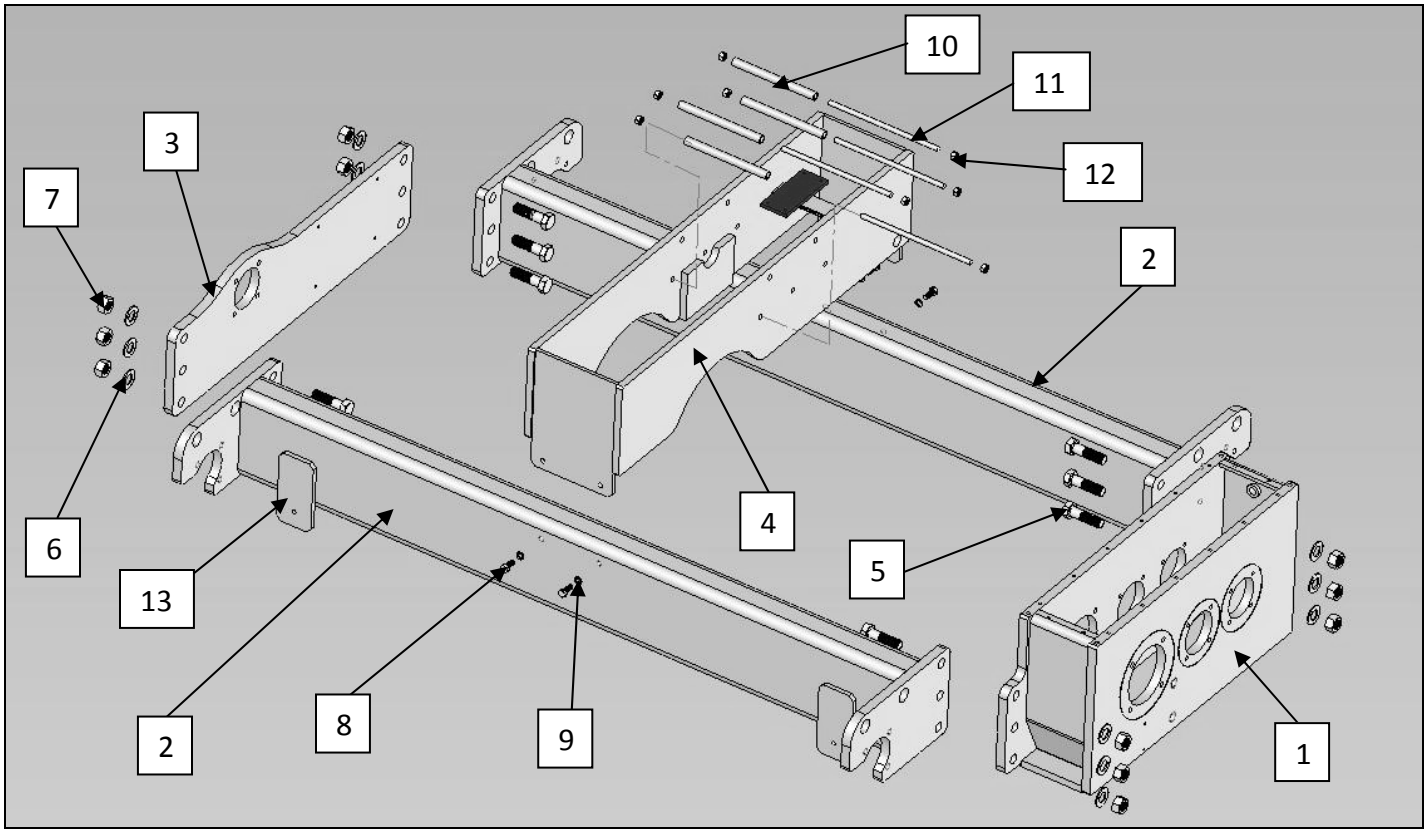
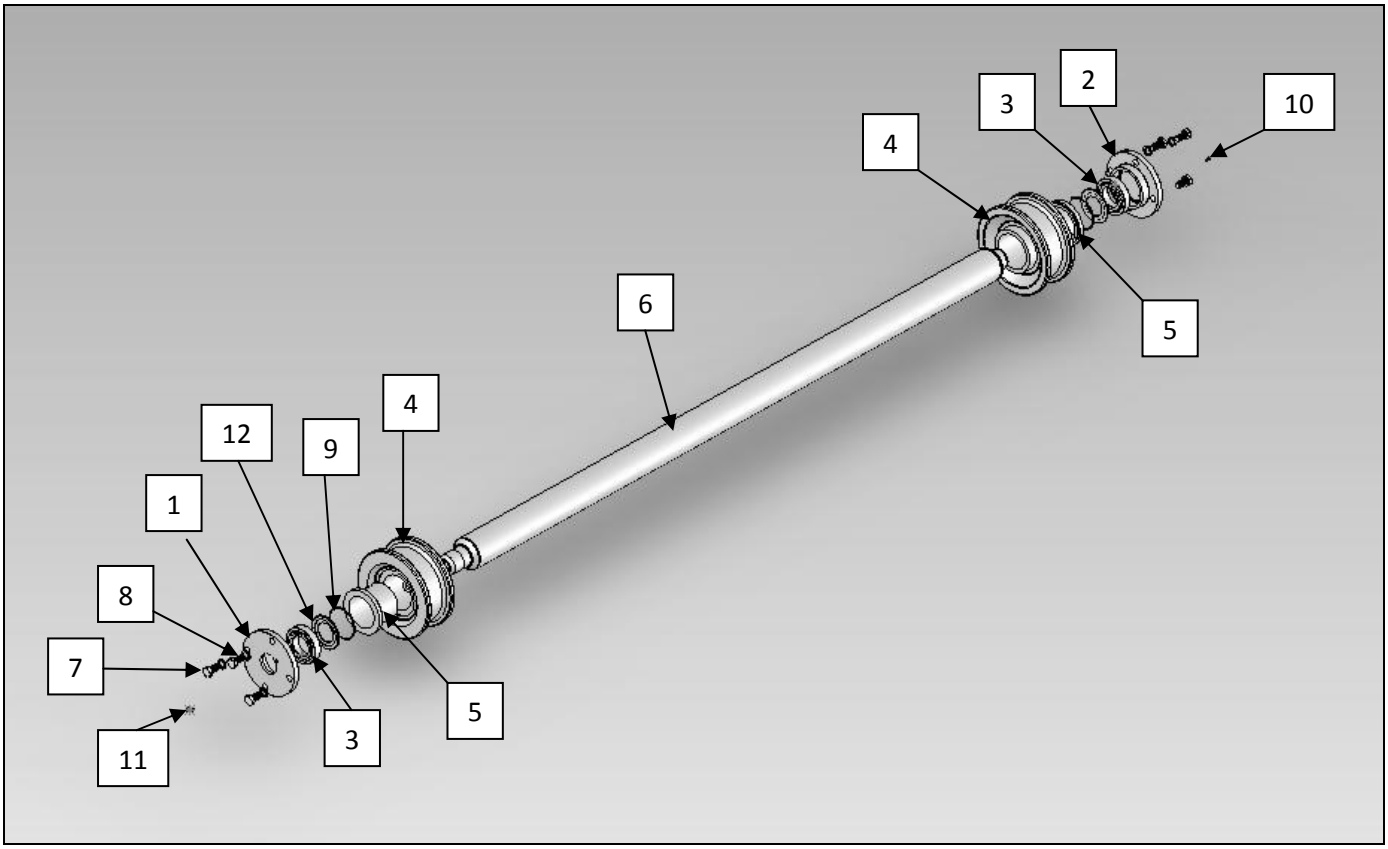
FIG. 1, STRUCTURE ASSEMBLY



ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	GEARBOX HOUSING	100893-0000
2	2	TROLLEY WHEEL MODULE	SEE TABLE
3	1	TROLLEY TAIL BEARING SIDE PLATE	100916-0000
4	1	TOP SHEAVE POCKET	401907-0000
5	12	BOLT, HX HD, 1”-8 X 3 1/2" LG. A325	105604-00
6	12	FLATWASHER, 1” (HARDENED)	105605-00
7	12	NUT, HVY HX, 1”-8 A325	104037-00
8	4	BOLT, HX HD, 1/2"-13 X 1 1/4" LG	100404-00
9	4	LOCKWASHER, 1/2"	100612-00
10	4	SPACER, 1/2 Sch. 40 Pipe -9-1/2” Lg	
11	4	ROD, Threaded, 1/2-13 x 12 3/4" Lg.	
12	8	NUT, Nyloc, Hex Hd, 1/2-13	105032-00
13	4	BUMPER, Size 80	102545-00

	6’ GAGE	8’ GAGE	10’ GAGE
ITEM 2	401898-0000	401899-0000	401900-0000

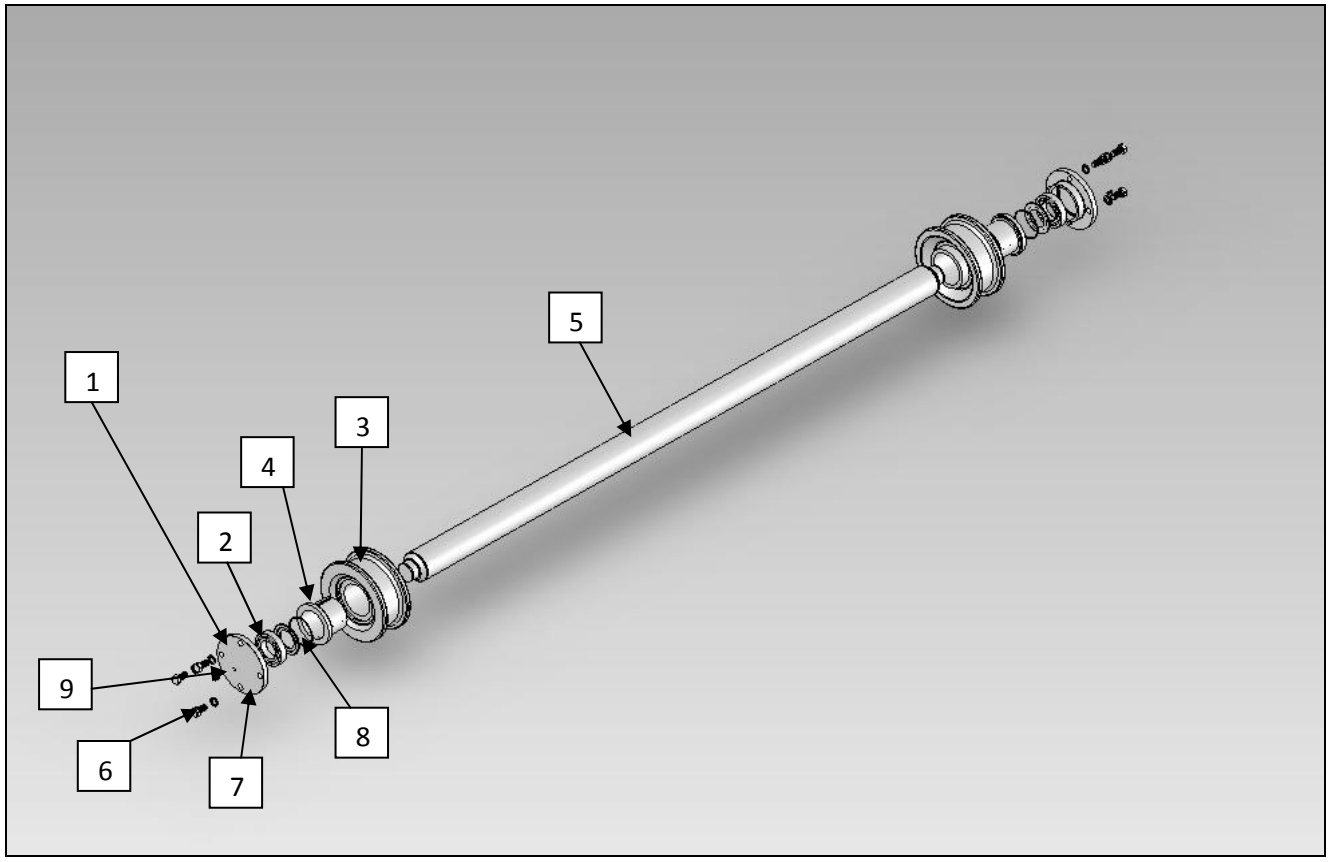
FIGURE 2, WHEEL AND DRIVE AXLE ASSEMBLY



ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	101871-0000	Capsule, Open
2	1	101872-0000	Capsule, Closed
3	2	100048-00	Bearing
4	2	100978-0000	Wheel Drive
5	2	100951-00	Adapter, Sleeve
6	1	See chart below	Axle, Drive
7	6	100416-00	Bolt, H x Hd, 5/8-11 x 1 1/4
8	6	100614-00	Washer, Lock, 5/8
9	2	104524-00	Ring, Snap
10	1	100021-00	Fitting, Grease
11	1	100019-00	Fitting, Grease
12	2	102187-00	Seal

ITEM	6’ gage	8’ gage	10’ gage
6	100979-0000	100980-0000	100983-0000

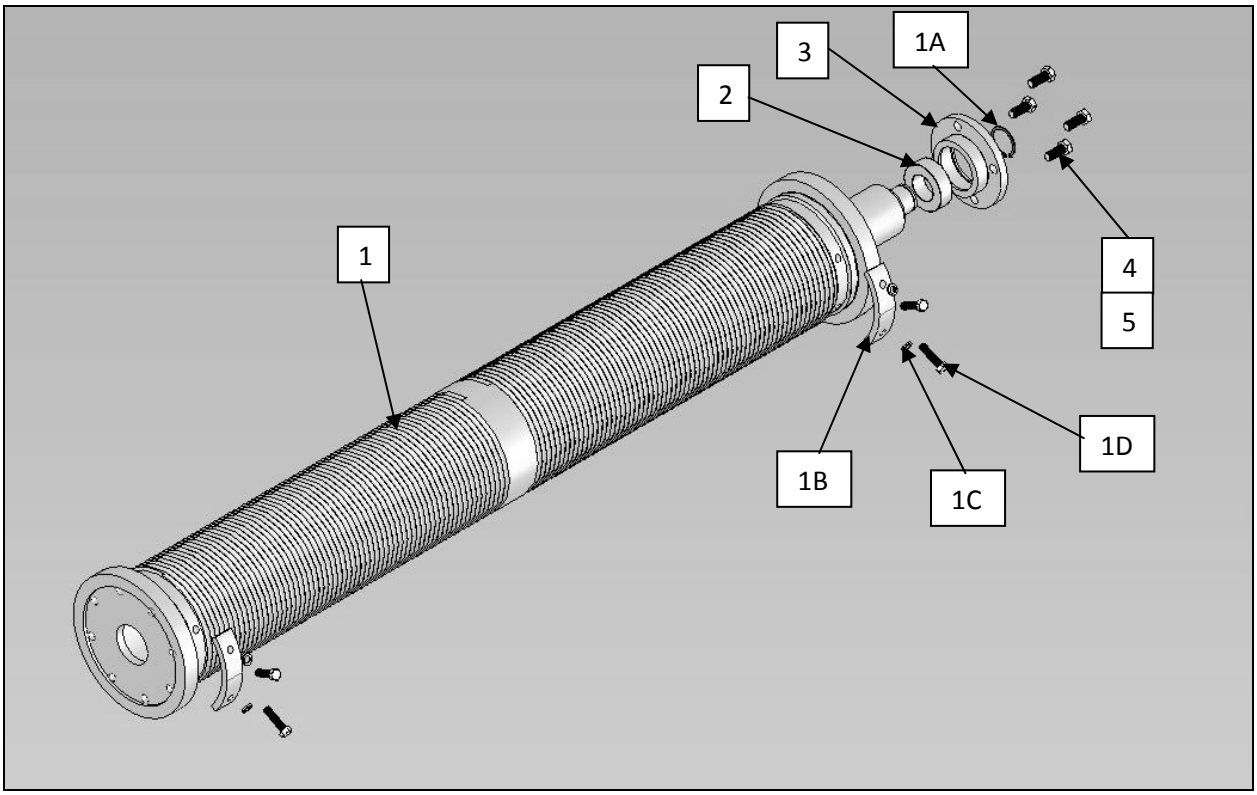
FIGURE 3, WHEEL AND IDLER AXLE ASSEMBLY



ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	101872-0000	Capsule, Closed
2	2	100048-00	Bearing
3	2	100978-0000	Wheel, Idler
4	2	100951-00	Adapter, Sleeve
5	1	See chart below	Axle, Idler
6	6	100416-00	Bolt, H x Hd, 5/8-11 x 1 1/4
7	6	100614-00	Washer, Lock 5/8
8	2	104524-00	Ring, Snap
9	2	100021-00	Fitting, Grease
10	2	102187-00	Seal

ITEM	6’ gage	8’ gage	10’ gage
5	100981-0000	100982-0000	100984-0000

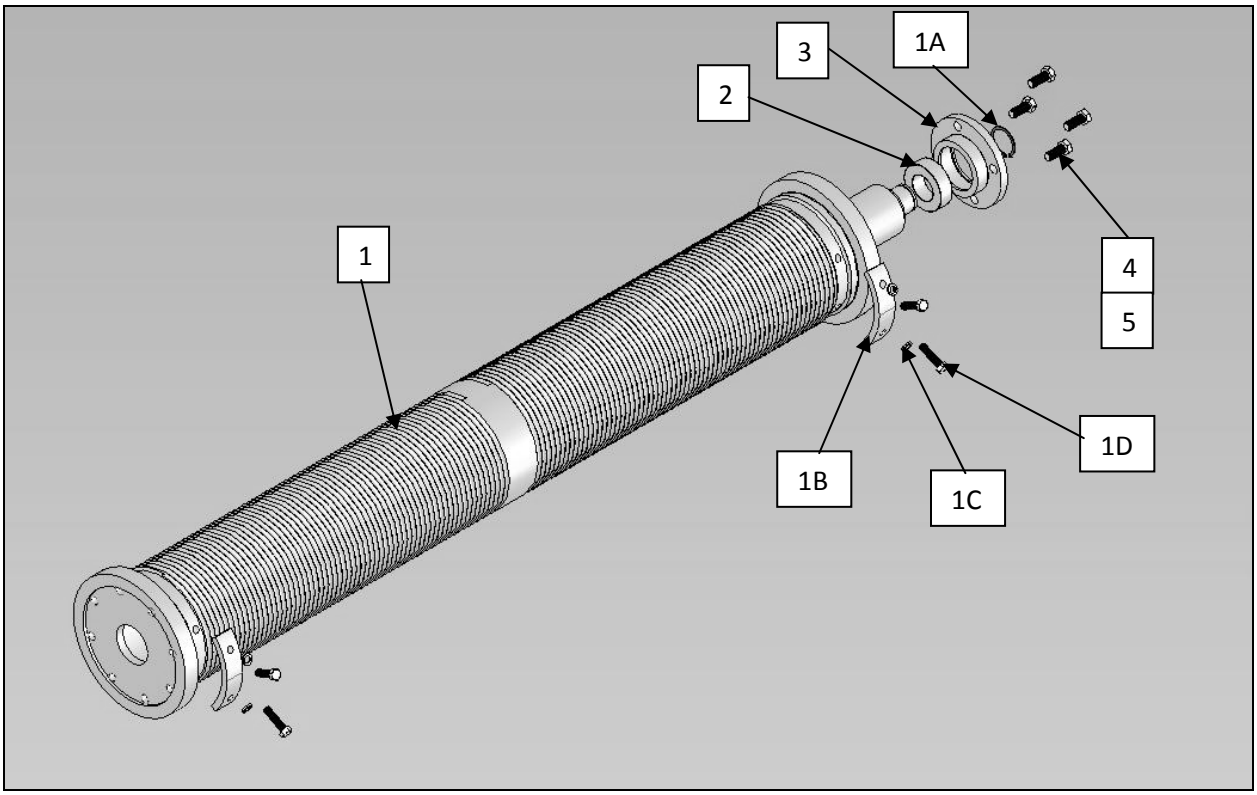
FIG. 4, HOIST DRUM ASSEMBLY UP TO 20 TON



ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	See chart below	Drum Assembly
1A	1	105077-00	RING, Snap
1B	2	100116-0000	CLAMP PLATE
1C	4	100612-00	WASHER, Lock, 1/2
1D	4	100408-00	BOLT, Hx Hd, 1/2–13 x 2” Lg
2	1	105657-00	BEARING
3	1	100976-0000	CAPSULE, Open
4	4	100614-00	WASHER, Lock, 5/8
5	4	100125-00	BOLT, Hx Hd, 5/8-11 x 1-1/2” Lg

ITEM	6’ Gage	8’ Gage	10’ Gage
1	200185-0000	200186-0000	200187-0000

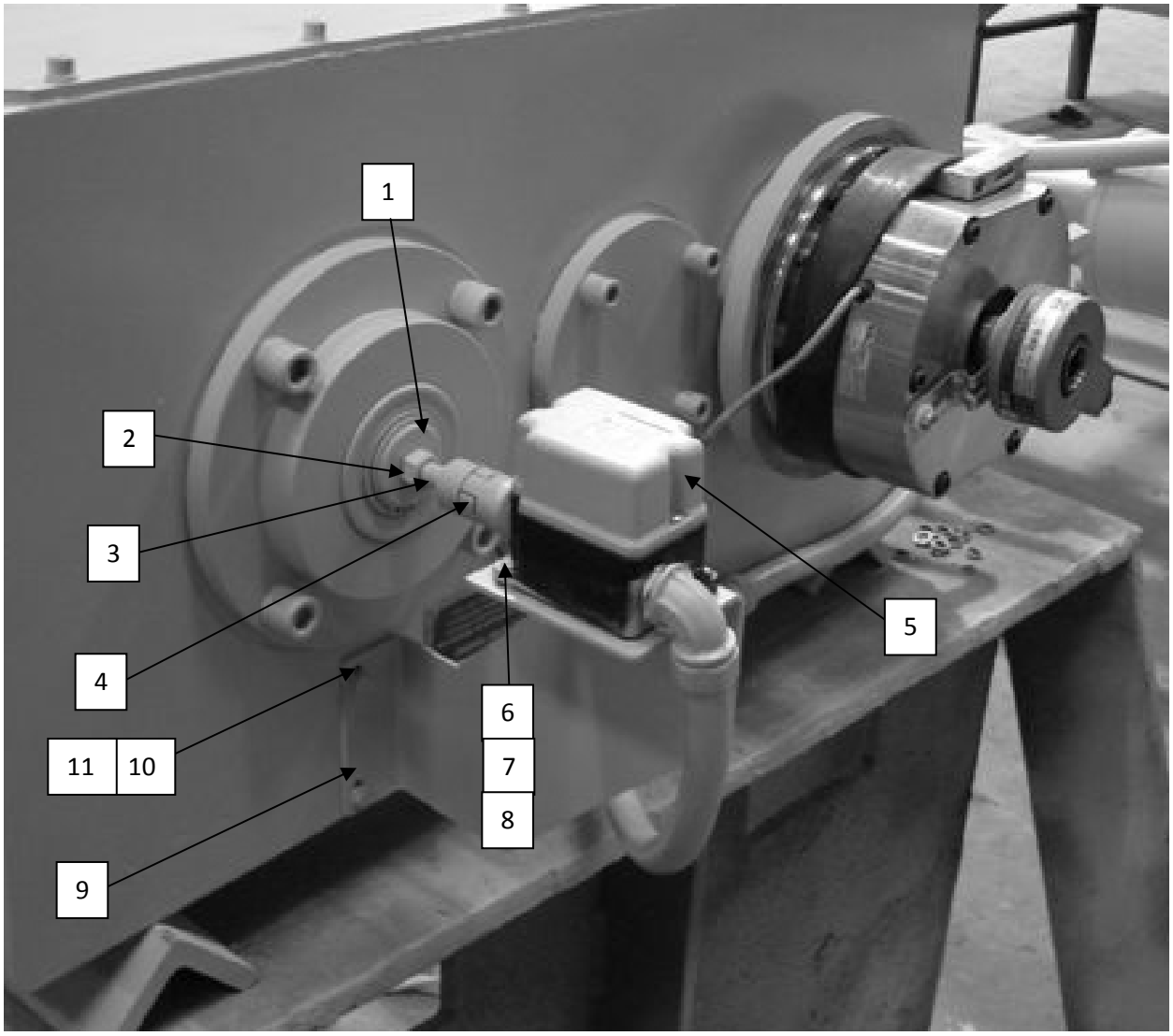
FIG. 4A, HOIST DRUM ASSEMBLY 25 TON



ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	See chart below	Drum Assembly
1A	1	105077-00	RING, Snap
1B	2	100116-0000	CLAMP PLATE
1C	4	100612-00	WASHER, Lock, 1/2
1D	4	100408-00	BOLT, Hx Hd, 1/2–13 x 2” Lg
2	1	105657-00	BEARING
3	1	100976-0000	CAPSULE, Open
4	4	100614-00	WASHER, Lock, 5/8
5	4	100125-00	BOLT, Hx Hd, 5/8-11 x 1-1/2” Lg

ITEM	6’ Gage	8’ Gage	10’ Gage
1	109321-0000	201139-0000	200205-0000

FIG. 5, GEAR LIMIT SWITCH INSTALLATION



ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	100627-00	FLATWASHER, 1/2
2	1	104354-00	NUT, Hx Hd, 1/2-20
3	1		STUD, 1/2 x 2 1/4 Lg
4	1	100026-00	COUPLING, Lovjoy, Half, 1/2" ID
4A	1	106233-00	COUPLING, Lovjoy, Half
4B	1	100722-00	COUPLING, Bushing
5	1	106218-0000	SWITCH, Limit
6	2	102416-00	SCREW, #12-24 x 2” Lg.
7	2	101737-00	LOCKWASHER, #12
8	2	104570-00	NUT, Hx, #12-24
9	1	106221-00	MOUNT BRACKET, Gear Switch
10	2	100007-00	BOLT, Hx Hd., 1/4-20 x 3/4 Lg.
11	2	100609-00	LOCKWASHER, 1/4

LEESON

ELECTRIC MOTORS
GEARMOTORS AND DRIVES

Motor Trouble-Shooting Chart

Caution:
1. Disconnect power to the motor before performing service or maintenance.
2. Discharge all capacitors before servicing motor.
3. Always keep hands and clothing away from moving parts.
4. Be sure required safety guards are in place before starting equipment.

Problem:	Like Causes:	What To Do:
Motor fails to start upon initial installation.	Motor is miswired.	Verify motor is wired correctly.
	Motor damaged and rotor is striking stator.	May be able to reassemble; otherwise, motor should be replaced.
	Fan guard bent and contacting fan.	Replace fan guard.
Motor has been running, then fails to start.	Fuse or circuit breaker tripped.	Replace fuse or reset the breaker.
	Stator is shorted or went to ground. Motor will make a humming noise and the circuit breaker or fuse will trip.	Disassemble motor and inspect windings and internal connections. A blown stator will show a burn mark. Motor must be replaced or the stator rewound.
	Motor overloaded or load jammed.	Inspect to see that the load is free. Verify amp draw of motor versus nameplate rating.
	Capacitor (on single phase motor) may have failed.	First discharge capacitor. To check capacitor, set volt-ohm meter to RX100 scale and touch its probes to capacitor terminals. If capacitor is OK, needle will jump to zero ohms, and drift back to high. Steady zero ohms indicates a short circuit; steady high ohms indicates an open circuit.
	Starting switch has failed.	Disassemble motor and inspect both the centrifugal and stationary switches. The weights of the centrifugal switch should move in and out freely. Make sure that the switch is not loose on the shaft. Inspect contacts and connections on the stationary switch. Replace switch if the contacts are burned or pitted.
Motor runs but dies down.	Voltage drop.	If voltage is less than 10% of the motor's rating contact power company or check if some other equipment is taking power away from the motor.
	Load increased.	Verify the load has not changed. Verify equipment hasn't got tighter. If fan application verify the air flow hasn't changed.
Motor takes too long to accelerate.	Defective capacitor	Test capacitor per previous instructions.
	Faulty stationary switch.	Inspect switch contacts and connections. Verify that switch reeds have some spring in them.
	Bad bearings.	Noisy or rough feeling bearings should be replaced.
	Voltage too low.	Make sure that the voltage is within 10% of the motor's name-plate rating. If not, contact power company or check if some other equipment is taking power away from the motor.
Motor runs in the wrong direction.	Incorrect wiring.	Rewire motor according to wiring schematic provided.
Motor overload protector continually trips.	Load too high.	Verify that the load is not jammed. If motor is a replacement, verify that the rating is the same as the old motor. If previous motor was a special design, a stock motor may not be able to duplicate the performance. Remove the load from the motor and inspect the amp draw of the motor unloaded. It should be less than the full load rating stamped on the nameplate.
	Ambient temperature too high.	Verify that the motor is getting enough air for proper cooling. Most motors are designed to run in an ambient temperature of less than 40°C. (Note: A properly operating motor may be hot to the touch.)
	Protector may be defective.	Replace the motor's protector with a new one of the same rating.
	Winding shorted or grounded.	Inspect stator for defects, or loose or cut wires that may cause it to go to ground.

Motor Trouble-Shooting Chart

10/13/00 (continued)

Problem:	Like Causes:	What To Do:
Motor vibrates.	Motor misaligned to load.	Realign load.
	Load out of balance. (Direct drive application.)	Remove motor from load and inspect motor by itself. Verify that motor shaft is not bent. Rule of thumb is .001" runout per every inch of shaft length.
	Motor bearings defective.	Test motor by itself. If bearings are bad, you will hear noise or feel roughness. Replace bearings. Add oil if a sleeve of bearing. Add grease if bearings have grease fittings.
	Rotor out of balance.	Inspect motor by itself with no load attached. If it feels rough and vibrates but the bearings are good, it may be that the rotor was improperly balanced at the factory. Rotor must be replaced or rebalanced.
	Motor may have too much endplay.	With the motor disconnected from power turned shaft. It should move but with some resistance. If the shaft moves in and out too freely, this may indicate a preload problem and the bearings may need additional shimming.
	Winding may be defective.	Test winding for shorted or open circuits. The amps may also be high. Replace motor or have stator rewound.
Bearings continuously fail.	Load to motor may be excessive or unbalanced.	Besides checking load, also inspect drive belt tension to ensure it's not too tight may be too high. An unbalanced load will also cause the bearings to fail.
	High ambient temperature.	If the motor is used in a high ambient, a different type of bearing grease may be required. You may need to consult the factory or a bearing distributor.
The motor, at start up, makes a loud rubbing or grinding noise.	Rotor may be striking stator.	Ensure that motor was not damaged in shipment. Frame damage may not be repairable. If you cannot see physical damage, inspect the motor's rotor and stator for strike marks. If signs of rubbing are present, the motor should be replaced. Sometimes simply disassembling and reassembling motor eliminates rubbing. Endbells are also sometimes knocked out of alignment during transportation.
Start capacitors continuously fail.	The motor is not coming up to speed quickly enough.	Motor may not be sized properly. Verify how long the motor takes to come up to speed, Most single phase capacitor start motors should come up to speed within three seconds. Otherwise the capacitors may fail.
	The motor is being cycled too frequently.	Verify duty cycle. Capacitor manufacturers recommend no more than 20, three-second starts per hour. Install capacitor with higher voltage rating, or add bleed resistor to the capacitor.
	Voltage to motor is too low.	Verify that voltage to the motor is within 10% of the nameplate value. If the motor is rated 208-230V, the deviation must be calculated from 230V.
	Starting switch may be defective, preventing the motor from coming out of start winding.	Replace switch.
Run capacitor fail.	Ambient temperature too high.	Verify that ambient does not exceed motor's nameplate value.
	Possible power surge to motor, caused by lightning strike or other high transient voltage.	If a common problem, install surge protector.

Lubrication Instructions For Ball Bearing Motors

Lubrication
This motor is supplied with pre-lubrication ball bearings. No lubrication required before start up.

Relubrication Intervals
The following intervals are suggested as a guide:

SUGGESTED RELUBRICATION INTERVALS		
HOURS OF SERVICE PER YEAR	H.P. RANGE	RELUBE INTERVAL
5,000	Sub Fractional to 7 1/2 10 to 40 50-200	5 Years 3 Years 1 Year
Continuous Normal Applications	Sub Fractional to 7 1/2 10 to 40 50 to 200	2 Years 1 Year 9 Months
Season Service Motor Idle 6 Months or More	All	1 Year (Beginning of Season)
Continuous High Ambients Dirty or Moist Locations High Vibrations Where Shaft End is Hot (Pumps-Fans)	Sub Fractional to 40 50 to 200	6 Months 3 Months

Lubrication

Use high quality ball bearing lubricant. Use consistency of lubricant suitable for class of insulation stamped on nameplate as follows:

LUBRICATION CONSISTENCY				
INSULATION CLASS	CONSISTENCY	TYPE	TYPICAL LUBRICATION	FRAME TYPE
B & F F & H	Medium	Polyurea	Shell Dolium R and/or Chevron SR1 2	Sub Fractional to 447T All

Procedure

If motor is equipped with Alemite fitting, clean tip of fitting and apply grease gun. Use 1 to 2 full strokes on motors in NEMA 215T frame and smaller. Use 2 to 3 strokes on NEMA 254T thru NEMA 365 T frame. Use 3 to 4 strokes on NEMA 404T frames and larger. On motors having drain plugs, remove drain plug and operate motor for 20 minutes before replacing drain plug.

On motors equipped with slotted head grease screw, remove screw and apply grease tube to hole. Insert 2 to 3 inch length of grease string into each hole on motors in NEMA 215T frame and smaller. Insert 3 to 5 inch length on larger motors. For motors having drain plug and operate motor for 20 minutes before replacing drain plug.

CAUTION: Keep lubricant clean. Lubricate motors at standstill. remove and replace drain plugs at standstill. Do not mix petroleum lubricant and silicone lubricant in motor bearings.

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ELECTRIC MOTORS, GEARMOTORS AND DRIVES

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Installation Maintenance Instructions
AC Induction Motors

Installation

After unpacking, check for damage. Be sure that shaft rotates freely. Before making electrical power connections, check for proper grounding of motor and application. All electrical contacts and connections must be properly insulated and enclosed. Couplings, belts, chains or other mounted devices must be in proper alignment, balance and secure to insure safe motor operation.

Electrical Wiring

Prior to connecting to the power line, check nameplate for proper voltage and rotation connection. This motor should be installed in compliance with the National Electrical Code and any other applicable codes. Voltage at motor not to exceed + or -10% of nameplate. Authorized person should make all electrical connections.

Mounting

This motor should be securely mounted to the application. Sufficient ventilation area should be provided to insure proper operation.

RECOMMENDED COPPER WIRE & TRANSFORMER SIZE

SINGLE PHASE MOTORS - 230 VOLTS

H.P.	TRANSFORMER KVA	DISTANCE - MOTOR TO TRANSF. IN FT.				
		100	150	200	300	500
1 1/2	3	10	8	8	6	4
2	3	10	8	8	6	4
3	5	8	8	6	4	2
5	7 1/2	6	4	4	2	0
7 1/2	10	6	4	3	1	0

THREE PHASE MOTORS - 230 & 460 VOLTS

H.P.	VOLTS	TRANSFORMER KVA	DISTANCE - MOTOR TO TRANSF. IN FT.				
			100	150	200	300	500
1 1/2	230	3	12	12	12	12	10
1 1/2	460	3	12	12	12	12	12
2	230	3	12	12	12	10	8
2	460	3	12	12	12	12	12
3	230	5	12	10	10	8	6
3	460	5	12	12	12	12	10
5	230	7	10	8	8	6	4
5	460	1/2	12	12	12	10	8
7 1/2	230	7 1/2	8	6	6	4	2
7 1/2	460	10	12	12	12	10	8
10	230	10	6	4	4	4	1
10	460	15	12	12	12	10	8
15	230	15	4	4	4	2	0
15	460	20	12	10	10	8	6
20	230	20	4	2	2	1	000
20	460		10	8	8	6	4
25	230		2	2	2	0	000
25	460	Consult	8	8	6	6	4
30	230	Local	2	1	1	00	0000
30	460	Power	8	6	6	4	2
40	230	Company	1	0	00	0000	300
40	460		6	6	4	2	0
50	230		1	0	00	0000	300
50	460		4	4	2	2	0
60	230		1	00	000	250	500
60	460		4	2	2	0	00
75	230		0	000	0000	300	500
75	460		4	2	0	00	000

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Technical Specifications

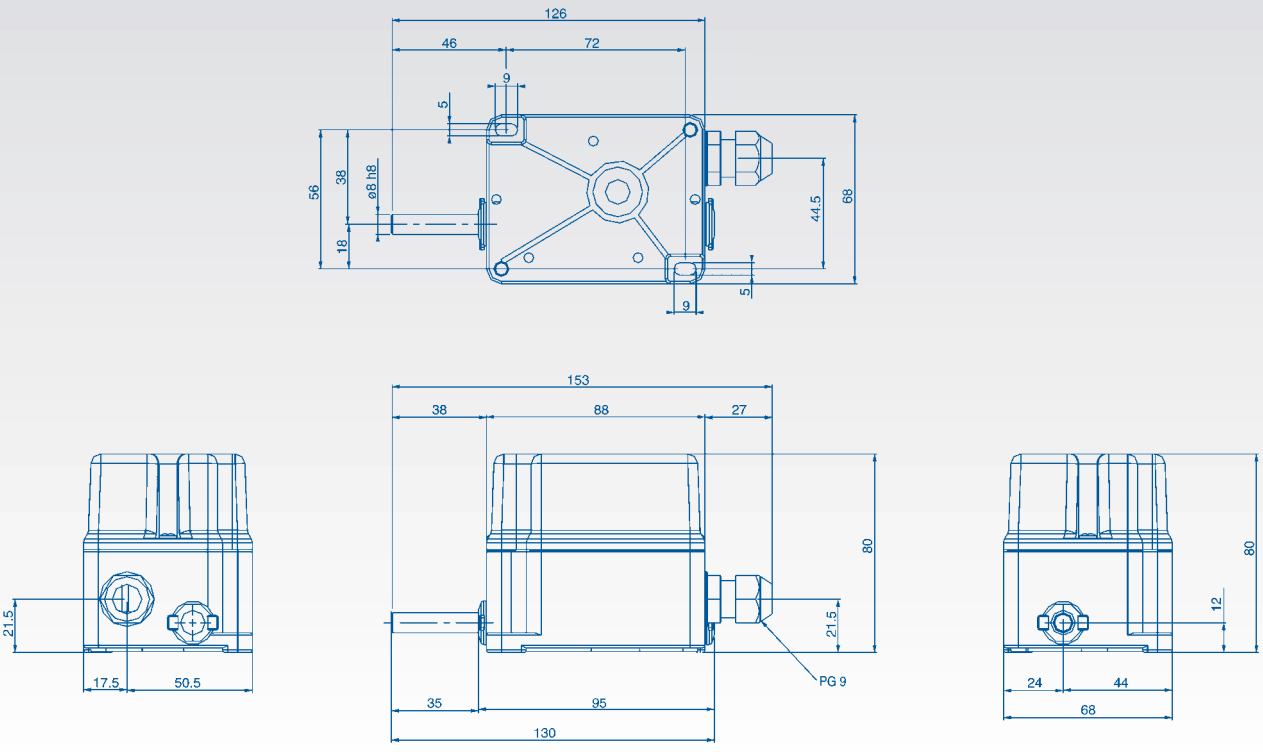
Conformity to Community Directives	73/23/CEE	93/68/CEE
Conformity to Standards	EN 60204-1	EN60947-1 EN 60947-5-1
	EN 60529	EN 50013 IEC 536
Ambient temperature	Storage	-40 °C / +70 °C
	Operational	-25 °C / +70 °C
Protection degree	IP 65	
Insulation category	Class II	
Cable entry	Cable clamp PG 9	
Homologations	CE - UL - (c)UL*	

**UL – (c) UL limit switches available on request.*

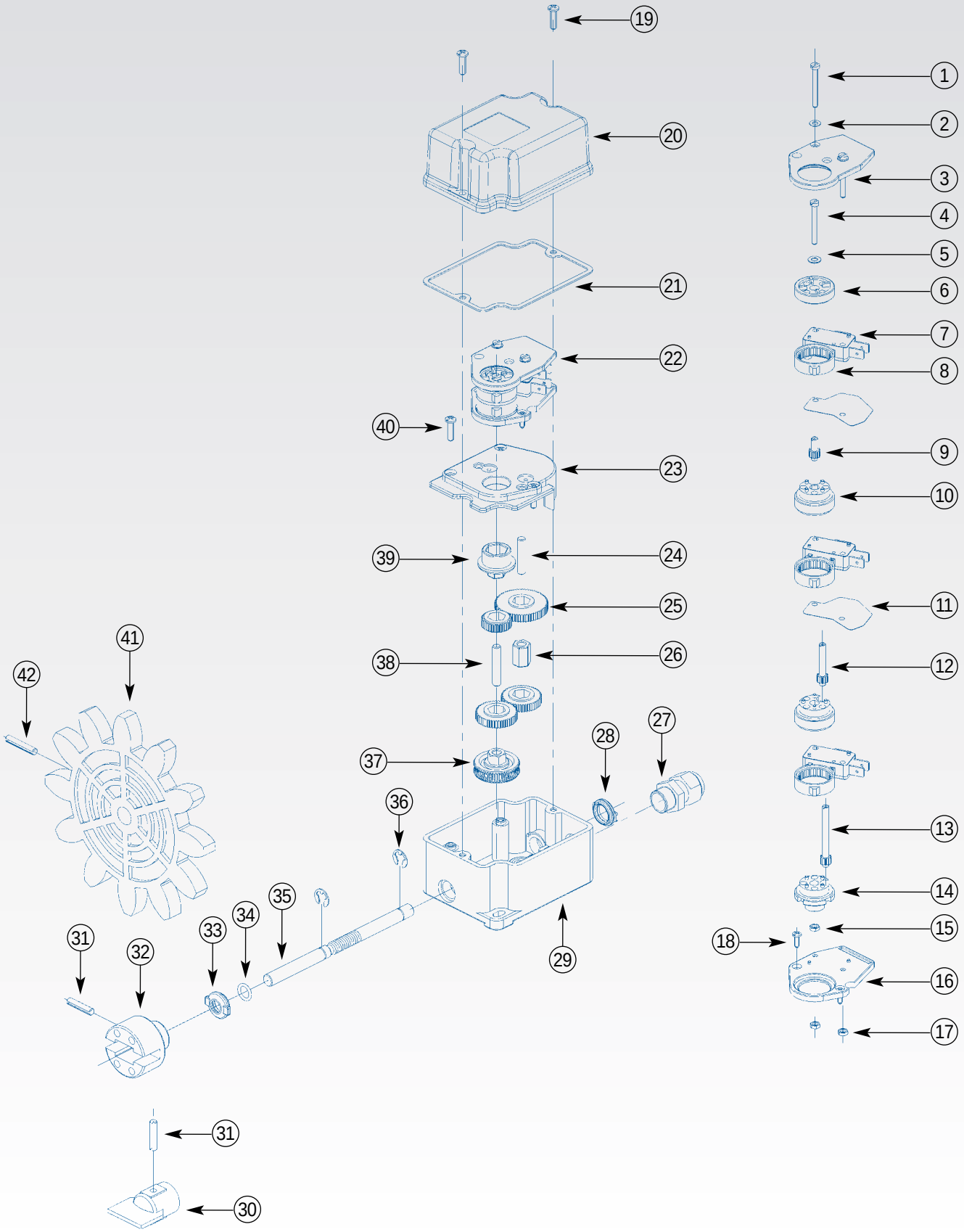
Technical Specifications of the Switches

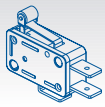
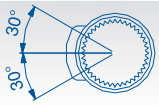
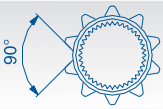
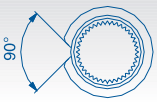
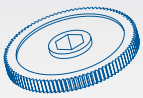
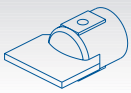
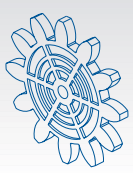
Utilisation category	AC 15
Rated operational current	3 A
Rated operational voltage	250 V
Rated thermal current	10 A
Rated insulation voltage	300 V ~
Mechanical life	1 x 10^6 operations
Terminal referencing	According to EN 50013
Connections	6.3 mm Faston taps
Homologations	CE - UL - (c)UL

Overall Dimensions



Detailed Drawing



	Drawing	Code	Description
7		PRSL0040XX	Snap action switch
8		PRSL7140PI	Pointed cam
		PRSL7141PI	Sector cam
		PRSL7142PI	10 point cam
		PRSL7143PI	Circular cam
		PRSL7144PI	180° cam
25		PRSL6600PI PRSL6601PI PRSL6602PI PRSL6603PI PRSL6604PI PRSL6605PI PRSL6606PI PRSL6607PI PRSL6608PI PRSL6609PI PRSL6611PI PRSL6612PI PRSL6613PI PRSL6614PI PRSL6615PI	Lateral gear wheel Z 36 Lateral gear wheel Z 38 Lateral gear wheel Z 40 Lateral gear wheel Z 42 Lateral gear wheel Z 44 Lateral gear wheel Z 46 Lateral gear wheel Z 48 Lateral gear wheel Z 50 Lateral gear wheel Z 52 Lateral gear wheel Z 54 Lateral gear wheel Z 56 Lateral gear wheel Z 58 Lateral gear wheel Z 60 Lateral gear wheel Z 62 Lateral gear wheel Z 64
30		PRSL0919PI	Male coupling + pin (31)
32		PRSL0920PI	Female coupling + pin (31)
35		PRTO0063PE	Single-thread worm shaft
		PRTO0075PE	Flexible shaft
37		PRSL6701PI	Central gear wheel Z 50
41		PRSL0911PI PRSL0912PI PRSL0913PI PRSL0914PI PRSL0915PI PRSL0916PI PRSL0917PI PRSL0918PI	Pinion gear M10 Z12 + pin (42) Pinion gear M12 Z10 + pin (42) Pinion gear M14 Z10 + pin (42) Pinion gear M16 Z10 + pin (42) Pinion gear M20 Z8 + pin (42) Pinion gear M5 Z12 + pin (42) Pinion gear M6 Z11 + pin (42) Pinion gear M8 Z12 + pin (42)

Standard Limit Switches

REVOLUTION RATIO	CODE	
	2 switches	3 switches
1:15	PF0901 0015 0003	PF0901 0015 0004
1:25	PF0901 0025 0005	PF0901 0025 0006
1:50	PF0901 0050 0005	PF0901 0050 0012
1:75	PF0901 0075 0004	PF0901 0075 0005
1:100	PF0901 0100 0005	PF0901 0100 0007
1:150	PF0901 0150 0003	PF0901 0150 0004

Standard limit switches are equipped with 2 or 3 snap action switches and with pointed cams PRSL7140PI. Other patterns and revolution ratios are available on request. Maximum revolution ratio 1:150.

Use and Maintenance Instructions

The MF2C rotary limit switch is an electromechanical device for low voltage control circuits (EN 60947-1, EN 60947-5-1) to be used as electrical equipment on machines (EN 60204-1) in compliance with the fundamental requirements of the Low Voltage Directive 73/23/CEE and of the Machine Directive 89/392/CEE.

The limit switch is designed for industrial use and also for use under particularly severe climatic conditions (operational temperature from –25 °C to +70 °C, suitable for use in tropical environment). The equipment is not suitable for use in environments with potentially explosive atmosphere, corrosive agents or a high percentage of sodium chloride (saline fog). Oils, acids or solvents may damage the equipment. Use the fixing holes on the base (29) to mount the limit switch. The use of special couplings (30, 32), flexible shafts or special driving systems (not supplied) are recommended for eliminating any misalignment between the limit switch shaft (35) and the reduction gear shaft to which it is connected. After loosening the central screw (04) use the screws (09, 12, 13) to adjust the operating point of the cams (08); once the cams are adjusted, tighten the central screw (04).

The switches (07) are designed for auxiliary control of contactors or electromagnetic loads (utilisation category AC-15 according to EN 60947-5-1). The switches (07) have positive opening operation contacts (EN 60947-5-1). Do not connect more than one phase to each switch (07). Do not oil or grease the control elements (08) or the switches (07). For easy wiring, the set of cams-switches (22) may be removed by loosening the screws (18) on the lower fixing plate; do not loosen the screws on the upper part of the set of cams-switches (01) in order not to take apart the switches; after wiring is completed, the set of cams-switches (22) must be properly fixed and screwed, paying attention to the coupling of the hexagonal plastic bushes (14, 39).

The installation of the limit switch shall be carried out by an expert and trained personnel. Wiring shall be properly done according to the current instructions.

Prior to the installation and the maintenance of the limit switch, the main power of the machinery shall be turned off.

Steps for the proper installation of the limit switch

- loosen the fixing screw (19) and remove the cover (20)
- connect the limit switch shaft (35) to the reduction gear shaft; to avoid any misalignment between the two shafts the use of couplings (30, 32), flexible shafts or special driving systems is recommended
- fix the limit switch firmly in place to prevent abnormal vibrations of the equipment during operation; use only the fixing holes on the base (29) to fix the equipment
- insert the cable into the limit switch through the cable clamp (27)
- strip the cable to a length suitable for wiring the switches (07)
- tape the stripped part of the cable
- clamp the wire into the cable clamp (27)
- connect all the switches (07) according to the contact scheme printed on the switches (use 6.3 mm Faston taps)
- adjust the operating point of the cams (08); for proper adjustment, loosen the central screw (04) of the cam set, adjust the operating point of each single cam (08) by turning its screw (09, 12, 13) (the numbers on the screws refer to the cams counting from bottom to top), then tighten the central screw (04)
- close the limit switch checking the proper positioning of the rubber (21) in the cover (20)

Periodic maintenance steps

- check the proper tightening of the screws (19) and cover (20)
- check the proper tightening of the central screw (04) holding the cams
- check the wiring conditions (in particular where wires clamp into the switch)
- check the proper positioning of the front (33) and rear (28) bush covers
- check the conditions of the rubber (21) fit between the cover (20) and the base (29) and check the tightening of the cable clamp (27) around the cable
- check that the limit switch enclosure (20, 29) is not broken
- check the alignment between the limit switch shaft (35) and the reduction gear shaft
- check that the limit switch is properly fixed

In case any component of the limit switch is modified, the validity of the markings and the guarantee on the equipment are annulled. Should any component need replacement, use original spare parts only.

TER declines all responsibility for damages caused by the improper use or installation of the equipment.

Request form for non standard limit switches

Cams

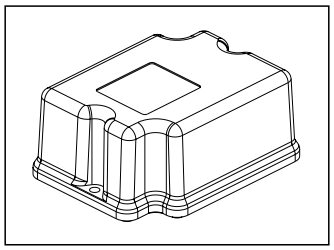
1	PRSL7140PI
2	PRSL7141PI
3	PRSL7142PI
4	PRSL7143PI
5	PRSL7144PI

Pinion gears

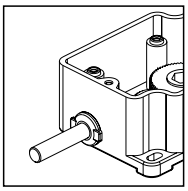
1	PRSL0911PI	M10	Z12
2	PRSL0912PI	M12	Z10
3	PRSL0913PI	M14	Z10
4	PRSL0914PI	M16	Z10
5	PRSL0915PI	M20	Z8
6	PRSL0916PI	M5	Z12
7	PRSL0917PI	M6	Z11
8	PRSL0918PI	M8	Z12

Instructions

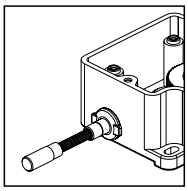
- Mark the box corresponding to the components required.
- Write the number corresponding to the **cams** required and to the **pinion gear** when required.
- Write the **revolution ratio** required.



Cover ☐

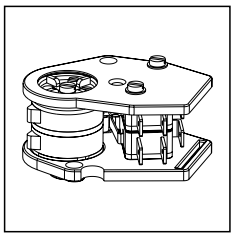


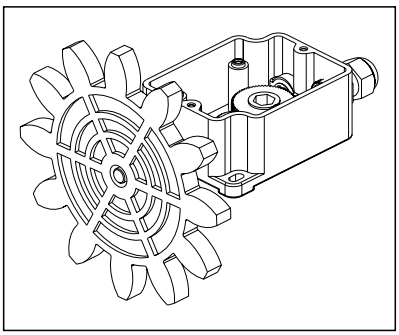
Standard shaft ☐



Flexible shaft ☐

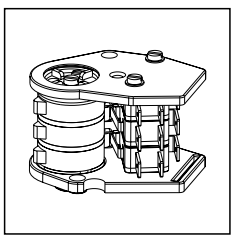
Cams ☐ ☐

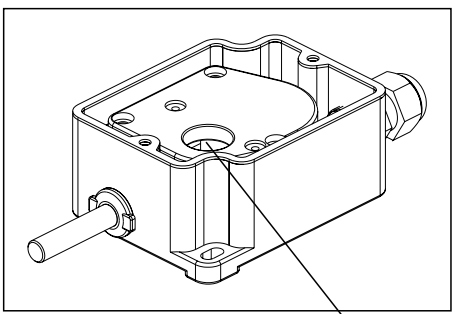




Pinion gear ☐

Cams ☐ ☐ ☐

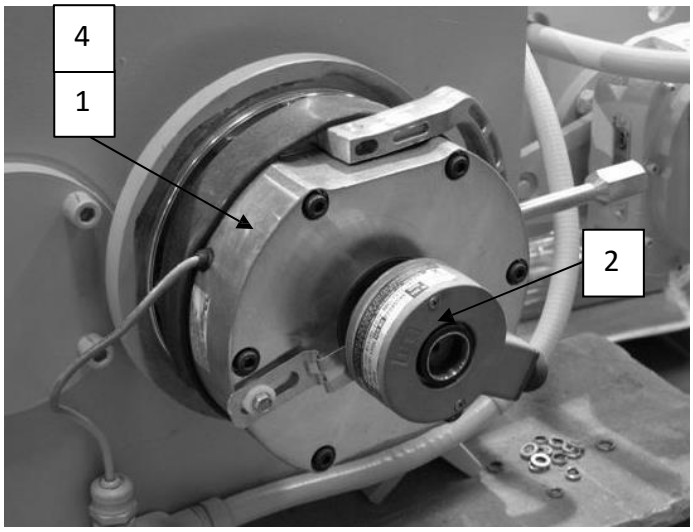


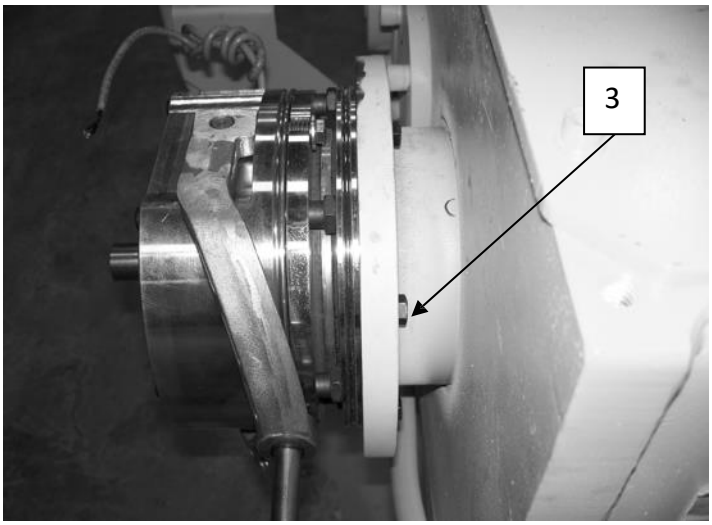


Revolution ratio _____

Remarks_____

FIGURE 6, HOIST BRAKE & ENCODER INSTALLATION T30





ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	202317-00	Hoist Brake Installation
2	1	717338-00	Encoder
3	6	105396-00	BOLT, Hx Hd, 3/8-16 x 1-1/4” Lg
4	1	100974-0000	Spacer

SERVICE MANUAL
FOR
ELECTRO-SHEAR MOTOR BRAKE
MODEL 8725-042/043
(8725-042 - STANDARD SHAFT LENGTHS)
(8725-043 - SPECIAL THRU SHAFT APPLICATION)

APPENDIX

I SPECIFICATIONS

Serial Number(s): _____

Thru: _____

Sold To: _____

_____

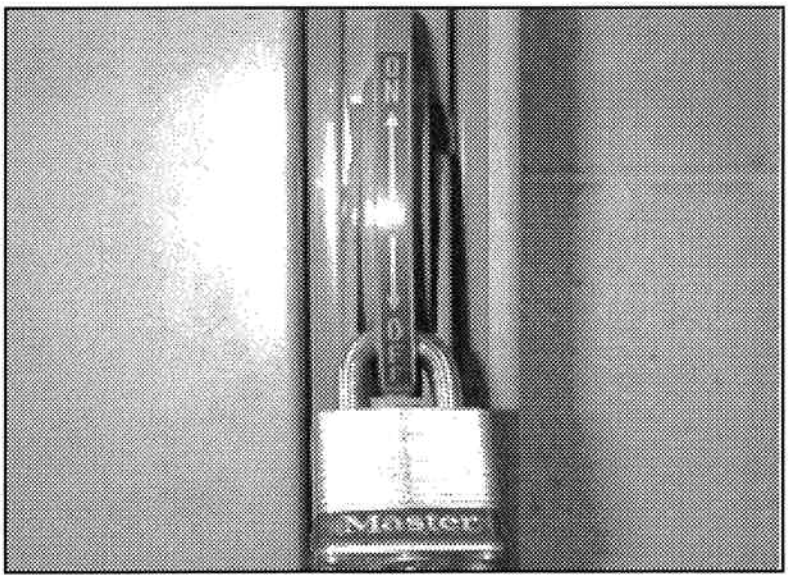
_____

Date: _____

MOTOR BRAKE APPLICATION

Coil Voltage: 460 VAC, 3 phase

CAUTION: 460 VOLTS, ALWAYS USE PROPER ELECTRICAL LOCKOUT PROCEDURES PRIOR TO ANY REPAIR OR INSTALLATION.



II DESCRIPTION AND OPERATION

ELECTRO-SHEAR Motor Brakes are spring-applied, electrically-released multiple disc "oil-shear" brakes. The brake disc stack is immersed in a bath of oil, totally enclosed against moisture or contamination. Braking torque is transmitted between the adjacent paper and steel discs through the shearing of the oil film between them until stopping speed is achieved.

Model 8725-042/043 units are designed as motor brakes. Referring to drawing 8725-101/102, the brake hub is mounted to the motor shaft. The brake friction discs (8725-220) are spline mounted to the hub. The main housing (8725-500) is fastened to the mounting flange of the motor frame. The brake drive discs (8725-221) are keyed to dowel pins mounted in the stationary main housing.

Brake force is provided by six (6) brake springs (1010-238, 1010-239 or combination of) interposed between brake actuator (8725-502) and the coil housing (8725-501). Brake release force is provided by the coil mounted in the coil housing, acting upon the pole piece mounted in the actuator. The brake torque can be varied to suit the requirements, by rearranging the disc stack (see drawing 8725-009, 8725-034 or 8725-036 depending upon torque requirements).

In its normal state, the brake disc stack is clamped between actuator (8725-502) and main housing (8725-500); the brake hub is "grounded" to the stationary main housing. When the motor is energized, the brake coil in the coil housing is simultaneously energized. The coil draws the pole piece, in the actuator, which moves the actuator away from the disc stack, unclamping the disc stack.

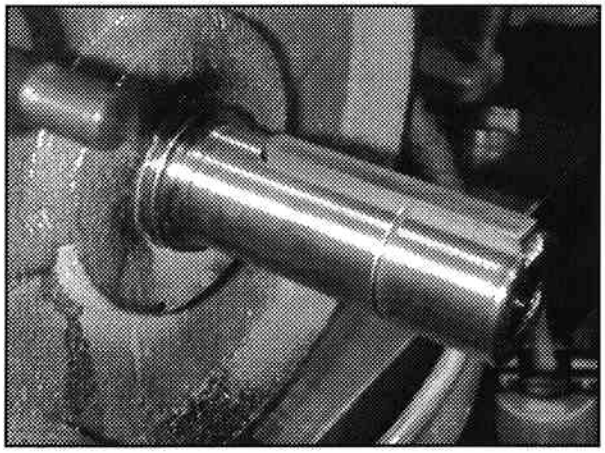
A manual brake release is provided for ease of installation and machine set-up. Rotate manual release levers to release brake as shown on drawing (8725-101/102).

III INSTALLATION

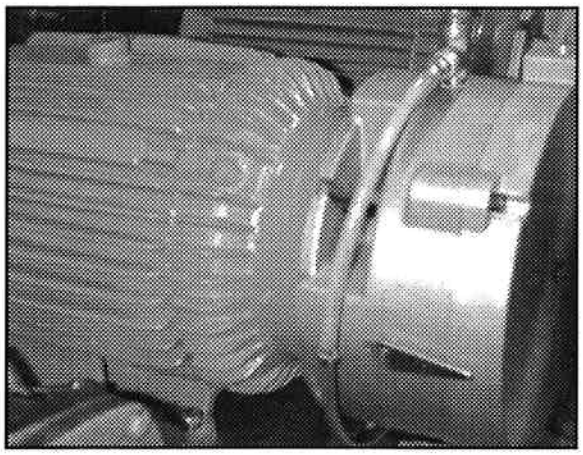
Referring to drawing 8725-101, follow the installation procedure as outlined below:
Use Proper Electrical Lockout prior to Installation or repair.

Step 1 - Disconnect and remove the present motor brake.

Step 2 - Fit a full length key to the hub and motor shaft; install the key into the motor shaft.



STEP 2



STEP 4

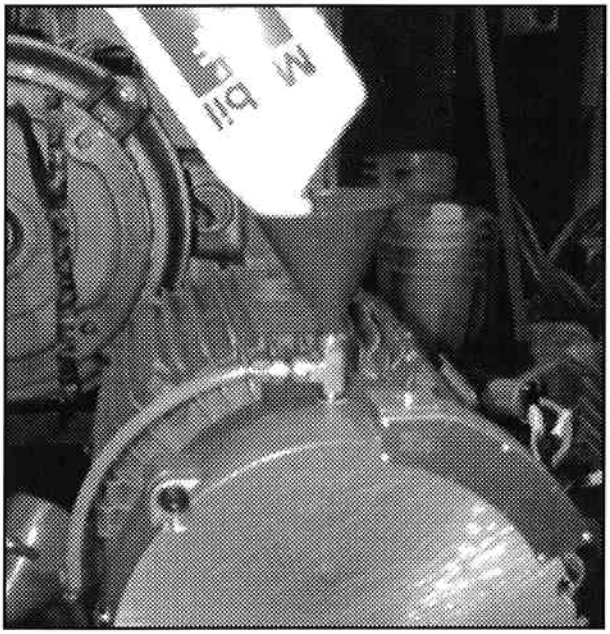
Step 3 - Use proper rigging practice to lift brake; Engage the brake hub onto the motor shaft, (caution: brake weighs approx. 50 lbs.) then rotate the brake to align the two (2) mounting holes in the main housing with the tapped holes in the motor mounting face.

Step 4 - Slide the brake towards the mounting face and secure the brake in place, using two (2) 5/8-11 hex screws and washers (8725-214) supplied with brake. (torque 5/8-11 screws to 105 ft-lbs.)

NOTE: THE BRAKE IS ASSEMBLED WITH THE ELECTRICAL CONNECTION NEAR THE TOP; HOWEVER, THE COIL HOUSING MAY BE ROTATED IN 120 DEGREE INCREMENTS TO RELOCATE THE ELECTRICAL CONNECTION AS DESIRED.

III INSTALLATION (cont.)

Step 5- Remove breather and fill the brake cavity with transmission fluid (Mobil ATF-210) to the mark (clamp) on plastic tube. (refer to level shown on drawing 8725-101); replace breather.



STEP 5

STEP 6

Step 6- With suitable inclosure, connect the electrical leads to a 460 volt/ 3 phase/ 60 cycle power source.

WARNING: DO NOT ENERGIZE BRAKE WITH COIL HOUSING REMOVED. COIL MAY BE DAMAGED, VOIDING WARRANTY.

IV TROUBLESHOOTING

A. Leaks oil through breather:

1. Oil level... may be overfilled.

B. Brake fails to engage:

1. Manual brake release engaged.
2. Brake springs broken.
3. Loss of disengage signal to coil.

C. Brake fails to release:

1. Improper electrical connection. (brake will not function single phase)
2. Foreign matter between coil and actuator.
3. Fuse blown. (if installed)
4. Improper spring used.
5. No energization power.
6. Excessive air gap. (requires replacement of plate stack)
7. Defective coil.
8. Unit ran without oil, causing seizure of disc stack.

D. Oil leakage:

1. Faulty seal between hub and main housing.
2. Faulty O-ring between main housing and coil housing.
3. Faulty O-ring in manual brake releases.
4. Pipe plug loose.
5. Sight gage loose.

V MAINTENANCE

Check oil level every month and change oil three (3) months after start up of an installation or repair. Change oil every six months there after.

Use Mobil ATF-210 automatic transmission fluid or equivalent.

Repipe plastic tube (sight gauge) after draining transmission fluid and fill unit based on levels shown on drawing 8725-045, 046 & 047.

To change the fluid, follow the procedure on the Single point lesson MWB101. (next page.)

Proper oil level for horizontal mount

*Fluid level in picture above is correct for standard motor RPM's. Please see the following page of correspondence for correct fluid levels of motors operating at higher than normal RPM's (2700-3600 RPM's).

Friction Products & Power Transmissions for Industry

April 26, 2011

Ace World Companies
10200 Jacksboro Hwy
Fort Worth, TX 76135

Subject: **Electro Shear Oil Levels for 2700 – 3600 RPM's**

AWC, thank you for your interest in oil level parameters in applications operating at higher rpm's than your standard 1800 RPM's. The operation of Electro Shear brakes incorporates the oil shear technology – which allows for shearing of the oil to generate torque , as well as the cooling and lubrication of discs , which allows any heat build up to dissipate through the cast aluminum housing.

The following has been the standard oil levels for the brakes we have furnished you, using your standard **1800 RPM's**:

Electro Shear Model 8725 w/ full disc stack: oil level is 1.5 " above the centerline.

Electro Shear Model 8727 w/ full disc stack: oil level is @ centerline.

Based upon our 'typical application history 'the following oil levels should be maintained when running **2700 – 3600 RPM's**:

Electro Shear Model 8725 w/ full disc stack: oil level should be @ 1.5 " below centerline.

Electro Shear Model 8727 w/ full disc stack: oil level should be @ 1.5 " below centerline.

Electro Shear Brake temperatures are a key measuring point of operation: Temperatures should not exceed 200 degrees F; with an optimum high temperature of 180 degrees F.

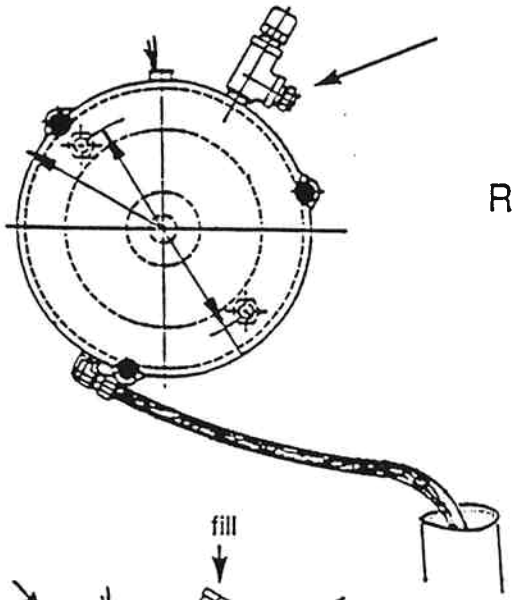
Cordially,
Midwest Brake

26255 Groesbeck Highway • Warren Michigan 48089
586 775-3000 • Fax: 586 775-3040 • www.midwestbrake.com • sales@midwestbrake.com

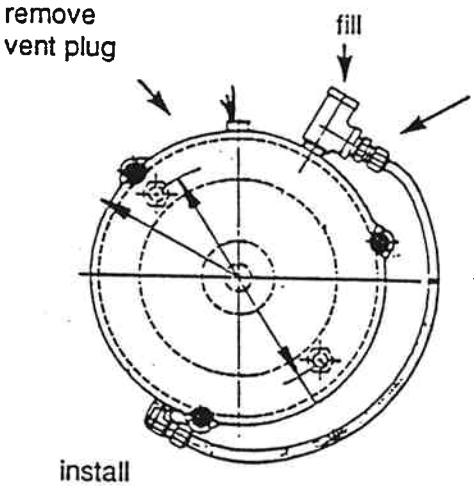
Single Point Lesson No. MWB101

Topic: Electro-Shear Maintenance (Horizontal Shown)

Check oil level every month and change oil three (3) months after start up of an installation or repair. Change oil every six (6) months there after.

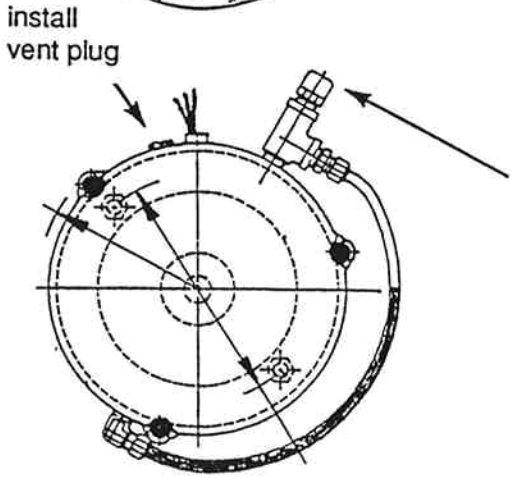


Remove plastic tubing at upper end to drain oil.



Re-attach plastic tube, tighten securely. Remove breather and vent plug, fill brake cavity with transmission fluid (Mobil ATF-210) or equivalent.

* Fill to centerline of unit or to mark (clamp) on plastic tube



Replace breather and vent plug using TEFLON tape on threads.

*incorrect fluid level. see the preceding page of correspondence.

VI DISASSEMBLY (refer to drawing 8725-101/102)

CAUTION: BEFORE WORKING ON MACHINERY, FOLLOW THE PROPER LOCK-OUT PROCEDURE TO SHUT OFF ALL ELECTRICAL POWER.

1. Disconnect plastic tubing from upper end to drain oil from main housing; re-pipe plastic tube after draining unit.

2. Disconnect wiring, using proper lock-out procedures.

3. Unfasten two (2) 5/8-11 hex head screws and washers (8725-214) that fasten the main housing to the C-face of the motor.

4. Using proper rigging practices to lift, slide unit of motor shaft.
   CAUTION, UNIT IS HEAVY (APPROXIMATELY 50LBS); PLACE UNIT ON WORK BENCH WITH MAIN HOUSING (8725-500) MOUNTING FACE DOWN.

5. Remove three (3) 3/8-16 socket head screws that fasten the coil housing (8725-501) to the main housing (8725-500); remove coil housing.

6. Remove six (6) brake springs (1010-238 or 239) from coil housing spring pockets; remove O-ring (OR275) from pilot diameter of coil housing.

7. Remove actuator (8725-502) from main housing.

8. Remove disc stack (8725-1406-238) sample stack (68 ft.-lbs.) (intact) from the main housing; also removing plastic shim (8725-270), making a written note of the arrangement of the disc stack, for use at assembly. The disc stack (8725-1406-238) (including shim) is pre-measured to a specified thickness (1.238/1.243) and must be replaced as a complete set. ***NOTE: TO INCREASE BRAKE TORQUE STRONGER SPRINGS MUST BE USED AS SHOWN ON DRAWING 8725-034 & 8725-036 DUMMY DISCS (8725-265) MUST BE SUBSTITUTED FOR STEEL PLATES IN ORDER TO REDUCE BRAKE TORQUE RATINGS.***

9. Turn the main housing over and remove oil seal (OS396-V); remove retaining ring (RR385) from groove in main housing.

VI DISASSEMBLY (cont.)

10. Block up main housing with the mounting face down; press hub with bearing attached from the main housing.

11. Remove retaining ring (RR235) from groove in hub and press bearing from hub.

*** NOTE: UNLESS MANUAL RELEASES ARE INOPERABLE, DO NOT DISASSEMBLE.*

VII ASSEMBLY (refer to drawing 8725-101/102)

IMPORTANT: BE SURE THAT ALL PARTS ARE THOROUGHLY CLEANED BEFORE BEGINNING ASSEMBLY... O-RINGS AND OIL SEALS ARE ONLY AS GOOD AS THE SURFACES THEY CONTACT; BE SURE THERE ARE NO NICKS OR SHARP EDGES ON THE ENTRY CHAMFERS... USE ALL NEW "COMMERCIAL" PARTS TO ASSURE LONG LIFE OF THE REBUILT BRAKE. ASSEMBLY SHOULD TAKE PLACE IN A CLEAN, DUST-FREE ENVIRONMENT, USING PROPER TOOLS AND GOOD FITTING PRACTICE, REMEMBER, THIS IS A PRECISION DEVISE. WE RECOMMEND VASELINE OR PARKER "O" RING LUBE AS THE LUBRICATING AGENT FOR ASSEMBLIES.

1. Check condition of oil seal surface on hub; surface must be polished (free of scratches), apply Loctite "Bearing Mount" and press bearing (BE208.5) onto hub until snug against the shoulder; install retaining ring (RR235) into groove provided in hub. ***NOTE: WHEN INSTALLING RETAINING RING, USE CAUTION AS NOT TO SCRATCH SEAL SURFACE.***

2. Place main housing (8725-500) on work bench with mounting face up; press hub/bearing assembly into main housing until snug against the shoulder; install retaining ring (RR385) into groove provided in main housing.

3. Lubricate the seal surface of the hub; apply Loctite "Bearing Mount" to O.D. of oil seal (OS396-V) and press oil seal into main housing (8725-500) and onto hub seal surface; note proper oil seal orientation prior to installation. Be careful as not to turn lip seal over.

4. Turn main housing over, place on work bench with mounting face down.

5. Install the disc stack (8725-1406-238) (typical 64 ft.-lbs.) into the main housing and onto the splined portion of the hub, ***REBUILD THE STACK ACCORDING TO THE ARRANGEMENT NOTED DURING DISASSEMBLY;*** the disc stack (8725=1406-238) including plastic shim (8725-270) is pre-measured to a specified thickness (1.238/1.243) and must be replaced as a complete set; using eight (8) drive discs (8725-221) and seven (7) friction discs (8725-220), and one spacer (8725-270) in a manner that will achieve the required number of active surfaces to achieve desired torque as shown on drawings 8725-009, 8725-034 and 8725-036. Note: Dummy disc (8725-265) are used in place of steel disc to reduce torque.

VII ASSEMBLY (continued)

6. Install actuator (8725-502) into main housing; rotate actuator to engage four (4) dowel pin pockets in the actuator with the four (4) dowel pins in the main housing.

6a. 8724-043 only - [see 8725-102 Print] Install Oil Seal (OS503) in Coil Housing (8725-507) and lube.

7. Lube and install O-ring (OR275) onto the pilot diameter on coil housing (8725-501); lube face of six (6) brake springs (1010-238, 239 or combination) and install them into spring pockets of the coil housing;

8. Align the three (3) mounting holes in the coil housing with the tapped holes in the main housing; install three (3) 3/8-16 socket head screws with flat washers through the coil housing and into the tapped holes in the main housing; draw the screws down uniformly to compress the brake springs.

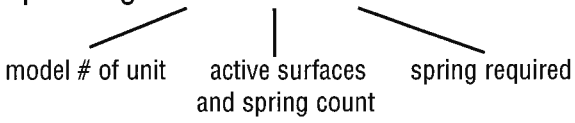
9. Reinstall plastic tube, tighten securely (if not done earlier). ***NOTE: TRANSMISSION OIL MUST BE ADDED DURING INSTALLATION PROCEDURE.***

10. To re-install the unit onto motor see section sectionion III. (page 3)

VIII PARTS LISTS

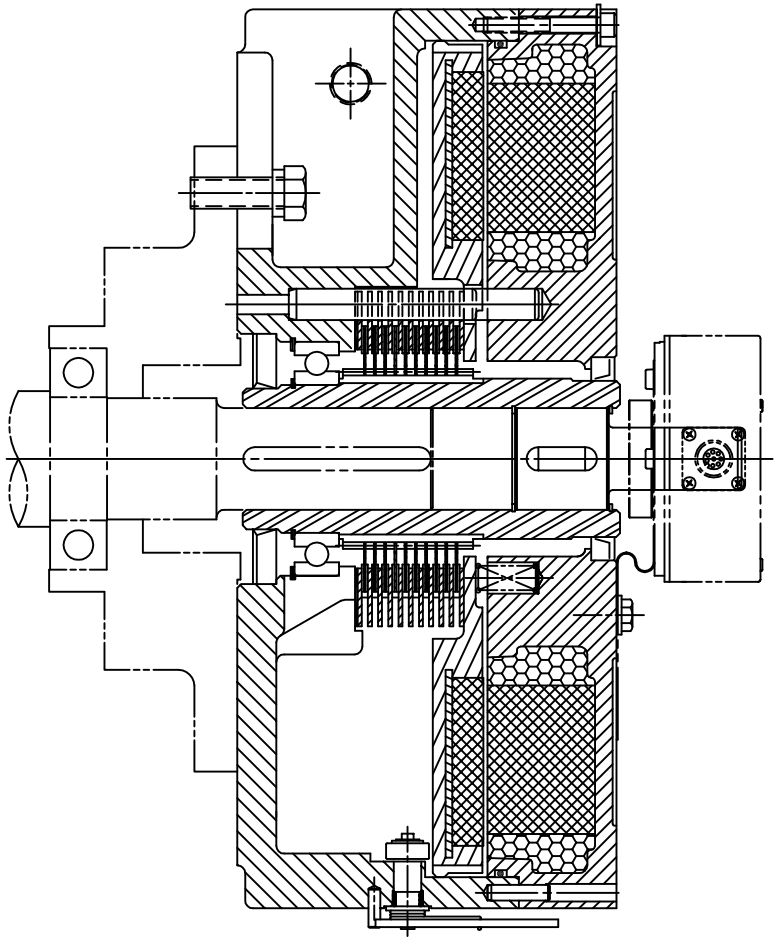
PARTS NUMBER	DESCRIPTION	QUANTITY
8725-214	Washer	2
8725-500-1	Main Housing	1
8725-501-1 (8725-042 Only)	Coil Housing	1
8725-507(8725-043 Only)	Coil Housing	1
8725-502	Actuator	1
8725-506	Cover	1
BE208.5	Bearing	1
BR012	Breather	1
CL005	Clamp	1
GA402	Gasket (for 8725-506)	1
OR275	O-ring	1
OS396-V	Oil Seal	1
OS503 (8725-043 Only)	Oil Seal	1
PT025	Plastic Tubing	22 In
PF245	Nipple	1
PF565	Tee Fitting	1
RL020	Manual Release (set)	2
RR235	Retaining Ring	1
RR385	Retaining Ring	1
SC480	Self tap pan head screw	9
SC600	Hex Hd Scr	1
TF641	90* 3/8 - 3/8 Fitting	2
TF907	Compression Fitting	2
WP-020	Welch Plug	1
WA035	Flat washer 3/8	3
WA200	#10 Washer -flat	1

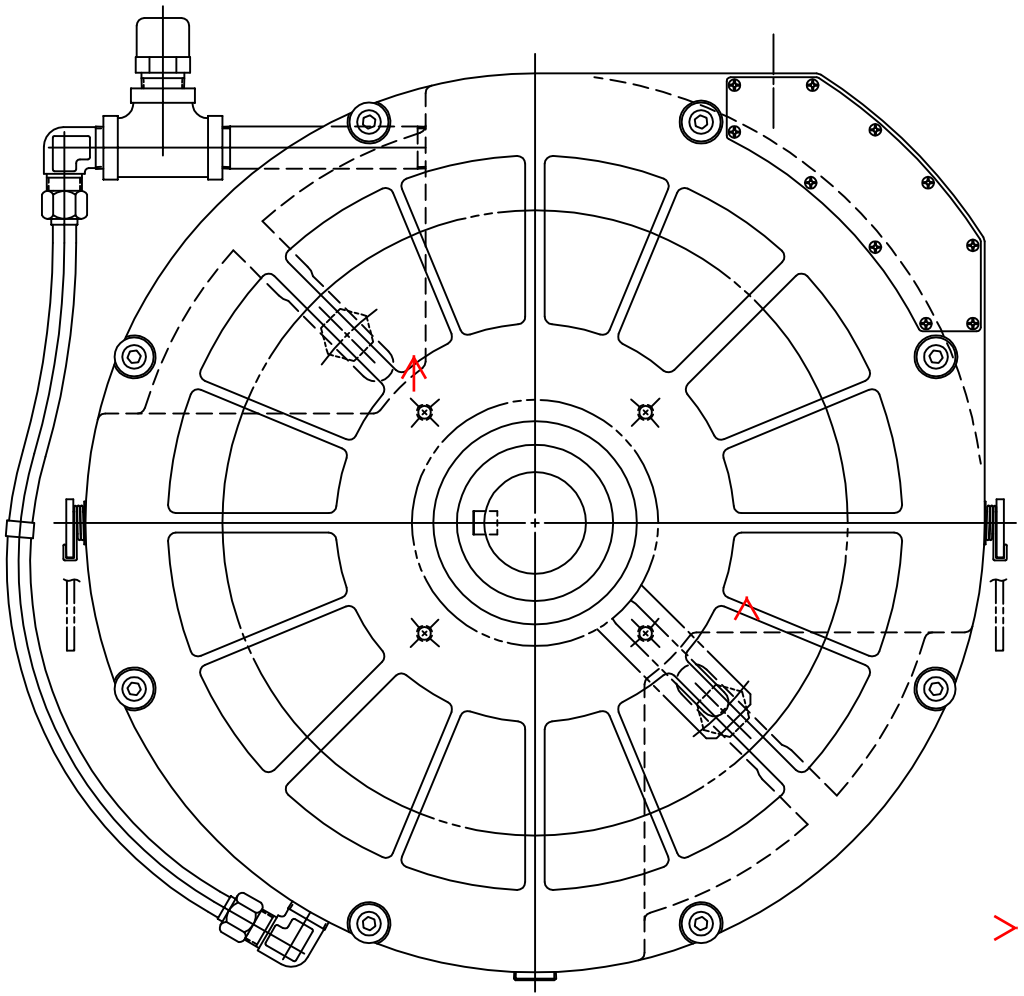
To order plate stack, you must know the required torque. (example)
64 ft.-lbs. is ordered by specifing 8725-1406-238 as shown on 8725-009 drawing



To order hub refer to hub chart, lower left hand corner of drawing 8725-101.

101 HUBS	***102 HUBS***	***102 HUBS***
8725-503 = 1.13 bore	8725-508 = 1.13 bore	8725-512 = 1.63 bore
8725-504 = 1.38 bore	8725-509 = 1.25 bore	8725-513 = 1.75 bore
8725-505 = 1.63 bore	8725-510 = 1.38 bore	8725-514 = 1.88 bore
	8725-511 = 1.50 bore	





QTY	PART NO.	DESCRIPTION	MATERIAL	SPECIFICATIONS

LIST OF MATERIALS

REV.	DATE	BY	DESCRIPTION

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SURF. FINISH

$\frac{1}{4}$ = 250 RMS
$\frac{1}{2}$ = 125 RMS
$\frac{3}{4}$ = 63 RMS
0 = 32 RMS
P = 16 RMS

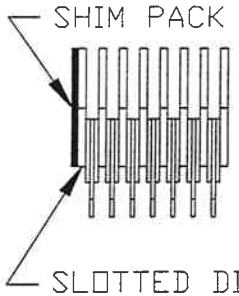
HEAT TREAT

TITLE	INSTALLATION DRAWING				
USED ON	ACE WORLD HOIST				
TOLERANCE UNLESS OTHERWISE SPECIFIED			DR.	DGK	2/24/09
	X	+/-.060	CHK.		
SCALE	XX	+/-.030	ENG.		
FULL	XXX	+/-.005	APP'D		

MIDWEST BRAKE
WARREN, MICHIGAN 48089

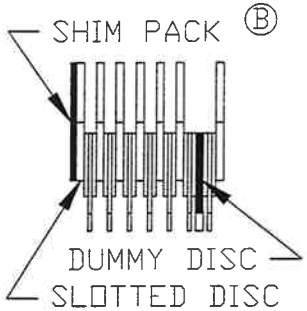
8727-019 -D

TORQUE (FT.-LBS.) =
64.0 W/"06" SPRINGS



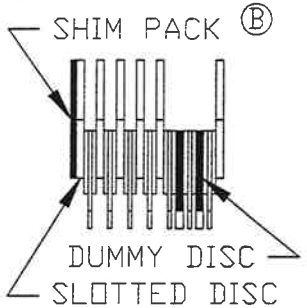
"14" ACTIVE SURFACES

TORQUE (FT.-LBS.) =
55.0 W/"06" SPRINGS



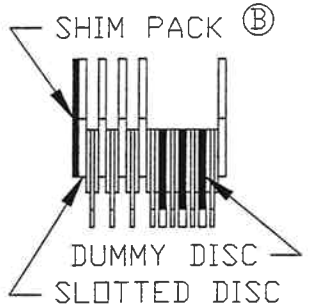
"12" ACTIVE SURFACES

TORQUE (FT.-LBS.) =
45.0 W/"06" SPRINGS



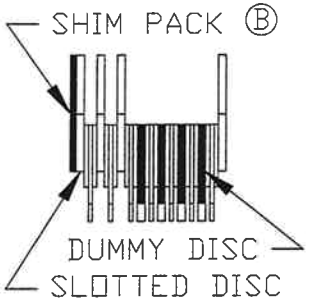
"10" ACTIVE SURFACES

TORQUE (FT.-LBS.) =
36.0 W/"06" SPRINGS



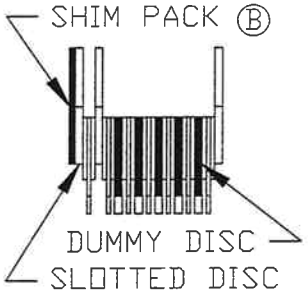
"08" ACTIVE SURFACES

TORQUE (FT.-LBS.) =
27.0 W/"06" SPRINGS



"06" ACTIVE SURFACES

TORQUE (FT.-LBS.) =
18.0 W/"06" SPRINGS



"04" ACTIVE SURFACES

Ⓒ NOTE:
STACK HEIGHT
1.238/1.243

NOTE:

THE LAST FOUR NUMBERS OF THE MODEL NUMBER INDICATE THE ACTIVE SURFACES (FIRST TWO NUMBERS) AND THE SPRINGS (LAST TWO NUMBERS) AS SHIPPED. EXAMPLE: -1406 OR -0806 CONTAIN (14) OR (8) ACTIVE SURFACES AND (6) SPRINGS. IF REQUIRED, TORQUE MAY BE CHANGED BY ARRANGING DISC STACK FOR VARIOUS TORQUE CAPACITIES AS SHOWN. ALWAYS START DISC STACK WITH SHIM PACK AT BOTTOM FOLLOWED BY ONE SLOTTED DISC. (LEFT HAND END OF ILLUSTRATION.)

Ⓓ
ENG. NOTE: TORQUE CALCULATED USING (6) 1010-238 SPRINGS

REV.	DATE	BY	DESCRIPTION
F	6/16/95	BCS	REVISED TORQUE CALLOUTS
E	7/13/94	TJC	REVISED TORQUE CALLOUTS
D	2/2/93	GAS	ENG. NOTE ADDED
C	6/15/91	GAS	ADDED STACK HEIGHT NOTE
B	5/24/91	MTM	REVISED TORQUE FOR SP176-ADDED SHIM PACKS
A	8/13/90	GK	REVISED-STACK ARRANGEMENTS-TO SHOW DUMMY DISCS

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SURF. FINISH
$\sqrt{_R}$ = 250 RMS
$\sqrt{}$ = 125 RMS
$\sqrt{M}$ = 63 RMS
G = 32 RMS
P = 16 RMS

QTY	PART NO.	DESCRIPTION	MATERIAL	SPECIFICATIONS

LIST OF MATERIALS

HEAT TREAT

TITLE: DISC STACK ARRANGMENT
USED ON: 8725 ELECTRO-SHEAR BRAKE

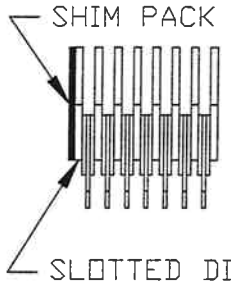
TOLERANCE (UNLESS OTHERWISE SPECIFIED)		DR.	GK	12/1/87
.X	+/-.060	CHK.		
.XX	+/-.010	ENG.		
.XXX	+/-.005	APP'D		

SCALE

MIDWEST BRAKE
WARREN, MICHIGAN 48089

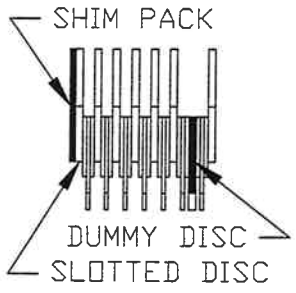
8725-009 -B

TORQUE (FT.-LBS.) =
76.0 W/"06" SPRINGS



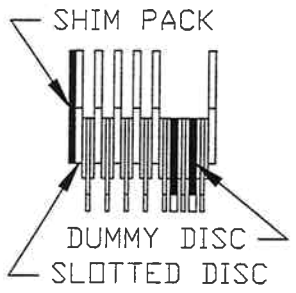
"14" ACTIVE SURFACES

TORQUE (FT.-LBS.) =
65.0 W/"06" SPRINGS



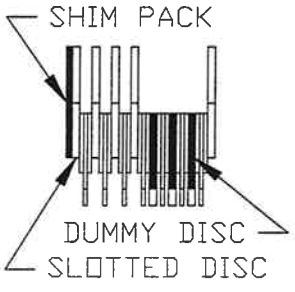
"12" ACTIVE SURFACES

TORQUE (FT.-LBS.) =
54.0 W/"06" SPRINGS



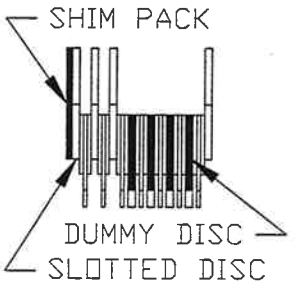
"10" ACTIVE SURFACES

TORQUE (FT.-LBS.) =
43.0 W/"06" SPRINGS



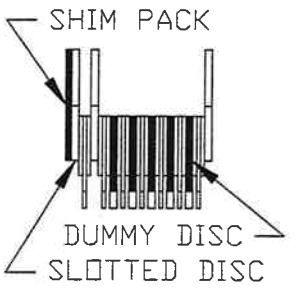
"08" ACTIVE SURFACES

TORQUE (FT.-LBS.) =
33.0 W/"06" SPRINGS



"06" ACTIVE SURFACES

TORQUE (FT.-LBS.) =
22.0 W/"06" SPRINGS



"04" ACTIVE SURFACES

NOTE:

THE LAST FOUR NUMBERS OF THE MODEL NUMBER INDICATE THE ACTIVE SURFACES (FIRST TWO NUMBERS) AND THE SPRINGS (LAST TWO NUMBERS) AS SHIPPED. EXAMPLE: -1406 OR -0806 CONTAIN (14) OR (8) ACTIVE SURFACES AND (6) SPRINGS. IF REQUIRED, TORQUE MAY BE CHANGED BY ARRANGING DISC STACK FOR VARIOUS TORQUE CAPACITIES AS SHOWN. ALWAYS START DISC STACK WITH SHIM PACK AT BOTTOM FOLLOWED BY ONE SLOTTED DISC. (LEFT HAND END OF ILLUSTRATION.)

Ⓐ ENG. NOTE: TORQUE CALCULATED USING (3) 1010-238 AND (3) 1010-239 SPRINGS.

QTY	PART NO.	DESCRIPTION	MATERIAL	SPECIFICATION

LIST OF MATERIALS

REV.	DATE	BY	DESCRIPTION
C	6/16/95	BCS	REVISED TORQUE CALLOUTS
B	7/13/94	TJC	REVISED TORQUES
A	2/22/94	DGK	1010-239 & -239 WERE SP176 & SP180

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SURF. FINISH
√ = 250 RMS
√ = 125 RMS
√ = 63 RMS
G = 32 RMS
P = 16 RMS

HEAT TREAT

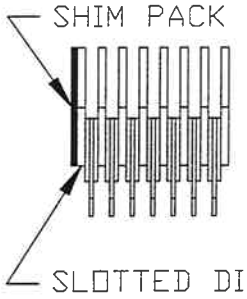
TITLE	DISC STACK ARRANGMENT				
USED ON	8725 ELECTRO-SHEAR BRAKE				
TOLERANCE (UNLESS OTHERWISE STATED)		DR.	DGK	8/12/91	
.X	+/-.060	CHK.			
.XX	+/-.010	ENG.			
.XXX	+/-.005	APP'D			

SCALE

SOMMER CO., INC.
WARREN MICHIGAN 48089

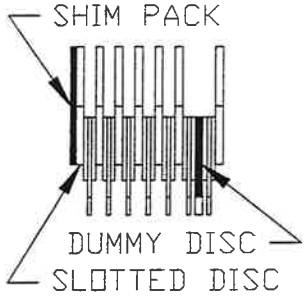
8725-034 -B

TORQUE (FT.-LBS.) =
89.0 W/"06" SPRINGS



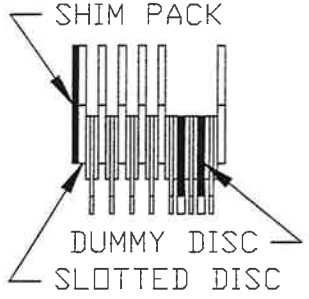
"14" ACTIVE SURFACES

TORQUE (FT.-LBS.) =
76.0 W/"06" SPRINGS



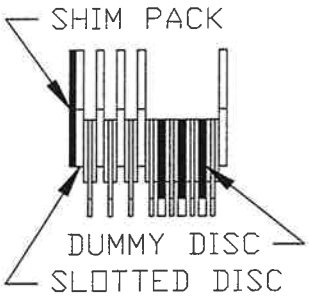
"12" ACTIVE SURFACES

TORQUE (FT.-LBS.) =
63.0 W/"06" SPRINGS



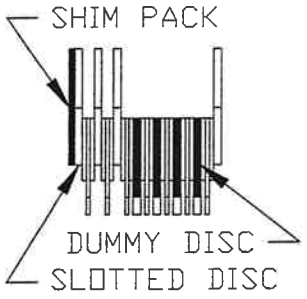
"10" ACTIVE SURFACES

TORQUE (FT.-LBS.) =
51.0 W/"06" SPRINGS



"08" ACTIVE SURFACES

TORQUE (FT.-LBS.) =
38.0 W/"06" SPRINGS



"06" ACTIVE SURFACES

TORQUE (FT.-LBS.) =
25.0 W/"06" SPRINGS

"04" ACTIVE SURFACES

NOTE:

THE LAST FOUR NUMBERS OF THE MODEL NUMBER INDICATE THE ACTIVE SURFACES (FIRST TWO NUMBERS) AND THE SPRINGS (LAST TWO NUMBERS) AS SHIPPED. EXAMPLE: -1406 OR -0806 CONTAIN (14) OR (8) ACTIVE SURFACES AND (6) SPRINGS. IF REQUIRED, TORQUE MAY BE CHANGED BY ARRANGING DISC STACK FOR VARIOUS TORQUE CAPACITIES AS SHOWN. ALWAYS START DISC STACK WITH SHIM PACK AT BOTTOM FOLLOWED BY ONE SLOTTED DISC. (LEFT HAND END OF ILLUSTRATION.)

Ⓐ NOTE: STACK HEIGHT 1.238/1.243

Ⓑ ENG. NOTE: TORQUE CALCULATED USING (6) 1010-239 SPRINGS.

QT'Y	PART NO.	DESCRIPTION	MATERIAL	SPECIFICATIONS

LIST OF MATERIALS

REV.	DATE	BY	DESCRIPTION
D	6/16/95	BCS	REVISED TORQUE CALLOUTS
C	7/13/94	TJC	REVISED TORQUES
B	9/15/92	GAS	1010-239 WAS SP180
A	6/15/92	GAS	NOTE ADDED

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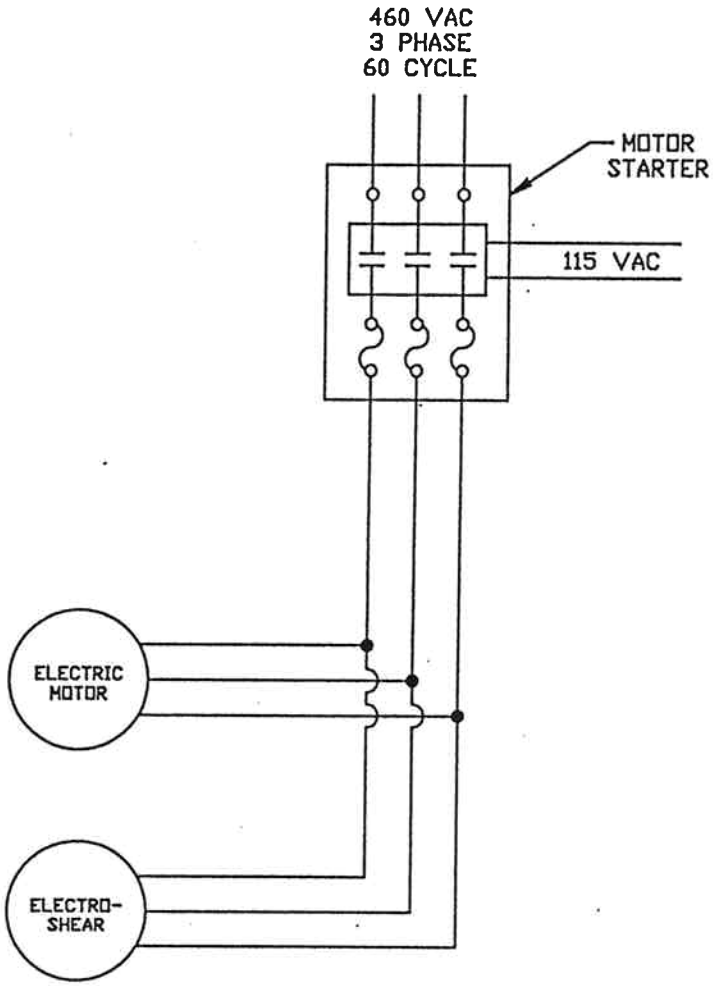
SURF. FINISH
$\sqrt{R}$ = 250 RMS
$\sqrt{}$ = 125 RMS
$\sqrt{\sqrt{}}$ = 63 RMS
G = 32 RMS
P = 16 RMS

HEAT TREAT

TITLE	DISC STACK ARRANGMENT			
USED ON	8725 ELECTRO-SHEAR BRAKE			
TOLERANCE (UNLESS OTHERWISE SPECIFIED)		DR.	DGK	9/27/91
.X	+/-.060	CHK.		
.XX	+/-.010	ENG.		
.XXX	+/-.005	APP'D		
SCALE				

MIDWEST BRAKE
WARREN, MICHIGAN 48089

8725-036 -B



NORMAL ELECTRICAL CONNECTION
FOR ELECTRO-SHEAR BRAKES
(SEE SHEET 2 FOR OPTIONAL CONNECTION)

QTY	PART NO.	DESCRIPTION	MATERIAL	SPECIFICATION

LIST OF MATERIALS

REV.	DATE	BY	DESCRIPTION
C	2/25/94	DGK	REDRAWN; ADDED SHT. 2;
			SIZE 00 STARTER WAS RELAY;
			REV'S 'A' & 'B' ON VOID DWG.

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SURF. FINISH

HEAT TREAT

TITLE	ELECTRICAL SCHEMATIC				
USED ON	ELECTRO-SHEAR BRAKES				
UNLESS OTHERWISE STATED TOLERANCE			DR.	DGK	2/25/94
X		+/-.010	ENG.		
SCALE XX		+/-.005	ENG.		
XXX		+/-.002	APP'D		

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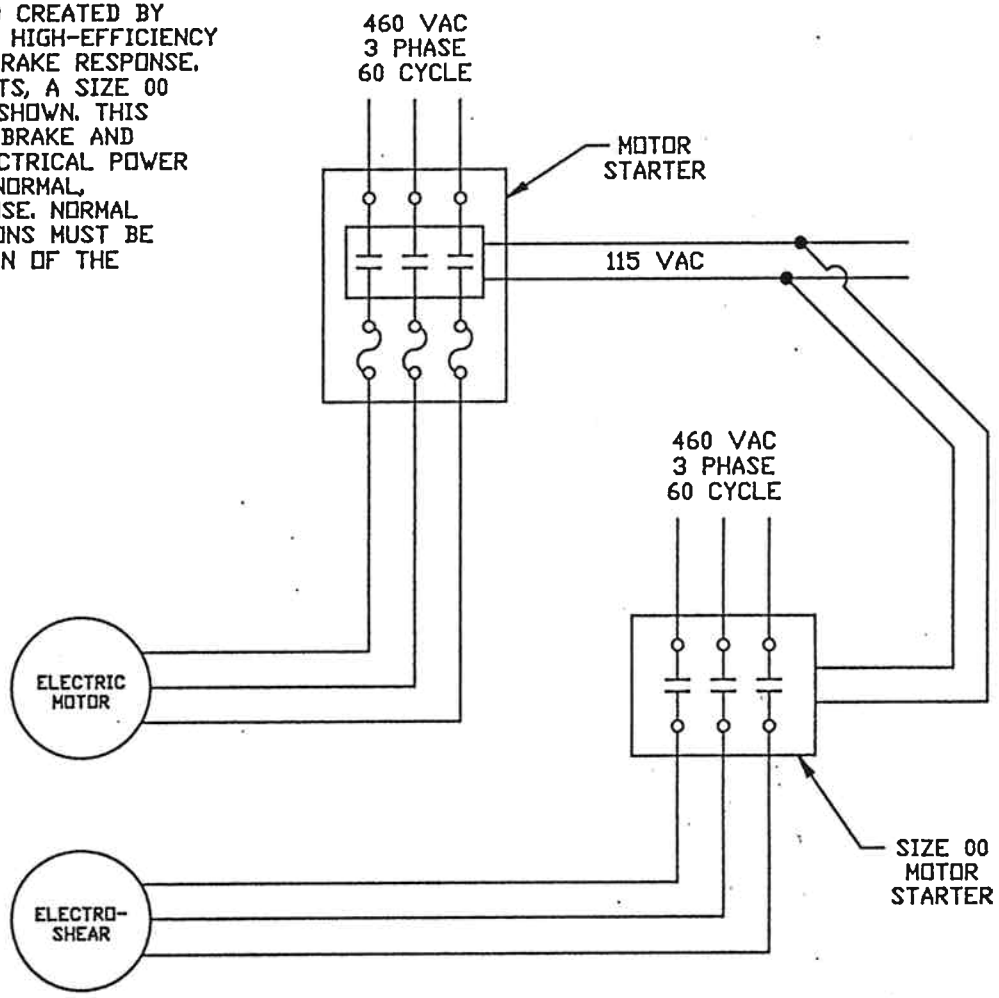
WARREN MICHIGAN 48089

8725-025 -C

NOTE:

A RESIDUAL ELECTRICAL FIELD CREATED BY ELECTRIC MOTORS, ESPECIALLY HIGH-EFFICIENCY MOTORS, CAUSES A DELAY IN BRAKE RESPONSE. BECAUSE THIS CONDITION EXISTS, A SIZE 00 MOTOR STARTER IS ADDED AS SHOWN. THIS STARTER WILL SEPERATE THE BRAKE AND MOTOR IMMEDIATELY WHEN ELECTRICAL POWER IS REMOVED, THUS ALLOWING NORMAL, INSTANTANEOUS, BRAKE RESPONSE. NORMAL ELECTRICAL SAFETY PRECAUTIONS MUST BE OBSERVED FOR THE PROTECTION OF THE OPERATOR.



OPTIONAL ELECTRICAL CONNECTION
FOR ELECTRO-SHEAR BRAKES

QTY	PART NO.	DESCRIPTION	MATERIAL	SPECIFICATION

LIST OF MATERIALS

REV.	DATE	BY	DESCRIPTION

PROPRIETARY INFORMATION

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SURF. FINISH

HEAT TREAT

TITLE	ELECTRICAL SCHEMATIC				
LINES ON	ELECTRO-SHEAR BRAKES				
TOLERANCE UNLESS OTHERWISE STATED			DR.	GK	5/18/89
X	+/-.005		CHK.		
XX	+/-.010		ENG.		
XXX	+/-.005		APP'D		
SCALE					

SOMMER CO., INC.
WARREN MICHIGAN 48089

8725-025 -C

SHT. 2 OF 2

Content Guide

Dynapar™ brand
NorthStar™ brand

Encoder Type	Typical Configuration	Encoder Reference
Dynapar brand Incremental Encoders with integral shaft. Industrial standard sizes range from 1 to 2.5 inch diameter.	Shaft sizes range from 1/8” to 1/2”. Available mounting configurations include flange, servo and face mounts. Models include electrical interface via side or end mounted MS connectors	**Use the Selection Guide on page 2.12** 
Dynapar brand Incremental Encoders with hub-shaft, hollow-shaft or ring-mount design. Easily motor mount without requiring adaptors or extra hardware.	Accept thru-shaft or shaft-hub sizes ranging from 1/8” to 2-7/8”. Available mounting configurations include flexible spring-tether, flange and ring mounts. Models include electrical interface via side or end mounted MS connectors	**Use the Selection Guide on page 2.58** 
Dynapar brand High performance encoders with 5000 PPR or greater resolution	Feature precision glass code-disk and high speed electronic components. Ideal for applications where maximum performance and accuracy at high RPM is required.	**Look for ❶ symbol in Table of Contents or on Selection Guide pages.** 
Dynapar brand Explosion-Proof encoders	For application in hazardous environments where flammable gases, vapors, liquids; combustible dust, or ignitable fibers are present. Approved to UL, Cenelec and CSA standards	**Look for ❷ symbol in Table of Contents or on Selection Guide pages.** 
NorthStar brand Heavy Duty Encoders	NorthStar brand RIM Tach® and SLIM Tach encoders use proven magnetoresistive (MR) technology to ensure the most rugged and robust feedback device possible.	**Use the Selection Guide on page 3.01** 
Dynapar brand Single and multi -turn **ACURO** Absolute Encoders	Signal output is a digital "word" based on the exact rotational position of the encoder's shaft. Unlike encoders that require a counting circuit to track position, absolute encoders provide the correct data after a power-down event.	**Use the Selection Guide on page 4.02** 

Dynapar™ brand NorthStar™ brand

Absolute, Incremental & Motor Mount Encoder
Table of Contents

Encoder part numbers and prices are created by combining a "Base Model" with a combination of desired features and options. The tables on the following pages are used to configure the exact encoder to best fulfil your application requirements. Some features cannot be combined and are so indicated in the tables.

GENERAL INFORMATION

DYNAPAR™ BRAND ABSOLUTE ENCODERS

ACURO™ SERIES

DYNAPAR™ BRAND INCREMENTAL ENCODERS

COMMERCIAL - LIGHT DUTY

INDUSTRIAL - DUTY

Absolute, Incremental & Motor Mount Encoder Table of Contents

DYNAPAR™ BRAND INCREMENTAL ENCODERS (CONTINUED)

MOTOR MOUNT - COMMERCIAL - LIGHT DUTY

MOTOR MOUNT - INDUSTRIAL DUTY

EXPLOSION PROOF - INDUSTRIAL DUTY

DYNAPAR™ BRAND SPARE PARTS & ACCESSORIES

Heavy Duty Incremental Encoders & Pulse Tachs

Table of Contents

Encoder part numbers and prices are created by combining a "Base Price" with a combination of desired features and options. The tables on the following pages are used to configure the exact encoder to best fulfil your application requirements. Some features cannot be combined and are so indicated in the tables. Consult Customer Service regarding any items which are not listed.

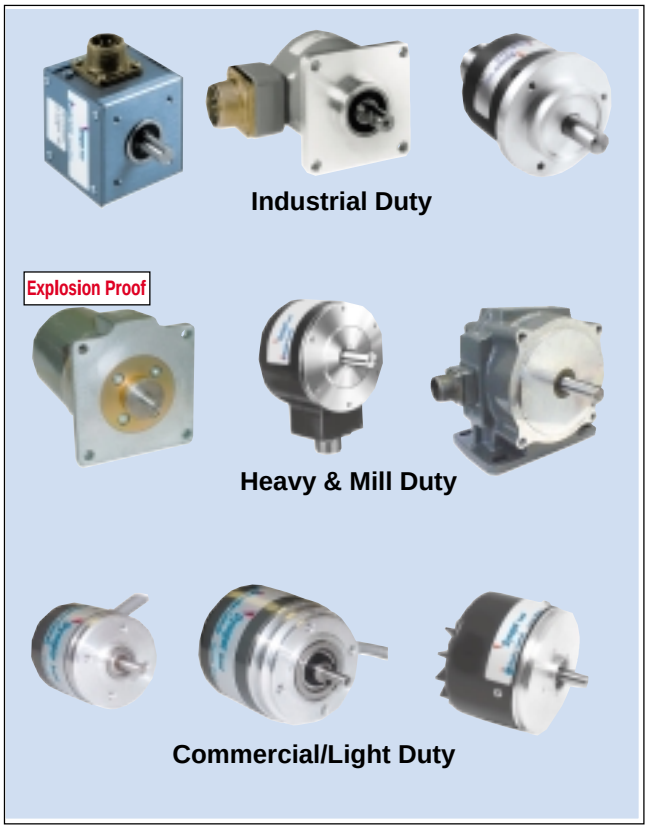
Notes

Introduction Incremental Encoders

GENERAL

Incremental Encoders are sensors capable of generating signals in response to rotary shaft movement. In many encoders, the signals contain direction as well as progression information. When used in conjunction with mechanical conversion devices, such as rack-and-pinions, measuring wheels or spindles, incremental shaft encoders can also be used to measure linear movement and/or speed and/or position. The encoder generates an electronic signal for each incremental change in position.

It produces a specific number of equally spaced pulses per revolution (PPR), for example 100 PPR, 1200 PPR, etc, commonly refered to as the encoder's resolution. The pulses can be releated to physical position, length, speed, etc.



APPLICATIONS

A host of applications are available for incremental encoders. They can be used as feedback transducers for motor-speed control, as sensors for measuring, cutting and positioning, and as input for speed and rate controls. *The selection guide on page XX can assist you in choosing the right encoder.*

Encoders are typically used on many industrial machines and processes:

- Door control devices
- Robotics
- Lens grinding machines
- Plotters
- Testing machines
- Ultrasonic welding
- Converting Machinery
- Assembly machines
- Labelling machines
- x/y indication
- Analysis devices
- Drilling machines
- Mixing machines
- Medical Equipment

IMPORTANCE OF QUALITY AND RELIABILITY

Encoders are precision instruments that are typically applied in rugged industrial environments. For continuous reliable performance in these applications, encoders require uncompromising design standards and skilled manufacturing.

Dynapar brand encoders offers a complete range of encoders and accessories – from ultraminiature to large heavy duty and mill duty packages. All represent a commitment to technology and quality while providing cost effective solutions. Every Dynapar brand encoder is 100% final tested and includes a one-year full warranty against defects in material and workmanship.

THE DELIVERY DIFFERENCE

Encoder's requirements typically involve combinations of many mechanical optical and electrical options which can produce thousands of model variations within a series of encoders. It is clearly impossible for a manufacturer or distributor to maintain stock of every model variant.

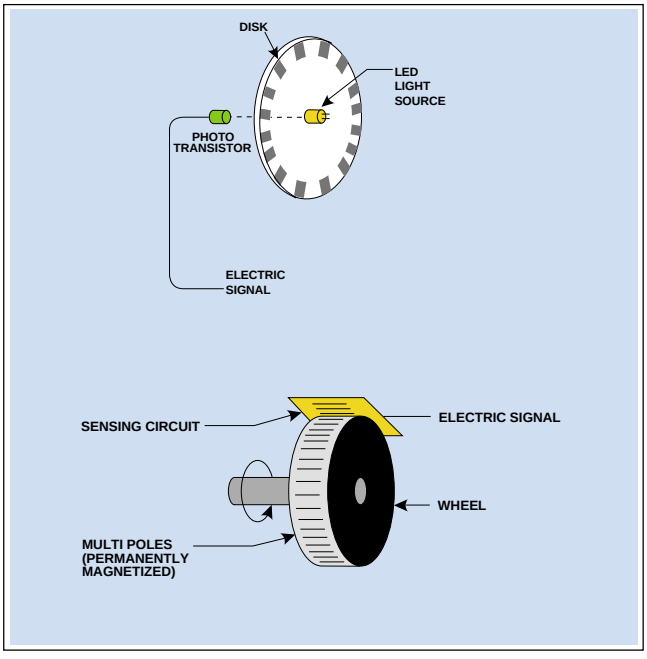
Danaher Controls has overcome this limitation through our expertise in cellular, just-in-time manufacturing. The exact model specification that you require is produced, tested and shipped in 3 days or less – configured as you need it and delivered when you need it!

SENSING TECHNOLOGY

Encoders transmit digital signals in order to achieve high transmission speeds. These signals are generated optically by using a patterned disc, or magnetically using a gear or encoded wheel. Both optical and magnetic operate through zero speed and are available in numerous resolutions.

Optical sensing technology provides high resolutions, high operating speeds, and rugged packaging for reliable, long life operation in most industrial environments.

Magnetic sensing technology provides good resolution, and high operating speeds as well as maximum resistance to dust, moisture, and thermal and mechanical shock.

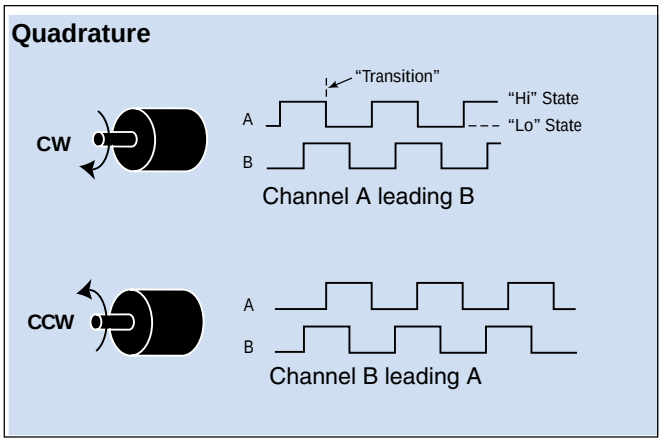


INCREMENTAL CODING

Provides a specific number of equally spaced pulses per revolution (PPR). The pulses will be produced regardless of rotation direction. A single channel output is used for applications where sensing the direction of movement is not important.

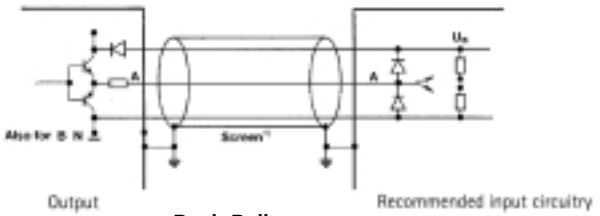
For direction sensing applications, "quadrature output", provides two channels that are coded 90 electrical degrees out of phase. It is used in bidirectional position sensing and length measuring applications.

Quadrature signals are decoded by specialized circuitry that determines direction of movement based on the phase relationship of channel A in respect to Channel B. Quadrature output allows monitoring of direction for processes which can reverse, or must maintain net position when standing still or mechanically oscillating. Bidirectional quadrature is recommended for most position, speed, and length applications



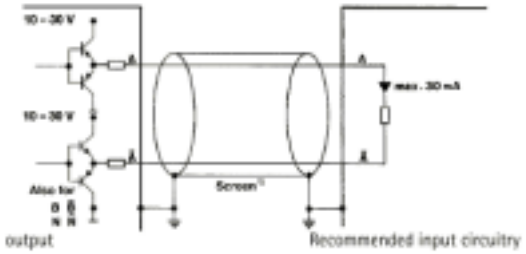
Some incremental encoders also incorporate another signal known as the "marker" or the "Z channel". This signal is produced only once per revolution of the encoder shaft. It is often used to locate a specific position during the shaft's rotation.

In addition to the output's coding, there are choices as to the type of output circuit that is used for signal transmission. Current sinking, current sourcing or push-pull circuits are used when the signal does not have to travel for a great distance and the environment is free of sources of electrical interference. It is important to know the type of circuit the encoder will be connected to in order to select the proper output.

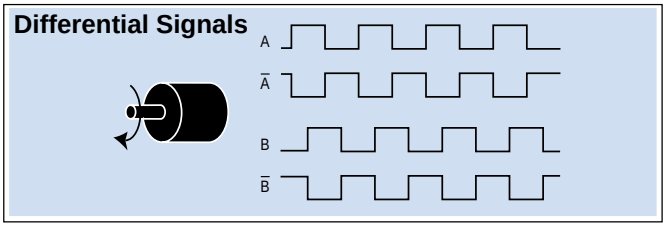


Push-Pull

For long distance transmission, and/or when high levels of electrical interference are present, a differential line-driver output circuit is often the best choice. This type of interface provides the A and B signals plus two additional signals which are their inverse complements (shifted 180 electrical degrees). It is able to drive long transmission lines and by comparing the each channel and its complement, common mode interference can be cancelled.

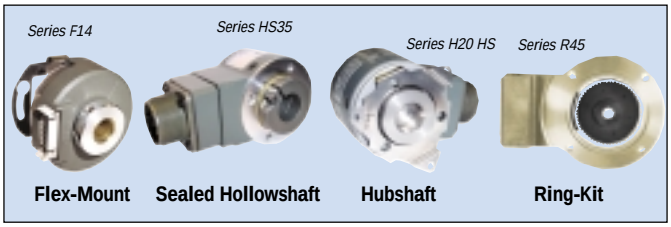


Push-Pull Complementary



MOTOR MOUNTING

We offer a complete range of encoders that are designed for fast, easy direct-to-motor installation (or mounting to other free shafts). These include sealed hollowshaft and hub-shaft designs and require no mounting adapters or couplings – saving you time and money. They provide the extended temperature range and rugged construction characteristics needed for the most demanding applications. *The selection guide on page XX can assist you in choosing a motor mount encoder.*



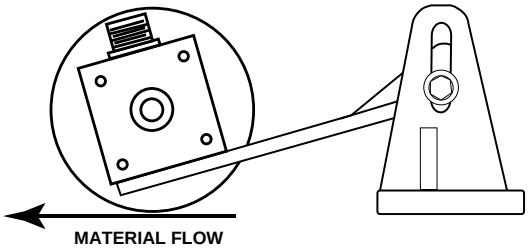
ABSOLUTE AND LINEAR ENCODERS

For specialty applications, our ranges of Absolute and Linear Encoders may be just what you need. Please refer to the separate Introductions and Selection Guides to become familiar with these products.

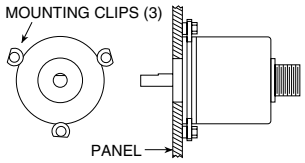
Introduction Incremental Encoders

Typical Encoder Mechanical Installations

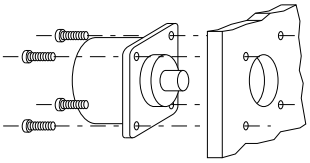
GENERAL MOUNTING



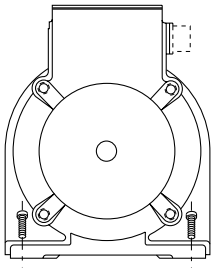
MEASURING WHEEL



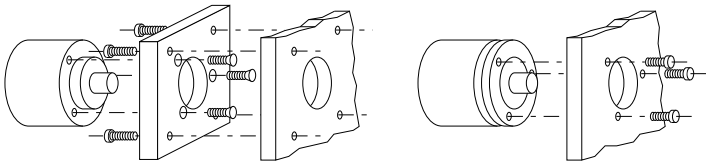
SERVO MOUNT



FLANGE MOUNT

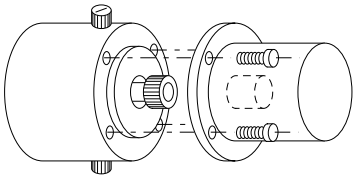


MILL-DUTY FOOT MOUNT

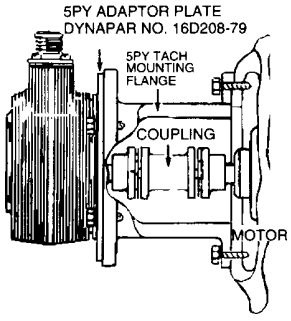


FACE MOUNT

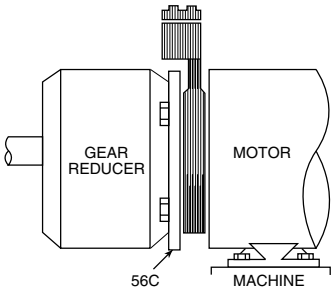
MOTOR MOUNTING



MOTOR MOUNT



5PY (or equivalent) **MOUNT**



RING MOUNT

Principles of Optical & Magnetic Sensing

(How Optical & Magnetic Sensors Operate)

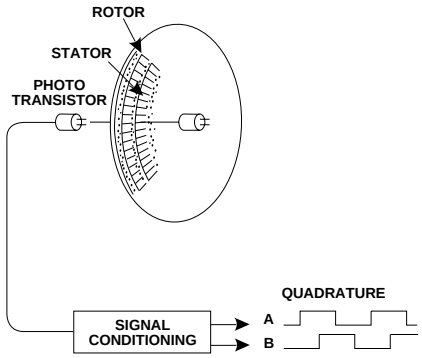
OPTICAL SENSORS

Incremental Sensing

Optical encoders utilize a rotor with a count pattern which interrupts the LED light source and changes the output of phototransistor sensors. The signal is amplified and shaped internally. Optical encoders provide operation through zero speed and have high resolution capability.

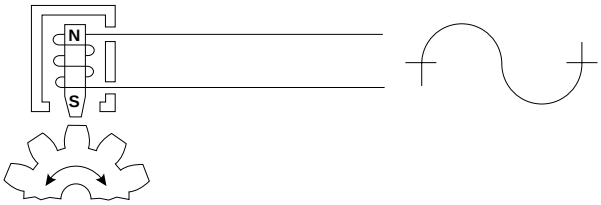
Quadrature

Quadrature output allows monitoring of direction for processes which can reverse, or must maintain net position when standing still or mechanically oscillating. Bidirectional quadrature is recommended for most position, speed, and length applications.



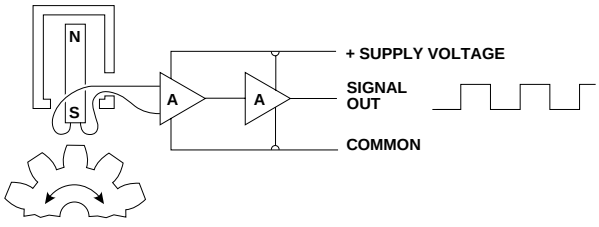
MAGNETIC SENSORS

Variable Reluctance



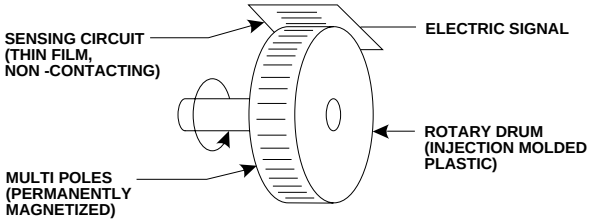
Variable reluctance devices utilize ferromagnetic gear teeth to disturb the flux, causing a change in reluctance. A pulsed voltage, proportional to mechanical motion, is generated in the coil. These are passive devices for maximum reliability. Low speed operation is limited to about 50 RPM. See Fundamentals of Digital Measurements section.

Magneto-Resistive



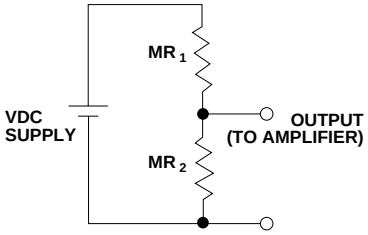
Magneto-resistive devices contain a highly sensitive bridge circuit which reacts to the movement of ferromagnetic gear teeth. This imbalance of the bridge circuit is amplified to create the output signal. Zero speed operation, high reliability, and wide temperature range are the main features.

High Resolution, Magneto-Resistive Rotary Drum Design



The sensing circuit consists of two magneto-resistive elements (MR_1 and MR_2) which alternately respond to the encoded magnetic poles on the rotary drum. The electrical output is then conditioned and amplified to provide a stream of electrical square-waves which correspond to the motion of the drum.

Basic Sensing Circuit



The sensing occurs on the perimeter, rather than the face, of the drum, making the unit more durable and less susceptible to shock and vibration. This non-optical, magnetic sensing technology is more resistant to dust, grease, moisture, and other contaminants commonly encountered in industrial environments.

Introduction Incremental Encoders

Resolution/Incremental Measuring

RESOLUTION is the number of measuring segments or units in one revolution of an encoder shaft. It is the smallest unit of movement detected by the encoder. If one revolution of the transducer shaft is divided into one thousand segments, the resolution would be 0.001. Likewise, if it is divided into ten segments, the resolution would be 0.1, and so on. Encoders can measure motion or position from 1 to 5000 pulses per revolution (PPR). With proper selection of an encoder and a counter/instrument, that resolution range can be extended to 1 to 20,000 PPR. (See **QUADRATURE**) The selected encoder must have resolution equal to or better than that required by the application.

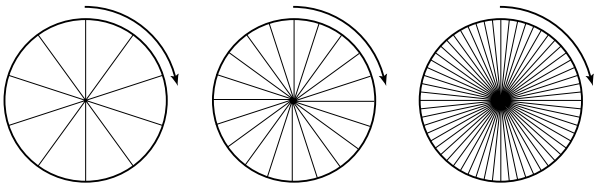


Figure 1

Linear/Straight-Line Measuring Techniques

Encoders are not limited to measuring rotary motion. Through mechanical means, usually through the use of rack and pinions or leadscrews, encoders can measure straight-line or linear motion. These mechanical systems with gearings and couplings are commonly used on machines for converting the rotary motion of an electric motor to the desired straight-line motion. When encoders are coupled to these mechanical systems, they can feedback motion and positioning data to the system controllers as it occurs on the machine.

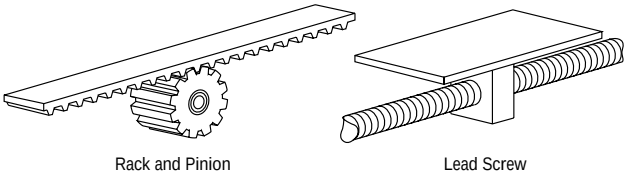


Figure 2: Typical Rotary/Linear Mechanical Elements

Digital Length & Position Measurements

Digitally measuring length or position is accomplished by accumulating and counting digital pulses that are related to the unit of length or travel. Total length or travel is accummulated from a reference point established before beginning the measurement. Calibrating the number of pulses per unit of measure is accomplished via selection of the proper transducer and possibly including a separate calibration step. (See **PULSE CALIBRATION**) Typical industrial devices for accumulating digital measurements from encoders include electronic counters, instruments, programmable logic controllers (PLC's), computerized numerical controllers (CNC's) etc.

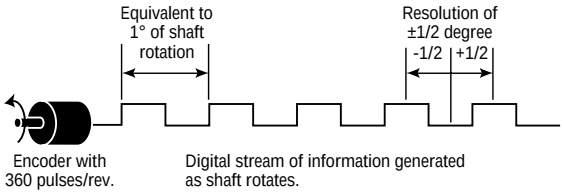


Figure 3

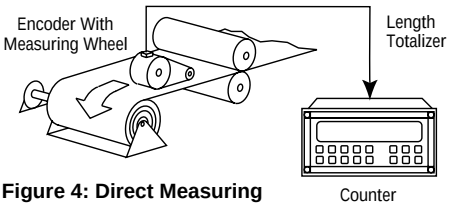


Figure 4: Direct Measuring

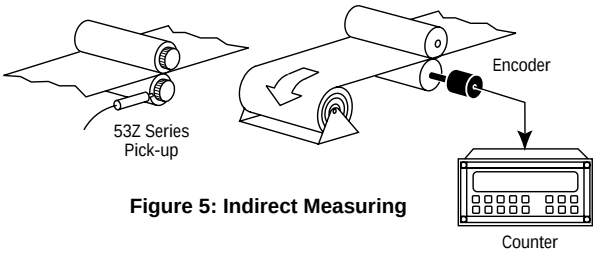


Figure 5: Indirect Measuring

Examples

1. To measure 10 inches of travel to 0.01 inch resolution.

   Total count = 1000; Resolution 0.01

   Assuming that it only requires one full turn of the encoder to measure total travel, a 1000 pulses per rev. encoder can satisfy this requirement. At full travel, the encoder and counter will read 9.99, which is within the stated tolerance of 0.01 inch.

2. To measure 360 degrees to 0.1 degree resolution.

   Total Count = 3600; Resolution 0.1

   An 1800 pulse per turn encoder with x2 multiplication can satisfy this requirement. At full travel the encoder and counter will read 360.0 degrees. For more details, see **PULSE MULTIPLICATION**.

3. **Typical Application:** An encoder is required on a milling machine to provide a digital readout display. The display must read directly in thousandths of an inch. The total travel of the milling machine bed is 36 inches. The travel is regulated by a precision leadscrew, which moves the milling machine bed 1/10th inch for every revolution (360°) of the leadscrew.

   Solution: Since the display must read directly in 1/1000th inch increments, the encoder must provide 100 pulses per revolution where each pulse represents .001 inch. An encoder is connected to the shaft of the leadscrew and the shaft is rotated. A pulse train is generated. These pulses are fed directly into an appropriate electric counter with digital display. Starting from a known reference position, the operator resets the counter to zero. The operator moves the milling machine bed from the zero position until the number 19.031 is shown on the counter. The operator is now exactly 19.031 inches from the zero position.

   In some systems, the number 19.031 is entered on the counter's preset function. When the counter counts 19,031 pulses, it stops the travel automatically. At this position, a hole is bored to a specific depth. An encoder on the "z" axis of the machine controls the drilling to a specified depth. Add to this an encoder for bed travel on the other axis, plus programmable control for the preset functions and sequences, and you have assembled some of the fundamental building blocks for an automated numerical control system.

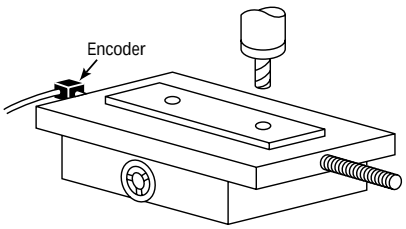


Figure 6

Accuracy and Resolution

The difference between accuracy and resolution in a transducer is important to understand. The fact that it is possible to have one without the other is often overlooked when specifying sensors.

Figure 13 shows a distance X divided into 24 increments or "bits". If X represents 360 degrees of shaft rotation, then one revolution has been resolved into 24 parts. In Figure 13, it is obvious that the 24 parts are not uniform. If this transducer were installed in an application, its output could not be used to measure position, velocity or acceleration with any accuracy.

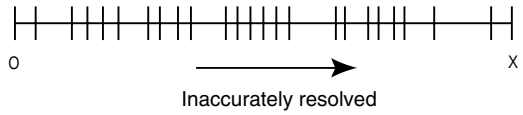


Figure 13

On the other hand, distance X in Figure 14 is divided equally into 24 parts. Each increment represents exactly 1/24 of a revolution. This transducer operates with accuracy as well as resolution. Accuracy, however, can be independent of resolution. A transducer may have a resolution of only two parts per revolution, yet its accuracy could be ±6 arcseconds.

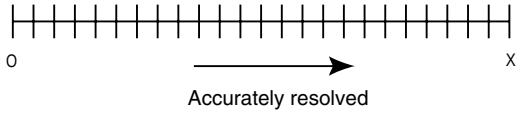


Figure 14

System Application Accuracy & Repeatability

System Accuracy: An encoders performance is typically stated as resolution of a turn, rather than accuracy of measurement. The encoders may be able to resolve one revolution of a shaft into precise bits very accurately, but the accuracy of each bit is limited by the quality of the machine motion being monitored. For example, if there are deflections of machine elements under load, or if there is a drive screw with 0.1 inch of play, using a 1000 count-per-turn encoder with an output reading to 0.001 inch will not improve the 0.1 inch tolerance on the measurement. The encoder only reports position; it cannot improve on the basic accuracy of the shaft motion from which the position is sensed.

Note: Given a particular machine design, some errors in measuring motion such as mechanical backlash and errors in leadscrews or gearing systems, are conditions that can be electronically compensated by some of the more advanced motion controllers.

System Repeatability: Repeatability is the tolerance to which the controlled machine element can be repeatedly positioned to the same point in its travel. Repeatability is generally less than system resolution, but somewhat better than system accuracy.

Bidirectional Measurements

Quadrature

Most incremental systems use two output channels for bidirectional position sensing:

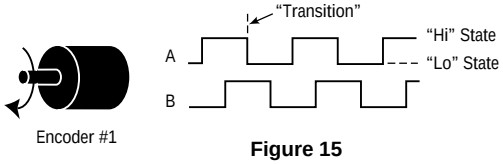


Figure 15
Channel A Leads Channel B
with CW Rotation of the Encoder Shaft

This allows an electronic counter to increment the count with each transition and to monitor the state of the opposite channel during these transitions. Using this information, we can determine if "A" leads "B", and thus derive direction (up/down count).

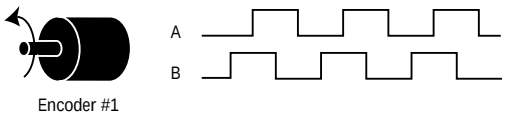


Figure 16
with the Reverse Shaft Rotation,
Channel B will Lead Channel A

In some unidirectional start-stop applications, it is important to have bidirectional information (channel A & B) even if reverse rotation of the shaft is not anticipated. An error in count could occur with a single-channel encoder due to machine vibration inherent in the system. For example, an error in count may occur with a single-channel encoder in a start/stop application if it mechanically stops rotating when the output waveform is in transition. As subsequent mechanical shaft vibration forces the output back and forth across this edge, the counter will up-count with each transition, even though the system is virtually stopped. By utilizing a bidirectional encoder, the counter monitors the transition in its relationship to the state of the opposite channel, and can generate reliable position information.

Pulse Multiplication: Most instruments, electronic counters, and PLC's incorporate high-speed, bidirectional detection circuits in their electronics. Most of these detection circuits have an additional feature to derive 1x, 2x, or 4x the basic encoder resolution. For example, these monitors/controls can be set to count the leading and trailing edges of the pulse train at channel A input (Figure 17). This doubles (x2) the number of pulses counted for one rotation of the encoder. You can improve the count resolution further by letting the input module count the leading and trailing edges of both pulse trains, thereby counting four times (x4) for the same degree of rotation (Figure 17).

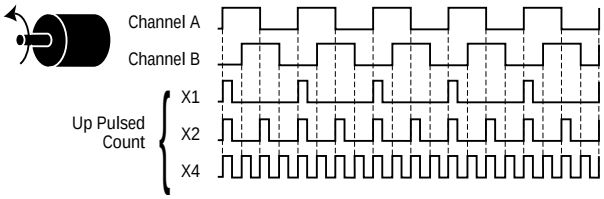


Figure 17

10,000 pulses **per turn** can be generated from a 2500 cycle, two-channel encoder. Typically with a Dynapar encoder, this 4x signal will be accurate to better than ±1 count.

Introduction Incremental Encoders

Typical Length Calibration Examples:

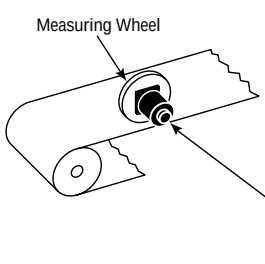


Figure 22

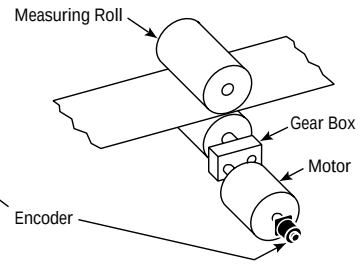


Figure 23

APPLICATION TYPE 1 **APPLICATION TYPE 2**

LENGTH	APPLICATION	
DISPLAY RESOLUTION	TYPE 1 Measuring Wheel	TYPE 2 Measuring Roll
1 Foot	$K = \frac{C}{(12)(N)}$	$K = \frac{(0.2618)(D)}{(G)(N)}$
1 Inch	$K = \frac{C}{(N)}$	$K = \frac{(3.1416)(D)}{(G)(N)}$
0.1 Inch	$K = \frac{(10)(C)}{(N)}$	$K = \frac{(31.416)(D)}{(G)(N)}$
0.01 Inch	$K = \frac{(100)(C)}{(N)}$	$K = \frac{(314.16)(D)}{(G)(N)}$
1 Meter	$K = \frac{M}{(N)}$	$K = \frac{(.079796)(D)}{(G)(N)}$
1 Decimeter	$K = \frac{(10)(M)}{(N)}$	$K = \frac{(0.797966)(D)}{(G)(N)}$
1 Centimeter	$K = \frac{(100)(M)}{(N)}$	$K = \frac{(7.97966)(D)}{(G)(N)}$
1 Millimeter	$K = \frac{(1000)(M)}{(N)}$	$K = \frac{(79.7966)(D)}{(G)(N)}$
0.1 Millimeter	$K = \frac{(10{,}000)(M)}{(N)}$	$K = \frac{(797.966)(D)}{(G)(N)}$

WHERE: G = Gear Ratio (increases rpm of encoder in relation to rpm of roll)
N = Encoder pulses per revolution
D = Roll diameter in inches
C = Measuring wheel circumference in inches
M = Measuring wheel circumference in meters
K = Value of the calibration

EXAMPLE: In a Type 2 application you wish to display FEET to the nearest 1 foot. From the table above:

$$K = \frac{(0.2618)(D)}{(G)(N)}$$

If G = 2.6, N = 1, X = 1, D = 9.15

$$K = \frac{(0.2618)(9.15)}{(2.6)(1)} = 0.92133$$

Ratio Calibration Examples:

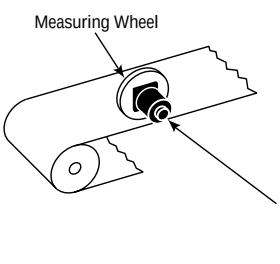


Figure 24

APPLICATION TYPE 1

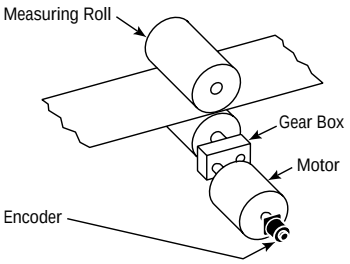


Figure 25

APPLICATION TYPE 2

RATIO	APPLICATION	
DISPLAY RESOLUTION	TYPE 1	TYPE 2
.001	$K = \frac{(5)(C)}{(N)}$	$K = \frac{(15.708)(D)}{(G)(N)}$
.0001	$K = \frac{(50)(C)}{(N)}$	$K = \frac{(15.708)(D)}{(G)(N)}$

WHERE: G = Gear Ratio (increases rpm of encoder in relation to rpm of roll)
N = Encoder pulses per revolution
D = Roll diameter in inches
C = Measuring wheel circumference in inches

A ratio indicator requires two inputs. However, a single calibrator can adjust one of the inputs in such a way that the correct ratio relationship can be read directly. This is done by calculating a combined calibration constant (K) for both inputs and using the calibrator to modify input A (the numerator) only. The calibrator can be external or a built-in function.

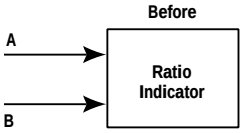


Figure 26

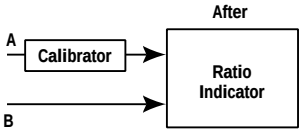


Figure 27

Example: Assume that both inputs are a Type 2 and that you wish to have a 0.001 display resolution.

$$K_A = \frac{\text{Input A}}{(15.708)(D)}{(N)(G)} \qquad K_B = \frac{\text{Input B}}{(15.708)(D)}{(N)(G)}$$

Assume:

Input A	Input B
D = 17.0"	D = 19.2"
N = 12	N = 12
G = 3.5	G = 2.8

Then:

$$K_A = \frac{(15.708)(17.0)}{(12)(3.5)} = 6.3580 \qquad K_B = \frac{(15.708)(19.2)}{(12)(2.8)} = 8.9760$$

Recalling that:

$$K_R = \frac{K_A \text{ for input A}}{K_B \text{ for input B}} = \frac{K_A}{K_B}$$

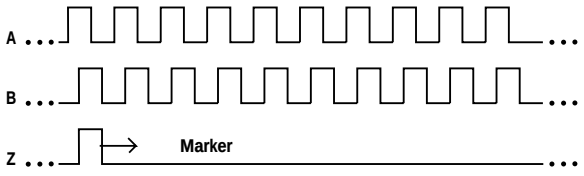
Therefore:

$$K_R = \frac{6.3580}{8.9760} = 0.70833$$

Marker Pulse

Reference Pulse

The reference pulse (sometimes called a Marker or Index Pulse) is a once-per-revolution pulse that occurs at precisely the same mechanical point in a 360 revolution of an encoder shaft. The pulse appears on an output separate from the specified pulse train. The duration of the reference pulse is usually the same pulse width as the output pulse. However, the reference pulse width may be different and is dependent on the specific encoder design. The reference pulse is generated and electrically configured similar to Channels A and B previously described.



(Typical, see individual model for exact configuration)

Figure 28

Typical Marker Pulse Applications

A unique shaft position can be identified by using the reference pulse output only, or by logically relating the reference pulse to the A and B data channels. Thus it is most frequently used in positioning and motion control applications as an electronic starting point of known position (a "reference" pulse) from which counting or position tracking begins.

In long travel or multiple turns of the encoder, the reference pulse is sometimes used by the control to initiate an electronic check on the total count received from the encoder. For example, each time a reference pulse is received by the control, the total count received from channels A and B should be an even multiple of the encoder's pulses per revolution.

Establishing Reference Position

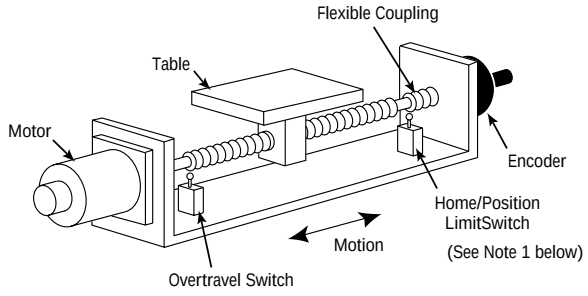


Figure 29
Ballscrew Position Table Example

In motion control encoder applications, a PLC, CNC, or motion controller will usually command a sequence of moves with each axis of a positioning system to bring the table to the same starting position before beginning a task. The purpose of these moves is to establish the starting position. The following is a typical automatic referencing and backlash compensation sequence for establishing a home position through the use of an encoder marker pulse.

1. If the Home Switch is open (indicating a position on the positive side of home) when the command is received, the axis is accelerated in the negative direction at the JOG ACCELERATION rate and moved at the FAST JOG VELOCITY until the Home Switch closes. (See Note 1 below)
2. The axis is stopped at the JOG ACCELERATION rate.
3. The axis is accelerated in the positive direction at the JOG ACCELERATION rate and moved at the FAST JOG VELOCITY until the Home Switch opens.
4. The axis is accelerated in the negative direction at the JOG ACCELERATION rate and moved at the SLOW JOG VELOCITY until the Home Switch closes and an encoder marker pulse is sensed by the control (in that order).
5. The axis is stopped at the JOG ACCELERATION rate.

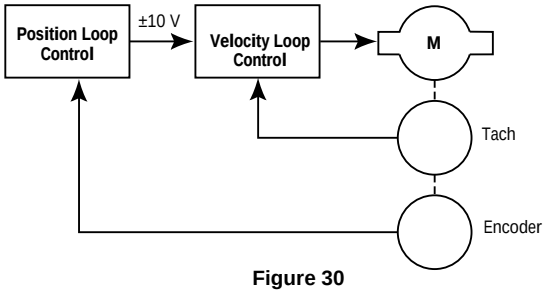


Figure 30
Typical System

Note 1: A home position limit switch is a mechanical device that is usually not repeatably accurate enough for the application.The encoder reference or marker pulse has much greater repeat accuracy and is therefore a better reference point to establish a starting point for subsequent measurements. The home limit switch is required to signal the control that the next marker pulse signal received is "Home" in multi-turn encoder applications.

Leadscrew/Ballscrew Applications

Measurement systems that use encoders and leadscrews can provide high resolution and high traverse speeds. For example, one system combines a 10 mm-pitch ballscrew with an encoder having 2500 lines. The evaluation of all rising and falling edges of the squarewave signal provides a resolution of 1 µm (0.05 mils) without interpolation.

Encoder PPR's and Servo Resolutions for Typical Leadscrew Applications

Servo Resolution	Encoder PPR and Logic Multiplier		
Leadscrew	0.5-in. Lead (2 pitch)	0.25-in. Lead (4 pitch)	0.2-in. Lead (5 pitch)
0.0001 in.	1,250 x 4	625 x 4	500 x 4
0.00005 in.	2,500 x 4	1,250 x 4	1,000 x 4
0.0005 in.	250 x 4	250 x 2	200 x 2
0.00025 in.	500 x 4	250 x 4	200 x 4
0.0002 in.	625 x 4	625 x 2	500 x 2
0.001 mm	3,175 x 4 (special)	3,175 x 2	1,270 x 4
0.002 mm	3,175 x 2	3,175 x 1	635 x 4
0.01 mm	635 x 2	635 x 1	508 x 1
0.005 mm	635 x 4	635 x 2	508 x 2

Introduction Incremental Encoders

Proper resolution keeps the cost of feedback down in a machine. This is best explained by a typical application. Consider that a machine axis is driven by a leadscrew. It is decided to attach the feedback transducer to the screw. It is quite practical to select an arrangement that allows direct coupling to the screw, rather than using gearing or belts and pulleys. In this example, assume a basic system resolution of 0.0001 inch and a four-pitch screw (0.25-inch lead). The feedback transducer would have to produce 2500 increments per revolution to match these characteristics.

A 625-line encoder with times 4 logic would be a perfect choice.

Disc/Dynapar encoders offer a wide range of resolutions for most industrial applications.

Transducer Operating Speed

All transducers have inherent mechanical and electronic limitations regarding speed. The combination of several design factors including bearings, frequency response of the electronics, and PPR of the application, etc. combine to determine “maximum operating speed” in any given application. Exceeding the maximum speed may result in incorrect data or premature failure. Dynapar encoder specifications easily exceed most application requirements for speed.

To determine the encoder’s maximum operating speed for a given application:

Step 1: Determine maximum electronic operating speed in RPM.

Step 2:

A. If the RPM calculated in Step 1 is less than or equal to the encoder’s maximum mechanical RPM specification, then the RPM calculated in Step 1 is the maximum operating speed specification for this particular encoder application.

B. If the RPM calculated in Step 1 is greater than the encoder’s maximum mechanical RPM specification, then the maximum mechanical RPM specification is the maximum operating speed for this encoder application.

Step 3:

Compare the maximum operating speed as determined in Step 2 above with the application requirements.

Encoder Output Signals, Ratings & Terminology

Encoders transmit digital measurement signals utilizing D.C. circuits to achieve the highest transmission speeds. Transmission is achieved either with current flowing to or from the encoder (current sinking or current sourcing outputs).

Dynapar encoder output circuits are designed to be compatible with most instruments, counters, controllers, and motor drivers so that the user can select and apply a unit with confidence. Standard encoder output circuits also minimize service inventory investments and are available with shorter lead times from the factory.

Standard Output Choices:

5-26 VDC	Current Sinking
5-26 VDC	Differential Line Drivers

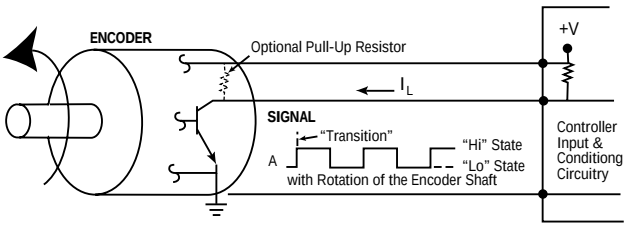


Figure 31
Typical Current Sinking Encoder Circuit

Current sinking derives its name from the fact that it “sinks current from a load.” The current flows from the load into the encoder. Like a mechanical switch, the encoder allows current to flow when turned ON and blocks current flow when turned OFF.

Output Signal Terminology

As mentioned previously encoders can have single channel outputs (signal A), dual channels (signals A & B) for bidirectional measurements, and marker pulse channels (signal Z) to serve various functional requirements for feedback applications (speed, length, position, etc.). In addition, the signals are typically transmitted as “single-ended” or with complementary “differential” outputs.

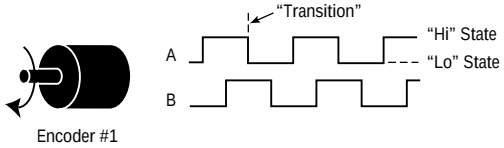


Figure 32
Single-Ended Output Signals

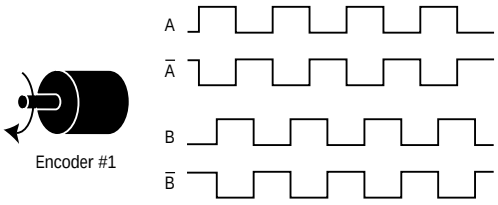


Figure 33
Differential Output Signals

The additional electronics required to utilize differential signals is economically justified most often when:

A. transmission distances (cable runs) exceed approximately 50 feet. Differential signals used with line driver outputs can successfully be transmitted hundreds of feet with proper wiring and grounding practices.

B. higher electrical noise immunity for signal lines is necessary.

General Wiring & Installation Guidelines

The most frequent problems encountered in transmitting an encoder’s signal(s) to the receiving electronics are signal distortion and electrical noise. Either problem can result in gain or loss of encoder counts. These problems can sometimes arise, but many problems can be avoided with good wiring and installation practices. The following descriptions and recommendations are presented as general guidelines and practices for field-installed equipment.

Protecting Signals from Radiated & Conducted Noise

Reasonable care must be taken when connecting and routing power and signal wiring on a machine or system. Radiated noise from nearby relays (relay coils should have surge suppressors), transformers, other electronic drives, etc. may be induced into the signal lines causing undesired signal pulses. Likewise, the encoder or trackball may induce noise into sensitive equipment lines adjacent to it.

Machine power and signal lines must be routed separately. Signal lines should be shielded, twisted and routed in separate conduits or harnesses spaced at least 12 inches apart. Power leads are defined here as the transformer primary and secondary leads, motor armature leads and any 120 VAC or above control wiring for relays, fans, thermal protectors, etc.

Continuity of wires and shields should be maintained from the encoder or trackball through to the controller avoiding the use of terminals in a junction box. This helps to minimize radiated and induced noise problems and ground loops.

In addition, operation may be influenced by transients in the encoder or trackball power supply. Typically, encoder power should be regulated to within ±5%, and it should be free of induced transients.

The encoder case must also be grounded to insure proper and reliable operation of the unit. Dynapar encoders usually have provisions for a case ground connection through the connector/cable if a ground cannot be secured through the mounting bracket/machine ground. DO NOT ground the encoder case through both the machine and the cable wiring. Use high quality shielded wire only and connect the shield only at the instrument end, as shown in Figure 34 below.

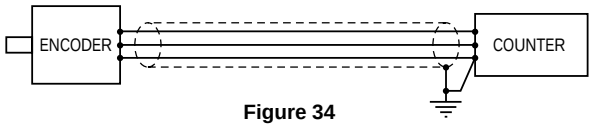


Figure 34

For more protection against electrical noise, specify an encoder with complementary output signals and connect with twisted-pair shielded wire—induced currents will self-cancel, as shown in Figure 35 below.

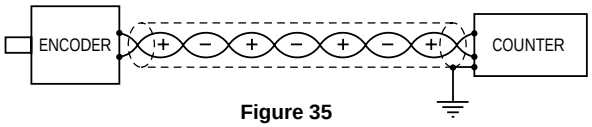


Figure 35

In industrial environments, high current fluxes are created by motors, remote control switches and magnetic fields. This can result in varying electrical potentials at different ground points. To avoid problems, ground the shield, together with all other parts of the system requiring grounding, from a single point at the instrument end, as shown in Figure 36 below.

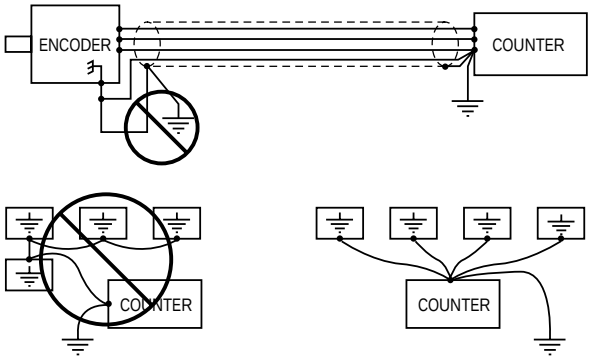


Figure 36

Signal distortion can be eliminated by complementary encoder signals (line drivers), used with differential receivers (line receivers or comparators) at the instrument end, as shown in Figure 37 below.

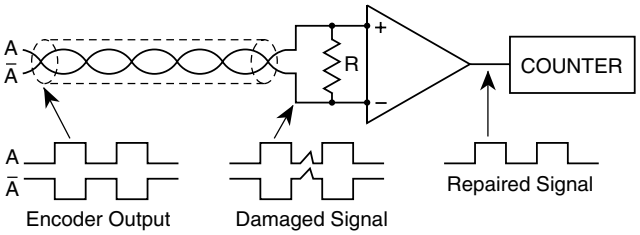


Figure 37

Grounding requirements, conventions and definitions are contained in the National Electrical Code. Local codes will usually dictate the particular rules and regulations that are to be followed concerning system safety grounds.

Signal Distortion

The majority of signal transmission problems involve electrical noise. Severity of the problem increases with transmission distance. Good shielding practice, as described previously, should be observed.

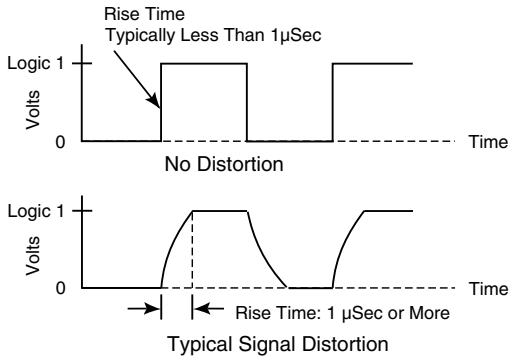


Figure 38

The primary cause of signal distortion is cable length, or more specifically, cable capacitance.

Generally, the receiving electronics will respond to an input signal that is either logical “0” or logical “1”. The region between logical 0 and logical 1 is undefined, and the transition through this region must be very rapid (less than about 1 µsec). As the leading edge of the waveform is distorted, the transition time increases. At some point, the receiver becomes unstable and encoder or trackball counts may be gained or lost.

To minimize distortion, low capacitance cable (typically less than 40 picofarads per foot) should be used. The longer the cable, the greater the potential for signal distortion. Beyond some cable length, the signal must be “reshaped” before it can be used reliably.

Squarewave distortion is not usually significant for cable lengths less than about 50 feet (capacitance up to about 1000 picofarads). Encoders and trackballs supplied with differential line drivers are recommended for applications with cable length requirements of hundreds of feet.

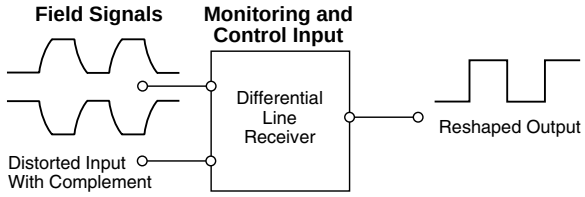


Figure 39

Greater assurance of signal integrity is best achieved when an encoder with line driver outputs is used in conjunction with a line receiver.

Introduction Incremental Encoders

Mechanical Installation

The method of coupling the encoder to the machine where motion is being detected is an important consideration because of possible errors or stresses which can be introduced. Care must be taken that the rated shaft loading, both radial and axial, not be exceeded.

Common causes of difficulty are end thrust, misalignment, and belt or gear thrust. Backlash or modulation in the coupling can cause errors in position indication. Therefore, mechanical coupling is best achieved by using a flexible coupling which compensates for the misalignment between the shaft of the encoder and the machine. This compensation is required because the smallest misalignment can result in high radial loads thereby inducing premature bearing failure.

Why Flexible Couplings?

When shafts are coupled, it is seldom practical to align them perfectly. Alignments can change due to wear in bearings, temperature changes, deflection due to external loading, etc.

When misalignment is greater than that allowed by the coupling, side thrust is created which can cause damage to the encoder shaft and bearings. A good criterion for a flexible coupling is to determine how long the coupling will last under operating misalignment, and the effect of this misalignment on shafts and bearings. This will yield better results than will choosing a coupling solely on the basis of how much misalignment it will take.

A coupling will last indefinitely if there is no misalignment. Generally, the greater the misalignment, the quicker the coupling will fail.

Encoders usually require a precision instrument coupling to prevent errors caused by backlash and to prevent damage to shaft and bearings. **Specifically, do not use fingered motor couplings with rubber spacers.**

For flexible shaft couplings that are specifically designed for use with our encoders, refer to the Dynapar brand CPL Series in this section.

Timing Belts

Use Series XL timing belts. Reliable long-life encoder performance is achievable provided the belt is installed in accordance with the manufacturer's instructions.

Belt Tension: The belt's positive grip eliminates the need for high initial tension. A properly tensioned belt will last longer, cause less wear on encoder bearings, and operate more quietly.

General Guidelines

Encoders are used to provide precise measurements of motion. Never hammer the end of the shaft. Avoid hammering the encoder case when mechanical fits are tight. Encoders provide quality measurements and longer life when common sense, care, and accurate alignments are achieved at the time of installation.

Caution: Any of these actions will void the warranty and will damage the product.

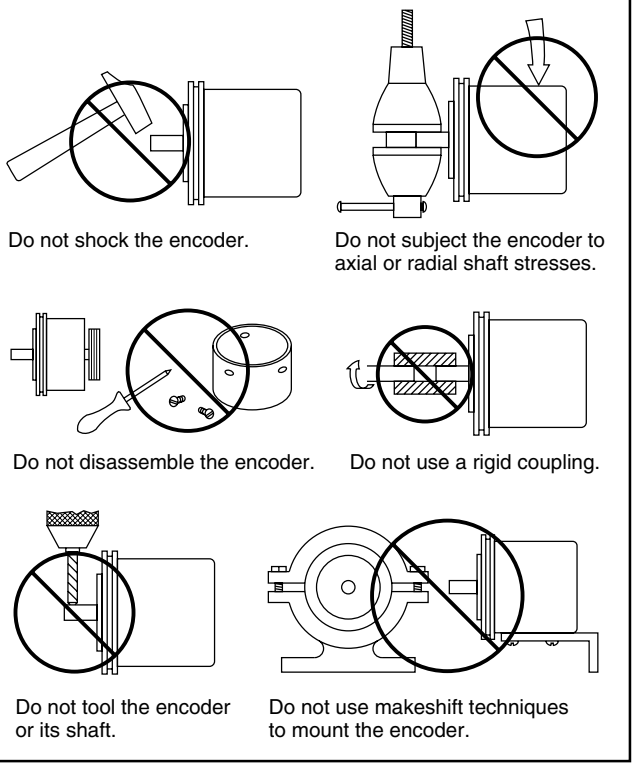


Figure 40

Fundamentals for Applying Magnetic Pickups

Principal of Operation: Variable Reluctance

Ferrous materials provide a low reluctance path for magnetic flux, whereas air provides a high reluctance path. A variable reluctance path, therefore, is one in which the reluctance in the path of the magnetic flux is varied, thereby varying the quantity of magnetic flux that is flowing through the path. Variable reluctance sensors utilize this change in magnetic flux. The path loops through a coil of wire, generating a voltage at the coil terminals that is exactly proportional to the rate of change of magnetic flux.

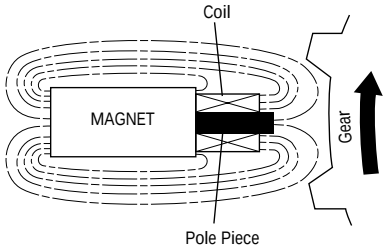


Figure 41
Variable Reluctance Concept

Variable reluctance units require motion to produce changes in magnetic flux which generate a signal. Typically, the positive portion of the electrical signal occurs as the target is moving into the center of the flux field. The negative portion of the electrical signal occurs as the target is moving out and away from the probe. The amplitude of the signals is in direct proportion to the rate of movement. Therefore, linear "surface speed" of the target is an important application consideration for variable reluctance pickups.

Application Consideration: Surface Speed

Dynapar variable reluctance sensors typically require that the target's linear surface speed be at least 180 inches per second. Since many applications use gears as targets, the following definitions, relationships and formulas can be used.

Typical gear specifications: 1) Number of teeth
2) Diametral pitch

Application parameters: The minimum gear RPM for which the sensor will be required to produce a useable signal. Therefore,

$$\text{Surface Speed (in./sec.)} = \frac{\text{RPM x Outside Dia. x } \pi}{60}$$

Outside Diameter (OD): The outside diameter is the overall diameter of the gear to the tops of the teeth. The OD can be determined from the following formula:

$$\text{OD} = \frac{\text{No. of Teeth} + 2}{\text{Diametral Pitch}}$$

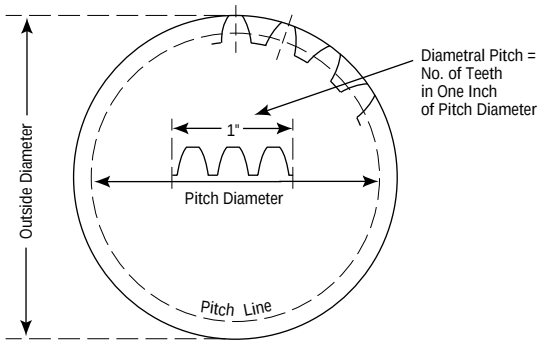


Figure 42

Principal of Operation: Hall Effect

A Hall Effect sensor utilizes the Hall Effect chip and a magnet to sense the change in magnetic field at the edge of a spur-gear tooth. Since pulse generation is based on the Hall Effect principle, the pickup operates down to zero speed without loss of signal. Refer to the pickup's catalog page for the target requirements. See figure 43 for gear and pickup compatibility.

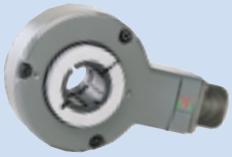
					Hall Effect			Variable Reluctance		
Gear	Dia.	Bore	Pitch	PPR	53Z	53ZK	54Z/54ZT	50	52BH	7143
16002070081	3-1/10"	3/8"	20	60	X	X	X	X		
16002070083	3-7/8"	1/2"	16	60	X	X	X	X		X
16002070184	3-3/4"	5/8"	16	60	X	X	X	X		X
16002070185	3-3/4"	7/8"	16	60	X	X	X	X		X
16002070216	5-1/2"	1-1/8"	11	60		X	X	X	X	X
16002070217	5-1/2"	1-3/8"	11	60		X	X	X	X	X
16002070218	5-1/2"	1-5/8"	11	60		X	X	X	X	X
16002600314	5-1/2"	1-7/8"	11	60		X	X	X	X	X
16002600315	5-1/2"	2"	11	60		X	X	X	X	X
16002600316	5-1/2"	2-1/8"	11	60		X	X	X	X	X
16002600317	5-1/2"	2-1/4"	11	60		X	X	X	X	X
16002600318	5-1/2"	2-3/8"	11	60		X	X	X	X	X
16002600319	5-1/2"	2-1/2"	11	60		X	X	X	X	X
16002600320	5-1/2"	2-7/8"	11	60		X	X	X	X	X
16002070213	3-3/4"	5/8"	32	120	X					
16002070214	3-3/4"	7/8"	32	120	X					
16002070219	5-1/2"	1-1/8"	22	120	X					
16002070220	5-1/2"	1-3/8"	22	120	X					
16002070221	5-1/2"	1-5/8"	22	120	X					
16002600307	5-1/2"	1-7/8"	22	120	X					
16002600308	5-1/2"	2"	22	120	X					
16002600309	5-1/2"	2-1/8"	22	120	X					
16002600310	5-1/2"	2-1/4"	22	120	X					
16002600311	5-1/2"	2-3/8"	22	120	X					
16002600312	5-1/2"	2-1/2"	22	120	X					
16002600313	5-1/2"	2-7/8"	22	120	X					
Key or Keyway				1		X	X			

Figure 43
Gear and Pickup Compatibility

Figure 43 is a chart listing Dynapar brand gears and the pickups with which they are normally used. A "X" indicates that they will work together.

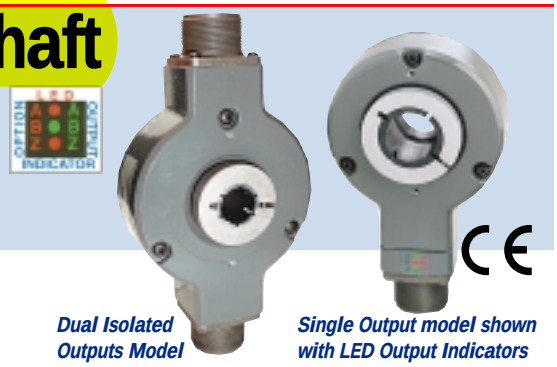
Selection Guide Incremental Motor Mount

Our motor mount encoders are especially well suited for fast, easy installation to motor shafts with minimal extra parts. This Selector Guide can assist you in determining the type of encoder that best fits your application requirements. Condensed description and specification information is provided. Complete information is available on the referenced page number that appears below each product's picture.

Type	H20 Hub-Shaft	HS20 Sealed Hollow Shaft	HS35 Sealed Hollow Shaft	HA/HR/HC26 Flamge Mount
				
Page Number	2.76	2.80	2.84	2.88, 2.92, 2.96
Description and Features	■ Female hub shaft and flexible spring mount directly to motor ■ High reliability features – metal disk, heavy duty bearing, electrical protection and high noise immunity	■ 2.0" diameter, hollowshaft design eliminates mounting bracket and flexible shaft coupling ■ Flexible tether minimizes bearing load ■ Robust metal hubshaft	■ 3.54" diameter, hollowshaft design eliminates mounting bracket and flexible shaft coupling ■ 1-1/2" installation depth ■ Unbreakable code disk	■ Integral coupling and flange adapter to fit NEMA frame size 42 motors ■ Thermally and electrically isolated from motor heat and noise ■ Models with high resolution and intrinsically safe design
Electrical Specifications				
Available Resolutions:	1 to 2540 PPR	1 to 2540 PPR	1 to 2500 PPR	1 to 5000 PPR
Output Frequency:	100 kHz	100 kHz	100 kHz	100 kHz
Input Power:	5 to 26 VDC, 80 to 135 mA	5 to 26 VDC, 100 mA	5 to 26 VDC, 100 mA	5 to 26 VDC, 80 mA
Available Output Types:	Open Collector, Push-Pull, or Differential Line Driver	Open Collector, Push-Pull, or Differential Line Driver	Open Collector, Push-Pull, or Differential Line Driver	Open Collector, Push-Pull, or Differential Line Driver
Terminations:	MS connector, M12 connector or shielded cable	MS connector, M12 connector or shielded cable	MS connector, M12 connector or shielded cable	MS connector, M12 connector or shielded cable
Mechanical Specifications				
Overall Size:	2.0" dia. x 1.75" dp.	2.0" dia. x 1.9" dp.	3.54" dia. x 1.8" dp.	3.25" dia. x 3.94" dp.
Shaft Size:	3/8" or 5/8"	6 to 16mm; 1/4" to 5/8"	6 to 24mm; 1/4" to 1-1/8"	1/4", 3/8", or 1/2"
Max. Shaft Speed:	10,000 RPM	3600 RPM	3600 RPM	10,000 RPM
Max. Shaft Load:	Tether design accomodates ±0.025" endplay	Tether design accomodates ±0.025" endplay	Tether design accomodates ±0.050" endplay	Integral Coupling
Mounting:	Robust, metal hubshaft	Robust, metal thru-hubshaft	Robust, metal thru-hubshaft	Flange mount with or without pilot; NEMA size 42 motor flange
Environmental Specifications				
Operating Temperature:	0° to +70°C, -40° to +85°C opt.	0° to +70°C -40° to +85°C opt.	-40° to +70°C 0° to +100°C opt.	0° to +70°C, -40° to +85°C opt.
Enclosure Rating:	NEMA 12 / IP54 NEMA 4 / IP66 opt.	NEMA 4 / IP65	NEMA 4 / IP66	NEMA 12 / IP54

Series HS35 Sealed Hollow Shaft

- *Hollow Shaft design eliminates mounting bracket, flexible shaft coupling, and installation labor*
- *Direct shaft mount eliminates shaft alignment procedures*
- *Flexible tether minimizes bearing load*
- *Unbreakable disk*
- *Robust metal hubshaft*
- *Electrically isolated and Thermally insulated*



Dual Isolated Outputs Model

Single Output model shown with LED Output Indicators

APPLICATION/INDUSTRY

The Dynapar brand Series HS35 Sealed Hollowshaft encoder is designed for easy installation on motor or machine shafts. Its hollowshaft design eliminates the need for a flexible shaft coupling, mounting bracket, flower pot, or flange adapter. This not only reduces the installation depth, but also lowers total cost.

DESCRIPTION

The Series HS35 Sealed Hollowshaft is equipped with an unbreakable disk that meets the demands of the most severe shock and vibration generating processes. Its floating shaft mount and spring tether eliminate bearing loads and flexible shaft couplings to eliminate wear and maintenance.

Series HS35 has complete electrical protection from overvoltage, reverse voltage, and output short circuits. In addition, the Series HS35 is not only electrically & thermally isolated, but also environmentally sealed with shaft seals at both ends.

FEATURES AND BENEFITS

Mechanical and Environmental Features

- Unbreakable code disk
- Flexible mounting
- Eliminated bearing loads
- Shaft seals at both ends of hollowshaft
- Sealed connector or cable exit
- Insulated from motor housing/shaft temperatures to 125˚C

Electrical Features

- Overvoltage, reverse voltage, & output short circuit protection
- Noise immunity to EN50082-2
- Electrically isolated

SPECIFICATIONS

STANDARD OPERATING CHARACTERISTICS

Code: Incremental
Resolution: 1 to 2500 PPR (pulses/revolution)
Accuracy: (worst case any edge to any other edge) ±7.5 arc-min.
Format: Two channel quadrature (AB) with optional Index (Z) and complementary outputs
Phase Sense: A leads B for CW shaft rotation viewing the shaft clamp end of the encoder
Quadrature Phasing: 90° ± 22.5° electrical
Symmetry: 180° ± 18° electrical
Index: 180° ± 18° electrical (gated with B low)
Waveforms: Squarewave with rise and fall times less than 1 microsecond into a load capacitance of 1000 pf

ELECTRICAL

Input Power: (each output)
4.5 min. to 26 VDC max. at 100 mA max., not including output loads
Outputs:
7273 Open Collector: 30 VDC max., 40 mA sink max.
7272 Push-Pull and Differential Line Driver: 40 mA sink or source
4469 Differential Line Driver: 100 mA sink or source
Frequency Response: 100 kHz min.
Electrical Protection: Overvoltage, reverse voltage and output short circuit protected
Noise Immunity: Tested to EN50082-2 (Heavy Industrial) for Electro Static Discharge, Radio Frequency Interference, Electrical Fast Transients, Conducted and Magnetic Interference
Mating Connector:
6 pin, style MS3106A-14S-6S (MCN-N4);
7 pin, style MS3106A-16S-1S (MCN-N5);
10 pin, style MS3106A-18-1S (MCN-N6)
5 pin, style M12: Cable with connector available
8 pin, style M12: Cable with connector available

MECHANICAL

Bearing Life: 80,000 hours at 3600 RPM; 128,000 hours at 1800 RPM
Shaft Loading: 40 lbs. radial, 30 lbs. axial
Shaft Speed: 3600 RPM max. (*Important: see Operating Temperature derating for >1800 RPM*)
Shaft Bore Tolerance: Nominal +0.0003"/ +0.0005" (+0.008/+0.013 mm)

Mating Shaft Requirements:
Runout: ±0.025" (±063 mm) radial typical;
Endplay: ±0.050" (±1.27 mm) axial typical;
Minimum: 1.25" (32 mm) recommended;
Maximum: 2.0" (51 mm) to fit inside cover;
Solid shaft recommended; keyway allowed; flatted shaft should not be used
Starting Torque: 5.0 oz-in max.
Running Torque: 4.5 oz.-in max.
Moment of Inertia:
≤ 5/8" bore: 7.9 x 10^{-4} oz–in–sec^2
> 5/8" bore: 25.6 x 10^{-4} oz–in–sec^2
Weight: 16 oz. max.

ENVIRONMENTAL

Operating Temperature:
Standard: –40 to +70 °C;
Extended: 0 to +100 °C;
≤ 5/8" bore: Derate 5 °C per 1000 RPM above 1800 RPM;
> 5/8" bore: Derate 10 °C per 1000 RPM above 1800 RPM.
Storage Temperature: –40 to +90 °C
Shock: 50 G's for 11 milliseconds duration
Vibration: 5 to 2000 Hz at 20 G's
Humidity: to 98% without condensation
Enclosure Rating: NEMA4/IP66 (dust proof, washdown)

Series HS35 Sealed Hollow Shaft

ELECTRICAL CONNECTIONS

6, 7 & 10 Pin MS Connectors and Cables - Code 7= 0 to 8, A to G

Connector & mate/accessory cable assembly pin numbers and wire color information is provided here for reference. HS35 models with direct cable exit carry the same color coding as shown for each output configuration.

Encoder Function	Cable #108594-* 6 Pin Single Ended		Cable #112123-* 6 Pin Dif Line Drv w/o Idx		Cable #108596-* 7 Pin Dif Line Drv w/o Idx		Cable #108595-* 7 Pin (If Used)		Cable #1400635-* 10 Pin (If Used)		Cable #108615-* 12 Pin CCW (If Used)	
	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color
Sig. A	E	BRN	E	BRN	A	BRN	A	BRN	A	BRN	5	BRN
Sig. B	D	ORN	D	ORN	B	ORN	B	ORN	B	ORN	8	ORN
Sig. Z	C	YEL	—	—	—	—	C	YEL	C	YEL	3	YEL
Power +V	B	RED	B	RED	D	RED	D	RED	D	RED	12	RED
N/C	F	—	—	—	—	—	E	—	E	—	7	—
Com	A	BLK	A	BLK	F	BLK	F	BLK	F	BLK	10	BLK
Case	—	—	—	—	G	GRN	G	GRN	G	GRN	9	—
Sig. $\bar{A}$	—	—	C	BRN/WHT	C	BRN/WHT	—	—	H	BRN/WHT	6	BRN/WHT
Sig. $\bar{B}$	—	—	F	ORN/WHT	E	ORN/WHT	—	—	I	ORN/WHT	1	ORN/WHT
Sig. $\bar{Z}$	—	—	—	—	—	—	—	—	J	YEL/WHT	4	YEL/WHT
0V Sense	—	—	—	—	—	—	—	—	—	—	2	GRN
5V Sense	—	—	—	—	—	—	—	—	—	—	11	BLK/WHT

5 & 8 Pin M12 Accessory Cables when Code 7= H or J

Connector pin numbers and cable assembly wire color information is provided here for reference.

Encoder Function	Cable # 112859- 5 Pin Single Ended		Cable # 112860- 8 Pin Single Ended		Cable # 112860- 8 Pin Differential	
	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color
Sig. A	4	BLK	1	BRN	1	BRN
Sig. B	2	WHT	4	ORG	4	ORG
***Sig. Z**	5	GRY	6	YEL	6	YEL
Power +V	1	BRN	2	RED	2	RED
Com	3	BLU	7	BLK	7	BLK
Sig. $\bar{A}$	–	–	–	–	3	BRN/WHT
Sig. $\bar{B}$	–	–	–	–	5	ORG/WHT
***Sig. $\bar{Z}$**	–	–	–	–	8	YEL/WHT

* Index not provided on all models. See ordering information

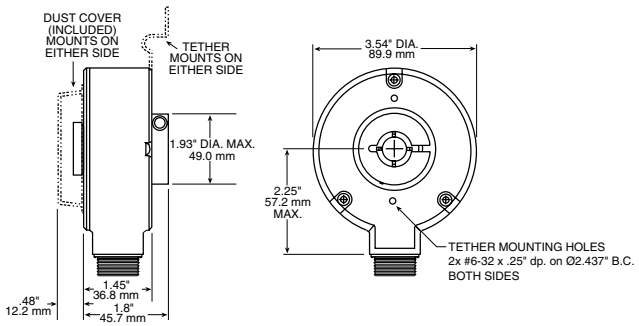
Cable Configuration: PVC jacket, 105 °C rated, overall foil shield; 24 AWG conductors, minimum

See "Accessories" Section for Connectors and Cable Assemblies Ordering Information

Series HS35 Sealed Hollow Shaft

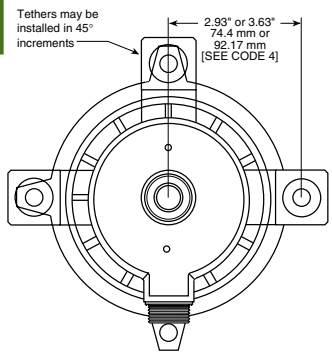
DIMENSIONS

Dimensions

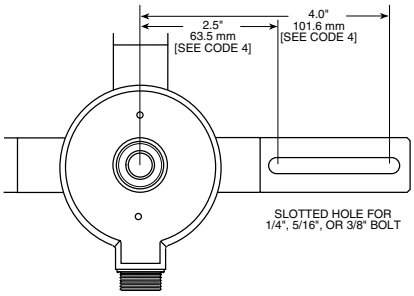


Code 4: Fixing

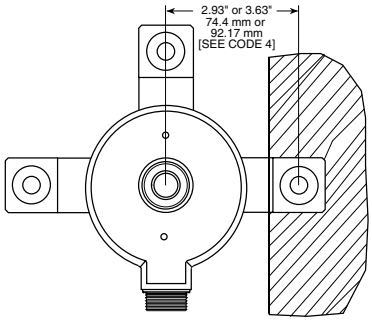
1, 2
C-face Motor Mount



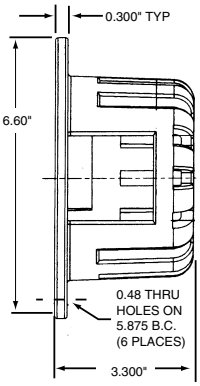
3
Fan Cover Motor Mount



1, 3
Machine Mount

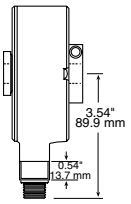


4, 5, 6, 7
Cover Option

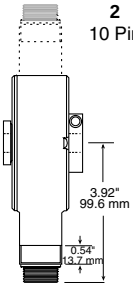


Code 7: Termination

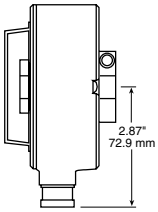
0, 1
6 & 7 Pin MS



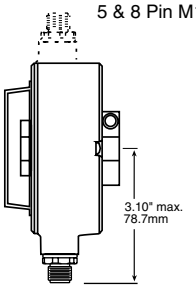
2
10 Pin MS



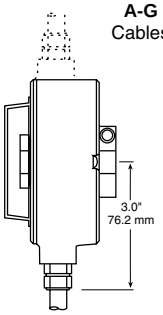
3
12 Pin MS



H, J
5 & 8 Pin M12



A-G
Cables



6 & 7 Pin and 10 Pin shown with
LED Output Indicator Option - Code 8: **PS**

Series HS35 Sealed Hollow Shaft

ORDERING INFORMATION

Code 1: Model	Code 2: PPR	Code 3: Bore Size	Code 4: Fixing	Code 5: Format	Code 6: Output	Code 7: Termination	Code 8: Options
HS35	□□□□	□	□	□	□	□	□□

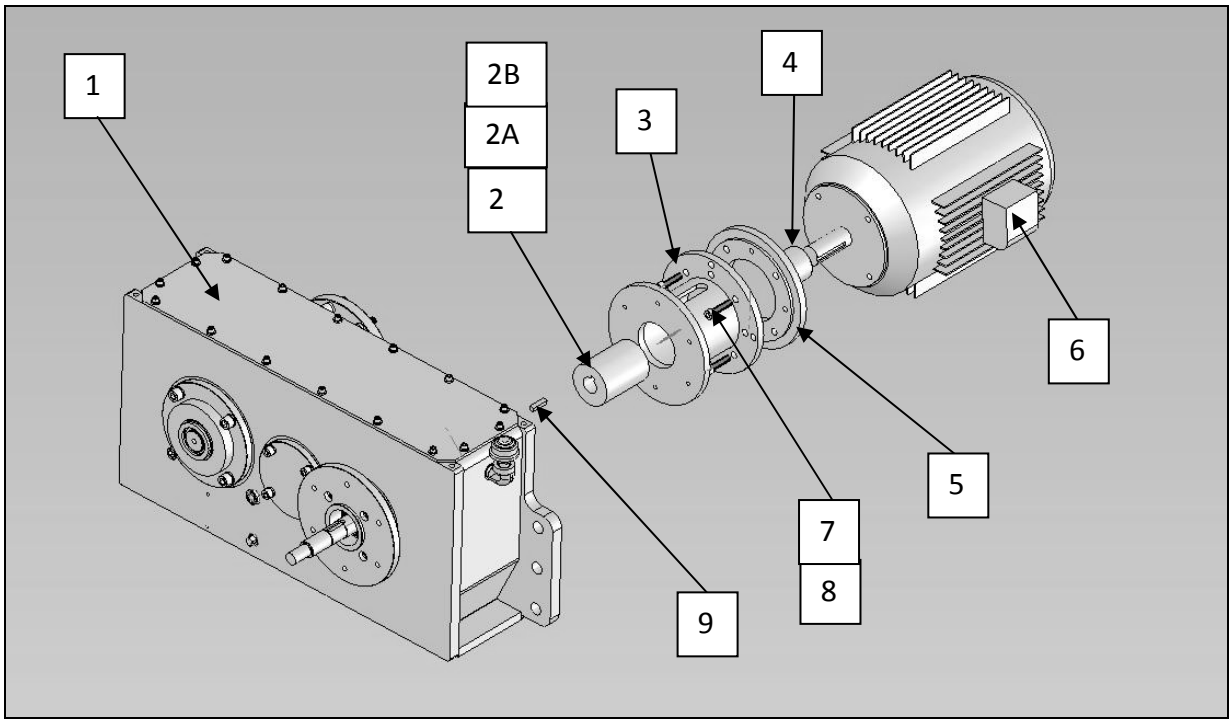
Ordering Information

Code 1: Model	Code 2: PPR	Code 3: Bore Size	Code 4: Fixing	Code 5: Format	Code 6: Output	Code 7: Termination	Code 8: Options
HS35 Size 35 heavy-duty, sealed hollowshaft encoder	**0001** **0500** **0003** **0512** **0010** **0600** **0012** **0900** **0050** **1000** **0060** **1024** **0064** **1200** **0100** **1270** **0120** **1500** **0240** **1800** **0250** **2000** **0300** **2048** **0360** **2400** **2500**	**0** 6 mm **1** 1/4" **2** 5/16" **3** 8 mm **4** 3/8" **5** 10 mm **6** 12 mm **7** 1/2" **8** 5/8" **9** 15 mm **A** 16 mm **B** 19 mm **C** 3/4" **D** 20 mm **E** 7/8" **F** 24 mm **G** 1" **H** 1-1/8"	**0** None - customer supplied **1** Clearance hole for 3/8" bolt on 5.88" dia. bolt circle (to fit 4-1/2" NEMA C-face) **2** Clearance hole for 1/2" bolt on 7.25" dia. bolt circle (to fit 8-1/2" NEMA C-face) **3** Slotted hole for bolt on 2.5" to 4.0" radius (to fit standard AC motor fan cover slots) Available when Code 5 is 0-4: **4** Same as **'1'**, w/ cover kit **5** Same as **'3'**, w/ cover kit Available when Code 5 is 5: **6** Same as **'1'** w/ dual cover kit **7** Same as **'3'** w/ dual cover kit	**0** single ended, undirectional (A) **1** single ended, bidirectional (AB) **2** single ended, bidirectional with index (ABZ) available when Code 6 is 3, 4, 5, 6, A or B: **3** differential, bidirectional ($A\bar{A}$ $B\bar{B}$) available when Code 6 is 3, 4, 5, 6, A or B and Code 7 is 2, 3, or 7 thru G, J: **4** differential, bidirectional with index ($A\bar{A}$ $B\bar{B}$ $Z\bar{Z}$) available when Code 6 is 3, 4, 5, 6, A or B, and Code 7 is 2, 7, A thru G, J: **5** Dual isolated differential, bi-directional w/index ($A\bar{A}B\bar{B}Z\bar{Z}$)	**0** 5-26V in, 5-26V open collector out **1** 5-26V in, 5-26V open collector out w/ 2.2kΩ pullups **2** 5-26V in, 5-26V push-pull out available when Code 5 is 3, 4 or 5: **3** 5-26V in, 5V line driver out (7272) **4** 5-26V in, 5-26V line driver out (7272) **5** 5-26V in, 5 V Differential Line Driver out (4469) **6** 5-15V in, 5-15 V Differential Line Driver out (4469) **A** same as **'3'** with high temp. to 100˚C **B** same as **'4'** with high temp. to 100˚C	**0** 6 pin connector **1** 7 pin connector **2** 10 pin connector **3** 12 pin connector **5** 6 pin connector, plus mating connector **6** 7 pin connector, plus mating connector **7** 10 pin connector, plus mating connector **8** 12 pin connector, plus mating connector **A** 18" (.5m) cable **B** 36" (1m) cable **C** 72" (2m) cable **D** 10' (3m) cable **F** 13" (.3m) cable with 10 pin connector plus mating connector **G** 13" (.3m) cable **J** 8 Pin M12 Connector available when Code 5 is 0 thru 2 **H** 5 Pin M12 Connector	available when Code 7 is 0 - 2 or 5 - 7: **PS** LED Output Indicator

109473-0001	Tether kit (clearance hole for 3/8" bolt on 5.88" dia. bolt circle)
109473-0002	Tether kit (clearance hole for 1/2" bolt on 7.25" dia. bolt circle)
109473-0003	Tether kit (slotted hole for bolt on 2.5" to 4.0" radius)
112121-0001	Spare Hub Clamp (Bore size Code 3: 0 - 9)
112121-0002	Spare Hub Clamp (Bore size Code 3: A - H)
110533-0001	Cover Kit, 56C face
110533-0002	Cover Kit, fan cover
110533-0003	Dual Cover Kit, 56C face
110533-0004	Dual Cover Kit, fan cover

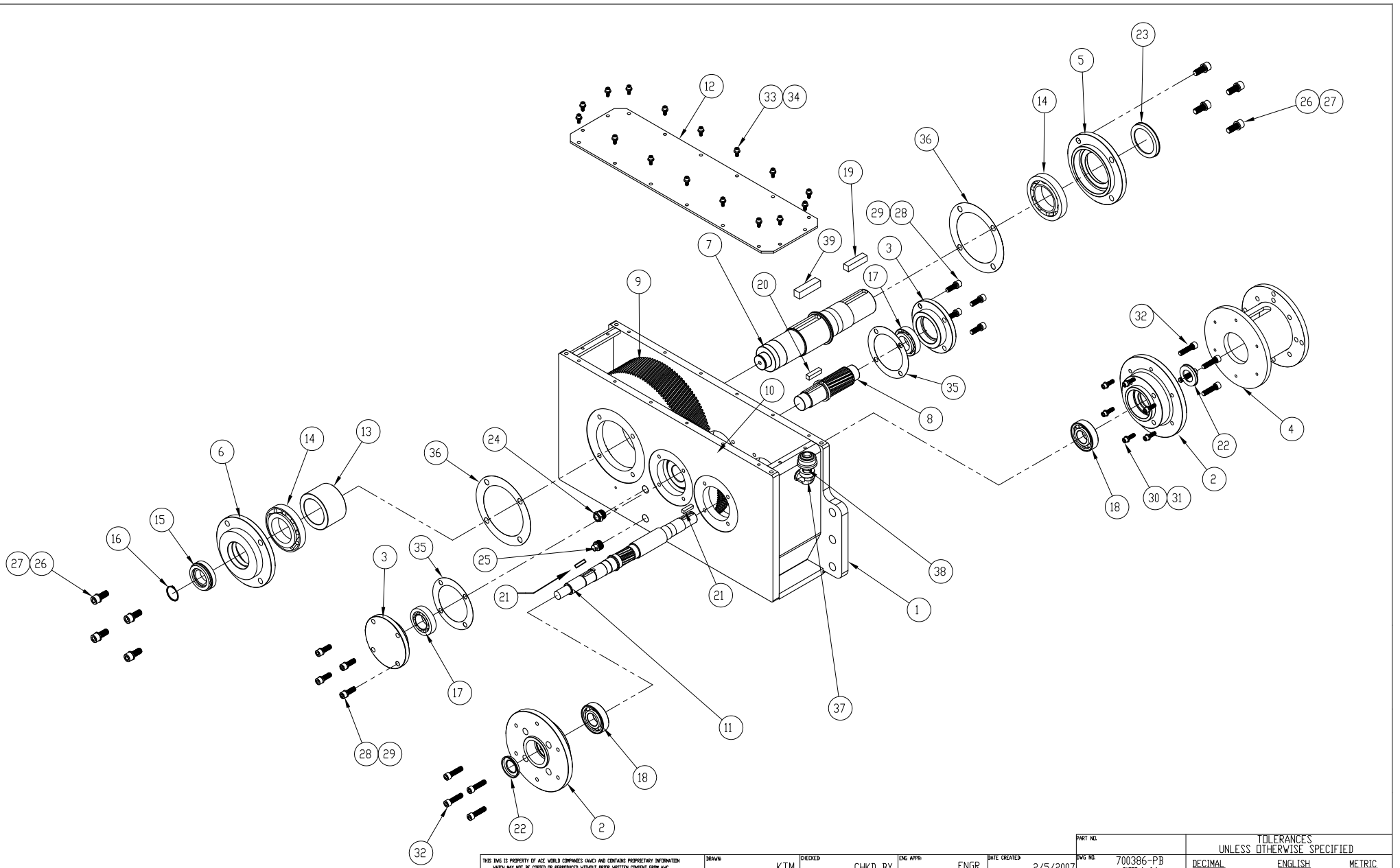
MOTOR MOUNT

FIGURE 7, HOIST MOTOR & REDUCER ASSEMBLY T30



ITEM	QTY	PART NUMBER	DESCRIPTION
1			Hoist Gearbox Assembly
2	1	100806-00	Coupling
2A	1	105597-00	Spider
2B	1	105594-00	Coupling
3	1	100907-0000	Adapter, Motor
4	1	106778-0000	Spacer
5	1	See Table	Adapter
6	1	See Table	Motor
7	4	100407-00	Cap screw, 1/2 -13 x 2” Lg
8	4	100612-00	Lock washer, 1/2"
9	1	101694-00	Keyway, 3/8” x 1 ½” Lg

TABLE				
6’, 8’ and 10’ GAGE				
ITEM 5	100903-0000	ITEM 6	10 HP	202356-00
5	100903-0000	6	15 HP	203956-00
5	100903-0000	6	20 HP	202359-00
5	100903-0000	6	25 HP	202357-00
5	100905-0000	6	30 HP	202358-00



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ACEWORLDCOMPANIES.COM

DRAWN: KTM | CHECKED: CHKD BY | ENG APPR: ENGR

T30HP2 HOIST GEARBOX ASSEMBLY

DO NOT SCALE DRAWING

DATE CREATED: 2/5/2007
LAST REVISED: 4/30/2008
WEIGHT:
SCALE: 1:10 B

PART NO.
DWG NO. 700386-PB
SHEET 1 of 1
JOB NO. –
QTY. –
THIRD ANGLE PROJECTION

TOLERANCES UNLESS OTHERWISE SPECIFIED

	ENGLISH	METRIC
DECIMAL .X	±.05	±.5mm
.XX	±.015	±.10mm
.XXX	±.005	±.01mm
.XXXX	±.0005	
ANGULAR ± 0°30'		HEAT TREATMENT
LINEAR FRACTIONAL	±1/16"	ROCKWELL ±4
HOLES FRACTIONAL	±1/32"	BRINELL ±15

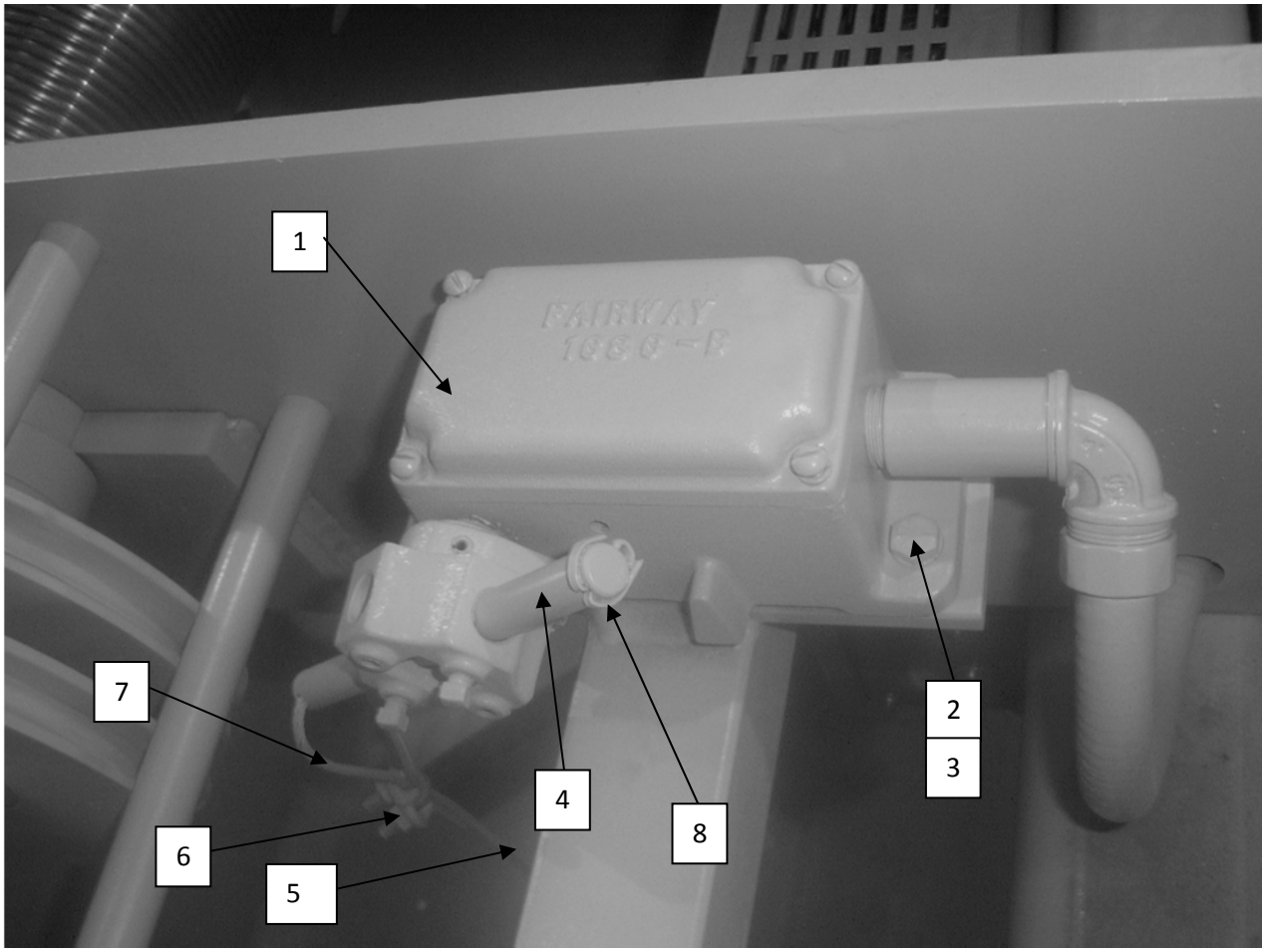
FIG.8 REDUCER PARTS LIST

ITEM	QTY.	PART NUMBER	DESCRIPTION
1	1	100893-0000	HOUSING, GEARBOX, T30HP2
2	2	100906-0000	T30HP2, BRAKE ADAPTOR/CAPSULES
3	2	100908-0000	CAPSULE, CLOSED
4	1		T30HP2, ADAPTOR, MOTOR
5	1	100909-0000	CAPSULE, OPEN
6	1	100899-0000	CAPSULE, OPEN
7	1	100912-0000	T30HP2, OUTPUT SHAFT, SINGLE
8	1	SEE TABLE	T30HP2, DRUM PINION & SHFT
9	1	SEE TABLE	T30HP2, DRUM GEAR
10	1	100911-0000	T30HP2, MOTOR GEAR
11	1	100915-0000	T30HP2, MTR PINION & SHAFT
12	1	100894-0000	T30HP2 GEARBOX LID, 1/4" THK.
13	1	100910-0000	SPACER, T30 DRUM GEAR
14	2	100703-00	BRG, 30216
15	1	100975-00	BEARING, BMB-6209/080S2/EB002A
16	1	100795-00	SNAP RING, EX, SH-177
17	2	100963-00	BEARINGS, 32209, SKF
18	2	100964-00	BEARINGS, 6308 2RS C3, DOUBLE SEAL
19	1	105087-0000	SQUARE, 3/4" 4140 ANNEALED
20	1	105602-00	KEYSTOCK, 1/2" SQ.
21	1	101694-00	KEYSTOCK, 3/8" SQ
22	2	100965-00	SEAL, CR 15142, NITRILE
23	1	100023-00	SEAL, 31173, 3-1/8" SHAFT
24	1	100008-00	SIGHT GAUGE
25	1	100009-00	PLUG 3/4 NPT MALE PLUG
26	8	100380-00	SCREW, SHCS, 5/8"-11 X 1 1/2"
27	8	100614-00	WASHER, LOCK, 5/8"
28	8	100374-00	SCREW, SHCS, 1/2"-13 X 1 1/2"
29	8	100612-00	WASHER, LOCK, 1/2"
30	6	100369-00	SCREW, SHCS, 3/8"-16 X 1 1/4" GR5
31	6	100611-00	WASHER, LOCK,3/8"
32	8	100090-00	SCREW, SHCS, 1/2"-13 X 2" GR5
33	16	101624-00	SCREW, SHCS, 5/16"-18 X 3/4" GR5
34	16	100610-00	WASHER, LOCK, 5/16"
35	2	32209SHIM	SHIM SET, 32209 CAPSULE, .003/.005/.010
36	2	22216SHIM	SHIM SET, 22216 CAPSULE, .003/.005/.010
37	1	3/4STELBOW90	ELBOW, ST, 3/4 X 90^0
38	1	100010-00	BREATHER, 3/4 NPT
39	1	105707-00	KEYSTOCK, SQ 7/8" X 3-3/8" 4140HT

RATIOS

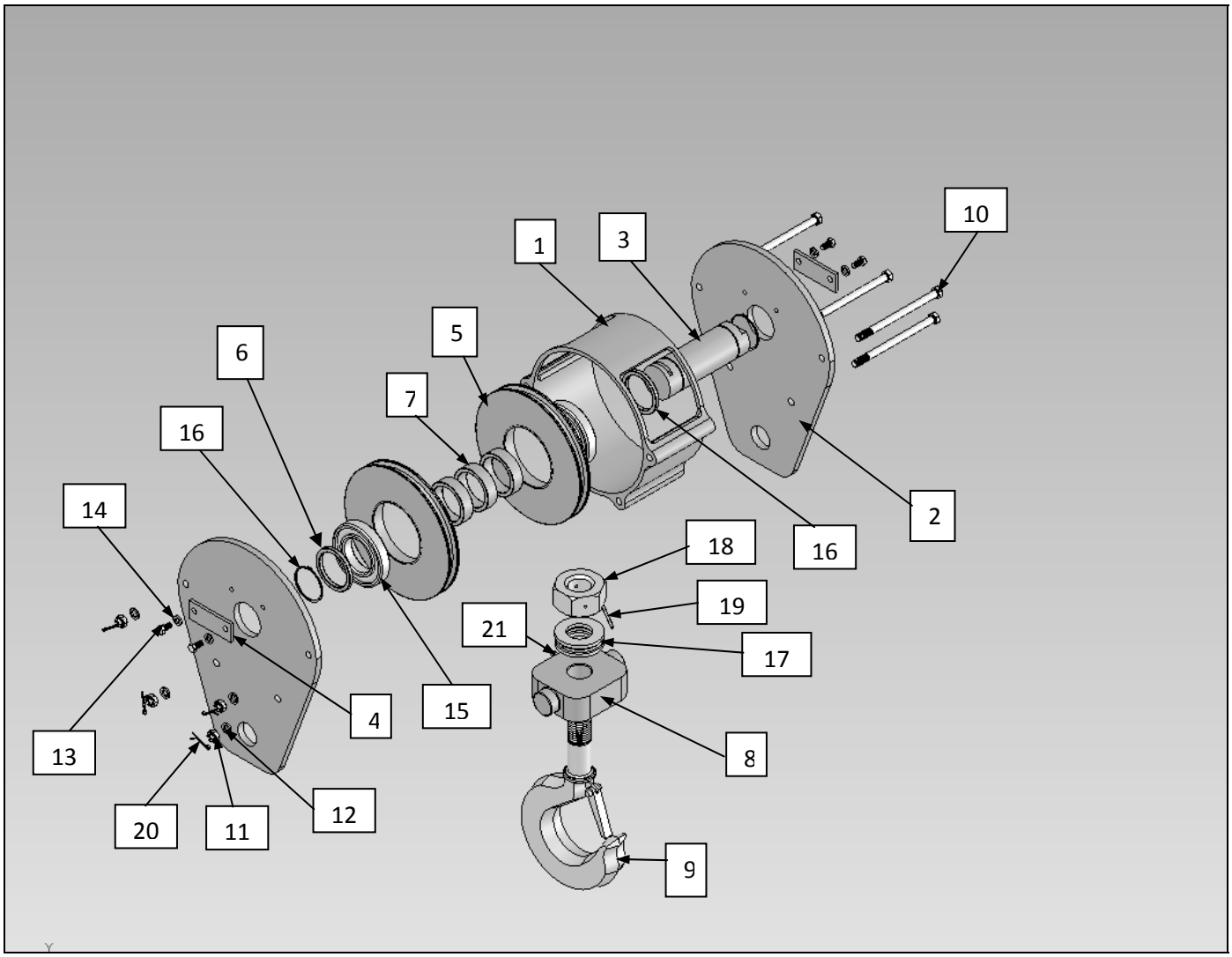
ITEM	34.1:1	39.6:1	49.7:1	56.5:1
8	100931-0000	100929-0000	100925-0000	100923-0000
9	100930-0000	100928-0000	100924-0000	100922-0000

FIG. 9, UPPER LIMIT SWITCH INSTALLATION T30



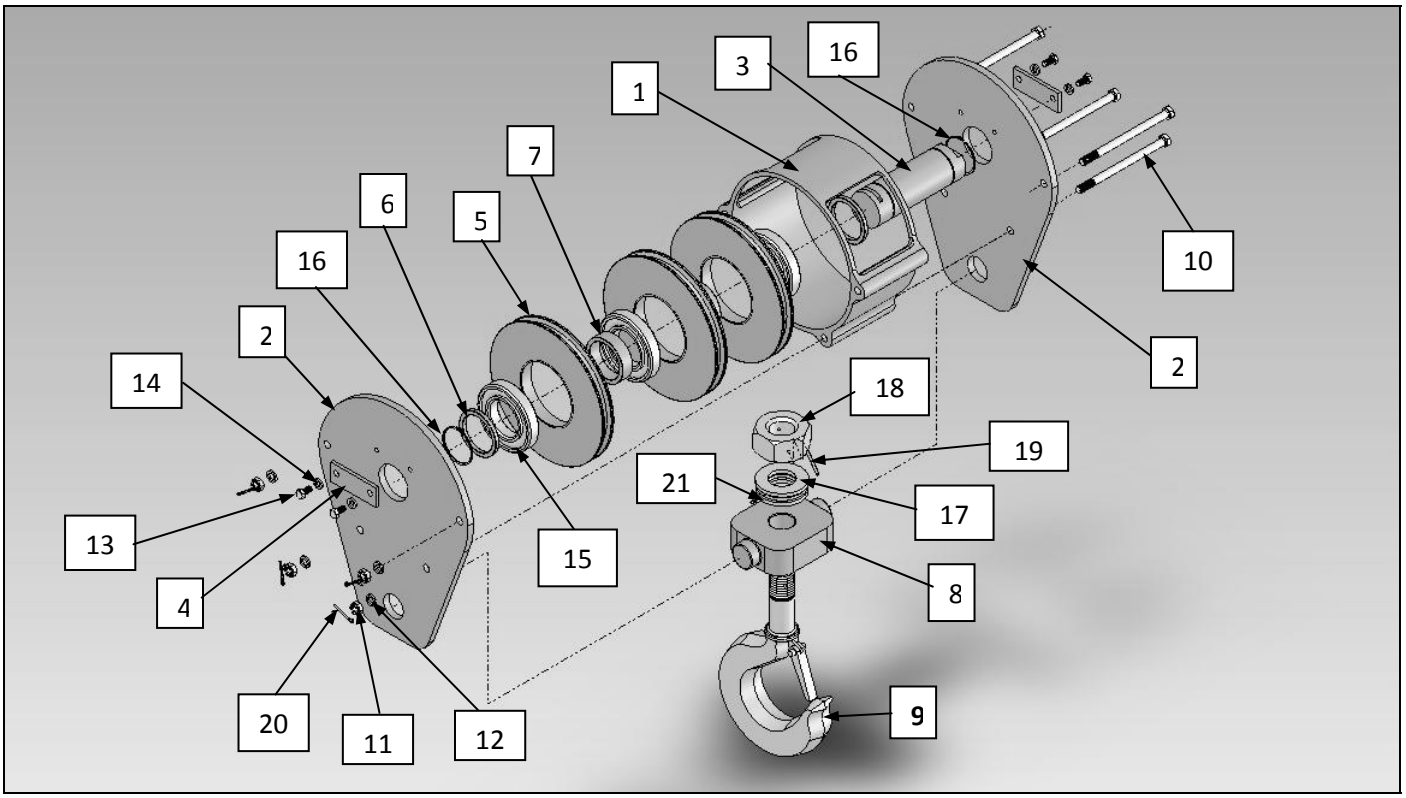
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	101135-00	SWITCH, Limit
2	4	100391-00	BOLT, Hx Hd., 5/16-18 x 3/4” Lg
3	4	100611-00	WASHER, Lock, 3/8”
4	1	101124-0000	ARM, Switch, Limit
5	1	101125-0000	WEIGHTS, Switch, Limit
6	2	101112-00	CLIP, Cable, 1/8
7	1	101110-00	CABLE, 1/8”
8	1	100016-00	PIN, Cotter, 1/8 x 1-1/2” Lg.

FIGURE 10, 5 & 7.5 TON LOADBLOCK ASSEMBLY, 200191-0000



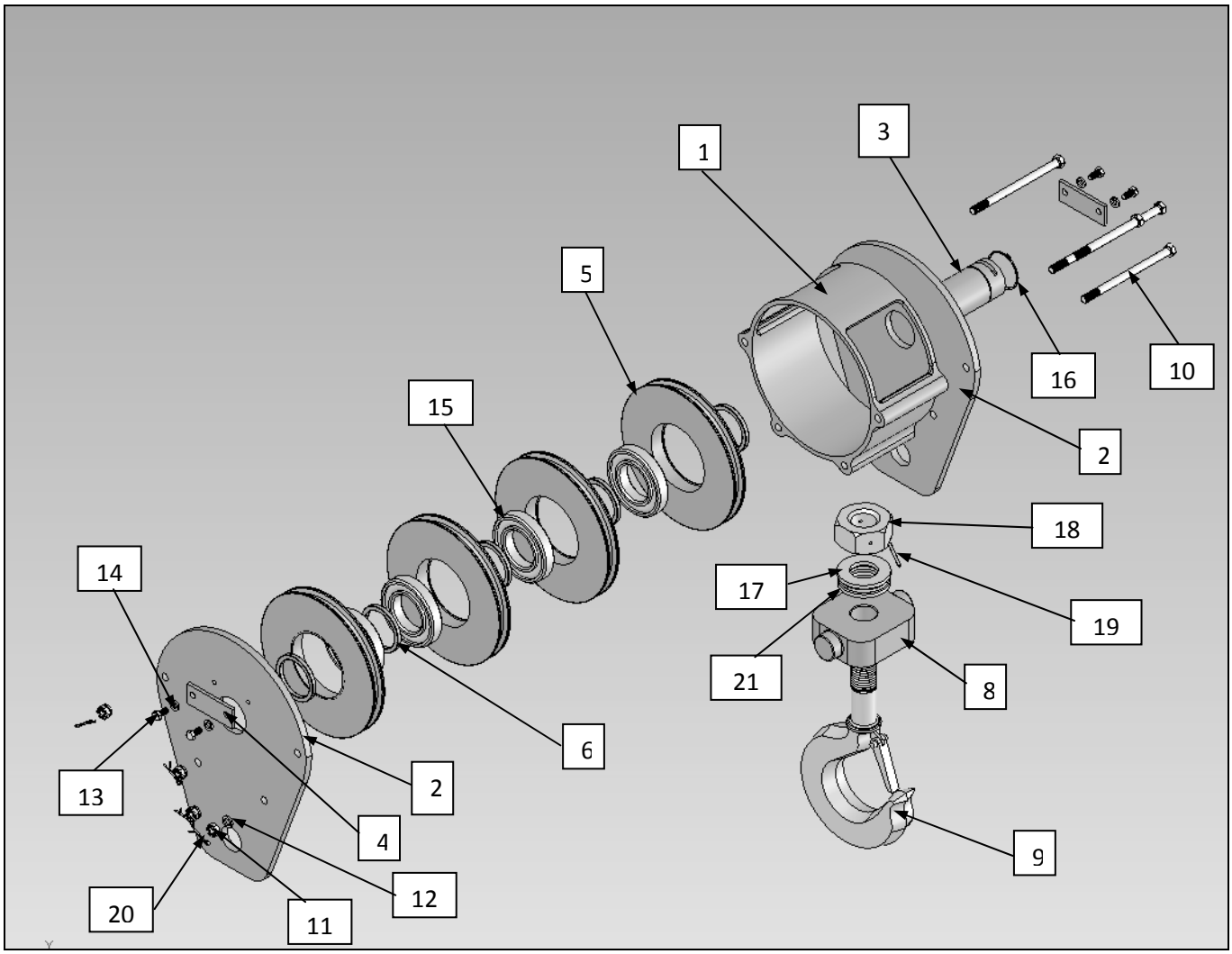
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	104373-0000	Skirt/Shroud
2	1	100956-0000	Side Plates (Pair)
3	1	100898-0000	Pin
4	2	100097-0000	Keeper
5	2	100890-0000	Sheave, 10”
6	2	100897-0000	Spacer
7	3	100896-0000	Spacer
8	1	100972-0000	Trunion
9	1	104911-0000	Hook
10	4	104354-00	Bolt, H x Hd, 1/2”-20 x 7 1/2 “
11	4	104356-00	Nut, Slotted, 1/2-20
12	4	100612-00	Washer, Lock 1/2
13	4	100110-00	Bolt, H x Hd, 3/8-16 x 3/4"
14	4	100611-00	Washer, Lock, 3/8”
15	2	101614-00	Bearing
16	2	104374-00	Ring, Snap
17	1	100699-00	Bearing
18	1	100601-00	Nut, Bearing
19	1	100652-00	Pin, Roll
20	4	104357-00	Pin, Cotter, 1/8 x 1 1/2
21	1	100021-00	Fitting, Grease

FIGURE 10, 10 TON LOADBLOCK ASSEMBLY, 200192-0000



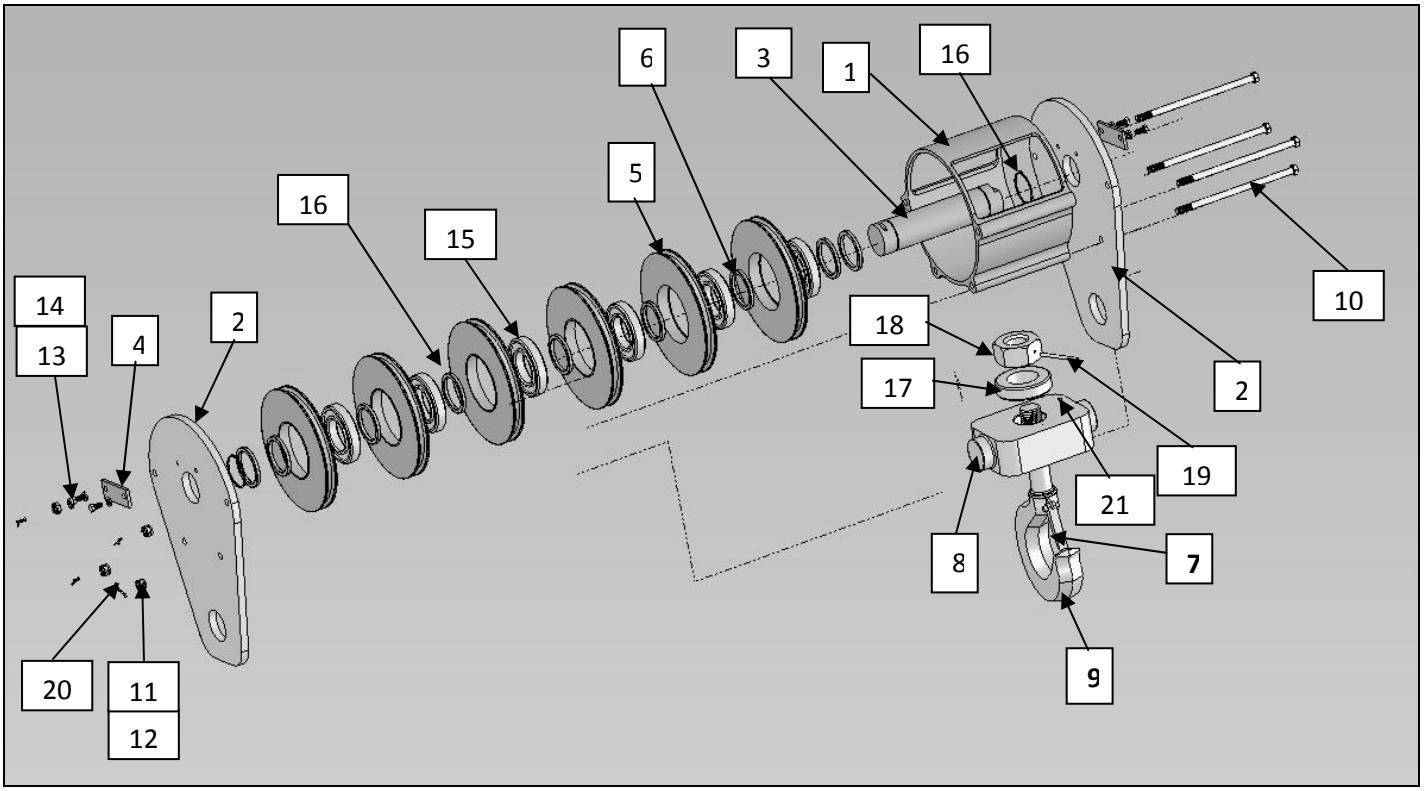
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	104373-0000	Skirt/Shroud
2	1	100956-0000	Side Plates (Pair)
3	1	100898-0000	Pin
4	2	100097-0000	Keeper
5	3	100890-0000	Sheave, 10”
6	2	100897-0000	Spacer
7	2	100896-0000	Spacer
8	1	100972-0000	Trunion
9	1	104911-0000	Hook
10	4	104354-00	Bolt, H x Hd, 1/2”-20 x 7 1/2 “
11	4	104356-00	Nut, Slotted, 1/2-20
12	4	100612-00	Washer, Lock 1/2
13	4	100110-00	Bolt, H x Hd, 3/8-16 x 3/4"
14	4	100611-00	Washer, Lock, 3/8”
15	3	101614-00	Bearing
16	2	104374-00	Ring, Snap
17	1	100699-00	Bearing
18	1	100598-00	Nut, Bearing
19	1	100650-00	Pin, Roll
20	4	104357-00	Pin, Cotter, 1/8 x 1 1/2
21	1	100021-00	Fitting, Grease

FIGURE 10, 15 TON LOADBLOCK ASSEMBLY, 200193-0000



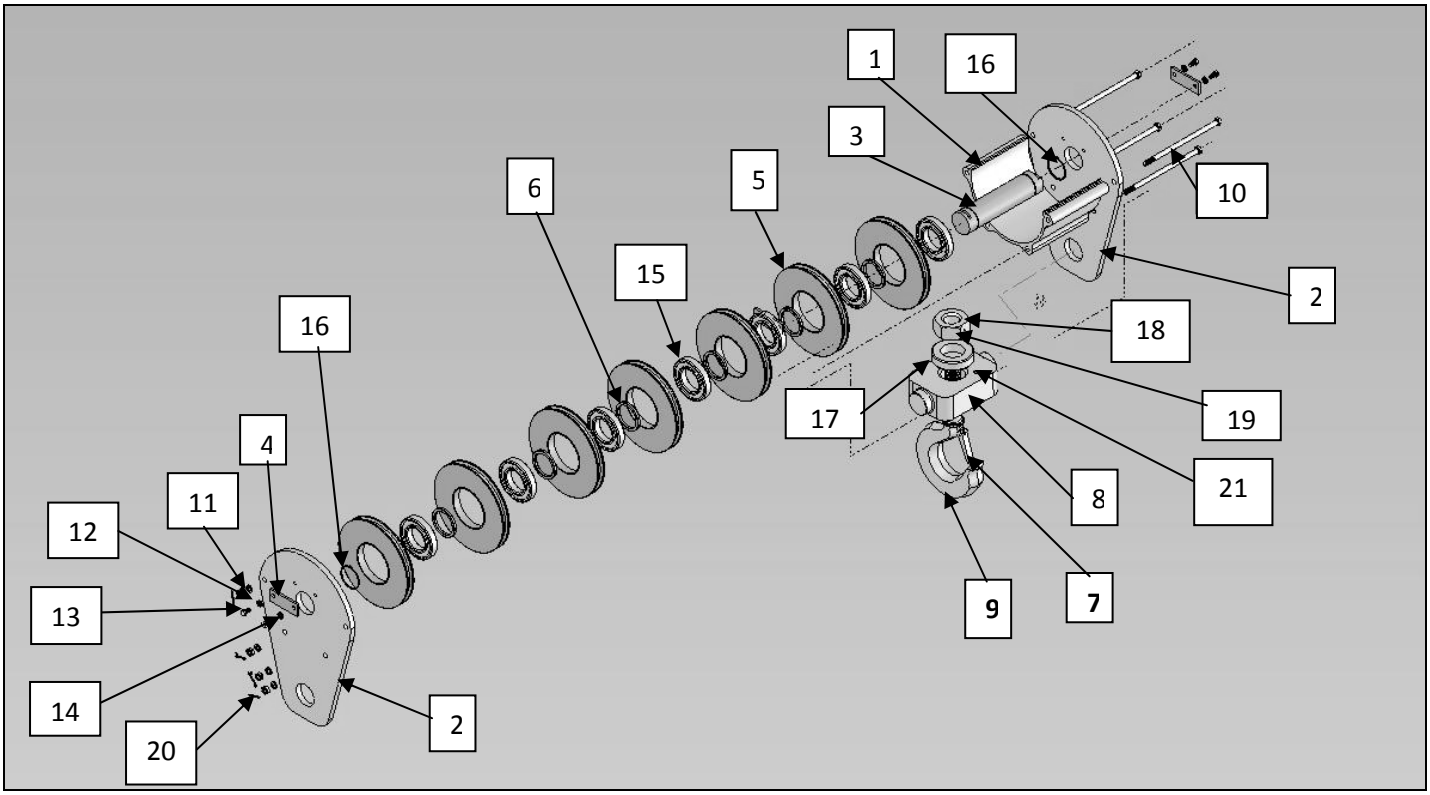
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	104373-0000	Skirt/Shroud
2	1	100956-0000	Side Plates (Pair)
3	1	100898-0000	Pin
4	2	100097-0000	Keeper
5	4	100890-0000	Sheave, 10”
6	5	100897-0000	Spacer
8	1	100972-0000	Trunion
9	1	104911-0000	Hook
10	4	104354-00	Bolt, H x Hd, 1/2”-20 x 10 1/2 “
11	4	104356-00	Nut, Slotted, 1/2-20
12	4	100612-00	Washer, Lock 1/2
13	4	100110-00	Bolt, H x Hd, 3/8-16 x 3/4"
14	4	100611-00	Washer, Lock, 3/8”
15	4	101614-00	Bearing
16	2	104374-00	Ring, Snap
17	1	100699-00	Bearing
18	1	100598-00	Nut, Bearing
19	1	100650-00	Pin, Roll
20	4	104537-00	Pin, Cotter, 1/8 x 1 1/2
21	1	100021-00	Fitting, Grease

FIGURE 10, 20 TON LOADBLOCK ASSEMBLY, 200194-0000



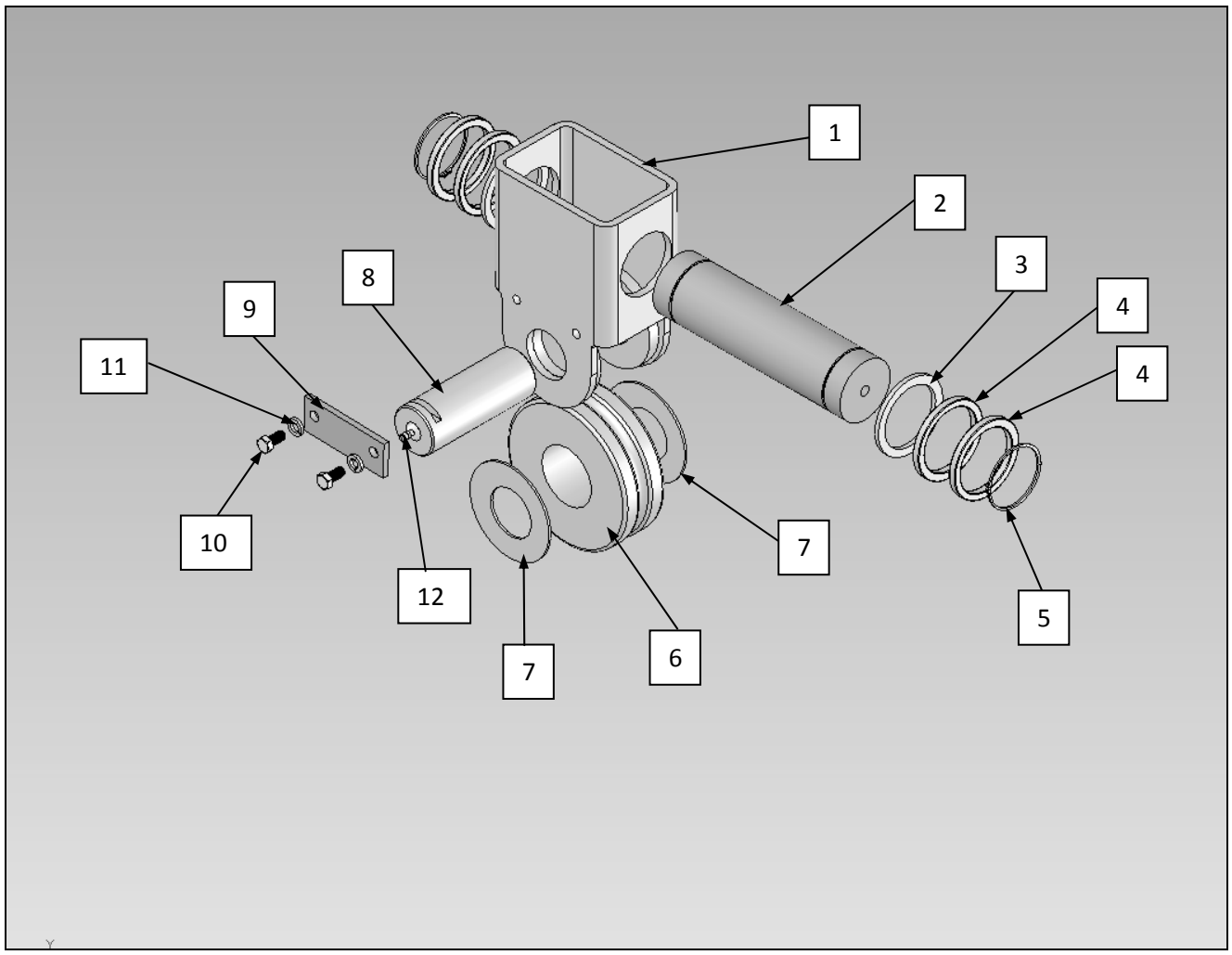
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	104372-0000	Skirt/Shroud
2	1	100954-0000	Side Plates (Pair)
3	1	106775-0000	Pin
4	2	100097-0000	Keeper
5	6	100890-0000	Sheave, 10”
6	9	100897-0000	Spacer
7	1	102264-00	Latch Kit
8	1	100953-0000	Trunion
9	1	102715-0000	Hook
10	4	104355-00	Bolt, H x Hd, 1/2”-20 x 10 1/2 “
11	4	104356-00	Nut, Slotted, 1/2-20
12	4	100612-00	Washer, Lock 1/2
13	4	100110-00	Bolt, H x Hd, 3/8-16 x 3/4"
14	4	100611-00	Washer, Lock, 3/8”
15	6	101614-00	Bearing
16	2	104374-00	Ring, Snap
17	1	100700-00	Bearing
18	1	100601-00	Nut, Bearing (Hook)
19	1	100652-00	Pin, Roll
20	4	104537-00	Pin, Cotter, 1/8 x 1 1/2
21	1	100021-00	Fitting, Grease

FIGURE 10, 25 TON LOADBLOCK ASSEMBLY, 200195-0000



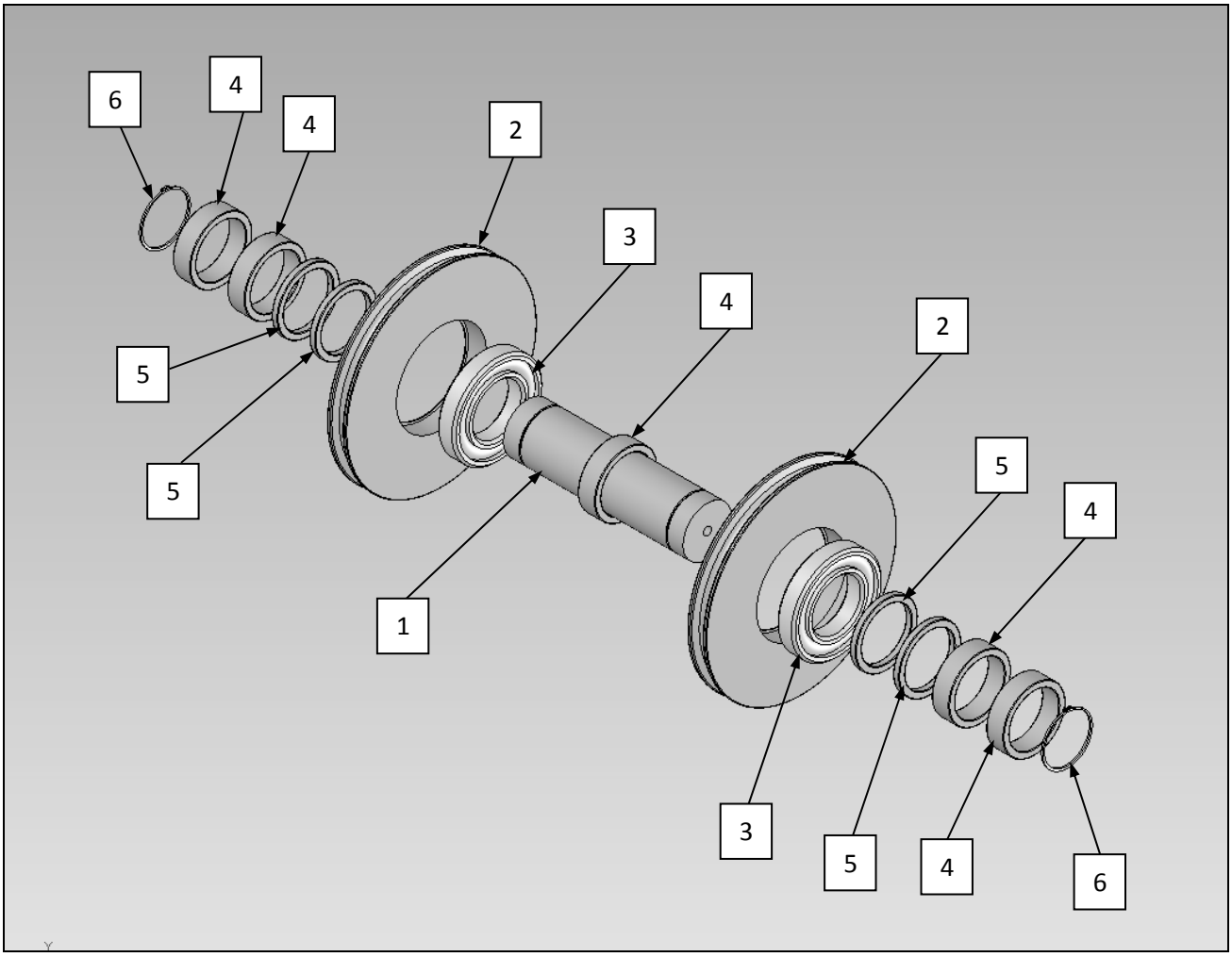
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	109583-0000	Skirt/Shroud
2	1	100954-0000	Side Plates (Pair)
3	1	106775-0000	Pin
4	2	100097-0000	Keeper
5	7	100890-0000	Sheave, 10”
6	6	100897-0000	Spacer
7	1	102264-00	Latch Kit
8	1	100953-0000	Trunion
9	1	102715-0000	Hook
10	4	104355-00	Bolt, H x Hd, 1/2”-20 x 10 1/2 “
11	4	104356-00	Nut, Slotted, 1/2-20
12	4	100612-00	Washer, Lock 1/2
13	4	100110-00	Bolt, H x Hd, 3/8-16 x 3/4"
14	4	100611-00	Washer, Lock, 3/8”
15	6	101614-00	Bearing
16	2	104374-00	Ring, Snap
17	1	100700-00	Bearing
18	1	100601-00	Nut, Bearing
19	1	100652-00	Pin, Roll
20	4	104537-00	Pin, Cotter, 1/8 x 1 1/2
21	1	100021-00	Fitting, Grease

FIGURE 11, 5 - 7.5 TON TOP SHEAVE ASSEMBLY, 401912-0000



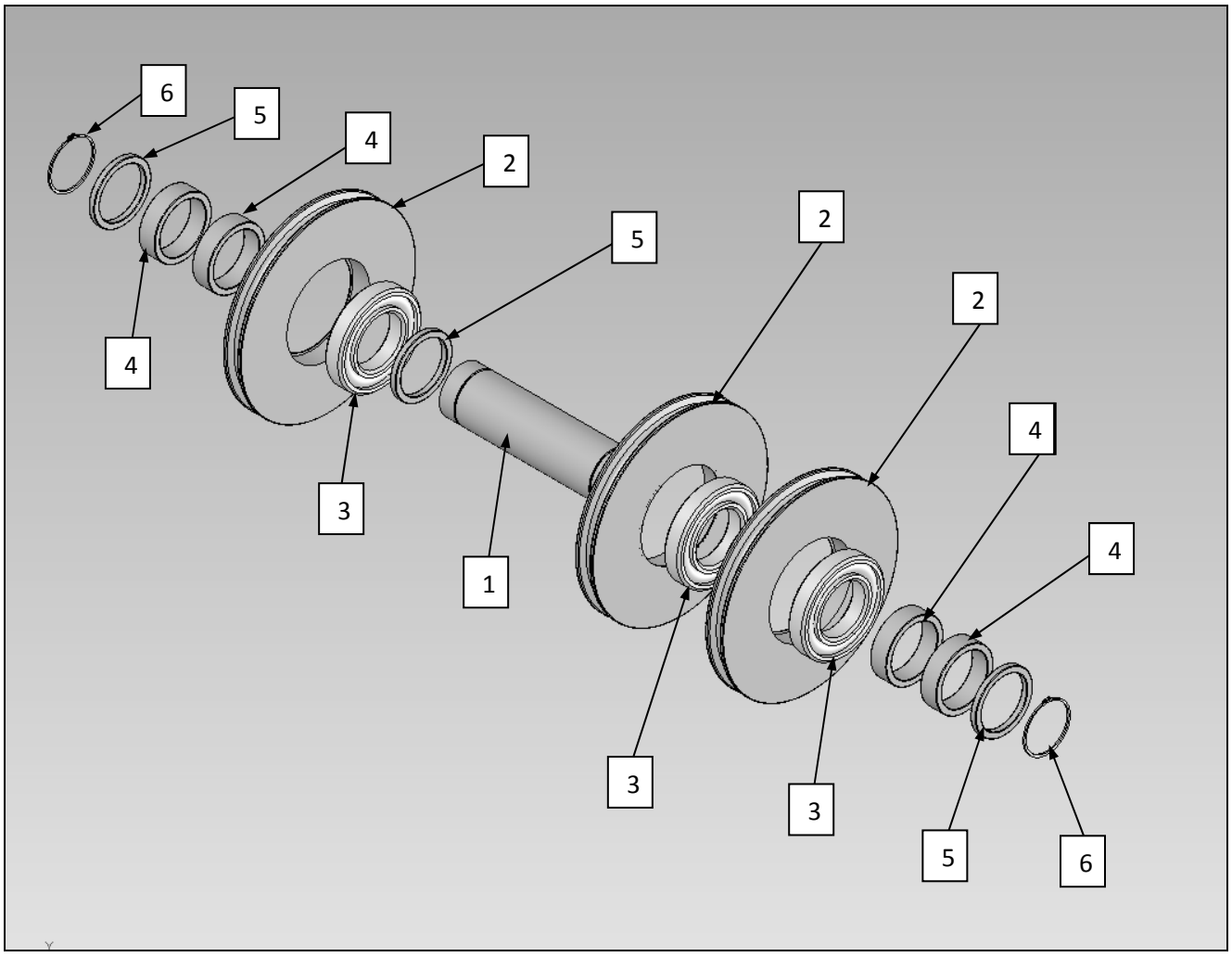
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	104828-0000	IDLER SHEAVE POCKET
2	1	106774-0000	PIN, Pivot
3	2	104370-00	SPACER
4	4	100897-0000	SPACER
5	2	104374-00	RING, Snap
6	1	104827-00	SHEAVE, Idler
7	2	101210-00	SPACER
8	1	102456-0000	PIN, Idler Sheave
9	1	100097-0000	KEEPER
10	2	100110-00	3/8 -16 X 3/4 Lg Hex Bolt
11	2	100611-00	3/8 Lockwasher
12	1	100021-00	GREASE FITTING, 1/8 NPT

FIGURE 11, 10 TON UPPER SHEAVE ASSEMBLY, 401913-0000



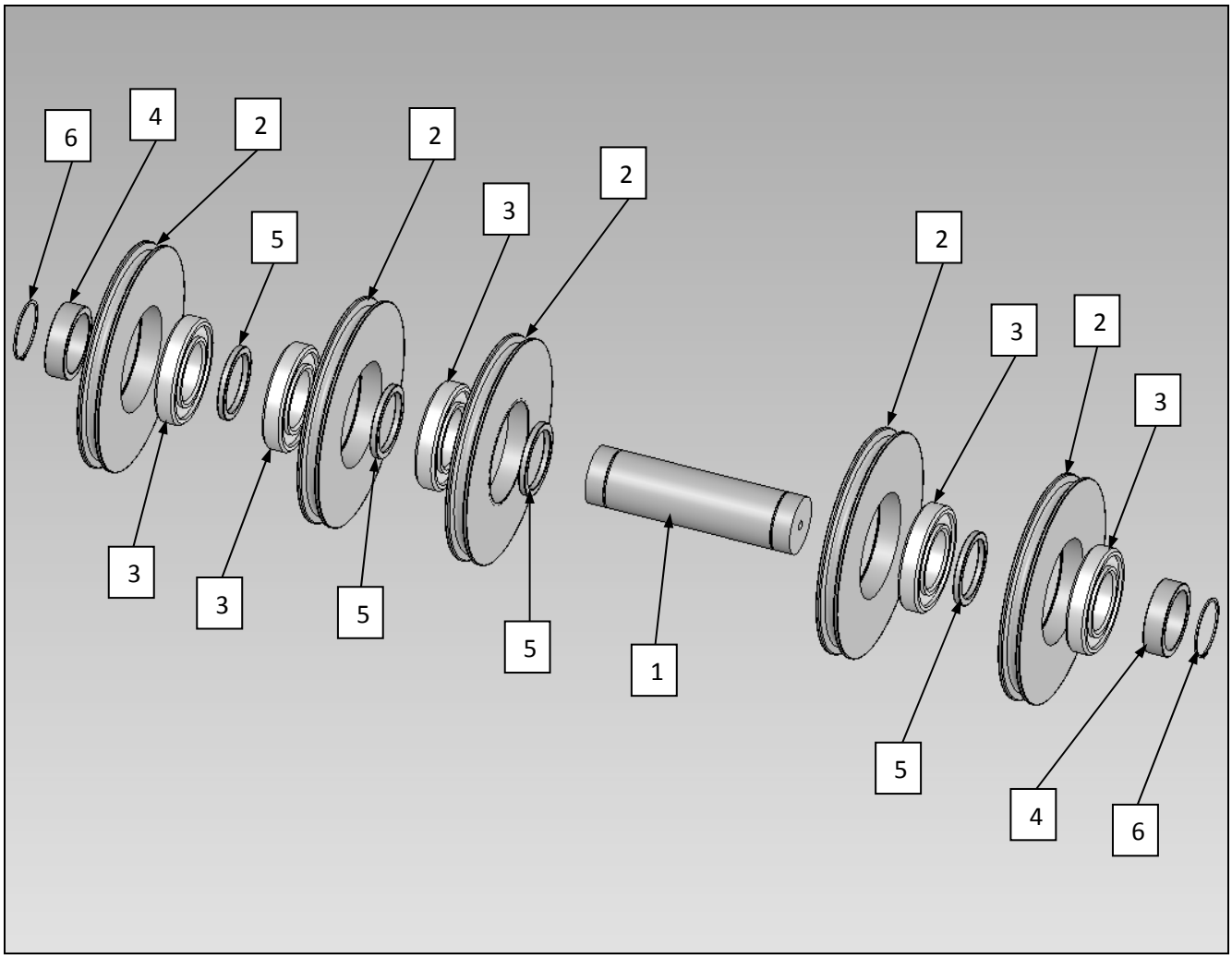
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	106774-0000	PIN, Sheave
2	2	100890-0000	SHEAVE
3	2	101614-00	BEARING
4	5	100896-0000	SPACER
5	4	100897-0000	SPACER
6	2	104374-00	RING, Snap

FIGURE 11, 15 TON UPPER SHEAVE ASSEMBLY, 401914-0000



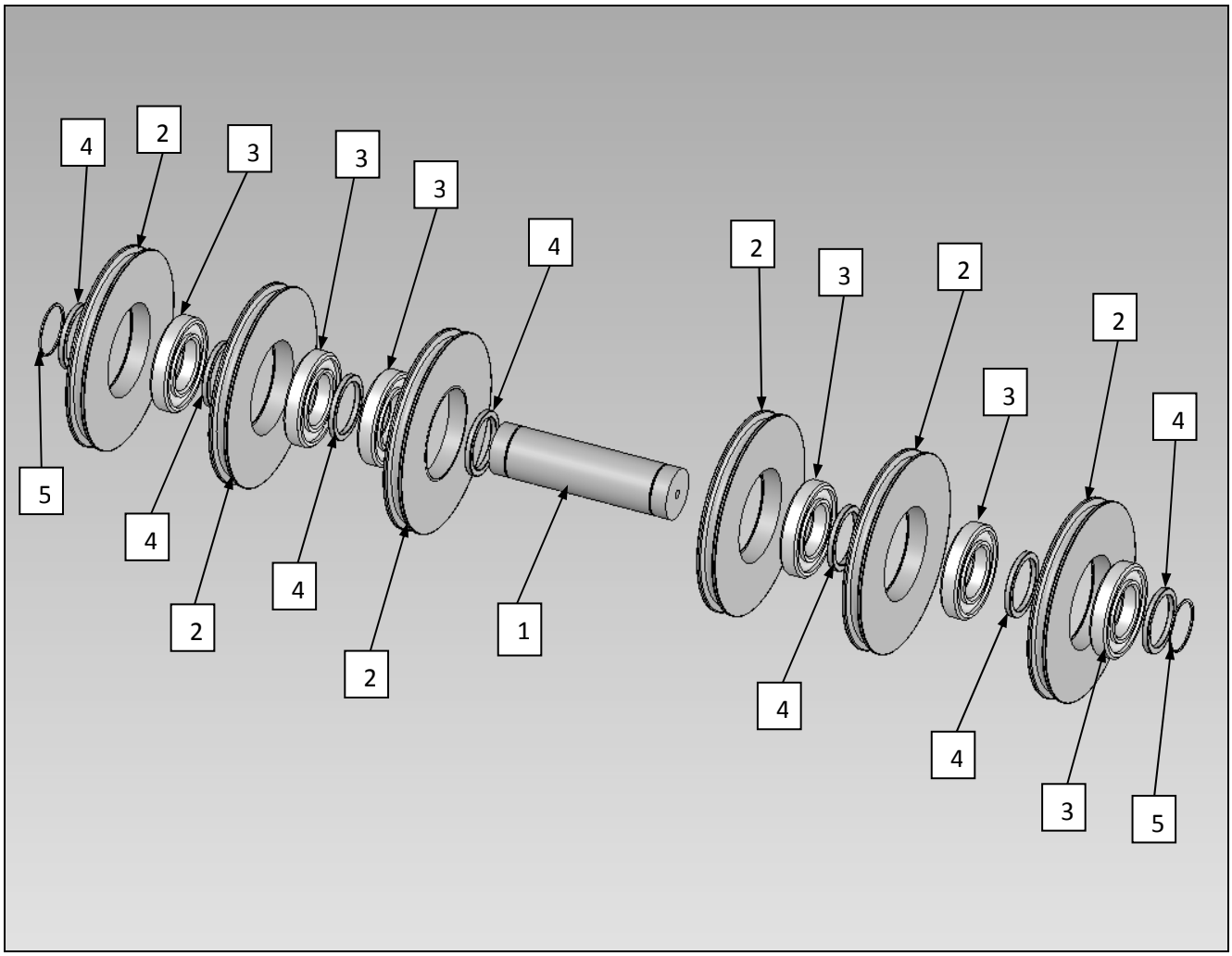
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	106774-0000	PIN, Sheave
2	3	100890-0000	SHEAVE
3	3	101614-00	BEARING
4	4	100896-0000	SPACER
5	4	100897-0000	SPACER
6	2	104374-00	RING, Snap

FIGURE 11, 20 TON UPPER SHEAVE ASSEMBLY, 401916-0000



ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	106774-0000	PIN, Sheave
2	5	100890-0000	SHEAVE
3	5	101614-00	BEARING
4	2	100896-0000	SPACER
5	4	100897-0000	SPACER
6	2	104374-00	RING, Snap

FIGURE 11, 25 TON UPPER SHEAVE ASSEMBLY, 401917-0000



ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	106774-0000	PIN, Sheave
2	6	100890-0000	SHEAVE
3	6	101614-00	BEARING
4	7	100897-0000	SPACER
5	2	104374-00	RING, Snap

FIGURE 12, TROLLEY DRIVE INSTALLATION

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	203476-00	Brake, Motor, Reducer combination for 80 FPM
1	1	203477-00	Brake, Motor, Reducer combination for 120 FPM
2	1	109664-0000	Torque Arm Bracket
3	2	419241-0B	Bushing, Torque Arm
4	1	100412-00	Bolt, ½-13 x 4” Gr. 5
5	4	100627-00	Washer, Flat ½
6	2	100586-00	Nut, ½ - 13
7	2	100405-00	Bolt, ½ - 13 x 1.50” Gr. 5

Quantities above double for 25 Ton capacity

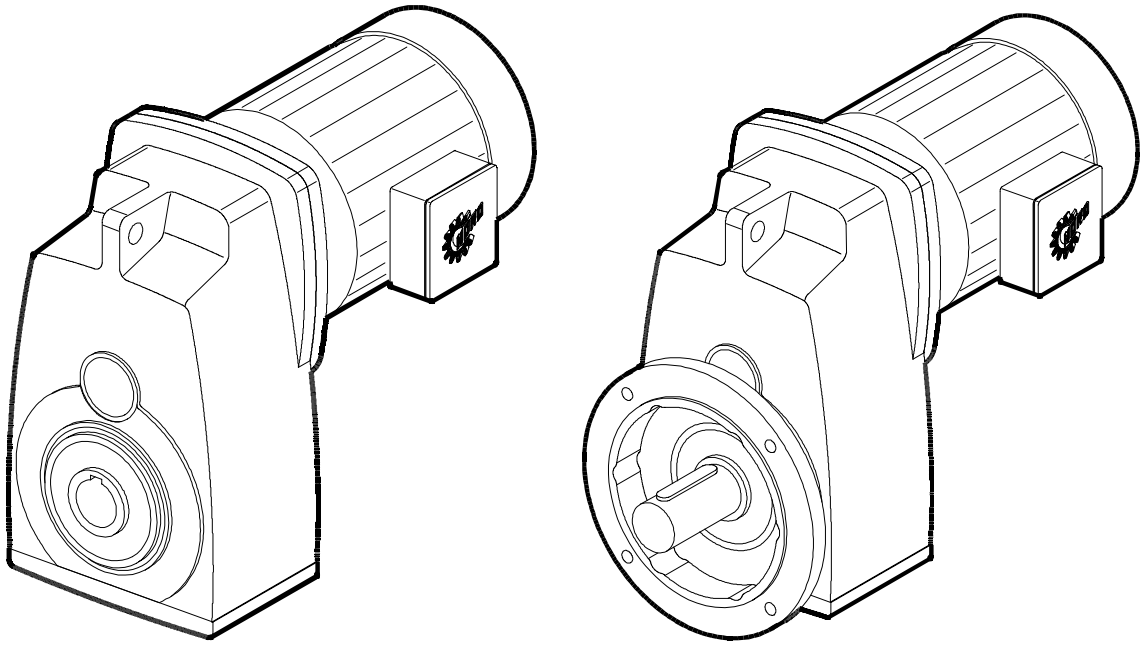
UNICASE® Shaft Mount Gearboxes
Installation and Maintenance Instructions

BIM 1020

USA

CDN

Retain These Safety Instructions For Future Use



INSPECTION OF UNIT

Thoroughly inspect the equipment for any shipping and handling damage before accepting shipment from the freight company. If any of the goods called for in the bill of lading or express receipt are damaged or the quantity is short, do not accept until the freight or express agent makes an appropriate notation on your freight bill or express receipt. If any concealed loss or damage is discovered later, notify your freight carrier or express agent at once and request him to make an inspection. We will be very happy to assist you in collecting claims for loss or damage during shipment; however, this willingness on our part does not remove the transportation company's responsibility in reimbursing you for collection of claims or replacement of material. Claims for loss or damage in shipment must not be deducted from the NORD Gear invoice, nor should payment of the NORD Gear invoice be withheld awaiting adjustment of such claims, as the carrier guarantees safe delivery.

If considerable damage has been incurred and the situation is urgent, contact the nearest NORD Gear Sales Office for assistance. Please keep a written record of all communications.

RECORD NAMEPLATE DATA

Locate the gear reducer nameplate and record all nameplate data for future reference.

SK _____ S/N _____

RATIO _____ MAX TORQUE _____ RPM _____ MTG. POS _____

STORAGE

PROPER STORAGE UNTIL INSTALLED

Keep unit in a dry, temperature controlled area. If stored other than said, long term storage methods must be applied to the unit including complete fill with lubricant. Protect machined surfaces and rotate shafts periodically. Prior to putting unit into service, drain lubricant and refill to proper level as determined by the mounting position.

PROPER HANDLING OF THE UNIT

Exercise care to prevent damage to the unit when moving. Lift only at designed lifting points. Do not attach other machinery and lift by the unit lifting points. The lifting points are to be used to lift the unit only. Insure that adequate safety measures are taken to protect personnel during transportation. Protect the mounting surface from damage.

INSTALLATION OF UNIT

To ensure long service and dependable performance, an enclosed gear drive must be rigidly supported and the shafts accurately aligned. The following describes the minimum precautions required to accomplish this end.

FOUNDATION
The responsibility for the design and construction of the foundation lies with the user. The foundation must be adequate to withstand normal operating loads and possible overloads while maintaining alignment to attached system components under such loads.

MOUNTING POSITION
Unless a unit is specifically ordered for inclined mounting, the foundation must be level and flat. The lubrication system may not operate properly if the unit is not mounted in the position for which it is designed. It may be desirable to elevate the foundation to facilitate oil drainage.

CONCRETE FOUNDATION
If a concrete foundation is used, steel mounting pads and bolts of sufficient size to distribute the stress into the concrete should be grouted into the foundation.

STEEL FOUNDATION
If a structural steel foundation is used (i.e. wide flange beams or channels), a base plate or sole plate of suitable thickness should be used and should extend under the entire unit.

FOOT MOUNTED UNITS
Use shims under the feet of the unit to align the output shaft to the driven equipment. Make sure that all feet are supported so that the housing will not distort when it is bolted down. Improper shimming will reduce the life of the unit and may cause failure. Dowel pins may be installed to prevent misalignment and ensure proper realignment if removed for service.

SHAFT MOUNTED UNITS
Shaft mounted drives should be mounted as close to the driven equipment bearing support as possible to minimize bearing loads due to overhung load. Design of the joint connection between the torque reaction arm and the foundation is the user's responsibility.

Hollow Shaft Diameter tolerance
Metric (mm)

≤ ∅ 18 = +0.018/-0.000
> ∅ 18 ≤ ∅ 30 = +0.021/-0.000
> ∅ 30 ≤ ∅ 50 = +0.025/-0.000
> ∅ 50 ≤ ∅ 80 = +0.030/-0.000
> ∅ 80 ≤ ∅ 120 = +0.035/-0.000
> ∅ 120 ≤ ∅ 180 = +0.040/-0.000

Inch

≤ ∅ 4.375 = +0.0010 / -0.0000
> ∅ 4.375 = +0.0015 / -0.0000

Customer shaft diameter tolerances with keyed hollow shafts
Metric (mm)

≤ ∅ 18 = +0.000/-0.011
> ∅ 18 ≤ ∅ 30 = +0.000/-0.013
> ∅ 30 ≤ ∅ 50 = +0.000/-0.016
> ∅ 50 ≤ ∅ 80 = +0.000/-0.019
> ∅ 80 ≤ ∅ 120 = +0.000/-0.022
> ∅ 120 ≤ ∅ 180 = +0.000/-0.025

Inch

≤ ∅ 1.500 = +0.000/-0.002
> ∅ 1.500 ≤ ∅ 2.500 = +0.000/-0.003
> ∅ 2.500 ≤ ∅ 7.000 = +0.000/-0.004

Shaft finish to be 125 micro inches or smoother.

Customer shaft diameter tolerance with Shrink Disc fit h6
Metric (mm)

≤ ∅ 18 = +0.000/-0.011
> ∅ 18 ≤ ∅ 30 = +0.000/-0.013
> ∅ 30 ≤ ∅ 50 = +0.000/-0.016
> ∅ 50 ≤ ∅ 80 = +0.000/-0.019
> ∅ 80 ≤ ∅ 120 = +0.000/-0.022
> ∅ 120 ≤ ∅ 180 = +0.000/-0.025

Inch

≤ ∅ 0.750 = +0.0000/-0.0004
> ∅ 0.750 ≤ ∅ 1.125 = +0.0000/-0.0005
> ∅ 1.125 ≤ ∅ 2.000 = +0.0000/-0.0006
> ∅ 2.000 ≤ ∅ 3.000 = +0.0000/-0.0007
> ∅ 3.000 ≤ ∅ 4.750 = +0.0000/-0.0008
> ∅ 4.750 ≤ ∅ 7.000 = +0.0000/-0.0010

Shaft finish to be 125 micro inches or smoother.

Customer shaft diameter tolerance with Shrink Disc fit f6 (looser fit)
Metric (mm)

≤ ∅ 18 = -0.016/-0.024
> ∅ 18 ≤ ∅ 30 = -0.020/-0.029
> ∅ 30 ≤ ∅ 50 = -0.025/-0.036
> ∅ 50 ≤ ∅ 80 = -0.030/-0.043
> ∅ 80 ≤ ∅ 120 = -0.036/-0.051
> ∅ 120 ≤ ∅ 180 = -0.043/-0.061

Inch

≤ ∅ 0.750 = -0.0006/-0.0011
> ∅ 0.750 ≤ ∅ 1.125 = -0.0008/-0.0013
> ∅ 1.125 ≤ ∅ 2.000 = -0.0010/-0.0016
> ∅ 2.000 ≤ ∅ 3.000 = -0.0012/-0.0019
> ∅ 3.000 ≤ ∅ 4.750 = -0.0014/-0.0023
> ∅ 4.750 ≤ ∅ 7.000 = -0.0017/-0.0027

Shaft finish to be 125 micro inches or smoother

FLANGE MOUNTED UNITS
If a structural steel foundation is used (i.e. wide flange beams or channels), a base plate or sole plate of suitable thickness should be used and should extend under the entire unit. If a bulk head plate is used it should be of proper strength to minimize buckling distortions.

Flange Pilot 'AK' or 'AK1' tolerance
Metric (mm)

> ∅ 50 ≤ ∅ 80 = +0.012/-0.007
> ∅ 80 ≤ ∅ 120 = +0.013/-0.009
> ∅ 120 ≤ ∅ 180 = +0.014/-0.011
> ∅ 180 ≤ ∅ 230 = +0.016/-0.013
> ∅ 230 ≤ ∅ 315 = +0.000-0.032
> ∅ 315 ≤ ∅ 400 = +0.000/-0.036
> ∅ 400 ≤ ∅ 500 = +0.000/-0.040

Inch

> ∅ 1.969 ≤ ∅ 3.150 = +0.005/-0.0003
> ∅ 3.150 ≤ ∅ 4.724 = +0.005/-0.0004
> ∅ 4.724 ≤ ∅ 7.087 = +0.006/-0.0004
> ∅ 7.087 ≤ ∅ 9.055 = +0.006/-0.0005
> ∅ 9.055 ≤ ∅ 12.402 = +0.000/-0.0013
> ∅ 12.402 ≤ ∅ 15.748 = +0.000/-0.0014
> ∅ 15.748 ≤ ∅ 19.685 = +0.000/-0.0016

BOLT STRENGTH
Bolt size, strength and quantity should be verified to insure proper torque reaction capacity whatever the mounting arrangement.

LUBRICATE SHAFTS
Both the hollow shaft and the driven shaft should be liberally lubricated before assembly. The unit must slide freely onto the driven shaft. Do not hammer or force the unit into place. For shrink disc, follow instructions below.

AXIAL RETENTION
Each drive shaft must be retained in place relative to the gear reducer. Or each gear reducer must be retained in place relative to the drive shaft. Either way NORD recommends the use of shaft shoulders, locking collars or FIXING ELEMENTS to axially retain the shaft or gear reducer in position.

SET SCREWS
If set screws are used for axial retention, they should be tightened evenly. Flats may be filed on the driven shaft and a thread-locking adhesive used for more position retention.

SNAP RING RETENTION
Placing external snap rings on drive shafts must be performed with caution. The groove, which the snap ring fits into, may weaken the drive shaft causing premature failure. NORD does not recommend this type of shaft retention.

THRUST PLATE
In applications, which are subject to high vibratory loads, a thrust plate will provide greater resistance to axial movement. Follow the manufacturer's recommendations for assembly.

SHRINK DISC
If a shrink disc is used to secure a reducer hollow shaft to the driven shaft, follow this assembly procedure. Start with the shrink disc mounted onto the extension of the hollow shaft disc locking bolts loosened.

1. Clean reducer bore and mating solid shaft to be free of any lubricants or dirt.
2. Slide reducer onto the solid shaft until it is about half way through.
3. Lubricate the remaining portion of the solid shaft with a #2 grease or similar lubricant. This part will be located under the bronze bushing. **Do not install grease under the shrink disc gripping area.** Finish installing the solid shaft into the reducer hollow bore.
4. Finger tighten all shrink disc bolts. Now, moving a circular pattern, tighten each shrink disc locking bolt 1/4 to 1/2 turn. **Do not use criss cross pattern.** Continue tightening in the same circular direction with 1/4 or 1/2 turn increments until all bolts reach the specified bolt tightening torque. Bolt tightening torque is shown on the shrink disc label for the particular unit.
5. Run unit for 24 hours, then retighten shrink disc locking bolts to the proper bolt torque as indicated above.

TORQUE REACTION ARM
On the shaft mount 'Clincher', torque is reacted through the integral torque tab, which is part of the casting. Commonly, NORD's optional RUBBER BUFFER bushings are installed on each side of the integral torque tab to dampen torque shocks and allow for mis-alignment received from the machinery during operation.

Torque arm connection fabrications should always be mounted perpendicular to a line through the output shaft center and the point at attachment of the torque arm to the unit housing. In this position the minimum load on the attachment structure arm will be experienced. The attachment structure must be rigid and may not deflect under any load. Doing so will place extra loads on the output bearings of the reducer.

PRIME MOVER MOUNTING
Align the prime mover to the reducer-input shaft using shims under the feet. Make sure that the feet are supported. Dowel the prime mover to its foundation.

SHAFT CONNECTIONS
When connecting shafts to either the input or output of the reducer, consider the following instructions.

FITS
Clearance or interference fits for coupling hubs should be in accordance with ANSI/AGMA 9002-A86 or as follows.

Output and Input shaft Diameter tolerance
Metric (mm)

≤ ∅ 18 = +0.012/+0.001
> ∅ 18 ≤ ∅ 30 = +0.015/+0.002
> ∅ 30 ≤ ∅ 50 = +0.018/+0.002
> ∅ 50 ≤ ∅ 80 = +0.030/+0.011
> ∅ 80 ≤ ∅ 120 = +0.035/+0.013
> ∅ 120 ≤ ∅ 180 = +0.040/+0.015

Inch

≤ ∅ 1.750 = +0.0000/-0.0005
> ∅ 1.750 = +0.0000/-0.0010

Output and Input shaft Drill and tap shaft end
Metric (mm)

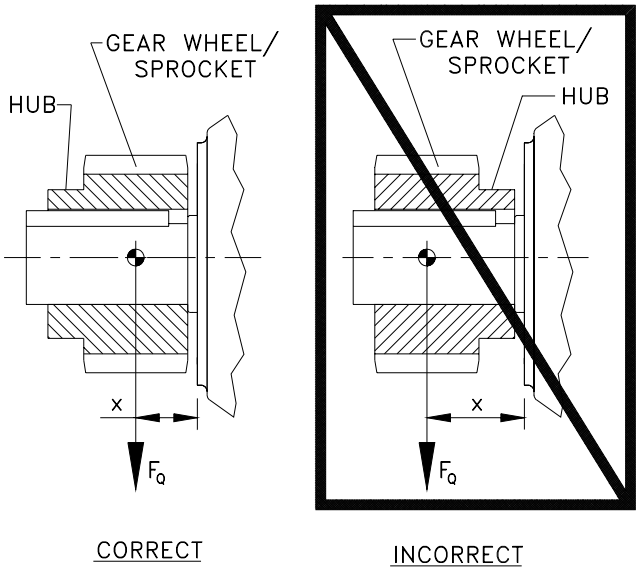
≤ ∅ 16 = M5
> ∅ 16 ≤ ∅ 21 = M6
> ∅ 21 ≤ ∅ 24 = M8
> ∅ 24 ≤ ∅ 30 = M10
> ∅ 30 ≤ ∅ 38 = M12
> ∅ 38 ≤ ∅ 50 = M16
> ∅ 50 ≤ ∅ 85 = M20
> ∅ 85 ≤ ∅ 130 = M24

Inch

≤ ∅ 0.438 = #10-24 x 0.4 deep
> ∅ 0.438 ≤ ∅ 0.813 = 1/4-20 x 0.6 deep
> ∅ 0.813 ≤ ∅ 0.938 = 5/16-18 x 0.7 deep
> ∅ 0.938 ≤ ∅ 1.125 = 3/8-16 x 0.9 deep
> ∅ 1.125 ≤ ∅ 1.375 = 1/2-13 x 1.1 deep
> ∅ 1.375 ≤ ∅ 1.875 = 5/8-11 x 1.4 deep
> ∅ 1.875 ≤ ∅ 3.250 = 3/4-10 x 1.7 deep
> ∅ 3.250 = 1-8 x 2.2 deep

Outboard pinion and sprocket fits should be as recommended by the pin sprockets with interference fits should be heated according to the manufacturer's recommendations, generally 250°F to 300°F, (120°C to 150° C) before assembling to the shaft.

LOCATION
Coupling hubs should be mounted flush with the shaft ends, unless specifically ordered for overhung mounting. Pinions,



sprockets and sheaves should be mounted as close as possible to the unit housing to minimize bearing loads and shaft deflections.

COUPLING ALIGNMENT
Shaft couplings should be installed according to the coupling manufacturer's recommendations for gap, angular and parallel alignment. In many installations, it is necessary to allow for thermal and mechanical shaft movement when determining shaft alignment. The coupling manufacturer's recommendations should be followed.

AXIAL DISPLACEMENT
The gap between shaft ends should be the same as the specified coupling gap unless overhung mounting of the coupling hub is specified. The coupling gap and shaft gap must be sufficient to accommodate any anticipated thermal or mechanical axial movement.

ANGULAR ALIGNMENT
Insert a spacer or shim stock equal to the required coupling gap between the coupling hub faces and measure the clearance using feeler gauges. Repeat this at the same depth at 90-degree intervals to determine the amount of angular misalignment.

PARALLEL ALIGNMENT
Mount a dial indicator to one coupling hub, and rotate this hub, sweeping the outside diameter of the other hub. The parallel misalignment is equal to one-half of the total indicator reading. Another method is to rest a straight edge squarely on the outside diameter of the hubs at 90-degree intervals and measure any gaps with feeler gauges. The maximum gap measurement is the parallel misalignment.

CHECKING ALIGNMENT
After both angular and parallel alignments are within specified limits, tighten all foundation bolts securely and repeat the above procedure to check alignment. If any of the specified limits for alignment are exceeded, realign the coupling.

SPROCKET OR SHEAVE ALIGNMENT
Align the sheaves or sprockets square and parallel by placing a straight edge across their faces. Alignment of bushed sheaves and sprockets should be checked after bushings have been tightened. Check horizontal shaft alignment by placing a level vertically against the face of the sheave or sprocket. Adjust belt or chain tension per the manufacturer's specified procedure.

OUTBOARD PINION ALIGNMENT
Align the pinion by adjusting the gear tooth clearance according to the manufacturer's recommendations and checking for acceptable outboard pinion tooth contact. The foundation bolts may have to be loosened and the unit moved slightly to obtain this contact. When the unit is moved to correct tooth contact, the prime mover should be realigned.

RECHECK ALIGNMENT
After a period of operation, recheck alignment and adjust as required.

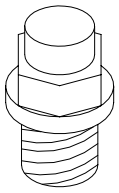
1. Properly install unit on a rigid foundation
   - adequately supported
   - securely bolted into place
   - leveled so as not to distort the gear case
2. Properly install couplings suitable for the application and connected equipment.
3. Ensure accurate alignment with other equipment.
4. Furnish and install adequate machinery guards as needed to protect operating personnel and as required by the applicable standards of the Occupational Safety and Health Administration (OSHA), and by other applicable safety regulations;
5. Ensure that driving equipment is running in the correct direction before coupling to reducers with backstops (designed to operate only in a specific direction) or machinery designed to operate only in one direction.

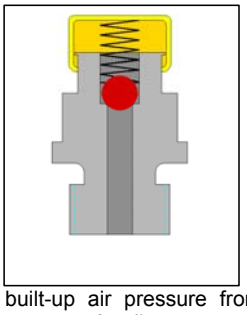
CHANGES IN PERFORMANCE SPECIFICATIONS
Owner has the responsibility to consult with NORD GEAR if such items such as applied loads, operating speeds or other operating conditions have changed.

WARNING:
LOCK OUT POWER before any maintenance is performed. Make absolutely sure that no voltage is applied while work is being done on the gearbox.

START-UP
1. Ensure that switches, alarms, heaters, coolers and other safety and protection devices are installed and operational for their intended purpose.
2. Verify that the installed mounting position is the same as the nametag mounting position. If not, adjust the oil level accordingly and relocate the vent plug, fill plug and drain plug according to the mounting position. See following.

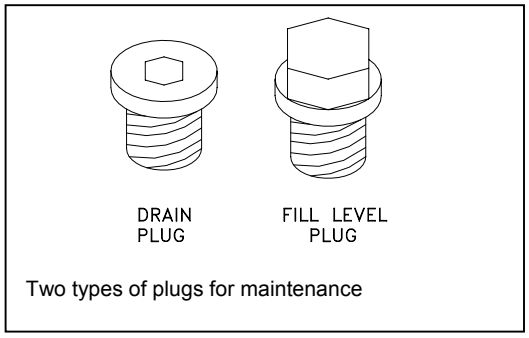
AUTOVENT PLUG
The Autovent plug is brass in color and will be located at the highest point on the gearbox. It operates like a check-valve to allow the reducer to relieve internal pressure while preventing lubricant contamination during cooling. A spring presses a ball or plunger against a machined orifice until pressure exceeds 2 psi. Above 2 psi the air is allowed to escape depressurizing the gearcase. When internal pressure drops below 2 psi, the autovent re-seals closing the unit to the outside environment. After shutdown, the reducer cools along with the air inside the reducer. The unit will temporarily maintain a slight vacuum until normalization occurs. NORD Gear supplies an Autovent as a standard feature.


AUTOVENT PLUG



The Autovent releases built-up air pressure from inside the gearbox (Max. pressure 2 psi).

FILL LEVEL & DRAIN PLUGS
The drain plugs are metric socket head cap screws. They will be located at the lowest part of the gearbox for ease of draining. The fill level plug is a hex head cap screw. It will be located between the Autovent and drain plug. Both types of plugs will have gaskets included to prevent oil from leaking.



Two types of plugs for maintenance

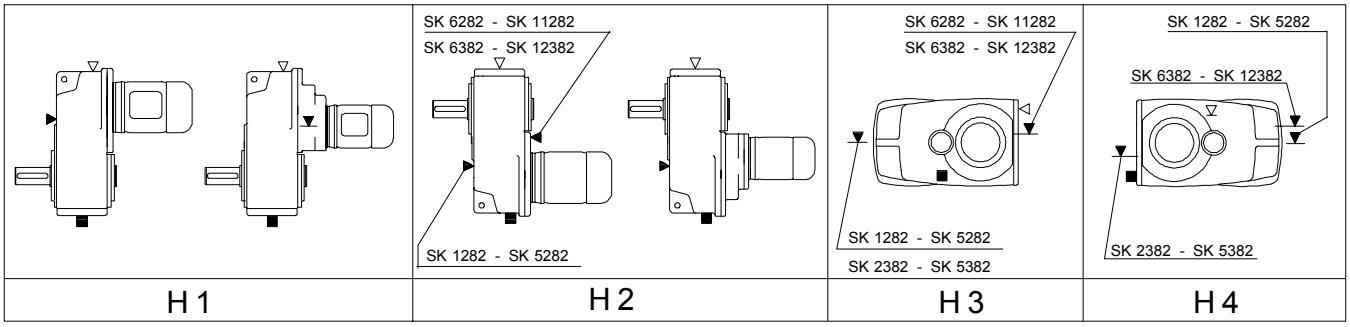
LUBRICANT
All NORD reducers are shipped from the factory properly filled with lubricant and all plugs are installed according to the mounting position given on the reducer nametag. Acceptable oil fill level is within ½ inch of the bottom of the fill plug threads.

OPERATION AND MAINTENANCE CHECKLIST
1. Operate the equipment as it was intended to be operated
2. Do not overload.
3. Run at correct speed.
4. Maintain lubricant in good condition and at proper level.
5. Dispose of used lubricant in accordance with applicable laws and regulations.
6. Apply proper maintenance to attached equipment at prescribed intervals recommended by the manufacturer.
7. Perform periodic maintenance of the gear drive as recommended by NORD.

MOUNTING POSITIONS

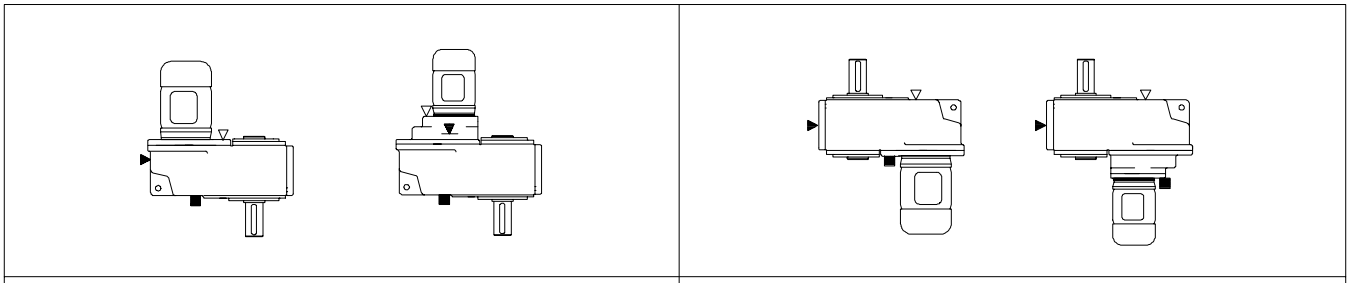
These charts detail the mounting positions for horizontal and vertical mounting. The Autovent, oil fill plug and drain plug are indicated on each mounting position picture. The factory set mounting position and plug locations match that shown on the gearbox nametag. For mounting orientations other than shown consult NORD Gear.

Horizontal position



H 1	H 2	H 3	H 4

Vertical position



H 5 *	H 6

Symbols: Vent plug Oil level Drain plug

* Mounting position H5 with lubricant expansion unit recommended

SK0182NB & SK1382NB have no vent or drain plugs. They are filled with synthetic oil so the units are "Lubed for Life".

MAINTENANCE

Mineral lubricant should be changed every 10,000 service hours or after two years. For synthetic oils, the lube should be changed every 20,000 service hours or after four years. In case of extreme operating (e.g. high humidity, aggressive environment or large temperature variations), shorter intervals between changes are recommended.

OIL SPECIFICATIONS

NORD supplies all reducers filled with oil from the factory. Consult the sticker adjacent to the fill plug to determine the type of lubricant installed at the factory. Standard lubricant is ISO VG220 mineral-based oil. However, some units have special lubricants designed to operate in certain environments or to extend the service life of the lubricant. If in doubt about which lubricant is needed, contact NORD Gear.

STANDARD OIL – ISO VG220

Ambient Temperature	Formulation
20 to 104°F (-5 to 40°C)	Mineral

TYPICAL OILS

Viscosity ISO NLGI	Formulation	Service Temperature Range	Mobil	Shell	Castrol	Klüber Lubrication	bp	Tribol
VG 460	Conventional Mineral	20°C to +50°C 68F to +122°F	Mobilgear 634	Omala 460	7EP	Klüberoil GEM 1-460	Energol GR-XP 460	Tribol 1100/460
	Synthetic PAO	-30°C to +80°C -22°F to +176°F	Mobil SHC 634	Omala 460 HD	Isolube EP 460	Klübersynth EG 4-460	N/A	Tribol 1510/460
VG 320	Conventional Mineral	0°C to +30°C 32°F to +86°F	Mobilgear 632	Omala 320	6EP	Klüberoil GEM 1-320	Energol GR-XP 320	Tribol 1100/320
	Synthetic PAO	-35°C to +80°C -31°F to +176°F	Mobil SHC 632	Omala 320 HD	Isolube EP 460	Klübersynth EG 4-320	N/A	Tribol 1510/320
VG 220	Conventional Mineral	-5°C to +40°C +20°F to +104°F	Mobilgear 630	Omala 220	5EP	Klüberoil GEM 1-220	Energol GR-XP 220	Tribol 1100/220
	Synthetic PAO	-34°C to +80°C -30°F to +176°F	Mobil SHC 630	Omala 220 HD	Isolube EP 220	Klübersynth EG 4-220	N/A	Tribol 1510/220
VG 150 & VG 100	Conventional Mineral	-15°C to +25°C 5°F to +77°F	Mobilgear 629	Omala 100	4EP	Klüberoil GEM 1-150	Energol GR-XP 100	Tribol 1100/100
	Synthetic PAO	-37°C to +10°C -35°F to +50°F	Mobil SHC 629	Omala 150 HD	Isolube EP 150	Klübersynth EG 4-150	N/A	N/A
VG 68	Conventional Mineral	-15°C to +25°C 5°F to +77F	Mobilgear 626	Omala 68	2EP	Klüberoil GEM 1-68	Energol GR-XP 68	Tribol 1100/68
	Synthetic PAO	-40°C to +10°C -40°F to +50F	Mobil SHC 626	N/A	Isolube EP 68	N/A	N/A	N/A
VG 32	Synthetic PAO	-40°C to +10°C -40°F to +50°F	Mobil SHC 624	N/A	N/A	Klüber-Summit HySyn FG-32	N/A	N/A

PAO = Poly Alpha Olefin

SPECIAL PURPOSE LUBRICANTS

Ambient Temperature	Formulation	Manufacturer	Oil Brand Name
20 to 104°F (-5 to 40°C)	*Food Grade* Oil - Synthetic	Chevron	FM ISO 220
20 to 104°F (-5 to 40°C)	*Food Grade* Oil - Synthetic	OilJAX	Magnaplate 85W140-FG
5 to 125°F (-20 to 50°C)	Fluid Grease	Mobil	Mobilux EP023
-30 to 140°F (-35 to 60°C)	Fluid Grease - Synthetic	Mobil	Mobilith SHC 007
-30 to 140°F (-35 to 60°C)	Fluid Grease - Synthetic	Shell	Albida LC

STANDARD BEARING GREASE – NLGI 2EP Lithium

Ambient Temperature	Formulation
-20 to 140°F (-30 to 60°C)	Mineral

OPTIONAL BEARING GREASES

Ambient Temperature	Formulation	Manufacturer	Grease Brand Name
-40 to 230°F (-40 to 110°C)	Synthetic	Shell	Aeroshell 6
-40 to 230°F (-40 to 110°C)	*Food Grade* - Synthetic	Lubriplate	SFL1

LUBRICANT CAPACITY

Each reducer has the oil level and oil quantity adjusted according to the mounting position shown in the tables. When replacing the oil, consult the tables below to determine the proper amount of oil to be installed according to the reducer size and mounting position. Note that this is approximate and the final level will be adjusted when the reducer is installed. Acceptable oil fill level is within ½ inch of the bottom of the fill plug threads.

LUBRICATION CAPACITY - SHAFT MOUNT 'CLINCHER' GEARBOXES

		MOUNTING POSITION					
		Horizontal				*Vertical*	
		H1	**H2**	**H3**	**H4**	**H5**	**H6**
SK 0182NB	quarts	0.42	0.63	0.53	0.53	0.58	0.58
	liters	0.40	0.60	0.50	0.50	0.55	0.55
SK0282NB	quarts	0.74	0.85	0.95	0.95	1.16	1.06
	liters	0.70	0.80	0.90	0.90	1.10	1.00
SK 1282	quarts	0.95	0.95	1.00	1.00	1.27	1.37
	liters	0.90	0.90	0.95	0.95	1.20	1.30
SK 2282	quarts	1.74	2.01	1.90	1.90	2.11	2.54
	liters	1.65	1.90	1.80	1.80	2.00	2.40
SK 3282	quarts	3.33	3.44	3.33	3.33	4.33	4.33
	liters	3.15	3.25	3.15	3.15	4.10	4.10
SK 4282	quarts	4.97	5.02	4.97	4.97	5.71	6.45
	liters	4.70	4.75	4.70	4.70	5.40	6.10
SK 5282	quarts	7.93	7.93	7.61	7.61	9.30	9.30
	liters	7.50	7.50	7.20	7.20	8.80	8.80
SK 6282	quarts	18.0	12.7	14.8	10.6	18.5	14.8
	liters	17.0	12.0	14.0	10.0	17.5	14.0
SK 7282	quarts	26.4	21.1	22.2	16.9	28.5	22.2
	liters	25	20	21	16	27	21
SK 8282	quarts	39.1	31.7	32.8	32.8	43.3	34.9
	liters	37	30	31	31	41	33
SK 9282	quarts	78.2	58.1	62.4	72.9	76.1	74.0
	liters	74	55	59	69	72	70
SK 10282	quarts	95	42	87	63	95	95
	liters	90	40	82	60	90	90
SK 11282	quarts	174	153	148	106	206	169
	liters	165	145	140	100	195	160

		MOUNTING POSITION					
		Horizontal				*Vertical*	
		H1	**H2**	**H3**	**H4**	**H5**	**H6**
SK 1382NB	quarts	1.37	1.48	2.01	2.11	2.22	2.43
	liters	1.30	1.40	1.90	2.00	2.10	2.30
SK 2382	quarts	1.80	2.01	1.59	1.59	3.28	2.75
	liters	1.70	1.90	1.50	1.50	3.10	2.60
SK 3382	quarts	4.33	3.49	3.49	3.49	5.92	4.33
	liters	4.10	3.30	3.30	3.30	5.60	4.10
SK 4382	quarts	6.24	5.18	5.18	5.18	8.77	7.19
	liters	5.90	4.90	4.90	4.90	8.30	6.80
SK 5382	quarts	13.21	7.08	8.77	8.77	14.80	12.68
	liters	12.50	6.70	8.30	8.30	14.00	12.00
SK 6382	quarts	17.4	10.1	13.2	14.8	19.0	13.7
	liters	16.5	9.6	12.5	14.0	18.0	13.0
SK 7382	quarts	23.3	16.9	20.1	24.3	26.4	21.1
	liters	22	16	19	23	25	20
SK 8382	quarts	35.9	26.4	31.7	37.0	40.2	33.8
	liters	34	25	30	35	38	32
SK 9382	quarts	77.2	47.6	63.4	68.7	78.2	74.0
	liters	73	45	60	65	74	70
SK 10382	quarts	90	77	85	85	93	93
	liters	85	73	80	80	88	88
SK 11382	quarts	169	148	143	164	222	164
	liters	160	140	135	155	210	155
SK 12382	quarts	169	148	143	164	222	164
	liters	160	140	135	155	210	155

Note: Filling quantities are approximate figures. Oil level must be checked according to oil level plug after final installtion.

Acceptable oil fill level is within 1/2 inch of the bottom of the fill plug threads. For mounting angles not shown, consult factory.

TROUBLE SHOOTING

PROBLEM WITH THE REDUCER		POSSIBLE CAUSES	SUGGESTED REMEDY
Runs Hot	Overloading	Load exceeds the capacity of the reducer	Check rated capacity of reducer, replace with unit of sufficient capacity or reduce load
	Improper lubrication	Insufficient lubrication	Check lubricant level and adjust up to recommended levels
		Excessive lubrication	Check lubricant level and adjust down to recommended levels
		Wrong lubrication	Flush out and refill with correct lubricant as recommended
Runs Noisy	Loose foundation bolts	Weak mounting structure	Inspect mounting of reducer. Tighten loose bolts and/ or reinforce mounting and structure
		Loose hold down bolts	Tighten bolts
	Worn RV Disc	Overloading unit may result in damage to disc	Disassemble and replace disc. Recheck rated capacity of reducer.
	Failure of Bearings	May be due to lack of lubricant	Replace bearing. Clean and flush reducer and fill with recommended lubricant.
		Overload	Check rated capacity of reducer.
	Insufficient Lubricant	Level of lubricant in the reducer not properly maintained.	Check lubricant level and adjust to factory recommended level.
Output Shaft Does Not Turn	Internal parts are broken	Overloading of reducer can cause damage.	Replace broken parts. Check rated capacity of reducer.
		Key missing or sheared off on input shaft.	Replace key.
		Coupling loose or disconnected.	Properly align reducer and coupling. Tighten coupling.
Oil Leakage	Worn Seals	Caused by dirt or grit entering seal.	Replace seals. Autovent may be clogged. Replace or clean.
		Overfilled reducer.	Check lubricant level and adjust to recommended level.
		Autovent clogged.	Clean or replace, being sure to prevent any dirt from falling into the reducer.
		Improper mounting position, such as wall or ceiling mount of horizontal reducer.	Check mounting position. Name tag & verify with mounting chart in manual.

NORD Gear Corporation
National Customer Service Toll Free 888-314-6673
www.nord.com

NORD Gear Limited
Toll Free in Canada 800-668-4378

WEST
1121 Railroad Street
Building 101
Corona, CA 92882
Phone 951-279-2600
Fax 888-408-6673

MIDWEST
PO Box 367
800 Nord Drive
Waunakee, WI 53597
Phone 608-849-7300
Fax 800-373-6673

SOUTH
100 Forsyth Hall Dr.
Building 100B
Charlotte, NC 28273
Phone 704-529-1255
Fax 888-259-6673

CANADA
41 West Drive
Brampton, Ontario L6T 4A1
Phone 905-796-3606
Fax 905-796-8130

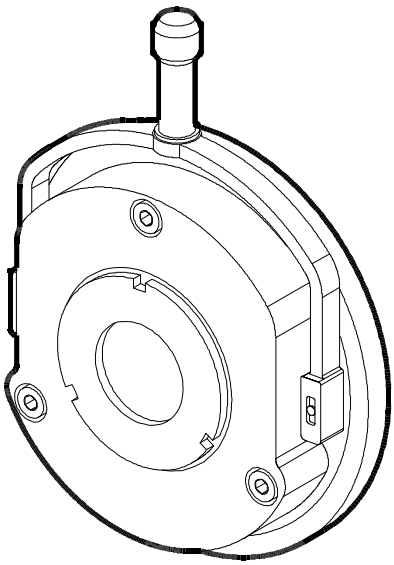
Motor Brakes
Installation and Maintenance Instructions

BIM 1090

USA

CDN

Retain These Safety Instructions for Future Use



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Safety Notice

This equipment contains high voltage! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt installation, operation and maintenance of electrical equipment.

Be sure that you are completely familiar with NEMA publication MG-2, safety standards for construction and guide for selection, installation and use of electric motors and generators, the National Electric Code and local codes and practices. Unsafe installation or use can cause conditions that lead to serious or fatal injury.

WARNING:

LOCK OUT POWER BEFORE ANY MAINTENANCE IS PERFORMED. MAKE ABSOLUTELY SURE THAT NO VOLTAGE IS APPLIED WHILE WORK IS BEING DONE ON THE GEARBOX. READ SAFETY INSTRUCTIONS PRIOR TO ANY WORK DONE ON THE MOTOR.

This instruction manual is not intended to include a comprehensive listing of all details for all procedures required for installation, operation and maintenance. This manual describes general guidelines that apply to most of the motor products shipped by NORD Gear. If you have a question about a procedure or are uncertain about any detail, DO NOT PROCEED. Please contact your NORD distributor for more information or clarification.

DANGER:

THE USER IS RESPONSIBLE FOR CONFORMING TO THE NATIONAL ELECTRIC CODE AND ALL OTHER APPLICABLE LOCAL CODES. WIRING PRACTICES, GROUNDING DISCONNECTS AND OVERCURRENT PROTECTION, ARE OF PARTICULAR IMPORTANCE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SERVERE BODILY INJURY OR LOSS OF LIFE.

GENERAL DESCRIPTION

BRAKES

General
NORD brakes are "spring set". When power is removed from the brake, the brake will automatically set to hold the load. NORD brakes are DC voltage brakes and in most instances are supplied with a motor mounted brake rectifier for easy connections to AC power. AC power is taken directly from the power line or from the terminal block of the motor and converted to DC by the supplied rectifier in the terminal box. **If the motor is connected to a frequency inverter, soft start, or is a two-speed motor, the AC power must be supplied to the brake rectifier separately from the motor power.**

When the brake is de-energized (Power Off), the braking springs exert a force against the anchor plate, which prevents the brake rotor from rotating. When the brake coil is energized (Power On), a magnetic field builds and pulls the anchor plate across the air gap to the brake casing, which frees the brake rotor and allows the motor shaft to rotate.

NORD Gear typically use brakes manufactured by Precima and Mayr. The Mayr brake is used mainly on the 20Nm and some of the 400-1200Nm sizes. For questions regarding brake manufacturer, please contact NORD Gear.

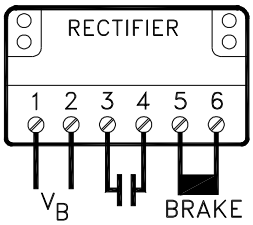
RECTIFIERS

General
The DC power required to energize the brake is not available in most applications. AC power is available in all applications since it is required to power the motor. The rectifier converts the available AC voltage to the DC voltage needed to power the brake.

Features
- Individual power supply for each motor.
- Compact size; mounted inside motor terminal box.
- Multiple voltage options
- Solid state bridge rectifier
- Integral protection against transient voltage spikes
- Half wave rectifier:
  DC voltage is 45% of the applied AC voltage
- Full wave rectifier:
  DC voltage is 90% of the applied AC voltage

Standard Rectifiers
As standard, NORD integral gearmotors with a DC brake include a rectifier mounted in the motor terminal box to supply DC power to the brake. The rectifier can be wired for switching either the AC power source or the DC voltage supply (output). Wiring the DC switching gives the fastest reaction (de-energize – brake engage – stopping) time. If AC switching is used, the source power can be attached to the motor brake terminals. Tapping into the motor terminals gives the slowest de-energize time (stopping), due to the collapsing time of the motor magnetic field.

Terminals
1 & 2 Brake system connection AC voltage
3 & 4 Switch contact or jumper (for DC switching)
5 & 6 Connection brake coil



Special Function Rectifiers & Current Sensing Relays
NORD offers special function rectifiers (Option FR) which provide improved brake performance. Refer to "BIM 1095 FR Brake Rectifier" for more information.

Another way of improving brake performance is using NORD's current sensing relay (Option IR). It requires no external wiring and screws into the spare side hole of the conduit box. Refer to "BIM 1092 IR Relay" for more information.

RECTIFIER PART NUMBERS & RATINGS

Part #	Color	Style	Input Voltage	Output Current	Temp
19141000	Black	Full-wave	110-230 VAC ± 10%	2A	-10°C to 80°C
19141010	Yellow	Half-wave	230-480 VAC ± 10%	2A	-10°C to 80°C
19141020	Grey	Half-wave	500-575 VAC ± 10%	2A	-10°C to 80°C

Cautions
- **Brake torque** - The brake torque is measured with a mean friction radius of the brake pad surface with a circumferential speed of 1m/sec (197 fpm).
- **Brake torque tolerance** - For different applications and operating conditions, brake torque can vary from +40/-20% compared to the rated brake torque.
- **Hoisting (lifting/lowering) applications** - must have the brake wired for fast response (DC-switching)
- **Initial operation & wear-in period** - In new condition, the brake will have a reduced torque of up to 30%. In order to achieve full rated brake torque, a short run-in period is required. The run in time will vary depending on system loads.

TECHNICAL DATA – PRECIMA BRAKES

Brake Size 5 - Tb = 5 Nm, 3.7 lb-ft max torque

NORD	Half-Wave		Full-Wave		Pc	Vc	Ic	Rc
p/n	[V_{AC}]	[A_{AC}]	[V_{AC}]	[A_{AC}]	[W]	[V_{DC}]	[A_{DC}]	[Ω]
19010212					22	**24**	0.92	26
19010912	230	0.09	115	0.19	22	**105**	0.21	500
19011902	400	0.05	200	0.11	22	**180**	0.12	1475
19011912	460	0.05	230	0.10	22	**205**	0.11	1900
19012212	500	0.04	250	0.08	21	**225**	0.09	2450
19012512	575	0.04	277	0.08	22	**250**	0.09	2850

Brake Size 10 - Tb = 10 Nm, 7.5 lb-ft max torque

NORD	Half-Wave		Full-Wave		Pc	Vc	Ic	Rc
p/n	[V_{AC}]	[A_{AC}]	[V_{AC}]	[A_{AC}]	[W]	[V_{DC}]	[A_{DC}]	[Ω]
19020222					28	**24**	1.17	20.6
19020922	230	0.14	115	0.29	33	**105**	0.32	332
19021902	400	0.07	200	0.14	29	**180**	0.16	1100
19021922	460	0.06	230	0.12	26	**205**	0.13	1620
19022222	500	0.06	250	0.12	30	**225**	0.13	1700
19022522	575	0.05	277	0.10	27	**250**	0.11	2323

Brake Size 20 - Tb = 20 Nm, 15 lb-ft max torque

NORD	Half-Wave		Full-Wave		Pc	Vc	Ic	Rc
p/n	[V_{AC}]	[A_{AC}]	[V_{AC}]	[A_{AC}]	[W]	[V_{DC}]	[A_{DC}]	[Ω]
19030224					36	**24**	1.50	16
19030924	230	0.16	115	0.32	38	**105**	0.36	292
19031904	400	0.09	200	0.19	38	**180**	0.21	857
19031924	460	0.09	230	0.19	43	**205**	0.21	976
19032224	500	0.08	250	0.15	38	**225**	0.17	1323
19032524	575	0.07	277	0.14	38	**250**	0.15	1666

Brake Size 40 - Tb = 40 Nm, 30 lb-ft max torque

NORD	Half-Wave		Full-Wave		Pc	Vc	Ic	Rc
p/n	[V_{AC}]	[A_{AC}]	[V_{AC}]	[A_{AC}]	[W]	[V_{DC}]	[A_{DC}]	[Ω]
19040232					41	**24**	1.69	14.2
19040932	230	0.21	115	0.41	49	**105**	0.46	226
19041902	400	0.11	200	0.23	45	**180**	0.25	723
19041922	460	0.11	230	0.22	50	**205**	0.24	840
19042232	500	0.09	250	0.18	44	**225**	0.20	1150
19042532	575	0.08	277	0.16	44	**250**	0.18	1425

Brake Size 60 - Tb = 60 Nm, 44 lb-ft max torque

NORD	Half-Wave		Full-Wave		Pc	Vc	Ic	Rc
p/n	[V_{AC}]	[A_{AC}]	[V_{AC}]	[A_{AC}]	[W]	[V_{DC}]	[A_{DC}]	[Ω]
19050252					52	**24**	2.18	11
19050952	230	0.27	115	0.54	63	**105**	0.60	174
19051902	400	0.14	200	0.27	54	**180**	0.30	602
19051952	460	0.13	230	0.25	57	**205**	0.28	740
19052252	500	0.10	250	0.20	50	**225**	0.22	1004
19052552	575	0.09	277	0.17	48	**250**	0.19	1300

Brake Size 100 - Tb = 100 Nm, 74 lb-ft max torque

NORD	Half-Wave		Full-Wave		Pc	Vc	Ic	Rc
p/n	[V_{AC}]	[A_{AC}]	[V_{AC}]	[A_{AC}]	[W]	[V_{DC}]	[A_{DC}]	[Ω]
19060252					80	**24**	3.33	7
19060952	230	0.40	115	0.79	92	**105**	0.88	120
19061902	400	0.21	200	0.41	83	**180**	0.46	390
19061952	460	0.20	230	0.40	91	**205**	0.44	464
19062252	500	0.16	250	0.32	79	**225**	0.35	643
19062552	575	0.14	277	0.28	79	**250**	0.31	795

Brake Size 150 - Tb = 150 Nm, 110 lb-ft max torque

NORD	Half-Wave		Full-Wave		Pc	Vc	Ic	Rc
p/n	[V_{AC}]	[A_{AC}]	[V_{AC}]	[A_{AC}]	[W]	[V_{DC}]	[A_{DC}]	[Ω]
19070252					77	**24**	3.20	7.5
19070952	230	0.39	115	0.79	92	**105**	0.88	120
19071902	400	0.18	200	0.36	73	**180**	0.40	445
19071952	460	0.15	230	0.31	70	**205**	0.34	600
19072252	500	0.15	250	0.30	76	**225**	0.34	670
19072552	575	0.14	277	0.27	76	**250**	0.30	825

Brake Size 250 - Tb = 250 Nm, 185 lb-ft max torque

NORD	Half-Wave		Full-Wave		Pc	Vc	Ic	Rc
p/n	[V_{AC}]	[A_{AC}]	[V_{AC}]	[A_{AC}]	[W]	[V_{DC}]	[A_{DC}]	[Ω]
19080252					101	**24**	4.21	5.7
19080952	230	0.51	115	1.03	120	**105**	1.14	92
19081902	400	0.27	200	0.54	108	**180**	0.60	300
19081952	460	0.24	230	0.49	111	**205**	0.54	380
19082252	500	0.20	250	0.40	100	**225**	0.44	507
19081962	575	0.17	277	0.34	95	**250**	0.38	655

Brake Size 400 - Tb = 400 Nm, 300 lb-ft max torque

NORD	Half-Wave		Full-Wave		Pc	Vc	Ic	Rc
p/n	[V_{AC}]	[A_{AC}]	[V_{AC}]	[A_{AC}]	[W]	[V_{DC}]	[A_{DC}]	[Ω]
19092254					127	**24**	5.28	4.54
19092954	230	0.56	115	1.13	131	**105**	1.25	82.6
19093904	400	0.33	200	0.67	135	**180**	0.74	241
19093954	460	0.31	230	0.61	141	**205**	0.68	303
19093964	500	0.26	250	0.51	130	**225**	0.57	389

Brake Size 800 - Tb = 800 Nm, 600 lb-ft max torque

NORD	Half-Wave		Full-Wave		Pc	Vc	Ic	Rc
p/n	[V_{AC}]	[A_{AC}]	[V_{AC}]	[A_{AC}]	[W]	[V_{DC}]	[A_{DC}]	[Ω]
19094254					152	**24**	6.32	3.79
19094954	230	0.85	115	1.70	197	**105**	1.89	54.8
19095904	400	0.47	200	0.95	191	**180**	1.05	170
19095954	460	0.44	230	0.87	201	**205**	0.97	213

Tb	=	Brake torque max
Half-Wave [V_{AC}]	=	Voltage AC with half-wave rectifier (range -30% to +10%)
Full-Wave [V_{AC}]	=	Voltage AC with full-wave rectifier (range -30% to +10%)
Half-Wave [A_{AC}]	=	Current AC to half-wave rectifier
Full-Wave [A_{AC}]	=	Current AC to full-wave rectifier
Pc	=	Power
Vc	=	Voltage DC (-30% to +10%)
Ic	=	Current DC
Rc	=	Resistance

Tolerance of the listed resistance figures ± 5%
Coil data at 20°C

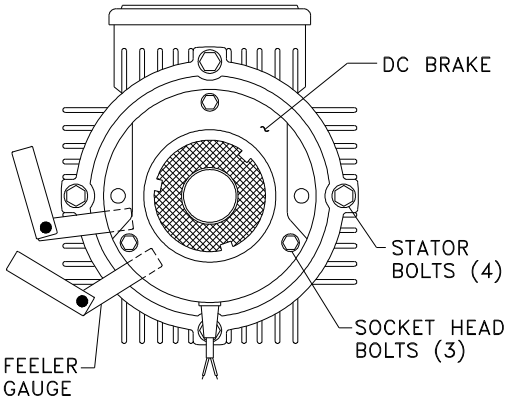
Precima 20Nm brake by special order only! NORD's standard 20Nm brake is manufactured by Mayr which needs no air gap adjustment. See page 9 for Mayr information.

MAINTENANCE – PRECIMA BRAKES

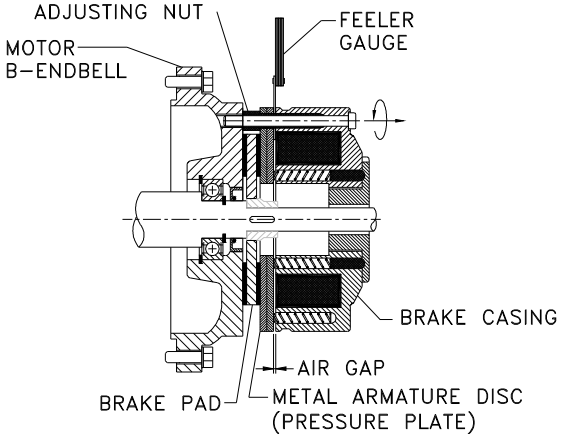
General
In order to get maximum life out of the brake, the air gap must be set properly and checked at regular intervals. As the brake wears and decreases in thickness, the air gap will increase. If the air gap is too large, the brake coil may not have enough magnetic force to pull the metal armature disc across the gap and the brake rotor will drag. Refer to the table below for maximum air gap allowance and minimum brake pad thickness.

Brake Air Gap Adjustment:
When a complete brake motor is supplied by NORD, the air gap is already set at the factory. If the brake is ordered as a part, the air gap must be set at the time of assembly. ***All brake air gap adjustments must be made with the brake assembled onto the motor and power off (Brake Engaged).*** If the brake has an optional hand release (Option HL), refer to page 9 for additional instructions.

While checking the air gap, measure the gap around the socket head cap screws as shown in the picture below.



BACK OF MOTOR
(FAN SHROUD REMOVED)



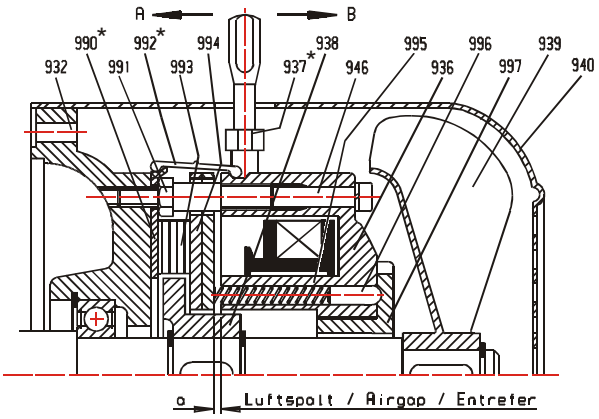
SECTION VIEW

- Loosen the socket head cap screw that attaches the brake to the motor B-endbell.
- Depending if the air gap needs to be increased/decreased, turn the adjusting nut accordingly. A quarter or half turn is usually sufficient for adjusting purposes.
- After adjusting the nut, tighten the socket head cap screw back onto the brake.
- Measure the air gap for spacing - Repeat process to achieve recommended setting.

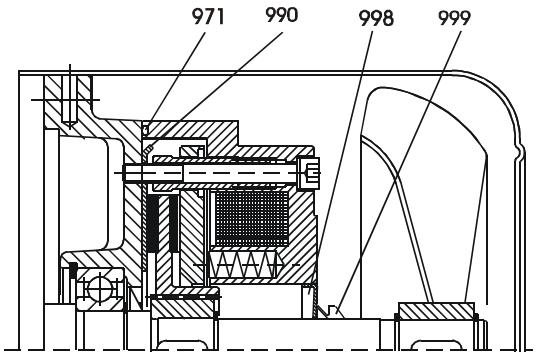
Size	Rated Torque lb-ft [Nm]	Power of Brake Coil W	Air Gap Setting in [mm]	Max Air Gap Before Re-Adjustment in [mm]	Minimum Rotor (Brake Pad) Thickness in [mm]
5	3.75 [5]	22	0.008 [0.2]	0.031 [0.8]	0.177 [4.5]
10	7.5 [10]	28	0.008 [0.2]	0.031 [0.8]	0.217 [5.5]
20	16 [20]	34	0.012 [0.3]	0.031 [0.8]	0.301 [7.6]
40	30 [40]	42	0.012 [0.3]	0.035 [0.9]	0.374 [9.5]
60	44 [60]	50	0.012 [0.3]	0.039 [1.0]	0.453 [11.5]
100	75 [100]	64	0.016 [0.4]	0.043 [1.1]	0.492 [12.5]
150	110 [150]	76	0.016 [0.4]	0.043 [1.1]	0.571 [14.5]
250	188 [250]	100	0.019 [0.5]	0.047 [1.2]	0.650 [16.5]

Rubber Dust Boot (Option SR)
The optional rubber dust boot protects the brake from dusty/sandy debris from reaching the brake pad. However, it also keeps the brake dust from getting out. Regular maintenance must be done to the brake to remove the brake dust. The amount of brake dust accumulated will vary with the brake size and application.

PARTS LIST – PRECIMA BRAKES



Normal Design, Enclosure IP55
with following options:
RG – Stainless Steel Disc (Item 990)
SR – Dust Boot-includes Option RG (Item 992)
HL – Hand Release (Item 937)



Optional Brake with optional IP66 enclosure

932	Non-drive endshield
936	Brake coil
937	Manual brake lever – optional
938	Brake hub
939	Fan
940	Fan cover
946	Fixing screw
971	O-ring - optional
990	Friction plate - optional
991	Setting bolt
992	Dust protection ring[1)] – optional
993	Brake disc
994	Anchor plate
995	Spring
996	Pressure plate adjustment**
997	Adjustable ring **
998	Bushing/seal - optional
999	V-ring - optional

[1)] Not available for 400N, and 800 Nm.
** Only for brakes that are 5 Nm to 40 Nm

BRAKE PAD REPLACEMENT – PRECIMA BRAKES

LIST OF TOOLS

Following are a list of tools to remove the brake:

- Screw drivers – Philips & Flat (to remove the fan cover)
- External snap ring pliers (to remove fan retaining snap ring)
- Large screw drive or a small pry bar (to pop off the fan)
- Metric sockets & T-handles and open-end wrenches

IMPORTANT

Ensure that the reducer load is supported. Removal of the brake will let the load free fall, which may cause injury.
Disconnect the power from the motor.

PROCEDURE

When the brake pad is worn to the minimum thickness as shown in the chart on page 5, the pad should be replaced to maintain the proper operation. To replace the pad:

- Remove the 4 bolts to remove the fan cover
- If the brake has a hand release, this can be removed by unscrewing.
- Remove the fan cover and note the position of the hand release slot if applicable.
- Remove the snap ring holding the cooling fan.
- Carefully remove the cooling fan, key and second snap ring.
- If the brake is equipped with a dust boot, remove it.
- Remove the 3 socket head cap screws holding the brake coil to the motor end-bell.
- Remove the brake coil, noting the hand release and power cable locations.
- The brake pad will now slide off the hub holding it on the shaft.
- Clean the brake, install the pad and reassemble.

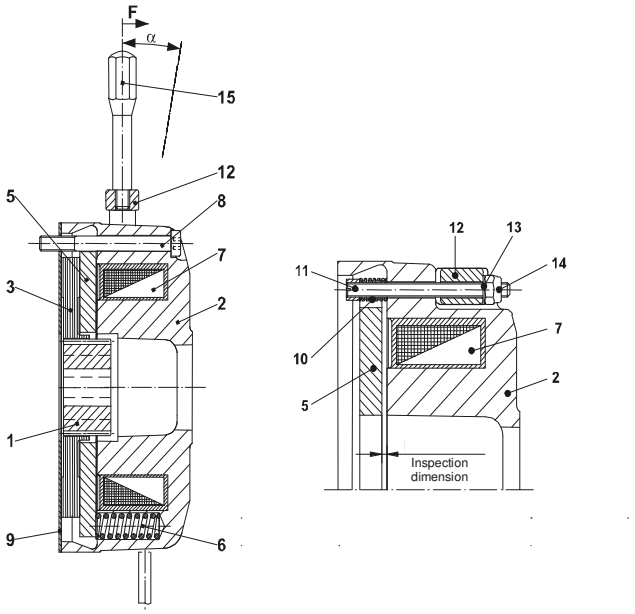
NOTE: Upon reassembly, the brake air gap setting must be checked and adjusted if needed, as noted in MAINTENANCE.

PRECIMA BRAKE REPLACEMENT PARTS				
BRAKE SIZE	**BRAKE DISC (PAD) [ITEM 993]**	**HANDLE [ITEM 937]**	**STAINLESS DISC [ITEM 990]**	**DUST BOOT [ITEM 992]**
5 NM	19120042	19150042	19130042	19110042
10NM	19120082	19150082	19130082	19110082
20NM[1)]	19120162	19150162	19130162	19110162
40NM[2)]	19120322	19150322	19130322	19110402
40NM[3)]	19120402	19150322	19130322	19110402
60NM	19120602	19150602	19130602	19110602
100NM	19120802	19150802	19130802	19110802
150NM	19121502	19151502	19131502	19111502
250NM	19122402	19152402	19132500	19112502
400NM	Call Factory	Call Factory	Call Factory	Call Factory
800NM	Call Factory	Call Factory	Call Factory	Call Factory

1) Alternate-Special order only. Standard brake is by Mayr – see page 7.
2) 90 and 100 frame motors with spline style hub.
3) 112 frame motor with hex style hub

MAINTENANCE – MAYR BRAKES (10 - 20Nm)

1. Gear hub
2. Coil carrier complete with coil (7)
3. Rotor
5. Armature disc
6. Helical spring (torque)
7. Coil
8. Fixing screw
9. Friction disc
10. Helical spring (hand release)
11. Threaded bolt
12. Lever
13. Washer
14. Hexagon nut
15. Hand release bar
16. Shoulder screw



This style brake needs very little maintenance while it is in operation. The air gap does not need to be adjusted. It is pre-set at the factory and is self adjusting for the life of the brake rotor pad. When the brake is not operation properly, the rotor pad may need to be replaced. The brake coil will have to be removed to check the brake pad thickness.

Size	Rated torque	Power of Brake Coil	Minimum Rotor Thickness (brake pad)
10	7.4 lb-ft / 10 Nm	33 Watts	0.20" / 5.2 mm
20	16 lb-ft / 20 Nm	43 Watts	0.27" / 6.8 mm

BRAKE PAD REPLACEMENT

LIST OF TOOLS

Following are a list of tools to remove the brake:

- Screw drivers – Philips & Flat (to remove the fan cover)
- External snap ring pliers (to remove fan retaining snap ring)
- Large screw drive or a small pry bar (to pop off the fan)
- Metric sockets & T-handles and open-end wrenches

IMPORTANT

Ensure that the reducer load is supported. Removal of the brake will let the load free fall, which may cause injury.
Disconnect the power from the motor.

PROCEDURE

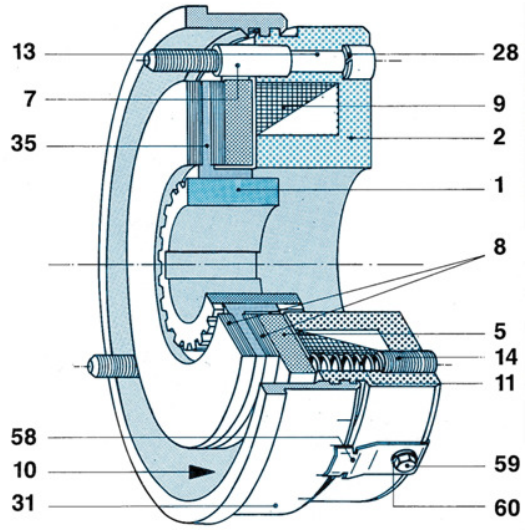
- Remove the 4 bolts to remove the fan cover.
- If the brake has a hand release, it can be removed by unscrewing it.
- Remove the fan cover and note the position of the hand release slot if applicable.
- Remove the snap ring holding the cooling fan in place.
- Carefully remove the fan, key and second snap ring.
- Remove the 3 socket head cap screws holding the brake coil to the motor endbell.
- Remove the brake coil, noting the hand release and power cable locations.
- The brake pad will now slide off the hub holding it on the shaft.
- Clean the brake coil, replace the pad, and reassemble.

NOTE: The air gap is self adjusting and can not be measured with the brake assembled. To check the proper operation, apply pressure to the hand release lever and turn the motor by hand to check for free rotation.

MAYR BRAKE REPLACEMENT PARTS								
BRAKE SIZE	Complete Brake Part Number (*Includes Brake Disc*)					BRAKE DISC (PAD) [ITEM 3]	HANDLE [ITEM 15]	STAINLESS DISC [ITEM 9]
	24VDC	105VDC	180VDC	205VDC	250VDC			
10NM	N/A	N/A	N/A	19021934	N/A	19120084	19150074	N/A
20NM	19030224	19030924	19031904	19031924[1)]	19032524	19120164	19150164	19130164

1) Standard NORD brake

MAINTENANCE - MAYR BRAKES (400 - 800Nm)



1. Gear hub
2. Coil body complete with coil (9) and guide bushes (7)
5. Armature disc
7. Guide bush
8. Friction lining
9. Coil
10. Anchor Plate
11. Helical spring
13. Fixing screw
14. Set screw
28. Spring washer
31. Threaded distance ring open
35. Rotor with friction linings (8)
58. Lock washer
59. Locking screw
60. Spring washer

This style brake may need the air gap adjusted or have the pad replaced. Both procedures are listed below.

Brake Size	Rated Torque	Power of Brake Coil	Minimum Rotor Thickness (Brake pad)	Air Gap Setting
400	300 lb-ft / 400 Nm	134 Watts	0.53" / 13.5 mm	0.015" / 0.4 mm
800	600 lb-ft / 800 Nm	196 Watts	0.79" / 20 mm	0.020" / 0.5 mm

LIST OF TOOLS

Following are a list of tools to remove the brake:

- Screw drivers – Philips & Flat (to remove the fan cover)
- External snap ring pliers (to remove fan retaining snap ring)
- Large screw drive or a small pry bar (to pop off the fan)
- Metric sockets & T-handles and open-end wrenches

IMPORTANT

Ensure that the reducer load is supported. Removal of the brake will let the load free fall, which may cause injury.
Disconnect the power from the motor.

PROCEDURE FOR CHECKING AND ADJUSTING THE AIR GAP

- Remove the 4 bolts to remove the fan cover.
- Remove the fan cover.
- Remove a plug from the threaded distance ring (31) and measure the air gap with a feeler gauge. If the distance is larger than 0.012"/0.3mm over the nominal setting listed in the table, the air gap should be adjusted.
- Loosen the fixing screws (13)
- Loosen the locking screw (59) and lock washer (60).
- Turn the threaded distance ring counterclockwise to decrease the air gap. One graduation on the stamped scale corresponds with .004"/0.1mm.
- Tighten the fixing and clamp screws and recheck the air gap.
- If the air gap is within specifications, reassemble the fan cover.

PROCEDURE FOR REPLACING THE BRAKE ROTOR PAD

- Remove fan cover and snap ring.
- Carefully remove the fan, key and second snap ring.
- Remove the 3 socket head cap screws holding the brake coil to the motor endbell.
- Remove the brake coil.
- The brake pad will now slide off the hub holding it on the shaft.
- Clean the brake coil, replace the pad, and reassemble.

NOTE: Check the air gap per the above procedure.

MAYR BRAKE REPLACEMENT PARTS		
BRAKE SIZE	**BRAKE DISC (PAD)**	**HANDLE**
400NM	19124004	19154002
800NM	Call Factory	Call Factory

HAND RELEASE BRAKE AIR GAP SETTING

When a complete brake motor is supplied by NORD, the brake air gap and hand release lever spacing are already set from the factory. Only the brake air gap will need to be adjusted for maintenance (Precima Brakes). Refer to the brake air gap setting on page 4. Thread adhesive is applied to the hand release adjusting bolt so it will not lose the setting. The spacing for the hand release can be checked only with the brake assembled onto the brake B-endbell. If the spacing needs to be adjusted, remove the brake from the motor B-endbell and the adjusting bolt will be accessible. Refer to Figure 1. ****20Nm Mayr brake air gaps do not need adjustment.***

If the brake is sent by itself from the factory, the brake air gap and hand release lever spacing must be set. If the air gap is set less than recommended, the brake will lose holding force prematurely. If very little air gap is set, the brake will not engage. Setting the brake air gap must be done with the brake removed from the motor. The "new" brake air gap value will be the sum of the brake air gap value and the hand release spacing value. After the gap has been set, assemble the brake onto the motor and measure both the brake air gap and hand release spacing with a feeler gauge. Refer to Figure 2.

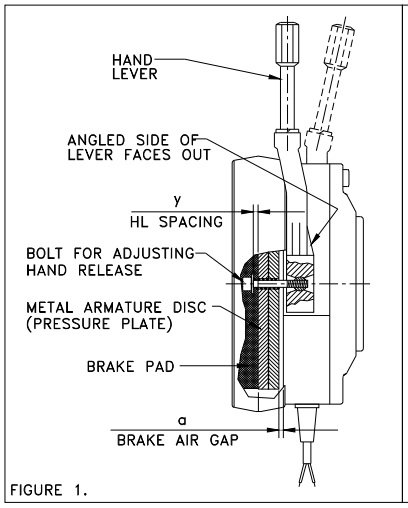


FIGURE 1.

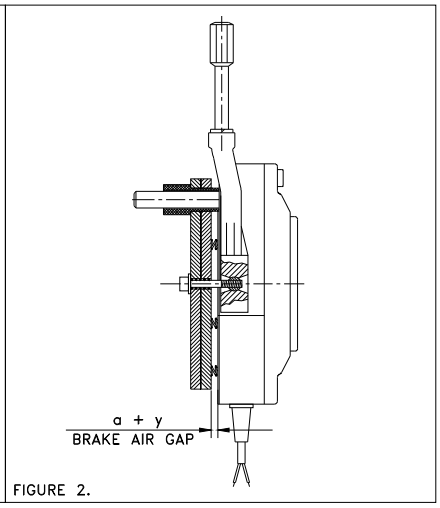


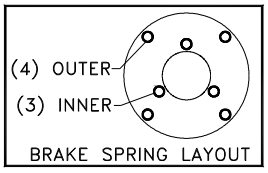
FIGURE 2.

	BRAKE SIZE								
	5	**10**	**20***	**40**	**60**	**100**	**150**	**250**	**400**
y	0.040" 1 mm	0.040" 1 mm	0.040" 1 mm	0.040" 1 mm	0.040" 1 mm	0.047" 1.2 mm	0.047" 1.2 mm	0.059" 1.5 mm	0.059" 1.5 mm

*** Mayr Brake Hand Release: Tighten hand lever bolts snug and then back off by 2 turns.**

ADJUSTING BRAKE TORQUE

The table below shows the rated torque of brakes as springs are removed (7, 5 or 3 springs). The springs are placed in such a way where there are three centers and four outer springs. The four outer springs are the ones that are removed for decreasing the torque. When decreasing the torque, remove springs opposite of each other to prevent uneven brake wear.



TORQUE ADJUSTMENT SPECIFICATIONS

Brake Size	Rated Torque *(full torque)* lb-ft [Nm]	Rated Torque lb-ft [Nm]	Rated Torque lb-ft [Nm]	Ring Nut Torque Adjustment	
				Torque Reduction Per Click Lb-ft [Nm]	Minimum Brake Torque Available lb-ft [Nm]
	7-springs	***5-springs***	***3-springs***		
5	3.7 [5]	2.6 [3.5]	1.5 [2.0]	0.15 [0.2]	0.9 [1.2]
10	7.4 [10]	5.18 [7.0]	3 [4.0]	0.15 [0.2]	1.8 [2.4]
20[1)]	15 [20]	N/A	N/A	0.81 [1.1]	7.5 [10.0]
20[2)]	15 [20]	10.3 [14]	6 [8]	0.22 [0.3]	3.6 [4.8]
40	30 [40]	20.72 [28]	12.58 [17]	0.74 [1.0]	8.5 [11.4]
60	44 [60]	32 [43]	19 [25]	*Does not include a ring nut*	
100	74 [100]	52 [70]	31 [41]	*Does not include a ring nut*	
150	111 [150]	79 [106]	48 [65]	*Does not include a ring nut*	
	8-springs	***6-springs***	***4-springs***		
250	184 [250]	138 [186]	92 [124]	*Does not include a ring nut*	
400	295 [400]	221 [298]	148 [200]	*Does not include a ring nut*	
800	600 [800]	442 [596]	296 [400]	*Does not include a ring nut*	

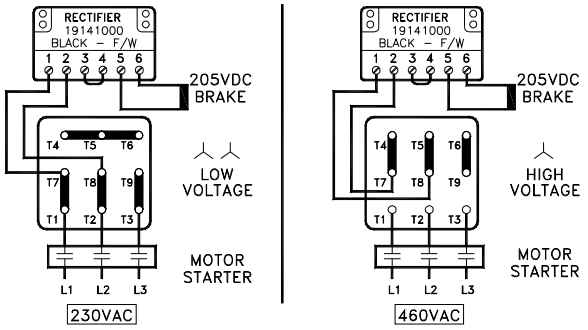
1) Standard Stock MAYR Brake 2) Special Order PRECIMA Brake

CONNECTION DIAGRAMS

230/460V, 60Hz, 3ø

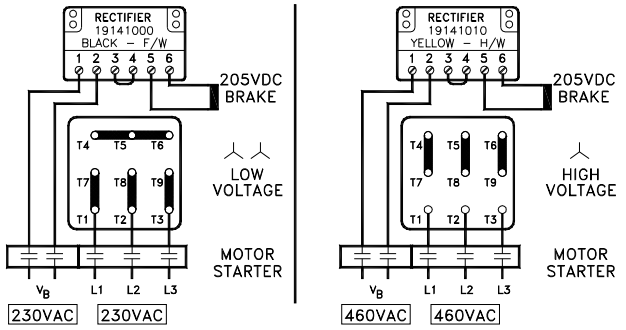
BR101

230/460V, 60Hz, 3ø
BRAKE WITH STANDARD FULL-WAVE RECTIFIER



BR102

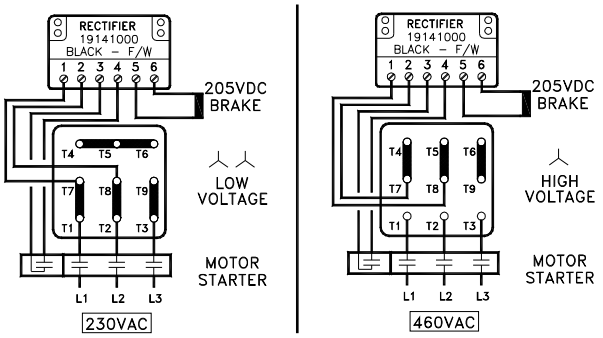
230/460V, 60Hz, 3ø
BRAKE WITH STANDARD FULL & HALF-WAVE RECTIFIER
WIRED TO SEPARATE POWER SOURCE



V_B = BRAKE VOLTAGE

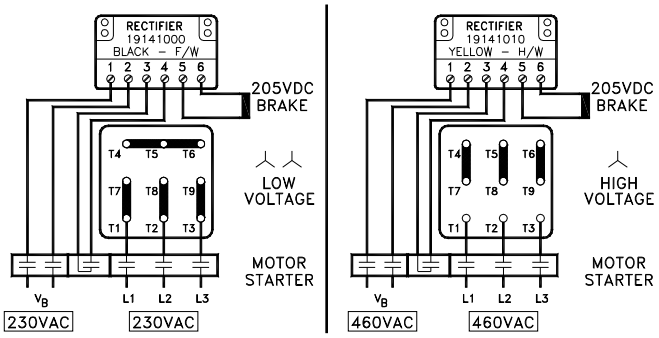
BR103

230/460V, 60Hz, 3ø
BRAKE WITH STANDARD FULL-WAVE RECTIFIER
WIRED FOR DC SWITCHING



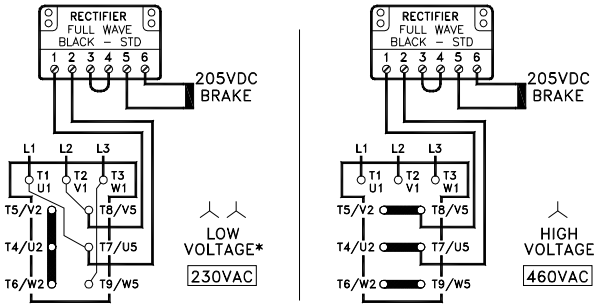
BR104

230/460V, 60Hz, 3ø
BRAKE WITH STANDARD FULL & HALF-WAVE RECTIFIER
SEPARATE POWER SOURCE & DC SWITCHING



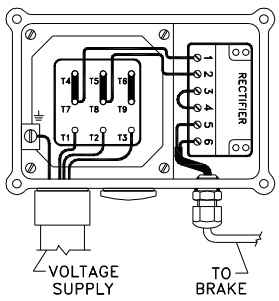
V_B = BRAKE VOLTAGE

BR201 **FOR MOTOR FRAMES 160 & LARGER, A 9 POST "T" STYLE TERMINAL BLOCK WILL BE USED. THE T-BLOCK NUMBERING WILL BE THE SAME AS THE "SQUARE" STYLE SHOWN IN BR101 THRU BR104.



*JUMPER WIRES WILL BE USED BETWEEN THE TERMINALS AS SHOWN.

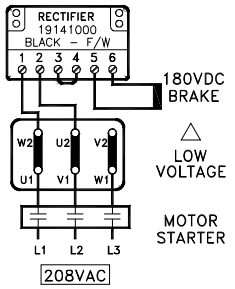
TYPICAL VIEW OF TERMINAL BOX WITH WIRING
("SQUARE" 9 POST TERMINAL)



208/360V, 60Hz, 3ø

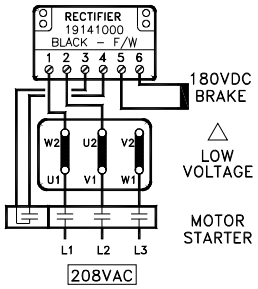
BR301

208/360V, 60Hz, 3ø
BRAKE WITH STANDARD
FULL-WAVE RECTIFIER



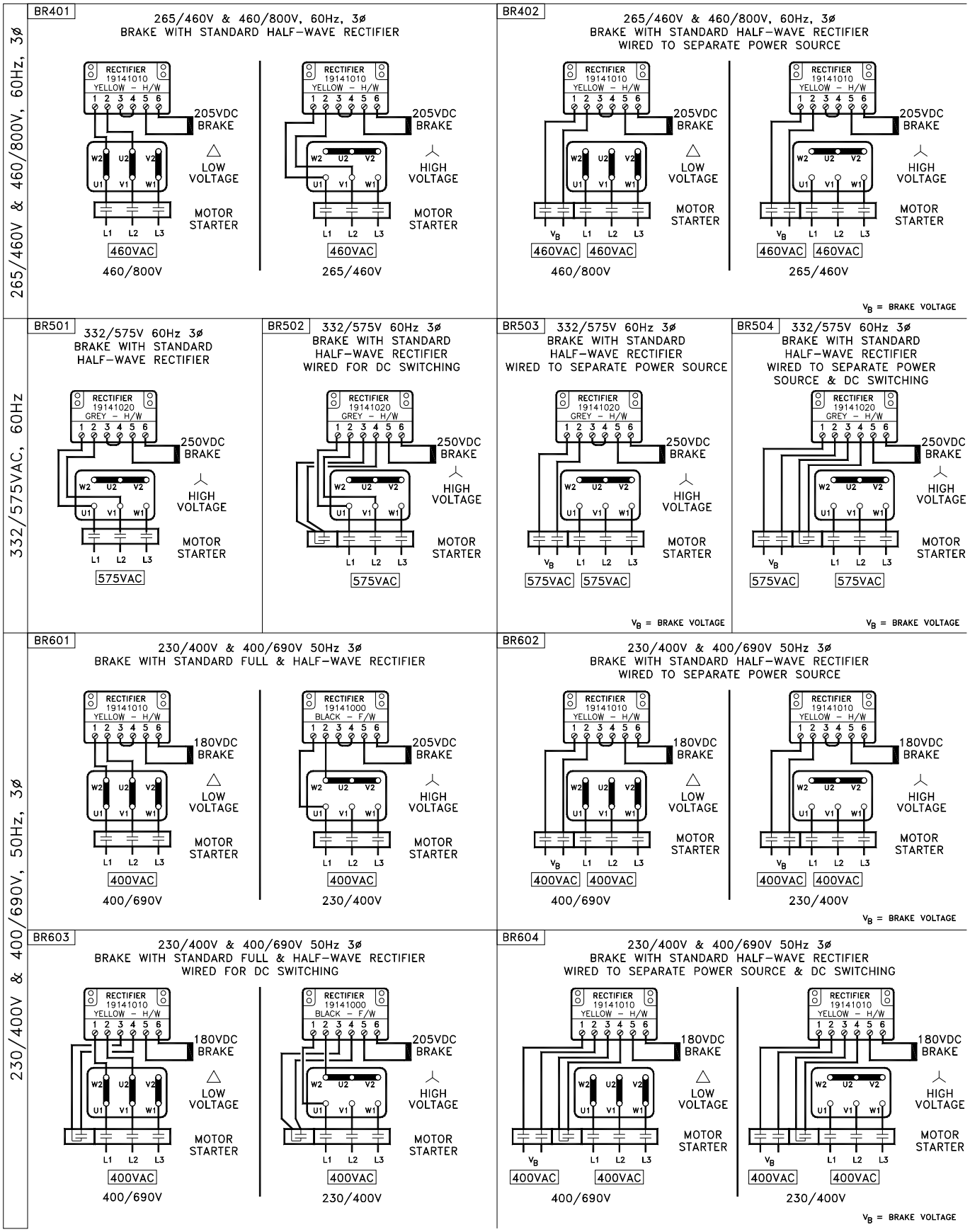
BR302

208/360V, 60Hz, 3ø
BRAKE WITH STANDARD
FULL-WAVE RECTIFIER
WIRED FOR DC SWITCHING



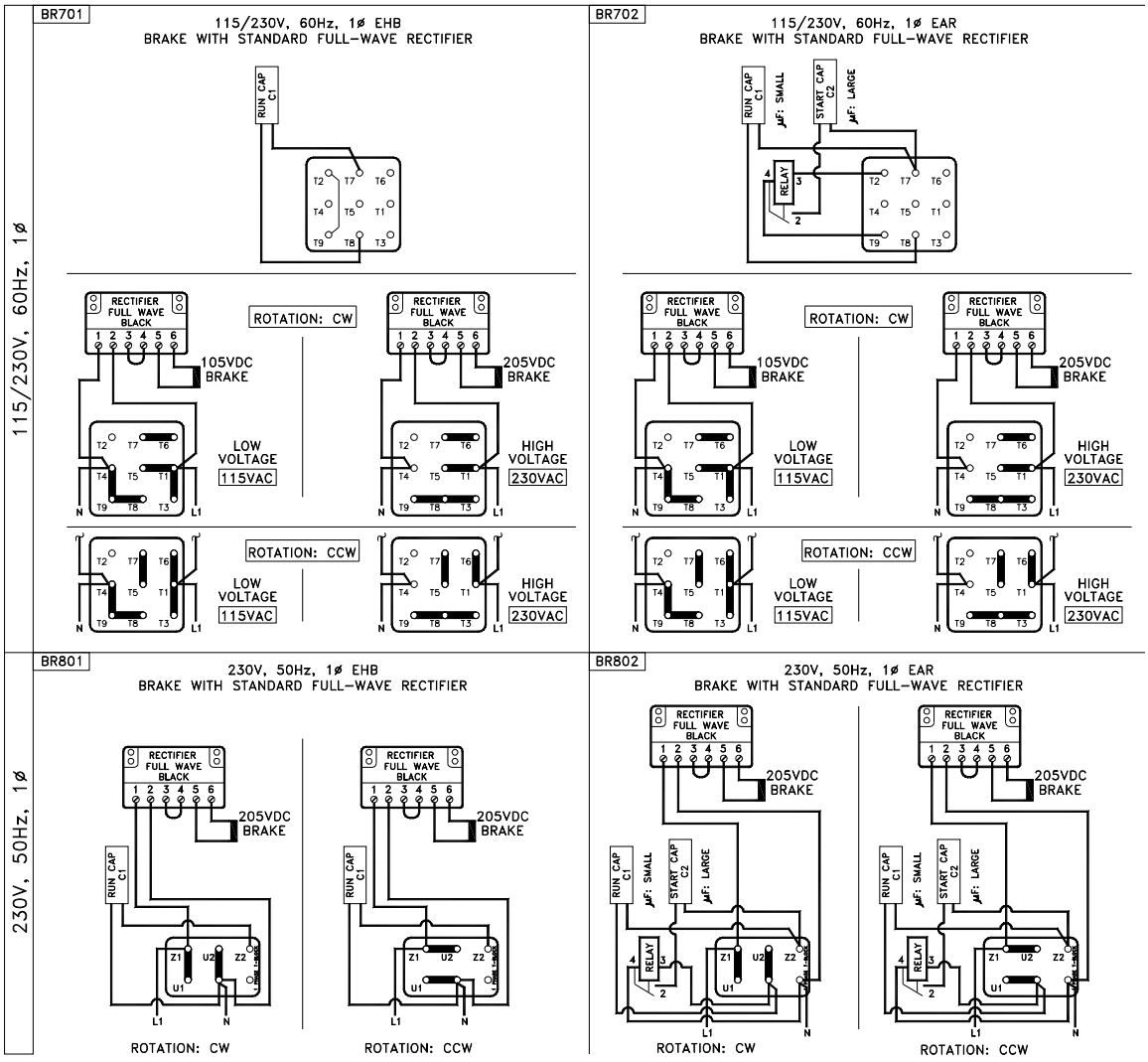
The external contacts shown for the brake operation must be rated for inductive loads and/or IEC class AC3 contacts.

CONNECTION DIAGRAMS (Cont.)



The external contacts shown for the brake operation must be rated for inductive loads and/or IEC class AC3 contacts.

CONNECTION DIAGRAMS (Cont.)



TROUBLESHOOTING

FAULTS	CAUSE	REMEDY
Brake doesn't release	Air gap too large	Check air gap and adjust
	Brake not receiving electrical power	Check electrical connection
	Failed rectifier	Replace rectifier
	Brake is getting too warm	Use fast response (FR) rectifier
	Voltage to brake coil too small	Check connection voltage of brake coil
	Rectifier supply voltage from inverter	Rectifier voltage must be from separate source. (Inverter output voltage varies)
Brake release is delayed	Air gap too large	Check air gap and adjust
	Voltage to brake coil too small	Check connection voltage of brake coil
Brake does not engage	Voltage to coil too large	Check connection voltages of brake windings
	Hand release is adjusted incorrectly	Adjust to correct air gap
	Anchor plate mechanically blocked	Remove mechanical blockage
Brake engagement is delayed	Voltage to coil too large	Check connection voltage of brake windings
	Brake is switched to AC side	Use DC switching

NORD Gear Corporation
National Customer Service Toll Free 888-314-6673
www.nord.com

NORD Gear Limited
Toll Free in Canada 800-668-4378

WEST
1121 Railroad Street
Building 101
Corona, CA 92882
Phone 951-279-2600
Fax 888-408-6673

MIDWEST
PO Box 367
800 Nord Drive
Waunakee, WI 53597
Phone 608-849-7300
Fax 800-373-6673

SOUTH
100 Forsyth Hall Dr.
Building 100B
Charlotte, NC 28273
Phone 704-529-1255
Fax 888-259-6673

CANADA
41 West Drive
Brampton, Ontario L6T 4A1
Phone 905-796-3606
Fax 905-796-8130

MOTORS

Standard efficiency, 1.15 Service factor
Inverter duty, TEFC
Synchronous speed 1800rpm @ 60Hz, 4-pole
Voltages: 230/460 & 332/575 – 60Hz, Three-phase
Continuos Duty, 40°C Ambient, up to 3300ft Elevation
Class B temperature rise, Class F insulation

CE / 60Hz

Frame Size	HP	kW	n_n Full Load rpm	Full-load current I_n 230V A	460V A	575V A	I_a/I_n %	Code Letter	T_n lb-in	T_a/T_n	T_k/T_n	pf	Eff. %	J_m Inertia lb-ft^2
63S/4	0.16	0.12	1700	0.88	0.44	0.35	300	H	5.93	2.7	3.5	0.66	52	0.00499
63L/4	0.25	0.18	1680	1.12	0.56	0.45	300	G	9.38	2.3	2.5	0.72	57	0.00665
71S/4	0.33	0.25	1710	1.56	0.78	0.62	340	H	12.3	2.3	3.0	0.64	63	0.0133
71L/4	0.50	0.37	1720	1.90	0.95	0.76	400	G	18.3	2.2	2.7	0.69	71	0.0173
80S/4	0.75	0.55	1710	2.70	1.35	1.08	400	H	27.6	2.0	2.3	0.71	72	0.0304
80L/4 **	1.0	0.75	1650	3.65	1.83	-	280	D	38.2	2.1	2.2	0.64	70	0.0623
90S/4 **	1.5	1.1	1660	4.83	2.42	-	320	D	57.0	2.6	2.5	0.68	73	0.0887
90L/4 **	2.0	1.5	1660	6.33	3.17	-	340	D	75.9	2.5	2.4	0.70	74	0.1182
100L/4 **	3.0	2.2	1700	9.04	4.52	-	350	D	111	2.2	2.5	0.70	75	0.1699
100L/40 **	5.0	3.7	1725	15.2	7.62	-	510	G	183	2.7	3.1	0.75	81	0.2831
132S/4 **	7.5	5.5	1730	19.8	9.91	-	380	C	273	2.2	2.6	0.71	85	0.8796
132M/4 **	10	7.5	1730	25.7	12.9	-	440	E	364	2.7	3.0	0.73	87	1.197
160M/4 *	15	11	1760	36.8	18.4	-	820	K	537	2.8	3.3	0.85	89	1.187
160L/4 *	20	15	1760	49	24.5	-	800	J	716	2.8	3.3	0.86	89	1.661
180M/4 *	25	18.5	1750	60	30.0	-	740	H	900	2.6	3.0	0.87	89	3.085
180L/4 *	30	22	1755	71	35.5	-	800	J	1080	2.9	3.3	0.87	90	3.560
200L/4 *	40	30	1755	91	45	-	580	F	1440	2.6	2.6	0.89	92	10.68
225S/4 *	50	37	1755	124	62	-	670	H	1800	2.2	2.2	0.83	91	13.29
225M/4 *	60	45	1760	143	71	-	700	H	2150	2.8	2.8	0.86	91	16.85
250M/4 *	75	55	1760	170	85	-	700	H	2690	2.6	2.6	0.89	90	19.93
280S/4 *	100	75	1770	223	111	-	670	G	3560	2.6	2.6	0.87	91	37.02
280M/4 *	125	90	1775	290	145	-	650	G	4440	2.6	2.6	0.86	91	42.71
315S/4 *	150	110	1775	345	173	-	750	H	5330	3.1	3.1	0.87	90	80.68
315M/40 *	200	150	1775	445	223	-	750	H	7100	3.2	3.2	0.86	93	125.8

* - Underwriter Laboratories Recognition - pending
** - Carries the CE mark

Abbreviations

- **n_n** - Full-load speed
- **I_n** - Full-load current
- **I_a/I_n** - Locked-rotor current ratio (percentage)
- **T_n** - Full-load torque
- **T_a/T_n** - Locked-rotor torque ratio
- **T_k/T_n** - Break-down torque ratio
- **pf** - Power factor
- **Eff.** - Nominal efficiency
- **J_m** - Motor inertia

FIGURE 13

REEVING DRAWINGS

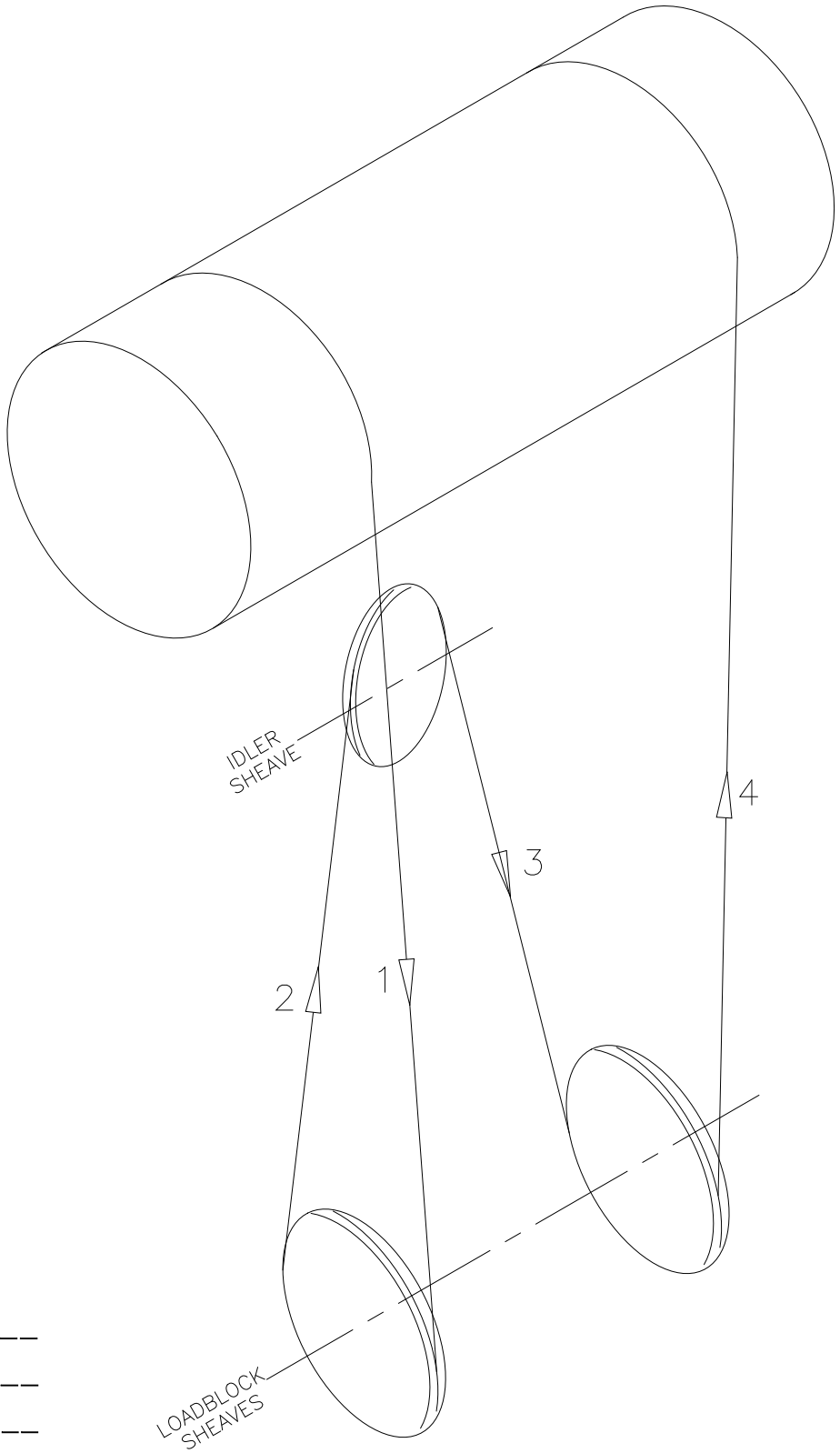
2 PD

3 PD

4 PD

6 PD

7 PD



ITEM #: _____

QTY.: _____

JOB: _____

REV.	DATE	DESCRIPTION

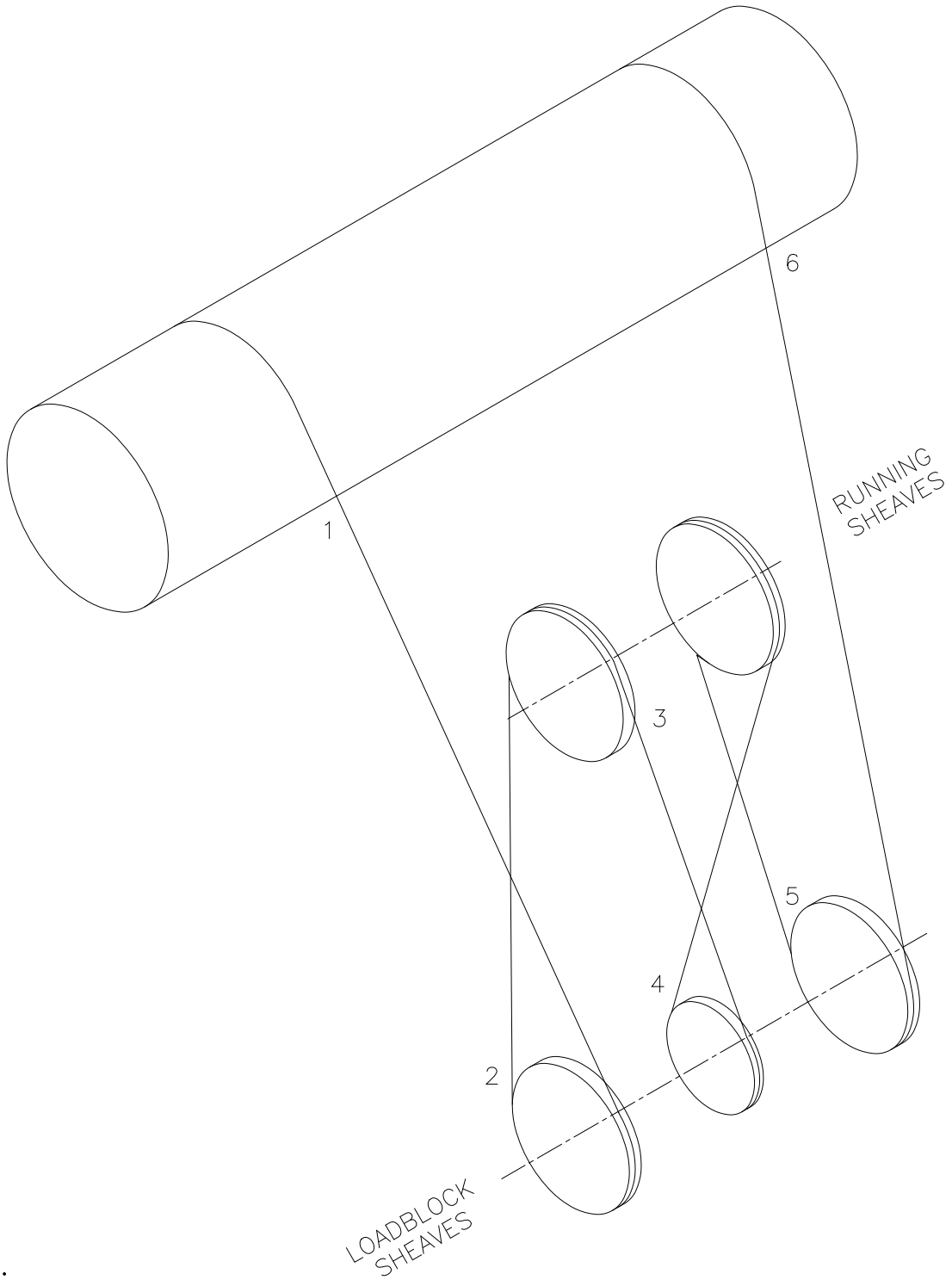
ACE *ENGINEERING LTD.*
10200 JACKSBORO HWY., FORT WORTH TX

2 P.D. REEVING, LOWERING OUTSIDE

Date: *12/12/01*

WIRE ROPE Part No.: *21*

DWG. *JB*	CHK. ____	APR. ____	File: *2PD - REEV*



ITEM #: _____

QTY.: _____

JOB: _____

REV.	DATE	DESCRIPTION

ACE *ENGINEERING CO., INC.*
10200 JACKSBORO HWY., FORT WORTH TX

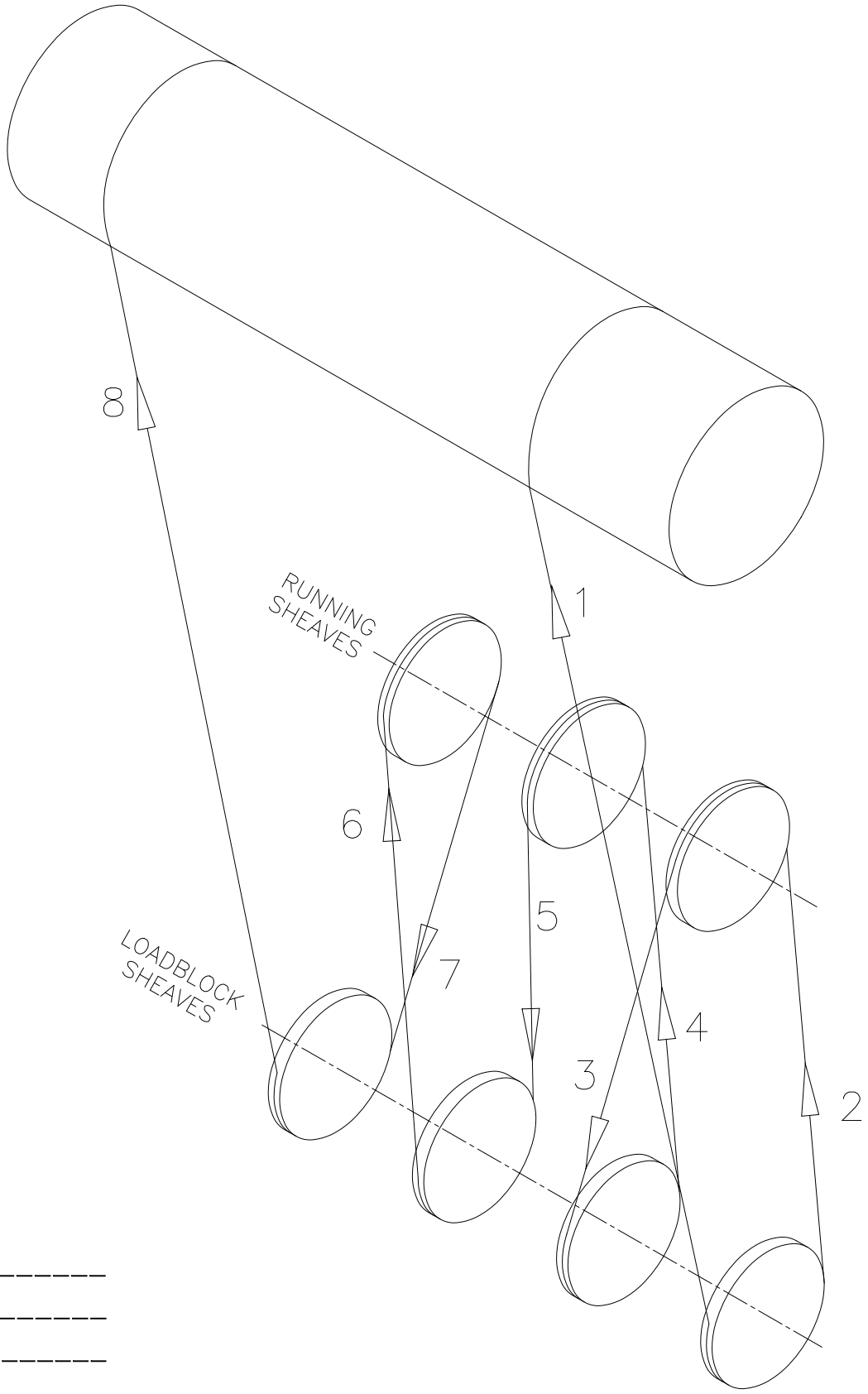
3 P.D. REEVING - LOWERING OUTSIDE

Date: *03/13/97*

WIRE ROPE Part No.:

_____*21*

DWG. *MLG*	CHK. ____	APR. ____	File: *REEV-3PD*



ITEM #: _____

QTY.: _____

JOB: _____

REV.	DATE	DESCRIPTION

ACE ENGINEERING LTD.
10200 JACKSBORO HWY., FORT WORTH TX

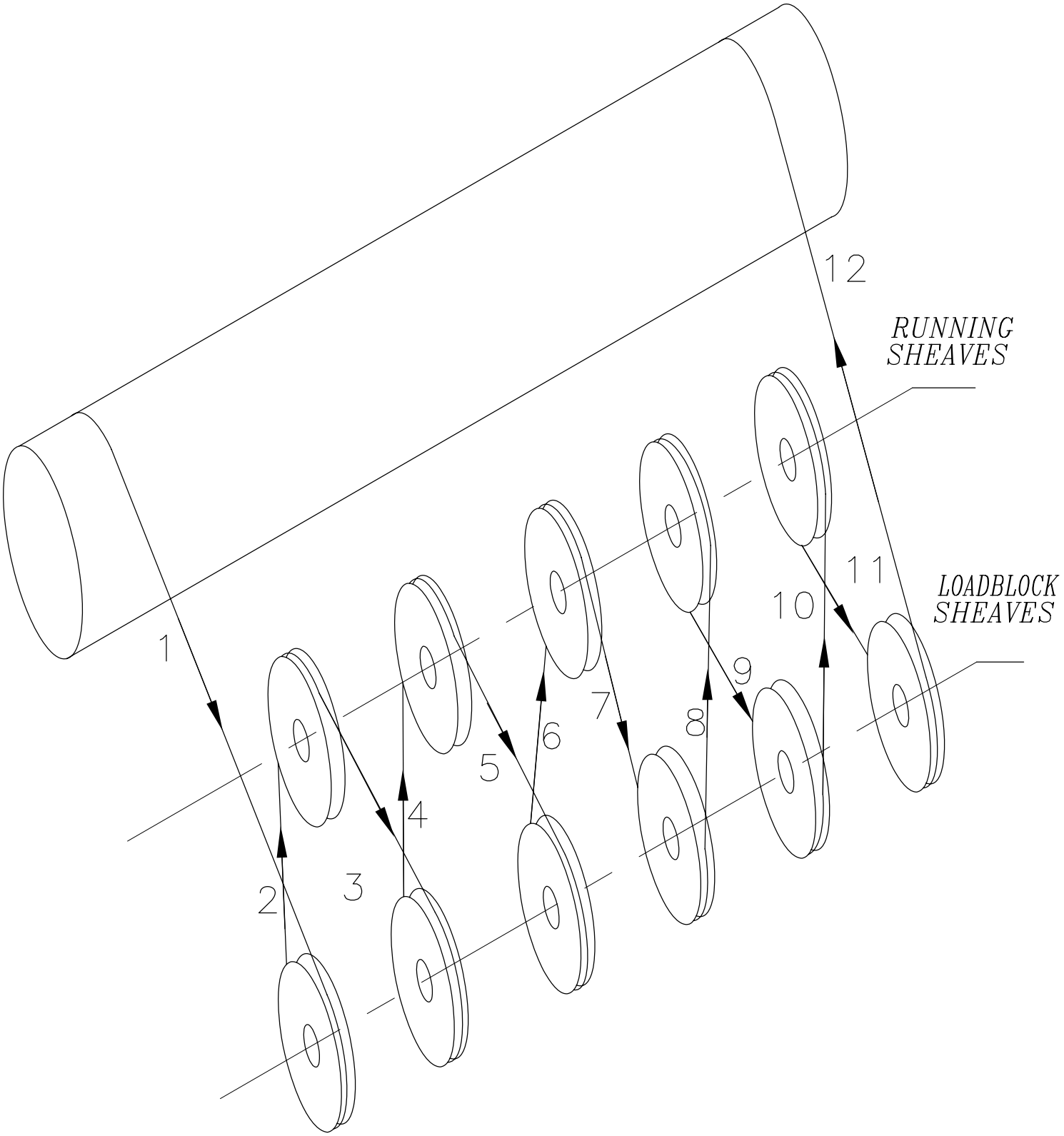
4 P.D. IN-LINE REEVING, LOWERING OUTSIDE

Date: 10/12/98

WIRE ROPE Part No.:

21

DWG. MQG | CHK. ____ | APR. ____ | File: REEV 4PD...



REV.	DATE	DESCRIPTION

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10200 Jacksboro Hwy – Ft Worth, TX 76135

DRAWN BY: THD | CHECKED BY: _ | APR.: R.REEVES | DATE: 3/9/2000 | QTY: | ITEM:

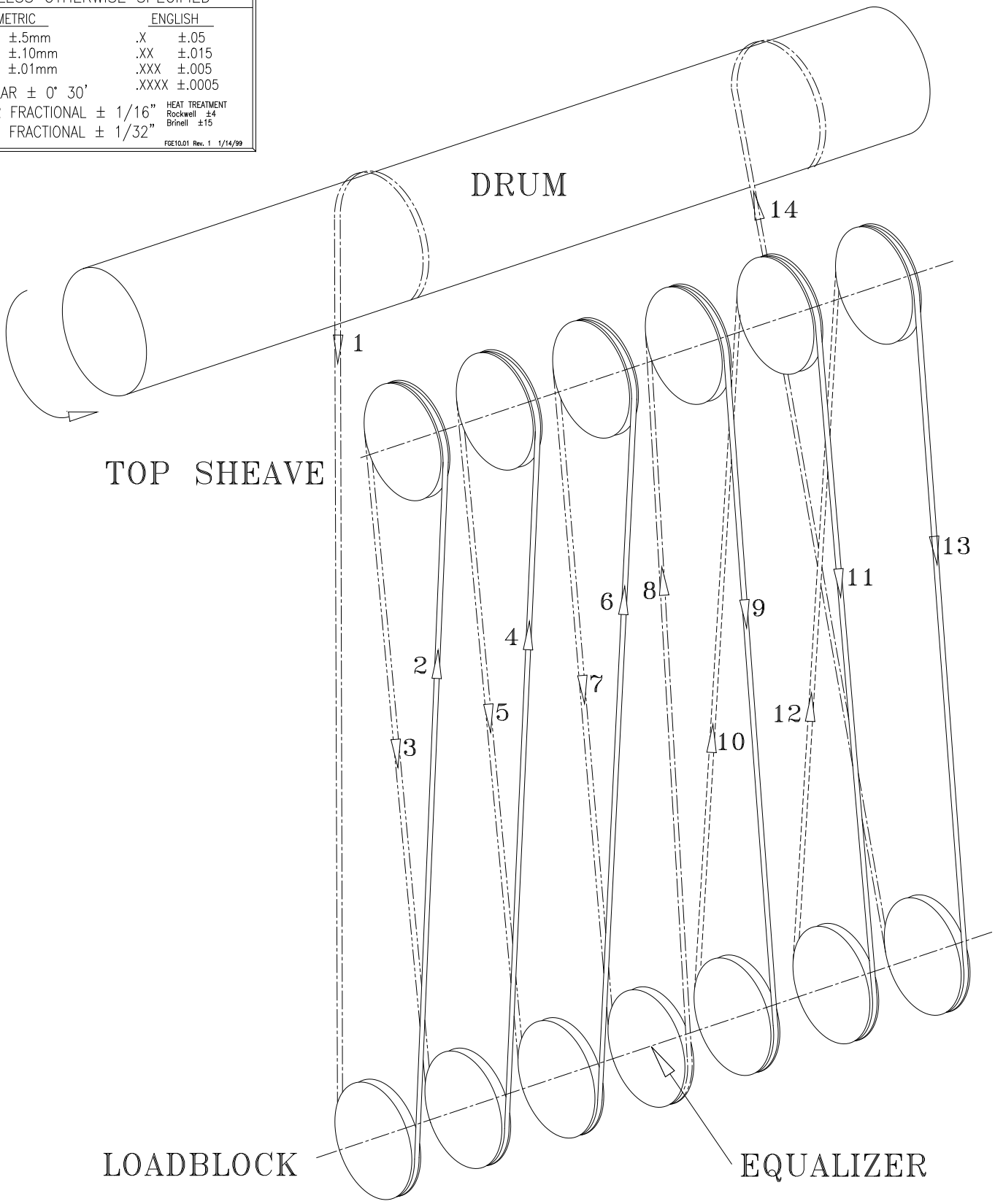
DRAWING TITLE
6 P.D. INLINE REEVING DIAGRAM LOWERING OUTSIDE

SCALE: NTS
FILE: 6PDREEV
PART NO. 6PDREEV
JOB NO.

TOLERANCES
UNLESS OTHERWISE SPECIFIED

METRIC	ENGLISH
.X ±.5mm	.X ±.05
.XX ±.10mm	.XX ±.015
.XXX ±.01mm	.XXX ±.005
	.XXXX ±.0005

ANGULAR ± 0° 30'
LINEAR FRACTIONAL ± 1/16"
HOLES FRACTIONAL ± 1/32"
HEAT TREATMENT Rockwell ±4 Brinell ±15
FGE10.01 Rev. 1 1/14/99



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10200 JACKSBORO HWY.
FORT WORTH, TX 76135
PHONE 817.237.7700
FAX 817.237.2777
ACEWORLDCOMPANIES.COM

DRAWN BY:	CHECKED BY:	APR.:	DATE:	QTY:	ITEM:
JB		JB	2/05/04		

DRAWING TITLE
7PD INLINE REEVING DIAGRAM
LOWERING OUTSIDE

SCALE: NTS
FILE: 7PDOUTLREEV
PART NO. 7PDOUTLREEV
JOB NO.