

FRV40-226-010-010

REV 1

DESCRIPTION, OPERATION, AND MAINTENANCE INSTRUCTIONS

Capstan

Halter Marine, Inc.
13085 Seaway Rd.
P.O. Box 3029
Gulfpport, MS 39505
50-SPNA-1-00031



PUBLISHED BY DIRECTION OF NOAA

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28 June 2007

RECORD OF CHANGES

Change No.	Date	Title and/or Brief Description	Signature of Validating Officer

APPROVAL AND PROCUREMENT RECORD PAGE

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TITLE OF MANUAL: Capstan

APPROVAL AUTHORITY: NOAA

Contract Number	Ship Applicability	Qty Of Manuals	Building Yard
50-SPNA-1-00031	FRV40-226	2 EA	Halter Marine Inc.

REMARKS:

CERTIFICATION: It is hereby certified that FRV40-226-010-010 to be provided under contract 50-SPNA-1-00031 has been approved by the approval data shown above.

Date: _____
Chand, LLC
Mathews, LA 70375
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VALIDATION PERFORMANCE

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Capstan

Contractor

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Halter Marine, Inc.

Chand, LLC.

Contract No.(s) and Purchase Orders, If Applicable
50-SPNA-1-00031

Chapter	Section	Paragraph	Date Validation Completed	Check here if Not Validated
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Contents of this manual have been validated and certified to be applicable to the equipment furnished under the above procurement as specified for Validation.

Name & Authority of Validating Officer:

Signature of Validating Officer:

FOREWORD

This manual is intended to clearly and accurately reflect the actual configuration of the installed equipment described for the FRV40-226-010-010 Capstan. Users are urged to report instances noted wherein the manual does not achieve this objective.

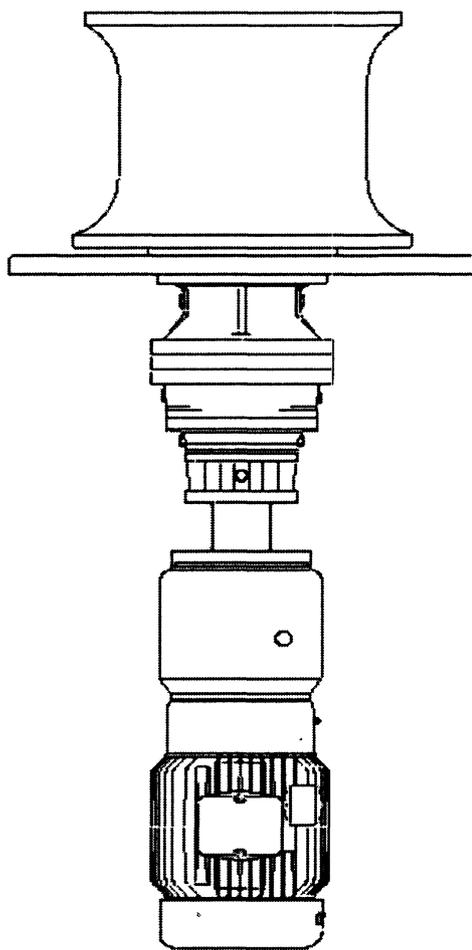
This technical manual provides the instructions necessary to operate, to perform maintenance on and troubleshooting of the Capstan. The text is broken down as follows:

- Section 1 - Capstan
- Section 2 - Planetary Gearbox
- Section 3 - Electric Motor

Section 1 – Capstan

PARTS AND INSTRUCTION MANUAL
Job: 11886 Model: MCF-16-15EB

Capstan
Built For: VT-HALTER



McELROY / CATCHOT
WINCH COMPANY

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SECTION 2

- General Arrangement
- Winch Assembly Drawings
- Component Data Sheets

SAFETY:

Safety, based on years of experience has been built into your Coastal Marine Equipment, Inc. product. This technical manual is provided to instruct the owner and operator of the proper and safe operation of this equipment. The owner and operators should be familiar with the contents of this manual before operating this equipment.

Proper periodic maintenance of this equipment will help prevent accidents and keep it functioning properly. Ultimately it is the operator's responsibility to know the correct operation of the equipment and location of all personnel in the work area.

GENERAL SAFETY RULES:

- ✓ This equipment is not approved for or designed as a personnel lift.
- ✓ Do not wear loose clothing while operating this equipment.
- ✓ Do not operate this equipment in any manner other than the purpose it was designed for.
- ✓ Never operate this equipment alone.
- ✓ Do not stand in the path of the rope while the unit is under load.
- ✓ Do not try to perform any repair or maintenance on the equipment while it is running.
- ✓ The foundation should be able to withstand the breaking strength of the rope / chain.
- ✓ Most likely the manufacturer will not perform the installation. It is recommended that sufficient safety guards be placed on or near the equipment to prevent personnel from coming in contact with the end of the rope / chain under load.
- ✓ The manufacturer assumes no responsibility for the design or installation of safety guards.
- ✓ Keep all personnel not involved with the operation of this equipment clear of moving cable and rotating parts.

CAUTION

- 1. NEVER PULL EQUIPMENT FOUNDATION TO DECK FOUNDATION DURING INSTALLATION.**
- 2. USE SHIMS OR CHOCKFAST BETWEEN EQUIPMENT AND DECK FOUNDATION TO MAINTAIN ALIGNMENT PRIOR TO SECURING EQUIPMENT TO FOUNDATION.**
- 3. FAILURE TO ALIGN EQUIPMENT DURING INSTALLATION CAN CAUSE BEARING AND GEAR FAILURE AND VOID ALL WARRANTIES PROVIDED BY THE MANUFACTURER.**
- 4. WELDING OF FRAME DURING INSTALLATION CAN CAUSE DISTORTION AND MISALIGNMENT OF EQUIPMENT. IT IS RECOMMENDED TO SECURE FOUNDATION TO THE DECK WITH THE MOUNTING HOLES PROVIDED.**
- 5. KEEP FINGERS AND TOOLS AWAY FROM ROTATING PARTS DURING OPERATION.**
- 6. GOOD SAFETY PRACTICES SHOULD BE FOLLOWED AT ALL TIMES.**
- 7. CHECK LUBRICATION BEFORE OPERATING EQUIPMENT.**

INSTALLATION:

GENERAL INSTALLATION REQUIREMENTS:

Electrical Requirements:
15 HP, 575 V, 3 PH, 60 HZ

FOUNDATION:

The vessel's equipment foundation should be a level, flat, smooth surface rigid enough to withstand the breaking strength of the rope.

LIFTING:

Never lift the equipment by the gearbox. Use lifting eye provided.

MOUNTING:

Any gaps between the equipment mounting pads and vessel foundation must be eliminated with the use of shims or chocking compound. This is to assure that the equipment frame is not pulled or twisted. The equipment should be attached to the foundation with the proper sized mounting bolts.

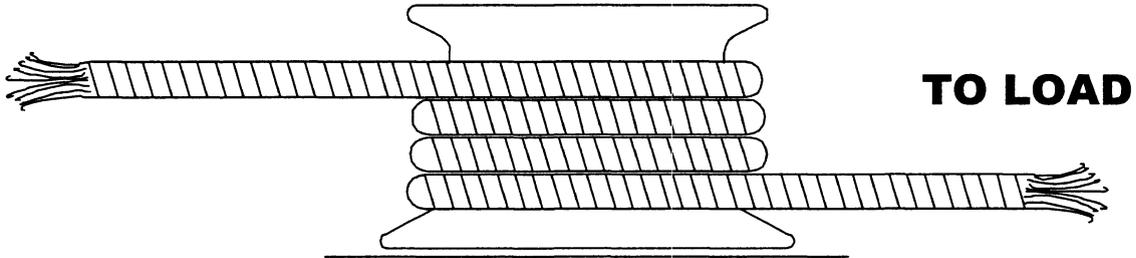
CATHEAD OPERATION:

1. Wrap load end closest to the cathead base.
2. Wrap three to five wraps on cathead
3. To pull load apply tension to the operator end of the rope
4. To stop pulling, let slack on the operator end so head will turn within rope coils.

WARNING

**LINE UNDER TENSION CAN RECOIL.
AVOID POSSIBLE ENTANGLEMENT IN LINE.
DO NOT LIFT LOADS WITH CATHEAD.**

TO OPERATOR



LUBRICATION:

Failure to perform regular periodic preventative maintenance can result in premature failure of equipment components. Due to the severe operating conditions experienced in the marine environment a regular maintenance schedule will greatly extend the life expectancy of your equipment. The equipment should be inspected before each use and periodically during times of dormancy.

Your equipment was properly lubricated prior to shipment from the manufacturing facility but should be checked frequently and before each use. The recommendations listed below are averages based on daily use. These recommendations should be adjusted based on your operating conditions and environmental extremes. Do not mix different brands and types of lubricants. Improper lubrication can be avoided by using good judgment based on the operating conditions.

LUBRICATION SCHEDULE

#	Item / Lubrication Point	Type	Intervals	Quantity
1	Cathead	# 1	Each Use	-
1	Planetary Reducer	# 2	Each Use**	12.5 Pints
1	Electrical Motor Bearings	# 2	Each Use	-

**** Change every 6 months**

LUBRICANT TYPE

#1-Shell Alvania EP2 or Equal

#2-Shell Omala 220 or Equal

MAINTENANCE:

Regular periodic inspection and maintenance is the key safe operation and extended equipment life. Below you will find some recommended areas of inspection but you may find it necessary to add other areas of inspection based on your particular usage.

BASIC CHECK POINTS:

1. In general, check for damaged, deformed, cracked, corroded, loose, worn or missing parts, fasteners and welds.
2. Touch-up any damaged painted surfaces to prevent excessive corrosion.
3. Inspect the rope regularly for signs of fatigue.
4. Check gear reducers for leaks.

RECOMMENDED SPARES

PARTS	QTY
Dip Stick	Two
Upper Bushing	Two
Lower Bushing	Two
Hatch Gasket	Two
Oil Check Gasket	Two
Brake Disc Kit	One
Brake Spring Kit	One
Thrust Washer	Two
Reducer / Brake O-ring / Seal kit	Two
Electric Motor Repair Kit	One

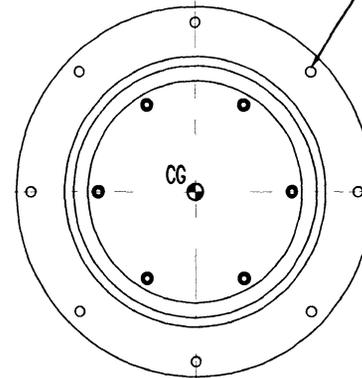
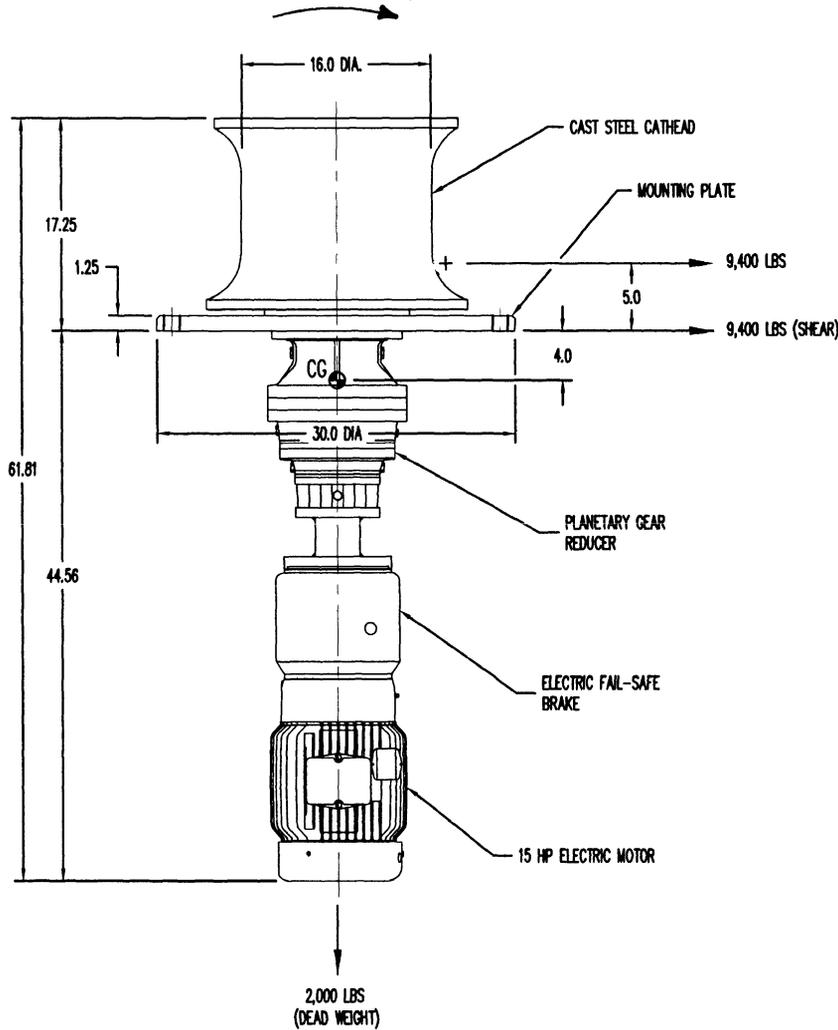
SECTION 2

- GENERAL ARRANGEMENT
- ASSEMBLY DRAWINGS
- COMPONENT DATA SHEETS

PROPRIETARY NOTICE

THIS DRAWING, SKETCH OR TEXT CONTAINS CONCEPTS, DESIGN, PRODUCTS & INFORMATION THAT IS PROPRIETARY TO **MCFLROY/CATCHOT** & MAY NOT BE REPRODUCED OR GIVEN TO A THIRD PARTY WITHOUT THE WRITTEN CONSENT OF **MCFLROY/CATCHOT WINCH CO., INC.**

BENDING MOMENT:
51,700 IN. LBS. @ RATED LOAD
124,080 IN. LBS. @ STALL



PLAN VIEW

DRILL .812" DIA. (8-PLACES) EQ. SP. ON
27.50" D.B.C. FOR 3/4" DIA. GR. 8 MOUNTING
BOLTS (SHIPYARD SUPPLIED)

CAUTION

- READ CAREFULLY BEFORE INSTALLING THIS EQUIPMENT.
- 1) DECK DOUBLER AND/OR FOUNDATION SHOULD BE AS FLAT AS POSSIBLE.
 - 2) IF GAPS EXIST BETWEEN EQUIPMENT FOUNDATION AND DECK DOUBLER/FOUNDATION, THESE GAPS MUST BE ELIMINATED BY USE OF SHIMS OR CHOCKING TO AVOID DISTORTION OF EQUIPMENT FRAME.
 - 3) FAILURE TO SHIM OR CHOCK BETWEEN EQUIPMENT FOUNDATION AND DECK DOUBLER/FOUNDATION, WHEN REQUIRED CAN CAUSE BEARING AND GEARBOX FAILURE AND WILL VOID ALL WARRANTIES PROVIDED BY THE MANUFACTURER.

PERFORMANCE
9,400 LBS LINE PULL AT 48 FPM

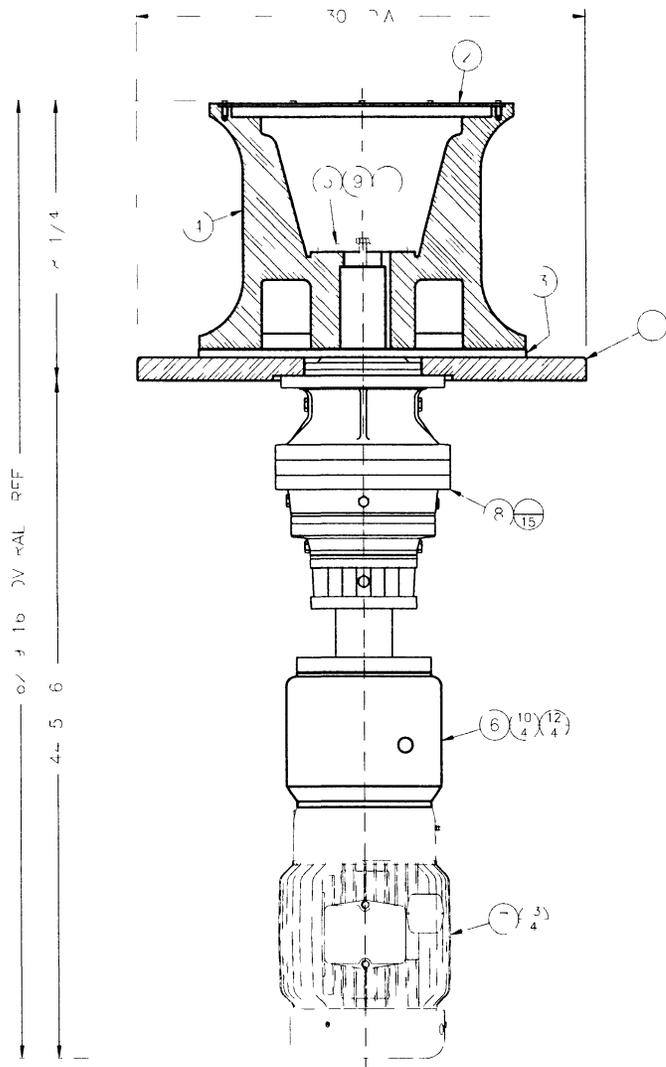
ELECTRICAL REQUIREMENTS
575 V., 3 PH., 60 HZ.
15 HP ELECTRIC MOTOR

CERTIFIED FOR CONSTRUCTION 2/26/04

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE TO BE IN INCHES. TOLERANCES: FRACTIONS ±1/32 ANGLES ±1/2° DECIMALS ±.005 SURF. FINISH: SEE DIMS. BREAK ALL SHARP EDGES. AS2

NOBEL NO.	MC 5 5F3
DRAWN	2/26/04 M. McCluney
CHECK	
APPR.	
ASSY.	
WT.	1400 LBS (CALC)

MCFLROY/CATCHOT WINCH COMPANY P.O. BOX 451 P.O. BOX 39535 4532 OH (216) 875-6377	
SIZE	DRIVING/PART NO.
B	1031
SCALE	3/32" = 1"
SHEET	1 OF 1



BILLS OF MATERIAL					
ITEM NO	QTY	PART NO	DESCRIPTION	MATERIAL	WEIGHT
1	1	40039	MOUNTING PLATE		280
2	1	40041	COVER PLATE		5
3	1	40042	THRUST WASHER		5
4	1	40074	6 CA HEAD VA HINGE		750
5	1	40082	CATCHER PLATE		7
6	1	6305	ALISA BRAK		8
7	1	10013	15 HP ELECTRIC MOTOR		90
8	1	60033	PLANETARY GEARBOX		169
9	1	600907	HPCS M 2 x 1.75 x 60 mm G	TAIN FS	
10	5	60025-05	LOCK WASHER 1/2	AINL SS	
11	5	60020 05	SHCS 1/2 13 NC x 1 2 C		3
12	4	60016 05	HECS 1/2 13 NC x 1 3/4	CRANE	
13	4	60020 05	SHCS 1/2 13 NC x 4 C		

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
 DECIMALS + /32 ANGLES + /2
 DIMENSIONS X + 0.01
 XX 0.02
 XXX 0.02
 3 AD RAD 0.2
 UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
 DECIMALS + /32 ANGLES + /2
 DIMENSIONS X + 0.01
 XX 0.02
 XXX 0.02
 3 AD RAD 0.2
 UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
 DECIMALS + /32 ANGLES + /2
 DIMENSIONS X + 0.01
 XX 0.02
 XXX 0.02
 3 AD RAD 0.2

WCH 53
 EXT AS Y ENG C/
 SCALE N/A
 DRAWN BY M B
 APPROVED BY ADG

MCELROY/CATCHOT WINCH COMPANY
 10 POX 4632 710X MS 30535 4632 PH (8) 87 6397

**16" CAPSTAN ASSEMBLY
 MODEL MCF-16-15EB**

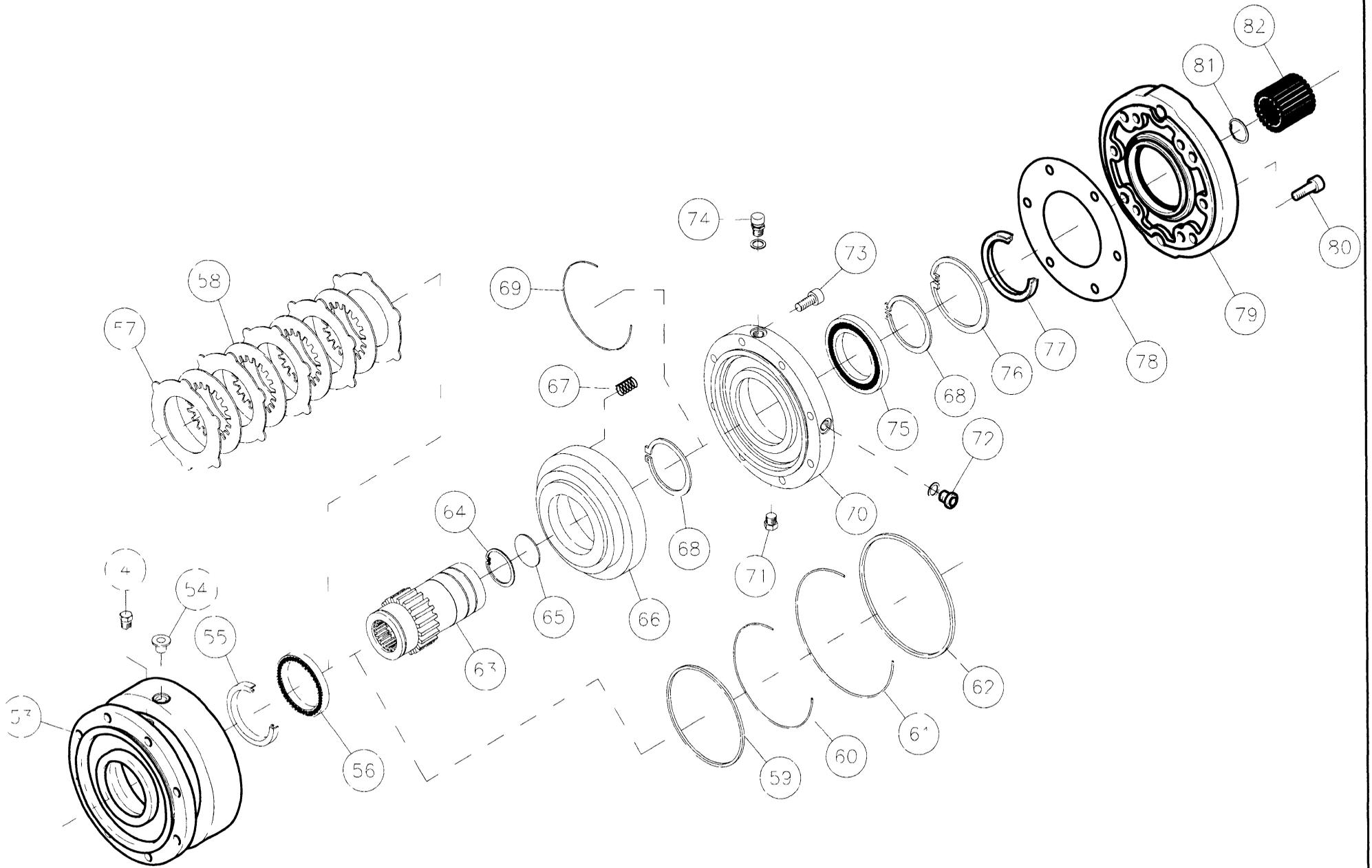
12	DET 0	RA 16/AR 0	RF 1910
B	AF 8/2/05	20060	0

Section 2 – Planetary Gearbox

PLANETARY GEARBOX

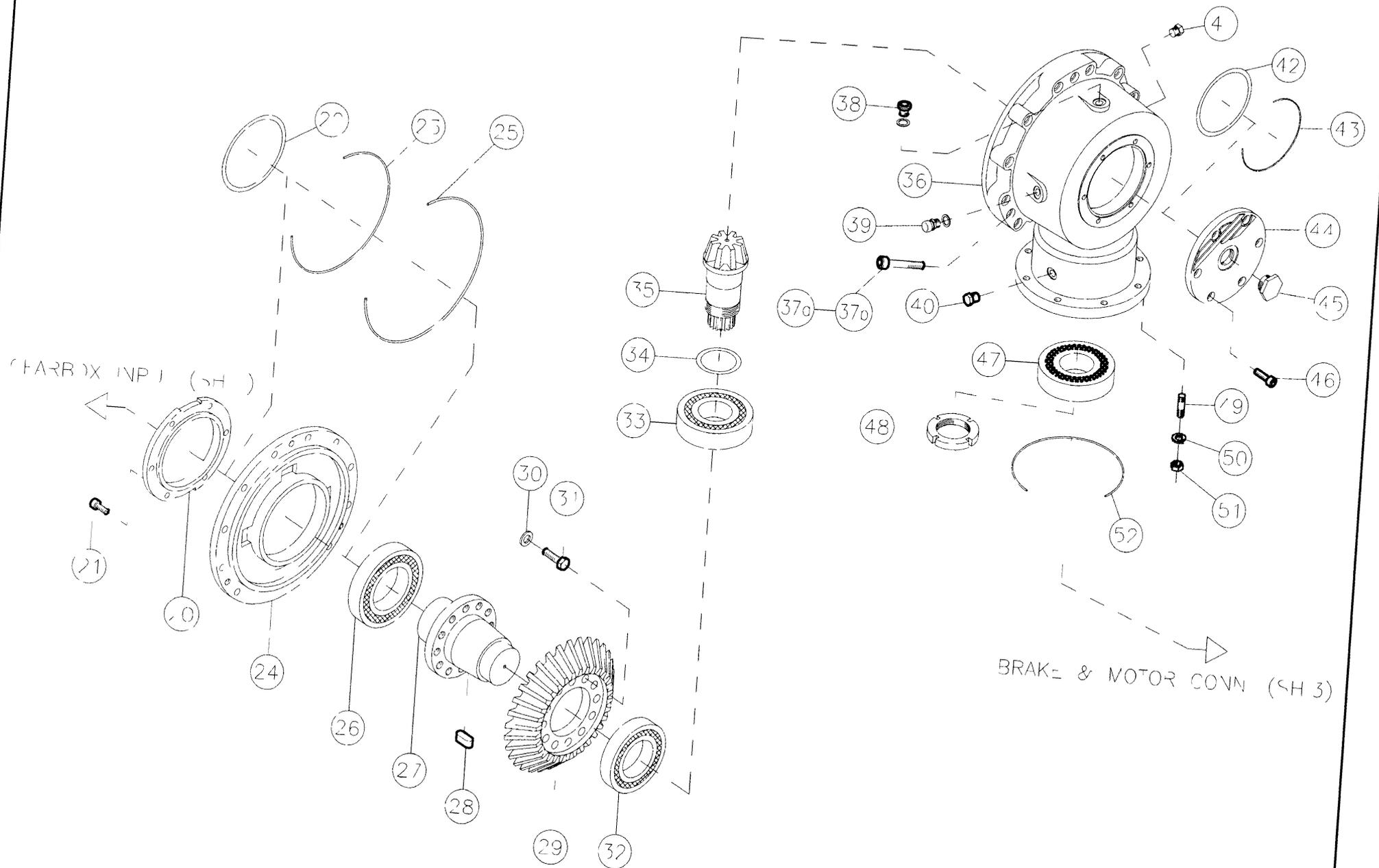
PART NO.60033

SERIES 2000



A-210 5/8" (S12)
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SERIES 2000



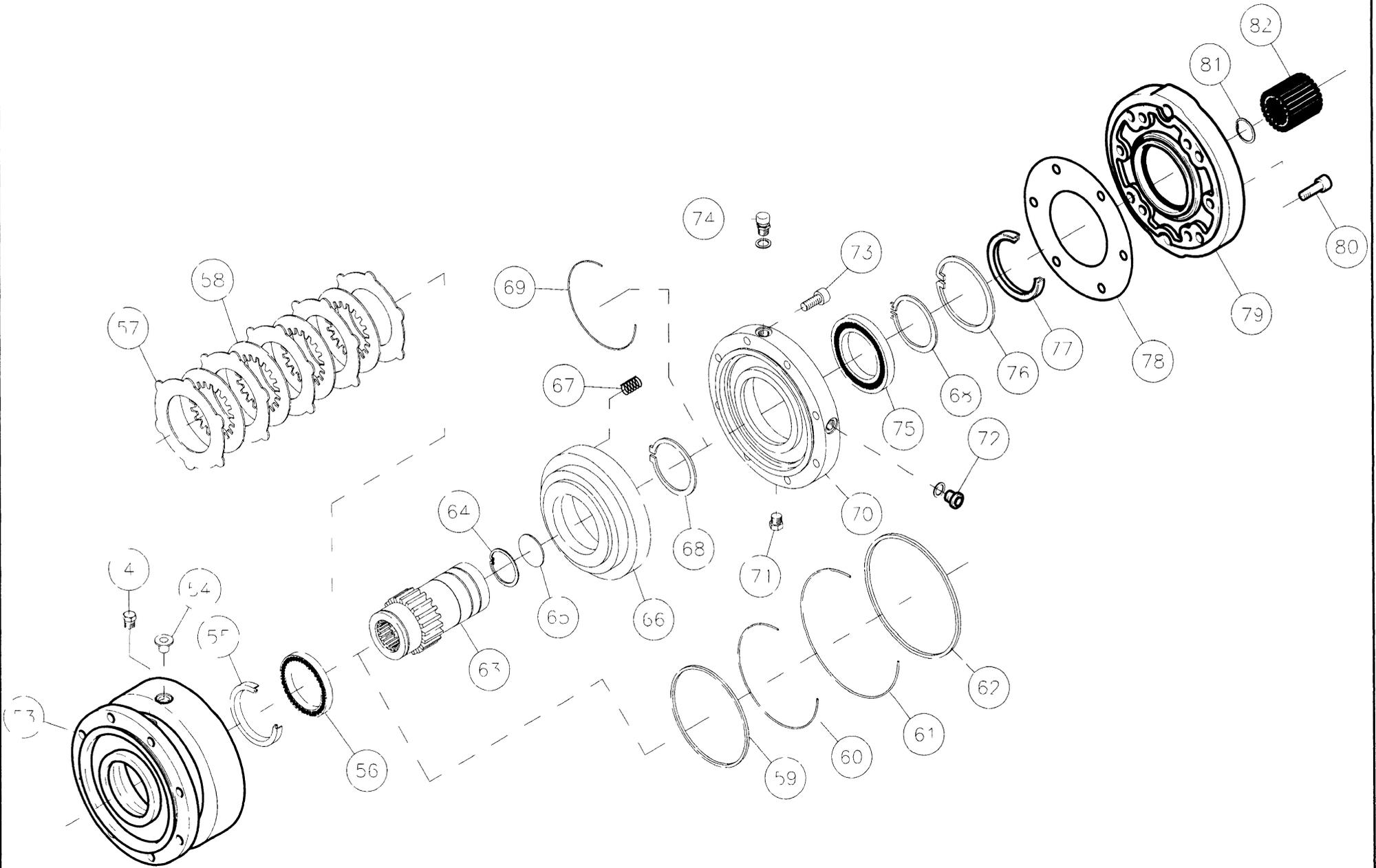
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84				
83				
82	24-035	15B2601	SAE "C" COUPLING	1
81	C080021	154B2934	RETAINING RING INT.	1
80	C030061	154-2522	SOCKET HEAD CAP SCREW	6
79	11-378	154-5566	SAE "C" FLANGE	1
78	FG0395	154-2932	GASKET	1
77	C120009	154B2446	RING OIL SEAL	1
76	C080095	154-2459	RETAINING RING INT.	1
75	C010024	154-2312	BALL BEARING	1
74	C173001	154-3115	OIL BREATHER	1
73	C030060	154-2521	SOCKET HEAD CAP SCREW	8
72	C172002	154-3099	SIGHT GAUGE	2
71	C174001	154-2712	MAGNETIC TAP	1
70	26-619	154-5962	RF-5 CLOSING COVER	1
69	C140065	154B3010	"O" RING	1
68	C085060	154-2489	RETAINING RING EXT.	2
67	14-016	154-1548	SPRINGRF5/21	3
66	18-025	154-1672	RF-5/21-RF5/130 BRAKE PISTON	1
65	C110045	154-2704	EXPANSION CAP	1
64	C080042	154-2446	RETAINING RING INT.	1
63	02-283	154-3503	INPUT SHAFT RF-5 BRAKE	1
62	C165027	154B3670	PARBAK RING	1
61	C142259	154B3659	"O" RING	1
60	C142251	154B3656	"O" RING	1
59	C165026	154B3669	PARBAK RING	1
58	C200411	154-5970	STEEL DISC	6
57	C200863	154B2833	SINTERED DISC	7
56	C010045	154-2376	BALL BEARING	1
55	C125024	154B3608	RING OIL SEAL	1
54	C169001	154-3502	PLASTIC TAP	1
53	40-034	154B3388	RFF-5 BRAKE HOUSING	1
52	C140065	154B3010	"O" RING	1

POS.	OLD P/N	NEW P/N	DESCRIPTION	QTY.
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<div style="border: 1px solid black; padding: 10px; display: inline-block;"> Planetary Gearbox </div>				
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SERIES 2000



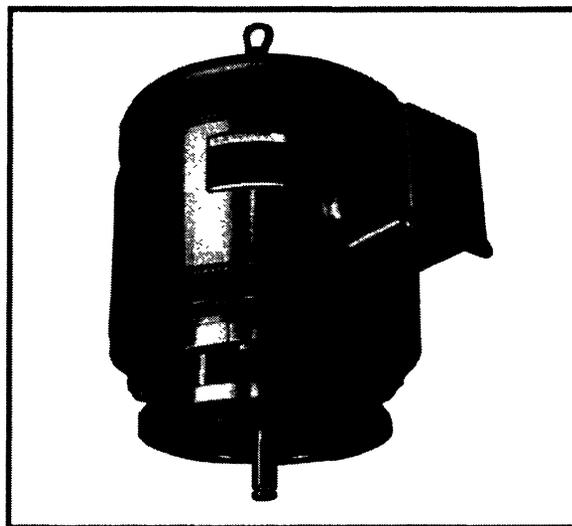
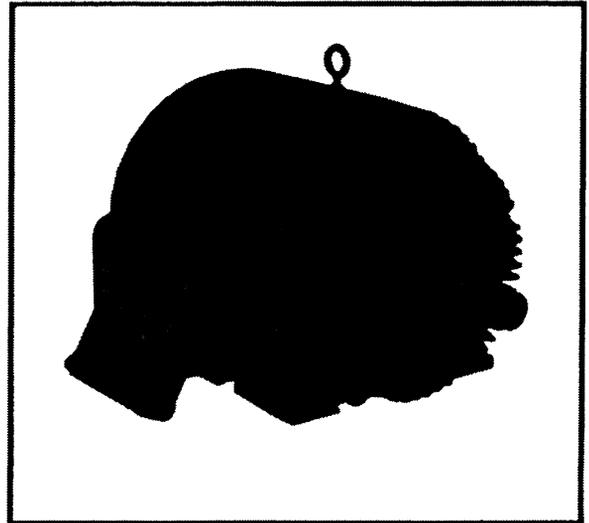
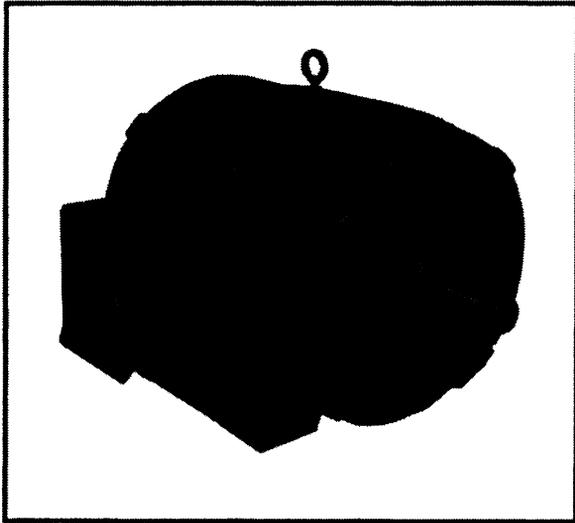
A-10 V- (S12)
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Section 3 – Electric Motor

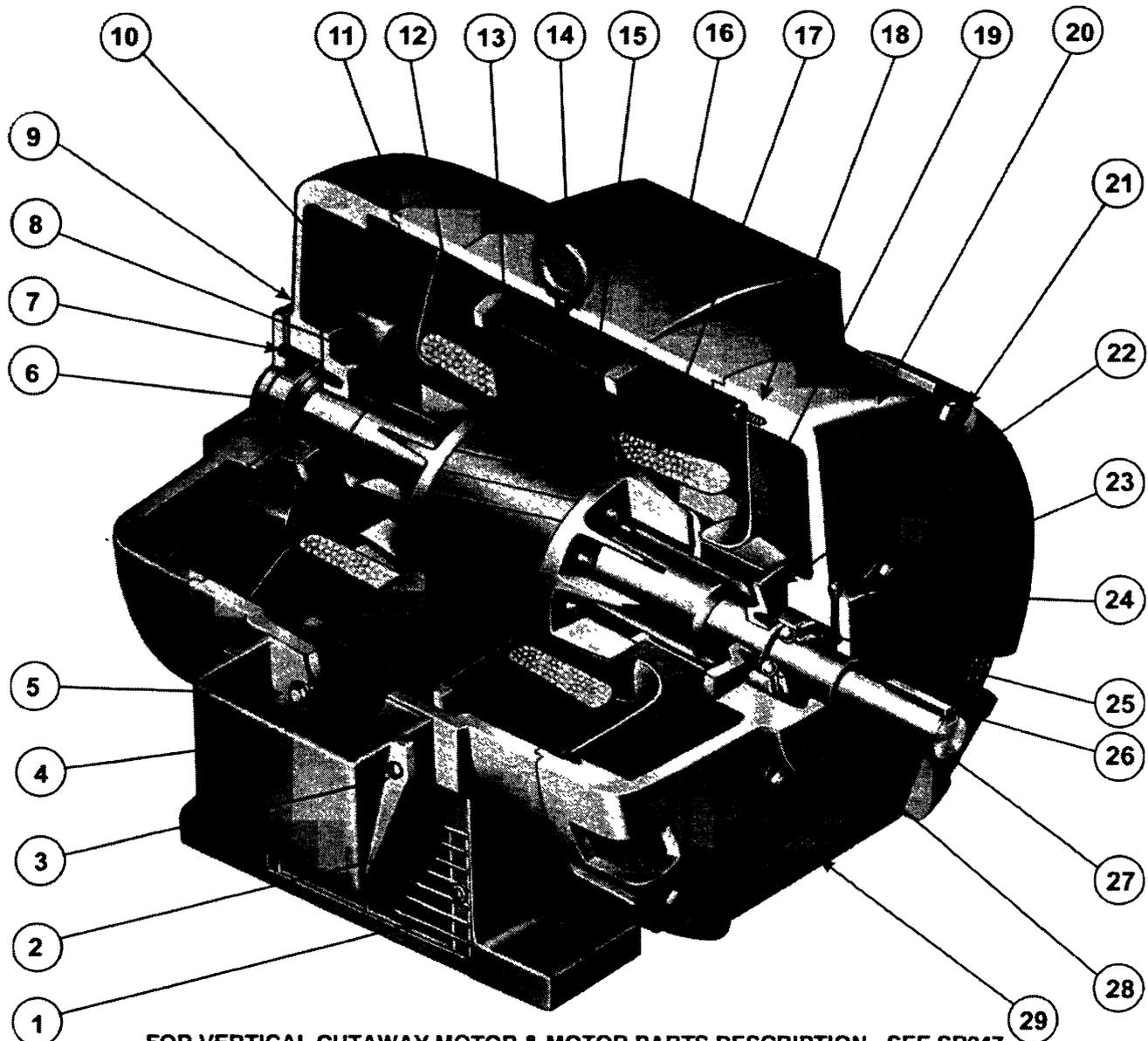
ELECTRIC MOTOR

PART NO.60013

Standard Induction Motors



**Installation, Operation,
& Maintenance Instructions**



FOR VERTICAL CUTAWAY MOTOR & MOTOR PARTS DESCRIPTION - SEE SB247

ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1.	** Frame Vent Screen	11.	Bracket O.P.E.	21.	Bracket Holding Bolt
2.	Conduit Box Bottom	12.	Baffle Plate O.P.E.	22.	Inner Bearing Cap P.E.
3.	Conduit Box Top-Holding Screw	13.	Rotor Core	23.	Inner Bearing Cap Bolt
4.	Conduit Box Top	14.	Lifting Eye Bolt	24.	Grease Plug
5.	Conduit Box Bottom-Holding Bolt	15.	Stator Core	25.	*Ball Bearing P.E.
6.	*Ball Bearing O.P.E.	16.	Frame	26.	Shaft Extension Key
7.	Pre-loading Spring	17.	Stator Winding	27.	Shaft
8.	Inner Bearing Cap O.P.E.	18.	Baffle Plate Holding Screw	28.	Drain Plug (grease)
9.	Grease Plug	19.	Baffle Plate P.E.	29.	** Bracket Screen
10.	Inner Bearing Cap Bolt	20.	Bracket P.E.		

P.E. = Pulley End

O.P.E. = Opposite Pulley End

* = Bearing Numbers are shown on motor nameplate when requesting information or parts always give complete motor description, model and serial numbers.

** = Bracket and frame screens are optional.

WARNING

These instructions must be followed to ensure safe and proper installation, operation and maintenance of the motor. They should be brought to the attention of all persons who install, operate or maintain this equipment

GENERAL INFORMATION

Marathon Electric motors are all fully factory tested and inspected before shipping. Damage during shipment and storage can occur. Motors not correctly matched to the power supply and/or the load will not operate properly. These instructions are intended as a guide to identify and eliminate these problems before they are overlooked or cause further damage.

ACCEPTANCE

Check carefully for any damage that may have occurred in transit. If any damage or shortage is discovered, do not accept until an appropriate notation on the freight bill is made. Any damage discovered after receipt of equipment should be immediately reported to the carrier.

STORAGE

- A Keep motors clean
 - 1 Store indoors
 - 2 Keep covered to eliminate airborne dust and dirt
 - 3 Cover openings for ventilation, conduit connections, etc to prevent entry of rodents, snakes, birds, and insects, etc
- B Keep motors dry
 - 1 Store in a dry area indoors
 - 2 Temperature swings should be minimal to prevent condensation
 - 3 Space heaters are recommended to prevent condensation
 - 4 Treat unpainted flanges, shafts, and fittings with a rust inhibitor
 - 5 Check insulation resistance before putting motor into service (Consult manufacturer for guidelines)
- C Keep Bearings Lubricated
 - 1 Once per month, rotate shaft several turns to distribute grease in bearings
 - 2 If unit has been stored more than one year, add grease before start-up (Refer to lubrication procedure)

INSTALLATION

UNCRATING AND INSPECTION

After uncrating, check for any damage which may have been incurred in handling. The motor shaft should turn freely by hand. Repair or replace any loose or broken parts before attempting to use the motor.

Check to be sure that motor has not been exposed to dirt, grit, or excessive moisture in shipment or storage before installation.

Measure insulation resistance (see operation). Clean and dry the windings as required.

Never start a motor which has been wet without having it thoroughly dried.

SAFETY

Motors should be installed, protected and fused in accordance with latest issue of National Electrical Code, NEMA Standard Publication No. MG 2 and local codes.

Eyebolts or lifting lugs are intended for lifting the motor only. These lifting provisions should never be used when lifting or handling the motor with other equipment (i.e. pumps, gear boxes, fans or other driven equipment) as a single unit. Be sure the eyebolt is fully threaded and tight in its mounting hole.

Eyebolt lifting capacity ratings is based on a lifting alignment coincident with the eyebolt centerline. Eyebolt capacity reduces as deviation from this alignment increases. See NEMA MG 2.

Frames and accessories of motors should be grounded in accordance with National Electrical Code (NEC) Article 430. For general information of grounding refer to NEC Article 250.

Rotating parts such as pulleys, couplings, external fans, and shaft extensions should be permanently guarded.

LOCATION

In selecting a location for the motor, consideration should be given to environment and ventilation. A motor with the proper enclosure for the expected operating condition should be selected.

The ambient temperature of the air surrounding the motor should not exceed 40°C (104°F) unless the motor has been especially designed for high ambient temperature applications. The free flow of air around the motor should not be obstructed.

The motor should never be placed in a room with a hazardous process, or where flammable gases or combustible material may be present, unless it is specifically designed for this type of service.

- 1 Drip-proof (open) motors are intended for use indoors where atmosphere is relatively clean, dry and non-corrosive.
- 2 Drip-proof (open) fire pump motors are to be installed in a Type 2 drip-proof environment as defined in NEMA 250.
- 3 Totally enclosed motors may be installed where dirt, moisture and corrosion are present, or in outdoor locations.
- 4 Explosion proof motors are built for use in hazardous locations as indicated by Underwriters' label on motor. Consult UL, NEC, and local codes for guidance.

Refer to Marathon Electric for application assistance.

FLOOR MOUNTING

Motors should be provided with a firm, rigid foundation, with the plane of four mounting pads flat within .010" for 56 to 210 frame, .015" from 250 through 500 frame. This may be accomplished by shims under the motor feet. For special isolation mounting, contact Marathon Electric for assistance.

V-BELT DRIVE

- 1 Select proper type and number of belts and sheaves. Excessive belt load will damage bearings. Sheaves should be in accordance to NEMA Spec. MG-1 or as approved by the manufacturer for a specific application.
- 2 Align sheaves carefully to avoid axial thrust on motor bearing. The drive sheave on the motor should be positioned toward the motor so it is as close as possible to the bearing.

- When adjusting belt tension, make sure the motor is secured by all mounting bolts before tightening belts.
- Adjust belt tension to belt manufacturers recommendations. Excessive tension will decrease bearing life.
- For more information see Marathon Electric Publication SB588.

DIRECT CONNECTED DRIVE

Flexible or solid shaft couplings must be properly aligned for satisfactory operation. On flexible couplings, the clearance between the ends of the shafts should be in accordance with the coupling manufacturer's recommendations or NEMA standards for end play and limited travel in coupling.

MISALIGNMENT and RUN-OUT between direct connected shafts will cause increased bearing loads and vibration even when the connection is made by means of a flexible coupling. Excessive misalignment will decrease bearing life. Proper alignment, per the specifications of the coupling being used, is critical.

Some large motors are furnished with roller bearings. Roller bearings should **not** be used for direct drive.

ELECTRICAL CONNECTIONS

CAUTION

Install and ground per local and national codes. Consult qualified personnel with questions or if repairs are required.

WARNING

- Disconnect power before working on motor or driven equipment.
- Motors with automatic thermal protectors will automatically restart when the protector temperature drops sufficiently. Do not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.
- Motors with manual thermal protectors may start unexpectedly after protector trips. If manual protector trips, disconnect motor from power line. After protector cools (five minutes or more) it can be reset and power may be applied to motor.
- Discharge all capacitors before servicing motor.
- Always keep hands and clothing away from moving parts.
- Never attempt to measure the temperature rise of a motor by touch. Temperature rise must be measured by thermometer, resistance, imbedded detector, or thermocouple.
- Electrical repairs should be performed by trained and qualified personnel only.
- Failure to follow instructions and safe electrical procedures could result in serious injury or death.
- If safety guards are required, be sure the guards are in use.

- All wiring, fusing, and grounding must comply with National Electrical Codes and local codes.
- To determine proper wiring, rotation and voltage connections, refer to the information and diagram on the nameplate, separate connection plate or decal. If the plate or decal has been removed, contact Marathon Electric for assistance.
- Use the proper size of line current protection and motor controls as required by the National Electrical Code and local codes. Recommended use is 125% of full load amps as shown on the nameplate for motors with 40°C ambient

and a service factor over 1.0. Recommended use is 115% of full load amps as shown on the nameplate for all other motors. Do not use protection with larger capacities than recommended. Three phase motors must have all three phases protected.

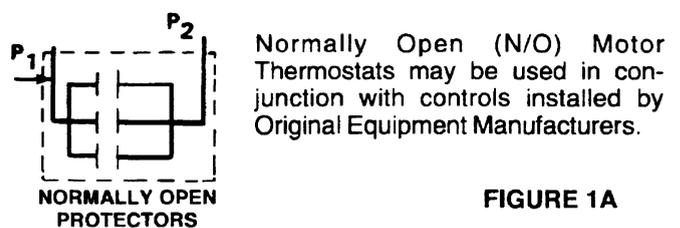
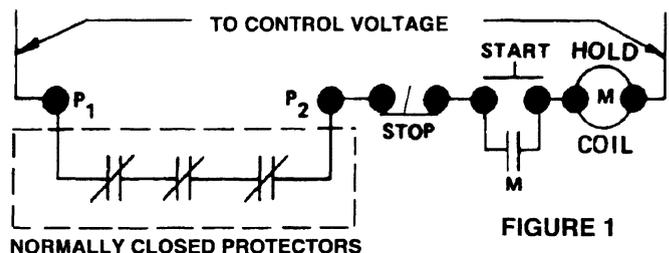
THERMAL PROTECTOR INFORMATION

The nameplate will indicate one of the following:

- Motor is thermally protected
- Motor is not thermally protected
- Motor is provided with overheat protective device

For examples, refer to paragraphs below:

- Motors equipped with built-in thermal protection have "THERMALLY PROTECTED" stamped on the nameplate. Thermal protectors open the motor circuit electrically when the motor overheats or is overloaded. The protector cannot be reset until the motor cools. If the protector is automatic, it will reset itself. If the protector is manual, press the red button to reset.
- Motors without thermal protection have nothing stamped on nameplate about thermal protection.
- Motors that are provided with overheat protective device that does not open the motor circuit directly will indicate "WITH OVERHEAT PROTECTIVE DEVICE".
 - Motors with this type of "Overheat Protective Device" have protector leads brought out in the motor conduit box marked "P1" and "P2". These leads are intended for connection in series with the stop button of the 3-wire pilot circuit for the magnetic starter which controls the motor. See Figure 1.
 - The circuit controlled by the above "Overheat Protective Device" must be limited to a maximum of 600 volts and 360 volt-amps.



Normally Open (N/O) Motor Thermostats may be used in conjunction with controls installed by Original Equipment Manufacturers.

FIGURE 1A

CHANGING ROTATION

- Keep hands and clothing away from rotating parts.
- Before the motor is coupled to the load, determine proper rotation.
- Check rotation by jogging or bumping. Apply power to the motor leads for a short period of time, enough to just get motor shaft to rotate a slight amount to observe shaft rotating direction.
- Three phase - interchange any two (2) of the three (3) line leads. Single phase - reconnect per the connection diagram on the motor.

REDUCED VOLTAGE STARTING

Motors used on reduced voltage starting, should be carefully selected based upon power supply limitations and driven load requirements. The motors starting torque will be reduced when using reduced voltage starting. The elapsed time on the start step should be kept as short as possible and should not exceed 5 seconds. It is recommended that this time be limited to 2 seconds. Refer to Marathon Electric for application assistance.

OPERATION

WARNING

Disconnect and lock out before working on motor or driven equipment.

BEFORE INITIAL STARTING

1. If a motor has become damp in shipment or in storage, measure the insulation resistance of the stator winding.

$$\text{Minimum Insulation Resistance} = 1 + \frac{\text{Rated Voltage}}{1000}$$

In Megohms

Do not attempt to run the motor if the insulation resistance is below this value.

2. If insulation resistance is low, dry out the moisture in one of the following ways:
 - a. Bake in oven at temperature not more than 90°C (194°F).
 - b. Enclose motor with canvas or similar covering, leaving a hole at the top for moisture to escape, and insert heating units or lamps.
 - c. Pass a current at low voltage (rotor locked) through the stator winding. Increase the current gradually until the winding temperature, measured with a thermometer, reaches 90°C (194°F). Do not exceed this temperature.
3. See that voltage and frequency stamped on motor and control nameplates correspond with that of the power line.
4. Check all connections to the motor and control with the wiring diagram.
5. Be sure rotor turns freely when disconnected from the load. Any foreign matter in the air gap should be removed.
6. Leave the motor disconnected from the load for the initial start (see following caution). Check for proper rotation. Check for correct voltage (within ± 10% of nameplate value) and that it is balanced within 1% at the motor terminals. After the machine is coupled to the load, check that the nameplate amps are not exceeded. Recheck the voltage level and balance under load per the above guidelines.

Shut down the motor if the above parameters are not met or if any other noise or vibration disturbances are present. Consult NEMA guidelines or the equipment manufacturer if any questions exist before operating equipment.

CAUTION

For motors nameplated as "belted duty only", do not run motor without belts properly installed.

COLLECTOR RINGS (Wound Rotor Motors Only)

The collector rings are sometimes treated at the factory to protect them while in stock and during shipment. The brushes have been fastened in a raised position. Before putting the motor into service, the collector rings should be cleaned to remove this treatment. Use a cleaning fluid that is made for degreasing electrical equipment. All of the brushes must be released and lowered to the collector surface. Keep the rings clean and maintain their polished surfaces. Ordinarily, the rings will require only occasional wiping with a piece of canvas or non-linting cloth. Do not let dust or dirt accumulate between the collector rings.

BRUSHES (Wound Rotor Motors Only)

See that the brushes move freely in the holders and at the same time make firm, even contact with the collector rings. The pressure should be between 2 and 3 pounds per square inch of brush surface.

When installing new brushes, fit them carefully to the collector rings. Be sure that the copper pigtail conductors are securely fastened to, and make good contact with, the brushholders.

ALLOWABLE VOLTAGE AND FREQUENCY RANGE

If voltage and frequency are within the following range, motors will operate, but with somewhat different characteristics than obtained with correct nameplate values.

1. Voltage: Within 10% above or below the value stamped on the nameplate. On three phase systems the voltage should be balanced within 1%. A small voltage unbalance will cause a significant current unbalance.
2. Frequency: Within 5% above or below the value stamped on the nameplate.
3. Voltage and Frequency together: Within 10% (providing frequency above is less than 5%) above or below values stamped on the nameplate.

CLEANLINESS

Keep both the interior and exterior of the motor free from dirt, water, oil and grease. Motors operating in dirty places should be periodically disassembled and thoroughly cleaned.

CONDENSATION DRAIN PLUGS

All explosion proof and some totally enclosed motors are equipped with automatic drain plugs, they should be free of oil, grease, paint, grit and dirt so they don't clog up. The drain system is designed for normal floor (feet down) mounting. For other mounting positions, modification of the drain system may be required, consult Marathon Electric.

SERVICE

WARNING

Disconnect power before working on motor or driven equipment. Motors with automatic thermal protectors will automatically restart when the protector cools. Do not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.

CAUTION

Overgreasing bearings can cause premature bearing and/or motor failure. The amount of grease added should be carefully controlled.

NOTE

If lubrication instructions are shown on the motor nameplate, they will supersede this general instruction.

Marathon Electric motors are pregreased with a polyurea mineral oil NGLI grade 2 type grease unless stated otherwise on the motor nameplate. Some compatible brands of polyurea mineral base type grease are: Chevron SRI #2, Rykon Premium #2, Exxon Polyrex EM or Texaco Polystar RB.

Motors are properly lubricated at the time of manufacture. It is not necessary to lubricate at the time of installation unless the motor has been in storage for a period of 12 months or longer (refer to lubrication procedure that follows).

LUBRICATION PROCEDURES

1. Stop motor. Disconnect and lock out of service.
2. Remove contaminants from grease inlet area.
3. Remove filler and drain plugs.
4. Check filler and drain holes for blockage and clean as necessary.
5. Add proper type and amount of grease. See the Relubrication Time Intervals table for service schedule and Relubrication Amounts table for volume of grease required.
6. Wipe off excess grease and replace filler and drain plugs (see following warning).
7. Motor is ready for operation.

WARNING

If motor is nameplated for hazardous locations, do not run motor without all of the grease or drain plugs installed.

RELUBRICATION TIME INTERVAL

(For motors with regreasing provisions).

Service Condition	NEMA FRAME SIZE					
	140-180		210-360		400-510	
	1800 RPM and less	Over 1800 RPM	1800 RPM and less	Over 1800 RPM	1800 RPM and less	Over 1800 RPM
Standard	3 yrs.	6 months	2 yrs.	6 months	1 yr.	3 months
Severe	1 yr.	3 months	1 yr.	3 months	6 months	1 month
Seasonal	See Note 2.					

NOTE

1. For motors nameplated as "belted duty only" divide the above intervals by 3.
2. Lubricate at the beginning of the season. Then follow service schedule above.

SEASONAL SERVICE: The motor remains idle for a period of 6 months or more.

STANDARD SERVICE: Up to 16 hours of operation per day, indoors, 100°F maximum ambient.

SEVERE SERVICE: Greater than 16 hours of operation per day. Continuous operation under high ambient temperatures (100° to 150°F) and/or any of the following: dirty, moist locations, high vibration (above NEMA standards), heavy shock loading, or where shaft extension end is hot.

RELUBRICATION AMOUNTS

(For motors with regreasing provisions).

NEMA FRAME SIZE	VOLUME cu. in. (fluid oz.)
140	.25 (.14)
180	.50 (.28)
210	.75 (.42)
250	1.00 (.55)
280	1.25 (.69)
320	1.50 (.83)
360	1.75 (.97)
400	2.25 (1.2)
440	2.75 (1.5)
500	3.00 (1.7)

TROUBLESHOOTING

WARNING

1. Disconnect power before working on motor or driven equipment.
2. Motors with automatic thermal protectors will automatically restart when the protector temperature drops sufficiently. Do not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.
3. Motors with manual thermal protectors may start unexpectedly after protector trips. If manual protector trips, disconnect motor from power line. After protector cools (five minutes or more) it can be reset and power may be applied to motor.
4. Discharge all capacitors before servicing motor.
5. Always keep hands and clothing away from moving parts.
6. Never attempt to measure the temperature rise of a motor by touch. Temperature rise must be measured by thermometer, resistance, imbedded detector, or thermocouple.
7. Electrical repairs should be performed by trained and qualified personnel only.
8. Failure to follow instructions and safe electrical procedures could result in serious injury or death.
9. If safety guards are required, be sure the guards are in use.

If trouble is experienced in the operation of the motor, make sure that:

1. The bearings are in good condition and operating properly.
2. There is no mechanical obstruction to prevent rotation in the motor or in the driven load.
3. The air gap is uniform. (Consult manufacturer for specifications).
4. All bolts and nuts are tightened securely.
5. Proper connection to drive machine or load has been made.

In checking for electrical troubles, be sure that:

1. The line voltage and frequency correspond to the voltage and frequency stamped on the nameplate of the motor.
2. The voltage is actually available at motor terminals.
3. The fuses and other protective devices are in proper condition.
4. All connections and contacts are properly made in the circuits between the control apparatus and motor.

These instructions do not cover all details or variations in equipment nor provide for every possible condition to be met in connection with installation, operation or maintenance. Should additional information be desired for the purchaser's purposes, the matter should be referred to the nearest Marathon Electric Manufacturing Corp. sales office listed on the back page.

MOTOR TROUBLE SHOOTING CHART

Your motor service and any trouble shooting must be handled by qualified persons who have proper tools and equipment.

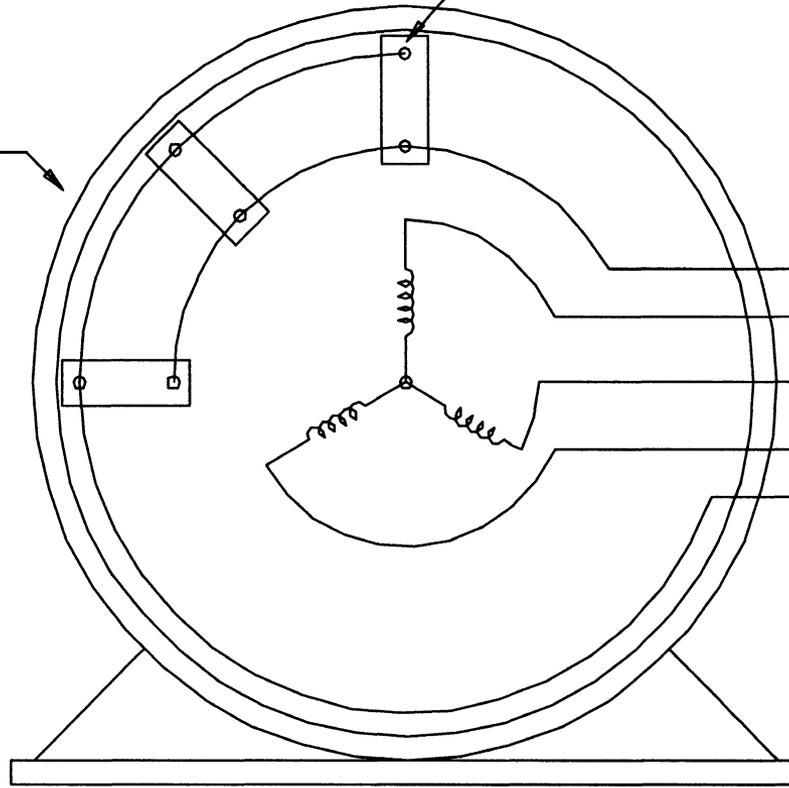
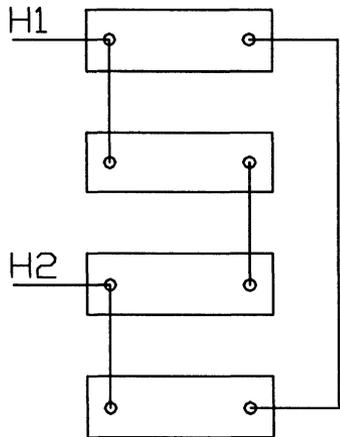
TROUBLE	CAUSE	WHAT TO DO
Motor fails to start	Blown fuses	Replace fuses with proper type and rating
	Overload trips	Check and reset overload in starter
	Improper power supply	Check to see that power supplied agrees with motor nameplate and load factor
	Improper line connections	Check connections with diagram supplied with motor
	Open circuit in winding or control switch	Indicated by humming sound when switch is closed Check for loose wiring connections Also see that all control contacts are closing
	Mechanical failure	Check to see if motor and drive turn freely Check bearings and lubrication
	Short circuited stator	Indicated by blown fuses Motor must be rewound
	Poor stator coil connection	Remove end bells, locate with test lamp
Motor stalls	Rotor defective	Look for broken bars or end rings
	Motor may be overloaded	Reduce load
	One phase may be open	Check lines for open phase
	Wrong application	Change type or size Consult manufacturer
	Overload	Reduce load
Motor runs and then dies down	Low voltage	See that nameplate voltage is maintained Check connection
	Open circuit	Fuses blown, check overload relay, stator and pushbuttons
Motor does not come up to speed	Power failure	Check for loose connections to line, to fuses and to control
	Not applied properly	Consult supplier for proper type
	Voltage too low at motor terminals because of line drop	Use higher voltage on transformer terminals or reduce load
	Starting load too high	Check connections Check conductors for proper size
	Broken rotor bars or loose rotor	Check load motor is supposed to carry at start
Motor takes too long to accelerate and/or draws high amp	Look for cracks near the rings A new rotor may be required as repairs are usually temporary	
	Open primary circuit	Locate fault with testing device and repair
	Excessive load	Reduce load
	Low voltage during start	Check for high resistance Adequate wire size
Wrong rotation	Defective squirrel cage rotor	Replace with new rotor
	Applied voltage too low	Get power company to increase power tap
Motor overheats while running under load	Reverse sequence of phases	Reverse connections at motor or at switchboard
	Overload	Reduce load
	Frame or bracket vents may be clogged with dirt and prevent proper ventilation of motor	Open vent holes and check for a continuous stream of air from the motor
	Motor may have one phase open	Check to make sure that all leads are well connected
	Grounded coil	Locate and repair
Motor vibrates	Unbalanced terminal voltage	Check for faulty leads, connections and transformers
	Motor misaligned	Realign
	Weak support	Strengthen base
	Coupling out of balance	Balance coupling
	Driven equipment unbalanced	Rebalance driven equipment
	Defective bearings	Replace bearing
	Bearings not in line	Line up properly
	Balancing weights shifted	Rebalance motor
Unbalanced line current on polyphase motors during normal operation	Polyphase motor running single phase	Check for open circuit
	Excessive end play	Adjust bearing or add shim
	Unequal terminal volts	Check leads and connections
Scraping noise	Single phase operation	Check for open contacts
	Unbalanced voltage	Correct unbalanced power supply
	Fan rubbing air shield	Remove interference
Noisy operation	Fan striking insulation	Clear fan
	Loose on bedplate	Tighten holding bolts
	Airgap not uniform	Check and correct bracket fits or bearing
Hot bearings general	Rotor unbalance	Rebalance
	Bent or sprung shaft	Straighten or replace shaft
	Excessive belt pull	Decrease belt tension
	Pulleys too far away	Move pulley closer to motor bearing
	Pulley diameter too small	Use larger pulleys
Hot bearings ball	Misalignment	Correct by realignment of drive
	Insufficient grease	Maintain proper quantity of grease in bearing
	Deterioration of grease or lubricant contaminated	Remove old grease, wash bearings thoroughly in kerosene and replace with new grease
	Excess lubricant	Reduce quantity of grease, bearing should not be more than 1/2 filled
Broken ball or rough races	Overloaded bearing	Check alignment, side and end thrust
		Replace bearing first clean housing thoroughly

SINGLE VOLTAGE THREE PHASE MOTOR WITH 2 LEADS OUT FROM SPACE HEATERS.

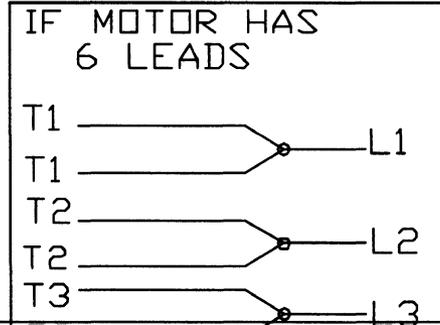
SPACE HEATER

SPACE HEATERS CONNECTED IN PARALLEL

SPACE HEATERS CONNECTED IN SERIES PARALLEL



VIEW OF TERMINAL END



				<input checked="" type="checkbox"/> MAX. SURFACE ROUGHNESS UNLESS NOTED OTHERWISE TOL. ON XX± .02 XXX±.005 XXXX±.0005 ANGLES± 7'30"	
		MATL SPEC		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES 	
		FINISH		DRAWN BY PGK 08-06-1996 CHKD BY ML 08-07-1996	
6 08-07-1996		REDRAWN ON CADD		APPD BY TB 08-07-1996 WAUSAU, WISCONSIN 54401	
REV DATE		CHANGE		PART NAME CONNECTION DIAGRAM 3Ø - SINGLE VOLTAGE DRWG NO A-	
		CN 22509 PGK		REFERENCE DRW. DISTRIBUTION - WA - LB - WP - LM - BR CADD FILE NO. EE7300R	
		SHOP BOOK		PURCHASED	

The Metric System and Equivalents

Linear Measure Liquid Measure

1 centimeter = 10 millimeters = 39 inch
 1 decimeter = 10 centimeters = 3 94 inches
 1 meter = 10 decimeters = 39 37 inches
 1 dekameter = 10 meters = 32 8 feet
 1 hectometer = 10 dekameters = 328 08 feet
 1 kilometer = 10 hectometers = 3,280 8 feet

1 centiliter = 10 milliliters = 34 fl ounce
 1 deciliter = 10 centiliters = 3 38 fl ounces
 1 liter = 10 deciliters = 33 81 fl ounces
 1 dekaliter = 10 liters = 2 64 gallons
 1 hectoliter = 10 dekaliters = 26 42 gallons
 1 kiloliter = 10 hectoliters = 264 18 gallons

Weights

1 centigram = 10 milligrams = 15 grain
 1 decigram = 10 centigrams = 1 54 grains
 1 gram = 10 decigram = 035 ounce
 1 dekagram = 10 grams = 35 ounce
 1 hectogram = 10 dekagrams = 3 52 ounces
 1 kilogram = 10 hectograms = 2 2 pounds
 1 quintal = 100 kilograms = 220 46 pounds
 1 metric ton = 10 quintals = 1 1 short tons

Square Measure

1 sq centimeter = 100 sq millimeters = 155 sq inch
 1 sq decimeter = 100 sq centimeters = 15 5 sq inches
 1 sq meter (centare) = 100 sq decimeters = 10 76 sq feet
 1 sq dekameter (are) = 100 sq meters = 1,076 4 sq feet
 1 sq hectometer (hectare) = 100 sq dekameters = 2 47 acres
 1 sq kilometer = 100 sq hectometers = 386 sq mile

Cubic Measure

1 cu centimeter = 1000 cu millimeters = 06 cu inch
 1 cu decimeter = 1000 cu centimeters = 61 02 cu inches
 1 cu meter = 1000 cu decimeters = 35 31 cu feet

Approximate Conversion Factors

To change	To	Multiply by	To change	To	Multiply by
inches	centimeters	2 540	ounce-inches	newton-meters	007062
feet	meters	305	centimeters	inches	394
yards	meters	914	meters	feet	3 280
miles	kilometers	1 609	meters	yards	1 094
square inches	square centimeters	6 451	kilometers	miles	621
square feet	square meters	093	square centimeters	square inches	155
square yards	square meters	836	square meters	square feet	10 764
square miles	square kilometers	2 590	square meters	square yards	1 196
acres	square hectometers	405	square kilometers	square miles	386
cubic feet	cubic meters	028	square hectometers	acres	2 471
cubic yards	cubic meters	765	cubic meters	cubic feet	35 315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1 308
pints	liters	473	milliliters	fluid ounces	034
quarts	liters	946	liters	pints	2 113
gallons	liters	3 785	liters	quarts	1 057
ounces	grams	28 349	liters	gallons	264
pounds	kilograms	454	grams	ounces	035
short tons	metric tons	907	kilograms	pounds	2 205
pound-feet	newton-meters	1 356	metric tons	short tons	1 102
pound-inches	newton-meters	11296			

Temperature (Exact)

°F Fahrenheit 5/9 (after Celsius °C
 temperature temperature subtracting 32) temperature