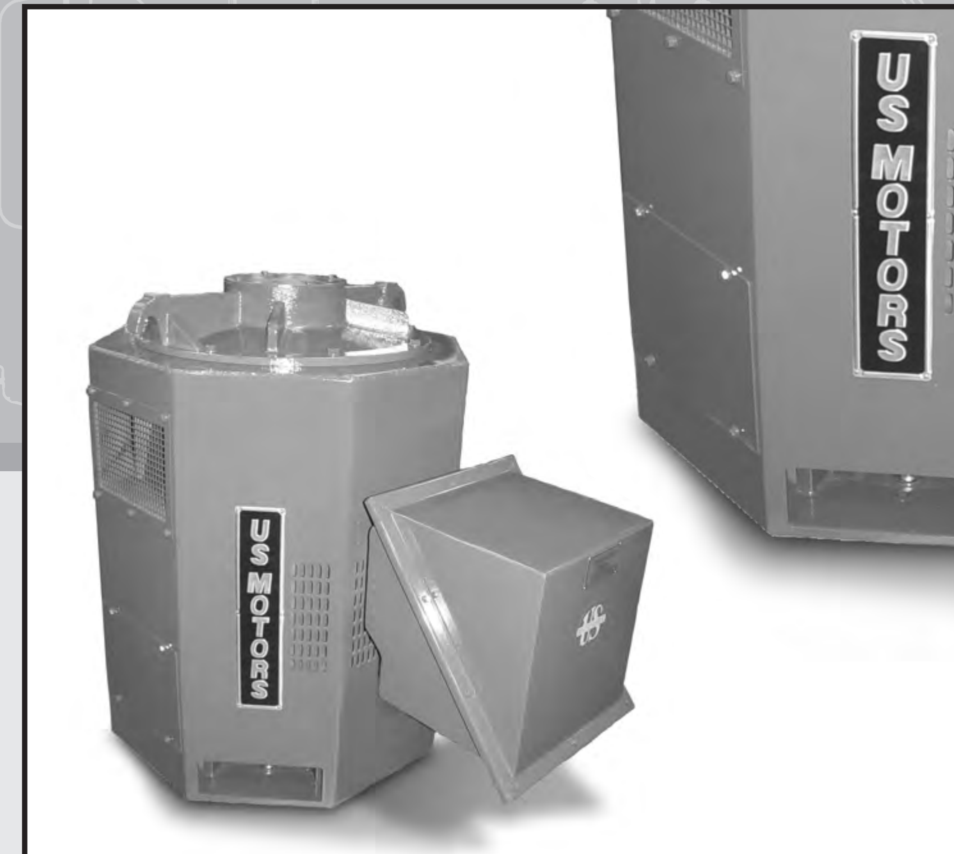
Vertical Normal Thrust Motors



Part NO. 424731

Installation, Operation, and Maintenance

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SAFETY FIRST!

High voltage and rotating parts can cause serious injury or loss of life. Installation, operation, and maintenance must be performed by qualified personnel. Familiarization with and adherence to NEMA MG2, the National Electrical Code, and local codes is recommended. It is important to observe safety precautions to protect personnel from possible injury. Personnel should be instructed to:

1. Disconnect all power to motor and accessories prior to initiating any installation, maintenance, or repairs. Also ensure that driven equipment connected to the motor shaft will not cause the motor to rotate (windmilling of fans, water flowing back through pump, etc.).

2. Avoid contact with rotating parts.

3. Act with care in accordance with this manual's prescribed procedures in handling and installing this equipment.

4. Be sure unit and accessories are electrically grounded and proper electrical installation wiring and controls are used in accordance with local and national electrical codes. Refer to "National Electrical Code Handbook" - NFPA No. 70. Employ qualified electricians.

5. Be sure equipment is properly enclosed to prevent access by children or other unauthorized personnel in order to prevent possible accidents.

6. Be sure shaft key is fully captive before unit is energized.

7. Provide proper safeguards for personnel against rotating parts and applications involving high inertia loads which can cause overspeed.

8. Avoid extended exposure to equipment with high noise levels.

9. Observe good safety habits at all times and use care to avoid injury to yourself or damage to equipment.

10. Be familiar with the equipment and read all instructions thoroughly before installing or working on equipment.

11. Observe all special instructions attached to the equipment. Remove shipping fixtures if so equipped before energizing unit.

12. Check motor and driven equipment for proper rotation and phase sequence prior to coupling. Also check if a unidirectional motor is supplied and note proper rotation.

13. Electric motors can retain a lethal charge even after being shut off. Certain accessories (space heaters, etc.) are normally energized when the motor is turned off. Other accessories such as power factor correction capacitors, surge capacitors, etc. can retain an electrical charge after being shut off and disconnected.

14. Do not apply power correction capacitors to motors rated for operation with variable frequency drives. Serious damage to the drive will result if capacitors are placed between the motor and drive. Consult drive supplier for further information.

Table of Contents

U.S. ELECTRICAL MOTORS INSTALLATION AND MAINTENANCE

Shipment, Handling & Storage

I. SHIPMENT

Prior to shipment, all motors undergo extensive mechanical and electrical testing, and are thoroughly inspected. Upon receipt of the motor, carefully inspect the unit for any signs of damage that may have occurred during shipment. Should such damage be evident, unpack the motor at once in the presence of a claims adjuster and immediately report all damage and breakage to the transportation company.

When contacting U.S. Electrical Motors concerning the motor, be sure to include the complete motor identification number, frame, and type which appear on the nameplate.

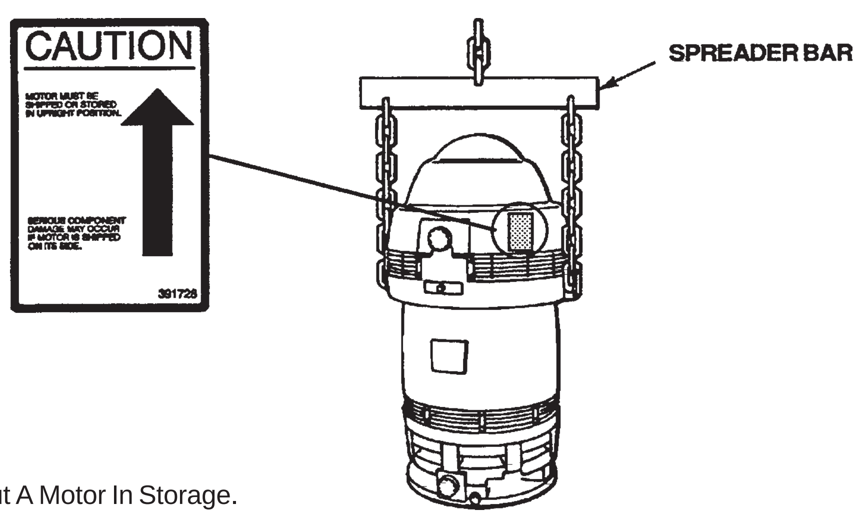
II. HANDLING

The equipment needed to handle the motor includes a hoist and spreader bar arrangement (see Figure 1) of sufficient strength to lift the motor safely. The spreader bar should have the lifting rings or hooks positioned to equal the span of the lifting lugs or eyebolts. The lifting lugs or eyebolts are intended to lift the motor weight only.

▲ ***WARNING***

Lifting the motor by other means may result In damage to the motor or injury to personnel.

FIGURE 1



III. STORAGE

1. When To Put A Motor In Storage.

   If a motor is not put into immediate service (one month or less), or if it is taken out of service for a prolonged period, special storage precautions should be taken to prevent damage. The following schedule is recommended as a guide to determine storage needs.

A. Out of service or in storage less than one month - no special precautions except that space heaters, if supplied, must be energized at any time the motor is not running.

B. Out of service or in storage for more than one month but less than six months - store per items 2A, B, C, D, E, and G, items 3A, and B, and item 4.

C. Out of service or in storage for six months or more - all recommendations.

2. Storage Preparation.

A. Where possible, motors should be stored indoors in a clean, dry area.

B. When indoor storage is not possible, the motors must be covered with a tarpaulin. This cover should extend to the ground; however, it should not tightly wrap the motor. This will allow the captive air space to breathe, minimizing formation of condensation. Care must also be taken to protect the motor from flooding or from harmful chemical vapors.

⚠ *CAUTION*

Immediately remove any shrink wrap used during shipping. Never wrap any motor in plastic for storage. This can turn the motor into a moisture trap causing severe, non-warranty damage.

C. Whether indoors or out, the area of storage should be free from excessive ambient vibration which can cause bearing damage.

D. Precautions should be taken to prevent rodents, snakes, birds, or other small animals from nesting inside the motors. In areas where they are prevalent, precautions must be taken to prevent insects, such as dauber wasps, from gaining access to the interior of the motor.

E. Inspect the rust preventative coating on all external machined surfaces, including shaft extensions. If necessary, re-coat the surfaces with a rust preventative material, such as Rust Veto No. 342 (manufactured by E.F. Houghton Co.) or an equivalent. The condition of the coating should be checked periodically and surfaces re-coated as needed.

F. Bearings:

When storage time is 6 months or more, grease lubricated cavities must be completely filled with lubricant. Remove the drain plug and fill cavity with grease until grease begins to purge from drain opening. Refer to section **IX. "LUBRICATION"** and/or review motor's lubrication nameplate for correct lubricant.

⚠ *CAUTION*

Do not re-grease bearings with drain closed or with unit running.

G. To prevent moisture accumulation, some form of heating must be utilized. This heating should maintain the winding temperature at a minimum of 5° above ambient. If space heaters are supplied, they should be energized. If none are available, single phase or "trickle" heating may be utilized by energizing one phase of the motor's winding with a low voltage. Request the required voltage and transformer capacity from U.S. Electrical Motors. A third option is to use an auxiliary heat source and keep the winding warm by either convection or blowing warm air into the motor.

3. Periodic Maintenance.

A. Grease lubricated bearings must be inspected once a month for moisture and oxidation by purging a small quantity of grease through the drain. If any contamination is present, the grease must be completely removed and replaced.

B. All motors must have the shaft rotated once a month to maintain a lubricant film on the bearing races and journals.

C. Insulation History:

The only accurate way to evaluate the condition of the winding insulation is to maintain a history of the insulation readings. Over a period of months or years these readings will tend to indicate a trend. If a downward trend develops, or if the resistance drops too low, thoroughly clean and dry the windings, retreating if necessary, by an authorized electrical apparatus service shop.

The recommended insulation resistance test is as follows:

(1) Using a megohm meter, with winding at ambient temperature, apply DC voltage (noted below) for sixty seconds and take reading.

Rated Motor Voltage	Recommended DC Test Voltage
Up to 600 (inclusive)	500 VDC
601 to 1000 (inclusive)	500 to 1000 VDC
1001 and up	500 to 2500 VDC (2500 VDC optimum)

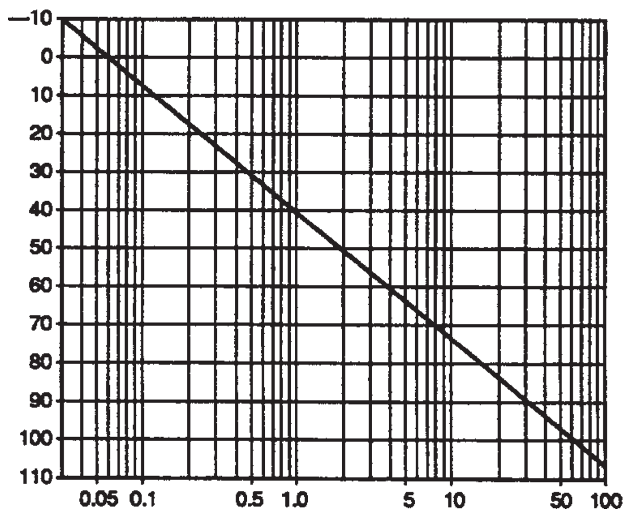
(2) For comparison, the reading should be corrected to a 40°C base temperature. This may be done by utilizing the following formula:

$$R_{40C} = K_t \times R_t$$

Where:
R_{40C} = insulation resistance (in megohms) corrected to 40°C
R_t = measured insulation resistance (in megohms)
K_t = temperature coefficient (from Graph 1)

GRAPH 1

WINDING TEMPERATURE (°C)



(Adapted from IEEE 43)

INSULATION RESISTANCE TEMPERATURE COEFFICIENT (K_t)

(3) Insulation resistance readings must not drop below the value indicated by the following formula:

$$R_m = Kv + 1$$

Where:
R_m = minimum insulation (in megohms) at 40°C
Kv = rated motor voltage in kilovolts

(4) Dielectric absorption ratio:

In addition to the individual test reading, a dielectric absorption ratio may be required. The dielectric absorption ratio is obtained by taking megohm meter readings at a one minute and ten minute interval, or when hand powered megohm meters are used, at a thirty second and sixty second interval. The voltage should be the same as outlined in part 1 of this procedure.

The ratio is obtained by dividing the second reading by the first reading and is based on a good insulation system increasing its resistance when subjected to a test voltage for a period of time.

10 Minute: 1 Minute	
Dangerous	= Less than 1.0
Poor	= 1.0 to 1.4
Questionable	= 1.5 to 1.9
Fair	= 2.0 to 2.9
Good	= 3.0 to 4.0
Excellent	= Over 4.0

60 Second: 30 Second	
Poor	= Less than 1.1
Questionable	= 1.1 to 1.24
Fair	= 1.25 to 1.3
Good	= 1.4 to 1.6
Excellent	= Over 1.6

If a low insulation resistance reading is obtained in either the individual test or dielectric absorption ratio test, thoroughly clean and dry the windings. Recheck insulation resistance and dielectric absorption ratio.

NOTE: Slightly lower dielectric absorption ratios may be acceptable when high initial insulation resistance readings are obtained (1000 + megohms). Refer any questions to USEM Product Service Department.

For additional information on insulation testing, refer to IEEE Transaction No. 43.

4. Start-up Preparations After Storage.

   A. Motor should be thoroughly inspected and cleaned to restore to an “As Shipped" condition.

   B. Motors which have been subjected to vibration must be disassembled and each bearing inspected for damage.

   C. When storage time has been six (6) months or more, grease must be completely changed using lubricants and methods recommended on the motor’s lubrication plate, or in Section **VII - "LUBRICATION."**

   D. The winding must be tested to obtain insulation resistance and dielectric absorption ratio as described in Section **III., item 3**.

   E. Contact USEM Product Service Department prior to start-up if storage time has exceeded one year.

IV. INSTALLATION LOCATION

When selecting a location for the motor and driven unit, keep the following items in mind:

1. The location should be clean, dry, well ventilated, properly drained, and provide accessibility for inspection, lubrication, and maintenance. Outdoor installations on open dripproof motors require protection from the elements.

2. The location should provide adequate space for motor removal without shifting the driven unit.

3. Temperature rise of a standard motor is based upon operation at an altitude not exceeding 3300 feet (1000 meters) above sea level unless specified otherwise on nameplate.

4. To avoid condensation inside the motor, it should not be stored or operated in areas subject to rapid temperature changes unless it is energized or protected by space heaters.

5. The motor should not be installed in close proximity to any combustible material or where flammable gases may be present, unless it is specifically built for that environment and is U.L. labeled accordingly.

V. INITIAL INSTALLATION

1. General

Reliable, trouble free operation of a motor and driven unit depends on a properly designed foundation and base plus good alignment. If the motor and driven unit are not installed properly, the following may result:

* Noisy operation
* Bearing damage or failure
* Excessive vibration
* Motor failure

2. Shaft Alignment

On Solidshaft motors, the motor and pump shafts must be aligned within .002" TIR.

3. Electrical Connection.

Refer to the motor nameplate for power supply requirements and to the connection diagram on the motor. Be sure connections are tight. Check carefully and assure that they agree with the connection diagram, then carefully tape all connections with electrical tape to be sure that they will not short against each other or to ground. Be sure the motor is grounded to guard against possible electrical shock. Refer to the National Electrical Code Handbook (NFPA No. 70) and to local electrical codes for proper wiring, protection, and wire sizing. Be sure proper starting equipment and protective devices are used for every motor. For assistance contact the local sales office of the motor starter manufacturer for the particular brand of equipment you are using.

Part Winding Starters: Part winding starters used with part winding start motors should have the timer set at a minimum time consistent with the power company requirements. The recommended maximum time on part winding is two seconds. Setting the timer for longer periods can cause permanent damage to the motor and may void the warranty. Note that motor may or may not start on part winding start connection.

4. Direction Of Rotation.

Some high speed motors have unidirectional ventilating fans. When the motor has a unidirectional ventilating fan, the direction of rotation is indicated by an arrow mounted on the motor and by a warning plate mounted near the main nameplate.

⚠ *CAUTION*

Apply power <u>momentarily</u> to observe the direction of rotation for which the leads are connected. The motor should be uncoupled from the driven equipment during this procedure to assure driven equipment is not damaged by reverse rotation. Couplings (if installed) should be properly secured.

To reverse direction of rotation (if motor is not operating in the correct direction) interchange any two of the three power leads on the motor. Be sure the power is off and steps are taken to prevent accidental starting of the motor before attempting to change electrical connection.

5. Initial Start.

After installation is completed, but before motor is put into regular service, make an initial start as follows:

A. Ensure that motor and control device connections agree with wiring diagrams.

B. Ensure that voltage, phase, and frequency of line circuit (power supply) agree with motor nameplate.

C. Check insulation resistance according to Section **III "STORAGE"** item 3.

D. Check all foundation, and coupling bolts (if applicable) to ensure they are tight.

E. If motor has been in storage, either before or after installation, refer to Section **III "STORAGE"** item 4 for preparations.

F. Check for proper or desired rotation. See item 4 of this section for details.

G. Ensure that all protective devices are connected and operating properly, and that all outlet accessory, and access covers have been returned to their original intended position.

H. Start motor at lowest possible load and monitor to be sure that no unusual condition develops.

> ***⚠ WARNING***
>
> ***All loosened or removed parts must be reassembled and tightened to original specifications. Keep all tools, chains, equipment, etc. clear of unit before energizing motor.***

I. When checks are satisfactory to this point, increase load slowly up to rated load and monitor unit for satisfactory operation.

VI. NORMAL OPERATION

Start the motor in accordance with standard instructions for the starting equipment used.

1. General Maintenance.

   Regular, routine maintenance is the best assurance of trouble-free, long-life motor operation. It prevents costly shutdown and repairs. Major elements of a controlled maintenance program are:

   A. Trained personnel who have a working knowledge of rotational equipment and have read this manual.

   B. Systematic records which contain at least the following:

      1. Complete nameplate data.
      2. Prints (wiring diagrams, certified outline dimensions).
      3. Alignment data.
      4. Results of regular inspection, including vibration and bearing temperature data, as applicable.
      5. Documentation of any repairs.
      6. Lubrication data:
         - Method of application
         - Types of lubricants for wet, dry, hot, or adverse locations
         - Maintenance cycle by location (some require more frequent lubrication)

2. Inspection and Cleaning

   Stop the motor before cleaning. ***CAUTION: Assure against accidental starting of the motor.*** Clean the motor inside and out regularly. The frequency of cleaning depends upon actual conditions existing around the motor. Use the following procedures as they apply:

   A. Wipe off dirt, dust, oil, water, or other liquids from external surfaces of motor. These materials can work into or be carried into the motor windings and may cause overheating or insulation breakdown.

   B. Remove dirt, dust, or debris from ventilating air inlets. Never allow dirt to accumulate near air inlets. Never operate motor with air passages blocked.

   C. Clean motors internally by blowing with clean, dry, compressed air at 40 to 60 PSI. If conditions warrant, use a vacuum cleaner.

> **⚠ *CAUTION***
> ***When using compressed air, always use proper eye protection to prevent accidental eye injury.***

   D. When dirt and dust are solidly packed, or windings are coated with oil or greasy grime, disassemble the motor and clean with solvent. Use only high-flash naphtha, mineral spirits, or Stoddard solvent. Wipe with solvent dampened cloth, or use suitable soft bristled brush. ***DO NOT SOAK***. Oven dry (150 – 175°F) solvent cleaned windings thoroughly before reassembly.

   E. After cleaning and drying the windings, check the insulation resistance per Section **III, Item 3.**

VII. LUBRICATION

Motor must be at rest and electrical controls should be locked open to prevent energizing while being serviced. If motor is being taken out of storage refer to Section **III "STORAGE"**, item 4 for instructions.

1. Relubrication of Units in Service

   Grease lubricated bearings are pre-lubricated at the factory and normally do not require initial lubrication. Relubricating interval depends upon speed, type of bearing and service. Refer to Table 1 for suggested regreasing intervals and quantities. Note that operating environment and application may dictate more frequent lubrication.

   To relubricate bearings, remove the drain plug. Inspect grease drain and remove any blockage (caked grease or foreign particles) with a mechanical probe, taking care not to damage bearing.

⚠ *WARNING*

Under NO circumstances should a mechanical probe be used while the motor is in operation.

   Add new grease at the grease inlet. New grease must be compatible with the grease already in the motor (refer to table 2 for compatible greases).

⚠ *CAUTION*

Greases of different bases (lithium, polyurea, clay, etc.) may not be compatible when mixed. Mixing such greases can result in reduced lubricant life and premature bearing failure. Prevent such inter-mixing by disassembling motor, removing all old grease and repacking with new grease per item B of this section. Refer to Table 2 for recommended greases.

   Run the motor for 15 to 30 minutes with the drain plug removed to allow purging of any excess grease. Shut off unit and replace the drain plug. Return motor to service.

⚠ *CAUTION*

Overgreasing can cause excessive bearing temperatures, premature lubricant breakdown and bearing failure. Care should be exercised against overgreasing.

2. Change of Lubricant

Motor must be disassembled as necessary to gain full access to bearing housing(s).

Remove all old grease from bearings and housings (including all grease fill and drain holes). Inspect and replace damaged bearings. Fill bearing housings both inboard and outboard of bearing approximately 30 percent full of new grease. Grease fill ports must be completely charged with new grease. Inject new grease into bearing between rolling elements to fill bearing. Remove excess grease extending beyond the edges of the bearing races and retainers.

Table 1
Recommended Grease Replenishment Quantities & Lubrication Intervals

Bearing Number		Grease Replenishment Quantity (Fl. Oz.)	Lubrication Interval		
62xx, 72xx	63xx, 73xx		1801 thru 3600 RPM	1201 thru 1800 RPM	1200 RPM and slower
03 thru 07	03 thru 06	0.2	1 Year	2 Years	2 Years
08 thru 12	07 thru 09	0.4	6 Months	1 Year	1 Year
13 thru 15	10 thru 11	0.6	6 Months	1 Year	1 Year
16 thru 20	12 thru 15	1.0	3 Months	6 Months	6 Months
21 thru 28	16 thru 20	1.8	3 Months	6 Months	6 Months

Refer to motor nameplate for bearings provided on a specific motor.

For bearings not listed in Table 1, the amount of grease required may be calculated by the formula:

$$G = 0.11 \times D \times B$$

Where:
G = Quantity of grease in fluid ounces.
D = Outside diameter of bearing in inches.
B = Width of bearing in inches.

Table 2
Recommended Greases

Motor Frame Size	Motor Enclosure	Grease Manufacturer	Grease (NLGI Grade 2)
All Thru 447	All	US Electrical Motors Chevron USA, Inc. Exxon Mobil	Grease No. 83343 SRI No. 2 Polyrex-EM
449 and Up	Open Dripproof		
449 and Up	TEFC and Explosionproof	US Electrical Motors Exxon Mobil	Grease No. 974420 Mobilith SHC-100

The above greases are interchangeable with the grease provided in units supplied from the factory (unless stated otherwise on motor lubrication nameplate).

VIII. FUNDAMENTAL TROUBLESHOOTING - PROBLEM ANALYSIS

This chart can reduce work and time spent on motor analysis. Always check the chart first before starting motor disassembly, as what appears to be a motor problem may often be located elsewhere. For additional information, consult our website at www.usmotors.com.

SYMPTOM	PROBABLE CAUSE	ANALYSIS
Motor fails to start	Defective power supply	Check voltage across all phases above disconnect switch.
	Blown or defective primary fuses	
	Blown or defective secondary fuses	Check voltage below fuses (all phases) with disconnect closed.
	Open control circuit	Push reset button.
	Overload trips are open	
	Defective holding coil in magnetic switch	Push start button and allow sufficient time for operation of time delay, if used, then check voltage across magnetic holding coil. If correct voltage is measured, coil is defective. If no voltage is measured, control circuit is open.
	Loose or poor connections in control circuits.	Make visual inspection of all connections in control switch.
	Magnetic switch closes	Open manual disconnect switch, close magnetic by hand, and examine contractors and springs.
	Poor switch contact	
	Open circuit in control panel	Check voltage at Tl, T2, & T3
	Open circuit in leads to motor	Check voltage at leads in outlet box
	Leads improperly connected	Check lead numbers and connections.
Motor fails to come up to speed	Low or incorrect voltage	Check voltage at Tl, T2, & T3 in control panel and at motor leads in outlet box.
	Incorrect connection at motor	Check for proper lead connections at motor and compare with connection diagram on motor.
	Overload - mechanical	Check impeller setting. Check for a tight or locked shaft.
	Overload - hydraulic	Check impeller setting. Check GPM against pump capacity and head.
Motor Vibrates	Shafts misaligned	Check alignment of motor to pump.
	Worn line shaft bearings or bent shaft	Disconnect motor from pump and run motor only to determine source of vibration.
	Hydraulic disturbance in discharge piping	Check isolation joint in discharge piping near pump head.
	Ambient Vibration	Check base vibration level with motor stopped.
	System Natural Frequency (Resonance)	Revise rigidity of support structure.
Motor noisy	Worn thrust bearing	Rotate rotor by hand, and make visual examination of balls and races. Bearing noise is commonly accompanied by a high frequency vibration and/or increased temp.
	Electrical noise	Most motors are electrically noisy during the starting period. This noise should diminish as motor reaches full speed.

SYMPTOM	PROBABLE CAUSE	ANALYSIS
Motor overheating (Check with thermocouple or by resistance methods. Do not depend on hand.)	Overload	Measure load and compare to nameplate rating. Check for excessive friction in motor or in complete drive. Reduce load or replace motor with greater capacity motor. Refer to Appendix C.
	Motor intake or exhaust blocked or clogged.	Clean motor intake and exhaust areas. Clean filters or screens if motor is so equipped.
	Unbalanced voltage	Check voltage to all phases. Refer to Appendix A.
	Open stator windings	Disconnect motor from load. Check idle amps for balance in all three phases. Check stator resistance in all three phases.
	Over / Under Voltage	Check voltage and compare to nameplate voltage.
	Ground	Locate with test lamp or insulation tester and repair.
	Improper Connections.	Recheck connections.
Bearing Overheating	Misalignment	Check alignment.
Generally, bearing tempatures (as measured by a tipsensitive RTD or thermocouple touching the bearing outer race) should not exceed 90°C when using mineral-based lubricants or 120°C when using synthetic-based lubricants.	Excessive thrust.	Reduce thrust from driven machine.
	Bearing over-greased.	Relieve bearing cavity of grease to level specified in lubrication section.
	Motor overloaded	Measure load and compare to nameplate rating. Check for excessive friction in motor or in complete drive. Reduce load or replace motor with greater capacity motor. Refer to Appendix C.
	Motor intake or exhaust blocked or clogged.	Clean motor intake and exhaust areas. Clean filters or screens if motor is so equipped.

IX. SPARE PARTS

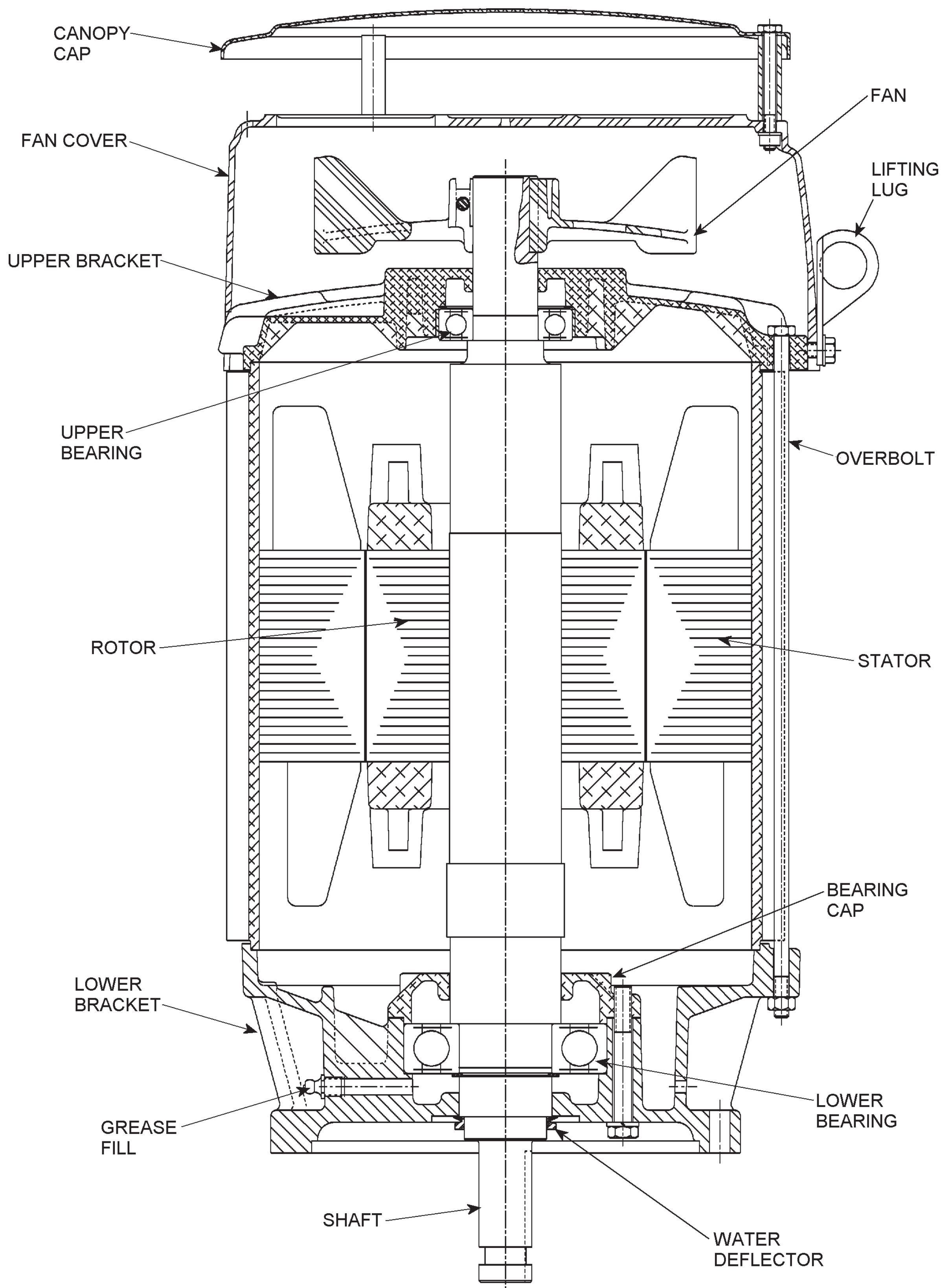
A parts list is available for your unit and will be furnished upon request. Parts may be obtained from local U.S. Electrical Motors distributors and authorized service shops, or through U.S. Electrical Motors distribution center.

U.S. ELECTRICAL MOTORS
3363 Miac Cove
Memphis, Tennessee 38118
(901) 366-4225

Drawings for many standard designs are supplied on the following pages. Most of the parts should be easy to identify. If however, there is some deviation from your machine, consult the factory for assistance.

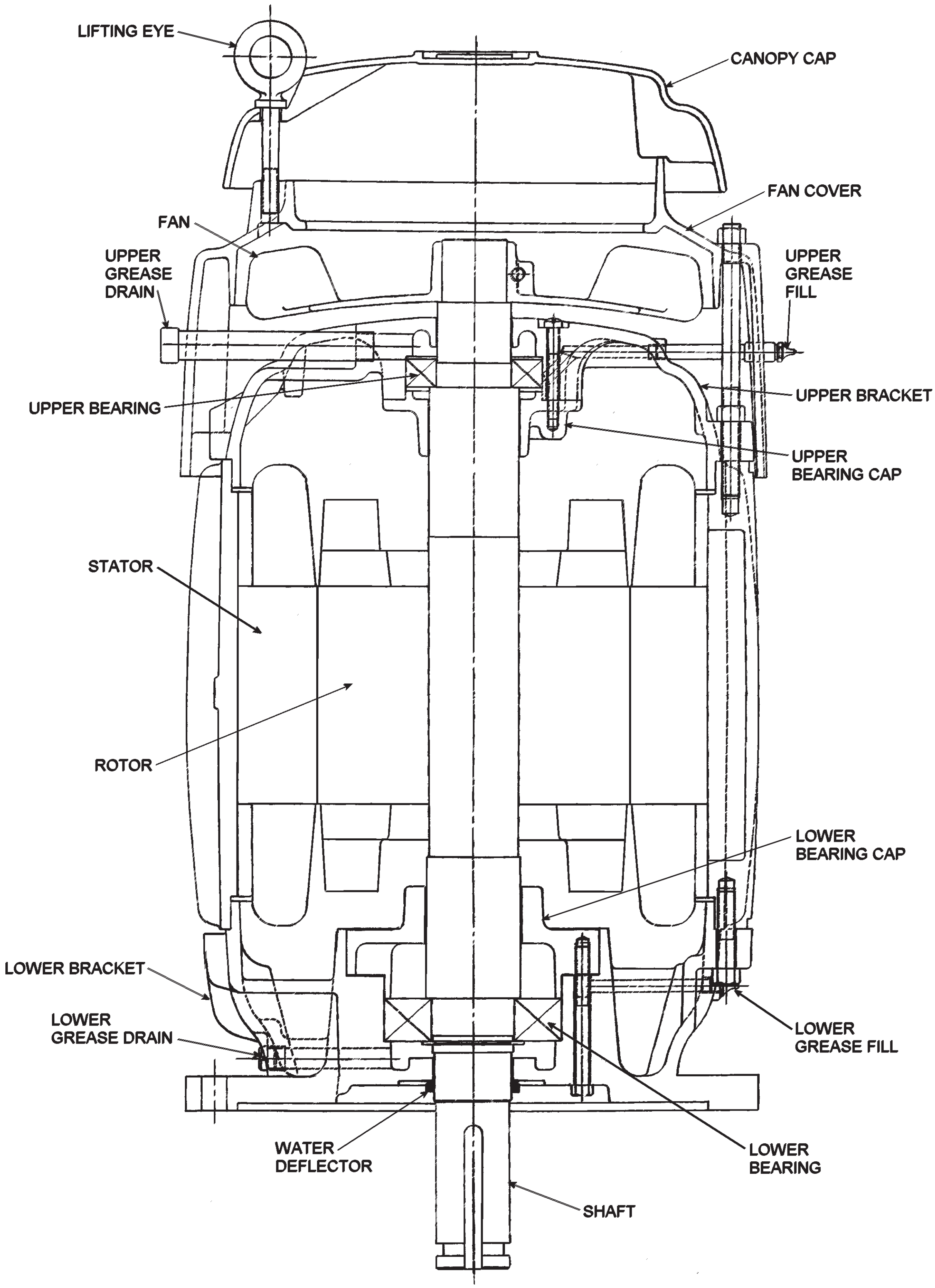
Spare Parts

180 thru 280 Frames
Type TV



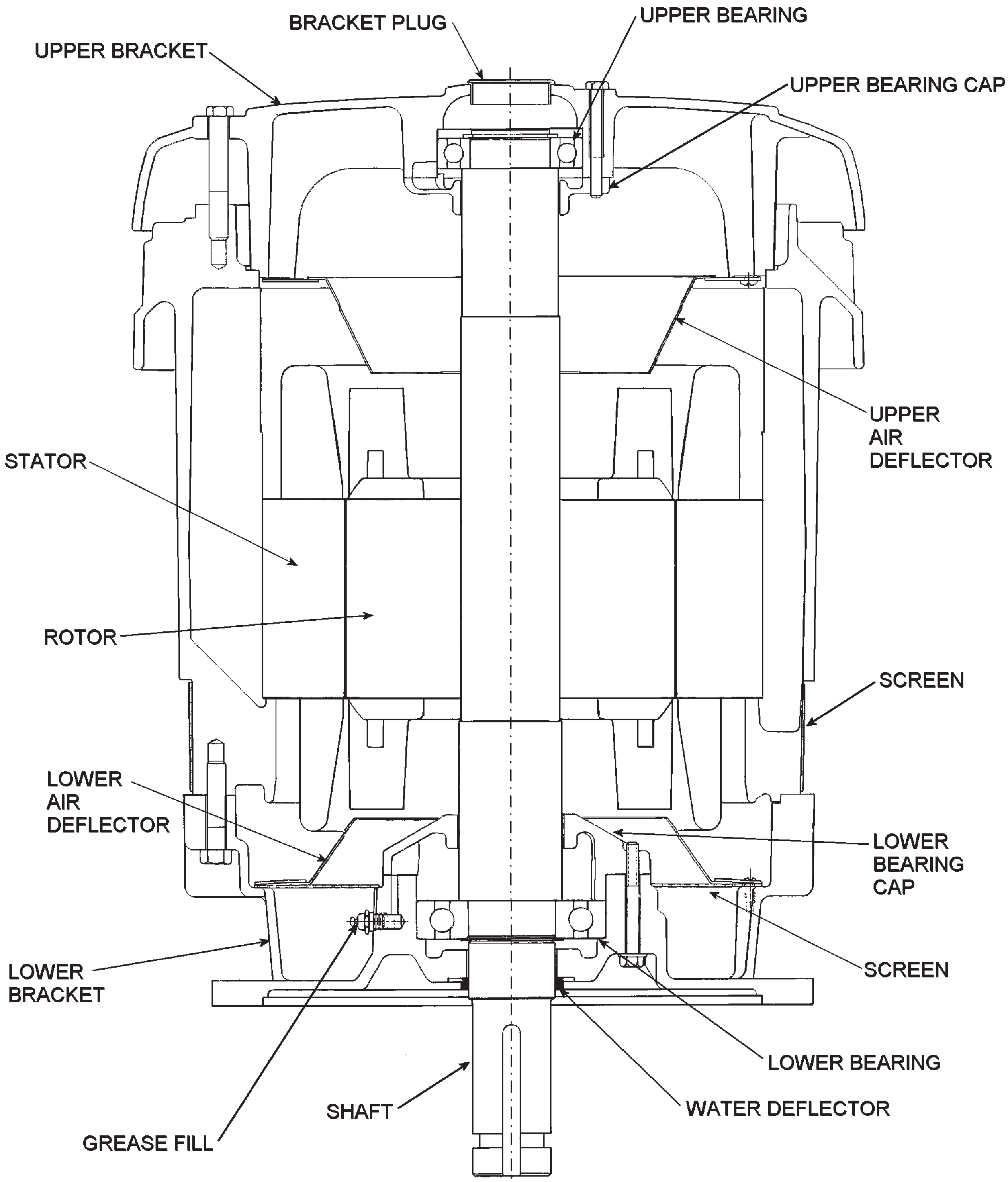
Spare Parts

320 Thru 440 Frame
Type TV and LV

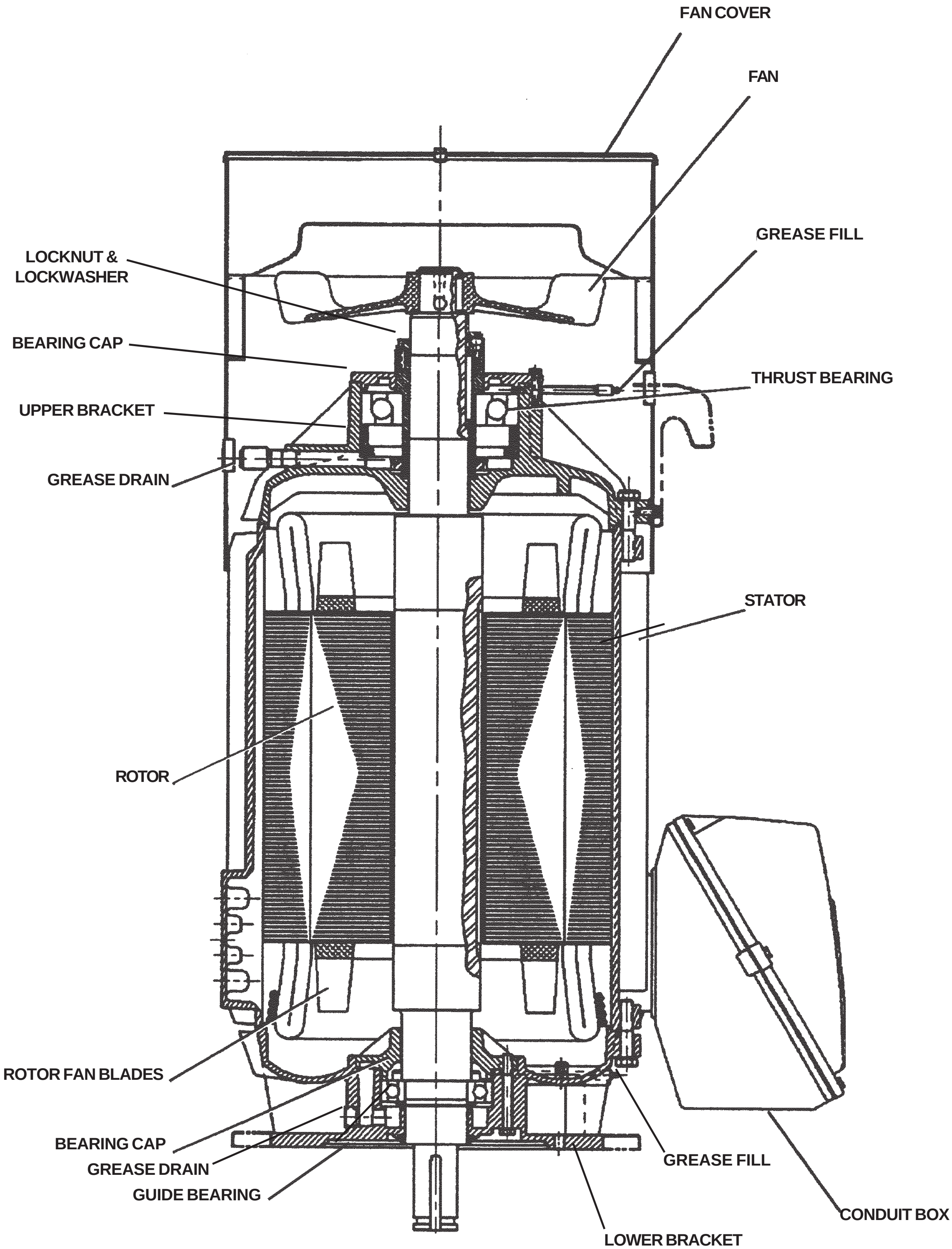


Spare Parts

320 thru 440 Frames
Type RV

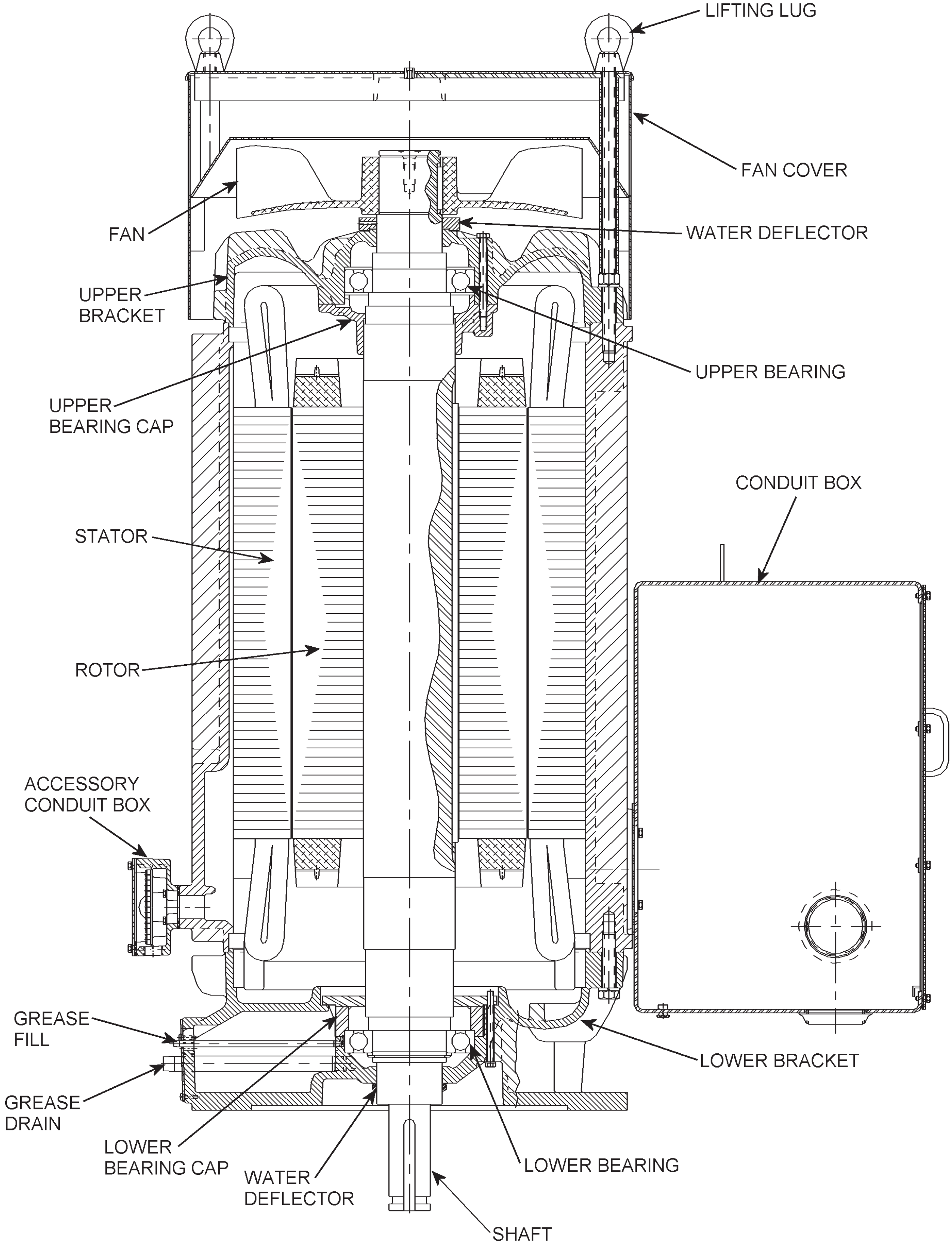


Spare Parts
449 Frame
Types JV & JV-3



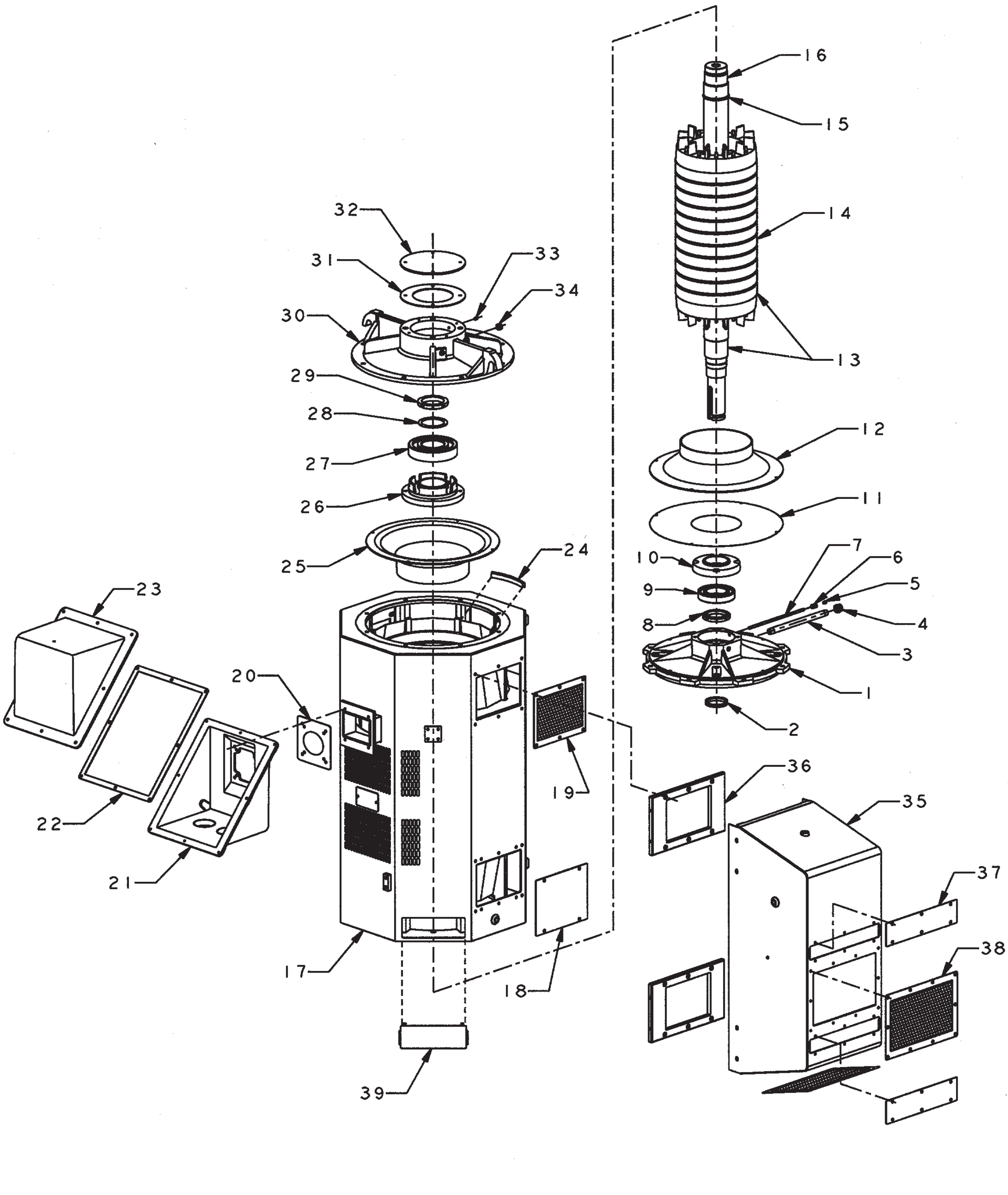
Spare Parts

5800 Frame
Type JV



Spare Parts

5000 Frame
Type RV



Spare Parts

5000 Frame
Type RV

Item No.	Quantity	Name of Part	Remarks / Limitations
1	1	Lower Bracket	All Motors
2	1	Shaft Water Slinger	All Motors
3	1	Pipe Nipple (Lower Grease Drain)	All Motors
4	1	Pipe Cap (Lower Grease Drain)	All Motors
5	1	Grease Zerk Fitting	All Motors
6	1	Pipe Coupling (Lower Grease Fill)	All Motors
7	1	Pipe Nipple (Lower Grease Fill)	All Motors
8	1	Snap Ring (Lower Bearing)	All Motors
9	1	Lower Bearing	All Motors
10	1	Lower Bearing Cap	All Motors
11	1	Lower Intake Screen	Only on WP-1
12	1	Lower Air Deflector	All Motors
13	1	Rotor Assembly	All Motors
14	1	Rotor Core	All Motors
15	1	Snap Ring (Upper Bearing Cap Retainer)	All Motors
16	1	Rotor Shaft	All Motors
17	1	Stator Assembly	All Motors
18	2	Lower Air Intake Cover	Only on WP-1
19	2	Upper Air Intake Screen	Only on WP-1
20	1	Gasket (Outlet Box Base to Stator)	All Motors
21	1	Outlet Box Base	All Motors
22	1	Gasket (Outlet Box Cover to Base)	All Motors
23	1	Outlet Box Cover	All Motors
24	16	Grommet (Air Deflector to Frame Baffle)	All Motors - 8 on each end
25	1	Upper Air Deflector	All Motors
26	1	Upper Bearing Cap	All Motors
27	1	Upper Bearing	All Motors
28	1	Upper Bearing Insulated Washer	All Motors
29	1	Upper Bearing Locknut	All Motors
30	1	Upper Bracket	All Motors
31	1	Gasket (Upper Bracket Cover Plate)	All Motors
32	1	Upper Bracket Cover Plate	All Motors
33	1	Grease Zerk Fitting	All Motors
34	1	Grease Drain Pipe Plug	All Motors
35	2	WP2 Intake Box	Only on WP-2
36	4	Adapter Flange	Only on WP-2
37	4	Filter Access Cover	Only on WP-2
38	4	Intake Screen	Only on WP-2
39	4	Cover (Flange Access)	Only on WP-2

Installation Record

NAMEPLATE AND INSTALLATION INFORMATION

SERIAL NUMBER OR MODEL NUMBER .... ____________
HORSEPOWER .... ____________
MOTOR RPM .... ____________
PHASE .... ____________
FREQUENCY .... ____________
AMPS .... ________ AT ____________ VOLTS
DESIGN .... ____________
FRAME .... ____________
TYPE .... ____________
DATE PURCHASED .... ________ P.O. NUMBER ____________
DATE INSTALLED .... ____________
LOCATION OF JOB SITE .... ____________
MACHINE OR INSTALLATION NUMBER .... ____________
PURCHASED FROM .... ____________
MOTOR RESISTANCE LINE TO LINE AT TIME OF INSTALLATION .... ____________

INSULATION TO GROUND READING AT TIME OF INSTALLATION .... ____________

RECORD OF MAINTENANCE

GRADE AND TYPE OF LUBRICANT USED .... ____________

DATE OF LAST RELUBRICATION	INSULATION RESISTANCE		OVERHAUL OR REPAIR	
	DATE	MEGOHMS	DATE	ACTION

Table 3
Threaded Fastener Torque Requirements

All threaded fasteners used for rigid joints (cast iron and low carbon steel) in products of U.S. Electrical Motors, are to be tightened to the torque values listed in the following tabulation. Values are based upon dry assembly.

Diameter of Fastener	Number of Threads Per Inch	Grade5 Fasteners	Grade 2 Fasteners
#6	32	16 lb.-in.	10 lb.-in
	40	18	12
#8	32	30	19
	36	31	20
#10	24	43	27
	32	49	31
#12	24	66	37
	28	72	40
1/4"	20	96	66
	28	120	76
5/16"	18	16 lb.-ft.	11 lb.-ft.
	24	18	12
3/8"	16	29	20
	24	34	23
7/16"	14	46	30
	20	52	35
1/2"	13	70	50
	20	71	55
9/16"	12	102	
	18	117	
5/8"	11	140	
	18	165	
3/4"	10	249	
	16	284	
7/8"	9	401	
	14	446	
1"	8	601	
	14	666	
1-1/8"	7	742	
	12	860	
1-1/4"	7	1046	
	12	1196	
1-3/8"	6	1371	
	12	1611	
1-1/2	6	1820	
	12	2110	

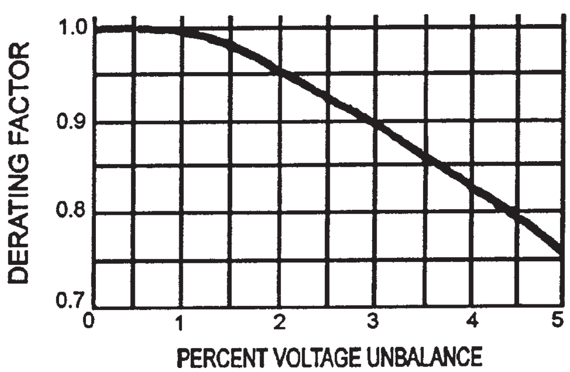
The above torque limits are not to be used when a drawing or specification lists a specific torque.

Effects of Unbalanced Line Voltage.

A potential cause of premature motor failure is unbalanced line (supply) voltage. Three phase motors produce useful work when they efficiently convert electrical energy into mechanical energy. This is accomplished when each phase of the supply voltage is of equal strength and works in harmony to produce a rotating magnetic field within the motor.

When the value of supply voltage leg to leg is not equal (e.g. 460-460-460), the risk of unbalanced line voltage is present. If this voltage unbalance exceeds about 1%, excessive temperature rise will result. Unless the motor HP capacity is derated to compensate, the motor will run hot resulting in degradation of the insulation system and bearing lubricant.

From NEMA MG-1, 14.35: Derating factors due to unbalanced line voltage



Example: Field ratings of Phase A - 480 v, Phase B = 460 v, Phase C = 450 v

As a rule of thumb, the percentage increase in temperature rise will be about two times the square of the percentage voltage unbalance. In this case the average voltage (480 + 460 + 450) is equal to 463 volts. The maximum deviation between legs is 17 volts (480 - 463 volts).

The Percentage voltage unbalance is determined as follows: 17 / 463 x 100 = 3.7%. The temperature rise will then increase $(3.7)^2$ x 2 = 27%. This condition will reduce the typical life of your motor to less than 25% of its design life. Should this condition be present, call your electric utility and resolve your unbalanced supply condition.

Other areas of motor performance will also be effected - e.g., loss of torque capacity, change in full load RPM, greatly unbalanced current draw at normal operating speed. Refer to NEMA MG-1 section 14.35 for details.

Motors Applied to Variable Frequency Drives (VFD's).

Electric motors can be detrimentally affected when applied with variable frequency drives (VFD's). The non-sinusoidal waveforms of VFD's have harmonic content which causes additional motor heating; and high voltage peaks and short rise times, which result in increased insulation stress, especially when long power cable lengths are used. Other affects of VFD's on motor performance include reduced efficiency, increased load current, vibration and noise. Standard motors utilized with VFD's must be limited to those application considerations defined in NEMA MG-1 Part 30.

NEMA MG-1 Part 31 defines performance and application considerations for Definite-Purpose Inverter Fed motors. To insure satisfactory performance and reliability, U.S. Motors offers and recommends nameplated inverter duty motor products which meet the requirements of NEMA MG-1 Part 31. The use of non-inverter duty motors may result in unsatisfactory performance or premature failure, which may not be warrantable under the Terms and Conditions of Sale. Contact your U.S. Motors Field Sales Engineer for technical assistance in motor selection, application and warranty details.

ELECTRIC MOTOR LOAD TEST USING THE WATT HOUR METER

In the analysis of electric motors it is sometimes desirable to conduct an accurate load check on a particular installation to determine whether the motor is operating within the rating and horsepower for which it was designed. Since most pump installations have their own watt hour power meters, accurate readings will permit a load check via the following formula:

K = Disc constant (watts per revolution of disc per hour). This is typically found on the meter face.

R = Revolutions of disc in watt meter within the time of the test.

T = Time of test, in seconds.

Transformer ratio = Stated on meter face. Must be included where current transformers are used with watt meters.

To obtain input kilowatts:

$$\text{Input KW} = \frac{K \times R \times 3.6}{T}$$

To obtain input horsepower:

$$\text{Input HP} = \frac{K \times R \times 4.83 \times \text{Transformer Ratio}}{T}$$

The watt hour meter measures power consumed over a period of time. It is necessary to establish the rate at which power is being consumed by the work being done. We establish this rate by counting the revolutions of the disc in a given time. Here is a typical example of a load check:

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- Pump motor to be load checked is rated 100 HP, 1800 RPM, 3-phase, 60 Hz, 1.15 service factor, 91.0 Percent Efficiency.
- Disc constant (K) found on face of meter = 40.
- Transformer ratio found on face of meter = 3.

DATA FOUND FROM TESTS
With stop watch, disc was observed to revolve 10 times in exactly 49 seconds. Therefore, R = 10; T = 49.

THUS

$$\text{Input HP} = \frac{40 \times 10 \times 4.83 \times 3}{49} = 118.29$$

Output HP = Input HP x Motor Efficiency
Output HP = 118.29 x 91% = 107.54

CONCLUSION
The output HP (107.54) is greater than output HP shown on nameplate (100 HP), but is well within the 1.15 service factor which applies to this motor.