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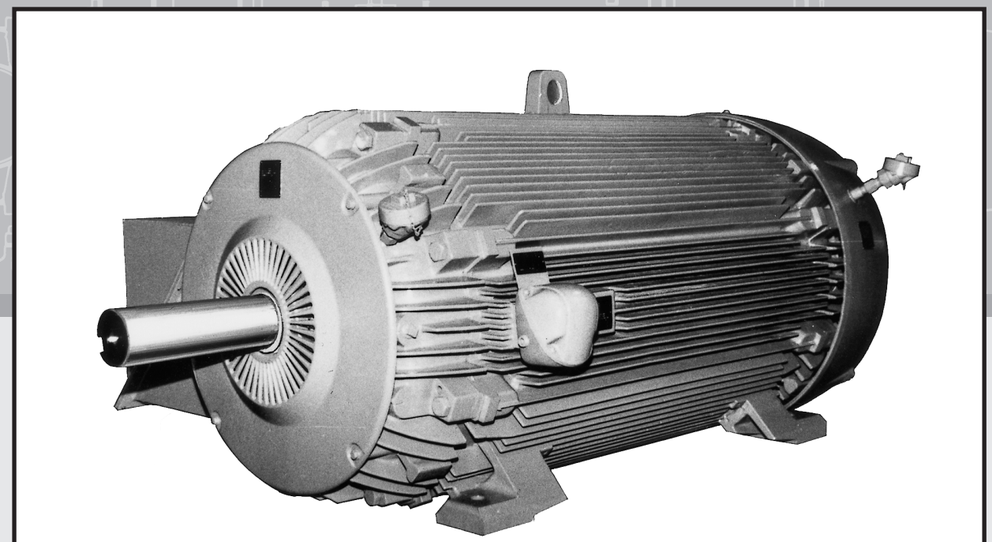
TITAN HORIZONTAL
LARGE AC ELECTRIC MOTORS



P/N 348672

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

EMERSON™
Motor Technologies

IN209-5A Rev. 10/02

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SAFETY FIRST

High voltage and rotating parts can cause serious injury or loss of life. Safe 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 maintenance or repairs.
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 your 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.
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. Do not apply power factor correction capacitors to motors rated for operation with variable frequently drives. Serious damage to the drive will result if capacitors are placed between the motor and drive. Consult your drive supplier for more information.

U.S. ELECTRICAL MOTORS INSTALLATION AND MAINTENANCE

Table of Contents

Shipment & Handling

I. SHIPMENT

Prior to shipment, all Titan Line Motors undergo extensive electrical and mechanical 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 and U.S Electrical Motors.

When contacting U.S Electrical Motors concerning the motor, be sure to include the complete motor identification number, frame and type which appears on the nameplate (see installation record in this manual).

II. HANDLING

The equipment needed to handle the motor includes a hoist and spreader bar arrangement of sufficient strength to lift the motor safely. The spreader bar arrangement should always be employed whenever multiple lifting lugs or eyebolts are provided (See Figures 1A & 1B). The spreader bar should have the lifting hooks positioned to equal the span of the eyebolts or lifting lugs. The eyebolts or lifting lugs provided are intended to lift the motor weight only. See Table 6 for motor weights.

⚠ CAUTION

Lifting the motor by means other than specifically noted may result in damage to the motor or injury to personnel. Note that the eyebolt on the top of WPII enclosure is intended for lifting the tophat only.

FIGURE 1A

Typical Construction With Two Eyebolts

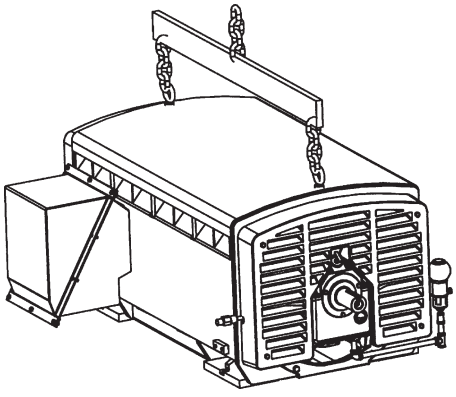
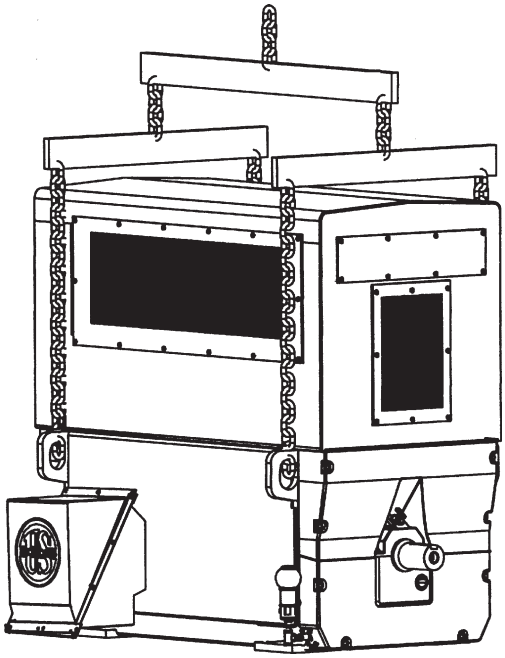


FIGURE 1B

Typical Construction With Four Lifting Lugs



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 but less than six months - store per Items 2 A through 2F, 2H, 3 and 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. Do not tightly wrap the motor as this will restrict air flow and result in surface condensation. Care must also be taken to protect the motor from flood damage or from any harmful chemical vapors.

   (C) Whether indoors or out, the area of storage should be free from excessive 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 also be taken to prevent insects, such as mud 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, recoat 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 recoated as needed.

   (F) To prevent moisture accumulation, some form of heating must be utilized to prevent condensation. This heating should maintain the winding temperature at a minimum of 5°C 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 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 too keep the winding warm by either convection or blowing warm air into the motor.

   (G) Bearing cavities must be completely filled with lubricant during long term storage. Remove the drain plug and fill cavity with grease at the grease inlet until it begins to purge from the drain hole then replace the drain plug. Refer to Section XI "Lubrication" for recommended greases. At approximately 2 month intervals, a small quantity of grease should be injected into grease fitting with drain plug removed. Exiting grease should be inspected for moisture and contamination. If moisture or contamination is present, the motor bearings should be inspected and fresh grease installed.

(H) All motors must have the shaft rotated a few turns once a month to maintain a lubricant film on bearing races.

3. Periodic Maintenance/ 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.

The recommended insulation resistance test is as follows:

(A) Using a megohmmeter, with winding at ambient temperature, apply DC voltage (noted below) for 60 seconds and take reading.

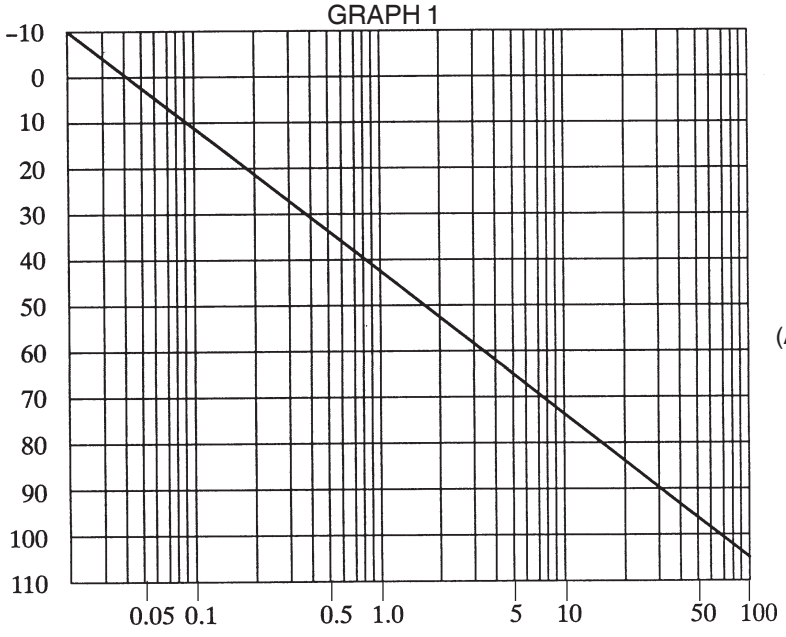
Rated Motor Voltage	Recommended DC Test Voltage
600 and less	500 VDC
601 to 1000 incl.	500 to 1000 VDC
1001 and up	500 to 2500 VDC (2500 VDC optimum)

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

$$R40C = Kt \times Rt$$

Where R40C = insulation resistance (in megohms) corrected to 40°C
Rt = measured insulation resistance (in megohms)
Kt = temperature coefficient (from Graph 1)

GRAPH 1



(ADAPTED FROM IEEE 43)

Installation Resistance Temperature Coefficient: Kt

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

$$Rm = Kv + 1$$

Rm = minimum insulation, in megohms, at 40°C
Kv = rated motor voltage in kilovolts

(D) 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 megohmmeter readings at a one minute and ten minute interval or when hand powered megohmmeters are used, at a thirty second and sixty second interval. The voltage should be the same as outlined in Part A 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.

The ratios are as follows:

10 minute : 1 minute			60 second : 30 second		
Dangerous	=	less than 1.0	Poor	=	less than 1.1
Poor	=	1.0 to 1.4	Questionable	=	1.1 to 1.24
Questionable	=	1.5 to 1.9	Fair	=	1.25 to 1.3
Fair	=	2.0 to 2.9	Good	=	1.4 to 1.6
Good	=	3.0 to 4.0	Excellent	=	Over to 1.6
Excellent	=	Over 4.0			

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 (1,000 + megohms). Refer any questions to U.S.E.M. 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) If motor has been in storage for less than 6 months, remove grease drain plugs at each end of the motor. Remove a small quantity of grease with a scavenger and replace drain plugs. If any moisture or contamination is evident in the grease, it must be completely changed by disassembling the unit and repacking per section XI "Lubrication".

(C) If motor has been in storage for 6 months or more, grease must be completely changed by disassembling the unit and repacking per section XI "Lubrication".

(D) The winding must be tested to obtain insulation resistance and dielectric absorption ratio as described in Part 3 of this section.

(E) If storage has exceeded one year, the U.S.E.M. Quality Assurance Department must be contacted prior to equipment start-up.

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. Ambient vibration should be kept to a minimum. Outdoor installations on Open Dripproof motors require protection from the elements.

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

3. The temperature rise of a standard motor is based on operation at an altitude not higher than 3,300 feet above sea level. See NEMA MG-1 20.40 for normal service condition.

4. To avoid condensation inside of motor, motors should not be stored or operated in areas subject to rapid temperature changes unless they are energized or protected by space heaters.

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

V. FOUNDATION

Concrete (reinforced as required) makes the best foundation, particularly for large motors and driven units. A sufficient mass provides rigid support that minimizes deflection and vibration. It may be located on soil, structural steel, or building floors, provided the total weight (motor, driven unit and foundation) does not exceed the allowable bearing load of the support. (Allowable bearing loads of structural steel and floors can be obtained from engineering handbooks; building codes of local communities give the recommended allowable bearing loads for different types of soil). It is recommended that a fabricated steel base (sole plate) be used between motor feet and foundation. See Figure 2. Base foot pads should be level and in the same plane.

Grouting

Grouting is the process of firmly securing equipment to a concrete base. This base is a continuation of the main foundation, designed to dampen any machine vibration present and prevent the equipment from shaking loose during operation. A serviceable and solid foundation can be laid only by careful attention to proper grouting procedure.

In practical terms, “grout” is a plastic filler which is poured between the motor sole plate and the foundation upon which it is to operate. Being plastic, it is expected to fill all spaces and cavities before it sets or solidifies and becomes an integral part of the principal foundation. In order to function properly, the principal foundation should be allowed to fully set through chemical reaction and dehydration as recommended by the grout manufacturer, prior to motor installation.

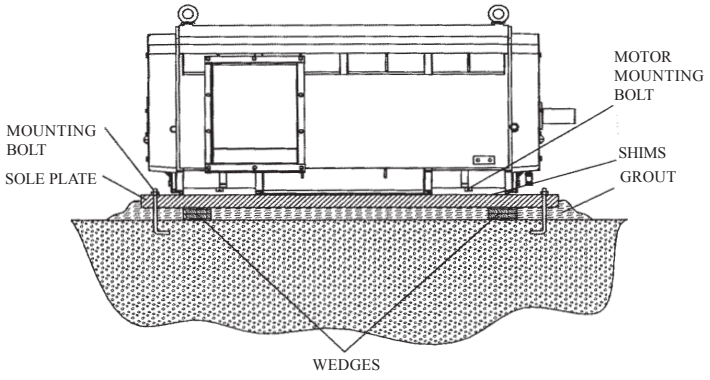


FIGURE 2

TYPICAL MOTOR MOUNTING ARRANGEMENT

VI. INITIAL INSTALLATION

1. Coupling or Pulley Installation

   Remove the shaft locking device shipped on motor (as applicable). Wash protective coating from the motor shaft extension(s) with solvent. Install couplings or pulleys on motor shaft per manufacturers' recommended fit and mounting practices.

⚠ **Caution**: ***Hammering or pounding with a mallet to install couplings or pulleys will damage bearings.***

   In belted applications, the driver pulley should be positioned as close to the shaft shoulder as possible to assure longest bearing life and keep shaft bending moment to a minimum. Take care to ensure that the inboard edge of the pulley hub does not ride-up on the shaft shoulder blend radius.

⚠ **Caution**: ***Belt tension should not exceed the transmission drive manufacturers' recommendations. Excessive belt tension reduces belt life. Overload due to overtensioning of belts reduces bearing life and can induce shaft fatigue failure.***

⚠ **Caution**: ***Excessive bending movement due to placing of pulley far out on the shaft extension will reduce bearing life and may lead to shaft fatigue failure.***

⚠ **Caution**: ***Placing the pulley hub onto shaft against the shaft shoulder blend radius may cause a large stress riser in the shaft, resulting in shaft fatigue failure. Prevent this from occurring by using a chamfered spacer ring or chamfering the end of the hub bore.***

2. Rough Alignment

   Inspect sole plate mounting pads and bottom of motor feet for dirt or irregularities that would prevent proper seating. Position and shim the motor such that the coupling hubs are aligned within 1/32" and the motor shaft is level. The motor shaft must be slightly lower than the driven shaft to allow for final adjustment shims.

3. Final Alignment

   Accurate shaft alignment between motor and driven equipment is essential for trouble-free operation. Improper alignment can result in vibration, bearing overload and excessive shaft stresses. Flexible couplings may not adequately compensate for excessive misalignment.

   Whenever aligning a motor to driven equipment, keep the following rules in mind:
   - Do not place more than five shims in a shim pack under any one machine foot, as the flexibility of the shim pack will contribute to a soft foot condition.
   - After any corrective adjustment, tighten foot bolts securely and recheck alignment.
   - When making shim adjustments, change only one foot at a time.
   - Recheck alignment after the motor has been in service for approximately one week and readjust as necessary.

   A. Angular Alignment (See Figure 3A)

   Check for angular misalignment of motor to driven unit shaft. (See Figure 3A). Measure distance between coupling hub faces (with feeler gauges) at four places equally spaced around the outside diameters. Position motor as necessary to be within the maximum allowable misalignment of .001 in. per foot of coupling radius.

B. Parallel Alignment (See Figure 3B)

Fasten a dial indicator onto one coupling hub with the indicator button on the cylindrical surface of the opposite coupling hub. Rotate shafts together and take readings at four points, 90° apart. Relocate motor until total indicator movement in full rotation does not exceed .002". Transfer indicator to opposite hub and repeat the parallel alignment procedure. Recheck angular alignment as described in Step A.

FIGURE 3
FLEXIBLE COUPLINGS

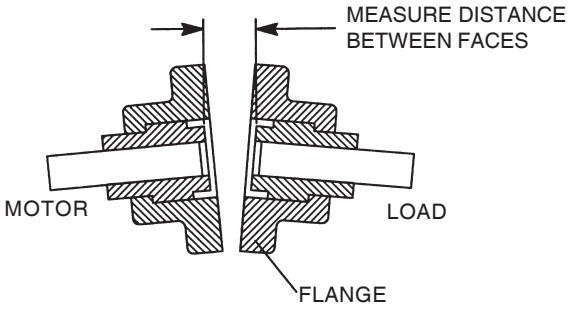


FIGURE 3A
ANGULAR MISALIGNMENT

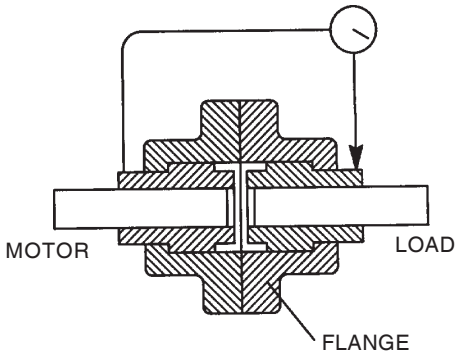


FIGURE 3B
PARALLEL ALIGNMENT

C. Soft Foot Check

Check and correct any "soft foot" condition to assure that equal pressure is exerted on each motor foot by the following shimming procedure. Bolt all motor feet down solidly to the motor bedplate or foundation. Mount the base of the dial indicator from the motor's foundation, and place and zero out the indicator on the motor shaft or coupling. Back off one of the take off end bolts and check indicator for change in reading, a .001 inch reading is maximum. Shim at foot if required and go to other take off end bolt. This procedure should be repeated on the opposite end until no reading is greater than .001 inches.

D. Hot Alignment

It is possible for motor shaft height to change relative to the driven equipment and this should be compensated for during the alignment procedure. Recheck parallel alignment (vertical) of coupled drive by repeating after normal operating temperature is reached. If shimming is changed, repeat alignment procedure to the extent necessary to assure proper alignment.

4. Electrical Connection

Refer to the motor nameplate for power supply requirements and to the connection diagram for connection parameters. Be sure connections are tight. Recheck carefully and assure that they agree with the connection diagram. Insulate all connections with electrical tape to insure that they will not short against each other or to ground. Be sure the motor is grounded to guard against 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 motor starter manufacturer. Apply the above precautions to all accessories as well.

5. Reversing Rotation

The direction of rotation may be reversed by interchanging any two, of the three power phases to the motor leads. Be sure that the power is off and steps are taken to prevent accidental starting of the motor before attempting to change any electrical connections.

⚠ CAUTION

Some motors have unidirectional ventilating fans. Running such a unit in reverse for any extended length of time will result in motor damage. On motors that are unidirectional, the direction of rotation is noted by an arrow mounted above the take-off-shaft and by a warning plate mounted near the main nameplate. To determine direction of rotation for which leads are connected, apply power momentarily and observe rotation. Motor should be uncoupled from driven equipment to insure driven equipment is not damaged by reverse rotation. Motor coupling may require removal or suppport if motor is operated uncoupled from driven equipment.

6. Initial Start

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

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

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

C. Check insulation resistance according to Section III “Storage”, Part 3.

D. Check all foundation and base bolts to insure that they are tight.

E. If motor has been in storage, either before or after installation, refer to Section III “Storage”, Part 4 for preparations.

F. Check for proper or desired rotation. See Part 5 of this section.

G. Insure that all protective devices are connected and are operating properly.

H. Run motor at minimum possible load long enough to be certain that no unusual condition develops. Listen and feel for excessive noise, vibration, clicking or pounding. If any are present, stop motor immediately. Investigate the cause and correct before putting motor into service. In the case of vibration, see Part 7 of this section.

⚠ CAUTION

Repeated trial starts can overheat the motor (particularly for across-the-line starting) or the external starting equipment. If repeated trial starts are made, allow sufficient time between starts to permit heat to be dissipated from windings and controls to prevent overheating. Refer to Starting Duty Nameplate (if supplied) and NEMA MG1-12.54, MG1-20.42 and MG1-20.43 for allowable starting frequency and load inertia (WR^2).

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

7. Vibration

Motors are supplied as standard in accordance with NEMA MG-1, section 7, which dictates that motor no-load vibration when mounted on a resilient base shall not exceed the limits as outlined in the following table:

TABLE 1
NO-LOAD VIBRATION LIMITS

Speed, RPM	Rotational Frequency, Hz	Velocity, Inches per second peak
3600	60	0.15
1800	30	0.15
1200	20	0.15
900	15	0.12
720	12	0.09
600	10	0.08

If vibration is deemed excessive, check for and correct any misalignment and/or "soft foot" condition per item 3 of this section.

VII. NORMAL OPERATION

Start the motor in accordance with standard instructions for the starting equipment used. Connected load should be reduced to the minimum, particularly for reduced voltage starting and/or high inertia connected loads, until the unit has reached full speed.

1. General Maintenance

Routine maintenance is the best assurance of trouble-free motor operation; it prevents costly shutdown and repairs. Major elements of a controlled maintenance program include:

A. Trained personnel who KNOW the work.
B. Systematic records, which contain at least the following:

1. Complete nameplate data.
2. Prints (wiring diagrams, certified outline dimensions).
3. Alignment data (departures from perfect alignment, allowance for temperature).
4. Winding resistance and temperature.
5. Results of regular inspection, including vibration and bearing temperature data as applicable.
6. Documentation of any repairs.
7. Lubrication data (method of application, type of lubricant used, maintenance cycle by location).

2. Inspection & Cleaning

Stop the motor before cleaning. (⚠**CAUTION**: ***See section on safety, page i).*** Clean the motor, inside and outside, regularly. The frequency depends upon actual conditions existing around the motor. Use the following procedures, as they apply:

A. Wipe any contaminants from external surfaces of the motor.

B. Remove dirt, dust, or debris from ventilating air inlets. Use compressed air as necessary. Never allow dirt to accumulate near air inlets. Never operate motor with air passages blocked or restricted. For stubborn dirt in tubes of Totally-Enclosed-Tube-Cooled motors, use a tool similar to a shotgun "ramrod".

⚠ CAUTION

When using compressed air, always use proper eye protection to prevent accidental eye injury.

C. Filters in weather protected top hats should be removed and cleaned per filter manufacturer's recommendations.

D. Clean motors internally by vacuuming or blowing with clean, dry compressed air. Generally a pressure not exceeding 30 PSI is recommended.

E. 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 bristle brush. **DO NOT SOAK**. Oven dry (150 - 175°F) solvent cleaned windings thoroughly before reassembly.

F. After cleaning and drying the windings, check the insulation resistance. Refer to Section III, Part 3 for procedure.

VIII. DOWELING

Doweling the motor (and driven unit) accomplishes the following:

1. Restricts movement of the motor and driven unit.
2. Eases realignment if motor is removed from base.
3. Temporarily restrains the motor, should mounting bolts loosen.

The following procedure for inserting dowel pins is recommended.

1. Check the alignment after the unit has been in operation approximately one week. Correct if necessary.
2. Drill through motor feet on drive end and into base. Drill diameter must be slightly smaller than the intended dowel size to allow for reaming operation.
3. Ream holes in the feet and base to the proper diameter for the pins (light press fit). Clean out the chips.
4. Insert dowel pins.

IX. DISASSEMBLY

See Figure 4 for Bearing Housing Cross Section.

A. Disconnect power. Refer to section on Safety, page i.

B. Remove grills and/or weather protected tophat as required.

C. Remove bearing cap screws.

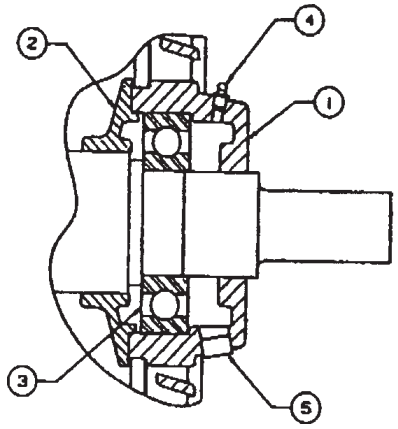
D. Remove bearing temperature detector probes from brackets as applicable.

E. Remove bracket to stator bolts and remove brackets.

F. If bearings are to be replaced, remove bearings from rotor shaft with a bearing puller. Pull on inner bearing race to remove bearings without damage.

Hazardous Location Motors: (Underwriter's Laboratories Requirements)
These motors are built to specifications approved by Underwriter's Laboratories. Assembly and inspection is made by authorized personnel at our factory before the Underwriter's Label is affixed. The Label is void if the unit is disassembled at other than U.S. Electrical Motors plant of manufacture or a U. S. Electrical Motors authorized and U.L. approved service shop, unless specific approval for such action is obtained from Underwriter's Laboratories.

FIGURE 4
BEARING HOUSING CONSTRUCTION



1. BEARING BRACKET
2. BEARING CAP
3. BEARING
4. GREASE FILL FITTING
5. GREASE DRAIN PLUG

X. REASSEMBLY

A. Clean all machined and mating surfaces on bearing caps, bracket fits, etc.

B. Remove old grease from grease cavities and bearings.

C. Carefully inspect bearings for nicks, dents or any unusual wear patterns. Damaged bearings must be replaced.

D. If motor is supplied with insulated bearing shaft journals, inspect for damage and repair as necesary before reassembly.

E. Reassemble motor by reversing the disassembly procedure in Section IX “Disassembly”. Bearings should be installed per bearing manufacturer's recommended procedure. Pack bearings with grease per Section XI "Lubrication".

F. Torque bolts per values in Table 4.

G. Touch up any scratched or chipped paint to protect motor surfaces.

XI. LUBRICATION

A. Relubrication of Units in Service

Units with 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 2 for suggested regreasing intervals. Note that operating environment and application may dictate more frequent lubrication.

Motor must be at rest and electrical controls should be locked open to prevent energizing while motor is being serviced (Refer to section on Safety, page i). If motor is being taken out of storage, refer to Section III "Storage". Part 4, for preparation instructions.

To relubricate bearings, remove the drain plug. Inspect grease drain and remove any blockage (caked grease or foreign particles) with a mechanical probe or scavenger (take care not to damage bearing). *Under NO circumstances should a mechanical probe or scavenger be used while the motor is in operation.* Add new grease at the grease inlet. New grease must be compatible with grease already in the motor (refer to Tables 2 and 3 for compatible greases and replenishment quantities).

⚠ 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 intermixing by disassembling motor, removing all old grease and repacking with new grease per Item B of this section. (Refer to Table 3 for recommended grease).

Run the motor for 15 to 30 minutes with the drain plug removed to allow purging of any excess grease (to eliminate the possibility of overgreasing). Shut off unit and replace the drain plug. Put motor back into operation.

⚠ CAUTION

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

B. Change of Lubricant:

Motor must be disassembled as outlined in Section IX "Disassembly".

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 fittings should be fully charged with new grease. Inject new grease into bearing between rolling elements to fill bearing. Remove any excess grease extending beyond the edges of the bearing races and retainers.

Table 2: Suggested Regreasing Quantities and Intervals

Bearing Number		Bearing	Grease	Lubrication Interval		
Common	AFBMA	Type	Fl. oz.	1801-3600 RPM	1201-1800 RPM	0-1200 RPM
6313	65BC03X3	Ball	0.8	6 months	12 months	12 months
6316	80BC03X3	Ball	1.2			
6318	90BC03X3	Ball	1.5	3 months		
6220	100BC02X3	Ball	1.1			
6320	100BC03X3	Ball	1.8	N/A		
6222	110BC02X3	Ball	1.4			
6322	110BC03X3	Ball	2.1		6 months	
6226	130BC02X3	Ball	1.6			
6228	140BC02X3	Ball	1.9			
6232	160BC02X3	Ball	2.5			6 months
6234	170BC02X3	Ball	2.9			
6334	170BC03X3	Ball	4.6			
NU220	100RU02M30	Cylindrical Rllr.	1.1		3 months	
NU222	110RU02M30	Cylindrical Rllr.	1.4			
NU226	130RU02M30	Cylindrical Rllr.	1.6			
NU228	140RU02M30	Cylindrical Rllr.	1.9			
C2220 CARB	N/A	Toroidal Rllr.	1.4			
C2222 CARB	N/A	Toroidal Rllr.	1.8			
C2226 CARB	N/A	Toroidal Rllr.	2.5			

For motors mounted vertically, or in hostile environments, reduce intervals shown by 50 percent.

For bearings not listed in Table 2, 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 = Bearing width in inches

The following greases are interchangeable with the grease provided in units supplied from the factory unless stated otherwise on a lubrication nameplate attached to the motor. The lubricants listed in this table correspond to ambient air temperatures between -5C and +40C. Refer to office for air temperatures consistently outside of this range.

Table 3: US Motors Approved Greases for Titan Horizontal Motors with Antifriction Bearings

Motor Frame Size	Motor Enclosure	Motor Type Designation	Grease Manufacturer	Grease Mfg Part No.	Grease Description
All	Open Dripproof	H, HE, HEI R, RE, REI	US Electrical Motors Chevron USA, Inc. Shell Oil Co. Exxon Co., USA	Grease No. 83343 SRI No. 2 Dolium-R Polyrex-EM	Polyurea-base NLGI #2
5000	TEFC and Explosionproof (Automotive Duty)	JAD, JDE EAD, EDE			
449 and up	TEFC and Explosionproof (not Automotive Duty)	J, JC, JCE, E, EC JI, JEI, JCI, JCEI, JT	US Electrical Motors Mobil Oil Co.	Grease No. 974420 Mobilith SHC-100	Lithium Complex NLGI #2

TABLE 4
RECOMMENDED FASTENER TORQUE VALUES

Fastener Size	Torque* (Ft.- Lbs.)
1/4 - 20 UNC	8
5/16 - 18 UNC	17
3/8 - 16 UNC	30
7/16 - 14 UNC	50
1/2 - 13 UNC	75
9/16 - 12 UNC	110
5/8 - 11 UNC	150
3/4 - 10 UNC	260
7/8 - 9 UNC	430
1 - 8 UNC	640
1-1/8 - 7 UNC	800
1-1/4 - 7 UNC	1120
1-3/8 - 6 UNC	1460
1-1/2 - 6 UNC	1940

*Based upon using a dry (unlubricated) Grade 5 fastener

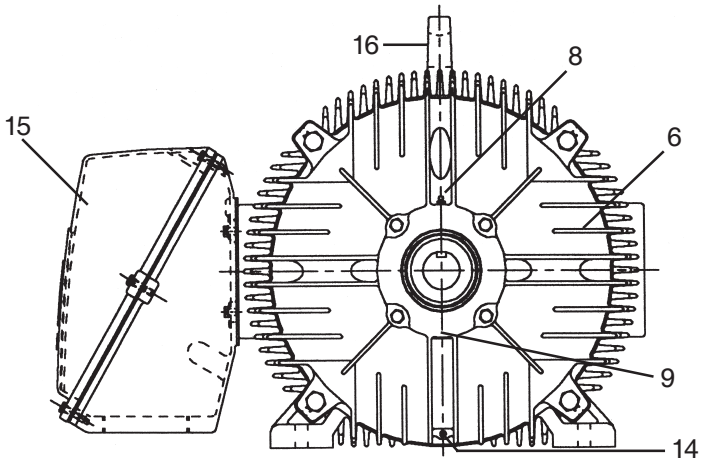
XII. RENEWAL PARTS AND SERVICE

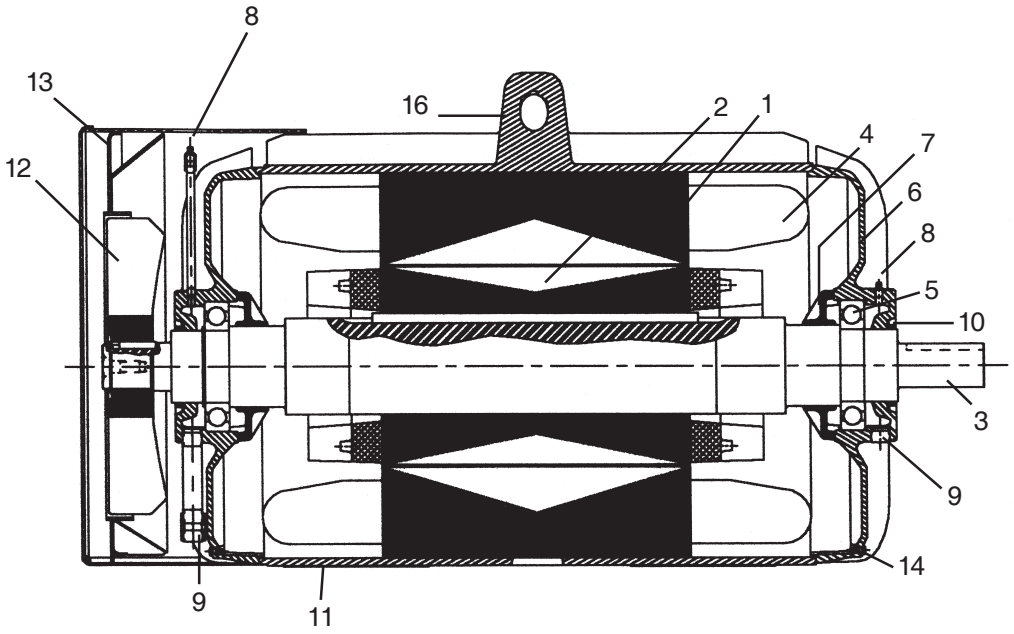
Parts lists for specific units can be furnished upon request. Parts may be obtained from local U.S. Motors distributors and authorized service shops, or via the U.S. Motors Distribution Center:

U.S. ELECTRICAL MOTORS DISTRIBUTION CENTER
3363 MIAC COVE
MEMPHIS, TN 38118
PHONE (901) 794-5500
FAX (901) 366-2661

449 Frame, Type J

1. Stator
2. Rotor
3. Shaft
4. Stator Coils
5. Bearing
6. Bearing Bracket
7. Bearing Cap
8. Grease Fill
9. Grease Drain Plug
10. Shaft Seal Slinger
11. Stator Housing (Frame)
12. Fan
13. Fan Cover Guard
14. Condensate Drain
15. Terminal Box
16. Lifting Lug

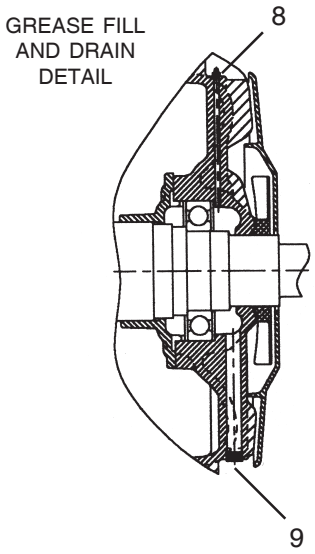


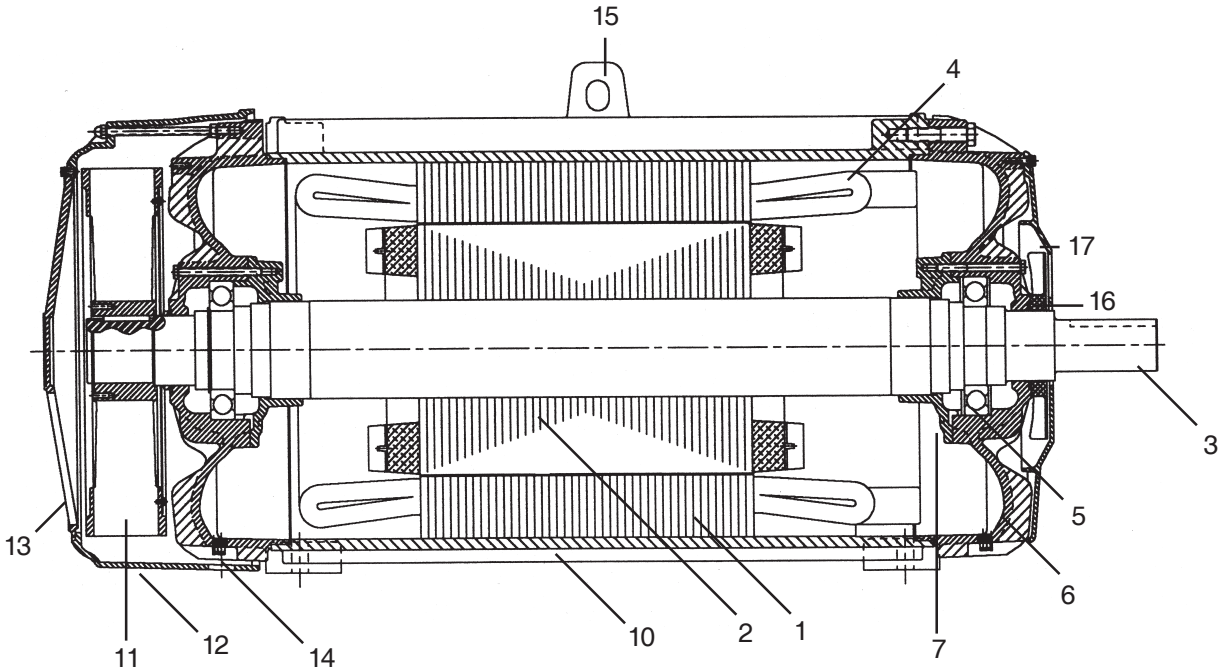


Cutaway Drawings

5800 Types J, E

1. Stator
2. Rotor
3. Shaft
4. Stator Coils
5. Bearing
6. Bearing Bracket
7. Bearing Cap
8. Grease Fill
9. Grease Drain
10. Stator Housing (Frame)
11. Main Cooling Fan
12. Fan Cover Guard
13. Grill
14. Condensate Drain
15. Lifting Lug
16. Drive End Cooling Fan
17. Drive End Fan Cover Guard

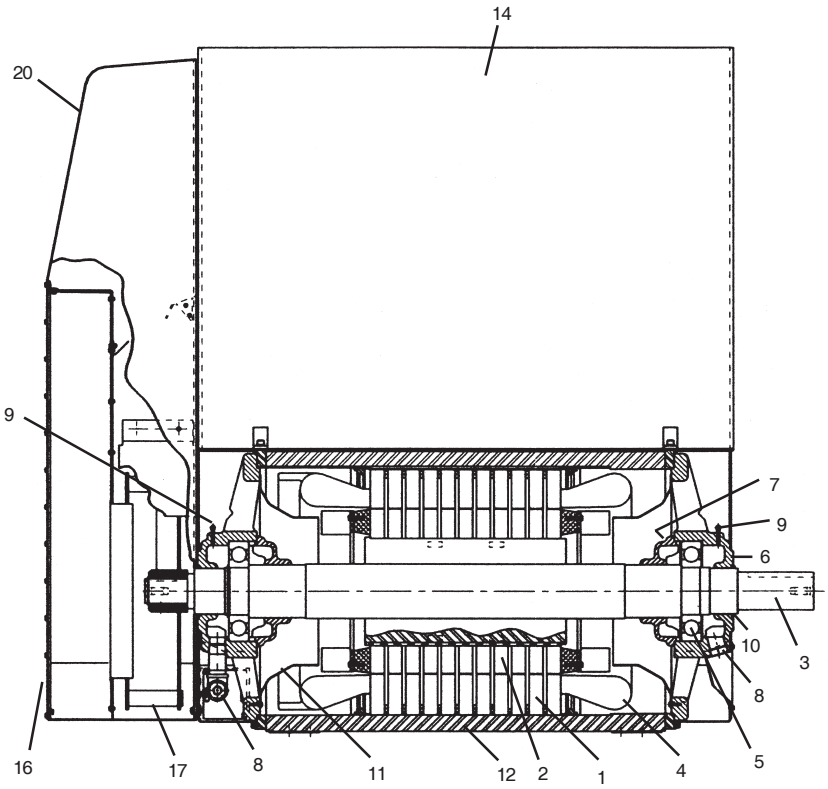


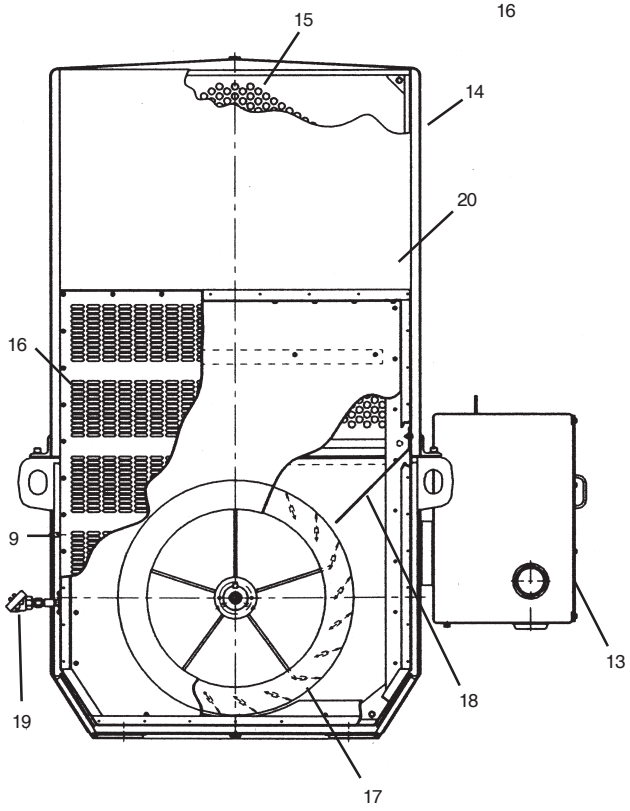


Cutaway Drawings

8000 Frame Type JT

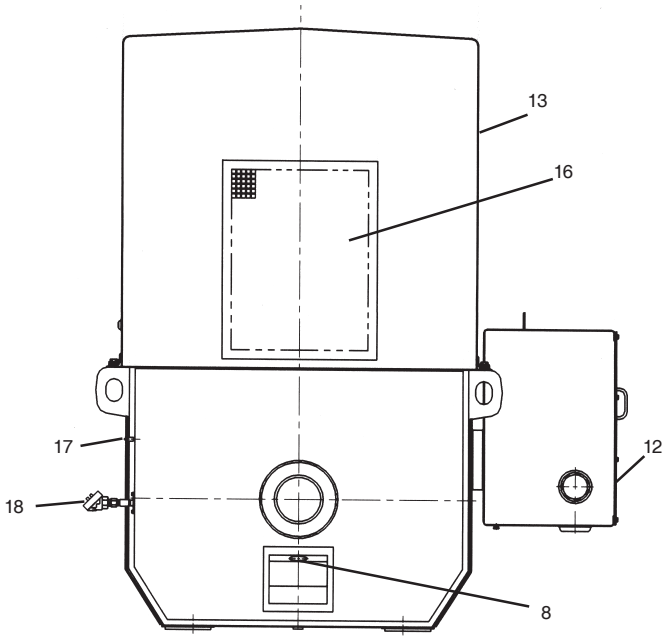
1. Stator
2. Rotor
3. Shaft
4. Stator Coils
5. Bearing
6. Bearing Bracket
7. Bearing Cap
8. Grease Drain Plug
9. Grease Fill
10. Shaft Seal Slinger
11. Air Deflector
12. Stator Housing (Frame)
13. Terminal Box
14. Top Hat
15. Tube Bundle
16. Air Intake Grill
17. Fan
18. Fan Baffle (Wiper.)
19. Bearing Temperature Detector Housing
20. Fan Cover Assembly



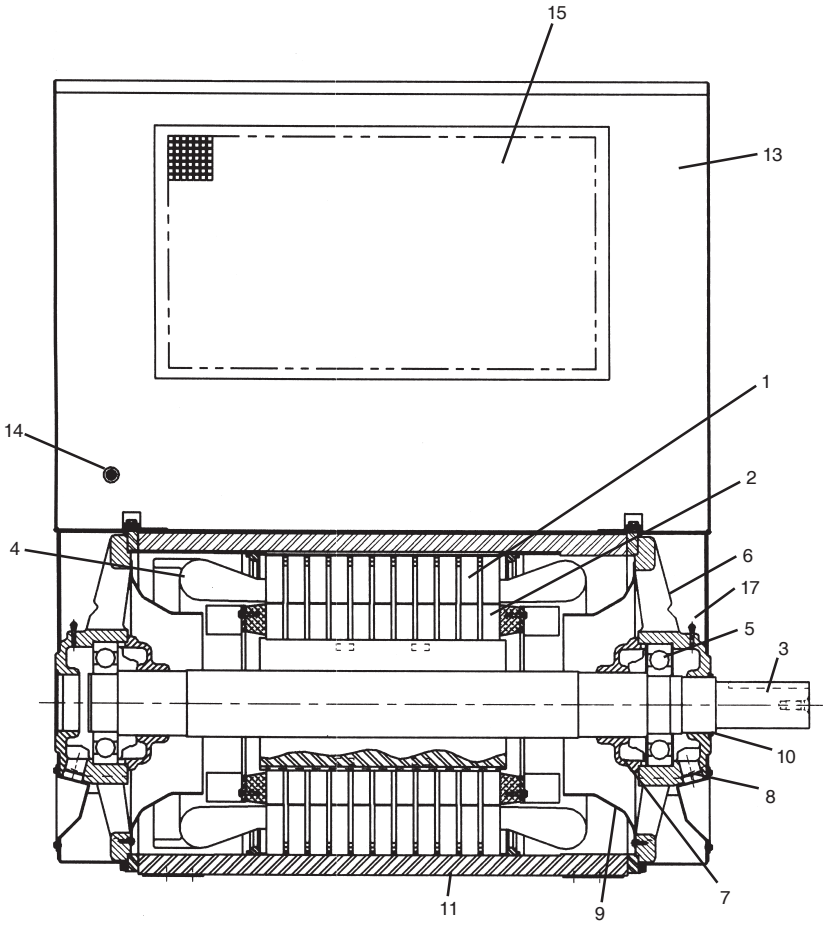


Cutaway Drawings

8000 and 9600 Frame Type R WP-II



1. Stator
2. Rotor
3. Shaft
4. Stator Coils
5. Bearing
6. Bearing Bracket
7. Bearing Cap
8. Grease Drain Plug
9. Air Deflector
10. Shaft Seal Slinger
11. Stator Housing (Frame)
12. Terminal Box
13. Tophat
14. Air Pressure Differential Port
15. Air Intake Screen
16. Air Exhaust Screen
17. Grease Fill
18. Bearing Temp Detector Housing



XIV. TROUBLESHOOTING

TROUBLE	POSSIBLE CAUSE	CORRECTION
Motor will not start	Does not rotate. Usually line trouble single phasing at starter.	Check source of power supply. See Safety instructions! Check overloads, controls and fuses. Check voltage, compare with nameplate voltage.
	Rotates but does not come up to speed. Load too heavy.	Disconnect motor from load to verify if motor starts without load. Reduce load-or replace motor with motor of greater load capacity.
Excessive motor humming	High voltage	Check input voltage and proper motor lead connection.
Noise	Unbalanced rotor	Balance rotor assembly.
Clicking	Contaminants in air gap	Remove rotor assembly and clean motor.
Rapid knocking	Bad bearing; contaminated grease	Replace bearing and regrease per lubrication section.
Vibration	Misalignment in coupling or feet	Realign motor per initial installation section.
	Vibration in driven equipment	Disconnect motor from driven equipment. See section on safety. Run motor unconnected and check vibration. If vibration drops dramatically, then the driven equipment or alignment may be the cause of vibration.
	Ambient Vibration	Check base vibration level with motor stopped.
	System natural frequency (resonance)	Revise rigidity of motor base structure.
Vibration *"following motor repair"*	Rotor out of balance; balance weights or fans shifted on rotor.	Balance rotor assembly.
Fine dust under coupling with rubber buffers or pins	Misalignment	Realign couplings, inspect couplings. See initial installation section.
Bearing overheating	Misalignment	Realign unit. See initial installation section.
	Excessive tension in belt drive	Reduce belt tension.
	Excessive end thrust	Reduce thrust from driven machine. Recheck alignment. See initial installation section.
	Too much grease in bearing	Relieve bearing cavity of grease to level specified in lubrication section.

Troubleshooting

TROUBLE	POSSIBLE CAUSE	CORRECTION
Motor overheating (Check with thermocouple or by resistance methods - do not depend on hand)	Overload	Measure load; compare with nameplate rating; check for excessive friction in motor or complete drive. Reduce load or replace motor with greater capacity motor.
	Dirt in motor intake or exhaust openings	Clean motor intake and exhaust areas. Clean filters or screens if motor is so equipped. See safety section.
	Unbalanced voltage	Check voltage, all phases.
	Open stator windings	Disconnect motor from load. Check idle amps for balance in all three phases. Check stator resistance in all three phases for balance. See safety section.
	Over / under voltage	Check voltage and compare to nameplate voltage.
	Ground	Locate with test lamp or insulation tester and repair.
	Improper connections	Recheck connections.

U.S. ELECTRICAL MOTORS INSTALLATION AND MAINTENANCE

Installation Record

XV. INSTALLATION RECORD

NAMEPLATE ID # _____ CUSTOMER ID # _____

FRAME _____ TYPE _____ HORSEPOWER _____ RPM _____ VOLTAGE _____

PHASE _____ FREQUENCY _____ AMPS _____ DESIGN _____ CODE _____

DATE OF PURCHASE _____ DATE INSTALLED _____

PURCHASED FROM _____

LOCATION OF MOTOR _____ INSTALLATION # _____

DRIVE END BEARING # _____ OPPOSITE END BEARING # _____

MOTOR RESISTANCE LINE TO LINE AT TIME OF INSTALLATION _____

INSULATION TO GROUND READING AT TIME OF INSTALLATION _____

GRADE & TYPE OF LUBRICANT USED _____

INSPECTION RECORD

DATE CHECKED							
Bearings							
Lubrication							
Excess Heat							
Excess Noise							
Speed							
Voltage							
Amps							
Insulation							
Cleaning							
Alignment							
Vibration							
Temperature							
Insul. Resistance							
Condition							