



Installation, Operation
and Maintenance Manual

Vertical Solid Shaft Normal Thrust and In-Line AC Motors

- Vertical Mount
- Solid Shaft
- Normal/Medium/Extended Thrust
- In-Line Coupled
- API 610 Style (P-Base)
- 180-449 Frames



ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, and/or service this motor. Read and understand this manual in its entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

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Receiving and Handling

Acceptance

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

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

Unpacking

If facilities for the shelter of equipment are not available, do not unpack until ready for use. If this equipment is to be stored for any period of time prior to installation, the area should be dry and protected and not subject to severe humidity changes, extreme oil, dirt and similar adverse conditions.

After unpacking and inspecting, turn the motor shaft by hand to assure that there are no obstructions to free rotation.

Storage

Motors or generators must be stored in a clean, dry area protected from extremes of temperature, moisture, shock and vibration. Storage temperatures of 10 to 49 degrees C (50 to 120 degrees F) with a maximum relative humidity of 60% must be observed. In addition, motors subjected to extended storage must be handled and treated per the requirements specified in publication “**Motors-5.0.**” This publication is available from your Allen-Bradley Sales Office or online at: <http://www.ab.com/drives/motors>.

- Bearings – Ball & Roller (anti-friction). The bearings are to be fully greased at the time of going into extended storage. Motor shafts are to be rotated manually every 6 months and additional grease added purging some of that in cavity. Grease in the bearings is to be purged at the time of removal from storage, making sure that an ample supply of fresh grease is in each grease cavity.
- All condensate drains to be fully operable while in storage, and/or the drain plugs removed. The motors must be stored so that the drain is at the lowest point. All breathers and automatic “T,” drains must be operable to allow breathing at points other than through the bearing fits.
- All units equipped with heaters are to have the heaters connected if storage conditions in any way simulate or approach atmospheric conditions experienced in operation.
- Windings to be megged at the time equipment is put in storage. At the time of removal from storage, the resistance reading must not have dropped more than 50% from the initial reading. Any drop below this point necessitates electrical or mechanical drying. Where a large quantity of motors are stored, an inspection or sampling should be made by removing the end brackets. Visually inspect for the presence of water in the grease or rust on the bearing. If present, replace the bearings and relubricate.
- All external parts and motors subjected to corrosion should be protected by corrosion resistant coating proven adequate for prevailing conditions.

- Where motors are not stored in the original containers, but are removed and mounted on other pieces of machinery, the mounting must be such that the drains and breathers are fully operable. In this respect, the drains must be kept at the lowest point in the motor and/or the drain plugs removed so that all condensation can automatically drain out.
- All other storage conditions apply, including rotation of motor shafts. Where such conditions cannot be met, the equipment must be treated the same as if it were mounted in its normal position, and all protective devices such as heaters, breathers, and drains must be fully operable.

Installation

Inspection

After the motor is unpacked, examine the nameplate data to see that it agrees with the power circuit to which it will be connected. The motor is guaranteed to operate successfully with frequency not more than 5% and voltage not more than 10% above or below the nameplate data, or combined variation of voltage and frequency of not more than 10% above or below nameplate data. Efficiency, power factor and current may vary from nameplate data.

If the motor is totally-enclosed, fan-cooled and equipped with condensate drain plugs. The plugs must be removed to permit escape of moisture. The drain plug is located on the flange bracket. Certain motors are furnished with hex-head "T-Drains," which should be left in place. Some explosion-proof motors are equipped with explosion-proof drains which must remain in place.

As shipped, the motor is ready for immediate service. If the motor has been in storage for an extended period or has been subjected to adverse moisture conditions, it is best to check the insulation resistance of the stator winding with a megger or an insulation resistance meter before initial starting.

If the insulation resistance is lower than that calculated from the formula in the Maintenance section (see page 8), the winding should be dried out in one of two ways:

1. Bake in an oven at a temperature not exceeding 90 degrees C (200 degrees F) until insulation resistance becomes constant. If this is done, motor should be relubricated before reinstallation.
2. With rotor locked, apply low voltage and gradually increase current through windings until temperature (measured with a thermometer) reaches 90 degrees C (200 degrees F). Do not exceed this temperature.

Table A
General Effect of Voltage & Frequency Variation on Induction-motor Characteristics

Variation	Starting & Maximum Running Torque	Sync Speed	Slip %	Full Load Speed	Efficiency			Power Factor/COS			Full Load Current	Starting Current	Temperature Rise (full load)	Maximum Overload Capacity	Magnetic Noise (no-load in particular)
					Full-Load	3/4 Load	1/2 Load	Full Load	3/4 Load	1/2 Load					
Voltage Variation:															
120% voltage	Increase 44%	No change	Decrease 30%	Increase 1.5%	6-0% Decrease (1-75 HP) 0-3% Increase (100-200 HP)	Decrease 1/2-2 points	Decrease 7-20 points	Decrease 5-15 points	Decrease 10-30 points	Decrease 15-40 points	Increase 12%	Increase 20%	Increase 5-6 degrees C.	Increase 44%	Noticeable increase
110% voltage	Increase 21%	No change	Decrease 17%	Increase 1%	Slight decrease	Practically no change	Decrease 1-2 points	Decrease 5-10 points	Decrease 5 points	Decrease 5-6 points	Increase 2-4%	Increase 10-12%	Increase 3-4 degrees C.	Increase 21%	Increase slightly
Functions of Voltage	(voltage) ²	Constant	$\frac{1}{(\text{voltage})^2}$	(sync speed slip)								voltage		(voltage) ²	
90% Voltage	Decrease 19%	No change	Increase 23%	Decrease 1-1/2%	Decrease 2 points	Practically no change	Increase 1-2 points	Increase 5 points	Increase 2-3 points	Increase 4-5 points	Increase 11%	Decrease 10-12%	Increase 6-7 degrees C.	Decrease 19%	Slight decrease
Frequency Variation:															
105% frequency	Decrease 10%	Increase 5%	Practically no change	Increase 5%	Slight increase	Slight increase	Slight increase	Slight increase	Slight increase	Slight increase	Slight decrease	Decrease 5-6%	Slight decrease	Slight decrease	Slight decrease
Function of frequency	$\frac{1}{(\text{frequency})^2}$	Frequency		(sync speed slip)								$\frac{1}{\text{frequency}}$			
95% frequency	Increase 11%	Decrease 5%	Practically no change	Decrease 5%	Slight decrease	Slight decrease	Slight decrease	Slight decrease	Slight decrease	Slight decrease	Slight increase	Increase 5-6%	Increase slightly	Increase slightly	Increase slightly

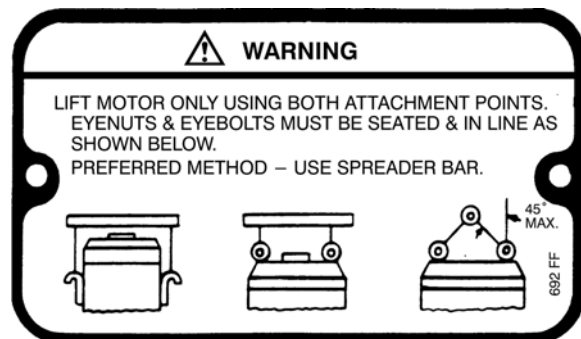
NOTE: This table shows general effects, which will vary somewhat for specific ratings.

Lifting Means



ATTENTION: When lifting means are provided for handling the motor, it should not be used to lift the motor plus additional equipment such as gears, pumps, compressors or other driven equipment. Failure to observe this precaution could result in bodily injury.

Lifting means are provided for handling the motor only and should not be used to lift the motor plus the driven equipment without consulting the local Allen-Bradley Sales Office. In all cases, care should be taken to assure lifting in the direction intended in the design of the lifting means. Likewise, precautions should be taken to prevent hazardous overloads due to deceleration, acceleration or shock forces. Refer to Lifting Nameplate to assure correct lifting procedure. (See below).



When mounting the motor it is essential that motor and drive unit be rigidly supported in correct alignment. This also applies when mounting In-line NEMA LP motors.

Allowances should be made for shaft growth (due to thermal expansion) to avoid potential problems with seals and/or bearings. All motors with the thrust bearings located in the top will have some degree of shaft growth. The following chart lists the expected amount of growth for Allen-Bradley LP motors.

Shaft Growth

Frame Size	Growth mm (inches)	Frame Size	Growth mm (inches)
180	0.05 (0.002)	360	0.43 (0.017)
210	0.13 (0.005)	400	0.46 (0.018)
250	0.25 (0.010)	444/445	0.51 (0.020)
280	0.30 (0.012)	447/449	0.56 (0.022)
320	0.38 (0.015)		

National Electrical Code



ATTENTION: The user is responsible for conforming with the National Electrical Code and all other applicable local codes. Wiring practices, grounding, disconnects and overcurrent protection are of particular importance. Failure to observe these precautions could result in severe bodily injury or loss of life

All motors & generators covered by this document should be installed and protected in accordance with the National Electrical Code.

The user must select a motor starter and overcurrent protection suitable for this motor and its application. Consult motor starter application data as well as the National Electric Code and/or other applicable local codes.

Important: When motors are provided with thermal protection (typically thermostats), it is important to properly connect and apply the devices. This will ensure that the motor is properly protected from being operated if thermal limits are reached and/or exceeded. The control system must be configured to reduce the motor load and/or shut down the motor control system to allow the motor to cool to a level within acceptable operating ranges. If the motor is operated with the thermal protective devices tripped (indicating an over temperature condition), the motor insulation could be damaged and complete failure of the motor insulation is possible. In the event of motor failure due to an over temperature condition, Rockwell Automation requires that motor thermal protective devices (when supplied) be adequately monitored and incorporated into the motor control system to maintain warranty. Failure on the part of the individual installing this equipment to take these steps will result in the factory warranty being voided.

Grounding

Motors should be grounded to limit their potential to ground in the event of accidental connection or contact between live electrical parts and the metal exteriors. See the *National Electrical Code*, Article 430 for information on grounding of motors, Article 445 for grounding of generators, and Article 250 for general information on grounding. In compliance with NEC the terminal housing has grounding provisions which have been approved by the Underwriters Laboratory, UL, and Canadian Standards Association, CSA. In making the ground connection, the installer should make certain there is a solid and permanent metallic connection between the ground point and the motor or generator terminal housing. External grounds should not be used on motors located in hazardous environments.

There are applications where grounding the exterior parts of a motor or generator may result in greater hazard by increasing the possibility of a person in the area simultaneously contacting ground and some other nearby live electrical part or other ungrounded electrical equipment. In portable equipment it is difficult to be sure that a positive ground connection is maintained as the equipment is moved, and providing a grounding conductor may lead to a false sense of security. When careful consideration of the hazards involved in a particular application indicate the machine frames should not be grounded or when unusual operating conditions dictate that a grounded frame cannot be used, the installer should make sure the machine is permanently and effectively insulated from ground. In those installations where the machine frame is insulated from ground, it is recommended that appropriate warning labels or signs be placed on or in the area of the equipment by the installer.

Starting



ATTENTION: Before starting the motor, remove all unused shaft keys and loose rotating parts to prevent them from flying off.

The rotor should rotate freely when the shaft is turned by hand.

The motor should run smoothly with little noise. If the motor should fail to start and produces a decided hum, it may be that the load is too great for the motor or that it has been connected improperly. Shut down immediately and investigate for trouble.

Operate at normal load for an initial period to check for any unusual noise, heating or excessive current.

To reverse the direction of rotation, interchange any two of the power leads.

Maintenance

The fundamental principle of electrical maintenance is to keep the motor clean and dry. This requires periodic inspection of the motor, the frequency (depending upon the type of motor) and the service.

Important: In order to retain UL listing, UL listed motors must be returned to an Allen-Bradley service facility for repairs or maintenance which requires opening the motor enclosure.

The following items should be checked at regular intervals:

- Windings should be dry and free of dust. Windings may be cleaned by suction cleaners or by wiping. Nozzles on suction type cleaners should be non-metallic. Gummy deposits of dirt and grease may be removed by using mineral spirits. Do not use gasoline or other inflammable solvents.
- Terminal connections, assembly screws, bolts and nuts should be tight. They may loosen if motor is not securely mounted and tend to vibrate.
- Long storage or unusual operating conditions may cause motor insulation to absorb moisture. Therefore a megger should be used to check insulation resistance of the motor to ground. Periodic megger readings should be taken at approximately the same temperature and humidity conditions to determine possible deterioration of the insulation. Standards of the IEEE recommend that the insulation of stator windings of clean dry machines at room temperature (approximately 25 degrees C or 77 degrees F) should not be less than:

$$\text{Insulation Resistance (meg-ohms)} = \frac{\text{Motor Rated Voltage} + 1000}{1000}$$

If the resistance is below this value, follow the corrective procedure outlined in the *Installation* section.

- Totally-enclosed, fan-cooled motors require very little attention. Be sure that the external air chamber of this motor does not become clogged with foreign material which will restrict the passage of air.
- Squirrel cage rotors are rugged and in general, give little trouble. The first symptom of a defective rotor is lack of torque. This may cause a slowing down in speed accompanied by a growling noise or perhaps failure to start the load.

This is caused by an open or high resistance joint in the rotor bar circuit. Such a condition can generally be detected by looking for evidence of localized heating.

Repairing end rings should be done only by a competent person. It is recommended that a factory representative be consulted before attempting to do this work.

Disassembly

If it becomes necessary to disassemble this motor, care should be taken not to damage the stator windings as the insulation may be injured by improper or rough handling. Precautions to keep bearings clean should be exercised.

Remove bearing cartridge screws before removing end shield screws. Marking end shields relative to position on frame will make reassembly easier.

Bearings should not be removed unless they are to be replaced. When removal is necessary, it is recommended that an authorized Allen-Bradley Repair Facility be utilized.

The thrust bearing systems used may be one of several types depending on the application requirements. Your authorized repair facility is best equipped to service these bearing systems.

Lubrication

This motor has been properly lubricated at the time of manufacture – it is not necessary to lubricate it at the time of installation. If motor has been in storage for a period of six months or more, lubricate before starting.

Lubrication of anti-friction bearings should be done as a part of a planned maintenance schedule. The recommended lubrication interval should be used as a guide to establish this schedule.

Cleanliness is important in lubrication. Any grease used to lubricate anti-friction bearings should be fresh and free from contamination. Similarly, care should be taken to properly clean the grease inlet area of the motor to prevent grease contamination.

Recommended Lubricant

For motors operating in ambient temperatures shown below, use the following lubricants or their equivalent:

Operating Temperature: -25 to 50 degrees C (-15 to 120 degrees F)	Chevron Oil – SRI No. 2* Shell Oil Co. – Dolium R
Minimum Starting Temperature -75 degrees C (-100 degrees F)	Shell Oil Co. – Aeroshell #7

* Standard lubricant

Special Applications

Silicone grease may be required in special high temperature applications. Consult your local Allen-Bradley Representative.



ATTENTION: Mixing lubricants is not recommended due to possible incompatibility. If changing lubricant without motor disassembly is desired, follow lubrication instructions and repeat lubrication after 100 hours of service. Care must be taken to look for signs of lubricant incompatibility, such as extreme “soupiness” visible from the grease relief area. Failure to observe this precaution could result in damage to or destruction of the equipment.

Lubrication Frequency

Standard Conditions:	Eight hours per day; normal or light loading, clean, 40 degree C (100 degrees F) maximum ambient.
Severe Conditions:	Twenty-four hour per day operation or shock loading, vibration, or in dirt or dust at 40-50 degrees C (100-120 degrees F) ambient.
Extreme Conditions:	Heavy shock or vibration, or dust.

Ball Bearings

Horsepower	Condition		
	Standard	Severe	Extreme
1 through 7-1/2 HP, 1800 RPM & slower	2 Years	6 Months	1 Month
10 through 75 HP, 1800 RPM and slower	1 Year	3 Months	1 Month
100 HP & greater, 1800 RPM and slower	1 Year	3 Months	1 Month
All over 1800 RPM	6 Months	2 Months	1 Month

Roller Bearings

For Roller Bearings – divide the above times by 2.

Recommended Volume

Frame Size	1800 RPM & Slower	3600 RPM
182 through 215	0.5 Cu. In.	0.5 Cu. In.
254 through 286	1.0 Cu. In.	1.0 Cu. In.
324 through 365	1.5 Cu. In.	1.5 Cu. In.
404 through 449	2.5 Cu. In.	1.0 Cu. In.

Lubrication Procedure

Anti-friction bearings may be lubricated with the motor running or stationary. However, stationary with the motor warm is preferred.

1. Locate the grease inlet, clean the area and replace the pipe plug with a grease fitting (if the motor is not equipped with grease fittings).
2. Add the recommended volume of the lubricant using a hand operated grease gun.
3. Run the motor for two hours.
4. Replace the pipe plug in grease inlet.

Total Maintenance Program

Allen-Bradley can provide a wide range of maintenance programs to help you reduce downtime, improve productivity and increase profits. Capabilities include:

- Electrical and Mechanical Start-Up Service
- Electrical Preventive Maintenance
- Mechanical Preventive Maintenance
- Vibration Analysis
- Mobile Van Repair Service
- Balancing and Alignment Service
- Maintenance Service
- 24-Hour Technical Support
- Modernization Service

For more information contact your local Allen-Bradley Sales Office.

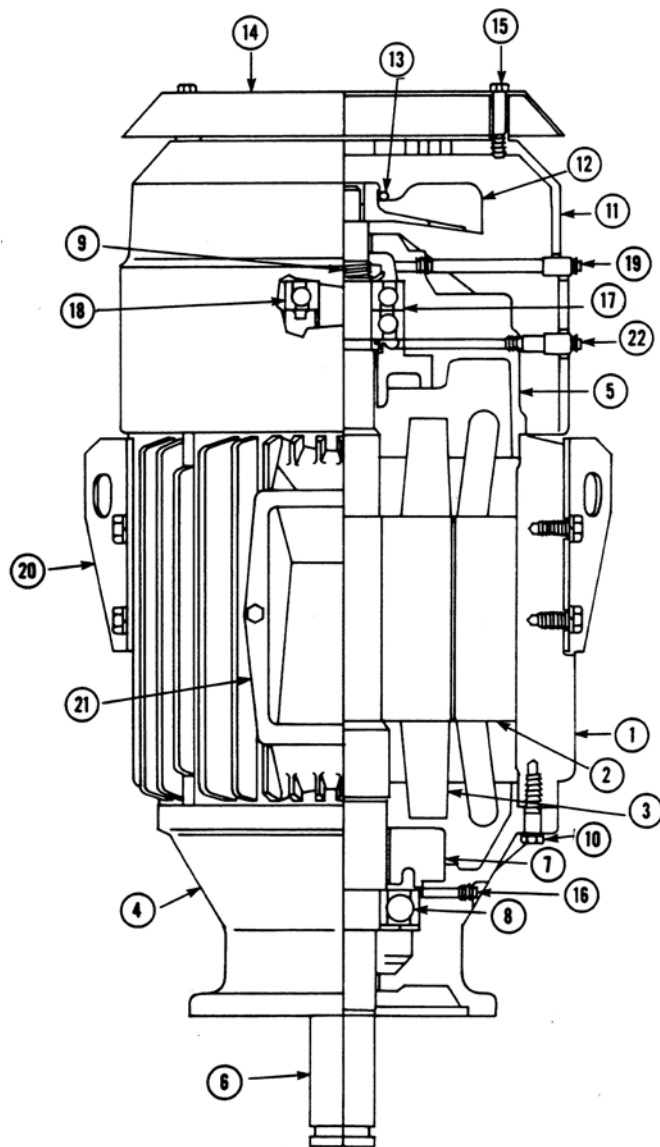
Renewal Parts

Parts can be obtained from your nearest Allen-Bradley parts distributor, or directly from the factory. When ordering parts for which a part number is not available, give complete description of part and purchase order number, serial number, model number, etc., of the equipment on which the part is used.

A detailed parts list, which gives recommendations for spare parts that should be stocked for your equipment, can also be ordered.

Figure 1
General Cross Section & Parts Identification

Find No.	Part Description
1	Frame
2	Stator
3	Rotor
4	Back End Bracket
5	Front End Bracket
6	Shaft
7	Back End Inner Cap
8	Back End Ball Bearing
9	Bearing Locknut & Lockwasher
10	Back End Bracket Bolts
11	Fan Cover
12	Outer Fan
13	Fan Clamp
14	Drip Cover
15	Drip Cover Bolts
16	Grease Entry Back End
17	Thrust Ball Bearing, Medium Thrust
18	Thrust Ball Bearing Normal Thrust
19	Grease Inlet Front End
20	Lifting Plates
21	Conduit Box
22	Grease Drain



Allen-Bradley Parts

Online Documentation

The latest motor information can be obtained from the Allen-Bradley Drives & Motors home page on the World Wide Web at:

<http://www.ab.com/drives/motors>

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

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