Installation, Operation
and Maintenance Manual

Large AC Motors

- Frames E5000 through E5800
- Horizontal Mounting

CONTROLMATCHED
Variable Speed Solutions

Rockwell
Automation

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General Description

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 personal injury or loss of life.

Important: The motor shaft must be blocked to prevent axial movement whenever the motor is moved.

These instructions are not meant to cover all details or variations in equipment, nor to provide every possible contingency or hazard to be met in connection with installation, operation and maintenance. Should further information be desired or particular problems arise which are not covered sufficiently, the matter should be referred to Allen-Bradley.

Allen-Bradley Large AC Motors are designed and built to unique systems standards to provide you with a drive power system composed of matched components. Such a system is capable of delivering the horsepower, torque, speed and power efficiency characteristics that you need for your production machinery.

Allen-Bradley Motors are designed for easy disassembly, reassembly, and inspection and are available with a variety of enclosures such as:

- Drip-proof protected
- NEMA I weather protected
- NEMA II weather protected
- Force ventilated
- Reduced noise levels

In addition, a number of accessories are available (refer to “Optional Accessories” on page 28 for a complete listing).

Receiving and Accepting

ATTENTION: Eyebolt(s) or lifting lug(s) are intended for lifting the motor only with the standard accessories such as tachometer, brakes, etc., mounted by Allen-Bradley. The lifting means on the motor must not be used to lift the unit plus additional equipment. The lifting means on the motor cannot be used to lift assemblies or equipment mounted on a common base. Failure to observe this precaution could result in personal injury.

In all cases, care should be taken to assure lifting in the direction intended in the design of the lifting means. Lift using all lugs provided. In addition, precautions must be taken to prevent hazardous overloads due to deceleration, acceleration or shock forces. Angle of lift with rope or chain should never be less than 45 degrees from the horizontal.

Upon receipt, thoroughly inspect the wrapping and crate for any sign of damage. If any damage is evident, do not accept the motor 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.

Storage

Do not unpack until ready for use. If the motor is to be stored for a period of time prior to installation, it should be placed in an area which is clean, dry and warm. Severe humidity changes, extreme oil and dirt, fumes or other adverse conditions may under certain conditions, damage motor insulation or electrical parts.

Whenever the storage area is cold and damp or severe humidity changes exist, space heaters (when provided) should be energized. Motors not equipped with space heaters may be kept warm by placing several 100 or 150 watt electric lamps within the motor enclosure and connecting them to a power supply.

The motor should be inspected periodically and the insulation resistance checked and recorded monthly. If there is a significant change in insulation resistance, it should be investigated and corrective action taken. Grease lubricated motors are shipped with the proper amount of grease in each bearing.

If the motor is stored for more than one month, the shaft should be rotated (by hand) at least once a month. This distributes the grease, guarding against bearing corrosion due to condensation, or to the presence of contaminating gases near the motor.

If the motor is stored and directly exposed to weather conditions, it is important that the bearing grease be inspected for the presence of water at the grease drain. If the grease is contaminated with water, then the housing must be flushed out and new grease added.

Oil lubricated motors are tested with an oil containing a rust inhibitor. This additive protects the bearings and associated structural parts from rust and corrosion. Prior to shipment the oil is drained.

When received, the bearing oil reservoir should be refilled to the required oil level with the proper oil lubrication. See “Lubrication” on page 9 for Lubrication and type.

If the motor is to be stored for more than one month, the shaft should be rotated by hand every month at least 10 to 15 revolutions to assure that an oil film is on the wearing surfaces.

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**.

Installation

ATTENTION: To guard against personal injury or death caused by contact with moving parts, guards (coupling, belt, chain, etc.) must be installed. Machines accessible to the public should be further guarded by screening, guard rails, etc.

Handling

Carefully uncrate the motor. Lifting provisions are integral lifting devices at the four corners. Place a lifting hook in each of the lifting devices and carefully lift the motor from its packing, using a hoist with adequate capacity.

Important: To protect against damage to the top cover or to special hoods or enclosures, use a spreader bar where necessary.

Inspection

Before installing the motor, perform the following checks:

1. Inspect for any damage resulting from shipment. Refer to "Receiving and Accepting" on page 3.
2. If the motor has been in storage for an extended period or has been subjected to adverse moisture conditions, check the insulation resistance of the stator winding. See "Checking Insulation Resistance" on page 19.
3. Examine the motor nameplate data to make sure it agrees with the power circuit to which it will be connected. The motor is guaranteed to operate successfully at a line frequency not more than 5%, and line voltage not more than 10%, above or below the nameplate ratings, or a combined variation of voltage and frequency of not more than 10% above or below nameplate ratings. Efficiency, power factor and current may vary from nameplate data.
4. Verify that the direction of motor rotation is correct for the intended application.

Location

The motor must be located in an environment that satisfies local and national codes. The following additional considerations should also govern its location.

On open and protected motors, installation and location should be such that the equipment is in a clean area or a room with adequate ventilation for machines which are not equipped with filters. Neighboring equipment should be spaced so that each motor is accessible for inspection, cleaning and repair. It is important for all machines that the external openings for ventilation are not obstructed in any manner that might limit the free passage of air.

Exposure to dirt, dust, stray oil, high ambient temperature/humidity, and atmospheric contamination should be avoided, if possible. Acids, alkalies and gases also have detrimental effects on electrical machinery.

If the room is not large enough to have natural ventilation, some external source of forced and filtered air will be necessary. The room should be such that the heat developed during operation can escape and will not be recirculated through the equipment.

Permanent handling equipment such as chain blocks or other lifting means are desirable to facilitate major service and repair without complete disassembly of the individual units.

Foundation

The dimensions for mounting are shown on the outline drawing supplied with the motor and should be referred to before foundation planning.

Large motors require a concrete foundation. The foundation should consist preferably of solid concrete walls or piers and should be carried down far enough to rest on a solid sub-base. This base should be of sufficient stiffness to prevent vibration and assure long, trouble-free operation. If necessary, a consulting engineer, who is familiar with foundation design, should design and supervise its construction.

If the foundation is to be steel girders, the girders should be well braced and supported by adequate columns to prevent vibration due to resonance. The natural frequencies of the motor and supporting structure must be at least 20% away from the speed of rotation and twice the speed of rotation and multiples of the power line frequency.

The size of the foundation is determined by the weight, size and speed of the equipment and by the type and condition of the underlying soil. The width and length of the foundation are usually made to extend at least 150 mm (6 inches) beyond the equipment on all sides of the base. Increased width and weight are necessary for operation at higher speeds and for foundations that project above the floor level to give stability against rocking and resonant vibration.

Large motors are not rigid or self-supporting and should be uniformly supported. Therefore, when set on the foundation or base, adequate support should be provided by leveling plates and shims between the frame and the foundation at points of loading (i.e. under the frame feet, intersection points of the beams, under long unsupported sections of the base). The number of shims should be kept to a minimum. A few thick ones are preferred over many thin ones.

A 25.4 mm (1 inch) space should be allowed between the base and foundation for grouting. The concrete surface should be roughed to provide a good bonding surface. The lateral clearance for positioning the base can be made by providing a space around the holddown bolts, that are secured headdown to an anchoring washer. A sleeve may be used to form the hole when pouring the foundation around the bolt for the length between the anchoring washer and the top surface of the concrete foundation. The size and depth of the hole will depend upon the size of the motor and accuracy of the hole location. A template can be used to locate the holddown bolts. The bolts can be locked in place later, by filling the clearance hole with grouting.

Pre-installation Checks

Important: Oil sumps must be filled to the proper level in sleeve bearing motors prior to rotating shaft.

Before shipment, every motor is carefully leveled, end play checked on sleeve-bearing units and given a running test to check operation. The test includes balance and bearing temperatures. Although complete factory tests have been made, motors should be checked for any change resulting from improper handling during shipment, by the user or an unsatisfactory foundation. Failure to check or do the necessary work as mentioned above, will cause misalignment resulting in vibration and premature bearing failure.

Before the motor is checked for alignment, all shipping blocks and supports added at the factory to prevent the rotating element from moving during shipping should be removed. The shaft should turn freely. The degree of accuracy required in the alignment depends on the rated speed of the machine. The greater the speed, the greater the care and accuracy necessary in the alignment.

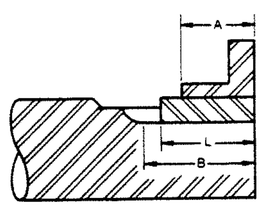
The motor must be level to maintain the proper oil level and free-turning oil rings. Check the driven equipment to make sure that the motor will be coupled to a level shaft. If necessary, level it up before coupling.

Coupling

1. In preparation for making the coupling alignment, wash off the rust-protective slushing compound on the motor shaft and factory installed couplings with solvent.

   On sleeve bearing motors, remove the rust preventative from the shaft to expose the magnetic center and rotor float scribe lines. Fill oil sumps with proper oil to the proper level.

2. The couplings should be heated for proper mounting. Do not press or drive it onto the shaft. The shaft extension key length should be sized per sketch below.



L = Key length = (A + B) / 2
A = Coupling hub length
B = Keyway length

3. Motors supplied with sleeve bearings.

   The drive end shaft extension is scribed with three lines indicating the magnetic center line and rotor end float limits. A single scribe line, magnetic center only is used in cases where the float extreme scribe lines would interfere with a shaft shoulder or extension keyway.

   The magnetic center scribe line is filled with light colored paint and covered with masking tape prior to coating with rust protection. The distance from the magnetic center scribe line to the reference surface is indicated on a nameplate attached to the motor frame. The magnetic center is within +1.5 mm (+0.06 inch) of the rotor float mechanical center.

Rotor end float is 12.7 mm (0.50 inch) minimum. Sleeve bearing motors are not designed to withstand external axial thrust. A limited axial float coupling should be used. Total end float of the coupling should not exceed 4.8 mm, ± 2.4 mm (0.19 inch ±0.09 inch).

The motor axial placement should be established by locating the shaft on its magnetic center and spaced from the driven equipment as recommended by the coupling manufacturer.

4. After the motor is properly positioned for axial end play and with the hold-down bolts snug, but not tightened, prepare for the coupling alignment. Mount the coupling hubs, but do not engage the coupling.

Coupling Alignment

There are a number of different procedures for aligning the motor to the driven equipment. The end result depends upon the accuracy of the parts in roundness, flatness, runout of the reference surfaces, rigidity of the mounting and the skill of the set-up person. The motor base surfaces must be flat and parallel to the shafts. Make allowance for inserting shims under the motor to make the elevation adjustment. The size of the shims should be the full length of the motor foot pad, they should be flat, and free of any burrs. Insert the shims carefully to maintain the foot plane and to avoid bending or twisting the motor frame. For a poor mounting surface, it may be necessary to machine a shim to compensate for the slope or surface irregularity. To minimize soft stacking, use the thickest shim stock combination with the fewest shims.

A preliminary line-up can be made with feeler gauge by measuring at top, bottom and sides between faces of the hubs. Angular alignment is satisfactory when there is not more than 0.05 mm (0.002 inch) difference between all sides of the hubs. Parallel alignment check can be made with a straight edge or dial indicator, to determine if both hubs are parallel within 0.05 mm (0.002 inch). During shimming, use shims that are as thick as possible to avoid a sponginess of an excessive number of layers.

Coupling Alignment Procedure

For more accurate alignment, use two sets of indicators.

1. For angular alignment clamp a dial indicator to the motor coupling hub and secure the probe against the end of the connecting shaft or face of the coupling.

Important: Do not rely on magnetic clamping only. Use additional positive clamping.

Verify that the support arm or probe does not deflect under its own weight when the shaft is rotated. Repeat measurements until consistent readings are obtained. Mark the shaft at the point where the probe touches it and turn both shafts keeping the probe on the reference mark. Shoulder shaft to end of bearing float to maintain axial position.

2. Note the dial indicator reading at 0 degrees (starting point), 90, 180 and 270 degrees. The total angular misalignment should not exceed 1/2 mil (0.0005 inch) per inch (0.0005 mm per millimeter) of coupling hub radius. For checking the coupling face or shaft runout, hold the one shaft stationary and rotate the other shaft if possible.

Maximum Permissible = [Coupling Hub Radius in inches (mm)]
Angular Misalignment x [0.0005 inches (mm)]

3. Check for excessive shaft parallel runout by using the accurately ground or machined diameter provided on most coupling hubs. Set up a dial indicator with the probe mounted securely on the machined diameter. Mark the shaft at the point where the probe touches it and turn both shafts keeping the probe on the reference mark. To check the shaft or coupling diameter runout, hold one shaft stationary and rotate the other shaft if possible.
4. Note the dial indicator reading at 0 degrees (starting point), 90, 180 and 270 degrees.

   Important: The maximum permissible runout between the two coupling hubs is 0.05 mm (0.002 inch).
5. Tighten the motor and driven equipment hold-down bolts and recheck alignment. The feet must be tightened down uniformly. Check to make certain that feet are on the same plane by measuring the feet springback when a bolt is loosened. It should not exceed 0.1 mm (0.004 inch) at any foot as the others remain tight. Repeat with two adjacent bolts loose. The shaft springback should not exceed 0.025 mm (0.001 inch).
6. In some cases it may be necessary to make a hot alignment check to compensate for thermal expansion. A compensating offset alignment should be made cold. The unit may run rough until the equipment temperatures stabilize.

   Important: Do not use the coupling to compensate for poor alignment. This can result in vibration noise, coupling wear, overloaded bearings and early failure.

   If for any reason the alignment of the set does not fall into line, contact Allen-Bradley.

Lubrication

Important: The lubrication system should be checked in preparation for rotating the shaft during the alignment operation

Anti-friction Bearings (Grease Lubricated)

Bearing chambers are packed with grease during assembly, and do not normally need additional grease at time of installation unless the unit has been in prolonged storage. See “Bearing Lubrication” on page 15.

Sleeve Bearing (Oil Lubricated)

Important: Sleeve bearing motors are shipped from factory without oil. Fill oil sumps to proper level before rotating the shaft. Failure to observe this precaution could result in damage to or destruction of the equipment.

Lubrication for sleeve bearing motors should be selected as follows:

Ambient Temperature	**Viscosity** *at 37.8 degrees C (100 degrees F)* 600 RPM or Less	Over 600 RPM
–18 to 50 degrees C (0 to 120 degrees F)[1]	300 SUS (68 cST)	150 SUS (32 cST)
–20 to 50 degrees F (–30 to 10 degrees C)[2]	150 SUS (32 cST)	90 SUS (18 cST)

1 For higher temperatures, oil coolers should be used.
2 For lower temperatures, heaters should be used to assure adequate oil starting temperatures.

- Viscosity in SUS (centistokes) at 37.8 degrees C (100 degrees F)

- Pour point: Below minimum starting temperature.
- Quality: Use a good grade of turbine type oil, with rust, foam, and oxidation inhibitors. Avoid automotive oils or additives other than those specifically recommended by the oil manufacturer.

  To fill sleeve-bearing motor oil reservoirs on motors not equipped with constant level oilers, be sure that drain plugs are in place and secure and fill through filler cap until oil level shows at top line marked on oil gauge. Oil level must never be below bottom line marked on oil gauge. For motors with constant level oilers, refer to the instructions. See “Optional Accessories” on page 28.

  Important: On motors equipped with a circulating oil lube system and adjustable needle valve, valve must be adjusted or flooding of oil sump may occur. Disconnect valve and adjust to flow rate defined on dimension sheet. If dimension sheet is not available, set value for 0.10 GPM flow

Electrical Connection

Important: Motor and control wiring overload protection and grounding should be in accordance with the National Electrical Code and any local code requirements.

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.

A conduit box may be provided for the power lines to the stator and other conduit boxes for all other electrical connections.

Provisions for grounding the frame are provided in the form of tapped holes.

Grounding

Important: Failure to properly ground the motor may cause serious injury to personnel.

All motors must be grounded with the grounding conductor equipped with a brazed copper terminal or with a suitable solderless terminal fastened to the motor. Solder terminals must not be used. A washer should be used between bolt head and terminal lug. The other end should be fastened with suitable clamps or terminals to rigid metallic conduit or to the nearest available ground. Grounding conductor size should be in accordance with the National Electrical Code. Attachment to the motor should not be made under a foot bolt head.

Grouting

Grout should be used, but not applied until all alignment and leveling has been completed. In addition, the set must be running satisfactorily after the 4-hour run-in test (consider bearing noise, temperature and vibration). A good quality commercial non-shrinking type of grouting compound should be used. A cement/sand ratio of 1:1 is recommended.

Grout should be used with a minimum quantity of water to give a stiff mix. The roughened concrete surface should be washed to remove the dust and loose particles. Grouting should be applied to a wet surface but to assure a good bond, there must be no puddles of water or contamination from oil or grease. Prepare only the amount that can be handled within set time and without adding water to the original mix.

The grouting should be done quickly and continuously. Tamp in place and vent the pockets to assure a solid casting. It is suggested that the motor remain idle while the grout is hardening. At least 48 hours curing timed is desirable for that grout to develop adequate strength before operating this set, or any nearby large equipment which could create a vibration.

Operation

Pre-operation Check

⚠ **ATTENTION:** To guard against personal injury or death caused by electric shock, disconnect and lockout all ungrounded conductors of the power line before proceeding

Before starting the motor for the first time, the following checks must be made:

1. Hold-down and bearing bracket bolts must be tight.
2. If the motor has been idle for a long period of time after installation, check insulation resistance (see page 19). Check sleeve bearings for shaft corrosion.
3. Check the incoming power to be sure that line voltage, frequency and phase are correct for the motor (refer to the motor nameplate).
4. Inspect all electrical connections for correct termination, clearance, mechanical strength, and electrical continuity.
5. Check to be sure that the shipping brace (when provided) has been removed from the motor shaft.
6. For machines supplied with oil lubricated bearings, check the lubrication system to assure the oil reservoirs have been filled to the proper oil level with the appropriate oil type. Do not overfill oil reservoirs.
7. If possible, manually turn the shaft to make sure that it rotates freely.

ATTENTION: To guard against machine damage caused by incorrect motor rotation, it is recommended that the motor be uncoupled from its load during the check for rotation and/or during the initial start. Some motors are designed for a single direction of rotation. Running those units in the wrong direction will reduce air flow and cause overheating. Verify that both the motor and driven equipment are operating in the correct direction of rotation. If it is necessary to change rotation, disconnect and lockout all input power and interchange any two input power phases.

8. Check direction of rotation by momentarily applying power to the motor.
9. Replace all panels and covers.
10. Verify that coupling guards and other protective enclosures are not blocking the ventilating air over the motor and exhaust openings.

Initial Start

Read and fully understand each of the steps in the following procedure before attempting to start the motor.

1. When alignment is correct and motor is properly lubricated, prepare for a no-load uncoupled run. The coupling should be uncoupled and a safety clamp should be on the sleeve away from the shaft hub.
2. Inspect the motor carefully. Make the initial start by following the regular sequence of starting operations in the control instructions.
3. After starting, verify that the motor is running smoothly. If the motor shows excessive vibration, shut down immediately and investigate. Check for coupling and key unbalance, lack of lubrication, foot planity and structural resonance.
4. Check that the oil rings, when supplied, are operating properly and that oil is being fed to the shaft. Check bearing temperatures frequently. They should not exceed 85 degrees C (185 degrees F). Likewise the rate of temperature rise should not be excessive. At initial start, the bearing temperature rate-of-rise is more indicative of trouble than overall temperature for a minimum of two hours. If at any time the rate of rise curve appears too steep, stop the motor immediately and re-check its alignment.
5. Verify that the protective controls are functioning properly before any prolonged operation.
6. Run the motor for at least two hours.

Coupled Start

After the initial run, assemble the coupling and lubricate with the manufacturer's recommended lubricant. Ensure that the coupling is not binding, the motor shaft is on its magnetic center and coupling axial movement is within the bearing float limit.

Try no load coupled startup, repeating procedures as outlined in the *Initial Start*. Check to see that the driven equipment is not transmitting vibration back to the motor through the coupling or the base.

Vibration Limits

RPM	Max. Amplitude (Peak to Peak) on Bearing Housing
3000-4000 incl.	0.025 mm (0.001 inches)
1500-2999 incl.	0.038 mm (0.0015 inches)
1000-1499 incl.	0.050 mm (0.002 inches)
999 and Below	0.063 mm (0.0025 inches)

Vibration severity and conversion of the above limits to velocity or acceleration can be determined by using the vibration nomograph on page 27.

Starting Duty (Jogging and Repeated Starts)

Important: Repeated starts and/or jogs can greatly reduce the life of an induction motor. If it is necessary to repeatedly start or jog a motor, check the application with your local Allen-Bradley Sales Office.

At ambient temperature, the motor is normally capable of making two starts in succession and coasting to rest between starts.

The motor is also capable of making one start at its rated load operation temperature. For cooling time required before additional starts can be made, consult your local sales office or the motor starting nameplate (if provided).

If more starts than defined above are attempted in shorter period of time, severe damage to the motor electrical windings and rotor may result.

The starting conditions listed above apply only if the inertia of the connected load, the load torque during acceleration, the applied voltage, and the starting method are those for which the motor was designed. For starting situations not covered here, consult your sales office before proceeding. Refer also to the motor nameplate which may list special starting conditions.

Operational Run

Important: Replace covers and protective devices before operating.

Make final check as required. Prepare for grouting the base. Realign if necessary.

Routine Maintenance

Important: Do not use solvents containing tri-chloroethane to clean interior or exterior of motor. Damage may occur to paint and insulation system.

Scheduled Maintenance

There are two inspection periods which are important to the proper operation and maintenance of your motor. These occur every 3 months (or 500 operating hours - whichever comes first) and every six months, respectively. In addition, the following should also be observed:

- Provide adequate ventilation
- Keep inlet and exhaust air openings clean and free of obstructions.
- Avoid sharp blows and excessive axial thrust loads on the output shaft (especially on sleeve bearing motors).
- Maintain proper lubricant level (check weekly on oil-lubricated units).

AC motors when properly applied, require minimal routine maintenance. Since clearances and fits are precisely machined, no periodic mechanical adjustments are required. Like any precision machine, periodic inspection and simple routine maintenance will prolong your motor's life and help identify potentially damaging conditions.

Periodic Inspection

Every 3 months (or 500 operating hours, whichever comes first).

1. Listen for any abnormal noises.
2. Check for excessive vibration.
3. Check all air passages and assure that they are not blocked or clogged.
4. Check to see that all covers are in place and secure.
5. Check for proper lubrication.
6. Check bearing temperature rise.
7. Check voltage and frequency variations. Unbalanced voltage or single-phase operation of polyphase motors will cause excessive heating and ultimately failure. Only a slight unbalance of voltage applied to a polyphase motor will cause large unbalance currents and result in overheating. Periodic checks of phase, voltage, frequency, and power consumption of an operating motor are recommended. These checks can also provide an excellent indication of the load from the driven equipment. Comparisons of this data with previous no-load and full load power demands will give an indication of the performance of the driven machine.
8. Remove all power and verify that all electrical connections are tight.
9. Check for frayed points on interconnecting wiring, especially at points where it contacts the motor frame.

Semi-Annual Maintenance

1. Inspect and clean rotor ends, windings and fan blades.
2. Check electrical connections for tightness and absence of corrosion.

Bearing Lubrication

Depending on the application and rating, the motor is equipped with either anti-friction or sleeve type bearings. When properly cared for (i.e., inspection and lubrication) bearings will provide years of uninterrupted service. Use one of the following lubrication procedures, depending on the type of bearings with which your motor is equipped.

Anti-Friction Bearing (Grease Lubricated)

This motor has been properly lubricated at the time of manufacture and it is not necessary to lubricate at time of installation. When the 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 relubrication periods shown in Table B on page 16 are offered as a guide for varying service conditions, speeds, bearing types and operating hours.

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 areas of the motor to prevent grease contamination.

Important: Mixing lubricants is not recommended due to possible incompatibility. If it is desired to change lubricant without motor disassembly, follow instructions for lubrication and repeat lubrication a second time 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.

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 Exxon – UNIREX 2 Shell Oil Co. – Dolium R Texaco Inc. – Premium RB
Minimum Starting Temperature –75 degrees C (–100 degrees F)	Shell Oil Co. – Aeroshell #7

Grease Lubrication Procedure

ATTENTION: To guard against personal injury or death from rotating parts or electrical shock, relubrication should only be performed while the motor is stationary and disconnected from the power source.

1. Relubrication with the shaft stationary and a warm motor is recommended.
2. Locate the grease inlet, clean the area and replace the pipe plug with a grease fitting (if the motor is not so equipped).

3. Remove relief plug. If grease is caked around the plug, clean with a wooden stick or suitable tool. If severe caking appears at the plug, run the motor until the bearing housing is warm, permitting free flow of grease through the housing.
4. Add the recommended volume of the recommended lubricant using a hand operated grease gun.
5. Start the motor and run with the relief plug open for 30 minutes until all excess grease is removed.
6. Replace plugs and wipe off any excess grease.

Lubrication Instructions

1. Select service conditions from Table A
2. Select lubrication frequency from Table B.
3. Select recommended volume from Table C.
4. Lubricate the motor at the required frequency with the required lubricant volume in accordance with the above procedure.

Table A
Service Conditions

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.

Table B
Lubrication Frequency for Ball and Roller Bearings

	Condition		
Speed	**Standard**	**Severe**	**Extreme**
1800 RPM & slower	6 Months	3 Months	2 Months
3600 RPM	6 Months	3 Months	1 Month

Roller Bearings – Divide the above time period by 2.

Table C
Lubrication Volume

	Volume (Cubic Inches)	
Frame Size	**1800 RPM & Slower**	**3600 RPM**
5000	2.5	1.5
5800	3.0	1.5

Oil Mist Lubrication

Refer to the Oil Mist Instruction Sheet.

Replacement Bearings

Your maintenance program will not be complete without including spare bearings. It must be remembered that the bearing is a wearable component and therefore must eventually be replaced. To assure that you are able to maintain original operation we recommend the purchase of spares directly from Allen-Bradley.

All bearings used are subject to exact specifications. Markings on the bearing do not indicate complete specifications.

Sleeve Bearings (Oil Lubricated)

Oil should be changed periodically (at least every 6 months), or immediately if discolored or contaminated. Follow the schedule on the motor nameplate, or use the following schedule.

Table D
Lubrication Schedule

Speed	Service Conditions *(see below)*	Change Oil
3600 RPM	Standard	Every 6 months
	Severe	2000 hours
1800 RPM & Slower	Standard	Every 6 months
	Severe	2000 hours

Table E
Service Conditions

Condition	Description
Standard Conditions	Normal or light loading, clean –18 to 40 degrees C (0 to 104 degrees F) ambient air.
Severe Conditions	Medium shock, vibration, dirt, dust, –30 to 50 degrees C (–20 to 120 degrees F) ambient air.

Lubrication for sleeve bearing motors should be selected as follows:

- Viscosity in SUS (centistokes) at 37.8 degrees C (100 degrees F)
- Pour point: Below minimum starting temperature.
- Quality: Use a good grade of turbine type oil, with rust, foam, and oxidation inhibitors. Avoid automotive oils or additives other than those specifically recommended by the oil manufacturer.

	Viscosity *(at 37.8 degrees C (100 degrees F)*	
Ambient Temperature	**600 RPM or Less**	**Over 600 RPM**
–18 to 50 degrees C (0 to 120 degrees F)[1]	300 SUS (68 cST)	150 SUS (32 cST)
–20 to 50 degrees F (–30 to 10 degrees C)[2]	150 SUS (32 cST)	90 SUS (18 cST)

1 For higher temperatures, oil coolers should be used.
2 For lower temperatures, heaters should be used to assure adequate oil starting temperatures.

Sleeve Bearing Oil Change Procedure

1. De-energize the motor by opening manual disconnects.
2. Remove the drain plug and drain oil.
3. If the oil appears to be contaminated, the housing should be flushed with fresh oil.
4. Replace plug and fill through filler cap until oil level is at proper level indicated on sight gauge.
5. Tighten fill cap and plugs, fill constant level oiler if provided.
6. Start unit and observe. Verify that there is no oil leakage and level does not drop.

Winding Maintenance

De-energize motor by opening manual disconnect and locking out power. To inspect the ends and outside surface of the windings, remove the endcover from the motor. Inspection of these portions of the windings will provide a good indication of their general condition. To thoroughly inspect and clean the windings it may be necessary to remove the rotor.

There are numerous methods for cleaning windings. The following methods are most commonly used, in order of preference.

Important: Before cleaning the windings, check for loose blocking, evidence of damage to insulation, distortion or movement of coils, etc. If any of these conditions exist, contact Allen-Bradley for recommendations.

Dry Wiping

This method is satisfactory when the surfaces to be cleaned are accessible and when only dry dirt is to be removed. Use a clean dry, lintless cloth (lint will adhere to the insulation and increase dirt collection). Lint is particularly objectionable on high voltage insulation systems as it tends to concentrate corona discharge.

Brushing and Suction Cleaning

Remove the dry dust and dirt by brushing with a bristle brush, followed by a vacuum suction cleaning. Do Not use wire brushes.

Blowing

Dry dirt and dust can be removed from inaccessible crevices by using a jet of low pressure compressed air.

Important: To avoid damage to the windings, do not use air pressures greater than 30 psi (200 kPa). Avoid directing the air in such a way that the dirt will be blown into inner crevices. Also, avoid using flammable solvents, avoid inhaling fumes, protect eyes and skin.

Solvent Cleaning

Important: Do not use solvents to clean windings with Class H (silicone) insulation (see nameplate for type of insulation). Refer to “Cleaning With Water and Detergents” for proper method of cleaning silicone insulation.

Oil, grease, tar and wax can be removed with a cloth moistened with solvent, followed by wiping with a dry cloth. Typical solvents which can be used (or equivalent) are:

- Atlantic Safety Solvent
- Graymills Solvent
- De-Greaseall
- Zep
- Stoddard Solvent

Important: Adhere to the solvent manufacturer's precautions.

Cleaning with Water and Detergent

Windings can be cleaned by hose washing or by pressure spray from a low pressure steam generator or shop steam line.

Important: Jet pressure and temperature should not exceed 30 psi (200 kPa) and 90 degrees C (194 degrees F), respectively. Oil, grease, tar and wax can be removed by adding a non-conductive detergent to the wash water. After washing, it is necessary to dry the windings in an oven (see “*Checking Insulation Resistance*”).

Reconditioning (Re-Varnishing) Windings

If after cleaning with solvent or water and detergent, the insulation shows signs of dryness, it may be necessary to re-varnish the windings. Contact Allen-Bradley for type and proper method of re-varnishing.

Checking Insulation Resistance

If the motor has been in storage for an extensive 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.

Minimum accepted megohm level (RM) of the entire machine winding at 40 degrees C (104 degrees F) is the *insulation kv rating + 1 megohm*. For machines in good condition, insulation and resistance readings of 10 to 100 times (RM) are common. If the insulation resistance is lower than that calculated, the windings should be dried out using 1 of the following methods:

1. Bake in an oven (preferably circulating air oven) at a temperature not exceeding 90 degrees C (200 degrees F) until insulation resistance becomes constant.
2. With the rotor locked, apply low voltage and gradually increase current through winding (do not exceed 50% full load amps) until winding temperature, measured with a thermometer, reaches 90 degrees C (200 degrees F). Do not exceed this temperature.

Troubleshooting

Trouble	Cause	Solution
Motor will not start	Motor improperly connected.	Check motor connection and control connections.
	Incorrect line voltage.	Check nameplate for required voltage. Measure volts at motor.
	Overload relay tripped.	Correct and reset.
	Fuses blown or defective.	Replace fuses.
	Open circuit in stator or rotor.	Check for open circuit.
	Short circuit in stator.	Check for short circuit.
	Grounded winding.	Check for ground.
Motor noise	Winding single-phased.	If winding is single-phased, unit will not start. Stop unit and try to restart.
	Loose mounting.	Check and correct.
	Noisy bearing.	Check and replace.
	Coupling halves loose.	Inspect alignment and tighten.
	Vibration.	Check alignment with driver disconnected. Check feet plane. Correct balance of motor rotor if necessary. Check key unbalance on coupling.
	Loose covers on pipe.	Tighten down.
	Uneven air gap.	Check gap.
Excessive Bearing Temperature (anti-friction bearing)	Excessive lubrication.	Clean out grease reservoir.
	Inadequate lubrication.	Add lubricant per nameplate instructions.
	Bent Shaft.	Replace shaft.
	Coupling misalignment.	Realign unit.
	Inadequate internal clearance.	Incorrect replacement bearing - consult factory.
	Inadequate ventilation.	Clean filters. Check for blocked louvers.
Excessive Bearing Temperature (sleeve bearing)	Inadequate oil supply.	Refer to nameplate requirements and correct. Check for proper fill, oil, oil level, leaks.
	Excessive end thrust.	Check coupling float, shaft level, air baffle balance.
	Contaminated oil.	Drain and refill, change filters (if provided) in flood lube system. Inspect for source of contamination.
	Tight clearance.	Check bearing bore and shaft O.D. for proper clearance.
	Bent Shaft.	Straighten and refinish.
	Oil rings not functioning.	Check for damage/binding (roundness, burrs, shaft level).
	Bearing material torn.	Dress down, scrape and refit.
	Rough shaft or corrosion.	Dress and polish shaft.
	Bearing misalignment.	Realign or reseat bearing. Check feet flatness and reshim.
	Coupling misalignment.	Realign motor.
	Shaft current.	Insulate bearing and isolate shaft from ground.
Excessive Temperature	Overload.	Reduce load to nameplate rating or replace with larger unit.
	Restricted ventilation.	Check openings and duct work for obstructions and correct.
	Electrical.	Check for grounded or shorted coils and unbalanced voltages between phases.
Oil Leak (sleeve bearing units)	Overfilled.	Drain to proper level or adjust oiler elevation.
	Sealing surface of bearing cap not flat.	Stone or file flat, remove burrs.
	Screws loose.	Tighten.
	Pipe fittings loose.	Tighten or replace worn threaded parts.
	Bearing air pressure equalizer vent passage clogged.	Clear out passage.
	Wrong sealing compound used on bearing cap surface.	Use Permatex Aviation type No. 3 or other non-hardening gasket sealer.
Oil Leak (pressure lubrication system)	Too much oil flow in pressure lube system.	Reduce flow (change orfice).
	Drain line too small.	Use larger lines.
	Air pressure unbalanced.	Clean venting pipes.

Trouble	Cause	Solution
Excessive Vibration	Coupling misalignment.	Realign to operating condition.
	Coupling unbalance.	Re-balance.
	Coupling key unbalance.	Re-balance.
	Foundation structure improperly designed.	Correct foundation or mounting base under motor.
	Rotor Unbalance.	Re-balance rotor.
	Worn bearing.	Replace bearing if bore oversized.
	Coupled equipment.	Check uncoupled and if necessary, re-balance equipment.
	Shaft straighteners.	Straighten without residual stress to avoid springback or replace shaft.

Stator Core Removal - E5000, E5800 Frame

The stator core is located by a machined bore in the frame. The air gap is accurately maintained by this bore and the bearing bracket fits machined into the frame ends. The axial location of the stator core is set at the factory to align with the rotor core. The frame and stator core are then drilled and locked in position with set screws.

To remove the stator core, it is necessary to remove the locking pins located on the top center rib and bottom center of the frame.

After the locking pins have been removed, the stator core and frame should be supported in a vertical position, suspended from a crane by the stator core lifting straps. Heat should then be applied to the frame to expand it and allow it to drop away from the stator core.

Heat the frame in an oven to allow sufficient expansion for reassembly at the stator core. Locate the core in the same axial position as originally set at the factory. Support the core until the frame is cooled, drills and tap frame and stator core, install new set screws. Stake set screws in place.

Rotating Assembly Removal

This procedure explains how to remove the rotating assembly.

1. Remove bearing housings. Refer to “Anti-Friction Bearing Replacement” on page 23 or “Sleeve Bearing Replacement” on page 24.
2. Protect shaft journals by wrapping with heavy kraft paper or equivalent.
3. Fit a steel pipe or tube (proper inside diameter, length, and strength) over end of the rotor shaft opposite coupling end of shaft. Do not place pipe over journal, but over portion of shaft adjacent to rotor core.
4. Attach rope slings (fastened to hoisting crane or chain hoist) to steel pipe and portion of shaft adjacent to coupling location.
5. Slowly and carefully move rotor through stator assembly until end of steel pipe extends beyond coupling end of stator assembly. Move hoist horizontally and vertically - in such a way that rotor does not slide against stator winding.
6. Wrap kraft paper around the shaft adjacent to end of steel pipe. Secure a rope sling to this wrapped-portion of shaft, and attach sling to an additional hoist (or to same hoist if a turnbuckle or other means of vertical adjustment can be used with this third rope sling).

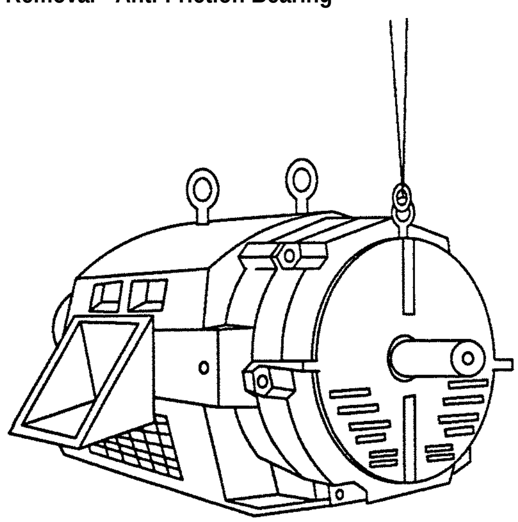
7. Lift third rope sling until it supports weight of rotor end to which pipe is fitted.
8. Remove steel pipe (and its associated sling) from shaft.
9. Carefully lower rotor onto a large sheet of thick cardboard (or other suitable material) placed on floor. Block rotor in place.
10. The rotor and the interior of the stator assembly may be inspected or cleaned as desired.
11. Assemble in reverse order. If stator core was moved, the air gap alignment must be checked and reset if necessary.

Bracket Removal (Anti-friction bearing in bracket)

Refer to Figure 1.

1. Remove covers or accessories that are mounted to the bearing housing.
2. Remove bolts holding bracket to frame and bearing inner cap bolts.
3. Take bracket off by prying between bracket mounting bolt lugs and frame bosses. Pry evenly to avoid cocking bracket on bearing. Do not try to remove bracket when bearing is hot. Bracket will be free of the frame fit when moved 10 mm (0.375 inches). The bracket will be free of the bearing when moved approximately 50 mm (2 inches). When removing the bracket from the unit, use suitable lifting means to support the bracket and to avoid injury.
4. The bearing can now be removed. Refer to "Anti-Friction Bearing Replacement" on page 23 or "Sleeve Bearing Replacement" on page 24.
5. Reassemble parts in reverse order.
6. On totally enclosed fan cooled (TEFC) motors the inboard surface of the bracket and bearing inner cap are covered with a metal thermal barrier. Prior to reassembly of the motor, a check should be made to assure that these thermal barriers are in place, as the motor bearings may overheat without them.

Figure 1
Bracket Removal - Anti-Friction Bearing

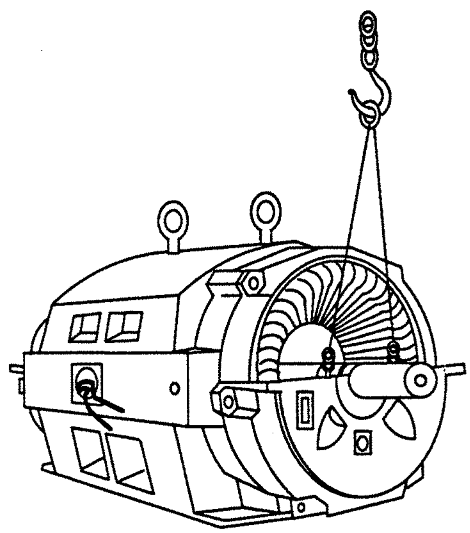


Bracket Removal (Sleeve bearing bracket with rabbet fit)

Refer to Figure 2.

1. Remove covers or accessories that are mounted to the bracket.
2. Remove bearing (refer to "Anti-Friction Bearing Replacement" on page 23 or "Sleeve Bearing Replacement" on page 24).
3. Lift shaft off the bracket seal fits using a rope or non-metallic sling or jack.
4. Remove bolts holding bracket to frame.
5. Take bracket off by prying between bracket mounting bolt lugs and frame bosses. Pry evenly to avoid cocking bracket. Bracket will be free of frame fit when moved 10 mm (0.375 inches). When removing the bracket from the unit, use suitable lifting means to support bracket and to avoid injury
6. Reassemble parts in reverse order.

Figure 2
Bracket Removal - Sleeve Bearing



Anti-Friction Bearing Replacement

1. Remove bracket.
2. The bearing can now be removed by using a conventional bearing puller located behind the bearing race. Protect the shaft center by using a spacer block of brass (or other soft material) between the shaft and bearing puller.
3. Clean and inspect all parts.

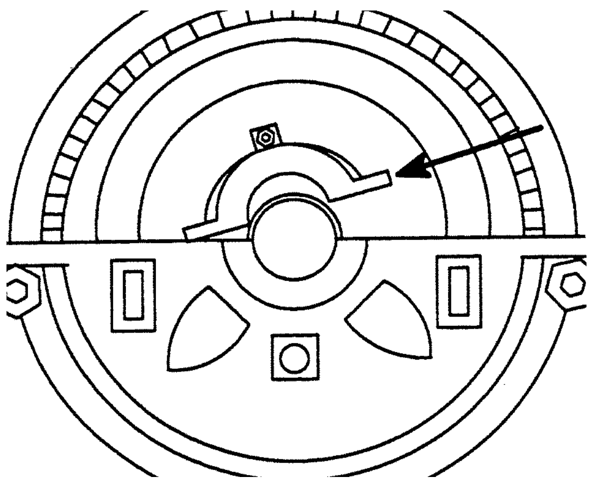
   On totally enclosed fan cooled (TEFC} motors equipped with space heaters, it will be necessary to disconnect the leads from the space heater terminals prior to removing the bearing inner cap.
4. All shaft shoulders should be dressed to assure square shoulders for bearing replacement.

5. Heat bearing in oil to 121-135 degrees C (250-275 degrees F). Hold at this temperature for at least 20 minutes to permit thorough absorption for heat and adequate expansion. The bearing can be assembled without force if properly heated.

   Alternate Method - Heat bearing in electric oven or home type electric roaster. Wrap bearing to keep dirt out. Heat to 121-130 degrees C (250-275 degrees F). Hold at this temperature for at least 30 minutes after oven reaches this temperature to permit thorough absorption of heat and adequate expansion. Check bearing with thermometer if possible to assure temperature.
6. Place bearing on shaft making sure that it is contacting locating shoulder on the shaft. Allow to cool.
7. Reassemble parts in reverse order of removal.
8. Lubricate bearings as indicated under "Lubrication" on page 9.

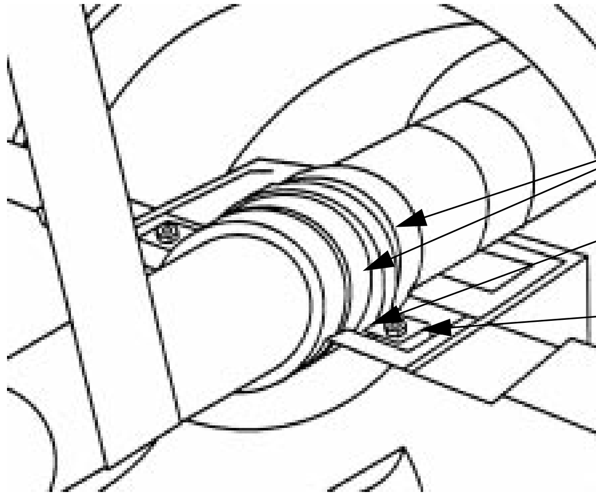
Sleeve Bearing Replacement

1. Remove top cover or grille as required.
2. Remove bearing temperature detectors (if used).
3. Remove screws used to hold top half of bearing housing to bottom half.
4. Back-off top half of housing using jack screws in tapped holes (if equipped). Otherwise use two pry bars in vent holes to lift cap evenly (housing halves are doweled together).



5. Using hand pressure, separate the bearing halves (bearing halves are doweled together).

   Important: Some models are equipped with socket head screws in addition to the dowels. These screws must be removed before attempting to pry bearing top off.
6. Remove top half of bearing and bearing anti-rotation keying devices from bearing housing.



7. Using a rope or sling (non-metal) around the shaft, raise it just high enough to spin-out the bottom half of the bearing.

8. Unseat and spin bearing half, up and out of housing.

Important: Shims used to limit axial float are located on the outboard end of the bearing in the housing. Remove and note the quantity used at each end (see figure above).

9. Remove bottom half of bearing and gently lower shaft.

10. Verify that bearing journal and shoulders are free of nicks and burrs. Dress with rubber stone or replace as necessary.

11. Using a clean lint-free cloth, wipe bearing journal and bearing clean and dry.

12. Shaft and bearing bore must be free of oil.

13. As in step 7, raise the shaft as required to reassemble bearing. Do not allow the shaft to touch the bearing and smear the bluing.

14. Gently lower the shaft until it is in its final position.

15. Assemble top half of bearing.

16. Reassemble parts in reverse order of removal. Make sure dowel pins are engaged in top and bottom halves of housing.

17. By hand (or suitable wrench) slowly rotate the shaft 1/2 turn in one direction to transfer bluing to bearing high spots.

18. Remove screws used to hold top half of bearing housing to bottom half.

19. Back-off top half of housing using jack screws in tapped holes, if so equipped. Otherwise use two pry bars in vent holes to lift cap evenly (housing halves are doweled together).

20. Using a small pry and nominal hand pressure, separate the bearing halves (bearing halves are doweled together).

Important: Some models are equipped with socket head screws in addition to the dowels. These screws must be removed before attempting to pry bearing top off.

21. Raise the shaft as in step 7, free bearing from shaft and remove.

22. Using proper tools, scrape all high spots. Clean bearing and bearing journal.
23. Repeat steps 12 through 22 until inspection shows at least 70% contact on center of bottom half.
24. Wipe bearing and journal, then pour fresh clean oil on bearing journal and over bearing. Be sure to cover both inside and outside diameters. Replace bottom half of bearing. Use caution to prevent damage to bearing and to prevent dirt from contaminating bearing surface.
25. Replace anti-rotation keys. Tabs to prevent axial bearing movement should be installed pointing toward the bearing.
26. Assemble top half of bearing.
27. Reassemble parts in reverse order of removal. Make sure dowel pins are engaged in top and bottom halves of housing. Apply non-hardening aviation type Permatex #3 (or equivalent) to faces of lower bearing housing.
28. When restarting a motor which has had bearings replaced, repeat the "Initial Start" procedure.

Total Service Programs

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

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

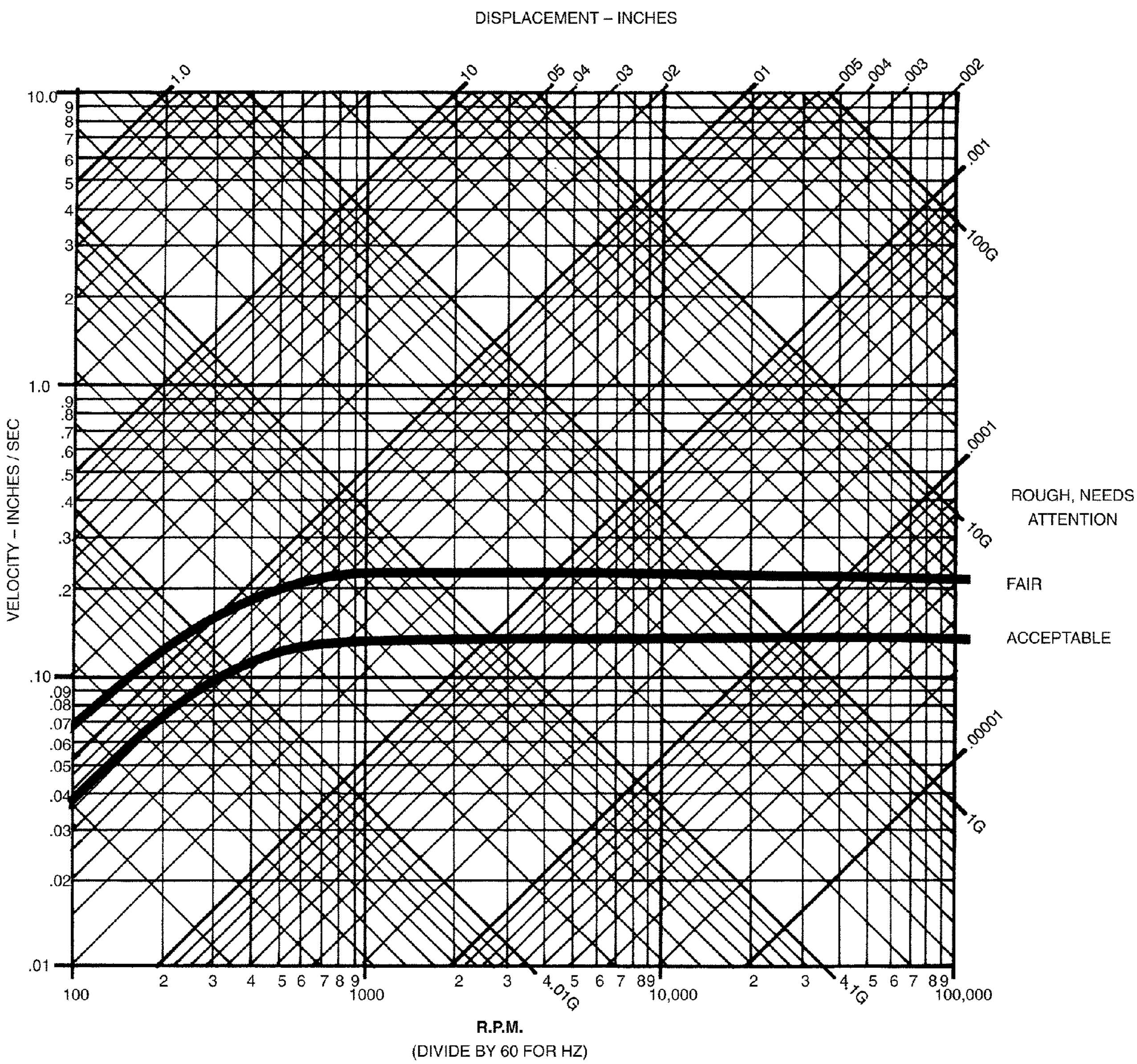
For more information contact your local Allen-Bradley Sales Office.

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.

Vibration Nomographs



Optional Accessories

Option	Purpose	Principle of Operation	Installation/Interconnect	Remarks
Winding Rtd-Resistance Temperature Detector	To measure or monitor winding temperature during operation.	The RTD uses a wire wound in a flat ribbon coil. It is wound so that it is a non-inductive device. Its mode of operation is that of a linear change in resistance with temperature changes.	Two (2) RTD's per phase, six (6) in total are installed. Each RTD is located between the top and bottom coils in the slot. The small gauge RTD leads from the detector are terminated at a terminal strip located inside the motor enclosure. From this terminal strip, large gauge leads are brought out to a separate conduit box. One side of the bridge circuit must be grounded. This can be done either at the motor terminal box or at the instrumentation end of the circuit. Voltages that might appear on the circuit will then be passed to ground.	1. Can provide either continuous temperature measuring or temperature monitoring. 2. Needs a separately mounted control and power source to read temperature or to provide a means for relay operation (for either alarm or motor shutdown features.) 3. Temperature can be monitored using an ohm meter or resistance bridge and converting the resistance to temperature. <u>Types Available</u> Standard - 100 ohms at 0 degrees C. The wire element is platinum. Optional - either 120 ohms Nickel at 0 degrees C or 10 ohms Copper at 25 degrees C. Dual element RTD's are available on special order.
Winding Thermostat	To indicate that the winding temperature has exceeded normal operating temperatures.	The thermostat uses a bi-metal snap action disc to operate a set of contacts. The operating temperature is factory selected and non-adjustable. The contacts can be wired directly to a relay to provide either alarm indication or motor shut down features. Means of temperature measuring or monitoring cannot be provided with this device.	A hermetically sealed switch is attached to a temperature collector strip. The switch has a set of integral contact terminals. Leads are connected and brought out to a separate conduit box. One thermostat is installed in motor coil head. The temperature collector strip is woven in between several coils.	1. Cannot be used to measure or monitor temperatures. 2. Can be directly wired to motor starter hold in coil relay to provide motor shut down due to excessive temperature. 3. Can be wired directly to an alarm circuit without the use of a separate relay. 4. AC or DC operation. 5. Thermostat provides a thermally automatic reset feature. The snap action automatic reset feature can cause difficulty in troubleshooting unless it is connected to a manual reset relay. <u>Types Available</u> Standard - thermostat with one set of N.C. contacts that open on increased temperature. Operating temperature is factory selected and non-adjustable. Set at maximum temperature and limit of insulation system. Special order - More than one switch and different temperature settings.

Option	Purpose	Principle of Operation	Installation/Interconnect	Remarks
Winding Thermocouple	To measure or monitor winding temperature.	The T/C uses a junction of two dis-similar metals to generate a voltage which varies linearly with change in junction temperature. The T/C is located between two layers of flexible glass and resin. The assembly is approximately 1.25 mm (0.05 in.) thick and as wide as the slot.	Two T/C's are installed per phase, six (6) in total. Form wound motors have the bi-metal junction located between the top and bottom coil sides in the slot. The T/C wire is interrupted by a terminal strip located inside the motor enclosure, allowing for replacement of the T/C wire in case of damage. Using the same type of T/C wire, connect to terminal strip posts in separate conduit box. Leads are tagged.	1. Can provide either continuous temperature measuring or monitoring. 2. Can measure temperature by using a potentiometer and converting from voltage to temperature by using conversion tables. 3. Needs separately mounted control and power source to read temperature or to provide a means of relay operation for either alarm or motor shutdown features. Types Available Standard - Iron-Constantan. Special order - 1) Copper - Constantan 2) Chromel-Alumel 3) Chromel-Constantan
Winding Thermistors	To indicate the winding temperature has exceeded normal operating temperatures.	Device is a semiconductor that changes its resistance abruptly at a certain temperature. The change is used to trigger a switching action in an external control which provides an alarm or shutdown signal.	Thermistors are installed in the coil head or slot between top and bottom coil sides. 6 are installed in the slot on form wound stators and 3 in the coil heads on random wound stators. A controller, included in the thermistor package is mounted in an accessory conduit box. Leads are brought to a terminal strip located in the motor enclosure. Separate leads continue to the controller located in the accessory conduit box where connections are made.	Cannot be used to measure or monitor winding temperatures. Types Available Standard - 155 degree C for use in coil heads of random wound stators. Other switching temperatures are available by special order. Types for installation in form wound stator slots between top and bottom coil sides also available on special order.
Bearing Rtd - Resistant Temperature Detector	To measure or monitor bearing temperature during operation.	The RTD uses a wire wound in a coil. It is wound so that it is a non-inductive device. Its mode of operation is that of a linear change in resistance with temperature. The RTD coil is located inside of a 4.76 mm (0.19 inch) diameter stainless steel tube. Standard is a tip-sensitive RTD. A special fitting is used which provides both oil sealing features and a quick disconnect spring loading to assure the RTD is always in contact with the bearing.	One RTD is installed per bearing. The tip of the RTD is in actual contact with the bearing. The small gauge RTD leads are protected with a metal armored sheath and are terminated in a terminal strip inside a separate conduit box. A terminal strip is supplied inside a conduit box. Leads are tagged.	1. Provides either continuous temperature measuring or monitoring. 2. Needs a separately mounted control and power source to read temperatures or to provide a means of relay operation for either alarm or motor shutdown features. 3. Temperature can be monitored using an ohm meter or a resistance bridge and converting the resistance (after subtracting lead resistance) to temperature by using the appropriate conversion tables. Types Available Standard - 100 ohms at 0 degrees C, tip-sensitive. The wire element is platinum. Also available are either 120 ohms at 0 degrees C, 10 ohms at 25 degrees C. Special order - 1) Insulated tip-sensitive. 2) Dual elements with one tube.

Option	Purpose	Principle of Operation	Installation/Interconnect	Remarks
Bearing Thermocouple T/C	To measure or monitor bearing temperature during operation.	The T/C uses a junction of two dis-similar metals to generate a voltage which varies linearly with change in junction temperature. The bi-metal junction is located inside a 4.76 mm (0.19 inch) diameter tube. Standard is a tip-sensitive T/C. A special fitting is used which provides both oil sealing features and a quick disconnect, spring loaded to assure the T/C is always in contact with the bearing.	One T/C is installed per bearing. The tip (bi-metal junction) is in actual contact with the bearing. The small gauge T/C wires are protected with metal armored sheath and are terminated at a terminal strip inside a separate conduit box. Each bearing T/C has its own conduit box. Using the same type of T/C wire, connect to terminal strip posts in separate conduit box. Leads are tagged.	1. Provides continuous temperature measuring or monitoring. 2. Can also measure temperature by using a potentiometer and converting voltage to temperature by use of conversion tables. 3 Needs separately mounted control and power source to read temperature or to provide a means of relay operation for either alarm of motor shutdown features. <u>Types Available</u> Standard is Iron-Constantan. Special order - 1) Copper-Constantan, Chromel-Alumel, Chromel-Constantan. 2) Tip grounded (copper wire) in any type above with uninsulated bearings. 3) Insulated tip-sensitive
Bearing Thermostat *(Also called Bearing Temperature Relay or Gas Bulb Switch)*	To warn of excessive bearing (anti-friction) or oil (sleeve) temperatures.	The device operates due to expansion of gas within a sealed gas bulb element which is placed in contact with the bearing housing (anti-friction) or in the oil contained in the oil sump (sleeve bearing). As the temperature of the bearing or oil increases, the gas in the element expands and deflects a diaphragm in the switch. The movement of the diaphragm activates the switch contacts. The contacts can be wired directly to a relay to provide either alarm indication or motor shutdown.	The contacts can be wired directly to a relay to provide either alarm indication or motor shutdown. The gas bulb must be mounted horizontally or vertically pointing downward. The gas bulb must be in contact with the bearing housing (anti-friction bearing) or submersed in the oil (sleeve bearing) for proper operation.	1. Thermostat cannot be used to provide a read out of the bearing temperature. 2. It is equipped with a manual reset. 3. Contacts are rated for AC and DC. 4. Trip temperature is preset. 5. The thermostat is not an adequate device for continuous monitoring of bearing temperatures and therefore is not recommended as a reliable protective device. <u>Types Available</u> Standard - N.C. contacts. Contacts operate on increasing temperature. Special order - Thermostats with N.O. contacts and various trip temperature settings are available.
Bearing Thermometer	Directly measures oil temperature in the bearing sump (sleeve bearing) or outer race (anti-friction bearing).			A standard thermometer is not stocked by Allen-Bradley and is not recommended as a reliable protective device
Space Heaters	Space heaters are used to prevent condensation of moisture within the motor enclosure during shutdown or storage periods.	Coiled nickel-chrome resistance wire is located with uniform spacing over the width and length then embedded in high-grade refractory material which both insulates the wire and transfers heat rapidly to the sheath. Refractory is then compressed to rock hardness and maximum density under hydraulic pressure. The elements are oven-baked at high temperatures to semi-vitrify and mature the refractory.	Space heaters are normally in the form of a flat or annular strip and are mechanically fastened to the inside surfaces of the frame. Disconnect power to space heaters before performing maintenance work on motor.	Space heaters are selected using the following parameters (unless otherwise specified): 1. Sheath temperature 200 degrees C (392 degrees F) nominal maximum as standard. Lower sheath temperatures are available. 2. Temperature rise inside of motor raised approximately 6 degrees C or 10 degrees F above ambient. 3. Assume ambient maximum of 40 degrees C (104 degrees F). Space heaters are sized mounted and terminated at an accessory conduit box. Leads are tagged.

Option	Purpose	Principle of Operation	Installation/Interconnect	Remarks
Oil Circulation System	To provide a source of cool, clean oil to the bearings.	The oil lubrication system consists of provisions for introducing oil to the bearing and drains permitting removal of excess oil from the sump (without flooding or letting the sump level become too low). It consists of bearing modifications to introduce oil into the journal area. A metering device which controls the amount of oil introduced to the bearing, and a modified sump which will provide adequate drain without total evacuation of the oil in the sump.	If a system is equipped with a variable needle valve to control flow rate, this valve must be adjusted. Disconnect valve and adjust to flow rate shown on dimension sheet. If dimension sheet is not available adjust for 0.10 GPM flow rate.	The need for a lubrication system exists on some ratings due to journal size and speed of the shaft. In those cases the unit would be supplied with inlet and outlet provisions as standard for connection to a customer provided source of oil. Available options 1. Separately mounted pump and sump 2. Motor shaft mounted and driven pump and sump 3. Oil coolers for above sumps 4. Oil heaters & thermostats for sumps 5. Sump thermometers for sumps 6. Oil filters Ratings that require a flood lubrication system are shown on the motor data sheets.
Differential Air Pressure Switch	Indicates dirty or clogged air filters.	The switch is connected through tubing or hoses to static pressure probes located on the wet and exhaust sides of the air filters. As the filters become clogged, the static pressure drop across the filters will increase and the air flow through the motor will be reduced. The probes sense the change in static pressure drop across the filter and as a result of this pressure imbalance, a diaphragm in the switch body is deflected. The switch diaphragm deflection will actuate the switch contacts.	The differential air pressure switch consists of a switch body that encloses a diaphragm and contact switch connected to static pressure probes on either side of the filter through tubing and/or hose.	The device is an indicator of reduced air flow (increased static air pressure drop) through the air filters. It cannot be used to measure actual air flow rates. Its primary function is as a maintenance aid to alert the user of the filter condition. The standard device features an enclosed switch which is mounted on the outside of the motor. The switch contacts are preset to actuate at a static pressure differential of 0.5" W.G. (This value indicates clogged filters). The switch can be utilized to activate an alarm or shut down the motor.
Differential Air Pressure Indicator *(Manometer)*	Used to measure the static air pressure drop across the air filters which is an indication of the degree of blockage of the filter.	This is an inclined-vertical manometer connected to static pressure probes through tubing and/or hose, located on the inlet and exhaust sides of the air filters. As the filters become clogged during operation, the static air pressure drop across the filters will increase and the liquid column level in the manometer tube will change. This change in liquid column level in the manometer is calibrated to indicate the static pressure drop in inches of water.	The differential air pressure indicator or gauge consists of an inclined-vertical manometer with red oil liquid column connected to static pressure probes on either side of the air filter by means of tubing and/or hoses.	The device is a continuous indicator of static air pressure drop across the air filters (i.e. reduced air flow volume). it cannot be used to measure actual air flow rates. its primary function is as a maintenance aid to alert the user of the filter condition. The standard device is molded plastic manometer with an epoxy coated aluminum face plate and brass static pressure probes. The manometer scale is marked at the factory-green pointer at the clean filter pressure differential red pointer at the dirt filter pressure differential level.

Option	Purpose	Principle of Operation	Installation/Interconnect	Remarks
Pressure Switches	To warn of pressure below a set limit. This can be applied to oil pumps/oil systems or water coolers. (heat exchangers)	The device consists of an adjustable sensor and contacts.	The device is connected into the system close to the pressure source using tubing and fittings as required. The conduit box is provided for connections. The device has a set of contacts and must be wired into an appropriate circuit to provide protection.	The device is set at the factory for safe operation. Adjustments can be made in the field to suit special conditions.
Constant Level Oiler	Constant level oilers are used as small supplementary oil sumps which provide an additional source of oil to replenish small amounts of oil lost by long term leakage. They provide this feature without changing the oil level in the sump.	The device is mounted on the side of a unit and is interconnected to the bearing housing. As oil in the bearing sump is lowered, the constant level device adds oil to a pre-determined level. This level is set at the factory and should not require additional adjustments.	If the oiler is to be replaced or its operation checked, the following procedure should be followed: The oiler is to maintain the oil level in the bearing sump oil level gage between the “Max” and “Min” levels. Trico Oiler 1. Adjust the oiler by loosening the 3 set screws on the housing. 2. Raise or lower the oiler bottle to raise or lower the oil level in the bearing sump level gage. 3. When the oil level in the bearing sump level gage is between the “Max” and “Min” levels, tighten the 3 set screws. 4. The oiler must be adjusted with the motor running. Oil-Rite Oiler 1. The oil level groove on the oiler body (below the oilers bottle), must be located at the mid-point between the “Max” and “Min” level on the bearing sump oil level gage. 2. The position of the oiler is adjusted by changing the length of the pipe nipple threaded into the bottom of the oiler body.	Features 1. Auxiliary source of oil for make-up of oil due to leakage. 2. Provides an indication of rate of oil leakage by the change in oil level in the constant level oiler. 3. Gives a “quick look” assurance that oil is in the bearing without the need to get close to the housing or shaft.

Option	Purpose	Principle of Operation	Installation/Interconnect	Remarks
Insulated Bearings	Insulated bearings are used when the design of the motor dictates it or the application warrants the need of an insulated bearing. The purpose of an insulated bearings is to prevent damaging current flow across the oil or grease film which may damage the bearings and/or shaft.	The sources of bearing voltage or currents can be varied. Typical causes could be lack of symmetry in the stator configuration, segmental laminations, unequal windings sections of excessive rotor eccentricity (unequal air gaps). From the field application of the sources could be from the driven equipment, including DC generators, control systems, etc.		Insulated bearings are provided whenever test dictates the need. Sleeve bearing motors are insulated at the bearing. Anti-friction bearing motors are fitted with insulated sleeves in the bearing bracket. A nameplate notifies the user of insulated bearings in the unit. This is to alert the user to ground his driven equipment, if necessary. NOTE: If insulated bearings are required, insulated bearing temperature detectors may also be required.
Current Transformers	Current transformers are a means of measuring or sensing current flow through the input leads of AC motors.	Current transformers consist of a laminated iron core with windings of a predetermined ratio for use with specific metering or relaying devices. Applications involve use of current transformers either for differential protection or metering line phase current.	The current transformers can be supplied and mounted in an oversize main motor conduit box. The transformers will be identified by a ratio on the transformer nameplate and will include screw type terminals on the secondary terminals.	The selection of the current transformers is based upon the ratio that the user requires for matching his meters or related instrumentation.
Lightning Arrestors and Surge Capacitors	Lightning arrestors serve to limit the crest value of incoming voltage curves. Surge capacitors tend to lengthen the rise time of the surge wave front reducing its effects on the stator winding.		Arrestors and/or capacitors can be mounted in an oversize main conduit box. They are connected from line leads to ground, generally as near as possible to the motor.	Standard capacitance value for surge capacitors is 1.0 mfd - 460, 575 volts, 0.50 mfd - 2300-7000 volts. They are suitable for 25, 40, 50, or 60 hz systems. Arrestors are selected according to the maximum RMS line to ground voltage.
Air Filters	Filters wills handle high-velocity air speeds up to 600 FPM (3 ms) net face-velocity. Resistance to air flow of a clean filter should not exceed 37 N/m^2 gauge (0.15" W.G.).			It is recommended that the filters be cleaned or replaced when the static air pressure drop across the filters reaches 123.3 N/m^2 gauge (0.50" W.G.). Permanent, cleanable all metal filters are supplied as standard. Disposable filters can be supplied by special order.

Notes

Notes

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

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