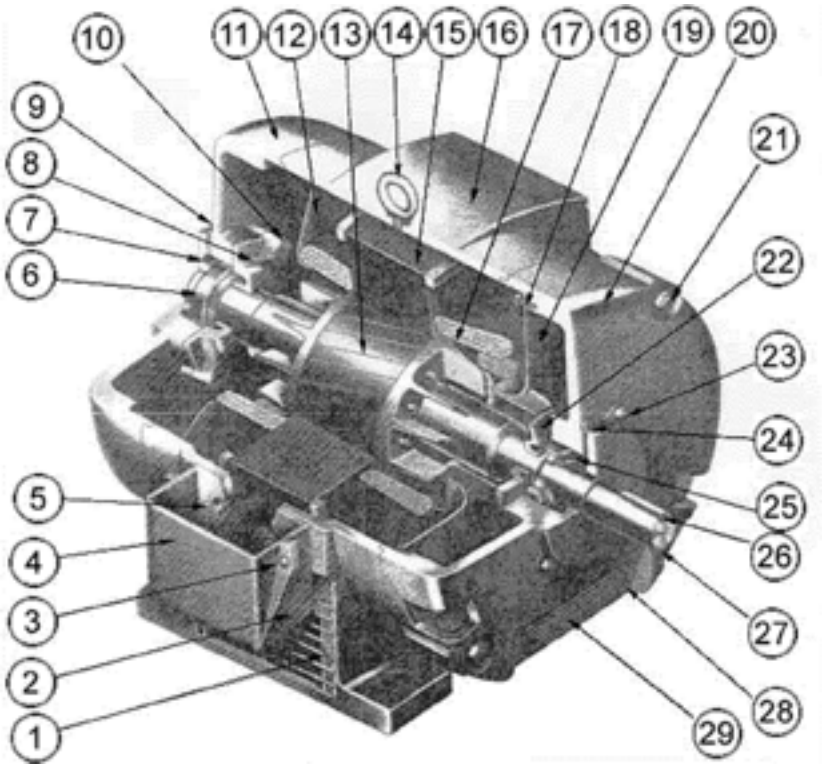
AC Standard Induction Motors
Installation, Operation, and Maintenance

Manufactured for Zenith® Pumps, a Colfax Buisiness Unit

Important

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



Typical Cutaway View of a Drip-proof, Horizontal Integral Horsepower Motor

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

1 Bracket and frame screens are optional.
2 Bearing numbers are shown on motor nameplate. When requesting information or parts always give complete motor description, model, and serial numbers.

General Information

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

Acceptance

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

Storage

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

Installation

Uncrating and Inspection

After uncrating, check for any damage which may have been incurred in handling. The motor shaft should turn freely by hand. Repair or replace any loose or broken parts before attempting to use the motor. Check to be sure that motor has not been exposed to dirt, grit, or excessive moisture in shipment or storage before installation.

Measure insulation resistance (see Operation). Clean and dry the windings as required. Never start a motor which has been wet without having it thoroughly dried.

Safety

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

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

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

Frames and accessories of motors should be grounded in accordance with National Electrical Code (NEC) Article 430. For general information of grounding refer to NEC Article 50.

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

Location

In selecting a location for the motor, consideration should be given to environment and ventilation. A motor with the proper enclosure for the expected operating condition should be selected. The ambient temperature of the air surrounding the motor should not exceed 40°C (104°F) unless the motor has been specially designed for high ambient temperature applications. The free flow of air around the motor should not be obstructed.

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

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

Floor Mounting

Motors should be provided with a firm, rigid foundation, with the plane of four mounting pads flat within 0.25 mm (0.010 in.) for 56 to 210 frame; 0.38 mm (0.015 in.) from 250 through 500 frame. This may be accomplished by shims under the motor feet. For special isolation mounting, contact manufacturer for assistance.

V-Belt Drive

1. Select proper type and number of belts and sheaves. Excessive belt load will damage bearings. Sheaves should be in accordance to NEMA Spec. MG-1 or as approved by the manufacturer for a specific application.

2. Align sheaves carefully to avoid axial thrust on motor bearing. The drive sheave on the motor should be positioned toward the motor so it is as close as possible to the bearing.(104°F) unless the motor.
3. When adjusting belt tension, make sure the motor is secured by all mounting bolts before tightening belts.
4. Adjust belt tension to belt manufacturers recommendations. Excessive tension will decrease bearing life.

Direct Connected Drive

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

MISALIGNMENT and RUN-OUT between direct connected shafts will cause increased bearing loads and vibration even when the connection is made by means of a flexible coupling. Excessive misalignment will decrease bearing life. Proper alignment, per the specifications of the coupling being used, is critical. Some large motors are furnished with roller bearings. Roller bearings should **not** be used for direct drive.

Electrical Connections

Attention

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

Attention

To guard against personal injury and/or machine damage, assure that the following guidelines are followed:

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

1. All wiring, fusing, and grounding must comply with National Electrical Codes and local codes.
2. To determine proper wiring, rotation and voltage connections, refer to the information and diagram on the nameplate, separate connection plate or decal. If the plate or decal has been removed, contact manufacturer for assistance.
3. Use the proper size of line current protection and motor controls as required by the National Electrical Code and local codes. Recommended use is 125% of full load amps as shown on the nameplate for motors with 40°C ambient and a service factor over 1.0. Recommended use is 115% of full load amps as shown on the nameplate for all other motors. Do not use protection with larger capacities than recommended. Three phase motors must have all three phases protected.

Thermal Protector Information

The nameplate will indicate one of the following:

- ☑ Motor is thermally protected,
- ☑ Motor is not thermally protected,
- ☑ Motor is provided with overheat protective device.

For examples, refer to the paragraphs below.

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

Changing Rotation

1. Keep hands and clothing away from rotating parts.
2. Determine proper rotation BEFORE coupling motor to load.
3. Check rotation by jogging or bumping. Apply power to the motor leads for a short period of time, enough to just get motor shaft to rotate a slight amount to observe shaft rotating direction.
4. Three phase - interchange any two (2) of the three (3) line leads. Single phase - reconnect per the connection diagram on the motor. Normally Open (N.O.) motor thermostats may be used in conjunction with controls installed by an OEM.

Reduced Voltage Starting

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

Operation Before Initial Starting

Attention

To guard against personal injury and/or equipment damage, remove all power to the drive and motor before performing installation, troubleshooting or maintenance. Motors with automatic thermal protectors can restart when the protector temperature drops sufficiently. Do not use motors with automatic thermal protectors in applications where automatic restart is undesirable.

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

   $$\text{Minimum Insulation Resistance (in Megohms)} = 1 + \frac{\text{Rated Voltage}}{1000}$$

   Do not attempt to run the motor if the insulation resistance is below this value.
2. If insulation resistance is low, dry out the moisture in one of the following ways:
   a. Bake in oven at temperature not more than 90°C (194°F).
   b. Enclose motor with canvas or similar covering. Leave a hole at the top for moisture to escape, and insert heating units or lamps.
   c. Pass a current at low voltage (rotor locked) through the stator winding. Increase the current gradually until the winding temperature, measured with a thermometer, reaches 90°C (194°F). Do not exceed this temperature.
3. Verify that voltage and frequency stamped on motor and control nameplates correspond with that of the power line.
4. Check all connections to the motor and control with the wiring diagram.
5. Be sure rotor turns freely when disconnected from the load. Any foreign matter in the air gap should be removed.
6. Leave the motor disconnected from the load for the initial start (see following Attention). Check for proper rotation.

Check for correct voltage (within +10% of nameplate value) and that it is balanced within 1% at the motor terminals. After the machine is coupled to the load, check that the nameplate amps are not exceeded. Recheck the voltage level and balance under load per the above guidelines.

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

Attention

To guard against personal injury and/or machine damage, ensure that belts are properly installed, before energizing any motor with a nameplate that reads "Belted Duty Only."

Allowable Voltage and Frequency Range

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

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

Cleanliness

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

Condensation Drain Plugs

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

Service

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

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

Important: If lubrication instructions are shown on the motor nameplate, they will supersede this general instruction. Motors are pre-greased with a polyurea mineral oil NGLI grade 2 type grease unless stated otherwise on the motor nameplate. Some compatible brands of polyurea mineral base type grease are: Chevron SRI #2, Rykon Premium #2, Shell Oil Dolium R or Texaco Polystar RB.

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

Lubrication Procedures

1. Stop motor. Disconnect and lock out of service.
2. Remove contaminants from grease inlet area.
3. Remove filler and drain plugs.

4. Check filler and drain holes for blockage and clean as necessary.
5. Add proper type and amount of grease. See the Re-lubrication Time Intervals table for service schedule and Re-lubrication Amounts table for volume of grease required.
6. Wipe off excess grease and replace filler and drain plugs (see Important statements above).
7. Motor is ready for operation.

Re-lubrication Time Interval & Amounts - Motors with re-greasing provisions

	NEMA Frame Size [1]					
	140-180		210-360		400-510	
Severe Condition	**1800 RPM & Less**	**Over 1800 RPM**	**1800 RPM & Less**	**Over 1800 RPM**	**1800 RPM & Less**	**Over 1800 RPM**
Standard	3 years	6 months	2 years	6 mo.	1 year	3 mo.
Severe	1 year	3 months	1year	3 mo.	6 months	1 mo.
Seasonal	See note [2].					

[1] For motors nameplated as "belted duty only", divide the intervals by 3.

[2] Lubricate at the beginning of the season. Then follow service schedule above.

Seasonal service — The motor remains idle for a period of 6 months or more.

Standard service — Up to 16 hours of operation per day, indoors, 38° C (100° F) maximum ambient.

Severe service — Greater than 16 hours of operation per day. Continuous operation under high ambient temperatures 38°-65° C (100°-150° F) and/or any of the following: dirty, moist locations, high vibration (above NEMA standards), heavy shock loading, or where shaft extension end is hot.

Re-lubrication Amounts - Motors with re-greasing provisions

NEMA Frame Size	Volume cu. In. (fluid oz.)
140	0.25 (0.14)
180	0.50 (0.28)
210	0.75 (0.42)
250	1.00 (0.55)
280	1.25 (0.69)
320	1.50 (0.83)
360	1.75 (0.97)
400	2.25 (1.2)
440	2.75 (1.5)
500	3.00 (1.7)

Troubleshooting Refer to previous “Attention” statements before performing service or troubleshooting.

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

- ☑ The bearings are in good condition and operating properly.
- ☑ There is no mechanical obstruction to prevent rotation in the motor or in the driven load.
- ☑ The air gap is uniform. (Consult manufacturer for specifications).
- ☑ All bolts and nuts are tightened securely.

- ☑ Proper connection to drive machine or load has been made.

In checking for electrical trouble, assure that:

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

Motor Troubleshooting Chart

These instructions do not cover all details or variations in equipment nor provide for every possible condition to be met in connection with installation, operation or maintenance. Should additional information be desired for the purchaser's purposes, the matter should be referred to the manufacturer.

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

Trouble	Cause	What To Do
Motor fails to start	Blown fuses	Replace fuses with proper type and rating
	Overload trips	Check and reset overload in starter.
	Improper power supply	Verify that power supplied agrees with motor nameplate and load factor.
	Improper line connections	Check connections with diagram supplied with motor.
	Open circuit in winding or control switch	Indicated by humming sound when switch is closed. Check for loose wiring connections. Also verify that all control contacts are closing.
	Mechanical failure	Verify that motor turns freely. Check bearings and lubrication.
	Short-circuited stator	Indicated by blown fuses. Motor must be rewound.
	Poor stator coil connection	Remove end bells, locate with test lamp.

Trouble	Cause	What To Do
	Rotor defective	Look for broken bars or end rings.
	Motor may be overloaded	Reduce load.
Motor stalls	One phase may be open	Check lines for open phase.
	Wrong application	Change type or size. Consult manufacturer.
	Overload	Reduce load.
	Low voltage	Verify that nameplate voltage is maintained. Check connection.
	Open circuit	Fuses blown, check overload relay, stator and pushbuttons.
Motor runs and then dies down	Power failure	Check for loose connections to line, to fuses and to control.
Motor does not come up to speed	Not applied properly	Consult supplier for proper type.
	Voltage too low at motor terminals because of line drop	Use higher voltage on transformer terminals or reduce load. Check connections. Check conductors for proper size.
	Starting load too high	Check load motor is supposed to carry at start.
	Broken rotor bars or loose rotor	Look for cracks near the rings. A new rotor may be required as repairs are usually temporary.
	Open primary circuit	Locate fault with testing device and repair.
Motor takes too long to accelerate and/or draws high amp	Excessive load	Reduce load.
	Low voltage during start	Check for high resistance. Adequate wire size.
	Defective squirrel cage rotor	Replace with new rotor.
	Applied voltage too low	Get power company to increase power tap.
Wrong rotation	Wrong sequence of phases	Reverse connections at motor or at switchboard.

Trouble	Cause	What To Do
Motor overheats while running under load	Overload	Reduce load.
	Frame or bracket vents may be clogged with dirt and prevent proper ventilation of motor	Open vent holes and check for a continuous stream of air from the motor.
	Motor may have one phase open	Check to make sure that all leads are well connected.
	Grounded coil	Locate and repair.
	Unbalanced terminal voltage	Check for faulty leads, connections and transformers.
Motor vibrates	Motor misaligned	Realign.
	Weak support	Strengthen base.
	Coupling out of balance	Balance coupling.
	Driven equipment unbalanced	Rebalance driven equipment.
	Defective bearings	Replace bearing.
	Bearings not in line	Line up properly.
	Balancing weights shifted	Rebalance motor.
	Polyphase motor running single phase	Check for open circuit.
	Excessive end play	Adjust bearing or add shim.
Unbalanced line current on polyphase motors during normal operation	Unequal terminal volts	Check leads and connections.
	Single phase operation	Check for open contacts.
	Unbalanced voltage	Correct unbalanced power supply.
Scraping noise	Fan rubbing air shield	Remove interference.
	Fan striking insulation	Clear fan.
	Loose on bed-plate	Tighten holding bolts.
Noisy operation	Air gap not uniform	Check and correct bracket fits or bearing.
	Rotor unbalance	Rebalance.
Hot bearings general	Bent or sprung shaft	Straighten or replace shaft.
	Excessive belt pull	Decrease belt tension.
	Pulleys too far away	Move pulley closer to motor bearing.
	Pulley diameter too small	Use larger pulleys.
	Misalignment	Correct by realignment of drive.

Trouble	Cause	What To Do
Hot bearings ball	Insufficient grease	Maintain proper quantity of grease in bearing.
	Deterioration of grease or lubricant contaminated	Remove old grease, wash bearings thoroughly in kerosene and replace with new grease.
	Excess lubricant	Reduce quantity of grease, bearing should not be more than 1/2 filled.
	Overloaded bearing	Check alignment, side and end thrust.
	Broken ball or rough races	Replace bearing, first clean housing thoroughly.