*Quality People. Building Solutions.*

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**Date:** 3/13/2024
**Return Request:** 3/23/2024
**Project:** Stone Bank HQ - Chenal
**Supplier:** Woodbury Beach
**Manufacturer:** SPX Technology
**Submittal:** Cooling Tower
**Submittal Number:** 23 65 00-01
**Drawing # and Installation:** Mechanical Drawings

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WDD Architects
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N. Little Rock, AR 72118
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Batson Inc.
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Reviewed for Compliance
EAST HARDING CONSTRUCTION
03/18/2024

9924 Landers Rd.
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SPX®
WHERE IDEAS MEET INDUSTRY

USER MANUAL

# Recold

## OPERATION - MAINTENANCE

M06-1339B ISSUED 5/2012

READ AND UNDERSTAND THIS MANUAL PRIOR TO OPERATING OR SERVICING THIS PRODUCT.

Recold®

# general information

**Note**

***Recold Evaporative Cooling products are designed for extended, trouble-free service when properly installed, operated and maintained. This bulletin is published as a guide to maximizing service life and obtaining optimum performance through a program of regular inspection and maintenance.***

## Severe Service

It should be noted that these recommended maintenance procedures should be considered as basic requirements In a normal operating environment, Whenever severe operating conditions prevail the frequency of inspection and service should be increased accordingly. Atmospheric conditions, such as industrial and chemical fumes, salt, dust, or unusual airborne contaminates and particulates will be absorbed by the recirculating water system and may form solutions and deposits harmful to the products.

## Safety

All recirculating water systems can contain chemical additives for water quality control and biological contaminants removed from the air by the washing action of the water,

Personnel exposed to the saturated effluent, drift, or direct contact should use proper precaution. Proper siting requires good judgement to preclude the air discharge recirculating into fresh air intakes or to avoid directing discharge air from the building into the air supply to the cooling product if the building exhaust could contain contaminants.

**⚠ Warning**

***Cooling Tower Cleaning – Any evaporative-type cooling tower must be thoroughly cleaned on a regular basis to minimize the growth of bacteria, including Legionella Pneumophila to avoid the risk of sickness or death. Service personnel must wear proper personal protective equipment. Do NOT attempt any service unless the fan motor is locked out.***

**Safety Precautions** – Before performing any maintenance or inspection all power should be disconnected and locked in the off position. Operation, maintenance and repair should be performed by qualified personnel familiar with the procedures set forth in this manual.

# general information

**Warranties** – Please refer to the limitation of warranties in affect at the time of purchase of this product.

## Vibration

Vibration is present, to some degree, in all mechanical systems. However, refrigerant/process fluid piping requires special attention due to the following factors.

1. *Structural Resonance* – when the natural frequency of the piping coincides with the exciting frequency caused by discharge gas pulsations vibration in the piping is amplified.
2. *Forced Vibration* – caused by movement of the compressor
3. *Acoustical Resonance* – occurs when the piping system geometry amplifies discharge gas pulsations at specific locations.

Vibration historically has been a source of refrigerant line breakage and system leaks so problems of this nature are best avoided during the design phase or, alternately, solved early in the system operation.

## Coil *(if applicable)*

### Condenser Tube – Bundle Inspection

The coil is leak tested at 350 psig before shipment. Recold will not be responsible for loss of refrigerant. It is The responsibility of the installer to verify that the system is sealed before charging with refrigerant.

### Freeze-up Protection for Fluid Coolers

**The simplest and most fool-proof method of protecting the coil from freeze-up is to use a glycol solution inside the coil.** If this is not possible a heat load must be maintained on the coil at all times so that the water temperature does not drop below 50°F. Also, full flow condition should be maintained in the coil.

# general information

In order to keep water temperatures from dropping below 50°F some type of capacity control is normally required during freezing weather. Operating dry with a remote sump is an excellent way to reduce unit capacity at low temperatures (this is covered under recirculating water freeze-up protection). Other methods that can be used are modulating the dampers, fan cycling or two speed motors. These can be used individually or in combination with dry operation.

If an anti-freeze solution is not used the coil must also be drained immediately whenever the pump is shut down or flow stops. This can be accomplished by automatic drain valves and air vents in the piping to and from the cooler.

***Recirculating Water System***

The most fool-proof method of protecting the recirculating water system from freeze-up is thru the use of a remote sump located inside the building below the unit.

The recirculating water pump is mounted at the remote sump and whenever it is shut off, all of the water in the unit drains back to the warm sump inside.

If a remote sump cannot be used, pan heaters are available, either steam, hot water or electric type to keep the pan water from freezing when the unit is shut down. Water lines to and from the unit must also be wrapped with electric heating cable and insulated to protect them from freeze-up. A condenser or cooler cannot be operated dry (fans on, pump off) with this method unless water is completely drained from the pan.

**⚠ Caution**

***The pan heaters are sized to prevent pan water from freezing when the unit is shut down but they are not sufficient to prevent freeze-up when the fans are turned on.***

# pre start-up

## Cleanliness

Dirt and debris may accumulate in the pan section during shipping and storage. This should be flushed out prior to start-up to prevent clogging the water distribution system The inlet screens should be inspected for foreign material at this time.

## Pump Operation

Before initial start of the pump, check as follows:

1. Be sure that pump operates in direction indicated by the arrow on the pump casing (suction cover). Check rotation each time motor leads have been disconnected.
2. Check all connections of motor and starting device with wiring diagram. Check voltage, phase and frequency of line circuit with motor nameplate.
3. Check suction and discharge piping and pressure gauges for proper operation.
4. Turn rotating element by hand to assure that it rotates freely.

**Note**

***Running*** – Periodically inspect pump while running, but especially after first start and following repair

1. Check pump and piping for leaks. Repair immediately.
2. Record pressure gauge readings for future reference.

3 Record voltage, amperage per phase, and kW.

## Fan Motor / Sheave Alignment

RECOLD Evaporative Cooling Equipment is shipped with fan motor(s), sheaves and belts factory adjusted. No adjustments are required at start-up. A straight edge placed across both sheaves should make (4) point contact when properly aligned.

# maintenance recommendations

## Make-up Valve

Adjust the float level upon the initial fill so the valve is completely closed when the water level is ½" below overflow level. Make-up water supply pressure should be maintained between 15 and 45 psig for proper operation of the valve. The valve assembly should be inspected monthly and adjusted as required. Replace the valve seat if leakage occurs when the valve is in the closed position.

## Pump Maintenance

**Cleaning** – Remove oil, dust, water, chemicals from exterior of motor and pump. Keep motor air inlet and outlet open. Blow out interior of open motors with clean compressed air at low pressure. Regularly drain moisture from TEFC motors,

**Labeled Motors** – It is imperative for repair of a motor with Underwriters Laboratories' label that original clearances be held, that all plugs, screws, other hardware be fastened securely, and that part replacements be exact duplicates or approved equals. Violation of any of the above invalidates Underwriters' Label.

## Motor Maintenance *(same as pump maintenance)*

If the fan motor is cycled for capacity control or power savings, the control device should be adjusted for sufficient "deadband" operation to prevent starting the motor more than 5 times per hour. If two-speed motors are used, the motor starter should include a 15 second time delay when switching from high to low speed. Each low speed start and each high speed start count as one start.

## Access Doors

If scale deposits or water is found around the access doors, adjust the two tension tabs inside the door trough. With the fan and pump off and the access door removed, reach inside and bend the tabs away from the trough until they align with the edge of door track. A six inch screw driver or channel lock pliers can be used. Adjust as necessary until leaking stops when door is installed.

# maintenance recommendations

## Bearings - Lubrication

Grease should be fed slowly every 3 months or after a prolonged shut down. Use waterproof synthetic grease. Mobil SHC 460 grease is recommended.

## Belts

Should be inspected for proper tension after the first 18 hours of operation and monthly thereafter. Belts should not “chirp” or squeal” on start-up.

## Recommended Monthly Inspection

1. Clean pan section interior. Dirt and other impurities which have washed into the pan should be hosed from the pan area. Shut off water to float valve and open the drain connection for flushing
2. Clean pan suction strainer, if furnished,
3. Check water operating level. Adjust float arm as required, (Do not bend float arm).
4. Check belt tensioning. Belts should be re-adjusted after 18 hours of initial operation and monthly thereafter.
5. Inspect fan motor(s) and water circulation pump(s) and lubricate per the lubrication nameplate or manufacture’s recommendations.
6. Inspect fan wheels, housing and inlet screens removing any debris which may have accumulated during operation
7. Inspect the water distribution system to insure that nozzles and spray orifices are functioning correctly. The inspection should be made with the circulation pump on and fans off, (See Maintenance Check List Form 1192).

## Recommended Annual Inspection

In addition to the above maintenance activities a general inspection of the unit surface should be completed at least once a year. Surface corrosion in spot areas should be wire brushed and cleaned thoroughly. These locations may then be resurfaced with rust inhibitive paint. Remove spray header caps and flush out.

# water quality

## Recirculating Water Quality Guidelines

| | **G235 Galvanized Steel** | **Stainless Steel** (optional) |
|---|---|---|
| pH | 7.0 to 9.0 | 6.5 to 9.0 |
| Hardness as $CaCO_3$ | 500 ppm max. | 500 ppm max. |
| Alkalinity as $CaCO_3$ | 500 ppm max. | 500 ppm max. |
| Total Dissolved Solids | 1500 ppm max. | 2000 ppm max. |
| Chlorides as NaCl | 750 ppm max. | 1500 ppm max. |
| Sulfates | 500 ppm max. | 750 ppm max. |

**Note**

***Cycles of concentration, i.e., ratio of dissolved solids in recirculated water to dissolved solids in make-up, should be determined and monitored frequently by a competent water treatment expert.***

To limit cycles of concentration so the above guidelines are maintained, it is necessary to “bleed” or “blowdown” a certain portion of the recirculated water. Normally this is achieved automatically with a solenoid valve actuated by a conductivity meter set at the desired “microohms” corresponding to the desired cycles of concentration. It should be noted that these are guidelines and even though these individual values are met, under certain conditions the water quality can be aggressive. For example, water with very alkalinity and levels of chlorides and sulfates approaching maximum recommended levels can be corrosive.

## Bleed

All Recold products are furnished with a bleed system fitting and valve to continuously remove a small portion of the recirculated water to keep the water quality within the above listed parameters. On Evaporative Condensers and Fluid Coolers this device is located on the discharge side of the pump. On Cooling Towers the fitting is located in the water distribution piping. It is important to note that since “bleed” rate is a function of evaporation rate (i.e., amount of heat rejected), if the bleed setting is manual based on design heat load, too much water will be removed when the heat load is less than design.

# water quality

One method of calculating evaporation and bleed is shown below:

Evaporation rate = water flow rate (GPM) x range (°F) x .001 (or for each 10° cooling range, 1% of the water flow will be evaporated).

$$\text{Bleed Rate} = \frac{\text{Evaporation Rate}}{\text{Cycles of Concentration, less 1}}$$

Assume a 100 ton system, 300 GPM cooled from 95° to 85°
Evaporation Rate- 300 x 10 x .001 = 3 GPM

Assume 4 cycles of concentration:

$$\text{Bleed Rate} = \frac{3}{4\text{-}1} = 1 \text{ GPM (at full heat load)}$$

The above water bleed system is a good means of control for many forms of scale build up or corrosion. Some system conditions, however, may be much more severe requiring more extensive forms of water treatment. It is important that operating and maintenance personnel be aware of this problem and know when to recommend water treatment. Following are important signs to look for when inspecting a given unit.

1. Scale formation on the heat exchanger surfaces with resulting decreased operating efficiency of equipment.
2. Accelerated corrosion or rusting of the metal surfaces, resulting in coil or casing failure.
3. Slime and algae formation on the metal surfaces, tending to block circulation piping and the water distribution system.

***Following are guidelines to be used in water treatment:***

1. Any water treatment must be compatible with galvanized steel and copper.
2. The water pH should be maintained between 7.0 and 9.0 at all times, (see water quality guidelines).
3. Batch feed process should never be used.
4. Acid treatment not recommended due to corrosive effect on galvanized steel and other materials.

# parts

Contact your local Recold sales representative for factory authorized parts. Be sure to include the Serial Number from the product nameplate when ordering or requesting quotations.

SPX®
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# Recold user manual

**SPX COOLING TECHNOLOGIES INC.**
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ISSUED 6/2012 M06-1339B

**CoolSpec™ Version 7.3.25**
Product Data: 8/28/2023 (Current)
11/27/2023 3:27:42 PM

## Job Information

Replacement JWH115C Tower
Stone Bank
Little Rock, AR

## Selected by

Woodbury-Beach Company
6329 Crystal Hill Road
North Little Rock, AR 72118 US

Dain Matthey
Tel 501-753-8323
dmatthey@woodburybeach.com

## Fluid Cooler Definition

| | | | |
|---|---|---|---|
| Manufacturer | Recold | Fan Motor Speed | 1800 rpm |
| Product | JW | Required Fan Motor Output per cell * | 40.00 BHp |
| Model | JWH-115C | Required Fan Motor Output total * | 40.00 BHp |
| Cells | 1 | Fan Motor Capacity per cell | 40.00 Hp |
| | | Fan Motor Output per cell | 40.00 BHp |
| Coil Material | Copper | Fan Motor Output total | 40.00 BHp |
| Fan | Centrifugal, Fan Standard | Air Flow per cell | 69000 cfm |
| Fan Speed | 290 rpm | Air Flow total | 69000 cfm |
| Fans per cell | 1 | Pump Motor Output per cell | 5.00 BHp |
| Pumps per cell | 1 | Pump Water Flow per cell | 400.0 gpm |
| Model Group | Standard | | |

* Required Fan Motor Output assumes VFD operation

## Conditions

| | | | |
|---|---|---|---|
| Tower Water Flow | 570.0 gpm | Air Density In | 0.07065 lb/ft³ |
| Hot Water Temperature | 97.00 °F | Air Density Out | 0.07123 lb/ft³ |
| Range | 10.00 °F | Humidity Ratio In | 0.01820 |
| Cold Water Temperature | 87.00 °F | Humidity Ratio Out | 0.02899 |
| Approach | 7.40 °F | Wet-Bulb Temp. Out | 87.79 °F |
| Wet-Bulb Temperature | 79.60 °F | Estimated Evaporation | 6.2 gpm |
| Relative Humidity | 50 % | Coil Pressure Drop | 1.3 psi |
| Additive Content | 0.0 % | Total Heat Rejection | 2839000 Btu/h |
| Capacity | 100.0 % | | |

- This selection satisfies your design conditions.

## Weights & Dimensions

| | Per Cell | Total |
|---|---|---|
| Shipping Weight | 10670 lb | 10670 lb |
| Heaviest Section | 10670 lb | |
| Max Operating Weight | 20170 lb | 20170 lb |
| Width | 20'-9" | 20'-9" |
| Length | 8'-4 ½" | 8'-4 ½" |
| Height | 9'-4" | |

Weights and dimensions do not include options; refer to sales drawings.

# SPX Cooling Technologies
# Certification of Limited Warranty

SPX Cooling Technologies, Inc. ("SPX Cooling") hereby warrants the Recold JC, Recold JT, Recold JW, Recold MC, Recold MT and Recold MW products will be free from all defects in materials and workmanship for a period of eighteen (18) months from the date of shipment by SPX Cooling to the original installation.

The obligation under this warranty is limited to the repair or the replacement of defective materials, at SPX Cooling's option, F.O.B. original shipping point or EXWORKS plant. Warranty on repaired or replaced equipment will be for the time remaining under the terms of the original warranty. This warranty is non transferable.

This warranty does not obligate SPX Cooling to bear the cost of labor, transportation charges, or other costs incurred in connection with the repair or replacement of defective parts; nor does this warranty apply to normal wear and tear nor to damage resulting from operations not conforming with the Recold's operation and maintenance instructions, accident, alteration, misuse or an abnormally corrosive or abrasive use environment.

**SPX Cooling's total liability for damages related to the performance of or failure to perform shall be limited to the amount of the contract price and in no event shall either party hereto be responsible or held liable to the other for any special, punitive, indirect, incidental, or consequential damages.**

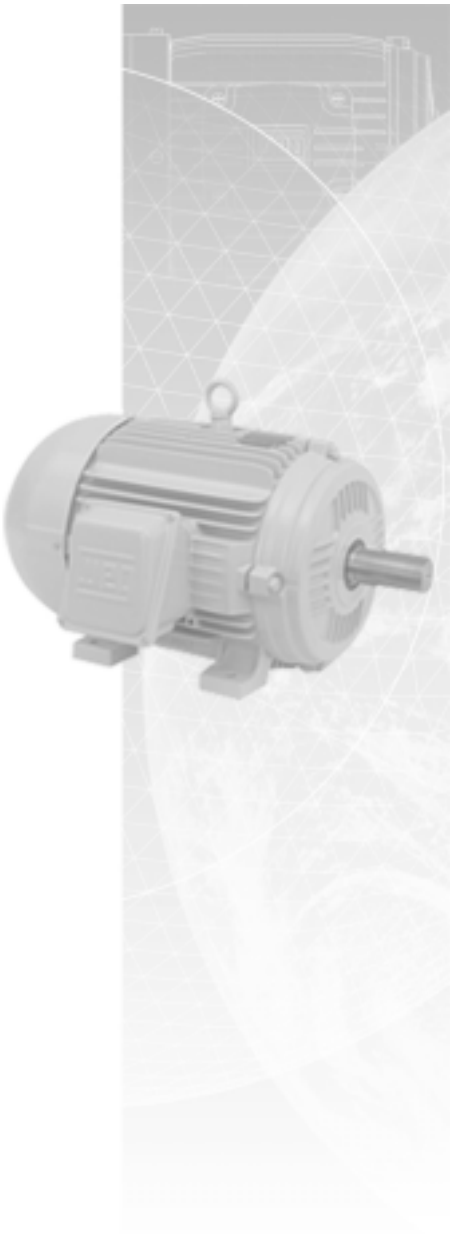
**The above warranties are in lieu of all other warranties expressed or implied, and all implied warranties of merchantability and fitness for a particular purpose are hereby disclaimed and excluded from this agreement.**

SPX®

**SPX Cooling Technologies, Inc.**
7401 W 129 Street | Overland Park, KS 66213
913 664 7400 | spxcooling.com

WARRANTY 2010-1209

# INSTALLATION AND MAINTENANCE MANUAL FOR NEMA LOW VOLTAGE ELECTRIC MOTORS

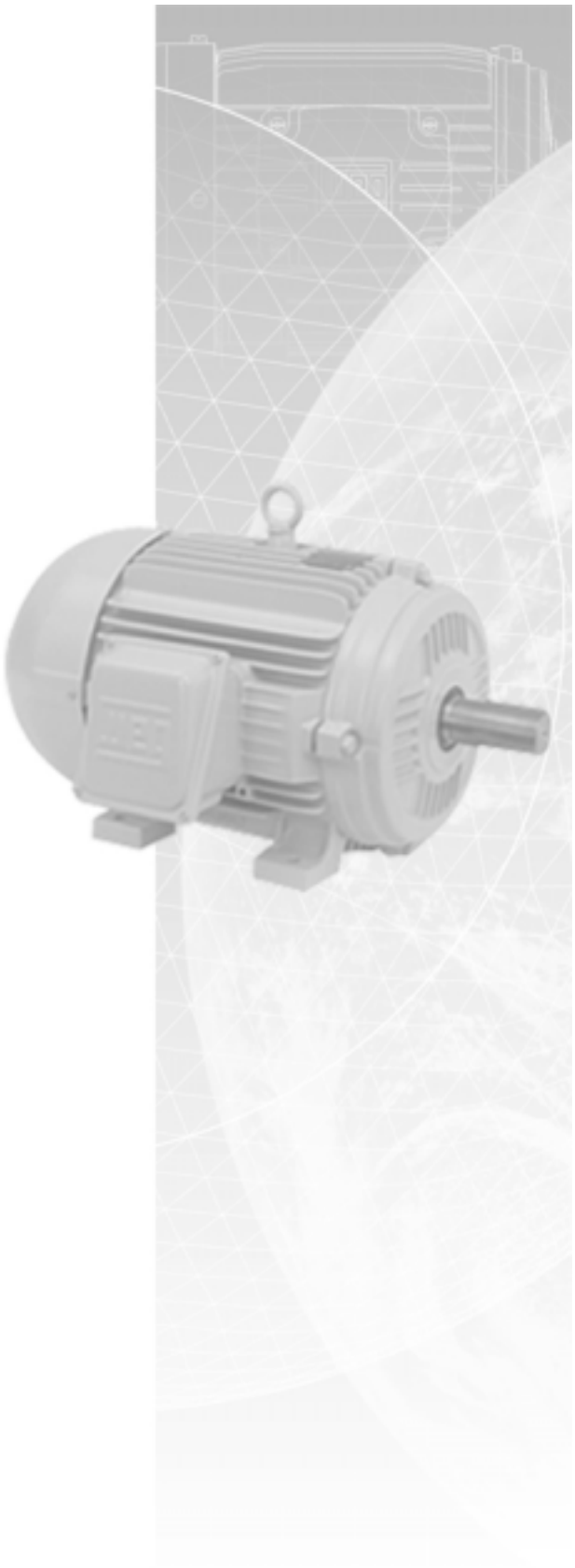


*The electric motor is the item of equipment most widely used by man in his pursuit of progress, as virtually all machines and many renowned inventions depend upon it.*
*By virtue of the prominent role the electric motor plays in the comfort and welfare of mankind, it must be regarded and treated as a prime power unit embodying features that merit special attention, including its installation and maintenance.*
*This means that the electric motor should receive proper attention.*
*Its installation and routine maintenance require specific care to ensure perfect operation and longer life of the unit.*
*THE WEG ELECTRIC MOTOR INSTALLATION AND MAINTENANCE MANUAL provides the necessary information to properly install, maintain and preserve the most important component of all equipment:*

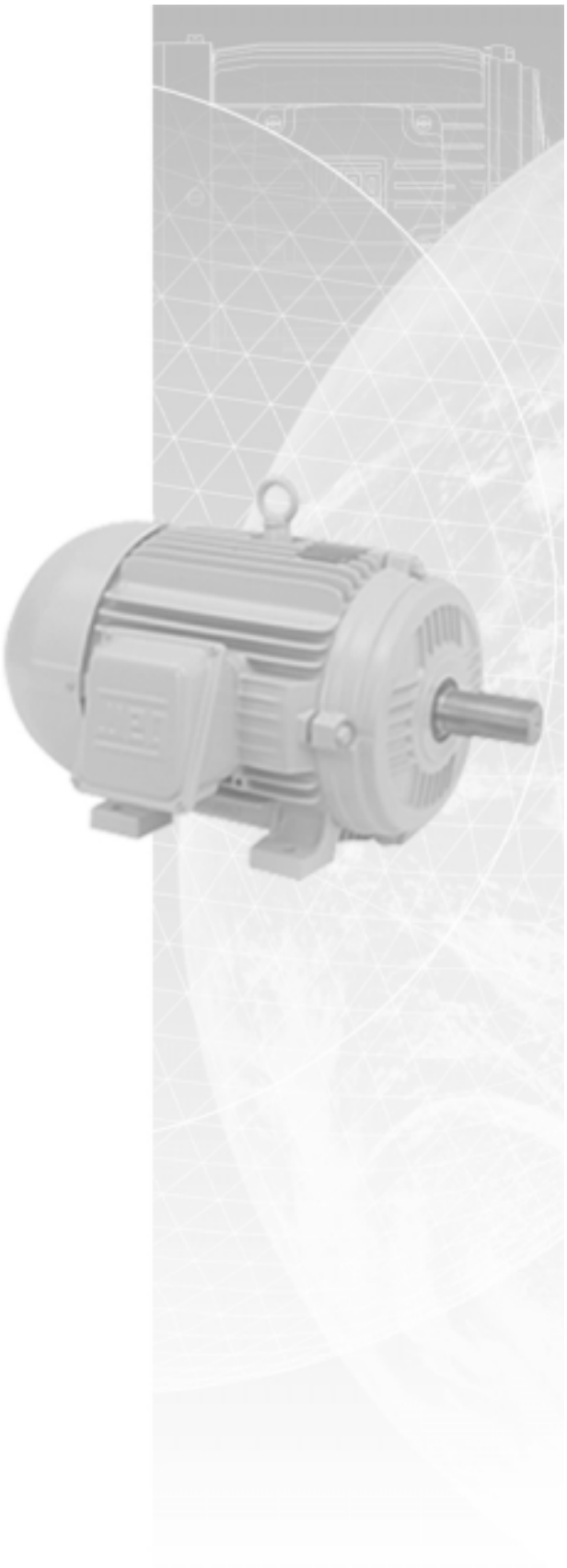
*THE ELECTRIC MOTOR!*

*WEG*

# Contents



# 1. Introduction



This manual covers all the three-phase and single-phase asynchronous squirrel-cage induction motors, from 140T to 580T frame sizes.

The motors described in this manual are subject to continuous improvement and all information is subject to change without notice.
For further details, please consult WEG.

# 2. Basic Instructions

## 2.1 Safety Instructions

All personnel involved with electrical installations, either handling, lifting, operation and maintenance, should be well-informed and up-to-date concerning the safety standards and principles that govern the work and carefully follow them.
Before work commences, it is the responsibility of the person in charge to ascertain that these have been duly complied with and to alert his personnel of the inherent hazards of the job in hand.
It is recommended that these tasks be undertaken only by qualified personnel and they should be instructed to:

- avoid contact with energized circuits or rotating parts,
- avoid by-passing or rendering inoperative any safeguards or protective devices,
- avoid extended exposure in close proximity to machinery with high noise levels,
- use proper care and procedures in handling, lifting, installing, operating and maintaining the equipment, and
- follow consistently any instructions and product documentation supplied when they do such work.

Before initiating maintenance procedures, be sure that all power sources are disconnected from the motor and accessories to avoid electric shock.
Fire fighting equipment and notices concerning first aid should not be lacking at the job site; these should be visible and accessible at all times.

## 2.2 Delivery

Prior to shipment, motors are factory-tested and balanced. They are packed in boxes or bolted to a wooden base.
Upon receipt, we recommend careful handling and a physical examination for damage which may have occurred during transportation.
In the event of damage and in order to guaranty insurance coverage, both the nearest WEG sales office and the carrier should be notified without delay.

## 2.3 Storage

Motors should be raised by their eyebolts and never by their shafts. It is important that high rating three-phase motors be raised by their eyebolts. Raising and lowering must be steady and joltless, otherwise bearings may be harmed.
When motors are not immediately installed, they should be stored in their normal upright position in a dry even temperature place, free of dust, gases and corrosive atmosphere.
Other objects should not be placed on or against them.
Motors stored over long periods are subject to loss of insulation resistance and oxidation of bearings.

**Bearings and lubricant deserve special attention during prolonged periods of storage. Depending on the length and conditions of storage it may be necessary to regrease or change rusted bearings. The weight of the rotor in an inactive motor tends to expel grease from between the bearing surfaces thereby removing the protective film that impedes metal-to-metal contact.**
**As a preventive measure against the formation of corrosion by contact, motors should not be stored near machines which cause vibrations, and every 3 month their shafts should be rotated manually.**

Insulation resistance fluctuates widely with temperature and humidity variations and the cleanliness of components. When a motor is not immediately put into service it should be protected against moist, high temperatures and impurities, thus avoiding damage to insulation resistance.
If the motor has been in storage more than six month or has been subjected to adverse moisture conditions, it is best to check the insulation resistance of the stator winding with a megohmeter.
If the resistance is lower than ten megohms the windings should be dried in one of the two following ways:

1) Bake in oven at temperatures not exceeding 194 degrees F until insulation resistance becomes constant.
2) With rotor locked, apply low voltage and gradually increase current through windings until temperature measured with thermometer reaches 194 degrees F. Do not exceed this temperature.

If the motor is stored for an extensive period, the rotor must be periodically rotated.
Should the ambient conditions be very humid, a periodical inspection is recommended during storage. It is difficult to prescribe rules for the true insulation resistance value of a machine as resistance varies according to the type, size and rated voltage and the state of the insulation material used, method of construction and the machine's insulation antecedents. A lot of experience is necessary in order to decide when a machine is ready or not to be put into service. Periodical records are useful in making this decision.

The following guidelines show the approximate values that can be expected of a clean and dry motor, at 40°C test voltage in applied during one minute.

Insulation resistance Rm is obtained by the formula:

$$Rm = Vn + 1$$

Where: Rm - minimum recommended insulation resistance in MΩ with winding at 40°C
Vn - rated machine voltage in kV

In case the test is carried out at a temperature other than 40°C, the value must be corrected to 40°C using an approximated curve of insulation resistance v.s temperature of the winding with the aid of Figure 2.1; it's possible verify that resistance practically doubles every 10°C that insulating temperature is lowered.

*Example:*

Ambient temperature = 50°C
Motor winding resistence at 50°C = 1.02 MΩ
Correction to 40°C

$$R_{40°C} = R_{50°C} \times K_{50°C}$$

$$R_{40°C} = 1.02 \times 1.3$$

$$R_{40°C} = 1.326\ M\Omega$$

The minimum resistence Rm will be:

$$Rm = Vn + 1$$
$$Rm = 0.440 + 1$$
$$Rm = 1.440\ M\Omega$$

On new motors, lower values are often attained due to solvents present in the insulating varnishes that later evaporate during normal operation. This does not necessarily mean that the motor is not operational, since insulating resistance will increase after a period of service.
On motors which have been in service for a period of time much larger values are often attained. A comparison of the values recorded in previous tests on the same motor under similar load, temperature and humidity conditions, serves as a better indication of insulation condition than that of the value derived from a single test. Any substantial or sudden reduction is suspect and the cause determined and corrective action taken.
Insulation resistance is usually measured with a MEGGER.
In the event that insulation resistance is inferior to the values derived from the above formula, motors should be subjected to a drying process.

## 2.3.1 Drying the windings

This operation should be carried out with maximum care, and only by qualified personnel. The rate of temperature rise should not exceed 5°C per hour and the temperature of the winding should not exceed 105°C. An overly high final temperature as well as a fast temperature increase rate can each generate vapour harmful to the insulation.
Temperature should be accurately controlled during the drying process and the insulation resistance measured at regular intervals.
During the early stages of the drying process, insulation resistance will decrease as a result of the temperature increase, but the resistance will increase again when the insulation becomes dryer.
The drying process should be extended until sucessive measurements of insulation resistance indicate that a constant value above the minimum acceptable value has been attained. It is extremely important that the interior of the motor be well ventilated during the drying operation to ensure that the dampness is really removed.
Heat for drying can be obtained from outside sources (an oven), energization of the space heater (optional), or introducing a current through the actual winding of the motor being dried.

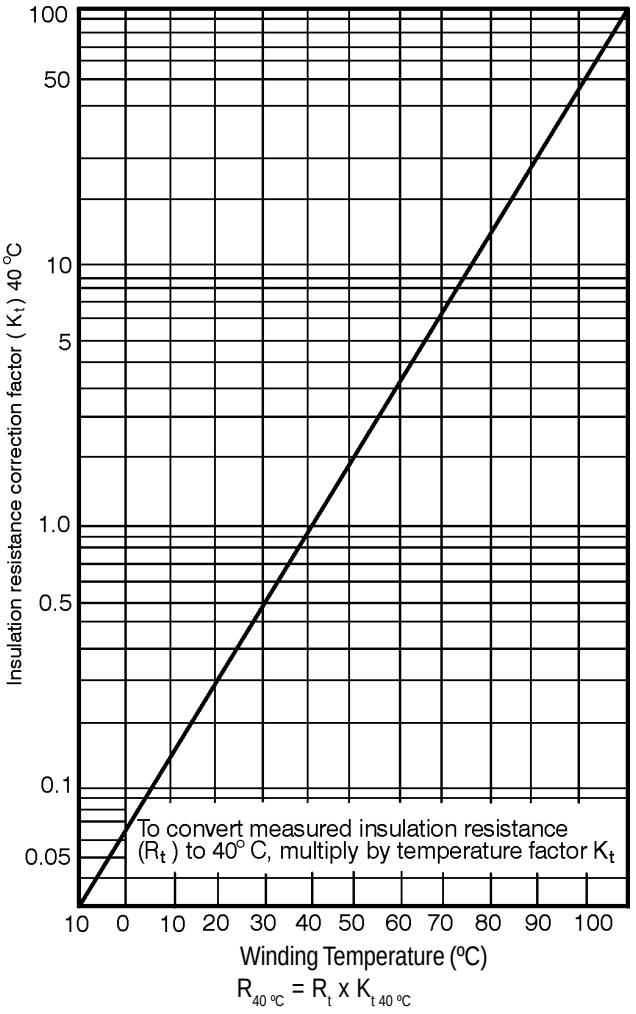



*Figure 2.1*

# 3. Installation

Electric machines should be installed in order to allow an easy access for inspection and maintenance. Should the surrounding atmosphere be humid, corrosive or contain flammable substances or particles, it is essential to ensure an adequate degree of protection.
The installation of motors in environments where there are vapours, gases or dusts, flammable or combustible materials, subject to fire or explosion, should be undertaken according to appropriate and governing codes, such as NEC Art. 500 (National Electrical Code) and UL-674 (Underwriters Laboratories, Inc.) Standards.
Under no circumstances can motors be enclosed in boxes or covered with materials which may impede or reduce the free circulation of ventilating air. Machines fitted with external ventilation should be at least 50cm from the wall to permit the passage of air.
The opening for the entry and exit of air flow should never be obstructed or reduced by conductors, pipes or other objects.
The place of installation should allow for air renewal at a rate of 700 cubic feet per minute for each 75 HP motor capacity.

## 3.1 Mechanical Aspects

### 3.1.1 Foundation

The motor base must be levelled and as far as possible free of vibrations. A concrete foundation is recommended for motors over 100 HP. The choice of base will depend upon the nature of the soil at the place of erection or of the floor capacity in the case of buildings.
When dimensioning the motor base, keep in mind that the motor may occasionally be run at a torque above that of the rated full load torque.
Based upon Figure 3.1, foundation stresses can be calculated by using the following formula:

$$F1 = 0.2247\ (0.009\ x\ g\ x\ G - 213\ Tmáx/A)$$

$$F2 = 0.2247\ (0.009\ x\ g\ x\ G + 213\ Tmax/A\ )$$

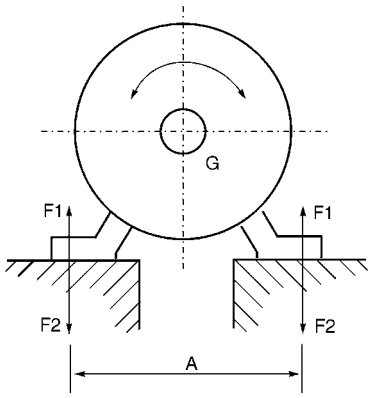



*Figure 3.1 - Base stresses*

Where:

F1 and F2 - Lateral stress (Lb)
g - Force of gravity (32.18 ft/s$^2$)
G - Weight of motor (Lb)
Tmax - Maximum torque (Lb . Ft)
A - Obtained from the dimensional drawing of the motor (in)

Sunken bolts or metallic base plates should be used to secure the motor to the base.

### 3.1.2 Types of Bases

*a) Slide Rails*

When motor drive is by pulleys the motor should be mounted on slide rails and the lower part of the belt should be pulling.
The rail nearest the drive pulley is positioned in such a manner that the adjusting bolt be between the motor and the driven machine.
The other rail should be positioned with the bolt in the opposite position, as shown in Figure 3.2.
The motor is bolted to the rails and set on the base. The drive pulley is aligned such that its center is on a plane with the center of the driven pulley and the motor shaft and that of the machine be parallel.

The belt should not be overly stretched, see Figure 3.11.
After the alignment, the rails are fixed.

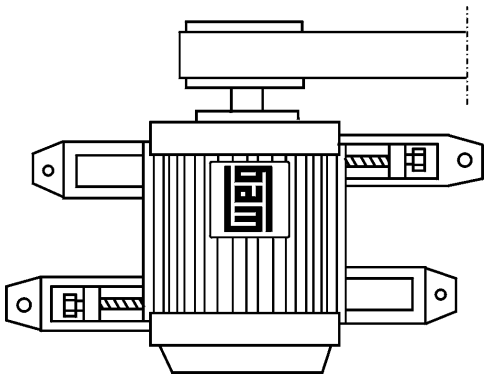


*Figure 3.2 - Positioning of slide rails for motor alignment*

*b) Foundation Studs*

Very often, particularly when drive is by flexible coupling the motor is anchored directly to the base with foundation studs.
It is recommended that shim plates of approximately 0.8 inches be used between the foundation studs and the feet of the motor for replacement purposes. These shim plates are useful when exchanging one motor for another of larger shaft height due to variations allowed by standard tolerances.
Foundation studs should neither be painted nor rusted as both interfere with to the adherence of the concrete, and bring about loosening.
After accurate alignment and levelling of the motor, the foundation studs are cemented and their screws tightened to secure the motor.

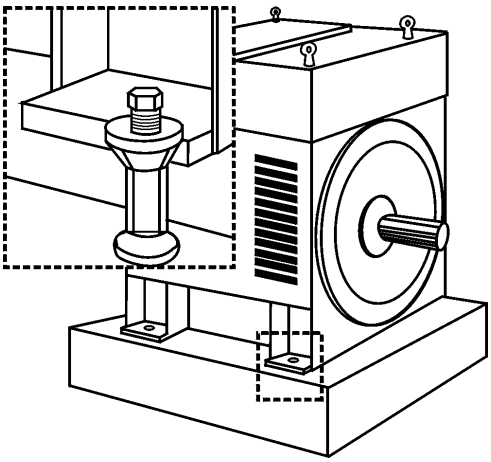


*Figure 3.3 - Motor mounted on a concrete base with foundation studs*

### 3.1.3 Alignment

The electric motor should be accurately aligned with the driven machine, particularly in cases of direct coupling. An incorrect alignment can cause bearing failure vibrations and even shaft rupture.
The best way to ensure correct alignment is to use dial gauges placed on each coupling half, one reading radially and the other exially - Figure 3.5.

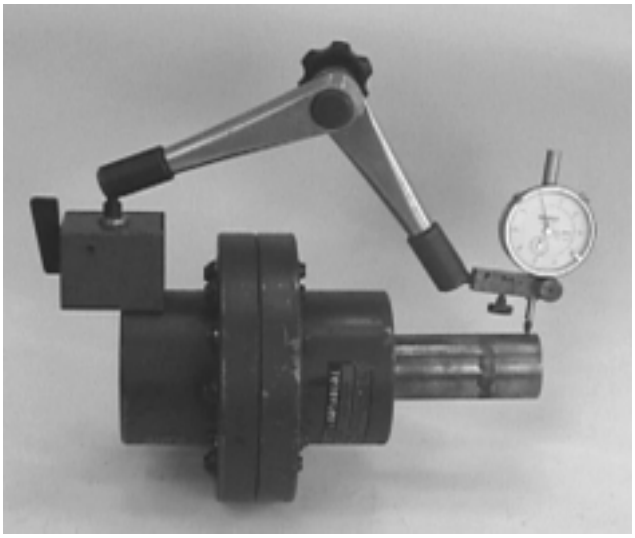


*Figure 3.5 - Alignment with dial gauges*

Thus, simultaneous readings are possible and allow for checking for any parallel (Figure 3.6a) and concentricity deviations (Figure 3.6b) by rotating the shafts one turn.
Gauge readings should not exceed 0.02 inches. If the installer is sufficiently skilled, he can obtain alignment with feeler gauges and a steel ruler, providing that the couplings are perfect and centered - Figure 3.6c.

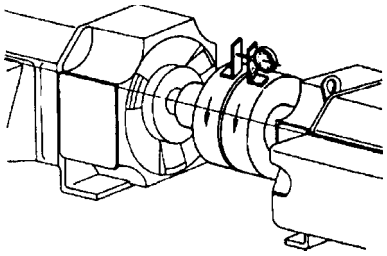


*Figure 3.6a - Deviation from parallel*

*Figure 3.6b - Deviation from concentricity*

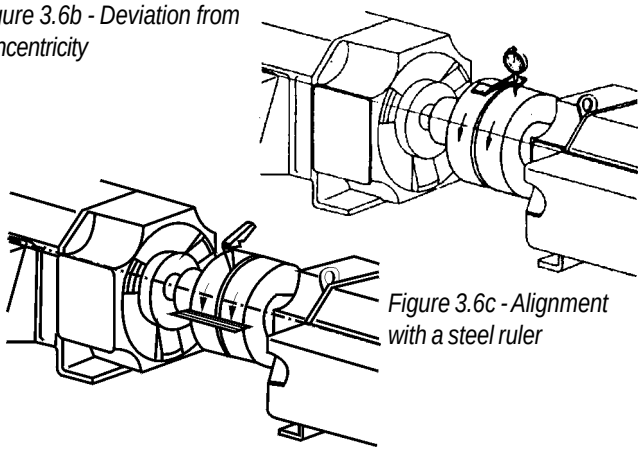


*Figure 3.6c - Alignment with a steel ruler*

### 3.1.4 Coupling

*a) Direct Coupling*

Direct coupling is always preferable due to its lower cost, space economy, no belt slippage and lower accident risk.
In the case of speed ratio drives, it is also common to use a direct coupling with a reducer (gear box).

CAUTION: Carefully align the shaft ends using, whenever feasible, a flexible coupling.

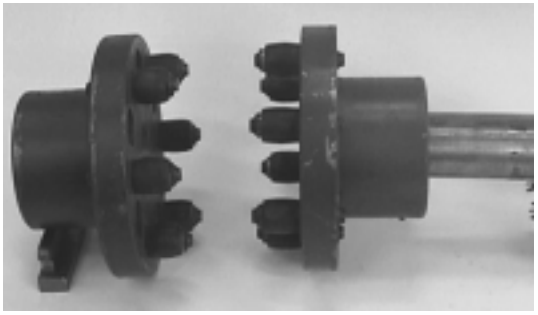


*Figure 3.7 - A type of direct coupling*

*b) Gear Coupling*

Poorly aligned gear couplings are the cause of jerking motions which bring about the vibration of the actual drive and vibrations within the motor.

Therefore, due care must be given to perfect shaft alignment: exactly parallel in the case of straight gears, and at the correct angle for bevel or helical gears.
Perfect gear engagement can be checked by the insertion of a strip of paper on which the teeth marks will be traced after a single rotation.

### *c) Belt and Pulley Coupling*

*Belt coupling is most commonly used when a speed ratio is required.*
Assembly of Pulleys: To assemble pulleys on shaft ends with a keyway and threaded end holes the pulley should be inserted halfway up the keyway merely by manual pressure.
On shafts without threaded end holes the heating of the pulley to about 80°C is recommended, or alternatively, the devices illustrated in Figure 3.8 may be employed.

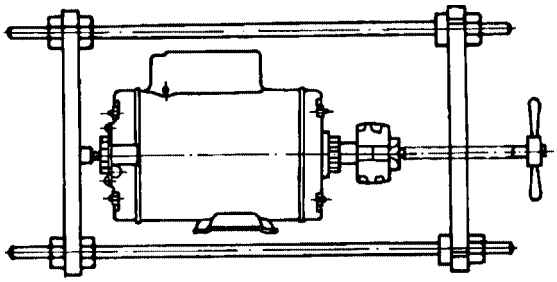


*Figure 3.8 - Pulley mounting device*

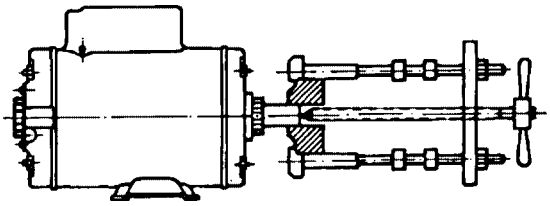


*Figure 3.8a - Pulley extractor*

Hammers should be avoided during the fitting of pulleys and bearings. The fitting of bearings with the aid of hammers leaves blemishes on the bearing races. These initially small flaws increase with usage and can develop to a stage that completely impairs the bearing.
The correct positioning of a pulley is shown in Figure 3.9.

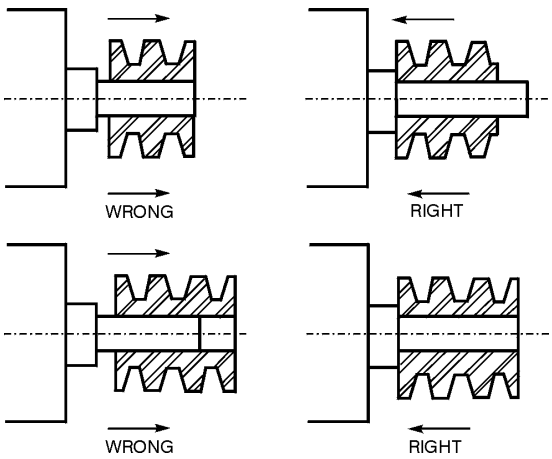



*Figure 3.9 - Correct positioning of pulley on the shaft*

RUNNING: To avoid needless radial stresses on the bearings it is imperative that shafts are parallel and the pulleys perfectly aligned. (Figure 3.10).

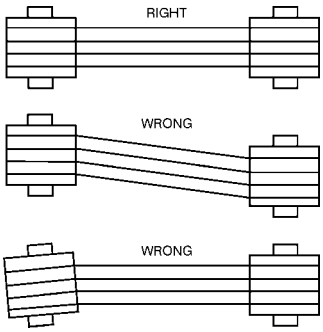



*Figure 3.10 - Correct pulley alignment*

Laterally misaligned pulleys, when running, transmit alternating knocks to the rotor and can damage the bearing housing. Belt slippage can be avoided by applying a resin (rosin for example).
Belt tension should be sufficient to avoid slippage during operation (Figure 3.11).
Pulleys that are too small should be avoided; these cause shaft flexion because belt traction increases in proportion to a decrease in the pulley size. Table 1 determines minimum pulley diameters, and Tables 2 and 3 refer to the maximum stresses acceptable on motor bearings up to frame 580. Beyond frame size 600, an analysis should be requested from the WEG engineering.

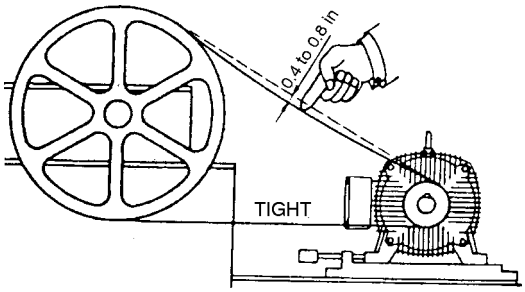
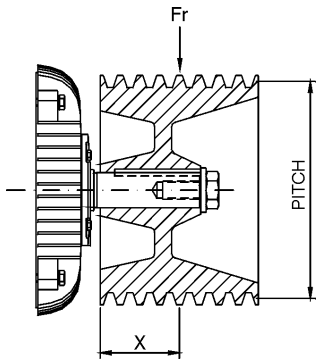



*Figure 3.11 - Belt tensions*

***Table 1** - Minimum pitch diameter of pulleys*

| Frame | Ball bearings | | | | | | |
|---|---|---|---|---|---|---|---|
| | Bearing | Size X Inches | | | | | |
| | | 0.79 | 1.57 | 2.36 | 3.15 | 3.94 | 4.72 |
| 140 | 6205-Z | 1.7 | 1.85 | 2 | | | |
| W 180 | 6206-Z | 3.03 | 3.23 | 3.46 | | | |
| 180 | 6307-Z | 1.69 | 1.81 | 1.93 | | | |
| W 210 | 6308-Z | | 2.86 | 3.00 | 3.16 | | |
| 210 | 6308-Z | | 2.90 | 3.06 | 3.22 | | |
| W 250 | 6309 C3 | | 4.37 | 4.54 | 4.72 | 4.92 | |
| 250 | 6309 C3 | | 4.41 | 4.59 | 4.77 | 4.97 | |
| 280 | 6311 C3 | | | 5.08 | 5.19 | 5.47 | 5.65 |
| 320 | 6312 C3 | | | 7.44 | 7.76 | 7.94 | 8.18 |
| 360 | 6314 C3 | | | 8.73 | 9.00 | 9.28 | 9.57 |




| Frame | Poles | | Ball Bearing | | | | | Roller Bearing | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Bearing | Size X Inches | | | | Bearing | Size X Inches | | | | | | |
| | | | 1.97 | 3.15 | 4.33 | 5.51 | | 1.97 | 3.15 | 4.33 | 5.51 | 6.69 | 8.27 |
| 400 | II | 6314 C3 | 7.3 | 7.62 | 7.94 | 8.24 | | - | - | - | - | - | - |
| | IV-VI-VII | 6314 C3 | | | | | NU 316 | 4.13 | 4.31 | 4.49 | 4.67 | 4.85 | - |
| 440 | II | 6314 C3 | 11.75 | 12.16 | 12.61 | 13.08 | | - | - | - | - | - | - |
| | IV-VI-VIII | 6319 C3 | | | | | NU 319 | 4.02 | 4.17 | 4.32 | 4.47 | 4.62 | 4.82 |
| 500 | II | 6314 C3 | 23.54 | 24.34 | 25.12 | 25.87 | | - | - | - | - | - | - |
| | IV-VI-VIII | 6319 C3 | | | | | NU 319 | 6.52 | 6.73 | 6.95 | 7.17 | 7.39 | 7.67 |
| 5008 | II | 6314 C3 | 44.66 | 45.79 | 46.98 | 48.23 | | - | - | - | - | - | - |
| | IV-VI-VIII | 6322 C3 | | | | | NU 322 | 8.73 | 8.95 | 9.96 | 11.34 | 12.87 | 14.82 |
| 580 | II | 6314 C3 | 57 | 58 | 59 | 60 | | - | - | - | - | - | - |
| | IV-VI-VIII | 6322 C3 | | | | | NU 322 | 10.72 | 10.91 | 11.11 | 11.31 | 11.50 | 11.76 |

Important: 1) Peripheral speeds for solid grey cast iron pulleys FC 200 is V = 115 ft/s.
2) Use steel pulleys when peripheral speed is higher than 115 ft/s.
3) V-belt speed should not exceed 115 ft/s.

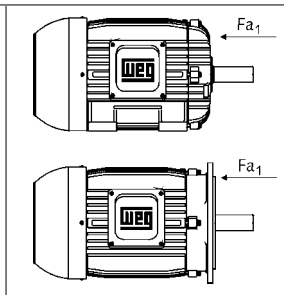
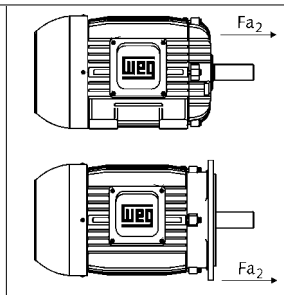
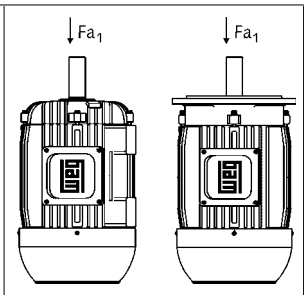
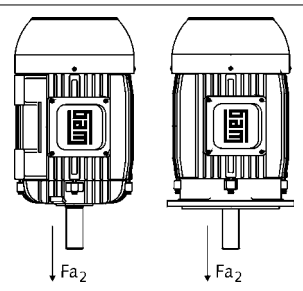
***Table 2** - Maximum acceptable radial load (Lbf)*

| Nema 56 Motors | | | | |
|---|---|---|---|---|
| Frame | Radial Force (Lbf) | | | |
| | Poles | Distance X | | |
| | | 1 | 1,18 | 2 |
| 56A | II | 88 | - | 59 |
| | IV | 88 | - | 59 |
| 56B | II | 88 | - | 59 |
| | IV | 86 | - | 59 |
| 56D | II | 127 | - | 70 |
| | IV | 141 | - | 70 |

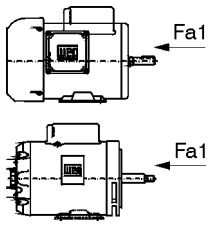
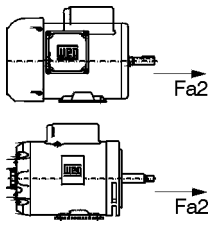
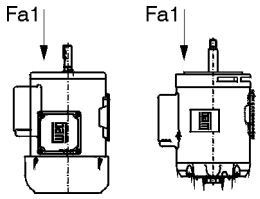
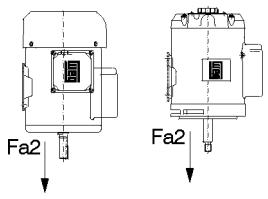
| Saw Arbor Motors | | | | |
|---|---|---|---|---|
| 80 LMS | II | - | 355 | - |
| 80 MMS | II | - | 359 | - |
| 80 SMS | II | - | 357 | - |
| 90 LMS | II | | 427 | - |
| | IV | - | 555 | - |

***Table 3*** *- Maximum acceptable axial load (Lbf)*

IP55 Totally Enclosed Motors - 60Hz
Position / Construction Form

| FRAME |  | | | |  | | | |  | | | |  | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | II | IV | VI | VIII | II | IV | VI | VIII | II | IV | VI | VIII | II | IV | VI | VIII |
| 140 | 103 | 141 | 167 | 187 | 112 | 152 | 185 | 207 | 99 | 132 | 158 | 178 | 105 | 143 | 174 | 198 |
| W 180 | 108 | 145 | 180 | 202 | 154 | 209 | 255 | 286 | 94 | 130 | 165 | 183 | 141 | 194 | 240 | 269 |
| 180 | 149 | 207 | 249 | 286 | 269 | 370 | 443 | 500 | 136 | 189 | 229 | 266 | 253 | 352 | 421 | 480 |
| W 210 | 196 | 264 | 326 | 368 | 329 | 447 | 544 | 610 | 176 | 238 | 297 | 339 | 310 | 421 | 518 | 582 |
| 210 | 189 | 257 | 315 | 357 | 324 | 443 | 533 | 599 | 160 | 220 | 275 | 310 | 295 | 405 | 493 | 553 |
| W 250 | 282 | 372 | 443 | 485 | 471 | 620 | 734 | 811 | 240 | 317 | 394 | 414 | 430 | 564 | 685 | 743 |
| 250 | 273 | 368 | 436 | 485 | 463 | 615 | 727 | 813 | 220 | 310 | 379 | 421 | 410 | 557 | 672 | 749 |
| 280 | 355 | 480 | 551 | 624 | 621 | 826 | 959 | 1,082 | 275 | 388 | 427 | 502 | 540 | 736 | 838 | 961 |
| 320 | 374 | 498 | 588 | 668 | 703 | 930 | 1,091 | 1,232 | 266 | 366 | 432 | 511 | 597 | 793 | 937 | 1,078 |
| 360 | 890 | 1,181 | 1,144 | 1,323 | 890 | 1,181 | 1,375 | 1,552 | 745 | 985 | 1,144 | 1,323 | 745 | 985 | 1,144 | 1,323 |
| 400 | 877 | 1,148 | 1,347 | 1,521 | 877 | 1,148 | 1,347 | 1,521 | 705 | 890 | 1,060 | 1,241 | 705 | 890 | 1,060 | 1,241 |
| 440 | 842 | 1,303 | 1,563 | 1,821 | 842 | 1,303 | 1,563 | 1,821 | 568 | 884 | 1,109 | 1,488 | 568 | 884 | 1,109 | 1,488 |
| 500 | 769 | 1,250 | 1,481 | 1,728 | 769 | 1,250 | 1,481 | 1,728 | 355 | 721 | 844 | 1,190 | 355 | 721 | 844 | 1,109 |
| 5008 | 791 | 1624 | 1909 | 2137 | 791 | 1624 | 1909 | 2137 | 728 | 1548 | 1808 | 2029 | 728 | 1548 | 1808 | 2029 |
| 580 | 679 | 1,406 | 1,649 | 1,865 | 679 | 1,406 | 1,649 | 1,865 | 033 | 474 | 549 | 597 | 033 | 474 | 549 | 597 |

Open Motors - NEMA 56 Frames - 60Hz
Position / Construction Form

| FRAME |  | |  | |  | |  | |
|---|---|---|---|---|---|---|---|---|
| | II | IV | II | IV | II | IV | II | IV |
| 56 A | 68 | 90 | 83 | 112 | 63 | 85 | 79 | 108 |
| 56 B | 66 | 90 | 81 | 110 | 63 | 83 | 77 | 105 |
| 56 D | 63 | 88 | 105 | 145 | 59 | 81 | 101 | 138 |

The maximum radial load for each frame are determined, by graphs.

**INSTRUCTIONS ON HOW TO USE THE GRAPHS**

1 - Maximum radial load on shaft.
2 - Maximum radial load on bearings.

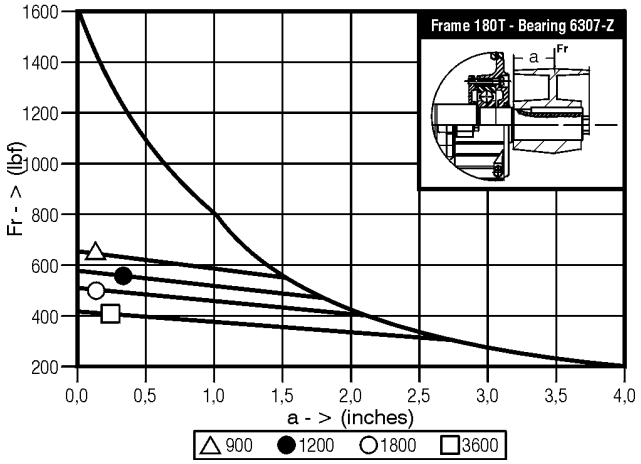
Where: X - Half of pulley width (inches)
Fr- Maximum radial load in relation to the diameter and pulley width.

*Example:*
Verify whether a 2HP motor, II Pole, 60Hz withstands a radial load of 110Lb, considering a pulley width of 4 inches.

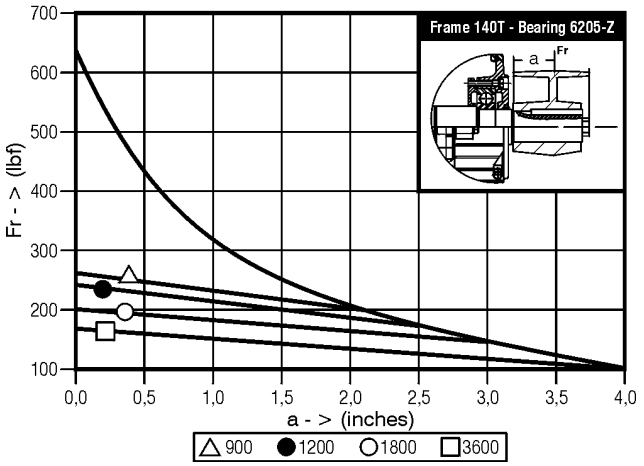
Frame: 145T
Fr: 110Lb
X: 2 inches

1 - Mark the distance X
2 - Find out line N = 3600 for bearing
Based on the above, this bearing withstands a radial load of 130Lb.

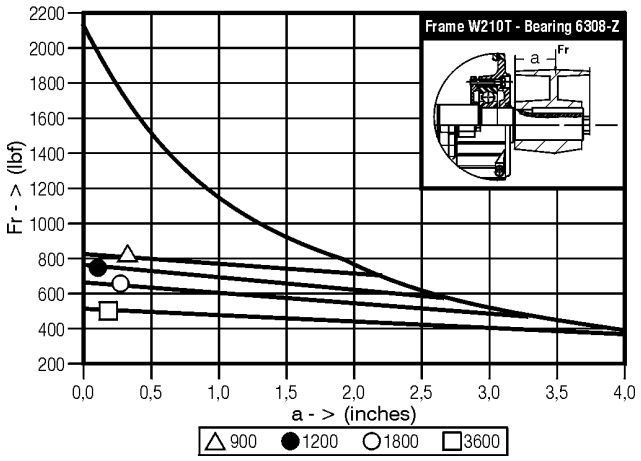
***Frame 180T***



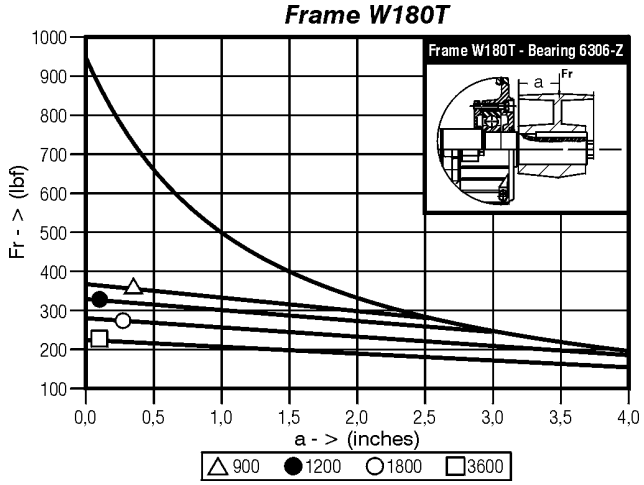

***Frame 140T***



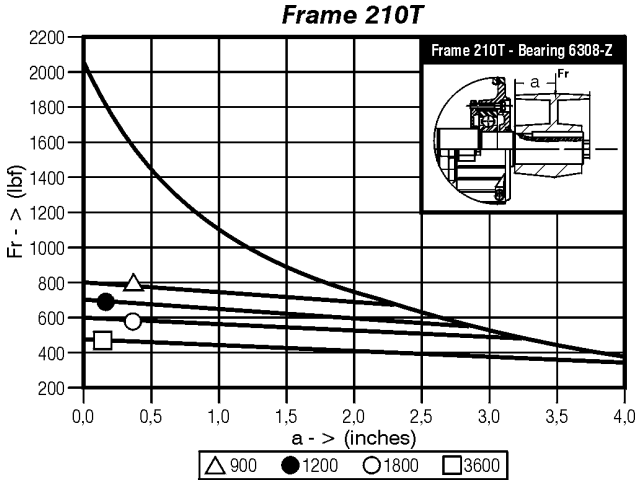

***Frame W210T***



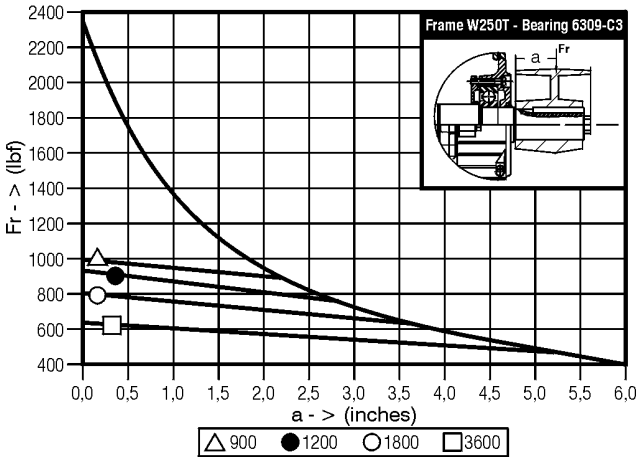

***Frame W180T***




***Frame 210T***



### Frame W250T

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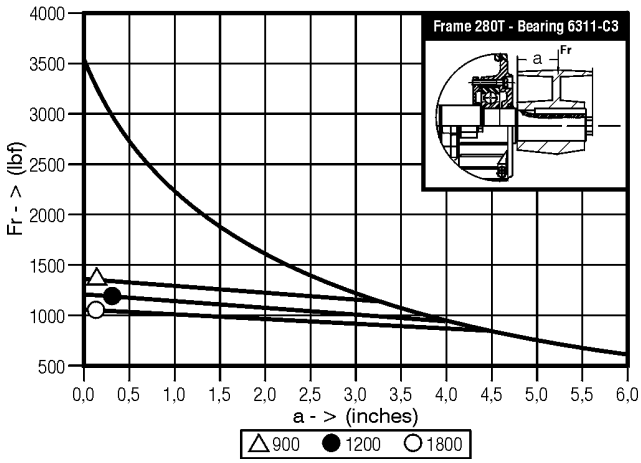
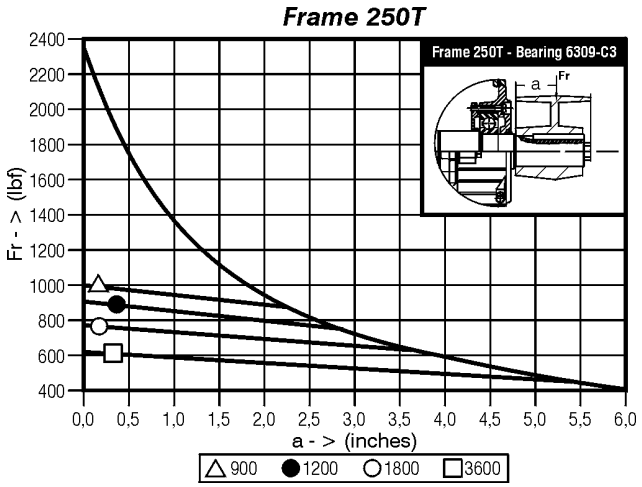
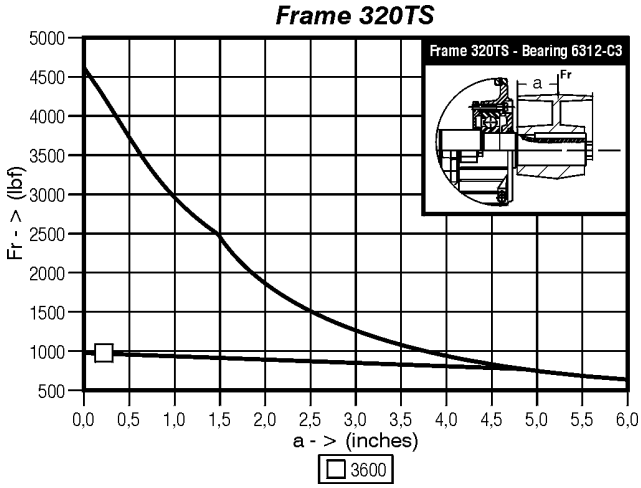



### Frame 250T




### Frame 320TS

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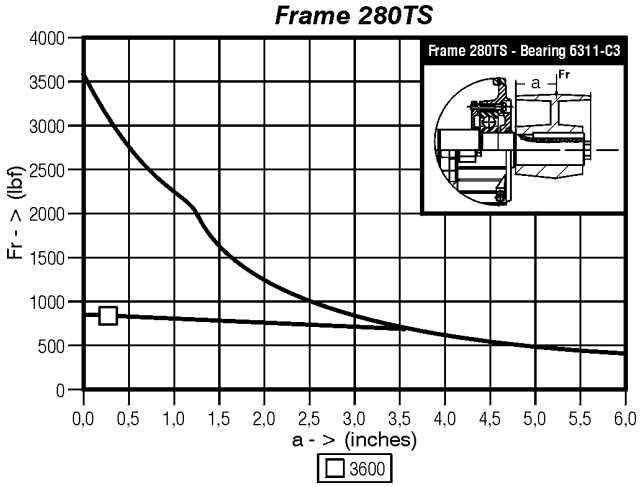


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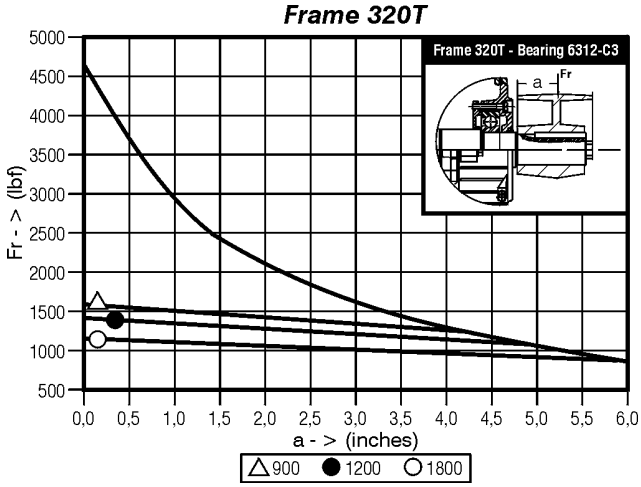
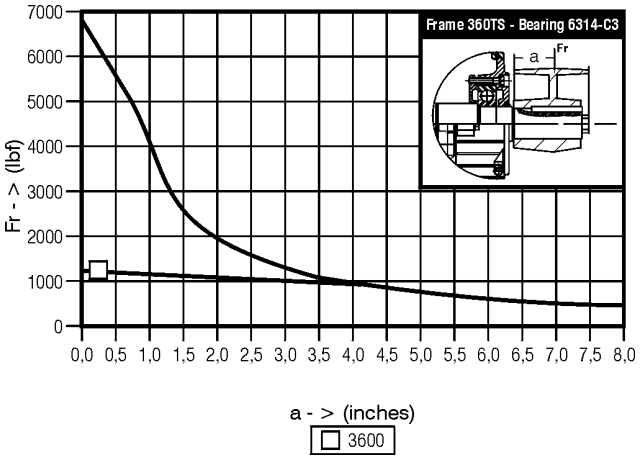
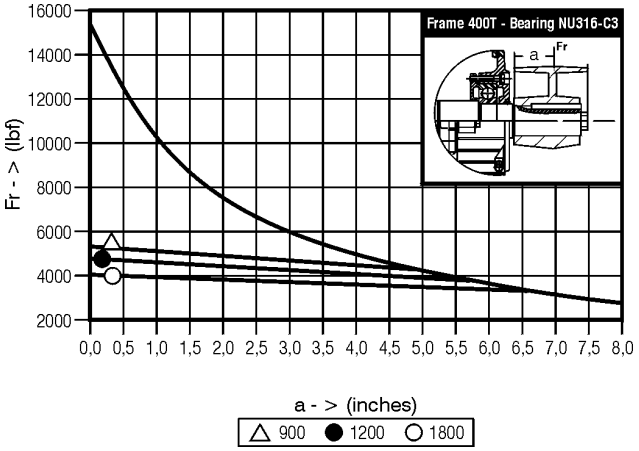


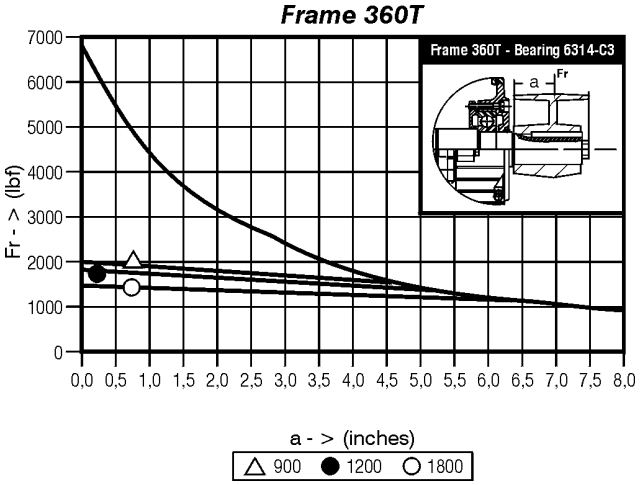
### Frame 360TS




### Frame 400T




### Frame 360T

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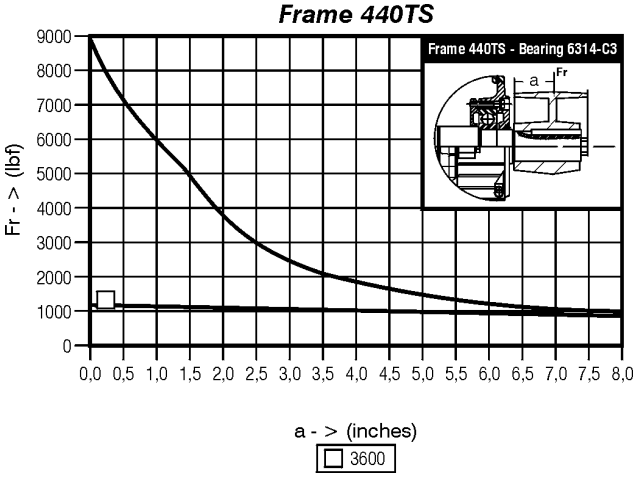
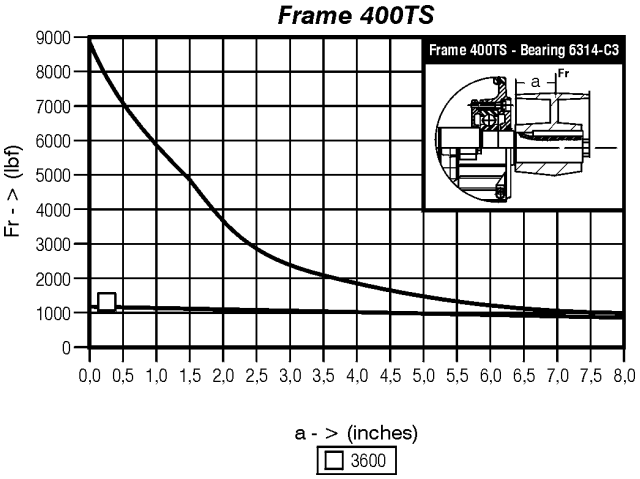
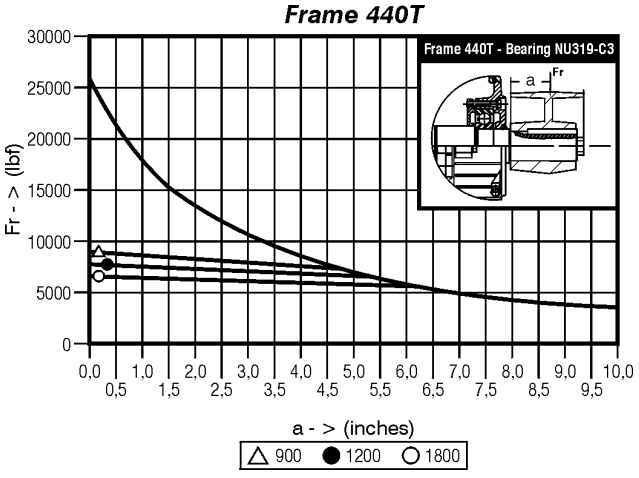



### Frame 400TS




### Frame 440T



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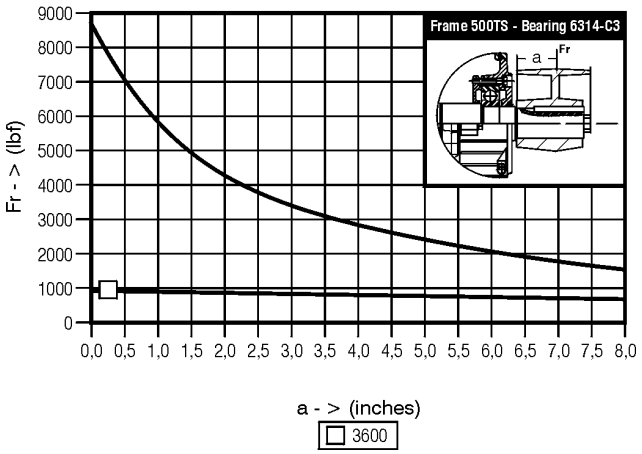


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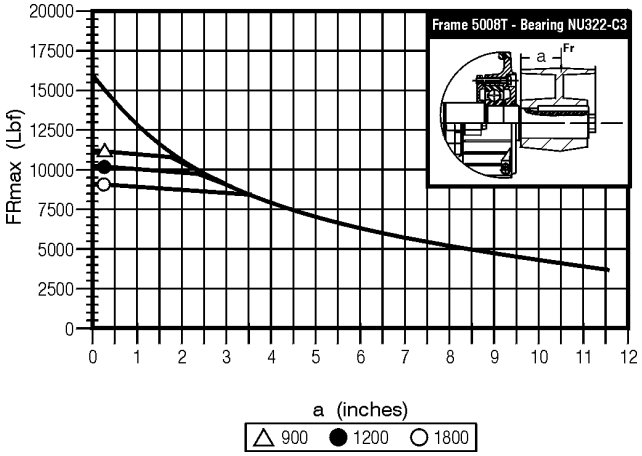
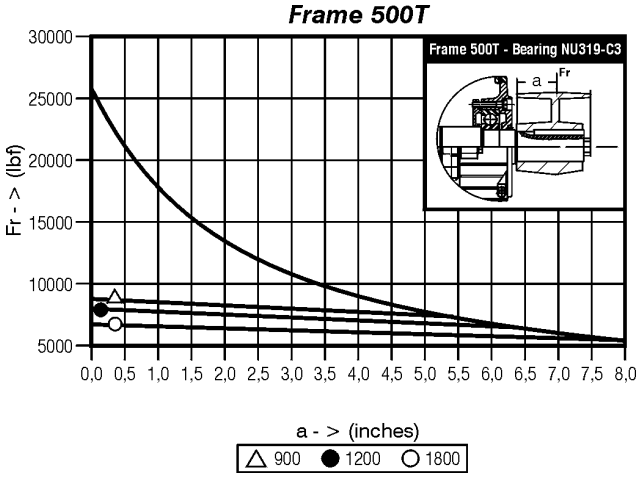
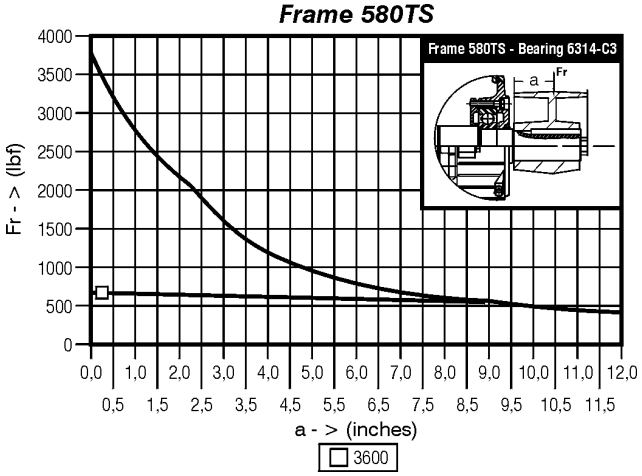


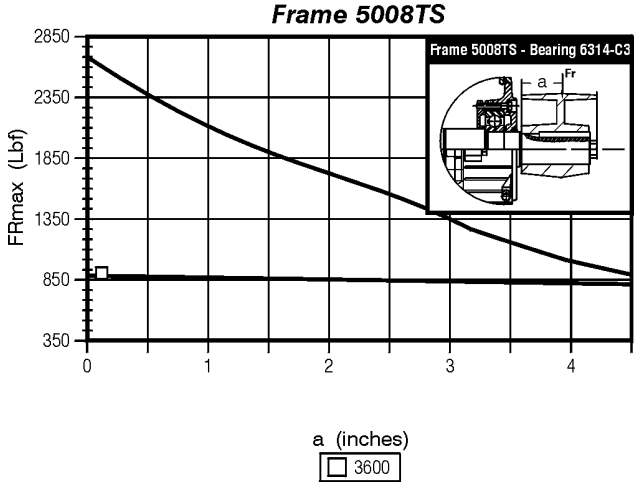

### Frame 500T



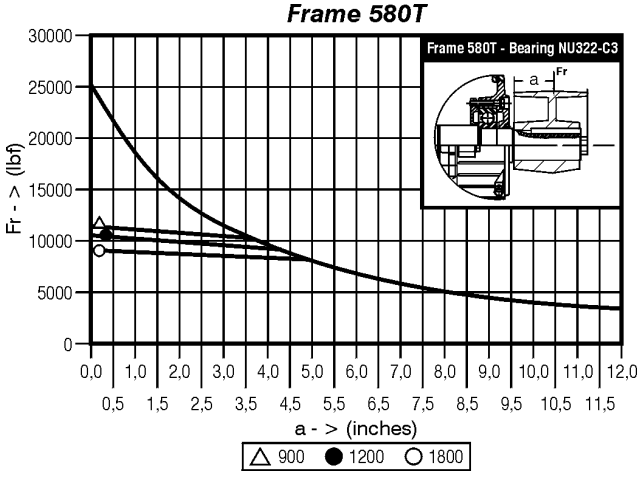

### Frame 580TS




### Frame 5008TS




### Frame 580T




**Note:** For frames 600 and above, consult your engineering representative.

## 3.2 Electrical Aspects

### 3.2.1 Feed System

Proper electric power supply is very important. The choice of motor feed conductors, whether branch or distribution circuits, should be based on the rated current of the motors as per NFPA-70 Standard article 430.
Tables 4, 5 and 6 show minimum conductor gauges sized according to maximum current capacity and maximum voltage drop in relation to the distance from the distribution center to the motor, and to the type of installation (Overhead or in ducts).

**To determine the conductor gauge proceed as follows:**

a) Determine the current by multiplying the current indicated on the motor nameplate by 1.25 and then locate the resulting value on the corresponding table.
If the conductor feeds more than one motor, the value to be sought on the table should be equal 1.25 times the rated current of the largest motor plus the rated current of the other motors.
In the case of variable speed motors, the highest value among the rated currents should be considered.
When motor operation is intermittent, the conductors should have a current carrying capacity equal or greater, to the product of the motor rated current times the running cycle factor shown on Table 7.

***Table 7** - Running cycle factor*

**Motor Short**

| Motor short time rating / Duty Classification | 5min | 15min | 30 at 60min | Continuos |
|---|---|---|---|---|
| Short (operating valves, activating contacts etc) | 1.10 | 1.20 | 1.50 | - |
| Intermittent (passenger or freight elevators, tools, pumps, rolling bridges etc) | 0.85 | 0.85 | 0.90 | 1.40 |
| Cyclic (rolling mills,mining machines etc) | 0.85 | 0.90 | 0.95 | 1.40 |
| Variable | 1.10 | 1.20 | 1.50 | 2.00 |

b) Locate the rated voltage of the motor and the feed network distance in the upper part of the corresponding table. The point of intersection of the distance column and the line referring to current will indicate the minimum required gauge of the conductor.

*Example:*
Size the conductors for a 15 HP, three-phase, 230V, 42A, motor located 200 feet from the main supply with cables laid in conduits.

a) Current to be located: 1.25 x 42A = 52.5A
b) Closest value on table 6:55A
c) Minimum gauge: 6 AWG

### 3.2.2 Starting of Electric Motor

Induction motors can be started by the following methods:

#### Direct Starting

Whenever possible a three-phase motor with a squirrel cage rotor should be started directly at full supply voltage by means of a contactor (Connection diagram a). This method is called Direct-on-Line (DOL) starting.
There are DOL starter assemblies available combining a three-pole contactor, a bimetal relay (overload protection device), and a fuse (short circuit protection on branch circuit).
DOL starting is the simplest method, only feasible however, when the locked rotor current (LRC) does not influence the main electric supply lines.
Initial locked rotor current (LRC) in induction motors reach values six to eight times the value of the full load current. During starting by the DOL method, starting current can reach these high levels. The main electrical supply should be rated sufficiently, such that during the starting cycle no supply disturbance to others on the power network is caused by the voltage drop in the main supply.
This can be achieved under one of the following situations:

a) The rated main supply current is high enough for the locked rotor current not to be proportionally high.
b) Motor locked rotor current is low with no effect on the networks.
c) The motor is started under no-load conditions with a short starting cycle and, consequently, a low locked rotor current with a transient voltage drop tolerable to other consumers.

#### Starting with a compensating switch (auto-transformer starting)

Should direct on line starting not be possible, either due to restrictions imposed by the power supply authority or due to the installation itself, reduced voltage indirect starting methods can be employed to lower the locked rotor current. The single line connection diagram (C) shows the basic components of a compensating switch featuring a transformer (usually an auto-transformer) with a series of taps corresponding to the different values of the reduced voltage. Only three terminals of the motor are connected to the switch, the other being interconnected as per diagram, for the indicated voltage.

#### Star-Delta starting

It is fundamental to star-delta starting that the three-phase motor has the necessary numbers of leads for both connections:

6 leads for Y/Δ
or 12 leads for YY/ΔΔ

All the connections for the various voltages are made through terminals in the terminal box in accordance with the wiring diagram that accompanies the motor. This diagram may be shown on the nameplate or in the terminal box.
The star-delta connection is usually used only in low-voltage motors due to normally available control and protection devices. In this method of starting the locked rotor current is approximately 30% of the original LRC. The locked rotor torque is reduced proportionally as well. For this reason, it is very important before deciding to use

***Table 4** - Wire and cable gauges for single-phase motor installation (voltage drop < 5%) (in conduits)*

| Supply Voltage | Distance of motor from distribution centre (feet) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 115 | 34 | 51 | 69 | 85 | 102 | 137 | 171 | 205 | 240 | 273 | 308 | 342 | 428 | 514 |
| 230 | 69 | 102 | 138 | 170 | 204 | 274 | 342 | 410 | 480 | 546 | 616 | 684 | 856 | 1028 |
| 460 | 138 | 204 | 276 | 340 | 408 | 548 | 684 | 820 | 960 | 1092 | 1232 | 1368 | 1712 | 2056 |
| 575 | 170 | 250 | 338 | 420 | 501 | 670 | 840 | 1010 | 1181 | 1342 | 1515 | 1680 | 2105 | 2530 |
| Current (A) | Cable gauge (conductor) | | | | | | | | | | | | | |
| 5 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 12 | 12 | 12 | 12 | 10 | 10 | 8 |
| 10 | 14 | 14 | 14 | 14 | 12 | 12 | 10 | 10 | 10 | 8 | 8 | 8 | 6 | 6 |
| 15 | 12 | 12 | 12 | 12 | 12 | 10 | 8 | 8 | 6 | 6 | 6 | 6 | 4 | 2 |
| 20 | 12 | 12 | 12 | 10 | 10 | 8 | 8 | 6 | 6 | 6 | 4 | 4 | 4 | 2 |
| 30 | 10 | 10 | 10 | 8 | 8 | 6 | 6 | 6 | 4 | 4 | 2 | 2 | 2 | 1/0 |
| 40 | 8 | 8 | 8 | 8 | 6 | 6 | 4 | 4 | 2 | 2 | 2 | 2 | 1/0 | 2/0 |
| 55 | 6 | 6 | 6 | 6 | 6 | 4 | 4 | 2 | 2 | 1/0 | 1/0 | 1/0 | 1/0 | 2/0 |
| 70 | 4 | 4 | 4 | 4 | 4 | 2 | 2 | 2 | 1/0 | 1/0 | 2/0 | 2/0 | 2/0 | 2/0 |
| 95 | 2 | 2 | 2 | 2 | 2 | 2 | 1/0 | 1/0 | 1/0 | 2/0 | 3/0 | 3/0 | 4/0 | 250M |

***Table 5** - Wire and cable gauges for three-phase motor installation - aerial conductors with 25cm spacing (voltage drop < 5%)*

| Supply Voltage | Distance of motor from distribution centre (feet) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 115 | 51 | 69 | 85 | 102 | 137 | 171 | 205 | 240 | 273 | 308 | 342 | 428 | 514 | 685 |
| 230 | 102 | 138 | 170 | 204 | 274 | 342 | 410 | 480 | 546 | 616 | 684 | 856 | 1028 | 1370 |
| 460 | 204 | 276 | 340 | 408 | 547 | 684 | 820 | 960 | 1092 | 1232 | 1368 | 1712 | 2056 | 2740 |
| 575 | 250 | 338 | 420 | 501 | 670 | 840 | 1010 | 1181 | 1342 | 1515 | 1680 | 2105 | 2530 | 3350 |
| Current (A) | Cable gauge (conductor) | | | | | | | | | | | | | |
| 15 | 14 | 14 | 14 | 12 | 12 | 10 | 10 | 10 | 8 | 8 | 8 | 6 | 6 | 4 |
| 20 | 14 | 14 | 12 | 12 | 10 | 10 | 8 | 8 | 8 | 6 | 6 | 4 | 4 | 2 |
| 30 | 14 | 12 | 10 | 8 | 8 | 8 | 6 | 6 | 4 | 4 | 4 | 2 | 2 | 1/0 |
| 40 | 12 | 10 | 10 | 8 | 8 | 6 | 4 | 4 | 4 | 2 | 2 | 2 | 1/0 | 2/0 |
| 55 | 10 | 10 | 8 | 8 | 6 | 4 | 4 | 2 | 2 | 2 | 1/0 | 2/0 | 3/0 | -- |
| 70 | 8 | 8 | 6 | 6 | 4 | 2 | 2 | 2 | 1/0 | 1/0 | 2/0 | 3/0 | -- | -- |
| 100 | 6 | 6 | 4 | 4 | 2 | 2 | 1/0 | 2/0 | 3/0 | 4/0 | 4/0 | -- | -- | -- |
| 130 | 4 | 4 | 4 | 2 | 1/0 | 1/0 | 2/0 | 4/0 | -- | -- | -- | -- | -- | -- |
| 175 | 2 | 2 | 2 | 1/0 | 2/0 | 3/0 | -- | -- | -- | -- | -- | -- | -- | -- |
| 225 | 1/0 | 1/0 | 1/0 | 2/0 | 3/0 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 275 | 2/0 | 2/0 | 2/0 | 4/0 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 320 | 3/0 | 3/0 | 3/0 | 4/0 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

***Table 6** - Wire and cable gauges for three-phase motor installation (voltage drop < 5%) (in conduits)*

| Supply Voltage | Distance of motor from distribution centre (feet) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 115 | 85 | 102 | 120 | 137 | 171 | 205 | 240 | 273 | 308 | 342 | 428 | 514 |
| 230 | 170 | 204 | 240 | 274 | 342 | 410 | 480 | 546 | 616 | 684 | 856 | 1028 |
| 460 | 340 | 408 | 480 | 548 | 684 | 820 | 960 | 1092 | 1232 | 1368 | 1712 | 2056 |
| 575 | 420 | 501 | 590 | 670 | 840 | 1010 | 1181 | 1342 | 1515 | 1680 | 2105 | 2530 |
| Current (A) | Cable gauge (conductor) | | | | | | | | | | | |
| 15 | 12 | 12 | 12 | 10 | 10 | 8 | 8 | 8 | 6 | 6 | 6 | 4 |
| 20 | 12 | 10 | 10 | 10 | 8 | 8 | 6 | 6 | 6 | 6 | 4 | 4 |
| 30 | 10 | 8 | 8 | 8 | 6 | 6 | 6 | 4 | 4 | 4 | 2 | 2 |
| 40 | 8 | 8 | 6 | 6 | 6 | 4 | 4 | 4 | 2 | 2 | 2 | 1/0 |
| 55 | 6 | 6 | 6 | 4 | 4 | 4 | 2 | 2 | 2 | 1/0 | 1/0 | 1/0 |
| 70 | 4 | 4 | 4 | 4 | 2 | 2 | 2 | 1/0 | 1/0 | 1/0 | 2/0 | 2/0 |
| 95 | 2 | 2 | 2 | 2 | 2 | 1/0 | 1/0 | 1/0 | 1/0 | 2/0 | 3/0 | 4/0 |
| 125 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 2/0 | 2/0 | 3/0 | 3/0 | 4/0 | 250M |
| 145 | 2/0 | 2/0 | 2/0 | 2/0 | 2/0 | 2/0 | 2/0 | 3/0 | 3/0 | 4/0 | 250M | 300M |
| 165 | 3/0 | 3/0 | 3/0 | 3/0 | 3/0 | 3/0 | 3/0 | 3/0 | 4/0 | 4/0 | 250M | 350M |
| 195 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 4/0 | 250M | 250M | 300M | 350M |
| 215 | 250M | 250M | 250M | 250M | 250M | 250M | 250M | 250M | 250M | 300M | 350M | 400M |
| 240 | 300M | 300M | 300M | 300M | 300M | 300M | 300M | 300M | 300M | 300M | 400M | 500M |
| 265 | 350M | 350M | 350M | 350M | 350M | 350M | 350M | 350M | 350M | 350M | 500M | 500M |
| 280 | 400M | 400M | 400M | 400M | 400M | 400M | 400M | 400M | 400M | 400M | 400M | -- |
| 320 | 500M | 500M | 500M | 500M | 500M | 500M | 500M | 500M | 500M | 500M | 500M | -- |

**Note:** The above indicated values are orientative. For guaranteed values, contact the Local Power Company.

star-delta starting to verify if the reduced locked rotor torque in "STAR" connection is enough to accelerate the load.

### 3.2.3 Motor Protection

Motor circuits have, in principle, two types of protection: motor overload, locked rotor and protection of branch circuit from short circuits. Motors in continuous use should be protected from overloading by means of a device incorporated into the motor, or by an independent device, usually a fixed or adjustable thermal relay equal or less than to the value derived from multiplying the rated feed current at full load by:

- 1.25 for motors with a service factor equal or superior to 1.15 or;

- 1.15 for motors with service factor equal to 1.0.

Some motors are optionally fitted with overheating protective detectors (in the event of overload, locked rotor, low voltage, inadequate motor ventilation) such as a thermostat (thermal probe), thermistor (PTC), RTD type resistance which dispense with independent devices.

THERMOSTAT (THERMAL PROBE)**:** Bimetallic thermal detectors with normally closed silver contacts. These open at pre-determined temperatures. Thermostats are series connected directly to the contactor coil circuit by two conductors.

THERMISTORS: Semi-conductor heat detectors positive temperature coeficient (PTC) that sharply change their resistance upon reaching a set temperature. Thermistors, depending upon the type, are series or parallel-connected to a control unit that cuts out the motor feed, or actuates an alarm system, in response to the thermistors reaction.

RESISTANCE TEMPERATURE DETECTORS (RTD) - PT 100:The resistance type heat detector (RTD) is a resistance element usually manufactured of copper or platinum.
The RTD operates on the principle that the electrical resistance of a metallic conductor varies linearly with the temperature. The detector terminals are connected to a control panel, usually fitted with a temperature gauge, a test resistance and a terminal changeover switch.

Subject to the desired degree of safety and the client's specification, three (one per phase) or six (two per phase) protective devices can be fitted to a motor for the alarm stems, circuit breaker or combined alarm and circuit breaker, with two leads from the terminal box to the alarm or circuit breaker system and four for the combined system (alarm and circuit breaker).
Table 9 compares the two methods of protection.

## 3.3 Start-up

### 3.3.1 Preliminary Inspection

Before starting a motor for the first time, it will be necessary to:

a) Remove all locking devices and blocks used in transit and check that the motor rotates freely;

b) Check that the motor is firmly secured and that coupling elements are correctly mounted and aligned.;

c) Ascertain that voltage and frequency correspond to those indicated on the nameplate. Motor performance will be satisfactory with main supply voltage fluctuation within ten per cent of the value indicated on the nameplate or a frequency fluctuation within five per cent or, yet, with a combined voltage and frequency variance within ten per cent;

d) Check that connections are in accordance with the connection diagram shown on the nameplate and be sure that all terminal screws and nuts are tight;

e) Check the motor for proper grounding. Providing that there are no specifications calling for ground-insulated installation, the motor must be grounded in accordance with prevalent standard for grounding electrical machines. The screw identified by the symbol ⏚ should be used for this purpose.
This screw is generally to be found in the terminal box or on one foot of the frame;

f) Check that motor leads connecting with the mains, as well as the control wires and the overload protection device, are in accordance with Nema Standards;

g) If the motor has been stored in a damp place, or has been stopped for some time, measure the insulating resistance as recommended under the item covering storage instructions;

h) Start the motor uncoupled to ascertain that it is turning in the desired direction. To reverse the rotation of a three-phase motor, invert two terminal leads of the mains supply.
High voltage motors bearing an arrow on the frame indicating rotation direction can only turn in the direction shown.

### 3.3.2 The First Start-up

*Three-Phase Motor with Cage Rotor:*
After careful examination of the motor, follow the normal sequence of starting operations listed in the control instructions for the initial start-up.

### 3.3.3 Operation

Drive the motor coupled to the load for a period of at least one hour while watching for abnormal noises or signs of overheating.
Compare the line current with the value shown on the nameplate.
Under continuous running conditions without load fluctuations this should not exceed the rated current times the service factor, also shown on the nameplate.
All measuring and control instruments and apparatus should be continuously checked for anomalies, and any irregularities corrected.

### 3.3.4 Stopping

*Warning:*

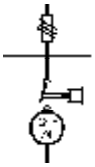
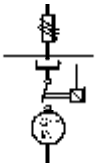
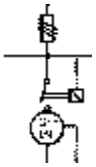
To touch any moving part of a running motor, even though

disconnected, is a danger to life and limb.

*Three-phase motor with cage rotor:*
Open the stator circuit switch. With the motor at a complete stop, reset the auto-transformer, if any, to the "start" position.

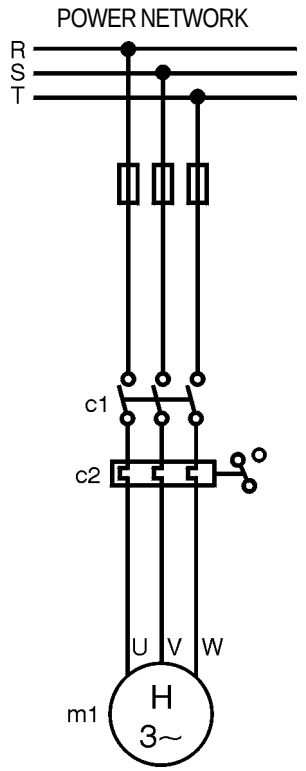
Caption: ◯ unprotected
◑ partially protected
● totally protected

***Table 9** - Comparison between motor protection system*

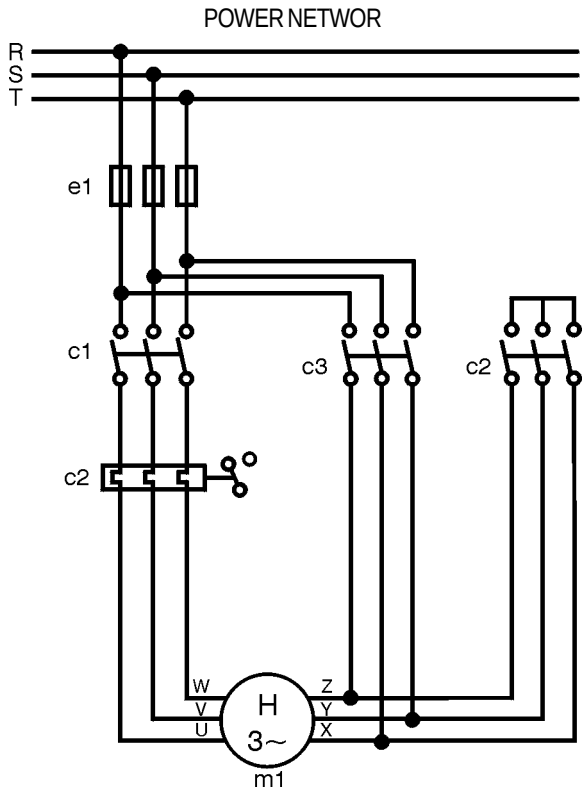
| **Causes of overheating** | Current-based protection | | Protection with probe thermistor in motor |
|---|---|---|---|
| | Fuse only | Fuse and thermal protector | |
| |  |  |  |
| 1. Overload with 1.2 times rated current | ◯ | ● | ● |
| 2. Duty cycles S1 to S8 IEC 34, EB 120 | ◯ | ◑ | ● |
| 3. Brakings, reversals and frequent starts | ◯ | ◑ | ● |
| 4. Operating with more than 15 starts p/hour | ◯ | ◑ | ● |
| 5. Locked rotor | ◑ | ◑ | ● |
| 6. Fault on one phase | ◯ | ◑ | ● |
| 7. Execessive voltage fluctuation | ◯ | ● | ● |
| 8. Frequency fluctuation on main supply | ◯ | ● | ● |
| 9. Excessive ambient temperature | ◯ | ● | ● |
| 10. External heating caused by bearings, belts, pulleys etc. | ◯ | ◯ | ● |
| 11. Obstructed ventilation | ◯ | ◯ | ● |

## CONNECTION DIAGRAMS

a) Direct starting




b) Star-Delta starting




c) Auto-transformer starting

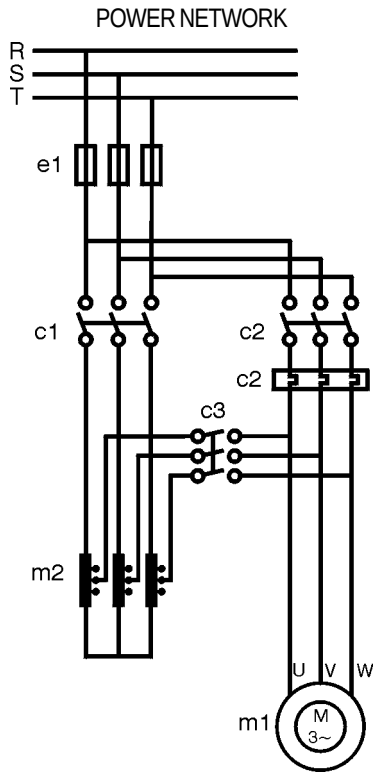


***Table 11** - Bearing specifications by type of motor*

| NEMA Frames | Mounting | Bearings | |
|---|---|---|---|
| | | Front (D.E.) | Rear (O.D.E.) |
| Open drip proof motors | | | |
| B48 and C48 | ALL FORMS | 6203 Z | 6202 Z |
| 56 and A56 | | 6203 Z | 6202 Z |
| B56 and C56 | | 6203 Z | 6202 Z |
| D56 and F56H/G56H | | 6204 Z | 6202 Z / 6203 Z |
| Totally enclosed fan cooled motors | | | |
| 143 T | ALL FORMS | 6205 ZZ | 6204 ZZ |
| 145 T | | 6205 ZZ | 6204 ZZ |
| 182 T | | 6307 ZZ | 6206 ZZ |
| 184 T | | 6307 ZZ | 6206 ZZ |
| W 182 T | | 6206 ZZ | 6205 ZZ |
| W 184 T | | 6206 ZZ | 6205 ZZ |
| 213 T | | 6308 ZZ | 6207 ZZ |
| 215 T | | 6308 ZZ | 6207 ZZ |
| W 213 T | | 6308 ZZ | 6207 ZZ |
| W 215 T | | 6308 ZZ | 6207 ZZ |
| 254 T | | 6309-C3 | 6209 Z-C3 |
| 256 T | | 6309-C3 | 6209 Z-C3 |
| W 254 T | | 6309-C3 | 6209 Z-C3 |
| W 256 T | | 6309-C3 | 6209 Z-C3 |
| 284 T and TS | | 6311-C3 | 6211 Z-C3 |
| 286 T and TS | | 6311-C3 | 6211 Z-C3 |
| 324 T and TS | | 6312-C3 | 6212 Z-C3 |
| 326 T and TS | | 6312-C3 | 6212 Z-C3 |
| 364 T and TS | | 6314-C3 | 6314-C3 |
| 365 T and TS | | 6314-C3 | 6314-C3 |
| 404 T | | NU 316-C3 | 6314-C3 |
| 404 TS | | 6314-C3 | 6314-C3 |
| 405 T | | NU 316-C3 | 6314-C3 |
| 405 TS | | 6314-C3 | 6414-C3 |
| 444 T | | NU 319-C3 | 6316-C3 |
| 444 TS | | 6314-C3 | 6314-C3 |
| 445 T | | NU 319-C3 | 6316-C3 |
| 445 TS | | 6314-C3 | 6314-C3 |
| 447 T | | NU 319-C3 | 6316-C3 |
| 447 TS | | 6314-C3 | 6314-C3 |
| 449 T | | NU 322-C3 | 6319-C3 |
| 449 TS | | 6314-C3 | 6314-C3 |
| 504 T | | NU 319-C3 | 6316-C3 |
| 504 TS | | 6314-C3 | 6314-C3 |
| 505 T | | NU 319-C3 | 6316-C3 |
| 505 TS | | 6314-C3 | 6314-C3 |
| 5008 T | | NU 322-C3 | 6319-C3 |
| 5008TS | | 6314-C3 | 6314-C3 |
| 586 T | | NU 322-C3 | 6319-C3 |
| 586 TS | | 6314-C3 | 6314-C3 |
| 587 T | | NU 322-C3 | 6319-C3 |
| 587 TS | | 6314-C3 | 6314-C3 |

| Saw Arbor motor frame | Mounting | Bearings | |
|---|---|---|---|
| | | Front (D.E.) | Rear (O.D.E.) |
| 80 S MS | B3 | 6307 ZZ | 6207 ZZ |
| 80 M MS | | 6307 ZZ | 6207 ZZ |
| 80 L MS | | 6307 ZZ | 6207 ZZ |
| 90 L MS | | 6308 ZZ | 6208 ZZ |

| ODP Motors Nema-T frames | Mounting | Bearings | |
|---|---|---|---|
| | | Front (D.E.) | Rear (O.D.E.) |
| E143/5T | HORIZONTAL MOUNTING ONLY | 6205 ZZ | 6204 ZZ |
| F143/5T | | 6205 ZZ | 6204 ZZ |
| 182 T | | 6206 ZZ | 6205 ZZ |
| 184 T | | 6202 ZZ | 6205 ZZ |
| 213/5T | | 6208 ZZ | 6206 ZZ |
| 254 T | | 6309 Z-C3 | 6209 Z-C3 |
| 256 T | | 6309 Z-C3 | 6209 Z-C3 |
| 284 T | | 6311 Z-C3 | 6211 Z-C3 |
| 284 TS | | 6311 Z-C3 | 6211 Z-C3 |
| 286 T | | 6311 Z-C3 | 6211 Z-C3 |
| 286 TS | | 6311 Z-C3 | 6211 Z-C3 |
| 324 T | | 6312 Z-C3 | 6212 Z-C3 |
| 324 TS | | 6312 Z-C3 | 6212 Z-C3 |
| 326 T | | 6312 Z-C3 | 6212 Z-C3 |
| 326 TS | | 6312 Z-C3 | 6212 Z-C3 |
| 364 T | | 6314 C3 | 6314 C3 |
| 364 TS | | 6314 C3 | 6314 C3 |
| 365 T | | 6314 C3 | 6314 C3 |
| 365 TS | | 6314 C3 | 6314 C3 |
| 404 T | | NU 316 C3 | 6314 C3 |
| 404 TS | | 6314 C3 | 6314 C3 |
| 405 T | | NU 316 C3 | 6314 C3 |
| 405 TS | | 6314 C3 | 6314 C3 |
| 444 T | | NU 319 C3 | 6316 C3 |
| 444 TS | | 6314 C3 | 6314 C3 |
| 445 T | | NU 319 C3 | 6316 C3 |
| 445 TS | | 6314 C3 | 6314 C3 |

| IEC frame | Mounting | Bearings | |
|---|---|---|---|
| | | Front (D.E.) | Rear (O.D.E.) |
| Totally enclosed fan cooled motors | | | |
| 63 | B3 | 6201 ZZ | 6201 ZZ |
| 71 | | 6203 ZZ | 6202 ZZ |
| 80 | | 6204 ZZ | 6203 ZZ |
| 90 S - L | | 6205 ZZ | 6204 ZZ |
| 100 L | | 6206 ZZ | 6205 ZZ |
| 112 M | | 6307 ZZ | 6206 ZZ |
| 132 S - M | | 6308 ZZ | 6207 ZZ |
| 160 M - L | | 6309-C3 | 6209 Z-C3 |
| 180 M - L | | 6311-C3 | 6211 Z-C3 |
| 200 M - L | | 6312-C3 | 6212 Z-C3 |
| 225 S/M | | 6314-C3 | 6314-C3 |
| 250 S/M | | 6314-C3 | 6314-C3 |
| 280 S/M | | 6314-C3 | 6314-C3 |
| | | 6316-C3 | 6316-C3 |
| 315 S/M | | 6314-C3 | 6314-C3 |
| | | 6319-C3 | 6316-C3 |
| 355 M/L | | 6314-C3 | 6314-C3 |
| | | NU 322-C3 | 6319-C3 |

***Table 12** – Bearing lubrication intervals and amount of grease*

| **BALL BEARINGS - Series 62/63** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Relubrication intervals (running hours – horizontal position) | | | | | | | | | | | | | |
| | II pole | | IV pole | | VI pole | | VIII pole | | X pole | | XII pole | | Amount of grease |
| Serie 62 | | | | | | | | | | | | | |
| Bearing | 60Hz | 50Hz | 60Hz | 50Hz | 60Hz | 50Hz | 60Hz | 50Hz | 60Hz | 50Hz | 60Hz | 50Hz | (g) |
| 6209 | 18400 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 9 |
| 6211 | 14200 | 16500 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 11 |
| 6212 | 12100 | 14400 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 13 |
| Serie 63 | | | | | | | | | | | | | |
| Bearing | 60Hz | 50Hz | 60Hz | 50Hz | 60Hz | 50Hz | 60Hz | 50Hz | 60Hz | 50Hz | 60Hz | 50Hz | (g) |
| 6309 | 15700 | 18100 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 13 |
| 6311 | 11500 | 13700 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 18 |
| 6312 | 9800 | 11900 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 21 |
| 6314 | 3600 | 4500 | 9700 | 11600 | 14200 | 16400 | 17300 | 19700 | 19700 | 20000 | 20000 | 20000 | 27 |
| 6316 | - | - | 8500 | 10400 | 12800 | 14900 | 15900 | 18700 | 18700 | 20000 | 20000 | 20000 | 34 |
| 6319 | - | - | 7000 | 9000 | 11000 | 13000 | 14000 | 17400 | 17400 | 18600 | 18600 | 20000 | 45 |
| 6322 | - | - | 5100 | 7200 | 9200 | 10800 | 11800 | 15100 | 15100 | 15500 | 15500 | 19300 | 60 |

***Table 13** – Bearing lubrication intervals and amount of grease*

| **BALL BEARINGS - Series NU3** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Relubrication intervals (running hours – horizontal position) | | | | | | | | | | | | | |
| | II pole | | IV pole | | VI pole | | VIII pole | | X pole | | XII pole | | Amount of grease |
| Bearing | 60Hz | 50Hz | 60Hz | 50Hz | 60Hz | 50Hz | 60Hz | 50Hz | 60Hz | 50Hz | 60Hz | 50Hz | (g) |
| NU 309 | 9800 | 13300 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 13 |
| NU 311 | 6400 | 9200 | 19100 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 18 |
| NU 312 | 5100 | 7600 | 17200 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 21 |
| NU 314 | 1600 | 2500 | 7100 | 8900 | 11000 | 13100 | 15100 | 16900 | 16900 | 19300 | 19300 | 20000 | 27 |
| NU 316 | - | - | 6000 | 7600 | 9500 | 11600 | 13800 | 15500 | 15500 | 17800 | 17800 | 20000 | 34 |
| NU 319 | - | - | 4700 | 6000 | 7600 | 9800 | 12200 | 13700 | 13700 | 15700 | 15700 | 20000 | 45 |
| NU 322 | - | - | 3300 | 4400 | 5900 | 7800 | 10700 | 11500 | 11500 | 13400 | 13400 | 17300 | 60 |
| NU 324 | - | - | 2400 | 3500 | 5000 | 6600 | 10000 | 10200 | 10200 | 12100 | 12100 | 15000 | 72 |

Notes:

- The ZZ bearings from 6201 to 6307 do not require relubrication as its life time is about 20,000 hours.
- Tables 1 and 2 are intended for the lubrication period under bearing temperature of 70ºC (for bearings up to 6312 and NU 312) and temperature of 85ºC (for bearings 6314 and NU 314 and larger).
- For each 15ºC of temperature rise, the relubrication period is reduced by half.
- The relubrication periods given above are for those cases applying Polyrex® EM grease.
- When motors are used on the vertical position, their relubrication interval is reduced by half if compared to horizontal position motors.

**Compatibility of Polyrex® EM grease with other types of grease:**

Containing polyurea thickener and mineral oil, the Polyrex® EM grease is compatible with other types of grease that contain:

- Lithium base or complex of lithium or polyurea and highly refined mineral oil.
- Inhibitor additive against corrosion, rust and anti-oxidant additive.

Notes:

- Although Polyrex® EM is compatible with types of grease given above, we do no recommended to mix it with any other greases.
- If you intend to use a type of grease different than those recommended above , first contact WEG.
- On applications (with high or low temperatures, speed variation, etc), the type of grease and relubrification interval are given on an additional nameplate attached to the motor.

# 4. Maintenance

A well-designed maintenance program for electric motors can be summed up as: periodical inspection of insulation levels, temperature rise, wear, bearing lubrication and the occasional checking of fan air flow.
Inspection cycles depend upon the type of motor and the conditions under which it operates.

## 4.1 Cleanliness

Motors should be kept clean, free of dust, debris and oil. Soft brushes or clean cotton rags should be used for cleaning. A jet of compressed air should be used to remove non-abrasive dust from the fan cover and any accumulated grime from the fan and cooling fins.
Oil or damp impregnated impurities can be removed with rags soaked in a suitable solvent.
Terminal boxes fitted to motors with IP55 protection should be cleaned; their terminals should be free of oxidation, in perfect mechanical condition, and all unused space dust-free.
Motors with IPW 55 protection are recommended for use under unfavourable ambient conditions.

## 4.2 Lubrication

Proper lubrication extends bearing life.

### Lubrication Maintenance Includes:

a) Attention to the overall state of the bearings;
b) Cleaning and lubrication;
c) Critical inspection of the bearings.

Motor noise should be measured at regular intervals of one to four months. A well-tuned ear is perfectly capable of distinguishing unusual noises, even with rudimentary tools such as a screw driver, etc., without recourse to sophisticated listening aids or stethescopes that are available on the market.
A uniform hum is a sign that a bearing is running perfectly. Bearing temperature control is also part of routine maintenance.
Constant temperature control is possible with the aid of external thermometers or by embedded thermal elements. WEG motors are normally equipped with grease lubricated ball or roller bearings.
Bearings should be lubricated to avoid metallic contact of the moving parts, and also for protection against corrosion and wear. Lubricant properties deteriorate in the course of time and mechanical operation: furthermore, all lubricants are subject to contamination under working conditions.
For this reason lubricants must be renewed and any lubricant consumed needs replacing from time to time.

### 4.2.1 Periodical Lubrication

WEG motors are supplied with sufficient grease for a long running period. Lubrication intervals, the amount of grease and the type of bearing used in frames 140T to 580T are to be found in Tables 11, 12 and 13.
Lubrication intervals depend upon the size of the motor, speed, working conditions and the type of grease used.

### 4.2.2 Quality and Quantity of Grease

***Correct lubrication is important!***
Grease must be applied correctly and in sufficient quantity as both insufficient or excessive greasing are harmful.
Excessive greasing causes overheating brought about by the greater resistance encountered by the rotating parts and, in particular, by the compacting of the lubricant and its eventual loss of lubricating qualities.
This can cause seepage with the grease penetrating the motor and dripping on the coils.

**GREASES FOR MOTOR BEARINGS**

| **For operating temperatures from -30 to 170ºC** | |
|---|---|
| **Type** | **Supplier** |
| Polyrex® EM | Esso |

### 4.2.3 Lubricating Instructions

a) Frame 140T to 210T motors
Frame 140T to 210T size motors are not fitted with grease nipples. Lubrication is carried out during periodical overhauls when the motor is taken apart.

### Cleaning and Lubrication of Bearings

With the motor dismantled and without extracting the bearings from the shaft, all existing grease should be removed and the bearings cleaned with Diesel oil, kerosene or other solvent, until thoroughly clean.
Refill the spaces between the balls or rollers and the bearing cages with grease immediately after washing. Never rotate bearings in their dry state after washing.
For inspection purposes apply a few drops of machine oil. During these operations maximum care and cleanliness is recommended to avoid the penetration of any impurities or dust that could harm the bearings. Clean all external parts prior to reassembly.

b) Frame 360T to 580T Motors
Motors above 360T frame size are fitted with regreasable bearing system.
The lubrication system from this frame size upwards was designed to allow the removal of all grease from the bearing races through a bleeder outlet which at the same time impedes the entry of dust or other contaminants harmful to the bearing.
This outlet also prevents injury to the bearings from the well-known problem of over-greasing.

It is advisable to lubricate while the motor is running, to allow the renewal of grease in the bearing case.
Should this procedure not be possible because of rotating parts in the proximity of the nipple (pulleys, coupling sleeves, etc.) that are hazardous to the operator the following procedure should be followed:
- Inject about half the estimated amount of grease and run the motor at full speed for approximately a minute; switch off the motor and inject the remaining grease.
The injection of all the grease with the motor at rest could cause penetration of a portion of the lubricant through the internal seal of the bearing case and hence into the motor.

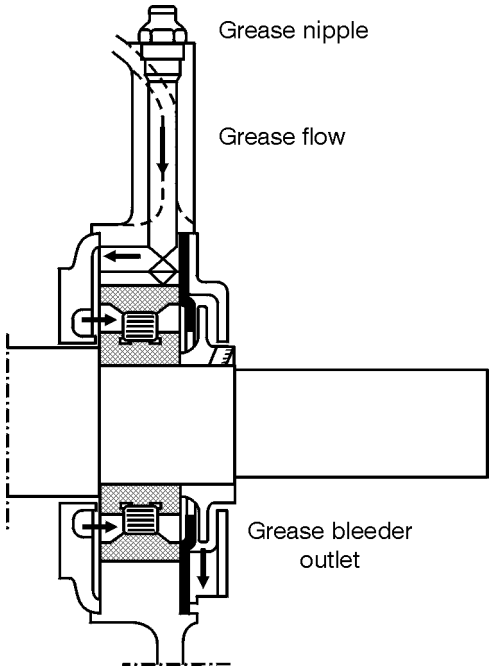



*Figure 4.1 - Bearings and lubrication system*

Nipples must be clean prior to introduction of grease to avoid entry of any alien bodies into the bearing.
For lubricating use only a manual grease gun.

### Bearing Lubrication Steps

1. Cleanse the area around the grease nipples with clean cotton fabric.
2. With the motor running, add grease with a manual grease gun until the lubricant commences to be expelled from the bleeder outlet, or until the quantity of grease recommended in Tables 12 or 13 has been applied.
3. Allow the motor to run long enough to eject all excess grease.

### 4.2.4 Replacement of Bearings

The opening of a motor to replace a bearing should only be carried out by qualified personnel.
Damage to the core after the removal of the bearing cover can be avoided by filling the gap between the rotor and the stator with stiff paper of a proper thickness.

Providing suitable tooling is employed, disassembly of a bearing is not difficult.
The extractor grips should be applied to the sidewall of the inner ring to be stripped, or to an adjacent part.
To ensure perfect functioning and to prevent injury to the bearing parts, it is essential that the assembly be undertaken under conditions of complete cleanliness and by competent personnel.
New bearings should not be removed from their packages until the moment of assembly.
Prior to fitting a new bearing, ascertain that the shaft has no rough edges or signs of hammering.

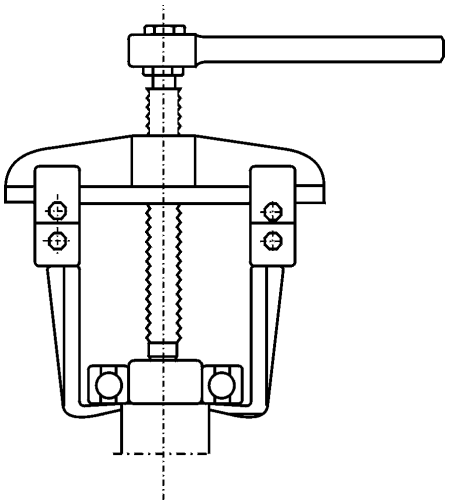


*Figure 4.2 - A bearing extractor*

During assembly bearings cannot be subjected to direct blows.
The aid used to press or strike the bearing should be applied to the inner ring.

## 4.3 Air Gap Checking (Large Rating Open Motors)

Upon the completion of any work on the bearings check the gap measurement between the stator and the rotor using the appropriate gazes.
The gap variation at any two vertically opposite points must be less than 10% of the average gap measurement.

## 4.4 Explosion Proof Motor Repair Steps

### 4.4.1 Objective

In view of the heavy liability associated with burning of motors of this type, this product has been designed and manufactured to high technical standards, under rigid controls. In addition, in many areas it is required that explosion proof motors ONLY be repaired by licensed personnel or in licensed facilities authorized to do this type of work.
The following general procedures, safeguards, and guidelines must be followed in order to ensure repaired explosion proof motors operate as intended.

### 4.4.2 Repair Procedure and Precautions

Dismantle the damaged motor with appropriate tools without hammering and/or pitting machined surfaces such as enclosure joints, fastening

holes, and all joints in general.
The position of the fan cover should be suitably marked prior to removal so as to facilitate reassembly later on.
Examine the motor's general condition and, if necessary, disassemble all parts and clean them with kerosene. Under no circumstances should scrapers, emery papers or tools be used that could affect the dimensions of any part during cleaning.
Protect all machined parts against oxidation by applying a coating of vaseline or oil immediately after cleaning.

***STRIPPING OF WINDINGS***
This step requires great care to avoid knocking and/or denting of enclosure joints and, when removing the sealing compound from the terminal box, damage or cracking of the frame.

***IMPREGNATION***
Protect all frame threads by inserting corresponding bolts, and the joint between terminal box and frame, by coating it with a non-adhesive varnish (ISO 287 - ISOLASIL).
Protective varnish on machined parts should be removed soon after treating with impregnating varnish. This operation should be carried out manually without using tools.

***ASSEMBLY***
Inspect all parts for defects, such as cracks, joint incrustations, damaged threads and other potential problems.
Assemble using a rubber headed mallet and a bronze bushing after ascertaining that all parts are perfectly fitted.
Bolts should be positioned with corresponding spring washers and evenly tightened.

***TESTING***
Rotate the shaft by hand while examining for any drag problems on covers or fastening rings.
Carry out running tests as for standard motors.

***MOUNTING THE TERMINAL BOX***
Prior to fitting the terminal box all cable outlets on the frame should be sealed with a sealing compound (I$^{st}$ layer) and an Epoxy resin (ISO 340) mixed with ground quartz (2$^{nd}$ layer) in the following proportions:

| | |
|---|---|
| 340A resin | 50 parts |
| 340B resin | 50 parts |
| Ground quartz | 100 parts |

Drying time for this mixture is two hours during which the frame should not be handled and cable outlets should be upwards.
When dry, see that the outlets and areas around the cables are perfectly sealed.
Mount the terminal box and paint the motor.

### 4.4.3 Miscellaneous Recommendations

- Any damaged parts (cracks, pittings in machined surfaces, defective threads) must be replaced and under no circumstances should attempts be made to recover them.
- Upon reassembling explosion proof motors IPW55 the substitution of all seals is mandatory.
- Should any doubts arise, consult WEG.

# 5. Malfunctioning

Most malfunctions affecting the normal running of electric motors can be prevented by maintenance and the appropriate precautions.
While ventilation, cleanliness and careful maintenance are the main factors ensuring long motor life, a further essential factor is the prompt attention to any malfunctioning as signalled by vibrations, shaft knock, declining insulation resistance, smoke or fire, sparking or unusual slip ring or brush wear, sudden changes of bearing temperatures.
When failures of an electric or mechanical nature arise, the first step to be taken is to stop the motor and subsequent examination of all mechanical and electrical parts of the installation.
In the event of fire, the installation should be isolated from the mains supply, which is normally done by turning off the respective switches.
In the event of fire within the motor itself, steps should be taken to restrain and suffocate it by covering the ventilation vents.
To extinguish a fire, dry chemical or $C0_2$ extinguishers should be used - never water.

## 5.1 Standard Three-Phase Motor Failures

Owing to the widespread usage of asynchronous three-phase motors in industry which are more often repaired in the plant workshops, there follows a summary of possible failures and their probable causes, detection and repairs.
Motors are generally designed to Class B or F insulation and for ambient temperatures up to 40°C.
Most winding defects arise when temperature limits, due to current overload, are surpassed throughout the winding or even in only portions thereof. These defects are identified by the darkening or carbonizing of wire insulation.

### 5.1.1 Short Circuits Between Turns

A short circuit between turns can be a consequent of two coinciding insulation defects, or the result of defects arising simultaneously on two adjacent wires. As wires are randomly tested, even the best quality wires can have weak spots. Weak spots can, on occasion, tolerate a voltage surge of 30% at the time of testing for shorting between turns, and later fail due to humidity, dust or vibration.
Depending on the intensity of the short, a magnetic hum becomes audible.
In some cases, the three-phase current imbalance can be so insignificant that the motor protective device fails to react. A short circuit between turns, and phases to ground due to insulation failure is rare, and even so, it nearly always occurs during the early stages of operation.

### 5.1.2 Winding Failures

#### a) One burnt winding phase

This failure arises when a motor runs wired in delta and current fails in one main conductor.
Current rises from 2 to 2.5 times in the remaining winding with a simultaneous marked fall in speed. If the motor stops, the current will increase from 3.5 to 4 times its rated value.
In most instances, this defect is due to the absence of a protective switch, or else the switch has been set too high.

#### b) Two burnt winding phases

This failure arises when current fails in one main conductor and the motor winding is star-connected. One of the winding phases remains currentless while the others absorb the full voltage and carry an excessive current.
The slip almost doubles.

#### c) Three burnt winding phases

***Probable cause 1***

Motor only protected by fuses; an overload on the motor will be the cause of the trouble.
Consequently, progressive carbonizing of the wires and insulation culminate in a short circuit between turns, or a short against the frame occurs.
A protective switch placed before the motor would easily solve this problem.

***Probable cause 2***

Motor incorrectly connected. For example: A motor with windings designed for 230/400V is connected through a star-delta switch to 400V connection.
The absorted current will be so high that the winding will burn out in a few seconds if the fuses or a wrongly set protective switch fail to react promptly.

***Probable cause 3***

The star-delta switch is not commutated and the motor continues to run for a time connected to the star under overload conditions.
As it only develops 1/3 of its torque, the motor cannot reach rated speed. The increased slip results in higher ohmic losses arising from the Joule effect. As the stator current, consistent with the load, may not exceed the rated value for the delta connection, the protective switch will not react.
Consequent to increased winding and rotor losses the motor will overheat and the winding burn out.

***Probable cause 4***

Failures from this cause arise from thermal overload, due to too many starts under intermittent operation or to an overly long starting cycle.
The perfect functioning of motor operating under these conditions is only assured when the following values are heeded:
a) number of starts per hour;
b) starting with or without load;
c) mechanical brake or current inversion;
d) acceleration of rotating masses connected to motor shaft;
e) load torque vs. speed during acceleration and braking.

The continuous effort exerted by the rotor during intermittent starting brings about heavier losses which provoke overheating.
Under certain circumstances with the motor idle there is a possibility that the stator winding is subjected to damage as a result of the

heating of the motor. In such a case, a slip ring motor is recommended as a large portion of the heat (due to rotor losses) is dissipated in the rheostat.

### 5.1.3 Rotor Failures

If a motor running under load conditions produces a noise of varying intensity and decreasing frequency while the load is increased, the reason, in most cases, will be an unsymmetrical rotor winding.
In squirrel-cage motors the cause will nearly always be a break in one or more of the rotor bars; simultaneously, periodical stator current fluctuations may be recorded. As a rule, this defect appears only in molded or die cast aluminum cages.
Failures due to spot heating in one or another of the bars in the rotor stack are identified by the blue coloration at the affected points.
Should there be failures in various contiguous bars, vibrations and shuddering can occur as if due to an unbalance, and are often interpreted as such. When the rotor stack acquires a blue or violet coloration, it is a sign of overloading.
This can be caused by overly high slip, by too many starts or overlong starting cycles. This failure can also arise from insufficient main voltage.

### 5.1.4 Bearing Failures

Bearing damage is a result of overloading brought about by an overly taut belt or axial impacts and stresses.
Underestimating the distance between the drive pulley and the driven pulley is a common occurrence.
The arc of contact of the belt on the drive pulley thus becomes inadmissibly small and thereby belt tension is insufficient for torque transmission.
In spite of this it is quite usual to increase belt tension in order to attain sufficient drive.
Admittably, this is feasible with the latest belt types reinforced by synthetic materials.
However, this practice fails to consider the load on the bearing and the result is bearing failure within a short time.
Additionally there is the possibility of the shaft being subjected to unacceptably high loads when the motor is fitted with a pulley that is too wide.

### 5.1.5 Shaft Fractures

Although bearings traditionally constitute the weaker part, and the shafts are designed with wide safety margins, it is not beyond the realm of possibility that a shaft may fracture by fatigue from bending stress brought about by excessive belt tension.
In most cases, fractures occur right behind the drive end bearing.
As a consequence of alternating bending stress induced by a rotating shaft, fractures travel inwards from the outside of the shaft until the point of rupture is reached when resistance of the remaining shaft cross-section no longer suffices.
Avoid additional drilling the shaft (fastening screw holes) as such operations tend to cause stress concentration.

### 5.1.6 Unbalanced V-Belt Drives

The substitution of only one of a number of other parallel belts on a drive is frequently the cause of shaft fractures, as well as being malpractice.
Any used, and consequently stretched belts retained on the drive, especially those closest to the motor, while new and unstretched belts are placed on the same drive turning farther from the bearing, can augment shaft stress.

### 5.1.7 Damage Arising from Poorly Fitted Transmission Parts or Improper Motor Alignment

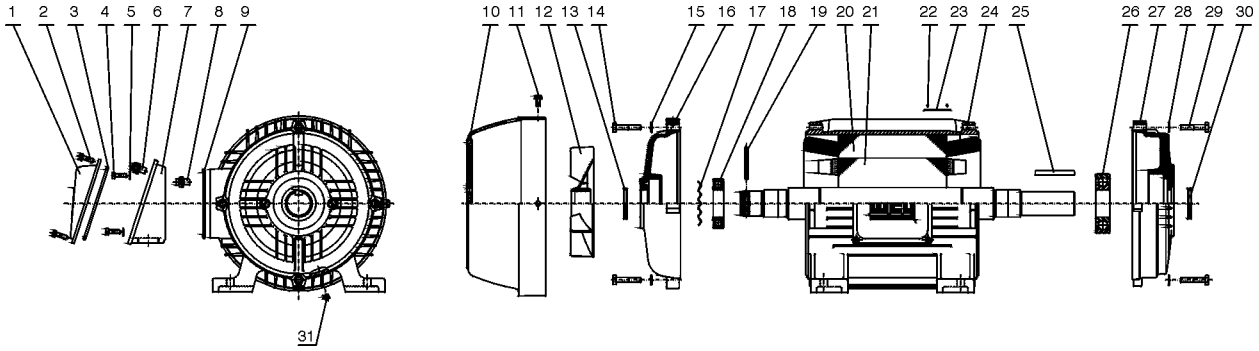
Damage to bearing and fracture in shafts often ensue from inadequate fitting of pulleys, couplings or pinions. There parts “knock” when rotating. The defect is recognized by the scratches that appear on the shaft or the eventual scalelike flaking of the shaft end.
Keyways with edges pitted by loosely fitted keys can also bring about shaft failures.
Poorly aligned couplings cause knocks and radial and axial shaking to shaft and bearings.
Within a short while these malpractices cause the deterioration of the bearings and the enlargement of the bearing cover bracket located on the drive end side.
Shaft fracture can occur in more serious cases.

## 5.2 Troubleshooting chart

| FAILURE | PROBABLE CAUSE | CORRECTIVE MEASURES |
|---|---|---|
| **Motor fails to start** | • No voltage supply<br>• Low voltage supply<br>• Wrong control connections<br>• Loose connection at some terminal lug<br>• Overload | • Check feed connections to control system and from this to motor.<br>• Check voltage supply and ascertain that voltage remains within 10% of the rated voltage shown on the motor nameplate.<br>• Compare connections with the wiring diagram on the motor nameplate.<br>• Tighten all connections.<br>• Try to start motor under no-load conditions. If it starts, there may be an overload condition or a blocking of the starting mechanism. Reduce load to rated load level and increase torque. |
| **High noise level** | • Unbalance<br>• Distorted shaft<br>• Incorrect alignment<br>• Uneven air gap<br>• Dirt in the air gap<br>• Extraneous matter stuck between fan and motor casing<br>• Loose motor foundation<br>• Worn bearings | • Vibrations can be eliminated by balancing rotor. If load is coupled directly to motor shaft, the load can be unbalanced.<br>• Shaft key bent; check rotor balance and eccentricity.<br>• Check motor aligment with machine running.<br>• Check shaft for warping or bearing wear.<br>• Dismantle motor and remove dirt or dust with jet of dry air.<br>• Dismantle motor and clean. Remove trash or debris from motor vicinity.<br>• Tighten all foundation studs. If necessary, realign motor.<br>• Check lubrication. Replace bearing if noise is excessive and continuous. |
| **Overheating of bearings** | • Excessive grease<br>• Excessive axial or radial strain on belt<br>• Deformed shaft<br>• Rough bearing surface<br>• Loose or poorly fitted motor end shields<br>• Lack of grease<br>• Hardened grease cause locking of balls<br>• Foreign material in grease | • Remove grease bleeder plug and run motor until excess grease is expelled.<br>• Reduce belt tension.<br>• Have shaft straightened and check rotor balance.<br>• Replace bearings before they damage shaft.<br>• Check end shields for close fit and tightness around circumference.<br>• Add grease to bearing.<br>• Replace bearings.<br>• Flush out housings and relubricate. |
| **Intense bearing vibration** | • Unbalanced rotor<br>• Dirty or worn bearing<br>• Bearing rings too tight on shaft and/or bearing housing<br>• Extraneous solid particles in bearing | • Balance rotor statically and dynamically.<br>• If bearing rings are in perfect condition, clean and relubricate the bearing, otherwise, replace bearing.<br>• Before altering shaft or housing dimensions, it is advisable to ascertain that bearing dimensions correspond to manufacturer's specifications.<br>• Take bearing apart and clean. Reassemble only if rotating and support surfaces are unharmed. |
| **Overheating of motor** | • Obstructed cooling system<br>• Overload<br>• Incorrect voltages and frequecies<br>• Frequent inversions<br>• Rotor dragging on stator<br>• Unbalanced electrical load (burnt fuse, incorrect control) | • Clean and dry motor; inspect air vents and windings periodically.<br>• Check application, measuring voltage and current under normal running conditions.<br>• Compare values on motor nameplate with those of mains supply. Also check voltage at motor terminals under full load.<br>• Exchange motor for another that meets needs.<br>• Check bearing wear and shaft curvature.<br>• Check for unbalanced voltages or operation under single-phase condition. |

# 6. Spare Parts and Component Terminology

## THREE-PHASE MOTORS IP55 NEMA
## Frames 140T - W180T - 180T - 210T and W210T

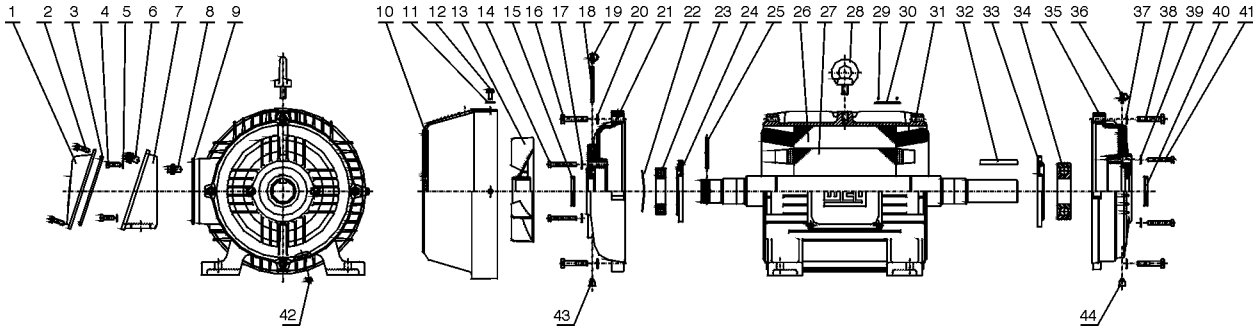



| Part Nr. | Description |
|---|---|
| 1 | Terminal box cover |
| 2 | Terminal box cover fixing bolt |
| 3 | Terminal box cover gasket |
| 4 | Terminal box fixing bolt |
| 5 | Terminal box fixing washer |
| 6 | Terminal box grounding lug |
| 7 | Terminal box |
| 8 | Frame grounding lug |
| 9 | Terminal box o'ring gasket |
| 10 | Fan cover |
| 11 | Fan cover fixing bolt |
| 12 | Fan |

| Part Nr. | Description |
|---|---|
| 13 | V'Ring |
| 14 | Non-drive end endshield fixing bolt |
| 15 | Non-drive end endshield washer |
| 16 | Non-drive endshield |
| 17 | Spring washer |
| 18 | Non-drive bearing |
| 19 | Fan fixing pin |
| 20 | Wound stator |
| 21 | Rotor / shaft assembly |
| 22 | Nameplate fixing rivet |
| 23 | Nameplate |
| 24 | Frame |

| Part Nr. | Description |
|---|---|
| 25 | Shaft key |
| 26 | Drive end bearing |
| 27 | Drive endshield |
| 28 | Drive endshield washer |
| 29 | Drive end endshield fixing bolt |
| 33 | V'Ring |
| 31 | Drain plug |

## THREE-PHASE MOTORS IP55 NEMA
## Frames 250T - W250T - 280T and 320T

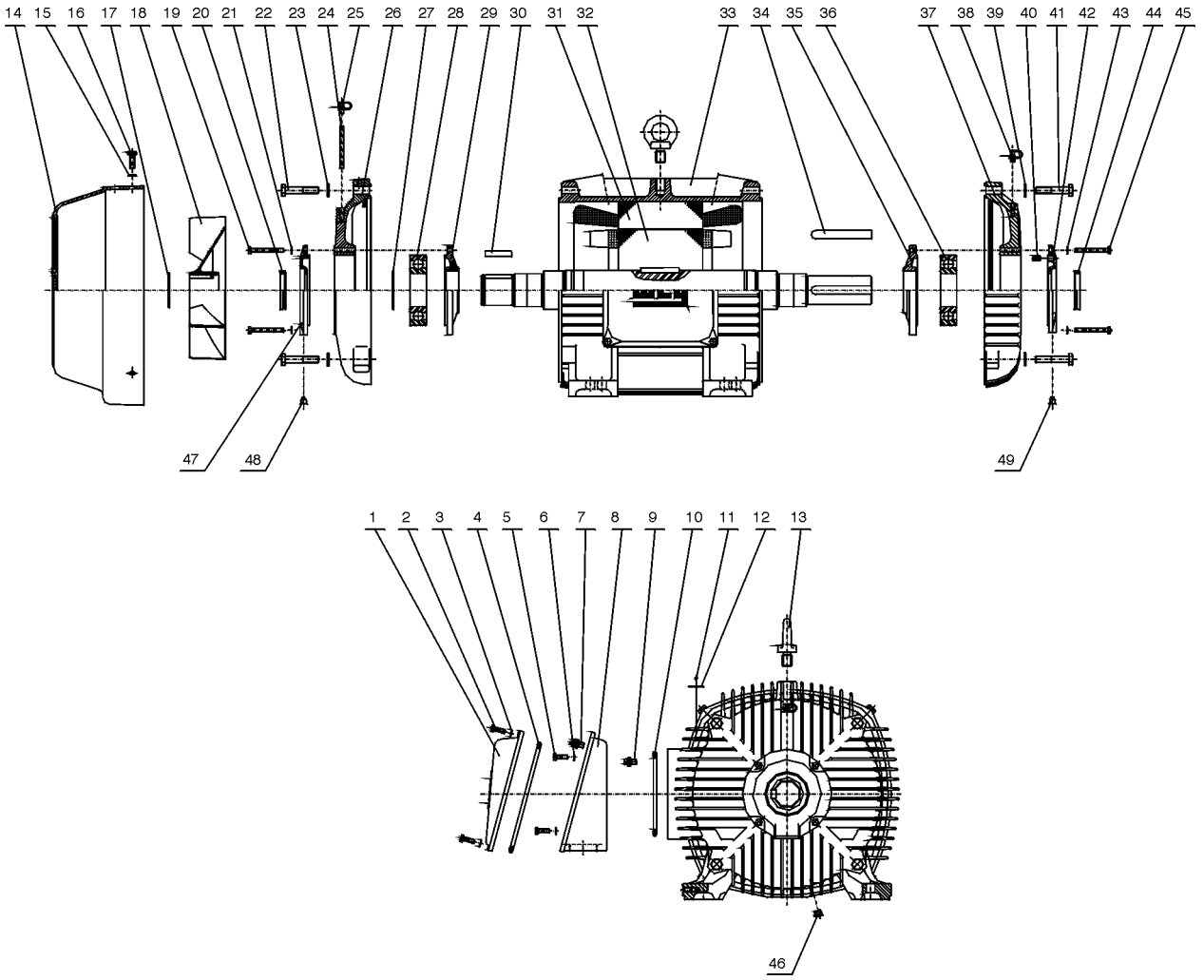



| Part Nr. | Description |
|---|---|
| 1 | Terminal box cover |
| 2 | Terminal box cover fixing bolt |
| 3 | Terminal box cover gasket |
| 4 | Terminal box fixing bolt |
| 5 | Terminal box fixing washer |
| 6 | Terminal box grounding lug |
| 7 | Terminal box |
| 8 | Frame grounding lug |
| 9 | Terminal box o'ring gasket |
| 10 | Fan cover |
| 11 | Fan cover washer |
| 12 | Fan cover fixing bolt |
| 13 | Fan |
| 14 | Non-drive end bearing cap bolt |
| 15 | V'Ring |

| Part Nr. | Description |
|---|---|
| 16 | Non-drive end endshield fixing bolt |
| 17 | Non-drive end bearing cap washer |
| 18 | Non-drive end grease nipple |
| 19 | Non-drive end grease nipple cover |
| 20 | Non-drive end endshield washer |
| 21 | Non-drive endshield |
| 22 | Spring washer |
| 23 | Non-drive end bearing |
| 24 | Non-drive end bearing cap |
| 25 | Fan fixing pin |
| 26 | Wound stator |
| 27 | Rotor and shaft |
| 28 | Eyebolt |
| 29 | Nameplate fixing rivet |

| Part Nr. | Description |
|---|---|
| 30 | Nameplate |
| 31 | Frame |
| 32 | Shaft key |
| 33 | Drive end bearing cap |
| 34 | Drive end bearing |
| 35 | Drive andshield |
| 36 | Drive end grease nipple cover |
| 37 | Drive endshield washer |
| 38 | Drive end endshield fixing bolt |
| 39 | Drive end bearing cap washer |
| 40 | V'Ring |
| 41 | Drive end bearing cap fixing bolt |
| 42 | Drain plug |
| 43 | Non-drive and grease relief |
| 44 | Drive end grease relief |

## THREE-PHASE MOTORS IP55 NEMA T
## Frames 360T - 400T - 440T - 500T and 580T

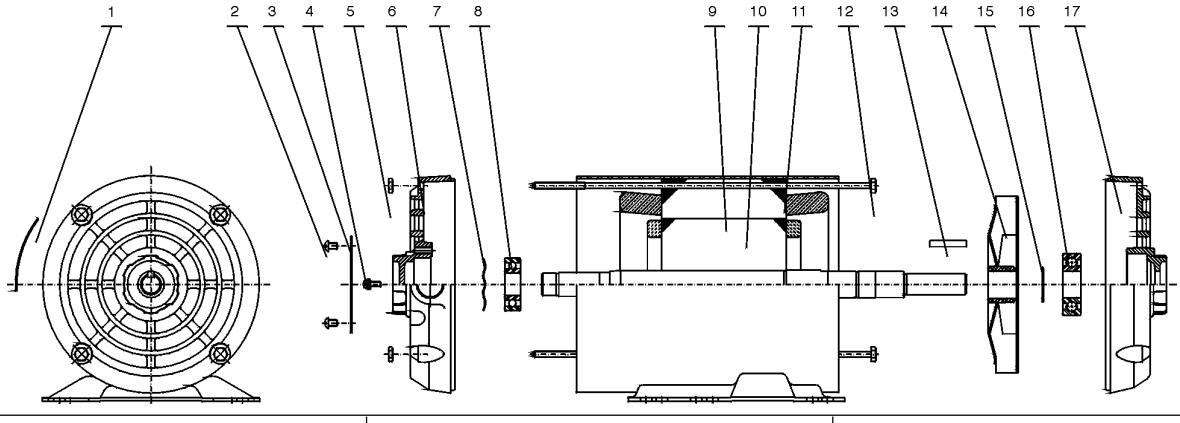



| Part Nr. | Description |
|---|---|
| 1 | Terminal box cover |
| 2 | Terminal box cover fixing bolt |
| 3 | Terminal box cover washer |
| 4 | Terminal box cover gasket |
| 5 | Terminal box fixing bolt |
| 6 | Terminal box fixing washer |
| 7 | Terminal box grounding lug |
| 8 | Terminal box |
| 9 | Frame grounding lug |
| 10 | Terminal box o'ring gasket |
| 11 | Nameplate fixing rivet |
| 12 | Nameplate |
| 13 | Eyebolt |
| 14 | Fan cover |
| 15 | Fan cover washer |
| 16 | Fan cover fixing bolt |
| 17 | Fan fixing ring |

| Part Nr. | Description |
|---|---|
| 18 | Fan |
| 19 | Non-drive end bearing cap bolt |
| 20 | V'Ring |
| 21 | Non-drive end bearing cap washer |
| 22 | Non-drive end endshield fixing bolt |
| 23 | Non-drive end endshield washer |
| 24 | Non-drive end grease nipple |
| 25 | Non-drive end grease nipple cover |
| 26 | Non-drive enshield |
| 27 | Bearing cap |
| 28 | Non-drive bearing |
| 29 | Internal non-drive end bearing cap |
| 30 | Fan fixing key |
| 31 | Wound stator |
| 32 | Rotor / shaft assembly |
| 33 | Frame |

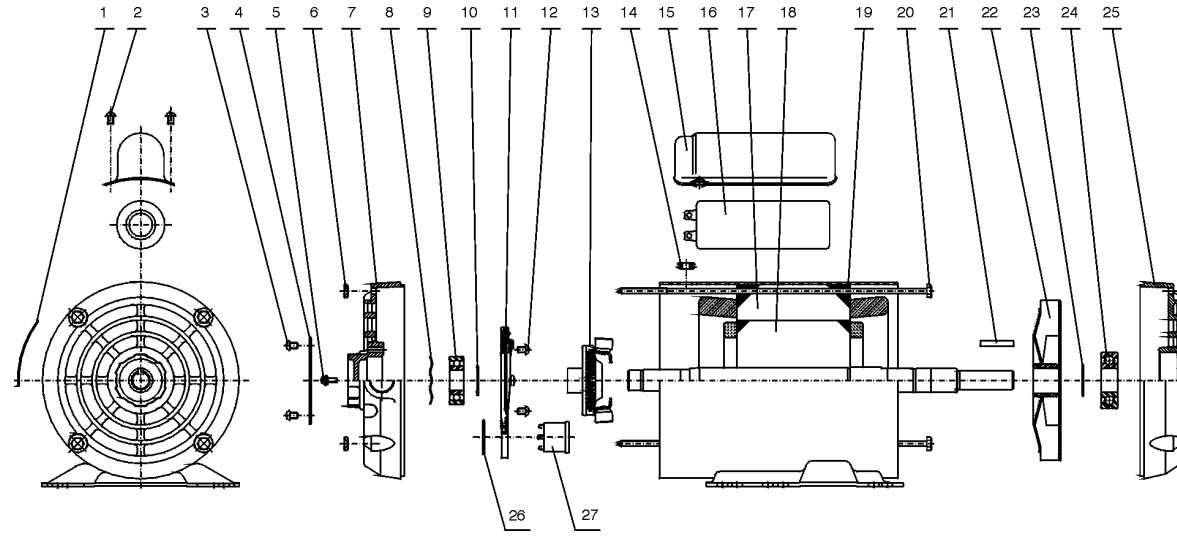
| Part Nr. | Description |
|---|---|
| 34 | Shaft key |
| 35 | Internal drive end bearing cap |
| 36 | Drive end bearing |
| 37 | Drive endshield |
| 38 | Drive end grease nipple cover |
| 39 | Drive endshield washer |
| 40 | Pre-load spring |
| 41 | Drive end endshield fixing bolt |
| 42 | External drive end bearing cap |
| 43 | Drive end bearing cap washer |
| 44 | V'Ring |
| 45 | Drive end bearing cap fixing bolt |
| 46 | Drain plug |
| 47 | External non-drive end bearing cap |
| 48 | Non drive end grease relief |
| 49 | Non-drive end grease relief |

## THREE-PHASE MOTORS NEMA 56
## Frames A56 - B56 - D56 - F56H and G56H




| Part Nr. | Description |
|---|---|
| 1 | Sticker |
| 2 | Terminal box cover fixing bolt |
| 3 | Terminal box cover |
| 4 | Grounding lug |
| 5 | Through bolt fastening nut |
| 6 | Non-drive endshield |
| 7 | Spring washer |
| 8 | Non-drive end bearing |
| 9 | Wound stator |
| 10 | Rotor / shaft assembly |
| 11 | Frame |
| 12 | Through bolt |
| 13 | Shaft key |
| 14 | Fan |
| 15 | Drive end bearing fastening washer |
| 16 | Drive end bearing |
| 17 | Drive endshield |

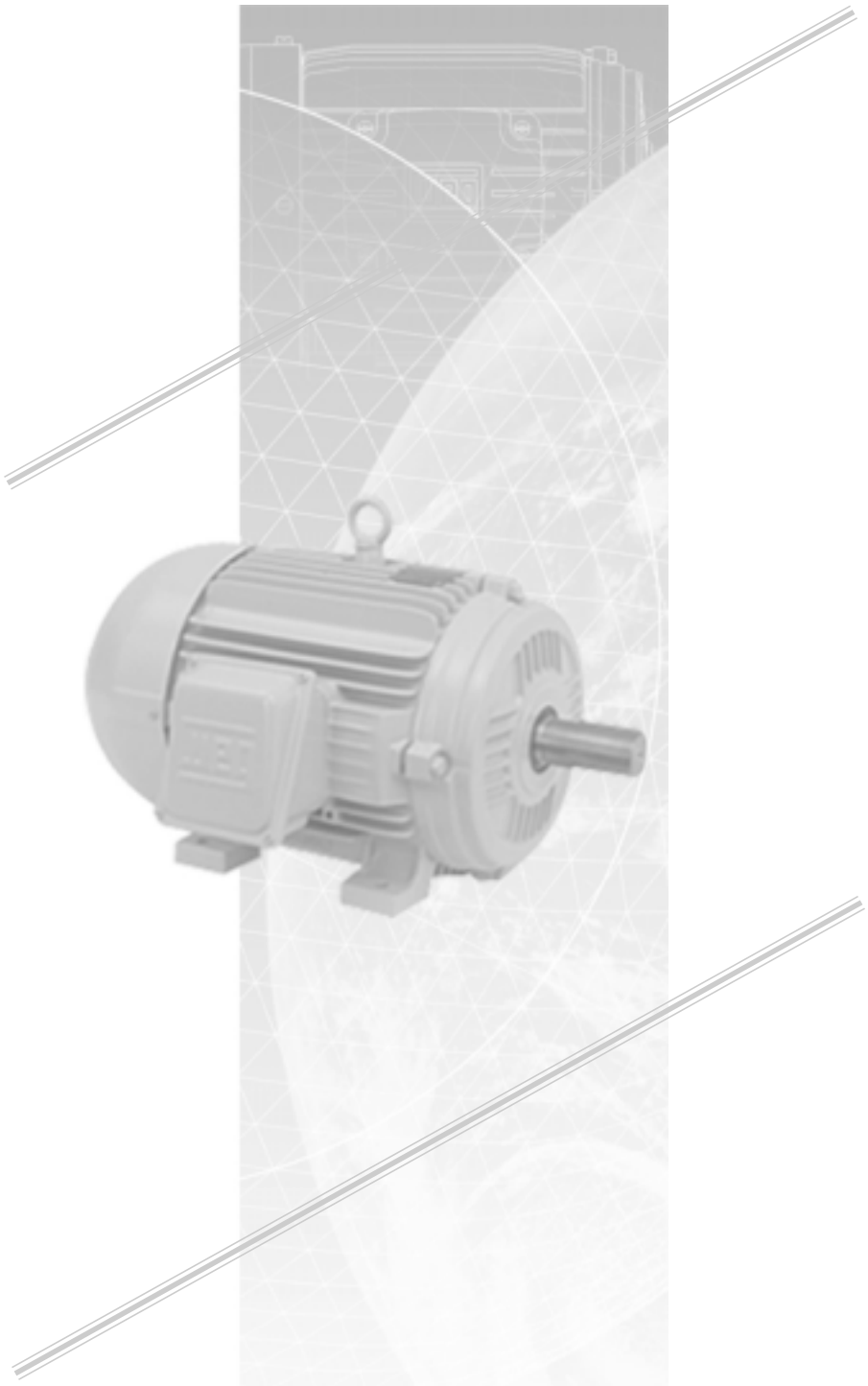
## SINGLE-PHASE MOTORS NEMA 56
## Frames B48 - C48 - C56 - A56 - B56 - D56 - F56H - G56H




| Part Nr. | Description |
|---|---|
| 1 | Sticker |
| 2 | Capacitor cover fixing bolt |
| 3 | Terminal box cover fixing bolt |
| 4 | Terminal box cover |
| 5 | Grounding lug |
| 6 | Through bolt fastening nut |
| 7 | Non-drive endshield |
| 8 | Spring washer |
| 9 | Non-drive and bearing |
| 10 | Non-drive and bearing fastening washer |
| 11 | Stationary switch |
| 12 | Stationary switch fastening bolt |
| 13 | Centrifugal switch |
| 14 | Rubber ring for lead passing hole to capacitor |
| 15 | Capacitor cover |
| 16 | Capacitor |
| 17 | Wound stator |
| 18 | Rotor / shaft assembly |
| 19 | Frame |
| 20 | Through bolt |
| 21 | Shaft key |
| 22 | Fan |
| 23 | Drive end bearing fastening washer |
| 24 | Drive end bearing |
| 25 | Drive endshield |
| 26 | Overload thermal protector fixing ring |
| 27 | Overload thermal protector |

***Note:*** *For F56H and G56H frame motors: 1) Part nr. 2 = 3 pieces; 2) Part nr. 15 and 16 = 2 pieces*

N O T E S :



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MARLEY®

user manual

# **Fluid Cooler** pump

INSTALLATION - OPERATION - MAINTENANCE

Z0560176_A ISSUED 06/2017

READ AND UNDERSTAND THIS MANUAL PRIOR TO OPERATING OR SERVICING THIS PRODUCT.

# contents

**Note**

***This manual contains vital information for the proper operation and maintenance of your Marley MH Fluid Cooler Pump. Carefully read the manual before operation and follow all instructions. Save this manual for future reference.***



The following defined terms are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning the life of the product.

**⚠ Caution**

***Indicates presence of a hazard which will or can cause personal injury or property damage if ignored.***

**Note**

***Indicates special instructions on installation, operation or maintenance which are important but not related to personal injury hazards.***

## inspection

**Note**

***Check pump for shortage and damage immediately upon arrival. Note damage or shortage on freight bill (bill of lading); immediately notify your Marley sales representative.***

### EXTERIOR

Pay particular attention to conduit box, external hardware and accessories. Touch up abrasions or scratches with approved paint.

### INTERNAL

If extensive or serious external damage is noted, if impeller is damaged (look in ports), or if shaft binds or sticks, disassemble as required to permit internal inspection.

## handling

**⚠ Caution**

***Handle with care. Dropping or jarring can seriously damage motor bearings or break pump parts. Lift with device having capacity for pump weight, and use lifting hooks or eye bolts (if provided) or rig double sling around motor frame and pump casing. Do not use sling through pump motor adapter nor around suction and discharge flanges.***

## operation

### Pre-Start

Before initial start of the pump, check as follows:

1. The rotation must be checked upon installation. Close, then break the contacts quickly and observe the rotation of the exposed portion of the rotating parts. Rotation must agree with the rotation arrow on the motor. For all pumps, the standard rotation is counterclockwise when viewed from the suction end. Motor wiring is easily changed in the field. Observe the wiring diagram on the inside of the terminal box cover, or on the motor nameplate.
2. Check voltage, phase and frequency of line circuit with motor nameplate.
3. Check the suction hood and discharge piping for proper installation.
4. Assure that the collection basin is filled with water to the level indicted in Startup portion of the MH Fluid Cooler User Manual. This water level ensures that the pump is primed.

# operation

**⚠ Caution**

***Do not run pump dry hoping it will self-prime.***

Serious damage may result if started dry.

## Starting

Proceed as follows to start pump:

1. Prime the pump as outlined in Pre-Start. If pump does not prime properly, or loses prime during start-up, shut down and correct condition before repeating procedure.
2. Start the motor (pump).

## Running

Periodically inspect pump while running, but especially after first start and following repair.

1. Check pump and piping for leaks. Repair immediately.
2. Record voltage, amperage per phase, and kW (if an indicating wattmeter is available).

## Freezing Protection

Protect pumps shut down during freezing conditions by one of the following methods:

1. Drain pump; remove all liquid from the casing.
2. Keep fluid moving in pump and insulate or heat the pump to prevent freezing. If heated, do not let temperature go above 100° to 150°F.
3. Fill pump completely with antifreeze solution.

# maintenance

## Cleaning

• Remove oil, dust, dirt, water, chemicals from exterior or motor and pump.

• Keep motor air inlet and outlet open.

• Blow out interior of open motors with clean compressed air at low pressure.

• Regularly drain moisture from TEFC motors.

## Temperature

Total temperature, not the rise, is the measure of safe operation for a motor. If temperature by thermometer exceeds limits for insulation class, investigate and change operating conditions.

## Labeled Motors

It is imperative for repair of a motor with Underwriters' Laboratories label that original clearances be held; that all plugs, screws, other hardware be fastened securely, and that parts replacements be exact duplicates or approved equals. Violation of any of the above invalidates Underwriters' label.

## Lubrication

Pumps should require no maintenance. Due to the double shielded prelubricated bearings, no lubrication is required for the life of the bearings. Inspect bearings periodically to determine the condition of the grease and replace the bearings if necessary.

# mechanical seal assembly

## JM FRAME MOTOR

### A. Disassembly:

1. Turn off power.
2. Drain pump.
3. Remove bolts holding base to foundation
4. Remove pump casing bolts.
5. Remove motor and rotating element from casing, leaving casing and piping undisturbed.
6. Insert a screwdriver in one of the impeller waterway passages and back off the impeller retaining assembly with a socket wrench, as shown in Figure 1.

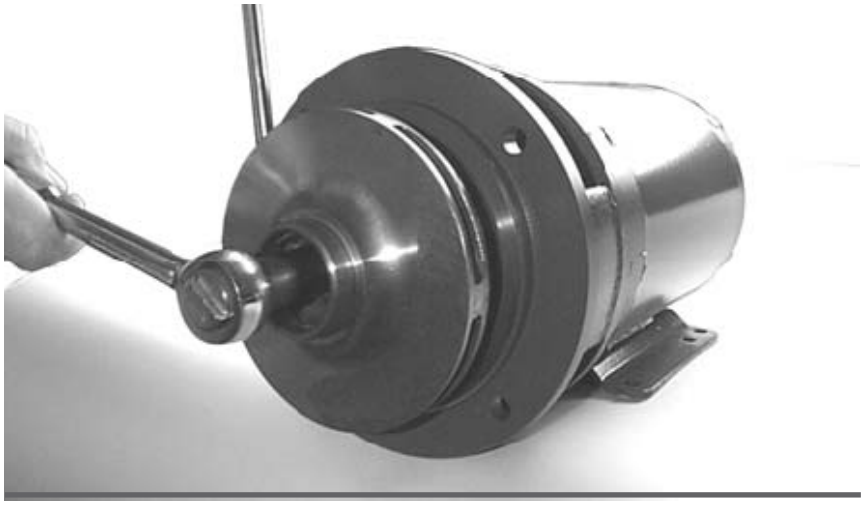

**Figure 1** *Back off the impeller retaining assembly.*

7. Remove impeller from shaft, being careful not to lose the impeller key, spring and seal retainer. If impeller is difficult to remove, it may be necessary to use a bearing puller to pull off impeller.
8. Pry off rotating member of mechanical seal from sleeve by using two (2) screwdrivers.
9. Remove bolts holding adapter to motor and take off adapter.
10. Place adapter on a flat surface with case rabbet facing down, and push out stationary part of mechanical seal.
11. Inspect the shaft sleeve, shaft O-ring and flinger. If damaged or worn, remove and replace with a new one.

## mechanical seal assembly

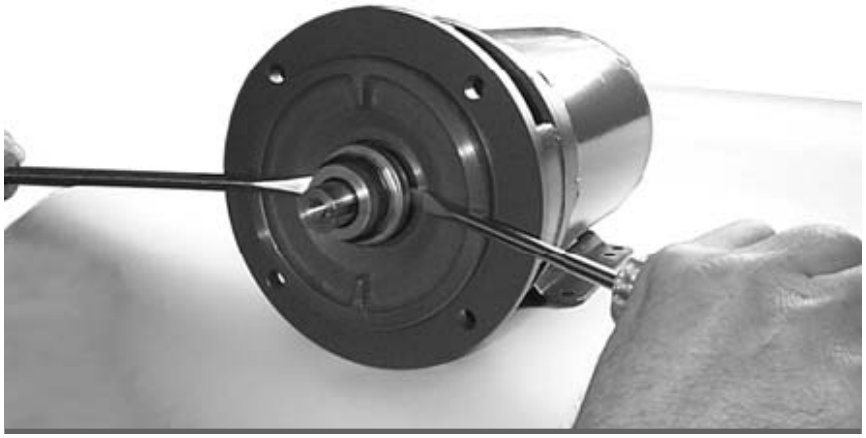

**Figure 2** *Prying off the rotating member.*

### B. Reassembly:

**Note**

***The mechanical seal is a precision product and should be handled accordingly. Use care when handling the lapped running surfaces of the mechanical seal to ensure they remain clean and free of chips or scratches.***

1. Clean gasket and flange faces, seal seat cavity, shaft sleeve, and motor shaft.
2. Lubricate the seal seat cavity of the adapter and the rubber cup or O-ring of seal seat with the lubricating fluid that comes with the mechanical seal or repair kit. Press the stationary seat in seal seat cavity of the adapter squarely and evenly using a arbor press (if possible) and the cardboard disc supplied with the seal. Be certain that the lapped face (shiny side) is facing you.
3. Install the flinger on the motor shaft until it bottoms on the motor shaft.
4. Slide the shaft O-ring on the motor shaft until it is tight against the flinger. Make sure that the shaft O-ring does not get damaged during this procedure.

## mechanical seal assembly

5. Position shaft sleeve chamfer towards motor and slide on motor shaft.
6. With motor preferably in vertical position, remount the adapter on motor, making sure the motor shaft does not dislocate or chip the stationery seat of the seal.
7. Apply the lubricating fluid that comes with the mechanical seal or repair kit to the shaft sleeve and the rubber bellows of the rotary seal. Slide the seal head on the sleeve; press the rubber drive band on the rotary head until the lapped face on the head seats firmly against the lapped face of the stationary seat. Do not chip or scratch faces during installation. Take extra care to make sure the lapped faces are clean. Install seal spring on seal head and retainer on spring.
8. Place key in key seat. Line up keyway in impeller with key on motor shaft, and slide impeller on motor shaft. Be certain that the key is positioned in the keyway of the motor and impeller. Slightly compress seal spring with impeller and hold impeller while installing impeller retaining assembly in motor shaft.
9. Insert a screwdriver in a waterway passage of the impeller holding it against rotation and tighten the retaining assembly as discussed in paragraph 7 of disassembly instructions. The impeller will compress the seal spring to the proper length assuring the correct pressure on the lapped surfaces.
10. Remove any burrs caused by screwdriver on the vane of impeller in waterway passage.
11. Slide motor and rotating element in casing. Be sure that any damaged O-ring or gasket is replaced.
12. Tighten casing bolts alternately and evenly.
13. Replace hold-down bolts.
14. Check for free rotation after assembly is completed.
15. Seal all drain openings using pipe sealant on threads.
16. Reprime before starting. Do not start until pump is completely filled with water.

# mechanical seal replacement

## C56 FRAME MOTOR

### A. Disassembly:

Refer to “JM FRAME” Disassembly, Notes 1-11.

12. Inspect the stub shaft. If damaged or worn, replace with a new one; removal:

A. Drive pin from stub shaft and remove pin.

B. Loosen set screws

C. Remove stub shaft from motor shaft.

### Assembly:

For motors with drilled hole:

A. Slide stub shaft on motor shaft. Line up set screws in stub shaft with motor keyway, and drilled hole in stub shaft with drilled hole in motor shaft.

B. Tighten set screws

C. Insert #12 drill in pilot hole of stub and motor shaft. Drill out opposite side of stub shaft.

D. Install pin

**For motors without a drilled hole in the motor shaft:**

A. Slide stub shaft on motor shaft. Line up set screws in stub shaft with keyway in motor shaft.

B. Position stub 3 3/32” from Motor C face. (See Figure 3)

C. Tighten set screws


**Figure 3** *Positioning the stub.*

D. Insert #12 drill in stub shaft pilot hole and drill completely through motor shaft and opposite side of stub shaft. See Figure 4.

E. Install pin

**Figure 4** *Positioning the stub.*

## B. Reassembly:

⚠ **Caution**

***The mechanical seal is a precision product and should be handled accordingly. Use care when handling the lapped running surfaces of the mechanical seal to ensure they remain clean and free of chips or scratches.***

1. Clean gasket and flange faces, seal seat cavity, and stub shaft.
2. Lubricate the seal seat cavity of the adapter and the rubber cup or O-ring of seal seat with the lubricating fluid that comes with the mechanical seal or repair kit. Press the stationary seat in seal seat cavity of the adapter squarely and evenly using a arbor press (if possible) and the cardboard disc supplied with the seal. Be certain that the lapped face (shiny side) is facing you.
3. With motor preferably in vertical position, remount the adapter on motor, making sure the stub shaft does not dislocate or chip the stationery seat of the seal.

## mechanical seal replacement

4. Apply the lubricating fluid that comes with the mechanical seal or repair kit to the stub shaft and the rubber bellows of the rotary seal. Slide the seal head on the stub; press the rubber drive band on the rotary head until the lapped face on the head seats firmly against the lapped face of the stationary seat. Do not chip or scratch faces during installation. Take extra care to make sure the lapped faces are clean. Install seal spring on seal head and retainer on spring.
5. Place key in key seat. Line up keyway in impeller with key on stub shaft, and slide impeller on stub shaft. Be certain that the key is positioned in the keyway of the stub and impeller. Slightly compress seal spring with impeller and hold impeller while installing impeller retaining assembly in stub shaft.
6. Insert a screwdriver in a waterway passage of the impeller holding it against rotation and tighten the retaining assembly as discussed in paragraph 7 of disassemby instructions for JM shaft. The impeller will compress the seal spring to the proper length assuring the correct pressure on the lapped surfaces.
7. Remove any burrs caused by screwdriver on the vane of impeller in waterway passage.
8. Slide motor and rotating element in casing. Be sure that any damaged O-ring or gasket is replaced.
9. Tighten casing bolts alternately and evenly.
10. Replace hold-down bolts.
11. Check for free rotation after assembly is completed.
12. Seal all drain openings using pipe sealant on threads.
13. Reprime before starting. Do not start until pump is completely filled with water. The approved lubricating fluid for seal installation is included with the mechanical seal or repair kit.

**⚠ Caution**

***Do not use other lubricating liquids. We recommend stocking a spare mechanical seal or repair kit to eliminate down time.***

# **Fluid Cooler** pump

**USER MANUAL**

**SPX COOLING TECHNOLOGIES, INC.**
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Z0560176_A (05-1109A) | ISSUED 06/2017


SPX

MARLEY®

user manual

# **CoolBoost Pump** control panel

INSTALLATION - OPERATION

10000023641 ISSUED 7/2023

READ AND UNDERSTAND THIS MANUAL PRIOR TO OPERATING OR SERVICING THIS PRODUCT.

# introduction

These instructions are intended to assure that field connections are completed properly and the control system operates for the maximum time possible. Since product warranty may depend on your actions, please read these instructions thoroughly prior to operation. Reference job specific wiring diagrams on the inside of the CoolBoost pump control panel.

If you have questions about the operation and/or maintenance of this control system and you do not find the answers in this manual, please contact your Marley sales representative.

**⚠ Warning**

***Hazard of electrical shock or burn. Be sure to turn off power to the panel before servicing. If working on equipment out of site of panel disconnect, lockout using standard lockout procedure.***

## Safety First

The Marley control system uses UL listed components installed in accordance with the National Electric Code. The location of the cooling product and field installation of the control system can affect the safety of those responsible for installing, operating or maintaining the tower and controls. However, since SPX Cooling does not control the tower location, or field installation, we cannot be responsible for addressing safety issues that are affected by these items.

**⚠ Warning**

***The following safety issues should be addressed by those responsible for installation, maintenance or repair of the tower and controls:***

- ***Access to and from the control panel (including the customer supplied main disconnect/branch circuit protection.)***
- ***Proper grounding of electrical control circuits.***
- ***Sizing and protection of branch circuits feeding the control panel.***
- ***Qualification of persons who will install, maintain and service the electrical equipment.***

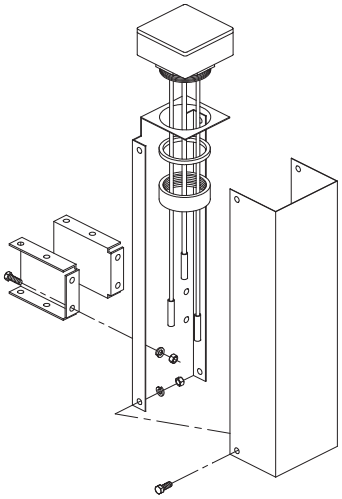
These are only some of the safety issues that may arise in the design and installation process. SPX Cooling strongly recommends that you consult a safety engineer to be sure that all safety considerations have been addressed.

**⚠ Warning**

***Other safety issues are addressed in literature supplied with your cooling product. You should closely review the literature prior to installing, maintaining or repairing your cooling product.***

## Circulating Pump Circuits

For the low-water safety circuit connect the two “low water probes”, located in the basin stilling chamber to user terminal points in the control panel. Marley probes are furnished with 30'-0" leads. Refer to the wiring diagram in the control panel for connection points.



*Stilling Chamber*

*Water Level Probes*


*Water Level Card*

# operation

**Main Circuit Breaker:** Operating handle for the main breaker is pad-lockable for lock out/tag out.

Rotating the handle to the OFF position turns power off to the panel.

Rotating the handle to the ON position provides power to the control panel.

If servicing the panel hot (door open and main breaker in energized position) be sure to align the keyed slot on back of the operating handle with the key on the main breaker shaft before closing the door.

**Power ON Light:** A pilot light indicates the main disconnect is on and the control panel is powered.

## Pump Operation

Standard operation of the pump is by manual control only, using a two-position selector switch located on the door. A removable "run enable" jumper is provided so customer may take control of cycling the pump. See the control panel wiring diagram.

**⚠ Caution**

***Cycling the pump on and off for temperature control could cause scaling on the coils and is not recommended.***

**OFF-ON Selector Switch**

- OFF position – pump motor is off.
- ON position – pump motor will run constantly unless a safety circuit is activated.

If the water temperature in the cold-water basin drops to 35°F a N.O. contact from the optional ABH basin heater circuit thermostat will close and latch-in a relay, which in turn shuts off the circulating pump. This is a safety circuit to prevent pumping freezing water. To reset this circuit, press the reset button on the door. The circuit can be only reset once the cold-water basin temperature rises above 45°F.

If the basin water drops to a dangerously low level, the water level card contact will close and also energize the latch-in relay shutting the circulating pump off. This is a safety circuit preventing the pump from running dry. To reset this circuit, press the reset button on the door. The circuit can only be reset if the water in the basin has risen to an acceptable operating level.

# operation

## Integrated Basin Heater Control Circuit Option

The Marley ABHi basin heater package controls the ON and OFF operation of the basin heater device providing freeze protection in the cold-water collection basin of the fluid cooler. The stand-alone control package includes a main circuit breaker disconnect that feeds a contactor providing power for the heater element.


An RTD (resistant temperature device) monitors water temperature in the basin for the temperature controller and includes a low water cutout circuit preventing the control from energizing if the sensor is not submerged in water. Standard sensor lead length is 30'-0; longer leads are available.

The solid state temperature controller is located on the door.. A power contactor inside the control panel is used to energize the heating element.

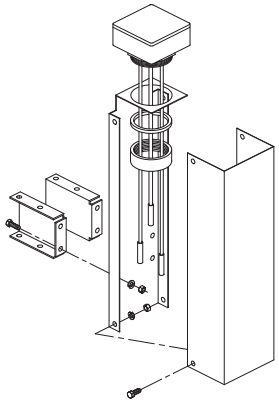
The temperature controller and basin heater element maintain water temperature in the basin between 40°F and 45°F.

Refer to Marley **"ABHi Basin Heater Integrated Controller"** User Manual Z1079659 for additional information.

# operation

## Solid-state Water Level Control and Alarm Circuit Option

The number of probes depends on the number of optional circuits being furnished. Each water level event requires one card. The card includes an on-board relay with (1) form “C” dry contact. Contacts are wired to a user terminal strip for connection to remote devices such as makeup solenoids and alarms.



*Stilling Chamber*

*Water Level Probes*

*Water Level Card*

Water make-up control – Form “C” 1- N.O.  1 – N.C. contact wired to 120 VAC fused circuit for customer use to power a remote solenoid.

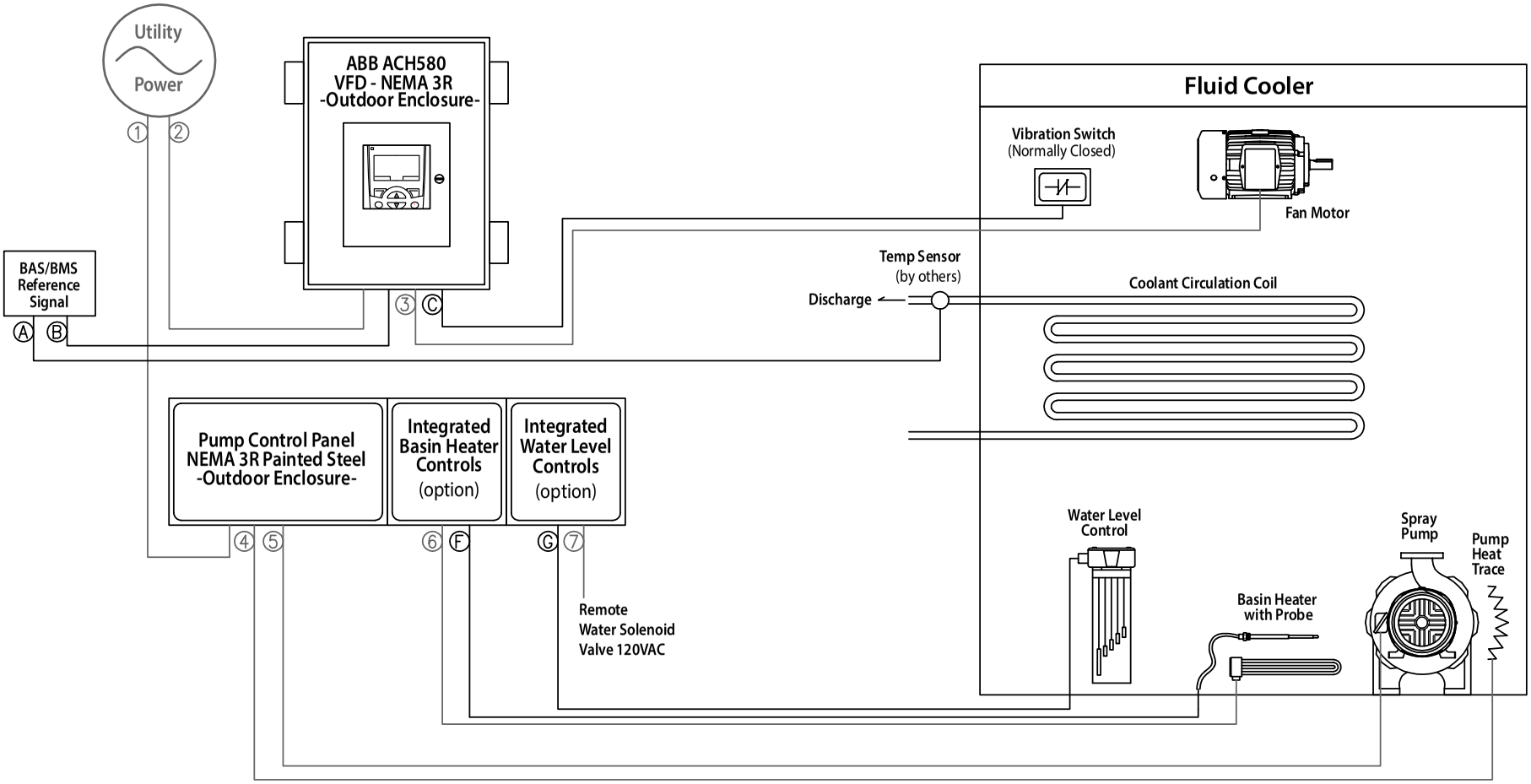
High water alarm - N.O. contact wired to user terminal block

Low water alarm - N.O. contact wired to user terminal block

High water cutoff – N.C. contact wired to user terminal block

Low water cutoff - N.C. contact wired to user terminal block

## **Electrical One-Line example** (wiring by others)




① - Feed from utility power to pump/combo control by others, (3) wires pluse ground (NEC)
② - Feed from utility power to VFD by others, (3) wires plus ground. (NEC)
③ - Feed from VFD to motor by others, (3) wires plus ground (NEC)
④ - Feed from pump/combo control to heat trace by others, (2) wires plus ground. (NEC)
⑤ - Feed from pump/combo control to pump motor by others, (3) wires plus ground (NEC)
⑥ - Feed from pump/combo control to basin heater by others, (3) wires plus ground. (NEC)
⑦ - Feed from water level control to solenoid by others, (2) wires plus ground (NEC)

Ⓐ - From temperature sensor to BMS (Building Management System) (RTD by others)
Ⓑ - 4-20ma speed reference signal from BMS to VFD
Ⓒ - Vibration N.C. contacts to VFD
Ⓕ - Basin heater probe cable (5 wires w/shield) by SPX/Marley
Ⓖ - Water level control system, 18AWG wires 30 foot each, by SPX/Marley

——— = **Power Wiring**
——— = **Control Wiring**

# **CoolBoost Pump** control panel

**USER MANUAL**

**SPX COOLING TECH, LLC**
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SPX
TECHNOLOGIES

# AFBUP, AFBUP-S, AFXUP, AFXUP-S

**On/Off, Spring Return, 24 to 240 VAC**

**Torque min. 180 in-lb, for control of air dampers**

## Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

## Operation

The AFB and AFX series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

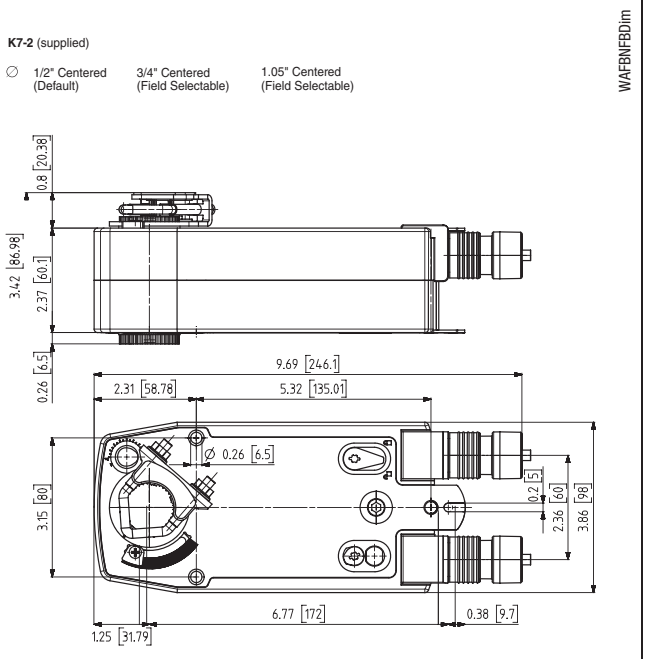
The AFB and AFX series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The AFBUP-S and AFXUP-S versions are provided with two built-in auxiliary switches. These SPDT switches provide safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°. The AFBUP, AFBUP-S, AFXUP and AFXUP-S actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

| Technical Data | | AFBUP, AFBUP-S, AFXUP, AFXUP-S |
|---|---|---|
| Power supply | | 24...240 VAC -20% / +10%, 50/60 Hz<br>24...125 VDC ±10% |
| Power consumption | running | 7 W |
| | holding | 3.5 W |
| Transformer sizing | | 7 VA @ 24 VAC (class 2 power source)<br>8.5 VA @ 120 VAC<br>18 VA @ 240 VAC |
| Electrical connection | | |
| AFBUP... | | 3 ft, 18 GA appliance cable, 1/2" conduit connector<br>**-S models:** Two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors |
| AFXUP... | | 3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance cable, with or without 1/2" conduit connector<br>**-S models:** Two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with or without 1/2" conduit connectors |
| Overload protection | | Electronic throughout 0 to 95° rotation |
| Control | | On/Off |
| Torque | | 180 in-lb [20 Nm] minimum |
| Direction of rotation | spring | reversible with CW/CCW mounting |
| Mechanical angle of rotation | | 95° (adjustable with mechanical end stop, 35° to 95°) |
| Running time | motor | < 75 sec |
| | spring | 20 sec @ -4°F to 122°F [-20°C to 50°C];<br>< 60 sec @ -22°F [-30°C] |
| Position indication | | visual indicator, 0° to 95°<br>(0° is full spring return position) |
| Manual override | | 5 mm hex crank (3/16" Allen), supplied |
| Humidity | | max. 95% RH non-condensing |
| Ambient temperature | | -22°F to 122°F [-30°C to 50°C] |
| Storage temperature | | -40°F to 176°F [-40°C to 80°C] |
| Housing | | Nema 2, IP54, Enclosure Type2 |
| Housing material | | Zinc coated metal and plastic casing |
| Agency listings † | | cULus acc. to UL60730-1A/-2-14,<br>CAN/CSA E60730-1:02, CE acc. to<br>2004/108/EC & 2006/95/EC |
| Noise level | | <50dB(A) motor @ 75 seconds<br>≤62dB(A) spring return |
| Servicing | | maintenance free |
| Quality standard | | ISO 9001 |
| Weight | | 4.6 lbs (2.1 kg), 4.9 lbs (2.25 kg) with switches |
| † Rated Impulse Voltage 4kV, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 3. | | |
| **AFBUP-S, AFXUP-S** | | |
| Auxiliary switches | | 2 x SPDT 3A (0.5A) @ 250 VAC, UL Approved<br>one set at +10°, one adjustable 10° to 90° |

**Dimensions** (Inches [mm])



## Accessories

| | |
|---|---|
| AV 8-25 | Shaft extension |
| IND-AFB | Damper position indicator |
| K7-2 | Universal clamp for up to 1.05" dia jackshafts |
| KH-AFB | Crank arm |
| TF-CC US | Conduit fitting |
| Tool-06 | 8mm and 10 mm wrench |
| ZG-100 | Universal mounting bracket |
| ZG-101 | Universal mounting bracket |
| ZG-118 | Mounting bracket for Barber Colman® MA 3../4.., Honeywell® Mod III or IV or Johnson® Series 100 replacement or new crank arm type installations |
| ZG-AFB | Crank arm adaptor kit |
| ZG-AFB118 | Crank arm adaptor kit |
| ZS-100 | Weather shield (metal) |
| ZS-150 | Weather shield (polycarbonate) |
| ZS-260 | Explosion-proof housing |
| ZS-300 | NEMA 4X housing |

**Note:** When using AFBUP, AFBUP-S, AFXUP, AFXUP-S actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

## Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, two SPDT auxiliary switch shall be provided having the capability of one being adjustable. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

## Wiring Diagrams

### *INSTALLATION NOTES*

1 Provide overload protection and disconnect as required.

2 ***CAUTION** Equipment Damage!*
Actuators may be connected in parallel.
Power consumption and input impedance must be observed.

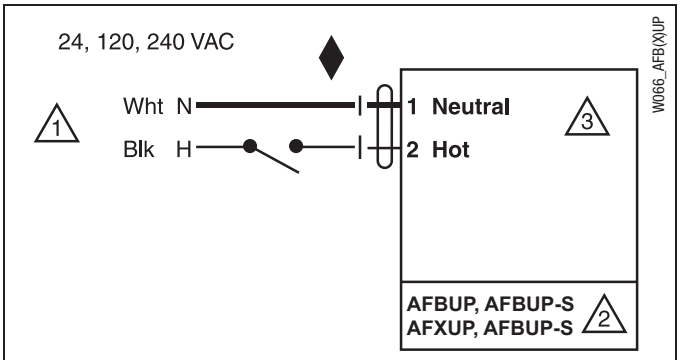
3 No ground connection is required.

4 For end position indication, interlock control, fan startup, etc., AFBUP-S and AFXUP-S incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at +10°, one is adjustable 10° to 90°.

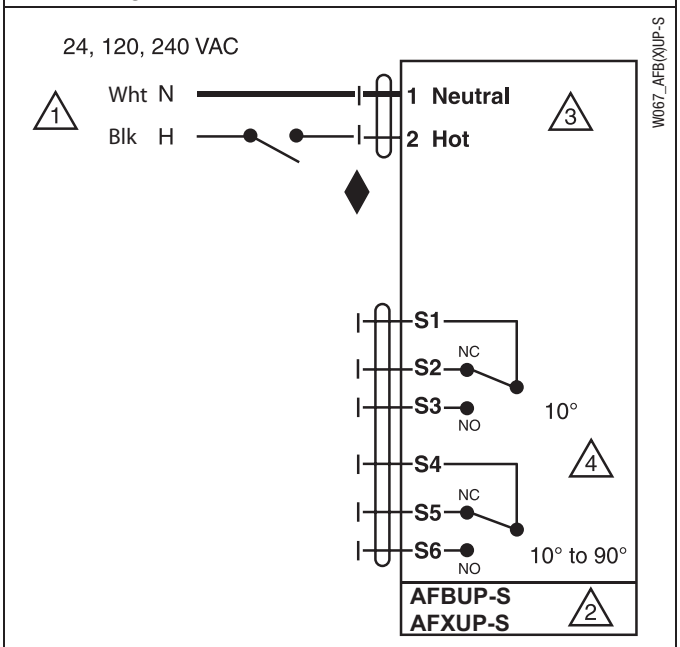
### *APPLICATION NOTES*

Meets cULus requirements without the need of an electrical ground connection.

***WARNING** Live Electrical Components!*
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.




**On/Off wiring for AFBUP, AFXUP**




**Auxiliary Switches for AFBUP-S, AFXUP-S**

## LETTER OF TRANSMITTAL

TO: East Harding Construction

DATE: April 1, 2024

RE: Stone Bank

JOB NO.: 23-057

ATTN: Jake Honeycutt, Jack Whitley, Kim Brass

| COPIES | DATE | NO. | DESCRIPTION |
|---|---|---|---|
| 1 Emailed | 03/29/24 | 65 00 01-1-200 | *Cooling Tower (CT-1)* |
| | | | |
| | | | |
| | | | |
| | | | |

THESE ARE TRANSMITTED:

[ ]For Approval [ ]As Requested [XX] Reviewed for General Compliance [ ]Resubmit___copies for approval

[ ]For Your Use [ ]For Review and Comment [] Reviewed and Noted [ ]Submit ___copies for distribution

[ ]For Your Information [] Revise and Resubmit Comments [ ]Return___corrected prints

REMARKS:

COPY TO: Job File

BY: JoAnn White

JoAnn White, CIT
Contract Administrator

# SHOP DRAWING SUBMITTAL REVIEW COMMENTS

**Batson Inc.**
ENGINEERING SOLUTIONS
1300 Brookwood Drive
Little Rock, AR 72202
501.664.3311

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| | |
|---|---|
| *CLIENT* | **WDD Architects** |
| *PROJECT* | **Stone Bank** |
| *ENG JOB #* | **5978** |
| *SUBMITTAL #* | **Mechanical #1** |
| *PAGE* | **1 of 2** |
| *DATE* | **3/26/2024** |
| *REVIEWER* | **Cooper Longley** |

SEE SHOP DRAWINGS & APPROVAL STAMP ON SHOP DRAWING DOCUMENTS FOR ADDITIONAL INFORMATION AND NOTATIONS

| NO. | DESCRIPTION | APPROVED | APPROVED AS CORRECTED | REVISE & RESUBMIT | NOT APPROVED | SUBSTITUTIONS | REMARKS |
|---|---|---|---|---|---|---|---|
| 1 | COOLING TOWER (CT-1) | X | | | | | |
| | | | | | | | |
| 2 | EXHAUST FANS (EF-4 THRU 12 & EF-23 THRU 25) | | X | | | X | EF-24 NOT SPECIFIED AS GN-168 IN SUBMITTAL, BUT FAN QUANTITY IS CORRECT |
| | | | | | | | |
| 3 | HEATING BOILER (HWB-1) | X | | | | X | 208/1 PH POWER ACCEPTABLE |
| | | | | | | | |
| 4 | PUMPS (CP-1,2,&3) | X | | | | | |
| | | | | | | | |
| 5 | 23 05 29 HANGERS & SUPPORTS | X | | | | | |
| | | | | | | | |
| 6 | 23 05 53 MECHANICAL IDENTIFICATION | X | | | | | |
| | | | | | | | |
| 7 | 23 07 00 MECHANICAL INSULATION | X | | | | | |
| | | | | | | | |
| 8 | 23 09 00 CONTROLS | X | | | | | |
| | | | | | | | |
| 9 | 23 11 23 NATURAL GAS PIPING | X | | | | | |
| | | | | | | | |
| 10 | 23 21 13 HYDRONIC PIPING | X | | | | | |
| | | | | | | | |

The Contractor is reminded that per the specifications:

1) The Contractor is responsible for submitting all items required.
2) When substitutions to the specifications and drawings are approved, the Contractor is responsible for all costs related to other systems affected by the incorporation of substitutions into the work.

# SHOP DRAWING SUBMITTAL REVIEW COMMENTS

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|---|---|---|---|---|

SEE SHOP DRAWINGS & APPROVAL STAMP ON SHOP DRAWING DOCUMENTS FOR ADDITIONAL INFORMATION AND NOTATIONS

| | |
|---|---|
| *CLIENT* | **WDD Architects** |
| *PROJECT* | **Stone Bank** |
| *ENG JOB #* | **5978** |
| *SUBMITTAL #* | **Mechanical #1** |
| *PAGE* | **2 of 2** |
| *DATE* | **3/26/2024** |
| *REVIEWER* | **Cooper Longley** |

| NO. | DESCRIPTION | APPROVED | APPROVED AS CORRECTED | REVISE & RESUBMIT | NOT APPROVED | SUBSTITUTIONS | REMARKS |
|---|---|---|---|---|---|---|---|
| 11 | 23 31 13 METAL DUCTS | X | | | | | |
| | | | | | | | |
| 12 | 23 33 00 AIR DUCT ACCESSORIES | | X | | | | PROVIDE SIGHT BAFFLE FOR LSR2 THRU9 |
| | | | | | | | |
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The Contractor is reminded that per the specifications:

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2) When substitutions to the specifications and drawings are approved, the Contractor is responsible for all costs related to other systems affected by the incorporation of substitutions into the work.

EAST HARDING
CONSTRUCTION

2230 Cottondale Lane, Suite 3
Little Rock, AR 72202
501.661.1646 – 501.661.9546 (fax)
www.eastharding.com

**Submittal**
**#38**

## Distribution Summary

*Distributed on by*

**To:**

**Message:**

**Additional Attachments:**

| NAME | RESPONSE | ATTACHMENTS | COMMENT |
|---|---|---|---|

# 23.038 650001 100 200 Cooling Tower

| | | | |
|---|---|---|---|
| **SPEC SECTION:** | | **CREATED BY:** | |
| **STATUS:** | Open | **DATE CREATED:** | 03/18/2024 |
| **ISSUE DATE:** | 03/18/2024 | **REVISION:** | 0 |
| **RESPONSIBLE CONTRACTOR:** | Comfort Systems USA (Arkansas), Inc. | **RECEIVED FROM:** | Matthew Aldridge |
| **RECEIVED DATE:** | // | **SUBMIT BY:** | // |
| **FINAL DUE DATE:** | 04/06/2024 | **LOCATION:** | |
| **TYPE:** | Product Information | **COST CODE:** | |
| **APPROVERS:** | Jake Honeycutt **(East-Harding, Inc.)**, Jack Whitley **(East-Harding, Inc.)**, JoAnn White **(Wittenberg, Delony & Davidson, Inc.)** | | |
| **Project: 23.038:** | | | |
| **Architect's Project: 23-057:** | | | |

**BALL IN COURT:**
Matthew Aldridge **(Comfort Systems USA (Arkansas), Inc.)**

**DISTRIBUTION:**
Kim Brass **(East-Harding, Inc.)** , Jon Isham **(East-Harding, Inc.)** , Jake Honeycutt **(East-Harding, Inc.)** , Jack Whitley **(East-Harding, Inc.)**

**DESCRIPTION:**

**ATTACHMENTS:**

## SUBMITTAL WORKFLOW

| # | NAME | SUBMITTER/ APPROVER | SENT DATE | DUE DATE | RETURNED DATE | RESPONSE | ATTACHMENTS | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| 1 | Matthew Aldridge | Submitter | | 3/19/2024 | | Pending | | |
| 2 | Jake Honeycutt | Approver | | 3/21/2024 | | Pending | | |
| 3 | Jack Whitley | Approver | | 3/23/2024 | | Pending | | |
| 4 | JoAnn White | Approver | | 4/6/2024 | | Pending | | |

**BY** **DATE** **COPIES TO**

SPX COOLING TECHNOLOGIES

**Woodbury Beach Company**

6329 CRYSTAL HILL RD
NORTH LITTLE ROCK, AR 72118-5232
(501) 753-8323 /
email: dmatthey@woodburybeach.com

**Submittal to:**
Comfort Systems USA (Arkansas)
9924 Landers Road
North Little Rock, AR 72117

**Project:**
Stone Bank
Replace Recold JW115 Tower
Spec 23-65-00

**Engineer:**
Batson Firm
Little Rock, AR

Quote No. DAIN MATTHEY_240118_095315464 February 28, 2024

| TOWER MODEL | PERFORMANCE CONDITIONS | MECHANICAL DATA PER CELL | TOWER DIMENSIONS | WEIGHTS |
|---|---|---|---|---|
| One (1) Recold Model **JWH-115C** factory assembled 1-Cell forced draft counterflow fluid cooler | Per 1-cell tower:<br>570 gpm<br>97°F Hot Water<br>87°F Cold Water<br>79.6°F Entering WB<br>1.3 psi press drop<br>30% Glycol | **Main motor: 1 @ 50 HP**<br>Premium Efficiency TEFC<br>3 phase / 60 Hz /<br>460 Volts 1.15sf / TEFC<br>1800 RPM<br><br>**Pump(s): 1 @ 5 HP** | Each cell: (without options)<br>Length 8' - 4 1/2"<br>Width 20' - 9"<br>Height 9' - 4" | Per cell:<br>Shipping: 11,672 lb<br>Per 1-cell tower:<br>Shipping: 11,672 lb |

*Quantities shown below are per cooler.*

**Base Tower Construction/Equipment:**
Galvanized steel base construction.
Stainless steel sump pan sides, floor panels, coil supports, anti-cavitation swirl arrestor hood and external float box.
Belt drive centrifugal fan.
Triple-pass 17 mil PVC drift eliminators designed and manufactured by Marley.
Motor(s) will meet or exceed the EISA 2007 government efficiency standards
Greaselines will be included outside of the tower's casing for ease of maintenance.

**Coil Section:**
Corrosion resistant copper tube bundle constructed with 5/8 in O.D. copper tubing.
(4) 3 inch 150 lbs cast brass flange inlet connections per cell for process fluid.
(4) 3 inch 150 lbs cast brass flange outlet connections per cell for process fluid.
Standard Wall Tubes, Top 4 Rows.
Standard Wall Tube, Rest of Coil.
Tube bundles water immersion tested to 350 psi .
Factory installed positive closure dampers which help protect the coil from freezing during shutdown.

**Collection Basin Connections and Accessories:**
Mechanical type water make-up float valve.
Electric immersion heater complete with thermostat for freeze protection of the collection basin during cold weather system shutdown.

**Spray System and Accessories:**
PVC distribution header pipe and branch arms with polypropylene spray nozzles.
(1) spray pump installed and piped in the factory.

**Maintenance & Maintenance Access Features:**
Large removable access doors in sump section and coil section.
Fan and motor are located out of the wet area, for ease of access and maintenance.

**Control Systems:**
(1) Factory mounted and wired VFD control panel NEMA3R with pump starter package
Factory wired sump pan heater control.
Wire positive closure dampers control.
Low level water cut-off for protection of the pump.
Pump heat trace and insulation.

**Startup Service and One Day Owner Training**

## SUBMITTAL DOCUMENTS

### Drawings & Data

| *Transmittal Code* | *Approval Code* | *No. of Copies* | *Drawing Number /Rev/Date* | *Description* |
|---|---|---|---|---|
| E | SFA | 1 | Z0908221 | Schematic |
| E | SFA | 1 | Z0908255 | Discharge Air Dampers |
| E | SFA | 1 | Z0908258 | Basin Heat |
| E | SFA | 1 | Z0908246 | Control Detail |
| E | SFA | 1 | | Vibration Switch |
| E | SFA | 1 | | Selection Data |
| E | SFA | 1 | | Sound Data |
| E | SFA | 1 | Z0908311 | Hoisting Detail |
| E | SFA | 1 | | Warranty |

**Transmittal Codes:**
**E** = Enclosed Herewith
**S** = Sent Separately

**Approval Codes:**
**SFA** = Approval Document. Equipment is held for Approval and Release.
**AFC** = Certified Document. Equipment has been Approved for Construction.
Changes made after this point may result in price adds and/or delays.
**INF** = Information Document. Submitted for Information only.

**Estimated Shipment Lead-Time After Drawing Approval:** 90 business days.

*Lead times are estimates and are subject to change at time of release*

**February 28, 2024**

For: SPX Cooling Tech, LLC

By: Woodbury Beach Company

**Dain Matthey**

**CoolSpec™ Version 7.3.25**
Product Data: 8/28/2023 (Current)
11/27/2023 3:27:42 PM

## Job Information

Replacement JWH115C Tower
Stone Bank
Little Rock, AR

## Selected by

Woodbury-Beach Company
6329 Crystal Hill Road
North Little Rock, AR 72118 US

Dain Matthey
Tel 501-753-8323
dmatthey@woodburybeach.com

## Fluid Cooler Definition

| | | | |
|---|---|---|---|
| Manufacturer | Recold | Fan Motor Speed | 1800 rpm |
| Product | JW | Required Fan Motor Output per cell * | 40.00 BHp |
| Model | JWH-115C | Required Fan Motor Output total * | 40.00 BHp |
| Cells | 1 | Fan Motor Capacity per cell | 40.00 Hp |
| | | Fan Motor Output per cell | 40.00 BHp |
| Coil Material | Copper | Fan Motor Output total | 40.00 BHp |
| Fan | Centrifugal, Fan Standard | Air Flow per cell | 69000 cfm |
| Fan Speed | 290 rpm | Air Flow total | 69000 cfm |
| Fans per cell | 1 | Pump Motor Output per cell | 5.00 BHp |
| Pumps per cell | 1 | Pump Water Flow per cell | 400.0 gpm |
| Model Group | Standard | | |

* Required Fan Motor Output assumes VFD operation

## Conditions

| | | | |
|---|---|---|---|
| Tower Water Flow | 570.0 gpm | Air Density In | 0.07065 lb/ft³ |
| Hot Water Temperature | 97.00 °F | Air Density Out | 0.07123 lb/ft³ |
| Range | 10.00 °F | Humidity Ratio In | 0.01820 |
| Cold Water Temperature | 87.00 °F | Humidity Ratio Out | 0.02899 |
| Approach | 7.40 °F | Wet-Bulb Temp. Out | 87.79 °F |
| Wet-Bulb Temperature | 79.60 °F | Estimated Evaporation | 6.2 gpm |
| Relative Humidity | 50 % | Coil Pressure Drop | 1.3 psi |
| Additive Content | 0.0 % | Total Heat Rejection | 2839000 Btu/h |
| Capacity | 100.0 % | | |

- This selection satisfies your design conditions.

## Weights & Dimensions

| | Per Cell | Total |
|---|---|---|
| Shipping Weight | 10670 lb | 10670 lb |
| Heaviest Section | 10670 lb | |
| Max Operating Weight | 20170 lb | 20170 lb |
| Width | 20'-9" | 20'-9" |
| Length | 8'-4 ½" | 8'-4 ½" |
| Height | 9'-4" | |

Weights and dimensions do not include options; refer to sales drawings.

**CoolSpec™ Version 7.3.25**
Product Data: 8/28/2023 (Current)


11/25/2023 2:52:56 PM

## Job Information

Replacement Fluidcooler
Stone Bank
Little Rock, AR

## Selected by

Woodbury-Beach Company
6329 Crystal Hill Road
North Little Rock, AR 72118 US
dmatthey@woodburybeach.com

Dain Matthey
Tel 501-753-8323

## Fluid Cooler Definition

| | | | |
|---|---|---|---|
| Manufacturer | Recold | Fan Speed (100.0 %) | 290 rpm |
| Product | JW | Fan Motor Speed (100.0 %) | 1800 rpm |
| Model | JW-115C | Fan Motor Capacity per cell | 40.00 Hp |
| Cells | 1 | Fan Motor Output per cell | 40.00 BHp |
| Fan | Centrifugal, Fan Standard | Fan Motor Output total | 40.00 BHp |
| Fans per cell | 1 | | |
| Model Group | Standard | | |

## Sound

1 - Cell sound data for an unobstructed environment.

Sound Pressure Level (SPL) expressed in dB (re: 20x10-6 Pa)
Sound Power Level (PWL) expressed in dB (re: 1x10-12 watts)

| Distance | Location | Octave Band Center Frequency (Hz) 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | Overall dBA |
|---|---|---|---|---|---|---|---|---|---|---|
| 5.00 ft | Blower End SPL | 81 | 74 | 74 | 71 | 70 | 63 | 75 | 56 | 78 |
| 5.00 ft | Cased Side SPL | 76 | 76 | 76 | 72 | 73 | 65 | 65 | 54 | 76 |
| 5.00 ft | Cased End SPL | 82 | 81 | 75 | 69 | 65 | 56 | 57 | 50 | 72 |
| 5.00 ft | Air Discharge SPL | 80 | 80 | 83 | 79 | 75 | 72 | 66 | 53 | 81 |
| 50.00 ft | Blower End SPL | 72 | 64 | 64 | 57 | 53 | 47 | 53 | 37 | 61 |
| 50.00 ft | Cased Side SPL | 66 | 66 | 60 | 55 | 54 | 50 | 49 | 40 | 59 |
| 50.00 ft | Cased End SPL | 68 | 66 | 57 | 54 | 51 | 46 | 49 | 35 | 58 |
| 50.00 ft | Air Discharge SPL | 64 | 62 | 66 | 62 | 57 | 54 | 48 | 36 | 64 |
| | Fluid Cooler PWL | 98 | 95 | 98 | 94 | 89 | 86 | 81 | 69 | 95 |

## Notes

- Sound Pressure Levels at Air Discharge are measured on the cased face side opposite the motor, far enough outside the air stream to prevent air noise from affecting the reading.
- Sound pressure levels were measured and recorded in full conformance with CTI ATC-128 test code November 2019 revision published by the Cooling Technology Institute (CTI).

## Other Resources

For additional information on sound-related topics please see:

Sound Power Impacts Per CTI Code Revision
https://spxcooling.com/library/sound-power-impacts-per-cti-code-revision/
Understanding and Evaluating Cooling Tower Sound Levels Among Manufacturers
https://spxcooling.com/library/understanding-and-evaluating-cooling-tower-sound-levels-among-manufacturers/

# SPX Cooling Technologies Certification of Limited Warranty

Version 07-1253

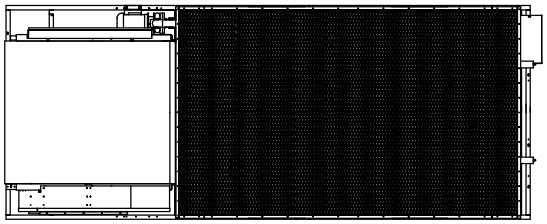
SPX Cooling Technologies, Inc. ("SPX Cooling") hereby warrants the Recold JW® fluid cooler will be free from all defects in materials and workmanship for a period of eighteen (18) months from the date of shipment by SPX Cooling to the original installation.

The obligation under this warranty is limited to the repair or the replacement of defective materials, at SPX Cooling's option, F.O.B. original shipping point or EXWORKS plant. Warranty on repaired or replaced equipment will be for the time remaining under the terms of the original warranty. This warranty is non transferable.

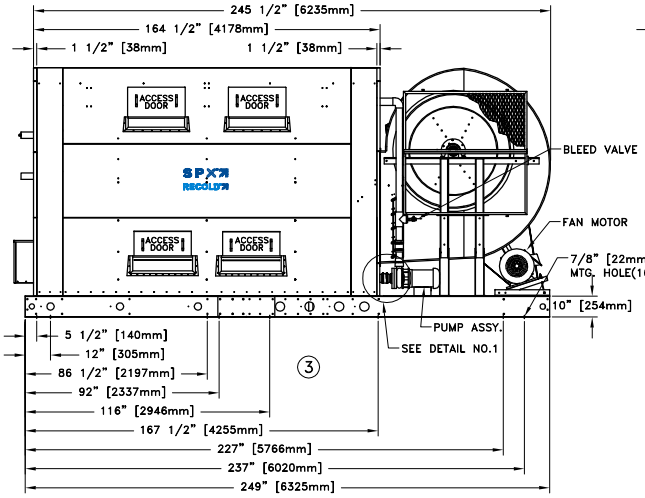
This warranty does not obligate SPX Cooling to bear the cost of labor, transportation charges, or other costs incurred in connection with the repair or replacement of defective parts; nor does this warranty apply to normal wear and tear nor to damage resulting from operations not conforming with the JW's operation and maintenance instructions, accident, alteration, misuse or an abnormally corrosive or abrasive use environment.

**SPX Cooling's total liability for damages related to the performance of or failure to perform shall be limited to the amount of the contract price and in no event shall either party hereto be responsible or held liable to the other for any special, punitive, indirect, incidental, or consequential damages.**

**The above warranties are in lieu of all other warranties expressed or implied, and all implied warranties of merchantability and fitness for a particular purpose are hereby disclaimed and excluded from this agreement.**

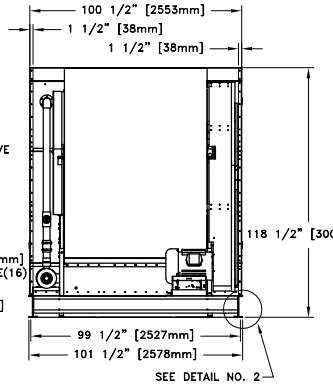


PLAN VIEW

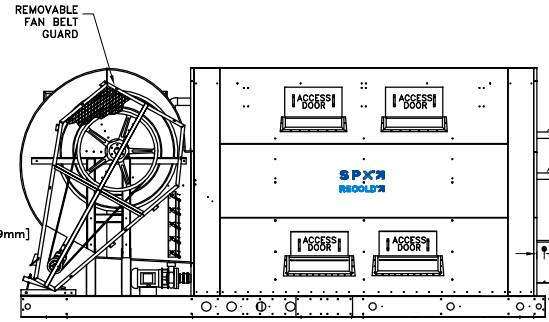



ALL DOORS ARE NOMINAL 19" [483mm] X 27" [686mm] AND INTERCHANGEABLE

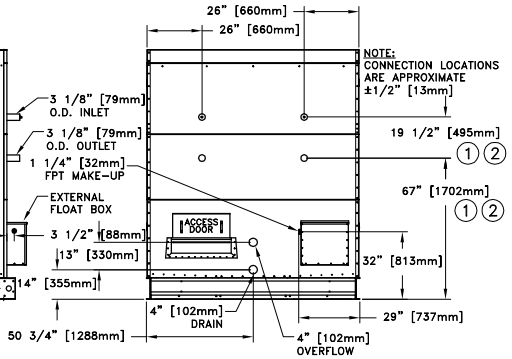
RIGHT SIDE ELEVATION



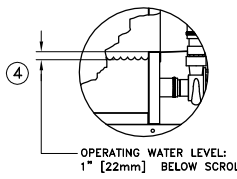

FAN END



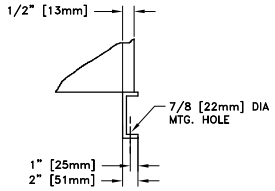

LEFT SIDE ELEVATION




CONNECTION SIDE




DETAIL NO. 1



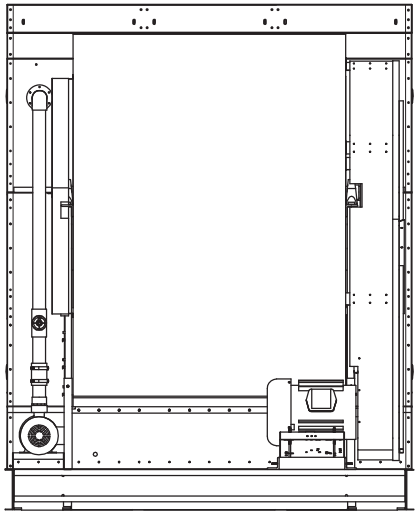

DETAIL NO. 2

NOTES:

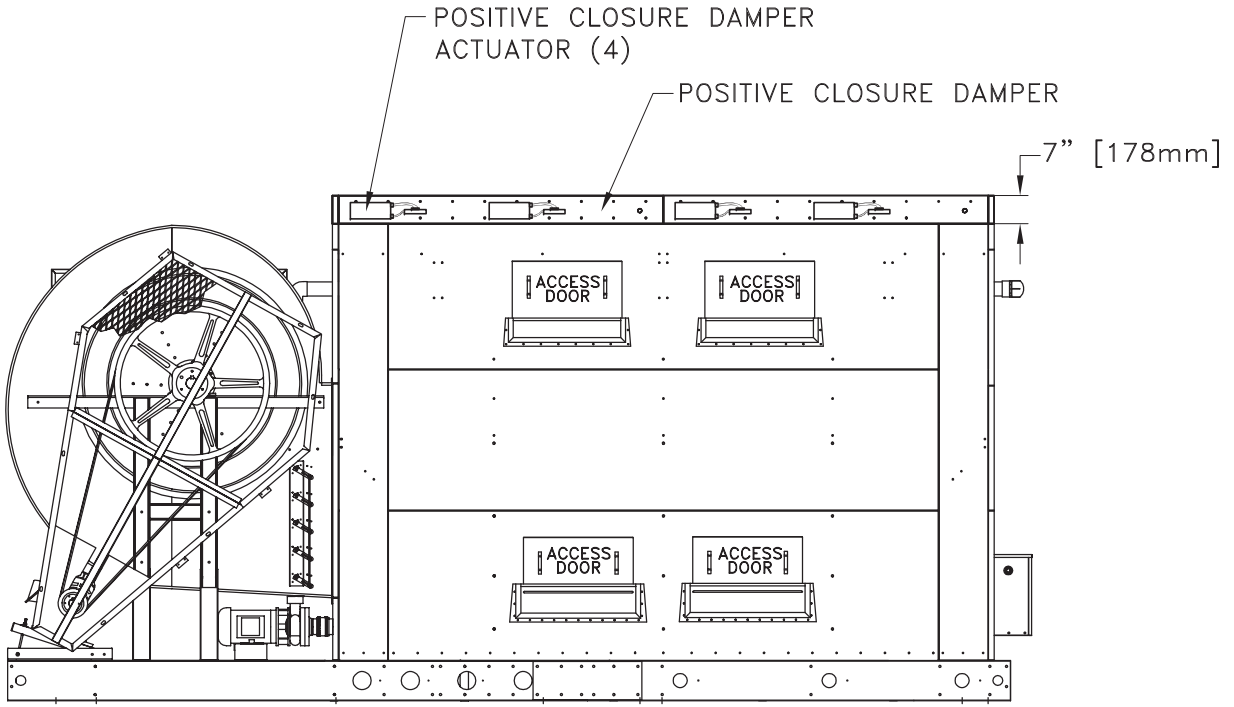
1. CONSULT FACTORY FOR SIZE AND LOCATION OF CONNECTIONS FOR HIGH FLOW (JWH) MODELS.
2. DIMENSIONS APPLY TO LOW FLOW (JWL), STANDARD FLOW (JW) AND HIGH FLOW (JWH) MODELS EXCEPT AS INDICATED IN NOTE NO. 1.
3. IF SUPPORTING THE UNIT ON BEAMS, REFER TO THE RECOLD SUGGESTED SUPPORTING STEEL DRAWING FOR REQUIRED MOUNTING HOLE LOCATIONS.
4. OPERATING WATER LEVEL: 1" BELOW SCROLL OPENING OF FAN. DETAIL NO. 1



| DRAWN BY | DRAWN DATE | QTC DRAWING | | | | RECOLD |
|---|---|---|---|---|---|---|
| TRINH | 12/10/2019 | BASE UNIT JW–115 | | | | |
| CHECKED BY | CHECKED DATE | | | | | |
| ABRAHAM_STD | 12/11/2019 | | | | | |
| RELEASED BY | RELEASED DATE | ECM NUMBER | ORDER NUMBER | FORMAT | PLOT | DRAWING NUMBER / REV. |
| ABRAHAM_STD | 12/11/2019 | 25360 | –/– | ANSI A | 1=1 | Z0908221 / A |



FAN END




LEFT SIDE ELEVATION

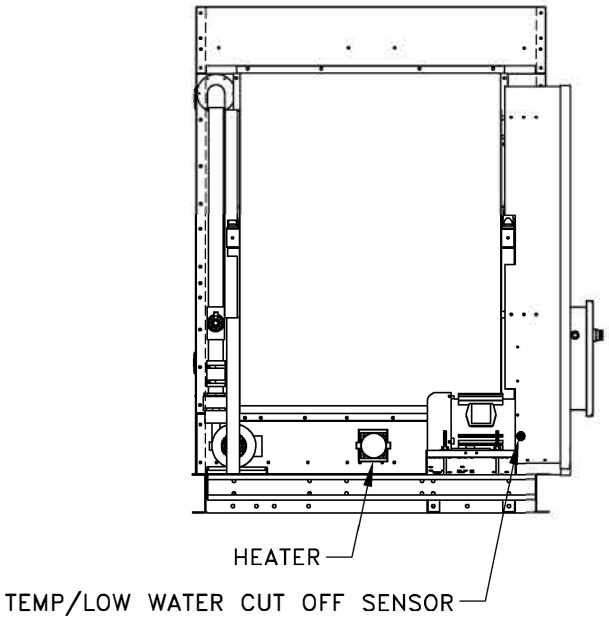
NOTES:

① UNIT SHOWN IS GENERIC J-SERIES

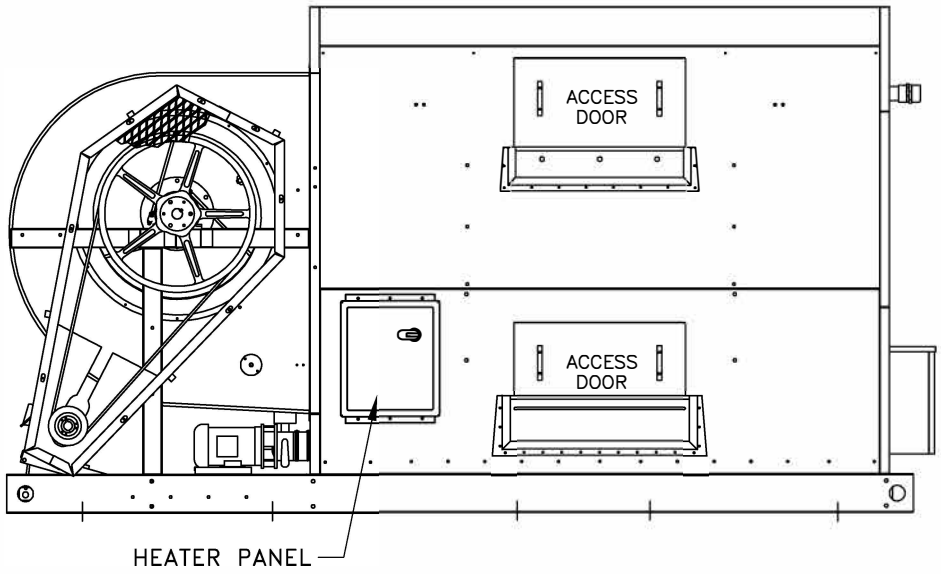


Recold Item No:

| DRAWN BY | DRAWN DATE | QTC DRAWING-POSITIVE CLOSURE DAMPER | | | | Recold® | |
|---|---|---|---|---|---|---|---|
| TRINH | 12/16/2014 | JW-115 JC 425-450 JT 49340-49360 | | | | | |
| CHECKED BY | CHECKED DATE | | | | | | |
| ABRAHAM_STD | 02/17/2015 | | | | | | |
| RELEASED BY | RELEASED DATE | ECM NUMBER | ORDER NUMBER | FORMAT | PLOT | DRAWING NUMBER | REV. |
| ABRAHAM_STD | 02/17/2015 | | -/- | ANSI A | 1=1 | Z0908255 | |




FAN END




LEFT SIDE ELEVATION

NOTES:

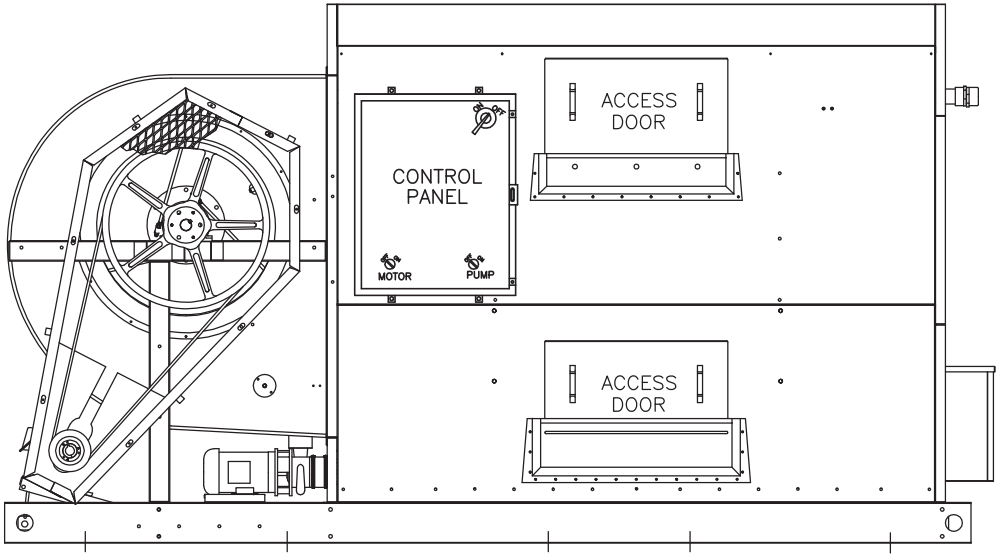
① UNIT SHOWN IS GENERIC J–SERIES WITH A INDEECO HEATER AND PANEL



Recold Item No:

| DRAWN BY | DRAWN DATE | | | | | | |
|---|---|---|---|---|---|---|---|
| TRINH | 12/16/2014 | QTC DRAWING | | | | | |
| CHECKED BY | CHECKED DATE | SUMP PAN HEATER INDEECO, J–SERIES | | | | | |
| ABRAHAM_STD | 03/05/2015 | | | | | | |
| RELEASED BY | RELEASED DATE | ECM NUMBER | ORDER NUMBER | FORMAT | PLOT | DRAWING NUMBER | REV. |
| ABRAHAM_STD | 03/05/2015 | | –/– | ANSI A | 1=1 | Z0908258 | |

Recold®




# LEFT SIDE ELEVATION

NOTES:

① CONTROL PANEL LOCATION SHOWN IS STANDARD FOR ALL J-SERIES MODELS

② CONTROL PANEL EXACT LOCATION CAN VARY DEPENDING ON THE SPACE AVAILABLE



Recold Item No:

| DRAWN BY | DRAWN DATE | | | | | | |
|---|---|---|---|---|---|---|---|
| TRINH | 12/16/2014 | QTC DRAWING | | | | | Recold® |
| CHECKED BY | CHECKED DATE | CONTROL PANEL STANDARD LOCATION J-SERIES | | | | | |
| ABRAHAM_STD | 02/16/2015 | | | | | | |
| RELEASED BY | RELEASED DATE | ECM NUMBER | ORDER NUMBER | FORMAT | PLOT | DRAWING NUMBER | REV. |
| ABRAHAM_STD | 02/16/2015 | | -/- | ANSI A | 1=1 | Z0908246 | |

# **IMI** vibration switch

specifications

## Product Benefits

- Unique patented, spring loaded, magnetically coupled sensor, requiring no power
- Offers cost effective protection for critical situations
- Provides better control over trip sensitivity
- Remote reset models available
- 30' cord set

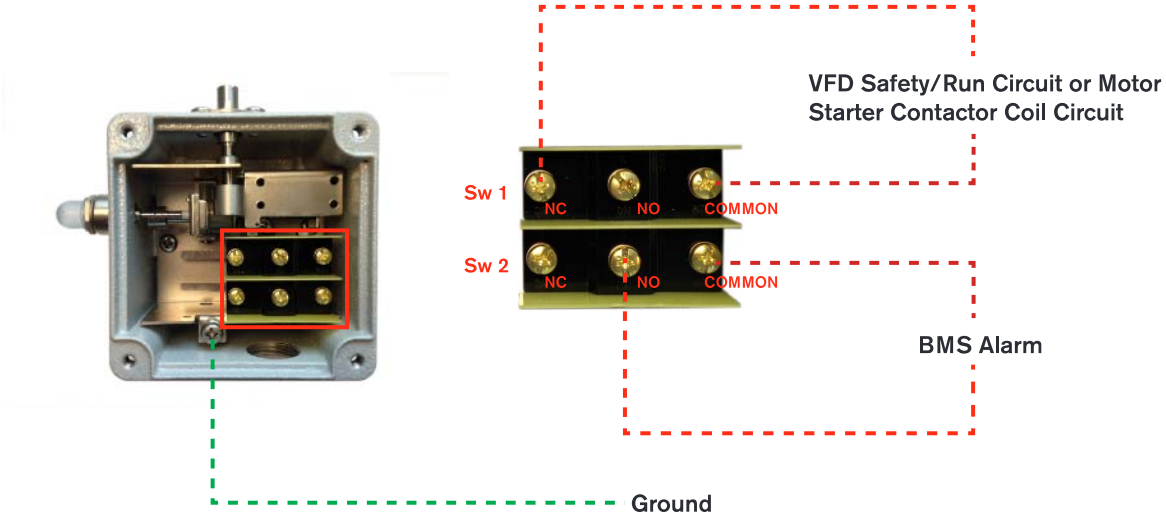

| Model | Reset | Relay Contact Output | Measurement Range | Frequency Range |
|---|---|---|---|---|
| 2558910 | Manual external reset button | One - DPDT form "C" 15 amp at 120 VAC | Inertial 1-7 g pk 0-68.7 m/s² pk adjustable | 0 to 6000 cpm 0-100 Hz |
| 2558911 | Manual external reset button and 24 VDC remote reset solenoid | | | |
| 2558912 | Manual external reset button and 120 VAC 60 Hz remote reset solenoid | | | |
| 2558913 | Manual external reset button and 240 VAC 50 Hz remote reset solenoid | | | |

| Model | Startup Delay | Trip indication | Enclosure type | Conduit fitting* | Electrical Certification |
|---|---|---|---|---|---|
| 2558910 | No | External red indicator | NEMA 4X / IP56 epoxy painted aluminum | One - 3/4 inch NPT threaded female connection with liquid tight fitting and cord provided | c SP us CE |
| 2558911 | Timer required in customer's start circuit | | | | |
| 2558912 | | | | | |
| 2558913 | | | | | |

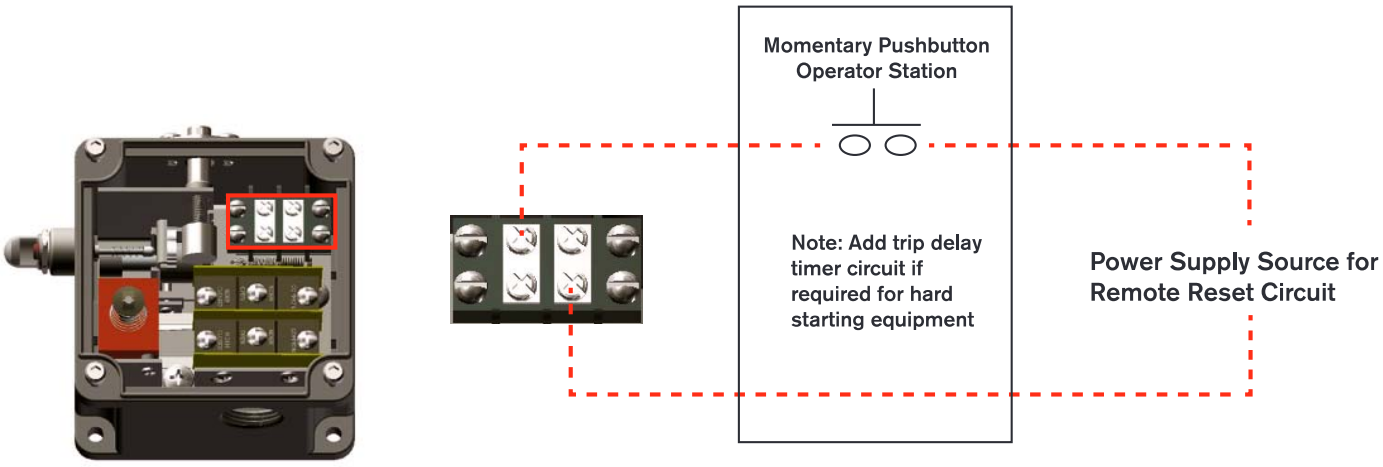
*If using conduit, seal the inside of the switch with a vapor barrier. Refer to the Vibration Switch User Manual for additional details.

MARLEY®

## Typical output contact wiring




## Typical remote reset wiring




**SPX COOLING TECHNOLOGIES, INC.**
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913 664 7400 | spxcooling@spx.com
spxcooling.com

SPEC-IMI-17A | ISSUED 06/2017


SPX

# Copper Coil INSIGHT

## Overview

Copper heat-exchange coils, used in every Recold Fluid Cooler and Evaporative Condenser, provide many distinct advantages.

## Primary Benefits

- Half the corrosion rate of carbon steel in closed systems, translates into potentially longer product life
- Seven times greater thermal conductivity than carbon steel, allows for smaller equipment size and less equipment weight
- Easier system circuit changes or repairs, with no welding required
- Greener product

## Benefit Detail

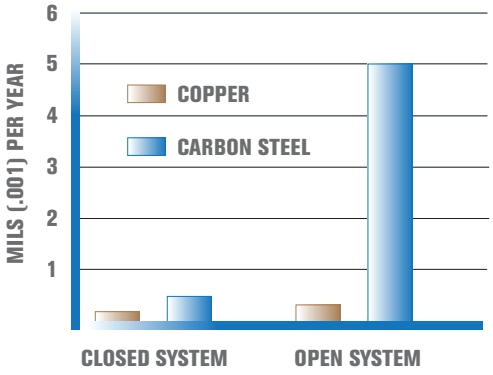
Longer Equipment Life:

- Copper provides superior corrosion resistance, extending equipment life
- Copper maintains system efficiency better with time
- Coils can be drained as often as necessary

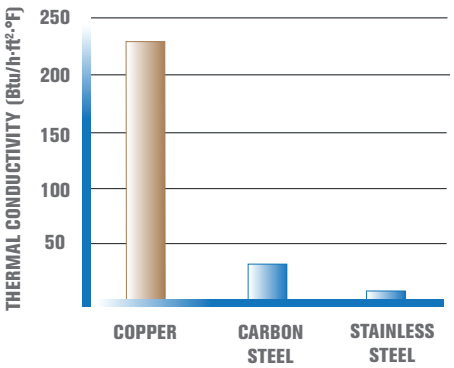
Greater Thermal Efficiency:

- Thermal conductivity of copper is more than seven times that of carbon steel, enhancing heat transfer
- Smaller equipment size
- Lower equipment weight

*more*




Adapted from *Standards for Corrosion Rates,* Bennett P. Boffardi, Ph.D., FNACE



# **Copper Coil** INSIGHT

## *Benefit Detail*

Easier to work with:

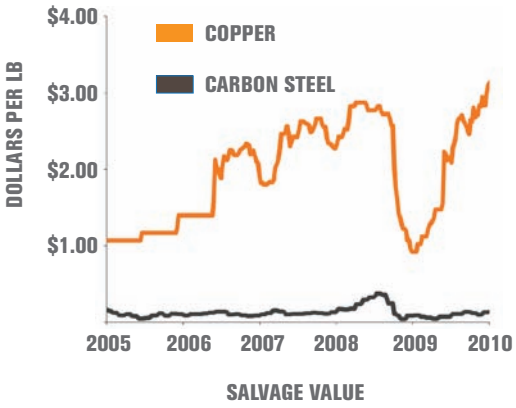
- Copper can be brazed, unlike steel which has to be welded
- Copper coils can easily be circuited to separate multiple loads within the same unit if desired

Green material:

- Recyclable at the end of its useful life, potentially resulting in a higher salvage value per pound than steel
- Copper is naturally bacteriostatic (inhibits bacteria growth)
- Less process fluids required because less heat transfer surface is needed for the same amount of cooling

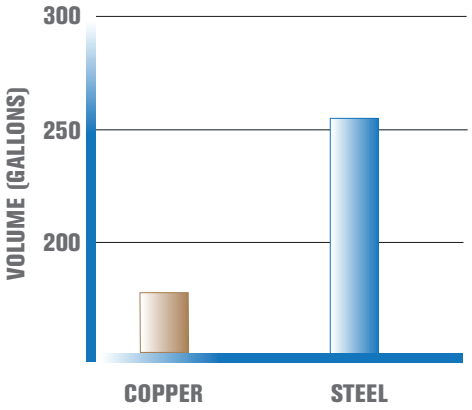
## *History*

- Recold has manufactured heat exchange equipment serving refrigeration, HVAC, and industrial applications for over 75 years. For the best value in evaporative cooling equipment, insist on a Recold heat transfer coil made from copper.




## *Key Contacts*

- Refrigeration applications: Mike Lloyd
  mike.lloyd@spx.com
- HVAC applications: Jon Walker
  jon.walker@spx.com




*Internal coil volume typical of a 100 ton forced-draft fluid cooler*

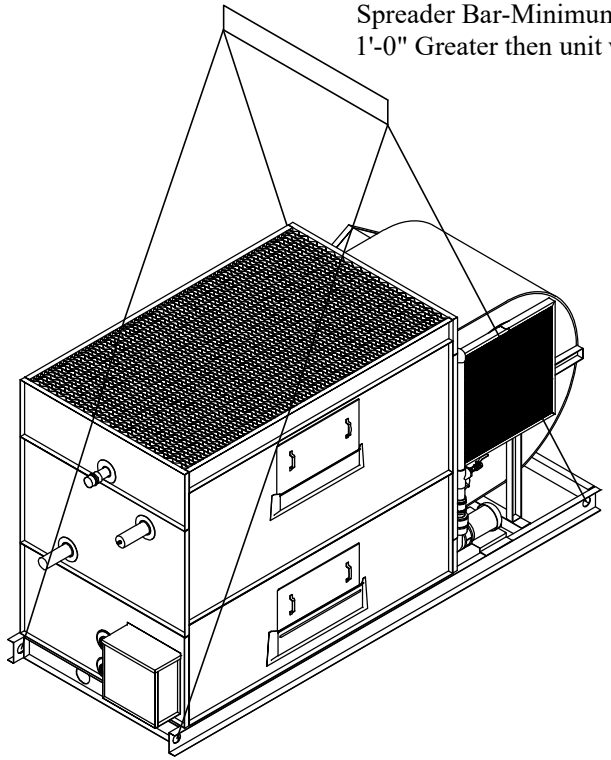
SPX
COOLING TECHNOLOGIES

7401 WEST 129 STREET | OVERLAND PARK, KANSAS 66213 UNITED STATES | 913 664 7400 | spxcooling@spx.com | **spxcooling.com**

**Contact your Marley Sales Representative at spxcooling.com/en/sales/**

# HOISTING INSTRUCTIONS J-SERIES

This instruction is published as a guide for the rigging of JC, JW, and JT products. Rigger should always follow appropriate safety precautions. For extended lifts or where additional safety precautions are required, add safety slings beneath the tower.



Spreader Bar-Minimum Length
1'-0" Greater then unit width

| JW | | | JC | | | JT | | |
|---|---|---|---|---|---|---|---|---|
| MODEL | WEIGHT (lbs) | WIDTH (inches) | MODEL | WEIGHT (lbs) | WIDTH (inches) | MODEL | WEIGHT (lbs) | WIDTH (inches) |
| 10A | 910 | 31 | 20 | 810 | 31 | 1830 | 853 | 31 |
| 10B | 955 | | 25 | 910 | | 2140 | 1142 | 37 |
| 10C | 1005 | | 30 | 960 | | 2550 | 1597 | 45 |
| 15B | 1365 | 37 | 38 | 1280 | 37 | 2565 | 1616 | |
| 15C | 1435 | | 46 | 1350 | | 3175 | 2504 | 56 |
| 25A | 1850 | 45 | 52 | 1360 | | 3185 | 2528 | |
| 25B | 1955 | | 58 | 1435 | | 31100 | 2557 | |
| 25C | 2075 | | 63 | 1940 | 45 | 37110 | 3906 | 67 |
| 35A | 2955 | 56 | 72 | 1955 | | 37130 | 3943 | |
| 35B | 3140 | | 80 | 2075 | | 37140 | 3988 | |
| 35C | 3305 | | 90 | 2955 | 56 | 40160 | 5133 | 94 |
| 50A | 4380 | 67 | 110 | 3090 | | 40180 | 5194 | |
| 50B | 4635 | | 120 | 3305 | | 40215 | 5579 | |
| 50C | 4885 | | 135 | 4355 | 67 | 40240 | 5675 | |
| 70B | 6685 | 94 | 165 | 4610 | | 40265 | 5709 | |
| 70C | 7085 | | 180 | 4860 | | 49290 | 7886 | 101 |
| 85B | 7725 | | 200 | 4880 | | 49310 | 7916 | |
| 85C | 8185 | | 240 | 6675 | 94 | 49340 | 8486 | |
| 100B | 9170 | 101 | 270 | 7045 | | 49360 | 8624 | |
| 100C | 9675 | | 285 | 7075 | | 49390 | 8978 | |
| 115B | 10080 | | 320 | 7725 | | 49415 | 9028 | |
| 115C | 10670 | | 350 | 8180 | | | | |
| 130B | 11025 | | 375 | 9160 | 101 | | | |
| 130C | 11720 | | 400 | 9660 | | | | |
| | | | 425 | 10070 | | | | |
| | | | 450 | 10660 | | | | |
| | | | 475 | 11005 | | | | |
| | | | 525 | 11700 | | | | |

WEIGHTS SHOWN ARE FOR STANDARD UNITS
WEIGHTS FOR OPTIONS NOT INCLUDED



Recold Item No:

| DRAWN BY | DRAWN DATE | | | | | | |
|---|---|---|---|---|---|---|---|
| TRINH | 12/16/2014 | QTC DRAWING | | | | | |
| CHECKED BY | CHECKED DATE | HOISTING INSTRUCTIONS, J-SERIES | | | | | |
| ABRAHAM_STD | 03/05/2015 | | | | | | |
| RELEASED BY | RELEASED DATE | ECM NUMBER | ORDER NUMBER | FORMAT | PLOT | DRAWING NUMBER | REV. |
| ABRAHAM_STD | 03/05/2015 | | –/– | ANSI A | 1=1 | Z0908311 | |

Recold®