IMPORTANT:

READ THIS MANUAL THOROUGHLY BEFORE INSTALLING AND OPERATING UNIT. IT IS THE CUSTOMERS RESPONSIBILITY TO WIRE UNIT WITH THE APPLICABLE ELECTRICAL CORD AND PLUG FOR USE IN HAZARDOUS DUTY ENVIRONMENTS PER LOCAL LAWS AND REGULATIONS. WIRING SHOULD BE COMPLETED BY A LICENSED ELECTRICIAN WITH KNOWLEDGE ON HAZARDOUS DUTY WIRING.

Phoenix C1X - Membrane Based Portable Lube and Hydraulic Oil Purifier Cart For use in Hazardous Duty Locations.

Rev 5 – 09092015-KB

INDEX

SECTION 1

PHOENIX SPECIFICATIONS

FLOW RATE:	1 GPM
MAX OPERATING VISCOSITY	3 cSt to 3000 cSt
FLUID/OIL COMPATIBILITY	MINERAL BASED, PAO AND POLYOLESTER (Phosphate Ester Membrane Optional)
MAX RECOMMENDED OPERATING PRESSURE	20 PSIG
MIN/MAX OPERATING AMBIENT TEMP	0 – 50 C
MIN/MAX STORAGE TEMP	- 20 – 60 C
MIN/MAX OPERATING FLUID TEMP	- 15C – 80 C
EMPTY WEIGHT	250 LBS
INLET/OUTLET CONNECTIONS	¾” Male JIC
DIMENSIONS	20”W X 22”D X 51”H
VOLTAGE	110V STANDARD 230 V OPTIONAL
MAX AMPERAGE DRAW	12.5 AMPS/ 6 AMPS
MOTOR ELECTRICAL SPECIFICATIONS	Class 1, Group c&D,Class 2, Group F&G, T3C
MOTOR ELECTRICAL CONTRO BOX SPECIFICATIONS	Class 1, Div 1 & 2, GR, C&D, Class II Div 1 & 2 GR, E, F, G
COMPRESSED AIR REQUIREMENT	80-85 PSIG – 13 SCFM

SECTION 2:

Phoenix Portable Lube and Hydraulic Membrane Oil Purifier

For use in Hazardous Locations.

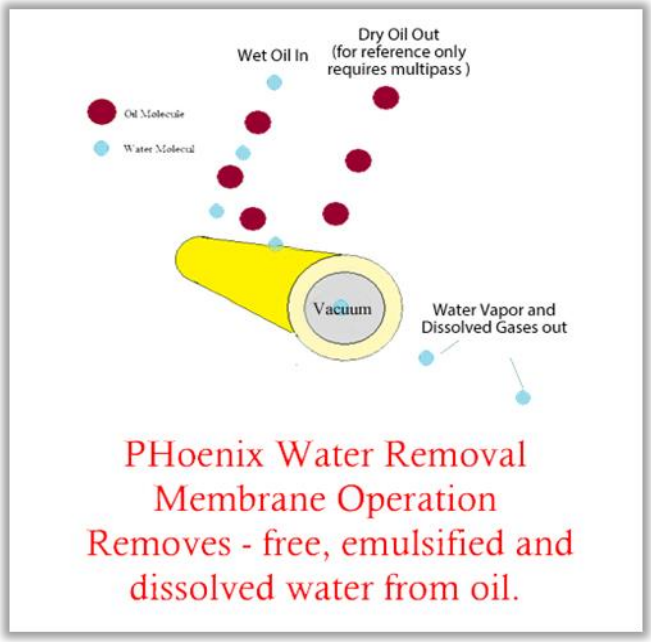
(Description and Operation)

The Phoenix oil purifier is a compact and portable oil purifier cart with the capability to remove particulate along with free, emulsified and dissolved water from lube and hydraulic systems of between 5 and 150 gallons. It is supplied with its own 1 GPM fluid pump. This purifier can be purchased without a fluid pump as a hand carried unit under the part number PHX-M.

The Phoenix utilizes a cutting edge hollow fiber membrane bundle to remove water from oil. Moisture is pulled out of the oil by a vacuum as wet oil passes across the outside of the membrane. A vacuum created by a supplied vacuum generator pulls moisture through the membrane where it is expelled as vapor from the vacuum generators exhaust port. Water levels as low as 25 ppm are achievable depending on oil sump size and water ingression levels. This cutting edge water removal membrane has no limit to the quantity of water it can remove and requires minimal maintenance and operator attention. It should provide years of worry and trouble free operation before replacement.

IMPORTANT NOTE:

The membrane bundle is not serviceable in the field and should be returned for replacement when its useful life is complete. Never try to disassemble the membrane housing in the field or damage to the bundle may occur.



Disclaimer: Photo is illustrative. The membrane is not claimed as defect free and there may be very slight oil carryover to the vacuum side. This does not however effect the performance or many benefits of the Phoenix Purifier. Water Removal is multi-pass and requires several passes of oil across membrane to be fully effective.

Figure 1

(SECTION 2: Description and Operation - Continued)

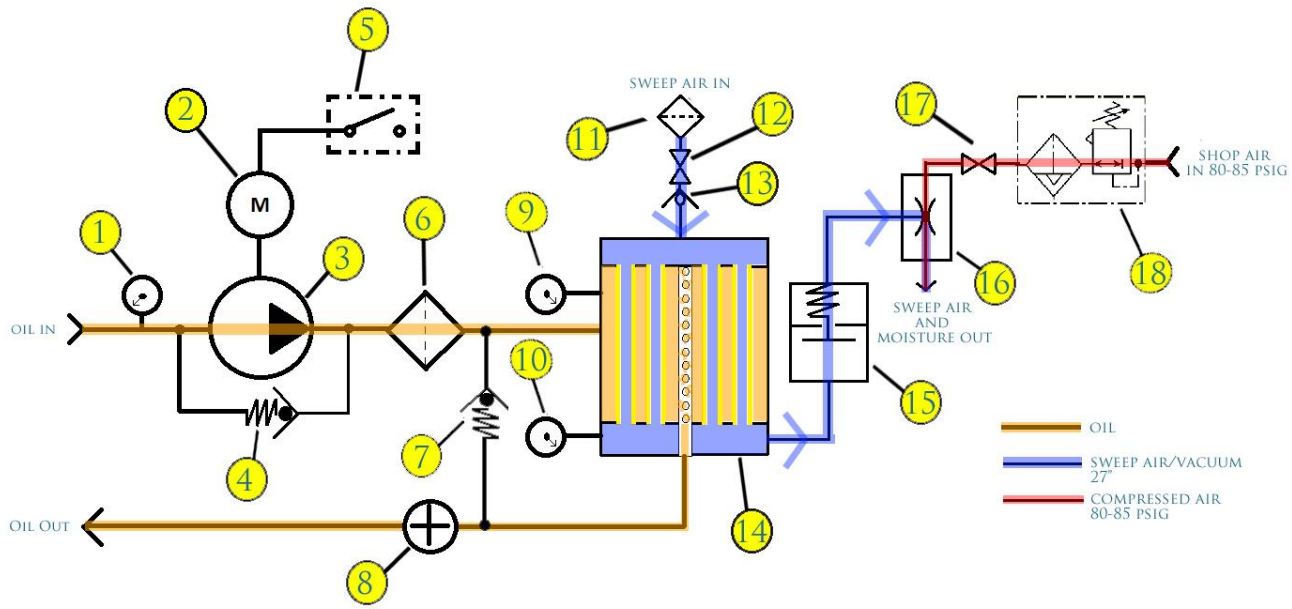


Figure 2

Oil is pumped into the Phoenix Cart by (item 3) a 1 gpm gear pump with a (item 4) built in 65 psid relief valve. The motor and on off switch (items 2 and 5) connected to the pump are specified for use in Hazardous duty locations. Oil then flows into (item 6) particulate filter element and housing. There is a visual filter plugged indicator on the filter housing to tell when the filter element is plugged. (Item 1) is a vacuum gauge which shows the inlet vacuum that the fluid pump is pulling. A vacuum reading above 25” is an indication of restriction in the fluid line. To prevent cavitation and potential damage to the fluid pump never run the Phoenix for prolonged periods of time with a vacuum reading above 25” on (Item 1) . Reference the trouble shooting guide included with this manual for tips on lowering the vacuum reading.

Oil then passes into (item 14) the maintenance free and non-replaceable water removal membrane. A 20 psid spring loaded check valve (Item 7) is piped in parallel with the water removal membrane housing to provide pressure relief across the membrane bundle in the event of excess differential pressure. The membrane housing may handle up to 150 psig of total pressure however (Item 7) the relief limits the total pressure drop possible across the membrane bundle to about 20 psid. This total pressure may be read from the (item 9) 0-100 psig liquid filled pressure gauge installed on the membrane housing.

After oil enters the housing it is forced across the water removal membrane and then exits the housing. Water is removed from the oil as it passes across the membrane. If the spring loaded bypass (item 7) is open then partial flow from the membrane housing will recombine with partial non dewatered oil passing through the check valve. Both combined flows exit the purifier and return to the oil reservoir through (item 8) - a sight glass with a spinning oil flow indicator. A vacuum is generated by the (item 16) maintenance free vacuum venturi which pulls sweep air through (item's 11,12 &13) the (vent filter, vacuum control valve and leak prevention check valve) and then through the center of the membrane hollow fiber. (Item 18) is a filter pressure regulator where shop air of a minimum 80-85 psig is connected. The shop air is what generates the vacuum in the venturi (item 16).

(Item 15) An air eliminator is installed between the membrane housing and vacuum generator in order to prevent any oil leakage to the vacuum side in the event that the membrane is compromised. The air eliminator (Item 15) and the check valve installed (Item 13) allow the Phoenix to automatically seal itself completely off in the unlikely event of a membrane break or rupture. See figures 3 through 5 below showing sweep air flow for further information.

The total vacuum generated by (Item 16) vacuum generator is controlled by maintaining 80-85 psig on the regulator (item 18) and manually throttling down on the control valve (item 12) and may be read in inches of mercury on the vacuum gauge (item 10). Vacuum is typically set between 26" and 27" of mercury. There is a sight glass and drip leg located on the membrane housing - just under the vacuum gauge(item 9) in order to drain any potential but unlikely liquid condensation from the line.

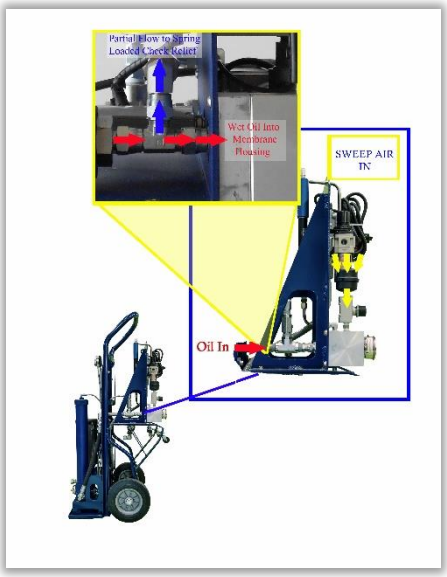


Figure 3

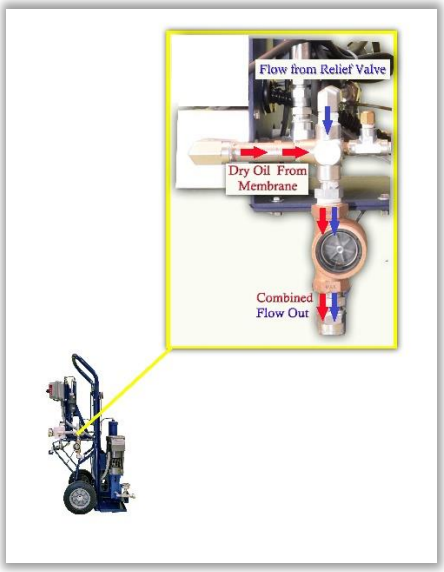


Figure 4

Figure 5

SECTION 3: COMPONENT LIST AND DESCRIPTION

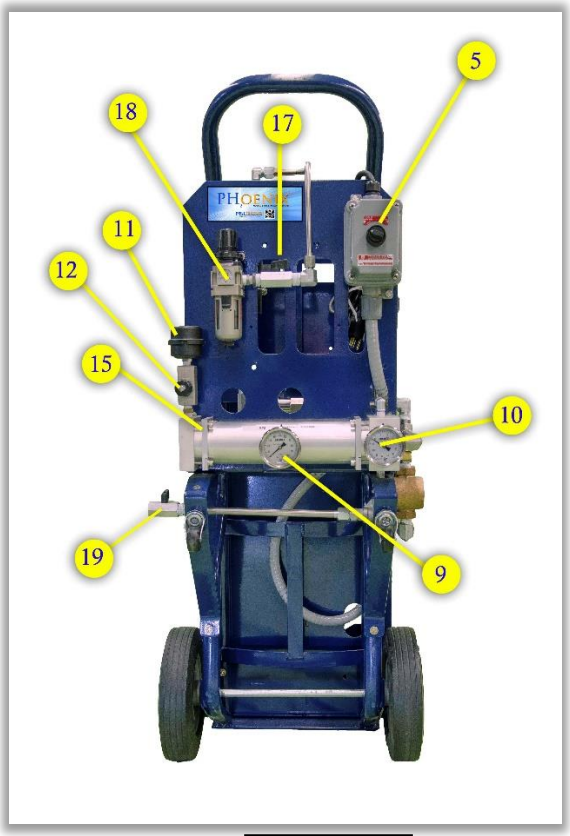


Figure 6

Figure 7

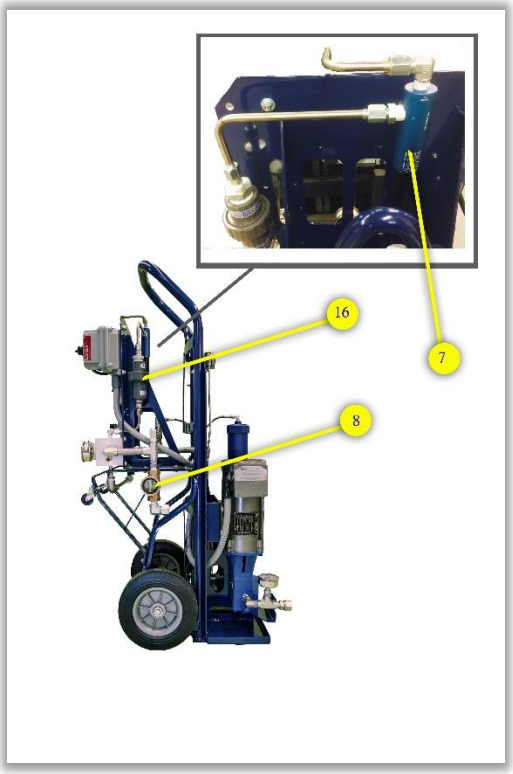


Figure 8

(SECTION: 3 Component List and Description – Continued)

See Figures 6-8 on page 5

Item	Qty	Description
1	1	Inlet Vacuum Gauge
2	1	110/230 V Class 1, Group D, Class 2, Group F&G, T3C Fluid Pump Motor
3	1	1 gpm Gear Pump with 65 psid integral relief.
4	1	¼" Oil Sample Valve
5	1	Class 1, Div 1 & 2, GR, C&D, Class II Div 1 & 2 GR, E, F, G Fluid Pump Motor On/Off Switch
6	1	7 micron Particulate Spin on Filter
7	1	Maintenance Free Vacuum Venturi Generator
8	1	Outlet Oil Flow Sight Glass with Spinner
9	1	0-100 PSIG Membrane Housing Pressure Gauge
10	1	0-30 Compound Vacuum and Pressure Gauge
11	1	Vacuum Vent Filter
12	1	Vacuum Level Control Valve
13	1	Filter Plugged Pop Out Indicator.
15	1	Water Removing Membrane Housing
16	1	Vacuum Air Eliminator and Leak Preventer
17	1	Compressed Air Isolation Valve
18	1	Compressed Air Filter/Regulator
19	1	Condensation drip Leg and Drain Valve

Section 4:

(RECOMMENDED INSTALLATION)

IMPORTANT

DO NOT CONNECT THE PHOENIX PURIFIER OUTLET LINE TO ANY POINT OR PRESSURE LINE WHERE THE BACK PRESSURE COULD EXCEED 20 PSIG OR DAMAGE TO THE MEMBRANE BUNDLE COULD OCCUR AND REPLACEMENT MAY BE NECESSARY. IT IS IDEAL TO CONNECT THE RETURN LINE OF THE PHOENIX TO A POINT OF LOWEST PRESSURE AS POSSIBLE SUCH AS ON A T DOWNSTREAM OF A BREATHER FILTER

There are several ways to connect the Phoenix membrane purifier to a reservoir with some being better than others. Figures 10 shows two ideal ways since they both allow suction from the bottom of the reservoir where water and particulate can collect and return to the top away from the suction. This provides the maximum turnover of oil while the siphon breaks provide a level of safety in the event of a hose or fitting break/leak preventing the possibility of accidentally completely draining the reservoir. The return pipe should be unobstructed and end below the oil line to prevent aeration of the oil upon return to the reservoir.

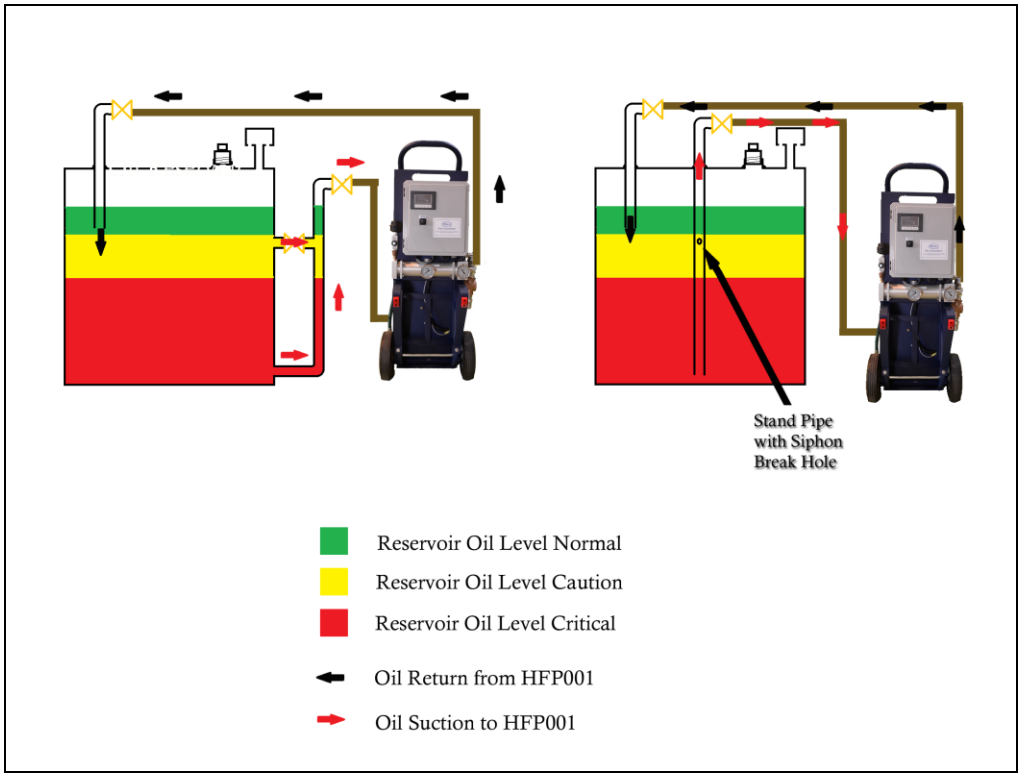


Figure 10

Section 5:

Unit Startup/Crane Rigging Instructions

CRANE RIGGING

If lifting and moving unit with a crane lift from this point figure 11 only!

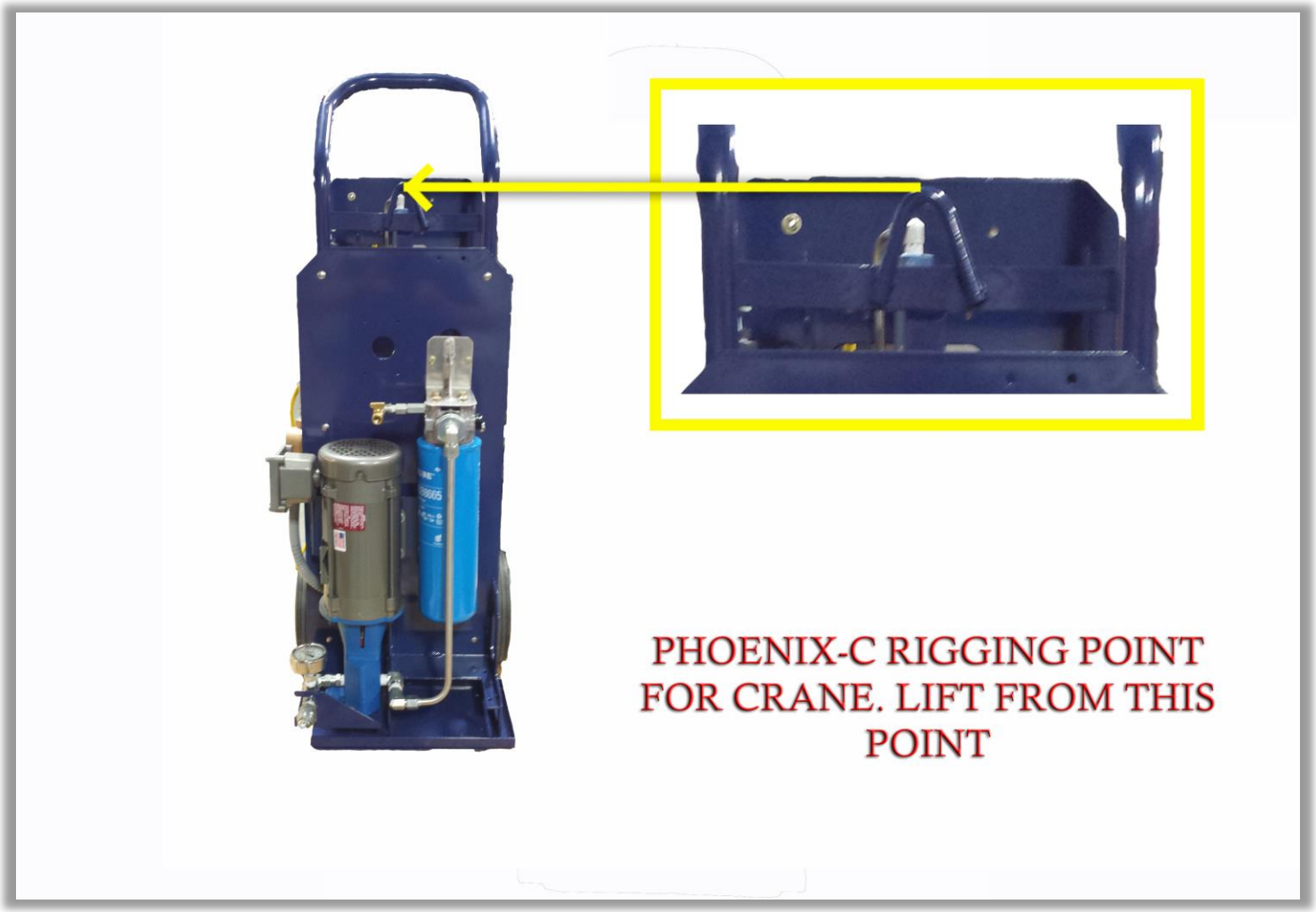


Figure 11

ϟ Connections ϟ

Electrical – See Figure 12 Below. Should be done by a licensed Electrician knowledgeable in Hazardous Duty Wiring and Recepticles. The Phx –CX is not shipped with a powercord or plug since there are too many available explosion proof plugs to standardize on. It is therefore the customers responsibility to pick and wire the correct plug and cord based on applicable voltage, amp draw along with local explosion proof codes and laws or catastrophic damage can occur to both people and property. Once Electrical is connected then Plug Phoenix into Power Supply.

Inlet/Outlet Hoses – See Figure 13 Below. Use ¾ " Hydraulic Full Vacuum Hose with Jic Swivel Connections. Cases where oil viscosity is higher than 360 weight may require 1" Hydraulic Hose adapted down to ¾" connections on the unit. Inlet Hose should be less than 10' if possible. Open all supply and return valves off of the oil supply system to make sure oil has an unobstructed flow path to and from Phoenix. Check for any leaks in hoses and connections before continuing.

Compressed Air – See Figure 14 Below. Requires 80-85 psig and 13 SCFM at the inlet to the air regulator. Use only correct hose type for air supply and at a minimum 1/2" air hose.

Figure 12

Figure 13

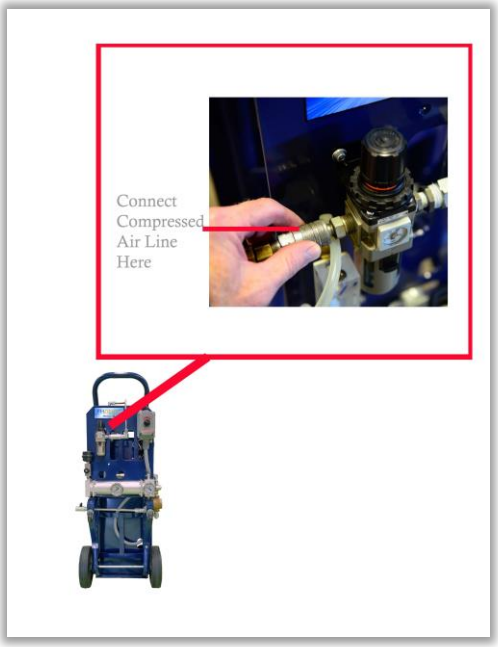


Figure 14

1. MAKE SURE ALL CONNECTIONS AND SUPPLY VALVES TO PHOENIX ARE OPEN AND THEN ENERGIZE FLUID PUMP BY TURNING POWER KNOB TO RIGHT.

.

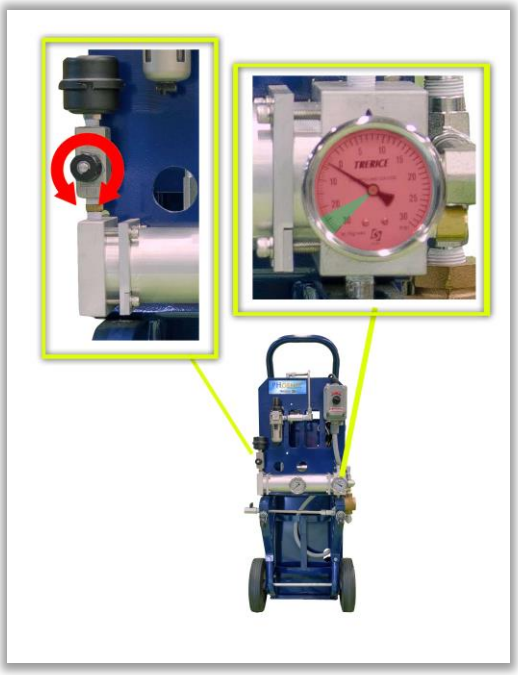
2. IMMEDIATELY CHECK SPINNER FLOW INDICATOR ON SIDE OF UNIT TO SEE IF OIL IS FLOWING OUT WHICH MAY TAKE A FEW SECONDS OR SO. IF OIL IS CONFIRMED CHECK INLET COMPOUND VACUUM GAUGE TO INSURE THAT READING IS BETWEEN 0 PSIG AND 25” HG. IF READING IS OUT OF SPECIFICATION OR IF OIL IS NOT SHOWING IN SPINNER FLOW INDICATOR – SHUT DOWN UNIT AND LOOK FOR OBSTRUCTION IN OIL LINES OR CHECK IN TROUBLE SHOOTING GUIDE OF THIS MANUAL.

3. CHECK MEMBRANE PRESSURE GAUGE ON FRONT OF MEMBRANE HOUSING TO INSURE PRESSURE IS LESS THAN 25 PSIG. IF PRESSURE IS HIGHER THAN 40 PSIG SHUT UNIT DOWN AND LOOK FOR OBSTRUCTION IN UPSTREAM HOSES AND ALSO CHECK TO MAKE SURE ALL SUPPLY VALVES FROM OIL SUPPLY ARE COMPLETELY OPEN. IF ISSUE CONTINUES CHECK TROUBLE SHOOTING GUIDE IN THIS MANUAL.

IF UNIT IS FUNCTIONING NORMALLY CHECK ALL SUPPLY HOSES AND FITTINGS ON UNIT FOR ANY OIL LEAKAGE AND CORRECT OR TIGHTEN AS NECESSARY BEFORE GOING FORWARD.

4. AIR REGULATOR IS FACTORY SET HOWEVER SOME ADJUSTMENT MAY NEED TO BE DONE IN THE FIELD. TO ADJUST PRESSURE LIFT KNOB TILL RED LINE IS SHOWING AND TURN REGULATOR TILL PRESSURE GAUGE READS 80-85 PSIG. ONCE ADJUSTED PUSH KNOB BACK DOWN TO LOCK IT.

5. OPEN AIR SUPPLY VALVE ON FRONT OF UNIT AND INSURE THAT PRESSURE ON REGULATOR PRESSURE GAUGE REMAINS AT A STEADY 80-85 PSIG. IF PRESSURE LOWERS INSURE AIR SUPPLY IS ADEQUATE AND AIR HOSES AND CONNECTIONS ARE OF THE CORRECT SIZE TO PREVENT RESTRICTION.



6. CHECK VACUUM GAUGE ON FRONT OF UNIT AND INSURE VACUUM IS BETWEEN 24 AND 27 HG OF MERCURY. IF VACUUM IS LOWER ADJUST THROTTLE VALVE UNDER VENT FILTER TILL HIGHEST VACUUM IS REACHED. DO NOT CLOSE ADJUSTMENT VALVE ALL THE WAY SINCE SOME SWEEP AIR IS REQUIRED. TURN KNOB JUST UNTIL 27" OF VACUUM IS REACHED ON GAUGE.

IF VACUUM REMAINS LOW CHECK TROUBLE SHOOTING SECTION OF THIS MANUAL.

7. MONITOR PARTICULATE FILTER DIFFERENTIAL PRESSURE USING GREEN TO RED INDICATOR ON SIDE OF SPIN ON FILTER HOUSING HEAD.

FILTER ELEMENT REQUIRES REPLACING WHEN WHITE FILTER PLUGGED INDICATOR IS SHOWING IN THE RED. TURN PHOENIX OFF AND USE STRAP WRENCH TO REMOVE FILTER. RUB A LITTLE OIL ON ORING OF NEW FILTER, INSTALL AND TIGHTEN SNUG. INSPECT FOR ANY LEAKS AFTER STARTING UNIT BACK UP.

MONITOR FILTER INDICATOR REGULARLY AND ONLY RUN PHOENIX WITH MSC APPROVED PARTICULATE FILTER INSTALLED. RUNNING UNIT WITH A DIFFERENT FILTER TYPE WILL VOID WARRANTY AND MAY CAUSE PERMANENT DAMAGE TO THE WATER REMOVAL MEMBRANE WHICH WILL THEN REQUIRE PREMATURE REPLACING.

8. OCCASIONALY INSPECT SIGHT GLASS IN AIR REGULATOR TO SEE IF ANY MOISTURE FROM COMPRESSED AIR SYSTEM HAS PRECIPITATED OUT. IF THERE IS MOISTURE PRESENT IN BOTTOM OF REGULATOR SQUEEZE BOTTOM REGULATOR DRAIN VALVE TO DRAIN MOISTURE FROM REGULATOR BOWL.

9. OCCASIONALY DURING VERY HIGH WATER IN OIL CONTAMINATION LEVELS - WATER CONDENSATION MAY BECOME PRESENT IN VACUUM LINE. DURING THOSE TIMES IT MAY BE NECESSARY ON OCCASION TO CHECK CONDENSATION DRAIN LINE FOR ACCUMULATED MOISTURE AND DRAIN. TO DO THIS – TURN OFF AIR SUPPLY AND THEN OPEN DRAIN VALVE IN CONDENSATION DRAIN LINE LOCATED UNDER MEMBRANE HOUSING. NO PRESENCE OF CONDENSATION DOES NOT MEAN THAT THE PHOENIX IS NOT WORKING, ONLY THAT WATER LEVELS ARE NOT HIGH ENOUGH IN OIL TO CAUSE CONDENSATION TO FORM.

A SMALL AMOUNT OF OIL MAY PASS THROUGH THE MEMBRANE AND CONDENSE IN THIS LINE WHICH IS NORMAL AND SHOULD BE DRAINED. HOWEVER IF LARGE AMOUNTS OF OIL ARE PRESENT PLEASE CONTACT YOUR PHOENIX REPRESENTATIVE.

OPERATIONAL CHECK LIST

ITEM	DESCRIPTION	READING AND CHECK	READING
1	COMPRESSED AIR REGULATOR	80-85 PSIG ON GAUGE , CHECK SIGHT GLASS FOR MOISTURE AND DRAIN PER INSTRUCTIONS ON PAGE 14	
2	VACUUM LEVEL	24 -27” HG MERCURY ADJUST PER INSTRUCTIONS ON PAGE 13. VACUUM MAY VARRY ON ITS OWN DEPENDING ON AMOUNT OF MOISTURE IN OIL. **DO NOT** CLOSE VACUUM ADJUSTMENT VALVE ALL THE WAY.	
3	MEMBRANE PRESSURE GAUGE	0-20 PSIG. IF HIGHER CHECK PAGE 12 OF MANUAL FOR TROUBLE SHOOTING.	
4	MEMBRANE CONDENSATION DRAIN VALVE	INSPECT FOR CONDENSATION PER PAGE 14 . DRAIN IF NECESSARY.	
5	OIL FLOW SIGHT GLASS	INSPECT OIL QUALITY (OIL WILL BECOME CLEAR AS WATER IS REMOVED) AND ALSO THAT OIL IS FLOWING	
6	PUMP SUCTION VACUUM GAUGE	15 PSIG – 25 HG MERCURY	
7	PARTICULATE FILTER DP GAUGE	FILTER REQUIRES REPLACEMENT IF WHITE INDICATOR MOVES INTO THE RED	

Figure 15

Figure 16

Figure 17

SECTION 6:

Phoenix PREVENTATIVE MAINTENANCE AND RECOMMENDED SPARE PARTS

IMPORTANT NOTE: There is very little preventative maintenance required for the Hazardous Duty X Model Phoenix Purifier. The amount required is limited to replacement of the particulate filter and the inlet breather filter. There is no maintenance required on the water removal membrane which **is not field serviceable**. Always operate the Phoenix with an MSC approved Filter Element and also a breather filter per Figure 18 below or premature damage to the water removal membrane may occur

RECOMMENDED SPARE PARTS LIST

PART NUMBER	DESCRIPTION	REPLACEMENT INTERVAL
FS-05-25	Breather filter Element	3-6- Months of operation or when necessary.
MSCP568665	7 MICRON SPIN ON PARTICULATE FILTER – DO NOT USE ANTHING OTHER THAN AN MSC APPROVED FILTER OR WATER REMOVAL MEMBRANE CAN BE DAMAGED.	When necessary when filter plugged indicator indicates or up to 6 months of operation whichever comes first.

Figure 18 – Recommended Filter Element Change out.

SECTION 7: TROUBLE SHOOTING GUIDE

This is only a guide. If these recommendations do not solve the problem please contact your Sales representative for further help.

PROBLEM DESCRIPTION	POSSIBLE CAUSE/SOLUTION
NO POWER TO UNIT OR UNIT WILL NOT RUN	• Insure Phoenix-CX is plugged into specified power source and make sure there is power to that source. • If Problem continues have a licensed electrician investigate that there is power at the source and motor controller.
POWER TO UNIT – AND PUMP RUNNING BUT NO FLOW OUT OF SPINNING INDICATOR	• Inspect filter element plugged indicator to make sure element is not plugged. If filter is plugged the pump will relieve through its 65 psig spring loaded relief valve and there will be no flow. Replace filter if necessary. • Inspect membrane pressure gauge on front of unit and if pressure is over 50 psig check for obstructions down stream of phoenix such as unopened return valve on system. Again pump is designed to relieve back to the inlet in the event of greater than 65 psig of backpressure.
LOW OR NO VACUUM ON FRONT RIGHT VACUUM GAUGE	• Inspect pressure regulator to insure 80-85 psig of pressure is present. • Insure air supply valve downstream of regulator is open. • Feel exhaust of vacuum venturi to insure compressed air is flowing out. • See page 12 on adjusting vacuum control knob. • Check condensation drain valve per instructions on step 13 to see if high levels of water condensation are present. If too much condensation builds up unit is designed to isolate vacuum line from outlet of venturi. Drain condensation and start unit back up.

	IMPORTANT NOTE: IF OIL IS PRESENT IN CONDENSATION DRAIN LINE THIS MAY INDICATE A COMPROMISED MEMBRANE. SHUT UNIT DOWN AND CONTACT YOUR SALES REPRESENTATIVE.

(SECTION 7: Trouble Shooting Guide – Continued)

PRESSURE HIGHER THAN 10 -20 PSIG ON FRONT PRESSURE GAUGE	• **Make sure Pressure Gauge is reading correctly and 0's out when unit is shut down. If not then replace gauge.** • **Check for obstruction upstream in return line and remove any obstructions or blockage. See page 7 for recommended Phoenix installation procedure.**
VACUUM LEVEL HIGH ON FRONT RIGHT VACUUM GAUGE BUT VACUUM LEVEL UNRESPONSIVE WHEN VACUUM CONTROL VALVE IS TURNED.	• **Breather Filter Plugged. See page 16 for replacement part.** • **Check inlet check valve just below breather filter to insure it is not stuck shut.**
VACUUM LEVEL READS ABOVE 25" ON INLET FLUID PUMP VACUUM GAUGE – item 6 page 15	• **Insure a minimum of ¾ "diameter fittings and full vacuum rated hydraulic hose is used. 1" may be required for oils higher than 360 weight.** • **Decrease length of hose to reduce restriction into purifier.** • **Insure any supply or block valves to purifier located on lube and hydraulic system are open** **.**

SECTION 8: PHOENIX C FLUSHING PROCEDURE

IT IS RECOMMENDED THAT WHEN USING THE PHOENIX C WITH MORE THAN ONE TYPE OF OIL THAT IT BE FLUSHED OUT BEFORE CHANGING TO ANOTHER OIL. THIS WILL PREVENT OIL CROSS CONTAMINATION IN RESERVOIRS.

STEP 1 – Turn Phoenix C off

STEP 2 – Disconnect inlet hose from oil reservoir. Remove any quick disconnect hydraulic Coupling from end of hose if used so that air can be pumped through Phoenix.

STEP 3 - Leave outlet hose connected to oil reservoir so any oil in Phoenix can be pumped Back in without loss.

STEP 4 - Power on Phoenix and allow oil to pump out and back into reservoir. Watch outlet Oil flow sight glass (see page 11 – item 6) till there is no more oil coming out. Should take approximately 1 – 2 minutes max.

STEP 5 - To prevent cross contamination of oil it is recommended that the Particulate Element be changed each time a different oil is used. Install a new Particulate element into filter housing. See page 12 for filter element change out procedure.

STEP 5 - Empty approximately 2-3 gallons into a 5 Gallon bucket with whatever type of oil the Phoenix is to filter next.

STEP 6 - Insert inlet and outlet hoses into bucket and flush new oil through Phoenix for About 5 minutes.

Phoenix is now flushed out and ready to run on new oil.

SECTION 9: DATA SHEETS

KILLARK®
Killark Electric Manufacturing Company,
A Subsidiary of Hubbell Incorporated,
Box 5325, St. Louis, MO 63115

INSTALLATION, OPERATION & MAINTENANCE DATA SHEET

SEAL-X® FXS/FXCS SERIES FACTORY-SEALED CONTROL STATION SUB-ASSEMBLIES.

FOR CLASS I, DIV. 1 & 2, GR. C & D, CLASS II, DIV. 1 & 2, GR. E, F & G AND CLASS III HAZARDOUS LOCATIONS.

DIRECTIONS FOR INSTALLATION

CAUTION: Before beginning installation, make sure that the supplying circuit is turned OFF.

CAUTION: For installations in extreme cold weather conditions nearing or exceeding -30 C (-22 F), avoid sharp wire bends. A sharp bend in the wire in these temperatures could result in insulation failure due to cracking.

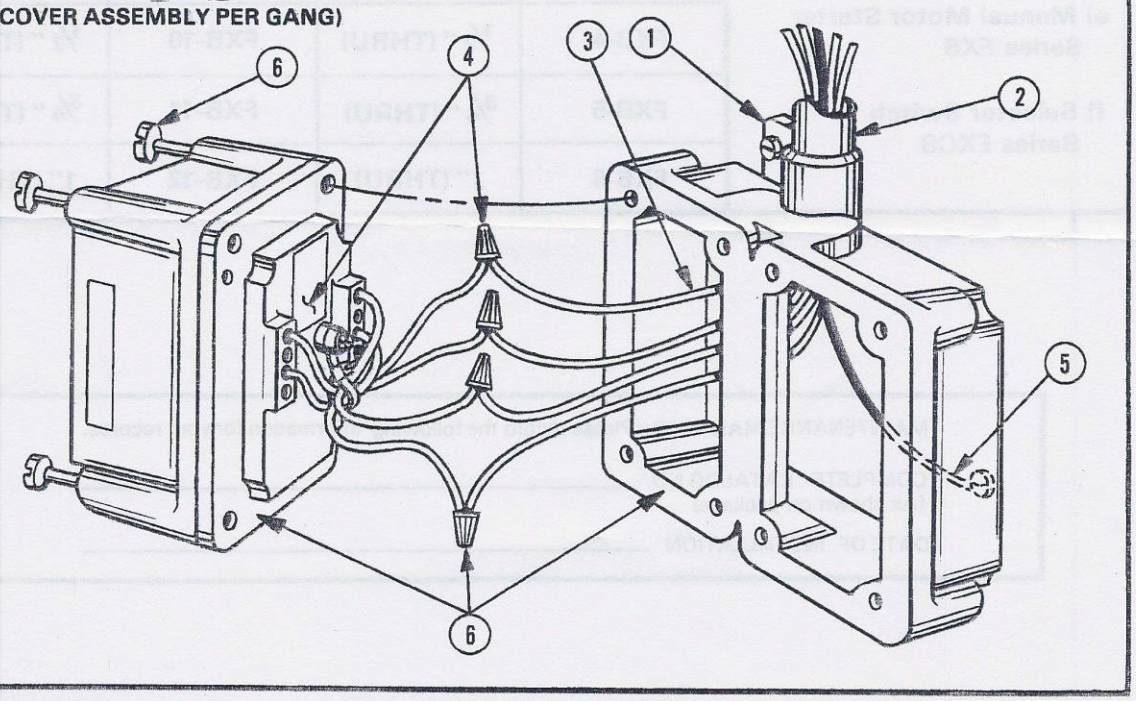
Be sure to check the catalog number on the box or cover with the number on the carton(s) to be certain you have the correct components.

1. Using the Installation Drawing below as a guide, install the FXB Splice Box using the cast-on mounting lugs (1/4" dia. bolts are recommended for secure mounting).
2. Attach the conduit to the box.
3. Pull the wires through the conduit and through the splice box.
4. Make the wiring connections as shown on the wiring diagram on the back of the sealed cover.
5. Connect the ground wire to the ground screw in the splice box.
6. To complete the installation, push the connected wires into the splice box, **check the flange surfaces to make sure they are clean and smooth**, and install the cover assembly. The four cover bolts should be tightened so a .0015" feeler guage will not enter more than 1/8" at any point around the flange joint.

TO INSTALL A NEW COVER ON AN EXISTING FXB SPLICE BOX: Remove and disconnect the old cover assembly, then follow Steps 4 thru 6 above for the new cover assembly.

NOTE: All installations must comply with applicable local and/or National Electrical Code.

TYPICAL INSTALLATION DRAWING
(ONE COVER ASSEMBLY PER GANG)



SEE REVERSE SIDE FOR OPERATION AND MAINTENANCE DATA.

OPERATIONAL DATA

This enclosure is made of cast copper-free aluminum alloy. It is suitable for Class I, Div. 1 & 2, Gr. C & D, Class II, Div. 1 & 2, Gr. E, F & G, and Class III hazardous locations. Like all electro-mechanical devices, these control stations require occasional maintenance. Parts may wear out or become defective due to adverse environmental conditions.

MAINTENANCE DATA

CAUTION - Disconnect this device from the supplying circuit before opening.
The flanges and operator shaft(s) should be lubricated occasionally to prevent corrosion, using Killark LUBG General Purpose lubricant. **Keep all flanges clean and free from scratches.** Many types of control station configurations are offered, and internal and external service parts are available. Consult the Killark factory for parts breakdowns.

REMEMBER TO SAVE ONE OF THESE SHEETS FOR MAINTENANCE PERSONNEL.

TYPICAL CONTROL STATION CONFIGURATIONS

COVER ASSEMBLIES (ONE REQUIRED PER GANG)	BOX IDENTIFICATION			
	SINGLE GANG		DOUBLE GANG	
	CAT. NO.	HUB SIZE	CAT. NO.	HUB SIZE
a) Pushbutton Series FXCS	FXB-1	½"	FXB-7	½"
b) Combination Pushbutton & Pilot Light Series FXCS	FXB-2	¾"	FXB-8	¾"
c) Pilot Light Series FXCS	FXB-3	1"	FXB-9	1"
d) Snap Switch Series FXS	FXB-4	½" (THRU)	FXB-10	½" (THRU)
e) Manual Motor Starter Series FXS	FXB-5	¾" (THRU)	FXB-11	¾" (THRU)
f) Selector Switch Series FXCS	FXB-6	1" (THRU)	FXB-12	1" (THRU)

MAINTENANCE MANAGER: Please record the following information for your records.

COMPLETE CATALOG NO. _____
(As shown on package)

DATE OF INSTALLATION _____

P/N 00909408 FORM NO. K0889 R3/97

BALDOR • RELIANCE

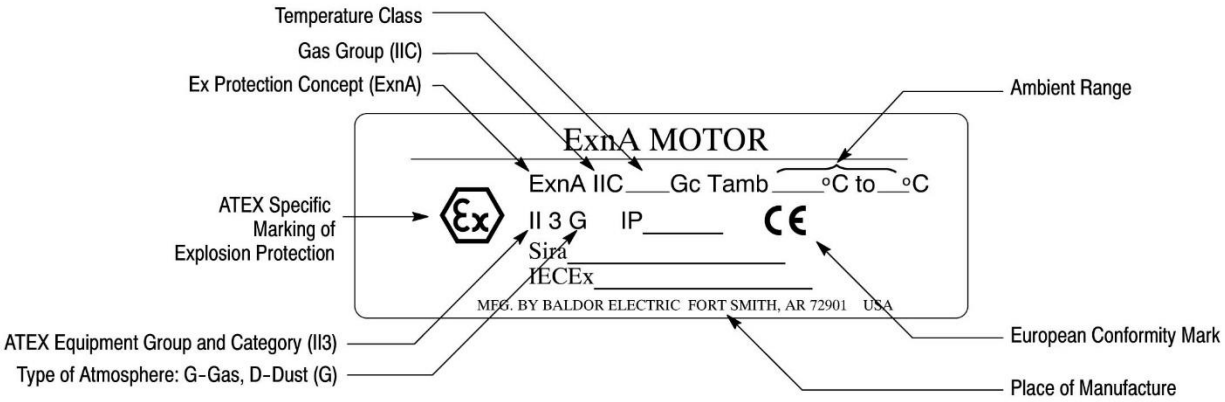
Integral Horsepower
AC Induction Motors
ODP, WPI Enclosures
TENV, TEAO, TEFC Enclosure
Explosion Proof

10/14 Installation & Operating Manual MN408

Equipment Marking for IEC Certified Product

IEC certified products have special markings that identify the protection concept and environment requirements. An example is shown in Figure 1-1.

Figure 1-1 IEC Certified Product Markings



Specific Conditions of Use:

If the motor certificate number is followed by the symbol "X", this indicates that the motor has specific conditions of use which are indicated on the certificate. It is necessary to review the product certification certificate in conjunction with this instruction manual.

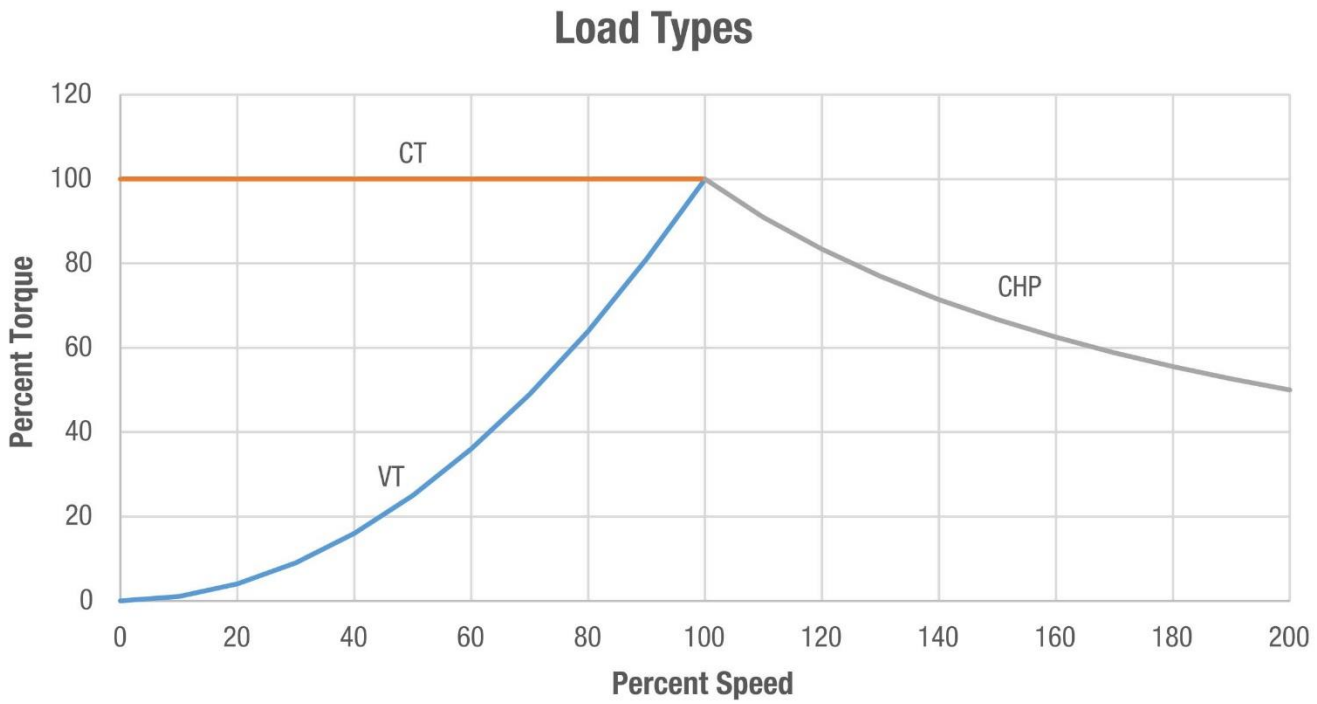
Operation On Frequency Converters:

If the motor is evaluated for operation with an adjustable speed drive, the type of converter (for example PWM for Pulse Width Modulated) and safe speed ranges (for example 0- 120Hz) will be specified in the certification documents or on motor nameplates. It is necessary to consult the adjustable speed drive manual for proper set up. IECEx Certificates are available online at www.iecex.com

Unit Conversions	
Inches to Millimeters	Inches x 25.4 = mm
Millimeters to Inches	mm x .03937 = Inches
Horsepower to Kilowatts	Hp x .746 = Kw
Kilowatts to Horsepower	Kw x 1.341 = Hp
Pounds to Kilograms	Lbs x .454 = Kg
Kilograms to Pounds	Kg x 2.205 = Lbs

Typical Speed vs Torque Curves are shown in Figure 1-2. For values relative to your specific motor, consult the motor nameplate marking.

Figure 1-2 Typical Speed vs Torque Curves



EMC Compliance Statement for European Union

The motors described in this instruction manual are designed to comply 2004/108/EC . These motors are commercial in design and not intended for residential use. When used with converters, please consult converter manufacturers literature regarding recommendations on cable types, cable shielding, cable shielding termination, connection recommendations and any filters which may be recommended for EMC compliance. For additional information, consult Baldor MN1383.

Section 2

Installation & Operation

Overview

Installation should conform to the National Electrical Code as well as local codes and practices. When other devices are coupled to the motor shaft, be sure to install protective devices to prevent future accidents. Some protective devices include, coupling, belt guard, chain guard, shaft covers etc. These protect against accidental contact with moving parts. Machinery that is accessible to personnel should provide further protection in the form of guard rails, screening, warning signs etc.

Location

It is important that motors be installed in locations that are compatible with motor enclosure and ambient conditions. Improper selection of the motor enclosure and ambient conditions can lead to reduced operating life of the motor.

Proper ventilation for the motor must be provided. Obstructed airflow can lead to reduction of motor life.

1. **Open Drip–Proof/WPI** motors are intended for use indoors where atmosphere is relatively clean, dry, well ventilated and non–corrosive.
2. **Totally Enclosed and WPII** motors may be installed where dirt, moisture or dust are present and in outdoor locations.

Severe Duty, IEEE 841 and Washdown Duty enclosed motors are designed for installations with high corrosion or excessive moisture conditions. These motors should not be placed into an environment where there is the presence of flammable or combustible vapors, dust or any combustible material, unless specifically designed for this type of service. IEEE841 motors are suitable for application in Class I Division 2 and Class I Zone 2 areas on sine wave power in accordance with the applicable codes and standards.

Hazardous Locations are those where there is a risk of ignition or explosion due to the presence of combustible gases, vapors, dust, fibers, or flyings. Facilities requiring special equipment for hazardous locations are typically classified in accordance with local requirements. In the US market, guidance is provided by the National Electric Code.

EMC Compliance Statement for European Union

The motors described in this instruction manual are designed to comply 2004/108/EC . These motors are commercial in design and not intended for residential use.

Mounting Location

The motor should be installed in a location compatible with the motor enclosure and specific ambient. To allow adequate air flow, the following clearances must be maintained between the motor and any obstruction:

Table 2-1 Enclosure Clearance

TEFC / TENV (IC0141) Enclosures	
Fan Cover Air Intake	180 – 210T Frame 1” (25mm)
Fan Cover Air Intake	250 – 449T Frame 4” (100mm)
	IEC 112 – 132 1” (25mm)
	IEC 160 – 280 4” (100mm)
Exhaust	Envelope equal to the P Dimension on the motor dimension sheet
OPEN/Protected Enclosures	
Bracket Intake	Same as TEFC
Frame Exhaust	Exhaust out the sides envelope A minimum of the P dimension plus 2” (50mm) Exhaust out the end same as intake.

The motor must be securely installed to a rigid foundation or mounting surface to minimize vibration and maintain alignment between the motor and shaft load. Failure to provide a proper mounting surface may cause vibration, misalignment and bearing damage.

Foundation caps and sole plates are designed to act as spacers for the equipment they support. If these devices are used, be sure that they are evenly supported by the foundation or mounting surface.

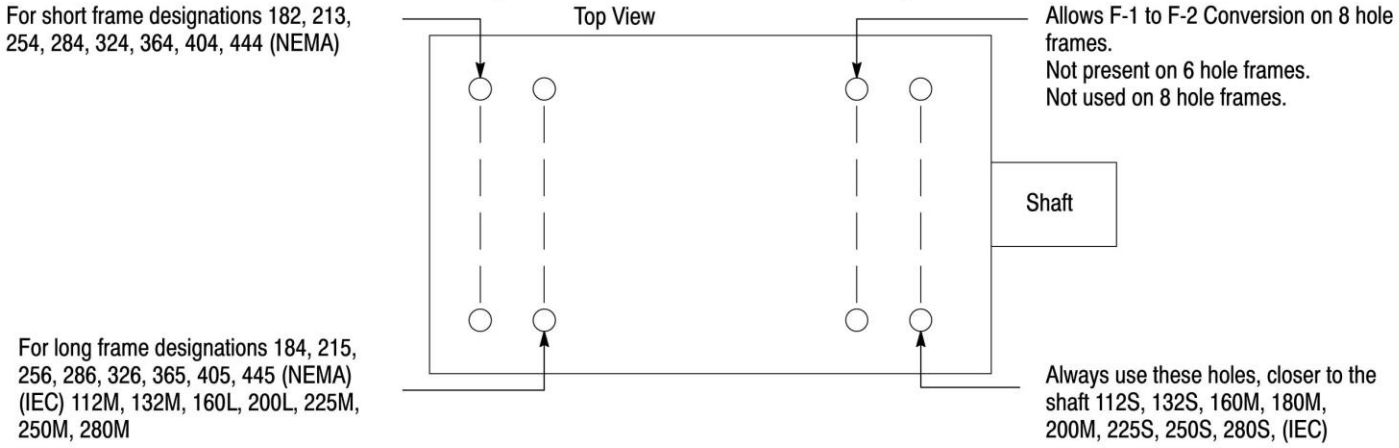
When installation is complete and accurate alignment of the motor and load is accomplished, the base should be grouted to the foundation to maintain this alignment.

The standard motor base is designed for horizontal or vertical mounting. Adjustable or sliding rails are designed for horizontal mounting only. Consult your Baldor distributor or authorized Baldor Service Center for further information.

Frame Mounting Holes

Some motors have standardized frames containing 6 or 8 mounting holes. 6 hole frames are not suitable for field reversal of mounting from F–1 to F–2, etc. Figure 2-1 indicates the proper mounting holes to use.

Figure 2-1 6 & 8 Hole Motor Frame Mounting



Caution: **Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the load (gears, pumps, compressors, or other driven equipment) from the motor shaft before lifting the motor.**

In the case of assemblies on a common base, any lifting means provided on the motor should not be used to lift the assembly and base but, rather, the assembly should be lifted by a sling around the base or by other lifting means provided on the base. Assure lifting in the direction intended in the design of the lifting means. Likewise, precautions should be taken to prevent hazardous overloads due to deceleration, acceleration or shock forces.

Alignment

Accurate alignment of the motor with the driven equipment is extremely important. The pulley, sprocket, or gear used in the drive should be located on the shaft as close to the shaft shoulder as possible. It is recommended to heat the pulley, sprocket, or gear before installing on the motor shaft. Forcibly driving a unit on the motor shaft will damage the bearings.

1. Direct Coupling
   For direct drive, use flexible couplings if possible. Consult the drive or equipment manufacturer for more information. Mechanical vibration and roughness during operation may indicate poor alignment. Use dial indicators to check alignment. The space between coupling hubs should be maintained as recommended by the coupling manufacturer.
2. End-Play Adjustment
   The axial position of the motor frame with respect to its load is also extremely important. The standard motor bearings are not designed for excessive external axial thrust loads. Improper adjustment will cause failure.
3. Pulley Ratio
   The best practice is to not exceed an 8:1 pulley ratio.

Caution: **Do not over tension belts. Excess tension may damage the motor or driven equipment.**

4. Belt Drive
   Align sheaves carefully to minimize belt wear and axial bearing loads (see End-Play Adjustment). Belt tension should be sufficient to prevent belt slippage at rated speed and load. However, belt slippage may occur during starting.

Doweling & Bolting

After proper alignment is verified, dowel pins should be inserted through the motor feet into the foundation. This will maintain the correct motor position should motor removal be required. (Baldor•Reliance motors are designed for doweling.)

1. Drill dowel holes in diagonally opposite motor feet in the locations provided.
2. Drill corresponding holes in the foundation.
3. Ream all holes.
4. Install proper fitting dowels.
5. Mounting bolts must be carefully tightened to prevent changes in alignment.

Use a flat washer and lock washer under each nut or bolt head to hold the motor feet secure.

Flanged nuts or bolts may be used as an alternative to washers.

WARNING: **Guards must be installed for rotating parts such as couplings, pulleys, external fans, and unused shaft extensions, should be permanently guarded to prevent accidental contact by personnel. Accidental contact with body parts or clothing can cause serious or fatal injury.**

Guarding

Guards must be installed for rotating parts such as couplings, pulleys, external fans, and unused shaft extensions. This is particularly important where the parts have surface irregularities such as keys, key ways or set screws. Some satisfactory methods of guarding are:

1. Covering the machine and associated rotating parts with structural or decorative parts of the driven equipment.
2. Providing covers for the rotating parts. Covers should be sufficiently rigid to maintain adequate guarding during normal service.

Power Connection

Motor and control wiring, overload protection, disconnects, accessories and grounding should conform to the National Electrical Code and local codes and practices.

For ExnA hazardous location motors, it is a specific condition of use that all terminations in a conduit box be fully insulated. Fully insulated and lugged terminations must be bolted and provided with lock washer to prevent rotation. Flying leads must be insulated with two full wraps of electrical grade insulating tape or heat shrink tubing.

Grounding

In the USA consult the National Electrical Code, Article 430 for information on grounding of motors and generators, and Article 250 for general information on grounding. In making the ground connection, the installer should make certain that there is a solid and permanent metallic connection between the ground point, the motor or generator terminal housing, and the motor or generator frame. In non–USA locations consult the appropriate national or local code applicable.

Motors with resilient cushion rings usually must be provided with a bonding conductor across the resilient member. Some motors are supplied with the bonding conductor on the concealed side of the cushion ring to protect the bond from damage. Motors with bonded cushion rings should usually be grounded at the time of installation in accordance with the above recommendations for making ground connections. When motors with bonded cushion rings are used in multimotor installations employing group fusing or group protection, the bonding of the cushion ring should be checked to determine that it is adequate for the rating of the branch circuit over current protective device being used.

There are applications where grounding the exterior parts of a motor or generator may result in greater hazard by increasing the possibility of a person in the area simultaneously contacting ground and some other nearby live electrical parts of other ungrounded electrical equipment. In portable equipment it is difficult to be sure that a positive ground connection is maintained as the equipment is moved, and providing a grounding conductor may lead to a false sense of security.

Select a motor starter and over current protection suitable for this motor and its application. Consult motor starter application data as well as the National Electric Code and/or other applicable local codes.

For motors installed in compliance with IEC requirements, the following minimum cross sectional area of the protective conductors should be used:

Crosssectional area of phase conductors, S	Minimum crosssectional area of the corresponding protective conductor, S_p
mm^2	mm^2
$S < 16$	S
$16 < S \leq 35$	16
$S > 35$	$0{,}5\ S$

Equipotential bonding connection shall made using a conductor with a cross-sectional area of at least 4 mm^2.

Conduit Box

For ease of making connections, an oversize conduit box is provided. Most conduit boxes can be rotated 360 ° in 90 ° increments. Auxiliary conduit boxes are provided on some motors for accessories such as space heaters, RTD's etc.

AC Power

Motors with flying lead construction must be properly terminated and insulated.

Connect the motor leads as shown on the connection diagram located on the name plate or inside the cover on the conduit box. Be sure the following guidelines are met:

1. AC power is within ±10% of rated voltage with rated frequency. (See motor name plate for ratings).

OR

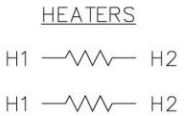
2. AC power is within ±5% of rated frequency with rated voltage.

OR

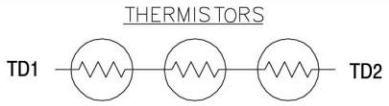
3. A combined variation in voltage and frequency of ±10% (sum of absolute values) of rated values, provided the frequency variation does not exceed ±5% of rated frequency.

Performance within these voltage and frequency variations are shown in Figure 2-3.

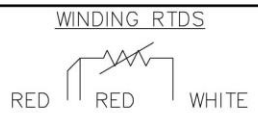
Figure 2-2 Accessory Connections



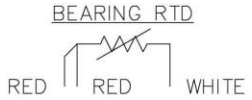
One heater is installed in each end of motor.
Leads for each heater are labeled H1 & H2.
(Like numbers should be tied together).



Three thermistors are installed in windings and tied in series.
Leads are labeled TD1 & TD2.



Winding RTDs are installed in windings (2) per phase.
Each set of leads is labeled 1TD1, 1TD2, 1TD3, 2TD1, 2TD2, 2TD3 etc.



* One bearing RTD is installed in Drive endplate (PUEP), leads are labeled RTDDE.
* One bearing RTD is installed in Opposite Drive endplate (FREP), leads are labeled RTDODE.
* Note RTD may have 2–Red/1–White leads; or 2–White/1–Red Lead.

Rotation

All three phase motors are reversible. To reverse the direction of rotation, disconnect and lock out power and interchange any two of the three line leads for three phase motors. For single phase motors, check the connection diagram to determine if the motor is reversible and follow the connection instructions for lead numbers to be interchanged. Not all single phase motors are reversible.

Adjustable Frequency Power Inverters used to supply adjustable frequency power to induction motors produce wave forms with lower order harmonics with voltage spikes superimposed. Turn–to–turn, phase–to–phase, and ground insulation of stator windings are subject to the resulting dielectric stresses. Suitable precautions should be taken in the design of these drive systems to minimize the magnitude of these voltage spikes. Consult the drive instructions for maximum acceptable motor lead lengths, and proper grounding.

Note: Main power leads for CE Marked Motors may be marked U,V,W – for standard configurations, please consult connection diagrams.

Caution: **The space heaters are designed to operate at or below the maximum surface temperature stated on the nameplate. If the marked ambient and/or voltage are exceeded this maximum surface temperature can be exceeded and can damage the motor windings. If applied in a division 2 or zone 2 environment this excessive temperature may cause ignition of hazardous materials.**

AC Motor Connection Diagram

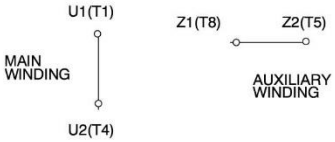
IEC VERSUS NEMA LEAD MARKING

EXAMPLE COMPARISIONS OF IEC AND NEMA LEADING MARKINGS FOR COMMON CONNECTION TYPES ARE SHOWN BELOW.

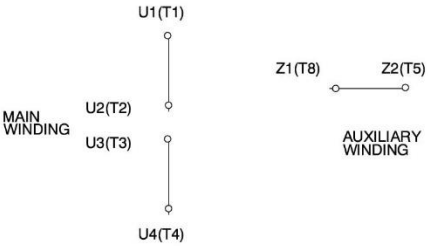
SINGLE PHASE MOTORS

SINGLE VOLTAGE NON REVERSIBLE

SINGLE VOLTAGE REVERSIBLE



DUAL VOLTAGE REVERSIBLE



AC Motor Connection Diagram

THREE PHASE

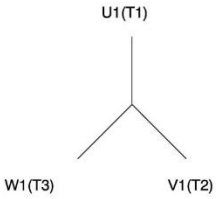
FOR SINGLE WINDING 3 PHASE MOTORS, LEAD MARKINGS CAN BE DIRECTLY TRANSLATED BETWEEN IEC AND NEMA DESIGNATIONS. FOR THESE MOTORS, THE LEAD MARKINGS ARE EQUIVALENT AS FOLLOWS:

U1=T1	U2=T4	U5=T7	U6=T10
V1=T2	V2=T5	V5=T8	V6=T11
W1=T3	W2=T6	W5=T9	W6=T12

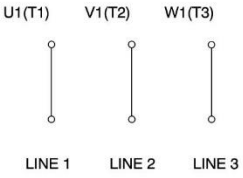
EXAMPLES OF COMMON CONNECTIONS ARE GIVEN BELOW.

THREE LEADS

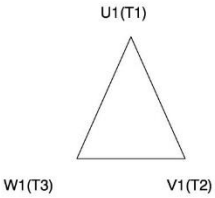
WYE CONNECT



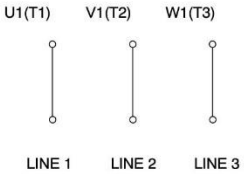
WIRING DIAGRAM



DELTA CONNECT



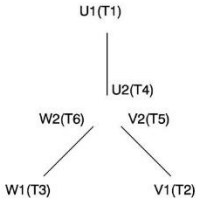
WIRING DIAGRAM



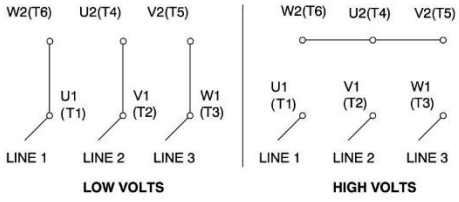
AC Motor Connection Diagram

SIX LEADS

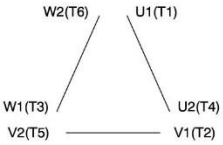
DELTA-WYE CONNECT



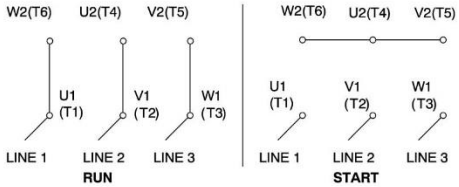
DUAL VOLTAGE-HIGH TO LOW VOLTAGE RATIO 1.73:1



WYE-DELTA CONNECT



WYE START-DELTA RUN
SINGLE VOLTAGE

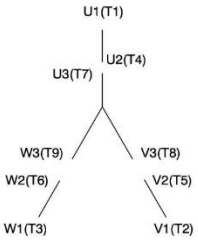


AC Motor Connection Diagram

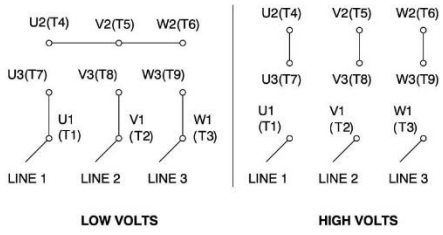
NINE LEADS

DUAL VOLTAGE-HIGH TO LOW VOLTAGE RATIO 2:1

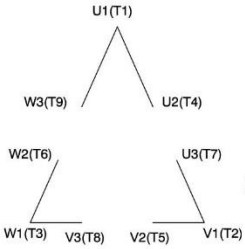
WYE CONNECT



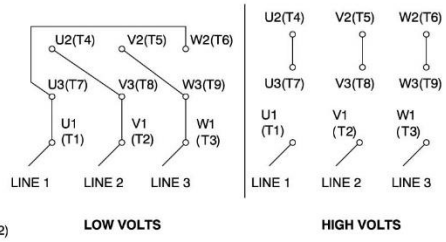
WIRING DIAGRAM



DELTA CONNECT



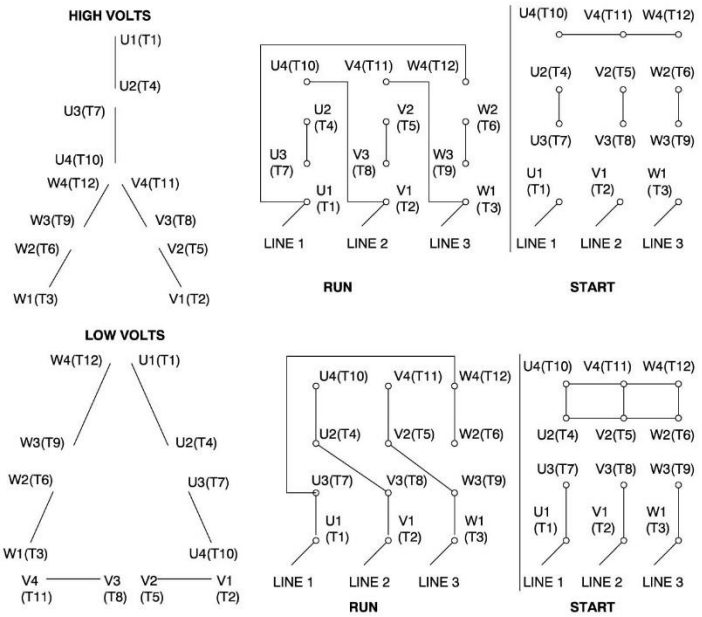
WIRING DIAGRAM



AC Motor Connection Diagram

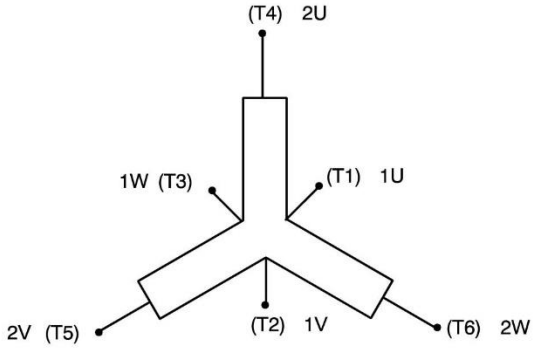
TWELVE LEADS

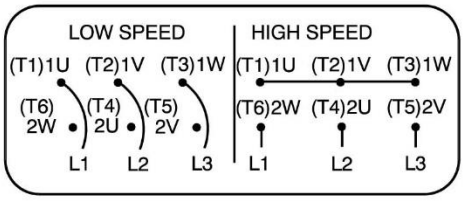
DUAL VOLTAGE WYE START – DELTA – RUN



AC Motor Connection Diagram

SINGLE WINDING MULTI-SPEEDS CONSTANT TORQUE

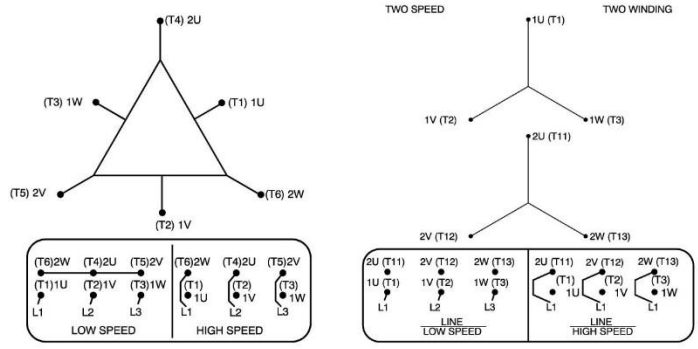


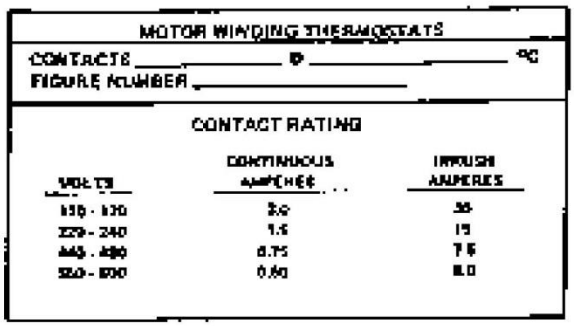


(N.P. 1634–DE)

AC Motor Connection Diagram

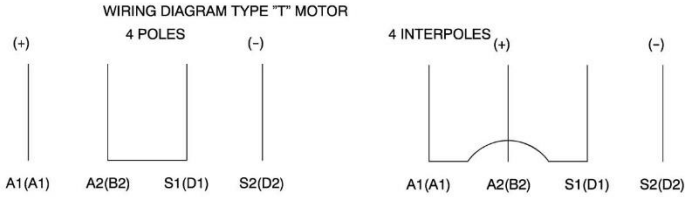
SINGLE WINDING MULTI-SPEEDS CONSTANT HP.





DC Motor Connection Diagram

WIRING DIAGRAM TYPE "T" MOTOR



COUNTERCLOCKWISE ROTATION CLOCKWISE ROTATION

ROTATION – FACING COMMUTATOR END

COMPARISON OF IEC AND NEMA LEAD MARKINGS
FOR DIRECT CURRENT MOTORS

A1--A1
A2--B2
S1--D1

S2--D2

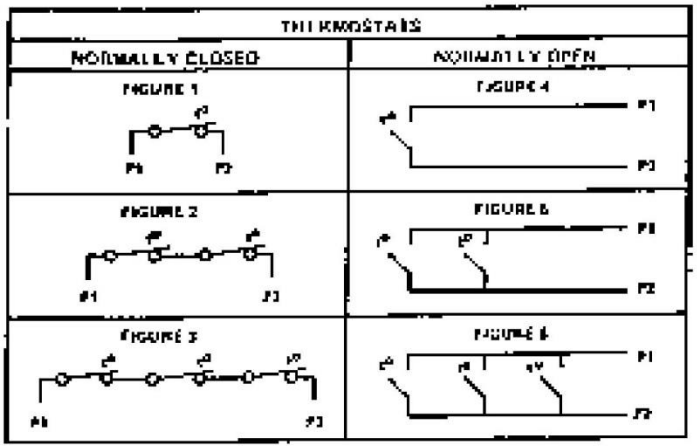
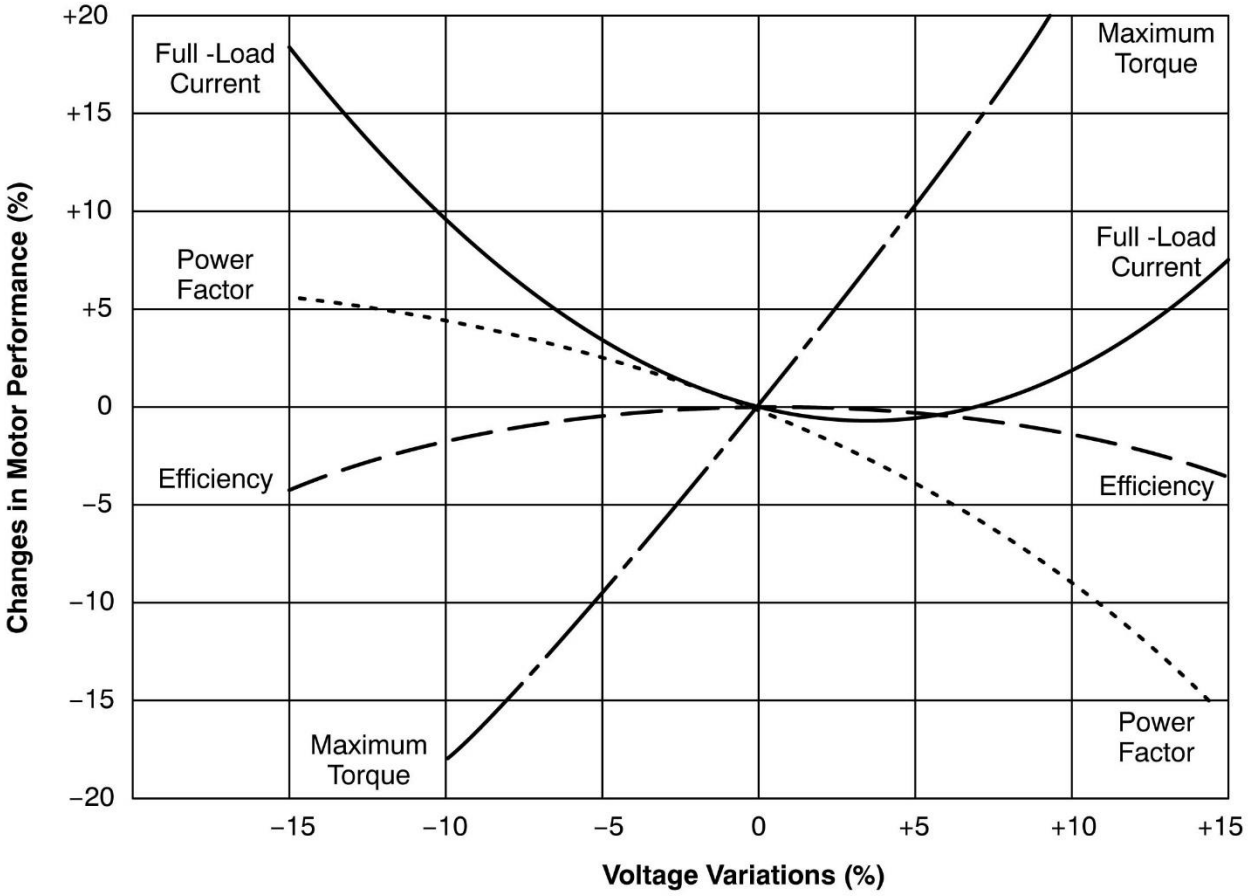


Figure 2-3 Typical Motor Performance VS Voltage Variations



Initial Lubrication

Baldor•Reliance motors are shipped from the factory with the bearings properly packed with grease and ready to operate. Where the unit has been subjected to extended storage (6 months or more) the bearings should be relubricated (regreasable type) prior to starting. When motors are equipped for oil mist lubrication refer to the instruction manual for installation, operation, and maintenance of oil mist lubrication systems.

Caution: **Shaker Duty motors must be properly lubricated prior to Start Up to prevent damage. See Section 3.**

First Time Start Up

Be sure that all power to motor and accessories is off. Be sure the motor shaft is disconnected from the load and will not cause mechanical rotation of the motor shaft.

1. Make sure that the mechanical installation is secure. All bolts and nuts are tightened etc.
2. If motor has been in storage or idle for some time, check winding insulation integrity.
3. Inspect all electrical connections for proper termination, clearance, mechanical strength and electrical continuity.
4. Be sure all shipping materials and braces (if used) are removed from motor shaft.
5. Manually rotate the motor shaft to ensure that it rotates freely.
6. Replace all panels and covers that were removed during installation.
7. Momentarily apply power and check the direction of rotation of the motor shaft.
8. If motor rotation is wrong, be sure power is off and change the motor lead connections. Verify rotation direction before you continue.
9. Start the motor and ensure operation is smooth without excessive vibration or noise. If so, run the motor for 1 hour with no load connected.

10. After 1 hour of operation, disconnect power and connect the load to the motor shaft. Verify all coupling guards and protective devices are installed. Ensure motor is properly ventilated.
11. If motor is totally enclosed fan–cooled or non–ventilated it is recommended that condensation drain plugs, if present, be removed. These are located in the lower portion of the end–shields. Totally enclosed fan–cooled "XT" motors are normally equipped with automatic drains which may be left in place as received.

Coupled Start Up

This procedure assumes a coupled start up. Also, that the first time start up procedure was successful.

1. Check the coupling and ensure that all guards and protective devices are installed.
2. Check that the coupling is properly aligned and not binding.
3. The first coupled start up should be with no load. Apply power and verify that the load is not transmitting excessive vibration back to the motor though the coupling or the foundation. Vibration should be at an acceptable level.
4. Run for approximately 1 hour with the driven equipment in an unloaded condition.

The equipment can now be loaded and operated within specified limits. Do not exceed the name plate ratings for amperes for steady continuous loads.

Jogging and Repeated Starts

Repeated starts and/or jogs of induction motors generally reduce the life of the motor winding insulation. A much greater amount of heat is produced by each acceleration or jog than by the same motor under full load. If it is necessary to repeatedly start or jog the motor, it is advisable to check the application with your local Baldor distributor or Baldor Service Center.

Heating - Duty rating and maximum ambient temperature are stated on the motor name plate. Do not exceed these values. If there is any question regarding safe operation, contact your local Baldor distributor or Baldor Service Center.

Hazardous Locations

Hazardous locations are those where there is a risk of ignition or explosion due to the presence of combustible gases, vapors, dust, fibers or flyings.

Selection

Facilities requiring special equipment for hazardous locations are typically classified in accordance with local requirements. In the US market, guidance is provided by the National Electric Code. In international hazardous location areas, guidance for gas / vapor / mist classification is given in IEC60079–14, or for dust in IEC61241–14. This classification process lets the installer know what equipment is suitable for installation in that environment, and identifies what the maximum safe temperature or temperature class is required. It is the customer or users responsibility to determine the area classification and select proper equipment.

Areas are classified with respect to risk and exposure to the hazard. In the US market, areas are typically classified as follows Class, Division, Group and Temperature Class. In some newer installations in the US and in most international markets, areas are classified in Zones.

Protection Concepts

Class I Division 1 / Zone 1 [Equipment Group I (mining) or II (surface), Equipment Protection Level (EPL) Gb, Mb]

Baldor offers a range of motors suitable for installation in a Division 1 or Zone 1 environment. These motors are known as explosion proof or flameproof. Motors that are explosion proof or flameproof use specially machined flameproof joints between the end bell or bracket and the frame, as well as along the rotating shaft and at connection box covers and entries. The fit of these flameproof joints are designed to contain the combustion or quench the flame of an explosive gas atmosphere prior to it exiting the motor. These flameproof joints have lengths and widths selected and tested based on the gas group present in the atmosphere. Baldor•Reliance motors are typically designed to meet Class I (Division 1) Group C and D (explosion proof) or Ex d IIB (flameproof).

An application note regarding equipment applied in accordance with the US National Electric Code (NFPA 70–2008) – according to Article 500.8(C) Marking, sub clause (2) in the fine print note, it is noted that Equipment not marked to indicate a division is suitable for both Division 1 and Division 2 locations. These motors are not gas tight. To the contrary, this protection concept assumes that due to the normal heating and cooling cycle of motor operation that any gas present will be drawn into the motor. Since flameproof or explosion proof motors are designed to contain the combustion and extinguish any flame transmission, for this protection concept, only external surface temperatures are of concern. Thermal limiting devices such as thermostats, thermistors or RTDs may be provided on these motors to limit the external surface temperature during overload conditions.

If thermostats are provided as a condition of certification, it is the installer's responsibility to make sure that these devices are properly connected to a suitable switching device. The ATEX directive requires that motor shutdown on thermal trip be accomplished without an intermediate software command. Where intermediate circuitry is involved the circuit shall fall within the scope of a safety, controlling and regulating device as defined in article 1(2) of European Directive 94/9/EC, and shall be covered by an appropriate EC Type Examination Certificate.

Flameproof motors, internationally referred to as Ex d use a protection concept similar to that used in Class I Division 1 motors, with minor differences in the flameproof joints and cable entry designs. Flameproof and explosion proof motors are both type tested. Representative motors are connected to a reference gas and ignited in laboratory conditions to verify that the flame is not transmitted outside the motor enclosure and to determine the maximum internal pressure encountered.

Explosion proof and Flame proof motors shipped without a conduit box require use of a certified box of suitable dimensions and that is appropriate for the classification. Openings in connection boxes must be closed with suitably certified and dimensioned device.

Hazardous location motors equipped with NPT pipe nipples are designed and built such that the pipe nipple is securely attached to the motor frame. This is accomplished externally by interference between the threads as well as tack welding. The conduit box is securely attached to the pipe nipple at the factory per:

1. Standard Commercial NPT & Explosion Proof IEC/ATEX parts : L-1 gauging notch +/- 1 thread (ref. ANSI/ASME B1.20.1 and Clarification Sheet ExNB/98/06/010/CS) Note: Clarification Sheet ExNB/98/06/010/CS provides inspection criteria to meet (6 threads minimum per engineering part drawing for ATEX parts).
2. Explosion Proof UL conduit boxes & MSHA parts: L-1 gauging notch "+1 min to + 3 1/2 max threads. Note: Provides inspection criteria to meet (5 threads minimum per engineering part drawing for MSHA parts and meet UL 1203 requirement for L-1 gauging notch flush to + 3 1/2 max threads).

This allows the end user to position the conduit box according to the application then secure when in place. For obvious reasons having the conduit box snug prior to affixing to the pipe nipple is preferable. However, the guidance in numbers 1 and 2 above can be used in determining thread engagement.

Note: In the United States most non-mining applications have rigid conduit for cabling, therefore not tack welding the conduit box to the pipe nipple is standard. In markets outside the United States, flexible conduit/cabling are common and end users should take note to secure the conduit box to the pipe nipple once in position. Further, the flexible leads should be secured to inhibit forces acting on the conduit box.

Class I Division 2 / Zone 2 Ex nA, [Equipment Protection Level (EPL) Gc]

This protection concept relies on having no sources of ignition present such as arcing parts or hot surfaces. For this protection concept, internal temperatures as well as external temperatures are considered. In many cases, the internal temperatures are higher than the external temperatures and therefore become the limiting factor in determination of temperature code designation. In these applications, it is very important to use a motor that has been evaluated thermally for use with an inverter or converter, if variable speed operation is desired. Thermostats used for Class I Division 2 and Ex nA motors are used to protect the motor only. For motors using flying lead construction, it is important to use connection lugs and insulate with heat shrink tubing or a double wrap of insulation grade electrical tape to avoid the risk of spark or ignition.

Class II Division 1 / Zone 21 [Equipment Group III, Equipment Protection Level (EPL) Db]

This area classification is one where the risk of ignitable concentrations of dust is present at all or some of the time. The protection concepts used for Class II Division 1 is similar to flamepath, except with additional dust exclusion paths designed for the rotating shaft. In the international designations, this concept is referred to as dust ignition proof or Ex tD. External surface temperature remains the limiting factor. Thermal limiting devices such as thermostats, thermistors or RTDs may be provided on these motors to limit the external surface temperature during overload conditions. If thermostats are provided as a condition of certification, it is the installer's responsibility to make sure that these devices are properly connected to a suitable switching device.

Note: In the North American area classification system, Class III exists for fibers and flyings.
In the IEC designation, both dusts and flyings are absorbed into Group III.

Class II Division 2 / Zone 22 [Equipment Group III, Equipment Protection Level (EPL) Dc]

This area classification is one where the risk of exposure to ignitable concentrations of dust are not likely to occur under normal operating conditions and relies heavily on the housekeeping practices within the installation.

Sine Wave Power Operation for Division 1 or 2 and Zone 1 or 2 and Zone 21 or 22 Hazardous Location.

These motors are designed to operate at or below the maximum surface temperature (or T–Code) stated on the nameplate. Failure to operate the motor properly can cause this maximum surface temperature to be exceeded. If applied in a Division 1 or 2 / Zone 1 or 2 and Zone 21 or 22 environment, this excessive temperature may cause ignition of hazardous materials. Operating the motor at any of the following conditions can cause the marked surface temperature to be exceeded.

1. Motor load exceeding service factor nameplate value
2. Ambient temperatures above nameplate value
3. Voltages above or below nameplate value
4. Unbalanced voltages
5. Loss of proper ventilation
6. Altitude above 3300 feet / 1000 meters
7. Severe duty cycles of repeated starts
8. Motor stall
9. Motor reversing
10. Single phase operation of polyphase equipment
11. Variable frequency operation

Variable Frequency Power Operation for Division 1 or 2 and Zone 1 or 2 and Zone 21 or 22

Hazardous Location (motors with maximum surface temperature listed on the nameplate).
Only motors with nameplates marked for use on inverter (variable frequency) power, and labeled for specific hazardous areas may be used in those hazardous areas on inverter power. The motor is designed to operate at or below the maximum surface temperature (or T–Code) stated on the nameplate.
Failure to operate the motor properly can cause this maximum surface temperature to be exceeded.

If applied in a Division 1 or 2 / Zone 1 or 2 and Zone 21 or 22 environment, this excessive temperature may cause ignition of hazardous materials. Operating the motor at any of the following conditions can cause the marked surface temperature to be exceeded.

1. Motor load exceeding service factor nameplate value
2. Ambient temperature above nameplate value
3. Voltage (at each operating frequency) above or below rated nameplate value
4. Unbalanced voltages
5. Loss of proper ventilation
6. Operation outside of the nameplate speed / frequency range
7. Altitudes above 3300 feet / 1000 meters
8. Single phase operation of polyphase equipment
9. Unstable current wave forms
10. Lower than name plate minimum carrier frequency

Thermal Limiting
Thermal limiting devices are temperature sensing control components installed inside the motor to limit the internal temperature of the motor frame by interrupting the circuit of the holding coil of the magnetic switch or contactor. They are required for most Division 1 and Zone 1 applications. For Division 2 or Zone 2 applications, motors should be selected that preclude running temperatures from exceeding the ignition temperatures for the designated hazardous material. In Division 2 or Zone 2 classified locations, thermal limiting devices should only be used for winding protection and not considered for limiting all internal motor temperatures to specific ignition temperatures.

Equipotential Bonding and Shaft Current Reduction
Larger motors (ie WP construction) may require proper bonding between motor enclosures and covers to avoid the risk of stray currents during start up. Fastening methods and bonding straps must not be modified. Bearing currents can exist in some motors for both line–fed and inverter–fed applications. Larger line–fed motors may require at least one insulated bearing to prevent a flow of current through the bearings. Do not defeat such insulation whether the motor is line–fed or inverter–fed applications. Inverter–fed motors may require additional bearing insulation or even a shaft brush. Do not defeat such features. When the motor and the coupled load are not on a common conductive baseplate, it may also be necessary to electrically bond together the stationary parts of the motor and the coupled equipment.

Repair of Motors used in Hazardous Locations

Repair of hazardous certified motors requires additional information, skill, and care. It is the customer's responsibility to select service shops with proper qualifications to repair hazardous location motors. Contact the manufacture for additional repair details. Use only original manufacturer's parts.

Repair of Explosion Proof or Flame Proof Motors Class I Division 1 and Zone 1

In the North American market, recertification programs are offered by Underwriters Laboratories and Canadian Standards Association which allow authorized service shops to mark the rebuilt motors as certified. In the international markets using IEC based requirements, repair should be undertaken only after consulting IEC60079–19 Explosive Atmospheres–Part 19 Equipment repair, overhaul and reclamation. If use of a certified repair facility is desired, consult the IECEX Repair Scheme at http://www.iecex.com/service_facilities.htm

Explosion proof and flameproof motors achieve their safety based on the mechanical construction – flameproof joints and bearing clearance, and the electrical design including any thermal limiting devices. If it is necessary to repair a flameproof or explosion proof motor, it is critical that the mechanical flameproof joints be maintained. Consult Baldor Electric Company for flameproof joint construction details.
Use only Baldor•Reliance supplied parts. Baldor does not recommend reclamation of parts.
Since this protection method also relies on temperature being maintained, make sure that any rewinding uses the original electrical designs, including any thermal protection that may be present.

Repair of Dust Ignition Proof Motors – Class II Division 1 and 2, Zone 21 and 22.

For Dust Ignition Proof, proper sealing is required. Do not modify the motor construction to add any additional opening, and ensure that proper sealing is maintained in the connection box and at the shaft seal. Since this protection method also relies on temperature being maintained, make sure that any rewinding uses the original electrical designs, including any thermal protection that may be present

Repair of Class I Division 2 and Zone 2 motors

For Division 2 and Zone 2, the internal and external temperatures are of concern. Since this protection method also relies on temperature being maintained, make sure that any rewinding uses the original electrical designs, including any thermal protection that may be present. Use only Baldor replacement thermostats, if provided.

Section 3

Maintenance & Troubleshooting

WARNING: **UL and EX Listed motors must only be serviced by UL or EX Approved Authorized Baldor Service Centers if these motors are to be returned to a hazardous and/or explosive atmosphere.**

General Inspection

Inspect the motor at regular intervals, approximately every 500 hours of operation or every 3 months, whichever occurs first. Keep the motor clean and the ventilation openings clear. The following steps should be performed at each inspection:

WARNING: **Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.**

1. Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Oily vapor, paper pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Perform a dielectric with stand test periodically to ensure that the integrity of the winding insulation has been maintained. Record the readings. Immediately investigate any significant decrease in insulation resistance.
3. Check all electrical connectors to be sure that they are tight.

Relubrication & Bearings

Bearing grease will lose its lubricating ability over time, not suddenly. The lubricating ability of a grease (over time) depends primarily on the type of grease, the size of the bearing, the speed at which the bearing operates and the severity of the operating conditions. Good results can be obtained if the following recommendations are used in your maintenance program.

Type of Grease A high grade ball or roller bearing grease should be used. Baldor motors are pregreased, normally with Polyrex EM (Exxon Mobil) or as stated on the nameplate.
Do not mix greases unless compatibility has been checked and verified.

Ball Bearing Motors

Operating Temperature –25 °C (–15 °F) to 50 °C (120 °F)

EXXON	POLYREX EM (Standard on Baldor motors)
EXXON	UNIREX N2
EXXON	BEACON 325
CHEVRON OIL	SRI NO. 2 (Compatible with Polyrex EM)
CHEVRON OIL	BLACK PEARL
TEXACO, INC.	PREMIUM RB
TEXACO, INC.	POLYSTAR
AMOCO	RYKON # 2
PENNZOIL	PENNZLUBE EM–2
DARMEX	DARMEX 707
DARMEX	DARMEX 711
PETRO–CANADA	PEERLESS LLG
SHELL OIL	DOLIUM BRB

Minimum Starting Temperature –60 °C (–76 °F)

SHELL OIL CO.	AEROSHELL 7 (Standard on Baldor motors)
MOBIL	MOBIL 28
MOBIL	MOBILITH SHC 100 (Low Temperature – Arctic Duty)

Roller Bearing Motors

Operating Temperature –25 °C (–15 °F) to 50 °C (120 °F)

TEXACO, INC.	PREMIUM RB
MOBIL	MOBILITH SHC 220 (Standard on Baldor motors)
CHEVRON OIL	BLACK PEARL

Relubrication Intervals

Recommended relubrication intervals are shown in Table 3-1. It is important to realize that the recommended intervals of Table 3-2 are based on average use.

Refer to additional information contained in Tables 3-2, 3-3 and 3-4.

Table 3-1 Relubrication Intervals *

NEMA / (IEC) Frame Size	Rated Speed - RPM					
	10000	6000	3600	1800	1200	900
Up to 210 incl. (132)	**	2700 Hrs.	5500 Hrs.	12000 Hrs.	18000 Hrs.	22000 Hrs.
Over 210 to 280 incl. (180)		**	3600 Hrs.	9500 Hrs.	15000 Hrs.	18000 Hrs.
Over 280 to 360 incl. (225)		**	* 2200 Hrs.	7400 Hrs.	12000 Hrs.	15000 Hrs.
Over 360 to 449 incl. (315)		**	*2200 Hrs.	3500 Hrs.	7400 Hrs.	10500 Hrs.

* Relubrication intervals are for ball bearings.
For vertically mounted motors and roller bearings, divide the relubrication interval by 2.

** For motors operating at speeds greater than 3600 RPM, contact Baldor for relubrication recommendations.

Table 3-2 Service Conditions

Severity of Service	Hours per day of Operation	Ambient Temperature Maximum	Atmospheric Contamination
Standard	8	40 °C	Clean, Little Corrosion
Severe	16 Plus	50 °C	Moderate dirt, Corrosion
Extreme	16 Plus	>50 °C* or Class H Insulation	Severe dirt, Abrasive dust, Corrosion, Heavy Shock or Vibration
Low Temperature		<–29 °C **	

* Special high temperature grease is recommended (Dow Corning DC44). Note that Dow Corning DC44 grease does not mix with other grease types. Thoroughly clean bearing & cavity before adding grease.

** Special low temperature grease is recommended (Aeroshell 7).

Table 3-3 Relubrication Interval Multiplier

Severity of Service	Multiplier
Standard	1.0
Severe	0.5
Extreme	0.1
Low Temperature	1.0

Some motor designs use different bearings on each motor end. This is normally indicated on the motor nameplate. In this case, the larger bearing is installed on the motor Drive endplate. For best relubrication results, only use the appropriate amount of grease for each bearing size (not the same for both).

Table 3-4 Bearings Sizes and Types

Frame Size NEMA (IEC)	Bearing Description (These are the "Large" bearings (Shaft End) in each frame size)			
	Bearing	Weight of Grease to add * oz (Grams)	Volume of grease to be added	
			in^3	teaspoon
56 to 140 (90)	6203	0.08 (2.4)	0.15	0.5
140 (90)	6205	0.15 (3.9)	0.2	0.8
180 (100–112)	6206	0.19 (5.0)	0.3	1.0
210 (132)	6307	0.30 (8.4)	0.6	2.0
250 (160)	6309	0.47 (12.5)	0.7	2.5
280 (180)	6311	0.61 (17)	1.2	3.9
320 (200)	6312	0.76 (20.1)	1.2	4.0
360 (225)	6313	0.81 (23)	1.5	5.2
400 (250)	6316	1.25 (33)	2.0	6.6
440 (280)	6318	1.52(40)	2.5	8.2
440 (280)	6319	2.12 (60)	4.1	13.4
5000 to 5800 (315–355)	6328	4.70 (130)	9.2	30.0
5000 to 5800 (315–355)	NU328	4.70 (130)	9.2	30.0
360 to 449 (225–280)	NU319	2.12 (60)	4.1	13.4
AC Induction Servo				
76 Frame 180 (112)	6207	0.22 (6.1)	0.44	1.4
77 Frame 210 (132)	6210	0.32 (9.0)	0.64	2.1
80 Frame 250(160)	6213	0.49 (14.0)	0.99	3.3

* Weight in grams = .005 DB of grease to be added

Note: Not all bearing sizes are listed. For intermediate bearing sizes, use the grease volume for the next larger size bearing.

Caution: **To avoid damage to motor bearings, grease must be kept free of dirt. For an extremely dirty environment, contact your Baldor distributor or an authorized Baldor Service Center for additional information.**

Relubrication Procedure Be sure that the grease you are adding to the motor is compatible with the grease already in the motor. Consult your Baldor distributor or an authorized service center if a grease other than the recommended type is to be used.

Caution: **Do not over–lubricate motor as this may cause premature bearing failure.**

With Grease Outlet Plug

1. With the motor stopped, clean all grease fittings with a clean cloth.
2. Remove grease outlet plug.

Caution: **Over–lubricating can cause excessive bearing temperatures, premature lubrication breakdown and bearing failure.**

3. Add the recommended amount of grease.
4. Operate the motor for 15 minutes with grease plug removed. This allows excess grease to purge.
5. Re-install grease outlet plug.

Without Grease Provisions

Note: Only a Baldor authorized and UL or CSA certified service center can disassemble a UL/CSA listed explosion proof motor to maintain it's UL/CSA listing.

1. Disassemble the motor.
2. Add recommended amount of grease to bearing and bearing cavity. (Bearing should be about 1/3 full of grease and outboard bearing cavity should be about 1/2 full of grease.)
3. Assemble the motor.

Sample Relubrication Determination

Assume - NEMA 286T (IEC 180), 1750 RPM motor driving an exhaust fan in an ambient temperature of 43 °C and the atmosphere is moderately corrosive.

1. Table 3-2 list 9500 hours for standard conditions.
2. Table 3-3 classifies severity of service as "Severe".
3. Table 3-5 shows that 1.2 in^3 or 3.9 teaspoon of grease is to be added.

Note: Smaller bearings in size category may require reduced amounts of grease.

Shaker Duty Motors only

Caution: **Shaker Duty motors must be properly lubricated prior to Start Up to prevent damage. See Table 3-6.**

Lubrication should be performed before Start Up and at regular maintenance intervals.
Follow these recommendations to ensure proper lubrication.

Recommended Lubricant

For ambient temperatures between –15 °F to 120 °F the following lubricants are recommended:
Mobil PolyrexEM, Texaco Premium RB, Exxon Unirex N–2.

Do not mix greases unless compatibility has been checked and verified.

Table 3-5 Lubrication Volume

NEMA Frame Size	Volume in Cubic Inches					
	Normal Duty		Severe Duty		Extreme Duty	
	Start Up	Relub	Start Up	Relub	Start Up	Relub
184TY	1.4	0.5	1.4	0.5	2.7	0.5
215TY	1.6	0.5	1.6	0.5	4.5	1
256TY	7	1			11	2
286TY	9	1			15	3

Lubrication Frequency

Normal Duty 8 hours per day (16 hours per day in a clean environment). Lubricate every 2 months.

Severe Duty 16 hours per day or more in a dirty environment (corrosive atmosphere, chemical fumes, acids, alkalies or extreme high humidity). Lubricate every month or 700 hours of operation.

Extreme Duty operation in extremely dirty or dusty environments and high ambient temperatures exceeding 104 °F (40 °C). Lubricate twice a month or 350 hours of operation.

Lubrication Procedure

1. Locate the grease inlet and outlet. Clean the areas.
2. Remove the plug(s) and install a grease fitting in the inlet if grease fitting is not already installed.
3. Add the recommended amount of lubricant.
4. Run the motor for two hours with the outlet plug removed.
5. Install outlet plug.

Note: To loosen hardened grease it may be necessary to insert a rod or wire into the grease inlet and outlet holes.

Table 3-6 Troubleshooting Chart

Symptom	Possible Causes	Possible Solutions
Motor will not start	Usually caused by line trouble, such as, single phasing at the starter.	Check source of power. Check overloads, fuses, controls, etc.
Excessive humming	High Voltage. Eccentric air gap.	Check input line connections. Have motor serviced at local Baldor service center.
Motor Over Heating	Overload. Compare actual amps (measured) with nameplate rating.	Locate and remove source of excessive friction in motor or load. Reduce load or replace with motor of greater capacity.
	Single Phasing.	Check current at all phases (should be approximately equal) to isolate and correct the problem.
	Improper ventilation.	Check external cooling fan to be sure air is moving properly across cooling fins. Excessive dirt build-up on motor. Clean motor.
	Unbalanced voltage.	Check voltage at all phases (should be approximately equal) to isolate and correct the problem.
	Rotor rubbing on stator.	Check air gap clearance and bearings. Tighten “Thru Bolts”.
	Over voltage or under voltage.	Check input voltage at each phase to motor.
	Open stator winding.	Check stator resistance at all three phases for balance.
	Grounded winding.	Perform dielectric test and repair as required.
	Improper connections.	Inspect all electrical connections for proper termination, clearance, mechanical strength and electrical continuity. Refer to motor lead connection diagram.
Bearing Over Heating	Misalignment.	Check and align motor and driven equipment.
	Excessive belt tension.	Reduce belt tension to proper point for load.
	Excessive end thrust.	Reduce the end thrust from driven machine.
	Excessive grease in bearing.	Remove grease until cavity is approximately 3/4 filled.
	Insufficient grease in bearing.	Add grease until cavity is approximately 3/4 filled.
	Dirt in bearing.	Clean bearing cavity and bearing. Repack with correct grease until cavity is approximately 3/4 filled.
Vibration	Misalignment.	Check and align motor and driven equipment.
	Rubbing between rotating parts and stationary parts.	Isolate and eliminate cause of rubbing.
	Rotor out of balance.	Have rotor balance checked are repaired at your Baldor Service Center.
	Resonance.	Tune system or contact your Baldor Service Center for assistance.
Noise	Foreign material in air gap or ventilation openings.	Remove rotor and foreign material. Reinstall rotor. Check insulation integrity. Clean ventilation openings.
Growling or whining	Bad bearing.	Replace bearing. Clean all grease from cavity and new bearing. Repack with correct grease until cavity is approximately 3/4 filled.

Suggested bearing and winding RTD setting guidelines for Non–Hazardous Locations ONLY

Most large frame AC Baldor motors with a 1.15 service factor are designed to operate below a Class B (80 °C) temperature rise at rated load and are built with a Class H winding insulation system. Based on this low temperature rise, RTD (Resistance Temperature Detectors) settings for Class B rise should be used as a starting point. Some motors with 1.0 service factor have Class F temperature rise.

The following tables show the suggested alarm and trip settings for RTDs. Proper bearing and winding RTD alarm and trip settings should be selected based on these tables unless otherwise specified for specific applications.

If the driven load is found to operate well below the initial temperature settings under normal conditions, the alarm and trip settings may be reduced so that an abnormal machine load will be identified.

The temperature limits are based on the installation of the winding RTDs imbedded in the winding as specified by NEMA. Bearing RTDs should be installed so they are in contact with the outer race on ball or roller bearings or in direct contact with the sleeve bearing shell.

Table 3-7 Winding RTDs – Temperature Limit In °C (40 °C Maximum Ambient)

Motor Load (Typical Design)	Class B Temp Rise ≤ 80 °C		Class F Temp Rise ≤ 105 °C		Class H Temp Rise ≤ 125 °C	
	Alarm	Trip	Alarm	Trip	Alarm	Trip
≤ Rated Load	130	140	155	165	175	185
Rated Load to 1.15 S.F.	140	150	160	165	180	185

Note: • Winding RTDs are factory production installed, not from Mod–Express.

When Class H temperatures are used, consider bearing temperatures and relubrication requirements.

Table 3-8 Bearing RTDs – Temperature Limit In oC (40 °C Maximum Ambient)

Bearing Type Oil or Grease	Anti–Friction		Sleeve	
	Alarm	Trip	Alarm	Trip
Standard*	95	100	85	95
High Temperature**	110	115	105	110

Notes: * Bearing temperature limits are for standard design motors operating at Class B temperature rise.

** High temperature lubricants include some special synthetic oils and greases.

Greases that may be substituted that are compatible with Polyrex EM (but considered as “standard” lubricants include the following:

– Texaco Polystar
– Mobilith SHC–100
– Darmex 707
– Rykon Premium #2
– Pennzoil Pennzlube EM–2
– Darmex 711
– Chevron SRI #2
– Chevron Black Pearl
– Petro–Canada Peerless LLG

See the motor nameplate for replacement grease or oil recommendation.

Contact Baldor application engineering for special lubricants or further clarifications.

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BOSTON
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13098 GEORGE WEBER DR, SUITE 400
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ONE ELLIS DRIVE
AUBURN, NY 13021
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GREENSBORO, NC 27406
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