YORK BY JOHNSON CONTROLS	CENTRIFUGAL LIQUID CHILLER	
SERVICE INSTRUCTION	Supersedes: 160.84-M1 (314)	Form 160.84-M1 (1015)

YMC² MODEL B
CHILLER, MOTOR, AND COMPRESSOR

LD17500

R-134A

Issue Date:
October 30, 2015

IMPORTANT!

READ BEFORE PROCEEDING!

GENERAL SAFETY GUIDELINES

This equipment is a relatively complicated apparatus. During rigging, installation, operation, maintenance, or service, individuals may be exposed to certain components or conditions including, but not limited to: heavy objects, refrigerants, materials under pressure, rotating components, and both high and low voltage. Each of these items has the potential, if misused or handled improperly, to cause bodily injury or death. It is the obligation and responsibility of rigging, installation, and operating/service personnel to identify and recognize these inherent hazards, protect themselves, and proceed safely in completing their tasks. Failure to comply with any of these requirements could result in serious damage to the equipment and the property in which it is situated, as well as severe personal injury or death to themselves and people at the site.

This document is intended for use by owner-authorized rigging, installation, and operating/service personnel. It is expected that these individuals possess independent training that will enable them to perform their assigned tasks properly and safely. It is essential that, prior to performing any task on this equipment, this individual shall have read and understood the on-product labels, this document and any referenced materials. This individual shall also be familiar with and comply with all applicable industry and governmental standards and regulations pertaining to the task in question.

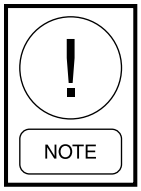
SAFETY SYMBOLS

The following symbols are used in this document to alert the reader to specific situations:

Indicates a possible hazardous situation which will result in death or serious injury if proper care is not taken.

Identifies a hazard which could lead to damage to the machine, damage to other equipment and/or environmental pollution if proper care is not taken or instructions and are not followed.

Indicates a potentially hazardous situation which will result in possible injuries or damage to equipment if proper care is not taken.



Highlights additional information useful to the technician in completing the work being performed properly.

External wiring, unless specified as an optional connection in the manufacturer's product line, is not to be connected inside the control cabinet. Devices such as relays, switches, transducers and controls and any external wiring must not be installed inside the micro panel. All wiring must be in accordance with Johnson Controls' published specifications and must be performed only by a qualified electrician. Johnson Controls will NOT be responsible for damage/problems resulting from improper connections to the controls or application of improper control signals. Failure to follow this warning will void the manufacturer's warranty and cause serious damage to property or personal injury.

YMC² with high speed direct drive permanent magnet rotor hermetic motor

Motor auto-rotation electrical hazard

While the chiller is off, thermal energy provided to the chiller shells through the plant systems can result in auto rotation of the hermetic motor by refrigerant vapor driven across the compressor impeller. This results in the permanent magnet motor rotor acting as an electrical generator. The output at the motor terminals will vary directly with speed of rotation and may provide a safety hazard to a service person if unaware.

The force to drive the rotation depends on maintenance of differential pressure across the chiller shells by cooled or warmed liquid flow through the tubes of one shell and existence of refrigerant to vaporize and flow across the impeller. Rotation is impeded when the motor leads are connected to the VSD output and is also impeded when the leads are removed and electrically connected together. Conditions that do not initiate rotation when the motor leads are connected could incite rotation and electrical potential across phases if the leads are disconnected.

The following are recommendations to safely service the machine:

- ***Shut down the machine, extend the Variable Geometry Diffuser and close discharge isolation valve (if so equipped). Isolation prevents a path for refrigerant movement. Isolation that is relied upon should be locked in position to prevent inadvertent restoration to a dangerous condition.***
- ***Remove and secure input power to the VSD and wait 15 minutes for DC bus to dissipate.***
- ***Open the VSD panel with proper electrical PPE for the drive rating and measure voltage at the motor connection points.***
- ***If measured voltage is zero, install shorting/grounding wires to short together and ground the three motor phases. Wire should be a minimum of AWG 0.* NOTE: *A shorting harness is also available as P/N 325-44935-000.***
- ***If the voltage is not zero, this indicates that the motor is auto rotating. The service technician must take the necessary measures to stop refrigerant and/or liquid flow through the machine such as closing discharge or liquid line isolation, stopping customer water pumps, etc. to cease generation of electrical potential before shorting or grounding motor leads.***
- ***If the motor is to be disconnected from the output of the VSD, a set of shorting/grounding wires would need to be installed directly to the motor structure.***

When the machine is ready for return to service or standby, remove shorting/grounding wiring with care that auto-rotation remains prohibited so the free motor wires are safe to handle.

Because of the use of shorting and grounding devices during the process, be very certain they have been removed before applying line power to the VSD for return to service.

PACEMAKER

Strong Magnets are contained within this component and special precaution required if the motor is opened for service

Magnets could affect the functioning of pacemakers and implanted heart defibrillators.

- ***A pacemaker could switch into test mode and cause illness.***
- ***A heart defibrillator may stop working.***
- ***If you wear these devices keep sufficient distance to magnets 40 inches (100 cm).***
- ***Warn others who wear these devices from getting too close to magnets.***

MAGNETIC FIELD

Strong Magnets are contained within this component and special precaution required if the motor is opened for service

Magnets produce a far-reaching, strong magnetic field. They could damage TVs and laptops, computer hard drives, credit and ATM cards, data storage media, mechanical watches, hearing aids and speakers.

Keep magnets away from devices and objects that could be damaged by strong magnetic fields.

CHANGEABILITY OF THIS DOCUMENT

In complying with Johnson Controls' policy for continuous product improvement, the information contained in this document is subject to change without notice. Johnson Controls makes no commitment to update or provide current information automatically to the manual or product owner. Updated manuals, if applicable, can be obtained by contacting the nearest Johnson Controls Service office or accessing the Johnson Controls QuickLIT website at http://cgproducts.johnsoncontrols.com.

It is the responsibility of rigging, lifting, and operating/service personnel to verify the applicability of these documents to the equipment. If there is any question regarding the applicability of these documents, rigging, lifting, and operating/service personnel should verify whether the equipment has been modified and if current literature is available from the owner of the equipment prior to performing any work on the chiller.

CHANGE BARS

Revisions made to this document are indicated with a line along the left or right hand column in the area the revision was made. These revisions are to technical information and any other changes in spelling, grammar or formatting are not included.

ASSOCIATED LITERATURE

MANUAL DESCRIPTION	FORM NUMBER
Installation Checklist and Request for Startup	160.84-CL1
Startup Checklist	160.84-CL2
Service - OptiView Control Panel and Unit Controls	160.84-M2
Installation and Reassembly	160.84-N1
Unit Operations and Maintenance Manual	160.84-OM1
Field Connections	160.84-PW1
Field Control, Wiring and MBC Modifications	160.84-PW2
VSD Wiring Diagrams	160.84-PW3
Unit Renewal Parts	160.84-RP1
OptiViewTM Renewal Parts	160.84-RP2
Centrifugal Chiller Long Term Storage	50.20-NM5
All Products - Replacement Parts Electrical Connectors	50.20-RP1
All Products - Replacement Parts Fittings	50.20-RP2

SYSTEM NOMENCLATURE

Y M C 2 - S 0756 A B

- YORK
- Magnetic Bearing
- Centrifugal Chiller
- S = Single Stage
  T = Two Stage
- Capacity in KW
- Refrigerant R-134a
- Mod Level

COMPRESSOR NOMENCLATURE

M2 B - 197 F A C D

- Motor
- Motor Design Level
- Impeller Tip Diameter (mm)
- Rotation
  - F = Forward
  - R = Reverse
- Impeller Design Revision Level
- Gas Path Revision Level
- Down Discharge

VESSEL NOMENCLATURE

E A 25 14 271 B R 1 1 F C R

- Vessel
  - E = Evaporator
  - C = Condenser
- Heat Exchanger Mod Level
- Nominal Inside Diameter (Inches)
- Nominal Length (Feet)
- Marketing Tube Number
- Tube Code
  - B = 3/4" Code 1
  - C = 3/4" Code 2
  - D = 3/4" Code 3
  - E = 3/4" Code 4
  - 2 = 1" Code 1
  - 3 = 1" Code 2
  - 4 = 1" Code 3
  - 5 = 1" Code 4
- Vessel Refrigerant Pressure Code
  - R = Code 180
  - S = Code 235
  - T = Code 300
  - U = Code 350
  - V = Code 400
- Water Side Pressure Code
  - 1 = 150 psi
  - 3 = 300 psi
- Number of Passes
- Water Connection Type
  - F = Flanges
  - G = Grooved Standard
  - A = Victaulic AGS
- Waterbox Type
  - C = Compact
  - M = Marine
- Inlet from Front View
  - R = Right
  - L = Left

VARIABLE SPEED DRIVE NOMENCLATURE

HYP 0774 X H C 15 D - 40 A

- Hyper
- Amps
  - 0490, 0612, 0774
- X = Factory Mount
  R = Retrofit Model
- H = YMC² Chiller
- C = Condenser Cooled
  E = Evaporator Cooled
- Liquid DWP
  - 15 = 150 psi
  - 30 = 300 psi
- D = Disconnect Switch
  B = Circuit Breaker
- 40 = 380V 60Hz
  50 = 400V 50Hz
  46 = 460V 60Hz
  68 = 415V 50Hz
- Mod Level

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES (CONT'D)

LIST OF TABLES

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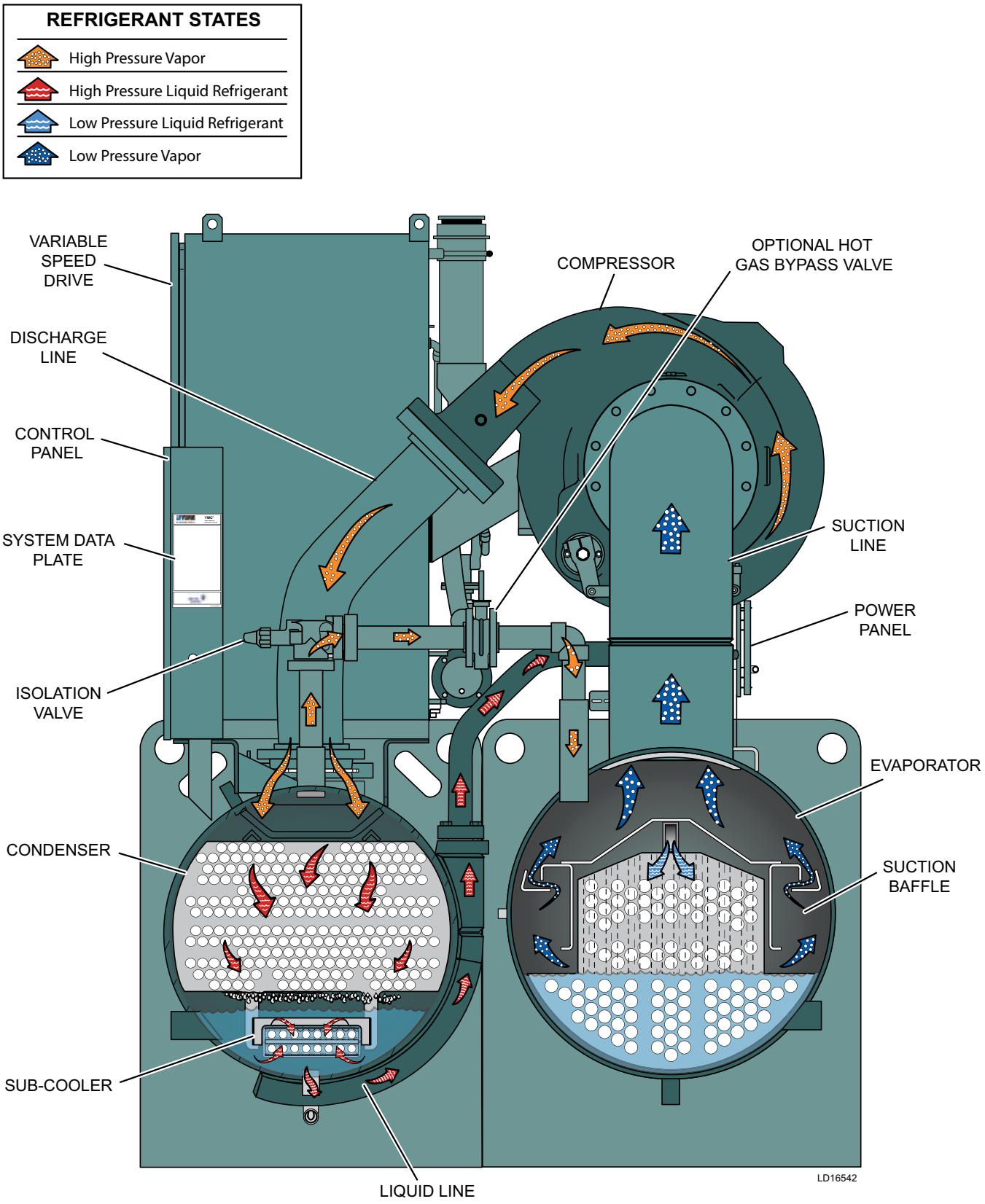


FIGURE 1 - REFRIGERANT FLOW-THRU CHILLER

SECTION 1 - GENERAL

GENERAL DESCRIPTION

The chiller is a dual shell vapor-compression machine with a centrifugal compressor directly connected to the rotor of a hermetic permanent magnet AC variable frequency motor. On two-stage chillers, each stage with its own housing and scroll exist on opposite ends of the motor shaft. The motor rotor is a permanent magnet design. The motor housing is iron and is removable from the compressor scroll housing at the diffuser plate joint. The compressor casing is fully accessible with vertical circular joints and fabricated of close-grain cast iron. The compressor contains variable geometry diffuser technology.

NOTE

Compressor and motor fittings and fasteners are metric thread.

Compressors use the variable geometry diffuser for throttling gas in capacity control. The motor stator is cooled with liquid or two-phase refrigerant and the rotor and bearings cooled by refrigerant vapor. The liquid used for stator cooling is expanded and the resultant gas continues for rotor and bearing cooling. A return drain path is piped to the evaporator shell for the excess liquid.

The lightweight, high strength, cast aluminum, fully shrouded impeller is mounted directly to the motor rotor shaft, which is described in detail in the driveline service section of this manual.

WARNING

Ensure power is removed from the input side of the VSD at all times when the chiller is under vacuum (less than atmospheric pressure). The VSD maintains voltage to ground on the motor when the chiller is off while voltage is available to the VSD. Insulating properties in the motor are reduced in vacuum and may not insulate this voltage sufficiently.

The evaporator is a hybrid falling film and flooded design. The refrigerant enters a spray header at the top and is distributed over the axial length of tubes. Evaporated and overspray refrigerant exits the bottom of the falling film section to the flooded section. Evaporated refrigerant exits the flooded section around the outside of the falling film shroud, through mist eliminating baffles, and to the suction.

The condenser is conventional shell and tube with integral subcooler section in the bottom, from which liquid refrigerant is passed to the evaporator though the liquid line and level control valve.

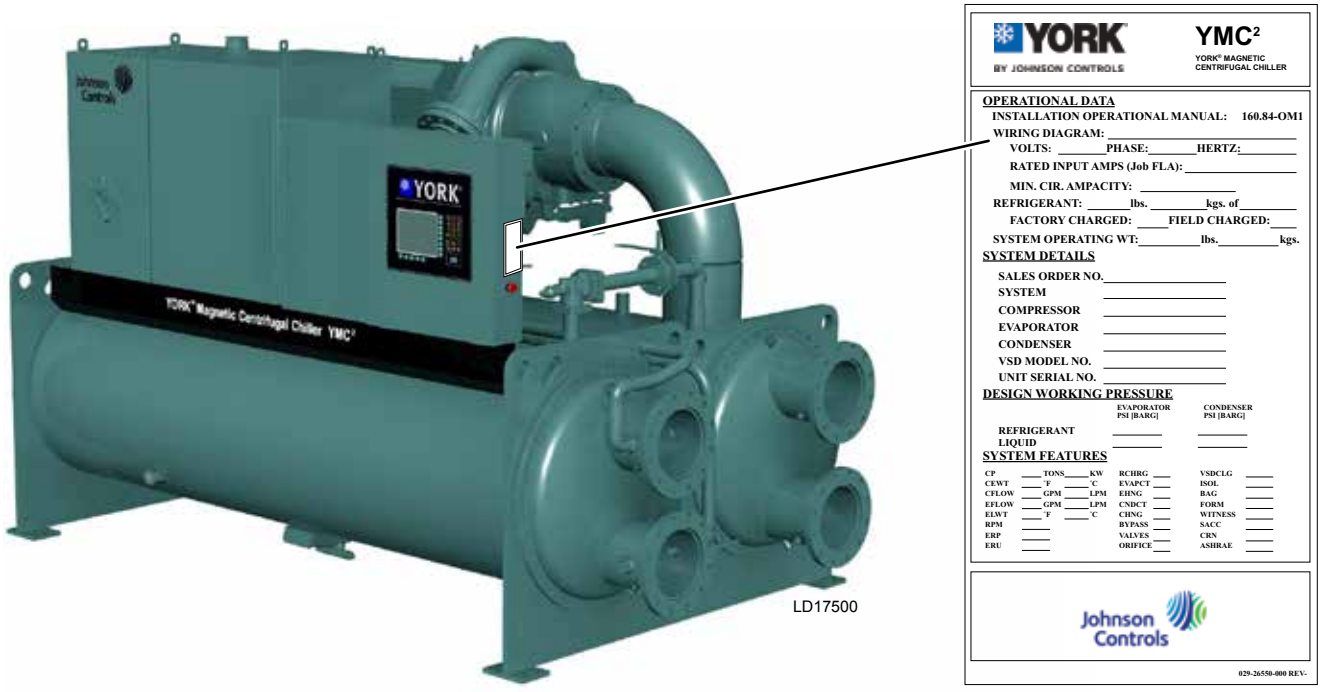


FIGURE 2 - UNIT DATA PLATE

NOMENCLATURE

Each chiller is identified by nomenclature printed on a data plate which is located on the side of the unit control panel (see *Figure 2 on page 13*). When contacting the factory, include the complete chiller and compressor model and serial numbers. Be sure these numbers are copied accurately.

PANEL RIGGING

Power Panel

TABLE 1 - POWER PANEL

DESCRIPTION	POUNDS	KILOGRAMS
Power Panel	300	135

1. Attach rigging chains to an adequate lifting device.
2. Attach the chains to the lifting holes at the top of the Power Panel as shown in *Figure 3 on page 14*.
3. Lift the Power Panel slightly off the ground to check for center of gravity. Make adjustments as necessary to level the Power Panel.

CAUTION

Use lifting chains with working load limit each 70 % of the total power panel weight.

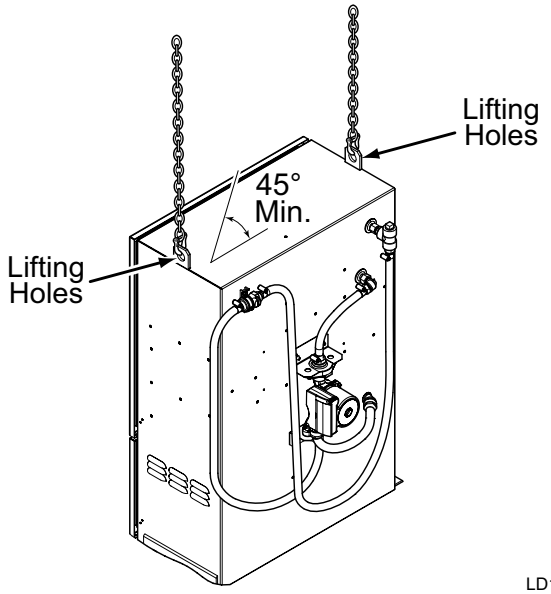


FIGURE 3 - POWER PANEL

OptiView™ Control Center

DANGER

The OptiView™ Control Center weighs over 50 pounds and a technician and helper are needed for the installation of the panel.

TABLE 2 - CONTROL PANEL WEIGHTS

DESCRIPTION	POUNDS	KILOGRAMS
OptiView	75	34

1. Lift the OptiView™ Control Center carefully with assistance.

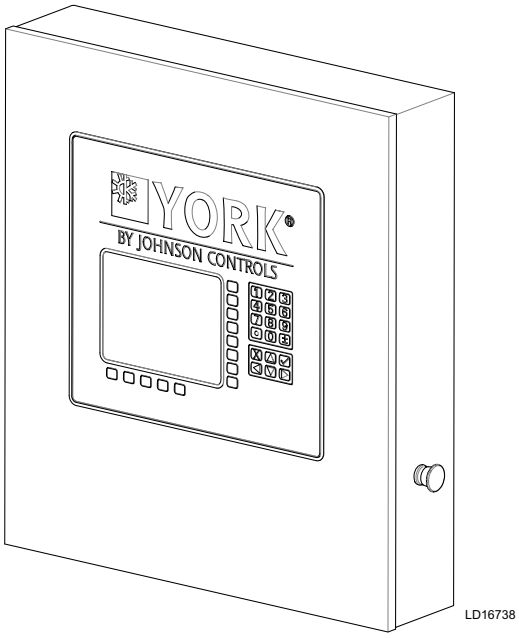


FIGURE 4 - OPTIVIEW CONTROL CENTER

Variable Speed Drive (VSD)

TABLE 3 - VARIABLE SPEED DRIVE WEIGHTS

MODEL	POUNDS	KILOGRAMS
HYP0490XH	1,226	556
HYP0612XH	1,954	886
HYP0774XH	2,060	934

CAUTION

The VSD is shipped with glycol in the cooling system. The VSD coolant must be changed to the inhibitor provided with the shipped loose items prior to starting the unit.

1. Attach rigging chains from an adequate lifting device to the four lifting holes at the top of the VSD as shown in *Figure 5 on page 15*.
2. Lift the VSD slightly off the ground to check for center of gravity. Make adjustments as necessary to level the VSD.

CAUTION

Use lifting chains with working load limit each 35% of total VSD weight.

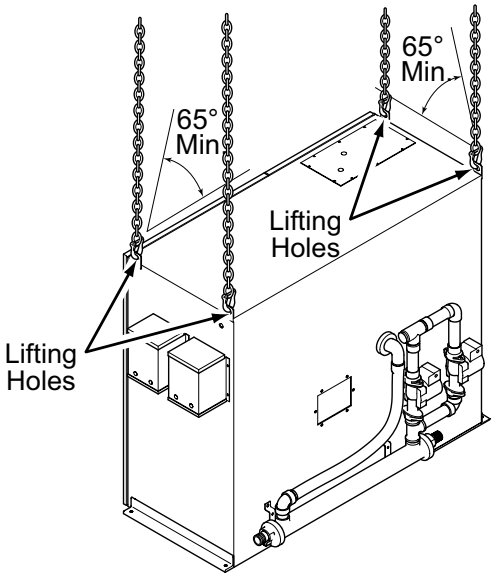


FIGURE 5 - VARIABLE SPEED DRIVE RIGGING

CHILLER FASTENERS

TABLE 4 - GENERAL FASTENER TORQUE

GRADE 2				
BOLT SIZE	HEX HEAD TORQUE		SOCKET HEAD OR 12 POINT TORQUE	
(INCH)	FT-LBS	N-M	FT-LBS	N-M
1/4	5	7	7	9
5/16	8	11	12	16
3/8	814	19	22	30
7/16	23	32	37	50
1/2	36	49	56	76
5/8	71	96	109	148
3/4	119	161	181	246
GRADE 5				
BOLT SIZE	HEX HEAD TORQUE		SOCKET HEAD OR 12 POINT TORQUE	
(INCH)	FT-LBS	N-M	FT-LBS	N-M
1/4	9	12	10	14
5/16	13	17	19	26
3/8	22	29	34	47
7/16	36	49	57	78
1/2	55	75	87	118
5/8	109	148	169	229
3/4	184	249	279	379
GRADE 10				
BOLT SIZE	HEX HEAD TORQUE		SOCKET HEAD OR 12 POINT TORQUE	
(INCH)	FT-LBS	N-M	FT-LBS	N-M
1/4	10	14	14	19
5/16	20	27	30	41
3/8	35	47	50	68
7/16	52	71	81	109
1/2	75	102	121	164
5/8	155	210	240	325
3/4	260	353	395	536

NOTE: Fasteners not mentioned with specific torque requirements in the service sections should have the above torques applied.

TABLE 5 - RE-ASSEMBLY TORQUE VALUES

UNIT							
ITEM		**DESCRIPTION**	**YORK PART NUMBER**	**SAP NUMBER**	**QUANTITY**	**TORQUE VALUE**	
						FT-LBS	**N-M**
A	**4**	HCS M24 X 3 X 90MM LG.	021-33185-090	731065	12	170	230
B	**10**	HCS M20 X 2.5 X 60MM LG.	021-33184-060	731063	1	470	640
C	**13**	HCS5 0.750-10 X 2.000 GR 5 ZN	021-32012-016	588676	8	50	68
D	**30**	HCS M6 X 1 X 16MM LG.	021-31205-016	730686	6	50	68
E	**32**	HCS M20 X 2.5 X 60MM LG.	021-33184-060	731063	12	95	130
F	**38**	NUT HEX 0.375-16 X GR 5 ZN.	021-32006-501	616900	6	50	68
HOT GAS							
G	**7**	HCS5 0.625-11 X 4.500 GR 5 ZN	021-32010-036	616908	4	65	88
LIQUID LINE							
H	**5**	HCS5 0.625-11 X 2.250 GR 5 ZN	021-32010-018	679632	8	50	68
END SHEETS (CON-EVAP ASSY)							
J	**3**	HCS5 0.625-11 X 2.500 GR 5 ZN	021-32010-020	616904	8	154	209
COMPRESSOR PIPING							
K	**33**	Hose, Motor Cooling 1-1/2" (Shell End)	Refer to *Table 6 on Page 24* and *Table 7 on Page 24* for Torque Specifications				
L	**33**	Hose, Motor Cooling M48x2 (Comp End)					
M	**8**	Metric, Connr 3/8 O.D. Tube M16x1.5					
N	**15**	Nut, 3/8 O.D. Tube					
VSD MOUNTING							
O	**1**	HCS5 0.438-14 X 1.250 GR 5 ZN	021-32007-010	730831	4	50	68
PANEL MOUNTING							
P	**14**	HCS5 0.250-20 X 1.000 GR 5 ZN	021-32004-008	730793	8	7	10

NOTES: Unless otherwise specified, all screw must be tightened to the following torque values with lightly oiled threads.|
** Lubricated with oil and graphite on male and female threads and under bolt heads. Do NOT use Moly-kote.

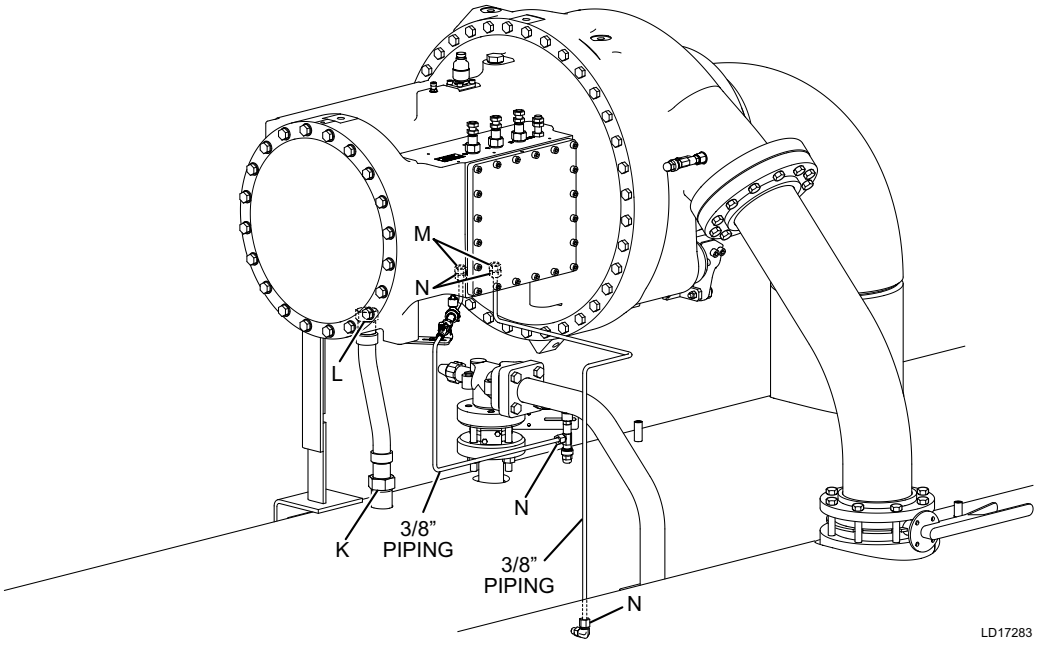
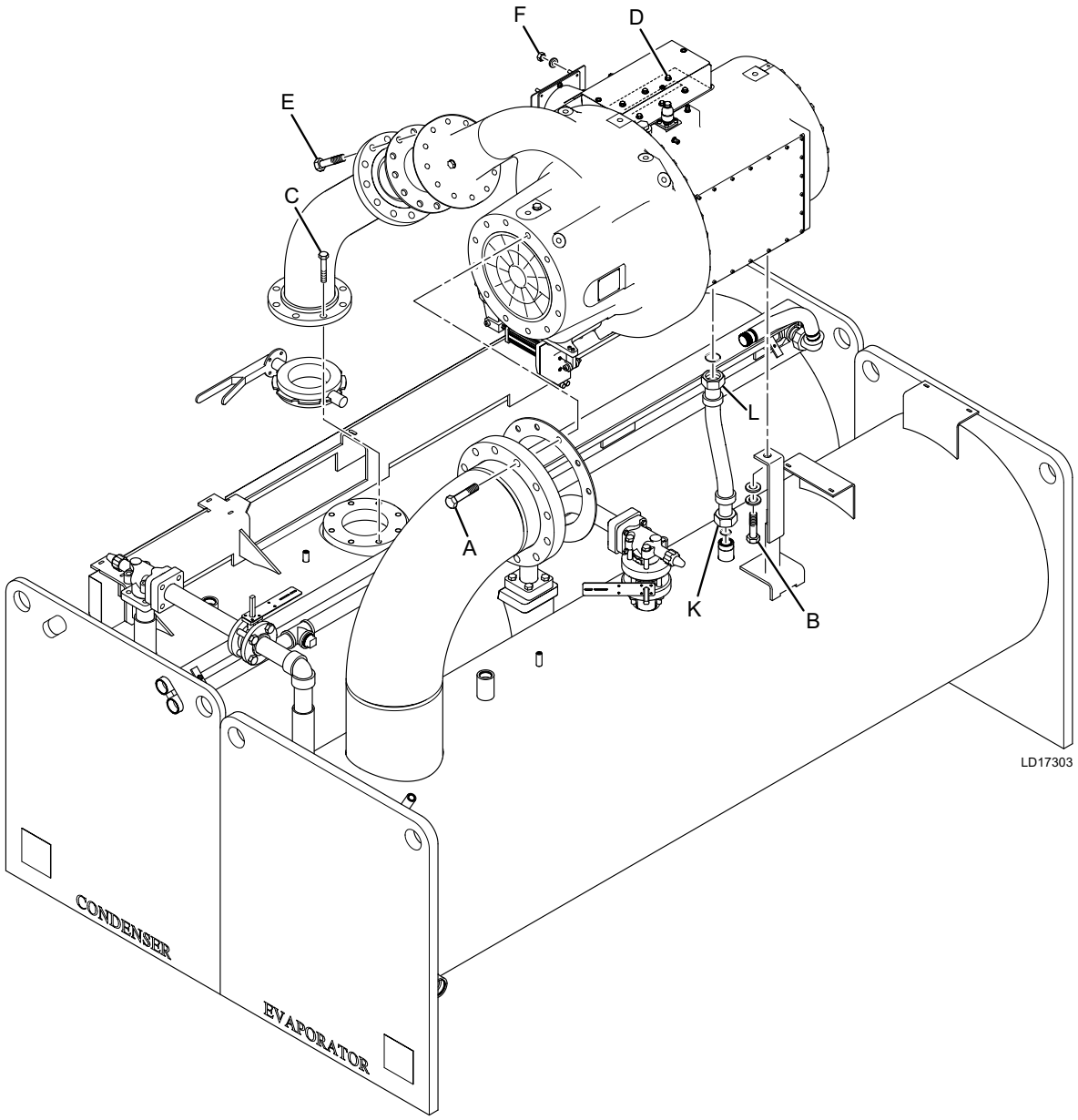
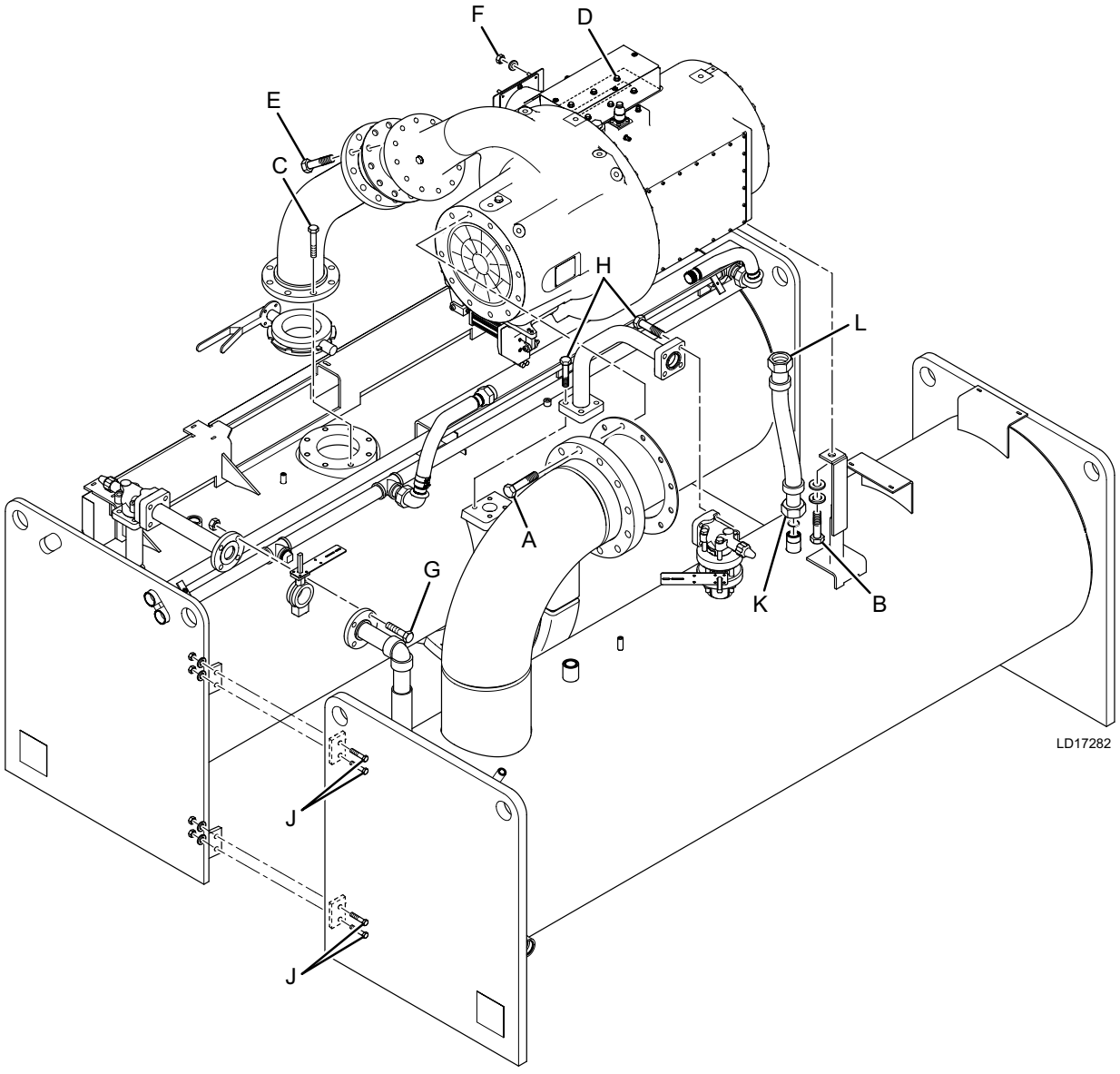


FIGURE 6 - YMC² PIPING REASSEMBLY HARDWARE IDENTIFICATION



Refer to *Table 5 on Page 16* for the torque values.

FIGURE 7 - YMC² REASSEMBLY HARDWARE IDENTIFICATION



Refer to *Table 5 on Page 16* for the torque values.

FIGURE 8 - YMC² REASSEMBLY HARDWARE IDENTIFICATION

Refer to *Table 5 on Page 16* for the torque values.

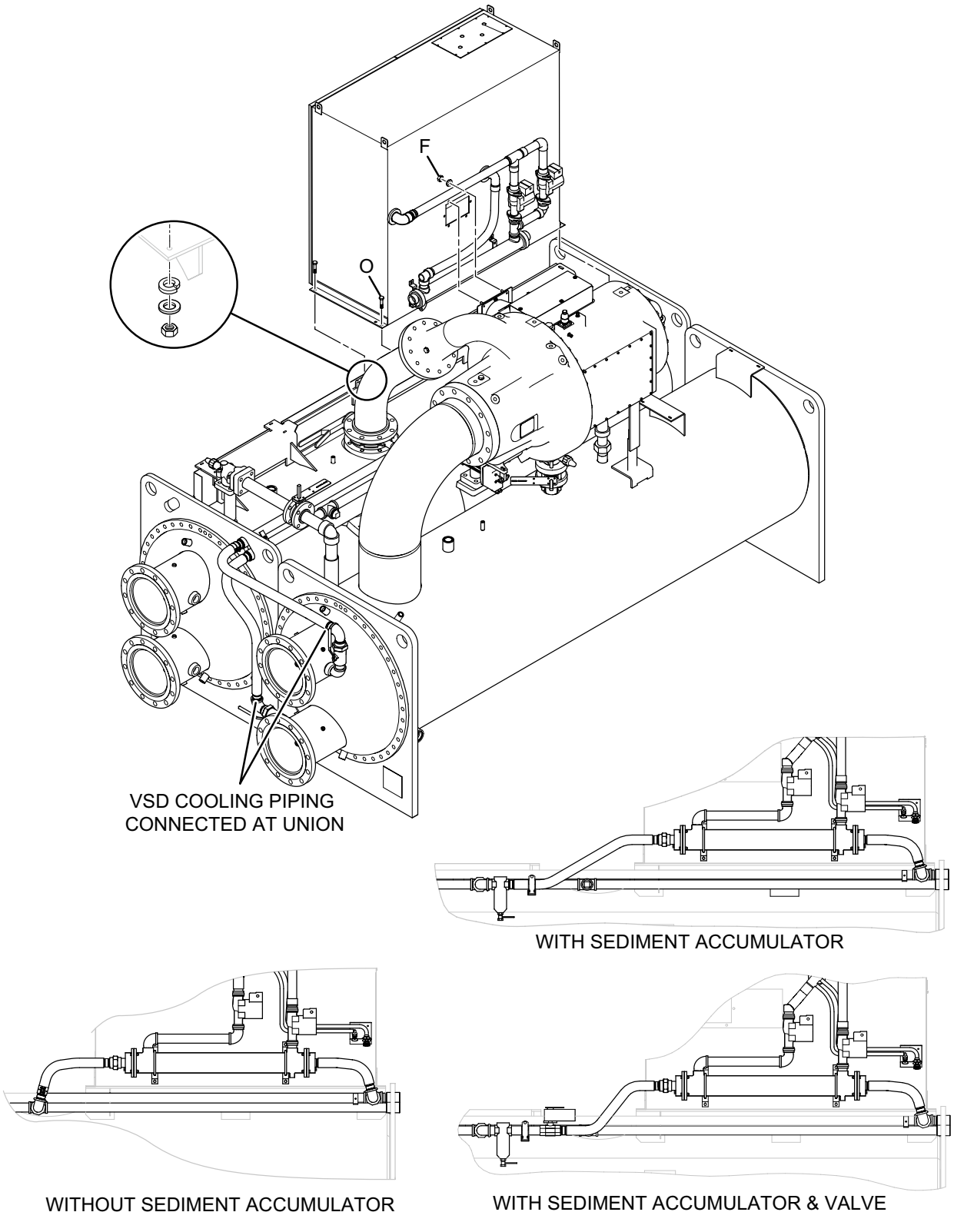


FIGURE 9 - VSD MOUNTING HARDWARE IDENTIFICATION

Refer to *Table 5 on Page 16* for the torque values.

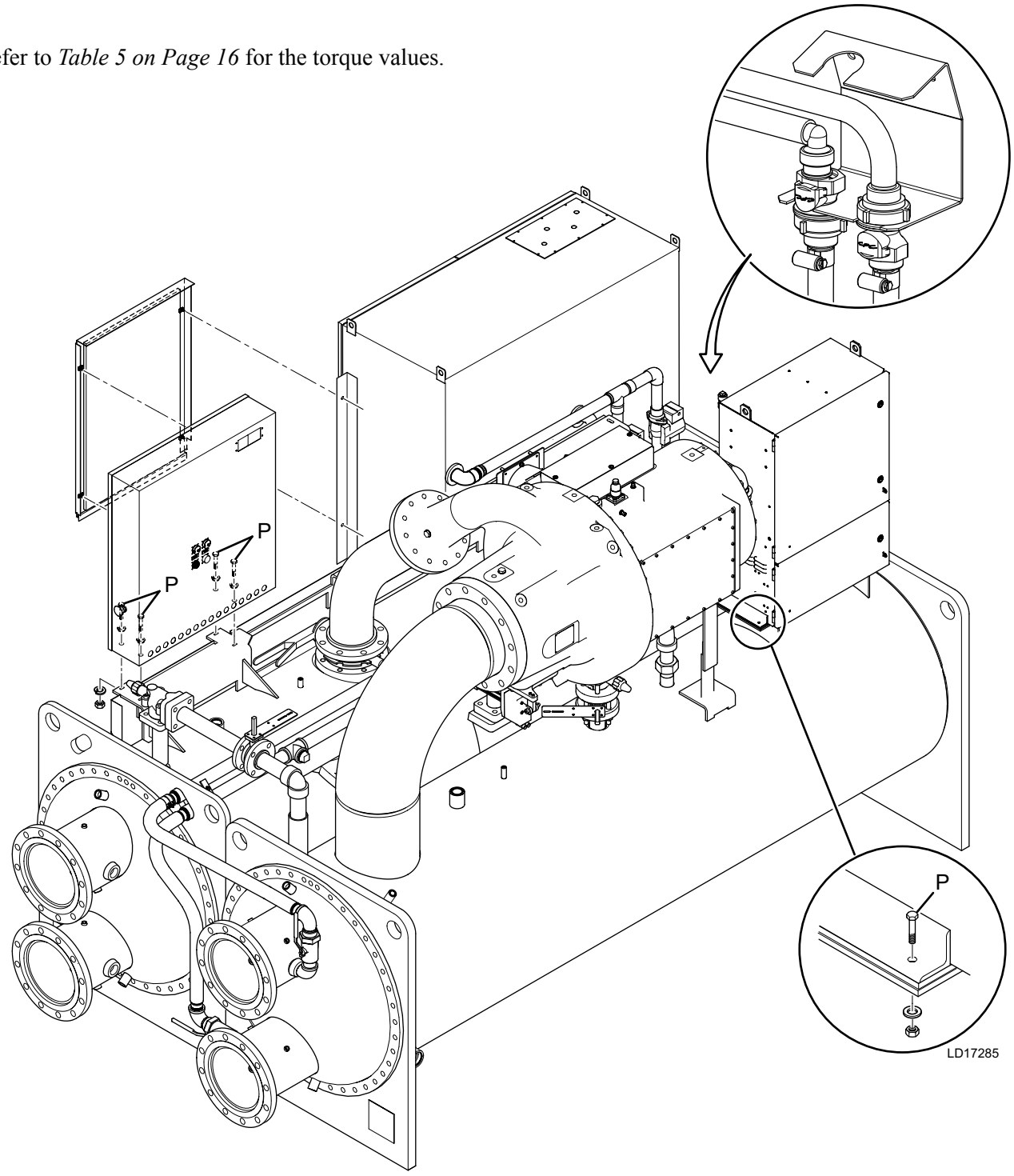


FIGURE 10 - POWER AND CONTROL PANEL MOUNTING HARDWARE IDENTIFICATION

SECTION 2 - CHILLER REFRIGERANT SERVICE

TRIMMING CHARGE IN THE CHILLER

The following flow diagram outlines the proper way to attain correct refrigerant charge and set proper level control setpoint in the chiller. The level control setpoint is programmable from the OptiView panel refer to *YMC² OptiView Control Panel Service Manual (Form 160.84-M2)* for additional details. The discharge superheat and evaporator small temperature difference (approach) at the design condition are available on the Sales Order.

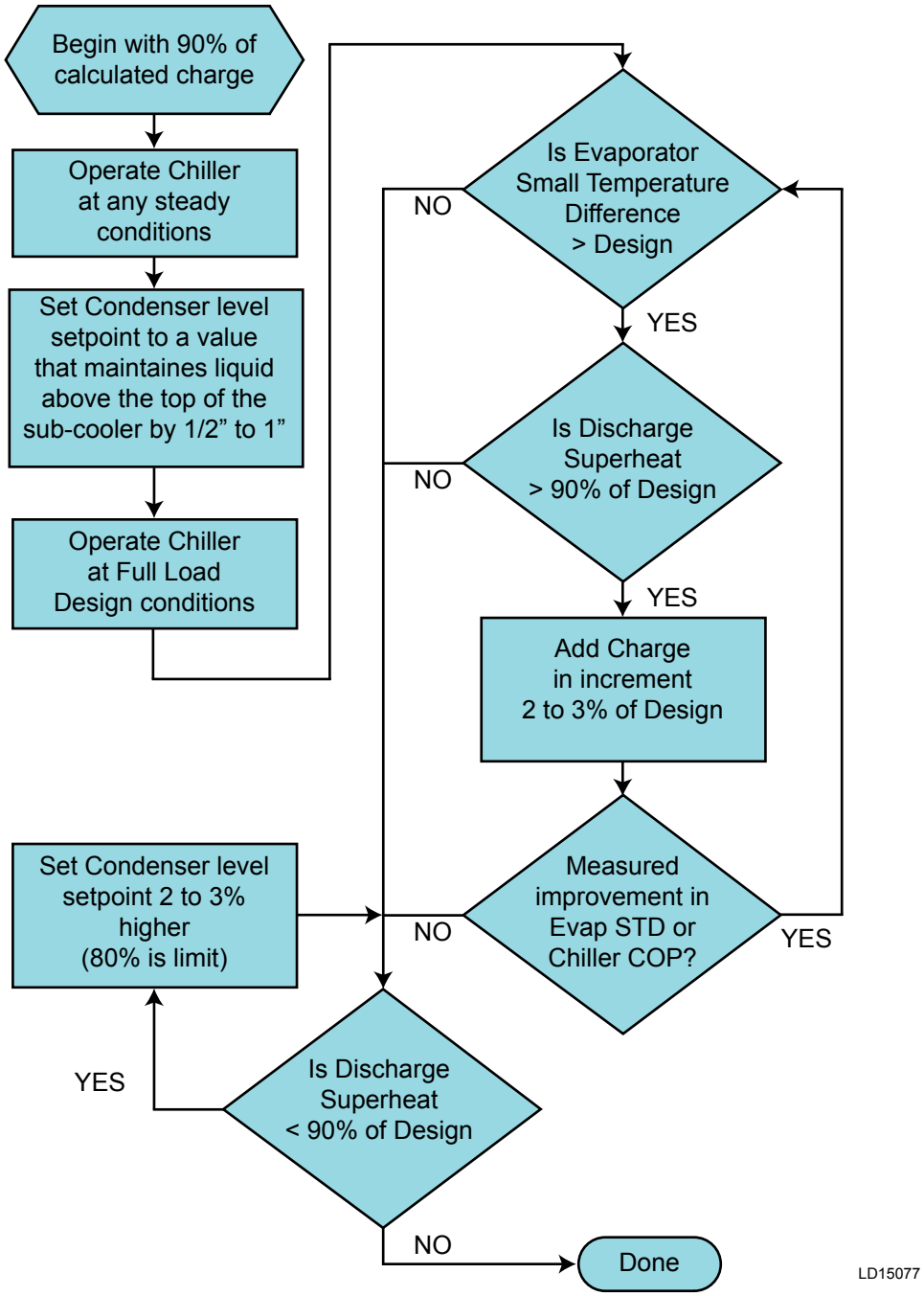


FIGURE 11 - REFRIGERANT CHARGING

Transferring Charge

Although the chiller is an oil-free design, the components are not degraded by trace amount of polyolester (POE) oil. However, excess oil introduced by pumpout units can eventually effect the heat transfer. When using a oil-lubricated charge transfer unit, use only POE oil and minimize oil loss or carryover as much as practical.

PIPING JOINT ASSEMBLY

Reassembly

The following is a step-by-step procedure to be used to reassemble the chiller refrigerant piping.

Assembly of SAE Straight Thread O-ring Port Fittings

The male and female ends of SAE and ISO 6149 straight thread O-ring ports have UN/UNF or Metric straight threads. An elastomeric O-ring is fitted to the male end. During assembly, the O-ring is firmly sandwiched between the angular sealing surface of the female port and the shoulder of the male end. Sealing is thus affected and maintained by the O-ring compression which results from the clamping force generated by tightening. The straight threads do NOT offer sealing action; they provide the resistance (holding power) for service pressure.

Adjustable End Assembly

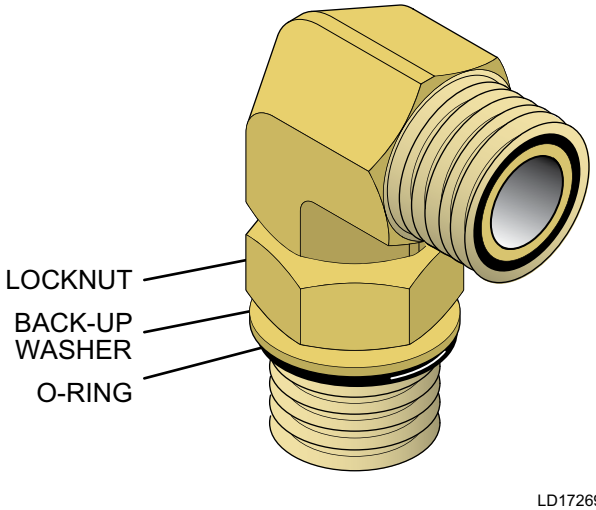


FIGURE 12 - ADJUSTABLE END FITTING (1)

1. Inspect to ensure that both matching parts are free of burrs, nicks, scratches or any foreign particles.
2. Install O-ring on port end of fitting, if it is NOT pre-installed, take care NOT to nick the O-ring.
3. Lubricate O-ring with a light coat of synthetic Polyolester (POE) oil or POE grease.
4. Back off locknut as far as possible. Make sure back-up washer is NOT loose and is pushed up as far as possible. This ensures the O-ring is completely at the back of the land so it remains in the land area when the fitting is turned out at step 6.

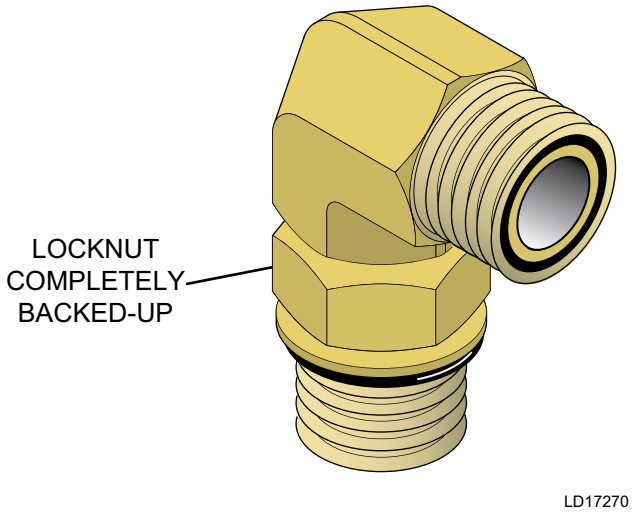


FIGURE 13 - ADJUSTABLE END FITTING (2)

5. Screw fitting into port until the back-up washer contacts the face of the port. Light wrenching may be necessary.

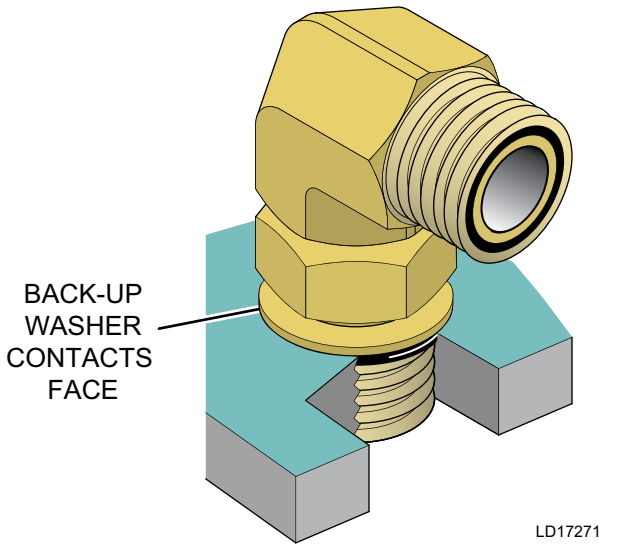


FIGURE 14 - ADJUSTABLE END FITTING (3)

6. To align the tube end of fitting to accept incoming tube or hose assembly, unscrew by required amount, but NOT more than one full turn. More than one turn makes the locknut push the O-ring into the machine threads beyond the fitting land area during step 7.
7. Using two wrenches, hold fitting in desired position and tighten locknut to the appropriate torque value shown in *Table 6 or Table 7 on Page 24*.
8. Inspect to ensure that O-ring is NOT pinched and the back-up washer seats flat on face of port.

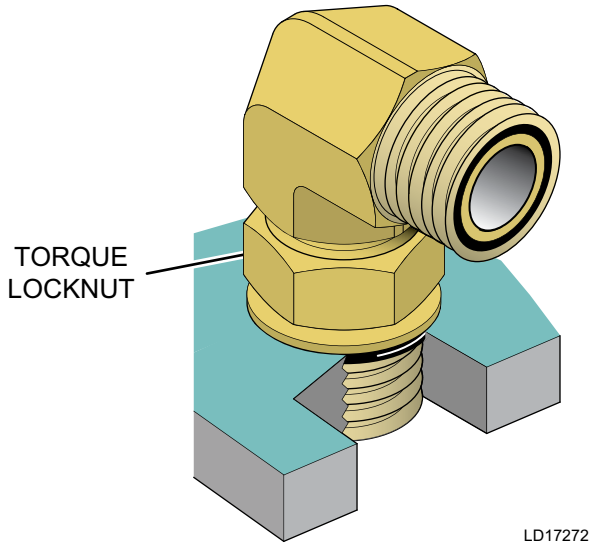


FIGURE 15 - ADJUSTABLE END FITTING (4)

Straight Non-Adjustable End Assembly

1. Inspect to ensure that both matching parts are free of burrs, nicks, scratches or any foreign particles.
2. Install O-ring on port end of fitting, if it is NOT pre-installed, use care NOT to nick the O-ring.
3. Lubricate O-ring with a light coat of synthetic Polyolester (POE) oil or POE grease.
4. Screw fitting into port until the hex flat contacts the port face. Light wrenching may be necessary.
5. Tighten to give torque for the specified size as specified in *Table 6 or Table 7 on Page 24*.

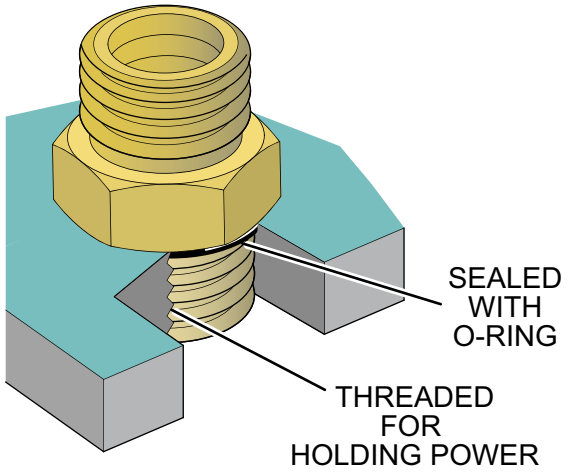


FIGURE 16 - NON - ADJUSTABLE END FITTING

Assembly of O-ring Face Seal Fittings

The male end and female nut of face seal fittings have UN/UNF or Metric straight threads. An elastomeric O-ring is fitted into the grooved male end. During assembly, the O-ring is firmly sandwiched between the sealing surfaces. Sealing is thus affected and maintained by the O-ring compression which results from the clamping force generated by tightening the nut. The straight threads do NOT offer sealing action; they provide the resistance (holding power) for service pressure.

O-ring Face Seal Assembly

1. Inspect to ensure that both matching parts are free of burrs, nicks, scratches or any foreign particles.
2. Install O-ring in grooved face seal end of fitting, if it is NOT pre-installed, use care NOT to nick the O-ring.
3. Lubricate O-ring with a light coat of synthetic Polyolester (POE) oil or POE grease.
4. Thread the nut by hand, and tighten nut to the appropriate torque value shown in *Table 6 or Table 7 on Page 24*.

TABLE 6 - ASSEMBLY TORQUE FOR SAE TUBE FITTINGS

TUBE SIZE	SAE STRAIGHT THREAD SIZE (O-RING PART NUMBER)	SAE STRAIGHT THREAD TORQUE (FT-LBS)	FACE SEAL TUBE-SIDE THREAD SIZE (O-RING PART NUMBER)	FACE SEAL TUBE-SIDE TORQUE (FT-LBS)
1/4"	7/16-20 (028-12961-001)	25	9/16-18 (028-12961-011)	18
3/8"	9/16-18 (028-12961-003)	35	11/16-16 (028-12961-012)	30
1/2"	3/4-16 (028-12961-004)	60	13/16-16 (028-12961-013)	40
5/8"	7/8-14 (028-12961-005)	100	1-14 (028-12961-014)	60
3/4"	1 1/16-12 (028-12961-006)	135	1-3/16-12 (028-12961-015)	85
1"	1 5/16-12 (028-12961-008)	200	1-7/16-12 (028-12961-016)	110
1-1/4"	1 5/8-12 (028-12961-017)	250	1-11/16-12 (028-12961-022)	140
1-1/2"	1 7/8-12 (028-12961-020)	305	2-12-UN2A (028-12961-019)	180
**	2 1/4-12 (028-12961-)	225	-	-

NOTE:
** = SAE SIGHTGLASS

TABLE 7 - ASSEMBLY TORQUE FOR METRIC TUBE FITTINGS

FITTING SIZE	PORT THREAD SIZE	TORQUE PER M-882	
		FT-LBS	N-M
M10	M10 x 1	17	23
M12	M12 x1.5	24	33
M14	M14 x 1.5	34	46
M16	M16 x 1.5	46	63
M18	M18 x 1.5	61	83
M22	M22 x 1.5	94	127
M27	M27 x 2	139	189
M30	M30 x 2	167	226
M33	M33 x 2	194	263
M42	M42 x 2	265	359
M48	M48 x 2	302	410
M60	M60 x 2	359	487

SECTION 3 - MOTOR DIAGNOSTICS

MOTOR TESTING

The motor is wired as two parallel circuits in WYE configuration. Phase to Ground can be checked with Meg Ohm meter. Phase to Phase can only be checked with a milliohm meter, because the phases are ganged together internally in WYE configuration. Resistance to ground should be at least 5 Meg Ohm at 500 volts if they need to be checked. Motor leads should be disconnected from the lugs in the drive for testing. Installation torque on the wire stud nuts is 18 to 24 to 27 N-m (18 to 20 ft-lbs) Adhere to cautions in the front of this manual regarding auto rotation electrical hazard. If initial readings at power wire ends are below criteria, remove the external leads and test at the motor lugs to distinguish leads versus motor issues.

Unit must be at positive pressure (no vacuum) during the resistance meg ohm test procedure.

MOTOR COOLING

The motor stator is cooled with liquid refrigerant along the outside of the stator, between the stator sleeve and the motor housing. Refer to *Figure 17 on page 26*. Refrigerant from the liquid line leaving the condenser is driven through a line to the underside of the motor housing by condenser pressure and passes through the stator cooling circuit to the electronic expansion valve (EEV). The EEV is regulated by the OptiView panel to maintain the motor housing temperature above the predicted or measured dewpoint. Refrigerant leaves the valve in two directions, toward each bearing. The path to the bearing opposite the low stage impeller end has an installed orifice to balance the required flows. The area outboard of that bearing is vented with a large line back to the top of the evaporator, to create the pressure difference that drives the cooling flows. The refrigerant from the EEV going toward the low stage compressor end bearing area enters on the compressor side. There it mixes with any impeller balance piston labyrinth seal gas flow and flashes to vapor as it expands and converts the heat gained from the diffuser plate and cooling the stator. The flash vapor flows through the bearing, through the rotor-to-stator gap and through the opposite end bearing to cool the rotor and bearings. The refrigerant from the EEV going to the opposite end bearing enters the bearing area on the rotor side, flashes, and passes through that bearing. Both of the vapor flows join passing through the opposite (high stage) compressor end bearing and exit the vent to the evaporator vapor space. Liquid refrigerant overflow that does not expand to vapor at the low stage compressor end bearing area is freely drained by a separate line to the evaporator just above the flooded pool. Any liquid in the stream entering the opposite end bearing area passes through openings in the bearing plate and exits with the vapor flow through the vent.

The liquid feeding the cooling system is protected by an inline strainer to control any flushed inadvertent construction debris. A ball valve and an angle isolation valve exist in this line as part of chiller isolation to segregate charge in either shell for maintenance and to isolate the strainer if it ever requires maintenance due to flow restriction and motor overheating. The valves must be open for operation.

The VSD monitors motor stator temperatures from winding thermistors connected to the drive. The thermistor wiring comes through the MBC feedthroughs for each end of the shaft direct to the connector plate. A wire harness from there to the VSD carries the signals.

Motor Winding Thermistor

This testing is to be conducted when any one of the motor winding thermistor values is either minimum (low 32°F) or maximum (high 303°F). These extreme values will cause either a high or low motor winding temperature fault. Perform the following test to verify motor winding thermistor integrity. The testing described below will be conducted from within the VSD cabinet and this access to these test locations requires that all electrical, lock out tag out policies must be adhered to.

All of the below steps are to be conducted at the J4 wire harness, the J4 connector on the VSD Logic Board 031-02911-001 and at 4TB inside the VSD cabinet. The J4 cable must removed for all of the below steps. The thermistors are set up in pairs at the connector. The J4 harness connector test location will check the integrity of the entire electrical path from the J4 connector and harness, through 4TB and the wires from 4TB to the motor housing temperature connector as well as the internal wiring to the actual winding thermistors. *Table 9 on Page 29* for equivalent resistance to temperature values.

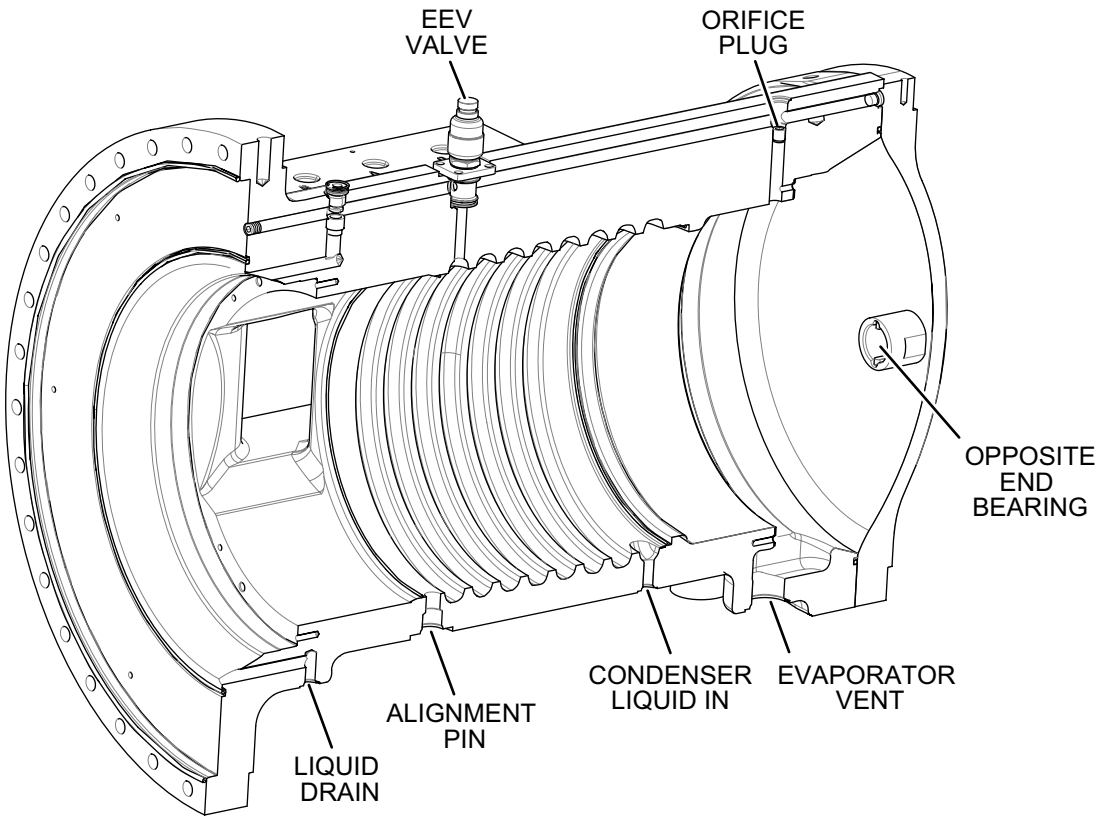


FIGURE 17 - MOTOR COOLING PATHS

Once all 4 numbered steps are performed, use the Solution *Table 8 on Page 28* for what needs to be done to resolve issue.

Prior to proceeding, all wire terminations should be verified for proper installation, location and tightness.

1. Using a Digital multi meter conduct a resistance test of the motor winding thermistors. The first step is to check the thermistor resistance values that feed back to the logic board. This is also to check the wiring integrity back to the motor sensing locations. If any channel should indicate a resistance value inconsistent with the expected value, proceed to step 2. The J4 Harness sockets should equal some very high resistance value equivalent to the values as shown on the Thermistor curve, *Table 9 on Page 29* for the motor ambient temperature and be consistent between all 6 thermistors. An example would be that 50K resistance = 76.3°F and 40K = 85.5°F.

   Measurments should be taken on the J4 wire harness connector socket pairs

   Sockets 1 to 2 = Motor Temp # 1

   Sockets 3 to 4 = Motor Temp # 2

   Sockets 5 to 6 = Motor Temp # 3

   Sockets 7 to 8 = Motor Temp # 4

   Sockets 9 to 10 = Motor Temp # 5

   Sockets 11 to 12 = Motor Temp # 6

2. Should any of the previous locations yield an unacceptable value, perform a resistance check of the thermistors at the 4TB terminal strip inside the VSD. This will eliminate or confirm the integrity of the J4 wiring harness from 4TB to the VSD Logic board J4 location. This check must be done on the motor side of 4TB at the wires to the motor. These wires are also set up in pairs and should be measured on the pairs as outlined below.

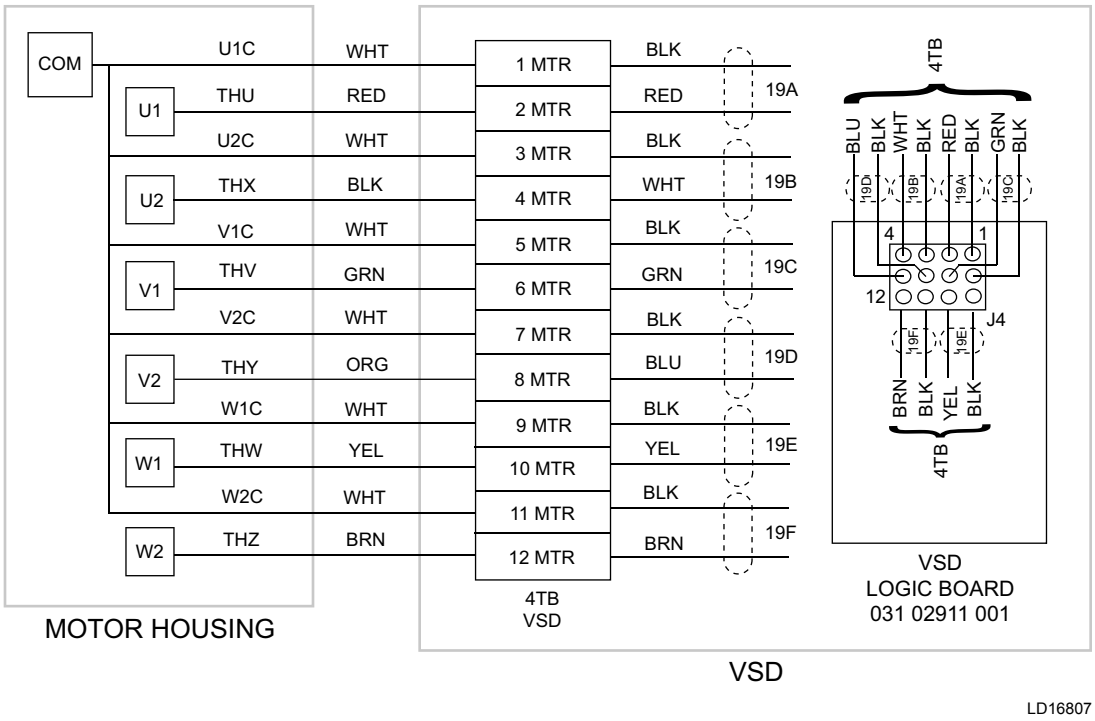


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FIGURE 18 - MOTOR WINDING THERMISTORS

Measurments should be taken on the 4TB wire pairs:

1 and 2 MTR = Motor Temp # 1

3 and 4 MTR = Motor Temp # 2

5 and 6 MTR = Motor Temp # 3

7 and 8 MTR = Motor Temp # 4

9 and 10 MTR = Motor Temp # 5

11 and 12 MTR = Motor Temp # 6

3. If the previous locations still yield unacceptable values, there are 2 options. The first is to perform a resistance check of the thermistors from the motor penetration connector. This will eliminate or confirm the integrity of the wiring harness between the motor and 4TB and identify if the source is the thermistors and/or internal motor monitoring wiring.

   Measurements should be checked on the connector plate sockets:

   A - B = Motor Temp 1, Z1 End U1 temperature
   C - D = Motor Temp 2, Z1 End V1 temperature
   E - F = Motor Temp 3, Z1 End W1 temperature
   G - H = Motor Temp 1, Z2 End U2 temperature
   J - K = Motor Temp 2, Z2 End V2 temperature
   L - M = Motor Temp 3, Z2 End W2 temperature

4. On the VSD Logic board, the J4 Board connector Pins should be equal in value in the 25 KOhm range or higher. Note that these values will climb the longer the test leads are in contact. This check is performed to validate the board level physical handling of the thermistor signals at the VSD Logic board. This check is for proper resistance values in the signal path where it lands on the board.

   Measurement points

   Pins 1 to 2 =
   Pins 3 to 4 =
   Pins 5 to 6 =
   Pins 7 to 8 =
   Pins 9 to 10 =
   Pins 11 to 12 =

Measure the R261 resistor on the back of the logic board. It is next to the J4 connector but on the back of the board. It should equal 11 Ohm.

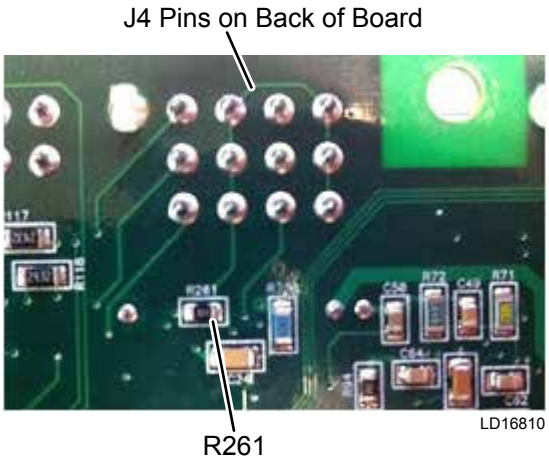

FIGURE 19 - R261 RESISTOR

5. After all of the above steps have been completed please refer to the *Table 8 on Page 28* to determine the solution.

MOTOR HOUSING THERMISTOR

The OptiView monitors motor housing temperature thermistor located inside the MBC compartment. Refer to the system wiring diagram and control service manual for information. OptiView controls the motor cooling refrigerant flow in response to this temperature.

HIGH PRESSURE CUTOUT SWITCH

The compressor high pressure cutout switch is mounted inside the MBC cavity area of the compressor motor. The path from the compressor scroll to the switch is integral to the diffuser plate and the motor housing. An O-ring seals the switch to the pressure port.

TABLE 8 - SOLUTION

STEP 1 RESULT	STEP 2 RESULT	STEP 3 RESULT	STEP 4 RESULT	SOLUTION
Pass	Pass	Pass	Pass	The issue is with the VSD Logic board and it will need to be replaced.
Fail	Pass	Pass	Pass	Replace connector and sockets for wire harness from 4TB to VSD Logic board J4 connection.
Fail	Fail	Pass	Pass	The issue is the wires from the motor penetration spades to 4TB. This not a serviceable item. Remove the wires from 4TB and securely wire nut them. Disable the appropriate motor temperture at the Motor Details Screen. This requires an Admin password. This can be serviced at a later date.
Fail	Fail	Fail	Pass	The issue is the motor thermistor(s). This not a serviceable item. Remove the wires from 4TB and securely wire nut them. Disable the appropriate motor temperture at the Motor Details Screen. This requires an Admin password. (Reference Form 160.84-M2)
Pass	Pass	Pass	Fail	The issue is with the VSD Logic board and it will need to be replaced.

TABLE 9 - THERMISTOR CURVE

R OHM	DEG C	DEG F	R OHM	DEG C	DEG F	R OHM	DEG C	DEG F
50000	24.60	76.28	33500	33.90	93.03	17000	50.91	123.64
49500	24.83	76.69	33000	0.01	32.02	16500	51.70	125.05
49000	25.06	77.10	32500	34.63	94.33	16000	52.51	126.52
48500	25.29	77.52	32000	35.00	95.00	15500	53.36	128.04
48000	25.52	77.94	31500	35.38	95.68	15000	54.23	129.62
47500	25.76	78.37	31000	35.77	96.38	14500	55.15	131.26
47000	26.00	78.80	30500	36.16	97.09	14000	56.09	132.97
46500	26.25	79.24	30000	36.56	97.81	13500	57.08	134.75
46000	26.49	79.69	29500	36.97	98.54	13000	58.11	136.60
45500	26.74	80.14	29000	37.38	99.29	12500	59.19	138.54
45000	27.00	80.59	28500	37.81	100.05	12000	60.32	140.57
44500	27.25	81.06	28000	38.24	100.83	11500	61.50	142.70
44000	27.51	81.52	27500	38.68	101.63	11000	62.75	144.94
43500	27.78	82.00	27000	39.13	102.44	10500	64.06	147.30
43000	28.04	82.48	26500	39.59	103.27	10000	65.44	149.80
42500	28.31	82.96	26000	40.07	104.12	9500	66.91	152.44
42000	28.59	83.46	25500	40.55	104.98	9000	68.47	155.25
41500	28.86	83.96	25000	41.04	105.87	8500	70.13	158.24
41000	29.15	84.46	24500	41.54	106.78	8000	71.92	161.45
40500	29.43	84.97	24000	42.06	107.70	7500	73.83	164.89
40000	29.72	85.50	23500	42.59	108.65	7000	75.90	168.62
39500	30.01	86.02	23000	43.13	109.63	6500	78.14	172.66
39000	30.31	86.56	22500	43.68	110.63	6000	80.60	177.08
38500	30.61	87.10	22000	44.25	111.65	5500	83.31	181.95
38000	30.92	87.65	21500	44.83	112.70	5000	86.32	187.37
37500	31.23	88.21	21000	45.43	113.78	4500	89.70	193.46
37000	31.55	88.78	20500	46.05	114.89	4000	93.55	200.39
36500	31.87	89.36	20000	46.68	116.03	3500	98.01	208.41
36000	32.19	89.95	19500	47.33	117.20	3000	103.28	217.90
35500	32.52	90.54	19000	48.01	118.41	2500	109.70	229.46
35000	32.86	91.15	18500	48.70	119.66	2000	117.84	244.11
34500	33.20	91.76	18000	49.41	120.94	1500	128.82	263.87
34000	33.55	92.39	17500	50.15	122.27	1000	145.32	293.57
33500	33.90	93.03				500	176.69	350.04

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SECTION 4 - MAGNETIC BEARING CONTROLS DIAGNOSTICS

DESCRIPTION OF COMPONENTS

The compressor is driven by a hermetic permanent-magnet high speed motor with magnetic bearings. The impeller is mounted directly to the common shaft of the motor rotor, overhung outside of the impeller-end bearing set. The motor is supported between an impeller end bearing set and an opposite-impeller end bearing set. Each one of the two bearing sets includes the following components:

- **Four Radial Magnets –** The bearing's radial electromagnets are in pairs with magnets oriented directly across the axis of the shaft from each other. Two pairs exist for each bearing oriented in orthogonal axes. The axes are rotated 45 degrees from horizontal and vertical so that gravity is countered by the shared attraction of the upper magnet in both axes together.
- **Axial Magnet –** The axial magnetic bearing applies attractive force to a step on the rotor shaft.
- **Radial Position Sensors –** The bearing set includes a pair of radial position sensors in two orthogonal axes in line with the magnetic bearing axes. These are inductive coil sensors.
- **Axial Position Sensor –** The bearing set includes an axial inductive coil position sensor.
- **Touchdown Bearing –** A pair of angular contact ball bearings exists with clearance from their inside diameter to the shaft to accept touchdown of the rotating shaft on a magnetic bearing failure and to support the shaft when idle.

The Aixial magnets are called Z1 at the low stage Impeller end and Z2 on the end opposite the low stage impeller.

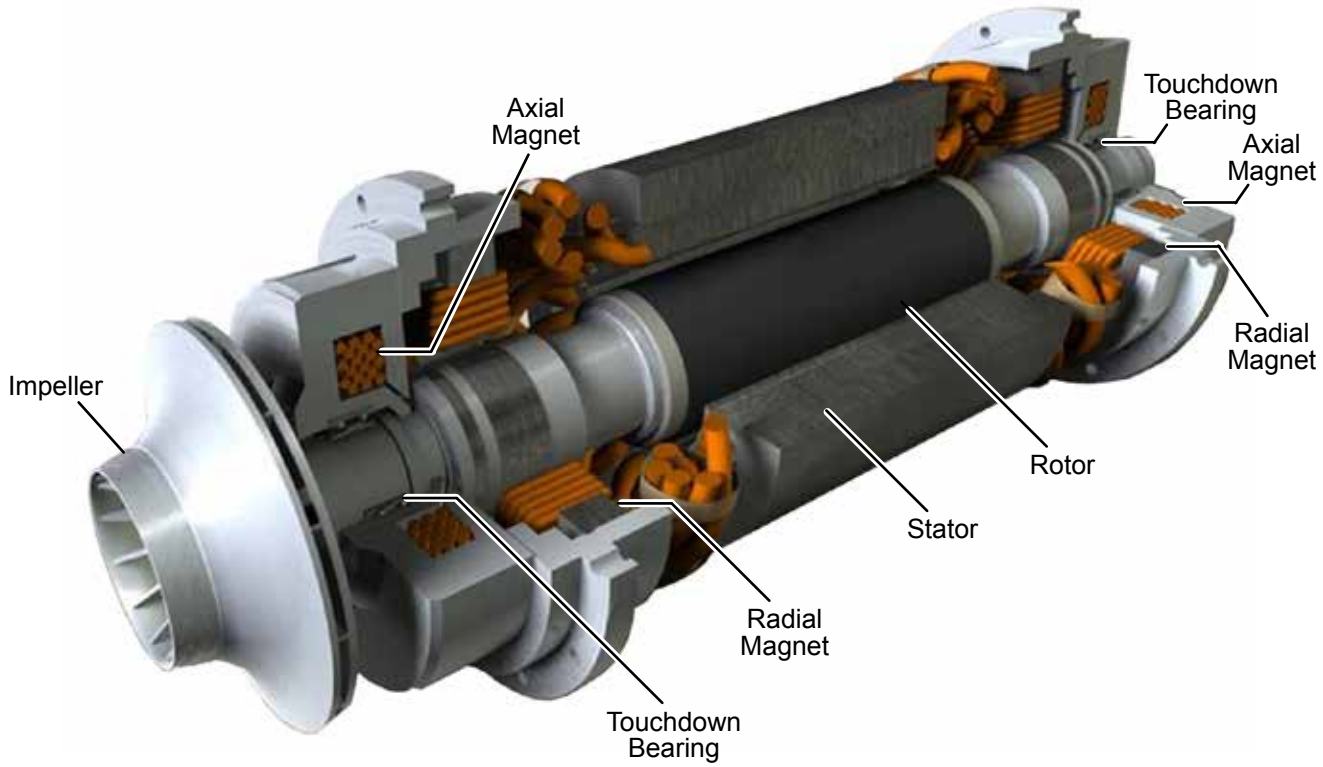

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FIGURE 20 - DRIVELINE DIAGRAM

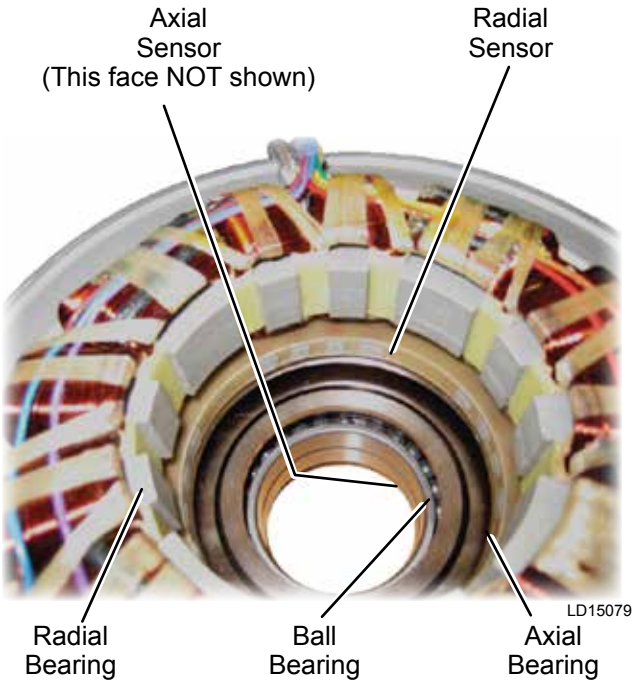

FIGURE 21 - BEARING DIAGRAM

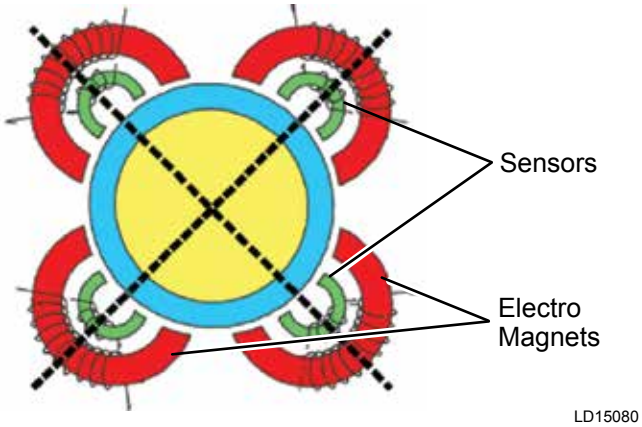

FIGURE 22 - RADIAL BEARING, SENSORS AND AXIS ORIENTATION

The bearing position sensors, when powered and having signals processed electronically, produce an output voltage proportional to their distance away from the target. For radial sensors, the target is the shaft. For axial sensors, the target is a magnetic steel ring pressed on the shaft between two aluminum rings.

The radial sensors are located as an opposed pair across the shaft in each axis. The axial sensors are an adjacent annular pair at each target ring. Each location's sensor pair output voltage is processed so it equals zero when the shaft or target ring is centered between the sensors and increases positively or negatively as the target is moved in either direction.

The bearing cartridges at either end are the same part. However, when installed facing each other, the relationship is inverted across the vertical centerline. Therefore, the bearing and position feedthrough connectors are individual parts specifically made for the Z1 end versus the Z2 end. Their wiring internal to the motor changes pin location accordingly at the bearing connector to serve the correct channel. Always ensure the proper feedthrough part number as shown on the cable outside the motor is used for each location. (Reference the *Renewal Parts Manual (Form 160.84-RP1)*

The Magnetic Bearing Controller (MBC) determines the shaft position by comparing the position sensor processor output DC signal to a reference voltage input. The current to the magnets in the bearings is then modulated in proportion to move the shaft and maintain the position sensor signal equal to the reference. The current is from pulsed power duty cycles. The bearing coils on opposite ends of an axis (V1 versus V3 for instance) split the duty cycle of the energizing current. Therefore, as the upper bearing current increases, the lower decreases nearly proportionally.

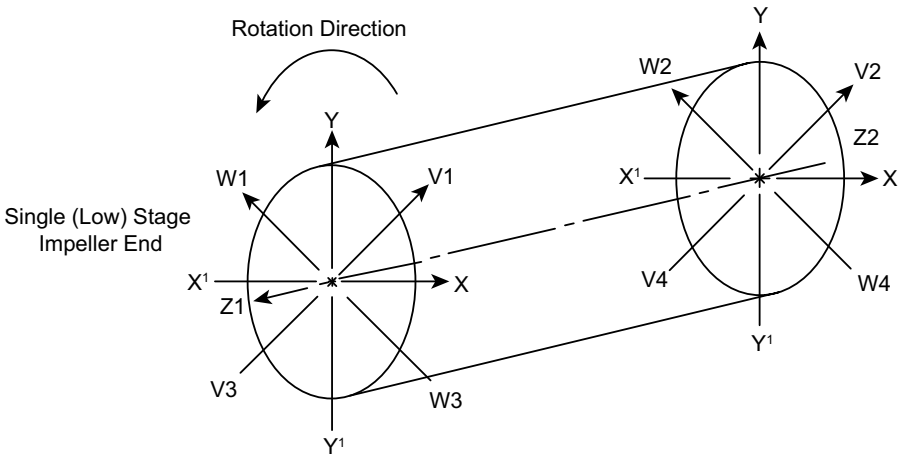

FIGURE 23 - AXIS IDENTIFICATION

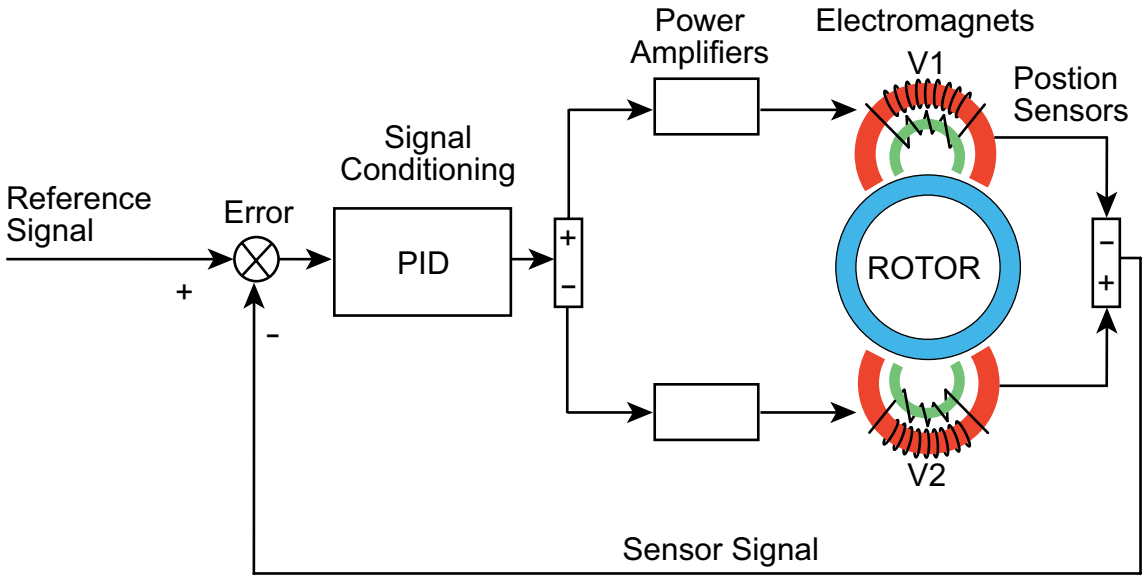

FIGURE 24 - MAGNETIC BEARING CONTROLLER DESCRIPTION

FUNCTIONS

The Magnetic Bearing Controller (MBC) performs the following functions:

- Monitors and maintains shaft position.
- Monitors bearing temperatures.
- Receives a signal indicating the motor rotational speed from the VSD.
- Communicates with the OptiView panel over Modbus communicaton.
- Communicates availability, faulted, and permissive to rotate to OptiView over digital contacts.

The interfaces and operation of the MBC are described in the *Controls Service Manual (Form 160.84.M2)*. The wiring to and from the MBC boards is shown in the *Controls Wiring Manual (Form 160.84-PW2)*.

HARDWARE

The MBC is a pair of circuit boards within a compartment on the side of the compressor motor housing mounted together to a heat sink plate in contact with the housing. The cooling for the boards is by conduction through the plate to the housing. The MBC can only be replaced as this single assembly. See *Figure 25 on page 34*. The cover to the MBC compartment is not intended to contain pressure. It includes a magnetic flapper to allow the compartment to vent freely in case of an electrical feed-through seal failure inside. The boards include the hardware and software to operate the compressor driveline magnetic bearings. The power board requires 150Vdc ± 10 %. The power board generates 5 Vdc for the control board operation.

POWER

The MBC is powered from the chiller power panel cabinet with 160 Vdc from the output of a dedicated power supply. That output voltage precision is rated for ± 1%. That supply is fed from the critical load bus from the power panel un-interrupted power supply with battery backup. It remains live when either 115 VAC line power is available to the UPS from the control transformers on the VSD or the UPS battery is connected and the UPS is enabled. The UPS is enabled when line power is available or with line power lost until a period of time after shaft rotation is ceased. The output of the power supply passes through an electrical filter network to condition the power quality for the MBC.

If power must be removed from the MBC to perform service, BOTH sources must be isolated:

- ***120VAC control power (typically from the VSD line-to-control transformer)***
- ***Battery supply to the UPS at the Power Panel battery disconnect switch. See Figure 26 on page 35.***

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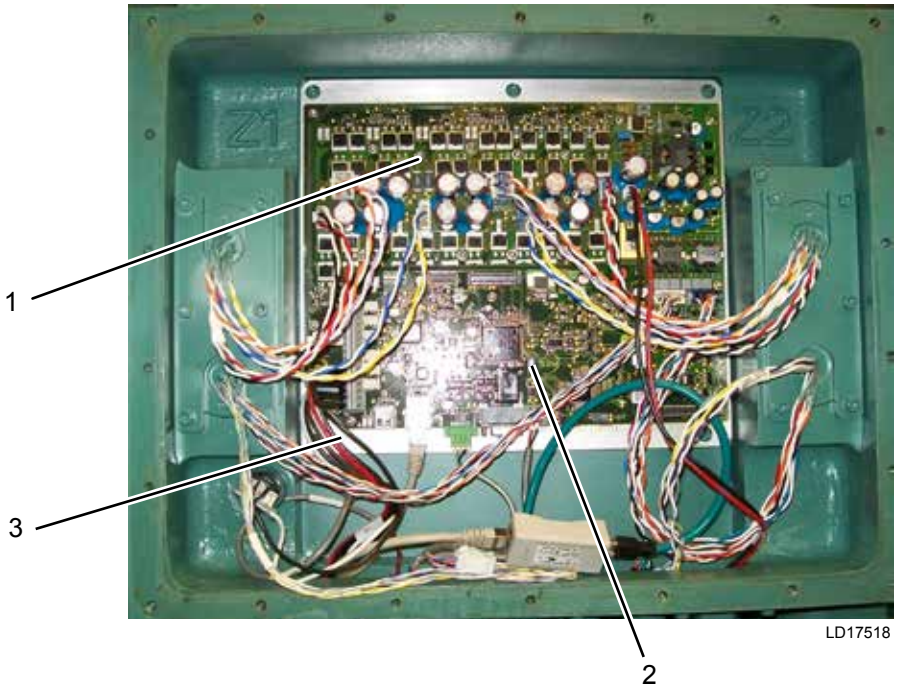

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The Main Components of the MBC are:

1	Power Board
2	Control Board
3	Heat Sink Plate

FIGURE 25 - OVERVIEW OF THE MBC

FIGURE 26 - POWER PANEL BATTERY DISCONNECT SWITCH

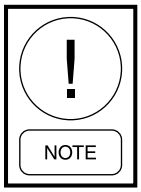
MOTOR SHAFT CONTROL

The MBC includes an oscillator section to generate a high frequency sine wave excitation current for the shaft position sensor coils. The oscillator section divides into two circuits, one powering the radial position sensors and the other powering the axial sensors. The sensor coils are in parallel across the excitation source. A capacitor is also in parallel with the sensors to condition the circuit. If enough position sensor coils loose continuity, the oscillator will overload through the capacitor and the MBC will present an oscillator overload fault. When the coils are restored, the oscillator resets. A tap on the center of each sensor feeds the position signal back to the processor. When the MBC is in Levitate or Rotate mode, the processor determines the necessary correction to maintain the shaft centered and commands the amplifiers on its power board appropriately. Centered shaft is near zero position. The amplifiers feed the bearing coils to increase or decrease their attraction force to position the shaft. Coils on opposite ends of the same axis (V1 versus V3, for instance) decrease current to one end as current is increased on the other end.

TABLE 10 - BEARING LIMITS

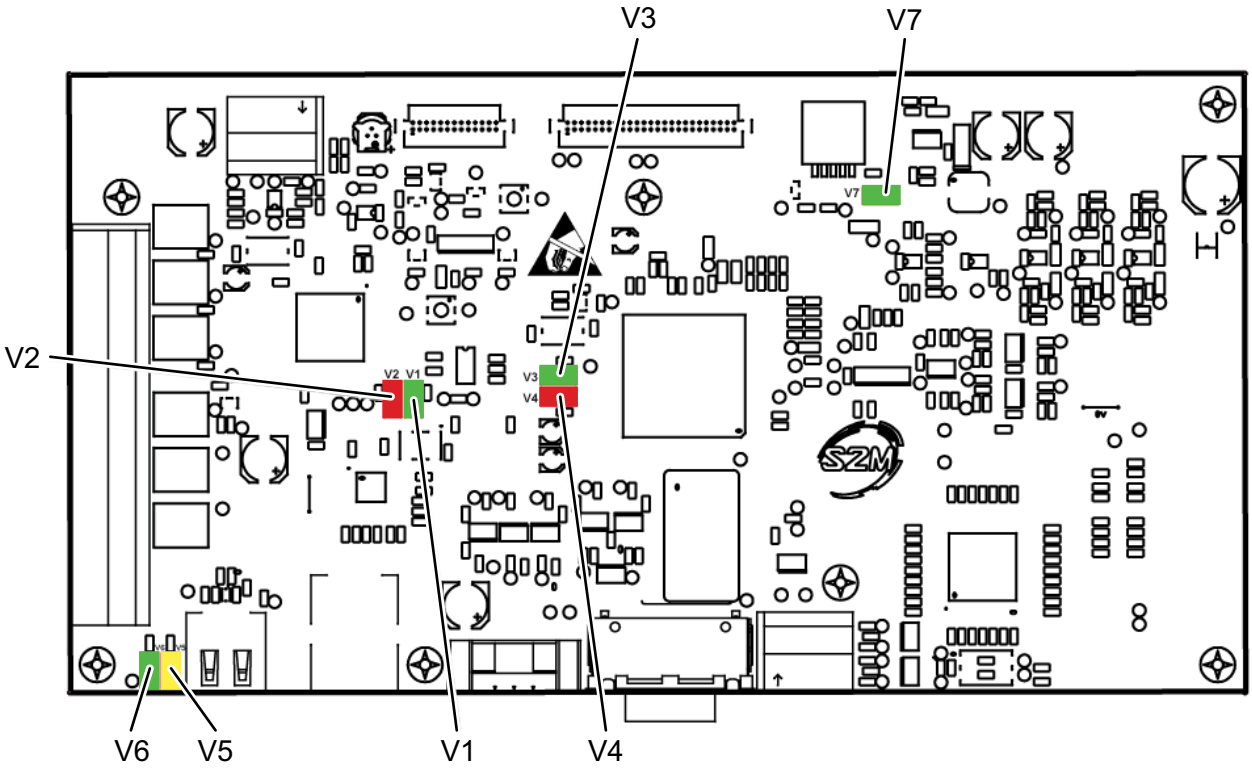
BEARING LIMITS	COIL QTY	MAX CURRENT/ COIL	NOMINAL AIR GAP	POSITION FAULT
Radial	8	4 Amp	150 µm	100 µm
Axial	2	16 Amp	200 µm	100 µm

The MBC has two features related to the 1x rotation vibration. These are called Automatic Vibration Reduction (AVR) and Automatic Balancing System (ABS). Some degree of imbalance is inevitable in any rotating machine. Imbalance presents itself as a vibration at rotational speed. Standard bearings put force into the shaft to keep it centered and into the housing to counter the shaft force caused by imbalance. This unit's magnetic bearing system can manipulate its reaction to this imbalance as required to smooth the operation. AVR operates over the range of the bearing system natural frequency and shifts the phase of its radial displacement reaction 90 degrees to control 1x rotation as it passes through the minimum bearing stiffness point. AVR becomes active when Rotation is commanded on and the speed signal from the VSD indicates to the MBC that speed is above 70 HZ. The AVR technology is effective above 80 Hz and to the ABS frequency of 225 Hz. The ABS technology is effective above 225 Hz in the axial direction and above 255 Hz in the radial axes. ABS allows the shaft to vibrate freely only at 1x rotation by filtering this frequency out of the driver signal to the radial bearings. This prevents imbalance and runout forces from transmitting to the stationary driveline hardware. It also reduces the bearing currents required to stabilize the shaft and eliminates the cyclic force that would exist to keep the shaft geometrically centered in opposition to the natural orbit due to minor imbalance.



If the MBC, the motor bearings, or the motor are ever replaced in the field, the repair must be followed by an Automatic Axial Centering performed in ADMIN access by a qualified service technician from the OptiView MBC Diagnostics screen prior to running the chiller. Contact Product Technical Support for the password and refer to the Controls Service Manual (Form 160.84.M2) calibration and programming section.

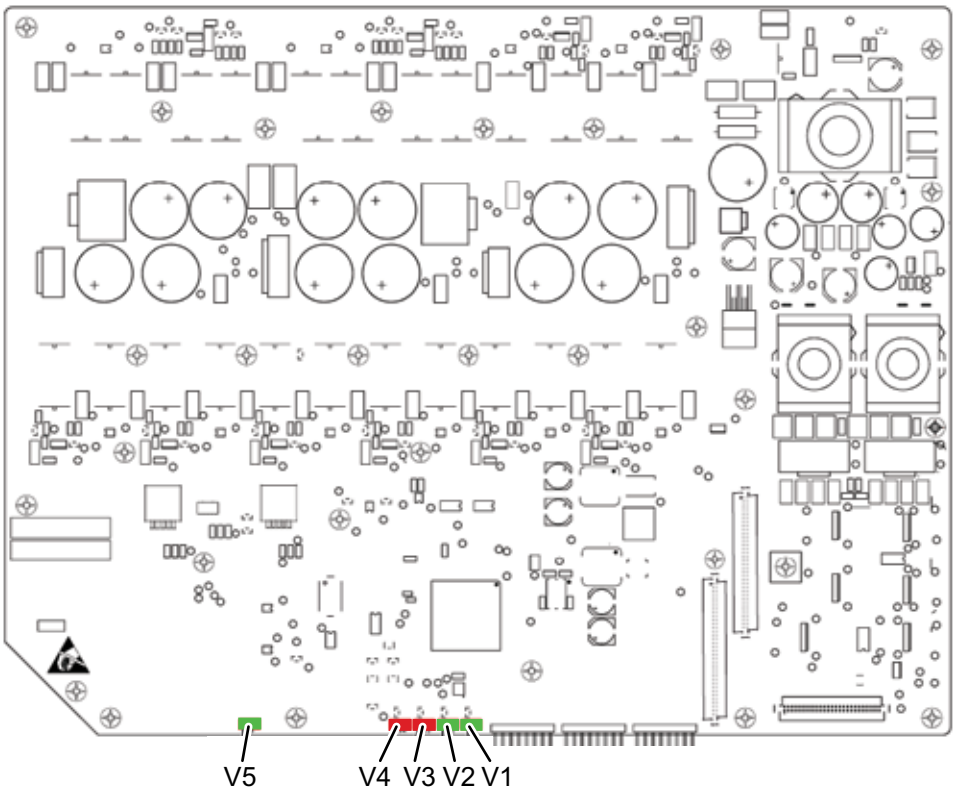
The procedure determines the position sensor readouts at each physical limit of axial travel (bumping touchdown bearings) and determines the proper position offsets to run in true center of the physical limits. These offsets are stored in the MBC memory.



CONTROL BOARD LEDS

LED	COLOR	MEANING WHEN LED COMES ON
V1	Green	Ethernet link
V2	Red	Processor running
V3	Green	Levitation activated
V4	Red	Levitation disabled
V5	Yellow	Not used
V6	Green	Not used
V7	Green	Presence of 5 VDC voltage

FIGURE 27 - CONTROL BOARD LEDS



POWER BOARD LEDS

LED	COLOR	MEANING WHEN LED COMES ON
V1	Green	Not used
V2	Green	Not used
V3	Red	Solid state: amplifier is levitated Fast blinking state: amplifier is enabled, but is in a fault condition
V4	Red	Slow blinking state: amplifier is functional and operating correctly
V5	Green	Presence of 150 VDC voltage

FIGURE 28 - POWER BOARD LEDS

TROUBLESHOOTING

NOTE

For all troubleshooting, refer to wiring diagram Form 160.84.PW2 and the Controls Service manual Form 160.84-M2.

Communication Issue

OptiView does not attempt communication with the MBC until its microboard receives signal via its I/O board indicating the MBC Alive contacts are closed and ceases communication when indications are those have gone open. RS485 communications can be broken or can be incorrect due to noise, etc.

- Check that the MBC is powered.
  - Power Board V5 LED lit, indicating 150 VDC nominal supply voltage present. If not check for voltage and wiring and connector continuity.
  - Between 135 and 165 volt DC is present to MBC Power Board connector P18 connector. Red wire is positive voltage to P18 Pin 1. Black wire is negative voltage to P18 Pin 2.

  - Control Board V7 LED lit, indicating 5 VDC sent from the power board. If not, check that the board is seated on the power board.

- Check that the MBC Alive Contacts (MBC Control Board J12-13 to J12-14) close when the MBC is powered and the 115VAC transmitted to J12-13 from the OptiView I/O board TB6-CL1 returns from J12-14 to I/O board TB3-71. OptiView will only attempt communication when software recognizes that I/O board TB3-71 has voltage. Check the OptiView MBC Screen to see the MBC Alive LED. If it is lit, the microboard is getting the input. If not, and voltage is available at TB3-71, check the ribbon cable between the I/O board and OptiView to determine if I/O board or microboard issue exists.
- Check OptiView MBC Screen for valid data when MBC Alive is made. If the values on OptiView are showing XXX Then a problem likely exists with the serial communication between the MBC and OptiView.
  - Check the OptiView COM 6 transmit and receive LED's: Red CR3 = Transmit / Green CR2 = Receive
  - If transmit is flashing and not receive, target the wiring, its polarity, or the MBC boards.
  - If transmit is not flashing and MBC Alive input is good, check OptiView microboard.
  - Check that the polarity of the coms wiring from end to end is correct using *Field Control, Wiring and MBC Modifications Manual (Form 160.84-PW2)*.
- Check the MBC Com Error Statistics on the OptiView Setpoints – Setup - Diagnostics – VSD/ MBC Comms screen. These can indicate the difference between a noise or grounding issue versus failure of the coms drivers/receivers or wiring.

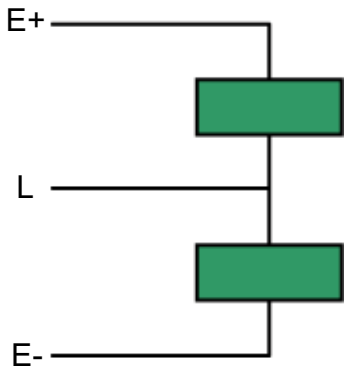
Oscillator Fault

Oscillator faults designate themselves to the direction with the problem (Radial or Axial). Oscillator faults could be caused by an open or short in the position sensor coil windings or connecting wiring, or an MBC control board problem.

- Check the fault history for a position that appears out of normal or coincident position faults.
- Check continuity of all position sensor wiring for the direction of the failure (Radial or Axial).
- Check the position sensor coil resistance per *Figure 29 on page 38 and Figure 30 on page 38*
- Check insulation resistance using a 500 VDC Megohmeter across the machine casing to each connection wire below. The resistance to ground should be higher than 2 MΩ.

Position Sensors

Disconnect the position sensor circuit from the MBC control board. Check sensor resistance according to the tables below:



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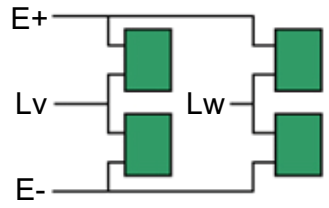
SENSOR DIRECTION	LEADS	VALUE
Axial	Between E+ and E-	4.8 Ohm
Axial	Between E- and L	2.7 Ohm

FIGURE 29 - AXIAL SENSOR



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SENSOR DIRECTION	LEADS	VALUE
Radial	Between E+ and E-	2.1 Ohm +/- 10%
Radial	Between E- and L	1.7 Ohm +/- 10%

FIGURE 30 - RADIAL SENSOR

TABLE 11 - POSITION SENSOR WIRE ROUTING TABLE (REFER TO FORM 160.84-PW2)

FUNCTION	POWER BOARD CONNECTION
LW 1-3	P3-2
LV 1-3	P3-1
E+ WV13	P3-12
E- VW13	P3-11
LZ1	P3-3
E+ Z1	P3-14
E-Z1	P3-13

FUNCTION	POWER BOARD CONNECTION
LW 2-4	P2-2
LV 2-4	P2-1
E+ WV24	P2-12
E- VW24	P2-11
LZ2	P2-3
E+ Z2	P2-14
E-Z2	P2-13

Position Fault

Position faults could be caused by dynamic conditions in the compressor, some mechanical obstruction in the driveline, bogus position reading, failed bearing coil not positioning the shaft as required, failed MBC control board, or failed MBC power board amplifier circuits.

- Check the fault history for a position or bearing current that appears out of normal or coincident position faults with high or low bearing current.
- Command Manual Levitate the shaft from the OptiView MBC Screen and check the indications:

  Positions V13, W13, V24, W24, Z1, and Z2 when levitated and static should go to < 10 µm

  All bearing currents when levitated and static go greater than 0.25 amp
- If ALL of the bearing currents = 0 AND amplifier board temperature = 0 (MBC Details Screen), suspect the connection between the MBC control board and the MBC amplifier (power) board. Check that the control board is seated properly into the power board connector.
- If ALL of the bearing currents = 0 and a valid amplifier board temperature exists, suspect the amplifier board.
- If individual bearing coil currents are showing = 0, measure the bearing coil resistance per below.
- If individual positions are showing failure to respond, measure bearing and position sensor resistances as detailed above for Oscillator Fault.
- Always consider continuity through connectors also. Recognize bearing current commands will be increased by design to try and correct a position that is not at center. Failure to deliver bearing current can be due to the bearing, wiring, or the MBC boards. Identify boards by ruling out wiring and coils.

Magnetic Bearing Coils

Disconnect the two applicable coil power wires from the amplifier board at the terminal blocks on the amplifier board. Connect an ohmmeter to the two power wires to determine resistance through the bearing coils. If an impedance meter is available, the inductance can be checked also.

For a radial bearing

- The resistance should be 2.6 Ohm +/- 10%.
- The inductance (at 4 Amp) should be 157 mH.

For an axial bearing

- The resistance should be 0.5 Ohm +/- 10%.
- The inductance (at 16 Amp) should be 63 mH.

Check insulation resistance using a 500 VDC Megohmeter from one bearing coil wire to machine casing ground. The resistance to ground should be higher than 2 MΩ.

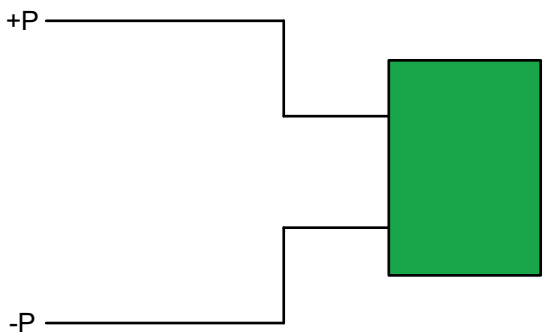

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FIGURE 31 - BEARING COIL RESISTANCE

TABLE 12 - BEARING COIL WIRE ROUTING TABLE (REFER TO FORM 160.84-PW2)

FUNCTION	POWER BOARD CONNECTION
Axial Z1 P+	P9-1 parallel with P9-4
Axial Z1 P-	P9-3 parallel with P9-6
Radial W1 P+	P7-1
Radial W1 P-	P7-2
Radial W3 P+	P7-3
Radial W3 P-	P7-4
Radial V1 P+	P5-1
Radial V1 P-	P5-2
Radial V3 P+	P5-3
Radial V3 P-	P5-4

FUNCTION	POWER BOARD CONNECTION
Axial Z2 P+	P10-1 parallel with P10-4
Axial Z2 P-	P10-3 parallel with P10-6
Radial W2 P+	P8-1
Radial W2 P-	P8-2
Radial W4 P+	P8-3
Radial W4 P-	P8-4
Radial V2 P+	P6-1
Radial V2 P-	P6-2
Radial V4 P+	P6-3
Radial V4 P-	P6-4

Digital Signal Issues

Fault Contacts

When the MBC is indicating a fault, the OptiView MBC shows MBC Fault LED lit. That occurs when 120VAC is removed from OptiView I/O board TB3-70.

- Check that OptiView MBC screen does not have MBC Fault LED lit when the MBC is powered and has no standing fault. The MBC will have continuity through the fault dry contacts from J12-9 to 10 when no fault is present.
- If OptiView shows a fault (MBC screen Fault LED lit), the 120VAC signal back to OptiView I/O board TB3-70 is open.
- Ensure that the MBC Power board V3 LED is not blinking, indicating a fault. That would legitimately command the fault contacts open.
- If no fault is expected, check 120VAC fault wiring from OptiView I/O board to MBC.
- If 120VAC is at I/O board TB3-70 and a fault is indicated on OptiView, the issue is with OptiView I/O board, its connection to the microboard or the microboard itself.

Rotation Allowed Contacts

The MBC will have continuity from J12-11 to 12 when it is well, levitated and permits the motor shaft to be driven.

- Manually Levitate from OptiView MBC Screen and check that the Rotation Allowed LED on the OptiView MBC screen lights.
- If not check 120VAC wiring from OptiView I/O board to MBC and back.
- If 120VAC is at I/O board TB3-30 and Rotation Allowed LED is not lit on the MBC Screen, the issue is with OptiView I/O board, its connection to the microboard, or the microboard itself.

Bearing Temperature

Bearing temperature fault could be a problem with air gap cooling or the thermocouple. To check the thermocouple:

Isolate power from the MBC. Disconnect the temperature sensor to be checked.

The temperature sensor diagram is as follows:

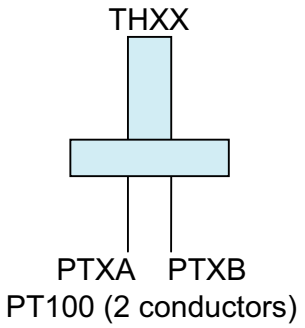

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FIGURE 32 - BEARING TEMPERATURE SENSOR

TABLE 13 - BEARING TEMPERATURE WIRING

DESCRIPTION	CONNECTOR
Z1 BearingTemperature	P3-7 / P3-8
Z2 Bearing Temperature	P2-7 / P2-8

Check the resistances between two sensor probe connection conductors.

TABLE 14 - RESISTANCE

(°C)	(°F)	(%/K)	RESISTANCE (Ω)		
			MIN.	TYP.	MAX.
-40	-40	0.84	340	359	379
-30	-22	0.83	370	391	411
-20	-4	0.82	403	424	446
-10	14	0.80	437	460	483
0	32	0.79	474	498	522
10	50	0.77	514	538	563
20	68	0.75	555	581	607
25	77	0.74	577	603	629
30	86	0.73	599	626	652
40	104	0.71	645	672	700
50	122	0.70	694	722	750
60	140	0.68	744	773	801

Check insulation:

- ☐ Between the machine casing and each sensor connection wire.
- ☐ Between the shielding of the sensor connection wires and each sensor connection wire.
- ☐ Between the machine casing and the shielding of the sensor connection wire.

The insulation values must be greater than 2 MΩ at 500 VDC.

MBC Board Temperatures

Board temperature faults can be due to board problems, board temperature sensor problems or motor housing temperatures too high.

- Validate if the unit is experiencing high motor housing temperatures and remedy before condemning the MBC.
- Validate the MBC boards are clean and securely fastened to their mounting plate, which serves as a heat sink and that plate is securely mounted to the motor housing.
- If the problem is a bogus reading from the board sensors or a board problem, replace the MBC assembly.

Speed Signal Fault

Check continuity and polarity from VSD per below:

- VSD Logic 4TB 1MBC goes to MBC Control board J11 terminal 1 (+).
- VSD Logic 4TB 2MBC goes to MBC Control board J11 terminal 2 (-).

Check 5 VDC voltage pulses on the signal from the VSD when running.

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SECTION 5 - COMPRESSOR SERVICE

Refer to magnet safety precautions in the front of this manual.

The compressor is the heart of the chiller and every effort should be made to maintain and keep it operating at peak efficiency. Being a precision-built machine, it is important to ensure cleanliness when the system is opened.

The compressor should not be disassembled for inspection purposes only. However, if the compressor fails to function as outlined in the OPERATING MANUAL, it may be necessary to do so. Individual parts are available for replacement as described in the following compressor servicing section.

SERVICE GUIDELINES

Electrical Safety - Always de-energize, lockout and tag out all applicable sources of electrical power when working on the compressor or motor. The motor and MBC has power from two sources -

1. VSD transformers,
2. Battery and UPS in the Power Panel.

The overhaul and replacement of parts of these compressors, like any other mechanical operation on machinery, is best accomplished by experienced service personnel using tools and measuring instruments to accomplish accuracy in their work.

There are a number of good practices that should be followed in disassembly and reassembly of the compressor; some of these are listed below.

Do Not Mix Parts - Refer to the replacement parts manual, OptiView™ Renewal Parts *(Form 160.84-RP2)* for the proper YORK part numbers while working in this document. Keep parts in some general order when removing them from the compressor. It is suggested that parts be laid out to follow exploded views as shown in the many illustrations outlining the disassembly and assembly of the various parts.

Do Not Mix Cap Screws and Washers - Cap screws are suited to the location in which they are used. Too long or too short a cap screw can result in leakage and/or interference with some interior parts. Washers have been selected for specific screws, etc. It is very important to use correct washers or lock washers. The Parts List and Figures in this instruction show the correct length and size of screws and washers. See the Renewal Parts Manual to order the correct part numbers.

Inspect as Compressor is Disassembled - If possible, it is desirable to record shaft and impeller runouts before disassembly. Once driveline parts have been disassembled and cleaned, many valuable indications of the compressor condition are lost. Materials found or burned surfaces can often give an indication as to why a part or parts have failed.

Protect Parts and Surfaces - Do not pile or throw parts indiscriminately. Tape surfaces subject to scratching or nicking during repair operations. Plug off any passages likely to accumulate dust or abrasives.

Clean Thoroughly - No compressor is completely overhauled if it is not cleaned internally to "new part" condition. Dirty parts can not be inspected or fitted and will cause excessive wear when the compressor is in operation.

CLEANING AND CHECKING WEARING PARTS

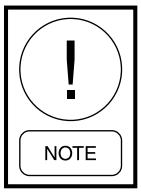
Before reassembling the compressor, all parts should be thoroughly checked for wear.

Worn parts should be replaced with new and each new part should be thoroughly examined for shipping damage.

While the driveline is open, carefully clean the interior, using an approved safety solvent and a lint free cloth.

Clean and check all cooling passageways and all tubing.

Before assembling parts, balance piston and eye seal friction surfaces should be lightly coated with a molybdenum disulfide lubricant such as "Molykote" or "Molkolube" and oil. Be sure to use new, YORK POE refrigerant Oil.



"Molkolube" is available from:
Dow Corning Corporation
Dept. A0021
P.O. Box 1767
Midland, Michigan

Westinghouse Electric Corporation (Sales offices in all major cities). When ordering "Molkolube" No. 8565-3, available from YORK Part No. 364-21508 in 2 oz. cans.

When reassembling parts, each part should be carefully checked for signs of uneven wear, keeping in mind that a nicely polished surface is not an indication of excessive wear. Sudden, excessive wear on any part of the compressor is not normal but is usually caused by some other condition which must be determined and corrected to assure long periods of trouble-free operation.

Seals may be reused if their rubbing surfaces and matching surfaces of their corresponding rotating parts are nicely polished with no sign of uneven wear or gouging.

The impeller should be checked around its outside circumference for evidence of rubbing. If this condition is found, excess displacement is indicated, and the impeller may be worn sufficiently to require replacement.

All gaskets and O-rings should be replaced with new when reassembling the driveline to assure that all surfaces have a tight seal after reassembly.

RIGGING THE COMPRESSOR OR MOTOR

When it becomes necessary to remove a compressor or motor from a unit or base, proper rigging methods must be used to avoid damage to the equipment and/or injury to service personnel. Portable cranes must be of adequate capacity and properly positioned and blocked to prevent tipping or slipping while lifting the compressor or motor. Be sure chains are of adequate strength. Ensure any hoist rings used are installed to the torque rating stamped on the ring. Compressor weights are shown in *Table 16 on Page 45*. Compressor and motor lifting lug holes are metric thread M20 x 2.5 -6H

Use lifting chains with working load limit each 70% of total driveline weight.

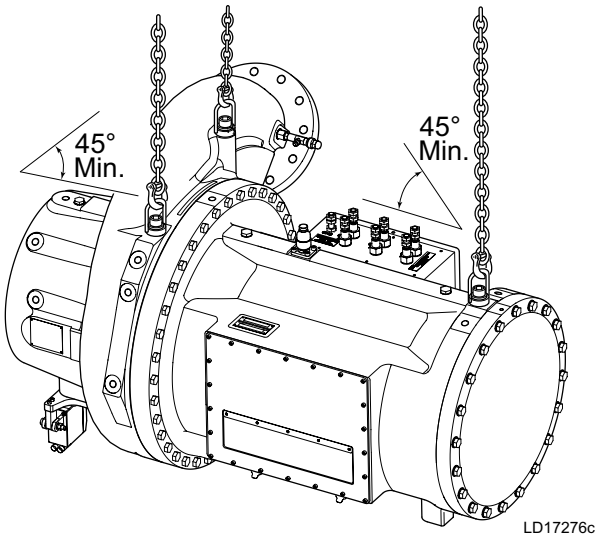


FIGURE 33 - DRIVELINE RIGGING 3 CHAINS

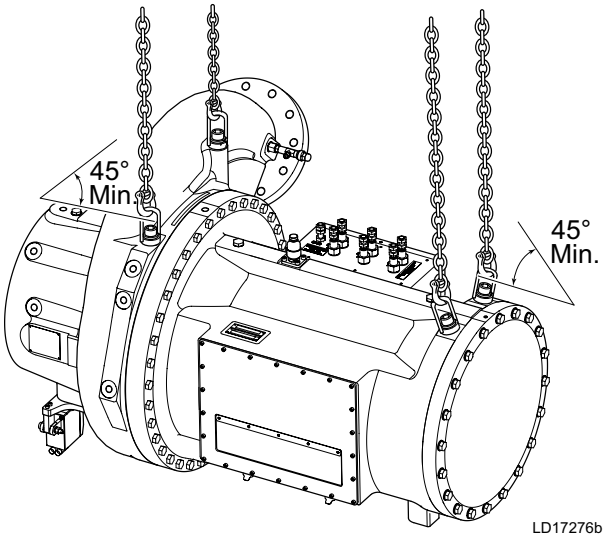


FIGURE 34 - DRIVELINE RIGGING 4 CHAINS

Compressor Motor Assembly

SPECIAL TOOLS

Special tools are available as an option and will be furnished when ordered. These tools are listed in *Table 15 on Page 45*.

TABLE 15 - DRIVELINE TOOL KITS

DESCRIPTION	YORK PART NUMBER
Driveline Rigging Kit	364-52982-000
Impeller Tensioning Tool Kit (w/o Hydraulic Pump)	364-53746-000
Hand Hydraulic Pump	364-53747-000
Grounding Harness	325-44935-000

All of the hoist rings and guide studs required for lifting and disassembling the compressor and motor parts are included in the Driveline Rigging Kit (364-52982-000), which should be obtained for this work.

Tools to remove the impeller are in the Impeller Tensioning Kit (364-53746-000), refer to *Figure 72 on page 67*. The hydraulic hand pump to operate the impeller stud stretch tool is a separate optional kit (364-53747-000) if a suitable pump is not available locally.

TABLE 16 - DRIVELINE COMPONENT WEIGHTS FOR LIFTING INFORMATION

COMPRESSOR MODEL	COMPRESSOR WITH MOTOR		SCROLL WITH VGD		VGD ASSEMBLY		DIFFUSER PLATE		ROTOR		MOTOR	
	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb
M2C-197FAC	1430	3160	380	830	35	80	40	90	50	110	1000	2200
M2C-197FACD	1430	3160	380	830	35	80	40	90	50	110	1000	2200
M2C-205FAC	1440	3170	380	830	40	80	44	100	50	110	1000	2200
M2C-205FACD	1440	3170	380	830	40	80	44	100	50	110	1000	2200
M2C-218FAC	1500	3300	440	970	50	110	42	90	50	110	1000	2200
M2C-233FAC	1500	3310	440	970	50	110	43	100	50	110	1000	2200
M2C-246FAC	1500	3310	440	980	60	130	43	100	50	110	1000	2200

ELECTRICAL ISOLATION

To service any components in the driveline or MBC,

1. Isolate electrical power supply to the chiller from the facility.
2. Isolate the Power Panel battery from the Uninterrupted Power Supply by opening the Power Panel disconnect switch.
3. Isolate plant fluid flow to the chiller at appropriate valves or have refrigerant isolated to prevent freewheeling the driveline and generating electrical energy from the permanent magnet rotor. While the chiller is off, thermal energy provided to the chiller shells through the plant systems can result in auto rotation of the hermetic motor by refrigerant vapor driven across the compressor impeller. This results in the permanent magnet motor rotor acting as an electrical generator. The output at the motor terminals will vary directly with speed of rotation and may provide a safety hazard to a service person if unaware. See the Caution note in the front of this manual for further detail.

MBC COMPARTMENT

The motor MBC compartment houses the following components:

- MBC Assembly
- Motor Housing Temp Thermistor
- Wiring Connector Plate
- High Pressure Cutout Switch (HPCO)
- MBC Feed-throughs

To access any of these, remove the 22 screws holding the MBC cover plate to the motor casting. The plate is not a pressure boundary. It includes a means for any inadvertent leaked refrigerant to freely vent to prevent buildup.

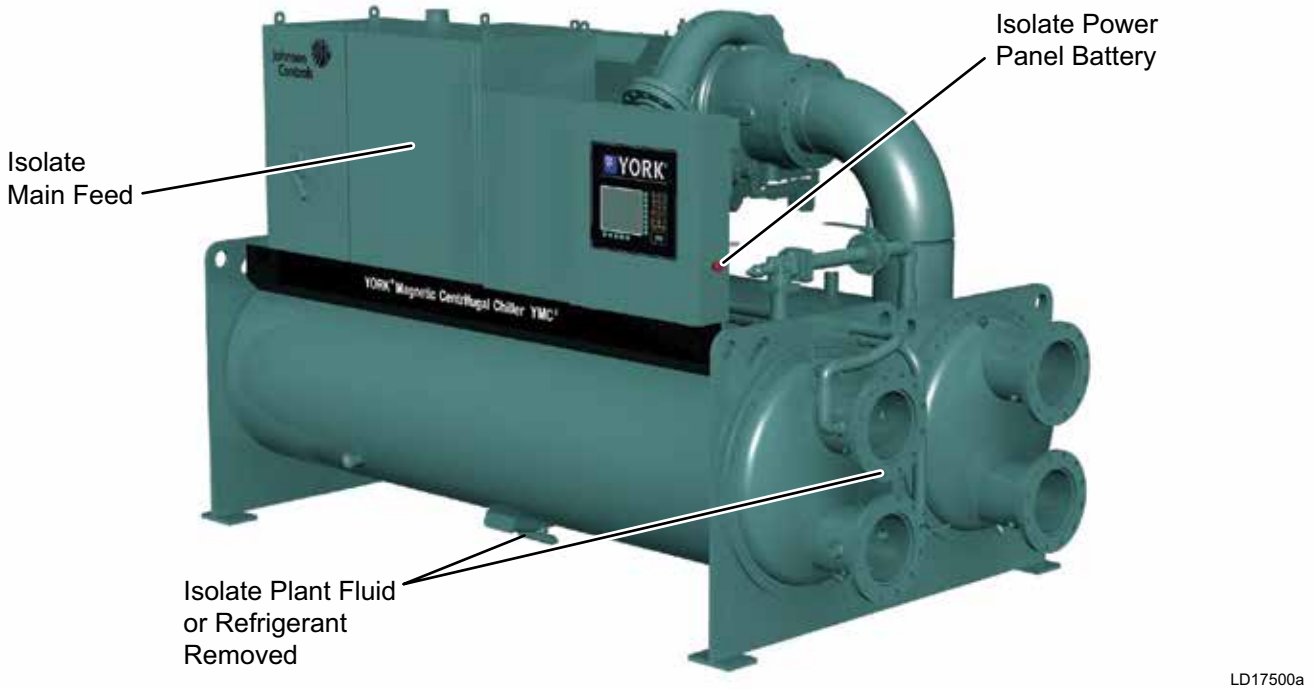


FIGURE 35 - CHILLER ISOLATION

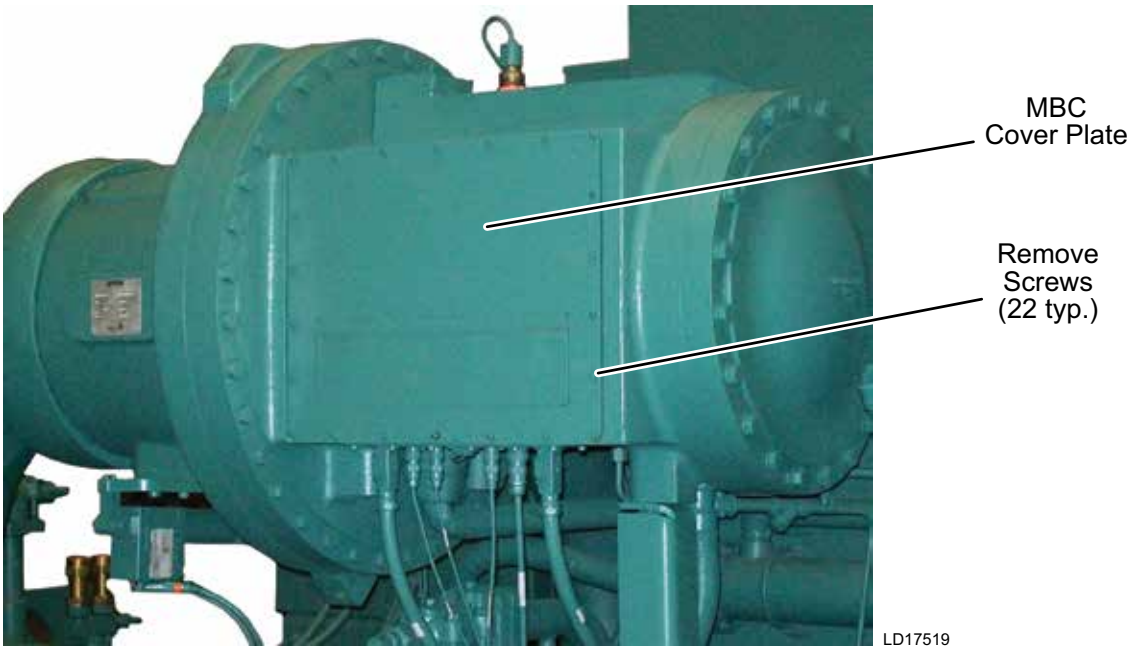


FIGURE 36 - MAGNETIC BEARING COMPARTMENT

When the work is completed, reinstall the MBC cover plate and torque the screws to 17 N-m (12 ft-lbs).

Inside the MBC Compartment:

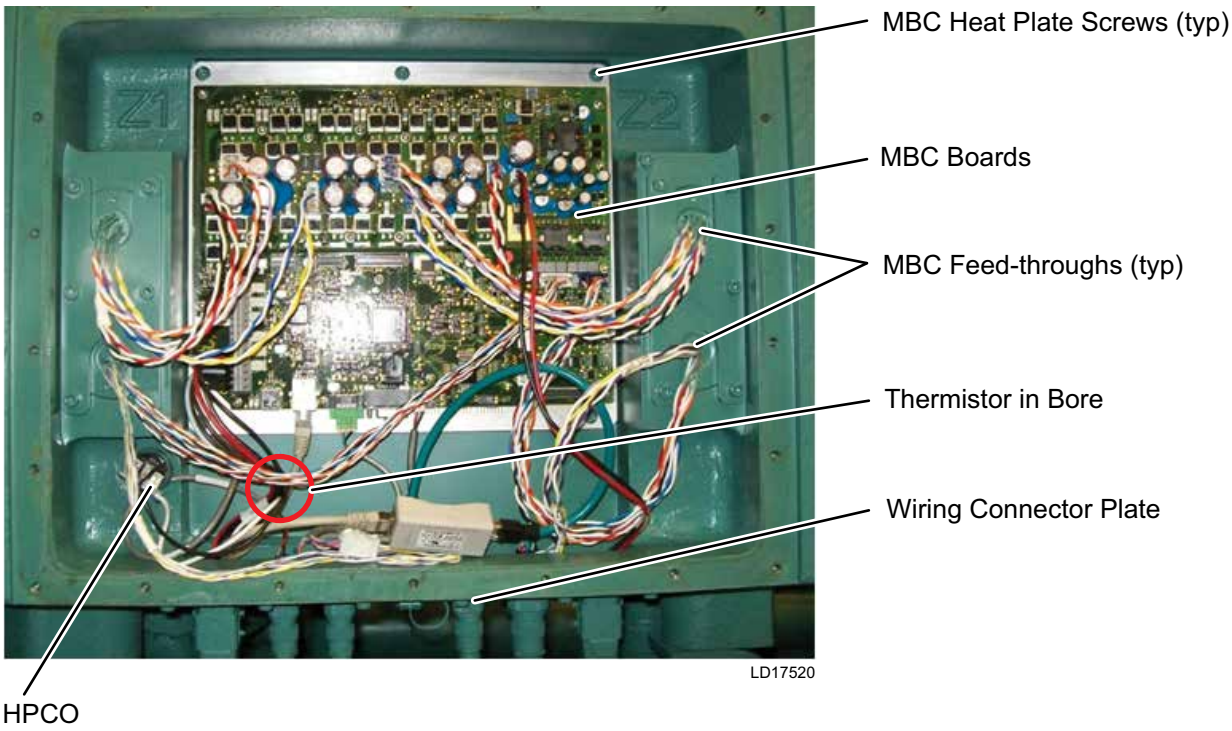


FIGURE 37 - INSIDE MAGNETIC BEARING COMPARTMENT

MBC REPLACEMENT

The MBC is replaced as an assembly consisting of two circuit boards on a heat sink plate. Refer to the MBC Controls Diagnostics section of this manual for troubleshooting.

1. Remove the wire harness connectors on the MBC Boards. Refer to *Field Control, Wiring and MBC Modifications Manual (Form 160.84-PW2)* for wiring diagrams.
2. Remove the six screws holding the MBC heat plate to the motor housing and lift the assembly from the housing.
3. Install new assembly in reverse order and torque the MBC Plate fasteners to 9 N-m (7 ft-lbs).

MOTOR HOUSING TEMP THERMISTOR REPLACEMENT

1. Remove the thermistor wiring connector from the Wiring Connector Plate.
2. Remove the thermistor from the motor housing by removing the threaded liquid-tight fitting. This is not a refrigerant pressure boundary. It is a closed bore.
3. Insert new thermistor wire through the liquid tight threaded fitting.
4. Connect the wiring to the connector plate.
5. Apply thermal compound to exposed surface of sensor.
6. Insert sensor to bottom of well in housing then screw in fitting and snug against housing, then snug fitting to sensor.

WIRING CONNECTOR PLATE REPAIR

1. Remove the appropriate connector according to the detail in *Field Control, Wiring and MBC Modifications Manual (Form 160.84-PW2)*.
2. Install the new or repaired connector.

HPCO REPLACEMENT

The HPCO is a part of the REFRIGERANT PRESSURE BOUNDARY. Refrigerant must be removed to change the switch.

1. Remove the wires from the spade connectors on the back of the switch.
2. Verify refrigerant is removed from the chiller compressor/motor/evaporator and the system is within 2 psig of ambient pressure under nitrogen.
3. Grasping the 14 mm Metric hex at the base of the switch with an appropriate wrench, unscrew the switch counterclockwise. The switch is M10x1 Metric threads.
4. Install a new O-ring, lightly lubricated with POE oil.
5. Install the new HPCO switch and torque to 11 N-m (8 ft-lbs).

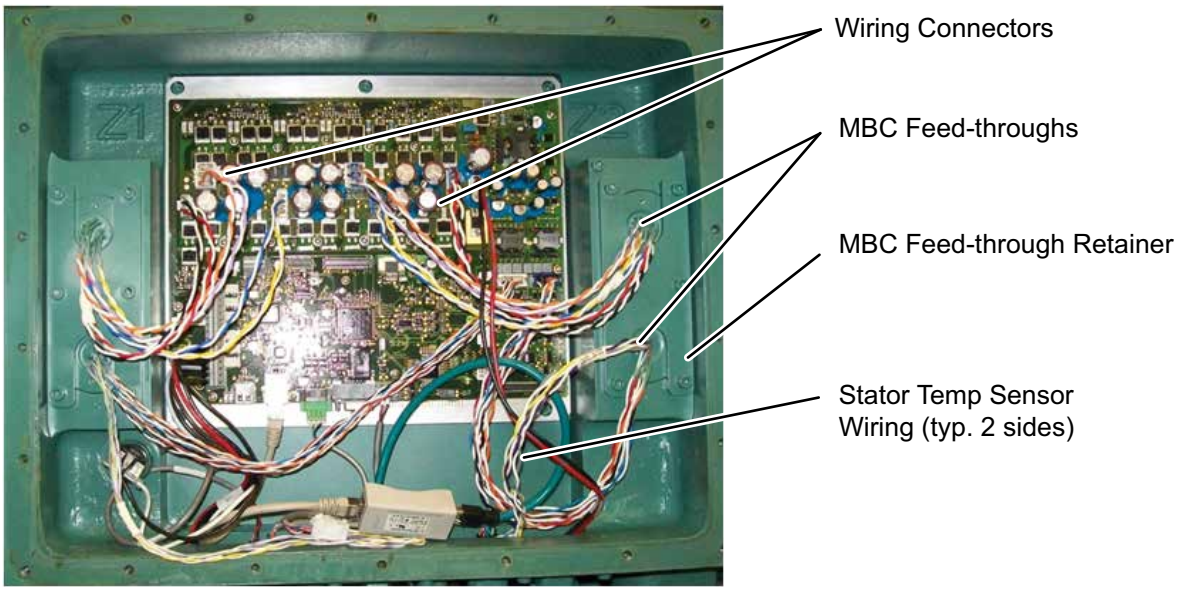


FIGURE 38 - MAGNETIC BEARING COMPARTMENT WIRING

MBC FEED-THROUGH REPLACEMENT

Each MBC Feed-through is a part of the REFRIGERANT PRESSURE BOUNDARY. Refrigerant must be removed to change the devices.

1. Remove the wire harness connectors on the MBC boards. Refer to *Field Control, Wiring and MBC Modifications Manual (Form 160.84-PW2)*.
2. Disconnect the associated stator temperature sensor wiring connector P31 (Z1 side) or P32 (Z2 side), if applicable.
3. Verify refrigerant is removed from the chiller compressor/motor/evaporator and the system within 2 psig of ambient pressure under nitrogen.
4. Remove the six bolts securing the appropriate feed-through retainer plate.
5. Thread a removal tool into the tapped holes in the front of the feed-through housing.
6. Pull the feed-through forward carefully against its OD O-ring resistance, careful not to jar the wiring when the feed-through clears the bore.
7. Secure the visible section of the motor internal wiring so it remains accessible and disconnect the wiring connectors to the motor internal wiring.
8. Install a new O-ring, lightly lubricated with POE grease or POE oil onto the new feed-through.
9. Connect the new feed-through wiring to the motor internal wiring and remove any temporary restraints.
10. Install the feed-through into the machined hole, pushing until the shoulder bottoms. When installing take care not to damage the wire harness by pinching or compromising the wire insulation.
11. Install the retainer plate and 6 bolts and torque them to 9 N-m (7 ft-lbs).
12. Connect the wire harness connectors to the MBC boards. Refer to *Field Control, Wiring and MBC Modifications Manual (Form 160.84-PW2)*.

POWER FEED-THROUGH TERMINAL REPLACEMENT

The Power feed-through terminals are a part of the REFRIGERANT PRESSURE BOUNDARY. Refrigerant must be removed to change the devices.

The motor main power feed-through terminal studs are located on the top of the motor within the motor power adapter box.

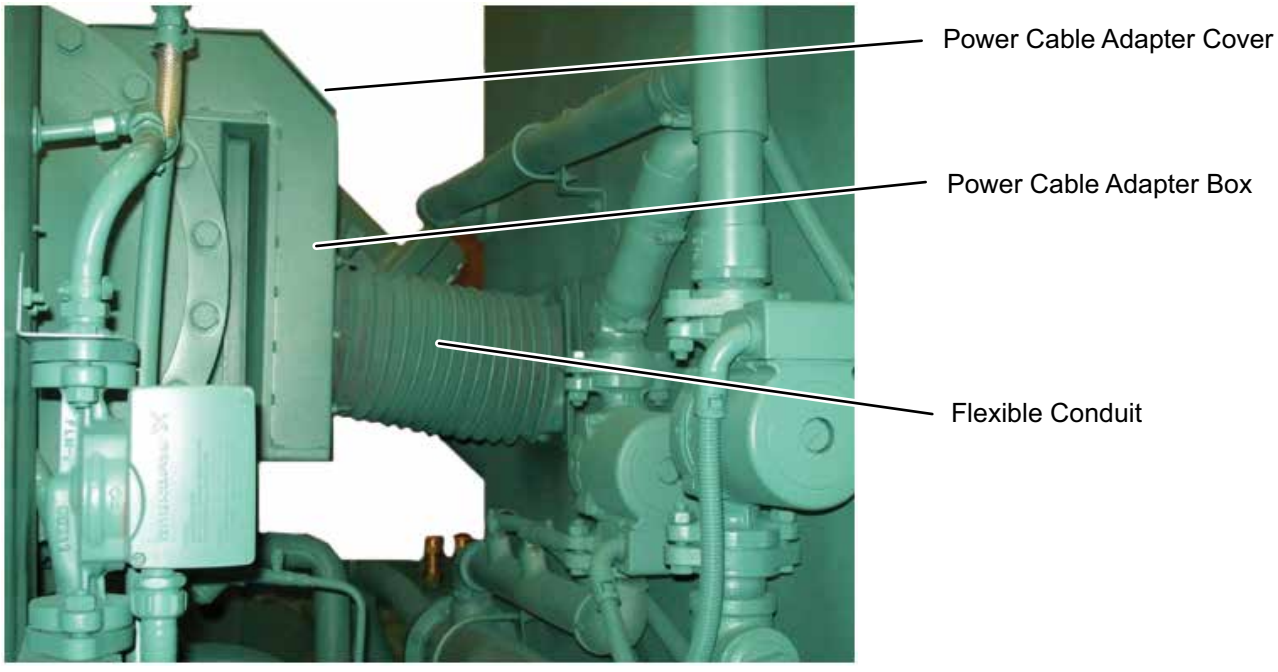


FIGURE 39 - VSD TO COMPRESSOR WIRING

1. Remove the four screws that secure the adapter box access cover to the top of the box.
2. Remove the six 3/8 x 16 nuts from the studs on the flexible conduit flange at its attachment to the box and pull it back toward the VSD to gain access to the 2 power wires per phase and ground wire.
3. Remove the wires from the motor terminal studs in the top of the box as follows. Hold the inner nut with a wrench and loosen the outer nut to free the wiring terminal rings. Do not let the studs turn in the housing.
4. Pull the wiring out from the flexible conduit opening so it does not restrict removal of the box from the motor.
5. Remove the six metric 6 x 1 hex cap screws inside the motor adapter box holding the motor box to the top of the motor and remove the box.
6. Remove the 20 metric M12 x 1 socket head cap screws securing the motor power cover plate and remove the plate
7. Remove the wires from the applicable motor terminal studs to be removed inside the motor casting as follows. Hold the inner nut with a wrench and loosen the outer nut to free the wiring terminal rings. Do not let the studs turn in the housing.
8. Remove jam nuts from studs to be removed.
9. Remove any or all of the problematic studs by turning the stud counterclockwise with the hex on the stud outside of the motor housing.
10. Put a new O-ring lightly lubricated with POE grease or POE oil onto the replacement stud.
11. Ensure the O-ring land area is free from burrs or debris and install the replacement stud into the hole in the motor casting. See *Figure 41 on page 51*. Torque as follows:
    A. Power stud - 70 N-m (50 ft-lbs).
    B. Ground stud- 35 N-m (26 ft-lbs).
12. Install the jam nuts to the studs and re-connect the internal wires to the motor power studs
13. Install the motor lead pairs onto the appropriate lugs. The power leads are labeled as U1, U2, V1, V2, W1 and W2. They are connected as pairs to each of the corresponding power lugs. The wire pairs will be U1 and U2, V1 and V2, W1 and W2. The casing is stamped to the left side of each lug to indicate which phase connects to each lug. The stamp marks will read U, V, W and GND.

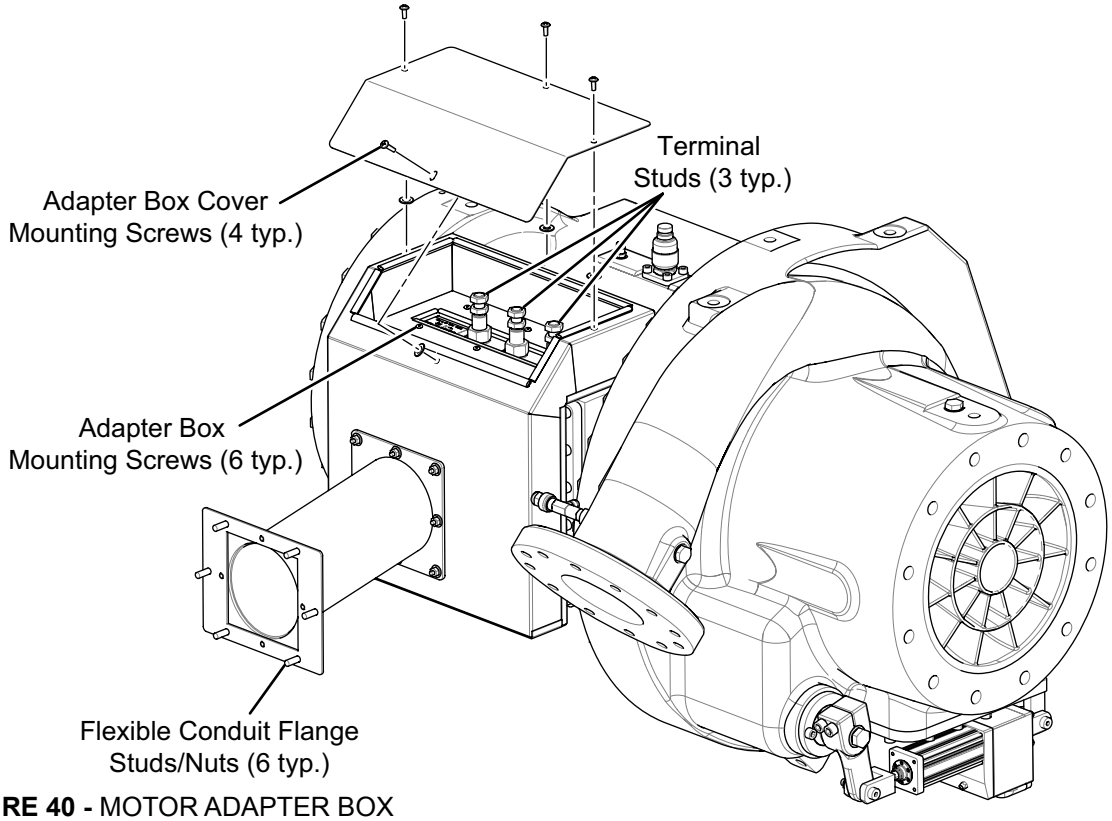


FIGURE 40 - MOTOR ADAPTER BOX LD17523

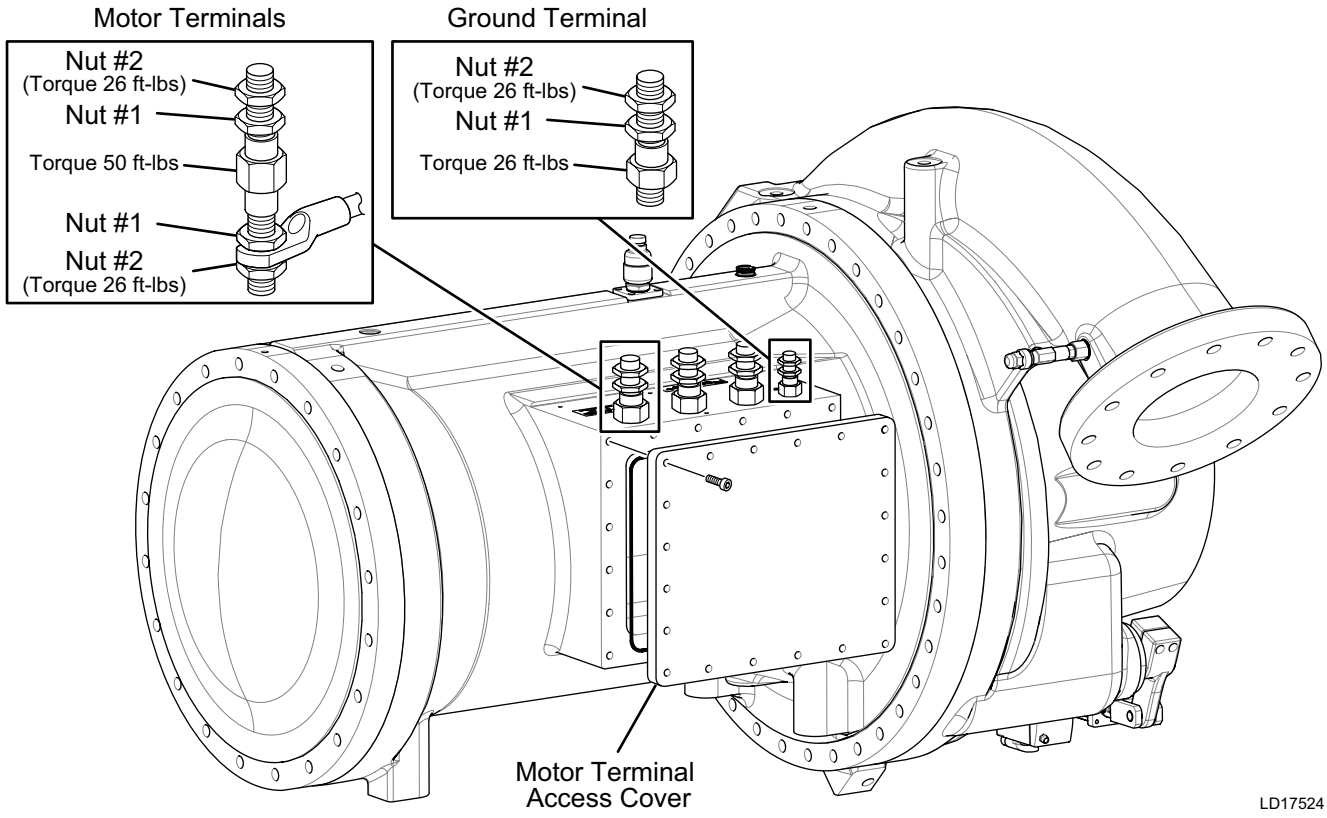


FIGURE 41 - MOTOR TERMINALS

14. When installing the power leads, make sure to maintain a minimum ¾" gap between lead connectors. This is a voltage spacing requirement and phase to phase shorting can occur if the spacing is not correct.
15. Install the internal power wiring to the feed-through studs. Ensure wires are landed to the proper studs. Place the terminal lugs between Nut 1 and Nut 2 and by holding Nut 1 stationary torque Nut 2 to 35 N-m (26 ft-lbs).
16. Install a new O-ring, lightly lubricated with POE grease or POE oil into the groove on the motor power cover plate.
17. Install the power cover plate to the housing with metric M12 x 1 socket head cap screws torqued in an alternating pattern to 140 N-m (103 ft-lbs).
18. Install the motor adapter box to the top of the motor with the six metric M6 x 1 Gr 8.8 hex cap screws and lock washers torqued to 3 N-m (2.2 ft-lbs).
19. Guide the six power wires and ground wire back through the adapter box toward the terminal studs and install the flexible conduit and its flange over the six 3/8x16 studs on the adapter box and secure with lock washers and nuts. Torque the flex conduit flange stud nuts to 30 N-m (22 ft-lbs).
20. Install the external wires to the motor power studs and ground stud
21. Install the motor lead pairs onto the appropriate lugs. The power leads are labeled as T1, T2, T3. They are connected as pairs to each of the corresponding power lugs. The wire pairs will be UT1 VT2, WT3. The casing is stamped to the left side of each lug to indicate which phase connects to each lug. The stamp marks will read UT1, VT2, WT3 and GND.
22. When installing the power leads, make sure to maintain a minimum ¾" gap between lead connectors. This is a voltage spacing requirement and phase to phase shorting can occur if the spacing is not correct. Install jam nut P/N 021-33159-000 on each of the power lugs.
23. Install the power wiring to the feed-through studs. Ensure wires are landed to the proper studs. Place the terminal lugs between two nuts by holding the inner nut stationary torque outer nut to 35 N-m (26 ft-lbs).
24. Install the motor power adapter box cover with four 1/4x20 pan head machine screws.

MOTOR COOLING ELECTRONIC EXPANSION VALVE (EEV) REPLACEMENT

The EEV is a part of the REFRIGERANT PRESSURE BOUNDARY. Refrigerant must be removed to change the device.

The motor cooling refrigerant Electronic Expansion Valve (EEV) is located on the top of the motor housing, threaded into a seat open to refrigerant cooling passageways. See *Figure 42 on page 52*.

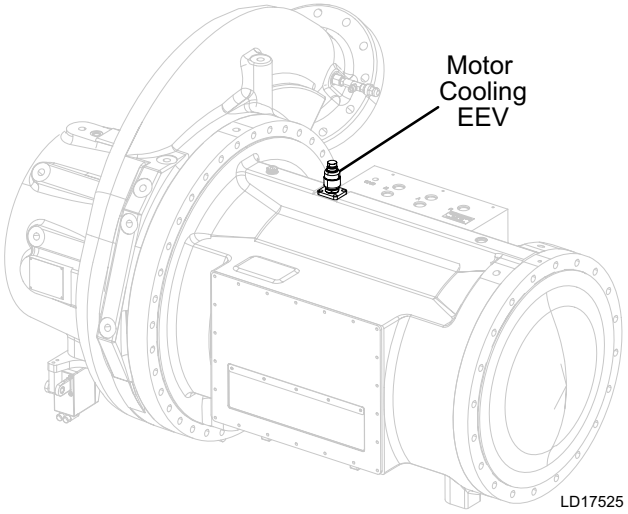


FIGURE 42 - MOTOR COOLING EEV

The valve assembly consists of a body installed in the motor housing, sealed with two O-rings and held in place with a bolted flange. To repair an actuator failure, only replace the actuator and gasket into existing body. See *Figure 43 on page 52*.

1. Remove the power wiring connection to the motor cooling valve motor terminal. This connector requires the detent be released and then the cover removed from the connection.
2. The actuator can be removed by leaving the flanged body in the motor housing and removing the motor by rotating the nut counterclockwise.
3. The sealing gasket is between the motor actuator housing and the body. Replace during reassembly.
4. If the body is required to be removed, remove the 4 cap screws securing its flange to the motor housing and lift out.

To replace the valve parts

1. Put new O-rings lightly lubricated with POE oil on the valve body and install into the motor housing. Torque the 4 metric M8 x 1.25 cap screws securing its flange to the motor housing to 40 N-m (30 ft-lbs).
2. Use a new sealing gasket between the motor actuator housing and the body. Screw the actuator into place and torque to 45 ft-lbs with the nut on the housing.
3. Reconnect the electrical connector and fasten its cover in place.

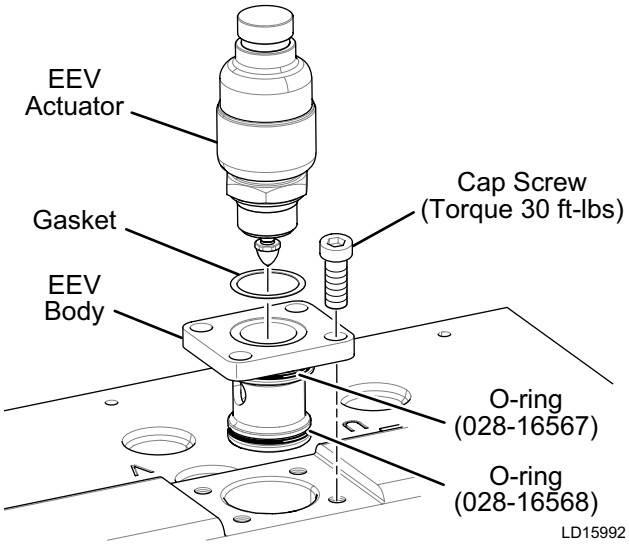


FIGURE 43 - EEV ASSEMBLY

VGD CONTROL SHAFT REMOVAL AND SEAL REPLACEMENT

The VGD Control Shaft is a part of the REFRIGERANT PRESSURE BOUNDARY. Refrigerant must be removed to change the device.

1. Remove the two wiring connectors to the VGD actuator by unscrewing the knurled connector at the actuator and pulling off the connector.
2. Remove the VGD actuator by removing the metric M10 x 1.5 nut and M12x45 bolt on the clevis connector at the shaft and housing ends of the actuator. Torque is 30 N-m (22 ft-lbs).
3. Mark the orientation of the external arm relative to the shaft cover plate for a starting point upon reassembly.
4. Remove the external arm by loosening the two M12 x 1 bolts clamping it to the shaft and sliding the arm off the end of the shaft.
5. Remove the VGD internal linkage access plate from the compressor casting.
6. Through the access opening, support the internal arm against the compressor housing to prevent motion while the VGD shaft bolt is removed by turning counterclockwise. It holds the internal arm onto a flat sided tapered shaft.

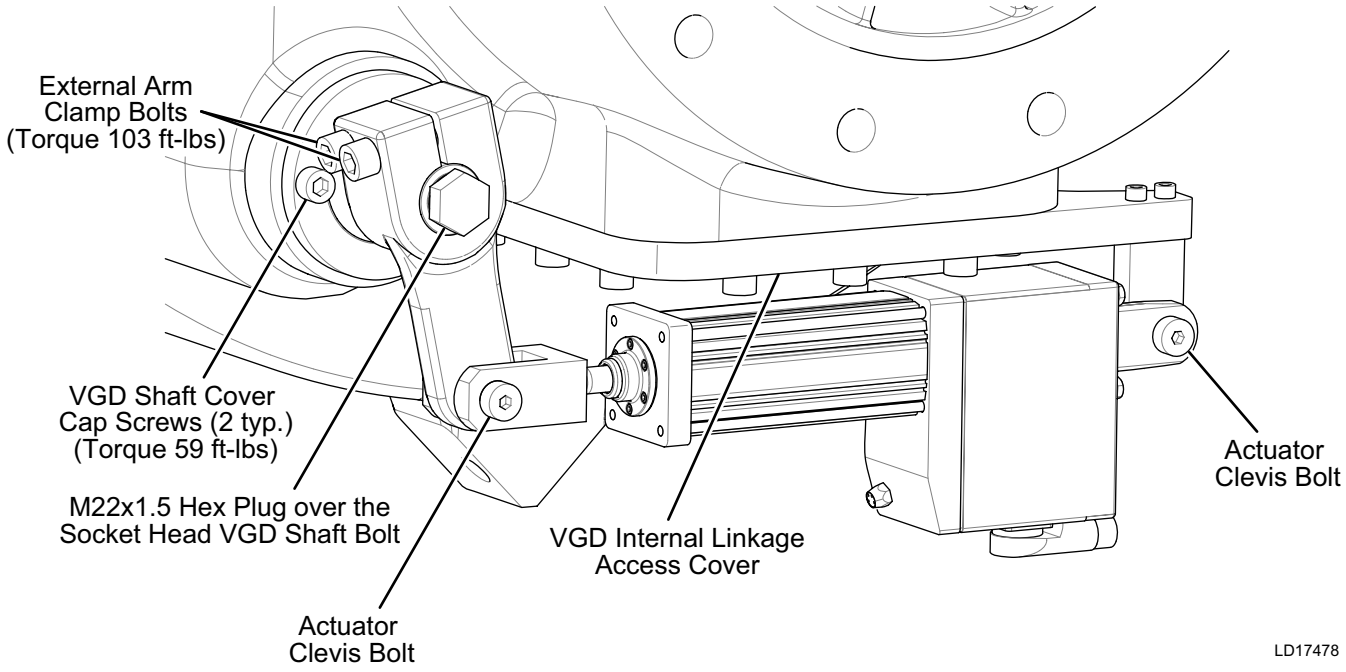


FIGURE 44 - VGD ACTUATOR ASSEMBLY

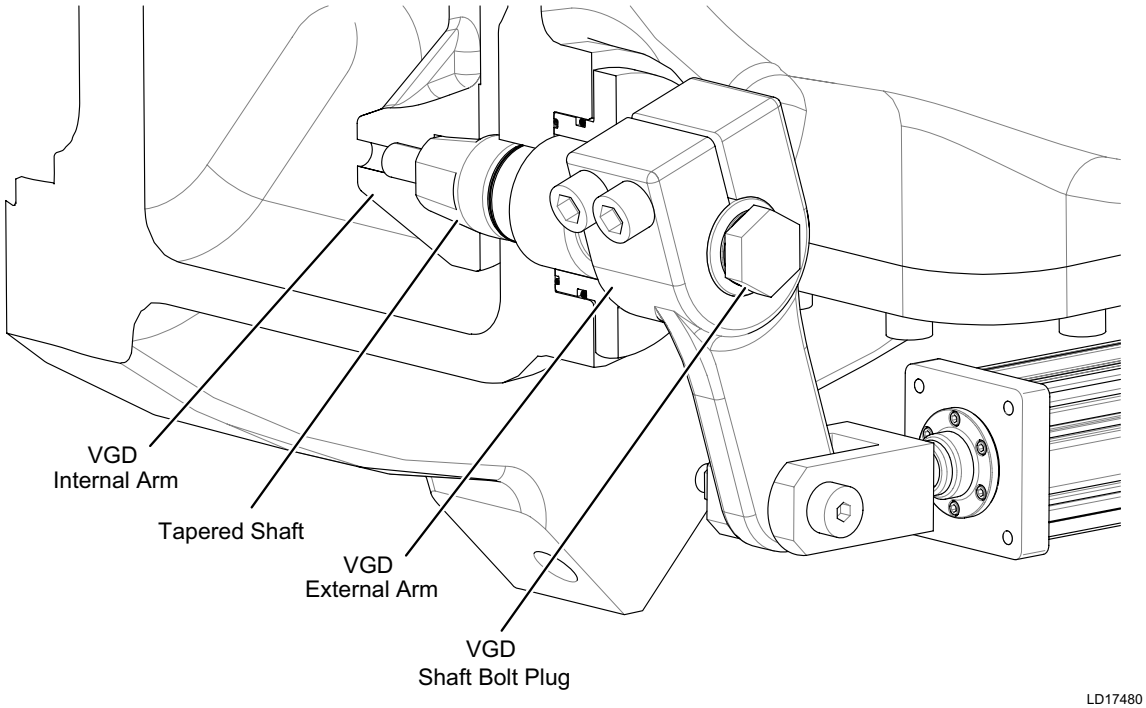


FIGURE 45 - VGD INTERNAL / EXTERNAL LINKAGE

7. Remove the M22x1.5 plug with O-ring from the end of the VGD shaft external to expose the socket head of the VGD Shaft bolt.

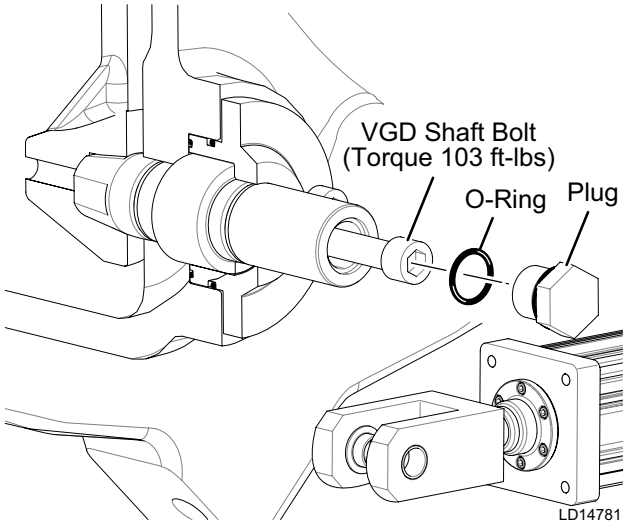


FIGURE 46 - VGD SHAFT BOLT

8. Turn the VGD Shaft bolt outside the compressor counterclockwise to remove. The bolt is seated with 140 N-m (103 ft-lbs) torque.
9. Remove the two metric M10x1.5 socket head cap screws from the VGD shaft cover.
10. Pull the shaft cover out the front of the compressor to remove. These parts seal with O-rings in their bores. Pull and rotate to overcome the O-rings resistance to remove.
11. Replace the shaft if any damage is visible to the O-ring grooves or any sealing surface.
12. Replace all of the O-rings, lightly lubricated with POE grease.
13. Apply a film of valve stem lubricant (YORK part 360-00125-000), in the areas shown in *Figure 47 on page 54.*

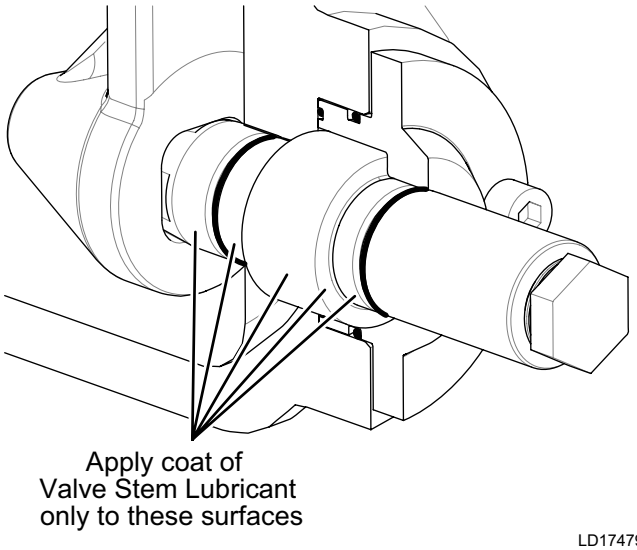


FIGURE 47 - VGD SHAFT LUBRICATION

14. Insert the shaft with lubrication and O-rings with POE grease into the shaft bore.
15. Install the shaft cover with its O-rings and the two metric M10x1.5 socket head cap screws torqued to 80 N-m (59 ft-lbs).
16. Through the access cover, install the internal arm onto the flat-sided tapered shaft with flats matching internal flats in the arm and arm oriented so it can swing fully through the travel of the VGD drive ring.
17. With the internal arm supported, install the VGD shaft bolt from outside the compressor through the shaft to the internal arm and torque to 140 N-m (103 ft-lbs).
18. Install a new O-ring lightly lubricated with POE grease or POE oil onto the shaft bolt hex plug and install the M22x1.5 plug with 127 N-m (94 ft-lbs) torque.
19. Install a new O-ring lightly lubricated with POE grease into the VGD internal linkage access cover groove and install the cover to the compressor housing using 12 metric M10 x1.5 bolts torqued in a crossing pattern to 80 N-m (59 ft-lbs).

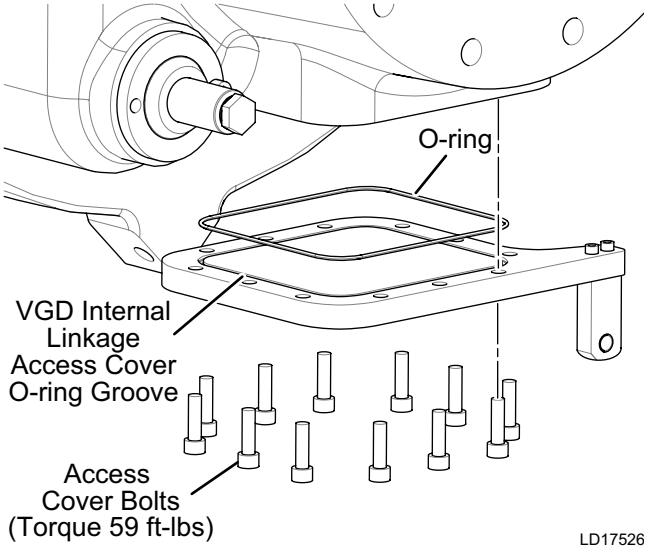


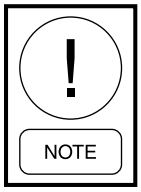
FIGURE 48 - VGD INTERNAL ACCESS COVER

20. Proceed to the VGD to Actuator setup section following to complete installation with proper adjustment.

VGD TO ACTUATOR SETUP

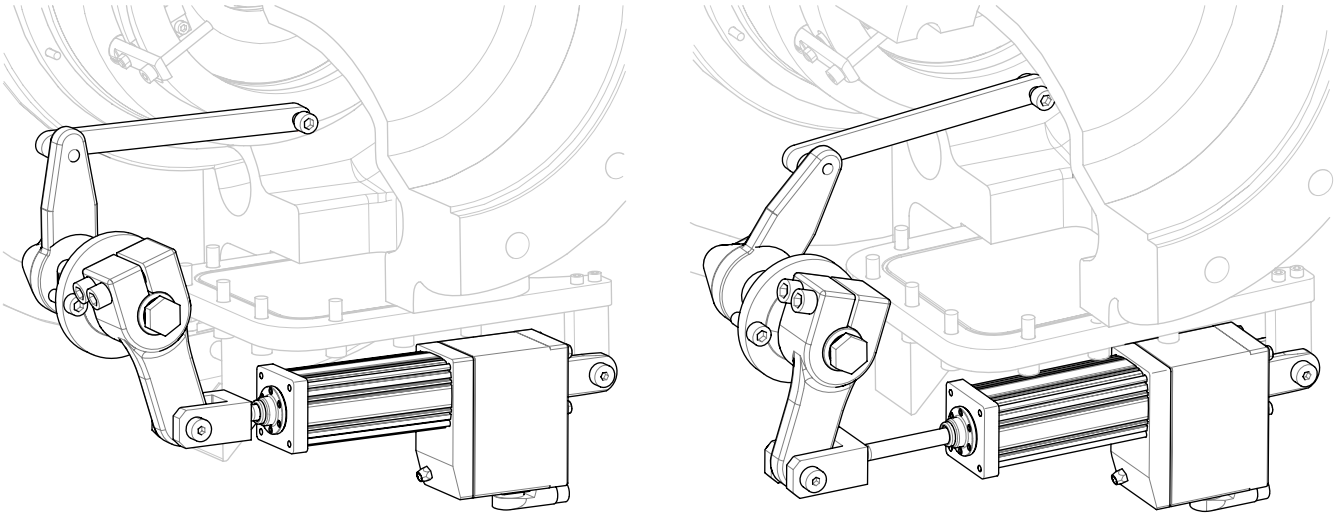
Perform this procedure any time any part is removed or replaced that could affect the location of the actuator stroke relative to the motion of the VGD internal mechanism, such as actuator replacement, VGD shaft or VGD repairs. Follow the mechanical task with VGD calibration from the Control Panel according to *Service - OptiView Control Panel and Unit Controls (Form 160.84-M2)*.

1. Install the VGD external arm over the VGD shaft so it points left (9 O'clock) position looking toward the shaft end, and snug its clamp bolts so it can slip on the shaft with a little drag.
2. Ensure the housing end of the actuator is connected into the stationary mount with the metric M10 x 1.5 nut and M12x45 bolt on the clevis connector at the shaft and housing ends of the actuator. Loctite primer (Grade N) and Loctite removable thread sealer (Loctite 243) should be used on the bolt to nut joint. Torque is 30 N-m (22 ft-lbs).
3. If replacing the actuator, remove the forward clevis and M10x1.5 jam nut from the old one to install to the new one. Install the Jam nut over the threads of the actuator shaft. Loctite primer (Grade N) and Loctite removable thread sealer (Loctite 243) should be used on the threads. Turn the threaded clevis onto the shaft. Snug the jam nut to the rear of the clevis to 30 N-m (22 ft-lbs).



The actuator shaft will screw into or out of the actuator between its fully withdrawn (clockwise) and fully extended (counter-clockwise) extents. At the extent, it spins but no longer moves linearly. This will be used to set the starting stroke point in the next steps.

4. With the actuator mounted at the housing end and forward clevis installed, rotate the actuator shaft fully clockwise until the actuator shaft travel stops moving in towards the actuator.



VGD CLOSED POSITION **VGD OPEN POSITION**

FIGURE 49 - VGD CLOSED (EXTENDED) / OPEN (RETRACTED) POSITION

5. Back the actuator shaft out counter clockwise 1 full turn (no more, no less).
6. Starting at the 9 O'clock position, rotate the VGD external arm counterclockwise until the VGD mechanism stops moving internally (fully extended position).
7. Continue to rotate the VGD external arm lever, slipping on the VGD shaft, until the hole in arm lines up with the hole in actuator clevis as it was set above. Do not go counterclockwise beyond the hole, or it is required to loosen the arm clamp bolt and start again at the 9 O'clock position.
8. Install the shoulder bolt through the forward clevis and VGD arm, do not install nut.
9. Torque external arm clamp bolts fully to 140 N-m (103 ft-lbs) to secure the VGD arm to the VGD shaft in this position.
10. Remove the forward clevis shoulder bolt and manually operate the VGD arm. Verify that the VGD arm hole and clevis hole align when the lever is rotated counterclockwise until the VGD stops internally. If the holes do not align within ¼ inch, repeat all of the adjustment procedure steps above.
11. Install the M12x45 shoulder bolt through the forward clevis and VGD arm and torque the metric M10 x 1.5 nut. Loctite primer (Grade N) and Loctite removable thread sealer (Loctite 243) should be used on the bolt to nut joint. Torque is 30 N-m (22 ft-lbs).
12. Re-connect the power wire connectors; Black is communications from Optiview panel. Orange is power from the Power Panel.
13. When the chiller is first powered with the compressor in place, perform a VGD calibration from the Control Panel according to *Service - OptiView Control Panel and Unit Controls (Form 160.84-M2)*.

REMOVAL OF THE DRIVELINE

Refer to the instructions for rigging the compressor or motor previously in this section for all lifts.

1. Remove refrigerant from the chiller according to charge handling procedures in the *Operation and Maintenance Manual (Form 160.84.O1)*.
2. Disconnect all six of the control wiring connectors on the outboard side of the motor from the motor wiring connector plate. Wires are labeled and can be followed *Field Control, Wiring and MBC Modifications Manual (Form 160.84-PW2)*.
3. Disconnect the EEV wiring from the EEV on top of the motor by releasing the detent and removing the cover at the connector on top of the valve. Then pull apart the connector.
4. Disconnect the power and ground wires to the motor using the appropriate steps defined in the POWER FEED-THROUGH TERMINAL REPLACEMENT section of this manual. If the power wire terminal box is not expected to affect the work planned when the driveline is removed, alternately it can be left on the motor and the power wires disconnected inside the VSD at the terminal studs. Installation torque there is 24 to 27 N-m (18 to 20 ft-lbs). The flex conduit can be removed from the VSD at the flange on the studs on the back of the VSD or the motor box flange. A debris gasket exists at either flange of the flex conduit.
5. Remove the two wiring connectors to the VGD actuator by unscrewing the knurled connector at the actuator and pulling off the connector.
6. Remove the VGD actuator by removing the metric M10 x 1.5 nut and M12x45 bolt on the clevis connector at the shaft and housing ends of the actuator. Torque is 30 N-m (22 ft-lbs).

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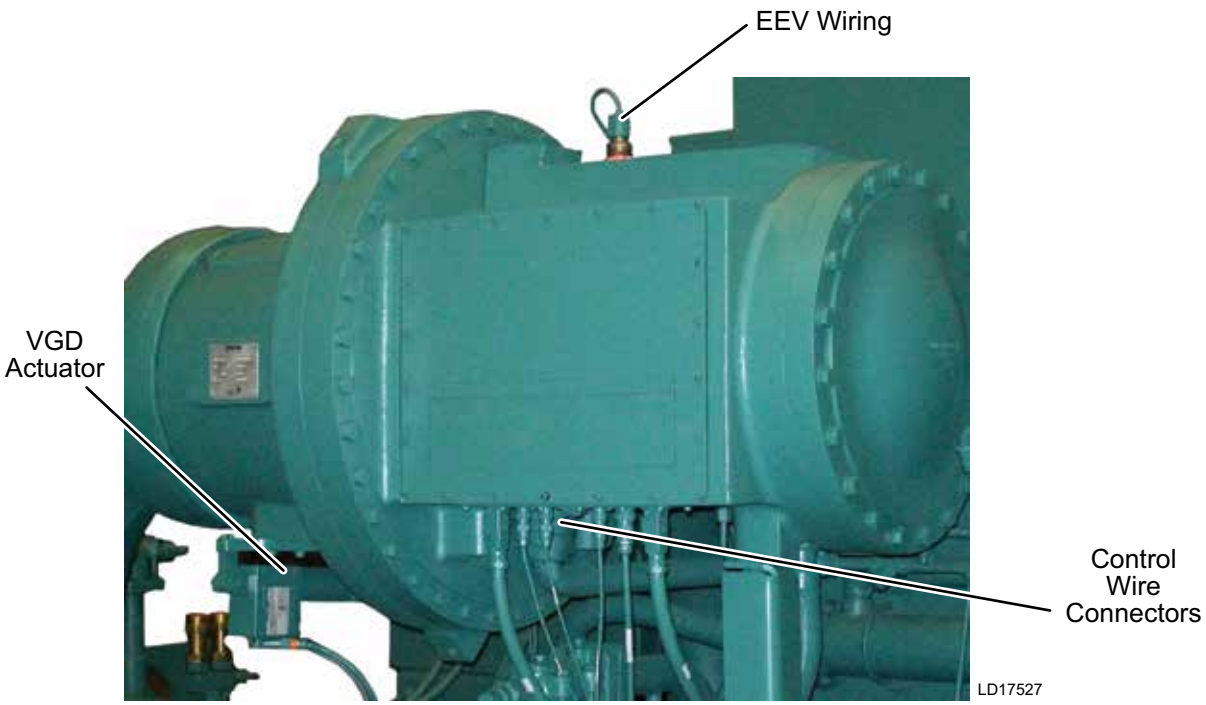

FIGURE 50 - DRIVELINE WIRING DISCONNECTS

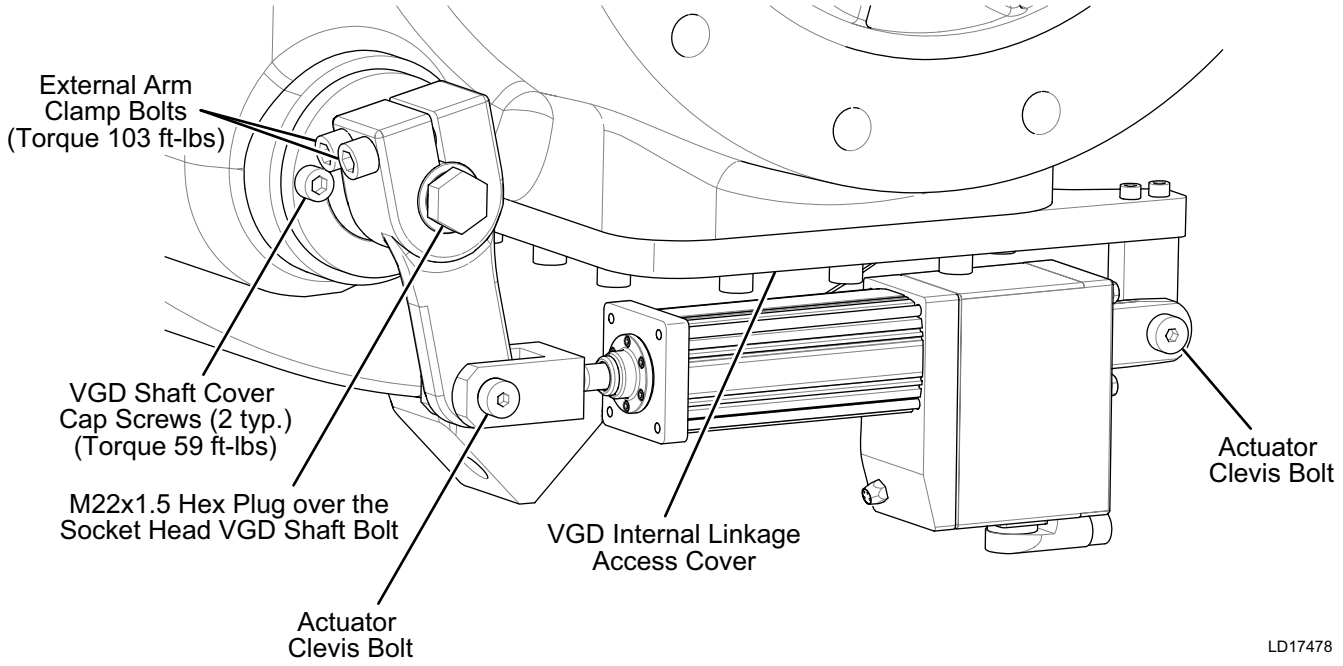

FIGURE 51 - VGD ACTUATOR

7. Disconnect the following refrigerant lines to the motor. Reference the refrigerant service section of this manual for piping O-ring and O-ring face seal joints (Refer to *Figure 52 on page 59*).
    - Liquid refrigerant cooling supply: M16x1.5 at motor, 9/16x18 UNF at liquid line.
    - Liquid refrigerant cooling drain: M16x1.5 at motor, 9/16x18 UNF at evaporator.
    - Vapor refrigerant cooling return: M48x2 at Motor end, 1-1/2 TUBE X 2-12 UNF-2B at evaporator end.
    - Cap all removed lines and fittings to maintain cleanliness of lines and parts during maintenance.
8. Connect rigging in accordance with the rigging section previously in this manual and draw up slack in the lifting chains.
9. Carefully remove the metric M20 x 2.5 Hex cap screw from the underside of the motor bracket at the motor. Torque is 130 N-m (96 ft-lbs).
10. Carefully remove the bolts in the compressor discharge flange and suction flange.
11. Remove the driveline from the chiller.
12. To reinstall, work in reverse order of the steps above. Use a new gasket at the suction flange, new O-ring lightly lubricated with POE grease or POE oil on the discharge flange, and tubing fittings.
    - Suction Flange Bolts: M24x3 x 90 mm. Torque 230 N-m (170 ft-lbs).
    - Discharge Flange Bolts: M20x2.5 x 60 mm. Torque 130 N-m (96 ft-lbs).
    - Refrigerant tubing: Refer to the Chiller System Service section of this manual for methods.
13. Perform the procedure outlined in the VGD to Actuator setup section of this manual.

Refer to *Table 5 on Page 16* for the torque values.

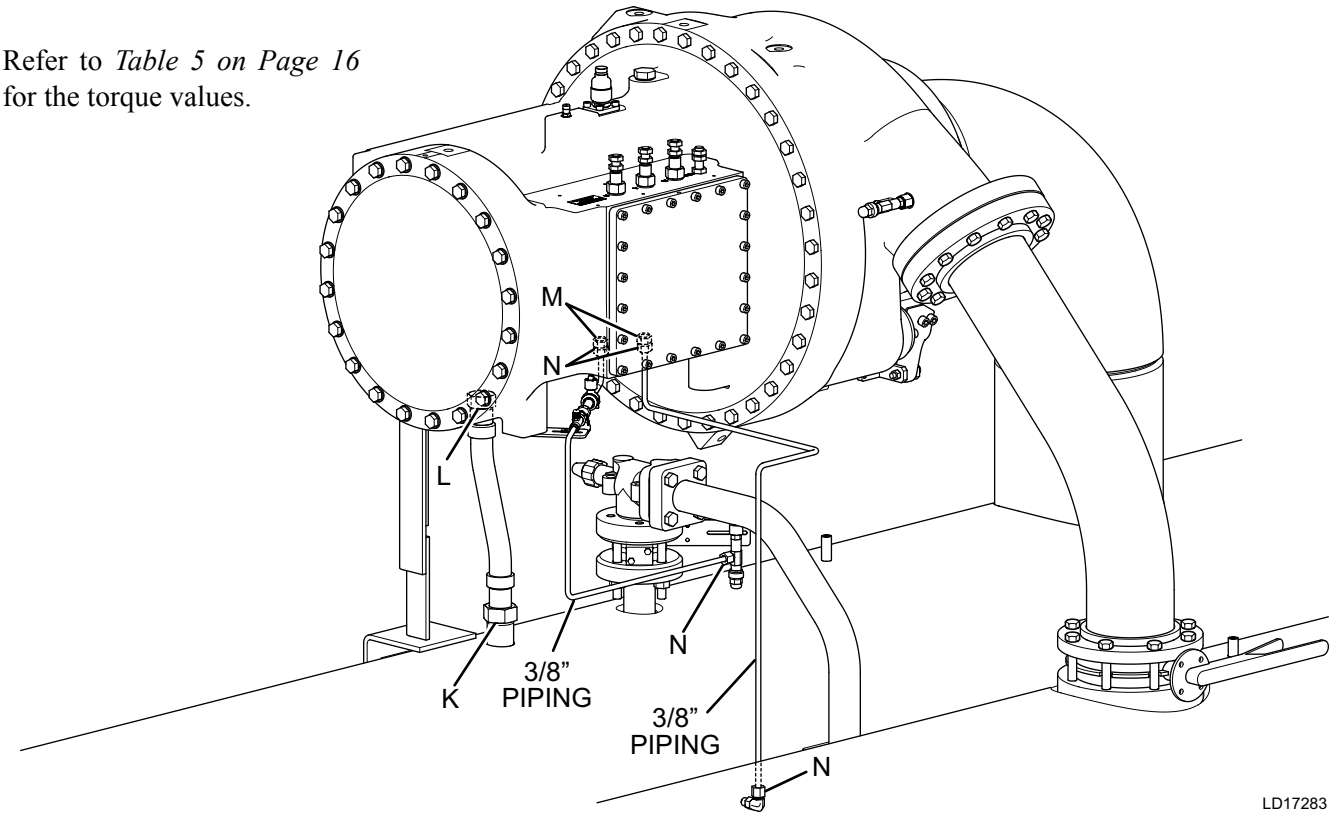

FIGURE 52 - COMPRESSOR PIPING

INLET GUIDE VANE INSERT REPLACEMENT

On some split shipment chiller forms, the compressor suction line is flanged at the compressor and the evaporator. On those units, remove the suction elbow to access the inlet guide vane insert.

On other units, the compressor suction line is welded to the evaporator and flanged only at the compressor. On those units, the driveline must be removed to access the inlet guide vane insert.

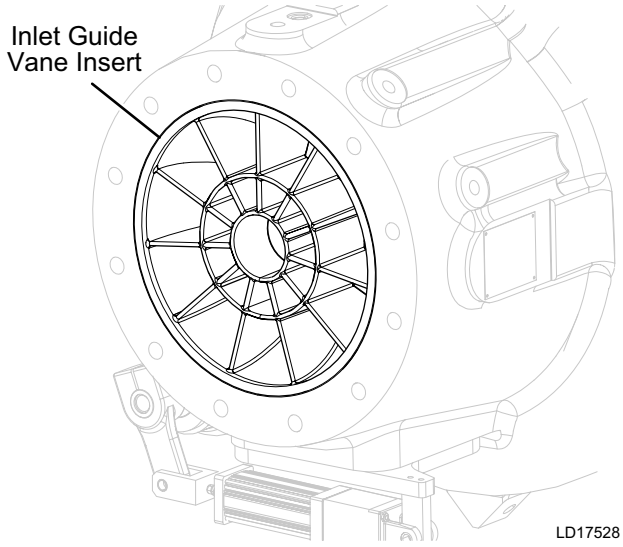

FIGURE 53 - GUIDE VANE

To remove the guide vane insert piece, grasp firmly and pull out of the nose of the compressor.

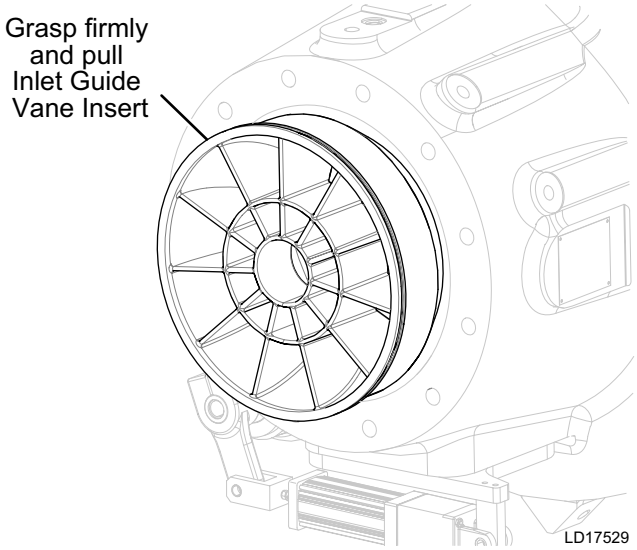

FIGURE 54 - GUIDE VANE REMOVAL

Before re-installing, install a new O-ring lightly lubricated with POE grease into the groove on the outside circumference of the guide vane insert.

FIGURE 55 - GUIDE VANE O-RING

Insert the guide vane into place as shown below. There is no orientation required for the guide vanes during this step. When the guide vane is in place seat the guide vane using a rubber mallet or the heel of your hand. When seated the face of the guide vanes will be flush with the scroll housing.

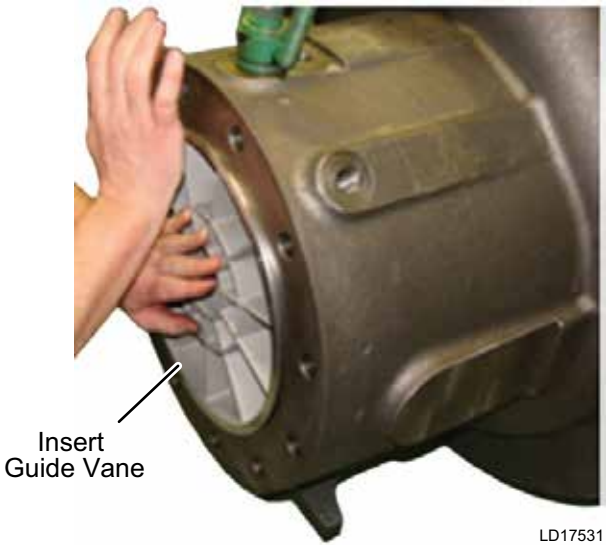

FIGURE 56 - GUIDE VANE INSTALLATION

REMOVAL OF COMPRESSOR FROM MOTOR

1. Remove the driveline according to the previous section.
2. With the motor supported by its feet and compressor flange, connect appropriate rigging to the compressor in accordance with the rigging section previously in this manual and draw up slack in the lifting chains.
3. Remove the M16 x 2 Hex cap screws from the motor flange to compressor (scroll) assembly at the 3 O'clock and 9 O'clock positions and install guide studs so the scroll can be moved away horizontally without damaging the impeller seals.
4. Loosen and remove the remaining M16 x 2 Hex cap screws from the motor to scroll flange in a crisscross pattern, adjusting rigging as necessary as the compressor becomes free from the motor to keep it elevated and motor mating flange parallel with motor.

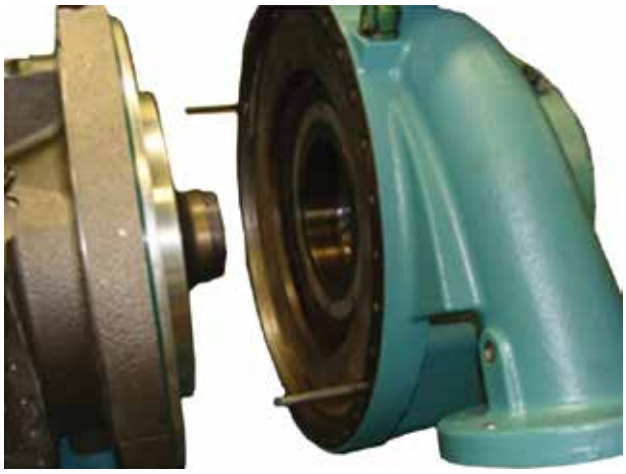

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FIGURE 57 - COMPRESSOR MOTOR REMOVAL

5. Move the compressor (scroll) away from the motor and set on cribbing for working. Most work within the compressor can be performed with the compressor suction flange downward and parallel to the floor.

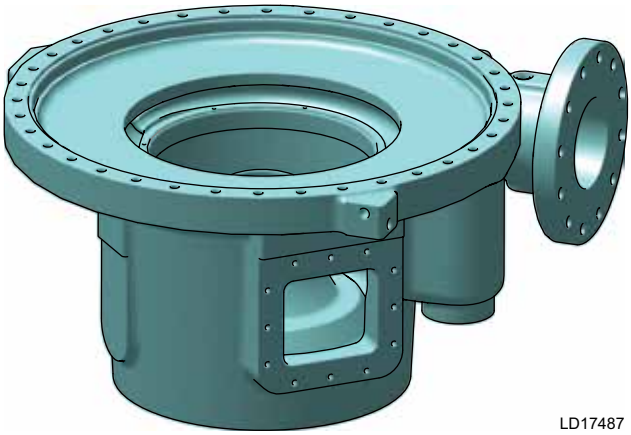

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FIGURE 58 - COMPRESSOR SCROLL

RE-ASSEMBLY OF COMPRESSOR TO MOTOR

1. Install a new O-ring lightly greased with POE grease onto the motor flange of the compressor scroll casting.
2. Install 2 guide pins M 16 x 2 into the scroll assembly at the 3 and 9 position. These guide studs must be used to prevent damage to the eye seal during this process.
3. Coat the outside of the suction eye of the impeller with a POE oil/molykote (graphite powder) mix.
4. Rig the scroll assembly for mounting using a three chain method. It is preferred that the chain on the suction side of the scroll utilize a winching device capable of adjusting the attitude of the scroll as it joins the motor housing.
5. Make sure during the rigging arrangement that the scroll discharge line orientation is 45 Degree relative to the motor feet.
6. As the scroll is moved into place caution must be used to insure that the O-ring stays in the proper location and is not compromised.
7. Carefully move the scroll into place onto the motor housing. During this process check the rigging and adjust it as necessary to keep the scroll seating flange parallel to the motor flange to prevent damage to the eye seal as two components are joined.

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FIGURE 59 - COMPRESSOR MOTOR RE-ASSEMBLY

8. With the scroll in place install 36 metric M16 x 2 bolts, lightly lubricated with POE oil through the motor flange into the compressor casting threaded holes. Torque to 330 N-m (243 ft-lbs) using a 4 way crossing pattern.

IMPELLER EYE SEAL REPLACEMENT

1. Remove the compressor from the motor and support it with eye seal bore facing upward, according to the previous section.

FIGURE 60 - EYE SEAL REMOVAL

2. Remove the three metric 8 x 20 socket head shoulder screws from the eye seal retainer.
3. The eye seal can then be lifted out in three parts.

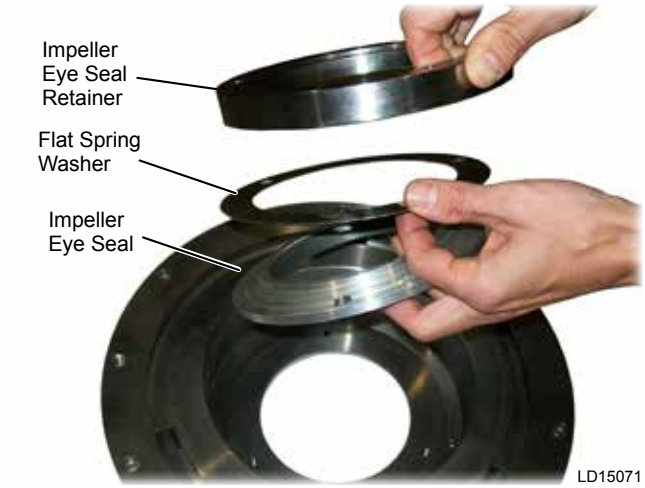


FIGURE 61 - EYE SEAL

Re-installation

1. On a clean working surface prepare the suction eye for installation into the scroll assembly.
2. Insert the spring washer into the seal retainer. During this step take care to align the bolt holes.

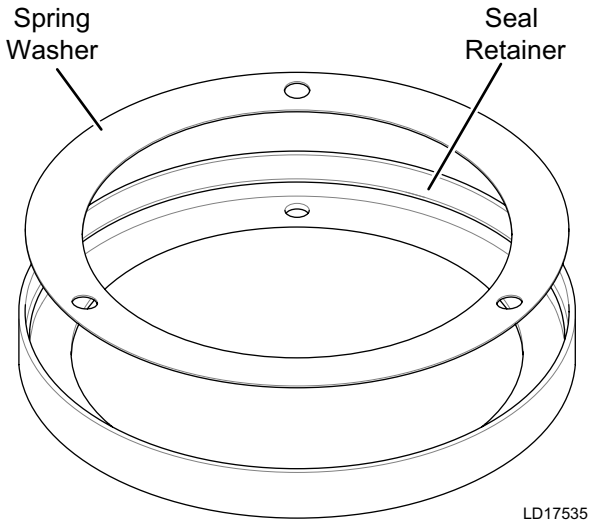


FIGURE 62 - SPRING WASHER SEAL RETAINER

3. Insert the eye seal into the seal retainer with the flange/raised lip portion leading into the retainer as shown. During this step take care to align the bolt holes.

FIGURE 63 - EYE SEAL ASSEMBLED

4. Coat the raised face on the eye seal with a POE oil/molykote (graphite powder) mix.


LD17537

FIGURE 64 - EYE SEAL LUBRICATION

5. Carefully invert the eye seal assembly and insert into the scroll assembly as shown.


LD17538

FIGURE 65 - EYE SEAL INSTALLATION

6. Use Loctite primer (Grade N) and Loctite removable thread sealer (Loctite 243) item on the 3 metric 8 x 20 socket head shoulder screws, install through the holes in the retainer, spring and seal and torque to 17 N-m (12 ft-lbs).


LD17539

FIGURE 66 - EYE SEAL TORQUE

5

VGD REPLACEMENT

If the VGD requires replacement, it is only available as a replacement assembly including the nozzle base plate, VGD rings and all connected hardware.

1. Remove the compressor from the motor and support it with nozzle plate facing upward, according to the Compressor removal section, previously.
2. Remove the Impeller eye seal according to the previous section. It is attached to the nozzle base plate, which is part of the VGD assembly.
3. Remove the VGD internal linkage access plate from the compressor casting.
4. Through the access opening, support the internal arm against the compressor housing to prevent motion while the internal link attachment bolt is removed by turning counterclockwise.
5. Remove the internal link attachment bolt(s) from the VGD drive ring and the VGD internal arm as necessary.
6. Remove the six M6 x 1 socket head cap screws that secure the VGD nozzle plate into the compressor scroll.
7. Insert M6 x 1 guide studs into every other hole (3 locations) to ensure the VGD nozzle plate is extracted from the scroll uniformly.

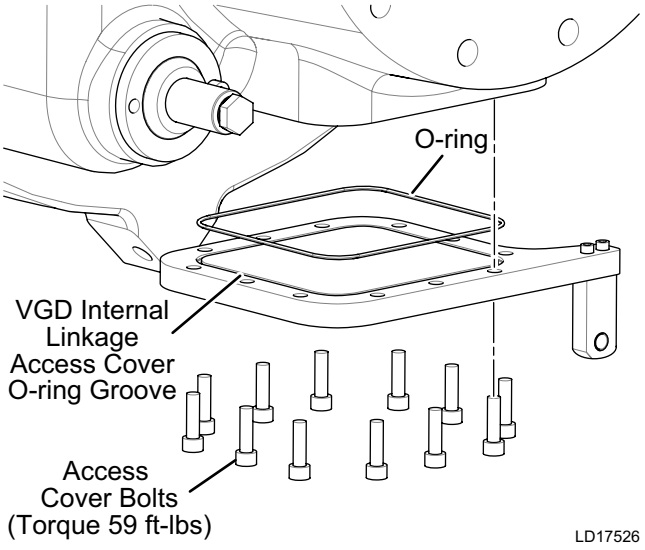


FIGURE 67 - VGD INTERNAL LINKAGE ACCESS COVER

8. Screw in three M10 x 1.5 hoist rings in the three symmetric rigging holes spaced among the bolt holes. The weights are listed in the compressor rigging section of this manual.
9. Lift the VGD assembly from the scroll.
10. To return to service, lift the VGD assembly into place on the scroll assembly, over the guide studs. Note that the VGD assembly is oriented by the bolt pattern and can only be installed in the intended orientation.
11. Remove guide studs and hoist rings and install 6 metric M6 x1 socket head cap screws lightly lubricated with POE oil and torque to 80 N-m (59 ft-lbs).

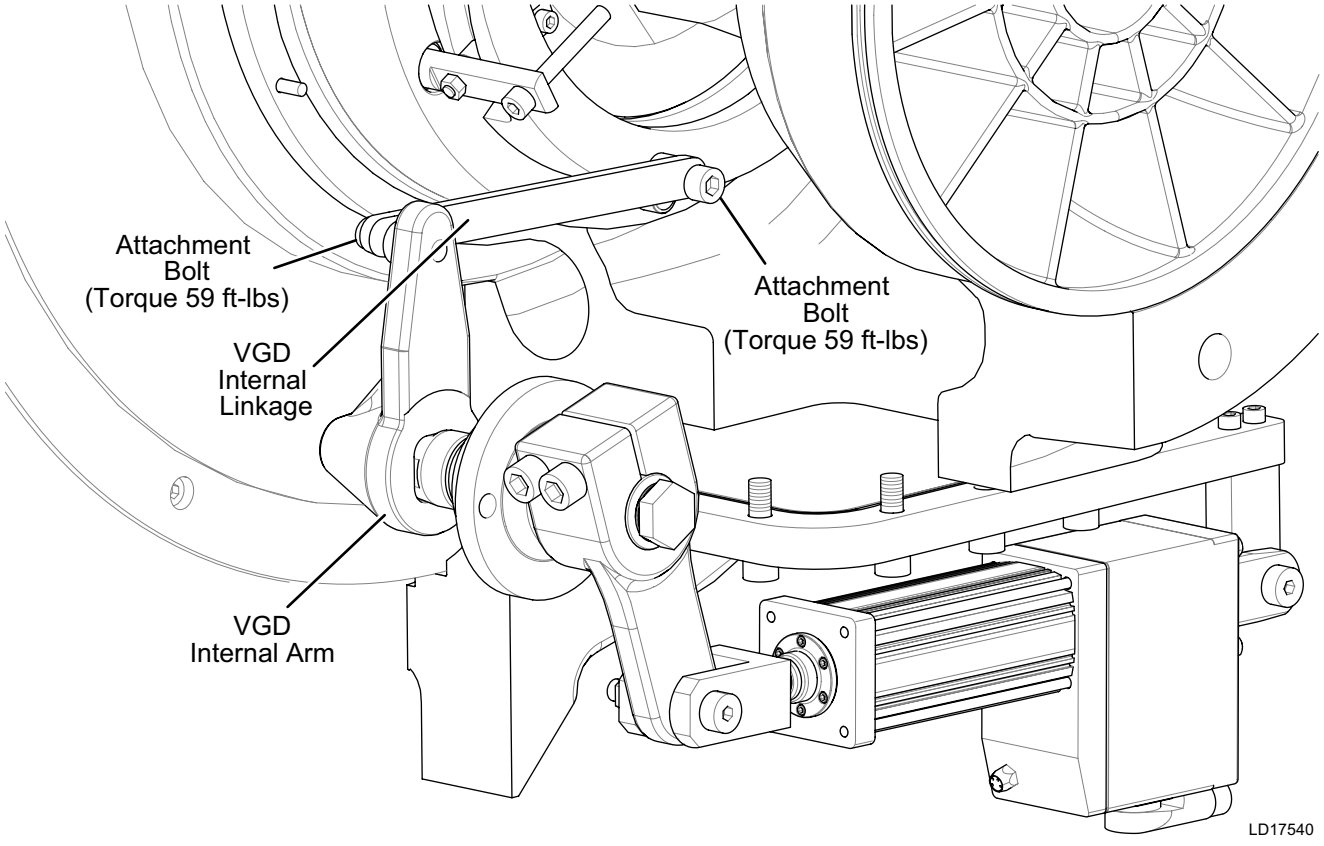


FIGURE 68 - VGD INTERNAL LINKAGE

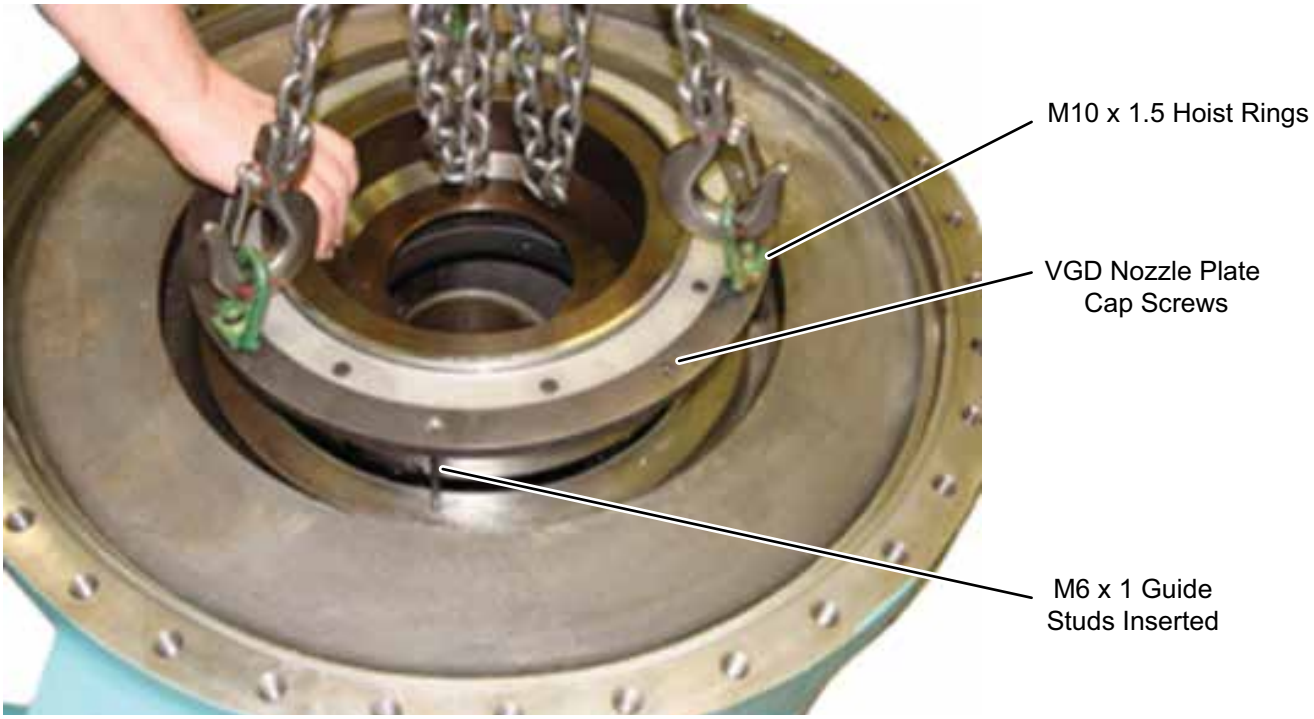


FIGURE 69 - VGD SCROLL REASSEMBLY

12. Through the access opening, support the internal VGD control arm against the compressor housing to prevent motion while the internal link attachment bolt is connected by turning clockwise.
13. Install the internal link attachment bolt(s) from the VGD drive ring and the VGD internal arm. Refer to *Figure 68 on page 64*. Use Loctite primer (Grade N) and Loctite removable thread sealer (Loctite 243) item on the M10 x 1.5 bolts and torque to 80 N-m (59 ft-lbs).
14. Install a new O-ring lightly lubricated with POE grease into the VGD internal linkage access cover groove and install the cover to the compressor housing using 12 metric M10 x1.5 bolts torqued in a crossing pattern to 80 N-m (59 ft-lbs).
15. Install the Impeller eye seal according to the appropriate reassembly steps in the Impeller Eye Seal section previously.

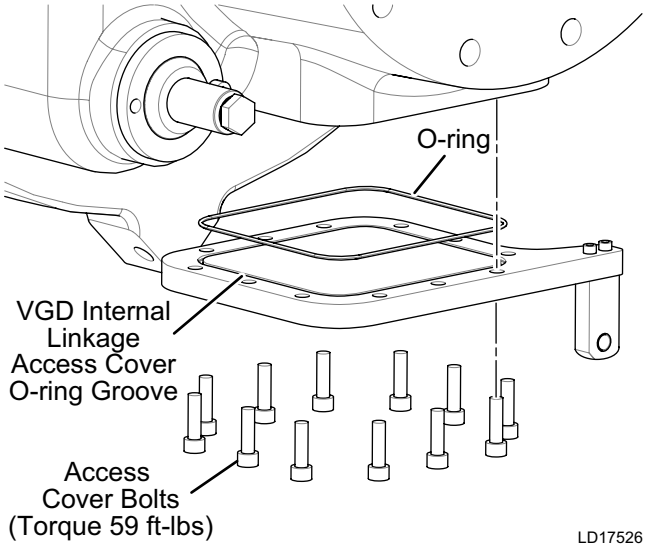


FIGURE 70 - VGD INTERNAL LINKAGE ACCESS COVER

IMPELLER REPLACEMENT

The compressor must be removed from the motor according to the compressor removal section previously. The impeller stud and nut can be re-used during installation. The nut must be removed by stretching the stud and should not be removed with a standard wrench and torque. The Impeller and Balance Piston are delivered as an assembly, with the Balance Piston installed and the assembly factory-balanced.

1. Assemble the hydraulic stud tensioner part number 364-53746-000 onto the impeller stud end and against the impeller end. This is a special tool listed in the special tools section of this manual. This part number is critical to ensure the piston diameter applies the proper force to the stud at the pressure stated below.
2. Connect a hydraulic hand pump to the stud tensioner. If a pump is not available locally, a hand pump with gage are available as chiller service parts, listed in the special tools section of this manual.
3. Apply 4000 psig to the device within +/- 100 psi to stretch the stud.
4. Using the rotation wrench (029-18461-000), rotate the nut driver counterclockwise 1 full turn to
5. Back the nut from the impeller face with the stud stretched at 4000 psi. The force necessary to turn
6. The nut is very light. Holding the impeller circumference by hand should be sufficient to prevent the shaft from turning.
7. Remove the rotation wrench.
8. Release pressure on the tensioner and then remove the tensioner assembly.
9. Remove the impeller by lifting and moving it away from the keyed shaft.
10. Remove the impeller stud counterclockwise from the threaded hole in the shaft end. The stud should turn easily.

Re-installation

1. Ensure both of the impeller keys are installed on the shaft and the Ball Bearing thrust ring is installed over the keys and back against the shaft shoulder close to the shaft bearing. The keys may be very snug and some emory cloth work may need to take place on the keys only for proper fit. Be certain all parts are wiped perfectly clean at time of fitup.
2. Note: The thrust rings are sized specifically for each shaft end with the I.D. of the thrust ring at .001” larger than the O.D. of the shaft. The Z1 end thrust ring is slightly larger than the Z2 end thrust ring. Be certain the proper ring is being used. When sliding the thrust ring into place, be certain that the ring is seated to the shaft should near the bearing inner race. Because of the tight tolerance it is important to make sure the thrust ring is perpendicular to the shaft or it may lodge during installation. If the ring will not slide over the keys, the keys may need more fitment work. Do not force the ring into place since the impeller will need to slide over the same location. All components must slide into place with minimal force.

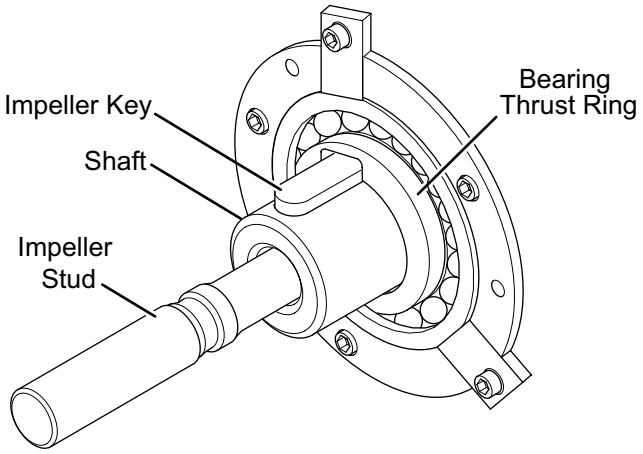
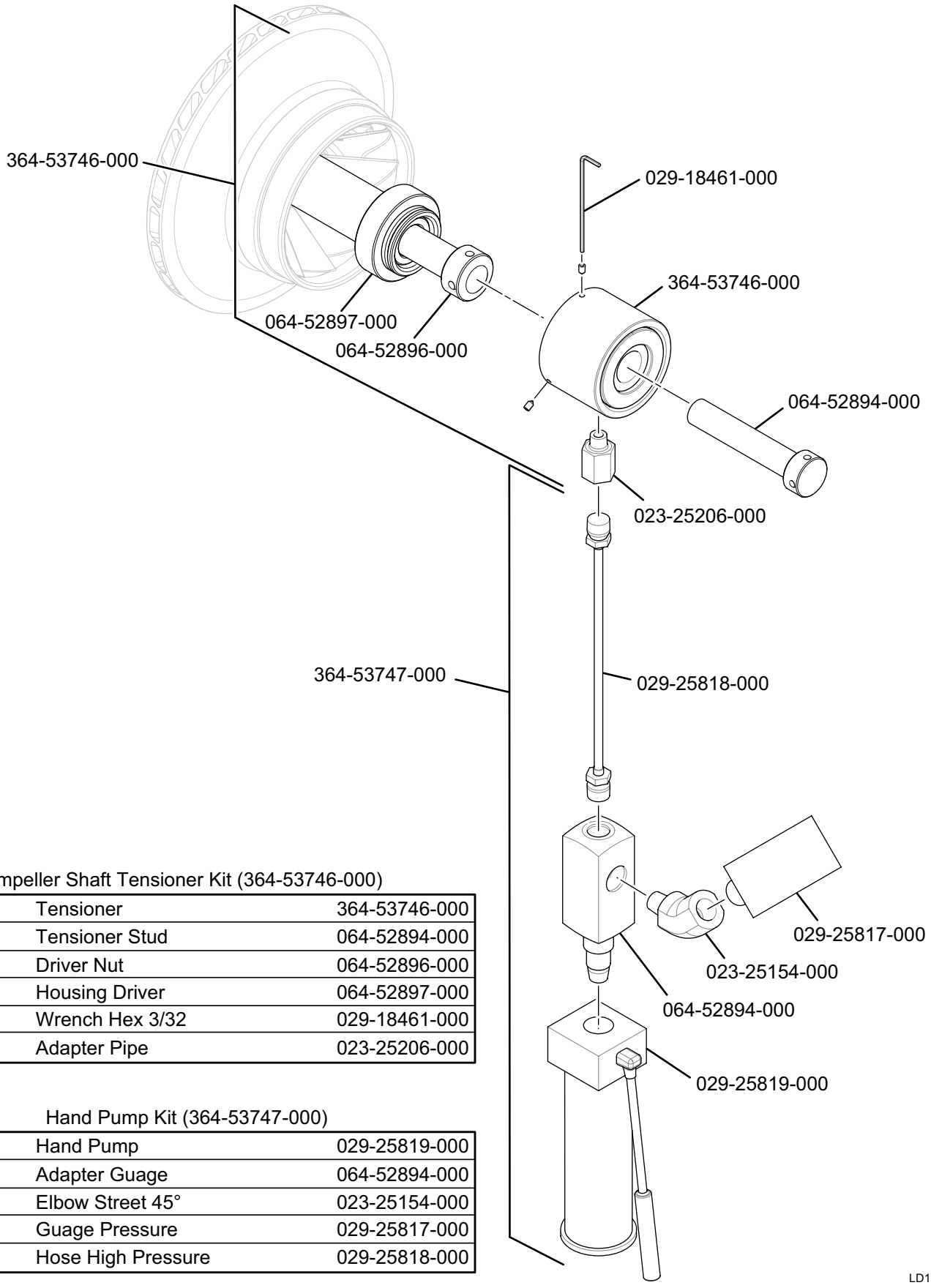


FIGURE 71 - SHAFT KEY AND THRUST RING



Impeller Shaft Tensioner Kit (364-53746-000)

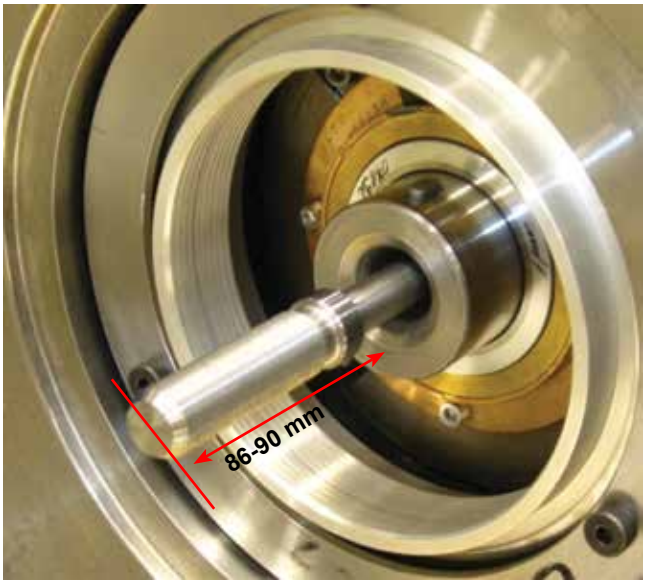
1	Tensioner	364-53746-000
2	Tensioner Stud	064-52894-000
3	Driver Nut	064-52896-000
4	Housing Driver	064-52897-000
5	Wrench Hex 3/32	029-18461-000
6	Adapter Pipe	023-25206-000

Hand Pump Kit (364-53747-000)

1	Hand Pump	029-25819-000
2	Adapter Guage	064-52894-000
3	Elbow Street 45°	023-25154-000
4	Guage Pressure	029-25817-000
5	Hose High Pressure	029-25818-000

FIGURE 72 - IMPELLER SHAFT TENSIONER KIT

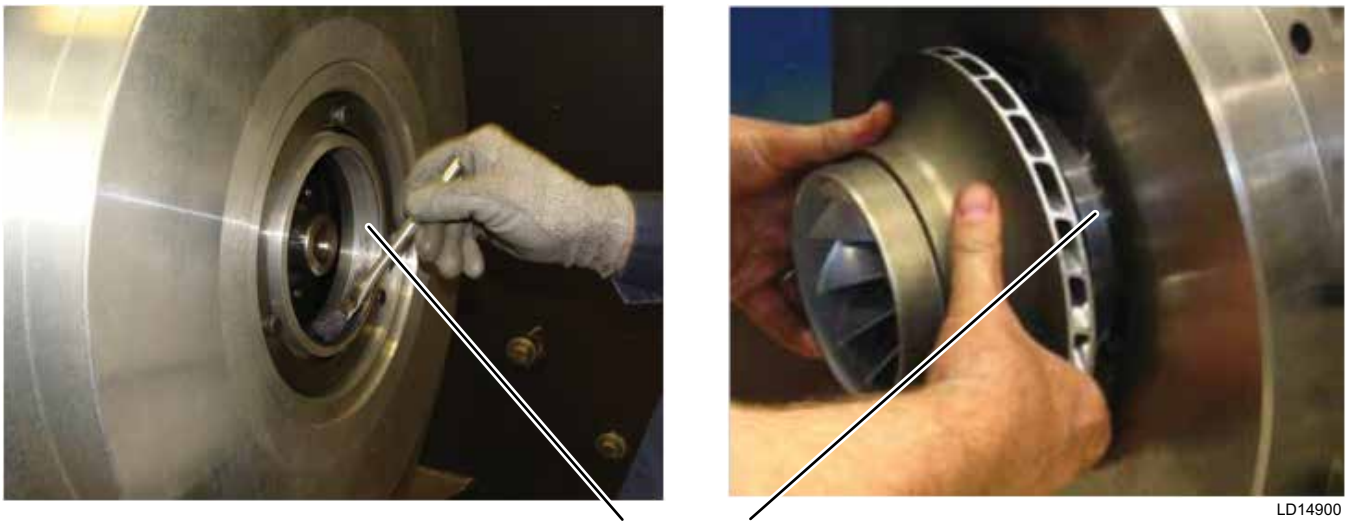
3. Install the impeller stud into the shaft, threading by hand until it bottoms out and then back out approximately 1 turn. This should leave the stud protruding 86 to 90 millimeters (3.39” to 3.54”) from the end of the shaft. If the stud can not be turned to result in 86 to 90 mm beyond the end of the shaft, check the stud and the hole for thread damage.



LD14899

FIGURE 73 - IMPELLER STUD

4. Prepare the balance piston seal face for impeller installation by applying a coat of 011-00253-000 Molybdenum lubricant mixed with a small amount of POE oil to the balance piston and seal surface.
5. Install the impeller over the shaft aligned to accept the shaft keys. When installing the impeller, use care to not damage the balance piston seal face or the balance piston face of the impeller during installation.
6. Thread the impeller nut onto the stud threads fingertight against the impeller.
7. Assemble the hydraulic stud tensioner assembly onto the impeller stud and against the impeller according to *Figure 73 on page 68*.
8. Connect the hydraulic hand pump to the stud tensioner according to *Figure 73 on page 68* and apply 4000psi to the stud tensioner assembly within ± 100psi to stretch the stud.



LD14900

FIGURE 74 - BALANCE PISTON SEAL LUBRICATION

LD15065

FIGURE 75 - IMPELLER MOUNTING NUT

9. Using the rotation wrench (029-18461-000), rotate the nut driver until finger-tight. With the stud stretched at 4000 psi, the nut will need rotated about 2/3 of a turn. The force necessary to turn the
10. Nut is very light. Holding the impeller should be sufficient to prevent the shaft from turning. If the
11. Nut will not tighten easily to contact the impeller face, investigate for problems with the hardware.
12. Remove the rotation wrench.
13. Release pressure and remove the tensioner.
14. Check impeller runout. For the 197FAC, 205FAC, 218 FAC, 233FAC, and 246FAC compressors, it should be within 0.10 mm (0.004 inch) Rim and 0.10 mm (0.004 inch) Eye, radial.

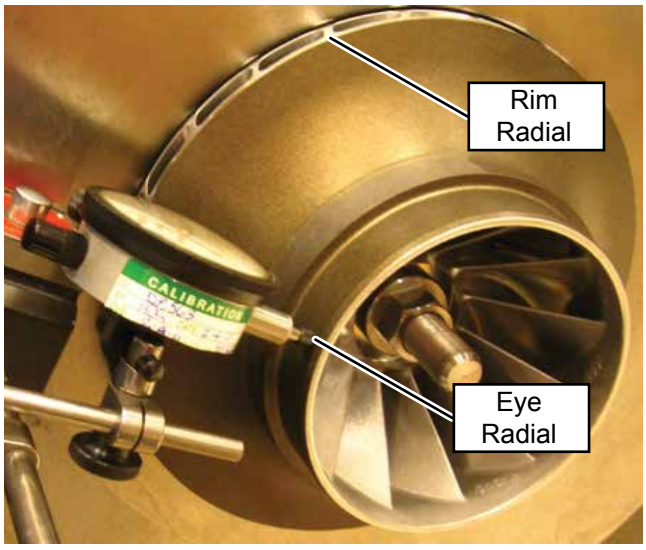


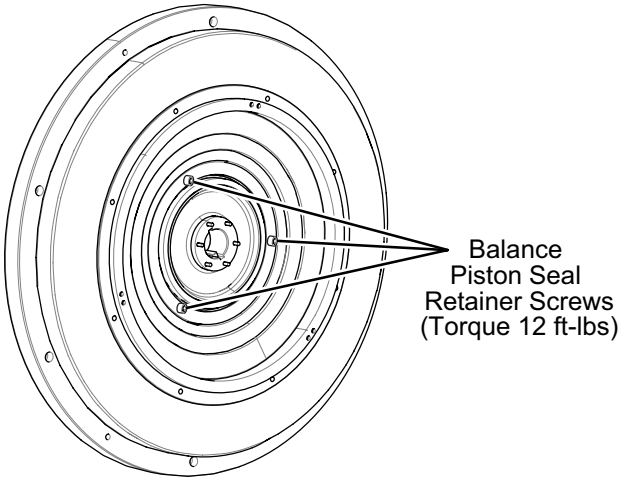
FIGURE 76 - CHECK IMPELLER RUNOUT

5

BALANCE PISTON SEAL REPLACEMENT

The compressor must be removed from the motor according to the compressor removal section previously and the impeller removed according to the previous section.

1. While supporting the balance piston seal retainer ring and parts captured behind it, remove the three M8x1.25 socket head shoulder screws that secure it to the diffuser plate.



LD17543

FIGURE 77 - BALANCE PISTON SEAL RETAINER

2. Remove the seal retainer, spring washer, and seal ring.

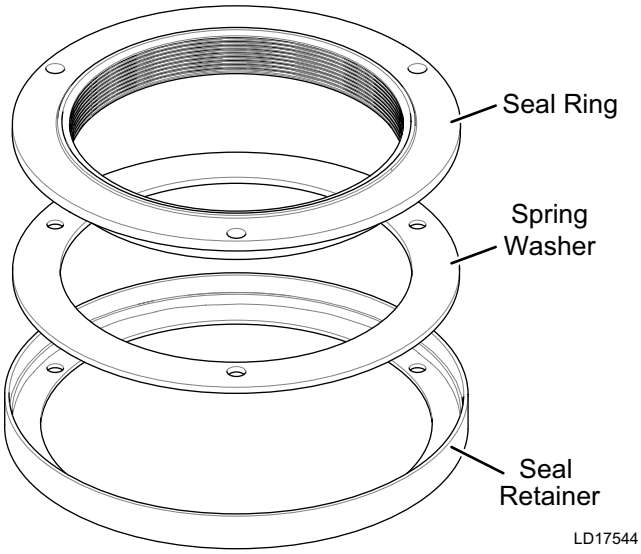


FIGURE 78 - BALANCE PISTON SEAL

Re-installation

1. On a clean working surface prepare the seal for installation into the diffuser plate.
2. Insert the spring washer into the seal retainer. During this step take care to align the bolt holes.
3. Insert the eye seal into the seal retainer with the flange/raised lip portion leading into the retainer as shown. During this step take care to align the bolt holes.
4. Prepare the new seal ring for assembly by applying a coat of 011-00253-000 Molybdenum lubricant mixed with a small amount of POE oil to the back of the seal ring.

FIGURE 79 - SEAL RING LUBRICATION

5. Carefully invert the eye seal assembly and insert into the diffuser plate such that the retainer is outboard.

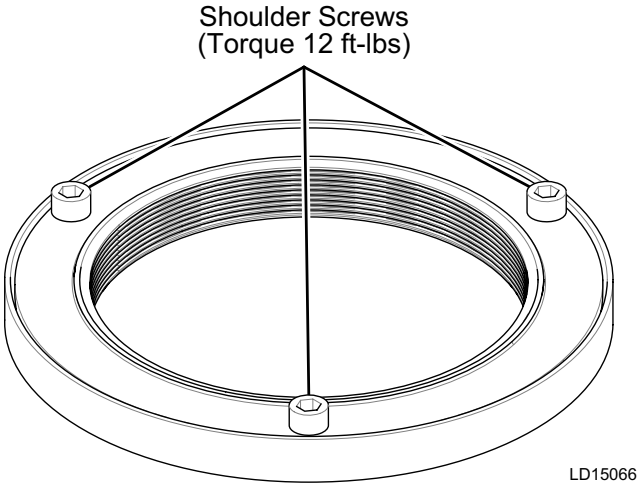


FIGURE 80 - BALANCE PISTON SEAL REASSEMBLY

6. Use Loctite primer (Grade N) and Loctite removable thread sealer (Loctite 243) item on the 3 metric 8 x 20 socket head shoulder screws, install through the holes in the retainer, spring and seal and torque to 17 N-m (12 ft-lbs).

BEARING CARTRIDGE, ROTOR, OR TOUCHDOWN BEARING REPLACEMENT

The compressor must be removed from the motor according to the compressor removal section previously. If the rotor is to be replaced, the compressor end bearing will need removed. When any work is done on these components, axial travel clearance will need to be checked and if necessary, brought into specification by changing shim thickness at the opposite drive end bearing.

Compressor End Bearing Removal

The impeller must be removed according to the Impeller Removal section, and the thrust washer and two impeller shaft keys also removed and stored.

1. Install a M10 x 1.5 swivel lug hoist ring through the taped hole in the top of the diffuser plate. The weights are listed in the compressor rigging section of this manual.

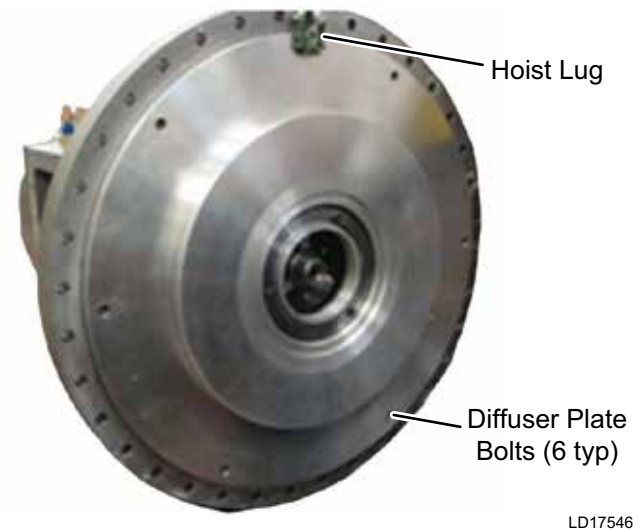


FIGURE 81 - DIFFUSER PLATE RIGGING

2. Take up slack in rigging chain on the hoist ring
3. Remove the M8 x 1.25 socket head cap screws at the 3 O'clock and 9 O'clock positions and install guide studs from the driveline rigging service kit.
4. Remove the remaining four M8 x 1.25 socket head cap screws to free the diffuser plate from the motor and remove the plate to storage. The torque to install is 40 N-m (30 ft-lbs).
5. Turn the motor so the diffuser plate end is facing upward.

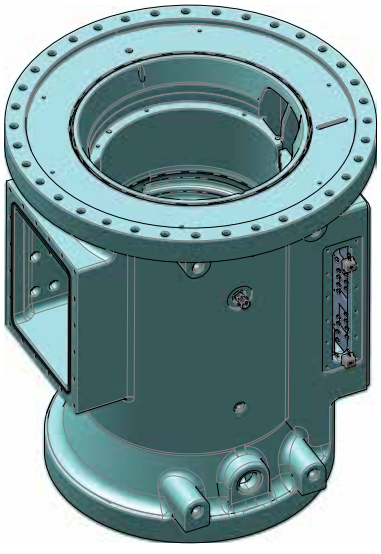


FIGURE 82 - MOTOR HOUSING

6. Disconnect the bearing wiring connectors from the leads coming from both of the MBC feed-throughs for the Z1 bearing.
7. Install the stud of the tapered guide cone that came with the driveline rigging service kit into the free end of the motor rotor shaft.
8. Using two M8 x 1.25 swivel lugs from the service kit, rig the bearing for level lifting.
9. Remove three M8 X 1.25 cap screws and washers and install three M8 X 1.25 guide studs as shown below. These studs are provided as part of service kit.

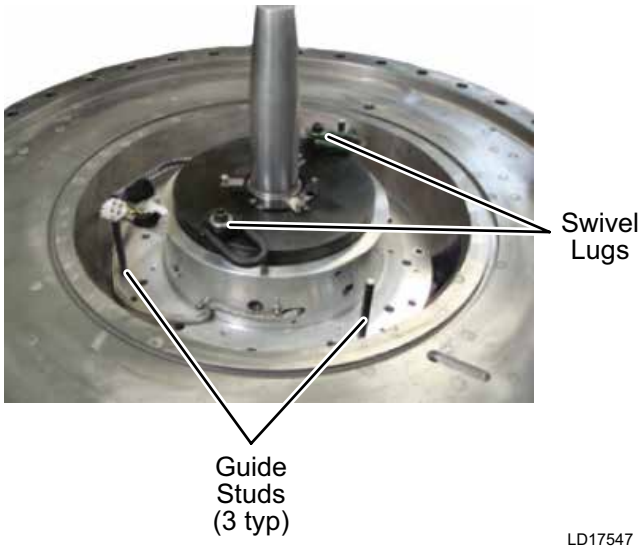


FIGURE 83 - COMPRESSOR END BEARING

10. Remove the remaining of the six M8 x 1.25 socket head cap screws and washers securing the bearing to the housing. The torque to install is 40 N-m (30 ft-lbs).
11. Carefully lift the bearing from the housing. Note that no shims are used under the bearing on this end.
12. The bearing will be re-installed in reverse order using the tapered guide cone, guide studs, and lifting lugs to direct, align and move the bearing.

Compressor End Bearing Reassembly

1. Ensure the motor is oriented so the bore runs vertical with the compressor end facing upward.
2. Ensure the motor cavity flange and bearing surfaces are pristine clean.
3. Ensure three M8 X 1.25 guide studs provided as part of the rigging service kit are installed in every other bearing bolt hole in the motor flange.
4. Install the stud of the tapered guide cone that came with the driveline rigging service kit into the free end of the motor rotor shaft.
5. Lift the bearing with the swivel lugs provided in the rigging service kit and carefully install in the motor bore over the guide studs.

LD17548

FIGURE 84 - COMPRESSOR END BEARING

6. Remove the lifting swivel lugs.
7. Install three of the M8 X 1.25 socket head cap screws with plain washers finger-tight through the bearing and then remove the guide studs and install the remaining three screws with washers. Torque all six screws with washers evenly to 40 N-m (30 ft-lbs).
8. Connect the bearing wiring connectors from the leads coming from both of the MBC feed-throughs for the Z1 bearing.

NOTE

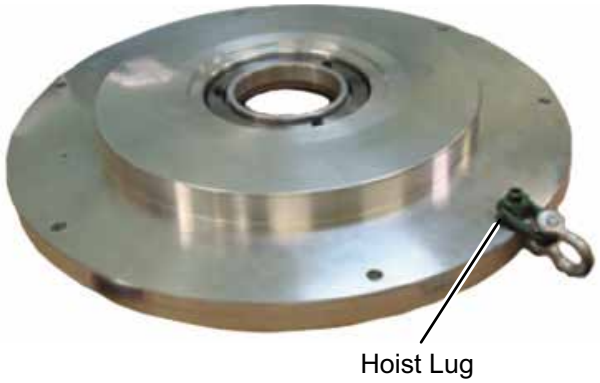
Prior to installing the diffuser plate, be sure the wiring is connected and checked for continuity by performing a winding resistance check according to the Magnetic Bearing Controls Diagnostics section of this manual.

9. Turn the motor so it is setting on its feet horizontally in preparation to install the diffuser plate and impeller.
10. Install M8 x 1.25 guide studs from the driveline rigging service kit at the 3 O'clock and 9 O'clock positions in the motor end to accept the diffuser plate
11. Ensure the balance piston seal is installed in the diffuser plate. Refer to the Balance Piston Seal replacement section.
12. Ensure the balance piston seal plate is installed behind the seal on the motor-inboard side of the diffuser plate with 6 bolts. The seal plate is mounted with the counter bore outwards from the diffuser plate so that the bolts are recessed below the face of the plate when installed. The bolts must be prepared with Loctite primer (Grade N) and Loctite removable thread sealer (Loctite 243). The bolts are torqued to 13.6 N-m (10 ft-lbs).

LD17549

FIGURE 85 - BALANCE PISTON SEAL PLATE

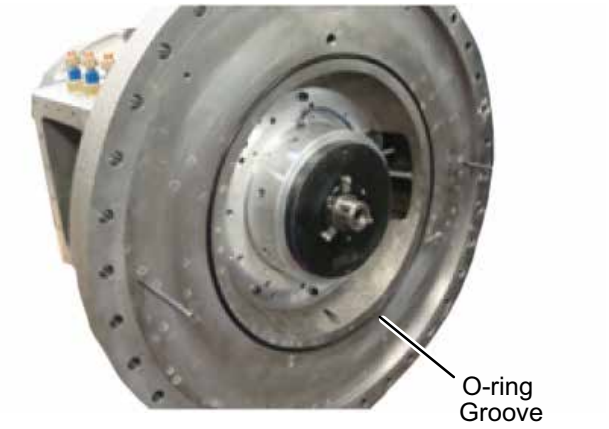
13. Install a M10 x 1.5 swivel lug hoist ring through the taped hole in the top of the diffuser plate.



LD17550

FIGURE 86 - DIFFUSER PLATE

14. Install a new O-ring lightly lubricated with POE grease into the O-ring groove on the face of the motor housing to seal to the diffuser plate.



LD17551

FIGURE 87 - MOTOR HOUSING O-RING

15. Carefully install the diffuser plate over the guide studs to the end of the motor, ensuring the O-ring remains in position.
16. Install the six M8 x 1.25 socket head cap screws to mount the diffuser plate to the motor, removing the guide studs after the plate is held in place by some of the cap screws. The torque to install is 40 N-m (30 ft-lbs).
17. Remove the hoist ring from the diffuser plate.
18. Install the impeller according to the Impeller Replacement section of this manual.
19. After installing the diffuser plate and impeller, check the axial clearance according to the Rotor Axial Clearance check procedure at the end of this subsection.

Rotor Removal

If the rotor is to be removed for service or replacement, the compressor end bearing needs removed but the opposite end bearing should be in place.

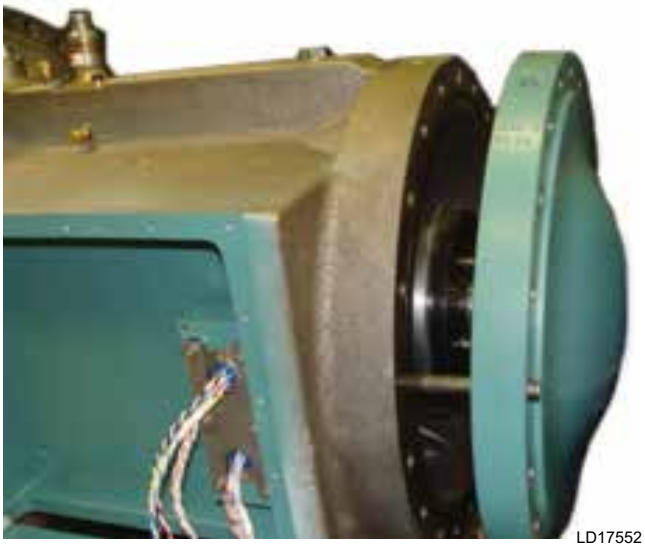
The rotor for this motor is a highly specialized rotor and several precautions must be observed when handling the rotor in any fashion. It is a permanent magnet type of rotor. This means that the assembler should take steps to prevent any unwanted contact to the rotor with steel tools etc. The rotor should never be handled in area where metal shavings, grinding dust etc, is present.

The rotor has a carbon fiber sleeve that could be damaged during service. The purpose of this sleeve is to provide containment for the rotor materials at the very high rotating speeds of the rotor. Any damage to the sleeve could result in a catastrophic failure of the rotor. Extreme care is always recommended when handling this rotor.

1. Ensure the compressor-end bearing has been removed according to that section previously.
2. Arrange the motor housing so that it is sitting vertically on the non-drive end. The rotor will always be removed from or inserted to the motor through the compressor end. It is important to make sure that the motor housing is level. This will make removal of the rotor easier.
3. Using a M14 x 2 swivel lug, install the lug provided as part of the rigging service kit into the impeller stud hole on the exposed end “Z1SIDE” of the shaft.
4. Work the Nomex sheet that came in the rigging service kit around the rotor, between it and the stator down its full length to protect the rotor as it is removed from the stator bore.
5. Carefully lift the rotor out of the bore vertically. Be prepared for its magnetism and have a pristine space prepared to land it while out of the unit, where others will be aware of the consequences of its magnetic field on tools, iron debris that would contaminate it, magnetic strips and pacemaker devices that it could affect.

Rotor Installation

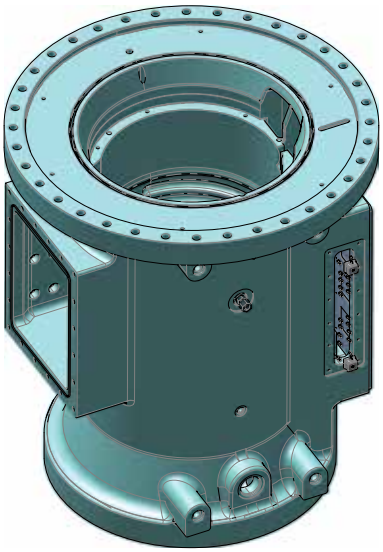
1. Place the motor housing horizontally and remove the non-drive side end bell. Two M16 x 2 guide studs are available in the rigging service tool kit for use in this task.



LD17552

FIGURE 88 - MOTOR END BELL REMOVAL

2. Ensure the non-drive end bearing is installed with a shim of thickness to match the last used or calculated shim thickness, according to the non-drive end bearing section of this manual. The bearing will accept the rotor and provide a stop for insertion.
3. Turn the motor so the bore runs vertical with the compressor end facing upward and the end where the endbell was removed facing downward. Level the machined face that mates with the diffuser in several directions to ensure the perpendicular bore is plumb so the rotor inserts smoothly. Refer to the previous use of 3-D graphic of motor without diffuser plate with open end up



LD17485

FIGURE 89 - MOTOR HOUSING

4. Insert the Nomex sheet that came in the rigging service kit around the ID of the stator bore down its length to protect the rotor as it is inserted into the stator bore.

LD17553

FIGURE 90 - MOTOR / STATOR PROTECTION

5. Using a M14 x 2 swivel lug, install the lug provided as part of the rigging service kit into the impeller stud hole on the exposed end of the rotor shaft marked “Z1SIDE”.

LD17554

FIGURE 91 - ROTOR SWIVEL LUG

6. Lift the rotor carefully by the swivel ring lug, taking care not to magnetically stick it to any ferrous object.
7. Install the tapered guide cone that came with the driveline rigging service kit into the opposite end of the motor rotor shaft, marked “Z2SIDE”.

LD17555

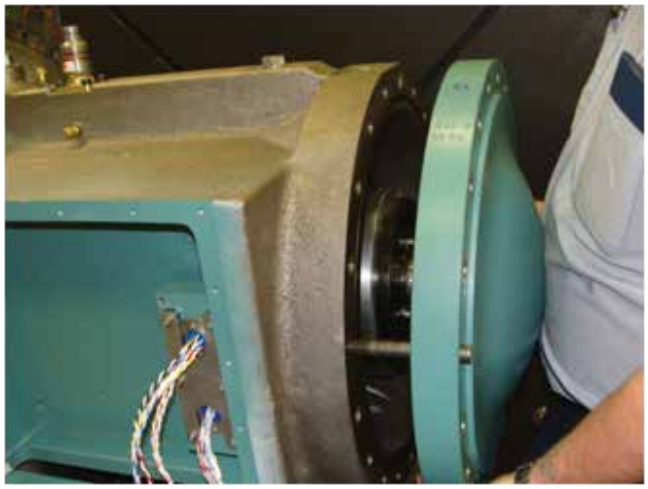
FIGURE 92 - ROTOR RIGGING

8. Carefully insert the rotor into the stator until seated on the Z2 bearing. Do not drop the rotor onto the bearing.
9. Remove the paper sleeve and swivel lifting lug. Remove the tapered guide pin from the Z2 shaft end.
10. Install the compressor end bearing according to the procedure in this section and perform the prescribed axial clearance check. The axial clearance check section reinstalls the motor end bell.

Non-drive End Bearing Removal

This bearing is shimmed from the motor housing with a single shim of selectable thickness to establish the necessary rotor axial free travel. It is imperative that the surfaces joined are all completely clean. This bearing can be replaced with the rotor installed or removed as suits the scope of work.

1. Place the motor housing horizontally and remove the non-drive side end bell. Two M16 x 2 guide studs are available in the rigging service tool kit for use in this task.



LD17556

FIGURE 93 - MOTOR END BELL REASSEMBLY

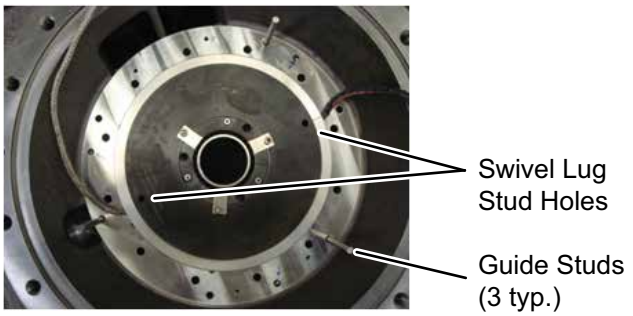
5

2. Place the motor vertically with compressor end down. Remove the thrust ring retainer bolt from the center of the shaft on the non-drive end exposed. Use an adjustable wrench as shown to hold the shaft. This bolt has an install torque of 140 N-m (103 ft-lbs).

LD17557

FIGURE 94 - THRUST RING RETAINER BOLT

3. Remove the thrust ring retainer disk and its two shaft keys.
4. Remove the bearing thrust ring that was between the bearing retainer and the bearing over the shaft and keys. Set it aside. This Z2 end ring is not the same as the Z1 end ring.
5. Disconnect the bearing wiring connectors from the leads coming from both of the MBC feed throughs for the Z2 bearing.
6. Using two M8 x 1.25 swivel lugs from the service kit, rig the bearing for level lifting
7. Remove the six M8 X 1.25 bolts that secure the bearing and shim to the motor housing.
8. Install three M8 X 1.25 guide studs as shown below. These studs are provided as part of the rigging service kit.



LD17558

FIGURE 95 - BEARING GUIDE STUDS

9. Lift the bearing out vertically using the swivel lugs.
10. Remove and retain the bearing shim that was found behind the bearing and determine and record its thickness to the nearest 0.002mm or 0.0001 inch.

LD17559

FIGURE 96 - BEARING SHIM

Non-drive End Bearing Reassembly

Refer to graphics above as necessary.

1. Ensure the motor cavity flange, shim, and bearing surfaces are pristine clean.
2. Ensure three M8 X 1.25 guide studs provided as part of the rigging service kit are installed in every other bearing bolt hole in the motor flange. This is critical to ensure the bearing shim remains positioned to accept bolts when the bearing is over it.
3. Install the bearing shim found or a new one calculated if this is an iterative step.

4. Lift the bearing with the swivel lugs provided in the rigging service kit and carefully install in the motor bore over the guide studs and onto the bearing shim.

LD17548

FIGURE 97 - Z2 BEARING RIGGING

5. Remove the lifting swivel lugs.
6. Install three of the M8 X 1.25 bearing socket head cap screws with plain washers finger-tight and then remove the guide studs and install the remaining three screws with washers. Torque all six screws with washers evenly to 40 N-m (30 ft-lbs).
7. Connect the bearing wiring connectors from the leads coming from both of the MBC feed throughs for the Z2 bearing.
8. Ensure both of the keys are installed on the shaft and the Ball Bearing thrust ring is installed over the keys and back against the shaft shoulder close to the shaft bearing. The keys may be very snug and some emory cloth work may need to take place on the keys only for proper fit. Be certain all parts are wiped perfectly clean at time of fitup.

LD17747

FIGURE 98 - BEARING AND SHIM

NOTE

The thrust rings are sized specifically for each shaft end with the I.D. of the thrust ring at .001" larger than the O.D. of the shaft. The Z1 end thrust ring is slightly larger than the Z2 end thrust ring. Be certain the proper ring is being used. When sliding the thrust ring into place, be certain that the ring is seated to the shaft should near the bearing inner race. Because of the tight tolerance it is important to make sure the thrust ring is perpendicular to the shaft or it may lodge during installation. If the ring will not slide over the keys, the keys may need more fitment work. Do not force the ring into place since the retainer will need to slide over the same location. All components must slide into place with minimal force.

9. Install the thrust ring retainer on the end of the shaft over the keys. Then holding the shaft from rotation by the retainer, torque the thrust ring retainer bolt to of 140 N-m (103 ft-lbs).
10. After installing the bearing, check the axial clearance according to the Rotor Axial Clearance check procedure which follows.

Rotor Axial Clearance Check

To perform this function the motor must be in a horizontal position. The diffuser plate should be installed. If the clearance needs adjusted, that is accomplished on the non-drive end, which does not require the diffuser plate removed. The drive-end thrust ring and impeller must be installed. The impeller holds the thrust ring in place and the thrust rings establish the stop to travel against the touchdown bearing inner race. This section will use a dial indicator that must be capable of measuring 0.002mm or 0.0001" and be repeatable. The axial tolerances for this portion of the build are very tight and reliable measuring equipment is essential.

Follow the mechanical task with MBC Auto centering process from the Control Panel according to *Service - OptiView Control Panel and Unit Controls (Form 160.84-M2)*.

1. Ensure the diffuser plate and impeller are mounted according to the applicable sections.
2. Using a steel plate bolted very solidly to the diffuser plate as shown to mount a magnetic base dial indicator. Else, mount a clamp base dial indicator firmly. Set up the dial indicator to measure total axial travel to a point on the shaft end or impeller that will not be rotated to skew the reading.
3. Move the shaft assembly fully in both directions to set up the indicator for a baseline zero measurement at full travel towards the opposite-compressor end (Z2) bearing. Repeat this movement at least twice to ensure that full travel bump to bump is achieved and that the indicator does not bottom out in either direction.
4. With the shaft at full Z2 direction travel and the indicator set to zero, move the shaft full travel to the compressor end (Z1) bearing direction and note the travel measurement. Repeat this step to verify the travel distance.
5. The acceptable values for axial travel are 0.4mm ± 0.025mm (0.157" ±.001").
6. If the measured values fall outside of the above tolerance, the shim located at the Z2 bearing will need to be replaced. Using the shim thickness known from just installed or found when the existing shim is removed, determine the new thickness of a single replacement shim required to meet the above tolerance. Shims can be obtained in 0.025 mm increments from 1.000 to 2.000 mm from *Unit Renewal Parts (Form 160.84-RP1)*.

LD17561

FIGURE 99 - ROTOR AXIAL CLEARANCE CHECK

7. If the shim must be replaced, the motor must be supported on the Z1 end in a manner that will not damage the impeller or diffuser plate. Use care when orienting the motor to this position. Go to the Non-drive end (Z2) bearing removal section of this manual and remove the bearing cartridge and install the new shim.
8. Repeat the axial thrust check to achieve the travel within tolerance as stated.
9. Repeat steps in this section as needed.
10. Record the final values when the compressor assembly is complete for future record.
11. Install a new O-ring, lightly lubricated with POE grease in the end bell groove the non-drive end of the motor and re-install the end bell with the M16 x 2 bolts torqued to 330 N-m (243 ft-lbs) in a pattern as shown below in two passes of 50% and 100% torque:

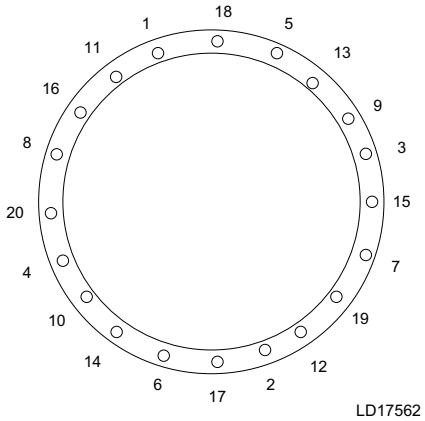


FIGURE 100 - END BELL TORQUE PATTERN

12. When the chiller is first powered with the compressor in place, perform the MBC Axial Centering process from the control panel in ADMIN access level according to *Controls Service Manual, (Form 160.84-M2),* SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES section. This is necessary for the MBC to recognize the changes in geometry and control properly.

TOUCHDOWN BEARING REPLACEMENT

The bearing cartridge must be removed as discussed in the bearing replacement section of this manual. This procedure will replace the touchdown bearing set in an otherwise good bearing cartridge on the bench. At the present time, the procedure is not validated. Instead, a touchdown bearing replacement can be addressed with a complete bearing cartridge replacement.

NOTES

The following factors can be used to convert from English to the most common SI Metric values.

TABLE 17 - SI METRIC CONVERSION

MEASUREMENT	MULTIPLY ENGLISH UNIT	BY FACTOR	TO OBTAIN METRIC UNIT
Capacity	Tons Refrigerant Effect (ton)	3.516	Kilowatts (kW)
Power	Horsepower	0.7457	Kilowatts (kW)
Flow Rate	Gallons / Minute (gpm)	0.0631	Liters / Second (l/s)
Length	Feet (ft)	0.3048	Meters (m)
	Inches (in)	25.4	Millimeters (mm)
Weight	Pounds (lbs)	0.4538	Kilograms (kg)
Velocity	Feet / Second (fps)	0.3048	Meters / Second (m/s)
Pressure Drop	Feet of Water (ft)	2.989	Kilopascals (kPa)
	Pounds / Square Inch (psi)	6.895	Kilopascals (kPa)

TEMPERATURE

To convert degrees Fahrenheit (°F) to degrees Celsius (°C), subtract 32° and multiply by 5/9 or 0.5556.

Example: (45.0°F - 32°) x 0.5556 = 7.22°C

To convert a temperature range (i.e., a range of 10°F) from Fahrenheit to Celsius, multiply by 5/9 or 0.5556.

Example: 10.0°F range x 0.5556 = 5.6 °C range

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