YORK®	VARIABLE SPEED OIL PUMP DRIVE	
SERVICE INSTRUCTIONS	Supersedes: Nothing	Form 160.52-M2 (899)

MODEL YK (MODEL D & E)
CENTRIFUGAL LIQUID CHILLERS

00130VIP

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VSD OIL PUMP GENERAL INFORMATION – MOD D CHILLERS

VSD OIL PUMP STYLE VARIATIONS

INPUT VOLTAGE RANGE	VSOP DRIVE PART NUMBER	MAXIMUM OUTPUT RATING
208 VAC / 60 Hz 230 VAC / 60 Hz 240 VAC / 60 Hz	024-30468-001	220 VAC / 60 Hz 8.4 Amps
380 VAC / 50 Hz 400 VAC / 50 Hz 415 VAC / 50 Hz 460 VAC / 60 Hz 575 VAC / 60 Hz*	024-30468-002	440 VAC / 60 Hz 4.2 Amps

* 575 Volt unit requires step-down transformer to supply 460 VAC to VSOP drive.

VSD OIL PUMP DRIVE OVERVIEW

The new YORK Variable Speed Oil Pump Drive (VSOP Drive) is an air-cooled, transistorized, PWM inverter in a very compact package. The VSOP drive has the same four major components that most AC motor drives have: pre-charge, rectifiers, DC bus, and the inverter. The VSOP drive is not repairable, but is simply replaced if it fails.

The VSOP Drive has been added to Model "D" YK Chillers to replace the mechanical valve system used in the past to regulate oil pressure. This new system will improve bearing lubrication by providing a higher oil pressure during the pre-lube cycle, and provide a method of regulating oil pressure to a specific programmed value during the run time of the compressor.

Chillers manufactured before June of 1997 or a MOD "C" YK chiller will require an EPROM upgrade for the Microcomputer Control Center, and the logic board must be changed to use the VSOP drive option. The following EPROM version is required: C.02F.16 (Part Number 031-01431-002) for the standard chiller. Version C.02T.16 (Part Number 031-01431-003) will be available for Remote Chiller Communications applications. The Micro Board will change from a 031-01065-001 to a 031-01065-002.

Chillers manufactured after June of 1997 will have the above software EPROMs installed in the Microcomputer Control Center.

Chillers with a VSD on the compressor will have the correct software for the VSOP drive if the software is a version C.YKV.06.02 or later.

These EPROMs have the following operational enhancements that revise Service Manual 160.49-M2 as follows:

KNOWN PROBLEMS

Early version of VSOP drive software did not work properly with a YORK chiller. To verify the software version on the VSOP drive, do the following: Open the enclosure door and look for the VSOP drive in the upper right hand corner. In the center of the control board, locate the square chip, approximately one square inch. On this chip is a label. If the label has C13.XX on it, or a lower number, the VSOP drive should be replaced.

A few of the VSOP drives have demonstrated a sensitivity to line voltage disturbances, such that is caused by the switching of power factor correction capacitors. These line voltage disturbances cause the DC bus voltage to exceed a safe limit for an extremely short period of time. New VSOP drives have a 50 msec. timer placed on the high DC bus voltage shutdown. If you suspect this is your problem, verify the software version as stated in the previous paragraph. The software version that contains this fix is a C30.2A. These drives will be available sometime in July of 1999.

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VARIABLE SPEED OIL PUMP DRIVE OPERATION - MODEL D CHILLER

MICROCOMPUTER CONTROL CENTER OPERATION

The Microcomputer Control Center maintains desired system oil pressure by controlling the speed of the oil pump. The speed at which the oil pump runs is determined by the VSOP drive output frequency. The Micro Board applies a speed command to the VSOP drive to control the output frequency. The speed command is in the form of a Pulse Width Modulation (PWM) signal as explained later.

During the Pre-Lube period and the first 15 seconds of compressor run, the software in the Micro Board operates the VSOP drive over a range of 25 Hz to 60 Hz to maintain the oil pressure at 45 PSID. Thereafter, it operates the VSOP drive over this range to maintain the oil pressure to the programmed **"Oil Pressure Setpoint"** (20 to 45 PSID).

As with the fixed speed oil pump application, 13 seconds after a chiller start is initiated, the oil pump is turned on by a run signal from Relay Board TB3-29 (ref. Fig. 1). TB3-29 energizes new Relay 3R (instead of the oil pump contactor as was previously done in the fixed speed oil pump application). The closing of 3R contacts applies a GROUND connection from Power Supply Board J5-1 to the RUN input of the VSOP drive. This starts the oil pump. The Micro Board applies a speed command from J10-2 (through the Refrigerant Level Control Board) to the VSOP drive's "PWM" input that ramps the VSOP drive output frequency from 25Hz to whatever frequency is required (up to a maximum of 60Hz) to achieve the 45 PSID target oil pressure. The target oil pressure remains 45 PSID throughout the pre-lube period and during the first 15 seconds of compressor run. While the target pressure is in effect,

OIL PRESSURE=XX.XPSID;TARGET=XX.X PSID

is displayed when the OIL PRESSURE display key is pressed. As with the previous fixed speed oil pump application, the compressor is started 50 seconds after the chiller start is initiated.

After the compressor has been running for 15 seconds, the target oil pressure becomes the "**Oil Pressure Setpoint**" (20 to 45 PSID) that has been programmed by the Service Technician using procedure under **"Programming"**. The Micro Board then applies a speed command to the VSOP drive that changes the output frequency of the VSOP drive as required to achieve this oil pressure. The programmed **Oil Pressure Setpoint** is the oil pressure for the remainder of "SYSTEM RUN" and through "SYSTEM COASTDOWN". While the programmed **Oil Pressure Setpoint** is in effect,

OIL PRESSURE=XX.X PSID; SETP=XX.X PSID

is displayed when the OIL PRESSURE key is pressed.

During oil pump operation, the actual oil pressure and the frequency of the VSOP drive, is commanded to be running and can be monitored with the DISPLAY DATA key. One of the scrolled messages is

OIL PUMP VSD=XXX HZ;PRS=XX.XPSID

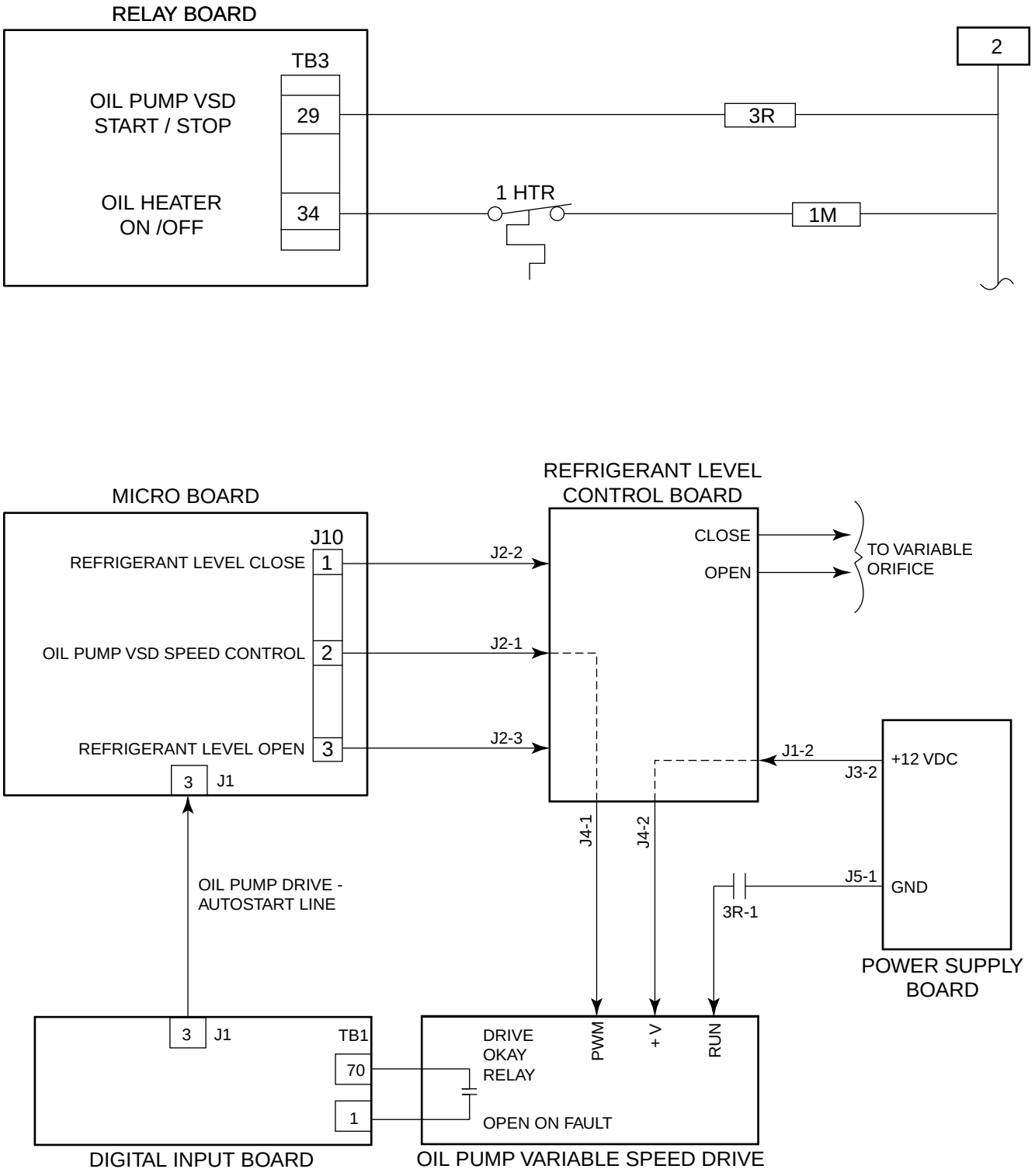

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FIG. 1

AUTOMATIC SPEED CONTROL

The Micro Board controls the VSOP drive output frequency by applying a Pulse Width Modulation (PWM) speed command signal to the VSOP drive (ref Fig. 2). The signal is applied every 0.7 seconds. Within the 0.7 second period, the duration of time that the signal is "low" (0VDC) , determines the VSD output frequency between 25 to 60Hz. If the signal remains "high" (+12VDC) for the entire 0.7 second period, it is commanding the VSOP drive's output frequency to 25Hz. If the signal is low for the entire 0.7 second period, it is commanding the VSOP drive's output frequency to 60Hz. Frequencies between these extremes are achieved by driving the signal low for a proportionate amount of time within the 0.7 second period. For example, if the signal is low for 50% (0.35 seconds) of the 0.7 second period, it would be commanding the VSOP drive to operate at a frequency that is halfway between 25 and 60Hz, or 42.5Hz. The resolution, or smallest increment of change, is 0.01 seconds. This allows the output frequency to be changed in 0.5 Hz steps. The formula provided in Figure 2 can be used to calculate the output frequency for a given PWM signal.

The entire VSOP drive run time is divided into "**Oil Pressure Control Periods**". They run consecutively and continuously; when the first one ends, the next one begins. This repeats until the oil pump is shut down. The duration of the periods are determined by the "OIL PRS CTRL PERIOD SETPOINT", programmed by the Service Technician using instructions under **"Programming"**. This setpoint is programmed in multiples of 0.3 seconds over the range of 0.3 to 2.7 seconds, by programming a "MULTIPLIER" value of 1 through 9. The program multiplies this value by 0.3 to produce periods over the range of 0.3 to 2.7 seconds. This multiplier value also determines the magnitude of output frequency correction when the error between the actual oil pressure and the oil pressure setpoint is > ± 6 PSID). The programmed value (1 through 9) is multiplied by 0.5Hz to provide greater frequency change to more quickly correct the oil pressure. If the error is > ±0.5 PSID & < ± 6 PSID, the output frequency is increased or decreased 0.5Hz. At the end of each period, the actual oil pressure is compared to the programmed **Oil Pressure Setpoint** and the Micro Board changes the speed command as required per the following:

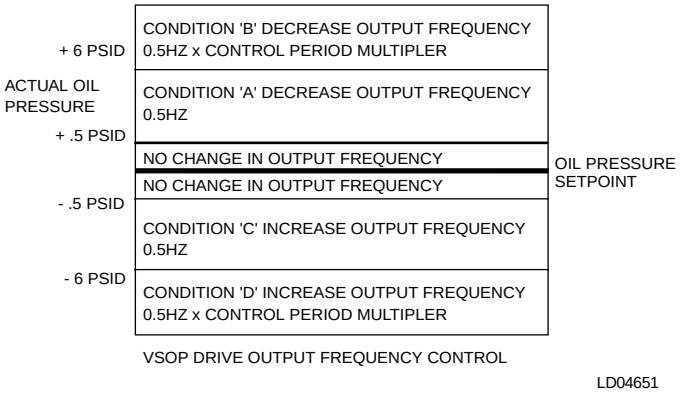
If actual oil pressure is:

a. >(setpoint + 0.5 PSID) & ≤(setpoint + 6 PSID), decrease output frequency 0.5Hz.

b. >(setpoint + 6 PSID), decrease output frequency 0.5Hz x Control Period Multiplier.

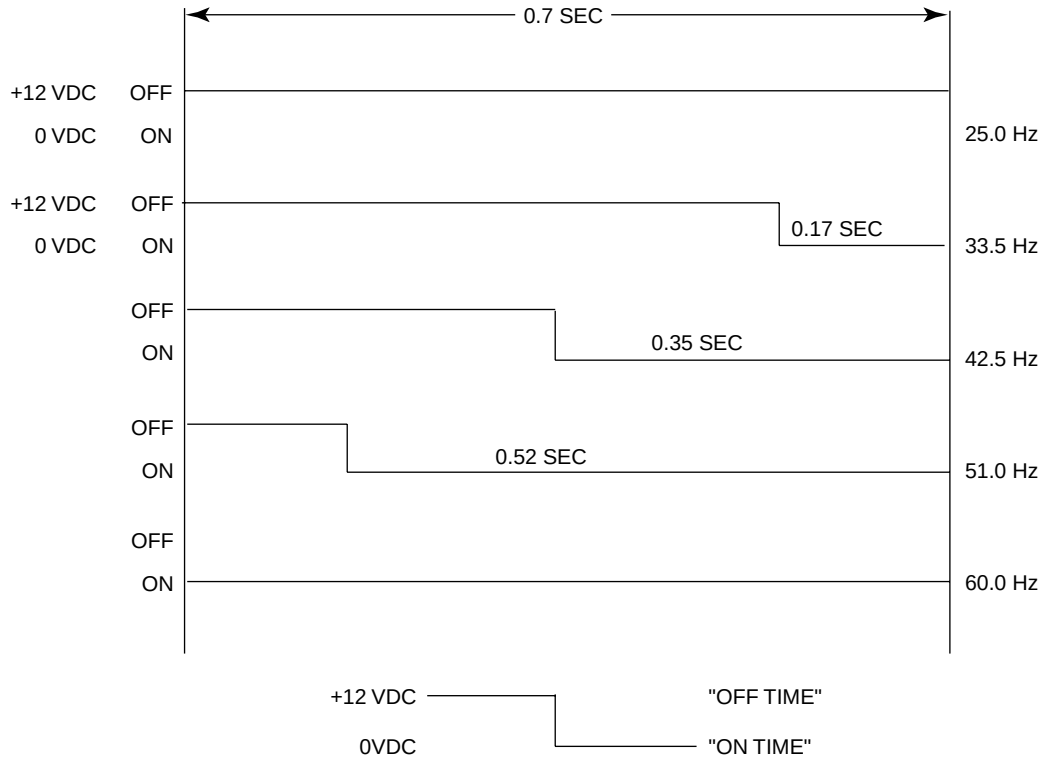
c. <(setpoint – 0.5 PSID) & ≥(setpoint – 6 PSID), increase output frequency 0.5Hz.

d. <(setpoint – 6 PSID), increase output frequency 0.5Hz x Control Period multiplier.



Since this EPROM version can be used on chillers that are equipped with the VSOP drive and those that are not, VSOP drive control must be enabled or disabled, as appropriate, and the associated setpoints programmed using the **"Programming"** procedure on page 8.

OIL PUMP VARIABLE SPEED DRIVE



OUTPUT FREQUENCY IN HZ = (ON TIME IN SECONDS / 0.02) + 25

SMALLEST INCREMENT OF CHANGE = 0.010 SEC; 0.5 Hz

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FIG. 2- PULSE WIDTH MODULATION (PWM) SPEED CONTROL SIGNAL

MANUAL SPEED CONTROL

The oil pump speed can be manually controlled using the Pre-Rotation Vanes OPEN, CLOSE, HOLD or AUTO keys in SERVICE mode. Manual pump speed control must be selected using the procedure below.

After the pump has been turned on with the "MANUAL OIL PUMP" key, the "OPEN" and "CLOSE" keys can be used to increase or decrease the VSOP drive's output frequency over the range of 25Hz to 60Hz. Each time the "OPEN" key is pressed, the frequency is increased 0.5Hz. Each time the "CLOSE" key is pressed, the frequency is decreased 0.5Hz. If the AUTO key is pressed, automatic operation as described previously is resumed.

A special feature allows the VSOP drive to output a specific pre-determined frequency. This permits service analysis of oil pressure at various oil pump speeds. This frequency is programmed as the "OIL PUMP VSD FREOUENCY=XX HZ" setpoint in the **"Programming"** procedure below. If the "HOLD" key is pressed, the VSD output goes to the OIL PUMP VSD FREQUENCY.

During manual operation, the DISPLAY DATA key can be used to monitor the VSOP drive's commanded output frequency and system oil pressure. One of the scrolled messages is

OIL PUMP VSD FREQ=XX.XHZ;PRS=XX.XPSID

As on fixed speed oil pump applications, after the pump is manually turned on, it is automatically turned off after 10 minutes of operation, if not manually terminated earlier.

To enable the keypad PRV Service keys for manual oil pump speed control, perform the following:

1. This procedure assumes VSOP drive operation has been selected using the procedure below under **"Programming"**
2. Using **Access Code 1 3 8 0**, enter **Program** Mode.

   PROGRAM MODE SELECT SETPOINT

   is displayed.
3. Press OPTIONS key.
4. Use the ADVANCE DAY/SCROLL key to scroll to the message

   MANUAL CONTROL = X (0=VANES, 2=OP)

   If the Liquid Level option is not installed

   MANUAL CONTROL = X (0=VANES, 1=LVL, 2=OP)

   If the Liquid Level option is installed
5. Press the **"2"** key.
6. Press ENTER key.
7. Press PROGRAM key to exit.

Manual oil pump speed control can be confirmed by pressing the "DISPLAY DATA" key. The first scrolled message will be

MANUAL OIL PUMP SPEED CONTROL ALLOWED

PROGRAMMING

This EPROM version can be used in chillers that are equipped with the VSOP Drive and those that are equipped with the fixed speed oil pump. If the chiller is equipped with the VSOP Drive, VSOP Drive application must be selected below. If the chiller is not equipped with the VSOP drive, fixed speed oil pump application must be selected. If VSOP Drive application is selected, additional VSD setpoints, as described below, must be entered. Also, the **"Standby Lubrication"** feature, as described below, can be enabled or disabled in this procedure.

1. Using **Access Code 1 3 8 0**, enter **Program** Mode.

   PROGRAM MODE, SELECT SETPOINT

   is displayed.
2. Press OIL PRESSURE key.

   VSD OIL PUMP INSTALLED = 0 (0=NO;1=YES)

   is displayed.
3. Using ENTRY keys, press **"1"** if chiller is equipped with the VSOP Drive. Press **"0"** if this is a fixed speed oil pump application.
4. Press ENTER key.
5. Press ADVANCE DAY/SCROLL key.

   ENABLE STANDBY LUBE = 0 (0=NO;1=YES)

   is displayed.

6. Using ENTRY keys, press **"1"** if the STANDBY LUBRICATION feature, as described below, is desired. Otherwise, press **"0"** .
7. Press ENTER key.
8. If FIXED SPEED oil pump application was selected, by entering **"0"** in step 2 above, press PROGRAM key to exit. Otherwise, press ADVANCE DAY/SCROLL key.

   OIL PRS CTRL PERIOD = __ x 0.3 SECONDS

   is displayed.
9. Using ENTRY keys, enter desired value **"1"** through **"9"**. Recommended value **"3"** will provide correct operation in most applications. If the CANCEL key is pressed, default value **"3"** is displayed.
10. Press ENTER key.
11. Press ADVANCE DAY/SCROLL key.

    OIL PRESSURE SETPOINT = XXPSID

    is displayed.
12. Using ENTRY keys, enter desired value between "20" and "45" PSID. Recommended value "35" will provide correct operation in most applications. If CANCEL key is pressed, default value "35" is displayed.
13. Press ENTER key.
14. Press ADVANCE DAY/SCROLL key.

    OIL PUMP VSD FREQUENCY = XX Hz

    is displayed.
15. Using ENTRY keys, enter desired value between "25" and " 60" Hz. If CANCEL key is pressed, default value "25" is displayed.
16. Press ENTER key.
17. Press PROGRAM key to exit.

MICRO BOARD CHANGES

The VSOP drive's PWM speed command input is generated on the Micro Board and is fed to the VSOP drive via J10-2. J10-2 is not present on Micro Board part number 031-01065-001. The Micro Board has been revised to include these circuits and the part number has been changed to 031-01065-002. Micro Board part number 031-01065-002 is required on all VSOP drive applications.

STANDBY LUBRICATION

To maintain oil seal integrity while the chiller is shut down, the oil pump is turned on for 2 minutes every 24 hours, if the chiller has not run in the past 24 hours. While the pump is running,

STANDBY LUBE IN PROCESS - X.X MIN LEFT

is displayed. If a VSOP drive is installed, the operating oil pressure will be the programmed oil pressure setpoint, programmed by the Service Technician.

To prevent oil pump damage due to low oil level, if at least 15 PSID of oil pressure is not achieved within 30 seconds of starting the oil pump, the cycle is terminated and

STANDBY LUBE LOCKOUT- CHECK OIL LEVEL

is displayed when the STATUS key is pressed. No more standby lubrication cycles will be performed until the WARNING RESET key is pressed in SERVICE mode, at which point another cycle will be attempted. Starting the chiller also resets this STANDBY LUBE LOCKOUT.

Standby lubrication cycles will not be performed if either oil pressure transducer is out of range (HOP $\leq$ 6.8 PSIG; LOP $\leq$ 0 PSIG). No message will appear to indicate that the lubrication cycle will not be performed. The verification of correct pressure assures that standby lubrication cycles will not be performed during maintenance of the chiller or until the chiller has been charged with refrigerant and chiller commissioning has been completed.

These standby lubrication cycles are enabled or disabled by the Service Technician using the VSOP drive selection procedure described above. It is recommended that the standby lubrication be enabled on chillers that remain shut down for periods of 24 hours or greater.

SAFETY SHUTDOWNS

HIGH OIL FLOW

If either of the following conditions occur, a safety shutdown is initiated and

DAYTIME-HIGH OIL FLOW

is displayed when the STATUS key is pressed.

a. If the oil pressure is < 40.0 PSID for 5 continuous seconds during the last 10 seconds of the compressor pre-lube or during the first 15 seconds of SYSTEM RUN.

b. If the oil pressure is < the programmed OIL PRESSURE SETPOINT and the speed command is at 60Hz for 5 continuous seconds, anytime after the first 30 seconds of SYSTEM RUN.

The "DAY-TIME-HIGH OIL FLOW" safety checks are not performed during MANUAL SPEED control. All other oil pressure safety shutdown thresholds are the same as with the fixed speed oil pump applications. For both fixed speed and variable speed oil pump applications, the shutdown threshold for "DAY-TIME-HIGH OIL PRESSURE is now 90 PSID.

OIL PUMP OPERATION AFTER POWER FAILURES

If a power failure occurs while the chiller is running, the duration of the power failure determines whether a "SYSTEM COASTDOWN" (post-lube) is performed when power is restored.

If the power failure is less than 2 minutes in duration, a standard 2.5 minute "SYSTEM COASTDOWN" operation is performed when power is restored. During the "SYSTEM COASTDOWN", the oil pump runs. If configured for AUTO-RESTART AFTER POWER FAILURE, a SYSTEM COASTDOWN is performed prior to the chiller automatically restarting.

If the power failure is greater than 2 minutes in duration, there is no 2.5 minute "SYSTEM COASTDOWN".

DIAGNOSTIC SOFTWARE - DIGITAL OUTPUTS

If VSOP drive operation has been enabled in the **"Programming"** procedure above, the VSOP drive's frequency control output from the Micro Board can be manually controlled using the **Digital Outputs** portion of **Diagnostic Software**. The following messages are displayed:

OUTPUT--VSD OIL PUMP PULSE--1, 9 MORE

Manual control of these outputs is the same as manual control of all other outputs using the **Digital Outputs** section of **Diagnostic Software**. The output is driven high (+12vdc) when the "1" key is pressed. The Micro Board should be commanding the VSOP drive output frequency to 25Hz. It is driven low (<1vdc) when the "0" key is pressed. The Micro Board should be commanding the VSOP drive output frequency to 60Hz. When the "0" key is pressed, "0" is displayed in place of "1". Refer to instructions in Service Manual 160.49-M2, Section 5.

If VSOP drive operation is not selected, these messages are replaced by:

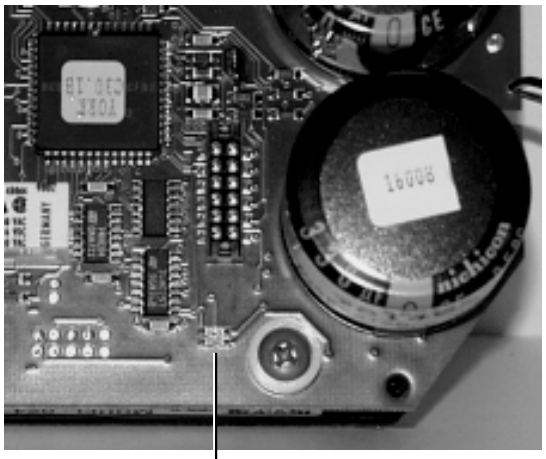
OUTPUT--HI SPEED THRUST SOL--1, 9 MORE

FAULT INDICATIONS FROM THE VSOP DRIVE

OIL PUMP DRIVE STATUS LED

The VSOP drive has a drive status LED located in the lower right corner on the control board near the mounting screw. The panel door for the VSOP drive must be opened to view the drive status LED. The state and color of the LED can determine the status of the VSOP drive. The condition of the LED is as follows:

- A constant GREEN LED will indicate that the VSOP drive is in a running condition with no fault conditions valid.
- A constant RED LED will indicate that the VSOP drive is in a stopped condition, or torque limit during a running condition.
- If the LED is not lit at all, the VSOP drive has failed or the input power has been removed.
- A flashing RED LED will indicate that the VSOP drive is in a faulted condition. The fault conditions are explained below.



VSOP DRIVE OKAY RELAY

The VSOP drive is equipped with a set of normally open contacts. These contacts are open when the VSOP drive is in a faulted condition. These contacts are driven closed when the VSOP drive condition is okay. The contacts are connected between TB1-70 and TB1-1. When the contacts are open a voltage of 115VAC will be measured at the TB1 connections and the chiller will initiate a Cycling Shutdown. The following message will appear on the display when the STATUS key is pressed on the Microcomputer Control Center.

DAY-TIME-OIL PUMP DRIVE - AUTOSTART

Refer to the fault conditions below to determine if the Cycling Shutdown will auto reset. If the shutdown is of the type that will auto reset, the drive okay relay will close the contacts when the fault has cleared. If the shutdown is not of the type that will auto reset, the drive okay relay will not close the contacts unless the input power to the VSOP drive is removed for 30 seconds and reapplied.

AUTO RE-SETTABLE SHUTDOWNS

When the VSOP drive okay relay de-energizes one of the following faults has occurred.

Heatsink Overtemperature

The temperature of the VSOP drive heatsink has exceeded 100ºC. The VSOP drive will restart automatically when the heatsink temperature is less than 100ºC.

Possible Problems:

The drive is located in a location that is too hot. The mechanical room may be too hot, or the location of the VSOP drive may be too close to the discharge of the compressor.

Possible Soultions:

Locate the VSOP drive in a cooler location. Move the VSOP drive away for the discharge of the compressor.

Undervoltage

- A 230 volt unit will fault if the input voltage falls below 140VAC for a period of time greater than 40 seconds or instantly if the input voltage is less than 139VAC.
- A 460 volt unit will fault if the input voltage falls below 280VAC for a period of time greater than 40 seconds or instantly if the input voltage is less than 279VAC.
- A 460 volt unit with a 575VAC line and a transformer will fault if the input voltage falls below 350VAC for a period of time greater than 40 seconds or instantly if the input voltage is less than 349VAC.

The VSOP drive will restart automatically 10 seconds after the fault has cleared.

Possible Problems:

There may be noise on the input line, or the line voltage may not be correct.

Possible Solutions:

Verify the input voltage.

Overvoltage

- A 230 volt unit will fault if the input voltage is higher than 254 VAC.
- A 460 volt unit will fault if the input voltage is higher than 508 VAC.
- A 460 volt unit with a 575VAC line and a transformer will fault if the input voltage is higher than 635 VAC.

The VSOP drive will restart automatically in 10 seconds after the fault has cleared.

Possible Problems:

The input voltage may not be correct. Power factor correction capacitors or other VSD's on the same input line can distort the line voltage causing the VSOP drive to fault.

Possible Solutions:

Verify the input voltage. Refer to known problems on page 3 of this form.

NON AUTO RESETTABLE SHUTDOWNS

Overload

The overload shutdown is based on a high level of current over a period of time.

- 230 volt unit, the overload timer starts timing when output current is greater than 7.5 amps, and will shut down in 5 minutes. The time is reduced as the current is increased, at 8.5 amps a shutdown will occur in 40 seconds.
- 460 volt, the overload timer starts timing when output current is greater than 4.1 amps, and will shut down in 5 minutes. The time is reduced as the current is increased,at 4.3 amps a shutdown will occur in 40 seconds.

The VSOP drive will restart when input power is removed for 30 seconds and reapplied.

Possible Problems:

Something maybe binding up the oil pump i.e. dirt in the oil or other material from manufacturing.

Possible Solutions:

Reverse the direction of the oil pump. This may free up the oil pump.

Connect the motor across the line voltage using an overload protector. This may also free up the oil pump.

Clean the oil.

Output line to line short

- Motor is shorted or wires are shorted at the VSOP drive output terminal block.

The VSOP drive will restart when input power is removed for 30 seconds and reapplied.

Possible Problems:

The VSOP drive output maybe shorted. The motor maybe shorted phase to phase or phase to ground.

The VSOP drive output filter board maybe shorted.

Possible Solutions:

Refer to the troubleshooting guide for blown input fuses.

Locked Rotor

- The rotor of the motor is locked and will not rotate.

The VSOP drive will restart when input power is removed for 30 seconds and reapplied.

Possible Problems:

Dirt from the oil may be jammed in the oil pump.

Possible Solutions:

Reverse the direction of the oil pump. This may free up the oil pump.

Connect the motor across the line voltage using an overload protector. This may also free up the oil pump.

Clean the oil.

TROUBLESHOOTING GUIDE (MOD D CHILLERS)

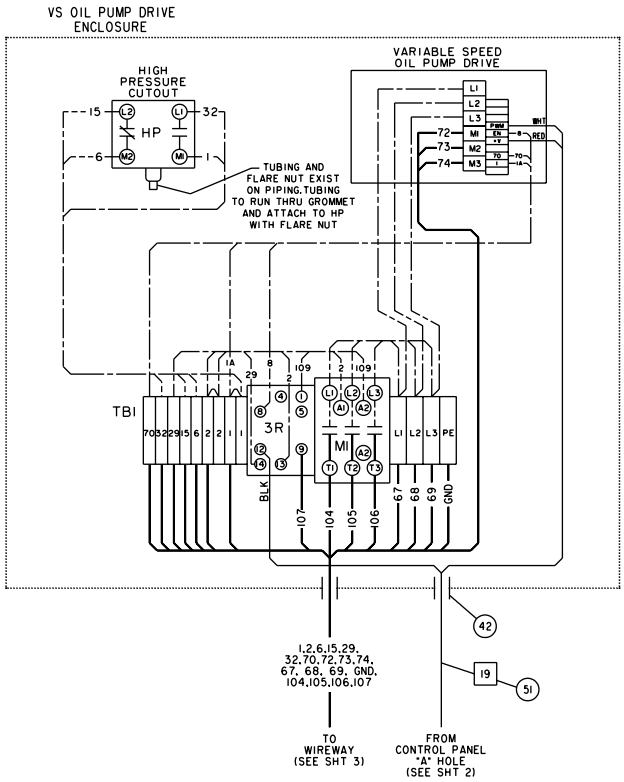
PROBLEM	MEASUREMENTS REQUIRED	SOLUTION
Blown Input Fuses or the status LED is not lit.	1. Remove input wires, L1-L3 from the VSOP drive, measure resistance, input phase to phase on the VSOP drive. 2. Remove wires M1-M3, measure resistance, output phase to phase on the VSOP drive. 3. Inspect components on VSOP drive output filter board. Remove T1-T3 wires from VSOP drive output filter board. Measure resistance phase to phase.	1. (a) If input is shorted, replace VSOP drive. 1. (b) If input is not shorted, replace L1–L3 and continue to the next step. 2. (a) If output is shorted, replace VSOP drive. 2. (b) If output is not shorted, replace M1-M3, and continue to next step. 3. (a) If any components are visibly damaged, replace VSOP drive output filter board. 3. (b) If any shorts or opens are detected, replace VSOP drive output filter board. 4. Replace the blown input fuses.
Status display on the Microcomputer Control Center reads OIL PUMP DRIVE–AUTOSTART, and the status LED is flashing RED on the VSOP drive.	1. Refer to the Auto Re-settable and Non-Re-settable shutdowns in the previous section.	1. Correct for any of the fault conditions in the previous section.
Status display on the Microcomputer Control Center reads OIL PUMP DRIVE – AUTOSTART, but the status LED is a constant RED on the. VSOP drive.	1. Measure voltage between terminal #1on the VSOP drive and Ground. 2. Measure voltage between TB1-70 on the digital input board and ground.	1. (a) If 0 VAC is measured, replace VSOP drive. 1. (b) If 115 VAC is measured, continue to the next step. 2. (a) If 0 VAC is measured, verify wiring between terminal #1 on the VSOP and TB1-70. Replace wire if required. 2. (b) If wiring is okay, verify operation of the digital input board and Microcomputer Control Center. Replace parts as needed.
Trying to start the VSOP drive, but the VSOP drive will not start and the status LED is a constant RED.	1. Measure voltage between terminal V+ on the VSOP drive and ground on the power supply board. 2. Manually start the VSOP drive from the Microcomputer Control Center. Measure voltage between terminal EN on the VSOP drive and ground. 3. Remove wire #29 from TB3 on the relay output board and connect to wire #1.	1. (a) If 0 VDC is displayed, verify wiring from V+ to the power supply board. 1. (b) If 12 VDC is measured, continue to the next step. 2. (a) If 12 VDC is displayed, verify wiring from EN to the power supply board. 2. (b) If 0 VDC is measured, continue to the next step. 3. (a) If VSOP drive starts, verify wiring to relay output board and micro board. 3. (b) If VSOP drive does start, replace 3R. If VSOP drive still does not start, replace VSOP drive.

PROBLEM	MEASUREMENTS REQUIRED	SOLUTION
Oil pressure will not regulate to the setpoint in automatic mode.	1. None	1. (a) Verify wiring between VSOP drive, refrigerant level control board and micro board. 1. (b) If wiring is okay, continue to the next step. 2. Connect the Run signal to ground. Remove J4-1 and connect it to J4-2. The oil pressure should maintain a minimum pressure. Connect J4-1 to ground. The oil pressure should increase. If the oil pressure does not increase, replace the VSOP drive. 3. Remove the wire from J10-2 on the micro board. Connect a 10K resistor to J10-2 and +12V supply. Program the oil pump for 45Hz. Connect a meter across the resistor. The reading should not be 0V or 12V, but around 6V. If the voltage is 0V or 12V, replace the micro board. If the voltage is 6V, replace refrigerant level control board.
VSOP drive will shut down and autostart everyday at the same time.		1. Refer to the second paragraph under Known Problems on Page 3.
The oil pump motor rotation is reverse.		1. Reverse two of the wires on M1-M3 of the VSOP drive.

DRIVE REPLACEMENT INSTRUCTIONS

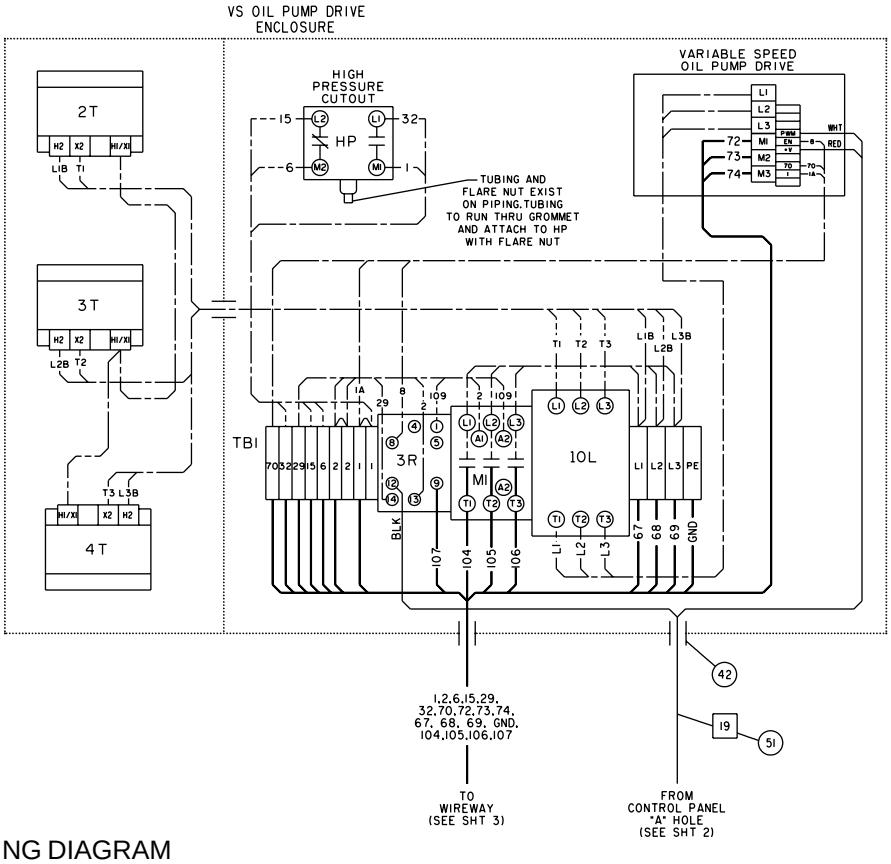
1. Remove power from the chiller at the main power disconnect.
2. Wait 5 minutes for the DC Bus Voltage to decay to a safe level.
3. Take note of all wiring connected to the VSOP drive.
4. Remove all wiring from VSOP drive.
5. Remove the four screws on the VSOP drive and the two screws holding the power resistor to the right of the VSOP drive.
6. **Carefully**, remove the VSOP drive from the heatsink. **Do not** nick or scratch the heatsink.
7. Clean the heatsink with a rag and rubbing alcohol.
8. Apply a thin coating of Heatsink grease (013-02997-000) to the bottom of the VSOP drive.
9. Replace the VSOP drive and install the four mounting screws using a torque of 18-20 ft.-lb.
10. Mount the power resistor to the right of the VSOP drive.
11. Rewire the VSOP drive using Figure 3 on the next page.
12. Reapply power to the chiller at the main power disconnect.

WIRING FOR 230V
AND 460V UNITS



- OR -

WIRING FOR 346V
AND 600V UNITS



LD04378

FIG. 3 – SYSTEM WIRING DIAGRAM

MOST FREQUENTLY ASKED QUESTIONS

1. **Why doesn't the rotation of the motor change when I change the input wiring to the VSOP drive?**

   The VSOP drive converts the input line into a DC bus voltage then converts the DC bus voltage back into an AC voltage with a varying frequency. So, the output section of the drive isolates the output from the input of the drive.

2. **How is oil pressure regulated?**

   A differential oil pressure setpoint is programmed through the Microcomputer Control Center. This setpoint is then used to regulate the oil pressure. The speed of the oil pump motor will increase if the oil pressure is less than the setpoint by 0.5 PSID. Also, the speed of the oil pump motor will decrease if the oil pressure is greater than the setpoint by 0.5 PSID.

3. **On a 50 Hz installation, how can the VSOP drive still run at 60 Hz?**

   Normal operation of a motor requires that the increase in frequency and the increase in voltage occur at the same rate. This is called linear volts/Hz curve. If the supply voltage for 50 Hz is the same as 60 Hz, then the drive can develop enough voltage to supply a 60 Hz motor. The gating of the output power devices determines the output frequency, not the input frequency to the VSOP drive.

4. **What are the differences between the Solid State Starter (SSS) and a VSOP drive?**

   The SSS reduces the amplitude of the voltage applied to the motor during start-up, by gradually turning on SCR's connected to the input line. Inrush current is reduced since the voltage applied to the motor is reduced. This method of controlling a motor has no effect on the frequency of the voltage. When full voltage is applied to the motor the SCR's are fully turned on. The VSOP drive is the same as a Variable Speed Drive. This type of drive employs an input stage, an energy storage stage, and an output stage. The input stage converts the AC input into a DC supply by rectifying the input line voltage. The DC supply is stored in the energy storage stage. The energy is stored in a capacitor bank. The stored energy is then converted into a varying voltage and frequency in the output stage. The output stage uses very fast switches that switch with a constant frequency (of about 6 KHz) but with a varying duty cycle. The varying duty cycle allows the output to vary in frequency and voltage.

5. **Can the VSOP drive be bypassed and run the oil pump motor directly across the line?**

   Yes, but the oil pressure will not be regulated. The chiller will shutdown on high oil pressure. This should be done to troubleshoot the motor or the VSOP drive only.

6. **Can I read the VSOP output frequency with a hand-held meter?**

   Yes, but the meter reading will not be correct. The output frequency of the VSOP drive is actually several KHz. This frequency is what is called the carrier frequency. The motor acts like a filter to the carrier frequency and the fundamental frequency, or 60 Hz, is what is left. The hand-held meter will detect the carrier frequency, but not the fundamental frequency.

REMOTE KEYPAD UNIT

OPERATING INSTRUCTIONS

The Remote Keypad Unit (RKU) is a portable, handheld accessory for use with the YORK International Variable Speed Oil Pump Drive (VSOP). When connected to a VSOP drive, the Remote Keypad Unit provides the ability to view the different controls within the VSOP drive. Typically, the RKU will be used to determine what condition is causing the VSOP drive to fault. The RKU is available from the Baltimore Part Center with the following part number WAEXRK01. (Yes this is a real YORK part number and the last two digits are zero, one.) Operation of the RKU is covered in Form 160.00-NO7.

SERVICE PARTS LIST

VSOP DRIVE 230 VAC UNIT	024-30468-001
VSOP DRIVE 460 VAC UNIT	024-30468-002
INPUT FUSES with a Liquid Cooled Solid State Starter	
200, 208, 220, 230, 240 Volts	025-25584-000 (FNQ-15)
380, 400, 415, 440, 460, 480 Volts	025-25515-000 (FNQ-7)
550, 575, 600 Volts	025-27971-000 (KTK-10)
INPUT FUSES with a VSD Compressor Drive	025-25515-000 (FNQ-7)
HEATSINK GREASE	013-02997-000
RELAY 3R	024-27806-000
SUPPRESSOR FOR RELAY 3R	024-26598-000
OUTPUT FILTER BOARD	031-01739-000
STEP DOWN TRANSFORMER FOR 575 VAC INSTALLATIONS	025-33233-000

YK MOD E CHILLERS ONLY
VSD OIL PUMP GENERAL INFORMATION

OBJECTIVE

This section will only cover the changes between the Mod. “D” chiller and the Mod. “E” chiller as they pertain to the VSD oil pump drive. The changes will include an updated troubleshooting guide for the Mod. “E” chiller.

VSD OIL PUMP DRIVE OVERVIEW

The VSD oil pump (VSOP) drive used in the Mod. “E” YK chiller is the same as the VSOP drive used in the Mod. “D” YK chiller, described on pages 3 thru 17.

Refer to pages 3 thru 17 for detailed information about fault messages and troubleshooting of the VSOP drive on a Mod. “D” YK chiller.

Refer to form 160.55-O1 for information about operation of the various features of the VSOP drive on the Mod. “E” YK chiller.

Refer to form 160.55-M1for information about updated fault messages, and details about the software operation of the VSOP drive as it pertains to the Graphic Control Center.

SAFETY SHUTDOWNS

PRESSURE SETPOINT NOT ACHIEVED

The Safety shutdown **OIL – VARIABLE SPEED PUMP – PRESSURE SETPOINT NOT ACHIEVED** has replaced the message for **HIGH OIL FLOW.**

If either of the following conditions occur, a safety shutdown is initiated and **OIL – VARIABLE SPEED PUMP – PRESSURE SETPOINT NOT ACHIIEVED** is displayed

a. If the oil pressure is < 35.0 PSID for 5 continuous seconds during the last 10 seconds of the compressor pre-lube or during the first 15 seconds of SYSTEM RUN.
b. If the oil pressure is < the programmed **OIL PRESSURE SETPOINT** and the speed command is at 60Hz for 5 continuous seconds, anytime after the first 30 seconds of SYSTEM RUN.

The **OIL – VARIABLE SPEED PUMP – PRESSURE SETPOINT NOT ACHIIEVED** safety checks are not performed during MANUAL SPEED control whether the chiller is running or not.

DIAGNOSTIC SOFTWARE

The diagnostic software no longer supports the VSOP drive, since the VSOP drive is now directly controlled from the Micro Board.

VSOP DRIVE OKAY RELAY

The VSOP drive is equipped with a set of normally open contacts. These contacts are open when the VSOP drive is in a faulted condition. These contacts are driven closed when the VSOP drive condition is okay. The contacts are connected between TB3-70 and TB3-1 on the I/O board. When the contacts are open a voltage of 115VAC will be measured at the TB3 connections and the chiller will initiate a Cycling Shutdown with the following message appear on the display **OIL VARIABLE SPEED PUMP - DRIVE CONTACTS OPEN**. Refer to the fault conditions below to determine if the Cycling Shutdown will auto reset. If the shutdown is of the type that will auto reset, the drive okay relay will close the contacts when the fault has cleared. If the shutdown is not of the type that will auto reset, the drive okay relay will not close the contacts unless the input power to the VSOP drive is removed for 30 seconds and reapplied.

AUTO RE-SETTABLE SHUTDOWNS

Refer to the Troubleshooting Guide on pages 13 and 14 for detailed information about fault messages and troubleshooting of the VSOP drive on a Mod. “D” YK chiller.

NON AUTO RESETTABLE SHUTDOWNS

Refer to the Troubleshooting Guide on pages 13 and 14 for detailed information about fault messages and troubleshooting of the VSOP drive on a Mod. “D” YK chiller.

TROUBLESHOOTING GUIDE
(MOD E CHILLERS)

PROBLEM	MEASUREMENTS REQUIRED	SOLUTION
Blown Input Fuses or the status LED is not lit.	1. Remove input wires, L1-L3 from the VSOP drive, measure resistance, input phase to phase on the VSOP drive. 2. Remove wires M1-M3, measure resistance, output phase to phase on the VSOP drive. 3. Inspect components on VSOP drive output filter board. Remove T1-T3 wires from VSOP drive output filter board. Measure resistance phase to phase.	1. (a) If input is shorted, replace VSOP drive. 1. (b) If input is not shorted, replace L1–L3 and continue to the next step. 2. (a) If output is shorted, replace VSOP drive. 2. (b) If output is not shorted, replace M1-M3, and continue to next step. 3. (a) If any components are visibly damaged, replace VSOP drive output filter board. 3. (b) If any shorts or opens are detected, replace VSOP drive output filter board. 4. Replace the blown input fuses.
Status display on the Microcomputer Control Center reads OIL PUMP DRIVE–AUTOSTART, and the status LED is flashing RED on the VSOP drive.	1. Refer to the Auto Re-settable and Non-Re-settable shutdowns in the previous section.	1. Correct for any of the fault conditions in the previous section.
Status display on the Microcomputer Control Center reads OIL PUMP DRIVE – AUTOSTART, but the status LED is a constant RED on the VSOP drive.	1. Measure voltage between terminal #1 on the VSOP drive and Ground. 2. Measure voltage between TB3-70 on the digital input board and ground.	1. (a) If 0 VAC is measured, replace VSOP drive. 1. (b) If 115 VAC is measured, continue to the next step. 2. (a) If 0 VAC is measured, verify wiring between terminal #1 on the VSOP and TB1-70. Replace wire if required. 2. (b) If wiring is okay, verify operation of the digital input board and Microcomputer Control Center. Replace parts as needed.
Trying to start the VSOP drive, but the VSOP drive will not start and the status LED is a constant RED.	1. Measure voltage between terminal V+ on the VSOP drive and ground. 2. Manually start the VSOP drive from the Graphic Control Center. Measure voltage between terminal EN on the VSOP drive and ground.	1. (a) If 0 VDC is measured, verify wiring from V+ on the VSOP drive to the J20-2 connector on the Micro Board. If the wiring is okay, then replace the Micro Board. 1. (b) If 12 VDC is measured, continue to the next step. 2. (a) If 12 VDC is measured, verify wiring from EN on the VSOP drive to the J20-3 on the Micro Board. 2. (b) If 0 VDC is measured, replace VSOP drive.

PROBLEM	MEASUREMENTS REQUIRED	SOLUTION
Oil pressure will not regulate to the setpoint in automatic mode.	1. None 2. Manually start the VSOP drive from the Graphic Control Center. Measure voltage between terminal EN on the VSOP drive and ground.	1. (a) Verify wiring between VSOP drive and Micro Board. 1. (b) If wiring is okay, continue to the next step. 2. Connect the EN signal to ground. Remove J20-1 and connect it to J20-2. The oil pressure should maintain a minimum pressure and the VSOP drive should run at 25 Hz. Connect J20-1 to ground. The oil pressure will increase. The VSOP drive should run at 60 Hz. If the oil pressure does not increase, replace the VSOP drive. 3. Remove the wire from J20-1 on the micro board. Connect a 10K resistor to J20-1 and +12V supply. Program the oil pump for 45Hz. Connect a meter across the resistor. The reading should not be 0V or 12V, but around 6VDC. If the voltage is 0V or 12V, replace the micro board.
The chiller is shut down on **OIL – LOW DIFFERENTIAL PRESSURE** and the LED on the VSOP drive is green.		1. Verify operation of the low and high oil pressure transducers. 2. Verify the connections of the EN wire between the VSOP drive and the Micro Board.
VSOP drive will shut down and autostart every day at the same time.		1. Refer to the second paragraph under Known Problems on Page 3.
The oil pump motor rotation is reverse.		1. Reverse two of the wires on M1-M3 of the VSOP drive.

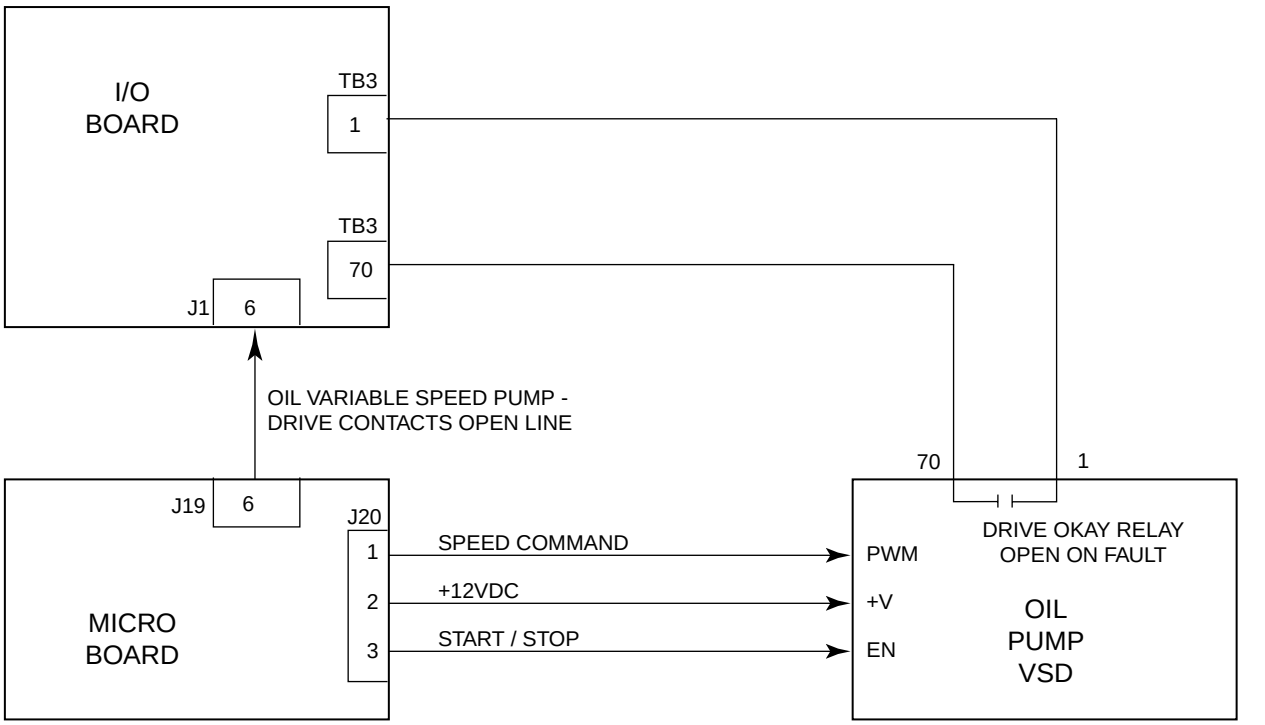


FIG. 4 – OIL PUMP VSD – INTERFACE

P.O. Box 1592, York, Pennsylvania USA 17405-1592

Form 160.52-M2 (899)
Supersedes: Nothing