



BY JOHNSON CONTROLS

# Service Information

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201.21-NM4, 201.23-NM1, 201.23-NM2

**SI0219**

**211**

**Equipment Affected:** YCAV & YCIV Chillers

**LOW SUCTION PRESSURE AND HIGH  
FLASH TANK FAULT TROUBLESHOOTING**

## GENERAL

This instruction is intended as an aid for diagnosing the many causes of low suction pressure and high flash tank faults on YCAV and YCIV chillers. Due to the complexity of these chillers, this instruction should only be used by technicians who have completed factory training on this equipment or who have demonstrated skills troubleshooting electrical, VSD and mechanical equipment problems on YCAV/YCIV products. In addition, technicians working on these products must have an IOM and electrical safety training. It is also very important that technicians using this instruction should not change programmed chiller parameters other than those specifically indicated in this instruction, since it could cause damage to the chiller. When testing is completed, all modified programming parameters must be returned to their original values. Review the entire document before using it for troubleshooting, since this instruction is not intended to be used as a sequential procedure. The use of specific tests and the sequence of applying them will vary.

This letter is not intended for the following purposes:

- As a notification to pro-actively test or pro-actively change any component on any chiller and should only be used when troubleshooting “actual” repetitive system faults related to low suction pressure or a high flash tank level.
- To imply warranty.
- To outline every possible cause of a low suction pressure or high flash tank fault. Always utilize experience and good troubleshooting practices in conjunction with this document.

## SAFETY

Always follow Johnson Controls safety policy practices when performing any checks outlined in this instruction. Turn power OFF and assure the DC bus voltage is less than 5VDC whenever working inside the panel. Always check the DC bus with a meter to verify the voltage is less than 5VDC. Wear protective clothing as required per the Johnson Controls policy when making any checks on live circuitry or working near live circuitry.

Work on this equipment should only be done by properly trained personnel who are qualified to work on this type of equipment. Failure to comply with this requirement could expose the worker, the equipment and the building and its inhabitants to the risk of injury or property damage.

The instructions on this service bulletin are written assuming the individual who will perform this work is a fully trained HVAC & R journeyman or equivalent, certified in refrigerant handling and recovery techniques, and knowledgeable with regard to electrical lock out/tag out procedures. The individual performing this work should be aware of and comply with all Johnson Controls, national, state and local safety and environmental regulations while carrying out this work. Before attempting to work on any equipment, the individual should be thoroughly familiar with the equipment by reading and understanding the associated service literature applicable to the equipment. If you do not have this literature, you may obtain it by contacting a Johnson Controls Service Office.

Should there be any question concerning any aspect of the tasks outlined in this bulletin, please consult a Johnson Controls Service Office prior to attempting the work. Please be aware that this information may be time sensitive and that Johnson Controls reserves the right to revise this information at any time. Be certain you are working with the latest information.

**Product Technical Support**

## TOOLS

- Chiller IOM (YCAV or YCIV as needed)
- Flashlight
- Manifold Gauges
- Thermocouple Temperature Tester

## OPERATION OF THE FEED VALVE, FLASH TANK, DRAIN VALVE & LEVEL SENSOR SYSTEM

The operation of the flash tank and feed/drain valves, for the purposes of troubleshooting, is much like a storage tank and two valves. The feed valve is on the inlet of the flash tank (storage tank) and is nothing more than a fill valve for the purpose of keeping a level in the flash tank (storage tank). The feed valve is designed to work slowly to correct for level changes in the flash tank (storage tank) and responds to the level based on the output of the level sensor. The slow reaction avoids affecting refrigerant metering control performed by the drain valve. The drain valve is on the outlet of the flash tank (storage tank) and acts as a system TXV to control refrigerant flow to the evaporator based on suction superheat. The drain valve corrects for changes in suction superheat quickly, as is typical for an expansion valve device, to avoid slugging the compressor with liquid refrigerant.

While the microprocessor tries to control the level in the flash tank to 35%, it will do so slowly over time and will only control to this level when the flash tank economizer valve is open. In many cases, the level will be below the 35% point when the economizer solenoid valve is open. When the economizer solenoid valve is closed, the level will often be well below 35% in most instances, since the flash tank is acting like a pipe. With the valve closed, the chiller microprocessor will not try to control the level in the flash tank to 35%, since no subcooling is required to take place in the flash tank.

The flash tank sight glass is at a tank level that corresponds to a 32% level at the bottom of the sight glass, 35% at the middle of the sight glass and 38% at the top of the sight glass. These values will be of use when troubleshooting level sensor faults.

## LOW SUCTION PRESSURE FAULTS CAUSED BY LOW FLOW

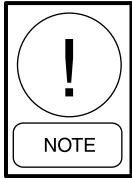
Check approximate flow across the evaporator using a flow meter or the pressure drop charts in the IOM. If flow is near the minimum or below the minimum allowed in the IOM, it may be causing the low suction pressure fault. Running a single system on the chiller and checking the temperature differential across the evaporator (return minus leaving water temp) is also a quick means for checking for low flow, if the flow cannot be measured using a flow meter or there is doubt about the accuracy of the flow pressure drop measurement. **Low flow should be suspected, if only a single compressor on the chiller is running “fully loaded” on a two system chiller and a resulting temperature differential greater than 8° F degrees across the evaporator is observed. On a three compressor system, greater than 5.3° F of temperature differential with a single compressor running is suspect and on a four compressor system, greater than 4° F with only a single compressor running is suspect.**

## LOW SUCTION PRESSURE FAULTS CAUSED BY LOW SUBCOOLING

Low refrigerant charge is often responsible for low suction pressure faults. Run the suspect system to full speed and check for bubbles or a loss of liquid in the liquid line sight glass. A full column of liquid should normally be observed in the liquid line sight glass except during transients, such as fan cycling or a rapid speed increase. If there is no liquid or there are bubbles consistently observed in the sight glass, the system is under charged or there are non-condensables in the system. Check the “liquid line subcooling” of the system. The “liquid line subcooling” should normally be 7 to 12° F on a 95° F day. If needed, turn fans OFF to approximately duplicate these conditions in colder ambients. If high subcooling is noted along with bubbles in the sight glass, there are non-condensables in the system. To verify correct charge, check subcooling along with verifying there are no bubbles in the sight glass. Do not weigh the charge, it wastes time and is usually not necessary. Always measure liquid pressure as close to the feed valve as possible on the liquid line and measure liquid line temperature as close as possible to the feed valve when checking “liquid subcooling”.

## LOW SUCTION PRESSURE FAULTS CAUSED BY AN INCORRECT TRANSDUCER OUTPUT

The suction pressure transducer can easily be checked by installing a manifold gauge on the suction line and comparing the micro panel display reading to the gauge. The two readings should be reasonably close. Make sure that your manifold gauges are reading correctly before condemning the transducer, since gauge accuracy is very important when working with R-134A at low pressures.

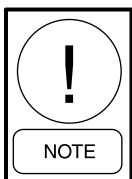


*There is rarely a need to check transducer voltages, since the micro panel is acting as a digital meter and converting the voltage for you. If there is still doubt the micro panel is reading the pressure correctly, the transducer from the suspect system can be plugged into the input of another system that is providing a correct reading. Gauge reading comparison on a properly operating system versus the panel display is also a useful means of checking gauge accuracy.*

## LOW SUCTION PRESSURE FAULTS CAUSED BY A DEFECTIVE FEED OR DRAIN VALVE

A defective feed or drain valve may cause low suction pressure faults. A defective feed valve that causes a low suction pressure fault will often be accompanied by a legitimate 0% (empty) flash tank level or very low actual flash tank level percentage resulting from lack of refrigerant flow. It will also appear that the feed valve is opening appreciably more than other system (s) on the chiller when the feed valve percentage is viewed. If feed valve operation problems are suspected, operate the valve in the SERVICE mode (*see IOM for instructions on how to use the SERVICE mode*). Assure the valve is operating by viewing the valve sight glass while running it from 0% to 100% and 100% to 0%. The valve should visibly open and close smoothly. When the test is complete, be sure to close the valve to the 0% position and recycle power to the system. This test cannot be performed on some old style valves, since they were not produced with integral sight glasses. The only tests that can be performed without sight glasses are audibly listening for valve motor operation or touching the valve to feel possible internal movement while the valve is operated from 0% to 100% and 100% to 0%. Be aware that audible noise and feeling the valve only assures the motor is operating, it does not allow diagnosis of a valve that is sticking or uncoupled/broken from the drive motor. Sometimes the noise level and feel can be compared to the other system, if the valve is suspect. Always check any plugs in the wiring between the feed valve and valve controller as well as the chiller microprocessor board and the valve controller, since a bad connection or corrosion on the pins will cause problems with valve operation and possibly cause the valve to lose steps. With power off, check the feed valve and controller wiring after a controlled chiller shutdown.

A defective drain valve will often appear to be open near the 100% point if it is defective and starving the evaporator. If a drain valve operation problem is suspected, operate the valve in the SERVICE mode (*see IOM for instructions on how to use the SERVICE mode*). Assure the valve is operating by viewing the valve sight glass while running it from 0% to 100% and 100% to 0%. The valve should visibly open and close smoothly. When the test is complete, be sure to close the valve to the 0% position and recycle power to the system. This test cannot be performed on some old style valves, since they were not produced with integral sight glasses. The only tests that can be performed without sight glasses are audibly listening for valve motor operation or feeling the valve while the valve is operated from 0% to 100% and 100% to 0%. Be aware that audible noise and feeling the valve only assures the motor is operating, it does not allow diagnosis of a valve that is sticking or uncoupled/broken from the drive motor. Sometimes the noise level and feel can be compared to the other system, if the valve is suspect. Always check any plugs in the wiring between the drain valve and valve controller as well as the chiller microprocessor board and the valve controller, since a bad connection or corrosion on the pins will cause problems with valve operation and possibly cause the valve to lose steps. Check valve wiring after a controlled shutdown, with power off.



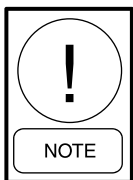
*Keep in mind that a low suction fault with a drain valve position near 100% and a micro panel display level indicating more than about 5% in the flash tank is often caused by a defective level sensor outputting a higher than actual level, rather than a bad drain valve. Check the level sensor accuracy, since the flash tank is likely empty, although it indicates a reasonable level that should allow the system to operate. Use the following procedure for checking the level sensor. Be aware that in almost all cases, drain and feed valves that are replaced are not defective. Contact Product Technical Support before changing a feed or drain valve.*

## LOW SUCTION PRESSURE FAULTS CAUSED BY AN INCORRECT LEVEL SENSOR OUTPUT

Level sensors that cause actual low suction pressure faults typically have a positive offset error of more than 10% based on the micro panel display percentage. For example, if the level is actually 35%, but the display indicates 45%, it is exhibiting a positive error offset of 10%. Normally, a problem sensor will read high in comparison to the actual tank level. If the sensor reading is more than a value of 10% above the actual level percentage, there is a risk of the flash tank running out of refrigerant when discharge pressures are low or the compressor is accelerating. When the flash tank runs out of refrigerant due to level sensor error, the drain valve is unable to control superheat and suction pressure drops. In some cases, the system only goes into suction limiting and will not accelerate in speed. In other cases, it will fault on low suction pressure. When a level sensor provides an output in error above the actual level, it may be telling the microprocessor that the flash tank has a level when it is actually empty or virtually empty. With a display level indicating between 5 to 10% or more when the flash tank is actually empty, the microprocessor believes the level is temporarily sufficient and may not react fast enough to raise the level, especially if the economizer valve is closed and the flash tank is simply acting like a pipe.

Whenever a level sensor is suspected of causing low suction pressure faults, the history buffer should be reviewed. When the flash tank is empty and the evaporator is starved, you will often find the drain valve position near 100% in the history (typically over 90%) at the time of the fault. This is a good indication the drain valve is wide open trying to control superheat. Looking further at the history data, you will typically see the flash tank level at 5% or higher, although the tank may be empty in terms of real refrigerant level. If the feed or drain valves are suspected, operate the drain and feed valves in the SERVICE mode to assure they open and close properly to rule out a problem valve, wiring, or controller. *See the drain and feed valve checks* under the section “Low Suction Pressure Faults Caused By a Defective Feed or Drain Valve” located on page 3 of this document.

If low suction pressure faults have been or are occurring while the drain valve is between 90 and 100% open when the fault occurred and there is a solid column of liquid in the liquid line sight glass when the chiller is fully loaded during operation, the following procedure can be used to run the system and verify the accuracy of the level sensor and the possibility of it causing the problem.



***There must be a solid column of liquid in the liquid line sight glass before performing the test. If there are bubbles in the sight glass or it is believed to be empty, measure subcooling and assure it is between 7 and 12° F fully loaded. If there are bubbles in the glass and the subcooling is high, it's likely there are non-condensables in the system. There is no need to weigh charge if subcooling is low, just add a little charge to increase it to the recommended value and assure the sight glass is clear.***

1. Before starting the test on a system, be sure the load is high enough to cause the economizer valve to open. The other system or systems may need to be temporarily turned off. It will be easier to obtain a level in the sight glass once the economizer valve opens.
2. Run the system until a level is obtained in or near the middle of the flash tank sight glass. The microprocessor level setpoint can be temporarily adjusted upward to speed the process, since the operating level in the flash tank will often run below the level of the sight glass. To adjust the setpoint above or below the microprocessor default setting of 35%, press SERVICE 2878 ENTER on the keypad. Scroll through the SERVICE key displays by pressing the DOWN ARROW key (7) times until the FEED VALVE LEVEL SETPOINT message appears. Key in 45.0 and press ENTER. Be sure to key in the decimal point. 45.0% is a good starting point and it will reduce the time it takes to get the refrigerant level in the glass. This value can be adjusted higher or lower while the system is running, if the level overshoots above or below the sight glass during operation of the system.



***DO NOT change any other programmed point under the password protected displays when changing the Feed Valve Level Setpoint. This could cause damage to the chiller.***

It may take a short period of run time until the level reaches the middle of the glass to allow comparing the sight glass level to the display.

3. The middle of the flash tank sight glass is 35%. When the level is about midway in the glass, read the level percentage on the micro panel display.



***There may be a few second delay between the level sensor recognizing a level change and the micro panel display update. Assure the level stabilizes in the sight glass for a few seconds before recording the display reading. Do not attempt to take the reading if the level is moving as a result of a transient from fan cycling or a speed change.***

Compare the level in the glass at midpoint (35%) to the display and assure the display indicates between 25% and 45%. If the level is not within this range and low suction pressure faults occur, the level sensor should be replaced. If problems occur trying to get the level in the center of the glass, the bottom of the glass is 32% and the top of the glass is 38%, which allows a little flexibility to take a reading anywhere in this range. Keep in mind that the acceptable range is typically an error reading on the chiller display of plus or minus 10%. When verifying level sensor accuracy to resolve low suction pressure faults, the microprocessor panel display reading should be less than 10% above the actual sight glass level percentage. For example, if the sight glass level is determined to be 33%, the highest acceptable micropanel display reading to avoid low suction pressure faults would be 43%.



***When troubleshooting, keep in mind that unless the level sensor is reading a displayed level numerically more than 10% above the actual level in the sight glass, it is unlikely that it is the cause of repeated low suction pressure faults, and should not be changed without contacting factory technical support.***

In some cases, a sensor will display a correct reading but may be intermittent. If this is suspected, “lightly” tap the electronics enclosure of the level sensor with the handle of a screwdriver and watch the display for a significant change in the sensor display. When this type of mechanically intermittent problem is encountered, an erratic response in the level display will be noted. Erratic sensors that rapidly shift in output (display %) are often responsible for systems that exhibit both high flash tank faults and low suction pressure faults. Also, check plugs between the level sensor and the chiller control (microprocessor) board, since a corroded or loose pin connection will cause intermittent or erratic level sensor displays.

## **HIGH FLASH TANK FAULTS CAUSED BY INCORRECT LEVEL SENSOR OUTPUTS**

Level sensors that cause “High Flash Tank Faults” are generally very easy to diagnose. Typically, there will be no obvious level in the flash tank sight glass (bottom of glass equals 32%), while the level display will be significantly higher. Typically there will be an error of plus 15% or more in the level sensor output before a high flash tank fault occurs.

High flash tank level faults are often caused by intermittent sensors that produce an output level spike that intermittently causes a fault. If this is suspected, “lightly” tap the electronics enclosure of the level sensor with the handle of a screwdriver and watch the panel display for an erratic response.

## **REFRIGERANT HANDLING WHEN CHANGING DRAIN VALVES, FEED VALVES OR LEVEL SENSORS**

When changing a drain/feed valve or a level sensor, there is no need to remove refrigerant from the entire system. Refrigerant should only need to be removed from the low side of the refrigerant system. In most cases, the compressor can be run and the majority of the refrigerant can be pumped into the high side of the condenser. To do this, close the liquid line stop valve, open the drain and feed valves to 100% in the SERVICE mode and disconnect the wiring at the plug connectors. Wire 115VAC to the economizer valve. Run the system and allow it to pump down to slightly above 0 PSIG. Turn off the UNIT switch and close the discharge and oil supply line valves. If the system

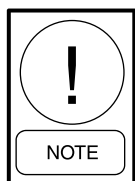
requires multiple runs to pump the system down, open the oil supply line and discharge valves after the anti-recycle timer times out and restart the system. Once the pumpdown is complete, turn off the UNIT switch. Remove power from the chiller. Pump out the remaining refrigerant into a recovery cylinder. Change the defective component using a nitrogen purge when brazing and evacuate the low side to 500 microns and assure the vacuum holds. Install the refrigerant that was recovered, remove the temporary 115VAC wiring to the economizer solenoid and re-connect the drain and feed valve wiring. Turn power on and close the valves in the SERVICE mode. Recycle power. Open the liquid stop valve discharge service valve and oil supply line service valve. The system is now ready to run. Be aware that since most of the refrigerant was pumped into the condenser the system may go down on suction pressure or go into suction limiting during the initial start. The refrigerant should redistribute itself after a couple minutes of operation and the system should run normally.

## VALVE CONTROLLER TROUBLESHOOTING

Valve controllers are rarely a problem. If a valve controller is suspected of causing problems, the easiest method of diagnosing it is to switch the inputs and outputs of two systems at the controller. If the controller is causing the problem, the problem should switch to the opposite system after the wiring change.

## NEW LEVEL SENSOR SUPPLIER

A new level sensor supplier has been qualified. The first of the new sensors (*see Fig.1*) will begin showing up on new chiller start-ups and as spare parts at the beginning of 2010. These sensors also have the capability of simply changing the probe head versus removing the entire sensor when a problem occurs, eliminating the need to remove refrigerant from the low side of the system. They can also be field calibrated to compensate for a supplier calibration error.



***The following two procedures outline changing the sensor head and recalibrating. When recalibrating, DO NOT press any buttons in the sensor other than the specific button indicated. Pressing any one of the other buttons will mis-calibrate the sensor and require the head to be changed.***



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**FIGURE 1 - NEW LEVEL SENSOR SUPPLIER INTRODUCED INTO PRODUCTION 10/09**

## CHANGING THE SENSOR HEAD (ELECTRONICS) ON NEW STYLE SENSORS

Changing the sensor head on new style level sensors is only required if there is a total failure of the electronics or if the sensor displays significant error. The procedure below outlines the simple steps required to perform a sensor head change. The replacement part number for the sensor head is 025-44012-000. Note that the replacement head is factory calibrated and only requires installation.

### Tools

- 1-1/16" hex wrench
- Adjustable wrench (1-9/16" min. opening)
- 1/4" open end wrench
- #2 Phillips or flat blade screwdriver
- Utility knife

### Disconnect Power

1. Shut the chiller down and remove power. Unplug the DIN connector from the head of the level sensor.



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### Remove Sensor Head Cover

2. Cut the "Factory Calibrated" label along the joint of the sensor head cover to break the seal.



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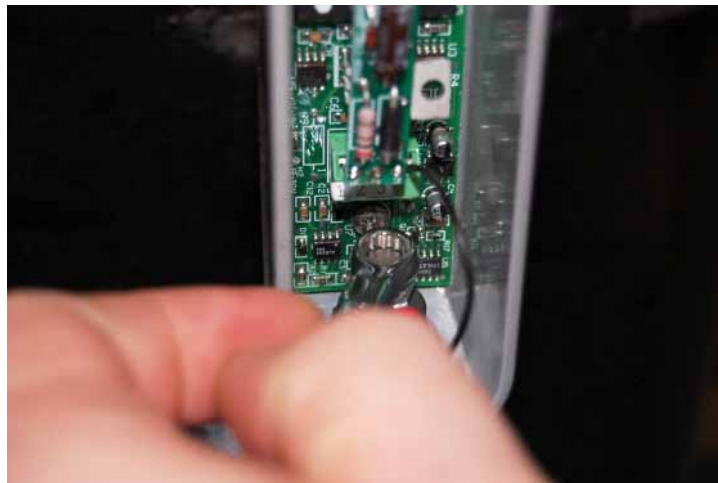
3. Unscrew the (2) cover screws and remove the sensor cover using a #2 Phillips or flat blade screwdriver.



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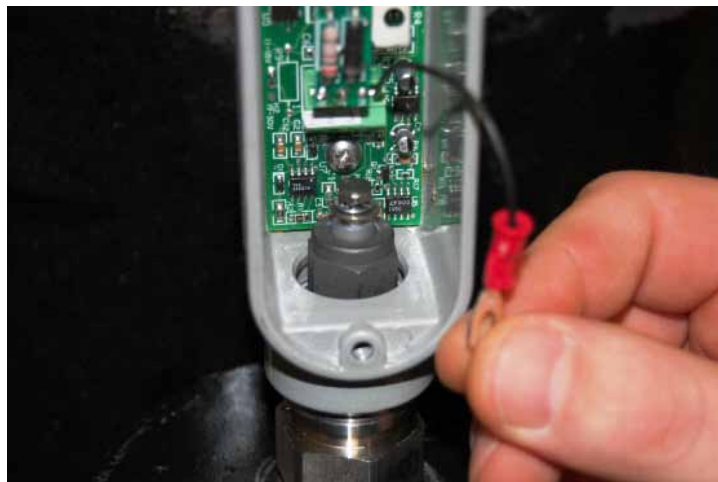
### Remove Probe Wire

4. Loosen the 1/4" hex probe screw using an open end wrench.



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5. Remove the probe connector terminal.



LD14656

## Remove Sensor Head

6. Using a 1-1/16" wrench to hold the probe body hex nut, turn the sensor head with an adjustable wrench.



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7. Remove the sensor head.



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## Install New Head

8. Thread the replacement sensor head onto the probe by hand.



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9. Tighten the electronic head using a 1-1/16" wrench on the probe hex nut and the adjustable wrench on the head.



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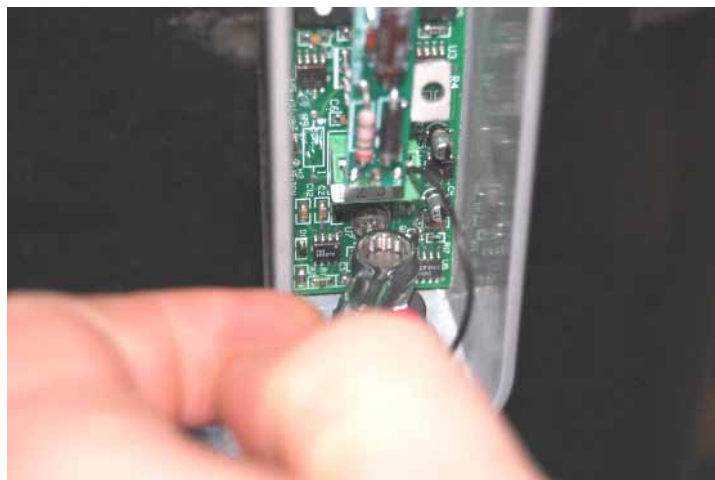
### Connect Probe Wire & DIN Connector

10. Reconnect the probe wire terminal to the probe by inserting the connector between the washers.



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11. Tighten using a 1/4" open end wrench.



LD14662

12. Reconnect the DIN Connector.



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### Install J-box Cover

13. Install the electronic head cover using a #2 Phillips or flat blade screwdriver.



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### VALIDATE OUTPUT READINGS

Repower the chiller to assure the drain and feed valves are returned to the closed position. Turn on the system and obtain a level in the sight glass. Use procedures outlined previously, if needed. Check the output percentage value on control panel versus the liquid level in the flash tank. You should typically expect to see 35% plus or minus 5% when the level is in the center of the sight glass. Contact factory technical support if the error is out of the range of plus or minus 10% with the new sensor head installed.

### RE-CALIBRATING THE NEW STYLE SENSORS

If a significant error in the level sensor display is causing nuisance low suction pressure trips or high flash tank levels, the level sensor can normally be field re-calibrated. The following procedure outlines the steps required to make the adjustment:

1. Use a utility knife and slit the “Factory Calibrated” label along the joint of the sensor cover and head. Unscrew the two cover screws using a #2 Philips screwdriver. Remove the sensor cover.



SLIT LABEL

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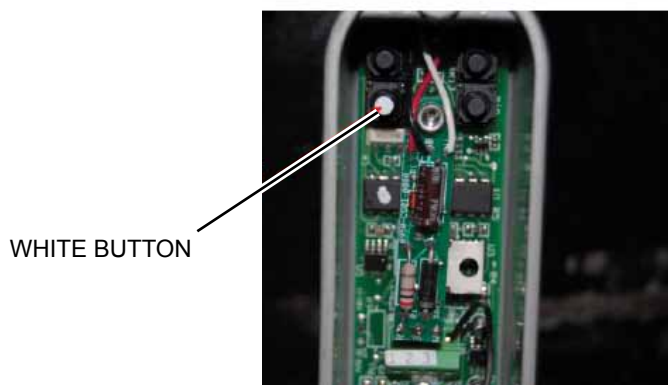


REMOVE SCREWS

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2. Using prior outlined procedures in this document, obtain a refrigerant level in the flash tank sight glass. Although it would be ideal to obtain a level in the exact center of the glass to allow for calibration at 35%, there is enough forgiveness in the system operation that the calibration does not need to be exact. It is also recommended that the level be in the upper half of the flash tank sight glass when the calibration is performed, so the sensor reads a few percent low. Normally, a slightly low reading sensor will not cause a problem and will help assure there is still a level in the tank when the sensor reads very low values.

Although some sensor electronics may be difficult to view directly while in a chiller, orient yourself as needed to view the electronics in the sensor head as if you are directly facing it.



WHITE BUTTON

WHITE BUTTON



PRESS BUTTON ONCE

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Locate the lower of the two pushbutton switches in the upper left hand corner of the sensor head. The lower button will normally be marked with a “white” dot. With the level in the upper half of the flash tank sight glass, momentarily press the “white” button one time. This is all that is necessary to calibrate the sensor to read 35%. The display on the panel will indicate that the calibration change has been made.

3. Re-install the sensor cover to complete the re-calibration procedure.