CFT series
recirculating chillers

NESLAB P/N 000877
Rev. 7 April 1998

Service Manual

Note: This manual contains information on MD30 pumps only. See Manual 000878 for information on PD pumps.

Contents

Safety

Warnings

Make sure you read and understand all instructions and safety precautions listed in this manual before installing or operating your unit. If you have any questions concerning the operation of your unit or the information in this manual, contact our Sales Department for assistance.

Performance of installation, operation, or maintenance procedures other than those described in this manual may result in a hazardous situation and may void the manufacturer's warranty.

Transport the unit with care. Sudden jolts or drops can damage the refrigeration lines.

Do not attempt to defeat any of the interlock switches or safety features built into the unit.

Observe all warning labels.

Never remove warning label.

Never operate damaged or leaking equipment.

Never operate the unit without cooling fluid in the fluid reservoir.

Make sure the unit is off before connecting or disconnecting the power cord or other cables.

Always turn off the unit and disconnect the power cord from the power source before performing any service or maintenance procedures, or before moving the unit.

Always empty the fluid reservoir before moving the unit.

Never operate equipment with damaged power cords.

Refer service and repairs to a qualified NESLAB technician.

In addition to the safety warnings listed above, warnings are posted throughout the manual. These warnings are designated by an exclamation mark inside an equilateral triangle. Read and follow these important instructions. Failure to observe these instructions can result in permanent damage to the unit, significant property damage, or personal injury or death.

General Information

How to decode the unit's part number (example - 394103030200):

394	1	03	03	02	00
MODEL	**CONDENSER**	**ELECTRICAL**	**PUMP**	**CONTROL**	**CATALOG**
337 CFT 150	0 None	▶ 03 115v 60Hz	▶ 03 PD1	01 Analog	▶00 Standard
393 CFT 25	▶ 1 Air cooled	04 208-230v, 60Hz, 1ø	04 PD2	▶ 02 Digital	01-99 Custom
▶ 394 CFT 33		05 208-230v, 60Hz, 3ø	15 MD30		
395 CFT 75		06 220-240v, 50Hz, 1ø			
396 CFT 300		07 220-240v, 50Hz, 3ø			

Table 1

Theory of Operation

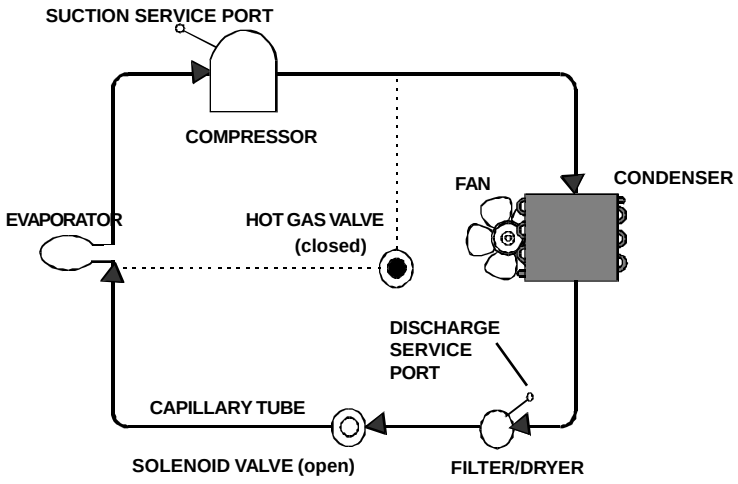
The chiller operates in two modes: COOL and HEAT/IDLE. The controller compares setpoint to actual temperature and decides which mode is required. This is a thermostatic (not proportional) control system. The compressor, pump, and fan motor all run continuously.

The thermal transfer of the HEAT mode is not as efficient as the COOL mode. This results in units running at little or no load to spend most of their time in the HEAT mode with brief periodic COOL periods. A duty cycle of 20% COOL / 80% HEAT may be typical for units running under no load. This duty cycle will reverse as increasing load is applied, reaching 100% COOL / 0% HEAT at full load.

This system results in tighter temperature control than cycling the compressor on and off, as is typical in a household refrigerator.

The default mode is HEAT. A failure of the temperature sensor or controller will generally result in the HEAT mode. This prevents a possible freezing of the cooling fluid and resulting damage.

If the setpoint is below the actual temperature, the controller is in COOL mode. The controller's triac output provides a "closure" to supply line voltage to the **solenoid coil**. The **solenoid valve**, which is normally-closed, is then pulled open by the coil and a standard refrigeration cooling loop exists.



COOL MODE

Figure 2

Refrigerant, as a gas, is pressurized in the **compressor**. It then enters the **condenser** and changes to a liquid due to the cooling provided by the fan and condenser fins. Heat is given up to the air at this point. The liquid refrigerant exits the condenser and passes through a **filter/dryer** which traps contaminants and absorbs any water moisture in its desiccant element. The **discharge service port** is piggybacked on the filter/dryer for service access. The refrigerant then passes through the open **solenoid valve** and enters the **capillary tube**. The restriction of the tube meters the flow. The capillary tube ends at the **evaporator**. The evaporator is a coil located inside the fluid tank. As the liquid refrigerant encounters the increased volume of the evaporator, it expands tremendously, changing from a liquid to a gas, and absorbing heat from the fluid (cooling it) in the process. The refrigerant, now a gas, exits the evaporator then enters the compressor at low pressure and is re-compressed.

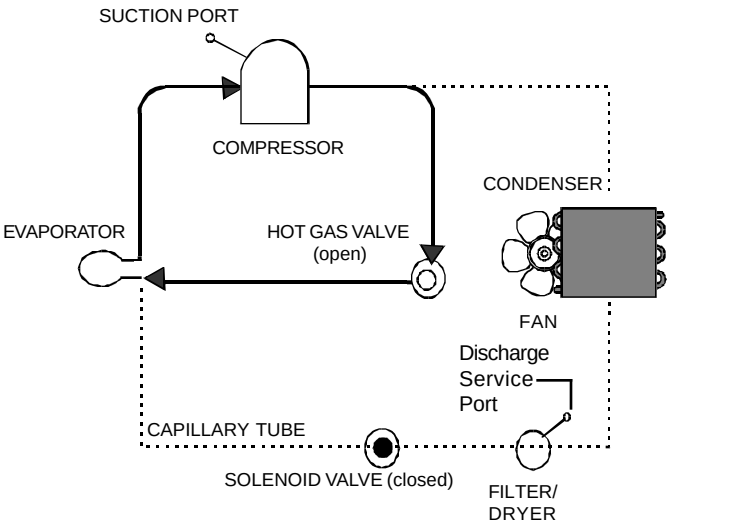


Figure 3

If the setpoint is above the actual temperature, the controller is in HEAT/IDLE mode. The triac output opens, turning the solenoid coil off. The solenoid valve then drops closed. This stops the flow of refrigerant at that point.

During the heat/idle mode when the liquid line solenoid valve is closed, the pressure drops in the suction line back to the compressor. When the pressure drops to a pre-determined value, the hot gas bypass valve will open and allow hot gas to flow to the evaporator as stated. The hot gas valve opens on a decrease in pressure on its discharge port. The discharge port is connected to the evaporator side of the system.

The refrigerant gas is now routed directly to the evaporator. The gas is not allowed to condense, as it has bypassed the condenser completely. The hot gas passing through the evaporator coil adds some heat to the fluid, then returns directly through the suction filter to the compressor. This unloads the compressor, resulting in lower discharge pressure, higher suction pressure, and less power consumption. Observing the suction pressure in this mode will indicate the setting of the Hot Gas Bypass (ADR) valve.

Troubleshooting

Fuse Information

This information applies to any CFT units using a controller consisting of two circuit boards stacked together. See Figure 4 and 5.

The outer board (furthest from the control panel) carries line voltage. The inner board (closest to the control panel) has only low voltage on it.

The outer board contains a fuse. The fuse is metric sized, 5mm x 20mm. It is rated 500ma, 250 volt, time delay. The replacement NESLAB part number is 001661. An alternate replacement is Radio Shack part number 270-1061.

If the fuse fails, the pump, fan, and compressor will still operate, and the power switch will still illuminate. The solenoid valve coil will not be powered, resulting in the valve dropping closed and stopping the flow of refrigerant. The temperature of the circulating fluid will rise.

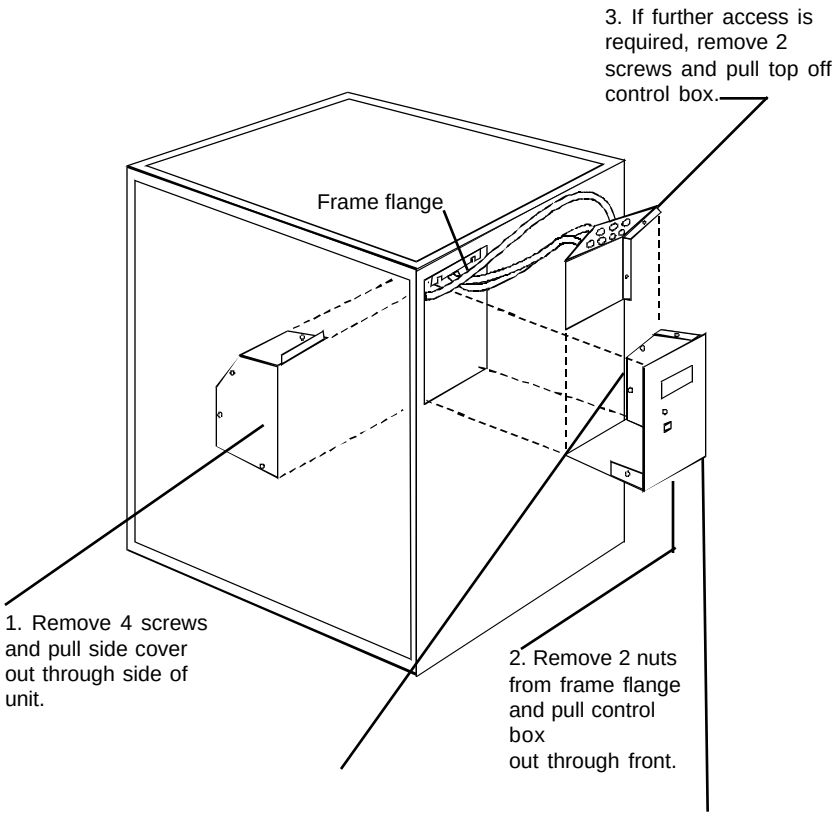
Analog units: the COOL lamp will not illuminate.

Digital units: the display and the IDLE / COOL lamps will not light.

To access the fuse:

1. **Disconnect unit from line voltage.**
2. Remove the unit wrap around access cover (8 screws).
3. Remove the L-shaped access cover from the control box.
4. Locate the fuse. It is on the top edge of the circuit board, mounted in two clips.
5. Remove the fuse from the clips using a fuse puller.
6. Test fuse for continuity using an ohmmeter. (It is a glass fuse, but the element is hard to see.)
7. Replace with a new fuse if necessary.
8. Test unit before re-installing access covers.

Control Box Access



FUSE TYPE AND LOCATION

500mA 250v
Time Delay
5 X 20 mm
NESLAB PN 001661
Radio Shack PN 270-1061

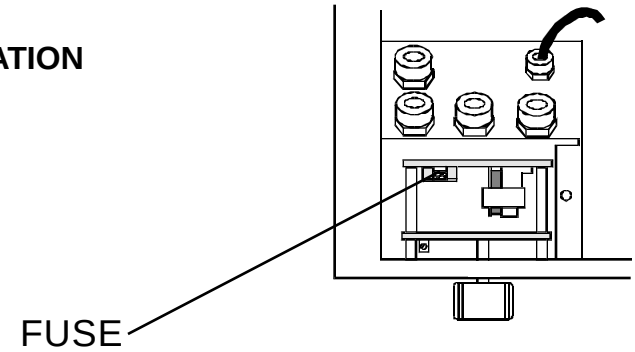


Figure 4

Symptom: Unit runs away cold

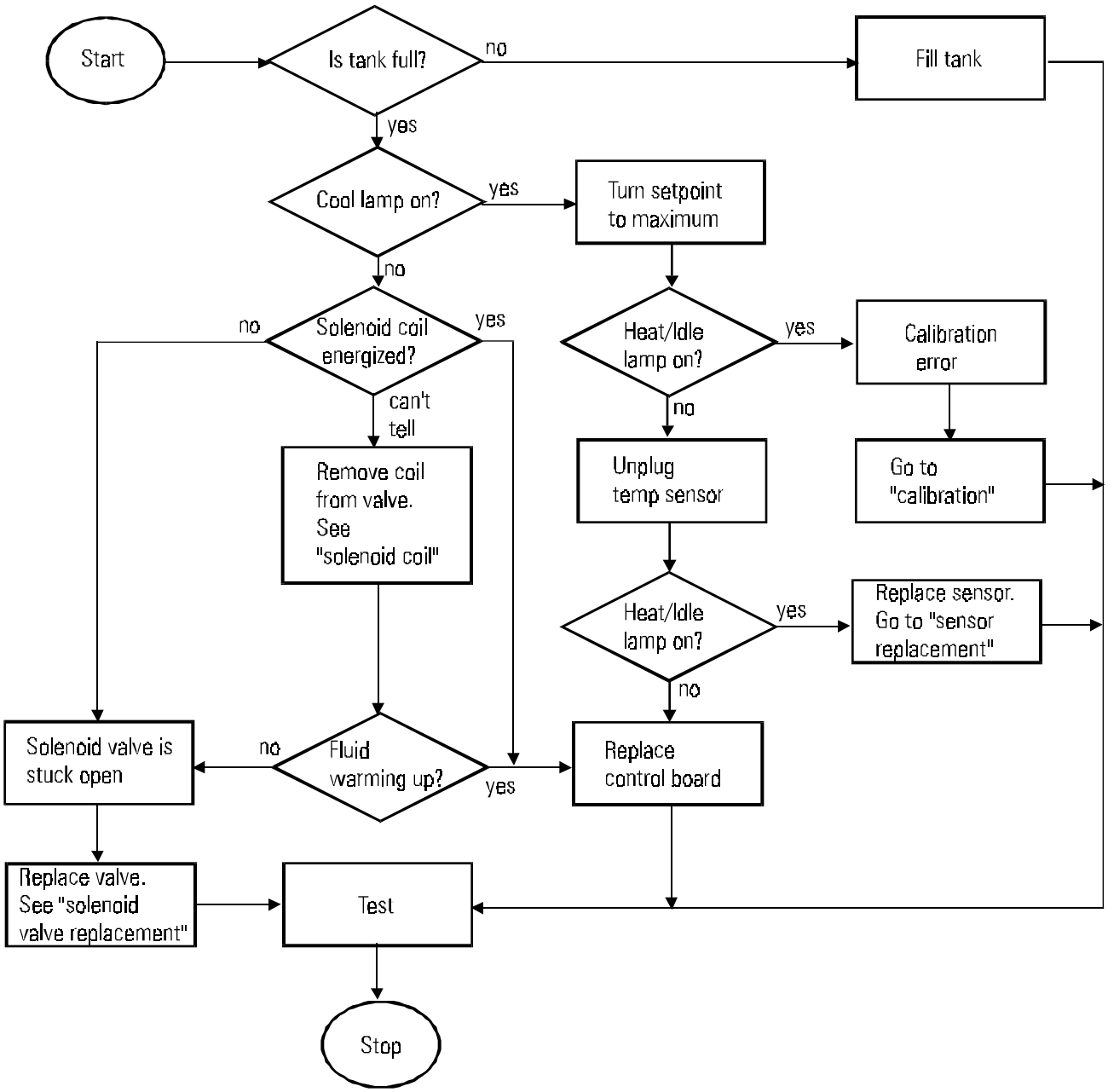


Figure 5

Symptom: Unit runs away hot

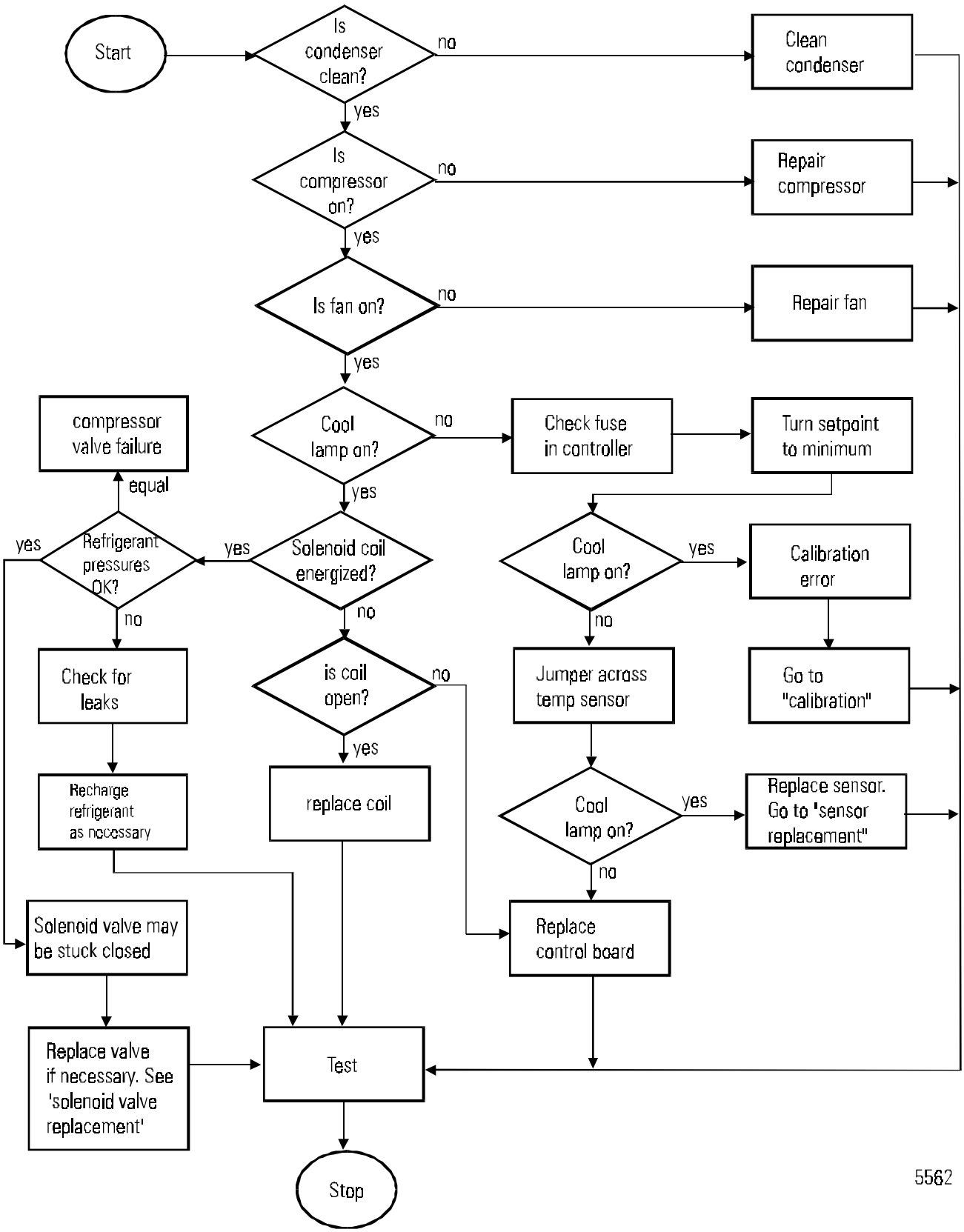


Figure 6

Electrical System

Sensor Testing

Diode sensors measure temperature by measuring the DC voltage drop across a diode. This drop decreases as temperature increases.

You will need a digital multimeter with a DIODE TEST range, usually indicated by a little diode symbol.

Test as follows:

1. **Disconnect unit from line voltage**.
2. Loosen (but do not remove) compression fitting on top of tank and pull sensor out of fitting.
3. Use a digital multimeter * . Set meter to “diode test” range - indicated by a diode symbol.
4. Unplug sensor from control board (orange connector).
5. Sensor must pass all below tests to be good. Replace the sensor if it fails any step.
6. Connect sensor blue wire to red meter lead. Connect sensor grey wire to black/common meter lead.
7. Observe meter reads a typical diode drop - between 0.550 and 0.650 volts. Some meters show this as millivolts and will display 550 to 650. This shows forward bias is correct.
8. Warm sensor by hand. Observe meter reading begin to decrease. It may take a minute. This shows sensor is responding to a temperature change.
9. Reverse the meter leads to the sensor (sensor grey to meter red, sensor blue to meter black/common).
10. Observe the meter indicates overrange or open - the display may vary depending on the meter used, but generally will show “OL” or similar indication. This shows reverse bias is correct.
11. Connect sensor blue to meter red (leave sensor grey unconnected).

12. Touch meter black/common lead to shell of sensor. Be careful not to touch the sensor shell or the probe tips with your fingers. (Your skin resistance would cause a false reading.) Observe overrange or open. This shows isolation between diode and shell of sensor.

* The sensor may also be tested using an analog multimeter. Due to the widely differing responses of various analog meters, we can only offer a general guideline. For each step, compare the result to a known good 1N914 , 1N914A, or 1N4148 diode. Use whatever resistance scale offers a good resolution reading. The higher the “ohms per volt” specification of the meter, the more likely meaningful results will be obtained. A minimum specification of 20,000 ohms per volt is recommended. The $10 “shirt pocket” meter will not have adequate response.

The controller must be calibrated if the sensor is replaced. See Calibration.

IN CASE OF FAILURE:

There are a couple of things you may be able to do to resurrect a defective sensor until you can get a replacement. Slice the rubber heat-shrink boot along its length so you can peel it off. Now you can slide the sensor assembly out of the tube.

1. See if there is any moisture inside the tube (may be caused by condensation). The tube can be dried out by heating it up with a hair dryer.

2. If you suspect a diode failure, you can try replacing the diode. It is a standard silicon signal diode, and may be replaced with a type 1N4148, 1N4148A, 1N914, or 1N914A. These, or equivalents, are available at your local Radio Shack store.

Sensor Replacement

(Locations are given from the vantage point of standing in front of the unit control panel.)

Removal of sensor:

1. **Disconnect unit from line voltage**.
2. Remove access cover from the unit (8 screws and star washers).
3. Locate sensor on the tank.
4. Loosen (but do not remove) the compression nut (upper most plastic nut) and slide the sensor out.
5. Remove the left side access cover on the controller (3 screws).
6. Disconnect the terminal plug (connector) from the circuit board.
7. Loosen the right lower strain release nut on the back of the controller.
8. Note the orientation of the gray and blue wire in the terminal plug.
9. Loosen set screws and remove the wires (blue & gray) from the terminal plug.
10. Remove the old sensor from the unit.

Installation of the sensor:

1. Slide the wires from the new sensor into the strain release nut.
2. Connect the wires (blue & gray) to the terminal plug (connector). Gray to the right and blue to the left when installed.
3. Connect the terminal plug to the circuit board.

4. Tighten the strain release nut so that is secures the wire (do not over tighten).

5. Go to the CALIBRATION procedure and calibrate the new temperature sensor to the control board.

6. Install the left side cover panel on the controller (3 screws).

7. Insert the sensor into compression nut on the tank.

8. Tighten the compression nut finger tight (using a wrench could damage the nut).

9. Secure any excess wire with a cable tie.

10. Replace the access cover.

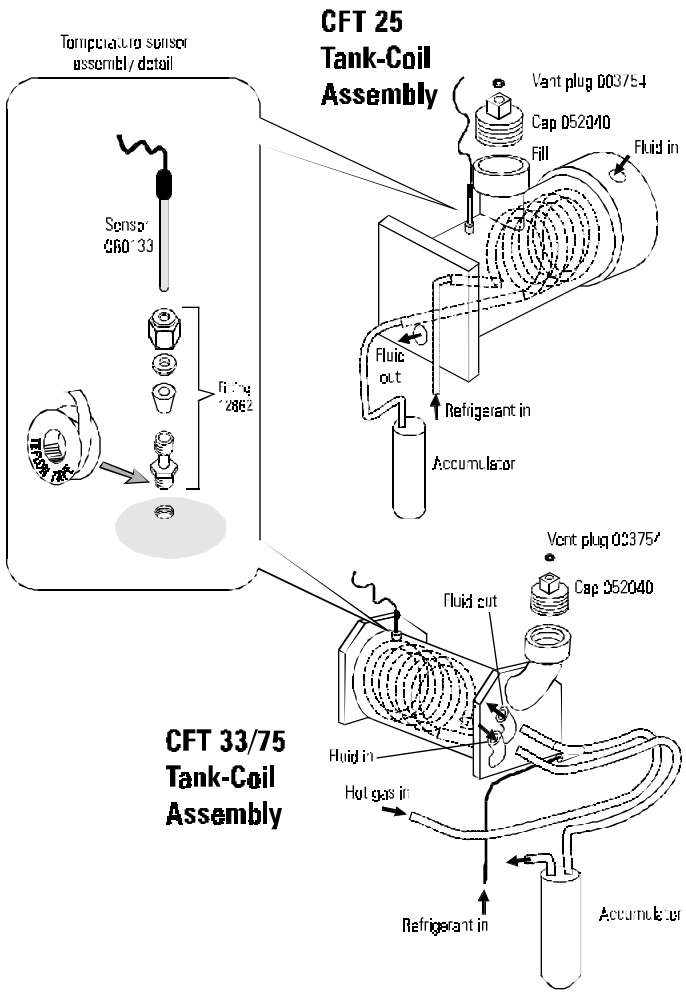


Figure 10

Control Board Testing

Older units (single circuit board)

WARNING: Manipulate the sensor connections with care. While the sensor only has about 2 volts DC across it, it is LINE VOLTAGE AC with respect to ground!

If the unit passes steps 1-8 below, the control board is good.

1. **Disconnect the unit from line voltage.**
2. Disconnect either sensor wire (the blue or the grey) from the terminal strip. This opens the sensor circuit.
3. Reconnect to power and turn on. If all is well, the control board will not output voltage to the solenoid coil. The coil being off will cause the valve to drop closed. The amber (HEAT) lamp should be lit.
4. **Disconnect the unit from line voltage.**
5. Restore the sensor connection. Now connect the blue and grey wires together at the terminal strip. This short-circuits the sensor. If you don't have a jumper wire, you can just put both sensor wires on the same terminal strip tab temporarily.
6. Reconnect to power and turn on. If all is well, the control board will output voltage to the solenoid coil. The coil being on will cause the valve to open. The green (COOL) lamp should be lit.
7. **Disconnect the unit from line voltage.**
8. Remove the jumper or restore to original configuration.

Newer units (double-stacked circuit board)

If the unit passes steps 1-8 below, the control board is good.

1. **Disconnect the unit from line voltage**.

2. Disconnect the orange sensor connector from the control board. This opens the sensor circuit.

3. Reconnect to power and turn on. If all is well, the control board will not output voltage to the solenoid coil. The coil being off will cause the valve to drop closed. The amber (HEAT) lamp should be lit. If the unit is not equipped with the amber lamp, the green (COOL) lamp should be off.

4. **Disconnect the unit from line voltage.**

5. You must now bridge across the sensor connector pins at the control board. This short-circuits the sensor input. If you cannot access the pins, temporarily remove the sensor wires from the orange connector, and replace them with a wire connecting the two terminals together; and replace the connector.

6. Reconnect to power and turn on. If all is well, the control board will output voltage to the solenoid coil. The coil being on will cause the valve to open. The green (COOL) lamp should be lit.

7. **Disconnect the unit from line voltage.**

8. Remove the jumper or restore to original configuration.

Control Board Replacement

(Locations are from the vantage point of facing the control panel in front of the unit.) See Figure 10.

Removal:

1. **Disconnect unit from line voltage.**
2. Remove the knob from the control panel using an Allen wrench.
3. Remove access cover from the unit (8 screws and star washers).
4. Remove cover from left side of the controller housing assembly (3 screws).
5. Remove 2 nuts and star washers from top of the controller housing face plate.
6. Tip the controller housing forward and lift off lower lip then move the controller toward the inside of the unit.
7. Remove 2 screws holding the back plate to the front plate of the controller housing.
8. Make note of the orientation of each wire so that they can be returned to the proper location on the new board. Disconnect 4 wires from the small (toward the rear) circuit board.
9. Disconnect orange terminal plug (connector) holding gray and blue wires on the lower right side of the large circuit board (forward one).
10. Remove the circuit board from the face plate by removing the 4 screws and star washers from the corner of the large (forward) circuit board.

Installation:

(Locations are from the vantage point of facing the control panel installed.)

1. Ensure that the lamp is placed through the hole in the face plate assembly.
2. With the circuit board in proper orientation secure it to the face plate with 4 screws and star washers.
3. Connect the orange male terminal plug (connector) holding the gray and blue wires into the green female connector on the large circuit board (one nearest the face plate).
4. Connect wires to small circuit board as noted during removal. (See wiring diagram at the end of this manual for location.)
5. Secure the back plate to the right side plate with two screws.
6. Go to CALIBRATION procedures and calibrate the new circuit board to the sensor.
7. Lower the controller on to the front panel in the notched area and secure with two star washers and nuts.
8. Install access cover on the left side of the controller (3 screws).
9. Install access cover on unit securing with 8 screws and star washers (4 on each side).
10. Install knob with Allen® wrench.

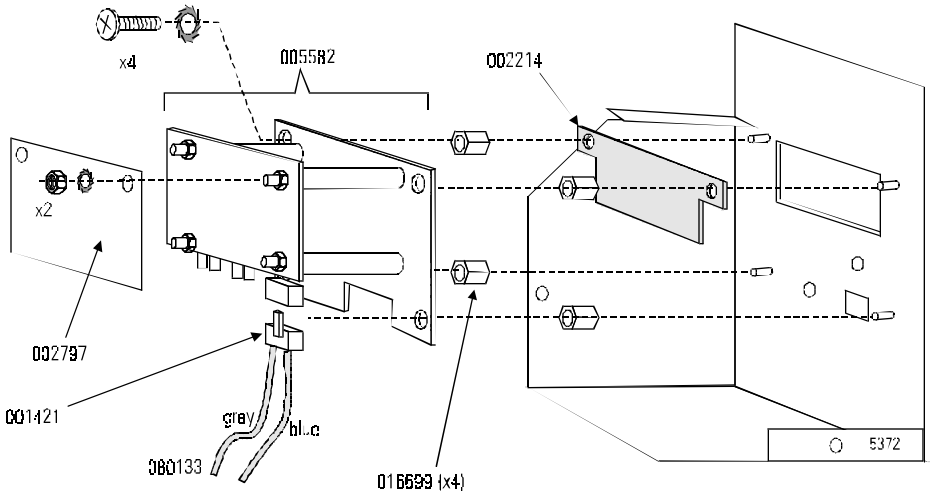


Figure 9

Analog Calibration

Calibration will be required if either the temperature sensor or the control board are replaced.

1. **Disconnect unit from line voltage**. To remove the temperature sensor: remove the access cover from the CFT. Loosen the compression nut on top of the PVC water tank. Pull the sensor out.

2. Obtain a container deep enough to immerse ¾ of the sensor length. A large foam coffee cup works well. Place the sensor and a reference thermometer in the container.

3. Fill the container with water. It is best to use water of approximately the same temperature as your desired circulating temperature. If the desired temperature is unknown, use 60°F / 15°C if the control board is the old style using a single circuit board; or 68°F / 20°C is the control board is the current style using two circuit boards stacked together.

4. Turn on the CFT. Adjust the setpoint (dial on front of CFT) to agree with the temperature indicated on the reference thermometer.

5. Allow the unit to stabilize for a few minutes. Until the COOL lamp is cycling.

6. Compare the indicated temperature on the CFT dial with the reference thermometer. If they agree, no adjustment is required. Go to step 9.

7. Remove the knob from the shaft using an Allen wrench. Reposition the knob so the indicator line is pointing at the temperature indicated on the reference thermometer and tighten the Allen® set screw.

8. Calibration is complete. **Turn CFT off and disconnect unit from line voltage.** Restore the sensor to the tank fitting. Replace all access covers.

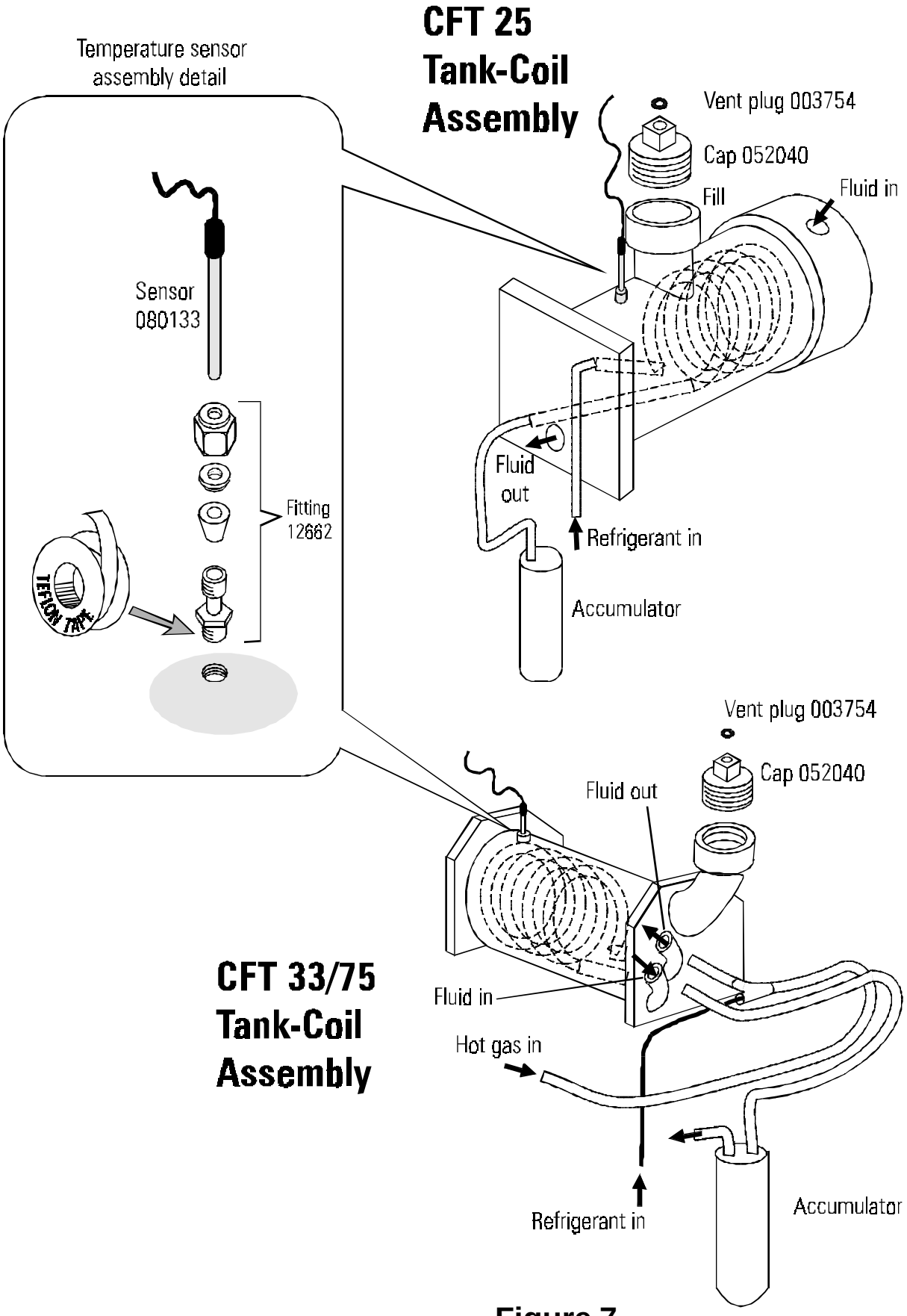

CFT 25
Tank-Coil
Assembly
Temperature sensor
assembly detail
Sensor
080133
Fitting
12662
TEFLON TAPE
Vent plug 003754
Cap 052040
Fill
Fluid in
Fluid
out
Refrigerant in
Accumulator
Vent plug 003754
Cap 052040
Fluid out
Fluid in
Hot gas in
Refrigerant in
Accumulator
CFT 33/75
Tank-Coil
Assembly

Figure 7

Digital Calibration

Calibration will be required if either the temperature sensor or the control board are replaced.

1. **Disconnect unit from line voltage**. To remove the temperature sensor remove the access cover from the CFT and loosen the compression nut on top of the PVC water tank.
2. Obtain a container deep enough to immerse 3/4 of the sensor length. A large styrofoam coffee cups works well. Place the sensor and a reference thermometer in the container.
3. Fill the container with water. It is best to use water of approximately the same temperature as your desired circulating temperature.
4. Remove the access cover from the CFT control box.
5. Connect to line voltage and turn on the CFT. Adjust the setpoint (dial on front of CFT) to agree with the temperature indicated on the reference thermometer.
6. Allow the unit to stabilize for a few minutes. Until the unit's COOL and IDLE lamps cycle.
7. Compare the displayed temperature on the CFT with the reference thermometer. If they agree, no adjustment is required. Go to step 9.
8. **CAUTION: LINE VOLTAGE IS PRESENT INSIDE THE CONTROL BOX**. Adjust trimpot "Z" (on the top edge of the control board) until the displayed temperature agrees with the reference thermometer.
9. Calibration is complete. **Turn CFT off and disconnect from line voltage.** Restore the sensor to the tank fitting. Replace all access covers.

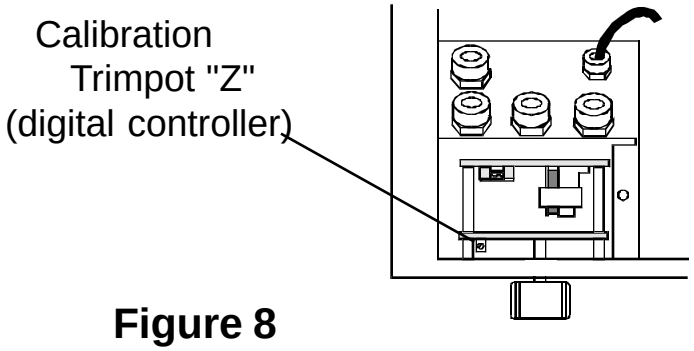


Figure 8

Refrigeration System

CAUTION

This section is intended for use by qualified refrigeration technicians only. Servicing refrigeration systems is hazardous and must be performed only by qualified persons.

Refrigeration systems contain various hazards, including (but not limited to) the following:

1. Refrigeration systems contain refrigerant gases at very high pressures, even when not running.
2. Sudden release of refrigerant gases will result in rapid expansion and severe frostbite hazard. Refrigerant gases will cause severe injury to unprotected flesh.
3. Refrigerant gases are not flammable and are chemically inert. However, they are heavier than air and will displace oxygen. They can cause suffocation if released in a confined area.
4. Refrigerant gases (other than R134a) used in this product are classified as Ozone Depleting Chemicals by the US Environmental Protection Agency. While they pose no hazard sealed inside the refrigeration system, intentional release into the atmosphere is outlawed under the 1990 Clean Air Act.
5. Compressor start and run capacitors store hazardous levels of electricity, even when the unit is not running or plugged in.
6. Refrigeration system components operate at high temperatures and present a severe burn hazard.

Troubleshooting Chart: Refrigeration Pressures

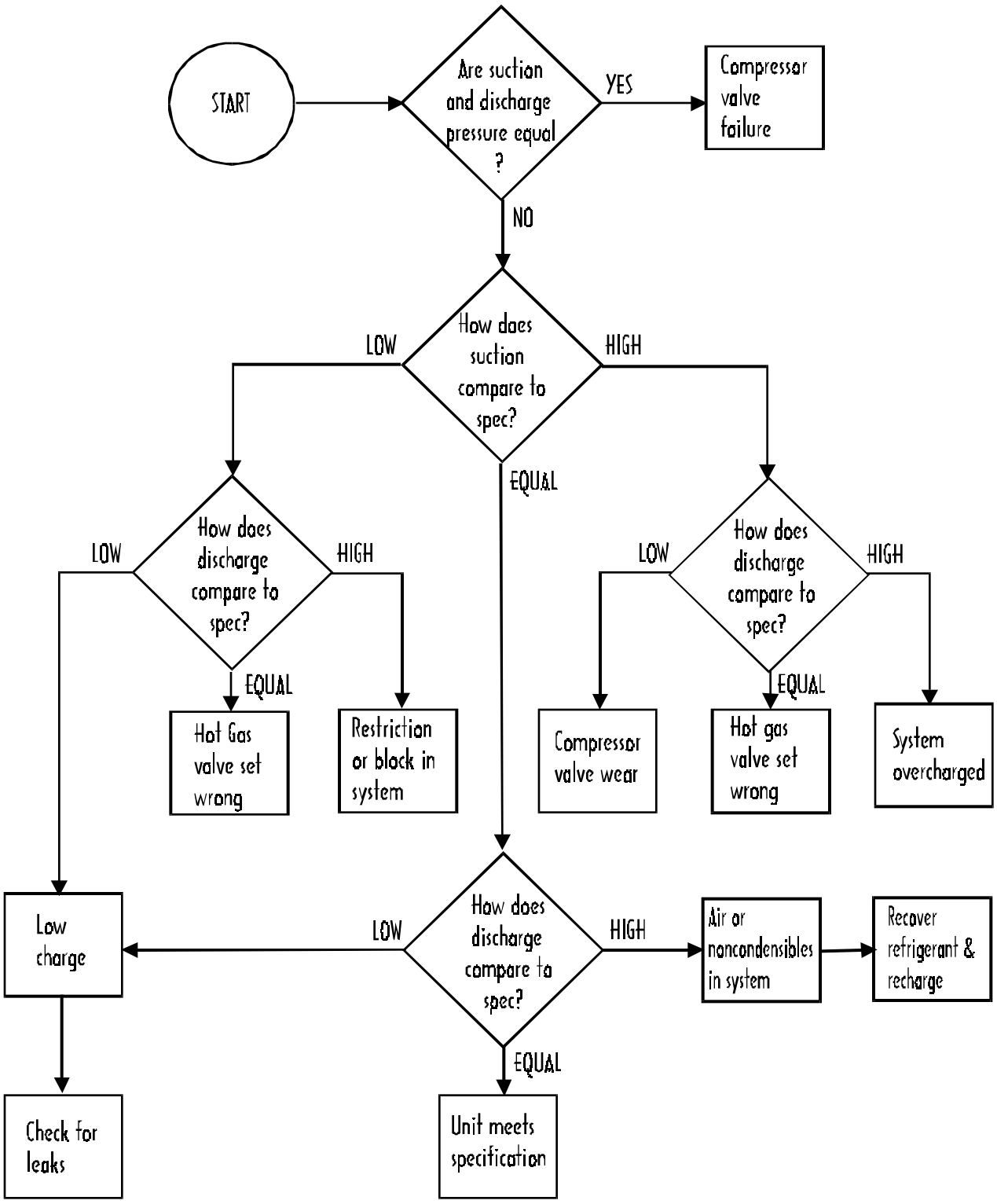


Figure 11

Compressor Replacement

1. Before proceeding confirm that the problem is not external to the compressor (electrical). If the compressor does not start/ run, check the following:

   A. Is proper voltage present at the compressor terminals?

   B. Are all starting devices (capacitors, potential relays) good?

   C. Are the motor windings known to be good or bad? If in doubt, ohmmeter readings of the windings may be compared to the replacement compressor.

2. **Disconnect unit from line voltage.**

3. Remove all access covers.

4. Recover the system refrigerant.

5. Disconnect wires, starting devices, etc. from compressor.

6. Remove valve cores from both Shrader valves. Note: Apply nitrogen purge while brazing.

7. Remove the coil from the solenoid valve and move it out of the torch area. Wrap a damp rag around the solenoid valve body.

8. Remove internal parts of solenoid valve (see solenoid disassembly procedures).

9. Unsolder and remove compressor and dryer. Protect the insulation with a damp rag. On the CFT 25 it may be necessary to remove the fan bracket to base mount bolts in order to obtain sufficient clearance to remove the compressor. Also additional room can be made by removing the lower mount bolt from the left rear bracket (next to the accumulator).

NOTE: If a compressor burnout is suspected, invert old compressor and drain out a small sample of oil. Test the oil for acidity, following the manufacturer's recommendations on the acid test kit. If the oil is acidic, the refrigeration system will need flushing to remove the acidic oil. Replace with new oil.

10. Unpack new compressor. Remove all plugs from the ports. Compressors are typically shipped pressurized with a dry nitrogen charge. **Safety glasses are especially necessary when removing plugs.** Orient compressor so the plug will exit the port pointing away from you and others.

NOTE: Replacement Copeland compressors already contain an adequate oil charge. It is not necessary to add any oil to the new compressor.

11. Remove the suction service port stem from the old compressor, and insert it into the new compressor.
12. Apply nitrogen purge gas to the stem.
13. Braze in place using BAg 28 (silver solder) compound.
14. Install 4 new shock mounts or the ones from the old compressor.
15. Position the new compressor in place and secure with washers and pins (4 each).
16. Position the new dryer in place. Ensure the flow direction arrow points toward the solenoid valve and that the service port will be accessible (CFT25).
17. Wrap a damp rag around the dryer.
18. Apply nitrogen purge gas to the suction service port.
19. Braze the suction and discharge lines to the compressor using BAg 28.
20. Braze the dryer in place, using BAg 28.
21. Reassemble the solenoid.
22. Insert new valve cores in the Shrader valves.
23. Pressurize system and leak check.
24. Remount fan and tank frame support bracket, if necessary.
25. Evacuate system.
26. Charge system to specifications.
27. Test system.
28. Install access covers

Condenser

The condenser should be cleaned periodically. The grille covering the condenser is removable on most units. The best way to remove dust is to force it out in the opposite direction from which it entered. If compressed air is available, direct the air against the inside of the condenser. If a vacuum cleaner is used, apply the vacuum to the outside of the condenser. Straighten any bent fins using a fin comb.

Fan Motor Replacement

1. **Disconnect unit from line voltage.**
2. Remove access cover from the unit; 8 screws and star washers.
3. Unbolt the fan bracket from the base of the condensing unit.
4. Pull the fan assembly (motor, blade and bracket) out of the unit.

   NOTE: The CFT 25 fan may have to be disassembled in the unit.
5. Transfer the blade, bracket, and/or conduit to the new motor.
6. Wire the new motor to the unit.
7. Reassemble in reverse order.

Hot Gas Valve Operation

(also known as Automatic Discharge Relief Valve)

This valve is closed during the cool mode. When the unit switches to heat mode, the solenoid valve in the liquid line closes. The resulting decrease in suction pressure opens the hot gas valve. This provides a path for refrigerant gas to enter the evaporator directly without going through a liquid phase, providing a heating effect.

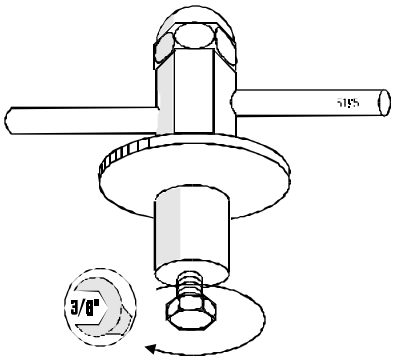


Figure 12

Hot Gas Valve Setting

Observing the suction pressure (while the unit is running in the heat/idle cycle) will indicate the setting of the hot gas valve. Please refer to the table on page 34 for the correct setting. Turning the adjustment clockwise will increase the pressure setting on the valve.

Hot Gas Valve

(continued)

LEAKS

Carefully check for leaks where the adjusting screw enters the valve body. If an internal leak occurs, the refrigerant will escape along the threads of the adjusting screw. This failure will require replacement of the valve.

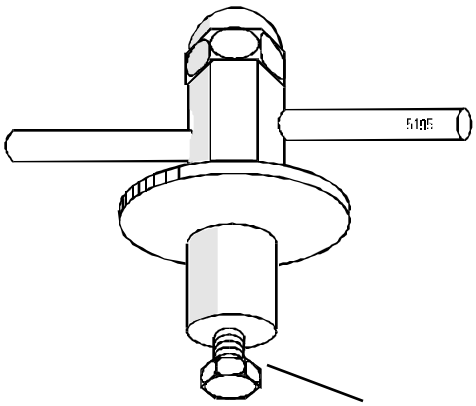


Figure 13

Solenoid Coil

The solenoid coil should be energized in the cool mode (opening the solenoid valve), and off in the heat mode.

The coil can be tested by removing the coil from the valve and sliding the coil over a screwdriver shaft. Turn the unit on and adjust the setpoint up and down. You should feel the coil attract the screwdriver in the cool cycle, and release in the heat mode.

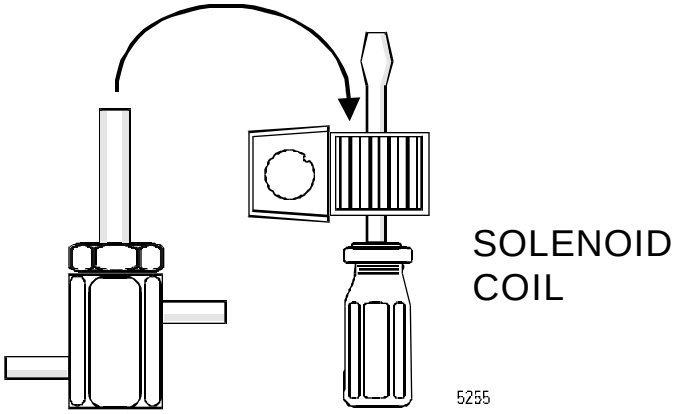


Figure 14

If the coil never turns on, either the coil is open or the control voltage is missing. First check that the fuse is good. The coil can be tested for continuity using an ohmmeter. Turn the unit off. Unplug the coil from the wiring harness and measure the coil resistance. For a 120v it should be 170 - 230 ohms and for the 208v unit it should be 750 - 850 ohms.

Replacements are available as a coil only, or a coil assembly. The assembly includes the electrical connector. Refer to the parts list for part numbers.

If a coil is obtained locally, be sure it is type OMKC-1 and rated for the proper VAC. **Do not substitute a DC coil.**

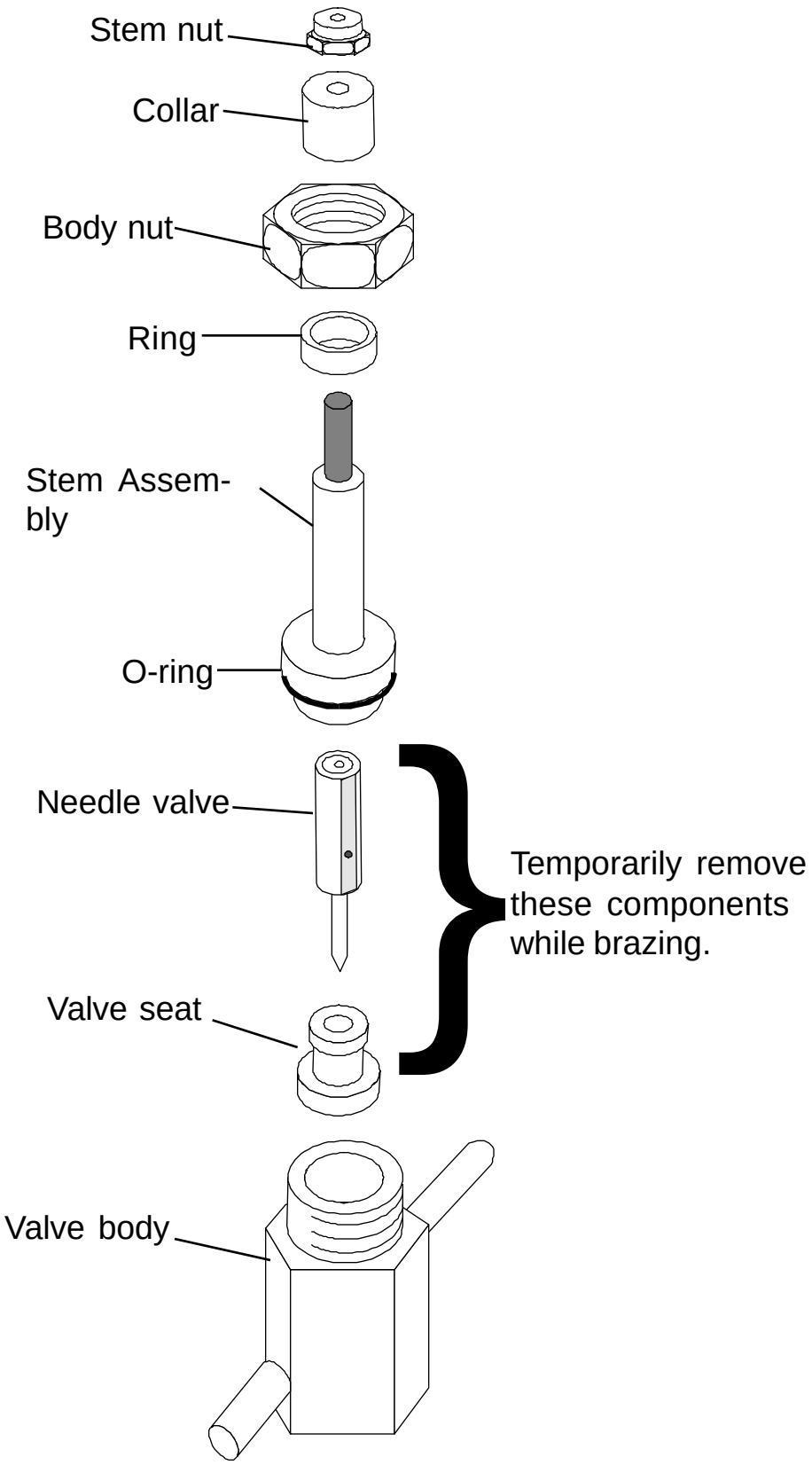

Stem nut
Collar
Body nut
Ring
Stem Assem-
bly
O-ring
Needle valve
Temporarily remove
these components
while brazing.
Valve seat
Valve body

Figure 15

Solenoid Valve Rebuild/Replacement

Rebuild Procedure:

NOTE: Usually the solenoid valve can be rebuilt in place, completely avoiding any brazing and greatly reducing the time needed for repair.

1. **Disconnect unit from line voltage.**
2. Remove access cover (8 screws and star washers).
3. Recover refrigerant.
4. Remove coil.
5. Remove large nut from valve body.
6. Remove internal valve components. (Make note of component orientation.)
7. Inspect interior of valve body for cleanliness and lack of burrs or wear.
8. Disassemble new valve, and transfer components to the existing valve body.
9. Install large nut onto valve body.
10. Pressurize system and leak check. As the valve is normally closed, be sure that both sides of the valve are pressurized. (Apply pressure to both the high and low side of the system.)
11. Begin evacuation of system.
12. Install coil.
13. Charge system to specification.
14. Test system.
15. Reinstall access cover.

Replacement Procedure:

1. **Disconnect unit from line voltage.**
2. Remove access cover (8 screws and star washers).
3. Recover refrigerant.
4. Remove coil.
5. Remove both valve cores from the Shrader® valves.
6. Disassemble old solenoid assembly and remove internal valve components (for purging). Place nut and stem assembly back on valve.
7. Apply nitrogen purge to the system.
8. Unsolder the valve and dryer and remove.
9. Disassemble new valve. Place nut and stem assembly back on the valve.
10. Place new valve and dryer in position. Check that the flow direction arrows on the dryer point toward the solenoid and that the line from the dryer goes into the side marked "**IN**" on the solenoid valve.
11. Wrap a damp rag around the valve and dryer.
12. Apply nitrogen purge gas to the system.
13. Braze in place using BAg 28 compound (silver solder).
14. Remove rags and inspect brazing.
15. Assemble the solenoid valve internal parts.
16. Install new valve cores in the Shrader® valves.
17. Pressurize system and leak check. The solenoid valve is closed, so be sure to pressurize both sides. (Apply pressure to both the high and low side of the system.)
18. Begin evacuation.
19. Install coil.
20. Charge system to specification.
21. Test system.
22. Reinstall access cover.

Tank Removal and Installation Procedure

Removal procedures:

1. **Disconnect unit from line voltage.**
2. Drain fluid from system.
3. Remove the access cover from the unit; 8 screws and star washers.
4. Locate the sensor on the top of the tank. Loosen the compression fitting and remove the sensor.
5. Loosen clamp on tank hose that goes to the pump and remove hose.
6. Loosen clamp on tank hose that goes to the unit inlet and remove hose.
7. Cut tywrap securing armaflex on refrigeration lines going to the tank and remove armaflex.
8. Recover the system refrigerant.
9. Remove valve cores from both Shrader® valves.
10. Remove the solenoid coil from the solenoid.
11. Remove nut from solenoid valve, remove internal parts (save these for reinstallation) and reinstall the nut. (This will allow purge to flow through the system.)

    See Solenoid valve rebuilding section for more detailed instruction of this procedure.
12. Apply nitrogen purge gas to the system.
13. Unsolder the two tank-to-refrigeration-system-lines and the dryer.
14. Remove and discard the dryer.
15. Loosen and undo the two tank-hold-down-clamps and remove the tank from the unit.

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Installation Procedure:

1. Place the new tank into the unit and secure with 2 clamps.
2. Apply nitrogen purge gas to the system. Note: Wrap a wet rag around the tank bulkhead fittings to prevent damage during brazing.
3. Braze refrigeration lines in place using BAg 28 compound (silver solder). (Use a hot flame)
4. Install new dryer (use a damp rag around the dryer) and braze using BAg 28 compound (silver solder).
5. Remove the purge.
6. Reassemble the solenoid valve (See the section on solenoid rebuilding for instructions) and install coil.
7. Install new valve cores in the Shrader® valves.
8. Install the hoses from pump and unit inlet.
9. Pressurize the system and leak check. Leak check the water hoses. Perform tank coil leak check.
10. Install insulation on refrigeration lines that was earlier removed.
11. Install the sensor (see section on sensor installation for detailed instruction).
12. Evacuate system
13. Charge the refrigeration system.
14. Test the system.
15. Install the access cover with 8 screws and star washers.

Table 2

Refrigerant charging data

Part number prefix:	Refrigerant:	Liquid charge, ounces	Liquid charge, grams	Suction pressure, PSIG	Suction pressure, kPa	Discharge pressure, PSIG	Discharge pressure, kPa	Hot gas setting, PSIG	Hot gas setting, kPa	Speed check, °F / min	
CFT 25	331 334	12	6	170	38 - 42	260 - 290	160 - 180	1100 - 1240	5	35	5
	347	22	6.5	185	60 - 65	415 - 450	235 - 245	1620 - 1690	25	170	5
	393	134a	4	115	25 - 28	172 - 193	145 - 160	1000 - 1100	5	35	4
CFT 33	332 335	12	7	200	36 - 40	250 - 275	150 - 180	1030 - 1240	5	35	2.5
	348	22	11	310	70 - 75	482 - 520	210 - 220	1450 - 1515	25	170	3
	394	134a	7	200	42 - 45	290 - 310	180 - 200	1240 - 1380	5	35	2.5
CFT 75	333	500	32	900	35 - 48	240 - 330	180 - 200	1240 - 1380	5	35	
	333 336	12 TXV	28	800	36 - 40	250 - 275	150 - 180	1030 - 1240	5	35	4.5
	336	12 Cap tube	17	480	40 - 45	275 - 310	175 - 195	1200 - 1345	5	35	4.5
	349	22	18.5	525	70 - 75	482 - 520	210 - 225	1450 - 1550	25	170	4.5
	395	134a	13.75	390	37 - 41	255 - 282	170 - 185	1175 - 1275	5	35	4.3

Specified with ambient air temp of 68°F (20°C) and water maintained at 68°F (20°C)

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Part number prefix:	Refrigerant:	Liquid charge:	Liquid charge: metric	Suction pressure: PSIG	Suction pressure: kPa	Discharge pressure: PSIG	Discharge pressure: kPa	Hot gas setting: PSIG	Hot gas setting: kPa	Speed check: °C / min	
CFT 150	337	R22	29 oz	822 g	70	480	270	1860	25	172	2.8
					Ambient air temp of 68°F (20°C) and water maintained at 68°F (20°C)						
CFT 300 CP55, TU5, TU6	396	R22	8.5-9.5 lbs	3.8-4.3 kg	85-90	585-620	265-280	1827-1930	25	172	6.4
					Ambient air temp of 74°F (23°C) and water maintained at 68°F (20°C)						
CFT 300 PD2 pump	396	R22	8.5-9.5 lbs	3.8-4.3 kg	88-94	605-650	265-280	1827-1930	25	172	6.4
					Ambient air temp of 74°F (23°C) and water maintained at 68°F (20°C)						

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Speed Check Procedure

SPEED CHECK is a term used to define how fast a chiller can cool as it drops past 20°C when it is running at maximum. The unit of measure is “degrees per minute”. This will provide a number that is easy to obtain and compare.

Here is an example of how to perform the test.

1. Find the DROP figure, either from the table (next page), from the appropriate refrigerant data file on the NESLAB Online Bulletin Board System, from the construction sheet (available on microfiche at LSI depots), or by calling Technical Service. From the table we find the DROP for a CFT150 is 2.8°C per minute. (See Figure 16 for a graphic depiction.)
2. Divide the DROP in half (example: 1.4°C).
3. Add this half to 20°C to find the START TEMP point (example: 21.4°C).
4. Subtract this half from 20°C to find the STOP TEMP point (example: 18.6°C).
5. Connect the unit’s outlet and inlet with as short a loop of hose as practical. Insert a thermometer in the loop with 0.1°C resolution. We use a pointy Phillips-head screwdriver to pierce a hole in the wall of the hose, then insert the thermometer in the hole. It doesn’t leak too badly.
6. Heat the fluid (100% water) to at least 30°C, then turn unit to full cool by turning the setpoint to minimum.
7. Begin timing as the START TEMP (21.4°C) is passed.
8. Stop timing when the STOP TEMP (18.6°C) is passed.
9. Elapsed time must be one minute or less to pass.

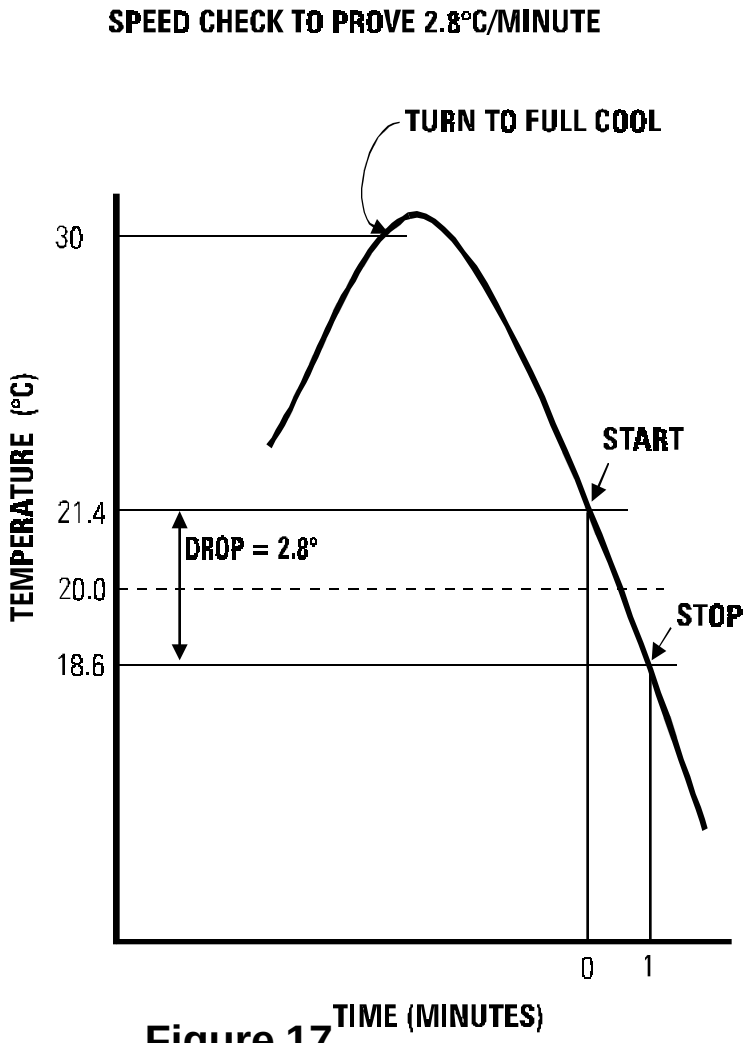


Figure 17

SPEED CHECK TABLE for STANDARD CFT UNITS

Model	Drop
CFT25:	5.0°C
CFT33:	(R12): 2.5°C
CFT33:	(R22): 3.0°C
CFT50:	1.0°C
CFT75:	4.5°C
CFT150:	2.8°C

Table 3

MD30 Pump

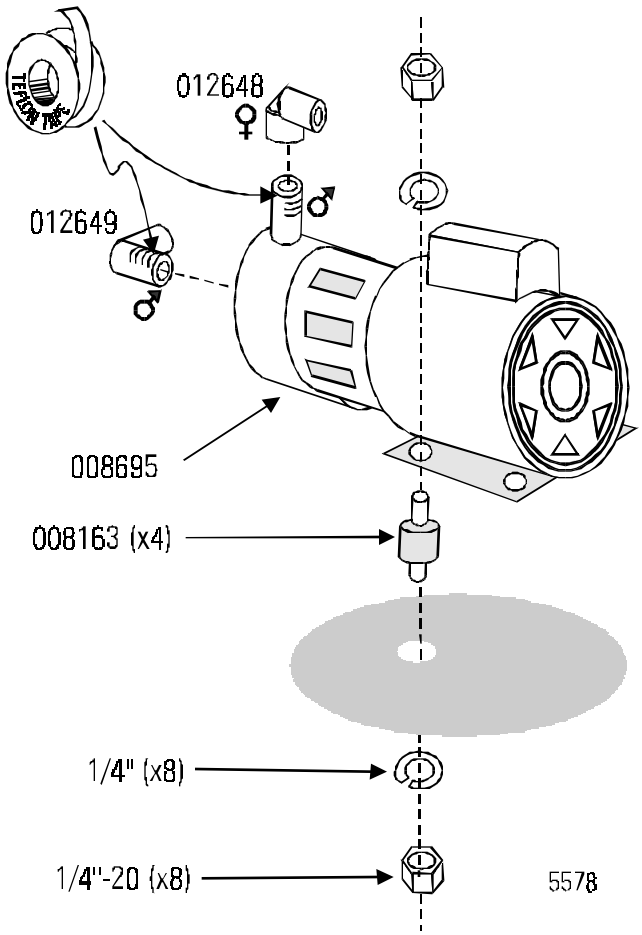
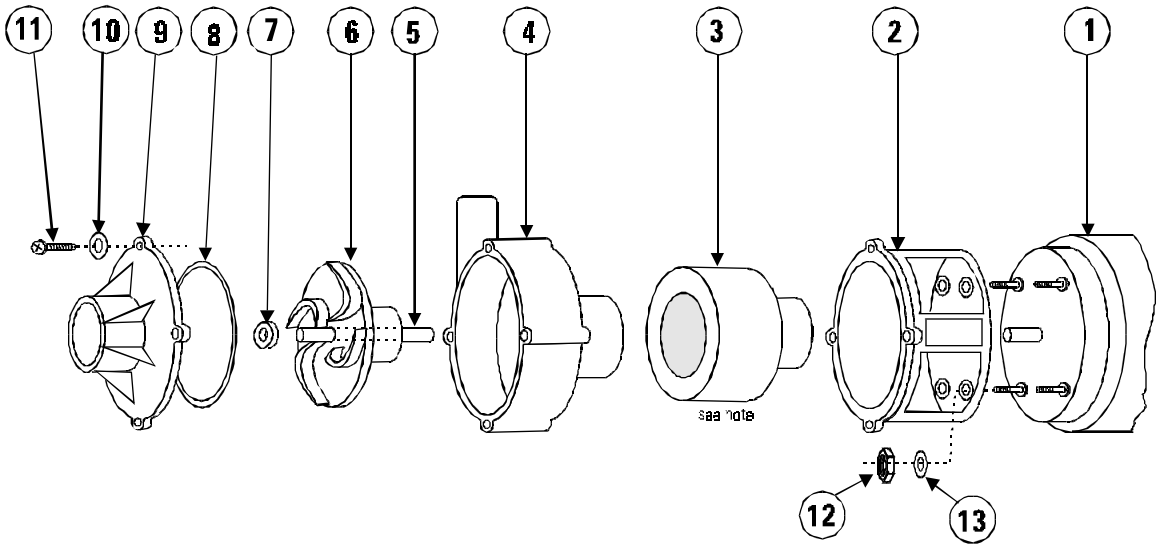


Figure 17

Figure 18

MD-30 PUMP ASSEMBLY



ITEM	DESCRIPTION	MARCH PART NUMBER	NESLAB PART NUMBER
1a	AC Motor 115volt 60Hz	130-022-10	
1b	BC Motor 115volt 50/60Hz	130-048-10	
1c	AC or BC motor 230volt 50/60Hz	130-049-10	
2	Motor connecting bracket	130-066-10	008433
3	Drive magner assembly	130-043-02	008434
4	Pump housing	130-018-10	008186
5	Impeller shaft	130-024-10	008519
6a	AC impeller & magnet assembly	130-020-10	008185
6b	BC encapsulated impeller assembly	130-069-02	
7	Thrust washer (ceramic)	130-028-10	008435
8a	2 5/8" x 3/32" think O-ring BUNA-N	130-011-10	008436
8b	2 5/8" x 3/32" think O-ring VITON	130-033-10	008437
9	Pump housing cover	130-021-10	008187
10	#10 ID washer	150-051-10	
11	#10-32 x 1 3/8" screw	823-008-10	
12	#10 ID lockwasher	821-038-10	
13	#10-32 nut	802-008-10	
		ORDER FROM: March Manufacturing, Inc. 1819 Pickwick Ave. Glenview IL 60025 (708) 729-5300	**ORDER FROM:** NESLAB Instruments, Inc. PO Box 1178 Portsmouth NH 03802 (800) 4-NESLAB

NOTE: When attaching drive magnet (item 3) to the motor shaft, position the face of the drive magnet 3/32" (2.4mm) below the face of the motor bracket (item 2).

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PD Pumps

NOTE: PD pumps are covered in a separate service manual. Request manual 000878.

CE Compliance Supplement

Description of changes made to the CFT 25, 33, 75 to meet CE Compliance (PCO #3099)

The following changes to all of the standard 220/50Hz CFT 25, 33, 75 units are implemented by PCO #3099:

1) A 2.2uF filtering capacitor circuit was added to the control box of each unit. This circuit filters line noise that is caused by the unit itself.

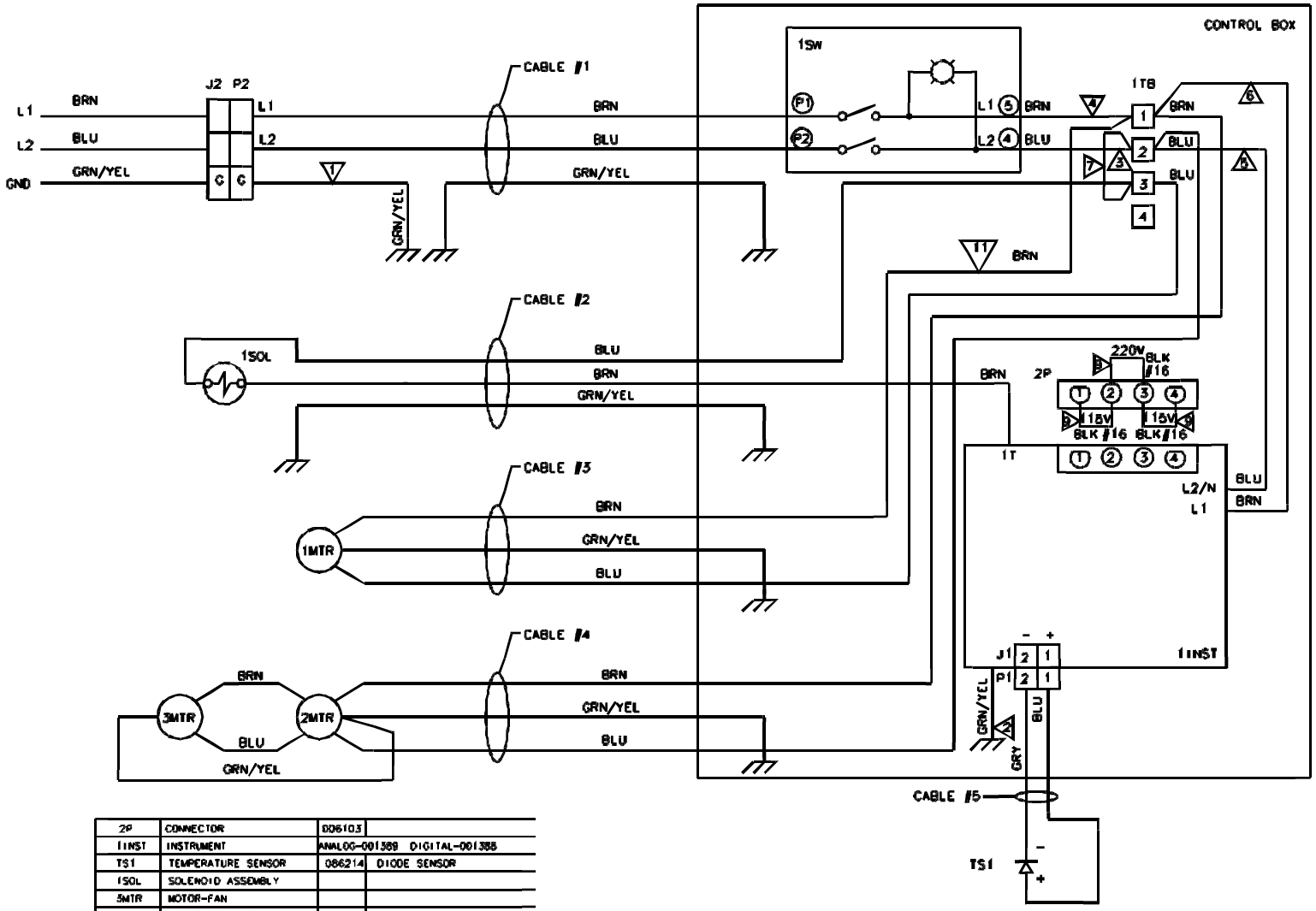
2) The diode probe in each unit was shielded by replacing the two 24 gage wires used in the probe with a 24/2 AWG shielded cable. This shielded cable was grounded to the chassis of the unit as well as to the probe itself. By implementing this change, it improved the units capability to withstand RF signal bombardment.

CFT 25, 33, 75 Standard Product to CE Compliant Standard Product Conversion Chart

Standard Product				CE Compliant Standard Product		
Item Number	Unit	Size	Kind	Volts	Hz	Item Number
393106030102	CFT	25	A	220	50	393106030103
393106030203	CFT	25	D	220	50	393106030205
394106030101	CFT	33	A	220	50	394106030106
394106030201	CFT	33	D	220	50	394106030209
394106040101	CFT	33	A	220	50	394106040103
394106040201	CFT	33	D	220	50	394106040208
395106030105	CFT	75	A	220	50	395106030106
395106030207	CFT	75	D	220	50	395106030211
395106040109	CFT	75	A	220	50	395106040112
395106040205	CFT	75	D	220	50	395106040208

Parts List

Part Description	Part Number
Gauge, pressure 0-30 PSI	**008724**
Gauge, pressure 0-100 PSI	008723
Pump, MD30 115v	008123
Valve, ADR CFT 25/33/75	009136
Dryer, CFT 25/33	009358
Dryer, CFT 75	009362
Valve, solenoid CFT 25/33	009741
Valve, solenoid CFT 75	009475
Tank coil assembly CFT 25	052208
Tank coil assembly CFT 33	051788
Tank coil assembly CFT 75	052073
Control board analog	001389
Control board digital	001388
Switch, rocker 16a, 115v	001765
Sensor	080133
Condensing unit CFT 25 115v	007590
Condensing unit CFT 33 115v	007589
Condensing unit CFT 75 208v	007591
Coil, solenoid CFT 25/33 115v	009474
Coil, solenoid assembly CFT 25/33 115v	058465
Coil, solenoid CFT 75 208v	009476
Coil, solenoid assembly CFT 75 208v	058478



2P	CONNECTOR	006103	
1INST	INSTRUMENT	ANALOG-001389 DIGITAL-001388	
TS1	TEMPERATURE SENSOR	086214	DIODE SENSOR
1SOL	SOLENOID ASSEMBLY		
3MTR	MOTOR-FAN		
2MTR	MOTOR-COMPRESSOR		
1MTR	MOTOR-PUMP		
1TB	TERMINAL BLOCK	001406	
P1	CONNECTOR		
J1	CONNECTOR		
1SW	SWITCH		

▲ REMOVED 1SOL(OFF CABLE #3)(OCS10925) 8-3-93 PM RJS DW
ADDED 2P TO 1INST (OCS10984).

B	DELETED REAR BOX & WIRE(10)(PCO22969) 1SW WAS 1CB(P/N001427) (PCO22993)	5-6-93	DCH	BJ	SW	
C	TS1 P/N 086214 WAS 080188(PCO04190)	4-24-94	LAT			

McDONOUGH 6-11-93
SCHULTZ 6-11-93
ROBINSON 6-14-93

AS SHOWN

CFT-25,33,75 R134a

C 6.2152 C

N/A 1 OF 1

CFT series
recirculating chillers

NESLAB P/N 000877
Rev. 7 April 1998

Service Manual

Note: This manual contains information on MD30 pumps only. See Manual 000878 for information on PD pumps.