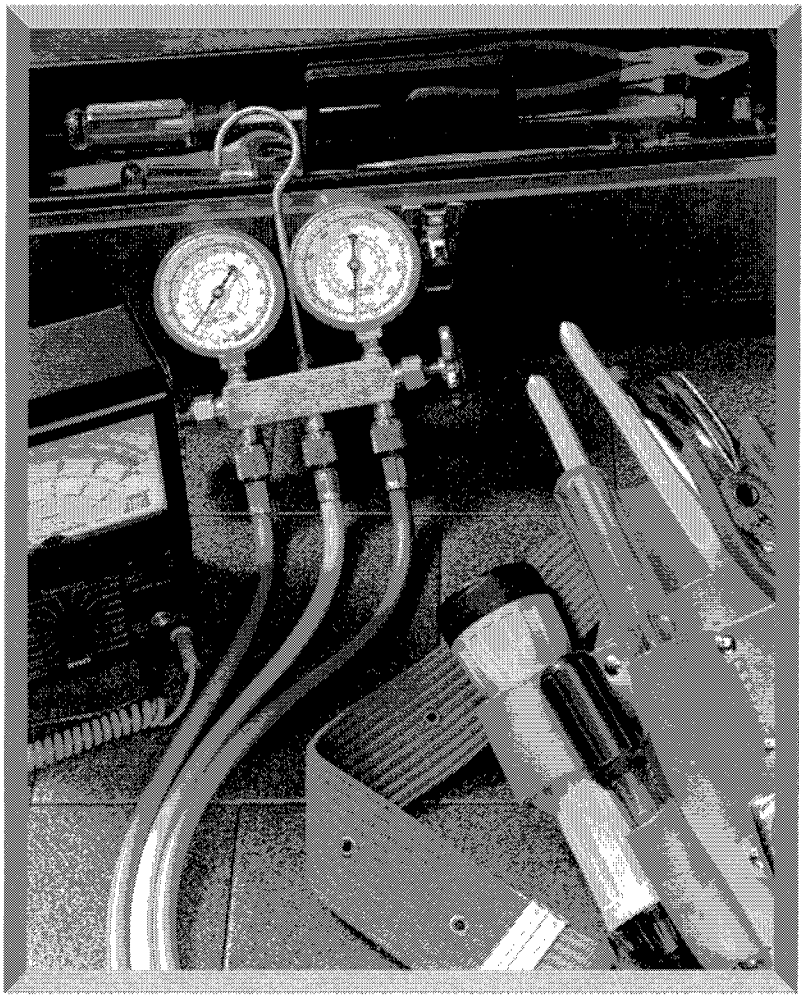
CARRIER

SERVICE *Training*



32MP

Microprocessor Control

Familiarization • Operating Sequences

32MP-01A (Rev 8/91)

021-022

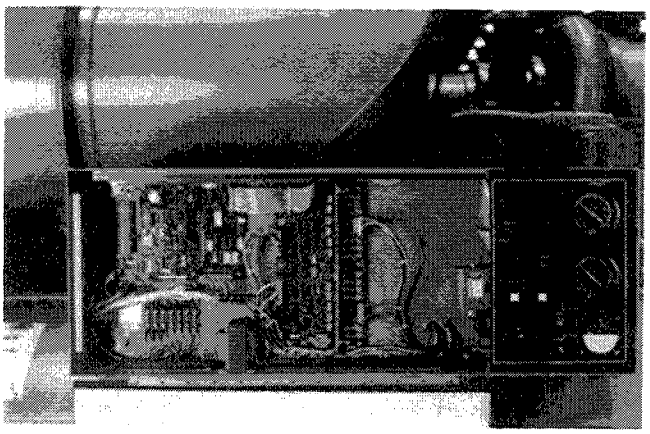
32MP PROGRAM GUIDE

This is part one of a two-part lesson on Carrier's 32MP microprocessor control system.

The 32MP replaces the 32SM as the standard control on Carrier's centrifugal chillers. The major difference between the two controls is that the 32MP has a microprocessor to receive, process, and store information sent from other components, which provides for better capacity control and minimum energy usage for any operating condition.

In part one of this program we will cover:

Handout material should include the Start-Up, Operation and Maintenance Instructions for your model machine.



1. This is the 32MP "Intelligent" microprocessor control system for Carrier's centrifugal liquid chillers. It monitors and controls all operations of the chiller, from performing prestart-up checks to starting, stopping, recycling, and providing safety protection. The control system can also diagnose a machine malfunction, check to see if all components in the control system are connected and operating properly, and let you know the operational mode of the machine; all this through number codes which appear on a liquid crystal display.

2. This 32MP service training lesson is divided into two parts.

This lesson is part one; here's what we'll cover:

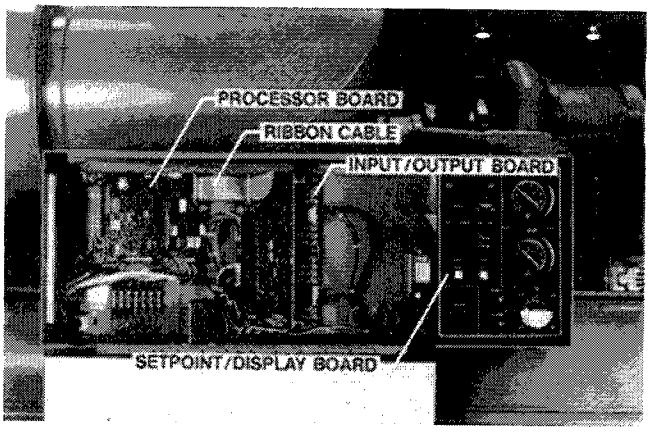
Familiarization. In this section we'll show you what the components look like, how they operate, and what features they provide.

In the second section, electrical operating sequences, we'll cover: manual start-up, manual and safety shutdown, and recycle shutdown and start- up. We will also cover the purge cycle and operation of the movable diffuser wall.

Part two is the next training lesson. In it we'll cover start-up and troubleshooting. The start-up section will explain the steps you should follow when starting the machine. Troubleshooting will show you how the control system can help you to diagnose a component malfunction.

3. The 32MP replaces the 32SM as the standard control on all machines manufactured after April, 1985. This new control can also be retrofitted on existing chillers to replace the 32SM.

The major difference between the two controls is that the 32MP has a microprocessor to receive, store, and process information sent from other components, which provides for better capacity control and minimum energy usage for any operating condition.



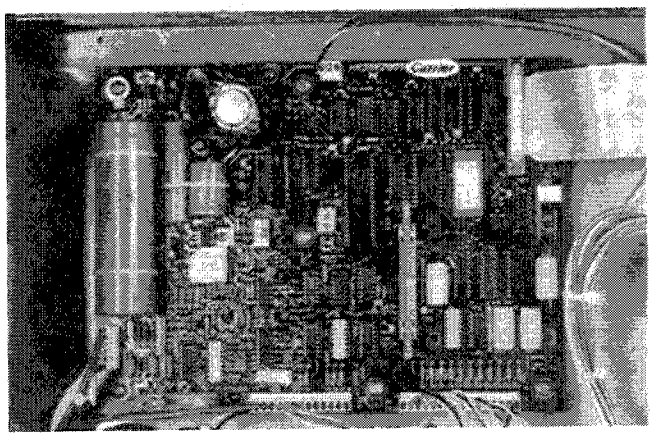
4. There are three main components which make up the basic control system -- the processor board, the input/output board, and the set-point/display board. Also included in the control system are temperature sensors, a current transformer, safety switches, and control contacts.

The processor board receives, stores, and processes information sent to it from the other components in the system.

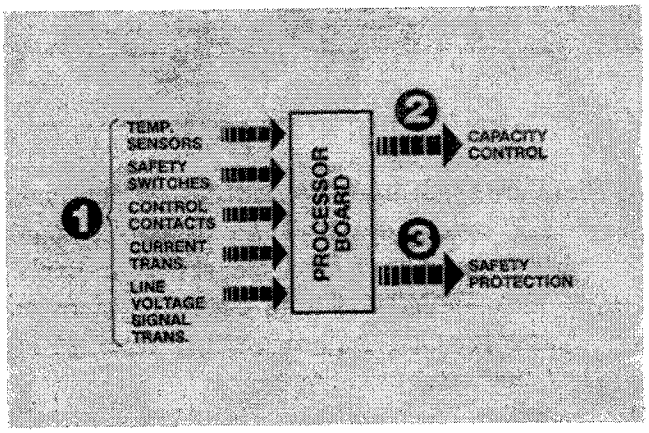
The input/output board energizes the components in the 115 volt control section. It also monitors the position of the safety switches and contacts connected to it and relays this information to the processor board.

The setpoint/display board has a two-digit display to communicate with the machine operator or service person. This board is also the input center for all machine setpoints and local start/stop operating commands.

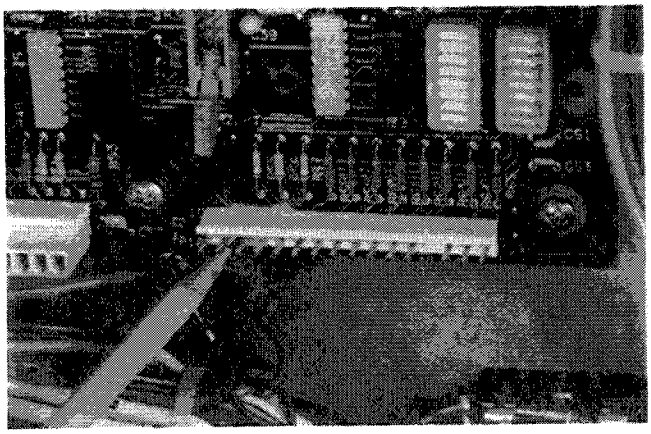
All three boards communicate with each other through a ribbon cable.



5. The processor board is the brain of the system.



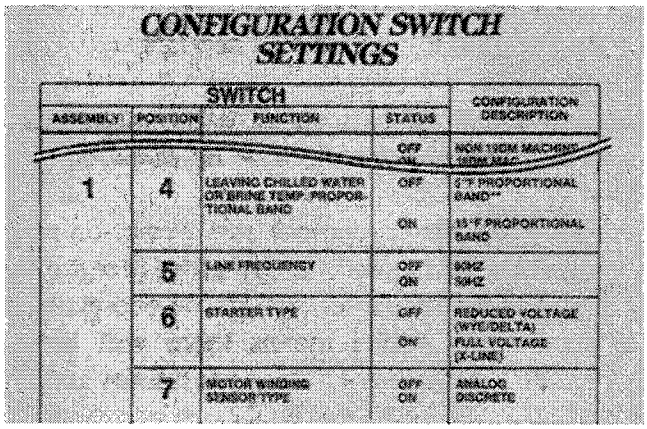
6. It contains a microprocessor that receives, processes, and stores the information sent to it from temperature sensors, safety switches and control contacts, a current transformer, and a line voltage signal transformer. With this information, the processor board can provide capacity control and safety protection for the machine.



7. All electrical connections to the processor board are made to pin terminal strips located around the edge of the board.

8. Because this control system will be used for different chiller models and applications, the processor board must have a way of identifying the unit it is controlling. To do this, it uses four dip switch assemblies. Each dip switch has eight switch positions that can be set to on or off. These switches must be field set.

To set the dip switches, first remove the protective plastic cover. Notice that the switch assemblies are identified as S1 through S4 on the board.

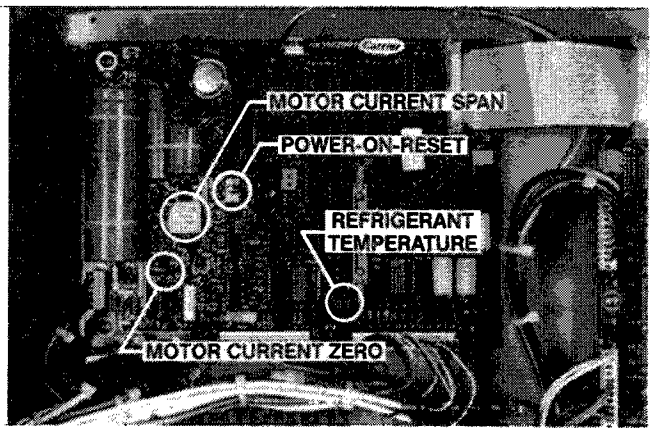


CONFIGURATION SWITCH SETTINGS

SWITCH ASSEMBLY	SWITCH POSITION	FUNCTION	STATUS	CONFIGURATION DESCRIPTION
			OFF	NON 190M MACHINE
1	4	LEAVING CHILLED WATER OR BRINE TEMP. PROPORTIONAL BAND	OFF	2°F PROPORTIONAL BAND**
			ON	10°F PROPORTIONAL BAND
	5	LINE FREQUENCY	OFF	60HZ
			ON	50HZ
	6	STARTER TYPE	OFF	REDUCED VOLTAGE (WYE-DELTA)
			ON	FULL VOLTAGE (X-LINE)
	7	MOTOR WINDING SENSOR TYPE	OFF	ANALOG
			ON	DISCRETE

9. After you've removed the plastic cover, refer to the Configuration Switch Setting chart in the Start-up Instructions for the proper switch settings. Part of the chart is shown here.

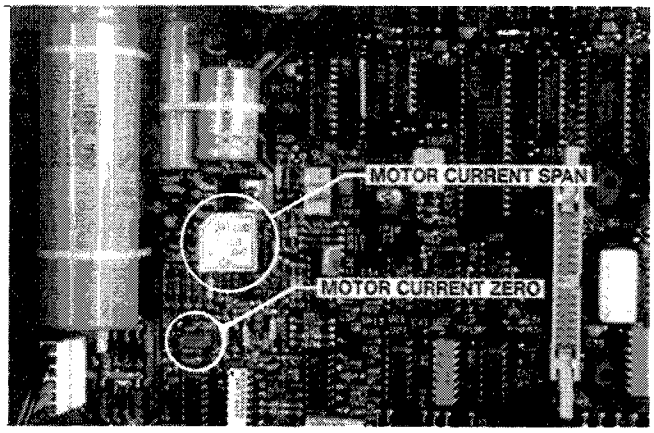
Then, find the switch assembly number on the chart that corresponds to the switch assembly number on the board and set the switch as required. For example, if you have a 60-cycle machine, switch position 5 on switch bank 1 must be set to the OFF position.



10. Also located on this board are three potentiometers and the power-on-reset pushbutton.

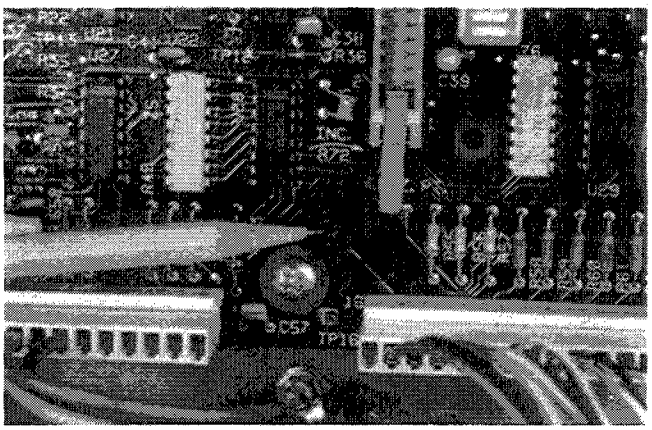
The potentiometers, which are variable resistors, are for motor current zero; motor current span; and refrigerant temperature adjustment.

CAUTION: These potentiometers should only be set using the procedures covered in this training program or the Installation and Operation Manual. Failure to follow the procedure could result in damage to the machine or control components.



11. The motor current zero potentiometer is pre-set to zero at the factory and is used as a reference point for the current span. Later in the program, we'll see how to tell whether or not the motor current zero is properly set.

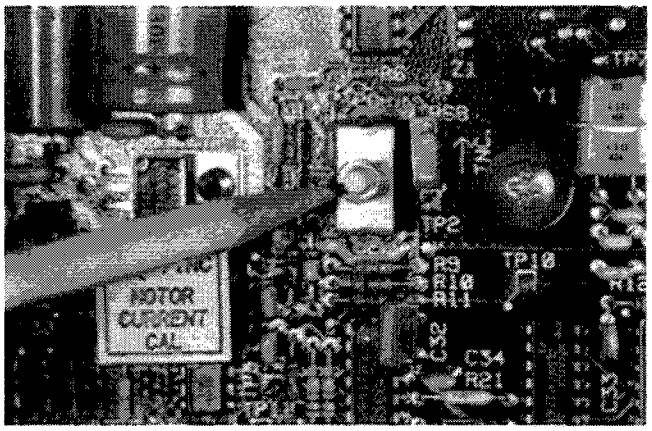
The motor current span potentiometer is used only to calibrate the electrical demand setting. The electrical demand, which is on the setpoint/display board, is used to limit the current draw of the compressor motor down to 40% of the rated load amps. We'll see how to adjust the current span in the start-up section of this program.



12. The refrigerant setpoint potentiometer is used for brine applications. It's used to set the low limit for the cooler refrigerant temperature to prevent freeze-up in the cooler tube bundle. For chilled water applications, the processor board automatically sets the refrigerant temperature at 33°F (.56°C) with the proper dip switch setting.

Without low limit refrigerant protection, freeze-up could occur if the refrigerant charge is low. What happens is that the saturated suction temperature will drop and the water or brine may freeze and damage the tubes.

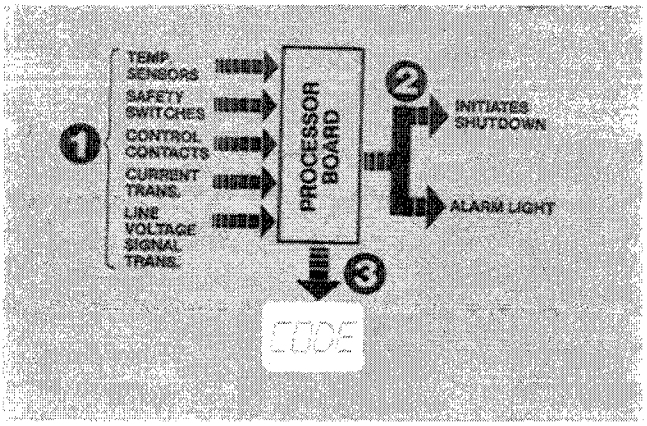
The refrigerant potentiometer is set during the controls test.



13. To initiate the controls test, press the power-on-reset button on the processor board and then press the reset button on the setpoint/ display board. When these buttons are pressed in that order, the setpoint/display board will be activated for the controls test as we will see later.

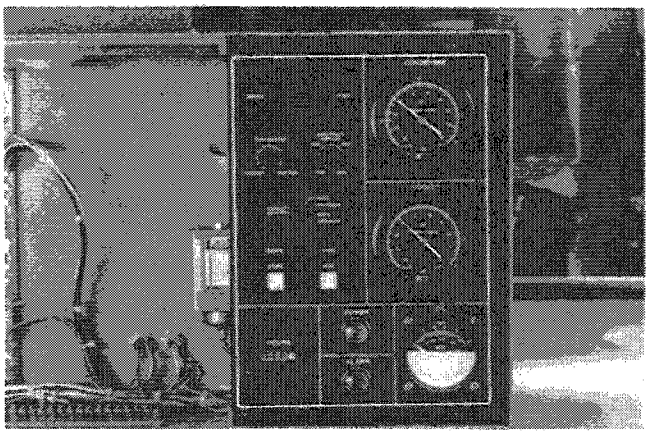
This test should be performed before initial start-up or to troubleshoot a machine malfunction.

CAUTION: Never depress the power-on-reset button while the machine is operating because the oil pump and compressor will be de-energized at the same time, which means there will be no lubrication for the motor during coastdown and the motor bearings may be damaged.



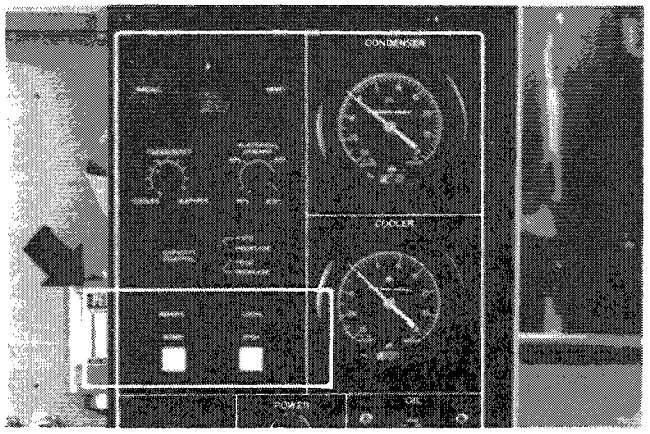
14. The processor board also activates the display on the setpoint/display board when a machine malfunction occurs. It can detect a malfunction through input signals from the temperature sensors, the safety switches and contacts, a current transformer, and a line voltage signal transformer.

When the processor receives a signal indicating a malfunction, it initiates a shutdown, energizes the alarm light on the gauge panel, and loads a failure code into the display.



15. Now, let's check out the set-point/display board. This board is the input center for all machine setpoints and local operating commands.

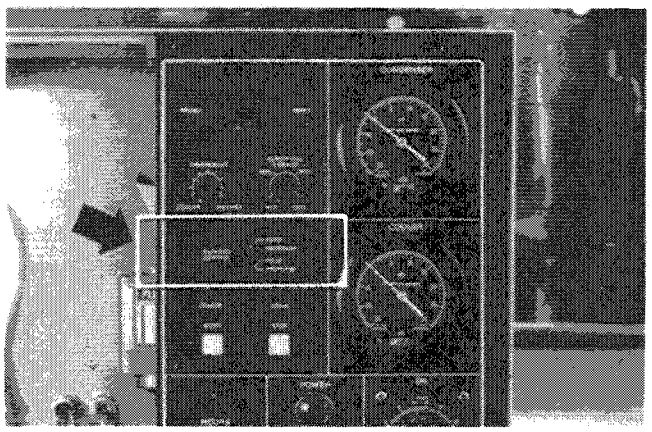
Starting at the bottom of the board, we have the following components: a start and stop push-button; a local/remote switch; a capacity control knob, a thermostat, and an electrical demand knob; a recall and reset pushbutton; and between them, a numerical two-digit liquid crystal display.



16. The start and stop pushbuttons are for local start-up and shutdown.

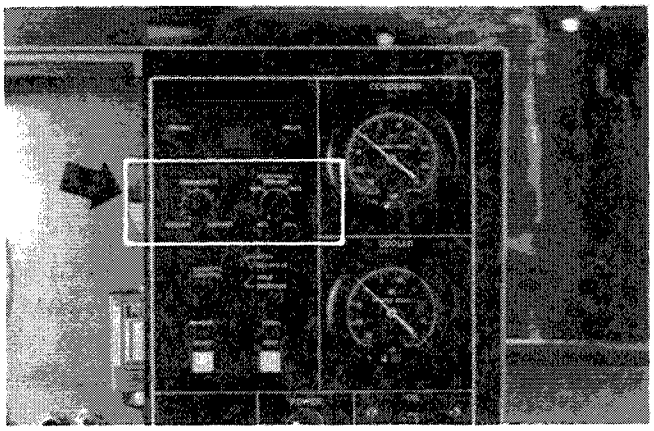
The local/remote switch, when set to local, lets the processor board know that it will be receiving control signals from only the setpoint/display board. When set to remote, the processor board knows that some or all of the signals will be sent from a remote location; such as the optional expanded services panel, an energy management system, a remote start switch, or the Carrier Comfort Network.

The local/remote switch must be set to local to start the machine from the setpoint/display board. However, you can stop the machine from the setpoint/display board with the switch set to either local or remote.



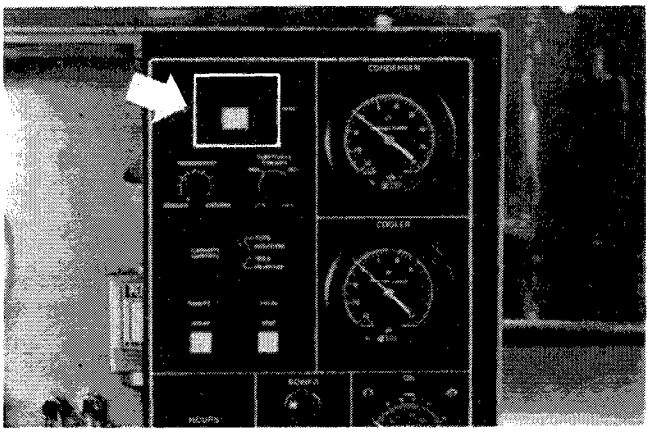
17. The four position capacity control knob is for selecting automatic or manual control of the guide vane position. There are three manual positions -- decrease, hold, and increase. Decrease closes the vanes; hold maintains the position that the vanes are in; and increase opens the vanes.

However, when set to INCREASE, the vanes will only open if the leaving water or brine setpoint and the electrical demand setpoint have not been reached; if either setpoint is reached, the vanes will not open any further. The guide vanes are located in the refrigerant vapor stream entering the compressor and control the capacity of the machine by opening or closing.

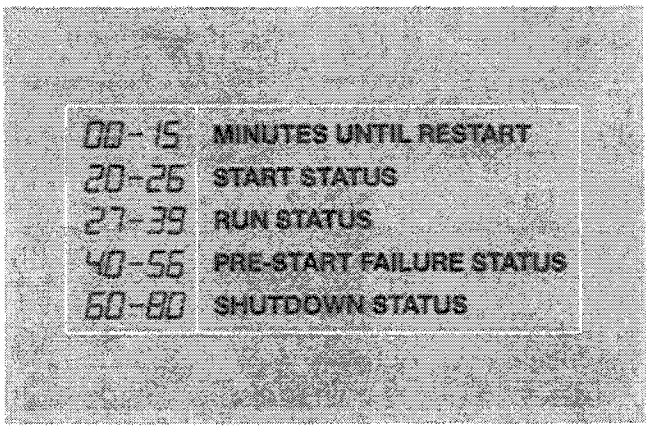


18. The thermostat control knob is for adjusting the leaving chilled water or brine temperature setpoint. The temperature range for water applications is 35-65°F (1.67 to 18.3°C) and for brine it's 0-45°F (-17.8 to 7.0°C).

The electrical demand control knob, which is adjustable from 40-100%, limits the current draw of the motor by controlling the guide vane position. Limiting the current reduces the compressor capacity for part load operation by preventing the motor from drawing current in excess of the percent of rated load amps selected. Later, we'll see how the electrical demand works with the processor board and current transformer to control motor current.

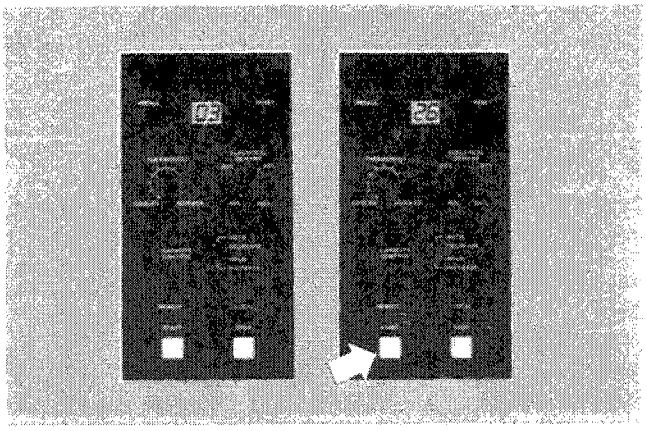


19. Here we can see the two-digit display which is used by the control system to communicate with the machine operator.



20. The display uses number codes to show you the following: 00-15 for the number of minutes remaining until restart; 20-26 for the start status code; 27-39 for the run status code; 40-56 for pre-start failure status code; and 60-80 for shutdown status code. Each number represents a specific description or malfunction. For a complete explanation of the codes, refer to the machine's Start-up, Operation, and Maintenance Instructions.

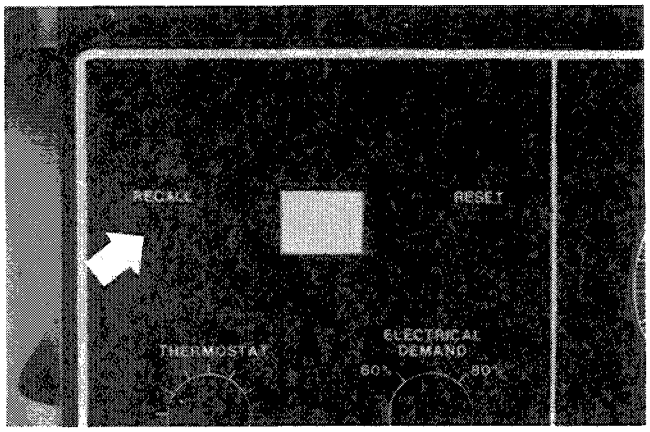
Remember, the display is also used for the controls test to determine if the control components are connected and operating properly. The controls test will be covered later in the program.



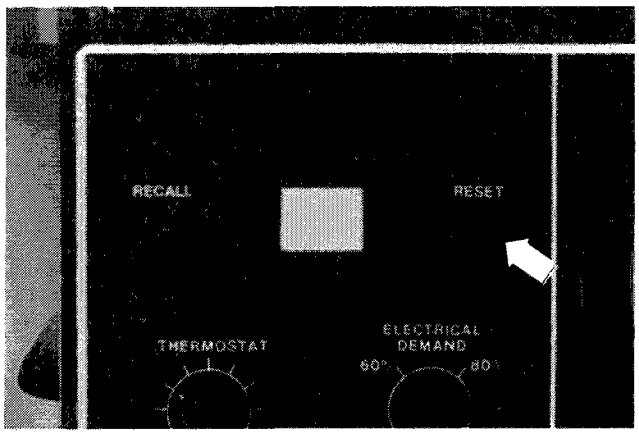
21. Now, let's see what appears in the display at the initial start-up.

As shown on the left, when the control system is first energized, a "03" will show in the display. This is the number of minutes remaining until start-up. The time on the display will decrease in one minute intervals. After three minutes has elapsed, the display will indicate the start status. With the local/remote switch in the local position, the display will show a "20." Then, when the start button is pressed, a "26" will show in the display; this means that start-up is in progress and the processor board is checking to make sure all safeties are within limits. When the machine is running, the status code corresponding to the sequence being executed will be shown.

Keep in mind that any time you have power to the control system, there will always be a code or a time shown in the display corresponding to the status of the machine. The only time there may not be a code shown is when the display is in the recall mode.

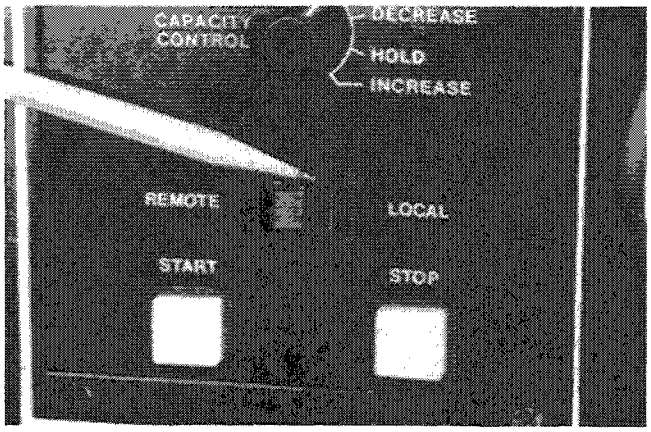


22. To get into the recall mode, press the recall button located to the left of the display. When this button is pressed, the display can show up to five safety shutdown codes beginning with the most recent and sequencing back to the least recent, at three-second intervals. The display will automatically sequence back as long as the button is depressed. After the least recent shutdown code is displayed, the display will go blank for 10 seconds.



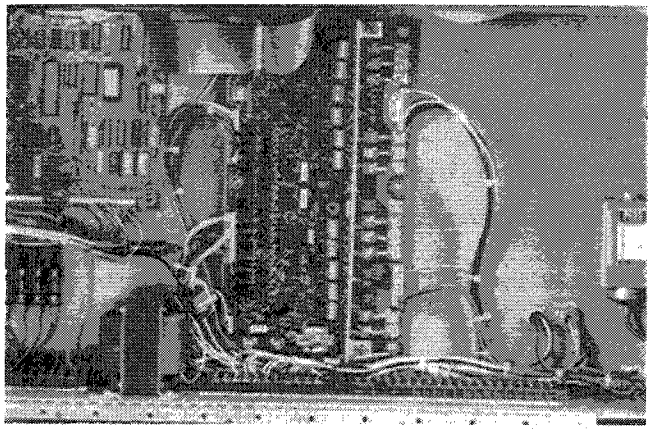
23. The reset button on the right of the display is for clearing a safety lock-out after the problem has been corrected. This button also overrides the starts counter and steps through the controls test; we'll cover both of these later.

After pressing the reset to clear a lock-out or to override the counter, you'll have to press the start button to initiate a start-up.

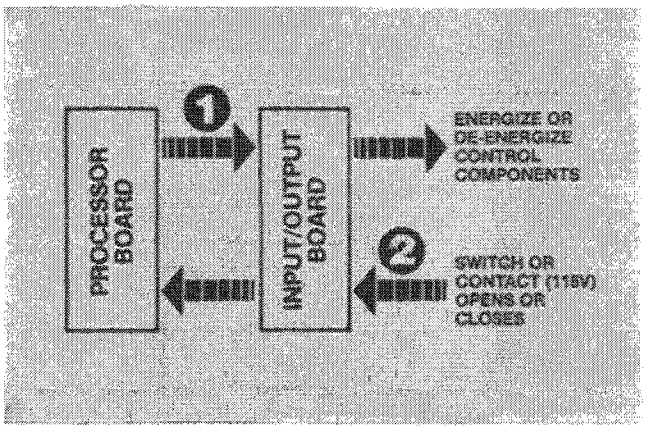


24. Keep in mind that to reset a lock-out, you must set the local/remote switch to local before pressing the reset button. Then, with the switch at local, you can start the machine from the setpoint/display board; or if you want to start the machine from a remote location, then set the switch to remote. The display will indicate which start command will be accepted by the microprocessor.

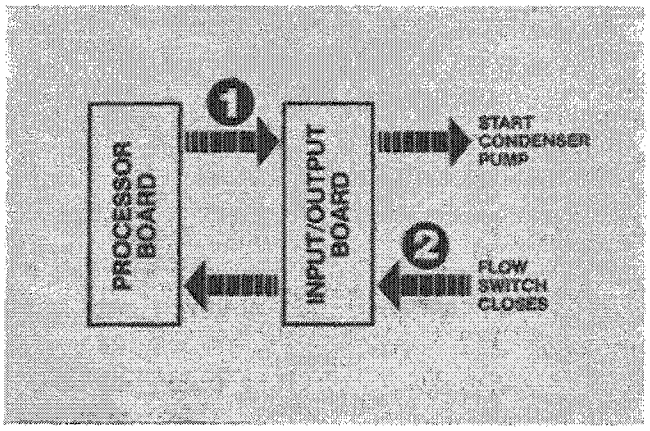
Code 20 is start-up from the setpoint/display board, Code 21 is from the remote contacts, and 22 is from the expanded services panel.



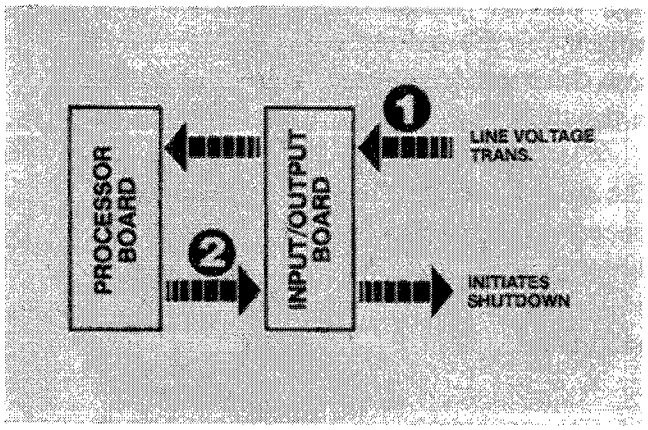
25. Now, let's see how the input/output board works. This board, like the processor board, has all electrical connections made to pin terminal strips.



26. The board receives signals from the processor board to energize or de-energize the control components in the 115 volt circuit. Also, when a switch or contact opens or closes in the 115 volt circuit, a signal is sent back to the processor board. With this information, the processor board knows whether the machine is operating properly or if there is a malfunction.



27. For example: Five seconds after the start button is depressed, the processor board sends a signal to the input/output board to start the condenser water pump. When the pump is started, the condenser water flow switch closes, sending a signal to the input/output board. The input/output board then signals the processor board that the pump has started and that flow has been established.

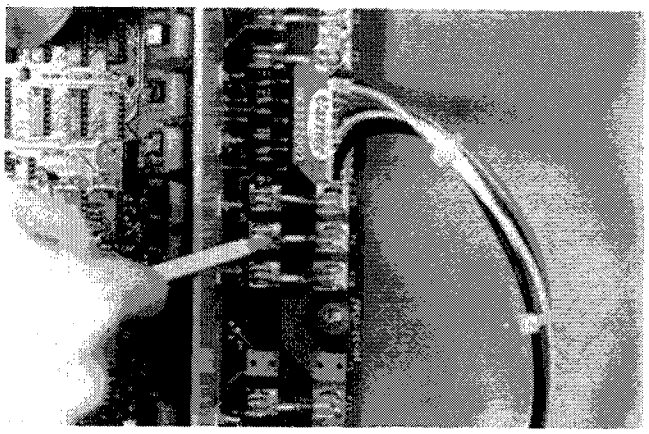


28. The input/output board also has a line voltage transformer which monitors the 115 volt power supply for high, low, or loss of line voltage and sends a signal to the processor board to initiate a safety shutdown if the limits are exceeded.

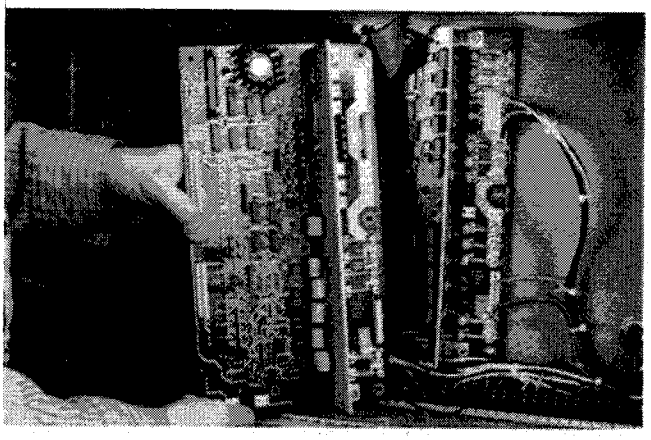
CONDITION	LIMITS	PERIOD
LINE VOLTAGE LOSS	57.5V ± 5%	1 CYCLE
HIGH LINE VOLTAGE	135.7V ± 3%	1 MINUTE
LOW LINE VOLTAGE	94.3V ± 3%	5 SECONDS

29. For example: If there is a line voltage loss and the voltage drops to 57.5 volts for one cycle, the processor board will shut down the machine and load a code of "67" in the display.

Remember, after a safety shutdown, you should correct the problem and then press the reset and start button, in that order.

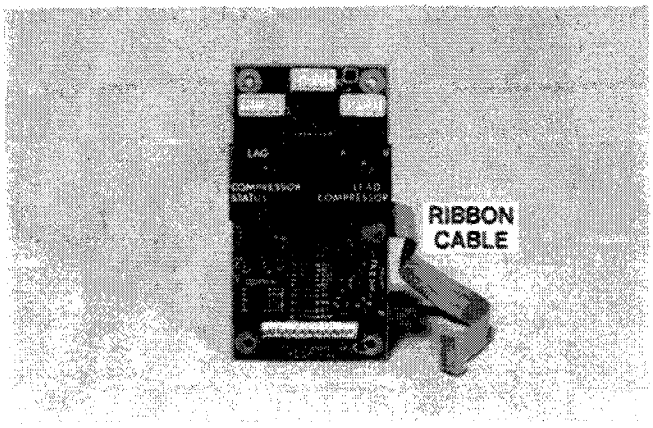


30. The input/output board has fuses for over current protection. So, if you have to troubleshoot the system, don't forget to check the fuses.



31. We've just covered the main components which make up the 32MP control system for single compressor machines.

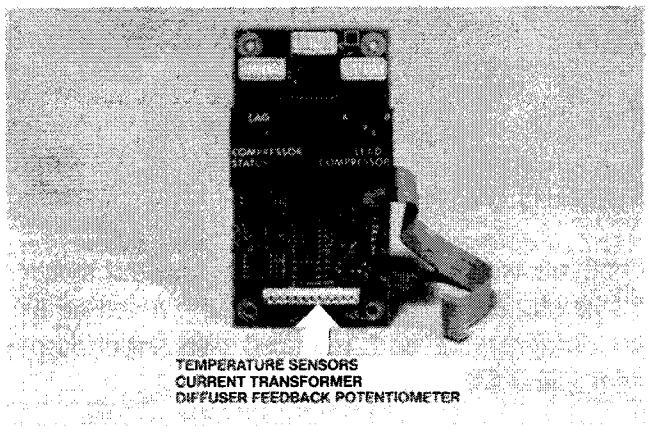
If you are working on a 19DR, the control system will be slightly different. The 19DR machine has two compressors and requires two input/output boards, one for each compressor.



32. Also, the 19DR will have another board not found on single compressor machines; it's called the analog expansion board and it provides the processor board with information relating to the second compressor.

Like the processor board and input/output board, the analog expansion board has all its electrical connections made to pin terminal strips.

Connected to one of its two pin terminal strips is a ribbon cable which communicates the information back to the processor board.

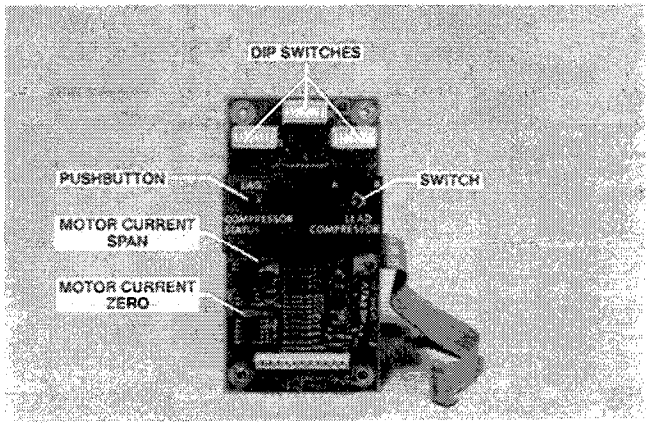


33. Connected to the other pin terminal strip are three temperature sensors, a current transformer, and a diffuser feedback potentiometer.

The three temperature sensors measure the compressor motor winding, the thrust bearing, and the compressor discharge temperatures.

The current transformer measures the motor current for the second compressor. We will see how the transformer measures current a little later in the program.

The diffuser feedback potentiometer is used only when the 19DR is equipped with DM compressors; these compressors have a moveable diffuser wall. We'll see how this potentiometer works in the operating sequence section of this program.



34. Also located on the analog expansion board are three 8-position dip switches, a motor current span potentiometer, a two-position switch, a momentary contact push-button, and a motor current zero potentiometer.

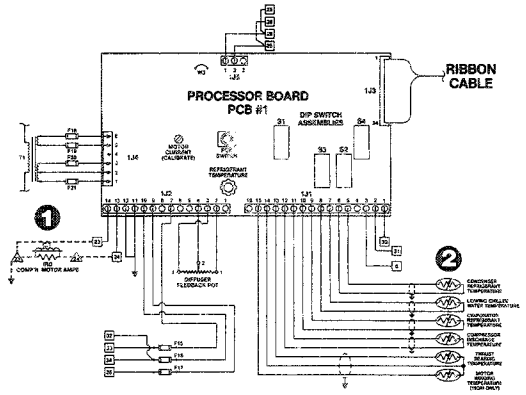
The dip switches are set according to the application. Refer to the Configuration Switch Setting chart for the analog expansion board in the 19DR Start-up Instructions.

The motor current span and zero potentiometers are similar to the ones on the processor board except these are used to calibrate the electrical demand setting for the second compressor.

The two-position switch is used to indicate which compressor (A or B) is the lead compressor. The lead compressor is the one that is started first.

The compressor that starts second is called the lag compressor.

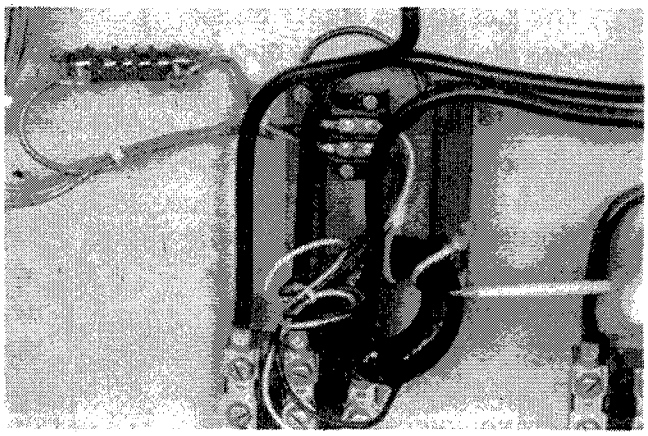
The pushbutton is used to tell the processor board to display, on the setpoint/display board, the status codes for the lag compressor.



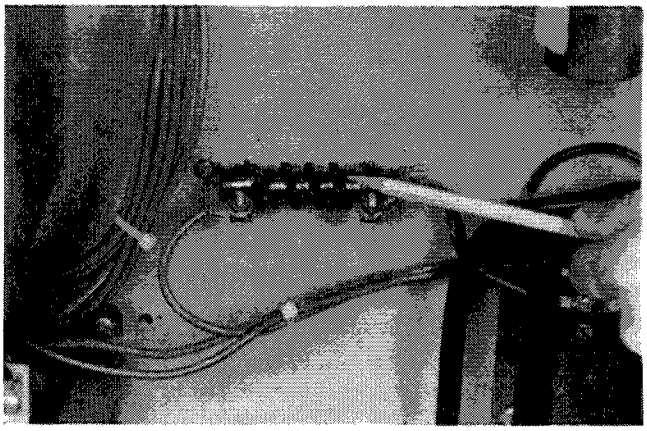
35. Now that we know what the boards look like and how they operate, let's check out the current transformer and temperature sensors.

All machines factory equipped with the 32MP will have a current transformer and temperature sensors connected to the processor board, as we can see here on this section of the wiring diagram for a 19DM. The current transformer is at 1 and the temperature sensors, at 2.

And remember, the 19DR will also have a current transformer and temperature sensors connected to the analog expansion board.



36. Let's start with the current transformer and see how it works. This transformer is in the motor starter circuit. One leg of the compressor motor wiring is run through the transformer. When the compressor motor is operating, a current is induced into it. However, because of the number of windings in the transformer, the induced current is only a small fraction of the actual current draw of the motor.

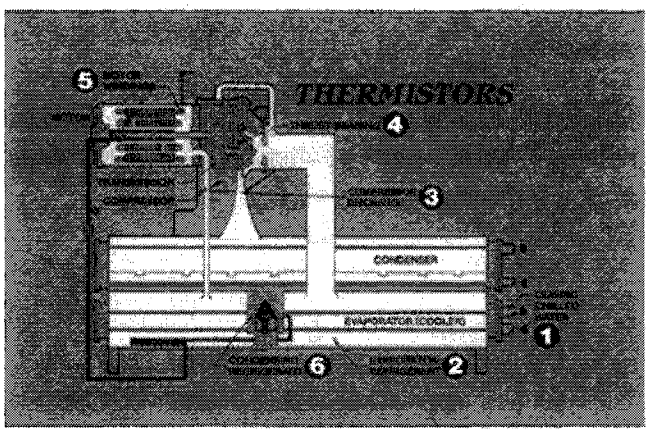


37. The current sensed by the transformer will flow through a signal resistor and produce a voltage. This resistor is connected across the transformer. The voltage across the resistor will vary in direct proportion to the current flowing through it. What this means is that as the current increases, the voltage increases.

38. The size of the signal resistor is chosen so that when the compressor is operating at rated load amps, the voltage across the resistor will be .5 volts AC. Rated load amps refers to the current draw of the compressor at full load conditions.

The processor board has .5 volts placed in its memory as a reference point, so that if the voltage is above or below .5, it knows the percent of rated load amps at which the compressor is operating. For example: If the processor senses .25 volts, it knows the compressor is operating at 50% of rated load amps .25 ÷ .5 = .5 (50%). Later we'll see how the processor uses the voltage signal from the current transformer to control guide vane position and determine motor acceleration time.

39. Next, let's see how the temperature sensors effect the operation of the machine. The sensors used in this control system are thermistors. A thermistor is a device with a variable resistance that changes with the temperature. The thermistors used in this system have a negative temperature coefficient; this means that as the temperature increases, the resistance decreases and vice-versa. These resistances, which vary the voltage signals to the processor board, provide capacity control and safety protection on all machines; in addition, on the DM they also provide diffuser wall positioning.



40. On all 17 and 19 series chillers factory equipped with the 32MP, the thermistors are for: leaving chilled water, evaporator refrigerant, compressor discharge, and thrust bearing.

A motor winding thermistor is also found on all 19 series chillers and a condenser refrigerant thermistor is only on the 17,19DK/DM and 19DR models.

41. To control the machines capacity, the leaving chilled water thermistor is monitored by the processor board. The processor board compares this temperature to the chilled water or brine setpoint and changes the position of the guide vanes as required to maintain the setpoint.

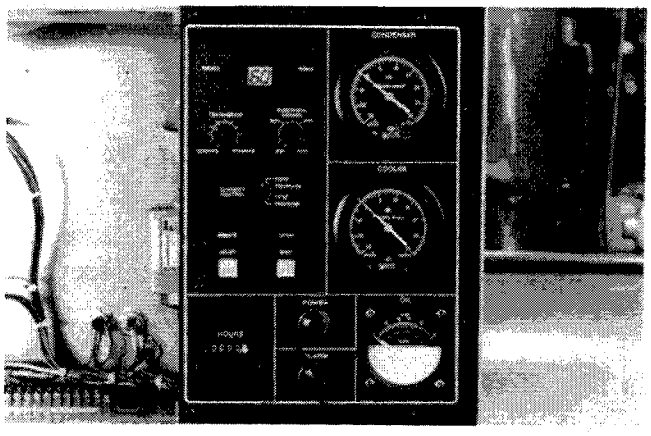
For example:

If the leaving chilled water or brine temperature is below the setpoint, the processor board will send out a signal to close the guide vanes, which will decrease the capacity and raise the temperature.

If the temperature is above the setpoint, the processor board will send out a signal to open the guide vanes, which will increase the capacity and lower the temperature.

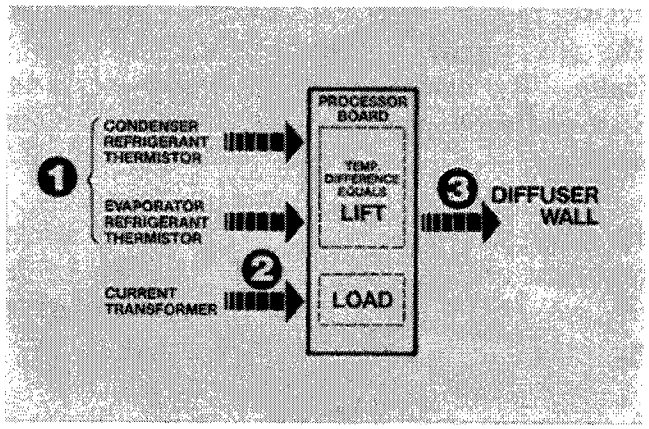
Note: There is a temperature range above and below the setpoint at which the guide vanes do not move; this is called the deadband and will be covered later.

42. Now, let's see how the thermistors for the compressor discharge, the evaporator refrigerant, the motor winding, and thrust bearing provide safety protection for the machine. For each of these thermistors a reference voltage is placed in the processor board's memory that is equal to a trip temperature or resistance. If any thermistor reaches its trip temperature, the processor board senses this, shuts down the machine, loads a code into the display, and energizes the alarm light on the gauge panel.



43. For example: If the compressor discharge temperature reaches 220°F (104°C), the machine is shut down, a code of "60" is loaded into the display, and the alarm light is lit. The alarm light tells you there is a problem and the "60" tells you what the problem is; in this case, it's the compressor discharge temperature.

Remember, after a safety shutdown, you should correct the problem and then press the reset and start button to initiate a manual start-up.



44. Here's how the condenser and evaporator refrigerant thermistors and the current transformer control the movable diffuser wall on the DM machines or the 19DR machines with DM compressors.

The processor monitors the temperature difference between the condenser and evaporator. This represents the pressure difference between the cooler and condenser which is known as lift. The processor also monitors the voltage signal from the current transformer, which represents the load on the compressor. With this information -- lift and load -- the processor then determines how much to open or close the diffuser wall to operate the machine at optimum efficiency.

Later in the operating sequence section of this program, we'll see how the diffuser wall is activated. Also, we'll see how the condenser and evaporator thermistors are used to initiate the purge cycle.

45. The processor also monitors the thermistors to determine if they are working properly.

Each thermistor has a resistance range of 168,230 to 166 ohms which represents a voltage range placed in the processor boards memory. These voltages or resistances are equivalent to a temperature range of -40 to 259°F. If the processor board monitors a thermistor temperature outside this range for more than 3 seconds, it will assume the thermistor is faulty and will energize the alarm light, load an alternating code 64 and another

number in the display and shut down the machine. The other number indicates which thermistor is faulty. The numbers for each sensor are in the Start-up Operation and Maintenance Book for your machine.

46. Now, let's cover the features that this microprocessor control system provides. Some of the features we've already covered, so we'll start by reviewing those first.

A thermostat control permits local adjustment of the leaving chilled water temperature from 35-65°F (1.67 to 18.3°C) or brine temperature from 0-45°F (-17.8 to 7.0°C).

An electrical demand control limits the maximum current down to 40% of rated load amps.

A capacity control knob, with four positions, permits selection of automatic or manual control over leaving water or brine temperature. The capacity control knob, the electrical demand, and thermostat control are all on the setpoint/display board.

A safety lockout feature monitors all safety inputs from thermistors, switches and contacts and shuts the machine down if a limit is exceeded.

47. A voltage protection feature monitors the 115 volt power supply for high, low, or loss of line voltage and initiates a safety shutdown if the limits are exceeded.

A self-diagnostic feature monitors individual analog and discrete inputs for control malfunction and displays troubleshooting information. Analog refers to devices whose signal varies such as the thermistors and the current and line voltage signal transformers. Discrete refers to devices which can only generate two signals (for example, open or closed) such as safety switches and contacts.

A safety shutdown alarm feature energizes a panel mounted alarm light and a set of dry contacts for installation of a field-supplied remote alarm.

A controls test displays the status of each of the control circuit inputs and outputs and starts the components to confirm proper operation. We'll cover this test in detail later.

A shutdown status recall feature displays the last five reasons for safety shutdowns when the recall button is pressed. They will be displayed beginning with the most recent to the least recent reason.

48. These features, along with the ones we'll cover next can be split into three categories: guide vane control, safety, and added flexibility.

In the guide vane control category the features are: The thermostat, electrical demand, and capacity control knob.

In the safety category are the safety lockout and voltage protection.

The added flexibility category includes those features which enhance the overall operation of the machine, but do not control capacity or provide safety protection. These features include: the self-diagnostic check, safety shutdown alarm, controls test, and shutdown status recall.

49. Now, let's cover the remaining features. We'll start with the guide vane control category, which includes: proportional band, ramp loading, deadband, and capacity override.

50. The proportional band feature provides the rate of speed at which the guide vanes change position in proportion to how far the leaving chilled water or brine temperature is from setpoint. The actual rate at which the guide vanes change position is determined by how long the guide vane motor is being energized and de-energized within a 10-second period.

51. The farther away that the leaving chilled water or brine temperature is from the setpoint, the faster the guide vanes move. The closer to setpoint, the slower they move. The processor board can be configured for a 5 or 15°F proportional band (2.8 or 8.3°C) with the dip switches. At the 5°F (2.8°C) setting, the proportional band is from approximately 1.5°F (.8°C) below setpoint to 5°F (2.8°C) above; and for 15°F (8.3°C), it's approximately 1.5°F (.8°C) below to 15°F (8.4°C) above. The rate of change of guide vane position will be faster at either end of each proportional band.

Remember: When the leaving temperature is above the setpoint, the guide vanes open; and when it is below the setpoint, the guide vanes will close. The only exception is when the leaving temperature is within the deadband, which we'll cover in a minute.

52. The ramp loading feature, which works with proportional band, slows the rate of guide vane opening during start-up. If the guide vanes open rapidly, the refrigerant in the oil boils off, driving the oil out of the compressor. This results in poor lubrication. The ramp loading feature prevents this from happening.

Also the ramp loading feature prevents rapid increases in compressor loading which causes higher power consumption and increased operating costs.

There are eight different ramp loading rates. These rates are set with the dip switches and will limit the average rate that the leaving chilled water or brine temperature can decrease in °F or °C/minute. Refer to the configuration chart in the Start-up Instructions for details.

53. To determine how long ramp loading lasts, first, subtract the leaving temperature setpoint from the leaving temperature at start-up, this is the temperature difference. Then, divide the temperature difference by the ramp loading rate, the result is the number of minutes for ramp loading.

For example: If we have a setpoint of 45°F (7.2°C), a leaving temperature at start-up of 65°F (18.3°C), and a ramp loading rate of 3°/minute (1.67°C); ramp loading lasts approximately 6 and 2/3 minutes - that's 65 - 45 = 20, and 20 ÷ 3 = 6 2/3.

There is one thing that you should keep in mind about ramp loading, the ramp loading rates limit the average drop of the leaving chilled water or brine temperature; the actual decrease in temperature will probably not equal this rate. So, it is very unlikely that the leaving water or brine setpoint will be reached when ramp loading is complete.

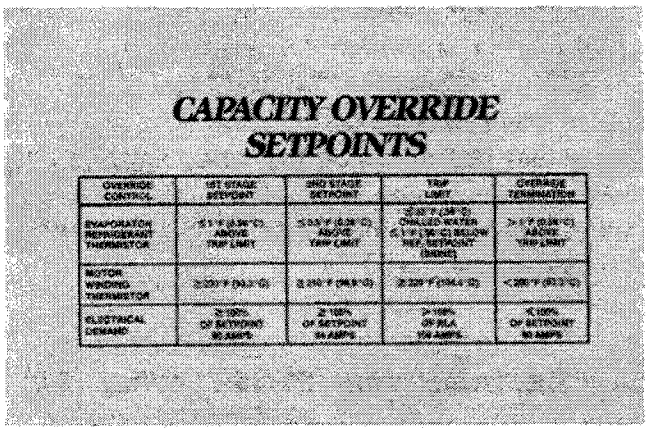
54. The deadband feature of 1° or 2°F (.56 or 1°C) provides a temperature range at which the guide vanes do not move. When set at 1°F (.56°C), the processor board will not initiate guide vane movement when the leaving water temperature is within .5°F (.28°C) of setpoint [that's .5°F (.28°C) above or below setpoint]. When set at 2°F (1°C), the guide vanes will not move when the leaving water is within 1°F (.56°C) above or below setpoint. The deadband is set with dip switches.

55. The capacity override feature prevents the guide vanes from opening further or closes them to minimize the possibility of a safety shutdown. The evaporator refrigerant and motor winding thermistors, and the electrical demand provide two stages of override control. The first stage prevents the guide vanes from opening further and displays a blinking diagnostic code indicating the reason for override. The second stage drives the guide vanes closed until the override condition falls below the first stage override set-point. This will terminate override and return the machine to temperature control. However, if the condition exceeds the second stage override setpoint and reaches the trip limit, a safety shutdown will be initiated.

Let's use the electrical demand as an example and see how override works.

56. We'll assume the electrical demand on the setpoint/display board is set at 80% of rated load amps. The rated load amps of our machine is 100. This gives us an actual demand setpoint of 80 amps (that's 80% of 100).

When the machine is operating, the processor board compares the electrical demand setpoint of 80 amps with the current draw of the motor. Remember, the processor board monitors motor current through the current transformer in the starter circuit.



57. If the motor current reaches 100% of the 80 amp demand setpoint, the first stage override setpoint is reached and the guide vanes will not open any further. If the motor current continues to increase to 105% of demand setpoint (that's 1.05 x 80 = 84 amps) the second stage override is reached and the guide vanes will close and will continue to close until the current draw falls below the first stage override of 80 amps. When this happens, override will be terminated and the machine will return to temperature control. However, if the current increases above the trip limit of 108% of rated load amps (that's 1.08 x 100 = 108 amps), the starter overloads will open and the compressor will stop. The processor board senses this and initiates a safety shut-down. It sends out a signal to close the guide vanes, de-energize the oil pump, condenser and evaporator pump, and tower fan relays. The processor also loads the appropriate code in the display, and energizes the alarm light.

58. Next, let's check out the remaining safety features of this control system. They include: compressor anti-recycle timers, compressor starts counter, motor acceleration time, starter transition time, failsafe shutdown sequence, and the oil pump interlock.

59. The compressor anti-recycle feature prevents rapid compressor cycling. This feature uses two timer circuits within the processor board; a 15-minute minimum start-to-start timer, and a three-minute minimum stop-to-start timer.

60. These two situations show how the timers work:

The 15-minute timer starts when the machine starts and continues to run until 15 minutes has elapsed. This timer will run even if the machine shuts down before 15 minutes, as long as power is supplied to the control panel. The 3-minute timer starts when the machine shuts down and will continue to run until 3 minutes has elapsed. Both the 15- and 3-minute timer must time out before the machine can restart.

61. The compressor starts counter prevents the compressor from starting after the recommended limit of four non-recycle starts in a 6 hour period. A non-recycle start is any manually initiated start; for example, a time clock or pressing the start button.

62. To override the starts counter, which is part of the circuitry on the processor board, do the following after code "41" appears in the display:

1. Find and correct the problem if it was a safety shutdown. If the machine is cycling off of a time clock more than 4 times in a 6-hour period, reprogram the time clock so that this doesn't happen.

2. Press the reset button on the setpoint/display board to clear the shutdown, after the problem has been corrected.

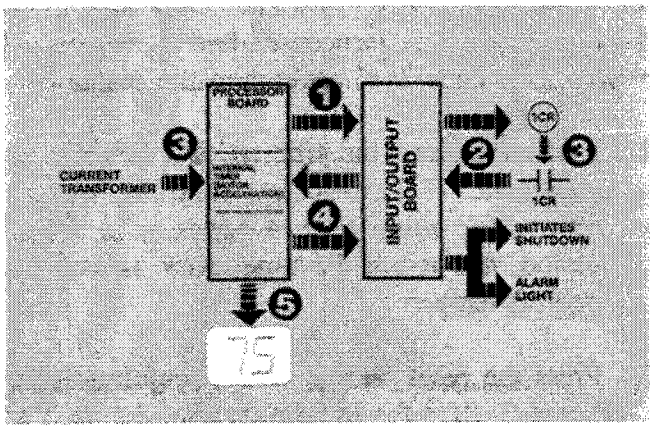
3. Press the start button. A "41" will show on the display, indicating 4 shutdowns in a 6-hour period.

4. Press reset again, then the start button, in that order.

This procedure allows one additional start. This means, if you have another shutdown in 6 hours, you'll have to perform the same procedure we just covered to get the machine started.

Don't abuse the starts counter override feature. It's there for a reason and that's to make the operator aware that he has exceeded the recommended number of start-ups in a 6-hour period. So, if you have a shutdown, find and correct the problem.

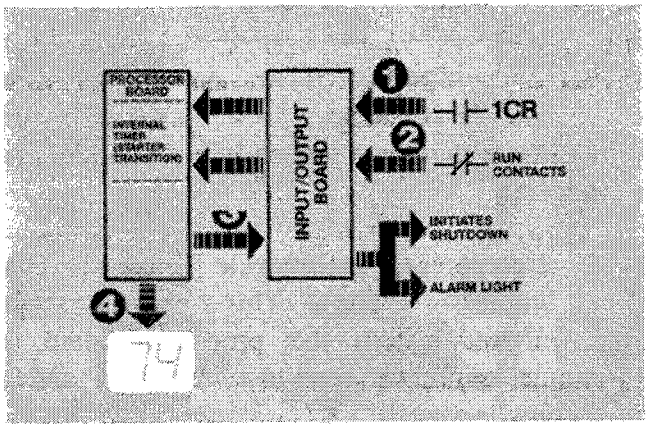
63. The motor acceleration time feature monitors motor inrush current at start-up to prevent motor damage. If the current doesn't drop below the rated load amps in approximately 45 seconds for reduced current starters or 10 seconds for across-the-line starters, the machine is shut down. However, on the 19CB the times are different; it's approximately 90 seconds for reduced current starters and 20 seconds for across the line.



64. Here's how it works:

At start-up, the processor board sends a signal to the input/output board to energize the 1CR coil to start the motor. The auxiliary 1CR normally closed contacts open. The input/output board senses this and sends a signal back to the processor board that the motor has started. This signal starts the processor board's internal timer which monitors motor acceleration time. With the timer started, the processor board monitors the motor amps through the current transformer in the starter circuit. If the time limit is exceeded before the current drops to or below the rated load amps, the processor board sends a signal to the input/output board to initiate a shutdown and energize the alarm light. The processor also loads a code of "75" in the display. Remember, the time limit is approximately 45 seconds (or 90 seconds on the 19CB) for reduced current starters and approximately 10 seconds (or 20 seconds on the 19CB) for across-the-line starters.

65. The starter transition time feature monitors the time it takes the starter to switch from star to delta for reduced current starters. If the transition time is greater than 90 seconds, (or 210 seconds on the 19CB), the machine is shut down to prevent motor and starter damage.

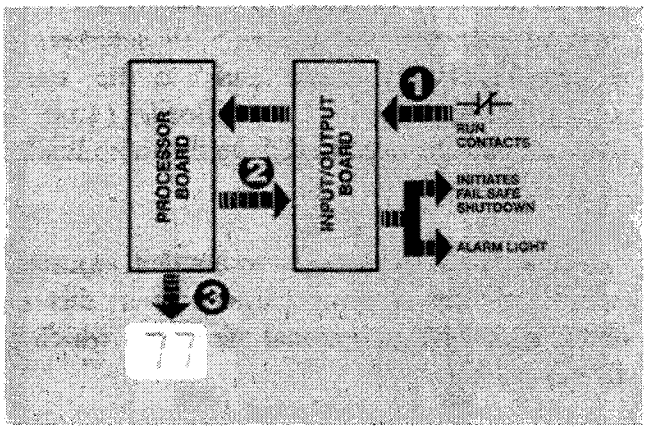


66. Here's how it works:

At start-up, when the auxiliary 1CR contacts open (as just described), the input/output board sends an input signal to start the processor board's internal timer which monitors starter transition time. Then, the processor board will wait approximately 90 seconds to receive another input signal from the input/output board indicating the run contacts have closed, which means transition has taken place. When this happens, the timer will stop and the machine will continue to run. If it takes longer than 90 seconds, (210 for a 19CB), the timer will time out and the processor board will send a signal to the input/output board to initiate a shutdown. The processor board also energizes the alarm light and loads a code of "74" in the display.

67. The failsafe shutdown sequence keeps the oil pump, the water pumps, and the tower fan outputs energized if the starter run contact fails to open on a shutdown command from the processor board.

If during the compressor off state the processor monitors a motor current signal greater than 10 percent rated load amps, the oil pump is energized to prevent damage to the bearings. If during the compressor off state the processor monitors that both auxiliary starter contacts have energized, the processor will display an alarm.



68. Here's how it works:

The run contact is used to indicate whether or not the compressor motor is running. If it doesn't open when shutdown is commanded, the input/output board sends a signal to the processor board that the run contact is still closed. The processor assumes the compressor is still operating and sends a signal back to the input/output board to initiate the failsafe shutdown, energize the alarm light, and load a "77" in the display. We will cover this in more detail in the operating sequence.

69. When the compressor is off, the failsafe feature operates differently. If the motor current signal from the current transformer is greater than 10 percent of the rated load amps, the processor initiates failsafe by energizing the oil pump, energizing the alarm light, and loading a code "77" in the display.

70. If both auxiliary starter contacts 1CR and the run contact energize, the processor energizes the alarm light and loads a "77" in the display.

Keep in mind if the oil and water pumps and the tower fan were de-energized with the compressor operating, the machine could be damaged. For example, if the chilled water pump was de-energized, the water in the cooler could freeze and damage the tubes.

71. The last safety to discuss is the oil pump interlock. This normally open contact, located on the output from the input/output board to the 1CR relay, will close when the oil pump starter contact closes, preventing the compressor from accidental start-up if the oil pump is not on.

72. Next, let's check out the remaining added flexibility features. They include: sequencer outputs for the pumps and tower fan, a remote start/stop input, a spare safety input, a power "on" light, low load recycle, a purge malfunction override, and control expandability.

73. The sequencer outputs for the pumps and tower fan are provided at the input/output board. This feature automatically starts and stops the cooler and condenser water pumps and cooling tower fan based on the operating mode.

The remote start/stop input provides for manual start-up and shutdown by a time clock or a switch at a remote location.

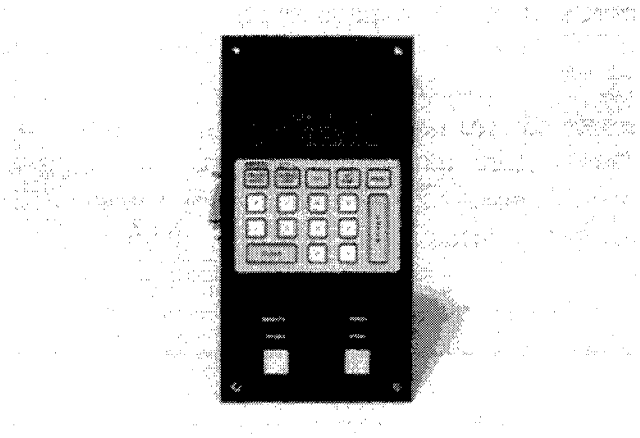
The spare safety input monitors and initiates a machine shutdown upon a request from additional field supplied safeties. The spare safety and remote start/stop inputs are provided by the input/output board.

The power "on" light on the gauge panel indicates when the control center is energized.

74. The low load recycle automatically stops the machine when the leaving water or brine temperature drops to 5°F (2.8°C) below the leaving setpoint or within 3°F (1.7°C) of the refrigerant temperature setpoint. It automatically restarts the machine when the leaving water or brine temperature is more than 5°F (2.8°C) above the setpoint, if the 15- and 3-minute internal timers have timed out.

The purge malfunction override, which monitors how long the purge pump operates, prevents excessive purging. The function of the purge pump is to remove air and non-condensibles from the refrigerant system. We'll cover the low load recycle and the purge override in more detail in the operating sequence section of this program.

The control expandability feature allows you to use a variety of control options and also provides a communication link between the basic control system and a higher level controller such as an energy management system. This feature is called the expanded services panel (ESP) and is an option that is connected to the processor board.



75. This is the optional expanded services panel (ESP) which increases the features provided by the basic control system. The expanded services panel can take the place of the setpoint/display board as the input center for all machine setpoints and manual stop and start commands. It can be located on the basic control panel or in a customer supplied enclosure for remote use.

The panel also provides the system with additional monitoring capabilities, data logging and options such as chilled water and electrical demand reset, lead-lag control of two machines, and auto restart after power failure.

Located on the panel is a five-digit display, a key pad, a panel/remote switch, and a stop and start switch.

76. The key pad and display are used to program the panel.

When programming, the keys that you press will either tell the panel what options are being used or adjust the leaving chilled water setpoint, the electrical demand setpoint, or ramp loading rate. These adjustments will override all setpoints on the setpoint/display board and the dip switch settings for ramp loading. Ramp loading from the panel can only be used to reduce the ramp loading rate set by the dip switches.

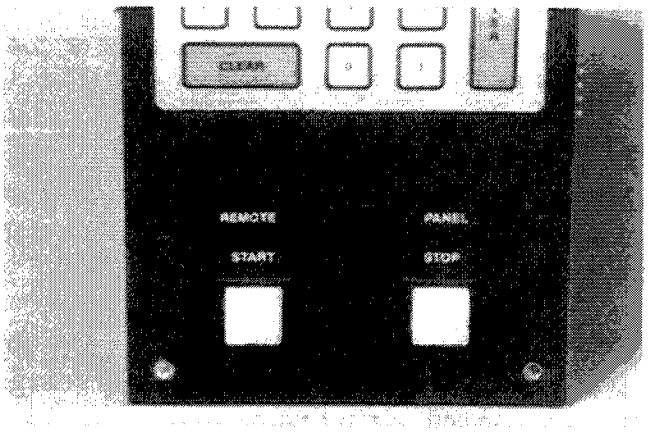
With this panel you also have another adjustable setpoint, it's for entering chilled water; this setpoint is used with an optional thermistor which we will cover later.

Also, when programming the expanded services panel, the display will show you what is being entered into the panel's memory.

77. The key pad can also be used with the display to monitor the machine parameters. These parameters, which will be shown on the display, will be the actual thermistor temperatures, the motor current as a % of the rated load amps, and the line voltage supplied to the input/output board. The key pad and display can also be used to recall up to the last five safety shutdown codes. However, the display will automatically show the present operating or shutdown status code, like the set-point/display board.

For complete details on how to program and operate the panel, refer to the training program, Expanded Service Panel (ESP-II) 32MP-06, catalog number 021-014.

78. Another feature of this panel is data logging. This feature provides inputs to a computer terminal for printouts of the setpoints, ramp loading rate, status and shutdown codes, and operating parameters. This allows you to keep an up-to-date hard copy record of the machine's operation.



79. Now, let's check out the switch that's labeled panel and remote, also the start and stop push buttons on the panel.

The panel/remote switch should be set to remote any time the expanded services panel will receive operation commands from the Carrier Comfort Network (CCN). The CCN 32MP Gateway Module is the interface between the ESP and CCN. Whenever the CCN 32MP gateway is not present, always leave the switch in the panel mode, so the programming mode is not disabled.

Additionally, the panel/remote switch should be set to remote if any of the following are used: a start or stop command from a remote location (such as the machine control center, a time clock, a remote start/stop switch, or an energy management system).

When the switch is set to the panel position, the start and stop switches on the panel will provide manual control of the machine. Also, with the switch in this position, you can program the panel. If the remote contacts have been enabled in the ESP Program, the start pushbutton will be disabled, and start-up of the machine will be accomplished through the remote contact.

80. Next, let's check out the options that are available with the expanded services panel. They include: chilled water and electrical demand reset, lead-lag operation of two machines, and auto restart after power failure.

81. The chilled water reset option allows the leaving chilled water or brine setpoint to change with the load to maintain the space temperature requirements.

Chilled water reset can be controlled from:
1. Cooler chilled water temperature differential.
2. A remote temperature; for example, outdoor air, supply air, or return chilled water.
3. An energy management system.

82. Cooler temperature difference can be used as the input on which to base the reset setpoint. The temperature difference or ▲T is related to load, high load = high ▲T, low load = low ▲T as compared to design ▲T. The setpoint can be increased or decreased based on the differential. An optional return water sensor must be installed for this option.

83. Remote temperature reset allows the leaving water setpoint to be increased or decreased based on an external temperature such as outside air, supply air or the return chiller water temperature. To sense the external temperature, an optional thermistor must be installed. How much the leaving water or brine setpoint is increased or decreased, for any of the resets, will depend on the program placed into the panel's memory.

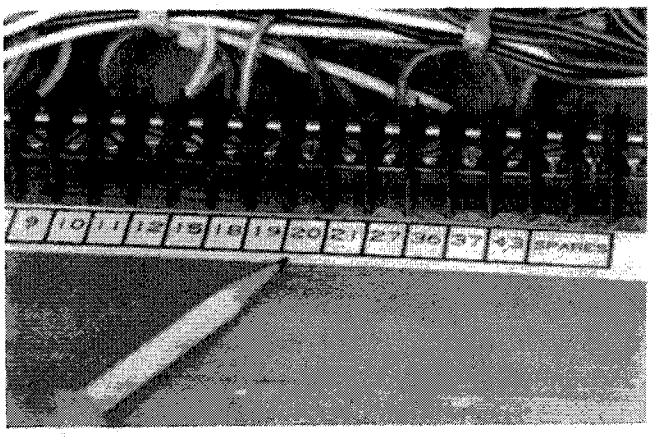
84. The expanded services panel can also be connected to an energy management system which supplies a 4-20 milliamp or 1-5 volt DC signal to reset the leaving water temperature setpoint up or down.

85. Now, let's check out the electrical demand reset option. This option limits compressor motor current during peak power demand periods. The utility companies charge a higher rate during these periods if the building exceeds a pre-determined KW usage.

The current will be limited as a percent of the rated load amps. For example: Let's assume the rated load amps is 100. If we reset to 70%, this means the motor current will be limited to 70 amps (that's 70% x 100).

Electrical demand reset can be controlled from:

1. Contacts or switches. And,
2. An energy management system.



86. Electrical demand reset can be provided by three field-installed switches or contacts. When these switches or contacts close, either manually or automatically, they can provide up to three steps of reset.

Here's how:

The contacts or switches are connected to terminals 19, 20, and 21 on the terminal strip in the control center. Each terminal will then have a percent value programmed into the panel.

For example: Terminal 19 could be 40%; terminal 20, 60%; and terminal 21, 80%.

Then, if you want to reset the electrical demand to 80%, you must close the contact or switch connected to Terminal 21.

If more than one switch or contact is closed, the lowest reset value of the closed switches or contacts will be chosen by the processor board.

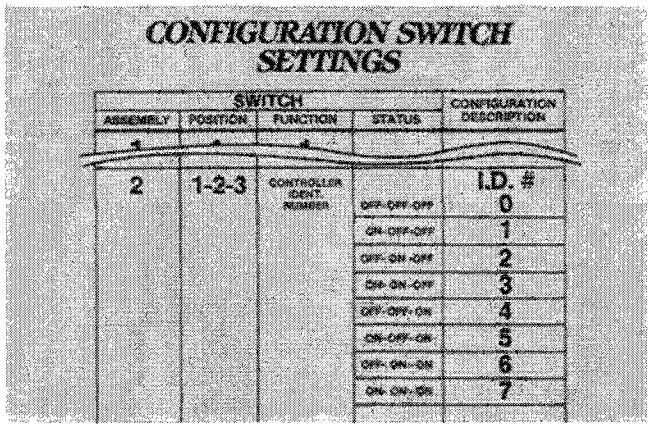
87. You can also connect the expanded services panel to an energy management system which supplies a 4-20 milliamp or 1-5 volt DC signal to provide electrical demand reset.

When using the energy management system for reset, you can program in the milliamp or voltage range to represent a reset range.

For example: 20 milliamps can represent a reset to 40% and 4 milliamps, a reset to 100%. The actual number of reset steps will only be limited by the panel's memory.

88. The next option we'll cover is lead-lag.

This option is used to automatically start and stop the lag machine based on the cooling requirements when two machines are installed in series or parallel. The information that you program into the panel will determine the conditions for starting and stopping the lag chiller and the order in which the machines are started. The machine selected as lead will always start first and the lag will always start second. The panel selects the order in which the machines are started based on the machine identification numbers programmed into the panel for the lead machine.

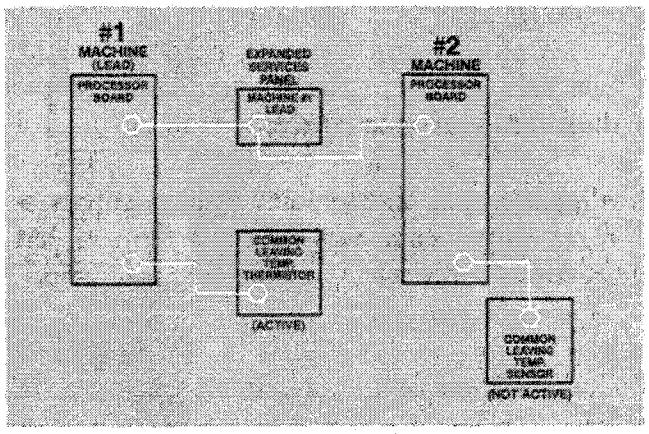


89. The machine identification number is set with dip switch assembly 2; dip switches 1, 2, and 3.

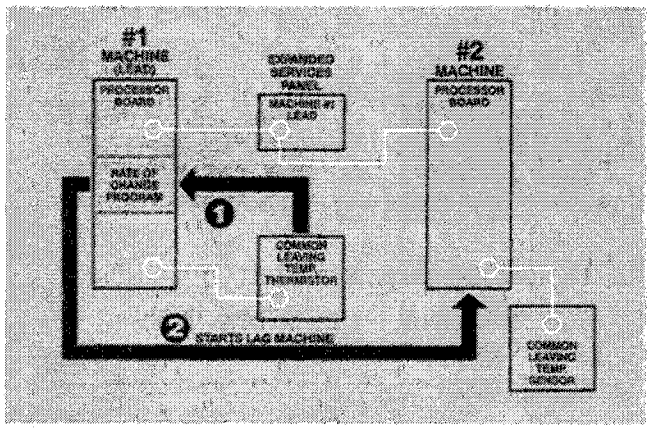
Here's an example:

If dip switch 1 is set to the on position, and dip switch 2 and 3 are set to the off position, the machine's identification number is "1".

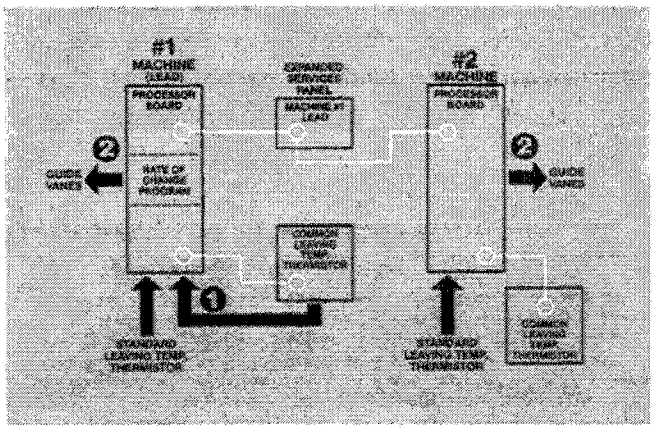
Remember, the dip switches are on the processor board and each machine must use a different identification number.



90. Lead-lag requires two common leaving chilled water thermistors. When setting up the system for lead-lag, the common thermistors must be connected to each machine. The lead machine is determined by the machine identification number programmed into the expanded services panel.



91. The common point thermistor will serve two purposes. One, it sends a signal to the processor board of the lead machine. This allows the board to calculate the rate of change of the leaving water temperature. When the rate of change calculated by the processor falls below the rate of change programmed into the panel, the lag machine is started.



92. The second purpose of the common thermistor is that it will signal the processor board to control the guide vane position; it does this by overriding the signals sent to the processor boards by the standard leaving chilled water thermistor of each machine. However, the standard leaving water thermistor on the lead machine can still initiate recycle shutdown, which we'll cover in the operating sequence.

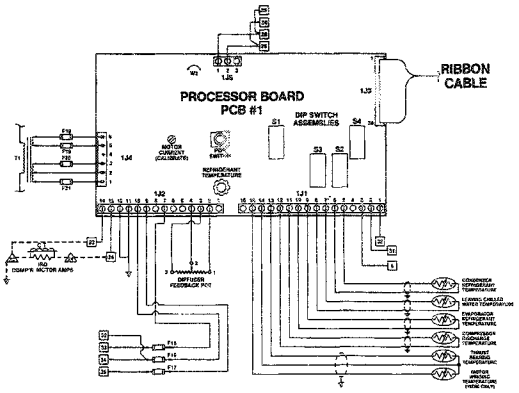
If your machine has other optional thermistors or sensors, they must also be connected to each machine.

93. The last option is auto restart after a power failure. This option does what its name implies; it allows the machine to automatically restart 3 minutes after the power has been restored, if a shutdown has not been initiated by a computer, a time clock, or pressing the stop button.

94. Although the expanded services panel provides a number of added features, you must still use the setpoint/display board to: reset a safety shutdown, perform the controls test, and manually adjust the guide vane position.

95. Now that we know what the components are in the basic and expanded control system, let's check out the electrical operating sequences for a chiller with the 32MP microprocessor controller.

Here are the sequences that we will cover: Manual start-up, manual and safety shutdown, and recycle shutdown and start-up. We will also cover the purge cycle and the operation of the movable diffuser wall.



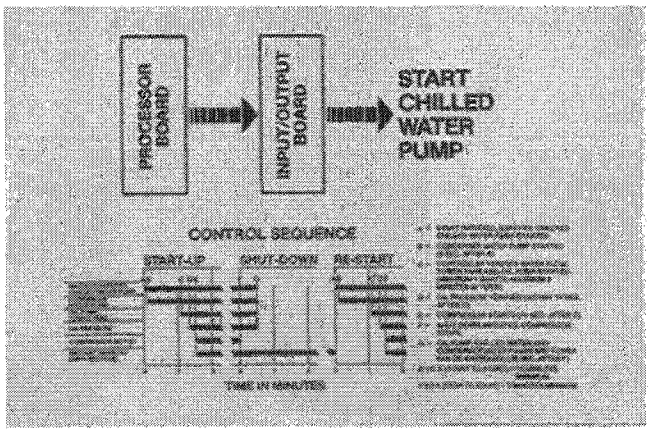
96. Before we start the operating sequence, let's take a look at part of the wiring diagram.

This is what the processor board looks like on the diagram.

Notice that the wiring connections are made to pin terminal strips located around the edge of the board. On this board they are labeled 1J1 to 1J5, shown here in blue. The pin terminals for each terminal strip are also labeled.

The input/output and setpoint display boards are also set up the same way with pin terminal strip connections. All wiring to the terminal strips is done at the factory.

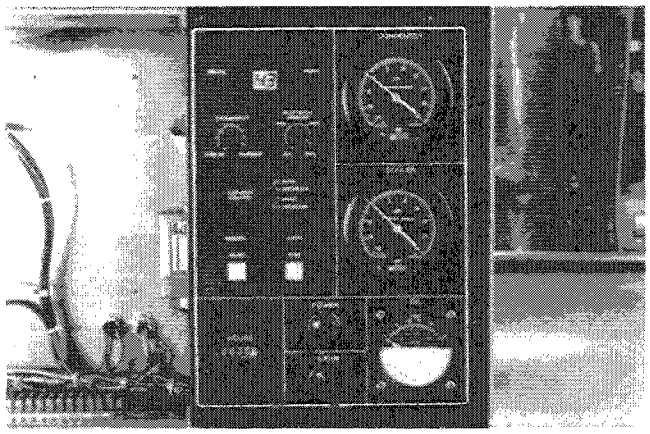
Notice that there aren't any circuits shown on the processor board that you can follow; this is the same for the input/output and setpoint/display boards. So, instead of using the wiring diagram to explain the operating sequence, we'll use . . .



97. a block diagram, at the top, which will show you what happens pictorially. For example, here we are showing the processor board sending a signal to the input/output board to start the chilled water pump. We'll also use the control sequence chart, at the bottom, which is actually part of the wiring diagram label.

The sequence chart tells you what component is energized and when it is energized.

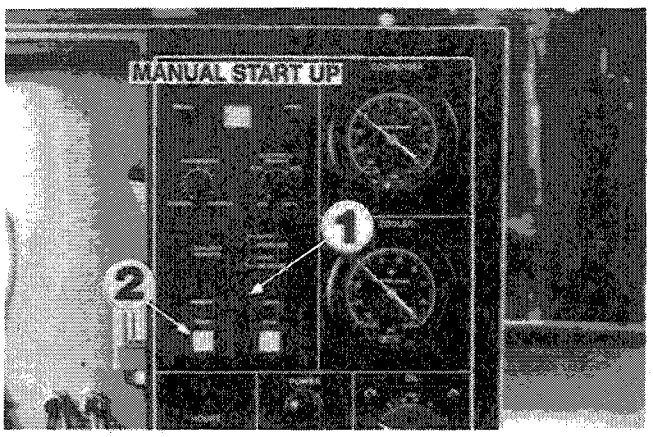
> [Located at the back of this Service Training book on Page 33, is the actual wiring diagram for the 17 and 19 series machines. You can use this diagram as a reference to determine what board and terminals a component is connected to. Understanding the diagram for your machine will help you to troubleshoot the control system, if a malfunction occurs.]



98. Keep in mind as we cover the operating sequences, that if a system malfunction occurs, the machine will shut down, the safety alarm light will be energized, and the appropriate code will be displayed.

For example, if the chilled water flow switch does not close within the required time limit at start-up, the machine is shut down, the alarm light is energized, and a code of "43" is displayed.

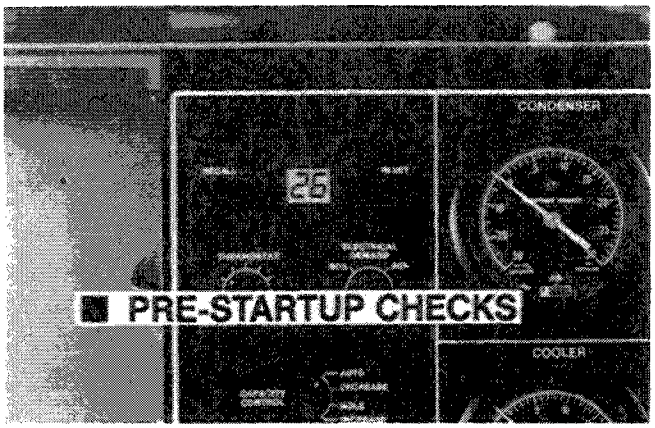
To put the machine back into operation, you should correct the problem and then press the reset and start button, in that order.



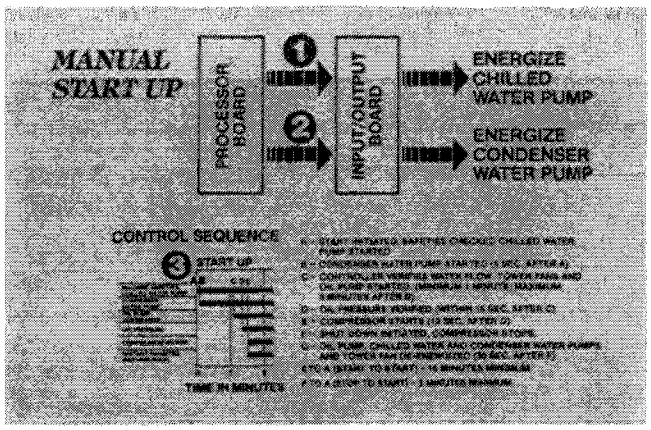
99. Now, let's begin with manual start-up, which can be initiated after the 15-minute start-to-start and 3-minute stop-to-start timers have timed out.

When these timers time out, the appropriate start-up code is displayed.

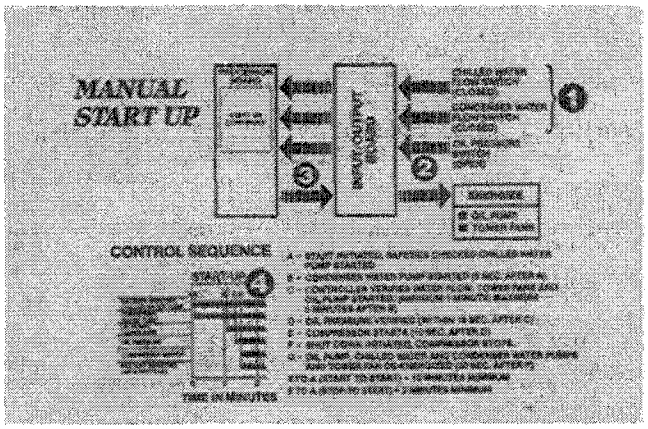
With the local/remote switch set to local, press the start button on the setpoint/display board. If the machine is started and stopped from a remote location, set the switch to remote and close the remote start/stop device's contacts.



100. This will cause a "26" to be displayed, indicating that the controller is performing a series of pre-start-up checks to verify that all the safeties are within their limits. The term controller refers to the processor, input/output and setpoint/display board.



101. If all the safeties check out OK, the processor board sends a signal to the input/output board to energize the chilled water pump. Five seconds later the processor board sends another signal to the input/output board to energize the condenser water pump. This is shown at points A and B on the control sequence chart.

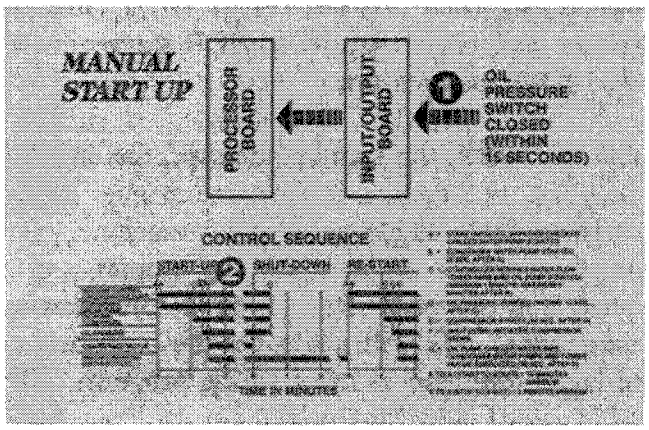


102. One minute later, the input/output board will monitor the chilled water and condenser water flow switches. These switches must close within five minutes after the pumps are energized. If they do, the input/output board senses this and sends a signal to the processor board, indicating the pumps have started and there is water flow.

Then, if the processor board receives a signal from the input/output board that the oil pressure switch is open, start-up continues. Keep in mind that the machine is not yet running, therefore, the switch should be open. If the processor board receives a signal that the switch is closed, the processor board assumes the switch is faulty and terminates the start-up.

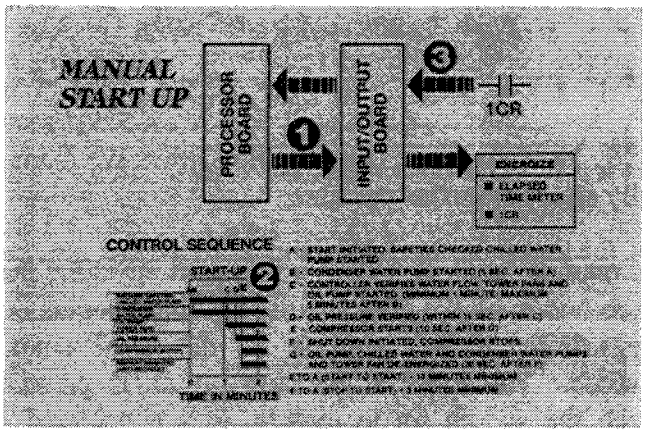
If the oil pressure switch is open, the processor board then sends a signal back to the input/output board to energize the tower fans and oil pump.

This is shown at point C on the control sequence chart.



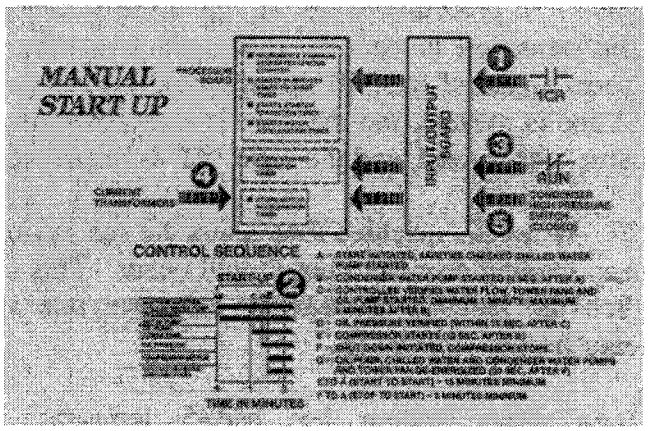
103. Once the signal is sent to energize the oil pump, the input/output board will monitor the oil pressure switch for up to 15 seconds. If the switch closes within this time limit, the input/output board will send a signal back to the processor board that the oil pressure switch has closed and the oil pump is operating. This is point D on the control sequence chart.

Note that the oil pump sequencing for 19DM or 19CB style compressors will be different.



104. Ten seconds later, the processor board sends a signal back to the input/output board to energize the elapsed time meter and the 1CR (compressor start) relay. The 1CR relay energizes the compressor motor starter which starts the compressor motor. This is shown at point E on the control sequence chart.

The processor board will then wait up to 2 seconds to receive a signal from the input/output board that the 1CR auxiliary contact has opened, indicating that the compressor motor starter was energized.



105. If the 1CR auxiliary contact opens within 2 seconds, the start-up will continue.

The processor board increments the 4 manual starts per 6-hour counter and starts the internal 15-minute start-to-start timer (also shown at E on the control sequence chart).

The processor board also starts its internal timers which calculate the starter transition and motor acceleration time.

The starter transition timer is stopped when the processor board receives a signal from the input/output board that the run contact has closed.

The motor acceleration timer is stopped when the motor inrush current drops to the rated load amps. Remember, the processor board monitors motor current through the voltage signals from the current transformer in the motor starter.

Also, the input/output board monitors the condenser high pressure switch and sends a signal back to the processor board to let it know if the switch is open or closed.

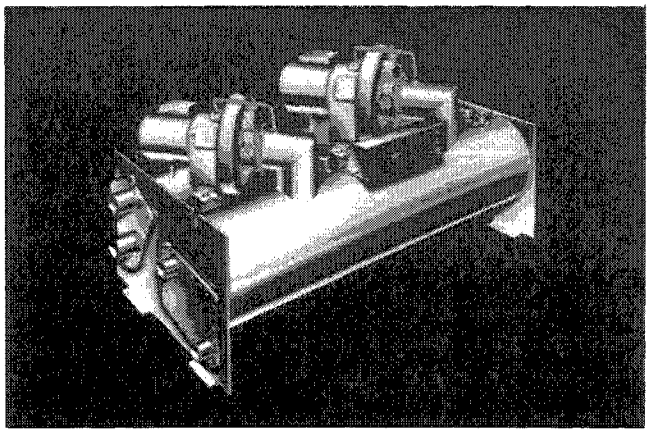
If the condenser high pressure switch is closed and the motor acceleration and starter transition time limits are not exceeded, the machine will enter the run mode.

106. The processor waits for up to 30 seconds after transition to confirm that there is a motor current signal of over 10 percent rated load amps. If none is present, the machine is shut down, the alarm is energized, and the code "82" is displayed.

107. When the machine first enters the run mode, ramp loading capacity control will occur. This is when the leaving temperature pulldown rate is being limited at start-up.

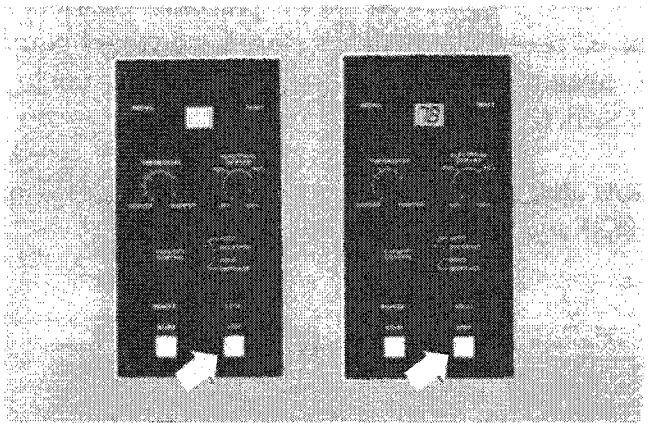
When ramp loading has ended, temperature capacity control will start. This is when the machine is operating normally under temperature control to maintain the leaving chilled water or brine setpoint.

108. During the run mode, if the electrical demand limit, the refrigerant temperature, or motor temperature override is reached, the guide vanes are prevented from opening further or are driven closed to reduce the chances of nuisance safety trips.



109. The operating sequence we've just covered is for a single compressor machine. If you have a 19DR, a 19DM or a 19CB, the operating sequence will be a little different. Remember, the 19DR has two compressors, and the 19DM has a movable diffuser wall. You may see a 19DR machine with two 19DM compressors.

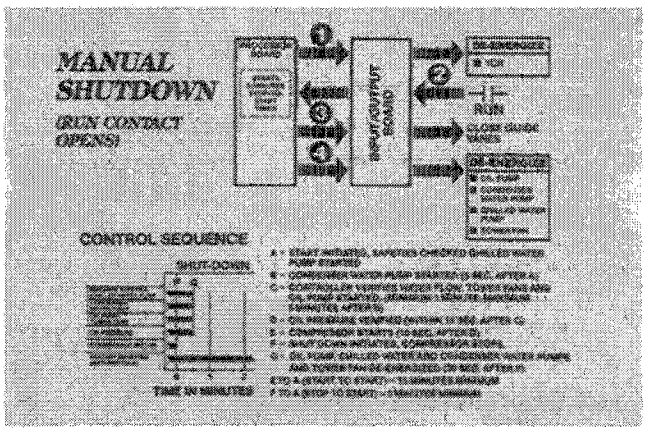
With the 19DR, the lead compressor, the one that starts first, will operate in the same manner as just described for a single compressor machine. For complete details on how the lag compressor is started and stopped, refer to the 19DR Start-up Instructions. We will not cover the operation of the lag compressor in this training program. The 19DM requires a longer prelube cycle in some instances to calibrate the diffuser wall potentiometer. For complete details on this, refer to the 19DM start-up instructions.



110. Now, let's see what happens when we manually shut down the machine.

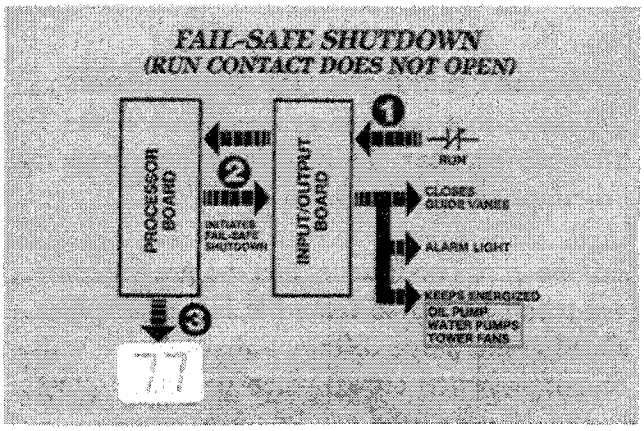
A manual local shutdown is initiated any time the stop button on the setpoint/display board is pressed regardless of the position of the local/remote switch. However, if the stop button is pressed with the switch set to remote, it is considered a safety shutdown and will require a manual reset to start the machine again; a "78" will also be displayed.

A manual remote shutdown is initiated if the local/remote switch is set to remote and the remote start/stop contact opens.

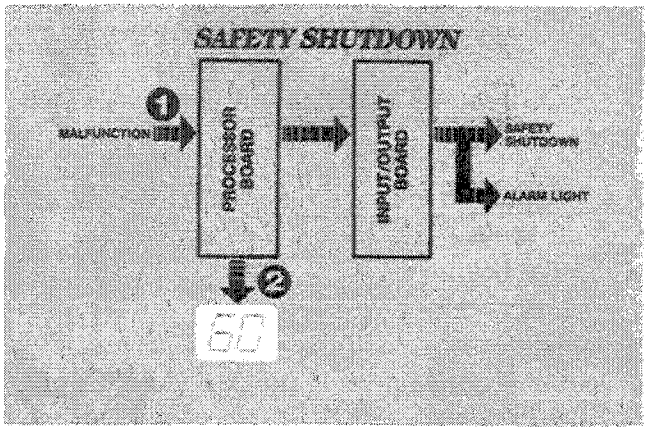


111. When the stop button is pressed, the processor board sends a signal to the input/output board to de-energize the 1CR relay and stop the compressor motor.

If the run contact opens within 1 second after the 1CR relay is de-energized, the input/output board senses this and signals the processor board, indicating the compressor motor has stopped. The processor board then starts the internal 3-minute stop-to-start timer and sends a signal back to the input/output board to close the guide vanes. Thirty seconds later the processor board sends another signal to the input/output board to de-energize the oil pump, the condenser and chilled water pump, and tower fan relays. This is shown at points F and G on the chart.



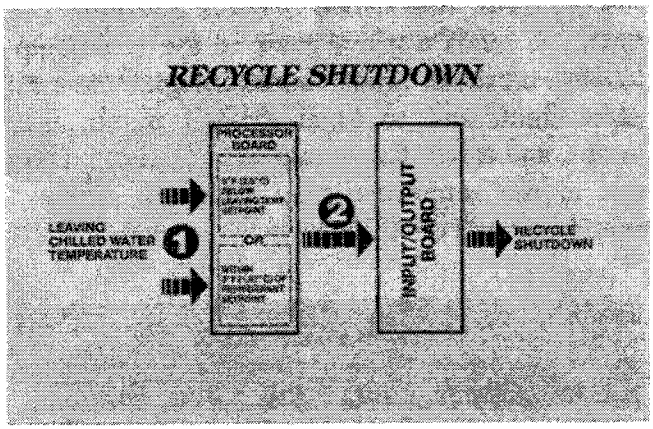
112. If the run contact does not open within 1 second after the 1CR relay is de-energized, the processor board receives a signal from the input/output board that the motor is still running. The processor board then initiates a failsafe shutdown. It sends a signal back to the input/output board to close the guide vanes, energize the safety alarm light, and to keep the oil pump, water pumps, and tower fans energized. A signal is also sent to the setpoint/display board to display a shutdown code of "77".



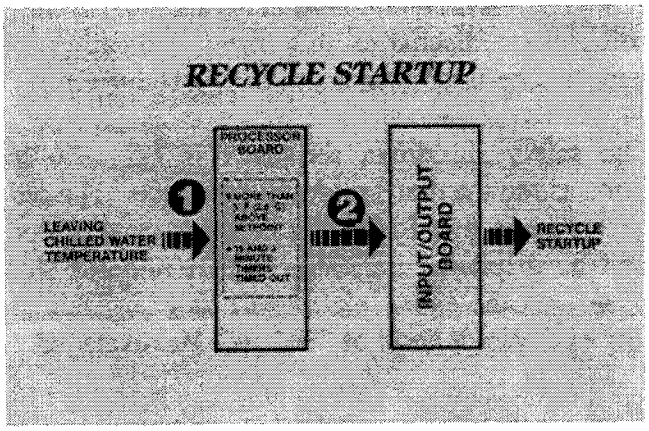
113. Next, let's cover the safety shutdown.

A safety shutdown is initiated when the machine is in the run mode and the processor board receives a signal that a malfunction has occurred; an example might be that it receives a signal from the compressor discharge thermistor indicating the temperature is greater than 220°F (104.4°C).

The safety shutdown sequence is basically the same as the manual shutdown sequence. The only exception is that for the safety shutdown, a code will be displayed indicating the reason for shutdown and the safety alarm will be energized. In this example, a code of "60" will be displayed.

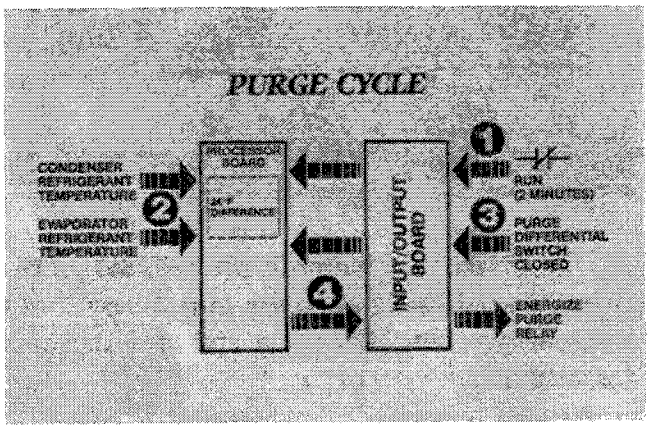


114. A recycle shutdown is also initiated during the run mode. However, the recycle shutdown sequence begins whenever the processor board senses that the leaving chilled water or brine temperature is 5°F (2.8°C) below the leaving temperature setpoint or within 3°F (1.67°C) of the refrigerant setpoint. The processor board then signals the input/output board to initiate the recycle shutdown sequence which is also basically the same as the manual shutdown sequence. The only exception is that the recycle shutdown does not de-energize the chilled water pump.



115. A recycle start-up is automatically initiated following a recycle shutdown when the processor board senses that the leaving chilled water or brine temperature has risen more than 5°F (2.8°C) above the leaving temperature setpoint, and the 15- and 3-minute internal timers have timed out.

The recycle start-up sequence is basically the same as a manual start-up sequence. The only exceptions are that for a recycle start-up a fixed 0.625°F/ minute (35°C) ramp loading rate is used and the 4 starts per 6-hour counter is not incremented.



116. Now, let's cover the purge cycle. This cycle only applies to machines equipped with purge pumps.

With the purge control switch set to auto, the purge cycle starts when the following three conditions exist:

The first condition is that the processor board receives a signal for 2 continuous minutes from the input/output board indicating that the run contact is closed and the compressor motor is running.

The second condition is that the processor board has sensed that there is at least a 24°F (13.4°C) difference between the condenser and evaporator refrigerant temperatures.

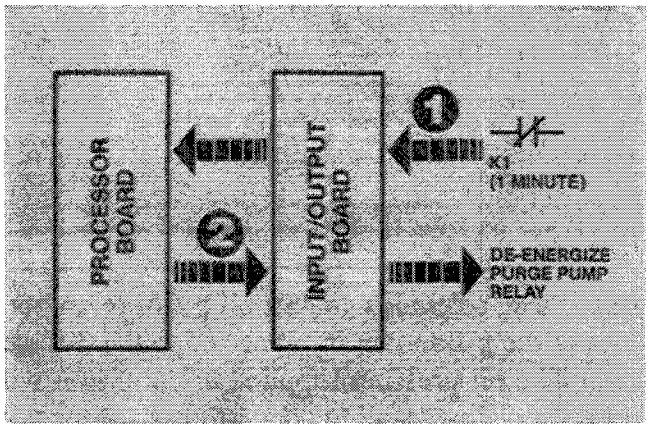
And, the third condition is that the processor board must receive a signal from the input/output board indicating the purge differential switch has closed. The purge switch closes when the purge pressure is within 2 psi of the condenser pressure.

When all three conditions are met, the processor board sends a signal to the input/output board to energize the purge relay, which closes the purge contacts to start the purge pump.

117. The purge pump will continue to operate until one of the following conditions occur which will de-energize the purge pump relay:

1. The purge chamber pressure drops to 4 psi below the condenser pressure, which causes the purge differential switch to open.

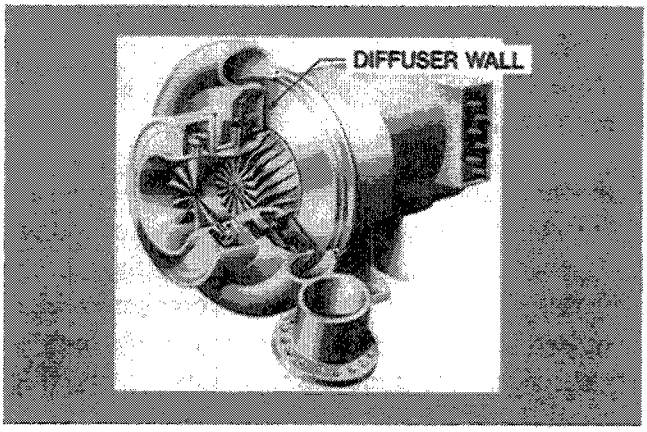
2. Or the purge cycle lasts for more than 1 minute, which initiates the purge malfunction override. Remember, this is a feature of the control system which prevents excessive purging.



118. The purge override is initiated if the processor board receives a signal for more than 1 minute from the input/output board indicating the purge contact (Kl) is closed and the purge pump is running. The processor board will then send a signal back to the input/output board to de-energize the purge pump relay.

119. Once the relay is de-energized, the processor board will not send another signal to re-energize it for at least 10 minutes. If three consecutive 1 minute on and 10-minute off cycles occur, the processor board will lockout the signal to energize the purge pump and send a signal to the setpoint/display board to display a blinking code of "37". The purge pump will not operate again until you press the reset button on the setpoint/display board. However, the machine will continue to operate even if the purge pump is locked out.

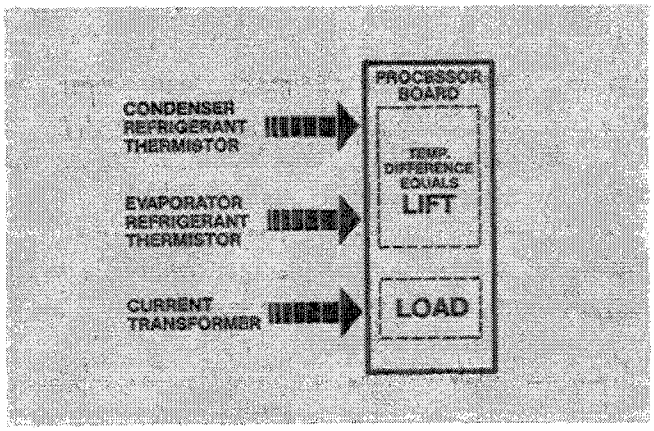
The reasons for a purge malfunction are: a faulty purge switch, a plugged purge sampling line, or an improperly calibrated purge switch.



120. Now let's cover the operation of the movable diffuser wall on DM compressors.

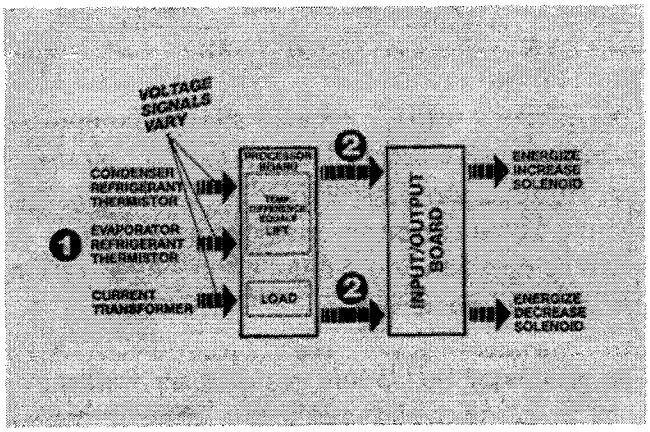
The diffuser wall is located at the compressor discharge and is opened or closed on commands sent from the processor board to the input/output board. The diffuser wall is positioned so that the machine operates at optimum efficiency at varying lift and load conditions.

The processor board initiates diffuser wall movement based on the lift and load of the compressor.



121. Earlier in the program we covered how the processor board determined the lift and load. Let's quickly review.

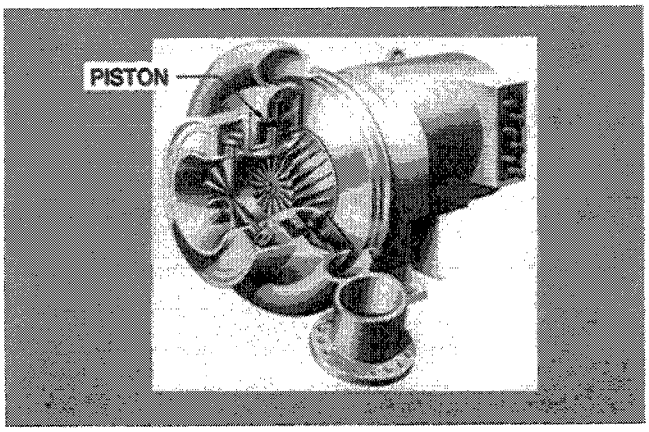
The processor board monitors the temperature difference between the condenser and evaporator refrigerant thermistors. This represents the pressure difference between the cooler and condenser which is known as lift. The processor also monitors the voltage signal from the current transformer, which represents the load.



122. Keep in mind that the condenser and evaporator refrigerant thermistors and the current transformer provide voltage signals to the processor board which represent the actual lift and load.

As the lift and load vary, the voltage signals received by the processor board will also vary.

The processor uses these two signals to calculate the position that the diffuser wall must be in for optimum operating efficiency. The processor will send a signal to the input/output board to energize the solenoids which move the diffuser wall. The solenoids are known as the increase and decrease solenoids.

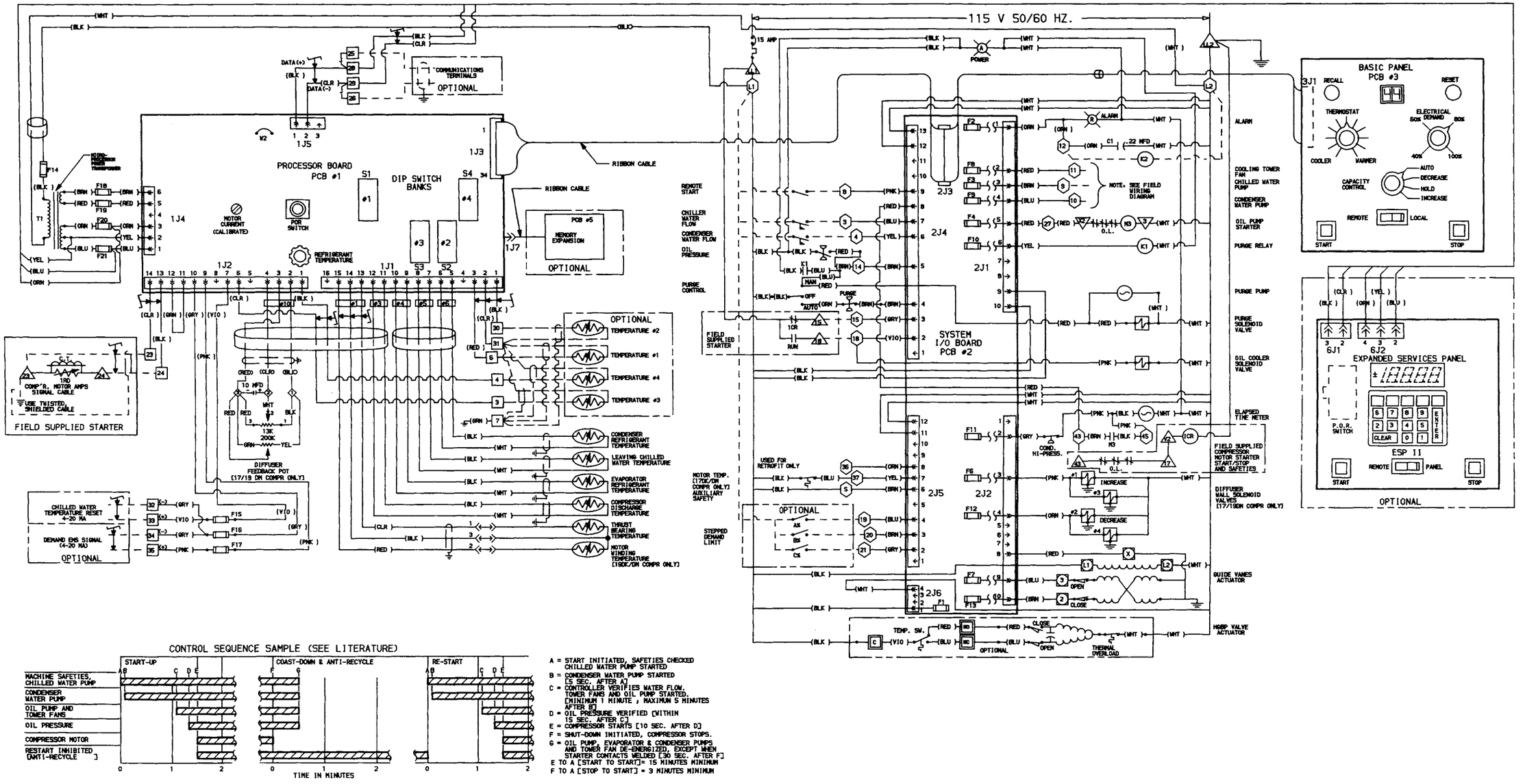


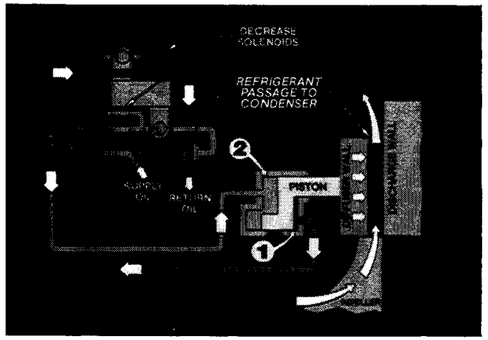
123. These solenoids control oil pressure on both sides of the piston that is connected to the diffuser wall. The oil pressure supplied to the piston will cause the diffuser wall to open or close, as we will see in a minute.

When the diffuser wall opens or closes, the lift and load will change and so will the voltage signals to the processor board.

When the wall is at the optimum position, both the increase and the decrease solenoids will be de-energized to hold the wall at that position until the conditions change.

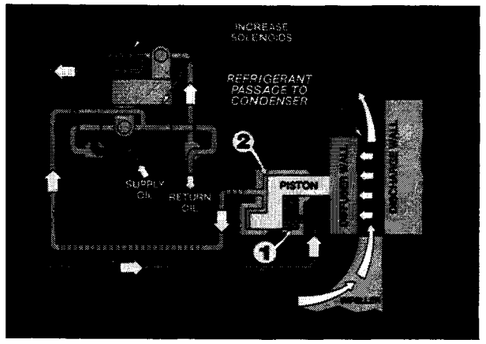
17/19DK,DM,DR SCHEMATIC



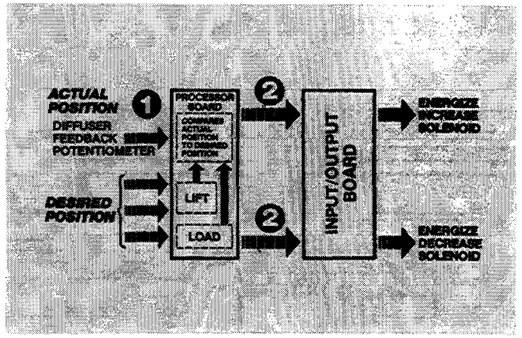


Here's a diagram which shows how the oil 's to the diffuser wall. We'll use it to explain the wall is actually moved. We have sim- ed the diagram to make it easier to understand.

:n the decrease solenoids are energized, the oil ı diffuser wall chamber 1 bleeds out through return oil line; and the supply oil flows to nber 2. With the higher pressure in chamber 2, piston moves to the right which causes the ıser wall to close and move toward the harge wall. Notice that the diffuser wall is on lischarge side of the impeller.



When the increase solenoids are energized, lirection of the oil flow changes. The oil from ser chamber 2 will now bleed out through the n oil line; and the supply oil will now flow to ıber 1. With the higher pressure in chamber 1, piston moves to the left which causes the ser wall to open and move away from the ıarge wall.



126. The processor keeps track of the actual diffuser wall position by monitoring the diffuser feedback potentiometer. It compares the actual position to the desired position which is determined by the lift and load. The processor then sends out the appropriate signal to the input/output board to energize the increase or decrease solenoids. When the actual position is within ± 2.5% of the desired position, the processor will de-energize the solenoids.

When the compressor is first started (start button pressed) after a controls power failure or after a P.O.R. button has been pressed, the processor initiates a diffuser wall calibration before compressor start. Just after the oil pump is energized and the pressure has been confirmed, the diffuser wall solenoids are energized to close the wall completely. This is performed for at least two minutes.

If the wall continues to move after the two-minute period, the oil pump will continue to run. Once the wall stops, the processor checks the diffuser wall potentiometer signal and uses this as the initial reference for a closed diffuser wall.

127. This completes part one of our training lesson on Carrier's 32MP microprocessor control system. Part two will cover Start-up and Troubleshooting.

Book	32MP-03A	(021-024)
Program	32MP-04A	(021-025)

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