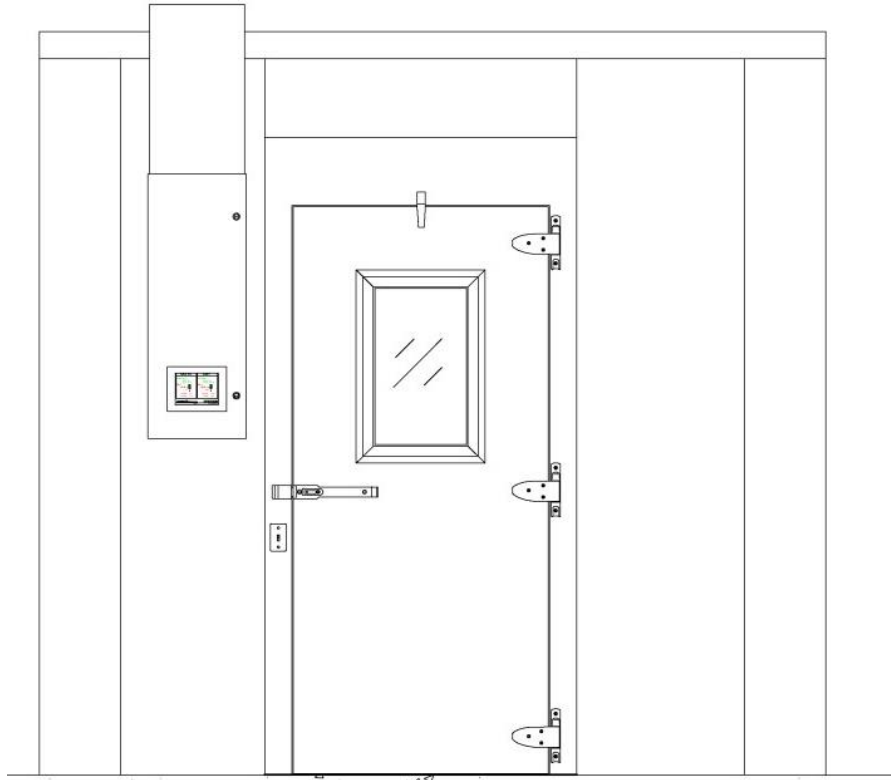




BIOCOLD
ENVIRONMENTS FOR LIFE

OPERATIONS & MAINTENANCE MANUAL



WEBSTER UNIVERSITY
INTERDISCIPLINARY SCIENCE BUILDING (ISB)
CONTROLLED ENVIRONMENT ROOM (CER)
+4°C WITH NON-CONDENSING HUMIDITY





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1. Introduction

BioCold Environmental rooms offer exceptional temperature and humidity control, as specified, for a wide range of applications. This manual is prepared for the walk-in environmental room installed at Webster University for the Interdisciplinary Science Building (ISB) in Webster Groves, Missouri. This manual contains information needed for proper operation of the BioCold environmental room. This chamber uses a BioCold Continuous Refrigeration system with hot gas bypass system with resistive heat, designed to accurately control room temperature at +4°C with ambient / non-condensing.

The control console also complies with the Americans with Disabilities Act (ADA). The BioLogic™ touchscreen allows system monitoring with a secure and dynamic interface at the screen or remotely.

This manual contains information needed for proper operation of the BioCold environmental rooms using the BioLogic™ touchscreen. For any questions or troubleshooting information not addressed in this manual, please contact the BioCold Environmental factory in Ellisville, Missouri (USA) at 636.349.0300 or service@biocold.com.

2. Principles of Operation

The BioCold refrigeration system operates as a “continuous proportional hot gas bypass system.” The compressor / condenser unit operates 100% of the time and does not cycle on/off or pump down even during a defrost cycle. BioCold takes the third refrigeration line (5/8” hot gas line) to the evaporator and introduces this through a side port manifold after the liquid expansion valve and before the distributor. The three refrigeration lines are introduced to the room through the ceiling and directly into the side of the air handler with only a few inches of exposed refrigeration lines. The liquid and hot gas solenoid valves are set on top the room, located near the ceiling stub out of the three refrigeration lines.

The BioCold control system includes a 7” color touchscreen user interface as well a programmable logic controller (PLC) with integrated process controls. The PLC is a modular system that includes a temperature process module, as well as dedicated logic modules for controlling chamber components. All operating parameter changes can be made via password-protected access at the color touchscreen interface, which also offers alarm history log and chamber trend data recording.

During normal operation, the 3/8” liquid line (cooling) solenoid valve (Sporlan Model XUP) and the 5/8” hot gas line (heating) solenoid valve (Sporlan Model XRM) cycle in order to control temperature in the evaporator coil. Both valves are normally closed and open when energized.

These valves are controlled by the microprocessor-based temperature controller with a 3/32 VDC output from a solid state relay inside the controller. This signal operates two (2) triac relays with one normally open for the liquid valve and the other normally closed for the hot gas valve. Thus, when one valve is open, the other is closed.

During normal operation, if there is a low temperature alarm event, the control signal is removed from both triac relays, causing both normally closed solenoid valves to close, the unit to pump down, and the compressor to shut off on low suction pressure control. When the remote interlock circuit is wired in series with the compressor contactor, both pump down and contactor coil interlock will occur during a low temperature alarm event. Also during a low limit alarm event in the cold rooms (default alarm temperature of +1°C), the alarm and compressor will cycle on / off, due to the fact that the room will begin to warm as soon as the compressor shuts off. When the room warms above the low limit alarm setpoint, the compressor will come back on, again dropping the temperature below the low alarm setpoint until the malfunction is diagnosed and remedied.

The control console is protected at all times. The unit is wired with a branch circuit using UL489 circuit breakers. Independent temperature safety limit controls are present for high and low temperature monitoring. Remote dry contacts also protect the mechanical equipment. Both an audible and visual alarm, and if applicable, personnel emergency alarm indicators are present as an additional safety feature; the alarm includes an adjustable delay and callback features.





3. Chamber Operations

The BioCold BioLogic™ Console is located on the walk-in exterior wall adjacent to the entry door. The console has a 7" color touchscreen and is connected to the component box mounted on top of each room via low voltage (24VDC) connections. This touchscreen has an "always on" display and high-precision touch accuracy for easy reference and adjustment.

All normal chamber operations are controlled at the BioLogic™ control panel, with temperature setpoint, current temperature reading, alarm setpoints, alarm history, temporary silence switch, and data logging / trend screen incorporated into the control panel. The component box houses the controls that operate the following: interior evaporator fans, lights, heaters, dehumidifier, and alarms.

NOTE: The component box contains equipment that operates on 115/230V, 1-phase or 3-phase power. This component box has a rotary disconnect and should only be opened by a trained professional.

3.1. Overview and Startup

Operation begins by applying power at the circuit breaker panel. After a few seconds of a self-test warm-up, the system will be ready to operate. The desired operating temperature is set or verified on the MAIN screen. The wide range rooms can be set to any temperature between +2°C and +40°C.

The startup procedure requires the user to have administrator privileges to modify the factory parameters like the setpoint. Details of each screen are provided in its corresponding section below.

- a) Ensure control console and condensing unit have power and power disconnects are in ON position.
- b) Touch LOG ON button on welcome screen (Figure 1, left).
- c) Enter the appropriate USER NAME and PASSWORD in the LOG ON popup window.
- d) Touch MAIN button on the welcome screen.
- e) Set controller setpoint to desired operating temperature.

NOTE: If room is in alarm condition on initial startup, temporarily adjust alarm settings to mitigate an alarm condition. Alarm settings can be readjusted once room reaches normally operating temperatures.

3.2. BioLogic™ Screens and Windows

BioCold designs specialized screens for the control console that monitors and modifies changes in the CER. This section educates the user on the basic functions and / or operations of the screen and its corresponding windows that may pop-up during user options, configuration settings or alarms.

NOTE: The control console screens for your specific CER may vary slightly from those shown in this manual as each console is uniquely tailored for each room. This manual allows the user(s) to gain basic understanding to control the console and its settings.





3.2.1. Log On Window

The LOG ON window (Figure 1) will appear when the LOG ON button is selected. Each parameter has a predetermined security setting in which a user only with that security level or higher may modify that specific parameter. Details are provided in the corresponding Security section below.



Figure 1. Log On Window

3.2.2. Main Screen

The BioLogic™ MAIN operating screen (Figure 2) navigates to all the information needed for normal system monitoring, including temperature and humidity, as applicable, setpoints, current temperature and / or humidity reading(s), and high / low alarm setpoints. The MAIN button is available on each console screen. The temperature or humidity setpoint is changed directly from the MAIN screen or the TEMPERATURE TUNING screen.

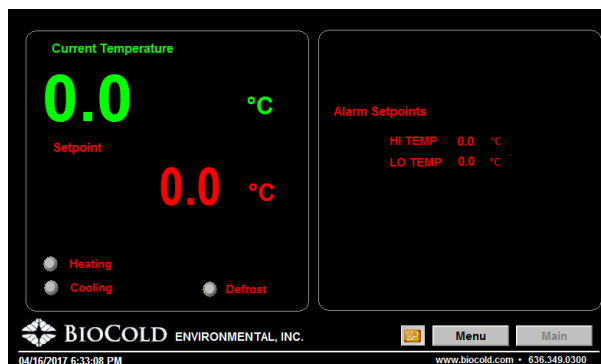


Figure 2. Main Screen

The MAIN screen also displays the status of various parameters, based on the specifications of the room. The status will show a green circle when that parameter is enabled or active. Examples of the various statuses available for display include, but are not limited to, (1) the heat being pumped in via resistive heater(s) or hot gas typically, (2) the cooling of the liquid valve(s), (3) the humidifier(s), (4) dehumidifier(s), (5) defrost, and / or (6) the specific system or zone in a multi-system or multi-zone chamber.

NOTE: When a loss of power to the control panel occurs, an error message may be seen. This is due to the RTD resetting itself; at initial power, the RTD reads a temperature of -270°C, which results in a failure / alarm. This is as-designed and allows the personnel to acknowledge the power incident and assess any other conditions as needed.

To adjust any parameters, users must first log on with the corresponding privileges (See Security, Section 3.3.).





Once logged on, the user may adjust temperature setpoints either by using the + / - buttons, or by using the popup keypad (Figure 3) to input the specific value. To access the popup keypad, first click on the setpoint digits (in Figure 2, this would be "0.0") to view the cursor, and then double-click to activate the popup keypad.

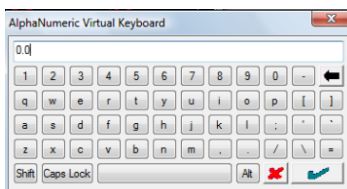


Figure 3. Alphanumeric Keyboard

3.2.3. Menu Screen

The BioLogic™ MENU operating screen (Figure 4) navigates to all the information needed for normal system monitoring, including temperature and humidity, as applicable, setpoints, current temperature and / or humidity reading(s), and high / low alarm setpoints. The MAIN button is available on each console screen. The temperature or humidity setpoint is changed directly from the MAIN screen. The screen contains buttons for each page needed for chamber operation. Based on the logon privileges, unavailable features will be grayed and non-selectable. The MAIN button is available on each console screen.

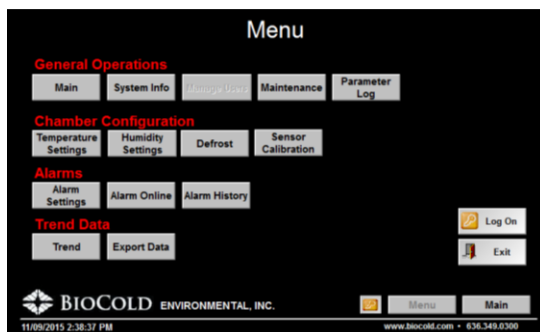


Figure 4. Menu Screen

The MENU screen is divided into four primary options and CER-dependent secondary options of control:

1. General Operations
 - a. Main
 - b. System Info
 - c. Factory (for BioCold or authorized use only)
 - d. Log On
 - e. Exit (user must be logged on)
2. Chamber Configurations (may include but are not limited to these options)
 - a. Temperature Settings
 - b. Defrost Settings (not applicable for warm rooms)
 - c. Humidity Settings
 - d. Redundancy Settings
 - e. Grow Lights
 - f. Sensor Calibration





- g. Parameter Log
- h. Ventilation
- 3. Alarms
 - a. Alarm Settings
 - b. Alarm Online
 - c. Alarm History
- 4. Trend Data
 - a. Trend
 - b. Export Data.

These screens and any corresponding windows not identified earlier are further detailed in its corresponding sections.

3.2.4. System Information (Startup) Screen

The BioLogic™ SYSTEM INFORMATION screen (Figure 5) is the central screen to navigate to other screens, if needed. The user can LOG ON via this screen or the MENU screen. The information on this startup screen cites factory information such as the version of the software and its corresponding project name.



Figure 5. System Information (Startup) Screen

3.2.5. Parameter Log Screen

The BioLogic™ PARAMETER LOG screen (Figure 6) is a table that is automatically generated to display changes made by a user to the settings of the control console. The timestamp, details of the change, new value, previous value, and user, respectively are captured in this table.

Figure 6. Parameter Log Screen





3.2.6. Maintenance Schedule Checklist Screen

BioCold Environmental highly recommends the upkeep and maintenance of the CER (see Section 3.5). The MAINTENANCE popup window (Figure 7a) provides a reminder for Facilities and/or the responsible team to ensure that the scheduled maintenance is performed. To remove this popup window, hit the Maintenance Reminder acknowledged button.



Figure 7a. Maintenance Schedule Checklist Screen

The MAINTENANCE screen (Figure 7b) will appear with maintenance information. The checklist includes:

1. Check the fan motor operations
2. Remove any obstructions from fan intake
3. Clean any dust accumulation from compressor / condensing unit
4. Verify the alarm settings and modify as needed
5. Clean the condenser coil, based on the hours of operation.

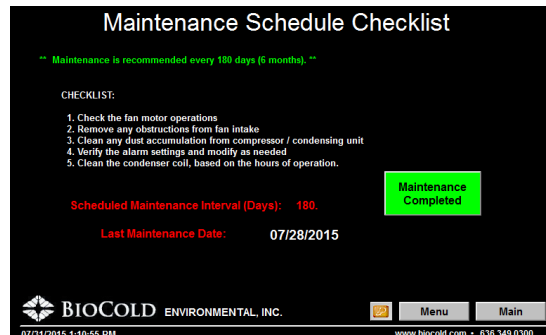


Figure 7b. Maintenance Schedule Checklist Screen

A scheduled interval of 180 days is recommended. This field is editable but a value no greater than 180 days is suggested to ensure that the equipment is checked and operates as specified by the requirements. Once this maintenance is completed, the authorized user will select the MAINTENANCE COMPLETED button and the “Last Maintenance Date” will show as that current day and the interval clock will reset.

3.2.7. Temperature Configuration (Settings) Screen

The BioLogic™ Control Panel incorporates a microprocessor-based Proportional, Integral, and Derivative (PID) controllers for both temperature and humidity (where applicable). These controllers use the PID bands to provide straight-line control.





The TEMPERATURE CONFIGURATION (settings) screen (Figure 8) includes all the parameters needed for temperature operation and adjustment. This single room operates under a single sensor.

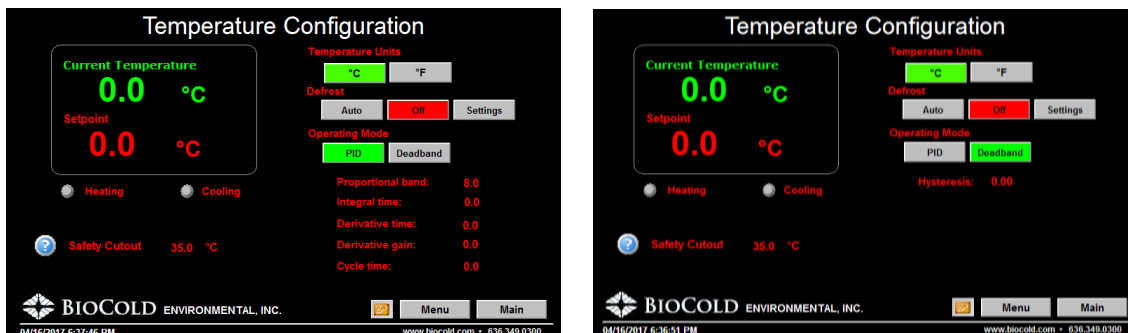


Figure 8. Temperature Configuration Screen with Deadband (left) and PID (right) Mode

The standard operating temperature of the room determines the available parameters on the screen. For example, a cold room or freezer will include the defrost setting. A stability, warm or wide range room may include Chamber Temperature Limits (i.e., cut-outs and cut-ins), which are set values to efficiently use as well as protect the equipment for the CER. More detail is provided in the Additional Information, Warning and Alarm Screen(s) section below.

3.2.7.1. Temperature Setpoint

To adjust the temperature setpoint, click on the temperature setpoint value, and use the popup keypad to adjust chamber temperature. Two operating modes are available: PID or Deadband or hysteresis control.

3.2.7.2. Temperature Units

The user has the option to select the units of temperature. Both the English unit of Fahrenheit and the metric unit of Centigrade (Celsius) are available. The numeric value of the temperature will be converted automatically based on the selected unit.

NOTE: When selecting a different temperature unit, the alarm may be triggered because the range of the alarm setting has not changed. An authorized user will need to adjust this value via the ALARM SETTINGS screen to disengage the alarm based on the selected unit for temperature.

3.2.7.3. Temperature Operation Modes

For normal operation, PID mode provides the tightest control. Each of the PID parameters may be individually adjusted using the Proportional Band, Integral, Derivative and Cycle Time parameters.

3.2.7.3.1. PID Mode

When in PID, five (5) control tuning parameters are calculated: Proportional Band, Integral Time, Derivative Time, Derivative Gain, and Cycle Time.

The default values for the temperature modes are:

1. Proportional Band: 2.0
2. Integral Time = 250.0





3. Derivative Time = 60.0
4. Derivative Gain = 1.0
5. Cycle Time = 15.0

- a) **Proportional Band:** This band is a percentage value or amount of change for the input parameter to generate a full change (0 to 100% or vice versa) in the output of the controller. The narrower the band, the smaller the area of the controller's proportioning action. This value is also referenced as the gain, which is the reciprocal of the proportional band. For example, a PB = 25 will have a change of 100% in the output when the parameter has changed by 25° from the setpoint. Trial-and-error settings may need to be tried to achieve the desired PB control.
- a. The desired PB results in a value very close to the setpoint. In the Figure 9 below, the temperature oscillations of the purple line mimics that with close to ideal tuning, with the red line as the setpoint.
 - b. If the result seen is more similar to the blue line with large over-and under-shooting values, then adjust the PB to one-half the current value.
 - c. The green line correction action would be to multiply the PB by 2x since no oscillations are detected.

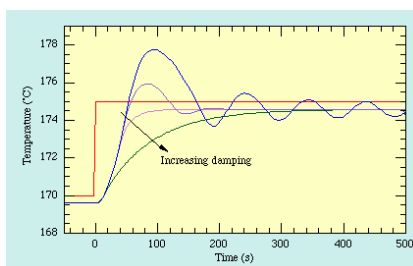
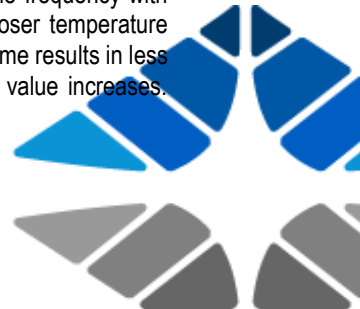


Figure 9. PID Oscillation Adjustments Graph

- b) **Integral Time:** This reset adjusts the proportional bandwidth to the setpoint; this function of time compensates for the offset from the setpoint. Excessive overshoot may indicate that this value is set too high; output oscillations indicate that the Integral value may be too low. Note that changes to this value require a corresponding change in the Derivative Time; these values are inversely proportional.
- c) **Derivative Time:** This value adjusts for the expected rate of the rise/fall of a system parameter like the temperature, and allows for an automatic modification of the proportional band to reduce the magnitude of the offshoot value. Excessive overshoot may indicate that this value is set too high as with the Integral Time. Note that changes to this value require a corresponding change in the Integral Time; these values are inversely proportional.
- d) **Derivative Gain:** The other derivative parameter is the derivative gain. The magnitude of the derivative error to the control action is the derivative gain. If the controller is determining a significant change, the derivative value creates a "slowing" action for the change requested by the controller. The default derivative gain is 1.0.
- e) **Cycle Time:** This time is also known as the duty cycle of the controller, which equates to the total length of time for the full on/off cycle. The unit for the cycle time is seconds and governs the frequency with which the controller monitors system conditions. A shorter cycle time will provide closer temperature control, with more frequent indexing of the refrigeration solenoid valves. Longer cycle time results in less frequent valve indexing with a gradual loss of straight line control as the cycle time value increases.





Controls are factory set with a cycle time of five (5) seconds, but this value may be adjusted to any non-zero value.

3.2.7.3.2. Deadband Mode

When in Deadband mode, hysteresis determines the operations. The hysteresis is the value above / below the set point that the operating condition does not change. For example, if the hysteresis is 1.0 and the temperature setpoint is +4.0°C then the heating will turn off at +5.0°C and turn off at +3.0°C. The general idea is to have a more steady heating or cooling when the temperature outside a range of tolerance.

The default hysteresis value is 0.1.

Chamber Temperature Limits (i.e., cutouts and / or cutins) are set values to efficiently use as well as protect the equipment for the CER. More detail is provided in the Additional Information, Warning and Alarm Screen(s) section below.

3.2.8. Defrost Setting Screen

The defrost setting can be accessed via the MENU screen or the TEMPERATURE CONFIGURATION (Figure 10) screen. Defrost cycles are not typically needed on BioCold rooms operating at +4°C or above, and the defrost cycles will default to ON for freezer rooms. Details of this screen are provided in its corresponding section below.

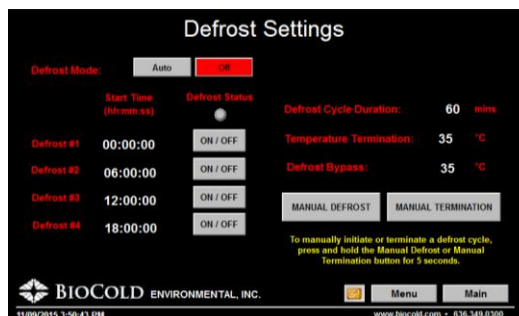
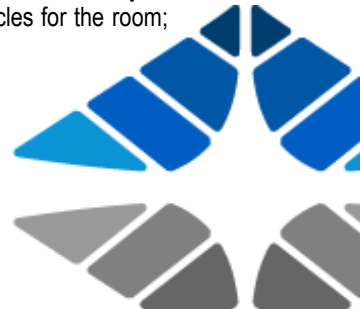


Figure 10. Defrost Setting Screen

In the event that regular defrost cycles do become necessary, the user sets this parameter by selecting the AUTO button for defrost on the Temperature Configuration Screen. The display allow the user to adjust the start times and duration of defrost cycles, up to four (4) cycles per day. The settings on the Defrost Settings screen will control defrost cycles when the Defrost Mode is set to AUTO, currently the button shows as OFF next to the corresponding start times. The defrost time clock is based on the touchscreen internal clock on the lower left corner.

This screen allows the authorized user to adjust the start times and duration of defrost cycles, up to four (4) cycles per day. Enter the start time using the military format for each cycle. For example, 2:15pm would equate to 14:15:00 value for the start time. The defrost cycles are individually enabled by selection the ON/OFF button next to the corresponding defrost start time. When the ON/OFF button is gray, that defrost cycle is disabled; when the button is green, the defrost cycle will trigger at the start time.

To enable the defrost cycles; select the Defrost Mode to AUTO in the DEFROST MODE field. Each individual cycle must be also enabled (i.e., set to ON (green)) to start the defrost cycle. To disable all the defrost cycles for the room; select the OFF button in the upper left for the DEFROST MODE field.





Note: The defrost time clock is based on the touchscreen internal clock on the lower left corner.

The room can be controlled manually for the defrost cycles. The MANUAL DEFROST button allows the room to start manually defrosting at that button request and will last based on the DEFROST CYCLE DURATION value entered. Alternately, if the system is currently in defrost mode, the MANUAL TERMINATION button allows the authorized user to instantly stop the current defrost cycle

3.2.9. Calibration Screens

The chamber is equipped with offset calibration capabilities for the temperature and humidity (as applicable) sensor(s), which can be accessed via the SENSOR CALIBRATION button on the MENU screen. Two calibration options are available to more accurately adjust to the room's present value temperature.

3.2.9.1. Calibration Mode

To calibrate chamber temperature on the CALIBRATION MODE screen (Figure 11), adjust the sensor calibration offset so that the system reading aligns with the standard instrument.

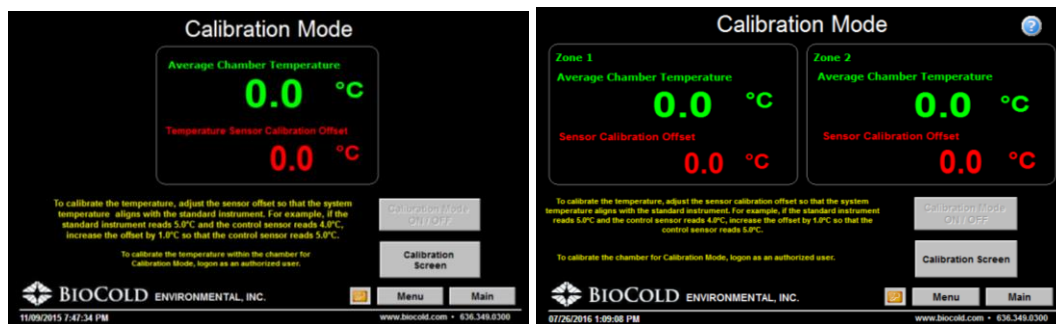


Figure 11. Sensor Calibration Mode Screen

Entering a negative value as the offset will subtract this value from the average sensor reading; a positive value for the sensor calibration offset will raise the sensor reading. This value is added to the current sensor reading prior to initially computing the average value.

The CALIBRATION MODE button allows the room to be calibrated by disabling all outputs from the PLC as well as the corresponding alarms. Only an authorized user can access this mode.

The CALIBRATION SCREEN button displays a new screen to allow adjustment to the average chamber parameters for mapping purposes.

3.2.9.2. Calibration with Uniformity Offset

The dimensions of a larger chamber can result in varying sensor readings. The sensor temperature is the averaged sensor calibration offset plus an initially averaged chamber parameter, given no uniformity temperature calibration offset.





The uniformity calibration offset is the value obtained during the room mapping process. The final averaged chamber temperature is the addition of the uniformity calibration offset with the average of both the sensor reading and the sensor calibration offset.

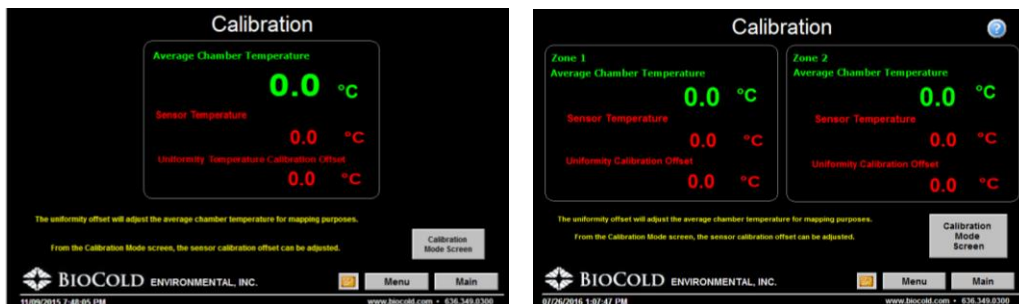


Figure 12. Calibration Screen

On the CALIBRATION SCREEN (Figure 12), entering a negative value as the offset will subtract this value from the average sensor reading; a positive value for the sensor calibration offset will raise the sensor reading. To enter a new value, double-tap on the sensor calibration offset value and use the popup on-screen keyboard to enter new values. This value is added to the current sensor reading prior to initially compute the average value.

3.2.10. Alarm Settings Screen

The BioLogic™ system provides alarm outputs if the room temperature. The high and lows of the parameters for this room are set in this screen (Figure 13) and are also displayed on the MAIN screen. Additional alarm parameters for delays and callbacks are also editable on this screen.

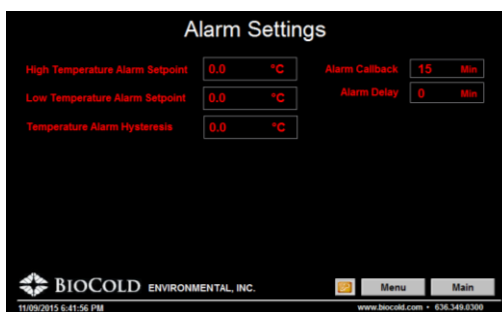
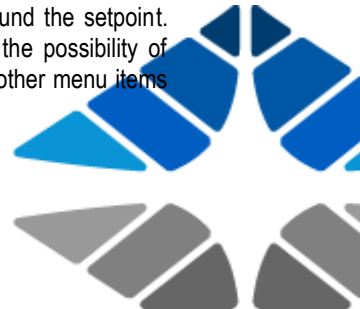


Figure 13. Alarm Settings Screen

3.2.10.1. High and Low Alarms

The high and low setpoints for the high and low alarms, respectively, can be set for the temperature as well as the humidity, if applicable. This value will trigger an alarm when the present value exceeds the high alarm setpoint or falls below the low alarm setpoint.

Upon operation near the desired setpoint the alarms can be set to the desired tolerance around the setpoint. BioCold recommends setting the alarms a minimum of 2.0°C from the setpoint to minimize the possibility of setting the alarms off when the door is left open for short periods of time. Do not change any other menu items





when setting the alarms. The operator with the appropriate security level may set these alarms based on site requirements and specifications.

3.2.10.2. High and Low Alarm Indicator

When an alarm event occurs, the audible alarm will sound and an alarm popup (Figure 14) will appear on the screen. To temporarily silence the audible alarm, press the ALARM SILENCE button. Use the ALARM DETAILS button to obtain the details of alarm and the alarm can also be silenced from this screen. This screen is also available on the MENU screen utilizing the ALARM ONLINE button for the status. See the below section for more details on the ALARM ONLINE screen.



Figure 14. Temperature Alarm Popup Windows

The audible alarm, i.e., buzzer, will continue until the alarm condition is remedied or the alarm is manually silenced by the operator. If the alarm is manually silenced, the alarm will re-sound based upon the Alarm Callback value if the chamber is still in alarm condition.

3.2.10.3. Callback and Delay Timers

There are various timers associated with the alarms. Typically, two types of timers are available: callback timer and delay timer.

The callback timer re-sounds the alarm after the Alarm Callback value has elapsed and the CER is still in the alarm condition. The callback timer will be reset if the alarm condition is remedied. This timer is used to silence the timer in order to contact an authorized user, facilities, and / or BioCold to investigate this alarm as needed.

The delay timer prevents the alarm from triggering and the buzzer from sounding until the Alarm Delay value has elapsed. The delay timer also delays any of the fail-safe triggers until this delay value has completed. This delay is useful when often opening or closing the door for extended periods of time or other circumstances where there are known and frequent external factors that may trigger an alarm otherwise

3.2.11. Alarm Online (Status) Screen

The ALARM ONLINE (Figure 15) screen cites the status of the current or past alarms within this chamber. When an alarm event occurs, the ALARM ONLINE screen provides details concerning the nature of the alarm and user responding to the alarm. The specific details are:

- a) the time the alarm occurred;
- b) the type of alarm (i.e., high temperature alarm);





- c) the time the alarm event cleared/normalized;
- d) the user who acknowledged the alarm condition.

Additional fields may be selected by the user using the COLUMN button.

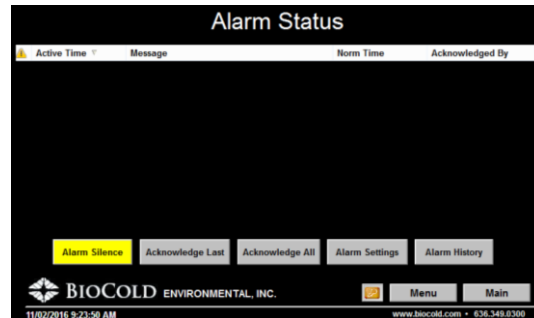


Figure 15. Alarm Online (Status) Screen

The ALARM SILENCE button is highlighted in yellow and appears on the ALARM ONLINE screen. This will silence the audible alarm until the failure can be diagnosed and repaired. If multiple alarms are triggered, then the latest individual or all the current alarms can be acknowledged by selecting the ACKNOWLEDGE LAST or ACKNOWLEDGE ALL button, respectively.

3.2.12. Alarm History Screen

The ALARM HISTORY screen (Figure 16) displays up to the last 100 alarm events with information showing:

- a) the time the alarm occurred;
- b) the type of alarm (i.e., high temperature alarm);
- c) the time the alarm event was acknowledged; and
- d) the time the alarm event cleared/normalized.

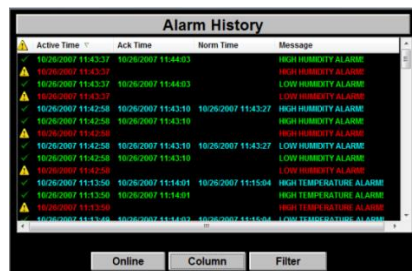


Figure 16. Alarm History Screen

Additional fields may be selected by the user using the COLUMN button on the ALARM HISTORY screen.





3.2.13. Trend Screen

The BioLogic™ HMI hard drive stores temperature and humidity trend data via the TREND screen (Figure 17) securely for a period of 365 days. Data can be accessed using the TREND button from the MENU screen.

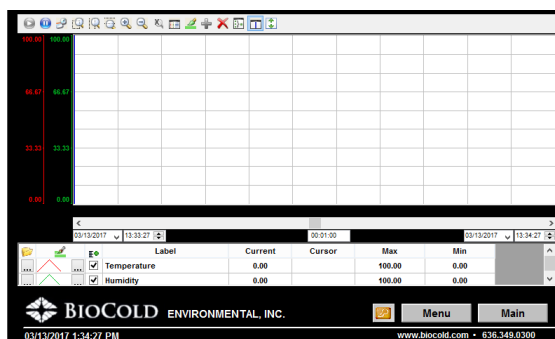


Figure 17. Trend Data Screen

The toolbar across the top of the Trend grid allows a single-button manipulation of the data within the grid. The options are from left to right:

Command/Tool	Description
Run	Sets the trend control to Run Mode (a.k.a. Online Mode). In this mode, the X-axis continues to scroll with the passage of time and the trends are updated with current tag values.
Stop	Sets the trend control to Stop Mode (a.k.a. Historical Mode). In this mode, the X-axis is stopped and the trends display only historical data. If decimation is enabled for one or more trends, the calculation and redrawing is done only in this mode.
Period	Opens a dialog which can be used to modify the X-axis scale main settings.
Window Zoom	Allows the user to click on the trend graph and drag the cursor to select the area that must be visible when the cursor is released. This option is disabled when the Multiple Section option (for the Y scale) is active.
Horizontal Zoom	Allows the user to click on two points in the trend graph, defining the horizontal scale that must be available.
Vertical Zoom	Allows the user to click on two points in the trend graph, defining the vertical scale that must be available. This option is disabled when the Multiple Section option (for the Y scale) is active.
Zoom In	Allows the user to zoom in (display half of the current X and Y scales) each time they click on the trend graph.
Zoom Out	Allows the user to zoom out each time they click on the trend graph.
Cancel Zoom	Cancels the current Window , Horizontal or Vertical Zoom and returns the trend graph to its original scale.
Legend Properties	Opens a dialog which can be used to modify the Legend main settings.
Pen Style	Opens a dialog which can be used to modify the pen style of the selected trend.
Add Pen	Opens a dialog which can be used to add a new trend to the trend control.
Remove Pen	Removes the selected trend from the trend control.
Multiple Sections	Switches the Y scale between Multiple Sections (a section for each trend) and Single Section (all trend share the same Y scale section).



<u>Command/Tool</u>	<u>Description</u>
Cursor	Switches the cursor (ruler) between visible and hidden.
Auto Scale	Changes the Y axis scale to fit all values from the trends that are currently being monitored.

3.2.14. Export Data Screen

From the MAIN menu, the EXPORT DATA button allows users to export the proprietary secure data stored on the HMI into a CSV file which can be easily viewed using spreadsheet software such as Microsoft Excel. This screen is called the EXPORT DATA screen (Figure 18).

Note: A mouse or stylus is recommended to enter information during this exporting of data exercise. To enter a new value without a mouse, double-tap on the desired field value and use the popup on-screen keyboard to enter new value.

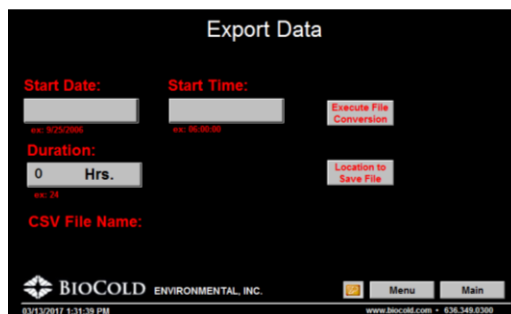


Figure 18. Export Data Screen

- To transfer the file to the USB device:
 - Unlock / unscrew and open the touchscreen enclosure.
 - Insert the memory stick in the USB port underneath the bezel of the touchscreen.
- From the EXPORT Data screen, enter a start date (mm/dd/yyyy), start time (hh:mm:ss), and duration (in hours) for the period to be downloaded.

For example, to download data for the week of July 1, 2016, enter a start date of 07/01/2016, start time of 00:00:00 and duration of 168 hours.

- Select the LOCATION TO SAVE FILE button to enter the desired file name of the document being generated and the path where the file will be saved

** The downloaded data has a default location in the folder \\storagecard\biocold\TrendHstCSV\ on the storage card (typically an SD card).

** The USB memory device displays as the "HardDisk" icon in the Windows Explorer window.

- Hit the EXECUTE FILE CONVERSION button to generate the file.





3.2.15. Fuji Limit Controller

The Fuji PXR4 limit temperature controller (Figure 19) provides alarm outputs if the room temperature exceeds the high or low temperature alarm settings as a safety cutout to shut down all or most heat-producing components to protect the control panel. When either alarm occurs, the appropriate HIGH or LOW alarm light will illuminate on the face of this controller and the remote alarm dry contacts will be activated. The range of this controller's alarm setpoints is wider than the range of the CER's alarm setpoints so the audible alarm would sound before the limit alarm would take effect.



Figure 19. Limit Controller

The upper right corner of limit controller indicates its function of °C, or as a temperature limit controller. As needed, a humidity limit controller may also be required and would be annotated with the %RH designation.

3.2.15.1. Display

The limit controller display is as follows:

- Upper right corner of controller indicates function: °C or %RH.
- PV (Process Value) = Indicates actual temperature/humidity level in chamber
- SV (Set Value) = Indicates temperature/humidity setpoint
- AL 1 AND AL2 = Indicate alarm conditions (Unit is in alarm when lit).

The controller automatically returns to the default display screen after about one (1) minute of inactivity.

3.2.15.2. Clock

The clock on the limit controller can be adjusted as needed. On the face of the limit controller, push the ESC button once or twice to show the following:

>Stop
Set Param
Set Clock
Prg Name

- a. Push the down button to select "**Set Clock.**"





- b. Push the OK button once and then the up or down buttons as necessary to select the current day of the week.
- c. Push the right arrow key to the first time digit. (Use a 24 hour format.)
- d. Set the first digit by pushing the up or down buttons and then push the right button.
- e. Similarly, set the subsequent time digits and the date digits.
- f. When complete push the OK button

Push the ESC button and the date/time will be displayed.

3.2.15.3. Menu Selection

All control functions are available via the green SEL (select) button.

The three menus for the limit controller are accessed by pressing and holding the SEL button. While holding the SEL button, the menus will scroll automatically. Release the button at the menu desired; the up and down chevron or arrow buttons are to the right of the green SEL button, respectively. The submenus are adjusted using these buttons. Values are changed by tapping the SEL button until the value flashes then moving the value up or down using the arrow keys. Enter new values using the SEL button. After a period of approximately one minute, the control will revert to the default display.

- The first menu begins with the parameter "Stby"
- The second menu begins with the parameter "P"
- The third menu begins with the parameter "P-n1"

To change setpoint values, press the arrow button up or down, based upon the appropriate direction. No other adjustments will need to be made other than changing the alarm setpoints. The controllers can be "locked" by using the "LOC" function to prevent unauthorized tampering and are unlocked at the factory - consult the Fuji Microcontroller Manual for more details.

3.2.15.4. High and Low Alarms

The high and low alarms are factory preset at a safety setpoint temperature above ambient (+35°C for instance) and 1.0°C, respectively.

- **To change High Limit Alarm value:**
 - Press SEL button and hold down until you see "STby".
 - Press down arrow until you see "AL1"
 - Press SEL until lower number flashes.
 - Use arrow keys to create a new value for the high limit alarm
 - Press SEL to enter.
- **To change Low Limit Alarm value:**
 - Press SEL button and hold down until you see "STby".
 - Press down arrow until you see "AL2"
 - Press SEL until lower number flashes.
 - Use arrow keys to create a new value for the low limit alarm





- Press SEL to enter.

3.3. Adjusting the HMI Time and Date

The data collected is based upon the time and date located in the left side of the footer of most screens. If the date and time of the touchscreen need to be adjusted, then follow these instructions below. A USB mouse is recommended to make this adjustment and an admin user for the touchscreen is required.

3.3.1. Via the Factory Screen

- 1) Login to the touchscreen as a “biocold” user from the MAIN or MENU screen.
- 2) Select the FACTORY button from the MENU screen
- 3) Double tap on the parameter to be changed.
 - a. Enter the time using the military format of 00:00:00 (hh:mm:ss)
 - b. Enter the date using the format of MM/DD/YYYY
- 4) Hit the corresponding button adjacent to the parameter to set value

3.3.2. Via Windows Desktop

- 1) Open the control panel door.
- 2) Plug the USB mouse into the USB port on the bottom side of the HMI unit.
- 3) Login to the touchscreen as an “admin” user from the MAIN or MENU screen.
- 4) Go to MENU screen (Figure 20)
- 5) Select the Logon button (gold key icon)
 - a) Enter valid username
 - b) Enter valid password
 - c) Hit “OK” button



Figure 20. Logging into Project

- 6) In the MENU screen, select the Exit button (to the right side of the screen) and confirm the command (Figure 21).





Figure 21. Logging Out of Project

- 7) The screen will now look similar to a Windows screen with a Remote Agent dialog window on the desktop.
- 8) Use the mouse to cursor to the lower part of the screen to view the Taskbar.
- 9) Double-click on the time in the Taskbar.
- 10) In the popup window, check the checkbox to “Automatically adjust clock for Daylight Savings.”
- 11) Make any necessary adjustments to the date, hour and/or minute value(s) (Figure 22).

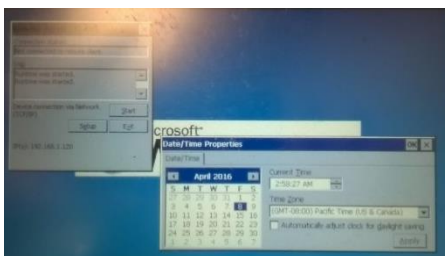


Figure 22. Adjusting Date and Time

- 12) Hit the “Apply” button.
- 13) On the Remote Agent window, hit the “Start” button.
If the program does not start within one (1) minute, cycle the power to the touchscreen.

3.4. Security

The BioCold BioLogic™ HMI interface incorporates logic designed to ensure that only authorized users can modify various parameters to ensure the chamber integrity. The MANAGE USERS screen (Figure 23) allows the administrator to manage the users for the room via the MENU screen. This screen option is unavailable until an admin or user of higher privilege is authenticated and the button will be selectable by the admin. The administrator has up to four (4) user account management options: create user, delete user, reset user password, and unblock a user.

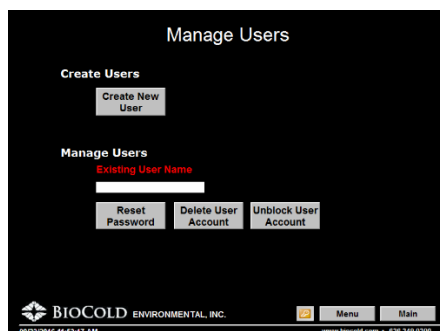


Figure 23. Manage Users Screen





3.4.1. User Accounts

The BioCold BioLogic™ HMI interface has three (3) levels of customer account access security during runtime: guest, user, and administrator. A fourth account is specifically set aside for the factory for development and runtime rights. Only the administrator can create and manage the users once the HMI is fielded.

Screen fonts will be a light grey when the current user logged in is not authorized to make changes to a button selection; conversely, the button font will be black with the appropriate access level. Editable values such as setpoints will show as a grey text field background when not accessible by that user level. A blue text field background on editable values indicates an authorized user is logged in.

A full group account matrix is provided below.

To create a new user account, log on with an administrator level username and password. The MENU screen will now show a MANAGE USER button in the top row. Click on that row to display the MANAGE USERS screen (Figure 24).

3.4.1.1. Guest Access Level

The GUEST account is the default access to the chamber operation and allows basic project control.

Without logging in, a user from the GUEST level can only view most chamber parameters as applicable via the MENU or system information screen:

- (MAIN, TEMPERATURE or HUMIDITY SETTING) temperature and humidity setpoints
- (MAIN, TEMPERATURE or HUMIDITY SETTING) current temperature and humidity readings
- (MAIN or ALARM SETTING) high and low alarms setpoints
- (SENSOR CALIBRATION) calibration values
- (MAIN or REDUNDANT) refrigeration system or controls status
- (ALL) alarm and notification / informational popup windows
- (ALARM HISTORY and ALARM ONLINE) current and past alarm information
- (SYSTEM INFO) startup or project information
- (PARAMETER LOG) changes to parameters by a user or PLC
- (MAINTENANCE) scheduled maintenance information.

Guests cannot modify any chamber settings but can silence an active alarm via its corresponding popup. Guests are able to manipulate the trend data to zoom in, zoom out, etc. because there is no modification to the actual values.

3.4.1.2. User Access Level

The USER level account has all the viewing rights as the GUEST account as well as can access most chamber functions. The user can edit the values or settings for the following parameters:

- (ALARM SETTING and TEMPERATURE / HUMIDITY SETTINGS) high and low setpoints and corresponding hysteresis, alarm delay, alarm callback
- (EXPORT DATA) reports for trend data
- (MAINTENANCE) maintenance duration and last timestamp
- (MENU) exiting or restarting the project server.





The USER has a minimum password size of five (5) characters with a minimum of one (1) alpha character and one (1) numeric character and no requirement for special characters. The password will expire after 180 days. This user will be logged off the project ten (10) minutes after the last user action. For security purposes, the account will be locked up after three (3) invalid attempts and will remain locked until unblocked by the administrator.

3.4.1.3. Administrator Access Level

The ADMINISTRATOR level account has all the viewing and editing rights as the USER account as well as can access most chamber functions.

- (MANAGE USERS) user access control
- (SENSOR CALIBRATION) sensor offsets

The chamber is shipped with one default administrator account:

Default Administrator Login: admin
Default Password: 63011 or 63011a

The ADMINISTRATOR has a minimum password size of six (6) characters with a minimum of one (1) alpha character and one (1) numeric character and no requirement for special characters. The password will expire after 180 days. This user will be logged off the project ten (10) minutes after the last user action. For security purposes, the account will be locked up after three (3) invalid attempts and will remain blocked until unblocked by the factory.

3.4.1.4. User Account Access Matrix

Permission	Group Account			
	Guest	User	Admin	Factory
VIEW	X	X	X	X
Current Temperature and Humidity Values	X	X	X	X
Temperature and Humidity Setpoints	X	X	X	X
Temperature and Humidity Calibration Offsets	X	X	X	X
Heating and Cooling Status	X	X	X	X
Humidification Equipment Status	X	X	X	X
Defrost Status (Cold Rooms and Freezers)	X	X	X	X
High and Low Alarm Setpoints	X	X	X	X
Alarm Hysteresis Values	X	X	X	X
Door Alarm Delay and Inhibit	X	X	X	X
Temperature and Humidity Operating Modes	X	X	X	X
Temperature Units	X	X	X	X
Temperature and Humidity PID and Deadband Parameters	X	X	X	X
Temperature Cutouts and Cutins	X	X	X	X
Alarm and Failure Popup Windows	X	X	X	X
Refrigeration System Status and Failure(s)	X	X	X	X
Alarm Silence	X	X	X	X
Informational Popup Windows	X	X	X	X
Alarm History	X	X	X	X
Current Alarm Online	X	X	X	X
Startup / System Information Screen	X	X	X	X
All Screens Except Manage Users Screen	X	X	X	X



Permission	Group Account			
	Guest	User	Admin	Factory
Manage Users Screen			X	X
Log In or Exit Project			X	X
Parameter Log	X	X	X	X
Scheduled Maintenance Information	X	X	X	X
Trend Data	X	X	X	X
Export Data	X	X	X	X
Controller Status	X	X	X	X
SELECT / EDIT / MODIFY				
Temperature and Humidity Setpoints		X	X	X
Temperature and Humidity Calibration Offsets		X	X	X
High and Low Alarm Setpoints		X	X	X
Alarm Hysteresis Values		X	X	X
Temperature and Humidity Operating Modes		X	X	X
Temperature Units		X	X	X
Temperature and Humidity PID and Deadband Parameters		X	X	X
Temperature Cutouts and Cutins		X	X	X
Humidification Equipment / Heater Mode(s)		X	X	X
Alarm Silence	X	X	X	X
Redundant Refrigeration System Selection		X	X	X
Redundant Refrigeration System Failure Reset		X	X	X
Redundant Refrigeration System Switchover and Overlap		X	X	X
Redundant Recovery Delay		X	X	X
Scheduled Maintenance Information		X	X	X
Current Temperature and Humidity Values		X	X	X
Temperature and Humidity Setpoints		X	X	X
Defrost Settings (Coolers and Freezers)		X	X	X
Add or Delete Users			X	X
Calibration Mode for Testing Purposes			X	X
Change User Passwords			X	X
Door Alarm Delays and Inhibits		X	X	X
Log In or Exit Project			X	X

3.4.2. List User Accounts

A list of users can be displayed for the user with admin privileges and higher. To generate this list, login as an authorized user and then select the SHOW USERS button. The current users will display vertically next to the button.

3.4.3. Create New User Account

Click the CREATE USER button to display the NEW USER ACCOUNT window (Figure 24). On this screen, first enter the user name and password for the new user, then assign that user to a group, either user or admin. Click OK to establish the new login account.

Figure 24. New User Account Window





SECURITY TIPS:

1. To prevent unauthorized access, always log out after making changes to chamber parameters. To log out, press the LOG ON button from the Startup or Menu screens. The popup window will provide an option to LOG OFF.
2. For additional protection, all accounts have an automatic logout function. User level accounts will automatically log off after 5 minutes of inactivity; Administrator level accounts will log off after 15 minutes of inactivity.

3.4.4.Delete User Account

An authorized admin user may remove accounts that are no longer needed. First enter the user name in the Existing User Name field and then click the DELETE USER button. Click OK to remove that login account.

3.4.5.Unblock User Account

The user will be locked out after three (3) consecutive invalid login attempts within five (5) minutes. Any locked out user can be unlocked by an authorized user of a higher security level; e.g., the user-level account must be unlocked by an administrative user account. However, the counter does reset and more attempts are possible by waiting five (5) minutes after the second invalid attempt to reset this counter. In other words, as long as the final attempt is not executed until after waiting the configured amount of time, the user will not be locked out.

To unblock a user, insert the locked out username in the Existing User Name field and then select the Unblock User button. The user will then be unblocked and now has permission to access the data for users.

3.4.6.Reset User Password

An authorized user may also reset another lower-level user's account. First enter the user name in the Existing User Name field. Enter the first verification password and the popup stating the password mismatch will likely appear. Enter the second password verification and the notification window for mismatched passwords will disappear. Click the Reset Password button the new password will take effect for the login account. The password successfully changed window will also appear; hit OK to acknowledge the change.

3.5. Remote Monitoring and Control

BioLogic™ control systems are equipped for remote monitoring and control using a TCP/IP web thin client and/or secure viewing software. The touchscreen is the server for the application (i.e., the thick client). Any thin client machine will need to run the Web Thin Client to remotely view the chamber information. The Ethernet port on the touchscreen must be connected to the local area network (LAN) of the site. To identify the IP address of the server after LAN connection,

- 14) Open the control panel door.
- 15) Plug the USB mouse into the USB port on the bottom side of the HMI unit.
- 16) Login to the touchscreen as an "admin" user from the MAIN or MENU screen.
- 17) Go to MENU screen at the footer of the screen
- 18) Select the Logon button (gold key icon)
 - a) Enter valid username





- b) Enter valid password
 - c) Hit "OK" button
- 19) In the MENU screen, select the Exit button (to the right side of the screen) and confirm the command when prompted.
- 20) The screen will now look similar to a Windows screen with a Remote Agent dialog window on the desktop.
- 21) Use the mouse to cursor to the lower part of the screen to view the Taskbar.
- 22) Under the Hidden Icons triangle, locate the Remote Agent startup icon (Figure 25) and click on that icon.



Figure 25. Remote Agent Startup Icon

- 23) The Remote Agent popup window (Figure 26) will display with the IP address.

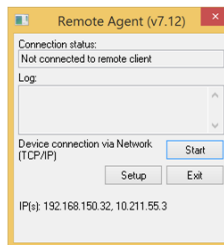


Figure 26. Remote Agent Popup Window

- 24) Download the Web Thin Client viewer from the following web address:
<https://www.dropbox.com/s/u7bxnor436wvo44/ThinClientSetup.exe?dl=0>
- 25) Open an Internet Explorer® browser window on the client machine and connect to the CER IP address using the following URL as an example with the identified IP address from Step 10 in its place. If a problem is encountered, then login to the IE program as an administrator.

<http://192.168.1.57/startup.html>

- 26) The login prompt will popup. Login with a valid username and password.

Note that only one web thin client license is available with each CER. Multiple licenses are available as an upgrade. With a single license, when more than one user attempts to access remotely, any secondary client will be denied access until the license is released.

4. Periodic Maintenance

BioCold environmental rooms are designed for long-term operation with minimal maintenance needs. BioCold recommends the following periodic maintenance schedule.

Regular Cleaning:





- ☐ Environmental room finishes may be cleaned on an as-needed basis with standard commercial detergents. Corrosive solvents may damage painted finish.

Monthly Maintenance:

- ☐ Visually inspect compressor/condensing unit to ensure fan intake is not obstructed.
- ☐ Visually inspect evaporator fan coil to ensure it is clear of ice.

Quarterly Maintenance:

- ☐ Clean compressor/condensing unit to remove dust accumulation and potential obstructions.

5. Regulatory Data Compliance

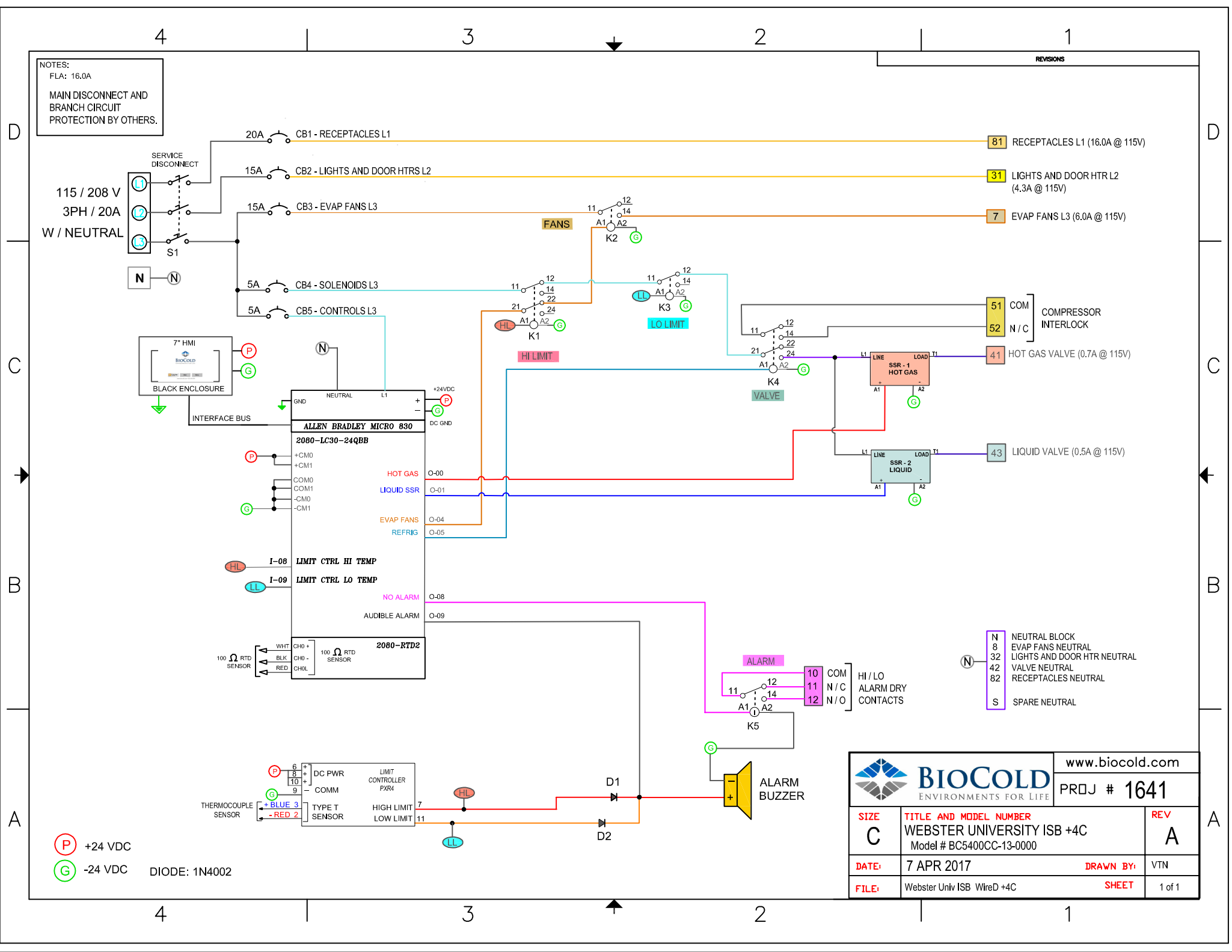
5.1. 21 CFR Part 11

Ensuring 21 CFR Part 11 compliance is fundamental to each BioCold project as electronic records are created, archived, and maintained within this control panel. The BioLogic design enables the client to retrieve and transmit the data through multiple media storage devices, via a secure network or externally. The applicable Predicate Control rules take precedence to ensure that the original automated data entries are stored properly.

BioCold understands that our compliance as the supplier or vendor of this project must be in accordance with your established processes. BioCold advises the authorized personnel or compliance department (i.e., the party liable for ownership of these records) to implement and adhere to established Procedural Requirements that includes but is not limited to formal training, accountability guidelines, and documentation control processes to maintain the integrity, confidentiality (as applicable), and authenticity of the automated electronic records generated. Ultimately, the record owner or end user has the responsibility to employ best practices for controls once the control panel is fielded.

The BioLogic offers its products and ongoing services through the life of the control panel.







SERVICE MANUAL

WALK-IN COOLERS AND FREEZER

IM-268S-11

Routine maintenance _____	2
Safety Walk Strips _____	2
Gaskets	
Replacing magnetic gasket on hinged Walk-In doors _____	3
Replacing wiper gasket at bottom of hinged Walk-In door _____	3
Hinged Walk-In Doors	
Replacing the D-1000 touch latch on Walk-In doors _____	4
Replacing D-1250 spring loaded hinges on Walk-In door panels _____	5
Shimming Walk-In door hinges _____	5
Anti-Condensate Heaters	
Replacing anti-condensate heater element around door frame of hinged Walk-In doors _____	6
Reach-In Doors	
Replacing magnetic gasket on hinged Reach-In doors _____	7
Adjusting self-closing hinges on Reach-In doors _____	7
Replacing hinges on Reach-In door panels _____	8
Replacing anti-condensate heater element around frame of hinged Reach-In doors _____	8
Pressure Relief Port	
Replacing klixon on Pressure Relief Port _____	9
Replacing anti-condensate heaters on Pressure Relief Ports _____	9
Replacing magnetic gasket on Pressure Relief Ports _____	9
Door Closer	
Replacing Door Closer _____	10

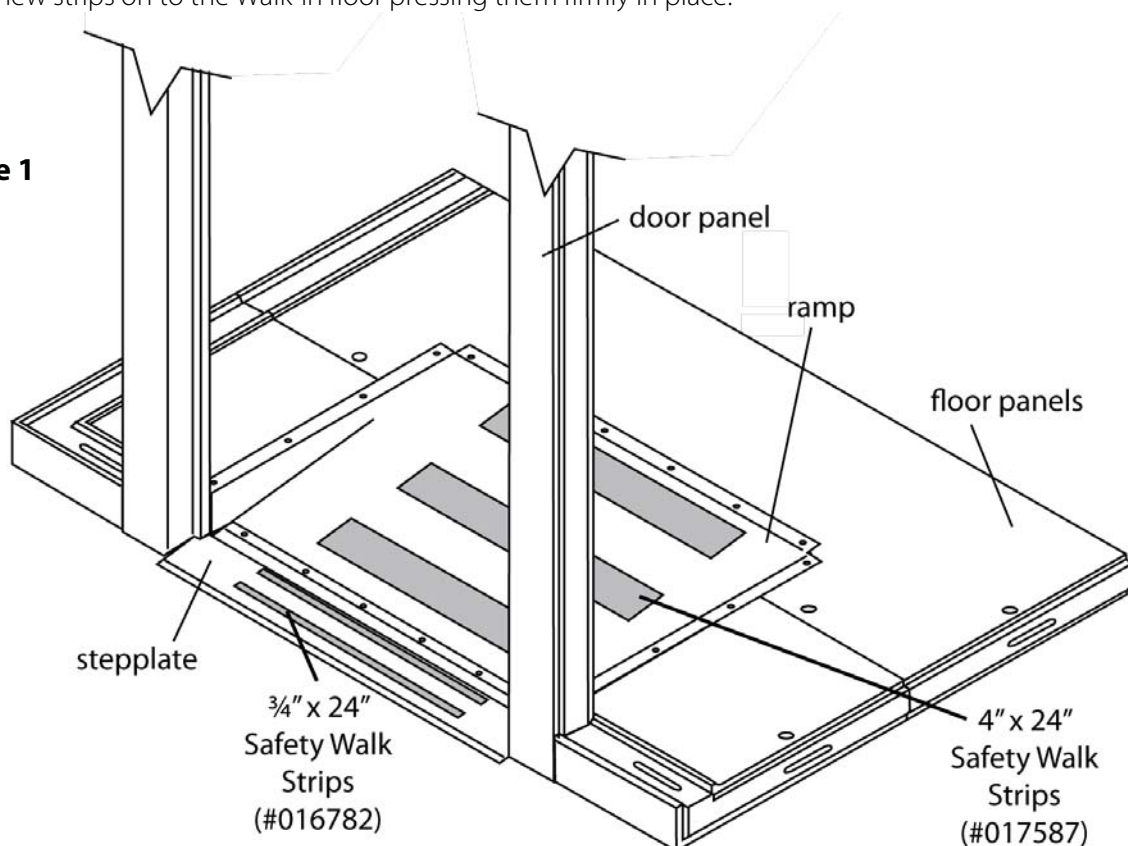
ROUTINE MAINTENANCE

- A. Keep all walkway surfaces clean and free of spilled liquids and food particles.
- B. Walk-In panels and magnetic door gasketing should be periodically wiped clean with a damp cloth. Use only mild soap to clean the panels: never abrasive pads or powders that could mar the finish. Remove all soap film and thoroughly dry with a clean cloth. Protect Digital and Electronic Alarms from moisture, or warranty is null and void.
- C. Never flush the inside of the Walk-In with water. Use a clean damp mop or rag when cleaning spills on the floor.
- D. Heater wires should be checked for proper function. Feel for warmth around the door frames on hinged entrance doors and pressure relief port doors, if applicable. Note: Condensation or Ice buildup around doors may indicate leakage or heater failure. Contact a serviceman immediately.
- E. Keep door gaskets clean with a solution of water and mild soap.
- F. Inspect refrigeration units frequently for proper function of evaporator & condenser fan motors, drain pan heaters, defrost controls, and drain line heaters. Condensate water must never be permitted to drip on the Walk-In floor. Drain pan or drain line heater failure will result in ice buildup and Evaporator damage. Refer to the Refrigeration System Instructions for proper drain pan and condensate drain line instructions.
- G. Don't overload the Walk-In with product. Maintain orderly storage to permit good airflow within the unit.
- H. Inspect the condition of abrasive anti-skid strips monthly. Replace or add additional strips when necessary.

REPLACING SAFETY WALK STRIPS

- A. Remove old worn Safety Walk Strips from Walk-In floor, ramps, or a stepplate. *See figure 1.*
- B. Clean and completely dry areas where new strips are to be placed.
- C. Install new strips on to the Walk-In floor pressing them firmly in place.

Figure 1



GASKETS

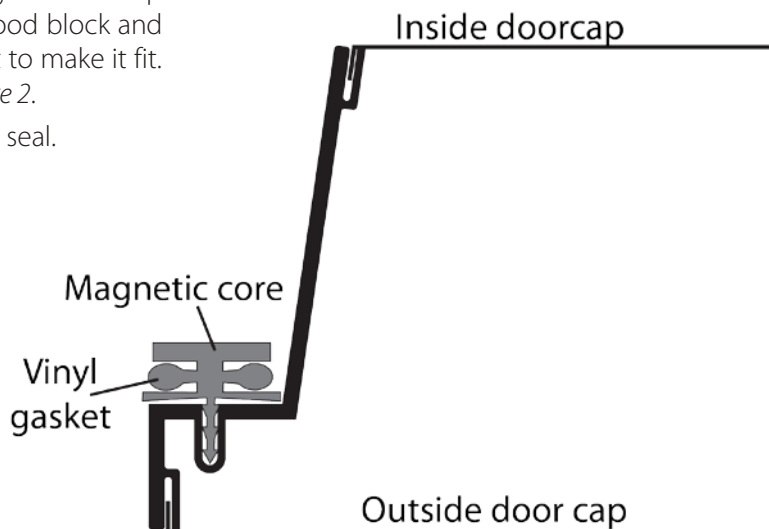
Replacing magnetic door gasket on Hinged Walk-In doors

- A. Remove the old gasket and clean the surface where the new gasket will be placed.
- B. Position the new gasket, starting at the top corners. Tap it into place with a wood block and hammer. Do not stretch the gasket to make it fit. Be sure the gasket lies flat. *See Figure 2.*
- C. Check door for proper operation and seal.

Part Numbers:

#016543 – 24" x 78"
#017402 – 30" x 78"
#017403 – 30" x 84"
#016546 – 34" x 78"
#016547 34" x 84"
#054117 – 36" x 78"
#054119 – 36" x 84"
#032999 – 42" x 78"
#032999 – 42" x 84"
#016548 – 48" x 84"
#016549 – 60" x 84"

Figure 2

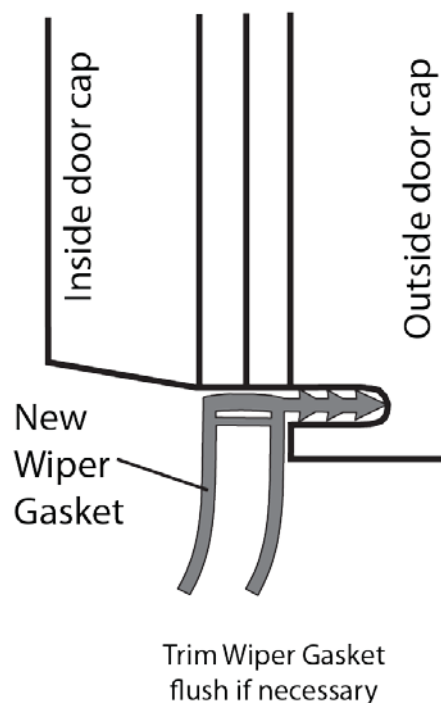


- A. Open the door 90 degrees.
- B. Grasp the old gasket and pull it away from the interior skin of the door. Clean the surface where the new gasket is to be placed.
- C. Position the new gasket; tap it into place with a wood block and hammer. Do not force the gasket into place; excessive force may damage the door cap.
- D. If the gasket binds when the door is closed, the gasket is too wide. Be sure the gasket is properly centered, and trim the ends as needed. *See Figure 3.*

Part Numbers:

#016614 – 30" Door
#016611 – 34" Door
#054028 – 36" Door
#016612 – 42" & 48" Doors
#016613 – 60" Door

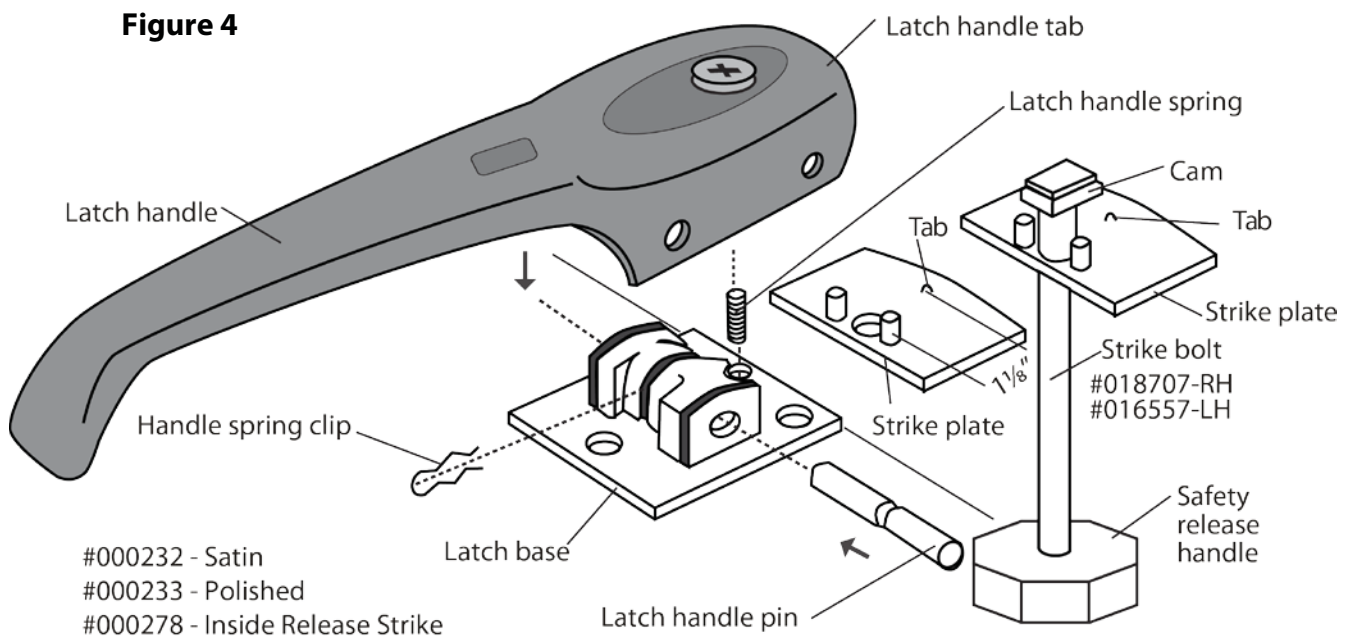
Figure 3



HINGED WALK-IN DOORS

Replacing the D-1000 touch latch on Walk-Ins

- A. Remove the defective latch assembly. First remove the handle spring clip from under the handle at the back of the latch base, using a pair of needle-nose pliers. *See Figure 4.*
- B. Using a hammer and punch, drive out and remove the latch handle pin from the handle. Remove the three ¼-20 oval-head machine screws from the latch base and remove the base.
- C. From the inside of the Walk-In, drill out the roll pin from the safety release handle and remove the handle. (Doors prior to 1995) Current production doors are provided with an interior mounted safety knob which is threaded directly onto the strike bolt. Loosen the allen screw located in the side of the knob using a 5/32 allen key and turn counter clockwise until disengaged from the strike bolt. Pull the strike bolt from the outside away from the Walk-In wall. The strike plate will fall away.
- D. Secure the new D-1000 latch base to the Walk-In door with three ¼-20 oval-head machine screws.
- E. Insert the new strike bolt with attached strike plate into the holes on the door jamb panel.
- F. Screw the new inside knob onto the strike bolt until adequate tension is applied to the rod to hold the assembly firmly in place. Tighten the set screw on the side of the knob using a 5/32 allen key to allow for ¼ turn safety release operation. Check to be certain that the "T" rod rotates freely when turning the inside knob.
- G. Insert the latch handle spring into the indicated hole on the latch base. Slip the latch handle over the latch base and align all holes. Be sure the latch handle spring engages the latch handle tab on the underside of the handle. Insert the latch handle pin through the handle and base. Using needle-nose pliers, insert the spring clip through the slot in the latch base assembly. Make certain to align the slot in the latch handle pin with the slot in the base before inserting the clip. This will firmly secure the latch handle in place for use.
- H. Open and close the door several times to assure proper operation of the latch.



Replacing D-1250 spring-loaded hinges on Walk-In door panels

- Close the door. Securely hold the door in place by shimming between the outside doorcap and the door frame. Remove the slotted machine screws from the hinge base and blade. If tamperproof screws are used *See Figure 5*. Remove the defective hinge assembly. Secure the new hinge assembly with a screwdriver by tightening the machine screws in the same holes.
- Remove the shims from around the perimeter of the door frame.
- Open the door and check for proper operation and seal.

Shimming Walk-In door hinges

- If the Walk-In door is installed properly, no shimming is required. Shim only where misapplication or poor installation of the door panel have caused the door cap to seal improperly. If the door cap toes outward at the top or bottom of the latch side of the panel, shim the diagonally opposite hinge base outward, forcing the corner of the door cap back into alignment with the door frame for a positive seal. *See Figure 6*.
- To shim hinges on Walk-In doors, loosen the machine screws on the base of the hinge enough to slip the required number of shims into place behind the base. *See Figure 7*. Where tamper-proof screws are used, loosen them by tapping the screw head counterclockwise with a center-punch and hammer as shown in *Figure 5*.
- Retighten machine screws and check door cap for proper seal.

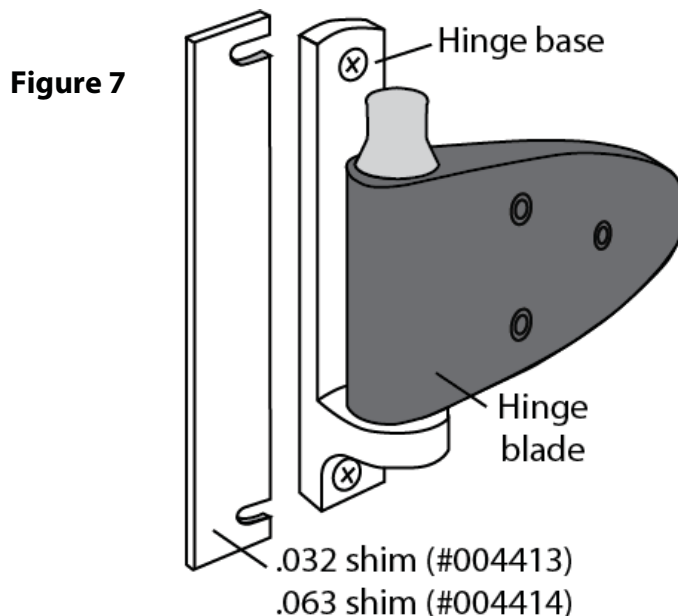
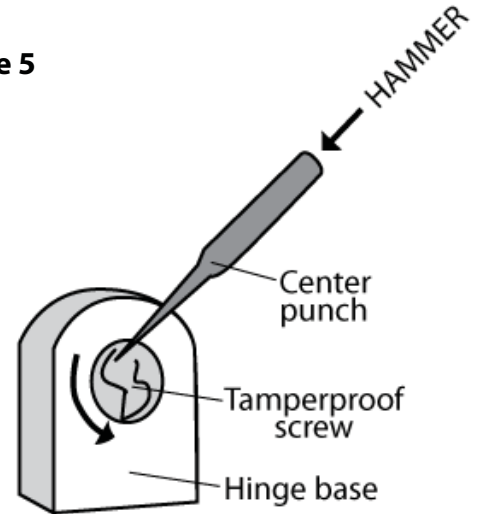
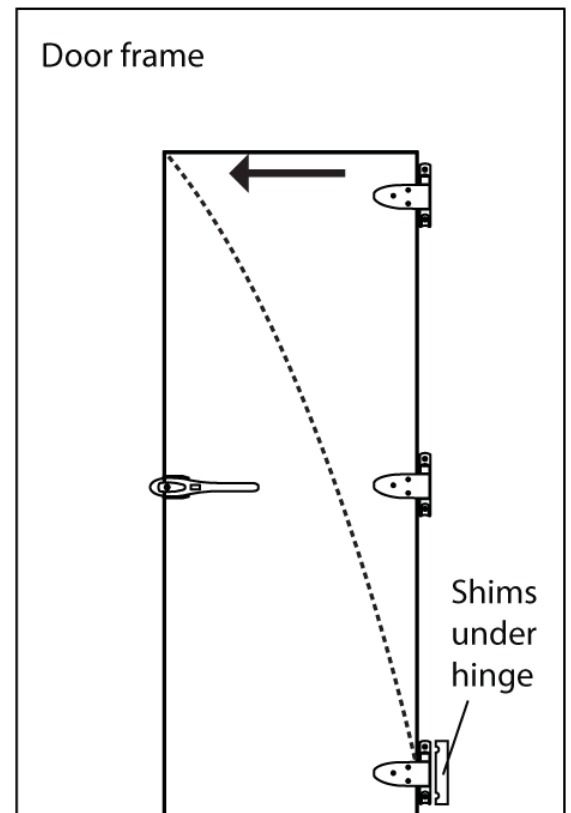


Figure 5



Bally also offers a screw remover tool.
Call the factory for details.

Figure 6

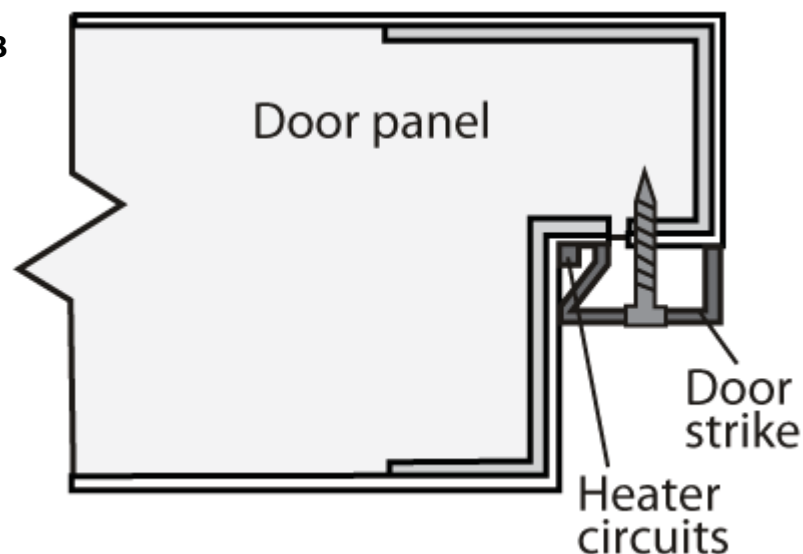


ANTI-CONDENSATE HEATER

Replacing anti-condensate heater element around door frame of hinged Walk-In doors

- A. Disconnect the outside power source leading to the door frame light junction box. Open the door 180 degrees. A large piece of cardboard can be used to close off the open doorway until the heater is replaced.
- B. Remove the light switch on the exterior of the door panel. Disconnect the heater wire leads by unscrewing the wire nuts. Remember how the wires are connected so you can attach the proper leads on the new wire.
- C. Remove the screws from the door strikes around the door frame. Remove the strikes. *See Figure 8.*
- D. Remove the screws which secure the stepplate. Remove the stepplate.
- E. Remove the defective heater element from the door frame and the grooved hardboard at the base of the frame. Take note of the position of the heater element in the grooved hardboard before removing it. (For replacement or updated heaters, a new hardboard will be supplied with an installation diagram.)
- F. Apply a small bead of silicone caulking around the perimeter of the door frame to retain the new heater element until the door strikes can be reinstalled.
- G. Guide the leads of the new heater element into the switch box containing the light switch. Note: Only heater wire leads are to protrude into the switch box-- this will prevent premature heater burnout. Press the heater element firmly into the corner around the perimeter of the door frame. Locate and press the heater element back into the grooved hardboard exactly the same way it was removed. When the heaters are first energized, they will contract. If the wire is not pressed into the corners, it could short out by pulling too tight against the edges of the strikes and sillplate.
- H. Replace and secure the stepplate to the Walk-In floor. Replace the door strikes. Be careful not to pinch the wires when remounting the hardware.
- I. Reconnect the new heater element to the heater wire leads. Recaulk the opening in the door frame where the heater wire passes through into the junction box. This is very important.
- J. Re-energize the outside power source to the door frame light junction box. Check for proper operation.

Figure 8



REACH-IN DOORS

Replacing magnetic gasket on Reach-In doors

- A. To replace the magnetic door gasket, it may be necessary to remove the door from the Walk-In. Simply open the door and lift it off the hinge bases. Lay the door facedown on a flat working surface.
- B. Remove the defective gasket and clean the surface where the new gasket will be placed.
- C. Position the new gasket and tap firmly into place with a wood block and hammer. Be sure the gasket lies flat. *See Figure 2.*
- D. Place the door back on the hinges. Check the door for proper operation and seal.

Part Numbers:

#016582 – 18½" x 30"

#016584 – 20" x 30"

#016583 – 30" x 30"

Adjusting self-closing hinges on Reach-In doors

- A. Do not oil door hinges. If dirt accumulates on the Delrin cams and causes them to bind, apply dry silicone spray lubricant.
- B. Begin by determining whether the hinge is correctly adjusted. When the strap of the hinge is flush with the flange, there must be clearance as shown in *Figure 9*. Without clearance, the door may not close. Adjust the hinge by following these steps:
 1. Open the door 90 degrees and lift the door from its hinge bases.
 2. Adjust the hinges as shown in *Figure 10*
 - a. Put a pencil mark on cam and on hinge; this enables you to see how much the cam is being turned.
 - b. Loosen bottom nut and turn half way off.
 - c. Tap against bottom of nut with a hammer until pin and cam are loose. The reason for this is the pin has a tapered shaft.
 - d. Turn cam in direction of the arrow in increase clearance; opposite direction to decrease.
 - e. Hold cam in position and tighten bottom nut securely.
 3. Replace the door on its hinge bases. Check to make sure door operates properly.

Figure 9

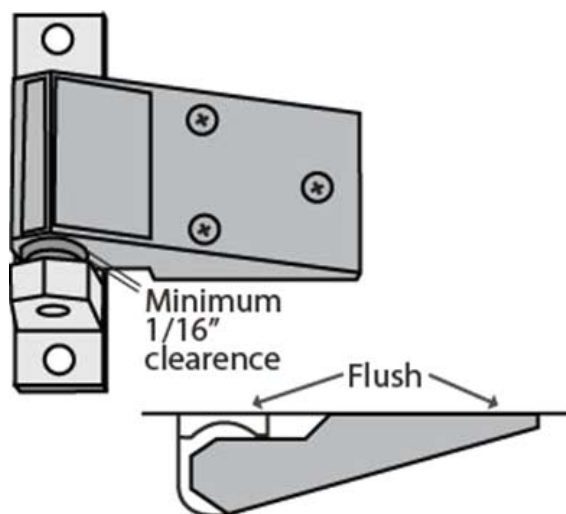
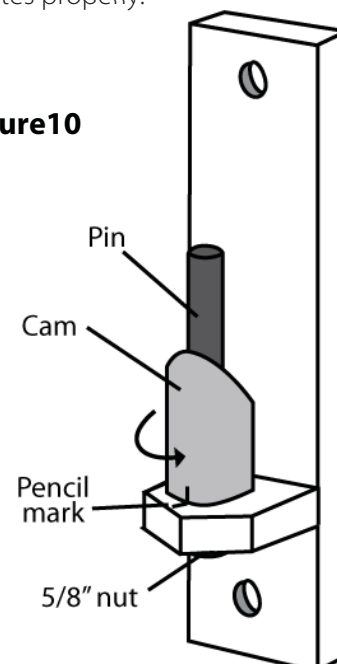


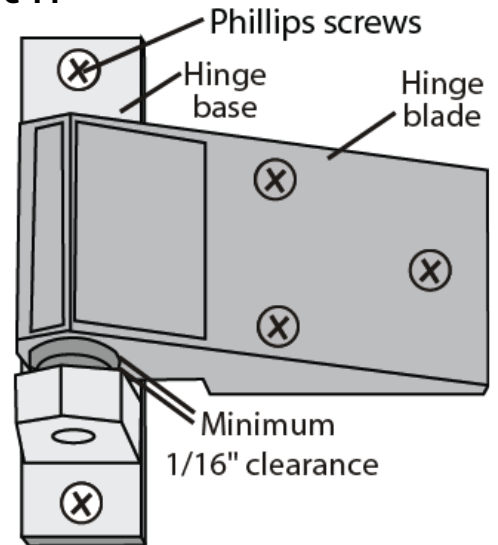
Figure10



Replacing hinges on Reach-In door panels

- A. Close the door and shim the cap securely around the perimeter of the frame. Remove the slotted machine screws from the hinge base and blade. If tamperproof screws are used *Refer to Figure 5.* Remove the defective hinge assembly. *See Figure 11.*
- B. Secure the new hinge assembly using a screwdriver to tighten the slotted machine screws in the same holes.
- C. Remove the shims around the perimeter of the door frame.
- D. Open the door and check for proper

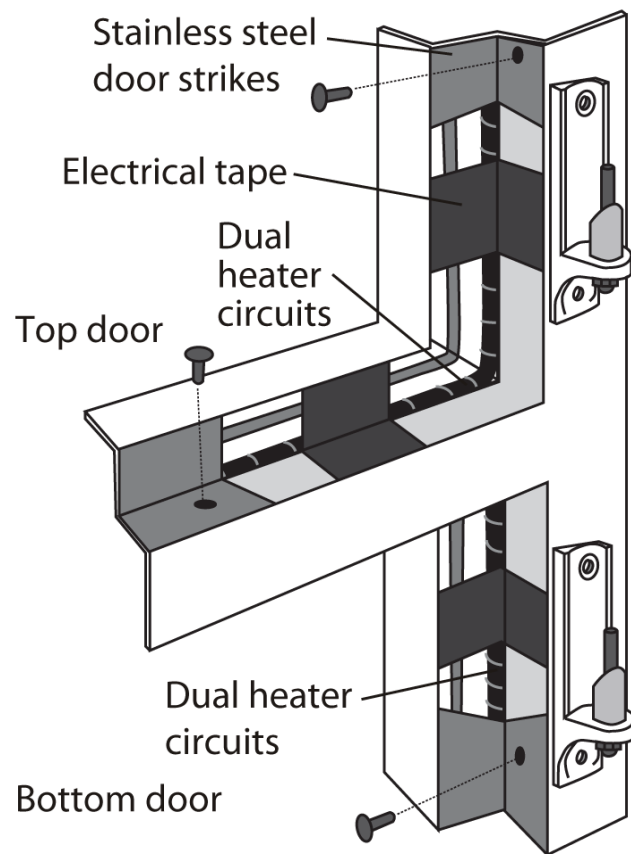
Figure 11



Replacing anti-condensate heater element around door frame of Reach-In doors

- A. De-energize the outside power source leading to the door frame junction box. Open the door a full 180 degrees and lift it from the hinge bases.
- B. Remove the screws from the stainless steel door strikes around the door frame. Remove the strikes. *See Figure 12.*
- C. Remove the cover plate from the junction box on the inside of the door frame. Locate and disconnect the defective heater element from the door frame.
- D. Remove the defective heater element from the door frame.
- E. Apply a small bead of silicone sealant around the perimeter of the door frame to retain the new heater element. Press the new heater element firmly into the corner around the perimeter of the door frame. The heater element may also be taped into position with UL-approved electrical tape. (Remove) *See Figure 12.* Run the heater leads into the junction box.
- F. Reconnect the heater element to the outside power source. Recaulk the opening in the door where the heater wire passes into the junction box.
- G. Replace the door strikes and junction box cover plate. (Be careful not to break or pinch the heater element.) Replace the door on the hinge bases.
- H. Re-energize the power source to the door frame junction box. Check the door for proper operation and seal.

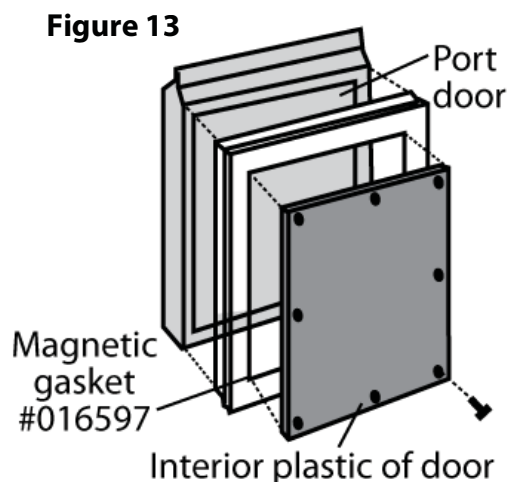
Figure 12



Pressure Relief Ports (PRP)

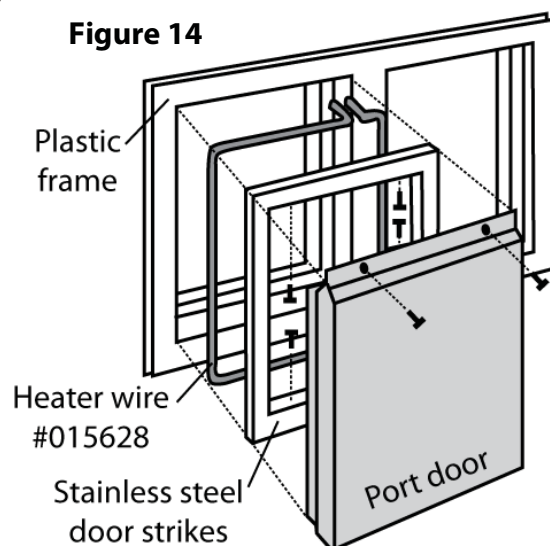
Replacing magnetic gasket on PRP

- Remove the port door by removing the screws from the poly-hinge at the top of the port door. *See Figure 14.*
- Remove the interior plastic panel from the door by removing the screws around its perimeter beneath the magnetic gasket.
- Remove and discard the defective gasket.
- Position the new gasket (#016597) and the interior plastic panel on the door; secure with screws.
- Reinstall the port door.



Replacing anti-condensate heaters on PRP

- Disconnect the power supply at its source, and remove the port door by removing the two screws from the poly-hinge at the top of the door. *See Figure 14.*
- Remove the stainless steel door strikes by removing the two screws in the top and bottom flanges.
- Disconnect the defective anti-condensate heater in the junction box at the top of the door. Discard the old heater.
- Insert the new heater (#015628) and reassemble the door strikes. Exercise care not to pinch the heater wire beneath the door strikes.
- Replace the port door and refasten the screws.
- Reconnect the electrical power.



Replacing klixon on PRP

- Disconnect power at its source, and remove the electrical junction box cover above the port.
- Remove the screws located in flanges on the exterior of the port, and lift the unit from the panel.
- Disconnect the appropriate wire nuts in the junction box. Remove and replace the defective klixon (#017083). *See Figure 15.*
- Caulk around the perimeter of the opening, and replace the port. Rewire and replace the junction box cover. Reconnect electrical power. *See Figure 16.*

Figure 15

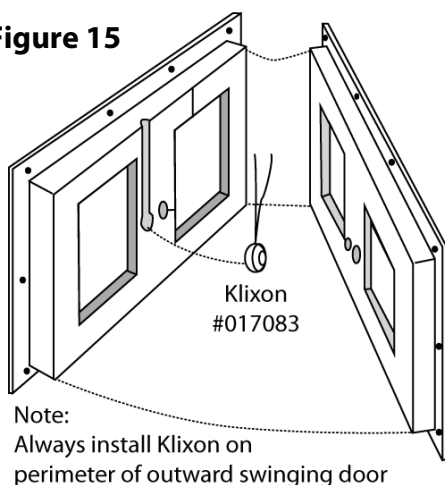
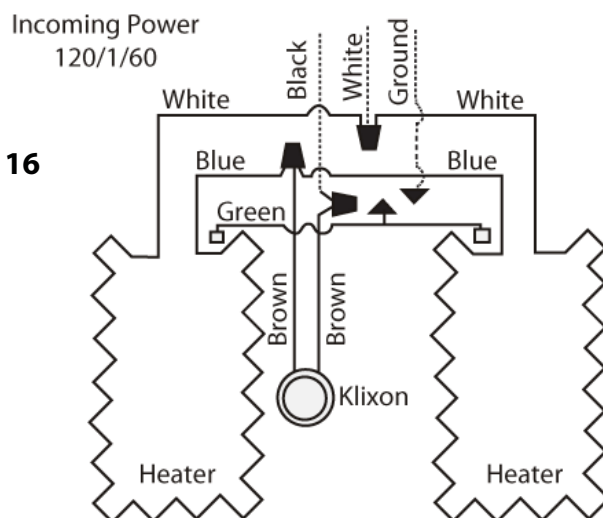


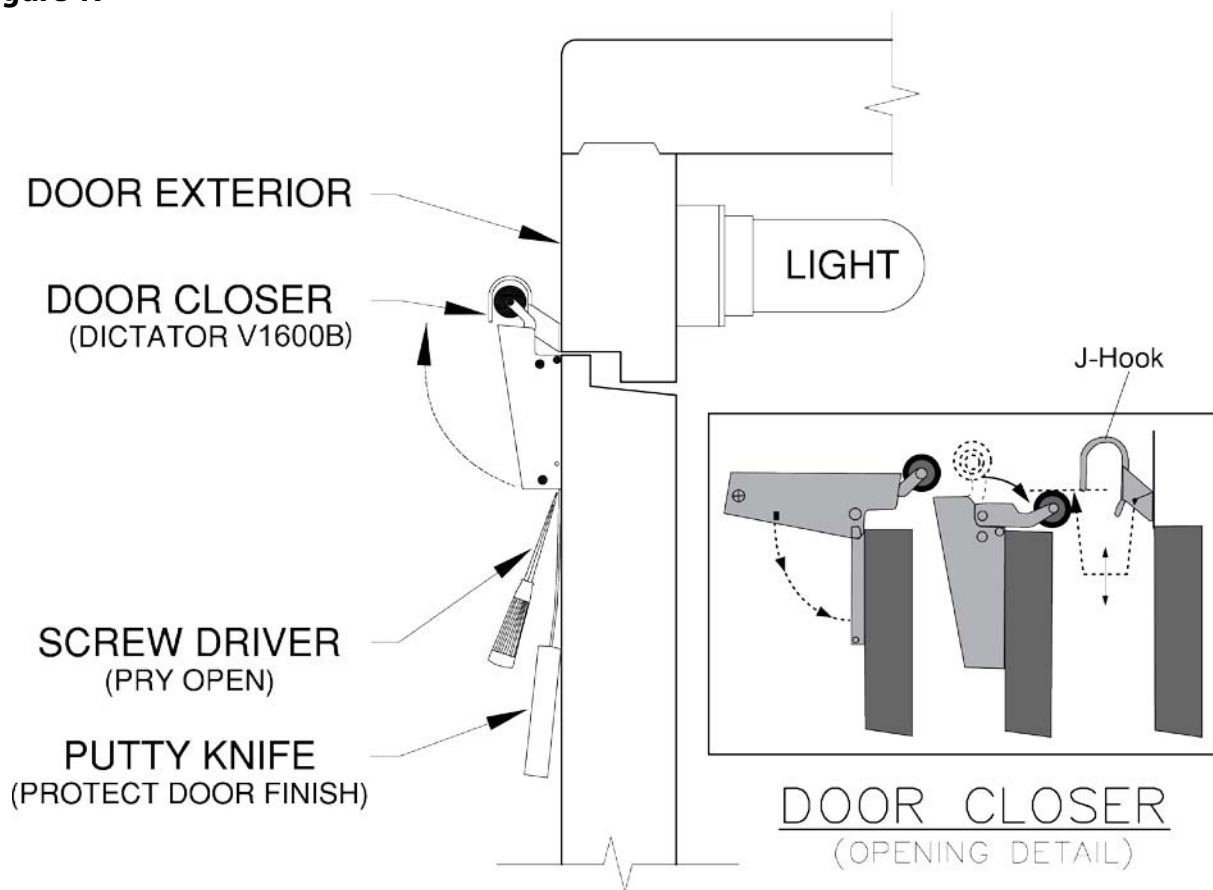
Figure 16



Replacing Door Closer

- A. Position a putty knife against the base of the bottom of the closer cover to protect the door surface as shown. See figure 17. Pry open the cover using a small flat bladed screw driver. The closer cover is friction fit onto its base and will pry out and upward away from the door.
- B. Remove all mounting screws from the closer base on the door and from the “J” hook mounted on the door frame.
- C. Install new closer and “J” hook onto door and frame using the existing holes. If for any reason the existing holes do not line up with the holes in the new closer you will be required to drill and tap the door at the location of the holes for the new closer mounting base. Once firmly secured, rotate the cover back down over the base and snap into place.
- D. Adjust the “J” hook, if required, to align the rubber wheel of the closer with the tip of the hook. When properly aligned the tip of the hook should touch the top of the rubber wheel as the wheel passed into the hook.

Figure 17



Part Number: #031349 – Dictator Hydraulic Door Closer V1600B



Installation and Operations Manual

H-IM-UC

August 2012

Part No. 25008201

Replaces None. Information formerly included in H-IM-64L

Unit Coolers

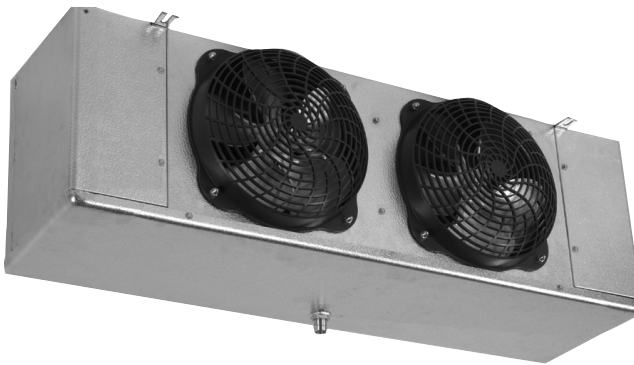
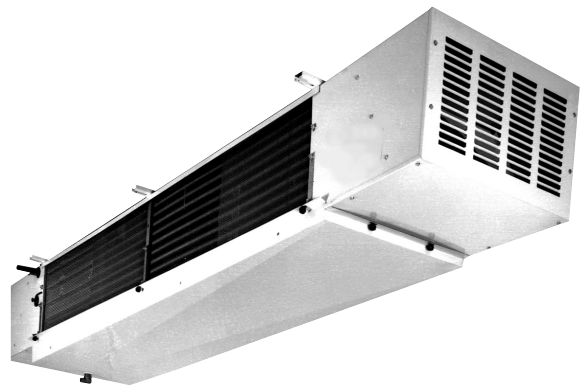


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General Safety Information

1. Installation and maintenance to be performed only by qualified personnel who are familiar with this type of equipment
2. Some units are pressurized with dry air or inert gas. All units must be evacuated before charging the system with refrigerant.
3. Make sure that all field wiring conforms to the requirements of the equipment and all applicable national and local codes.

4. Avoid contact with sharp edges and coil surfaces. They are a potential injury hazard.
5. Make sure all power sources are disconnected before any service work is done on units.

WARNING: Refrigerant can be harmful if it is inhaled. Refrigerant must be used and recovered responsibly. Failure to follow this warning may result in personal injury or death.

Inspection

Responsibility should be assigned to a dependable individual at the job site to receive material. Each shipment should be carefully checked against the bill of lading. The shipping receipt should not be signed until all items listed on the bill of lading have been accounted. Check carefully for concealed damage. Any shortage or damages should be reported to the delivering carrier. Damaged material becomes the delivering carrier's responsibility, and should not be returned to the manufacturer unless prior approval is given to do so. When uncrating, care should be taken to prevent damage. Heavy equipment should be left on its shipping base until it has been moved to the final location. Check the serial tag information with invoice. Report any discrepancies to your Heatcraft Refrigeration Products Sales Representative.

Warranty Statement

Seller warrants to its direct purchasers that products, including Service Parts, manufactured by SELLER shall be of a merchantable quality, free of defects in material or workmanship, under normal use and service for a period of one (1) year from date of original installation, or eighteen (18) months from date of shipment by SELLER, whichever first occurs. Any product covered by this order found to Seller's satisfaction to be defective upon examination at Seller's factory will at SELLER's option, be repaired or replaced and returned to Buyer via lowest common carrier, or SELLER may at its option grant Buyer a credit for the purchase price of the defective article. Upon return of a defective product to SELLER's plant, freight prepaid, by Buyer, correction of such defect by repair or replacement, and return freight via lowest common carrier, shall constitute full performance by SELLER of its obligations hereunder.

SELLER shall have no liability for expenses incurred for repairs made by Buyer except by prior, written authorization. Every claim on account of breach of warranty shall be made to SELLER in writing within the warranty period specified above – otherwise such claim shall be deemed waived. Seller shall have no warranty obligation whatsoever if its products have been subjected to alteration, misuse, negligence, free chemicals in system, corrosive atmosphere, accident, or if operation is contrary to SELLER's or manufacturer's recommendations, or if the serial number has been altered, defaced, or removed.

Seller makes no express warranties except as noted above. All implied warranties are limited to the duration of the Express Warranty. Liability for incidental and consequential damages is excluded.

The forgoing is in lieu of all other warranties, express or implied, notwithstanding the provisions of the uniform commercial code, the Magnuson-Moss Warranty - Federal Trade Commission Improvement Act, or any other statutory or common law, federal or state.

SELLER makes no warranty, express or implied, of fitness for any particular purpose, or of any nature whatsoever, with respect to products manufactures or sold by seller hereunder, except as specifically set forth above and on the face hereof. It is expressly understood and agreed that SELLER shall not be liable to buyer, or any customer of buyer, for direct or indirect, special, incidental, consequential or penal damages, or for any expenses incurred by reason of the use or misuse by buyer or third parties of said products. To the extent said

products may be considered "consumer products," As defined in Sec. 101 of the Magnuson-Moss Warranty - Federal Trade Commission Improvement Act, SELLER makes no warranty of any kind, express or implied, to "consumers," except as specifically set forth above and on the face hereof.

The following conditions should be adhered to when installing this unit to maintain the manufacturers warranty:

- (a) System piping must be in accordance with good refrigeration practices.
- (b) **Inert gas must be charged into the piping during brazing.**
- (c) The power supply to the unit must meet the following conditions:
 - A. Three phase voltages must be +/- 10% of nameplate ratings. Single phase must be within +10% or -5% of nameplate ratings.
 - B. Phase imbalance cannot exceed 2%.
- (d) All control and safety switch circuits must be properly connected according to the wiring diagram.
- (e) The factory installed wiring and piping must not be changed without written factory approval.
- (f) All equipment is installed in accordance with Heatcraft Refrigeration Products specified minimum clearances

Recommended Unit Cooler Placement

Some general rules for evaporator placement which must be followed are:

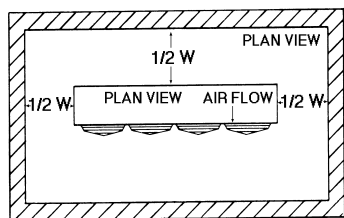
1. The air pattern must cover the entire room.
2. **NEVER** locate evaporators over doors.
3. Location of aisles, racks, etc. must be known.
4. Location relative to compressors for minimum pipe runs.
5. Location of condensate drains for minimum run.

The size and shape of the storage will generally determine the type and number of evaporators to be used and their location. The following are some typical examples:

NOTE: Leave space equal to unit height between bottom of unit and product. Do not stack product in front of fans.

Minimum Unit Clearances

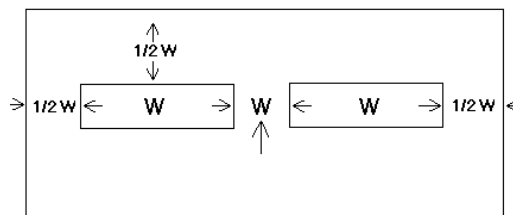
Figure 1. Medium Profile and Large Unit Coolers



One evaporator

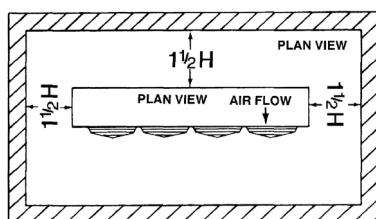
NOTE:

W = Total width of evaporator coil surface.



Two evaporators

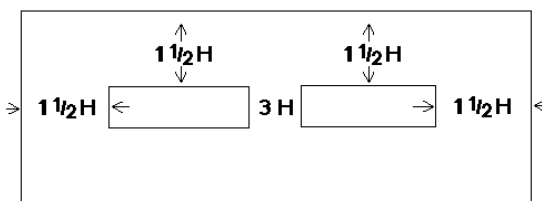
Figure 2. Low Profile Unit Coolers



One evaporator

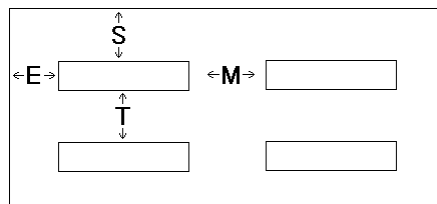
NOTE:

H = Total height of evaporator coil surface.



Two evaporators

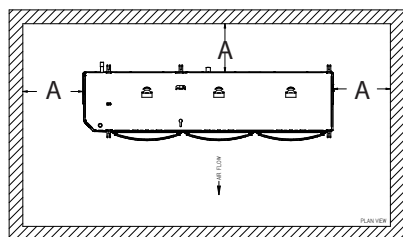
Figure 3. Center Mount Unit Coolers



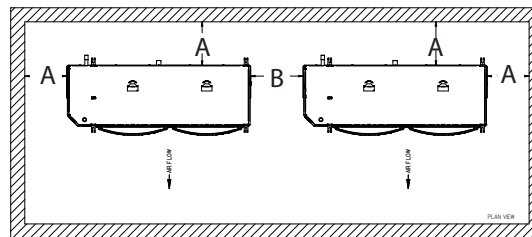
Recommended Maximum - Minimum Dimensions for Center Mount Unit Cooler Installations.

E		S		M		T	
Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
25'	2'	20'	3'	40'	3'	40'	6'

Figure 3A. Slim Contour Unit Coolers



	Min
A	18"
B	36"



Unit Cooler Mounting

Most evaporators can be mounted with rod hangers, lag screws, or bolts. Use 5/16" bolt and washers or rod for up to 250 pounds, 3/8" for up to 600 pounds and 5/8" for over 600 pounds. Care should be taken to mount the units level so that condensate drains properly. Note that some unit cooler designs achieve drain pan slope by using different height mounting brackets. In this situation, the top of the mounting brackets should be level. Adequate support must be provided to hold the weight of the unit.

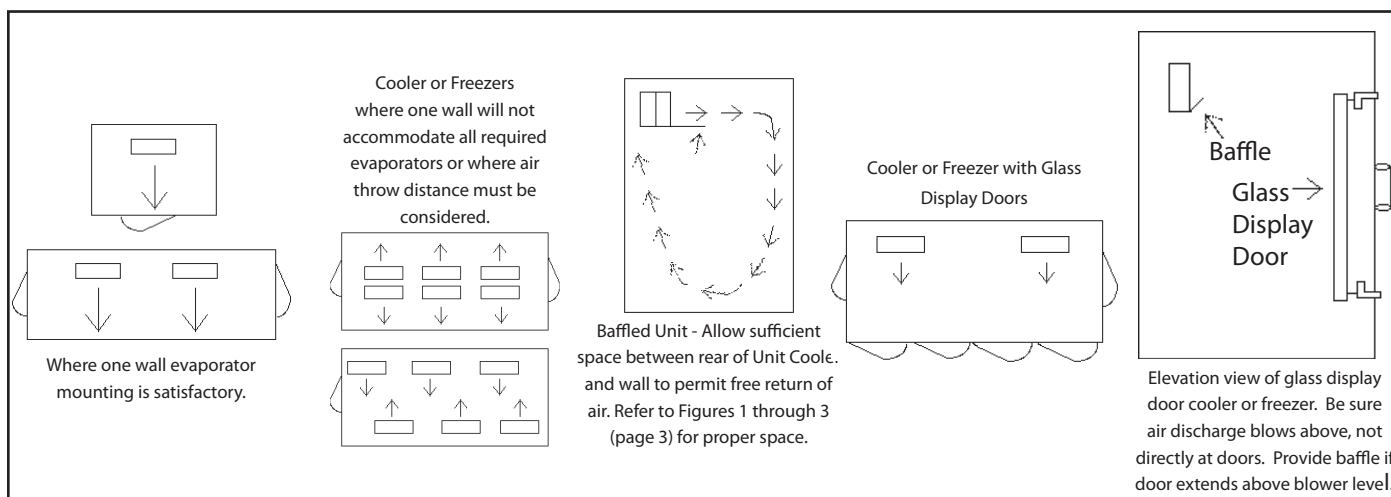
When using rod hangers, allow adequate space between the top of the unit and the ceiling for cleaning. To comply with NSF Standard 7, the area above the unit cooler must be sealed or exposed in such a way to facilitate hand

cleaning without the use of tools. When lagging or bolting the unit flush to the ceiling, seal the joint between the top and the ceiling with an NSF listed sealant and ends of open hanger channels must be sealed to prevent accumulation of foreign matter.

When locating unit coolers in a cooler or freezer, refer to Figures 1 through 4 for guidelines.

NOTE: Always avoid placement of Unit Coolers direct above doors and door openings.

Figure 4. Large Coolers and Freezers Placement.



Defrost Troubleshooting

Fan Motor

If the motor does not operate or it cycles on thermal overload, remove motor leads from terminal block and apply correct voltage across the leads. If motor still does not operate satisfactorily, it must be replaced. Before starting the unit, rotate fan blades to make sure they turn freely and have sufficient clearance.

Fan Delay & Defrost Termination Control

This control is a single pole double throw switch. The red lead wire is wired to common. The black wire is wired in series with the fan motors. The brown wire is wired in series with the defrost termination solenoid in the timer. The brown and red contacts close and the black and red contacts open when the temperature is above 55°F. The black and red contacts close and the brown and red contacts open when the temperature is below 35°F.

On initial "pull down" of a warm box the fan will not start until the coil temperature reaches approximately 35°F. If the box is still comparatively warm (60°F) when the fan starts, then blowing this warm air over the coil may cause it to warm up to 55°F and thus stop the fan. Therefore, the fan may recycle on initial "pull down." This control cannot be adjusted.

If the fan motor fails to start when the control is below 35°F, disconnect the fan motor leads and check the motor as described for fan motors. Also check whether current is being supplied at "N" and "4" from the timer. The fan delay control must be below 35°F when checking for a closed circuit.

Defrost Heater

If unit shows very little or no defrosting and does not heat, disconnect heater and check to find if it is burned out. To test, apply correct voltage across heater or use continuity flashlight battery tester.

Drain Pan

If drain pan has an ice build-up, drain line may be frozen. The drain line should be pitched sharply and exit cabinet as quickly as possible. Sometimes location and ambient at the drain outside of cabinet may cause freeze-up. A drain line heater may be required to correct the freeze-up. Any traps in the drain line must be located in a **warm ambient**.

Field Wiring

The field wiring should enter the areas as provided on the unit. The wiring diagram for each unit is located on the inside of the electrical panel door. All field wiring should be done in a professional manner and in accordance with all governing codes. Before operating unit, double check all wiring connections, including the factory terminals. Factory connections can vibrate loose during shipment.

1. The serial data tag on the unit is marked with the electrical characteristics for wiring the unit.
2. Consult the wiring diagram in the unit cooler and in the condensing unit for proper connections.
3. Wire type should be of copper conductor only and of the proper size to handle the connected load.
4. The unit must be grounded.
5. For multiple evaporator systems, the defrost termination controls should be wired in series. Follow the wiring diagrams for multiple evaporator systems carefully. This will assure complete defrost of all evaporators in the system.
6. Multiple evaporator systems should operate off of one thermostat.
7. If a remote defrost timer is to be used, the timer should be located outside the refrigerated space.

WARNING: All wiring must be done in accordance with applicable codes and local ordinances.

Condensate Drain Lines

Either copper or steel drain lines should be used and properly protected from freezing. In running drain lines, provide a minimum 1/4 inch per foot pitch for proper drainage. Drain lines should be at least as large as the evaporator drain connection. All plumbing connections should be made in accordance with local plumbing codes. All condensate drain lines must be trapped, and run to an open drain. They must never be connected directly to the sewer system. Traps in the drain line must be located in a warm ambient. We recommend a trap on each evaporator drain line prior to any tee connections. Traps located outside, or extensive outside runs of drain line must be wrapped with a drain line heater. The heater should be connected so that it operates continuously. It is recommended that the drain line be insulated to prevent heat loss. A heat input of 20 watts per linear foot of drain line for 0°F (-18°C) room applications and 30 watts per linear foot for -20°F (-29°C) rooms is satisfactory. In freezers, the evaporator drain pan fitting should be included when heating and insulating the drain line.

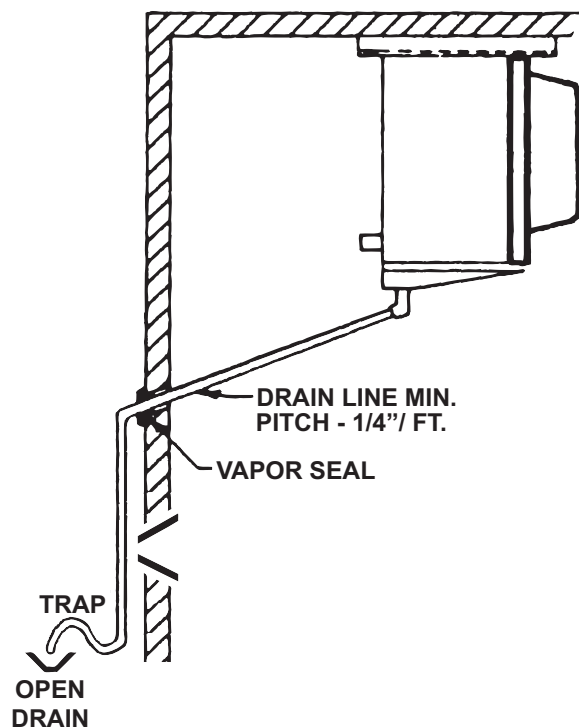
Inspect drain pan periodically to insure free drainage of condensate. If drain pan contains standing water, check for proper installation. The drain pan should be cleaned regularly with warm soapy water.

WARNING: All power must be disconnected before cleaning. Drain pan also serves as cover of hazardous moving parts. Operation of unit without drain pan constitutes a hazard.

Traps on low temperature units must be outside of refrigerated enclosures. Traps subject to freezing temperatures must be wrapped with heat tape and insulated.

NOTE: Always trap single evaporator system drain lines individually to prevent humidity migration.

Figure 5. Condensate Drain Lines



Check Out and Start Up

NOTE: All adjustable controls and valves must be field adjusted to meet desired operation. There are no factory preset controls or valve adjustments. This includes low pressure, high pressure, adjustable head pressure systems and expansion valves.

After the installation has been completed, the following points should be covered before the system is placed in operation:

- Check all electrical and refrigerant connections. Be sure they are all tight.
- Check the room thermostat for normal operation and adjust.
- Wiring diagrams, instruction bulletins, etc. attached to the condensing units should be read and filed for future reference.
- All fan motors on evaporators should be checked for proper rotation. Fan motor mounts should be carefully checked for tightness and proper alignment.
- Electric and hot gas evaporator fan motors should be temporarily wired for continuous operation until the room temperature has stabilized.
- Do not leave unit unattended until the system has reached normal operating conditions and the oil charge has been properly adjusted to maintain the oil level between 1/4 and bottom of the sight glass.
- Make sure all Schrader valve caps are in place and tight.

Operational Check Out

After the system has been charged and has operated for at least two hours at normal operating conditions without any indication of malfunction, it should be allowed to operate overnight on automatic controls. Then a thorough recheck of the evaporator operation should be made as follows:

- Check liquid line sight glass and expansion valve operation. If there are indications that more refrigerant is required, leak test all connections and system components and repair any leaks before adding refrigerant.
- Thermostatic expansion valves must be checked for proper superheat settings. Feeler bulbs must be in positive contact with the suction line and should be insulated. Valves set at high superheat will lower refrigeration capacity. Low superheat promotes liquid slugging and compressor bearing washout.
- Check defrost controls for initiation and termination settings, and length of defrost period. Set fail safe at length of defrost + 25%.
Example: 20 minute defrost + 5 minutes = 25 minute fail safe
- Check drain pan for proper drainage.
- Install instruction card and control system diagram for use of building manager or owner.

Evaporator Superheat

Check Your Superheat. After the box temperature has reached or is close to reaching the desired temperature, the evaporator superheat should be checked and adjustments made if necessary. Generally, systems with a design TD of 10°F should have a superheat value of 6° to 10°F for maximum efficiency. For systems operating at higher TD's, the superheat can be adjusted to 12° to 15° F as required.

NOTE: Minimum compressor suction superheat of 20°F may override these recommendations on some systems with short line runs.

To properly determine the superheat of the evaporator, the following procedure is the method Heatcraft recommends:

WARNING: If the condensing unit has no flooded condenser head pressure control, the condensing unit must have the discharge pressure above the equivalent 105°F condensing pressure.

1. Measure the temperature of the suction line at the point the bulb is clamped.
2. Obtain the suction pressure that exists in the suction line at the bulb location by either of the following methods:
 - a. A gauge in the external equalized line will indicate the pressure directly and accurately.
 - b. A gauge directly in the suction line near the evaporator or directly in the suction header of the evaporator will yield the same reading as 2a above.
3. Convert the pressure obtained in 2a or 2b above to saturated evaporator temperature by using a temperature-pressure chart.
4. Subtract the saturated temperature from the actual suction line temperature. The difference is Superheat.

Figure 6. Bulb and Contact Location

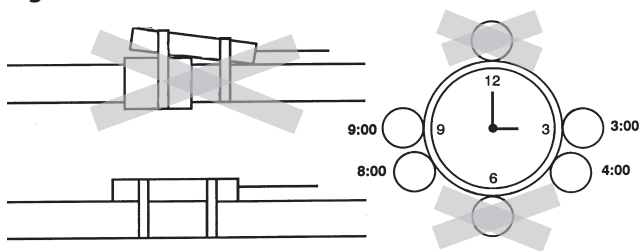
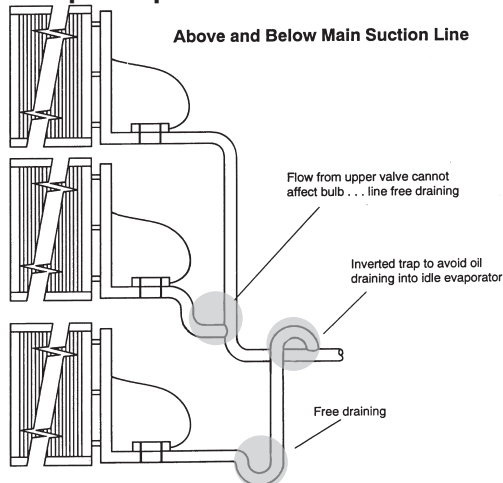


Figure 7. Multiple Evaporators



Alternative Superheat Method

The most accurate method of measuring superheat is found by following the previous procedure, Temperature/Pressure method. However, that method may not always be practical. An alternative method which will yield fairly accurate results is the temperature / temperature method:

1. Measure the temperature of the suction line at the point the bulb is clamped (outlet).
2. Measure the temperature of one of the distributor tubes close to the evaporator coil (inlet).
3. Subtract the inlet temperature from the outlet temperature. The difference is Superheat.

This method will yield fairly accurate results as long as the pressure drop through the evaporator coil is low.

Slim Contour Exclusive Information

The Slim Contour has several exclusive features that improve the servability.

Cassette Removal/Replacement

Removal of modular cassettes in the Slim Contour improve access and the speed required to service the unit cooler.

1. Turn off electrical feed to the unit.
2. Remove the fan guard (2 Screws).
3. Remove screws from modular cassette and pull cassette forward, but do not fully remove cassette. (Figure 8)
4. With the cassette slightly removed, reach behind the cassette and unplug wired connection. This will separate the cassette from unit cooler. (Figure 9)
5. Once the cassette has been removed from the unit cooler, the cassette can be stored on the unit by using the service clip feature. (Figure 10)
6. To reinstall cassette, reconnect plug and slide cassette back into place. Re-secure the cassette by placing screws in place.

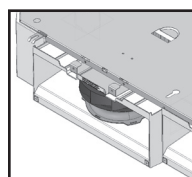


Figure 8.
Cassette Removal (Step 3)

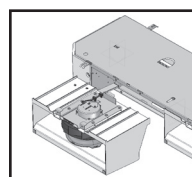


Figure 9.
Cassette Removal (Step 4)

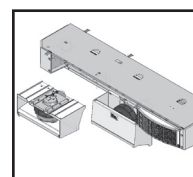


Figure 10.
Cassette Removal (Step 5)

Service Clip Feature

The Slim Contour features a service clip on all of its modular cassettes. The service clip is exclusive to Slim Contour cassettes and is designed to improve the servability of the unit cooler. The service clip features two separate hooks that can be used to aide in common maintenance.

The service clip that is featured on top of the cassettes motor can be used to suspend the cassette while being removed to assist in removing the power connection of the cassette (Figure 11.). The Slim Contour cassette also can be suspended from the drain pan using the screw mounts (Figure 12.)

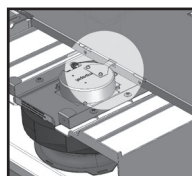


Figure 11.
Service Clip (Feature 1)

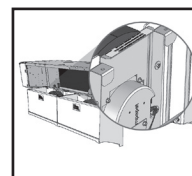


Figure 12.
Service Clip (Feature 2)

Table 1. Expansion Valve Selection For 100# Head Pressure Valve

BTUH at about 10° T.D.	R-507/R404A		R-507/R404A		R-22		R-22	
	-20°F/-29°C Evap.		+25°F/-4°C Evap.		-20°F/-29°C Evap.		+25°F/-4°C Evap.	
	Sporlan	ALCO	Sporlan	ALCO	Sporlan	ALCO	Sporlan	ALCO
3,000-5,000	EGSE 1/2 ZP	HFESC-1/2-RZ	EGSE 1/2 C	HFESC-1/2-RC	EGVE 1/2 Z	HFESC-1-HZ	EGVE 1/2 C	HFESC-1/2-HC
5,500-7,000	EGSE 1/2 ZP	HFESC-1/2-RZ	EGSE 1 C	HFESC-1/2-RC	EGVE 1 ZP	HFESC-1-HZ	EGVE 1 C	HFESC-1-HC
7,500-8,000	EGSE 1 ZP	HFESC-1/2-RZ	EGSE 1 C	HFESC-1-RC	EGVE 1 ZP	HFESC-1 1/2-HZ	EGVE 1 C	HFESC-1-HC
8,500-10,000	EGSE 1 ZP	HFESC-1-RZ	EGSE 1 1/2 C	HFESC-1 1/4-RC	EGVE 1 1/2 ZP	HFESC-1 1/2-HZ	EGVE 1 C	HFESC-1-HC
10,500-11,000	EGSE 1 ZP	HFESC-1 1/4-RZ	EGSE 1 1/2 C	HFESC-1 1/4-RC	EGVE 1 1/2 ZP	HFESC-2-HZ	EGVE 1 1/2 C	HFESC-1-HC
11,500-13,000	EGSE 1 1/2 ZP	HFESC-1 1/2-RZ	EGSE 1 1/2 C	HFESC-1 1/4-RC	EGVE 1 1/2 ZP	HFESC-2-HZ	EGVE 1 1/2 C	HFESC-1-HC
13,500-15,000	EGSE 1 1/2 ZP	HFESC-2-RZ	EGSE 2 C	HFESC-1 1/2-RC	EGVE 2 ZP	HFESC-2 1/2-HZ	EGVE 1 1/2 C	HFESC-2-HC
15,500-17,000	EGSE 2 ZP	HFESC-2-RZ	EGSE 2 C	HFESC-2-RC	EGVE 2 ZP	HFESC-2 1/2-HZ	EGVE 2 C	HFESC-2-HC
17,500-20,000	EGSE 2 ZP	HFESC-3 1/2-RZ	SSE 3 C	HFESC-2-RC	EGVE 3 ZP	HFESC-3-HZ	EGVE 2 C	HFESC-2 1/2-HC
20,500-24,000	SSE 3 ZP	HFESC-3 1/2-RZ	SSE 3 C	HFESC-3-RC	SVE 3 ZP	HFESC-3-HZ	SVE 3 C	HFESC-3-HC
24,500-28,000	SSE 3 ZP	HFESC-3 1/2-RZ	SSE 4 C	HFESC-3-RC	SVE 4 ZP	HFESC-5 1/2-HZ	SVE 3 C	HFESC-3-HC
28,500-34,000	SSE 4 ZP	HFESC-5-RZ	SSE 4 C	HFESC-3-RC	SVE 5 ZP	HFESC-5 1/2-HZ	SVE 4 C	HFESC-5 1/2-HC
34,500-40,000	OSE 6 ZP	HFESC-5-RZ	SSE 6 C	HFESC-5-RC	SVE 8 ZP	HFESC-5 1/2-HZ	SVE 4 C	HFESC-5 1/2-HC
40,500-50,000	OSE 8 ZP	HFESC-7-RZ	OSE 8 C	HFESC-5-RC	SVE 10 ZP	HFESC-8-HZ	SVE 5 C	HFESC-5 1/2-HC
50,500-60,000	OSE 9 ZP	HFESC-10-RZ	OSE 9 C	HFESC-7-RC	SVE 10 ZP	HFESC-8-HZ	SVE 8 C	HFESC-8-HC
60,500-70,000	OSE 9 ZP	HFESC-10-RZ	OSE 9 C	HFESC-10-RC	OVE 15 ZP	HFESC-10-HZ	SVE 8 C	HFESC-8-HC
70,500-80,000	OSE 12 ZP	HFESC-10-RZ	OSE 12 C	HFESC-10-RC	OVE 15 ZP	HFESC-15-HZ	SVE 10 C	HFESC-10-HC
80,500-90,000	OSE 12 ZP	HFESC-13-RZ	OSE 12 C	HFESC-10-RC	OVE 15 ZP	HFESC-15-HZ	SVE 10 C	HFESC-10-HC
90,500-100,000	OSE 12 ZP	HFESC-13-RZ	OSE 12 C	HFESC-13-RC	OVE 15 ZP	HFESC-15-HZ	OVE 15 C	HFESC-15-HC
100,500-110,000	OSE 21 ZP	TRAE-20-RZ	OSE 21 C	HFESC-13-RC	OVE 20 ZP	HFESC-20-HZ	OVE 15 C	HFESC-15-HC
110,500-120,000	OSE 21 ZP	TRAE-20-RZ	OSE 21 C	HFESC-13-RC	OVE 20 ZP	HFESC-20-HZ	OVE 15 C	HFESC-15-HC
120,500-130,000	OSE 21 ZP	TRAE-20-RZ	OSE 21 C	TRAE-20-RC	OVE 20 ZP	HFESC-20-HZ	OVE 15 C	HFESC-15-HC

NOTES:

1. Valve selections assume standard conditions and 100°F vapor-free liquid.
2. Equivalent valve may be used in place of selection.
3. For "Medium Temp R-507," valve designation will use "P" for refrigerant code.

Table 2. Expansion Valve Selection 180# Head Pressure Valve

BTUH at about 10° T.D.	R-507/R404A		R-507/R404A		R-22		R-22	
	-20°F/-29°C Evap.		+25°F/-4°C Evap.		-20°F/-29°C Evap.		+25°F/-4°C Evap.	
	Sporlan	ALCO	Sporlan	ALCO	Sporlan	ALCO	Sporlan	ALCO
3,000-5,000	EGSE 1/2 ZP	HFESC-1/2-RZ	EGSE 1/2 C	HFESC-1/2-RC	EGVE 1/2 ZP	HFESC-1/2-HZ	EGVE 1/2 C	HFESC-1/2-HC
5,500-7,000	EGSE 1/2 ZP	HFESC-1-RZ	EGSE 1 C	HFESC-1/2-RC	EGVE 1 ZP	HFESC-1-HZ	EGVE 1/2 C	HFESC-1-HC
7,500-8,000	EGSE 1 ZP	HFESC-1-RZ	EGSE 1 C	HFESC-1/2-RC	EGVE 1 ZP	HFESC-1-HZ	EGVE 1 C	HFESC-1-HC
8,500-10,000	EGSE 1 ZP	HFESC-1-RZ	EGSE 1 C	HFESC-1-RC	EGVE 1 1/2 ZP	HFESC-1 1/2-HZ	EGVE 1 C	HFESC-1-HC
10,500-11,000	EGSE 1 ZP	HFESC-1 1/4-RZ	EGSE 1 1/2 C	HFESC-1-RC	EGVE 1 1/2 ZP	HFESC-1 1/2-HZ	EGVE 1 C	HFESC-1-HC
11,500-13,000	EGSE 1 1/2 ZP	HFESC-1 1/4-RZ	EGSE 1 1/2 C	HFESC-1 1/4-RC	EGVE 1 1/2 ZP	HFESC-2-HZ	EGVE 1 C	HFESC-1 1/2-HC
13,500-15,000	EGSE 2 ZP	HFESC-1 1/2-RZ	EGSE 1 1/2 C	HFESC-1 1/4-RC	EGVE 2 ZP	HFESC-2-HZ	EGVE 1 1/2 C	HFESC-1 1/2-HC
15,500-17,000	EGSE 2 ZP	HFESC-2-RZ	EGSE 2 C	HFESC-1 1/2-RC	EGVE 2 ZP	HFESC-2 1/2-HZ	EGVE 1 1/2 C	HFESC-1 1/2-HC
17,500-20,000	EGSE 2 ZP	HFESC-2-RZ	EGSE 2 C	HFESC-1 1/2-RC	EGVE 3 ZP	HFESC-2 1/2-HZ	EGVE 1 1/2 C	HFESC-2-HC
20,500-24,000	SSE 3 ZP	HFESC-3-RZ	SSE 3 C	HFESC-2-RC	SVE 3 ZP	HFESC-3-HZ	SVE 2 C	HFESC-2-HC
24,500-28,000	SSE 4 ZP	HFESC-3-RZ	SSE 3 C	HFESC-2-RC	SVE 4 ZP	HFESC-3-HZ	SVE 3 C	HFESC-2 1/2-HC
28,500-34,000	SSE 4 ZP	HFESC-5-RZ	SSE 4 C	HFESC-3 1/2-RC	SVE 4 ZP	HFESC-5 1/2-HZ	SVE 3 C	HFESC-3-HC
34,500-40,000	SSE 6 ZP	HFESC-5-RZ	SSE 6 C	HFESC-3 1/2-RC	SVE 5 ZP	HFESC-5 1/2-HZ	SVE 3 C	HFESC-3-HC
40,500-50,000	OSE 9 ZP	HFESC-7-RZ	SSE 6 C	HFESC-3 1/2-RC	SVE 8 ZP	HFESC-5 1/2-HZ	SVE 4 C	HFESC-5 1/2-HC
50,500-60,000	OSE 9 ZP	HFESC-7-RZ	OSE 9 C	HFESC-5-RC	SVE 10 ZP	HFESC-8-HZ	SVE 5 C	HFESC-5 1/2-HC
60,500-70,000	OSE 9 ZP	HFESC-10-RZ	OSE 9 C	HFESC-7-RC	OVE 15 ZP	HFESC-8-HZ	SVE 5 C	HFESC-5 1/2-HC
70,500-80,000	OSE 12 ZP	HFESC-10-RZ	OSE 12 C	HFESC-7-RC	OVE 15 ZP	HFESC-10-HZ	SVE 8 C	HFESC-8-HC
80,500-90,000	OSE 12 ZP	HFESC-10-RZ	OSE 12 C	HFESC-10-RC	OVE 15 ZP	HFESC-10-HZ	SVE 8 C	HFESC-8-HC
90,500-100,000	OSE 12 ZP	HFESC-13-RZ	OSE 12 C	HFESC-10-RC	OVE 15 ZP	HFESC-15-HZ	SVE 10 C	HFESC-8-HC
100,500-110,000	OSE 12 ZP	HFESC-13-RZ	OSE 12 C	HFESC-10-RC	OVE 20 ZP	HFESC-15-HZ	SVE 10 C	HFESC-10-HC
110,500-120,000	OSE 12 ZP	HFESC-13-RZ	OSE 12 C	HFESC-10-RC	OVE 20 ZP	HFESC-15-HZ	SVE 10 C	HFESC-10-HC
120,500-130,000	OSE 21 ZP	HFESC-13-RZ	OSE 12 C	HFESC-13-RC	OVE 20 ZP	HFESC-15-HZ	OVE 15 C	HFESC-10-HC

Table 3. Evaporator Troubleshooting Chart

SYMPTOMS	POSSIBLE CAUSES	POSSIBLE CORRECTIVE STEPS
Fan(s) will not operate.	1. Main switch open. 2. Blown fuses. 3. Defective motor. 4. Defective timer or defrost thermostat. 5. Unit in defrost cycle. 6. Coil does not get cold enough to reset thermostat.	1. Close switch. 2. Replace fuses. Check for short circuits or overload conditions. 3. Replace motor. 4. Replace defective component. 5. Wait for completion of cycle. 6. Adjust fan delay setting of thermostat. See Defrost Thermostat Section of this bulletin.
Room temperature too high.	1. Room thermostat set too high. 2. Superheat too high. 3. System low on refrigerant. 4. Coil iced-up. 5. Unit cooler located too close to doors. 6. Heavy air infiltration.	1. Adjust thermostat. 2. Adjust thermal expansion valve. 3. Add refrigerant. 4. Manually defrost coil. Check defrost controls for malfunction. 5. Relocate unit cooler or add strip curtain to door opening. 6. Seal unwanted openings in room.
Ice accumulating on ceiling around evaporator and/or on fan guards venturi or blades.	1. Defrost duration is too long. 2. Fan delay not delaying fans after defrost period. 3. Defective defrost thermostat or timer. 4. Too many defrosts.	1. Adjust defrost termination thermostat. 2. Defective defrost thermostat or not adjusted properly. 3. Replace defective component. 4. Reduce number of defrosts.
Coil not clearing of frost during defrost cycle.	1. Coil temperature not getting above freezing point during defrost. 2. Not enough defrost cycles per day. 3. Defrost cycle too short. 4. Defective timer or defrost thermostat.	1. Check heater operation. 2. Adjust timer for more defrost cycles. 3. Adjust defrost thermostat or timer for longer cycle. 4. Replace defective component.
Ice accumulating in drain pan	1. Defective heater. 2. Unit not pitched properly. 3. Drain line plugged. 4. Defective drain line heater. 5. Defective timer or thermostat.	1. Replace heater. 2. Check and adjust if necessary. 3. Clean drain line. 4. Replace heater. 5. Replace defective component.
Uneven coil frosting	1. Defective heater. 2. Located too close to door or opening. 3. Defrost termination set too low. 4. Incorrect or missing distributor nozzle.	1. Replace heater. 2. Relocate evaporator. 3. Adjust defrost termination setting higher. 4. Add or replace nozzle with appropriately sized orifice for conditions.

Replacement Parts by Commercial Refrigeration Parts

InterLink is your link to a complete line of dependable and certified commercial refrigeration parts, accessories and innovative electronic controls for all Heatcraft Refrigeration Products (HRP) brands - including Bohn, Larkin, Climate Control and Chandler. At InterLink, we provide our wholesalers with a comprehensive selection of product solutions and innovative technologies for the installed customer base. And every product is built to ensure the same high performance standards with which all HRP brands are built — backed by a dedicated team to serve every customer need, delivering at the best lead times in the industry.

Replacement parts should be obtained from your local InterLink wholesaler. Replacement parts, which are covered under the terms of the warranty statement on page 2 of this manual, will be reimbursed for total part cost only. The original invoice from the parts supplier must accompany all warranty claims for replacement part reimbursement. Heatcraft Refrigeration Products reserves the right to adjust the compensation amount paid on any parts submitted for warranty reimbursement when a parts supplier's original invoice is not provided with a claim. **For more information, call 800-686-7278 or visit www.interlinkparts.com.**

For more detailed information on the following topics, please visit <http://heatcraftprd.com/service/publibrary.asp> for our complete Refrigeration Systems Installation and Operation Manual (H-IM-64L).

Defrost Thermostat
Expansion Valves & Nozzles
Refrigerant Oils
Recommended Refrigerant Piping Practices
Line Sizing Charts
Hot Gas Defrost Systems
Evacuation and Leak Detection

Refrigerant Charging Instructions
System Balancing — Compressor Superheat
General Sequence and Operation
Troubleshooting Guides
Preventive Maintenance Guidelines
Typical Wiring Diagrams

Since product improvement is a continuing effort, we reserve the right to make changes in specifications without notice.

The name behind the brands you trust.™  Worldwide Refrigeration

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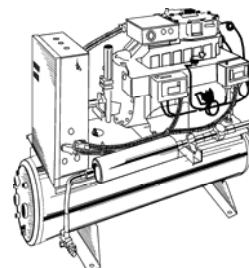
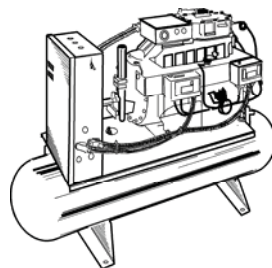
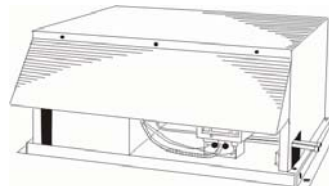
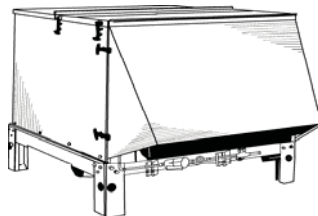
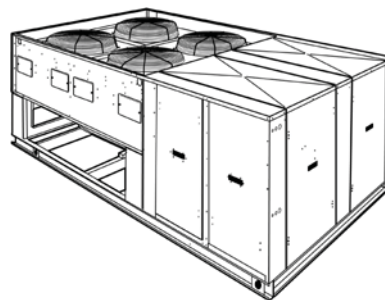
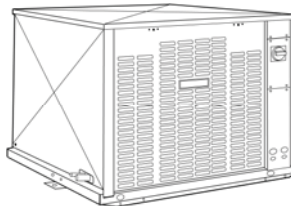
CHANDLER
REFRIGERATION

LARKIN

Installation and Maintenance Instructions

for

**Air-Cooled, Remote and Water-Cooled
Condensing Units**



National Refrigeration and Air Conditioning Canada Corp.,
159 Roy Blvd., P.O. Box 2020, Brantford, Ontario, N3T 5Y6
Phone: 800-463-9517, 519-751-0444 Fax: 519-753-1140
Visit our web site at www.keepriterefrigeration.com

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General Safety

IMPORTANT SAFETY NOTE

Only a qualified refrigeration mechanic who is familiar with refrigeration systems and components, including all controls should perform the installation and start-up of the system. To avoid potential injury, use care when working around coil surfaces (if applicable) or sharp edges of metal cabinets. All piping and electrical wiring should be installed in accordance with all applicable codes, ordinances and local by-laws.

WARNING

Always **disconnect and lock off** the main power supply on any system that will be worked on to avoid accidental start up of the equipment.

Inspection

Inspect all equipment before unpacking for visible signs of damage or loss. Check shipping list against material received to ensure shipment is complete.

IMPORTANT: Remember, you, the consignee, must make any claim necessary against the transportation company. Shipping damage or missing parts, when discovered at the outset, will prevent later unnecessary and costly delays. **If damage or loss during transport is evident, make claim to carrier, as this will be their responsibility, not that of the manufacturer.**

Should carton be damaged, but damage to equipment is not obvious, a claim should be filed for “concealed damage” with the carrier.

IMPORTANT: Check the **electrical ratings** on the unit to make sure they correspond to those ordered and to electrical power available at the job site. Save all shipping papers, tags, and instruction sheets for reference by installer and owner.

Handling, Placement and Installation

IMPORTANT: When selecting a location for the condensing unit, consideration should be given to some of the following:

- (a) Loading capacity of the floor or roof. Check building codes for weight distribution requirements.
- (b) Distance to suitable electrical supply.
- (c) Distance to the evaporator.
- (d) Adequate air circulation and ventilation.
- (e) Close proximity to water source and floor drains (water-cooled units)
- (f) Accessibility for maintenance.
- (g) Local building codes.
- (h) Adjacent buildings relative to noise levels.
- (i) Wishes of the end user / owner.

When all of the above points have been considered and a specific location chosen, it is advisable to obtain written approval of this location from the building and/or condensing unit owner. This may be a means of avoiding disagreement and expense at a later date.

A fully qualified and properly equipped crew with the necessary tackle and rigging should be engaged to locate the condensing unit in position. When lifting the unit, spreader bars and chafing gear should be used to prevent damage.

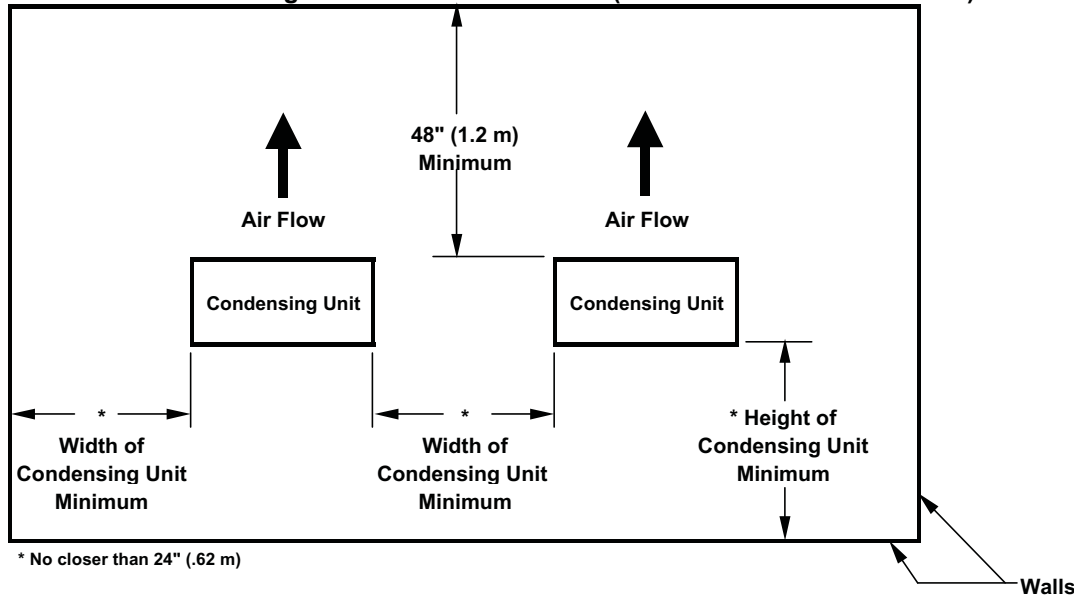
The unit should be placed on a base, which is level and even. Units should be lagged to sleepers or support base. Place unit where it will not be subject to damage by traffic or flooding. On critical installations where noise is liable to be transmitted through the floor structure, vibration isolators should be installed. Isolators should be installed under mounting base and may be rubber or cork or equal.

DO NOT USE THE SHIPPING SKID AS A PERMANENT BASE.

The condensing unit should be positioned to allow adequate space for performing service work.

Indoor and outdoor air-cooled condensing units should be positioned using the guidelines shown below.

Air Cooled Condensing Unit Minimum Clearance (for Horizontal Air Flow Units)

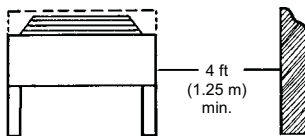


SPECIAL NOTE FOR LARGE AIR COOLED CONDENSING UNITS: Vertical flow air cooled condensing units are large and heavy pieces of mechanical equipment and must be handled as such. A fully qualified and properly equipped crew with the necessary tackle and rigging should be engaged to locate the condensing unit into location. The unit can be lifted by means of lifting holes located in the base frame of the unit. Spreader bars should be used to prevent damage to the sides of the unit. Do not sling directly around the base of unit. The unit should be placed on a base which is level and even.

Air Cooled Condensing Unit Minimum Clearance (For Vertical Air Flow Units)

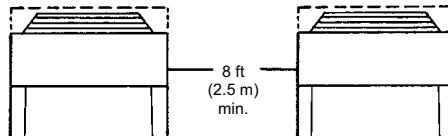
WALLS OR OBSTRUCTIONS

All sides of the unit must be a minimum of 4 feet (1.25 m) away from the wall or obstruction. Overhead obstructions are not permitted. If enclosed by three walls, the unit must be installed as indicated for units in a pit.



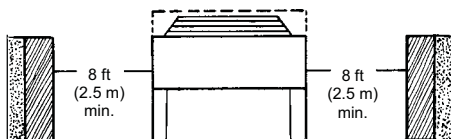
MULTIPLE UNITS

A minimum of 8 feet (2.5 m) is required between multiple units placed side by side. If placed end to end, the minimum distance between units is 4 feet (1.25 m).



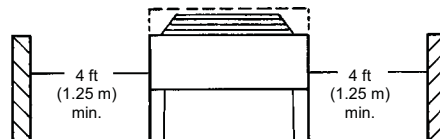
UNITS IN PITS:

The top of the unit must be level with, or above the top of the pit. In addition, a minimum of 8 feet (2.5 m) is required between the unit and the pit walls.



LOUVERS / FENCES:

Louvers/fences must have a minimum of 80% free area and 4 feet (1.25 m) minimum clearance between the unit and the louver/fence. Height of louver/fence must not exceed top of unit.



Units equipped with spring-mounted compressors have shipping spacers that are designed to hold the compressor rigidly during transit to prevent possible damage. Before operating the unit, it is necessary to remove these spacers. To remove the shipping spacers, follow these steps:

- Remove the upper nuts / washers.
- Discard the shipping spacers.
- Install the rubber cone washers (located in the electrical box).
- Replace the upper mounting nuts / washers.
- Allow 1/16 inch space between the mounting nuts / washers and the compressor foot.

On units equipped with rigid mounted compressors, check the compressor mounting bolts to insure they have not vibrated loose during shipping.

Ventilation

If the compressors or condensing units are to be located in machine rooms, adequate ventilation air must be provided in order to avoid an excessive temperature rise in the room. Air requirements vary with ambient air temperatures and the refrigeration load, however the following rule of thumb may be used to approximate ventilating air quantities:

Model Type	Air Quantity
Air-cooled condensing units (for horizontal air flow units)	1,000 cfm (472 L/s) per Hp
Air-cooled compressors (with remote condensers)	250 cfm (118 L/s) per Hp
Suction cooled or water-cooled compressors (with remote or water cooled condensers)	200 cfm (94 L/s) per Hp

All of the above mentioned air quantities are based on relatively short discharge line runs within the machine rooms. If using long uninsulated discharge line runs are unavoidable in the machine room, additional ventilation air is required to offset the heat added to the room by the discharge gas.

Electrical Information

WARNING

All wiring and connections to the unit must be made in accordance with national as well as local electrical codes and by-laws.

Electrical wiring should be sized in accordance with the minimum circuit ampacities shown on the unit nameplate and applicable electrical codes. The unit power connections are approved for copper wire only.

Connect the field power supply through a fused branch circuit disconnect switch. The entering service fuse must not exceed the maximum overcurrent protection (MOP) value on the unit data plate.

Field connected control circuit wires are terminated directly at the control circuit terminal block in accordance with the appropriate wiring diagram.

Voltage at the unit terminals must not vary more than the allowable variation during start-up and while under full load. If the voltage is normal at the supply with the compressor not running and drops considerably when the switch is closed and the motor is trying to start, there is a high resistance due to undersized wires or faulty connections. Voltage drop between inoperative and full load must not exceed 3% of line voltage. In addition, the phase imbalance at the motor terminals should be within 2% on three phase units.

60 Hz Supply		50 Hz Supply	
Power	Allowable Variation	Power	Allowable Variation
115-1-60	103-127 V	100-1-50	90-110 V
208/230-1-60	197-254 V	200/220-1-50	190-242 V
208/230-3-60	187-254 V	200/220-3-50	180-242 V
460-3-60	414-506 V	380/400-3-50	342-440 V
575-3-60	518-632 V		

All systems should use a liquid line solenoid valve (installed at the evaporator) and should be energized by the room or fixture thermostat. For systems with a defrost time clock, the liquid line solenoid and thermostat should be energized by the time clock. Initially set the defrost time clock (model 8145) as follows:

Air defrost evaporators; 3 per day (every 8 hours) with the time termination at 45 minutes.

Electric defrost evaporators; 4 per day (every 6 hours) with time termination set (Fail Safe) at 30 minutes. Check that the wiring from the defrost termination thermostat is wired to terminal "X" on the clock and terminates the defrost cycle when the evaporator coil reaches approximately 55 °F. The fan delay thermostat wiring should also be checked for proper operation. This ensures that all water droplets have been refrozen to the coil before the evaporator fan starts back up.

Note: The above settings are guidelines only and must be re-adjusted to suit local field conditions and actual evaporator equipment specifications.

Refer to the evaporator installation manual for further information.

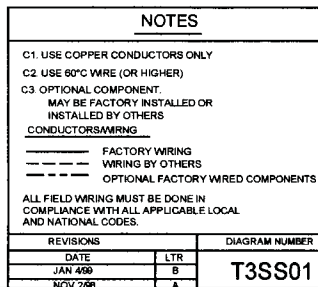
An evaporator airflow interlock is recommended on some installations so that the compressor will pump down and shut off in the event that the evaporator fan is off for any reason. This is wired into the control circuit in series with the thermostat and solenoid valve.

Refer to the following wiring diagrams for typical air defrost and electric defrost wiring arrangements.

WARNING

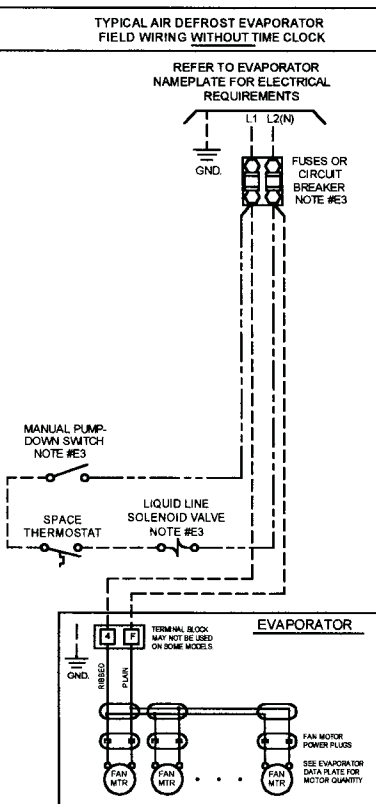
Any deviation or change to the electrical components or wiring as supplied on the original equipment, or noncompliance with the voltage and phase balance requirements without written authorization will void the warranty.

- 208-230/3/60 & 200-220/3/50
- STANDARD COMPRESSOR, UP TO 3 CYLINDER.
- STANDARD CONTROL CIRCUIT.



FOR KUCB, TLP, BA, TWB, TTW OR BTW SERIES
AIR DEFROST EVAPORATORS

NOTES



- E1. USE COPPER CONDUCTORS ONLY
- E2. USE 60°C WIRE (OR HIGHER)
- E3. OPTIONAL COMPONENT.
MAY BE FACTORY INSTALLED OR
SUPPLIED BY OTHERS.
- E5. OVERCURRENT PROTECTION FOR EACH
EVAPORATOR MUST NOT EXCEED MAXIMUM
VALUE SHOWN ON EVAPORATOR NAMEPLATES.
- E6. IF FAN POWER SAME VOLTAGE AS CONTROL
VOLTAGE WIRE TO 1 AND N
- ON TIME CLOCK.

TERMINALS

- - COMPONENT TERMINAL - MARKED
- - COMPONENT TERMINAL - UNMARKED
(IDENTIFIABLE BY LOCATION)
- - COMPONENT TERMINAL - UNMARKED
(UNIDENTIFIABLE)
- - TERMINAL BLOCK TERMINAL
- - WIRE SPLICED

CONDUCTORS/WIRING

- _____ FACTORY WIRING
 ----- WIRING BY OTHERS
 - - - - - OPTIONAL COMPONENT WIRING
 (SOME OPTIONAL COMPONENTS
 MAY BE FACTORY WIRE.)

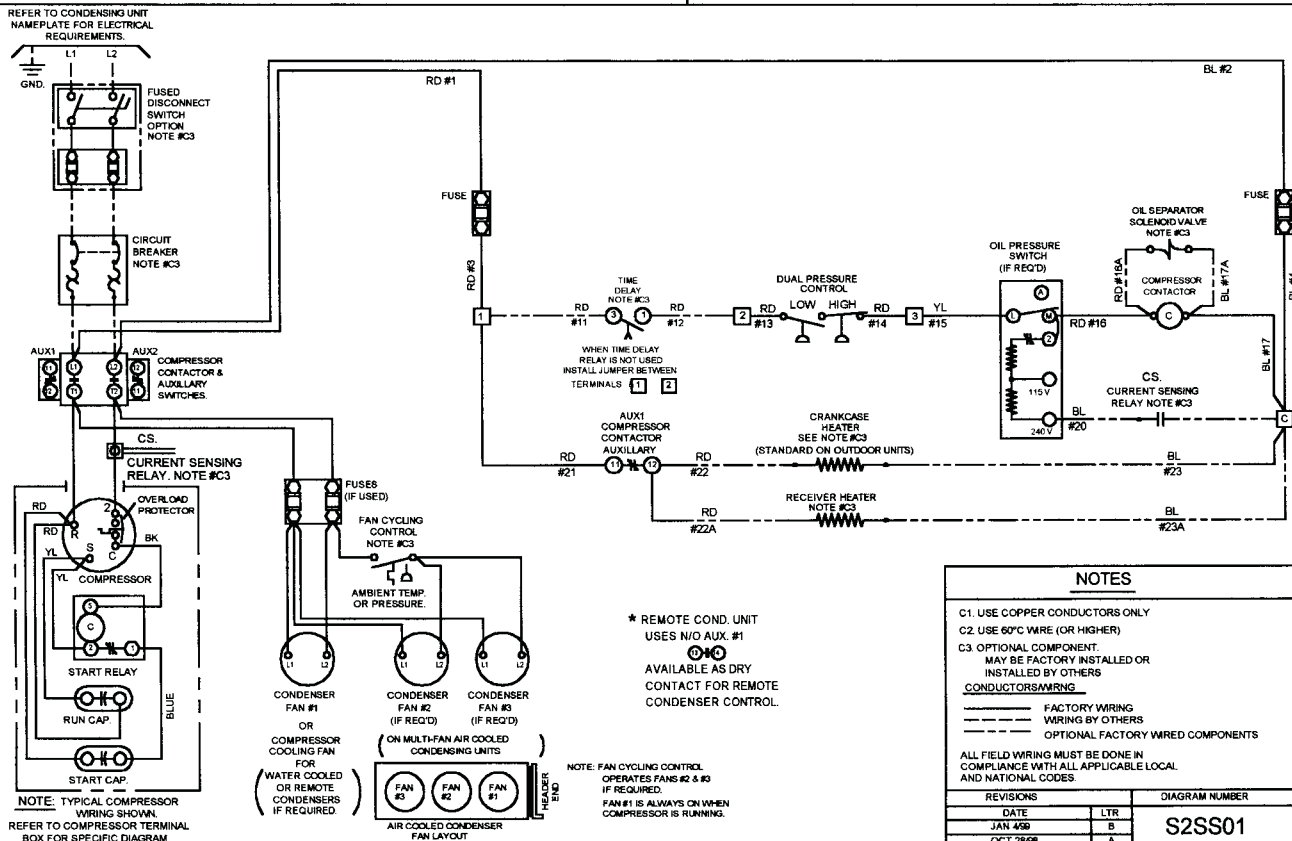
- ALL FIELD WIRING MUST BE DONE IN COMPLIANCE WITH ALL APPLICABLE LOCAL AND NATIONAL CODES.

REVISIONS		DIAGRAM NUMBER
DATE	LTR	KSA01
JULY 11/01	B	
NOV 1/98	A	

Electrical Wiring Diagram – Horizontal Air Flow Condensing Units (K-Line)

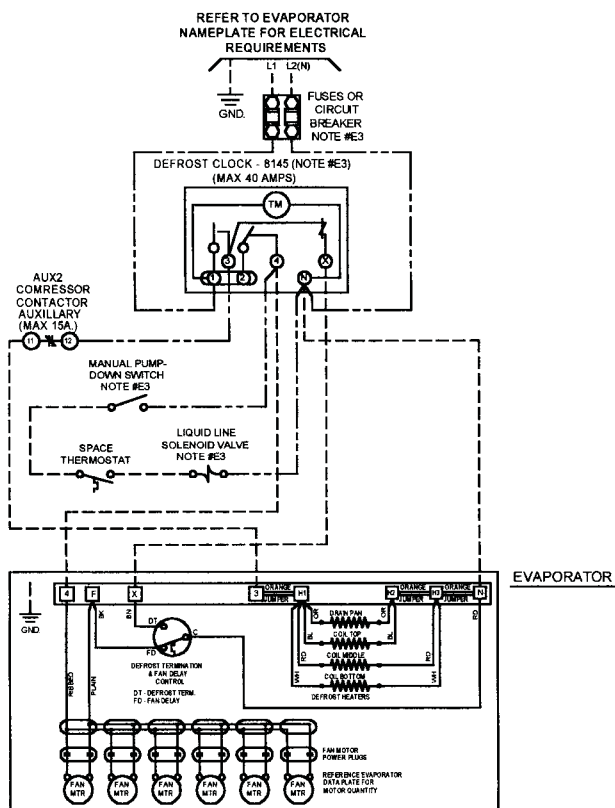
CONDENSING UNIT WIRING DIAGRAM

- 208-230/1/60 & 200-220/1/50
- STANDARD COMPRESSOR, UP TO 3 CYLINDER.
- STANDARD CONTROL CIRCUIT.



TYPICAL EVAPORATOR WIRING: FOR KUCB, TLP, OR BF SERIES, ELECTRIC DEFROST EVAPORATOR

WITH DEFROST TIME CLOCK / WITHOUT DEFROST CONTACTOR



NOTES

- E1) USE COPPER CONDUCTORS ONLY
- E2) USE 60°C WIRE (OR HIGHER)
- E3) OPTIONAL COMPONENT. MAY BE FACTORY INSTALLED OR SUPPLIED BY OTHERS.
- E4) HEATER LOADS ARE NOT CONCURRENT WITH REFRIGERATION LOADS.
- E5) OVERCURRENT PROTECTION FOR EACH EVAPORATOR MUST NOT EXCEED MAXIMUM VALUE SHOWN ON EVAPORATOR NAMEPLATES.

TERMINALS

- COMPONENT TERMINAL - MARKED
- COMPONENT TERMINAL - UNMARKED (IDENTIFIABLE BY LOCATION)
- COMPONENT TERMINAL - UNMARKED (UNIDENTIFIABLE)
- TERMINAL BLOCK TERMINAL
- WIRE SPLICE

CONDUCTORS/WIRING

- FACTORY WIRING
- WIRING BY OTHERS
- OPTIONAL COMPONENT WIRING (SOME OPTIONAL COMPONENTS MAY BE FACTORY WIRED)

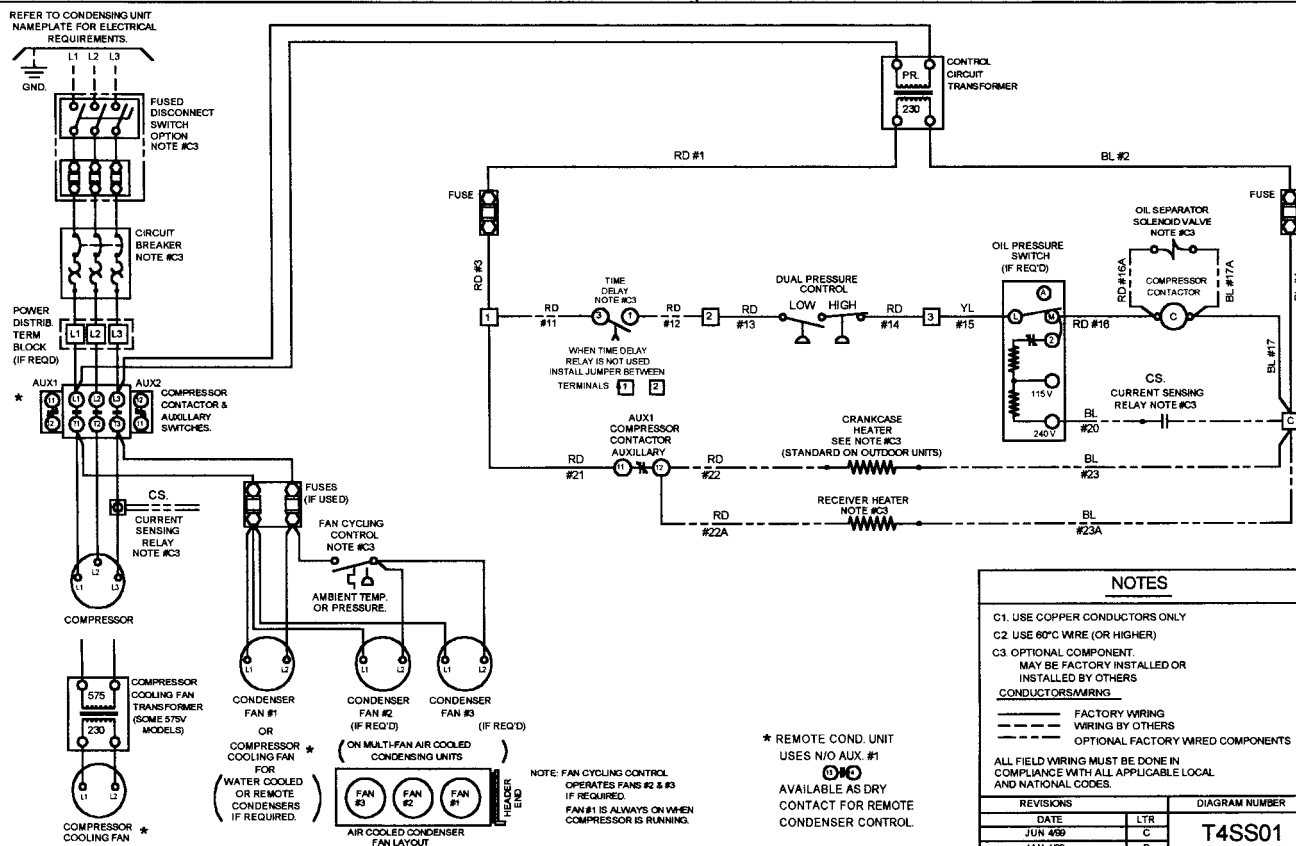
ALL FIELD WIRING MUST BE DONE IN COMPLIANCE WITH ALL APPLICABLE LOCAL AND NATIONAL CODES.

REVISIONS		DIAGRAM NUMBER
DATE	LTR	KSE01
NOV 1/98	A	

Electrical Wiring Diagram – Horizontal Air Flow Condensing Units (K-Line)

CONDENSING UNIT WIRING DIAGRAM

- 460/3/60, 575/3/60 or 380-400/3/50
- STANDARD COMPRESSOR, UP TO 3 CYLINDER.
- STANDARD CONTROL CIRCUIT.

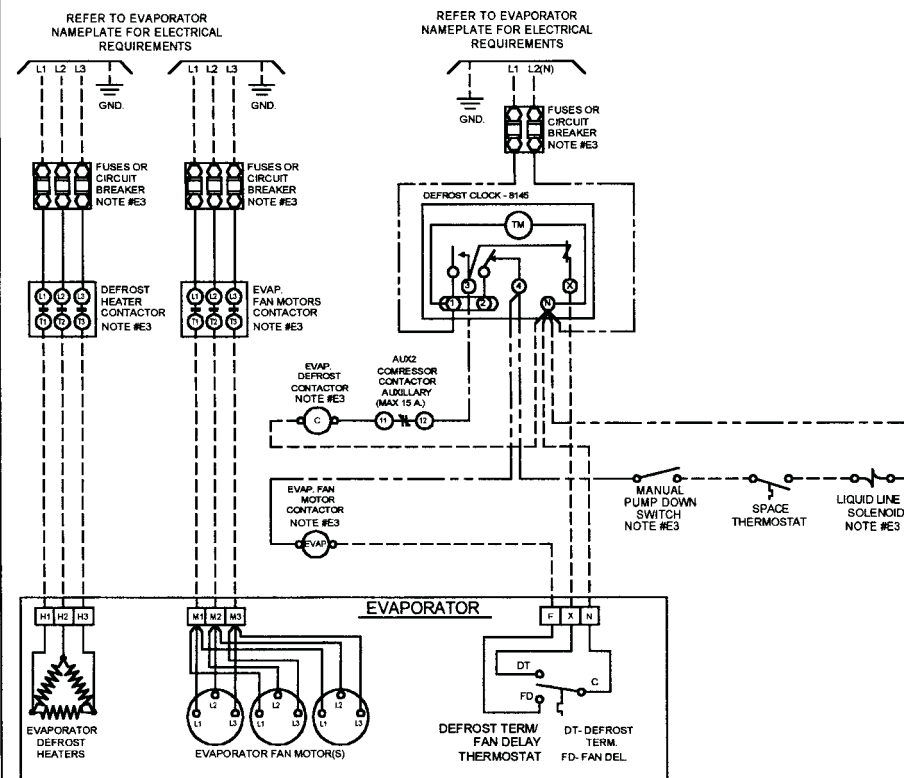


TYPICAL EVAPORATOR WIRING: JUCJ, JUCT OR BB SERIES ELECTRIC DEFROST EVAPORATOR

WITH DEFROST TIME CLOCK, EVAPORATOR FAN CONTACTOR AND DEFROST HEATER CONTACTOR.

NOTES

- E1) USE COPPER CONDUCTORS ONLY
- E2) USE 60°C WIRE (OR HIGHER)
- E3) OPTIONAL COMPONENT. MAY BE FACTORY INSTALLED OR SUPPLIED BY OTHERS.
- E4) HEATER LOADS ARE NOT CONCURRENT WITH REFRIGERATION LOADS.
- E5) OVERCURRENT PROTECTION FOR EACH EVAPORATOR MUST NOT EXCEED MAXIMUM VALUE SHOWN ON EVAPORATOR NAMEPLATES.

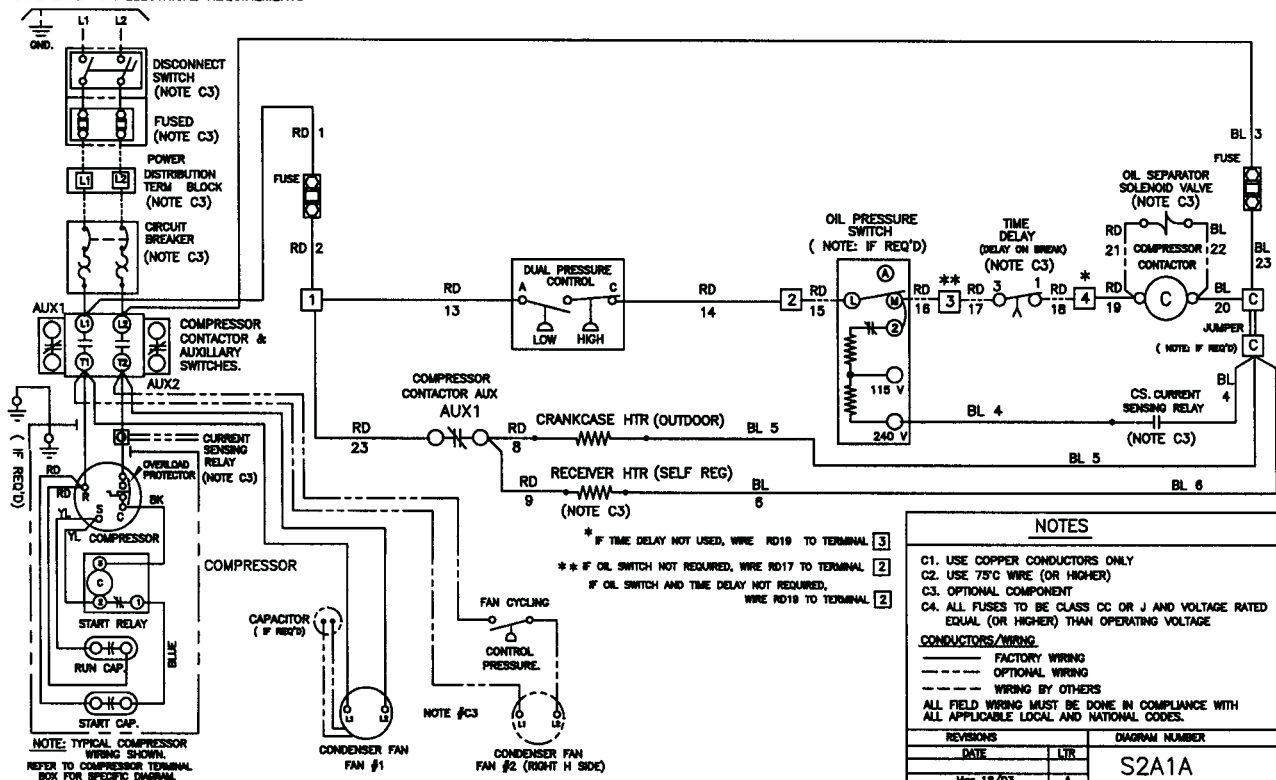


Electrical Wiring Diagram – Horizontal Air Flow Condensing Units (KE-Line)

CONDENSING UNIT WIRING DIAGRAM

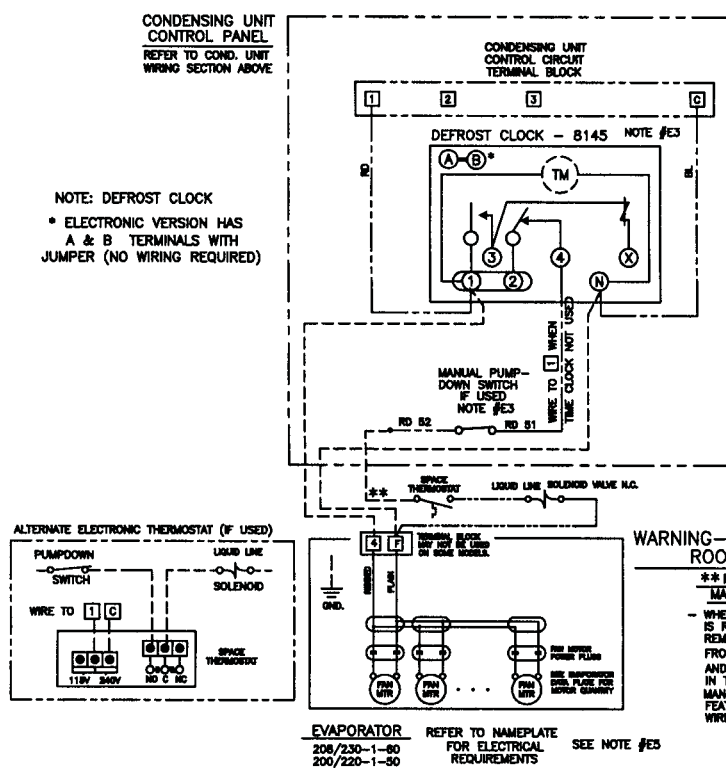
- 208/230V-1-60 or 200/220V-1-50 Hz
- INHERENT LINE BREAK MOTOR PROTECTION
- STANDARD CONTROL CIRCUIT

REFER TO CONDENSING UNIT NAMEPLATE FOR ELECTRICAL REQUIREMENTS



TYPICAL EVAPORATOR WIRING: FOR SINGLE AIR DEFROST EVAPORATOR- SINGLE POINT

FOR USE WITH: 208/230-1-60, 200/220-1-50 OR 208/230-3-60, 200/220-3-50 CONDENSING UNITS
WITH OR WITHOUT DEFROST TIME CLOCK AND FOR TOTAL EVAP FAN AMPS NOT EXCEEDING 12A



NOTES

- E1. USE COPPER CONDUCTORS ONLY
- E2. USE 75°C WIRE (OR HIGHER)
- E3. OPTIONAL COMPONENT. MAY BE FACTORY INSTALLED IN CONDENSING UNIT, OR SUPPLIED BY OTHERS.
- E5. OVERCURRENT PROTECTION FOR EVAPORATOR MUST NOT EXCEED MAXIMUM VALUE SHOWN ON EVAPORATOR NAMEPLATE.
- E6. ALL FUSES TO BE CLASS CC OR J AND VOLTAGE RATED EQUAL (OR HIGHER) THAN OPERATING VOLTAGE

TERMINALS

- - COMPONENT TERMINAL - MARKED
- - COMPONENT TERMINAL - UNMARKED (IDENTIFIABLE BY LOCATION)
- - COMPONENT TERMINAL - UNMARKED (UNIDENTIFIABLE)
- - TERMINAL BLOCK TERMINAL
- - WIRE SPLICE

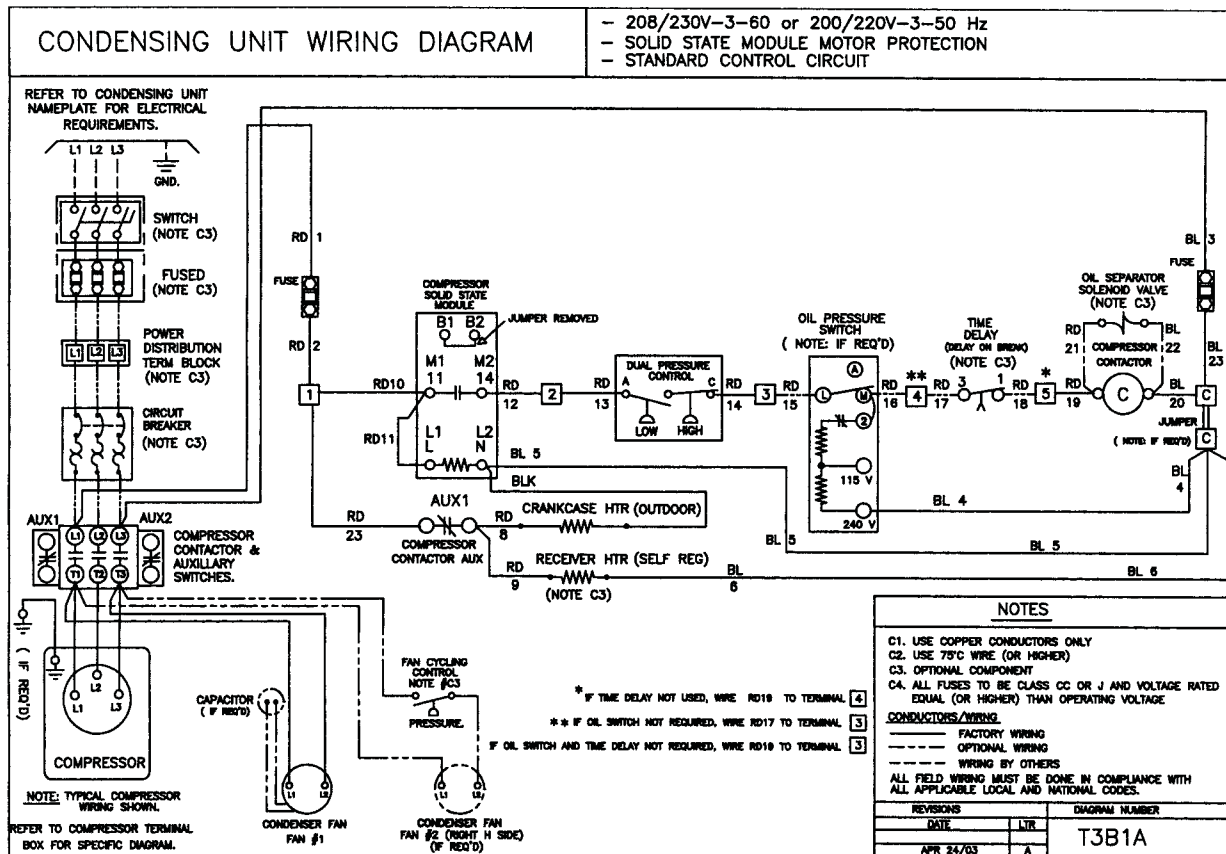
CONDUCTORS/WIRING

- FACTORY WIRING
- WIRING BY OTHERS
- OPTIONAL COMPONENT WIRING (SOME OPTIONAL COMPONENTS MAY BE FACTORY WIRING.)

ALL FIELD WIRING MUST BE DONE IN COMPLIANCE WITH ALL APPLICABLE LOCAL AND NATIONAL CODES.

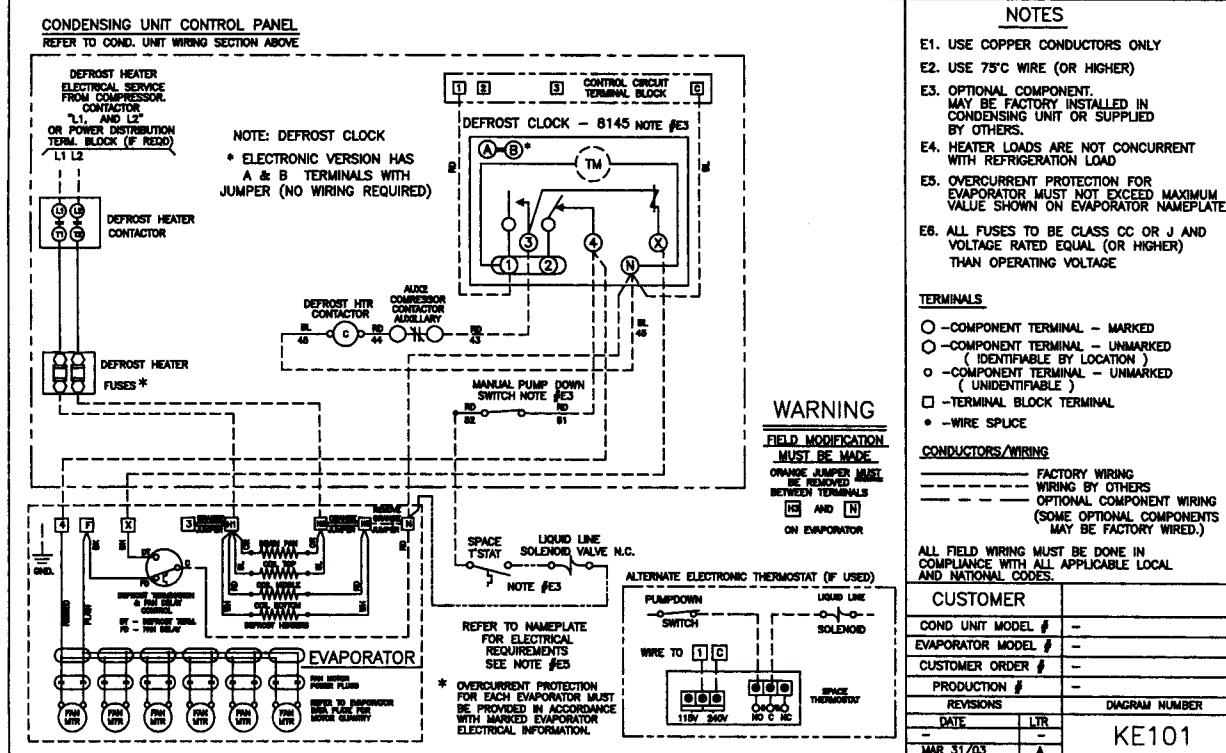
CUSTOMER	
COND UNIT MODEL #	-
EVAPORATOR MODEL #	-
CUSTOMER ORDER #	-
PRODUCTION #	-
REVISIONS	
DATE	LTR
MAR28/03	A
DIAGRAM NUMBER	
KA101	

Electrical Wiring Diagram – Horizontal Air Flow Condensing Units (KE-Line)

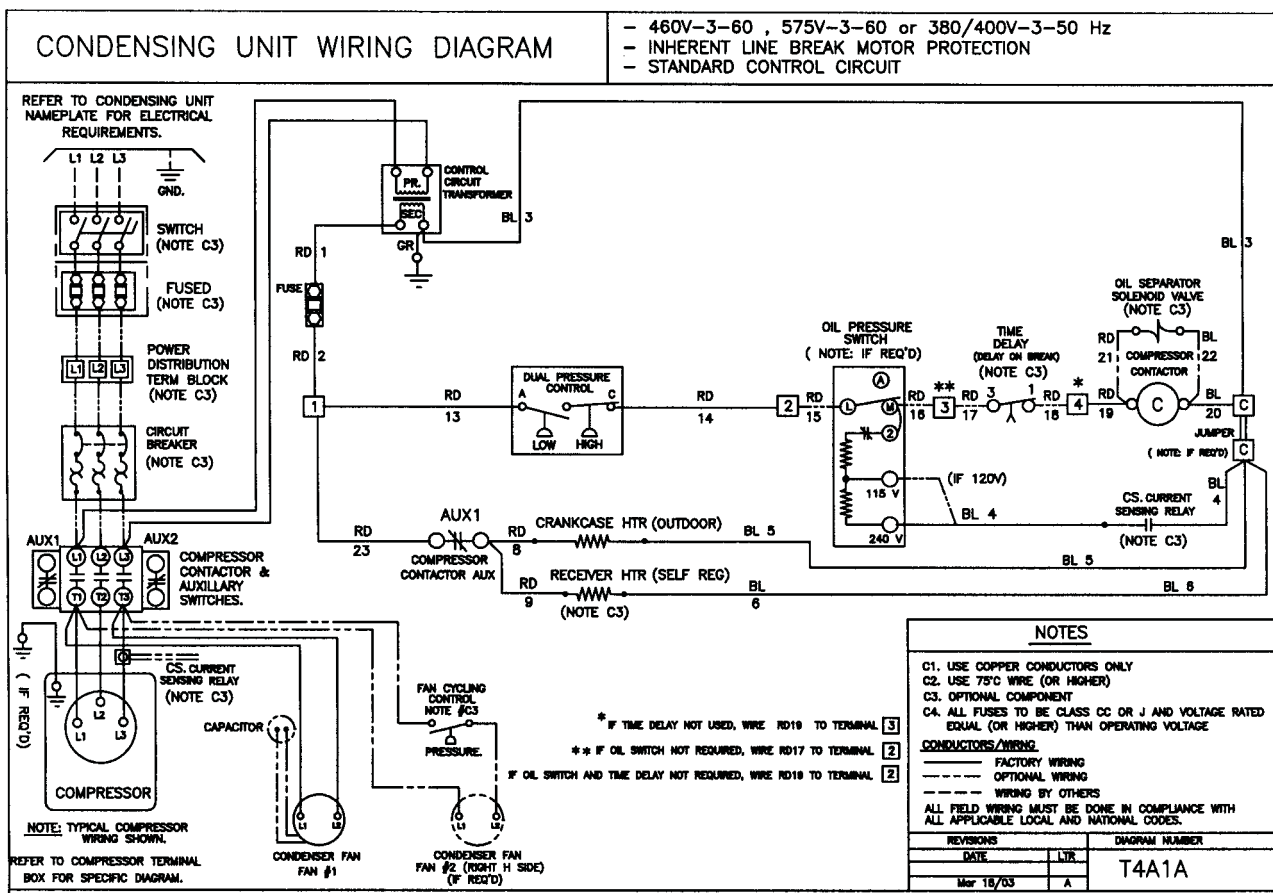


TYPICAL EVAPORATOR WIRING: FOR SINGLE LOW PROFILE ELECT DEFROST EVAPORATOR– SINGLE POINT

FOR USE WITH: 230v SINGLE OR THREE PHASE CONDENSING UNITS WITH DEFROST TIME CLOCK, AND DEF. HTR. CONTACTOR.

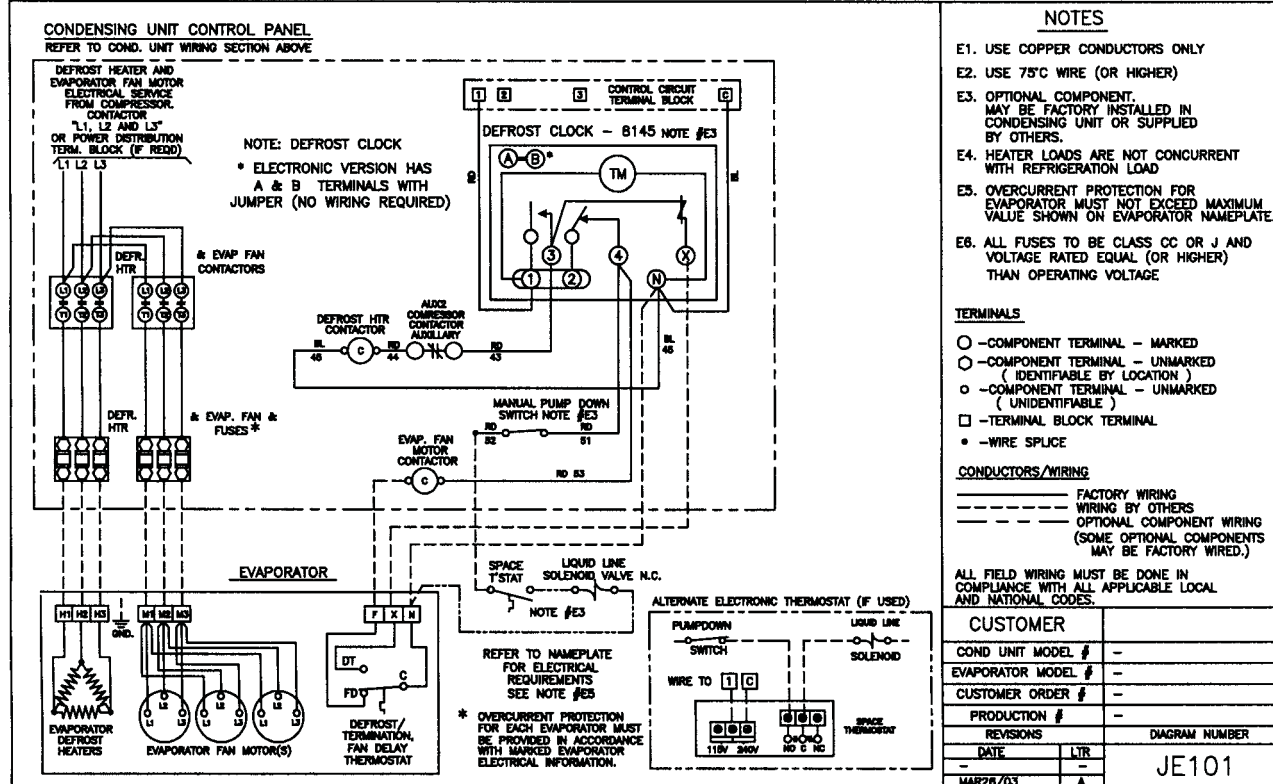


Electrical Wiring Diagram – Horizontal Air Flow Condensing Units (KE-Line)



TYPICAL EVAPORATOR WIRING: FOR SINGLE MED PROFILE ELECT DEFOST EVAPORATOR- SINGLE POINT

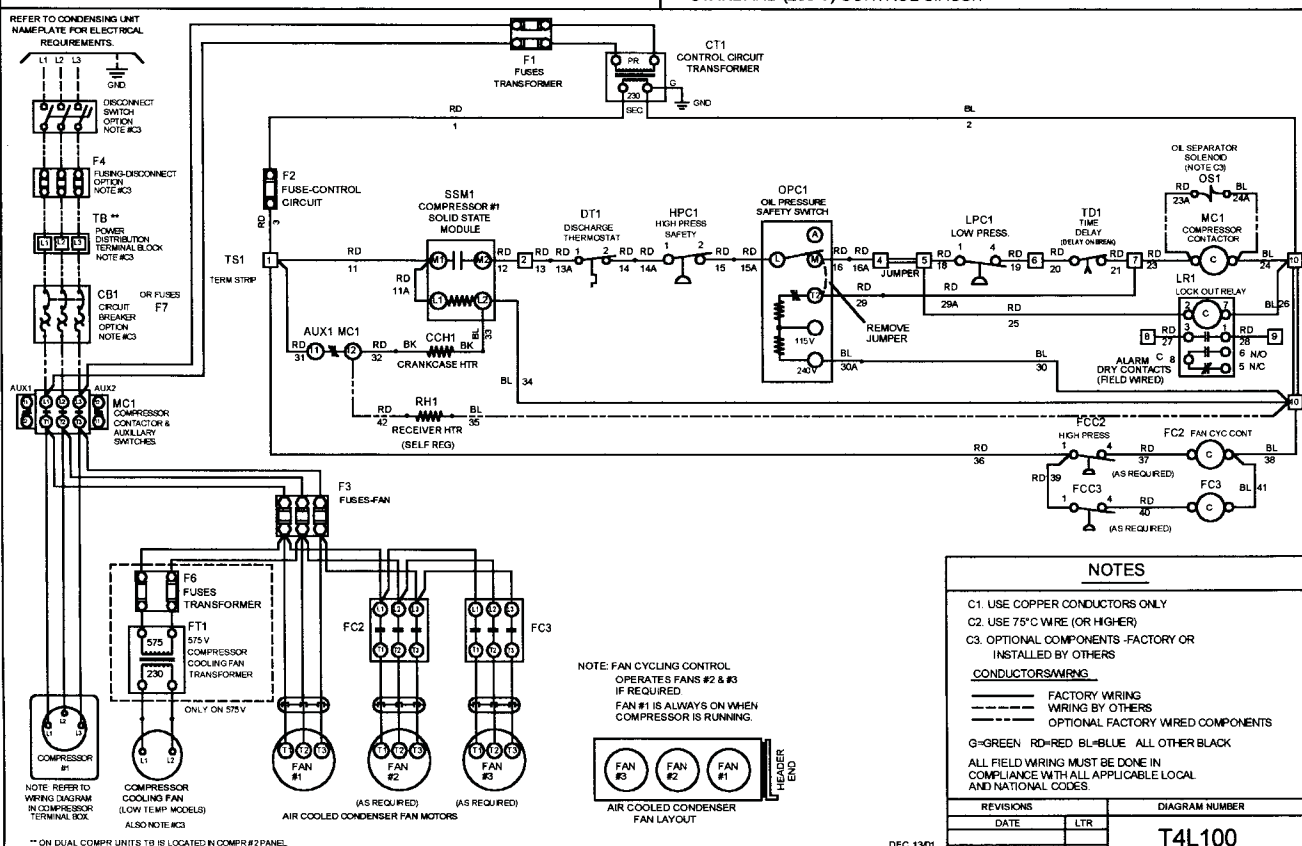
FOR USE WITH: THREE PHASE CONDENSING UNITS WITH DEFOST TIME CLOCK, & EVAP FAN AND DEFR. HTR. CONTACTORS.



Electrical Wiring Diagram – Vertical Air Flow Condensing Units

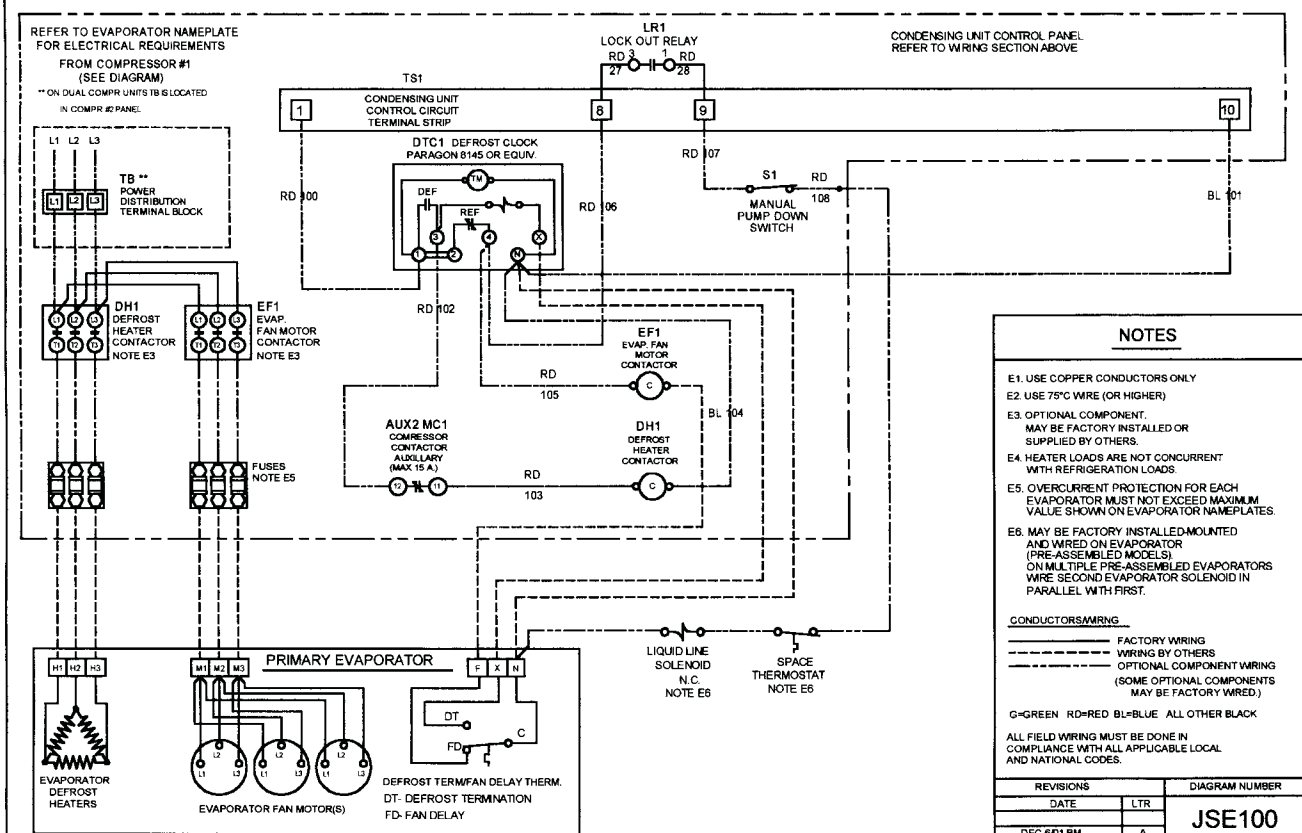
CONDENSING UNIT WIRING DIAGRAM: COMPRESSOR #1

- 460/3/60, 575/3/60 or 380-400/3/50
- SOLID STATE MODULE COPELAND COMPRESSORS (4D-6D-8D)
- STANDARD (230 V) CONTROL CIRCUIT



EVAPORATOR WIRING DIAGRAM: COMPRESSOR #1

- JUCC, JUCT OR BB SERIES ELECTRIC DEFROST EVAPS
- WITH DEFROST TIME CLOCK, EVAP FAN CONTACTOR
AND DEFROST HEATER CONTACTOR. (ONE EVAP)



Refrigerant Piping

WARNING

All local codes must be observed in the installation of refrigerant piping.

IMPORTANT PIPING NOTE

Appropriate line sizing practices must be used throughout the installation of the refrigeration system. Special consideration must be taken when the condensing unit is installed above the evaporator. **REFRIGERATION GRADE COPPER TUBING MUST BE USED FOR PIPING SYSTEMS.**

Piping practice and line sizing charts as recommended by A.S.H.R.A.E. or other reputable refrigeration standards must be followed to ensure minimum pressure drop and correct oil return. An inert gas such as dry nitrogen should be passed through the piping during welding or brazing operations. This reduces or eliminates oxidation of the copper and formation of scale inside the piping. For specific piping requirements refer to your local distributor or sales representative.

Correct line sizing is most critical because of the several factors involved:

- (a) Minimum pressure drop to ensure efficient compressor performance.
- (b) Sufficient gas velocity to maintain proper oil return to the compressor under all load conditions.
- (c) Elimination of conditions on multiple evaporators whereby oil may log in an idle evaporator.

Suction lines should be sized on the basis of a maximum total pressure drop equivalent to a 2°F (1.1°C) change in saturated temperature. At 40°F (4.4°C) suction temperature, this is approximately 3 psig (20.7 kPa) for R-22. At -20°F (-28.9°C) suction temperature, this is approximately 1.3 psig (9.0 kPa) for R-404A.

Horizontal liquid lines should be sized on a basis of a maximum pressure drop equivalent to a 2°F (1.1°C) drop in the sub-cooling temperature. If the lines must travel up vertically then adequate sub-cooling must be provided to overcome the vertical liquid head pressures. A head of two feet of liquid refrigerant is approximately equivalent to 1 psig (6.9 kPa). Liquid line velocities should not exceed 300 fpm (1.52 m/s). This will prevent possible liquid hammering when the solenoid valve closes.

Pressure Loss of Liquid Refrigerant in Liquid Line Risers

(Expressed in Pressure Drop PSIG and Subcooling Loss °F)

Refrigerant	Liquid Line Rise in Feet									
	10'		15'		20'		25'		30'	
	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F
R-134a	4.9	2.0	7.4	2.9	9.8	4.1	12.3	5.2	14.7	6.3
R-22	4.8	1.6	7.3	2.3	9.7	3.1	12.1	3.8	14.5	4.7
R-404A, R-507	4.1	1.1	6.1	1.6	8.2	2.1	10.2	2.7	12.2	3.3

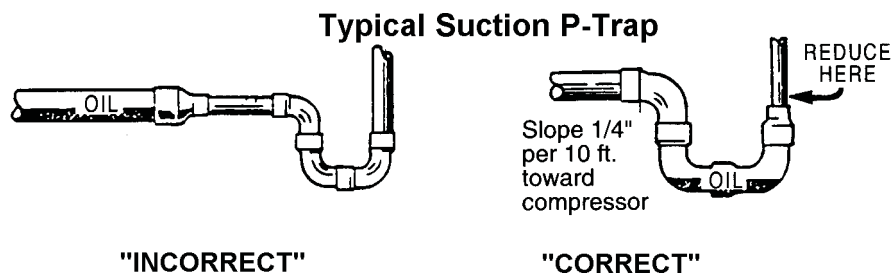
Refrigerant	Liquid Line Rise in Feet							
	40'		50'		75'		100'	
	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F
R-134a	19.7	8.8	24.6	11.0	36.8	17.0	49.1	23.7
R-22	19.4	6.2	24.2	8.0	36.3	12.1	48.4	16.5
R-404A, R-507	16.3	14.1	20.4	5.6	30.6	8.3	40.8	11.8

Based on 110 °F liquid temperature at bottom of riser.

At the temperatures encountered in the condenser, receiver and liquid line a certain amount of oil is always being circulated with the refrigerant through the system by the compressor. However, at the evaporator temperature, and with the refrigerant in a vapor state, the oil and refrigerant separate. This oil can only be returned to the compressor by gravity or by entrainment in the suction gas. Roof installations leave no alternative but by entrainment for oil return, so suction gas velocity and correct line sizing to maintain this velocity are imperative. Care must be taken not to oversize the suction line in the desire for maximum performance.

Gas velocity in vertical suction lines must not be less than 1,000 fpm (5 m/s) and preferably 1,250 to 1,500 fpm (6 to 8 m/s).

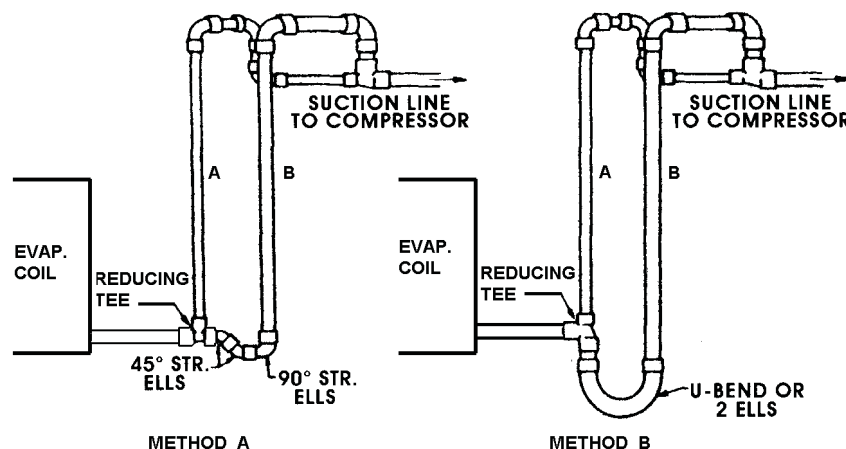
Important: A suction trap must be installed at the base of all suction risers of four (4) feet or more in order to trap oil and allow entrainment in the suction gas.



IMPORTANT PIPING NOTE

If steps of capacity control are supplied on a compressor, provisions must be made for oil return by sizing suction risers to maintain adequate gas velocities at reduced refrigerant flow.

Typical Double Riser Construction



During the lower capacity running mode (compressor capacity control energized) oil will collect in the elbow or at U-bend below pipe "B". This will divert the gas and oil to flow up the smaller pipe "A" at a higher velocity.

IMPORTANT: When welding service valves or any components that may be damaged by heat, manufacturer's installation instructions must be adhered to. Wrapping components with a wet cloth will help to prevent damage from heat.

IMPORTANT: All suction lines outside of the refrigerated space must be insulated.

Water-Cooled Condensers

WARNING

All water and drain connections to the unit must be made in accordance with national as well as local plumbing codes and by-laws.

Cooling water circuits in some shell and tube water-cooled condensers may be either series or parallel as required by the particular application. The “series” flow is usually for city water where lower entering water temperatures exist and higher-pressure drops can be tolerated (such as city water supplies). The “parallel” circuit flows are usually required when the water temperatures enter at 85°F (29.4°C) or higher requiring lower water pressure drops (such as closed loop cooling tower supplies).

On some condensers, the water circuiting may be entirely internal with only an inlet and outlet water fitting. The water inlet is always at the bottom connection.

All water-cooled condensers require a water regulating valve that must be installed upstream of the condenser. The water-regulating valve is adjustable and is set to

provide the desired condensing pressure. As the condensing pressure rises, the valve will open and allow more water to flow. As the condensing pressure lowers the valve will start to close to reduce the amount of water flow into the condenser. If water supply pressure is excessive, a pressure-reducing valve must be used since the allowable working pressure of water valves and condensers is normally 150 psig (1136 kPa). Typical condensing temperatures normally range between 90 to 110 °F. The actual water inlet temperature and water supply flow capacity available at the site determines the suitable condensing temperature. Lower inlet water temperatures (below 70 °F) allow the condensing unit to run at a lower condensing temperature without resulting in a high water flow rate (consumption). Higher water inlet temperatures (above 85 °F) require the condensing temperature to be higher to avoid excessive water flow rates. Refer to the water flow rate chart to estimate the flow rate (GPM-US gallon per minute) at given water temperatures and loads. The TD (temperature difference) is the difference between the condensing temperature and the water inlet temperature.

Example: Given 80 °F inlet water available, +25 °F evaporating temperature application and 1 ton (12,000Btuh) evaporator load. The results are:

20 °F TD = 100 °F Cond.Temp., series flow is $.148 \times 12 = 1.78$ GPM, parallel flow = $.185 \times 12 = 2.22$ GPM

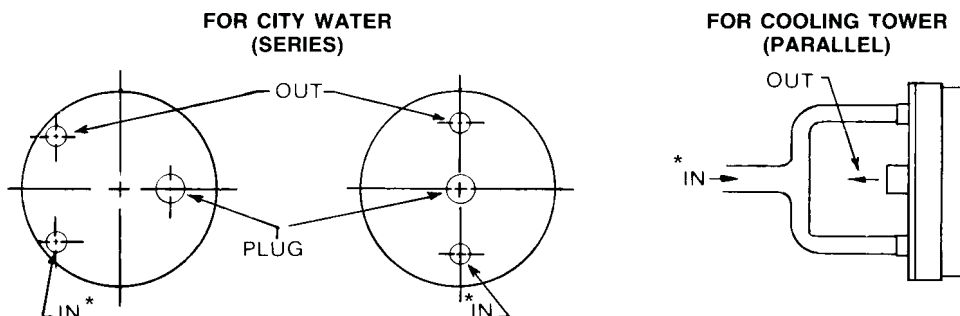
30 °F TD = 110 °F Cond.Temp., series flow is $.103 \times 12 = 1.24$ GPM, parallel flow = $.128 \times 12 = 1.54$ GPM

Knowing the GPM you can estimate the pressure drop through the condenser (and compressor, if with body coil). Refer to the Typical Pressure Drop tables and use the appropriate flow to estimate the resulting pressure drop. If using a condenser that has only ONE water circuit (two connections) use the “parallel” column on the GPM flow rate chart.

Care should be exercised in locating the condensing unit so that the condenser will never be exposed to temperatures below freezing.

Excessive water velocities or cavitation on the waterside of the condenser tubes may damage a water-cooled condenser. In order to prevent operating difficulties, care should be taken to follow the instructions outlined below:

- (a) Water velocities through the condenser should not exceed 7 fps (2.13 m/s). Higher velocities can result in “impingement corrosion”. In order to maintain water velocities at an acceptable level, parallel circuiting of the condenser may be necessary when high water flow is required.
- (b) If a water-circulating pump is used, it should be installed so that the condenser is fed from the discharge side of the pump.



* From compressor cooling coil (if equipped) and water regulating valve

- (c) If the condenser is installed more than 5 ft (1.52 m) higher than the outlet drain point of the condenser, a vacuum breaker or open vent line should be provided to prevent the outlet line from creating a partial vacuum condition.

CONSULT THE FACTORY OR LOCAL SALES REPRESENTATIVE FOR FURTHER INFORMATION.

WATER FLOW REQUIREMENTS (Gallon Per Minute Per 1 MBH Evaporator Load)

HIGHER WATER FLOW RATES

20 ° TD (Condensing Temperature - Entering Water Temperature)						
Evaporating Temperature	SERIES			PARALLEL		
	Condensing Temperature			Condensing Temperature		
	90 °F	100 °F	110 °F	90 °F	100 °F	110 °F
45	0.135	0.137	0.142	0.168	0.172	0.175
25	0.144	0.148	0.153	0.179	0.185	0.189
15	0.148	0.153	0.158	0.185	0.192	0.197
-10	0.167	0.173	0.182	0.208	0.217	0.225
-30	0.183	0.190	0.200	0.227	0.237	0.250

LOWER WATER FLOW RATES

30 ° TD (Condensing Temperature - Entering Water Temperature)						
Evaporating Temperature	SERIES			PARALLEL		
	Condensing Temperature			Condensing Temperature		
	90 °F	100 °F	110 °F	90 °F	100 °F	110 °F
45	0.092	0.093	0.095	0.113	0.115	0.118
25	0.097	0.100	0.103	0.121	0.125	0.128
15	0.100	0.103	0.107	0.125	0.130	0.133
-10	0.113	0.118	0.123	0.142	0.147	0.153
-30	0.123	0.128	0.135	0.153	0.160	0.168

Typical Pressure Drops (PSIG) Condensers

Model (HP)	Flow (GPM)	Pressure Drop		Water Valve Size
		Series	Parallel	
1,1 1/2 , 2	1		0.6	1/2
	2		2	
	3		4.2	
3, 3 1/2, 4	2	2.4	0.3	3/4
	4	8.7	1.2	
	6	18.6	2.5	
5, 6	2	2.7	0.4	1
	4	9.9	1.4	
	6	21	2.9	
7 1/2, 9	3	2.7	0.4	1
	5	7.2	1	
	9	21	2.9	
10	5	2.6	0.35	1 1/4
	10	9	1.25	
	15	18	2.7	
15	10		0.7	1 1/4
	15		1.4	
	25		3.4	
20, 25	10		0.4	1 1/2
	20		1.3	
	40		4.6	
30. 35. 40	Consult factory for Data			

Typical Pressure Drops (PSIG) Compressor Coil (smaller models only)

Compressor Model Family	Flow (GPM)	Pressure Drop
KW	1	1.7
	2	6.2
	3	13.5
EW / 3W	1	0.5
	2	1.3
	3	2.8
	4	5.9

Larger compressor models use fans in place of water cooling coils.

System Accessories

In order to ensure trouble free operation of the refrigeration system it is important that the following system accessories be reviewed and installed.

- (a) A **moisture indicating LIQUID SIGHT GLASS** should be installed in the liquid line between the receiver and as close as possible to the expansion valve on the evaporator. If it is mounted on the condensing unit, it will be mounted downstream of the receiver outlet service valve and immediately after the liquid line drier. It will change color if there is moisture present in the system. It also allows the contractor to detect a shortage of refrigerant or flash gas in the liquid line. Bubbles are not normally visible in the sight glass of a properly charged system, however it is normal to see bubbles appear in the sight glass for a few minutes when the compressor starts. **Bubbles in a sight glass installed on the condensing unit must never be used as the final indicator for shortage of refrigerant in the system.**
- (b) A **LIQUID LINE FILTER DRIER** (sealed or replaceable core) should be installed in the system to remove foreign matter and moisture that may have entered the system during installation. Liquid line driers should be installed downstream of the receiver outlet valve and upstream of the liquid line solenoid valve (if supplied). Liquid line driers may or may not have access valves, depending on the size and application. They should be replaced whenever there is excessive pressure drop across the filter, or when the system becomes contaminated due to system leaks, compressor burn-outs, acid formation, or moisture accumulation as indicated by the moisture indicating sight glass. Refer to the specific manufacturer's recommendation for servicing.
- (c) A **DISCHARGE MUFFLER** may be used to help minimize the noise created in the discharge line of the compressor. This noise may be the result of variations in piping configuration, the pattern of the gas flow, line sizes, operating pressures or compressor and unit mounting. A particular combination of gas flow and piping will result in a resonant frequency, which may amplify the sound and vibration to an undesirable level. Gas pulsations from the compressor discharge may also be amplified in a similar manner.
- (d) A **DISCHARGE OIL SEPARATOR** may be used with flooded systems, low temperature systems and systems with long runs of piping or other factors that tend to cause oil return problems. They help maintain oil volume levels in the compressor oil sump.
- (e) A **LIQUID LINE SOLENOID VALVE** must be installed at the evaporator. Installing a solenoid valve will allow all of the refrigerant to be pumped out of the low side (evaporator and suction line) when the thermostat has been satisfied. This reduces the risk of refrigerant migrating or flooding back to the compressor. Locating the solenoid at the evaporator (instead of the condensing unit) will minimize the pump-down time and refrigerant capacity required by the receiver.
- (f) A **SUCTION LINE FILTER** (sealed or replaceable core) when used are always installed upstream of the compressor suction service valve and any accumulators or other options that may be installed. Suction filters are equipped with "Schrader" type access valves that allow plugged filters and elements to be identified quickly when the pressure drops get too high. Refer to the specific manufacturer's recommendation for servicing.
- (g) Units equipped with spring-mounted compressors should have **VIBRATION ELIMINATORS** in both the suction and discharge lines. They minimize noise transmission and provide flexibility if it is ever necessary to remove a compressor. Vibration eliminators should be installed at ninety degrees to the vibration for best results and whenever possible, in a horizontal position, parallel to the compressor crankshaft. Suction vibration eliminators **MUST be insulated** on low temperature systems to prevent refreezing of condensate, causing expansion damage to the bellows inside the eliminator. This expansion can eventually fatigue the copper bellows causing rupture and loss of refrigerant.
- (h) A **SUCTION LINE ACCUMULATOR** is used to prevent liquid refrigerant from reaching the compressor. Liquid flood back can occur for various reasons such as a malfunctioning expansion valve, refrigerant overcharge, hot gas defrost cycle or extremely low load on the evaporator. An accumulator should be used if frost or dirt collect on the evaporator coil(s). This can reduce the heat transfer. Some suction line accumulators are equipped with a built in suction to liquid line heat exchangers. All hot gas defrost systems must use an accumulator.
- (i) A **SUCTION TO LIQUID HEAT EXCHANGER** should be used if a system requires long liquid lines from the receiver to the evaporator or if the liquid has to rise vertically upward any distance. It can help prevent excessive frosting on the compressor body and increase superheat in the suction line reducing the possibility of liquid refrigerant from returning to the compressor.
- (j) A **PHASE / VOLTAGE MONITOR** protects the system against phase loss (single phasing), phase reversal (improper sequence), high voltage and low voltage (brownouts).

Leak Testing

IMPORTANT: All system piping, including the condensing unit and accessories should be thoroughly tested for leaks prior to start up and charging. The system should be initially pressurized to a maximum of 150 psig (1136 kPa) with dry nitrogen to ensure that the system is free of major leaks. With the system free of major leaks, a more detailed leak check should be performed. Discharge the initial dry nitrogen charge and add enough refrigerant to raise the system pressure up to 10 psig (170 kPa) (tracer amount). Add dry nitrogen to increase the system pressure to a maximum of 150 psig (1136 kPa). It is recommended that an electronic leak detector be used when checking for leaks because of its greater sensitivity to small leaks. As a further check it is recommended that this pressure be held for a minimum of 12 hours and then rechecked. The system must be leak free for satisfactory operation.

WARNING

HFC-134a has been shown to be combustible at pressures as low as 5.5 psig (140 kPa) at 350 °F (176.7 °C) when mixed with air at concentrations more than 60% air by volume. At lower temperature, higher pressures are required to support combustion. Therefore, air should never be mixed with HFC-134a for leak detection.

IMPORTANT ENVIRONMENTAL NOTE

When conventional leak detection methods are employed using HCFC or CFC tracer gas, all of the tracer gas must be reclaimed and disposed of in a proper manner.

Evacuation and Dehydration

When the system is completely free of refrigerant leaks, an evacuation of the entire system should be completed by using a "high vacuum" pump. This evacuation, if completed correctly, will ensure long life for the system as well as elimination of moisture and non-condensable gas problems. **Moisture problems causing compressor failure will void warranty. Follow the recommended procedure carefully.**

CAUTION

Do not use the refrigeration compressor to evacuate the system. Never start the compressor or perform a megger insulation test while the system is in a vacuum.

Dehydration Procedure

Use only a "high vacuum" pump capable of drawing a vacuum of 100 microns. Change the vacuum pump oil frequently. Gauges or vacuum measuring instruments should be suitable to measure conditions at any stage of the process in order to give the operator indications of progress. For specific recommendations, refer to the vacuum pump supplier for these instruments.

Copper jumper lines should be used to interconnect both high and low-pressure sides of the system. These lines should be at least 3/8" O.D. in order to handle the light density vapor at high vacuum obtained at completion of operation. Lines smaller than 3/8" O.D. will slow down the process considerably as well as making final system vacuum questionable. The entire system temperature should be over 60 °F (16 °C) for evacuation to be effective. If the temperature is less than 60 °F (16 °C) the final vacuum should be 50 microns. Double evacuation with a "sweeping " of dry nitrogen is recommended. First evacuation should be to at least 750-micron depth. When this point is reached, break the vacuum with refrigerant or dry nitrogen to melt any moisture, which may have frozen during the first vacuum stage.

IMPORTANT ENVIRONMENTAL NOTE

When conventional leak detection methods are employed using HCFC or CFC tracer gas, all of the tracer gas must be reclaimed and disposed of in the proper manner.

Reclaim any tracer gas from the system and re-evacuate to a final vacuum of at least 100 microns at a minimum 60 °F (16 °C) system temperature. With this degree of evacuation, all moisture and non-condensables will be removed from the entire system.

Line Insulation

After the final system leak test is complete, it is important that all refrigerant lines exposed to high ambient conditions must be insulated to reduce the heat pick-up and prevent the formation of flash gas in the liquid lines. Suction lines should be insulated with 3/4 inch wall insulation, Armstrong "Armaflex" or equal. To prevent rupture due to condensate re-freezing, all suction vibration eliminators on low temperature systems **must be completely insulated**. Liquid lines exposed to high ambient temperatures should be insulated with 1/2 inch wall insulation or better. Any insulation that is to be located in an outdoor environment should be protected from UV exposure to prevent deterioration of the insulating value.

Refrigerant Charging

Condensing units must be charged only with the refrigerant for which they were designed. The type of refrigerant to be used is specified on the name plate of the unit. Installing a liquid line drier between the service gauge and the liquid service port when charging a unit will ensure the refrigerant supplied to the system is clean and dry. This is especially important when charging a low temperature system. Blend type refrigerants (400 series, i.e. R404A) **must not be vapor charged** unless the cylinder is completely emptied into the system.

Weigh the refrigerant drum before and after charging in order to keep an accurate record of the weight of refrigerant put into the system.

IMPORTANT REFRIGERANT CHARGING NOTE

Overcharging a system can result in poor system performance, personal injury and / or compressor damage. **DO NOT** charge strictly by the holding capacity of the receiver. **DO NOT** assume that bubbles in a sight glass, when located at the condensing unit, indicates the system is undercharged.

Note: To estimate the total system requirement, refer to the manufacturer's evaporator and condensing unit specifications on typical operating charges and include the amount for the liquid lines (see tables below). Allow an extra 10% to 15% safety factor. Ensure the receiver can handle the required charge during the pump down mode. (Refer to the condensing unit brochure pump down specifications).

Break the vacuum by charging liquid refrigerant into the receiver side only (charge through the receiver outlet valve gauge port with the valve in the open position). Close the valve and then continue to charge through the gauge port feeding the liquid line and evaporator. Start the compressor and continue to charge.

Refrigerant may be added at the compressor through the compressor suction service valve **in gas form only**. When liquid charging is used, a liquid charging valve must be installed. While charging the system, special attention should be paid to the oil level in the compressor.

If charging to the "bubble" method (observing liquid line sight glass), always use a sight glass located directly before the TXV (thermostatic expansion valve) for the final indicator.

On units that use an adjustable flooded condenser pressure-regulating valve (Sporlan ORI-6 or ORI-10) the proper adjustment must be set. Sporlan set their controls at 120 psig (929 kPa). These controls should be re-adjusted to the following pressures:

185 psig (1377 kPa) for R-22 (2 1/2 turns in clockwise for ORI-6, 4 turns in for ORI-10)

200 psig (1480 kPa) for R-404A (3 turns in clockwise for ORI-6, 5 turns in for ORI-10)

Refer to Sporlan's installation instructions (bulletins 90-30-1 and 90-31) for further details.

**Typical Air-Cooled Condensing Unit (with Horizontal Airflow Condensers)
Refrigerant Operating Charges (LBS) (Less Evaporator and Liquid Lines)**

Warm Ambients * (above 50 °F) ambient application			Cold Ambients ** (below 50 °F) (outdoor winter operation with flooded head pressure control)		
Model HP	R-22	R-404A / R-507	Model HP	R-22	R-404A / R-507
1/2 H, M	2.0	1.7	1/2 H, M	3.3	2.9
1/2 L	2.0	1.7	1/2 L	3.3	2.9
3/4 H, M	2.4	2.1	3/4 H, M	4.2	3.6
3/4 L	2.0	1.7	3/4 L	3.3	2.9
1 H, M & L	3.2	2.8	1 H, M & L	4.9	4.3
1 1/2 H, L	4.2	3.7	1 1/2 H, L	6.1	5.3
1 1/2 M	5.1	4.4	1 1/2 M	7.6	6.6
2 H, M, L	5.1	4.4	2 H, M, L	7.6	6.6
3 H, M, L	6.5	5.7	3 H, M, L	10.2	8.9
3 1/2 M	6.1	5.3	3 1/2 M	9.8	8.5
3 1/2 L	8.3	7.2	3 1/2 L	13.5	11.8
4 H, M	7.7	6.7	4 H, M	13.1	11.4
4 L	8.5	7.4	4 L	13.7	11.9
5 H	7.7	6.7	5 H	13.1	11.4
5 M	13.4	11.7	5 M	22.8	19.8
6 L	11.5	10.0	6 L	19.3	16.8
7 1/2 M †	19.6	17.1	7 1/2 M †	28.5	24.8
7 1/2+M †	25.5	22.2	7 1/2+M †	38.9	33.0
7 1/2 L †	16.3	14.2	7 1/2 L †	22.8	19.8
9 L	19.6	17.1	9 L	28.5	24.8
10 M, L	23.5	20.4	10 M, L	38.0	33.0
15 M, L	32.6	28.3	15 M, L	54.3	47.2
20 M	47.9	41.7	20 M	65.3	56.8
20 L	36.7	31.9	20 L	54.3	47.2
25 M, L	47.9	41.7	25 M, L	72.2	62.8
30 M, L	47.9	41.7	30 M, L	72.2	62.8

* Above conditions are with condenser 40 % full and receiver 10 % full.

** Above conditions are with condenser flooded at between 60 - 80 % full with fan cycling where available and receiver 10 % full.

H = High temperature M = Medium temperature L = Low temperature

† = on KE 7.5 HP machines, use refrigerant charge indicated for 6 HP

For R-134a charges consult factory.

**Refrigerant Charge (LBS) for
Liquid Lines (per 10 Feet)**

Line Size (inches)	R-134a, R-22	R-404A, R-507
3/8	0.4	0.34
1/2	0.74	0.64
5/8	1.19	1.03
7/8	2.47	2.12
1 1/8	4.22	3.61
1 3/8	6.42	5.5
1 5/8	9.1	7.8

**Typical Air-Cooled Condensing Unit (with Vertical Airflow Condensers)
Refrigerant Operating Charges (LBS) (Less Evaporator and Liquid Lines)**

TYPE	HP	WARM AMBIENTS* AMBIENT TEMP>50F		COLD AMBIENTS**			
				AMBIENT TEMP.			
				+40F	-40F	+40F	-40F
		R22	R404A	R22		R404A	
SINGLE CIRCUIT UNITS	15 H	25.7	---	30.0	47.7	---	---
	20 H	25.7	---	30.0	47.7	---	---
	25 H	31.2	---	36.3	57.9	---	---
	30 H	39.6	---	46.2	74.1	---	---
	35 H	46.8	---	46.8	83.7	---	---
	40 H	49.7	---	49.7	94.6	---	---
	50 H	64.4	---	64.4	117.8	---	---
	15 M	31.2	29.5	35.4	53.1	33.1	48.5
	20 M	31.2	29.5	35.4	53.1	33.1	48.5
	25 M	38.2	36.0	43.3	64.9	40.5	59.2
	30 M	48.3	45.6	54.9	82.8	51.3	75.6
	35 M	56.8	53.7	56.8	93.8	53.7	85.9
	40 M	62.6	58.7	62.6	107.4	58.7	97.7
	50 M	80.1	75.4	80.1	133.5	75.4	121.9
	10L	19.1	18.5	28.9	32.0	26.9	29.7
	15L	27.7	26.8	43.1	48.0	40.1	44.4
	22L	28.2	27.2	40.3	53.3	37.7	49.0
	27L	34.4	33.2	49.2	65.0	46.0	59.7
	30L	37.5	36.0	54.9	73.5	51.1	67.3
	40L	51.0	49.1	73.5	97.4	68.6	89.5
DUAL CIRCUIT UNITS	30 H	51.5	---	59.9	95.3	---	---
	40 H	51.5	---	59.9	95.3	---	---
	50 H	62.4	---	72.7	115.8	---	---
	60 H	79.2	---	92.4	148.2	---	---
	70 H	93.6	---	93.6	167.5	---	---
	80 H	99.5	---	99.5	189.2	---	---
	100 H	128.8	---	128.8	235.7	---	---
	30 M	62.4	58.9	70.8	106.2	66.2	97.0
	40 M	62.4	58.9	70.8	106.2	66.2	97.0
	50 M	76.4	72.1	86.6	129.7	81.0	118.5
	60 M	96.6	91.1	109.9	165.6	102.6	151.1
	70 M	113.6	107.4	113.6	187.6	107.4	171.7
	80 M	125.1	117.4	125.1	214.8	117.4	195.4
	100 M	160.2	150.9	160.2	267.1	150.9	243.9
	20L	38.3	36.9	57.8	64.0	53.9	59.3
	30L	55.4	53.5	86.1	95.9	80.2	88.7
	44L	56.5	54.4	80.7	106.6	75.5	98.0
	54L	68.9	66.4	98.3	129.9	92.0	119.5
	60L	75.0	72.0	109.7	146.9	102.2	134.6
	80L	102.1	98.3	146.9	194.9	137.3	179.0

These figures are guidelines only

--- Not Applicable

* Based on condenser summer charge +receiver 15% full +
sub-cooling circuit 100% full (where applicable)

** Based on condenser summer charge +condensers flooded
(between 60-80% full with fan cycling-- where applicable)

+receiver 15% full + sub-cooling circuit 100% full (where applicable)

Compressor Oils

Check to see that the oil level is 1/8 to 1/3 up on the compressor sight glass on compressors so equipped before starting the compressor and after 15 to 20 minutes of operation.

CAUTION: Oil levels should not be allowed to go above the centre or 1/2 of the sight glass. Excessive oil levels in the compressor can result in excessive compressor noise, higher power consumption or internal compressor damage.

Welded hermetic compressors normally do not have sight glasses or means of determining their oil level. This type of compressor is usually installed in packaged systems or in close proximity to the fixture.

All welded hermetic compressors are factory charged with enough oil to compensate for any piping losses up to about 35 ft (10.7 m) (one way) remote location. In the event of any substantial oil loss due to a leak or excessive line run, recharge as per the table below.

Add approximately 1/3 fl oz per foot (32 ml per meter) for any remote location over 35 ft (10.7 m). If in doubt of an actual oil level, the only positive check is to remove the compressor and drain the oil (through the suction connection) and recharge with the correct factory charge (refer to unit specifications). **DO NOT** re-use drained oil that has been exposed to the atmosphere. **DO NOT** re-fill, at any one time more than a total of 110 % of the compressor's factory specified charge. Allow time for some of the oil to circulate into the system.

Refrigeration Oils - Copeland Semi-Hermetic Reciprocating Compressors

Lubricant Type		Traditional Refrigerants		Interims R-401A, R-401B, R402A, R-408A, R409A (MP-39, MP-66, HP-80, FX-10, FX 56)	HFC's R-134a, R-404A, R 507, R-407C, R- 410A
		R-12	R-22, R-502		
POE's	Copeland Ultra 22CC	NOT ACCEPTABLE	A	A	P
	Mobil EAL ARTIC 22 CC		A	A	P
	ICI (Virginia KMP) Emkarate RL 32CF		A	A	P
	Thermal Zone 22CC		A	A	P
Mineral Oils	Witco Suniso 3GS	P	P	PM	NOT ACCEPTABLE
	Texaco Capella WF32	P	P	PM	
	Calumet RO15 (Witco)	P	P	PM	
	Witco LP-200*	P	P		
	Penreco* Sontex 200-LT Shritene	P	P		
A/B	Copeland Ultra 200	A	A	PM	NOT ACCEPTABLE
	Shreve Zerol 200 TD	A	A	PM	
	Soltex AB200A	A	A	PM	
	Thermal Zone 200	A	A	PM	
A/B M/O Mix	Shell 22-12	A	A	P	NOT ACCEPTABLE
	Witco R-195-0	A	A	P	

Legend P = Preferred Lubricant Choice

A = Acceptable Alternative

M = Mixture of Mineral Oil and AlkylBenzene
(AB) with 50 % AB.

* BR, QR and Scroll A/C applications

**Refrigeration Oils--Bitzer Semi-Hermetic Reciprocating Compressors:
2KC-05.2(Y) to 6F-50.2(Y)**

Lubricant Type		(H)CFC R-22	Interim Blends R-401A, R-401B, R-402A, R-408A, R-409A, (MP-39, MP-66, HP-80, FX-10, FX56)	HFC's R-134a, R-404A, R-507, R-407C
Polyol Ester	ICI (Virgina KMP) Emkarate RL32S	A*	A*	P
	Mobil EAL Arctic 32	A*	A*	P
	Castrol Icematic SW32	A*	A*	P
Mineral Oils	Suniso 3GS	A	A	Not Acceptable
	Suniso 4GS	A	A	
	Capella Oil WF32	A	A	
	Capella Oil WF68	A	A	
	Esso Zerice R68	A	A	
Alkyl Benzene	Zerol 150	P	P	Not Acceptable
	Zerol 300	P	P	
	Icematic 2284	P	P	
	Esso Zerice S46	P	P	
	Esso Zerice S68	P	P	
A/B M/O Mix	Shell Clavus SD 2212	P	P	Not Acceptable
	Esso Zerice R46	A	A	

Legend: P = Preferred A= Acceptable Alternative

- Compressor with "Y" designation are factory charged with polyolester oil

* NOTE: When operating (H)CFC with ester oils the quantity of refrigerant dissolved in the oil is more than doubled as compared with conventional lubricants. Special care should be taken. Refer to Bitzer Technical Bulletin KT-510-2, section 5 for additional information.

**Refrigeration Oils--Carlyle Semi-Hermetic Reciprocating Compressors:
06D/E and 06CC**

Lubricant Type		(H)CFC R-22	HFC's R-134a, R-404A, R-507, R-407C
Polyol Ester	Totaline P903-1001,1701	Not Approved	A
	Castrol E68		A
	ICI Emkerarate RL68H		A
	CPI CP-2916S		A
	CPI Solest 68		A
	BP Marine Enersyn MP-S68		A
Mineral/Alkyl Benzene	Witco Suniso 3GS	A	Not Approved
	Totaline P903-2001	A	
	Texaco Capella Oil WFI-32-150	A	
	IGI Cryol -150	A	
	Shrieve Zerol-150	A	

A = Approved

Some restrictions may apply. For further information consult Carlyle factory or Carlyle web site.

Due to the extreme hygroscopic (moisture absorbing) characteristics of Polyol Ester (POE) oils, systems MUST NEVER be left open to the atmosphere for any extended period of time. Simply pulling a deep vacuum on the system during the evacuation and dehydration procedure WILL NOT remove moisture that is absorbed into POE oils.

System Start-up Check List

IMPORTANT START-UP NOTE

Only a qualified refrigeration mechanic who is familiar with compressor performance and the function and adjustment of all controls and components should start up the compressor. Finishing up work on the installations should be planned so that a qualified mechanic is on the job for at least the first full day that the unit is in operation.

Before any refrigeration system is started, the following items should be checked:

- (1) Check that all electrical and refrigeration connections are tight.
- (2) Check compressor crankcase oil level (if equipped with sight glass). It should be from 1/8 to 1/2 full in the sight glass.
- (3) Insure that compressor shipping spacers (spring mounted compressors) or hold down nut (solid mounted compressors) are properly in place.
- (4) Check that the compressor discharge and suction shut-off valves are open.
- (5) Ensure that the high and low pressure controls (see table below) pressure regulating valves, oil pressure safety controls and any other safety controls are adjusted properly.
- (6) Check that the room thermostat is set for normal operation and adjust if required.
- (7) Check all motors, fans and pump bearings in the condenser and evaporator. If they are the type that require oil or grease, make sure that this is attended to in accordance with the tag, which will be attached. Fan blades and pumps should be checked for correct rotation, tightness and alignment. Air should draw air through the condenser (air cooled condensing unit models).
- (8) Electric and hot gas evaporator fan motors should be temporarily wired for continuous operation until the room temperature has stabilized.
- (9) Observe the system pressures during the charging and initial operation process. **DO NOT** add oil while the system is low on refrigerant charge unless the oil level is dangerously low.
- (10) Continue to charge the system until it has enough charge for proper operation. **DO NOT OVERCHARGE THE SYSTEM.** Note that bubbles in the sight glass may not necessarily mean a shortage of refrigerant. It could be caused by a restriction.
- (11) **DO NOT** leave the system unattended until the system has reached its normal operating condition and the oil charge has properly adjusted itself to maintain the proper level in the sight glass.
- (12) Compressor performance, and that of all of the moving components, should be watched carefully throughout the first operating cycle and then checked periodically during the first day of operation. **Careful attention to details at this time will pay dividends in trouble-free performance of the entire system.**
- (13) Check that the wiring diagrams, instructions bulletins etc. are read and attached to the unit for future reference. Ensure that the Warranty Activation Certificate is filled in and either faxed or mailed back to the number or address provided.

CAUTION

Extreme care must be used when starting a compressor for the first time after the system has been charged. During this time liquid refrigerant may have migrated to the compressor crankcase, creating a condition that could cause the compressor damage due to slugging. Energizing a crankcase heater (if so equipped) 24 hours prior to start-up is recommended. If the compressor is not equipped with a crankcase heater, directing a 500 watt heat lamp or other safe heat source on the lower shell or crankcase of the compressor for approximately thirty minutes is recommended.

WARNING

Three phase scroll compressors must be checked for correct rotation. During the initial start up, observe the suction and discharge gauges to ensure the suction pressure drops and the discharge pressure rises.

Pressure Control Settings

Minimum Temperature °F *	R-134a		R-22		R-404A, R-507	
	Cut-in (PSIG)	Cut-out (PSIG)	Cut-in (PSIG)	Cut-out (PSIG)	Cut-in (PSIG)	Cut-out (PSIG)
50	35	5	70	20	85	30
40	25	5	55	20	70	30
30	17	5	40	20	50	30
20	12	0	30	10	40	20
10	7	5" Hg	20	0	30	10
0	5	5" Hg	15	0	20	5
-10	-	-	15	0	15	0
-20	-	-	10	0	10	0
-30	-	-	10	0	6	3" Hg

* The coldest Temperature of either the fixture or outdoor ambient.

High Pressure Control Settings

Refrigerant	Maximum Cut-out (PSIG)	
	Air-Cooled Units	Water Cooled Units
R-134a	250	200
R-22	370	315
R-404A	400	315

Low Temperature Room Pull-Down

It can take up to two weeks to properly start-up and pull-down a large freezer. Large freezers should be pull-down to temperature in stages. Too fast a pull-down can cause structural problems in pre-fabricated rooms and will damage (crack) concrete floors. Reduce room temperature by 10 to 15 °F (5.6 to 8.4 °C) per day. Hold this temperature for 24 to 48 hours at 35 °F (1.7 °C) and again at 25 °F (-3.9 °C). Monitor the amount of defrost water during this pull down stage.

Once the room is pulled down to temperature, expect frost on the compressor end bell and any exposed suction line. A lack of frost in these areas probably indicates too high of suction superheat. Reduce defrost frequency to 30 minutes every 6 hours if possible. Adjust the defrost termination (and time clock) so that the coil and drain pan are **COMPLETELY** free of frost / ice at termination. Too short of a defrost cycle will allow residual ice to grow. Too long of a defrost will allow the coil(s) to steam at the end of the cycle. The steam will condense and freeze fans, fan guards and create frosting on the ceiling of the room. The evaporator fan delay must allow any condensate left on the coil surface to refreeze before the fans start.

Checking Superheat

IMPORTANT SYSTEM BALANCING NOTE

To obtain maximum system capacity and insure trouble free operation it is necessary to check both the compressor and evaporator superheat.

Compressor Superheat

Compressor suction superheat must be checked. To check the superheat at the compressor the following steps should be followed:

- (1) Measure the suction pressure at the suction service valve of the compressor. Determine the saturated temperature corresponding to this pressure from a "Pressure- Temperature" chart.
- (2) Measure the suction temperature of the suction line about 6 inches (15 cm) back from the compressor suction valve using an accurate thermometer.
- (3) Subtract the saturated temperature (from step 1) from the actual suction line temperature (from step 2). This difference is the **actual superheat at the compressor**.

System capacity decreases as the suction superheat increases. For maximum system capacity, the suction superheat should be kept as low as is practical. The superheat at the compressor should range within 20 to 45 °F (11.2 to 25.2 °C) Superheat.

NOTE: Too low of a suction superheat can result in liquid being returned to the compressor. This can cause dilution of the oil and eventually cause failure of the bearings and rings through wash out as well as liquid slugging.

NOTE: Too high of a suction superheat will cause excessive discharge temperatures which cause a break down of the oil and will result in piston ring wear, piston and cylinder wall damage.

If adjustment to the suction superheat is required, it should be done either by adjusting the thermostatic expansion valve at the evaporator, the use of liquid to suction heat exchanger or suitable use of suction line insulation.

Evaporator Superheat

Once the refrigerated space is at its design temperature or close to design temperature, the evaporator superheat must be checked. To check the suction superheat at the evaporator the following steps should be followed:

- (1) Measure the suction pressure in the suction line at the bulb location by either,
 - (a) A gauge in the external equalizer line will indicate the pressure directly and accurately.
 - (b) A gauge directly in the suction line near the evaporator or directly in the suction header will suffice.
- (2) Measure the temperature of the suction line at the point where the thermostatic expansion valve bulb is clamped to the suction line.
- (3) Convert the pressure obtained in step 1 above to a saturated evaporator temperature from a "Pressure- Temperature" chart.
- (4) Subtract the saturated temperature (from step 1) from the actual suction line temperature (from step 2). This difference is the **actual superheat at the evaporator**.

The superheat at the evaporator should be a minimum of 6 to 10 °F (3.4 to 5.6 °C) for systems with a 10 °F (5.6 °C) design TD (temperature difference) to a maximum of 12 to 15 °F (6.7 to 8.4 °C) for systems with a higher operating TD.

Low temperature applications (freezers) should be set at superheats of 4 to 6 °F (2.2 to 3.4 °C).

TD = Box temperature – evaporating temperature.

System Operational Check List

When the system has been running trouble free for an extended time (two weeks or more) and design conditions are satisfied, the following check list should be followed:

- (1) Check that compressor **discharge and suction pressures** are operating within the allowable design limits for the compressor. If not, take the necessary corrective action.
- (2) Check the liquid line sight glass and expansion valve operation. If there is an indication that the system is low on refrigerant, thoroughly **check the system for leaks before adding refrigerant**.
- (3) Check the **level of the oil** in the compressor sight glass (if so equipped). Add oil as necessary.
- (4) The thermostatic expansion valve must be checked for **proper superheat settings**. The sensing bulb must have positive contact with the suction line and should be insulated. Valves operating at a high superheat setting results in low refrigeration capacity. Low superheat settings can cause liquid slugging and compressor bearing washout. (Refer to the section on compressor and evaporator superheats)
- (5) Check the **voltage and amperage** readings at the compressor terminals. Voltage reading must be within the recommended guidelines. Normal operating amperages can be much lower than the compressor nameplate values.
- (6) To check the **high pressure control setting** it is necessary to build up the head pressure to the cut-out point of the control. This can be done by stopping the condenser fan(s) (air cooled condensing units) or pump and watching the pressure rise on a high pressure gauge to make sure the high pressure control is operating at the setting.
- (7) Check the **low pressure settings** by throttling the compressor shut-off valve and allowing the compressor to pump down. This operation must be done with extreme caution to avoid too sudden a reduction in crankcase pressure, which will cause oil slugging and possible damage to the compressor valves. Close the valve a turn at a time while watching the compound gauge for change and allowing time for the crankcase pressure to equalize with the pressure control bellows pressure. The slower the pressure is reduced, the more accurate will be the check on the pressure control setting.
- (8) Recheck all **safety and operating controls** for proper operation and adjust as necessary.
- (9) Check **defrost controls for initiation and termination settings**, and the length of defrost period. Set the fail safe on the time clock at the length of defrost plus 25 %.
- (10) If the system is equipped with winter head pressure controls (fan cycling or flooded valves), **check for operation**.
- (11) Fill in the **Service Log** in the back of this Installation Manual.

System Troubleshooting

The following System Troubleshooting Guide lists the most common types of malfunctions encountered with refrigeration systems. These simple troubleshooting techniques can save time and money minimizing unnecessary downtime and end-user dissatisfaction.

Contact the factory or your local sales representative for further information or assistance.

System Troubleshooting Guide	
Condensing Unit Problem	Possible Causes
Compressor will not run. Does not try to start.	1. Main power switch open. 2. Fuse blown or tripped circuit breaker. 3. Thermal overloads tripped. 4. Defective contactor or coil. 5. System shut down by safety devices. 6. Open thermostat or control. No cooling required. 7. Liquid line solenoid will not open. 8. Loose wiring.
Compressor hums, but will not start.	1. Improperly wired. 2. Low line voltage. 3. Loose wiring. 4. Defective start or run capacitor. 5. Defective start relay. 6. Motor windings damaged. 7. Internal compressor mechanical damage.
Compressor starts, but trips on overload protector.	1. Improperly wired. 2. Low line voltage. 3. Loose wiring. 4. Defective start or run capacitor. 5. Defective start relay. 6. Excessive suction or discharge pressure. 7. Tight bearings or mechanical damage in compressor. 8. Defective overload protector. 9. Motor windings damaged. 10. Overcharged system. 11. Shortage of refrigerant. 12. Suction or discharge pressure too high. 13. Inadequate ventilation. 14. Operating system beyond design conditions.
Compressor short cycles.	1. Low pressure control differential set too low. 2. Shortage of refrigerant. 3. Low airflow at evaporator(s). 4. Discharge pressure too high. 5. Compressor internal discharge valves leaking. 6. Incorrect unit selection (oversized).
Start relay burns out.	1. Improperly wired. 2. Low or high line voltage. 3. Short cycling. 4. Improper mounting of relay. 5. Incorrect start or run capacitor. 6. Incorrect relay.
Contact welded stuck on start relay	1. Short cycling. 2. No bleed resistor on start capacitor.
Start capacitor burns out	1. Improperly wired. 2. Short cycling. 3. Low line voltage. 4. Relay contacts sticking. 5. Incorrect capacitor. 6. Start winding remaining in circuit for prolonged period.

Condensing Unit Problem	Possible Causes
Compressor noisy or vibrating.	1. Flood back of refrigerant. 2. Improper piping support on the suction or discharge lines. 3. Broken or worn internal compressor parts. 4. Incorrect oil level. 5. Scroll compressor rotating in reverse (three phase). 6. Improper mounting on unit base.
Discharge pressure too high.	1. Non-condensables in the system. 2. System overcharged with refrigerant. 3. Discharge service valve partially closed. 4. Condenser fan not running. 5. Dirty condenser coil.(air-cooled condensers) 6. Dirty tubes. .(water-cooled condensers) 7. Defective or improperly set water regulating valve. (water-cooled condensers) 8. Defective or improperly set flooded head pressure control.
Discharge pressure too low.	1. Low suction pressure. 2. Cold ambient air. 3. Suction service valve partially closed. 4. Shortage of refrigerant. 5. Defective or improperly set water regulating valve. (water-cooled condensers) 6. Defective or improperly set flooded head pressure control.
Suction pressure too high.	1. Excessive load. 2. Compressor internal valves broken. 3. Incorrect unit selection (undersized). 4. Improper TXV bulb charge.
Suction pressure too low.	1. Shortage of refrigerant. 2. Evaporator dirty or iced up. 3. Clogged liquid line filter drier. 4. Clogged suction line filter or compressor suction strainers. 5. Expansion valve malfunctioning. 6. Condensing temperature too low. 7. Improper TX valve selection. 8. Evaporator distributor feed problems.
Low or no oil pressure.	1. Low oil level. (trapped oil in evaporator or suction line) 2. Clogged suction oil strainer. 3. Excessive liquid refrigerant in the crankcase. 4. Worn oil pump. 5. Oil pump reversing gear sticking in the wrong position. 6. Worn bearings. 7. Loose fitting on oil line. 8. Pump housing gasket leaking.
Compressor loses oil.	1. Refrigerant leak. 2. Short cycling. 3. Excessive compressor ring blowby. 4. Refrigerant flood back. 5. Improper piping or traps. 6. Trapped oil in evaporator.
Compressor runs continuously	1. Excessive load. 2. Too low of a system thermostat setting or defective thermostat. 3. Shortage of refrigerant. 4. Leaking compressor internal valves. 5. Malfunctioning liquid line solenoid. 6. Incorrect unit selection (undersized).

System Troubleshooting Guide

Fixture Problem	Possible Causes
Room temperature too high.	1. Defective room thermostat or improper differential / setting. 2. Malfunctioning liquid line solenoid valve. 3. Insufficient air across evaporator coil (iced up coil, product blocking evaporator, fan blade / motor problem). 4. Improper evaporator superheat (low refrigerant charge, plugged TXV strainer, poor TXV bulb contact, incorrect TXV setting). 5. Malfunctioning condensing unit.
Room temperature too low.	1. Defective room thermostat or improper differential / setting. 2. Malfunctioning liquid line solenoid valve.
Ice accumulating on ceiling.	1. Defrost on too long (improper setting / defective termination thermostat, improper setting / defective time clock). 2. Too many defrosts per day. 3. Fans not delayed after defrost (improper setting / defective fan delay thermostat).
Evaporator coil not clear of ice after defrost.	1. Defrost on too short (improper setting / defective termination thermostat, improper setting / defective time clock). 2. Electric heaters defective / miswired / low voltage. 3. Not enough defrosts per day. 4. Air defrost evaporator operating at too low of temperature (require electric defrost). 5. Defective / miswired interlock at compressor contactor. 6. Defective defrost contactor or coil.
Ice building up in drain pan.	1. Improper slope in pan. 2. Blocked drain line (unheated , not insulated). 3. Electric heater in drain pan defective / miswired / low voltage). 4. Not enough defrosts per day. 5. Lack of or improper P-trap in drain line.
Evaporator fans will not operate.	1. Main power switch open. 2. Fuse blown or tripped circuit breaker. 3. Defective contactor or coil. 4. Room temperature too high (fan delay thermostat open). 5. Fan delay thermostat improper setting / defective. 6. Defective fan motor (low voltage / tripped on thermal overload). 7. Defective time clock. 8. Normal mode during defrost cycle (electric defrost type evaporator).

IMPORTANT TROUBLESHOOTING NOTE

Before any components are changed on the refrigeration system, the cause of the failure must be identified. Further problems will exist unless the true cause or problem is identified and corrected.

Customer Instructions

Maintenance Program

In order to ensure that the refrigeration system runs trouble free for many years, a follow-up maintenance program (consisting of a minimum of two inspections per year) should be set up. A qualified refrigeration service mechanic should carry out this semi-annual inspection. The main power supply **must be disconnected and locked off** to avoid accidental start up of the equipment.

- (1) Check electrical components and tighten any loose connections.
- (2) Check all wiring and electrical insulators.
- (3) Check contactors to ensure proper operation and contact point for wear.
- (4) Check that fan motors (if applicable) are operational, ensure fan blades are tight and all mounting bolts are tight.
- (5) Check oil and refrigerant levels in the system.
- (6) Ensure that the condenser surface (if applicable) is cleaned and free of dirt and debris.
- (7) Check the operation of the control system. Make certain that all of the safety controls are operational and functioning properly.
- (8) Check all refrigeration piping. Make sure that all mechanical joints and flare nuts are tight.

Service Parts Availability

Genuine replacement service parts should be used whenever possible. Refer to the Service Parts List on the back cover of this Installation and Maintenance Manual or attached to the unit. Parts may be obtained by contacting your local sales representative or authorized distributor.