



Controls

HORIZON[®]

**Single and Two-Stage Steam and
Two-Stage Direct-Fired**

**Absorption Chiller
With Microprocessor Control Panel**

**Unit Models
ABDA, ABTF, ABSD**

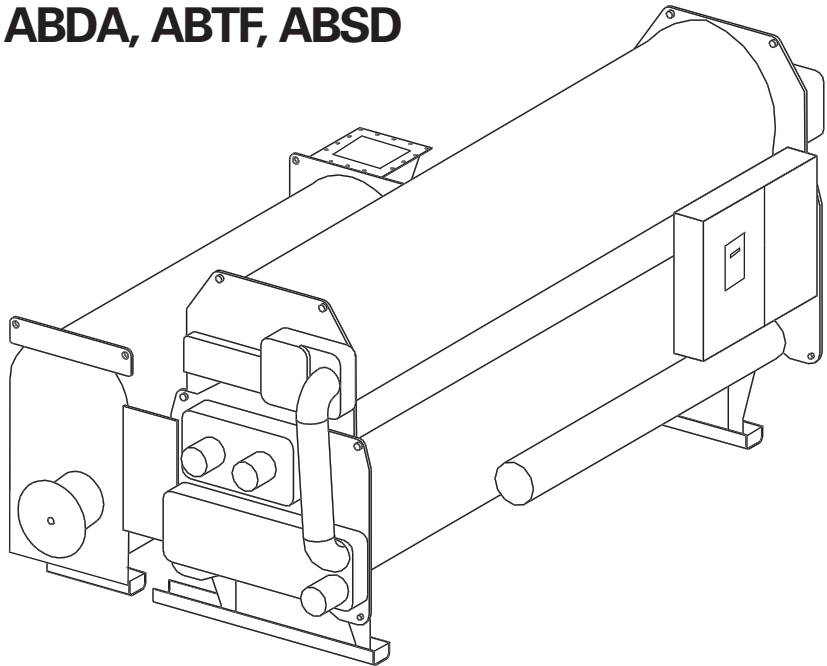


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This advanced model Absorption machine was developed with the assistance of Gas Research Institute.

(1) Introduction

The following information describes the Trane microprocessor based absorption control panel (UCP = Unit Control Panel). This section details the control strategies designed to ensure a more reliable and efficient chiller operation. Limit modes provide functional but limited machine operation to avoid any safety shutdown, therefore; keeping the chiller on line. When a safety condition is actually violated, the UCP safeties provide protection to the machine and personnel by terminating machine operation. Proportional, Integral, and Derivative (PID) lithium bromide concentration control provides for stable and efficient machine performance. Reduced cooling water temperatures to 65°F, when available, can further improve machine efficiency.

The controls discussion within the operation maintenance manual has owner level information that is not repeated here. The content of this section is service level oriented. Therefore, knowledge of the operation and maintenance material is important for a complete understanding of this control system. Review and understand the information in this manual before troubleshooting or startup is attempted.

Manual Layout

The table of contents outline the topics covered. The following are the major sections:

Absorption Cycle (Section 2) - This section covers the basics of the solution cycle; how the refrigerant and lithium bromide flows through the chiller. An understanding of the absorption cycle is necessary to follow how the lithium bromide cycle is controlled by the Unit Control Panel (UCP).

Sequence of Operation (Section 3) - The microprocessor has a programmed sequence for machine startup, shutdown, operating limit and safety shutdown. This section describes these events in the sequence.

Control Panel Layout (Section 4) - This section provides control type and location information within the unit control panel.

Clear Language Display (CLD) (Section 5) - The (CLD) is the device that allows the operator to communicate with the machine. The details include how to use it and information on reports, settings and functional keys.

Sensors and Controls (Section 6) - Various temperature sensors and machine-mounted controls connect to the control panel. This section explains the type and purpose of all sensors and controls that are connected to the UCP.

Control Strategy (Section 7) - The control system objective and strategy is discussed along with limit and shutdown methods.

Limits and Safeties (Sections 8 - 20) - These sections explain the limit and safety function of the UCP and how they may affect machine operation. The limits provide protection for the chiller to overcome transient operating conditions.

Purge System (Section 21) - This section explains the theory and operation of the Purifier Purge including the setpoints, inputs, outputs, operating modes, operation status and timers.

(2) Absorption

In the case of ABDA machines, a burner provides heat energy input while the ABTF is a regulated supply of 115-psig steam or 350°F hot water supplied to the high temperature generator. In both cases refrigerant water vapor is separated from the dilute lithium bromide solution when it is boiled. The hot refrigerant vapor produced by the high temperature generator is directed to the low temperature generator tubes to further heat and boils the lithium bromide and produce additional water vapor. This vapor leaves the low temperature generator as condensed refrigerant water that is piped to the condenser section. The refrigerant vapor separated from the lithium bromide in the low temperature generator passes to the condenser as vapor where it also condenses. The entire condensed refrigerant is then returned to the evaporator to replace the refrigerant used by the evaporator. Using the refrigerant vapor, that is produced in the high temperature generator to produce additional refrigerant in the second stage generator, provides the two-stage effect.

The lithium bromide cycle is reverse parallel. All the diluted lithium bromide from the absorber is pumped through the low temperature heat exchanger and then to the low temperature generator where the lithium bromide is partially concentrated.

When the partially concentrated lithium bromide solution leaves the low temperature generator, part of the flow is diverted to the high temperature solution pump, which pumps the lithium bromide into the high temperature solution and condensate heat exchangers, and then to the high temperature generator. The lithium bromide that is not diverted exits the low temperature generator and is mixed with concentrated lithium bromide returning from the high temperature generator, by way of the high temperature heat exchanger and float valve. The resulting intermediate lithium bromide solution passes through the low temperature heat exchanger to the absorber spray solution pump, for distribution over the absorber tubes completing the lithium bromide cycle.

When the intermediate lithium bromide solution is sprayed onto the absorber tubes, the solution is cooled from the cooling tower water flowing through the tubes. The low partial pressure created by this activity allows the lithium bromide to absorb the refrigerant water vapor produced by the evaporator section. The resulting dilute lithium bromide solution falls to the bottom of the absorber, where it is again pumped through the low temperature, high temperature and condensate heat exchangers, before entering the generators for refrigerant reclaim and subsequent lithium bromide reconcentration.

The refrigerant pump circulates refrigerant that is stored in the evaporator pan; to constantly wet the evaporator tubes. As the refrigerant contacts the tubes containing warm system water flowing through the evaporator tubes, the refrigerant vaporizes, removing heat from the system water. The resulting vapor is absorbed by the lithium bromide in the absorber, to sustain the cooling process.

The fluid temperatures and lithium bromide concentrations are illustrated in Figures 1 (Model ABTF) and 2 (Model ABDA) and Tables 1 and 2, and are described in the following text, are valid when the machine is operating at the nominal design conditions of 44°F leaving evaporator, 85°F entering cooling water and 115 psig steam, or at design burner input rate. The fluid temperatures and concentrations will change if the cooling water drops below design conditions, or the energy input are reduced for part load operation. This machine is designed to operate efficiently with an entering condenser water temperature of 95 to 54°F.

Condensate Heat Exchanger ABTF only

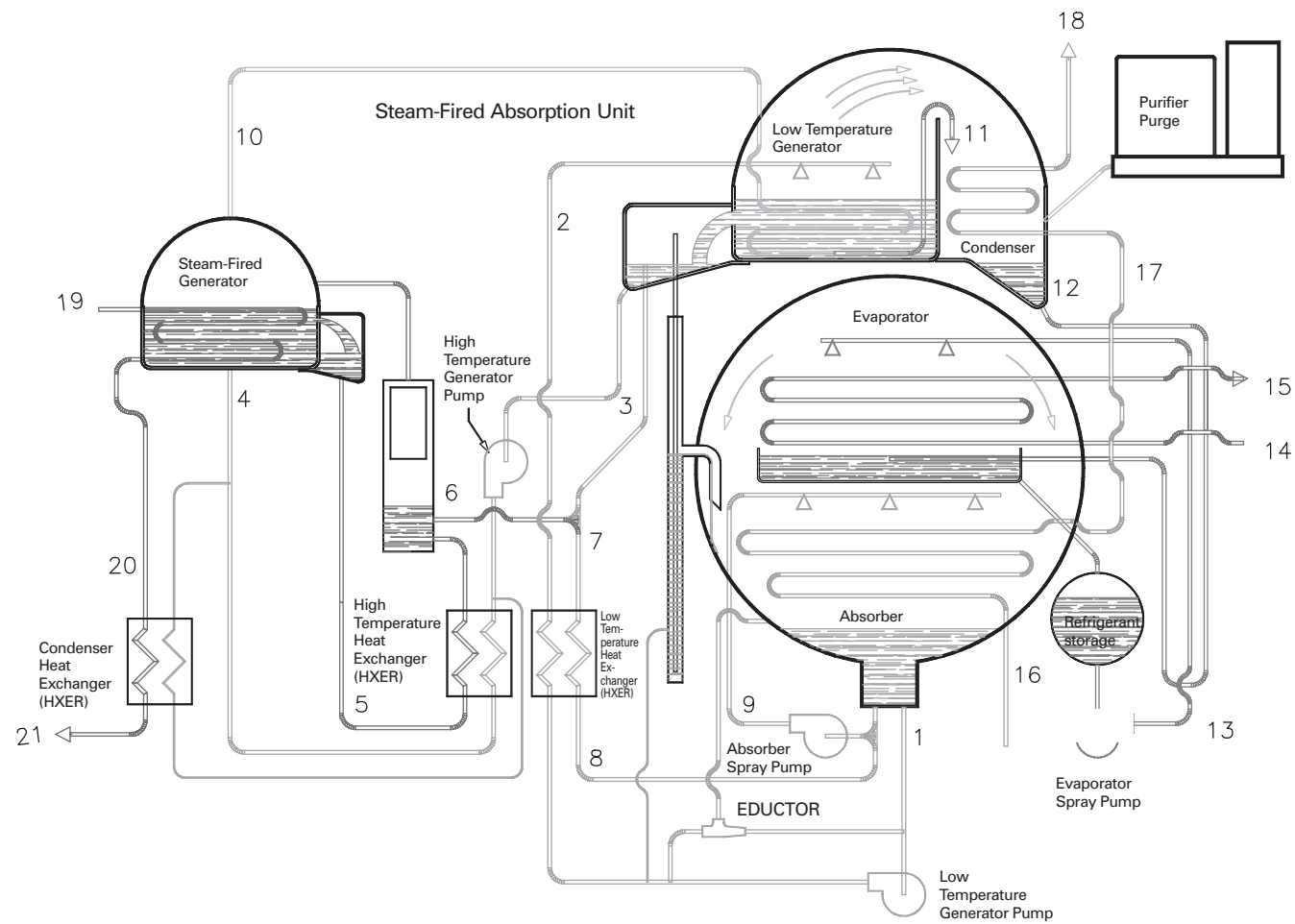
The condensate heat exchanger is used to recover heat from the steam condensate, after it has passed through the high temperature generator. Some lithium bromide solution from the High Temperature Solution Pump (HTSP) is supplied to one side of this heat exchanger, to reduce the condensate temperature and preheat some of the lithium bromide entering the generator.

Hot Water Heating ABDA only (Figure 1)

Heating only or simultaneous heating with cooling is accomplished utilizing a heat exchanger. As system heating water flows through the heat exchanger tube bundle a relatively cool area compared to the hot refrigerant vapor is created. This cool area draws hot refrigerant vapor (10 ltems) through the heat exchanger where the vapor condenses transferring heat to the system water (16 to 17 ltems) within the heat exchanger tubes. The condensed liquid refrigerant returns to the high temperature generator.

It should be noted that there is a trade off during simultaneous heating and cooling; hot refrigerant vapor consumed during heating of the system water is no longer available for cooling loads. This creates the need to establish a priority mode of operation, cooling priority or heating priority. The control system will utilize the available refrigerant to meet the needs of the priority mode of operation. The priority is selected at the clear language display under operator settings.

Figure 1. ABTF fluid cycle - (Ref. Table 1)



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Table 1. ABTF machine cooling cycle (See Figure 1)

Point	Lithium Bromide Solution or Refrigerant Water	Concentration %	Temperature (°F)	Temperature (°C)
1	Absorber Dilute Solution	58	95	35
2	Absorber Dilute Solution Entering the Low Temperature Generator (LTG)	58	180	82
3	Solution Leaving the Low Temperature Generator (LTG)	60	190	88
4	Solution Entering the High Temperature Generator (HTG)	60	300	149
5	Solution Leaving the High Temperature Generator (HTG)	65.5	325	163
6	Solution Leaving High Temperature Heat Exchanger (HTHX) and Flow Control Device	65.5	240	116
7	Mixed Solution (Intermediate with Concentrated) Entering Leaving Temperature Heat Exchanger (LTHX)	63.5	215	102
8	Solution Entering Absorber Sump or Spray Pump	63.5	125	52
9	Absorber Spray Solution (Mixed with absorber dilute)	61.5	112	44
10	High Temperature Generator (HTG) Refrigerant Vapor	–	300	149
11	Low Temperature Generator (LTG) Refrigerant Vapor	–	190	88
12	Condensed Refrigerant	–	100	38
13	Evaporator Pump Refrigerant	–	42	6
14	System Chilled Water/Entering	–	54	12
15	System Chilled Water/Leaving	–	44	7
16	Absorber Cooling Water	–	85	29
17	Absorber Leaving or Condenser Entering Cooling Water	–	93	34
18	Condenser Leaving Cooling Water	–	97	36
19	Steam Entering Unit and 115 psig	–	346	174
20	Condensate Leaving Generator or Entering Condensate Heat Exchanger	–	346	174
21	Condensate Leaving Machine	–	210	99

Figure 2. ABDA fluid cycle - (Reference Table 2)

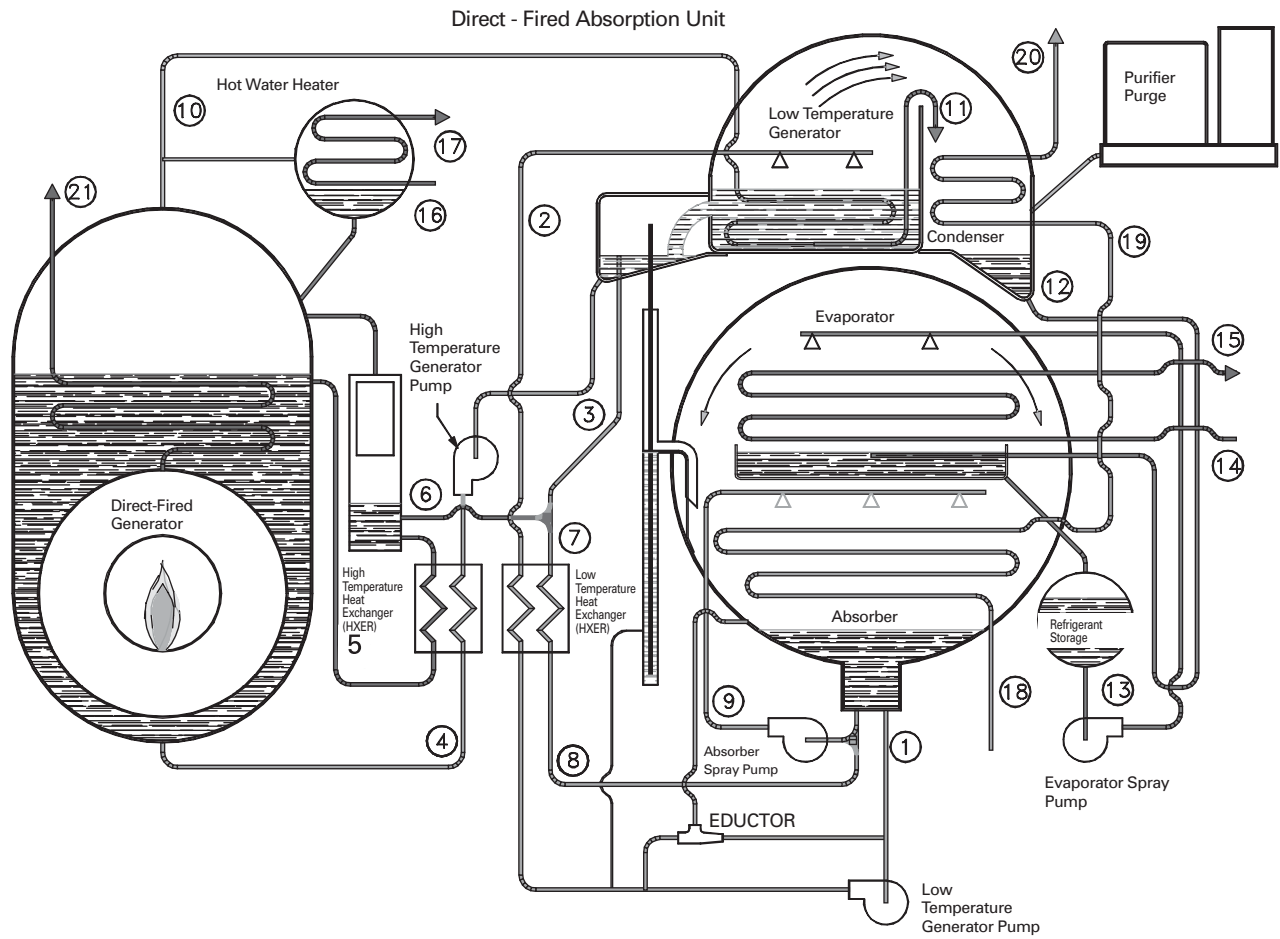


Table 2. ABDA machine cooling cycle (See Figure 2)

Point	Lithium Bromide Solution or Refrigerant Water	Concentration %	Temperature (°F)	Temperature (°C)
1	Absorber Dilute Solution	57	95	35
2	Absorber Dilute Solution Entering the Low Temperature Generator (LTG)	57	165	74
3	Intermediate Solution Leaving the Low Temperature Generator (LTG)	59	175	79
4	Intermediate Solution Entering the Low Temperature Generator (LTG)	59	275	135
5	Concentrated Solution Entering the High Temperature Generator (HTG)	65.5	320	160
6	Concentrated Solution Leaving High Temperature Heat Exchanger (HTHX) and Flow Control Device	65.5	210	99
7	Mixed Solution (Intermediate with Concentrated) Entering Low Temperature Heat Exchanger (LTHX)	63	200	93
8	Mixed Solution Entering Absorber Sump or Spray Pump	63	118	48
9	Absorber Spray Solution (Mixed with absorber dilute)	61.3	112	44
10	High Temperature Generator (HTG) Refrigerant vapor	–	305	152
11	Low Temperature Generator (LTG) Refrigerant Vapor	–	193	89
12	Condensed Refrigerant	–	102	39
13	Evaporator pump refrigerant	–	42	6
14	System Chilled Water - entering	–	54	12
15	System Chilled Water - leaving	–	44	7
16	System heating Water - entering	–	130	54
17	System heating Water - leaving	–	140	60
18	Absorber Cooling Water	–	85	29
19	Absorber Leaving or Condenser Entering Cooling Water	–	95	35
20	Condenser Leaving Cooling Water	–	100	38
21	Exhaust Gas	–	350	177

Note: Table 2 is a typical example of a machine operating at a standard rating point. (for example, 85° tower, 44° leaving chilled water at full load).

Machine Solution Cycle

The machine solution cycle is discussed in this section. Refer to the cooling cycle schematic, Figure 3, during the cycle explanation and reference Table 3.

Figure 3. Single-stage absorption refrigeration cycle

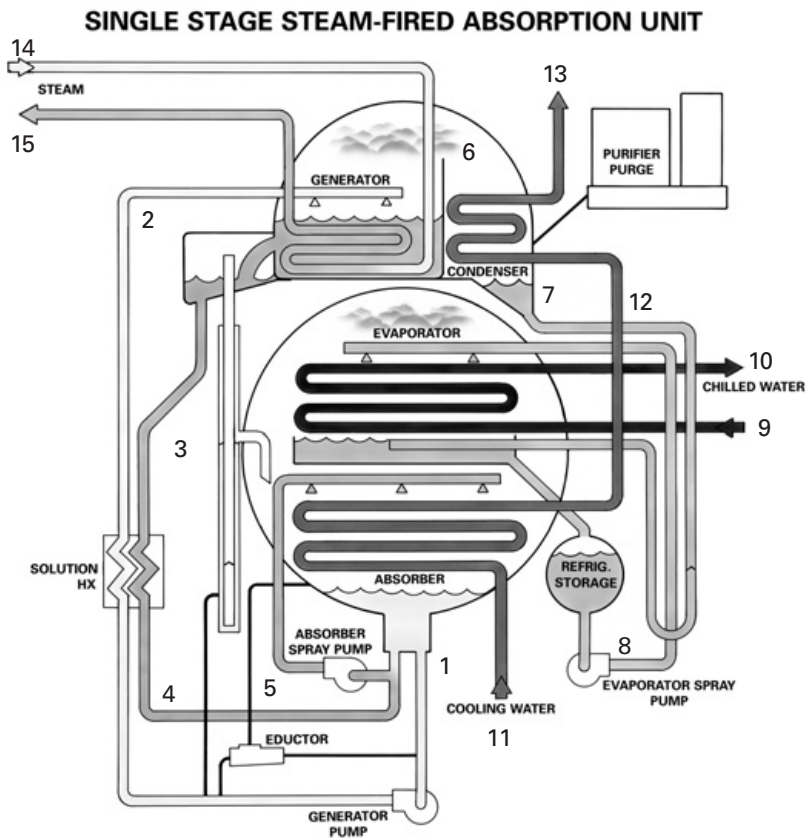


Table 3. Machine cooling cycle (Ref. Figure 3) (Typical Temperatures)

Point	LiBr Solution or Refrigerant Water	Concentration %	Temperature (°F)	Temperature (°C)
1	Absorber Dilute Solution	60.8	107	42
2	Absorber Dilute Solution Entering the LTG	60.8	185	85
3	Solution Leaving the LTG	64.4	216	102
4	Solution Entering ABS Sump/Spray Pump	64.4	129	54
5	ABS Spray Solution (Mixed w/abs dilute)	63.1	121	49
6	LTG Refrigerant Vapor	NA	208	98
7	Condensed Refrigerant	NA	110	43
8	Evaporator Pump Refrigerant	NA	41	5
9	System Chilled Water/Entering	NA	54	12
10	System Chilled Water/Leaving	NA	44	7
11	Absorber Cooling Water	NA	85	29
12	Absorber Leaving/Condenser Entering Cooling Water	NA	94	34
13	Condenser Leaving Cooling Water	NA	101.6	38.6
14a	Steam Entering Unit @12 psig @ Sea Level	NA	244	118
14b	Hot Water Entering Unit @270°F (option)	NA	270	132
15a	Condensate Leaving Generator	NA	244	118
15b	Hot Water Leaving Generator (option)	NA	222	106

(3) Sequence of Operation

The sequence of operation illustrates time and events that occur at initial power-up, at startup when auto is selected, or auto off cycle, or manual stop operation. The time line sequence of operation follows the events that are discussed in the following text.

The time line illustration indicates time and corresponding event. The operator interface displays the time and events that are referenced in the sequence as they occur. Familiarization with the sequence helps to understand when external and internal control devices are cycled on or off. The time line provides information that may not be obvious when watching the display. Additionally, this information can be used for abnormal operation troubleshooting purposes.

Operational Diagnostics During Machine Startup.

During the machine start sequence, the chiller relies on external devices to successfully start and provide correct feedback. Specifically, the devices and diagnostics include the chilled water and condenser pump starter, flow switch confirmation, and ventilator fan operation. The appropriate message will be displayed on the operator interface as the start sequence progresses.

The UCP2 waits up to four minutes and fifteen seconds for proof of chilled water flow, after a water pump start command output is enabled. Failure to receive chilled water flow confirmation within the allotted time results in a message stating "Diagnostics -auto." This is a MAR-auto

restart diagnostic where the chiller will start once the chilled water flow switch logic is satisfied.

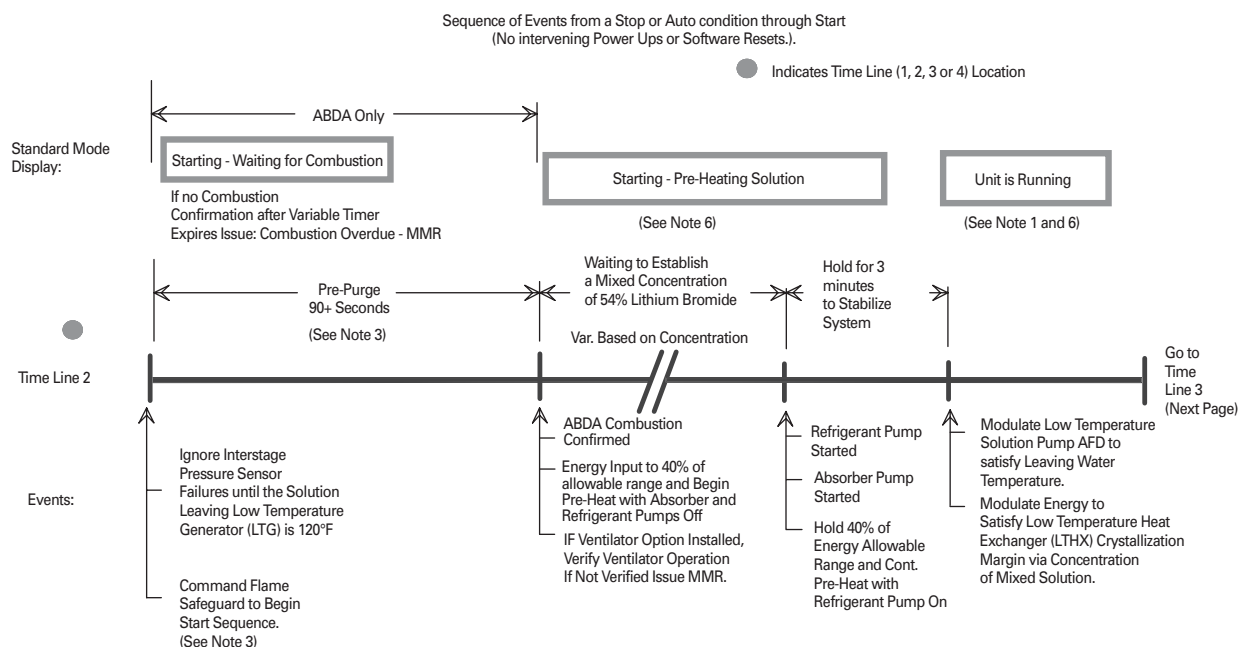
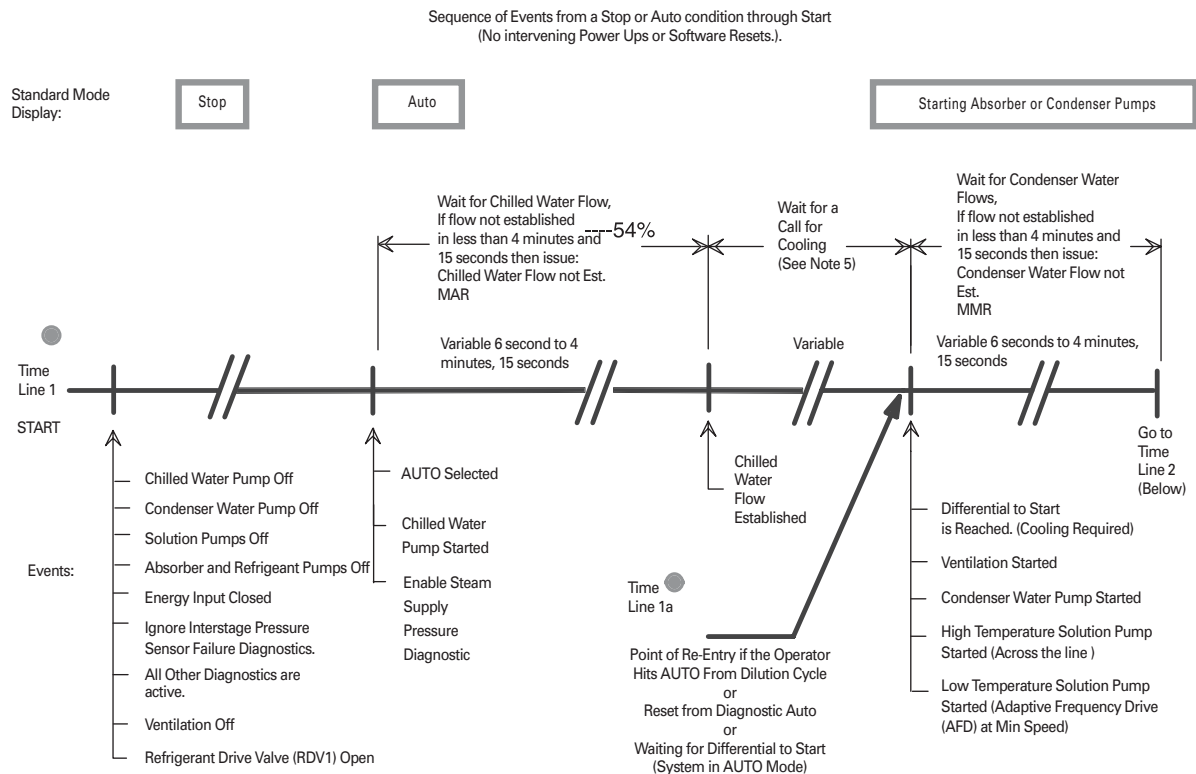
Failure to receive condenser water flow or ventilator fan confirmation within the time period's results in an MMR-Manual restart diagnostic where the chiller must be reset before continued operation is allowed.

ABDA Burner Sequence

The burner start sequence is the same for cooling or heating operating. Always refer to the burner manufacture literature and the actual sales order which may have inclusions for special devices. A typical burner sequence of operation is provided in the burner section of this manual. The burner has a flame safeguard device that controls the burner when there is a call for heat from the chiller panel. The flame safeguard controls burner startup, shutdown, and monitors burner operation. After confirmation of combustion, the chiller sets the burner-firing rate via an analog signal from the burner module. The fire rate signal is proportional to the energy input as determined by the chiller control.

Sequence of Operation

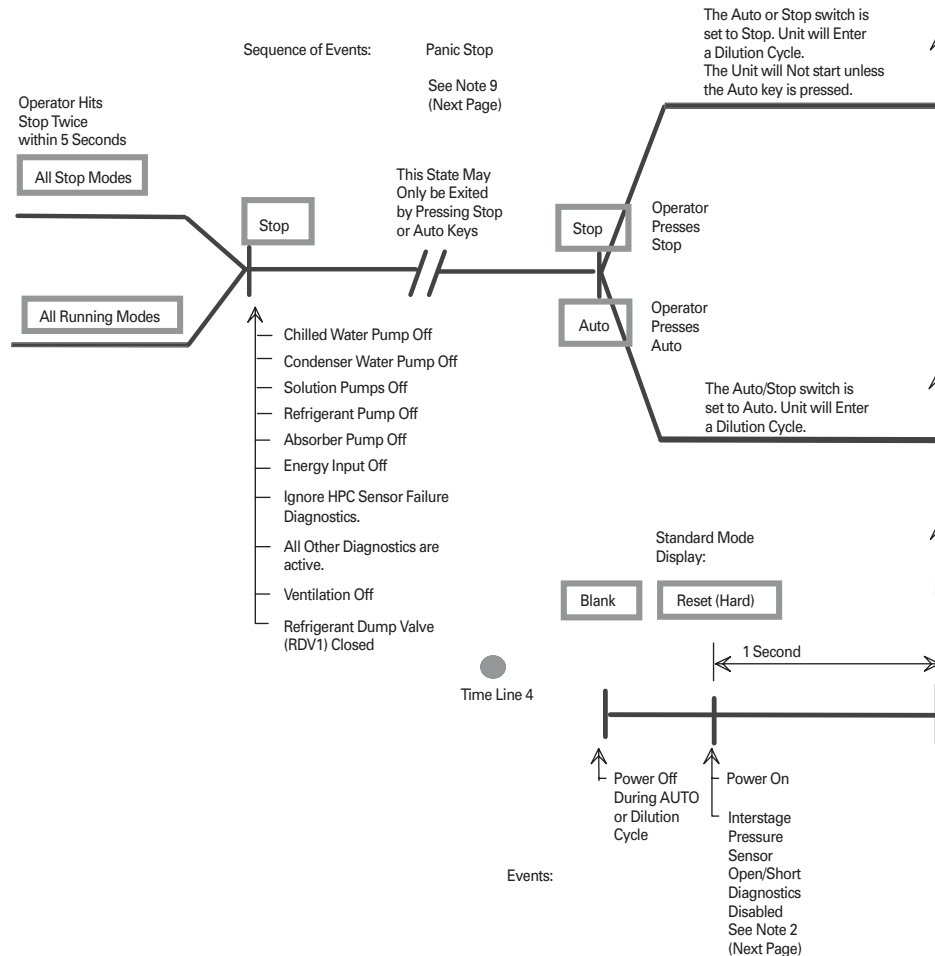
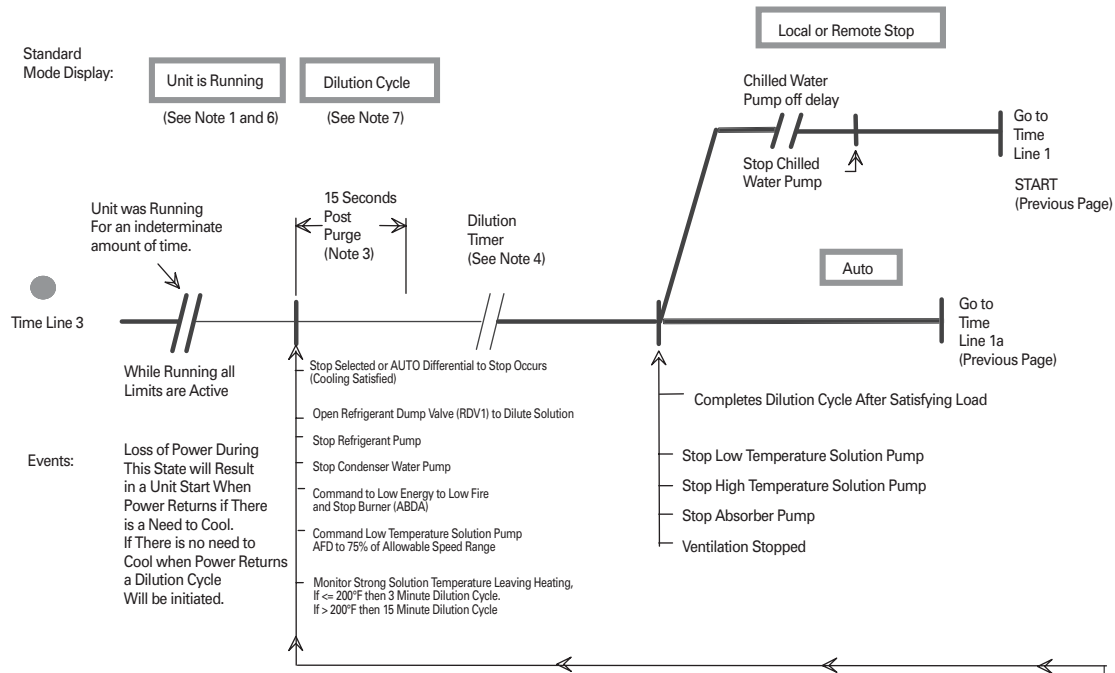
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Sequence of Operation

(Notes - Reference Next Page)

Sequence of Events: From Running through Dilution Cycle
(No intervening Diagnostics or Software Resets.).



Sequence of Operation Time Line

Referenced Notes (See pages 11 & 12)

- 1) See "Using the Control Panel" for a listing of valid modes that may occur during "Unit is Running."
- 2) Upon power up, refrigerant dilution valve 1 (RDV1) remains off for thirty seconds.
- 3) Model ABDA Only - For the specific flame safeguard sequence see the appropriate burner literature.
- 4) When a "need to cool" exists, an incomplete dilution cycle can be exited by pressing the Auto key. The chiller will proceed with a new startup sequence.
- 5) The "Auto, waiting for a need to cool" can be exited by pressing Stop.
- 6) Power loss at this point will result in a dilution cycle upon re-establishing power, if there is no need to cool.
- 7) Power loss at this point will result in the remainder of a dilution cycle being completed upon re-establishing power.
- 8) Chilled water pump will be stopped after the dilution cycle is completed for all Machine Shutdown Auto Reset and Machine Shutdown Manual Reset except in the case of chilled water pump flow overdue where the chilled water pump signal remains on.
- 9) Panic stop; operator presses the stop key twice within 5 seconds. This state may be exited by pressing either the stop or auto key.

Startup/Shutdown

Startup Pre-heat

Solution pumps are started before energy is input.

The controls execute a pre-heat sequence upon startup to establish an adequate concentration level before releasing to closed loop control. Pre-heat sequence consists of the energy input command held at a reduced rate. (40%) until the Lithium Bromide solution concentrations reach 54%.

Service Tests: Manual energy input is allowed during this pre-heat sequence.

Control of Leaving Water Temperature and concentration are overridden.

Limits and safeties are active.

Shutdown Dilution Cycle

When the chiller cycles OFF a dilution cycle mixes the strong lithium bromide solution with refrigerant water to reduce solution concentrations and minimize the potential for solution crystallization. The dilution cycle is performed on all shutdown modes with one exception. The exception is a "Panic Stop" which consists of an operator depressing the stop key twice) within a 5 second period. This will stop the machine without the normal dilution cycle. A restart can be initiated at anytime by pressing the auto key. A dilution cycle is initiated by pressing the stop key.

Terminating the energy input, opening the refrigerant dump valve, and running the solution pump for 3 to 15 minutes dilutes the solution. This dilution cycle duration is determined by the solution temperature when the dilution sequence is initiated.

The refrigerant valve (RDV1) dumps refrigerant from the evaporator into the absorber on command to dilute the lithium bromide solution. This action occurs when a dilution cycle or safety shutdown is initiated by the machine control.

Solution Temperature Leaving LT6 +	Solution Temperature Leaving High Temperature Generator (HTG)	Dilution Time
Less than 158°F	Less than 200°F	3 minutes
Greater than or Equal to 150°F	Greater than or Equal to 200°F	15 minutes

During the dilution cycle Refrigerant Dump Valve 1 (RDV1) opens. Once opened, RDV1 remains open until the dilution cycle is completed, or the machine is restarted after power failure, or control reset.

The operator can abort the dilution cycle to restart the unit by pressing the auto key to restart. The chiller will restart if the LEAVING WATER TEMPERATURE is greater than the differential to start set point.

If a reset is performed during the dilution cycle, and there is dilution time remaining the dilution cycle will be continued.

Normal Stop

Press the stop key for a machine stop mode. The alternate methods to stop are the External stop input and remote clear language display (CLD) "Stop". Reaching the differential to stop chilled water setpoint is another condition that results in a shutdown sequence and is followed by a restart when the differential to start chilled water set point is reached.

The stop mode shutdown sequence is as follows:

When the CLD stop command is initiated, the burner is driven to low fire. A 30-second run unloaded delay, allows the burner to move to low fire, from a high fire position, before the burner start command is removed.

The solution pumps are automatically adjusted to 75% of their allowable operating range during the dilution cycle.

The condenser water and evaporator refrigerant pumps are cycled off.

The chilled water pump remains on through the dilution cycle and until the CLD adjusted CHWP time delay expires.

When the dilution cycle is complete, the machine solution pumps and ventilation fan are stopped. The RDV1, which

opened when the dilution cycle started, remains open until the machine is restarted. The CLD displays stop with the completion of the dilution cycle.

Panic Stop

Panic Shutdown (Pressing the Stop key twice within 5 Second Interval initiates a machine panic stop)

NOTE: This is not to be used unless absolutely necessary. Failure to properly dilute lithium bromide can crystallize the chiller.

Panic stop can only be exited at the local CLD. When a panic stop is initiated the following events occur:

- The machine solution pumps are stopped immediately and without a DILUTION cycle.
- The chilled water pump (CHWP) and cooling water pump (CWP) are also commanded off immediately.
- The Refrigerant Dump valve (RDV1) is opened to dilute the lithium bromide in the absorber with refrigerant.
- The Ventilator fan is stopped.
- The Energy input start command is removed, stopping the burner.
- The CLD will display "Panic Shutdown"

To exit Panic Shutdown either press AUTO or STOP.

Pressing the STOP key will initiate a dilution cycle. Pressing the AUTO key will allow a chiller restart.

The chiller will then resume normal operation assuming that the panic condition was corrected prior to restart.

Safety Reset

If the operator performs "Reset" during the dilution cycle, the control remembers the amount of time remaining in the current dilution cycle. Once the reset is complete, the dilution cycle will be re-entered automatically. If the machine was operating when a safety shutdown occurred the machine will resume normal operation after resetting the CLD.

(4) Control Panel Identification

The following information explains the details of chiller control. The details include hardware identification and location, control strategies, limits and operating sequences.

Control Panel Location and

Internal Hardware

Component Description

The main control panel (Figure 3) has two sections. The left side (control side) includes clear language display (mounted through door), chiller, circuit, purge, stepper, and optional communications modules, a terminal block, and a 115Vac-control voltage to 24Vac transformer. The right side (power side) consists of a main line voltage terminal block or disconnect service for line power connections, line voltage to control voltage transformer, relays, transformers, starter module and purge module. Line voltage is restricted to the right-hand side.

The inner control panel components are illustrated in Figure 4. Modules are stacked in a top, bottom or middle configuration.

Voltages in Panels

Voltages present within the unit control panel includes:

- Three phase line voltage (power side only)
- 115Vac control circuits
- 24Vac module power supply

Low voltage, low power (30Vdc or less — Class II) circuit connection points are located on the left side of modules. High voltage, high power (greater than 30Vdc — Class I) circuit connection points are located on the right side of modules. All 115Vac circuits are Class 1. See Figure 5.

The stepper drive uses less than 30Vdc however, the output signals are Class 1 due to its output current (amps).

Class 1 and Class 2 wiring must not be routed together without shielding.

Figure 3. Machine control panel

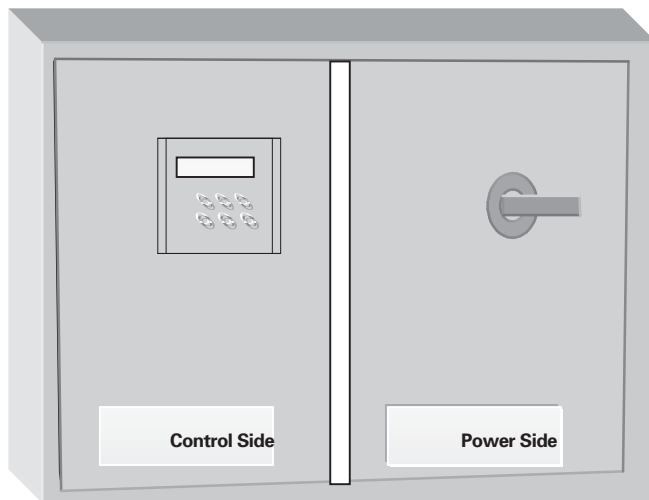
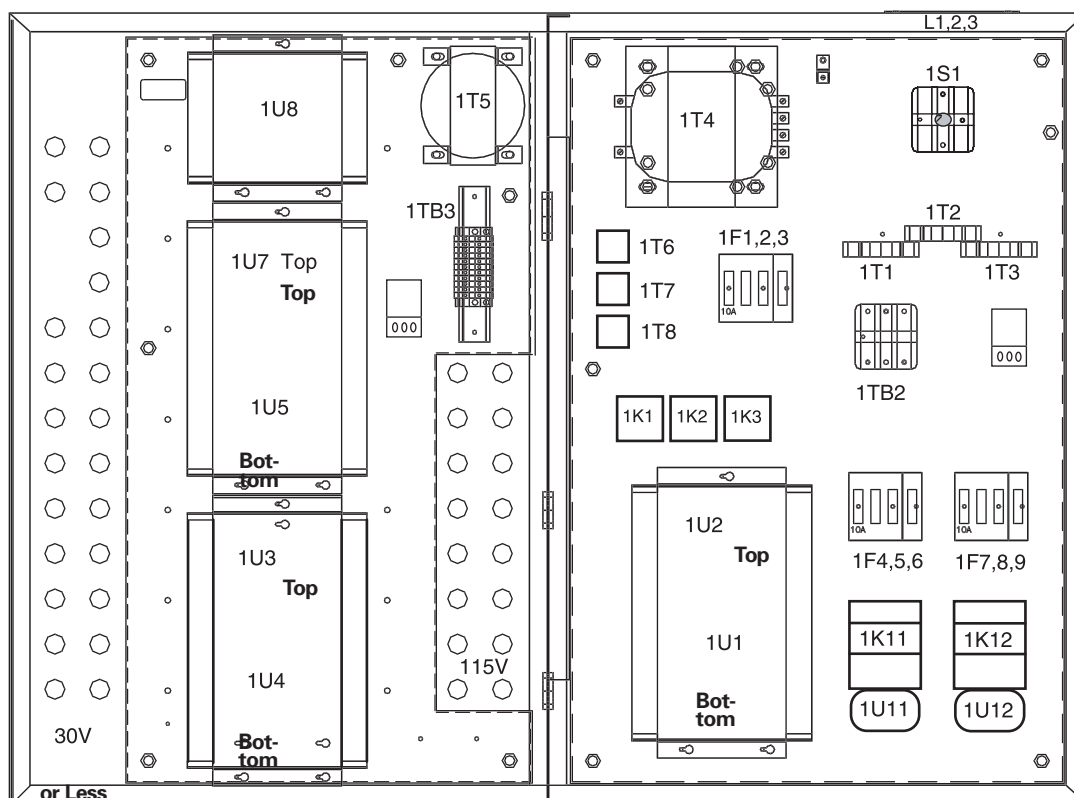


Figure 4. Panel layout



Panel Layout Legend

1U1 - Starter Module
1U2 - Circuit Module
1U3 - Chiller Module
1U4 - Purge Module
1U5 - Stepper Module
1U7 - Options Module *
1U8 - Tracer Communication Module *
1U9 - Remote Clear Language Display * IPC Buffer Module
1U10 - Printer Communication Module *
1T1-2-3 - Phase Current Transformer
1T4 - Line Voltage Transformer
1T5 - Control Voltage Transformer
1T6-7-8 - Under-Over Phase Voltage Transformers *
L1-2-3 - Main Power Entrance
1TB2 - Pump Motor Terminal Block
1TB3 - UCP2 Control Panel Mounted Terminal Strip

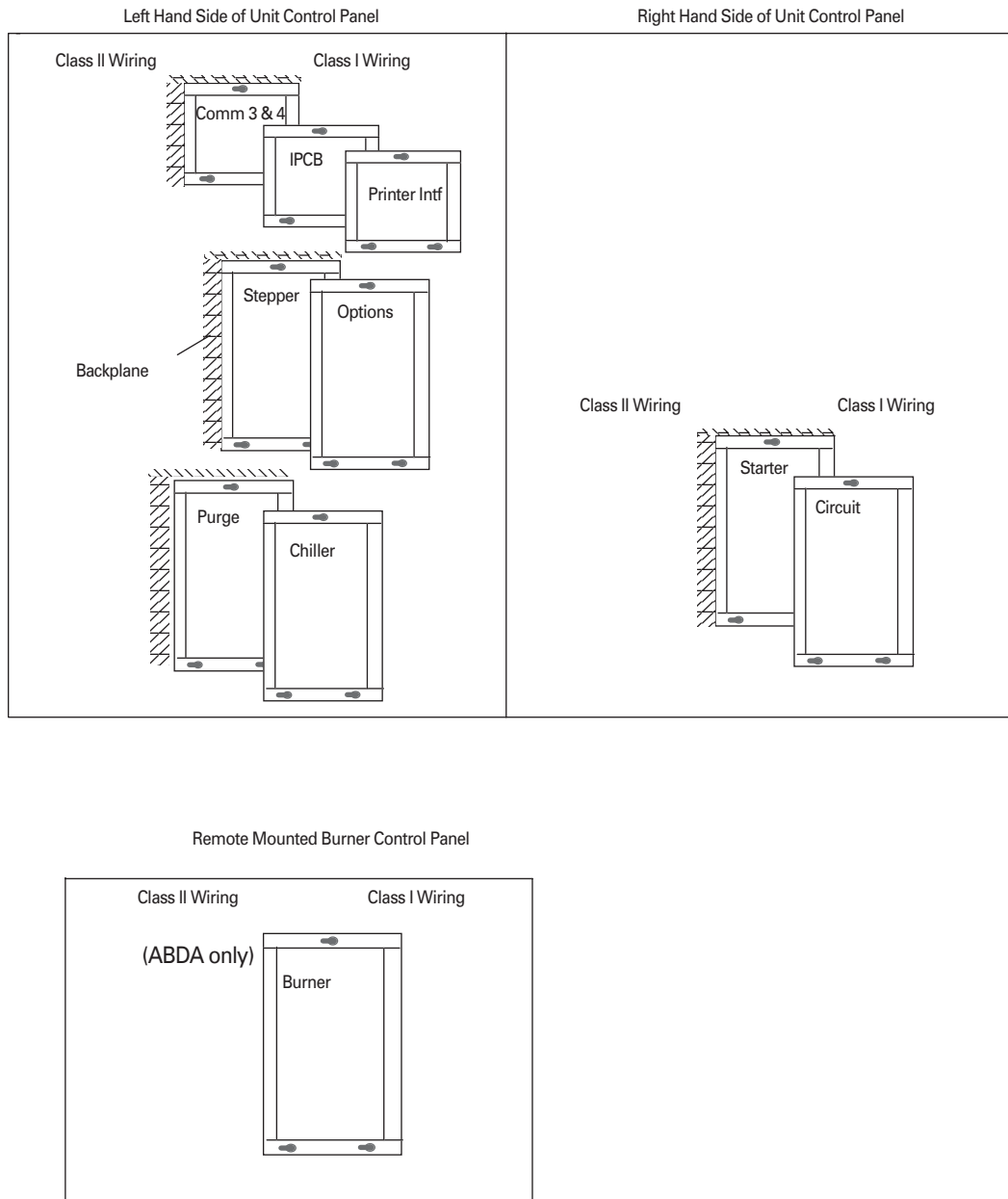
* Not Standard

1S1 - Line Voltage Fused Disconnect Switch *
1K1 - Refrigerant Pump Abnormal Relay
1K2 - High Temperature Solution Pump Abnormal Relay
1K3 - Interstage Vapor High Pressure Cutout Relay
1K11 - Refrigerant Pump Contactor
1K12 - HT Solution Pump Contactor
1U11 - Refrigerant Pump Overload
1U12 - HT Solution Pump Overload
1F1, F2 - Line Voltage Transformer Fuses
1F3 - Phase Voltage Transformer Fuse *
1F4, F5, F6 - Refrigerant Pump and Absorber Solution Pump Motor Fuses
1F7, F8, F9 - High and Low Temperature Solution Pump Motor Fuses

Control Modules

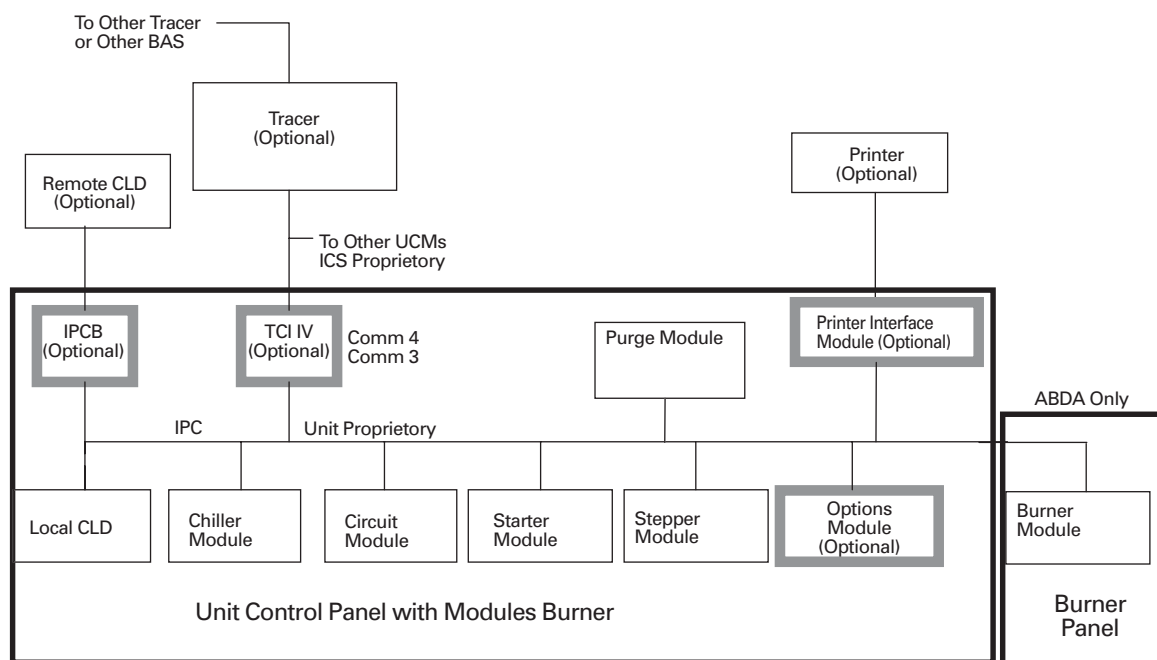
Microprocessor control modules are mounted on the left-hand and right-hand side of the main unit control panel and in the burner control panel.

Figure 5. Location of microprocessor control modules within the main unit control panel and burner panel



Signal Block Diagram

The following block diagram illustrates the interrelationship of the interprocessor communications (IPC) link. These connections allow the individual microprocessors to communicate. All standard control modules are mounted in the chiller control panel with the exception of the burner module, which is mounted in the burner control panel. The option modules (shaded box) are present only when specified. The Tracer, printer, and remote CLD are optional components that provide communications outside of the unit control panel. The remote CLD is the only communication device that is installed outside of the machine control panels.



Note: The Tracer and Printer are not expected to exist together in an installation.

The **Chiller Module (1U3)** serves as the master control for the unit. It is responsible for implementing the Leaving Water Temperature control algorithms that control chiller capacity. The chiller module manages machine safety, operating limits, and chilled water temperature by monitoring unit-mounted sensors and information from other modules on the interprocessor communications (IPC) link.

When machine-operating conditions change, the chiller module initiates communications to the other panel modules to manage that change. The input or output ports on the chiller module monitor and/or control-chilled water

pumps are electrically controlled and interlocked to the unit control panel. This interlocking arrangement provides protection from improper system water pump control or loss of flow conditions, which can damage the machine.

This module communicates with the stepper module to control machine energy input, the starter module to start or stop solution pumps, control solution flow, and the operator interface to display operation status information to the operator.

Setpoint Communication and Storage

The machine setup information selected at the operator interface is stored in the chiller module memory. This module contains non-volatile memory that is retained when the panel is not powered. The

and cooling water pump operation. The evaporator and condenser water module is responsible for verifying that the setup memory is not corrupted, and for substituting default settings if the stored settings become corrupted.

1U1 Starter Module

The starter module controls pump operation and provide an interface to the adjustable frequency variable speed drives for lithium bromide solution flow control.

1U2- Circuit Module (standard)

The circuit module is located in the lower portion of the control panel beneath the Chiller module. The main purpose of the circuit module is to control and manage the Lithium Bromide. The circuit module is responsible for implementing the concentration control algorithm. Also, the circuit module collects input data from unit temperature and pressure sensors, and switch inputs, and makes this information

available to the chiller module via an interprocessor communications link. This module also provides output contact closures for control devices.

1U4 Purge Module

The purge module manages the purge system logic. In auto mode, the module monitors a sensor located on the condensing unit suction line to determine when pumpout is required. A module output then turns on the pumpout cycle. The pumpout cycle data is monitored and stored. This information is available from the clear language display (CLD).

1U5 Stepper Module (standard)

The stepper module 1U3 receives input from unit sensors and binary input devices. This information is provided to other modules as needed on the IPC link. The stepper output is used to control the hot water valve when the heating option is specified and the energy value for steam or hot water indirect fired units.

1U6 Local Clear Language Display (LCLD, or Operator Interface)

The LCLD is mounted on the control panel door. The module has connecting wiring accessible on the door backside. The LCLD is used to communicate with the chiller module in order to change various machine-operating parameters and monitor machine data. See the operator interface for complete details.

1U7 Options Module

When optional functions are specified that require additional input or outputs (I/O) option modules are used. Some of these options are standalone, such as Generic BAS interface; other options support other additions to the chiller control. Features supported by the options module are external chilled water and hot water setpoint and other hot water simultaneous heating requirements.

1U8, 9,10 Optional External Communications Modules

- **IPC Buffer Module** - Used to communicate to external devices.
- **Printer Communications Interface** - required for printer compatibility.
The printer interface module provides a pre-formatted chiller log to a printer. The printer interface can be programmed via the LCLD to print a chiller log on command, at the time of a diagnostic, and/or on a periodic basis.
- **Tracer Communications Interface Module** - Required for Tracer compatibility.
Comm 4 are an optional module that provides a 9600-baud non-isolated communications link to SUMMIT. Comm 3 is an optional module that provides a 1200 baud isolated communications link to TRACER 100.

3U3 Burner Module (ABDA only)

The burner module serves as an interface to the burner and flame safeguard control. Some of these functions include burner start, reset, and fuel select, alarm feedback, and combustion confirmation and provides an interface for burner firing rate modulation output. The burner module also houses the simultaneous heating water control algorithms providing control output for the heating system water valve located on the optional auxiliary heat exchanger. The burner module has other input or output (I/O) capabilities used to support I/O expansion.

Terminal Blocks

Terminal blocks are utilized for various connection points within the control panel as identified below.

- 1TB1 Main power terminal block (standard).
- 1TB2 Pump Motor Terminal Block - Line voltage distribution point for the three phase solution pump motors.
- 1TB3 Control Panel Mounted Terminal Strip - Provides termination points for internal wiring, and also for field wiring interface points. See the electrical connection points on the typical unit schematics.

Main Power Termination Point

The connection point in the power section for customer three phase power.

- 1TB1 Main terminal block (standard).
- 1S1 Line voltage non-fused disconnect switch -optional.
- Circuit breaker or shunt trip circuit breaker - optional.

Circuit Breakers and Fuses

Circuit breakers and fuses provide the branch circuit protection identified.

- 1CB2 Line voltage transformer circuit breaker
- Circuit breaker provides branch circuit protection to 1T5 primary winding.
- 1F1, 1F2 Line voltage transformer fuses
- 1F3 Phase voltage transformer fuse
- 1F4, 1F5, 1F6 Refrigerant and absorber solution pump motor fuses.
- 1F7, 1F8, 1F9 High and low temperature solution pump motor fuses
- 1F10, 1F11, 1F12 Burner fan motor fuses (ABDA only)

Relays

The following relays are utilized to isolate the starter panel signals from low voltage control panel module input signals.

- 1K1- Refrigerant pump abnormal relay.
- 1K2- High temperature solution pump abnormal relay.

Transformers

Transformers are utilized to reduce voltage levels. Some are used to distribute power and others for module input signals. The various transformers are identified below.

1T1, 1T2, 1T3 Phase Current Transformers

Current transformers are used to sense the 3 phase current draw of the total system. The output of each current transformer is input to the 1U1 starter module. Current transformers are polarity sensitive. Typically, there is a marking "dot" on one side and the secondary wires are black and white. The installation of the transformers must be with the markings all facing the same direction in reference to the current flow through the primary wiring. The current transformer outputs are input to the starter module, which monitors current.

Total Motor Current Monitoring

Current transformers are used to monitor total unit currents. See Table 3 to select CT Rating. In many cases more than one selection is possible:

1. Locate unit RLA in left column.
2. Determine the Current Transformer (CT) Meter Scale [Rated Primary Current of Current Transformer (CT) / Number of Primary Turns] located in right
3. Determine the Current Transformer (CT) Factor = (Actual Motor RLA / Current Transformer (CT) Meter Scale) x 100%
4. In this case the Rated Primary Current of the Current Transformer (CT) should be picked to be greater than Actual Motor RLA x Number of Primary Turns. The Current Transformer (CT) Factor must be 66% or greater but not more than 100%.
5. From the calculated Current Transformer (CT) Factor the Motor Overload settings can be found in Table 4.

Table 3. Current transformer selection table for single CT and phase systems

Unit RLA	CT Rating (Assumes Single Pass through CT Core Unless Noted Otherwise)	CT Meter Scale Value
5.6 - 8.3A	8.3A (50A with Six Passes Through Core)	50A/6 = 8.333A
6.7 - 10A	10.0A (50A with Five Passes Through Core)	50A/5 = 10A
8.4 - 12.5A	12.5A (50A with Five Passes Through Core)	50A/4 =
11.2 - 16.6A	16.6A (50A with Three Passes Through Core)	50A/3 = 16.67A
16.7 - 25A	25.0A (50A with Two Passes Through Core)	50A/2 = 25A
25 - 37.5A	37.5A (75A with Two Passes Through Core)	75A/2 = 37.5A
33.4 - 50A	50A	50A
50 - 75A	75A	75A
67 - 100A	100A	100A
100 - 150A	150A	150A
134 - 200A	200A	200A

Table 4 - Current gain settings as a function of CT factor for UCP2 starter module

CT Factor	Current Gain Setting
66	00
67	01
68	02
69	03
70	04
71	06
72	07
73	08
74	09
75	10
76	11
77	12
78	13
79	15
80	15
81	16
82	17
83	18
84	19
85	20
86	21
87	22
88	22
89	23
90	24
91	25
92	25
93	26
94	27
95	28
96	28
97	29
98	30
99	30
100	31

1T4 Line Voltage Transformer

Transformer that steps down line voltage to 115Vac control powered circuits.

1T5 - Control Voltage Transformer

Transformer that steps down the 115Vac control voltage to 24Vac power.

1T6, 1T7, 1T8 Under-Over Phase Voltage Transformer (Optional)

Voltage potential transformers provide an isolated secondary voltage that is a proportional representation of the primary voltage. Each line voltage of the three-phase supply to the unit control panel is sensed. Each potential transformer's low voltage output is input to the 1U5 starter module.

Contactors

Contactors are used to control the line voltage supplied to the pump motors

- 1K11 - Refrigerant pump contactor
- 1K12 - High temperature solution pump contactor

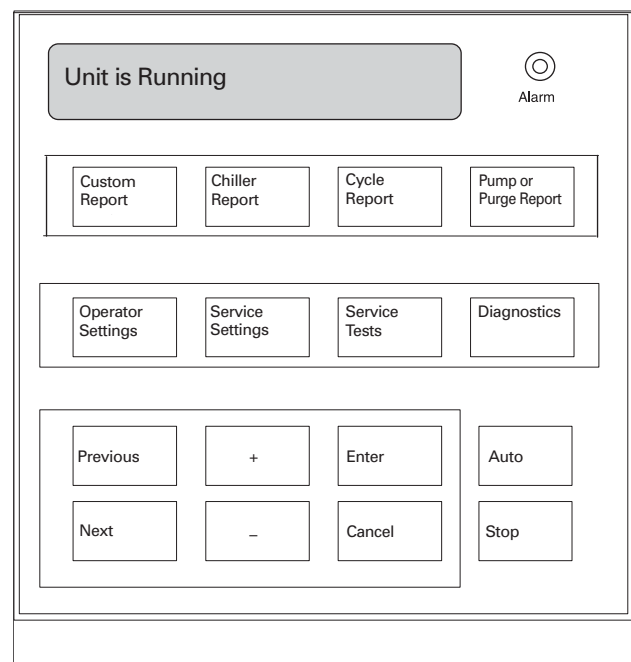
(5) Using the Control Panel

The operator interface or local clear language display (LCLD) is used to communicate with the chiller. The machine operator can select information displayed from group menus that have predetermined information. All operator selected and monitored information is entered and displayed from this device. The operator interface obtains the selected setup values and data from the interprocessor communications (IPC) link. The settings and temperatures will not be displayed until they have been read via the IPC. Displayed items, such as temperature, will be updated every two seconds. Service mode menus provide machine setup, service tests, and manual control operation. The LCLD has four operator report menus and four select settings group menus. A detailed description of menu use and function follows later in this section.

Display

Figure 6 illustrates the operator Interface which has a two-line, forty-character display, an alarm indicator (LED), and a keypad for the selection of specific chiller information. The display has backlighting for legibility in low light conditions. The backlight is also used to maintain the operating temperature of the display. During low ambient temperature periods the backlight will illuminate.

Figure 6. Operator interface (Local Clear Language Display - LCLD)



The panel controls the backlight current based on the equipment room ambient temperature.

Menus

The display has access to the current operation status, specific machine data, machine setup, service, and diagnostic messages. Details of these menus are discussed later in this section

Alarm LED.

- 1) The single red LED (located to the right of the display) will BLINK whenever a machine manual reset (MMR) diagnostic exists and manual machine reset is required to restore operation. This light is also lit when a manual service function is set to manual.
- 2) The alarm LED will illuminate continuously when a service test item is placed into manual mode operation. The LED serves as a reminder that something remains in manual mode. Manual mode operation of any service tests (password protected) item must be terminated before the machine is allowed to operate unattended in the auto mode.

Operator Interface (LCLD) Operation

Keypad

Figure 6 illustrates the operator interface keypad. The keypad is a sealed membrane type with 16 keys arranged 4 by 4. The keys are separated into three fields:

- 1) Report keys are located across the top row and are used for viewing of preformatted information.
- 2) The second rows of keys are settings group menus. These menus can have security passwords at operator and service levels.
- 3) Functional keys are located across the bottom two rows and are used to input changes.

The functional keys are discussed next since the operation determines how the user communicates with the report and settings menus.

Functional Keys

The **Next** and **Previous** keys allow the operator to step through the various menus within a group. The report group will sequence around to the top or bottom of that group when the end or beginning is reached, respectively. The **(+)** and **(-)** keys cause the displayed values to increase or decrease, respectively. If the **(+)** or **(-)** key is held down for more than 1/2 second it will increment or decrement the setting continuously at 10 counts per second, until the key is released. (Settings do not wrap around when the end of range is reached). Once the **(+)** or **(-)** key has been pressed to select a particular setting, the **Enter** key or **Cancel key** must be pressed. (The **Next** or **Previous** keys will not advance until **Enter** or **Cancel** is pressed). A Setting is not changed until the **Enter** key is pressed. The **Cancel** key is pressed if a changed setting should not be saved. When the **Enter** key is pressed the display will blank out momentarily to indicate to the operator that the keystroke was recognized.

If the boundaries of a specific selection are exceeded the operator interface will display out of range and will not allow that selection to be entered.

When **Auto** is pressed the chiller will enter an auto mode of operation.

When **Stop** is pressed the chiller will stop, entering the "Unit is Preparing to Shutdown" mode.

During the five-second period a message indicating the optional emergency stop command will be displayed. The **Stop** key is located in the lower right hand corner.

WARNING

If the Stop key is pressed a second time within five seconds an immediate "Panic Stop" will be executed, overriding the normal "Unit is Preparing to Shutdown" mode.

To restart the dilution cycle, press the **Stop** key. To reenter the auto mode press **Auto**. If the leaving water temperature does not exceed the differential to start, the machine will finish dilution and remain in standby until the water temperature requires a restart. The "Auto waiting need to cool" is now displayed on the CLD. If the leaving water temperature is greater than differential to start, then the restart auto sequence will occur.

When the **Auto** or **Stop** key is pressed the display will go to the first display of the Chiller Report indicating the current operating mode.

Using Group Menus

1. Select one of the group keys labeled **Chiller**, **Cycle**, or **Purge-Pump** that contain preformatted reports menus. Pressing Custom Report will bring up its header display, however; there may not be any items within this group at this time. They can be operator selected from the other menus in the top row of the LCD. Pressing Operator Settings, Service Settings, Service **Tests**, or **Diagnostics** will bring up its header display. See the operator interface overview for a listing of display headers and the menu items.

2) While scrolling through the displays within each group menu, press the **Next** key to advance, or press the **Previous** key to backup. To quickly go to the last menu item, press the **Previous** key at the display header.

To Create the Custom Report:

1. Go to one of the Report Groups (Chiller, Cycle, and Pump/Purge) and select the desired menu item to add to the Custom Report.

2. Press the **(+)** key. The item is now entered into the Custom Report group.

3. To add another item repeat steps 1 and 2.

4. Up to twenty items can be entered into the Custom Report group. When there are twenty items in the report no more can be added until one is removed.

5. To remove an item from the Custom Report, press the **(-)** key, while it is displayed.

To Change Settings

1. Press the appropriate settings group key.

2. Press the **Next** key at the header display.

3. Enter password if required (see page 60).

4. Use the **Next** or **Previous** keys to bring up the item to be changed.

5. When the item to be changed is on the display, press the **(+)(-)** to bring up the new value.

6. Press **Enter** to enter the new value. Press **Cancel** to keep the previous value.

To Reset the Chiller

1. Press the **Diagnostics** group key.

2. The **Diagnostics** display header will be shown. Press the **Next** key.

3. Enter password if required

4. View all active diagnostics displayed. Investigate and correct the problem that caused the shut down, before proceeding to restart the chiller.

5. To reset the chiller press **Next** until the diagnostics clearing display stating "Press **(Enter)** to clear all diagnostics and reset system" is displayed. Press **Enter**. With the diagnostic cleared, the chiller will return to the operational mode that was interrupted by the diagnostic. The chiller must not be reset until the diagnostic condition is addressed, and corrected. If required, contact the local Trane service agency for assistance.

6. The **chiller will restart if "auto" operation was interrupted and the differential to start set point is satisfied**. If machine shutdown is desired, press stop. This prevents a machine start when the control is reset.

To Change Setpoint

1. Press Operator settings key.

2. Use the **Next** key to advance to the "Front Panel Chilled Water Setpoint.

3. Using the **+ or -** keys change the setpoint as desired. Press **Enter**.

Purging

The purge operation mode is normally set to "ON" mode.

While in ON, purging will occur during machine auto and stop modes of operation. To check or set to mode:

1. Press **Operator Settings** key.
2. Press **Next** to advance to the "Purge Operating Mode" display.
3. Use **+ or -** keys to toggle between on, stop, or service pumpout. Select **ON** and Press Enter.

For manual **on** purging see maintenance section.

Operator Interface (LCLD) Overview

The following is a listing of preformatted menu information contained in the operator interface, including options.

Menu items are listed in sequence and in columns under each group key.

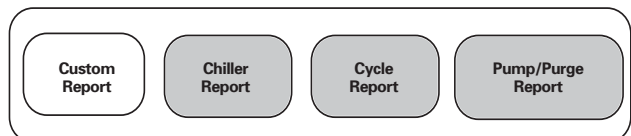
Operator Interface Detail

This section provides the detailed menu information available from the operator interface.

Report Menus

The **Report Keys** (top row) allow the operator to access four menus labeled CUSTOM, CHILLER, CYCLE, and PUMP/PURGE. The CUSTOM report is operator selected. The (CHILLER, CYCLE, and PURGE/PUMP) have preformatted menus that cannot be altered.

When a report group key is selected, the menu header is displayed. The header indicates the title of the report group and a brief summary of the reports in the group. This feature allows the user to determine if the desired information is in the group. The header also serves as the top of the report indicator.



Custom Report

The **Custom Report** contains information selected by the operator. The operator can select and display up to twenty items from the CHILLER, CYCLE, and/or PUMP/PURGE report groups. The Custom report menu is the only information that can be selected by the user.

The custom reports are easily programmed by the following sequence:

To create a custom report when the desired report is being displayed from one of the other report menus, press the (+) key. The custom report group can holdup to 20 entries. Attempting to enter more results in the display indicating "User Report -> Full." To remove reports from the custom group, simply press the (-) key while it is being displayed. The custom report sequence starts with the following header display:

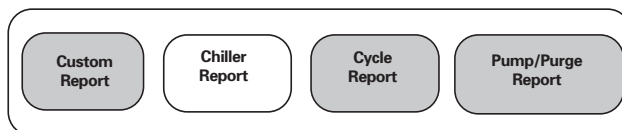
*User Defined Report
Press (Next)(Previous) to Continue*

If no entries are selected and the Next key is pressed, the following is displayed:

*No Items are selected for Custom Report
See Operators Manual to Select Entries*

If entries exist they will be displayed in the order that they were selected from the other report groups.

The preformatted **Chiller Report, Cycle Report, and Pump/Purge menu** groups contain information that cannot be changed.



Chiller Report

The **Chiller Report** has information about **machine** status, water temperatures, and setpoints.

1. The **Chiller Report** header is displayed upon normal power-up and when the "Chiller Report" key is pressed.
*Chiller Status, Water Temperatures and Setpoints
Press (Next)(Previous) to Continue*

Pressing "Next" or "Previous" will sequence to the next two informational lines of display.

2. Chiller Operating Mode: Two lines of display indicate the Chiller Operating Mode depending upon machine status, various chiller operation modes that can be displayed are illustrated in the column to the right. In the case of timing functions, line 2 indicates the associated timer information. Timer functions inform the operator of expected sequence of operation delays.

*Operating Mode Line 1
and Line 2*

Typical “Chiller Operation Mode Displays” are provided in the following table.
(This is not an all-inclusive listing)

Machine Condition	Displayed Message (First Line/Second Line)
Reset	Resetting
Stop	Local Stop: Cannot be overridden by any External or Remote Device
Remote Stop	Remote Display Stop: Chiller may be set to Auto by any External or Remote Device
External Unit Stop	Remote Run Inhibit from External Source
Unit Remote Stop	Remote Run Inhibit from Tracer
Start	Initializing
Start	Starting is Inhibited by Staggered Start Time Remaining: Minute or Second
Auto	Auto Waiting for Evaporator Water Flow
Auto	Waiting for Tracer Communications to Establish Operating Status
Auto	Auto Waiting for a Need to Cool
Auto	Auto * Waiting for a Need to Heat
Auto	Auto * Waiting for a Need to Cool/Heat
Auto	Waiting for Auxiliary Water Flow *
Start	Starting - Waiting for Absorber/Condenser Water Flow
Start	Starting Solution Pumps
Start	Waiting for Ventilation
Start	Starting - Waiting for Combustion
Start	Starting-Preheating solution
Start	Starting - Pre-heating Solution Spray Pumps Off
Start	Starting - Pre-heating Solution Spray Pumps On
Run: Normal Cooling Only	Unit is Cooling
Run: Normal Heating Only	Unit is Heating*
Run: Normal Cooling Priority	Unit is Cooling and Heating *
Run: Normal Heating Priority	Unit is Heating and Cooling *
Run Softload	Unit is Running Softloading
Run: Solution Flow Limited by Low Pressure	Unit is Running: Low Interstage Pressure Limit

* ABDA Only with Heating Option (Shaded)

	Continued from Column 1
Run: Low Cooling Water Temperature Limit	Unit is Running: Low Absorber or Condenser Temperature Limit
Run: Evaporator Limit	Unit is Running: Low Evaporator Refrigerant Temperature Limit
Run: Solution Flow Limited by High Interstage Pressure Limit	Unit is Running: High Interstage Pressure Limit
Run: Generator Solution Temperature Limit	Unit is Running: High Generator Solution Temperature Limit
Run: High Exhaust Gas Temperature Limit	Unit is Running: High Exhaust Gas Temperature Limit
Run: Burner Cycled Off	Unit is Running: Burner Cycled Off
Run: Crystallization Sensing Detection and Recovery	Solution Recovery: Pump Off Time Remaining: Minute or Second
Run: Crystallization Sensing Detection and Recovery	Solution Recovery: Pump Off Time Remaining: Minute or Second
Dilution Cycle	Dilution Cycle Remaining: Minute or Second Waiting for a Need to Cool
Dilution Cycle	Dilution Cycle Remaining: Minute or Second Diagnostic Shutdown Auto
Dilution Cycle	Dilution Cycle Remaining: Minute or Second Diagnostic Shutdown Stop
Dilution Cycle	Dilution Cycle Remaining: Minute or Second Local Stop
Dilution Cycle	Dilution Cycle Remaining: Minute or Second Remote Stop
Dilution Cycle	Dilution Cycle Remaining: Minute or Second Remove Run Inhibit from External Source
Dilution Cycle	Dilution Cycle Remaining: Minute or Second Remote Run Inhibit from Tracer
Dilution Cycle	Dilution Cycle Remaining: Minute or Second Waiting for Absorber or Condenser Flow
Dilution Cycle	Chilled Water Pump Delay Time: Minute or Second
Stop: Transitioning to Stop	Transitioning to Stop
Panic Shutdown	Panic Shutdown Sequence Complete Press Auto or Stop to Continue
Diagnostic Shutdown Stop Mode	Diagnostic Shutdown Stop
Diagnostic Shutdown Auto from Auto Mode	Diagnostic Shutdown Auto

The following displays appear as the next key is pressed to advance through the menu.

The displays are self explanatory except as noted. Some displays are present only when the option is selected. In some cases options are user selectable, others are factory selected per order.

3. Active Priority Setpoint-Heat or Cool Priority Setpoint Source Setpoint **(only with Auxiliary Heating option is installed)**

<i>Priority</i>	<i>Status 1</i>
<i>(settings source) Priority:</i>	<i>Status 2</i>

The unit can be selected as cooling only, heating only, cooling priority, and heating priority. The following display identifies the active priority AND where the priority selection originated.

- Status 1 and 2 will be one of the following: 1) Cooling Only, 2) Heating Only, 3) Cooling Priority, 4) Heating Priority
- Settings source will be one of the following: 1) Front Panel, 2) External, 3) Tracer

Notes about diagnostics occurring during simultaneous operation:

- Diagnostics occurring that effect the priority mode will shutdown the chiller, and alarm.
- Diagnostics occurring with the non-priority mode will cease operation in the non-priority mode and allow continued operation in the priority mode. To do this, the control system will change over to the non-simultaneous mode of operation leaving the priority mode only in operation. The diagnostic will be tagged as an informational warning (IFW) type.

These same diagnostics, if occurred in heating or cooling only mode, would be machine shutdown manual reset required (MMR), or machine shutdown automatic reset (MAR) types.

4. Chilled Water Setpoint or Evaporator Leaving Water Temperature **(unless Heat Only)**

<i>Chilled Water Setpoint (Source)</i>	<i>xxx.xf/c</i>
<i>Evaporator Leaving Water Temperature:</i>	<i>xxx.xf/c</i>

If the source is front panel then (Source) will not be displayed, otherwise (Source) will be one of the following: External, Tracer, or, Reset

5. Chilled Water Reset Source (when Enabled) Setpoint or Chilled Water Setting Source Setpoint (Unless Heat Only).

<i>(Source):</i>	<i>CWS xxx.xf/c</i>
<i>(Settings Source):</i>	<i>CWS xxx.xf/c</i>

(Source) will be either: Outdoor Air, Return Reset, or, Constant Return Reset.
(Settings Source) will be either: Front Panel, External, or Tracer.

6. Hot Water Setpoint or Evaporator Leaving Water Temperature **(unless Cool Only).**

<i>Hot Water Setpoint (Source):</i>	<i>xxx.xf/c</i>
<i>Hot Water Leaving Temperature:</i>	<i>xxx.xf/c</i>

(Source) will be either: Front Panel, External or Tracer.

7. Hot Water Reset Source (when Enabled) Setpoint/Hot Water Setting Source Setpoint (Unless Cool Only).

<i>(Source):</i>	<i>HWS xxx.xf/c</i>
<i>(Settings source):</i>	<i>HWS xxx.xf/c</i>

(Source) will be either: Outdoor Air Reset, Return Reset, or Constant Return Reset.
(Settings source) will be either: Front Panel, External, or Tracer.

8. (Unless Heating only)

<i>Chilled Water Entering Temperature:</i>	<i>xxx.xf/c</i>
<i>Chilled Water Leaving Temperature:</i>	<i>xxx.xf/c</i>

9. **(Only with Auxiliary Heating option installed and selected).**

<i>Hot Water Entering Temperature:</i>	<i>xxx.xf/c</i>
<i>Hot Water Leaving Temperature:</i>	<i>xxx.xf/c</i>

10. Absorber Entering Water Temperature:

<i>Absorber Leaving Water Temperature:</i>	<i>xxx.xf/c</i>
--	-----------------

11. Condenser Leaving Water Temperature:

<i>Press (Next)(Previous) to Continue</i>	<i>xxx.xf/c</i>
---	-----------------

12. **Option:** Chilled Water Flow or Absorber or Condenser Water Differential Water Sensing Option and devices installed.

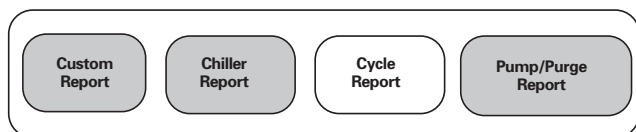
<i>Approximate Chiller Water Flow:</i>	<i>xxxgpm/lps</i>
<i>Approximate Absorber/Condenser Water Flow</i>	<i>xxxgpm/lps</i>

13. **Option:** Only with water flow option installed.

<i>Approximate Chiller Capacity:</i>	<i>xxxxTons</i>
<i>Press (Next)(Previous) to Continue</i>	

14. **Option:** Only with temperature sensor installed (or Tracer)

<i>Outdoor Air Temperature:</i>	<i>xxx.xf/c</i>
<i>Press (Next) (Previous) to Continue</i>	



Cycle Report

The **CYCLE REPORT** is used to display the current machine operating temperatures and pressures. The following menu identifies the cycle report.

1. Cycle Report

Press (Next)(Previous) to Continue

- | | |
|---|---------------|
| 2. Solution Temperature Leaving HTG: | xxx.xf/c |
| Interstage Vapor Temperature | xxx.xf/c |
| 3. Solution Temperature Entering Level Control: | xxx.xf/c |
| Mixed Solution Temperature Entering LTHX: | xxx.xf/c |
| 4. Solution Temperature Leaving LTG: | xxx.xf/c |
| Interstage Vapor Pressure: | xxx.xpsig/kpa |
| 5. HTG Leaving Concentration: | xxx.x% |
| LTG Leaving Concentration: | xxx.x% |
| 6. Burner Exhaust Gas Temperature: | xxx.xf/c |

7. Sensing Detection and Recovery (SDR)

Temperature and Trip Temperature. The SDR temperature monitor determines if lithium bromide flow is restricted at the low temperature heat exchanger. When a solution restriction is detected the SDR initiates a recovery mode to protect the solution from crystallization.

SDR Temperature:	xxx.xf/c
Trip Temperature:	xxx.xf/c

- | | |
|--|----------|
| 8. Solution Temperature Leaving LTG: | xxx.xf/c |
| Saturated Condenser Refrigerant Temperature: | xxx.xf/c |
| 9. Absorber Entering Concentration: | xxx.x% |
| Lithium Bromide Crystallization Margin: | xxx.xf/c |

The Lithium Bromide Crystallization margin is the difference between the mixed lithium bromide solution temperature leaving the low temperature heat exchanger and its theoretical crystallization temperature.

- | | |
|---|-----------|
| 10. Solution Temperature Entering Absorber: | xxx.x f/c |
| Absorber Spray: | xxx.xf/c |
| 11. Solution Temperature Leaving Absorber: | xxx.xx% |
| Lithium Bromide | |
| Solution Temperature Entering LTG. | xxx.xf/c |
| 12. Saturated Evaporator Refrigerant Temperature: | xxx.xf/c |
| Evaporator Leaving Water Temperature: | xxx.xf/c |
| 13. Evaporator Entering Water Temperature: | |

	xxx.xf/c
Evaporator Leaving Water Temperature:	xxx.xf/c

- | | |
|---|----------|
| 14. Absorber Leaving Water Temperature: | xxx.xf/c |
| Condenser Leaving Water Temperature: | xxx.xf/c |

15. Solution Pump speed Reported Command: If the solution pump AFD Speed is set to Auto/[manual] Control

Solution Pump AFD Auto or [manual] Speed
Command: xxx.x
Press (Next)(Previous) To Continue

Or if in limit mode

Solution Pump AFD Auto or [manual] Speed
Command: xxx.x
[Limit Mode]

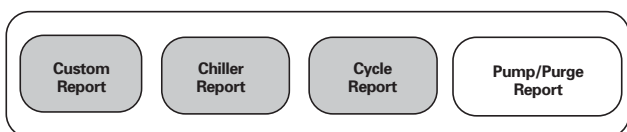
16. Heating:

Auxiliary Heat Valve Step Position:	xxxxx steps
Auxiliary Heat Valve Position:	xxx%

17. Energy Input Auto or [manual] Command: xxx.x
Press (Next) (Previous) To Continue

If limit

Energy Auto or manual] Command: xxx.x
[limit mode]



Purge/Pump Report

The **PUMP/PURGE REPORT** displays run time information regarding the purge and machine solution pumps.

1. Pump or Purge Hours, Starts and Amps

Press (Next) (Previous) to Continue

2. Purge Operating Mode:

(Mode)

Purge Status:

(Status)

Possible values of (Mode) are Stop, On, and Service Pumpout.

Possible values of [Status] are:

Standby	(Condensing Unit is Off, Vac Pump is On unless chiller is Stopped)
Collection Enabled	(Condensing Unit is On, Vac Pump is on)
Pumping Out	(Temperature initiated pumpout)
Service Pumpout	(Pumpout initiated by the service setpoint)
Diagnostic Alarm	(Purge is idle unless mode is service pumpout)
	(IFW at CLD, Purge Module Alarm Relay "On")

3. Purge Refrigerant Suction Temperature: xxx.xf/c

Press (Next) (Previous) to Continue

3.1 Purge Refrigerant Suction Temperature: xxx.xf/c Inhibited by Low Condenser Temperature

3.2 Purge Refrigerant Suction Temperature: xxx.xf/c Inhibited by High Condenser Temperature

4. Purge Pumpout Rate/Purge Max Pumpout Rate.
If the maximum pumpout rate is exceeded then the purge will shutdown and an IFW will appear at the CLD.

Purge Pumpout Rate:

xxx.xMinimum/24 Hours

Purge Maximum Pumpout Rate Setpoint:

xxx.xMinimum/24 Hours

5. Purge Total Pumpout Time: xx,xxx.xMin

(Tank pumpout time)

Purge Total Run Time: xx,xxx.x Hours

(Condensing unit run time)

6. Service Log: Pumpout Time:

x,xxx.x Min

Service Log Time since Reset:

x,xxx Days

(Note: Service log reset function is located within Service Settings Group).

7. 30 Day Purge Pumpout Average:

xxx.x Min

Chiller Average Run Time:

xxx.x Hour/Day

8. Total Motor Phase Currents % RLA.

A xxx% B xxx% C xxx%

9. Total Motor Phase Currents Amps

A xxx Amps, B xxx Amps, C xxx Amps

10. Option: The following will be displayed only if Line Voltage Sensing Option Installed.

Motor Voltages

AB xxx Volts, BC xxx Volts, CA xxx Volts

11. Chiller Starts and Run Time. Starts are incremented and run time is accumulated when the solution pumps start and/or run.

Chiller Starts: xxxx

Accumulated Run Time: xxHours: xxMinutesxxSeconds

Operator Level Password

The operator settings, service settings (basic setup), and diagnostics group menus can be secured with an operator level password. This feature is selected within a higher security level accessible in the service level password field startup group. This feature is set at the factory. If operator password is desired contact your local Trane service company.

- When this feature is enabled, the display following the header will state either "Settings in this menu are LOCKED or UNLOCKED."
- If LOCKED, the second line will state "**Enter password to unlock.**" Operator level password is (+ + + + & Enter). An incorrect password will result in the message "access denied."
- If UNLOCKED, the second line will state "**Press (Enter) to lock.**" Pressing ENTER will lock all the settings within the three groups (operator settings, service settings (basic setup), and diagnostic groups).
- When locked, menu items can be viewed, however, the second line of the displays will not indicate "Press +/- to change setting" and any attempt to change a setting will cause the second line to momentarily indicate "setting is locked."
- To UNLOCK, sequence back to the screen that states enter password to unlock the three groups (operator settings, service settings (basic setup), and the diagnostics groups).

When "Service Settings and Field Startup" selection of this feature is disabled, the previous operator password displays and indications of locked or unlocked are bypassed and not shown.

Custom Report

Chiller Report

Cycle Report



User Defined Custom Report
Press Next or Previous to Continue



Chiller Status
Water Temperatures and Setpoints
Press (Next) (Previous) to Continue

Operational Mode Line 1
Operational Mode Line 2

Active Priority (Status 1)
(settings source) Priority
(Status 2)

Chiller Water Setpoint (Source)
xxx.x f/c
Evaporator Leaving Water Temperature:
xxx.x f/c

(source) CWS: xxx.x f/c
(settings source)
CWS: xxx.x f/c

Hot Water Setpoint (Source):
xxx.x f/c
Hot Water Leaving Temperature:
xxx.x f/c

(Source) HWS: xxx.x f/c
(settings source) HWS: xx.x f/c

Evaporator Entering Water Temperature:
xxx.x f/c
Evaporator leaving Water Temperature:
xxx.x f/c

Hot Water Entering Temperature:
xxx.x f/c
Hot Water Leaving Temperature:
xxx.x f/c

Absorber Entering Water Temperature:
xxx.x f/c
Absorber Leaving Water Temperature:
xxx.x f/c

Condenser Leaving Water Temperature:
xxx.x f/c
Press (Next) (Previous) to Continue

Approximate Evaporator Water Flow:
xxxxx gpm/lpm
Approximate Absorber/Condenser Water Flow:
xxxxx gpm/lpm

Approximate Chiller Capacity:
xxx Tons
Press (Next) (Previous) to Continue



Cycle Report
Press (Next) (Previous) to Continue

Solution Temperature Leaving Heating:
xxx.x F/C
Interstage Vapor Temperature:
xxx.x F/C

Solution Temperature Entering Level Control:
xxx.x F/C
Mixed Solution Temperature Entering LTHX:
xxx.x F/C

Solution Temperature Entering Heating:
xxx.x F/C
Interstage Vapor Pressure:
xxx.x psig/kpa

Heating Leaving Concentration:
xxxxx % Lithium Bromide
LTG Leaving Concentration:
xxxxx % Lithium Bromide

Heating Cutout Monitor Temperature:
xxx.x F/C
Burner Exhaust Temperature:
xxx.x F/C

SDR Temperature: xxx.x F/C
Trip Temperature: xxx.x F/C

Solution Temperature Leaving LTG:
xxx.x F/C
Saturated Condenser Refrigerant Temperature:
xxx.x F/C

Absorber Entering Concentration:
xxxxx % Lithium Bromide
Lithium Bromide Crystallization Margin:
xxx.x F/C

Solution Temperature Entering Absorber:
xxx.x F/C
Absorber Spray Temperature:
xxx.x F/C

Solution Temperature Leaving Absorber:
xxx.x F/C
Solution Temperature Entering LTG:
xxx.x F/C

Saturated Evaporator Refrigerant Temperature:
xxx.x F/C
Evaporator Leaving Water Temperature:
xxx.x F/C

Evaporator Entering Water Temperature:
xxx.x F/C
Absorber Entering Water Temperature:
xxx.x F/C

Absorber Leaving Water Temperature:
xxx.x F/C
Condenser Leaving Water Temperature:
xxx.x F/C

Solution Pump AFD Auto Speed Command:
xxx.x
Press (Next) (Previous) to Continue

Solution Pump AFD Auto Speed Command:
xxx.x
Unit Running in Capacity Limit

Energy Input Auto Command: xxx.x

Energy Input Auto Command: xxx.x
Press (Next) (Previous) to Continue

Purge/Pump Report



Pump/Purge Hours, Starts and Amps
Press (Next) (Previous) to Continue

Purge Operating Mode: (Mode)
Purge Status: (status)

Purge Refrigerant Suction Temperature:
xxx.x F/C
Press (Next) (Previous) to Continue

Purge Pumpout Rate:
xxx.x Minutes/24 Hours
Purge Maximum Pumpout Rate:
xxx.x Minutes/24 Hours

Purge Total Pumpout Time:
xx,xxx.x Minutes
Purge Total Run Time:
xx,xxx.x Hours

Service Log, Pumpout time:
xxxx.x Minutes
Service Log, Time Since Reset:
xxxx Days

30 Day Purge Pumpout Average:
xxx.x Minutes
Chiller Average Run time:
xxx.x Hour/Day

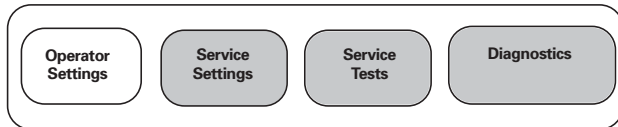
Total Motor Phase Currents
% RLA
A xxx% B xxx% C xxx%

Motor Phase Currents - Amps
A xxx Amps B xxx Amps
C xxx Amps

Motor Voltages
AB xxx Volts BC xxx Volts
CA xxx Volts

Chiller Starts - xxx
Accumulated Run Time:
Hours: Minutes: Seconds

Settings Menu



Operator Settings

The **Settings keys** (second row) allow the operator to select from four menu groups. Entering a group allows the operator to select any items contained within the group. A settings group starts at a header display when the selected setting key is pressed.

Operator Settings

1. Operator Settings

Chilled Water Setpoints and Purge Control

Press (Next) (Previous) to Continue

2. If Password Feature Enabled

Settings in this Menu are: (Status)

Where status is locked or unlocked.

3. Purge Mode

Purge Operating Mode: (Mode)

Press (+) (-) to Change Setting

Possible values of (Mode) are: Stop, ON, Service Pumpout (service pumpout turns on the pumpout valve for continuous pumpout during servicing). Normally set to ON.

4. Clock

Current Time and Date HH: MM xm Mon xx,xxxx

To Change Day, Press (+) (-) and (Enter)

The five times changing screens are as follows:

Current Time and Date HH: MM xm Mon xx,xxxx

(Enter) to Change: (Next) to continue

Current Time and Date HH: MM xm Monxx,xxxx

To Change Hour, Press (+) (-) and (Enter)

Above screen repeats for minutes, month, and year.

5. Chilled Water Setpoint

Front Panel Chilled Water Setpoint: xxx.x f/c

Press (+) (-) to Change Setting

Range of Values for ABS is 38 to 70°F (3.3 to 21.1°C) in increments of 1 or 0.1°F or °C. Default is 44.0°F (6.7°C).

To change the setpoint, press (+) (-) to new setpoint, then press **Enter** (or press **Cancel** to revert back to previous setpoint).

When the Front Panel Chilled Water Setpoint is within 1.7°F of the leaving water temperature cutout setpoint or within 2.7°F of the low refrigerant temperature cutout setpoint, the second line of this display will read: "Limited by Cutout Setpoint, (+) to Change."

6. Chilled Water Setpoint Source (applicable with External Chilled Water Setpoint Only). If the Tracer Option is installed, the word "Default" will appear in front of the setpoint source.

(Default) Chilled Water Setpoint Source:

(Source)

Possible values of (source) are Front Panel Default or External.

7. Chilled Water Reset Type:

Press (+) (-) to Change Setting

The possible values for (type) are: Disable-Default, Return, Constant Return, or, Outdoor Air

When Disable or Constant Return are selected, other chilled water reset displays are removed.

8. Reset Ratio

(Type) Reset Ratio: xxx %

Press (+) (-) to Change Setting

Steps 8, 9 and 10 are displayed only if Return or Outdoor Air is selected as the chilled water reset type.

9. Start Reset

(Type) Start Reset Setpoint xxx.x F

Press (+) (-) to Change Setting

10. Max Reset

(Type) Max Reset Setpoint xxx.x F

Press (+) (-) to Change Setting

11. Front Panel Hot Water Setpoint.

This setpoint is displayed when the Hot water option is enabled.

Front Panel Hot Water Setpoint xxx.x F/C

Press (+) (-) to Change Setting

Set Point Range is 140 to 180 degree F in increments of 1 or 0.1°F or °C depending on the Service Setup Screen xxx or xxx.x. Default is 140°F.

12. Hot Water Setpoint Source Displayed if the Auxiliary Heating and the External Hot Water Setpoint options are selected.

If a Tracer is installed, the word "Default" will appear in front of the setpoint source.

(Default) Hot Water Setpoint Source:

(Source)

Selection options are: Front Panel, Default-External.

13. Heat/Cool Priority Setpoint Source is available only if the Auxiliary Heating and the Ext Priority Setpoint options are installed).

If a Tracer is installed, the word "Default" will appear in front of the setpoint source.

(Default) Priority Setpoint Source:
(Source)

Selection options of (source) are Front Panel, Default-External.

14. Hot Water Reset Type

Hot Water Reset Type: (Type)
Press (+) (-) to Change Setting

The selections for (type) are Disable-Default, Return, Constant Return, or Outdoor Air.

When Disable or Constant Return Chilled Water Reset are selected, there are no other selection options available.

15. Reset Ratio

This screen is displayed when Return or Outdoor Air is selected as the Hot Water reset type.

(Type) Reset Ratio: xxx %
Press (+) (-) to Change Setting

16. Start Reset

Displayed when Return or Outdoor Air is selected as the Hot Water reset type.

(Type) Start Reset Setpoint: xxx.x F
Press (+) (-) to Change Setting

17. Max Reset

Displayed when Return or Outdoor Air is selected as the Hot Water reset type.

(Type) Max Reset Setpoint: xxx.x F
Press (+) (-) to Change Setting

18. Heat/Cool Priority Select

Displayed when the Auxiliary Heating Option is installed.

Heat/Cool Priority: (Status)

Press (+) (-) to Change Setting

Possible values for status are:

Cooling Only, ROM Default
Heating Only
Cooling Priority
Heating Priority

19. Heat/Cool Priority Setpoint Source

Displayed when the Auxiliary Heating and EXT Priority Setpoint is selected.

(Default) Priority Setpoint Source:
(Source)

(Source) can be either Front Panel-default, or External.

20. Fuel Select

The Fuel Select Setpoint is displayed when the alternate Fuel Option is enabled.

Fuel Select: (Source)

Press (+) (-) to Change Setting

(Type) will be either Gas-default or Alternate.

21. Fuel Select Setpoint Source

Displayed when the alternate Fuel is selected.

(Default) Fuel Select Setpt Source: (Source)

(Source) will be either Front Panel-default, or External

22. Setpoint Source Override:

(Source)

The options are: "None" - "Default," Use Front Panel Setpoints" and "Override Tracer."

Operator Settings



Chilled Water Setpoints and Purge Control
Press (Next) (Previous) to Continue

Settings in this Menu are (Status)
(Password Message)

Purge Operating Mode: (Mode)
Press (+) (-) to Change Setting

Current time/Date HH:MM xm Mon,
xx, xxxx
(Enter) to Change: (Next) to Continue

Current Time/Date HH:MM xm Mon
xx, xxxx
To Change Hour, Press (+) (-) and Enter

Current Time/Date HH:MM xm Mon
xx, xxxx
To Change Minute, Press (+) (-) and Enter

Current Time/Date HH:MM xm Mon
xx, xxxx
To Change Month, Press (+) (-) and Enter

Current Time/Date HH:MM xm Mon
xx, xxxx
To Change Day, Press (+) (-) and Enter

Current Time/Date HH:MM xm Mon
xx, xxxx
To Change Year, Press (+) (-) and Enter

Front Panel Chiller Water Setpoint:
xxx.x F/C
Press (+) (-) to Change Setting

(Default) Chilled Water Setpoint
Source:
(Source)

Chilled Water Reset Type:
(Type)
Press (+) (-) to Change Setting

(Type) Reset Ratio: xxx%
Press (+) (-) to Change Setting

(Type) Start Reset Setpoint: xxx.x F
Press (+) (-) to Change Setting

(Type) Maximum Reset Setpoint: xxx.x F
Press (+) (-) to Change Setting

Chilled Water Flow Pretest: D/E
Press (+) (-) to Change Setting

Front Panel Hot Water Setpoint: xxx.x F/C
Press (+) (-) to Change Setting

(Default) Hot Water Setpoint Source:
(Source)

Hot Water Reset Type: (Type)
Press (+) (-) to Change Setting

(Type) Hot Water Reset Ratio: xxx %
Press (+) (-) to Change Setting

(Type) Hot Water Start Reset Setpoint:
xxx.x F
Press (+) (-) to Change Setting

(Type) Hot Water Maximum Reset Setpoint:
xxx.x F
Press (+) (-) to Change Setting

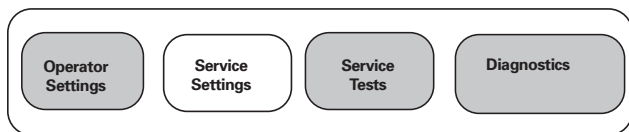
Unit Function: (Cool/heat)
Press (+) (-) to Change Setting

(Default) Priority Setpoint Source:
(Source)

Front Panel Fuel Select: (Type)
Press (+) (-) to Change Setting

(Default) Fuel Select Setpoint Source:
(Source)

Setpoint Source Override:
(Source)



The Service Settings menu has three submenus within it. First menu is non-password protected consisting of all of the settings, feature enables, setpoints etc. While seldom changed by a user, changes do not seriously affect the protection or reliability of the chiller.

The other submenus (field startup and machine configuration) are protected, each with a separate service level password. These are for changing parameters and settings regarding field commissioning and fundamental protection and control of the chiller subsystems (Field Startup), or for programming of the unit control module (UCM) as to how the specific chiller was built in the Factory (Machine Configuration). Once properly set, these menus should never be changed again without specific knowledge of the effects of the changes. In rare instances, certain field problems may be corrected by making changes in these protected menus but certain aspects of chiller reliability may be compromised. The main reason for accessibility is for field commissioning and to allow for the programming of service replacement modules.

1. Service Setting Group Heading

Service Settings: Basic Setups:

Press (Next) (Previous) to Continue

2. Keypad/Display Lockout

This display appears if the keypad lockout feature is enabled.

Press (Enter) to Lock Display and Keypad

Password will be required to Unlock

If the Enter key is pressed to lock the keypad, the following message is displayed, and all further input from the keypad is ignored, including the Stop key, until the password is entered. The password is entered by pressing the Previous and Enter keys at the same time.

*****Display and Keypad are Locked*****

*****Enter Password to Unlock*****

If the keypad is locked and the password is entered, the display will return to the Chiller Report and display the current Operating Mode.

3. Language: xxxxxxxx

Press (+) (-) to Change Setting

Selections are: English- Default, Francais, Deutsch, Espanol, Nippon (AKA Katakana, Use Japanese Characters), Italiano, Netherlands

4. Possible values of [Type] are: English- Default, SI

Possible values of [Type] are: English- Default, SI

5. Decimal Places Displayed: (Status)

Press (+) (-) to Change Setting

The choices for Status are: XXX.X- Default or, XXX

6. Display Menu Headings: (d/e)

Press (+) (-) to Change Setting

Default is Enabled. If disabled, the Menu Headings in each Menu or Group are removed.

7. Press (Enter) to Clear the Custom Menu.

When Enter is pushed a two-second message appears as shown below and then returns to above screen.

Custom Menu has been Cleared

8. Clear Service Log

Press (Enter) to Clear the Service Log

When Enter is pushed a two-second message appears as shown below and then returns to above screen.

Service Log has been Cleared

9. Differential to start Setpoint: xxx.xf/c

Press (+)(-) to Change Setting

Range of Values is 1 to 10°F (0.5 to 5.5°C) in increments of 1 or 0.1°F, or °C Default 3°F (1.7°C).

10. Differential to Stop Setpoint: xxx.x f/c

Press (+)(-) to Change Setting

Range of Values is 1 to 10°F (0.5 to 5.5°C) in increments of 1 or 0.1°F. Default is 5°F (2.8°C).

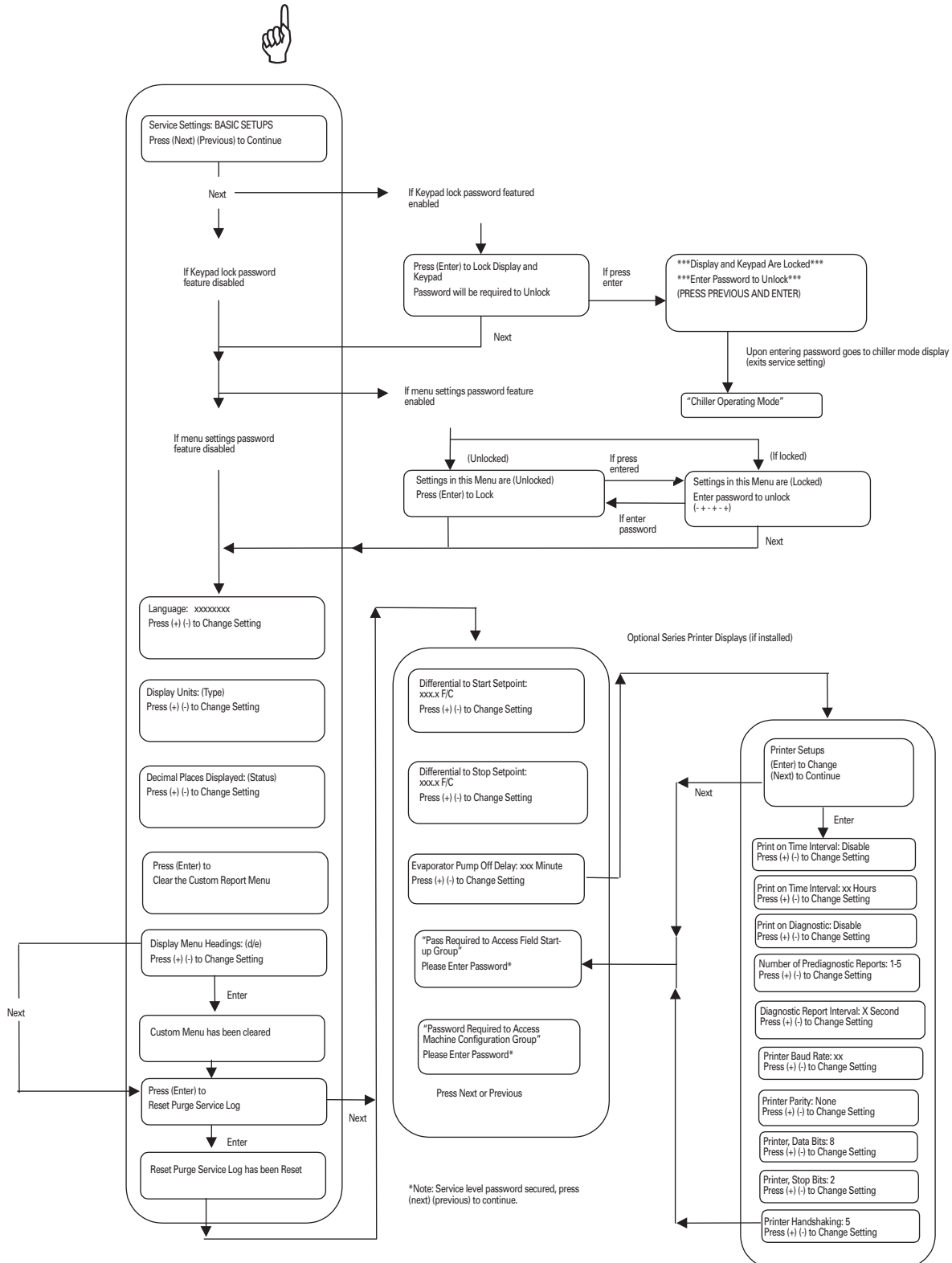
11. Evap Pump Off Delay: xxx Min

Press (+) (-) to Change Setting

Range of Values is 1 to 30 minutes in increments of 1 Minute. Default is 1 Minute.

This is the length of time the evaporator pump will be instructed to remain on after the dilution cycle terminates.

Service Settings



Display screens 12 and 13 provide entry into two service level menus. These are used to initially configure and adjust machine controls. Changing items in these menus will affect operation and may reduce machine reliability; therefore, it is strongly recommended that these settings only be changed by or under the direction of trained personnel. Call your local Trane service company for assistance.

12. *Password Required to Access Field Startup Group*
Please Enter Password.

13. *Password Required to Access Machine Configuration Group*
Please Enter Password.

SERVICE SETTINGS

FIELD STARTUP Group

The Field Startup Group is Password Protected.
The password is

+ + - - + + Enter

This menu group deals with the Field Commissioning of the chiller and the fundamental control and protection of the chiller subsystems. If the field startup password is entered, the display goes to the menu defined below. If a key is not pressed every 10 minutes (default time setting) in this password protected menu, the display returns to the Chiller Operating Mode display of the Chiller Report, and the password must be entered again to return to this menu.

1. Field Start-up Group Heading

This heading is always present to indicate the top of the menu.

2. Keypad/Display Lock Feature Enable

The Keypad and Display lock feature is Enabled or disabled at this screen. Enabling here allows for its use elsewhere. When disabled, the choice to lock elsewhere is hidden. Actual locking takes place within the Basic field service settings group. Possible values of [d/e] are: Disable; Module Default, or, Enable.

If Enabled, the service setting menu will contain the following screens:

If this menu item is currently Unlocked:

Press (Enter) to Lock Display and Keypad
Password will be Required to UnLock

When locked is selected the CLD displays:

****DISPLAY AND KEYPAD ARE LOCKED****
*****ENTER PASSWORD TO UNLOCK*****

No access is permitted to either the Report screens or the Setting Screens when locked. With this selection, both the STOP and AUTO keys do not function.

To UNLOCK, press the PREVIOUS and ENTER keys at the same time.

When the keypad lock feature is Disabled, the keypad lock display disappears and the non-password-protected area of the Service Settings menu and the Keypad/Display are unlocked.

3. Menu Settings Password Enable

When the feature is Disabled, the Menu Setting Password display does not appear at the top of each of the Settings Menus and the Menu Settings cannot be password protected. When the Menu Setting Password feature is Enabled, the Menu Settings Password display appears just below each of the Settings Menu Headers so the settings can be changed if the proper password is entered.

When enabled here but unlocked in basic service settings group the setting display will be:

Settings in this menu are: Unlocked

Press (Enter) To Lock

When Locked out, a message appears on the screen to describe the lockout condition.

Settings in this menu are: Locked

Enter password to UnLock

When locked the password to unlock is

- + - - + +

Possible values of [d/e] are Disable, module Default, or, Enable.

4. Password Duration Time

Range of Values is 1 to 240 minutes in increments of 1 minute. Module Default is 10 minutes.

Once a password has been successfully entered, the password entry screens for the newly assigned password-protected menu will be replaced by a "Press (Enter) to access" screen. This screen will be the re-entry password for the duration of the timer. A timer is set to the value of the password duration setpoint every time a CLD button is pressed. If the timer expires (no key activity for the length of the password duration time), the password protection will be re-enabled on all three menus and the password will need to be re-entered on each menu individually to regain access.

5. ICS Address

ICS address is used only with Trane BAS systems for machine ID during communications.
Range of Values is 1 to 127 in increments of 1.
Module Default is 66.

6. Power Up Start Delay Time

This timer allows operators to stagger restarts of multiple chillers after a power outage. This prevents excessive locked rotor amps from being drawn at the same time.
Range of Values is 0 to 600 seconds in increments of 1.
Module Default is 0 second.

7. Cooling Delta Temperature Setpoint

Enter the value of the difference between the entering and leaving design chilled water temperatures. Be sure to set this according to the design conditions, as it will affect machine operation. This control feature allows the chiller to control according to what percentage the machine is of its design full capacity. This assumes constant flow.

The selectable Range of Values are 4 to 30°F (2.2 to 16.7°C) in increments of 1 or 0.1°F or C depending on the Service Setup Screen xxx or xxx.x. Module Default is 10°F (5.5°C).

8. Leaving Water Temperature Cutout Setpoint

Range of Values is 35 to 38°F in increments of 1 or 0.1°F or C depending on the Service Setup Screen xxx or xxx.x. The Module Default is 38°F (3.3°C).

When the chilled water cutout setpoint is within 1.7°F of the CLD Chilled Water Setpoint, the CLD Chilled Water Setpoint is increased along with the cutout setpoint to maintain the 1.7°F differential. A message will be displayed for 2 seconds to indicate that the FPCW setpoint has been increased.

9. Low Refrigerant Temperature Cutout Setpoint

Range of Values is 35 to 38°F in increments of 1 or 0.1°F or C depending on the Service Setup Screen xxx or xxx.x. The module Default is 38°F (3.3°C).

When the cutout setpoint is within 2.7°F of the CLD Chilled Water Setpoint, the CLD Chilled Water Setpoint is increased along with this setpoint to maintain the differential. A message will be displayed for 2 seconds to indicate that the FPCW setpoint has been increased.

10. Softloading Time Setpoint

Soft load time (control response) is the time that the control will use to ramp to a new target set point. This setpoint is always active when the machine is started for softload, or any chilled water setpoint change.

The selectable Range of Values is 0 to 100 in increments of 1. The module Default is 15. A value of 0 minutes disables Softloading.

(See Also Softloading under "Control").

11. Energy Valve Soft Unload Control - INDIRECT FIRED ONLY

This feature can be enabled or disabled on steam or hot water machines. The purpose of this feature is to ramp the closure of the energy valve upon normal shutdown. This prevents the unnecessary tripping of field supplied pressure relief valves which have been known not to react as fast as the chiller valve. Energy valve will not soft unload in the event of emergency stop or abnormals.

12. Energy Valve Soft Unload Rate:

Present only when above is enabled. Range of Values is 1 to 9 percent of allowable range per 5 second period. Default is 3%. For example. Valve will close 3% of its allowable range of travel in 5 seconds. [9 fastest, 1 slowest].

13. OPTION: Under or Over Voltage Protection Enable

This screen is suppressed when the Line Voltage Sensing Option is not installed. Enable only if potential transformers are installed and functional. Possible values of [d/e] are: Disable; Module Default Enable.

14. Absorber or Condenser Temperature Low Relay Setpoint

Used to control an external device in an attempt to correct the low tower temperature to minimize "carry-over" in the generator-condenser section. When the absorber entering water temperature is below this setpoint, the relay will energize, and at 5 degrees F, above this setpoint, the relay will de-energize. On power-up, if the Absorber Entering Water temperature is within the 5-degree hysteresis band the relay will be de-energized. This setting does not alter any other internal control algorithm. It does not change the internal low abs temperature limit algorithm.

Range of Values is 40 to 90°F (4.4 to 32.2°C) in increments of 1 or 0.1°F or C depending on the Service Setup Screen xxx or xxx.x. Module Default is 70°F (21.1°C).

Evaporator Leaving Water Control

See Table 5 for initial settings for items 15,16,17 and 18.

Table 5. Evaporator leaving water control settings

Item	Leaving Water Temperature	ABDA	ABSD	ABTF
15	Gain	80	40	80
16	Reset	200	250	200
17	Derivative	0	0	0
18	Evaporator Time Constant	20	15	20

15. Chilled Water Control Gain Setpoint

The Range of Valves is 0 to 1000 in increments of 1. The module Default is 500. (See also control system PID and limit). (See Table 5).

16. Chilled Water Control Reset Setpoint

The Range of Valves is 0 to 1000 in increments of 1. The module Default is 200. (See above Table 5).

(See also control system PID and limit).

17. Chilled Water Control Derivative Setpoint

The Range of Valves is 0 to 1000 in increments of 1. The module Default is 0. (See above Table 5).

(See also control system PID and limit)

18. Evaporator Time Constant

This is a number that reflects the estimated time it takes for chiller water to pass through the system loop piping. This value will change slightly with each machine installation.

The Range of Valves is 0 to 600 in increments of 1. The module Default is 100. (See above Table 5).

Concentration Control

19. LTHX Crystallization Temperature Margin Setpoint

This selection determines how close to solution crystallization the machine can operate. Range of Values is 0 to 30°F (0 to 16.6°C) in increments of 1 or 0.1°F or C depending on the Service Setup Screen xxx or xxx.x. Module default is 15°F.

(See Also Low Temperature Heat Exchanger (LTHX) Margin Control)

See Table 5A for initial settings for items 20, 21, 22, & 25.

Table 5A. Concentration control setpoints

Item	Conc	ABDA	ABSD	ABTF
20	Prop. Gain	150	180	250
21	Reset	250	350	400
22	Derivative	400	20	300
25	Generator Time Constant	20	20	20

20. Concentration Control Gain Setpoint

The Range of Valves is 0 to 1000 in increments of 1. The module Default is 500. (See above Table 5A). (See also control system PID and limit).

21. Concentration Control Reset Gain Setpoint

The Range of Valves is 0 to 1000 in increments of 1. The module Default is 200. (See above Table 5A). (See also control system PID and limit).

22. Concentration Control Derivative Setpoint

The Range of Valves is 0 to 1000 in increments of 1. The module Default is 0. (See above Table 5A). (See also control system PID and limit).

23. Concentration Offset Generator Number 1 Setpoint

Used to calibrate the calculated strong concentration reading to the actual strong solution sampled. This adjustment corrects for any CLD readout error.

The Range of Valves is 0.0 to 100.0 in increments of 0.1. The module Default is 0.0.

24. Concentration Offset Generator Number 2 Setpoint

Used to calibrate/match the control system calculated intermediate concentration reading to the actual strong solution sampled and measured at machine startup or service inspection. This adjustment allows for any reading error from tolerance summation to be offset.

The Range of Valves is 0.0 to 100.0 in increments of 0.1. The module Default is 0.0.

25. Generator Time Constant Setpoint

This is a number that reflects the derived time it takes for lithium bromide to pass through the generator. This number is factory set and should not require field adjustment. The Range of Valves is 0 to 100 in increments of 1. The Module Default is 30.

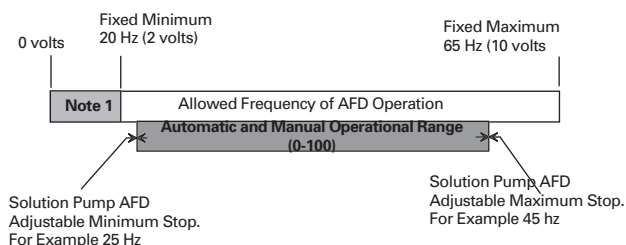
Solution Flow Control

Solution Pump Speed Setup

The solution pump AFD's are factory programmed. However, the actual minimum and maximum speed of the Low Generator Temperature Solution Pump (LTSP) solution pump may require some adjustment to fine-tune the operating range for proper and efficient operation. The ABS AFD simply follows the changes made to the Low Generator Temperature Solution Pump (LTSP). Increasing the Minimum of the Low Generator Temperature Solution Pump (LTSP) will automatically increase the ABS pump minimum speed, and so forth. [The ABS will operate at different speeds than the Low Generator Temperature Solution Pump (LTSP) for each given point.] (See AFD section for more information.) The minimum Low Generator Temperature Solution Pump (LTSP) speed must be low enough for good turndown of chiller capacity; however, not too low as to cause SDR trips. See SDR section. The maximum speed must be set to accomplish full load without losing the liquid level in the absorber sump, which should run about 1" below the ABS water box.

Figure 7 illustrates the selectable Low Generator Temperature Solution Pump (LTSP) range of the total drive output frequency range. The machines operating range are less than the capabilities of the AFD. A maximum frequency of 65 Hz and a Minimum speed of 20 Hz are factory programmed into the LTSP AFD. The minimum and maximum operating points within that range are defined with UCP2. The next two setpoints define the operational range of the LTSP by setting the minimum and maximum flow speeds.

Figure 7 – Selectable LTSP range - solution flow automatic speed drive control (2 - 10 volts)



Note 1: The PWM voltage below 2 volts is not valid during any running or stop mode. This voltage is only during a module reset.

Note 2: The Operational range is displayed in the Cycle Report and can be adjusted manually from Service Tests. The Adjustable Minimum and Maximum Stops can be set in the Field Startup sub-menu within Service Settings.

Note 3: For more information on procedures to set the min and max stops on the UCM, see the Mechanical Interface - Electrical (Hardwired) section of this chapter.

26. Solution Pump AFD Minimum Frequency Setpoint

This setpoint will set the UCP2 minimum flow output signal in hertz for the LTSP.

Selectable Range is 20 to 65 Hz in increments of 1. Module Default is 20. Typical setting of minimum is 27-32 Hz.

27. Solution Pump AFD Maximum Frequency Setpoint

This setpoint will set the UCP2 maximum flow output signal in hertz for the Low Generator Temperature Solution Pump (LTSP).

Selectable Range is 20 to 65 Hz in increments of 1. Module Default is 60. Typical maximum speed is 48.

Energy Input

ABDA 48Hz, ABTF 54-60 Hz, ABSD

Energy input means direct-fired Burner or indirect fired steam or hot water.

The next three entries setup the energy-input requirements.

28. EV Maximum Travel Setpoint

This Menu is only displayed on steam or hot water units

Range of Values for ABS is 0 to 60,000 Steps in increments of 100 Steps. All 90-degree rotational stepper actuators are 16,300 steps. Module Default is 16,300 Steps.

With burners, the value will be determined after the burner min and max fire rates are established during startup. (100%=10v, 10% = 1vdc.)

29. Energy Input Closed Stop

Energy input closed stop is the minimum input position for energy input.

On direct-fired machines this is the burner minimum fire rate position. The feedback voltage at (Gas) low fire position times 10. Such as, [1.5 Vdc times (10% or 1vdl)] =15%

On steam or hot water machines with valves, the typical min open stop is 0% [Horizon] adaptive, 10% non-adaptive.

Range of Values is 0 to 100% in increments of 1%. Module Default is 10%.

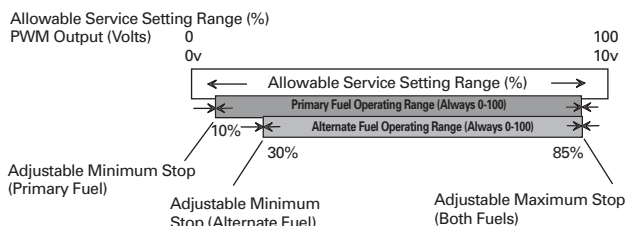
30. Energy Input Open Stop

Energy input open stop is the adjustable maximum limit selected on direct-fired machines. This is the burner maximum fire rate position. The feedback voltage at (Gas) high fire position times 10. Such as, [9.5 Vdc times (10% or 1vdl)] = 95%. See Figure 8.

With heat source valves, the typical max open stop is 50-80% for non-adaptive, 100-120% for adaptive.

Range of Values for ABS is 0 to 100% in increments of 1%. Module Default is 100%

Figure 8. Direct-fired energy input burner control output (0 - 10 volts)



In-Direct Fired Energy Input Adaptive Mode

The maximum energy input is typically set to 110%. The control system reads the steam pressure to the valve and to the chest, knows the valve size from another setting, and knows the valve characteristics are programmed into the logic therefore, the CPU can calculate the valve throughput and will allow a maximum of 110% with this setting. This feature allows for constant max flow with variances in pressures.

31. Minimum Alternate Fuel Firing Rate (ABDA Only)

This is only displayed if unit type is Direct-Fired and the alternate fuel is installed.

When the alternate fuel minimum fire position is established at startup, the feedback voltage is again measured and multiplied by 10 to give this minimum rate as a percentage. For example, 3vdc times 10% or 1vdc = 30% (typical of oil).

The range of values shall be 0-100 in increments of 1. Module Default is 30.

33. Maximum Wait for Combustion Time Setpoint

This is displayed for Direct-Fire units only. Range of Values for is 3 to 10 minutes in increments of 1. Module Default is 10. Combustion must be proven prior to this time expiring else abnormal occurs.

Optional Direct-Fired Heating Mode Settings

34. Heating Delta Temperature Setpoint

Enter the value of the difference between the entering and leaving design heating water temperatures. This is similar to the cooling delta T input and provides machine capacity feedback to the control system. This must be set to the design delta T of the heating bundle.

The selectable range of values are 100 to 180°F. Module default is 140°F. See Table 5B for initial settings for items 35-36.

Table 5B. Heating mode settings

Item		ABDA	ABSC	ABTF
35	Gain	100	NA	NA
36	Reset	200	NA	NA
37	Deriv	0	NA	NA

35. Hot Water Control Gain

This menu is displayed only on Direct Fired units with the Auxiliary Heating option installed. Factory default setting is 800.

Range of Values is 1 to 1000 in increments of 1.

36. Hot Water Control Reset

This menu is displayed only on Direct Fired units with the Auxiliary Heating option Installed. Factory default setting is 200.

Range of Values is 1 to 1000 in increments of 1.

37. Hot Water Control Derivative

This menu is displayed only on Direct Fired units with the Auxiliary Heating option installed. Factory default setting is 0.

Range of Values is 1 to 1000 in increments of 1.

38. Aux Heat Valve Maximum Travel Setpoint

This menu is only displayed on Direct-Fired units with the Auxiliary Heating Option Installed. This is a three-way butterfly arrangement that has a maximum of 90 degrees rotation. The 90 degrees rotation corresponds to 16,300 steps. Module Default is 16,300 Steps.

Range of Values for ABS is 0 to 60,000 steps are in increments of 100 Steps.

39. Auxiliary Heat Valve Closed Stop

This menu is only displayed on Direct Fire units with the Auxiliary Heating Option Installed. Sets the minimum open position.

Range of Values for ABS is 0 to 100% in increments of 1%. Module default is 10%.

40. Auxiliary Heat Valve Open Stop

This menu is only displayed on Direct-Fired units with the Auxiliary Heating Option installed. Sets the maximum open position of the valve.

Range of Values for ABS is 0 to 100% in increments of 1%. Module Default is 100%.

Purge Control

41. Purge Maximum Pumpout Rate

Range of Values is 1 to 250 Minutes or 24 Hours in increments of 1 Minute or 24 Hours. Module default is 200 minutes or 24 Hours.

When this maximum is reached the control will annunciate an IFW diagnostic on the CLD. The Purge module will also recognize this as an IFW type diagnostic and continue to purge.

Items 42 and 43 are used to provide a timed pumpout feature. This pumpout is independent of the purifier purge pumpout logic. The duration is how long the motorized valve will be energized every interval. To disable this feature set the duration, item 43, to 0 minutes.

42. Purge Pumpout Interval Setpoint

This setpoint sets the interval between absorber purge chamber pumpout cycles.

Range 10-250 minutes. Default at 60 minutes.

43. Purge Pumpout Duration Setpoint

This setpoint sets the length of each Absorber pumpout cycle. (The length of time that the Absorber chambers motorized pumpout valve is energized.) Typically set to 0 minutes when not used.

Range 0-10 minutes, Default at 10 minutes.

Optional Flow Display Settings (Option)

With this option two-design points that reflect the pressure drop curve must be selected. One can be the job specific design point and the other selected from an appropriate pressure drop curve or alternate selection output. This information is then input in the following screens.

44. Low Evaporator Water Flow Warning Setpoint

The following will be displayed only if the Differential Water Sensing Option is installed.

Range of values is 0.0 to 4.0 gpm or ton (lpm or ton) in increments of 0.1.

45. Variable Flow Rate Control

The following will be displayed only if the Differential Water Press Sensor Option is installed. This screen allows the feature to be enabled or disabled. Variations in evap water flow will be recognized as a control input to improve machine control. The default is disabled.

46. Evaporator Flow Rate - High

Enter the higher point flow rate.

Range of Values is 100 to 7000 in increments of 1. Module Default is 1750.

46. Evaporator Flow Rate - Low

Enter the lower point flow rate.

Range of Values is 100 to 7000 in increments of 1. Module Default is 700.

48. Evaporator Pressure Drop - High

Enter the pressure drop at the higher flow rate.

Range of Values is 1 to 255.

49. Evaporator Pressure Drop - High

Enter the corresponding pressure drop at the lower flow rate. Range of Values is 1 to 255.

50. Evaporator Fluid Coefficient

This input identifies the proper fluid characteristics. Water is 100. (This number is found by multiplying the specific gravity times the specific heat times 100.)

51. Absorber or Condenser Flow Rate - High

Enter the higher point flow rate.

Range of Values is 100 to 7000 in increments of 1. Module Default is 1750.

52. Absorber or Condenser Flow Rate - Low

Enter the higher point flow rate.

Range of Values is 100 to 7000 in increments of 1. Module Default is 750.

53. Absorber or Condenser Pressure Drop - High

Enter the corresponding pressure drop at the higher flow rate.

Range of Values is 1 to 255.

54. Absorber or Condenser Pressure Drop - Low

Enter the corresponding pressure drop at the lower flow rate.

Range of Values is 1 to 255.

Energy Input

The various energy-input devices have different energy input levels with a constant command signal level when a linear command signal is utilized. For example, when commanding a butterfly type valve to open 25% with a 25% command signal, there would be more energy input because of the nature of butterfly valves. (for example, As the valve is first opened through its first part of actuation, a higher rate of energy is input to the chiller than during the later portion of the valve travel.) For this reason the control system can be modified using the energy input coefficient to attain a more linear input characteristic. This is done by altering the input command signal depending on the energy-input device. Figures 9, 10 and 11 illustrate three different scenarios. Figure 10 illustrates the butterfly scenario and indicates how the command signal will be reduced during the first part of the operation. There are four values to be entered.

For linear energy input characteristics they are as follows: B0=0, B1=100, B2=0, B3=0. To enter these first set all individually using the (+) (-) and use Next key. When at the load display press enter. This can only be performed in local stop while no diagnostics are present. Once these are entered they will be active until such time that others are entered in the same manner.

The following Table 6 indicates preset settings for various machine types.

Table 6 – B0, B1, B2 and B3 settings

Unit Type	B0	B1	B2	B3
Butterfly - Steam	20	168	-187	116
Butterfly - Hot Water	0	263	-376	207
V-Ball - Steam	10	211	-241	122
V-Ball - Hot Water	0	196	-195	98
ABDA - Non-linear	0	60	-55	87
ABDA - Linear	0	100	0	0

55. Load Coefficients (ABDA)

Top Level Energy Linearization Menu

The following will be displayed if the chiller is running.

*Press (Enter) To View
Energy Coefficients*

The following will be displayed if the chiller is stopped.

*Press (Enter) To Edit
Energy Coefficients*

If the Enter key is selected while viewing this menu, the series of screens shown below are accessed. Note that the second line of these screens will indicate whether or not editing of this setpoint is allowed (based on chiller operating state).

56. Energy Linearization Coefficient Number 0

Energy Coefficient 0: xxx E-1

Press (+)(-) to Change Setting

Range of Values is -20000 to 20000 in increments of 1. Default is 0.

57. Energy Linearization Coefficient Number 1

Energy Coefficient 1: xxx E-2

Press (+)(-) to Change Setting

Range of Values is -20000 to 20000 in increments of 1. Default is 100.

58. Energy Linearization Coefficient Number 2

Energy Coefficient 2: xxx E-4

Press (+)(-) to Change Setting

Range of Values is -20000 to 20000 in increments of 1. Default is 0.

59. Energy Linearization Coefficient Number 3

Energy Coefficient 3: xxx E-6

Press (+)(-) to Change Setting

Range of Values is -20000 to 20000 in increments of 1. Default is 0.

60. Adaptive Energy Linearization Coefficient Upload Menu

The following will be displayed if the chiller is stopped.

Pressing the Enter key will cause a transitional message to be displayed for two seconds indicated that the coefficients have been loaded into the energy linearization function.

Press (Enter) To Load Energy Coefficients

The following figures illustrate three various energy input coefficient configurations.

Figure 9 - Linear coefficients

Used with Modulating Head burners or anytime straight line control is desired.

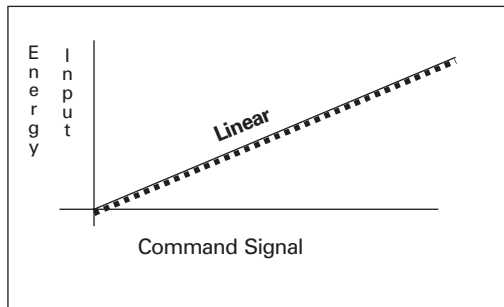


Figure 10 - Butterfly valve coefficients

Used on fixed head burners with butterfly valve gas control.

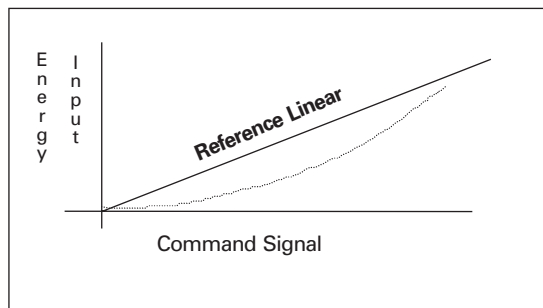
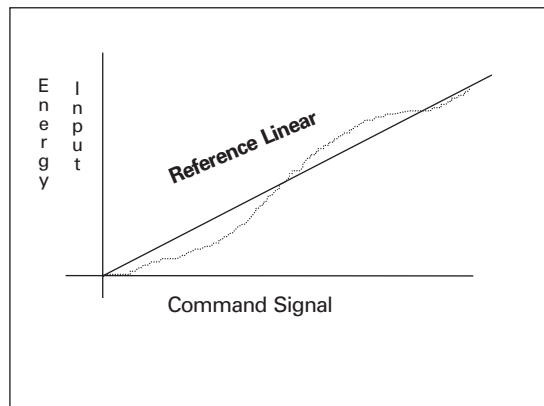


Figure 11 - Adaptive coefficients

As determined by Control System.



Service Settings: Field Start Up Group (++→++) OVERVIEW

[Shaded is sales order specified]

1.	Password required to access field start up group (++→++)
2.	Keypad or Display lock feature: [d/e] Press (+)(-) to change setting
3.	Menu settings password feature: [d/e] Press (+)(-) to change setting
4.	Password duration time: xxx minute Press (+)(-) to change setting
5.	ICS address: xx Press (+)(-) to change setting
6.	Power up start delay time: xxx second Press (+)(-) to change setting
7.	Cooling delta temperature setpoint: xx.x f/c Press (+)(-) to change setting
8.	Leaving water temperature cutout setpoint: xxx.x f/c Press (+)(-) to change setting
9.	Low refrigerant temperature cutout setpoint: xxx.x f/c Press (+)(-) to change setting
10.	Softload time: xxx minute Press (+)(-) to change setting Energy Vlv Soft Unload Control: [d/e] Press (+)(-) to change setting
11.	Energy Vlv Soft Unload rate: xxx %/5 second Press (+)(-) to change setting
12.	Under or over voltage protection: [d/e] Press (+)(-) to change setting
13.	Absorber or condenser temperature low relay setpoint: xxx.x f/c Press (+)(-) to change setting
14.	Chilled water control gain: xxxx Press (+)(-) to change setting
15.	Chilled water control reset: xxxx Press (+)(-) to change setting
16.	Chilled water control derivative: xxxx Press (+)(-) to change setting
17.	Evaporator time constant: xxx second Press (+)(-) to change setting
18.	LTHX crystallization margin setpoint: xxx.x f/c Press (+)(-) to change setting
19.	Concentration control gain: xxxx Press (+)(-) to change setting
20.	Concentration control reset: xxx Press (+)(-) to change setting
21.	Concentration control derivative: xxxx Press (+)(-) to change setting
22.	Concentration offset generator number 1: xxx.x% Press (+)(-) to change setting
23.	Concentration offset generator number 2: xxx.x% Press (+)(-) to change setting
24.	Generator time constant: xxx second Press (+)(-) to change setting
25.	Solution pump AFD minimum frequency: xx hz Press (+)(-) to change setting
26.	Solution pump AFD maximum frequency: xx hz Press (+)(-) to change setting
28.	EV Maximum Travel Setpoint: xx,xxx Steps Press (+)(-) to change setting
29.	Energy input closed stop: xxx% Press (+)(-) to change setting
30.	Energy input open stop: xxx% Press (+)(-) to change setting
31.	Minimum alternate fuel firing rate: xxx% Press (+)(-) to change setting
33.	Maximum wait for combustion time: xx minute Press (+)(-) to change setting
34.	Heating delta temperature setpoint: xx.x f/c Press (+)(-) to change setting
35.	Hot water control gain: xxxx Press (+)(-) to change setting
36.	Hot water control reset: xxxx Press (+)(-) to change setting
37.	Hot water control derivative: xxxx Press (+)(-) to change setting
38.	Auxiliary heat valve maximum travel: xxxx steps Press (+)(-) to change setting
39.	Auxiliary heat valve closed stop: xxx% Press (+)(-) to change setting
40.	Auxiliary heat valve open stop: xxx% Press (+)(-) to change setting
41.	Purge maximum pumpout rate: xxx min or 24 hours Press (+)(-) to change setting
42.	Absorber Purge Pumpout Interval: xxx minutes Press (+)(-) to change setting
43.	Absorber Pumpout Duration: xxx minutes Press (+)(-) to change setting
44.	Low evaporator flow warning: xx.x gpm/ton Press (+)(-) to change setting
45.	Variable FLOW Rate Control: [d/e] Press (+)(-) to Change Setting
46.	Evaporator Flow Rate - High: xxx gpm Press (+)(-) to Change Setting
47.	Evaporator flow rate - Low: xxx gpm Press (+)(-) to change setting
48.	Evaporator Pressure Drop - High: xx.x Ft Press (+)(-) to change setting
49.	Evaporator Pressure Drop - Low: xx.x Ft Press (+)(-) to change setting
50.	Evaporator fluid coefficient: xxx Press (+)(-) to change setting
51.	Absorber or condenser flow rate - High: xxx gpm Press (+)(-) to change setting
52.	Absorber or condenser flow rate - Low: xxx gpm Press (+)(-) to change setting
53.	Absorber or condenser Pressure Drop - Low: xxx Ft Press (+)(-) to change setting
54.	Absorber or condenser Pressure Drop -High: xxx Ft Press (+)(-) to change setting

(Service Settings continued)

Energy Coefficients

55	Press (Enter) To View Energy Coefficients Press (Enter) To Edit Energy Coefficients
56	Energy Coefficient 0: xxx E-1 Press (+)(-) to Change Setting
57	Energy Coefficient 1: xxx E-2 Press (+)(-) to Change Setting
58	Energy Coefficient 2: xxx E-4 Press (+)(-) to Change Setting
59	Energy Coefficient 3: xxx E-6 Press (+)(-) to Change Setting
60	Press (Enter) To Load Energy Coefficients

SERVICE SETTINGS

Machine Configuration Group

Machine Configuration Group Setpoints

Machine configuration settings define selection of variations in the unit. The settings define indirect or direct fired, size, and other optional features.

The Machine Configuration group is **Password Protected**. The password is

+ - + - + - Enter

If the machine configuration password is entered, the display goes to the menu defined below. If a key is not pressed every 10 minutes after entering the menu, the display returns to the Chiller Operating Mode display of the Chiller Report. The password must be entered again to return to this menu.

Editing menus in the Machine Configuration group is not allowed unless the machine is off (for example Local Stop, Remote Stop). This feature is shown below on an example setpoint screen where the second line of the setpoint display indicates whether or not a setpoint change is allowed. If a (+)(-) key is selected when not in a stop mode, the display will indicate that changes to the setpoint are not allowed with a brief message. Example: (Where "setpoint description" can be any setting item in the menu).

Possible values of status are: Press (+)(-) to Change Setting, Machine Must Be Stopped To Change Configuration.

1. Machine Configuration Group Heading

This header is not suppressed if the headers in the Service Settings menu are not revealed.

2. Unit Frequency

Possible values of Frequency are: 60 Hz; module default, 50 Hz

3. Unit Types

Possible values for type: Direct-Fired module Default, 1 Stage (Hot Water), 1 Stage (Steam), 2 Stage (Hot Water), 2 Stage (Steam)

4. Nominal Unit Tons

Possible values of [tons] are "100" through "2000" in 10 ton increments. The module default is 500 tons.

5. Rated Load Amps

The range of values is 0-2500 in 1 amp increments. The module default is 50 Amps.

6. Current Gain Setpoint

This selection is used by UCP2 to determine when the current transformers are outputting a secondary current that reflects the full load RLA. The actual output is compared to the expected value based on this setting to determine the % of total current. This is then multiplied by the RLA value (item 5 above) to display the total current.

The range of values is decimal 00 through 31. Module default is 00.

Motor current overload is handled with individual motor overloads or the AFD.

Note: The current overload setting terminology was used on older UCP2 models. See current transformers in the panel section for setup information.

7-8-9 Indirect fired only

7. Valve Type Setpoint

Energy Input Valve Type: [status]

Press (+)(-) to Change Setting

Possible values for status is:

V-Ball; ROM Default, Butterfly.

8. Valve Size Setpoint

Energy Input Valve Size: xx inches

Press (+)(-) to Change Setting

The range of values shall be 1-10 inches in increments of 1 inch. ROM default is x inches.

9. Adaptive Steam Flow Control

Adaptive Steam Flow Control: [Status]

Press (+)(-) to Change Setting

Possible values for status is:

On; ROM default, Off.

10. High Pressure Cutout Setpoint

When the concentrator pressure as determined by the interstage transducer output equals this setting, machine shutdown will occur. Manual reset is then required (MMR).

The range of values are 0-15 Psig in increments of 1 Psig. Module default is 3 PSIG.

Direct Fired Setup

11. Flame Safeguard Type – Direct-Fired Only

Possible values for status is: Mechanical-Module Default, Electronic- (future)

12. Ventilation Confirmation – Direct-Fired Only

Possible values for status is installed, not installed-module default.

13. Ventilator Confirmation Binary Contacts – Direct-Fired Only

This setpoint is only displayed if the previous Ventilator Confirmation is installed. Possible values for status are Normally Open (Close for confirmation), Normally Closed-Module Default. (Open for confirmation)

Direct Fired Heating Option Setup

14. Auxiliary Heating Option - Direct Fire Only

Used to activate heating features of the controls. Possible values for status is installed, not installed-module default.

When the option is de-installed, the Heat or Cool Priority setpoint will be set to Cooling Only and a brief message will be displayed.

15. Auxiliary Heating Four to Two-Pipe Conversion

Only with the previous Auxiliary Heating option installed.

Output contacts are utilized for control of system water valves. Valves may be used to convert from heating to cooling and heating to cooling on two-pipe systems.

Possible values for statuses are installed, Not installed-module default.

16. Auxiliary Hot Water Flow Switch

Only with the previous Auxiliary Heating option installed. Priority heating and heat only modes require this input. Its use is optional on cooling priority.

Possible values for statuses are Not Installed-Module Default, Software, and Hardware.

Sales Order Specified Features

17. Line Voltage Sensing Option

Only to be installed if voltage potential transformers and fuses and wiring are present.

Possible values for statuses are installed or not installed-module default.

18. Unit Line Voltage

The following will be displayed only if previous line voltage sensing option is installed.

Possible values of [volt] are “180” through “6600” in 5 volt increments. Module Default is 460 volts.

19. External Chilled Water Setpoint Option

Feature allows an external analog signal to adjust the chilled water setpoint remotely. (See ECWS section)

Possible values for statuses are installed or not installed-module default.

20. External Hot Water Setpoint Option – Direct-Fired Only

The following will be displayed only if the Auxiliary Heating Option is installed.

Feature allows an external analog signal to adjust the heating water setpoint remotely. (See ECWS section)

Possible values for statuses are installed or not installed-module default.

21. External Setpoint Type Selection, 4-20ma/2-10Vdc

This setpoint is only displayed if External Hot Water or external chilled water is installed.

When external analog signals are utilized this setting defines the type. Possible values for status are: 4-20ma; module default, 2-10Vdc

22. External Unit Function Option - Direct Fire Only

Only with Auxiliary Heating option installed. Possible values for statuses are installed or not installed-module default.

Allows the selection of priority from a remote location via two binary input contacts that allow four choices. See sales order schematics.

Contact A	Contact B	Mode
Open	Open	Cooling Only
Closed	Open	Cooling Priority
Closed	Closed	Heating Only
Open	Closed	Heating Priority

23. Alternate Fuel Option – Direct-Fired Only

When installed creates another minimum fire rate stop for alternate fuel setpoint within field startup group. Possible values for statuses are installed, or not installed-module default.

24. Flue Gas Recirculation – Direct-Fired Only

Flue Gas Recirculation: [Status]

Press (+)/(-) to Change Setting

Possible values for status(s) are: Installed or not installed; ROM Default.

25. External Fuel Select Control – Direct-Fired Only

Only with Alternate Fuel option installed.

Possible values for status(s) are installed, Not Installed-Module Default.

Allows remote selection or change over of fuel types.

26. Differential Water Press Sensing Option

Possible values for status(s) are installed or not installed-module default.

This option screen applies to both the evaporator and condenser differential water pressure

27. Tracer Option

Possible values for status(s) are installed or not installed-module default.

Note that the Tracer Option will automatically be installed if communication with a Tracer module occurs.

28. TCI Option

Possible values for status(s) are installed, Not Installed-Module Default.

Note that the TCI Option will automatically be installed if communication with a TCI module occurs.

29. Printer Option

Printer Option: [status]

Press (+)/(-) to Change Setting

Possible values for status(s) are installed or not installed; ROM default.

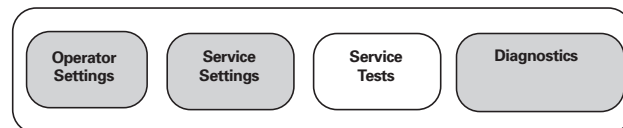
Service Settings: Machine

Configuration Group (+ - + - + -)

In all cases the second line would be

“Press (+) (-) to change setting”

1.	Password required to access machine configuration Group (++++)
2.	Unit frequency: [Freq]
3.	Unit type: [type]
4.	Nominal unit tons: [tons]
5.	Rated load amps: xxxx amps
6.	Current gain setpoint: xx
7.	Energy input valve type: [status]
8.	Energy input valve size: xx inches
9.	Adaptive steam control: [status]
10.	High pressure cutout setting: xx psig
11.	Flame safeguard type: [type]
12.	Ventilation confirmation: [status]
13.	Ventilator contacts: [status]
14.	Auxiliary heating option: [status]
15.	Four to two-pipe conversion: [status]
16.	Auxiliary hot water flow switch: [status]
17.	Line voltage sensing option: [status]
18.	Unit line voltage: [volts]
19.	External chilled water setpoint: [status]
20.	External hot water setpoint: [status]
21.	External setpoint input: [type]
22.	External unit function: [type]
23.	Alternate fuel option: [status]
24.	Flue gas recirculation: [status]
25.	External fuel select: [status]
26.	Diff water pressure sensor option: [status]
27.	Trace option: [status]
28.	TCI option: [status]
29.	Printer option: [status]



Service Tests

The Service Test menu provides access to screens used to change certain operating parameters from “Auto” mode to manual mode. A manual mode control signal overrides specific auto control functions. Tests and status screens provide a means to check the operation of some output and input devices.

Anytime a manual mode is selected the alarm light will remain on.

Normal machine operation does not require the use of any service test menus; therefore they remain within a password-protected menu. Manual operation of these items will affect chiller operation and will cause unreliable operation, if left in manual mode. Therefore, we recommend that only qualified personnel use service tests.

1. Service Tools Group Password Request
Pswd Reqd to Access Service Tools Group
Please Enter Password

The Password is ++—++ followed by enter.

When the service tools password is entered, the display goes to the menu defined below. The display returns to the Chiller Operating Mode of the Chiller Report, when no usage of the keypad exceeds the duration of the password enable timer (factory default is 10 minutes). The password must be entered again to return to this menu.

During the password duration time period (password remains active from previous password entry) the following screen is displayed.

1.1 *Press (Enter) To Access Service Tools Group*

2. The display header is:
Service Tests and Overrides
Press (Next)(Previous) to Continue

3. *Chilled Water Pump: (Status)*
Press (Next)(Previous) to Continue

Values for Status are: Auto- Default or On
Status will be set back to Auto on any transition from running to stop modes of operation.

4. *Chilled Water Flow Switch Status:*
Flow Switch is open/no Flow
(Or)
Flow Switch is Closed/Flow

5. Water Flow Sensing. The following will be displayed if the Differential Water Pressure Sensor Option is installed and selected from the machine configuration menu.

Chilled Water Flow Diff Pressure: xxpsid
Press (Next)(Previous) to Continue

6. *Absorber or Condenser Water Pump: (Status)*
To avoid Freeze up Turn on chilled water

Values for Status are: Auto- Default, On This Setpoint will be set back to Auto on any transition from Running to Stop mode of operation .

7. *Absorber or Condenser Water Flow Switch Status:*
Flow Switch is open/no Flow
(Or)
Flow Switch is Closed/Flow

8. Water Flow Sensing. The following will be displayed if the differential water pressure sensor is installed and selected from the machine configuration menu.

Absorber or Condenser Differential Pressure: xxPsid
Press (Next)(Previous) to Continue

9. *Hot Water Pump: Status*
Press (+)(-) to Change Setting

10. *Hot Water Flow Switch Status*
Flow Switch Is Open/no flow

11. Low Temperature Solution pump.
LTG Solution Pump Control: (Status)
Press (+)(-) to Change Setting

Values for Status are: Auto- default or on.
This Setpoint will return to Auto on any transition from running to stop

12. High Temperature Solution pump.
Solution Pump Control: (Status)
Press (+)(-) to Change Setting

Values for Status are: Auto-default or on
This setpoint will return to auto on any transition from running to stop.

13. *Absorber Spray pump control: (Status)*
Press (+)(-) to Change Setting

Values for status are auto-default or on.
This setpoint will return to Auto on any transition from running to stop.

14. Refrigerant Pump Control.
Refrigerant Pump Control: (Status)
Press (+)(-) to Change Setting

Values for Status are: Auto-default or on.
This Setpoint will return to Auto on any transition from running to stop

15. Pipe Conversion Control. Used with heating heat exchanger.

Pipe Conversion Control: (Status)
Press (+)(-) to Change Setting

Values for Status are: Auto- Default, two-pipe test

16. Solution Pump AFD Speed Control
(Auto/Manual) (Related to Item 10)
Solution Pump AFD (Status) Speed Control:
(Status) (Message)

Values for status are auto-default or manual.

Values for [message] are Press (+) (-) to Change Setting.
This setpoint will return to auto on any transition from running to stop

16.1. LTSP Solution Pump AFD Speed Command. (0-100% speed) (Related to Item 10)

*Solution Pump (Status) Speed Command: xxx
(Message)*

Values for Status are Auto-Default, Manual.

Values for Message are: [Press (Next)(Previous) To Continue], or,
[xxx = xx Hz] Where xxx is 0 to 100%

If a Limit Mode exist the Messages are: Limited Manual Command: xxx

Status will follow the speed control setpoint and will return to Auto on any transition from running to stop

17. Energy Input control (Auto, Manual or Slave)

*Energy Input Control: (Status)
Press (+)(-) to Change Setting*

Values for [Status] are Auto- Default, Manual, or Slave.

This Setpoint will return to Auto on any transition from running to stop.

17.1 Energy Input Command: (Input Rate)

*Energy Input (Status) Cmd: xxx
(Message)*

(Status) Values are: Auto- Default, Manual, or, slave

[Message] values are:

If auto, Press (Next)(Previous) To Continue

If manual, Press (+)(-) to Change Setting

If slave, Press (Next)(Previous) To Continue

The (message) is as follows if in:

Auto and a Limit Exists - (Limit Mode)

Manual and a Limit Exists - Limited Manual

Command xxx, Slave and a Limit Exists - Limited

Manual Command xxx

[Status] will follow the speed control setpoint and will return to Auto on any transition from running to stop.

18. Auxiliary heating valve Manual/auto control

(Heating units only)

*Auxiliary Heat Valve Control: (Status)
Press (+)(-) to Change Setting*

Values for status are: Auto-default or manual.

This setpoint will be return to auto on any transition from running to stop.

19. If the Heat Valve control status is "Auto" the following is displayed:

*Aux Heat Valve Auto Position: xxx
(Limit Mode)*

19.2. If the heat valve control status is "Manual" the following is displayed.

When the heat valve control status is transitioned from "Auto" to "Manual", the manual mode target is set to the current Heat Valve position.

*Auxiliary Heat Valve Manual Position Command: xxx
Limited Manual Command: xxx*

19.3. Auxiliary Heat Valve Position Indications

*Aux Heat Valve Step Position: xxxxxxSteps
Aux Heat Valve Position: xxx%*

xxxxx steps is the number of steps where the valve is currently positioned.

xxx is the percent open of the set operational range.

20. Module Software Revision Identifications.

*Press (Enter) to Display Software
Revision Levels or (Next) to Continue*

20.1 through 20.5

If (Enter) is selected the following screen can be displayed 5 times with 5 different pairs of modules.

*(Module 1) (Revision Level)
(Module 2) (Revision Level)*

[Module 1,2] will be one of the following: Chiller, Circuit, Starter, Options, Stepper 1, Stepper 2, TCI, Purge, LCLD, and RCLD.

Revision Level will either be "number" representing the software version number of the particular module, or, "Not installed" if the module is not present or not communicating on the interprocessor communications-IPC link.

Service Tests

* Note: When in the manual mode the "Alarm" LED illuminates to indicate that the manual mode has been selected.

* Normal operation does not require use of Service Tests. Password access only. Service Tests should only be performed by knowledgeable personnel if tests are required

Differential Water Pressure Sensing Options (if installed)

Differential Water Pressure Sensing Options (if installed)

Evaporator differential water press: xx.x psid/kPa
Press (Next) (Previous) to continue

Evaporator entering pressure: xx.x psid/kPa
Evaporator leaving pressure: xx.x psid/kPa

Absorber or Condenser differential water press: xx.x psid/kPa

Condenser entering water press: xx.x psid/kPa
Condenser leaving water press: xx.x psid/kPa

Password required to access service tools group
Please enter password (+ + - - + +) and press enter

Service tests and overrides
Press (Next) (Previous) to continue

Chilled Water Pump: (Auto or On)
Press (+) or (-) to change setting

Chilled water flow switch status:
Flow switch is open or no flow or flow switch is closed/flow

Absorber or condenser water pump (Auto or On)
To avoid freeze-up turn on chilled water

Absorber or condenser water flow switch status:
Flow switch is open or no flow or flow switch is closed or flow

Hot Water Pump: auto/on
Press(+)(-) To Change Setting

Hot Water Flow Switch Status:
Flow Switch is xxxxxx

LTG solution pump control: (Auto or On)
Press (+) or (-) to change setting

HTG solution pump control: (Auto or On)
Press (+) or (-) to change setting

Absorber pump control: (Auto, Off, On)
Press (+) or (-) to change setting

Refrigerant pump control: (Auto, Off, On)
Press (+) or (-) to change setting

Pipe Conversion control: (Auto or On)
Press (+) or (-) to change setting

Solution pump AFD speed control:
(Auto or Manual)
Press (+) or (-) to change setting

Solution pump AFD (status)
speed Command: xxx
(Message)

Energy input control: (status)
Press (+) (-) to change setting

Energy input (Status) Command: xxx
(Message)

Auxiliary heat valve control:
(status)
Press (+) or (-) to change setting

Auxiliary heat valve (status)
position: xxx
(Message)

Auxiliary heat valve step position:
xxxxx steps
Auxiliary heat valve position: xxx

Press enter to display software
Revision levels or (Next) to continue

Enter

Chiller (Revision level)
Circuit (Revision level)

Next

Starter (Revision level)
Options (Revision level)

Next

Stepper (Revision level)
Burner (Revision level)

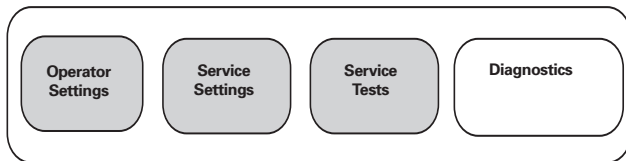
Next

TCI (Revision level)
Purge (Revision level)

Next

LCLD (Revision level)
RCLD (Revision level)

Next



Diagnostics Menu

The Diagnostics Menu contains both active and historical information. The menu contains the ability to clear active diagnostics, historic diagnostics, and purge diagnostics as individual groups. In order to alert the machine operator that a new diagnostic occurred the CLD would automatically go to this menu and display certain messages as explained below.

New Diagnostic Display sequence.

When a new diagnostic is detected the display will reset to the diagnostic menu. A "one-time" screen display will inform the user what the new diagnostic is.

This "one-time" screen will vary depending on the type of diagnostic detected. The two major categories of diagnostics are those which are informational warning only (IFW), and those which have resulted in machine shutdown; machine shutdown manual reset required (MMR) and machine shutdown auto reset (MAR).

The "one-time" IFW information screen would be:
"A New Warning has been Detected"
"Press (Next) for more"

The "one-time" MMR/MAR diagnostic screen would be:
"A Machine Shutdown Has Occurred"
"Press (Next) for More"

Pressing (Next) will display "Press (Next) to display operating mode at time of last diagnostic" and the previous "one-time" screen will no longer exist.

The diagnostics menu (p.60) illustrates an overview of the diagnostic key screens.

Header Screen:

"Active and Historic Diagnostics"
"Press (Next)(Previous) to Continue"

1. If there are no diagnostics present, the following screen will be displayed under the Diagnostics Group heading screen:

"No Diagnostic Present"
Press (NEXT)(Previous) to Continue"

2. Single Active diagnostics

2.1 If there are any diagnostics present, the following 3 screens are displayed sequentially when the Next key is pressed. The first screen is:

"Diagnostics Report Follows"
Press (Next) for More

2.2. The second screen is

Press (Next) to Display Operating Mode
At Time of Last Diagnostic

2.3. The third screen will be the chiller operating mode display that was present when the most recent diagnostic occurred.

3. Multiple Active Diagnostics.

If there are one or more diagnostics present, the following displays will be inserted into the display sequence. Diagnostics will be listed in order of occurrence from newest to oldest. Diagnostics will be displayed on 2 screens. The two screens will vary slightly depending on whether the diagnostic is active or historic.

3.1. The first active diagnostic screen will be:

(Sequence #) (Diagnostic)
(Next) Diagnostic Type)

The sequence number will run from 1 through n ($n \leq 20$) and number the diagnostics sequentially where the most recent diagnostic is sequence number [01].

The possible replacements for [diagnostic type] are:

- Warning Only - Reset Not Req'd (Applies to all IFW diagnostics).
- Unit Shutdown - Reset Req'd (Applies to all MMR diagnostics).
- Unit Shutdown - Automatic Reset (Applies to all MAR diagnostics).

3.2. The second active diagnostic display screen will contain the diagnostic sequence number, a time and date stamp, and a help message suggesting possible service procedures. The second active diagnostic display screen will be:

(SN) Occurred at HH: MM XM Oct 23, 199X
(Help Message)

The time will be displayed as HH: MM am/pm.

(HH=Hours, MM=minutes, xm=AM or PM The date will be displayed as month date, - year.

Depressing the next key will advance the display to the next diagnostic in the sequence.

4. Historic Diagnostics

4.1 The first historic diagnostic screen will be:

(Sequence Number) (Diagnostic)
Historic Only, Press (Next) For More

The definitions of diagnostic and sequence number are the same as for the active diagnostic messages. If Next is pressed, the second historic diagnostic screen is displayed.

4.2. The second historic diagnostic screen will be:

*(sn) Occurred at HH: MM xm Mon xx, 199x
Historic Only Reset at End of Diagnostic Menu*

4.3. Up to 20 diagnostics will be displayed.

At the end of the diagnostic menu, there will be 3 screens that allow the user to Clear or Reset the different diagnostic groups.

5. Clearing Active Diagnostics

If any active diagnostics are present, and the Unit Mode is Auto, the following screen will be displayed:

*Press (Enter) to Clear Active Diagnostics and Reset
System - The Unit May Start*

If any active diagnostics are present and the Unit Mode is Stop, the following screen will be displayed:

*Press (Enter) to Clear Active Diagnostics and Reset
System*

If the enter key is depressed, the following message is displayed for 2 seconds:

*Active Diagnostics Have Been Cleared
System is Resetting*

The display will be reset to the operating mode screen of the chiller report after this message clears.

WARNING: - Resetting

Be Aware That If The Chiller Mode Was Auto And There Is A Need To Cool, The Unit Will Attempt To Start.

This start will begin when the reset is complete. If dilution cycle was in operation and reset is executed the dilution cycle is aborted and restart will occur.

6. Clearing informational warnings (IFW)

If any IFW diagnostics are present, the following screen will be displayed

Press (Enter) to Clear all IFW Diagnostics

If the enter key is depressed, the following message is displayed for two-seconds:

*IFW Diagnostics Have Been Cleared
Diagnostics Report is Being Reset*

7. Clearing Historic Diagnostics

If any historic diagnostics are present, the following screen will be displayed:

Press (Enter) to Clear Historic Diagnostics

If the enter key is depressed, the following message is displayed for 4 seconds:

*Historic Diagnostics Have Been Cleared
Diagnostic Report Is Being Reset*

8. Clearing Purge Diagnostics

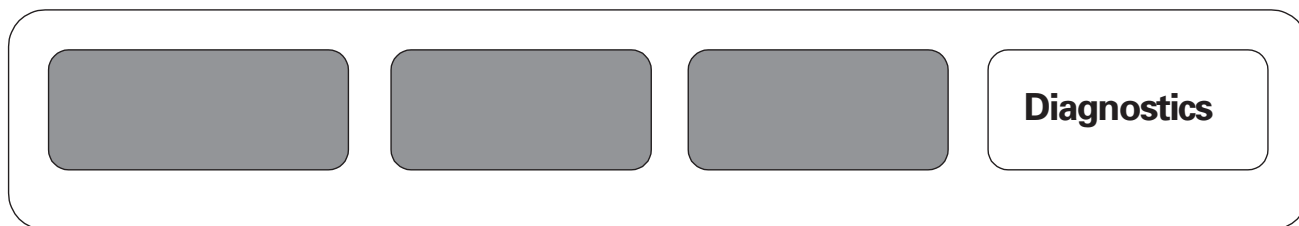
If any purge diagnostics are present, the following screen will be displayed:

"Press (Enter) to Clear Purge Diagnostics"

If the enter key is depressed, the following message is displayed for 4 seconds:

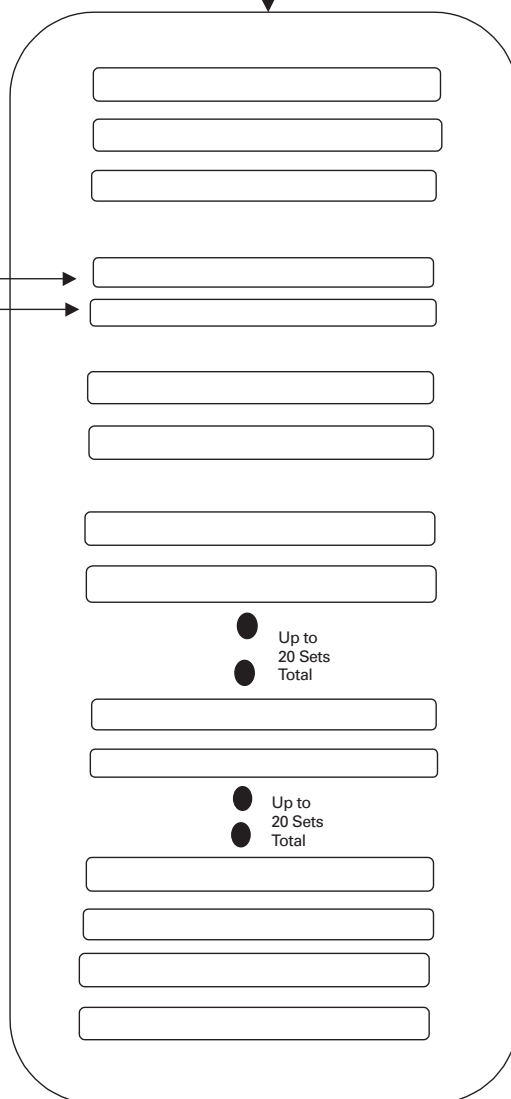
*Purge Diagnostics Have Been Cleared
Diagnostic Report is Being Reset*

The display will be reset to the top of the Diagnostic Menu after this message clears.



Press Diagnostic Key

Diagnostic Occurs



Header Screens

New Diagnostic
One Time Display

Operating Mode at Last
Diagnostic

Set of Screens for First
Active Diagnostic

If More Active

Set of Screens for First Historic
Diagnostic

If More Historic

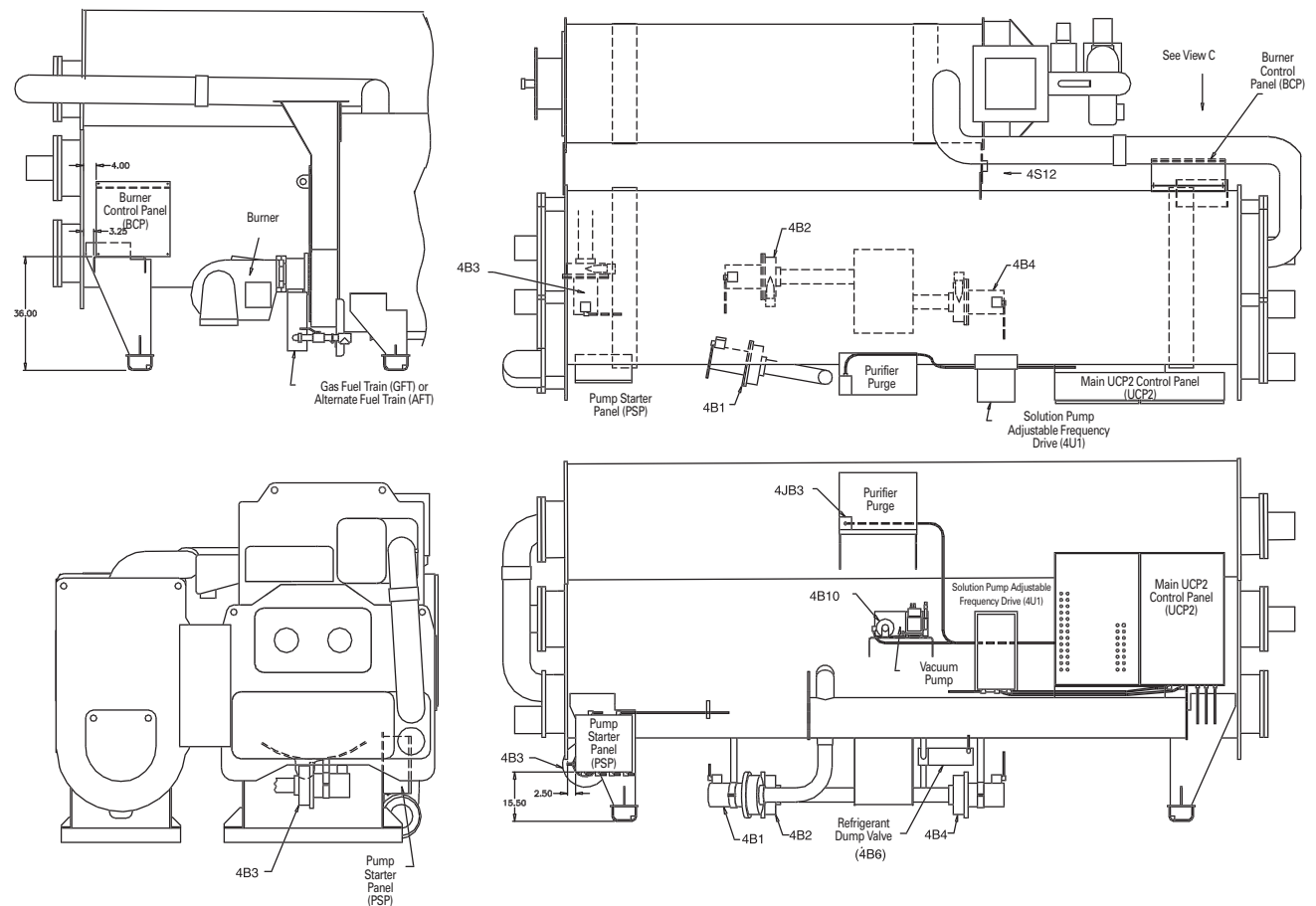
Screen(s) to Clear
(Reset) Diagnostics

(6) Sensors and Controls

ABDA Control Locations

Machine controls are factory mounted and wired. External controls are connected with field wiring, and are controlled by the chiller or used by the chiller system.

Figure 12. Location of electrical components



Machine Sensors

Figure 12. Machine Sensor Locations (Continued)

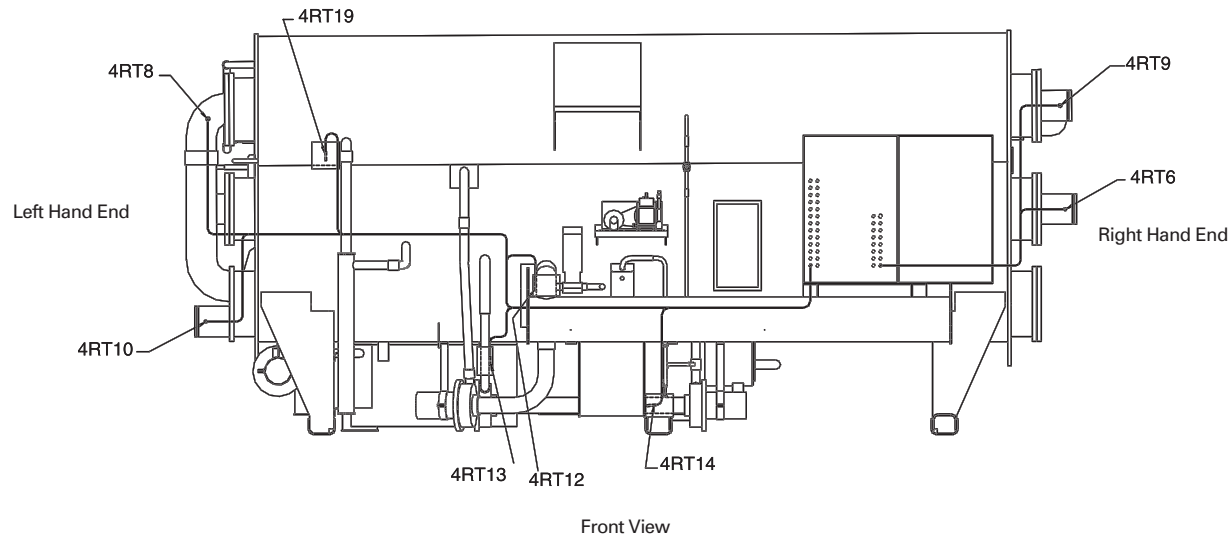


Figure 13. Sensor locations of the absorption fluid cycle – see table 7

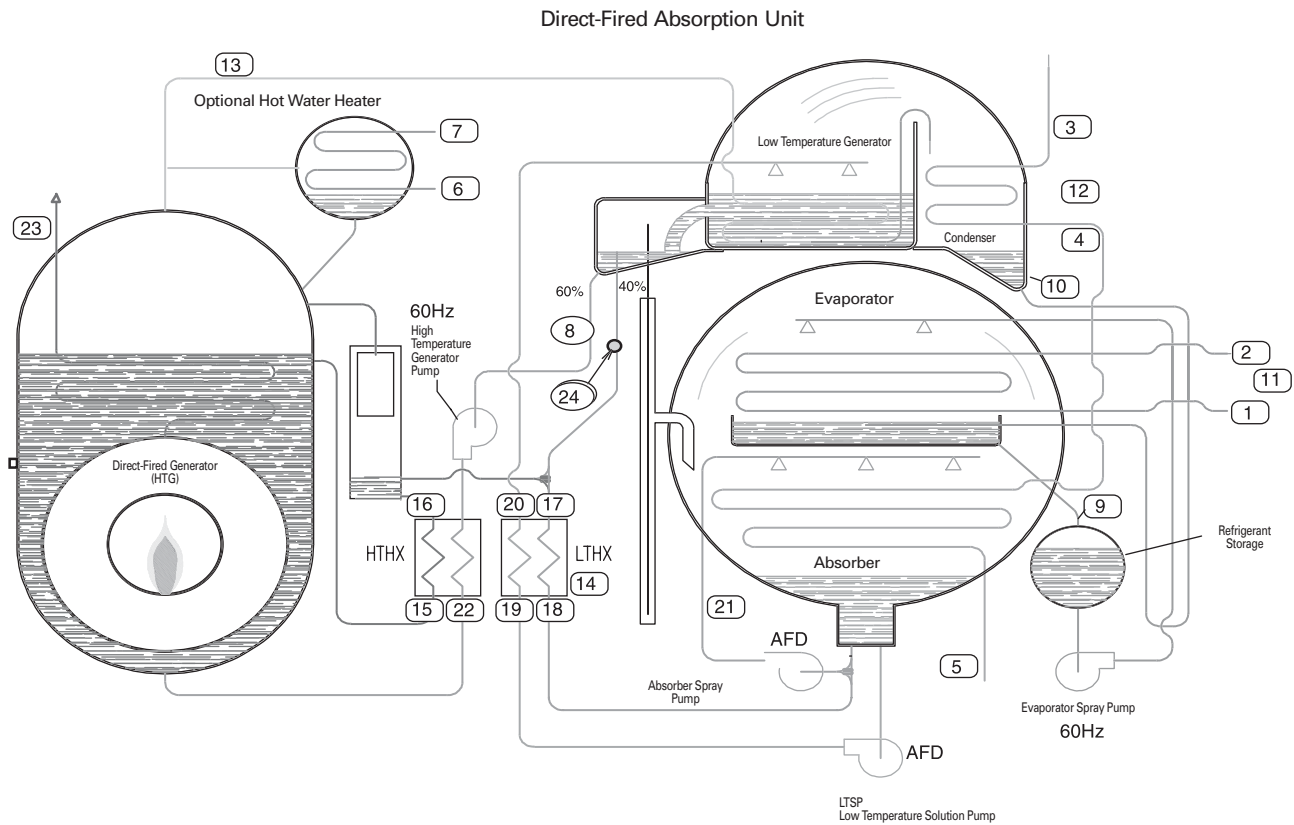


Table 7 identifies unit sensors, primary function control or monitor, connection points and the normal operation temperature range of the sensors located in the fluid cycle.

Table 7

Figure 13 Sensor Reference		Usable Range in °F	Sensor Primary Function	Module
1	Evaporator Leaving Water Temperature	28 - 70 Design 44	LCWT Control	Chiller
2	Evaporator Entering Water Temperature	28 - 80 Design 54	LCWT Control	Chiller
3	Condenser Leaving Water Temperature	55 - 110 Design 103	Monitor	Chiller
4	Absorber Leaving Water Temperature	45 - 100 Design 95	Monitor	Chiller
5	Absorber Entering Water Temperature	55 - 110 Design 85	ELWT-Fd fwd & Low Tower Limit	Chiller
6	Entering Heating Hot Water Temperature (Used for Simultaneous Heat or Cool)	120-200 Design 130-170	Monitor	Burner
7	Leaving Heating Hot Water Temperature (Used for Simultaneous Heat or Cool)	120-200 Design 140-180	Monitor	Burner
8	Solution Temperature Leaving Low Temperature Generator (LTG)	120 - 200 Design 175	Concentration Calc (LTG)	Stepper
9	Saturated Evaporator Refrigerant Temperature	28 - 60 Design 38	Evaporator Limit	Stepper
10	Saturated Condenser Refrigerant Temperature	80 - 180 Design 100	Concentration Calc (LTG)	Stepper
11	Diff Evaporator Water Pressure	NA	Monitor	TBD
12	Diff Tower Water Pressure	NA	Monitor	TBD
13	Interstage Vapor Pressure Transducer	14.9 - 0 PSIG	High and Low Pressure Limit	Circuit
15	Solution Temperature Leaving High Temperature Generator (HTG)	200 - 320 Design 300	Concentration Calc (HTG)	Circuit
16	Solution Temperature Entering Level Control (Before Level Control)	120 - 200 Design 190	Calc Mixed Concentration	Circuit
17	Mixed Solution Temperature Entering Low Temperature Heat Exchanger (LTHX) (After Split)	120 - 200 Design 190	Calc Mixed Concentration	Circuit
18	Solution Temperature Entering Absorber	80 - 180 Design 115	Control T-Margin	Stepper
19	Solution Temperature Leaving Absorber	80 - 180 Design 100	Monitor	Stepper
20	Solution Temperature at Low Temperature Generator (LTG) Sprays	120-20 Design 158	Monitor	Stepper
21	Absorber Spray Temperature	80-180 Design 105	Monitor	Stepper
22	Solution Temperature Entering High Temperature Generator (HTG)	200-320 Design 270	Monitor	Stepper
23	High Flue Gas Temperature Cutout	200-350 Design 425	Temperature Monitor	Circuit
24	Sense Detect Recovery (SDR) Temperature	200 - 320 Design 230	SDR Logic	Circuit
	Outdoor Air Temperature (Optional)	-20 - 60 Design 80	Chilled Water Reset Control	Chiller

ABTF Control Locations

Machine controls are factory mounted and wired. External controls are connected with field wiring, and are controlled by the chiller or used by the chiller system.

Figure 14. Machine sensor locations

(Other Sensors on Next Page)

NAME	SENSOR APPLICATION	SENSOR TYPE
4RT1	SDR TEMP	THRMSTR
4RT2	SOL TEMP ENT LEVEL CTRL	THRMSTR
4RT3	MIX SOL TEMP ENT LTHX	THRMSTR
4RT5	SOL TEMP LVG HTG	THRMSTR
4RT6	EVAP ENT WTR	THRMSTR
4RT7	EVAP LVG WTR	THRMSTR
4RT8	COND ENT WTR	THRMSTR
4RT9	COND LVG WTR	THRMSTR
4RT10	ABS ENT WTR	THRMSTR
4RT12	SAT EVAP RFGT TEMP	THRMSTR
4RT13	SOL TEMP AT ABS SPRAYS	THRMSTR
4RT14	SOL TEMP LVG ABS	THRMSTR
4RT15	SOL TEMP ENT ABS	THRMSTR
4RT16	SOL TEMP ENT LTG	THRMSTR
4RT17	SOL TEMP ENT HTG	THRMSTR
4RT18	SOL TEMP LVG LTG	THRMSTR
4RT19	SAT COND RFGT TEMP	THRMSTR
4RT22	ENT STEAM OR HOT WTR TEMP	THRMSTR
4RT23	LVG STEAM CHX OR LVG HOT WTR TEMP	THRMSTR
4R1	INTERSTAGE PRESSURE	TRANS DUCER

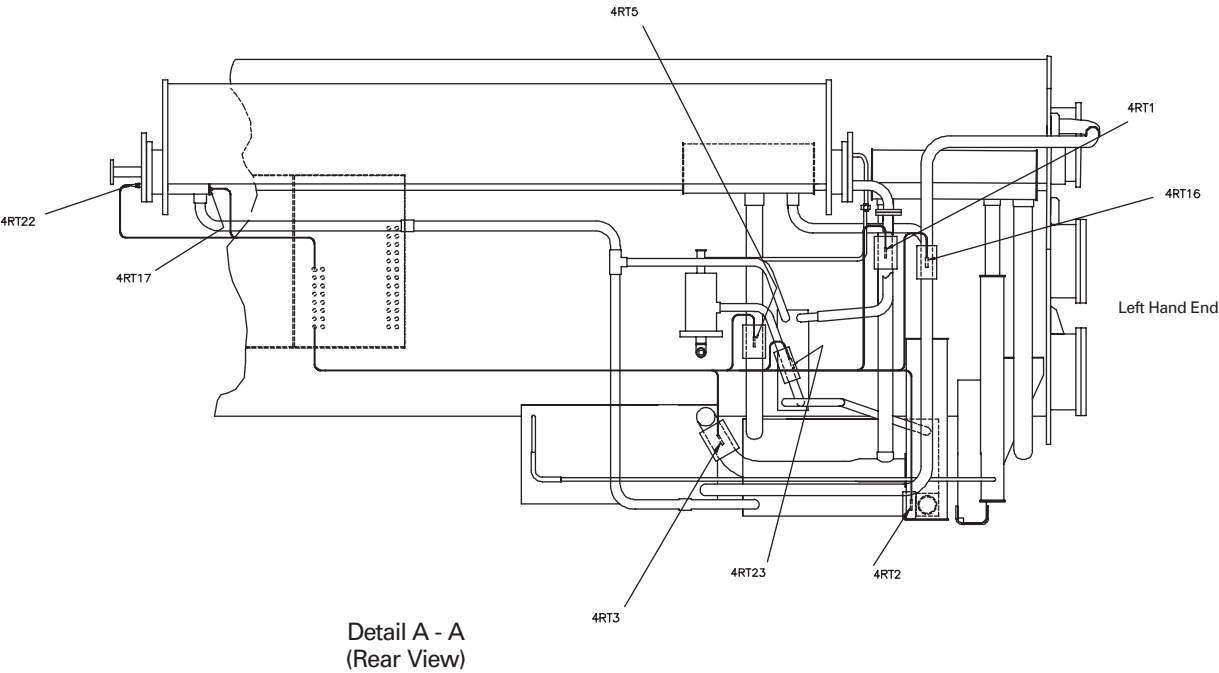
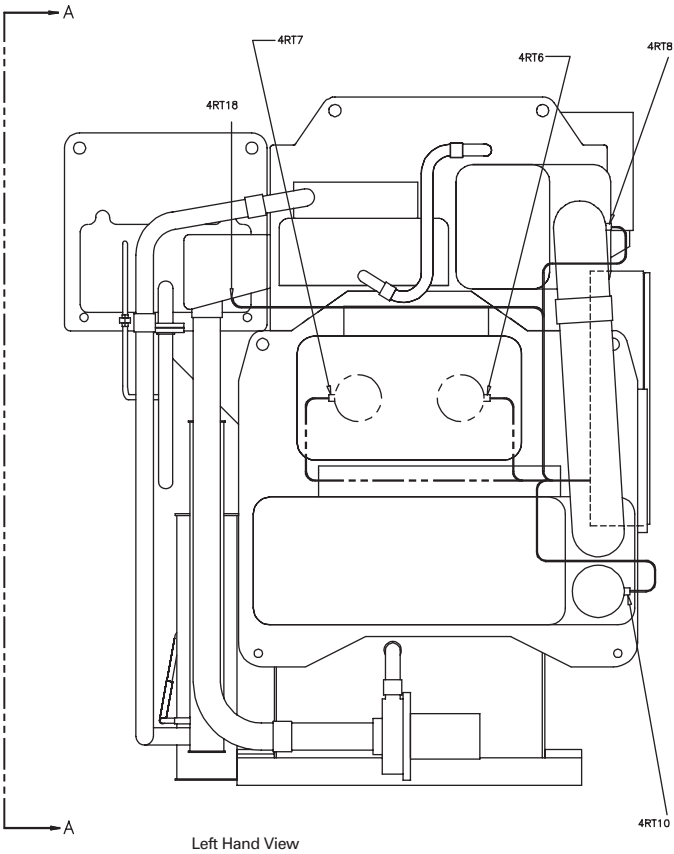


Figure 14. Machine Sensor Locations (Continued)

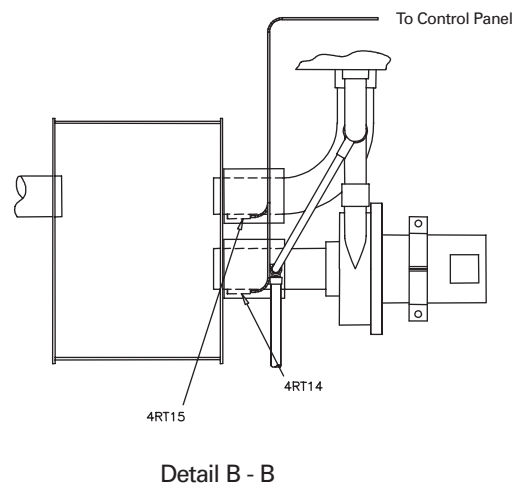
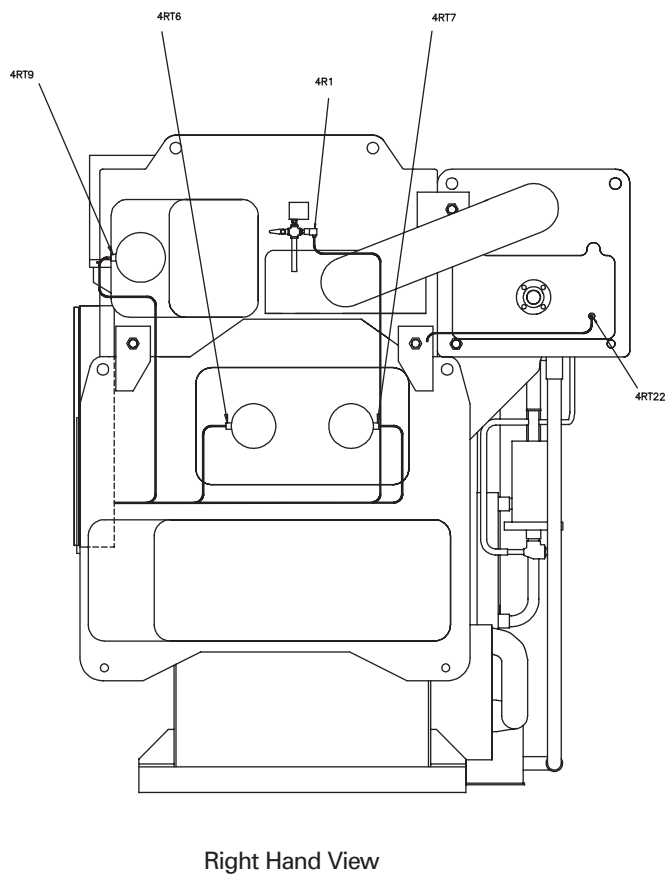
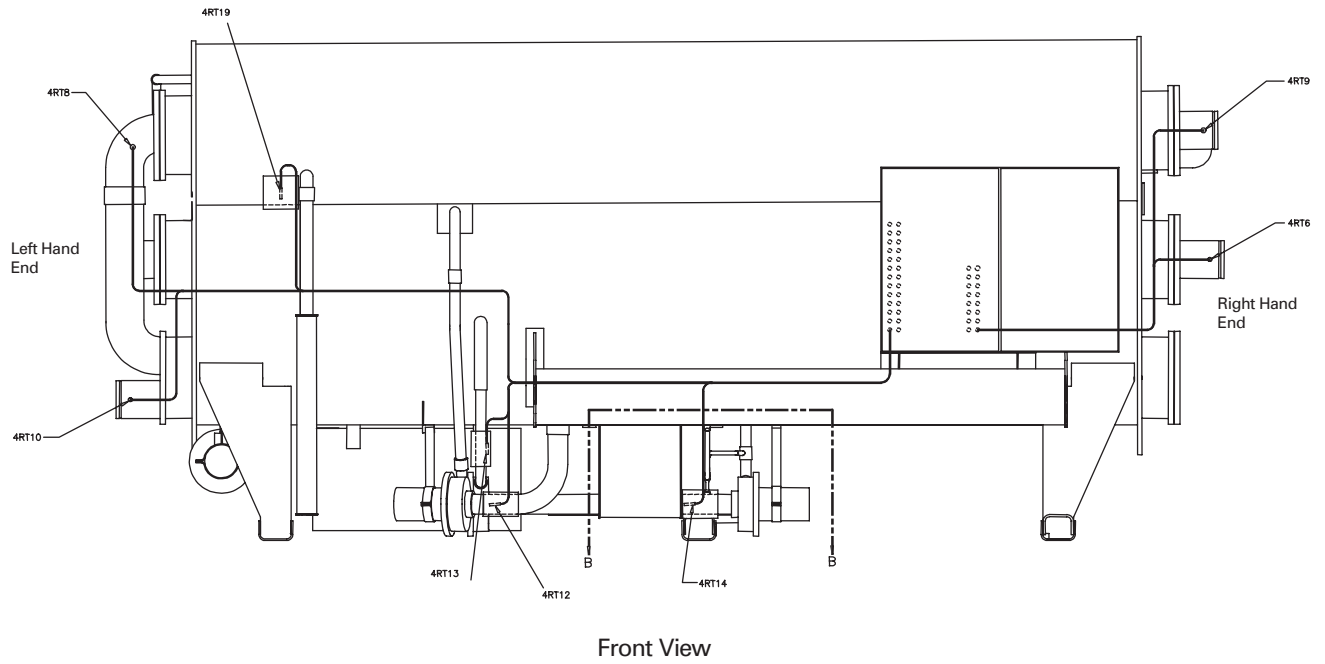
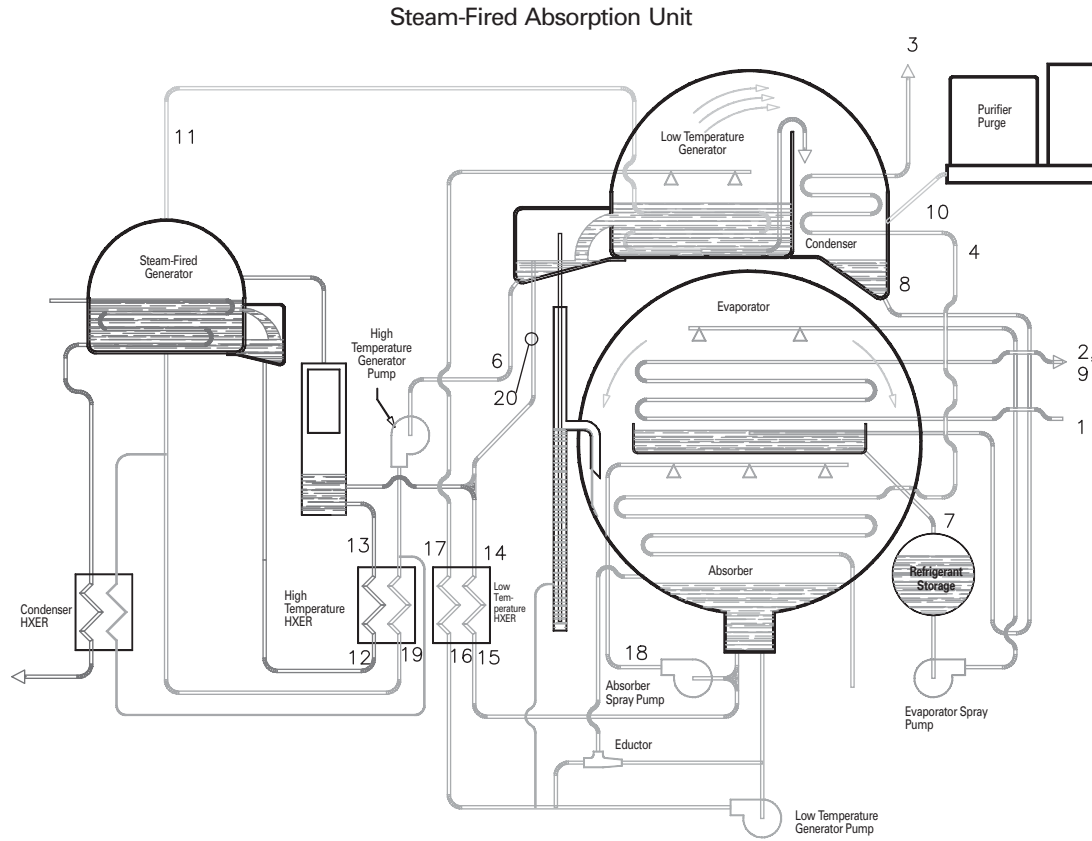


Figure 15. ABTF absorption fluid cycle sensor locations

See Table 8



1 Evaporator Entering Water Temperature - 4RT6	13 Solution Temperature Entering Level Control - 4RT2
2 Evaporator Leaving Water Temperature - 4RT7	14 Mixed Solution Temperature Entering LTHX - 4RT3
3 Condenser Leaving Water Temperature - 4RT9	15 Solution Temperature Entering Absorber - 4RT15
4 Absorber Leaving Water Temperature - 4RT8	16 Solution Temperature Leaving Absorber - 4RT14
5 Absorber Entering Water Temperature - 4RT10	17 Solution Temperature Entering LTG - 4RT16
6 Solution Temperature Leaving LTG - 4RT18	18 Solution Temperature at Absorber Sprays - 4RT13
7 Saturated Evaporator Refrigerant Temperature - 4RT12	19 Solution Temperature Entering HTG - 4RT17
8 Saturated Condenser Refrigerant Temperature - 4RT19	20 SDR Temperature Sensor - 4RT1
9 Evaporator Water Pressure Differential-optional - 4R4	
10 Absorber/Cond. Water Pressure Differential-optional - 4R5	
11 Interstage Vapor Pressure Transducer - 4R1	
12 Solution Temperature Leaving HTG - 4RT5	

Table 8. Provides machine sensors, primary function control or monitor, connection points, and normal operation temperature range

Figure 13 Sensor Reference		Usable Range in °F	Sensor Primary Function	Module
1	Evaporator Leaving Water Temperature	28 - 70 Design 44	LCWT Control	Chiller
2	Evaporator Entering Water Temperature	28 - 80 Design 54	LCWT Control	Chiller
3	Condenser Leaving Water Temperature	55 - 110 Design 103	Monitor	Chiller
4	Absorber Leaving Water Temperature	45 - 100 Design 95	Monitor	Chiller
5	Absorber Entering Water Temperature	55 - 110 Design 85	ELWT-Fdwd & Low Tower Limit	Chiller
6	Solution Temperature Leaving LTG	120 - 200 Design 175	Concentration Calc (LTG)	Stepper
7	Saturated Evaporator Refrigerant Temperature	28 - 60 Design 38	Evaporator Limit	Stepper
8	Saturated Condenser Refrigerant Temperature	80 - 180 Design 100	Concentration Calc (LTG)	Stepper
9	Diff Evaporator Water Pressure	NA	Monitor/control	option
10	Diff Tower Water Pressure	NA	Monitor/control	option
11	Interstage Vapor Pressure Transducer	14.9 - 0 PSIG	High and Low Pressure Limit	Circuit Limit
12	Solution Temperature Leaving High Temperature Generature (HTG)	200 - 320 Design 300	Concentration Calc (HTG)	Circuit
13	Solution Temperature Entering Level Control (Before Level Control)	120 - 200 Design 190	Calc Mixed Concentration	Circuit
14	Mixed Solution Temperature Entering Low Temperature Heat Exchanger (LTHX) (After Split)	120 - 200 Design 190	Calc Mixed Concentration	Circuit
15	Solution Temperature Entering Absorber	80 - 180 Design 115	Control T-Margin	Stepper
16	Solution Temperature Leaving Absorber	80 - 180 Design 100	Monitor	Stepper
17	Solution Temperature at Low Temperature Generator (LTG) Sprays	120-20 Design 158	Monitor	Stepper
18	Absorber Spray Temperature	80-180 Design 105	Monitor	Stepper
19	Solution Temperature Entering High Temperature Generator (HTG)	200-320 Design 270	Monitor	Stepper
20	Sense Detect Recovery (SDR) Temperature	200 - 320 Design 230	SDR Logic	Circuit

Figure 15. ABTF absorption fluid cycle sensor locations

See Table 8

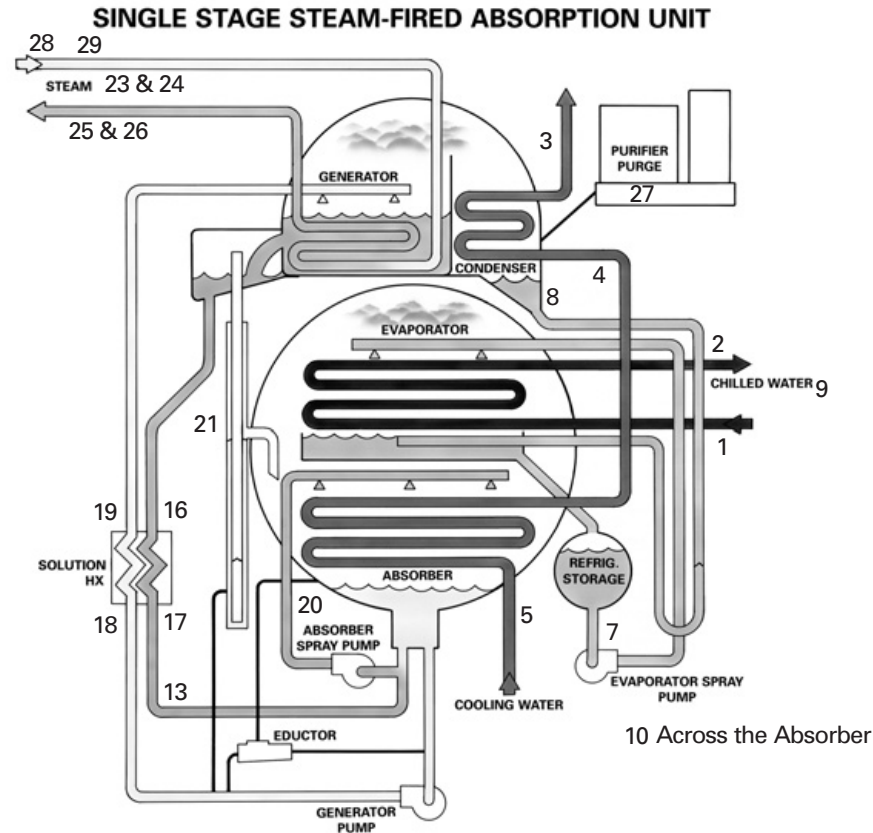


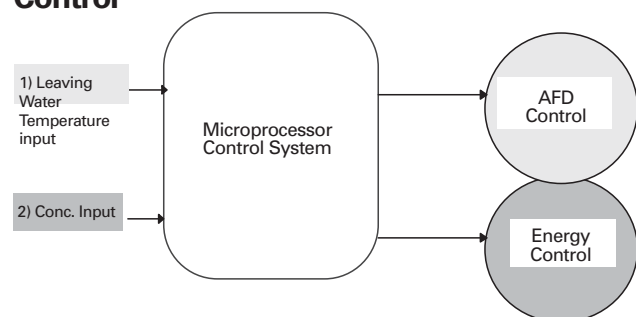
Table 3. Sensing points for single stage Horizon Chiller

1	Evaporator Entering Water Temperature
2	Evaporator Leaving Water Temperature
3	Condenser Leaving Water Temperature
4	Absorber Leaving Water Temperature
5	Absorber Entering Water Temperature
6	Solution Temperature Leaving LTG
7	Saturated Evaporator Rfgt Temperature
8	Saturated Condenser Rfgt Temperature
9	Evaporator Water Pressure Differential
10	Absorber/Condenser Water Pressure Differential
11	N/A
12	N/A
13	Soln Concentration (%LiBr) - Derived Value
14	N/A
15	N/A
16	N/A
17	Solution Temperature Entering Absorber
18	Solution Temperature Leaving Absorber
19	Solution Temperature Entering LTG
20	Solution Temperature at Absorber Sprays
21	Crystallization Detection Temperature
22	N/A
23	N/A
24	Generator Entering Hot Water Temperature (Hot Water Only)
25	Steam Condensate Temperature Leaving Generator (Steam Only)
26	Generator Leaving Hot Water Temperature (Hot Water Only)
27	Purge Refrigerant Suction Temperature
28	Energy Valve Upstream Pressure (Steam Only)
29	Energy Valve Downstream Pressure (Steam Only)

(7) Machine Control Strategy

The unit control panel is designed to reliably achieve and maintain the required leaving chilled water setpoint. The control compares the leaving water temperature to the panel set point, and adjusts generator solution flow, and the energy applied as needed. Adjusting the generator solution flow maintains the required leaving water temperature. Adjusting the energy input creates the solution concentration needed to sustain the desired chilled water temperature. These two adjustments are the two primary control algorithms employed to optimize machine efficiency.

Simplified Diagram of Leaving Water Temperature Control and Concentration Control



1. Leaving Water Temperature (LWT)

The machine panel controls the chilled water leaving temperature by controlling the refrigerant vapor pressure in the evaporator. The refrigerant vapor pressure is determined by lithium bromide concentration and temperature at the absorber sprays. The absorber spray concentration is changed by adjusting the generator solution flow. An adjustable frequency drive (AFD) is used to change pump speed which determines the absorber spray and low temperature solution flow.

As the generator solution flow is varied, the corresponding volume of strong solution leaving the generator changes. This solution then mixes with recirculated dilute solution to produce the absorber spray solution.

The absorber spray concentration, temperature, and AFD pump speed determine the absorber vapor pressure. This absorber combination controls the refrigerant vapor pressure. The resulting refrigerant spray temperature produces the desired leaving chilled water temperature setpoint.

2. Concentration Control

The concentration control adjusts the energy input for optimum solution efficiency. The strong solution concentration is typically maintained at 15 degrees F from the theoretical crystallization point. This is called the low temperature heat exchanger (LTHX) temperature margin. As strong solution concentration is varied by Leaving Water Temperature solution flow control, the theoretical crystallization temperature is changed. The control system adjusts the energy input to maintain the LTHX temperature margin throughout the load range. The simplified control illustration below illustrates the two control inputs and indicates that these inputs must pass through the "limit control" before the signals pass to the solution pump AFD and/or energy input control.

In addition to the microprocessor control of Leaving Water Temperature and generator solution concentration, the microprocessor monitors conditions during machine operation that could affect unit reliability. If an unusual condition is detected control limits will override Leaving Water Temperature and concentration control requests. The override limit would prevail when a control output (from Leaving Water Temperature or concentration control) request is greater than allowed by the particular limit schedule. The Limit control will modify the output signal maintaining limited chiller operation.

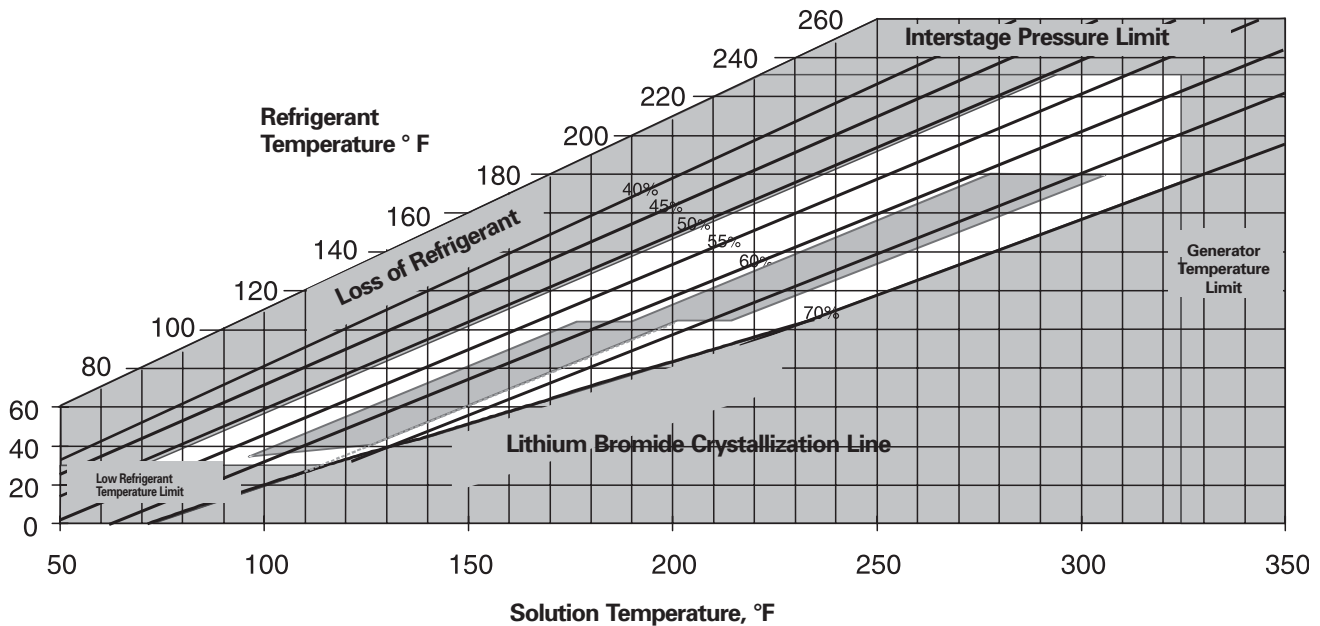
When a limit or safety assumes control, the clear language display will indicate the active limit mode. A limit mode does not necessarily mean that a problem exists. In many cases this limit is a normal function such as soft load during startup. The microprocessor will shutdown the chiller if the limit or safety condition reaches a level that could cause damage to the machine.

Horizon's Adaptive Cycle Management

The Equilibrium chart below illustrates the Generator Temperature Limit, the Interstage Pressure Limit and the Low Refrigerant Temperature Limit areas with respect to the normal cycle operation. These three limits along with PID Concentration and Solution Controls provide complete cycle management.

The white area in the middle of the chart illustrates the safe cycle operating area. Solution Concentration Control provides a margin of safety from the cycle to the Lithium Bromide Crystallization Line.

Cycle Management



Management Functions

- Low Refrigerant Temperature Limit Control - Freeze Protection
- High Generator Solution Temperature Limit Control - Prevents Hydrogen Generation
- High Interstage Pressure Limit Control - Prevents Generator Over Pressure
- Solution Concentration Control - Prevents Crystallization and Loss of Refrigerant

(8) Leaving Chilled Water Temperature Control

The unit control maintains leaving water temperature setpoint by varying the refrigerant vapor pressure in the evaporator. The leaving water temperature is third in the hierarchy of control, after safety functions (first) and machine protection (second).

The unit control monitors leaving chilled water temperature changes via a temperature sensor. By modulating solution flow and solution concentration, the potential to produce chilled water is modified to meet changes in leaving chilled water temperature. When no other limits with higher precedence are operating, the unit control system maintains the leaving chilled water temperature over the capacity range of the chiller. See Figure 16.

The lithium bromide concentration and temperature from the absorber sprays determine the absorber vapor pressure and the resulting refrigerant vapor pressure and temperature (NOTE 1). The refrigerant water vapor absorption rate is a function of absorber solution temperature and concentration. The condenser cooling water temperature is critical to the stability of the absorber solution cycle. Evaporator capacity is then only a function of absorber spray concentration. Absorber spray flow is changed by adjusting the solution pump speed with an adjustable frequency drive (AFD) control.

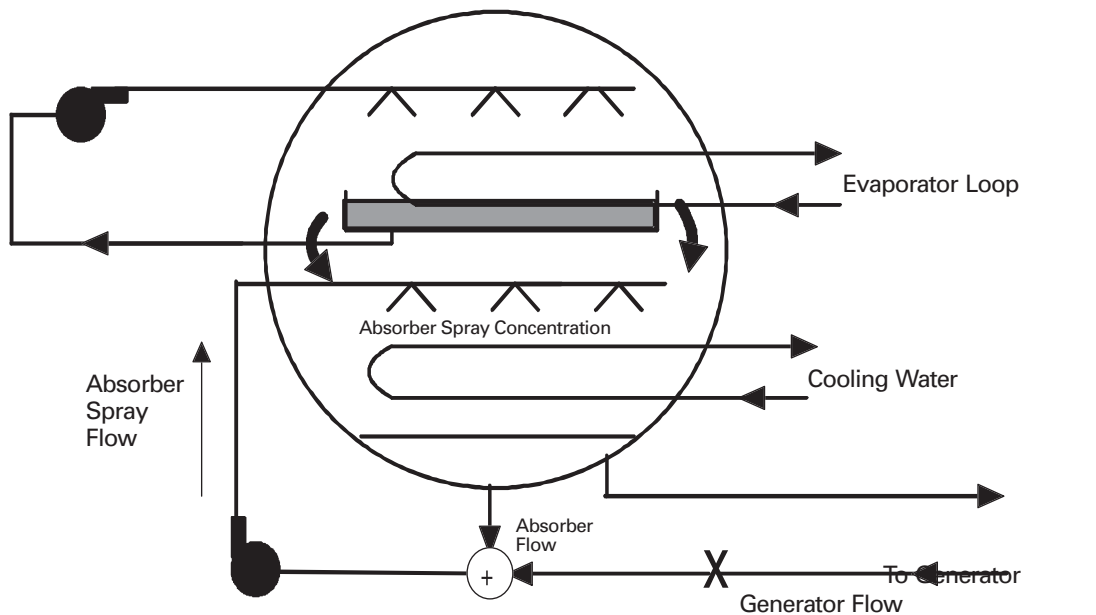
The solution concentration is changed by adjusting the speed of the LTSP using an AFD. Solution flows and concentrations are adjusted any time the demand for chilled water changes or the temperature of the entering tower water changes. In summary, varying the lithium bromide solution flow adjusts the amount of strong solution mixed with dilute solution to develop the absorber spray concentration.

The refrigerant vapor dilutes the lithium bromide as the sprayed solution is cooled by the condenser water flowing through the absorber tubes. Diluted solution is recycled to the generators to reclaim the refrigerant and concentration in the lithium bromide. Cooling capacity is the rate at which refrigerant is vaporized from the evaporator. To keep the cycle in balance, the rate at which refrigerant is vaporized must equal the rate at which refrigerant vapor is recovered.

NOTE 1) There is two ways to change absorber spray concentration — change concentration from the generator or change the flow from the generator. The most efficient mode of operation is to maintain a constant concentration from the generator and vary the amount of solution being concentrated. This is the method used to control.

Controlling capacity by modulating solution flow rate also yields the fastest responding system. Concentration control is tied to leaving water temperature control to anticipate changes in the machine cycle. Any change in solution flow is matched by a corresponding change in heat input. The net result is to minimize disturbances to concentration control.

Figure 16. Temperature control monitoring flow results



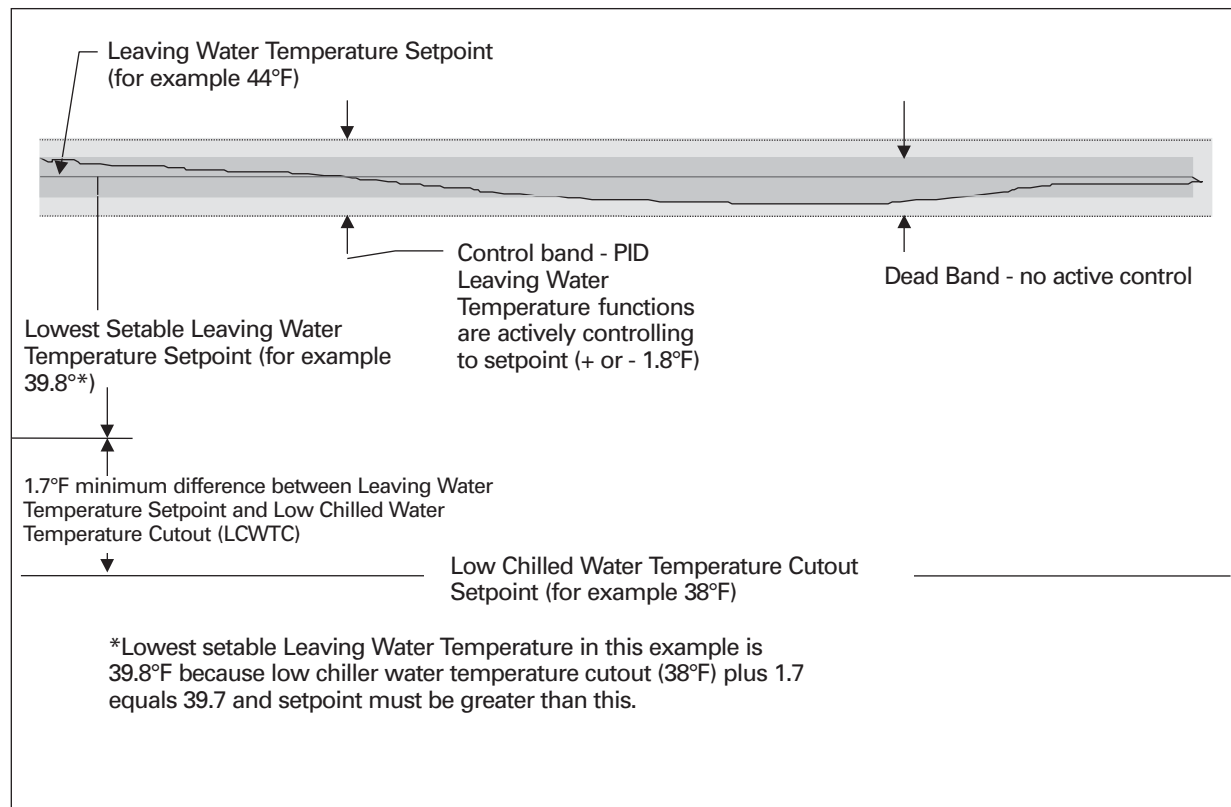
(9) Low Leaving Water Temperature Cutout (LCWTC)

The low chilled water temperature cutout will integrate to trip when the chilled water leaving temperature approaches the low leaving water temperature setpoint. The setpoint is factory adjusted at 38°F and should not be lowered. The setpoint can be raised using the service settings; field startup group menu. The range is 35-38°F. The low leaving water temperature cutout setpoint should never be less than 1.7°F below the leaving chilled water temperature setpoint when the cutout setpoint is 38°F. See Figure 17.

Control Band

The control band is a region “around” setpoint within which the leaving water temperature is allowed to drift. The control band is the setpoint + or - 1.0 degrees F. The control algorithms are active within this band to maintain control. A stable control band is a result of a properly tuned control “Gains “. The control band is affected by Proportional, Integral, Derivative (PID) gain settings. Factory settings accommodate most applications. Gain adjustments are accessible to allow a qualified individual to adjust unit performance for a given installation. **Only qualified personnel should attempt gain adjustments.**

Figure 17



(10) Concentration Control

The concentration control algorithm adjusts the energy input to deliver concentrated solution for optimum solution cycle efficiency.

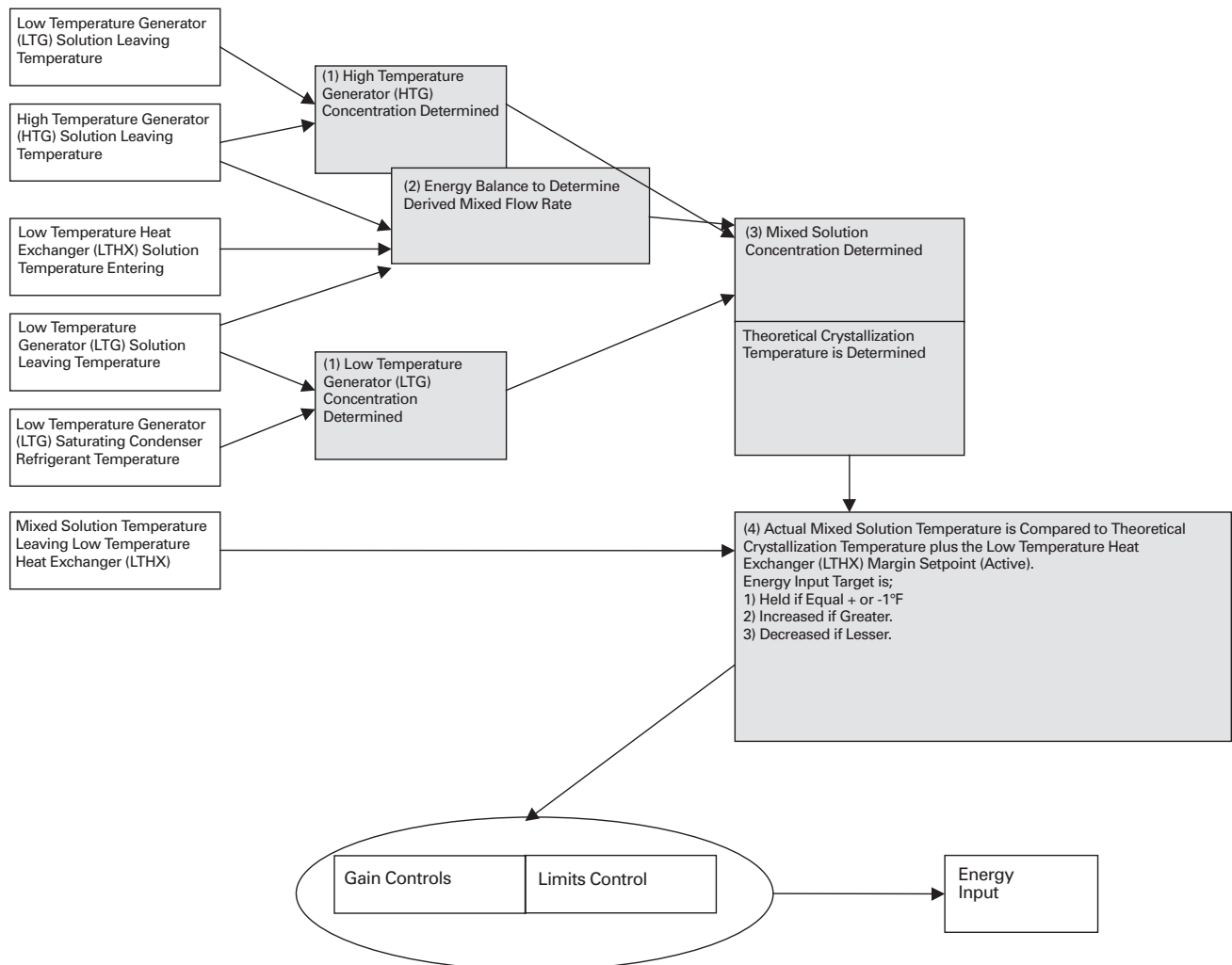
(1) The microprocessor calculates the High Temperature Generator (HTG) and Low Temperature Generator (LTG) solution concentrations continuously any time the machine is operating. This information is determined from machine temperatures supplied to the microprocessor. See the illustration below.

(2) The High Temperature Generator (HTG) strong and Low Temperature Generator (LTG) intermediate solution flows provide the MIXED solution concentration. The absorber spray solution concentration is a combination of the mixed and dilute recirculated solution. The displayed absorber entering solution concentration is a calculated value based upon this combination.

(3) The mixed concentration is determined from the proportions of two flow inputs. The theoretical crystallization temperature is determined from the derived concentration.

(4) When no limit conditions take precedence and with solution flows within the set AFD operating range, the mixed concentration is controlled to a preset number of degrees away from the theoretical crystallization line. This distance between the actual concentration temperature and the crystallization temperature is called the Low Temperature Heat Exchanger Margin (LTHX Margin). The LTHX margin is typically set at 15 degrees F. Above 15% load the strong solution leaving the low temperature heat exchanger will be maintained 15 degrees from theoretical crystallization point. The control system determines if the margin is less than, greater than or equal to the LTHX setpoint, and adjusts the energy input to maintain the LTHX margin throughout the load range. With a change in solution flow the energy input is adjusted to maintain the mixed concentration margin.

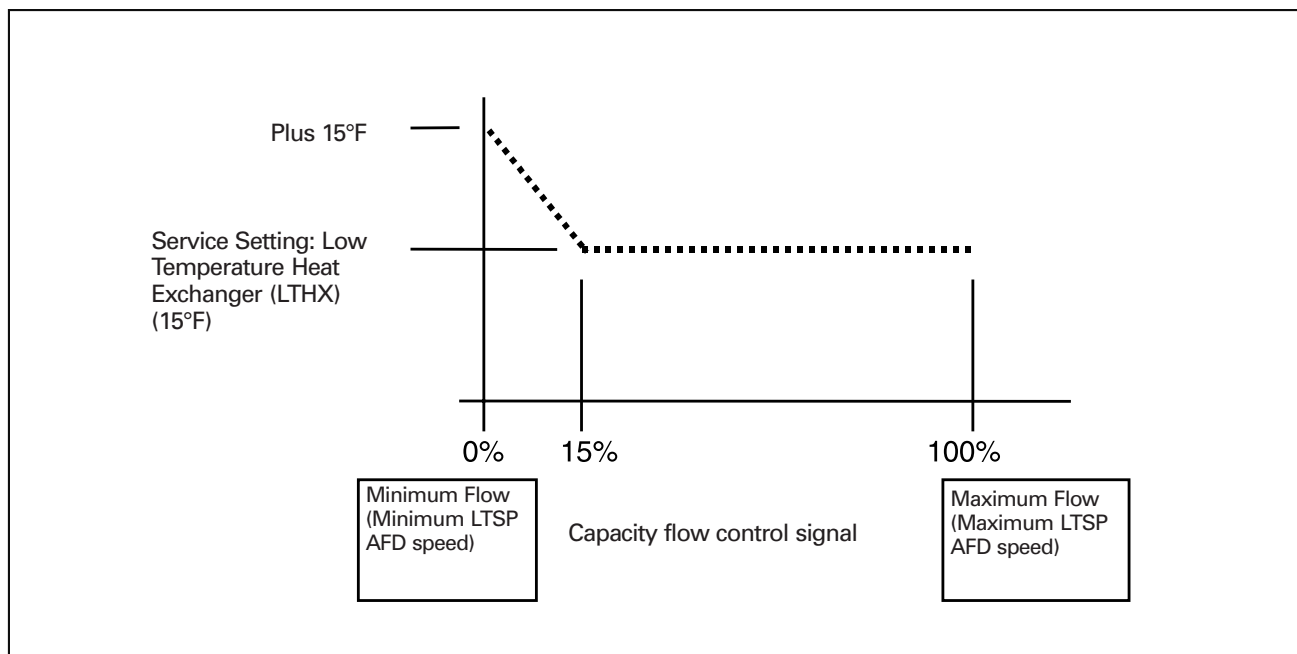
Concentration Control Block Diagram



Low Temperature Heat Exchanger (LTHX) Margin Vs Capacity Control Signal

The microprocessor will control the generator concentrations to maintain the selected Low Temperature Heat Exchanger (LTHX) service setting setpoint. The Low Temperature Heat Exchanger (LTHX) margin setpoint is located in the service settings field startup group menu. The standard set point is 15°F which is the solution margin at nominal design conditions. As the evaporator load decreases and the capacity control signal decreases, the margin will increase to a maximum of 30°F at minimum generator flow as illustrated in Figure 18. Between 15% and minimum solution pump speed, the Low Temperature Heat Exchanger (LTHX) margin increases to 30°F. The following chart illustrates this activity. The generator flow is controlled by changing the Low Temperature Generator (LTG) pump speed as evaporator load decreases.

Figure 18



Note:

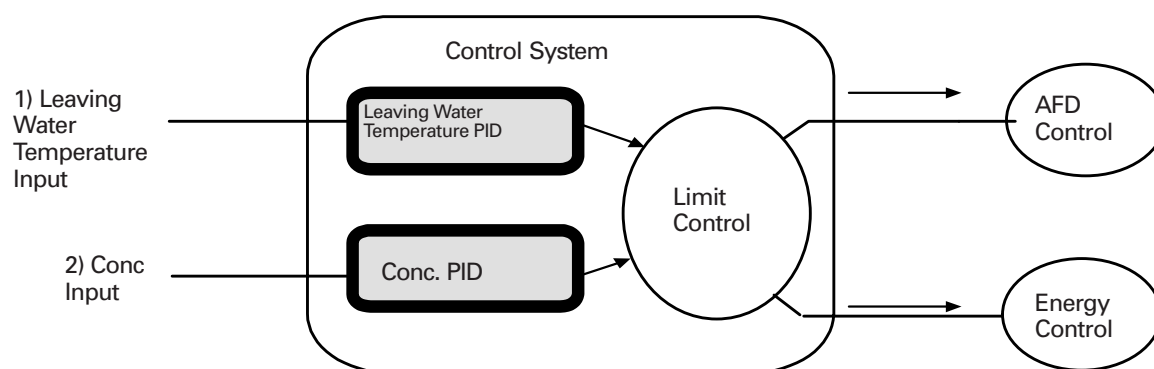
When the energy input is greater than 90% and if the margin begins to widen (lack of heat input to concentrator) the UCP may slowdown the drives in an effort to maintain Low Temperature Heat Exchanger (LTHX) margin setpoint.

(11) Control System's PID Control

The simplified control (Figure 19) illustrates how the microprocessor uses two temperature inputs to manage AFD solution speed control and energy input. The PID generated by these inputs can be modified by limit functions before the final output signals are transmitted to the respective control devices. The chiller module determines when and how the output signals are transmitted.

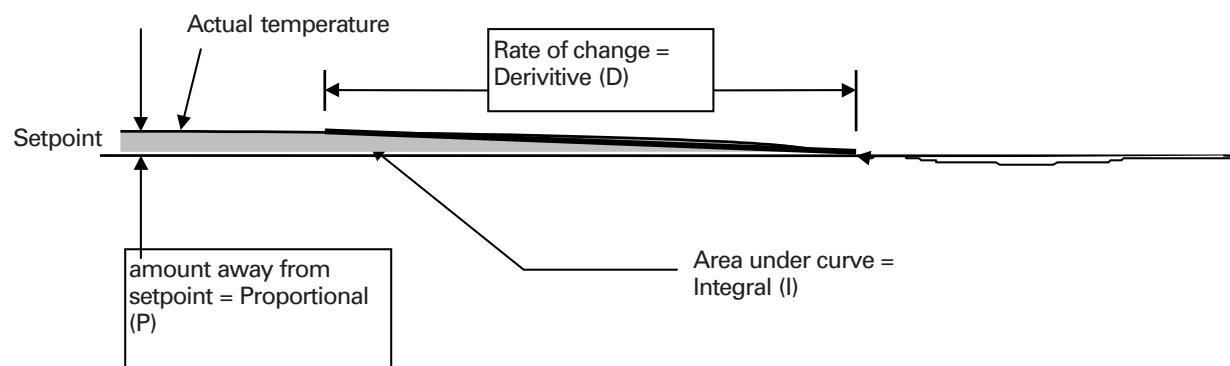
Gain, Reset and derivative settings are available at the CLD in the service setting (service level inputs). Factory tested settings are intended to provide satisfactory performance under most site conditions, however, these inputs are accessible for those occasions when it is necessary to make field adjustments.

Figure 19. Simplified diagram of leaving water temperature control and concentration control



An input from Leaving Water Temperature or Conc. control must first pass through PID control and second limit control before reaching the output device. The microprocessor first performs the PID functions of the control to determine what control correction signal is required, and second, determines if that signal is allowable by safeties or limit schedules condition.

Figure 20. Identifies the PID functions.



Gain = P, Reset = P/I, D = derivative

The PID functions look at the actual temperature versus setpoint, evaluates the distance away from the setpoint (P), the length of time away from setpoint (I), and the rate of change away or towards the setpoint (D).

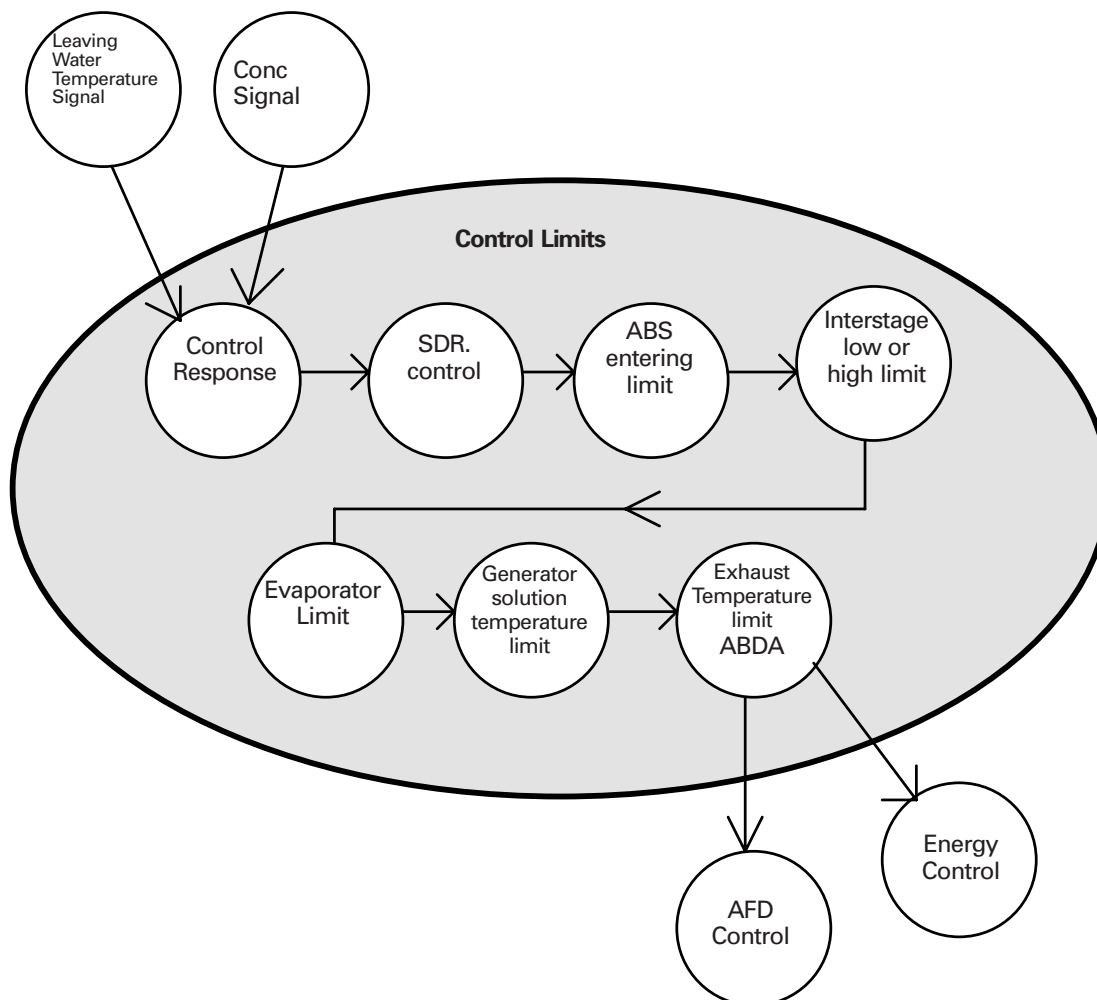
(12) Control System Limits

The microprocessor control continuously monitors for unsafe or unreliable operating conditions known as control limits and safeties. If such a condition is detected the limit control system can override Leaving Water Temperature and concentration control requests. The override limit would only occur when a control output (from Leaving Water Temperature or concentration control) request is greater than allowed by the particular limit schedule. The limit control will then modify the output signal maintaining chiller operation but at a reduced reliable capacity. The control priority changes from leaving water control to the particular limit or safety control. This allows continued chiller operation possibly at a reduced capacity. The system will adjust solution flow or energy input to maintain reliable machine operation before reaching a shut off condition. The microprocessor will shutdown the chiller if a condition is reached that could cause damage to the machine.

When the limit or safety takes over the priority control, the clear language display will indicate the active limit mode. A limit mode does not necessarily mean that a problem exists. In many cases this limit is a normal function such as soft load during startup.

During cooling operation the microprocessor will shutdown the chiller if the limit or safety reaches a condition that could cause damage to the machine. Figure 21 identifies the various limit conditions that could override Leaving Water Temperature and concentration control. The input signal must pass through each window without violating the conditions of each window to successfully output the desired command.

Figure 21



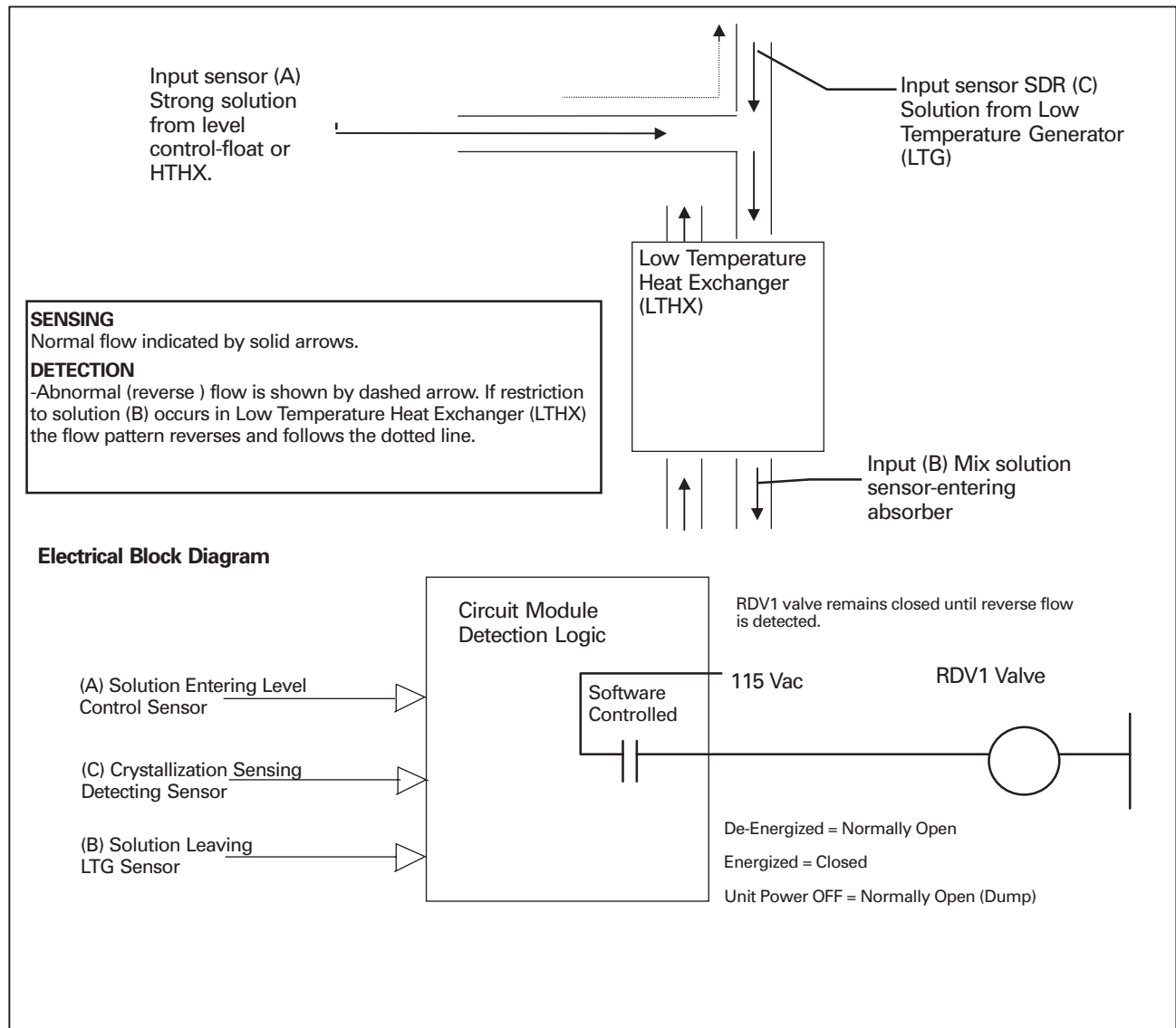
(13) Crystallization Sensing Detection and Recovery (SDR)

SDR is a control system strategy that through continuous sensing will detect unusual solution flow patterns, and upon detection, a recovery cycle is executed and operating adjustments are made to correct the condition. The system protects the generator solution cycle from solution crystallization and in worst case shuts the machine down safely when it cannot produce the required chilled water temperature. See Figure 22.

*SDR becomes functional when the solution temperature difference between the strong leaving High Temperature Heat Exchanger (HTHX) and the solution leaving the Low Temperature Generator (LTG) becomes greater than 10°F; at other times, SDR temperature will be displayed as "invalid".

The SDR system feature provides a secondary line of defense against crystallization over and above the routine Low Temperature Heat Exchanger (LTHX) concentration control system. The SDR feature protects the machine from transient conditions that the machine does not control. This system replaces the PCL float and logic of prior designs. Some transient operating conditions may cause salt crystals to precipitate out of the solution. Continued operation with this condition can restrict solution flow through the heat exchanger, resulting in a chiller failure that may be difficult to correct. The SDR control system detects this condition and takes corrective control action first, to correct the condition, and second, to maintain limited machine operation. The SDR will cycle twice before the machine is actually shut down upon the third occurrence.

Figure 22. Solution flows



The SDR uses temperature sensors to detect reverse flow from the high temperature generator. Under normal operation solution from the high temperature generator mixes with solution from the low temperature generator before passing through the low temperature heat exchanger. A temperature sensor placed above the mixing point will normally measure a temperature equal to the solution temperature leaving the low temperature generator. When the mixed lithium bromide solution flow through the low temperature heat exchanger is restricted with crystals, the normal path of solution flow is interrupted. Solution from the high temperature generator flows back wards into the low temperature generator outlet. A temperature sensor above the mixing point will see the hotter solution from the high temperature generator. The temperature sensor is designated Crystallization Sensing Detection sensor. Figure 22 illustrates the solution flows.

C) RECOVERY SEQUENCE

When reverse flow is sensed the microprocessor system will perform the crystallization recovery sequence. This sequence dilutes the lithium bromide solution breaking up the "Blockage" that caused the reverse flow. Each SDR cycle performed will be recorded by the control system. Each of the first two SDR detections will cause the active margin to be increased by 5 degrees. The minimum solution pump flow command is increased 5%, and the ON/OFF Pump sequence will be performed. On the third SDR occurrence reverse flow detection, an MMR will be issued, and a Dilution Cycle will be initiated.

System Response to a SDR is as follows:

1. Energy Inputs Commanded Off
All solution pumps stop,
RDV1 opens to dilute the absorber .
3 minutes elapses
2. High and Low Temperature Solution Pumps turn ON.
The display indicates a 5-min Pump On SDR timer.
5 minutes elapses
3. High and Low Temperature Solution Pumps turn OFF.
The display indicates 3 min Pump Off SDR timer.
3 minutes elapses

4. System will restart normal chiller operation (unless the system has been commanded to Stop or there are pending diagnostics).

Total time elapsed is 11 minutes

If a Stop has been commanded or there is an active MMR or MAR diagnostic the unit will enter a Dilution Cycle.

The active Low Temperature Heat Exchanger (LTHX) Margin is increased 5°F and the minimum solution pump speed increased 10%, to improve ability to stay on line.

After completion of the recovery operation:

- If SDR temperature is less than or equal to the Low Temperature Generator (LTG) solution temperature +3 deg, then control returns to normal operating status. .
If $\text{SDR Temperature} \leq [\text{Low Temperature Generator (LTG) sol} + 3^\circ\text{F}]$ then OK
- If SDR temperature is greater than (Low Temperature Generator (LTG) temperature + temperature leaving float valve) / 2) AND there is 10°F or greater difference between Leaving Float Valve and Leaving LTG Temperatures, then control returns to SDR mode.

If $\text{SDR Temperature} > [(\text{Low Temperature Generator (LTG) sol} + \text{High Temperature Generator (HTG) sol}) / 2]$ and $[\text{High Temperature Generator (HTG) sol} \geq (\text{Low Temperature Generator (LTG) sol} + 10^\circ\text{F})]$ then returns SDR.

The active Low Temperature Heat Exchanger (LTHX) Crystallization Temperature Margin Setpoint will return to the service settings value and active minimum solution pump flow command at the next Reset. The front panel Low Temperature Heat Exchanger (LTHX) Crystallization Temperature Margin Setpoint does not reflect the increased value of the 5°F increase.

Reset, Stop, or Panic stop during SDR cycle

If a Reset is issued, the unit will remain in a SDR Mode until the ON/OFF Pump sequence is complete. The Reset will then be performed and the unit will start if the unit mode is Auto and there are no latching diagnostics. Otherwise, a Dilution Cycle will be initiated.

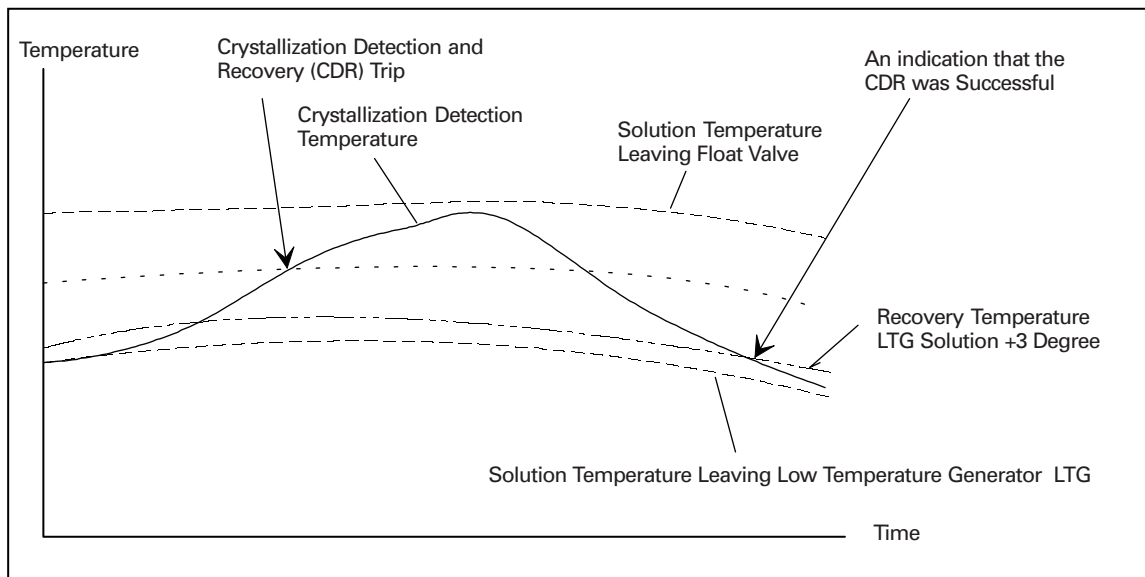
If a Stop is issued, the unit will remain in a SDR Mode until the ON/OFF Pump sequence is complete. A Dilution Cycle will then be initiated.

If a Panic Stop is issued, a Panic Stop is initiated without delay.

Diagram Illustration of an SDR Occurrence

- Figure 23 illustrates a typical SDR trip temperature (center dotted line) and crystallization sensing detection sensor temperature (solid).
- The **left arrow** point indicates where the solid line crosses the dotted line. This is where the SDR trip criteria is met and recovery mode is initiated.
- The **right arrow** point indicates where the SDR temperature has been reduced to the recovery temperature (SDR sensor temperature is below the low temperature solution temperature + 3°F) required for operation. Operation will be restored after the 11 minute recovery cycle is complete.

Figure 23



Soft Loading Time [Control Response]

Summary

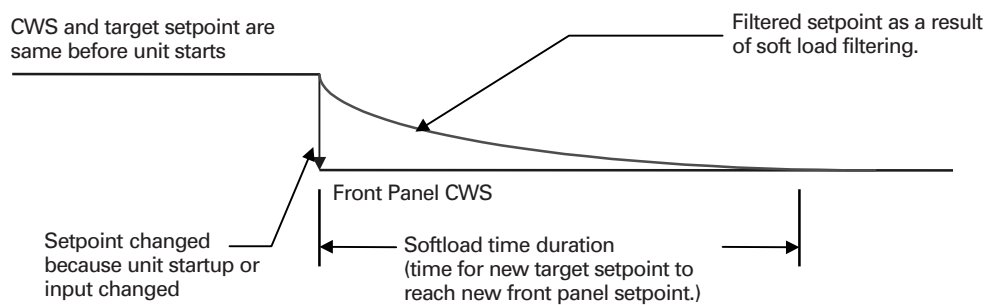
Horizon chiller control (soft loading feature) ramps setpoint changes. This provides a controlled transition during machine startup and when setpoint changes are entered during operation. Soft Loading along with solution pre-heating are used to bring the chiller solution concentrations and temperatures up to normal operating levels in a controlled manner.

Details:

The control response set point can be adjusted within the field startup settings menu group. The microprocessor filtered control response determines how fast the machine loads or unloads to a new setpoint target. This occurs at startup and whenever an input setpoint is changed. Any chilled water set point change entered into the CLD is modified (FILTERED) to eliminate major upset of the absorption solution cycle. The filtered setpoint can be viewed by pressing "Enter" while viewing the setpoint screen. This filtered setpoint is the actual target that the control is proceeding towards. At the end of the soft load time setting the filtered and setting values will be equal.

On startup, the filtered setpoint will be equal to the current leaving water temperature. Soft load will slope the filtered setpoint towards the active setpoint over the softload time period. The Active setpoint will be reached at the end of the filtered soft loading time (control response time) period. See Figure 24.

Figure 24



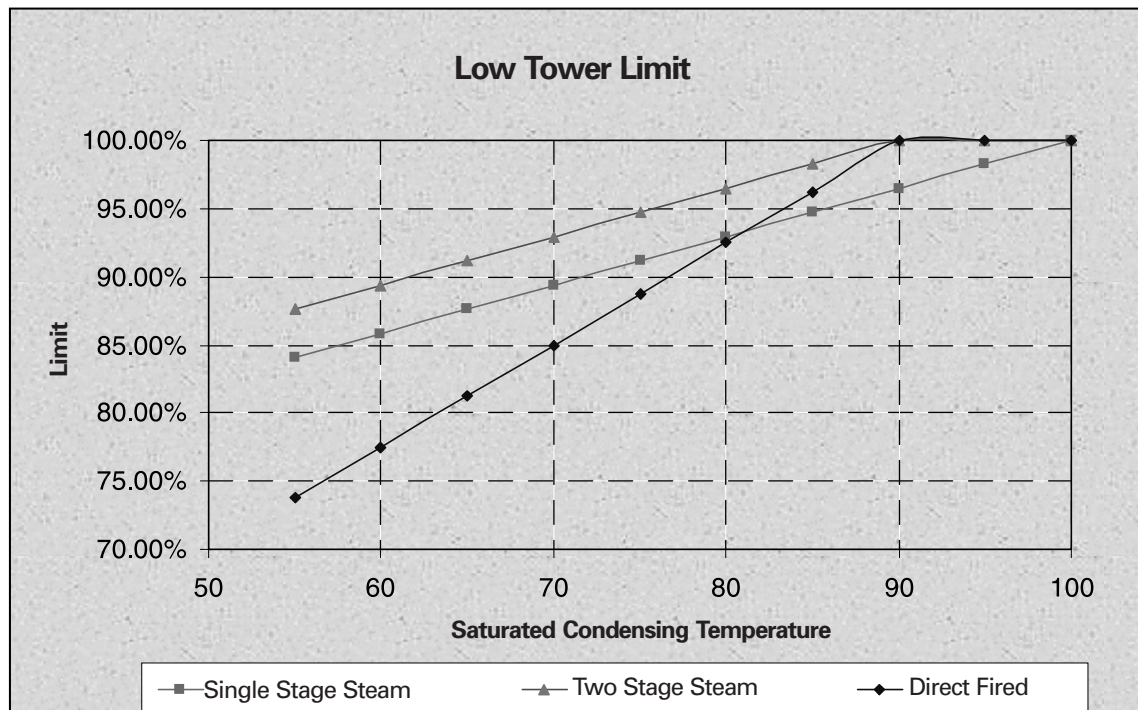
Softloading time is factory set to 15, but has an adjustment range of 1 to 100 within the field startup group on the CLD by service personnel at startup. This soft loading time will affect how fast the Chilled Water; Heated Water and Crystallization Margin internal setpoints reach their respective targets. The filter is active at all the times and will apply the time period to any setpoint change.

(14) Absorber (Abs) Entering and Low Condensing Temperature Limit

The purpose of this limit is to provide reliable machine operation with variations in entering absorber water temperatures.

- Fluctuations in entering saturated condensing temperatures above 90°F (100°F ABSD) will have an affect on the energy input because of the built in feed-forward gain function. Sudden changes will result in an appropriate energy input change. After the transient is over the energy input will be re-established to the new input level required for equilibrium at the new ABS temperature.
- When the saturated condensing temperatures drops below 90°F (100°F ABSD) there is a potential capacity flow boundary (limit) imposed on solution capacity flow control (AFD) signal and an energy input adjustment. See Figure 25. Reference the left column for the maximum Flow that will be allowed at a saturated condensing temperature.
- Only when the desired control system capacity flow signal exceeds the allowed flow will "Capacity limited by Low condensing temperature limit" become displayed and active.

Figure 25

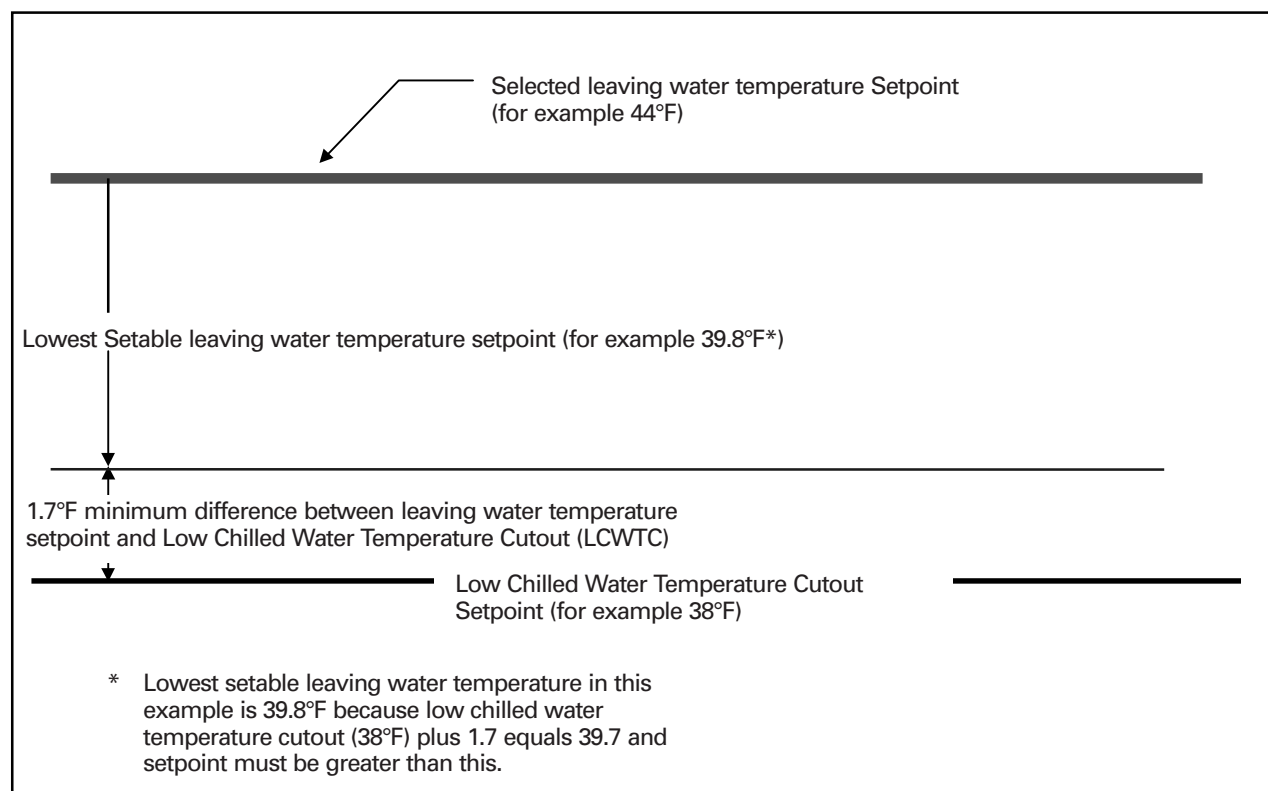


(15) Chilled and Refrigerant Temperature Cutouts, Limit and Differential to Start or Stop

Low Chilled Water Temperature Cutout (LCWTC)

The low chilled water temperature cutout (LCWTC) will shut the machine down when the leaving water temperature (Leaving Water Temperature) reaches the chilled water cutout setpoint. The cutout setpoint is factory adjusted at 38°F and should not be changed. In special cases the setpoint can be changed, if necessary, using the service settings; field startup group menu. The adjustable range is 35-38°F. The chilled water temperature setpoint cannot be set lower than 1.7°F above the chilled water cutout, which is 38°F in this discussion. Therefore, the lowest leaving water temperature (Leaving Water Temperature) setpoint allowed is 39.8°F with 38°F (LCWTC). Figure 26 illustrates a pictorial relationship.

Figure 26. Example illustrating leaving water temperature setpoint and LCWTC setpoint range



Low Refrigerant Temperature Cutout (LRTC) and Limit

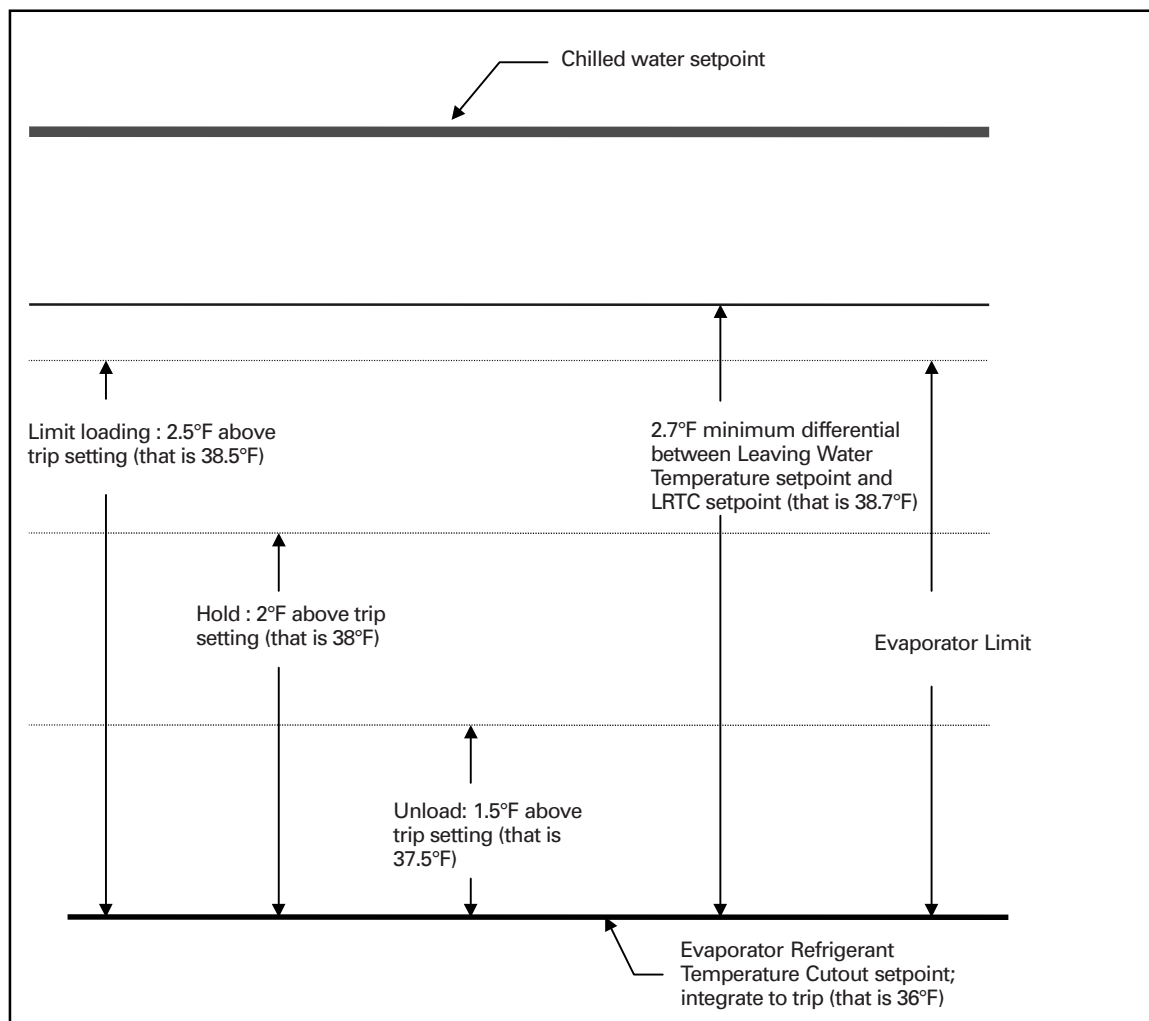
The low refrigerant temperature cutout (LRTC) limit is used to prevent a chiller shutdown when the evaporator refrigerant temperature approaches the cutout setpoint. This is accomplished by limiting loading, holding or unloading in sequence to prevent the refrigerant temperature from reaching the cutout setpoint. If the limiting action is successful, the chiller will stay in limit until the refrigerant water temperature recovers. If the limiting actions do not prevent a continued decline in refrigerant temperature, the low temperature cutout point will be reached and trip the chiller off. An MMR diagnostic then locks out chiller operation.

To restore service, the diagnostic must be manually reset. The factory setting of 36°F should not be changed, however it is accessible from within the service settings: field startup group menu if the chiller selection requires a new setpoint for stable operation.

An example of how the refrigerant limiting function operates is illustrated in Figure 27. Assume the LRTC is set to 36°F.

- Limit loading occurs at 38.5°F
- Hold loading at 38°F
- Unload occurs at 37.5°F
- Limit loading : 2.5°F above trip setting (that is 38.5°F)
- Cutout will occur at 36°F

Figure 27. Refrigerant limiting function operation

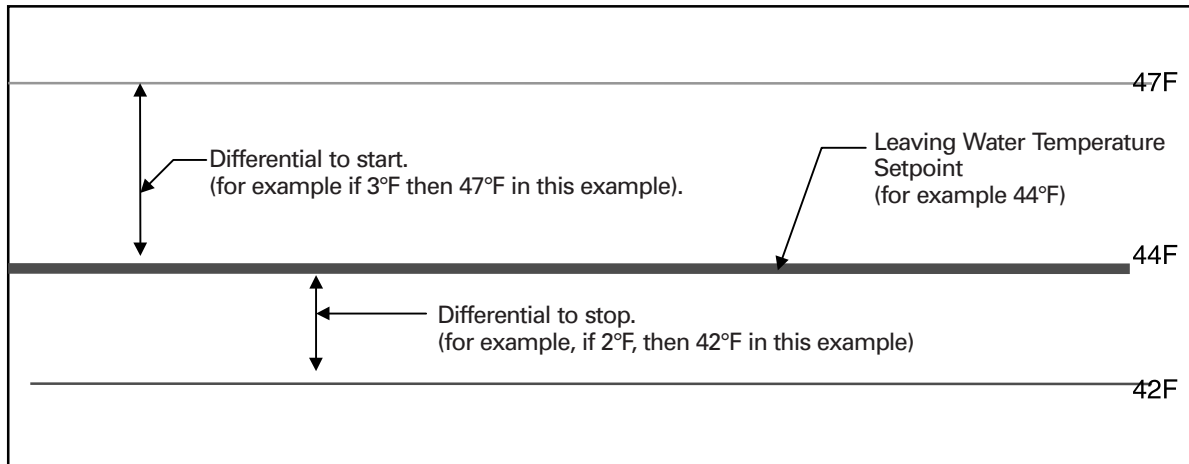


Differential to Start/Stop

With the chiller in Auto mode waiting for a need to cool and the leaving water temperature (Leaving Water Temperature) reaches the **Differential-to-Start** setpoint, the chiller start sequence is initiated as the Leaving Water Temperature reaches the **Differential-to-Stop** setpoint. The chiller returns to the AUTO mode waiting for a need to cool mode after completing a solution dilution cycle (Reference Figure 28).

- Differential-to-start is the number of degrees above the chilled water setpoint that the return water temperature must increase to start the chiller. The differential-to-start setpoint is LCD menu adjustable from 1 to 10°F (0.5 to 5.55°C).
- Differential-to-stop is the number of degrees below the chilled water setpoint that the supply water temperature drops before the chiller shuts down. The differential-to-stop setpoint is adjustable on the LCD from -1 to -10°F (-0.5 to -5.55°C).
- Both are integrated functions to avoid nuisance start or stops on momentary fluctuations in temperature.
- Both setpoints move with respect to the active chilled water setpoint.
- Differential-to-stop must be set above low leaving water temperature cutout setpoint, otherwise cutout occurs before differential to stop occurs.
- Differential-to-stop must be set above evaporator low refrigerant temperature limit control, otherwise limit functions become active before differential to stop is reached.

Figure 28. Example illustrating the leaving water temperature setpoint and the differential to start and stop setpoints



Filtered Setpoint Feature

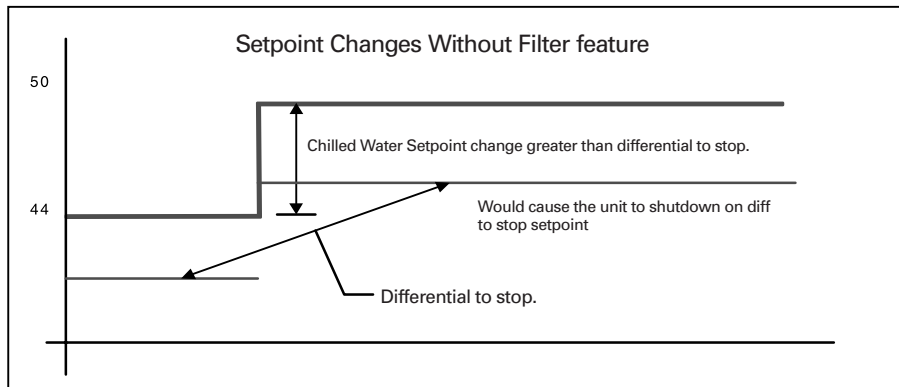
The micro utilizes a filtered chilled water setpoint feature. Figure 29 illustrates a typical front panel setpoint change from 44 to 50°F. The first illustration is without a filtered setpoint feature and the second figure is with the filtered feature.

Without a filtered setpoint change the chiller would cycle off because of the 4°F differential to stop being reached immediately. (Vertical rises shown in third figure).

The filtered setpoint feature allows the operator to change the chilled water set point without a chiller shutdown.

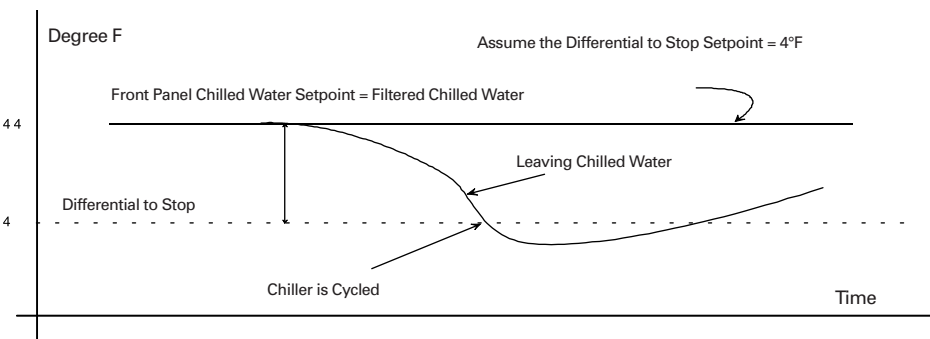
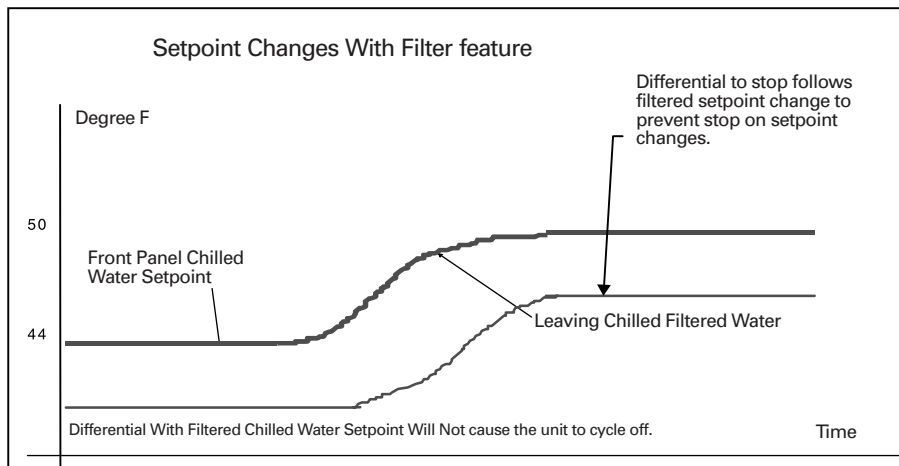
The micro response to a loss of chilled waterload does not have the same filtered setpoint associated with it. Rapid load changes will simply be presented to the Differential to Stop logic as large difference between the chilled water setpoint and the leaving water temperature.

Figure 29. Three examples of setpoint changes with and without the filter feature



Both cases assume the Differential to Stop Setpoint = 4 Deg F

Each of the differential control functions is softened with an integration of time and temperature difference from the chilled water setpoint.



Leaving Water Temperature Control Setpoints

Table 9 identifies the maximum differential-to-stop and start settings recommended for the leaving water temperature (Leaving Water Temperature) setpoints, without violating the LCWTC or LRTC factory settings. Even though the clear language display (CLD) differential-to-stop can be set up to 10°F, the following table identifies the maximum setting to avoid overlap of the evaporator limit and/or low chilled water temperature cutout.

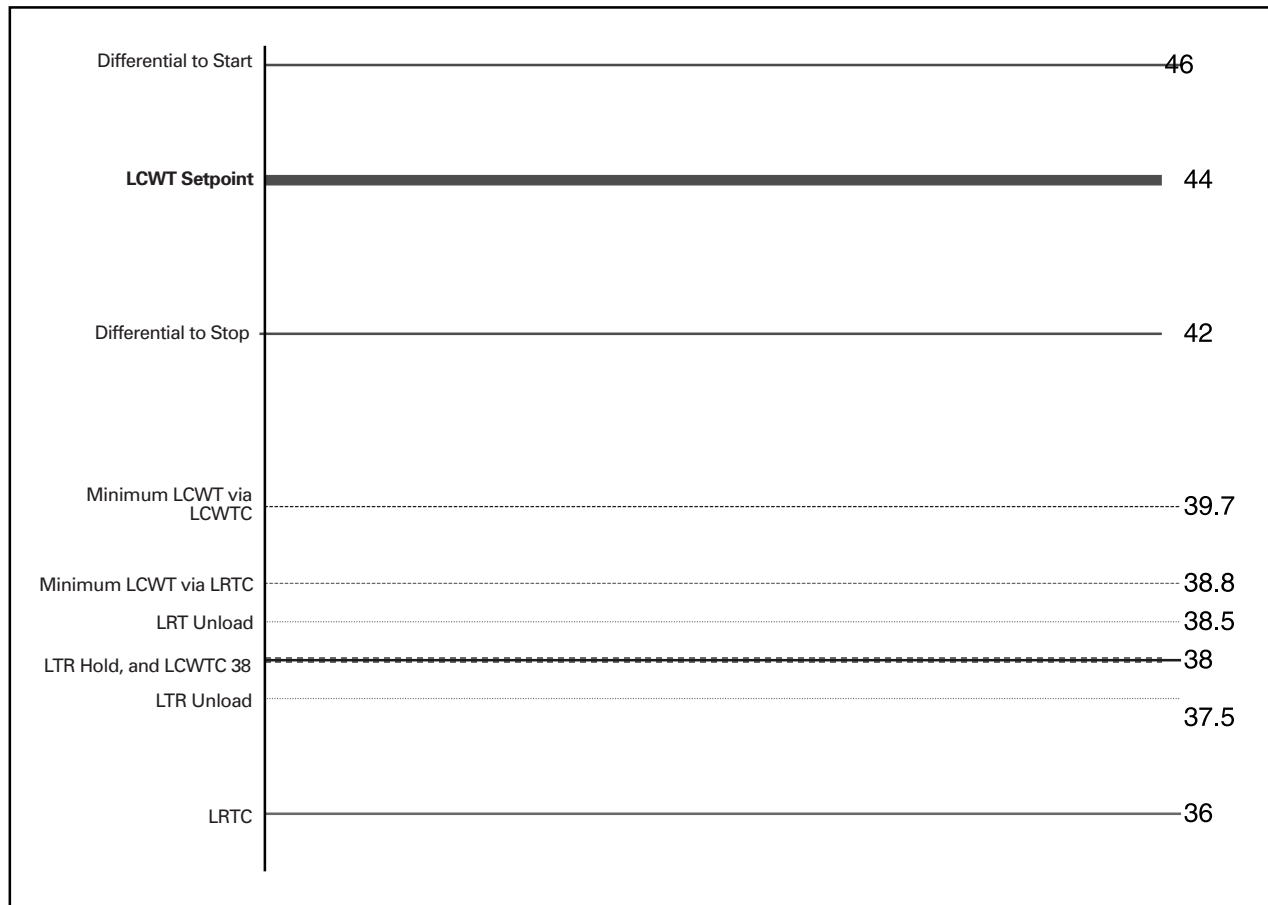
Figure 30 is a composite of all the settings regarding leaving water temperature (LWT) control. Depending on where the actual leaving water temperature falls within the figure below, will indicate the active UCP2 control functions.

Table 9. Maximum differential start and stop settings for leaving water temperature setpoints

LWT STPT	40°F	41°F	42°F	43°F	44°F	45°F	46°F	47°F	48°F	49°F
Differential to Start	1-10°F	1-10°F	1-10°F	1-10°F	1-10°F	1-10°F	1-10°F	1-10°F	1-10°F	1-10°F
Differential to Stop	1-1.4°F	1-2.4°F	1-3.4°F	1-4.4°F	1-5.4°F	1-6.4°F	1-7.4°F	1-8.4°F	1-9.4°F	1-10°F
LCWTC	38°F	38°F	38°F	38°F	38°F	38°F	38°F	38°F	38°F	38°F
LRTC	36°F	36°F	36°F	36°F	36°F	36°F	36°F	36°F	36°F	36°F

In order to increase the differential-to-stop without violating the LWTC or LRTC, the factory settings of 38°F and 36°F respectively would need to be altered from within the password protected service settings, field startup group menus. As stated previously, they are each adjustable from 35-38°F. The factory settings should not be altered if at all possible.

Figure 30. Leaving water temperature control settings



(16) Inter-Stage Pressure Limit

High Interstage Pressure

A pressure transducer monitors the inter-stage vapor pressure generated by first stage generator. This pressure is a function of the energy input to the first stage generator, the presence of noncondensable gases, and the condensing temperature. The inter-stage pressure transducer is mounted vertically on a stand off tube to isolate it from any lithium bromide that may be carried with the water vapor. If this pressure rises above the 3 psig cutout of the HPC, the chiller will be shut down, protecting the chiller and the rupture disk (~15PSIG).

The interstage pressure cutout setpoint is factory set to 3PSIG. This is adjustable within service setting: machine configuration menu group on the CLD. The range is 0-15.

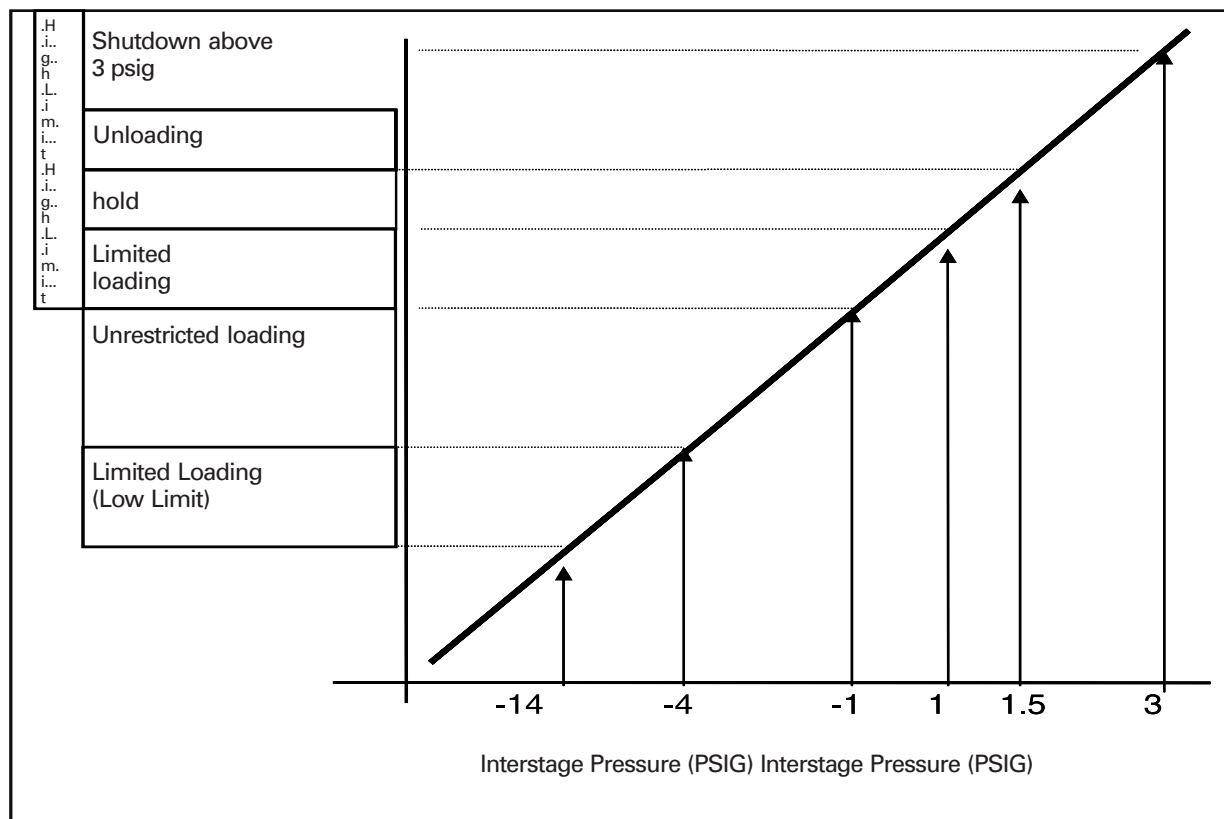
The limit is a proportional control that limits loading as the Interstage Vapor Pressure approaches the UCP2 high-pressure cutout setpoint. See the illustration below for an understanding of the allowed loading verses interstage pressures.

Low Interstage Pressure Limit

To avoid sensor diagnostic at startup the diagnostic is not enabled until the Solution Temperature Leaving the LTG is above 120 Degree F. At this point the microprocessor monitors the inter stage pressure for a continued increase. Low interstage pressure limit will likely be displayed as the machine interstage pressure is brought up from the low pressures at a cold startup.

Figure 31 identifies how the microprocessor responds to a pressure increase as the pressure approaches cutout.

Figure 31. Example illustrating the microprocessor response to a pressure increase approaching cutout



(17) Generator Solution Temperature Limit Control

As the solution temperature increases, the control system will limit machine energy input attempting to keep the chiller operational. Limited energy input to the first-stage generator begins when the strong solution leaving the temperature exceeds 315°F.

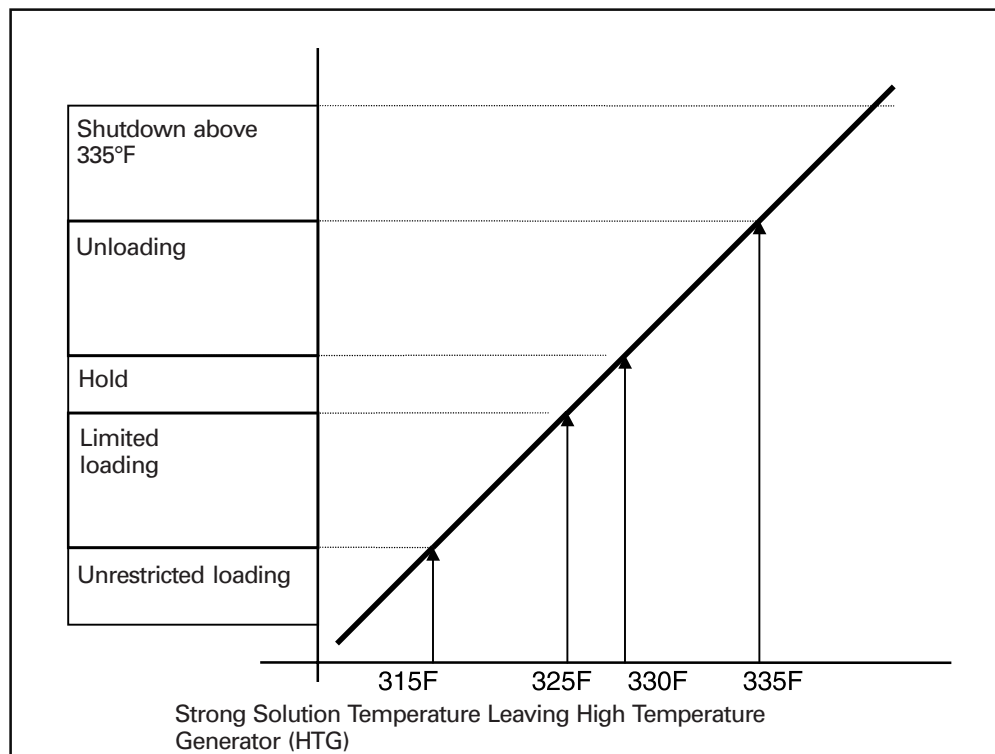
The control system will enter limit loading from 315 to 325°F; on further temperature increase will:

- hold at 325 to 330°F and
- unload at 330 to 335°F and
- shut down the machine above 335°F.

Operation at or above solution temperatures above 335°F will cause rapid solution inhibitor depletion and potential operational problems.

The resulting machine shutdown causes a manual reset-MMR- diagnostic. The high limit must be cleared and problem corrected before a restart is attempted. The control range is fixed in the software.

Figure 32



(18) High Exhaust Gas Temperature Limit and Cutout

The purpose of this limit and cutout is to protect the direct-fired generator from excessive temperatures that could result from a loss of solution flow. The unusual temperature increase results from the loss of heat transfer to the lithium bromide solution surrounding the direct fired chamber and flue gas tubes, when the solution flow is restricted.

The high exhaust gas temperature probe is located in the stack above the top row of fire tubes and senses the temperature approximately 12" from the side of the shell. There are two conductor-jacketed cables mounted in the sensor probe. They are the exhaust gas temperature RTD temperature sensor and the HTC thermal couple. A twisted cable containing two stranded wires connects the RTD to the burner module. The flat-jacketed cable connects the HTC sensor to the high temperature generator cutout switch.

High Exhaust Gas Temperature Limit

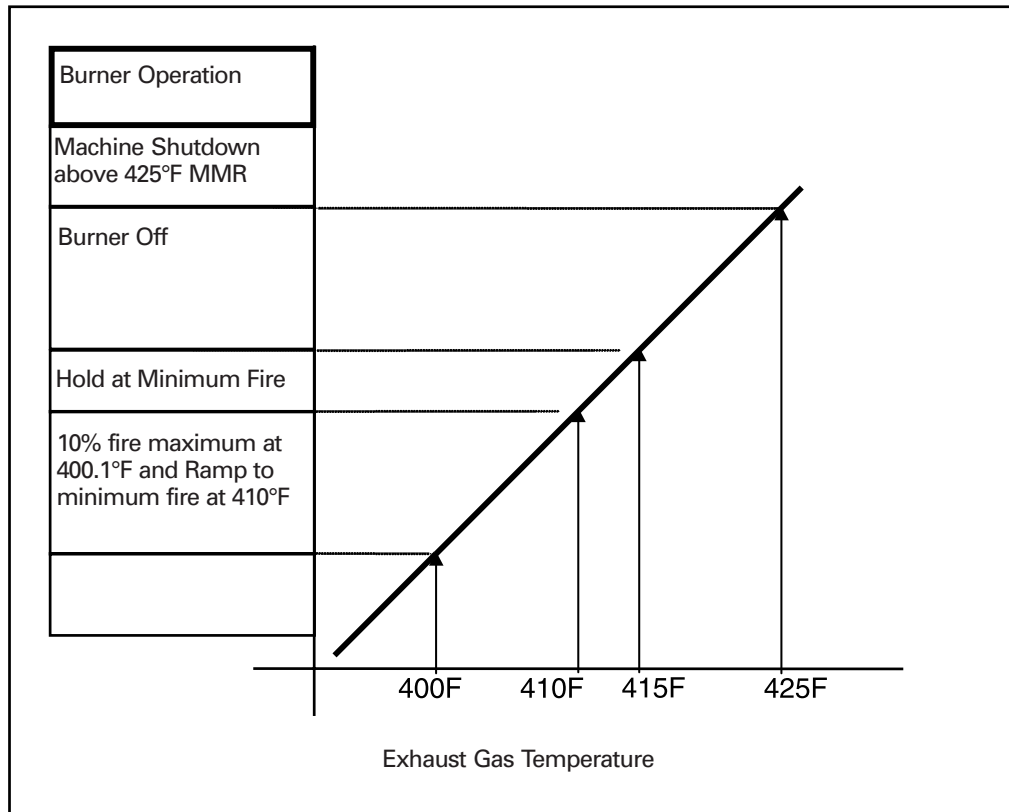
This limit function reduces the burner fire rate or turns off the burner lowering the overall generator temperature when the temperature zone is violated. Figure 33 illustrates the associated temperatures.

Several events could potentially cause a high exhaust gas temperature.

- extremely high tower temperature is one possible cause.
- solution flow to the direct fired generator being interrupted because of a failed high temperature solution pump,
- a restricted solution flow thru the HTG.

The limit responds to the Exhaust Gas Temperature sensor located in the exhaust gas stream. The limit is based on a schedule (shown below).

Figure 33. Exhaust stack limit during automatic operation



High Exhaust Gas Temperature Cutout - HEGTC

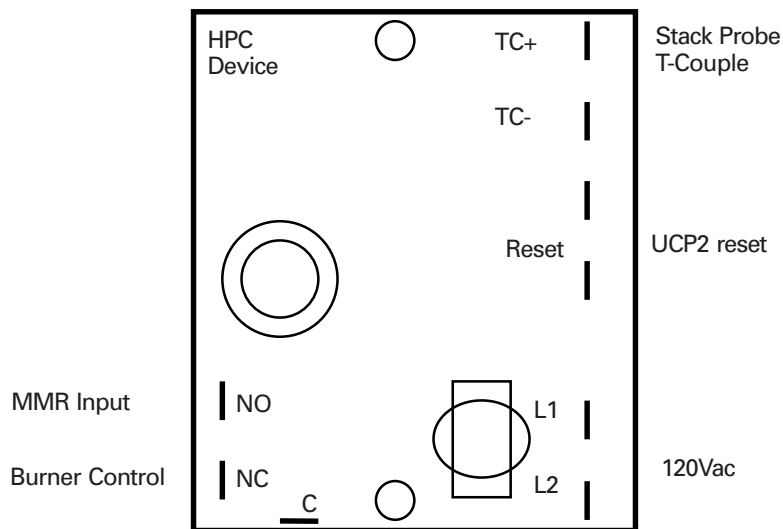
(Direct Fire Only)

The High Exhaust Gas Temperature Cutout (HEGTC) provides machine shutdown when an unusual operating condition causes excessive flue gas temperature.

The exhaust gas temperature limit and high temperature cutout are two active sensors located in the stack that continually monitor flue gas temperature during normal operation. The exhaust gas temperature limit attempts to reduce the stack temperature to safe operational levels. The high temperature cutout shuts the burner off if the flue gas temperature reaches 425°F.

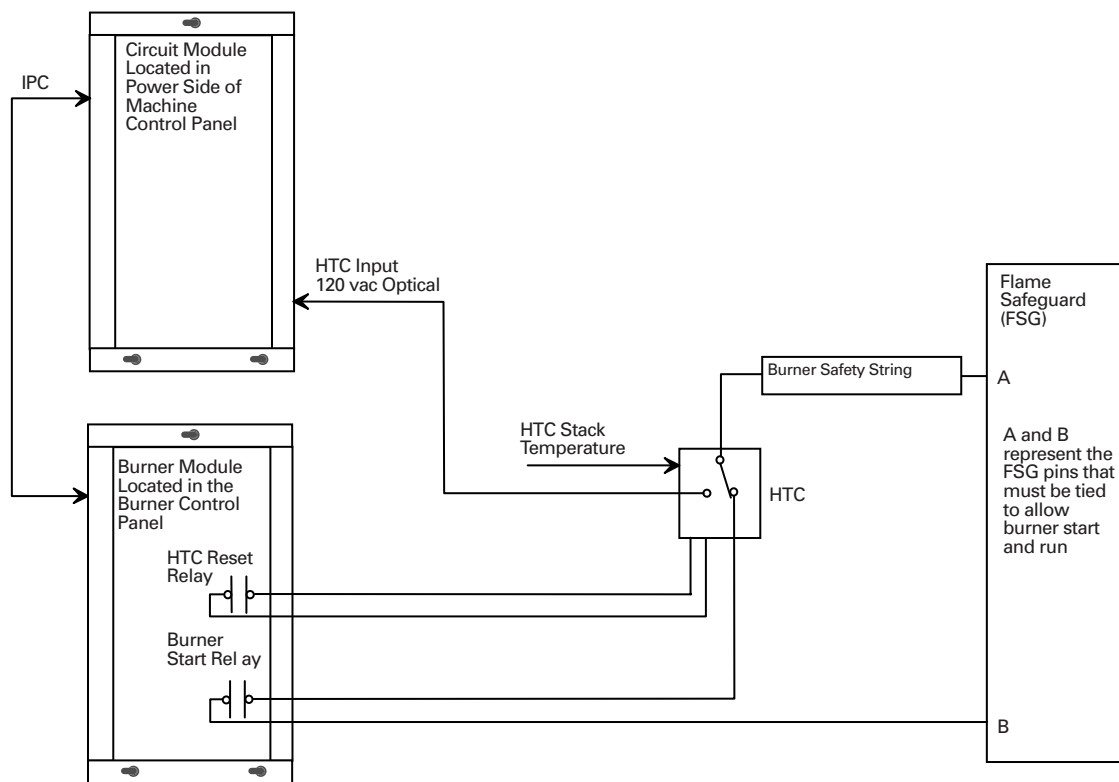
The HTC control module (Figure 34) is located in a small enclosure along side of the burner control panel. The sensor is located in the exhaust gas temperature probe along with the limit temperature sensor. The HTC trips if the sensed stack temperature exceeds 425°F for more that 6 continuous seconds. The HTC device normally closed contacts (NC) open, removing the burner flame safeguard start command, and the normally open contacts (NO) close, to provide a trip signal input to the circuit module optical input. An MMR diagnostic message is displayed on the CLD.

Figure 34. HTC control module



The HTC device latches in the tripped position until the unit control panel is manually reset from within the diagnostics menu group.

Figure 35. The following diagram indicates a typical HTC circuit



(19) Adaptive Steam Control

Horizon steam-fired chillers have added adaptive steam flow control. The flow control algorithm directly controls the rate at which steam enters the unit. Direct control of steam flow guarantees that steam consumption will not exceed the maximum desired flow rate under any condition. This function replaces the start up demand limit used on old absorption chillers. It provides superior protection for marginally sized boilers because it is active all the time, but at the same time does not interfere with normal operation of the chiller. Steam flow control will compensate for variations in steam supply pressure or generator pressure variations at start up or low cooling water temperatures. This gives the unit better carry-over protection and improved crystallization temperature margin control.

% Energy input Auto Command verses Energy Valve Position

- Steam flow control converts the non-dimension % Energy input Auto Command (cycle report; second from last item) to a required steam flow rate. Two factory mounted pressure transducers measure steam supply pressure and pressure drop across the steam valve. Steam flow characteristics for all of the valve types and sizes available for Horizon chillers have been programmed into the software. Given steam flow rate and pressure drop across the valve, the characteristic equation for steam flow is solved for valve position. If steam pressure fluctuates, the energy valve is repositioned to maintain the desired energy input; therefore, the energy valve mechanical position likely will not always be the same for a given energy input auto command. Energy valve position is indicated as the last item in cycle report.
- For a given valve opening position there is greater steam flow when a greater differential pressure exists than when less differential exists. Because the steam flow rate will change with given pressures the % Energy Input Auto Command must be used to determine the firing rate. The valve position simply states physically where the valve position is not the steam flow rate.

Field set-up of the unit is simplified because energy valve end stops are automatically set by the inputs in the machine configuration menu: unit size in tons, valve size in inches, and valve type (V-ball or butterfly). Steam flow control is possible because of the addition of two factory mounted pressure transducers on the steam line. In addition to flow control, steam pressure measurements are valuable pieces of information to a service technician or plant operator and are available on the clear language display.

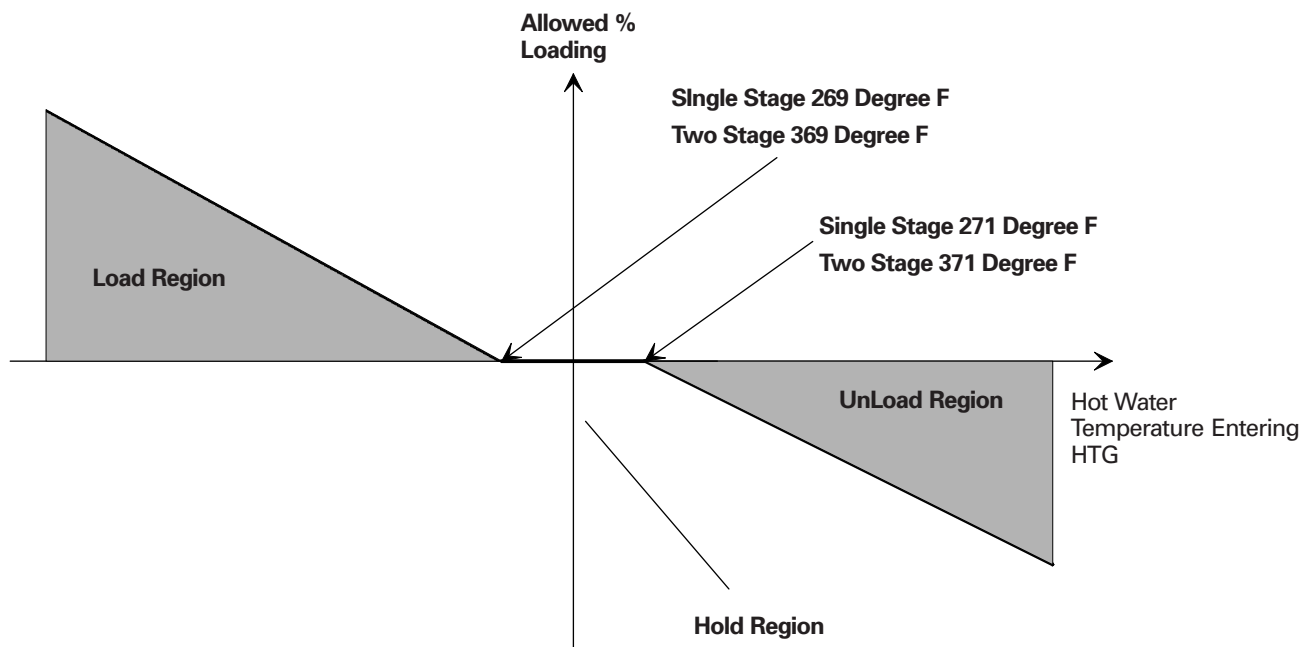
In service test, manual control uses steam flow control to convert the energy input to a steam valve position. Steam valve position in while in manual control will have demand limit and carry-over protection active. Because steam flow control is active, the valve position will adjust to changes in steam pressure.

(20) Generator Entering Hot Water Limit Control (Hot Water Only)

Generator Entering Hot Water Temperature Limits apply to both single and two stage absorption units. The purpose is to limit the heat energy to the generator to prevent tube expansion damage within the generator. See Figure 36.

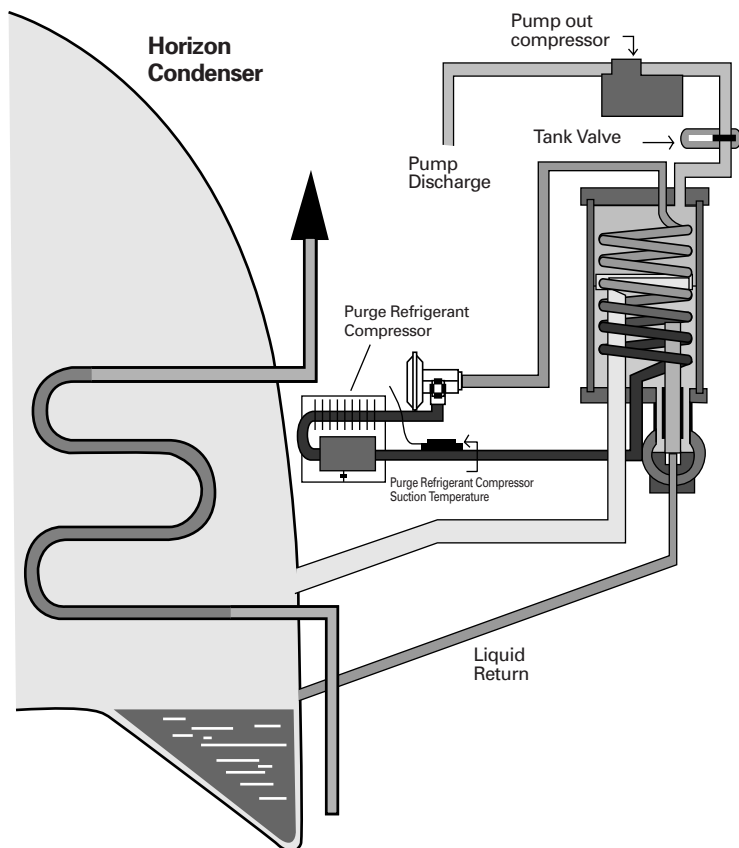
This is a proportional limit control that will limit loading as the hot water temperature approaches the temperature limit value. There is a one-degree dead band above and below the limit value where no loading is allowed. If the limit value is reached and exceeded beyond the dead band, the limit algorithm will cause the unit to unload at a rate that is proportional to the amount of error that is sensed. The loading and unloading proportional rate is 3%/°F. The limit value for a single stage unit is fixed at 270°F and the limit value for a two-stage absorber is fixed at 370°F.

Figure 36. Loading region and temperature limits



(21) Purge System

Figure 37. Horizon Purifier Purge



Purge Theory and Operation

An absorption chiller operates with all portions of the system below atmospheric pressure. This can result in air leakage into the system. The presence of air or other non-condensables degrades the performance of the system and must be removed. Excessive heat can also liberate hydrogen from the water in the system. The removal of air, hydrogen and other non-condensables is the function of the Purifier Purge. See Figure 37.

The primary purge tank is connected to the Horizon condenser by supply and return lines through which refrigerant may freely flow. The purge refrigeration system has its evaporator located inside this tank. The purge evaporator coil is capable of presenting a 28°F condensing surface to the chiller refrigerant contained in the tank. The temperature of the refrigerant in the Horizon condenser range is 50°F with low cooling water temperature to 180 F when the chiller is in heating only operation. When the purge is running, the Horizon condenser refrigerant is attracted to the cold surface of the purge evaporator. When the refrigerant vapor touches the surface of the purge evaporator it condenses into a liquid, leaving a partial vacuum behind. More condenser refrigerant vapor migrates to fill this vacuum. As the refrigerant condenses into a liquid, any non-condensables present in the chiller are left behind to fill more and more of the space in the tank. The liquid refrigerant returns to the chiller condenser via the liquid return line.

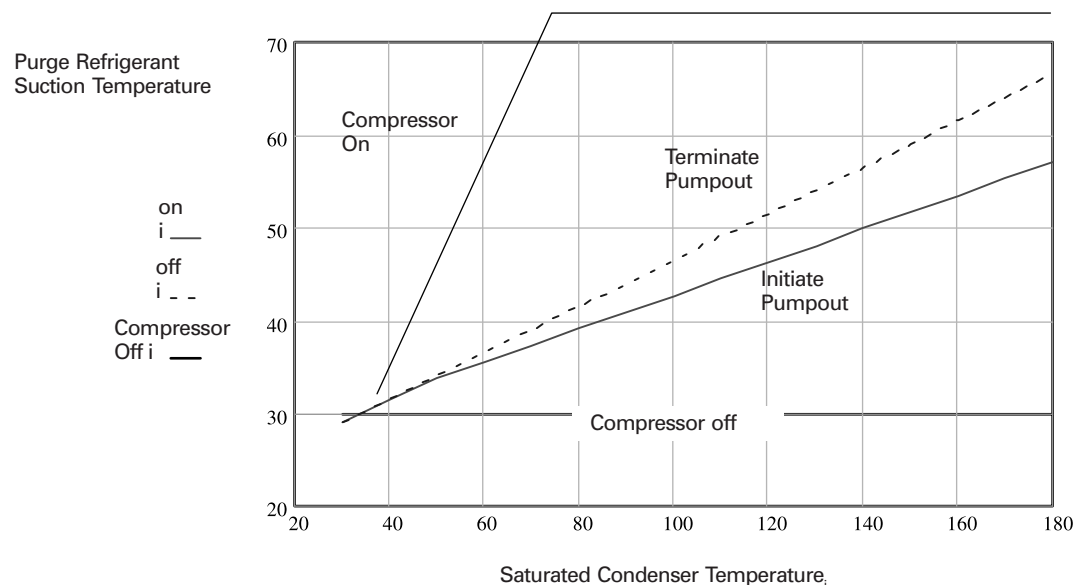
The temperature of the purge refrigerant system is monitored. At the start of a purge cycle, when there is little or no air in the tank, the purge return refrigerant temperature is approximately the same as the chiller condenser refrigerant temperature. The air that accumulates in the tank is not an efficient heat transfer medium. As air fills the tank, the purge return refrigerant temperature begins to fall. Low refrigerant temperature indicates air, or other non-condensables, in the purge tank. At this point, a pumpout cycle is initiated to remove the non-condensables from the collection tank. With non-condensables removed from the tank, the refrigerant temperature will rise and the pumpout cycle will be terminated until another tank of non-condensables is collected. The temperatures at which the purge pumpout cycle is initiated and terminated have been determined to be a function of condenser saturation temperature.

Figure 38 is a plot of the purge pump-out schedule as a function of saturated condenser temperature.

Purge Service Log Reset

The purge service log reset is used to reset the Service Log data in the Pump/Purge Report menu. This can be used to track the pumpout time after the unit has been serviced. Clearing the service log resets both the Service Log Pumpout Time and the Service Log Time since Reset.

Figure 38. Purge pump-out schedule



Purge Setpoints

The set points used by the purge module are provided by clear language display (CLD).

Purge Operating Mode

The purge-operating mode will indicate the desired mode of operation. These operating modes will be Stop, On, Service Pumpout. The default setpoint is on.

Maximum Pumpout Rate

The maximum pumpout rate is expressed in maximum allowable minutes of pumpout per 24 hours. It will be adjustable from 1 to 250 minutes. It is used to generate a diagnostic when the actual 24-hour rate exceeds this value. The default setpoint is 200 minutes.

Explanation: Pumpout activity is indicative of the amount of air leaking into the chiller refrigerant system. The operator wants to know when the air leakage rate changes. Through this set point, he can indicate the expected leakage rate, and can set a criteria upon which to be notified via a diagnostic should the rate be higher than expected.

Inputs

Chiller Condenser Saturation Temperature (Liquid Temperature)

The chiller condenser saturation temperature is provided by the stepper module via the IPC.

Explanation: The chiller liquid temperature is used to determine purge pumpout operation. The purge refrigerant compressor suction temperature at which pumpout is started and terminated is a function of chiller liquid temperature.

Purge Refrigerant Compressor Suction Temperature

The purge refrigerant compressor suction temperature is sensed via a thermistor device attached to the purge refrigerant compressor suction line. The range will be -10 to 130°F.

Explanation: The purge refrigerant compressor suction temperature is used to initiate and terminate the pumpout cycle.

Liquid Level Sensor

The liquid level sensor is a binary input used to indicate the presence of a high level of liquid refrigerant in the primary purge tank. The switch is a normally closed float switch, open for high liquid level (in which case a diagnostic is called), closed for acceptable level.

Explanation: During certain failure modes of the purge system, liquid refrigerant can fill the tank. A pumpout cycle would then discharge large quantities of refrigerant water. In such a circumstance, it is necessary to generate a diagnostic and discontinue operation of the purge.

Service Pumpout Setpoint

If the pumpout rate timer exceeds the maximum pumpout rate setpoint while the service pumpout switch is in the service position, a non-latching diagnostic will be set. When this diagnostic is cleared, the pumpout rate timer will be reset to zero. Since pumpout time is also accumulated in the daily timer, no data loss occurs because of this reset.

Design: The Purge Module has as a binary input labeled Service Pumpout Switch. This input is unused for production; however, if module communications were lost and a service person wanted to pumpout, this input could be jumpered to enter the Service Pumpout mode.

Outputs

Purge Refrigerant Compressor Relay

This relay is used to activate and deactivate the purge refrigerant system. The purge refrigerant system includes the purge refrigerant compressor and purge refrigerant condenser fan. The compressor relay will be deactivated when purge saturation temperature falls below 30 degrees F. The compressor relay is reactivated when saturation temperature is above the pumpout termination temperature.

Purge Pumpout Compressor Relay

This relay is used to activate and deactivate the purge pumpout compressor. The purge pumpout compressor pumps the air out of the primary purge tank and into the chiller vent line.

Tank Valve Relay

This relay is used to control the tank valve. The tank valve controls the flow of purge tank exhaust from the primary purge tank to the pumpout pump.

Alarm Relay

This relay will be energized in the presence of latching purge diagnostics. It will be de-energized at all other times. It is anticipated that a customer supplied alarming device will be controlled by this relay.

Purge System Operating Modes

The purge system operating modes are dictated by the purge operating mode set point. They are in effect as long as there are no purge diagnostics that preclude operation currently true. If a latching diagnostic exists, all outputs are turned off with the exception of the alarm relay.

The purge-operating mode indicates the desired mode of operation.

These operating modes are: Stop, On, Service Pumpout. The default set point is on.

Stop

In this mode the purge system is not running. All relays are turned off.

On

This mode is the normal operation state. On mode corresponds to continuously running the Compressor Relay, and vacuum pump. Pumpout is initiated via the refrigerant suction temperature.

Service Pumpout

The service pumpout status is intended to aid the serviceman in accomplishing certain mechanical repairs.

Service Pumpout mode initiates the pumpout sequence regardless of the chiller running state OR the refrigerant suction temperature.

Purge Status of Operation

The purge status indicates the current operating status. Values of operating status are:

Ready to Pumpout - (Condensing Unit is On, Pump is On)
Pumping Out - (Temperature initiated Pumpout)
Service Pumpout - (Pumpout initiated by the Service Setpoint)
Diagnostic Alarm - (Purge is idle unless mode is Service Pumpout)
Standby - (Condensing Unit is Off, Pump is on unless Mode is Stop)

Above values are explained on the following page.

Ready to Pumpout

In running status, the purge refrigerant system is running and the pumpout is disabled. The purge outputs shall have the following status:

Purge refrigerant compressor relay	on
Purge pumpout relay	on
Tank valve relay	off
Alarm relay	off

During running status, the purge refrigerant compressor suction temperature is monitored. When this temperature falls below the calculated temperature to initiate pump out, the pumpout status is entered. When this temperature then rises above the calculated pumpout termination temperature, the pumpout status is terminated. If the service pumpout switch is in the on position, the service pumpout status is entered. The pumpout compressor relay needs to be activated for a minimum of 30 seconds before the purge will allow transitioning to the Pumpout or Service Pumpout status.

Pumping Out of Condenser

Pumpout is initiated by opening the tank valve. When the purge refrigerant compressor suction temperature drops below the calculated pumpout initiate temperature, the outputs shall have the following status:

Purge refrigerant compressor relay	on
Purge pumpout compressor relay	on
Tank valve relay	on
Alarm relay	off

The system remains in this mode until the purge refrigerant compressor suction temperature rises above the calculated pumpout termination temperature, indicating a sufficient amount of air has been removed. At this point the system returns to the "Ready to Pumpout".

Pumping out absorber

Pumpout is initiated opening the solenoid valve located on the absorber belly. The outputs will have the following status.

Purge refrigerant compressor relay	on
Purge pumpout compressor relay	off
Tank valve relay	off
Absorber valve relay	on
Alarm relay	off

The system will remain in this mode until the duration time expires.

Service Pumpout

The service pumpout status is intended to aid the serviceman in accomplishing certain mechanical repairs.

Service Pumpout mode initiates the pumpout sequence regardless of the chiller running state OR the refrigerant suction temperature. The outputs should have the following states:

Diagnostic Alarm

This status is active whenever the purge has an active latching diagnostic. Pumpout is inhibited unless the purge is in the Service Pumpout mode.

The outputs should have the following states unless in Service Pumpout mode:

Purge refrigerant compressor relay	off
Purge pumpout compressor relay	off
Exhaust valve relay	off
Tank valve relay	off
Alarm relay	on

Standby

In idle status, the purge is on, the purge refrigerant system is not running, and the pumpout is disabled. The purge outputs shall have the following status:

Purge refrigerant compressor relay	off
Purge vacuum pumprelay	on
Tank valve relay	off
Alarm relay	off

If the service pumpout switch is in the on position, the service pumpout state is entered.

Timers

Pumpout Rate Timer

The purpose of the pumpout rate timer is to have a current indication of the pumpout activity for the previous 24 hours. The pumpout rate timer will be the summation the last 24 hours. The pumpout rate timer has 0.1-minute resolution with a range of 0 to 250 minutes.

The primary purposes of the pumpout rate timer are to provide real time display of current pumpout activity and to provide diagnostic capability. The accumulated time is compared against the maximum pumpout rate setpoint to determine if a diagnostic should be generated. If a diagnostic is generated, clearing the diagnostic will reset this timer to zero.

Total Pumpout Time

The timer increments when the Tank Valve is opened.

Purge Run Time

The Run Time when the compressor (Copland) unit is commanded on.

Service Log

The service log tracks two items of data:

1. Total purge pumpout time since last reset.
2. Elapsed calendar days since last reset.



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