a nudyne company

Semi Instantaneous Water Heater
Water-to-Water Mini-Pack™ System
DWSW Pneumatic
Operating and Maintenance Manual

Designed and Manufactured in Accordance with ASME Code Section VIII, Div 1

U

Dec 2025

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Warranty

Operating and Installation Instructions
(Pneumatic)

Congratulations on your purchase of a new Ace “Mini-Pack”. In this book, we have included installation and maintenance instructions that, if followed, will provide you with many years of service from your new unit. Also included are instruction manuals for each of the controls furnished with the heater. Please read them carefully. They should be helpful in both the installation and service of this unit. Keep these instructions with the Mini-Pack for future reference.

The Ace Mini-Pack is of rugged construction, yet of simple design. The heater uses steam (or water) from a boiler to heat domestic water. The Mini-Pack’s temperature control system enables it to control the heated water within $\pm$ 4ºF of the selected temperature during normal operating conditions. This close control is accomplished by placing the temperature control element directly in the constant flow path of the hot domestic water outlet. The integral circulator constantly recirculates a portion of the heated water to the cold-water inlet, making the total volume of the heater a tempering chamber. This also eliminates any overheated water pockets caused by control valve lag when the hot water demand is suddenly reduced.

The Mini-Pack features total rust free construction with austenitic stainless and copper for all domestic water contact surfaces, providing a high quality, low maintenance and an extremely cost effective domestic water heating package.

The tubes are rolled and flared into a stainless steel tube sheet. All Ace Mini-Packs can be serviced completely without breaking the domestic water lines or disturbing the heater foundation.

Each Mini-Pack is constructed and stamped in accordance with Section VIII, Div. 1, of the ASME Code, which is stamped on the Mini-Pack rating plate.

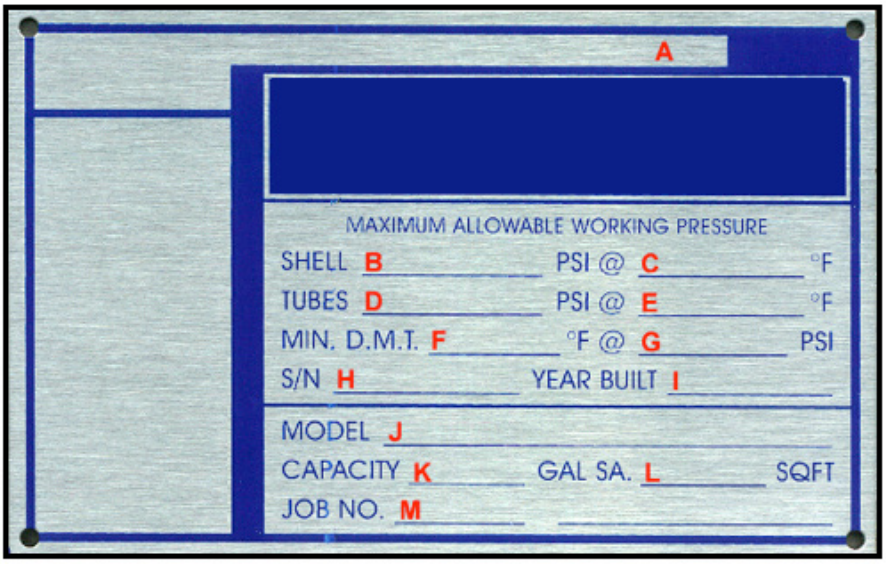
Experience in the field has proven that the Ace Mini-Pack, if properly applied and maintained, will give many years of efficient, dependable and economical service.

The Mini-Pack™ Nameplate and Model Number

The Mini-Pack Nameplate

The following illustration is an accurate depiction of the nameplate found on the mini-pack.

A. NB or serial number
B. Shell pressure
C. Shell temperature
D. Tube pressure
E. Tube temperature
F. Min. Atmospheric Pressure
G. Atmospheric temperature
H. Serial number
I. Year built
J. Model number
K. Capacity
L. Square feet
M. Job number



SI H 08 L SW W A 1.25

The Mini-Pack Model Number

SI = Model (SI = Semi-Instantaneous)
V = Type (H = Horizontal, V = Vertical)
08 = Shell diameter in inches
L = Blank (standard), L (Long), XL (Extra long) bundle length
SW = Tube bundle type (SW = Single wall, DW = Double wall)
W = Heating medium (S = Steam, W = Water)
A = Control valve (A = Air Operated, P = Pilot operated, E = Electric)
1.25 = Valve size

Ace Mini-Pack

ASME Code, Section VIII, Division 1 constructed pressure vessel, National Board registered. All stainless steel construction on the water side, pressure vessel quality carbon steel on the steam side.

1.5" thick rigid fiberglass insulation with a 24 gauge annealed stainless steel jacket. Minimizes standby heat loss, is durable and looks great.

NEMA 4X, UL listed control panel with a user freiendly control interface, off/on switch, power indicator, and over temperature alarms. All internal components are sized accordingly.

Electric steam control valve, fail closed in the event of power loss of over temperature. Available in pneumatic, electro¬pneumatic, and pilot

HOT STEAM INLET

Teflon baffles extend the life of the tube bundle.

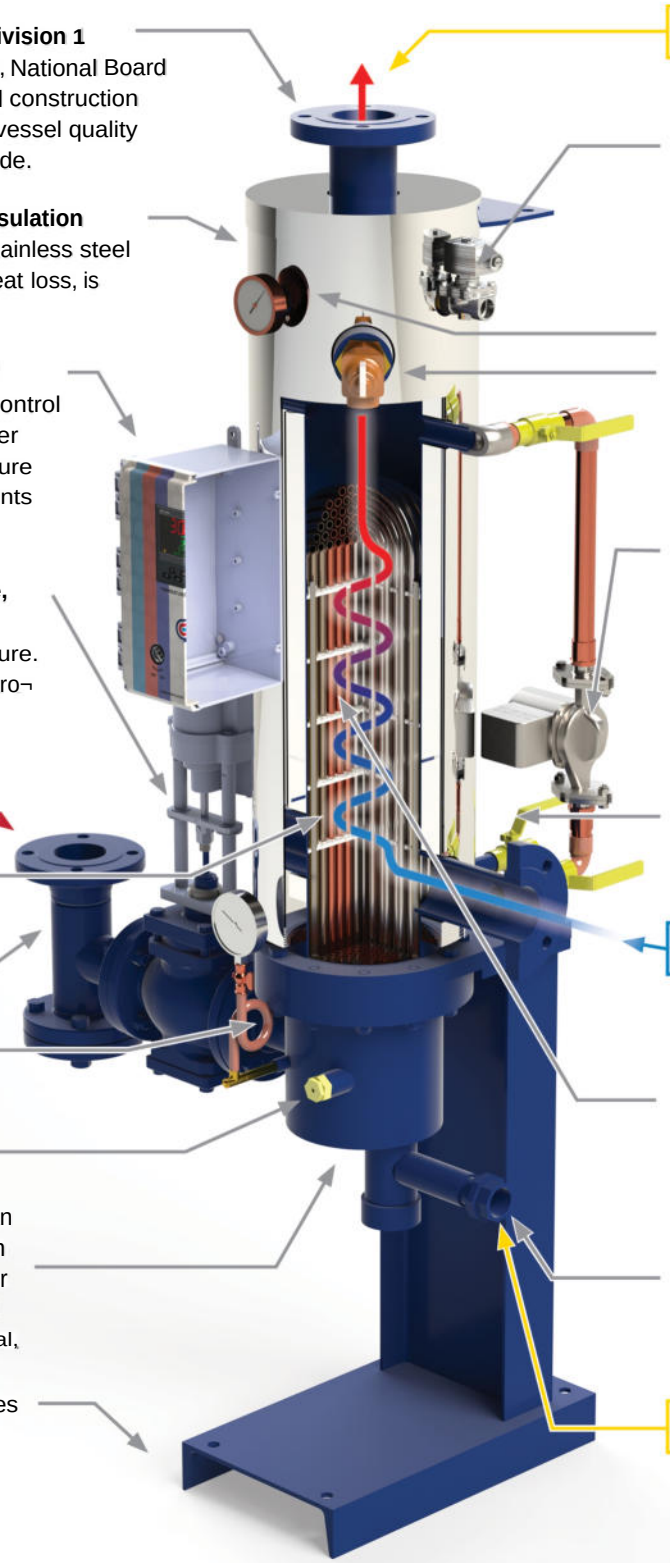
Steam inlet strainer

Steam pressure gauge with isolation valve and siphon.

Steam vacuum breaker

Single wall tube bundles can be removed from the bottom without removing the shell or steel base. Double wall tube bundles require shell removal,

Structural steel base requires minimum floor space.



HOT WATER OUTLET

Secondary high temperature set point opens a water solenoid valve, dumping hot water down a drain.

Water temperature gauge.

ASME temperature and pressure relief valve.

Integral stainless steel circulator, acts as an anticipator and eliminates stratification. Provided with isolation valves for ease of maintenance.

Water drain valve

COLDWATER INLET

Single or double wall tube bundle, available in copper, 90/10 copper¬nickel, 316/L Stainless steel and titanium.

Orifice union with an engineered opening functions as a simple steam trap.

CONDENSATE OUTLET

ACE a nudyne company

How it Works!

The Mini-Pack is designed to heat domestic hot water using existing plant steam or hot boiler water, and regulates the domestic hot water outlet temperature to a close tolerance of ±4ºF from the set point. The advantage of this system is it replaces the need for large hot water storage tanks and is much more efficient.

As there is a demand for domestic hot water, the temperature control bulb will sense the drop in water temperature. The temperature bulb sends a signal to the control valve to open and allow steam or hot boiler water into the heat exchanger tube bundle. As the steam or hot boiler water passes through the tubes, the domestic water in the shell is rapidly heated. Above the tube bundle, a minimal water volume storage area is provided to give the controls sufficient time to react to the changes in water temperature.

The circulator constantly rotates the water in the shell, eliminating any hot spots, which could cause false readings at the control valve.

As the steam or boiler water passes through the tubes, it is sub-cooled by the incoming domestic cold water. As the demand for hot water fluctuates, the control valve will respond accordingly, quickly reacting to keep the water temperature within ±4ºF. In the event the water temperature in the Mini-Pack continues to climb, the high limit control will trip, cutting the electrical current to the solenoid valve on the control panel, which in turn relieves the air signal to the control valve and causes it to close.

On units equipped with a double safety solenoid valve, the system is designed to dump the overheated water through the solenoid dump valve when the high limit is tripped.

Receiving Your Mini-Pack™

Check Equipment Received. Inspect the unit for any shipping damage. Make sure you have received all loose parts, as listed on the "Bill of Lading". Larger strainers, usually 2 ½" and above, are shipped loose. Note any damages or shortages on the bill of lading prior to signing it. If the Mini-Pack is received damaged or missing parts, it is your responsibility to notify the shipping company and file a freight claim. Ace Heaters cannot send replacement parts for freight damaged or missing equipment as warranty items. Permission to return goods must be received from the factory prior to shipping. Goods returned without a Returned Goods Authorization number will not be accepted. Purchased parts are subject to replacement only under the manufacturer's warranty. The warranty does not include the cost of labor, removal, or installation of the warranted part.

General Installation Instructions

NOTE: ***All electrical and piping installation should only be accomplished by qualified personnel following all applicable local, and state codes required for their installation.***

Code Requirements: It is very important that your installation comply with all federal, state and local codes as well as meet good industry practices as shown in publications issued by ASME, UL, ASHRAE, ABMA, etc.

Placement: The Mini-Pack can be mounted two ways; either vertically on its base or horizontally, using its mounting brackets for wall, ceiling or rack mounting. The Mini-Pack should be installed on a solid foundation, preferably a concrete pad or with heavy duty bolting if mounted on a wall or ceiling. Provide adequate clearance for normal inspection and maintenance purposes and allow tube pull clearance from the base of the unit. A minimum clearance of 24" is recommended from all accessories for ease of maintenance. Make sure the Mini-Pack is level, from side to side and front to back. Use metal shims if necessary.

Piping: Control valve hot water supply line shall be flushed prior to installation or with the shut-off valve closed to isolate the Mini-Pack from the system. This is imperative to avoid any damage to the valve seat during startup procedures AND TO AVOID WARRANTY ISSUES. All piping to and from the Mini-Pack must be provided with adequate supports and expansion compensation so that pipe stresses are not transmitted to the Mini-Pack. The relief valve and the double-safety solenoid valve, if supplied, should be piped to a safe drain.

Stud Nuts: During shipment, the bonnet and shell flange nuts may loosen and should be re-tightened before start-up. Tighten these nuts to the torques specified later in this manual. After the unit has been in operation for a few days and periodically thereafter, check and retighten. Note: Bolting is independent on the bonnet and shell-side flanges through the use of a threaded tube sheet flange(s). Therefore, stud bolt nuts must be re-tightened on both sides. See Figure 1.1 for single-wall bolting arrangement and Figure 1.2 for double-wall bolting arrangement.

Receiving Your Mini-Pack™

Torque's: The following are recommended bolt torque requirements

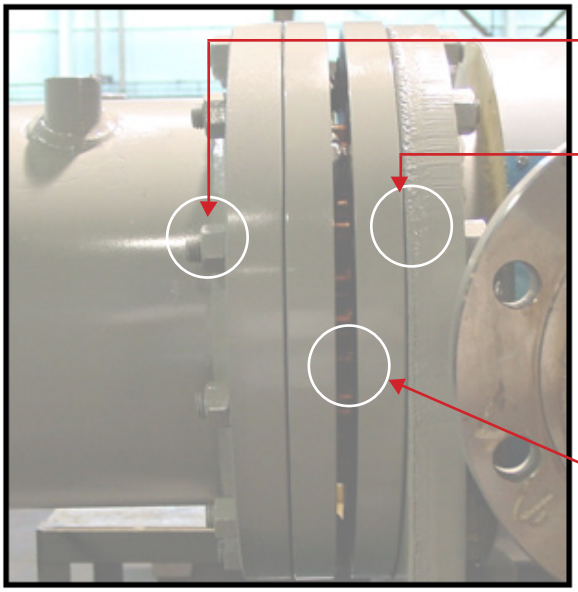
MP Size	Bolt Size * (Y)	Gasket Thickness**	Compressed Thickness (X)	Min Torque (T)	Max Torque*** (T)
4"	½"	¼"	0.018"	45 ft.lb	60 ft.lb
5"	½"	¼"	0.018"	45 ft.lb	60 ft.lb
6"	½"	⅜"	0.025"	45 ft.lb	60 ft.lb
8"	½"	⅜"	0.025"	45 ft.lb	60 ft.lb
10"	⅝"	⅜"	0.025"	90 ft.lb	120 ft.lb
12"	⅝"	⅜"	0.025"	90 ft.lb	120 ft.lb
16"	⅝"	½"	0.035"	90 ft.lb	120 ft.lb

Notes:

* Spray each stud bolt and nut generously with penetrating oil before re-torque.

** Gasket thickness before compression. All partition gaskets are ⅛" in width before compression. All gaskets expand twice their width after compression.

*** These are recommended torque values. Stud bolts must not be stressed above 60% of their yield strength.



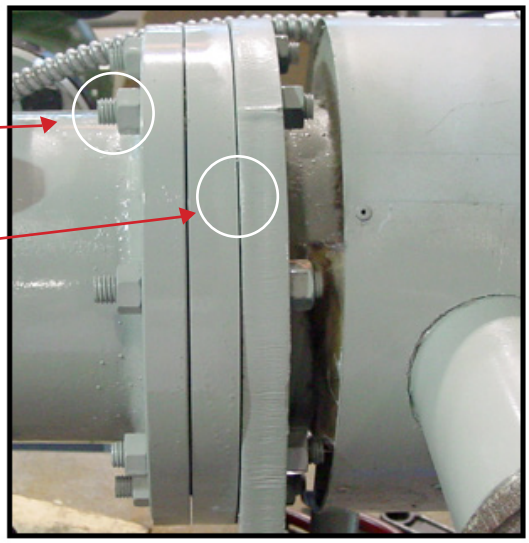


Figure 1.1 Shell flange to bonnet flange joint
DW Tube Bundle

Receiving Your Mini-Pack™

Water Connections: See Typical piping diagram (Page 9 and 10).

Relief Valve: The relief valve discharge must be piped to a floor drain to eliminate the potential of scalding burns. The drain line must be the same size as the relief valve outlet and have a downward slope to insure proper drainage. The drain line termination should be visible to see discharge. Check the relief valve nameplate. The unit's operating pressure cannot exceed that listed on the relief valve.

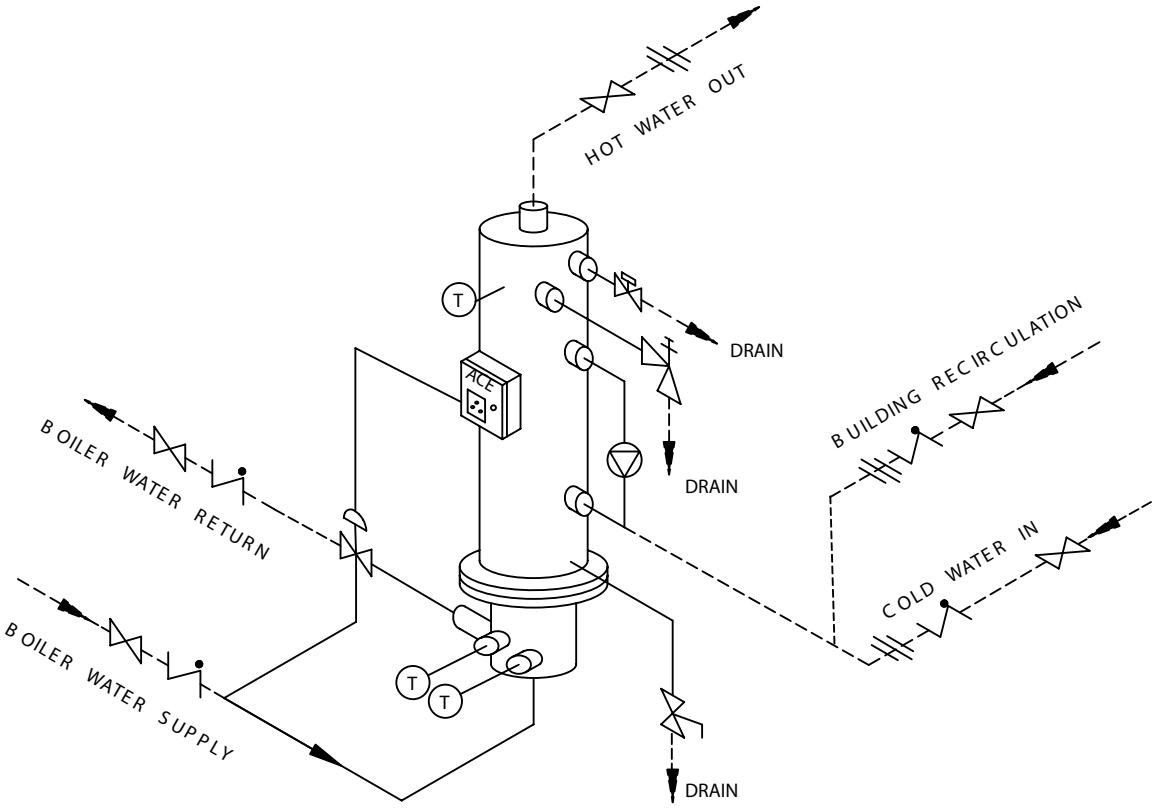
Electrical: The Mini-Pack is wired for 120volts 60hz 1phase 3 amps, unless otherwise noted on the heater nameplate. Verify the electrical supply using a voltmeter. The voltage tie-in leads are indicated on the wiring diagram. For your safety, turn off electrical power supply at the service entrance panel before making any electrical connections. This unit contains sensitive control components and should be protected by a suitable commercial grade surge protection device and electrically grounded. The Mini-Pack must be installed in accordance with the National Electric Code and all state and local codes.

Water Treatment: Proper water treatment plays an important role in protecting the life of your investment. Ace Heaters recommends consulting a water treatment specialist prior to start-up for recommendations on water treatment. The Mini-Pack uses boiler steam or hot water as its heating medium. On hot water systems, boiler makeup water continuously introduces contaminants; scale forming solids, corrosive minerals and oxygen, which can cause corrosion or scale formation inside the Mini-Pack tube bundle. Whenever appreciable amounts of raw makeup water are continuously added to your system, we recommend that the problem be brought to the attention of a qualified water consultant. Proper treatment will insure longer product life and reduced maintenance.

Control Valve Air Supply Pressure: The pneumatic controller used on the Mini-Pack requires a reliable compressed air supply. The air supply to the control valve shall be 30 PSI. Optimum supply pressure to the temperature controller is at least 35 PSI.

Double Safety Solenoid Valve (optional): If so equipped, the solenoid valve discharge must be piped to a floor drain. The drain line must be the same size as the solenoid valve outlet and have a downward slope to insure proper drainage. The drain line termination should be visible to see discharge.

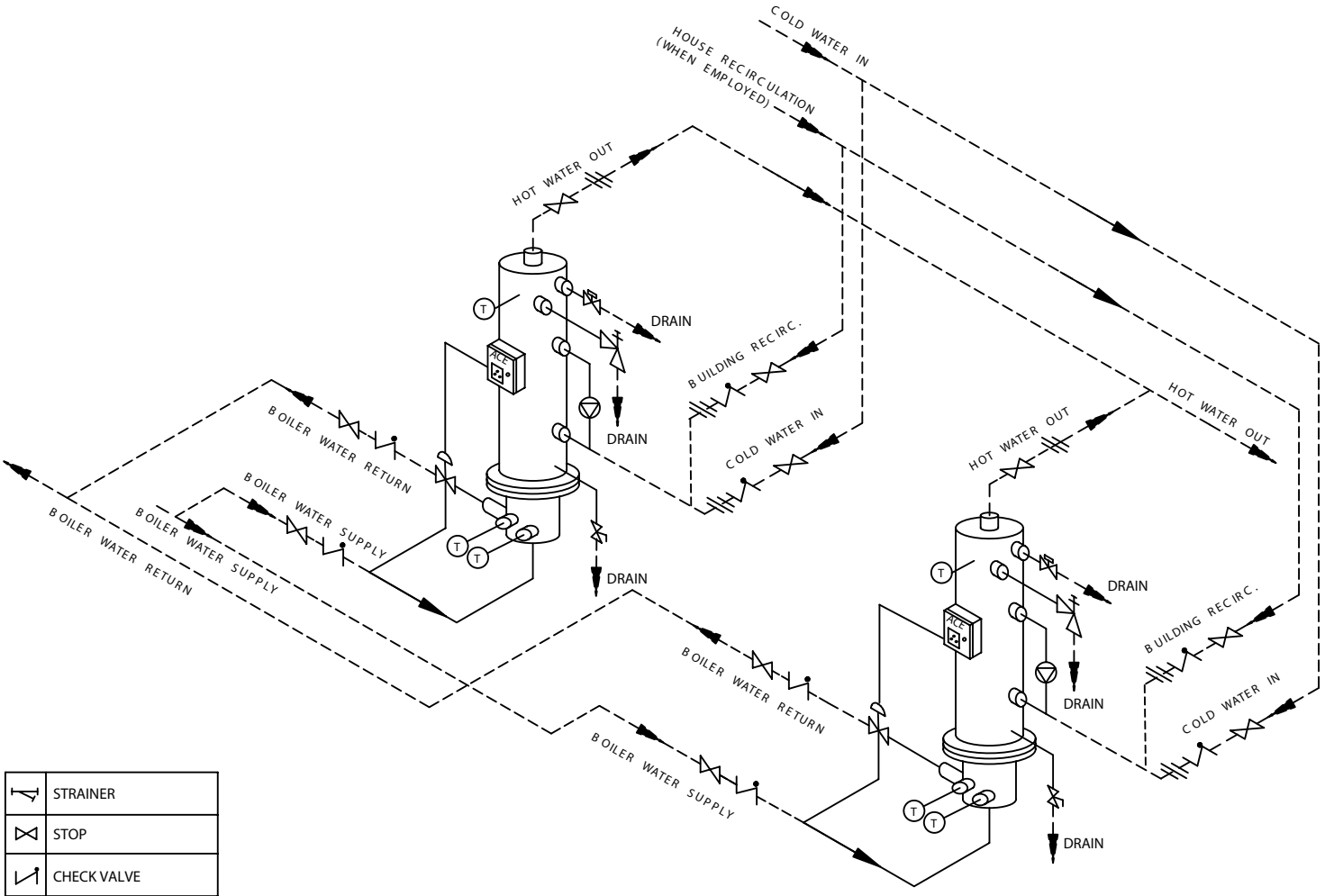
Installation Diagram



	STRAINER
	STOP
	CHECK VALVE
	CONTROL VALVE
	RELIEF VALVE
	DRAIN VALVE
	UNION
T	TEMP. GAUGE
P	PRESSURE GAUGE
	INTERNAL RECIRCULATOR
	OVER-TEMP SOLENOID OPTION
	AUX. TRAP OPTIO N

FIELD PIPING
BY OTHERS

Installation Diagram



	STRAINER
	STOP
	CHECK VALVE
	CONTROL VALVE
	RELIEF VALVE
	DRAIN VALVE
	UNION
T	TEMP. GAUGE
P	PRESSURE GAUGE
	INTERNAL RECIRCULATOR
	OVER-TEMP SOLENOID OPTION
	AUX. TRAP OPTION

FIELD PIPING
BY OTHERS

ACE
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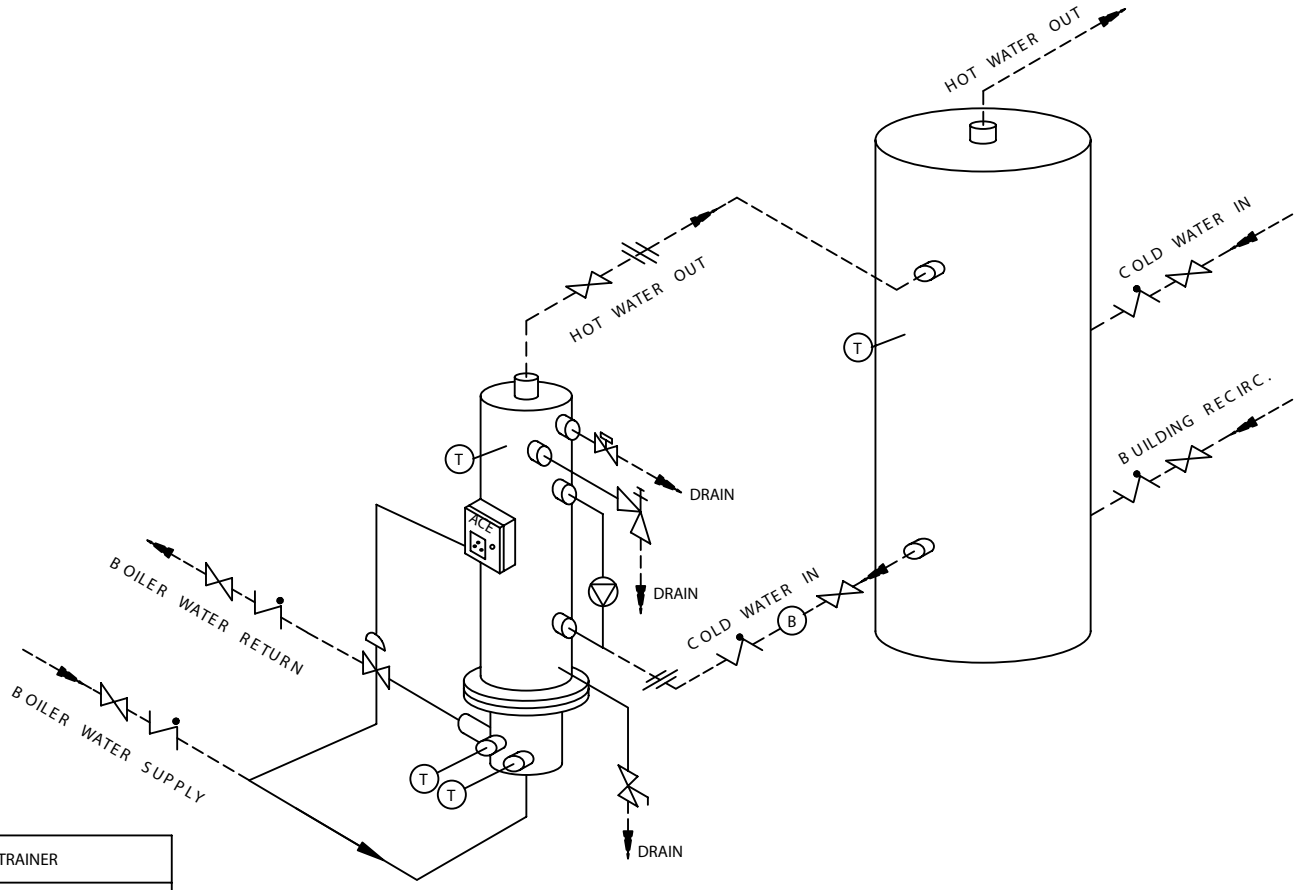
Installation Diagram

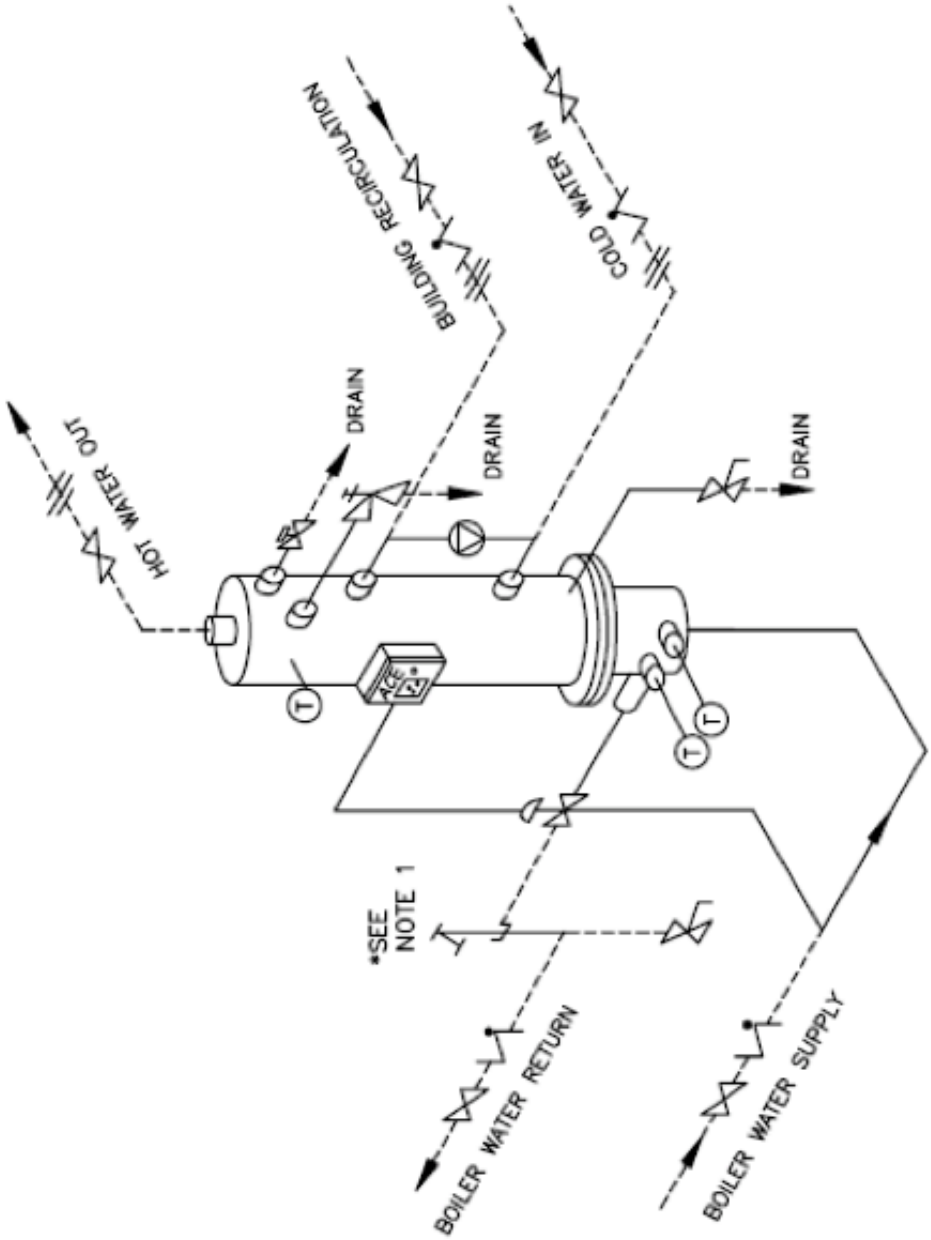


	STRAINER
	STOP
	CHECK VALVE
	CONTROL VALVE
	RELIEF VALVE
	DRAIN VALVE
	UNION
T	TEMP. GAUGE
P	PRESSURE GAUGE
	INTERNAL RECIRCULATOR
	OVER-TEMP SOLENOID OPTION
	AUX. TRAP OPTION
B	TANK RECIRCULATOR

FIELD PIPING
BY OTHERS

Water-to-Water with Tank

Installation Diagram (Single-Wall)

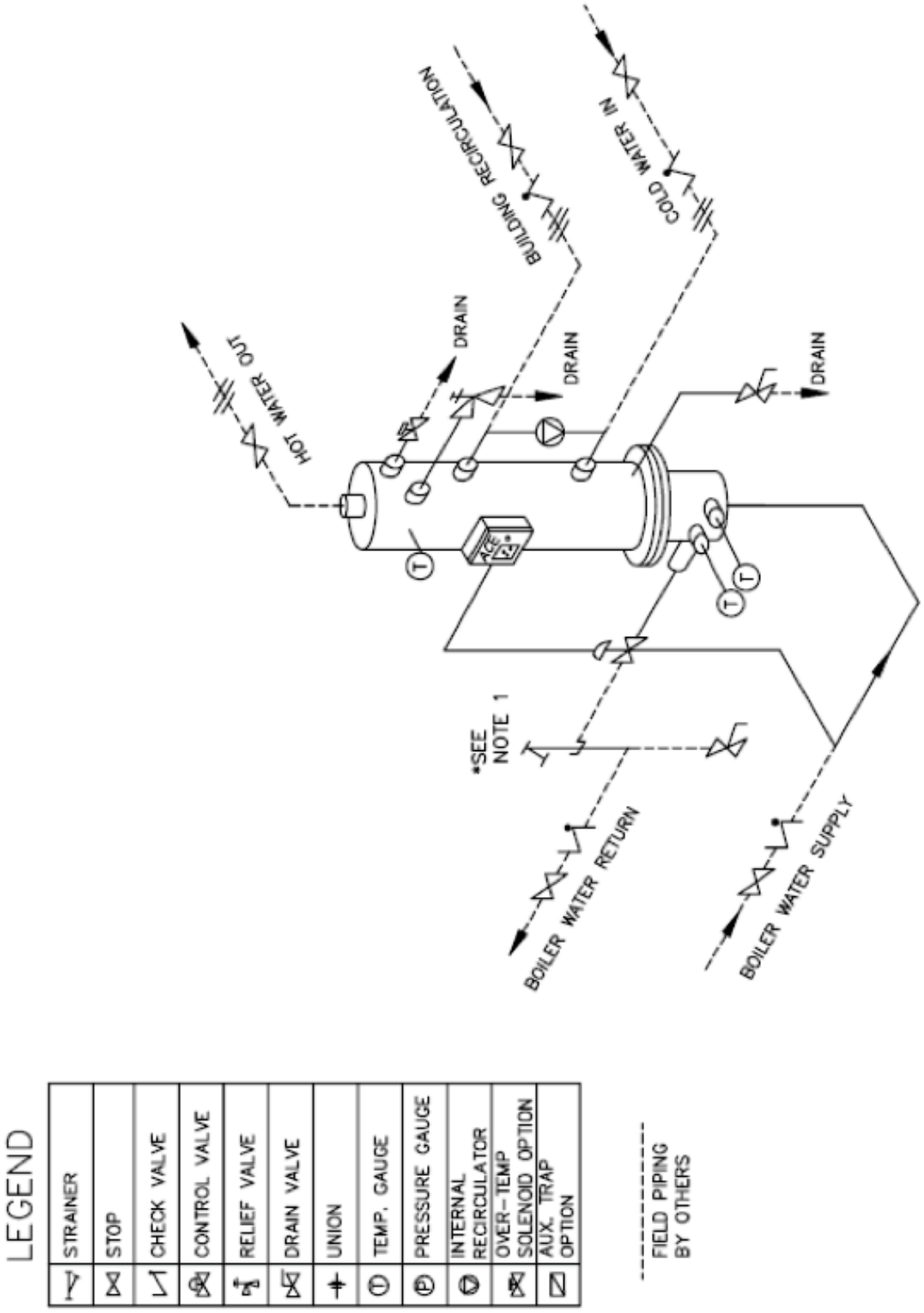


LEGEND

	STRAINER
	STOP
	CHECK VALVE
	CONTROL VALVE
	RELIEF VALVE
	DRAIN VALVE
	UNION
T	TEMP. GAUGE
P	PRESSURE GAUGE
	INTERNAL RECIRCULATOR
	OVER-TEMP SOLENOID OPTION
	AUX. TRAP OPTION

---------- FIELD PIPING BY OTHERS

Installation Diagram (Double-Wall)



Before Start-Up

1. Verify the Mini-Pack is installed in accordance with the appropriate installation diagram located on (*Page 9 and 10*).
2. It is recommended that a strainer be installed upstream of the control valve to entrap any damaging debris in the system and extend the life of the coil and control valve. It is also recommended that isolation valves and temperature gauges be installed upstream and downstream of the control valve. This is ideal for periodic maintenance purposes.
3. Verify 120 volts 60hz 1phase voltage supply to the control panel. No additional field wiring is required.
   Caution: *The toggle switch on the control panel must be in the "off" position prior to connection to the power source. Failure to do so may damage the safety solenoid if so equipped.*
4. Verify an air supply pressure of at least 35 PSI to the to the air filter regulator upstream of the Accritem.

Start-Up Instructions

1. It is assumed that installation is complete and that all connections have been made, including: electrical, water boiler, domestic water, instrument air, vents, drains and safety valve discharge lines. Prior to start-up inspect the strainer for any dirt, scale, welding particles or debris that may have accumulated during construction. *Make sure the General Installation procedure has been followed* (*See Page 6*).
2. Make sure the power switch is in the "off" position.
3. Set the high limit control (figure 2.0) 12º to 15ºF higher than the Accritem (figure 2.2) setting (Domestic hot water outlet temperature). For example, if the system is heating domestic water from 40 to 140ºF, the high limit should be set at ~152ºF. The high limit aquastat will automatically reset when the temperature drops the set differential number of degrees. The adjustable differential (figure 2.1) should be set so that the system does not start up again until the water temperature drops at least 5 degrees below the desired hot water outlet temperature (typically 135ºF on a 140ºF system). Continuing the example, with the high limit set at 152ºF, the differential should be set at least 17, thus ensuring that the system does not start heating until the water temperature drops 17 degrees down to 135ºF. Remove the cover to access the adjustment wheel. Refer to the included manufacturer's data sheet for adjustment information.

Figure 2.0

Figure 2.1

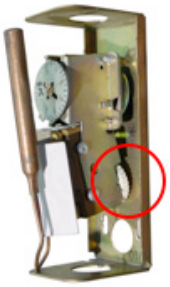


Figure 2.2

4. Close the shut-off valve on the bonnet side (heating medium side). Slowly introduce domestic water to the unit by opening the shut-off valves at the inlet and outlet of the shell. This will allow water to circulate in the shell. Open the relief valve when filling to purge the trapped air from the unit.

Installation Diagram (Double-Wall)

5. Plant boiler water is used as the heating medium and is controlled by a pneumatic control valve, which in turn receives its signal from the temperature controller (Accritem). Connect the air supply to the filter/regulator (minimum 35 PSI supply to the air pressure regulator). The instrument air supply gauge on the pressure regulator should be regulated to 30 PSI to the Accritem. If the control valve is equipped with a valve positioner these pressures will still apply. The outlet pressure gauge on the Accritem should read 30 PSI when fully opened, and 0 PSI when fully closed. Under normal operating conditions the outlet gauge reading will fall within this range.

6. Set the temperature knob on the Accritem (figure 2.2) to its lowest temperature setting.

7. Turn on the system by turning the control panel switch to the “ON” position (The manual boiler water supply valve should be closed at this time). The green light should come on. At the same time, it will energize the solenoid on the control panel allowing air to the control valve actuator, which in turn will open the control valve. Make sure the circulator pump is running. (Please refer to the pump instruction manual for details.)

8. Turn on a number of hot water fixtures to establish a steady 50% load if possible, with at least a flow of 8 to 10 GPM for the initial startup. Make sure these stay on and there is not an additional load applied elsewhere during initial startup.

9. Manually open the main boiler water shut-off valve upstream of the control valve and SLOWLY allow boiler water to pass through the control valve. Continue until the shut-off valve is 100% open.

10. The Mini-Pack will now function automatically, reacting according to demand fluctuations and will stabilize once limits are met.

11. Slowly increase the system temperature output by adjusting the temperature knob on the Accritem (figure 2.2). Watch the temperature gauge on the front of the unit and wait for the temperature to stabilize prior to turning it up again. Repeat this procedure slowly until the desired outlet temperature set point has been achieved. Please note that the temperature knob on the Accritem may not be accurate to the actual water temperature (see gauge on shell). Once you have achieved your set point, it is recommended to loosen the set screw on the knob and reposition as necessary to indicate the actual (gauge) temperature on the Accritem face plate.

12. Once stabilized, turn off the hot water fixtures one at a time and watch the temperature gauge on the unit. There should only be slight temperature fluctuations. With no hot water fixtures on, the temperature gauge should remain stable. Watch the temperature for 5 minutes to verify the valve has closed. If the temperature slowly creeps up, the valve is leaking hot water and may have debris on the seat or the valve requires “zeroing”. “Zeroing” the valve requires adjusting the stem length until the valve closes tightly. See Page 14 under Trouble Shooting.

Before Start-Up

13. With the system warm, check the operation of the high limit safety control (figure 2.0). Do this by rotating the temperature dial to its lowest setting and setting the Accritem control 20º above the high limit set point. Check that the temperature of the system matches the temperature set point of the high limit when it engages and shuts the control valve (the red high temp light will engage on the control panel as well). ***Caution:*** *Very hot water may splash as it is discharged; take the necessary precautions to avoid contact.* Return the temperature dial to the desired set point.

14. Observe the entire system over a period of variable loads to determine if any calibration is necessary on the Accritem temperature controller. The sensitivity of this controller is adjusted by turning the restriction screw. (*See inserts on the Accritem enclosed*).

15. After start-up, inspect the strainer for any dirt, scale, welding particles or debris that may have accumulated and remove as necessary; *any debris can damage the valve seat or obstruct it from full shut-off, resulting in possible over-temp conditions and/or scalding.*

16. Check the flange bolt section for leaks. Tighten only enough to stop leakage. *Never tighten more than necessary. Excessive tightening will shorten the life of the gasket and stretch the studs.*
See Page 7 for proper torque values.

Shut Down Instructions

1. De-energize all electrical power to the Mini-Pack.
2. Close the main upstream hot water shut-off valve to the Mini-Pack.
3. Close domestic water inlet and outlet shut-off valves.
4. Allow the unit to cool down. (Approximately 24 hours).

Safety Features

1. The pneumatic hot water control valve is designed to fail safe (closed) in the event of a power failure.
2. The single safety solenoid (standard) closes the air line from the Accritem to the actuator upon an over-temp or power failure. The three-way valve also vents any air left in the actuator, thus ensuring full shut-off of the control valve.
3. The relief valve is designed to relieve the pressure in the Mini-Pack in the event the pressure gets too high.
4. The double safety solenoid (Optional feature, figure 3) is designed to dump the hot domestic water from the shell in the event that the water temperature exceeds the set point on the high limit control. This should be piped to a safe drain per local and state codes.

Figure 3

Trouble Shooting

1. Water temperature too high:

1. Check the setting of the Accritem and its sensitivity screw (and positioner if provided), and verify a steady 30 PSI air supply pressure to the Accritem. The outlet pressure gauge on the Accritem should read 30 PSI when fully opened, and 0 PSI when fully closed. If this is not the case the sensitivity screw needs adjustment or the air passage is clogged. Under normal operating conditions the outlet gauge reading will fall within this range.
2. Confirm boiler water supply pressure to the control valve conforms to that specified in the List of Materials *(See List of Materials).*
3. Confirm that the domestic water inlet and outlet valves are 100% open.
4. Make sure the integral circulator pump is operational.
5. Check for proper condensate drainage, cleaning out any dirt and debris. Condensate should flow by gravity to a condensate receiver.
6. Check to see if the Packing gland around the valve stem is too tight or the valve stem is bent *(See Technical Data sheets).*
7. Check for proper spring tension on air operated valves *(See Technical Data sheets).*
8. Check for dirt under the valve seat and/or damage to the seat *(See Technical Data sheets).*
9. The temperature bulb's sensing element may be dysfunctional *(See Technical Data sheets).*

2. Banging or pinging:

Check and ensure that no air is present in the domestic piping or the hot water boiler lines. Relieve any air pockets as necessary.

3. **Erratic temperature control:**
    1. Check the setting of the Accritem and its sensitivity screw (and positioner if provided), and verify a steady 30 PSI air supply pressure to the Accritem. The outlet pressure gauge on the Accritem should read 30 PSI when fully opened, and 0 PSI when fully closed. If this is not the case the sensitivity screw needs adjustment or the air passage is clogged. Under normal operating conditions the outlet gauge reading will fall within this range.
    2. Make sure the integral circulator pump is operational.
    3. Check for proper flow direction of the circulator pump. The pump should be flowing down wards to the cold domestic inlet nozzle.
    4. Confirm boiler water supply pressure to the valve is steady and agrees with that specified in the List of Materials. *(See List of Materials).*
    5. Check the control temperature bulb for exterior scale or buildup and clean if necessary.
    6. Check for and clean out, any debris in the upstream strainer, valve body, and valve seat.
    7. Sticking valve stem. This can be caused by a bent valve stem or a valve stem not properly lubricated. A sticking valve stem can also be caused by the packing gland assembly being too tight. Loosen the packing gland assembly and lubricate.

Trouble Shooting

4. Poor recovery:

1. Check the setting of the Accritem and its sensitivity screw (and positioner if provided), and verify a steady 30 PSI air supply pressure to the Accritem. The outlet pressure gauge on the Accritem should read 30 PSI when fully opened, and 0 PSI when fully closed. If this is not the case the sensitivity screw needs adjustment or the air passage is clogged. Under normal operating conditions the outlet gauge reading will fall within this range.
2. Confirm boiler water supply pressure to the control valve meets that specified in the List of Materials. Check for a clogged strainer, a partially closed supply valve or other obstructions.
3. Make sure the Mini-Pack is not trying to supply more hot water than it was designed for *(See performance listed in List).*
4. Shut unit down, remove bonnet and coil. Inspect for scale and fouling, which restricts proper heat transfer. Clean with an approved chemical treatment as necessary.

5. Control Valve not closing:

1. Check the setting of the Accritem and its sensitivity screw (and positioner if provided), and verify a steady 30 PSI air supply pressure to the Accritem. The outlet pressure gauge on the Accritem should read 30 PSI when fully opened, and 0 PSI when fully closed. To achieve full shut-off, it is imperative that the outlet pressure gauge reads 0 PSI. If this is not the case the sensitivity screw needs adjustment.
2. The packing gland assembly is too tight, locking the valve stem *(See Technical literature).*
3. The temperature stem nut assembly is raised too high *(See Technical literature).*
4. Check for proper operation of the control valve solenoid. The solenoid should be energized and open when the system in normal operating conditions. When the system is off or an over-temp condition occurs, the solenoid should be de-energized and venting air out of its third port.
5. Check for and clean out, any debris in the upstream strainer, valve body, and valve seat. The valve seat may be worn or damaged and unable to seal properly *(See Technical literature).*

6. Zeroing the Powers Actuator: The actuator spring tension has been factory set. If the valve is leaking hot water, the actuator spring range requires adjustment. Follow the steps below and refer to the manufacturer's Technical instructions enclosed for more explicit direction.

To decrease spring tension on normally closed assembly.

1. Apply air pressure to the actuator to place the valve at "mid-stroke".
2. Hold the actuator stem in place and loosen the valve stem locknuts. *Do not turn the actuator stem at any time during this process as this may damage the diaphragm.*
3. While holding the actuator stem in place, turn the valve stem into the actuator stem (towards the actuator) to the desired position (1/4 to 1/2 turn each time) using the locknuts. Retighten the locknuts when finished.

To increase spring tension on normally closed assembly.

1. Apply air pressure to the actuator to place the valve at "mid-stroke".
2. Hold the actuator stem in place and loosen the valve stem locknuts. Do not turn the actuator stem at any time during this process as this may damage the diaphragm.
3. While holding the actuator stem in place, turn the valve stem out of the actuator stem (away from the actuator) to the desired position (1/4 to 1/2 turn each time) using the locknuts. Retighten the locknuts when finished.

Maintenance Instruction

KEEP TUBES CLEAN: In order to maintain high efficiency, the Mini-Pack tubes should be cleaned periodically. The frequency of cleaning the tubes depends on the characteristics of the water and the type of installation. Contact your local water treatment company for evaluation and recommendations.
GASKETS: Tighten gaskets during start up and periodically thereafter. Leaky gaskets can cause corrosion of the stud bolts. It is good practice to use a new gasket each time the tube bundle or bonnet is removed.
STUDS: Keep studs protected from corrosion with paint or oil. Keep stud bolts tight to prevent leaky gaskets. Stud bolts will not corrode if they are kept dry and protected. Use caution in removing and reinstalling the bonnet. The Mini-Pack must be shut down and drained before attempting removal. Before removing the nuts, apply penetrating oil and allow it to set for a few minutes. Forcing the nut off could cause breakage. Use a torch to heat the nut and it will come off easier. If a torch is not available, take a cold chisel and place it across the flat of the nut and strike several sharp blows with a heavy hammer. This should loosen the nut. If necessary, it is better to split the nut open and replace it than to break the stud off.
CONTROLS: Under normal conditions, controls furnished with the Mini-Pack require very little service. It is important, however, that the controls be protected from moisture. All controls should be checked frequently to make sure that they are working properly.
RELIEF VALVE: The Mini-Pack is equipped with a lever type relief valve of "ASME" rated capacity. To maintain the valve in good working condition, it should be manually opened once a month. The relief valve outlet should be piped directly to an open drain and the drain checked frequently for discharge. If the relief valve is leaking or does not operate freely it should be replaced.
HIGH LIMIT AQUASTAT: The Mini-Pack is equipped with a high limit temperature safety aquastat designed to shut down the unit in the event the water temperature exceeds the high limit set point. The high limit should be set 12ºF to 15ºF above the desired domestic hot water outlet temperature set point. For example, if the system is heating domestic water from 40ºF to 140ºF, the high limit should be set at ~152ºF. The high limit aquastat will automatically reset when the temperature drops the set differential number of degrees. The adjustable differential should be set so that the system does not start up again until the water temperature drops at least 5 degrees below the desired hot water outlet temperature (typically 135ºF on a 140ºF system). Continuing the example, with the high limit set at 152ºF, the differential should be set at least 17, thus ensuring that the system does not start heating until the water temperature drops 17ºF down to 135ºF. Refer to the included manufacturer's data sheet for adjustment information. Turn the high limit safety control up and down to verify proper operation.

Removing The Tube Bundle

Caution: It is recommended that you wear gloves and eye protection.

1. Shut down the unit as described in the shut down instructions.
2. After the Mini-Pack has cooled, isolate the Mini-Pack by closing off the manual valves at the domestic water inlet and outlet locations. Drain the water remaining in the shell to a safe sewer drain.
3. Disconnect the hot water inlet line and condensate outlet line from the tube bundle bonnet.

Maintenance Instruction

Removing The Tube Bundle

Caution: It is recommended that you wear gloves and eye protection.

4. Remove the nuts from the bonnet side first in order to remove the bonnet. Care must be taken when lowering the bonnet.
5. The tube bundle can now be removed by removing the nuts holding it to the shell.
6. ***Caution:*** *The tube bundle is very heavy. Care should be taken when removing it from the shell. Approximate tube bundle, bonnet, and shell weights without base are as listed.*

Mini-Pack Component Weights

Single-Wall Units

MP Size	Coil Weight	Bonnet Weight	Shell Weight
4"	30 lbs.	30 lbs.	60 lbs.
5"	54 lbs.	40 lbs.	73 lbs.
6"	77 lbs.	45 lbs.	85 lbs.
8"	110 lbs.	60 lbs.	115 lbs.
8L"	132 lbs.	60 lbs.	125 lbs.
10"	200 lbs.	95 lbs.	180 lbs.
10L"	230 lbs.	95 lbs.	200 lbs.
12"	253 lbs.	130 lbs.	250 lbs.
12L"	300 lbs.	130 lbs.	300 lbs.

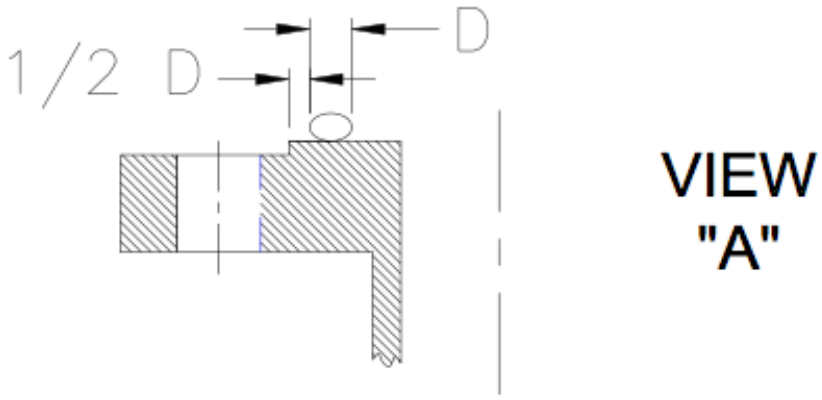
Double-Wall Units

MP Size	Coil Weight	Bonnet Weight	Shell Weight
5"	125 lbs.	40 lbs.	95 lbs.
6"	170 lbs.	45 lbs.	105 lbs.
8"	260 lbs.	60 lbs.	135 lbs.
10"	430 lbs.	95 lbs.	210 lbs.
12"	550 lbs.	130 lbs.	310 lbs.

Gasket Installation

Caution: It is recommended that you wear proper eye protection.

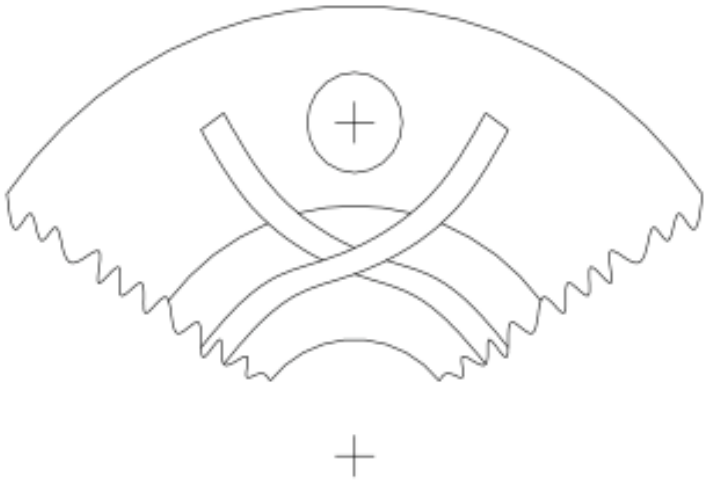
1. Thoroughly clean the gasket surface of foreign matter and scratches. Dirt and scale provide leakage paths.
2. Lubricate the bolts and the underside of the nuts. A heavy graphite and oil mixture will do. Threads should be well formed and free running. Lubricating the threads doubles the clamping force.
3. Gasket should be properly positioned before attempting to retighten bolts. The placement of the gasket is important and must be done on a clean surface area. It covers a very thin area, which widens as the bolts are tightened. Place the gasket on the flange toward the outside of the gasket sealing area so that a width of the flange is approximately equal to half the width of gasket is on the outside (as shown in VIEW “A”, D equals width of gasket). Peel back adhesive strip protective paper and firmly press down gasket as you go around flange. The adhesive strip will hold the gasket in position. Flanges, especially blind flanges, bend appreciably when bolts are torqued and might come together without adequately compressing the gasket if it were placed further toward the inside of the flange face.



VIEW "A"

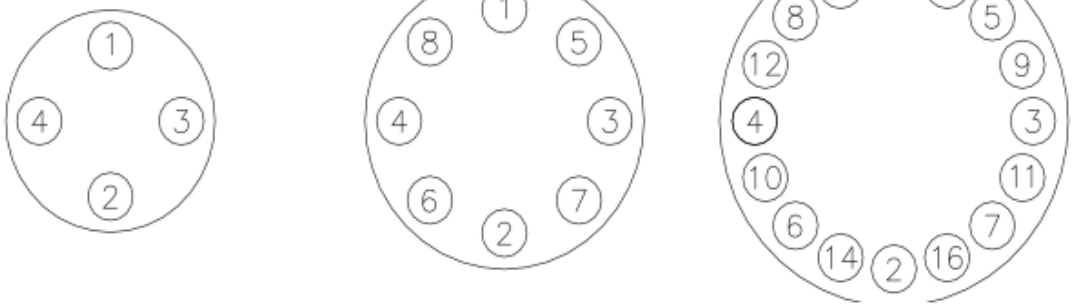
4. Complete the seal by crossing the ends near a bolt hole. Cross one end over the other about 1” and cut (as shown in VIEW “B”).

VIEW "B"



5. Assemble the flanged joints and torque the bolts as follows.
   a) Run up all the nuts, finger tight.
   b) Develop the required bolt stress in a minimum of about three equal steps, following a tightening sequence (as shown in VIEW “C”). The gasket material is highly compressible, but has little resilience; so gradual tightening is necessary to form a gasket of uniform thickness. Use a torque wrench to get recommended torque rating on Page 7.

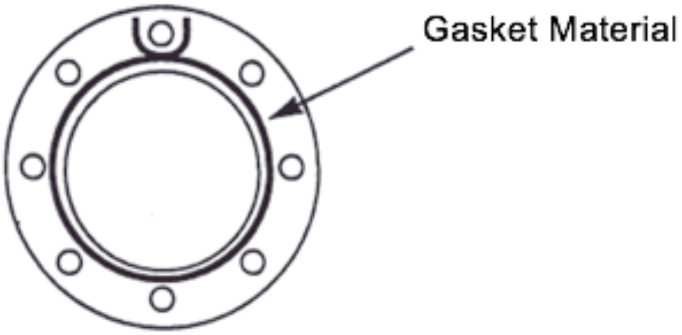
VIEW "C"



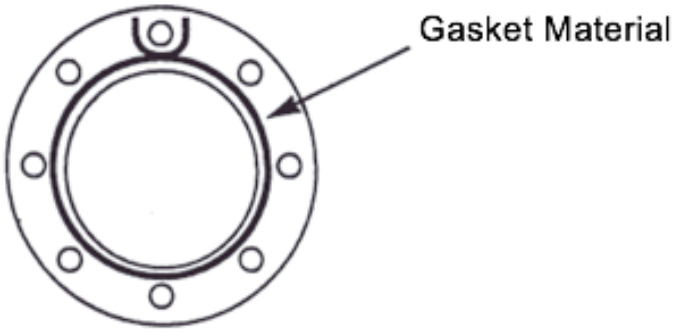
Tube Bundle and Bonnet Installation

Caution: It is recommended that you wear proper eye protection.

1. Flange and tube sheet preparation: Thoroughly clean the gasket surface of foreign matter and scratches. Dirt and scale provide leakage paths.
2. Apply gaskets: Install gasket material on stationary flange with adhesive side down. See Step #3 from Gasket Installation above on Page 17.
    a) Overlap material at top of flange.
    b) Overlapped ends should protrude out of flange, with one end on each side of top bolt.
    c) Make sure gasket does not extend into bore.



3. Install heat exchanger bundle: Bundle should be lifted or jacked with care as to not damage the tubes or tube sheet gasket surface. Lift the bundle to the proper height prior to tightening nuts down. Do not use the nuts to lift the bundle into the shell. Bundle should be left supported until installation is complete.
4. Apply gasket material on channel bonnet: Overlap gasket material around bolt hole as above. Apply gasket on divider sections as well. Overlap the divider gasket strips over the main gasket.



5. Bolting bonnet: Use jack or overhead support to lift bonnet into position, align with the bolts that are in place, level and slide the bonnet against tube sheet. Install nuts on bolts in place and tighten finger tight. The bonnet should be left supported until installation is complete.

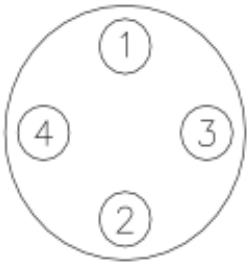
Tube Bundle and Bonnet Installation

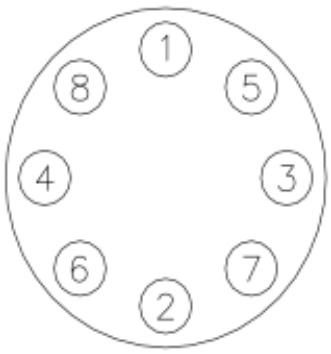
Caution: It is recommended that you wear proper eye protection.

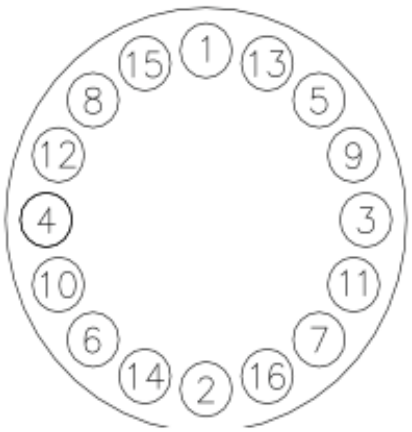
6. Torque: Unless otherwise specified, when using Goretex or spiral wound gaskets, use the following table to find recommended bolt tightening torque.

MP Size	Bolt Weight	Minimum Torque	Maximum Torque
4"	½"	45 ft. lb	60 ft. lb
5"	½"	45 ft. lb.	60 ft. lb
6"	½"	45 ft. lb.	60 ft. lb
8"	½"	45 ft. lb.	60 ft. lb
10"	⅝"	90 ft. lb.	120 ft. lb
12"	⅝"	90 ft. lb.	120 ft. lb
16"	⅝"	90 ft. lb.	120 ft. lb

7. Torque bolts: Set torque wrench to half of recommended torque rating. Tighten bolts according to alternating crossover pattern. Do not over tighten any one bolt initially as this could crimp the gasket. The sequence is to lightly tighten the first bolt then move directly across the circle for the second bolt. Continue as illustrated below. Tighten each bolt in increments repeating the cycle until half torque ratings are reached. Reset torque wrench to full torque rating, and repeat tightening sequence in increments until full torque ratings are reached. Remember, for the gaskets to work properly, the flange faces must be kept parallel and the bolts tightened uniformly.







8. Completion: When bolt-tightening sequence is complete, remove the support from the tube sheet and the channel bonnet.

Preventive Maintenance

Every 3 Months:

1. Visually check for leaks at any joints, including the valve body, piping, and controls.
2. Visually check for corrosion on the control valve, Accritem, bulb, and strainer.
3. Check for full valve shut-off. *Refer to Trouble Shooting section on Page 14.*
4. Check for full valve travel. Less than full valve travel may indicate a leak in the diaphragm or bulb, or a plugged air line.
5. Test the Accritem control knob for freedom of movement. Lubricate if necessary.
6. Remove the Accritem from the Mini-Pack and check the temperature control bulb for any corrosion or erosion. Remove/clean any scale from bulb surface.
7. Strainers should be inspected and cleaned. Damaged screens should be replaced with same mesh.
8. Check and tighten flange nuts as needed.

Annual Maintenance:

1. The relief valve must be tripped to insure proper operation as a safety device.
2. Pull the tube bundle and clean the inside and outside of the tube bundle of scale. The frequency of tube cleaning will be determined after inspection. (Heavy scale will indicate that more frequent cleaning is necessary). A light sludge or scale coating on the tube greatly reduces its effectiveness. A marked increase in pressure drop and/or reduction in performance usually indicate cleaning is necessary. The tube bundle should be cleaned with a tube brush and/or an acceptable cleaning solution.
3. Check ALL operating components for proper functionality. Check all electrical connections.

Replacement Parts

Ace Heaters maintains a complete equipment list for each Mini-Pack, filed by serial number. In order for us to give prompt service and to ensure that correct parts are supplied, please be sure and supply the model and serial number.

Replacement parts may be ordered from directly from manufacturer.

Material Data Safety Sheets

Some of Ace products contain materials that have been recognized as posing health risks. Material Safety Data Sheets for these materials are available from your local Manufacturer's rep. When requesting this information, be sure to have the model number and serial number available.

If you do not know who your local Manufacturer's Rep is, you can find out by logging into the aceheaters.com website, and clicking on the Representative tab found in the table of contents.

ACE Mini-Pack/SWH BMS Panel (Water) – Water Only

Operating Keys

INDEX: Pressing the **INDEX** key advances the display to the next menu item.

UP ARROW: Increments a value or changes a menu item.

- If pressed during the **Operation Mode**, the Setpoint value will be increased.

DOWN ARROW: Decrements a value or changes a menu item.

- If pressed during the **Operation Mode**, the Setpoint value will be decreased.

ENTER: Stores the value or item change. If not pressed, the previously stored value or item will be retained.

- When pressed during the **Operation Mode**, the controller switches to the **Regulation Mode**.
- If held for more than 3 seconds during the **Operation Mode**, the controller switches to the **Initial Setting Mode**.
- If pressed during the **Regulation Mode** or **Initial Setting Mode**, the controller will return to the **Operation Mode**.

This instruction should be used with

ACE Mini-Pack/SWH BMS Panel (Water)
LOVE Controller Model **4C-5** (AJAX P/N: **CA4C-5**)

Home Display

The **Home Display** is the normal display while the control is operating.

Home Display will indicate the Temperature (**PV**) that is being measured on the top display and the SetPoint (**SV**) on the bottom display

Entering Initial Setting Mode

1) When the power is applied to the unit, display will show (**Home Display)** temperature on the PV screen. If not check wiring.
2) Hold the key for **3** seconds from the **Home Display** to get to the **Initial Setting Mode**.
3) Press the key to go through the different parameters, and the and keys to change parameters and to save the change.

Programming in Initial Setting Mode

4) In **Initial Setting Mode**, change the following parameters below.

Upper Display	Lower Display	Description
inPt	Pt3	Input Selection
tPUn	F	Temperature Unit
tP-H	212	Scale High Limit
tP-L	32	Scale Low Limit
CtrL	PID	Control Mode
S-HC	HEAt	Heat/Cool Selection
ALA1	11	Alarm 1 Setting
ALA2	3	Alarm 2 Setting
C-SL	rtU	Communication Protocol
CoSH	on	Communication Write Function
C-no	1	Controller Address
bPS	38Y4	Baud Rate Setting
Len	8	Communication Data Length
PrtY	none	Communication Parity Bit
StoP	1	Communication Stop Bit

5) When **inPt** is shown on the upper display, press the key to review the programmed parameters for the second time to check all parameters are set correctly.
6) Press the key to get back to the Home Display.
7) Use and key to change the **SV** (setpoint value) to within ± 2 F off the **PV** value. Press the key to save the new setpoint value.

Entering Regulation Mode

8) Press the key from the **Home Display** to get to the **Regulation Mode**.
9) Press the key to go through the different parameters, and the and keys to change parameters and to save the change.

Programming in Regulation Mode

10) In **Regulation Mode**, change the following parameters below.

Upper Display	Lower Display	Description
At	oFF	Auto Tune
P	40	Proportional Band (Units of C)
I	60	Integral Time (S)
d	15	Derivative Time (S)
ioF	0	Integral Deviation Offset
tPoF	0	Process Temperature Offset
CrHi	0	Analog Output High Limit
CrLo	0	Analog Output Low Limit

1) Press the key to get back to the Home Display.

Entering Operation Mode

11) Press the key from the **Home Display** to get to the **Operation Mode**.
12) Press the key to go through the different parameters, and the and keys to change parameters and to save the change.

Programming in Operation Mode

13) In **Operation Mode**, change the following parameters below.

Upper Display	Lower Display	Description
r-S	rUn	Select Run – Stop Output Control
AL1H	20	High Deviation Alarm On (F)
AL1L	15	High Deviation Alarm Off (F)
AL2L	20	Low Deviation Alarm Off (F)
LoC	oFF	Panel Security Lock
oUT1		Analog Output (%)

2) Press the key to get back to the Home Display.

Testing Operating Control

3) Change the **SV** (setpoint value) so that it is 20° below the **PV** (measured temperature). High Temperature Alarm will activate (dump valve if included) and light will come on.
4) Check to see that valve closes fully.
5) Deactivate High Temperature Alarm by raising the setpoint value to 5° above the **PV** (measured temperature).

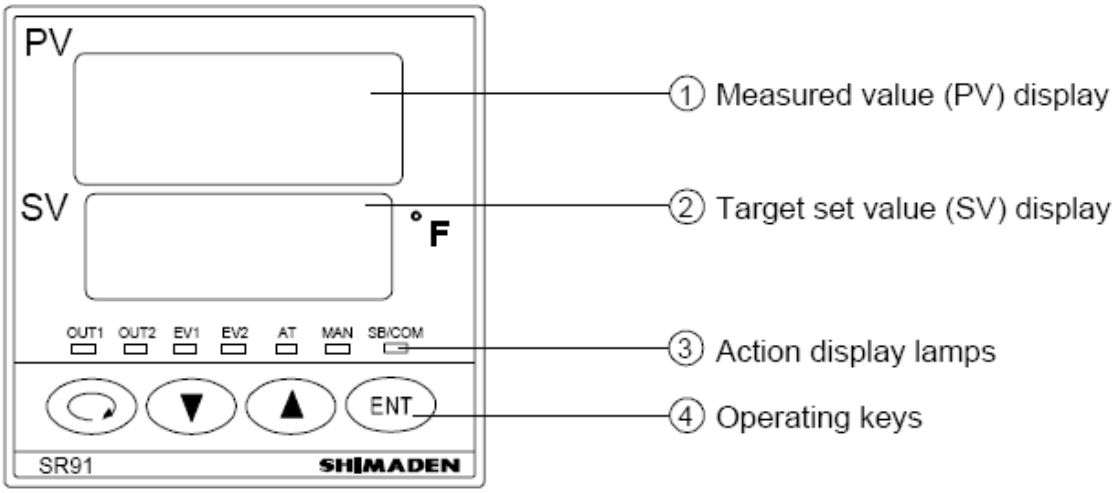
Change Setpoint

6) Change the **SV** (setpoint value) 120 F.

Enable Key Lock

7) Press the key from the **Home Display** to get to the **Operation Mode**.
8) Press the key until upper display shows **LoC**.
9) Press the and keys to change parameter to **LoC2** and to save the change.
10) Fill out the **Safety System Test Check Sheet**.

ACE Mini-Pack/SWH Digital Panel (Water)
ACE USB Digital Panel (Steam)



	Parameter key:	Used to get to the next parameter or different modes. Hold to scroll to the first screen.
	Arrow keys:	Used to change parameters.
	Enter key:	Used to set the parameter after it has been changed.

This instruction should be used with

ACE Mini-Pack/SWH Digital Panel (Water)
SHIMADEN Controller Model **SR93-8I-N-90-1400** (P/N: **CASR931400**)

Or

ACE USB Digital Panel (Steam)
SHIMADEN Controller Model **SR93-4I-N-90-1400** (P/N: **CASR96140**)

Entering Setup Mode

1) When the power is applied to the unit, display will show temperature or pressure on the PV screen. If not check wiring.
2) Hold the key for **3** seconds to get to the **Setup Mode**.
3) Press the key to go through the different parameters, and the and keys to change parameters and to save the change.

Programming in Setup Mode

4) In **Setup Mode**, change the following parameters below.
   *Start programming from **rAnG** parameter
   ** Indicates Steam Controller parameters

Upper Display	Lower Display	Description
PArA	Set	Setup Mode initial screen
LoCK	oFF	Key lock setting
P	10.0 (Water)	Output proportional band setting
I	60 (Water)	Output integral time
D	15 (Water)	Output derivative time
ñr	0.0	Output manual reset
SF	0.40	Output target value function
o_L	0.0	Output lower limit **Amuract Wiring Rev.D (Before 3/30/11) – 18.0
o_H	100.00	Output high limit
StEV	oFF	Event at Standby
E1_ň	Hd	High deviation alarm
E1_d	5.0 (Water) **3.0 (Steam)	High alarm differential
E1_i	1	High alarm event standby action
E2_ ň	Ld	Low deviation alarm
E2_d	0.1	Low alarm differential
E2_i	1	Low alarm event standby action
Ao_ñ	PV	Analog Output Type
Ao_L	40.0 (Water) **0.0 (Steam)	Analog Output Low Limit
Ao_H	200.0 (Water) **150.0 (Steam)	Analog Output High Limit
Act	rA	Reverse acting control
SoFt	oFF	Soft start time
SV_L	40.0 (Water) **0.0 (Steam)	Setpoint lower limit
SV_H	180.0 (Water) **Vessel – 8 (Steam)	Setpoint high limit
PV_b	0	Outlet temperature/pressure bias value

PV_F	0	Outlet temperature/pressure filter time
*** rAnG**	**34 (Water)** ****92 (Steam)**	**Sensor and measuring range** *** Start Here***
Unit	F (Water Only)	Temperature unit
Sc_L	0.0	Input scale lower limit
Sc_H	400.0 (Water) **150.0 (Steam)	Input scale high limit
Scdp	0.0	Input decimal point position
Disp	Pb	Temperature/pressure display at standby

5) When **PArA** shown, press the key to review the programmed parameters for the second time to check all parameters are set correctly.
6) Scroll until **PArA** shown on the display again, hold down the key for 3 seconds to get to **Operation Mode**.
7) Use and key to change the **SV** (setpoint value) to within ± 2 F/PSI off the **PV** value. Press the key to save the new setpoint value.

Programming High and Low Deviation Alarm

8) Press the until **E1Hd** is shown. Using the and key to change the value to **20** (for water) or **6** (for steam)
and press the key to save the new High Deviation alarm value.
9) Press the until **E2Ld** is shown. Using the and key to change the value to **-10** and press the key to save the new Low Deviation alarm value.
Note: The High Temperature/Pressure Alarm is activated when **PV** is **E1Hd** above **SP** and Low Temperature/Pressure Alarm is activated when **PV** is I**E2Ld**I below SP.
10) Hold the key for 3 seconds to display **PV** (measured temperature/pressure) and **SV** (setpoint value).

Testing Manual Valve Control

11) Press the key once to get to valve position screen.
12) Hold down the key until the **MAN** light starts to flash.
13) Change the parameter to **99.9** using the and key. Check to see that valve opens fully. (Valve should be at 90°)
14) Change the parameter to **50** using the and key. Check to see that valve opens to half way. (Valve should be at 45°)
15) Hold down key until **MAN** light stops flashing.

Testing Operating Control (Water Only)

16) Change the **SV** (setpoint value) so that it is 20° below the **PV** (measured temperature). High Temperature Alarm will activate (dump valve if included) and light will come on.
17) Check to see that valve closes fully.
18) Deactivate High Temperature Alarm by raising the setpoint value to 10° above the **PV** (measured temperature).

Testing Operating Control (Steam Only)

19) Remove Pressure Transducer and apply 15 PSI pressure.
20) Change the **SV** (setpoint value) so that it is 7 PSI below the **PV** (measured Pressure). High Pressure Alarm will activate and light will come on.
21) Check to see that valve closes fully.
22) Deactivate High Pressure Alarm by raising the setpoint value to 5 PSI above the **PV** (measured pressure)

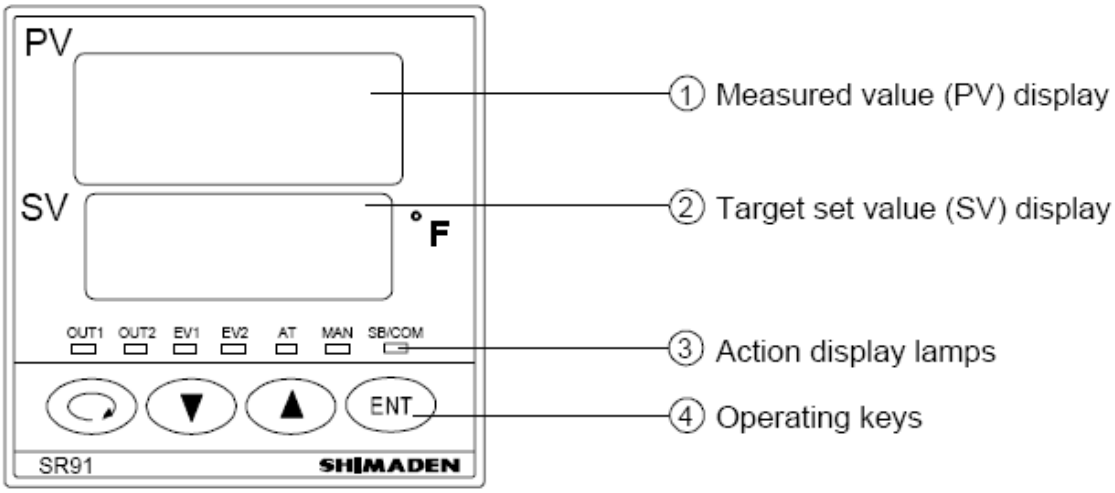
Change Setpoint

23) Change the **SV** (setpoint value) 120 F for Water and 10 PSI for Steam.

Enable Key Lock

24) Hold down key until you get see the Setpoint and Process Variable.
25) Hold down the key for 3 seconds to get to the **Setup Mode**.
26) Press the key until you see **LoCK** on the PV screen.
27) Change this parameter to **2** and press the ENT key to save the new parameter.
28) Hold down the key until you PV display shows **PArA**.
29) Hold down the key for **3** seconds to get back to the **Operation Mode**.
30) Fill out the **Safety System Test Check Sheet**.

ACE Mini-Pack/SWH BMS Panel (Water)
ACE USB BMS Panel (Steam)



	Parameter key:	Used to get to the next parameter or different modes. Hold to scroll to the first screen.
	Arrow keys:	Used to change parameters.
	Enter key:	Used to set the parameter after it has been changed.

This instruction should be used with

ACE Mini-Pack/SWH BMS Panel (Water)
SHIMADEN Controller Model **SR93-8I-N-90-1050** (AJAX P/N: **CASR931050**)

Or

ACE USB BMS Panel (Steam)
SHIMADEN Controller Model **SR93-4I-N-90-1050** (AJAX P/N: **CASR931050A**)

Entering Setup Mode

1) When the power is applied to the unit, display will show temperature or pressure on the PV screen. If not check wiring.
2) Hold the key for **3** seconds to get to the **Setup Mode**.
3) Press the key to go through the different parameters, and the and keys to change parameters and to save the change.

Programming in Setup Mode

4) In **Setup Mode**, change the following parameters below.
   *Start programming from **rAnG** parameter
   ** Indicates Steam Controller parameters

Upper Display	Lower Display	Description
PArA	Set	Setup Mode initial screen
LoCK	oFF	Key lock setting
P	10.0 (Water)	Output proportional band setting
I	60 (Water)	Output integral time
D	15 (Water)	Output derivative time
ñr	0.0	Output manual reset
SF	0.40	Output target value function
o_L	0.0	Output lower limit **Amuract Wiring Rev.D (Before 3/30/11) – 18.0
o_H	100.00	Output high limit
StEV	oFF	Event at Standby
E1_ň	Hd	High deviation alarm
E1_d	5.0 (Water) **3.0 (Steam)	High alarm differential
E1_i	1	High alarm event standby action
E2_ ň	Ld	Low deviation alarm
E2_d	0.1	Low alarm differential
E2_i	1	Low alarm event standby action
coññ	Loc	Communication mode
Prot	rtu	Communication protocol
Addr	1	Communication address
dAtA	8n1	Communication data format
SchA	Stx	Start character
bcc	1	BCC operation type
bPS	9600	Communication speed
dELY	20	Communication delay time
ñEñ	EEP	Communication memory mode
Act	rA	Reverse acting control
SoFt	oFF	Soft start time

SV_L	40.0 (Water) **0.0 (Steam)	Setpoint lower limit
SV_H	180.0 (Water) **Vessel – 8 (Steam)	Setpoint high limit
PV_b	0	Outlet temperature/pressure bias value
PV_F	0	Outlet temperature/pressure filter time
*** rAnG**	**34 (Water) **92 (Steam)**	**Sensor and measuring range * Start Here***
Unit	F (Water Only)	Temperature unit
Sc_L	0.0	Input scale lower limit
Sc_H	400.0 (Water) **150.0 (Steam)	Input scale high limit
Scdp	0.0	Input decimal point position
Disp	Pb	Temperature/pressure display at standby

5) When **PArA** shown, press the key to review the programmed parameters for the second time to check all parameters are set correctly.
6) Scroll until **PArA** shown on the display again, hold down the key for 3 seconds to get to **Operation Mode**.
7) Use and key to change the **SV** (setpoint value) to within ± 2 F/PSI off the **PV** value. Press the key to save the new setpoint value.

Programming High and Low Deviation Alarm

8) Press the until **E1Hd** is shown. Using the and key to change the value to **20** (for water) or **6** (for steam)
and press the key to save the new High Deviation alarm value.
9) Press the until **E2Ld** is shown. Using the and key to change the value to **-10** and press the key to save the new Low Deviation alarm value.
Note: The High Temperature/Pressure Alarm is activated when **PV** is **E1Hd** above **SP** and Low Temperature/Pressure Alarm is activated when **PV** is I**E2Ld**I below SP.
10) Hold the key for 3 seconds to display **PV** (measured temperature/pressure) and **SV** (setpoint value).

Testing Manual Valve Control

11) Press the key once to get to valve position screen.
12) Hold down the key until the **MAN** light starts to flash.
13) Change the parameter to **99.9** using the and key. Check to see that valve opens fully. (Valve should be at 90°)
14) Change the parameter to **50** using the and key. Check to see that valve opens to half way. (Valve should be at 45°)
15) Hold down key until **MAN** light stops flashing.

Testing Operating Control (Water Only)

16) Change the **SV** (setpoint value) so that it is 20° below the **PV** (measured temperature). High Temperature Alarm will activate (dump valve if included) and light will come on.
17) Check to see that valve closes fully.

18) Deactivate High Temperature Alarm by raising the setpoint value to 5° above the **PV** (measured temperature).

Testing Operating Control (Steam Only)

19) Remove Pressure Transducer and apply 15 PSI pressure.
20) Change the **SV** (setpoint value) so that it is 7 PSI below the **PV** (measured Pressure). High Pressure Alarm will activate and light will come on.
21) Check to see that valve closes fully.
22) Deactivate High Pressure Alarm by raising the setpoint value to 5 PSI above the **PV** (measured pressure)

Change Setpoint

23) Change the **SV** (setpoint value) 120 F for Water and 10 PSI for Steam.

Enable Key Lock

24) Hold down key until you get see the Setpoint and Process Variable.
25) Hold down the key for 3 seconds to get to the **Setup Mode**.
26) Press the key until you see **LoCK** on the PV screen.
27) Change this parameter to **2** and press the ENT key to save the new parameter.
28) Hold down the key until you PV display shows **PArA**.
29) Hold down the key for **3** seconds to get back to the **Operation Mode**.
30) Fill out the **Safety System Test Check Sheet**.

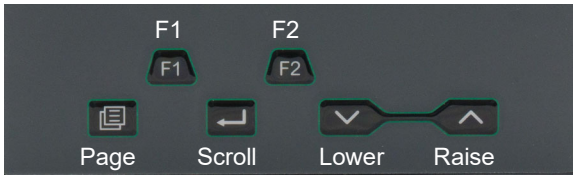
EPC3004

The start up display depends on the controller configuration and is described in subsequent sections.

General Description of Operator Buttons

On EPC3016 only the 4 navigation buttons (Page, Scroll, Down, Up) are available.
On EPC3008 and EPC3004 all 6 buttons (4 navigation and 2 function) are available.

Button Layout



Button Operation

Raise

The raise button increments parameter values to limits.

Parameter enumerations, however, do wrap-around.

Lower

The lower button decrements parameter values to limits.

Parameter enumerations, however, do wrap-around.

Page

In Operator levels 1 or 2 the Page button will select between the Home display or the Programmer Edit and Run lists (if one of the programmer features is enabled).

In Levels 3 or Config the Page button will scroll through list headers (no auto-repeat). If the Page button is pressed within a list, the display reverts to the top of the list. The top of the list shows the list header only with no initial parameters.

Page (held for >3 seconds)

The Goto parameter is selected directly. This operation can be performed from any display. If the Page is held for >3 seconds at power-up the Quick Start Mode is selected following the entry of a password.

Page+Raise

Scroll back the list headers (with auto-repeat).

Scroll

Select parameters in turn, returning to the first parameter in the list or to a list header if Level 3 or Configuration level is selected. If the button is held down the list will auto-repeat. In levels 1 and 2 this button also scrolls through promoted parameters when the HOME screen is selected.

Scroll+Raise

Scroll back through parameters from bottom to top (with auto-repeat).

Page+Scroll - all variants

Jump directly to the "HOME page". The current operating level remains unchanged. If the HOME page is already selected, these buttons will perform the custom function as detailed in "Functionality of the F1 and F2 and Page + Scroll buttons" on page 196. The default is Alarm Acknowledge.

Raise+Lower (Run/Hold)

If a programmer option is enabled and a program is configured, a momentary press of these keys toggles between Run and Hold modes.

Raise+Lower (hold for >3 seconds - Mode)

If a programmer option is enabled and a configured program is running, holding these buttons will abort the program.

If the HOME page is selected and the Programmer is not running, holding these buttons will invoke the 'Mode' display where the Loop Mode parameter will allow selection of Auto or Manual mode.

F1 and F2

F1 and F2 buttons are not available in EPC3016.

The functionality of these buttons is set by the Instrument function block. The default settings are:

- F1: Auto/Man.
- F2: Run/Hold.

Note: A time-out applies to all displays. If no button presses are detected within a timeout period (default 60s), the display will revert back to the Level 1 "HOME page".

Start Up—New Unconfigured Controller

If the controller is new and ordered as unconfigured it will start up in 'Quick Start Mode'. This is a built in tool which is provided to allow users to configure the product for the most commonly used functions such as the application type, input type, range, and digital input functions. The Quick Configuration code consists of two ‘SETS’ of five characters each. The upper section of the display shows the set selected, the lower section shows the five digits which make up the set. Each digit may result in multiple parameter values being set. The opening set is SET1 as shown.

Initially all characters are shown as an ⁜. This is generally the default character for ‘not fitted/none’ or ‘use default’. The first character, initially flashing, selects the Application Type as listed in the Quick Start Tables in the following sections. To select the required application type press or .

Note: Quick Code 1 will only be available if the correct hardware is fitted for the application. For example, the VPU application must have IO1 and IO2 as relay, triac or logic outputs.

Press to select the second character. The second character selects the ‘Input 1 Type’ as listed in the Quick Start Tables in the following sections. If hardware or features are not available then the character is skipped over when pressing scroll.

Continue to set up all 5 characters using the Quick Start Tables.

When the last character in SET1 has been entered the display will automatically go to SET2.

Adjust these in the same way as SET1.

At any time to return to the start of SET1, press .

⚠ WARNING

HAZARD OF INCORRECT CONFIGURATION

Incorrect configuration can result in damage to the process and/or personal injury and must be carried out by a competent person authorized to do so. It is the responsibility of the person commissioning the controller to ensure the configuration is correct.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

More detailed features available in the product may also be configured by entering a Configuration Level. This is explained in "Configuration Level" on page 95, or by using iTools as explained in "Configuration Using iTools" on page 212. iTools is a configuration package available free of charge from Eurotherm by accessing www.eurotherm.com.

Quick Start Tables

The first digit in SET 1 will select an application which automatically configures relevant function block parameters and creates connections between them to make a complete control strategy relevant to that application.

The *Configuration Using iTools* chapter has a section called "Applications" on page 228, which provides a general description of the available applications and their associated graphical wiring (as diagrams).

Further more, descriptions of each application are available in additional addendum's to this manual and are listed below:

- Application '1' - Heat only controller.
- Application '2' - Heat/Cool controller.
- Application 'V' - VPU Heat only controller - addendum part number HA033033 EPC3000 Temperature Control Applications.
- Application 'C' - carbon potential - addendum part number HA032987.
- Application 'D' - dew point control - addendum part number HA032994.

They are available from www.eurotherm.com.

Note: The controller must be fitted with the correct hardware otherwise the application code will not be selectable. For example, a VPU controller must have a digital output fitted in both IO1 and IO2.

The digits will present "X" when not fitted and the HMI will skip over that field. Similarly, entering a value of "X" in a field will disable that feature, if appropriate.

Quick Code Set 1

Digit 1	Digit 2	Digit 3	Digit 4	Digit 5
Application	**Analog Input 1 Type**	**Analog Input 1 Range**	**Analog Input 2 Type**	**Analog Input 2 Range**
X = None 1 = PID Heat Only Control 2 = PID Heat/Cool Control V = VPU Heat Only Control C = Carbon Potential Control* D = Dew Point Control*	X = Use Default **Thermocouple** B = Type B J = Type J K = Type K L = Type L N = Type N R = Type R S = Type S T = Type T **RTD** P = Pt100 W = Pt1000 **Linear** M = 0-80mV V = 0-10V 2 = 0-20mA 4 = 4-20mA	X = Use Default 1 = 0-100°C 2 = 0-200°C 3 = 0-400°C 4 = 0-600°C 5 = 0-800°C 6 = 0-1000°C 7 = 0-1200°C 8 = 0-1300°C 9 = 0-1600°C A = 0-1800°C F = Full range	X = Not fitted or Use Default **Thermocouple** B = Type B J = Type J K = Type K L = Type L N = Type N R = Type R S = Type S T = Type T **RTD** P = Pt100 W = Pt1000 **Linear** M = 0-80mV V = 0-10V 2 = 0-20mA 4 = 4-20mA Z = HiZ	X = Not fitted or Use Default 1 = 0-100°C 2 = 0-200°C 3 = 0-400°C 4 = 0-600°C 5 = 0-800°C 6 = 0-1000°C 7 = 0-1200°C 8 = 0-1300°C 9 = 0-1600°C A = 0-1800°C F = Full range

Notes:

1. If no application is selected (1st character in SET 1 = X) the display will go directly to the EXIT screen. If accepted the controller will take on a set of default values. Any further configuration may be carried out by accessing the Configuration Level ("Configuration Level" on page 95) or through iTools configuration software ("Configuration Using iTools" on page 212).

2. For linear inputs the minimum/maximum input voltage/current will cause the display to read range low/high respectively.
3. If the input 2 is not fitted Set 2 will be selected immediately after Input 1 Range has been set.

* Temperature, Carbon potential and dew point control are described as separate supplements to this manual and are available from www.eurotherm.com. Part numbers HA033033, HA032987 and HA032994 respectively.

Quick Code Set 2

Digit 1	Digit 2	Digit 3	Digit 4	Digit 5
CT Input Range	**LA Function**	**LB Function**	**Option DIO Function**	**Temperature Units**
X = Not fitted or not used 1 = 10A 2 = 25A 5 = 50A 6 = 100A 7 = 1000A	X = Not used W = Alarm Acknowledge M = Auto/Manual R = Program Run/Hold L = Key Lock P = Setpoint Select T = Program Reset U = Remote/Local Select V = Recipe Load Select K = Loop Track	X = Not fitted or not used W = Alarm Acknowledge M = Auto/Manual R = Program Run/Hold L = Key Lock P = Setpoint Select T = Program Reset U = Remote/Local Select V = Recipe Load Select K = Loop Track	X = Not fitted or not used 1 = Config 1 2 = Config 2 3 = Config 3 4 = Config 4 5 = Config 5 6 = Config 6 7 = Config 7 8 = Config 8 9 = Config 9	X = Use Default C = Celsius F = Fahrenheit K = Kelvin

Notes:

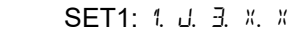
1. The Quick Code assumes that the CT input is monitoring the current of the heat channel load which in all applications is wired to IO1.PV.
2. If IO.1 module is a DC Output module then CT Input digit is not alterable.
3. If CT input is not set to X, the CT Input will be enabled and will monitor the current; however, CT alarms will not be configured. This means that if CT alarms are required they must be wired by the user. A typical example of wiring alarms is shown in section "Example 1: To Wire an Alarm" on page 224.

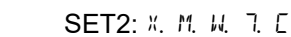
Quick Codes DIO

If the Options module has been fitted then the function of the module is defined by fixed configurations. These are selected by Digit 4 in the previous table. The fixed configurations are listed in the table below:

Config	Function	Config	Function	Config	Function
Config 1	DIO1 = Programmer Event Output 1 DIO2 = Programmer Event Output 2 DIO3 = Programmer Event Output 3 DIO4 = Programmer Event Output 4 DIO5 = Programmer Event Output 5 DIO6 = Programmer Event Output 6 DIO7 = Programmer Event Output 7 DIO8 = Programmer Event Output 8	Config 4	DIO1 = BCD Input 1 DIO2 = BCD Input 2 DIO3 = BCD Input 3 DIO4 = BCD Input 4 DIO5 = Programmer Run/Hold DIO6 = Programmer Reset DIO7 = Programmer Advance DIO8 = Not Used BCD Output wired to Program Number	Config 7	DIO1 = Programmer Run DIO2 = Programmer Hold DIO3 = Programmer Reset DIO4 = Programmer Advance DIO5 = Not Used DIO6 = Not Used DIO7 = Not Used DIO8 = Not Used
Config 2	DIO1 = Programmer Event Output 1 DIO2 = Programmer Event Output 2 DIO3 = Programmer Event Output 3 DIO4 = Programmer Event Output 4 DIO5 = BCD Input 1 DIO6 = BCD Input 2 DIO7 = BCD Input 3 DIO8 = Programmer Run/Hold BCD Output wired to Program Number	Config 5	DIO1 = BCD Input 1 DIO2 = BCD Input 2 DIO3 = BCD Input 3 DIO4 = BCD Input 4 DIO5 = BCD Input 5 DIO6 = BCD Input 6 DIO7 = BCD Input 7 DIO8 = BCD Input 8 BCD Output wired to Recipe Load	Config 8	DIO1 = Programmer Run DIO2 = Programmer Hold DIO3 = Programmer Reset DIO4 = Not Used DIO5 = Not Used DIO6 = Not Used DIO7 = Not Used DIO8 = Not Used
Config 3	DIO1 = Programmer Event Output 1 DIO2 = Programmer Event Output 2 DIO3 = Programmer Event Output 3 DIO4 = Programmer Event Output 4 DIO5 = Programmer Run DIO6 = Programmer Hold DIO7 = Programmer Reset DIO8 = Programmer Advance	Config 6	DIO1 = BCD Input 1 DIO2 = BCD Input 2 DIO3 = BCD Input 3 DIO4 = BCD Input 4 DIO5 = Not Used DIO6 = Not Used DIO7 = Not Used DIO8 = Not Used BCD Output wired to Recipe Load	Config 9	DIO1 = Programmer Event Output 1 DIO2 = Programmer Event Output 2 DIO3 = Programmer Event Output 3 DIO4 = Programmer Event Output 4 DIO5 = Not Used DIO6 = Not Used DIO7 = Not Used DIO8 = Not Used

Example of Quick Codes

SET1: 

SET2: 

The controller is configured for PID Heat Only, Input 1 Thermocouple Type J, Range 0–400℃, Input 2 and Range not used, CT Input not used, Digital Input LA will select Auto/Manual, Digital Input LB will select Global Acknowledge of Alarms, the optional digital IO will be configured in accordance with ‘Config 7 in the above table,Temperature Units Degrees Celsius.

To Save or Discard Quick Codes

When all characters have been entered the display will show:

If no is selected (by pressing ↵) the display returns to SET1.

Press ^ or v to select SAVE then either press ↵ to save immediately or wait for 2 seconds to save automatically. This accepts the Quick Configuration Codes and the controller enters Operator Level 1.

OR

Press ^ or v to select diSc then either press ↵ to select or wait for 2 seconds to accept. This discards the last entered codes and returns the controller to its previous settings.

Selecting either SAVE or diSc will result in the instrument performing a restart.

Configure the Communications Protocol

From firmware versions V3.01 and above, the communications protocol and associated selections may be chosen during the start-up sequence. This is to simplify access to Digital Communications when the instrument is being configured. When the controller is new and first switched on, or following a cold start, the following sequence is displayed at start up and after the Quick Codes have been saved:

Operation	Action	Display	Notes
Digital comms setup is selected		COmm SETUP	
Select the required serial protocol	1. Press ↵ to select the serial Protocol to be used for your process	NONE S. PROT	NONE - No serial comms mrtu - ModbusRTU EI bS - EI-Bisynch This list only appears for serial comms (EPC3004, EPC3008, EPC3016 with Serial Option board).
If Modbus or EI-Bisynch is selected	2. Press ↵ to select the node address	1 ADDR	
Select Ethernet protocol	3. Press ↵ to select Ethernet Protocol	NONE E. PROT	NONE = No Ethernet mtCP - ModbusTCP Slave only EI Pm - EtherNet/IP Slave and Modbus TCP Slave bACm - BACnet Slave and Modbus TCP Slave mmSt - Modbus TCP Master and Slave This list only appears if the Ethernet option module is installed and the features have been purchased.
Turn Auto discovery on or off	4. Press ↵ to select Auto Discovery	OFF A. DISC	See "AutoDiscovery" on page 320. OFF - No auto discovery On - Auto discovery enabled
Save and exit comms set up	5. Press ↵	no EXIT	no - Return to comms set up SAvE - Save the comms settings di Sc - Discard comms settings. The questions will be asked again at the next power up.

Note: In all cases the option is selected using ^ or v .

To Re-Enter Quick Code mode

It is possible to re-enter Quick Start mode, by holding down the Page key during power up. Enabling Comms Protocol does not appear when the quick code is re-entered.

It is then necessary to enter the configuration level password. See "To Select Configuration Level" on page 97.

If the configuration of the instrument is subsequently modified by a change made via Configuration Mode this will be shown by the quick code digits being separated by the decimal place dot (indicating that the codes shown may not reflect the current configuration). If the codes are then accepted the instrument is re-configured to satisfy the code settings.

Notes:

1. If the config clip is connected the instrument may be powered from the USB port of the PC. In this case it is necessary to disconnect the config clip to re-enter Quick Start Mode. Alternatively, disconnect the power pins from the config clip. See "Using the Configuration Clip" on page 213.
2. If a Cold Start (See "Cold Start" on page 244) has been invoked the instrument will always start in Quick Code Mode without the need to enter the configuration password. Enabling Comms Protocol will then be displayed.

Start Up - New Configured Controller

If a product has been ordered using the Order Code it will already be configured. When new, ‘out of the box’, it will then power up in operating Level 1.

Also, if it has previously been configured, for example, using the Quick Codes then it will start up in Operating mode.

The start up display is dependent upon the application or the way in which the controller is configured, see ‘Start-up Modes’ in the following section.

The view shown above is generally referred to as the ‘HOME’ Display.

In EPC3008 and EPC3004 the HOME display normally consists of three lines. The upper line normally shows the Process Value "PV",

The center line normally shows the Working Setpoint "WSP" if the controller is working in its normal Auto Mode or the Output demand if it is in Manual Mode. (Auto/Manual control is explained in section "Auto/Manual Mode" on page 79.

The lower line shows a scrolling message providing a longer description of the selected parameter. It may also display a further parameter value if this has been set up in the instrument block, see "Display Functionality Sub-List (HmI)" on page 195.

Bar Graph

In EPC3008 and EPC3004 a bargraph may also be configured using iTools. The bargraph may be ‘soft’ wired to any convenient source such as PV input or output demand, see "Example 4: To Configure a Bargraph" on page 225.

EPC3016 has two lines of display. The line below the top one alternates between a mnemonic and the scrolling message. A bargraph is not available.

Setpoint

The Setpoint is defined as the value which the process is required to attain. The value of the setpoint may be obtained from a number of sources, for example, manually using the front panel keys, via the programmer function block, via an external analog source, via digital communications. The working setpoint is, therefore, defined as the current setpoint derived from any of these sources.

Subsequent Start-ups

When the controller is no longer new and has been in normal use it will start up in Level 1, even when it has been powered down in Operator level 2 or 3. If, however, it was powered down when in Configuration level it will power up in ‘Standby’ and show a message - ‘POWERED DOWN WHILST IN CONFIG MODE’. To clear the message re-enter configuration level (with password - see "To Select Configuration Level" on page 97), then, either continue with changes to the configuration or accept existing changes by exiting configuration level. The reason for this is that the controller may have been part configured prior to shut down and either needs completion of the configuration or confirmation that no further changes are required.

Start-up Modes

The controller may start in Manual or in Auto Mode depending on the setting of the ‘Recovery Mode’ parameter, see section "Configuration Sub-List" on page 119.

If the Recovery Mode has been set to Manual (default) the controller will start in ‘Man’ mode. It will show the letter ‘M’ and the ‘hand’ symbol in the display. Initially the output will be at the ‘Fallback Value’, see section "OP Sub-list" on page 131, but may then be changed using the raise or lower buttons. Auto mode may also be selected.

If the Recovery Mode has been set to ‘Last’ the controller will start in either in Manual mode or Auto mode depending on whatever mode it was in prior to being powered off. ‘Auto’ mode is shown in the EPC3004 controller view in the previous section.

For further information on start up modes see section "Start-up and Recovery" on page 302.

Standby

Standby is the term given when the instrument strategy is not controlling due to the following reasons:

- If the instrument is being configured i.e. in Quick Code Mode, Configuration Mode or a clone file is being loaded.
- If the instrument has detected an unexpected condition (for example, was powered down whilst in configuration mode, or fitted hardware does not match expected hardware). See "Start up Diagnostic mode" on page 62 for more information on unexpected conditions that will place the instrument into standby.
- If the instrument is forced into standby via the Instrument.Diagnostics.ForceStandby parameter, see "Subsequent Start-ups" on page 75.

When the instrument is in standby, the following occurs:

- All relay, logic or triac outputs are placed into their 'Off' state, unless being used as Valve Raise (Up) / Lower (Down). In this case the Standby Action is configurable by the ‘StandbyAction’ parameter (Rest, Up, Down) found in the ‘IO’ list, (section "I/O List (io)" on page 107).
- Analog outputs will go to the ‘OutputLow’ limit found in the ‘IO’ list.
- The control loop will be placed into Hold.
- If an alarm has the ‘StandbyInhibit’ parameter set to ‘On’ (section "Alarms List (ALm)" on page 141), then the alarm is inhibited (active alarms will be turned Off and new alarm conditions will not be acted upon).
- If in standby due to the instrument being configured, a running program will reset.

⚠ WARNING

LOSS OF COMMUNICATIONS

If an output is not internally wired by the application, but is written to by communications, ensure that the appropriate action is taken in the event that communications is lost.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Auto-scaling of decimal point

The range of values displayed on the ‘top line’ will vary for each instrument version. If a value exceeds the display capabilities, the resolution will automatically be reduced by a factor of 10, up to the display limit in the table below. If the value cannot be displayed, HHHH or LLLL will be shown.

Auto-scaling is applied to parameter values being edited via the HMI.

Instrument	Decimal points	Minimum	Maximum
EPC3016	0	−1999	9999
	1	−199.9	999.9
	2	−19.99	99.99
	3	−1.999	9.999
EPC3008	0	−1999	19999
	1	−199.9	1999.9
	2	−19.99	199.99
	3	−1.999	19.999
EPC3004	0	−19999	99999
	1	−1999.9	9999.9
	2	−199.99	999.99
	3	−19.999	99.999
	4	−1.9999	9.9999

Operator Levels

What is in this Chapter?

This chapter describes the different operator levels:

- Operator Level 1.
- Operator Level 2.
- Introduction to Operator Level 3.
- Return from a higher level to a lower level of operation.

Overview

There are 5 levels of operation:-

1. LEu 1 - Level 1 has no password, the control is active and only the home list is accessible.
2. LEu2 - Level 2. The control is active and an extended home list is accessible.
3. LEu3 - Level 3. The control is active and the complete operator parameter set is shown and modifiable; the complete Configuration parameter set is shown, (read only); the user calibration (two point cal) facility is available.
4. ConF - Configuration level is used to setup the whole controller; the configuration parameters are accessible; the operator parameters are available, without the need to switch to operator mode. The instrument calibration parameters are also available in this mode. See "User Calibration" on page 369.

Levels 2, 3 and Configuration can be restricted by passwords.

5. In addition the Quick Start Mode (See "Start Up—New Unconfigured Controller" on page 67) is provided to allow users to configure the product in the minimum number of operations. It is only available at power up after the instrument is cold started or by holding the Page key during power up.

Operator Level 1

Operator Level 1 is entered:

1. After the Quick Code has been entered for those controllers supplied unconfigured.
2. After power up when the controller has been configured.

The display shown below is for a typical temperature controller.

Process Value (PV)

Manual output level (%) or Setpoint (SP) (Required Temperature)

Scrolling messages (when applicable)

Bargraph (not EPC3016)

Press ^ to increase the setpoint

Press v to decrease the setpoint

The new setpoint is entered when the button is released and is indicated by a brief flash of the SP value

In general the current value of the process is shown in the upper display.

By default the controller will start in' Manual' Mode. This is shown by 'M' in the display, the 'Hand' symbol, the value of the output (in %) and the bargraph (if available).

In 'Auto' mode, the required value (Setpoint) is shown in the lower display.

Additional scrolling messages are shown, for example, when operator parameters are selected (see section "Level 1 Operator Parameters" on page 81). These may be standard descriptions of the parameter currently selected or they may be user specific messages which have been set up using iTools. (See "Parameter Promotion" on page 233).

Auto/Manual Mode

In Manual mode the value of the output is increased or decreased directly by the operator using the Up and Down buttons.

In Auto mode the process is adjusted automatically by the controller in response to differences between the setpoint and the actual measured value.

In Operator Level 1 the controller may be placed into manual operation as follows:

- By default in EPC3008 and EPC3004 controllers, Auto/Manual may be selected by the user by toggling the F1 button.
- By default in EPC3016 controller Auto/Manual may be selected by the user by pressing and holding the ^ and v buttons for longer than 3 seconds. This will show the A-M (Auto-manual select) parameter. Then press ^ or v to toggle between auto and manual.

Manual is indicated in the HMI by showing the ‘Hand’ symbol and the character ‘M’.

The current level of the output demand is shown as a percentage. This may be increased or decreased by pressing the or buttons respectively.

Note: Alternative ways to select Auto/Manual may be configured and will be explained in subsequent chapters of this manual.

System Messages

In addition to standard (or customized) scrolling messages, System Messages may be shown at any time. A list of these is shown in "Notification Messages" on page 378. The following two messages are typical and could appear at start up.

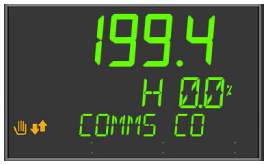
Setting the Comms Password

If the comms password has not been set and either Fixed comms or Option comms has been configured then this notification message will be scrolled across the HMI 'PLEASE SET THE COMMS PASSWORD VIA ITOOLS'. Until the comms password is set, Fixed comms and Option comms will have a limited parameter read/write access. This security feature is described in section "Comms Configuration Level Password" on page 21.

Comms Configuration Active

The scrolling message ‘COMMS CONFIGURATION ACTIVE’ will be displayed if, for example, iTools is connected to the controller and has been placed in configuration mode by iTools. The controller will be placed into standby mode.

The character ‘H’ signifies that the controller has been placed into Hold mode and is displayed as shown below.



Note: The displays shown above also apply if the controller is in Operator Levels 1, 2 or 3.

Bargraph

In EPC3008 and EPC3004 a bargraph may also be shown which displays the configured value as a horizontal bar. This is set up in Configuration Level (See "Display Functionality Sub-List (Hmi)" on page 195).

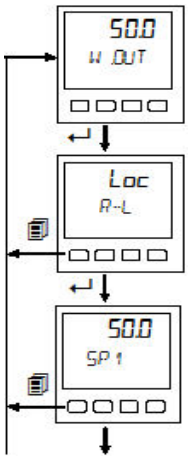
Level 1 Operator Parameters

A minimal list of parameters is available in Operator Level 1 which is designed for day to day use. Access to these parameters is not restricted by a password.

Press ↵ to step through the list of available parameters. The mnemonic of the parameter is shown in the lower display. Alternatively, press and hold ↵ then press ∧ to scroll forward through parameters and ∨ to scroll back.

Press ⧉ to return to the Home display.

The value of the parameter is shown in the upper display. If the value is read/write press ∧ or ∨ to adjust. If no key is pressed for 60 seconds the controller returns to the HOME display. The navigation is shown diagrammatically for the first two parameters in the example below:



The parameters that appear depend upon the functions configured. The list can also be customized using iTools by adding or removing parameters. The table below shows an example of the list of parameters in Level 1. Parameters may be added to or deleted from this list, see "Parameter Promotion" on page 233.

Parameter Mnemonic	Scrolling name	Description	Further information
W.OUT	WORKING OUTPUT	The output demand – 0% to 100% or −100% to +100%.	
R-L	REMOTE-LOCAL SELECT	Selects the Remote or Local setpoint source.	"Loop - Main Sub-list" on page 117.
SP 1	SETPOINT 1	The value which the process is required to attain as set by setpoint 1.	
SP2	SETPOINT 2	The value which the process is required to attain as set by setpoint 2 if selected.	
AI 1.PV	PV	The current value of the process (read only) read by the primary input IP1.	
AI2.PV	PV	The current value of the process (read only) read by the secondary input IP2.	If the secondary input is used.
LBA.I	CT LOAD CURRENT	The current being supplied to the heater as measured by the CT.	If the CT is being used.

Level 1 Programmer Display

By default, if the controller has the programmer installed, the status of a running program can be displayed.

Programmer List

Press the page button , the display will show

Repeatedly press to read the currently running program.

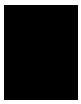
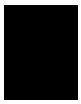
Parameters displayed depend on the program and the type of segment configured but generally include the following:

Parameter Mnemonic	Scrolling name	Description
P.NUM	PROGRAM NUMBER	Alterable but does not affect the running program.
P.NAME	PROGRAM NAME	Read only. This parameter is available in firmware versions V3.01 and above.
P.CUR	CURRENT PROGRAM	Read only.
C.NAME	CURRENT PROG NAME	Read only.This parameter is available in firmware versions V3.01 and above.
P.MODE	PROGRAM MODE	Displays the current mode e.g. Run, Hold, Reset.
P.SP	PROGRAM SETPOINT	Read only.
P.TIM.L	PROGRAM TIME LEFT	Read only.
P.CYC.L	PROGRAM CYCLES LEFT	Read only.
S.NUM	CURRENT SEGMENT NUMBER	Read only.
S.NAME	SEGMENT NAME	Read only.This parameter is available in firmware versions V3.01 and above.
S.TYPE	CURRENT SEGMENT TYPE	Read only.
S.TIM.L	SEGMENT TIME LEFT	Read only.
TSP	TARGET SETPOINT	Read only.
R.RATE	RAMP RATE	Read only.
EVT.x	EVENT x	Event off or on. Further events are shown if configured.
P.ADVN	PROGRAM ADVANCE	Read only.

By default the programmer parameters available in Level 1 are read only. It is possible, however, to provide programmer edit access to Level 1, see "Programmer List (PROG)" on page 135. If this has been done the lists of parameters is shown in section "Level 2 Programmer Display" on page 87.

Programmer Status Indicator

The current status of the running program is displayed as follows:

State	Ramp/Step Up		Dwell		Ramp/Step Down	
Reset						
Run						
Hold/Holdback		Flashing (1 second period 66% duty cycle)		Flashing (1 second period 66% duty cycle)		Flashing (1 second period 66% duty cycle)
Complete (Dwell End)	Not applicable			Flashing (2 seconds period 66% duty cycle)	Not applicable	

Operator Level 2

To Select Operator Level 2

Operator level 2 is normally restricted by a password. By default the password is 0002 in a new controller. Enter Level 2 as follows:

Operation	Action	Display	Notes
Select Level 2	1. Press and hold until GOTO is shown. 2. Press to choose LEu 2 (Level 2). 3. Press to enter.		
Enter the password	4. Press or to enter the correct digit value of the password. 5. Press to accept the value and move to the next digit. 6. The controller will now show the top of the HOME list in Level 2.		Press to move to the next digit. The default password for level 2 is '0002'. A special case exists if a security code has been configured as '0000'. If this has been done it is not necessary to enter a code and the controller will enter the chosen level immediately. If an incorrect code is entered the display will return to HOME. After three wrong attempts the password entry system will lock out for a time set by the 'password Lockout Time' set in the "Security Sub-List (SEC)" on page 197.
Select Level 2 parameters	7. Repeatedly press .		The list of available parameters is given in the table in the next section.

Level 2 Operator Parameters

Parameters available in level 1 are also available in level 2, but level 2 includes additional parameters for commissioning purposes and for more detailed operation.

Press ↵ to step through the list of available parameters. The mnemonic of the parameter is shown in the lower display. Press ⧉ to return to the previous parameter.

The value of the parameter is shown in the upper display. If the value is read/write press ∧ or ∨ to adjust. If no key is pressed for 60 seconds the controller returns to the top of the HOME list.

By default the following table lists all possible parameters available in both Levels 1 and 2. Parameters associated with a particular feature will only be shown if that feature is configured.

Parameter Mnemonic	Scrolling name	Description	Further information
W.OUT	WORKING OUTPUT	The output current demand – 0% to 100% or -100% to +100%.	Level 1 & 2
R-L	LOOP REMOTE/LOCAL	Selects the Remote or Local setpoint source.	Level 1 & 2
SP.HI	SETPOINT HIGH	Maximum value allowed for the local setpoints (SP1 and SP2).	
SP.LO	SETPOINT LOW	Minimum value allowed for the local setpoints (SP1 and SP2).	
SP 1	SETPOINT 1	The value which the process is required to attain as set by setpoint 1	Level 1 & 2
SP2	SETPOINT 2	The value which the process is required to attain as set by setpoint 2 if selected.	Level 1 & 2
SP.UP	SETPOINT RATE UP	Limits the maximum rate at which the working setpoint can change in an increasing (upwards) direction. Setpoint rate limiting is often used to prevent rapid bumps in controller output that may damage equipment or product, or cause upset to downstream processes.	
SP.DWN	SETPOINT RATE DOWN	Limits the maximum rate at which the working setpoint can change in an increasing (downwards) direction.	
AI 1.PV	PV	The current value of the process (read only) read by the primary input IP1.	Level 1 & 2
AI2.PV	PV	The current value of the process (read only) read by the secondary input IP2.	Level 1 & 2
TUNE	AUTOTUNE ENABLE	Starts an autotune.	"Autotuning" on page 309
PB.H	CH 1 PROPORTIONAL BAND	Channel 1 (heat) proportional band.	
PB.C	CH2 PROPORTIONAL BAND	Channel 2 (cool) proportional band.	
TI	INTEGRAL TIME	Integral time.	
TD	DERIVATIVE TIME	Derivative time.	
CBH	CUTBACK HIGH THRESHOLD	High cutback.	
CBL	CUTBACK LOW THRESHOLD	Low cutback.	

Parameter Mnemonic	Scrolling name	Description	Further information
MR	CONTROL MANUAL RESET	If the integral parameter is turned off the controller is working in proportional only or proportional + derivative. This parameter allows the output to be adjusted manually to offset and difference between SP and PV.	
HYS.H	CONTROL CH1 ON OFF HYSTERESIS	If channel 1 is configured for On/Off control this parameter allows a difference to be set between the output being on or off.	
HYS.C	CONTROL CH2 ON OFF HYSTERESIS	If channel 2 is configured for On/Off control this parameter allows a difference to be set between the output being on or off.	
C.DB	CONTROL CH2 DEADBAND	The Ch1/Ch2 Deadband is a gap in percent between output 1 going off and output 2 coming on and vice versa. For on/off control this is taken as a percentage of the hysteresis.	
OUT.HI	OUTPUT HIGH LIMIT	To limit the maximum controller output.	
OUT.LO	OUTPUT LOW LIMIT	To limit the minimum controller output.	
LD.I	CT LOAD CURRENT	This is the sampled RMS current measured during the on time of the heater.	Level 1 & 2
LK.I	CT LEAK CURRENT	The RMS current measured flowing through the load during the off states of the controller.	
LD.SP	CT LOAD THRESHOLD	Sets a threshold to trigger an alarm if the load current is exceeded.	
LK.SP	CT LEAK THRESHOLD	Sets a threshold to trigger an alarm if the leak current is exceeded.	
OC.SP	CT OVERCURRENT THRESHOLD	Sets a threshold to trigger an over current alarm if the current measured exceeds a maximum limit set by the process.	
CS.ID	CUSTOMER ID	A user configurable non-volatile identification parameter.	
REC.NO	DATASET TO LOAD	Selects which recipe dataset to load.	
STORE	DATASET TO SAVE	Selects which of the 5 recipe dataset in which to store the current active parameters.	

The home list can be customized by adding up to 60 parameters; iTools will be required to configure the promoted parameters, see "Parameter Promotion" on page 233.

Level 2 Programmer Display

If the controller has the programmer installed, by default, the programmer can be edited and operated from the HMI. A step by step guide to setting up a program is given in "To Setup a Program from the HMI" on page 268.

Programmer List

Press the page button , the display will show

Repeatedly press to read the currently running program. The program can be Run, Held or Reset from this list.

Parameters displayed are (but not limited to depending on the program):

Parameter Mnemonic	Scrolling name	Description
P.NUM	PROGRAM NUMBER	Alterable, but does not run a program.
P.NAME	PROGRAM NAME	Read only.This parameter has been added in firmware versions V3.01 and above.
P.CUR	CURRENT PROGRAM	Read only.
C.NAME	CURRENT PROG NAME	Read only.This parameter has been added in firmware versions V3.01 and above.
P.MODE	PROGRAM MODE	The programmer can be changed to Run, Hold, Reset,
P.SP	PROGRAM SETPOINT	Read only.
P.TIM.L	PROGRAM TIME LEFT	Read only.
P.CYC.L	PROGRAM CYCLES LEFT	Read only.
S.NUM	CURRENT SEGMENT NUMBER	Read only.
S.NAME	SEGMENT NAME	Read only.This parameter has been added in firmware versions V3.01 and above.
S.TYPE	CURRENT SEGMENT TYPE	Read only.
S.TIM.L	SEGMENT TIME LEFT	Read only.
TSP	TARGET SETPOIN	Read only.
R.RATE	RAMP RATE	Read only.
EVT.X	EVENT X	Event off or on. Further events are shown if configured.
P.ADVN	PROGRAM ADVANCE	Alterable YES/NO. Advances the program to the next segment.

Program Setup List

By default programs can be set up in Level 2.

Press the page button , the display will show

Repeatedly press to read the currently running program. Programs can be edited from this list.

Parameter Mnemonic	Scrolling name	Description
P.NUM	PROGRAM NUMBER	Alterable but does not run a program. If the program is running WORk is shown signifying the working program.
P.NAME	PROGRAM NAME	Read only.This parameter has been added in firmware versions V3.01 and above.
HB.STY	HOLDBACK STYLE	Alterable: PROG (holdback applies to the whole program). SEGm (holdback applies to each segment).
HB.TYP	HOLDBACK TYPE	Alterable: OFF, LOW, HIGH, bANd. For a full definition see "Holdback" on page 261.
RAMP.U	RAMP UNITS	Alterable: P.SEC (per second), P.mIN (per minute), P.HR (per hour).
DWEL.U	DWELL UNITS	Alterable: SECS, mINS, HrS.
P.CYC	PROGRAM CYCLES	Alterable: The number of time a program repeats. CONt (continuous) or 1 to 9999. **Default 1**
P.END	PROGRAM END TYPE	Alterable: Behavior when the program ends dWEL (dwell at current setpoint). RSEt (reset). tRAk (track).
S.NUM	CURRENT SEGMENT NUMBER	Alterable:
S.NAME	SEGMENT NAME	Read only.This parameter has been added in firmware versions V3.01 and above.
S.TYP	SEGMENT TYPE	RAtE, tImE, dWEL, Step, CALL, ENd.
TSP	TARGET SETPOINT	Alterable:
R.RATE	RAMP RATE	Alterable:
EV.OP	EVENT OUTPUT	Alterable:
DUR	DURATION	Alterable: Appears if the segment type is Dwell or Time.
R.TIME	TIME TO TARGET	Alterable: Appears if the segment type is Time.
C.PROG	CALL PROGRAM	Alterable: Appears if the segment type is Call.
C.CYC	CALL CYCLES	Alterable: Appears if the segment type is Call.

The above is a summary the parameters which are displayed (but not limited to) and depends on the program. A full description of the parameter meanings and how to set up programs is given in the following sections:

- Configuration chapter "Programmer List (PROG)" on page 135.
- Programmer chapter "Programmer" on page 257.

Operator Level 3

In Operator level 3 (and in Configuration Level) all parameters are organized in lists (or groups). Only parameters related to enabled functions are shown.

Each list may contain operator level and configuration parameters; the parameters are only shown when the instrument is in the appropriate mode. If a list does not contain at least one displayable parameter, it is skipped completely.

During navigation, the lower display shows the mnemonic code of the parameter or the List header. After 6 seconds, a scrolling string with either the parameter or the List description will be displayed.

To Enter Level 3

Operation	Action	Display	Notes
Select Level 3	1. Press and hold ⧉ until LEu 3 is shown. 2. Press ↵ to enter.	LUL3 GOTO	LEu 1 is displayed first. Continue to hold the button to obtain LEu3.
Enter the password	3. Press ∧ or ∨ to enter the correct digit value of the password. 4. Press ↵ to accept the value and move onto the next digit. 5. If the correct password has been entered the message PASS will be displayed momentarily. The controller is now operating in Level 3.	0___ CODE LEU3 PASS	Press ↵ to move to the next digit. The default password for level 3 is '0003'. A special case exists if a pass code has been configured as '0000'. If this has been done it is not necessary to enter a code and the controller will enter the chosen level immediately. If an incorrect code is entered the display will return to HOME. If an incorrect code is entered the display will return to HOME. After three wrong attempts the password entry system will lock out for a time set by the 'password Lockout Time' set in the "Security Sub-List (SEC)" on page 197.
Select list headers	6. Repeatedly press ⧉	A1 LIST	This shows the Analog Input List. Press ⧉ + ∧ to return to the previous list header.
Select parameters in the list	7. Repeatedly press ↵	tC IN. TYP	This shows the Input Type.

To return to the HOME page relevant to the controller mode press the 'Home' key combination (Page+Scroll).

The HOME display is also selected after a timeout period with no key presses. The timeout defaults to 60 seconds but can be adjusted between 0 and 60 seconds. A setting of 0 means no timeout (see "Display Functionality Sub-List (HmI)" on page 195), so that the HMI remains in the selected level.

Level 3 Operator Parameters

The Operator Level 3 lists are essentially the same as configuration level. These are shown in the next chapter.

To Return to a Lower Level

From Level 3 you can select Level 1 or Level 2 as follows:

1. Press and hold until GOTO is displayed.
2. Press or to select LEu 1 (or LEu2).
3. Press to accept.

The display will briefly show PASS and will return to the selected level default display.

A security code is not required when going from a higher level to a lower level.

Note: if the controller had been switched off whilst operating in levels 2 or 3 it will return to operator level 1 when switched on again. If it was switched off when in configuration level it will start up with a message - PCnF - POWERED DOWN WHILST IN CONFIG MODE. See section "Subsequent Start-ups" on page 75.

Eurotherm Complete Manual Refer to the following link

https://www.htsei.com/wp-content/uploads/2021/06/EPC3000-User-Guide.pdf

FACTORY LIMITED WARRANTY POLICY

The Ace Factory limited warranty provides assurance that all products are free from manufacteres defects at the time of shipment and meet specifications and performance described in the product literature.

It is important to understand the difference between a factory warranty and an installed warranty. There are many factors that can occur to the products after they are shipped that the company has no control over and can not fully verify. These includes:

1. Hidden damage during the shipping.
2. Handling damage.
3. Damage during storage.
4. Installation conditions.
5. Other unknown variables in the system design: maintenance, pulsation and vibrations.

The installed warranty is the responsibility of the architech, specifying engineer, contractor and/or owner who jointly have control over the application, installation, location, operating and maintenance conditions.

The Ace Heaters, LLC warranty excludes extended liabilities. Extended liability typically occurs when products are installed without proper drainage, flooding containment or when safety devices are not tested and repaired or replaced when needed.

Product problems are often caused by the condition of the water, the lack of water treatment and/or the improper treatment of the water, insufficient combustion air, improper draft conditions, bolts not re-tightened, pipes not flushed and cleaned of oil, metal chips, rags, vibration and pulsation etc. These are installation, operating and/or maintenance conditions that are beyond the seller's responsibility and are not covered by the factory warranty, but may be covered by the installer's warranty.

The factory warranty covering company products is based upon extensive product development and testing. Combustion products under go certification testing and approvals to Underwriters Laboratory (UL) standards. Auditing of the production of combustion products is conducted by a nationally recognized testing laboratory.

Pressure vessel products are designed and manufactured to American Society of Mechanical Engineering (ASME) and National Board (NB) Design standards. Design reviews, factory product manufacturing quality inspections and testing are carried out by a third party National Board authorized inspection agency.

Ace Heaters, LLC products have proven themselves in service for over 85 years which indicates that the company products perform exceedingly well when normal installation, operating and maintenance conditions exist.

The following is a review from the terms and conditions of sale. Also included in paragraph two, below, is the Ace Heaters LLC nonconformance policy.

1. Ace Heaters, LLC warrants its products against defective material and/or workmanship only. The warranty does not apply to operational failures, electrical failures, gasket leaks, and/or other malfunctions caused by improper application, installation and/or maintenance.

2. It is the buyer's responsibility to inspect and accept the product, when received, as conforming to their purchase order, specifications and approved drawings. All claims for non-conformance, errors, shortages, etc. must be made within 10 days after receipt of the shipment.

3. Ace Heaters, LLC do not provide a warranty or guarantee, express or implied, in any manner, form, usage of trade, merchantability or fitness which extend beyond the product description and quotation.

4. Ace Heaters, LLC liability is limited to the factory repair or replacement of warranty failures, or non-conformance, upon the return of the product to the factory.

5. Ace Heaters, LLC is not liable for any direct or consequential damages.

6. Ace Heaters, LLC warranty is based upon section 23161(2) of the uniform commercial code and is printed in the terms and conditions of sale which is referenced in every quotation, on the back of sales order acknowledgements and invoices. It is legally correct and is an industry standard policy.

Water Heater – Water Quality Requirements

Properly ensuring the water within the water heater is treated is essential for maintaining the water heaters performance over time and preserving the components connected to the system. It is advisable to manage any water treatment program under the guidance of a water treatment specialist.

Water heaters can suffer from scale buildup and chemically induced corrosion due to poor water quality. Among these problems, the most common is the formation of scale inside the unit, which predominantly occurs on the hottest surface; the u-tube bundle heat exchanger. The accumulation of scale in the unit can lead to a reduction in the water heater's capacity as it coats the heat exchanger surface.

Poor water quality can contribute to chemically induced corrosion of the heat exchanger or the vessel. Different forms of chemically induced corrosion may arise, including general corrosion, pitting corrosion, and stress corrosion. Such corrosion has the potential to significantly decrease the lifespan of the vessel or the tube bundle. General corrosion might manifest as a uniform deterioration of the tube, tubesheet, or vessel material, eventually causing material failure. Pitting corrosion involves the creation of small pits on the tubes, tubesheet, or shell, which can ultimately lead to material failure. Stress corrosion results in stress corrosion cracking. This refers to the development of brittle cracks along the metal's stress lines and grain boundaries. Stress corrosion cracking is more likely to affect materials like austenitic stainless steel, such as the grade 316L commonly used in the water heater's vessel, tubes, and tubesheet. This type of corrosion is associated with the presence of chlorides in the water. The likelihood of stress corrosion cracking increases with higher concentrations of chlorides and temperatures.

Under normal design and operating conditions, the water temperatures within a water heater usually remain below the threshold required for stress corrosion to occur.

Ace Heaters, LLC requires all water heaters to be operated within the following ranges to help control corrosion and scaling:

Water Property	Range
Alkalinity (CO_3, HCO_3)	Less than 300 ppm
Chlorides	Less than 100 ppm
Conductivity	Less than 1,500 ppm (3,000 uS/cm)
pH	6-8
Silica	Less than 150 ppm
Sulfates	Less than 250 ppm
Total Dissolved Solids	Less than 50 ppm
Total Hardnes (Ca and Mg)	Less than 150 ppm

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WARRANTY

Limited

Ace Heaters, LLC provides a limited warranty on its products against **defective material and/or workmanship only**. This limited warranty is not applicable to operational failures, electrical failures, gasket leaks, wear or malfunctions caused by improper application, storage, installation, and/or maintenance.

Product Period - The following Limited Warranty period are from date of shipment:

Tanks

Tanks - Carbon Steel: One Year
Tanks - Stainless Steel: Three Years
Storage Water Heaters Single-wall or Double-wall Tank/Exchanger Coils: One Year
Clean Steam Generators: One Year
Linings: (Pro-rated Warranty)
Magnesium Anodes must be used at all times to maintain the Limit Warranty
Section VIII Tanks:
Epoxy: 30" dia. and above (Three years)
Glass: 24" dia. and under (One year).
Glass: 30" dia. and above (Five years).
Cement: (Five years).
Pre-Krete: (Ten years).
Section IV Tanks: SW Model Only
Glass (One year) & Epoxy (Three years).
Minipacks™ Single-wall or Double-wall: One Year
Shell & Tube Heat Exchangers Single-wall or Double-wall: One Year
Atlas™ Series Condensing Boiler (Heat Exchanger): One Year
Triton™ Series Near Condensing Boiler (Heat Exchanger): Twelve Years
Liberty™ Series Condensing Boiler (Heat Exchanger): Ten Years
B-Series Copper Fin Boiler: Three Years

Controls: Components manufactured by other than Ace Heaters, LLC such as controls, instruments, forced draft burner, etc., provided with the boilers and packaged products are not covered by the Ace Heaters, LLC Warranty. However, Ace Heaters, LLC extends to the customer the same warranty provided by the manufacturer to Ace Heaters, LLC. The customer shall receive the full benefits of adjustments made to Ace Heaters, LLC by the manufacturer.

Any claim for adjustment under this limited warranty must be made within the warranty period. Ace Heaters, LLC's liability shall be limited to factory repair or, at Ace Heaters, LLC's option, replacement of all parts which, upon test and examination by Ace Heaters, LLC, prove to be defective material and/or workmanship and within the above limited warranty. If required by Ace Heaters, LLC, parts which are claimed to be defective must be promptly delivered to the Ace Heaters, LLC facility, transportation charges prepaid. This warranty does not cover the cost of labor, removal, or installation of the warranted item during the limited period. This warranty is limited to the above and applies only for the period set forth. Ace Heaters, LLC will not be liable for any loss damage, direct, incidental or consequential damages of any kind, whether based upon warranty, contract, negligence or strict liability and arising in connection with the sale, use or repair of the products. Ace heaters's maximum liability shall exceed the contract price for the product's merchantability or fitness for any particular purpose and in no event shall be held responsible for any consequential damages.

For complete Limited Warranty conditions see Section G and H under terms and condition of sale.

Ace Heaters, LLC, also doing business as Ace Heaters, LLC, is referred to herein as Ace Heaters, LLC

a nudyne company
Ace Heaters, LLC
130 Klug Circle, Corona CA 92878
PHONE: (951) 738-2230 • FAX: (951) 281-4959
www.aceheaters.com

Ace Heaters, LLC

WARNING

PRODUCT
SAFETY NOTICE

ACE BOILER AND WATER HEATER PRODUCTS OPERATE AT HIGH TEMPERATURE AND PRESSURES

- Before using this product, read and understand instructions. Save these instructions for future use.
- Before servicing, to prevent serious burns or injury, the boiler and water heater products must be cooled to less than 80°F (27°C) and the pressure must be 0 psi (0 bar).
- Turn off the electrical power before making electrical connections to prevent electrical shock.
- These products must be placed in a controlled location where untrained or unqualified personnel cannot access the operating or safety controls, must not be able to come in contact with high temperature or high pressure parts and must not perform maintenance or demolition work.
- All work performed must be by qualified properly equipped personnel trained in the proper application, installation, and maintenance or demolition of plumbing, steam, and electrical equipment and/or systems in accordance with all applicable codes and ordinances.
- ACE Boilers and Water Heaters are complete package units with safety and operating controls and are constructed with non ASBESTOS materials. Any replacement gaskets, refractory, insulation, etc used must not contain Asbestos.
- No additional insulation is required on the Boilers and Water Heaters.
- Additions or replacement of insulation on any connecting pipes or accessories to the Boilers and/or Water Heaters must be of "NON-ASBESTOS" and contain only non-hazardous materials.
- Crystalline Silica, a material known to cause cancer, may be encapsulated in some refractory or insulation materials and must be handled only by authorized trained personnel. Crystalline Silica as used is encapsulated and is not harm full in this form. Care must be taken during removal or replacement of refractory or insulation to remove it in bulk form and avoid generation or inhalation of dust. Removal must be properly performed by trained, qualified and equipped personnel. This is also true of Asbestos not contained in ACE products but may be otherwise contained in replacement materials or parts, in connecting piping or other nearby products.
- All safety and operating controls must be set within the specified operating limits and tested periodically to assure proper operation. All limit and operating controls must be installed in series on the boiler.
- Connect drain pipes to a safe drain to prevent serious personal injury from relief valve discharge and or from boiler blow down discharge.
- After installation, check for proper operation of all limit and operating controls before leaving the site.
- Perform scheduled and annual inspections including checking Controls for proper calibration and performance.

Failure to follow these warnings, to allow access by unauthorized persons and the use of non-properly trained and equipped personnel in the operation, service, modification, removal or demolition of these products or replacement of parts with non-authorized factory non-asbestos materials could cause damage, personal injury or death.

ACE
a **nudyne** company

Ace Heaters, LLC
www.aceheaters.com

Aceheaters.com
130 Klug Circle
Corona, CA 92878

(951) 738-2230