CONSTANT TEMPERATURE BATH USER MANUAL

(STAINLESS STEEL & TIGER TANK SERIES)

PCT Document Number:
29-000-0004

Revision Date:
19-AUG-2005

Revision Level:
B (Released)

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ABOUT THIS BOOK

Purpose

The purpose of *The Constant Temperature Bath User Manual* is:

- To provide the operator with a sufficient understanding of the equipment.
- To enable the operator to operate the equipment productively and safely.

Audience

The Constant Temperature Bath User Manual is intended for use by the various engineers, technicians, operators, and other personnel involved in installing, operating, and maintaining this equipment.

Review & Revision Policy

When appropriate, *The Constant Temperature Bath User Manual* and its supporting documentation will be reviewed and updated accordingly.

When appropriate, the revised information will be sent to the affected parties.

Questions/Comments/Contact Information

Your comments are important to us.

If you have any questions, comments, or other feedback regarding *The Constant Temperature Bath User Manual,* please contact us.

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Notes

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CHAPTER 1
SYSTEM INFORMATION & INSTALLATION

Purpose

This chapter describes:

- The Process Tank, in general,
- Other Tank Types Available
- Bath Safety Overtemp Devices
- Facilities Requirements
- Liquid Level Sensor Recommendations
- Pre- & Post-Installation Precautions: Do's & Don't's
- Suggested Tank Mounting Methods
- Tank Installation Procedure

> **NOTE:**
> Only qualified electricians and facilities installation personnel should work on this system.

The Process Tank

In General

The contaminant-free vessel uses *approved chemistry* which aids in the cleaning or etching of the submerged wafers. Because of its design, there are no induced contaminants from the process which also inhibits redepositing particles from the cleaning bath.

An optional feature is the ***Recirculation Tank***. This feature is available in a variety of vessel materials, and has a 4-sided overflow weir. This tank is designed for low water volume while providing the ultimate in cleaning.

Other Tank Types Available

The Constant Temperature Bath is available in 3 types:

- Stainless Steel
- Static Tiger Tank
- Recirculating Tiger Tank

Safety Features

Bath Safety Overtemp Devices

The tank comes with a J-type Thermocouple (TC) located on the wall of the process vessel, near the heater element; and an open-on-rise Thermal Switch with a pre-set temperature of 205°C for most tanks.

Other temperatures are available by request.

Facilities Requirements

Power

The power requirements are specific to each system.

Most tanks have heaters that range in size from 1500–4000 watts, 208–230 VAC, single phase, 50/60 Hz.

Depending on the heater size, systems may draw from 15–30 amps.

IMPORTANT:
Make sure relays, breakers, and controllers are sized appropriately for your system.

Refer to the wiring diagram located in Appendix A. "Drawings & Diagrams".

NOTE:
The Serial Number Plate on your system states the power information.

If you have any questions, please contact PCT Systems' Engineering Department.

Wattage Chart

> **NOTE:**
> Wattage values are shown at 208VAC.

Model	Wattage	Amps	Ohms
TT4	1588	7.5	28
TT8	2372	11	19
TT10	2372	11	19
TT14	2689	13	16
TT20	2640	12.6	16.5
TTF4-360	3072	14.8	14.1
TTF8-360	2606	16	13
TTF10-360	3068	14.8	14.1
TTF14-360	3050	14	15
TTF20-360	2939	13.4	15.5

Exhaust

The minimum requirement for the exhaust is 120 cubic feet/second.

Ground

PCT Systems strongly recommends the use of GFCI's (ground fault circuit interrupt) with any heated chemical tank for personnel protection.

Liquid Level Sensor Recommendations

PCT Systems strongly recommends the use of a Low Liquid Sensor in the tank to prevent heater failure.

Some recommended sensor types include:

- N2 Bubble-Type Liquid Level Sensor (see the next section)
- Optical Sensor
- Float Sensor

N2 Bubble-Type Liquid Level Sensor

A Nitrogen (written as N2 or N_2) Bubble-Type Liquid Level Sensor is an option available from PCT Systems.

Figure 1-1: Nitrogen Liquid Level Bubble Sensor Assembly Information

BILL OF MATERIALS				
ITEM	QTY	DESCRIPTION	MFG	P/N
1	1	REGULATOR, PRESSURE	SMC	NAR2000-NO1-1 YSI
2	1	BRACKET, REGULATOR MOUNTING	SMC	B220
3	1	NEEDLE DIAL PRESSURE DISPLAY	SMC	K-20
4	1	ELBOW, FEMALE 1/4"NPT, SS (PENINSULA VALVE)	SSP	1/4FF
5	2	NIPPLE, MALE / MALE, 1/4 NPT, SS (PENINSULA VALVE)	SSP	1/4HN
6	1	FLOWMETER, AIR	DWYER	RMA-1-SSV S35F
7	1	ELBOW, 1/4 NPT / 1/8 TUBE, POLYPRO	RYAN-HERCO	0635-033
8		TUBING, 1/4"OD, CLEAR PP, FLEXIBLE		
9	1	FITTING, SPEEDFIT UNION TEE, 1/4"OD TUBE	RYAN-HERCO	1217-033
10	1	PRESSURE SENSOR SWITCH	WORLD MAGNETICS	PSF 100A
11	1			
12	1	BRACKET, HOSE MOUNTING	PCT-1587	
13		TUBING, 1/4"OD, PFA	FLOUROWARE	AT-250-047
14				
15				

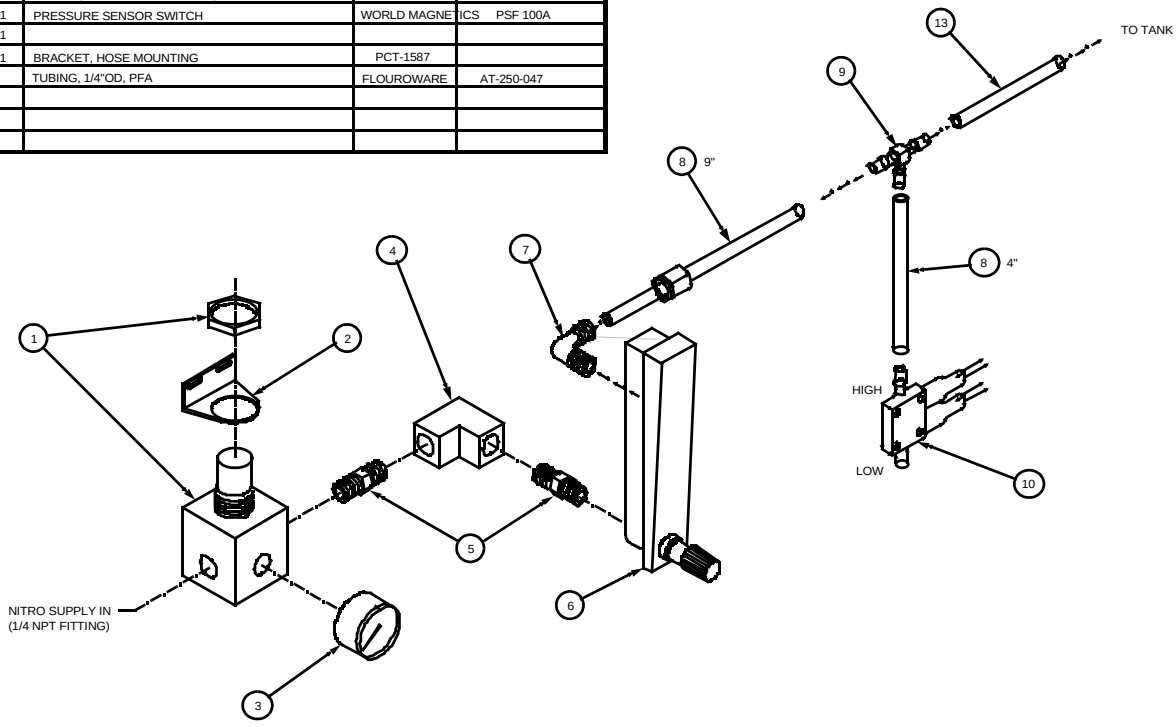
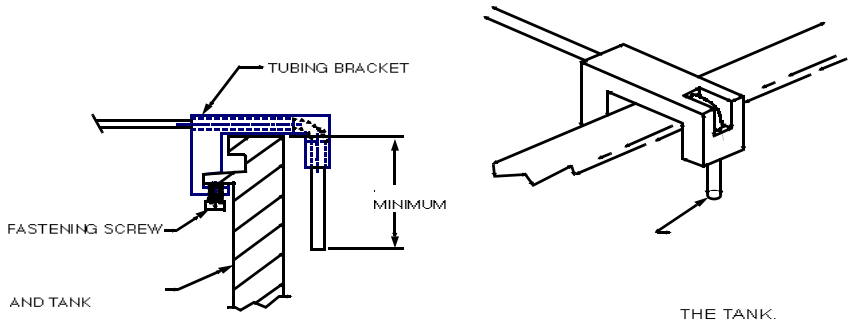


Figure 1-2: Example of a Method to Secure Senor Tubing to the Tank



USE A SIMILAR BRACKET OR A BARBED ELBOW FITTING TO SECURE THE TUBING TO THE SIDE OF THE TANK.

Installation Precautions: Do's & Don't's

Do Not

- Modify the unit in anyway.
- Penetrate the housing, flange, or cable.
- Immerse the leads, plug, or cable in liquid.
- Heat the unit beyond temperature specification.
- Pull or tug on the power or sensor leads.
- Move the bath when it contains heated liquid.
- Handle the unit when the power is ON or when the bath has not cooled.
- Leave heated chemistry unattended while heater is energized.

WARNING:

Do not heat solvents beyond the flash point.
(Always check with your chemical manufacturer or supplier for flash point specifications.)

- Heat flammable liquids in a quartz Constant Temperature Bath.
- Operate this unit without liquid filled to the minimum level:
  - **QUARTZ STATIC UNITS:** The minimum fill level is at the white and gray interface line.

- **STAINLESS STEEL STATIC UNITS:** The minimum fill level is 1.5 inches from the top of the stainless steel tank.

- Throw away a damaged unit or non-operational unit.
  (Always contact PCT Systems regarding our rebuild and repair service. We repair all makes of controlled temperature baths and will also upgrade them to our specifications.)
- Do not use cable extensions to the power cable. Construct an outlet within range of the system cable. The operation of the equipment may be compromised by extending the cable length. Instead, a protected outlet should be installed near this system.

Do

- Handle the tank/unit with care.

IMPORTANT:
If your system has a quartz tank, handle it with care.
The tank can shatter if subjected to abrupt impact.

REMINDER:
The tank housing and flange require special handling.

Protect the tank assembly from damage.

Even a very small hole can cause a leak of chemical or fumes into the housing and damage the heaters and transducers.

- Inspect and open shipping containers carefully.
- Keep the protective plastic seal, on the tank, intact until installation is finished.
- Terminate the cable with the vent tube to a clean air environment.
- Cover the tank/quartz vessel with a sheet of rigid material to protect it from tools or objects which may fall in or on it during installation.
- Connect all cables **BEFORE** turning the power ON. Power must be in the OFF position before plugging the cables into the outlet.
- Protect the cables from breakage, stress, or tension. Protect the ground shield. Broken or damaged cables may cause equipment failure.
- Wear appropriate clean room safety apparel.
  This system is an ultra-clean chemical processing system. Apparel must provide protection from the chemicals used in your process.

- Fill the vessel with liquid to the minimum level before turning ON the unit.
  - **QUARTZ STATIC UNITS:** The minimum fill level is at the white and gray interface line.
  - **STAINLESS STEEL STATIC UNITS:** The minimum fill level is 1.5 inches from the top of the stainless steel tank.
- Operate with the proper exhaust.
- Allow the unit to cool to the proper temperature prior to draining.

Post-Installation Precautions

There are 2 important considerations after tank installation:

- **EXHAUST VENTING**

  Process fumes require venting from the work area.

  The fumes cause the RTV seal around the quartz flange to fail prematurely, **AND**, the fumes may be harmful to the operators.

- **MOVING THE VESSEL**

  Empty the liquid from the vessel prior to moving it.

  Prevent any liquid from splashing on the seal or on people.

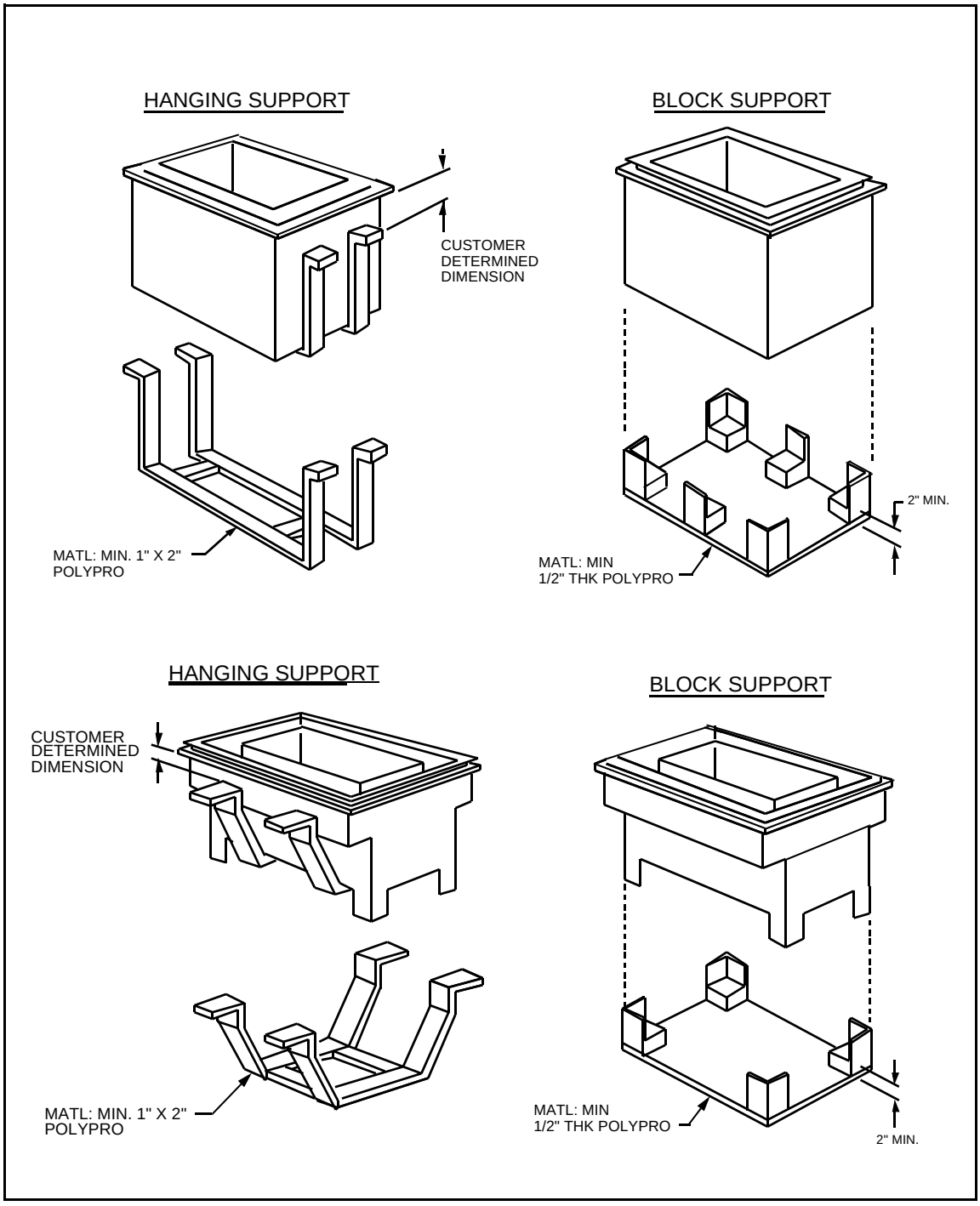
WARNING:

Because hot liquid is dangerous, cool the liquid before moving the vessel.

Suggested Tank Mounting Methods

Tank Capacity	Mounting Method
< 15 liter	Process tanks with capacity less than 15 liters have no overflow weir. Mount the tank using a plastic flange around the top edge of the tank.
15–50 liter	Process tanks with an overflow weir or those tanks that will be filled with more than 15 liters of liquid must be mounted on a support base to prevent stress to the quartz vessel. *See* Figure 1-3 *for suggested methods.*
> 50 liter	Tanks with greater than 50 liter capacity require special support mounting. *Contact PCT Systems Customer Service for assistance and mounting methods designed for your system.*

Figure 1-3: Suggested Methods for Tank Support



Tank Installation Procedure

Perform the following procedure/checklist to ensure the equipment functions correctly:

1. Prepare for installation by:
   - Reviewing the "Installation Precautions: Do's & Don't's" and the "Post-Installation Precautions" sections located in this chapter.
   - Securing the plug and the vent tube end of the flexible cable in a clean air environment (Headcase).
   - Reviewing the appropriate drawings and diagrams.
2. Place and mount the unit into the appropriate location.
   - The T-flange supports the unit.
     Be sure the bench cut-out is sized appropriately.
     (Refer to the mounting pattern in Figure 1-3.*)*
   - As the unit is lowered into the cut-out, the 6-pin cable plug with vent Tube—containing the power and overtemperature sensor lead(s)—must pass through the bench and terminate in the Headcase or other suitable clear air (fume-free) environment.

WARNING:

Do not allow the plug end of the cable to be exposed to wet chemicals or chemical fumes during installation.

Exposure may result in damage to internal components and void the warranty.

   - Immediately place a protective cover over the bath to protect the vessel from tools or fittings that may fall into it, causing damage or contamination.
3. ***If you have purchased a PCT model controller*** with this bath, please refer to the appropriate controller chapter located in this Manual or the separate controller manual before proceeding.
4. Make the electrical connections.

REMINDER:

Make sure all safety sensors are connected to the controller.

- Depending on the controller, your system may have a 6-pin-bath-to-the-controller plug or bare wires to the terminal block.
- For the 6-pin configuration:
  - The leads exit the cable connected at the bottom of the bath enclosure and fit into the 6-pin receptacle a the back of the controller.
- The power specifications and sensor configuration specific to this unit are detailed on the wiring diagram located in Appendix A. "Drawings & Diagrams".

  If your Manual does not contain a wiring diagram or the diagram does not agree with the appearance of the unit, please contact PCT Systems Customer Service immediately.

5. ***If the unit has a drain assembly***, then connect the drain assembly **BY HAND.**
   - The drain assembly (or depending on your system, the PTFE assembly) allows connection of a drain valve to the 3/4" NPT drain stem.
     - Teflon® tape may be required on NPT fittings.
   - Attach the drain valve.
   - Do not over-tighten the valve on the drain stem.
     Be careful not to strip the treads.
     A snug fit is all that is required.

   The drain fitting information for your system is located on the installation drawing in Appendix A.

IMPORTANT:
Damage to the drain resulting from over-tightening, modification, or failing to follow the guidelines will not be covered by the warranty.

6. ***If this system has a magnetic stirrer unit for bath agitation,*** then continue with the following:
   - The stirrer motor operates with either N2, CDA, or water.
   - The stirrers have been supplied with a small diameter nozzle for greatest economy.
   - To connect the stirrer unit, clamp a 3/8" flexible tubing to the inlet port.

- The port for spent water or air must remain unobstructed.
- If water is used, the outlet and port should be drained into the house drain.
- Place the stirring bar in the center of the bath and start the water or air flow slowly. Then, gradually increase the water or air flow to gradually increase the stirrer speed. This gradual increase will avoid losing coupling with the magnetic field.
    - Typically, the average air flow required to start the magnetic stirrer is 10–15scfh. However, higher flow rates are required with more viscous liquids.
    - When water is used as the driving medium, check occasionally to see that the water does not fill the container and reach the impeller wheel. This will only impede the rotation of the impeller.

WARNING:

Do not attempt to use several stirrers in series by allowing the exit water or air of the first unit to be the driving medium of the second.

This configuration causes excessive pressure to build within the first stirrer, causing damage to it.

IMPORTANT:

Only operate the unit when the liquid is filled to the minimum fill level.

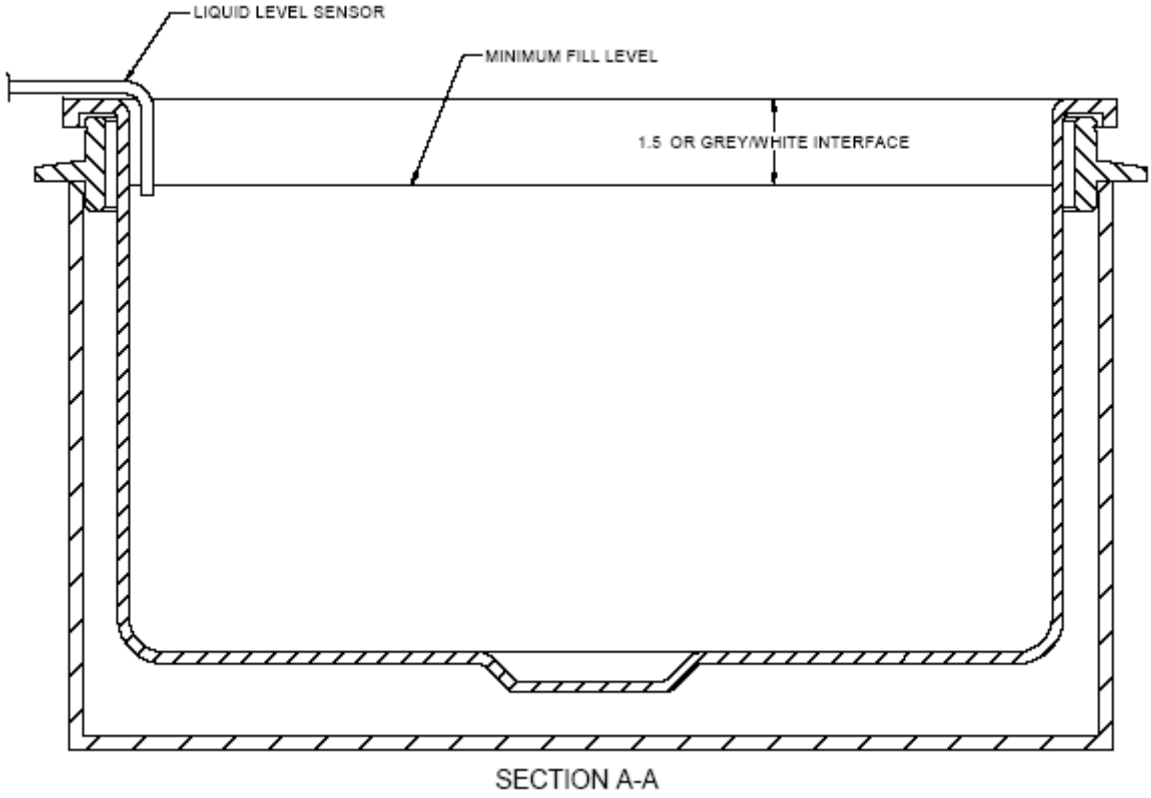
FOR QUARTZ STATIC UNITS: The minimum fill level is at the white and gray interface line.

FOR STAINLESS STEEL STATIC UNITS: The minimum fill level is 1.5 inches from the top of the stainless steel tank.

7. Use appropriate liquid level sensors.
    - A minimum or low liquid level sensor should be used in conjunction with the tank temperature controller.
        - The minimum level to operate the heater should be 2” below the top of the tank.

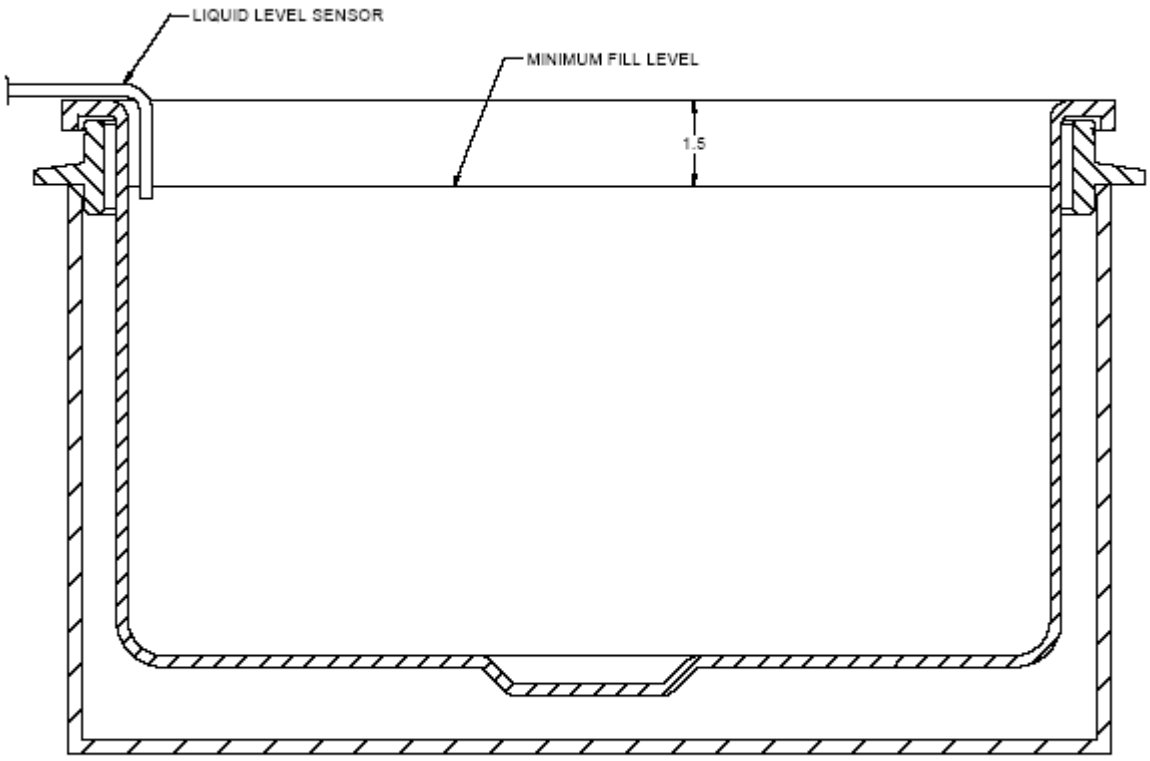
- On **QUARTZ UNITS**, the minimum fill level is the grey/white interface.

Figure 1-4: Liquid Level and Sensor Placement: Quartz Tank



- **STAINLESS STEEL STATIC UNITS:** The minimum fill level is 1.5 inches from the top of the stainless steel tank.

Figure 1-5: Liquid Level and Sensor Placement: Stainless Steel Static Unit



NOTE:
For a larger version of these drawings, please see Appendix A, "Drawings & Diagrams".

Notes

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CHAPTER 2
OPERATING & MAINTAINING THE SYSTEM

Purpose

This chapter explains how to:

- Start the System and Initiate a Cleaning Process
- Perform Preventive Maintenance

Start the System

1. **BEFORE STARTING THE CONTROLLER OR THE SYSTEM,** review the following information.

Table 2-1: Operating Precautions

Process Bath	Liquid in the vessel must **NOT** cascade over the outer flange of the process tank. The RTV seals used are adequate to seal out occasional spills and vapor. Continuous exposure will cause premature failure of the seals.
Liquid Level	Maintain the minimum liquid level in the vessel. ▪ **QUARTZ STATIC UNITS:** The minimum fill level is at the white/gray interface line. ▪ **STAINLESS STEEL STATIC UNITS:** The minimum fill level is 1.5 inches below the top of the tank.
Liquid Temperature	The maximum temperature for tanks with quartz drain fittings is 190°C. The maximum temperature for tanks with PTFE drains is 165°C. **DO NOT** exceed this temperature.
Heating Solvents 	 **IMPORTANT** **NEVER EXCEED THE FLASH POINT FOR THE CHEMICAL USED IN THE VESSEL.** Some chemicals will burn BELOW 70°C. It is your responsibility to safely use all chemicals. Never leave heated chemistry unattended. *Please contact PCT Systems if you have any questions.*

Operator Safety Note

DANGER:

Operators must not put their hand or any body part into the process tank during an operating cycle.

2. System start-up should be performed in this sequence:
    a. Verify all safety devices are connected properly.
    b. Verify the liquid level in tank is at the correct height.
    c. Turn the system ON.
    d. Start a process program in memory or start a new process program.

Preventive Maintenance

Daily maintenance must be done.

Regular maintenance ensures the optimum benefits from this equipment.

The tank has a longer life when it is flushed daily.

Daily Maintenance

Daily maintenance is ***simple***!

AT THE END OF EACH SHIFT, at a minimum,

- Turn the power OFF to the unit before flushing the tank flange area.
- Rinse the flange poly/quartz interface area with DI water.

REMINDER:

Be sure to dispose of the flushed liquid in accordance to your companies policies and all regulations.

Be sure wear the proper personal protective equipment when flushing the this area.

CHAPTER 3
CONTROLLER: MODEL 90 OR 90N

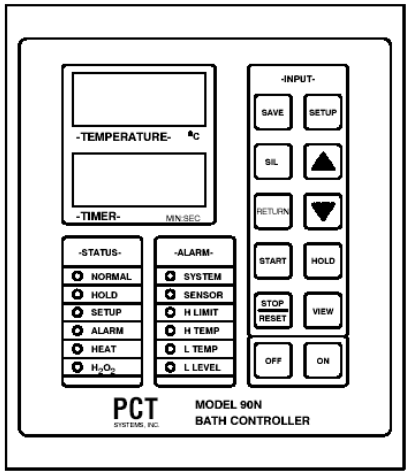
Purpose

This chapter discusses the:

- Product Overview of the controller
- 5 Primary Status Modes
- Alarms
- Input Keys
- Operation
- Tuning Discussion
- Backdoor Code
- System Specifications

Product Overview

Figure 3-1: Example of Typical Controller Face Plate



Two Setpoint Controller

The controller is a 2-setpoint controller (PID and ON/OFF).

- **SETPOINT I (PS)** is the bath process temperature.
- **SETPOINT II (HS SETTING)** drives a NORMALLY-CLOSED solenoid, which adds deionized water to the bath for makeup in Nitride Etch and Phosphoric Acid applications.

REMINDER:

The Setpoint II should be determined by your engineering staff according to your specifications and procedures.

IMPORTANT:

PCT Systems has temporarily set the Setpoint II (HS setting) temperature at 200°C to avoid any problems during start-up.

ALSO, **AT NO TIME** should the Setpoint II output to be ON continuously.

This situation may create a hazardous condition by adding more water than is required. Setpoint II is normally set 1°–2°C above Setpoint I.

PLEASE NOTE: PCT Systems is not recommending a setpoint, but rather, is reflecting an accepted industry procedure.

Technical Overview

The controller is a microprocessor-based controller/timer.

- It monitors temperature utilizing a Type-J thermocouple sensor and controls the bath temperature with a standard 3-mode (PID) control scheme with Anti-Reset Windup.
- Numerous status and alarm functions are incorporated to monitor various system parameters.
- A down-count/up-count programmable timer, with cumulative over-timer and pre-warn, is integrated into the system.
- A pilot-duty, photo-isolated, triac output is used to drive a remote heater power relay.
- An **OPTIONAL** power pack provides the on-board load carrying solid state switching.
- An **OPTIONAL** auxiliary relay can be utilized for either timer or DI output.
- An independent high limit circuit is provided.
    - It is powered by an isolation transformer that draws power from the primary side of the master relay. The sensor is a Type-J thermocouple. This circuit shuts OFF the internal master relay should an over-temperature condition occur.

- To indicate system and display status, as well as annunciate various alarms, 12 discrete LEDs are utilized.
- A 12-key membrane switch, incorporated in the face panel, allows for user setup and adjustment of the system, plus full timer control.
- To view both the process temperature and the timer simultaneously, 2 numeric displays are utilized.
  - Each of the displays has multiple diagnostic and setup functions that may be activated by the keyboard or by the microprocessor during various setup and alarm conditions.
- The microprocessor section consists of 2 circuit boards: one for display and the other for control.
  - The **CONTROL BOARD** contains 2 transformers and provides the isolated DC supplies (+5 volts and +12 volts) necessary to run the system. It also contains an instrumentation amplifier, A/D converter, EEPROM memory, and the microprocessors.
  - The **DISPLAY BOARD** contains all of the 7 segment and LED displays, as well as the audio transducer.

5 Primary Status Modes

The 5 primary status modes, indicated by LEDs on the face plate, are the:

- Normal Mode
- Hold Mode
- Alarm Mode
- Heat Mode
- Setup Mode

Normal Mode

This mode is the *normal condition* for the system.

It indicates that the system is operating within the defined parameters.

Hold Mode

This mode is a *standby condition* for the unit.

It allows all normal monitoring and timing functions while disabling the heater.

TO EXIT THIS MODE, either:

- Press the RESET key OR
- Depress the HOLD key a second time.

NOTE:
For safety reasons, the unit always starts up in the HOLD mode and is in this mode after a power failure.

When in the HOLD mode, the display reads “Hold”.

Alarm Mode

The various alarm conditions are activated by many sources and annunciated by both the displays and an audio tone.

The mode indicator shows that an alarm has occurred and the system is still performing under the special conditions required by that alarm.

THE ONLY WAY TO EXIT THIS MODE is to clear the condition causing the alarm.

Heat Mode

This LED is illuminated whenever the heater is ON.

NOTE:
When the unit is near the setpoint, the LED continuously cycles ON and OFF.

Setup Mode

When in this mode, the SETUP key causes the controller to step through the display of parameters, shown, in order, in the following table:

Table 3-1: Table of Display Codes (in order) & Setting Ranges

Code	Description	Setting Range
CS	Clock Setpoint	0:00 to 99:59 (Minutes:Seconds)
PA	Pre-Alarm Offset	0:00 to 0:59 Seconds
PS	Process Setpoint	0.0–199.9°C
HS	DI Setpoint (optional)	0.0–199.9°C
HI	High Alarm Setpoint	0.0–199.9°C
LO	Low Alarm Setpoint	0.0–199.9°C
AC	Access Code	0–9999
CR	Cycle Rate	0–19 Seconds
Pb	Proportional Band	0.0–19.9°C
rE	Reset	0.0–19.9 Minutes
rA	Rate	0.0–19.9 Minutes
CA	Calibration	±9.9°C
CD	Clock Direction	UP/DN (Up or Down)
RL	Relay Logic	0=Timer During 1=Timer After 2=DI

UP/DOWN KEY

While in the SETUP mode, depressing either the UP or DOWN key causes the display to advance or retard, respectively.

Depressing either the UP or DOWN key once and releasing it allows the accurate setting of the least significant digit.

Holding down either the UP or DOWN key activates the automatic, rapid incrementing or decrementing of the display.

TO EXIT THIS MODE, press the RESET key.

RATE & RESET VARIABLES

This system may operate in either a 1-, 2- or 3-mode configuration.

SETTING THE RATE OR RESET VARIABLES TO 0.0 eliminates the respective function.

> **REMINDER:**
>
> The RATE and RESET settings adjust the sampling period directly in tenths of minutes. Thus, smaller numbers create more rapid sampling.

CALIBRATION ADJUSTMENT

The ***CA*** (***Calibration Adjustment***) allows the elimination of various sensor and system errors.

- Thermocouple sensors are manufactured within a specific tolerance.
- The tolerance may lead to a difference between the actual bath temperature and the temperature displayed.
- This error, coupled with the differential error caused by sheathing the sensor in materials, such as Teflon, may cause a difference in the actual bath temperature and display temperature.
- This difference is simply corrected by monitoring the bath temperature and utilizing the offset—to add or subtract the appropriate number of degrees—to bring the displayed temperature into compliance with the actual bath temperature.

SAVE KEY

While in the PROGRAM mode, depressing the SAVE key causes the setup parameters to be written into the EEPROM memory.

The save routine takes about 2 seconds to complete and is indicated by a series of dashes through the displays.

- This is a permanent (10-year minimum life) memory that does not require battery backup.
- This feature provides the OEM with the ability to program initial conditions prior to shipment, then, allows the user to modify these conditions and permanently save the new parameters.
- All this can be done from the keyboard.

Alarms

Visual Alarms

There are 6 visual alarms LEDS:

- System Alarm
- Sensor Alarm
- High Limit (H Limit) Alarm
- High Temperature (H Temp) Alarm
- Low Temperature (L Temp) Alarm
- Liquid Level (L Level) Alarm

Essentially, these alarms are visual annunciators of the system functions.

System Alarm

This alarm is a “catch-all” indicator for the miscellaneous diagnostics.

The malfunction of the EEPROM save routine is a good example. This alarm simply indicates to the operator that something has gone wrong, and the operator should either repeat the command or reset the unit.

Sensor Alarm

This alarm indicates a defective “sensor”. The sensor is either OPEN or NOT CONNECTED.

- Special circuitry monitors the sensors for an OPEN circuit.
- The processor continually monitors the input and, if it detects an OPEN sensor, shuts OFF the heater output and activates the SENSOR alarm. When this action occurs, the process display alternately flashes the temperature and the code “***OP***”, for open sensor.

High Limit (H Limit) Alarm

Powered by the high-limit power supply, the LED remains ON—even after the master relay has de-energized and shuts off the controller. This alarm alerts the operator that the system has shut down and why.

The LED is wired directly to the high limit circuit and lights whenever the high limit circuit turns the master relay OFF.

High Temperature (H Temp) Alarm

This alarm activates when the process temperature exceeds the high alarm setpoint.

When this condition occurs, the display alternately displays the process temperature and the code, "***HI***".

Low Temperature (L Temp) Alarm

This alarm acts in the same manner as the high temperature alarm, except it compares the process temperature to the low alarm setpoint.

After the system initially comes out of the warm-up mode, this alarm activates when the process temperature drops below the setpoint. In this case, the code, "***LO***" and the process temperature flash alternately on the display.

Liquid Level (L Level) Alarm

This alarm monitors an **OPTIONAL** Remote Liquid Level Sensing Circuit and activates when a low liquid level is detected. The code, "***LL***" and the process temperature flash alternately on the display.

Audio Alarm

All of the alarms previously described, activate an Audio Tone, the alarm status LED, and the Individual Alarm Annunciator.

The Tone and the LEDs alternate ON and OFF to draw attention to the alarm.

REMINDER:

As described in the "Visual Alarms" section, many of the alarms have additional visual displays to further define or draw attention to them.

Input Keys

The 12 keys available on the controller are the:

- View Key
- Setup Key
- Up Key
- Down Key
- Silence the Alarm (SIL) Key
- Return Key
- Save Key
- Hold Key
- Start Key
- Stop/Reset Key
- On Key
- Off Key

VIEW Key

When **NOT** in the SETUP mode, use this key to view the process setpoint and programmed process time.

This key is a momentary key that will change displays to show the corresponding setpoints, as along as it is depressed.

SETUP Key

Use this key to put the system into the SETUP mode. Once the system is in this mode, use this key to advance through the parameters.

TO PLACE THE UNIT IN SETUP MODE, press the SETUP key one time.

NOTE:
If access code protection is selected, an additional step is required.

See the "Access Code" section for more information.

TO SCROLL THROUGH THE SETUP PARAMETERS, enter the SETUP mode (by pressing the SETUP key), then press the SETUP key again.

TO EXIT THE SETUP MODE, depress the RETURN key.

UP Key

TO ADVANCE THE DISPLAY, enter the SETUP mode (by pressing the SETUP key once), then press the UP key.

- Depressing the UP key one time and releasing it allows the accurate setting of the least significant digit.
- Holding the UP key down activates the automatic, rapid incrementing of the display.

DOWN Key

TO CAUSE THE DISPLAY TO DECREASE, enter the SETUP mode (by pressing the SETUP key once), then press the DOWN key.

- Depressing the DOWN key one time and releasing it allows the accurate setting of the least significant digit.
- Holding the DOWN key down activates the automatic, rapid decrementing of the display.

Silence the Alarm (SIL) Key

This key allows for the elimination of the audio portion of the alarm as well as the portion of the alarm display that affects the process display.

This action allows the unit to be returned to a functional condition where the setpoints can be examined and reset without the interference of the special alpha displays.

NOTE:
However, the alarm status and annunciator LEDs will continue to flash to indicate the alarm. Where applicable, the output to the heater is turned OFF to protect the equipment from any potential damage.

RETURN Key

WHEN THE SYSTEM IS IN THE SETUP MODE, press the RETURN key to return the system the standard operating mode.

IF THE SYSTEM IS IN THE HOLD MODE, press the RETURN key to exit the HEATER HOLD mode.

SAVE Key

When in the SETUP mode, press the SAVE key to permanently save the system parameters.

> **IMPORTANT:**
> The SAVE key is only active in the SETUP mode.

HOLD Key

Pressing the HOLD key puts the unit into the HOLD mode.

This mode disables the heater output.

When in the HOLD mode, the timer display reads "HOLD".

TO EXIT THIS MODE, either depress the RESET key or depress the HOLD key a second time.

> **NOTE:**
> For safety reasons, the unit always starts up in the HOLD mode or enters the HOLD mode after a power failure.

START Key

Pressing the START key activates the timer.

Pressing the START key also starts the system if it has been reset, or it will continue if the timer has been placed in the HALT mode.

For more information about the HALT mode, see the "Stop/Reset Key" *section.*

STOP/RESET Key

This multifunctional key's purpose varies with the current system mode.

IN THE RUN MODE

If the timer is running, pressing the STOP/RESET key stops the count and places the system in the HALT mode.

IN THE HALT MODE

If the timer is in the HALT mode, pressing the STOP/RESET key resets the timer in preparation for the next run.

ON Key

Pressing the ON key turns ON the main power to the controller by ***activating*** the internal electronic latch and master relay.

OFF Key

Pressing the OFF key turns OFF the main power to the controller by ***deactivating*** the internal electronic latch and master relay.

Operation

Timer

The timer may be configured *either* to count up or to count down.

- **IN THE SETUP MODE,** the timer is programmed to a specific time, a specific pre-alarm offset, and a count direction.
- **DEPENDING ON THE MODE SELECTED,** the UP/DOWN count time can be pre-set and will count down from the pre-set time or count up to the pre-set time. In both cases, it has the additional feature of accumulating overcount.
- **IN THE COUNT DOWN MODE,** once the timer counts down to zero (0), it begins counting up to record the time that has elapsed passed the pre-set time.
- **IN THE UP COUNT MODE,** once the timer reaches the pre-set value, it returns to zero (0) and counts up again to record the time that has elapsed passed the pre-set time.
- **IN BOTH MODES, WHEN THE DISPLAY IS IN OVERCOUNT**, the display flashes to indicate this condition.

The VIEW key may be used to examine the pre-set time.

- This value and the initial pre-set time are stored in the EEPROM memory, thus, they automatically are ready when the system is initially powered up.

Press the START key to start the timer.

- This condition is valid if the unit is in the NORMAL mode and the timer has been reset.

In the RUN (normal) mode, press the STOP/RESET key to stop the timer.

- When the timer is in the RUN mode, pressing the STOP/RESET key halts the system's operations and freezes the display on the current timer value. If the count is "over", the display will flash.
- A second depression of the STOP/RESET key causes the timer to reset. This action places the pre-set value in the timer display, stops the display flashing, and cancels any timer audio tones.

If the START key is pressed when the timer is in the HALT mode, the timer will continue from its current count.

The ***Pre-Warn Tone*** has a 50/50 duty cycle and a 1/2-second period.

- After the pre-set time has elapsed, the pre-warn tone turns into a continuous tone.
- The timer must be stopped to enter the PROGRAM mode.
- In the SETUP mode, the pre-set time and pre-warn tone are entered.

  For more information, please see the "Setup Key" *section of this chapter.*

High Limit Circuity

The unit contains special ***High Limit Circuitry***.

This circuitry consists of a redundant ***Single-Setpoint Temperature Monitor*** built into the same package.

This monitor is powered by a separate ***Isolation Transformer*** and utilizes the totally independent ***High Limit Thermocouple***.

The monitor's purpose it to monitor the bath for excessive temperature and, should such a condition occur, physically turn OFF the unit.

NOTE:

This system is different than the *high alarm setpoint*, which is a **SOFTWARE** function under microprocessor control.

The high limit circuitry is a redundant **HARDWARE** function capable of turning OFF the controller, independent of the basic control system.

The high limit thermocouple is processed through an ***Instrumentation Amplifier*** that also provides the reference and cold junction compensation. This signal, which is a measure of the thermocouple temperature, is compared to a pre-calibrated mechanical setpoint.

IF THE TEMPERATURE AT THE THERMOCOUPLE EXCEEDS THE RESET VALUE, the circuit turns OFF the internal load carrying master relay. Its also LIGHTS the high limit LED alarm light.

- If the unit is ON when this condition occurs, the unit will shut OFF.
- If the unit is OFF, it cannot be turned ON until this high limit condition is cleared.

NOTE:

Again, the high limit circuit is powered by its own transformer and, thus, remains ON at all times—even when the power switch is OFF.

The heater and microprocessor sections are electrically connected to the master relay output and, thus, are disabled by this alarm.

Access Code

In some cases, it may be desirable to ***restrict access to the SETUP mode***. To do this, an access code system is incorporated.

- **IF THE ACCESS CODE IS SET TO 0000,** the function is eliminated and the system operates as previously described.

The code is any number from 1–9999, and is determined and programmed into the system by the customer's authorized personnel.

- After this code is entered into the EEPROM, any attempt to enter the SETUP mode will cause an "***AC***" to appear in the display. The UP and DOWN keys are then used to enter the access code. After the proper code has been entered, the operator simply depresses the SETUP key to access the parameters.

Rate/Reset

The controller may operate in either a 1-, 2-, or 3-mode configuration.

SETTING THE RATE OR RESET VARIABLES TO 0.0 eliminates the respective function.

NOTE:
The RATE and RESET settings adjust the sampling period directly in tenths of minutes.

Smaller numbers create a more rapid sampling.

For more information about sampling, please see the "Tuning Discussion" *section of this chapter.*

Timer Relay

When the optional auxiliary relay is provided, the logic for the relay is selected by the "***RL***" parameter in the setup stack.

The relay responds as follows:

RL=0 (DURING)

This configures the auxiliary relay as a timer relay.

It is active for the period that the timer is active.

It activates when the timer is started and deactivates when the timer has completed its count.

RL=1 (DONE)

This configures the auxiliary relay as a timer relay.

It activates at the completion of the timer cycle.

It remains active until the timer is reset.

DI Relay

When the auxiliary relay is provided, the logic for the relay is selected by the "***RL***" parameter in the setup stack.

If **RL=2**, then the relay is designated as an DI relay. This relay is active when the process temperature is above the HS setting.

Snap Switch

The unit has provisions for the connections of a normally closed snap switch as a redundant high temperature safety. This connection allows the snap switch to be placed in series with the internal master relay coil.

When the snap switch is OPEN, the unit is shut OFF.

Tuning Discussion

Overview

The control scheme used in this controller is a standard PID system with Anti-Reset Windup.

This section briefly reviews PID control *as it relates to this system*.

> **NOTE:**
> This discussion specifically relates to this device and may be somewhat different for other systems.

Proportional Mode

The terms ***PID*** and ***3-Mode*** are interchangeable.

The first mode of control, ***P*** (***Proportional***), refers to the basic control scheme.

The concept is that the controller determines the percentage of heat required by the system, and adjusts the average power input to the heater to balance the system.

The power to the heater is either fully ON or fully OFF.

The proportional amount is a ratio of the amount of time ON to the amount of time OFF. Thus, proportional control, in this application, is more correctly termed ***Time Proportioning***.

Cycle Rate

The ***Cycle Rate*** (***CR***) setting is used to determine the rate at which the heater power is turned ON and OFF.

The proportioning of the output power is accomplished by varying the percentage of time that the unit is ON during the period.

For example, if CR=10, the unit will cycle ON and OFF once every 10 seconds.

If the process has determined that the system requires only half of the temperature, the output will be ON for 5 seconds and OFF for 5 seconds in a continuous cycle.

As the heat requirement varies, this percentage increases to slightly longer periods ON, such as 5.1 seconds ON, and 4.9 seconds OFF.

The opposite is also true for decreasing heat load requirements. Thus, when the system is at or near the setpoint, the HEAT LED in the status box flashes continuously, indicating the time proportioning of the heater.

To compute the required percentage of ON-time, the system utilizes the ***Proportional Band*** (***PB***) as set in the Programming mode. It is over this band that the output will vary from 0–100%.

If, for example, the setpoint is at 100°C and the Proportional Band is set at 10°C, the controller time proportions the output from 100% to 0% when the process temperature varies from 90°–100°C. When the process temperature is at 90°C and less, the output is fully ON. For temperatures from 90^0–100^0C, the output proportions from 100% down to 0%. For temperatures above 100°C, the output is fully OFF.

NOTE:

At this point, it is important to note that we are discussing systems in which the RATE and RESET functions are not used. RATE and RESET will cause a shifting in the Proportional Band and vary the percentages just discussed. However, RATE and RESET do not affect the basic theory, only the position of the Proportional Band at any moment in time.

Proportional Band and Cycle Rate Relationship

Now, we will tie the Proportional Band and Cycle Rate together using the previous example.

We have a cycle rate of 10 seconds with a Proportional Band of 10°C and a setpoint of 100°C.

When the process temperature is 96°C, we see that it is 40% into the Proportional Band.

Based on this position, we require 40% heater output, with the 10 second Cycle Rate. This means that the heater is ON for 4 seconds and OFF for 6 seconds.

Obviously, a proportional control requires a certain degree of error to have the heat ON. Therefore, in the example just given, if we find that only 10% of the heat is required to maintain the desired temperature, then the unit will cycle 1 second ON and 9 seconds OFF, and the temperature will stabilize at 99°C. *This is not the desired 100°C!* The difference between the two points is termed, ***Droop***.

- ***Droop*** is the difference between the Setpoint and the Control Point in a proportional system.

Integral Mode or Automatic Reset Mode

To remove this Droop, we need the second mode, the ***I*** (***Integral***) mode or, more commonly termed, ***Automatic Reset Mode***.

The program calculates the difference between the current process temperature and the desired setpoint, then mathematically corrects the system to compensate for this error.

How often this correction occurs is based on the parameter programmed in the ***RE*** (***Reset Adjustment***) parameter.

Anti-Reset Windup is a special feature incorporated in the software that locks out the Reset function when the system is outside of the Proportional Band. Obviously, if the system was automatically adjusting the Droop before the system was nearing stability, large errors would occur. Anti-Reset Windup is used to eliminate such potential errors.

Derivative Mode

The third mode in the PID scheme is the ***D*** (***Derivative***) mode or, more commonly referred to as, ***Rate***.

When a system has large step changes in heat requirements, it may require this third mode to compensate for such changes.

Its primary function is to eliminate “overshoots” as the temperature is stabilizing. This mode controls the rate of change of the temperature when large temperature fluctuations occur.

On systems where overshoot is not a problem, the Rate function may be eliminated.

In general, bath control requires reset on all occasions. Rate may not be required and should be set to zero (0), unless overshooting occurs.

Backdoor Code

A special code has been incorporated into the software to ensure factory access to all functions—regardless what the customer has done with their access codes.

The Backdoor Code is 321.

System Specifications

Name	PCT Systems, Inc. Model 90: Constant Temperature Bath Controller
Temperature Range	0.0°–199.9°C
Temperature Resolution	0.1°C
Noise Rejection	NMR: -60dB @ 60Hz CMR: -120dB @ 60Hz
Time Range	0:00–99:59 (Minutes:Seconds)
Time Resolution	1 Second
Measuring Time	4 Conversions/Second
Display	8, 0.56” high, 7-segment, LED Uniplanar Numerals, 12 Discrete LEDs (Red, Green, Amber)
Annunciator	Audio Tone, ~2500 Hz
Setup Memory	EEPROM, All Parameters
Memory Retention	10 Years without Power
Sensor	Standard: Type-J Thermocouple, Cold Junction Compensation, Up Scale Break Protection
Control	PID with Anti-Reset Windup
Adjustment	Cycle Rate: 1–19 Seconds Proportional Band: 0.1°–19.9°C Reset (Integral): 0.1–19.9 Seconds Rate (Derivative): 0.1–19.9Seconds Calibration Offset: $\pm$9.9°C
Operating Range	0°C to 50°C
Storage Range	-40°C to 60°C
Construction	Enclosure: Kydex Face: Lexan, Back Printed
Size (H x W x D)	7” x 6” x 5.25” 178 mm x 152 mm x 133 mm
Weight	$\leq$ 4 pounds (1.8 kg)
Connection	Rear, Screw-Type, 3/8-inch Centers; Thermocouple: Miniature, Type-J, Jack
Output	SSR, Optically Isolated, Zero Cross, 20 Amp, 208 VAC
Power	11 VA, 208 VAC $\pm$10%, 50/60 Hz

Notes

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CHAPTER 4
TROUBLESHOOTING GUIDE

Purpose

This chapter explains the action needed to resolve the following problems:

- Shipping Damage
- You are Unclear as to How to Install or Operate the Unit
- The Unit Malfunctions or is Broken
- The Tank Will Not Heat

If the solutions in this chapter do not resolve the problem, or you experience other equipment difficulties, call Customer Service at (510) 657-4412 so we can advise you.

WARNING:

This system equipment is **DEPOT REPAIR ONLY.**

You must call Customer Service for repair service.

Any attempt to modify, repair or open the equipment or controller will void the warranty.

REMINDER:

A damaged unit may be repairable. Please contact PCT Systems Customer Service for assistance.

PROBLEM	SOLUTION
Shipping Damage	1. Leave the items, packing materials, and container “as is”. 2. Notify your carrier’s local office and ask for an immediate inspection of the container and the contents. 3. Review the information contained in Chapter 6: Packaging Equipment for Shipping. 4. After inspection has been made by the carrier and you have received acknowledgement in writing as to the damage, contact our Customer Service at (510) 657-4412 for an RMA number. Please Note: ▪ It is your responsibility to follow the above instructions or the carrier will not honor any claims for damage. ▪ Also, if there are any shortage or question regarding this shipment, please notify us within five (5) days. ▪ Upon delivery from the carrier, the product becomes your property. Therefore, it is important for you to take note of any damage, whether obvious or hidden, and report it to the transportation company within **five (5) days of receipt of the shipment** to avoid forfeiting claims for damage.
You are Unclear as to How to Install or Operate the Unit	1. Contact our Customer Service Department at (510) 657-4412. 2. We will answer your questions directly or put you in touch with an Applications Engineer who will be pleased to assist you.
The Unit Malfunctions or is Broken	1. Contact our Customer Service Department at (510) 657-4412. 2. We will review the details of the situation with you and determine the correct course of action. 3. If it is determined that the unit should be returned to PCT Systems, Customer Service will issue an RMA number. ▪ Then, follow the preparation, packing, and shipping instructions described in Chapter 6: Packaging Equipment for Shipping.
The Tank Will Not Heat	1. Measure the resistance between the 2 heater leads. ▪ The resistance should measure between 14–25 ohms, depending on your system’s heater type. 2. Check the J-type thermocouple (TC) connection. ▪ An open TC will likely keep the temperature controller from functioning correctly. 3. Measure the resistance between the red and white TC wires. ▪ This measurement should be 3–4 ohms.

CHAPTER 5
WARRANTY INFORMATION

Purpose

This chapter describes:

- The Designed & Intended Use of the equipment
- The Product Warranty Information—Quartz Systems
- The Product Warranty Information—Stainless Steel Systems
- Non-Warranty Repairs

In General

PCT Systems ships the tested equipment in special packaging which protects the system during transport. Carefully read the information contained in this chapter.

IMPORTANT:
This equipment becomes your property when the contracted shipper picks up the equipment at the factory.

It is important that you inspect the equipment immediately and note any damage, whether obvious or hidden (internal breakage, crushed cord, etc.), and report it to the shipper and PCT Systems.

Report damaged containers or equipment to the transportation company immediately.

Designed & Intended Use

The PCT Systems Constant Temperature Bath is to be used in a manner that is consistent with the contents of this Manual, the supporting drawings and diagrams, and any additional information or instructions separate from this Manual.

This equipment is not to be used for any other purpose.

Operating this equipment in any way that is contrary to its original designed and intended use, without prior authorization from PCT Systems, Inc., may constitute a deviation from and violation of the original designed and intended use.

If any unauthorized deviation or alteration occurs, the warranty, be it expressed, implied, or statutory, may become invalid.

The results of such actions may also expose the end user, its employees, and visitors to unsafe conditions and other negative consequences.

IMPORTANT:
We strongly encourage you to contact PCT Systems before making any alterations or deviations to this equipment or its operation.

Product Warranty Information—*Quartz Systems*

Coverage—New Systems

The coverage for this system is pro-rated, provided the housing or quartz is not damaged or modified:

- **FULL COVERAGE:** The initial 6 months or 1,040 hours, whichever comes first.
- **50% COVERAGE:** The next 3-month period or 520 hours, whichever comes first.
- **25% COVERAGE:** The final 3 months of the first 12-month period, or 520 hours, whichever comes first.
- **QUARTZ BREAKAGE WARRANTY:** 90 days, excluding mishandling and shipping damage.

REMINDER:
Flammable liquids are not to be used or heated at any time in the Quartz Constant Temperature Bath.

The Quartz Constant Temperature Bath is not designed for use with flammable liquids.

These percentages apply to the value defined by PCT Systems, Inc. at the time of repair. The decision to repair or replace warranted systems is reserved by PCT Systems, Inc.

If operated within the scope detailed in this Manual, the equipment will operate correctly for the maximum lifetime.

Flexible Drain Stem

If the system uses a flexible drain stem, the warranty reduces to 6 months.

NOTE:
Flexible drain stem limits the maximum temperature operation to 150°C.

Coverage—Rebuilt Products: Standard PCT Systems or Other Makes

PCT Systems warrants all products to be free from manufacturing defects in materials and workmanship, when used under normal operating conditions for a period of 3 months from the date of original shipment from the factory.

Provided the housing or quartz is not damaged or altered, the coverage for this system is:

- **FULL COVERAGE:** 3 months or 520 hours, whichever comes first.

Note:

1. The above percentages refer to cost as defined and judged by PCT Systems necessary to repair or replace warranted units.
2. Hours are based on a single, 8-hour shift, 5-day work week. The end user or installer must supply start-up installation sign-off dates or usage logs upon the request of PCT Systems.

Exclusions from the Warranty

The following items are exclusions from the warranty, and, as a result, voids the warranty.

1. Impact or other physically induced damage or cracking or damage to the quartz.
    - It is the Buyer's responsibility to inspect each unit upon receipt for any damage.
    - Inspect for quartz breakage or signs of cracks.
    - It is also the Buyer's responsibility to notify PCT Systems immediately in the event of such a discovery.
    - If the damage has been caused by shipment, the Buyer should follow the guidelines set forth in this Manual.

2. Damage to the heater element or sensor, resulting from corrosion caused by quartz breakage or by improper installation or operation of the unit based on guidelines set forth in this Manual and other warnings attached to the unit.
3. Failure caused by improper use of extra non-standard sensors to operate the unit, other than the specific sensor applied by PCT Systems, without written approval from PCT Systems.
    - The unit's process temperature sensor and all safety over-temperature devices supplied with this unit must be properly connected to the system's process temperature controller and over-temperature controller before heat up.
    - Failure to use the supplied safety overtemperature devices could result in an unsafe operating condition.
4. Failure to use the supplied overtemperature devices.
5. Where failure is caused by negligence (for example, not connecting safety and overtemperature sensor devices, inadequate preventive maintenance, and other items described in this Manual), abuse, or vandalism.
6. Penetration of the unit enclosure, cabling, or fittings for any reason.
7. Submersion of the unit or other non-standard exposure of the unit and the unit's seal to chemicals.
8. Controller componentry failures caused by installation of the controller in a improper environment where it is subject to corrosive vapors, fumes, or extreme vibration.
9. Damage caused by failure to operate the unit at the minimum fill-level.

REMINDER:

FOR QUARTZ STATIC UNITS: The minimum fill level is at the white and gray interface line.

Other Information

PCT Systems:

- Does not warrant merchantability or fitness for any specific purpose and there are no warranties, expressed or implied, other than those stated herein.
- Is not responsible for any consequential, incidental, or other damages.

- Liability is limited to the repair or replacement of such defective product or refund of purchase price at PCT System's sole option, as stated previously.

All claims must be made within the warranty period.

Product Warranty Information—*Stainless Steel Systems*

Coverage—New Systems

The coverage for this system is pro-rated, provided the housing is not damaged or modified:

- **FULL COVERAGE:** The initial 6 months or 1,040 hours, whichever comes first.
- **50% COVERAGE:** The next 3-month period or 520 hours, whichever comes first.
- **25% COVERAGE:** The final 3 months of the first 12-month period, or 520 hours, whichever comes first.

These percentages apply to the value defined by PCT Systems, Inc. at the time of repair. The decision to repair or replace warranted systems is reserved by PCT Systems, Inc.

If operated within the scope detailed in this Manual, the equipment will operate correctly for the maximum lifetime.

Coverage—Rebuilt Products: Standard PCT Systems or Other Makes

PCT Systems warrants all products to be free from manufacturing defects in materials and workmanship, when used under normal operating conditions for a period of 3 months from the date of original shipment from the factory.

Provided the housing is not damaged or altered, the coverage for this system is:

- **FULL COVERAGE:** 3 months or 520 hours, whichever comes first.

Note:

1. The above percentages refer to cost as defined and judged by PCT Systems necessary to repair or replace warranted units.
2. Hours are based on a single, 8-hour shift, 5-day work week. The end user or installer must supply start-up installation sign-off dates or usage logs upon the request of PCT Systems.

3. **FOR COATED STAINLESS STEEL BATHS:** The coating is warranted for 60 days only.

Exclusions from the Warranty

The following items are exclusions from the warranty, and, as a result, voids the warranty.

1. Impact or other physically induced damage.
    - It is the Buyer's responsibility to inspect each unit upon receipt for any damage.
    - It is also the Buyer's responsibility to notify PCT Systems immediately in the event of damage discovery.
    - If the damage has been caused by shipment, the Buyer should follow the guidelines set forth in this Manual.
2. Damage to the heater element or sensor, resulting from improper installation or operation of the unit based on guidelines set forth in this Manual and other warnings attached to the unit.
3. Failure caused by improper use of extra non-standard sensors to operate the unit, other than the specific sensor applied by PCT Systems, without written approval from PCT Systems.
    - The unit's process temperature sensor and all safety over-temperature devices supplied with this unit must be properly connected to the system's process temperature controller and over-temperature controller before heat up.
    - Failure to use the supplied safety overtemperature devices could result in an unsafe operating condition.
4. Failure to use the supplied overtemperature devices.
5. Where failure is caused by negligence (for example, not connecting safety and overtemperature sensor devices, inadequate preventive maintenance, and other items described in this Manual), abuse, or vandalism.
6. Penetration of the unit enclosure, cabling, or fittings for any reason.
7. Submersion of the unit or other non-standard exposure of the unit and the unit's seal to chemicals.
8. Controller componentry failures caused by installation of the controller in a improper environment where it is subject to corrosive vapors, fumes, or extreme vibration.
9. Damage caused by failure to operate the unit at the minimum fill-level.

REMINDER:

STAINLESS STEEL STATIC UNITS: The minimum fill level is 1.5 inches from the top of the stainless steel tank.

Other Information

PCT Systems:

- Does not warrant merchantability or fitness for any specific purpose and there are no warranties, expressed or implied, other than those stated herein.
- Is not responsible for any consequential, incidental, or other damages.
- Liability is limited to the repair or replacement of such defective product or refund of purchase price at PCT System's sole option, as stated previously.

All claims must be made within the warranty period.

Non-Warranty Repairs

Repairs are quoted using one 8-hour shift per day for 5 days each week.

The Buyer is responsible for all shipping costs to PCT Systems or other designated, factory-certified rebuild facilities.

Call PCT Systems Customer Service for repair quotes.

Notes

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CHAPTER 6
RECEIVING, REPAIR & RETURN INFORMATION

Purpose

This chapter describes:

- The Receiving, Unpacking & Inspection Instructions
- How to Report Damage
- Arranging for Service or Repair to the Equipment
- The Return Shipping Information

In General

PCT Systems ships the tested equipment in special packaging which protects the system during transport. Carefully read the information contained in this chapter.

> **IMPORTANT:**
> This equipment becomes your property when the contracted shipper picks up the equipment at the factory.
>
> It is important that you inspect the equipment immediately and note any damage, whether obvious or hidden (internal breakage, crushed cord, etc.), and report it to the shipper and PCT Systems.

Report damaged containers or equipment to the transportation company immediately.

Receiving, Unpacking & Inspection Instructions

PCT Systems ships the tested equipment in special packaging which protects the system during transport. Carefully read these receiving instructions.

This equipment becomes your property when the contracted shipper picks up the equipment at PCT Systems factory. It is important that you inspect the equipment immediately and note any damage, whether obvious or hidden (internal breakage, crushed cord, etc.).

Immediately report damaged crates/containers or equipment to the transportation company.

Step 1: Inspect the Container Upon Receipt & Before Opening

Visually inspect the outside of the shipping crates/containers for damage.

- **IF THERE IS NO DAMAGE**, continue with Step 2.
- **IF THERE IS DAMAGE**, follow the "How to Report Damage" section contained in this chapter.

Step 2: Open the Container.

WARNING:

FOR QUARTZ TANKS, the quartz can shatter if subjected to abrupt impact.

Handle the shipping crate carefully and protect it from impact.

- Open the container carefully.
- Use a sharp blade to cut the packing tape—do not cut deeply into the shipping carton. Try to avoid scoring the vessel or equipment with the cutter.
- Inspect the contents for damage.
- Report any damage to the shipper immediately.

Step 3: Remove the Unit from the Container.

- Use care when removing the contents of the container—especially if the system has a quartz tank.

IMPORTANT:

Avoid tearing the clear plastic seal placed over the vessel.

Do not remove or tear the protective cover on the tank until it is fully installed into the wet process area.

Step 4: Inspect the Contents for Damage.

- After unpacking the equipment, inspect the contents immediately for any damage.
  - Prior to shipment, the vessel has been tested and examined to ensure proper performance and to be free from scratches, dents, and external cosmetic defects.

- Should you find any scratches, dents, or cosmetic defects on these items, preserve the shipping container and contact the carrier to file a damage claim.
    - You may be requested to take photographs to document your claim.

How to Report Damage

Follow these steps to report damage:

1. Notify the shipper immediately to pick up the damaged equipment in its original shipping container. Leave it in the condition in which you received it.

> **IMPORTANT:**
> If the carton is opened before detecting damage and the carton is not damaged, repackage the equipment in its original packaging, or use suitable packaging which provides the same protection as the original packaging. Damaged packaging will not give adequate protection to equipment.

2. The shipper will give you a receipt when the damaged equipment is picked up. List all damages you find and give a copy to the shipper with the damaged equipment. The shipper will send an acknowledging copy of their damage report.
3. Contact PCT Systems Customer Service Department to request an Returned Materials Authorization (**RMA**) number. Include a copy of the shippers damage report and your Purchase Order number.
    - To avoid possible losses or misunderstandings, products should not be returned to the factory without an RMA number.
    - No credits, allowances, or adjustments shall be made until alleged defects are established to the satisfaction of PCT Systems.
    - Time spent by PCT Systems to check equipment that is found to have no fault may be chargeable, warranty status notwithstanding.
    - PCT Systems will ship repaired systems back to the Buyer freight collect.

For more information about requesting an RMA number, please see the "Return Material Authorization" section in this chapter.

Arranging for Service or Repair to the Equipment

This section contains instructions for obtaining a Return Material Authorization (**RMA**) from PCT Systems and shipping the equipment to the Service Department.

The Return Procedure in this section is required in order for PCT Systems to execute repairs efficiently and restore your system in minimum time.

Return Material Authorization

A Return Material Authorization (**RMA**) from PCT Systems, Inc. is required prior to shipping equipment to PCT Service.

For RMA numbers, either:

- Call Customer Service at (510) 657-4412
- Email at sales@pctsystems.com

Inspection Fee

An **INSPECTION FEE** applies to all equipment sent to PCT Systems for repair/diagnosis. This Fee is quoted when the RMA request is processed. This Fee is charged against the Purchase Order authorizing repair or replacement of the equipment. This Fee is not refunded or waived for equipment which does not need repair or for equipment with no Purchase Order to repair or replace parts. This Fee will be applied to the rebuild charge. If the Buyer elects not to issue an order for the rebuild (or replacement with a PCT Systems bath), the inspection fee will apply.

IMPORTANT:
The problem with the system may be caused by incorrect program usage. Ask for assistance with setting the program before shipping system for repair.

Repairs covered by warranty is exempt from the Inspection Fee.

Units accepted that have not been properly drained, rinsed, or packaged will be subject to an additional handling charge.

Credit, allowance, or adjustment to the outstanding invoice will be issued after inspection and evaluation by PCT Systems Service Department.

Repair Charge/Expedite Fee/Field Technician Service

Repair time is calculated using one 8-hour shift per day for 5 days each week.

Faster service is available on request. An **EXPEDITE FEE** applies to rush service and is quoted at the time of order.

The **REPAIR CHARGE** is calculated with the number of hours required to repair the equipment multiplied by the Service Hour Rate. The Service Hour Rate is quoted at the time of order.

An option, which may be available for some repairs, is **FIELD TECHNICIAN SERVICE**. Your equipment will be diagnosed and repaired in place. Ask for details regarding this service option.

Disposal Fee

PCT Systems will dispose of equipment that cannot be repaired for a $500 **DISPOSAL FEE**.

Prepare a Purchase Order if you want PCT Systems to dispose of this equipment.

Return Shipping Information

Shipping Preparation

The Buyer is responsible for all shipping costs to PCT Systems or other designated, factory-certified rebuild facilities, and the return shipping.

Federal and State laws governing safety for people, require flushing chemicals from parts prior to transport.

Equipment must be neutralized and chemical-free prior to packaging for shipment.

Rinse the equipment, including the insulation if equipment has internal leakage, with DI water then drain until dry.

- Solutions may have seeped through and soaked the insulation. These units should be placed into a proper drain sink and allowed to fully drain prior to packaging. Units not properly rinsed, drained, and packaged will be refused and returned to the Buyer at the Buyer's expense.

IMPORTANT:

PCT Systems will only work on a system which are:
1. Free of chemical residue (cleaned as described above).
2. Free of phenol solvents (no contamination).

Packaging Equipment for Shipping

1. Flush and neutralize the equipment of all chemicals.
   For more information, please see the "Shipping Preparation" *section of this chapter.*

2. Wrap the ***clean***, ***dry equipment*** in heavy plastic (10 mil or thicker) bags. Tightly secure these bags so as to contain any seepage from insulation during transit.

   WARNING:
   The shipping company will declare the shipment undeliverable if the packaging leaks. If the shipper determines the leaking solution is hazardous, your company is liable for damages.

3. Pack the bagged equipment into the original or equivalent shipping carton and fill the spaces in the box with bubble pack or other cushion material that provides substantial protection.

   NOTE:
   A minimum of 4–6 inches of packing materials around all sides is required.

4. Either pack in the same container or send separately the user/installer usage logs. These logs are required for systems in repair. Also, if requested by PCT Systems, send the installation sign-off information.
5. Place a notification/declaration tag on the bagged unit before closing box. This tag must state the chemicals used in the tank. If the notification/declaration tag is missing, the shipment will be refused service and returned to the shipper freight collect.
6. Mark each box with caution labels indicating **THIS SIDE UP** at the top edge of the box. It is important that the tank remains upright.
7. Mark each box with caution labels reading **FRAGILE** on each surface of the box. This labeling helps ensure careful handling during transit.
8. Insuring the full value of the equipment is strongly recommended.

Notes

Please use this blank page for writing notes.

APPENDIX A
DRAWINGS & DIAGRAMS

Purpose

The drawing(s) for this system is/are inserted after this page or may be sent as separate documents (in electronic or hard-copy format).

These drawings may be used for installation or system maintenance, repair, or troubleshooting.

Location of plumbing connections, electrical connections, and clearances are on the installation drawings.

IMPORTANT:
If you do not have copies of these drawings, whether in electronic or hard copy form, please contact PCT Systems Customer Service.

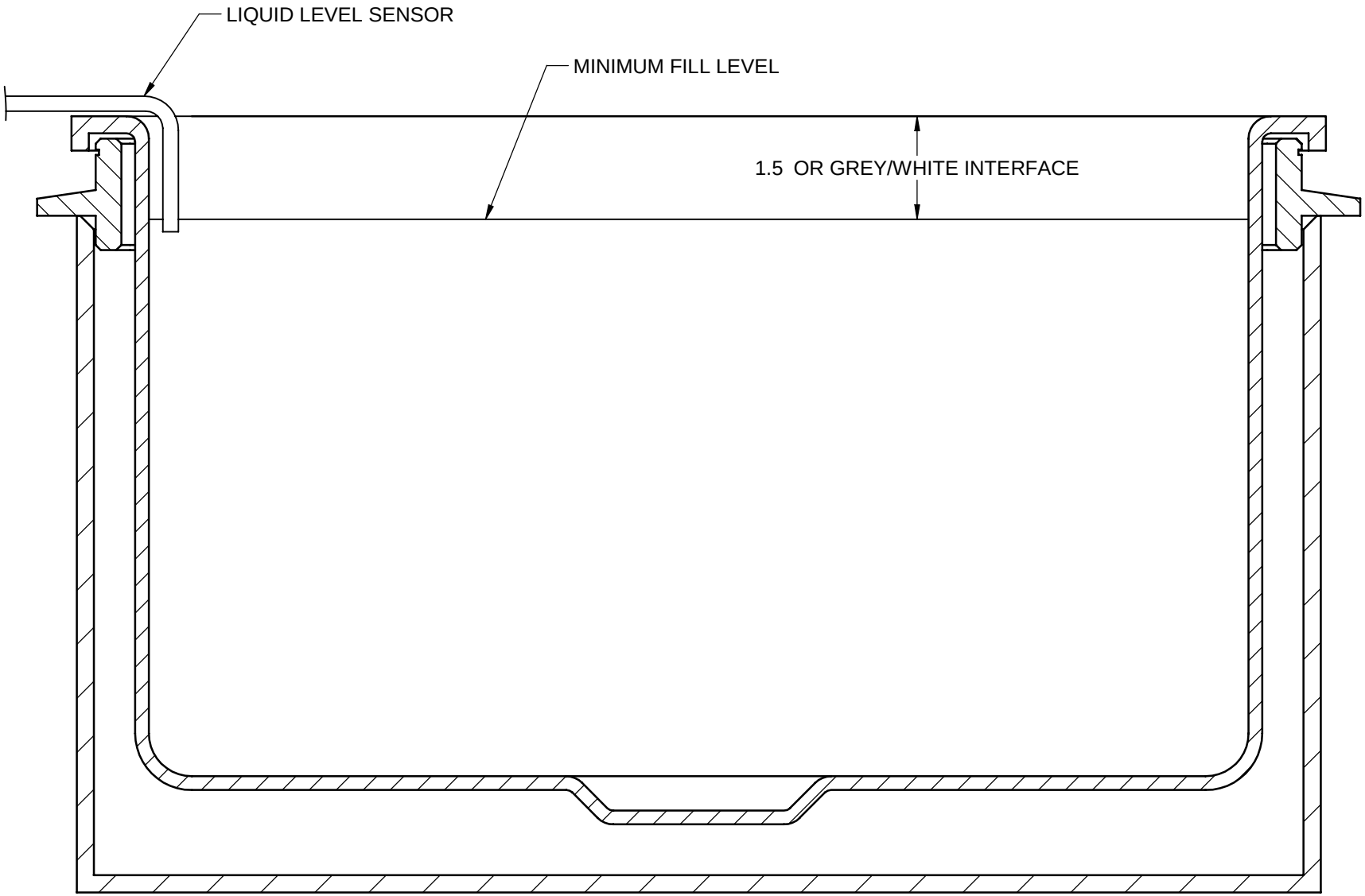
Notes

Please use this blank page for writing notes.

. INTERPRET THIS DRAWING PER ASME Y 14.5M-1994]
. ALL DIMENSIONS ARE IN INCHES. (REF)
. REMOVE ALL BURRS AND SHARP EDGES
.THREADS: EXT. CL2A, INT. CL2B

NOTES: (UNLESS OTHERWISE SPECIFIED)

REVISIONS				
REV	ECO	DESCRIPTION OF CHANGE	DATE	APPROVAL
1	XXXX	BASELINE		



SECTION A-A

MATERIAL:

FINISH:

THIRD ANGLE PROJECTION

TOLERANCES	HOLES
DECIMALS .X ± .1 .XX ± .06 .XXX ± .031	.0 - .250 + .007 - .003 .251-.500 + .010 - .005 .501 & UP + .015 - .008
ANGLES ± .5°	

SOLID-EDGE

PCT SYSTEMS, INC.
44000 OLD WARM SPRINGS BLVD.
FREMONT. CA 94538

DRAWN H. AMOROSO DATE 19 MAY 04

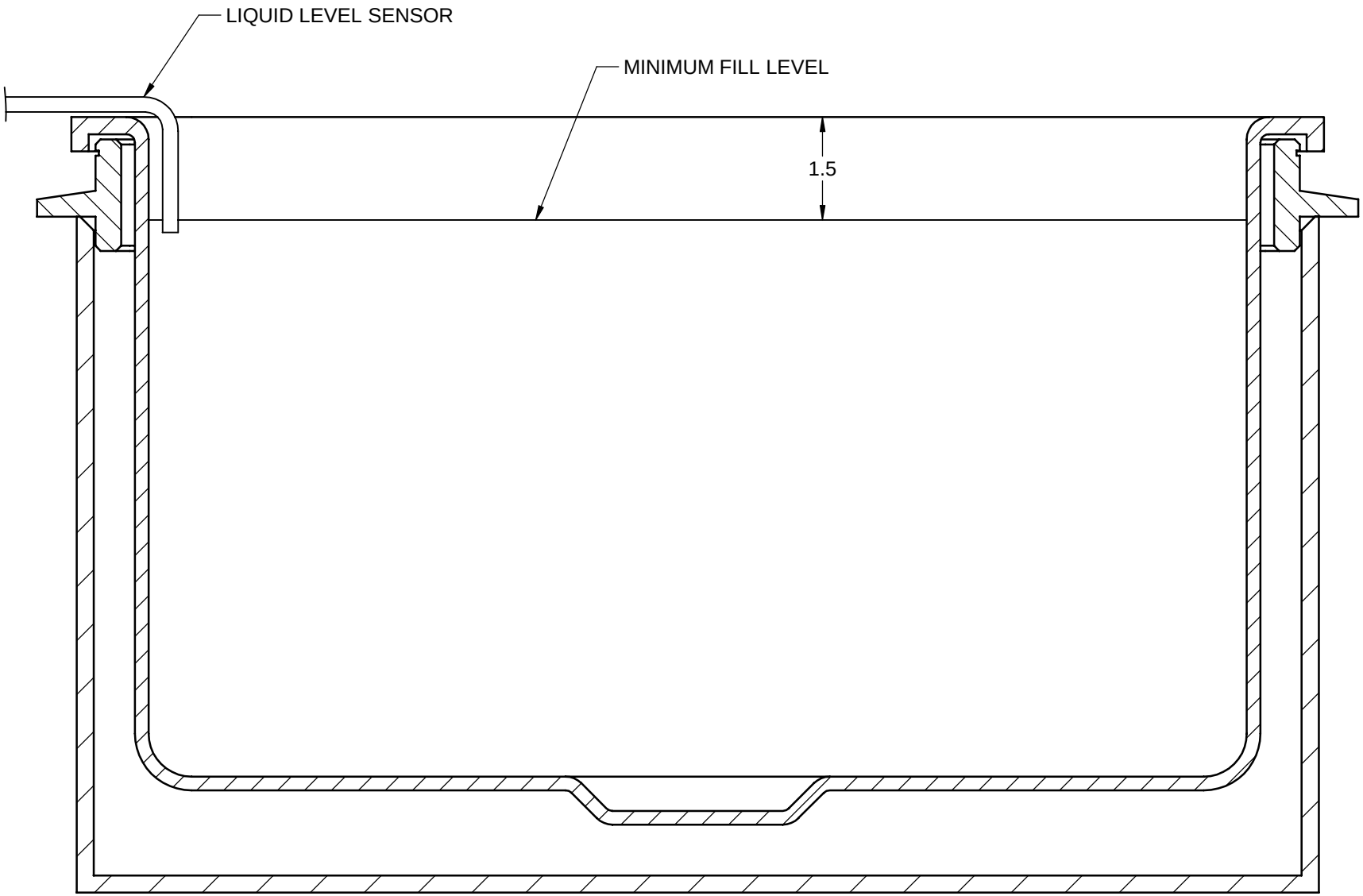
PART NO. PN

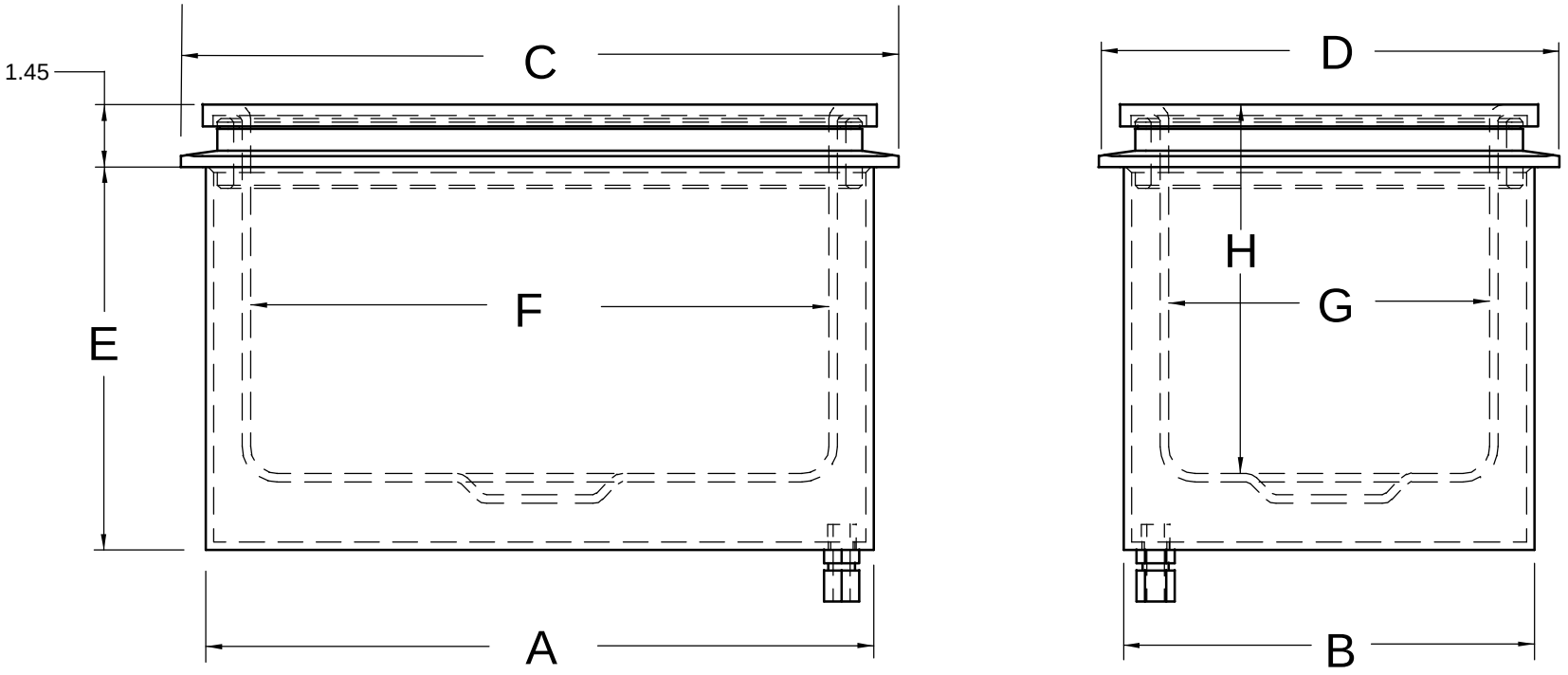
TITLE
LIQUID LEVEL
AND SENSOR

DRW NO. PCT-3451

REV. 1

SHEET 1 OF 1

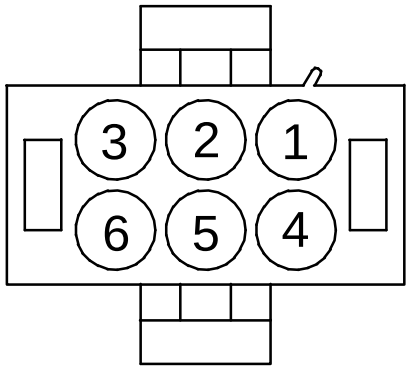

LIQUID LEVEL SENSOR
MINIMUM FILL LEVEL
1.5

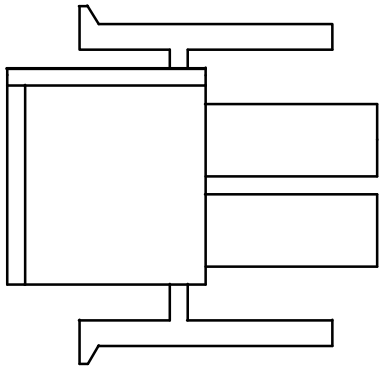


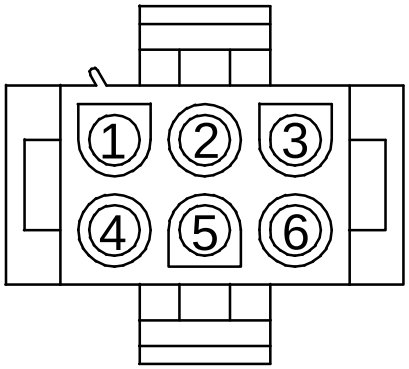
	A	B	C	D	E	F	G	H
TT4	9.9	9.9	11.13	11.13	10.0	7.9	7.9	10.0
TT8	13.5	9.5	14.75	10.75	8.0	11.5	7.5	8.0
TT10	15.5	9.5	16.75	10.75	9.0	13.5	7.5	9.0
TT14	18.0	10.0	19.25	11.25	10.0	16.0	8.0	10.0
TT16	18.5	11.0	19.75	12.25	11.0	16.5	9.0	11.0
TT16S	20.0	11.0	21.25	12.25	11.0	18.0	9.0	11.0
TT20	14.13	13.13	15.38	14.38	12.0	12.13	11.13	12.0

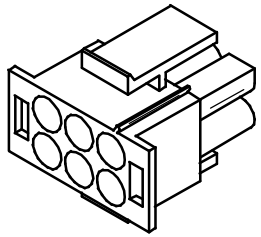
STANDARD STATIC TANKS

NOTE: ADD 3" ADDITIONAL DEPTH FOR OPTIONAL DRAIN STEM CLEARANCE





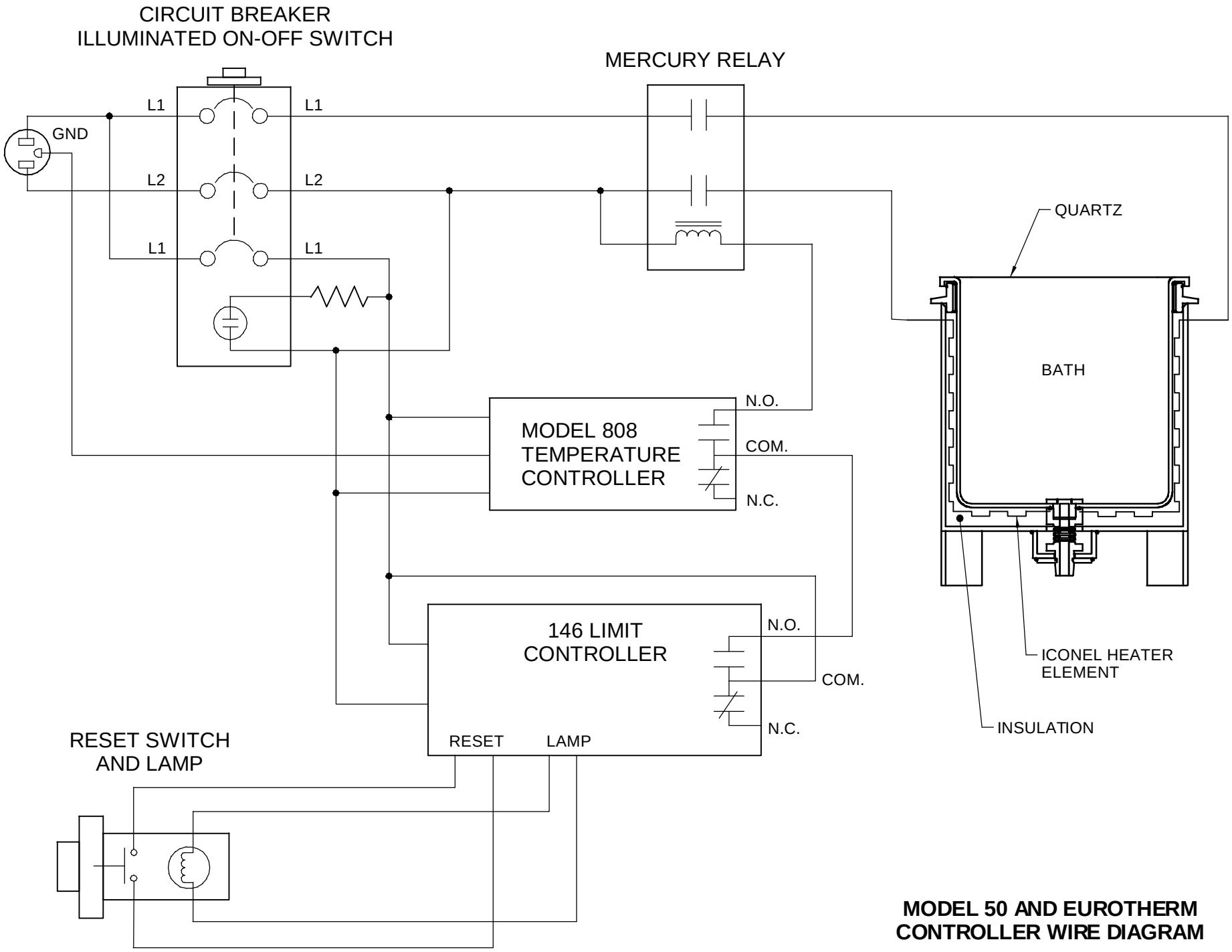




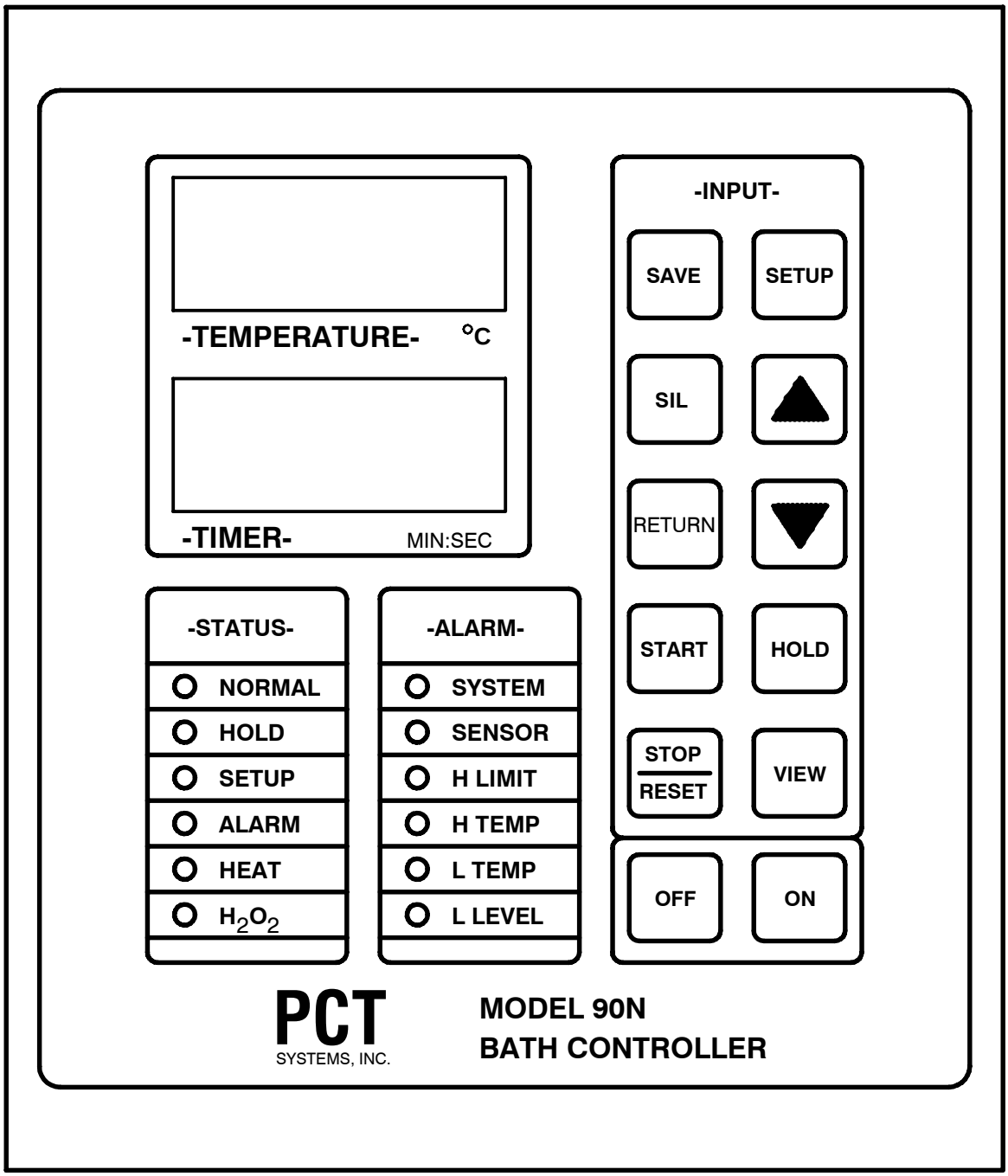
PIN	COLOR	AWG	TYPE	FUNCTION
6	RED	14	STRANDED	HEATER
3	BLK	14	STRANDED	
5	ORN	24	STRANDED	THERMOSTAT (OPEN ON RISE)
2	GRY	24	STRANDED	
4	RED	24	SOLID (-)	THERMOCOUPLE (J TYPE)
1	WHT	24	SOLID (+)	

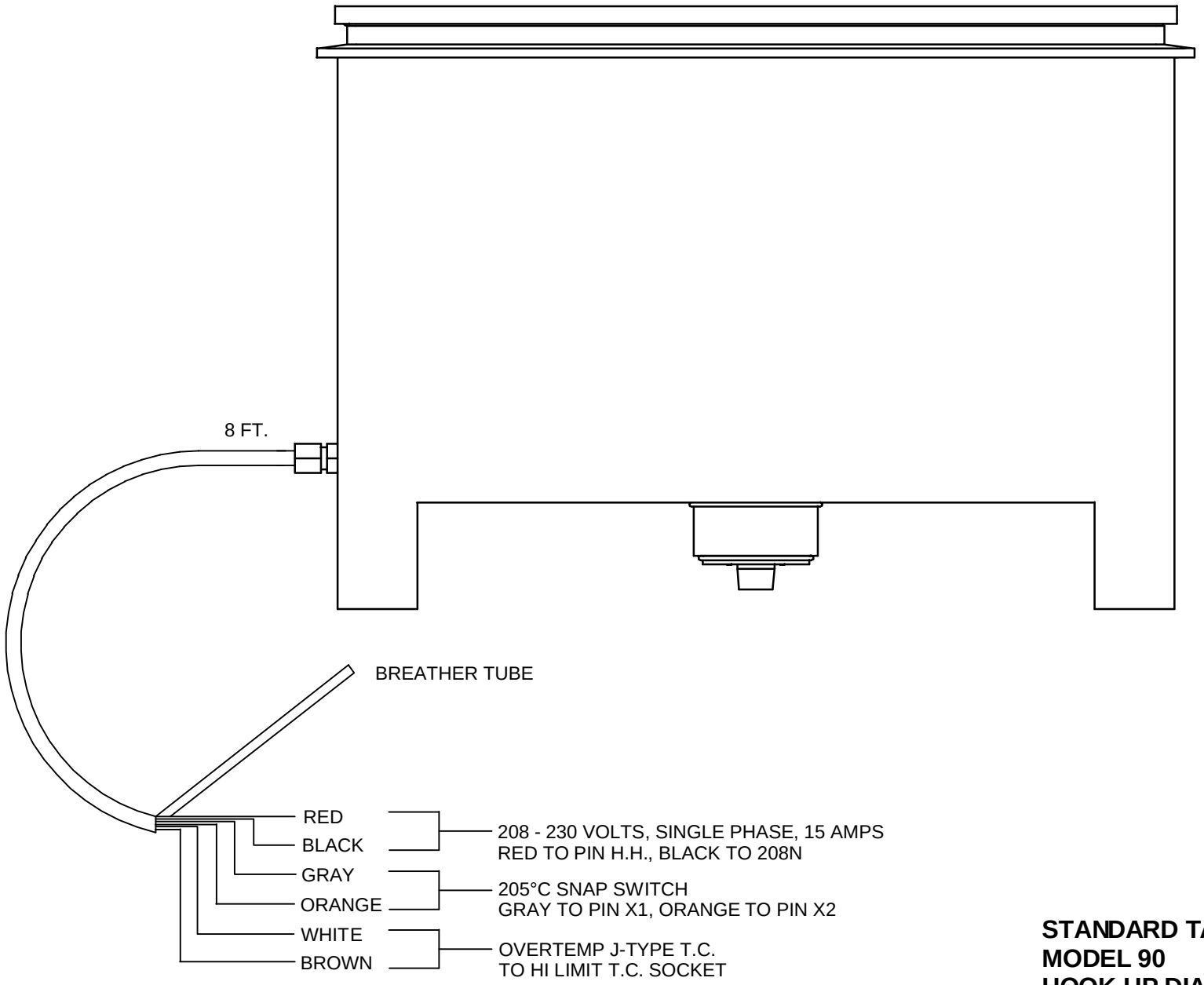
RESISTANCE (NOMINAL)	
MODEL	OHMS
TT4	28
TT8	19
TT10	19
TT14	14
TT16	14
TT20	14

MODEL 50 PLUG CONFIGURATION

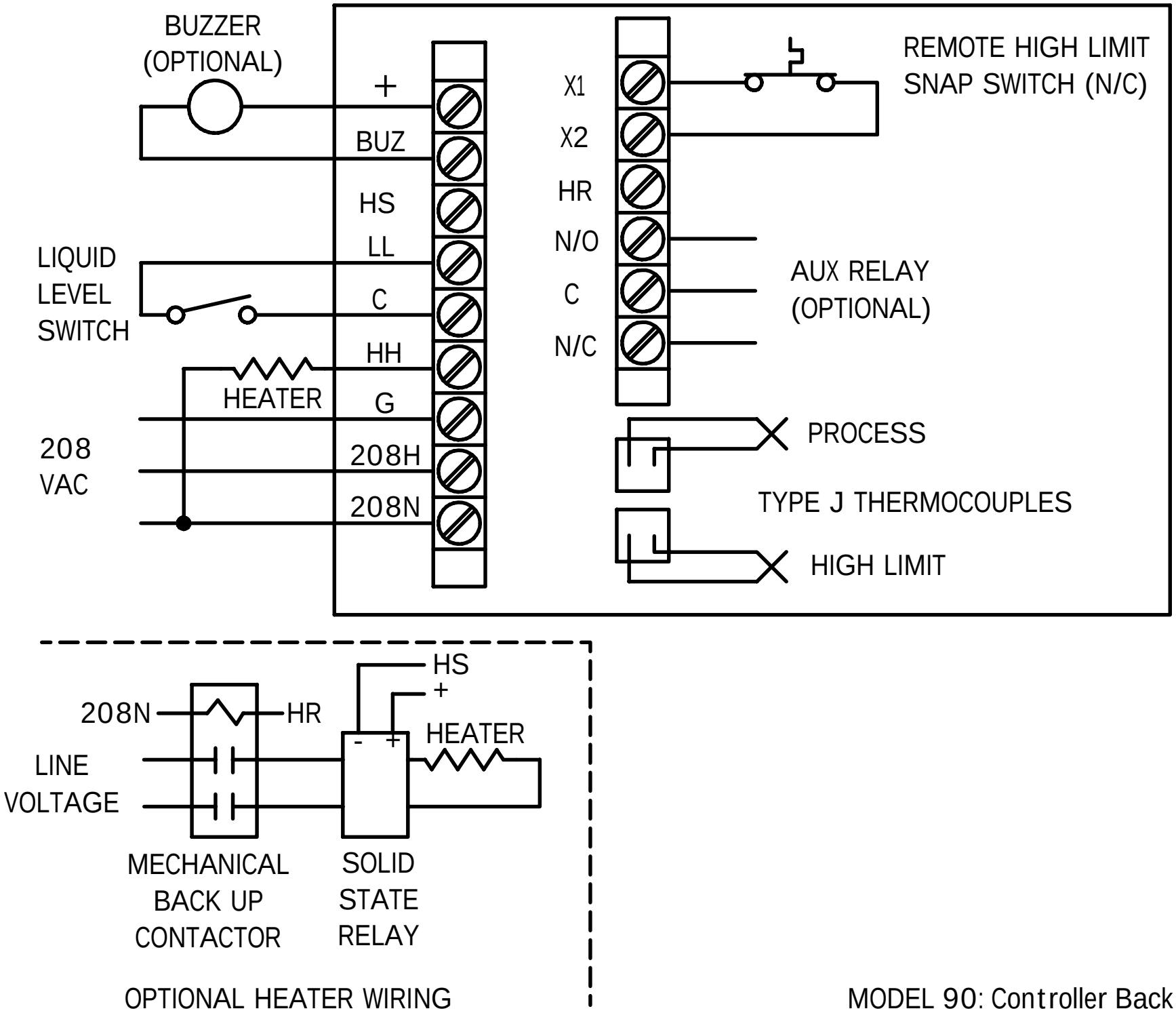


MODEL 50 AND EUROTHERM CONTROLLER WIRE DIAGRAM


-TEMPERATURE-
°C
-TIMER-
MIN:SEC
-STATUS-
NORMAL
HOLD
SETUP
ALARM
HEAT
H_2O_2
-ALARM-
SYSTEM
SENSOR
H LIMIT
H TEMP
L TEMP
L LEVEL
-INPUT-
SAVE
SETUP
SIL
RETURN
START
HOLD
STOP
RESET
VIEW
OFF
ON
PCT
SYSTEMS, INC.
MODEL 90N
BATH CONTROLLER



STANDARD TANK
MODEL 90
HOOK-UP DIAGRAM



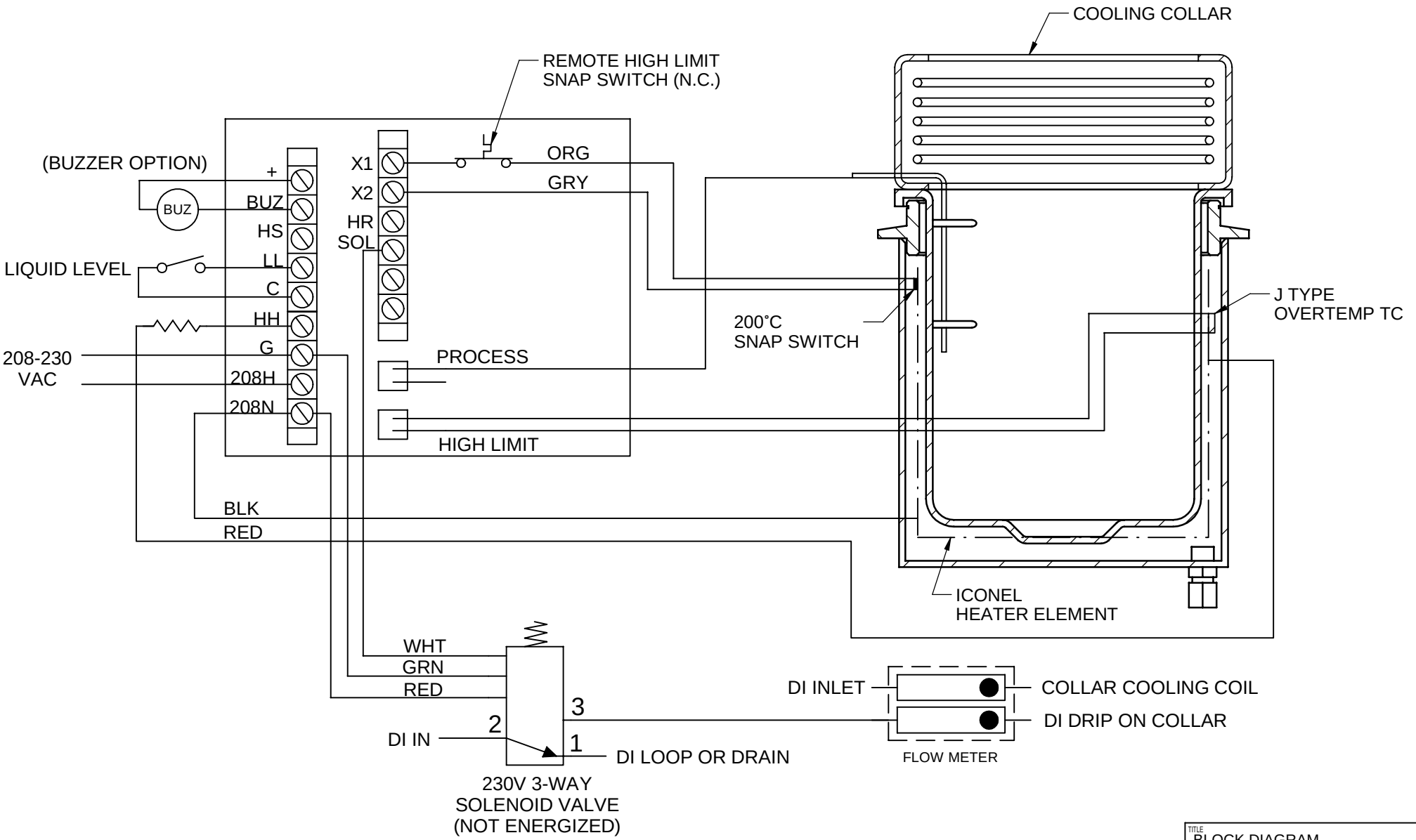
OPTIONAL HEATER WIRING

MODEL 90: Controller Back Panel

. INTERPRET THIS DRAWING PER ASME Y 14.5M-1994]
. ALL DIMENSIONS ARE IN INCHES. (REF)
. REMOVE ALL BURRS AND SHARP EDGES
.THREADS: EXT. CL2A, INT. CL2B

NOTES: (UNLESS OTHERWISE SPECIFIED)

REVISIONS				
REV	ECO	DESCRIPTION OF CHANGE	DATE	APPROVAL
B	XXXX	REVISED AND REDRAWN		



MATERIAL:

FINISH:

THIRD ANGLE PROJECTION

TOLERANCES
DECIMALS
ANGLES ± .5°

HOLES
.0 - .250 + .007 - .003
.251-.500 + .010 - .005
.501 & UP + .015 - .008

SOLID-EDGE

PCT SYSTEMS, INC.
PCT SYSTEMS, INC.
44000 OLD WARM SPRINGS BLVD.
FREMONT. CA 94538

DRAWN H. AMOROSO DATE 25 MAY 04

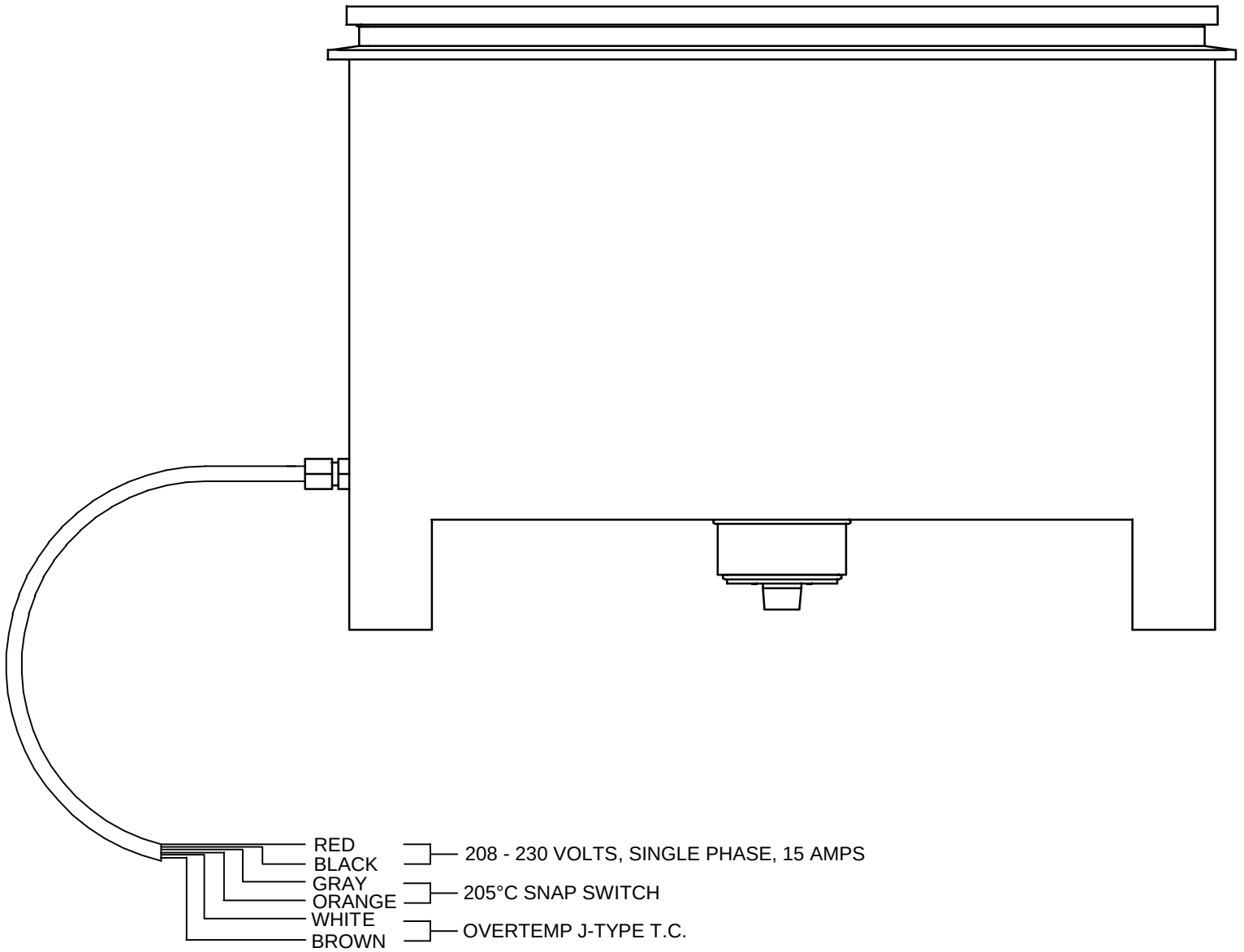
PART NO. PN

TITLE
BLOCK DIAGRAM,
MODEL 90N,
BATH CONTROLLER INTERFACE

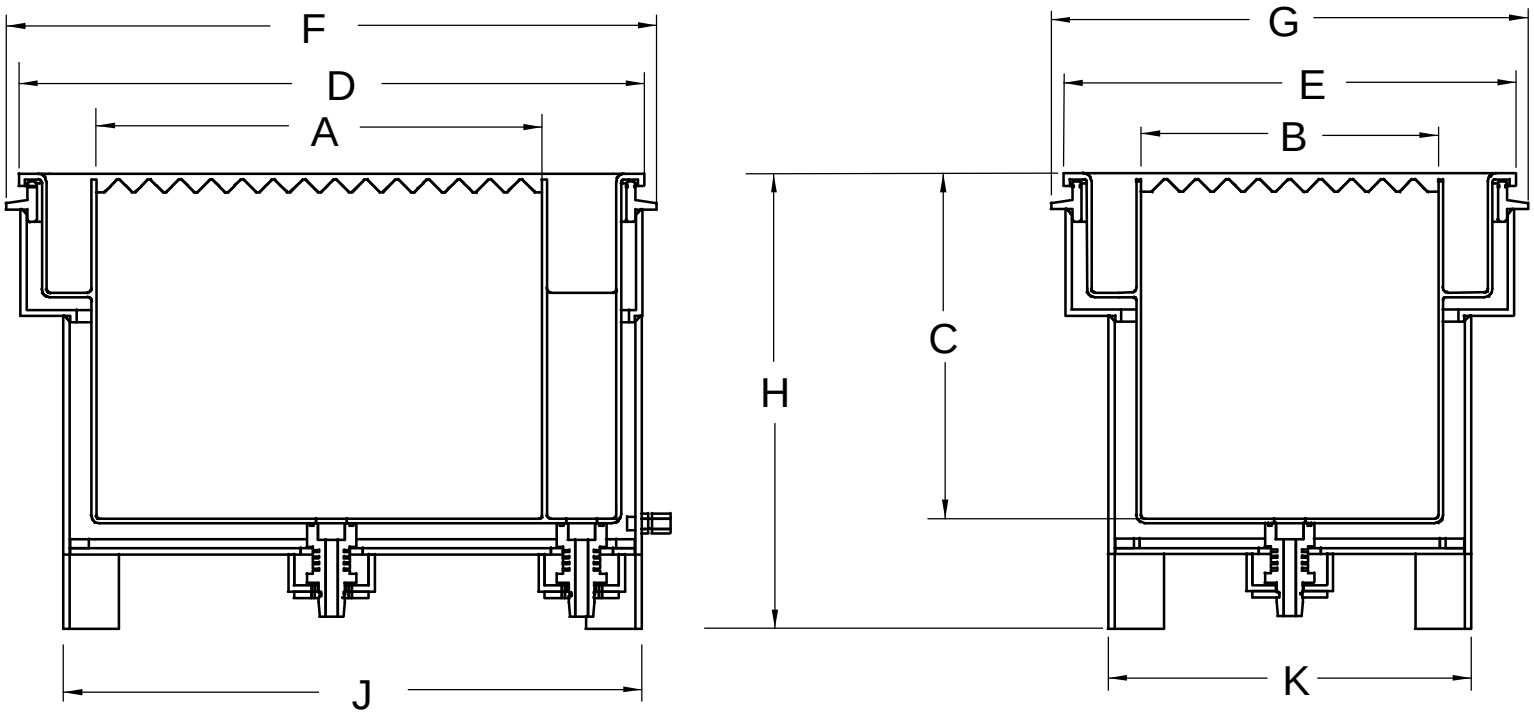
DRW NO. PCT-3456

REV. B

SHEET 1 OF 1



STANDARD TANK
CABLE WIRE DIAGRAM



DRW	MODEL	A	B	C	D	E	F	G	H	J	K
1048	TTF4	7.75	7.75	9.6	15.0	14.0	16.0	15.0	14.1	13.1	10.4
1284	TTF8	11.5	7.5	7.8	18.75	13.75	19.75	14.75	12.7	16.85	10.15
1762	TTF10	13.5	7.5	8.8	20.75	13.75	21.75	14.75	13.5	18.85	10.15
1205-0	TTF14	16.0	8.0	9.8	23.25	14.25	24.25	15.25	14.5	21.35	10.65
1173-3	TTF20	11.0	12.0	11.7	18.25	18.25	19.25	19.25	15.95	16.35	14.65
1380-2	TTF30	21.5	11.5	12.94	28.75	17.75	29.75	18.75	17.7	26.9	14.15

STANDARD RECIRCULATING TANKS

APPENDIX B
OTHER INFORMATION

Purpose

Occasionally, other information, not contained in this Manual, is sent to you as an addendum to this Manual.

This Appendix provides a place to store this information.

Heater Wattage Chart

NOTE:
The wattage values are shown at 208VAC.

Model	Wattage	Amps	Ohms
TT4	1588	7.5	28
TT8	2372	11	19
TT10	2372	11	19
TT14	2689	13	16
TT20	2640	12.6	16.5
TTF4-360	3072	14.8	14.1
TTF8-360	2606	16	13
TTF10-360	3068	14.8	14.1
TTF14-360	3050	14	15
TTF20-360	2939	13.4	15.5