

TYTAN™

Inline Water Heater

Instruction Manual



**PROCESS
TECHNOLOGY**

www.process-technology.com

7010 Lindsay Dr., Mentor, OH 44060 Phone: 440-974-1300 Fax: 440-974-9561 USA/CN: 800-621-1998

TABLE OF CONTENTS:

| | |
|--|-----------|
| RELATED DOCUMENTS | 3 |
| INTRODUCTION..... | 4 |
| SYSTEM SPECIFICATIONS | 6 |
| MODEL NUMBER..... | 10 |
| MODEL NUMBER EXPLANATION..... | 11 |
| FACILITY REQUIREMENTS | 13 |
| WATER PLUMBING REQUIREMENTS..... | 14 |
| ELECTRICAL REQUIREMENTS | 14 |
| INSTALLATION | 15 |
| INSPECTION AND UNCRATING | 15 |
| POSITIONING AND MOUNTING..... | 17 |
| PLUMBING..... | 18 |
| WIRING | 20 |
| RC1, RC2 COMMUNICATIONS (OPTIONAL)..... | 22 |
| RC3 COMMUNICATIONS (OPTIONAL)..... | 23 |
| RI REMOTE INTERFACE (OPTIONAL) | 23 |
| OPERATIONS | 25 |
| CONTROL PANEL | 25 |
| TEMPERATURE CONTROLLER E5CN | 26 |
| PARAMETER SETTINGS E5CN..... | 29 |
| CHANGING SET POINT E5CN..... | 30 |
| HIGH ALARM E5CN | 30 |
| PID TUNING E5CN..... | 31 |
| TEMPERATURE CONTROLLER E5CK (RC OPTIONS) | 32 |
| PARAMETER SETTINGS E5CK | 35 |
| CHANGING SET POINT E5CK | 36 |
| HIGH ALARM E5CK | 37 |
| PID TUNING E5CK..... | 38 |
| OVER TEMPERATURE CONTROLLER: FDC-L91..... | 39 |
| SYSTEM START UP | 42 |
| SYSTEM SHUT DOWN..... | 42 |
| MAINTENANCE..... | 43 |
| WARRANTY | 44 |

RELATED DOCUMENTS:

The following documents are to be used in conjunction with this manual:

ANSI/NFPA70 – National Electric Code[→], latest edition. To be used to determine appropriate electrical service, wire sizing, routing and protection.

SEMI S2 – Semiconductor Equipment Safety Guidelines, latest edition. To be used in conjunction with safe operation, access and decommissioning procedures.

OMRON E5CN INSTRUCTION MANUAL – To be used to access features of the E5CN temperature controller. (Secure appropriate manual for any optional temperature controller used in place of the E5CN).

OMRON E5CK INSTRUCTION MANUAL (for units with RC1, RC2 or RC3 option) – To be used to access features of the E5CK temperature controller.

ANY – State or local building codes that would cover the electrical, mechanical, or physical installation of electrical heating equipment.

National Electric Code[→]
NFPA 1999 Copyright
National Fire Protection Association
Quincy, Mass. 02269

INTRODUCTION:

The following symbols and warning labels appear on the unit and in the instruction manual. The table below provides an explanation of each one.








| DESCRIPTION | PICTORAL DESCRIPTION |
|---|---|
| <p>DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.</p> |  |
| <p>WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.</p> |  |
| <p>CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.</p> |  |
| <p>DANGER: HAZARDOUS VOLTAGE ENCLOSED Voltage or current hazard sufficient to cause shock, burn or death. Disconnect and lock out power before servicing.</p> |  |
| <p>WARNING: HAZARDOUS VOLTAGE Contact may cause electric shock or burn. This unit to be serviced by trained personnel only.</p> |  |
| <p>CAUTION: HOT SURFACE. DO NOT TOUCH Heater column may be hot. Allow unit to cool before servicing.</p> |  |
| <p>PROTECTIVE EARTH (GROUND)</p> |  |

Table 1: TYTAN Warning Labels

INTRODUCTION (Continued):

The TYTAN water heater is designed for inline heating of de-ionized (DI) water, city water, reverse-osmosis (RO) water, and filtered seawater. It can perform both as a recirculating heater or a single-pass heater.

TEMPERATURE PERFORMANCE: The TYTAN water heater is designed to provide a specified temperature increase at a given flow rate. Table 2 shows the maximum temperature increase (ΔT) that can be achieved for continuous flow conditions at the specific heater power ratings varying from 24 kW to 144 kW (Higher wattage systems available upon request). The temperature control system provided with the heater will modulate the power to the heating columns in order to maintain your specific outlet temperature setting.

| Flow Rate GPM | Heater Power (Kilowatts) | | | | | | | | |
|------------------|---|-------|------|-------|------|-------|-------|-------|-------|
| | 12 | 18 | 24 | 36 | 48 | 72 | 96 | 120 | 144 |
| | Maximum Theoretical Temperature Rise (°F) | | | | | | | | |
| 1 | 80.8 | 121.2 | - | - | - | - | - | - | - |
| 2 | 40.4 | 60.6 | 80.8 | 121.2 | - | - | - | - | - |
| 4 | 20.2 | 30.3 | 40.4 | 60.6 | 80.8 | 121.1 | - | - | - |
| 6 | 13.5 | 20.2 | 26.9 | 40.4 | 53.8 | 80.8 | 107.7 | 134.6 | - |
| 8 | 10.1 | 15.1 | 20.2 | 30.3 | 40.4 | 60.6 | 80.8 | 101.0 | 121.2 |
| 10 | 8.0 | 12.1 | 16.1 | 24.2 | 32.3 | 48.4 | 64.6 | 80.8 | 96.9 |
| 12 | 6.7 | 10.1 | 13.4 | 20.2 | 26.9 | 40.4 | 53.8 | 67.3 | 80.8 |
| 14 | 5.7 | 8.6 | 11.5 | 17.3 | 23.0 | 34.6 | 46.1 | 57.7 | 69.2 |
| 16 | 5.0 | 7.5 | 10.1 | 15.1 | 20.2 | 30.3 | 40.4 | 50.5 | 60.6 |
| 18 | 4.5 | 6.7 | 8.9 | 13.4 | 17.9 | 26.9 | 35.9 | 44.8 | 53.8 |
| 20 | 4.0 | 6.0 | 8.0 | 12.1 | 16.1 | 24.2 | 32.3 | 40.4 | 48.4 |
| 22 | 3.6 | 5.5 | 7.3 | 11.0 | 14.6 | 22.0 | 29.3 | 36.7 | 44.0 |
| 24 | 3.3 | 5.0 | 6.7 | 10.1 | 13.4 | 20.2 | 26.9 | 33.6 | 40.4 |

Table 2: Maximum Temperature Rise

SAFETY DEVICES: The TYTAN water heaters include a comprehensive system of safety controls and devices to insure safe and long-lasting operation. The list of safeties is included in *Table 3: system specifications* provided on the following page.

SYSTEM SPECIFICATIONS:

| | | | | |
|---------------------------------|---|-----------------|----------------|-------------------|
| Product | TYTAN inline titanium water heater | | | |
| Standards | UL, cUL standard CE, SEMI S3 optional (-SC) | | | |
| Available Wattage Range | 12kW – 144kW Refer to model number label for the wattage of any specific unit | | | |
| Available Voltages | 208V – 600V, 50/60Hz, 3 phase standard (Some voltages available in single phase or with special construction, consult factory for details) | | | |
| Cabinet dimensions: | Width | Depth | Height | Weight |
| 12kW – 48kW | 28.5-in (75 cm) | 13.5-in (34 cm) | 36-in (91 cm) | 145 lbs. (66 kg) |
| 72kW | 37.5-in (95 cm) | 13.5-in (34 cm) | 36-in (91 cm) | 230 lbs. (104 kg) |
| 96kW – 144kW | 28-in (71 cm) | 17-in (43 cm) | 63-in (160 cm) | 300 lbs. (136 kg) |
| Wetted surfaces: | | | | |
| Heating elements | CP2 titanium standard, (316SS optional [-S option]) | | | |
| Columns and plumbing | CP2 titanium standard, (316SS optional [-S option]) | | | |
| PRV Valve | PVDF | | | |
| Operating temperatures: | | | | |
| Process inlet | | | | |
| Process outlet | Up to 194°F (90°C), depending upon operating conditions | | | |
| Temperature accuracy | +/- 1°F, depending upon operating conditions | | | |
| Ambient air temperature | 86°F (30°C) maximum | | | |
| Water pressure range | Minimum 10 psi (69 kPa, 0.69 bar) Maximum 100 psi (690 kPa, 6.9 bar) | | | |
| Minimum water flow rate: | | | | |
| 12kW - 24kW | 0.5 gpm (2 lpm) | | | |
| 36kW – 48kW | 1.0 gpm (4 lpm) | | | |
| 72 kW | 1.5 gpm (6 lpm) | | | |
| 96kW | 2.0 gpm (8 lpm) | | | |
| 120kW | 2.5 gpm (10 lpm) | | | |
| 144kW | 3.0 gpm (12 lpm) | | | |
| Standard Safety Devices: | EMO Pushbutton Pressure Relief Valve (PRV), connected to inlet manifold Electrically grounded heating chamber construction Ground Fault Protection (GFP) Safety Limit Control (SLC) Bimetallic heater over temperature sensor(s) Heater outlet overtemperature alarm Solid state relay (SSR) overheat bimetallic sensor Sensor failure detection Control circuit fuse protection | | | |

Table 3: TYTAN Specifications

SYSTEM SPECIFICATIONS (Continued):

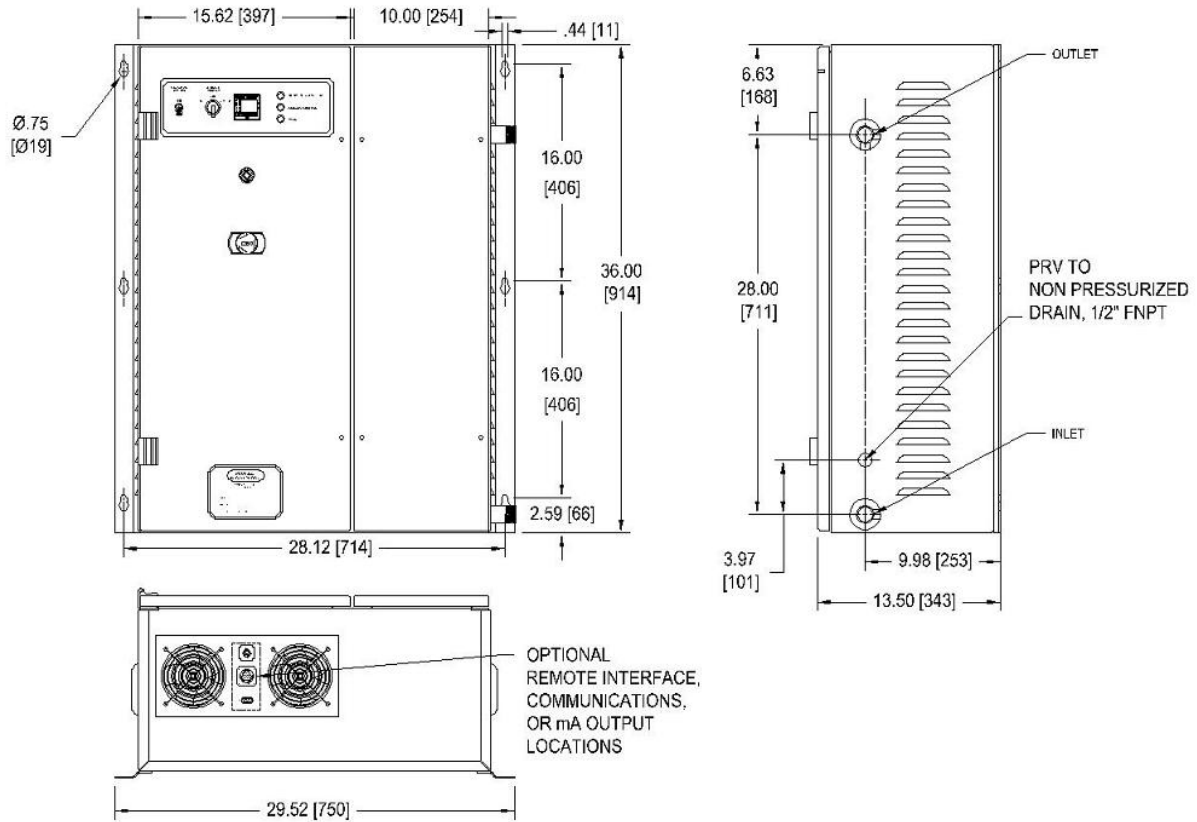


Figure 1: Dimensional Drawing, 12kW – 48kW Units

SYSTEM SPECIFICATIONS (Continued):

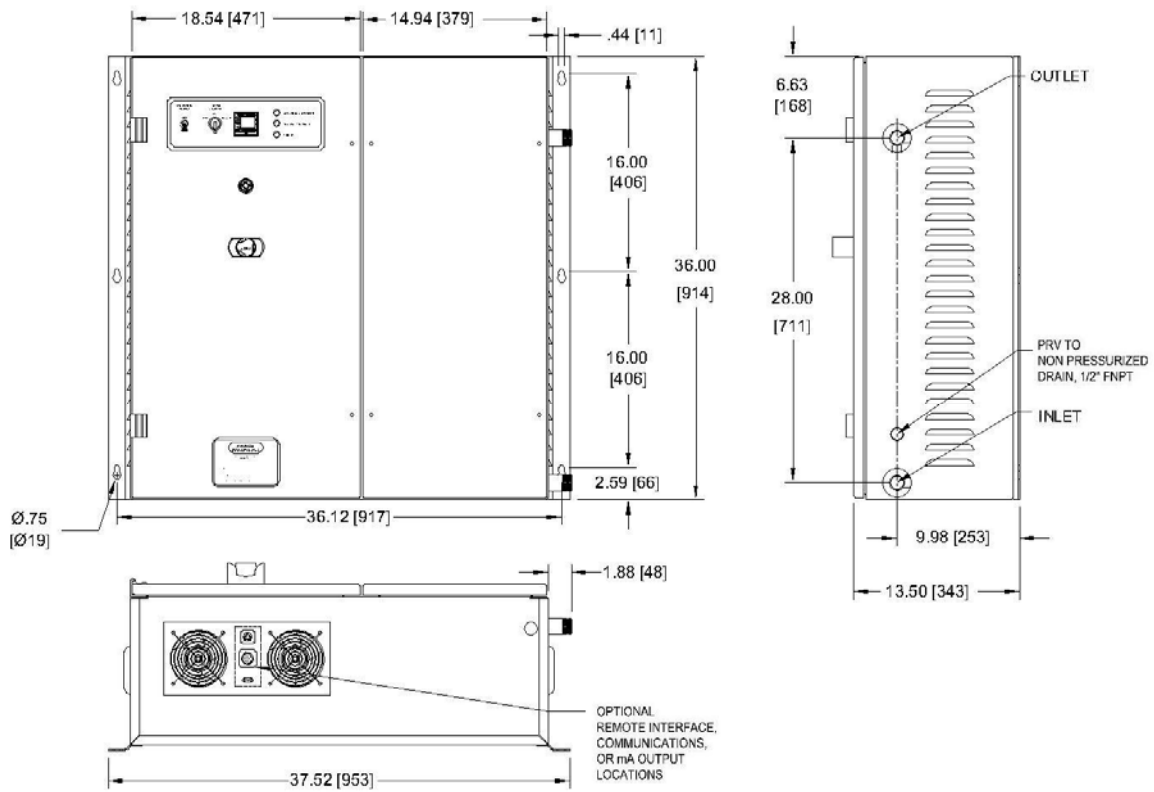


Figure 2: Dimensional Drawing, 72kW Unit

SYSTEM SPECIFICATIONS (Continued):

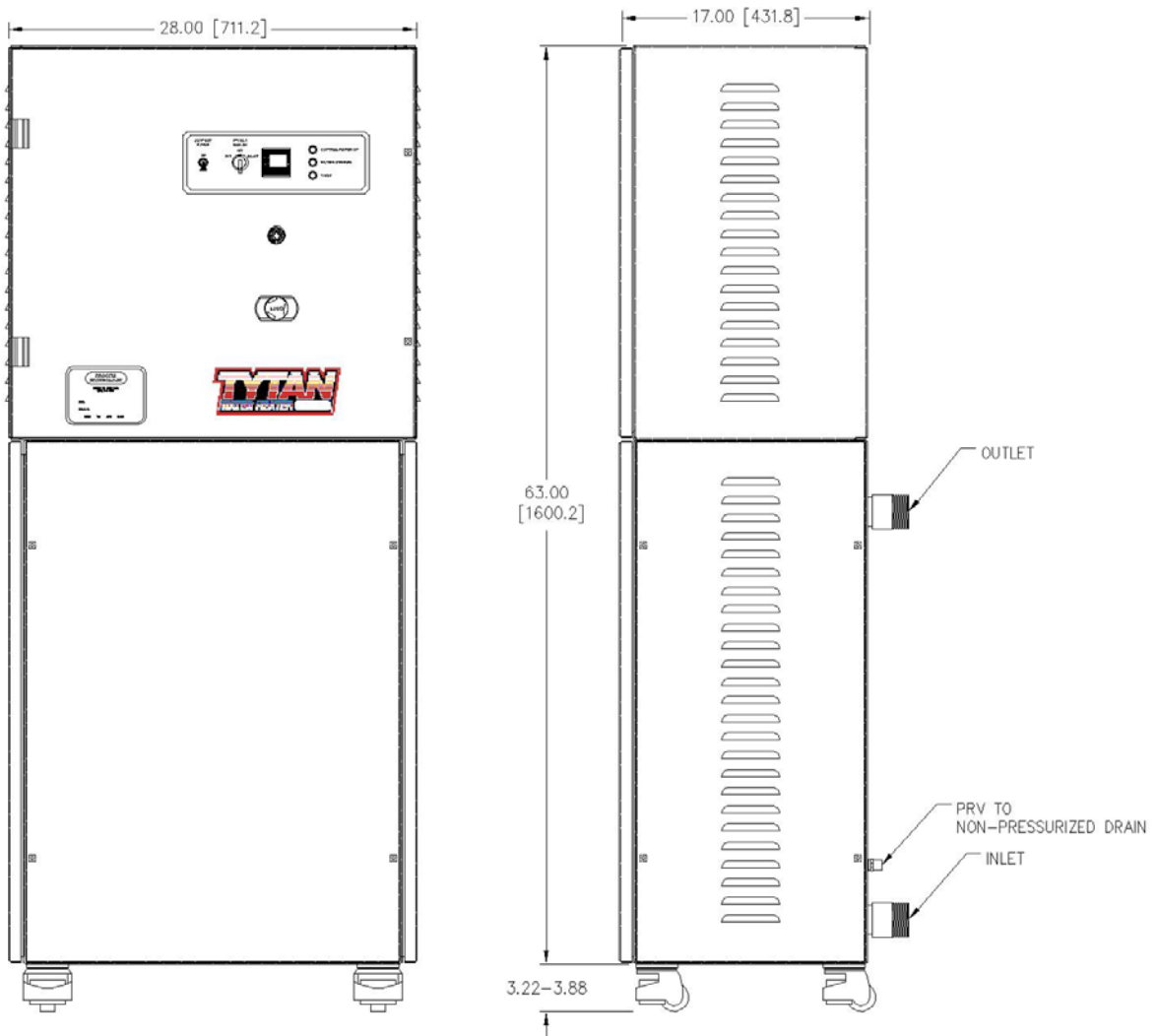


Figure 3: Dimensional Drawing, 96kW – 144kW Units

MODEL NUMBER:

Process Technology model numbers are designed to offer some description of the heater construction, including features and options. The model number can be found on the model/serial number label located on the front of the unit, near the bottom (see figures 1-3).

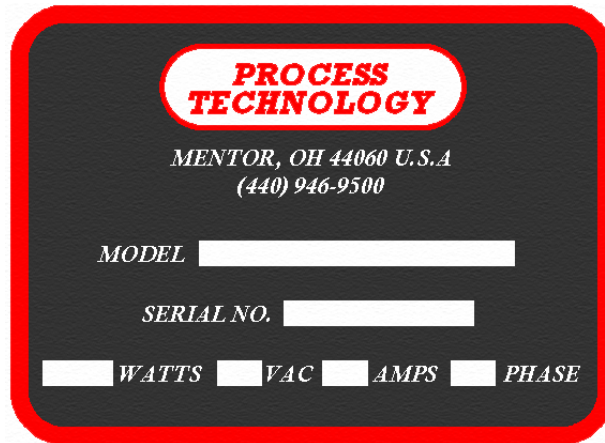


Figure 4: Model/Serial Number Label

Model Number (Continued):

Model Number Explanation:

Provided below is an example of a typical model number along with an explanation of each part. This key will help you understand your model number.

Model number example:

TY-072-480-3-SC-RI

① ② ③ ④ ⑤

- ① **Heater Series.** The beginning of each model number will designate the product line. In this case, the TYTAN inline titanium water heater.

- ② **Heater Wattage.** The numerical portion of the model number will always begin with the wattage of your heater. The table provided below identifies the standard available wattage ratings and the number of heater columns needed to provide that amount of Wattage.

| HEATER MODEL NUMBER | HEATER WATTAGE (W) | NUMBER OF HEATER COLUMNS | WATTAGE PER HEATING COLUMN (W) | HEATER MODEL NUMBER | HEATER WATTAGE (W) | NUMBER OF HEATER COLUMNS | WATTAGE PER HEATING COLUMN (W) |
|---------------------|--------------------|--------------------------|--------------------------------|---------------------|--------------------|--------------------------|--------------------------------|
| 012 | 12,000 | 1 | 12,000 | 072 | 72,000 | 3 | 24,000 |
| 018 | 18,000 | 1 | 18,000 | 096 | 96,000 | 4 | 24,000 |
| 024 | 24,000 | 1 | 24,000 | 120 | 120,000 | 5 | 24,000 |
| 036 | 36,000 | 2 | 18,000 | 144 | 144,000 | 6 | 24,000 |
| 048 | 48,000 | 2 | 24,000 | | | | |

Table 4: Wattage and Column Table

Model Number Explanation (continued):

TY-072-480-3-SC-RI

①

②

③

④

⑤

- ③ **Heater Voltage.** The first character following the heater Wattage will describe the rated Voltage of the heater.
- ④ **Heater Phase.** This character will specify if this unit is designed for single phase (-1) or three phase (-3) power.
- ⑤ **Options.** The remaining characters will specify any options included in this system. Many of these options can be combined on a single Tytan water heater. Only a few options are mutually exclusive.

| Model Number | Option |
|--------------|--|
| -CB | Include circuit breaker with disconnect switch. |
| -SC | Built to SEMI S3 standards, CE compliant version (Includes -CB option) |
| -PLC | PLC temperature controller, in place of the standard PID controller |
| -RI | Remote interface. This will allow the user to start, stop, reset the unit and monitor the safety circuit remotely. |
| -RC1 | RS485 communications interface with the Omron PID temperature controller (requires optional E5CK controller) |
| -RC2 | RS232 communications interface with the Omron PID temperature controller (requires optional E5CK controller) |
| -RC3 | 4-20mA process output (requires optional E5CK controller) |
| -S | Wetted surfaces to be passivated 316 stainless steel. |
| -X | Special option, consult factory |
| -## | Special construction design, consult factory for details |
| | |

Table 5: TYTAN Options

FACILITY REQUIREMENTS:

Before installing the TYTAN inline water heater confirm the facility requirements listed below.

Space Requirements:

The TYTAN inline water heater is constructed in a wall-mounted or freestanding enclosure. The dimensions of this enclosure are based upon the wattage of the unit. This enclosure includes the common framework for the heating column(s) as well as the electrical components.

The enclosure requires adequate ventilation. Locate equipment so that ventilation provisions on the bottom and sides of the enclosure are not obstructed. The ventilation fan exhausts air through these openings which prevents overheating of the interior. Be sure to provide adequate clearance for normal operation and maintenance of this heater.

The standard dimensions of the various models are shown in Table 3 (see appendix for custom made units). Allow additional space on all sides of the unit for the control ventilation and service access. (all dimensions are in inches).

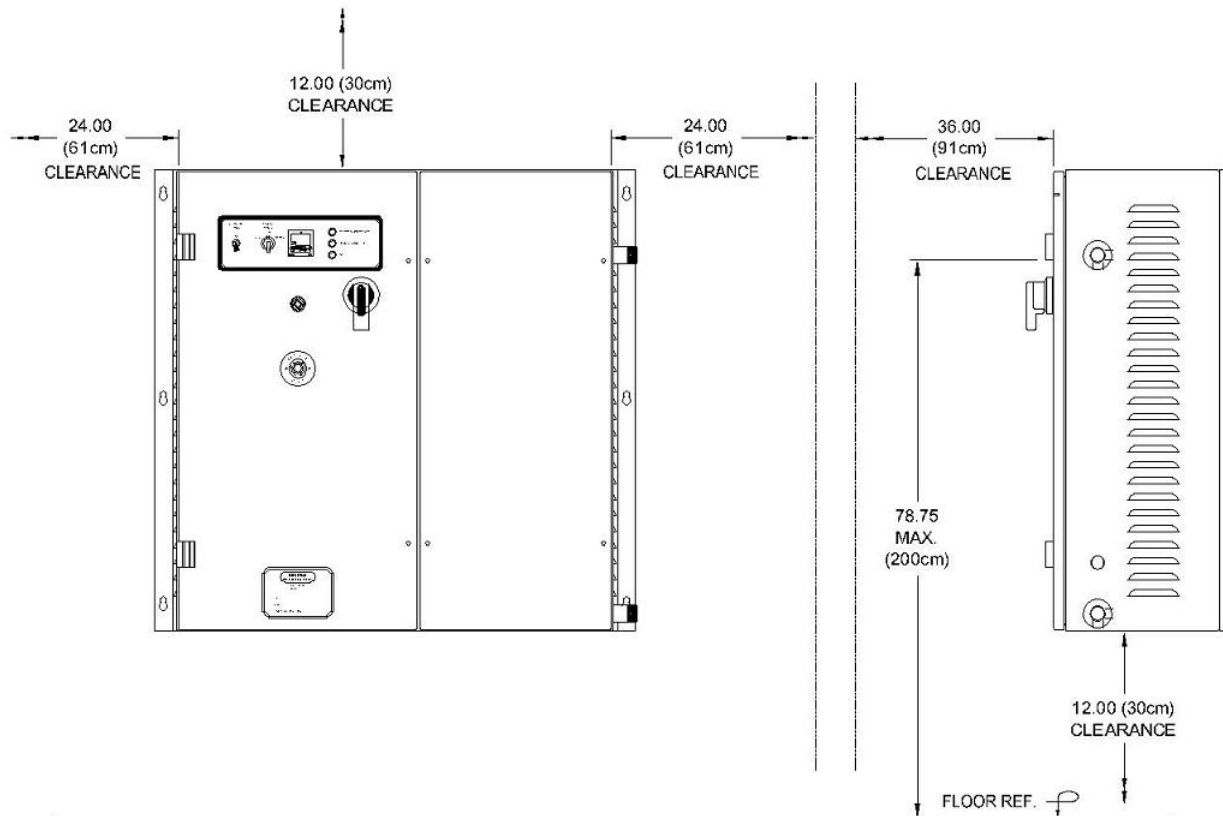


Figure 5: Clearance Dimensions for Wall-Mounted Units (72kW Model Shown)

Facility Requirements (continued):

Water Plumbing Requirements:

The customer supplied inlet and outlet plumbing must be rated to withstand temperatures up to 275°F (135°C) at pressures up to 100 psi (6.9 Bar).

The wall-mounted TYTAN units are supplied standard with 1-inch MNPT threaded pipe connections for the plumbing inlet and outlet. These connections extend from the right side of the unit, with the inlet near the bottom and the outlet near the top (see figures 1-2). There is also a ½-inch FNPT threaded pipe connection for the PRV valve on the right side of the enclosure which must be plumbed to a non-pressurized drain. Special plumbing connections are available as an option. Refer to your specific unit for any special connections.

The free-standing TYTAN units are supplied standard with 2-inch MNPT threaded pipe connections for the plumbing inlet and outlet. These connections extend from the back of the unit, with the inlet near the bottom and the outlet near the top (see figure 3). There is also a ½-inch FNPT threaded pipe connection for the PRV valve on the back of the enclosure, which must be plumbed to a non-pressurized drain. Special plumbing connections are available as an option. Refer to your specific unit for any special connections.



Do not reverse the plumbing connections of this unit. Failure to observe the correct plumbing orientation will result in high-temperature conditions and heater failure.

Electrical Requirements:

NOTE: Ensure electrical power fusing and disconnects meet local jurisdictional requirements. Fuse ratings noted in this document are for reference only. Ensure external electrical components comply with local requirements before operating this unit.

Reference the model/ serial number label to identify the electrical power requirements of this unit (see figure 4). Verify that the incoming electrical service is rated and fused for the required amperage draw.



Do not exceed the rated voltage. Irreparable damage to the heating column or control circuitry may result.

INSTALLATION:

NOTE: The mounting and installation of this unit should only be performed by qualified personnel.

Inspection and Uncrating:

The wall-mounted TYTAN units are shipped in a horizontal position. The free-standing TYTAN units are shipped in a vertical position.



Due to the weight of the unit, DO NOT ATTEMPT to move or lift the unit without the appropriate material handling equipment.

- 1) Inspect the shipping crate for evidence of damage. If any damage is detected, contact the carrier immediately.
- 2) Inspect the shock sensors located on the outside of the crate. The shock sensors will indicate if the unit experienced rough handling. If the sensors indicate that the unit has experienced rough handling, contact the carrier immediately. If the shock sensor on the outside of the crate is missing, there is also a shock sensor located on the inside of the crate.



Figure 6: Shockwatch Sensor

INSTALLATION (Continued):

Uncrating the wall-mounted units:

- 3) Remove the top of the crate.
- 4) Remove any protective packaging material and any other materials that may have been packed in the crate with the enclosure.
- 5) Remove any braces used to hold the unit in place during shipping.
- 6) Using a hoist or other suitable lifting device, lift the unit from the mounting holes on the side flanges and remove from the crate. Do NOT lift the unit by holding the plumbing connections or (if present) the disconnect handle.

Uncrating the free-standing units:

- 3) Remove the front of the crate.
- 4) Remove any protective packaging material and any other materials that may have been packed in the crate with the enclosure.
- 5) Remove any braces used to hold the unit in place during shipping.
- 6) Using a hoist or other suitable lifting device, lift the unit from underneath and remove from the crate. Do NOT lift the unit by holding the plumbing connections or (if present) the disconnect handle.



**Do not tip the unit beyond 10° from vertical.
Serious personal injury or equipment damage
may result.**

INSTALLATION (Continued):

Positioning and Mounting:


Wall-mounted units:

The wall-mounted TYTAN units must be anchored to a support structure that can support at least 275-pounds (125 kg). We recommend that the mounting bolts are no smaller than a 3/8-16 thread.


We recommend that the unit is mounted such that the temperature controller is no more than 78-inches (2 meters) above the floor level (see figure 5).

Free-standing units:

Move the unit into position by lifting the unit from underneath using a fork truck or other suitable handling equipment. Position the equipment to avoid damaging the cooling fans located on the bottom of the unit.

| | |
|--|---|
|  | <p>The castors should not be used to move the unit over long distances or on uneven surfaces. They are intended to facilitate small adjustments to the position of the unit at its place of operation. Move the unit slowly, as there is no means of slowing or stopping the unit. Ensure that there are sufficient personnel to move the unit safely. Failure to follow these instructions can result in serious personal injury and/or damage to the unit.</p> |
|--|---|

Place the unit on a hard, level surface. Ensure the unit is secured so as not to roll as the casters are unlocked. Once the unit is in position, lock the four castors.

| | |
|---|--|
|  | <p>Ensure the unit is on a smooth, level surface and there are sufficient personnel to hold the unit in place. As the leveling feet are retracted and the unit rests on the castors unexpected movement may result. Failure to properly secure the unit may result in serious personal injury and/or damage to equipment.</p> |
|---|--|

INSTALLATION (Continued):

Plumbing:

The plumbing installation of this unit should only be performed by qualified technicians.



Verify that the water supply is shut off, and any necessary lockout/tagout devices are properly installed.

The customer supplied inlet and outlet plumbing must be rated for temperatures up to 275°F (135°C) at pressures up to 100 psi (6.9 Bar).

On all TYTAN units, the lower plumbing connection will always be the inlet, and the upper plumbing connections will always be the outlet. The inlet plumbing to the unit must include the means to drain the unit, which may be necessary in the case of replacing the heating column or other parts.



Do not reverse the plumbing connections of this unit. Failure to observe the correct plumbing orientation will result in high-temperature conditions and heater failure.

INSTALLATION (Continued):

Plumbing (Continued):

When tightening all connections on this unit, be sure to support the TYTAN heater connection to prevent excessive torque or strain from damaging the internal plumbing of the unit.

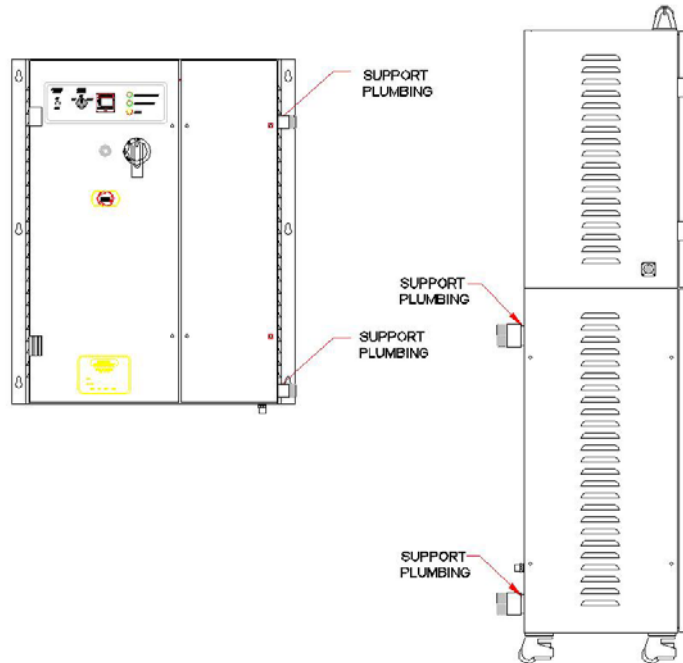


Figure 7: Tytan Heater Connection Support



Failure to properly support the TYTAN plumbing connections during tightening will result in equipment damage and internal water leaks. Such damage is not covered under the product warranty.

Inlet/Outlet Plumbing Connections:

- 1) Remove the protective plastic caps from inlet and outlet plumbing.
- 2) Test fit the piping to insure proper length.
- 3) Support the TYTAN pipe fittings to avoid any damage during tightening.
- 4) Tighten the connections as required. Take care not to over-tighten.
- 5) Establish water flow through the unit. Inspect the plumbing for leaks.

INSTALLATION (Continued):


Plumbing (Continued):

PRV Plumbing Connection:

- 1) Test fit the drain pipe to insure proper length. The PRV must be connected to a non-pressurized drain.
- 2) Support the TYTAN PRV fitting to avoid any damage during tightening.
- 3) Tighten the connection as required. Take care not to over-tighten.

Wiring:

The wiring of this unit should only be performed by qualified technicians.

| | |
|---|--|
|  | Verify that the electrical power supply is shut off, and any necessary lockout/tagout devices are properly installed. |
|---|--|

Power Connections:


TYTAN units are designed to operate on 4 wire electrical power supplies (3 power wires, 1 ground wire). All electrical connections should conform to local electrical codes and/or NFPA 70/79.

There is no pilot hole for incoming power supply conduit. This hole will have to be cut in the top of the enclosure during installation.



Figure 8: Recommended location for power supply conduit (72kW unit shown)

- 1) Check the model/serial number on the front of the unit for power requirements.

| | |
|---|---|
|  | Do not exceed the rated voltage. Irreparable damage to the heating column or control circuitry may result. |
|---|---|

INSTALLATION (Continued):

Wiring:

- 2) Remove front cover of the control side of the cabinet by loosening the cover mounting screws.
- 3) Cut a hole in the top of the enclosure for the incoming power supply to allow for the power supply to enter the top of the enclosure.
- 4) Fuse the incoming line for the rated amperage using an approved electrical disconnect box.
- 5) Connect the leads from the incoming power line to the appropriate terminals (reference the Electrical Schematic) making sure not to disturb existing wiring. Use care that no loose strands of wire are exposed out of the terminal connection. Torque all wires to the specified ratings located on the wiring diagrams and component labels.

| <u>TORQUE SPECIFICATIONS</u> |
|--------------------------------------|
| CIRCUIT BREAKER |
| |
| DISTRIBUTION BLOCK |
| PRIMARY: SECONDARY: SECONDARY: |
| POWER FUSES |
| |
| SAFETY CONTACTOR |
| |
| SOLID STATE RELAYS |
| INPUT : OUTPUT : |

Figure 9: Torque Specifications Label

- 6) Grounding is done internally from the Incoming Power Strip.

INSTALLATION (Continued):

Wiring:

RC1 (RS232), RC2 (RS485) Options: Serial Communication Interface:

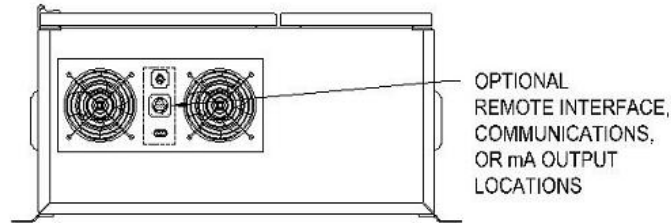


Figure 10: Location of optional interface connections

In units supplied with the RC1 (RS485) or RC2 (RS232) options, the Omron E5CK temperature controller is equipped with RS-232 / RS-485 Serial Communication capability for use with a customer-supplied host computer. If this option is used, all temperature and related parameters can be monitored or altered from the host computer. On these units, the communications wiring is made through a DB-9 receptacle located on the side or bottom of the cabinet. An independent serial cable should be installed between the host computer and the DB-9 receptacle (not included with unit).



Figure 11: DB9 connector, for optional -RC# remote communications

RC1 (RS485) Communications pin assignment:

| Pin Number | Signal |
|---------------------|---------------|
| 2 | Positive (+) |
| 3 | Negative (-) |
| 1, 4, 5, 6, 7, 8, 9 | Not used |

RC2 (RS232) Communications pin assignment:

| Pin Number | Signal |
|-------------------|---------------|
| 2 | Send |
| 3 | Receive |
| 5 | Signal Ground |
| 1, 4, 6, 7, 8, 9 | Not used |

INSTALLATION (Continued):

Wiring:

RC3 (4-20 mA) Option: Process Output:

Units provided with the RC3 option will include a 4-pin connector plug, for wiring of the 4-20 mA process output. This process output will allow the user to record the outlet temperature of the Tytan heater from a remote device. This signal is an output only.

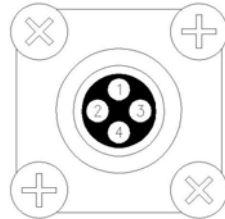


Figure 12: 4-pin connector plug, for optional –RC3 process output

RC3 option process output pin assignment:

| Pin Number | Signal |
|-------------------|---------------|
| 1 | Positive (+) |
| 2 | Negative (-) |
| 3, 4 | Not used |

RI Option: Remote Interface:

Units provided with the RI option will include a 16-pin connector plug which will allow remote operation of the Tytan inline water heater. The remote interface will allow remote operation of heater start/stop, remote EMO trip and remote monitoring of heater enabled and the status of the alarm system. Some of the remote interface inputs have been jumped at the factory, to allow for heater operation with the remote interface cable disconnected. These jumpers are located in the electrical side of the heater cabinet, and are marked by a red tag. If the customer wants to use the remote interface, these red tag jumpers must be removed.

If the unit was provided with a custom remote interface (**-RI#** at the end of the model number), then refer to the electrical prints (provided with the unit) for your specific signals and pin-out assignments.

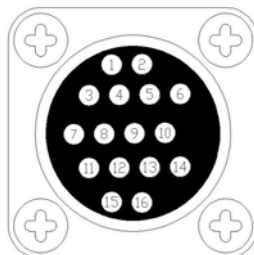


Figure 13: 16-pin connector plug, for optional -RI, -RI# remote interface

INSTALLATION (Continued):

Wiring:

RC3 option process output pin assignment:

| Pin Number | Signal | Signal type | Description |
|-------------------|----------------|-------------------------|---|
| 1, 2 | EMO | Input, Dry contacts | <p>The customer supplied remote controller can trip an EMO condition on the unit by opening contacts across these two pins.</p> <p>This is one of the signals that has been bypassed at the factory. In order to use this remote EMO feature, the red tag jumper must be removed.</p> <p>The EMO condition must be reset at the unit.</p> |
| 3, 4 | Start/Stop | Input, Dry contacts | <p>The customer supplied remote controller can start heater operation by closing the contacts across these pins, when the controller is in REMOTE mode only.</p> <p>This is one of the signals that has been bypassed at the factory. In order to use this remote EMO feature, the red tag jumper must be removed.</p> <p>Open contacts will stop heater operation.</p> |
| 9, 10 | System Fault | Output, Dry Contacts | <p>This output will apply open contacts across these pins when any alarm condition has been tripped. Once the alarm condition has been corrected, the unit will require a manual reset at the unit. The unit can not be reset remotely.</p> <p>Open contacts indicate all of the safety devices are in normal operating mode.</p> |
| 11, 12 | Heater Enabled | Output, Dry contacts | <p>This output will apply closed contacts across these pins when power is applied to the unit, there is not EMO condition and the heater selector switch is set to ON.</p> <p>Open contacts indicate the EMO has been tripped or the unit has been stopped or shut down.</p> |

OPERATIONS:

Control Panel:

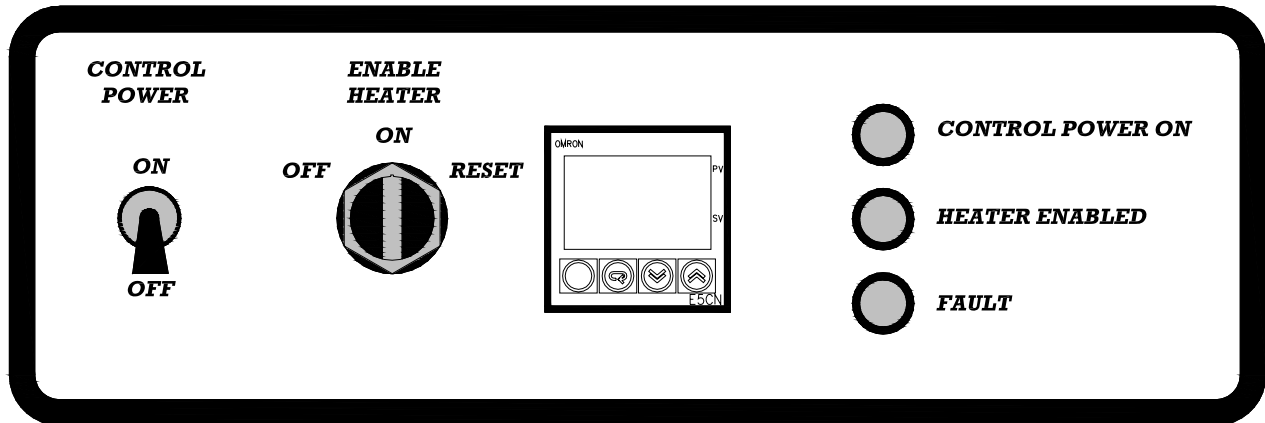


Figure 14: Temperature Controller and Control Panel.

The TYTAN Heating System incorporates a self-tuning, PID microprocessor based, digital temperature controller with a set high temperature alarm. The PID feature enhances the controller's ability to reach and maintain a constant process temperature. The self-tuning feature enables the controller to measure the process characteristics and indicate desired values, which can be displayed on LED displays.


The following sections provide a description and instructions for two available temperature controllers:

1. The Omron E5CN Controller. This is the temperature controller used on standard Tytan heaters. For a complete user guide, visit the Omron website; www.omron.com.
2. The Omron E5CK Controller. This is the temperature controller used on Tytan heaters with the RC1, RC2 or RC3 options. For a complete user guide, visit the Omron website; www.omron.com

These two temperature controllers program differently, and have slightly different control settings. Be sure to refer to the correct temperature controller section when programming your unit.

OPERATIONS (Continued):

Temperature Controller E5CN:

| | |
|---|--|
|  | This section contains information for the E5CN controller only. Do not use these instructions for any other temperature controller, or controller damage may result. |
|---|--|

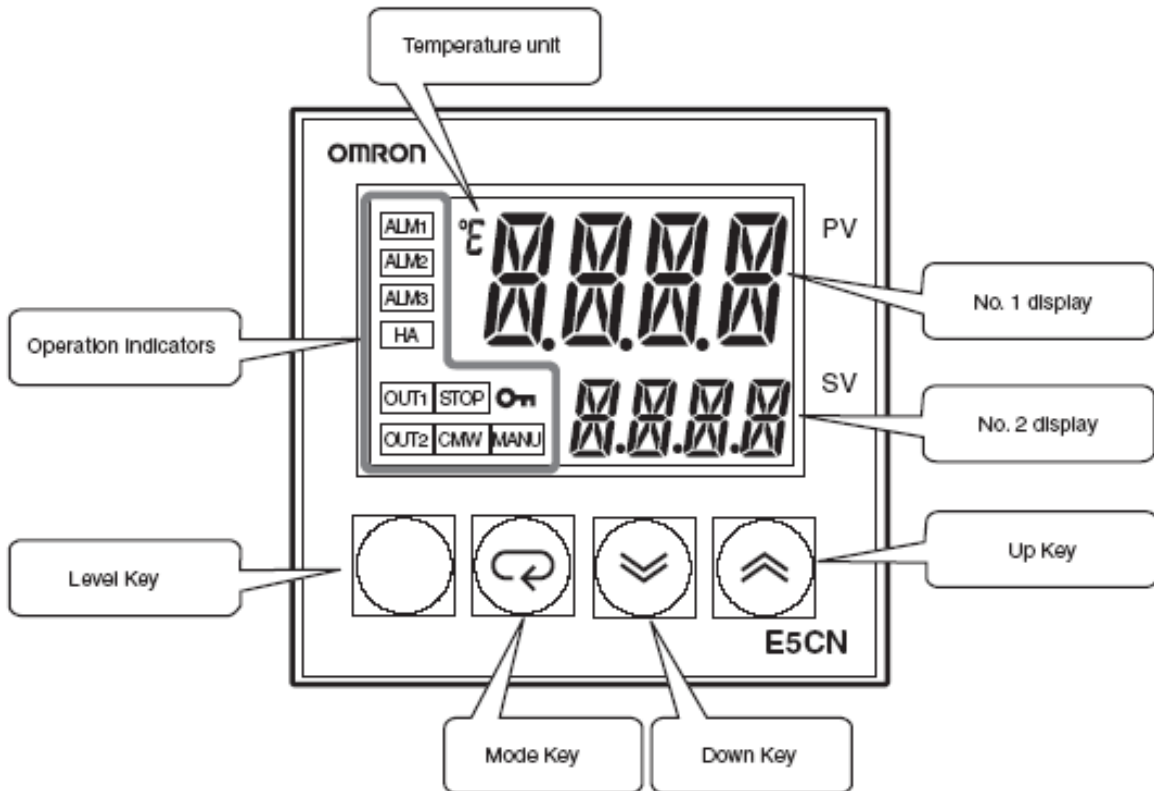


Figure 15: Omron Temperature Controller

DISPLAY FEATURES:

No. 1 display (PV): Shows the process value (outlet temperature), modes and parameter symbols.

No. 2 display (SV): Shows set points, parameter operation read value, or the variable input value.

Level key: Switches the controller between auto and manual operation.

Mode key: Press this key to change parameters within a setting level.

Up and Down arrow keys: Advances, increases or decreases the setting or values in the No. 2 display. Holding these keys down will speed up the rate of change.

OPERATIONS for E5CN (Continued):

Display Symbols:

Operation Indicators:

- ALM1:** Illuminates when the alarm 1 setting is ON (tripped) (120°C).
ALM2: Illuminates when the alarm 2 setting is ON (tripped) (110°C).
ALM3: Not available on this controller.
HA: Not available on this controller.
OUT1: Illuminates when the control output 1 is ON.
OUT2: Illuminates when control output 2 is ON (Not used).
STOP: Illuminates when the control operation has stopped.
CMW: Illuminates when communications wiring is enabled.
On : Illuminates when setting change protection is ON.
MANU: Illuminates when the controller is in Manual operation mode.

The following tables show the correspondence between symbols shown on the No.1 and No.2 displays and alphabetic characters.





| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | b | C | d | E | F | G | H | I | J | K | L | M |
| A | B | C | D | E | F | G | H | I | J | K | L | M |
| N | ō | P | Q | R | S | T | U | V | W | X | Y | Z |
| N | O | P | Q | R | S | T | U | V | W | X | Y | Z |

Figure 16: Omron Temperature Controller Display Symbols

OPERATIONS for E5CN (Continued):

Using the keys:

This section describes the basic functions of the front panel keys.

-  **Level Key:** Press this key to move between setting levels. The setting level is selected in the following order: operation level: adjustment level, initial setting level, communications setting level.
-  **Mode Key:** Press this key to change parameters within a setting level. The parameters can be reversed by holding down the key (moving one per second in reverse order).
-  **Up Key:** Each press of this key increments the value displayed on the No. 2 display or advances the setting. Holding the key down speeds up the incrementation.
-  **Down Key:** Each press of this key decrements values displayed on the No. 2 display or reverses the setting. Holding the key down speeds up the incrementation.

Selecting Menu Levels:

The following section describes how to access the various menu levels in the Omron controller.

- | | |
|---|---|
| <u>Operations Level:</u> | Press the mode key. |
| <u>Adjustment Level:</u> | Press and hold the level key for at least 1 second. |
| <u>Initial Setting Level:</u> | Press and hold the level key for at least 3 seconds. |
| <u>Protect Level:</u> | Press and hold the level key and the mode key simultaneously for at least 3 seconds. |
| <u>Advanced Function Setting Level:</u> | <i>(Note: in order to access this level, the ICPT setting in the protect level must be set at 0)</i> Index through the initial setting level and adjust the AmoV setting to “-169”. |

OPERATIONS for E5CN (Continued):

Mode Parameter Settings:

The Omron E5CN temperature controller has been programmed prior to shipment, so no additional programming is normally necessary. The table below shows the various controller settings for this unit when properly configured to operate the TYTAN inline heater. Some internal menus have been factory programmed and subsequently locked. Those menus are not listed.

The selections in **bold** indicate settings that have been changed from the original factory default for operation with the TYTAN inline heater.

| Level | Parameter | Description | Setting |
|-------------------------|------------------|--------------------------------|----------------|
| Operations Level | R-S | Run – Stop selection | RUN |
| | AL-1 | Alarm value 1 | 120°C |
| | AL-2 | Alarm value 2 | 110°C |
| Adjustment Level | LAdJ | Adjustment level | |
| | At | Autotune execute | OFF |
| | INS | Temperature input shift | 0.0 |
| | P | Proportion band | 80** |
| | I | Integral time | 233** |
| | D | Derived time | 40** |
| | SPRt | SP ramp set value | OFF |
| | OL-H | MV upper limit | 100.0 |
| | OL-L | MV lower limit | 0.0 |

** The P, I and D values may change following the execution of Auto-tune.

Table 6: Omron E5CN Parameters

OPERATIONS for E5CN (Continued):

Changing Primary Set Point:




1. The process Set Point can be changed in the normal display mode.
2. Press the up and down arrow keys to select the desired setting.

After changing the process set point (SP-0) on the Omron controller, you must manually adjust the SP2 setting on the Future Design over-temperature control. See OPERATIONS Over-Temperature Controller FDC-L91 section.

High Alarm:

The Omron E5CN temperature controller incorporates an independent high-temperature alarm. Alarm 1 (AL-1) prevents heater operation above a preset maximum temperature that may harm the process and potentially the tank material. If the process temperature exceeds the preset high alarm value, the heater will be disengaged and the audibly alarm will sound. The temperature controller will activate once the process temperature exceeds the set point by the preset value. The factory setting of this alarm temperature is 248°F (120°C).

The high alarm value can be adjusted to a lower setting through the operations level.

1. Press the mode key  to enter the operations level.
2. Press the mode key  to index through the operations level to the AL-1 setting.
3. Press the up or down key to adjust AL-1 to the desired setting.
4. Press the mode key  to index through the operations level to the AL-2 setting.
5. The AL-2 setting is normally set at 10°C below AL-1. Press the up and down keys to adjust AL-2 to the desired setting.
6. Press and hold the level key for a minimum of three seconds to return to the normal display.

OPERATIONS for E5CN (Continued):

PID Tuning:

The Omron E5CN temperature controller incorporates the capability of automatically tuning the PID parameters (Auto-Tuning) to fit the characteristics of the process. The optimum PID parameters are automatically set by forcibly changing the Manipulated Variable (MV) to calculate the characteristics (limit cycle method) of the control target. Depending on the auto-tune level selected, AT-1 or AT-2, the controller will run this test at either 40% or 100% of the actual Process Set Point. When the auto tuning is complete, the appropriate PID tuning parameters will be automatically installed into the non-volatile memory of the temperature controller.

1. Turn on water supply and set the desired water flow.
2. Set the Process Temperature Set point to the desired value.
(See **OPERATIONS; Changing Primary Set point,**.)
3. Press and hold the level key for a minimum of one second to enter the adjustment level.
4. Press the mode key to index through the adjustment level to get to the **At** setting.
5. Press the up or down arrow key to adjust the **At** value to oN.
6. Press and hold the level key for at least 3 seconds to return to the normal display.
7. Turn the ENABLE HEATER switch past the ON position to the RESET position, then release the switch, which will move to the ON position. If all criteria for the various safety devices have been met, the heater will begin to heat.
8. When the process is complete, the appropriate PID tuning parameters will be installed and retained in the non-volatile memory.

OPERATIONS for E5CK:

Temperature Controller E5CK:



This section contains information for the E5CK controller only. Do not use these instructions for any other temperature controller, or controller damage may result.

The Omron E5CK temperature controller is used on Tytan heaters that utilize the RC1, RC2 or RC3 options. For units with these options, refer to this section (E5CK controller). Do NOT use the section for the E5CN controller

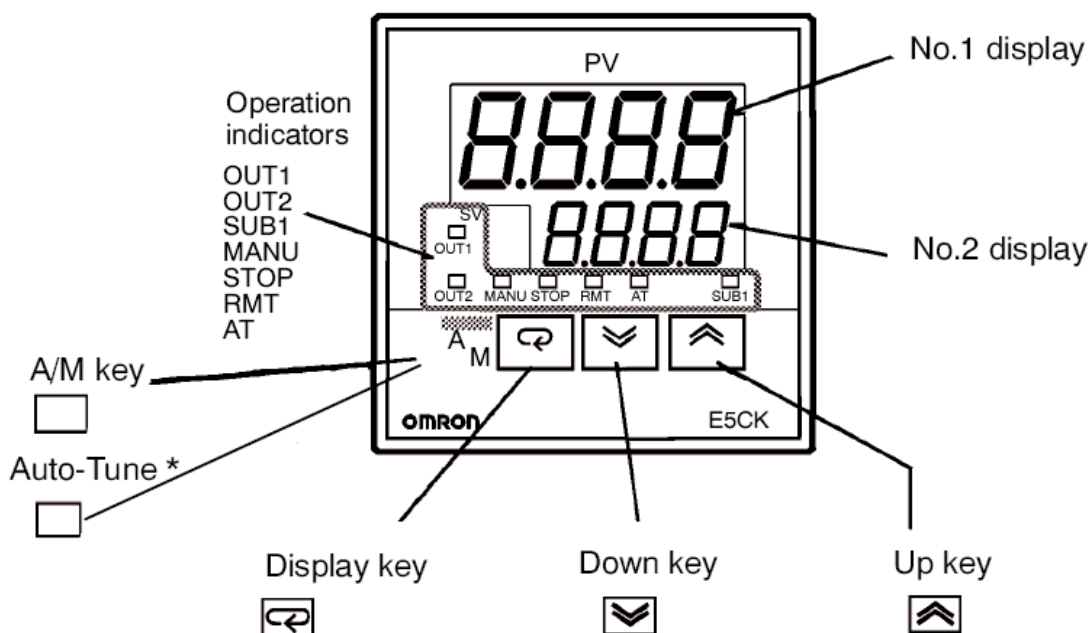


Figure 17: Omron Temperature Controller

DISPLAY FEATURES:

No. 1 display (PV): Shows the process value (outlet temperature), modes and parameter symbols.

No. 2 display (SV): Shows set points, parameter setting and the manipulated variable heat.

OPERATIONS for E5CK (Continued):

A/M key: Switches the controller between auto and manual operation.

Display key: Allows selection of the mode when depressed for more than 1 second. Switches parameters when depressed for less than one second.

Up and Down arrow keys: Advances, increases or decreases the setting or values in the No. 2 display.

OUT1: Illuminates when the controller's heat output is ON.

OUT2: Illuminates when the alarm 1 setting is ON (tripped).

SUB1: Illuminates when the alarm 2 setting is ON (tripped).

MANU: Illuminates when the controller is in Manual operation mode.

STOP: Illuminates when the control operation has stopped.

RMT: Illuminates when in Remote operation.

AT: Flashes during auto-tuning.

Display Symbols:

The following tables show the correspondence between symbols shown on the No.1 and No.2 displays and alphabetic characters.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | b | c | d | E | F | G | H | i | J | K | L | M |
| A | B | C | D | E | F | G | H | I | J | K | L | M |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| n | o | P | q | r | S | t | U | v | w | x | Y | Z |
| N | O | P | Q | R | S | T | U | V | W | X | Y | Z |

Figure 18: Omron Temperature Controller Display Symbols

OPERATIONS for E5CK (Continued):

Selecting Modes:

The modes are selected by pressing the Display Key for one second or greater. The up and down arrow keys allow the movement between modes in the top display.

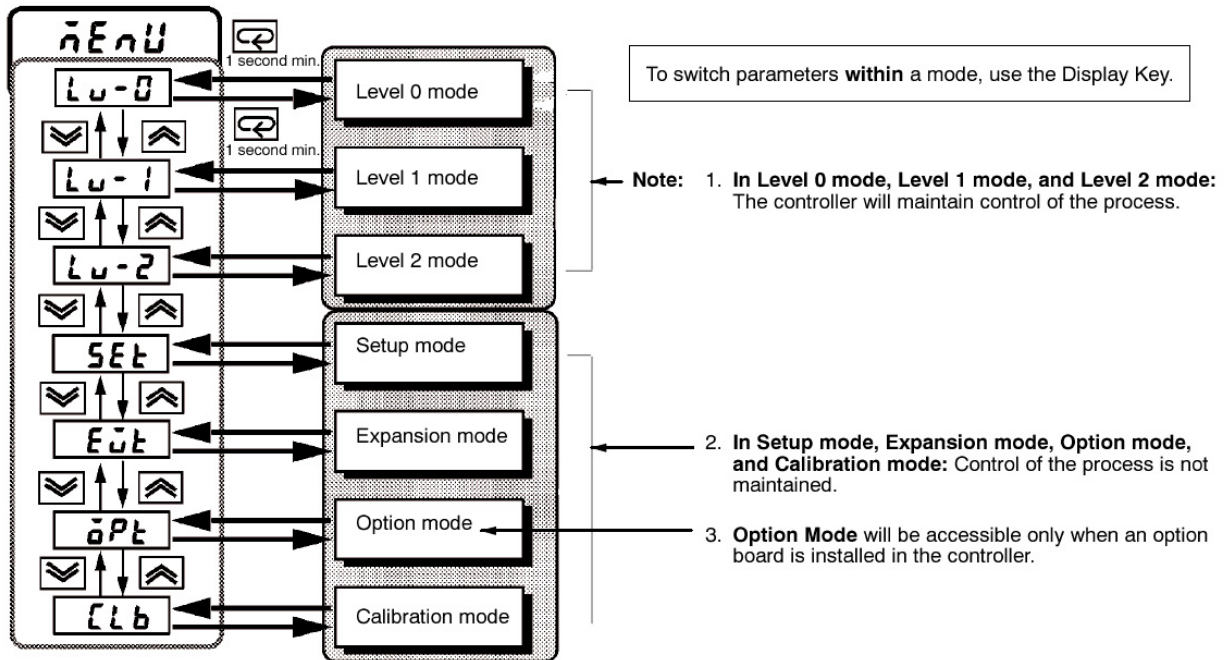


Figure 19: Omron E5CK Menu Navigation

OPERATIONS for E5CK (Continued):

Mode Parameter Settings:

The Omron E5CK temperature controller has been programmed prior to shipment, so no additional programming is normally necessary. The table below shows the various controller settings for this unit when properly configured to operate the TYTAN inline heater. Some internal menus have been factory programmed and subsequently locked. Those menus are not listed.

The selections in **bold** indicate settings that have been changed from the original factory default for operation with the TYTAN inline heater.





| Mode | Parameter | Description | Setting |
|----------------|--------------------------|--|-------------------------------|
| Level 0 | SP-n | Set point during ramp | NP |
| | O | Manipulated variable (MV) monitor for heat | 0 |
| | C-o | Manipulated variable (MV) monitor for cool | NP |
| | r – S | Run/Stop | Run |
| Level 1 | A t | Auto Tune (AT) execute/cancel | o-FF |
| | SP-0 | Set point 0 (Process Set point) | Determined by Operator |
| | A L – 1 | High Alarm | 120°C (248°F) |
| | A L – 2 | Temperature Deviation | 10°C (15°F) |
| | P | Proportional Band | 10.0 (default)** |
| | i | Integral Time | 233 (default)** |
| | D | Derivative Time | 40 (default)** |
| | C-SC | Cooling coefficient | |
| | C-db | Dead band | |
| | Of-R | Manual reset value | |
| | HYS | Hysteresis (heat) | |
| | CHYS | Hysteresis (cool) | |
| | C P | Heating control period/cycle time | 1sec |
| | C-CP | Cooling control period/cycle time | |
| S P r U | Set Point ramp time unit | M, minutes | |

** The P, I and D values may change following the execution of Auto-tune.

Table 7: Omron E5CK Parameters

OPERATIONS for E5CK (Continued):

Changing Primary Set Point:

3. The process Set Point can be changed in the level 1 mode menu.
4. Press the Display Key  for a minimum of one second to enter the level select mode.
5. Press the up or down arrow key to select the desired level. (Level 1 for process set point adjustment).
6. Press the Display Key  for a minimum of one second to enter the selected level mode menu.
7. Press the Display Key  for less than one second to cycle through the selected level mode menu until (SP-0) is shown on the upper display.
8. Press the up or down arrow key to adjust the (SP-0) value to the desired point.
9. Press the Display Key  for a minimum of one second to once again enter the level select mode.
10. Press the up or down arrow key to select the desired level. (Level 0 for normal control operation).

After changing the process set point (SP-0) on the Omron controller, you must manually adjust the SP2 setting on the Future Design over-temperature control.





(See OPERATIONS Over-Temperature Controller FDC-L91 section.

OPERATIONS for E5CK (Continued):

High Alarm:

The Digital Temperature Controller incorporates an independent alarm. The High Process Temperature Alarm (AL-1) prevents heater operation above a preset maximum temperature that may harm the process and potentially the tank material. If the process temperature exceeds the preset high alarm value, the heater will be disengaged. The temperature controller will activate once the process temperature exceeds the set point by the preset value. The factory setting of this alarm temperature is 248°F (120°C).

The high alarm value can be adjusted to a lower setting through mode Level 1.





7. The process Set Point can be changed in the level 1 mode menu.
8. Press the Display Key  for a minimum of one second to enter the level select mode.
9. Press the up or down arrow key to select the desired level. (Level 1 for high process temperature alarm adjustment).
10. Press the Display Key  for a minimum of one second to enter the selected level mode menu.
11. Press the Display Key  for less than one second to cycle through the selected level mode menu until (AL-1) is shown on the upper display.
12. Press the up or down arrow key to adjust the (AL-1) value to the desired point.
13. Press the Display Key  for a minimum of one second to once again enter the level select mode.
14. Press the up or down arrow key to select the desired level. (Level 0 for normal control operation).

OPERATIONS for E5CK (Continued):

PID Tuning:

The Digital Temperature Controller incorporates the capability of automatically tuning the PID parameters (Auto-Tuning) to fit the characteristics of the process. The optimum PID parameters are automatically set by forcibly changing the Manipulated Variable (MV) to calculate the characteristics (limit cycle method) of the control target. Depending on the auto-tune level selected, AT-1 or AT-2, the controller will run this test at either 40% or 100% of the actual Process Set Point. When the auto tuning is complete, the appropriate PID tuning parameters will be automatically installed into the non-volatile memory of the temperature controller.

The PID Tuning Process can be started by adjusting the (At) parameter.

9. Turn on water supply and set the desired water flow.
10. Set the Process Temperature Set point to the desired value.
(See **OPERATIONS; Changing Primary Set point,**.)
11. Press the Display Key  for a minimum of one second to enter the level select mode.
12. Press the up or down arrow key to select the desired level. (Level 1 for Auto Tune adjustment).
13. Press the Display Key  for a minimum of one second to enter the selected level mode menu.
14. Press the Display Key  for less than one second to cycle through the selected level mode menu until (At) is shown on the upper display.
15. Press the up or down arrow key to adjust the (At) value to the desired setting of (AT-2).
16. Press the Display Key  for a minimum of one second to once again enter the level select mode.
17. Press the up or down arrow key to select the desired level. (Level 0 for normal control operation). The "AT" LED will flash during the Auto-Tune cycle.
18. Turn the ENABLE HEATER switch past the ON position to the RESET position, then release the switch, which will move to the ON position. If all criteria for the various safety devices have been met, the heater will begin to heat.
19. When the process is complete, the "AT" LED will stop flashing. The appropriate PID tuning parameters are now installed and retained in the non-volatile memory.

OPERATIONS (Continued):

Over-Temperature Controller FDC-L91:

1. This over-temperature controller is located inside the electrical portion of the Tytan heater. It uses a separate temperature sensor to monitor the temperature on the surface of the heating elements.
2. This controller has two discreet set points:
 - SP2:** This is the over-temperature cutoff setting, which is set for 18°F (10°C) ABOVE the primary set point on the Process temperature controller.
 - HSP1:** This is an element high-temperature alarm setting, which is factory set at 248°F (120°C). Do not adjust this setting.

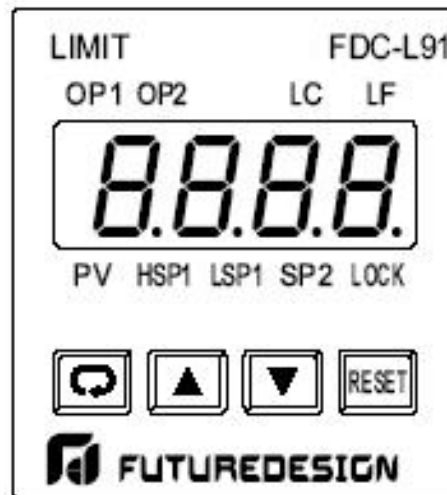


Figure 20: Futuredesign Over Temperature Controller

OPERATIONS (Continued):

Mode Parameter Settings:

The Futuredesign FDC-L91 temperature controller has been programmed prior to shipment, so no programming will be necessary. The table below shows the various controller settings for this unit when properly configured to operate the TYTAN inline heater.

| Parameter | Description | Default Setting |
|------------------|---------------------------------|--|
| HSP1 | Hi Limit Set Point | 120 C / 248 F |
| LSP1 | Low Limit Set Point | 82 C / 180 F |
| SP2 | Set Point 2 value, for Output 2 | 10 C / 18 F above "SP0" of the E5CN Temperature Controller |
| INPT | Input Type Selection | J_tC |
| UNIT | Process Unit | C / F |
| RESO | Display Resolution | NodP |
| IN.LO | Low Scale for Linear Input | 0 |
| IN.HI | High Scale for Linear Input | 100 C / 212 F |
| SHIF | PV Shift (offset) Value | 0 |
| FILT | PV Filter Time Constant | 2 |
| OUT1 | Output 1 Function | HI |
| O1.HY | Output Hysteresis Value | 0.1 |
| HSP.L | Lower Limit of HSP1 | 0 |
| HSP.H | Upper Limit of HSP1 | 150 C / 302 F |
| LSP.L | Lower Limit of LSP1 | 0 |
| LSP.H | Upper Limit of LSP1 | 120 C / 248 F |
| OUT2 | Output 2 Function | ALA |
| ADDR | Address Assgnmnt of Digital Com | Not used |
| BAUD | Baud Rate of Digital Com | Not Used |
| PARI | Parity Bit of Digital Com | Not Used |
| AL.FN | Alarm Function | PYLA |
| AL.MD | Alarm Mode | Norm |
| AL.HY | Alarm Hysteresis | 0.1 |
| AL.FT | Alarm Failure Transfer | ON |
| EIFN | Event Input Function | 0 |
| DISP | Normal Display Format | PV |

Table 8: Future Design L91 Parameters

OPERATIONS (Continued):

Programming FDC-L91:

Every time the primary set point of the main controller E5CN is modified, the SP2 setting on the over-temperature controller FDC-L91 must be changed *manually*.


To Change the SP2 set point on the FDC-L91 over-temperature controller, follow the following procedure:


Do not change any of the other settings in this controller.

1. Turn the “Enable Heater” switch to the *Off* position. Leave the “Control Power” switch in the *On* position.
2. Open the door to the control-portion of the unit.



When the enclosure door is open, be careful not to touch the electrified components inside. To avoid shock hazard, qualified personnel should only perform this procedure.

Note: If the “Lock” LED is lit on the face of the Over-temperature Controller, press the () key for 4 seconds to clear “lock” feature of the FDC-L91, enabling up / down key function.

3. Identify the over-temperature controller, tagged 1SLC.
4. Press the Index key () to advance through the menu until “SP2” is highlighted.
5. Using the up and down arrow keys, adjust the SP2 value until it is 18°F (10°C) higher than the set point on the temperature controller.

Note: Do not change any other settings on this controller.

6. Close the door to the control portion of the enclosure.

OPERATIONS (Continued):

System Start-Up:

- 1) Turn on water at its supply source. Allow water to flow for several minutes to insure that all entrapped air has been purged from the heating column(s).
- 2) Stop water flow at point of use location and check all plumbing connections and water heater for leaks. Repair any water leaks if applicable.
- 3) Enable the power at the MAIN SERVICE DISCONNECT (provided by customer).
- 4) Ensure that the disconnect handle on the front of the unit (if provided) is ON and the EMO button on the front panel is not depressed.
- 5) Turn the CONTROL POWER toggle switch to the ON position. At this time the temperature controller and all optional displays will come on.

Note: Temperature controller set point should be set to "0" at this time to prevent accidental heater engagement during calibration procedures. Reference temperature controller section if required.

- 6) Adjust the setpoint of the temperature controller to the desired value.
- 7) Turn the ENABLE HEATER switch past the ON position to the RESET position, then release the switch, which will move to the ON position. If all criteria for the various safety devices have been met, the heater will begin to heat.

System Shut-Down:

- 1) Turn the ENABLE HEATER switch from the ON position to the OFF position. Continue water flow through the heater until the outlet temperature display indicates 95°F (35°C) or less.
- 2) Turn the CONTROL POWER toggle switch to OFF.
- 3) Turn off the MAIN SERVICE DISCONNECT to the unit (provided by customer).
- 4) Stop water flow through the unit. If the shut down will be for an extended period, open the customer supplied drain located near the inlet plumbing connection to drain the water from the unit. Once the unit is drained, dry the unit by blowing inert gas (N2 or CDA) through the piping system.

MAINTENANCE:

The Tytan water heater requires only a routine inspection every 6 months to check the operation of the various operation and safety devices. Many of these devices require the control system to remain operational during inspection, while others may be checked while the unit is completely powered down.

| |
|--|
| <p>Note: Several maintenance tasks can be completed simultaneously while the cabinet access covers are open and lockout/tagout procedures are in place.</p> |
|--|

The maintenance procedures for this unit must be performed by qualified technicians.

Normal maintenance of TYTAN™ DI Water Heaters consists of the following:

- 1) Disinfect the water heater along with the rest of the plumbing system on a regular basis if continuous sanitizing such as ozone injection is not employed.
- 2) Inspect the temperature sensors every 24 months, replace as needed.
- 3) Replace the heater control relays and fan after approximately 24-30 months of use. Actual life expectancy varies with application conditions such as hours of operation; control tuning parameters, applied voltage and amperage.
- 4) The Solid State Relay fan should be replaced and the heat sink is to be cleaned every 24 months.

WARRANTY:

All PROCESS TECHNOLOGY equipment, heaters and controls have been carefully inspected before shipping and are warranted to be free from defects in workmanship and materials for a period of one year from date of purchase on a pro-rated basis. At its option, PROCESS TECHNOLOGY will repair or replace any defects that are exhibited under proper and normal use. PROCESS TECHNOLOGY disclaims any responsibility for misuse, misapplication, negligence or improper installation of equipment, tempering or other operating conditions that are beyond its control (such as excessively high or low purge gas supply pressure). PROCESS TECHNOLOGY makes no warranty or representation regarding the fitness for use or the application of its products by the customer.

All products and components not manufactured by PROCESS TECHNOLOGY will carry the original manufacturer's warranty, copies of which are available upon request. PROCESS TECHNOLOGY makes no warranty or representation, expressed or implied, with respect to the products not manufactured by PROCESS TECHNOLOGY.

Products must be installed and maintained in accordance with PROCESS TECHNOLOGY instructions.

PROCESS TECHNOLOGY is not liable for labor costs incurred in removal, reinstallation, or unauthorized repair of the product or for damage of any type including incidental or consequential damage.

PROCESS TECHNOLOGY neither assumes nor authorizes any representative of PROCESS TECHNOLOGY or any other person to assume for it any other liabilities in connection with the sale of the products. This warranty may not be verbally changed or modified by any representative of PROCESS TECHNOLOGY.

Shipping Damages:

Claims against freight carriers for damage in transit must be filed by the customer at the time of delivery or as soon as possible.

Returns:

No product shall be returned to PROCESS TECHNOLOGY without first obtaining a return material authorization (RMA) number from a PROCESS TECHNOLOGY representative. All returns must be freight prepaid. Freight collect or shipments without authorization will be refused.

Information:

PROCESS TECHNOLOGY will endeavor to furnish such advice as it may be able to supply with reference to the use by buyer of any material purchased, but PROCESS TECHNOLOGY makes no guarantees and assumes no obligation or liability for advice given verbally or in print or the results obtained. Buyer assumes all risk and liability that may result from the use of any material, whether used by itself or in combination with other products. No suggestion for product use shall be construed as a recommendation for its use in infringement on any existing patent.

Conflict Between Documents:

Acceptance of this offer is expressly conditioned upon agreement to all terms and conditions contained herein. In the event of a conflict between the terms and conditions of purchaser's purchase order, and PROCESS TECHNOLOGY's terms and conditions, proposal or offer, the latter shall govern.