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INSTRUCTION MANUAL



Perma Pure LLC Integrator Series

Model iCOOL

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A: SPECIFICATIONS

Physical Description

Single Channel System
1 x 5" Heat Exchanger
1 Active (cooled to 3.5°C) Heat Exchanger
LCD temperature display

Operating Specifications

Sample Gas Flow Range	1-3 LPM 2.1-6.4 SCFH
Inlet Dew Point at Rated Flow	300°F @ 12% H ₂ O, 2.5 LPM
Maximum Cooling Rate	58 BTU/Hr
Dimensions	7.25 x 8.25 x 10.5 in. HWD 18.5 x 21 x 26.7 cm
Weight	11 lbs 5 kg
Maximum Inlet Sample Temperature	392°F (200°C) SS, Durinert®, Glass Impingers 280°F (138°C) Kynar Impinger
Maximum Inlet Pressure	45 psig 3 bar / 2250 mmHg
Maximum Heat Exchanger Pressure Drop	<+1 in. H ₂ O
Ambient Temperature Range	33-104°F 0.6-40°C
Outlet Sample Gas Dew Point	39.2°F 4°C
Inlet Tubing Connection	3/8 in. FPT
Outlet Tubing Connection	1/4 in. FPT
Drain Tubing Connection	3/8 in. FPT
Voltage	90-240 VAC 50/60 Hz
Thermoelectric Elements	40 mm
Power Supply	100W
Cooling Down Time	Less than 3 minutes

B: LIMITED WARRANTY

Perma Pure LLC WARRANTY and DISCLAIMERS

Perma Pure (Seller) warrants that product supplied hereunder shall, at the time of delivery to Buyer, conform to the published specifications of Seller and be free from defects in material and workmanship under normal use and service. Seller's sole obligation and liability under this warranty is limited to the repair or replacement at its factory, at Seller's option, of any such product which proves defective within one year after the date of original shipment from seller's factory (or for a normal usable lifetime if the product is a disposable or expendable item) and is found to be defective in material or workmanship by Seller's inspection.

Buyer agrees that (1) any technical advice, information, suggestions, or recommendations given to Buyer by Seller or any representative of Seller with respect to the product or the suitability or desirability of the product for an particular use or application are based solely on the general knowledge of Seller, are intended for information guidance only, and do not constitute any representation or warranty by Seller that the product shall in fact be suitable or desirable for any particular use or application; (2) Buyer takes sole responsibility for the use and applications to which the product is put and Buyer shall conduct all testing and analysis necessary to validate the use and application to which Buyer puts the product for which Buyer may recommend the use or application of the product by others; and (3) the characteristics, specifications, and/or properties of the product may be affected by the processing, treatment, handling, and/or manufacturing of the product by Buyer or others and Seller takes no responsibility for he nature or consequence of such operations or as to the suitability of the product for the purposes intended to be used by Buyer or others after being subjected to such operations.

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C: PRINCIPLE OF OPERATION

Thank you for purchasing the Perma Pure Integrator Series Thermo-Electric Cooler. Our ICOOL features a unique slim design leaving additional space to install or access other sample conditioning system components. A unique shell design on this model provides easy access to electronic board, fan and the power supply. All electronic boards (control, relay, and display) are mounted on the front panel for easy access.

The process of sampling combustion product stack gas or exhaust from internal combustion engines requires a method to remove the moisture from the sample, without removing the gas components of interest. The Integrator Series Thermo-Electric Cooler is an ideal way to decrease the dew point of combustion gases to a repeatable, stable, constant low dew point. The Integrator Series cooler prevents water condensation in sample pre-filters, sample pumps, and gas analyzers. For gas analyzers where water vapor is an interferent, a stable, repeatable dew point becomes a part of the gas analyzer performance specification. Perma Pure's Integrator Series coolers provide this constant low water concentration, resulting in an accurate component gas measurement.

All Perma Pure coolers use thermo-electric elements (Peltier elements) to cool the sample gas to the desired dew point temperature. A Perma Pure Thermo-Electric Cooler is best illustrated as a small heat pump with no moving parts. The Peltier elements operate on direct current and may be used for heating or cooling by reversing the direction of current flow. This is achieved by moving heat from one side of the module to the other with current flow and the laws of thermodynamics. A typical single stage Peltier (Figure 1) consists of two ceramic plates with p- and n-type semiconductor material (bismuth telluride) between the plates. The elements of semiconductor material are connected electrically in series and thermally in parallel.

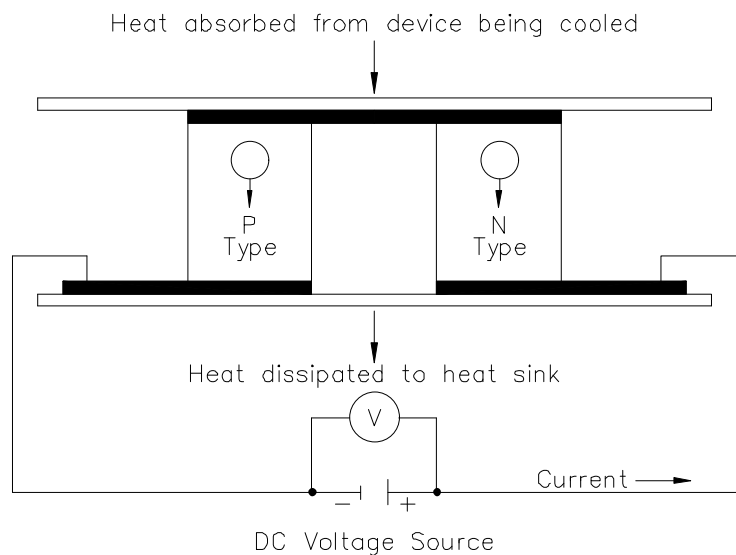


Figure 1: Thermo-electric element (Peltier)

When a positive DC voltage is applied to the n-type thermo-electric element, electrons pass from the p- to the n-type thermo-electric element and the cold side temperature will decrease as heat is absorbed. The heat absorption (cooling) is

proportional to the current and the number of thermo-electric couples. This heat is transferred to the hot side of the Peltier element where it is dissipated into the heat sink and surrounding environment.

The Integrator Series Thermo-Electric Coolers remove the moisture from the sample gas by cooling the gas as it passes through a laminar impinger (heat exchanger). A diagram showing the gas flow path through an impinger is shown in the Appendix. The heat exchanger, made of 316L stainless steel, Durinert[®] (a corrosion-resistant inert coating over 316L stainless steel), PVDF (Kynar), or glass, is mounted within a thermally insulated heat transfer block bored to receive the heat exchanger without a mechanical lock. This assembly allows the easy removal of any heat exchanger simply by slipping it out of the cooling block by hand. The heat transfer block cools the heat exchanger through the heat pumping action of the peltier element. The heat transfer block is on the cold side of the thermo-electric element and the heat sink is on the hot side of the thermo-electric element. The heat from the heat transfer block is pumped to the heat sink where it is then dissipated into the air by the heat sink fan. See Figure 2. The desired temperature is maintained by a closed loop control system, which is implemented through a digital controller. The controller uses an interchangeable thermistor in the heat transfer block located very close to the cold side of the peltier element as the input sensor.

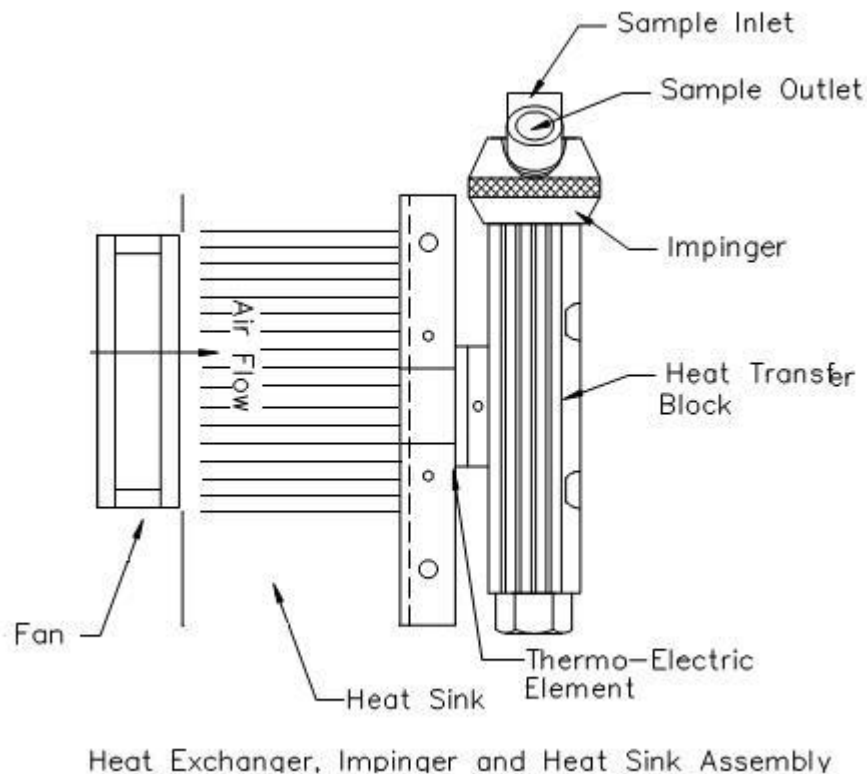


Figure 2: Heat Exchanger, Impinger and Heat Sink Assembly

The sample gas is passed to the Classic Thermo-Electric Cooler via the heated filter sample probe and heated sample line. The Integrator Series Thermo-Electric Cooler

lowers the sample dew point below 4° C (39.2°F). As the gas cools and the moisture vapor condenses, the condensate exits the heat exchanger through the bottom drain connection. Particulate matter which passes through the sample cooler is removed by an optional pre-filter, located downstream from the cooler along with an optional water slip sensor. The conditioned sample gas can then be directed to the gas analyzers.

D: INSTALLATION

The Model ICOOL should be installed away from heat sources in a well ventilated area of an instrument rack or enclosure. ***REMEMBER***, *the Model ICOOL can only control to 61° F DIFFERENTIAL from ambient temperature.* Thus, at an output temperature control of 39° F, the maximum ambient temperature is 100° F, above which cooling control is lost. When this differential is exceeded, the controller will go full-on, with the cooling capacity floating in relation to the ambient temperature above 104° F. No damage will occur to the cooler; however, the output dew point will also float in relation to the ambient temperature. The more stable the ambient temperature environment around the ICOOL, the better the output dew point stability.

The outlet tubing of all metal or Kynar heat exchangers is 1/4" compression tube fittings; the user should always use the compression type fittings provided for that purpose by the factory. The inlet tubing of all metal or Kynar heat exchangers is 3/8" tube fitting to mate with most standard 3/8" sample lines.

The condensate drain connection is a Kynar® straight 3/8" MNPT x 1/4" barbed tube fitting. An automatic condensate drain, Model 3KPB-001 Peristaltic Pump, dual head, is recommended for water removal. This pump uses size 17 tubing.

CAUTION: Do not reduce the size of the condensate tubing since doing so restricts water flow resulting in water slip (moisture carryover) in the sample.

CAUTION: If using a stainless steel sample line, place 2 inches of TEFLON tubing in between the exchanger inlet fitting and the heated line. This prevents the sample cooler from heat sinking the incoming heated line, which adds undue load to the cooler.

E: START-UP PROCEDURE

Plug in the power cord to a properly grounded main circuit. The Ready Green LED will come on within 3 minutes, indicating the relay temperature (10°C) has been achieved. After approximately 3 minutes, the set point of +3.5°C. (38.3°F) is achieved. The sample gas flow may be started immediately after the Green LED comes on.

The ICOOL is virtually maintenance free. However, in the event of electrical problems, contact the Perma Pure LLC service department for troubleshooting assistance.

F: LED INDICATORS

The ICOOL has one green and one red LED operating indicators. These indicators are arranged horizontally on the front of the cooler. The green LED indicates the READY operating temperature status, normally set for 3.5°C (38°F). After the set-point temperature is reached, the sample pump may be turned on by the internal relay. When the impinger temperature is below 10°C (50°F) the ready LED will be on. At one degree above the set temperature, the ready LED will be off. The red LED is the thermistor failure indicator. When this occurs, the red LED stays illuminated.

The ICOOL cooler has an analog voltage output, the connector is found on the bottom left side of the cooler marked TEMP OUT. This output is factory standard at 0-5 VDC = 0-20°C (0.25 V / °C).

The ICOOL cooler has a relay output, the connector is found on the bottom of the cooler marked RELAY OUT. This output is Form C, rated for 10 AMP @ 250 VAC.

G: I/O TERMINAL BLOCK DESCRIPTION

The I/O terminal blocks are found on the bottom back of the cooler:

TEMP OUT TEMP OUT is located between the power connector and the relay out connector. TEMP OUT is the standard analog output (low voltage DC output) for Integrator Series Thermo-Electric Coolers. ICOOL has one active 5" heat exchanger. The output is 0vdc to 5vdc for a temperature range of 0°C to 20°C.

From left to right

- X Terminal 1 is the signal return.
- X Terminal 2 is earth ground. This terminal should be used to ground the shield of the shielded twisted pair cable that is used to connect the analog output to a receiving instrument.
- X Terminal 3 is the temperature output.

RELAY OUT RELAY OUT is located on the bottom of the unit on the right side. RELAY OUT is the I/O terminal block used for the internal relay.

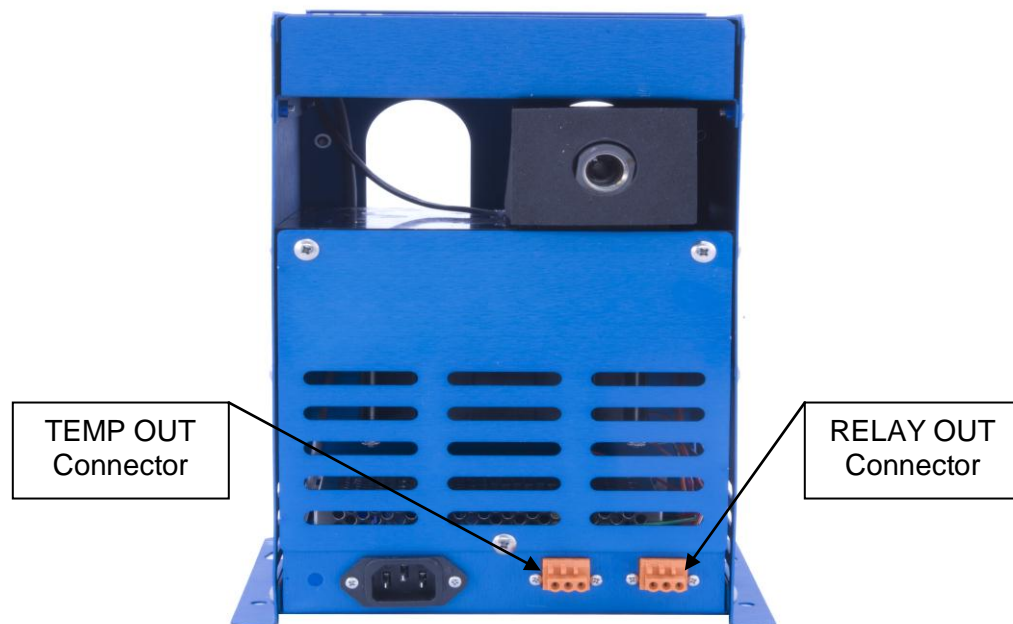
From left to right

- X Terminal 1 is the normally open relay contact. This terminal can be used in combination with the common connection as a ready alarm to control the sample pump. This contact will be connected to the common connection when the temperature of the impinger is below the ready temperature.
- X Terminal 2 is the common relay contact.
- X Terminal 3 is the normally closed relay contact. This terminal can be used in combination with the common connection as a high temperature alarm. This contact will be connected to the common connection when the temperature of the impinger is above the ready temperature.

H: TEST & ADJUSTMENT PROCEDURES

NOTE: All test and adjustment procedures have been performed at the factory. Therefore, no adjustment should be necessary.

Remove top cover panel to access the 4 push buttons, located on the control board. The button located farthest to the right is considered Button #1 in this manual. The buttons are then numbered from right to left which the left most button being Button #4.



Temperature Set Point

The temperature set point is the temperature the unit will maintain the cooling block surrounding the impinger, approximately equal to the output dew point.

Press and hold Button #1 to display the temperature set point.

Press and hold Button #3 to increase the set point.
Press and hold Button #4 to decrease the set point.

The value is automatically stored when Button #1 is released.

Ready Set Point

The ready set point is the temperature the unit will turn on the output relay. The relay will be reset, turn off, at one degree above the ready set point.

Press and hold Button #2 to display the ready set point.

Press and hold Button #3 to increase the set point.
Press and hold Button #4 to decrease the set point.

The value is automatically stored when Button #2 is released.

Voltage Output

The voltage output can be calibrated through the push buttons. A voltmeter is required to adjust this output.

Connect the voltmeter to the TEMP OUT connector. Select an input range on the voltmeter to accommodate the 0 to 5 VDC.

Press and hold Button #1 and Button #2 together. The value 10.0 will be displayed. The voltmeter should read 2.5 VDC. Use Button #3 and Button #4 to correct the voltage output if necessary.

Press and hold Button #3 to increase the output voltage.
Press and hold Button #4 to decrease the output voltage.

The value is automatically stored when Button #1 and Button #2 are released.

For further service assistance, contact:

Perma Pure LLC

8 Executive Drive

Toms River, NJ 08755

Tel: 800-337-3762 (toll free U.S.)

Tel: 732-244-0010

Fax: 732-244-8140

Email: info@permapure.com

or your local representative