



TotalTemp
TECHNOLOGIES, INC.

Benchtop Chamber Operator's Manual



Models C230, C460, C900
Rev. 3 03/2023

Introduction

Thank you for purchasing a Benchtop Temperature Chamber from TotalTemp Technologies. This product was designed to provide years of efficient trouble-free operation. Please read and understand this manual plus the controller manual for safe and best use of this product.

Safety

Safety Symbols:

The following symbol on equipment indicates the existence of a hazard that is explained in more detail in the manual.



The following symbol on the equipment indicates there is danger of electric shock if the indicated panel is removed while the product is connected to power.



The following symbol indicates the possible presence of danger caused by hot surfaces.



General Warnings:

This device employs line voltage connected components and caution should always be used to avoid electrical hazards.

Due to the extreme temperatures that these systems are capable of, always exercise caution in the vicinity of the system. Burns from either extreme hot or cold conditions may result. As a rule, hands off should be the policy for the temperature chamber interior and exterior.

When operating at cold temperatures, condensation or frost on the internal surfaces and interior walls will occur if operated with the door open or for longer periods of time with below ambient temperature settings. At extreme cold operating temperatures, some frost or condensation may occur on the exterior of the chamber. Likewise at very hot operating temperatures, the external surfaces will become very warm. Use caution.

Always avoid moisture near electrical power connections. Do not operate the product with the cover panels removed. The protective covers reduce the risks of exposure to electrical and thermal hazard, as well as protect the internal components from damage due to corrosion from condensation inside the unit. Excessive condensation or other electrical hazards may result if this precaution is not observed. Always keep the door closed while at very high or low temperatures. TotalTemp provides an optional gas purge system that can be used to keep frost from accumulating on devices and the interior walls. It is recommended to keep the Nitrogen gas purge hooked up to this unit and flow rate adjusted for increased protection from excessive moisture accumulation on the devices under test, and interior walls. Soft plugs are provided to close off access ports at the sides of the benchtop chamber. They should be used to keep condensation and heat loss to a minimum. These systems employ expendable compressed liquid refrigerants. Extreme caution should always be observed when handling these cryogenic fluids. The extremely cold temperatures and high pressures of the refrigerants must be respected. Additionally, if portable tanks are being used, the tanks are typically very heavy. Tip over and other mishandling accidents must be avoided. Always strap top-heavy tanks to a wall or other immovable fixture to prevent accidental tip over of tanks. This is especially important for high pressure Liquid CO₂ (L-CO₂) tanks which are more top heavy and do not have a built-in halo to protect the tank valves from breakage and accidental venting of refrigerant. As a rule, keep tanks secured and always keep valve covers on high pressure tanks when they are not in use. Face shield and insulating gloves are recommended when handling cryogenic fluid connections.

Warning! Tank shut off hazard:

Misuse could result in burst hose, damaged equipment or other safety hazard. After using the equipment, some people will elect to shut off the coolant source at the tank or point of supply. If this is done, be aware that if the system has been recently used, cryogenic liquid in the hose will expand dramatically as it warms up in the hose. If the valve is closed at the supply and the control solenoid is closed in the temperature chamber at the other end of the hose, excessive pressure will build up in the hose. The hazard is far less if the system has not been used recently in the cooling mode but still requires the user's attention. In order to prevent this hazard, the user, as a rule should either leave valve at supply open when connected to the chamber or vent remaining pressurized coolant from the hose. Alternatively, right after closing tank valve, set the controller to operate at a cold temperature until the pressure in the hose is relieved or carefully open the connection at an end of the hose using a wrench until pressure is relieved. Armored or vacuum jacketed L-N₂ hoses purchased from TotalTemp have a pressure relief safety built into the hose to prevent rupture, however it is still recommended to not rely on the overpressure safety valve every time system is shut off. It is also recommended that any L-N₂ hoses acquired from somewhere other than TotalTemp be fitted with pressure relief valves as well. **When connecting and disconnecting hose fittings containing cryogenic fluids, it is recommended that the user wear face shield and gloves to reduce the chance of injury from high pressure gas discharge or contact with cryogenic temperature liquids or gasses.**

Hazard due to moisture in system:

Moisture and contamination are the primary cause of valve failure. When disconnecting a coolant delivery hose, it is recommended to place a protective cap on the open end of the hose and system inlet. If the system has been recently used in the cooling mode, temperatures inside the hose below the dew point will result in moisture or frost accumulation inside the hose. When the system is put back into use, this water or ice could contaminate the coolant valve(s) resulting in erratic operation or run-away cooling. An open hose is an invitation to particles, dirt, and insects that might contaminate the cooling solenoid.

Asphyxiation and excessive or harmful gas hazard:

Cryogenic gases released by the systems are not toxic or chemically hazardous. Although it is important to avoid face or any skin contact with the exhaust gas due to the possible extreme temperatures and pressures, there also is a possible hazard due to the displacement of breathable Oxygen with the exhaust from the system. CO₂ can often be detected by the gassy smell that is characteristic of carbonated beverages such as beer or sodas. Nitrogen is not detectable by human senses as our breathable air is already around 80% Nitrogen. The temperature chambers should only be used in an area that has at least normal ventilation. It is recommended that the exhaust be vented to outside the work area if there is any question about the ventilation or there are multiple systems operating in a closed room. If there is ever a question of the concentration of exhaust gas in the room, TotalTemp recommends an Oxygen monitoring system be in place in the room where the exhaust is being vented. These can be in the form of a handheld alarm, a wall mounted instrument or a sensor that can be monitored by the Synergy Nano temperature controller. Consult factory for options and pricing. **Be aware that there is often very little time between the first signs of dizziness and unconsciousness.**

Also – there is potential for harmful gases emitting from the material(s) in the DUT (Device Under Test). It is imperative that the user be aware of the temperature limitations of the material(s) used in the DUT. NEVER heat any explosive or flammable materials in a temperature chamber.

Built in out-of-range safety controls:

The controllers employed by TotalTemp have several built-in watchdog features.

- 1) Setpoints above and below the allowable limits of product operation have been blocked at the factory. Do not attempt to defeat these limits.
- 2) Additionally, the controllers will go into an alarm/shutdown condition if the temperatures measured goes beyond preset limits
- 3) Open or shorted sensor or erratic readings will also put the controller into a shutdown mode.

All TotalTemp systems have a fixed bimetal thermostat that latches power off for heating and cooling circuits in the event that temperatures exceed 205°C. On the rear electrical interface panel of the plate chassis, there are two LED indicator lights. The green LED light indicates power to the safety thermal switch and should always be on during normal operation. The red LED light indicates the thermal safety switch has tripped due to an over-temperature condition. It is only safe to use the system if the green light is on and the red light is off. If the system is turned ON and there are any other combinations of LED states besides Green ON and Red OFF, first cycle remove system power until the problem is resolved.



1- Failsafe Working, Normal operation

Temperature limits set in the controller are intended to prevent operation at temperatures above 175C. Therefore, under normal operation the red LED should never come on. Device under test self-heating, system component failure or other possible issues could cause the red LED to come on. Should the red LED come on, turn the system off immediately. Before using the system again, make sure the temperature of the system is back in normal operating range (< 200 deg C), then turn power back on again. Under normal conditions, cycling power resets the bimetal failsafe thermostat latch circuit. If the green light comes on and the red is off, the safety switch has reset itself and normal operation may be reestablished. If the red light continues to come on, the system needs to cool down or needs service. Remove power and consult factory.

Controllers may also be equipped with an independent redundant failsafe system. A high and low limit setting may be easily entered from the front panel to protect against unintended cooling and heating beyond user set limits. This controller uses its own sensor in the chamber and provides an enhanced level of safety. If a system does not have such and that is needed, it can be added on a retrofit basis. Consult factory for options and pricing.

The redundant coolant valve feature is an additional safety option. The redundant valve is plumbed in series with the main control valve(s) and it is energized whenever the system is powered on. The redundant valve does not cycle the way that the control valve cycles, thus does not accumulate the wear and tear of pulsing operation. The redundant valve will be ready to close when the signal from the independent redundant failsafe limit indicates an out of range condition. This improved level of safety will stop most single failure mode run away conditions. Be aware that the severe oil or moisture contamination that causes the primary valve to fail could also potentially cause the redundant valve to fail. Avoid any conditions which could allow water or oil contamination. Consult factory for options and pricing. The redundant valve option only applies generally only for L-N₂ systems, due to the extreme cold temperatures that can be achieved with L-N₂. Redundant valves are generally not used in L-CO₂ because the risk of runaway is less likely and less severe. Additionally, the extra valve plumbing in L-CO₂ systems can actually increase the chance of valve malfunction due to dry ice formation in the second valve orifice.

Equipment Ratings

Power Supply:

Check the Voltage and Amperage ratings on your product label near the power connector of your system and on the rear of the controller. Make sure power provided is within the voltage range and current is limited above maximum requirement of chamber. The controller and rest of the system can operate in the 50/60Hz range.

The correct Environmental Conditions for proper operation of the temperature system are as follows:

- Indoor use only, unless specified differently on the product label
- Altitude up to 2,000 M maximum
- Ambient temperature range no lower than 10°C and no higher than 40°C
- Maximum relative humidity of 80% for temperatures up to 31°C
- Pollution index of degree 2 or better
- Mains power supply voltage fluctuations shall not exceed $\pm 10\%$ of the nominal voltage as indicated on the product label
- Transient overvoltage's according to overvoltage category II

System Description

Theory of Operation:

Testing of electronic or other items at specific temperatures is required for a variety of purposes and is a common requirement of modern design, production, and diagnostics.

Temperature chambers provide a rapid and convenient method to perform this testing/conditioning. The chamber is well insulated however at more extreme temperatures the external walls of housing may be extremely hot or cold. As with any system capable of extreme temperatures **use caution** when using or handling the system. No environmentally hazardous gasses are released**. These systems also have a smaller footprint using less valuable lab space.

** Note on Environmental hazard of CO₂ gas: Commercial CO₂ gas is not toxic and not considered an environmental hazard as it consists of CO₂ previously captured from the environment for this use. It is not being made, it is simply being captured as a liquid and rereleased by a CO₂ cooled chamber to its original gaseous state.

Primary System Contents:

Convection chamber
Temperature Controller
Power cord
Optional or customer supplied CO₂ inlet hose

Accessories:

Optional redundant coolant valve (internal)
Optional redundant failsafe controller (front panel)
Coolant delivery hose
Purge accessories
Optional device hold down accessories or shelves
Coolant conversion options
DUT sensing probes and systems
Additional controller options
Adapter plates
Chassis mounted temperature probe terminal block for DUT sensor
Window
Cabling apertures
Complete list of options:
<https://www.totaltemptech.com/thermal-platforms-coldplates-options-and-accessories/>

Specifications:

C230 120v, 15A. 50-60 Hz. 16" x 12" x 12" workspace
C460 230v, 20A. 50-60 Hz. 19.5 x 16" x 12.4" workspace
C900 230v, 20A. 50-60 Hz. 25" x 25" x 25" workspace

Supplies Required:

Coolant-TotalTemp systems are designed for one of five coolant configurations as noted on equipment.

- 1) Standard configuration, high pressure L-N₂. 75-100 psi.
- 2) Special low-pressure L-N₂ for applications where high-pressure L-N₂ cannot be obtained. 15- 35 psi.
- 3) High pressure L-CO₂ 800-950 psi.
- 4) Low pressure L-CO₂ 300 psi.
- 5) Mechanical Refrigeration (compressors)

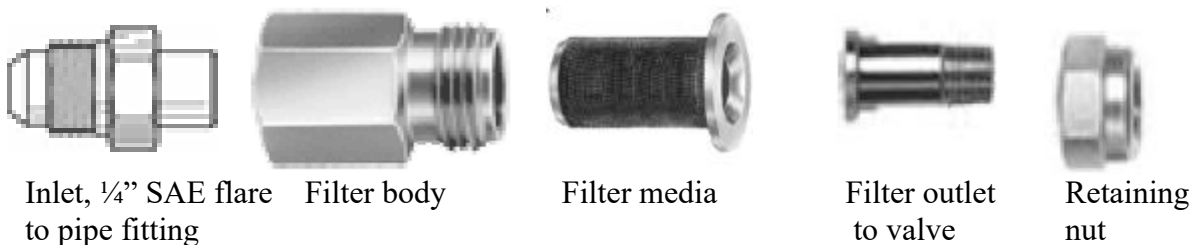
Consult factory if your available coolant does not match what the system you have is designed for. Read the label on product to determine proper coolant for existing system.

Coolant inlet fitting:

The coolant inlet on all products is a ¼” male SAE flare fitting (45° flare).

Coolant filter:

Directly behind the inlet fitting is a particulate filter to protect the valve and injection tubes from damage due to particulate contamination. The filter parts are assembled per the artwork below. The inlet nipple may be purchased separately as a wear item and the four pieces of the filter assembly must be purchased as a complete filter. Especially with Low pressure LN₂, ½” SAE flare inlet fitting is an option. That option also requires a filter body with a larger ¼” pipe thread opening.



Coolant Exhaust connection:

No exhaust hose is provided however it is recommended that if there is any question about the normal/adequate ventilation in the room to prevent the exhaust gas from exiting directly to the work area for noise and safety reasons. For light duty operation, in a normally vented room, the exhaust from a few units may be allowed to terminate into the room air without risk of asphyxiation. Used coolant exits as a gas from the 1-1/4” phenolic nipple at the left rear corner of the unit. **Use caution when installing and removing exhaust hose to hose nipple. Exhaust port is not designed to be structural and does not support twisting or excessive mechanical force.** It is recommended to hook the exhaust up to a vent from going outside of the local room. See Safety precautions.

Power, Standard Models:

C230 120v, 15A. 50-60 Hz.
C460 208 - 230v. 20A. 50-60 Hz.
C900 208 - 230v. 20A. 50-60 Hz.

Models intended for Europe and Asia are always 230v. unless otherwise specified. Always confirm proper configuration before connecting power to controller and controller to system. The umbilical cable on TotalTemp controllers is designed to be plugged into only the standard TotalTemp benchtop chamber systems, unless otherwise specified for a custom configured TotalTemp product.

Controller systems can operate on either 120, 208-240vac. 50/60 Hz. Systems must be operated on specified voltage. Chamber power connectors are keyed to disallow mating systems intended for alternate voltages however always note that the voltage applied is in accordance with *system* product labeling. Other power configurations are possible on special order basis.

Assembly:

The chamber system consists of six parts. Be aware of the following when installing:

- 1) ***The coolant source*** – Ensure proper pressure range before connecting coolant. Inlet fitting is ¼” SAE flare fitting.
- 2) ***The coolant exhausts*** – Provide proper venting to reduce noise and possibility of asphyxiation. Exhaust fittings are 5/8” male barbed hose nipple.
- 3) ***The power source*** – Verify proper voltage and amperage capacity before applying power.
- 4) ***The temperature controller*** – Note power switch is off when applying power, be familiar with proper use. Make sure switch(es) on rear always stays ON. Controllers are universal 120-240 v. Standard model chambers are 15A. max. 15 or 20 A. for custom temperature chambers. See ID tag on system.
- 5) ***The chamber*** – Verify unintended items do not contact surfaces inside chamber, hands off and caution must be the general rule.

For testing and programming purposes the controller can easily be powered up without the chamber. Otherwise, it is recommended to have all above system parts connected per this document before connecting the power source. Turn off circuit breaker at rear just to shut off heating/cooling and blower outputs only for test purposes.

Before Operating:

Verify that the voltage of the electrical supply matches the product ID tag for the product, and it has adequate capacity to supply the required current for the system heaters. Controllers are typically of universal voltage. Standard model controllers are designed for 15A or 20A maximum load. Systems have specific voltage ratings which must be observed. Verify that the system power cord is plugged into a properly grounded receptacle. Verify that the power cord plug in position at the receptacle is not blocked by any equipment for easy access to disconnect. Verify that the controller umbilical is properly connected and secured to the chamber. A disconnected sensor connection will cause an alarm condition on the controller which must be manually cleared before operation can continue. Be sure that the chamber power and chamber sensor connector are hooked to the chamber.

Verify that the correct coolant type and pressure is connected to the thermal system before attempting to use the cooling function. Although the coolant valve(s) are designed to withstand continuous operation under all conditions, understand that it is far more stressful on the coolant solenoid to run the system in the cooling mode when there is no coolant supplied to the system.

Make sure that any items that might be burned by heat or damaged from extreme cold are removed from the surfaces of the chamber prior to use.

Hands off is a good rule for operation.

Operation

Please read the “Getting Started” and the detailed controller operation manual for a good understanding of proper use of the controller basic and extended functions.

Controller Considerations:

Become familiar with the temperature controller to prevent accidental wrong settings or dangerous conditions. See ‘Getting Started’ document and detailed manual for your specific controller.

Shut Down:

Normal shut down. The main power switch/breaker on the front of the controller may be used to apply and remove power from the system.

Failsafe Shutdown.:

TotalTemp thermal systems all have set point limits and safety out-of-range limits built into the controllers. The chamber has an internal, fixed high temperature limit switch that will also shut the system down if the temperature sensed exceeds 200°C (+15-0°). When this temperature limit is exceeded, power will be removed from the heating and cooling circuits of the system. Normal operation may be restored when the temperature comes back into the operating range by turning power off, then back on.

NOTE: The built-in failsafe shutdown system is designed for use as intended only. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Optionally, system controllers also have a built in independent redundant high / low limit temperature safety limit control. This is done using a Watlow 1/32 DIN, EZ Zone PM limit controller at the front panel. When so equipped, the system will typically also have a series redundant coolant shut down valve. This redundant valve is not cycled to maintain temperature. Therefore, it will not accumulate the wear and tear that the control solenoid does and will be ready to protect the system and device under test should the main control valve experience a failure that might otherwise result in an uncontrolled cooling condition.

Maintenance:

There is no required maintenance for the benchtop chamber system other than inspecting the coolant filter and the periodic rebuild of the coolant solenoid valve. The valve is typically good for 10 million cycles (Gems valves). Cycle rate is 1-2 cycles per second when maintaining a cold temperature. The valve normally does not cycle when heating or going to a cold temperature. Doing the calculations, a typical valve life is found to be many years. If you experience erratic valve operation, inspect and troubleshoot the system before continuing to use the system to eliminate latent or pending valve problems and reduce the chances of accidental run-away cooling. Motor bearings are permanently lubricated with wide temperature range lubricant. Periodically inspect the hoses, power cord, controller umbilical and their associated connectors. Remove product from service if a hose or electrical connection appears damaged or worn. Check to confirm the silicone door seal is complete around the door and make sure access panels are always in place during use to prevent safety hazards and to prevent damage due to buildup of condensation or frost inside unit. Do not use any abrasive cleaners.

Doors and cabling feed thrus:

Be aware of condition of door seals and flap gaskets repair or replace any broken seals that are not in good condition. Keep door alignment and latch and adjusted to prevent excessive wear on the seal. Keep the door closed whenever possible and avoid operation with the door open as much as possible. Likewise keep provided soft plugs or suitable nonflammable plugs in cabling notches when operating, as much as possible. Doors are reversable however due to the lift off feature, you will need a different set of hinges to reverse side which the door hinges. The hinges are a hardware store item but they are reinforced with a weld by TotalTemp Technologies. TotalTemp can provide hinges for reversing the door. They are simply a reinforced standard model (McMaster Carr: left side #1151A87; right side #1151A88).

Troubleshooting:

After reading the operation manual, if problem persists or a clear solution is not provided, please consult the factory for resolution of the problem. Offices are open 8AM-5PM Pacific time, weekdays.

Storage:

When in use, some condensation can occur on surfaces of the chamber interior. Make sure system is dry before closing into any packaging. It is recommended to put a cap over the coolant inlet and exhaust connections to prevent foreign objects from lodging in the plumbing, especially the inlet. When packing, be careful to prevent stress from being applied to the electrical or plumbing connections. You may want to remove any coolant filter from the product so that it is not damaged in shipping. Store in a dry environment. Normal safe packing procedures should be followed if the unit is to be shipped. Controllers must be stored in non-condensing environments.

Service:



TotalTemp Technologies, Inc

3630 Hancock St. Ste 'A'

San Diego, CA 92110

www.TotalTempTech.com Support@TotalTempTech.com

(888) 712-2228 x1

Parts:

Contact the factory for any needs involving maintenance or accessory parts.

Warranty:

On the following page.





TotalTemp Technologies, Inc.
2 Year Domestic Warranty
(U.S.A. & Canada)

WARRANTY

TotalTemp Technologies, Inc (TotalTemp) warrants their standard Thermal Test Systems (Platforms, Chambers *and* Temperature Controllers) to be free from defects in material and workmanship for a period of two years from shipment date of product. If a defect is discovered in the product, TotalTemp will replace the failed component at their option. The replacement of failed components does NOT include labor for diagnosing the problem, or repairs and installation. In the event that TotalTemp will provide the warranty replacement components, TotalTemp will pay the least expensive transportation costs to the original sale destination of the product. The customer will be responsible for the costs and labor for installation of the new component. If the customer wishes, for purposes of diagnosing the problem, TotalTemp will provide a reasonable amount of technical assistance to the customer via email or telephone. The purpose of which is to help both parties provide the fastest solution possible at a reasonable cost to the customer.

EXCLUSIONS

This warranty covers defects in manufacturing discovered while using the product as recommended by the manufacturer. This warranty does not cover loss or theft, nor does coverage extend to damage caused by misuse, abuse, unauthorized modification, repair, or shipping of the product, improper storage conditions, or natural disasters. This warranty does not cover parts that are subject to normal wear and tear such as cryogenic solenoid valves.

LIMITS OF LIABILITY

Should the product(s) fail, TotalTemp will provide replacement components, at their discretion, as described in the preceding paragraphs. TotalTemp cannot be held liable for any damage that results from the failure of this product. Damages excluded include, but are not limited to the following: lost profits, lost savings, lost data, damage to other equipment, and incidental or consequential damages arising from the use, or inability to use this product. In no event, under any circumstances, will TotalTemp be liable for more than the amount of the original purchase price, excluding tax, shipping, and handling charges. By installing or using this product, the user accepts all terms described herein. Venue for enforcement of this warranty rests in San Diego County, California, U.S.A.



TotalTemp Technologies, Inc.
1 Year International Warranty
(Excludes U.S.A. & Canada)

WARRANTY

TotalTemp Technologies, Inc (TotalTemp) warrants their standard Thermal Test Systems (Platforms, Chambers *and* Temperature Controllers) to be free from defects in material and workmanship for a period of one year from shipment date of product. If a defect is discovered in the product, TotalTemp will replace the failed component at their option. The replacement of failed components does NOT include labor for diagnosing the problem, or repairs and installation. In the event that TotalTemp will provide the warranty replacement components, TotalTemp will pay the least expensive transportation costs to the original sale destination of the product. The customer will be responsible for the costs and labor for installation of the new component. If the customer wishes, for purposes of diagnosing the problem, TotalTemp will provide a reasonable amount of technical assistance to the customer via email or telephone. The purpose of which is to help both parties provide the fastest solution possible at a reasonable cost to the customer.

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