FTS Systems

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IMMERSION COOLERS FC50, FC100 OPERATOR'S MANUAL

FTS SYSTEMS FLEXICOOL
IMMERSION COOLERS

Part Number 100364359

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Original Instructions

The U.S. English version of this document is the original instructions.
All other languages are a translation of the original instructions.

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Important Symbols

WARNING! INJURY OR EVEN DEATH MAY RESULT IF A RECOMMENDATION MARKED WITH THIS SYMBOL IS NOT HEEDED.

CRUSH HAZARD. KEEP HANDS CLEAR WHEN OPERATING DOOR.

ELECTRIC SHOCK DANGER! USE APPROPRIATE CAUTION TO AVOID INJURY OR DEATH.

CORROSIVE CHEMICAL. WEAR SUITABLE GLOVES, SAFETY GLASSES, AND PROTECTIVE CLOTHING.

BURN DANGER! POTENTIALLY HOT SURFACE. USE APPROPRIATE CAUTION.

COLD BURN DANGER! POTENTIALLY EXTREMELY COLD SURFACE. USE APPROPRIATE CAUTION.

WARNING! HAZARDOUS MATERIAL/CONTACT HAZARD.

PROPERTY CAUTION! TO PREVENT DAMAGE TO CHAMBER EQUIPMENT AND/OR LOAD, ADHERE TO PROCEDURES MARKED BY THIS SYMBOL.

DO NOT STORE FLAMMABLE MATERIALS IN CHAMBER.

PRACTICAL OPERATING TIP. THESE RECOMMENDATIONS STREAMLINE UNIT OPERATION AND PREVENT COMMON OPERATOR ERRORS.

ALWAYS WEAR APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT (PPE) SUITED FOR THE TASK YOU ARE PERFORMING.

EXPLOSIVE MATERIALS HAZARD! KEEP OBJECTS AWAY FROM HEAT.

Safety Warnings

- ✓ *Always transport the unit with care. Sudden jolts or drops may damage the refrigeration system.*
- ✓ *Always observe all warning labels.*
- ✓ *Always turn off the unit and disconnect the line cord from the available power source prior to performing any service or maintenance procedures.*
- ✓ *Always turn off the unit and disconnect the line cord from the available power source prior to moving the unit.*
- ✓ *Always operate, store and transport the unit in the upright position.*
- ✓ *Never operate equipment with damaged line cords.*
- ✓ *Never remove warning labels.*
- ✓ *Never operate damaged or leaking equipment.*

Warranty Information

FTS Systems FlexiCool low temperature baths are warranted by SP Scientific to be free of defects in material and workmanship when operated under normal conditions as specified in the instructions provided in this manual. Please take this opportunity to locate the serial tag on your new FTS Systems FlexiCool and record the information below for future reference. SP Scientific also recommends that you complete and return your unit's warranty registration card.

Model Number _____

Serial Number _____

Part Number _____

Limited Warranty

SP Scientific (the "Company") shall warrant each of its products against defects in material or workmanship for a period of 12 months from the date of shipment provided that the product is used in a reasonable manner under appropriate conditions and consistent with the applicable operating instructions.

The obligation of the Company shall be, at its option, to repair or replace, without charge any parts that prove to be defective within the warranty period, if the purchaser notifies the Company promptly in writing of such defect. No product shall be returned to the Company without prior approval of the Company.

This limited warranty shall cover the costs of parts and labor to repair or replace all defective product(s) at the Seller's factory. For all products installed by the Company and located within the Company service travel areas, this warranty shall cover transportation charges to ship the product to and from the Company's factory and/or the costs of travel, room and board if the Company's employees conduct repair at the Buyer's location. In lieu of repair or replacement at the Company's factory, the Company may, in its discretion, authorize a third party to perform the repair or replacement at the Buyer's location, and at the Company's sole expense.

The Company shall not be responsible for labor charges payable with respect to persons other than Company employees. Replacement or repair of parts pursuant to this warranty shall not in any way extend the original warranty period. The Company shall not be responsible for any unauthorized repairs, replacements or product modifications, nor will it be responsible for any product failures resulting from such unauthorized repairs, replacements or product modifications negligently or otherwise made by persons other than Company employees or authorized representatives of the Company. The buyer shall assume transportation charges to ship the product to and from the Company's factory and the costs of travel, room and board if the Company's employees conduct repair at the Buyer's location within the warranty period if the product was not installed by the Company's and/or is not located within the Company's service travel areas.

THE COMPANY DOES NOT MAKE AND EXPRESSLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER WARRANTY, EXPRESSED OR IMPLIED, WITH RESPECT TO THE SALE, INSTALLATION, DESIGN OR USE OF ITS PRODUCTS. ADDITIONALLY, THE COMPANY SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OF OR ANY DEFECTS IN ITS PRODUCTS.

The Company's employees are available to provide general advice to customers concerning the use of the Company's products; however, oral representations are not warranties with respect to particular products or their uses and may not be relied upon if they are inconsistent with the relevant product specifications for the items set forth herein.

Notwithstanding the above, the terms and conditions set forth in the Company's formal sales contracts shall be controlling and supersede any inconsistent terms contained herein, and any changes to such contracts must be made in writing and signed by an authorized executive of the Company.

WARNING! THE DISPOSAL AND/OR EMISSION OF SUBSTANCES USED IN CONNECTION WITH THIS EQUIPMENT MAY BE GOVERNED BY VARIOUS FEDERAL, STATE OR LOCAL REGULATIONS. ALL USERS OF THIS EQUIPMENT ARE URGED TO BECOME FAMILIAR WITH ANY REGULATIONS THAT APPLY IN THE USERS AREA CONCERNING THE DUMPING OF WASTE MATERIALS IN OR UPON WATER, LAND OR AIR AND TO COMPLY WITH SUCH REGULATIONS.

Contents

Chapter 1

Introduction

Overview

THE FTS SYSTEMS FLEXICOOL IS NOT INTENDED FOR USE WITH EXTREMELY FLAMMABLE FLUIDS SUCH AS ISOPENTANE (C_5H_{12}).

The FTS Systems FlexiCool FC50 and FC100 are mechanically refrigerated Immersions Coolers that offer high heat removal and rapid cool down capabilities. The FlexiCool meets the requirements for a variety of applications and features an optional temperature controller that allows for programming and/or control from remote locations.

FC100

FC50

The FTS Systems FlexiCool comes equipped with one (1) of three (3) standard probe configurations that may be placed wherever direct cooling and heat removal from ambient to -100 °C is required. These probes allow the unit to achieve maximum efficiency through the direct expansion of refrigerant inside the probe, which eliminates the need for a secondary medium or pumping.

The three (3) standard probe configurations are:

Cartridge Probe (P1)

Flexible Probe (P2)

Coil Probe (P4)

Note: *For more information on the standard probes, refer to the Probes section of Chapter 3: Operation. Custom probes are available upon request.*

Key Features

- Digital control with external RTD.
- Choice of three (3) probe options
- Optional USB adapter, 2m cable, and software for plug and play operation.
- Mechanically refrigerated.

Key Benefits

- Allows for accurate process control.
- Allows cooling for a variety of applications.
- Permits complete control of the machine from a PC and allows for data logging.
- Eliminates costs and hazards associated with expendable refrigerants.

Getting Started

Initial Inspection

Your FTS Systems FlexiCool immersion cooler was carefully packed and thoroughly inspected before leaving the SP factory. However, in the unlikely event that shipping damage has occurred, retain all packing material and contact your freight carrier immediately.

DO NOT ACCEPT DAMAGED SHIPMENTS FROM A CARRIER WITHOUT A SIGNED NOTIFICATION OF DAMAGES.

Upon receiving your shipment, inspect all contents of your equipment for damage. Carefully remove the unit from the box taking care when handling the probe. Carefully remove all packing material from the unit and inspect for visible damage. Check packing material for small accessory items. Inspect the inside of the unit and related parts for visible damage and leaks. Check for visible liquid at or near the base of the unit.

If concealed damage or loss is discovered, contact the freight carrier immediately.[1] Keep all contents, packing material and related paperwork intact until a written report is obtained.

Note: *SP will cooperate in the matter of collecting your claim but is not responsible for the collection or free replacement of the material. When possible, replacement parts will be shipped and invoiced to you, making them a part of your claim.*

Lifting the FlexiCool

If no damage was discovered following the initial inspection of the FlexiCool, make sure that two (2) individuals are available to safely lift and carry the unit using proper lifting techniques (*i.e.,* bending at the knees, not at the back). The FlexiCool should be held beneath the front and rear, while keeping the unit level.

WARNING! THE FC100 WEIGHS APPROXIMATELY 70 LBS. (32 KG) AND THE FC50 WEIGHS APPROXIMATELY 50 LBS. (23 KG). ALWAYS PRACTICE TEAM LIFTING AND USE PROPER LIFTING TECHNIQUES WHEN MOVING HEAVY EQUIPMENT.

[1] "Concealed damage or loss" refers to damage or loss that does not become apparent until the merchandise has been unpacked and inspected. Should damage or loss be discovered, you may make a written request for inspection by the carrier's agent within 15 days of the delivery date. You may then file a claim with the freight carrier or SP Scientific, depending on the terms of your shipment. If your shipment was "FOB Destination" file your claim with SP Scientific and include the inspection report and any other supporting documents. If your shipment was "FOB Shipping Point" file your claim with the freight carrier and include the inspection report and any other supporting documents.

Setup

The FTS System FlexiCool Immersion Cooler is designed for bench-top installation in a laboratory environment. Your unit should be installed on a firm, level surface in a location that is convenient for both operation and service.

NEVER PLACE THE UNIT IN AND AREA WHERE EXCESSIVE HEAT, MOISTURE OR CORROSIVE MATERIALS ARE PRESENT.

Ambient Conditions

NEVER OPERATE THE FTS SYSTEMS FLEXICOOL IN AN AREA WITH AN AMBIENT TEMPERATURE ABOVE 31 °C (88 °F).

This unit is designed for operation in a normal indoor environment (systems should not be mounted outside or otherwise exposed to the elements). The environment should be free from air containing large amounts of moisture, salt or sulfur.

For best low-temperature operation, consider that the ideal ambient temperature for your FTS Systems FlexiCool is approximately 22 °C (71.6 °F). Higher ambient temperatures will limit the system's ability to achieve its ultimate low temperature.

Ambient Air Temperature Requirements	
12 to 20 °C (55 to 69 °F)	Acceptable, but expect reduction.
21 to 24 °C (70 to 75 °F)	Ideal.
25 to 27 °C (77 to 80 °F)	Acceptable, but a reduction in the cooling capacity of the unit is to be expected (*i.e.,* about a 1% cooling capacity reduction per degree above 25 °C (77 °F)).
28 to 30 °C (82 to 86 °F)	Expect reduced reliability. Warranty may be voided.
Over 31 °C (Over 88 °F)	Not Acceptable. Warranty will be voided.

Air Flow Considerations

The FTS Systems FC50 and FC100 are equipped with an air-cooled refrigeration system. Air is pulled from the left side of the unit to cool the refrigeration system components and then exits the rear panel. When positioning your system, ensure that it is located on a firm, level surface in an area that provides adequate air circulation.

Inadequate airflow will degrade the unit's cooling capacity and in extreme cases may result in compressor failure. A minimum of 4 inches (10.2 cm) of clearance on all sides of the unit is required to ensure proper airflow and avoid damage to the refrigeration system.

This equipment can add up to 3400 Btu/hr. (1 kw) of heat to the room. Always ensure that proper ambient temperature is maintained to ensure best performance.

Electrical Requirements

All 120 VAC / 60 Hz equipment is supplied with a 6 ft., 7 in (2 m) long power cord terminated with a molded NEMA 5-15P plug.

NEMA 5-15P

All 220 VAC / 50 Hz equipment is supplied with a 9 ft., 10 in (3 m) long, un-terminated, AWG 18-3 power cord. Both cords are detachable and have a molded IEC 60320 C-13 plug that attach to the machine.

Equipment rated with a nominal voltage of 120 VAC / 60 Hz should only be operated from 113 to 127 VAC. Equipment rated with a nominal voltage of 220 VAC / 50 Hz should only be operated from 211 to 240 VAC. Equipment rated with a nominal voltage of 230 VAC / 60 Hz should only be operated from 218 to 242 VAC.

Note: *Variances in frequency of ± 3 Hz are permitted.*

IEC Protection - Class 1

This unit's chassis is connected to earth ground through a 3-conductor mains cable. Ensure that the AC outlet has corresponding ground and that the voltage and frequency match the serial tag on the back of the unit.

Services and Utilities

The FTS Systems FlexiCool's serial tag, which is located on the unit's back panel, provides the unit serial number and electrical requirements. Ensure that the voltage, phase, frequency, and amperage listed on the serial tag match your facility's available power supply (*e.g.,* as a minimum the power outlet you intend to use must meet the requirements listed on the serial tag).

CAUTION! IF YOU ARE UNSURE ABOUT THE AVAILABLE ELECTRICAL VOLTAGE SUPPLY IN YOUR FACILITY, CONSULT A QUALIFIED ELECTRICIAN.

Prior to connecting your FTS Systems FlexiCool to the available electrical supply, ensure that the Main Power switch is in the Off position. You may connect the unit to the available electrical supply at this time.

Installation

Only qualified personnel should perform the installation of this unit. The voltage and frequency requirements are specified on the serial tag on the rear of the unit.

- Verify that the facilities voltage matches the requirement for the machine, which is printed on the serial tag on the rear of the machine.
- The electric service wiring must be of a large enough wire gauge that the voltage is maintained to the receptacle even when a full load is applied to the receptacle. Additionally, the receptacle voltage should be measured while that receptacle is under load.
- Ensure the proper amperage circuit breaker is installed in the line and located near the equipment.
- Plug in the line cord. Avoid the use of long extension cords, these cause a significant power drop between the wall receptacle and the machine.

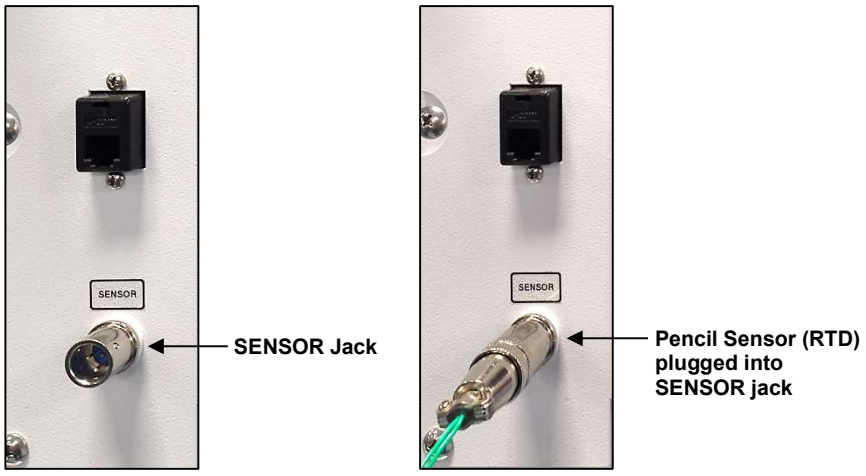
  Note: *For Lock Out / Tag Out plug the appropriate device into the line cord.*

CAUTION! IF YOU ARE UNSURE ABOUT THE AVAILABLE ELECTRICAL VOLTAGE SUPPLY IN YOUR FACILITY, CONSULT A QUALIFIED ELECTRICIAN.

System Preparation

1. Locate the provided pencil sensor (RTD) (control).

2. Plug the pencil sensor (RTD) into the jack labeled SENSOR on the back of the unit.

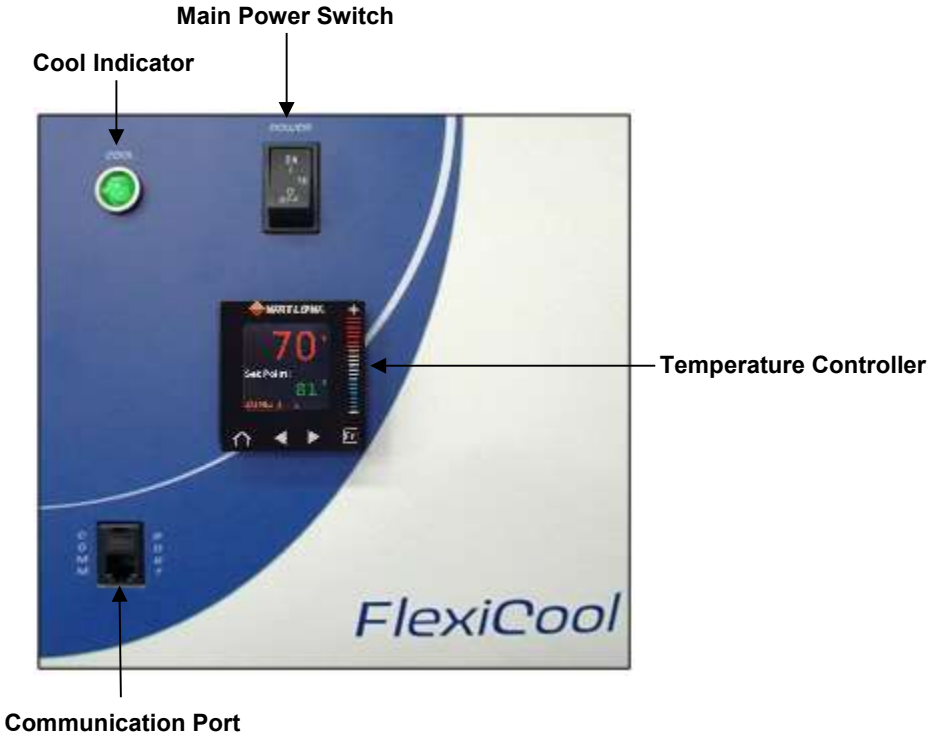


3. Place the sensor so that the shaft is in contact with the fluid / vapor whose temperature is to be controlled.
4. Plug the unit into the power source.

CAUTION LOW TEMPERATURES: STAINLESS STEEL PROBES AND FLUIDS IN CONTACT WITH THE PROBES CAN REACH EXTREMELY LOW TEMPERATURES (*E.G.*, -100 °C (-148 °F)). AVOID COLD BURNS BY NEVER HANDLING STAINLESS STEEL PROBES OR FLUIDS WHEN THEY REACH EXTREMELY LOW TEMPERATURES.

Front Panel Display

The front panel of the FlexiCool FC50 and FC100 (control) houses the main power switch, cool indicator, process temperature controller*, and communication port. The front panel of the FlexiCool FC50 or FC100 (no control) only features the main power switch and cool indicator.



*Optional: For models 100309134 and 100288620 Watlow will be standard controller.

Basic Operation

Start Up

1. Turn the main power switch to the ON position.

2. The controller will turn on and display the current process temperature and setpoint value.

3. Adjust the setpoint using the +/- Keys.

   Note: *The images below are samples. Specifications may be different from what is shown.*

Control

1. When the system is running, use the +/- Keys to bring up or down the setpoint.

Powering Off

1. Toggle the main power switch to the OFF position.

2. The refrigeration will shut down and the display will be blank.
3. Unplug the unit.
4. Thoroughly clean and dry the probe head after each use.

Delivery Line

The FTS Systems FlexiCool has a delivery line that carries the refrigerant to the probe and back. This flexible delivery line is made of corrugated stainless steel tubing with several layers of insulation. Although this line is strong, it can be damaged to the point of rupture if it is repeatedly bent too sharply or forcibly twisted. This line must remain gas-tight in order to contain the refrigerant charge in the unit.

- Never bend the delivery line more sharply than a 5-inch (12.7 cm) radius or a 10-inch (25.4 cm) diameter.
- Supporting the delivery line at one or more places is recommended to prevent sagging or stressing the line.
- Wide contact points on the supports are recommended to avoid compressing or degrading the internal insulation.
- Adjusting the delivery line when it is cold may damage the insulation or stainless steel tubing, which may result in reduced performance.

Note: *Do not move the delivery line when it is cold. Always turn the system off for at least 4 hours before making any adjustments to the placement of the delivery line.*

Probes

The FTS Systems FlexiCool comes equipped with one (1) of three (3) standard probe options:

Note: *Custom probes are available upon request.*

Cartridge Probe (P1 - Smooth Cylinder)

Well suited for cooling vapors.

Flexible Probe (P2 – Flexible Corrugated)

Corrugated, stainless steel flex-line makes this probe a versatile tool that can be used for any number of applications.

Coil Probe (P4 – Smooth Coil)

Provides the highest surface area and allows maximum cooling of immersion baths.

The Cartridge Probe (P1 - Smooth Cylinder) and the Coil Probe (P4 – Smooth Coil) are constructed of AISI Type 304 stainless steel heavy wall tubing and will withstand hard usage and corrosion attack normal to this type of stainless steel. However, if the probe comes into contact with other steel surfaces, the stainless surface will become contaminated with free iron and rusting or pitting of the stainless surface may occur. If such a condition is observed, treat with a 20% Nitric Acid solution by dipping or brushing for approximately one hour. While cleaning, be sure not to dip the brazed connection at the top of the coil in the acid solution. In severe cases, this pitting can lead to perforation.

The Flexible Probe (P2 – Flexible Corrugated) is constructed of flexible AISI Type 316L stainless steel tubing. The Flexible Probe has no protective braid and is much more susceptible to abrasion or puncture by a sharp object than the delivery line. Please observe the following precautions:

- Never reposition the Flexible Probe when it is cold.
- Do not allow the Flexible Probe to drag on the floor or other rough surfaces.
- Never wrap the Flexible Probe around the delivery line.
- Never chip ice from the probe.
- Never bend the Flexible Probe more sharply than a 1-inch (2.5 cm) inner radius or a 2-inch (5 cm) diameter.

Note: *All the precautions outlined for the delivery line in the Delivery Line section of this chapter apply to the Flexible probe.*

Sound Level

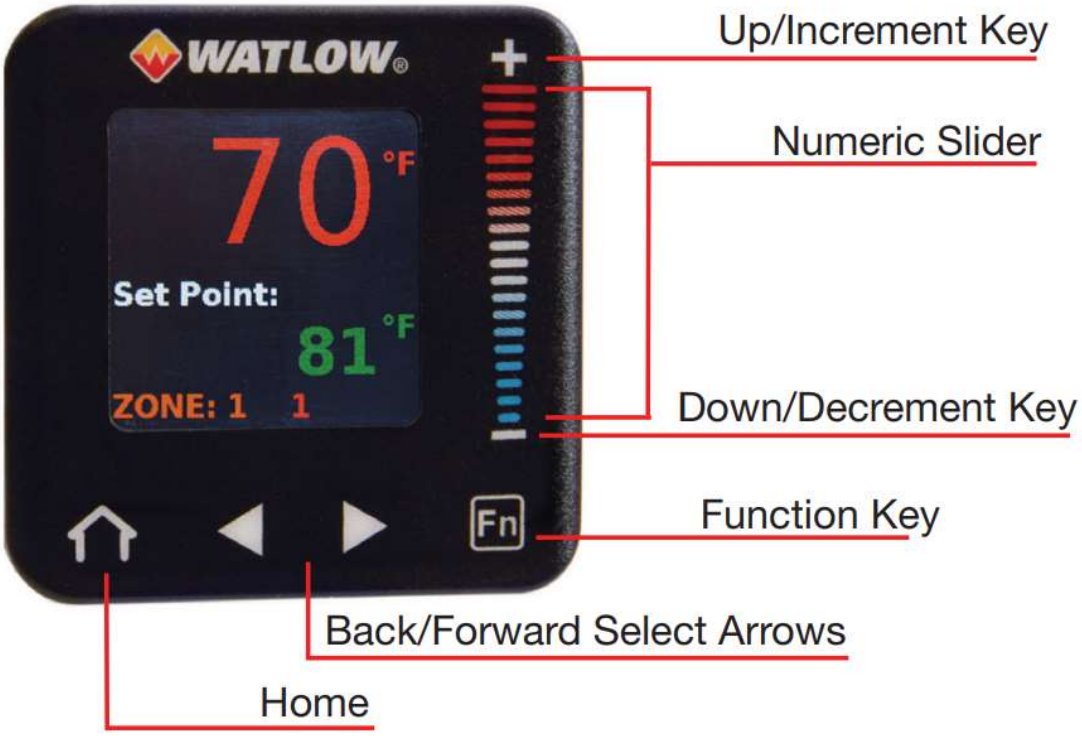
The maximum sound pressure level (SPL) recorded for the FlexiCool is 61 dBA. Readings were taken on all four (4) sides of the unit at a distance of 36 inches (91 cm) from a seated position of 48 inches (122 cm) high, while the unit was located on a 33-inch (84 cm) high bench. The maximum SPL of 61 dBA was recorded on the back side of the unit.

Watlow EZ-Zone Controller

Overview

The WATLOW EZ-ZONE controller is integrated into the FlexiCool FC50 and FC100 (control) Immersion Coolers. These controller instructions will refer to your FlexiCool as the base unit.

Note: *The image below is a sample. Specification may be different from what is shown.*



- Scroll up or down lists using the + or - keys.
- Increase or decrease numeric parameters with the slider.

- Select items or move to lists using the forward arrow.

- Return to the previous selection with the back arrow.

- Return to the home screen from any screen with the Home button.

1 - SET UP THE SENSOR INPUT

Sensor Types

- thermocouple
- millivolts
- volts
- milliamp
- 100Ω RTD
- 1000Ω RTD
- potentiometer
- analog input off

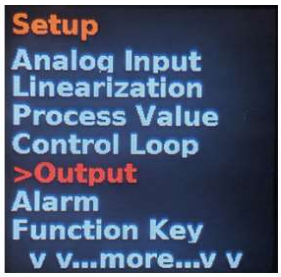
1. From **Home**, tap the *forward arrow* to go to **Operations**.
2. Scroll to **Setup** using the *+/- keys* then press *forward arrow* to select it.
3. Scroll to and select **Analog Input**.
4. Scroll to and select **Sensor Type**.
5. Scroll to and select your sensor type.
6. If you select ***Thermocouple***, a TC Linearization list opens. Use the *+/- keys* to find the correct type: J, K, N, R, S, or T.
7. If you select ***100Ω*** or ***1000Ω RTD***, press *back arrow* to return to **Sensor Type**, scroll to and select **RTD Leads**, then select **2** or **3**, as needed for your sensor.

2 - SET UP OUTPUTS

Repeat for all outputs

Output Functions

- heat control
- cool control
- event a
- event b
- alarm
- output off



1. From **Home**, tap the *forward arrow* to go to **Operations**.
2. Scroll to and select **Setup**.
3. Scroll to and select the **Output** list.
4. Scroll to **Output 1** and press *forward arrow* to select it.
5. Scroll and select **Output Function**.
6. Scroll up or down the list to select the output function, then use the back arrow to return to the **Output** list and select the settings for that Output function:

- For alarm outputs, select **Output Function Instance**, then select **Alarm Instance 1 - 4**.
- For heat or cool outputs, set the Time Base.
  - For a **Fixed Time Base,** select **Output Time Base** and use the *numeric slider* to set the time base cycle.
  - If you have a Switched DC or Open Collector and prefer a **Variable Time Base**, select **Output Low Power Scale** and set it with the *numeric slider.* Use the *back arrow* to return to **Output**, select **Output High Power Scale,** and set it with the *numeric slider.*

3 - SET UP ALARM TYPES / SIDES

Alarm Types

process: alarm set points are set directly

deviation: alarm set points are relative to the control loop's set point.

Off: no alarm occurs

Alarm Sides

high: alarm when process is above high alarm set point.

low: alarm when process is below low alarm set point.

both: high and low alarms are active.

Alarm sides allow you to set a high alarm, a low alarm, or both.

Alarm Type

1. From **Home**, tap the ***forward arrow*** to go to **Operations**, then scroll to and select **Setup**.
2. Scroll to and select **Alarm**.
3. Scroll to and select Alarm **1**, **2**, **3**, or **4**.
4. Scroll to and select **Alarm Type.**
5. Scroll to and select the type: **process**, **deviation**, or **off**

Alarm Sides

6. Use the ***back arrow*** to return to **Alarm 1**, **2**, **3**, or **4**.
7. Scroll to and select **Alarm Sides**.
8. Scroll to and select the desired sides option: **high**, **low**, or **both**.
9. Use the ***back arrow*** to return to the **Alarm** list.
10. Scroll to the **Alarm High Set Point** or **Alarm Low Set Point**, as necessary for your sides selection.

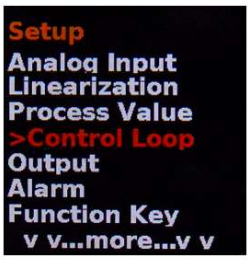
Repeat for remaining alarms

4 - CONTROL LOOP MODE, SET POINT, AUTOTUNE

NOTES: By default the control loop Heat algorithim is enabled for PID control and the Cool algorithim is OFF. To enable, go to Control Loop.

CAUTION: Autotune turns on the loop's heat output until the process value exceeds 90% of the set point, then turns the output off and repeats this. When finished the loop controls at the set point. Before starting Autotune, consider if it is safe to do so.

The system must be operational for autotuning to select PID settings.



Control Mode

1. From **Home**, tap the ***forward arrow*** to go to **Operations**.
2. Scroll to and select **Setup**.
3. Scroll to and select **Control Loop.**
4. Scroll to and select **Control Mode**.
5. Select **Off, Auto,** or **Manual**.
   Auto: loop adjusts output so process matches set point.
   Manual: user sets control loop output in percent power.
   Off: no control loop output

Control Loop Set Point

1. Press the **Home** button to return to the Home screen.
2. Use the *numeric slider* or the *+/-keys* to choose the set point.

Autotune

1. From **Setup**, scroll to and select **Control Loop.**
2. Scroll to and select **AutoTune**.
3. Select **Yes**.

Restarting

Due to the nature of the refrigeration system and its compressor, the FlexiCool should never be restarted immediately after it is powered off. SP recommends waiting approximately five minutes between shutting down and restarting the FlexiCool.

Multiple Machine / Controller Setup

Using the optional Communication Kit or through RS485/Modbus communication, WATLOW controllers may be wired together “daisy chained” to form a communication network. This communication network allows for remote control, monitoring and/or data logging through a single computer. The WATLOW controller can be configured with up to 247 unique addresses, which allows multiple machines to be monitored through a single computer, however the monitoring software can only view up to four (4) controllers at a single time.

Notes: *For more information on the optional Communication Kit (p/n COMMKIT) refer to your unit specifications or contact SP.*

For more information on RS485/Modbus communication, contact SP.

Connection Procedure

1. Connect your PC to the communication port on the front of the first machine.
2. Connect the back of the first machine to the front of the second machine using a standard (straight thru) RJ12 or RJ45 cable assembly.

   Note: *A 5-foot, straight, RJ12/45 (p/n 100004626) is available. For more information, contact SP Scientific.*
3. Connect each additional machine in the same “daisy chain” fashion.

   Note: *Each machine on the network must be given a unique address. If four (4) or more machines are on the network, you may need to add a terminating resistor (120Ω) to the last unit.*

Maintenance

	ALWAYS REMOVE POWER FROM THE UNIT BEFORE PERFORMING MAINTENANCE PROCEDURES.
	NOTICE: ONLY QUALIFIED PERSONNEL SHOULD PERFORM MAINTENANCE ON THE REFRIGERATION SYSTEM ITSELF, AND ONLY EPA CERTIFIED TECHNICIANS MAY EVACUATE OR CHARGE REFRIGERANTS.
	WARNING: HAZARDOUS VOLTAGES. RISK OF ELECTRIC SHOCK, DISCONNECT ALL POWER BEFORE SERVICING THIS UNIT. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.
	HAZARDOUS MATERIAL/CONTACT HAZARD: THE CHEMICALS USED IN THIS UNIT ARE CONTAINED WITHIN FULLY ENCLOSED SYSTEMS. NO MAINTENANCE ACTIVITIES INVOLVING THE REFRIGERATION SYSTEM ARE TO BE PERFORMED BY THE END-USER.
	HOT SURFACE: THE COMPRESSOR AND ASSOCIATED TUBING IN THE LOWER PORTION OF THE UNIT ARE LIKELY TO BE HOT AND POSE A POTENTIAL BURN HAZARD.

Cleaning

The following procedure should be performed on a routine basis, from weekly to monthly depending upon the operating environment.

1. Disconnect electric utilities.
2. Wipe down all exterior cabinet surfaces with a damp cleaning cloth.
3. Vacuum dust from the refrigeration condenser as well as all screens and openings.
4. Remove cabinet panels.
5. Blow compressed air systematically from the top to bottom. Let air settle for several minutes and repeat.
6. Check for areas that have frosted during operation and insulate as required.
7. Replace cabinet panels.
8. Connect electric utilities.

Compressor Safeties

Refrigerant Types and Properties

FC50 models equipped with a single-stage refrigeration system use 1.27 ounces of R1270 (Propylene).

FC100 models equipped with a cascade refrigeration system are comprised of two (2) separate compressors which utilize two (2) separate refrigerants. The first stage compressor, also referred to as the high stage, uses 1.02 ounces of R507 (Genetron® AZ-50). The second stage compressor, also referred to as the low stage, uses 1.24 ounces of R1150 (Ethylene).

	Properties	R1270 (Propylene)	R290 (Propane)	R507 (Genetron® AZ-50)	R1150 (Ethylene)
National Fire Protection Association (NFPA) Rating	Health	1 (Exposure would cause irritation with only minor residual injury)	2 (Intense or continued, but not chronic exposure could cause temporary incapacitation or possible residual injury)	2 (Intense or continued, but not chronic exposure could cause temporary incapacitation or possible residual injury)	1 (Exposure would cause irritation with only minor residual injury)
	Flammability	4 (Will rapidly or completely vaporize at normal atmospheric pressure and temperature, or is readily dispersed in air and will burn readily)	4 (Will rapidly or completely vaporize at normal atmospheric pressure and temperature, or is readily dispersed in air and will burn readily)	1 (Materials that require considerable preheating, under all ambient temperature conditions, before ignition and combustion can occur)	4 (Will rapidly or completely vaporize at normal atmospheric pressure and temperature, or is readily dispersed in air and will burn readily)
	Instability	0 (Normally stable, even under fire exposure conditions, and are not reactive with water)	0 (Normally stable, even under fire exposure conditions, and are not reactive with water)	0 (Normally stable, even under fire exposure conditions, and are not reactive with water)	2 (Undergoes violent chemical change at elevated temperatures and pressures, reacts violently with water, or may form explosive mixtures with water)
	Special				
Additional Information	Health	This product is a gas at normal temperature and pressure, and in ultra-low quantities, this makes inhalation or ingestion very unlikely. No harm is expected from contact of gas to the skin and eyes, however, liquid may cause frostbite.			
	Personal Safety Information	If handling cylinders, wear gloves as well as OSHA approved eye and foot protection.			
	Inhalation	Asphyxiation. Effects are due to lack of oxygen. Moderate concentrations may cause headache, drowsiness, dizziness, excitation, excess salivation, vomiting, and unconsciousness. Lack of oxygen can kill.			

Refrigeration System

The FlexiCool refrigeration system compressors are equipped with two safety devices for protection against low voltage or high temperatures. If the voltage drops below what is required for the compressor to operate, an overcurrent device turns the compressor off. If the compressor temperature rises too high due to insufficient air-cooling, a high-temperature thermostat deactivates the compressor.

Note: *High temperature of the compressor can be caused by blocked airflow or by a malfunction of the fan motor.*

The compressor will automatically start when the condition is corrected but will turn off again if the voltage is too low or the temperature is too high.

IF ANY REFRIGERATION SYSTEM PROBLEMS OCCUR MORE THAN ONCE, THE UNIT SHOULD BE SHUT OFF UNTIL THE CAUSE OF THE PROBLEM CAN BE DETERMINED AND CORRECTED. ALLOWING THE UNIT TO CONTINUE TO RUN DESPITE ENCOUNTERING A PERFORMANCE PROBLEM MAY LEAD TO FAILURE OF THE UNIT.

Appendix A: Temperature Calibration

Temperature calibration is performed to optimize system accuracy. The controller is factory calibrated using a certified National Institute of Standards and Technology (NIST) traceable measuring instrument, but during its operating life may experience some zero drift due to aging of components. To recalibrate the system, an independent measuring instrument with reference probe is required to compare actual readings to readings displayed on the controller.

To calibrate the system's temperature sensor:

1. Ensure that the provided Pencil Sensor (RTD) is plugged into the jack labeled SENSOR on the back of the unit.

Pencil Sensor (RTD) plugged into SENSOR jack

2. Ensure that the shaft of the Pencil Sensor (RTD) is in contact with the fluid or vapor temperature that needs to be controlled.
3. Place an NIST sensor (with independent measuring instrument) or thermometer in the same fluid or vapor as close as possible to the machine's Pencil Sensor (RTD).
4. Use the WATLOW controller to adjust the temperature setpoint to -40 °C (or other required temperature).
5. Allow the system temperature to stabilize (*i.e.*, wait approximately 10 minutes).
6. Press *forward key*  for 1 seconds to access *Operations* then, select the **+/-** Keys to browse to Setup.
7. Once at Setup, press *forward key*  to access the *Analog Input* section.
8. Again, press the *forward key*  **and**, use the **+/-** *Keys* to browse to the *Calibration Offset* section.
9. Set this value to Zero **or** use the **+/-** Keys to change this value.

Appendix B: Changing Temperature Display

DO NOT SET THE TEMPERATURE ABOVE 68 °F (20 °C) OR THE DESIRED SETPOINT CANNOT BE REACHED.

To change the WATLOW Controller's temperature display from degrees C to degrees F:

1. Press *forward key*  for 1 seconds to access *Operations* then, select the +/- Keys to browse to *Setup*.
2. Once at *Setup*, press the +/- *Keys* to browse to the *Global* section.
3. Once at the Global section, press *forward key*  to enter the *Display Units* section.
4. At the *Display Units* section, use the +/- Keys to change from C to F unit.

Appendix C: Troubleshooting

Symptom	Possible Cause	Remedy
Compressor shuts off and then turns itself back on in 3-4 minutes	Low voltage	Check the voltage on the unit while it is under load. The voltage must be within 5% of the voltage listed on the serial tag on the rear or the unit.
	High ambient temperature	Check the room temperature and compare with the Ambient Air Requirement listed in Installation and Startup. Take steps to reduce this temperature if it is too high.
	Dirty or blocked condenser fins	Clean condenser.
	Fan not working	Check for operation of the fan (you can feel air being drawn across the condenser). If it isn't working, please call SP Scientific Service.
Compressor fails to restart after it has been shut off	High pressure in the refrigeration system	Wait several minutes and try starting the unit again.
Gradual loss of Temperature	Dirty or blocked condenser fins	Clean condenser.
	Loss of refrigerant	Call SP Service.
Unit will not start	Improper voltage	Check power source. Ensure that the source voltage matches the unit's specified voltage listed on the serial tag on the rear or the unit.
	Main breaker off	Verify that the main breaker is in the on position.
Unit will not cool	Second or low stage has not started (*i.e.,* cascade units only)	Verify that the COOL light is illuminated.

Appendix D: Refrigerant Information

THE REFRIGERANTS AND INSULATING FOAM USED IN THE MANUFACTURE OF THIS EQUIPMENT CONTAIN FLUORINATED GREENHOUSE GASES.

EU F-Gas Regulation (517/2014)

SP Scientific freeze dryers, low temperature chillers, glycol coolers and low temperature vapor condensers utilize several hydrofluorocarbon (HFC) refrigerants and foam blowing agents. The import and use of these HFC refrigerants within the European Union (EU) are regulated by the EU F-Gas Regulation (517/2014). As a result, all SP Scientific products containing HFCs shall be labelled, and instruction manuals shall include the information placed on the label.

F-Gas labels shall include:

- The type of HFC refrigerants used.
- The quantity of HFC refrigerants expressed in weight (Kg),
- The GWP (global warming potential) of HFC refrigerants.
- The total CO_2 equivalent (CO_2e) of HFC refrigerants contained in the equipment.
- A reference that the refrigerants and insulating foam contain fluorinated greenhouse gases.

The following F-Gas information is provided for (MODEL) equipment. This information shall also be included on the F-Gas label attached to equipment after 1 January 2017.

Equipment Model	Gas #1			Gas #2			Gas #3			Total CO_2e (tonnes)
	F-Gas	Charge (Kg)	GWP	F-Gas	Charge (Kg)	GWP	F-Gas	Charge (Kg)	GWP	
FlexiCool Single (FC50)	R1270	0.040	1.8	N/Ap	N/Ap	N/Ap	N/Ap	N/Ap	N/Ap	0.000
FlexiCool single, special probe (FC50TJA)	R410a	0.064	2088	N/Ap	N/Ap	N/Ap	N/Ap	N/Ap	N/Ap	0.137
FlexiCool cascade (new style) (FC100)	R1150	0.033	3.7	R290	0.006	3.3	R1270	0.032	1.8	0.000
FlexiCool cascade (old style) (FC100)	R1150	0.033	3.7	R290	0.006	3.3	R507	0.032	3985	0.128

Equipment Model	Gas #1			Gas #2			Gas #3			Total CO_2e (tonnes)
	F-Gas	Charge (Kg)	GWP	F-Gas	Charge (Kg)	GWP	F-Gas	Charge (Kg)	GWP	
FlexiCool cascade (FC100PS)	R1150	0.039	3.7	R1270	0.031	1.8	N/Ap	N/Ap	N/Ap	0.000
FlexiCool cascade (FC100PT9/14)	R1150	0.033	3.7	R290	0.006	3.3	R507	0.034	3985	0.135
FlexiCool cascade (FC100PML)	R1150	0.033	3.7	R290	0.006	3.3	R1270	0.032	1.8	0.000
FlexiCool cascade (FC100SC/SC2)	R1150	0.033	3.7	R290	0.006	3.3	R507	0.034	3985	0.136
FlexiCool cascade (FC100SC3)	R1150	0.033	3.7	R290	0.006	3.3	R1270	0.032	1.8	0.000
FlexiCool cascade (FC100TJA)	R1150	0.033	3.7	R290	0.006	3.3	R1270	0.032	1.8	0.000
FlexiCool cascade (FC100XX10CX)	R1150	0.033	3.7	R507	0.034	3985	N/Ap	N/Ap	N/Ap	0.136

General EU Compliance Guidelines

Leak Prevention & Checking

Any equipment with less than 5 tonnes CO_2e (non-hermetic) or 10 tonnes CO_2e (in hermetically sealed systems[2]) is exempt from leak checking under the EU F-Gas regulation as of 01 January 2017. Owners and end-users of SP products with CO_2 weight limits above the aforementioned may be subject to the automatic leak detection requirement.

Record Keeping / F-Gas Registry

Many SP products are below the CO_2 weight limit threshold for meeting the record keeping requirement, however, some SP products are above the size threshold specified. In such cases, owners and end users must understand and comply with the record keeping requirements of the EU F-Gas regulation.

Note: *All importers of equipment pre-charged with HFCs must have a registry account.*

Recovery

Equipment owners and users must understand and meet mandatory obligations regarding the recovery of HFC refrigerants and foam blowing agents at end-of-life from equipment of all sizes. SP shall not assume responsibility for the disposal and/or recovery of HFC refrigerants and foam blowing agents.

[2] "Hermetically sealed equipment" means equipment in which all fluorinated greenhouse gas containing parts are made tight by welding, brazing or a similar permanent connection, which may include capped valves or capped service ports that allow proper repair or disposal, and which have a tested leakage rate of less than 3 grams per year under a pressure of at least a quarter of the maximum allowable pressure.

Service, Training and Certification

All servicing that involves breaking into the refrigeration circuit must be performed by technicians holding relevant training certificates. This applies to equipment of all sizes.

Control of Use / Service Ban

The 2014 EU F-Gas Regulation includes a “service ban” that bans the use of HFCs with a GWP above 2500 for the maintenance of existing refrigeration equipment with virgin refrigerant after January 2020.
The ban includes:

- A size threshold of 40 tonnes CO_2e.
- An exemption for equipment that cools products to below -50 ˚C.
- An exemption for the use of reclaimed refrigerant until 2030.

Note: *Many SP products are below size threshold specified or operate with products below -50˚C. For these products, the service ban has no impact. However, for medium- and large-sized systems that use a refrigerant with a GWP above 2500, and do not operate below -50 ˚C, the service ban requires compliance which shall be the responsibility of the equipment owner and/or end user.*

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