FLUKE®

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0011

Fogging Test Chamber User's Guide

Rev. 681501

Limited Warranty & Limitation of Liability

Each product from Fluke Corporation, Hart Scientific Division ("Hart") is warranted to be free from defects in material and workmanship under normal use and service. The warranty period is one year for the Fogging Test Chamber. The warranty period begins on the date of the shipment. Parts, product repairs, and services are warranted for 90 days. The warranty extends only to the original buyer or end-user customer of a Hart authorized reseller, and does not apply to fuses, disposable batteries or to any other product, which in Hart's opinion, has been misused, altered, neglected, or damaged by accident or abnormal conditions of operation or handling. Hart warrants that software will operate substantially in accordance with its functional specifications for 90 days and that it has been properly recorded on non-defective media. Hart does not warrant that software will be error free or operate without interruption. Hart does not warrant calibrations on the Fogging Test Chamber.

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Hart's warranty obligation is limited, at Hart's option, to refund of the purchase price, free of charge repair, or replacement of a defective product which is returned to a Hart authorized service center within the warranty period.

To obtain warranty service, contact your nearest Hart authorized service center or send the product, with a description of the difficulty, postage, and insurance prepaid (FOB Destination), to the nearest Hart authorized service center. Hart assumes no risk for damage in transit. Following warranty repair, the product will be returned to Buyer, transportation prepaid (FOB Destination). If Hart determines that the failure was caused by misuse, alteration, accident or abnormal condition or operation or handling, Hart will provide an estimate or repair costs and obtain authorization before commencing the work. Following repair, the product will be returned to the Buyer transportation prepaid and the Buyer will be billed for the repair and return transportation charges (FOB Shipping Point).

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Rev. 681501

Table of Contents

1 Before You Start

1.1 Symbols Used

Table 1 lists the International Electrical Symbols. Some or all of these symbols may be used on the instrument or in this manual.

Table 1 *International Electrical Symbols*

Symbol	Description
	AC (Alternating Current)
	AC-DC
	Battery
	CE Complies with European Union Directives
	DC
	Double Insulated
	Electric Shock
	Fuse
	PE Ground
	Hot Surface (Burn Hazard)
	Read the User's Manual (Important Information)
	Off
	On

Symbol	Description
	Canadian Standards Association
CAT II	OVERVOLTAGE (Installation) CATEGORY II, Pollution Degree 2 per IEC1010-1 refers to the level of Impulse Withstand Voltage protection provided. Equipment of OVERVOLTAGE CATEGORY II is energy-consuming equipment to be supplied from the fixed installation. Examples include household, office, and laboratory appliances.
	C-TIC Australian EMC Mark
	The European Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) mark.

1.2 Safety Information

Use this instrument only as specified in this manual. Otherwise, the protection provided by the instrument may be impaired.

The following definitions apply to the terms "Warning" and "Caution".

- "WARNING" identifies conditions and actions that may pose hazards to the user.
- "CAUTION" identifies conditions and actions that may damage the instrument being used.

1.2.1 ⚠ WARNINGS

To avoid personal injury, follow these guidelines.

GENERAL

- **DO NOT** use the instrument for any application other than calibration work. The instrument was designed for temperature calibration. Any other use of the unit may cause unknown hazards to the user.
- **DO NOT** use the unit in environments other than those listed in the User's Guide.
- The unit is not equipped with wheels. It is considered to be permanently set once it has been installed. If the unit must be moved for some reason, two should people pick the unit up, carefully lifting at the same time.
- Follow all safety guidelines listed in the user's manual.
- Calibration Equipment should only be used by trained personnel.
- If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.
- Before initial use, or after transport, or after storage in humid or semi-humid environments, or anytime the instrument has not been energized for more than 10 days, the instrument needs to be energized for a "dry-out"

period of 2 hours before it can be assumed to meet all of the safety requirements of the IEC 1010-1. If the product is wet or has been in a wet environment, take necessary measures to remove moisture prior to applying power such as storage in a low humidity temperature chamber operating at 50 degree centigrade for 4 hours or more.

- Overhead clearance is required. Do not place the instrument under a cabinet or other structure. Always leave enough clearance to allow for safe and easy insertion and removal of samples.
- The instrument is intended for indoor use only.

BURN HAZARD

- Extremely cold temperatures may be present in this equipment. Freezer burns and frostbite may result if personnel fail to observe safety precautions.
- High temperatures may be present in this equipment. Fires and severe burns may result if personnel fail to observe safety precautions.

ELECTRICAL HAZARD

- These guidelines must be followed to ensure that the safety mechanisms in this instrument will operate properly. This instrument must be plugged into a 115 VAC, 60Hz (230 VAC, 50Hz optional), AC only electric outlet. The power cord of the instrument is equipped with a three-pronged grounding plug for your protection against electrical shock hazards. It must be plugged directly into a properly grounded three-prong receptacle. The receptacle must be installed in accordance with local codes and ordinances. Consult a qualified electrician. DO NOT use an extension cord or adapter plug.
- **DO** use a ground fault interrupt device. This unit contains a fluid. A ground fault device is advised in case fluid is present in the electrical system and could cause an electrical shock.
- Always replace the power cord with an approved cord of the correct rating and type. If you have questions, contact an Authorized Service Center (see Section 1.3).
- High voltage is used in the operation of this equipment. Severe injury or death may result if personnel fail to observe the safety precautions. Before working inside the equipment, turn off the power and disconnect the power cord.
- The instrument is equipped with operator accessible system fuses. If a fuse blows, it may be due to a power surge or failure of a component. Replace the fuse once. If the fuse blows a second time, it is likely caused by failure of a component. If this occurs, contact an Authorized Service Center (see Section 1.3). Always replace the fuse with one of the same rating, voltage, and type. Never replace the fuse with one of a higher current rating.

1.2.2 ⚠ CAUTIONS

- Always operate this instrument at room temperature between 20°C and 24°C (65°F to 75°F). Allow sufficient air circulation by leaving at least 6 inches (15 cm) of clearance around the instrument.
- **DO NOT** use fluids to clean out the test wells.
- If a main supply power fluctuation occurs, immediately turn off the fogger. Power bumps from brown-outs and black-outs can damage the instrument. Wait until the power has stabilized before re-energizing the fogger.
- The **Factory Reset Sequence** should be performed only by authorized personnel if no other action is successful in correcting a malfunction. You must have a copy of the most recent Report of Test to restore the test parameters.
- **DO NOT** operate this instrument in an excessively wet, oily, dusty, or dirty environment.

1.3 Authorized Service Centers

Please contact one of the following authorized Service Centers to coordinate service on your Hart product:

Fluke Corporation, Hart Scientific Division.

799 E. Utah Valley Drive
American Fork, UT 84003-9775
USA

Phone: +1.801.763.1600
Telefax: +1.801.763.1010
E-mail: support@hartscientific.com

Fluke Nederland B.V.

Customer Support Services
Science Park Eindhoven 5108
5692 EC Son
NETHERLANDS

Phone: +31-402-675300
Telefax: +31-402-675321
E-mail: ServiceDesk@fluke.nl

Fluke Int'l Corporation

Service Center - Instrimpex
Room 2301 Sciteck Tower
22 Jianguomenwai Dajie
Chao Yang District
Beijing 100004, PRC
CHINA

Phone: +86-10-6-512-3436
Telefax: +86-10-6-512-3437
E-mail: xingye.han@fluke.com.cn

Fluke South East Asia Pte Ltd.

Fluke ASEAN Regional Office
Service Center
60 Alexandra Terrace #03-16
The Comtech (Lobby D)
118502
SINGAPORE

Phone: +65 6799-5588
Telefax: +65 6799-5588
E-mail: antng@singa.fluke.com

When contacting these Service Centers for support, please have the following information available:

- Model Number
- Serial Number
- Voltage
- Complete description of the problem

2 Introduction

The automotive industry has developed standard test methods for determining fogging characterstics, which is the tendency of interior trim materials to produce a light scattering film or mass deposit on a glass surface. “Fogging” is caused by the vaporization of volatile components from materials within the passenger compartment and the condensation of these volatiles on the cooler glass surface of the windscreen. The various test methods written by the auto manufacturers, SAE and ASTM require the use of a test chamber that simulates the conditions under which fogging takes place (see Appendix A - SAE Test Method). The Hart Model 0011 is an approved instrument for simulating the environment where Fog occurs.

The basic requirements for a test chamber or apparatus include a heated chamber or bath that controls the temperature of glass beakers at a set-point between about 60°C and 120°C according to the test method procedure. A glass test plate is placed on a silicone seal which rests over the opening of the beaker. The glass plate must be cooled by the apparatus to a temperature set-point between 20°C and 40°C. The test method specifies the temperature set-points to use (see Appendix A - SAE Test Method).

The user places a sample of the material being tested, cut to 58mm, at the bottom of each glass beaker used for the test and sets the SST ring on top of the material. Next, the beaker is inserted into the well covered with a silicone seal and glass plate. Finally, the condensing plate is placed over the glass plate and screwed into place. During the test, volatiles condense on the glass plates, which are later, removed and measured with a gloss meter if running the photometric test or an analytical balance when performing the gravimetric test to determine an actual fogging test number. Each test method has specific procedures that must be followed in order to maintain test consistency and accuracy (see Appendix A - SAE Test Method).

Normally three samples of the same material are tested simultaneously. Some of the test methods in use require the simultaneous test of a standard material (DIDP). Thus four test wells may be required, one for the standard and three for material samples (see Appendix A - SAE Test Method).

The Hart Scientific Model 0011 Fogging Test Chamber is designed specifically for the requirements of the various suggested test methods. Four heated test wells are machined into a solid aluminum block which is heat controlled by an adjustable precision temperature controller. Each Fogger ships with Pyrex beakers to run the tests, which are inexpensive and easily replaced. The test wells are heated and controlled by two digital micro-processor-based temperature controllers. They operate independent of each other to heat the beaker well and cool the cooling plates to the set-point entered by the user.

Silicone rubber gaskets are also provided which seal the test beakers to the glass plates. The beakers rest on a spring-loaded tension plate at the bottom of each test well to insure contact with the electrically cooled metal plate. No external cooling or liquid hookups are required to cool the plates. The cooled

condensing plates are easily removed for access to the beakers in the test wells. The temperatures of the heated test wells and the condensing plates are conveniently set via the LED displays on the panel at the back of the instrument. The Fogging Test Chamber is carefully calibrated at the factory to insure accuracy of the set-point temperatures, uniformity between the four test wells and between the four condensing plates, and temperature stability during the test procedure. The chamber is compact and self contained, occupying only 14" x 19" of bench space.

The heated beakers are controlled in a dry heated block assembly. No bath oils or fluids are required which means the glass beakers are never subjected to oil residue. The heated block has been designed for optimum uniformity and the absence of fluid heating medium reduces the impact of flow patterns.

The condensing plates are cooled by heat conduction in the cooling plate by thermoelectric devices using the Peltier effect. This eliminates an external chilled cooling bath and the problems of circulated fluid flow and its temperature gradients.

Figure 1 shows the side view of the Fogging Test Chamber. Figure 2 shows the controller temperature displays and top view of the Fogging Test Chamber.

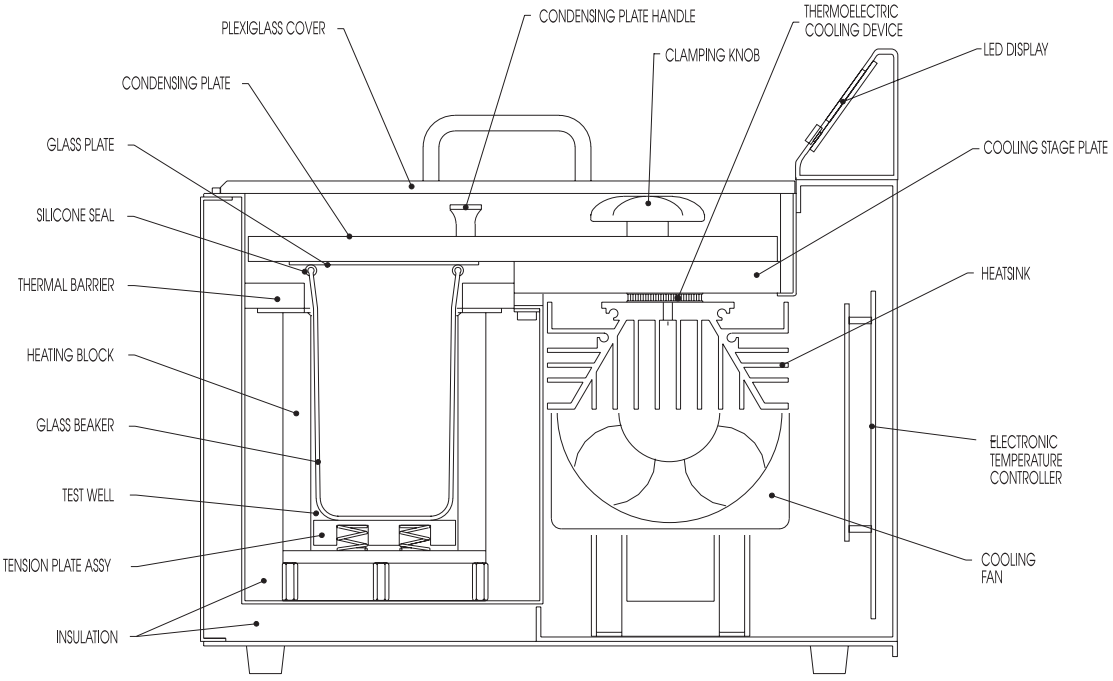


Figure 1 *Side View*

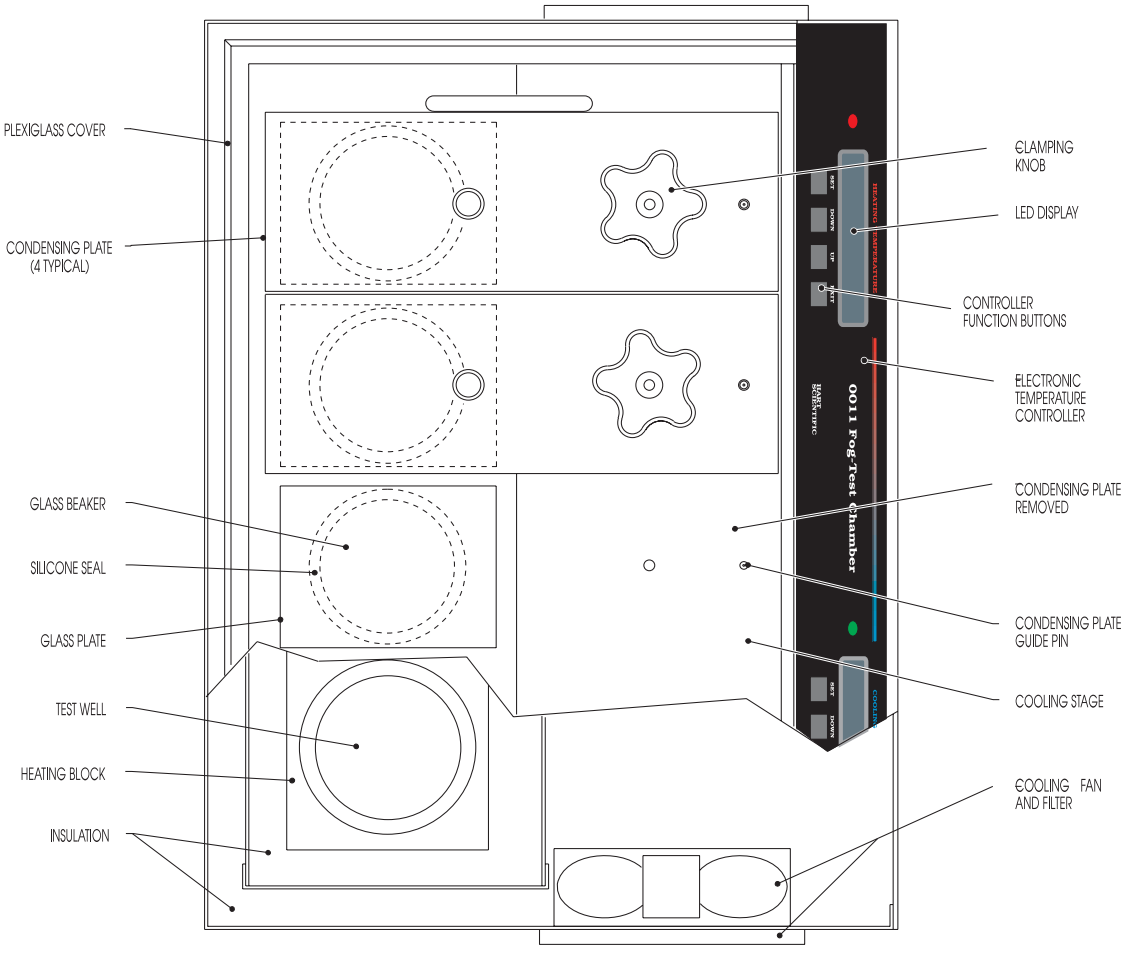


Figure 2 *Top View*

3 Specifications and Environmental Conditions

3.1 Specifications

Test Wells	Four
Glass Beakers	400ml Pyrex, 5.3" x 2.82" (134.62mm x 71.63mm)
Temperature Ranges **Heated Test Wells**	 50°C to 120°C (122°F to 248°F)
Condensing Plates	20°C to 40°C (68°F to 104°F)
Stability	±0.2°C
Set-point Repeatability	±0.2°C
Set-point Accuracy	±0.5°C
Uniformity Between Heated Test Wells	±0.5°C
Uniformity Between Condensing Plates	±0.5°C
Thermal Safety Cut-out	125°C (300°F)
Heat Time to Max	60 min.
Stabilization Time	30-60 min.
Computer Interface	RS-232 (Optional)
Power	115 VAC (±10%),50/60 Hz, 450 W (230 VAC [±10%], 50/60 Hz, 450 W optional)
System Fuse	115 VAC: 5 A, 250 V, F 230 VAC: 3.15 A, 250 V, F
Transformer Fuse (internal)	115/230 VAC: 1.25 A, 250 V, SB
Weight	70 lbs.
Size	19" Wide x 14" Deep x 10" High (483mm x 356mm x 254mm)
Shipping Weight	90 lbs.
Safety	OVERVOLTAGE (Installation) CATEGORY II, Pollution Degree 2 per IEC-61010-1

3.2 Environmental Conditions

Although the instrument has been designed for optimum durability and trouble-free operation, it must be handled with care. The instrument should not be operated in an excessively dusty or dirty environment. Maintenance and cleaning recommendations can be found in the Maintenance Section of this manual.

The instrument operates safely under the following conditions:

- ambient temperature range: 20 - 24°C (65 - 75°F)
- ambient relative humidity: maximum 80% for temperature <31°C, decreasing linearly to 50% at 40°C
- pressure: 75kPa - 106kPa
- mains voltage within ± 10% of nominal
- vibrations in the calibration environment should be minimized
- altitude does not effect the performance or safety of the unit
- indoor use only

4 Installation

4.1 Unpacking

Carefully unpack the fogging test chamber and confirm that all parts listed below are included with your chamber.

- Test Chamber
- Power Cord
- Plexiglass Cover
- 4 - tension plate assemblies (in place in the chamber)
- 4 - condensing plates with clamping knobs (in place)
- 6 - glass beakers, ground on top and bottom
- 4 - silicone seals
- 4 - sample retaining rings
- 12 - 3mm glass cover plates
- 1 - DIDP sample vials
- MSDS for Jayflex DIDP Plasticizer.
- Material Sample Cutter
- Instruction Manual
- Report of Calibration
- 1 - tension plate removing tool

Packing material has been placed in each test well to cushion the tension plates during shipment. To remove this padding you must remove the condensing plates. One plate at a time, turn the clamping knob counter clockwise until it comes off the threaded stud. Using the condensing plate handle carefully lift the plate from the chamber exposing the test well. Remove the padding from the test well.

4.2 Initial Set-up

Place the fog test chamber in your lab so that it is not directly under heating or air conditioning vents or any other location subject to wide variance in room temperature. Make sure that the black fan covers on the left and right sides of the chamber are not blocked (allow at least 6 inches clearance).

Use the following instructions during the initial operation of the fog test chamber and again when changing the set-point temperatures to allow equilibration of the chamber and condensing plates to the new set-points.

Prepare the test samples and test equipment according to the test method being followed (see Appendix A - SAE Test Method). Place a silicone gasket over the lip of each beaker. Remove the condensing plates from the chamber, place each

of the beakers in the test wells (the glass plates will be installed later). Replace the condensing plates by carefully guiding each one on to the guide posts of the cooling stage plate.

The cooling stage plate must be kept clean. Avoid any damage, such as nicks, to insure proper contact with the cooling plates. Also use the plates on the same well as they came shipped from the factory. Switching plates could introduce a slight error from the original calibration.

Replace the clamping knobs and tighten down the cooling plates. Place the plexiglass cover on the chamber. Plug the chamber power cord into a grounded mains outlet and turn the power switch on the back panel to "ON". Set the "Heating Well" and "Cooling Well" set-points to the temperature recommended in the test method you are using by following the instructions that follow.

4.3 Power

Plug the fogger power cord into a mains outlet of the proper voltage, frequency, and current capability. See Section 3.1, Specifications, for power details. Turn the fogger on using the rear panel "POWER" switch. The fogger will turn on and begin to heat to the previously programmed temperature set-point. The front panel LED display indicates the fogger temperature.

5 General Operation

5.1 Setting the Temperature

Section 6.2 explains in detail how to set the temperature set-point on the fogger using the front panel keys. The procedure is summarized here.

(1) Press SET **twice** to access the set-point value.

(2) Press UP or DOWN to change the set-point value.

(3) Press SET to program in the new set-point.

(4) Press EXIT to return to the temperature display.

When the set-point temperature is changed the controller switchs the well heater on or off to raise or lower the temperature. The cycle indicator, a two color LED, also indicates on (red when heating) or off (green when cooling). The displayed well temperature gradually changes until it reaches the set-point temperature.

Once the set-points have been reached, the instrument operator should wait at least 30 minutes to allow the instrument to equilibrate. The fog test chamber may be left on continuously so that it is ready for immediate use.

5.2 Testing Set-up

After the fog test chamber has stabilized at the temperatures you have set, you are ready to load your test samples and run a test. Remove the plexiglass cover. (Refer to Figure 2.) Remove the condensing plates and place a sample in the bottom of each beaker. Use the stainless steel sample retaining rings to hold your sample flat if needed. Carefully position a glass plate centered over the beaker mouth and silicone gasket. Replace the condensing plate using care not to move the glass plate from its position. Tighten the clamp knob. **MAKE SURE THE CONDENSING PLATES SIT ABSOLUTELY FLAT ON THE COOLING STAGE PLATE.** Replace the plexiglass cover.

The fog test chamber may take as long as 20 minutes to re-equilibrate after loading with samples and closing the cover. The duration of your test is determined by the test method you are following. Remove your samples from the fog test chamber at the end of the test period and follow the instructions given in the test method you are using to obtain proper results.

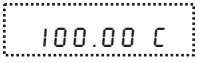
6 Controller Operation

This chapter discusses in detail how to operate the temperature controller using the front control panel. Using the front panel key-switches and LED display the user may monitor the well temperature, set the temperature set-point in degrees C or F, monitor the heater output power, adjust the controller proportional band, set the cut-out set-point, and program the probe calibration parameters, operating parameters, serial configuration, and controller calibration parameters. Operations of the functions are summarized in Figure 3 on page 18.

In the following discussion a solid box around the word SET, UP, EXIT or DOWN indicates the panel button while the dotted box indicates the display reading. Explanation of the button or display reading are to the right of each button or display value. The explanation that follows applies to both the heating and cooling controllers.

6.1 Well Temperature

The digital LED display on the rear panel allows direct viewing of the average of the four well temperatures. This temperature value is what is normally shown on the display. The units, C or F, of the temperature value are displayed at the right. For example,



Well temperature in degrees Celsius

The temperature display function may be accessed from any other function by pressing the “EXIT” button.

6.2 Temperature Set-point

The temperature set-point can be set to any value within the range and with resolution as given in the specifications. Be careful not to exceed the safe upper temperature limit of any device inserted into the well. A safety cut-out is set to monitor the heated block to help prevent this occurance.

Setting the temperature involves two steps: (1) select the set-point memory and (2) adjust the set-point value.

6.2.1 Programmable Set-points

The controller stores 8 set-point temperatures in memory. The set-points can be quickly recalled to conveniently set the fogger to a previously programmed temperature set-point.

To set the temperature, first select the set-point memory. This function is accessed from the temperature display function by pressing “SET”. The number of the set-point memory currently being used is shown at the left on the display followed by the current set-point value.

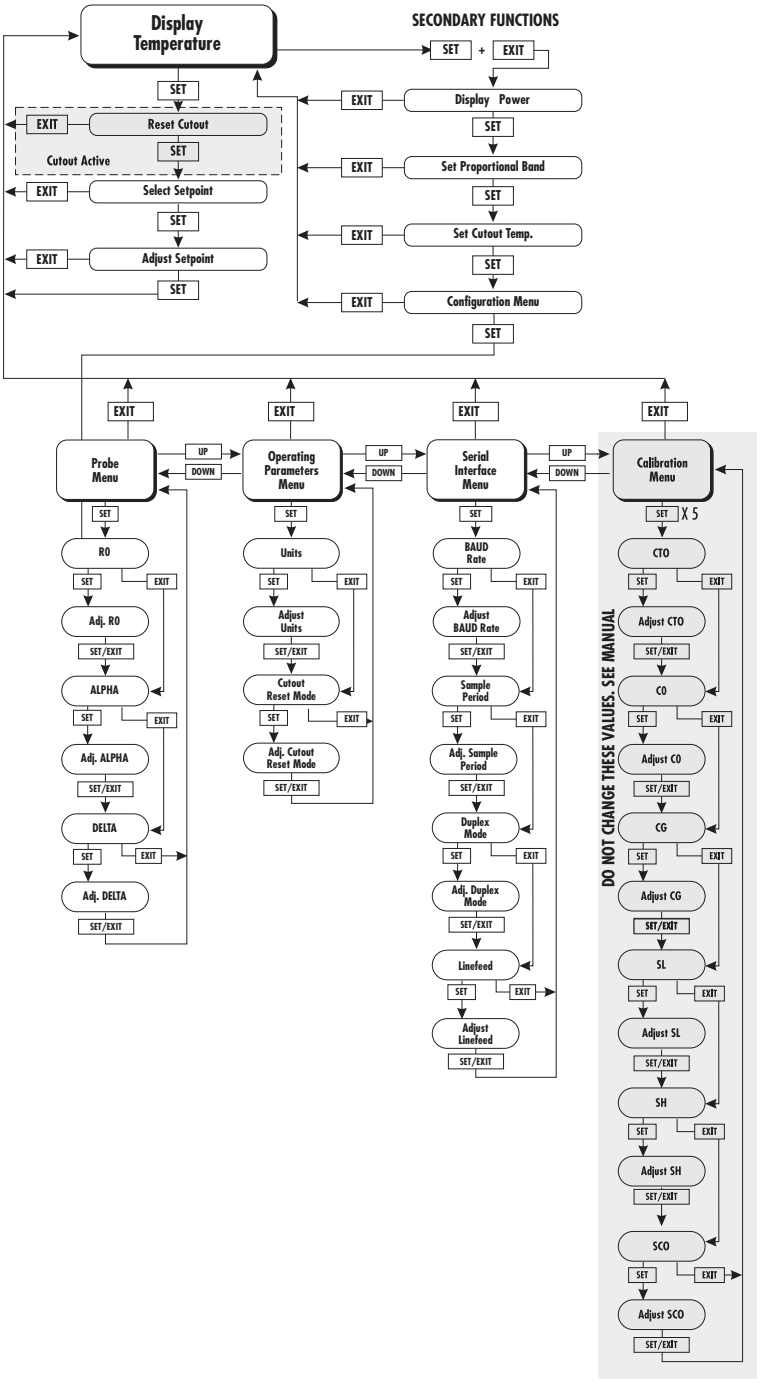


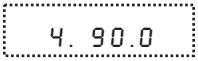
Figure 3 *Controller Operation Flowchart*

Well temperature in degrees Celsius

Access set-point memory

Set-point memory 1, 100.0°C currently used

To change the set-point memory press “UP” or “DOWN”.



New set-point memory 4, 90.0°C

Press “SET” to accept the new selection and access the set-point value.

Accept selected set-point memory

6.2.2 Set-point Value

The set-point value may be adjusted after selecting the set-point memory and pressing “SET”. The set-point value is displayed with the units, C or F, at the left.

Set-point 4 value in °C

If the set-point value need not be changed then press “EXIT” to resume displaying the well temperature. Press “UP” or “DOWN” to adjust the set-point value.

New set-point value

When the desired set-point value is reached press “SET” to accept the new value and access the temperature scale units selection. If “EXIT” is pressed instead then any changes made to the set-point will be ignored.

Accept new set-point value

6.3 Secondary Menu

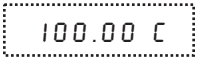
Functions which are used less often are accessed within the secondary menu. The secondary menu is accessed by pressing “SET” and “EXIT” simultaneously and then releasing. The first function in the secondary menu is the heater power display.

6.4 Heating Power

The temperature controller controls the temperature of the well by heating or cooling the well with the thermoelectric modules. The amount of heating or cooling power depends on the temperature set-point of the well. This heating

(or cooling) power value may be estimated by watching the red/green control indicator light or read directly from the digital display. By knowing the amount of heating the user can tell if the calibrator is heating up to the set-point, cooling down, or controlling at a constant temperature. Monitoring the percent heater power lets the user know how stable the well temperature is. With good control stability the percent heating power should not fluctuate more than ±1% within one minute.

The heater power display is accessed in the secondary menu. Press "SET" and "EXIT" simultaneously and release. The heater power is displayed as a percentage of full power.



Well temperature

Access heater power in secondary menu

Heater power in percent

Negative numbers indicate the well is being cooled. –100% means the well is being cooled at maximum power. 0 means the well requires neither heating nor cooling. 100% means the well is being heated at maximum power.

To exit out of the secondary menu press "EXIT". To continue on to the proportional band setting function press "SET".

6.5 Proportional Band

In a proportional controller such as this the heater output power is proportional to the well temperature over a limited range of temperatures around the set-point. This range of temperature is called the proportional band. At the bottom of the proportional band the heater output is 100%. At the top of the proportional band the heater output is 0. Thus as the temperature rises the heater power is reduced, which consequently tends to lower the temperature back down. In this way the temperature is maintained at a fairly constant temperature.

The temperature stability of the well and response time depend on the width of the proportional band. See Figure 4. If the band is too wide the well temperature will deviate excessively from the set-point due to varying external conditions. This is because the power output changes very little with temperature and the controller cannot respond very well to changing conditions or noise in the system. If the proportional band is too narrow the temperature may swing back

and forth because the controller overreacts to temperature variations. For best control stability the proportional band must be set for the optimum width.

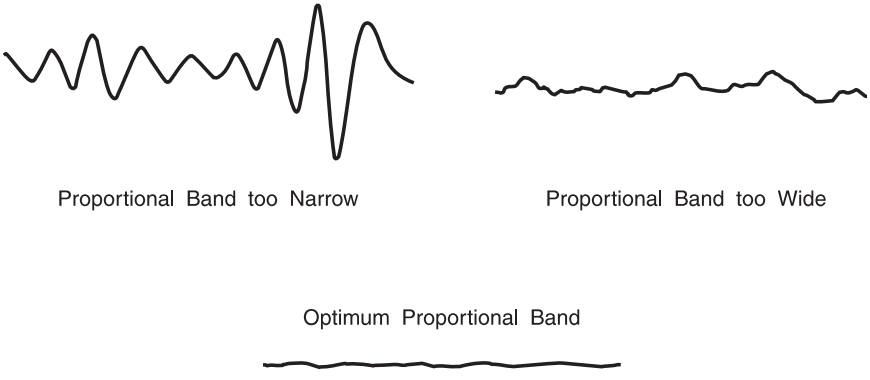


Figure 4 *Strip chart recordings showing various proportional band settings*

The proportional band width is set at the factory to about 8.0°C. The proportional band width may be altered by the user if he desires to optimize the control characteristics for a particular application.

The proportional band width is easily adjusted from the front panel. The width may be set to discrete values in degrees C or F depending on the selected units. The proportional band adjustment is be accessed within the secondary menu. Press “SET” and “EXIT” to enter the secondary menu and show the heater power. Then press “SET” to access the proportional band.

SET + EXIT *Access heater power in secondary menu*

12 Pct *Heater power in percent*

SET *Access proportional band*

Pb= 4.01C *Proportional band setting*

To change the proportional band press “UP” or “DOWN”.

Pb=10.00C *New proportional band setting*

To accept the new setting and access the cut-out set-point press “SET”. Pressing “EXIT” exits the secondary menu ignoring any changes just made to the proportional band value.

Accept the new proportional band setting

6.6 Cut-out

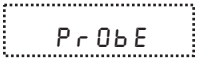
The cut-out temperature appears in the secondary menu but is not used. A hardware cut-out has been installed. Changing or setting this parameter does not affect the instrument.

6.7 Controller Configuration

The controller has a number of configuration and operating options and calibration parameters which are programmable via the front panel. These are accessed from the secondary menu after the cut-out set-point function by pressing "SET". There are four sets of configuration parameters — probe parameters, operating parameters, serial interface parameters, and controller calibration parameters. The menus are selected using the "UP" and "DOWN" keys and then pressing "SET".

6.8 Probe Parameters

The probe parameter menu is indicated by,



Probe parameters menu

Press "SET" to enter the menu. The probe parameters menu contains the parameters, R0, ALPHA, and DELTA, which characterize the resistance-temperature relationship of the platinum control sensor. These parameters may be adjusted to improve the accuracy of the fogger.

The probe parameters are accessed by pressing "SET" after the name of the parameter is displayed. The value of the parameter may be changed using the "UP" and "DOWN" buttons. After the desired value is reached press "SET" to set the parameter to the new value. Pressing "EXIT" causes the parameter to be skipped ignoring any changes that may have been made.

6.8.1 R0

This probe parameter refers to the resistance of the control probe at 0°C. The value of this parameter is set at the factory for best instrument accuracy.

6.8.2 ALPHA

This probe parameter refers to the average sensitivity of the probe between 0 and 100°C. The value of this parameter is set at the factory for best instrument accuracy.

6.8.3 DELTA

This probe parameter characterizes the curvature of the resistance-temperature relationship of the sensor on the cooling side. The value of this parameter is set at the factory for best instrument accuracy.

6.9 Operating Parameters

The operating parameters menu is indicated by,

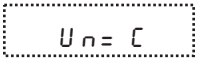
Operating parameters menu

Press “SET” to enter the menu. The operating parameters menu contains the units scale set and cut-out reset mode setting.

6.9.1 Temperature Scale Units

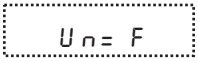
The temperature scale units of the controller may be set by the user to degrees Celsius (°C) or Fahrenheit (°F). The units are used in displaying the well temperature, set-point, and proportional band.

The temperature scale units selection is the first function in the operating parameters menu.



Scale units currently selected

Press “UP” or “DOWN” to change the units.



New units selected

Press “SET” to accept the new selection and resume displaying the well temperature.

6.9.2 Cut-out Reset Mode

The cut-out reset mode is not used. A hardware cut-out has been installed.

6.10 Serial Interface Parameters

The serial RS-232 interface parameters menu is indicated by,

Serial RS-232 interface parameters menu

The serial interface parameters menu contains parameters which determine the operation of the serial interface. These controls only apply to instruments fitted with the serial interface. The parameters in the menu are — BAUD rate, sample period, duplex mode, and linefeed. The Model 0011 serial interface option is configured to require two seperate serial ports; one for the heating and one for

the cooling controller. They operate completely independent of each other and require command to be send individually.

6.10.1 BAUD Rate

The BAUD rate is the first parameter in the menu. The BAUD rate setting determines the serial communications transmission rate.

The BAUD rate parameter is indicated by,

Serial BAUD rate parameter

Press "SET" to choose to set the BAUD rate. The current BAUD rate value is then displayed.

Current BAUD rate

The BAUD rate of the serial communications may be programmed to 300, 600, 1200, or 2400 BAUD. Use "UP" or "DOWN" to change the BAUD rate value.

New BAUD rate

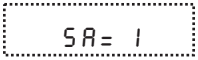
Press "SET" to set the BAUD rate to the new value or "EXIT" to abort the operation and skip to the next parameter in the menu.

6.10.2 Sample Period

The sample period is the next parameter in the serial interface parameter menu. The sample period is the time period in seconds between temperature measurements transmitted from the serial interface. If the sample rate is set to 5, then the instrument transmits the measurement over the serial interface approximately every five seconds. The automatic sampling is disabled with a sample period of 0. The sample period is indicated by,

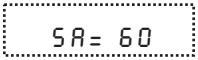
Serial sample period parameter

Press "SET" to choose to set the sample period. The current sample period value is displayed.



Current sample period (seconds)

Adjust the value with "UP" or "DOWN" and then use "SET" to set the sample rate to the displayed value.



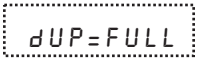
New sample period

6.10.3 Duplex Mode

The next parameter is the duplex mode. The duplex mode may be set to full duplex or half duplex. With full duplex any commands received by the fogger via the serial interface are immediately echoed or transmitted back to the device of origin. With half duplex the commands are executed but not echoed. The duplex mode parameter is indicated by,

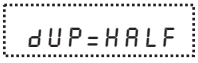
Serial duplex mode parameter

Press “SET” to access the mode setting.



Current duplex mode setting

The mode may be changed using “UP” or “DOWN” and pressing “SET”.



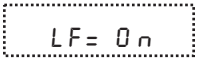
New duplex mode setting

6.10.4 Linefeed

The final parameter in the serial interface menu is the linefeed mode. This parameter enables (on) or disables (off) transmission of a linefeed character (LF, ASCII 10) after transmission of any carriage-return. The linefeed parameter is indicated by,

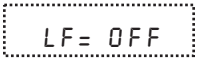
Serial linefeed parameter

Press “SET” to access the linefeed parameter.



Current linefeed setting

The mode may be changed using “UP” or “DOWN” and pressing “SET”.



New linefeed setting

6.11 Calibration Parameters

The user has access to a number of the instrument calibration constants namely CTO, C0, CG, SL, SH, and SCO. These values are set at the factory and must not be altered. The correct values are important to the accuracy and proper and safe operation of the fogger. Access to these parameters is available to the user only so that in the event that the controller’s memory fails the user may restore these values to the factory settings. The user should have a list of these constants and their settings with the certification sheet provided.

DO NOT change the values of the calibration constants from the factory set values. The correct setting of these parameters is important to the safety and proper operation of the fogger.

The calibration parameters menu is indicated by,

Calibration parameters menu

Press "SET" five times to enter the menu.

6.11.1 CTO

Parameter CTO sets the calibration of the over-temperature cut-out. This is not adjustable by software but is adjusted with an internal potentiometer. The Model 0011 does not use this function.

6.11.2 CO, CG, SL, SH, and SCO

These parameters calibrate the accuracy of the temperature set-point. These are programmed at the factory when the instrument is calibrated. Do not alter the value of these parameters.

7 Digital Communication Interface (Optional)

If supplied with the option, the fogger is capable of communicating with and being controlled by other equipment through the digital interface. Each controller is a separate device and is fitted with a separate RS-232 port. This means **two** ports are needed to operate both simultaneously.

With a digital interface the instrument may be connected to a computer or other equipment. This allows the user to set the set-point temperature, monitor the temperature, and access any of the other controller functions, all using remote communications equipment.

7.1 Serial Communications

The fogger may be installed with an RS-232 serial interface that allows serial digital communications over fairly long distances. With the serial interface the user may access any of the functions, parameters and settings discussed in Section6 with the exception of the BAUD rate setting.

7.1.1 Wiring

The serial communications cable attaches to the fogger through the DB-9 connector at the back of the instrument. Figure 5 shows the pin-out of this connector and suggested cable wiring. To eliminate noise, the serial cable should be shielded with low resistance between the connector (DB-9) and the shield.

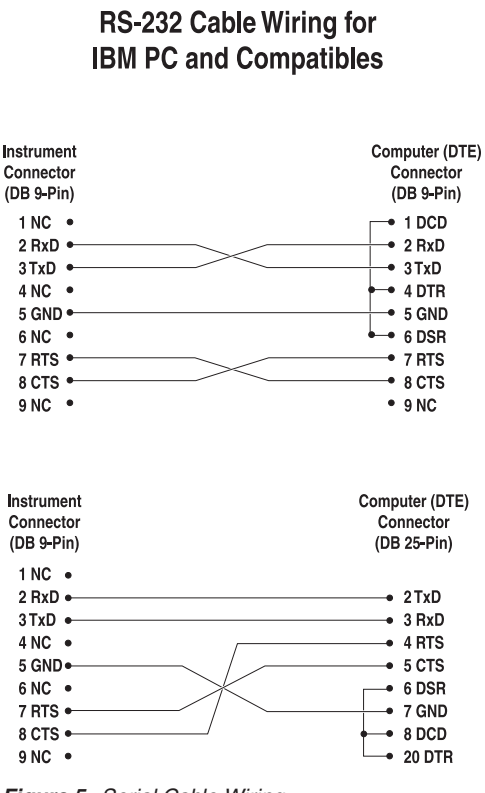


Figure 5 *Serial Cable Wiring*

7.1.2 Setup

Before operation the serial interface must first be set up by programming the BAUD rate and other configuration parameters. These parameters are programmed within the serial interface menu.

To enter the serial parameter programming mode first press “EXIT” while pressing “SET”

and release to enter the secondary menu. Press "SET" repeatedly until the display reads "ProbE". This is the menu selection. Press "UP" repeatedly until the serial interface menu is indicated with "SErIAL". Finally press "SET" to enter the serial parameter menu. In the serial interface parameters menu are the BAUD rate, the sample rate, the duplex mode, and the linefeed parameter.

7.1.2.1 BAUD Rate

The BAUD rate is the first parameter in the menu. The display will prompt with the BAUD rate parameter by showing "BAUd". Press "SET" to choose to set the BAUD rate. The current BAUD rate is displayed. The BAUD rate of the fogger serial communications may be programmed to 300, 600, 1200, or 2400 BAUD. The BAUD rate is pre-programmed to 1200 BAUD. Use "UP" or "DOWN" to change the BAUD rate value. Press "SET" to set the BAUD rate to the new value or "EXIT" to abort the operation and skip to the next parameter in the menu.

7.1.2.2 Sample Period

The sample period is the next parameter in the menu and prompted with "SAmPLE". The sample period is the time period in seconds between temperature measurements transmitted from the serial interface. If the sample rate is set to 5, then the instrument transmits the current measurement over the serial interface approximately every five seconds. The automatic sampling is disabled with a sample period of 0. Press "SET" to choose to set the sample period. Adjust the period with "UP" or "DOWN" and then use "SET" to set the sample rate to the displayed value.

7.1.2.3 Duplex Mode

The next parameter is the duplex mode indicated with "dUPL". The duplex mode may be set to half duplex ("HALF") or full duplex ("FULL"). With full duplex any commands received by the thermometer via the serial interface are immediately echoed or transmitted back to the device of origin. With half duplex the commands are executed but not echoed. The default setting is full duplex. The mode may be changed using "UP" or "DOWN" and pressing "SET".

7.1.2.4 Linefeed

The final parameter in the serial interface menu is the linefeed mode. This parameter enables ("On") or disables ("OFF") transmission of a linefeed character (LF, ASCII 10) after transmission of any carriage-return. The default setting is with linefeed on. The mode may be changed using "UP" or "DOWN" and pressing "SET".

7.1.3 Serial Operation

Once the cable has been attached and the interface set up properly the controller immediately begins transmitting temperature readings at the programmed rate. The serial communications uses 8 data bits, one stop bit, and no parity.

The set-point and other commands may be sent via the serial interface to set the temperature set-point and view or program the various parameters. The interface commands are discussed in Section 7.2. All commands are ASCII character strings terminated with a carriage-return character (CR, ASCII 13).

7.2 Interface Commands

The various commands for accessing the fogger functions via the digital interfaces are listed in this section (see Table 2). The commands are terminated with a carriage-return character. The interface makes no distinction between upper and lower case letters, hence either may be used. Commands may be abbreviated to the minimum number of letters which determines a unique command. A command may be used to either set a parameter or display a parameter depending on whether or not a value is sent with the command following a “=” character. For example “s”<CR> will return the current set-point and “s=150.00”<CR> will set the set-point to 150.00 degrees.

In the following list of commands, characters or data within brackets, “[” and “]”, are optional for the command. A slash, “/”, denotes alternate characters or data. Numeric data, denoted by “n”, may be entered in decimal or exponential notation. Characters are shown in lower case although upper case may be used. Spaces may be added within command strings and will simply be ignored. Backspace (BS, ASCII 8) may be used to erase the previous character. A terminating CR is implied with all commands.

Table 2 *Interface Command Summary*

Command Description	Command Format	Command Example	Returned	Returned Example	Acceptable Values
Display Temperature					
Read current set-point	s[etpoint]	s	set: 9999.99 {C or F}	set: 150.00 C	
Set current set-point to n	s[etpoint]=n	s=450			Instrument Range
Read temperature	t[emperature]	t	t: 9999.99 {C or F}	t: 55.69 C	
Secondary Menu					
Read proportional band setting	pr[op-band]	pr	pb: 999.9	pr: 15.9	
Set proportional band to *n*	pr[op-band]=n	pr=8.83			Depends on Configuration
Read heater power (duty cycle)	po[wer]	po	p%: 9999	po: 1	
Configuration Menu					
Probe Menu					
Read R0 calibration parameter	r[0]	r	r0: 999.999	r0: 100.578	
Set R0 calibration parameter to *n*	r[0]=n	r=100.324			98.0 to 104.9
Read ALPHA calibration parameter	al[pha]	al	al: 9.9999999	al: 0.0038573	
Set ALPHA calibration parameter to *n*	al[pha]=n	al=0.0038433			.00370 to .00399
Read DELTA calibration parameter	de[lta]	de	de: 9.99999	de: 1.46126	
Set DELTA calibration parameter to *n*	de[lta]=*n*	de=1.45			0.0 to 2.9
Operating Parameters Menu					
Set temperature units:	**u[nits]=c/f**				C or F
Set temperature units to Celsius	u[nits]=c	u=c			
Set temperature units to Fahrenheit	u[nits]=f	u=f			
Serial Interface Menu					
Read serial sample setting	sa[mple]	sa	sa: 9	sa: 1	
Set serial sampling setting to *n* seconds	sa[mple]=*n*	sa=0			0 to 4000
Set serial duplex mode:	**du[plex]=f[ull]/h[alf]**				FULL or HALF
Set serial duplex mode to full	du[plex]=f[ull]	du=f			
Set serial duplex mode to half	du[plex]=h[alf]	du=h			
Set serial linefeed mode:	**lf[eed]=on/of[f]**				ON or OFF
Set serial linefeed mode to on	lf[eed]=on	lf=on			
Set serial linefeed mode to off	lf[eed]=of[f]	lf=of			

Interface Command Summary continued

Command Description	Command Format	Command Example	Returned	Returned Example	Acceptable Values
Calibration Menu (WARNING – changing the following calibration values may change the accuracy of the instrument.)					
Read C0 calibration parameter	*c0	*c0	c0: 9	c0: 0	
Set C0 calibration parameter to *n*	*c0=*n*	*c0=0			–999.9 to 999.9
Read CG calibration parameter	*cg	*cg	cg: 999.99	cg: 406.25	
Set CG calibration parameter to *n*	*cg=*n*	*cg=406.25			–999.9 to 999.9
Read SL calibration paramter	*sl	*sl	sl: 999.99	sl: .04	
Set SL calibration parameter to *n*	*sl=*n*	*sl=.04			–999.99 to 999.99
Read SH calibration paramter	*sh	*sh	sh: 999.99	sh: .05	
Set SH calibration parameter to *n*	*sh=*n*	*sh=.04			–999.99 to 999.99
These commands are only used for factory testing.					
Read software cutout mode	*sco	*sco	sco: {ON or OFF}	sco: ON	
Set software cutout mode:	***sco=ON/OF[F]**				ON or OFF
Set software cutout mode on	*sco=ON	*sco=on			
Set software cutout mode off	*sco=OF[F]	*sco=off			
Miscellaneous (not on menus)					
Read firmware version number	*ver[sion]	*ver	ver.9999,9.99	ver.0011,2.24	
Read structure of all commands	h[elp]	h	list of commands		
Legend:	[] Optional Command data				
	/ Alternate characters or data				
	{} Returns either information				
	n Numeric data supplied by user–may be entered in decimal or exponential notation				
	9 Numeric data returned to user				
	x Character data returned to user				
Note:	When DUPLEX is set to FULL and a command is sent to READ, the command is returned followed by a carriage return and linefeed. Then the value is returned as indicated in the RETURNED column.				

8 Maintenance

The instrument has been designed with the utmost care. Ease of operation and simplicity of maintenance have been a central theme in the product development. Therefore, with proper care the instrument should require very little maintenance. Avoid operating the instrument in an oily, wet, dirty, or dusty environment.

- Batteries are used to maintain operating parameters in the unit. All operating parameters (both on the cold and hot side), including calibration parameters should be checked on a regular basis to insure accuracy and proper operation of the instrument. See the troubleshooting section for the procedure on checking the status of the battery.
- Cooling Fan Filters should be removed and cleaned periodically. Blockage from dust or other material affects the temperature uniformity of the cooling stage plate and thus the uniformity between condensing plates.
- Keep the cooling stage plate clean and free of dust or other material. Care should be used to protect the surface of the cooling stage plate and the bottom surface of the condensing plates. A good, flat, surface contact should be maintained between these parts during fog tests so that heat conduction between the surfaces is not hampered.
- If the outside of the instrument becomes soiled, it may be wiped clean with a damp cloth and mild detergent. Do not use harsh chemicals on the surface which may damage the paint.
- If a hazardous material is split on or inside the equipment, the user is responsible for taking the appropriate decontamination steps as outlined by the national safety council with respect to the material.
- If the mains supply cord becomes damaged, replace it with a cord of the appropriate gauge wire for the current of the instrument. If there are any questions, contact an Authorized Service Center for more information.
- Before using any cleaning or decontamination method except those recommended by Hart, users should check with an Authorized Service Center to be sure that the proposed method will not damage the equipment.
- If the instrument is used in a manner not in accordance with the equipment design, the operation of the fogger may be impaired or safety hazards may arise.
- No other regular service is required. General cleaning of all accessible parts of the chamber is a good idea. The various test accessories such as the glass plates, gasket, beakers, and seals are consumable items and need replacements. Maintenance and use of these accessories is covered in the various test methods (see Appendix A - SAE Test Method).

8.1 Replacement Parts

The following parts need to be replaced over time. Refer to the model number when reordering.

Model	Description	Unit
2000	Sample Retaining Ring	1 ea.
2002	Glass Beakers	Set of 6
2006	Beaker Seals	Set of 4
2004	Glass Cover Plates	Set of 24

9 Calibration Procedure

9.1 Temperature Calibration

Complete calibration of your fog test chamber was performed at the factory. This includes a test of temperature stability over time, a test of the accuracy of the digital temperature settings as compared against NIST traceable thermometers and sensors, and a test for uniformity between each of the heated wells and each of the condensing plates. Actual measurement data are provided on your Report of Calibration that is included with the fog test chamber. Any temperature calibration should be performed at the factory. See Section 1.3, Authorized Service Centers.

10 Troubleshooting

10.1 Troubleshooting

Problem	Causes and Solutions
Inconsistent Fog Numbers	Inconsistent data between the four test wells or between one test and another can be attributed to many things. If the test chamber and not the sample is suspect, check the following: 1. Improper beaker-to-plate sealing. If an inadequate seal occurs then "leaking fog" may occur during a test and lowering the amount of measurable fog deposits on the plate. Check the positioning of the beaker in the well, the seal, and the glass plate positions. If the silicone seal is worn or old, replace the seal. The beaker must be in good thermal contact with the bottom of the well and the glass plate must be firmly pressed up against the condensing plate. 2. Contamination. Check to see if new glass plates were used. Check if the beakers, seals, and ring weights have been cleaned and dried according to the test method used. Check that the handling of the samples and plates were consistent with the test method handling requirements. 3. Temperature performance of the chamber. If the instrument is suspected of being out of calibration, contact an Authorized Service Center (see Section 1.3). 4. Poor temperature uniformity between condensing plates. Remove and clean the air filters on both sides of the chamber. Make sure there are no obstructions on the bench top that are preventing sufficient air flow through the filters. 5. Ambient temperature and relative humidity fluctuations. The test method being used provides guidelines for environmental controls (see Section 11, Appendix A - SAE Test Method).
Temperature readout is not the actual temperature of the well	With the unit stable, slowly rotate the unit. If no change occurs, the unit may need to be calibrated. Contact an Authorized Service Center. If the display changes more than twice the normal display deviation, another unit in the area could be emitting RF energy. Move the unit to a different location and rotate the unit again. If the temperature is correct in this new area or deviates differently than the first area, RF energy is present in the room.
Instrument will not power up	The unit is equipped with two external fuses and one internal transformer fuse. Before servicing the internal fuse, contact an Authorized Service Center. If a fuse blows, it may be due to a power surge or failure of a component. DO NOT replace fuses with one of a higher current rating. Always replace the fuse with one of the same rating, voltage, and type (see XXXSection 3.1, Specifications for fuse details). If a fuse blows a second time, it is likely caused by failure of a component or part. Contact an Authorized Service Center (see Section 1.3, Authorized Service Centers) for further assistance.

Problem	Causes and Solutions
The controller does not maintain controller parameters or parameters are reset each time the power to the unit is removed	Note: Before performing the memory check, you need to record the controller calibration parameters (found in the CAL menu of the instrument) and any user-adjusted parameters that you have changed (such as the programmable set points and proportional band). Memory Check Doing a memory check is the easiest way to verify the ability of the battery to maintain controller parameters. 1. Power off the instrument. 2. Disconnect the instrument from AC power for 10 seconds. 3. Reconnect the AC power and power on the instrument. 4. If the displays show "InIT" and/or the cycle count shows a low number such as 0002, the battery is spent and should be replaced. Contact an Authorized Service Center for assistance. 5. After replacing the battery, you must reprogram the calibration and user-adjustable parameters into the controller.

10.2 CE Comments

10.2.1 EMC Directive

Hart Scientific's equipment has been tested to meet the European Electromagnetic Compatibility Directive (EMC Directive, 89/336/EEC). Selection of Light Industrial or Heavy Industrial compliance has been based on the intended use of the instrument. Units designed for use in a calibration laboratory have been tested to Light Industrial Standards. Units designed to be used in the "field" have been tested to both Light Industrial and Heavy Industrial Standards. The Declaration of Conformity for your instrument lists the specific standards to which the unit was tested.

A slight degradation of accuracy may be noticed between 300-350 Mhz. A piece of equipment in proximity to the unit under test must emit greater than 1000 times the permissible CE standard (EN55022) at these specific frequencies to have any effect on the unit. See the Section 10.1.2.

10.2.2 10.2.2 Low Voltage Directive (Safety)

In order to comply with the European Low Voltage Directive (73/23/EEC), Hart Scientific equipment has been designed to meet the IEC 1010-1 (EN 61010-1) and IEC 1010-2-010 (EN 61010-2-010) standards.

11 Appendix A - SAE Test Method

There are many recommended test methods such as SAE J1756, ASTM D5393-97 or ISO 6452. Due to copyright restrictions, we are not able to provide copies of these standards. Standards can be purchased from these agencies or any other appropriate standards authorities. These standards can also be accessed through their web sites: www.sae.org, www.astm.org, www.iso.ch/iso/en.

12 Appendix B - DIDP Material Safety Data Sheet

A Material Safety Data Sheet (MSDS) for the fogging compound; Jayflex DIDP Plasticizer, has been included with each vial of the chemical. As with all chemicals, please read the MSDS carefully to become familiar with the handling, storage, and safety considerations associated with this product.