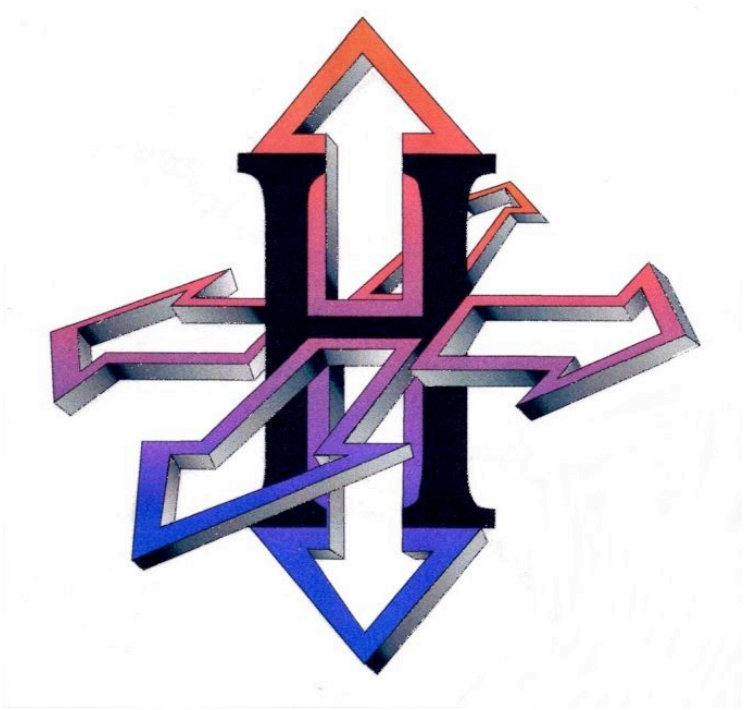
Installation, Operation,

and

Maintenance Instructions

for

Hanse Environmental, Inc.



HEI Series

REV A.1

Introduction

You are urged to ***carefully*** read the following pages, and particularly the **SAFETY** section, (immediately following), before installing or operating this equipment. This will result in safer operation, longer equipment life, more effective testing, and probably a lot less frustration too!

The staff and employees of ***Hanse Environmental, Inc.*** thank you for choosing our product. Please don't hesitate to call us with any questions or comments that you may have.

Hanse Environmental, Inc

235 Hubbard Street
Allegan, MI 49010
Phone: (269) 673-8638
Fax: (269) 673-8632
Email: Info@HanseEnv.com
Web Site: www.HanseEnv.com

Safety Information

Your ***Hanse Environmental Inc.*** Equipment is provided with several safety systems designed to help prevent accidental damage to product and equipment, and avoid injury to personnel. Always operate this equipment in accordance with the procedures set forth in the **OPERATION** section of this manual. The safety systems described below should be checked at least once every 30 days, and any inoperative or questionable conditions must be corrected before resuming operation. Servicing of this equipment and its associated utility service must be done only by *properly trained* personnel! Compressed air, liquid nitrogen, and high voltages can all cause severe injury or death if not properly handled.

WARNING!

EXTREME TEMPERATURES AND PRESSURES!

This equipment produces extreme temperatures and uses high pressure fluids. Failure to follow instructions and use proper safety precautions can cause injury or death.

WARNING!

ASPHYXIATION HAZARD!

This equipment uses LIQUID NITROGEN (LN_2) which can displace oxygen and cause severe injury or death due to a lack of oxygen.

ALWAYS allow adequate time for ventilation after opening doors before entering workspace!
NEVER operate this equipment unless all exhaust ports are securely ducted to outside of building

Properties: Liquid Nitrogen

- Liquid Nitrogen has a boiling point of -195.8°C
- Volume of expansion liquid to gas (at 15°C, 1 atm.) = 682.1
- Sg = 0.808 (at -195.8°C).
- Density of liquid (normal boiling point, 1 atm.) = 0.807 g/cc
- Colorless, Odorless liquid similar in appearance to water.

Known or Expected Hazards

Temperature Related

- The **extremely low temperature** of the liquid can cause severe burn-like damage to the skin either by contact with the fluid, surfaces cooled by the fluid or evolving gases. The hazard level is comparable to that of handling boiling water.
- The low temperature of the vapor can cause damage to softer tissues *e.g.* eyes and lungs but may not affect the skin during short exposure.
- Skin can freeze and adhere to liquid nitrogen cooled surfaces causing tearing on removal.
- Soft materials *e.g.* rubber and plastics become brittle when cooled by liquid nitrogen and may shatter unexpectedly.

Vapor Related

- Large volumes of nitrogen gas are evolved from small volumes of liquid nitrogen (1 liter of liquid giving 0.7 m^3 of vapor) and this can easily replace normal air in poorly ventilated areas leading to the danger of asphyxiation. It should be noted that oxygen normally constitutes 21% of air. Atmospheres containing less than 10% oxygen can result in brain damage and death (the gasping reflex is triggered by excess carbon dioxide and not by shortage of oxygen), levels of 18% or less are dangerous and entry into regions with levels less than 20% is not recommended.

Risks

For an untrained person, the risk of injury is moderate with cryogenic burns the most likely injury. However in exceptional circumstances when large amounts of material are spilled in an enclosed space, asphyxiation may be fatal.

Who is likely to be injured?

The most likely injury is to the person using the material although following major spillage all inhabitants of a room may be affected.

Precautions

Operation

- Liquid nitrogen should never be used except in a well-ventilated area.
- Only containers or fittings (pipes, tongs *etc*.) that have been designed specifically for use with cryogenic liquids may be used as non-specialized equipment may crack or fail.
- Skin contact with either liquid nitrogen or items cooled by liquid nitrogen should be avoided as serious burns may occur. Care must be taken with gloves, wrist-bands or bracelets which may trap liquid nitrogen close to the skin.
- Plumbing components need to be brass, copper or stainless steel chosen to meet the extreme cold and pressure requirements. **You cannot use carbon steel!**

Personal Protective Equipment

The following equipment should be worn when handling or dispensing liquid nitrogen:

- Face shield or safety glasses.
- Dry insulated gloves when handling equipment that has been in contact with the liquid. *NB* there is dispute over the advisability of wearing gloves while handling liquid nitrogen because there is a possibility that gloves could fill with liquid and therefore prolong hand contact which would make burns more severe. If gloves are worn they should be loose fitting and easily removed.
- Lab coat or overalls are advisable to minimize skin contact and also trousers *over* shoe/boot tops to prevent shoes filling in the event of a spillage.

Avoidance of Oxygen Depletion/ Asphyxiation

- **Liquid nitrogen should normally be used only in a well-ventilated area**.
- **Oxygen Sensors.** Oxygen sensors and alarms should be in place in any area where liquid nitrogen is to be used. Also recommended with the oxygen sensor is an interlock system to shut down safety valves if oxygen level drops below safe levels.
- **19.5% Oxygen is set by OSHA**

Training

- New users of liquid nitrogen should receive instruction in its use from trained members of the staff and should know the use of:
  - Oxygen alarms
  - Proper ventilation
  - Emergency ventilation
  - Evacuation plan
  - LN2 supply shutoff procedure.

Chamber Safety Features

Door Interlock Switches:

Doors are provided with safty switch, which will interrupt heat, cool, vibration, and optional humidity operation when the doors are open. These sensors are located near the top of each of the chamber doors. Operation of the vibration system with a door open can cause eardrum damage due to the high sound power levels produced. Do not open doors without switching off the vibration system first, and do not operate the equipment unless all door interlocks are functioning properly.

Note: door interlocks do not protect Access ports and plugs. They can also leak a significant amount of sound energy when open, although typically not enough to cause injury. Since they are provided for cables and hoses supporting product under test, it will often be necessary to operate the equipment with one or more of these port covers open. Packing the port with foam or other material rated for anticipated temperature ranges will greatly reduce noise leakage.

Be absolutely certain that no one is directly in front of an open access port before switching on the vibration system!

Interlock Safeties:

Multiple safety devices are interlocked such that heat, liquid nitrogen and vibration are inhibited when any of the safeties are activated. Safeties items include but are not limited to:

- Door closed limit switches
- High and Low air temperature limit controller
- Event control of heating and cooling
- Auxiliaries on motor starter
- Phase Load Monitor (PLR)

Temperature High/Low Limit Control:

A user-programmable limit is provided by the Honeywell Chart alarms. Alarm 1 is setup for use with the thermocouple (input 1). When the limit is tripped the safety valves and contactors power down to prevent additional temperature changes.

Secondary High Limit Control:

In addition to the user-programmable Hi/Lo limit control there is a Watlow series 97. It is a secondary adjustable control is provided to protect the chamber from high temperature damage. This device senses air temperature near the electric heat elements in the plenum area and will shut down the system if plenum temperatures exceed safe limits due to causes such as airflow obstruction or failure, heat controller failure, or excessive product loading with insufficient cooling (such as occurs when running out of LN_2).

This secondary limit can be reset by pressing the reset button located on the 97 controller.

LN2 Coil Limit Control:

There is a Watlow series SD. It is a secondary adjustable control is provided to protect the exhaust coming from the chamber from low temperature damage. This device senses exhaust temperature and will shut down the ln2 system if exhaust temperatures exceed safe limits due to causes such as airflow obstruction or failure, heat controller failure, or excessive product loading with insufficient cooling (such as occurs when running out of LN_2).

This secondary limit is self-resetting.

Specifications and Utility Requirements

Hanse Environmental Inc. builds multiple equipment sizes, with various optional features available, including modification of workspace height, heating and cooling capacity, and maximum vibration levels. Humidity and altitude chambers are also available upon request. Your chamber may vary if special requests were made at time of purchase concerning workspace dimensions, product mass or temperature ramp rates, or non-standard line voltages. Other manufacturers, such as Watlow, and JC Systems provide their own manuals along with the chamber. Material data sheets are also provided where required.

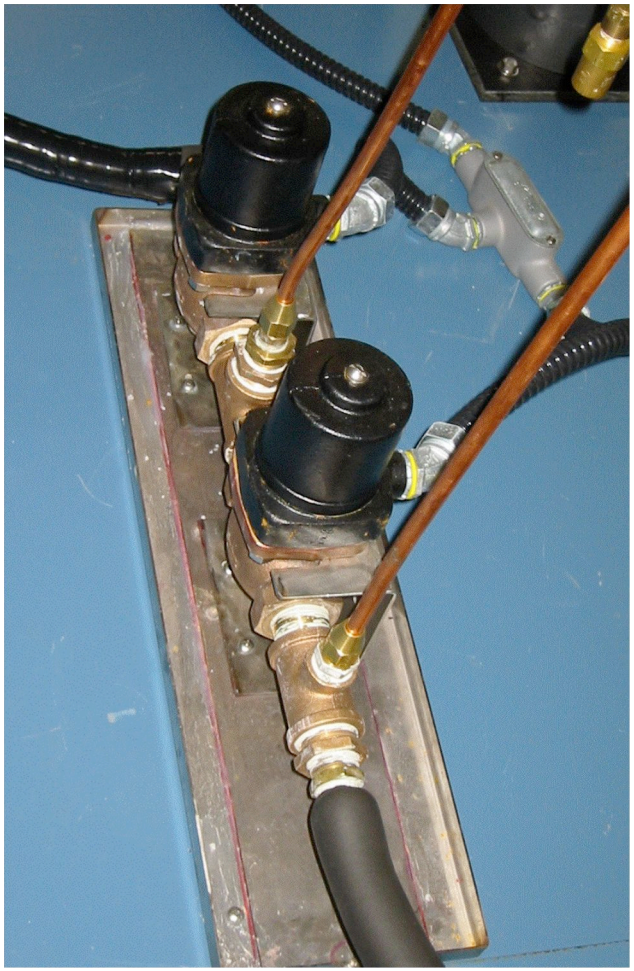
Utility Requirements

- Electric: Requirements vary with model and local requirements. Listed below is our FLA on 480V 3 Phase.
- Liquid Nitrogen: 1/2 Feed line @ 75 PSI Max
- Compressed Air: 1/4 @ 100 PSI Clean Dry Air

Service Connections

HEI-70

LN2 Connection



LN2 should be connected to Input of Regulator @ 75 PSI Max.

Electric Connection

480 VAC 80 Amp service should be connected to the top of the main breaker and ground line to Main ground lug.

Air Connection

Connect Air line to right side of Regulator. Air should be clean and dry.

Chamber Construction

Interior Chamber Liner

The chamber liner is constructed of 18 gauge, high nickel content, and series 300 stainless for maximum corrosion resistance. The liner is heliarc welded on all seams to insure a hermetic seal preventing moisture migration into the chamber during low-temperature operation. Provisions are made at all liner seams and corners to allow for thermal expansion during temperature cycling operation. All interior parts exposed to the chamber environments are fabricated of corrosion resistant materials.

Exterior Chamber

The exterior cabinet is composed of heavy-duty welded steel with 16 gauge sheet metal panels. Panel-to-chamber joints are sealed to prevent moisture migration into insulation area. The chamber exterior is finished with water-based enamel sprayed over cleaned, primed surface. The walls are insulated with Hanse Environmental's exclusive five-layer insulation for minimum heat and noise transfer to outside environment.

Chamber Doors Hardware and Windows

Single (1) front door of the same construction as the chamber that will give full access to the product under test. Doors close manual and are sealed with two silicone gaskets to maintain a moisture-proof seal under all chamber-operating conditions and to reduced noise levels. Hinges and latches are of heavy-duty design and are constructed of corrosion-resistant or plated materials.

One (1) multi-pane windows are provided, one in each chamber doors. The multi-pane window assembly incorporates an integral desiccant to insure dryness and minimizes internal fogging at low chamber temperatures.

Access Ports

The multiple 6" (15.2 cm) diameter stainless steel access ports with covers and plugs are provided to facilitated data acquisition wire and power wires to the product under test. The ports are welded on the interior, flanged, and sealed on the exterior. Ports are also provided with foam plug to minimize heat and noise transfer to outside environment. The port is covered with a hinged cover and fastener.

Chamber Lights

The chamber is provided with 120 v-halogen light(s) controlled from an external control switch. Lights are capable of rotating and pivoting to direct light as required for optimal viewing of product under test.

Features and Performances

SYSTEM FEATURES

- High Rate Heating System - 3 phase, solid-state control rectifier, 0 crossover fire, proportional control of Open Nichrome heater wire balanced system.
- Insulation – *Hanse Environmental, Inc.'s* exclusive six (6) insulation layers, staggered for superior thermal and noise insulation.
- Tempered Multipane Viewing Windows - one in each door, front and back.
- Interior Light - Multiple Halogen lights.
- Round Access Ports - 6" diameter ports with #2 charcoal polyester virgin material port plugs. One lower port used for vibrator inlet and to exhaust compressed air.

Air circulation:

The chamber is equipped with non-corrosive fans providing air circulation to minimize chamber temperature gradients. Three phase motors drive the fans. Baffles provide input and output air openings to direct the airflow in the chamber.

Major advantage of Hanse Environmental Inc. chamber is the air circulation design. This dynamic air circulation was designed to fit ***convection cooling design*** and minimize the excessive air for ***fan-forced cooling product.***

Air Blower Motors:

Heavy-duty ball bearing type motors are used to drive the air circulator blower. The blowers are driven by mean of extended stainless shafts. The motors are mounted vertically, outside the thermally conditioned space to minimize stress on the motor.

NOTE: The direction of rotation of circulators (fans) is very important. The air circulation must be from the chamber workspace, through the circulators (fans) past the heaters and back to the chamber workspace. If a circulator is rotating in the wrong direction (clockwise), two of the three, three-phase power lines must be switched. The corrected direction should be counter-clockwise.

Electrical Control Consoles:

One primary supply voltage is required to operate the chamber. All other required voltage is produced by transformers and power supplies located in the main control console. The console is assembled for easy maintenance. All relays, contactors, and motor starters are located in the control console. A complete set of electrical schematics is provided with the chamber. The electrical boxes are located on the chamber side.

Optional Humidity System:

Water is injected and atomized to provide humidity control in the working volume. Chamber humidity level is controlled through the chamber controllers.

Programmable Temperature Controller:

Product temperature, as well as air temperature are controlled by the unique, Watlow F4 or JC 600/620 temperature controller.

Temperature Sensors:

Chamber and product temperatures are measured by type T thermocouples. Back up air safety controller monitors a separate type T thermocouples.

Air Safety Controller:

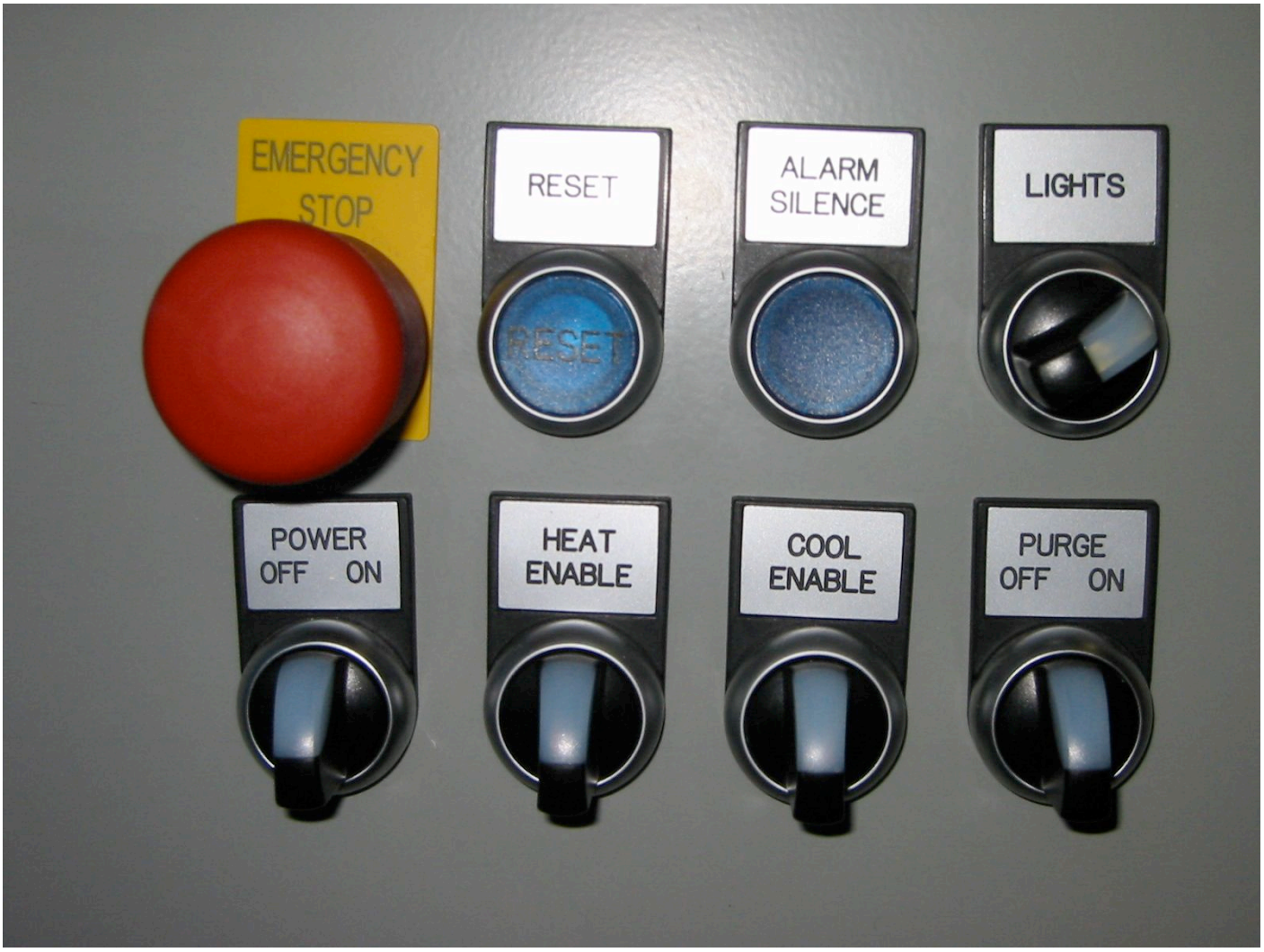
The Watlow Series 97 temperature controller included monitors a Type T thermocouples. Controller has two independent set points for monitoring high and low temperature limits. These high and low temperature alarms are wired into the chamber's safety circuit.

Control Software:

HanseView Control allows for manual and profile control.
HanseView Analysis allows for manual and profile control as well as vibration analysis.

Operator Control Switches:

Emergency Stop	Disables all chamber systems, turning power off to them
Reset	Resets Alarms and E-Stop
Alarm Silence	Silences Audio Alarm
Light On/Off	Turns on and off chamber lights
Power	Enables Chamber and Starts Circulators
Heat	Enables Heating
Cool	Enables Cooling
Purge	Enables Dry Air Purge



Operation

Check chamber functions and your personal understanding of the system ***before*** installing product to be tested, by following these steps with an empty chamber.

A. Verify that all utilities are on-line before operating equipment. Compressed air is required to operate cooling and vibration systems. Liquid nitrogen is required for proper cooling. (Empty or low LN_2 tanks produce a mixture of liquid and vapor which will not properly cool the chamber.) Proper voltage and phase electrical supply are necessary for full heating capability.

B. With all function switches in **OFF** position, turn **ON** main disconnect switch if not already on. Then open compressed air service valve and liquid nitrogen supply valve.

C. Be sure all doors are closed securely. Close doors by manually pushing closed as far as possible, then operate door close switch.

D. Some models are equipped with a programmable event to shut down the chamber at the end of a program. If fans do not start when reset switch is operated, check status of this event and also verify that all doors are closed and door sensors are properly sensing door closures.

Temperature System Operation - Manual

See Watlow F4 Manual or Jc Systems Manual

Temperature System Operation - Computer Control

See HanseView manual for control or Selected Optional Software

Calibration

Only qualified technical personnel should do calibration procedures with access to the equipment listed in each section.
Before beginning calibration procedures, warm up the equipment for at least 20 minutes.

Note:
If you are running a JC Controler Please See their manual Section 7-1

Watlow F4

Restore Factory Values

Each controller is calibrated before leaving the factory. If at any time you want to restore the factory calibration values, use the last parameters in the menu: Restore In x (1 to 3) Cal. Press right arrow
No special equipment is necessary.

Following Chapter 9 of the Watlow F4 Manual:

Input 1 Thermocouple Input Procedure

Equipment

- Type J reference compensator with reference junction at 32°F (0°C), or type J thermocouple calibrator to 32°F (0°C).
- Precision millivolt source, 0 to 50mV minimum range, 0.002mV resolution.

Setup and Calibration

1. Connect the correct power supply to terminals 1, 2 and 3 (see the Wiring Chapter and the Appendix).
2. Connect the millivolt source to Input 1 terminals 62 (-) and 61 (+).
3. Enter 50.000mV from the millivolt source. Allow at least 10 seconds to stabilize. Press the Right Key once at the Calibrate Input 1 prompt (Factory Page). At the 50.00mV prompt press Right Key once and to store 50.00mV press the Up Key once.
4. Enter 0.000mV from the millivolt source. Allow at least 10 seconds to stabilize. At the 0.00mV prompt press Right Key once and to store 0.00mV press Up Key once.
5. Disconnect the millivolt source and connect the reference compensator or thermocouple calibrator to Input 1 terminals 62 (-) and 61 (+). With type J thermocouple wire, if using a compensator, turn it on and short the input wires. When using a type J calibrator, set it to simulate 32°F (0°C). Allow 10 seconds for the controller to stabilize. Press Right Key once at the Calibrate Input x (1 or 2) prompt (Factory Page). At the 32°F Type J prompt press Right Key once and to store type J thermocouple calibration press Up Key once.
6. Rewire for operation and verify calibration.

Input 2 Voltage Input Procedure

Equipment

- Precision voltage source, 0 to 10V minimum range, with 0.001V resolution.

Setup and Calibration

1. Connect the correct power supply to terminals 1, 2 and 3 (see the Wiring Chapter and the Appendix).
2. Connect the voltage source to terminals 53 (+) and 58 (-) of the controller.
3. Enter 0.000V from the voltage source to the controller. Allow at least 10 seconds to stabilize. Press right arrow once at the Calibrate Input 2 prompt. At the 0.000V prompt press right arrow once and to store the 0.000V input press up arrow once.
4. Enter 10.000V from the voltage source to the controller. Allow at least 10 seconds to stabilize. Press right arrow once at the Calibrate Input 2 prompt (Factory Page). At the 10.000V prompt press right arrow once and to store the 10.000V input press up arrow once.

Input 3 Thermocouple Input Procedure

Equipment

- Type J reference compensator with reference junction at 32°F (0°C), or type J thermocouple calibrator to 32°F (0°C).
- Precision millivolt source, 0 to 50mV minimum range, 0.002mV resolution.

Setup and Calibration

1. Connect the correct power supply to terminals 1, 2 and 3 (see the Wiring Chapter and the Appendix).
2. Connect the millivolt source to Input 3 terminals 56 (-) and 55 (+).
3. Enter 50.000mV from the millivolt source. Allow at least 10 seconds to stabilize. Press the Right Key once at the Calibrate Input 3 prompt (Factory Page). At the 50.00mV prompt press Right Key once and to store 50.00mV press the Up Key once.
4. Enter 0.000mV from the millivolt source. Allow at least 10 seconds to stabilize. At the 0.00mV prompt press Right Key once and to store 0.00mV press Up Key once.
5. Disconnect the millivolt source and connect the reference compensator or thermocouple calibrator to Input 3 terminals 56 (-) and 55 (+). With type J thermocouple wire, if using a compensator, turn it on and short the input wires. When using a type J calibrator, set it to simulate 32°F (0°C). Allow 10 seconds for the controller to stabilize. Press Right Key once at the Calibrate Input x (1 or 2) prompt (Factory Page). At the 32°F Type J prompt press Right Key once and to store type J thermocouple calibration press Up Key once.
6. Rewire for operation and verify calibration.

Output 1A Milliamperes

Equipment

- Precision volt/ammeter with 3.5-digit resolution.

Setup and Calibration

1. Connect the correct power supply to terminals 1, 2 and 3 (see the Wiring Chapter and the Appendix).
2. Connect the volt/ammeter to terminals 42 (+) and 43 (-).
3. Press the Right Key at the Calibrate Output 1A prompt. At the 4.000mA prompt press Right Key once. Use the Up Key or the Down Key to adjust the display to the reading on the volt/ammeter. The controller should stabilize within one second. Repeat until the volt/ammeter reads 4.000mA. Press Right Key to store the value.
4. Press the Right Key at the Calibrate Output 1A prompt. At the 20.000mA prompt press Right Key once. Use the Up Key or the Down Key to adjust the display to the reading on the volt/ammeter. The controller should stabilize within one second. Repeat until the volt/ammeter reads 20.000mA. Press Right Key to store the value.

Output 1B Milliamperes

Equipment

- Precision volt/ammeter with 3.5-digit resolution.

Setup and Calibration

1. Connect the correct power supply to terminals 1, 2 and 3 (see the Wiring Chapter and the Appendix).
2. Connect the volt/ammeter to terminals 39 (+) and 40 (-).
3. Press the Right Key at the Calibrate Output 1B prompt. At the 4.000mA prompt press Right Key once. Use the Up Key or the Down Key to adjust the display to the reading on the volt/ammeter. The controller should stabilize within one second. Repeat until the volt/ammeter reads 4.000mA. Press Right Key to store the value.
4. Press the Right Key at the Calibrate Output 1B prompt. At the 20.000mA prompt press Right Key once. Use the Up Key or the Down Key to adjust the display to the reading on the volt/ammeter. The controller should stabilize within one second. Repeat until the volt/ammeter reads 20.000mA. Press Right Key to store the value.

Output 2A Milliamperes

Equipment

- Precision volt/ammeter with 3.5-digit resolution.

Setup and Calibration

1. Connect the correct power supply to terminals 1, 2 and 3 (see the Wiring Chapter and the Appendix).
2. Connect the volt/ammeter to terminals 36 (+) and 37 (-).
3. Press the Right Key at the Calibrate Output 2A prompt. At the 4.000mA prompt press Right Key once. Use the Up Key or the Down Key to adjust the display to the reading on the volt/ammeter. The controller should stabilize within one second. Repeat until the volt/ammeter reads 4.000mA. Press Right Key to store the value.
4. Press the Right Key at the Calibrate Output 2A prompt. At the 20.000mA prompt press Right Key once. Use the Up Key or the Down Key to adjust the display to the reading on the volt/ammeter. The controller should stabilize within one second. Repeat until the volt/ammeter reads 20.000mA. Press Right Key to store the value.

Watlow 97 Limit

The watlow 97 is a Over-Limit controller and should have a comparison calibration done once a year. If you feel you will be using this interment for data then you should perform the calibration procedure found in the Watlow 97 manual.

Watlow SD Limit

The watlow SD is a Under-Limit controller and should have a comparison calibration done once a year. If you feel you will be using this interment for data then you should perform the calibration procedure found in the Watlow SD manual.

Thermocouples

Thermocouples (T/C) do breakdown over time. It is recommended to check the accuracy of your Thermocouple against known T/C. Also make sure to check the insulation of the T/C for abnormal ware. Any ware that the two separate wires that make up a T/C touch create a new measurement point. Replacement of the T/C is advised. Our standard T/C is a 70XTSUC120A made by Watlow. This T/C is a Type T with non-grounding tip.

Ultrasonic Humidification Systems

System Description

The humidification systems provided with Hanse Environmental, Inc. chambers utilize the latest in ultrasonic nebulization principles to generate the moisture required in the chamber. The Ultrasonic Nozzle uses air and water under pressure. Atomized water leaving the nozzle is hit by the air reflected by the resonator as sound waves, nebulized into very small particles, like a fog, and rapidly absorbed by the air. The resonator is adjusted at the factory for maximum atomization and proper fog pattern. The fog pattern can be narrowed by moving the resonator further from the nozzle tip, and conversely, widened by moving the resonator closer to the tip.

Installation

The nozzle(s) are installed at the factory for proper distribution of the moisture introduced into the chamber. Even though the nozzles are designed for the temperature extremes experienced in the normal operation of the chamber, it is recommended that the nozzle(s) be removed when humidification testing is not being performed. The nozzle(s) mounting brackets are designed for ease of installation and removal. The direction of the nozzle(s) has been determined at the factory to maximize the distribution of the moisture within the chamber and should be maintained in the configuration.

The nozzle(s) are provided with hose connections that can be made within the confines of the chamber when installing or removing them. This will reduce the time required to go into humidification testing

Operation

The water and air supply to the nozzle(s) is regulated by in line pressure regulators. The water pressure to the nozzle(s) is adjusted at the factory to provide the proper amount of moisture to the chamber. The air regulator should be adjusted to maintain the air pressure to the nozzle(s) a minimum of 15 psi above the water line pressure. This is necessary to provide enough air pressure to open the water valve internal to the nozzle and allow atomization to begin. The air and water supplies to the nozzle(s) are controlled by 24V DC control valves.

The valves are controlled by the mode of operation of the chamber. When the humidification mode is disabled, Events 3 and 4, the water supply is turned off and the line(s) are vented to drain. Similarly, the air lines are turned off and ported to exhaust also. This prevents inadvertent operation of the system.

When humidity is called for, Events 3 and 4 enabled, and the nozzle(s) have been installed in the chamber, the water valve opens applying pressure to the nozzle(s). In addition, when the set point is above the humidity level in the chamber, the air valve opens which applies air pressure to the nozzle(s). This air pressure results in the opening of the water valve internal to the nozzle(s) and the atomization process is started.

As the humidity level in the chamber reaches the set point, the control system will start controlling the air valve to take control of the humidity level in the chamber. The valve will remove air

pressure from the nozzle(s) for longer and longer periods to control the humidity level within the set point parameters.

If the humidity function is turned off, Events 3 and 4, then the system reverts back to the condition described above and the air and water lines are ported to exhaust condition. At this point the nozzle(s) can be safely removed from the chamber once they have cooled off.

Maintenance

The humidification nozzle(s) do not require routine maintenance. The water supplied to them should be free of debris and suspended solids, and it is recommended that a 10 micron filter be installed between the chamber and the water supply. This will prevent premature plugging of the nozzle tip.

System Maintenance

Maintenance of this equipment should be done by a qualified technician. High voltage electrical systems, high pressure gas and mechanical systems all represent a potential for injury or death. The main power ***must*** be turned off at the main disconnect and all gas supplies should be turned off prior to servicing this equipment.

It is a good practice to keep a maintenance log for the chamber. The log should contain the tasks that must be accomplished and when they were performed.

The following is a list of maintenance tasks that should be performed on a monthly basis.

1. The proper function of the safety control devices should be checked on a regular basis. Replace any items that may be damaged or worn.
2. Check the product safety circuit high temperature trip point by lowering the setting of the product safety and programming the chamber set point 15 degrees higher to verify that the product safety trips at the high temperature it was set for. Check the product safety circuit low temperature trip point by raising the setting of the product safety and programming the chamber set point 15 degrees lower to verify that the product safety trips at the low temperature it was set for.
3. The electrical compartment should be kept clean and vacuumed if necessary.
4. The current draws of the major components should be checked with an amp. probe and recorded for future reference and to determine if there is any irregularity. Extreme caution must be taken whenever working with high voltage components.
5. Check the four screws on the bottom of the pneumatic pistons to insure that they are snagged.
6. The air lines to the pneumatic pistons should be checked for tightness.
7. The chamber lights should be checked and replaced if burned out – 50 watts, 110V, halogen bulbs.
8. Check the High Heat Limit by setting the HHL to 50 deg. C and running the chamber to 100 degrees C. The HHL should trip at 50 deg. C.
9. Check the door safety switches by leaving the left hand door of the front of the chamber open and turning the door switch to the closed position. Repeat the procedure on the rear door.
10. The seals and gaskets on the doors floors and ports should be inspected for adequate sealing. Remove any foreign material that may be embedded in the gasket. Worn or damaged gasket must be replaced.
11. Check all the fasteners on the chamber and tighten, if necessary, any loose fasteners.
12. Remove the baffle plate and check the blower wheel set screws for tightness.

The following is a list of maintenance tasks that should be performed on a **daily** basis.

1. Check the high and low temperature settings of the product saver to insure that they are set to the appropriate settings.
2. Make sure that the LN2 supply is on and that there is sufficient LN2 to perform you're testing.
3. Make sure that the air to the chamber is turned on.