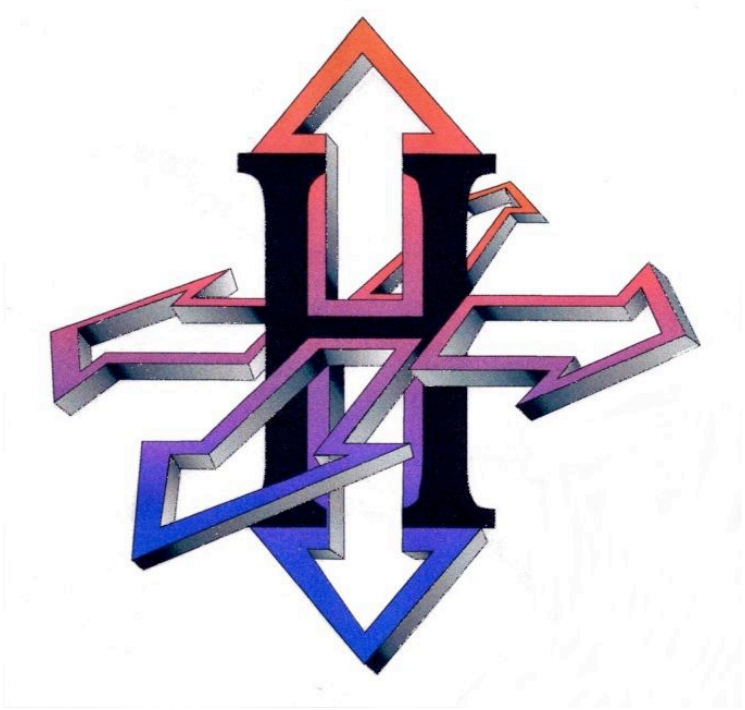
Installation, Operation,

and

Maintenance Instructions

for

Hanse Environmental, Inc.



TC 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.

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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!
HIGH SOUND LEVELS!

The blower can create High Level sound. It is recommended to use insulated ducts to lower the sound level and take proper precautions around the equipment to protect hearing.

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

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:

- High and Low air temperature limit.
- Event control of heating and cooling
- Auxiliaries on motor starter

Temperature High/Low Limit Control:

A user-programmable limit is provided by the Watlow F4 alarms. Alarm 1 is setup for use with the product thermocouple (input 3). Alarm 2 is setup for use with the interior box thermocouple (input 2) temperatures. These may have changed, as they are user programmable. When the limit is tripped the safety valves and contactors power down to prevent additional temperature changes.

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. Information shown is for standard VTC models. 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, provide their own manuals along with the chamber. Material data sheets are also provided.

Utility Requirements

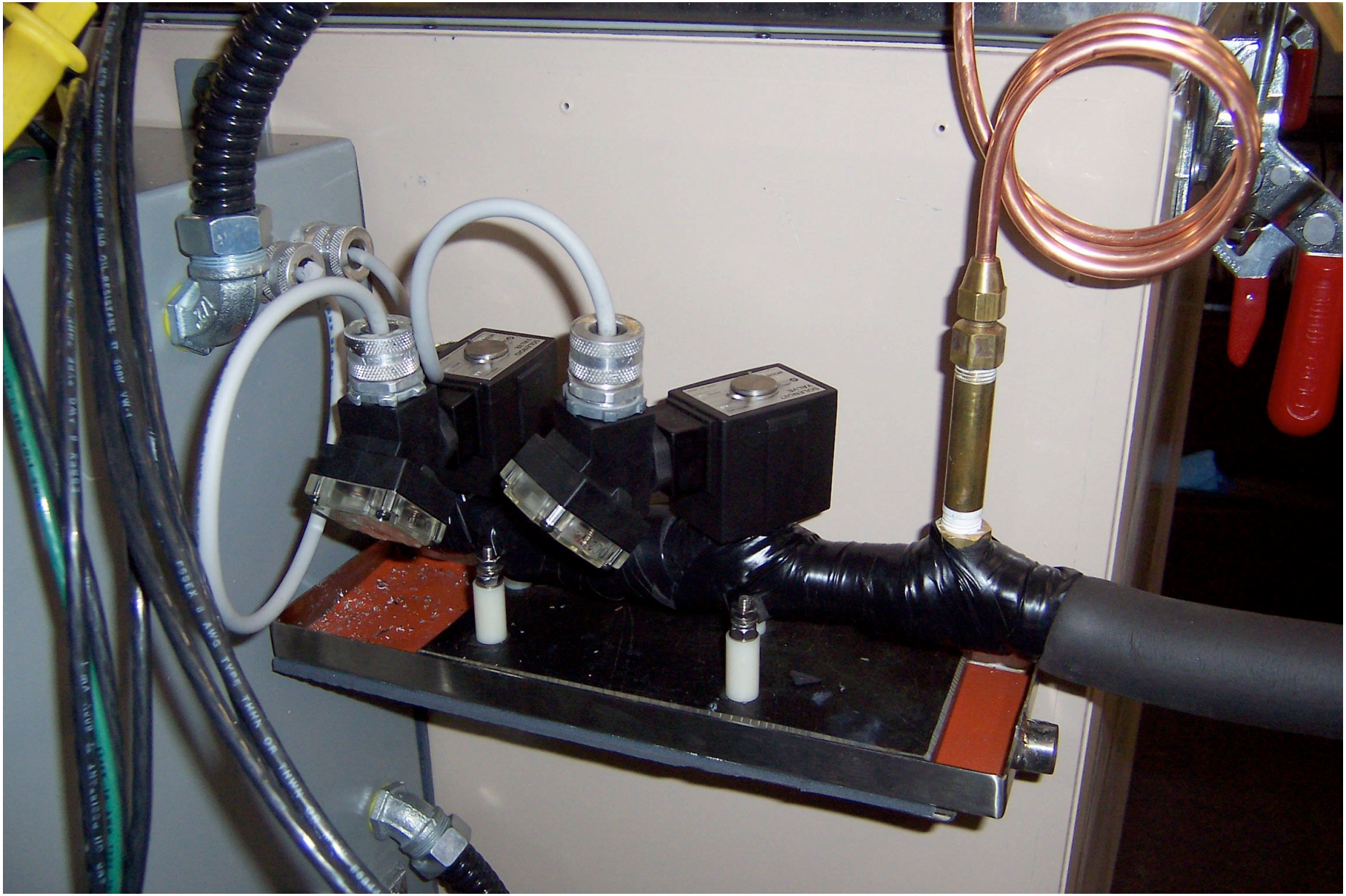
- Electric: 480 VAC 3 Phase @ 40 FLA.
- Liquid Nitrogen: 3/8 @ 50 PSI max.

Service Connections

TC

Side View

LN2 Valves



Control Councel

Left Photo Shows front of control counsel. The Controller is a F4S. It also shows the pilot switch and Thermocouples.

Right photo shows the Ln2 valves and electric councel

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 multi insulation for minimum heat and noise transfer to outside environment.

Chamber Doors Hardware

TC:

There is one top door access. This is removed with an overhead host and electric motor has enough wire slack to lift and perform inspection. If service is required please shut off main power and remove wires from blower motor to fully remove top.

SYSTEM FEATURES

- Heating System - 3 phase, solid-state control rectifier, 0 crossover fire, proportional control of Encased wire balanced system.

- Liquid Nitrogen Cooling System: Direct atomization in control plenum, control solinoid and redundant solenoid safety valve.

- Insulation – *Hanse Environmental, Inc.'s* exclusive multi layer insulation layers, staggered for superior thermal and noise insulation.

Performance

Overview

- Temperature Range: -100 to +200^{o}C
- Temperature Control: ± 1 ^{o}C after stabilization.

Temperature Control System:

Heating is accomplished with resistive electric elements, while cooling is accomplished by direct injection of liquid nitrogen (LN_2). Electric heaters are carefully selected and arranged to provide extremely rapid temperature rates of change without exceeding safe design limits of heat elements. Liquid nitrogen is injected using helical dispersion nozzles to quickly vaporize the liquid, providing maximum cooling without exposing product under test to un-vaporized nitrogen droplets.

Options

- Humidity: Direct Injection, 10 to 85% RH from 35 to 75^{o}C, Capacitance sensor.
- LN2 System: Complete installation, piping and controls

Air circulation:

The chamber is equipped with non-corrosive fan providing air circulation to minimize chamber temperature gradients. Three phase motors drive the fan.

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.

Chamber Controls and Instrumention

Programmable Temperature Controller:

Product temperature, as well as air temperature are controlled by the unique, Watlow F4 temperature controller.

Temperature Sensors:

Chamber and product temperatures are measured by type T thermocouples.

Control Software:

WatView Control software available for download and purchase depended on customers needs.

Operator Control Switches:

Master Power Enables Chamber to run.

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. 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.

C. Be sure all doors are closed securely.

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 event 8 (Digital out 8).

Watlow Inputs

- Input 1 Type T thermocouple.
  - Sending Air limited by cascade deviation amount
- Input 2 Type T thermocouple.
  - Interior of chamber.
- Input 3 Type T thermocouple.
  - Return air, control.

Watlow Outputs

- Control Outpus
  - 1A
    - Heat Increase DC
  - 1B
    - Cool Decrease DC
- Digital Outputs (Events)
  - 1
    - Heat Enable
  - 2
    - Cool Enable
  - 8
    - Circulator Fan

Temperature System Operation - Manual

See Watlow F4 Manual.

Temperature System Operation - Computer Control

See WatView manual for control

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.

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 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 2 terminals 58 (-) and 57 (+).
3. Enter 50.000mV from the millivolt source. Allow at least 10 seconds to stabilize. Press the Right Key once at the Calibrate Input 2 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 2 terminals 58 (-) and 57 (+). 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 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.

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 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.
6. 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.
7. Check all the fasteners on the chamber and tighten, if necessary, any loose fasteners.
8. 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.