



CHART INDUSTRIES, INC.

ISIS CHAMBER USER'S MANUAL

## Overview

### Service

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The Chart Environmental Chambers have been designed for years of safe and dependable operation. In the event service is required, contact the nearest Chart authorized service center or contact Chart at:

**Chart Industries, Inc.**  
**3505 County Road 42 West**  
**Burnsville, MN 55306 USA**  
**Phone: 1-888-877-3093**  
**[www.chartchambers.com](http://www.chartchambers.com)**

### Manufacturer

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The environmental chambers are designed and manufactured by:

**Chart Industries, Inc.**  
**3505 County Road 42 West**  
**Burnsville, MN 55306 USA**

### Design Modification

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DO NOT use this product in any manner not consistent with the instructions outlined in this manual!

NEVER alter the design, or perform service that is not consistent with the instructions outlined in this manual, without the prior written approval of Chart! Any service done without the approval of Chart will result in termination of product warranty.

### Additional Copies

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Additional copies of this manual are available by contacting Chart Industries, Inc. in Burnsville, MN (address listed above).

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*CHART INDUSTRIES, INC.*

- This manual is intended for use by Chart, Inc. Environmental Chamber customers. It is important to read and understand the information in this manual before installing or operating the chamber system. This will result in safer operation, longer equipment life, and more effective testing. Other component manufacturers which provide their own manuals are sent along with the chamber.
- The Environmental Chamber system offers you the ability to expose your new product to extreme temperatures at rapid rates of change. This has proven to be an extremely effective means of identifying failure-prone components and assemblies in the shortest possible time. The unique characteristics of Chart, Inc. Environmental Chamber systems are of key importance in achieving this effectiveness.
- The staff and employees of Chart Industries, Inc. thank you for choosing our product. Please don't hesitate to call us with any questions or comments that you may have. If after reading through this manual you are not confident in carrying out any task, please call Chart Industries Technical Service team at 1-888-877-3093.

## SAFETY FIRST!


Liquid Nitrogen is not harmful if handled properly. However, without proper handling, severe frost bite and cryogenic burning can result.

During this process, you will need:

- Safety glasses with side shields
- Cryogenic insulated gloves
- Hearing protection
- Leather working gloves
- Steel toed shoe

☐ Symbols and statements throughout this text and their meaning:

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 Text following this symbol needs extra attention.

NOTE: Text in this format is extra information helpful to the situation.

CAUTION: Text in this format is information to help avoid personal injury and/or property damage.

 **WARNING!:** Text in this format is information to help avoid serious personal injury or death, and property damage.

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|--------------------------|
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## Safety Information

- Your Chart 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!

 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 pressurized fluids. Failure to follow instructions and use proper safety precautions can cause injury or death**

### **WARNING! - ASPHYXIATION HAZARD:**

**This equipment uses LIQUID NITROGEN (LN<sub>2</sub>), which can displace oxygen and cause severe injury or death due to lack of oxygen. It is important to monitor oxygen levels in the working environment around the chamber to assure a safe working environment for all personnel.**

## Description of Safety Features

On each unit, there are a number of features, which help to ensure safe operation. These features are:

### Temperature High/Low Limit Control:

A user-programmable limit control is provided as an independent measure of safety against thermal runaway (hot or cold), which could occur from, but not limited to, the following:

- Programming error
- Primary controller failure
- Thermocouple breakage
- Heater SSR failure
- Circulation blower failure

The limit control is wired into the control devices to provide a totally independent safety system. A separate thermocouple is provided for the limit control and located inside the air plenum. If this device has reached an alarm condition, the system must be reset by pressing the “Chamber Reset” button on the control console.

**⚠ WARNING!:** The alarm set point of this device should never be set higher than +200°C or lower than -80°C as these are the maximum design temperature of the system.

It is important to note that this safety controller does not protect from a possible failure of the cooling solenoid valve. It is possible for this valve to fail and allow liquid nitrogen to continue flowing into the chamber, resulting in extremely cold temperatures. As a result, Chart recommends changing the solenoid valve on a regular basis as a preventative maintenance measure against such occurrences.



## Specifications and Utility Requirements

**Table 1 - Chamber Performance Specifications**

| P e r f o r m a n c e   |                             |
|-------------------------|-----------------------------|
| T e m p e r a t u r e   |                             |
| Allowable Range         | -80 to +200°C               |
| Temperature change rate | Up to 20°C/min              |
| Temperature Control     | +/- 2°C after stabilization |

**Table 2 - System Details**

| S y s t e m   D e t a i l s |  |
|-----------------------------|--|
| Cooling                     | LN <sub>2</sub> direct injection, time proportional control.   |
| Heating                     | 2 kW (4 kW in HP model) of heat provided by open nichrome wire heating elements. Time proportional solid state control of resistive heating elements in air conditioning plenum. |

### Programmable Control and Data Logging

|                |   |
|----------------|---|
| Controller     | Watlow Series 96 temperature controller.  |
| Communications | A serial communications connector is installed in the wall of the control panel, wired to the Watlow controller to facilitate communication with a PC. This feature is not standard, but can be ordered as an option. |

**Table 3 - Dimensions and Utilities**

| D i m e n s i o n s   a n d   U t i l i t i e s |   |
|---|---|
| Interior Workspace                              | 12" W x 14" D x 12" H                   |
| Overall Exterior Dimensions                     | 116" W x 146" D x 124" H                |
| Weight of System                                | 220 pounds (Approximate)                |
| Electrical                                      | 230 VAC 1PH; 20 FLA (HP model - 30 FLA) |
| Nitrogen  | 1/8" fpt; 40-50 psig, 175 psig MAX      |
| Exhaust   | 1" OD                                   |

## Features

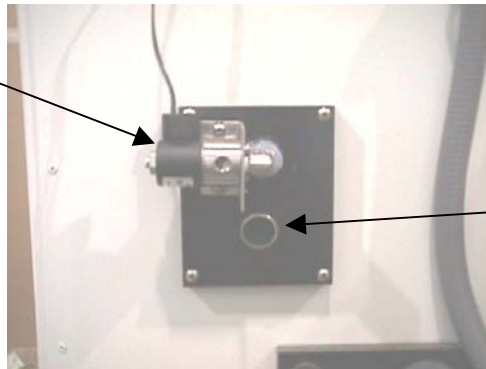
### ❑ Temperature Control System:

Heating is accomplished with resistive electric elements, while cooling is accomplished by blowing liquid nitrogen into the chamber. The liquid nitrogen is vaporized through nozzles and the cold vapor is circulated over the products in the chamber so that liquid nitrogen does not touch the product under test. Electric heaters are carefully selected and arranged to provide extremely rapid rates of temperature change without exceeding safe design limits of heat elements. The heaters and nitrogen nozzles are located in the air conditioning plenum.

**CAUTION:** Although the chamber is designed to use very small amounts of liquid nitrogen, the resulting nitrogen gas is vented out of the chamber. It is important to monitor the oxygen levels in the working environment around the chamber to ensure safe operating conditions.

The liquid nitrogen control is done by a solenoid valve. The solenoid valve is chosen for its compact size and high reliability. The temperature controller tells the solenoid valve when to open based on the temperature inside the chamber.

Cooling solenoid valve.



Nitrogen gas exhaust.

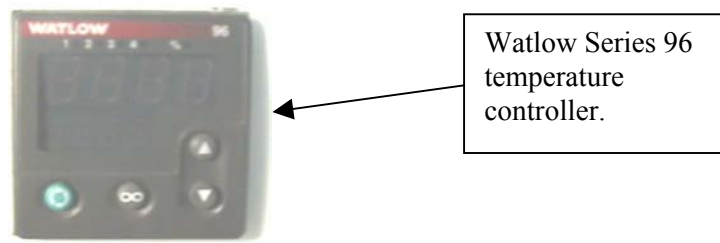
### ❑ Air Circulation Blower:

The chamber is equipped with a non-corrosive blower wheel, which provides air circulation to distribute temperature controlled air and minimize thermal enclosure temperature gradients. Baffles provide output air openings to direct the air flow out of the duct and into the workspace of the chamber. The blower is located in the air conditioning plenum. The blower draws air flow across the heater and nitrogen nozzle and out into the workspace of the chamber.

### ❑ Instruments:

Temperature is controlled by a Watlow Series 96 temperature controller. The input to the temperature controller is a type T thermocouple. The control thermocouple is mounted in

the air-flow plenum and is not directly visible. The following figure is a picture of the Watlow controller:



#### Temperature Safety Controller

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A temperature Hi/Lo limit control protects the chamber against thermal runaway due to a primary controller fault or control device failure. The input to the Hi/Lo limit control is a type T thermocouple. The thermocouple is mounted in the air-flow plenum and is not directly visible. The temperature safety controller is located inside the control box and is not to be adjusted by the operator.

## System Installation

### □ Location

The location of the chamber should be chosen with a few items in mind:

- The left side of the chamber has an access port, which allows passing power and data acquisition wires into the chamber and connecting to the device under test.
- The top side of the chamber has the control box. For safety and service reasons, this side must be kept clear at least three feet from the control box door.
- The front of the chamber contains the door. Enough room should be left so the door can swing fully open for ease of loading test items in and out of the chamber.
- The rear of the chamber contains the blower motor assembly. Space should be left to allow a service technician to access this assembly. Also note that the blower assembly has an extended shaft that protrudes through the chamber wall and connects to the blower wheel. Should the blower assembly ever need to be removed from the chamber, the blower will need to be able to slide back far enough to get the shaft back out of the chamber wall.
- The chamber weighs approximately 200 pounds, if it is going to be placed on a surface, be sure the surface can support the weight safely.

### □ Electrical Power Hook-Up

The electrical power needs to be connected from above and into the back of the control box. A large hole is provided in the back of the control console for the entrance of the power wires. The power specs are given in the Specs section of this manual. It is extremely important to run a properly sized ground wire. It is often beneficial to provide a ground wire that is actually larger than conventional standards. Doing so may aid in reducing any electrical noise problems. When running power there should be at least one to two feet of flexible conduit before the chamber connection to leave room for expansion and contraction of the floor as well as allow for slight variances in chamber placement. If the chamber uses the cord/plug supplied by Chart, that will make connecting power much simpler. If the customer does not wish to use the cord/plug assembly, it is possible to run wires directly into the control box and terminate at the same points as the cord/plug assembly did.

All power needed to operate the chamber is generated/supplied from the main control box. Only one main power supply is needed to operate the chamber. The power of the control box does not have any provisions for powering any devices under test.

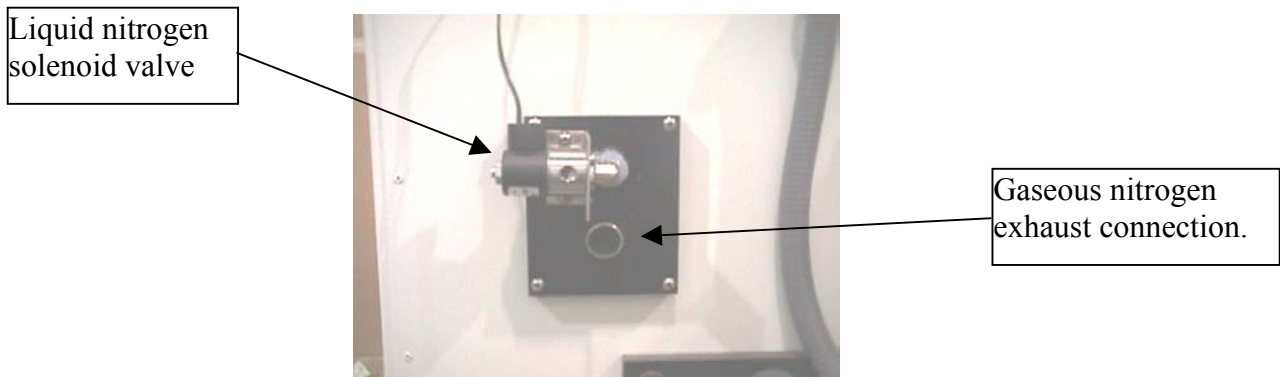
After the installation is complete, it is important to check the rotational direction of the blower. If the fans are not rotating in the proper direction, the heaters will not get sufficient air flow and cause premature burn-out and failure of the heater elements. If the fans are not rotating in the proper direction, switch two of the power leads to the blower, as this should change the rotational direction. Proper rotational direction will provide air

suction into the blower in the back wall of the chamber and discharge from the top of the chamber.

### ❑ Liquid Nitrogen Plumbing

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Along with the electrical power, bring in the LN<sub>2</sub> service from the top or the back of the chamber for easy access around the chamber. The connection point is at the solenoid valve on the back wall of the chamber. The nitrogen then flows through the valve and then enters the chamber to supply liquid nitrogen to the nozzle inside the plenum. The location of the liquid nitrogen inlet is dimensioned on the O&D drawing at the end of this manual.



A line relief valve should be installed between the LN<sub>2</sub> connection on the chamber (the solenoid valve) and the first manual shut-off valve upstream from this connection in the nitrogen pipe system. This relief valve should be rated at a pressure less than 175 psig, or the lowest pressure rated component in the system. This relief valve is not included with the system and should be taken care of at installation.

### ❑ Exhaust Gas Plumbing

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The exhaust gas of the chamber should be plumbed to the outside of the building. No fans or restrictions should be placed in this line. Any fans or restrictions will decrease system performance.

It is important to vent the system to the outside of the building for safety reasons. If the system is not vented to the outside of the building, there is a risk of an oxygen-depleted atmosphere in the area surrounding the chamber.

The vent piping should also be well insulated to prevent moisture present in the air from condensing/freezing on the outside surface of the exhaust pipe. The exit of the exhaust piping should be configured to prevent any water, rain, etc from flowing back into the chamber's exhaust system. Any water present in the system may form ice and break the cooling heat exchanger.

It may be possible to run the chamber without the exhaust gas plumbed out of the building. An evaluation of the size of the room containing the chamber, as well as the ventilation system (number of air changes) must be done to determine this. If it is determined that the room is ventilated well enough to not plumb the exhaust gas out of the building, it is highly recommended to install an oxygen monitor in the vicinity of the chamber to ensure safe working conditions for all personnel.

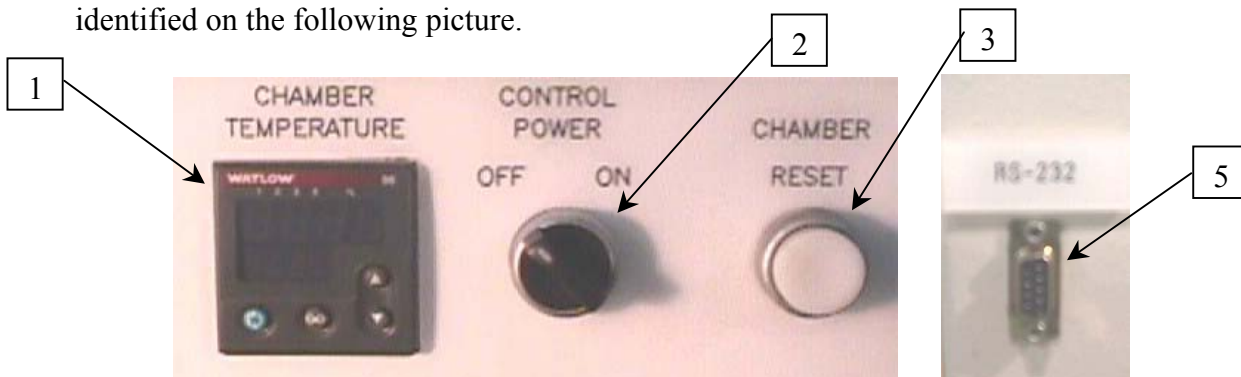
## Operation

Check system functions and your understanding of the system by following these steps with an empty thermal enclosure before installing the product to be tested.

1. Verify that all utilities are on-line before operating equipment. Liquid nitrogen is required for proper cooling. (Empty or low LN<sub>2</sub> 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. These requirements are listed in the Specifications section.
2. With all function switches in OFF position, connect power to the chamber.
3. Be sure chamber enclosure door is closed securely.
4. Turn the Control Power switch to the ON position.
5. Press Reset push-button to enable control circuits.
6. Adjust temperature set points on the temperature controller to achieve desired internal temperature.

### Operator Control Switches

The control console has several selector switches and buttons. The switches/buttons are identified on the following picture.



These switches/buttons provide the following control:

1. Watlow Controller  
Controls the internal chamber heating, cooling, circulations fans, air purge and window heaters.

2. Control Power (OFF, ON)

This switch controls the 24vdc control power in the control system. If this switch is turned OFF, all control functions will be disabled. The temperature controllers are powered from a 115vac circuit, so they will remain powered up even if the control power switch is turned OFF, however no heating, cooling, etc will be able to take place.

3. Chamber Reset (push button)

This button will be illuminated under normal operation. If the Temperature Safety controller goes into a high or low temperature alarm, this button will no longer be illuminated. The respective heating or cooling action will not be enabled until the alarm condition is no longer present and the Chamber Reset button has been pressed.

4. Air Safety (up, down; touch pad)

This controller is located inside the control box and is not to be adjusted by the operator. The controller has pre-set alarm set points to protect the chamber from thermal run-away and extreme temperature conditions.

5. SERIAL COMM (communications connection)

This connector is provided on the back of the control box for future serial communications with the Watlow controller. The cable that is attached to this connector is coiled up inside the control panel<sup>1</sup>.

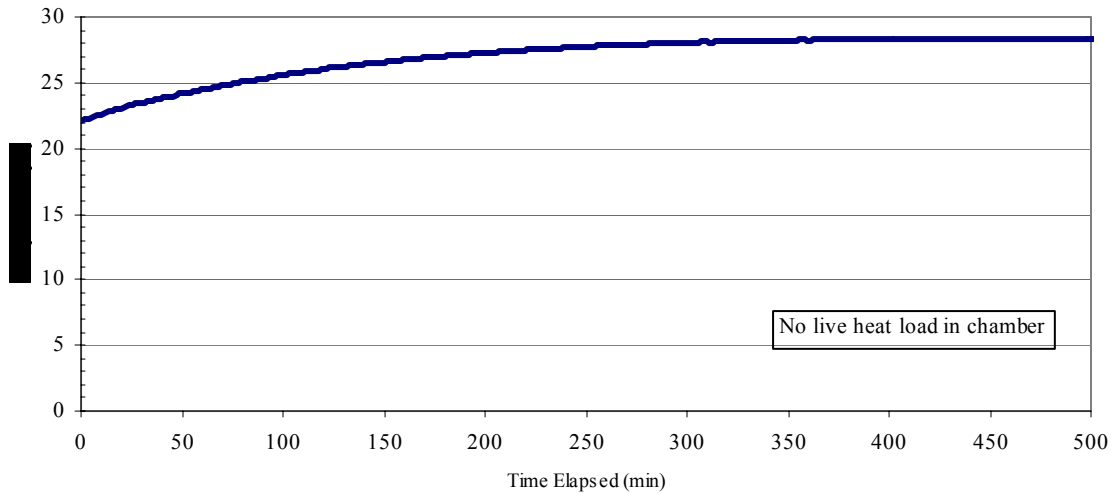
**CAUTION:** If the chamber is left with the circulation fan running, and either no temperature set point, or no liquid nitrogen supply, the internal chamber temperature will rise. This rise in temperature could damage product inside the chamber if it is not controlled.

The following graph shows the rise in internal chamber temperature with the circulation fan running and no cooling output being applied. It is important to note that the circulation fan does generate a small amount of heat, which causes the internal chamber temperature to rise slightly from ambient to about 28°C. This data assumes the chamber started at ambient temperature, there was no live heat generating product in the chamber, and neither heat nor cool outputs are being applied.

<sup>1</sup> If the RS-232 option is ordered, the cable will be installed to the controller.



NATURAL HEAT RISE IN ISIS-1.4



☐ Watlow Series 96 Controller Operation

NOTE: For more complete instructions on the operation of the Watlow Series 96 controller, refer to the supplied manual. All information in the Watlow controller manual takes precedence over information shown in this manual.

**Entering Temperature Set Points**

The temperature set point for the chamber is displayed on the bottom display of the Watlow controller. The set point is simply entered by using the up and down arrow buttons on the front of the controller. The up arrow is used to increase the set point and the down arrow is used to decrease the set point. If the buttons are pressed once, the set point will change by one degree. If the buttons are pushed and held, the set point will continue changing set point and will change faster as the button is held in longer.



### **Heating/Cooling Indicators**

When the Watlow controller is applying a heat or cool signal, an LED is indicated on the front panel. The longer the particular LED is on, the more heating/cooling power is being applied. If the LED is continuously on, that indicates full heating/cooling power. If a heating signal is being applied, the LED by the number 1 will be illuminated, if a cooling signal is being applied, the LED by the number 2 will be illuminated.



### Air Safety Controller Operation

**⚠️ WARNING!:** The alarm set point of this device should never be set higher than +200°C or lower than -80°C as these are the maximum and minimum design temperatures of the chamber system.

A temperature Hi/Lo limit control protects the chamber against thermal runaway due to a primary controller fault or control device failure. The controller is mounted inside the control box and is not to be adjusted by the operator. The input to the Hi/Lo limit control is a shielded type T thermocouple. The thermocouple is mounted in the air-flow plenum and is not directly visible.

The temperature safety controller has two independent set points. One set point is a high temperature safety and the other set point is for low temperature safety. If the chamber exceeds the set point of the high temperature safety, the temperature safety controller will issue an alarm (the red A1 indicator will no longer be visible), which will stop any further heat from being applied by the chamber's heaters. If the chamber goes below the set point of the low temperature safety, the temperature safety controller will issue an alarm (the red SP indicator will no longer be visible), which will stop any further cooling functions by the chamber. The red "A1" and "SP" indicators are illuminated when the alarm conditions are not present.

When either of the alarm conditions occur, the RESET button on the front of the chamber control panel will no longer be illuminated. The heating/cooling output will not be active until the alarm condition is no longer present and the RESET button has been pushed. The RESET button will become illuminated upon pushing it when no alarm conditions are present.

## System Maintenance

Maintenance of this equipment should be done by a qualified technician. High voltage electrical systems, cryogenic plumbing, and mechanical systems all represent a potential for injury or death. The main power must be removed from the chamber, and the liquid nitrogen supply should be disconnected prior to servicing this equipment. It is a good practice to keep a maintenance log for the system. The log should contain the tasks that must be accomplished and when they were performed.

Chart Industries does offer a service contract in which we will send a technician out to do routine maintenance items. Different plans are available. If interested, please call 1-888-877-3093 for details.

### Maintenance Tasks to be Performed on a Daily Basis:

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1. Check the high and low temperature settings of the air safety controller to insure that they are set to the appropriate settings for the product that is being tested. The high temperature set point (*SP*) should never be any higher than 200°C. The low temperature set point (*AL-2*) should never be set lower than -80°C.
2. Make sure that the LN<sub>2</sub> supply is on and that there is sufficient LN<sub>2</sub> to perform your test. The pressure of the LN<sub>2</sub> should also be verified and maintained at less than 175 psig.

### Maintenance Tasks to be Performed on a Monthly Basis:

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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. These would include the ON/OFF switch and door proximity switch.
2. Check the air safety circuit high temperature trip point by lowering the setting of the product safety (*SP*) below 30°C and programming the system set point to 45°C to verify that the safety circuit trips at the high temperature it was set for and heating is disabled. Check the product safety circuit low temperature trip point (*AL-2*) by raising the setting of the air safety (*AL-2*) above 0°C and programming the system set point to -15°C 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 (blower motor and heater) should be checked with an amp probe and recorded for future reference to determine if there is any irregularity. Extreme caution must be taken whenever working with high voltage components. Increased current draws may be an early sign of heater problems.

5. The seals and gaskets on the doors floors and ports should be inspected for adequate sealing. Remove any foreign materials that may be embedded in the gasket. Worn or damaged gasket should be replaced.
6. Check all the fasteners on the system and tighten if necessary.

Maintenance Tasks to be Performed Every Three Months:

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1. Measure and record the resistance of the heater. Changes in these measurements over time can help predict any future heater elements failing.

Maintenance Tasks to be Performed on an Annual Basis:

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1. Calibrate the Watlow controller.
2. Inspect seats of solenoid valve. Chart recommends replacing the valve as a preventative maintenance measure against thermal run-away conditions due to solenoid valve failure.

## REPLACEMENT PARTS

If any parts are required, please call 1-888-877-3093 for pricing and availability. The following information provides Chart Industries, Inc. part numbers to assist in finding the correct part.

### Liquid Nitrogen Solenoid Valve

The following table lists various items that may need to be replaced over time with respect to the liquid nitrogen control valves.

**Table 4 - Liquid Nitrogen Cooling Valve Parts**

| Item                                | Chart Industries, Inc. P/N |
|-------------------------------------|----------------------------|
| Cooling solenoid valve              | 11626691                   |
| Cooling solenoid valve for HP model | 11744195                   |

### Temperature Sensors

#### ***Thermocouples***

This type T thermocouple is a rugged and shielded sensor designed to withstand the entire temperature range of the chamber. The shielding helps ensure reliable input signals to the temperature controller. Chart sells this wire by the foot. The thermocouple wires run from the inside of the chamber, through the plenum and into the control box via conduit. Thermocouples are used for the chamber temperature control and the air controller.

**Table 5 - Replacement Thermocouple**

| Item              | Type | Chart Industries, Inc. P/N |
|-------------------|------|----------------------------|
| Thermocouple Wire | T    | 11082890                   |

### Door Guard Switch

The chamber door is monitored by a guard switch that keeps the chamber from running if the chamber door is opened. This serves as a safety function of the chamber. The following table identifies the part number for this switch.

**Table 6 - Door Guard Switch**

| Item              | CHART INDUSTRIES, Inc. P/N |
|-------------------|----------------------------|
| Door Guard Switch | 11354921                   |

## Warranty

Chart Industries, Inc. warrants the equipment and materials manufactured under this contract are in accordance with Chart Industries, Inc. specifications. If any part of said equipment or material manufactured by Chart Industries, Inc., as determined by the seller, is defective in workmanship or material, and not subjected to misuse or abuse,

- within 90 days from date of installation or within 120 days of invoice, whichever period is lesser, Chart Industries, Inc. will exchange and install a replacement part in place and stead of the said defective part without charge.
- Within one (1) year from date of invoice, Chart Industries, Inc. will furnish an exchange part for the defective one, f.o.b. seller's plants, and installation and cost of installation thereof will be the responsibility of the customer.

Accessories and components not manufactured by Chart Industries, Inc. shall be warranted to the extent of the original manufacturer's warranty.

Chart Industries, Inc. shall not be liable under this equipment warranty for any operational delays or consequential damages, and the customer assumes all risk and liability whatsoever resulting from the use of such equipment and materials, whether used singly or in combination with other substances. Chart Industries, Inc. makes no warranty of merchantability of such equipment and materials of their fitness for any purpose and Chart Industries, Inc. makes no other warranties expressed or implied except to the extent provided in the language on the face hereof. This equipment warranty cannot be modified in any way except be a written instrument duly executed by Chart Industries, Inc. and the customer. Chart's standard terms and conditions, supplied with quotation/proposal apply.

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