



INDUSTRIAL OVEN

OPERATION & MAINTENANCE MANUAL

ULTRA - TEMP SERIES

Model No. XXXXXX

Serial No. XXXXXX

TEMPERATURE CONTROLLER

- | | |
|--|---|
| ☐ Blue M Stat 350 | ☐ Yokogawa UT350 |
| ☐ Blue M Pro 350 | ☐ Yokogawa UP350 |
| ☐ Blue M Pro 550 | ☐ Yokogawa UP550 |
| ☐ Blue M Pro 750 | ☐ Yokogawa UP750 |
| ☐ Watlow F4 | ☐ |



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Rev. 08/17/07

TABLE OF CONTENTS

SECTION	Page
<u>INFORMATION</u>	
1.0 COMPANY INFORMATION & ASSISTANCE _____	4
2.0 SAFETY WARNINGS & SYMBOLS _____	5,6
3.0 PRODUCT SPECIFICATIONS & OVERVIEW _____	7-9
4.0 DRAWINGS, INFORMATION, and VENDOR INSTRUCTION LISTINGS _____	10
5.0 INSTALLATION INSTRUCTIONS	
5.1 Delivery and Uncrating of Unit _____	11
5.2 Location and Installation of Unit _____	11
5.3 Equipment Features and Access _____	12-14
5.4 Water Supply / Drain Connections _____	15
5.5 Inert Gas Supply Connections _____	16
5.6 Exhaust Connection _____	17
5.7 Chamber Venting _____	18
5.8 Power Supply Specifications and Connection _____	19
5.9 Application of Power _____	20
<u>SYSTEMS and CONTROL</u>	
6.0 AIR CIRCULATION SYSTEM _____	21-27
7.0 INERT GAS CONTROL SYSTEM MODEL IGF _____	28-30
8.0 OXYGEN ANALYZER / TRANSMITTER - Optional	
8.1 Overview _____	31
8.2 Series 2000 or Series 3000 _____	32
8.3 Analyzer or Transmitter _____	32
9.0 ELECTRIC HEATING SYSTEM & CONTROL _____	33
10.0 COOLING SYSTEM & CONTROL	
10.1 Cooling with Ambient Air - Model CW _____	34
10.2 Cooling with Ambient Air - Model IGF _____	35
10.3 Water Cooled Door - Optional _____	35

11.0	TEMPERATURE CONTROLLER	
11.1	Temperature Control _____	36
11.2	Non - Profiling Controllers _____	36
11.3	Profiling Controllers - Optional _____	37,38
12.0	OVERTEMPERATURE PROTECTION	
12.1	Yokogawa UT150L _____	39
12.2	Blue M Temp Limit (Alternate) _____	40
13.0	DOOR LIMIT SWITCH _____	41

CHAMBER OPERATION & MAINTENANCE

14.0	SEQUENCE of OPERATION _____	42,43
15.0	PREVENTATIVE MAINTENANCE _____	44
15.1	Maintenance Checks / Procedures _____	44-46
15.2	Preventative Maintenance Schedule / Log _____	47

SUPPLEMENTAL INSTRUCTIONS

1.0 COMPANY INFORMATION & ASSISTANCE

Congratulations on purchasing a chamber from one of the fine divisions of TPS - Thermal Product Solutions. You probably already know us as Lunaire Limited. We've changed our name and expanded our vision with the intent to provide you with more diversified solutions to your thermal product process requirements.

We truly hope that every aspect of chamber design and quality will measure up to your strictest standards. Your chamber has been designed to operate with the reliability you expect for the demands you impose on your product and research testing.

Headquartered in New Columbia, Pennsylvania, which is located in the North-central part of the state, TPS includes the following five divisions that manufacture environmental test chambers and industrial ovens.

Tenney Environmental - - - - Lunaire Environmental - - - - Gruenberg Oven - - - - Blue M - - - - Lindberg

Parts and service inquiries for equipment within each division should be directed to TPS by any of the following methods.

Important! Please have the **Model** and **Serial Numbers** of your unit available when contacting us.



Thermal Product Solutions
P.O. Box 150
White Deer, PA 17887

} Mailing Address

Phone: 570 - 538 - 7200

Fax - Parts Dept. 570 - 538 - 7385

Fax - Service Dept. 570 - 538 - 7391

Fax - Main: 570 - 538 - 7380

E - Mail Address: service@lunaire.com

Web site: www.thermalproductsolutions.com

Parts Replacement

Your equipment has been designed and manufactured to provide years of reliable service. In the event a component should fail, it is recommended that only OEM approved parts be used as replacements. Please contact the Parts Department for component replacement, or repair.

2.0 SAFETY WARNINGS & SYMBOLS



IMPORTANT NOTE: Additional Warning and Caution Statements are located throughout the manual.

1. Read this entire Operation Manual, as well as the vendor manuals and cut-sheets provided before operating this equipment! Failure to adhere to any Safety Warning, or failure to follow the proper operating procedures listed throughout any of the information provided, could cause damage to your equipment, personal injury, or death.
2. Obey all “CAUTION”, “DANGER”, and “WARNING” signs / labels mounted on the equipment. Do not remove any of these signs / labels.
3. Do not use this equipment in any manner not specified in this manual. Improper use may impair the safety features employed and will void your warranty.
4. Operators and service personnel must be familiar with the location and function of all controls and the inherent dangers of the equipment before operating or maintaining it.
5. Only qualified service personnel should ever be permitted to perform any service-related procedure on this equipment!
6. This equipment is not designed for use with volatile or explosive materials. Loading of such materials may result in explosion or fire.
7. Do not place the unit near combustible materials or hazardous fumes or vapors.
8. Do not install unit in a corrosive environment. A corrosive environment may lead to poor performance and deterioration of unit.
9. Make sure the chamber and any remote equipment provided are leveled when installed. The chamber door may swing shut on personnel if unit is tilted.
10. A main power disconnect switch may not be provided with your unit. If not provided, we recommend that a fused disconnect switch on a separate branch circuit be installed as the power source in accordance with all National and Local Electrical Codes.
11. Do not position the chamber in a manner that would make it difficult to operate your main power disconnect switch.
12. Your power supply line voltage may be too low or too high to properly and safely operate your equipment. Before making the power supply connection to your equipment, you must follow the specific directions stated under “Power Connection” in the Installation Instructions section. Failing to perform the directions stated may damage your equipment and void your warranty!
13. Control panels, gauge boxes, the conditioning compartment, etc., contain exposed electrical connections. Keep panels in place properly when the unit is in operation. Disconnect and Lock-Out / Tag-Out all electrical power from the unit at its source before servicing or cleaning.
14. Do not adjust any mechanical components or any electrical components except as directed in this manual.
15. Do not overload the floor of the chamber workspace or load the unit unevenly.
16. Do not exceed the temperature rating of your chamber.

17. Human exposure to temperature extremes can cause injury. Do not open oven doors until oven temperature drops below 200° F (93° C), when applicable. Take appropriate precautions before opening oven doors and upon handling any chamber contents.
18. Always cool the oven down below 167°F (75°C) before shutting it down. Otherwise, damage to the circulation motor shaft bearings will result.
19. Do not modify any component on this unit. Use only original equipment manufactured (OEM) parts as replacement parts. Modifications to any component, or the use of a non-OEM replacement part could cause damage to your equipment, personal injury, or death.

INTERNATIONAL WARNING / SAFETY SYMBOL DEFINITIONS

Obey all “DANGER”, “WARNING”, and “CAUTION” labels shown in the manual and mounted on the equipment. Do not remove any labels mounted on the equipment.

“WARNING OF HAZARDOUS AREA”



“WARNING OF DANGEROUS ELECTRIC VOLTAGE”



“WARNING OF HOT SURFACE”



“EARTH (GROUND) PROTECTIVE CONDUCTOR TERMINAL”



3.0 PRODUCT SPECIFICATIONS & OVERVIEW

Application:

This manual applies to the Blue M Ultra Temp Series Industrial Ovens, which are available in two models. The Model CW is a standard convection oven and the Model IGF is an inert gas equipped convection oven. Both ovens employ a welded and sealed inner chamber. Model IGF ovens include a unique inner /outer shell chamber constructed with an air gap which allows coolant ambient air to circulate around an inert gas inner chamber. A high volume air circulation system is used with an electric heating system to obtain maximum temperature uniformity.

<u>Model Type</u>	<u>Model No.</u>	<u>Workspace</u>	<u>Temp. Rating</u>
Standard Models	Model CW	1.6 to 24 Ft. ³	15° above ambient to 704° C
Inert Gas Models	Model IGF	1.6 to 24 Ft. ³	15° above ambient to 593° C

- Inert Gas Models are used in processing materials in a controlled environment. An inert atmosphere prevents oxidation from occurring on the product. It also eliminates the capability of oven air from supporting a flame.

Conditioning Functions:

- Heating of the oven is achieved by recirculating oven air through open air nichrome wire heater elements in the conditioning plenum. The plenum is located in the bottom of the chamber.
- Cooling of Model CW ovens is achieved by adjusting the dampers in the intake and exhaust ports located typically on the left side of the oven.
- Cooling of Model IGF ovens is achieved by circulating ambient air through an air gap between an inner and outer chamber shell. An intake blower motor is used to generate cooling airflow.
- Air flow is generated by a centrifugal type blower wheel mounted in the conditioning plenum. The blower wheel is directly driven by an externally mounted motor. A horizontal airflow type system is employed. For the Model CW, some of the air may be exchanged through the intake and exhaust ports to remove moisture or unwanted process vapors.
- When an inert gas atmosphere is employed (Model IGF) it is maintained in the oven during the entire process cycle. The oven is initially purged of atmospheric air for a specific time period before heating is allowed to begin. A constant flow of inert gas is then maintained during the heating and cooling cycles. Inert gas flow and chamber pressure are monitored and regulated with various instruments on the front control panel.

The following inert gases are approved for the Model IGF oven.

- Argon
- Carbon Dioxide
- Helium
- Nitrogen

Airflow Switches:

A differential air pressure switch is used to monitor the generation of airflow by the circulation blower. A loss of airflow detected by the switch will result in a shutdown of the oven's heaters and the activation of an alarm.

Temperature / Process Control:

For simple temperature control, a non-profiling controller is normally used. For temperature control with programming applications, a profiling controller will be used. The most commonly used controllers are listed below.

Non-Profiling Controller Models: (Non-Profiling Types Are Standard)

- Blue M Stat 350 - Yokogawa UT350

Profiling Controller Models: (Profiling Types Are Optional)

- Blue M Pro 350 - Yokogawa UP350
- Blue M Pro 550 - Yokogawa UP550
- Blue M Pro 750 - Yokogawa UP750
- Watlow F4

Overtemperature Protection:

Either a Yokogawa UT150L Limit Controller, or a Blue M Temp Limit Controller is provided for overtemperature protection. The protection circuitry will shut down the heat control system and blower when a high heat limit is detected and activate an alarm.

Additional Features:

Blue M ovens are designed with the capability to incorporate many other optional features for safety purposes, enhanced process control, and simplified operator interface. Consult a Blue M Applications Engineer or our Service Department for more information or questions.

Operating Parameters and Requirements:

This equipment is designed to operate safely when the following environmental conditions are met:

- Indoor use only.
- Within a temperature range of 5°C to 30°C (max).
- Maximum relative humidity 90%.

The listed chamber specifications are based on operation at 24° C ambient temperature, altitude at sea level, and a 60 Hz power supply. Chamber operation utilizing a 50 Hz power supply will derate the listed performance specifications.

Equipment damage, personal injury, or death may result if this equipment is operated or maintained by untrained personnel. Operators and service personnel must be familiar with the location and function of all controls and the inherent dangers of the equipment before operating or maintaining it. TPS shall not be liable for any damages, including incidental and/or consequential damages, regardless of the legal theory asserted, including negligence and/or strict liability. Observe all safety warnings and operating parameters listed in this manual, as well as all Caution, Danger, and Warning signs or labels mounted on the equipment to reduce the risk of equipment damage and personal injury:

4.0 DRAWINGS, INFORMATION, and VENDOR INSTRUCTION LISTINGS

The following drawings are provided:

Electrical Schematic	xxxxxWD
Wiring Parts List	xxxxxPW
General Layout	D001

The following information and vendor manuals are provided:

Note: Do to page volume, some manuals may only be included as an electronic copy on a CD.

Main Temperature Controller Manual

Yokogawa UT150L or Blue M Limit Controller Manual

Optional Equipment – The following vendor manuals will be supplied when the option is included.

Chart Recorder Manual

Process Timer

Trace Oxygen Transmitter

Note: Various other vendor manuals and product information sheets may be provided, which contain important operation and maintenance instructions. Their inclusion is subject to vendor availability.

5.0 INSTALLATION INSTRUCTIONS

Read this section **completely** before attempting to install, or operate the equipment.

5.1 Delivery and Uncrating of Unit

Inspect equipment and shipping crate immediately upon receipt. If any damage is apparent, you should discuss it with the trucking delivery person and contact the transportation company immediately. Make notes of any damage on the Bill Of Lading. Retain all shipping materials for inspection. Any claims for damage must start at the receiving point. Check packing slip carefully and make sure all materials have been received as indicated on the packing ticket. Unless otherwise noted, YOUR ORDER HAS BEEN SHIPPED COMPLETE.



Chambers and any remote machinery skids or control cabinets should be handled and transported in an upright position. They **must never** be carried on their back, front, or any side.

Important! Due to the vibration incurred during shipping and handling, it is possible that mechanical connections could become loose. Check all connections to make sure they are secure.

5.2 Location and Installation of Unit

- Classification: NFPA 86 Class B ovens are heat utilization equipment operating at approximately atmospheric pressure wherein there are no flammable volatiles or combustible material being heated in the oven.
- Do not place the unit near combustible materials or hazardous fumes or vapors.
- Do not locate unit in areas of wide ambient temperature variation such as near vents or outdoor entrances.
- Do not install unit in a corrosive environment. A corrosive environment may lead to poor performance and deterioration of unit.
- Ventilation: The oven should be installed in an area where there is good air ventilation. Allow a minimum of 5 inches between any wall and any oven side.
- **Do not position the oven in a manner that would make it difficult to operate your main power disconnect switch.**
- Make sure the oven is leveled when set up. The floor of the chamber should be leveled with a Spirit Level to +/- 1/8" (3.175 mm) front to back and side to side.

5.3 Equipment Features and Access

Utility connections along with various equipment features are shown in the photos below. Each utility is described in the sections that follow.

Important Note: Do not tamper with the airflow switch adjustment ports.



MODEL IGF 6680



MODEL CW

The Model CW has an extra door panel to further protect the operators from incidental burn injuries.

Safety
Door
Panel.



MODEL CW DOOR

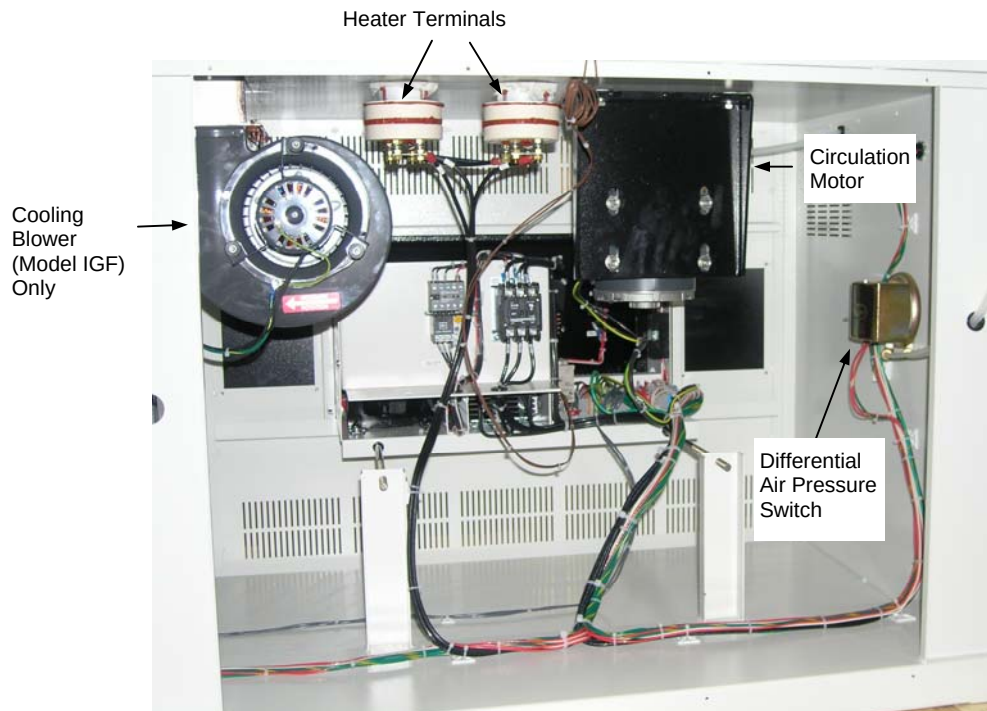
The Model IGF is constructed with a double door construction. This feature protects the operator from the hot door surface while providing an inert atmosphere chamber. Additionally the chamber is isolated from the ambient air path that surrounds the inner shell to allow cooling when necessary. The double latched door also aids in maintaining the door seal while operating at higher temperatures.

Door Latches

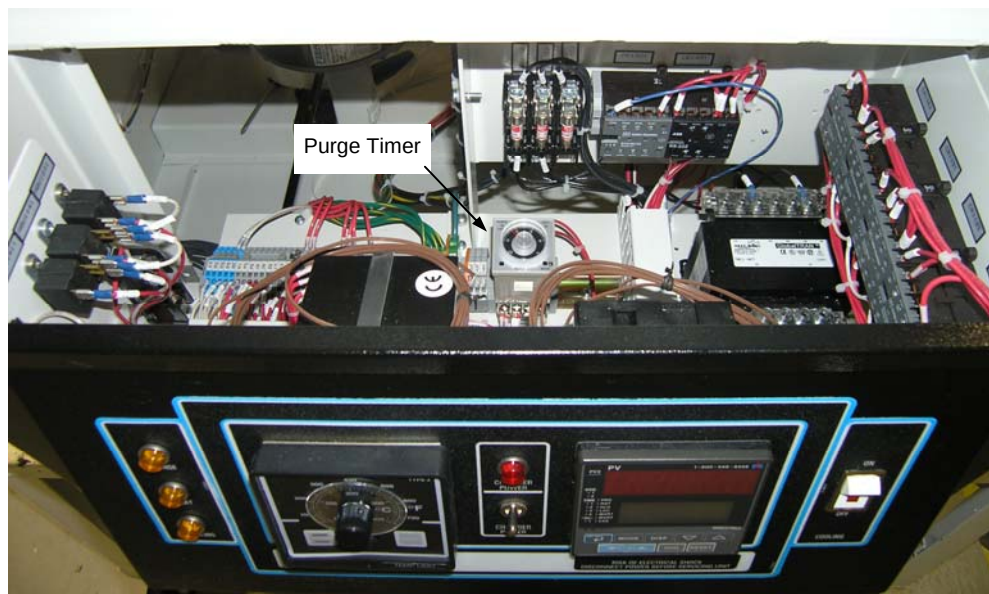


Inner Chamber
Door.

MODEL IGF DOOR



POWER EQUIPMENT ACCESS MODEL IGF 6680



CONTROL PANEL - MODEL IGF

5.4 Water Inlet / Outlet Connections

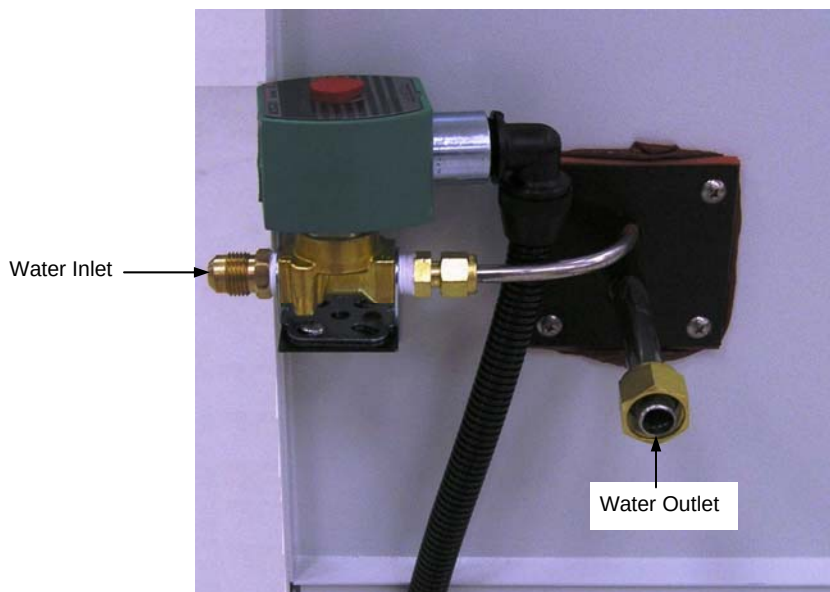
Water Inlet Connection: A city water supply is required for the optional water cooled door gasket. The inlet connection is located at the rear of the unit.

The supply should be rated 2-3 GPM. The connection type is 3/8" NPT(M). Make sure the connections are secure.

Water Outlet Connection: The outlet connection type is 1/2" NPT(F). Run your drain line to an open bell-type drain. The outlet may also be connected to a recirculating water system.



WARNING! Severe burn hazard. The use of the cooling coil to rapidly cool a high temperature oven (+100° C) will initially result in the emission of extremely hot steam from the drain line. This steam can cause severe burns. Stay clear from drain when steam is emitted.



WATER INLET & OUTLET CONNECTIONS

5.5 Inert Gas Supply Connections

An inert gas supply is required for process operation of the Model IGF. The selection of the approved gases listed below is primarily dependant upon compatibility with materials being processed.

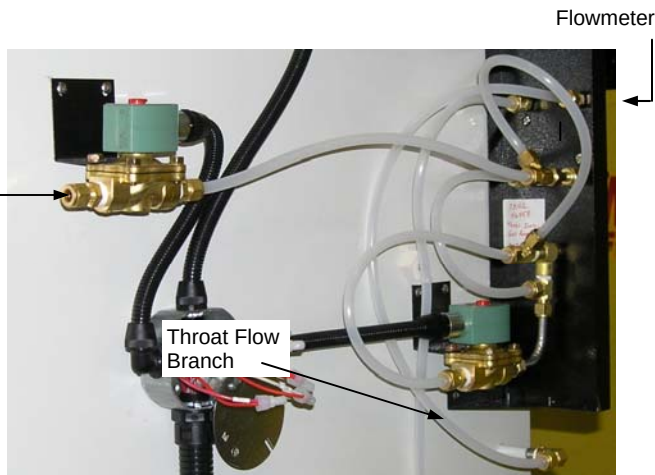


Warning! This oven is designed for use with only non-explosive, non-flammable, inert gases. Operator injury and equipment damage may result if these precautions are not followed.

The following inert gases are approved for this oven.

- Argon
- Carbon Dioxide
- Helium
- Nitrogen

A manually operated shut-off valve and a reliable pressure regulator should be installed between the source and the oven. Inlet pressure should be regulated to 40 PSIG. Maximum inlet pressure is 70 PSIG.



INERT GAS CONNECTIONS

The inlet connection is located at the left side of the unit behind the cover plate. The connection type is 3/8" NPT(F). Make sure the connection is secure.

The gas branches off from the main inlet in two directions. One branch introduces gas into the work chamber through the blower shaft seal. The second branch provides gas in the throat area between the inner and outer doors.



Warning! Suffocation hazard. The oven must be located in a well ventilated area. Although inert gases are not in themselves toxic, they can displace sufficient oxygen in poorly ventilated rooms to cause suffocation or asphyxiation.



Do not connect oven directly to a compressed gas cylinder or any other high pressure gas source.



Use only commercially prepared and bottled gases.



Do not exceed 70 PSIG gas inlet pressure.

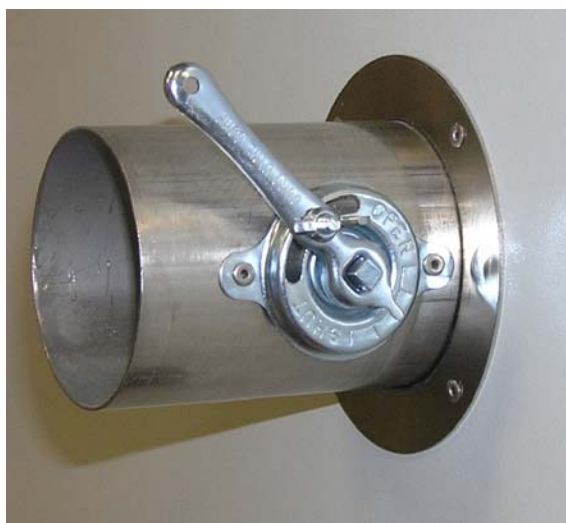
Important! Refer to the Inert Gas Control System section for information on setting the flow rates for your chamber.

5.6 Exhaust Connection

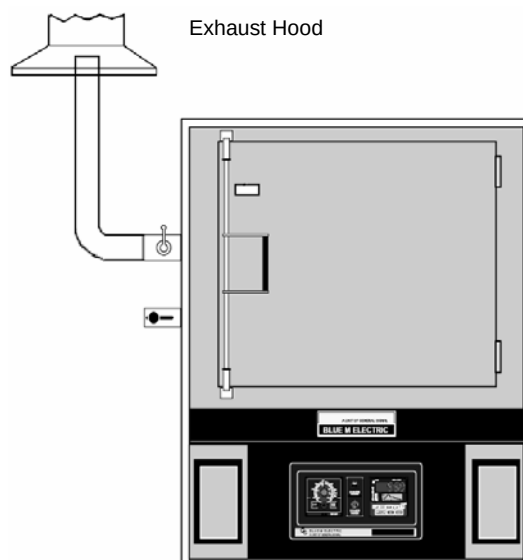
The exhaust port is located on the left side of the unit. Standard size is 3" O.D. but can be up to 8" on larger chambers.

A draft diverter, vacuum breaker, exhaust hood, or similar device should be connected between the oven and the exhaust. This connection prevents "chimney effect" which sucks heat out of the chamber and results in slow run-up times or poor temperature uniformity. Never use an exhaust stack directly between the oven and the exhaust.

A vent duct should be connected to the exhaust port and run to a location outside of the building (as necessary). This should be done in accordance with all local code regulations. Make sure the connection is secure.



EXHAUST DAMPER



EXHAUST MODIFICATIONS



Warning! The exhaust port or vents can become extremely hot. Do not touch. Avoid contact between the port and flammable materials. Do not vent exhaust against combustible surfaces, areas, or materials.

5.7 Chamber Venting

A Pressure relief valve PRV is installed on Model IGF units to allow a slight positive pressure to be established. This valve is designed to open at 0.5 PSIG or lower. The PRV is located on top of the chamber and the connection type is ½" NPT(F).



PRESSURE RELIEF VALVE – MODEL IGF



Warning! The exhaust port or vents can become extremely hot. Do not touch. Avoid contact between the port and flammable materials. Do not vent exhaust against combustible surfaces, areas, or materials.

5.8 Power Supply Specifications and Connection



Warning! Before making the power supply connection to your unit, you must perform the following procedure:

1. Verify the power supply voltage rating established for your chamber (listed above). The voltage rating is also found on the serial tag on the side of the oven. Note the rated value here: _____
2. Measure and record the intended voltage source. Note the measured value here: _____
3. Reference the “Line Voltage Min/Max Tables” below. Verify that the power supply voltage source you measured and recorded is within the minimum and maximum allowable operating voltages for your chamber rating. If it is not within this operating range, **do not make the power connection!** Otherwise, erratic operation and damage may occur to your equipment, which may void your warranty. If you have any questions, please call the TPS Service Department.

Important! One of the most common causes of equipment malfunction is low line voltage as the power source to the unit. Ordinarily in this condition, the heat output would be reduced and the system's motors would operate erratically, eventually overheat, and shut down. You must be certain that your equipment is connected to a circuit with an adequate voltage and current source. An oversupply voltage would also cause erratic operation and eventual shutdown, or damage to your equipment.

- 60 HERTZ SUPPLIES - LINE VOLTAGE MIN. / MAX. TABLE		
Nominal Voltage	Minimum Voltage	Maximum Voltage
208	188	228
230	207	253
460	414	506
480	432	528
60 Hz Supply	Operation outside these limits can result in damage to the system's motors.	

- 50 HERTZ SUPPLIES - LINE VOLTAGE MIN. / MAX. TABLE		
Nominal Voltage	Minimum Voltage	Maximum Voltage
200	180	220
220	198	242
380	342	418
400	360	440
415	374	456
50 Hz Supply	Operation outside these limits can result in damage to the system's motors.	

Making the Power Supply Connection to the Chamber:

This facility should be provided with a power source that is on a branch circuit of its own. A fused disconnect switch is located on the side of the oven. Various size knockouts are provided on the box.



Warning! High Accessible Current – An Earth connection is essential before connecting the power supply. Make sure all equipment is properly grounded in accordance with all codes.



FUSED DISCONNECT BOX

Note: Your equipment configuration may be slightly different from what is shown.

5.9 Application of Power

- Before energizing any equipment, make a visual inspection for loose components, electrical connections, fittings, etc. Shut all operating switches to the “OFF” position before energizing.
- Have trained personnel start and check out the equipment before its first cycle.

Motor Rotation Check: Units with three phase motors must be checked to insure proper motor rotation. A red arrow is located on the motor housing of three phase motors to show proper rotation. If it is opposite, shut down the oven and disconnect the main power supply source. Perform **Lock-Out / Tag-Out Procedures** established by your company. Reverse two of the line feeds to obtain proper operation. Failure to check motor rotation may result in **DAMAGE TO THE EQUIPMENT** due to opposite airflow, or no airflow.

6.0 AIR CIRCULATION SYSTEM

System Overview:

A high volume horizontal airflow system is employed with the conditioning system to provide maximum temperature uniformity. The heating, cooling, and generation of airflow occurs in the conditioning plenum located in the base of the oven. The plenum is isolated from the workspace so that no direct heat radiation to the workspace can occur.

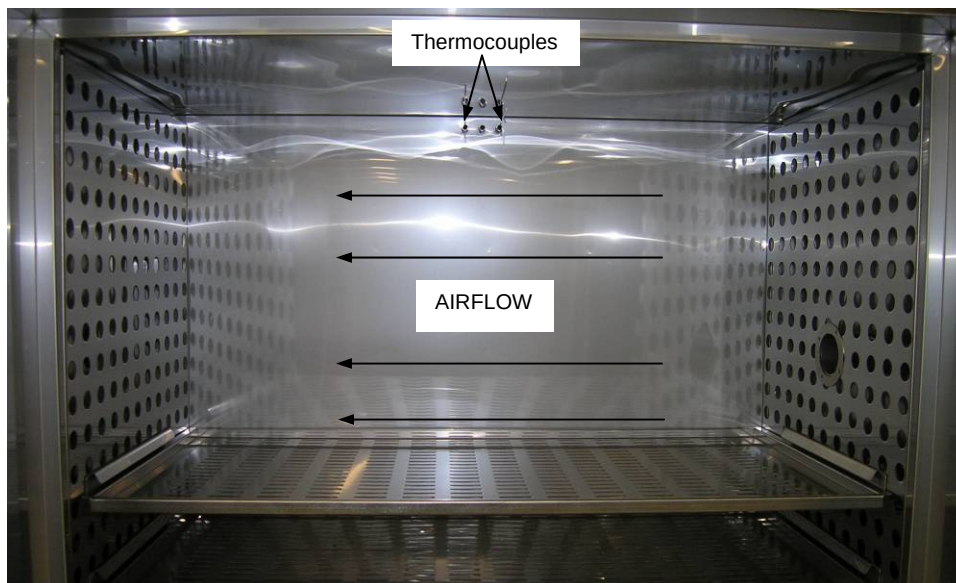
Air circulation is generated by a centrifugal type blower wheel, which is driven by an externally mounted motor.

Basic Airflow Description:

Model CW ovens are designed with a unique air flow management system that allows air circulation to be varied between a One-Pass Air Flow type system to a Full Recirculated Air Flow type system. This is achieved by opening / closing the air intake and exhaust dampers. Both systems are described later in the section. Dampers should be opened to remove unwanted process vapors, shorten drying times, or to cool down the oven after the heating cycle.

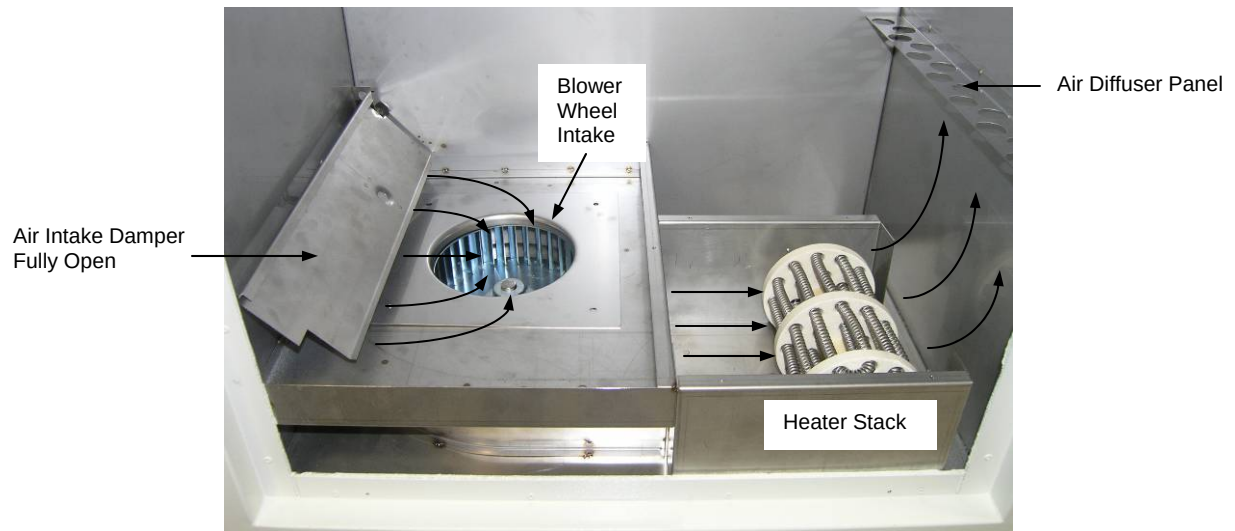
Process air is heated as it is drawn in by the blower wheel and forced through open air electric wire elements. The elements are configured in a cylindrical stack and are supported by ceramic discs. Heated air is discharged into the right side duct wall and then enters the workspace through perforations over the entire height and depth of the oven. Air flows horizontally across the workspace to condition the product and exits through perforations in the left side duct wall. Process air returns to the plenum for reconditioning. It may be mixed with fresh air in varying degrees, depending on the settings of the intake and exhaust dampers.

Type J thermocouples are used for temperature sensing by both the main and limit controllers. These are mounted in the airflow at the top of the workspace.



WORKSPACE AIRFLOW – MODEL CW

The photo below shows the conditioning plenum with both the main cover and separate heater cover removed. An air diffuser panel is mounted on the right side wall to uniformly direct airflow to both the top and bottom of the perforated duct wall. The air intake damper is shown fully open.



CONDITIONING PLENUM AIR CIRCULATION

The photo below includes the exhaust port, along with the heater cover installed. The air intake damper is shown fully open.

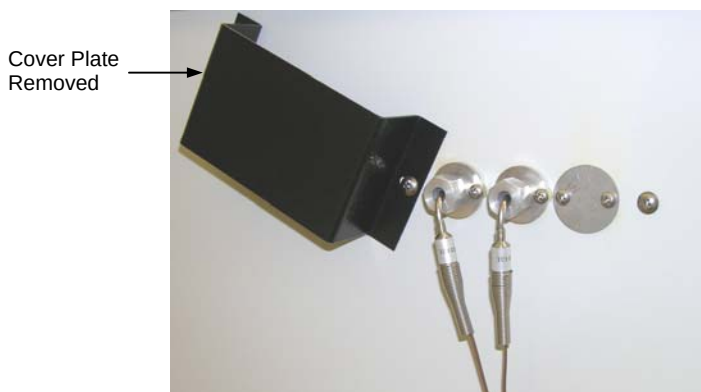


CONDITIONING PLENUM – INTAKE DAMPER FULLY OPEN

The photos below shows the intake damper fully closed.



CONDITIONING PLENUM – INTAKE DAMPER FULLY CLOSED



THERMOCOUPLE WIRES – REAR OF OVEN

Adjustable Air Intake and Exhaust Dampers:

Adjustable air intake and exhaust dampers are employed to vary air circulation between a One-Pass type system and a Full Recirculated type system.

Both dampers should be slightly opened for the following conditions.

1. To remove undesirable exhaust vapors generated by the heating process.

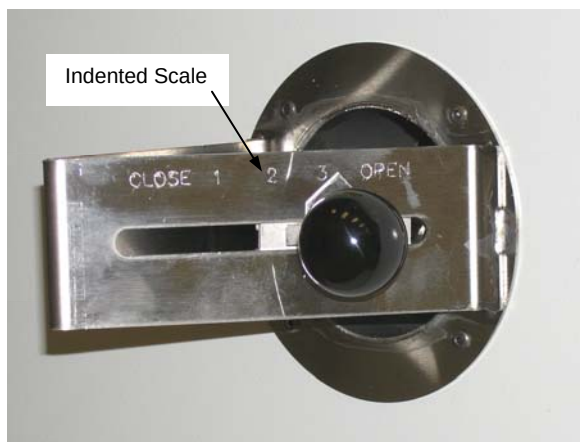
An exhaust duct should be connected to the exhaust port and run to a location out of the building in accordance with all local safety codes.

2. To promote faster drying times.
3. When operating near ambient temperatures.

Air friction caused by the blower wheel circulating process air causes a rise in chamber temperature. This can not be controlled by the temperature controller. Both dampers should be opened wider as you operate closer to ambient temperatures to purge excessive heat from the chamber.

Intake Damper: The intake damper includes a pivot assembly with a linkage to the butterfly damper. You must loosen the knob to slide the pivot assembly right or left, which opens and closes the damper. A damper setting scale is indented into the frame. It is marked "Closed, 1, 2, 3, Open". Make sure you tighten the knob after changing the setting.

Note: The indented scale is marked for reference only. There is no related unit of measure tied this scale.

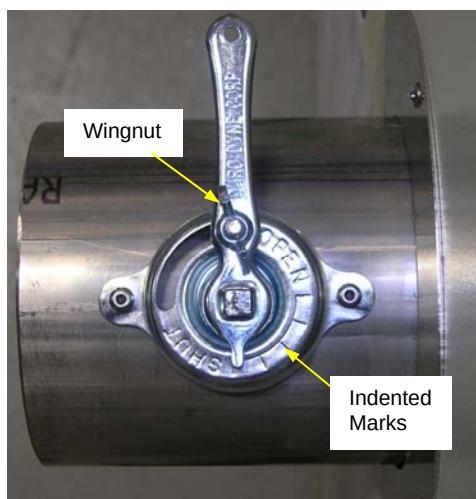


ADJUSTABLE AIR INTAKE DAMPER

Exhaust Damper: The exhaust damper includes a lever attached to the damper shaft. You must loosen the wingnut on the shaft assembly to open and close the butterfly damper. An indented "Open" to "Shut" scale is marked with graduated lines on the assembly. Make sure you tighten the wingnut after changing the setting.



ADJUSTABLE AIR EXHAUST DAMPER

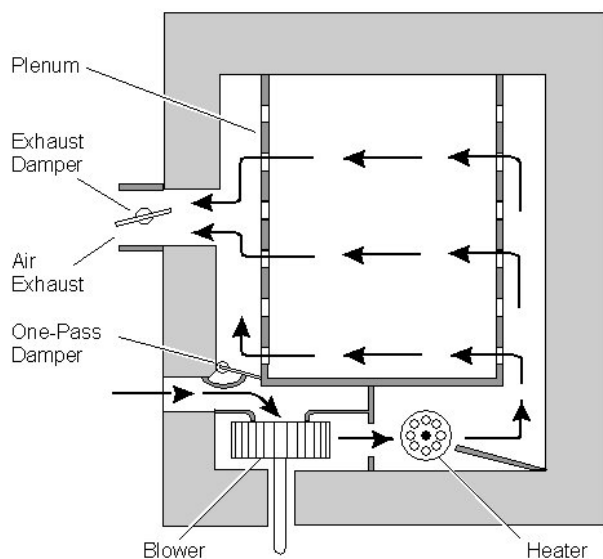


ADJUSTABLE AIR EXHAUST DAMPER

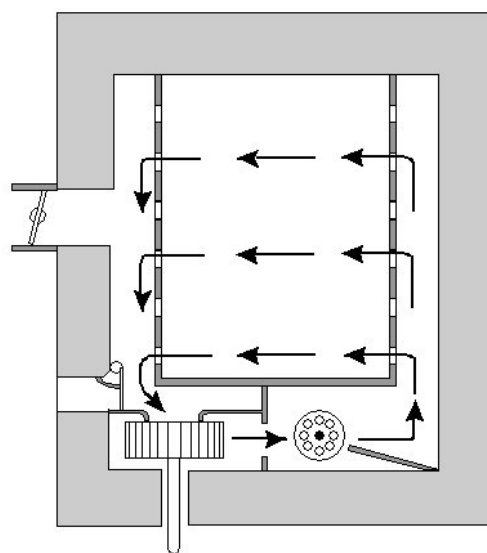
One-Pass Air Circulation System:

To operate with a One-Pass Air Flow System, the air intake and exhaust dampers must be fully opened. When the intake damper is fully opened, it will totally close off the recirculation path to the conditioning plenum from the left duct wall. Fresh ambient air will be drawn into the blower wheel inlet and then heated as it is forced through the heater stack.

Heated air will be discharged up into the right duct wall and into the workspace. It flows horizontally across the workspace to condition the product and exits through the left duct wall. Since the recirculation path is blocked by the intake damper, 100% of all process air is forced out of the exhaust damper. No air is recycled. This system will permit fast drying times, purge process vapors, and allow near ambient operation.



One - Pass Air Flow



Full Recirculated Air Flow

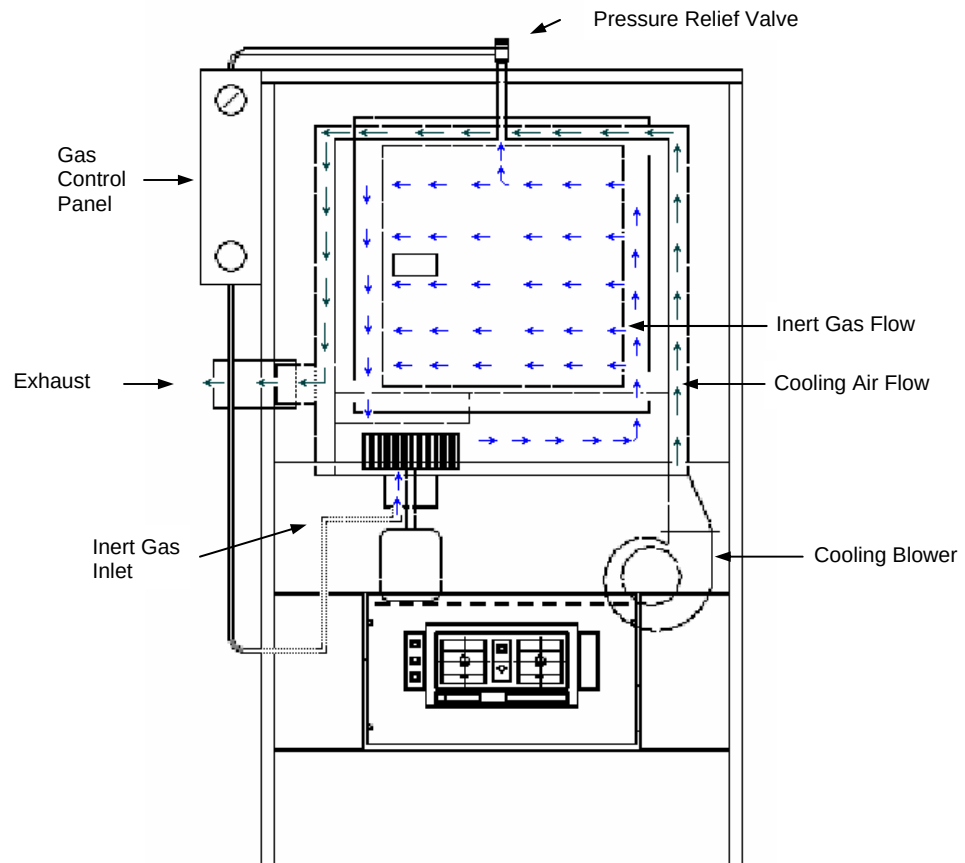
Full Recirculated Air Flow:

To operate with a Full Recirculated Air Flow System, both the intake and exhaust dampers must be fully closed. 100% of chamber air will be recirculated. This system allows rapid heat up rates and better temperature uniformity than with the One-Pass System.

Airflow Description with Inert Gas (Model IGF):

In Model IGF ovens, inert gas is injected near the intake of the blower wheel and mixes with circulating process air. The air will flow through the conditioning plenum where it will be conditioned by the heater coil. The air will then flow through the right side wall as previously described in the basic airflow system. In order to maintain an inert atmosphere the interior chamber is welded and sealed. A vent system located in the ceiling will allow excess return air to escape the chamber so that pressure does not violate the door seal integrity. Model IGF ovens employ a 0.5 psi max. pressure relief valve on the vent port in order to better regulate the inert atmosphere during the purge and run cycles.

The cooling ambient air is a separate one pass airflow system in which ambient air is circulated by the cooling blower around the chamber shell and out the exhaust vent. This feature is only present on the Model IGF oven.



MODEL IGF AIR FLOW

Differential Air Pressure Switches (FLS):

Differential air pressure type switches are utilized to monitor the correct operation of the blower motors employed. Correct rotation of the motor is necessary for the switches to properly operate. These devices use a diaphragm to sense pressure and to mechanically trigger a SPDT Snap Switch when the proper pressure is developed across the blower wheel or fan blade.

If a loss of pressure / airflow were detected, the switch would open causing power to be removed from the heaters. Loss of airflow may result from a motor malfunction, reversed motor rotation, a loose blower wheel, or reversed air sensor tubes.

Important Note: Do not tamper with the airflow switch adjustment ports located at the side of the unit. All switches were factory preset.



DIFFERENTIAL AIR PRESSURE SWITCH

Note: Your equipment configuration may be slightly different from what is shown.

7.0 INERT GAS CONTROL SYSTEMS - MODEL IGF

Overview:

An inert gas system is used to maintain an inert gas atmosphere in the oven, at a slight positive pressure during the entire process cycle. The oven is initially purged of atmospheric air for a specific time period before heating is allowed to begin. A constant flow of inert gas is then maintained during the heating and cooling cycles. Inert gas flow and chamber pressure are monitored and regulated with various instruments on the front control panel. The following inert gases are approved for this oven.

- Argon
- Carbon Dioxide
- Helium
- Nitrogen



Warning! This oven is designed for use with only non-explosive, non-flammable, inert gases. Operator injury and equipment damage may result if all safety precautions are not followed.

Operation:

There are three operational events required to prevent oxidized workloads. These include the Purge, Run Up and Hold, and Cool Down cycles. Initially, the Purge cycle is required to exhaust room air and replace it with inert gas. No heat should be applied during the purging cycle to prevent any remaining oxygen from recombining with hydrogen and forming water vapor. A Purge Timer will energize and open the Gas Purge solenoid valve. The standard timer used is an Eagle Signal Model B846-511, type 1/16 DIN unit that is installed in the control cabinet.

It is recommended that a volume of gas at least 5 to 10 times the volume of the work chamber be forced through the oven. The table below reflects a rate of approximately 7 times the volume for the work chamber shown. Your process may require adjustment to achieve the desired result.

Note: The purge timer will reset each time the door is opened.

GAS FLOW RATE TABLE				
Model	Purge Flow Rate	Purge Time	Run Flow Rate	Cool Down Flow Rate
IGF -5580	100 SCFH	11 min.	20 SCFH to Oven 5 SCFH to Throat	Same as Run Rate
IGF -6680	100 SCFH	27 min.	22.5 SCFH to Oven 7.5 SCFH to Throat	Same as Run Rate
IGF -7780	200 SCFH	18 min.	25 SCFH to Oven 7.5 SCFH to Throat	Same as Run Rate
IGF -8880	200 SCFH	33 min.	50 SCFH to Oven 15 SCFH to Throat	Same as Run Rate
IGF -9980	600 SCFH	24 min.	95 SCFH to Oven 25 SCFH to Throat	Same as Run Rate

Important! Make sure the **Purge Flow Rate** is maintained during the purge cycle. The pressure relief valve on top of the oven maintains a slight positive pressure (< 0.5 PSIG) in the chamber. A chamber pressure gauge is installed on the control panel to monitor chamber pressure.



WARNING! DO NOT ALLOW CHAMBER PRESSURE TO EXCEED 1.0 PSIG. Reduce the flow rate immediately if this occurs. Check the PRV valve for cleanliness if problem persists.

After the purge cycle has been completed, the purge timer will de-energize and close the Gas Purge Solenoid Valve. Gas will now flow through the Run Flow Adjustment valve on the panel. Adjust this to the run flow rate as listed on the table. The Run Up and Hold Cycle is necessary to maintain positive pressure in the chamber while running up to the setpoint operating temperature. One or two ounces per square inch (2 or 3 inches of water column) should be sufficient.

Note: The pressure indicated on the gauge may vary during different portions of the cycle. The pressure will increase as the temperature rises and decrease when the temperature drops.

Important! Make sure a minimum **Run Flow Rate** (see Table) is maintained during the run cycle as indicated on the panel flowmeter.

When the purge cycle has been completed, normally open contacts of the purge timer will close to energize a control relay, which enables the heat control circuitry.

During the Cool Down cycle, the inert gas atmosphere must be maintained until the work load is below the temperature at which oxidation will occur. 125° C is considered the highest safe temperature for most workloads.

Note: When processing high mass loads the work load temperature may be higher than the temperature shown on the temperature indicator.

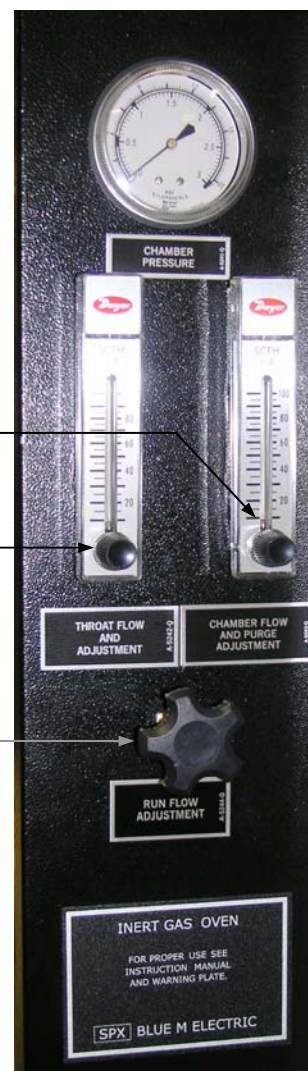
Metering Valve Adjusts
Purge Flow / Chamber
Maximum Pressure

Metering Valve Adjusts
Throat Flow
Maximum Pressure

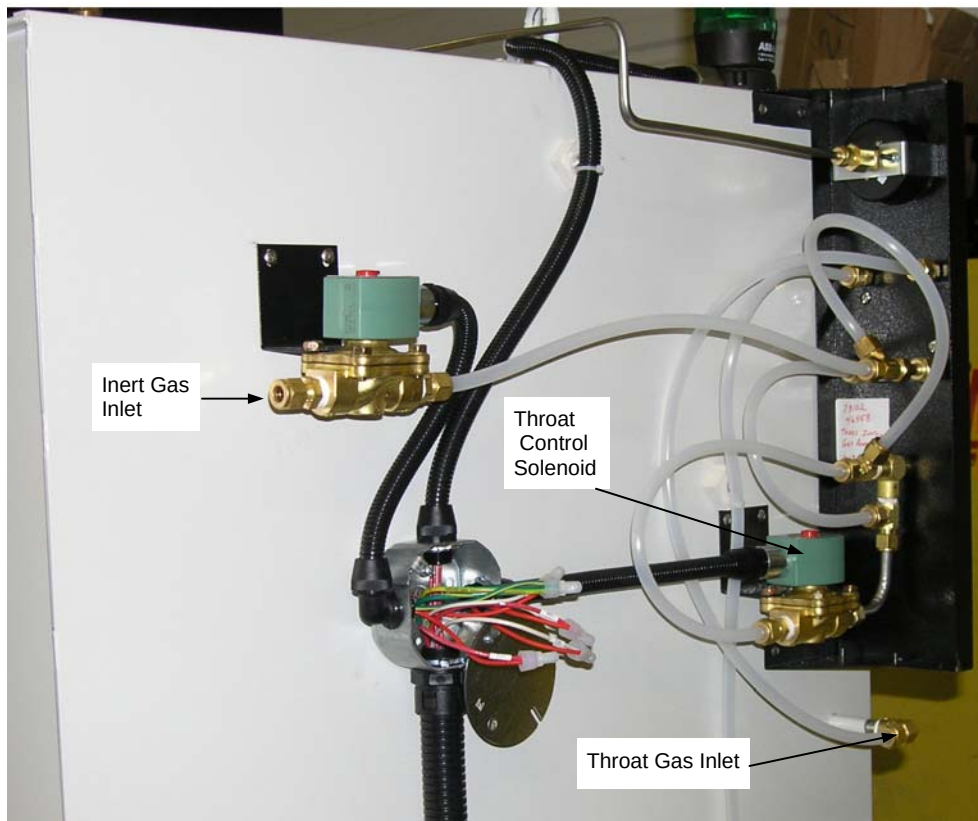
Run Flow
Adjustment Valve

Note: Gas flow to the throat is not to be included when calculating purge and/or flow rate and time.

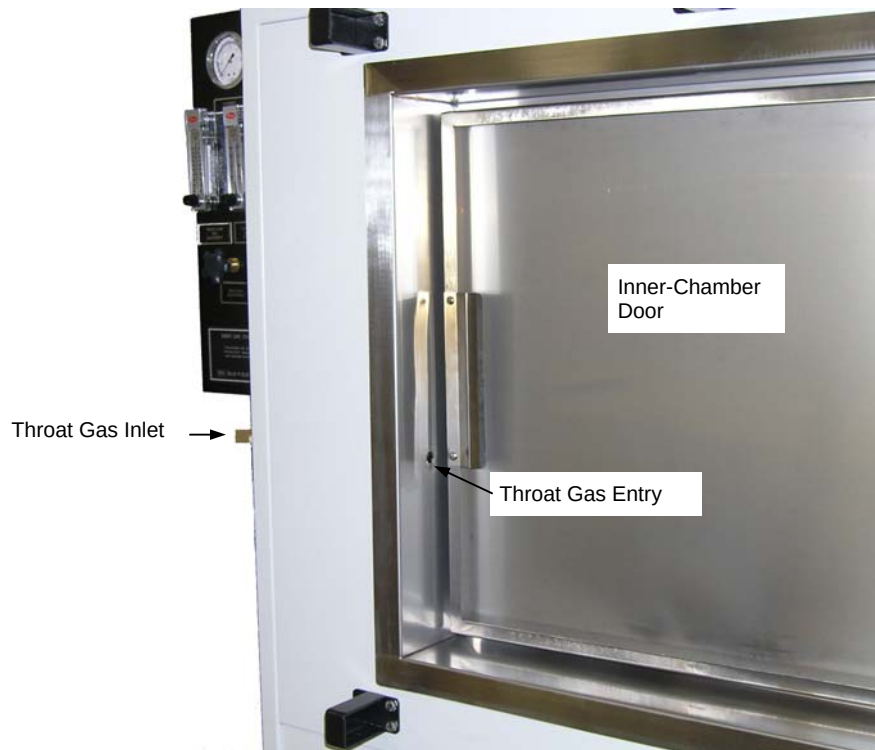
The “Throat” area is located between the chamber entrance door and the Main Oven door of the Model IGF. Gas introduced into this area is intended to provide additional protection from oxygen infiltration between the doors, it is not intended to provide purge or process flows.



GAS REGULATION



IGF GAS PLUMBING BEHIND SIDE PANEL



THROAT AREA MODEL IGF

8.0 OXYGEN ANALYZER / TRANSMITTER (Optional)

When an inert gas atmosphere is employed (Model IGF), it may be necessary to monitor the amount of oxygen present in the chamber atmosphere for safety or process control reasons. One of the following Alpha Omega Oxygen Analyzers / Transmitters may be employed as an option:

- Series 2000 Percent Oxygen Analyzer
- Series 2510 Percent Oxygen Transmitter
- Series 3000 Trace Oxygen Analyzer
- Series 3510 Trace Oxygen Transmitter

8.1 Overview

The analyzer / transmitter samples process air through a line that runs from the pressure relief valve fitting on top of the chamber. A flowmeter provides indication of the sample flow rate experienced by the analyzer / transmitter unit. The units employ a sensor which is a lead-oxygen battery consisting of a gold plated cathode and a lead anode fully self contained in an electrolyte solution. As a small amount of oxygen permeates through a Teflon membrane of the sensor it is reduced electro-chemically at the gold electrode. A resistor and a thermistor (for temperature compensation) are connected between the cathode and anode. As a result, the lead oxygen battery is always discharged. Current flowing through the resistor and thermistor is proportional to the oxygen concentration of the gas in contact with the Teflon membrane. By measuring the voltage between the resistor and thermistor, oxygen concentration can be accurately determined.



SERIES 3510 TRACE OXYGEN TRANSMITTER
Series 2510 is similar in appearance



SERIES 2000 PERCENT ANALYZER
Series 3500 is similar in appearance

8.2 Series 2000 or Series 3000

The Alpha Omega Series 2000 / 2510 units measure oxygen as a Percent of the atmosphere volume with the following specifications:

- Measurement Ranges in percent: 0-2, 0-5, 0-10, 0-25, 0-50, 0-100 (specified at time of order)
- Sample Gas pressure Limits: 0.1 to 1.0 psig
- Sample Flow Rate: 1.0 to 2.0 SCFH

The Alpha Omega Series 3000 / 3510 units measure the Trace oxygen in ppm of atmosphere volume with the following specifications:

- Measurement Ranges in ppm: 0-10, 0-50, 0-100, 0-500, 0-1000, 0-5,000 0-10,000 (specified at time of order)
- Sample Gas pressure Limits: 0.1 to 1.0 psig
- Sample Flow Rate: 1.0 to 2.0 SCFH

8.3 Analyzer or Transmitter

The Series 2000 Percent Oxygen Analyzer and the Series 3000 Trace Oxygen Analyzer are complete measurement devices. They have a keypad for data entry and programming, a sensor for Oxygen detection, a display to view data, and audible and visible alarm programs to alert technicians to process problems.

The transmitters will convert the voltage generated by the sensor and transmit a 4-20 mA output to the controller (MP750 or UP750) Input 2. When oxygen amounts exceed the setpoint value the controller will signal and alarm and de-energize a contact relay turning off power to the heater elements. The controller will also provide the display value in ppm or percent of oxygen present.

Refer to your included, model specific, vendor's user manual for complete operating instructions.

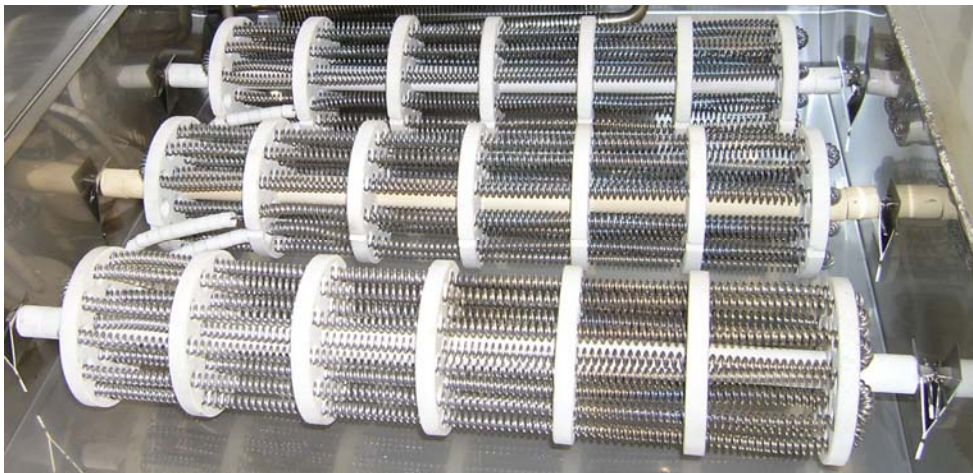
9.0 ELECTRIC HEATING SYSTEM & CONTROL

Overview:

Heating of the oven is achieved by recirculating oven air through open-air heavy gauge nichrome wire heater elements in the conditioning plenum. Each element is configured in a serpentine pattern within a cylindrical stack and supported by ceramic disks. More than one heater stack may be installed. This is determined by chamber size and heat demand. The heaters are isolated from the workspace so that no direct radiation can occur.

Heat Control:

The heat control circuitry is enabled through the High Limit Output of the Overtemperature Controller OTP. An output from the main temperature controller is used to energize a solid state relay(s) in the control cabinet. The relay(s) will close to provide power to the heater(s).



ELECTRICAL HEATERS

10.0 COOLING SYSTEMS & CONTROL

10.1 Cooling with Ambient Air - Model CW

Cooling in Model CW ovens is achieved by opening the air intake / recirculating and exhaust dampers on the left side of the oven. This allows fresh ambient air to mix in with conditioned air to cool the product. When the dampers are fully open the oven can exhaust to almost ambient temperature. Maintaining temperatures around ambient may be difficult as a result of air friction generated by the circulation blower wheel.

Exhaust



Intake

Note:
Damper positions
shown fully closed
(Recirc. Mode).

As an option, ovens may employ a motorized intake damper. The motor is installed on the back of the oven.

The motor may be controlled by a switch or a controller event. The event option would allow program control of the intake damper through the temperature controller.



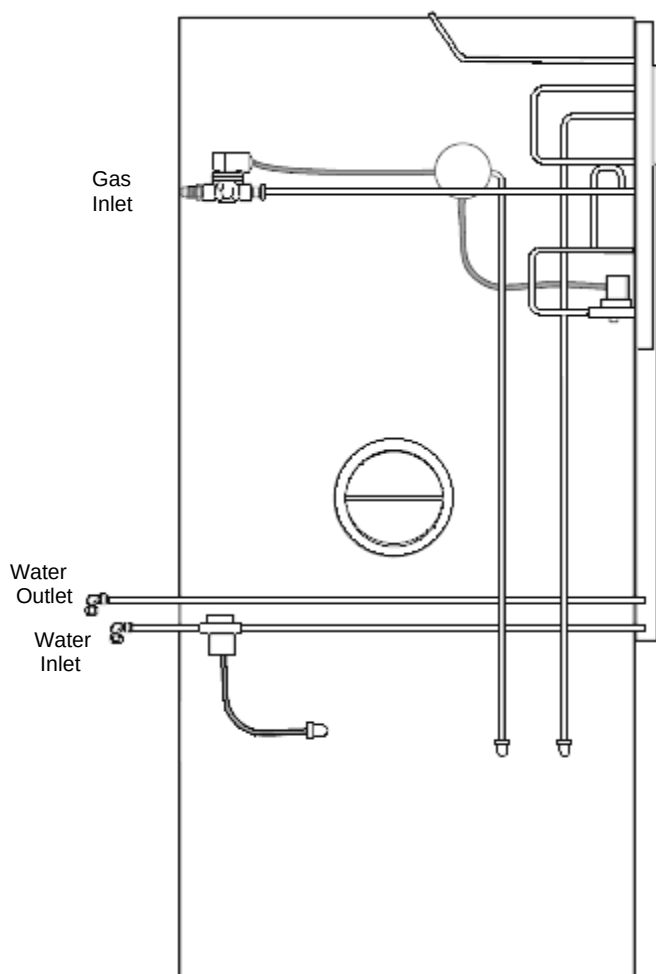
MOTORIZED DAMPER

10.2 Cooling with Ambient Air - Model IGF

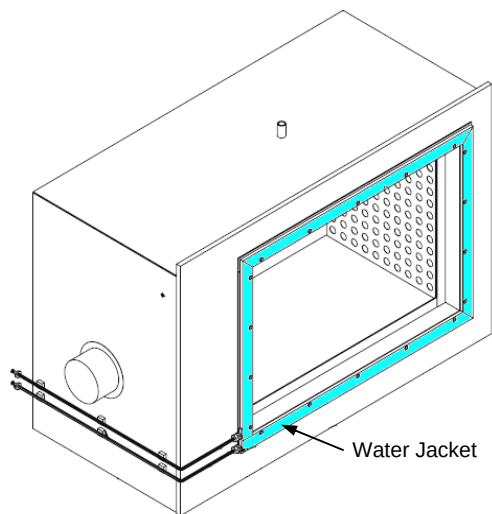
Cooling in Model IGF ovens is achieved by a cooling blower motor located in the machinery base. Ambient air will be drawn in by the blower, circulated around the inner chamber shell and expelled through the exhaust port on the left side of the oven. Control of the cooling rate can be achieved by adjusting the exhaust port damper. A diagram of the air circulation may be seen in the inert gas flow section of this manual.

10.3 Water - Cooled Door (Optional)

Due to the high process temperatures, a water cooled door may be desired to help keep the door seals cool. As an option, a customized door with an installed water jacket and plumbing may be provided. This will enable tap water to be circulated through the custom door unit to keep the door gaskets cool. Water flow rate is about 8-9 liters per minute (2-3 gallons per minute). The following diagram shows an example of the connection and routing of this option.



WATER COOLED DOOR OPTION



WATER JACKET ISO VIEW

11.0 TEMPERATURE CONTROLLER

11.1 Temperature Control

Heat control with the Stat-350 Controller is achieved with the time proportioned Output No.1. This output will energize a solid state relay, which will close to provide power to the electrical heaters. The OTP Contactor must be energized by the Temp Limit Controller to enable the heater power circuitry.

Note: In the Model IGF, heating of the oven can only begin once the purge cycle is complete (when Inert Gas is employed). The Heat Enable light on the control panel will then illuminate. The purge timer will be reset each time the oven door is opened.

Cooling control may be achieved either manually or automatically. In manual mode, a cooling switch on the control panel will energize a solenoid valve to allow water to flow through the cooling coil. Manual control is necessary when using a non-profiling controller without a cooling event output.

If the controller has the cooling event output, or when using a profiling controller, the Cooling Control relay is activated by Event No. 2 of the main temperature controller. Output contacts of this relay will close to energize and energize the Cooling Blower Motor. This permits cool air to flow around the inner chamber shell and cool the working chamber through the conduction heat transfer process.

Note: When cooling in control mode, ensure that the Cooling switch is in the **OFF** position on the front control panel.

Note: When controllers are described as “Blue M or Yokogawa”, Blue M will contain the same core Yokogawa features. The Blue M models will contain different OEM features such as key and lamp labels, and/or setup and operation features. Refer to your manual for specific details.

11.2 Non - Profiling Controllers

Blue M Stat-350: (or Yokogawa UT350)

Temperature control is achieved with the Blue M Model Stat-350 controller. The Stat-350 is a single setpoint type, 1/4 DIN controller with the following main features.

- Single Channel
- Automatic Control Only
- Auto-tuning, “SUPER” overshoot suppress function, and new “SUPER 2” hunting suppress function
- 1 Input Universal Process Input: Type J Thermocouple is used to sense oven temperature
- 1 Heat Control Output: Time Proportioned
- Up to 2 Contact Inputs
- Up to 3 Contact Outputs for Alarms / Events
- Support for Light Loader - LL100 PC-based Parameter Setting Tool
- Communications: RS-485, Modbus



YOKOGAWA UT350

11.3 Profiling Controllers - Optional

Blue M PRO-350 Controller: (or Yokogawa UP350)

The Blue M Model PRO-350 Controller is a profiling type, 1/4 DIN controller with the following main features. Please note that all features may not be used.

- Single Channel
- Program Capacity: 2 Profiles, 10 Segments per Profile
- Automatic / Manual Control
- 1 Process Input: Type J Thermocouple
- 1 Heat Control Output: Time Proportioned
- Wait Function

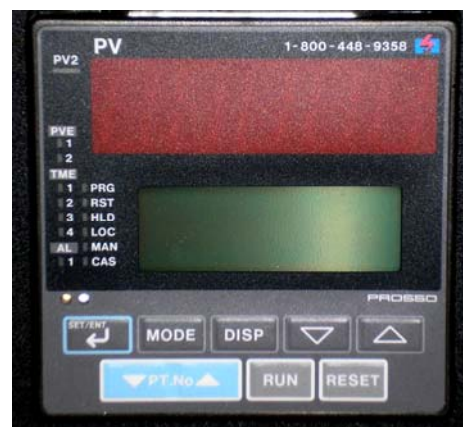


YOKOGAWA UP350

Blue M PRO-550 Controller: (or Yokogawa UP550)

The Blue M PRO-550 Controller is a profiling type, 1/4 DIN controller with the following main features. Please note that all features may not be used.

- Single Channel
- Program Capacity: 30 Profiles, 99 Segments per Profile, Maximum of 300 Segments
- Program and Local (Single Setpoint) Control
- 1 Process Input: Type J Thermocouple
- 1 Heat Control Output: Time Proportioned
- 8 Digital Inputs
- 7 Digital Outputs
- Communications: RS-485, Modbus
- Support for Light Loader - LL100 PC-based Parameter Setting Tool



BLUE M PRO-550

Blue M PRO-750 Controller: (or Yokogawa UP750)

The Blue M PRO-750 Controller is a profiling type, 1/4 DIN controller with the following main features. Please note that all features may not be used.

- Two Channel
- Program Capacity: 300 Profiles, 99 Segments per Profile, Maximum of 3,000 Segments
- Program and Local (Single Setpoint) Control
- 1 Process Input: Type J Thermocouple
- 1 Heat Control Output: Time Proportioned
- 7 Digital Inputs
- 7 Digital Outputs
- Communications: RS-485 with Modbus Protocol
- Support for Light Loader - LL100 PC-based Parameter Setting Tool



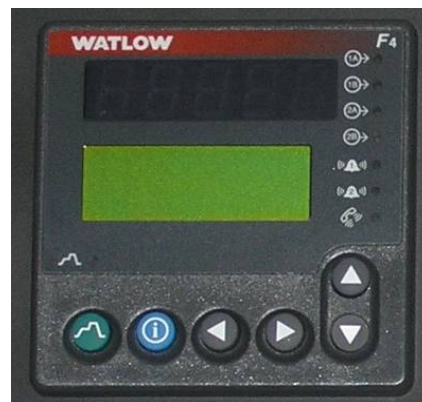
Blue M PRO-750

Watlow F4 Controller:

Temperature conditions may be controlled with the optional Watlow F4 Controller. The WF4 is a powerful ¼ DIN profiling type controller with the following features.

- Single Channel
- Profiling: Forty Profiles, 256 Steps
- Automatic & Manual Control
- 1 Input: Universal Type (RTD is Std.)
- 4 Digital Inputs
- 2 Auxiliary Analog Inputs - Optional
- 2 Control Outputs: Time Proportioned, On/Off, or 4-20 ma
- 2 Alarm Outputs
- 8 Digital Event Outputs
- 2 Retransmit Outputs - Optional

Communications: EIA-232 and EIA-485 with Modbus RTU protocol



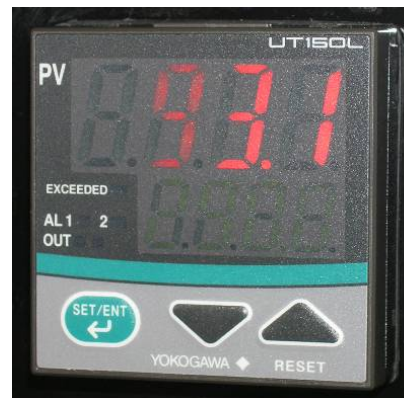
WATLOW - F4

12.0 OVERTEMPERATURE PROTECTION

12.1 Yokogawa UT150L

A Yokogawa 150L Limit Controller is normally used for overtemperature protection. This is a 1/16 DIN type controller, which is mounted on the main control panel. A Type J thermocouple is used for temperature sensing, which is placed in the workspace area. The high limit is normally set approximately 11° C (20° F) higher than the oven temperature setpoint.

Note: Alternate Limit Controllers may be used. Their overtemperature protection operation will be very similar.



YOKOGAWA UT150L

Setting the High Limit Setpoint:

1. Press the SET/ENT key for at least 3 seconds. **SP** will appear in the top display. Press the Up / Down arrow keys to change the **SP** value in the bottom display. Press the SET/ENT key to register this value.
2. Press the SET/ENT key for at least 3 seconds to return to the normal operating state.

High Limit Operation:

During normal operating conditions, Control Output contacts are closed to enable the heat contactor. When the process temperature value exceeds the High Limit setpoint SP, the controller's EXCEEDED and OUT LEDs will illuminate. Control Output will open to remove power to the heat contactor. The EXCEEDED LED will go out once conditions return to normal. The OUT LED will remain lit until the UT150L is reset.

Reset Operation:

When conditions return to normal and the EXCEEDED lamp extinguishes, press and hold the RESET key on the controller for at least 2 seconds or until the OUT LED extinguish.

Note: The UT150L is configured for automatic reset during a power up condition only. This includes the return of power after a power failure.

Controller Parameter Setup:

The pre-programmed controller configuration for your oven is documented in the Controller Parameter Setup Chart, which is part of your Test Report. This is located in the Supplemental Instructions Section.



Important! The configuration set-up is mainly provided for your reference. Not all of the parameters shown apply to your chamber. Changes to some of the set-up parameters may drastically affect your chamber performance and void your warranty. Contact the TPS Service Dept. before attempting any changes.

12.2 Blue M Temp Limit (Alternate)

The Blue M Temp Limit Controller provides an independent temperature control system to protect the oven from an overtemperature condition. A Type J thermocouple is used for temperature sensing, which is mounted in the workspace area.

The 1/4 DIN Temp Limit Controller is provided with an adjustable dial on the faceplate to set the High Limit setpoint. This setpoint is normally set approximately 11°C (20° F) above the rated operating temperature of the oven. A set-screw lock is provided to inhibit setpoint changes by locking the adjustable dial.

Operation:

During normal operation, normally open contacts of the controller will close to energize the OTP Contactor. OTP Contactor contacts close to enable the heater power circuitry. The green LED on the Temp Limit Controller will illuminate.

When the process temperature exceeds the High Limit setpoint, the Temp Limit's normally open contacts will reopen and deenergize the OTP Contactor causing power to be removed from the heaters. This is a latching type output. Normally closed contacts of the Temp Limit will reclose to energize and sound the alarm buzzer. The red LED on the Temp Limit will illuminate.

Reset Operation:

When conditions return to normal, press and hold the RESET key on the controller for at least 1 second. The red LED on the controller will extinguish.

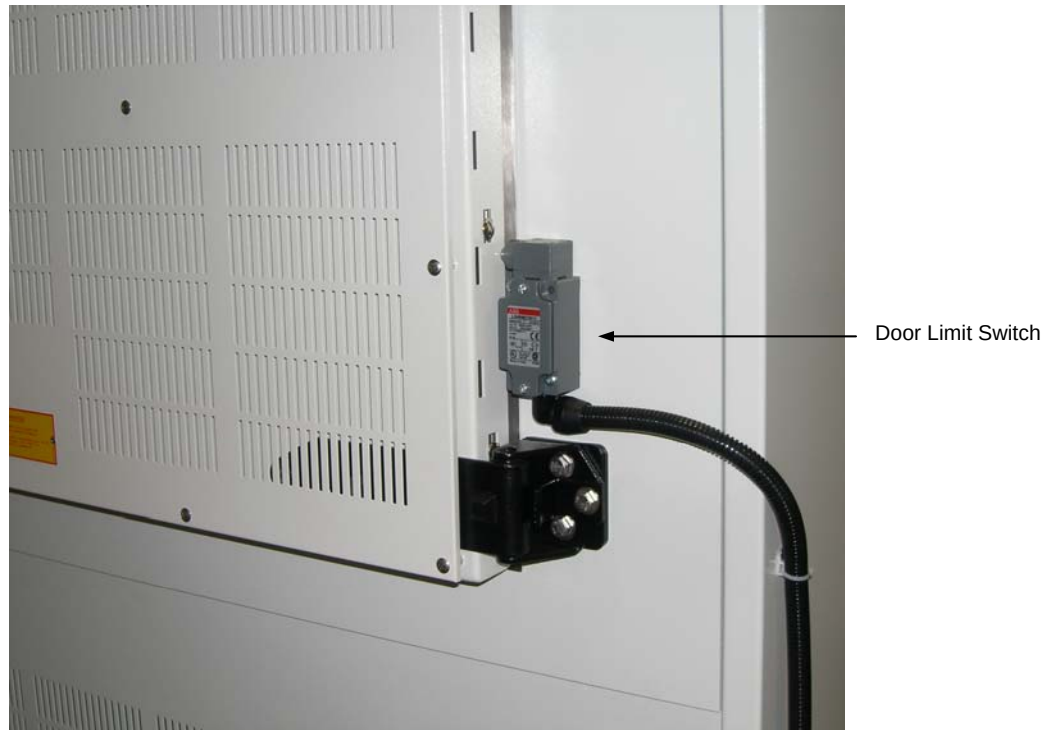


BLUE M TEMP. LIMIT

13.0 DOOR LIMIT SWITCH OPERATION (Optional)

Door Limit Switch (DS) may be installed on your oven. The door must be properly closed to activate the switch in order to begin a process cycle. If during the heating cycle the door is opened, DS will prevent hot air from being expelled from the oven by shutting down the heating system and the circulation blower.

When employed in a Model IGF oven, opening the door will also reset the Purge timer. Upon closing the door the purge timer will then reinitiate the process of eliminating oxygen from the chamber atmosphere.



DOOR LIMIT SWITCH

14.0 SEQUENCE OF OPERATION



WARNING! This equipment is not designed for use with volatile or explosive materials unless it is equipped with the solvent venting package and specifically stated in your oven specifications. Loading of such materials may result in explosion or fire.

Make sure the Installation Instructions have been properly followed before operating the oven. Some instructions vary slightly based on controller type (non-profiling or profiling)

1. Turn on the main power source to the oven and turn the Chamber Power switch to the ON position.

The Temperature Controller will energize and the Chamber Power light will illuminate.

Event Output No. 1 of the Temperature Controller will automatically close to energize the Temp Limit Controller and to enable the entire control circuitry.

2. Enter a temperature program (for Profiling type) or setpoint temperature into the Temperature Controller.
3. Make sure the Temp Limit Controller temperature setpoint is set approximately 11°C (20° F) above the rated operating temperature of the oven.
4. Load your product and close the oven door securely. If a door switch is employed, the circulation blower motor will start.

The following instructions pertain to profiling type controllers and options such as inert gas.

5. Press the Program button on profiling type Controller when employed.
6. If inert gas system is employed the following will take place.

The Eagle Signal B846-511 Purge Timer will energize and start the oven purge cycle. The Purge light will illuminate. Adjust the purge flow per process specifications with the purge flow adjustment on the control panel.



WARNING! DO NOT ALLOW CHAMBER PRESSURE TO EXCEED 1.0 PSIG.

After the 17 minute oven purge cycle has elapsed, the Purge Timer will shut off the high rate of inert gas flow into the oven. The Purge light will extinguish. A much lower inert gas flow rate will then be maintained to the oven. Adjust this with the run flow adjustment valve on the flow control panel.

The heating circuitry will be enabled, the Heat Enable light will illuminate, and the Temperature Controller's heat control output will start cycling power to the heaters.

7. When the heating / soak cycle is completed, Event No. 2 of the Profiling Controller will close to energize the Cooling solenoid valve when employed. Cool air will now circulate around the interior shell to cool oven chamber. The Cooling light will illuminate.
8. Open the oven door to unload your product. Circulation blower will stop if door switch is employed. You may start another cycle.



CONTROL PANEL – UNIVERSAL SLIDE TRAY

15.0 PREVENTATIVE MAINTENANCE & SERVICE

Warning! Only qualified maintenance and electrical personnel should be allowed to perform any maintenance or repair work.

Warning! Turn the main power disconnect switch on the front of the oven to the OFF position and proceed with your company's Lock-Out / Tag-Out procedure before servicing or cleaning. The oven's main power disconnect switch is a lockable type.

Frequency of preventative maintenance operations depends upon your particular process application and frequency of use. Because of this, a hard and fast schedule of maintenance operations is difficult to present. A set of guidelines suitable for an "average use" oven might not be sufficient for an oven with a high frequency use. Therefore, the preventative maintenance measures given here are offered as a guide, allowing you to arrange your own program.

A Preventative Maintenance Schedule / Log chart is provided at the end of this section. The suggested inspection / service dates given are for average use.

15.1 Maintenance Checks / Procedures

Door Gasket:

Inspect your door gasket(s) for wear (cracks, tears, etc.).

Inspection Period: 3 Months

Door Sealing Quality:

Check that the door seals evenly around its perimeter to negate heat loss. Adjust door latches if necessary.

Inspection Period: 3 Months

Chamber Interior Cleaning:



Remove All Power From Chamber!

Clean the interior of the chamber with a damp cloth and mild detergent. When completed, rinse the interior thoroughly with a damp cloth.

Inspection Period: 3 Months

Conditioner Blower Wheel:



Remove All Power From Chamber!

Inspect and clean the conditioner blower wheel in the conditioning plenum. Make sure it spins freely and is tight on its shaft.

Inspection Period: 6 Months

Motors / Motor Shaft Seals:

Remove All Power From Chamber!

Note: The motors are permanently sealed ball bearing types and require no lubrication.

Check motor shaft seals for deterioration.

Inspection Period: 6 Months

Pressure Relief Valves:

Remove All Power From Chamber!

Check Pressure Relief Valves on top of the chamber for cleanliness. Dirt buildup resulting from process vapors may cause the valves to open at a higher pressure. Make sure that the valves open at 0.5 PSIG or lower with a gas flow between 20 and 100 SCFH. The chamber pressure must never exceed 1.0 PSIG.

Inspection Period: 6 Months

General Electrical Connections:

Remove All Power From Chamber!

Inspect inside the control panel and the machinery compartment for loose electrical connections, frayed wires, loose components, or other potential problems.

Inspection Period: 6 Months

Electric Heaters:

Remove All Power From Chamber!

Inspect the electric heaters inside the chamber conditioning plenum and look for sagging elements, broken insulators, or other defects.

Inspection Period: 6 Months

Main Controller Calibration:

The main temperature controller should be checked for temperature indicating accuracy, and for the proper activation of limit or alarm outputs (when provided). Please reference the controller user manual for more information.

Inspection Period: 1 Year

Limit Controller Alarm Circuitry:

The Temperature Limit Controller should be checked for indicating accuracy and for proper activation of limit or alarm outputs. A quick test is as follows:

1. Set the OTP control at a temperature lower than the Operating temperature.
2. Run the unit in the normal operation mode. If the OTP circuit is performing properly, the unit should shut down when the chamber temperature exceeds the OTP setpoint temperature. If the unit fails to shutdown reduce the oven temperature to ambient and diagnose the OTP circuit.
3. Press the OTP reset switch to and restore the unit to operation. The OTP controller should be set to 11°C higher than the units normal operating temperature.

Please reference the controller user manual for more information.

Inspection Period: 6 Months

Electrical Supply Voltage:

Measure the power supply voltage to your oven and verify that it is within the $\pm 10\%$ tolerance established for the nameplate rating of your oven.

Inspection Period: 6 Months

Cleaning:

Important! NEVER use a cleaning solution that contains chloride or fluoride ions. These ions are aggressive and highly corrosive, and will attack stainless steel.

- Thoroughly wash all surfaces with an appropriate cleaning solution.
- Thoroughly rinse all surfaces.

15.2 Preventative Maintenance Schedule / Log

Important: For each of the items to be inspected, refer to item description sections for details on maintenance and service.

PREVENTATIVE MAINTENANCE SCHEDULE / LOG					
ITEM TO BE INSPECTED	Inspection Period	Actual Date Inspected / Serviced	Actual Date Inspected / Serviced	Actual Date Inspected / Serviced	Actual Date Inspected / Serviced
Door Gasket	3 Months				
Door Sealing Quality	3 Months				
Chamber Interior Cleaning	3 Months				
Blower Wheels	6 Months				
Motor Shaft Seals	6 Months				
Pressure Relief Valves	6 Months				
General Electrical Connections	6 Months				
Heater Electrical Connections	6 Months				
Air Filter (when employed)	1 Year				
Main Temperature Controller Calibration	1 Year				
Limit Controller Alarm Operation	6 Months				
Electrical Supply Voltage	6 Months				

SUPPLEMENTAL INSTRUCTIONS