

Centorr/Vacuum Industries Standard Vacuum Furnace Alarms Package

Centorr Vacuum Industries Vacuum/Controlled Atmosphere Standard Alarm Package

Customers purchasing high temperature vacuum furnaces have two main interests. The first is to make sure the furnace meets or exceeds the specifications for which it was developed, and the second is to ensure that the unit is safe to own and easy to operate. One of the reasons for Centorr/Vacuum Industries' long standing in an industry with many competitors is our ability to make safe furnaces that take virtually all possibilities under review.

We understand that the purchase of a vacuum furnace can be a time-consuming and difficult task. The selection process requires careful scrutiny of the vendor's offerings and is focused on key factors such as: price, delivery, quality, and the manufacturer's experience. Frequently, however, many important details are overlooked or assumed to be included in the offering. The most significant among these is the issue of safety.

You will find that the safety considerations of vacuum furnace systems engineered and manufactured by Centorr Vacuum Industries reflect a strong regard for "Murphy's Law".

Depending on the type of unit being designed, Centorr Vacuum Industries includes a specific set of alarms and interlocks. A summary of these is shown in the tables below:

All Centorr Vacuum Industries systems include a dedicated alarm panel as part of every control cabinet. The alarm panel provides visual as well as audible alarm signals with push-button to silence alarm. For computer systems, there is a push-button to silence alarms and a push-button to reset alarms, with display of all alarms on computer screen:

Typical Furnace Alarms *

Furnace Type	Alarms	Comments
Standard Vacuum Furnace Alarms	<ul style="list-style-type: none"> Chamber overtemperature condition - Separate and discreet overtemperature chamber control device (i.e. - Honeywell UDC-2300 controller with alarm setpoint) - shuts down heater power, (indicator light and alarm). Mandated by NFPA regulations. 	Standard
	<ul style="list-style-type: none"> Low water flow to critical circuits (i.e. - power supply, chamber, busswork, fan, water cooled heat exchanger) - shuts down heater power, (indicator light and alarm sound). 	Standard
Optional Alarms	<ul style="list-style-type: none"> Low compressed air source - pressure switch on incoming air feed circuit senses low gas pressure and closes valve, shuts down heater power, (indicator light and alarm sound). 	Optional
	<ul style="list-style-type: none"> Process temperature deviation alarm (+/- single setpoint) with event-driven operation on DCP-550 (indicator light and alarm sound). Customer must program when alarm is valid. Typically does not shut down heat power. 	Optional
	<ul style="list-style-type: none"> Loss of vacuum - single setpoint, automatic inert gas backfill, shuts down heater 	Optional



Photograph of C/VI gas panel with pressure

	<p>power, (indicator light and alarm sound). Customer must program when alarm is valid.Requires available events.</p> <ul style="list-style-type: none"> • Lamp Test function to light all alarm lights for diagnostic purposes (push-to-test). 	Optional
Furnace Type	Alarms	Comments
Controlled Atmosphere Positive Pressure Systems	<ul style="list-style-type: none"> • Low pressure inert gas - pressure switch on incoming gas circuit senses low gas pressure and closes valve, shuts down heater power, (indicator light and alarm sound). 	Optional
	<ul style="list-style-type: none"> • Chamber Overpressure Alarm - pressure switch on UVM/Chamber senses high gas pressure inside chamber and closes process gas valve (s), (indicator light and alarm sound). Also available as an "interlock" without alarm/light. 	Optional
	<ul style="list-style-type: none"> • Low water to water-cooled exhaust tower. Shuts down heater power, (indicator light and alarm sound). 	Standard
Hydrogen Gas Systems	<ul style="list-style-type: none"> • Low Process (H₂) Gas pressure - In the event of low process gas pressure, you will get an audible alarm, and the low pressure process gas indicator will light. The process gas line closes, the purge gas immediately is enabled as soon as chamber pressure drops below 1 psig. System does not go into hold and heater power stays on. • Low Purge Gas pressure - In the event of low purge gas pressure (during operation), you will get an audible alarm, and the low pressure purge gas indicator will light. The process gas line closes. System does not go into hold and heater power stays on. • High Chamber Pressure - In the event of high pressure in the chamber (above 3 psig), the process (H₂) gas line closes until the chamber pressure drops below the high setpoint, and opens again when chamber pressure is between 1-3 psig. System does not go into hold and heater power stays on. • Low Chamber Pressure - In the event of low pressure in the chamber (below 1 psig), an audible alarm sounds and the process (H₂) gas line is closed. The system immediately goes into a timed purge of inert gas (you can never have process gas flow when chamber is below lower set point). Customer can correct pressure issue and manually restart process gas flow. System does not go into hold and heater power stays on. • Loss of Pilot Flame - In the event of loss of pilot flame you will get an audible alarm and indicator light. The process (H₂) gas line closes. The system immediately goes into a timed purge of inert gas (you can never have process gas flow when pilot flame is out). Customer can restart pilot flame and manually restart process gas flow. System does not go into hold and heater power stays on. • Loss of Electrical Power - In the event of loss of power all process valves in the system will immediately go to closed position (normally closed solenoids/power to open). Exception is purge gas "Normally Open" solenoid (power to close) which initiates immediate purge of chamber with inert gas, evacuating all Hydrogen from the chamber. The NC (power to open, spring to close) burnoff tower valve will also close automatically and the bypass relief around the ball valve will open if required to vent the chamber in the case of an overpressure situation. • During Hydrogen operation, vacuum pump must continue to be run per NFPA 86D, 7-2.6. The vacuum pumping system shall be interlocked with the supply gas system so that mechanical pumps shall continue to operate while flammable gas is in the vacuum chamber, whether or not the flammable gas is to flow through the pumps. • Vacuum Interlock - Ensures chamber is under 100 microns vacuum before backfilling with inert gas prior to starting Hydrogen process cycle. Incorporates Hastings CVT-16 gauge buried in the control cabinet (to prevent operator tampering with setpoint) for vacuum interlock. • Tighten Door Clamps - furnace operator needs to manually tighten all door/binder trap clamps. After the vacuum pulls on the chamber, the door clamps can loosen, 	All Standard per C/VI Factory Mutual Approval and NFPA Regulations

	<p>and you need to manually tighten them to ensure no air leakage in through the door.</p> <ul style="list-style-type: none"> • Cooling Water - ensures cooling water has sufficient flow through water-cooled exhaust tower. 	
Hot Press	<ul style="list-style-type: none"> • Low or no hydraulic pressure, indicator light and alarm sound. Process into hold. • Low or no pneumatic pressure, indicator light and alarm sound. Process into hold. • Low water to top/bottom rams - shuts down heater power, (indicator light and alarm sound). • Ram travel in excess of 2" in 10 seconds - shuts down heater power, (indicator light and alarm sound). 	<p>Optional</p> <p>Optional</p> <p>Standard</p> <p>Optional</p>
Water Systems	<ul style="list-style-type: none"> • Cooling water supply pressure - shuts down heater power, (indicator light and alarm sound). • High water temperature alarms - shuts down heater power, (indicator light and alarm sound). 	<p>Optional</p> <p>Optional</p>

* Note - The above data is for reference only and can be customized for any particular unit.

Typical Furnace Interlocks/Safeties *

Furnace Type	Interlocks	Comments
Standard Interlocks	<ul style="list-style-type: none"> • UE three (3) position setpoint on Universal Vacuum Manifold: with <ul style="list-style-type: none"> - Vacuum interlock @ 27 in Hg gauge (75 torr), for heater power - Fan interlock @ 5 in Hg (530 torr), for operation - Backfill interlock @ 3 in Hg (680 torr), for operation 	Standard
	<ul style="list-style-type: none"> • Fan Shutter Limit Switches: Open/Closed on front and rear cylinders, and CW/CCW on rear swinging shutter. 	Standard
	<ul style="list-style-type: none"> • Vacuum Valves: all valves interlocked for safe operation. 	Standard
Safeties	<ul style="list-style-type: none"> • Door closure interlock: prevents heater power to furnace unless door is shut. 	Standard
	<ul style="list-style-type: none"> • 5 psig Spring-loaded pressure relief valve on UVM 	Standard
	<ul style="list-style-type: none"> • Chamber Overpressure Interlock - pressure switch on UVM/Chamber senses high gas pressure inside chamber and closes process gas valve (s). Also available as an "alarm". 	Optional
Miscellaneous	<ul style="list-style-type: none"> • [Systems with pneumatic clamps] Chamber temperature interlock to prevent door clamps from opening unless chamber is below 100°C. 	Optional
	<ul style="list-style-type: none"> • [Systems with incinerator] Open/Closed limit switches on Griff valve (s) interlocked with incinerator operation. 	Standard

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Centorr/Vacuum Industries systems also include provisions for the following occurrences:

EMERGENCY Stop (E-Stop) Button

Control panel will include large red "mushroom" style "Emergency Stop" Button that will turn off heater power, and bring the unit to safe operating condition (i.e. - close all valves to vacuum pumping system, exhaust valves, and inert gas lines, and maintain system in current state - either vacuum or positive pressure of inert gas, or purge flammable gases if present).

Power Failure Condition

System is designed to reach safe operating condition in the event of a power loss which can disable safety alarms (i.e. - all chamber isolation valves, exhaust valves and inert gas lines go to closed position isolating the chamber). Critical valves are either normally "closed" or normally "open" with spring-loaded returns, depending on system design.



Photograph of C/VI furnace chamber showing gas regulators on backfill line with 3 position U/E pressure switches, and chamber overpressure pressure switches.