

Vacuum Furnace Preventive Maintenance

Daily Checklist

Furnace Interior

- Inspect the inside of the furnace for signs of dirt and oil, which can prevent the production of high-quality work.
- Check the condition of the hot zone heating elements and shielding and make sure there are no broken or missing retaining wires.
- Inspect the heat shields to ensure that distortion has not shorted out an element. Shield distortion is normal due to the alternate heating and cooling of the furnace over time.

Seals

- Check the O-ring or lip seal on the furnace door for grit and dirt that might cause vacuum leaks.
- Clean the chamber-door or bottom-head flange and lightly grease the O-ring with a thin coating of high-quality vacuum grease. If you have a rotating door with a lip seal, use graphite powder instead. DO NOT use grease on a lip seal.

Pumps

- Check the oil levels and condition of all pumps (e.g., roughing, booster, holding, diffusion). The roughing pump oil should be circulating. Cloudy or discolored oil may indicate the presence of moisture or other contamination.
- Check that the roughing pump is operating at 140 °F (60 °C). Adjust pump water miser as necessary [160 °F (71 °C) for gas ballasting operation].
- Check the temperature and cooling-water profile of the diffusion pump. Verify that the water lines are cool to the touch; it is recommended that they are at or under 85 °F (29 °C) at the inlet water supply fitting.
- Verify the crossover setting of the diffusion pump (normal range is 60–80 microns).
- Verify the vacuum level when the booster is activated. Adjust if necessary (28 to 29 inches of mercury). The adjustable vacuum component can be a vacuum switch, vacuum controller or a backset switch. This is not required if using a variable frequency drive.

Valves & Gauges

- During the first vacuum pumpdown of the furnace, make sure all valves actuate in proper sequence.
- Check all vacuum gauges to ensure they are properly responding to pumpdown pressures and set points.
- Check the settings on the backfill valve switch. Adjust if necessary. These adjustable components are typically vacuum switches.

Water Lines

- Check the water flow from each drain line. A reduction in water flow indicates restrictions that must be located and corrected.
 - Closed Loop System: Check the water lines for leaks and any hoses that appear hotter to the touch than usual; this would indicate a lack of normal flow.
 - Open System: Visually inspect all water lines for flow and temperature.

Motors, Recorders & Programmers

- Inspect motors (and belts if applicable) for signs of vibration or excessive noise.
- Check to be sure that all recorders are accurately responding.
- Check the programmer to ensure it is operating properly.

Weekly Checklist**Furnace Interior & Exterior**

- Clean the chamber of all foreign matter. Depending on the rate of dirt accumulation, you may need to clean the furnace more often.
 - Brush or blow dirt out with clean, dry air or inert gas.
 - Wipe the inner chamber using a lint-free cloth dampened with a suitable solvent. On furnaces with an epoxy coating, we suggest denatured isopropyl or butyl alcohol – many other common solvents will damage this coating.
- Remove dirt and dust from the front of the control cabinet and clean all glass.
- EVERY TWO WEEKS (or whenever the shields and heating elements begin to show signs of discoloration) run a furnace cleanup cycle.

Water & Pneumatic Lines

- Examine individual water drain lines. Ensure there is no blockage or sediment buildup in circuits, concentrating on smaller hoses (e.g., VRT, power feedthrough, diffusion pump and convection motor water lines).
- Inspect the pneumatic lines for leaks.
- Verify that the regulator/lubricator/filter near the pneumatic bank is working properly, if applicable.

Voltage & Amperage

- Obtain the voltage and amperage readings of the diffusion pump's heaters.
- Take voltage and amperage readings of the gas blower motor at operating pressure to make sure amperage draw is not above motor rating.
- Take voltage output readings of the PCU (Power Control Unit) as fed from the programmer at different output percentages. Adjust if necessary. Refer to the PCU manufacturer's manual for further information.

Valves & Pressure Switches

- Test all pressure switches for proper operation. Adjust if necessary. These switches are normally located in or near the main junction box on the chamber.
- Lubricate any valves that have a grease or oil cup by filling the cup with grease/oil from the pump and turning it over until grease/oil comes out on the other side of the block. Always default to the proper lubricants listed in your pump operation manuals
 - Utilize diffusion pump oil to lubricate the diffusion pump shaft seal. Older diffusion pumps may require grease for lubrication.

Monthly Checklist**Furnace Interior & Exterior**

- Check all safety interlocks to ensure they are functioning properly.
- Inspect hot zone ceramic insulators for any deposits that could cause an unwanted drain of power to ground that would affect the heating cycle. Check resistance to ground.
- Check for deterioration of heating elements and thermocouples.

Transformers (VRT)

- Check the transformer (VRT) and power terminal connections for tightness.
WARNING: Turn off the power to the transformers before checking.
- Check electrical connection to power feedthrough bars for tightness.
WARNING: Turn off the power to the transformers before checking.

Pumps & Valves

- Inspect all lines, fittings and connections of backfill gases from point of origin to backfill valve assemblies at the furnace for leaks.
- Inspect the belt tensions on all pumps.
- Open and flush the water strainer in furnace water lines.
- Disassemble the manifold pressure-relief valves to inspect the springs and clean the valve bodies. Replace rusted or "dead" springs.

Control Cabinet

- Remove any dust and/or dirt from the control cabinet(s).
- Inspect the secondary power cables for wear and heat deterioration.

Semiannual Checklist**EVERY THREE MONTHS****Variable Reactance Transformers (VRT)**

- Inspect all VRT resistors.
- Inspect secondary power cables to the VRT for wear.
- Ensure that all cables to and from the VRT have tight connections.

Voltage & Amperage

- Inspect the setting of the blower blast gate to avoid exceeding motor amperage ratings (applicable for Ipsen MetalMaster/HR models).

Wiring & Fuses

- Inspect the wiring on all cabinets and junction boxes.
- Inspect all fuses for continuity.

Bottom-Head Alignment

- Inspect bottom-head or door alignment to tank flange.
- Ensure that the bottom-head motor and the gearbox shafts are aligned.

Thermocouples

- Test control and overtemperature thermocouples for proper response and direction.

EVERY SIX MONTHS**Thermocouples**

- Replace load thermocouples regardless of appearance. If the vacuum-indicating instrument shows a possible malfunction in the sensing head, apply corrective actions and replace the vacuum-sensing head.
 - NOTE: Keep spare sensing heads on hand at all times.

Controls System

- If you have a paper chart recorder, clean and lubricate the chart drive mechanics and slide-wire mechanism.
 - NOTE: This step is only applicable if you have an older furnace as newer ones are mostly digital.
- Check the temperature, calibration and stability on your test instruments.