

**OPP-TB-238216.100**

**Coils (Steam)**

**Freezestat Trips**

**Background**

This document is intended to assist with troubleshooting freezestat trips in steam coil systems.

**Diagnosis**

1. Ensure freezestats are installed properly (horizontal serpentine, not vertical). See Technical Bulletin [OPP-TB-238216.050](http://www.opp.psu.edu/services/stormwater/images/technical-bulletin)
2. Check for significant sources of leaking outside air.
   1. Ensure Outside Air (OA) dampers are in good working order: damper closes tightly when commanded shut[[1]](#endnote-1); no blades missing or damaged; blade seals and edge seals are in place and sealing properly; all damper blades and linkages are connected, adjusted, lubricated and rotate smoothly through full range of motion. Refer to manufacturer’s control damper Operation and Maintenance instructions.[[2]](#endnote-2)
   2. On units located outside, check that gaskets on access doors are installed and in good, flexible condition to seal properly.
   3. Coordinate with BAS analyst to set up and study trends of mixing plenum temperature (Mixed Air Temperature sensor) during unoccupied periods (when OA damper should typically be closed). Look for MAT that eventually falls to near freezing overnight, or that drops quickly even when OA damper is commanded closed, which would be an indication of significant leakage. If trend still shows low temperatures after the items above have been serviced and are functioning properly, then discuss with Area Supervisor and BOE and initiate a follow up work order to find and correct other more unusual sources of leakage.
3. Examine mixing sections for air blenders or some other method[[3]](#endnote-3) to thoroughly mix OA and Return Air (RA) streams. If not mixed well, a layer or stream of cold air can trip a particular section of the freezestat while the averaging mixed air sensor is ok.[[4]](#endnote-4) If no obvious method of adequate mixing is found, review existing conditions with Area Supervisor and BOE to evaluate options.[[5]](#endnote-5)
4. Check if unit has either internal or integral type face and bypass type preheat coil section. If so, take pictures and measure distance between leaving side of preheat section and entering side of cooling coil and/or distance to freezestat. Review existing conditions with Area Supervisor and BOE to evaluate options.[[6]](#endnote-6)
5. Ensure coil is piped properly for condensate drainage and air venting (adequate fill leg height, vacuum breaker and thermostatic air vent are installed). Refer to Technical Bulletin OPP-TB-238216.101
6. Check for blocked strainers (steam and condensate). **Remove screen** to inspect and clean properly. Using only external **blowdown valve to attempt to clean the screen is not acceptable**.
7. Ensure steam trap is operating properly and has the appropriate Maximum Operating Pressure (PMO) for the steam pressure used at the coil. Refer to Technical Bulletin [OPP-TB-238216.102](http://www.opp.psu.edu/services/stormwater/images/tb-238216.102)
8. Check for adequate supply of steam and effective, even heat transfer over the face of the coil.
9. Check cleanliness of heating coil fins. Clean as necessary.
10. Thermal imaging (InfraRed) cameras are recommended as a fast and easy method to graphically measure and record uneven hot/cold spots on active coils.
11. Verify proper operation, range of motion of control valves (ensure valve is not sticking).
12. Measure inlet pressure before steam control valve and at coil inlet (look for large pressure drop indicating possible blockage inside control valve).
13. Obtain entering and leaving air temperatures concurrent with airflow. Use BAS sensors and airflows and trend functions whenever available.
14. Review information gathered and specific unresolved conditions with Area Supervisor and BOE to develop corrective action plan.
15. Check and coordinate control PID reaction times between OA damper ramp time, fan speed ramp time and heating control valve reaction time. Coordinate with control analyst to determine setpoints and test and adjust as required to eliminate any out of sync operation or continuous hunting.[[7]](#endnote-7)
16. Check for and replace any malfunctioning freezestats. Refer to manufacturer’s literature and/or industry guidelines for recommended test procedures.
    1. Use experience, good judgment and simplest tests first. A full blown functional performance test can be more time-consuming and costly than to replace sensor strongly suspected to be bad.
    2. <http://www.peci.org/ftguide/ftct/testdir.htm>,

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| Testing Guidance Documents, TG06 | [Freezestat](http://www.peci.org/ftguide/ftg/Test_guidance/Tests/TG06-Freezestat.doc) |

**Corrective Action**

1. Attempt to troubleshoot and resolve as described in the diagnosis section of this document.
2. If nuisance trips persist, notify the Area Supervisor and Building Operations Engineer. Do not allow the condition to continue unresolved. The potential costly damages and disruption to facilities due to frozen and burst coils or critical unit downtime can be immense. Therefore, finding and fixing the underlying causes of these freezestat trips needs to be a high priority. If too busy during crisis periods, at a minimum create a follow up work order/project to resolve. Do not backlog these work orders.
3. Do not rely on opening access doors on unit to pull in tempered air from mechanical room to keep unit running as a seasonal resolution to the problem. See note 2 above.

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1. Endnotes:

   Visually check to see if the outside air, return air, and relief air damper blades open/close fully when overridden within the BAS.  This will help to determine if any actuators are set up backwards, if a damper shaft is loose at the actuator connection, if an actuator has failed, or if a damper is seized. [↑](#endnote-ref-1)
2. Typical COMMERCIAL CONTROL AND BACKDRAFT DAMPER OPERATION & MAINTENANCE instructions: <http://www.ruskin.com/doc/2730> [↑](#endnote-ref-2)
3. [Air Blenders and Baffle Plates](http://www.peci.org/ftguide/ftg/SystemModules/AirHandlers/AHU_ReferenceGuide/FTG_Chapters/Chapter_3_Economizer_Components_Supplemental_Information.htm#3_6_6_Air_Blenders_and) [↑](#endnote-ref-3)
4. This is a very common problem. See Design and Construction Standards, [23 73 00 AIR-HANDLING UNITS](http://www.opp.psu.edu/planning-construction/design_and_construction_standards/division-23-heating-ventilating-hvac#section-118), Air Mixing/Blender Section: [↑](#endnote-ref-4)
5. Long term solution might involve a project request to add field adjustable mixing baffles to deflect airstreams into each other. Refer to example sketch of ACF-1 mixing deflector modifications at Katz building at end of notes below.

    [↑](#endnote-ref-5)
6. Due to their arrangement and often being conservatively sized, face and bypass preheat coil sections can cause large leaving temperature variations between the heating and unheated bypass air paths. Thus they require extra length downstream or additional mixing baffles on the leaving side for adequate remixing. Confirm application specific requirements with actual manufacturer’s installation instructions. Long term solution might involve a project request to add mixing baffles if space allows or even changing out coil type of problem persists.

   Example: “2. Cooling coils should be located downstream at a distance no less than 36 inches from the outlet flange of the VIFB coil. Freezestat location should also follow this same guideline. Coils operating in VAV systems, or those operating at lower or higher than recommended air velocities, should be fitted with anti-stratification baffles.”

   --Excerpt from LJ Wing Vertical Integral Face-Bypass IOM literature; <http://mesteksa.com/fileuploads/Literature/LJ%20Wing/Coils/IOMVIFB-6.pdf>, p.3. [↑](#endnote-ref-6)
7. Create a trend study in the BAS that contains the following points: discharge air temperature setpoint, discharge air temperature, mixed air temperature, outside air temperature, fan start/stop, steam valve position, freezestat alarm,  outside air damper position, return air damper position, relief air damper position.  Set each of the trended points to update on a “change of value” of 1, and turn on historian.  Among many other things, this trend study can be used to determine if the PID loop controlling the steam valve is stable.  It can also be used to determine if the freezestat trips at a certain time of day or on fan start-up.

   If the fan trips on start-up, then adjusting the bias upward in the PID loop controlling the steam valve may help.  This establishes the position that the valve opens to the instant that the PID is enabled.  Also, adding a 1 minute delay will give the valve time to open and heat the coil before the fan starts and the outside air damper opens.

   Check for transition periods between unoccupied and occupied. For instance, heating control valve might be trying to maintain plenum temperature while off/unoccupied and when unit switches to occupied, the discharge air temperature might overshoot and command the heating valve to go closed as the OA damper is coming open and causing a freezestat trip. [↑](#endnote-ref-7)