Defrost Optimization: Troubleshooting Matrix

Defrost Phase	Normal Operation	Possible Issues	How to Identify	Impact on Energy Consumption	Notes
Pump Down	Fans on, liquid refrigerant supply off - Refrigerant boils off, providing some cooling during this mode.	Inadequate pump down	Air temperature drop is still significant at the end of pump down	Inadequate pump down leads to long hot gas times, incomplete defrost, drives inefficient settings such as elevated hot gas pressure perceived requirement	In the case of bottom-suction coils, some of the liquid can free-drain, potentially allowing for shorter pump down durations. Air temperature drop should be around 0-1°F at the end of pump down
		Liquid valve not fully closing	Air temperature drop still significant and won't drop even with longer pump down. Manually close liquid isolation valve an see if temperature drop goes away.	Inadequate pump down leads to long hot gas times, incomplete defrost, drives inefficient settings such as elevated hot gas pressure perceived requirement	
		Pump down too long	Air temperature drop decays to low level and pump down continues longer than needed	Increased fan power	
Hot Gas	Suction stop hot gas pilot solenoid opens, causing the hot gas operated suction stop valve to close. The main hot gas valve then opens to begin pressurizing the coil. Once the back pressure regulator setting is achieved, the regulator will begin to open and modulate automatically to maintain pressure at the desired setting	Excessive Fog	Clouds fog rolling out of coil during defrost, causing excessive frosting in areas of adjacent coils and/or frost accumulation on surrounding areas	Increased need for defrost, frost migrates from one area to another instead of going down the drain.	Hot gas back pressure regulator (BPR) settings should be done relative to the available hot gas supply pressure. These are typically in the range of 70-105 psig. There needs to be enough differential between the hot gas supply and the regulator setting pressures such that liquid can be adequately moved out of the coil as it is condensed during the defrost process. If not, the liquid will back up in the coil and reduce defrost performance. If the differential between the BPR setting and the supply pressure is too large, excessive hot gas will blow through to suction and false load the compressors.
		Incomplete Defrost	Ice build-up on the coil	Decreased coil performance during refrigeration, increases fan duty. Also may drive inefficient settings such as high condensing pressure in an attempt to clear the coil of ice build-up.	
		Defrost duration too long	Coil is free of frost and drain pan is clear long before hot gas terminates.	Increases load on the refrigeration system by adding heat to the room and false loading the compressors by returning hot gas to suction.	
		Drain backing up	Water drains excessively slow from the pan.	Causes hot gas time to be longer than would be needed if the drain evacuated the water more rapidly.	
		LTRL Check valve not operating properly	Coil has trouble building pressure, but is resolved when liquid line isolation valve is closed.	Causes difficulties building defrost pressure, may drive inefficient condensing pressure increase to overcome losses and build adequate defrost pressure. May also disrupt flow of refrigerant to other coils.	

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Defrost Phase	Normal Operation	Possible Issues	How to Identify	Impact on Energy Consumption	Notes
Hot Gas (Cont.)		Gas operated suction stop not fully closing	Difficulties obtaining adequate defrost pressure.	May drive inefficient condensing pressure settings to overcome losses. False loading of suction with hot gas leaking through	Note that the suction pressure also has an impact on the flow characteristics through the BPR. So a given regulator setting may function well under one condition, but if suction or hot gas supply pressure is changed, this may no longer be true. An alternative approach is to regulate the hot gas supply pressure and use some form of liquid trap in the place of the BPR. This eliminates the variation in supply pressure as condensing pressure changes as well as the possibility of excessive blow through of hot gas or the backing up of condensed hot gas in the coil.
		Suction stop hot gas pilot malfunction or restriction	Difficulties obtaining adequate defrost pressure due to suction stop not fully closing	May drive inefficient condensing pressure settings to overcome losses. False loading of suction with hot gas leaking through	
		Back pressure regulator improperly adjusted	coil pressure too low or too high.	Too low a setting results in excessive blow-through of hot gas to suction, false loading the compressors. Too high a setting results in liquid backing up in the coil, possible icing problems, lost coil performance, more fog in the room	
		Hot gas solenoid valve not fully opening or restriction in the hot gas supply	Operating the manual opening stem causes pressure to build more rapidly.	May drive inefficient condensing pressure settings to overcome losses.	
Bleed Down	The main hot gas valve closes. Hot gas pressure slowly bleeds through the internal bleed down in the CK5D suction stop valve. When pressure drops below 8-12 psig, the CK5D fully opens, allowing the pressure to equalize with suction.	Pressure bleeds down too slowly	Manually close the hot gas supply isolation valve to confirm that the hot gas valve is closing. Use suction stop valve manufacturers recommendations to troubleshoot.	If hot gas is not closing, or suction valve is not fully opening, decrease refrigeration performance will result, possibly driving inefficient settings and false loading of the system.	
Re-freeze	Liquid refrigerant supply solenoid valve opens and the coil begins cooling again with the fans off to prevent residual water from being blown out of the coil.	To long or too short re-freeze time	residual water on the coil remains unfrozen or freezes long before the coil goes back into refrigeration	If variable speed fans are present and group control is used, may drive higher fan speed on coils that are running, not a significant effect on energy, but some lost cooling capacity may occur.	