DEFROST AND FROST PREVENTION STRATEGIES

In cold weather conditions, condensation on the heat exchanger may rapidly turn into frost. The chart below outlines the outdoor air temperature and the corresponding return air relative humidity at which condensation accumulates on the heat exchanger.

The following pages outline three strategies for defrosting, and two strategies for frost prevention. The first two defrost strategies require integrated bypass and a drain pan, while the third does not.

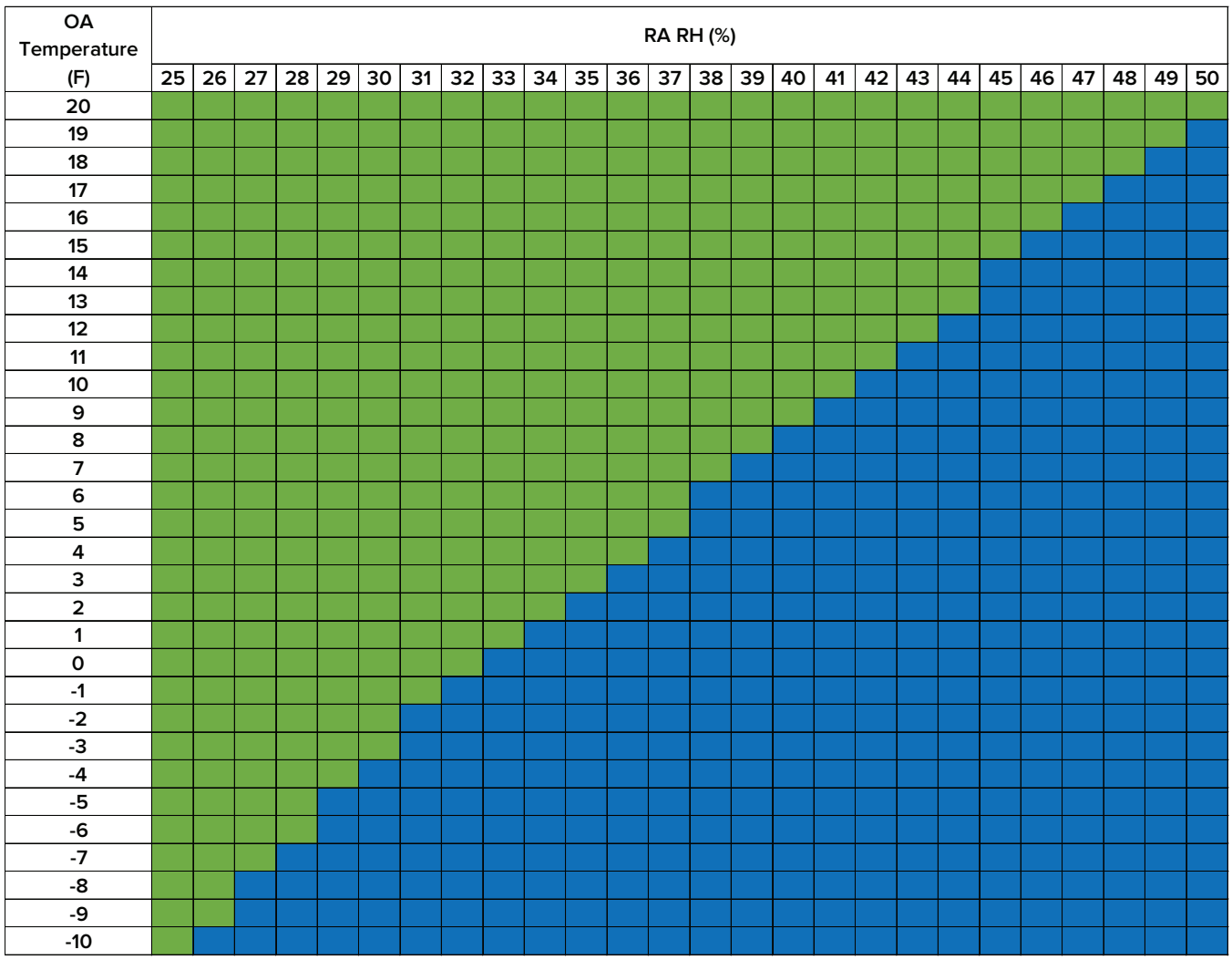
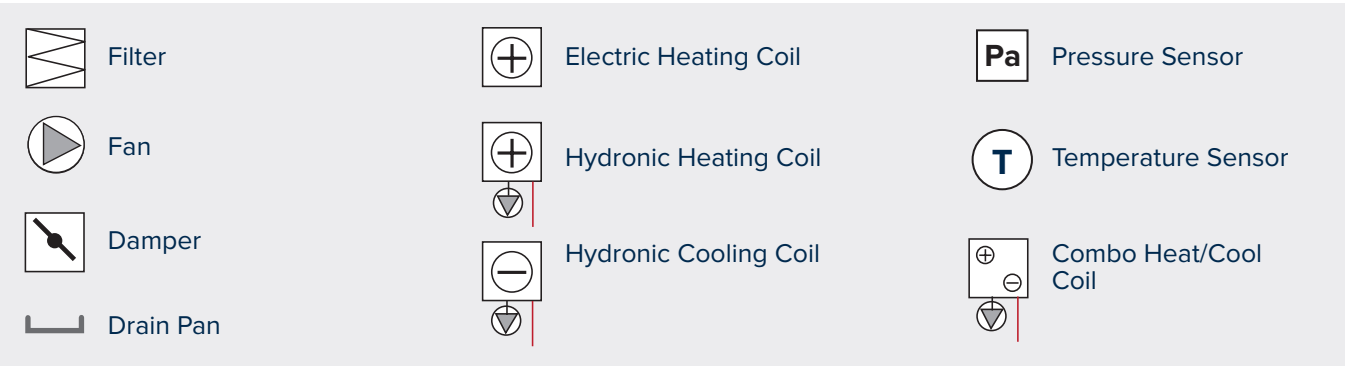


*Chart data is based off of Core Energy Recovery Solution's selection software.

Assumptions
SA/RA 2700 CFM
RAT = 70°F
OA RH = 90%

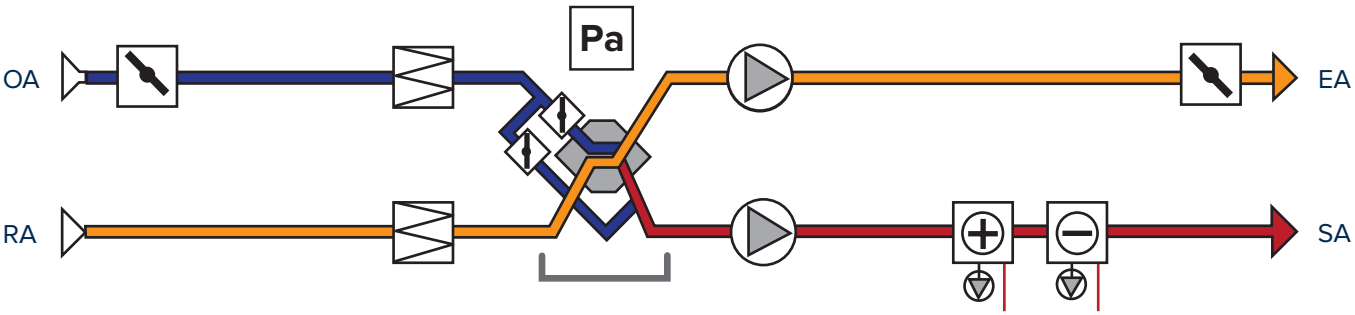
No Condensation

Condensation



DEFROST STRATEGIES
with Internal Bypass

1. Monitoring Pressure Drop Across the Heat Exchanger



The heat exchanger can be protected against frosting by continuously monitoring the pressure drop across the heat exchanger. The actual pressure drop across the heat exchanger will be measured during commissioning, when there is no frost accumulated.

The defrost will start when the pressure drop rises above the setpoint. This setpoint can be selected as either “Static” or “Dynamic”. During defrost (applies to both “Static” and “Dynamic”) the bypass damper will open 100% for a specified period of time, which can be assigned manually. The post-heating coil should be sized accordingly to maintain the supply air temperature setpoint during defrost.

Defrost Alarm Type

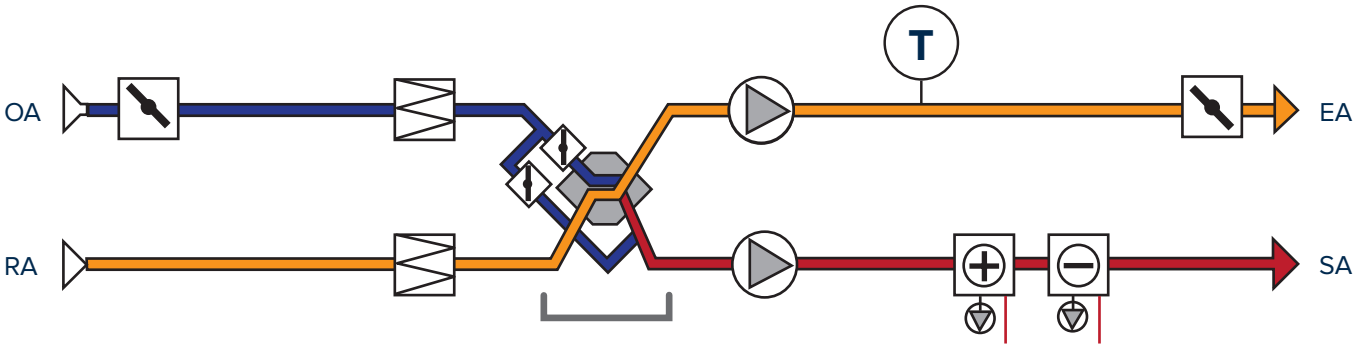
Static: The defrost will start if/when the actual pressure drop across the heat exchanger exceeds the setpoint.

Dynamic: The defrost will start if/when the actual pressure drop across the heat exchanger exceeds the calculated setpoint. The calculated setpoint (Current defrosting) is calculated from the percentage rise of the pressure drop on the heat exchanger. The percentage rise allows for some heat recovery during partial defrost of the heat exchanger. Defrosting will start if the pressure drop across the heat exchanger exceeds the setpoint (Defrost pressure dynamic in %) compared to a frost-free and clean heat exchanger.

Crossflow Heat Exchanger

Parameter	Value
Defrost type	Static
Defrost pressure, static	0.65 in. wc.
Defrost pressure, dynamic	25%
Status, defrost	0.60 in. wc.
Current defrost	0.60 in. wc.
Defrost time	300 S
Gain factor, heat recovery	25

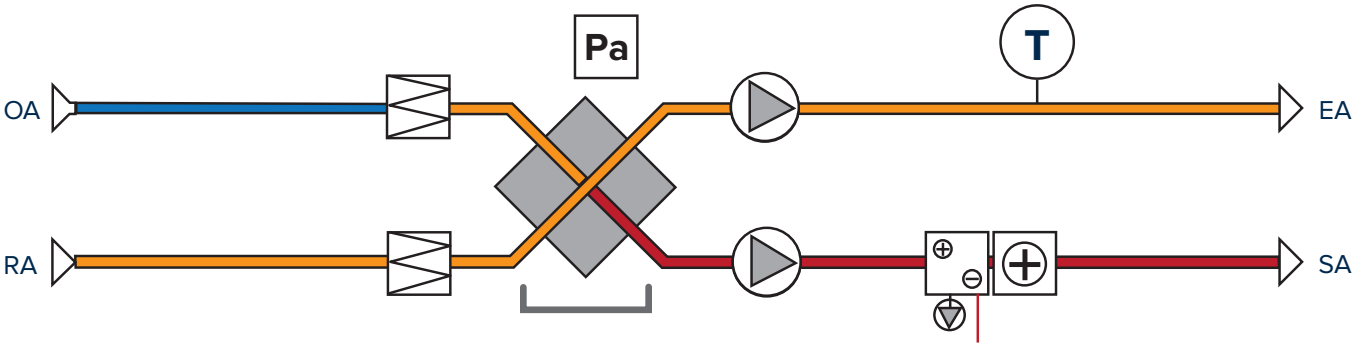
2. Monitoring the Exhaust Air Temperature



At temperatures below set value for the exhaust air temperature, the bypass damper will open to 100%. Thereby, the outdoor air passes around the heat exchanger and the return air passes through the heat exchanger. Due to the relatively high room temperature, this function will lead to the thawing of the frost accumulated on the heat exchanger. The post-heating coil should be sized accordingly to maintain the supply air temperature setpoint during defrost.

DEFROST STRATEGY
No Bypass

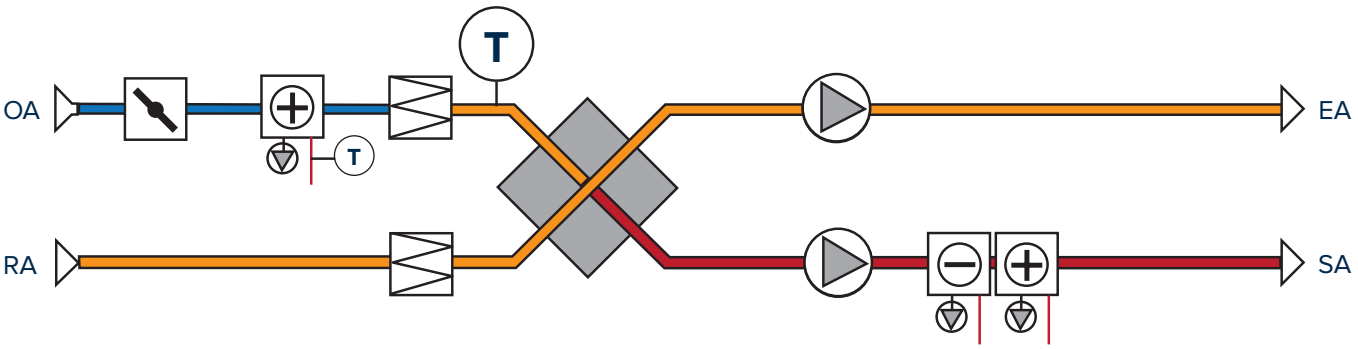
3. Timed Exhaust



When frost accumulation is detected (based on the exhaust air temperature or by monitoring the pressure drop Across the Heat Exchanger), the supply fan ceases operation for 5* minutes (*adjustable), while the exhaust fan continues to operate and thaw the ice accumulation on the heat exchanger. After 5 minutes, the supply fan will resume normal operation until frost is accumulated again. This cycle repeats itself until minimum normal operating cycle time, 30* minutes (*adjustable).

FROST PREVENTION STRATEGIES

1. Hydronic Pre-Heat



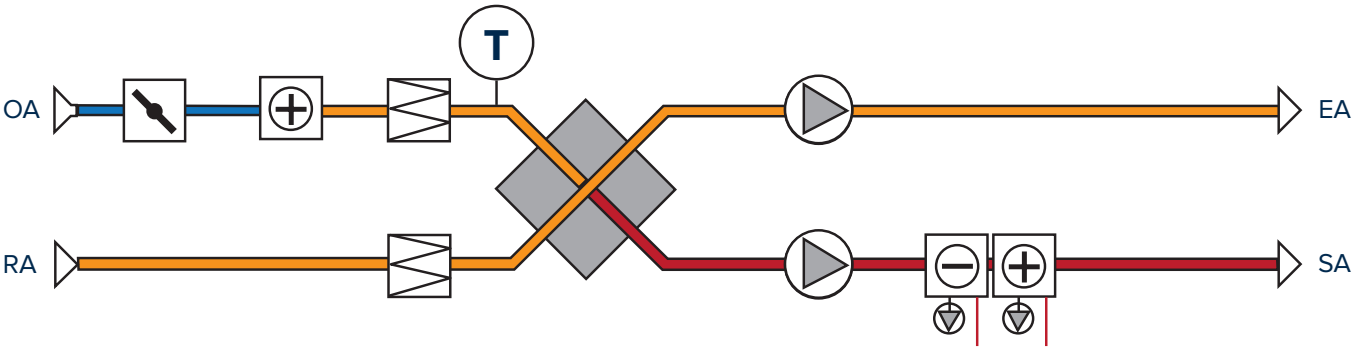
Water Pre-Heating Coil

Parameter	Value
Setpoint Pre-Heating Coil	25.0°F
Pump Operation	Constant
Pump Start	50.0°F
Frost Protection	41.0°F
Frost Alarm	-5°F
Frost P-Band	9.0°F
Start-Up Heating	50.0%
Standby Heating	77.0°F
Water Heating Coil Temp.	0.0°F
P-Band	3.6°F
I-Time	120 S
Motor Valve	0-10V

A hydronic pre-heat coil ensures that the temperature entering the heat exchanger is maintained at a required minimum temperature. If the maximum heat supply from the pre-heat coil cannot maintain the setpoint, a frost alarm will be activated and the fans will be stopped.

The hydronic pipe temperature sensor must always be connected to the heating coil's return pipe in order to protect the pre-heat coil against freeze damage.

2. Electric Pre-Heat



A SCR electric pre-heat coil ensures that the temperature entering the heat exchanger is maintained at a required minimum temperature. The pre-heat temperature sensor will come installed in the unit, positioned in the outdoor air stream. Pre-heat is controlled by a 0-10V signal.

Electric Pre-Heating Coil

Parameter	Value
Regulation Mode	0-10V
Aftercooling Time	60 S
Min. Airflow, 100% Heating	800 CFM
Min. Airflow, 0% Heating	400 CFM
P-Band	3.6°F
Setpoint Pre-Heating Coil	25.0°F
I-Time	120 S