



Best Energy Efficiency Practices ... HVAC Efficiency Operations

JEFFREY ROE & MATTHEW WOLFE 2/28/2023

District Mission



Each student is highly educated, prepared for leadership and service, and empowered for success as a citizen in a global community.





JEFFREY ROE:

- Energy Manager
- AEE Certified Energy Manager
- AEE Existing Buildings Commissioning Professional

MATTHEW WOLFE:

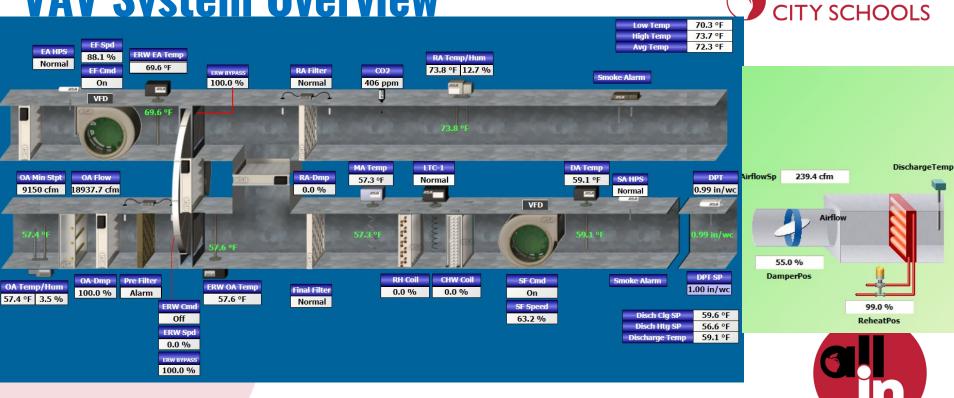
- Building Controls System Integrator
- AEE Certified Energy Manager





Air Handler Controls

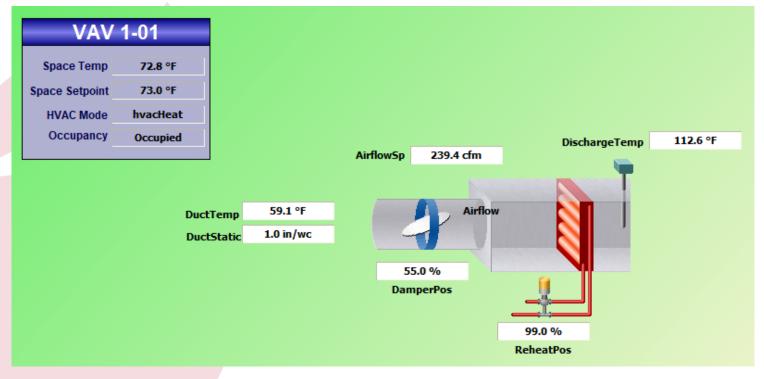
VAV System Overview



COLUMBUS

VAV System Overview







Economizer Controls

ERW EA Temp

69.6 °F

ASA

69.6 °F

EF Spd

88.1 %

EF Cmd

On

VFD

OA Flow

18937.7 cfm

QA-Dmp

100.0 %

Pre Filter

Alarm

FRW Cmd

Off

ERW Spd

0.0 % ERW BYPASS 100.0 %

EA HPS

Normal

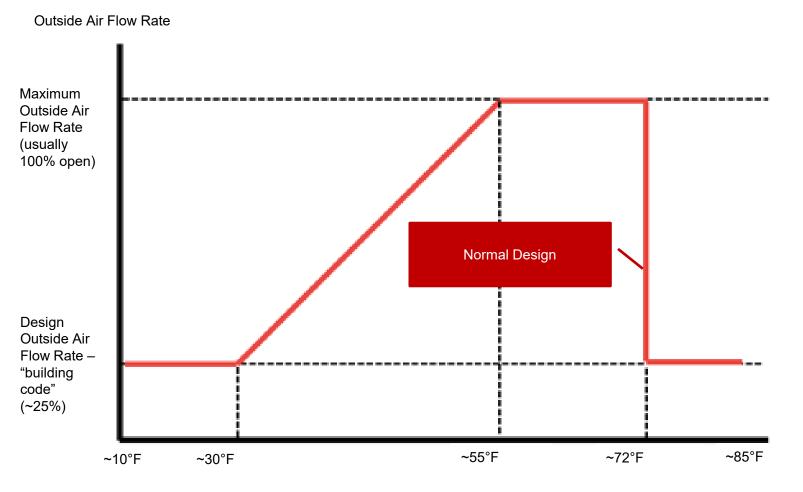
OA Min Stpt

9150 cfm

OA Temp/Hum

57.4 °F 3.5 %





Outside Air Temperature

Outside Air Flow Rate ~45°F Maximum Outside Air Physically Possible Flow Rate (Maximum airflow for indoor air maximum ventilation Normal Design (achieves building code at lowest possible energy use) Design Outside Air Flow Rate -"building code"

Outside Air Temperature

~30°F

~10°F

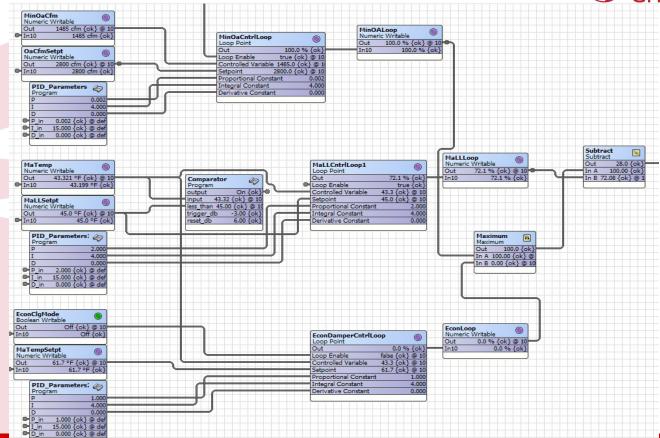
~55°F

~72°F

~85°F

Economizer Controls

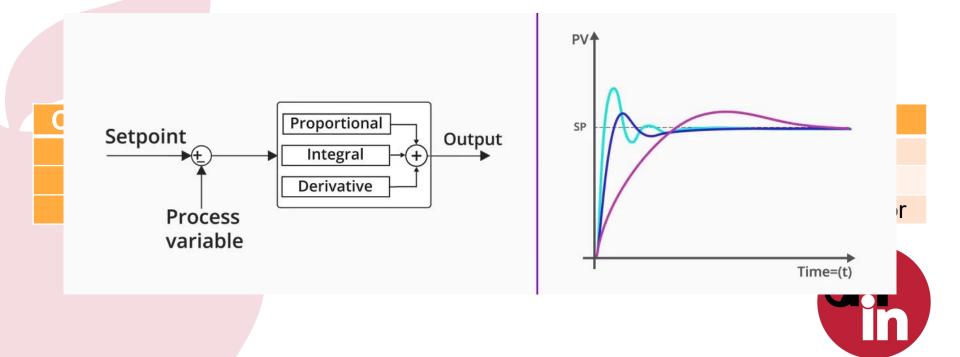






Economizer Controls





Discharge Pressure Reset





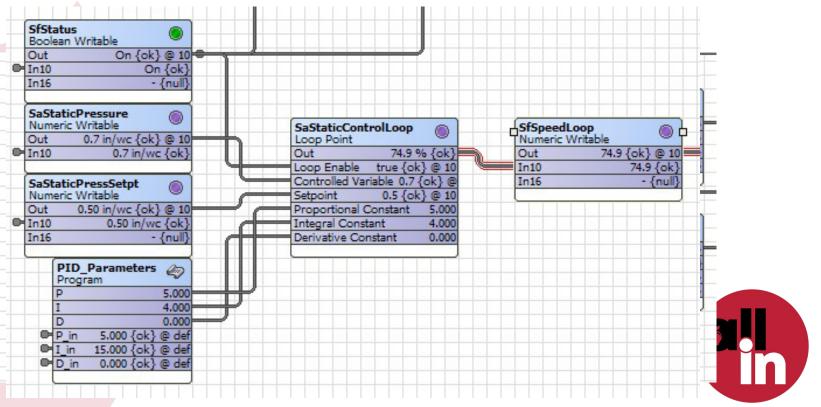
Discharge Pressure Reset



VAV TAG	ROOM #	ROOM NAME	Temp	Setpoint	Schedule	Mode	Flow	Flow Sp	Damper	Reheat	DaTemp
VAV 1-01	264H	Area C Bathrooms	72.8 °F	73.0 °F	Occupied	hvacHeat	239.4 cfm	239.4 cfm	56.0 %	99.0 %	108.2 °F
VAV 1-02	268	Elementary Classroom	73.1 °F	73.0 °F	Occupied	hvacHeat	586.9 cfm	550.9 cfm	52.0 %	38.0 %	86.3 °F
VAV 1-03	269	Elementary Classroom	72.8 °F	73.0 °F	Occupied	hvacHeat	553.0 cfm	550.9 cfm	48.0 %	36.0 %	68.6 °F
VAV 1-04	267	Elementary Classroom	73.0 °F	73.0 °F	Occupied	hvacHeat	548.8 cfm	550.9 cfm	46.0 %	34.0 %	65.9 °F
VAV 1-05	266	Elementary Classroom	73.4 °F	73.0 °F	Occupied	hvacHeat	557.3 cfm	550.9 cfm	52.0 %	31.0 %	62.3 °F
VAV 1-06	262	Science Lab	73.3 °F	73.0 °F	Occupied	hvacHeat	940.8 cfm	900.5 cfm	69.0 %	35.0 %	82.8 °F
VAV 1-07	255	Elementary Classroom	72.7 ⁰F	73.0 °F	Occupied	hvacHeat	612.4 cfm	599.6 cfm	45.0 %	38.0 %	76.2 °F
VAV 1-08	253	Elementary Classroom	73.3 °F	73.0 °F	Occupied	hvacHeat	606.0 cfm	599.6 cfm	45.0 %	37.0 %	94.2 °F
VAV 1-09	258	Elementary Classroom	73.1 °F	73.0 °F	Occupied	hvacHeat	603.9 cfm	620.8 cfm	48.0 %	49.0 %	94.0 °F
VAV 1-10	254	Elementary Classroom	73.4 °F	73.0 °F	Occupied	hvacHeat	620.8 cfm	599.6 cfm	49.0 %	51.0 %	97.0 °F
VAV 1-11	259	Elementary Classroom	73.6 °F	73.0 °F	Occupied	hvacHeat	862.4 cfm	800.9 cfm	46.0 %	0.0 %	59.3 °F
VAV 1-12	260,261	Ext. Learning Dist. Media	73.6 °F	73.0 °F	Occupied	hvacHeat	709.8 cfm	699.2 cfm	51.0 %	0.0 %	62.4 °F
VAV 1-13	235	Elementary Classroom	73.0 °F	72. 5 ⁰F	Occupied	hvacHeat	623.0 cfm	599.6 cfm	42.0 %	35.0 %	65.1 °F
VAV 1-14	230	Elementary Classroom	73.4 °F	73.0 °F	Occupied	hvacHeat	612.4 cfm	599.6 cfm	47.0 %	35.0 %	82.8 °F
VAV 1-15	228	Elementary Classroom	72.8 ⁰F	73.0 °F	Occupied	hvacHeat	603.9 cfm	599.6 cfm	47.0 %	38.0 %	76.3 °F
VAV 1-16	234	Elementary Classroom	72.9 ⁰F	73.0 °F	Occupied	hvacHeat	680.2 cfm	661.1 cfm	45.0 %	37.0 %	74.0 °F
VAV 1-17	232,237	Ext. Learning and Dist. Media	73.5 °F	73.0 °F	Occupied	hvacHeat	822.1 cfm	800.9 cfm	46.0 %	27.0 %	61.6 °F
VAV 1-18	220	Music Room	72. 5 ⁰F	73.0 °F	Occupied	hvacHeat	1125.1 cfm	1080.6 cfm	62.0 %	40.0 %	87.1 °F
VAV 1-19	263	Workroom Storage	74.3 °F	73.0 °F	Occupied	hvacHeat	86.9 cfm	84.8 cfm	40.0 %	0.0 %	63.3 °F
VAV 1-20	200AX	1st Floor West Corridor	75.5 °F	76.0 °F	Occupied	hvacCool	156.8 cfm	144.1 cfm	37.0 %	0.0 %	60.8 °F

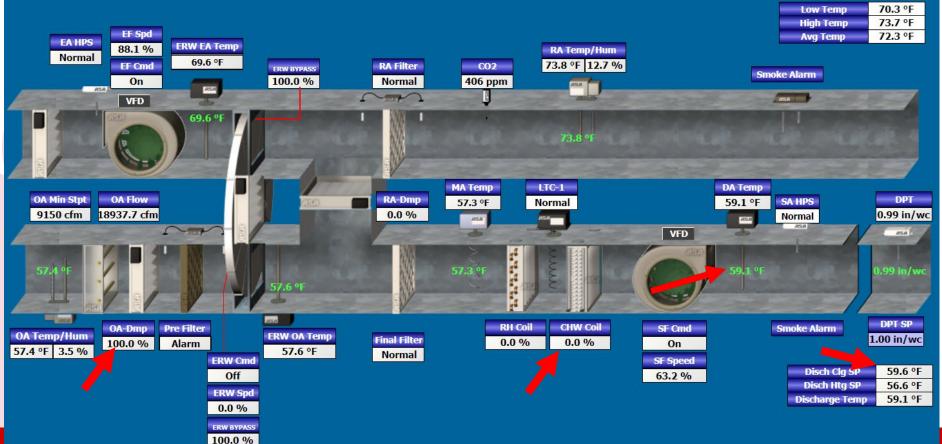
Discharge Pressure Reset





Discharge Temperature Reset





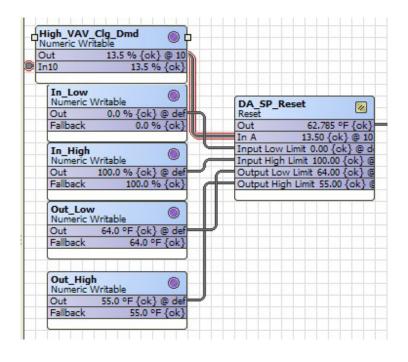
Discharge Temperature Reset



DaTemp 108.2 °F 86.3 °F
86.3 °F
68.6 °F
65.9 °F
62.3 °F
82.8 °F
76.2 °F
94.2 °F
94.0 °F
97.0 °F
59.3 °F
62.4 °F
65.1 °F
82.8 °F
76.3 °F
74.0 °F
61.6 °F
87.1 °F
63.3 °F
60.8 °F

Discharge Temperature Reset







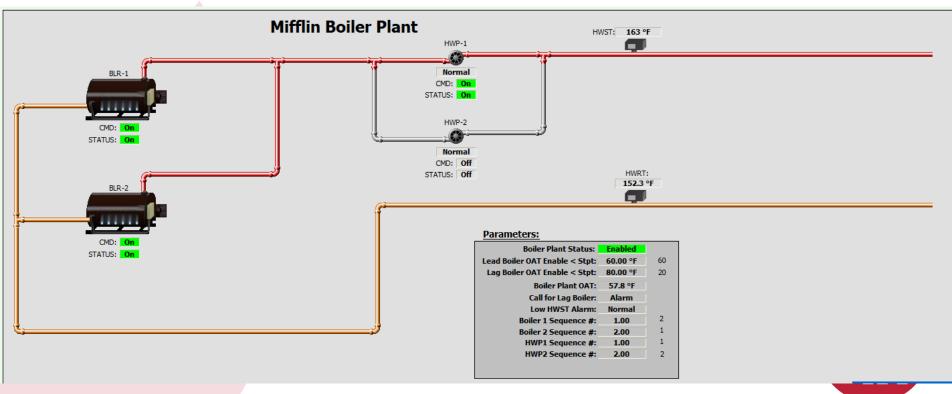




Boiler/Chiller Plant Controls

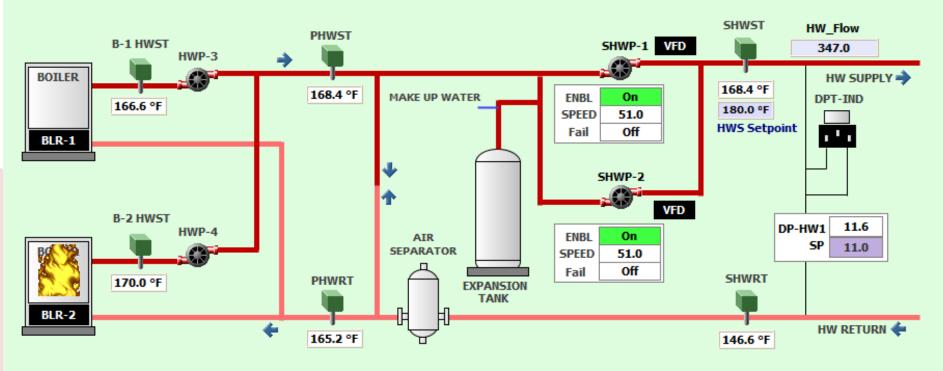
Secondary Loop Pressure Control





Secondary Loop Pressure Control

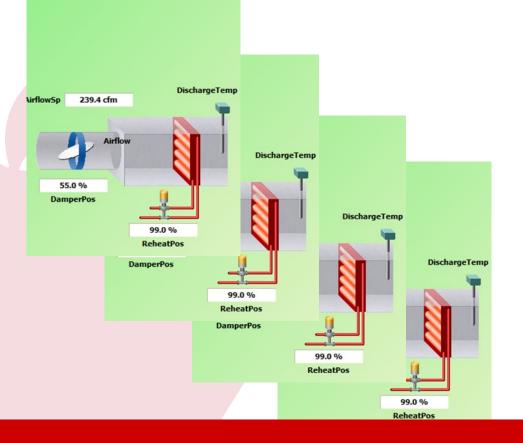


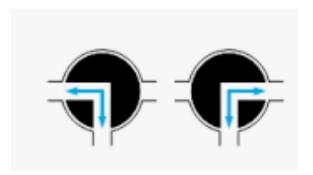




Secondary Loop Pressure Control CITY SCHOOLS



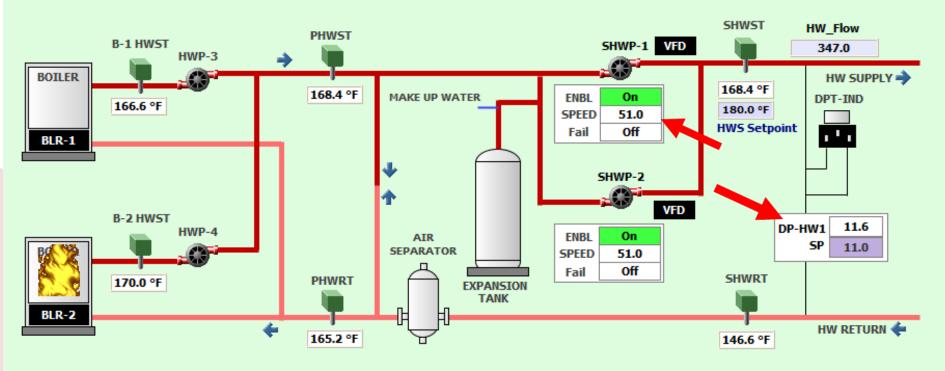






Secondary Loop Pressure Control



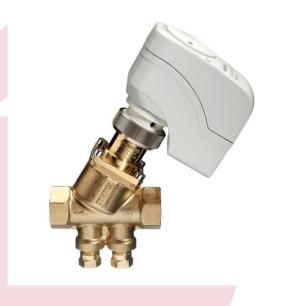




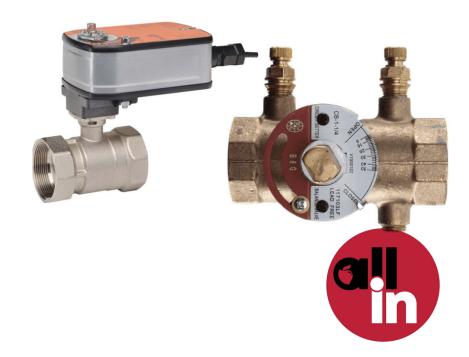
Secondary Loop Pressure Control CITY SCHOOLS



Pressure Independent Flow Control Valves



VS







End of Presentation

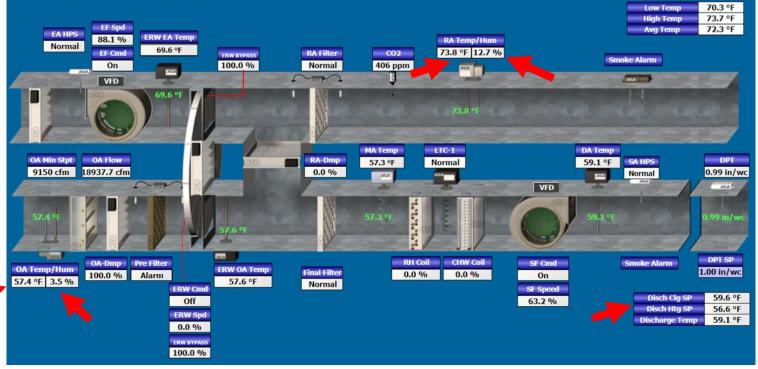


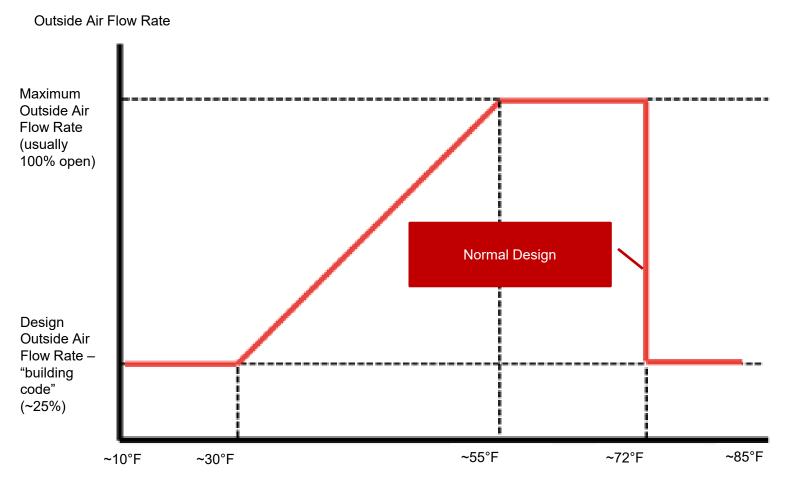


Extra Innings!

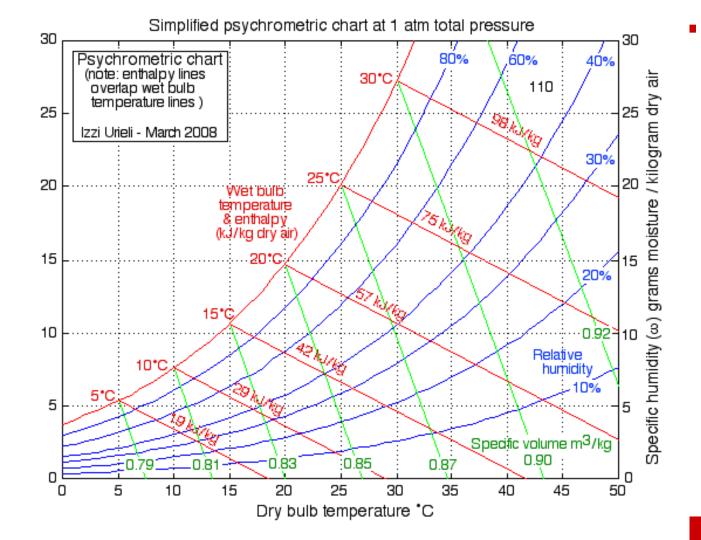
Enthalpy control

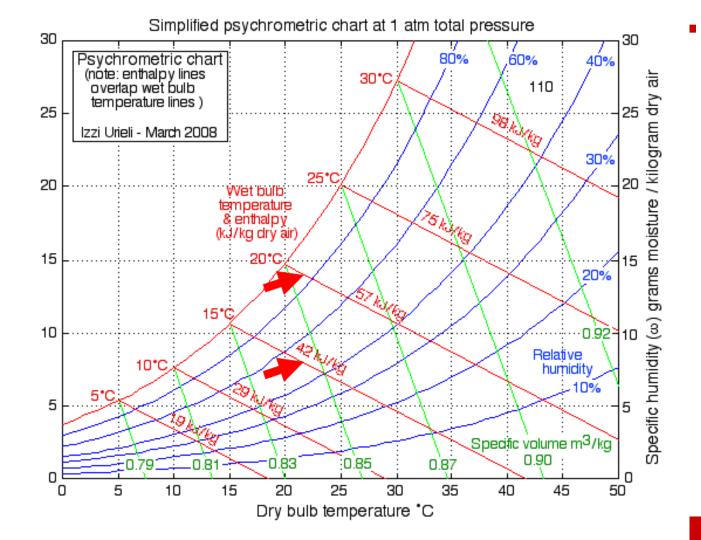






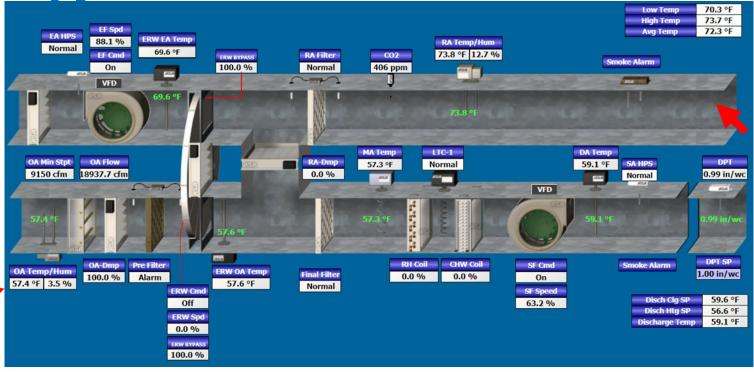
Outside Air Temperature



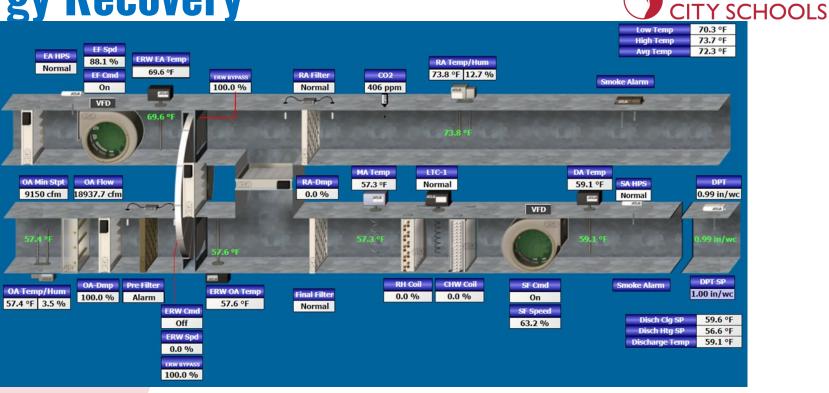


Enthalpy control





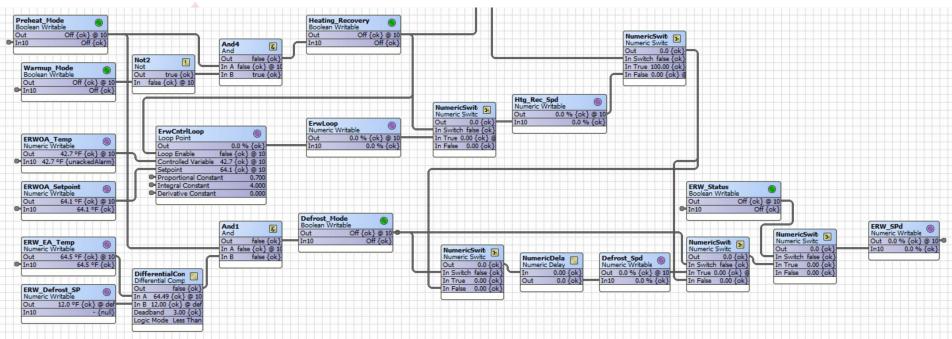
Energy Recovery



COLUMBUS

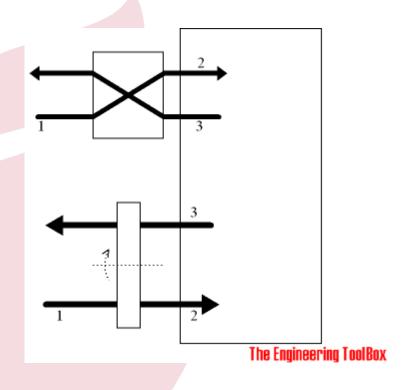
Energy Recovery Wheel Logic

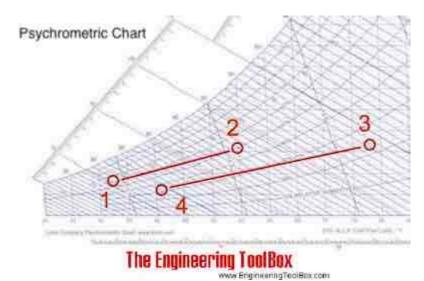




Energy Recovery Wheel vs Cube

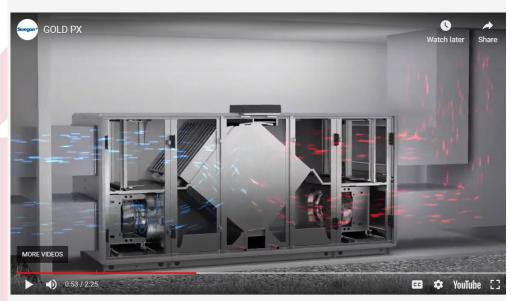






Energy Recovery Wheel vs Cube





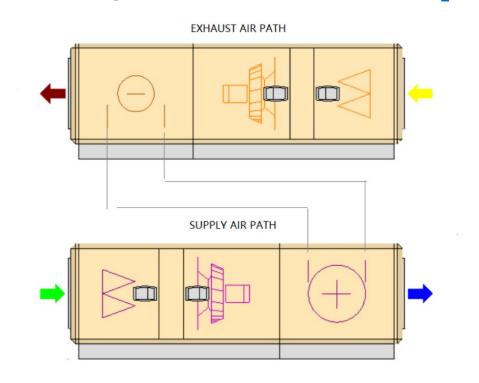


Air to Air Plate Heat Evchange

https://swegonnorthamerica.com/learn/hvac-technology/air-to-air-energy-recovery/

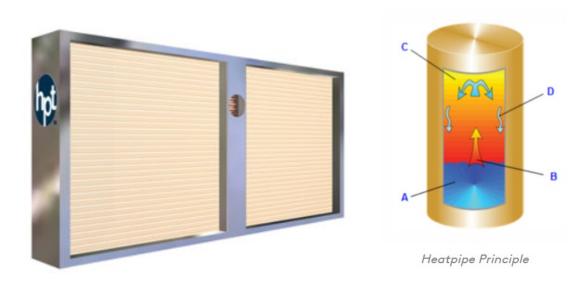
Energy Recovery Runaround Loop





Energy Recovery HeatPipe







Energy Recovery Wheel Logic



Comparing Heat Recovery Devices

	Rotor	Sensible Plate	Enthalpy Plate	Heatpipe	Run Around Loop
Energy Recovered	Sensible or Enthalpy	Sensible	Enthalpy	Sensible	Sensible
Efficiency	50 to 80%	50 to 75%	55 to 75%	40 to 60%	45 to 65%
EATR	0.5 to 10%	0 to 2%	0 to 5%	0 to 1%	0%
OACF	0.99 to 1.10	0.97 to 1.06	0.97 to 1.06	0.99 to 1.01	1.0

Note: There are multiple Efficiency Standards in use so it is important to know which one is being used when comparing technologies.

Air to Air Energy Recovery Device Comparison

Steam Condensate to Heat DHW





Biographical Information

Matt Wolfe, Building Controls System Integrator, Columbus City Schools

Matt Wolfe currently works at Columbus City Schools as a building controls system integrator and has served as HVAC supervisor. Prior to that he worked as an air quality technician at The Ohio State University. He has private experience supervising commercial and residential HVAC work as well. Matt recently became a Certified Energy Manager through the Association of Energy Engineers.

Matt is married with two elementary school aged children. His hobbies include tinkering with machines and travelling the country.

Jeff Roe, CEM, Energy Manager, Columbus City Schools

Jeff Roe currently works at Columbus City Schools as energy manager. Previously he served as senior energy engineer for a business unit at The Ohio State University. Prior to that Jeff was a contractor engineer supporting the AEP Ohio Business Incentives for Energy Efficiency program. He has also worked as an engineer in the coal fired power plan industry. Jeff is a Certified Energy Manger and Existing Buildings Commissioning Professional through the Association of Energy Engineers, as well as a past local chapter president.

Jeff is married with one elementary school aged daughter. His hobbies include woodworking and travelling the country.