Measure M1: Reduce supply air pressure setpoint for VAV system

Inputs

Orig. SP	**1.5 in w.g.**
New SP	**1.00 in w.g.**
ΔP:	**0.50 in w.g.**
η_{fan}	**0.6**
η_{motor}	**0.95**

Demand and Energy Savings

		[A]	[B]	[C]	[D]	
				Savings		
OA Temp Bin	**AHU Run Hours [1]**	**CFM**	**Delta BHP**	**kW**	**kWh**	
22.5	157	42,781	4.7	3.7	574	
27.5	190	44,841	4.9	3.8	728	
32.5	302	46,901	5.1	4.0	1,210	
37.5	372	48,961	5.3	4.2	1,556	
42.5	375	51,021	5.6	4.4	1,635	
47.5	344	53,081	5.8	4.5	1,560	
52.5	304	55,141	6.0	4.7	1,432	
57.5	320	57,201	6.2	4.9	1,564	
62.5	392	59,261	6.4	5.1	1,985	
67.5	330	61,321	6.7	5.2	1,729	
72.5	233	63,381	6.9	5.4	1,262	
77.5	375	65,441	7.1	5.6	2,097	
82.5	384	67,501	7.3	5.8	2,215	
87.5	154	69,561	7.6	5.9	915	
92.5	82	71,621	7.8	6.1	502	[F]
97.5	7	73,681	8.0	6.3	44	**6.3 kW**
Total	**4321**				**21,010**	

Equation Key

[1] AHU run hours from TMY weather data

Peak demand savings:

Equations:

[A] CFM = 412 x OAT + 33,511 (See trended data below)

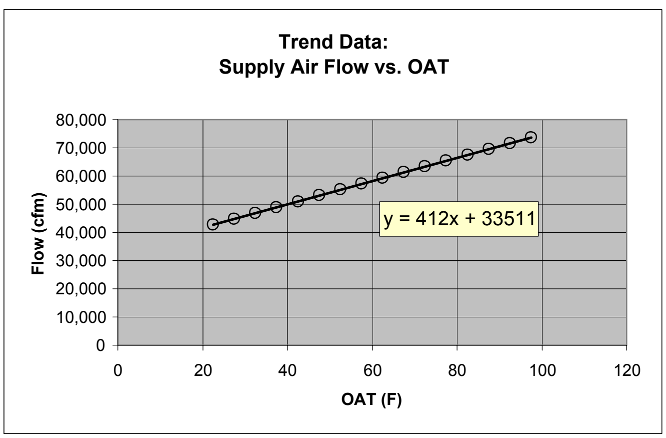
[B] Delta BHP = CFM * $(\rho/\rho std)$ * $(SP_{original} - SP_{new})$ / 6356 / ηfan

$(\rho/\rho_{std}$ = 0.83 in Denver)

[C] kW_{save} = (Delta BHP)* 0.746 / η_{motor}

[D] kWh_{save} = $(kW_{save}$ *hours$)_{bin}$

[F] Peak kW savings = kW savings at 97 F OAT



M2 - Reduce Minimum Outside Air & Add Economizer Controls (sensible control only)

Inputs

60,000	cfm - Constant Volume Supply fan flow
210	Max # occupants
45%	Existing Outside Air (OA) fraction - Fixed
100%	Maximum possible Outside Air (OA) fraction
7%	New Proposed Minimum OA fraction = ((20 cfm x 210 occ.) / 60,000 cfm)
0.6	kW/Ton - Existing chiller efficiency
80%	Boiler efficiency
71	F - Average return air temperature (RAT)
52	F - Average supply air temperature (SAT)

Demand and Energy Savings

Equation Key

		[A]	[B]			[C]	[D]	[E]	[F]
		Existing	New	New	Change in	Savings			
	Annual	OA Flow	OA Flow	OA Flow	OA Flow		Annual	Annual	
Temp Bin	Hours[1]	cfm	%	cfm	cfm	kW	kWh	Therms	
22.5	157	27,000	39%	23,505	-3,495	0.0	0	298	
27.5	190	27,000	44%	26,207	-793	0.0	0	73	
32.5	302	27,000	49%	29,610	2,610	4.5	1,360	0	
37.5	372	27,000	57%	34,030	7,030	10.6	3,927	0	
42.5	375	27,000	67%	40,000	13,000	16.6	6,227	0	
47.5	344	27,000	81%	48,511	21,511	22.7	7,794	0	
52.5	304	27,000	100%	60,000	33,000	27.4	8,318	0	
57.5	320	27,000	100%	60,000	33,000	20.0	6,390	0	
62.5	392	27,000	100%	60,000	33,000	12.6	4,928	0	
67.5	330	27,000	100%	60,000	33,000	5.2	1,708	0	
72.5	233	27,000	7%	4,200	-22,800	1.5	357	0	
77.5	375	27,000	7%	4,200	-22,800	6.6	2,491	0	
82.5	384	27,000	7%	4,200	-22,800	11.8	4,513	0	
87.5	154	27,000	7%	4,200	-22,800	16.9	2,597	0	
92.5	82	27,000	7%	4,200	-22,800	22.0	1,802	0	
97.5	7	27,000	7%	4,200	-22,800	27.1	190	0	27.1 kW
Total	**4321**						**52,601**	**372**	

Peak demand savings:

Notes:
[1] TMY2 hours (Boulder) May-Sep, M-F, 9AM-9PM [AHU & Chiller run hours]
Equations:
[A] Existing OA CFM = Design Supply CFM x %OA

[B] If [OAT > RAT, then New % OA = Minimim]; If [SAT < OAT < RAT, the New % OA = Maximum]; If [OAT < SAT then New % OA = (SAT-RAT)/(OAT - RAT)]

[C] If [OAT < RAT and OA CFM New > OA CFM Original] OR if [OAT>RAT and OA CFM new< OA CFM old] then: kW savings = 1.08 x 0.83 x (OA CFM Reduction) x $(RAT - OAT)_{bin}$ x 1/12,000 x Chlr kW/Ton
$(\rho/\rho_{std}$ = 0.83 in Denver)

[D] kWh = kW * $hours_{bin}$

[E] If [OAT<SAT and new % OA< original %OA] then: Therm savings = operating hours *{1.08 x 0.83 x (OA CFM Reduction) x $(RAT - OAT)_{bin\}}$ / {Boiler Efficiency * 100,000btu/therm}
[F] Peak kW savings = kW savings at 97 F OAT