

Energy Savings via Underrating HVAC Air Filtration Systems

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This case study is from a Medical Care Facility located in Central, MA. The building operator was looking to implement the latest technology in air filtration for the recent completion of a new wing of the facility.

The reasons for considering changes in the air filtration system was to conserve energy regarding operational costs of their system found in Table 1. (1) They desired to upgrade the filtration efficiency to meet or exceed the minimum air filtration guidelines (2) established by the AIA/FGI with assistance from the U.S. Department of Health and Human Services (DHHS) shown in Table 2. Extending the life cycle of the final filters was also considered to reduce maintenance, labor and the associated filter disposal costs.

The HVAC system is a variable air volume (VAV) type with a modular bank frame filtration system with upstream service. The system has two air handling units, AHU #1 & AHU #2 with (65) 24x24 filters for each unit. Each unit was designed to deliver approximately 80,000 CFM. The final filters were 90% (3) 12" deep conventional rigid box type filters with approximately 50 sq. ft. of micro-fine fiberglass air laid (lofted) media. The manufacturer's published initial (clean) resistance of the final filters is .82" w.g. operating at 500 fpm with the maximum recommended final resistance of 1.5" w.g. The final filters were scheduled for change-out every 12 months. The filter pressure differential devices installed were dial and pointer type gages.

The cost to underrate and upgrade the filtration system was a minimal, initial cost only, for the filters selected with no system modification required. The final filters selected

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TABLE 1



AIR FILTER ENERGY COST

Project: Medical Care Facility/Central, MA	Date: 6/30/04
Location: East Wing	Engineer: Chief Power Plant Engineer
Contact: Stephen W. Nicholas, CAFS	Contractor: Balco

SYSTEM INFORMATION

System #1		System #2	
AHU Tag	AHU #1	AHU Tag	AHU #2
Filters	(65) 24x24x12 90% efficiency	Filters	(65) 24x24x12 95% efficiency
Air Flow per filter (CFM)	1352	Air Flow per filter (CFM)	1500
Initial Resistance (in. w.g.)	0.75	Initial Resistance (in. w.g.)	0.31
Power Cost (\$/KWH)	0.10	Power Cost (\$/KWH)	0.10
Time Period (hours)	8760	Time Period (hours)	8760

Energy Costs

System #1		System #2	
Annual Energy Cost	\$160.64	Annual Energy Cost	\$73.67
System #2 will save	\$86.97	over System #1.	

TABLE 2

Filter Efficiencies for Central Ventilation and Air Conditioning Systems in General Hospitals & Rehabilitation Facilities

Area Designation	No. of filter beds	Filter bed No. 1 (%)	Filter bed No. 2 (%)
All areas for inpatient care, treatment and diagnosis, and those areas providing direct service or clean supplies such as sterile and clean processing, etc.	2	30	90
Protective environment room	2	30	99.97
Laboratories	2	80	na
Administrative, bulk storage, soiled holding areas, food preparation areas, and laundries. Notes: Additional roughing or prefilters should be considered to reduce maintenance required for filters with efficiency higher than 75 percent. The filtration efficiency ratings based on dust spot efficiency per ASHRAE 52.1-1992	1	30	na

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were the 95% (3) V-Cell 12" deep high capacity mini-pleat type with approximately 200 sq. ft. of micro-fine fiberglass wet laid (paper) type media. The air flow resistance published by the manufacturer is .36" w.g. @ 500 fpm. The installation of the filters included a system shut down with proper lock-out, tag-out procedures in effect. The lights in both units were shut off. The chief engineer used a flashlight to examine the filter holding frames upstream of the final filter bank. The HVAC technician checked the downstream side to caulk and seal any air leaks. AHU #1 continued to use the same type of filters provided with the new installation. The pressure differential gauges were zeroed and the static pressure tips inspected to insure proper location in a zone of minimum turbulence, in accordance with the original equipment manufacturer's (OEM), installation recommendations.

The final filters for AHU #2 using the V-Cell mini-pleat filters are now scheduled for change-out, every 24 months versus every 12 months for the conventional Rigid Box type. The filter surface area of the final filter section of AHU # 2 is approximately four times greater than the original filters. Actual air flow monitoring data of both units show the performance differences displayed in Table 3. The overall cost savings achieved by underrating the system by implementing the latest technology of the high efficiency, high capacity V-Cell final filters versus that of the Rigid-Box significantly lowered the pressure drop and energy costs.

The benefits of underrating HVAC air filtration systems by the Engineering Department of this Health Care Facility can also be implemented by other building operators looking to improve overall efficiency and performance of their HVAC filtration systems. Underrating air filtration systems can be accomplished with proper engineering practices found in the NAFA Guide to Air Filtration and The IOM of Air Filtration Systems.⁽⁴⁾ Facility owners will see immediate

TABLE 3

LOCATION	DATE	MONTH	RESISTANCE W.G.	TOTAL SUPPLY CFM	AMPS	
					FAN #1	FAN #2
AHU #1	1997	OCT	0.65	79,613.50	68.30	72.00
		NOV	0.75	80,978.00	72.30	75.80
		DEC	0.80	81,744.20	74.60	76.60
	1998	JAN	0.75	80,949.40	71.90	76.20
		FEB	0.85	86,061.00	84.10	90.50
		MAR	0.70	77,541.00	69.60	67.90
AHU #2	1997	APR	0.80	82,041.20	77.60	76.50
		MAY	0.70	77,062.10	66.60	65.50
		JUNE	0.80	84,105.50	82.10	80.10
	1998	OCT	0.25	89,037.00	66.30	59.10
		NOV	0.30	90,467.00	63.10	61.20
		DEC	0.30	89,502.00	62.40	59.70
AHU #2	1998	JAN	0.30	90,835.00	63.30	62.60
		FEB	0.35	90,600.00	62.00	61.00
		MAR	0.35	88,623.00	61.20	62.80
	1998	APR	0.35	91,680.00	63.10	64.80
		MAY	0.35	92,119.00	64.20	64.50
		JUNE	0.30	82,488.00	54.20	53.30

results, saving on valuable energy consumption while maintaining a safe, clean and comfortable indoor air environment for all the building occupants in the work place today.

References:

- (1) Based on Motor Blower Efficiency of 65%. Average CFM and Average Air Flow Resistance for 9 Months @ .10/kWh
- (2) American Institute of Architects, Academy of Architecture for Health with Assistance from the U. S.

Department of Health and Human Services - 1996-97 Edition Page # 3 Air Media re-print Summer 2001 edition.

(3) ANSI/ASHRAE Standard 52.1-1992 Average Atmospheric Dust Spot Efficiency

(4) National Air Filtration Association, (NAFA) Guide to Air Filtration 3rd edition Ch. 13.4; 13. and IOM Manual

AHU – Air Handling Unit
fpm – feet per minute
w.g. _ water gauge



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