

EXAMPLE ENERGY SAVINGS CALCULATIONS

A constant volume dual duct air terminal is upgraded with (2) RF-3 retrofit kits as shown in figure 5:

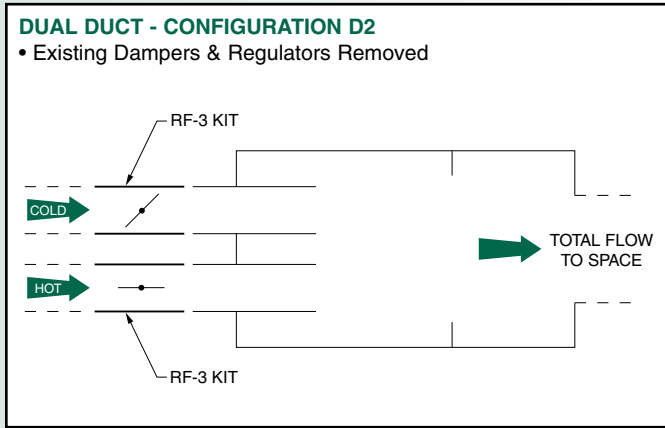


Figure 5

Constant Volume Cooling Cycle Assumptions

- 1000 ft² exterior zone
- 70% cold air / 30% warm air (return air) – average cooling cycle mixture
- Cooling ΔT = 20°F (75° space temp - 55° entering air temperature)
- Heating ΔT = 8°F (return air temp rise – return used for warm supply duct)
- 2 CFM/ ft²
- 2000 CFM Constant Volume Air Flow
- 1250 hours of operation per 1/2 year
- \$.10 / kWh
- 75° F space temperature

Calculate:

1. Total cooling load capability:
 $100\% \times 2 \text{ CFM/ft}^2 \times 1.08 \times 20^\circ\text{F}\Delta\text{T} = 43.2 \text{ BTUH/ft}^2$
2. Cold & warm air mixture (during average cooling cycle condition):
 $A = 70\% \text{ cold air} \times 2 \text{ CFM/ft}^2 \times 1.08 \times 20^\circ\text{F}\Delta\text{T} = 30.24 \text{ BTUH/ft}^2 \text{ Cooling}$
 $B = 30\% \text{ warm air} \times 2 \text{ CFM/ft}^2 \times 1.08 \times 8^\circ\text{F}\Delta\text{T} = 5.18 \text{ BTUH/ft}^2 \text{ Heating}$
3. Average cooling load required:
 $A - B = 30.24 - 5.18 = 25.06 \text{ BTUH/ft}^2 \text{ Cooling}$
4. With RF-3 retrofit kit installed on the cold duct, calculate CFM of cold air required to meet average cooling load:
 $(25.06 \text{ BTUH/ft}^2 \text{ Cooling}) / (1.08 \times 20^\circ\text{F}\Delta\text{T}) = 1.16 \text{ CFM/ft}^2$ (a reduction from 2.0 CFM/ft²)

Cooling Cycle Energy Savings:

Fan H.P. Reduction (based on 1000 CFM/HP):
 $(2.0 \text{ HP} - 1.16 \text{ HP}) \times .746 \text{ kW/HP} \times \$.10 / \text{kWh} \times 1250 \text{ hours per } 1/2 \text{ year} = \$78.33 / 1000 \text{ ft}^2 / 1/2 \text{ yr}$

Refrigeration Savings: $5.18 \text{ BTUH/ft}^2 \times 1 \text{ ton} / 12,000 \text{ BTUH} \times 1 \text{ HP} / .75 \text{ Ton} \times .746 \text{ kW/HP} \times \$.10 / \text{kWh} \times 1,000 \text{ ft}^2 \times 1250 \text{ hours per } 1/2 \text{ yr} = \$53.76 / 1000 \text{ ft}^2/1/2$

Constant Volume Heating Cycle Assumptions

- 1000 ft² exterior zone
- 80% cold air / 20% warm air (return air) – average heating cycle mixture
- Cooling ΔT = 15°F (70° space temp - 55° entering air temperature)
- Heating ΔT = 30°F (100° entering air temp - 70° space temp)
- 2 CFM/ ft²
- 2000 CFM Constant Volume Air Flow
- 1250 hours of operation per 1/2 year
- \$.10 / kWh
- 70° F space temperature

Calculate:

1. Total heating load capability:
 $100\% \times 2 \text{ CFM/ft}^2 \times 1.08 \times 30^\circ\text{F}\Delta\text{T} = 64.8 \text{ BTUH/ft}^2$
2. Hot & cold air mixture (during average heating cycle condition):
 $A = 20\% \text{ cold air} \times 2 \text{ CFM/ft}^2 \times 1.08 \times 15^\circ\text{F}\Delta\text{T} = 6.48 \text{ BTUH/ft}^2 \text{ Cooling}$
 $B = 80\% \text{ warm air} \times 2 \text{ CFM/ft}^2 \times 1.08 \times 30^\circ\text{F}\Delta\text{T} = 51.84 \text{ BTUH/ft}^2 \text{ Heating}$
3. Average heating load required: $B - A = 51.84 - 6.48 = 45.36 \text{ BTUH/ft}^2 \text{ Heating}$
4. With RF-3 retrofit kit installed on the hot duct, calculate CFM of hot air required to meet average heating load:
 $(45.36 \text{ BTUH/ft}^2 \text{ Heating}) / (1.08 \times 30^\circ\text{F}\Delta\text{T}) = 1.4 \text{ CFM/ft}^2$ (a reduction from 2.0 CFM/ft²)

Heating Cycle Energy Savings:

Fan H.P. Reduction (based on 1000 CFM/HP):
 $(2.0 \text{ HP} - 1.4 \text{ HP}) \times .746 \text{ kW/HP} \times \$.10 / \text{kWh} \times 1250 \text{ hours per } 1/2 \text{ year} = \$55.95 / 1000 \text{ ft}^2 / 1/2 \text{ yr}$

Heat Pump Savings: $6.48 \text{ BTUH/ft}^2 \times 1 \text{ ton} / 12,000 \text{ BTUH} \times 1 \text{ HP} / .75 \text{ Ton} \times .746 \text{ kW/HP} \times \$.10 / \text{kWh} \times 1,000 \text{ ft}^2 \times 1250 \text{ hours per } 1/2 \text{ yr} = \$67.14 / 1000 \text{ ft}^2 / 1/2 \text{ yr}$

Summary of Savings:	1 Year Savings / 1000 ft ²
Cooling:	
Fan Horsepower.....	\$78.33
Refrigeration Horsepower.....	\$53.76
Heating:	
Fan Horsepower.....	\$55.95
Heat Pump Horsepower.....	\$67.14
Depreciation = Product Cost / Yrs Useful Life = \$250 / 5	\$50.00
First year savings / Air terminal.....	\$305.18
plus any federal, state, or utility credits available	
(Savings will vary based on assumptions. A specific analysis should be performed for any retrofit candidate.)	