



**CONTROLS  
ESTIMATING  
AND  
DESIGN  
GUIDELINE**

**APPLICATION EXAMPLE #1**

**Rooftop Unit Reheat System**

- 25 ton rooftop unit
- 8 reheat zones

## Rooftop Unit

Constant volume, but serving multiple zones: need discharge air controls (to maintain 55 degree discharge air).

Cooling load was figured to be 25 tons: 300,000 BTU

Figure 400 CFM per ton: 10,000 CFM

Heating BTU's: need to raise 55 degree air (not 72 degree air) to a temperature suitable for heating, say, up to 90 degrees.

Delta T: 35 degrees

BTU (heating) =  $10,000 * 1.08 * 35 = 378,000$  BTU

Waterside:  $BTU = 500 * GPM * \text{delta T}$

For a waterside delta T of 10 degrees, GPM = 75.6

For a waterside delta T of 15 degrees, GPM = 50.4

For a waterside delta T of 20 degrees, GPM = 37.8

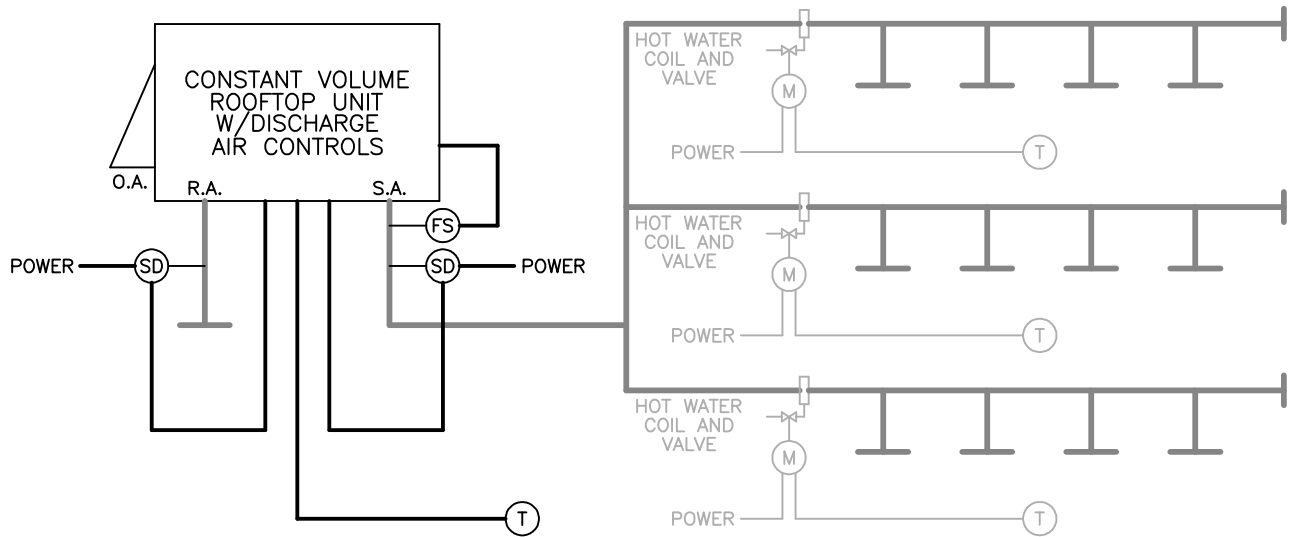
Use waterside delta T of 15 degrees

Total GPM = 50.4

8 reheat zones: average GPM = 6.3

Yields an average pipe size (per zone) of 1"

# ROOFTOP UNIT – CONSTANT VOLUME WITH HOT WATER REHEAT



## DESCRIPTION

Commercial packaged rooftop unit with distribution ductwork serving multiple zones. Each zone is equipped with a hot water coil and valve controlled by a thermostat or temperature sensor in the zone. The rooftop unit operates to maintain discharge air temperature setpoint, and should be ordered as such. Refer to hot water reheat coil sheets for zone controls.

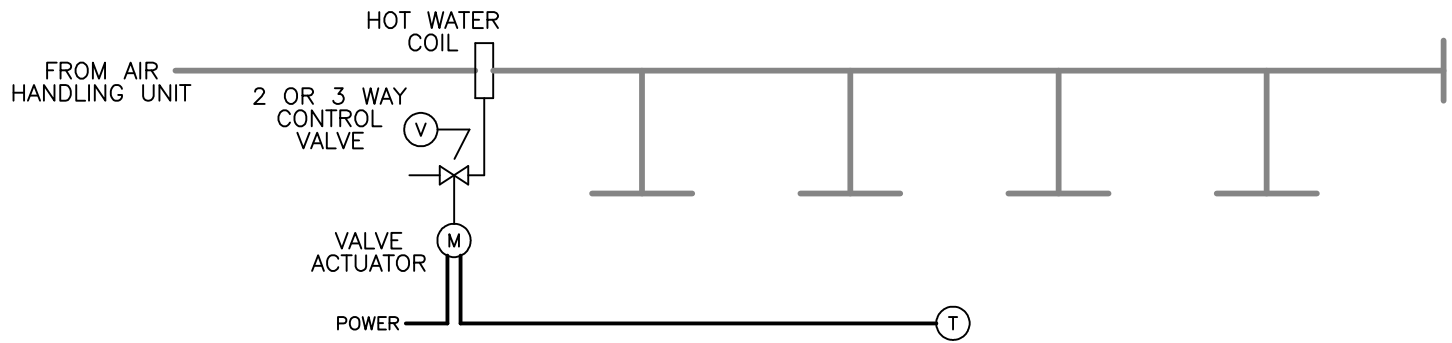
## COMPONENTS

	NOTES	LABOR (hours)	MATERIAL (cost)
(T) THERMOSTAT, PROGRAMMABLE	[1]	4.0	-----
(SD) DUCT MOUNTED SMOKE DETECTOR(S)	[2] [3]	4.0 (6.0)	150.00 ea.
(FS) FREEZESTAT	[4]	4.0	120.00
<b>STARTUP AND COMMISSIONING:</b>		4 hours	
<b>ENGINEERING TIME:</b>		2 hours	
<b>TOTALS:</b>		12.0	\$270.00

## NOTES

- [1] In this type of application, the thermostat is normally used for time of day and night setback control, and is usually furnished with the rooftop unit.
- [2] No smoke detector required if the rooftop unit CFM is less than 2000. Two smoke detectors required if the rooftop unit CFM is greater than 15000. Otherwise, one detector required in the supply air duct.
- [3] Labor includes power wiring to the detector and interlocking the detector to the rooftop unit. Labor does not include interlock to any fire alarm system.
- [4] Freezestat required to shut down the rooftop unit and protect the hot water coils in the event of failure.

# HOT WATER REHEAT COIL – TWO-POSITION CONTROL



## DESCRIPTION

Hot water coil served by an upstream air handling unit. The coil serves a single zone with a thermostat in the the zone.

## COMPONENTS

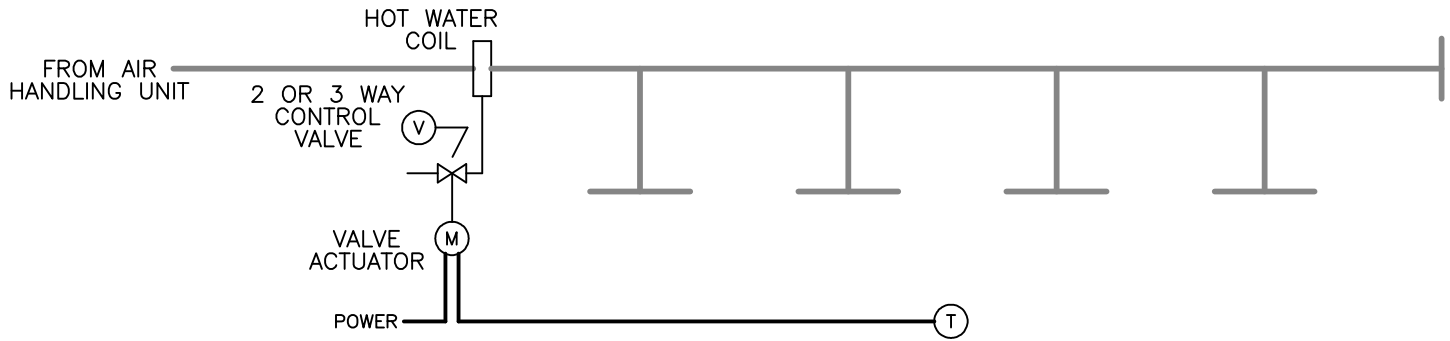
	NOTES	LABOR (hours)	MATERIAL (cost)
(T) THERMOSTAT		2.0	40.00
(M) VALVE ACTUATOR	[1]	2.0	-----
(V) 1/2" VALVE BODY (or)			70.00
(V) 3/4" VALVE BODY (or)	[2] [3] [4]		75.00
(V) 1" VALVE BODY		-----	85.00
<b>STARTUP AND COMMISSIONING:</b> 1 hour	<b>TOTALS:</b>	4.0	\$125.00
<b>ENGINEERING TIME:</b> 4 hours (per air handling unit)			

x 8 ZONES = 32.0      \$1000.00

## NOTES

- [1] For small two-position zone valves, the valve body and valve actuator are normally purchased as an assembly. Therefore, the cost of the actuator is included in the valve body cost.
- [2] For two position control, size the valve body according to line size (example: 3/4" pipe gets 3/4" valve).
- [3] Material costs shown for the valve bodies are for 3-way valves. Two-way valves are slightly less expensive.
- [4] There is no electrical labor associated with the valve body.

# HOT WATER REHEAT COIL – MODULATING CONTROL



## DESCRIPTION

Hot water coil served by an upstream air handling unit. The coil serves a single zone with a temperature sensor/controller in the zone.

## COMPONENTS

	NOTES	LABOR (hours)	MATERIAL (cost)
(T) TEMPERATURE SENSOR/CONTROLLER	[1]	2.0	75.00/60.00
(M) VALVE ACTUATOR	[1]	2.0	110.00/60.00
(V) 1/2" VALVE BODY (or)			40.00
(V) 3/4" VALVE BODY	[2] [3] [4]	-----	40.00
<b>STARTUP AND COMMISSIONING:</b> 1 hour			
<b>ENGINEERING TIME:</b> 8 hours (per air handling unit)			
<b>TOTALS:</b>		4.0	\$225.00

$$\times 8 \text{ ZONES} = 32.0 \quad \$1800.00$$

## NOTES

- [1] The higher of the two material costs for the temperature sensor/controller and the valve actuator are for 2–10 vdc control. The lower of the two costs are for floating control.
- [2] For modulating control, the valve body is sized according to flow rates and flow characteristics. Generally, this translates to a valve body size of 1 pipe size smaller than the line size.
- [3] Material costs shown for the valve bodies are for 3–way valves. Two–way valves are slightly cheaper.
- [4] There is no electrical labor associated with the valve body.