Combat Mold Without Reheat

The Control of Temperature and Humidity with conventional HVAC Systems

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Combat Mold with HVAC Systems

Mold is produced when spores that continually exist in outdoor and indoor air are exposed to levels of relative humidity above 70% and have a food source of dirt or building material (sheetrock, ceiling tiles, etc.).

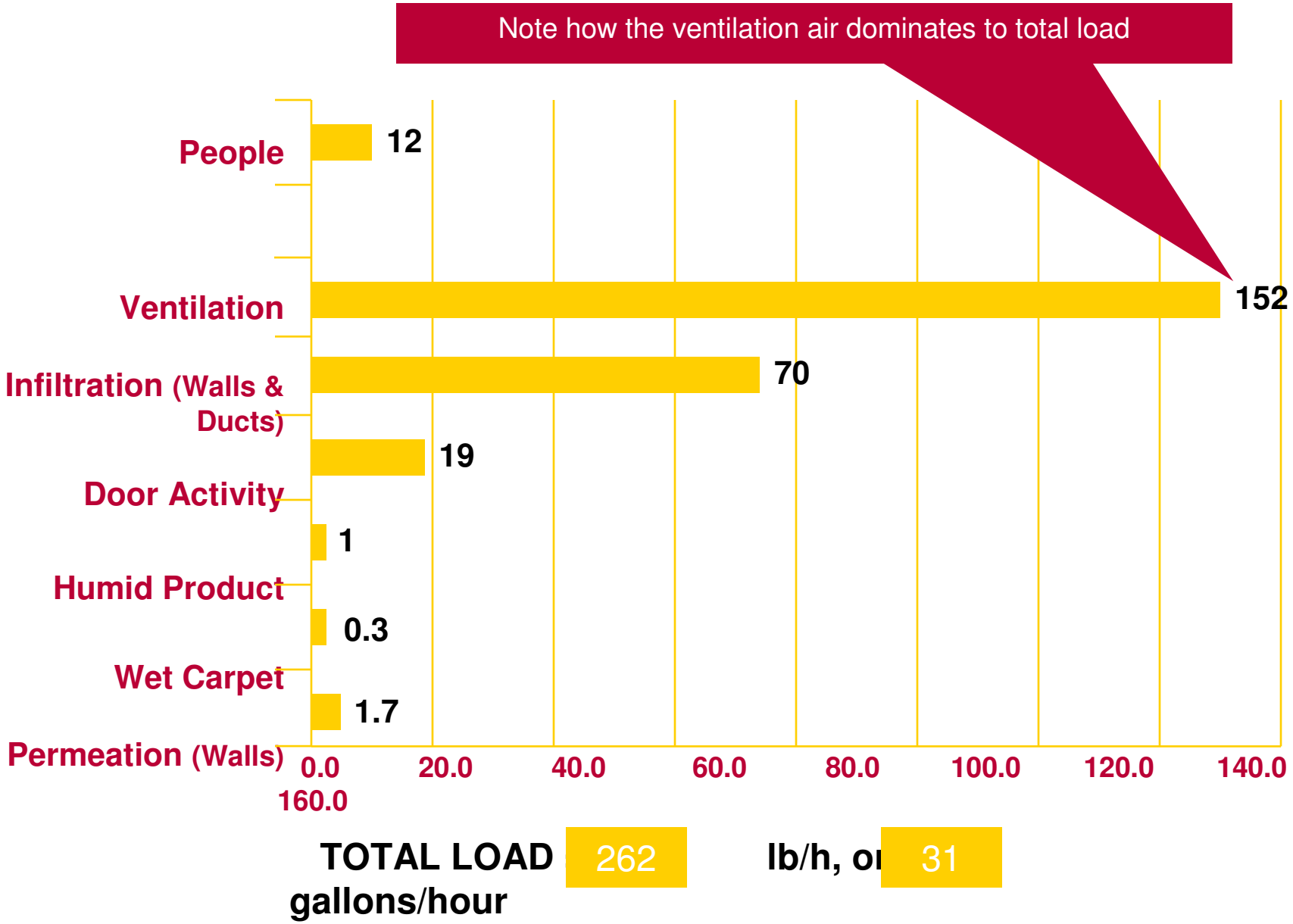
The answer to controlling the growth of mold is to control moisture below the 70% relative humidity threshold. HVAC systems can be utilized to combat this mold growth and improve indoor air quality.

Combat Mold with HVAC Systems

The possibility of mold growth due to high humidity can occur when a heating, ventilating and air conditioning (HVAC) system has the space temperature controlled by the following:

- On/off operation, of a direct-expansion cooling coil.
- The modulation of a control valve serving a chilled- water cooling unit.
- Supply air temperatures over 65 degrees when used in under-floor displacement distribution systems or as supplied to a space.

Looking at Load Elements

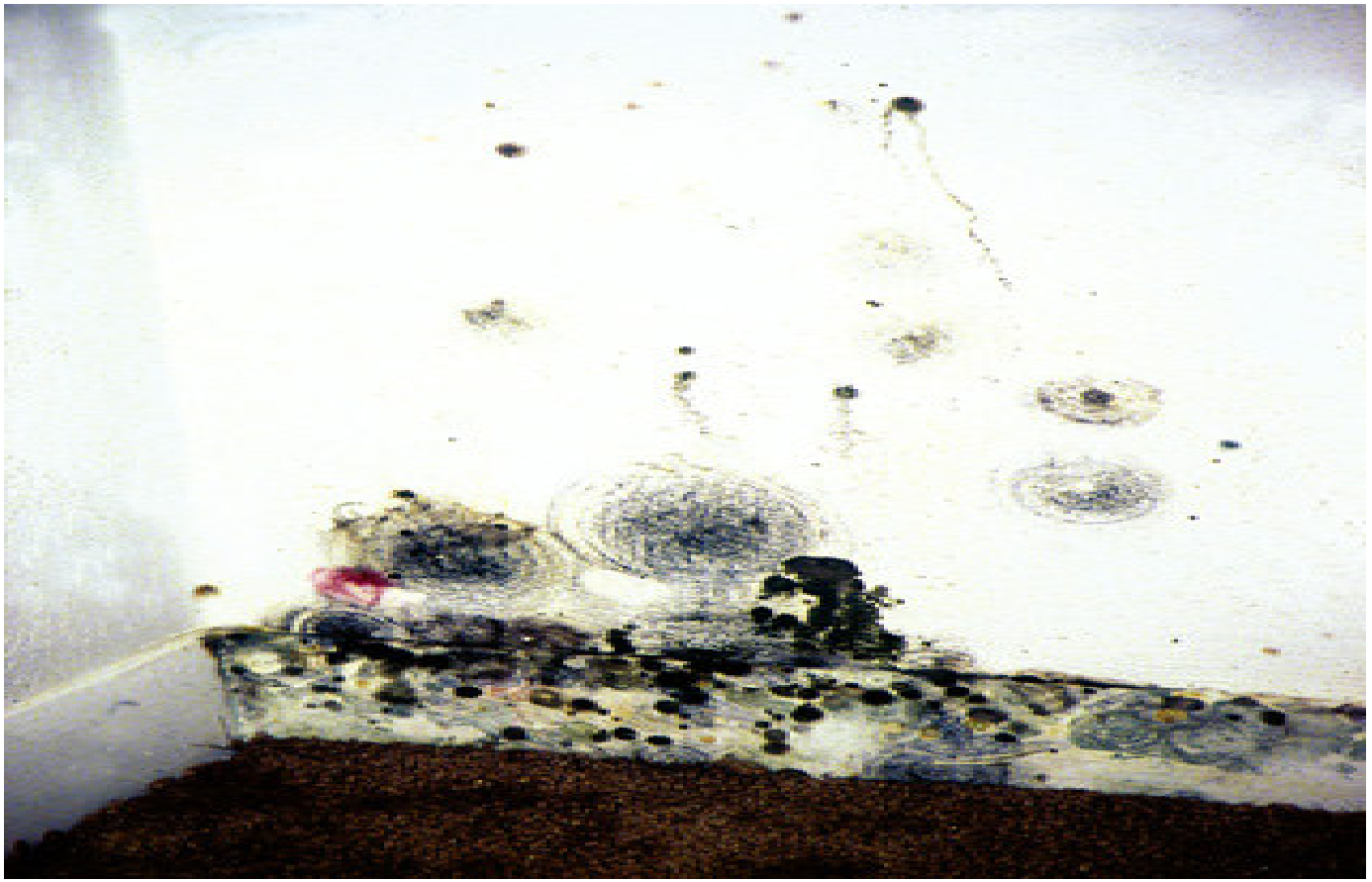


Does HVAC Cause Mold?

Some Say – YES!

Does HVAC Cause Mold?

Some Say – NO!



Rule of Thumb for Office Space Design

$$\frac{\text{1 Ton}}{\text{300 Square Feet}} = \frac{\text{12,000 BTU}}{\text{300 Square Feet}} = \frac{\text{40 BTU}}{\text{Square Feet}}$$

Sensible Interior Cubicle Space Load

Plug Load:

(i.e., computers, printers, etc.)

$$\frac{\text{200 Watts}}{\text{75 Square Feet}} = \frac{\text{2.7 Watts}}{\text{1 Square Feet}} = 9.2 \frac{\text{BTU/Hr}}{\text{Sq. Ft.}}$$

Lighting Load:

$$\frac{\text{200 Watts}}{\text{75 Square Feet}} = \frac{\text{2.7 Watts}}{\text{1 Square Feet}} = 9.2 \frac{\text{BTU/Hr}}{\text{Sq. Ft.}}$$

People Load:

$$\frac{\text{250 BTU/Hr/Person}}{\text{75 Square Feet}} = 3.2 \frac{\text{BTU/Hr}}{\text{Sq. Ft.}}$$

Outside Air Load

Based on 15% of 400 CFM or 60 CFM

Enthalpy:

Outside Air – 75 WB =	38.61 BTU/lb
Inside Air – 62.5 WB =	28.21 BTU/lb
	10.40 BTU/lb

$$H_T = CFM \times \Delta h \times 4.45$$

$$H_T = \frac{60\ CFM}{300\ SF} \times 10.40 \times 4.45$$

$$H_T = 9.3 \ \frac{BTU/Hr}{SF}$$

Derivation of 40 BTU/HR/SF

Sensible Interior Load	BTU/HR SQ. FT
Plug Load	9.2
Lighting Load	9.2
People Load	3.2
Total Interior Sensible Load	21.6
Interior Latent Load $\frac{\text{200 BTU/Hr/Person}}{\text{75 SF}}$	2.7
Outside Air Load	9.3
Perimeter Skin Load (16% of 40 BTU/SF)	6.4 $\frac{\text{BTU/HR}}{\text{SQ. FT}}$
Total Load (Sensible Plus Latent)	40 $\frac{\text{BTU/HR}}{\text{SQ. FT}}$

Room Sensible Heat Ratio

$$\text{SHR} = \frac{\text{Sensible Heat}}{\text{Total Heat}}$$

$$\text{SHR} = \frac{21.6}{21.6 + 2.7} = \frac{21.6}{24.3} = .89 \text{ @ } 40 \frac{\text{BTU/Hr}}{\text{Sq. Ft.}}$$

Sensible Interior Cubicle Space Load

Plug Load:

(i.e., computers, printers, etc.)

$$\frac{\text{112.5 Watts}}{\text{75 Square Feet}} = \frac{\text{1.5 Watts}}{\text{1 Square Feet}} = 5.1 \frac{\text{BTU/Hr}}{\text{Sq. Ft.}}$$

Lighting Load:

$$\frac{\text{112.5 Watts}}{\text{75 Square Feet}} = \frac{\text{1.5 Watts}}{\text{1 Square Feet}} = 5.1 \frac{\text{BTU/Hr}}{\text{Sq. Ft.}}$$

Derivation of Partial Load BTU/HR/SQ FT

Sensible Interior Load	BTU/HR SQ. FT	BTU/HR SQ. FT
Plug Load	9.2	5.1
Lighting Load	9.2	5.1
People Load	3.2	3.2
Total Interior Sensible Load	21.6	13.4
Interior Latent Load $\frac{\text{200 BTU/Hr/Person}}{\text{75 SF}}$	2.7	2.7
Outside Air Load	9.3	9.3
Perimeter Skin Load (8% of 40 BTU/SF)	6.4 $\frac{\text{BTU/HR}}{\text{SQ. FT}}$	6.4
Total Load (Sensible Plus Latent)	40 $\frac{\text{BTU/HR}}{\text{SQ. FT}}$	31.8 $\frac{\text{BTU/HR}}{\text{SQ. FT}}$

Partial Load Room Sensible Heat Ratio

$$SHR = \frac{\text{Sensible Heat}}{\text{Total Heat}}$$

$$SHR = \frac{13.4}{13.4 + 2.7} = \frac{13.4}{16.1} = .83$$

Under partial load conditions the room temperature is satisfied using a higher supply air temperature from the coil. However, due to a decreasing SHR and increasing supply air temperature, the coil is not removing the humidity and the humidity continues to climb in the space.

Use your HVAC system to precondition outside air that is being used for ventilation to prevent mold growth in buildings

PSYCHROMETRIC CHART

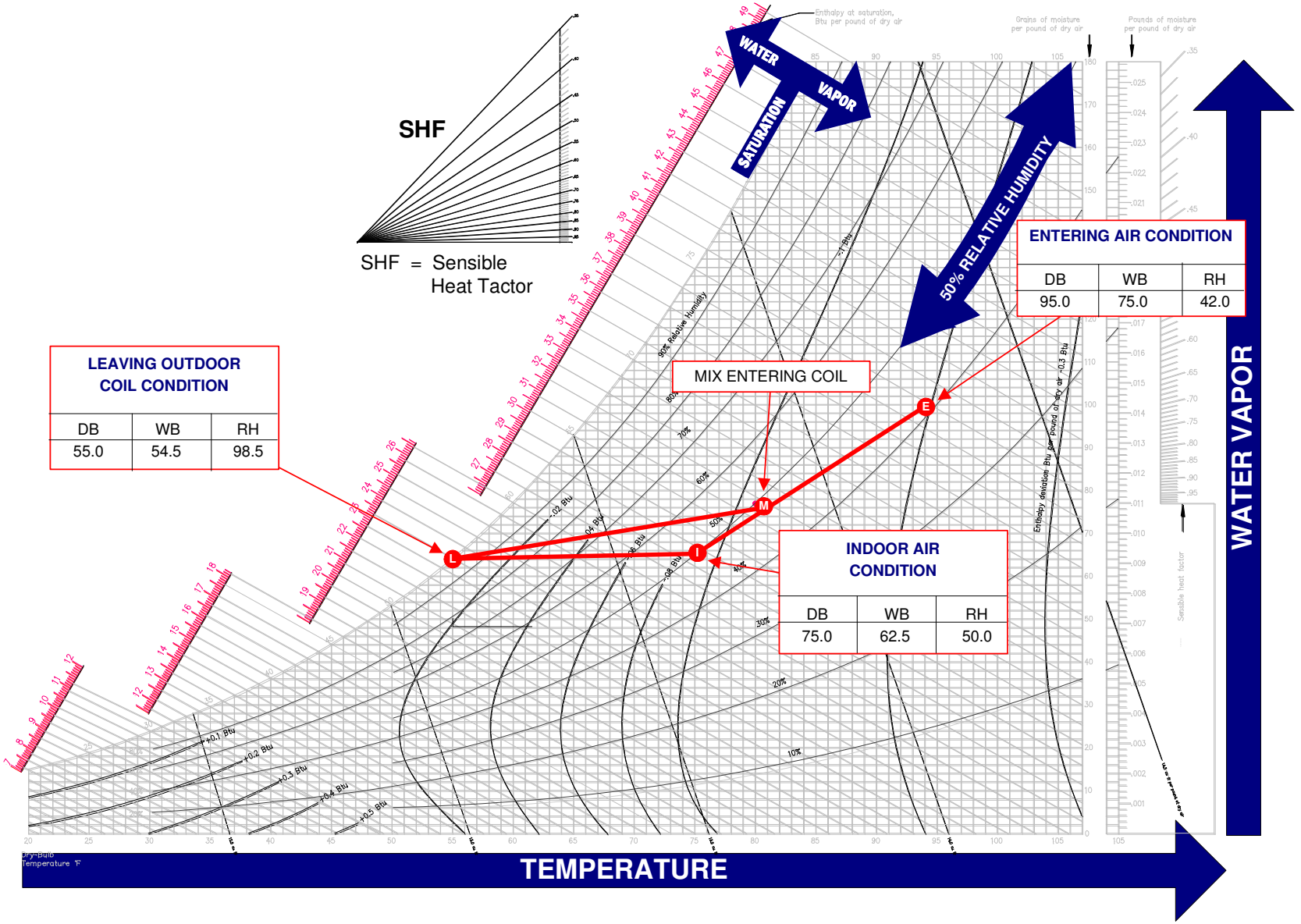


FIGURE 1 - TYPICAL AIR CONDITIONING CYCLE

PSYCHROMETRIC CHART

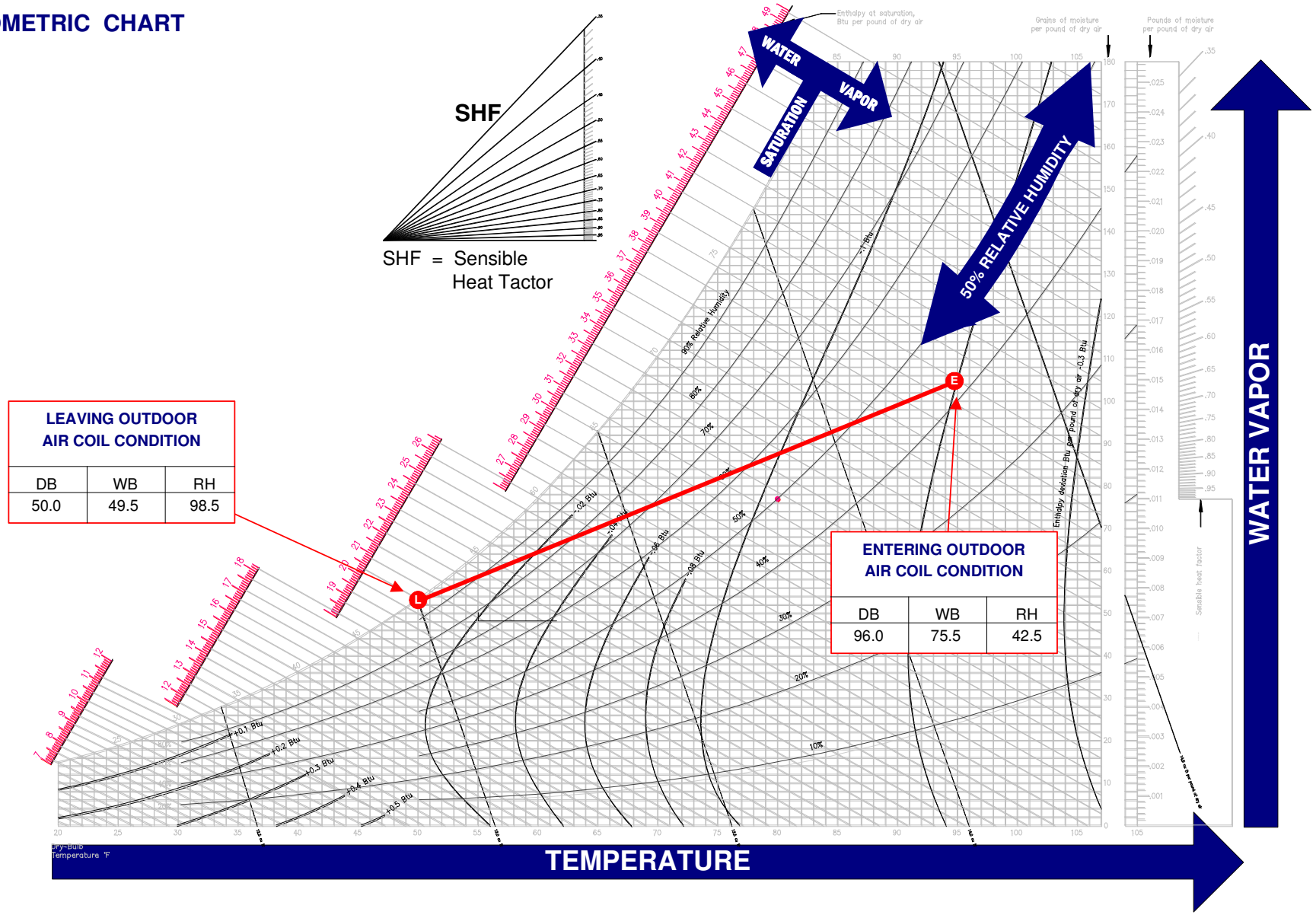


FIGURE 2 - PRECONDITIONING THE OUTSIDE AIR

PSYCHROMETRIC CHART

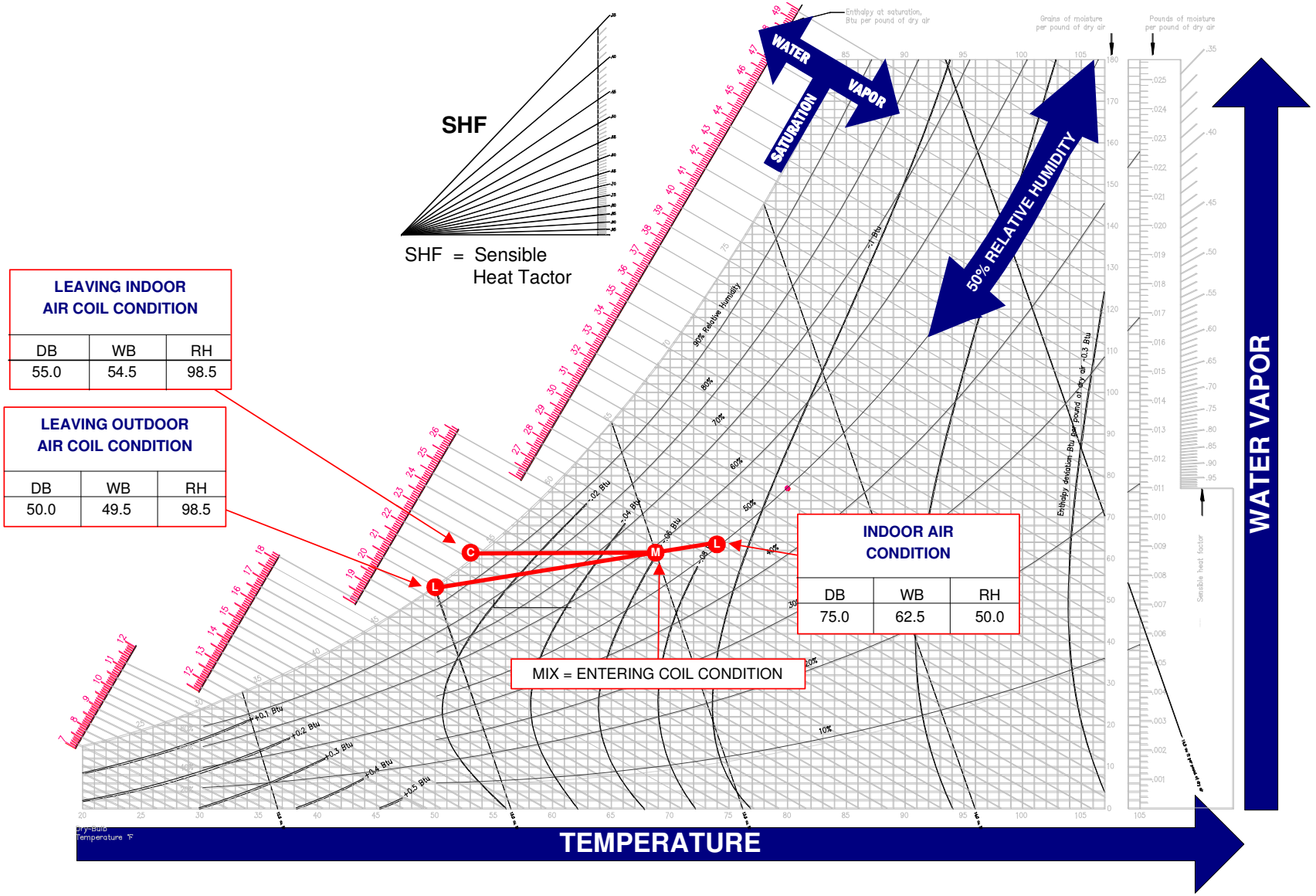


FIGURE 3 - DESIGN CYCLE TO PREVENT HIGH RELATIVE HUMIDITY INDOOR CONDITIONS

PSYCHROMETRIC CHART

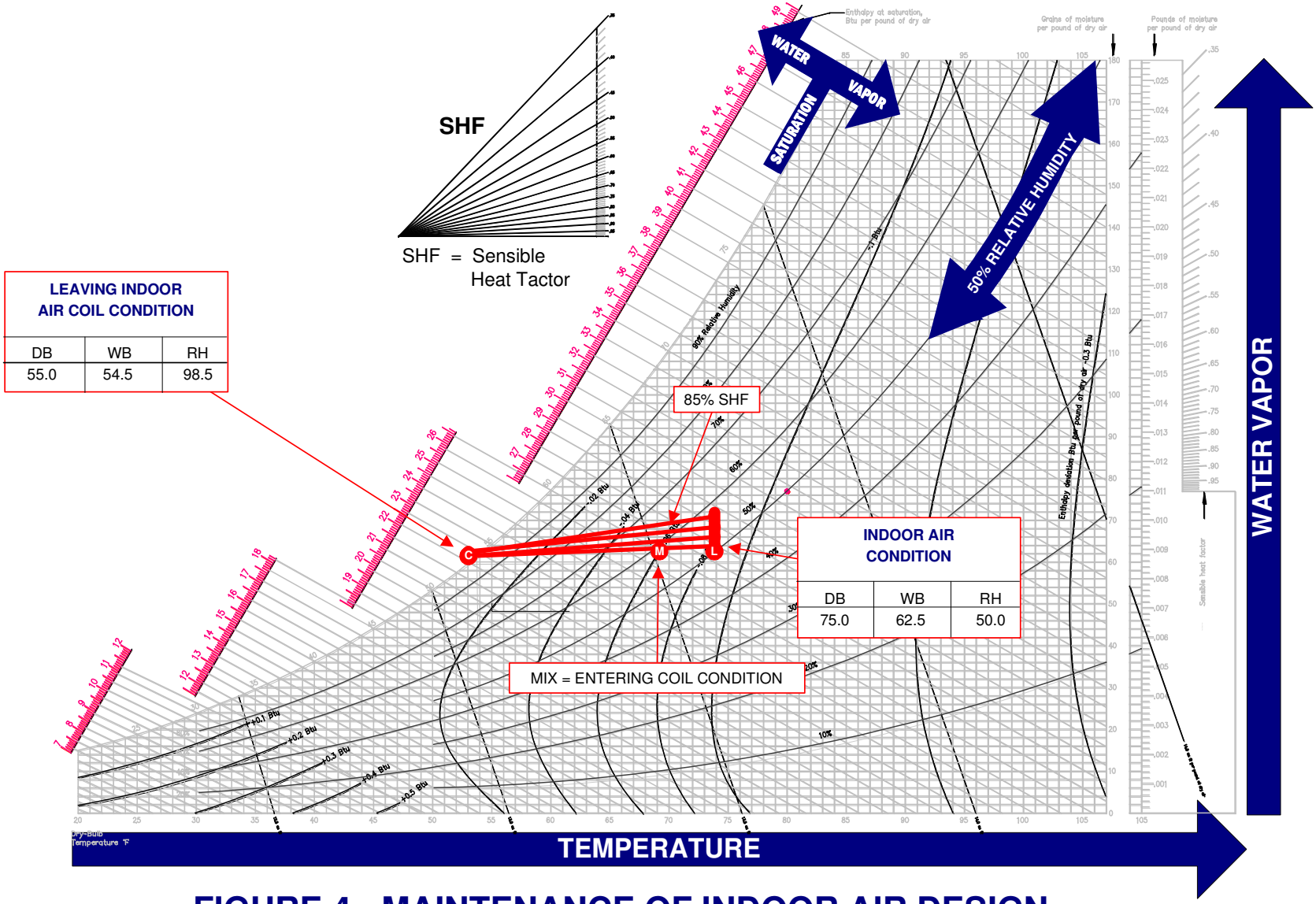


FIGURE 4 - MAINTENANCE OF INDOOR AIR DESIGN TEMPERATURE CONDITIONS WHILE HOLDING RELATIVE HUMIDITY LEVELS OF 50% TO 60% UNDER VARYING INTERNAL LOAD CONDITIONS

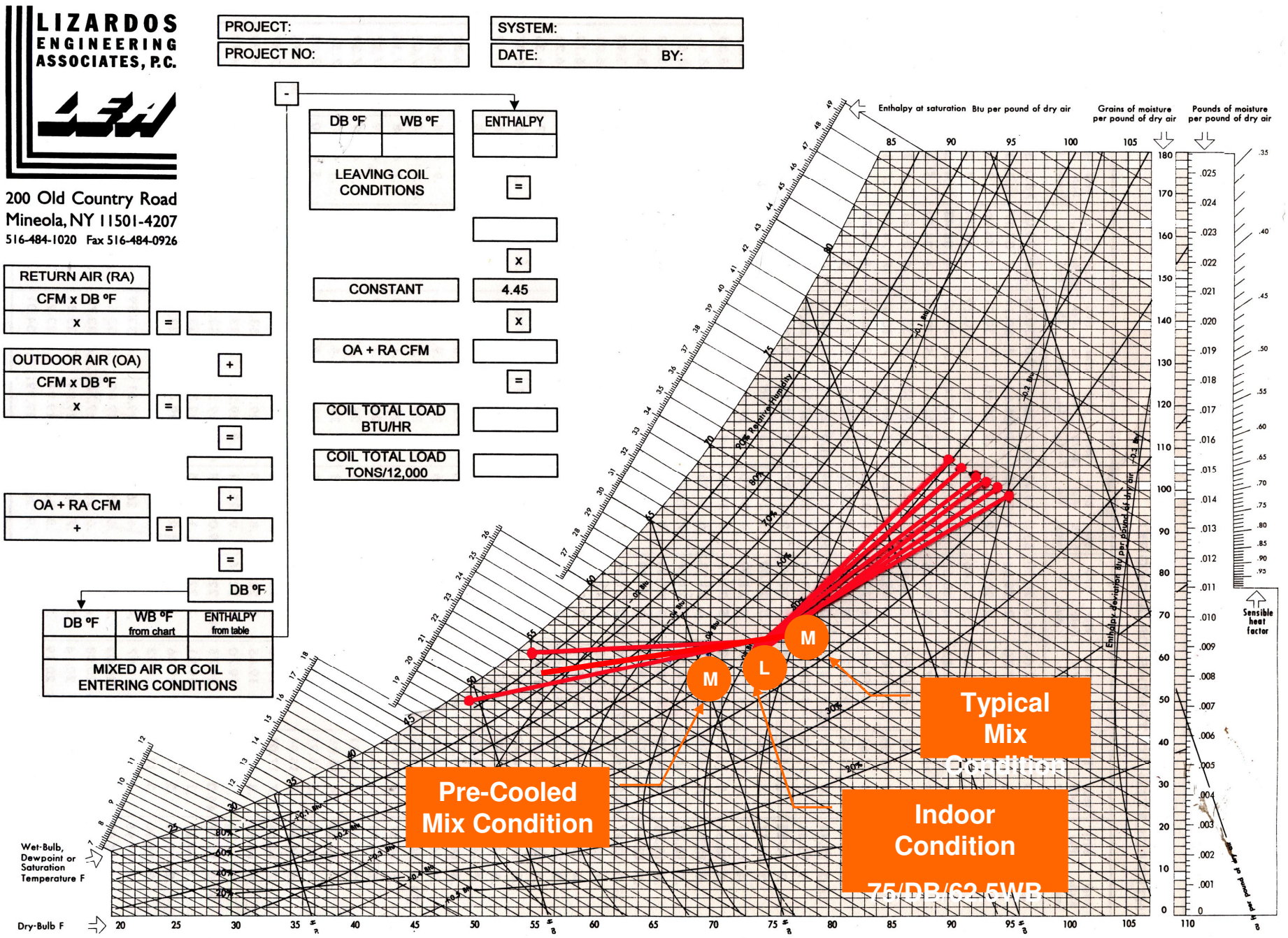


FIGURE 5 – SUMMARY OF OUTSIDE AIR MAKE UP CONDITIONS

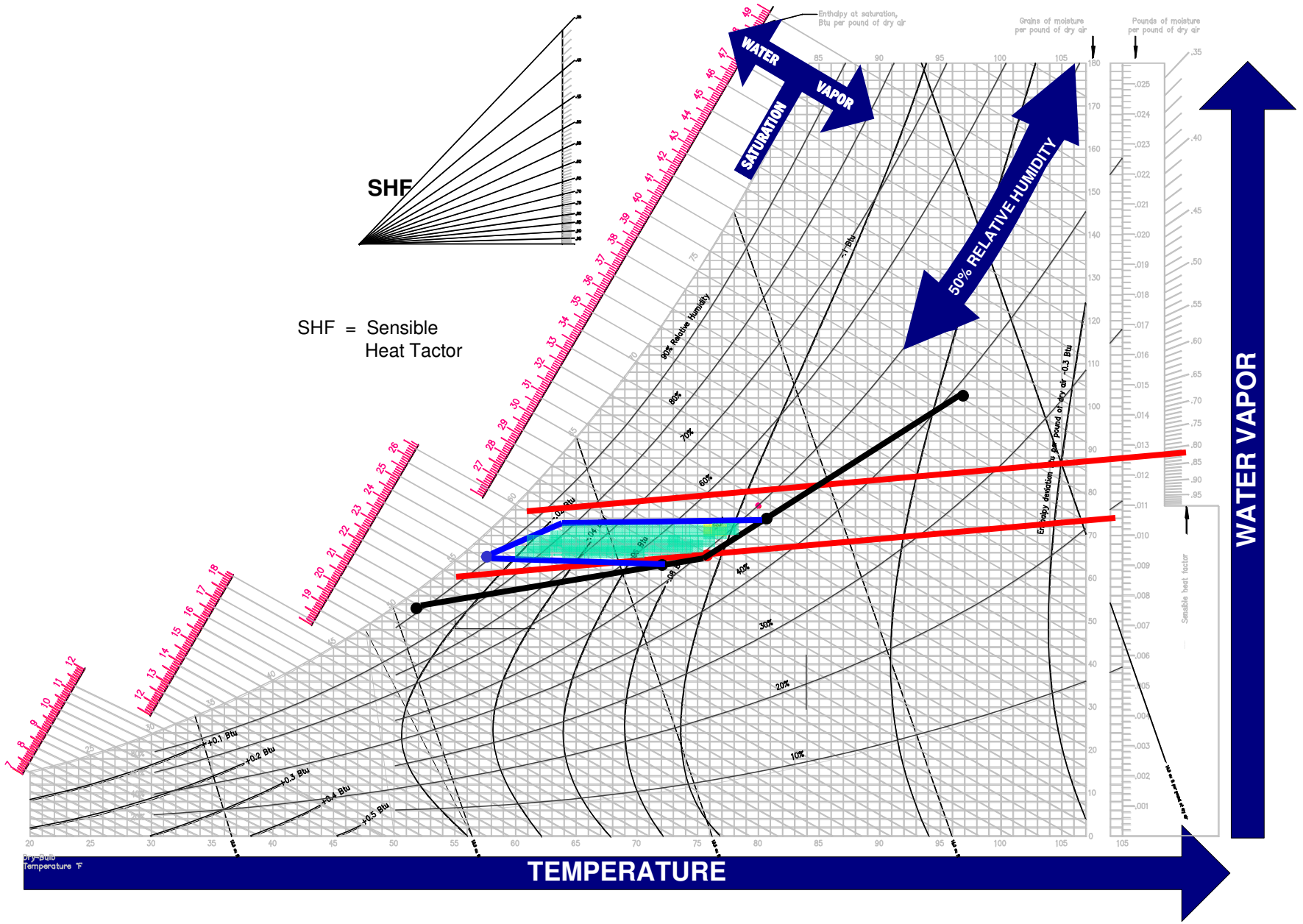
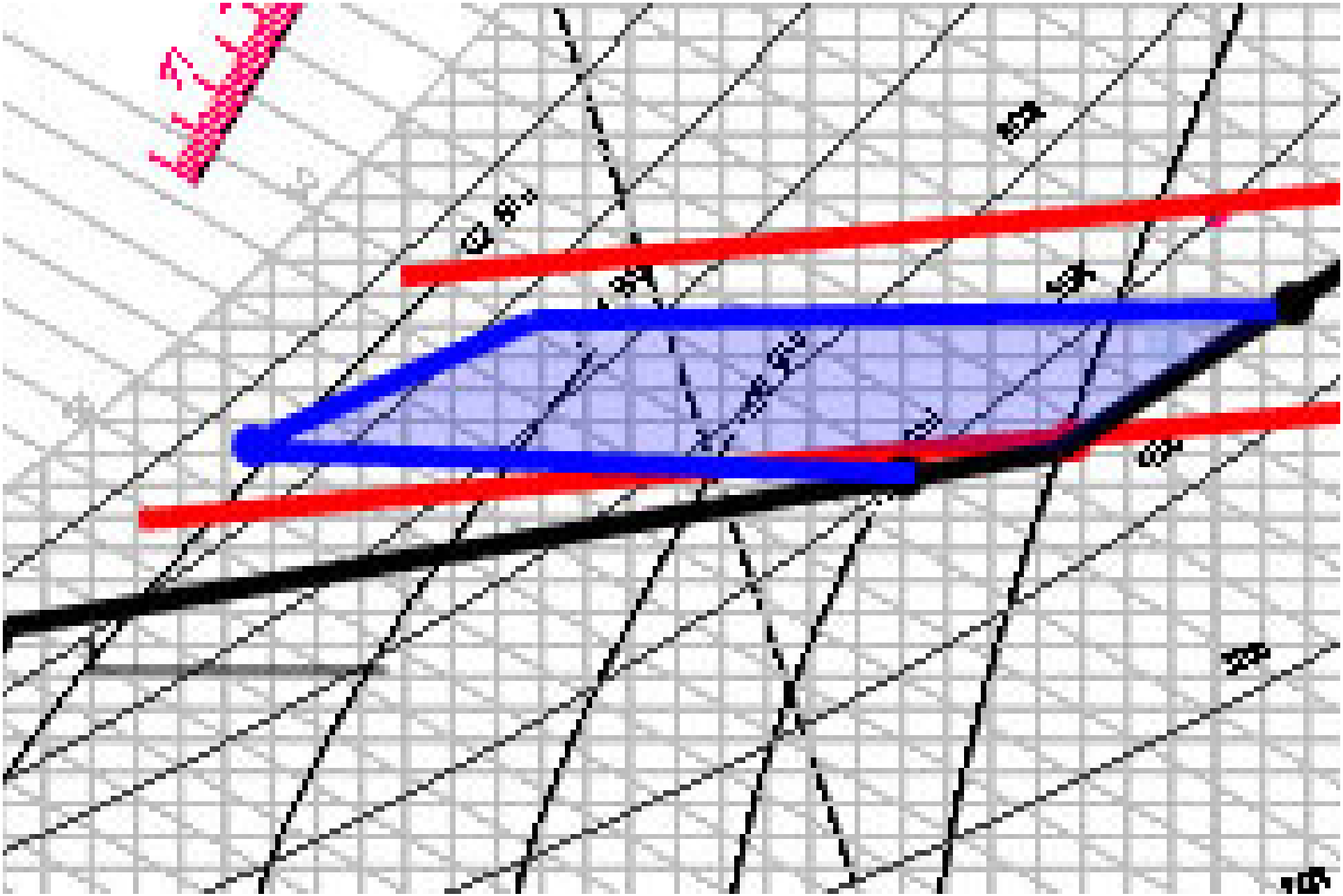


FIGURE 7 – OUTSIDE AIR CYCLES



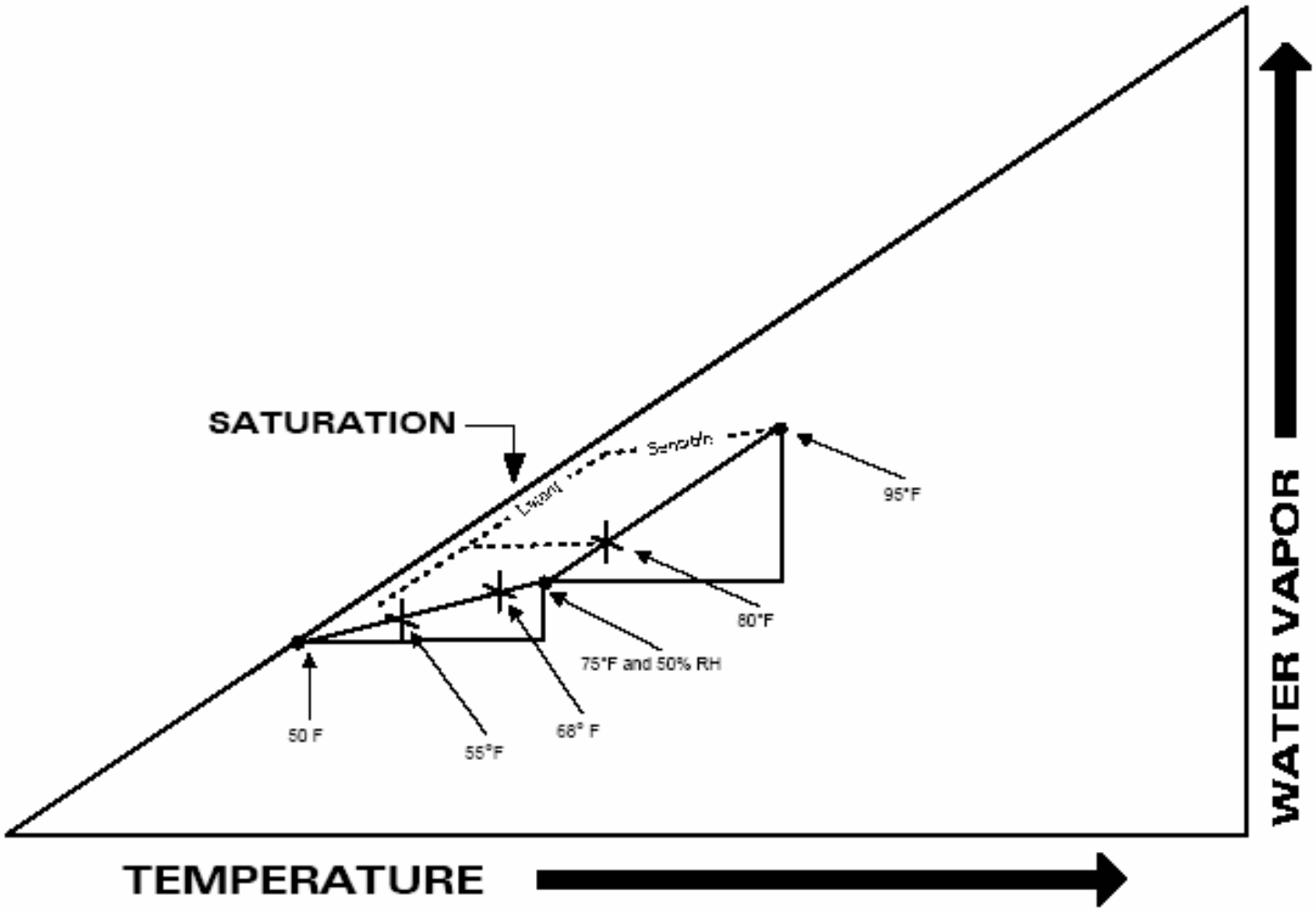
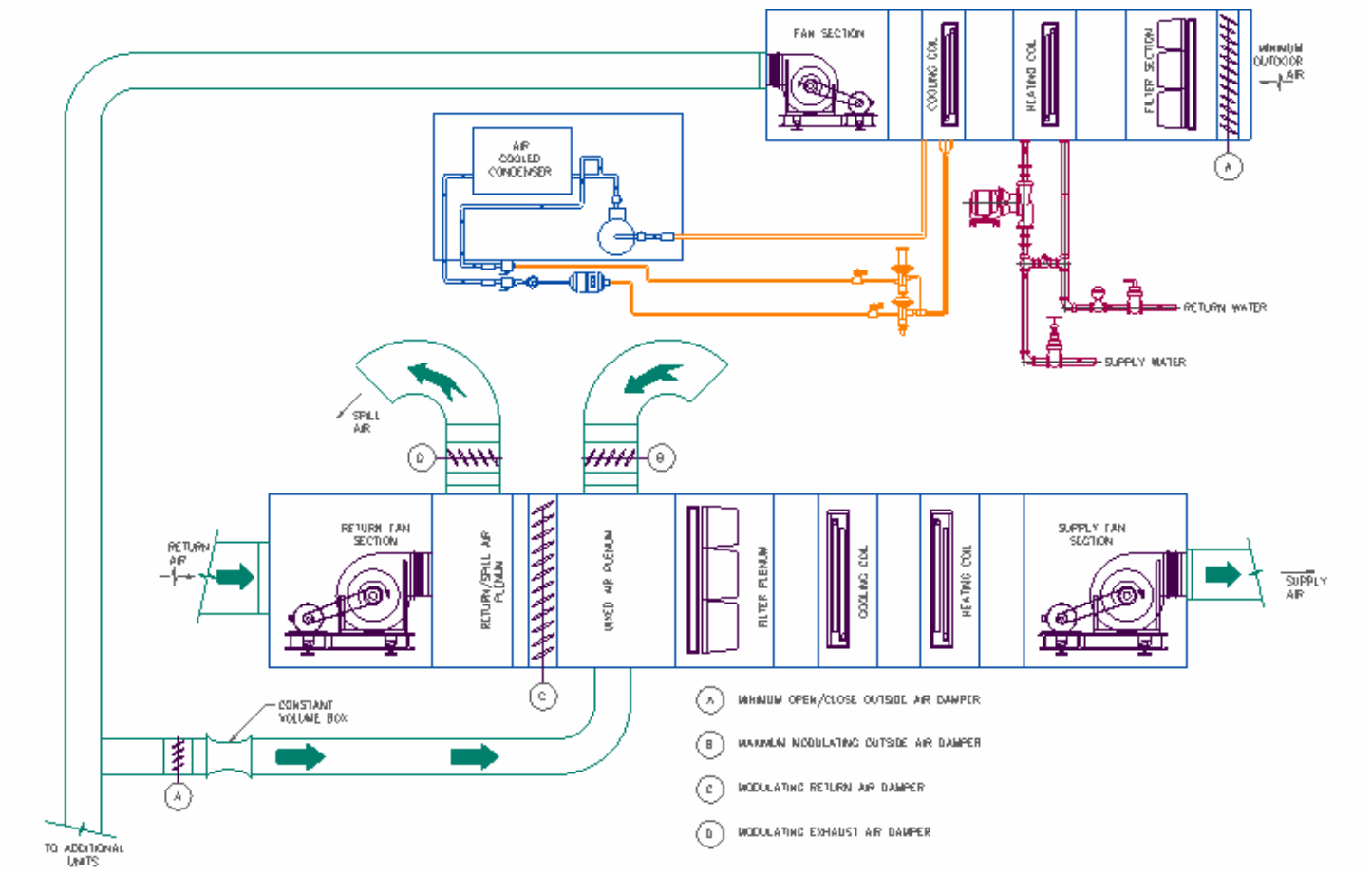
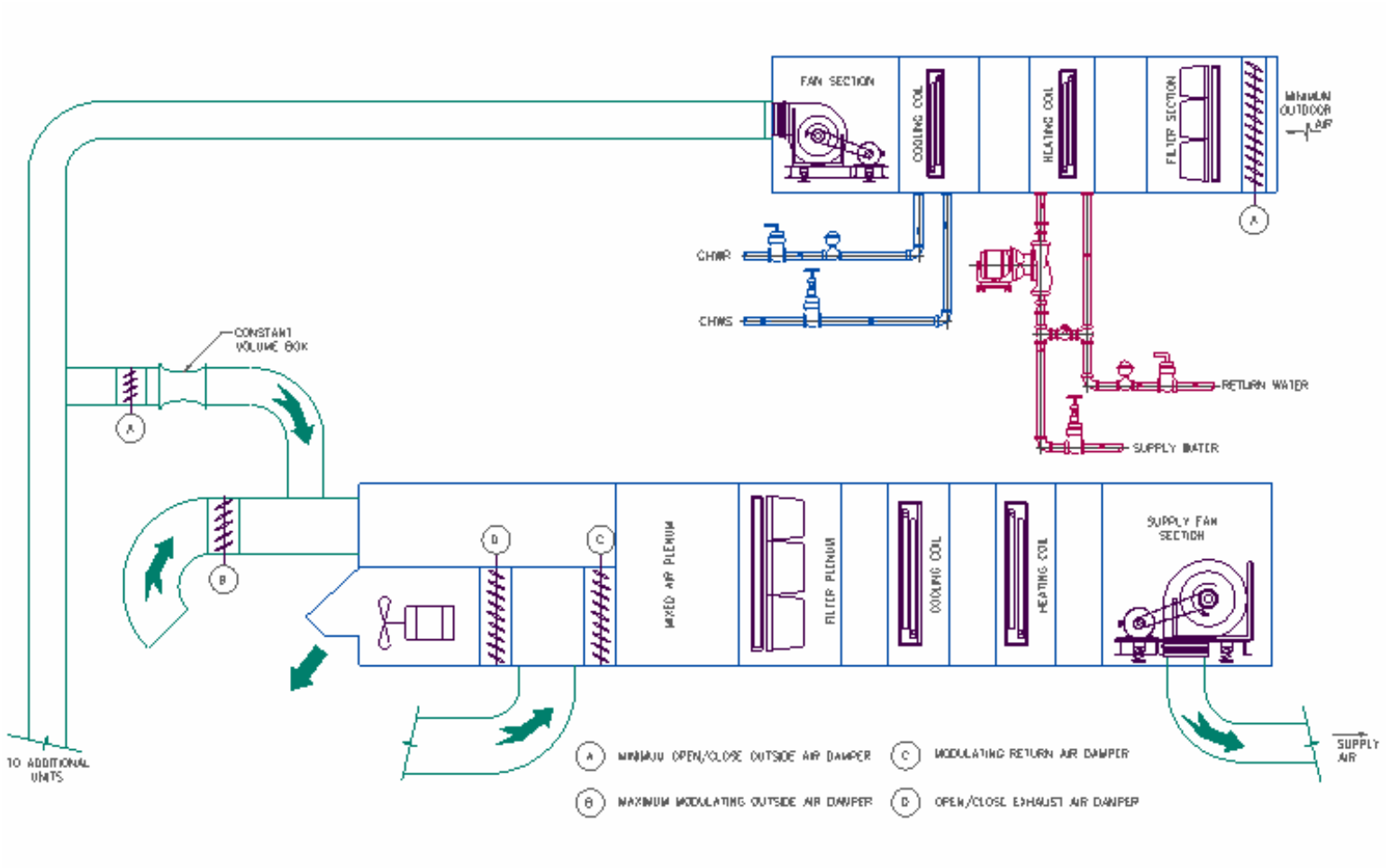


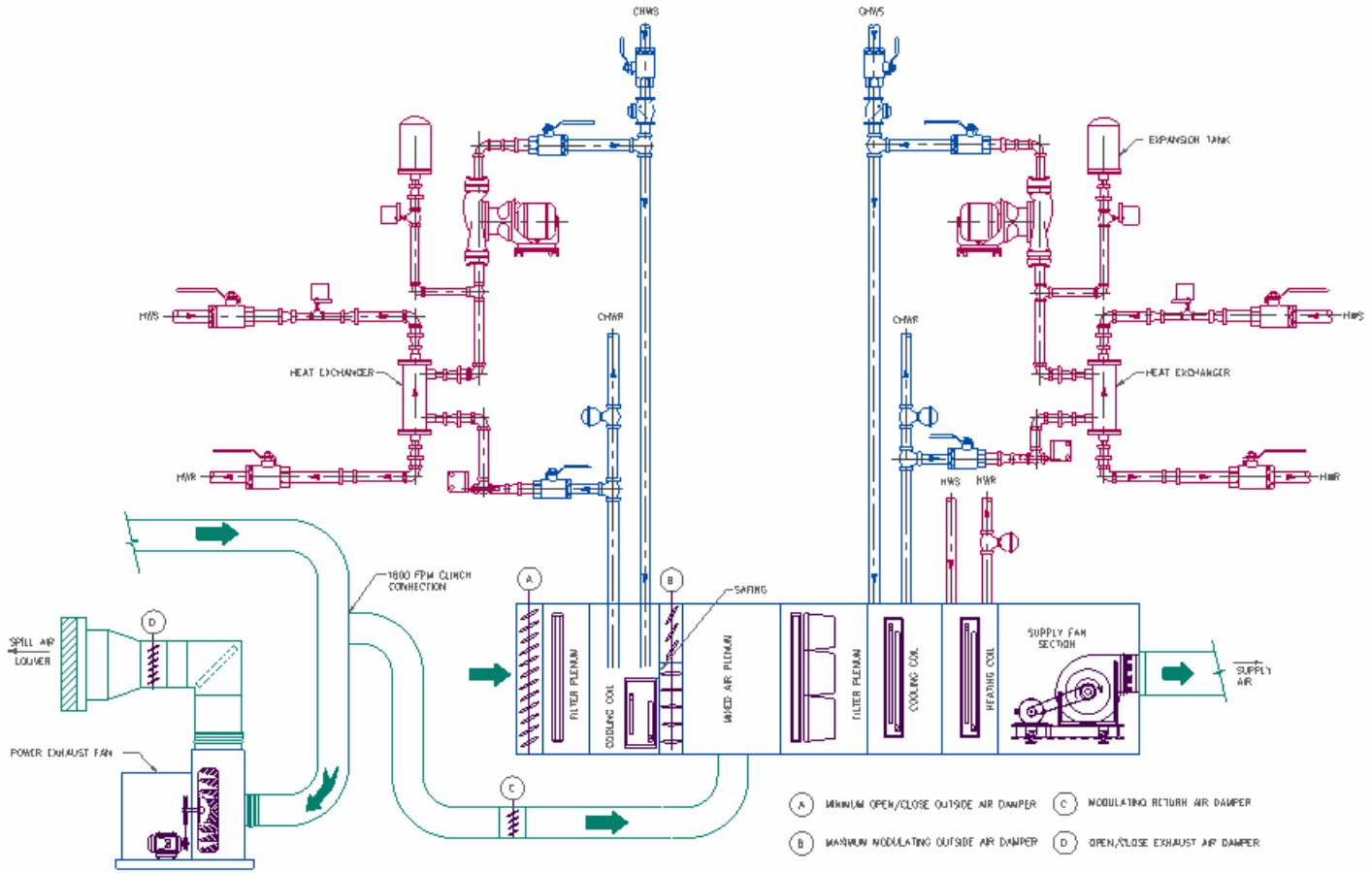
FIGURE 6 – SIMPLIFIED PSYCHOMETRIC CHART



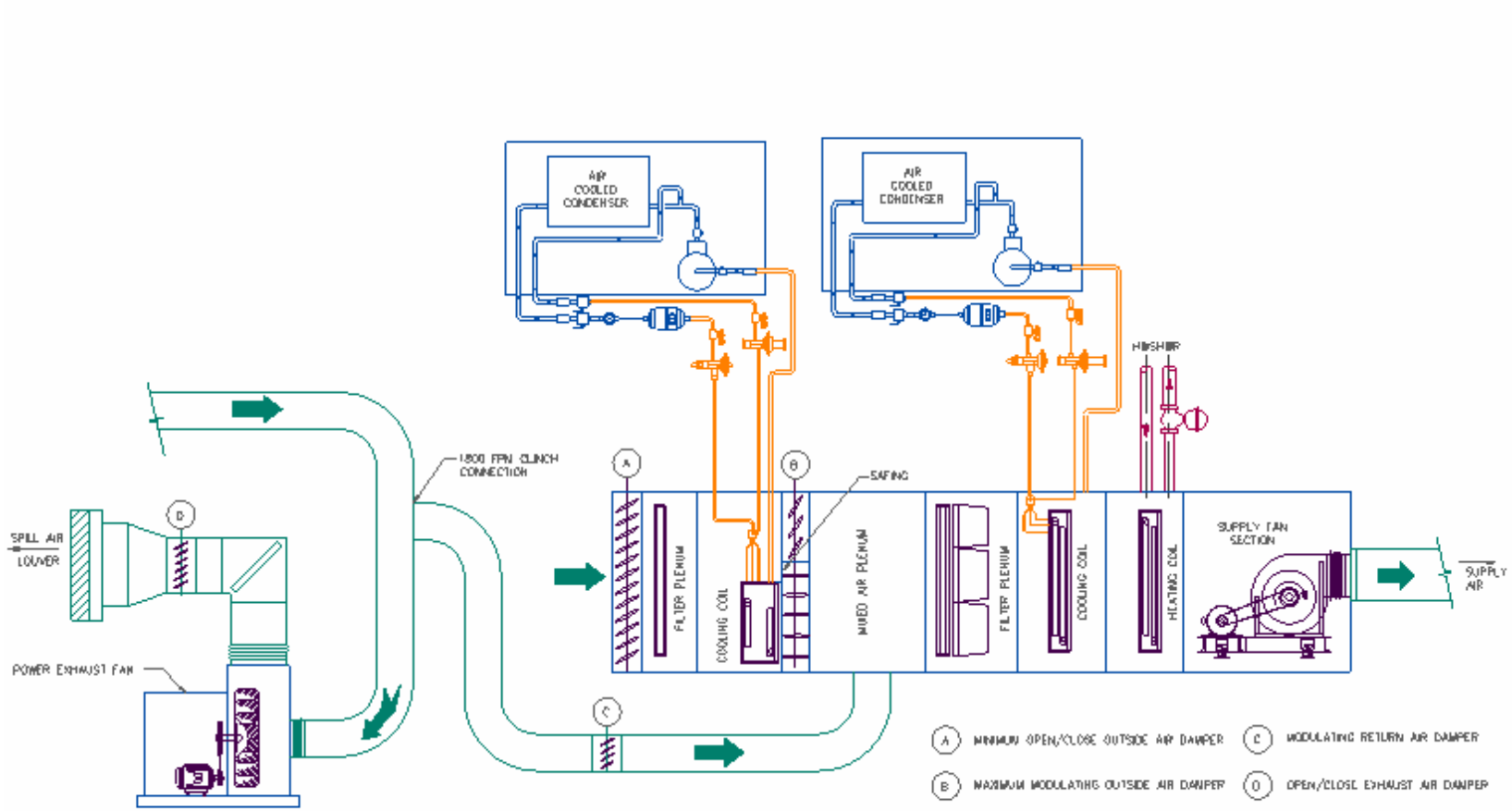
Air-Cooled Condensing Unit or a Chilled Water Supply to a Dedicated Air Handling Unit for Preconditioning Minimum Outdoor Air that serves Multiple Air Handling Units that Utilize a Return Fan Economizer Cycle



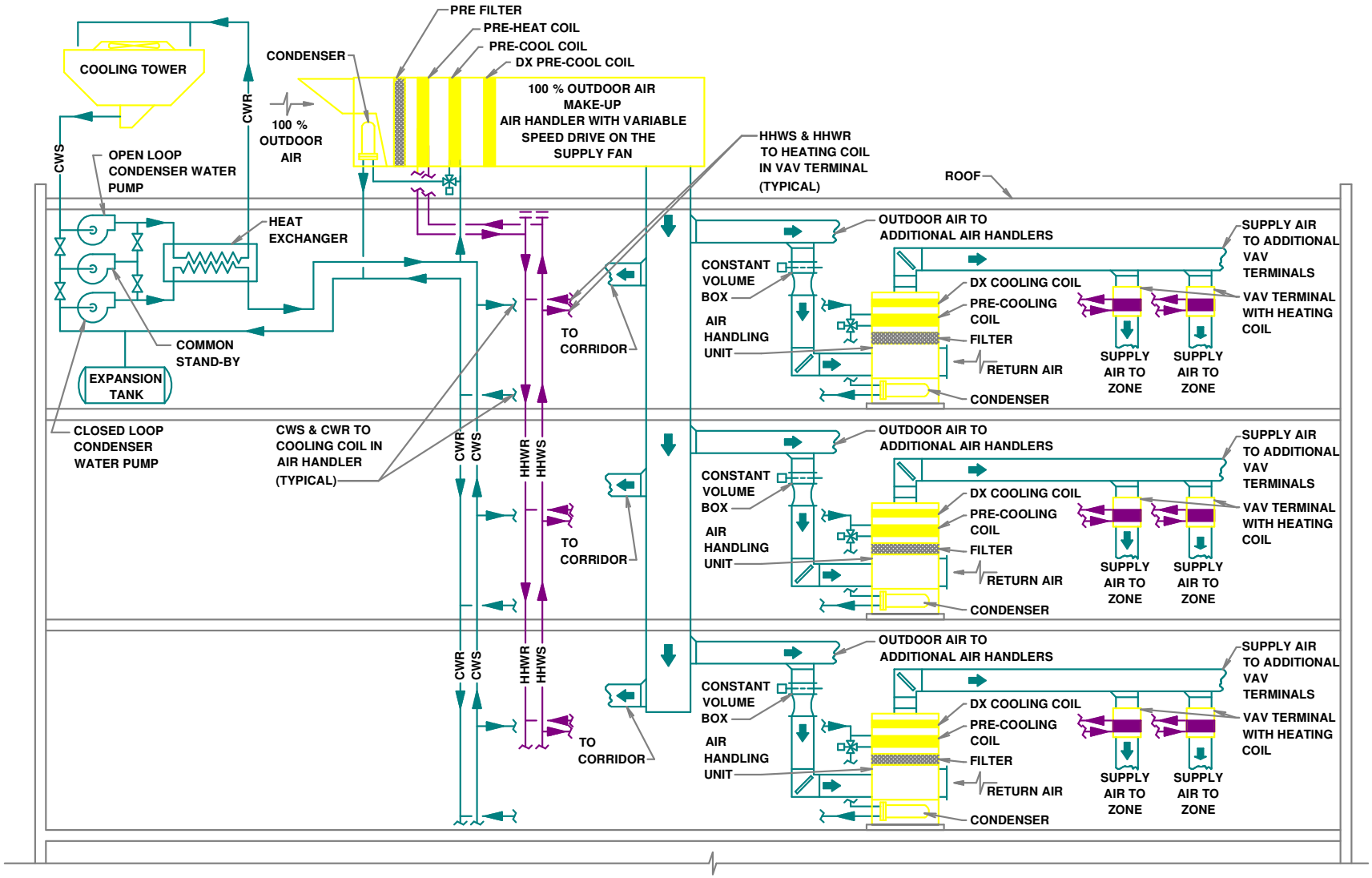
Air-Cooled Condensing Unit or a Chilled Water Supply Serving a Dedicated Air Handling Unit for Preconditioning Minimum Outdoor Air that Serves Multiple Air Handling Units that Utilize a Power Exhaust Fan Economizer Cycle



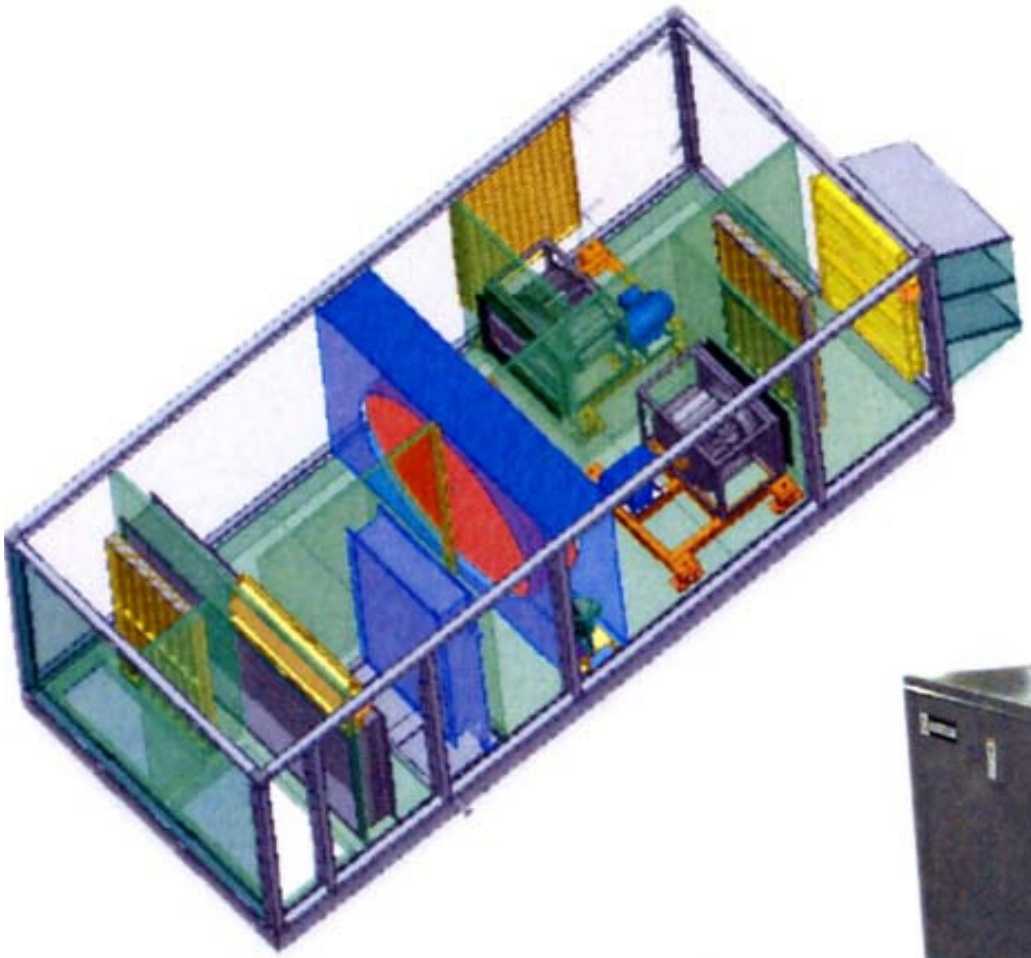
Chilled Water Supplied Air Handling Unit with a Minimum Outdoor Air Preconditioning Coil

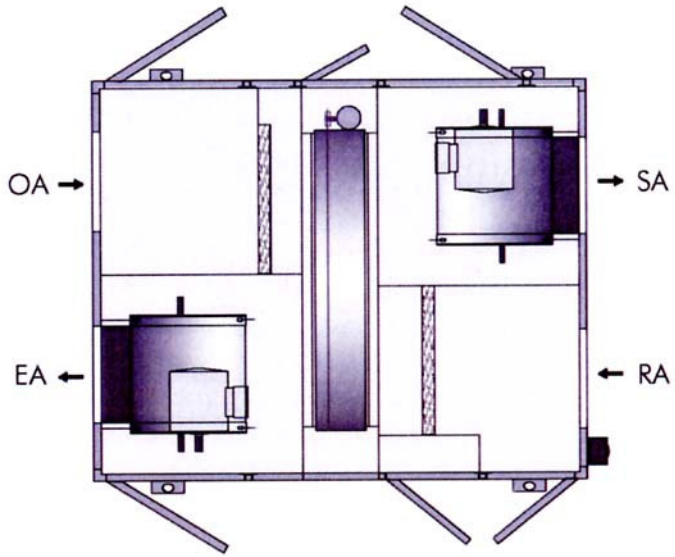


Air-Cooled Condensing Units Serving an Air Handling Unit with a Minimum Outdoor Air Preconditioning Coil



Preconditioned Outside Air Flow Diagram

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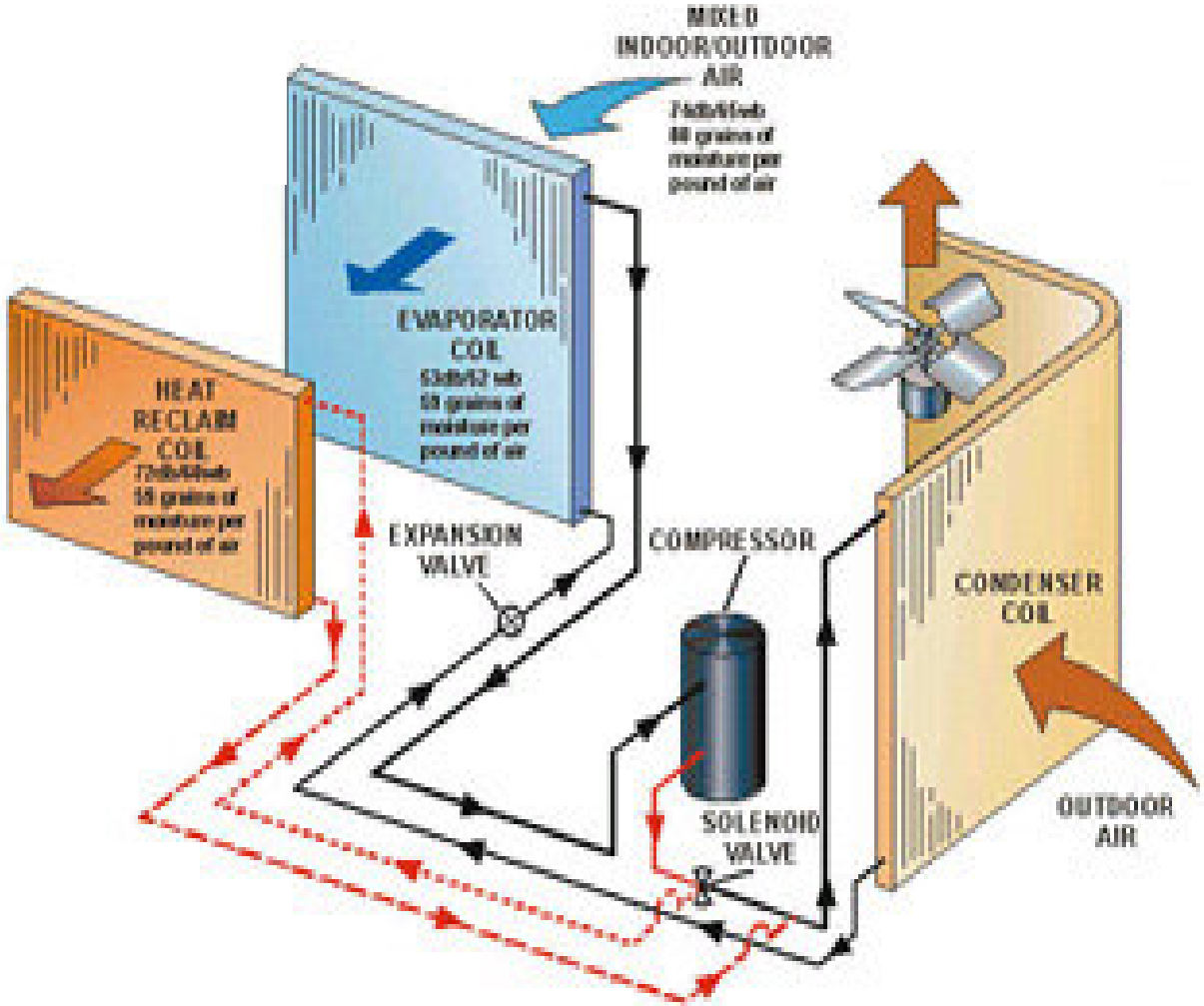
MIXED
INDOOR/OUTDOOR
AIR
EVAPORATOR
COIL
HEAT
RECLAIM
COIL
EXPANSION
VALVE
COMPRESSOR
CONDENSER
COIL
SOLENOID
VALVE
OUTDOOR
AIR

Thank you for your time. Please feel free to ask any and all questions.