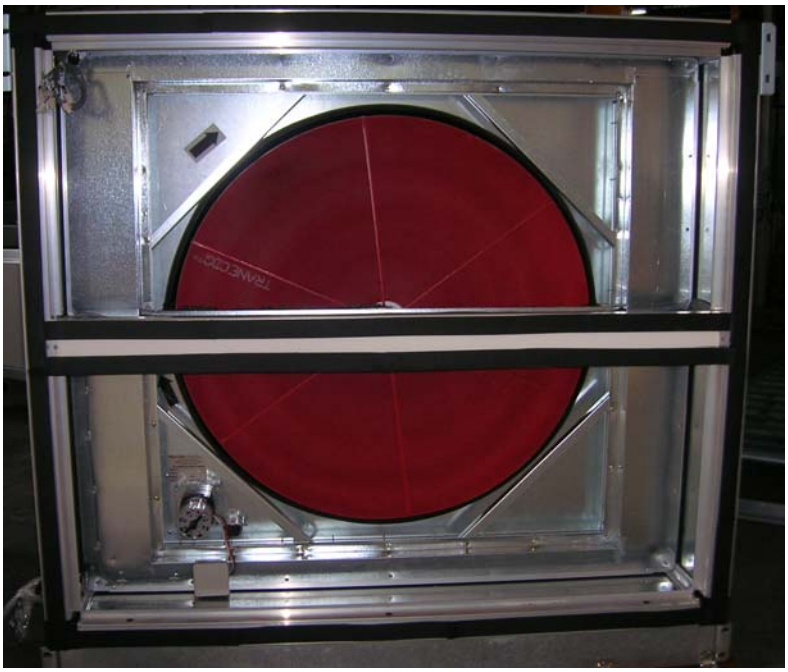
Trane AHU (CLCP) for Energy Efficient Humidity Control

CDQ™ Cool Dry Quiet Desiccant Dehumidification



CDQ-PRC001-E4

Contents

Introduction

CDQ Benefits

- Increased cooling coil latent (dehu midification) capacity
- Lower supply air dew points
- Decreased need for reheat
- Lower unit cooling sensible heat ratios (SHR)
- Warmer required chilled-water temperatures
- Decrease the required cooling capacity when dehumidifying
- Exhaust air is not required
- All electric system - no “expensive” gas heat needed

Lowers supply-air dew point

The addition of the CDQ desiccant wheel to the system enhances the dehumidification performance of the traditional cooling coil. The CDQ wheel transfers water vapor, and the cooling coil does all the dehumidification work in the system. The latent (dehumidification) capacity of the cooling coil increases without increasing its total cooling capacity. CDQ can achieve a lower supply-air dew point than the coil temperature.

Saves cooling and reheat energy

Utilizing the CDQ wheel enhances the dehumidification capabilities of a cooling coil. In order to remove the same amount of moisture, a cool-reheat system will require more cooling capacity and need to reheat CDQ will generally save cooling and reheat energy, any may even allow for downsizing of the cooling equipment.

The cooling coil sensible heat ratio (SHR-the ratio of sensible cooling to total cooling), is also lowered with CDQ without using reheat. This helps the unit provide significantly better part load dehumidification (up to 200 percent better) and reduces the need for reheat.

Extends achievable dew points of traditional DX or chilled water systems

A unique benefit of the CDQ system is that it can deliver a lower supply air dewpoint than other technology that uses a traditional cooling coil. A cooling coil can typically dehumidify air to a dew point that is 5^0F to 10^0F above the temperature of the fluid or refrigerant that flows through its tubes.

For example, 45^0F chilled water (depending on the flow rate and coil characteristics, of course) can dehumidify air to a dew point of 50^0F to 55^0F. By adding a CDQ desiccant wheel to the process, the supply-air dew point can be 0^0F to 10^0F below the chilled-water temperature. This can extend the achievable dew points of traditional DX or chilled-water systems.

Improves energy efficiency

A CDQ system can also improve the efficiency of chilled-water systems. Because the chillers can produce warmer water temperatures to achieve lower supply-air dew points, the chiller can be more efficient. CDQ may also reduce the pumping power by allowing reduced chilled-water flow rates, and may eliminate or reduce the need for glycol in the system. This allows building areas requiring lower dewpoints to use the same chilled water temperature as the rest of the facility.

Finally, in low dew point applications, CDQ may reduce overall energy use by eliminating the need for a coil defrost system or an active (high-temperature regenerated) desiccant system.

Reduces path noise control options

The main source of sound in ahu is fan & motor unit. The CDQ is a blow-thru design that is sandwiched in between, which means it is significantly quieter then a standard draw-thru unit.

Introduction

Figure 1. CDQ dehumidification processes

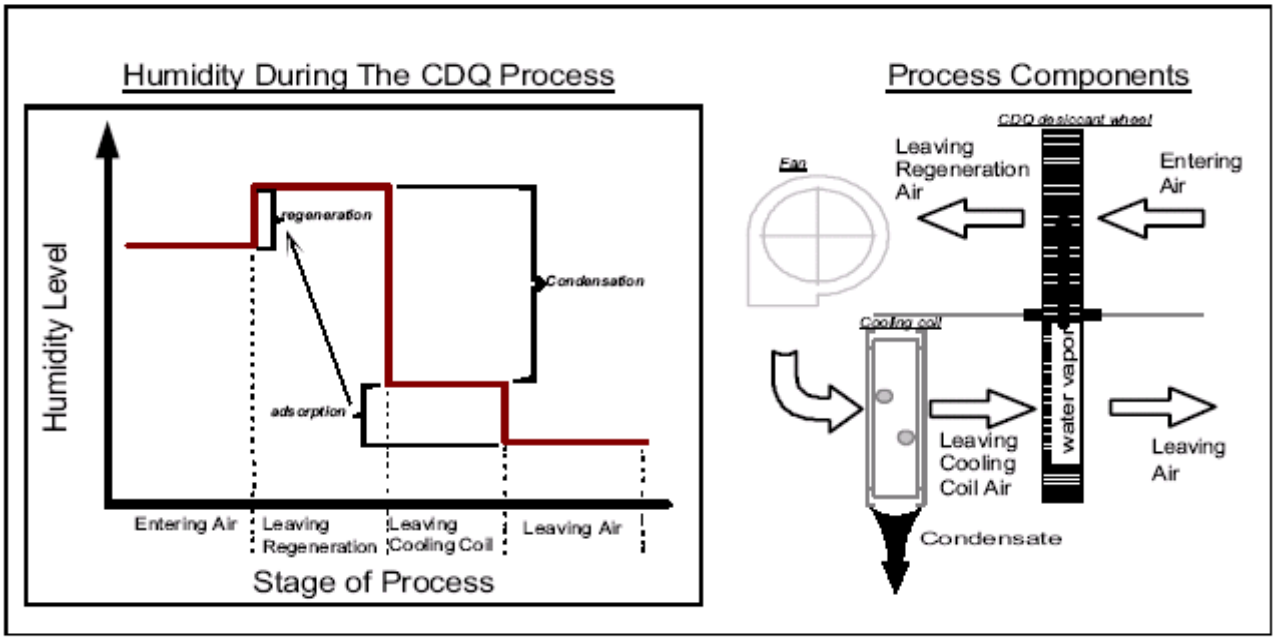


Figure 2

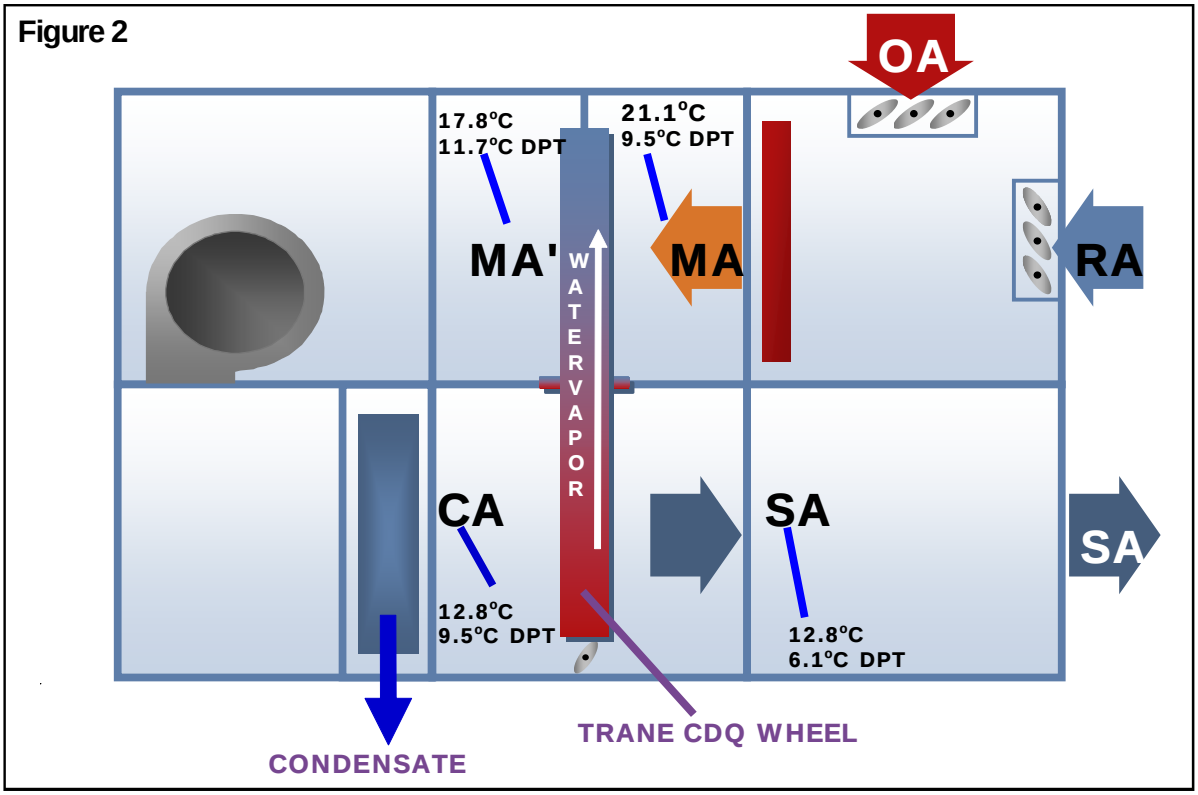


Figure 2 : Selection Example of AHU with CDQ - Supplying lower dew point air.

DPT = Dew Point Temperature

Introduction

What is CDQ

The TraneCDQ desiccant wheel is used to enhance the dehumidification performance of a traditional cooling coil. The wheel is configured in series with coil (see Figure 1,2 & 3) such that the "regeneration" side of the wheel is located upstream of the coil and the "process" side of the wheel is located downstream of the coil. The CDQ desiccant wheel absorbs water vapor from the air downstream of the cooling coil and then adds it back into the air upstream of the coil where the coil removes it through condensation. This process is accomplished without the need for a second regeneration air stream.

The addition of the CDQ desiccant wheel to the system enhances the dehumidification performance of the traditional cooling coil. The CDQ wheel transfers water vapor, and the cooling coil does all the dehumidification work in the system. The latent (dehumidificattion) capacity of the cooling coil increases without increasing its total cooling capacity. The system can achieve a lower supply-air dew point without lowering the coil temperature. Unlike a system with a cooling coil alone, the dew point of the air leaving the coil can be lower than the dry-bulb temperature leaving the coil.

Figure 3

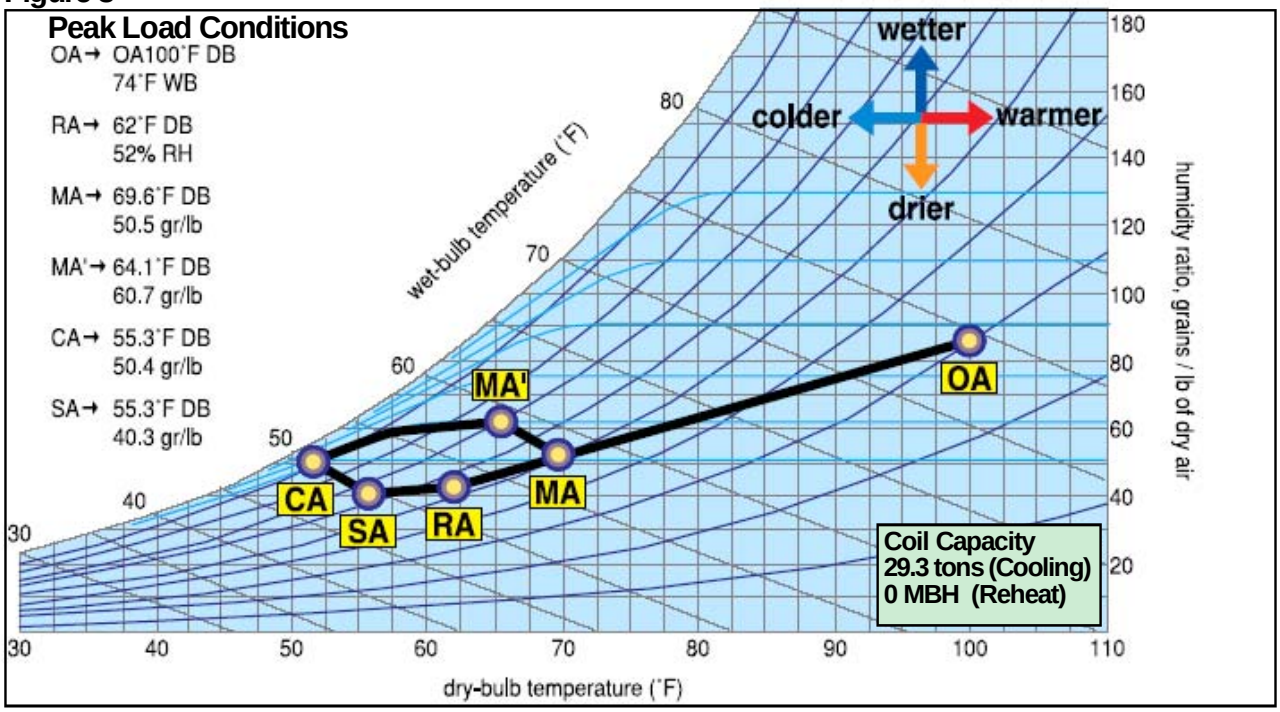


Figure 3 : Example of AHU with CDQ System that uses highly efficient system kW. CDQ System uses lower energy.

	Chiller (kW/Ton)	Chiller (kW)		AHU (kW)	System (kW)	AHU Heating (Thermal) (NaturalGas)
Cool & Reheat (1 Coil)	1.24	49.6	+	15.9	65.5	1.7
Cool & Reheat (2 Coils)		39.6	+	16.3	55..9	1.7
UpStream Coil	0.74					
DownStream Coil	1.24					
Split Dehumidifation Unit		35.1	+	16.9	52.0	
OA Coil	1.34					
RA Coil	0.74					
Trane CDQ	0.74	21.7	+	22.0	43.7	
Heat Regenerated Desiccant	0.74	32.5	+	23.5	56.0	3.4
Note Airflow : 15,000 CFM				✦ Energy Saving 33.3%		

Application

CDQ Application

The CDQ system can be applied in most commercial applications that require humidity control. This includes spaces that need to be maintained between 35 to 65 percent relative humidity. The benefit of using a CDQ system versus cool-reheat will vary by application, but the benefits of higher latent capacity, lower achievable supply-air dew point, and reduced reheat energy will be seen through the range of applications.

Application	Target Dewpoint or RH
Laboratories	40 DP
Dry air storage (military)	35% RH
Ice rinks	25 DP
Dorms	47 DP
Elder-care facilities	47 DP
Hospitals (operating rooms)	40 DP
Museums, archives	35 DP
Libraries	47 DP
Schools	47 DP
Supermarkets (freezer area)	42 DP
Office buildings	47 DP
Hotels	47 DP
Restaurants	47 DP

DPT = Dew Point Temperature (^{0}F)

35 to 45 Percent Relative Humidity Spaces

The CDQ system provides the most benefit in 35 to 45 percent relative humidity applications. This range of space relative humidity requires that the supply-air dew point be 30^{0}F to 48^{0}F. The primary benefit of using a CDQ system in these applications is the ability to use warmer coil temperatures (warmer chilled-water temperatures or higher suction temperatures) than would be required by another system. Dry storage/ archives, hospital operating rooms, and laboratories are just a few 35 to 45 percent relative humidity applications that may benefit from a CDQ system.

Dry Storage/Archives

This space type has a small latent load in the space and requires very little ventilation air to be introduced. The challenge for humidity control is keeping the space humidity level at the desired low level. Since the mixed-air relative humidity is low, the CDQ desiccant wheel will be operating at its most efficient conditions to help lower the supply air dew point. This will raise the required coil temperature and also lower the need for reheat.

Hospital Operating Rooms

Operating rooms are not only kept at a low relative humidity but also at cooler temperatures, a good fit for a CDQ system. The improved latent removal capacity not only reduces the required cooling needed but the lower supply-air dew points can eliminate the need for a secondary refrigeration coil or a heat regenerated active desiccant system. Because active desiccant systems provide hot air (which would then require a significant amount of post-cooling), the use of a CDQ system in this application can produce significant energy savings.

Laboratories

A CDQ system can help achieve the lower relative humidity needed for laboratories. Because the exhaust air often contains contaminants, total energy (enthalpy) recovery from the exhaust air is usually not permissible. A CDQ system can improve energy efficiency and latent removal from the space without the need to use the exhaust air stream.

50 to 65 Percent Relative Humidity Spaces

Most of the benefits of a CDQ system are also realized in these applications, particularly at part load conditions. The primary benefit in these applications is an increased latent capacity and lower SHR, which allows the unit to better match the space dehumification requirements. Schools and colleges, retail stores and restaurants, and office buildings are just a few 50 to 65 percent relative humidity applications that may benefit from a CDQ system.

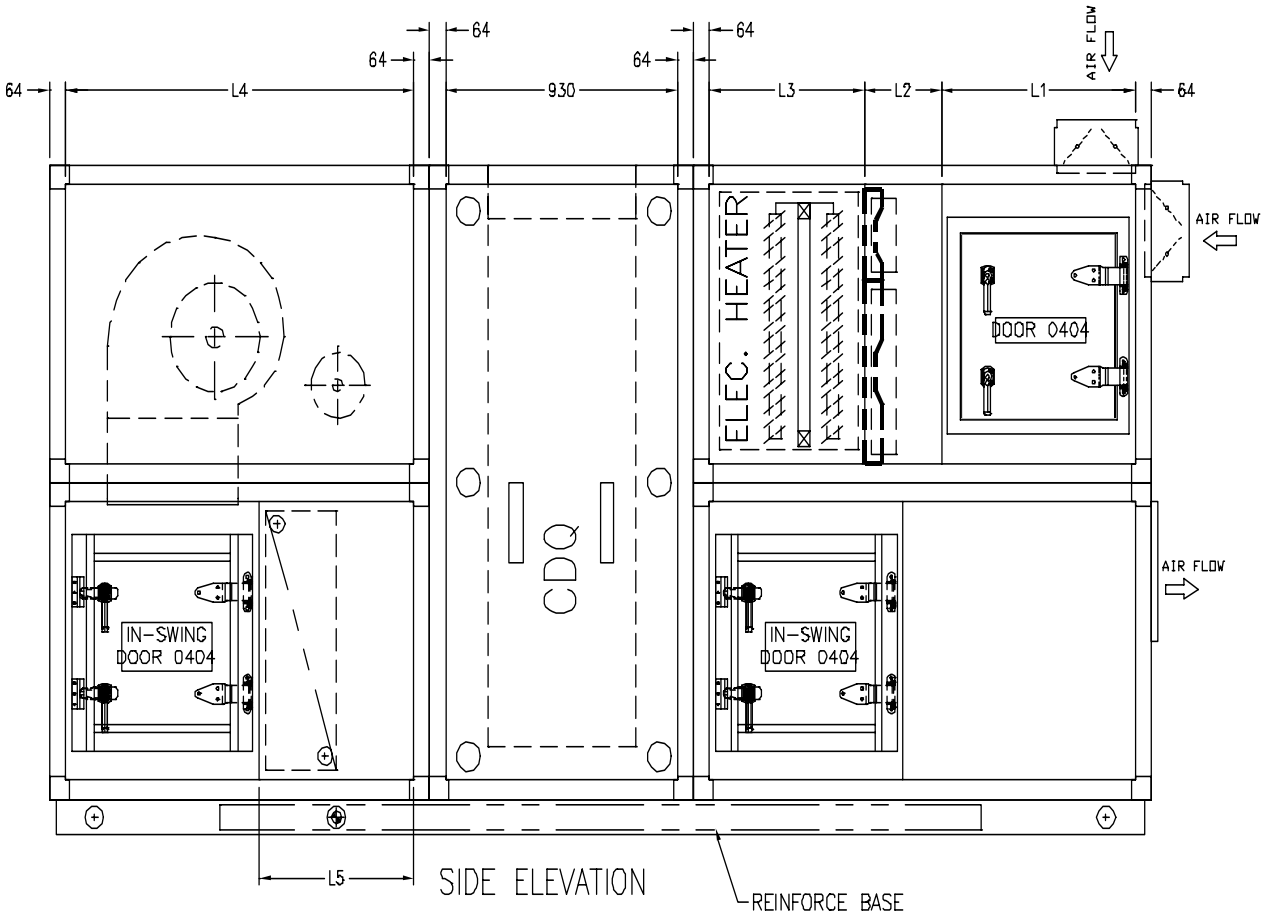
Schools and Colleges

Because of the high occupancy level of classrooms, the space latent load can be high. This load occurs years can be high. This load occurs year round, which results in a lower SHR at part load conditions. A CDQ air handler can be used to help achieve the higher latent capacity needed for classrooms. The system can be either constant volume or variable air volume (VAV). Humidity levels in schools can elevate during weekends and other times when the buildings are unoccupied. The same air handler can be used as a recirculating dehumidifier to keep the humidity levels under control during unoccupied hours.

Office Buildings

A constant volume or VAV system can be enhanced to get better humidity control in the space. A CDQ system can also be helpful in offices designed with under-floor air distribution. Air delivered at floor level is at a warmer dry-bulb temperature (typically around 65^{0}F). This can create a dehumidification challenge in many climates. A CDQ system can deliver air at 65^{0}F drybulb temperature, and at a dew point of 55^{0}F to 58^{0}F, without the need for overcooling and reheat (or overcooling and mixing in bypassed return air).

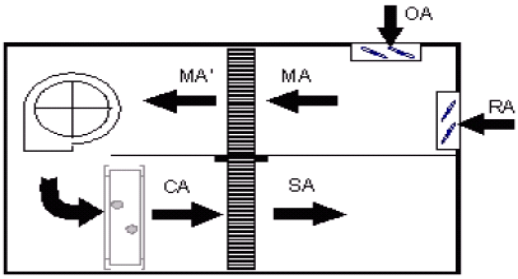
Dimensions



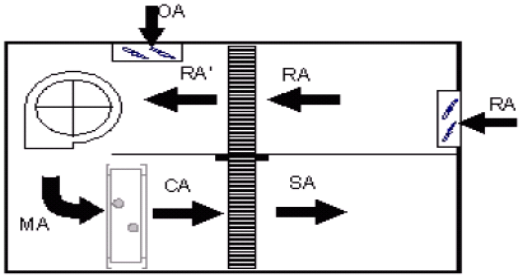
Model	Nominal Airflow		L4	L5			L3		L2		L1		
		Motor	Fan Section	Coil Section			Electric Heater Section		2"Pre+4"Catridge	2"Pre+15"Bag	Mixing/Intake Section		
		kW		4 R	6 R	8-2 R	1-3Steps	4Steps	Filter Section	Filter Section		Width	Height
CLCP003	0.6	0.18 - 3	1085	310	465	620	465	620	310	620	775	748	1616
CLCP004	1.0	0.37 - 3	1085	310	465	620	465	620	310	620	775	1058	1616
CLCP006	1.4	0.55 - 7.5	1240	310	465	620	465	620	310	620	775	1368	1616
CLCP008	1.9	0.75 - 7.5	1240	310	465	620	465	620	310	620	775	1678	1616
CLCP010	2.3	1.1 - 7.5	1240	310	465	620	465	620	310	620	775	1368	2236
		11 - 15	1395	310	465	620	465	620	310	620	775		
CLCP012	3.0	1.1 - 7.5	1395	310	465	620	465	620	310	620	775	1678	2236
		11 - 15	1550	310	465	620	465	620	310	620	775		
CLCP014	3.6	1.5 - 7.5	1395	310	465	620	465	620	310	620	775	1988	2236
		11 - 15	1550	310	465	620	465	620	310	620	775		
CLCP016	4.1	3 - 15	1550	310	465	620	465	620	310	620	775	1678	2856
		18.5	1705	310	465	620	465	620	310	620	775		
CLCP020	5.0	3 - 15	1705	310	465	620	465	620	310	620	775	1988	2856
		18.5 - 22	1860	310	465	620	465	620	310	620	775		
CLCP025	6.2	5.5 - 15	1860	310	465	620	465	620	310	620	775	1988	3476
		18.5 - 30	2015	310	465	620	465	620	310	620	775		
CLCP030	7.4	5.5 - 15	1860	465	465	620	465	620	310	620	775	1988	4096
		18.5 - 30	2015	465	465	620	465	620	310	620	775		
CLCP035	8.7	7.5 - 22	2015	465	465	620	465	620	310	620	775	2298	4096
		30	2170	465	465	620	465	620	310	620	775		
CLCP040	10.1	4 - 45	1860	465	465	620	465	620	310	620	775	2608	4096
CLCP045	11.5	4 - 45	1860	465	465	620	465	620	310	620	775	2918	4096

Note : Electric Heater is used when dryer air is needed.

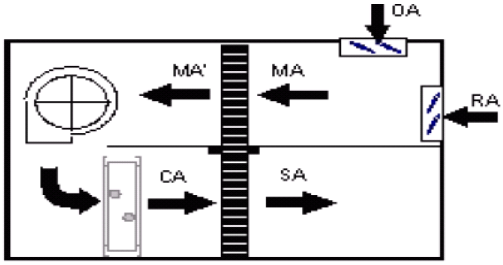
Selection Procedure



Outside Air 0-100%

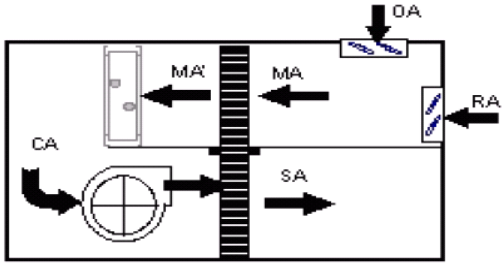


Outside Air 0-40%



Draw-Thru/Blow-Thru Wheel, Blow-Thru Coil

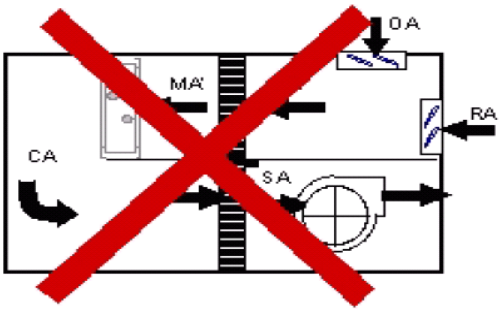
Recommended configuration for optimum performance



Draw-Thru/Blow-Thru Wheel, Draw-Thru Coil

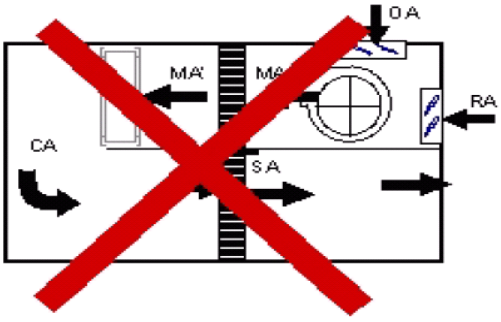
Not recommend for low dew point applications

Acceptable in comfort cooling applications where packaged equipment dictates this configuration



Draw-Thru Wheel, Draw-Thru Coil

Not recommended

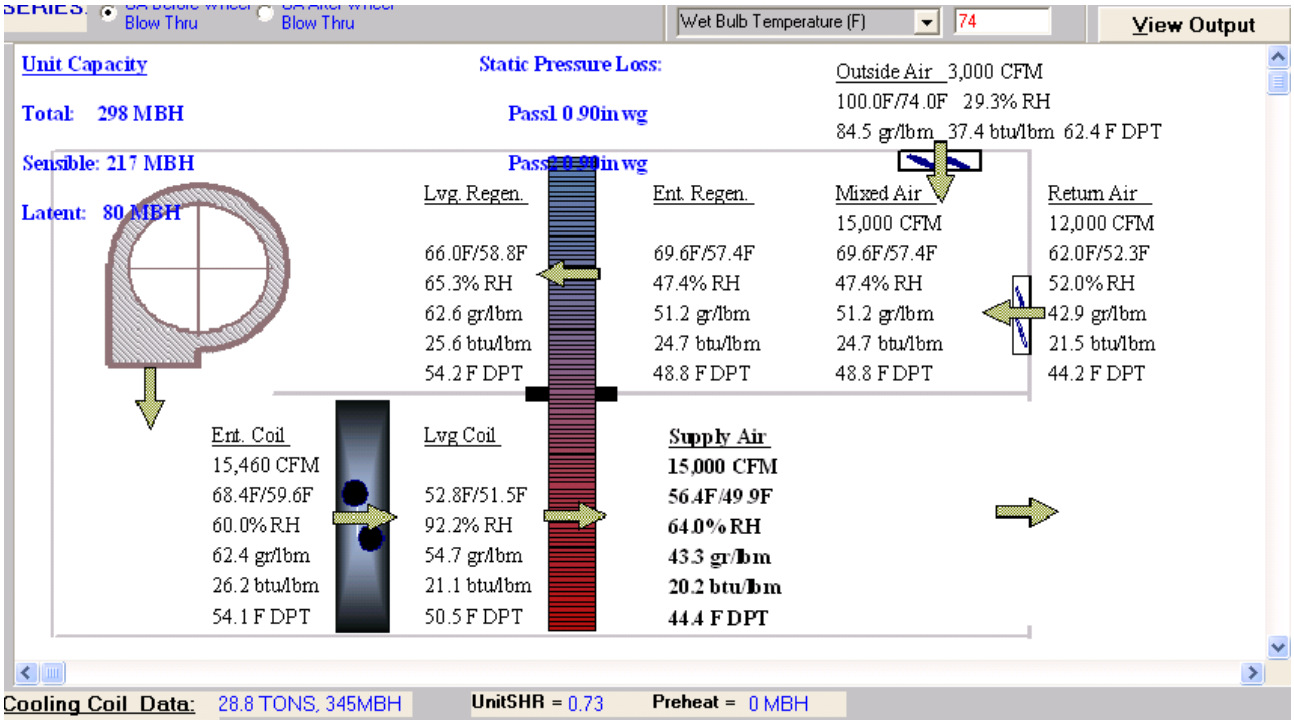


Blow-Thru Wheel, Blow-Thru Coil

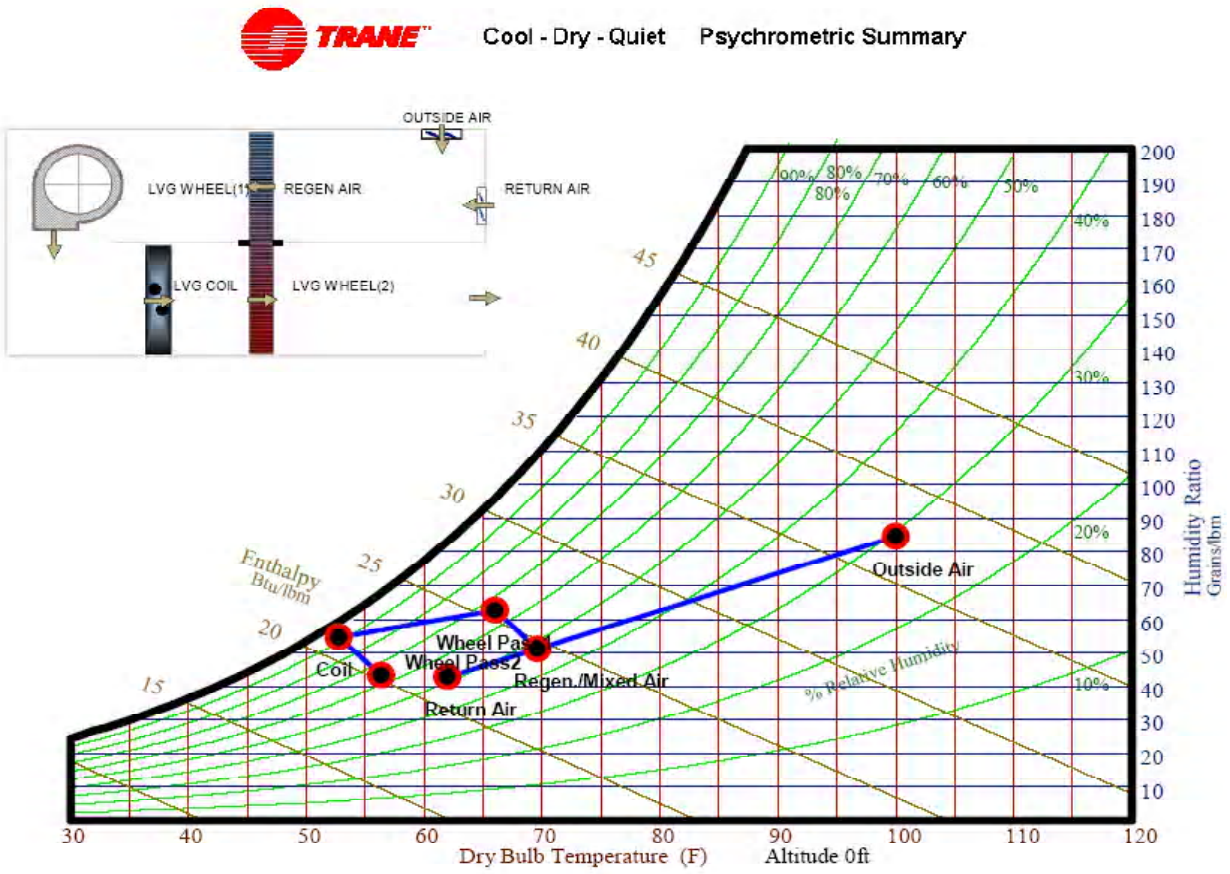
Not recommended

Selection Procedure

The CDQ performance program can be used to determine the required coil capacity based on the required supply-air dew point, dry-bulb temperature, and airflow. Performance runs should be completed for cooling design day, dehumidification design day, and possibly even a warm, rainy day. This will confirm that the cooling equipment is sized appropriately. In many comfort-cooling applications, the CDQ wheel may may only operate at part-load conditions. For these and other cases, it is a good idea to check the performance at a part-load condition to highlight the benefits of a CDQ system.



Performance Data



	AIR FLOW VOLUME (SCFM)	DRY BULB TEMPERATURE (F)	RELATIVE HUMIDITY (%)	HUMIDITY RATIO (grains/lbm)	ENTHALPY (btu/lbm)
RETURN AIR	12,000	62.0	52.0	42.9	21.5
OUTSIDE AIR	3,000	100.0	29.3	84.5	37.4
MIXED/REGEN.AIR	15,000	69.6	47.4	51.2	24.7
LVG WHEEL (1)	15,000	66.0	65.3	62.6	25.6
LVG COOLING COIL	15,000	52.8	92.2	54.7	21.1
LVG WHEEL(2)	15,000	56.4	64.0	43.3	20.2

UNIT SHR = 0.73

REQUIRED COIL CAPACITY 28.8 TONS, 345 MBH

REDUCTION IN REQUIRED COOLING CAPACITY USING CDQ vs COOLING WITH REHEAT 14.7 TONS, 33.8%

REQUIRED PREHEAT CAPACITY 0 MBH

REDUCTION IN REQUIRED REHEAT USING CDQ : 195.0 MBH

CDQ Mechanical Specifications

1. DEHUMIDIFICATION CASSETTE

1.1. The CDQ dehumification wheel shall be placed in the air handler as shown in the air handler unit drawings. The dehumidification wheel shall not require an additional regeneration airflow stream or the use of a high heat source. If any preheat is required it shall not exceed the scheedulled capacity.

1.2. The CDQ dehumidification wheel shall not utilize exhaust air. The CDQ wheel shall have no exhaust air tranfer.

1.3. Cassettes can be designed with either a vertical (side by side) or a horizontal (over/under) airflow arrangement as per requirements. The cassettes shall be mounted upright.

1.4. Cassettes casing shall be constructed of heavy duty G90 galvanixed steel. Cassettes up to 7000 cfm shall be single face panel construction for easy service access to the wheel drive motor and belt. Larger cassettes shall be double face panel with removable side panel for access to belt and drive motor. Small amounts of casing deflection shall have no significant impact on wheel performance or life. Casings shall have a 1" - 1 1/2" perimeter flange to facilitate inside AHU cabinet with self-tapping sheet metal screws. Alternatively, cassettes may be mounted using "safeoff" blanking to the side, top, and bottom of the cassette.

1.5. The CDQ dehumidification wheels shall be constructed of synthetic matrix with an adsorbent integrally bound into the matrix. The adsorbent shall be selected for its high affinity for water vapor at the CDQ operating conditions. The adsorbent shall be a type III desiccant. Construction of the wheel shall be corrugated, fluted design, which provides distinct passageways and prevents internal wheel bypass. The desiccant is intimately, permanently bound and uniformly dispersed throughout the wheel matrix. Because the dessiccant is not applied as a glued on surface coating, it is not susceptible to erosion, abrasion, or de lamination of the desiccant. The wheel matrix shall be rigid and glued layer-to-layer, and not susceptible to sagging or separation of the layers. The wheel shall be structurally reinforced with a spoking system to minimize wheel deflection. Because the product is nonmetallic, it offers complete resistance to corrosion. The media shall meet the flammability requirements governing this class of products and be UL recognized components in accordance to UL 1812 and UL1995.

1.6. All cassettes shall include both a circumferential seal as an air block-off around the perimeter, and an inner diametric seal separating regeneration and supply sides. Seals shall be full contact nylon brush seals, which minimizes leakage. Seals are factory set and field adjustable and make intimate contact with the wheel on all surfaces. CDQ cassette, wheel ans seal configuration allows for operation at high differential pressures. Seal replacement should not be necessary during the life of the product.

1.7. The drive system shall consist of a heavy-duty fractional horsepower A/C gear motor mounted in the cassette and cooled by the Ahu air stream. Motor location shall be as required. All motors have permanently lubricated bearings. Minimal amp draw will be reuired and all motors shall be 115V/1PH/60Hz or 230V/1PH/60Hz. Drive belts shall be high performance v-belt multilink belts. The multilink belt allows for replacement of individual links (1" each) if a section of belt becomes worn or breaks. Belts are installed under tension, require no mechanical tensioner, and do not require adjustment after startup. The rotation speed of the wheel shall not exceed the scheduled value.

1.8. The wheel matrix shall be cleanable by vacuuming or pressurized air blowing, or alternatively with low temperature steam, hot water, light detergent.

1.9. Cassettes shall be provided with bearings which support rotation of the wheel around a center shaft driven by a perimeter belt. The bearings shall be internal ball bearings press fitted into the bored wheel hub for all wheels up to and including 72" diameter. Internal bearings are permanently lubricated, no maintenance bearings which support fixed shaft operation of the wheel assembly. Flanged or pillow block bearings which support rotating shaft operation of the wheel assembly are used for all units larger than 72" diameter. Outboard bearings are provided with grease fittings for periodic lubrication. L10 bearing life is greater than 400,000 at design conditions.

1.10. The wheel cassette shall be continuous operation over ambient temperatures ranging from -40F to 200F at any relative humidity without adversely affecting wheel performance or life.

1.11. Performance shall be as predicted by CDQ selection software as scheduled. The performance shall be based on testing conducted on the wheel cassette installed in the air handler configuration as shown in the AHU drawings. Performance based on standalone desiccant wheel cassette or tests with two independent air streams are unacceptable. Performance data shall be from tests of a complete unit performed by an ISO 9000 certified laboratory. Temperature measurements shall be taken using instrumentation whose calibration is traceable to NIST standards. Dry bulb and wet temperature measurements shall be accurate to +/- 0.1 Deg F. Performance prediction for the CDQ air handler shall be available for multiple conditions as required.

Trane
www.trane.com

For more information, contact your local district office

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