REZNOR®

APPLICATION BULLETIN
FORM NO. **RZ-T-PC**
(Version A)

MAPS™ modular air processing system

MODULAR AIR PROCESSING SYSTEMS
100% Outside Air Treatment

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OVERVIEW

The PCCA/PCDA Series packaged direct expansion rooftops are designed to cool, dehumidify and heat high outside air year round for makeup air and ventilation applications. These rooftop systems are ETL Approved and include the same approaches to outside air treatment found in field engineered or split systems.

The PCCA unit is designed to provide an average cooling supply air temperature of 55°F. In heating modes, the indirect fired gas furnaces can provide an average temperature rise of 30°F to 100°F. The PCDA series packaged units offer all the features of the PCCA, but it also has a dedicated dehumidifier and compressor as an extra stage of control and dehumidification. Reheating the supply air is accomplished by full condenser heat of rejection at relatively low condensing temperatures and air pressure drop. Applications for the PCCA/PCDA series include:

Neutral Air

Treat 100% outside air to match desired space conditions (typically 70° – 75°F & 50% relative humidity). This method of outside air treatment minimizes the influence of outside air on building or return air loads. Benefits of isolating large outside air loads include design simplicity, improved space control and verification or management of outside air quantities.

Tempering Air

Use to partially condition high outside air. This application can dramatically reduce space conditioning equipment size when the application calls for significant make up air.

Sole Source

These units provide mechanical cooling, dehumidification and heating of high outside or mixed air quantities utilizing one dedicated unit. While the PCCA can be used as a sole source system, the PCDA product line increases comfort by providing dehumidification without overcooling.

Economizer

Use during the Spring and Fall when outside air does not need conditioning. Best for drier climates.

The PCCA/PCDA can be installed in a wide array of applications. These include:

Restaurants – Combined dining room ventilation and kitchen hood transfer air

ANSI Z83.9

LISTED

OVERVIEW (cont'd)

Schools – Classroom ventilation, laboratory ventilation and make up air to restrooms

Nursing Homes – Dedicated ventilation air to patient rooms

Hotels – Corridor ventilation and space conditioning

Sports & Recreational Facilities – Make up air to therapeutic pools, locker rooms and restrooms, ventilation air to minimize body odors

Smoking Lounges/ Casinos – Outside air dilution of tobacco particulates

Medical Facilities – Ventilation air for many types of minor out patient surgery, waiting rooms, etc.

Agriculture & Live Stock Facilities – Make up air for dilution of animal waste odor or ventilation air for plant growth

Office Buildings – Complete office ventilation and make up air for densely populated office buildings, such as a telemarketing business

Retail Stores/ Supermarkets – Specialty ventilation (printers, photographic equipment, etc.) or make up air for door infiltration

Public Assemblies – Ventilation air for densely occupied areas such as: churches, auditoriums, courtrooms and theaters

Industrial Ventilation – Make up and ventilation air for special processes, areas with noxious fumes, dusty environments, etc.

Retrofit Jobs – Meet local ventilation codes or enhance occupant comfort with fresh outside air dilution

Laboratories – Makeup air for fume hood exhaust

APPLICATION GUIDELINES

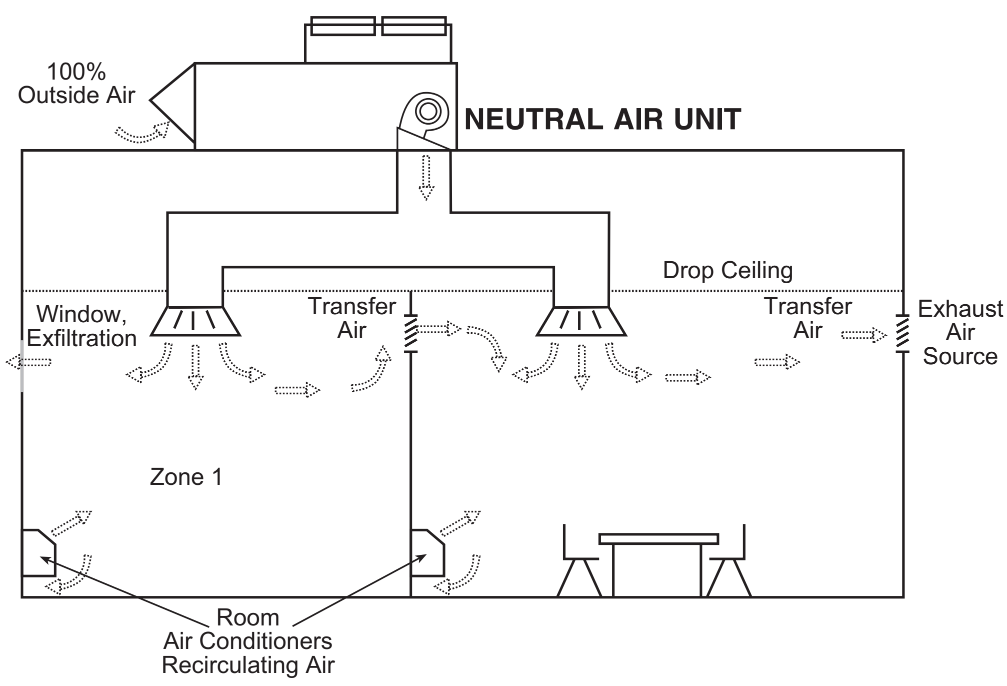
The PCCA and PCDA air cooled series rooftops are designed for full, partial or neutral conditioning of high outside air. Generally, products that deliver high outside air quantities fall into one of four basic system types. They include:

- Neutral Air Unit
- Tempering Air Unit
- Sole Source Air Unit
- Economizer Air Unit

Neutral Air Unit Application:

The Neutral Air Unit is sized to cool, dehumidify and reheat ventilation or makeup air. The system is applied so the outside air load has negligible influence on space loads or room equipment performance. Reheat is provided in cooling or dehumidification mode to provide constant temperatures of 70° - 75°F at a nominal 55°F dew point. If the designers intent is to isolate the outside air load from the building load and simplify HVAC controls the neutral air unit application is recommended.

A neutral air unit may be used to provide useful cooling with the proper control strategies. While the control strategy becomes more complex, the zone units may be downsized based on the neutral unit supplying 55°F supply air (i.e. reheat disabled) to the space at design conditions.



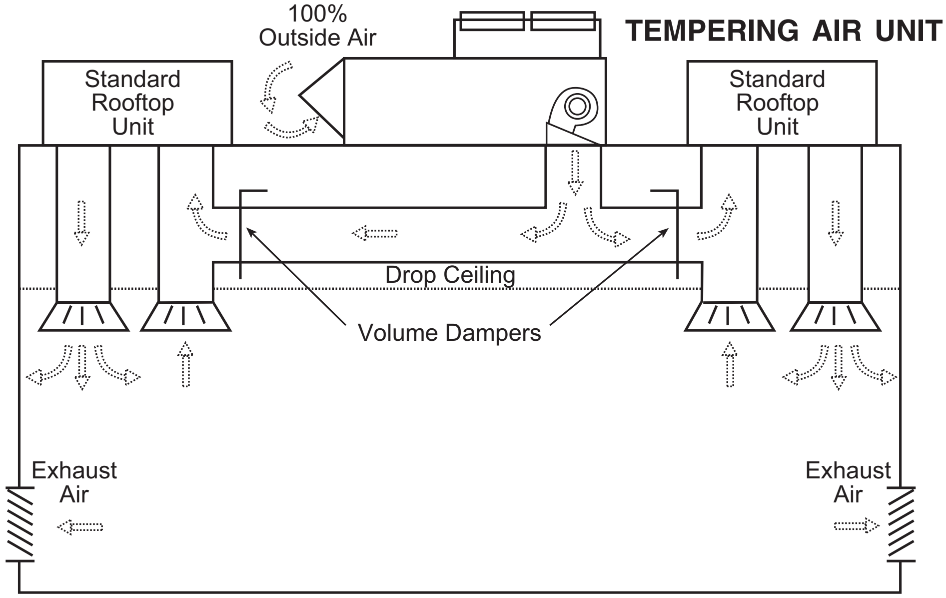
Applications:

- Health Care
- Hotels
- Labs
- Schools
- Night Clubs
- Commercial Buildings
- Painting Facilities
- Libraries
- Museums

APPLICATION GUIDELINES (cont'd)

Tempering Air Unit Application:

The Tempering Air Unit is sized for partial cooling, dehumidification and heating of ventilation or makeup air. Conventional space equipment is sized for space loads and typically a fraction of the tempered outside air load (typically less than 10%). The tempered outside air can be delivered directly to the space or return duct of a conventional rooftop. In humid climates mechanical cooling is typically disabled when outside air dewpoint is below 55°F.



Applications:

- Schools
- Retail Stores
- Restaurants
- Commercial Offices
- Fitness Centers
- Theaters

Sole Source Unit Application:

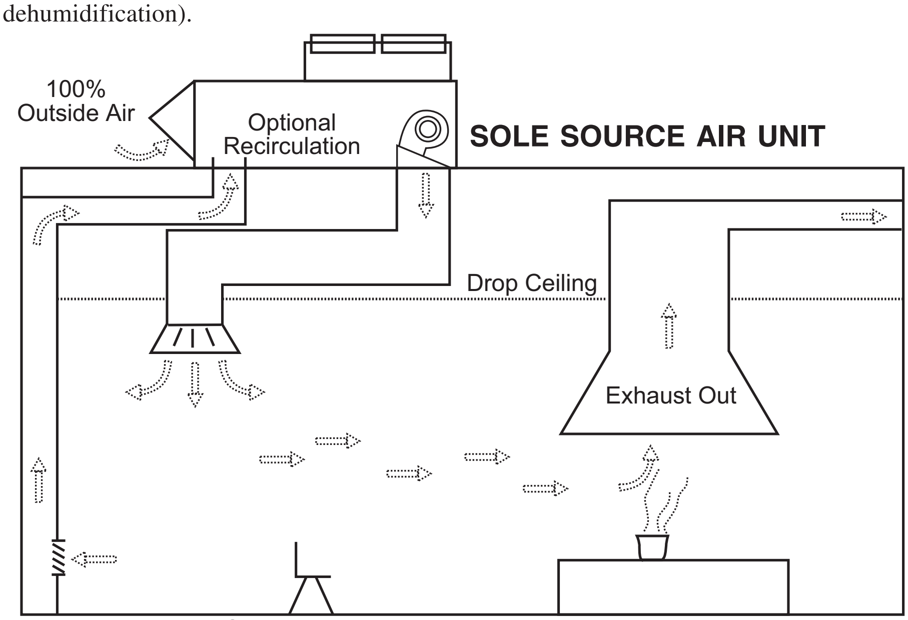
The Sole Source Unit is sized for full cooling, dehumidification and heating of 100% outside air plus internal space loads. While it is more efficient to reject space heat gains (absorbed by a refrigerant) to the outside air ambient as opposed to using cool makeup air, many process applications may find this approach an economical alternative to two separate units.

Providing recirculated air to the sole source unit is typical of a single zone rooftop (i.e. outside air is conditioned and return air loads rejected to the outside ambient). In mixed air applications a high fraction of outside air may represent up to 80% of the total system load in both heating and cooling. Modulation of sensible cooling and heating are important considerations to improve zone comfort. In summer months optional reheat may be used to prevent space overcooling (yet, provide constant dehumidification).

Although the PCCA and PCDA can be applied as sole source units for both 100% outside air and mixed air applications, each must be analyzed for both design and part load modulation requirements. Design, part load and modulation heating requirements are relatively easy to calculate. *The degree of modulation required for cooling and dehumidification is more difficult to calculate because of varying latent load fractions.* Review Part Load Control Guidelines starting on page 5 for additional information. For 100% outside air applications refer to Figure 1 on page 4 for recommended cooling change over set points. If the space requires mechanical cooling below those shown in Figure 1, contact a sales representative to ensure proper system design.

Applications:

- Laboratories
- Corridors
- Industrial Processes
- Locker Rooms
- Gymnasiums
- Kitchens
- Laundries
- Mortuaries
- Surgery Rooms



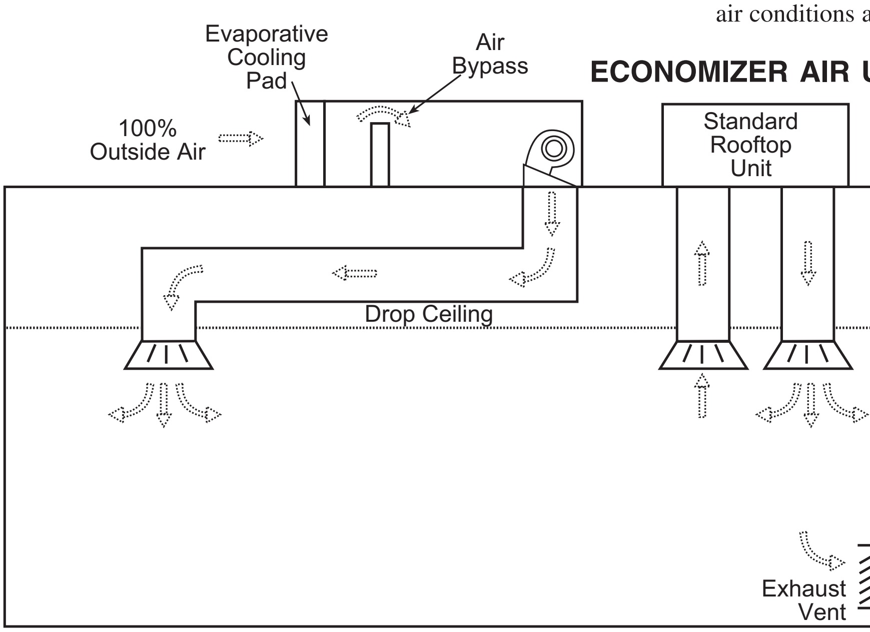
APPLICATION GUIDELINES (cont'd)

Economizer Unit Application:

All air side products can take advantage of local weather conditions to reduce the use of mechanical energy. The Economizer sequence is designed to accomplish ventilation at the lowest possible cost. In dry climates, evaporative cooling can be used to supplement mechanical cooling, so long as the resulting desired space relative humidity is not exceeded. In hot/dry climates (typically over 110°F), the addition of evaporative cooling may be used to lower entering dry bulb temperatures to the cooling coil (preventing direct expansion compressor overloads). As extreme outside air temperatures drop, it is desirable to disable evaporative cooling to prevent undesirable cooling coil latent loads. However, effective use of stand alone evaporative cooling may be employed at low loads (typically below 80°F).

The PCCA can be specified with a coil air bypass option. This feature is added to provide near neutral conditions when outside air conditions are very dry with minimum of static pressure losses.

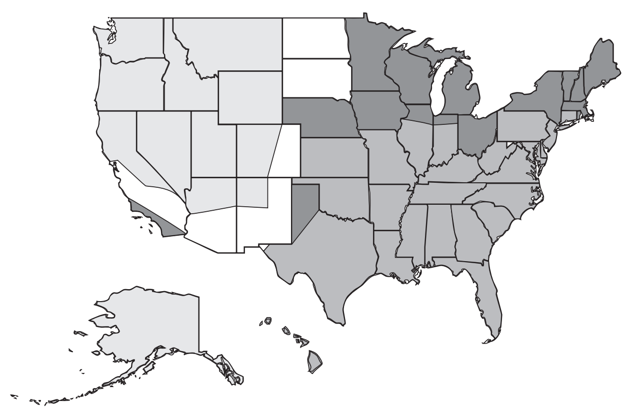
ECONOMIZER AIR UNIT



Applications:

Dry Climates

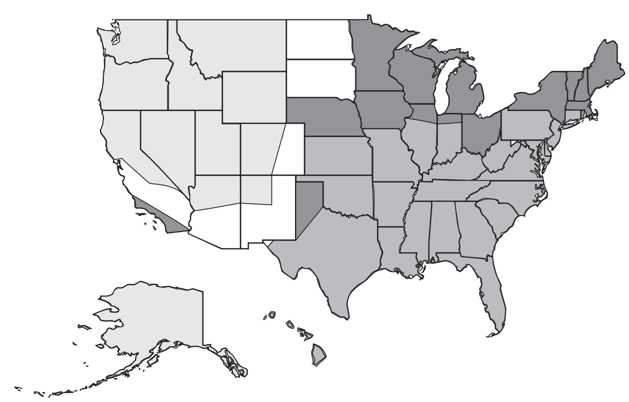
Spring/Fall Weather



OUTDOOR COOLING CHANGE OVER TEMPERATURE

	PCCA	PCDA
(light grey)	75°F	N/A
(white)	72°F	N/A
(dark grey)	68°F	65°F
(medium grey)	68°F	65°F

Figure 1 - PCCA & PCDA Cooling & Dehumidification Guidelines for <u>Outside Air Space Conditioning</u>



60 DEGREE DEW POINT FREQUENCY

- (light grey) Less than 200 Hours - based on 24 hour operation and year round schedule
- (white) Less than 1,000 Hours - based on 24 hour operation and year round schedule
- (dark grey) Above 1,000 Hours - 24 hour 7 days; Below 650 Hours - June-August, 12 hour operation
- (medium grey) Above 1,500 Hours - based on 24 hour operation and year round schedule

Figure 2 – 100 % Outside Air Applications for the PCDA dehumidifier include the southeast, northeast, extreme southwest, and the Hawaiian Islands. The PCCA series Rooftop can be applied in all areas.

MAPS™ HIGHLIGHTS

Each PCCA system is specifically designed for conditioning high outside or mixed air quantities in dry, humid or semi-humid climates. Although the PCCA is an all weather rooftop, the PCDA series is only applied in climates where dehumidification is required. Typically, this represents geographical areas that see a 60°F dewpoint frequency greater than 400 hours per year (see Figure 2 on page 4).

To illustrate the dehumidification performance of the PCDA rooftop, the performance of a stand-alone PCCA (Figure 3) is compared to the PCDA (Figure 4) at 95°/78°F dry bulb/wet bulb.

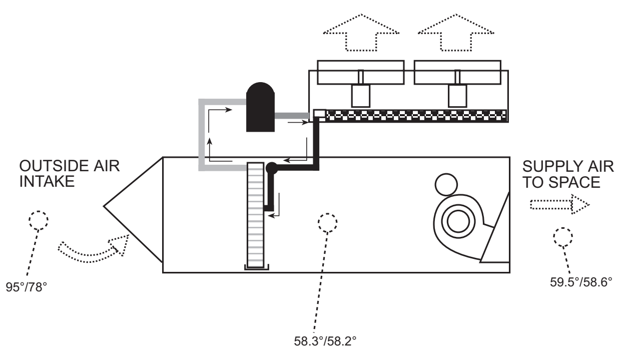


Figure 3 – PCCA Performance at 95°/78°F Outside Air and a Nominal Airflow Rate

Note that the PCCA is a typical air conditioning unit utilizing air cooled condensers (evaporator heat removal is rejected to the outdoor ambient).

Note that the PCDA uses basic refrigeration design for dehumidification and reheat. One coil is installed upstream and another downstream of the PCCA evaporator coil. The upstream PCDA evaporator tempers outside air and lowers wet bulb depression to the PCCA evaporator coil (86.4°/75.3°F). The heat removed from the PCDA evaporator is rejected to the PCDA indoor condenser coil which is located downstream of the PCCA evaporator coil (71.2°/61.5°F, including compressor heat of compression). If the PCCA evaporator coil were removed, the PCDA would resemble a standard residential dehumidifier.

Since the PCDA refrigeration circuit is independent of the PCCA condensing unit, dehumidifier performance is relatively constant so long as discharge air set point is maintained. ***This also translates into ease of commissioning and verification of dehumidifier performance under mild or extreme conditions***. Other package systems that use hot gas and/or sub cooling reheat recovery must maintain higher than needed condenser head pressures for reliable operation and adequate reheat. Under part load humidity conditions, poor performance of hot gas reheat and sub cooling reheat systems can be caused by compressor unloading and changing refrigerant conditions. ***Service, diagnosis and performance of hot gas reheat and sub cooling reheat systems can be difficult to verify at conditions other than design.***

The PCDA dehumidifier condenser provides a nominal 10 to 17 degrees of reheat to the supply air stream. This temperature rise is accomplished with high compressor COP's and low air pressure drop coils***. For equivalent reheat performance, other technologies, such as heat pipes or flat plate heat exchangers have greater than <u>10 times</u> the air pressure drop of the PCDA dehumidifier***. While the PCDA compressor consumes additional energy during dehumidification modes, the year round benefit of reduced fan energy results in lower annual energy costs.

Additionally, performance of wrap around heat pipes or flat plate heat exchangers is totally dependent on the main evaporator coil supplying a temperature gradient (the PCDA can cool, dehumidify and reheat independently when the main evaporator coil is disabled). If the main evaporator coil is off-line, no dehumidification is possible with wraparound systems. Typically, the PCDA evaporator can operate in a stand-alone capacity down to 65°F and 55% relative humidity outdoor ambient without reaching a coil frost temperature.

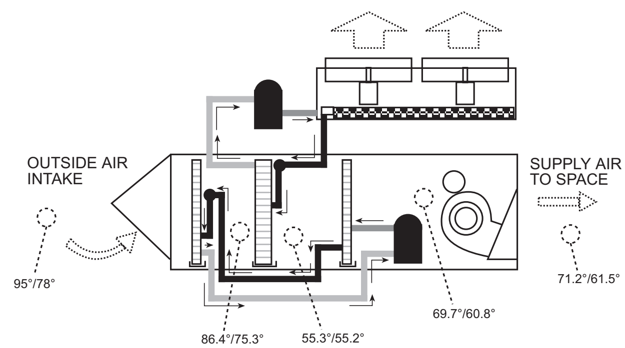


Figure 4 – PCDA Performance at 95°/78°F Using the PCCA Series Air Cooled Condenser

DRY CLIMATE APPLICATIONS

The PCCA series rooftop can be applied in dry climates for tempering of up to 100% outside air. While the PCCA delivers a nominal 55° to 65°F supply air for design cooling, mechanical cooling is typically disabled when the outdoor temperature is less than 75°F to avoid frequent compressor short cycling or hot gas bypass. For dry areas where episodes of humid weather occur, the PCCA may be ordered with an outdoor humidity controller to extend mechanical cooling below 70°F.

Each Model PCCA Rooftop may be combined with evaporative cooling pad options to extend equipment operation under severe conditions. A cooling coil bypass is available on several PCCA models for providing higher leaving supply air temperatures (this bypass is not recommended in dehumidification climates). See application rating from performance in the Dry Climate Table on page 11.

MAPS™ - PART LOAD CONTROL GUIDELINES

Equipment used for treatment of high outside air quantities is selected and sized based on worst case design conditions. *For efficient operation, equipment modulation or staging should be considered for part load conditions. As design extremes increase, staging or modulation of equipment capacity becomes increasing important.*

Examining the lowest stage or step of equipment capacity relative to a low load condition will help determine staging requirements. Designers should also consider the added benefits of equipment modulation (versus step control) at low loads and between equipment stages.

The following discussion is focused on neutral or tempering air units. Sole source systems will require a careful analysis of both outside air, return air loads and allowable control tolerances.

How to Estimate Equipment Unloading Requirements in Heat Mode (100% outside air):

1. Determine outside air temperature (T_O) in which heating is enabled. Typically based on an outside air temperature which will result in space temperatures less than 65°F.
2. Determine heating supply air discharge temperature (T_D). For a neutral air unit, typically 75°F.
3. Calculate lowest temperature (T_L) rise to maintain set point:

$$T_L = T_D - T_O$$

4. Determine design temperature rise (T_R) at worst case design temperature (T_W) from ASHRAE.

$$T_R = T_D - T_W$$

5. Determine number of equipment capacity steps and determine lowest temperature rise per stage (T_{STAGE}). For equal capacity increments, divide the design temperature rise by the number of stages:

$$T_{STAGE} = T_R \div STAGES$$

6. Compare the results from Step 5 and Step 3. If T_{STAGE} is greater than T_L, examine the difference and estimate if additional staging or modulation is required.

If $T_{STAGE} > T_L$; consider modulation

If the lowest step of equipment capacity results in a supply air temperature overshoot causing noticeable space temperature swings (in comfort or process applications), the designer should consider increased staging. If the difference in capacity steps or staging results in excessive temperature swings, the designer should consider increased modulation.

Lets assume the temperature overshoot at low load is 50°F. If supply air temperature set point is 75°F, the overshoot could result in a supply air temperature of 125°F (75 + 50 = 125). The actual supply air temperature would vary as the controller cycles to maintain set point. The degree of temperature control depends primarily on controller response and gas heat exchanger capacitance (or residual heat as equipment cycles on and off). A poor control strategy may result in excessive short cycling and reduced heat exchanger life.

Rapid short cycling of equipment is minimized by using discharge air control. Discharge air controls react slowly to temperature changes and provide minimum on/off heat exchanger times. However wide supply air temperature fluctuations may create problems for space set point control. *The higher the rate of outside air changes to the space the more risk of losing space temperature control.* For example a 15°F supply air fluctuation with outside air change-over rates of once every 20 minutes (3 ACH) may have little impact on space conditions. However if the outside air change-over rate to the space is once every 3 minutes (20 ACH), the average space temperature may vary excessively.

7. Determine outside air change over rate to the space:

OA-ACH = Supply Air Flow (CFM of outside air) x 60 ÷ Building Volume (cubic feet)

Compare Step 7 results to the variation in supply air temperature (Step 6) and recommend staging and/or modulation requirements as experience dictates. If outside air change-overs exceed 20 ACH and outside air is below 0°F, it is recommended to evaluate temperature rise based on actual air density.

In summary, when evaluating heating controls and modulation for 100% outside air treatment, the designer should consider the following:

- The greater the design temperature difference, the more control required at part load.
- Evaluate the smallest temperature rise needed at low load (i.e. heating discharge air setpoint minus winter change over setpoint).
- Evaluate the lowest step of heating equipment capacity and compare to the low load requirement.
- Examine outside air change-over rate and determine if added stages or modulation are required.

How to estimate Equipment Unloading Requirements in Cooling Mode (100% Outside Air): While our heating example was based solely on sensible heat, cooling and dehumidification part load requirements should be based on total energy (sensible and latent heat). Similar to heating, the more capacity required at design results in added staging or modulation at part load. *In humid climates where neutral or tempering units are applied, the lowest outside air load is typically based on a 55°F dew point.*

Analyzing weather parameters at low loads helps in defining realistic part load conditions. *A review of climatic data (TMY2) has lead to the following observations:*

Humid climates :

Below 63°F dry bulb the outside air dew point is typically below 55°F dew point.

Mild Climates :

Below 65°F dry bulb the outside air dew point is typically below 55°F dew point.

Outdoor Dry Bulb is 65° - 68°F:

- If outdoor conditions are above 55°F dew point and cooling coil set point is 55°F dry bulb, the low load sensible to heat ratio (SHR) is generally no greater than 0.65 – 0.70 (at 65°F or 68°F dry bulb).
- Providing active cooling below 65°F - 68°F dry bulb to account for episodes of a higher than 55°F dew point is difficult to justify based on energy consumption and added equipment costs.

MAPS™ - PART LOAD CONTROL GUIDELINES (cont'd)

Based on the above observations, the lowest load in a mild climate can be determined by subtracting the desired cooling discharge air set point (T2) minus the cooling disabled set point (T1) and accounting for a latent load fraction. For a mild climate, the low load temperature drop (T3) can be estimated as follows:

T2 = 55°F **T1 = 68°F** **SHR = 0.70**

T3 = T1 - T2 = 13°F

To simplify calculations, T3 can be converted to a total equivalent sensible temperature drop by dividing the SHR fraction:

$$T3_{TOTAL} = T3 \div SHR = 18.6°F$$

If the lowest compressor step (TC) results in an equivalent temperature drop **greater** than $T3_{TOTAL}$, added staging or modulation should be considered:

TC > T3 TOTAL : Consider modulation

If adequate modulation can not be obtained at low load, other options include:

- Lowering the cooling coil set point
- Raising the cooling change-over set point and hot gas bypass

The addition of hot gas bypass to the first stage compressor typically provides 50% modulation of nominal compressor capacity. Because all Reznor coils are fully intertwined, hot gas bypass allows the lead compressor to modulate as other compressor stages are enabled. Below are guidelines for applying the hot gas bypass option with high outside air applications:

PCCA 1 Stage – Requires Hot Gas Bypass

PCCA 2 Stage < 300 Cfm/Ton {PCDA < 225 Cfm/Ton}

PCCA 3 Stage < 200 Cfm/Ton {PCDA < 175 Cfm/Ton}

PCCA 4 Stage < 165 Cfm/Ton {PCDA < 130 Cfm/Ton}

MAPS™ - CONTROL GUIDELINES

Identifying applications as tempering, neutral or sole source units will aid in defining control sequences and expectations. Recognizing the variation of outside air extremes and limited equipment modulation capabilities at part load provides a baseline for comparing different system types or control strategies. As discussed in Part Load Control Guidelines, calculating outside air change-overs to the space becomes an important parameter in terms of specifications and control strategies.

It is important to recognize the extreme variations in outside air latent conditions and the resulting impact on equipment performance. ***Compressor potential can be used for sensible or latent work. If the latent load is reduced, the compressor simply performs more sensible work. This translates into lower leaving coil temperatures and compressor cycling.***

To minimize cooling energy consumption and equipment cycling, Reznor recommends the use of an outside air enthalpy control. The control, in conjunction with an outdoor cooling/heating change-over dry bulb sensor disables mechanical cooling in a range of 65° - 74°F dry bulb and 55°F dew point. The enthalpy control curve is shown in figure 5. Setting A is recommended for all applications.

MAPS™ - CONTROL GUIDELINES (cont'd)

In heating mode, it is important to remember the greater temperature difference (as opposed to cooling) is easily detected in comfort applications. ***Modulation at part load should be considered especially if high outside air change-overs occur in the space.*** Reznor recommends a nominal 25% modulation for most high outside air applications in cold climates. See Part Load Control Guidelines on page 6 for added details.

Each Maps system is equipped with discharge air control. Providing a discharge air control, combined with outdoor ambient feed back improves supply air temperature control, saves energy and reduces compressor cycling. *Reznor does not recommend controlling rooftop staging based only on outside air conditions (including two stage systems).* Since the majority of Maps applications are high outside air applications, the heating/cooling change-over is controlled solely on outside air temperature or mixed air conditions. *However if the outside air change-over rate is low (less than 6 ACH) and humidity control nonessential (dry climate) a zone control change-over may be a preferred option.*

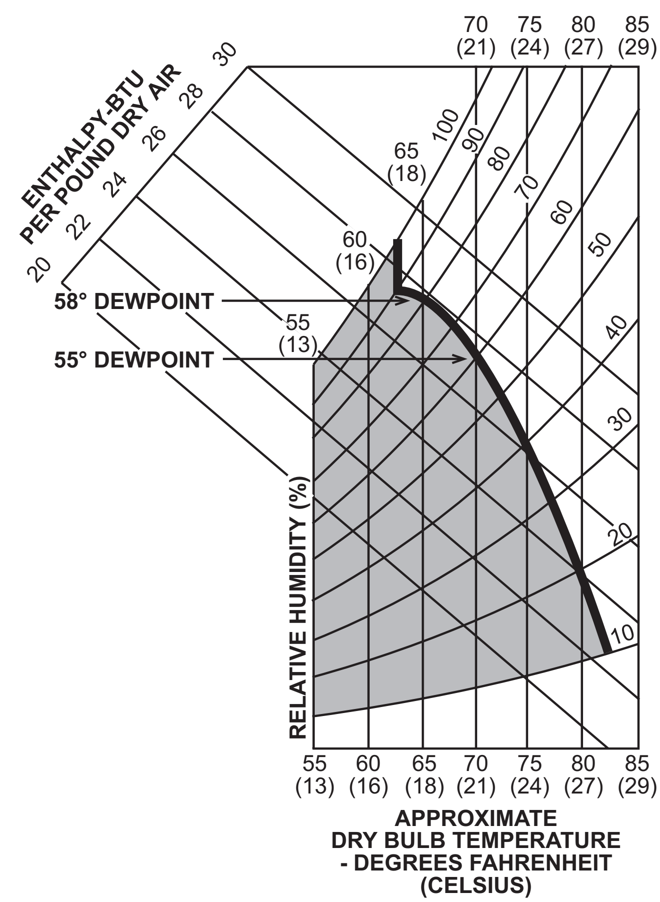


Figure 5 – Partial Psychrometric chart with controller performance curve superimposed. Shaded area represents control range. Areas to the right of the curve demand active cooling.

MAPS™ - CONTROL GUIDELINES (cont'd)

Below are highlights of the core strategies used by Reznor for high outside air applications:

Neutral Air Sequence – Discharge air control is set to maintain an average 72°F supply air set point (sensor reads reheat temperature). Reheat supply air temperature is maintained by cycling compressors based on a nominal 55°F dew point. If the outdoor ambient dew point is greater than 55°F or outdoor ambient dry bulb is greater than 78°F the unit is allowed to run.

Tempering Air Sequence – Discharge air control is set to maintain an average 55°F supply air set point (sensor reads cooling coil discharge temperature). Most tempering air applications should be specified with the same enthalpy control discussed in figure 5.

PCDA Dehumidifier Control Options: Controls are available to provide useful cooling under design conditions by disabling reheat capacity. Control inputs may be based on outdoor-dry bulb, indoor dry bulb or relative humidity. Sole source applications (with mixed air) can be specified with space sensor control (for Low ACH), combined with relative humidity control.

Gas Heating Temperature Control: The Maps heating/cooling change-over has a minimum 3 degree dead band to prevent simultaneous cooling and heating operation. Heating discharge air controls range from 2 stage mechanical control to 25% electronic modulation of gas input. See Part Load Control Guidelines on page 6 for additional information.

Other Control Sequence Options: Pressurization – Maps systems can be ordered with modulating return and outside air dampers to facilitate the control of building pressure. Outside air quantities can be varied with return air to provide building pressurization control (available in constant volume only).

Occupied and Unoccupied Modes: Recirculate return air in unoccupied modes to maintain heating set point, provide morning warm up sequences or temperature reset options.

QUICK PCCA/PCDA SELECTION PROCEDURE

The PCCA/PCDA Model numbers are derived from nominal ARI compressor ratings and designated by BTUH ÷ 1,000 (MBH). The estimated tons must be converted to MBH units. This can be accomplished by multiplying the tons by 12.

Actual rooftop performance for most high outdoor conditions will exceed model number designation by 10% to 15% (because model numbers are based on rated compressor capacity, not system performance).

Cooling & Dehumidification: Table 2 is useful for approximating gross equipment size for cooling and dehumidification of 100% outside air. This table shows the maximum CFM/Ton to meet typical cooling coil set points with various outside air entering conditions.

Example (Humid Design Outside Air):

Summer Outdoor Design Conditions (F)	95° DB/76° WB
100 % Make Up or Ventilation Air (CFM)	3400 CFM
Desired Leaving Air Dry Bulb (F)	56° DB/55.5° WB

QUICK PCCA/PCDA SELECTION PROCEDURE (cont'd)

From Table II on page 9 (at 95° DB/76° WB and 56° DB set point), the estimated requirement for cooling and dehumidification is 185 CFM/TON. The estimated gross tonnage required is determined by:

TONS (Required) = Supply Air (CFM) ÷ (CFM/TON)

Or,

3400 ÷ 185 equals <u>18.3 Tons</u>

18.3 Tons X 12 = 220 MBH

A PCCA210 would be the first selection proposed to meet the required outside air load (add 10%-15% to ARI rated capacity).

If the cooling coil setpoint is considered to be the desired dew point, and supply air reheat is required, a PCDA series rooftop should be selected. Again, the PCDA Models, are in units of MBH so the initial equipment selection would be a PCDA-206.

Model Size Description

Model PCCA - 100% outside air packaged cooling system

Model PCDA - 100 % outside air packaged cooling system with reheat

If an application calls for a 100% outside air packaged heating and cooling system with dehumidification at 20 tons of cooling and 350,000 BTUH of heating, the model size designation would be

Selection
Model PCDA - 241 - 350

Cooling Capacity			
PCCA		PCDA	
Size	Tons	Size	Tons
60	5	87	7
96	8	123	10
120	10	147	12
130	11	176	15
135	11	162	14
150	13	177	15
160	14	206	17
180	15	226	19
195	16	**241**	20
210	18	256	21
225	19	271	23
165	14	223	19
170	14	228	19
190	16	268	22
215	18	293	24
240	20	298	25
277	23	335	28
360	30	438	36

Heating Capacity	
Size	BTUH
000	*
100	100,000
125	125,000
150	150,000
175	175,000
200	200,000
225	225,000
250	250,000
300	300,000**
350	350,000
400	400,000**
500	500,000**
600	600,000**
700	700,000**

* If no heating is required, select size 000

**Dual furnace units

QUICK PCCA/PCDA SELECTION PROCEDURE (cont'd)

Table 2 – Required CFM/TON to Meet Cooling Coil Set Point for Various Outdoor Design Conditions 100% Outside Air

CFM PER TON

Cooling Coil Setpoint	Outdoor Degree F DB/ WB						
	Dehumidification Climates					Dry Climates	
	95/80	95/78	95/76	95/75	95/73	105/70	95/65
65	214	254	308	344	386	295	387
60	169	192	222	240	284	262	332
58	157	177	201	216	251	251	314
56	146	164	185	197	217	241	298
54	138	153	171	181	205	232	283

TECHNICAL OVERVIEW - Models PCCA and PCDA

The Maps series rooftop product line is designed for treatment of high outside air quantities in any climate. Heating capabilities are shown on page 8 (see Quick Selection Procedure). Heating options are capable of providing 30 to 100 degree temperature rise across the product air flow range. Total external static pressure capabilities of 2.25" w.c. are can be accomplished with a wide range of supply fan motors up to 10 BHP.

The following tables provide a reference of airflow ranges, compressor staging, tonnage and performance. Shaded model numbers indicate higher return air capabilities. Additional information can be found by running the MAPS Software Calculator program available from your Reznor Representative.

Cabinet Size	Model PCCA	Model PCDA	Capacity Steps PCCA/PCDA	PCCA Cooling[C] Compressor(s) Nominal Tons	Qty	PCCA Air Flow Range (CFM)[A]	Filters (Quantity) Size	Furnace Heating Capacity Range (MBH)
Cabinet A	**060**	**087**	1/2	5	1	850 - 3000	(2) 16" x 20", (1) 16" x 16"; (1) 20" x 20"	100 - 300
	096	**123**	3/4	3 / 5	1 / 1	950-3000		
	120	**147**	2/3	5	2	1500-3150		150 - 400
	130	**176**	2/3	5	2	2200-4000		
	135	**162**	2/3	5 / 6.25	1 / 1	1700-3150		
	150	**177**	2/3	6.25	2	1700-3150		
	160	**206**	2/3	6.25	2	2300-4000		
	180	**226**	3/4	5	3	2600-4000		
	195	**241**	3/4	5 / 6.25	2 / 1	2700-4000		
	210	**256**	3/4	5 / 6.25	1 / 2	2800-4000		
	225	**271**	3/4	6.25	3	3000-4000		
Cabinet B	**165**	**223**	2/3	10[B]	1	2400-5750	(2) 20" x 25"; (2) 25" x 25"	250 - 700
	170	**228**	2/3	11.25[B]	1	2700-5750		
	190	**268**	3/4	5 / 10[B]	1 / 1	3000-6700		
	215	**293**	3/4	5 / 11.25[B]	1 / 1	2700-6700		
	240	**298**	4/5	10[B]	2	3100-5750		
	277	**335**	4/5	11.25[B]	2	3200-5750		
	360	**438**	6/7	10[B]	3	5000-7100		

[A] PCDA ranges vary slightly

[B] Tandem Compressors

[C] Cooling only. Does not include dehumidification compressor.

TECHNICAL OVERVIEW - Models PCCA and PCDA (cont'd)

Application Ratings - Cooling Only Systems (PCCA)

100% Outside Air Performance
Humid Climates

	Entering Cond & Evap		95 Degree F Dry Bulb								
	Entering Evap Wet Bulb		75 Degree F Wet Bulb				78 Degree F Wet Bulb				
Cabinet Size	PCCA Size	SCFM	Cooling LDB (F)	Total Btu/hr	Latent Btu/hr	Power (Watts[A])	Cooling LDB (F)	Total Btu/hr	Latent Btu/hr	Power (Watts[A])	55 (F)[B] SCFM
Cabinet Size A	060	1200	59.3	67.2	20.9	5527	62.6	71.1	29.1	5682	-[C]
	096	1400	56.6	89.5	31.4	7903	59.8	95.1	41.8	8068	1080
	120	2200	57.9	134	45.7	11208	61	142.4	61.7	11542	1600
	130	2400	58.8	139.2	45.3	11529	62.1	147.2	61.9	11837	-[C]
	135	2400	58.2	143.8	48.6	12983	61.4	152.7	65.8	13424	1700
	150	2600	58.6	153.5	51.3	14803	61.8	162.9	69.7	15357	1800
	160	2800	59.2	159.2	51.1	15273	62.6	168.2	70.1	15800	-[C]
	180	3100	57.1	196.1	69.2	17007	60.3	208.3	92.1	17500	2375
	195	3300	57.5	205.8	72	18816	60.6	218.5	96.1	19410	2475
	210	3400	57.3	213.9	75.4	20413	60.5	226.9	100.2	21106	2575
	225	3500	57.1	221.9	78.7	22075	60.3	235.3	104.3	22868	2675
Cabinet Size B	165	2800	61	143.2	40.3	12054	64	153.7	60.1	12265	-[C]
	170	3000	60.7	155.8	44.8	12687	63.8	166.8	65.9	12983	-[C]
	190	4000	59.9	219.2	67.3	18671	63	233.3	95.2	18958	-[C]
	215	4600	60.5	244	72.7	19870	63.7	259.4	103.9	20260	2800
	240	4700	58.7	276.9	92.4	24810	61.6	297	127.7	25247	3250
	277	4800	57.8	295.4	102.3	25769	60.8	316.1	138.7	26342	3540
	360	6200	57.4	387.4	136	36955	60.4	415	183.6	37622	4600

Application Ratings - Cooling and ReHeat Systems (PCDA)

100% Outside Air Performance
Humid Climates

	Entering Cond & Evap		95 Degree F Dry Bulb										
	Entering Evap Wet Bulb		75 Degree F Wet Bulb					78 Degree F Wet Bulb					
Cabinet Size	PCDA Size	SCFM	Cooling LDB (F)	Total Btu/hr	Latent Btu/hr	Power (Watts[A])	Reheat LDB(F)	Cooling LDB(F)	Total Btu/hr	Latent Btu/hr	Power (Watts[A])	Reheat LDB(F)	55 (F)[B] SCFM
Cabinet Size A	087	1400	56.7	87.5	29.5	6467	75.3	60	92.5	39.6	6630	78	-[C]
	123	1700	55.7	111.1	39	9100	72.2	59	117.7	51.6	9273	75.8	1390
	147	2300	54.9	156.2	56.5	12410	69	58.2	165.4	73.9	12770	71.6	1975
	162	2600	56.1	168	58.8	14456	69.2	59.4	177.9	78	14924	71.6	2100
	176	2700	56.2	173.5	60.3	13266	73.5	59.5	183.4	79.9	13608	77	-[C]
	177	2700	56.5	178.3	61.8	16360	67.7	59.8	188.6	82.2	16953	71.1	2200
	206	3000	56.2	192.7	67	16818	73.1	59.6	203.3	88.6	17387	75.8	2400
	226	3500	55.1	236.3	85.5	19610	71	58.4	250.6	112.1	20119	73.6	3000
	241	3700	55.5	246.7	88.6	21518	69.6	58.7	261.1	116.2	22192	73.2	3100
	256	3750	55	254.4	92.3	23075	69.5	58.3	269.5	120.9	23776	73.1	3200
	271	3850	55.5	255.9	91.9	23374	70.3	58.8	270.9	120.5	24129	72.9	3300
Cabinet Size B	223	3600	59.6	194.9	57.5	14614	76.3	62.8	208.2	83	14858	80.1	-[C]
	228	3700	59	207	63.3	15107	75.9	62.2	220.7	89.7	15419	79.7	-[C]
	268	4800	58.2	281	90.2	22236	74.8	61.4	298.9	124.7	22604	78.6	-[C]
	293	5000	57.6	301.6	99.6	23008	74	60.8	320.3	135.8	23462	77.2	-[C]
	298	5000	56.2	322.2	112.8	27142	71.1	59.3	344.2	151.4	27670	73.8	4000
	335	5000	55	339.4	123.3	27835	69.2	58.1	362.1	162.7	28400	72.8	4300
	438	6400	54.5	442.3	162.7	39863	69.7	57.6	472.3	213.9	40592	72.4	5600

NOTES:

[A] Power (Watts) includes all power sources. Supply fan power is based on 0.5" w.c. of external static pressure

[B] Supply Air Flow (SCFM) required to deliver 55°F dry bulb (based on 95/78 entering conditions)

[C] To determine exact Standard CFM use the MAPS™ Calculator Program available from your Reznor Representative.

MORE NOTES:

- Double horizontal line indicates cabinet size change - see unit dimensions in product catalog
- Use MAPS™ calculator for additional performance parameters
- Reheat LDB (F) includes supply motor heat (based on 0.5" w.c. external static)
- Total Cooling Capacity does not include supply motor heat
- PCDA: Total Cooling Capacity reflects gross cooling coil capacity only

TECHNICAL OVERVIEW - Models PCCA and PCDA (cont'd)

Application Ratings - Cooling Only Systems (PCCA)

High Cfm/Ton Models

Mixed Air or Mild Climates

Cabinet Size	PCCA Size	SCFM	Total BTU/Hr	Latent Btu/hr	Power (Watts)	Total BTU/Hr	Latent Btu/hr	Power (Watts)
	Entering Condenser DB		95 Degree F Dry Bulb					
	Entering Evap DB/WB		85/72 Degree F			85/64 Degree F		
Cabinet Size A	**060**	2200	71.8	19.8	6253	64.9	0	5913
Cabinet Size A	**096**	2600	95.4	30.4	8903	85.1	0	8501
Cabinet Size A	**130**	3400	141	50.2	12724	122.6	1.1	11972
Cabinet Size A	**160**	3900	160.7	57.2	16878	140.3	1.5	15668
Cabinet Size B	**165**	4200	146.9	44.2	12935	130.6	0	12462
Cabinet Size B	**170**	4300	158.4	50.4	13546	139.9	0	12924
Cabinet Size B	**190**	5000	216.4	79.4	19449	184.9	3.7	18637
Cabinet Size B	**215**	6200	244	83.8	21570	210.6	0	20344

Application Ratings - Dehumidification and ReHeat (PCDA)

High Cfm/Ton Models

Mixed Air or Mild Climates

Cabinet Size	PCDA Size	SCFM	Total BTU/Hr	Latent Btu/hr	Power (Watts)	Cooling LDB (F)	Reheat LDB (F)	Total BTU/Hr	Latent Btu/hr	Power (Watts)	Cooling LDB (F)	Reheat LDB (F)
	Entering Condenser DB		85 Degree F Dry Bulb									
	Entering Evap DB/WB		78/71 Degree F					75/69 Degree F				
Cabinet Size A	**087**	1750	89.6	46.4	6428	55.1	70.2	86.6	45.1	6340	53	67.8
Cabinet Size A	**123**	2225	114.9	59.6	8739	55	67.5	111.2	58	8634	52.8	65.3
Cabinet Size A	**176**	3450	177.5	92.2	13423	55	69.2	171.8	89.7	13218	52.8	66.8
Cabinet Size A	**206**	3800	196.8	102.4	16935	55	68.5	190.5	99.6	16632	52.7	66.2
Cabinet Size B	**223**	3700	190.7	99	13420	55.1	71.1	184.1	96.6	13217	53.1	68.7
Cabinet Size B	**228**	4000	204.7	106.2	14213	55.2	70.3	197.3	102.7	14016	53	67.9
Cabinet Size B	**268**	5500	281.3	146	21450	55.2	69.6	271.3	141.4	21121	53	67.3
Cabinet Size B	**293**	5850	303.4	157.9	22488	55	69.1	292.8	152.9	22165	52.9	66.7

Application Ratings - Dry Climates (PCCA)

100% Outside Air Performance

Dry Climates

Cabinet Size	PCCA Size	SCFM	Total BTU/Hr	Cooling LDB (F)	Power (Watts)	SCFM	Total BTU/Hr	Cooling LDB(F)	Power (Watts)	SCFM	Total BTU/Hr	Cooling LDB (F)	Power (Watts)
			Entering Conditions Condenser Dry Bulb/ Evaporator Wet Bulb (DB/WB) - degrees F				Entering Conditions Condenser Dry Bulb/ Evaporator Wet Bulb (DB/WB) - degrees F				Entering Conditions Condenser Dry Bulb/ Evaporator Wet Bulb (DB/WB) - degrees F		
			90/65				105/69				110/70		
Cabinet Size A	**60**	**2500**	72.7	63.1	6237	**1600**	69.4	64.9	6457	**1300**	66.3	62.8	6346
Cabinet Size A	**96**	**3150**	97.4	61.4	9250	**2000**	91.5	62.6	8858	**1700**	88.5	61.8	9203
Cabinet Size A	**130**	**4000**	137.5	58.2	12739	**3300**	142	65.1	13582	**2500**	133.1	60.7	12908
Cabinet Size A	**160**	**4100**	151.7	55.7	15724	**3800**	162.2	65.5	18179	**3100**	156.1	63.4	17706
Cabinet Size B	**165**	**5600**	157.4	64	13740	**3200**	141.4	64.1	12975	**2700**	134.4	63.9	13005
Cabinet Size B	**170**	**5800**	169.3	63	14452	**3600**	155.8	64.9	14086	**2950**	146.6	64	14068
Cabinet Size B	**190**	**6850**	220.5	60.2	20695	**4600**	211.6	62.4	20051	**3700**	199.6	60.1	19738
Cabinet Size B	**215**	**6850**	236.2	59.9	21115	**5200**	234.9	63.2	21530	**4300**	224.4	61.7	21253
Cabinet Size B	**240**	**N/A**				**5800**	330	62.7	27086	**5600**	268.5	65.6	27704
Cabinet Size B	**360**	**N/A**				**7200**	357.4	59	39699	**7200**	367.7	62.7	41152

NOTES:

- Power (Watts) includes all power sources. Supply fan power is based on 0.5" w.c. of external static pressure
- Supply Air Flow (SCFM) conditioned to 55°F dry bulb
- Double horizontal line indicates cabinet size change - see unit dimensions in product catalog
- Use MAPS™ calculator for additional performance parameters
- Reheat LDB (F) includes supply motor heat (based on 0.5" w.c. external static)
- Total Cooling Capacity does not include supply motor heat
- PCDA: Total Cooling Capacity reflects gross cooling coil capacity only
- Always consider hotgas bypass for active cooling below 75°F ambient

STANDARD DESIGN FEATURES

Weather Secure Cabinet & Outside Air Intakes. All rooftop units include water and air leak resistant overlapping panel construction including 3” overlapped roof edges to ensure water resistant integrity. The outside air intake hood is designed for an average velocity of 250 feet/minute to reduce the possibility of water entertainment. For installations with prevailing wind speeds greater the 20 m.p.h., sheet metal louvers and moisture eliminator enhancements are available. To reduce water spray and comply with snow restrictions, each rooftop is installed on a standard 16” roof curb. The air handling cabinet is constructed of galvalume steel with minimum gauge thickness of: Bases - 12 gauge; Corner Posts and Tops - 20 gauge; Access Panels - 20 gauge. The interior of the cooling cabinet includes standard double wall floor and roof panels containing 1” R4 insulation. Side panel options are available with double wall construction and 1” R4 insulation. All units include return and supply air provisions as standard.

Agency Approvals. All MAPS™ rooftops are ETL Approved and tested to UL Standard 1995.

Furnace. Indirect gas fired heat section has a thermal efficiency of 80% plus. All units can be equipped for either natural gas or liquid propane and include an integral power vent system, which provides metered combustion air, dilutes flue products, and eliminates the need for a vent cap. Combustion air intake and flue outlet locations are on the same side of the unit. Each unit has all the required limit and safety controls including a venter pressure switch that verifies power vent flow prior to allowing operation of 24 volt gas valve. The furnace designs are certified by the Canadian Standards Association to ANSI Z83.

Gas Modulation. For applications with high air change over rates, units can be ordered with input modulation down to 25%. The modulation provides enhanced comfort, by eliminating temperature swings that normally occur between heating cycles (which are especially evident with high outside air).

Stainless Steel Heat Exchanger & Component Options. The heat exchanger is made of 409 stainless steel with venturi-design tubes. The die-formed burners are also constructed of 409 stainless steel and include flared ports with a stainless steel insert. To ensure corrosion resistance, each furnace floor is equipped with a 409 stainless steel condensate drip pan. These furnaces have over 30 years of proven field experience.

Intermittent Spark Pilot. Automatic lighting of pilot is achieved through an electronic spark on a call for heat. Pilot gas flow is shut off between heating cycles.

Compressors. High efficiency hermetic reciprocating compressors have been selected for their refrigeration reliability and proven field track record. Cabinet size A use compressors designed originally for heat pump applications. Cabinet size B utilize manifolded compressor sets. PCDA models add an additional compressor stage to PCCA units by providing a dedicated hermetic reciprocating compressor for dehumidification and condenser reheat.

Compressor Protection. Single compressors (6.25 tons or less) include crankcase heaters, internal temperature and current sensitive motor overloads for maximum protection. Tandem compressors (10 tons or greater) include crankcase heaters, current sensitive motor overloads and external high pressure cutouts.

Refrigerant Circuit. Included in each refrigerant circuit is a liquid line filter drier, dual gauge connections for high and low pressure readings, thermal expansion valve control, low pressure safety/loss of charge protector (auto-reset) and coil frost temperature control (auto-reset). Cabinet size B models are equipped with external high-pressure cutouts (manual-reset). PCDA series units are available with an external high ambient temperature lock out option (auto-reset).

Coils. The condenser, evaporator and dehumidifier coils are aluminum plate finned on multiple rows of seamless copper tubing. The tubes are mechanically expanded, firmly bonding the tube to the shoulder of each fin. All Multi-circuit evaporator coils are of the intermingled configuration to reduce the risk of coil freezing at part load and increase part load efficiency. Each PCDA series dehumidifier is equipped with no more than a one row evaporator and condenser coil to minimize parasitic losses.

Air Cooled Condensers. Modular condensing units are mounted and installed on 12 gauge engineered mechanical steel strut. Compressor and condenser coil mountings are designed to minimize vibration and piping stress. Vertical isolation of condensers and double wall roof and floor panels insulated with 1” thick insulation minimize compressor sound transmission through roof and wall structures. The condenser is designed for a vertical air discharge using propeller type fans, electronically balanced and direct-driven by 1075 RPM PSC fan motors. The condenser coil is inherently protected by the condenser cabinet to preclude the need for hail guards.

Supply Blower and Motor. A forward curved, statically and dynamically balanced DIDW centrifugal blower is used for the indoor air. The blower and housing are galvanized steel. There are a variety of motors (ODP, Totally Enclosed, High Efficiency) to meet your application needs.

Filters. Two inch, pleated or permanent metal mesh filters are installed in the filter rack. Due to frequent contact with outside air moisture, filter media that is subject to possible moisture damage should be inspected frequently.

Controls. Units are to be shipped with standard discharge air control.

For additional details or specifications refer to Model PCCA/PCDA product catalog or contact your Reznor Representative toll-free at **1-800-695-1901.**

For more information:
1-800-695-1901
www.ReznorOnLine.com
Thomas&Betts

1/01 YL 5M Form Number RZ-T-PC (Version A)