



TRANQUILITY TD SERIES

  
**CLIMATEMASTER**<sup>®</sup>  
Water-Source Heat Pump Systems

# DEDICATED OUTDOOR AIR SYSTEMS (TO) SERIES

## CLIMATEMASTER DEDICATED OUTDOOR AIR SYSTEMS - 100% OUTDOOR AIR APPLICATIONS

ClimateMaster Dedicated Outdoor Air Systems (TO) Series provides the most complete solution for your water-source application. Our many options and configurations allow the design for outdoor air requirements to be incorporated into the water loop system, further enhancing the advantages of a WSHP application. The ability to precisely control leaving air dew point temperature in summer, handle extremely cold entering air temperatures in winter, and perform at part load conditions give designers unmatched flexibility in building design, Indoor Air Quality (IAQ) and energy efficiency.

## CLIMATEMASTER'S APPROACH TO IAQ

### ISSUES OF INDOOR AIR QUALITY (IAQ)

Several HVAC trade and professional organizations, such as ASHRAE, have documented the need for suitable indoor air quality. A primary requirement for maintaining proper IAQ is the introduction of outdoor air. Unfortunately, outdoor air also introduces moisture into a facility and can create IAQ problems - mold, mildew and the proper environment for viruses and other organisms to flourish. The key to preventing mold formation and growth is to control the relative humidity within the space. However, a standard WSHP cannot achieve this because it is controlled on temperature alone. Instead, a system must be implemented that can provide full control of both temperature and humidity.

### OPTIMAL IAQ DESIGN

Several important IAQ issues must be addressed to design the most effective dehumidification system for the application. ClimateMaster reviews the following list of criteria when building all Tranquility OA Series IAQ units.

### DEDICATED OUTDOOR AIR SYSTEMS (DOAS)

The most energy efficient method for removing moisture is to use a dedicated outdoor air system that will reduce the dew point of supply air to below 55°F (13°C). This approach also helps remove existing moisture inside a facility. A DOAS design can also be optimized to remove maximum moisture at the lowest electrical consumption rate (Moisture Removal Efficiency, MRE) at both full and part-load conditions. ClimateMaster supplies DOAS units under our Tranquility OA (HFC-410A refrigerant) series product lines.

ASHRAE 90.1. The ASHRAE Building Code 90.1 establishes a standard for energy conservation of commercial HVAC equipment. It states that some systems cannot use new energy to reheat the air; rather, 75% of their energy must be site-recovered. ClimateMaster's Tranquility OA Series units comply with, and exceeds, this code by using hot gas reheat coils.

## LEAVING AIR TEMPERATURE CONTROL

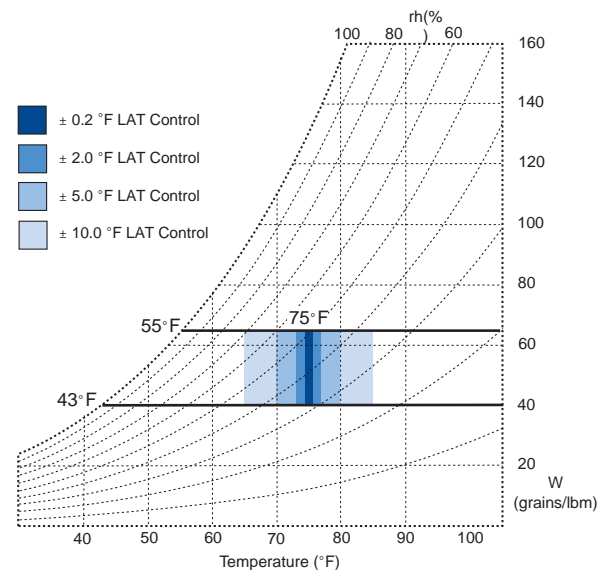
ClimateMaster's IAQ units provide precise discharge temperature by using fully modulating hot gas control valves. Other systems that use solenoid valves and/or liquid sub-cooling loops can control the leaving air temperature to only  $\pm 10^\circ\text{F}$  ( $\pm 6^\circ\text{C}$ ) and typically are closer to  $\pm 20^\circ\text{F}$  ( $\pm 11^\circ\text{C}$ ). These systems do not comply with standard 90.1. They require new energy to trim the leaving air temperature to avoid overcooling of the space. This lack of accuracy also directly affects operation costs. Costs rise when new energy is required to adjust high temperature fluctuations in order to meet preset temperatures. Table 1 below shows the potential increase in energy consumption that can occur at different control accuracies.

Table 1: Temperature Fluctuation and Corresponding Energy Consumption

ACCURACY TOLERANCE	POTENTIAL ENERGY CONSUMPTION
$\pm 0.2^\circ\text{F}$ ( $\pm 0.1^\circ\text{C}$ )	Base
$\pm 2.0^\circ\text{F}$ ( $\pm 1.0^\circ\text{C}$ )	10%
$\pm 5.0^\circ\text{F}$ ( $\pm 3.0^\circ\text{C}$ )	25%
$\pm 10.0^\circ\text{F}$ ( $\pm 6.0^\circ\text{C}$ )	50%

In addition, people can sense temperature differences greater than  $\pm 2.0^\circ\text{F}$  ( $\pm 1.0^\circ\text{C}$ ). Therefore, the greater the temperature swing, the more uncomfortable the occupants will be (see Figure 1).

Figure 1: Accuracy of LAT Control ( $^\circ\text{F}$ )



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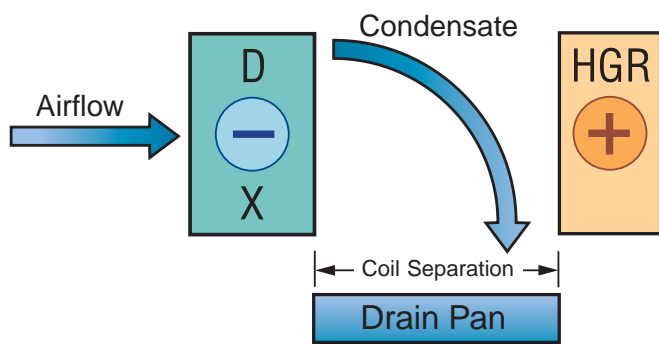
## DOUBLE-WALL CONSTRUCTION

(Horizontal Units & Vertical Units 20 tons and larger). Fiberglass insulation can cause IAQ problems because it wicks water from the air and promotes the growth of mold and bacteria. Our Tranquility OA systems avoid this problem by using either closed cell foam (vertical units) or internal galvanized liner (horizontal units). Most importantly, our systems don't add to the IAQ problem.

## AIR SEPARATED COILS

If a hot gas reheat coil is installed too close to the evaporator coil, re-hydration can occur. Water that forms on the evaporator coil can be blown onto the hot reheat coil, and thus be converted back into vapor and returned to the space. This completely negates all dehumidification efforts and fails to meet basic IAQ design requirements. Plus, the system ends up removing less moisture at a higher electrical cost. That's why we design our IAQ units with adequate separation between the outlet face of the evaporator coil and the inlet face of the hot gas reheat to prevent re-hydration (see Figure 2).

Figure 2: Re-Hydration Prevention



## FILTRATION

Outdoor air is full of many airborne particles and pollutants. Filtration is essential to prevent dirt from accumulating on coils and contaminating indoor spaces. When 1- or 2-inch wide (25 or 51 mm) filters are used, they must be frequently replaced. Therefore, our IAQ units are equipped with a minimum of 4-inch (102 mm), pleated filters to reduce filter maintenance.

## FULL-SIZE CONDENSERS

Our IAQ systems use the ideal control strategy that can provide first-stage cooling by delivering colder air to the space. Since the compressor must be energized for dehumidification, the unit can meet the space's part load sensible requirements. As a result, OA Series units can help reduce the size of the main building air conditioning system. This control is called room or OA reset of LAT.

## TRANQUILITY OA SERIES PRODUCT FEATURES

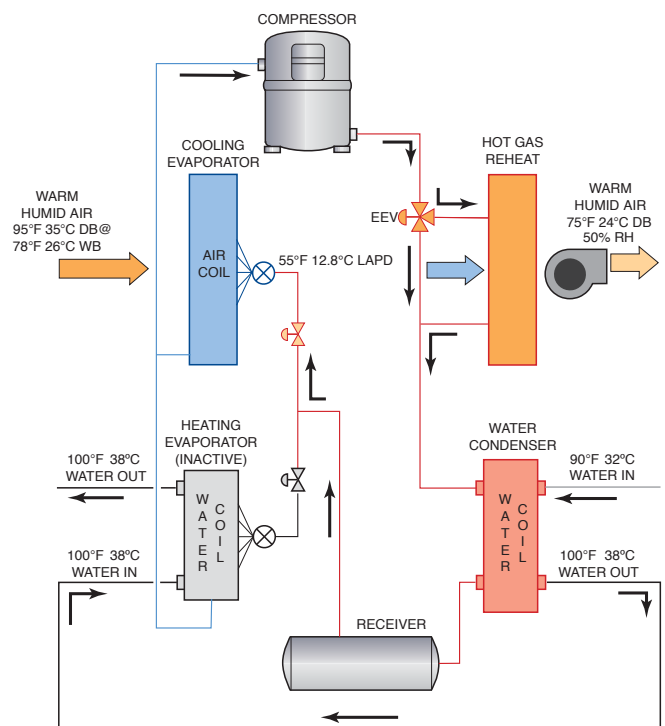
### WATER-SOURCE HEAT PUMP REFRIGERANT CIRCUIT

A heat pump "pumps" energy from a hot source to a cold source for heating purposes, while also pumping energy from a cold source to a hot source when cooling is required. Because of the innovative design of the OA Series refrigerant circuit, facilities can now achieve significant energy efficiency through improved energy recovery.

### NON-REVERSING VALVE TECHNOLOGY

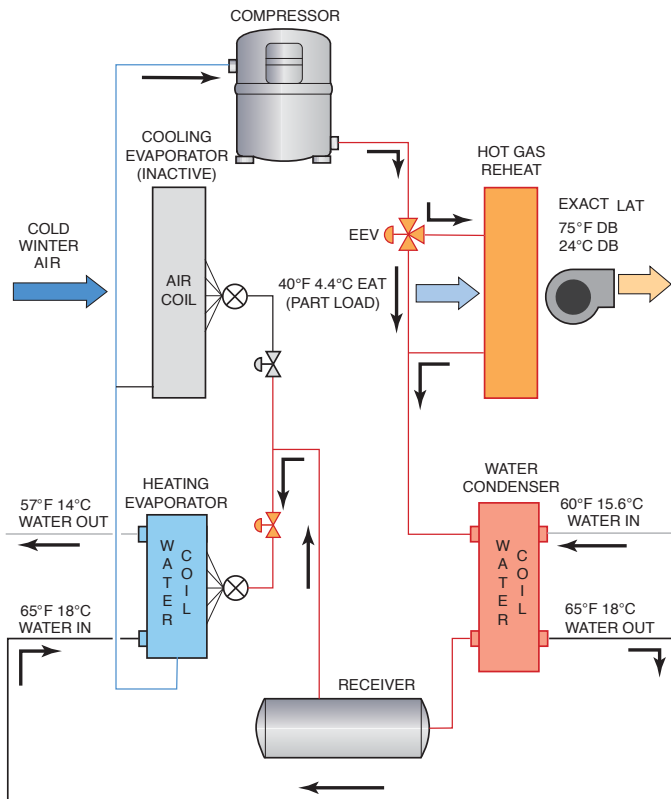
The ClimateMaster DOAS refrigerant circuit uses a four-element refrigeration system to overcome the typical problems that two-element reverse cycle systems encounter in outdoor air applications. In addition to the standard evaporator and reheat coils, this design uses two independent water condensers. One acts as the true condenser for the balance of the total heat of rejection (THR) of the system and the other is the evaporator in the reverse cycle heating mode. This design maximizes MRE and COP, providing the lowest operating cost to the user (see Figure 3).

Figure 3: Refrigerant Circuit Schematic with LAT Control: Cooling Mode



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Figure 4: Refrigerant Circuit Schematic with LAT Control: Heating Mode



## WINTER LAT CONTROL

Reverse cycle systems can only provide air at fixed temperatures, which is fine for space conditioning, but not for the varying requirements of a dedicated outdoor air system. Reverse cycle systems cannot control the amount of heat that's added to the air stream. This either overheats or under-heats the air, requiring new energy to meet preset temperatures. The ClimateMaster DOAS unit, however, precisely controls the amount of heat added to the air eliminating the need for other energy sources. Any extra energy is added back to the water loop to enhance the system's COP.

## ELIMINATING PREHEAT OF SUPPLY AIR

ClimateMaster OA Series units can heat 100% outdoor winter air without the need for a separate auxiliary heat source. Our system is effective down to 15°F (-9°C) winter design temperature as compared to a conventional system's minimum of 40°F (4°C). Horizontal units with optional ERV can handle 100% outdoor air without auxiliary heat regardless of outdoor design temperature. Other units (without ERV) may require a small amount of preheat when the outdoor temperature is below 15°F (-9°C).

## AUTO SEASON CHANGE-OVER

Conventional heat pumps must stop the compressor to change from heating to cooling. With the compressor off, untreated outdoor air is then delivered to the space. The ClimateMaster OA Series refrigerant circuit's creative design avoids this problem and automatically makes heating and cooling changes without losing LAT control like other types of DOAS units.

## INCREDIBLE SYSTEM - PHENOMENAL RESULTS

The real advantage of the refrigerant circuit is that it controls LAT in both the cooling and heating modes. This truly meets all energy codes including ASHRAE 90.1 and achieves EER's of 14+ and COP's approaching 6.0. By incorporating ClimateMaster DOAS units within the ClimateMaster WSHP system, a facility can expect up to 50% savings on its heating and cooling bills.

## RECOVERING ENERGY FROM EXHAUST AIR (HORIZONTAL UNITS ONLY)

### OPTION: Rx SERIES ENERGY RECOVERY WHEEL

ClimateMaster's enthalpy wheel recovers a significant amount of energy from exhaust air. This wheel is a rotary counter flow air-to-air device that transfers both sensible and latent heat between air streams.

In Figure 5, filtered outdoor air encounters the upper half of the wheel while exhaust air flows through the lower half of the wheel. As the wheel constantly rotates during ventilation, it recovers valuable energy. Except for its rotation, the wheel is a passive device. Its function basically reverses between summer and winter. Figure 5 shows the differences. For more information, read ClimateMaster's white paper (application bulletin) on Energy Recovery Wheel Technology.

## SUMMERTIME OPERATION

In summer, ventilation air transfers its heat to the mass of the wheel. When the wheel turns into the exhaust air stream, it releases its heat. This significantly cools the ventilation air even before it reaches the evaporator coil.

But the wheel also assists with dehumidification. Its media is impregnated with a water-selective desiccant (4Å molecular sieve) that captures moisture from outdoor air. When the wheel turns into the flow of drier exhaust air, moisture is released. This reduces the moisture load on the dehumidification coil.

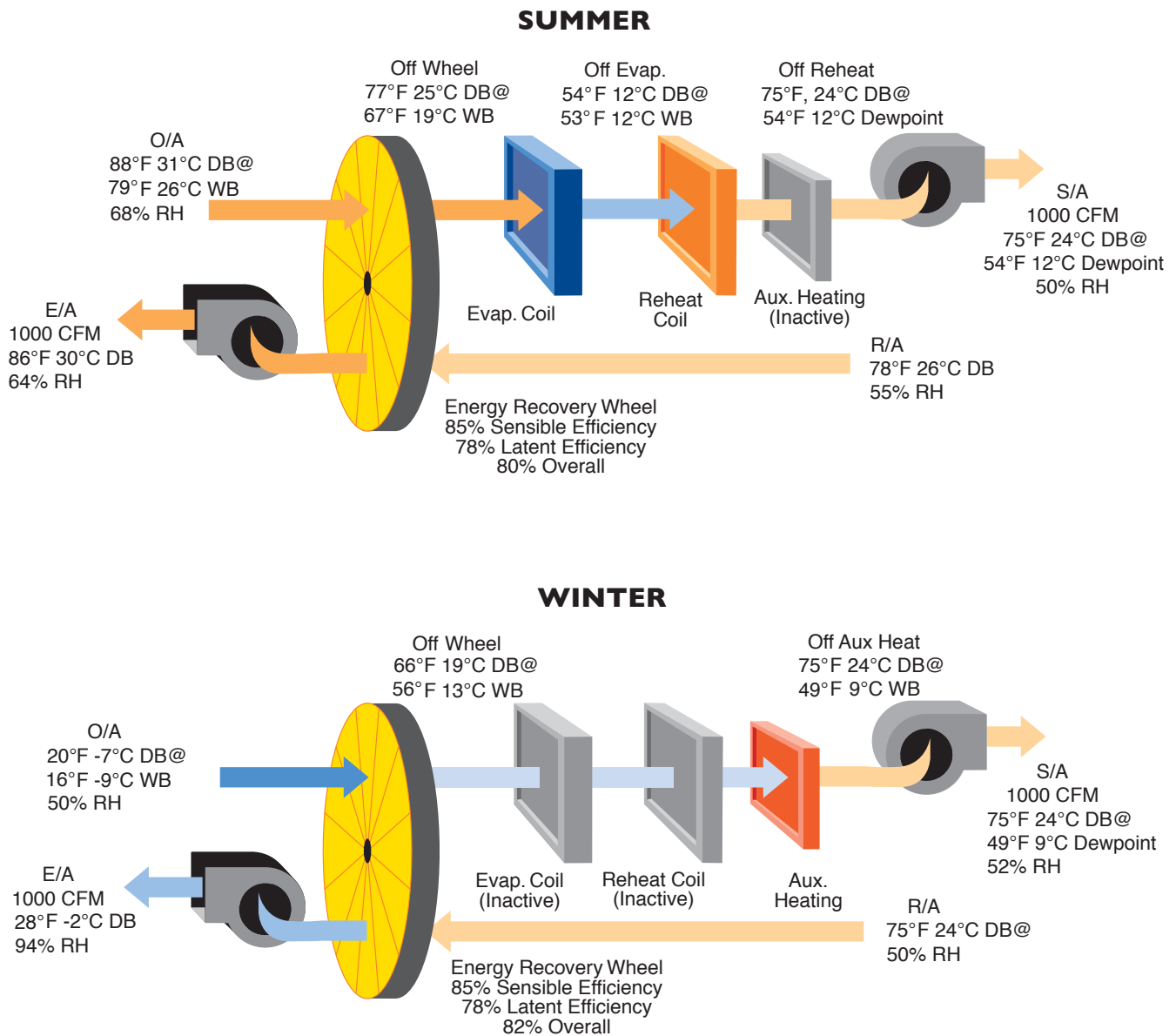
## WINTERTIME OPERATION

In winter, sensible heat is transferred from warm exhaust air to cooler ventilation air. This heat transfer works in reverse to that of summer because the exhaust air is much warmer than the incoming air from outdoors.

The transfer of moisture is also reversed. The wheel recovers moisture from the exhaust air and deposits it into the dry, cold incoming air.

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Figure 5: Energy Recovery Wheel Operation



## REDUCED LOADS

The energy recovered by the wheel significantly reduces sensible heating and cooling loads. Likewise, the load on the refrigerant dehumidification system is also reduced allowing you to use a smaller 100% outdoor air unit.

While the wheel cannot meet the full moisture load alone, it can greatly reduce peak loads on the outdoor air system, especially when there is a large difference in moisture content between the air streams.

Dehumidification through refrigeration is a standard industry approach. However, integrating an energy recovery wheel into this type of system allows the dehumidification circuit to work more efficiently. The wheel significantly decreases the refrigeration capacity required to ensure a complete year-round solution. Its impact is so great that it reduces the required compressor size by approximately half.

# DEDICATED OUTDOOR AIR SYSTEMS (TO) SERIES

## VERTICAL DOAS SYSTEMS UNIT FEATURES

### Leaving Air Temperature Control

- Leaving Air Temperature Control
- Supply air temperature controlled to  $\pm 0.2^{\circ}\text{F}$  ( $\pm 0.1^{\circ}\text{C}$ )
- Substantial energy savings and ASHRAE 90.1 compliant
- Conditioned outdoor air can be introduced directly into space

### Evaporator Coil

- Raised lance fins, rifled tubes maximize moisture removal

### Drain Pan

- Stainless steel pan minimizes corrosion
- Sloped design avoids hazardous puddling

### Fans

- Forward curved centrifugal blowers or plenum fans

### Refrigerant Reheat Coil

- Sized for neutral LAT (65 to 80°F, 18 to 27°C) with  $\pm 0.2^{\circ}\text{F}$  ( $\pm 0.1^{\circ}\text{C}$ ) control
- Adequate coil separation avoids re-hydration

### Scroll Compressor

- State-of-the-art compressor technology for highest efficiency and reliability
- Quiet operation
- Units 8 tons (28kW) and larger, multiple compressors are staged to match the load

### Electrical Service

- Single point connection, including heat - all units

### Insulation

- Closed cell foam or polystyrene board in double-wall construction
- Superior to fiberglass insulation - eliminates fiber-release into air
- Meets ASTM mold, mildew, moisture resistance specifications

### Refrigeration Circuit

- Dissipates captured heat into water loop
- Unique design - no reversing valve
- Modulating hot gas reheat

### Filters

- 4" deep extended surface, pre-filters (MERV 7)

## Additional Options Increase Flexibility

- Optional coil coatings available for corrosive environments
- Single phase available on 4 and 5 ton (14 and 18 kW) units
- Optional power disconnects (fused and non-fused)
- Units available in 4 - 30 tons (14 to 105 kW)
- Contact factory for non-standard options

## Vertical DOAS Dimensional Data

Model		Overall Cabinet		
		W	D	H
04 - 05	in.	34.0	38.9	60.1
	cm	86.4	98.8	152.7
08 - 15	in.	41.9	46.0	80.1
	cm	106.4	116.8	203.5
20 - 30	in.	77.3	61.5	70.0
	cm	196.3	156.2	177.8

## VERTICAL DOAS UNIT



## HORIZONTAL DOAS UNIT



# DEDICATED OUTDOOR AIR SYSTEMS (TO) SERIES

## HORIZONTAL DOAS SYSTEMS

### UNIT FEATURES

#### Precise Leaving Air Temperature Control

- Air temperature leaving dehumidifier controlled to  $\pm 0.2^{\circ}\text{F}$  ( $\pm 0.1^{\circ}\text{C}$ )
- Substantial energy savings
- Conditioned outdoor air can be introduced directly into space

#### Evaporator Coil

- Raised lance fins, rifled tubes maximize moisture removal
- Very high MRE's (Moisture Removal Efficiency)

#### Drain Pan

- Stainless steel pan minimizes corrosion

#### Refrigerant Reheat Coil

- Sized for neutral LAT (65 to 80°F, 18 to 27°C)
- Air separation avoids condensate re-vaporization

#### Scroll Compressor

- State-of-the-art compressor technology for highest efficiency and reliability
- Quietest operation for less noise
- Over 5 tons (18 kW), multiple compressors are staged to match the load

#### Fans

- Forward curved centrifugal blowers
- Backward-inclined centrifugal fans, plug fans on larger units

#### Electrical Service

- Single point power connection, for all units

#### Controls

- Simple ladder logic addresses wide variety of conditions
- System can handle dehumidification, cooling, and heating
- Occupancy contact ensures outdoor air enters only when needed

#### Cabinet Construction

- Corrosion-resistant galvanized with powder coat finish
- Meets 1000 hour salt spray test
- All serviceable elements accessible from one side of unit
- Double-wall construction
- R-5 insulation

#### Refrigeration Circuit

- Dissipates captured heat into water loop
- Unique design - no reversing valve
- Modulating hot gas reheat

#### Filters

- 4" deep extended surface pre-filters (MERV 7)

#### Outdoor Design (Rooftop Models)

- Rain hood, aluminum mist eliminator
- Stainless steel fasteners
- Isolation dampers
- TEFC motors

#### Rx Energy Recovery Wheel (Optional)

- Sensible and latent heat recovery
- Significant energy savings by lowering operating costs

#### Additional Options Increase Flexibility

- Top, bottom or end horizontal air discharge
- Horizontal or Rooftop configurations available
- Optional coil coatings available for corrosive environments
- Optional power disconnects (fused and non-fused)
- Contact factory for non-standard options

#### Dimensional Data - Without Wheel

Model		Overall Cabinet		
		W	D	H
02 - 05	in.	43.1	102.3	43.9
	cm	109.5	259.8	111.5
08 - 15	in.	55.1	129.6	48.6
	cm	149.0	329.2	123.4
20	in.	60.5	138.1	52.6
	cm	153.7	350.8	133.6
25 - 30	in.	67.1	144.7	63.1
	cm	170.4	367.5	160.3
36 - 46	in.	78.8	153.1	75.4
	cm	200.2	388.9	191.5
50 - 60	in.	93.5	165.2	83.6
	cm	237.5	419.6	212.3

#### Dimensional Data - With Wheel

Model		Overall Cabinet		
		W	D	H
02 - 03	in.	55.1	123.8	48.6
	cm	140.0	314.5	123.4
05	in.	60.5	130.3	52.6
	cm	153.7	331.0	133.6
08	in.	67.1	137.8	63.1
	cm	170.4	350.0	160.3
10	in.	78.5	140.8	73.4
	cm	199.4	357.6	186.4
15	in.	93.5	153.7	83.6
	cm	237.5	390.4	212.3
20 - 25	in.	96.5	164.2	92.6
	cm	245.1	417.1	235.2

