TRANQUILITY® TD SERIES

CLIMATEMASTER®
Water-Source Heat Pump Systems

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

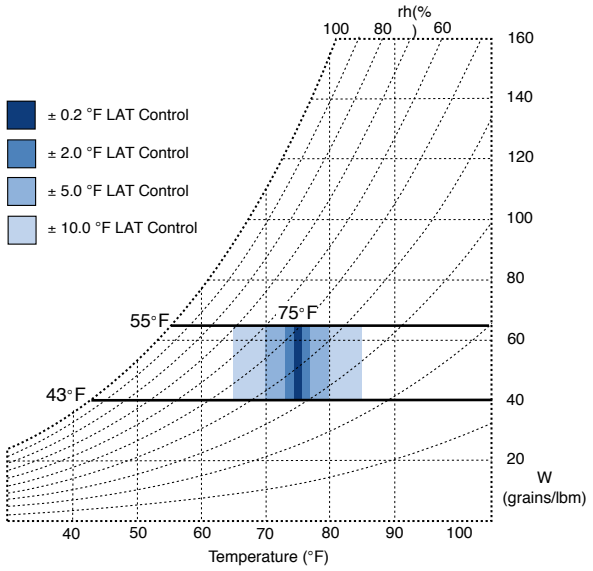
ClimateMaster's IAQ units provide precise discharge temperature by using fully modulating hot gas control valves. Other systems that use solenoid valves and/or liquid sub-cooling loops can control the leaving air temperature to only ±10°F (±6°C) and typically are closer to ±20°F (±11°C). These systems 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
±0.2°F (±0.1°C)	Base
±2.0°F (±1.0°C)	10%
±5.0°F (±3.0°C)	25%
±10.0°F (±6.0°C)	50%

In addition, people can sense temperature differences greater than ±2.0°F (±1.0°C). Therefore, the greater the temperature swing, the more uncomfortable the occupants will be (see Figure 1).

Figure 1: Accuracy of LAT Control (°F)



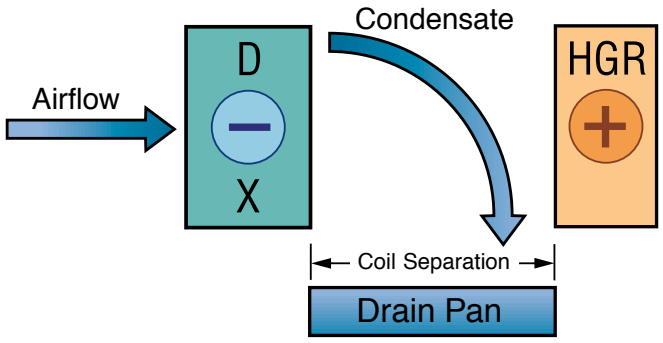
DOUBLE-WALL CONSTRUCTION

(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

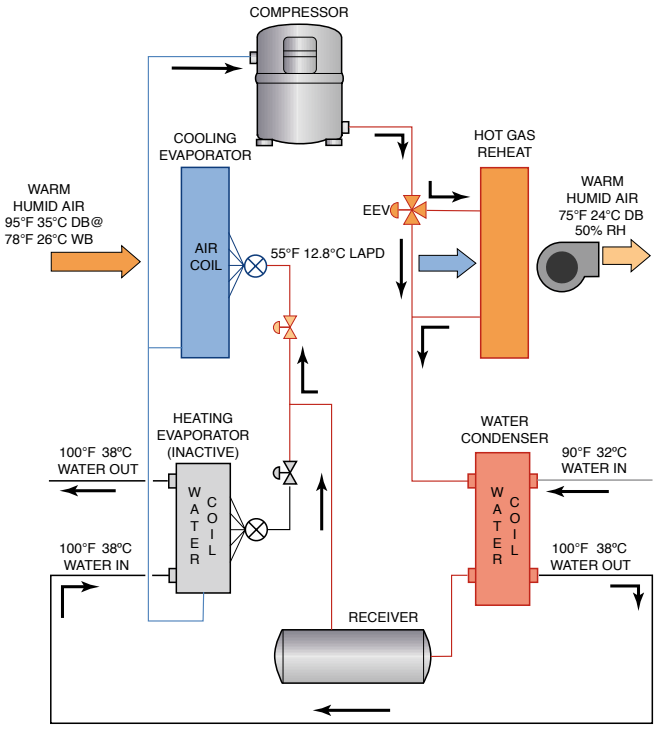
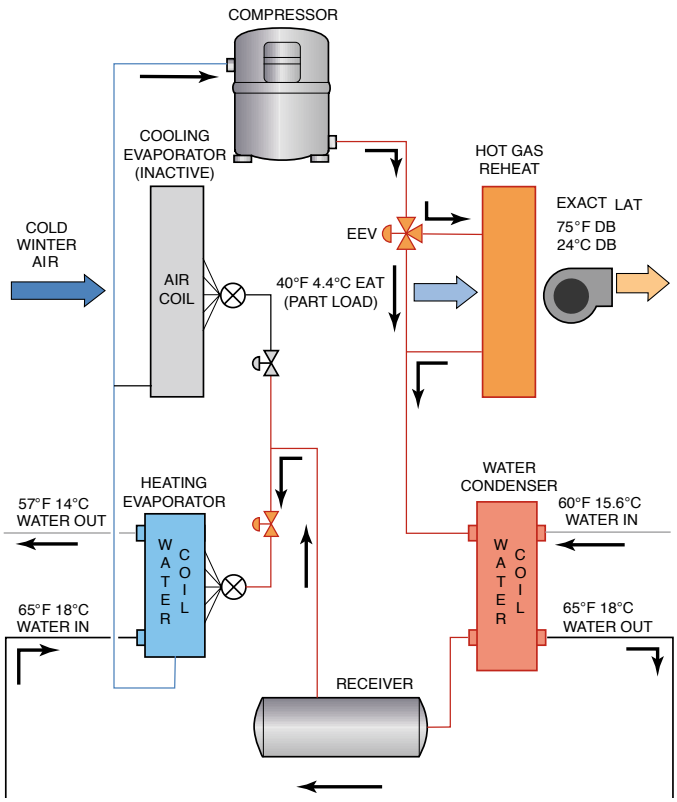


Figure 4: Refrigerant Circuit Schematic with LAT Control: Heating Mode



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.

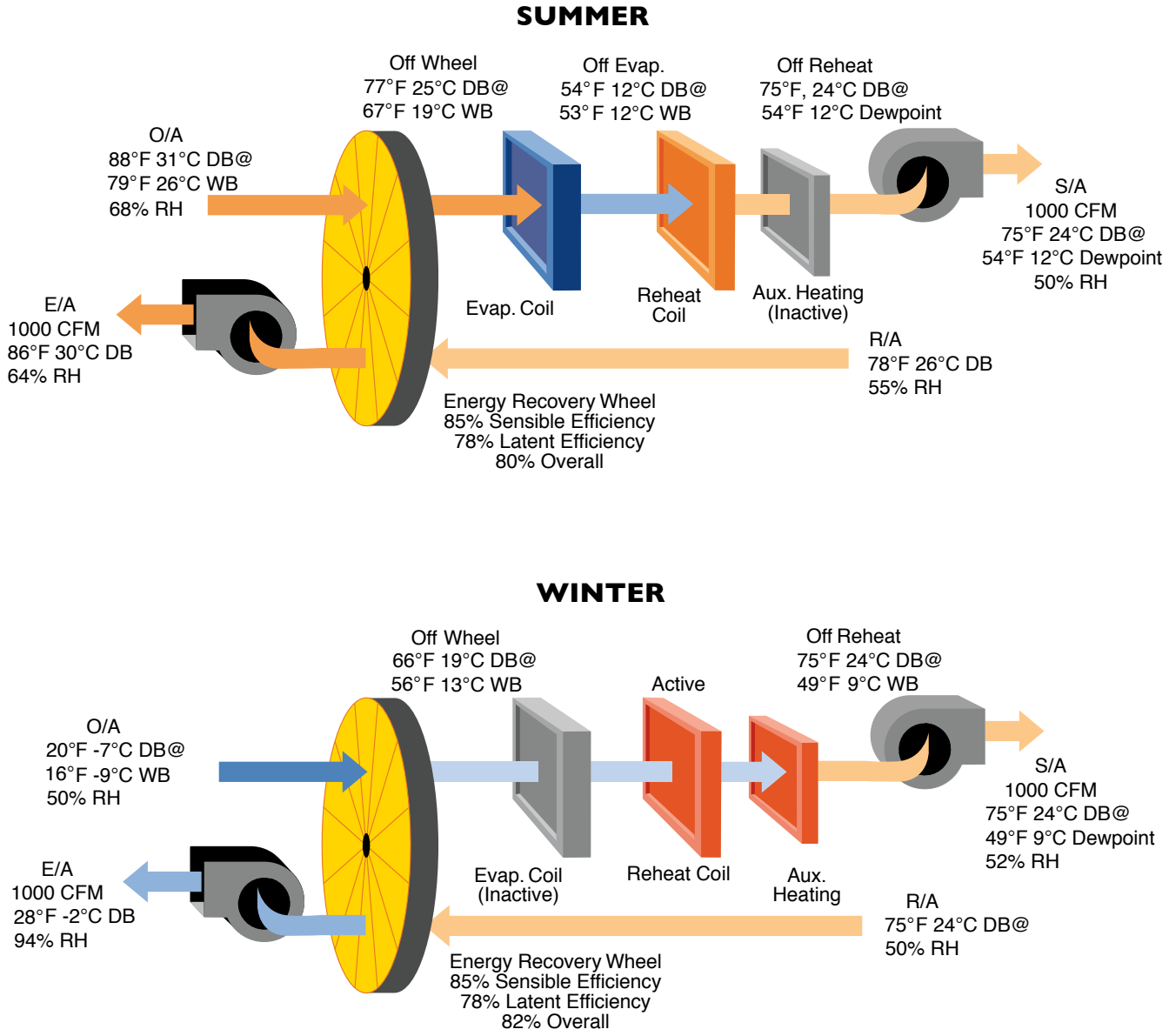
But the wheel also assists with dehumidification. Its media is impregnated with a water-selective desiccant (4Å molecular sieve) that captures moisture from outdoor air. When the wheel turns into the flow of drier exhaust air, moisture is released. This reduces the moisture load on the dehumidification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

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.

VERTICAL DOAS SYSTEMS UNIT FEATURES

Leaving Air Temperature Control

- Leaving Air Temperature Control
- Supply air temperature controlled to ±0.2°F (±0.1°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 ±0.2°F (±0.1°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

HORIZONTAL DOAS SYSTEMS

UNIT FEATURES

Precise Leaving Air Temperature Control

- Air temperature leaving dehumidifier controlled to ±0.2°F (±0.1°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 galvanneal 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

UNIT FEATURES

Product Series	Standard Features																	Factory Installed Options																				
	EarthPure® (HFC-410A) Refrigerant	Microprocessor CXM Controls *	Microprocessor DXM2 Controls	iGate® Advanced Control	ECM Fan Motor	Extended Range Capable Refrigerant Circuit (20°F to 120°F)	Copper Water Coil **	vFlow® Modulating Water Valve ‡	TXV	Dual Level Compressor Vibration Isolation	Field Convertible Discharge (Horizontal Units)	Multiple Access Panels for Installation and Service Ease	Scroll Compressors	Factory Installed Hanger Brackets (Horizontal Units)	Remote Reset at Thermostat	Condensate Overflow Protection	Cupro-Nickel Coil **	High Static Blower	UltraQuiet (MLze) Package	Extended Entering Water Temperature Insulation ***	Auto-Flow Water Regulation	Two-Way Control Valve	Downflow Configuration	Desuperheater Coil	DDC Controller	DXM Controller *	Coated Air Coil	Internal Secondary Pump	ECM Fan Motor	ClimaDry® Reheat	Internal Service Disconnect	vFlow® Modulating Water Valve ‡	vFlow® Internal Variable Water Flow Pump
Tranquility® 30 Digital Two-Stage (TE)	•		•	•	•	•	•		•	•	•	•	•	•	•	•	•		•	•			•	•	•	•	•	•		•	•	•	
Tranquility® 30 Two-Stage (TT)	•	•			•	•	•		•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•			
Tranquility® High Efficiency Two-Stage (TZ)	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•				•	•		•	•					•
Tranquility® 22 High Efficiency Two-Stage (TY)	•		•	•	•	•	•		•	•	•	•	•	•	•	•	•		•	•					•		•						
Tranquility® 20 Single-Stage (TS)	•	•				•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•			
Tranquility® 16 Compact (TC)	•	•				•	•		•	•	•	•	•	•	•	•	•	•	•	•					•	•	•		•				
Tranquility® High Efficiency (TR)	•	•				•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•				
Tranquility® Vertical Stack (TSM)	•	•				•	•		•	•					•	•	•	•	•	•	•	•			•	•	•	•		•			
Tranquility® Vertical Stack (TSL)	•	•				•	•		•	•					•	•	•		•	•	•	•			•	•	•	•		•			
Tranquility® Large (TL)	•	•				•	•		•			•	•		•	•	•	•	•	•	•	•			•	•	•		•				
Tranquility® Compact Belt Drive (TC)	•	•				•	•		•	•	•	•	•	•	•	•	•	•	•	•					•	•	•						
Tranquility® Console (TRC)	•	•				•	•		•						•	•	•		•	•	•	•			•	•	•			•			
Tranquility® Rooftop (TRE)	•	•				•	•		•	•		•	•		•	•	•	•		•	•	•	•		•	•	•		•				
Rx Energy Recovery Ventilator (ERV)						•						•																					
Tranquility® Modular Water-to-Water (TMW)	•	•				•	•		•	•		•	•		•		•		•	•				•	•	•							
Vertical Dedicated Outdoor Air (TOV)	•					•	•		•			•	•						•	†					•		•						
Horizontal Dedicated Outdoor Air (TOH)	•					•	•		•			•	•					•		†			•		•		•						

Some exceptions may apply to standard features and options, consult product submittal materials to determine availability.

* Control for TO Series is DDC with modulating HGR. Control for TMW 360-600 is DDC.

** Water coil construction for TO Series and TMW 360-600 is stainless steel.

*** Standard on TMW Series.

† Extended Range = 35°F–95°F EWT.

‡ Low system pressure drop valve is a standard feature, high system pressure drop valve is optional.

CLIMATEMASTER®
Water-Source Heat Pump Systems

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AHRI CERTIFIED® www.ahridirectory.org Water Source HP ANSI/AHRI/ASHRAE/ISO13256