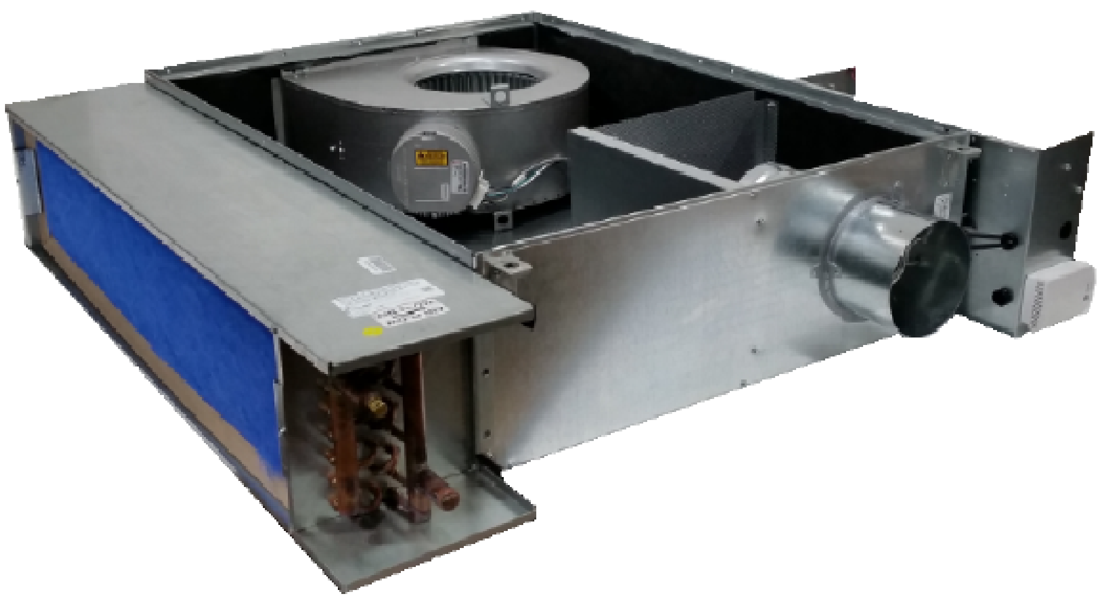
Product Catalog

# Chilled Water Sensible Cooling Terminal Units

## Dedicated Outdoor Air System (DOAS)



November 2022

**DOAS-PRC001K-EN**

# Introduction

The chilled water sensible cooling terminal units discussed in the catalog are an integral part of a system that includes a Dedicated Outdoor Air Unit, Water Chiller(s) and Controls. These chilled water sensible cooling terminal units are equipped with an air valve for controlling the ventilation air provided from the Dedicated Outdoor Air Unit, a chilled water coil intended to provide sensible cooling of the recirculated air drawn in from the ceiling plenum or space through the coil, a fan to deliver the mixture of ventilation air and cooled recirculated air to the space and optionally a hot water coil or electric heater to heat the air discharged from the unit if needed. Additionally, these chilled water sensible cooling terminal units can be equipped from the factory with unit mounted controls.

## Copyright



## Trademarks



## Revision History

- Updated the Digit 12, 13, 14, 15 — Controls in the Model Number chapter.
- Added Symbio™ 500 controller graphic in Tracer BACnet Controllers section in the Features and Benefits chapter.
- Updated the Performance data fan curve, LDxF DS02 figure in the Performance Data chapter.

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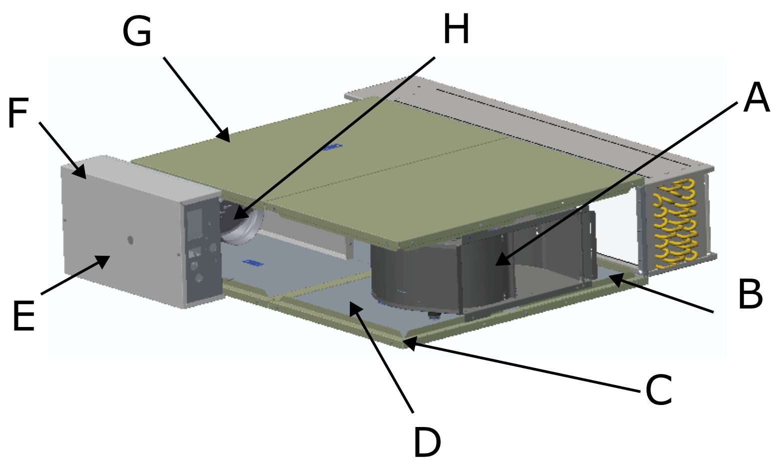
# Features and Benefits

These chilled water sensible cooling terminal units have been specifically designed to be an integral part of a Dedicated Outdoor Air System (DOAS). The unit has been designed with features to make the jobsite coordination and installation easier and with less risk. One of the many challenges on a job site is the coordination of the proper unit orientation for electrical connections and piping connections. An example of a feature to make installation easier, the units have a universal design so they can be flipped in field.

When using sensible cooling terminals like this, it is critically important that the entire building and associated DOAS be designed and operated properly to maintain indoor dew point below the temperature of chilled water supplied to the sensible cooling coils. These units are designed with two integrated features to protect the building and furnishings from unwanted condensation. First, these units are constructed with a drip pan located under the sensible chilled water coil to catch any condensate in the unlikely event that it is produced from the coil. Second, these units are equipped with a moisture sensor that will disable the cooling coil if moisture is detected in this drip pan.

The key to any system is proper control. The Trane UC400 controller is a BACnet® certified device that can be programmed from the factory with the control sequence to properly operate these terminal units as part of a Dedicated Outdoor Air System. This controller can be mounted, wired, tested and programmed at the factory with the proper control sequence for operation in this system.




| | |
|---|---|
| A | Technologically Advanced Units—New fan/motor/wheel assemblies are engineered as an air delivery system to provide the most efficient design available in the industry. For quiet comfort, you can trust and rely on Trane units. |
| B | Tough Interlocking Panels—Ruggedness and rigidity are assured with Trane's patent-pending interlocking panel construction. |
| C | Superior Metal Encapsulated Edges—All Trane chilled water sensible cooling units are complete with metal encapsulated edges to arrest cut insulation fibers and prevent erosion in the airstream. |
| D | Full Range of Insulation—Whether seeking optimal acoustical performance or cleanability, Trane has a complete line of insulation options, including double-wall, matte-faced, foil-faced, closed cell, etc. |
| E | Service Friendly:<br>• Internal shaft visible through control box cover sight hole for blade orientation verification.<br>• Same-side NEC jumpback clearance provides all high-voltage and low-voltage components on the same side to minimize field labor. |
| F | Control Flexibility—Trane factory installs more controllers than any other manufacturer in the industry. In addition to Trane DDC controls and simple factory-mounting of non-Trane controllers, Trane now offers a BACnet® controller that is completely factory commissioned to maximize installation quality and system reliability. Labor savings are maximized with Trane factory-commissioned controllers. |
| G | Accurate Flow Ring—Housed and recessed within the air valve to provide flow ring handling and shipping protection. The patented flow ring provides unmatched airflow measurement accuracy. |
| H | Rugged Air Valve—Trane air valves are heavy gage steel with a continuously welded seam to limit inlet deformation.This provides consistent and repeatable airflow across the flow ring with performance you can count on. |

# Construction

## UL-Listed Products

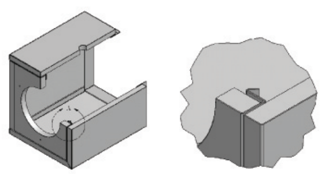
All Trane chilled water sensible cooling terminal units are listed in accordance with UL -1995 as terminal units. This listing includes the terminal with electric heaters. Additionally, all insulation materials pass UL 25/50 smoke and flame safety standards.

## Performance in Accordance with AHRI Standards

This standard sets forth classifications, performance testing requirements and test reporting requirements for air terminal units. The standard contains very detailed procedures that are to be followed for the testing and certification program associated with this standard. Chilled water sensible cooling terminal units are currently not included in any AHRI certification program, however, all the applicable performance data are obtained and represented in accordance with AHRI 880. The operating characteristics tested include discharge and radiated sound power, wide-open pressure drop and fan motor amp draw.

## Casing Design

*Interlocking Panels* – Patent-pending interlocking panels are designed using integral I-beam construction technology. This minimizes deformation and creates tremendous product rigidity. An additional benefit is a smooth unit exterior with few exposed screws - ideal for exposed ceiling applications. Trane chilled water sensible cooling terminal units are designed for use in systems that operate up to 5" w.c. of inlet static pressure.



*Metal Encapsulated Edges*— All Trane chilled water sensible cooling terminal units are complete with encapsulated edges to arrest cut fibers and prevent insulation erosion into the airstream. This is important for applications concerned with fiberglass erosion or projects with either double-wall or externally wrapped duct work.

*Trane Air Valve*— Primary airflow is measured and controlled here for VariTrane™ units. VariTrane™ products are the most rugged and reliable available.

*18-gauge Cylinder*—The 18–gauge cylinder limits deformation or damage during shipment and job site handling, and provides even airflow distribution across the flow ring for unmatched airflow measurement accuracy.

*Flow Ring*—The Trane flow ring is time tested to perform under the most demanding conditions. Trane's patented flow ring is recessed within the air valve cylinder to reduce the potential for damage during job site handling and installation.

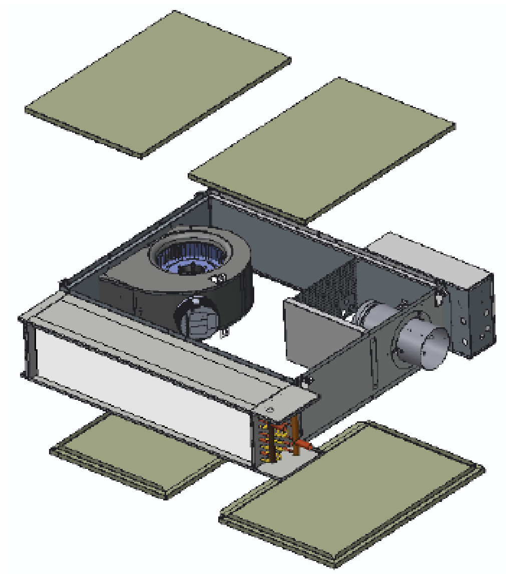
*External Shaft*—This simple design provides controller flexibility and is designed to facilitate actuator field replacement.

*Position Indicator*—The position indicator shows current air valve position to aid in system commissioning. Many times this can be seen from the floor without climbing a ladder.

*External Actuator*—This feature increases serviceability, control system compatibility, and actuator clutch access for simplified commissioning.

# Indoor Air Quality (IAQ) Features

Access is made easy on Trane chilled water sensible cooling terminal units, as shown below. Top and bottom access for the unit in either orientation.



Trane chilled water sensible cooling terminal units are designed with simplified access and a full line of insulation options including:

*Matte-faced*—Typical industry standard with reduced first cost.

*Closed-cell*—This insulation has an R-value and performance equivalent to matte-faced insulation. The main difference is the reduction of water vapor transmission. Closed-cell is designed for use in installations with a high chance of water formation. (It has been used to coat the exterior of chiller evaporator barrels for many years.)

*Foil-faced*—A fiberglass insulation with a thin aluminum coating on the air stream side to prevent fibers from becoming airborne. The aluminum lining is acceptable for many applications, however it is not as rugged as double-wall.

*Double-wall*—Premium insulation often used in many health care applications with insulation locked between metal liners. This eliminates the possibility for insulation entering the airstream and allows for unit interior wipe-down as needed.

# Tracer Building Automation System

Tracer® Building Automation Systems ensure comfort within your building.

Building controls have a bigger job description than they did a few years ago. It's no longer enough to control heating and cooling systems and equipment. Sophisticated buildings require smarter technology that will carry into the future. Tracer controls provide the technology platform – mobile, easy-to-use, cloud-based, scalable and open - for the next generation of data-driven, technology-enabled services that are creating high performance buildings.

With a Trane Tracer® Building Automation System, you'll:

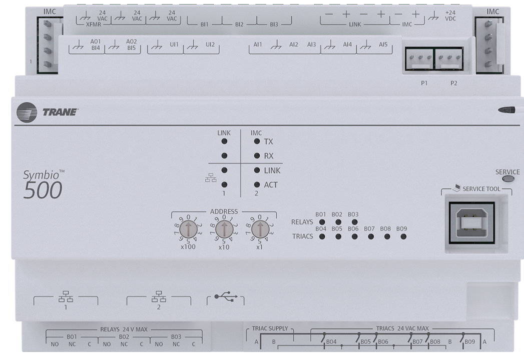
- Reduce operating costs through energy management strategies.
- Consistently provide occupant comfort.
- Enjoy reliable operation with standard, pre-engineered, and pretested applications.
- Easily troubleshoot and monitor either on site or from a remote location.
- Reduce installation time and simplify troubleshooting.

## Tracer BACnet Controllers

Trane offers a full line of programmable BACnet® controllers designed for simple integration into any system which can communicate via the BACnet® protocol. These controllers are factory-downloaded, commissioned, and shipped ready to be installed.

UC400 BACnet Controller

Symbio™ 500 Controller




See DDC Controls chapter for additional control options and sequence-of-operations.

## Air-Fi® Wireless System

For more detailed information on Air-Fi® Wireless systems and devices, see:

- BAS-SVX40*–EN *Air-Fi® Wireless Installation, Operation, and Maintenance*
- BAS-PRD021*–EN *Air-Fi® Wireless Product Data Sheet*
- BAS-SVX55*–EN *Air-Fi® Wireless Network Design Best Practices*

### Air-Fi® Wireless Communications Interface (WCI)

A factory-installed Air-Fi® Wireless Communications Interface (WCI) provides wireless communication between the Tracer® SC, Tracer® UC400/Symbio™ 500 VAV unit controllers and optionally, Air-Fi® Wireless Communication sensors.
The Air-Fi® WCI's wireless mesh network is the perfect alternative to a wired communication link. Eliminating the low-voltage wire between the zone sensor and the terminal unit controller, and between the unit controllers and the system controller will:

- Reduced installation time and associated risks.
- Completion of projects with fewer disruptions.
- Easier and more cost-effective re-configurations, expansions, and upgrades.

***Note:*** *WCI is not compatible with the Trane VAV UCM or Tracer® VV550 LonTalk® controller.*

### Air-Fi® Wireless Communication Sensor (WCS)

The Wireless Communications Sensor (WCS) communicates wirelessly to a Tracer® BACnet® unit controller that has an Air-Fi® WCI installed. A WCS is an alternative to a wired sensor when access and routing of communication cable are issues. It also allows flexible mounting and relocation. Also available are a non-display version of the WCS with a temperature setpoint knob, an occupancy / $CO_2$ sensor / zone temperature version of the WCS, and a relative humidity (RH) sensor add-on daughter board accessory.

## Factory-installed vs. Factory-commissioned

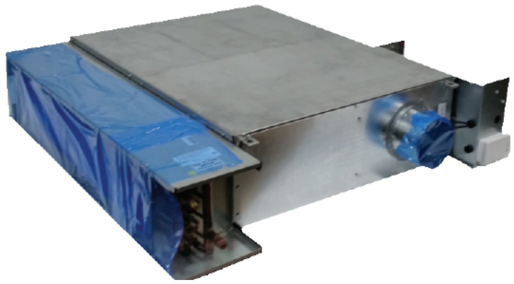
The terms factory-installed and factory-commissioned are often used interchangeably. Trane takes great pride in being the industry leader in factory-commissioned DDC controllers. The following table differentiates these concepts.

Factory-commissioned controllers provide the highest quality and most reliable units for your system. Additional testing verifies proper unit operation including occupied/unoccupied airflow and temperature setpoints, communication link functionality, and output device functionality. The benefits of factory-commissioning are standard on VariTrane™ terminal units with Trane DDC controls. This means that factory-commissioned quality on VariTrane™ units is now available on ANY manufacturer's control system that can communicate using the LonMark® Space Comfort Control (SCC) protocol or the BACnet® protocol. (See Controls section for complete listing of variables which are communicated.)

**Table 1. Factory-installed vs. factory-commissioned**

| | Factory-installed | Factory-commissioned |
|---|---|---|
| Transformer installed (option) | X | X |
| Wires terminated in reliable/consistent setting | X | X |
| Controller mounted | X | X |
| Electric heat contactors and fan relay wired | X | X |
| Controller addressing and associated testing | — | X |
| Minimum and Maximum airflows settings (occupied/unoccupied) | — | X |
| Minimum and Maximum temperature setpoints (occupied/unoccupied) | — | X |
| Minimum ventilation requirements | — | X |
| Heating offset | — | X |
| Trane Air-Fi® wireless communications modules (WCI) | X | X |
| Trane Air-Fi® Wireless Communications Sensor (WCS) | — | — |

# Indoor Air Quality Management During Construction



LEED wrap option is a pressure sensitive covering that prevents contamination of the terminal unit during the construction phase. It is utilized to seal all openings without constraining the installation process.

# Trane Systems — Proven Performance

Trane continues to be an industry leader in the development and implementation of effective systems strategies. A Dedicated Outdoor Air System coupled with these chilled water sensible cooling units in no different.

At the unit level, these units can be equipped with DDC controllers that follow the successful strategy of factory commissioning. At the terminal unit level, the unit controller will be mounted, wired, tested and programmed with the appropriate operating setpoints and sequences needed for proper operation. This can drastically reduce the system start-up time.

From a system perspective, proper coordination of all aspects of the HVAC system are critical to the effective operation of the system as well as comfortable occupants of the building. Again, Trane leads the way, with proven system level strategies to properly coordinate the control of the individual terminal units with the rest of the HVAC system.

# Agency Certifications

There are numerous regulations and standards in the industry that determine the construction and performance parameters for terminal units. Some of the more important of those standards and regulations are listed below, along with a brief description of what each one addresses.

## UL-Listed Products

All Trane chilled water sensible cooling terminal units are listed in accordance with UL -1995 as terminal units. This listing includes the terminal with electric heaters. Additionally, all insulation materials pass UL 25/50 smoke and flame safety standards.

## AHRI Certified Performance

All VariTrane™ units are AHRI certified. AHRI 880 guarantees the pressure drop, flow performance, and acoustical performance provided is reliable and has been tested in accordance with industry accepted standards. AHRI 885 uses AHRI 880 performance and applies accepted industry methods to estimate expected “NC” sound levels within the occupied space.

## American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE)

**ASHRAE - Standard 41.1**

**ASHRAE - Standard 41.2**

**ASHRAE - Standard 41.3**

These standards specify methods for temperature measurement (41.1), laboratory airflow measurement (41.2), and pressure measurement (41.3). While none of these standards specifically discusses air terminals, they discuss topics that are aspects of terminal box systems. Therefore, some engineers will include these standards in their specifications as a primer on accepted measurement techniques.

**ASHRAE - Standard 62.1**

This standard specifies the minimum ventilation rates for occupied spaces, as well as indoor air quality-related requirements for ventilation system components.

**ASHRAE - Standard 111**

This standard calls out procedures to be followed for testing and balancing HVAC systems. It includes descriptions of the equipment used, procedures followed, and field changes that must be made when a system is balanced.

## Air Conditioning and Refrigeration Institute (AHRI)

**AHRI Standard 880**

This standard sets forth classifications, performance testing requirements, and test results reporting requirements for air terminal units. The standard contains very detailed procedures that are to be followed for the testing and certification program associated with this standard. Chilled Water Sensible Cooling Terminal Units are not included in any AHRI certification program, however, all the applicable performance data are obtained and represented in accordance with AHRI 880. The operating characteristics tested include discharge and radiated sound power, wide-open pressure drop, and fan motor amp draw.

**AHRI Standard 885-2008**

This document provides a procedure to estimate sound pressure levels in an occupied space. The standard accounts for the amount of sound pressure in the space due to the air terminal, diffusers and their connecting low pressure ductwork. While sound generated from the central system fan and ductwork may be a significant factor in determining the sound pressure level in the room, this standard does not address those factors. It focuses solely on the terminal and items downstream of it. This standard is related to AHRI-880 by using sound power determined using AHRI-880 methodology as a starting point for the AHRI-885 procedure.

# Underwriter's Laboratory (UL) 1995

Underwriter's Laboratory is an independent testing agency that examines products and determines if those products meet safety requirements. Equipment manufacturers strive to meet UL guidelines and obtain listing and classifications for their products because customers recognize UL approval as a measure of a safely designed product. **Trane chilled water sensible cooling terminals are listed per UL-1995, Heating and Cooling Equipment.** The terminals are listed as an entire assembly.

# National Fire Protection Association (NFPA)

**NFPA 70**

This standard is also known as the National Electrical Code (NEC). The Code gives standards for installation of wiring and electrical equipment for most types of commercial and residential buildings. It is often referred to in air terminal specifications when fan-powered boxes, electric heat or electric controls are included.

**NFPA 90A**

This standard does not speak directly to air terminals but does discuss central system considerations pertaining to a fire and/or smoke condition. The standard discusses safety requirements in design and construction that should be followed to keep the air-handling system from spreading a fire or smoke. The standard specifies practices that are intended to stop fire and smoke from spreading through a duct system, keep the fire-resistive properties of certain building structures (fire walls, etc.) intact, and minimize fire ignition sources and combustible materials.

# Application Considerations

**Figure 1. Unit for sensible cooling only**

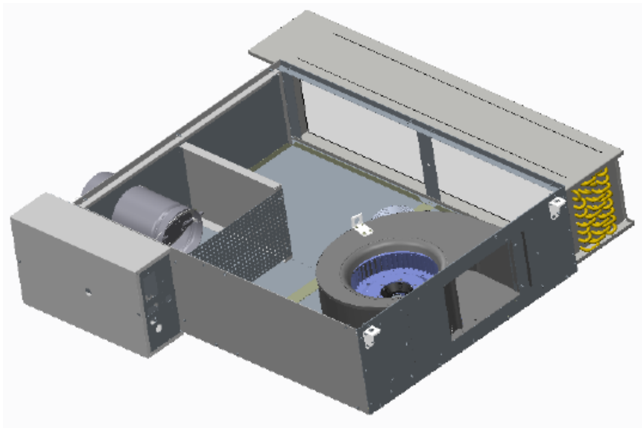


**Figure 2. Unit with hot water coil**

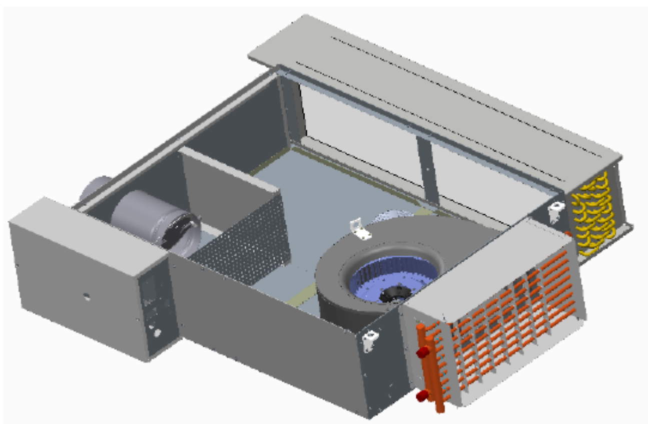
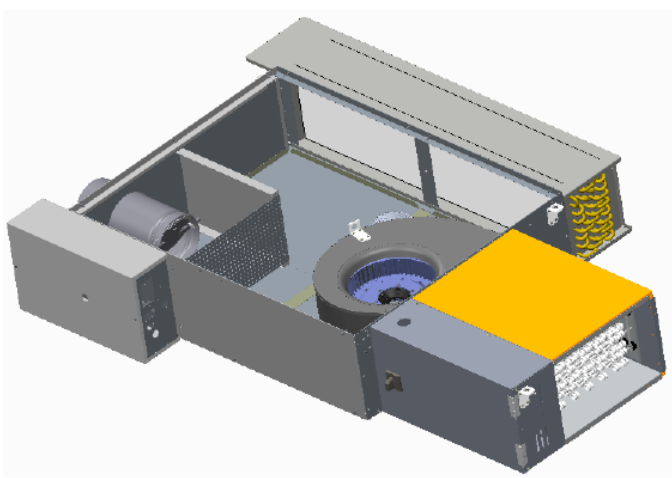


**Figure 3. Unit with electric heat**

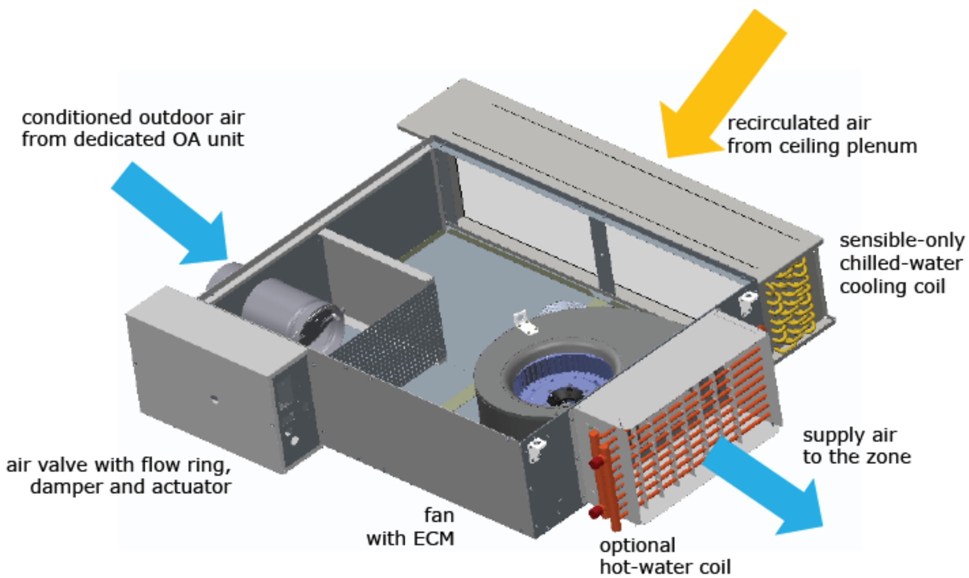


# Types of Chilled Water Sensible Cooling Terminal Units

The function of the Trane chilled water sensible cooling terminal units is a little different than traditional VAV Terminal Units. These terminal units are part of a **system** that uses a dedicated outdoor-air unit to distribute outdoor air to an air valve on each terminal unit to meet the ventilation requirements of the zone. Each terminal unit is also equipped with a sensible-only cooling coil mounted on the plenum inlet. Recirculated air from the plenum (or directly from the occupied space) is drawn in through this cooling coil by the local fan. This cooled air is then mixed with the conditioned (cooled, dehumidified, heated, or humidified) outdoor air from the dedicated OA unit, and distributed through the downstream ductwork to the zone.

In most applications, the water supplied to this local cooling coil is controlled to a temperature above the dew point in the zone. This avoids moisture in the air from condensing on the coil, so it operates dry and provides only sensible cooling. All the dehumidification must then be provided by the dedicated outdoor-air unit. Trane chilled water sensible cooling terminal units are built with a drip pan located beneath the cooling coil, with a moisture sensor installed in it, to detect and prevent any moisture from getting on the ceiling beneath the units or into the occupied space below. These terminal units can be configured with either a hot water coil or electric heater mounted at the unit discharge.

**Figure 4. Chilled water sensible cooling terminal unit function**




# Typical Application of Chilled Water Sensible Cooling Terminal Units

Chilled water sensible cooling terminal units can be applied in all the zones of a building designed with a dedicated outdoor air system capable of delivering sufficiently dehumidified outdoor air to each of the zones. Typically the chilled water supplied to these terminal units is at a higher temperature (54 to 59°F, warmer than the dew point in the space) than traditional chilled water systems. This is similar to other systems with coils in the occupied space intended to perform sensible cooling only. Additionally the dew point in the space must be controlled to avoid conditions in which condensation can develop on the sensible cooling coils on these terminal units.

Figure 5. Typical chilled water sensible cooling terminal unit application

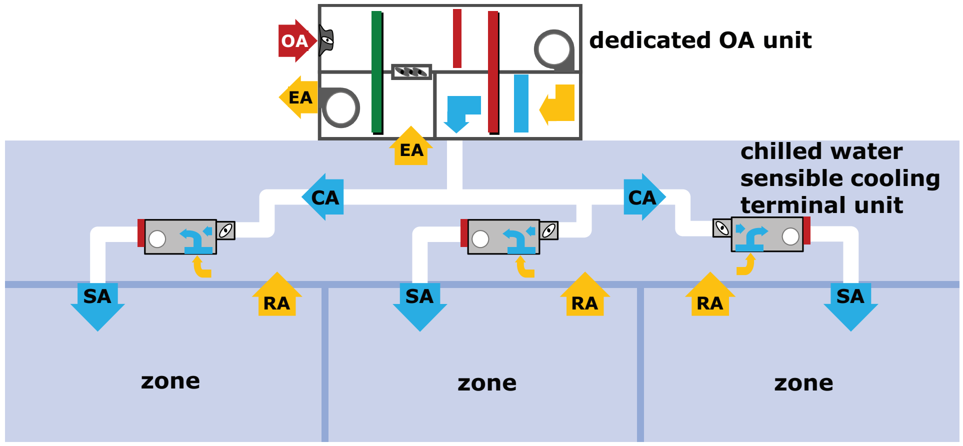



Table 2. DOAS with chilled water sensible cooling terminal units

| Parameter | Chilled Water Sensible Cooling Terminal Unit |
|---|---|
| Fan Operation | Continuous operation during occupied modes, intermittent operation during unoccupied modes. |
| Operating Sequence | Variable volume: Fan runs at minimum speed when the zone temperature is satisfied. Fan speed modulates up to maximum in conjunction with heating or cooling capacity, as needed to maintain desired zone temperature. |
| Fan Energization | Interlocked with the dedicated outdoor air system fan to deliver required outdoor air to the zone during occupied modes. |
| Terminal Fan Sizing | Fan should be sized to meet the greater of the design cooling or heating airflow to the zone. |
| Air Valve Sizing | Sized to meet the design outdoor airflow requirement for the zone. |
| Minimum Inlet Static Pressure Required for DOAS Fan Sizing | Sufficient to overcome air valve pressure loss only. |
| Acoustics | Produces slightly higher background sound pressure levels in the occupied space than a parallel fan-powered terminal unit. The sound levels vary slightly as the fan modulates between minimum and maximum speeds. |

# Energy Savings and System Controls

## Electrically Commutated Motor

The ECM provides an additional energy-saving option to the system designer. Some of the advantages of the motor include high efficiency, quiet operation, short payback, and easy installation. The primary benefit may be seen as increased efficiency, but it provides other benefits:

*Airflow Flexibility*—The ECM allows a greater airflow range per fan size. If a space is going to change uses and load components frequently, the ability to change supply airflow with the ECM without changing units will be a benefit.

*Airflow Balancing*—The ability of the ECM motor to self-balance to an airflow regardless of pressure can be an asset when trying to air balance a job. This will help eliminate additional dampers or changes to downstream ductwork to ensure proper airflow. For more information, please contact your local Trane sales engineer.

## Fan-Pressure Optimization

With Trane's Tracer® building automation system, the information from terminal units can be used for other energy-saving strategies. Fan-pressure optimization is the concept of reducing the DOAS supply fan energy usage based on the position of the terminal unit dampers.

The control system polls the terminal units for the air valve damper position on each unit. The duct static pressure setpoint for the DOAS supply fan is reset downward until the furthest-open damper is nearly wide open. The correct airflow is still being sent to each zone since the air valve controls in the terminal units are pressure-independent, but the fan uses less energy since it is able to generate less pressure, which results in fan energy savings.

# Control Types

Unlike other terminal units, chilled water sensible cooling units are almost exclusively configured as part of a direct digital control (DDC) system.

## Direct Digital Control (DDC) Systems

**Direct digital control (DDC) systems** became available as advances in computer technology made small microprocessors available and affordable. Much of the hardware in DDC systems is similar to analog electronic systems. The primary difference is that DDC controllers allow system integration, remote monitoring, and adjustment. The microprocessor is programmed using software that gives the controller a higher level of capability than either the pneumatic or analog electronic options.

**Benefits**

*Performance*—DDC controls offer PI control capability. A PI control scheme is the most accurate and repeatable control scheme available in the VAV terminal unit industry.

*Versatility*—DDC controller Symbio™ 500 controls accept software commands to determine how its outputs will be controlled. When a control sequence must be modified, making changes to the software instructions is easier and quicker than changing hardware.

*Operating and Maintenance Costs*—DDC controls can be networked together to provide system-control strategies for energy savings. Multiple controllers can be easily monitored and adjusted from a remote location. DDC controls also have system and individual diagnostic capability.

## DDC Controls Basic Information

DDC controls are the industry standard for terminal unit control systems. DDC systems use electronic field devices such as a flow transducer, a primary air modulating damper, and an electronic temperature sensor. These field devices report software instructions of how the outputs are positioned in relation to the inputs to a controller.

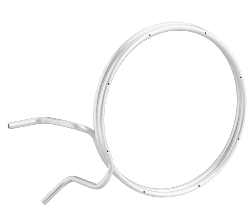
DDC controls provide flexibility and considerable diagnostic capability. DDC controllers can be connected together to form a network of controllers which can be can be monitored from a remote location to ensure proper operation. Commands and overrides can be sent for groups of controllers at one time to make system-wide changes. Commands and overrides can be sent to individual unit controllers to allow problem diagnosis, temporary shutdown, startup schedules or other specialized changes. When integrated into a building automation system, the operation of the terminal units can be coordinated with other components of the overall system to ensure comfortable, efficient operation and even reduce energy use.

DDC control of terminal units is a key element in providing intelligent and responsive building automation. Precision control, flexible comfort, and after hours access are all available with the DDC control system for Trane chilled water sensible cooling terminal units.

Key features of the system include:

- An advanced unit controller
- Flexible system design
- User-friendly interaction

# Flow Measurement and Control



One of the most important characteristics of a terminal unit is its ability to accurately sense and control airflow. The patented, multiple-point, averaging flow ring measures the velocity of the air at the unit ventilation air inlet.

The differential pressure signal output of the flow ring provides the terminal unit controller a measurement of the ventilation airflow through the inlet. The terminal unit controller then opens or closes the inlet damper to maintain the controller airflow setpoint.

## Flow Measurement

Most of these terminal units contain a differential pressure airflow measurement device, mounted at the ventilation air inlet, to provide a signal to the terminal unit controller. Numerous names exist for the differential pressure measurement device—flow sensor, flow bar, flow ring. The differential pressure measured at the inlet varies according to the volumetric flow rate of ventilation air entering the inlet.

The total pressure and the static pressure are measurable quantities. The flow measurement device in a terminal unit is designed to measure velocity pressure. Most flow sensors consist of a hollow piece of tubing with orifices in it. The air valve contains a flow ring as its flow measuring device. The flow ring is two round coils of tubing. Evenly spaced orifices in the upstream coil are the high-pressure taps that average the total pressure of air flowing through the air valve. The orifices in the downstream ring are low-pressure taps that average the air pressure in the wake of flow around the tube. By definition, the measurement of static pressure is to occur at a point perpendicular to the airflow. The low-pressure taps on the flow ring measure a pressure that is parallel to the direction of flow but in the opposite direction of the flow. This “wake pressure” that the downstream ring measures is lower than the actual duct static pressure. The difference between the “wake pressure” and the static pressure can be accounted for so that the above relationship between flow and differential pressure remain valid. The difference also helps create a larger pressure differential than the velocity pressure. Since the pressures being measured in terminal unit applications are small, this larger differential allows transducers and controllers to measure and control at lower flow settings than would otherwise be possible.

The average velocity of air traveling through the inlet is expressed in the equation:

$$FPM = 1096.5\sqrt{\frac{VP}{DENS}}$$

Where:

- FPM = Velocity of air in feet per minute
- 1096.5 = A constant
- VP = The velocity pressure of the air expressed in inches of water
- DENS = The density of the air expressed in pounds per cubic foot

Often, the density is assumed to be a constant for dry air at standard conditions [68°F (20°C)] and sea level pressure of 14.7 psi (101.4 kPa). These conditions have a density of 0.07496 lbs/cubic foot and yield the following commonly used equation:

$$FPM = 4005\sqrt{VP}$$

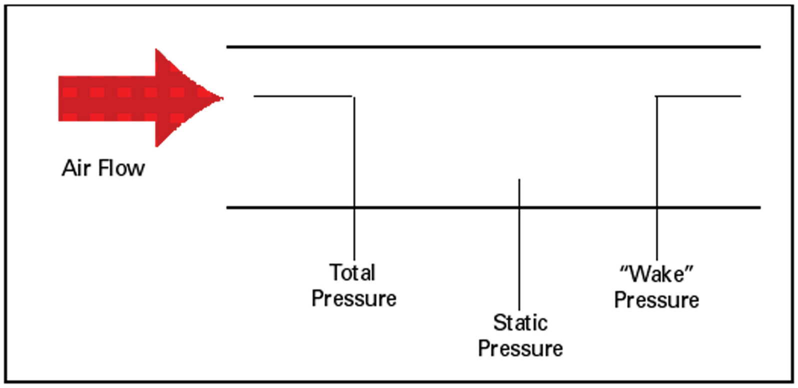
The amount of air traveling through the inlet is related to the area of the inlet and the velocity of the air:

AIRFLOW (cubic feet per minute, cfm) = AREA (square feet) x AVERAGE VELOCITY (feet per minute)

## Accuracy

The multiple, evenly spaced orifices in the flow ring of the terminal unit provide quality measurement accuracy even if ductwork turns or variations are present before the unit inlet. For the most accurate readings, a minimum of 1½ diameters, and preferably 3 diameters, of straight-run ductwork is recommended prior to the inlet connection. The straight-run ductwork should be of the same diameter as the air valve inlet connection. If these recommendations are followed, and the air density effects mentioned below are addressed, the flow ring will measure ventilation airflow within ±5% of unit nominal airflow.

Figure 6. Air pressure measurement orientations




## Air Density Effects

Changes in air density due to the conditions listed below sometimes create situations where the standard flow sensing calibration parameters must be modified. These factors must be accounted for to achieve accuracy with the flow sensing ring. Designers, installers, and air balancers should be aware of these factors and know of the necessary adjustments to correct for them.

### Elevation

At high elevations the air is less dense. Therefore, when measuring the same differential pressure at elevation versus sea level the actual flow will be greater at elevation than it would be at sea level. To calculate the density at an elevation other than standard conditions (most manufacturers choose sea level as the point for their standard conditions), you must set up a ratio between the density and differential pressure at standard conditions and the density and differential pressure at the new elevation.

$$\frac{\Delta P \text{ Standard Conditions}}{\text{DENS Standard Conditions}} = \frac{\Delta P \text{ New Conditions}}{\text{DENS New Conditions}}$$

Since the data from the manufacturer is published at standard conditions, this equation should be solved for the differential pressure at standard conditions and the other quantities substituted to determine the ratio for the differential pressure measured at the new conditions.

### Duct Pressure and Air Temperature Variations

While changes in these factors certainly affect the density of air, most operating parameters which systems need keep these effects very small. The impact on accuracy due to these changes is less than one half of one percent except in very extreme conditions. Extreme conditions are defined as those systems with inlet static pressures greater than 5 in. wg (1245 Pa) and inlet air temperatures greater than 100°F (37.8°C). Since those types of systems occur so infrequently, we assume the effects of duct pressure and air temperature variations to be negligible.

### Linearity

With the increased use of DDC controls instead of pneumatic controls, the issue of linearity is not as great as it once was. The important aspect of flow measurement versus valve position is the accuracy of the controller in determining and controlling the flow. Our units are tested for linearity and that position versus airflow curve is downloaded and commissioned in the factory to ensure proper control of the unit.

# Heat Options

## Chilled Water Cooling Coil Valve

A chilled water cooling coil is included in this terminal unit, and is mounted at the induction air inlet of the unit. When applying these coils it is important to make sure that they are operating in the proper airflow and water flow range. (See tables in Performance Data chapter for airflow and water flow rates.) Either a two-way or a three-way water valve can be used to control the coil. It is important to size the valve correctly, to ensure minimal pressure loss and maximum controllability. See Hot Water Heating Coil section below for details in properly selecting a valve.

## Hot Water Heating Coil

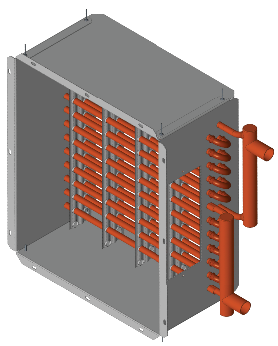


**Figure 7. Hot water coil**

**Figure 8. Trane hot water valve**

**Figure 9. Belimo hot water valve**

A hot water heating coil can be included in this terminal unit, and is mounted at the discharge of the unit. When applying these coils it is important to confirm they are operating in the proper air flow and water flow range. (See tables in Performance Data chapter for airflow and water flow rates.) Either a two-way or a three-way valve controls the coils.

The most important factor when sizing valves is the coefficient of velocity or $C_V$. This coefficient of velocity, which is commonly called the flow coefficient, is an industry standard rating. Valves having the same flow coefficient rating, regardless of manufacturer, will have the same waterside performance characteristics.

The preferred method is to size the valve for 3 to 5 psi for pressure drop when full open. Generally the rule of thumb is to use 4 psi.

*$C_V$ = GPM / 2 or GPM = 2 * $C_V$ (since square root of 4 = 2)*

This formula is very easy to use and is as accurate as any other method. Size the valve for a $C_V$ = 1/2 the GPM it must pass in modulating applications

The equation that governs valve sizing is:

$$C_V = \frac{GPM}{\sqrt{\Delta P}}$$

Where

- $C_V$ = Flow coefficient
- GPM = The maximum water flow rate through the valve in gallons per minute
- $\Delta P$ = The maximum allowable differential pressure across the valve in psi

The flow and differential pressure are generally the known quantities. The equation is solved for the flow coefficient. The flow coefficient is then compared to the published $C_V$ values for the control valves that are available. The control valve with the $C_V$ that is the closest, but greater than, the calculated flow coefficient is the correct choice for the control valve. This choice will keep the valve pressure drop below the maximum allowable valve pressure drop. The valve pressure drop should then be checked against the coil pressure drop. If the coil pressure drop is appreciably larger than the valve pressure drop, a valve with a smaller $C_V$ should be selected to produce a larger control valve pressure drop. If this new valve has a pressure drop that is much larger than the maximum allowable pressure drop for valves, the system designer should be consulted to make sure that the system hot water pumps can deliver the water at the new conditions.

## Electric Heat

An electric heater can be included in this terminal unit, and is mounted at the discharge of the unit. Electric heat coil capacity is rated in kilowatts (kW). Heaters are available with magnetic contactors for staged control, where total capacity is divided among the stage(s). Heaters are also available with SCR control.

Electric heat coils are available in single-phase or three-phase models. This refers to the type of power source connected to the heater. Single-phase models have resistance elements internally connected in parallel. Three- phase models have resistance elements internally connected in a delta or a wye configuration.

The current draw for the electric heater will depend upon whether it is a single-phase or three-phase heater. The current draw is necessary for determining what size wire should be used to power the electric heater and how big the primary power fusing should be. The equations for current draw for these heaters are:

$$1\phi \text{amps} = \frac{\text{kW} \times 1000}{\text{PrimaryVoltage}}$$

$$3\phi \text{amps} = \frac{\text{kW} \times 1000}{\text{PrimaryVoltage}\sqrt{3}}$$

Three-phase electric heat is available in balanced configurations. For example, a 9 kW three-phase coil, each stage would carry 1/3 or 3 kW of the load.

It is important to note that these heaters have certain minimum airflow rates for each amount of kW heat the heater can supply to operate safely. These airflow values are based upon a maximum rise across the electric heater of 50°F (28°C).

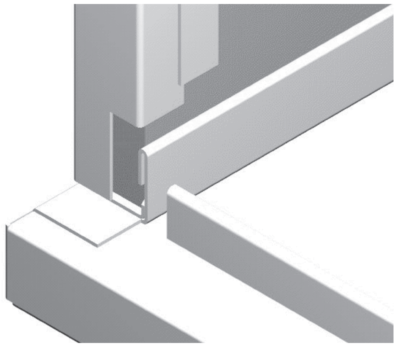
The equation that relates the airflow across an electric heater to the temperature rise and the coil change in temperature is:

$$\text{CFM} = \frac{\text{kW} \times 3145}{\Delta T}$$

Where

- CFM = Minimum airflow rate across the coil
- kW = The heating capacity of the electric coil
- 3145 = a constant
- $\Delta T$ = The maximum rise in air temperature across the coil, usually 50°F (28°C)

# Insulation



Insulation in a chilled water sensible cooling terminal unit is used to avoid condensation on the outside of the unit, to reduce the heat transfer from the cold ventilation air entering the unit, and to reduce the unit noise. The chilled water sensible cooling terminal product line offers four types of unit insulation. The type of facing classifies the types of insulation. To enhance IAQ effectiveness, edges of **all insulation types have metal encapsulated edges.**

**Matte-Faced**

This type of insulation is used for typical applications. It consists of a fiberglass core covered by a high-density skin. The dual-density construction provides good sound attenuation and thermal performance.

**Foil-Faced**

This type of insulation is used in applications where there is some concern regarding airborne contaminants entering the space, or dirt being trapped in the fibers of the insulation. The insulation is composed of a fiberglass core laminated to a foil sheet. Foil-faced insulation will provide the same sound attenuation performance as matte-faced insulation.

**Double-Wall**

This type of insulation is used in applications where there is extreme concern regarding airborne contaminants entering the space or dirt being trapped in the fibers of the insulation. The insulation is the same as the matte-faced insulation. However, after the insulation is installed, a second solid wall of 26-gauge steel covers the insulation. All wire penetrations of this insulation are covered by a grommet. This type of insulation will result in higher discharge and radiated sound power.

**Closed-Cell**

This type of insulation is used in applications where IAQ and fibers are of primary concern. The acoustics of the closed-cell insulation are similar to double-wall insulation. The thermal properties are similar to fiberglass insulation. This insulation contains no fiberglass.

# Acoustics

## Acoustical Best Practices

Acoustics with terminal units is sometimes more confusing than it needs to be. As we know, lower velocities within a unit leads to improved acoustical performance. Additionally, lower RPM provides better acoustical performance. It is as simple as that—there are some catches, however.

Additional considerations will be discussed in more detail throughout this portion of Application Considerations, such as unit size and type, appurtenance affects (due to insulation, attenuation, etc.), certification, and computer modeling. Let’s take a look at the first consideration, sizing of units.

## Sizing of Units

Before blindly increasing the size of units, we must first understand what is setting the acoustics within the space. In general, over 95% of acoustics in these terminal units, which set the sound pressure levels and ultimately the NC within the space, is from radiated sound. Radiated sound emanates from the unit and enters the occupied space via means other than through the supply ductwork. The most typical path is through the plenum space, then through the ceiling, then into the occupied space. While discharge sound should never be ignored, radiated sound is the most dominant and usually the most critical sound source.

When increasing **air valve** sizes, BE CAREFUL. **Oversizing an air valve can adversely impact the ability to modulate and properly control ventilation.** In extremely oversized situations, the air valve will operate like a two-position controlled device, with air either being “on”, or “off”, and not really much in between. The best way to avoid this is to understand that the minimum air velocity for most air valves is 300 FPM. This is a function of the flow sensing device and the ability of the pressure transducer and controller to properly read and report flow. This is not manufacturer specific, as physics applies to all. Therefore, when sizing air valves, minimum velocity for proper pressure independent flow is 300 FPM.

Modulation capability and range is vital for proper operation of the air valve in these terminal units. A good rule of thumb is to size maximum ventilation airflow for around 2000 FPM.

## Insulation Types

Insulation is a factor to consider when dealing with the acoustics of terminal units. Most insulation types will provide similar acoustical results, but there are exceptions. Double-wall and closed-cell foam insulation will generally increase your sound levels because of the increased reflective surface area that the solid inner-wall and closed-cell construction provides. This increase in sound will have to be balanced with the IAQ and cleanability considerations of the dual-wall and closed-cell construction.

## Placement of Units

Unit placement in a building can have a significant impact on the acceptable sound levels. Locating units above non-critical spaces (hallways, closets, and storerooms) will help to contain radiated sound from entering the critical occupied zones.

## Certification and Testing

Terminal units should be submitted based on the same criteria. There are several ways to ensure this by certification and testing.

Raw unit sound data can be good measurement criteria for evaluation. In using this as a basis for comparison, the designer needs to make sure that the information is based on the AHRI Standard 880-2011 that gives the procedure for testing.

Specifying NC or RC sound levels is a possible comparison, but the designer needs to be sure the comparison is fair. Two options are to specify the attenuation effect on which you would like the units to be evaluated or to specify that AHRI Standard 885-2008 transfer functions be used. The importance of AHRI Standard 885-2008 is that it is the first AHRI Standard that specifies exact transfer functions to be used for evaluation. Previous versions of the standard gave guidelines, but the manufacturers could choose their own set of factors.

## Path Attenuation

Sound generated by a terminal unit can reach the occupied space along several paths. The terminal unit generated sound will lose energy — i.e. the energy is absorbed by path obstacles—as it travels to the occupied space. This acoustical energy dissipation as it travels to the occupied space is called path attenuation. The amount of energy lost along a particular path can be quantified and predicted using the procedure outlined in AHRI-885. Each path must be considered when determining acceptable sound power generated by a terminal unit.

The term “transfer function” is often used to describe the entire path attenuation value for each octave band (i.e., the sum of all components of a particular path).

Examples of path attenuation include locating the terminal unit away from the occupied space, increasing the STC (sound transmission classification) of the ceiling tile used, internally lining ductwork, drywall lagging the ceiling tiles or enclosing the terminal unit in drywall. All of these choices have costs associated with them that must be weighed against the benefits. Some of these alternatives can be acoustically evaluated from application data provided in AHRI-885. Others may require professional analysis from an acoustical consultant.

## Computer Modeling

Computer modeling of acoustical paths is available to help estimate sound levels and determine problem sources. The software used by Trane for computer modeling is called Trane Acoustics Program (TAP™).

This software can analyze different room configurations and materials to quickly determine the estimated total sound levels (radiated and discharged) in a space. The Trane Official Product Selection System Trane Select Assist™ can also be used to determine sound levels of terminal units. You can base selections on a maximum sound level and enter your own attenuation factors (defaults based on AHRI-885 are also available).

# Duct Design

Designing cost-effective duct systems is challenging. Some duct design methods result in better pressure balance than others do. Duct shape and duct material can influence duct system design and cost. In addition, duct layout is properly designed for optimal duct installation and operation.

## Duct Design Program

Trane has developed a computer program, VariTrane™ Duct Designer, to aid in the duct design process. This program is used to calculate duct sizes, fitting sizes, terminal unit sizes, and pressure drops according to the equal friction or static regain method. The duct design program can be easily incorporated into the selection of terminal units. The inputs and outputs for the program enable terminal units to be selected based on the conditions you require. This makes selecting and scheduling units much easier. Contact the local sales office or the Trane C.D.S.™ department for more details on this program.

## Design Methods

The two most widely used supply duct design methods—equal friction and static regain—are discussed below.

**Equal Friction** – Using this method, ducts are sized at design flow to have roughly the same static pressure drop for every 100 feet of duct. Static pressures throughout the duct system can be balanced at design flow using balancing dampers, but are no longer balanced at part load flows. For this reason, equal friction duct designs are better suited for constant volume systems than for variable volume systems. If the equal friction method is used for the supply duct design, the terminal units usually require pressure-independent (PI) control capability to avoid excessive flow rates when duct pressures are high.

The ducts located downstream of the terminal unit are usually sized for equal friction. The advantage of this design method is its simplicity. Often, calculations can be made using simple tables and duct calculators. Drawbacks include increased higher total pressure drops and higher operating costs.

**Static Regain** – In the static regain method, ducts are sized to maintain constant static pressure in each section, which is achieved by balancing the total and velocity pressure drops of each section. In other words, static pressure is “regained” by the loss of velocity pressure. Since the static pressures throughout the duct system are roughly balanced at design and part load flow, static regain duct designs can be used successfully for either constant volume or variable volume systems. When the static regain method is used, the system is roughly pressure balanced at design.

Advantages of the static regain method include reduced total pressure drops, lower operating costs, and balanced pressures over a wide range of flows. The drawback of this design is the time-consuming, iterative calculation procedure and for large systems, it is essential to have a duct design computer program.

# Selection Procedure

The following is the general selection procedure for the Chilled Water Sensible Cooling Terminal Units. For particular design conditions not in this catalog, use the Trane Official Product Selection System (TOPSS™) or contact your local Trane Sales office.

1. **Required Information:** Gather all the required information needed to properly select these units. This includes all the unit airflows, applicable air temperatures (ventilation air, heating and cooling zone temperature setpoints, winter and summer plenum temperatures), entering chilled water temperature, entering hot water temperature (if applicable) and zone heating and cooling loads.
2. **Air Valve Selection:** Use the design ventilation airflows and Table 5, p. 29 to properly size the air valve. The air valve needs to be large enough to accommodate the max ventilation (primary) airflow. The heating and cooling airflows must be verified to be above the minimum airflow for the air valve selected above.
3. **Cooling Coil Selection:** Use the cooling design criteria and Table 8, p. 33to determine the cooling coil needed to meet the cooling demand of the coil and unit. Once the coil has been selected, determine the air pressure drop and fluid pressure drop from Table 8, p. 33 and Table 9, p. 34 respectively.
4. **Heating Coil Selection (if needed):**If the unit is equipped with on-board heat, determine the type of heat required.
   - For units with hot water heat use the heating design criteria and Table 7, p. 31 and Table 10, p. 35 to determine the hot water coil, air pressure drop and fluid pressure drop.
   - For units with electric heat use the heating design criteria and to determine the electric heater to meet the demand.
5. **Fan Selection/Confirmation:** Use the sum of all the air pressure drop values for the coils in the previous steps plus the design downstream static pressure plus any other accessories to determine the static pressure the fan must overcome. Use or Figure 10, p. 32 to confirm the fan is capable of delivering the required airflow at the required static pressure.
6. **Acoustic Performance:** Use Acoustics chapter data tables along with the selected unit configuration and operating parameters to determine the acoustical performance of the unit.

## Selection Example: LDWF Chilled Water Sensible Cooling Terminal Unit with Hot Water Heat

### Required Information

- Max Cooling Fan Airflow = 500 cfm
- Cooling Design Ventilation (Primary) Airflow = 100 cfm
- Max Heating Fan Airflow = 500 cfm
- Heating Design Ventilation (Primary) Airflow = 100 cfm
- Max Ventilation (Primary) Airflow = 150 cfm
- Min Fan Airflow = 200 cfm
- Downstream Static Pressure = 0.25 in. w.g.
- Entering Ventilation (Primary) Air Temperature (EDB) = 49°F
- Cooling Plenum Entering Dry Bulb Temperature (EDB) = 75°F
- Cooling Plenum Entering Wet Bulb Temperature (EWB) = 60.5°F
- Cooling Coil Entering Fluid Temperature = 57°F
- Zone Temperature during Summer/Cooling = 72°F
- Zone Cooling Load = 8.0 MBH (8,000 Btu/hr)
- Heating Plenum Entering Dry Bulb Temperature (EDB) = 70°F
- Heating Coil Entering Fluid Temperature = 180°F

- Zone Heating Load = 16.0 MBH (16,000 Btu/hr)
- Zone Temperature during Winter/Heating = 68°F

## Air Valve Selection

- Max Ventilation (Primary) Airflow = 150 cfm
- Cooling Design Ventilation (Primary) Airflow = 100 cfm
- Heating Design Ventilation (Primary) Airflow = 100 cfm

A 4–inch air valve is selected since its maximum airflow (225 cfm) is greater than the required 150 cfm. See Table 4, p. 29.

- Check — Are the Cooling and Heating Design Ventilation (Primary) Airflows above 300 FPM?
- Answer — Yes, minimum allowable airflow for a 4” air valve is 25 cfm (see Table 4, p. 29)
- The DS02 fan will be used in this instance. In Table 5, p. 29, the 4-inch air valve has a pressure drop of 0.01 in. w.g. at 150 cfm.

## Cooling Coil Selection

- 8,000 Btu/hr = 1.085 x 500 cfm x (72°F - Clg. SAT)
- Clg. SAT = 57.25°F

Because the air discharging from the fan is a mixture of the conditioned outdoor air from the DOAS and the air drawn through the cooling coil, the coil leaving air temperature must be calculated.

- 500 cfm x 57.25 F = 100 cfm x 49°F + (500 cfm - 100 cfm) x Clg. Coil LAT
- Clg. Coil LAT = 59.32°F
- Clg. Coil Capacity = 1.085 x 400 cfm x (75 - 59.32°F)
- Clg. Coil Capacity = 6,806 Btu/hr = 6.81 MBH

Interpolating from the Cooling Coil Performance tables (Table 9, p. 34), the required performance can be met with a 4-row coil operating at 3.53 gpm with approximately 0.06 in. w.g. of air pressure drop per Table 6, p. 31.

## Heating Coil Selection

- 16,000 Btu/hr = 1.085 x 500 cfm x (Htg. SAT - 68°F)
- Htg. SAT = 97.49°F

Because the hot water coil is on the unit discharge, the heating unit supply air temperature is the same as the heating coil leaving air temperature (LAT). The heating coil entering air temperature (Htg. EAT) is a mixture of the conditioned outdoor air for the DOAS and air drawn in from the plenum. In the heating mode, the chilled water coil will be off so the Cooling Coil leaving air temperature will be the same as the plenum temperature in the heating mode.

- 500 cfm x Htg. EAT = 100 cfm x 49°F + (500 cfm - 100 cfm) x 70°F
- Htg. EAT = 65.8°F
- Htg. Coil Capacity = 1.085 x 500 cfm x (97.49 - 65.8°F)
- Htg. Coil Capacity = 17,194 Btu/hr = 17.19 MBH

Interpolating from the heating coil performance tables (Table 10, p. 35), the required performance can be met with a 1-row coil operating at 3.28 gpm with approximately 0.07 in. w.g. of air pressure drop (Table 7, p. 31).

## Fan Selection/Confirmation

The fan must have the capability to deliver the required airflow and overcome all the static pressure resistances. This includes the downstream static pressure, cooling coil pressure drop and heating coil pressure drop, if applicable.

- Downstream static = 0.25 in. w.g.
- Cooling coil pressure drop = 0.06 in. w.g.

- Heating coil pressure drop = 0.07 in. w.g.
- Total static resistance = 0.35 in. w.g.

The fan curves shown in indicate the DS02 fan has sufficient static pressure capability to overcome all the resistances shown above when delivering the required 500 cfm. For more precise selections, the Trane Official Product Selection System (TOPSS™) should be used.

## Acoustic Performance

The acoustical performance of the unit will be based on the fan airflow, ventilation (primary) airflow and the pressure drop across the air valve. In this example, assume the pressure drop at the inlet of the air valve is 0.5”. Particularly for acoustics, prediction should be developed using an electronic selection program such as TOPSS for the specific operating point. As a rough approximation, interpolation from the data points in through Table 19, p. 47 can be used. Once these sound power results are obtained, the appropriate transfer functions shown in Table 22, p. 53 and Table 23, p. 53 can be used to determine the predicted sound pressure. These sound pressure results can be plotted on an NC curve to determine the resulting approximate NC value.

| | Octave Bands | | | | | | |
|---|---|---|---|---|---|---|---|
| | **2** | **3** | **4** | **5** | **6** | **7** | **NC** |
| Discharge | 68 | 63 | 62 | 59 | 54 | 51 | 21 (2) |
| Radiated | 61 | 57 | 57 | 52 | 43 | 35 | 31 (4) |

# Model Number

## Chilled Water Sensible Cooling Terminal Units

**Digit 1, 2— Unit Type**

**LD** = Chilled Water Sensible Cooling Terminal Units

**Digit 3— Heating**

**C** = Cooling Only
**E** = Electric Heat
**W** = Hot Water Heat

**Digit 4 — Development Sequence**

**F** = Sixth

**Digit 5, 6 — Primary Air Valve**

**04** = 4 in. inlet (225 max cfm)
**05** = 5 in. inlet (350 max cfm)
**06** = 6 in. inlet (500 max cfm)
**08** = 8 in. inlet (900 max cfm)
**RT** = 8x14 in. inlet (1800 max cfm)

**Digit 7, 8— Secondary Air Valve**

**00** = N/A

**Digit 9 — Fan**

**B** = DS02 Fan (1300 max cfm)

**Digit 10, 11— Design Sequence**

****** = Factory Assigned

**Digit 12, 13, 14, 15 — Controls**

**DD00** = Trane Actuator Only
**DE41** = Symbio™ 500 DDC - Sensible Cooling - Basic (No Water or Electric Heat)
**DE43** = Symbio™ 500 DDC - Sensible Cooling - Basic (Water Heat - Modulating)
**DE44** = Symbio™ 500 DDC - Sensible Cooling - Basic (Electric Heat - Staged)
**DE62** = Symbio™ 500 DDC - Sensible Cooling - Basic Plus Local (Electric Heat - Staged) Remote (Staged EH)
**DE65** = Symbio™ 500 DDC - Sensible Cooling - Basic (Electric Heat - Modulating SCR)
**DE66** = Symbio™ 500 DDC - Sensible Cooling - Basic Plus Local (Electric Heat - Modulating SCR) Remote (Staged EH)
**ENCL** = Shaft Only in Enclosure
**FM00** = Other Actuator and Control
**FM01** = Trane Supplied Actuator, Other Control
**SC41** = UC400 DDC - Sensible Cooling - Basic (No Water or Electric Heat)
**SC43** = UC400 DDC - Sensible Cooling - Basic (Water Heat, Modulating)
**SC44** = UC400 DDC - Sensible Cooling - Basic (Electric Heat- Staged)

**Digit 12, 13, 14, 15 — Controls (continued)**

**SC62** = UC400 DDC - Sensible Cooling- Basic Plus Local (Electric Heat - Staged), Remote (Staged)
**SC65** = UC400 DDC - Sensible Cooling- Basic (Electric Heat Modulating SCR)
**SC66** = UC400 DDC - Sensible Cooling- Basic Plus Local (Electric Heat - Modulating SCR) Remote (Staged)

**Digit 16 — Insulation**

**A** = 1/2 in. Matte-faced
**B** = 1 in. Matte-faced
**D** = 1 in. Foil-faced
**F** = 1 in. Double Wall
**G** = 3/8 in. Closed-cell

**Digit 17 — Motor Type**

**E** = High-efficiency Motor (ECM)
**F** = Variable Speed High-efficiency Electronically Commutated Motor (ECV)

**Digit 18 — Motor Voltage**

**1** = 115/60/1
**2** = 277/60/1

**Digit 19 — Outlet Connection**

**1** = Flanged
**2** = Slip–and-Drive Connection

**Digit 20 — Attenuator**

**0** = No Attenuator

**Digit 21 — Water Coil**

**0** = None
**3** = 1 Row, Discharge Installed, LH
**4** = 1 Row, Discharge Installed, RH
**5** = 2 Row, Discharge Installed, LH
**6** = 2 Row, Discharge Installed, RH
**C** = 1 Row Premium, Hot Coil on Discharge, LH
**D** = 1 Row Premium, Hot Coil on Discharge, RH
**E** = 2 Row Premium, Hot Coil on Discharge, LH
**F** = 2 Row Premium, Hot Coil on Discharge, RH

**Digit 22 — Control, Heat Connections**

**F** = Flippable Left and Right Hand

**Digit 23 — Unit Filter**

**0** = Construction Throw-away Filter
**8** = MERV 8 Filter

**Digit 24 — Disconnect Switch**

**0** = None
**W** = With

**Digit 25 — Power Fuse**

**0** = None
**W** = With

**Digit 26 — Electric Heat Voltage**

**0** = None
**A** = 208/60/1
**B** = 208/60/3
**C** = 240/60/1
**D** = 277/60/1
**E** = 480/60/1
**F** = 480/60/3

**Digit 27, 28, 29 — Electric Heat kW**

**000** = None
**005** = 0.5 kW
**010** = 1.0 kW
**015** = 1.5 kW
**200** = 20.0 kW

***Notes:***

- *0.5 to 8.0 kW in 1/2 kW increments*
- *8.0 to 18.0 kW in 1 kW increments*
- *18.0 to 20.0 kW in 2 kW increments*

**Digit 30 — Electric Heat Stages**

**0** = None
**1** = 1 Stage
**2** = 2 Stages Equal

**Digit 31 — Electric Heat Contactors**

**0** = None
**1** = 24V Magnetic
**5** = SCR Heat, Symbio™ 500, UC400
**6** = SCR Heat, FM00/ENCL/DD00

**Digit 32 — Airflow Switch**

**0** = None
**W** = With

**Digit 33 — Not Used**

**0** = Not Applicable

**Digit 34 — Actuator**

**0** = Standard
**A** = Belimo™ Actuator

**Digit 35 — Wireless Sensors**

**0** = None
**3** = Air-Fi® Wireless Communications

***Note:*** *All sensors selected in accessories.*

**Digit 36 — Pre-wired Factory Solutions**

**0** = None
**1** = Discharge Temperature Sensor (DTS)
**2** = Hot Water (HW) Valve Harness
**3** = DTS and HW Valve Harness
**7** = Chilled Water (CW) Valve Harness
**8** = CW and HW Valve Harness
**B** = DTS with CW Valve Harness
**C** = DTS with CW and HW Valve Harness

**Digit 37 — Not Used**

**0** = Not Applicable

**Digit 38 — Hot Water Piping Package**

**0** = None
**A** = 2–Way Automatic Balancing
**B** = 3–Way Automatic Balancing
**C** = 2-Way Standard Valve Only, Floating Point Actuator
**D** = 3-Way Standard Valve Only, Floating Point Actuator
**E** = 2-Way Standard Valve Piping Package, Floating Point Actuator
**F** = 3-Way Standard Valve Piping Package, Floating Point Actuator
**G** = 2-Way Belimo Valve Only, Floating Point Actuator
**H** = 3-Way Belimo Valve Only, Floating Point Actuator
**J** = 2-Way Belimo Valve Piping Package, Floating Point Actuator
**K** = 3-Way Belimo Valve Piping Package, Floating Point Actuator
**L** = 2-Way Belimo Valve Only, Analog Actuator
**M** = 3-Way Belimo Valve Only, Analog Actuator
**N** = 2-Way Belimo Valve Piping Package, Analog Actuator
**P** = 3-Way Belimo Valve Piping Package, Analog Actuator

**Digit 39 — Hot Water Valve**

**0** = None
**1** = Trane HW Valve, 0.7 Cv
**2** = Trane HW Valve, 2.7 Cv
**5** = Analog, HW Valve, field provided (Symbio™ 500, UC210, UC400)
**6** = Trane HW Valve, 1.7 Cv
**7** = Trane HW Valve, 5.0 Cv
**A** = Belimo HW Valve, 0.3 Cv
**B** = Belimo HW Valve, 0.46 Cv
**C** = Belimo HW Valve, 0.8 Cv
**D** = Belimo HW Valve, 1.2 Cv
**E** = Belimo HW Valve, 1.9 Cv
**F** = Belimo HW Valve, 3.0 Cv
**G** = Belimo HW Valve, 4.7 Cv

**Digit 40 — Hot Water Flow Rate**

**0** = None (No Flow Rate)
**A** = 0.5 gpm (0.03 L/s)
**B** = 1 gpm (0.06 L/s)
**C** = 1.5 gpm (0.09 L/s)
**D** = 2 gpm (0.13 L/s)
**E** = 2.5 gpm (0.16 L/s)
**F** = 3 gpm (0.19 L/s)
**G** = 3.5 gpm (0.22 L/s)
**H** = 4 gpm (0.25 L/s)
**J** = 4.5 gpm (0.28 L/s)
**K** = 5 gpm (0.32 L/s)
**L** = 5.5 gpm (0.35 L/s)
**M** = 6 gpm (0.38 L/s)
**N** = 6.5 gpm (0.41 L/s)
**P** = 7 gpm (0.44 L/s)
**Q** = 7.5 gpm (0.47 L/s)

**Digit 41 — Sensible Cooling Coil**

**2** = 2–Row Standard Cooling Coil
**4** = 4–Row Standard Cooling Coil
**6** = 6–Row Standard Cooling Coil

**Digit 42 — Chilled Water Coil Connections**

**D** = Cooling Coil Connections at Unit Discharge End
**V** = Cooling Coil Connections at Air Valve End

**Digit 43 — Chilled Water Piping Package**

**0** = None
**A** = 2-Way Automatic Balancing
**B** = 3-Way Automatic Balancing
**C** = 2-Way Standard Valve Only, Floating Point Actuator
**D** = 3-Way Standard Valve Only, Floating Point Actuator
**E** = 2-Way Standard Valve Piping Package, Floating Point Actuator
**F** = 3-Way Standard Valve Piping Package, Floating Point Actuator

**Digit 43 — Chilled Water Piping Package (continued)**

**G** = 2-Way Belimo Valve Only, Floating Point Actuator
**H** = 3-Way Belimo Valve Only, Floating Point Actuator
**J** = 2-Way Belimo Valve Piping Package, Floating Point Actuator
**K** = 3-Way Belimo Valve Piping Package, Floating Point Actuator
**L** = 2-Way Belimo Valve Only, Analog Actuator
**M** = 3-Way Belimo Valve Only, Analog Actuator
**N** = 2-Way Belimo Valve Piping Package, Analog Actuator
**P** = 3-Way Belimo Valve Piping Package, Analog Actuator

**Digit 44 — Chilled Water Valve**

**0** = None
**1** = Trane CW Valve, 0.7 Cv
**2** = Trane CW Valve, 2.7 Cv
**5** = Analog CW Valve, Field-Provided (Symbio™ 500, UC400)
**6** = Trane CW Valve, 1.7 Cv
**7** = Trane CW Valve, 5.0 Cv
**A** = Belimo CW Valve, 0.3 Cv
**B** = Belimo CW Valve, 0.46 Cv
**C** = Belimo CW Valve, 0.8 Cv
**D** = Belimo CW Valve, 1.2 Cv
**E** = Belimo CW Valve, 1.9 Cv
**F** = Belimo CW Valve, 3.0 Cv
**G** = Belimo CW Valve, 4.7 Cv

**Digit 45 — Chilled Water Flow Rate**

**0** = None (No Flow Rate)
**A** = 0.5 gpm (0.03 L/s)
**B** = 1 gpm (0.06 L/s)
**C** = 1.5 gpm (0.09 L/s)
**D** = 2 gpm (0.13 L/s)
**E** = 2.5 gpm (0.16 L/s)
**F** = 3 gpm (0.19 L/s)
**G** = 3.5 gpm (0.22 L/s)
**H** = 4 gpm (0.25 L/s)
**J** = 4.5 gpm (0.28 L/s)
**K** = 5 gpm (0.32 L/s)
**L** = 5.5 gpm (0.35 L/s)
**M** = 6 gpm (0.38 L/s)
**N** = 6.5 gpm (0.41 L/s)
**P** = 7 gpm (0.44 L/s)
**Q** = 7.5 gpm (0.47 L/s)
**R** = 8.0 gpm (0.50 L/s)

# Performance Data

**Table 3. Ventilation (primary) airflow control factory settings — I-P**

| Control Type | Air Valve Size (in.) | Maximum Valve (Cfm) | Maximum Controller (Cfm) | Minimum Controller (Cfm) | Constant Volume (Cfm) |
|---|---|---|---|---|---|
| Direct Digital Control/ UCM | 4 | 225 | 25-225 | 0 or 25-225 | 25-225 |
| | 5 | 350 | 40-350 | 0 or 40-350 | 40-350 |
| | 6 | 500 | 60-500 | 0 or 60-500 | 60-500 |
| | 8 | 900 | 105-900 | 0 or 105-900 | 105-900 |
| | 8x14 | 1300 | 220–1300 | 0 or 220–1300 | 220–1300 |

**Table 4. Ventilation (primary) airflow control factory settings — SI**

| Control Type | Air Valve Size (in.) | Maximum Valve (L/s) | Maximum Controller (L/s) | Minimum Controller (L/s) | Constant Volume (L/s) |
|---|---|---|---|---|---|
| Direct Digital Control/ UCM | 4 | 106 | 12-106 | 0, 12-106 | 12-106 |
| | 5 | 165 | 19-165 | 0, 19-165 | 19-165 |
| | 6 | 236 | 28-236 | 0, 28-236 | 28-236 |
| | 8 | 425 | 50-425 | 0, 50-425 | 50-425 |
| | 8x14 | 614 | 104–614 | 0, 104–614 | 104–614 |

***Note:*** *Maximum airflow must be greater than or equal to minimum airflow.*

**Table 5. Unit air valve and cooling coil air pressure drop**

| Fan/Inlet Size | Airflow Cfm | in. wg (I-P) | | Airflow L/s | Pa (SI) | |
|---|---|---|---|---|---|---|
| | | Air Valve | Unit Cooling Only | | Air Valve | Unit Cooling Only |
| 2 Row Sensible Cooling Coil | | | | | | |
| DS02-04 | 50 | 0.01 | 0.01 | 24 | 2 | 2 |
| | 150 | 0.01 | 0.03 | 70 | 2 | 7 |
| | 225 | 0.01 | 0.09 | 106 | 2 | 22 |
| DS02-05 | 150 | 0.01 | 0.03 | 71 | 2 | 7 |
| | 250 | 0.01 | 0.09 | 118 | 2 | 22 |
| | 350 | 0.02 | 0.21 | 165 | 5 | 52 |
| DS02-06 | 100 | 0.01 | 0.01 | 47 | 2 | 2 |
| | 300 | 0.1 | 0.07 | 142 | 25 | 17 |
| | 500 | 0.22 | 0.25 | 236 | 55 | 62 |
| DS02-08 | 400 | 0.01 | 0.03 | 189 | 2 | 7 |
| | 600 | 0.04 | 0.07 | 283 | 10 | 17 |
| | 750 | 0.07 | 0.13 | 354 | 17 | 32 |
| | 900 | 0.08 | 0.35 | 425 | 20 | 87 |
| DS02-8X14 | 600 | 0.01 | 0.12 | 283 | 2 | 30 |
| | 825 | 0.01 | 0.31 | 389 | 2 | 77 |
| | 1025 | 0.01 | 0.55 | 484 | 2 | 137 |
| | 1300 | 0.01 | 0.81 | 614 | 2 | 202 |

**Table 5. Unit air valve and cooling coil air pressure drop (continued)**

| Fan/Inlet Size | Airflow Cfm | in. wg (I-P) | | Airflow L/s | Pa (SI) | |
|---|---|---|---|---|---|---|
| | | Air Valve | Unit Cooling Only | | Air Valve | Unit Cooling Only |
| 4 Row Sensible Cooling Coil | | | | | | |
| DS02-04 | 50 | 0.01 | 0.01 | 24 | 2 | 2 |
| | 150 | 0.01 | 0.02 | 70 | 2 | 5 |
| | 225 | 0.01 | 0.07 | 106 | 2 | 17 |
| DS02-05 | 150 | 0.01 | 0.02 | 71 | 2 | 5 |
| | 250 | 0.01 | 0.09 | 118 | 2 | 22 |
| | 350 | 0.02 | 0.18 | 165 | 5 | 45 |
| DS02-06 | 100 | 0.01 | 0.01 | 47 | 2 | 2 |
| | 300 | 0.1 | 0.04 | 142 | 25 | 10 |
| | 500 | 0.22 | 0.2 | 236 | 55 | 50 |
| DS02-08 | 400 | 0.01 | 0.03 | 189 | 2 | 7 |
| | 600 | 0.04 | 0.03 | 283 | 10 | 7 |
| | 750 | 0.07 | 0.11 | 354 | 17 | 27 |
| | 900 | 0.08 | 0.4 | 425 | 20 | 100 |
| DS02-8X14 | 600 | 0.01 | 0.12 | 283 | 2 | 30 |
| | 825 | 0.01 | 0.31 | 389 | 2 | 77 |
| | 1025 | 0.01 | 0.57 | 484 | 2 | 142 |
| | 1300 | 0.01 | 0.81 | 614 | 2 | 202 |
| 6 Row Sensible Cooling Coil | | | | | | |
| DS02-04 | 50 | 0.01 | 0.01 | 24 | 2 | 2 |
| | 150 | 0.01 | 0.01 | 70 | 2 | 2 |
| | 225 | 0.01 | 0.04 | 106 | 2 | 10 |
| DS02-05 | 150 | 0.01 | 0.01 | 71 | 2 | 2 |
| | 250 | 0.01 | 0.05 | 118 | 2 | 12 |
| | 350 | 0.02 | 0.13 | 165 | 5 | 32 |
| DS02-06 | 100 | 0.01 | 0.01 | 47 | 2 | 2 |
| | 300 | 0.1 | 0.05 | 142 | 25 | 12 |
| | 500 | 0.22 | 0.26 | 236 | 55 | 65 |
| DS02-08 | 400 | 0.01 | 0.02 | 189 | 2 | 5 |
| | 600 | 0.04 | 0.02 | 283 | 10 | 5 |
| | 750 | 0.07 | 0.09 | 354 | 17 | 22 |
| | 900 | 0.08 | 0.32 | 425 | 20 | 80 |
| DS02-8X14 | 600 | 0.01 | 0.14 | 283 | 2 | 35 |
| | 825 | 0.01 | 0.27 | 389 | 2 | 67 |
| | 1025 | 0.01 | 0.56 | 484 | 2 | 139 |
| | 1300 | 0.01 | 0.84 | 614 | 2 | 209 |

**Table 6. Cooling coil air pressure drop**

| I-P | | | | SI | | | |
|---|---|---|---|---|---|---|---|
| Airflow (cfm) | 2-row (in. wg) | 4-row (in. wg) | 6-row (in. wg) | Airflow (L/s) | 2-row (Pa) | 4-row (Pa) | 6-row (Pa) |
| 100 | 0.01 | 0.01 | 0.01 | 47 | 2.5 | 2.5 | 2.5 |
| 200 | 0.01 | 0.02 | 0.03 | 94 | 2.5 | 5.0 | 7.5 |
| 300 | 0.02 | 0.04 | 0.06 | 141 | 5.0 | 10.0 | 14.9 |
| 400 | 0.03 | 0.06 | 0.09 | 188 | 7.5 | 14.9 | 22.4 |
| 500 | 0.04 | 0.09 | 0.13 | 235 | 10.0 | 22.4 | 32.4 |
| 600 | 0.06 | 0.12 | 0.18 | 282 | 14.9 | 29.9 | 44.8 |
| 700 | 0.08 | 0.15 | 0.23 | 329 | 19.9 | 37.4 | 57.3 |
| 800 | 0.10 | 0.19 | 0.29 | 376 | 24.9 | 47.3 | 72.2 |
| 900 | 0.12 | 0.23 | 0.35 | 423 | 29.9 | 57.3 | 87.2 |
| 1000 | 0.14 | 0.28 | 0.42 | 470 | 34.9 | 69.7 | 104.6 |
| 1100 | 0.16 | 0.33 | 0.49 | 517 | 39.8 | 82.2 | 122.0 |
| 1200 | 0.19 | 0.38 | 0.57 | 564 | 47.3 | 94.6 | 141.9 |
| 1300 | 0.22 | 0.43 | 0.65 | 611 | 54.8 | 107.1 | 161.9 |

**Table 7. Hot water coil air pressure drop**

| Fan/Inlet Size | I-P | | | SI | | |
|---|---|---|---|---|---|---|
| | Airflow (Cfm) | 1-Row HW (in. wg) | 2-Row HW (in. wg) | Airflow (L/s) | 1-Row HW (Pa) | 2-Row HW (Pa) |
| DS02 | 100 | 0.00 | 0.01 | 47 | 1 | 3 |
| | 300 | 0.04 | 0.08 | 142 | 10 | 20 |
| | 500 | 0.07 | 0.19 | 236 | 17 | 47 |
| | 800 | 0.12 | 0.28 | 378 | 30 | 70 |
| | 1100 | 0.22 | 0.40 | 519 | 55 | 100 |
| | 1300 | 0.30 | 0.52 | 614 | 75 | 130 |

**Figure 10. Performance data fan curve, LDxF DS02 — ECM**

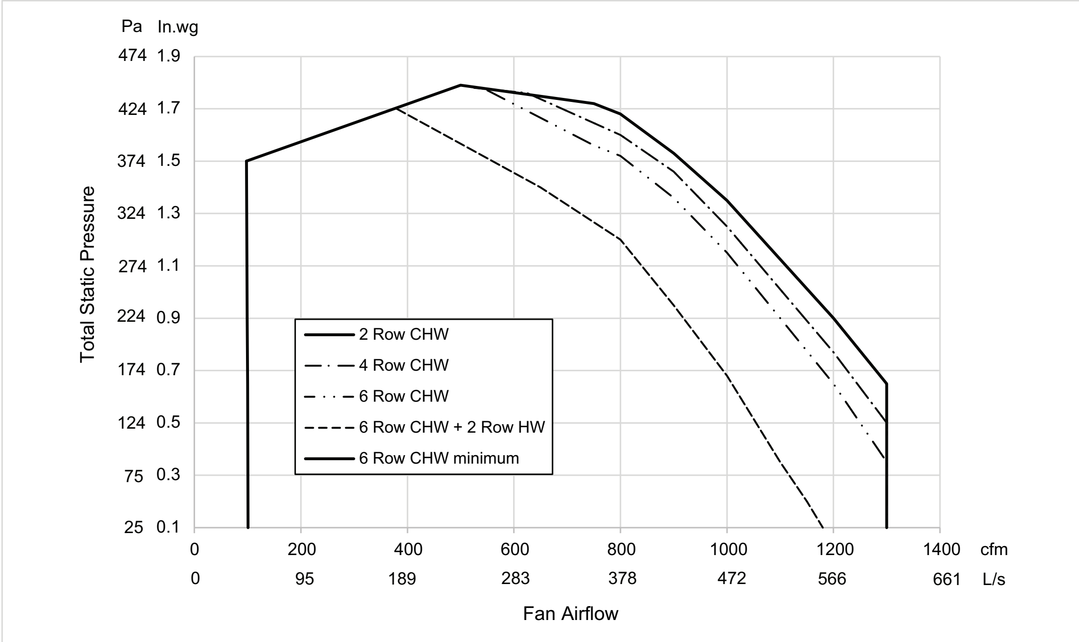


**Table 8. Cooling capacity (MBh), fan size DS02 — I-P**

| Rows | Water Flow Rate (gpm) | Water Pressure Drop (ft) | Cooling Coil Airflow (Cfm) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1300 |
| 2 | 1.0 | 0.37 | 1.60 | 2.50 | 3.20 | 3.60 | 3.90 | 4.20 | 4.40 | 4.60 | 4.80 | 4.90 | 5.00 | 5.10 | 5.20 |
| | 2.0 | 1.29 | 1.70 | 3.00 | 3.90 | 4.60 | 5.20 | 5.70 | 6.20 | 6.50 | 6.90 | 7.20 | 7.40 | 7.70 | 7.90 |
| | 3.0 | 2.72 | 1.80 | 3.10 | 4.10 | 5.00 | 5.70 | 6.30 | 6.90 | 7.40 | 7.80 | 8.20 | 8.60 | 8.90 | 9.20 |
| | 4.0 | 4.60 | 1.80 | 3.10 | 4.20 | 5.20 | 6.00 | 6.70 | 7.30 | 7.80 | 8.30 | 8.80 | 9.20 | 9.60 | 10.00 |
| | 5.0 | 7.02 | 1.80 | 3.20 | 4.30 | 5.30 | 6.10 | 6.90 | 7.50 | 8.20 | 8.70 | 9.20 | 9.70 | 10.10 | 10.60 |
| | 6.0 | 9.84 | 1.80 | 3.20 | 4.40 | 5.40 | 6.20 | 7.00 | 7.70 | 8.40 | 9.00 | 9.50 | 10.00 | 10.50 | 11.00 |
| | 7.0 | 13.09 | 1.80 | 3.20 | 4.40 | 5.40 | 6.30 | 7.10 | 7.90 | 8.60 | 9.20 | 9.80 | 10.30 | 10.80 | 11.30 |
| | 8.0 | 16.78 | 1.80 | 3.30 | 4.50 | 5.50 | 6.40 | 7.20 | 8.00 | 8.70 | 9.30 | 9.90 | 10.50 | 11.00 | 11.50 |
| 4 | 1.0 | 0.37 | 1.90 | 3.30 | 4.20 | 4.80 | 5.30 | 5.60 | 5.90 | 6.10 | 6.30 | 6.40 | 6.60 | 6.70 | 6.80 |
| | 2.0 | 1.27 | 2.00 | 3.70 | 5.10 | 6.30 | 7.20 | 8.00 | 8.70 | 9.30 | 9.80 | 10.20 | 10.60 | 10.90 | 11.20 |
| | 3.0 | 2.62 | 2.00 | 3.80 | 5.30 | 6.70 | 7.80 | 8.90 | 9.70 | 10.50 | 11.20 | 11.90 | 12.40 | 12.90 | 13.40 |
| | 4.0 | 4.44 | 2.00 | 3.80 | 5.40 | 6.90 | 8.20 | 9.30 | 10.30 | 11.20 | 12.10 | 12.80 | 13.50 | 14.20 | 14.70 |
| | 5.0 | 6.67 | 2.00 | 3.80 | 5.50 | 7.00 | 8.30 | 9.60 | 10.70 | 11.70 | 12.60 | 13.50 | 14.20 | 15.00 | 15.60 |
| | 6.0 | 9.37 | 2.00 | 3.90 | 5.60 | 7.10 | 8.50 | 9.70 | 10.90 | 12.00 | 13.00 | 13.90 | 14.80 | 15.50 | 16.30 |
| | 7.0 | 12.44 | 2.00 | 3.90 | 5.60 | 7.20 | 8.60 | 9.90 | 11.10 | 12.20 | 13.30 | 14.30 | 15.20 | 16.00 | 16.80 |
| | 8.0 | 15.92 | 2.00 | 3.90 | 5.60 | 7.20 | 8.70 | 10.00 | 11.30 | 12.40 | 13.50 | 14.50 | 15.50 | 16.40 | 17.20 |
| 6 | 1.0 | 0.34 | 2.00 | 3.60 | 4.70 | 5.50 | 6.00 | 6.40 | 6.70 | 6.90 | 7.10 | 7.30 | 7.40 | 7.60 | 7.70 |
| | 2.0 | 1.14 | 2.00 | 3.90 | 5.60 | 7.00 | 8.20 | 9.20 | 10.10 | 10.80 | 11.40 | 11.90 | 12.30 | 12.70 | 13.00 |
| | 3.0 | 2.36 | 2.00 | 3.90 | 5.80 | 7.40 | 8.80 | 10.10 | 11.20 | 12.20 | 13.10 | 13.90 | 14.60 | 15.20 | 15.80 |
| | 4.0 | 3.96 | 2.00 | 3.90 | 5.90 | 7.60 | 9.10 | 10.50 | 11.80 | 13.00 | 14.10 | 15.00 | 15.90 | 16.70 | 17.50 |
| | 5.0 | 5.94 | 2.00 | 3.90 | 5.90 | 7.70 | 9.30 | 10.80 | 12.20 | 13.50 | 14.70 | 15.80 | 16.80 | 17.70 | 18.60 |
| | 6.0 | 8.29 | 2.00 | 3.90 | 5.90 | 7.70 | 9.40 | 11.00 | 12.40 | 13.80 | 15.10 | 16.20 | 17.30 | 18.40 | 19.30 |
| | 7.0 | 11.11 | 2.00 | 3.90 | 5.90 | 7.90 | 9.50 | 11.10 | 12.60 | 14.10 | 15.40 | 16.60 | 17.80 | 18.90 | 20.00 |
| | 8.0 | 14.20 | 2.00 | 3.90 | 5.90 | 7.90 | 9.60 | 11.20 | 12.80 | 14.20 | 15.60 | 16.90 | 18.10 | 19.30 | 20.40 |

**Note:** Data taken with entering water temperature 57°F and entering air dry bulb temperature 75°F.

Table 9. Cooling capacity (kW), fan size DS02 — SI

| Rows | Water Flow Rate (L/s) | Water Pressure Drop (kPa) | Airflow (L/s) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 47 | 94 | 142 | 189 | 236 | 283 | 330 | 378 | 425 | 472 | 519 | 566 | 614 |
| 2 | 0.06 | 1.11 | 0.47 | 0.73 | 0.94 | 1.06 | 1.14 | 1.23 | 1.29 | 1.35 | 1.41 | 1.44 | 1.47 | 1.49 | 1.52 |
| | 0.13 | 3.86 | 0.50 | 0.88 | 1.14 | 1.35 | 1.52 | 1.67 | 1.82 | 1.90 | 2.02 | 2.11 | 2.17 | 2.26 | 2.32 |
| | 0.19 | 8.13 | 0.53 | 0.91 | 1.20 | 1.47 | 1.67 | 1.85 | 2.02 | 2.17 | 2.29 | 2.40 | 2.52 | 2.61 | 2.70 |
| | 0.25 | 13.75 | 0.53 | 0.91 | 1.23 | 1.52 | 1.76 | 1.96 | 2.14 | 2.29 | 2.43 | 2.58 | 2.70 | 2.81 | 2.93 |
| | 0.32 | 20.98 | 0.53 | 0.94 | 1.26 | 1.55 | 1.79 | 2.02 | 2.20 | 2.40 | 2.55 | 2.70 | 2.84 | 2.96 | 3.11 |
| | 0.38 | 29.41 | 0.53 | 0.94 | 1.89 | 1.58 | 1.82 | 2.05 | 2.26 | 2.46 | 2.64 | 2.78 | 2.93 | 3.08 | 3.22 |
| | 0.44 | 39.13 | 0.53 | 0.94 | 1.29 | 1.58 | 1.85 | 2.08 | 2.32 | 2.52 | 2.70 | 2.87 | 3.02 | 3.17 | 3.31 |
| | 0.50 | 50.16 | 0.53 | 0.97 | 1.32 | 1.61 | 1.88 | 2.11 | 2.34 | 2.55 | 2.73 | 2.90 | 3.08 | 3.22 | 3.37 |
| 4 | 0.06 | 1.11 | 0.56 | 0.97 | 1.23 | 1.41 | 1.55 | 1.64 | 1.73 | 1.79 | 1.85 | 1.88 | 1.93 | 1.96 | 1.99 |
| | 0.13 | 3.80 | 0.59 | 1.08 | 1.49 | 1.85 | 2.11 | 2.34 | 2.55 | 2.73 | 2.87 | 2.99 | 3.11 | 3.19 | 3.28 |
| | 0.19 | 7.83 | 0.59 | 1.11 | 1.55 | 1.96 | 2.29 | 2.61 | 2.84 | 3.08 | 3.28 | 3.49 | 3.63 | 3.78 | 3.93 |
| | 0.25 | 13.27 | 0.59 | 1.11 | 1.58 | 2.02 | 2.40 | 2.73 | 3.02 | 3.28 | 3.55 | 3.75 | 3.96 | 4.16 | 4.31 |
| | 0.32 | 19.94 | 0.59 | 1.11 | 1.61 | 2.05 | 2.43 | 2.81 | 3.14 | 3.43 | 3.69 | 3.96 | 4.16 | 4.40 | 4.57 |
| | 0.38 | 28.01 | 0.59 | 1.14 | 1.64 | 2.08 | 2.49 | 2.84 | 3.19 | 3.52 | 3.81 | 4.07 | 4.34 | 4.54 | 4.78 |
| | 0.44 | 37.18 | 0.59 | 1.14 | 1.64 | 2.11 | 2.52 | 2.90 | 3.25 | 3.58 | 3.90 | 4.19 | 4.45 | 4.69 | 4.92 |
| | 0.50 | 47.58 | 0.59 | 1.14 | 1.64 | 2.11 | 2.55 | 2.93 | 3.31 | 3.63 | 3.96 | 4.25 | 4.54 | 4.81 | 5.04 |
| 6 | 0.06 | 1.02 | 0.59 | 1.06 | 1.38 | 1.61 | 1.76 | 1.88 | 1.96 | 2.02 | 2.08 | 2.14 | 2.17 | 2.23 | 2.26 |
| | 0.13 | 3.41 | 0.59 | 1.14 | 1.64 | 2.05 | 2.40 | 2.70 | 2.96 | 3.17 | 3.34 | 3.49 | 3.60 | 3.72 | 3.81 |
| | 0.19 | 70.50 | 0.59 | 1.14 | 1.70 | 2.17 | 2.58 | 2.96 | 3.28 | 3.58 | 3.84 | 4.07 | 4.28 | 4.45 | 4.63 |
| | 0.25 | 11.84 | 0.59 | 1.14 | 1.73 | 2.23 | 2.67 | 3.08 | 3.46 | 3.81 | 4.13 | 4.40 | 4.66 | 4.89 | 5.13 |
| | 0.32 | 17.75 | 0.59 | 1.14 | 1.73 | 2.26 | 2.73 | 3.17 | 3.58 | 3.96 | 4.31 | 4.63 | 4.92 | 5.19 | 5.45 |
| | 0.38 | 24.78 | 0.59 | 1.14 | 1.73 | 2.26 | 2.75 | 3.22 | 3.63 | 4.04 | 4.43 | 4.75 | 5.07 | 5.39 | 5.66 |
| | 0.44 | 33.21 | 0.59 | 1.14 | 1.73 | 2.32 | 2.78 | 3.25 | 3.69 | 4.13 | 4.51 | 4.86 | 5.22 | 5.54 | 5.86 |
| | 0.50 | 42.44 | 0.59 | 1.14 | 1.73 | 2.32 | 2.81 | 3.28 | 3.75 | 4.16 | 4.57 | 4.95 | 5.30 | 5.66 | 5.98 |

**Note:** Data taken with entering water temperature 13.9°C and entering air dry bulb temperature 23.9°C.

### Table 10. Heating capacity (MBh), fan size DS02 — I-P

| Rows | Water Flow Rate (gpm) | Water Pressure Drop (ft) | Airflow (Cfm) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1300 |
| 1 | 1.0 | 0.15 | 6.87 | 9.06 | 10.47 | 11.53 | 12.40 | 13.14 | 13.77 | 14.32 | 14.80 | 15.07 | 15.44 | 15.78 | 16.09 |
| | 2.0 | 0.58 | 7.70 | 10.70 | 12.78 | 14.46 | 15.90 | 17.15 | 18.27 | 19.28 | 20.20 | 20.48 | 21.23 | 21.93 | 22.57 |
| | 3.0 | 1.27 | 7.92 | 11.16 | 13.45 | 15.34 | 16.97 | 18.42 | 19.73 | 20.92 | 22.01 | 23.02 | 23.83 | 24.70 | 25.53 |
| | 4.0 | 2.24 | 8.08 | 11.48 | 13.94 | 15.98 | 17.76 | 19.36 | 20.82 | 22.16 | 23.39 | 24.54 | 25.41 | 26.41 | 27.36 |
| | 5.0 | 3.48 | 8.17 | 11.69 | 14.25 | 16.39 | 18.28 | 19.99 | 21.54 | 22.98 | 24.32 | 25.57 | 26.47 | 27.57 | 28.61 |
| | 6.0 | 4.98 | 8.24 | 11.83 | 14.47 | 16.69 | 18.65 | 20.43 | 22.06 | 23.58 | 24.99 | 26.31 | 27.24 | 28.41 | 29.51 |
| 2 | 1.0 | 0.76 | 9.04 | 14.59 | 18.26 | 20.87 | 22.83 | 24.35 | 25.57 | 26.58 | 27.42 | 28.14 | 28.81 | 29.34 | 29.81 |
| | 2.0 | 2.60 | 9.45 | 15.95 | 20.70 | 24.34 | 27.24 | 29.61 | 31.59 | 33.28 | 34.74 | 36.02 | 37.48 | 38.49 | 39.40 |
| | 3.0 | 5.39 | 9.59 | 16.43 | 21.60 | 25.68 | 29.01 | 31.78 | 34.14 | 36.17 | 37.95 | 39.53 | 41.45 | 42.17 | 43.86 |
| | 4.0 | 9.06 | 9.66 | 16.68 | 22.08 | 26.40 | 29.96 | 32.96 | 35.54 | 37.78 | 39.75 | 41.51 | 43.75 | 45.19 | 46.49 |
| | 5.0 | 13.57 | 9.70 | 16.83 | 22.37 | 26.85 | 30.56 | 33.71 | 36.43 | 38.80 | 40.90 | 42.78 | 45.25 | 46.80 | 48.21 |

Table 11. Heating capacity (kW), fan size DS02 — SI

| Rows | Water Flow Rate (L/s) | Water Pressure Drop (kPa) | Airflow (L/s) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 47 | 94 | 142 | 189 | 236 | 283 | 330 | 378 | 425 | 472 | 519 | 566 | 614 |
| 1 | 0.06 | 0.45 | 2.01 | 2.66 | 3.07 | 3.38 | 3.64 | 3.85 | 4.04 | 4.2 | 4.34 | 4.42 | 4.53 | 4.62 | 4.72 |
| | 0.13 | 1.73 | 2.26 | 3.14 | 3.75 | 4.24 | 4.66 | 5.03 | 5.36 | 5.65 | 5.92 | 6 | 6.22 | 6.43 | 6.61 |
| | 0.19 | 3.8 | 2.32 | 3.27 | 3.94 | 4.5 | 4.97 | 5.4 | 5.78 | 6.13 | 6.45 | 6.75 | 6.98 | 7.24 | 7.48 |
| | 0.25 | 6.7 | 2.37 | 3.36 | 4.09 | 4.68 | 5.2 | 5.67 | 6.1 | 6.49 | 6.86 | 7.19 | 7.45 | 7.74 | 8.02 |
| | 0.32 | 10.4 | 2.39 | 3.43 | 4.18 | 4.8 | 5.36 | 5.86 | 6.31 | 6.74 | 7.13 | 7.49 | 7.76 | 8.08 | 8.38 |
| | 0.38 | 14.89 | 2.41 | 3.47 | 4.24 | 4.89 | 5.47 | 5.99 | 6.47 | 6.91 | 7.32 | 7.71 | 7.98 | 8.33 | 8.65 |
| 2 | 0.06 | 2.27 | 2.65 | 4.28 | 5.35 | 6.12 | 6.69 | 7.14 | 7.49 | 7.79 | 8.04 | 8.25 | 8.44 | 8.6 | 8.74 |
| | 0.13 | 7.77 | 2.77 | 4.67 | 6.07 | 7.13 | 7.98 | 8.68 | 9.26 | 9.75 | 10.18 | 10.56 | 10.98 | 11.28 | 11.55 |
| | 0.19 | 16.11 | 2.81 | 4.82 | 6.33 | 7.53 | 8.5 | 9.31 | 10.01 | 10.6 | 11.12 | 11.58 | 12.15 | 12.36 | 12.85 |
| | 0.25 | 27.08 | 2.83 | 4.89 | 6.47 | 7.74 | 8.78 | 9.66 | 10.42 | 11.07 | 11.65 | 12.16 | 12.82 | 13.24 | 13.62 |
| | 0.32 | 40.56 | 2.84 | 4.93 | 6.56 | 7.87 | 8.96 | 9.88 | 10.68 | 11.37 | 11.99 | 12.54 | 13.26 | 13.72 | 14.13 |

# Water Coil Notes

## Water Coil Notes (I-P)

- Fouling factor = 0.0005
- Use the following equations to calculate leaving air temperature (LAT) and water temperature difference (WTD).

$$LAT = EAT + \left[\frac{MBH \times 921.7}{Cfm}\right]$$

$$WTD = EWT - LWT = \left(\frac{2 \times MBh}{Gpm}\right)$$

- Capacity based on 70°F entering air temperature and 180°F entering water temperature. Refer to correction factors for different entering conditions.

**Table 12. Temperature correction factors for water pressure drop (ft)**

| Average Water Temperature (°F) | 200 | 190 | 180 | 170 | 160 | 150 | 140 | 130 | 120 | 110 |
|---|---|---|---|---|---|---|---|---|---|---|
| Correction Factor | 0.970 | 0.985 | 1.000 | 1.020 | 1.030 | 1.050 | 1.080 | 1.100 | 1.130 | 1.150 |

**Table 13. Temperature correction factors for coil capacity (MBh)**

| Entering Water Minus Entering Air (°F) | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 |
|---|---|---|---|---|---|---|---|---|---|---|
| Correction Factor | 0.355 | 0.446 | 0.537 | 0.629 | 0.722 | 0.814 | 0.907 | 1.000 | 1.093 | 1.187 |

## Water Coil Notes (SI)

- Fouling factor = 0.0005
- Use the following equations to calculate leaving air temperature (LAT) and water temperature difference (WTD).

$$LAT = EAT + \left[\frac{kW \times 0.83}{L/s}\right]$$

$$WTD = EWT - LWT = \left[\frac{kW}{(4.19)\ L/s}\right]$$

- Capacity based on 21°C entering air temperature and 82°C entering water temperature. Refer to correction factors for different entering conditions.

**Table 14. Temperature correction factors for water pressure drop (kPa)**

| Average Water Temperature (°C) | 93 | 88 | 82 | 77 | 71 | 66 | 60 | 54 | 49 | 43 |
|---|---|---|---|---|---|---|---|---|---|---|
| Correction Factor | 0.970 | 0.985 | 1.000 | 1.020 | 1.030 | 1.050 | 1.080 | 1.100 | 1.130 | 1.150 |

**Table 15. Temperature correction factors for coil capacity (kW)**

| Entering Water Minus Entering Air (°C) | 22 | 27 | 33 | 38 | 44 | 50 | 55 | 61 | 67 | 72 |
|---|---|---|---|---|---|---|---|---|---|---|
| Correction Factor | 0.355 | 0.446 | 0.537 | 0.629 | 0.722 | 0.814 | 0.907 | 1.000 | 1.093 | 1.187 |

# Acoustics Data

Table 16. Discharge sound power (dB) —Fan Valve — 0.5 to 1.5 in air valve

| Fan Size | Fan Airflow | | Inlet Size in. | Primary Airflow | | 0.5 in. Air Valve Pressure Drop | | | | | | 1.0 in. Air Valve Pressure Drop | | | | | | 1.5 in. Air Valve Pressure Drop | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfm | L/s | | cfm | L/s | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 |
| DS02 | 200 | 91 | 4 | 100 | 45 | 63 | 58 | 53 | 50 | 45 | 40 | 63 | 58 | 53 | 50 | 45 | 40 | 63 | 58 | 53 | 50 | 45 | 40 |
| | 400 | 182 | | 100 | 45 | 65 | 60 | 59 | 56 | 50 | 47 | 66 | 60 | 59 | 56 | 50 | 47 | 66 | 60 | 59 | 56 | 50 | 47 |
| | 600 | 272 | | 100 | 45 | 71 | 65 | 65 | 62 | 57 | 55 | 71 | 65 | 65 | 62 | 57 | 55 | 71 | 66 | 65 | 62 | 57 | 55 |
| | 400 | 182 | | 200 | 91 | 66 | 60 | 59 | 56 | 50 | 47 | 67 | 61 | 59 | 56 | 50 | 47 | 67 | 61 | 59 | 56 | 50 | 47 |
| | 600 | 272 | | 200 | 91 | 71 | 65 | 64 | 62 | 57 | 55 | 72 | 66 | 64 | 62 | 57 | 55 | 72 | 66 | 64 | 62 | 57 | 55 |
| DS02 | 200 | 91 | 5 | 100 | 45 | 63 | 58 | 53 | 50 | 45 | 40 | 63 | 58 | 53 | 50 | 45 | 40 | 63 | 58 | 53 | 50 | 45 | 40 |
| | 400 | 182 | | 100 | 45 | 65 | 60 | 59 | 56 | 50 | 47 | 66 | 60 | 59 | 56 | 50 | 47 | 66 | 60 | 59 | 56 | 50 | 47 |
| | 600 | 272 | | 100 | 45 | 71 | 65 | 65 | 62 | 57 | 55 | 71 | 65 | 65 | 62 | 57 | 55 | 71 | 66 | 65 | 62 | 57 | 55 |
| | 400 | 182 | | 200 | 91 | 66 | 60 | 59 | 56 | 50 | 47 | 67 | 60 | 59 | 56 | 50 | 47 | 67 | 61 | 59 | 56 | 50 | 47 |
| | 600 | 272 | | 200 | 91 | 71 | 65 | 64 | 62 | 57 | 55 | 71 | 65 | 64 | 62 | 57 | 55 | 71 | 66 | 64 | 62 | 57 | 55 |
| | 600 | 272 | | 300 | 136 | 72 | 66 | 64 | 62 | 57 | 55 | 73 | 66 | 64 | 62 | 57 | 55 | 73 | 66 | 64 | 62 | 57 | 55 |
| | 700 | 318 | | 100 | 45 | 73 | 68 | 67 | 64 | 60 | 58 | 73 | 68 | 67 | 64 | 60 | 58 | 73 | 68 | 67 | 64 | 60 | 58 |
| | 900 | 409 | | 100 | 45 | 77 | 73 | 72 | 70 | 66 | 65 | 77 | 73 | 72 | 70 | 66 | 65 | 77 | 73 | 72 | 70 | 66 | 65 |
| | 1100 | 499 | | 100 | 45 | 81 | 78 | 76 | 75 | 72 | 70 | 81 | 78 | 76 | 75 | 72 | 70 | 81 | 78 | 76 | 75 | 72 | 70 |
| | 1300 | 590 | | 100 | 45 | 85 | 82 | 80 | 79 | 76 | 75 | 85 | 82 | 80 | 79 | 76 | 75 | 85 | 82 | 80 | 79 | 76 | 75 |
| | 700 | 318 | | 200 | 91 | 72 | 68 | 67 | 63 | 59 | 57 | 72 | 68 | 67 | 63 | 59 | 57 | 72 | 68 | 67 | 63 | 59 | 57 |
| | 900 | 409 | | 200 | 91 | 77 | 72 | 72 | 69 | 65 | 64 | 77 | 72 | 72 | 69 | 65 | 64 | 77 | 72 | 72 | 69 | 65 | 64 |
| | 1100 | 499 | | 200 | 91 | 81 | 77 | 76 | 74 | 71 | 70 | 81 | 77 | 76 | 74 | 71 | 72 | 81 | 77 | 76 | 74 | 71 | 70 |
| | 1300 | 590 | | 200 | 91 | 84 | 81 | 79 | 78 | 76 | 74 | 84 | 81 | 79 | 78 | 76 | 74 | 84 | 81 | 79 | 78 | 76 | 74 |
| | 700 | 318 | | 300 | 136 | 73 | 67 | 66 | 62 | 58 | 56 | 73 | 67 | 66 | 62 | 58 | 56 | 73 | 67 | 66 | 62 | 58 | 56 |
| | 900 | 409 | | 300 | 136 | 76 | 72 | 71 | 68 | 65 | 63 | 76 | 72 | 71 | 68 | 65 | 63 | 76 | 72 | 71 | 68 | 65 | 63 |
| | 1100 | 499 | | 300 | 136 | 80 | 76 | 75 | 73 | 70 | 69 | 80 | 76 | 75 | 73 | 70 | 69 | 80 | 76 | 75 | 73 | 70 | 69 |
| | 1300 | 590 | | 300 | 136 | 84 | 81 | 79 | 78 | 75 | 74 | 84 | 81 | 79 | 78 | 75 | 74 | 84 | 81 | 79 | 78 | 75 | 74 |

**Table 16. Discharge sound power (dB) —Fan Valve — 0.5 to 1.5 in air valve (continued)**

| Fan Size | Fan Airflow | | Inlet Size in. | Primary Airflow | | 0.5 in. Air Valve Pressure Drop | | | | | | 1.0 in. Air Valve Pressure Drop | | | | | | 1.5 in. Air Valve Pressure Drop | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfm | L/s | | cfm | L/s | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 |
| | 200 | 91 | | 100 | 45 | 63 | 58 | 53 | 50 | 45 | 40 | 63 | 58 | 53 | 50 | 45 | 40 | 63 | 58 | 53 | 50 | 45 | 40 |
| | 400 | 182 | | 100 | 45 | 65 | 60 | 59 | 56 | 50 | 47 | 66 | 60 | 59 | 56 | 50 | 47 | 66 | 60 | 59 | 56 | 50 | 47 |
| | 600 | 272 | | 100 | 45 | 71 | 65 | 65 | 62 | 57 | 55 | 71 | 65 | 65 | 62 | 57 | 55 | 71 | 65 | 65 | 62 | 57 | 55 |
| | 400 | 182 | | 200 | 91 | 66 | 60 | 59 | 56 | 50 | 47 | 66 | 60 | 59 | 56 | 50 | 47 | 67 | 61 | 59 | 56 | 50 | 47 |
| | 600 | 272 | | 200 | 91 | 71 | 65 | 64 | 62 | 57 | 55 | 71 | 65 | 64 | 62 | 57 | 55 | 74 | 66 | 64 | 62 | 57 | 55 |
| | 600 | 272 | | 300 | 136 | 72 | 65 | 64 | 62 | 57 | 55 | 72 | 66 | 64 | 62 | 57 | 55 | 73 | 66 | 64 | 62 | 57 | 55 |
| | 600 | 272 | | 400 | 182 | 72 | 65 | 64 | 62 | 57 | 55 | 73 | 66 | 64 | 62 | 57 | 55 | 74 | 66 | 64 | 62 | 57 | 55 |
| | 700 | 318 | | 200 | 91 | 72 | 67 | 67 | 63 | 59 | 57 | 72 | 67 | 67 | 63 | 59 | 57 | 72 | 67 | 67 | 63 | 59 | 57 |
| | 900 | 409 | | 200 | 91 | 77 | 72 | 72 | 69 | 65 | 64 | 77 | 72 | 72 | 69 | 65 | 64 | 77 | 73 | 72 | 69 | 65 | 64 |
| DS02 | 1100 | 499 | 6 | 200 | 91 | 81 | 77 | 76 | 74 | 71 | 70 | 81 | 77 | 76 | 74 | 71 | 70 | 81 | 77 | 76 | 74 | 71 | 70 |
| | 1300 | 590 | | 200 | 91 | 84 | 81 | 79 | 78 | 76 | 74 | 81 | 71 | 79 | 78 | 76 | 74 | 84 | 81 | 79 | 78 | 76 | 74 |
| | 700 | 318 | | 300 | 136 | 72 | 67 | 66 | 62 | 58 | 56 | 72 | 67 | 66 | 62 | 58 | 56 | 73 | 67 | 66 | 62 | 58 | 56 |
| | 900 | 409 | | 300 | 136 | 76 | 72 | 71 | 68 | 65 | 63 | 76 | 72 | 71 | 68 | 65 | 63 | 76 | 72 | 71 | 68 | 65 | 63 |
| | 1100 | 499 | | 300 | 136 | 80 | 76 | 75 | 73 | 70 | 69 | 80 | 76 | 75 | 73 | 70 | 69 | 80 | 76 | 75 | 73 | 70 | 69 |
| | 1300 | 590 | | 300 | 136 | 84 | 81 | 79 | 78 | 75 | 74 | 84 | 71 | 79 | 78 | 75 | 74 | 84 | 81 | 79 | 78 | 75 | 74 |
| | 700 | 318 | | 400 | 182 | 72 | 66 | 65 | 61 | 57 | 55 | 73 | 67 | 65 | 61 | 57 | 55 | 74 | 67 | 65 | 61 | 57 | 55 |
| | 900 | 409 | | 400 | 182 | 76 | 71 | 71 | 68 | 64 | 62 | 76 | 71 | 71 | 68 | 64 | 62 | 77 | 72 | 71 | 68 | 64 | 62 |
| | 1100 | 499 | | 400 | 182 | 80 | 76 | 75 | 73 | 69 | 68 | 80 | 76 | 75 | 73 | 69 | 68 | 80 | 76 | 75 | 73 | 69 | 68 |
| | 1300 | 590 | | 400 | 182 | 83 | 80 | 79 | 77 | 74 | 73 | 83 | 80 | 79 | 77 | 74 | 73 | 83 | 80 | 79 | 77 | 74 | 73 |

Table 16. Discharge sound power (dB) —Fan Valve — 0.5 to 1.5 in air valve (continued)

| Fan Size | Fan Airflow | | Inlet Size in. | Primary Airflow | | 0.5 in. Air Valve Pressure Drop | | | | | | 1.0 in. Air Valve Pressure Drop | | | | | | 1.5 in. Air Valve Pressure Drop | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfm | L/s | | cfm | L/s | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 |
| DS02 | 400 | 182 | 8 | 200 | 91 | 65 | 60 | 59 | 56 | 50 | 47 | 66 | 60 | 59 | 56 | 50 | 47 | 66 | 61 | 59 | 56 | 50 | 47 |
| | 600 | 272 | | 200 | 91 | 71 | 65 | 64 | 62 | 57 | 55 | 73 | 65 | 64 | 62 | 57 | 55 | 71 | 66 | 64 | 62 | 57 | 55 |
| | 600 | 272 | | 300 | 136 | 71 | 65 | 64 | 62 | 57 | 55 | 72 | 65 | 64 | 62 | 57 | 55 | 72 | 66 | 64 | 62 | 57 | 55 |
| | 600 | 272 | | 400 | 182 | 72 | 65 | 64 | 62 | 57 | 55 | 72 | 66 | 64 | 62 | 57 | 55 | 73 | 66 | 64 | 62 | 57 | 55 |
| | 600 | 272 | | 500 | 227 | 72 | 65 | 64 | 62 | 56 | 54 | 72 | 66 | 64 | 62 | 56 | 54 | 74 | 67 | 64 | 62 | 56 | 54 |
| | 700 | 318 | | 250 | 114 | 72 | 67 | 66 | 62 | 58 | 56 | 72 | 67 | 66 | 62 | 58 | 56 | 72 | 67 | 66 | 62 | 58 | 56 |
| | 900 | 409 | | 250 | 114 | 76 | 72 | 71 | 69 | 65 | 64 | 76 | 72 | 71 | 69 | 65 | 64 | 76 | 72 | 71 | 69 | 65 | 64 |
| | 1100 | 499 | | 250 | 114 | 80 | 77 | 76 | 74 | 71 | 69 | 80 | 77 | 76 | 74 | 71 | 69 | 80 | 77 | 76 | 74 | 71 | 69 |
| | 1300 | 590 | | 250 | 114 | 84 | 81 | 79 | 78 | 75 | 74 | 84 | 81 | 79 | 78 | 75 | 74 | 84 | 81 | 79 | 78 | 75 | 74 |
| | 700 | 318 | | 500 | 227 | 71 | 66 | 65 | 61 | 56 | 54 | 72 | 66 | 65 | 61 | 56 | 54 | 73 | 67 | 65 | 61 | 56 | 54 |
| | 900 | 409 | | 500 | 227 | 75 | 71 | 70 | 67 | 63 | 62 | 76 | 71 | 70 | 67 | 63 | 62 | 76 | 71 | 70 | 67 | 63 | 62 |
| | 1100 | 499 | | 500 | 227 | 79 | 75 | 75 | 72 | 69 | 68 | 80 | 75 | 75 | 72 | 69 | 68 | 80 | 76 | 75 | 72 | 69 | 68 |
| | 1300 | 590 | | 500 | 227 | 83 | 80 | 78 | 77 | 74 | 73 | 83 | 80 | 78 | 77 | 74 | 73 | 83 | 80 | 78 | 77 | 74 | 73 |
| | 900 | 318 | | 750 | 341 | 75 | 70 | 69 | 66 | 62 | 60 | 77 | 71 | 69 | 66 | 62 | 60 | 77 | 71 | 69 | 66 | 62 | 60 |
| | 1100 | 409 | | 750 | 341 | 79 | 75 | 74 | 71 | 68 | 66 | 80 | 75 | 74 | 71 | 68 | 66 | 80 | 75 | 74 | 71 | 68 | 66 |
| | 1300 | 499 | | 750 | 341 | 83 | 79 | 78 | 76 | 73 | 72 | 83 | 79 | 78 | 76 | 73 | 72 | 83 | 79 | 78 | 76 | 73 | 72 |
| DS02 | 700 | 318 | 8X14 | 500 | 227 | 70 | 66 | 65 | 61 | 56 | 54 | 71 | 66 | 65 | 61 | 56 | 54 | 72 | 76 | 65 | 61 | 56 | 54 |
| | 900 | 409 | | 500 | 227 | 75 | 71 | 70 | 67 | 63 | 62 | 75 | 71 | 70 | 67 | 63 | 62 | 76 | 71 | 70 | 67 | 63 | 62 |
| | 1100 | 499 | | 500 | 227 | 79 | 75 | 75 | 72 | 69 | 68 | 79 | 75 | 75 | 72 | 69 | 68 | 79 | 76 | 75 | 72 | 69 | 68 |
| | 1300 | 590 | | 500 | 227 | 83 | 80 | 78 | 77 | 74 | 73 | 83 | 80 | 78 | 77 | 74 | 73 | 83 | 80 | 78 | 77 | 74 | 73 |
| | 900 | 409 | | 750 | 341 | 75 | 70 | 69 | 66 | 62 | 60 | 75 | 70 | 69 | 66 | 62 | 60 | 76 | 71 | 69 | 66 | 62 | 60 |
| | 1100 | 409 | | 750 | 341 | 79 | 75 | 74 | 71 | 68 | 66 | 79 | 75 | 74 | 71 | 68 | 66 | 80 | 75 | 74 | 71 | 68 | 66 |
| | 1300 | 590 | | 750 | 341 | 83 | 79 | 78 | 76 | 73 | 72 | 83 | 79 | 78 | 76 | 73 | 72 | 83 | 79 | 78 | 76 | 73 | 72 |
| | 1100 | 499 | | 1000 | 454 | 79 | 75 | 73 | 70 | 67 | 66 | 80 | 75 | 73 | 70 | 67 | 66 | 80 | 75 | 74 | 70 | 67 | 66 |
| | 1300 | 590 | | 1000 | 454 | 83 | 79 | 77 | 75 | 72 | 71 | 83 | 79 | 77 | 75 | 72 | 71 | 84 | 79 | 77 | 75 | 72 | 71 |

**Notes:**

1. All data are measured in accordance with industry standard AHRI 880-2011.
2. All sound power levels, dB re: 10-12 Watts
3. The air valve pressure drop values shown are for the pressure drop across the air valve only.
4. All acoustic performance data shown is with 1” matte faced insulation and a 6-row sensible cooling coil.

Table 17. Discharge sound power (dB) — Fan Valve — 2.0 to 3.0 in air valve

| Fan Size | Fan Airflow | | Inlet Size in. | Primary Airflow | | 2.0 in. Air Valve Pressure Drop | | | | | | 2.5 in. Air Valve Pressure Drop | | | | | | 3.0 in. Air Valve Pressure Drop | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfm | L/s | | cfm | L/s | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 |
| DS02 | 200 | 91 | 4 | 100 | 45 | 63 | 58 | 53 | 50 | 45 | 40 | 64 | 58 | 53 | 50 | 45 | 40 | 64 | 58 | 53 | 50 | 45 | 40 |
| | 400 | 182 | | 100 | 45 | 66 | 60 | 59 | 56 | 50 | 47 | 66 | 60 | 59 | 56 | 50 | 57 | 66 | 60 | 59 | 56 | 50 | 47 |
| | 600 | 272 | | 100 | 45 | 71 | 66 | 65 | 62 | 57 | 55 | 71 | 66 | 65 | 62 | 57 | 55 | 71 | 66 | 65 | 62 | 57 | 55 |
| | 400 | 182 | | 200 | 91 | 68 | 61 | 59 | 56 | 50 | 47 | 68 | 62 | 59 | 56 | 50 | 47 | 68 | 62 | 59 | 56 | 50 | 47 |
| | 600 | 272 | | 200 | 91 | 72 | 66 | 64 | 62 | 57 | 55 | 72 | 66 | 64 | 62 | 57 | 55 | 72 | 66 | 64 | 62 | 57 | 55 |
| DS02 | 200 | 91 | 5 | 100 | 45 | 63 | 58 | 53 | 50 | 45 | 40 | 64 | 58 | 53 | 50 | 45 | 40 | 64 | 58 | 53 | 50 | 45 | 40 |
| | 400 | 182 | | 100 | 45 | 66 | 60 | 59 | 56 | 50 | 47 | 66 | 60 | 59 | 56 | 50 | 47 | 66 | 60 | 59 | 56 | 50 | 47 |
| | 600 | 272 | | 100 | 45 | 71 | 66 | 65 | 62 | 57 | 55 | 71 | 66 | 65 | 62 | 57 | 55 | 71 | 66 | 65 | 62 | 57 | 55 |
| | 400 | 182 | | 200 | 91 | 67 | 61 | 59 | 56 | 50 | 47 | 57 | 62 | 59 | 56 | 50 | 47 | 68 | 62 | 59 | 56 | 50 | 47 |
| | 600 | 272 | | 200 | 91 | 71 | 66 | 64 | 62 | 57 | 55 | 71 | 66 | 64 | 62 | 57 | 55 | 71 | 66 | 64 | 62 | 57 | 55 |
| | 600 | 272 | | 300 | 136 | 73 | 66 | 64 | 62 | 57 | 55 | 74 | 67 | 64 | 62 | 57 | 55 | 7 | 67 | 64 | 62 | 57 | 55 |
| | 700 | 318 | | 100 | 45 | 73 | 68 | 67 | 64 | 60 | 58 | 73 | 68 | 67 | 64 | 60 | 58 | 73 | 68 | 67 | 64 | 60 | 58 |
| | 900 | 409 | | 100 | 45 | 77 | 73 | 72 | 70 | 66 | 65 | 77 | 73 | 72 | 70 | 66 | 65 | 77 | 73 | 72 | 70 | 66 | 65 |
| | 1100 | 499 | | 100 | 45 | 81 | 78 | 76 | 75 | 72 | 70 | 81 | 78 | 76 | 75 | 72 | 70 | 81 | 78 | 76 | 75 | 72 | 70 |
| | 1300 | 590 | | 100 | 45 | 85 | 82 | 80 | 79 | 76 | 75 | 85 | 82 | 80 | 79 | 76 | 75 | 85 | 82 | 80 | 79 | 76 | 75 |
| | 700 | 318 | | 200 | 91 | 72 | 68 | 67 | 63 | 59 | 57 | 72 | 68 | 67 | 63 | 59 | 57 | 72 | 65 | 67 | 63 | 59 | 57 |
| | 900 | 409 | | 200 | 91 | 77 | 72 | 72 | 69 | 65 | 64 | 77 | 72 | 72 | 69 | 65 | 64 | 77 | 72 | 72 | 69 | 65 | 64 |
| | 1100 | 499 | | 200 | 91 | 81 | 77 | 76 | 74 | 71 | 70 | 81 | 77 | 76 | 74 | 71 | 70 | 81 | 77 | 76 | 74 | 71 | 70 |
| | 1300 | 590 | | 200 | 91 | 84 | 81 | 79 | 78 | 76 | 74 | 84 | 81 | 79 | 78 | 76 | 74 | 84 | 81 | 79 | 78 | 76 | 74 |
| | 700 | 318 | | 300 | 136 | 73 | 67 | 66 | 62 | 58 | 56 | 73 | 67 | 66 | 62 | 58 | 56 | 73 | 67 | 66 | 62 | 58 | 56 |
| | 900 | 409 | | 300 | 136 | 76 | 72 | 71 | 68 | 65 | 63 | 76 | 72 | 71 | 68 | 65 | 63 | 76 | 72 | 71 | 68 | 65 | 63 |
| | 1100 | 499 | | 300 | 136 | 80 | 76 | 75 | 73 | 70 | 69 | 80 | 76 | 75 | 73 | 70 | 69 | 80 | 76 | 75 | 73 | 70 | 69 |
| | 1300 | 590 | | 300 | 136 | 84 | 81 | 79 | 78 | 75 | 74 | 84 | 81 | 79 | 78 | 75 | 74 | 84 | 81 | 79 | 78 | 75 | 74 |

### Table 17. Discharge sound power (dB) — Fan Valve — 2.0 to 3.0 in air valve (continued)

| Fan Size | Fan Airflow | | Inlet Size in. | Primary Airflow | | 2.0 in. Air Valve Pressure Drop | | | | | | 2.5 in. Air Valve Pressure Drop | | | | | | 3.0 in. Air Valve Pressure Drop | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfm | L/s | | cfm | L/s | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 |
| DS02 | 200 | 91 | 6 | 100 | 45 | 64 | 58 | 53 | 50 | 45 | 40 | 64 | 58 | 53 | 50 | 45 | 40 | 64 | 58 | 53 | 50 | 45 | 40 |
| | 400 | 182 | | 100 | 45 | 66 | 60 | 59 | 56 | 50 | 47 | 66 | 60 | 59 | 56 | 50 | 47 | 66 | 61 | 59 | 56 | 50 | 47 |
| | 600 | 272 | | 100 | 45 | 71 | 66 | 65 | 62 | 59 | 55 | 71 | 66 | 65 | 62 | 59 | 55 | 71 | 66 | 65 | 62 | 57 | 55 |
| | 400 | 182 | | 200 | 91 | 68 | 61 | 59 | 56 | 50 | 47 | 68 | 62 | 59 | 56 | 50 | 47 | 69 | 62 | 59 | 56 | 50 | 47 |
| | 600 | 272 | | 200 | 91 | 72 | 66 | 64 | 62 | 57 | 55 | 72 | 66 | 64 | 62 | 57 | 55 | 72 | 66 | 64 | 62 | 57 | 55 |
| | 600 | 272 | | 300 | 136 | 73 | 66 | 64 | 62 | 57 | 55 | 73 | 67 | 64 | 62 | 57 | 55 | 74 | 67 | 64 | 62 | 57 | 55 |
| | 600 | 272 | | 400 | 182 | 75 | 67 | 64 | 62 | 57 | 55 | 75 | 68 | 64 | 62 | 57 | 55 | 76 | 68 | 64 | 62 | 57 | 55 |
| | 700 | 318 | | 200 | 91 | 72 | 67 | 67 | 63 | 59 | 57 | 72 | 67 | 67 | 63 | 59 | 57 | 72 | 67 | 67 | 63 | 59 | 57 |
| | 900 | 409 | | 200 | 91 | 77 | 73 | 72 | 69 | 65 | 64 | 77 | 73 | 72 | 69 | 65 | 64 | 77 | 73 | 72 | 69 | 65 | 64 |
| | 1100 | 499 | | 200 | 91 | 81 | 77 | 76 | 74 | 71 | 70 | 81 | 77 | 76 | 74 | 71 | 70 | 81 | 77 | 76 | 74 | 71 | 70 |
| | 1300 | 590 | | 200 | 91 | 84 | 81 | 79 | 78 | 76 | 74 | 84 | 81 | 79 | 78 | 76 | 74 | 84 | 81 | 79 | 78 | 76 | 74 |
| | 700 | 318 | | 300 | 136 | 73 | 67 | 66 | 62 | 58 | 56 | 73 | 68 | 66 | 62 | 58 | 56 | 74 | 68 | 66 | 62 | 58 | 56 |
| | 900 | 409 | | 300 | 136 | 76 | 72 | 71 | 68 | 65 | 63 | 76 | 72 | 71 | 68 | 65 | 63 | 76 | 72 | 71 | 68 | 65 | 63 |
| | 1100 | 499 | | 300 | 136 | 80 | 76 | 75 | 73 | 70 | 69 | 80 | 76 | 75 | 73 | 70 | 69 | 80 | 76 | 75 | 73 | 70 | 69 |
| | 1300 | 590 | | 300 | 136 | 84 | 81 | 79 | 78 | 75 | 74 | 84 | 81 | 79 | 78 | 75 | 74 | 84 | 81 | 79 | 78 | 75 | 74 |
| | 700 | 318 | | 400 | 182 | 74 | 68 | 65 | 61 | 57 | 55 | 75 | 68 | 65 | 61 | 57 | 55 | 75 | 68 | 65 | 61 | 57 | 55 |
| | 900 | 409 | | 400 | 182 | 77 | 72 | 71 | 68 | 64 | 62 | 77 | 72 | 71 | 68 | 64 | 62 | 78 | 72 | 71 | 68 | 64 | 62 |
| | 1100 | 499 | | 400 | 182 | 80 | 76 | 75 | 73 | 69 | 68 | 80 | 76 | 75 | 73 | 69 | 68 | 80 | 76 | 75 | 73 | 69 | 68 |
| | 1300 | 590 | | 400 | 182 | 83 | 80 | 79 | 77 | 74 | 73 | 83 | 80 | 79 | 77 | 74 | 73 | 83 | 80 | 79 | 77 | 74 | 73 |

Table 17. Discharge sound power (dB) — Fan Valve — 2.0 to 3.0 in air valve (continued)

| Fan Size | Fan Airflow | | Inlet Size in. | Primary Airflow | | 2.0 in. Air Valve Pressure Drop | | | | | | 2.5 in. Air Valve Pressure Drop | | | | | | 3.0 in. Air Valve Pressure Drop | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfm | L/s | | cfm | L/s | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 |
| DS02 | 400 | 182 | 8 | 200 | 91 | 67 | 61 | 59 | 56 | 50 | 47 | 67 | 62 | 59 | 56 | 50 | 47 | 68 | 62 | 59 | 56 | 50 | 47 |
| | 600 | 272 | | 200 | 91 | 71 | 66 | 64 | 62 | 57 | 55 | 71 | 66 | 64 | 62 | 57 | 55 | 71 | 66 | 64 | 62 | 57 | 55 |
| | 600 | 272 | | 300 | 136 | 72 | 66 | 64 | 62 | 57 | 55 | 73 | 67 | 64 | 62 | 57 | 55 | 73 | 67 | 64 | 62 | 57 | 55 |
| | 600 | 272 | | 400 | 182 | 73 | 67 | 64 | 62 | 57 | 55 | 74 | 68 | 64 | 62 | 57 | 55 | 75 | 68 | 64 | 62 | 57 | 55 |
| | 600 | 272 | | 500 | 227 | 75 | 68 | 64 | 62 | 56 | 54 | 75 | 69 | 64 | 62 | 56 | 54 | 76 | 70 | 64 | 62 | 56 | 54 |
| | 700 | 318 | | 250 | 114 | 72 | 67 | 66 | 62 | 58 | 56 | 72 | 68 | 66 | 62 | 58 | 56 | 73 | 68 | 66 | 62 | 58 | 56 |
| | 900 | 409 | | 250 | 114 | 76 | 72 | 71 | 69 | 65 | 64 | 77 | 72 | 71 | 69 | 65 | 64 | 77 | 72 | 71 | 69 | 65 | 64 |
| | 1100 | 499 | | 250 | 114 | 80 | 77 | 76 | 74 | 71 | 69 | 80 | 77 | 76 | 74 | 71 | 69 | 80 | 77 | 76 | 74 | 71 | 69 |
| | 1300 | 590 | | 250 | 114 | 84 | 81 | 79 | 78 | 7 | 74 | 84 | 81 | 79 | 78 | 75 | 74 | 84 | 81 | 79 | 78 | 75 | 74 |
| | 700 | 318 | | 500 | 227 | 74 | 68 | 65 | 61 | 56 | 54 | 75 | 68 | 65 | 61 | 56 | 54 | 76 | 69 | 65 | 61 | 56 | 54 |
| | 900 | 409 | | 500 | 227 | 77 | 71 | 70 | 67 | 63 | 62 | 77 | 72 | 70 | 67 | 63 | 62 | 77 | 72 | 70 | 67 | 63 | 62 |
| | 1100 | 499 | | 500 | 227 | 80 | 76 | 75 | 72 | 69 | 68 | 80 | 76 | 75 | 72 | 69 | 68 | 80 | 76 | 75 | 72 | 69 | 68 |
| | 1300 | 590 | | 500 | 227 | 83 | 80 | 78 | 77 | 74 | 73 | 83 | 80 | 78 | 77 | 74 | 73 | 84 | 80 | 78 | 77 | 74 | 73 |
| | 900 | 318 | | 750 | 341 | 78 | 72 | 69 | 66 | 62 | 60 | 79 | 72 | 69 | 66 | 62 | 60 | 79 | 73 | 69 | 66 | 62 | 60 |
| | 1100 | 409 | | 750 | 341 | 81 | 75 | 74 | 71 | 68 | 66 | 81 | 76 | 74 | 71 | 68 | 66 | 81 | 76 | 74 | 71 | 68 | 66 |
| | 1300 | 499 | | 750 | 341 | 84 | 79 | 78 | 76 | 73 | 72 | 84 | 79 | 78 | 74 | 73 | 72 | 84 | 79 | 78 | 76 | 73 | 72 |
| DS02 | 700 | 318 | 8X14 | 500 | 227 | 73 | 67 | 65 | 61 | 56 | 54 | 74 | 68 | 65 | 61 | 56 | 54 | 75 | 68 | 65 | 61 | 56 | 54 |
| | 900 | 409 | | 500 | 227 | 76 | 71 | 70 | 67 | 63 | 62 | 76 | 71 | 70 | 67 | 63 | 62 | 77 | 72 | 70 | 67 | 63 | 62 |
| | 1100 | 499 | | 500 | 227 | 80 | 76 | 75 | 72 | 69 | 68 | 80 | 76 | 75 | 72 | 69 | 68 | 80 | 76 | 75 | 72 | 69 | 68 |
| | 1300 | 590 | | 500 | 227 | 83 | 80 | 78 | 77 | 74 | 73 | 83 | 80 | 78 | 77 | 74 | 73 | 83 | 80 | 78 | 77 | 74 | 73 |
| | 900 | 409 | | 750 | 341 | 77 | 71 | 69 | 66 | 62 | 60 | 78 | 72 | 69 | 66 | 62 | 60 | 78 | 72 | 69 | 66 | 62 | 60 |
| | 1100 | 409 | | 750 | 341 | 80 | 75 | 74 | 71 | 68 | 66 | 80 | 75 | 74 | 71 | 68 | 66 | 81 | 76 | 74 | 71 | 68 | 67 |
| | 1300 | 590 | | 750 | 341 | 83 | 79 | 78 | 76 | 73 | 72 | 83 | 79 | 78 | 74 | 73 | 72 | 84 | 79 | 78 | 74 | 73 | 72 |
| | 1100 | 499 | | 1000 | 454 | 81 | 75 | 74 | 70 | 67 | 66 | 81 | 75 | 74 | 70 | 67 | 66 | 82 | 76 | 74 | 71 | 67 | 66 |
| | 1300 | 590 | | 1000 | 454 | 84 | 79 | 77 | 75 | 72 | 71 | 84 | 79 | 77 | 75 | 72 | 71 | 84 | 79 | 77 | 75 | 72 | 71 |

**Notes:**

1. All data are measured in accordance with industry standard AHRI 880-2011.
2. All sound power levels, dB re: 10-12 Watts
3. The air valve pressure drop values shown are for the pressure drop across the air valve only.
4. All acoustic performance data shown is with 1” matte faced insulation and a 6-row sensible cooling coil.

Table 18. Radiated sound power (dB) — Fan/Valve — 0.5 to 1.5 in air valve

| Fan Size | Fan Airflow | | Inlet Size in. | Primary Airflow | | 0.5 in. Air Valve Pressure Drop | | | | | | 1.0 in. Air Valve Pressure Drop | | | | | | 1.5 in. Air Valve Pressure Drop | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfm | L/s | | cfm | L/s | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 |
| DS02 | 200 | 91 | 4 | 100 | 45 | 57 | 54 | 50 | 44 | 36 | 30 | 58 | 54 | 50 | 44 | 36 | 33 | 58 | 55 | 51 | 44 | 37 | 35 |
| | 400 | 182 | | 100 | 45 | 59 | 55 | 54 | 49 | 40 | 32 | 59 | 55 | 54 | 49 | 40 | 34 | 59 | 55 | 54 | 49 | 40 | 36 |
| | 600 | 272 | | 100 | 45 | 63 | 59 | 59 | 54 | 45 | 37 | 63 | 59 | 59 | 54 | 45 | 38 | 64 | 59 | 59 | 54 | 45 | 39 |
| | 400 | 182 | | 200 | 91 | 62 | 57 | 54 | 49 | 40 | 35 | 63 | 58 | 55 | 49 | 41 | 39 | 64 | 59 | 55 | 50 | 42 | 43 |
| | 600 | 272 | | 200 | 91 | 65 | 60 | 59 | 54 | 45 | 38 | 65 | 60 | 59 | 54 | 45 | 40 | 66 | 61 | 59 | 54 | 46 | 42 |
| DS02 | 200 | 91 | 5 | 100 | 45 | 57 | 54 | 50 | 44 | 36 | 28 | 57 | 54 | 50 | 44 | 36 | 32 | 58 | 54 | 50 | 44 | 37 | 35 |
| | 400 | 182 | | 100 | 45 | 58 | 55 | 54 | 49 | 40 | 32 | 59 | 55 | 54 | 49 | 40 | 34 | 59 | 55 | 54 | 49 | 40 | 36 |
| | 600 | 272 | | 100 | 45 | 63 | 59 | 59 | 54 | 45 | 37 | 63 | 59 | 59 | 54 | 45 | 38 | 64 | 59 | 59 | 54 | 45 | 39 |
| | 400 | 182 | | 200 | 91 | 61 | 55 | 54 | 49 | 40 | 34 | 62 | 56 | 54 | 49 | 40 | 38 | 63 | 57 | 55 | 49 | 41 | 41 |
| | 600 | 272 | | 200 | 91 | 64 | 59 | 59 | 53 | 45 | 37 | 65 | 59 | 59 | 54 | 45 | 40 | 66 | 60 | 59 | 54 | 45 | 42 |
| | 600 | 272 | | 300 | 136 | 66 | 60 | 59 | 53 | 44 | 39 | 68 | 61 | 59 | 54 | 45 | 43 | 69 | 62 | 59 | 54 | 45 | 46 |
| | 700 | 318 | | 100 | 45 | 66 | 59 | 61 | 56 | 44 | 37 | 66 | 59 | 61 | 56 | 44 | 37 | 66 | 59 | 61 | 56 | 44 | 38 |
| | 900 | 409 | | 100 | 45 | 71 | 63 | 66 | 61 | 50 | 43 | 71 | 63 | 66 | 61 | 50 | 43 | 71 | 63 | 66 | 61 | 50 | 44 |
| | 1100 | 499 | | 100 | 45 | 74 | 67 | 69 | 66 | 55 | 49 | 74 | 67 | 69 | 66 | 55 | 49 | 74 | 67 | 69 | 66 | 55 | 49 |
| | 1300 | 590 | | 100 | 45 | 77 | 71 | 72 | 69 | 59 | 53 | 77 | 71 | 72 | 69 | 59 | 53 | 77 | 71 | 72 | 69 | 59 | 53 |
| | 700 | 318 | | 200 | 91 | 66 | 59 | 61 | 55 | 43 | 36 | 66 | 59 | 61 | 55 | 43 | 36 | 67 | 60 | 61 | 55 | 44 | 42 |
| | 900 | 409 | | 200 | 91 | 70 | 63 | 65 | 61 | 49 | 42 | 70 | 63 | 65 | 61 | 49 | 43 | 70 | 63 | 65 | 61 | 49 | 44 |
| | 1100 | 499 | | 200 | 91 | 74 | 67 | 69 | 65 | 54 | 48 | 74 | 67 | 69 | 65 | 54 | 48 | 74 | 67 | 69 | 65 | 54 | 48 |
| | 1300 | 590 | | 200 | 91 | 77 | 70 | 72 | 69 | 58 | 52 | 77 | 70 | 72 | 69 | 58 | 52 | 77 | 71 | 72 | 69 | 58 | 53 |
| | 700 | 318 | | 300 | 136 | 67 | 60 | 60 | 54 | 42 | 38 | 68 | 61 | 60 | 55 | 44 | 42 | 69 | 62 | 61 | 55 | 45 | 45 |
| | 900 | 409 | | 300 | 136 | 70 | 63 | 64 | 60 | 48 | 42 | 71 | 64 | 65 | 60 | 49 | 44 | 71 | 64 | 65 | 60 | 49 | 47 |
| | 1100 | 499 | | 300 | 136 | 73 | 66 | 68 | 64 | 53 | 47 | 74 | 67 | 68 | 64 | 53 | 48 | 74 | 67 | 68 | 65 | 54 | 49 |
| | 1300 | 590 | | 300 | 136 | 76 | 70 | 72 | 68 | 58 | 52 | 77 | 70 | 72 | 68 | 58 | 52 | 77 | 70 | 72 | 68 | 58 | 53 |

**Table 18. Radiated sound power (dB) — Fan/Valve — 0.5 to 1.5 in air valve (continued)**

| Fan Size | Fan Airflow | | Inlet Size in. | Primary Airflow | | 0.5 in. Air Valve Pressure Drop | | | | | | 1.0 in. Air Valve Pressure Drop | | | | | | 1.5 in. Air Valve Pressure Drop | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfm | L/s | | cfm | L/s | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 |
| | 200 | 91 | | 100 | 45 | 57 | 54 | 50 | 44 | 36 | 28 | 57 | 54 | 50 | 44 | 36 | 32 | 58 | 54 | 51 | 44 | 37 | 35 |
| | 400 | 182 | | 100 | 45 | 58 | 54 | 54 | 49 | 40 | 32 | 59 | 55 | 54 | 49 | 40 | 34 | 59 | 55 | 54 | 49 | 40 | 36 |
| | 600 | 272 | | 100 | 45 | 63 | 59 | 59 | 54 | 45 | 37 | 63 | 59 | 59 | 54 | 45 | 38 | 64 | 59 | 59 | 54 | 45 | 40 |
| | 400 | 182 | | 200 | 91 | 60 | 55 | 54 | 48 | 40 | 33 | 62 | 56 | 54 | 49 | 40 | 37 | 63 | 57 | 55 | 49 | 41 | 40 |
| | 600 | 272 | | 200 | 91 | 64 | 59 | 59 | 53 | 45 | 37 | 64 | 59 | 59 | 54 | 45 | 39 | 65 | 60 | 59 | 54 | 45 | 41 |
| | 600 | 272 | | 300 | 136 | 65 | 59 | 59 | 53 | 44 | 38 | 66 | 60 | 59 | 53 | 45 | 41 | 67 | 61 | 59 | 54 | 45 | 44 |
| | 600 | 272 | | 400 | 182 | 66 | 60 | 57 | 53 | 44 | 39 | 68 | 61 | 59 | 53 | 45 | 44 | 69 | 63 | 60 | 54 | 45 | 47 |
| | 700 | 318 | | 200 | 91 | 66 | 59 | 61 | 55 | 43 | 36 | 66 | 59 | 61 | 55 | 43 | 39 | 67 | 60 | 61 | 55 | 44 | 41 |
| | 900 | 409 | | 200 | 91 | 70 | 63 | 65 | 61 | 49 | 42 | 70 | 63 | 65 | 61 | 49 | 43 | 70 | 63 | 65 | 61 | 49 | 44 |
| DS02 | 1100 | 499 | 6 | 200 | 91 | 74 | 67 | 69 | 65 | 54 | 48 | 74 | 67 | 69 | 65 | 54 | 48 | 74 | 67 | 69 | 65 | 54 | 48 |
| | 1300 | 590 | | 200 | 91 | 77 | 70 | 72 | 69 | 58 | 52 | 77 | 70 | 72 | 69 | 58 | 52 | 77 | 71 | 72 | 69 | 58 | 53 |
| | 700 | 318 | | 300 | 136 | 66 | 59 | 60 | 54 | 42 | 37 | 67 | 60 | 60 | 54 | 43 | 41 | 68 | 61 | 60 | 55 | 44 | 44 |
| | 900 | 409 | | 300 | 136 | 70 | 62 | 64 | 60 | 48 | 41 | 70 | 63 | 65 | 60 | 48 | 43 | 71 | 64 | 65 | 60 | 49 | 46 |
| | 1100 | 499 | | 300 | 136 | 73 | 66 | 68 | 64 | 53 | 47 | 73 | 66 | 68 | 64 | 53 | 47 | 74 | 67 | 68 | 64 | 53 | 48 |
| | 1300 | 590 | | 300 | 136 | 76 | 70 | 72 | 68 | 58 | 51 | 76 | 70 | 72 | 68 | 58 | 52 | 77 | 70 | 72 | 68 | 58 | 52 |
| | 700 | 318 | | 400 | 182 | 67 | 59 | 59 | 53 | 42 | 38 | 68 | 61 | 60 | 54 | 43 | 43 | 69 | 63 | 60 | 55 | 44 | 47 |
| | 900 | 409 | | 400 | 182 | 70 | 62 | 64 | 59 | 47 | 41 | 71 | 63 | 64 | 59 | 48 | 44 | 71 | 65 | 64 | 59 | 48 | 47 |
| | 1100 | 499 | | 400 | 182 | 73 | 66 | 68 | 64 | 53 | 46 | 73 | 66 | 68 | 64 | 53 | 47 | 74 | 67 | 68 | 64 | 53 | 49 |
| | 1300 | 590 | | 400 | 182 | 76 | 70 | 71 | 68 | 57 | 51 | 76 | 70 | 71 | 68 | 57 | 51 | 76 | 70 | 71 | 68 | 57 | 52 |

**Table 18. Radiated sound power (dB) — Fan/Valve — 0.5 to 1.5 in air valve (continued)**

| Fan Size | Fan Airflow | | Inlet Size in. | Primary Airflow | | 0.5 in. Air Valve Pressure Drop | | | | | | 1.0 in. Air Valve Pressure Drop | | | | | | 1.5 in. Air Valve Pressure Drop | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfm | L/s | | cfm | L/s | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 |
| DS02 | 400 | 182 | 8 | 200 | 91 | 59 | 55 | 54 | 48 | 40 | 33 | 59 | 55 | 54 | 49 | 40 | 38 | 60 | 56 | 54 | 49 | 41 | 41 |
| | 600 | 272 | | 200 | 91 | 63 | 59 | 59 | 53 | 45 | 37 | 64 | 59 | 59 | 54 | 45 | 39 | 64 | 59 | 59 | 54 | 45 | 42 |
| | 600 | 272 | | 300 | 136 | 64 | 59 | 59 | 53 | 44 | 39 | 64 | 59 | 59 | 53 | 45 | 41 | 65 | 60 | 59 | 53 | 45 | 44 |
| | 600 | 272 | | 400 | 182 | 64 | 59 | 59 | 53 | 44 | 38 | 65 | 60 | 59 | 53 | 44 | 42 | 66 | 61 | 59 | 53 | 45 | 45 |
| | 600 | 272 | | 500 | 227 | 65 | 59 | 58 | 53 | 44 | 38 | 66 | 61 | 59 | 53 | 44 | 43 | 68 | 62 | 59 | 53 | 45 | 47 |
| | 700 | 318 | | 250 | 114 | 65 | 59 | 60 | 55 | 42 | 36 | 65 | 59 | 60 | 55 | 43 | 39 | 66 | 60 | 60 | 55 | 44 | 43 |
| | 900 | 409 | | 250 | 114 | 70 | 62 | 65 | 60 | 49 | 42 | 70 | 63 | 65 | 60 | 49 | 43 | 70 | 63 | 65 | 60 | 49 | 45 |
| | 1100 | 499 | | 250 | 114 | 73 | 66 | 69 | 65 | 54 | 47 | 73 | 66 | 69 | 65 | 54 | 48 | 73 | 67 | 69 | 65 | 54 | 48 |
| | 1300 | 590 | | 250 | 114 | 76 | 70 | 72 | 69 | 58 | 52 | 77 | 70 | 72 | 69 | 58 | 52 | 77 | 70 | 72 | 69 | 58 | 52 |
| | 700 | 318 | | 500 | 227 | 65 | 59 | 59 | 53 | 41 | 37 | 67 | 60 | 59 | 53 | 43 | 43 | 68 | 62 | 60 | 54 | 44 | 47 |
| | 900 | 409 | | 500 | 227 | 69 | 62 | 63 | 58 | 46 | 40 | 69 | 63 | 64 | 59 | 47 | 44 | 70 | 64 | 64 | 59 | 48 | 47 |
| | 1100 | 499 | | 500 | 227 | 72 | 66 | 68 | 63 | 52 | 45 | 73 | 66 | 68 | 63 | 52 | 47 | 73 | 67 | 68 | 63 | 52 | 49 |
| | 1300 | 590 | | 500 | 227 | 75 | 69 | 71 | 67 | 56 | 50 | 76 | 69 | 71 | 67 | 56 | 50 | 76 | 70 | 71 | 67 | 56 | 51 |
| | 900 | 318 | | 750 | 341 | 69 | 62 | 63 | 57 | 46 | 41 | 70 | 64 | 63 | 58 | 47 | 46 | 72 | 66 | 64 | 58 | 48 | 50 |
| | 1100 | 409 | | 750 | 341 | 72 | 66 | 67 | 62 | 50 | 44 | 73 | 66 | 67 | 62 | 51 | 47 | 74 | 68 | 67 | 62 | 52 | 50 |
| | 1300 | 499 | | 750 | 341 | 75 | 69 | 71 | 66 | 55 | 48 | 76 | 69 | 71 | 66 | 55 | 50 | 76 | 70 | 71 | 66 | 55 | 52 |
| DS02 | 700 | 318 | 8X14 | 500 | 227 | 65 | 60 | 60 | 54 | 44 | 40 | 68 | 63 | 62 | 58 | 50 | 46 | 71 | 67 | 65 | 61 | 53 | 50 |
| | 900 | 409 | | 500 | 227 | 69 | 62 | 64 | 59 | 48 | 42 | 70 | 65 | 65 | 60 | 51 | 47 | 72 | 67 | 67 | 62 | 54 | 50 |
| | 1100 | 499 | | 500 | 227 | 72 | 66 | 68 | 63 | 52 | 46 | 73 | 67 | 68 | 64 | 54 | 48 | 74 | 69 | 69 | 65 | 56 | 51 |
| | 1300 | 590 | | 500 | 227 | 75 | 69 | 71 | 67 | 56 | 50 | 76 | 70 | 71 | 67 | 57 | 51 | 76 | 71 | 72 | 68 | 58 | 53 |
| | 900 | 409 | | 750 | 341 | 69 | 63 | 63 | 58 | 49 | 44 | 72 | 67 | 66 | 61 | 54 | 50 | 74 | 70 | 68 | 64 | 57 | 53 |
| | 1100 | 409 | | 750 | 341 | 72 | 66 | 67 | 62 | 52 | 46 | 74 | 68 | 68 | 64 | 55 | 50 | 75 | 71 | 70 | 66 | 58 | 54 |
| | 1300 | 590 | | 750 | 341 | 75 | 69 | 71 | 66 | 55 | 49 | 76 | 70 | 71 | 67 | 57 | 52 | 77 | 72 | 72 | 68 | 59 | 54 |
| | 1100 | 499 | | 1000 | 454 | 72 | 66 | 67 | 62 | 52 | 47 | 75 | 69 | 69 | 65 | 57 | 52 | 77 | 72 | 71 | 67 | 60 | 56 |
| | 1300 | 590 | | 1000 | 454 | 75 | 69 | 70 | 66 | 55 | 49 | 77 | 71 | 71 | 67 | 58 | 53 | 78 | 73 | 73 | 69 | 61 | 56 |

**Notes:**

1. All data are measured in accordance with industry standard AHRI 880-2011.
2. All sound power levels, dB re: 10-12 Watts
3. The air valve pressure drop values shown are for the pressure drop across the air valve only.
4. All acoustic performance data shown is with 1” matte faced insulation and a 6-row sensible cooling coil.

**Table 19. Radiated sound power (dB) — Fan/Valve — 2.0 to 3.0 in air valve**

| Fan Size | Fan Airflow | | Inlet Size in. | Primary Airflow | | 2.0 in. Air Valve Pressure Drop | | | | | | 2.5 in. Air Valve Pressure Drop | | | | | | 3.0 in. Air Valve Pressure Drop | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfm | L/s | | cfm | L/s | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 |
| DS02 | 200 | 91 | 4 | 100 | 45 | 58 | 55 | 51 | 45 | 37 | 37 | 58 | 55 | 51 | 45 | 37 | 38 | 59 | 55 | 51 | 45 | 37 | 41 |
| | 400 | 182 | | 100 | 45 | 59 | 55 | 54 | 49 | 41 | 38 | 60 | 56 | 55 | 49 | 41 | 39 | 60 | 56 | 55 | 49 | 41 | 40 |
| | 600 | 272 | | 100 | 45 | 64 | 59 | 59 | 54 | 45 | 40 | 64 | 59 | 59 | 54 | 45 | 40 | 64 | 59 | 59 | 54 | 45 | 41 |
| | 400 | 182 | | 200 | 91 | 65 | 60 | 56 | 50 | 42 | 43 | 65 | 60 | 56 | 50 | 43 | 45 | 66 | 61 | 56 | 50 | 43 | 45 |
| | 600 | 272 | | 200 | 91 | 66 | 61 | 60 | 54 | 46 | 44 | 67 | 62 | 60 | 54 | 46 | 41 | 67 | 62 | 60 | 54 | 46 | 46 |
| DS02 | 200 | 91 | 5 | 100 | 45 | 58 | 54 | 51 | 44 | 37 | 37 | 58 | 55 | 51 | 45 | 37 | 39 | 59 | 55 | 51 | 45 | 38 | 40 |
| | 400 | 182 | | 100 | 45 | 59 | 55 | 54 | 49 | 41 | 37 | 60 | 55 | 55 | 49 | 41 | 39 | 60 | 55 | 55 | 49 | 41 | 41 |
| | 600 | 272 | | 100 | 45 | 64 | 59 | 59 | 54 | 45 | 40 | 64 | 59 | 59 | 54 | 45 | 40 | 64 | 59 | 59 | 54 | 45 | 41 |
| | 400 | 182 | | 200 | 91 | 64 | 58 | 55 | 49 | 41 | 43 | 65 | 59 | 55 | 50 | 42 | 45 | 66 | 60 | 56 | 50 | 42 | 47 |
| | 600 | 272 | | 200 | 91 | 66 | 60 | 59 | 54 | 45 | 44 | 67 | 61 | 59 | 54 | 46 | 43 | 67 | 61 | 60 | 54 | 46 | 47 |
| | 600 | 272 | | 300 | 136 | 70 | 63 | 60 | 54 | 46 | 50 | 70 | 64 | 60 | 54 | 46 | 50 | 71 | 65 | 60 | 54 | 47 | 52 |
| | 700 | 318 | | 100 | 45 | 66 | 59 | 61 | 56 | 44 | 39 | 66 | 60 | 61 | 56 | 45 | 41 | 66 | 60 | 61 | 56 | 45 | 42 |
| | 900 | 409 | | 100 | 45 | 71 | 63 | 66 | 61 | 50 | 44 | 71 | 63 | 66 | 61 | 50 | 44 | 71 | 63 | 66 | 61 | 50 | 45 |
| | 1100 | 499 | | 100 | 45 | 74 | 67 | 69 | 66 | 55 | 49 | 74 | 67 | 69 | 66 | 55 | 49 | 74 | 67 | 69 | 66 | 55 | 49 |
| | 1300 | 590 | | 100 | 45 | 77 | 71 | 72 | 69 | 59 | 53 | 77 | 71 | 72 | 69 | 59 | 53 | 77 | 71 | 72 | 69 | 59 | 53 |
| | 700 | 318 | | 200 | 91 | 67 | 61 | 61 | 55 | 44 | 44 | 68 | 61 | 61 | 56 | 45 | 45 | 68 | 62 | 61 | 56 | 45 | 47 |
| | 900 | 409 | | 200 | 91 | 71 | 64 | 65 | 61 | 50 | 46 | 71 | 64 | 65 | 61 | 50 | 7 | 71 | 64 | 65 | 61 | 50 | 48 |
| | 1100 | 499 | | 200 | 91 | 74 | 67 | 69 | 65 | 54 | 49 | 74 | 67 | 69 | 65 | 54 | 50 | 74 | 67 | 69 | 65 | 54 | 50 |
| | 1300 | 590 | | 200 | 91 | 77 | 71 | 72 | 69 | 58 | 53 | 77 | 71 | 72 | 69 | 58 | 53 | 77 | 71 | 72 | 69 | 58 | 54 |
| | 700 | 318 | | 300 | 136 | 70 | 63 | 61 | 55 | 46 | 48 | 71 | 64 | 61 | 56 | 46 | 50 | 71 | 65 | 62 | 56 | 47 | 51 |
| | 900 | 409 | | 300 | 136 | 72 | 65 | 65 | 60 | 49 | 49 | 72 | 66 | 65 | 60 | 50 | 50 | 73 | 66 | 65 | 61 | 50 | 52 |
| | 1100 | 499 | | 300 | 136 | 74 | 68 | 69 | 65 | 54 | 50 | 75 | 68 | 69 | 65 | 54 | 51 | 75 | 68 | 69 | 65 | 54 | 53 |
| | 1300 | 590 | | 300 | 136 | 77 | 70 | 72 | 68 | 58 | 53 | 77 | 71 | 72 | 68 | 58 | 54 | 77 | 71 | 72 | 68 | 58 | 55 |

**Table 19. Radiated sound power (dB) — Fan/Valve — 2.0 to 3.0 in air valve (continued)**

| Fan Size | Fan Airflow | | Inlet Size in. | Primary Airflow | | 2.0 in. Air Valve Pressure Drop | | | | | | 2.5 in. Air Valve Pressure Drop | | | | | | 3.0 in. Air Valve Pressure Drop | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfm | L/s | | cfm | L/s | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 |
| DS02 | 200 | 91 | 6 | 100 | 45 | 58 | 54 | 51 | 45 | 37 | 37 | 58 | 55 | 51 | 45 | 38 | 39 | 59 | 55 | 51 | 45 | 38 | 41 |
| | 400 | 182 | | 100 | 45 | 59 | 55 | 54 | 49 | 41 | 36 | 59 | 55 | 55 | 49 | 41 | 40 | 59 | 56 | 55 | 49 | 41 | 41 |
| | 600 | 272 | | 100 | 45 | 64 | 59 | 59 | 54 | 45 | 42 | 64 | 59 | 59 | 54 | 45 | 43 | 64 | 59 | 59 | 54 | 45 | 45 |
| | 400 | 182 | | 200 | 91 | 63 | 58 | 55 | 49 | 41 | 43 | 64 | 59 | 56 | 49 | 42 | 45 | 65 | 60 | 56 | 50 | 42 | 47 |
| | 600 | 272 | | 200 | 91 | 66 | 60 | 59 | 54 | 45 | 44 | 66 | 61 | 59 | 54 | 46 | 45 | 66 | 61 | 60 | 54 | 46 | 47 |
| | 600 | 272 | | 300 | 136 | 68 | 62 | 60 | 54 | 46 | 47 | 69 | 63 | 60 | 54 | 46 | 49 | 69 | 64 | 60 | 54 | 46 | 51 |
| | 600 | 272 | | 400 | 182 | 70 | 64 | 60 | 54 | 46 | 50 | 71 | 65 | 61 | 54 | 46 | 52 | 72 | 66 | 61 | 55 | 47 | 53 |
| | 700 | 318 | | 200 | 91 | 67 | 61 | 61 | 55 | 44 | 43 | 67 | 61 | 61 | 56 | 45 | 45 | 68 | 62 | 61 | 56 | 45 | 47 |
| | 900 | 409 | | 200 | 91 | 70 | 63 | 65 | 61 | 49 | 45 | 71 | 64 | 65 | 61 | 50 | 47 | 71 | 64 | 65 | 61 | 50 | 48 |
| | 1100 | 499 | | 200 | 91 | 74 | 67 | 69 | 65 | 54 | 49 | 74 | 67 | 69 | 65 | 54 | 49 | 74 | 67 | 69 | 65 | 54 | 50 |
| | 1300 | 590 | | 200 | 91 | 77 | 71 | 72 | 69 | 58 | 53 | 77 | 71 | 72 | 69 | 58 | 53 | 77 | 71 | 72 | 69 | 58 | 54 |
| | 700 | 318 | | 300 | 136 | 69 | 62 | 61 | 55 | 45 | 47 | 69 | 63 | 61 | 56 | 46 | 49 | 70 | 64 | 62 | 56 | 46 | 50 |
| | 900 | 409 | | 300 | 136 | 71 | 64 | 65 | 60 | 49 | 47 | 71 | 65 | 65 | 60 | 49 | 49 | 72 | 66 | 65 | 60 | 50 | 51 |
| | 1100 | 499 | | 300 | 136 | 74 | 67 | 69 | 65 | 54 | 49 | 74 | 68 | 69 | 65 | 54 | 51 | 74 | 68 | 69 | 65 | 54 | 52 |
| | 1300 | 590 | | 300 | 136 | 77 | 70 | 72 | 68 | 58 | 53 | 77 | 71 | 72 | 68 | 58 | 53 | 77 | 71 | 72 | 68 | 58 | 54 |
| | 700 | 318 | | 400 | 182 | 70 | 64 | 61 | 55 | 46 | 49 | 71 | 66 | 62 | 65 | 47 | 52 | 72 | 67 | 62 | 57 | 48 | 53 |
| | 900 | 409 | | 400 | 182 | 72 | 66 | 65 | 60 | 49 | 50 | 73 | 66 | 65 | 60 | 49 | 52 | 73 | 67 | 65 | 60 | 50 | 53 |
| | 1100 | 499 | | 400 | 182 | 74 | 68 | 68 | 64 | 53 | 51 | 75 | 68 | 68 | 64 | 53 | 52 | 75 | 69 | 69 | 64 | 53 | 54 |
| | 1300 | 590 | | 400 | 182 | 77 | 70 | 71 | 68 | 57 | 53 | 77 | 71 | 72 | 68 | 57 | 54 | 77 | 71 | 72 | 68 | 57 | 55 |

Table 19. Radiated sound power (dB) — Fan/Valve — 2.0 to 3.0 in air valve (continued)

| Fan Size | Fan Airflow | | Inlet Size in. | Primary Airflow | | 2.0 in. Air Valve Pressure Drop | | | | | | 2.5 in. Air Valve Pressure Drop | | | | | | 3.0 in. Air Valve Pressure Drop | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfm | L/s | | cfm | L/s | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 |
| DS02 | 400 | 182 | 8 | 200 | 91 | 61 | 57 | 55 | 49 | 41 | 44 | 62 | 57 | 55 | 49 | 42 | 46 | 62 | 58 | 55 | 50 | 43 | 48 |
| | 600 | 272 | | 200 | 91 | 64 | 60 | 59 | 54 | 45 | 44 | 65 | 60 | 59 | 54 | 46 | 46 | 65 | 60 | 59 | 54 | 46 | 48 |
| | 600 | 272 | | 300 | 136 | 66 | 61 | 59 | 54 | 45 | 46 | 66 | 61 | 59 | 54 | 45 | 46 | 67 | 62 | 60 | 54 | 46 | 50 |
| | 600 | 272 | | 400 | 182 | 67 | 62 | 59 | 54 | 46 | 48 | 68 | 63 | 60 | 54 | 46 | 50 | 69 | 64 | 60 | 54 | 47 | 52 |
| | 600 | 272 | | 500 | 227 | 69 | 63 | 60 | 54 | 46 | 50 | 70 | 64 | 60 | 54 | 47 | 52 | 71 | 65 | 61 | 55 | 47 | 54 |
| | 700 | 318 | | 250 | 114 | 66 | 60 | 61 | 55 | 44 | 45 | 66 | 61 | 61 | 55 | 45 | 47 | 67 | 61 | 61 | 56 | 46 | 49 |
| | 900 | 409 | | 250 | 114 | 70 | 63 | 65 | 60 | 49 | 46 | 70 | 63 | 65 | 60 | 49 | 48 | 70 | 64 | 65 | 60 | 50 | 50 |
| | 1100 | 499 | | 250 | 114 | 74 | 67 | 69 | 65 | 54 | 49 | 74 | 67 | 69 | 65 | 54 | 50 | 74 | 67 | 69 | 65 | 54 | 51 |
| | 1300 | 590 | | 250 | 114 | 77 | 70 | 72 | 69 | 58 | 53 | 77 | 70 | 72 | 69 | 58 | 53 | 77 | 70 | 72 | 69 | 58 | 54 |
| | 700 | 318 | | 500 | 227 | 69 | 63 | 60 | 55 | 46 | 50 | 70 | 65 | 61 | 55 | 47 | 52 | 71 | 66 | 62 | 56 | 48 | 54 |
| | 900 | 409 | | 500 | 227 | 71 | 65 | 64 | 59 | 48 | 50 | 71 | 66 | 64 | 59 | 49 | 52 | 72 | 67 | 65 | 60 | 50 | 54 |
| | 1100 | 499 | | 500 | 227 | 73 | 67 | 68 | 63 | 52 | 51 | 74 | 68 | 68 | 63 | 53 | 53 | 74 | 68 | 68 | 64 | 53 | 54 |
| | 1300 | 590 | | 500 | 227 | 76 | 70 | 71 | 67 | 56 | 53 | 76 | 70 | 71 | 67 | 57 | 54 | 76 | 71 | 71 | 67 | 57 | 55 |
| | 900 | 318 | | 750 | 341 | 73 | 67 | 64 | 59 | 50 | 53 | 74 | 68 | 65 | 60 | 51 | 55 | 75 | 69 | 65 | 60 | 52 | 57 |
| | 1100 | 409 | | 750 | 341 | 74 | 68 | 68 | 63 | 52 | 53 | 75 | 69 | 68 | 63 | 53 | 55 | 76 | 70 | 68 | 63 | 53 | 57 |
| | 1300 | 499 | | 750 | 341 | 76 | 71 | 71 | 66 | 56 | 54 | 77 | 71 | 71 | 67 | 56 | 56 | 77 | 72 | 71 | 67 | 56 | 57 |
| DS02 | 700 | 318 | 8X14 | 500 | 227 | 73 | 69 | 68 | 63 | 56 | 52 | 74 | 71 | 70 | 66 | 58 | 54 | 76 | 73 | 71 | 67 | 60 | 56 |
| | 900 | 409 | | 500 | 227 | 73 | 70 | 69 | 64 | 56 | 53 | 75 | 71 | 70 | 66 | 58 | 55 | 76 | 73 | 72 | 68 | 60 | 56 |
| | 1100 | 499 | | 500 | 227 | 75 | 70 | 70 | 66 | 57 | 53 | 76 | 72 | 72 | 67 | 59 | 55 | 77 | 73 | 73 | 69 | 61 | 56 |
| | 1300 | 590 | | 500 | 227 | 77 | 72 | 72 | 69 | 59 | 54 | 78 | 73 | 73 | 69 | 60 | 56 | 78 | 74 | 74 | 70 | 61 | 57 |
| | 900 | 409 | | 750 | 341 | 76 | 72 | 71 | 67 | 60 | 56 | 78 | 74 | 73 | 69 | 62 | 58 | 79 | 76 | 75 | 71 | 64 | 60 |
| | 1100 | 409 | | 750 | 341 | 77 | 73 | 72 | 68 | 60 | 56 | 78 | 75 | 73 | 70 | 62 | 58 | 79 | 76 | 75 | 71 | 64 | 60 |
| | 1300 | 590 | | 750 | 341 | 78 | 74 | 73 | 69 | 61 | 57 | 79 | 75 | 75 | 71 | 63 | 58 | 80 | 77 | 76 | 72 | 64 | 60 |
| | 1100 | 499 | | 1000 | 454 | 79 | 74 | 73 | 69 | 62 | 59 | 80 | 76 | 75 | 71 | 65 | 61 | 81 | 78 | 77 | 73 | 66 | 62 |
| | 1300 | 590 | | 1000 | 454 | 79 | 75 | 74 | 70 | 63 | 59 | 81 | 77 | 76 | 72 | 65 | 61 | 82 | 78 | 77 | 73 | 66 | 62 |

**Notes:**

1. All data are measured in accordance with industry standard AHRI 880-2011.
2. All sound power levels, dB re: 10-12 Watts
3. The air valve pressure drop values shown are for the pressure drop across the air valve only.
4. All acoustic performance data shown is with 1” matte faced insulation and a 6-row sensible cooling coil.

Table 20. Sound noise criteria — fan/valve

| Fan Size | Fan Airflow | | Inlet Size | Primary Airflow | | Discharge Air Valve Pressure Drop | | | | | | Radiated Air Valve Pressure Drop | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfm | L/s | in | cfm | L/s | 0.5” | 1.0” | 1.5” | 2.0” | 2.5” | 3.0” | 0.5” | 1.0” | 1.5” | 2.0” | 2.5” | 3.0” |
| DS02 | 200 | 91 | 4 | 100 | 45 | 19(2) | 19(2) | 19(2) | 19(2) | 19(2) | 19(2) | 24(4) | 24(4) | 25(4) | 25(4) | 25(4) | 25(4) |
| | 400 | 182 | | 100 | 45 | 18(3) | 18(3) | 18(3) | 18(3) | 18(3) | 18(3) | 29(4) | 29(4) | 29(4) | 29(4) | 29(4) | 29(4) |
| | 600 | 272 | | 100 | 45 | 25(2) | 25(2) | 25(2) | 25(2) | 25(2) | 25(2) | 34(4) | 34(4) | 34(4) | 34(4) | 34(4) | 34(4) |
| | 400 | 182 | | 200 | 91 | 19(2) | 20(2) | 20(2) | 21(2) | 21(2) | 21(2) | 29(4) | 29(4) | 30(4) | 30(4) | 31(4) | 31(4) |
| | 600 | 272 | | 200 | 91 | 25(2) | 26(2) | 26(2) | 26(2) | 26(2) | 26(2) | 34(4) | 34(4) | 34(4) | 34(4) | 35(4) | 35(4) |
| DS02 | 200 | 91 | 5 | 100 | 45 | 19(2) | 19(2) | 19(2) | 19(2) | 19(2) | 19(2) | 24(4) | 24(4) | 25(4) | 25(4) | 25(4) | 25(4) |
| | 400 | 182 | | 100 | 45 | 18(3) | 18(3) | 18(3) | 18(3) | 18(3) | 18(3) | 29(4) | 29(4) | 29(4) | 29(4) | 29(4) | 29(4) |
| | 600 | 272 | | 100 | 45 | 25(2) | 25(2) | 25(2) | 25(2) | 25(2) | 25(2) | 34(4) | 34(4) | 34(4) | 34(4) | 34(4) | 34(4) |
| | 400 | 182 | | 200 | 91 | 19(2) | 19(2) | 20(2) | 20(2) | 20(2) | 21(2) | 29(4) | 29(4) | 29(4) | 30(4) | 30(4) | 30(4) |
| | 600 | 272 | | 200 | 91 | 25(2) | 25(2) | 25(2) | 25(2) | 25(2) | 25(2) | 34(4) | 34(4) | 34(4) | 34(4) | 34(4) | 34(4) |
| | 600 | 272 | | 300 | 136 | 27(2) | 27(2) | 28(2) | 28(2) | 28(2) | 29(2) | 34(4) | 34(4) | 34(4) | 35(2) | 36(2) | 37(2) |
| | 700 | 318 | | 100 | 45 | 28(3) | 28(3) | 28(3) | 28(3) | 28(3) | 28(3) | 36(4) | 36(4) | 36(4) | 36(4) | 36(4) | 37(4) |
| | 900 | 409 | | 100 | 45 | 32(3) | 32(3) | 32(3) | 32(3) | 32(3) | 32(3) | 41(4) | 41(4) | 41(4) | 41(4) | 41(4) | 41(4) |
| | 1100 | 499 | | 100 | 45 | 38(3) | 38(3) | 38(3) | 38(3) | 38(3) | 38(3) | 45(4) | 45(4) | 45(4) | 45(4) | 45(4) | 45(4) |
| | 1300 | 590 | | 100 | 45 | 42(3) | 42(3) | 42(3) | 42(3) | 42(3) | 42(3) | 48(4) | 48(4) | 48(4) | 48(4) | 48(4) | 48(4) |
| | 700 | 318 | | 200 | 91 | 27(3) | 27(3) | 27(3) | 27(3) | 27(3) | 27(3) | 36(4) | 36(4) | 36(4) | 36(4) | 36(4) | 36(4) |
| | 900 | 409 | | 200 | 91 | 31(3) | 31(3) | 31(3) | 31(3) | 31(3) | 31(3) | 40(4) | 40(4) | 40(4) | 40(4) | 40(4) | 40(4) |
| | 1100 | 499 | | 200 | 91 | 37(3) | 37(3) | 37(3) | 37(3) | 37(3) | 37(3) | 45(4) | 45(4) | 45(4) | 45(4) | 45(4) | 45(4) |
| | 1300 | 590 | | 200 | 91 | 42(3) | 42(3) | 42(3) | 42(3) | 42(3) | 42(3) | 48(4) | 48(4) | 48(4) | 48(4) | 48(4) | 48(4) |
| | 700 | 318 | | 300 | 136 | 27(2) | 27(2) | 28(2) | 28(2) | 28(2) | 29(2) | 35(4) | 35(4) | 36(4) | 36(4) | 36(4) | 37(2) |
| | 900 | 409 | | 300 | 136 | 31(3) | 31(3) | 31(3) | 31(3) | 31(3) | 31(3) | 40(4) | 40(4) | 40(4) | 40(4) | 40(4) | 41(4) |
| | 1100 | 499 | | 300 | 136 | 36(3) | 36(3) | 36(3) | 36(3) | 36(3) | 36(3) | 44(4) | 44(4) | 44(4) | 44(4) | 44(4) | 44(4) |
| | 1300 | 590 | | 300 | 136 | 41(3) | 41(3) | 41(3) | 41(3) | 41(3) | 41(3) | 48(4) | 48(4) | 48(4) | 48(4) | 48(4) | 48(4) |

**Table 20. Sound noise criteria — fan/valve (continued)**

| Fan Size | Fan Airflow | | Inlet Size | Primary Airflow | | Discharge Air Valve Pressure Drop | | | | | | Radiated Air Valve Pressure Drop | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfm | L/s | in | cfm | L/s | 0.5” | 1.0” | 1.5” | 2.0” | 2.5” | 3.0” | 0.5” | 1.0” | 1.5” | 2.0” | 2.5” | 3.0” |
| DS02 | 200 | 91 | 6 | 100 | 45 | 19(2) | 19(2) | 19(2) | 19(2) | 20(2) | 20(2) | 24(4) | 24(4) | 25(4) | 25(4) | 25(4) | 26(4) |
| | 400 | 182 | | 100 | 45 | 18(3) | 18(3) | 18(3) | 18(3) | 18(3) | 19(3) | 29(4) | 29(4) | 29(4) | 29(4) | 29(4) | 29(4) |
| | 600 | 272 | | 100 | 45 | 25(2) | 25(2) | 25(2) | 25(2) | 25(2) | 25(2) | 34(4) | 34(4) | 34(4) | 34(4) | 34(4) | 34(4) |
| | 400 | 182 | | 200 | 91 | 18(3) | 19(2) | 20(2) | 21(2) | 21(2) | 22(2) | 29(4) | 29(4) | 29(4) | 30(4) | 30(4) | 31(4) |
| | 600 | 272 | | 200 | 91 | 25(2) | 25(2) | 25(2) | 26(2) | 26(2) | 26(2) | 34(4) | 34(4) | 34(4) | 34(4) | 34(4) | 35(4) |
| | 600 | 272 | | 300 | 136 | 26(2) | 26(2) | 27(2) | 28(2) | 28(2) | 29(2) | 34(4) | 34(4) | 34(4) | 35(2) | 36(2) | 37(2) |
| | 600 | 272 | | 400 | 182 | 26(2) | 28(2) | 29(2) | 29(2) | 30(2) | 31(2) | 33(4) | 34(4) | 35(2) | 36(2) | 37(2) | 38(2) |
| | 700 | 318 | | 200 | 91 | 27(3) | 27(3) | 27(3) | 27(2) | 27(2) | 27(2) | 36(4) | 36(4) | 36(4) | 36(4) | 36(4) | 36(4) |
| | 900 | 409 | | 200 | 91 | 31(3) | 31(3) | 31(3) | 31(3) | 32(3) | 32(3) | 40(4) | 40(4) | 41(4) | 41(4) | 41(4) | 41(4) |
| | 1100 | 499 | | 200 | 91 | 37(3) | 37(3) | 37(3) | 37(3) | 37(3) | 37(3) | 45(4) | 45(4) | 45(4) | 45(4) | 45(4) | 45(4) |
| | 1300 | 590 | | 200 | 91 | 42(3) | 42(3) | 42(3) | 42(3) | 42(3) | 42(3) | 48(4) | 48(4) | 48(4) | 48(4) | 48(4) | 48(4) |
| | 700 | 318 | | 300 | 136 | 26(3) | 26(2) | 27(2) | 28(2) | 28(2) | 29(2) | 35(4) | 35(4) | 36(4) | 36(4) | 36(4) | 37(2) |
| | 900 | 409 | | 300 | 136 | 31(3) | 31(3) | 31(3) | 31(3) | 31(3) | 31(3) | 40(4) | 40(4) | 40(4) | 40(4) | 40(4) | 41(4) |
| | 1100 | 499 | | 300 | 136 | 36(3) | 36(3) | 36(3) | 36(3) | 36(3) | 36(3) | 44(4) | 44(4) | 44(4) | 44(4) | 44(4) | 44(4) |
| | 1300 | 590 | | 300 | 136 | 41(3) | 41(3) | 41(3) | 41(3) | 41(3) | 41(3) | 48(4) | 48(4) | 48(4) | 48(4) | 48(4) | 48(4) |
| | 700 | 318 | | 400 | 182 | 26(2) | 27(2) | 28(2) | 29(2) | 30(2) | 31(2) | 34(4) | 35(4) | 35(4) | 36(4) | 37(4) | 38(4) |
| | 900 | 409 | | 400 | 182 | 30(3) | 30(3) | 30(3) | 31(3) | 31(3) | 31(3) | 39(4) | 39(4) | 40(4) | 40(4) | 40(4) | 41(4) |
| | 1100 | 499 | | 400 | 182 | 35(3) | 35(3) | 35(3) | 35(3) | 35(3) | 35(3) | 44(4) | 44(4) | 44(4) | 44(4) | 44(4) | 44(4) |
| | 1300 | 590 | | 400 | 182 | 40(3) | 40(3) | 40(3) | 40(3) | 40(3) | 40(3) | 47(4) | 47(4) | 47(4) | 47(4) | 48(4) | 48(4) |

Table 20. Sound noise criteria — fan/valve (continued)

| Fan Size | Fan Airflow | | Inlet Size | Primary Airflow | | Discharge Air Valve Pressure Drop | | | | | | Radiated Air Valve Pressure Drop | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfm | L/s | in | cfm | L/s | 0.5” | 1.0” | 1.5” | 2.0” | 2.5” | 3.0” | 0.5” | 1.0” | 1.5” | 2.0” | 2.5” | 3.0” |
| DS02 | 400 | 182 | 8 | 200 | 91 | 18(3) | 18(3) | 19(2) | 20(2) | 20(2) | 21(2) | 28(4) | 29(4) | 29(4) | 29(4) | 30(4) | 30(4) |
| | 600 | 272 | | 200 | 91 | 25(2) | 25(2) | 25(2) | 25(2) | 25(2) | 25(2) | 34(4) | 34(4) | 34(4) | 34(4) | 34(4) | 34(4) |
| | 600 | 272 | | 300 | 136 | 25(2) | 26(2) | 26(2) | 27(2) | 27(2) | 28(2) | 34(4) | 34(4) | 34(4) | 34(4) | 34(4) | 35(2) |
| | 600 | 272 | | 400 | 182 | 26(2) | 27(2) | 28(2) | 28(2) | 29(2) | 29(2) | 33(4) | 34(4) | 35(2) | 35(2) | 35(2) | 35(2) |
| | 600 | 272 | | 500 | 277 | 26(2) | 28(2) | 29(2) | 29(2) | 30(2) | 31(2) | 33(4) | 34(4) | 34(4) | 35(2) | 35(2) | 36(2) |
| | 700 | 318 | | 250 | 114 | 26(3) | 26(3) | 26(3) | 27(3) | 27(3) | 27(2) | 35(4) | 35(4) | 35(4) | 36(4) | 36(4) | 36(4) |
| | 900 | 409 | | 250 | 114 | 31(3) | 31(3) | 31(3) | 31(3) | 31(3) | 31(3) | 40(4) | 40(4) | 40(4) | 40(4) | 40(4) | 40(4) |
| | 1100 | 499 | | 250 | 114 | 36(3) | 36(3) | 36(3) | 36(3) | 36(3) | 37(3) | 44(4) | 44(4) | 44(4) | 44(4) | 44(4) | 44(4) |
| | 1300 | 590 | | 250 | 114 | 41(3) | 41(3) | 41(3) | 41(3) | 41(3) | 41(3) | 48(4) | 48(4) | 48(4) | 48(4) | 48(4) | 48(4) |
| | 700 | 318 | | 500 | 227 | 25(2) | 27(2) | 28(2) | 29(2) | 30(2) | 31(2) | 34(4) | 34(4) | 35(4) | 35(4) | 36(4) | 37(4) |
| | 900 | 409 | | 500 | 227 | 29(3) | 30(3) | 30(3) | 30(3) | 31(3) | 31(3) | 39(4) | 39(4) | 39(4) | 39(4) | 40(4) | 40(4) |
| | 1100 | 499 | | 500 | 227 | 35(3) | 35(3) | 35(3) | 35(3) | 35(3) | 35(3) | 43(4) | 43(4) | 43(4) | 43(4) | 44(4) | 44(4) |
| | 1300 | 590 | | 500 | 227 | 40(3) | 40(3) | 40(3) | 40(3) | 40(3) | 40(3) | 47(4) | 47(4) | 47(4) | 47(4) | 47(4) | 47(4) |
| | 900 | 318 | | 750 | 341 | 29(3) | 29(2) | 31(2) | 32(2) | 32(2) | 33(2) | 38(4) | 38(4) | 39(4) | 40(4) | 40(4) | 41(2) |
| | 1100 | 409 | | 750 | 341 | 34(3) | 34(3) | 34(3) | 35(2) | 35(2) | 36(2) | 42(4) | 43(4) | 43(4) | 43(4) | 43(4) | 44(4) |
| | 1300 | 499 | | 750 | 341 | 39(3) | 39(3) | 39(3) | 39(3) | 39(3) | 40(3) | 46(4) | 46(4) | 47(4) | 47(4) | 47(4) | 47(4) |
| DS02 | 700 | 318 | 8X14 | 500 | 227 | 25(3) | 25(3) | 26(2) | 27(2) | 29(2) | 30(2) | 34(4) | 37(4) | 41(4) | 43(4) | 46(4) | 47(4) |
| | 900 | 409 | | 500 | 227 | 29(3) | 30(3) | 30(3) | 30(3) | 30(3) | 31(3) | 39(4) | 40(4) | 42(4) | 44(4) | 46(4) | 48(4) |
| | 1100 | 499 | | 500 | 227 | 35(3) | 35(3) | 35(3) | 35(3) | 35(3) | 35(3) | 43(4) | 44(4) | 45(4) | 46(4) | 48(4) | 49(4) |
| | 1300 | 590 | | 500 | 227 | 40(3) | 40(3) | 40(3) | 40(3) | 40(3) | 40(3) | 47(4) | 47(4) | 48(4) | 49(4) | 49(4) | 50(4) |
| | 900 | 409 | | 750 | 341 | 29(3) | 29(3) | 29(3) | 30(3) | 31(2) | 32(2) | 39(4) | 41(4) | 44(4) | 47(4) | 49(4) | 51(4) |
| | 1100 | 409 | | 750 | 341 | 34(3) | 34(3) | 34(3) | 34(3) | 35(3) | 35(3) | 43(4) | 44(4) | 46(4) | 48(4) | 50(4) | 51(4) |
| | 1300 | 590 | | 750 | 341 | 39(3) | 39(3) | 39(3) | 39(3) | 39(3) | 39(3) | 47(4) | 47(4) | 48(4) | 49(4) | 51(4) | 52(4) |
| | 1100 | 499 | | 1000 | 454 | 34(3) | 34(3) | 34(3) | 35(2) | 35(2) | 36(2) | 43(4) | 44(4) | 47(4) | 49(4) | 51(4) | 53(4) |
| | 1300 | 590 | | 1000 | 454 | 39(3) | 39(3) | 39(3) | 39(3) | 39(3) | 40(2) | 46(4) | 47(4) | 49(4) | 50(4) | 52(4) | 54(4) |

**Notes:**

1. NC values are calculated using modeling assumption based on AHRI 880-98-02.
2. All sound power levels, dB re: 10-12 Watts
3. The air valve pressure drop values shown are for the pressure drop across the air valve only.
4. All acoustic performance data shown is with 1” matte faced insulation and a 6-row sensible cooling coil.

### Table 21. Fan only sound power (dB)

| Fan | Fan Airflow | | Discharge Octave Bands | | | | | | Radiated Octave Bands | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfm | L/s | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 3 | 4 | 5 | 6 | 7 |
| DS02 | 200 | 91 | 64 | 58 | 55 | 51 | 45 | 41 | 57 | 54 | 51 | 44 | 36 | 27 |
| | 400 | 182 | 66 | 61 | 59 | 57 | 51 | 48 | 59 | 55 | 55 | 49 | 41 | 31 |
| | 600 | 272 | 71 | 66 | 65 | 63 | 58 | 56 | 63 | 59 | 59 | 54 | 46 | 37 |
| | 700 | 318 | 71 | 67 | 66 | 62 | 58 | 56 | 64 | 58 | 60 | 54 | 42 | 34 |
| | 900 | 409 | 76 | 72 | 71 | 68 | 65 | 63 | 69 | 62 | 64 | 60 | 48 | 41 |
| | 1100 | 499 | 80 | 76 | 75 | 73 | 70 | 69 | 73 | 66 | 68 | 64 | 53 | 47 |
| | 1300 | 590 | 84 | 81 | 79 | 78 | 75 | 74 | 76 | 70 | 72 | 68 | 58 | 51 |

### Table 22. AHRI 885-2008 add discharge transfer function assumptions

| | Octave Band | | | | | |
|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | 5 | 6 | 7 |
| Small Box (< 300 CFM) | -24 | -28 | -39 | -53 | -59 | -40 |
| Medium Box (300-700 CFM) | -27 | -29 | -40 | -51 | -53 | -39 |
| Large Box (> 700 CFM) | -29 | -30 | -41 | -51 | -52 | -39 |

**Notes:**

1. Subtract from terminal unit sound power to determine discharge sound pressure in the space.
2. NC Values are calculated using current Industry Standard AHRI 885-2008. Radiated Transfer Function obtained from Appendix E, Type 2 Mineral Fiber Insulation.
3. Application ratings are outside the scope of the Certification Program.

### Table 23. AHRI 885-2008 radiated transfer function assumptions

| | Octave Band | | | | | |
|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | 5 | 6 | 7 |
| Type 2- Mineral Fiber Insulation | -18 | -19 | -20 | -26 | -31 | -36 |
| Total dB reduction | -18 | -19 | -20 | -26 | -31 | -36 |

**Notes:**

1. Subtract from terminal unit sound power to determine discharge sound pressure in the space.
2. NC Values are calculated using current Industry Standard AHRI 885-2008. Radiated Transfer Function obtained from Appendix E, Type 2 Mineral Fiber Insulation.
3. Application ratings are outside the scope of the Certification Program.

# DDC Controls

## Controllers

DDC controllers are today’s industry standard. DDC controllers provide system-level data used to optimize system performance. Variables such as occupied/unoccupied status, minimum and maximum primary and fan airflow setpoints, current zone temperature and temperature setpoints, valve position, fan status (on or off, and mode of operation), heat status (on or off), and air valve size, temperature correction offsets, flow correction values, etc. are available on a simple twisted-shielded wire pair or communicated wirelessly.

Trane® DDC controllers provide Trane-designed, solid-state electronics intended specifically for terminal unit control in space comfort applications.

DDC control capabilities include:

- Pressure-independent (PI) operation, which automatically adjusts valve position to maintain required ventilation airflow. In certain low-flow situations or in cases where the flow measurement has failed, the DDC controller will operate in a pressure-dependent (PD) mode of operation.
- Multiple heating control options including staged electric, modulating hot-water, and modulating electric heat (SCR). Modulating heat options utilize a separate proportional-plus-integral control loop from that controlling airflow into the room. Staged heat options utilize a control algorithm based on heating setpoint and room temperature.
- 24 VAC binary input that can be configured as a generic input or as occupancy input. When the DDC controller is operation with Tracer® SC, the status of the input is provided to Tracer® SC for its action. In stand-alone operation and when configured for an occupancy input, the input will control occupancy status of the DDC controller.

**Figure 11. Flow sensor single vs. airflow delivery**

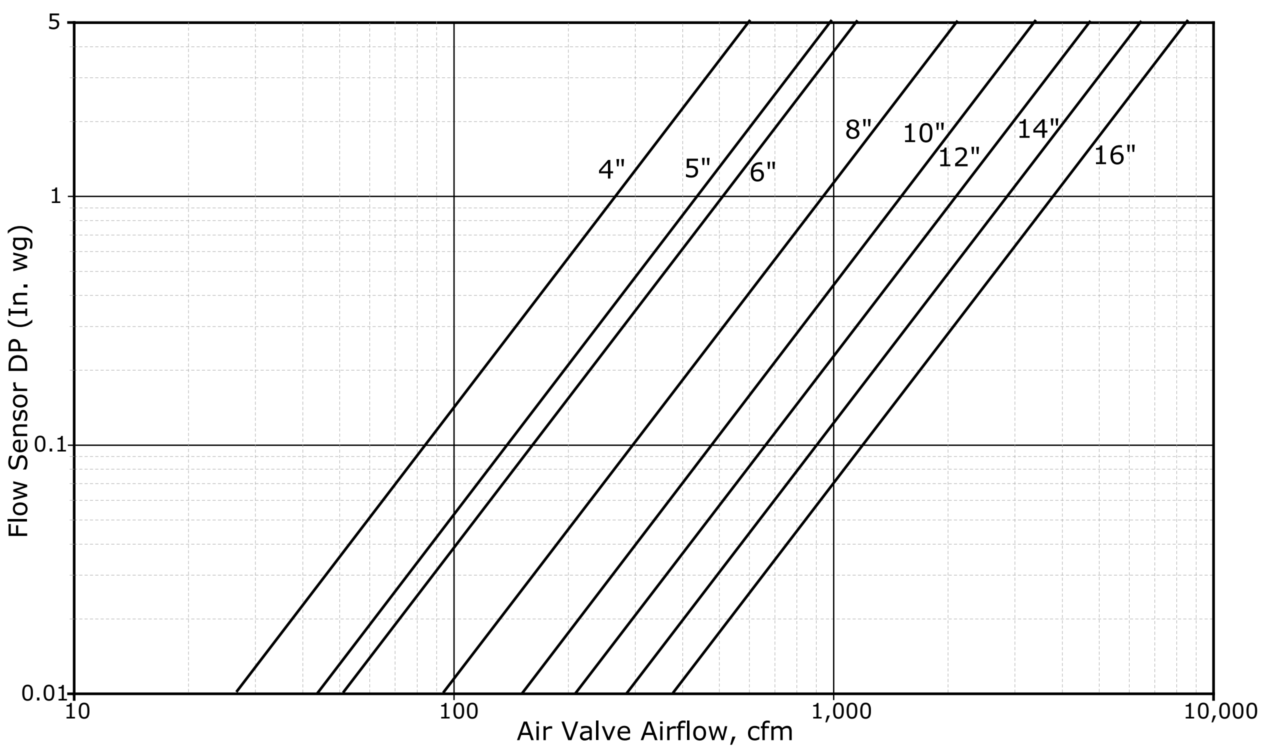
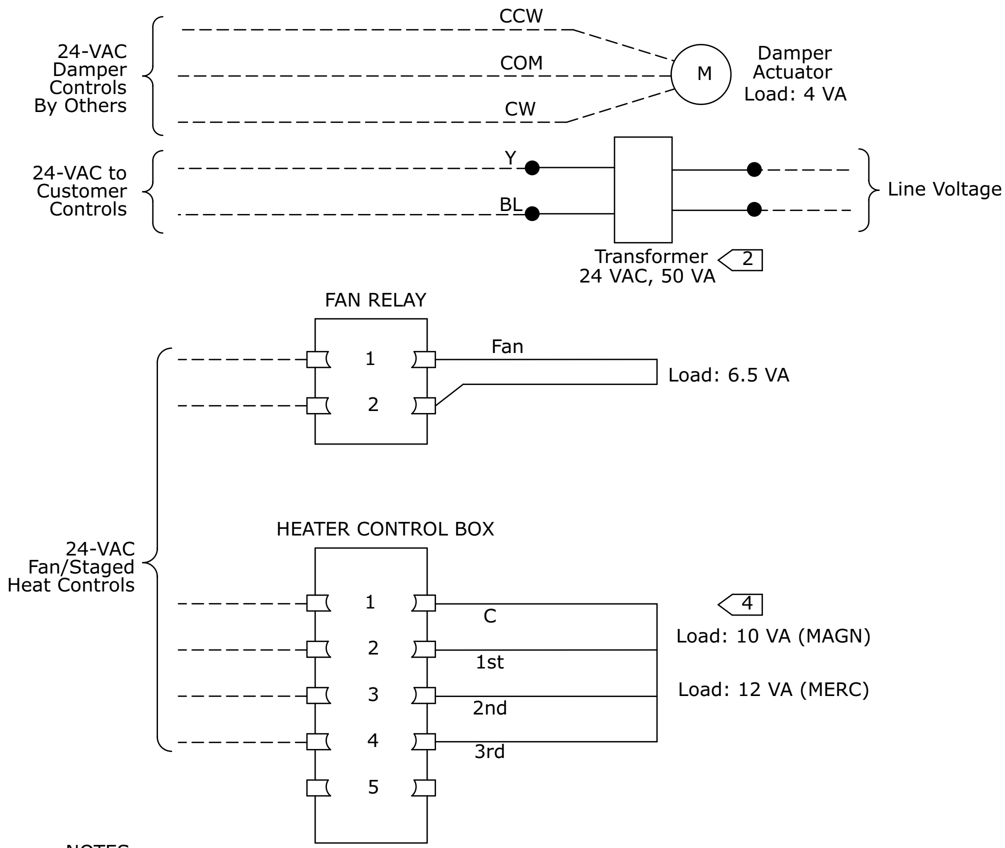


**Figure 12. Actuator — field installed DDC Controls (DD00)**

DD00 — Available for all Chilled Water Sensible Cooling Units

(Trane actuator for field-installed DDC controls)

A unit controller is not provided. The air damper actuator is provided with an integral screw terminal block. The fan contactor, 24-VAC control power transformer, and factory-installed electric heater contactor wires are attached to the outside of the unit for field connection of controls.




NOTES:

1. ——— Factory-installed
   – – – – Field Wiring
   —— – – —— Optional or installed by others

2. Located in Heater Terminal Box for electric heat.
   Located in Control Box for cooling only and hot water heat.
   Located in Control Box.

3. Not used.

4. Located in Heater Terminal box.

***Note:*** *Flow sensor DP (in. wg) is measured at the flow ring to aid in system balancing and commissioning. See “Valve/Controller Airflow Guidelines” for unit performance.*

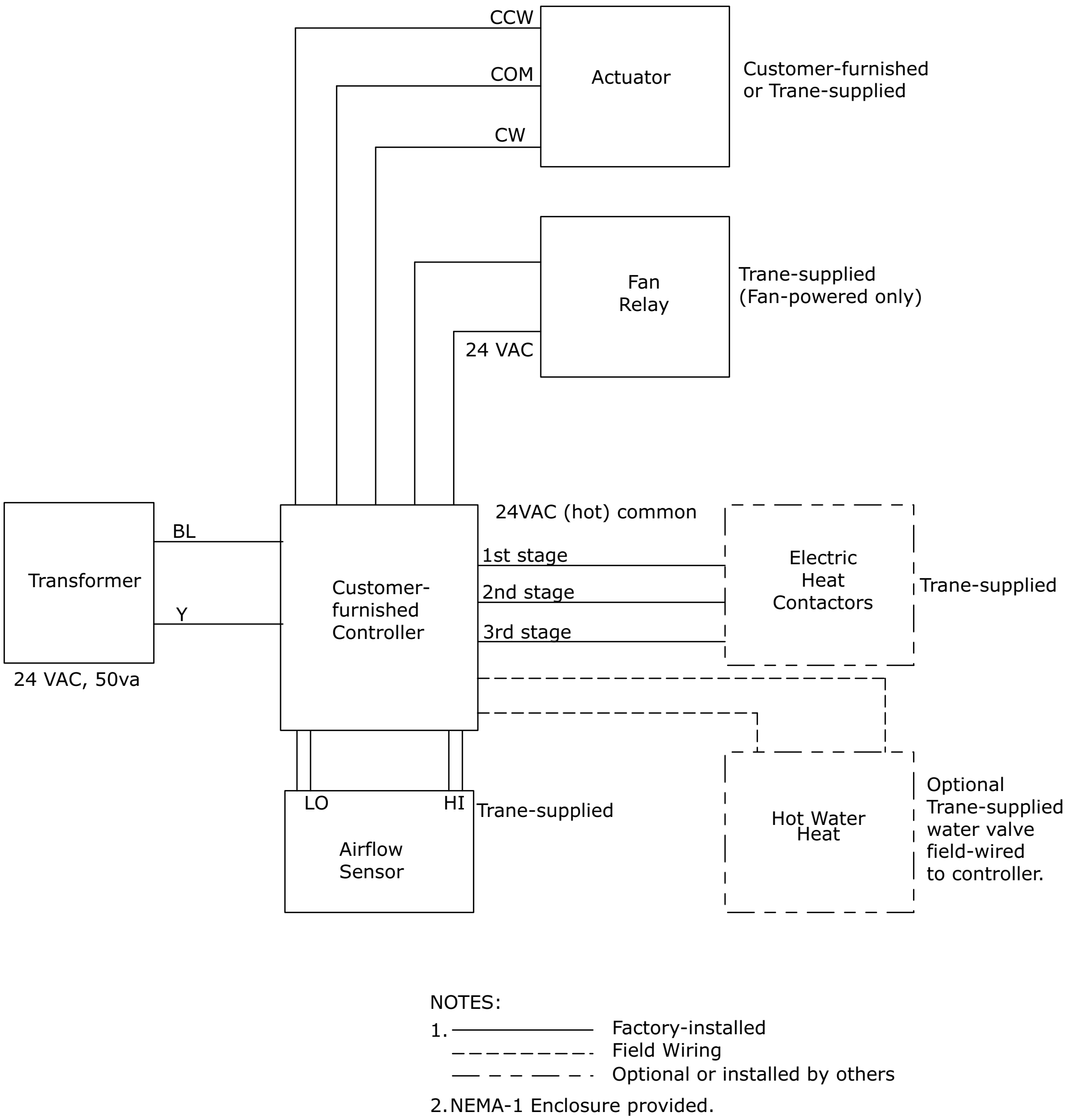
**Figure 13. Actuators (FM00 and FM01)**

Available on all Chilled Water Sensible Cooling Units

FM00 Customer-supplied actuator and DDC controller factory-installed.

FM01 Trane actuator and customer-supplied DDC controller factory-installed

All customer furnished controllers and actuators are installed and wired per control manufacturer's specifications. Metal control enclosure is standard.



# Symbio™ 500 and Tracer UC400 Programmable BACnet Controllers

## Introduction

The Tracer® UC400/Symbio™ 500 controller is a programmable general purpose BACnet®, microprocessor-based, Direct Digital Controller (DDC). When factory installed on Trane chilled water sensible cooling terminal units, it is factory downloaded with the appropriate sequences and settings. The control sequence for these units uses space temperature control.

The controller monitors the airflow through the air valve to maintain the required amount of conditioned outdoor air delivered from the Dedicated Outdoor Air Unit. The controller modulates cooling coil capacity and the fan airflow to maintain space temperature in the cooling mode. Similarly, if the unit is equipped with a heating coil (either hot water or electric heat), the controller modulates the heating capacity and the fan airflow to maintain space temperature in the heating mode.

The Tracer® UC400/Symbio™ 500 controller is BTL compliant with BACnet®, an open standard building automation protocol. It meets the application specific controller profile per ASHRAE 135-2004. This allows the Tracer® UC400/Symbio™ 500 controller to integrate with other BACnet® systems.

## Available Inputs

Required inputs include:

- Twisted/shielded communication link
- Zone sensor
- Setpoint
- Space temperature
- Discharge air temperature (DAT)
- Condensate detection switch
- 24 VAC power

Optional inputs include:

- Space relative humidity
- Supply (inlet) air temperature (SAT)
- $CO_2$ sensor
- Entering water temperature sensor
- Ancillary control

The spare inputs and outputs on the Tracer® UC400/Symbio™ 500 controller can be programmed using Tracer® TU Tracer Graphical Programming 2 (TGP2).

***Note:*** *For more information on using spare points, see BAS-SVX20, Tracer® UC400 /Symbio™ 500 Programmable Controller Installation, Operation, and Maintenance.*

## General Features and Benefits

### Assured Accuracy

- Proportional-plus-integral control loop algorithm for determining required cooling or heating capacity needed to control zone temperature. Fan and ventilation (air valve) airflows are limited by active minimum and maximum airflow setpoints.
- Pressure-independent (PI) operation that automatically adjusts air valve position to maintain required ventilation airflow. In certain low-flow situations or in cases where the flow measurement has failed, the DDC controller will operate in a pressure-dependent (PD) mode of operation.
- When combined with the patented Trane flow ring and pressure transducer, flow is repeatable to +/-5% accuracy across the pressure independent (PI) flow range. (See Valve/Controller Airflow Guidelines section).
- Improved 2-Point air balancing is available – Assures optimized flow-sensing accuracy across the operating range. This provides a more accurate airflow balancing method when compared to typical single-point flow correction air balancing.

- Analog input resolution of +/- 1/8°F within the comfort range maximizes zone temperature control yielding excellent comfort control.

## Reliable Operation

- Built for life – Trane products are designed to stand the test of time, with a proven design life that exceeds 20 years.
- Factory Tested – UC400/Symbio™ 500 programmed with appropriate sensible cooling programs and configured per unit parameters and optional customer supplied ventilation and fan airflow configuration values and UC400/Symbio™ 500 and/or WCI address values. Features tested in the factory include fan operation, electric heat contactor energization, air valve modulation, flow sensor operation, IMC communication between UC400/Symbio™ 500 and WCI, discharge temp sensor operation.

## Safe Operation

- All components, including the controller, pressure transducer, transformer, etc. are mounted in a NEMA 1 sheet metal enclosure and are tested as an assembly to UL1995 standards. The result is a rugged and safe controller, and thus, overall unit.
- When in PI-mode, electric heat is disabled when the sensed flow is below the minimum required.

## System-level Optimization

Trane controllers are designed to integrate into Trane Tracer® SC and leverage clear and clean unit-controller related data for system level control decisions. Integrating a Trane UC400/Symbio™ 500 controller into a Tracer® SC Control System provides the next step in building automation.

Specifically, system-level decisions on how to operate all components can be made. Energy efficient optimization strategies, like fan-pressure optimization, can be employed with the simple press of a button. The end-result is the most efficient and reliable building automation system available.

## Simplified Installation

*Factory Commissioned Quality* – All Trane DDC controllers are factory-commissioned. This means that the DDC boards are powered and run-tested with your specific sequence parameters. They are connected to a communication link to make sure that information and diagnostic data function properly. Before any unit ships it must pass a rigorous quality control procedure. You can be assured that a Trane chilled water sensible cooling terminal unit with Trane DDC controls will work right out of the crate.

*Tenant-Finish Heat Mode* – In some office projects, the building is being constructed as tenants are being identified. Tenant-finish heat mode is designed for applications when a given floor has not been occupied. The main AHU is used for heat and because the internal furnishings are not complete, the sensors have not been installed. In this case, the air valve drives open using the heat of the main AHU to keep plumbing lines from freezing. Operation of the chilled water sensible cooling terminal unit fan remains unaffected.

## Controller Flexibility

- Three configurable 24 Vac binary inputs are provided. When the DDC controller is operating with Tracer® SC, status of each input is provided to Tracer® SC. Defaults are as follows, however all inputs can be configured as the application requires.
  - First — Occupancy
  - Second — Condensate overflow
  - Third — not used
- Symbio™ 500, Tracer® UC400 Programmable BACnet® Controller certified performance ensures that a Trane chilled water sensible cooling terminal unit with controller will provide state-of-the-art, consistent open communication protocol for integration with the industry's latest (Non-Trane) building automation control systems, including Johnson Control, Andover, Siemens, Honeywell, etc.
- $CO_2$ demand controlled ventilation enables the terminal to adjust ventilation air flow setpoint based on the current occupancy in the zone. Trane demand controlled ventilation strategies are pre-defined for simplified application and can be easily customized to meet the needs of a specific system.

- Supports discharge air temp reset with modulating hot-water and SCR electric heat on units with mulitpoint-DAT sensor.

# Trane DDC Controller Logic

Following is the control sequence used for Trane chilled water sensible cooling terminal units:

**Occupied Mode:**

When the unit is in any of the Occupied Modes, the terminal unit fan shall operate continuously and the ventilation air damper shall open to either the Cooling or Heating Design Ventilation Airflow setpoint. If the zone is equipped with a $CO_2$ sensor, the controller shall continuously calculate the minimum ventilation airflow setpoint using the measured $CO_2$ concentration in the zone.

**Occupied Cooling Mode:**

When the unit is in Occupied Cooling Mode, the controller shall maintain the zone temperature at the active cooling setpoint by modulating both the terminal fan speed and chilled-water valve, while the ventilation damper is controlled to its minimum ventilation setpoint and the hot-water valve or electric heat remain off (if equipped). The controller shall first modulate the chilled-water valve to maintain zone temperature at its active cooling setpoint, while the fan operates at its Minimum Fan Airflow setpoint. When the requested cooling capacity has increased to the point where the chiller-water valve is fully open, the controller shall modulate the fan between its Minimum Fan Airflow and Maximum Cooling Fan Airflow setpoints to maintain zone temperature at its active cooling setpoint, while the chilled-water valve remains fully open. If the fan reaches its Maximum Cooling Fan Airflow setpoint, but the unit requires even more cooling capacity, the controller shall modulate the ventilation air damper between its active minimum ventilation airflow and Maximum Primary Airflow setpoints to maintain zone temperature at its active cooling setpoint, while the chilled-water valve remains fully open and the fan operates at its Maximum Cooling Fan Airflow setpoint.

**Occupied Heating Mode (for units equipped with a discharge air temperature sensor and hot water heating coil):**

When the unit is in Occupied Heating Mode, the controller shall maintain the zone temperature at the active heating setpoint by modulating both the terminal fan speed and hot-water valve, while the ventilation damper is controlled to its minimum ventilation setpoint and the chilled-water valve remains closed.

The controller shall modulate the hot-water valve to maintain zone temperature at its active heating setpoint, while the fan continues to operate at its Minimum Fan Airflow setpoint. When the discharge air temperature reaches the design heating discharge air temperature setpoint, the controller shall modulate the fan between its Minimum Fan Airflow setpoint and Maximum Heating Fan Airflow setpoint, while the hot-water valve modulates to maintain discharge air temperature at the design heating discharge air temperature setpoint. When the requested heating capacity has increased to the point where the fan has reached its Maximum Heating Fan Airflow setpoint, the controller shall modulate the hot-water valve to maintain zone temperature at its active heating setpoint, while the fan continues to operate at its Maximum Heating Fan Airflow setpoint.

**Occupied Heating Mode (for units equipped with a discharge air temperature sensor and modulating, SCR, electric heater):**

When the unit is in Occupied Heating Mode, the controller shall maintain the zone temperature at the active heating setpoint by modulating both the terminal fan speed and the electric heater (SCR), while the ventilation damper is controlled to its minimum ventilation setpoint and the chilled-water valve remains closed.

The controller shall modulate the electric heater to maintain zone temperature at its active heating setpoint, while the fan continues to operate at its Minimum Fan Airflow setpoint. When the discharge air temperature reaches the design heating discharge air temperature setpoint, the controller shall modulate the fan between its Minimum Fan Airflow setpoint and Maximum Heating Fan Airflow setpoint, while the electric heater modulates to maintain discharge air temperature at the design heating discharge air temperature setpoint. When the requested heating capacity has increased to the point where the fan has reached its Maximum Heating Fan Airflow setpoint, the controller shall modulate the electric heater to maintain zone temperature at its active heating setpoint, while the fan continues to operate at its Maximum Heating Fan Airflow setpoint.

**Occupied Heating Mode (for units equipped with one or two stages of electric heat):**

When the unit is in Occupied Heating Mode, the controller shall maintain the zone temperature at the active heating setpoint by modulating the terminal fan speed and staging electric heat, while the ventilation damper is controlled to its minimum ventilation setpoint and the chilled-water valve remains closed. The controller shall modulate the fan between its Minimum Fan Airflow setpoint and Maximum Heating Fan Airflow setpoint to maintain zone temperature at its active heating setpoint, while the electric heater remains off. When the requested heating capacity has increased to the point where the fan has reached its Maximum Heating Fan Airflow setpoint, the controller shall stage on electric heat to maintain zone temperature at its active heating setpoint, while the fan continues to operate at its Maximum Heating Fan Airflow setpoint.

**Unoccupied Mode:**

When in the Unoccupied Mode, the controller shall close the ventilation air damper, turn off the fan, close the chilled-water valve, and close the hot-water valve or turn off the electric heat (if equipped), unless unoccupied cooling, heating, or dehumidification is needed.

If the zone temperature rises above its Unoccupied Cooling Setpoint, the controller shall turn on the fan and operate at its Maximum Cooling Fan Airflow setpoint, fully open the chilled-water valve, close the hot-water valve or turn off the electric heat (if equipped), and close the ventilation air damper, until the zone temperature drops back to 2°F below the Unoccupied Cooling Setpoint. If condensate is detected or if the zone dew point rises above the Unoccupied Dew Point Setpoint, the controller shall close the chilled-water valve and open the ventilation air damper to its Maximum Primary (Ventilation) Airflow setpoint, until condensate is no longer detected and the zone dew point drops back below the Unoccupied Dew Point Setpoint.

[ALTERNATE SEQUENCE: If the zone temperature rises above its Unoccupied Cooling Setpoint, the controller shall turn on the fan and operate at its Maximum Cooling Fan Airflow setpoint, close the chilled-water valve, close the hot-water valve or turn off the electric heat (if equipped), and open the ventilation air damper to its Maximum Primary (Ventilation) Airflow setpoint, until the zone temperature drops back to 2°F below the Unoccupied Cooling Setpoint.]

If the zone dew point rises above its Unoccupied Dew Point Setpoint, but the zone temperature is between the Unoccupied Heating and Unoccupied Cooling Setpoints, the controller shall turn on the fan and operate at its Maximum Cooling Fan Airflow setpoint, close the chilled-water valve, close the hot-water valve or turn off the electric heat (if equipped), and open the ventilation air damper to its Maximum Primary (Ventilation) Airflow setpoint, until the space dew point drops back to 1°F below the Unoccupied Dew Point Setpoint.

If the terminal unit is equipped with hot water or electric heat, and the zone temperature drops below its Unoccupied Heating Setpoint, the controller shall turn on the fan and operate at its Maximum Heating Fan Airflow setpoint, fully open the hot-water valve (or turn on both stages of electric heat), close the chilled-water valve, and close the ventilation air damper, until the zone temperature rises back to 2°F above the Unoccupied Heating Setpoint.

**Condensate Avoidance:**

If the condensate detector indicates the presence of condensate in the drip pan, the controller shall close the chilled-water valve, and continue operating the terminal fan and ventilation air damper as normal. The unit shall return to normal operation when condensate is no longer detected.

If the measured zone dew point exceeds the entering chilled-water temperature, the controller shall close the chilled-water valve, and continue operating the terminal fan and ventilation air damper as normal. The unit shall return to normal operation when the zone dew point is less than 5°F below the entering chilled-water temperature.

If the zone dew point rises above its Occupied Dew Point Setpoint, the ventilation air damper shall be modulated further open until the zone dew point drops back below the Occupied Dew Point Setpoint.

## Tracer® Programmable BACnet® Controller—Unit Control Module

The Tracer® UC400/Symbio™ 500 is a microprocessor-based terminal unit controller with non-volatile memory which provides accurate ventilation and zone temperature control of air terminal units. Tracer® UC400/Symbio™ 500 provides a simple open protocol to allow integration of Trane terminal units and controllers into other existing control systems. The controller can operate in pressure-independent or pressure-dependent mode and uses a proportional plus integral control algorithm.

The controller monitors zone temperature setpoints, the current zone temperature and its rate of change and valve airflow (via flow ring differential pressure). The controller also accepts a supply air temperature value from the BAS. Staged electric heat, modulating (SCR) electric heat, and modulating hot water heat control are available as options. The control board operates using 24-VAC power. When used with a Tracer® SC or other Trane controllers, zone grouping and unit diagnostic information can be obtained. Factory-commissioning of parameters specified by the engineer can also be done. (See Factor Installed vs. Factory Commissioned table in Features and Benefits chapter for more details.)

## Specifications

**Supply Voltage:** 24 VAC, 50/60 Hz

**Maximum VA Load:**

**No Heat:** 8 VA (Board, Transducer, Zone Sensor, and Actuator)

***Note:*** *If using field-installed heat, 24 VAC transformer should be sized for additional load.*

**Output Ratings:**

- Actuator Output: 24 VAC at 12 VA
- 1st Stage Heat: 24 VAC at 12 VA
- 2nd Stage Heat: 24 VAC at 12 VA

**Binary Input:** 24 VAC, occupancy or generic

**Operating Environment:**

- 32 to 140°F, (0 to 60°C)
- 5% to 95% RH, non-condensing

**Storage Environment:**

- -40 to 180°F (-40 to 82.2°C)
- 5% to 95%RH, non-condensing

**Physical Dimensions:**

- Width: 5.5" (139.7 mm)
- Length: 4.5" (69.85 mm)
- Height: 2.0" (44.45 mm)

**Connections:** 1/4” (6.35 mm) Stab Connections

**Communications:**

- Tracer® UC400– Space Comfort Control (SCC) profile with FTT-10 transceiver.
- 22 awg. unshielded level 4 communication wire.

**Fan Control:** On, unless unoccupied and minimum flow has been released.

**Heat Staging:** Staged electric, modulating (SCR) electric, or hot water modulating

# Air-Fi Communications Interface (WCI)

The Air-Fi® Wireless Communications Interface (WCI) enables wireless communications between system controls, unit controls, and wireless sensors for Trane control products that use the BACnet® protocol. The WCI replaces the need for communications wire in all system applications.

## Air-Fi Wireless Communications Sensor (WCS)

The Air-Fi® Wireless Communications Sensor (WCS) is compatible with any Trane controller that uses a WCI. The WCS provides the same functions as many currently available Trane wired sensors. No further software or hardware is necessary for site evaluation, installation, or maintenance. Space temperature is standard on all models. (A service tool cannot be connected to a Trane wireless sensor.)

Five WCS models are available:

- $CO_2$ with occupancy WCS-S$CO_2$
- Digital display (WCS-SD) model
- Base (WCS-SB) model has no exposed display or user interface

- 2% relative humidity sensor module (WCS-SH), which can be field installed inside either the WCS-SD, WCS-SB. WCS-$SCO_2$

In most applications, one WCS sensor will be used per WCI acting as a router. However, up to 6 WCS sensors can be associated to a single equipment controller or BCI.

## Specifications

### Table 24. WCI and WCS specifications

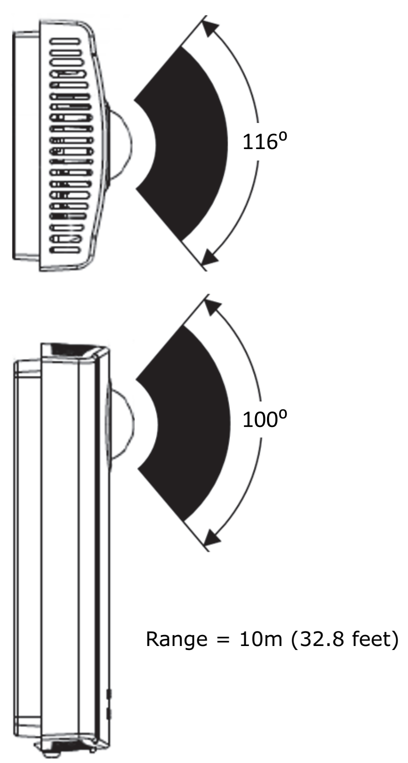
| General Specifications | |
|---|---|
| Operating temperature | —40 to 158°F (–40 to 70°C) |
| Storage temperature | -40 to 185°F (-40 to 85°C) |
| Storage and operating humidity range | 5% to 95% relative humidity (RH), non-condensing |
| Housing material | Polycarbonate/ABS (suitable for plenum mounting), UV protected, UL 94: 5 VA flammability rating |
| Range[a] | Open range: 2,500 ft (762 m) with packet error rate of 2%. Indoor: Typical range is 200 ft (61 m); actual range is dependent on the environment. See BAS-SVX55* for more detail. |
| Output power | 100 mW |
| Radio frequency | 2.4 GHz (IEEE Std 802.15.4-2003 compliant) (2405–2480 MHz, 5 MHz spacing) |
| Radio channels | 16 |
| **Wireless Communications Interface (WCI) Specifications** | |
| Voltage | 24 Vac/Vdc nominal ±10%. If using 24 Vdc, polarity must be maintained. |
| Power consumption | <2.5 VA |
| Indoor mounting | Fits a standard 2 in. by 4 in. junction box (vertical mount only). Mounting holes are spaced 3.2 in. (83 mm) apart on vertical center line. Includes mounting screws for junction box or wall anchors for sheet-rock walls. Overall dimensions: 2.9 in. (74 mm) by 4.7 in. (119 mm). |
| Outdoor mounting | Position enclosure in desired flat mounting location and mount using four (4) #8 sheet metal screws with the conduit connection pointing down. If not mounted to the HVAC equipment exterior wall, the conduit connection on the bottom of the enclosure is also available. Please note that the supplied plug must be installed into the unused conduit connection.<br>Overall dimensions: 3.9 in. (98 mm) by 6.4 in. (163 mm) by 1.7 in. (42 mm). |
| Wireless protocol | ANSI/ASHRAE Standard 135–2016 (BACnet®/ZigBee®[b] ) |
| **Wireless Communications Sensor (WCS) Specifications** | |
| Accuracy | 0.5°F for a range of 55 to 85°F (12.8 to 29.4°C) |
| Resolution | +0.125°F over a range of 60 to 80°F (15.56 to 26.67°C)/±0.25°F outside this range |
| Setpoint functional range | 45 to 95°F (7.22 to 35°C) |
| Sensor battery | Two (2) AA lithium 1.5 V batteries, 2800 mAh with an expected life of 15 years under typical operating conditions for non-$CO_2$ WCS. For WCS-$SCO_2$, expected battery life is 15 years for commercial buildings occupied 10 hours a day, five days per week. For buildings occupied 24 hours a day/seven days a week, the expected battery life is 10 years. |
| Address range | 001 to 999 |
| Maximum time between transmissions | 15 minutes |
| Minimum time between transmissions | 10 seconds. Time between transmissions can be shorter during user interaction. |
| Mounting | Fits a standard 2 in. by 4 in. junction box (vertical mount only). Mounting holes are spaced 3.2 in. (83 mm) apart on vertical<br>center line. Includes mounting screws for junction box and wall anchors for sheet-rock walls.<br>Overall dimensions: 2.9 in (74 mm) by 4.7 in. (119 mm) |

(a) Range values are estimated transmission distances for satisfactory operation. Actual distance is job specific and must be determined during site evaluation. Placement of the WCI is critical to proper system operation. In most general office space installations, distance is not the limiting factor for proper signal quality. Signal quality is more greatly affected by walls, barriers, and general clutter. Note that sheetrock walls and ceiling tiles offer little restriction to the propagation of the radio signal throughout the building as opposed to concrete or metal barriers. More details information, including wiring schematics, are available at http://www.trane.com.

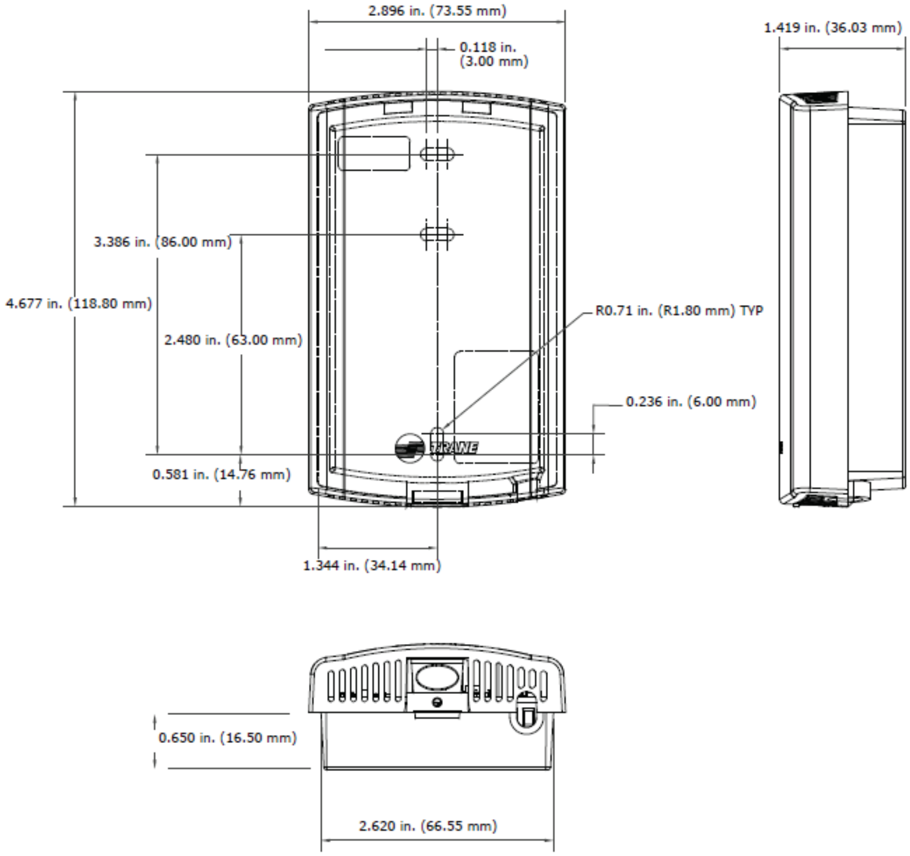
(b) ZigBee is a registered trademark of the ZigBee Alliance

| WCS-$SCO_2$ Sensor Specification<br>General Specifications | |
|---|---|
| Coverage Patterns | See the figure “WCS sensor coverage patterns,” which follows this table. |
| Occupied Timeout Delay | Average 10 minutes after motion is detected (Not adjustable) |
| Maximum Detection Range | 32 feet (10 m) |
| $CO_2$range | 0 — 10,000 ppm $CO_2$ |
| Accuracy at 25°C | ±40 ppm $CO_2$ + 3% of reading (includes repeatability) |
| Pressure dependence of output | Built-in pressure sensor eliminates inaccuracy due to altitude |
| Recommended calibration interval | None (auto-calibrated) |
| Response resolution | 50 ppm change or 15 minute heartbeat |
| Life expectancy | 15 years |
| Operating temperature | From 32 to 122°F (0 to 50°C) |
| Storage temperature | From —40 to 158°F (-40 to 70°C ) |
| Humidity range | 20% to 60% RH |
| Warm-up time | ≤ 1 min @ full spec ≤ 15 min |
| Housing material | Polycarbonate/ABS blend (wall) |
| **2% Relative Humidity (RH) Sensor Module** | |
| Accuracy | ±1.8% (typical) |
| Hysteresis | ±1% (typical) |
| Response time | 8 seconds |
| Long-term drift | <0.5%RH/year |

**Figure 14. WCS-$CO_2$ sensor coverage patterns**



## WCI Dimensions




# DDC Zone Sensors

The direct digital control (DDC) zone sensor is an uncomplicated, reliable electro-mechanical room sensor. No programming is required and most sensors contain an internal communications jack. Models are available with combinations of features such as override (on-cancel) buttons and space-mounted setpoint.

**Figure 15. DDC zone sensor with LCD**

**Figure 16. DDC zone sensors without LCD**

Four sensor variations are available:

- Sensor only (no communications jack)
- Sensor with override buttons
- Sensor with temperature setpoint only

- Sensor with temperature setpoint and override buttons

DDC Zone Sensor with LCD

The DDC zone sensor with LCD (liquid crystal display or digital) is compatible with VariTrane™ VAV and VariTrac™ controllers.

Digital Zone Sensor Summary

- Displays setpoint adjustment and space temperature in °F or °C.
- Simple, two-button control of space setpoint.
- Setpoint control and room temperature display can be optionally disabled.
- Includes button for timed override and a cancel feature for after-hours system operation.
- An easily accessible communications jack is provided for Trane portable edit terminal devices.
- Nonvolatile memory stores last programmed setpoints.
- For field balancing, maximum and minimum airflow or position can be overridden from the sensor.

## Specifications (Zone Sensor With LCD)

**Thermistor Resistance Rating**

10,000 Ohms at 77°F (25°C)

**Setpoint Resistance Rating**

Setpoint potentiometer is calibrated to produce 500 Ohms at a setting of 70°F (21.11°C)

**Temperature Range**

Displays 40 to 99°F (5 to 35°C)
With Setpoints 50 to 90°F (10 to 32°C)

**Electrical Connections**

Terminal Block – Pressure Connections
Communication Jack – WE – 616
4 VA maximum power input.

**Physical Dimensions**

Width: 2.8" (71.12 mm)
Length: 4.5" (114.3 mm)
Height: 1.1" (27.94 mm)

## Specifications (Zone Sensor Without LCD)

**Thermistor Resistance Rating**

10,000 Ohms at 77°F (25°C)

**Setpoint Resistance Rating**

Setpoint potentiometer is calibrated to produce 500 Ohms at a setting of 70°F (21.11°C)

**Electrical Connections**

Terminal Block – Pressure Connections
Communication Jack – WE – 616

**Physical Dimensions**

Width: 2.75" (69.8 mm)
Length: 4.5" (114.3 mm)
Height: 1.0" (25.4 mm)

# Zone Occupancy Sensor

The energy-saving zone occupancy sensor is ideal for zones having intermittent use during the occupied mode. The sensor sends a signal to the terminal unit controller upon detection of movement in the coverage area. The controller then changes the zone from occupied standby mode to occupied mode.

Figure 17. Zone occupancy sensor

**Occupancy Zone Sensor Summary**

- Compatible with VariTrane™ VAV and VariTrac™ controllers
- Used with UCM for controlling the occupied standby function
- Ceiling-mount PIR occupancy sensor detects motion over an adjustable range up to 360 degrees
- Single detector covers up to 1200 square feet. For areas larger than 1200 square feet, multiple sensors can be wired in parallel
- Adjustable time delay avoids nuisance change of state on loss of detection
- Adjustable sensitivity
- SPDT isolated contacts connect to UCM input

## Specifications

**Power Supply**

24 VAC or 24 VDC, ± 10%

**Maximum VA Load**

0.88 VA @ 24 VAC,
0.72 VA @ 24 VDC

**Isolated Relay Rating**

1 A @ 24 VAC or 24 VDC

**Operating Temperature**

32 to 131°F (0 to 55°C)

**Storage Temperature**

-22 to 176°F (-30 to 80°C)

**Humidity Range**

0 to 95% non-condensing

**Effective Coverage Area**

1200 sq ft

**Effective Coverage Radius**

22 feet

**Housing Material**

ABS Plastic

**Dimensions**

3.3" dia. x 2.2" deep (85 mm x 56 mm). Protrudes 0.36" (9 mm) from ceiling when installed.

# $CO_2$ Sensors

Figure 18. Duct-mounted $CO_2$ sensor (L) and wall-mounted $CO_2$ sensor (R)


Wall- and duct-mounted carbon dioxide ($CO_2$) sensors are designed for demand-controlled ventilation zone applications. The sensor is compatible with VariTrane™ VAV and VariTrac™ controllers. The Trane $CO_2$ sensors measure carbon dioxide in parts-per-million (ppm) in occupied building spaces. Outdoor airflow is reduced below design ventilation rates if the $CO_2$ concentration decreases due to reduced occupancy.

**$CO_2$ Zone Sensor Summary**

- Use with the UCM $CO_2$ input for demand control ventilation.
- Silicone-based NDIR sensor technology for long-term stability.
- Measurement range of 2000 ppm $CO_2$ input with an output of 0–10 Vdc.
- Wall-mount transmitter is compact and aesthetic in appearance.
- Optional zone return duct-mount transmitter is available.

## Specifications

**Measuring Range**
0–2000 parts per million (ppm)

**Accuracy at 77°F (25°C)**
< ± (40 ppm $CO_2$ + 3% of reading) (Wall only)

< ± (30 ppm $CO_2$ + 3% of reading)

**Recommended calibration interval**

5 years

**Response Time**

1 minute (0–63%)

**Operating Temperature**

59 to 95°F (15 to 35°C) (Wall only)

23 to 113°F (-5 to 45°C)

**Storage Temperature**

-4 to 158°F (-20 to 70°C)

**Humidity Range**

0–85% relative humidity (RH)

**Output Signal (jumper selectable)**

4-20 mA, 0–20 mA,
0–10 VDC

**Resolution of Analog Outputs**

10 ppm $CO_2$

**Power Supply**

Nominal 24 VAC

**Power Consumption**

<5 VA

**Housing Material**

ABS plastic

**Dimensions**

4 1/4" x 3 1/8" x 1 7/16" (Wall only)
(108 mm x 80 mm x 36 mm) (Wall only)

3 1/8" x 3 1/8" x 7 ¾"
(80 mm x 80 mm x 200 mm)

# Factory or Field Mounted Auxiliary Temperature Sensor

The auxiliary discharge temperature sensor is used in conjunction with the Trane DDC controller to sense duct temperature. When the DDC controller is used with a Building Automation System, the sensor temperature is reported as status only. When the DDC control is used as stand alone configuration and the sensor is placed in the supply air duct (upstream of the terminal unit), the sensor determines the control action of the UCM in a heat/cool changeover system. When factory mounted, the sensor is terminated. If sensor is field mounted, it is shipped loose and is terminated in the field.

## Specifications

**Sensing Element**

Thermistor 10,000 Ohms @ 77°F (25°C)

**Operating Environment**

-4 to 221°F (-20 to 105°C), 5%-95%RH
Non-Condensing

**Wiring Connection**

8 ft 18 awg

Sleeving for wire leads is acrylic #5 awg grade C rated @ 155°C

**Probe Dimensions**

3.4" long x 5/16" diameter
(86 mm x 7.9 mm diameter)

**Mounting**

In any position on duct.

Mount the sensor to the duct using
#10 x ¾" (19.05 mm) sheet metal screws.

# Control Relay

The control relay is an output device used to provide on/off control of electrical loads. The SPST relay also will isolate the electrical load from the direct digital controller.

## Specifications

**Coil Rating:**

- 24 VAC, 50/60 Hz, pull in at 85%
- 4 VA inrush, 3 VA sealed, Class B insulation

**Contact Rating:**

- 120 VAC, 12 FLA, 60 LRA, 18A Resistive Pilot Duty – 125 VA/3A
- 277 VAC, 7 FLA, 42 LRA, 18A Resistive Pilot Duty – 277 VA/3A

# Trane Control Valves

The modulating water valve is used to provide accurate control of either a chilled water coil or a hot water heating coil to help maintain a zone temperature setpoint. The valve plug is an equal percentage design and comes available in four different flow capacities for proper controllability. The valves are field-adjustable for use as a two- or three-way configuration. The valves ship in a two-way configuration with a cap over the bottom port. Conversion to three-way operation is accomplished by removing the plug from the "B" port. The valve actuator contains a three-wire synchronous motor.
The direct digital controller uses a time-based signal to drive the motor to its proper position. When power is removed from the valve, it remains in its last controlled position.

## Specifications

**Value Design**

Ball valve constructions designed for chilled/hot water or water with up to 50% glycol

**Temperature Limits**

- 32 to 201°F (0 to 94°C) Fluid
- 23 to 122°F (-5 to 50°C) Ambient

**Rated Body Pressure**

300 psi (2.06 mPa)

**Maximum Actuator Close-Off Pressure**

60 psi (0.4 mPa)

**Electrical Rating Motor Voltage**

24 VAC, 50/60 Hz

**Power Consumption**

3.0 VA at 24 VAC

**Valve Offerings**

All valves are modulating control with ½–in. (12.7 mm) O.D. NPT connections Cv offered:

0.7, 1.7, 2.7, 5.0

# Belimo Control Valves

The modulating water valve is used to provide accurate control of a hot water heating coil to help maintain a zone temperature setpoint. The valves available in seven different flow capacities for proper controllability. The valves are selectable in a two- or three-way configuration. The valve actuator contains a three-wire synchronous motor. The direct digital controller uses a time-based signal to drive the motor to its proper position. When power is removed from the valve, it remains in its last controlled position.

## Specifications

**Value Design**

Ball valve constructions designed for chilled/hot water or water with up to 50% glycol

**Temperature Limits**

- 32 to 201°F (0 to 94°C) Fluid
- -22 to 122°F (-30 to 50°C) Ambient

**Rated Body Pressure**

600 psi (4.14 mPa)

**Maximum Actuator Close-Off Pressure**

200 psi (1.38 mPa)

**Electrical Rating Motor Voltage**

24 VAC or 2V-10V, 50/60 Hz

**Power Consumption**

1.0 VA at 24 VAC

**Valve Offerings**

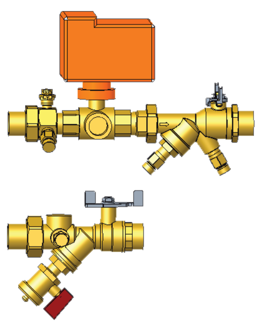
All valves are modulating control with ½–in. (12.7 mm) O.D. NPT connections Cv offered:

0.3, 0.46, 0.8, 1.2, 1.9, 3.0, 4.7

# VAV Piping Package

Figure 19. Standard valve piping package

Figure 20. Belimo valve piping package



- Offered in both 2-way and 3-way configurations
- The Automatic Balancing Flow Control sized for the specified VAV coil and gpm.
- Field connections are NPT with Coil connections Sweat to match the Trane VAV water coil copper
- For 3-way configuration the connections between the ATC valve and the supply shut off assembly are sweat to allow for field installation of hose or piping connection between the supply and return lines. Included in the package are:
  - P/T Ports for pressure and temperature measurement on both the supply and return sections.
  - Blow down drainable filter on the supply.
  - Y-Ball Combination Mesurflo Automatic Balance Valve on the Return side to isolate the coil.
  - Y-Ball Combination Strainer on the supply to isolate the coil.

- Each piping package is tagged to match the VAV terminal tag it is specified for.
- Each piping package includes a 24v floating point control modulating control ball valve or a 2V-10V analog control ball valve.
- The Cv is sized to match the specified gpm/coil performance of the VAV terminal unit. Package includes unions with sweat connections to the coil.

## Specifications

Differential Operating Pressure:

- 2519 (2–80 psid 0.5-3.0 gpm) / (3-80 psid 3.50 – 5.00 gpm)
- 2515 (3-80 psid 5.50 – 7.50 gpm)
- ± 10% accuracy of published flow

**Operating Temperature:**

- 32 to 225°F

# Differential Pressure Transducer

The differential pressure transducer is used in conjunction with the Trane direct digital controller and analog electronic controller. The pressure transducer measures the difference between the high-pressure and low-pressure ports of the Trane flow ring. The transducer is self-adjusting to changes in environmental temperature and humidity.

## Specifications

**Input Pressure Range**

0.0 to 5.0 in. wg
(Maximum input pressure 5 psig)

**Operating Environment**

32 to 140°F, (0 to 60°C)
5% to 95% RH, Non-Condensing

**Storage Environment**

-40 to 18°F, (-40 to 82.°C)
5% to 95%RH, Non-condensing

**Electrical Connections**

$V_{in}$ = 5.0 VDC nominal
(4.75 to 5.25 VDC acceptable)
Current Draw = 5 mA maximum
Null Voltage = 0.250 VDC ± 0.06 VDC
Span = 3.75 VDC ± 0.08 VDC

***Note:*** *Null and Span are ratio-metric with V in*

**Physical Dimensions**

Width: 2.5 inch (63.5 mm)
Length: 3.0 inch (76.2 mm)
Height: 1.5 inch (38.1 mm)

**Pressure Connections**

1/8 inch (3.175 mm) barbed tubing connections

# Transformers

The transformer converts primary power supply voltages to the voltage required by the direct digital controller and analog. The transformer also serves to isolate the controller from other controllers which may be connected to the same power source.

## Specifications

**Primary Voltage**

120 VAC

208 VAC

240 VAC

277 VAC

347 VAC

480 VAC

575 VAC

**Secondary Voltage** 24 VAC

**Power Rating**

50 VA

**Physical Dimensions**

For all voltages:

The transformers will be no larger than the following dimensions:

Width: 2.63" (66.7 mm)

Length: 2.50" (63.5 mm)

Height: 2.30" (58.4 mm)

# Trane Actuator – 90 Second at 60 Hz Drive Time

This actuator is used with DDC controls and retrofit kits. It is available with a 3-wire floating-point control device. It is a direct-coupled over the shaft (minimum shaft length of 2.1"), enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The actuator has an external manual gear release to allow manual positioning of the damper when the actuator is not powered.

## Specifications

**Actuator Design:** 3-wire, 24-AC floating-point control. Non-spring return.

**Actuator Housing:** Housing type-NEMA 1

**Rotation Range:** 90° clockwise or counterclockwise

**Electrical Rating:**

- Power Supply –24 VAC (20 to 30 VAC) at 50/60 Hz
- Power Consumption – 1.8 VA maximum, Class 2

**Electrical Connection:** Box Lug Terminals

**Manual Override:** External clutch release lever

**Shaft Requirement:**

- ½” round
- 2.1" length

**Humidity:** 5% to 95% RH, Non-Condensing

**Temperature Rating:**

- Ambient operating: 32 to 125°F (0 to 52°C)
- Shipping and storage: -20 to 130°F (-29 to 66°C)

**Torque:**

- Running: 35 in.-lb (4 N-m)
- Breakaway: 35 in.-lb (4 N-m) minimum
- Stall: 60 in.-lb (4.5 N-m) minimum

# Belimo Actuator – 95 Second Drive Time

This actuator is used with DDC controls and retrofit kits. It is available with a 3-wire floating-point control device. it is a direct-coupled over the shaft enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The actuator has an external manual gear release to allow manual positioning of the damper. The actuator is UL listed and carries the CE mark.

## Specifications

**Actuator Design:** 3-wire, 24 AC floating-point control. Brushless DC motor with internal control electronics and constant drive time.

**Rotation Range:** 95° clockwise or counterclockwise

**Electrical Rating:**

- Power Supply –24 VAC/DC
- Power Consumption – 2VA, 1.5W

**Electrical Connection:** Three box-type terminals for bare wire connections.

**Manual Override:** External clutch release lever.

**Shaft Requirement:**

- ½” round
- 2.1" length

**Humidity:** 5% to 95% Non-Condensing

**Temperature Rating:**

- Ambient operating: 32 to 125°F (0 to 52°C)
- Shipping and storage: -20 to 130°F(-29 to 66°C)

**Torque:**45 in.-lb (5 N-m)

# Actuator — Proportional, Non-Spring Return

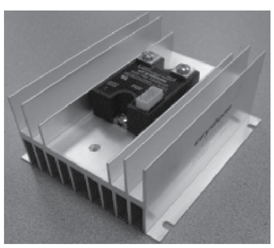

Proportional control damper actuators shall be electronic direct-coupled type, which require no crank arm and linkage and be capable of direct mounting to a shaft from 1/4-inch to 5/8-inch”. Actuators must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500 ohm resistor, a 4 to 20 mA control input from an electronic controller or positioner. Actuators shall have brushless DC motor technology and be protected from overload at all angles of rotation. Actuators shall have reversing switch and manual override on the cover. Run time shall be constant and independent of torque. Actuators shall be cULus listed, and be manufactured under ISO 9001 International Quality Control Standards.

## Specifications

| | |
|---|---|
| **Power supply** | 24VAC ± 20% 50/60Hz, 24VDC ± 10% |
| **Power Consumption** | 1.5W (0.4W) |
| **Transformer Sizing** | 3 VA (Class 2 power source) |
| **Overload Protection** | Electronic throughout 0 to 95° Rotation |
| **Operating Range Y** | 2 to 10 VDC, 4 to 20 mA |

| | |
|---|---|
| **Input Impedance** | 100 kW (0.1 mA), 500W |
| **Angle of Rotation** | 95°, adjustable with mechanical stop |
| **Torque** | 45 in-lbs (5 Nm) |
| **Direction of Rotation** | Reversible with switch.<br>• Switch position 0: counterclockwise<br>• Switch position 1: clockwise |
| **Manual Override** | External push button |
| **Running Time** | 95 seconds, constant independent of load |
| **Humidity** | 5 to 95% RH non-condensing (EN60730-1) |
| **Ambient Temperature** | -22 to 122°F (-30 to 50°C) |
| **Storage Temperature** | -40 to 176°F (-40 to 80°C) |
| **Housing** | NEMA 2, IP54, UL enclosure type 2 |
| **Housing Material** | UL94-5VA |
| **Agency Listing** | cULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EEC and 2006/95/EC |
| **Noise Level** | <35dB(A) |
| **Servicing** | Maintenance Free |
| **Quality Standard** | ISO 9001 |
| **Weight** | 1.7 lbs (0.5 kg) |

# Electric Heater Silicon-Controlled Rectifier (SCR)



- Microprocessor based burst-fire controller / SSR
- Low-voltage control
- Output status indicator
- 0-100% Control Range
- Synchronized triggering output (P3)
- 20 AC Cycles Base Period

## Specifications

| Input Specifications | DC Control |
|---|---|
| Supply Voltage Range (VDC) (P1) | 8-28 |
| Input Current Range [mA] | 20-30 |
| Nominal Input Impedance [Ohms] | 30K |
| Nominal Input Impedance [ohms][P4] | 20K |

| Output Status Functions | LED |
|---|---|
| Initial Logic Supply On | Flash Once |
| Load Voltage Missing / Load Open (W/ PLV = 0V) | Flash Once Intermittently |
| Load Voltage Missing / Load Open (W/ PLV > 0V) | Flash Twice Intermittently |

| General Specifications | Parameters |
|---|---|
| Dielectric Strength, Input/Output/Base (50/60Hz) | 4000 Vrms |
| Minimum Insulation Resistance (@ 500 V DC) | $10^9$ Ohm |
| Maximum Capacitance, Input/Output | 10 pF |
| Ambient Operating Temperature Range | -20 to 80°C |
| Ambient Storage Temperature Range | -40 to 125 °C |
| Encapsulation | Thermally conductive Epoxy |
| Input connector | Header Connector 3.5mm |
| Output Terminals | Screws and Saddle Clamps Furnished, Installed |
| Output Max Wire Size | Output:2 x AWG 8 (3.8mm) |
| Output Screws Maximum Torque | 20 in lbs (2.2 Nm) |

| Assembly Specifications | |
|---|---|
| Weight (typical) | 1.38 Lb (0.628 Kg.) |
| Heat Transfer Material Used | Thermal Pad |
| Material | Steel |
| Finish | Nickel Plate |
| Torque Applied | 20 in/lbs ± 10%. |

# Moisture Sensor


The moisture sensor is used to detect the presence of condensate in the drip pan located under the sensible cooling coil, and to provide a relay output. The device operates on 24 Volts AC and functions as a Normally Closed Sensor (contacts open upon the detection of moisture).

## Specifications

**Power Requirements:**

- Operating Voltage: 24 VAC
- Operating Current: 12 mA

**Contact Characteristics:**

- Initial Contact Resistance, maximum: 100 mohms
- Nominal Switching Capacity: 1A, 30 VDC
- Resistive load: 0.3A, 37.5 VA
- Switching Power (Resistive Load), maximum: 30W, 37.5 VA
- Switching Voltage, maximum: 110 VDC, 125 VAC
- Switching Current, maximum: 1A

# Controls Specifications

For all Trane chilled water sensible cooling terminal units, the unit controller continuously monitors the zone temperature and varies the fan airflow and cooling or heating capacity as required to meet zone setpoints. Fan and ventilation airflows are limited by adjustable minimum and maximum setpoints.

The controller will start and run the fan continuously during the occupied mode and intermittently during the unoccupied mode. See Trane DDC Controller Logic for sequence of operations.

## Direct Digital Controls (DDC)

### Direct Digital Controller

The microprocessor-based terminal unit controller provides accurate, pressure-independent control through the use of a proportional integral control algorithm and direct digital control technology. The controller monitors zone temperature setpoints, current zone temperature and its rate of change, and valve airflow. With the addition of optional sensors, zone $CO_2$ concentration, supply air temperature, discharge air temperature, and entering water temperature, occupancy status can be monitored. The controller is provided in an enclosure with 7/8" (22 mm) knockouts for remote control wiring. A Trane DDC zone sensor is required.

### System Communications

The Controller UCM sends and receives data from a Tracer® SC or other Trane Controller. Current unit status and setpoints may be monitored and/or edited via this data communication feature. Communication is available through either Air-Fi® wireless system or twisted pair shielded serial connection.

The following direct digital control features are available with Trane chilled water sensible cooling terminal units:

- Controls Option – DD00: Trane actuator for field-installed DDC controllers
- Controls Option – FM00: Factory installation of customer supplied actuator and DDC controls. Controls supplier is responsible for providing factory-installation and wiring instructions.
- Controls Option – FM01: Trane actuator with factory installation of customer supplied DDC controls. Controls supplier is responsible for installing and wiring instructions.
- Control Mode – The UCM Control Mode may be edited from occupied to unoccupied to accommodate night setback/setup.
- Control Offset – Enabling Control Offset will increase the cooling temperature setpoint and decrease the heating temperature setpoint by a control-offset value (Stored at limiting in the occupied mode).
- Drive damper fully open
- Drive damper fully closed
- Drive damper to maximum airflow setpoint
- Drive damper to minimum airflow setpoint
- Disable unit heat
- Reset-Enabling the reset function forces the controller and the flow sensor to recalibrate
- Programmable hot water or chilled water valve drive time
- Programmable air damper drive time

The following unit setpoints reside in the UC400 /Symbio™ 500 in nonvolatile memory. These setpoints are editable via the BAS BACnet® link or with Tracer® TU.

- Occupied cooling temperature setpoint [60 to 80ºF (15 to 26°C)]
- Occupied heating temperature setpoint [60 to 80ºF (15 to 26°C)]
- Unoccupied cooling temperature setpoint [60 to 100ºF (15 to 37°C)]
- Unoccupied heating temperature setpoint [30 to 100°F (15 to 37°C)]
- Design cooling (ventilation) airflow setpoint (10 to 110% of unit equivalent nominal airflow)
- Design heating (ventilation) airflow setpoint (10 to 110% of unit equivalent nominal airflow)
- Maximum ventilation (primary) airflow setpoint (10 to 110% of unit equivalent nominal airflow)

- Maximum cooling fan airflow setpoint (25 to 100% of nominal fan airflow)
- Maximum heating fan airflow setpoint (25 to 100% of nominal fan airflow)
- Minimum fan airflow setpoint (15 to 100% of nominal fan airflow)
- Flow measurement calibration correction (50 to 150%)
- Cooling Setpoint Low Limit – Applies low limit to programmed occupied cooling setpoint or zone sensor cooling setpoint [30 to 100°F (-1 to 37°C)].
- Heating Setpoint High Limit – Applies high limit to programmed occupied heating setpoint or zone sensor heating setpoint [30 to 100°F (-1 to 37°C)].
- Thermistor – Determines what type of zone temperature sensor will be used.
- Occupied and Unoccupied Outdoor Airflow Requirements – Determines the outdoor airflow required in the zone.
- Fan Configuration – allows option to shut off fan and close air valve when unit is unoccupied. Fan will operate in unoccupied mode if heat is active.
- Heating setpoint low limit.
- Cooling setpoint high limit.
- Local heating flow setpoint enable/disable and setpoint.

In addition to the above setpoints, the following status information can be transmitted to a Tracer® SC or other Trane controllers.

- Active cooling temperature setpoint
- Active heating temperature setpoint
- Primary (ventilation) airflow
- Current zone temperature
- Heat status (On/Off)
- Supply air temperature — Requires a field installed supply air temperature sensor
- Discharge air temperature — Requires the optional factory-installed discharge air temperature sensor or a field installed discharge air temperature sensor
- Failure Indicators – The UCM will indicate the following: 1) Temperature Sensor Failure; 2) Flow Sensor Failure; and 3) Local Zone Sensor Setpoint Failure.
- Fan Status (on/off)
- Calibration Status (calibration/not-calibrating)
- $CO_2$ Concentration—Available only if the unit has a $CO_2$ sensor.

## Optional Wireless Zone Sensor/Receiver

Factory mounted receiver with field mounted sensor accessory eliminates the need for the wiring between the zone sensor and unit level controller. See Wireless Receiver/Wireless Zone Sensor..

# Electrical Data

### Table 25. LDEF — electric coil kW guidelines, minimum to maximum (ECM units)

| Fan Size | Stages | Single-Phase Voltage | | | | Three-Phase Voltage | |
|---|---|---|---|---|---|---|---|
| | | 208V | 240V | 277V | 480V | 208V | 480V |
| DS02 | 1 | 1.0-8.0[a] | 1.0-9.0 | 1.0-11.0 | 1.0-14.0 | 1.0-14.0[b] | 1.0-12.0, 14.0 |
| | 2 | 1.0-8.0[a] | 1.0-9.0 | 1.0-11.0 | 1.0-14.0 | 1.0-14.0[b] | 1.0-12.0, 14.0 |

**Notes:**

1. Coils available with 24 VAC magnetic contactors, load carrying P.E. switches and P.E. switch with magnetic contactors.
2. Available kW increments are by 0.5 from 1.0 kW to 8.0 kW and by 1.0 kW afterward.
3. Each stage will be equal in kW output.
4. All heaters contain an auto thermal cutout and a manual reset cutout.
5. The current amp draw for the heater elements is calculated by the formula mentioned in the Formula section below.

(a) 8 kW not available with 115V motors
(b) 14kW not available with 115V motor

### Table 26. Fan electrical performance (ECM)

| Fan Size | HP | Maximum Fan Motor Amperage (FLA) | |
|---|---|---|---|
| | | 115V | 277V |
| DS02 | 0.75 | 9.6 | 5.2 |

### Table 27. Minimum unit electrical heat guidelines (ECM)

| Unit kW | Cfm | L/s |
|---|---|---|
| 1.0 | 100 | 47 |
| 1.5 | 116 | 55 |
| 2.0 | 156 | 74 |
| 2.5 | 195 | 92 |
| 3.0 | 234 | 110 |
| 3.5 | 274 | 129 |
| 4.0 | 313 | 148 |
| 4.5 | 352 | 166 |
| 5.0 | 392 | 185 |
| 5.5 | 431 | 203 |
| 6.0 | 470 | 222 |
| 6.5 | 510 | 241 |
| 7.0 | 549 | 259 |
| 7.5 | 588 | 278 |
| 8.0 | 628 | 296 |
| 9.0 | 700 | 330 |
| 10.0 | 785 | 370 |
| 11.0 | 863 | 407 |
| 12.0 | 942 | 445 |
| 13.0 | 1021 | 482 |
| 14.0 | 1099 | 519 |

# Formulas

Minimum Circuit Ampacity (MCA) = (motor amps + heater amps) x 1.25

Maximum Overcurrent Protection (MOP) = (2.25 x motor amps) + heater amps

General Sizing Rules:

- If MOP = 15, then fuse size = 15
- If MOP = 19, then fuse size = 15 with one exception. If heater amps x 1.25 > 15, then fuse size = 20.
- If MOP is less than/equal to MCA, then choose next fuse size greater than MCA.
- Control fusing not applicable.
- Standard Fuse Sizes: 15, 20, 25, 30, 35, 40, 45, 50, and 60.

**Useful Formulas:**

$$kW = \frac{cfm \times ATD}{3145} \qquad ATD = \frac{kW \times 3145}{cfm}$$

$$kW = 1214 \times L/s \times ATD \qquad ATD = \frac{kW}{1214 \times L/s}$$

$$3\phi \text{ amps} = \frac{kW \times 1000}{PrimaryVoltage \times \sqrt{3}}$$

$$1\phi \text{ amps} = \frac{kW \times 1000}{PrimaryVoltage}$$

# General and Dimensional Data

## General Data

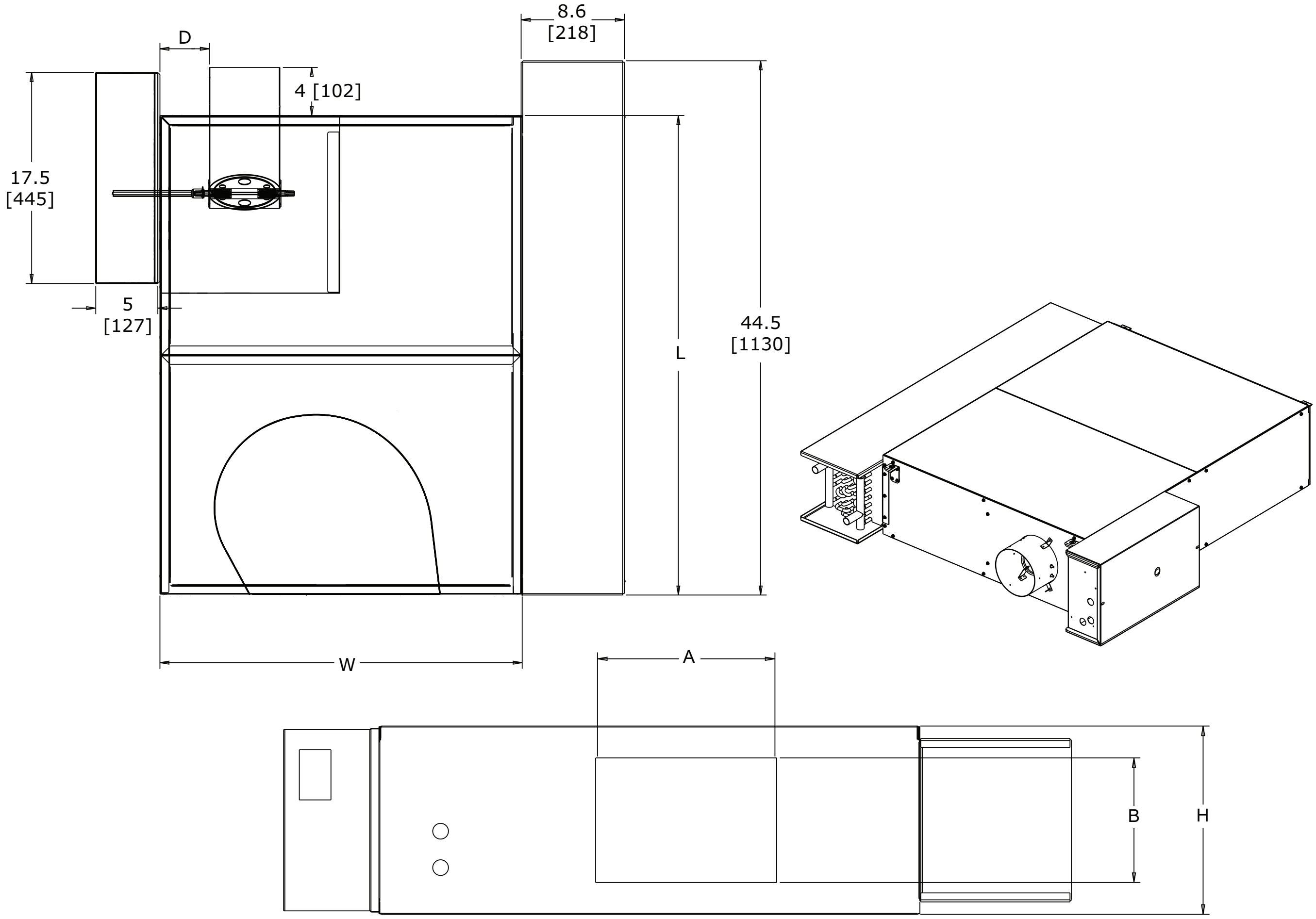
**Table 28. Chilled water sensible cooling terminal unit, fan size DS02 — general data, dimensions and weights**

| Description | Units | Cooling Only LDCF | Hot Water LDWF | Electric Heat LDEF |
|---|---|---|---|---|
| Filter Size | in. | 8 x 38 x 1 | 8 x 38 x 1 | 8 x 38 x 1 |
| | mm | 203 x 965 x 25 | 203 x 965 x 25 | 203 x 965 x 25 |
| Inlet Size Availability | in. | 4, 5, 6, 8, 8x14 | 4, 5, 6, 8, 8x14 | 4, 5, 6, 8, 8x14 |
| | mm | 104, 127, 152, 203, 256 | 104, 127, 152, 203, 256 | 104, 127, 152, 203, 256 |
| Unit Weight | lb | 125 | 131 | 143 |
| | kg | 57 | 59 | 65 |
| Dimensional Data | Reference Dimensional Drawing Section | | | |
| Height (H) | in. | 10.5 | 10.5 | 10.5 |
| | mm | 267.0 | 267.0 | 267.0 |
| Width (W) | in. | 35.0 | 35.0 | 35.0 |
| | mm | 889.0 | 889.0 | 889.0 |
| Length (L) | in. | 40.0 | 40.0 | 40.0 |
| | mm | 1016.0 | 1016.0 | 1016.0 |
| Discharge (A) | in. | 9.9 | 18.0 | 14.0 |
| | mm | 251.0 | 457.0 | 365.0 |
| Discharge (B) | in. | 6.8 | 10.0 | 9.0 |
| | mm | 173.0 | 254.0 | 229.0 |
| Discharge (D) | in. | 4.0 | 4.0 | 4.0 |
| | mm | 102.0 | 102.0 | 102.0 |

# Dimensional Drawings

## Dimensions — Cooling Only (LDCF)

**Figure 21. Chilled water sensible cooling terminal unit — cooling only (LDCF)**

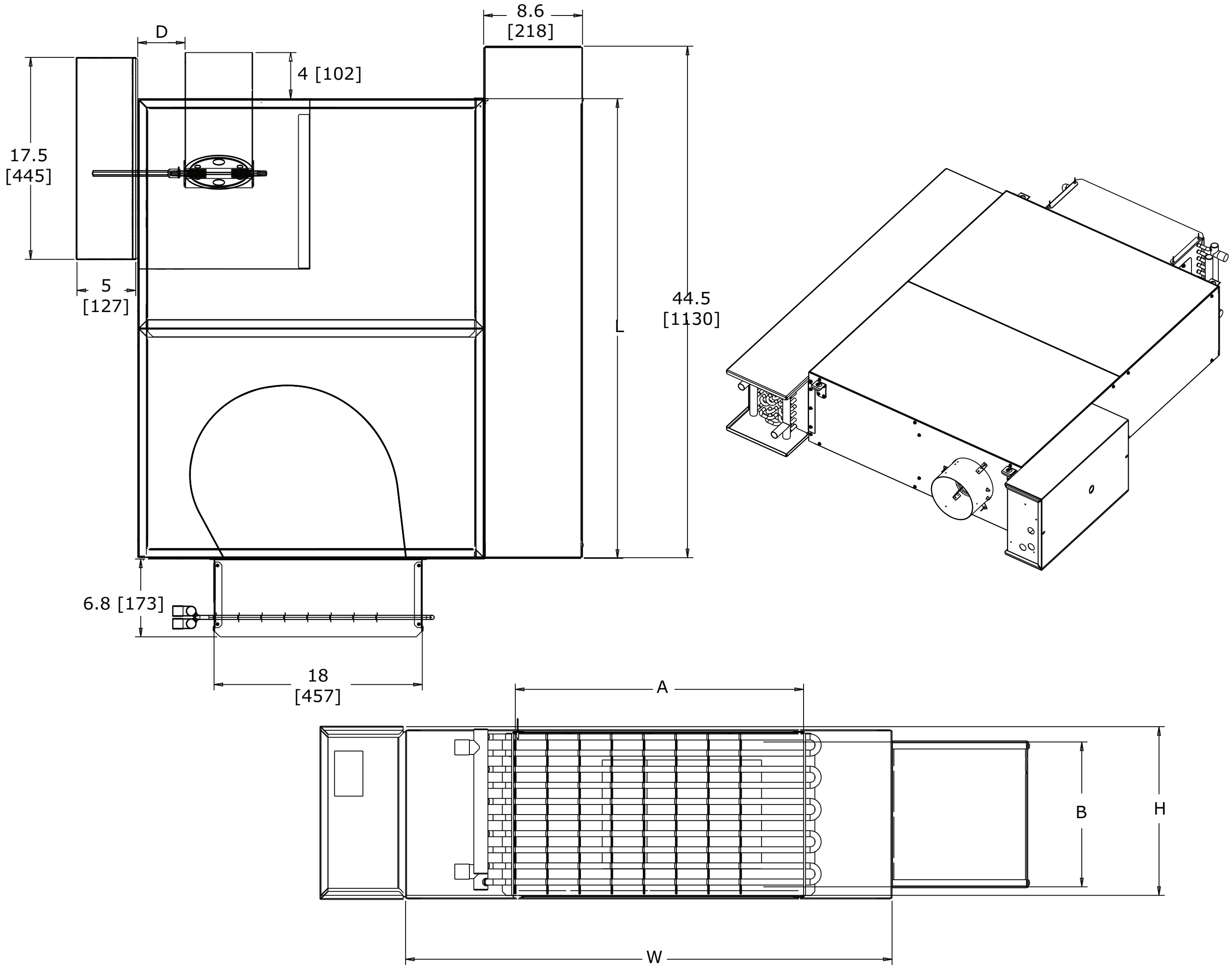



***Notes:***

- *Allow a minimum 6” (152mm) plenum inlet clearance for unducted installations.*
- *Flanged discharge outlet accepts up to a 1” (25mm) duct flange.*
- *Bottom access panel(s) standard.*
- *Control box enclosure provided with all control types*
- *Air valve centered between top and bottom panel*
- *All high and low voltage controls have same-side NEC jumpback clearance. (Left-hand shown, facing discharge. Unit can be flipped to right-hand orientation.)*

## Dimensions — Hot Water (LDWF)

**Figure 22. Chilled water sensible cooling terminal unit — hot water (LDWF)**

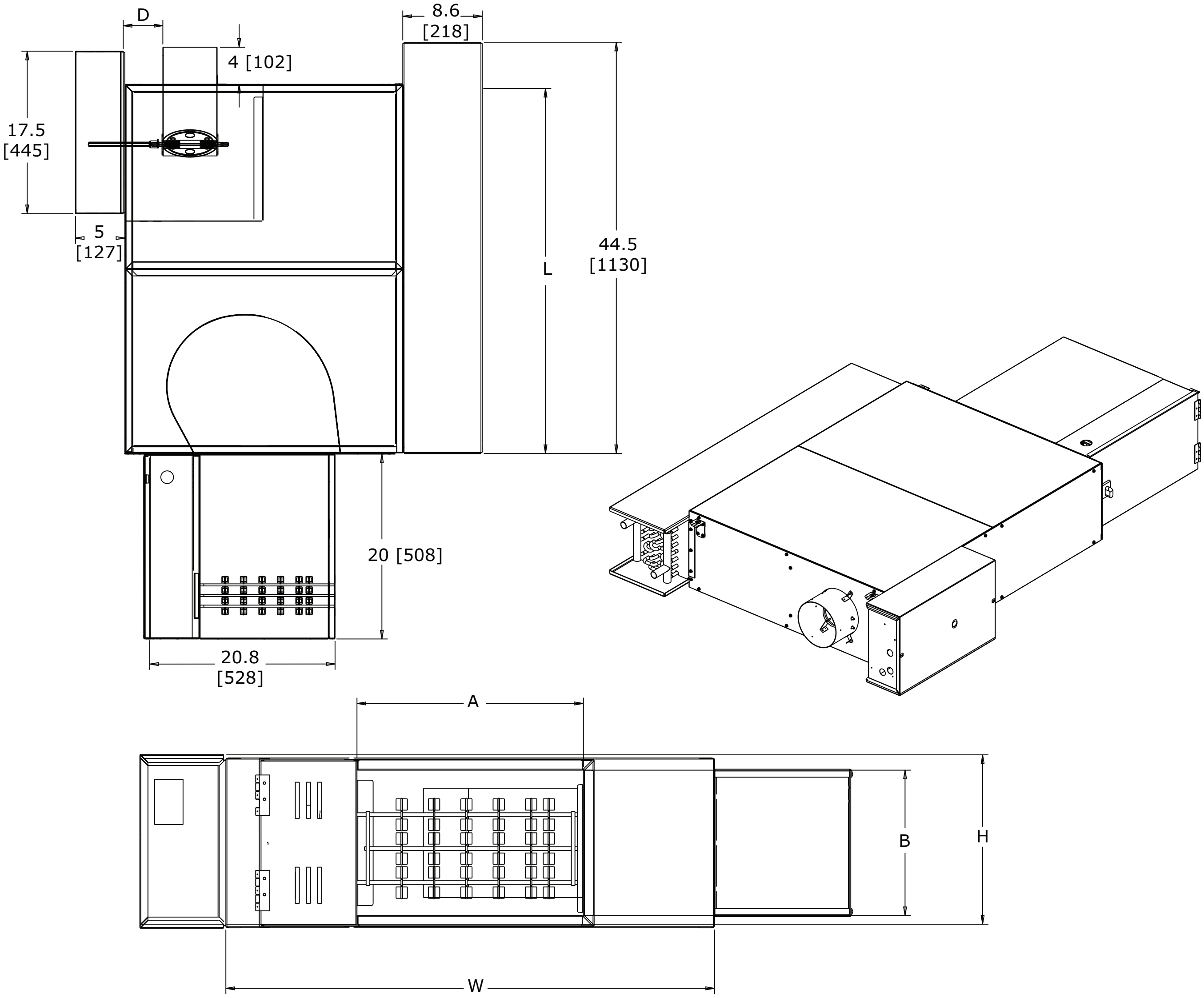



***Notes:***

- *Allow a minimum 6” (152mm) plenum inlet clearance for unducted installations.*
- *Flanged discharge outlet accepts up to a 1” (25mm) duct flange.*
- *Bottom access panel(s) standard.*
- *Control box enclosure provided with all control types*
- *Air valve centered between top and bottom panel*
- *Heating coil uninsulated. External insulation may be field supplied and installed as required.*
- *All high and low voltage controls have same-side NEC jumpback clearance. (Left-hand shown, facing discharge. Unit can be flipped to right-hand orientation.)*

## Dimensions — Electric Heat (LDEF)

**Figure 23. Chilled water sensible cooling terminal unit — electric heat (LDEF)**




***Notes:***

- *Allow a minimum 6” (152mm) plenum inlet clearance for unducted installations.*
- *Flanged discharge outlet accepts up to a 1” (25mm) duct flange.*
- *Bottom access panel(s) standard.*
- *Control box enclosure provided with all control types*
- *Air valve centered between top and bottom panel*
- *Electric heater uninsulated. External insulation may be field supplied and installed as required.*
- *All high and low voltage controls have same-side NEC jumpback clearance. (Left-hand shown, facing discharge. Unit can be flipped to right-hand orientation.)*

# Mechanical Specifications

## Chilled Water Sensible Cooling Terminal Unit Models: LDCF, LDWF, LDEF

LD = Low Height chilled water sensible cooling terminal unit

***Note:*** *L = Low Height*

### Model Details

- LDCF = cooling only
- LDWF = with hot water coil
- LDEF = with electric coil

### Casing

Galvanized steel, 22-gauge. Hanger brackets, bottom access and plenum filter are provided as standard.

### Agency Listing

Unit is UL and Canadian UL Listed as a room air terminal unit. Control # 9N65. AHRI 880 Certified.

### Insulation

**1/2–inch (12.7 mm) Matte-faced Insulation—**Interior surface of unit casing is acoustically and thermally lined with ½-inch, 1.5 lb/ft$^3$ (12.7 mm, 24.0 kg/m$^3$) composite density glass fiber with a high-density facing. Insulation R-Value is 1.9. Insulation is UL listed and meets NFPA-90A and UL 181 standards. There are no exposed edges of insulation (complete metal encapsulation).

**1–inch (25.4 mm) Matte-faced Insulation—**Interior surface of unit casing is acoustically and thermally lined with 1-inch, 1.0 lb/ft$^3$ (25.4 mm, 16.0 kg/m$^3$) composite density glass fiber with a high-density facing. Insulation R-Value is 3.85. Insulation is UL listed and meets NFPA-90A and UL 181 standards. There are no exposed edges of insulation (complete metal encapsulation).

**1–inch (25.4 mm) Foil-faced Insulation—** Interior surface of unit casing is acoustically and thermally lined with 1-inch, 1.0 lb/ft$^3$ (25.4 mm, 16.0 kg/m$^3$) density glass fiber with foil facing. Insulation R-Value is 3.85. Insulation is UL listed and meets NFPA-90A and UL 181 standards and bacteriological standard ASTM C 665. There are no exposed edges of insulation (complete metal encapsulation).

**1–inch (25.4 mm) Double-wall Insulation—**Interior surface of unit casing is acoustically and thermally lined with a 1-inch, 1.0 lb./ft$^3$ (25.4 mm, 16.0 kg/m$^3$) composite density glass fiber with high-density facing. Insulation R-value is 3.85. Insulation is UL listed and meets NFPA-90A and UL 181 standards. Insulation is covered by interior liner made of 26-gage galvanized steel. All wire penetrations are covered by grommets. There are no exposed edges of insulation (complete metal encapsulation).

**3/8–inch (9.5 mm) Closed-cell Insulation—**Interior surface of the unit casing is acoustically and thermally lined with 3/8-inch, 4.4 lb/ft$^3$ (9.5 mm, 70.0 kg/m$^3$) closed-cell insulation. Insulation is UL listed and meets NFPA-90A and UL 181 standards. Insulation has an R-Value of 1.4. There are no exposed edges of insulation (complete metal encapsulation).

### Air Valve

**Air Valve Round—**The primary (ventilation) air inlet connection is an 18-gauge galvanized steel cylinder sized to fit standard round duct. A multiple-point, averaging flow sensing ring is provided with balancing taps for measuring +/-5% of unit cataloged airflow. An airflow-versus-pressure differential calibration chart is provided. The damper blade is constructed of a closed-cell foam seal that is mechanically locked between two 22-gauge galvanized steel disks. The damper blade assembly is connected to a cast zinc shaft supported by self-lubricating bearings. The shaft is cast with a damper position indicator. The valve assembly includes a mechanical stop to prevent over-stroking.

## Fan Motor

### ECM

Electrically commutated motor (ECM) is designed for high-efficient operation with over 70% efficiency throughout the operating range. Motors will prevent backward rotation at start up. The motor and fan wheel assembly is isolated from the terminal unit.

## Transformer

The 50-VA transformer is factory installed in the fan control box to provide 24 VAC for controls.

## On/Off Switch

An on/off switch is provided as standard and allows the operator to turn the unit on or off by toggling to the appropriate setting. This switch breaks both legs of power to the fan and the electronic controls (if applicable).

## Outlet Connection

Flanged connection—Rectangular opening on unit discharge to accept 90° flanged ductwork connection.

## Filter

As standard, a 1 in (25 mm) filter is provided on the plenum inlet. Optionally, the unit can be configured with a 2 in (50 mm) MERV8 filter in lieu of the standard filter.

## Water Coil

### Hot Water Coils

Factory installed on the fan discharge. The coil has 1-row with 144 aluminum-plated fins per foot (0.305 m) or, if needed, 2-row with 144 aluminum-plated fins per foot (0.305 m). Full fin collars provided for accurate fin spacing and maximum fin-tube contact. The 3/8” (9.5 mm) OD seamless copper tubes are mechanically expanded into the fin collars. Coils are proof tested at 450 psig (3102 kPa) and leak tested at 300 psig (2068 kPa) air pressure under water. Coil connections are brazed. Gasketed access panels, which are standard, are attached with screws.

### Chilled Water Coils

Factory installed on the unit plenum inlet. The coils are 2, 4 or 6-rows with 120 aluminum-plated fins per foot (0.305 m). Full fin collars provided for accurate fin spacing and maximum fin-tube contact. The 3/8” (9.5 mm) OD seamless copper tubes are mechanically expanded into the fin collars. Coils are proof tested at 450 psig (3102 kPa) and leak tested at 300 psig (2068 kPa) air pressure under water. Each coil incorporates a drip pan on top and bottom for left or right-hand installations. Coil connections are brazed.

## Electric Heater

The electric heater is factory-provided and installed on the fan discharge. It is a UL recognized resistance open-type heater that contains a disc-type automatic pilot duty thermal primary cutout, and manual reset load carrying thermal secondary device. Heater element material is nickel-chromium. The heater terminal box is provided with 7/8” (22 mm) knockouts for customer power supply. Terminal connections are plated steel with ceramic insulators. All units with electric heat are single-point power connections.

## Electric Heat Options

**Silicon-Controlled Rectifier (SCR) —**Optional 0–10 Vdc electric heat control that provides modulation.

**Solid State Relay (SSR) –** Optional electric 24 Vac solid-state contactor(s) for use with direct digital controls.

**Magnetic Contactor —**Optional electric heater 24V contactor(s) for use with direct digital controls.

**Airflow Switch —** Optional air pressure device designed to disable heater when terminal fan is off.

**Power Fuse —**If a power fuse is chosen with a unit containing electric heat, then a safety fuse is located in the electric heater's line of power to prevent power surge damage to the electric heater. Any electric heat unit with a calculated MCA greater than or equal to 30 will have a fuse provided.

**Disconnect Switch —**A factory-provided door interlocking disconnect switch on the heater control panel disengages primary voltage to the terminal.

## Unit Controls Sequence Of Operation

See "Trane DDC Controller Logic," p. 59 Trane DDC Controller Logic section for sequence of operation.

## Direct Digital Controls

**DDC Actuator —**Trane 3-wire, 24-Vac, floating-point quarter turn control actuator with linkage release button. Actuator has a constant drive rate independent of load, a rated torque of 35 in-lb, a 90-second drive time, and is non-spring return. Travel is terminated by end stops at fully-opened and -closed positions. An integral magnetic clutch eliminates motor stall.

**DDC Actuator (Belimo) —** LMB24-3-T TN 3-wire, 24 Vac/Vdc, floating-point, quarter turn actuator with linkage release button. Actuator has constant drive rate independent of load, rated torque 45 in-lb, 95 sec drive time, and non-spring return. Travel is terminated by end stops at fully-opened and -closed positions. Internal electronic control prevents motor stall when motor reaches end stops.

**Direct Digital Controller —**Microprocessor-based terminal unit controllers provide accurate, pressure-independent control through the use of proportional integral control algorithm and direct digital control technology.

The controller, named the unit control module (UCM), monitors zone temperature setpoints, current zone temperature and its rate of change, and valve airflow using a differential pressure signal from the pressure transducer. Additionally, the controller can monitor either supply duct air temperature or $CO_2$ concentration via appropriate sensors. Controller is provided in an enclosure with 7/8–in. (22mm) knockouts for remote control wiring. Trane UCM zone sensor or Air-Fi® Receiver Interface Module paired with a Wireless Communications Sensor (WCS) is required.

**DDC Zone Sensor —**The UCM controller senses zone temperature through a sensing element located in the zone sensor. In addition to the sensing element, zone sensor options may include an externally-adjustable setpoint, communications jack for use with a portable edit device, and an override button to change the individual controller from unoccupied to occupied mode. The override button has a cancel feature that will return the system to unoccupied. Wired zone sensors utilize a thermistor to vary the voltage output in response to changes in the zone temperature. Wiring to the UCM controller must be 18- to 22-awg. twisted pair wiring. The setpoint adjustment range is 50 to 88°F (10 to 31°C). Depending upon the features available in the model of sensor selected, the zone sensor may require from a 2-wire to a 5-wire connection. Wireless zone sensors report the same zone information as wired zone sensors, but do so using radio transmitter technology. Therefore with wireless, wiring from the zone sensor to the UCM is unnecessary.

**Digital Display Zone Sensor with Liquid Crystal Display (LCD) —** Digital display zone sensor contains a sensing element, which signals the UCM. A Liquid Crystal Display (LCD) displays setpoint or zone temperature. Sensor buttons allow user to adjust setpoints, and allow zone temperature readings to be turned on or off. Digital display zone sensor also includes a communication jack for use with a portable edit device, and an override button to change UCM from unoccupied to occupied. Override button cancel feature returns system to unoccupied mode.

## Power Fuse

Optional fuse is factory installed in the primary voltage hot leg.

## Trane Water Valve

The valve is a field-adaptable, 2-way or 3-way configuration and ships with a plug in B port. This configures the valve for 2-way operation. For 3-way operation, remove the plug. The intended fluid is water or water and glycol (50% maximum glycol). The actuator is a synchronous motor drive. The valve is driven to a predetermined position by the UCM controller using a proportional plus integral control algorithm. If power is removed, the valve stays in its last position. The actuator is rated for plenum applications under UL 2043 and UL 873 standards.

- Pressure and temperature ratings: The valve is designed and tested in full compliance with ANSI B16.15 Class 250 pressure/temperature ratings, ANSI B16.104 Class IV control shutoff leakage, and ISA S75.11 flow characteristic standards.
- Flow capacity: 0.70 Cv, 1.7 Cv, 2.7 Cv, 5.0 Cv
- Overall diameter: ½–in. NPT
- Maximum allowable pressure: 300 psi (2068 kPa)
- Maximum operating fluid temperature: 201ºF (94°C)
- Maximum close-off pressure: 60 psi (0.4 MPa)
- Electrical rating: 3VA at 24 VAC
- 8–in. plenum rated cable with AMP Mate-N-Lok connector

## Belimo Water Valve

The intended fluid is water or water and glycol (50% maximum glycol). The actuator is a synchronous motor drive. The valve is driven to a predetermined position by the UCM controller using a proportional plus integral control algorithm. If power is removed, the valve stays in its last position. The actuator is rated for plenum applications under UL 2043 and UL 873 standards.

- Pressure and temperature ratings: The valve is designed and tested in full compliance with ANSI B16.15 Class 250 pressure/temperature ratings, ANSI B16.104 Class IV control shutoff leakage, and ISA S75.11 flow characteristic standards.
- Flow capacity: 0.3 Cv, 0.46 Cv, 0.8 Cv, 1.2 Cv, 1.9 Cv, 3.0 Cv, 4.7 Cv
- Overall diameter: ½–in. NPT
- Maximum allowable pressure: 600 psi (4137 kPa)
- Maximum operating fluid temperature: 201ºF (94°C)
- Maximum close-off pressure: 200 psi (1379 kPa)
- Electrical rating: 1VA at 24 VAC
- 8-in. plenum rated cable with AMP Mate-N-Lok connector.

# Unit Conversions

### Table 29. Conversions of length and area

| To convert | From | To | Multiply by |
|---|---|---|---|
| Length | in. | m | 0.0254 |
| | ft | m | 0.3048 |
| | m | in. | 39.3701 |
| | m | ft | 3.28084 |
| Area | $in^2$ | $m^2$ | 0.00064516 |
| | $ft^2$ | $m^2$ | 0.092903 |
| | $m^2$ | $in^2$ | 1550 |
| | $m^2$ | $ft^2$ | 10.7639 |

### Table 30. Conversions of velocity, pressure, and flow rate

| To convert | From | To | Multiply by |
|---|---|---|---|
| Velocity | ft/min | M/s | 0.00508 |
| | M/s | ft/min | 196.850 |
| Pressure | Psi | Pa | 6894.76 |
| | ft of water | Pa | 2988.98 |
| | in of water | Pa | 249.082 |
| | Pa | Psi | 0.0001450380 |
| | Pa | ft of water | 0.000334562 |
| | Pa | in of water | 0.00401474 |
| Flow Rate | Cfm | L/s | 0.4719 |
| | Cfm | $m^3/s$ | 0.000471947 |
| | Gpm | L/s | 0.0630902 |
| | $m^3/s$ | Cfm | 2118.88 |
| | L/s | Cfm | 2.1191 |
| | L/s | Gpm | 15.8503 |

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