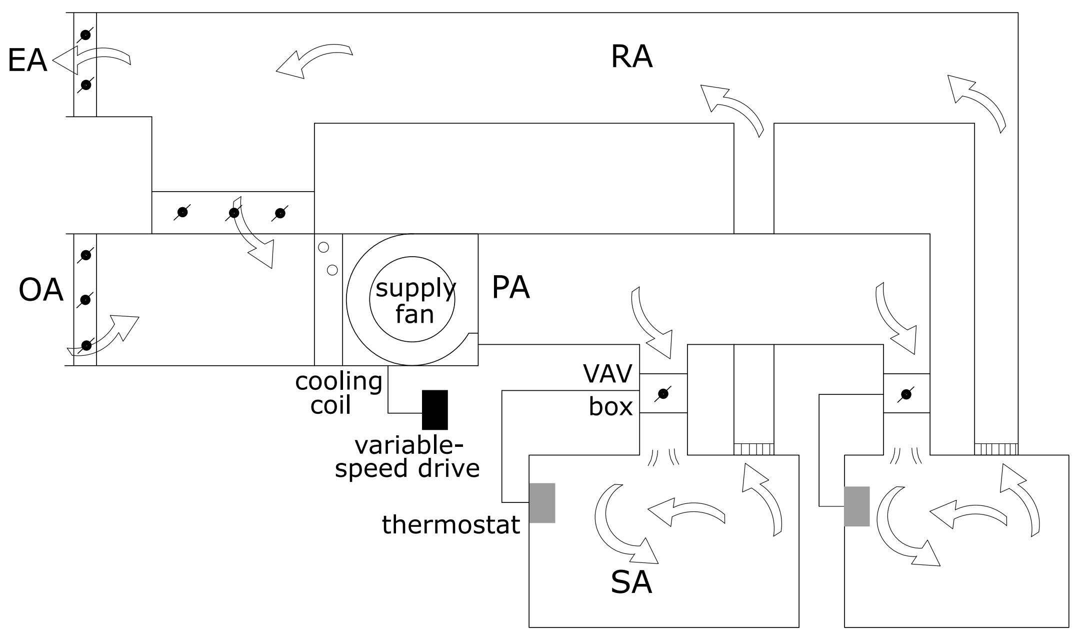
Product Catalog

VariTrane™ Products Single Duct/Dual Duct Units

VCC, VCW, VCE, VDD

Variable-Air-Volume (VAV) System



October 2025

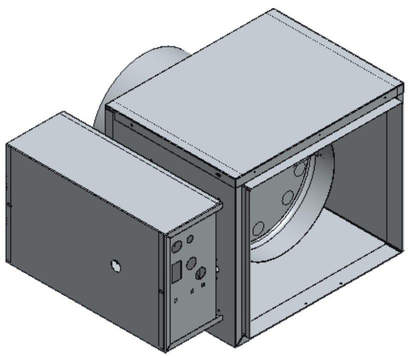
VAV-PRC011AF-EN

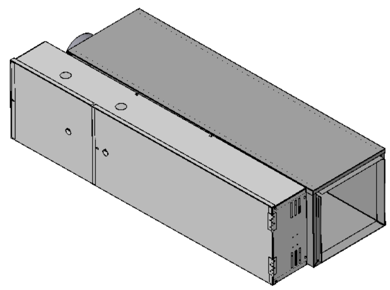
Introduction

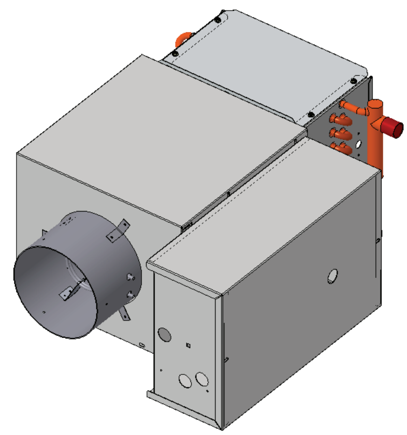
VariTrane™ variable-air-volume (VAV) units lead the industry in quality and reliability and are designed to meet the specific needs of today applications. This generation of VariTrane units builds upon the history of quality and reliability and expands the products into the most complete VAV offering in the industry.

Single-duct units provide an economical energy-savings system solution. This is the most common type of VAV unit.

Dual-duct units have two air valves. One heating valve and one cooling air valve modulate to provide occupant comfort. Alternatively, one valve is for conditioned recirculated air and the other is for outdoor air.







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Revision History

Updated Unit Attenuation topic in Application Considerations chapter.

Table of Contents

Features and Benefits

Construction

UL-Listed Products

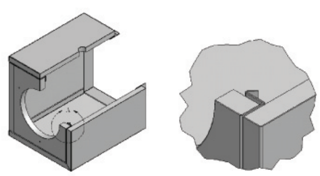
All VariTrane™ Units are listed in accordance with UL as terminal units. This listing includes the terminal with electric heaters. Additionally, all insulation materials pass UL 25/50 smoke and flame safety standards.

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.

Casing Design

Ultra-low Air leakage Unit Casing – VariTrane™ single duct units have been meticulously designed to provide industry leading air leakage performance. Utilizing a robust panel construction scheme and state of the art manufacturing processes, each unit is produced top rovide reliable performance. Trane's ultra-low leak casing meets the demands of the most stringent applications where reduced energy consumption and operating cost are critical. See, Table 20, p. 21 for air leakage performance data.



Metal Encapsulated Edges— All VariTrane™ 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. The Trane Air Valve provides best in class air leakage performance. See, Table 20, p. 21 for air leakage performance data.

Trane Air Valve— Ventilation airflow is measured and controlled here for VariTrane™ units. VariTrane™ products are the most rugged and reliable available. The Trane Air Valve provides best in class air leakage performance. See, Table 20, p. 21 for air leakage performance data.

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

System design should consider applicable ventilation and IAQ standards.(Contact your local Trane Sales Engineer for additional information). Good indoor air quality results from units and systems which:

- Provide the required amount of ventilation air to each zone during all operating conditions.

- Limit particulates from entering occupied spaces.

VariTrane™ 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.

VariTrane™ VAV units are the most prepared IAQ units in the industry. The end result is a reliable product designed for peak performance, regardless of job site conditions or handling.

Factory Installed Piping Packages

Single Duct VAV boxes with Hot Water Heating Coils can be provided with factory installed piping packages. Trane factory installed piping packages reduce project installed cost and risk by:

- Reducing time for field labor and coordination required for field provided and installed piping packages.
- Protecting piping package from shipping and handling damage with piping package enclosure as standard.
- Providing flexibility for piping connection sides with field flip-able unit.
- Leak testing all coils and piping package assemblies at the factory.
- Automatic control valves pre-wired to the unit controller and sequence factory programmed.

Tracer Building Automation System

Tracer® Building Automation Systems confirm comfort within your building.

Building controls have a bigger job description than they did a few years ago. It is 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 will:

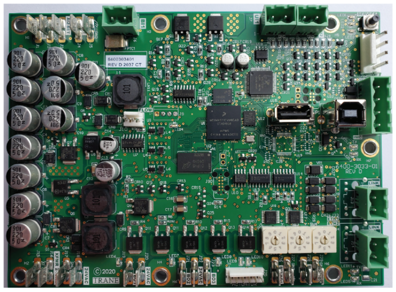
- Reduce operating costs through energy management strategies.
- Consistently provide occupant comfort.
- Enjoy reliable operation with standard, pre-engineered, and pretested applications.
- Easily troubleshoot and monitor either on site or from a remote location.
- Reduce installation time and simplify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

Whether factory-mounted or field-installed, Trane offers a wide range of controllers to suit virtually any application. These units are compatible with a variety of building types and can be used for new construction or renovation. Through extensive usability testing internally and with building operators, we've designed our controls for real world ease of use.

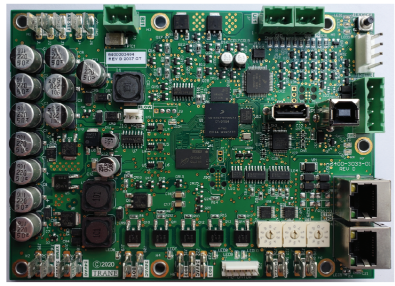
Tracer BACnet Controllers

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 for the VAV units to be installed.

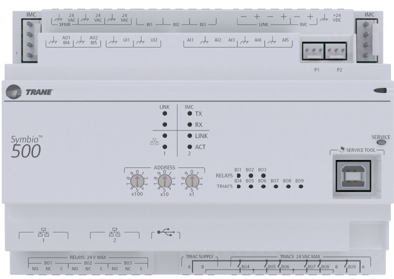
Symbio™ 210 BACnet® Controller



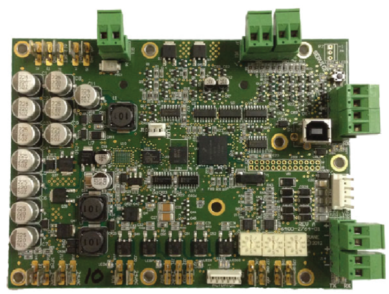
Symbio™ 210e BACnet® Controller



Symbio™ 500 Controller



UC210 BACnet® Controller



Air-Fi® Wireless System

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

- *Air-Fi® Wireless Systems - Installation, Operation, and Maintenance* (BAS-SVX40*-EN)
- *Air-Fi® Wireless Product Systems - Product Data Sheet* (BAS-PRD021*-EN)
- *Air-Fi® Network Design - Installation, Operation, and Maintenance* (BAS-SVX55*-EN)

Air-Fi® Wireless Communications Interface (WCI)

A factory-installed Air-Fi® Wireless Communications Interface (WCI) provides wireless communication between the Tracer® SC, Tracer® UC210, Symbio™ 210/Symbio™ 210e/ 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.

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 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
Testing of electric heat contactors and fan relay	—	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)	—	—
Duct temperature sensor	X	X
Pre-wired water valve harness	X	X

Trane VAV Systems — Proven Performance

Trane is the industry leader in VAV systems, including factory-commissioned controls and integration with other control systems. This leadership began with customers seeking the most reliable VAV products in the industry. The solution was factory-commissioned controls (see "Factory-installed vs. Factory-commissioned," p. 9). Since then, it has developed to include optimized system control strategies.

Control strategies are often made more complicated than necessary. VariTrane™ DDC controls simplify control strategies by pre-engineering control logic and sequencing into the controller. This information is available via a twisted-shielded wire pair or wireless communication, and accessible via a Trane Tracer® SC.

Optimized system control strategies, such as ventilation optimization, fan-pressure optimization, and optimal start/stop, are pre-engineered in VariTrane™ unit-level DDC controllers and the Tracer® SC building automation system.

This allows a Trane VAV system to meet or exceed the latest ASHRAE 90.1 Energy Efficiency standards. Pre-engineered controls allow consistent, high quality installations which are very repeatable. The end result is PROVEN control strategies you can rely on to perform.

Purchasing VAV controllers and VAV hardware from a single manufacturer provides a single contact for all HVAC system related questions.

Indoor Air Quality Management During Construction

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

Model Number Descriptions

Single-Duct VAV Units

Digit 1, 2 — Unit Type

VC = VariTrane™ Single—Duct

Digit 3 — Reheat

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

Digit 4 — Development Sequence

F = Sixth

Digit 5, 6 — Primary Air Valve

04 = 4–inch inlet (225 cfm)
05 = 5–inch inlet (350 cfm)
06 = 6–inch inlet (500 cfm)
08 = 8–inch inlet (900 cfm)
10 = 10–inch inlet (1400 cfm)
12 = 12–inch inlet (2000 cfm
14 = 14–inch inlet (3000 cfm)
16 = 16–inch inlet (4000 cfm)
24 = 24–inch x 16–inch inlet (8000 cfm)

Digit 7, 8, 9 — Not Used

000 = N/A

Digit 10, 11 — Design Sequence

M0 = New Hot Water Coil

Digit 12, 13, 14, 15 — Controls

DD00 = Trane Actuator Only and Enclosure
DD71 = UC210 DDC- Basic (No water or Electric heat)
DD72 = UC210 DDC- Basic (Water heat- N.C. 2-position)
DD73 = UC210 DDC- Basic (Water heat- Modulating)
DD74 = UC210 DDC- Basic (Electric heat- Staged)
DD75 = UC210 DDC- Basic (Electric heat- PWM)
DD76 = UC210 DDC Ventilation flow- cooling only
DD77 = UC210 DDC- Basic (Water heat- N.O. 2-position)

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

DD79 = UC210 DDC- Flow Tracking (Cooling only)
DD80 = UC210 DDC- Ventilation Flow (Water heat- N.C. 2-position)
DD81 = UC210 DDC- Ventilation Flow (Electric heat- Staged)
DD82 = UC210 DDC- Ventilation Flow (Water heat- Modulating)
DD83 = UC210 DDC- Basic plus- Local (Electric heat- PWM) Remote (Staged EH)
DD84 = UC210 DDC- Basic plus- Local (Water heat- Modulating) Remote (Water- N.C. 2-position)
DD85 = UC210 DDC- Basic plus- Local (Water heat- Modulating) Remote (Water- N.O. 2-position)
DD86 = UC210 DDC- Basic plus- Local (Water heat- N.O. 2-position) Remote (Water- Modulating)
DD87 = UC210 DDC- Basic plus- Local (Water heat- N.C. 2-position) Remote (Water- Modulating)
DD88 = UC210 DDC- Basic plus- Local (Water heat- N.O. 2-position) Remote (Water- N.O. 2-position)
DD89 = UC210 DDC- Basic plus- Local (Water heat- N.C. 2-position) Remote (Water- N.C. 2-position)
DD90 = UC210 DDC- Basic plus- Local (Water heat- N.O. 2-position) Remote (Water- N.C. 2-position)
DD91 = UC210 DDC- Basic plus- Local (Water heat- N.C. 2-position) Remote (Water- N.O. 2-position)
DD92 = UC210 DDC- Basic plus- Local (Electric heat- Staged) Remote (Staged EH)
DD93 = UC210 Ventilation Flow (Water heat- N.O. 2-position)
DD95 = UC210 Basic (Electric Heat Modulating SCR)
DD96 = UC210 Basic plus- Local (Electric heat- Modulating SCR) Remote (Staged EH)
DD97 = UC210 Ventilation Flow (Electric heat- Modulating SCR)
ENCL = Shaft Only in Enclosure
FM00 = Other Actuator and Control
FM01 = Trane Supplied Actuator, Other Control
N.C. = Normally-Closed
N.O. = Normally-Open
FM = Factory Installation of Customer-supplied Controllers
SE41 = Symbio™ 500 DDC- Basic (Cooling only)
SE42 = Symbio™ 500 DDC- Basic (Water heat - N.C. 2-position)
SE43 = Symbio™ 500 DDC- Basic (Water heat -Modulating)

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

SE44 = Symbio™ 500 DDC- Basic (Electric heat -Staged)
SE45 = Symbio™ 500 DDC- Basic (Electric heat -PWM)
SE46 = Symbio™ 500 DDC- Ventilation Flow (no reheat)
SE47 = Symbio™ 500 DDC- Basic (Water heat - N.O. 2-position)
SE49 = Symbio™ 500 DDC- Flow track (Cooling only)
SE50 = Symbio™ 500 DDC- Ventilation Flow (N.C. 2-position)
SE51 = Symbio™ 500 DDC- Ventilation Flow (Electric heat - Staged)
SE52 = Symbio™ 500 DDC- Ventilation Flow (Water heat-Modulating)
SE53 = Symbio™ 500 DDC- Basic plus Local (Electric heat - PWM) Remote (Staged)
SE54 = Symbio™ 500 DDC- Basic plus Local (Water heat Modulating) Remote (Water N.C. 2-position)
SE55 = Symbio™ 500 DDC- Basic plus Local (Water heat Modulating) Remote (Water N.O. 2-position)
SE56 = Symbio™ 500 DDC- Basic plus Local (Water heat - N.O. 2-position) Remote (Water- Modulating)
SE57 = Symbio™ 500 DDC- Basic plus Local (Water heat - N.C. 2-position) Remote (Water- Modulating)
SE58 = Symbio™ 500 DDC- Basic plus Local (Water heat - N.O. 2-position) Remote (Water N.O. 2-position)
SE59 = Symbio™ 500 DDC- Basic plus Local (Water heat - N.C. 2-position) Remote (Water N.C. 2-position)
SE60 = Symbio™ 500 DDC- Basic plus Local (Water heat - N.O. 2-position) Remote (Water N.C. 2-position)

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

SE61 = Symbio™ 500 DDC- Basic plus Local (Water heat - N.C. 2-position) Remote (Water N.O. 2-position)
SE62 = Symbio™ 500 DDC- Basic plus Local (Electric heat - Staged) Remote (Staged)
SE63 = Symbio™ 500 DDC -Ventilation Flow (water heat - N.O. 2-position)
SE65 = Symbio™ 500 DDC- Control with modulating SCR
SE66 = Symbio™ 500 DDC- Space temp control with local SCR and remote stage electric heat
SE67 = Symbio™ 500 DDC- Ventilation Flow with SCR electric heat
SE71 = Symbio™ 210e DDC- Basic (Cooling only)
SE72 = Symbio™ 210e DDC- Basic (Water heat - N.C. 2-position)
SE73 = Symbio™ 210e DDC- Basic (Water heat -Modulating)
SE74 = Symbio™ 210e DDC- Basic (Electric heat - Staged)
SE75 = Symbio™ 210e DDC- Basic (Electric heat - PWM)
SE76 = Symbio™ 210e DDC- Ventilation Flow (no reheat)
SE77 = Symbio™ 210e DDC- Basic (Water heat - N.O. 2-position)
SE79 =Symbio™ 210e DDC- Flow track (Cooling only)
SE80 =Symbio™ 210e DDC- Ventilation Flow (N.C. 2-position)
SE81 = Symbio™ 210e DDC- Ventilation Flow (Electric heat - Staged)
SE82 = Symbio™ 210e DDC- Ventilation Flow (Water heat-Modulating)
SE83 = Symbio™ 210e DDC- Basic plus Local (Electric heat - PWM) Remote (Staged)
SE84 = Symbio™ 210e DDC- Basic plus Local (Water heat Modulating) Remote (Water N.C. 2-position)
SE85 = Symbio™ 210e DDC- Basic plus Local (Water heat Modulating) Remote (Water N.O. 2-position)
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SE91 = Symbio™ 210e DDC- Basic plus Local (Water heat - N.C. 2-position) Remote (Water N.O. 2-position)
SE92 = Symbio™ 210e DDC- Basic plus Local (Electric heat - Staged) Remote (Staged)
SE93 = Symbio™ 210e DDC -Ventilation Flow (water heat - N.O. 2-position)
SE95 = Symbio™ 210e DDC- Control with modulating SCR

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

SE96 = Symbio™ 210e DDC- Space temp control with local SCR and remote stage electric heat
SE97 = Symbio™ 210e DDC- Ventilation Flow with SCR electric heat
SY71 = Symbio™ 210 DDC- Basic (Cooling only)
SY72 = Symbio™ 210 DDC- Basic (Water heat - N.C. 2-position)
SY73 = Symbio™ 210 DDC- Basic (Water heat-Modulating)
SY74 = Symbio™ 210 DDC- Basic (Electric heat - Staged)
SY75 = Symbio™ 210 DDC- Basic (Electric heat - PWM)
SY76 = Symbio™ 210 DDC- Ventilation Flow (no reheat)
SY77 = Symbio™ 210 DDC- Basic (Water heat - N.O. 2-position)
SY79 = Symbio™ 210 DDC- Flow track (Cooling only)
SY80 = Symbio™ 210 DDC- Ventilation Flow (N.C. 2-position)
SY81 = Symbio™ 210 DDC- Ventilation Flow (Electric heat - Staged)
SY82 = Symbio™ 210 DDC- Ventilation Flow (Water heat-Modulating)
SY83 = Symbio™ 210 DDC- Basic plus Local (Electric heat - PWM) Remote (Staged)
SY84 = Symbio™ 210 DDC- Basic plus Local (Water heat Modulating) Remote (Water N.C. 2-position)
SY85 = Symbio™ 210 DDC- Basic plus Local (Water heat Modulating) Remote (Water N.O. 2-position)
SY86 = Symbio™ 210 DDC- Basic plus Local (Water heat - N.O. 2-position) Remote (Water-Modulating)
SY87 = Symbio™ 210 DDC- Basic plus Local (Water heat - N.C. 2-position) Remote (Water-Modulating)
SY88 = Symbio™ 210 DDC- Basic plus Local (Water heat - N.O. 2-position) Remote (Water N.O. 2-position)
SY89 = Symbio™ 210 DDC- Basic plus Local (Water heat - N.C. 2-position) Remote (Water N.C. 2-position)
SY90 = Symbio™ 210 DDC- Basic plus Local (Water heat - N.O. 2-position) Remote (Water N.C. 2-position)
SY91 = Symbio™ 210 DDC- Basic plus Local (Water heat - N.C. 2-position) Remote (Water N.O. 2-position)
SY92 = Symbio™ 210 DDC- Basic plus Local (Electric heat - Staged) Remote (Staged)
SY93 = Symbio™ 210 DDC -Ventilation Flow (Water heat - N.O. 2-position)
SY95 = Symbio™ 210 DDC- Control with Modulating SCR
SY96 = Symbio™ 210 DDC- Space temp control with local SCR and Remote Stage Electric Heat
SY97 = Symbio™ 210 DDC- Vent Flow with SCR Electric Heat

Digit 16 — Insulation

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

Digit 17, 18 — Not Used

00 = Not Applicable

Digit 19 — Not Used

0 = Not Applicable

Digit 20 — Not Used

0 = Not Applicable

Digit 21 — Water Coil

0 = None
1 = 1 Row
2 = 2 Row
3 = 3 Row
4 = 4 Row
A = 1 Row Premium
B = 2 Row Premium
C = 3 Row Premium
D = 4 Row Premium

Digit 22 — Electrical Connections

F = Able to Flip for LH/RH Connections (VCEF Only)
L = Left, Airflow hits in face
R = Right, Airflow hits in face
0 = Opposite side connection, coil and control (VCWF Only)

Note: *VCCF/VCWF can be flipped in field for opposite connections.*

Digit 23 — Transformer

0 = None
1 = 120/24V, 50 VA
2 = 208/24V, 50 VA
3 = 240/24V, 50 VA
4 = 277/24V, 50 VA
5 = 480/24V, 50 VA
6 = 347/24V, 50 VA
7 = 380/24V, 50 VA
8 = 575/24V, 50 VA

Note: *For VCEF units with transformers the VA depends on the staging, control, and contactor type (ranges are 50 VA or 75 VA)*

Digit 24 — Disconnect Switch

0 = None
W = With

Note: *VCCF/VCWF— toggle disconnect. VCEF-door interlocking power disconnect.*

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
G = 347/60/1
H = 575/60/3
J = 380/50/3
K = 120/60/1

Digit 27, 28, 29 — Electric Heat kW

000 = None
010 = 1.0 kW
015 = 1.5 kW
460 = 46.0 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 46.0 kW in 2 kW increments*

Digit 30 — Electric Heat Stages

0 = None
1 = 1 Stage
2 = 2 Stages Equal
3 = 3 Stages Equal

Digit 31 — Electric Heat Contactors

0 = None
1 = 24V Magnetic
5 = 0 to 10Vdc SCR Heat; Symbio™ 210/210e, Symbio™ 500, UC200
6 = 0 to 10Vdc SCR Heat; FMTD/ENCL/DD00
7 = 24V SSR (Solid State Relay)

Digit 32, 33 — Not Used

00 = Not Applicable

Digit 34 — Actuator

0 = Standard
A = Spring Return, Normally Open
B = Spring Return, Normally Closed
C = Belimo™ Actuator
G = Trane Analog Actuator (Symbio™ 210/210e, Symbio™ 500, UC210)

Digit 35 — Sensor Options

0 = Standard, Wired
3 = Trane Air-Fi® Wireless Communications Interface

Digit 36 — Pre-wired Factory Solutions

0 = None
1 = Factory Wired Duct Temperature Sensor (DTS)
2 = HW Valve Harness
3 = Both Factory Wired DTS/HW Valve Harness
4 = Averaging DTS Factory-installed in Unit (Required Symbio™ 210/210e, Symbio™ 500, UC210, w/SCR Heat)
5 = Duct Temperature Sensor - Factory Mounted
6 = Factory-mounted DTS and HWV Harness

Digit 37 — Integral Attenuator with Cam Lock Bottom Access
0 = None
1 = Attenuator and Bottom Access - Left Side Controls
2 = Attenuator and Bottom Access - Right Side Controls
3 =Attenuator and Bottom Access - Left Side Controls, Right Side Water Coil Connections
4 = Attenuator and Bottom Access - Right Side Controls, Left Side Water Coil Connections
5 = Attenuator Only

Digit 38 — 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
Q = 2-Way Standard Valve Factory Mounted Piping Package, Floating Point Actuator
R = 3-Way Standard Valve Factory Mounted Piping Package, Floating Point Actuator
S = 2-Way Belimo Valve Factory Mounted Piping Package, Floating Point Actuator
T = 3-Way Belimo Valve Factory Mounted Piping Package, Floating Point Actuator
U = 2-Way Belimo Valve Factory Mounted Piping Package, Analog Actuator
V = 3-Way Belimo Valve Factory Mounted Piping Package, Analog Actuator

Digit 39 — 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™ 210/210e, Symbio™ 500, UC210)
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 — Flow Rate

0 = None
A = 0.5 gpm, 0.03 l/s
B = 1.0 gpm, 0.06 l/s
C = 1.5 gpm, 0.09 l/s
D = 2.0 gpm, 0.13 l/s
E = 2.5 gpm, 0.16 l/s
F = 3.0 gpm, 019 l/s
G = 3.5 gpm, 0.22 l/s
H = 4.0 gpm, 0.25 l/s
J = 4.5 gpm, 0.28 l/s
K = 5.0 gpm, 0.31 l/s
L = 5.5 gpm, 0.35 l/s
M = 6.0 gpm, 0.38 l/s
N = 6.5 gpm, 0.41 l/s
P = 7.0 gpm, 0.44 l/s
Q = 7.5 gpm, 0.47 l/s
R = 8.0 gpm, 0.50 l/s
S = 9.0 gpm, 0.57 l/s
T = 10.0 gpm, 0.63 l/s
U = 11.0 gpm, 0.69 l/s
V = 12.0 gpm, 0.76 l/s

Digit 41 — Air Leakage Class

0 = Standard Air Leakage
1 = Certified Ultra-Low Air Leakage

Single-Duct VAV Terminal Units

Selection Procedure

This section describes the catalog selection of single-duct VAV terminal units with specific examples. A computer selection program is also available to aid in selection of VAV terminal units. Selection of single-duct VAV terminal units can involve three elements:

- Air valve selection
- Heating coil selection (if required)
- Acoustics controls

Air Valve Selection

The wide-open static pressure and airflows are found in the performance data section of the catalog. To select an air valve, locate the required design cooling airflow for your terminal unit type and find the smallest air valve size that has a pressure drop equal to or lower than the maximum wide-open static pressure requirement.

Example: Cooling Only VCCF Terminal Unit

- Design cooling airflow: 1700 cfm
- Maximum wide open Air pressure drop: 0.25-inch wg
- Minimum cooling airflow: 850 cfm

From the performance data charts, select a valve size 12, which has a wide-open static pressure drop of 0.01-inch wg

Check the minimum and maximum cfm desired with the minimum and maximum cfm allowed in the table in the general data section. The maximum setting of 1700 cfm is within the acceptable range. The desired minimum setting of 850 cfm is acceptable for the cooling only box desired. Note that if an electric reheat box was selected, the minimum cfm would be dependent upon the kW of the electric heater. (See Electric Heat Unit Selection.)

Heating Coil Selection (If Required)

First, determine the amount of heat required to meet space and downstream duct heat losses from a load calculation.

Hot Water Heat

Select a hot water coil sufficient to meet the design heat loss.

Example: VCWF, Hot Water Unit Heat, Size 12 (See “Air Valve Selection,” p. 14)

- Heating airflow: 850 cfm
- Hot water flow: 1.0 gpm
- Design Heat Loss: Q = 25 MBh

Select hot water coil from the coil performance table in the Performance Data section of the catalog.

Selection:

A one-row coil is sufficient to meet design conditions. From the Hot Water Coil Capacity Data of the Performance Data Section, a one-row coil for a size 12 air valve will operate at the above conditions as follows:

- Coil Capacity: 25.17 MBh
- Water pressure drop: 0.72 ft WPD
- Air pressure drop (APD) of the hot water coil is included in the chart preceding the hot water coil performance data section.
- APD = 0.35 in. wg

Electric Heat

Determine the kW required to meet zone design heat loss.

- kW = MBh / 3.414
- MBh = Design Heat Loss

Select the nearest available kW with voltage and steps desired from the electric heater kW guideline table in the Performance Data section of the catalog.

Example: VCEF, Electric Unit Heat, Size 12 (See “Air Valve Selection,” p. 14)

- Heating airflow: 850 cfm

- Voltage: 277/60/1 VAC
- Design Heat Loss: Q = 25 MBh
- kW = Q/3.414
- kW = 25/3.414
- kW = 7.3

Selection:

Select 7.5 kW from the electric heat table in the voltage and stages required. The table shows the minimum cfm allowable for the kW selected. The static pressure requirement is shown as 0.06 in. wg for this example with a design cooling flow of 1700 cfm.

Check Leaving Air Temperature:

$$LAT = \frac{Q}{1.085 \times CFM} + T$$

T is the primary air temperature 55°F for this example.

$$LAT = \frac{3414 \times 7.5}{1.085 \times 850} + 55 = 82.8$$

Decide if leaving air temperature of 82.8°F is satisfactory for your application.

Acoustics

The acoustical data found in the VAV catalog is used to determine sound the terminal unit will generate. Locate the table for the VAV terminal unit of interest. Sound power data and an equivalent NC level for an AHRI 885-2008 transfer function is listed.

Example: VCCF, Cooling-Only Terminal Unit, Size 10 (See "Air Valve Selection," p. 14)

- Cooling Airflow: 1100 cfm
- Maximum inlet static pressure: 1.5-inch wg

Interpolation gives sound power data of:

Octave Band	2	3	4	5	6	7	NC
Discharge Sound Power	68	68	65	65	60	57	28
Radiated Sound Power	63	58	54	47	39	32	29

The NC level above is determined by using either the catalog's AHRI 885-2008 (mineral fiber for radiated sound) transfer function for the conditions shown in the acoustics table. A different transfer function could be applied as conditions dictate.

The maximum NC level is NC-29. If the maximum NC level was exceeded, it would have been necessary to reselect the next larger unit size.

Trane Select Assist™

Trane Select Assist™ is an online tool used to determine properly sized VariTrane™ VAV terminal unit and resulting performance data for specific input specifications. In addition to selection of VAV terminal unit configuration selections, Trane Select Assist also includes most other Trane products, allowing user to select all required equipment within the one program.

Within the tool, required fields are denoted by red shading, and for VAV terminal units include maximum and minimum airflows, control type, and unit model. (Models with reheat have additional required fields.) The user has the option of viewing information for an individual selection on one screen, or as a schedule with all VAV units required for the specific application.

Trane Select Assist also calculates sound power data for the selected terminal unit. Input is either maximum individual sound level for each octave band, or maximum NC value. Trane Select Assist will calculate acoustical data subject to default or user-supplied sound attenuation data.

Schedule View: The program has many time saving features such as:

- Copy/paste from spreadsheets like Microsoft® Excel
- Easily arrange fields to match your schedule

- Time-saving templates to store default settings

The use can also export the schedule view to Excel for modification or inclusion in engineering drawings as a schedule. Details regarding the program, its operation, and instructions on obtaining a copy are available from your local Trane sales office.

General Data

Table 2. 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/ Symbio™ 210, Symbio™ 210e, Symbio™ 500, and UC210	4	225	25-225	0,25-225	25-225
	5	350	40-350	0,40-350	40-350
	6	500	60-500	0,60-500	60-500
Direct Digital Control/ Symbio™ 210, Symbio™ 210e, Symbio™ 500, and UC210	8	900	105-900	0,105-900	105-900
	10	1400	165-1400	0,165-1400	165-1400
	12	2000	240-2000	0,240-2000	240-2000
Direct Digital Control/ Symbio™ 210, Symbio™ 210e, Symbio™ 500, and UC210	14	3000	320-3000	0,320-3000	320-3000
	16	4000	420-4000	0,420-4000	420-4000
	24 x 16	8000	800-8000	0,800-8000	800-8000

Table 3. 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/ Symbio™ 210, Symbio™ 210e, Symbio™ 500, and UC210	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
Direct Digital Control/ Symbio™ 210, Symbio™ 210e, Symbio™ 500, and UC210	8	425	50-425	0,50-425	50-425
	10	661	77-661	0,77-661	77-661
	12	944	111-944	0,111-944	111-944
Direct Digital Control/ Symbio™ 210, Symbio™ 210e, Symbio™ 500, and UC210	14	1416	151-1416	0,151-1416	151-1416
	16	1888	198-1888	0,198-1888	198-1888
	24 x 16	3776	378-3776	0,378-3776	378-3776

Performance Data

Performance Data — I-P

Table 4. Single duct (VCCF) ultra-low air leakage unit casing (cfm)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
4,5,6	0.1	0.2	0.5	1.2	1.9	2.5	2.9	3.2	3.3	3.5
8	0.1	0.3	0.6	1.3	2.0	2.6	2.9	3.1	3.2	3.2
10	0.2	0.3	0.7	1.5	2.2	2.7	3.0	3.2	3.3	3.3
12	0.3	0.5	1.0	1.9	2.6	3.2	3.7	4.1	4.6	5.1
14	0.3	0.6	1.1	2.0	2.8	3.5	4.1	4.7	5.3	6.2
16	0.3	0.6	1.2	2.2	3.1	3.8	4.5	5.2	5.9	7.0
24 x 16	1.8	3.4	6.3	11.0	14.9	18.8	22.8	27.1	31.4	35.2

Note: Casing leakage determined with the air valve fully open and unit discharge sealed. A precision low flow orifice upstream of the unit is used to measure the leakage rate as a function of the inlet positive static pressure. Leakage testing conducted in accordance with ASHRAE 130-2008.

Table 5. Single duct (VCCF) standard air leakage unit casing (cfm)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
4,5,6	0.2	0.5	1.4	3.5	5.7	7.5	8.8	9.5	9.9	10.5
8	0.4	0.8	1.8	4.0	6.1	7.7	8.8	9.3	9.5	9.6
10	0.5	1.0	2.1	4.4	6.5	8.1	9.1	9.6	9.8	10.0
12	0.8	1.5	2.9	5.6	7.8	9.7	11.2	12.4	13.7	15.4
14	0.9	1.7	3.3	6.1	8.5	10.5	12.2	14.0	16.0	18.6
16	1.0	1.9	3.7	6.7	9.2	11.4	13.4	15.5	17.8	20.9
24 x 16	5.4	10.3	18.9	33.0	44.8	56.3	68.3	81.2	94.1	105.5

Note: Casing leakage determined with the air valve fully open and unit discharge sealed. A precision low flow orifice upstream of the unit is used to measure the leakage rate as a function of the inlet positive static pressure. Leakage testing conducted in accordance with ASHRAE 130-2008.

Table 6. Single duct (VCCF) with integral attenuator and bottom access ultra-low air leakage unit casing (cfm)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
4,5,6	0.2	0.4	0.8	1.4	2.0	2.5	3.1	3.8	4.4	4.9
8	0.3	0.6	1.1	1.9	2.5	3.2	3.9	4.6	5.4	6.0
10	0.4	0.8	1.4	2.3	3.1	3.8	4.6	5.5	6.3	7.1
12	0.4	0.8	1.6	2.7	3.5	4.3	5.2	6.1	7.1	8.0
14	0.6	1.1	2.0	3.4	4.5	5.5	6.4	7.4	8.5	9.5
16	0.6	1.2	2.2	3.8	5.0	6.1	7.1	8.2	9.4	10.7
24 x 16	2.8	5.2	9.0	14.0	17.4	20.5	24.3	28.6	32.8	35.3

Note: Casing leakage determined with the air valve fully open and unit discharge sealed. A precision low flow orifice upstream of the unit is used to measure the leakage rate as a function of the inlet positive static pressure. Leakage testing conducted in accordance with ASHRAE 130-2008.

Table 7. Single duct (VCCF) with integral attenuator and bottom access standard air leakage unit casing (cfm)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
4,5,6	0.6	1.2	2.3	4.2	5.9	7.6	9.4	11.3	13.1	14.8
8	0.9	1.8	3.3	5.6	7.6	9.5	11.6	13.8	16.1	18.0
10	1.2	2.3	4.2	7.0	9.3	11.4	13.8	16.4	19.0	21.3
12	1.3	2.5	4.7	8.0	10.6	13.0	15.6	18.4	21.3	24.1
14	1.7	3.2	5.9	10.2	13.5	16.4	19.3	22.3	25.4	28.6
16	1.8	3.5	6.5	11.3	15.0	18.2	21.2	24.5	28.1	32.0
24 x 16	8.3	15.5	27.0	42.1	52.1	61.6	72.8	85.8	98.3	105.9

Note: Casing leakage determined with the air valve fully open and unit discharge sealed. A precision low flow orifice upstream of the unit is used to measure the leakage rate as a function of the inlet positive static pressure. Leakage testing conducted in accordance with ASHRAE 130-2008.

Table 8. Single duct (VCWF) 1/2-row coil - ultra-low air leakage unit casing (cfm)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
4,5,6	0.1	0.3	0.6	1.4	2.2	2.9	3.4	3.7	3.9	4.1
8	0.2	0.4	0.8	1.6	2.4	3	3.4	3.7	3.8	3.6
10	0.3	0.5	1	1.8	2.5	3.1	3.5	3.8	3.9	3.4
12	0.5	0.9	1.5	2.5	3.2	3.8	4.4	5	5.3	5.1
14	0.7	1.4	2.3	3.3	3.9	4.4	5.2	6	6.5	6.1
16	0.9	1.6	2.7	3.8	4.3	4.9	5.7	6.8	7.5	7.2

Table 8. Single duct (VCWF) 1/2-row coil - ultra-low air leakage unit casing (cfm) (continued)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
24 x 16	2.6	4.8	8.4	13.4	17.3	21.5	26.3	31.4	35.3	35.7

Note: Casing leakage determined with the air valve fully open and unit discharge sealed. A precision low flow orifice upstream of the unit is used to measure the leakage rate as a function of the inlet positive static pressure. Leakage testing conducted in accordance with ASHRAE 130-2008.

Table 9. Single duct (VCWF) 1/2-row coil - standard air leakage unit casing (cfm)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
4,5,6	0.4	0.9	1.9	4.3	6.7	8.7	10.1	11.1	11.7	12.3
8	0.6	1.3	2.5	4.9	7.1	8.9	10.3	11.1	11.3	10.7
10	0.8	1.6	3.1	5.5	7.5	9.2	10.6	11.5	11.6	10.3
12	1.4	2.6	4.6	7.4	9.5	11.4	13.2	14.9	15.9	15.3
14	2.2	4.1	6.8	10.0	11.6	13.3	15.5	17.9	19.5	18.2
16	2.7	4.9	8.1	11.5	13.0	14.7	17.2	20.3	22.6	21.6
24 x 16	7.8	14.5	25.3	40.3	52.0	64.5	79.0	94.2	105.8	107.0

Note: Casing leakage determined with the air valve fully open and unit discharge sealed. A precision low flow orifice upstream of the unit is used to measure the leakage rate as a function of the inlet positive static pressure. Leakage testing conducted in accordance with ASHRAE 130-2008.

Table 10. Single duct (VCWF) 3/4-row coil - ultra-low air leakage unit casing (cfm)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
4,5,6	0.2	0.3	0.7	1.5	2.3	3	3.5	3.9	4.2	4.5
8	0.2	0.5	0.9	1.7	2.4	3	3.5	3.8	4.1	4.2
10	0.3	0.6	1.2	2	2.6	3.1	3.5	3.8	4	3.9
12	0.5	0.9	1.6	2.6	3.3	3.9	4.4	5.1	5.7	6.2
14	0.8	1.4	2.5	3.7	4.3	4.7	5.3	6.1	6.9	7.4
16	0.9	1.7	2.9	4.2	4.8	5.3	6	6.9	8	8.8
24 x 16	2.8	5.2	9.2	14.7	18.6	22.4	26.6	31.4	36.1	39.2

Note: Casing leakage determined with the air valve fully open and unit discharge sealed. A precision low flow orifice upstream of the unit is used to measure the leakage rate as a function of the inlet positive static pressure. Leakage testing conducted in accordance with ASHRAE 130-2008.

Table 11. Single duct (VCWF) 3/4-row coil - standard air leakage unit casing (cfm)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
4,5,6	0.5	1.0	2.1	4.6	6.9	8.9	10.5	11.6	12.5	13.5
8	0.7	1.4	2.8	5.2	7.3	9.1	10.5	11.5	12.2	12.6
10	1.0	1.9	3.5	6.0	7.8	9.3	10.6	11.5	12.1	11.8
12	1.4	2.7	4.8	7.8	9.8	11.6	13.3	15.2	17.1	18.5
14	2.3	4.3	7.4	11.0	12.8	14.2	16.0	18.3	20.8	22.3
16	2.8	5.1	8.7	12.6	14.4	15.9	17.9	20.8	24.1	26.5
24 x 16	8.3	15.6	27.5	44.1	55.9	67.1	79.9	94.3	108.3	117.6

Note: Casing leakage determined with the air valve fully open and unit discharge sealed. A precision low flow orifice upstream of the unit is used to measure the leakage rate as a function of the inlet positive static pressure. Leakage testing conducted in accordance with ASHRAE 130-2008.

Table 12. Single duct (VCWF) 1/2-row coil with integral attenuator and bottom access ultra-low air leakage unit casing (cfm)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
4,5,6	0.2	0.5	1.0	1.9	2.7	3.5	4.1	4.7	5.2	6.0
8	0.4	0.8	1.4	2.4	3.3	4.0	4.7	5.4	6.1	6.6
10	0.6	1.1	1.9	3.0	3.8	4.5	5.3	6.2	6.9	7.1
12	0.7	1.2	2.1	3.4	4.3	5.1	6.0	7.0	7.9	8.3
14	0.8	1.5	2.6	4.2	5.2	6.3	7.5	8.9	10.3	11.1
16	0.9	1.7	2.9	4.5	5.7	6.8	8.2	9.8	11.3	12.3
24 x 16	3.3	6.1	10.6	16.2	19.8	23.1	27.1	31.8	36.2	38.6

Note: Casing leakage determined with the air valve fully open and unit discharge sealed. A precision low flow orifice upstream of the unit is used to measure the leakage rate as a function of the inlet positive static pressure. Leakage testing conducted in accordance with ASHRAE 130-2008.

Table 13. Single duct (VCWF) 1/2-row coil with integral attenuator and bottom access standard air leakage unit casing (cfm)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
4,5,6	0.7	1.4	2.9	5.7	8.2	10.4	12.3	14.0	15.7	17.9
8	1.2	2.3	4.3	7.3	9.8	12.0	14.1	16.2	18.2	19.7
10	1.7	3.2	5.7	9.0	11.3	13.5	15.9	18.5	20.6	21.3
12	2.0	3.7	6.4	10.2	12.8	15.2	18.1	21.1	23.8	24.9
14	2.4	4.5	7.9	12.5	15.6	18.8	22.5	26.8	30.9	33.3
16	2.7	5.0	8.7	13.6	17.1	20.5	24.6	29.4	34.0	36.8
24 x 16	9.8	18.3	31.7	48.7	59.4	69.3	81.3	95.3	108.6	115.8

Note: Casing leakage determined with the air valve fully open and unit discharge sealed. A precision low flow orifice upstream of the unit is used to measure the leakage rate as a function of the inlet positive static pressure. Leakage testing conducted in accordance with ASHRAE 130-2008.

Table 14. Single duct (VCWF) 3/4-row coil with integral attenuator and bottom access ultra-low air leakage unit casing (cfm)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
4,5,6	0.2	0.5	1.0	1.9	2.8	3.5	4.1	4.7	5.3	6.0
8	0.4	0.8	1.4	2.5	3.3	4.0	4.7	5.4	6.1	6.7
10	0.6	1.1	1.9	3.0	3.8	4.5	5.4	6.3	7.1	7.7
12	0.7	1.2	2.2	3.5	4.3	5.2	6.1	7.2	8.3	9.0
14	0.8	1.6	2.7	4.3	5.3	6.3	7.5	8.9	10.3	11.3
16	0.9	1.7	3.0	4.7	5.8	6.9	8.3	9.9	11.5	12.6
24 x 16	3.3	6.2	10.7	16.5	20.1	23.4	27.5	32.2	36.8	39.3

Note: Casing leakage determined with the air valve fully open and unit discharge sealed. A precision low flow orifice upstream of the unit is used to measure the leakage rate as a function of the inlet positive static pressure. Leakage testing conducted in accordance with ASHRAE 130-2008.

Table 15. Single duct (VCWF) 3/4-row coil with integral attenuator and bottom access standard air leakage unit casing (cfm)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
4,5,6	0.7	1.5	2.9	5.8	8.3	10.6	12.4	14.1	15.9	18.0
8	1.2	2.4	4.3	7.5	9.9	12.1	14.2	16.3	18.4	20.2
10	1.7	3.2	5.7	9.1	11.5	13.6	16.1	18.8	21.4	23.1

Table 15. Single duct (VCWF) 3/4-row coil with integral attenuator and bottom access standard air leakage unit casing (cfm) (continued)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
12	2.0	3.7	6.6	10.4	13.0	15.5	18.3	21.6	24.8	27.1
14	2.5	4.7	8.2	12.9	16.0	19.0	22.6	26.8	31.0	33.9
16	2.8	5.2	9.1	14.1	17.5	20.8	24.8	29.6	34.5	37.9
24 x 16	10.0	18.6	32.2	49.5	60.3	70.3	82.4	96.7	110.4	117.9

Note: Casing leakage determined with the air valve fully open and unit discharge sealed. A precision low flow orifice upstream of the unit is used to measure the leakage rate as a function of the inlet positive static pressure. Leakage testing conducted in accordance with ASHRAE 130-2008.

Table 16. Single duct (VCEF) with integral attenuator ultra-low air leakage unit casing (cfm)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
4,5,6	1.4	2.8	5.3	9.5	12.9	15.7	18.3	20.7	23.3	26.1
8	1.5	3.0	5.5	9.8	13.2	16.1	18.7	21.3	23.8	26.4
10	1.7	3.2	5.9	10.2	13.5	16.4	19.2	22.0	24.7	27.3
12	1.7	3.2	6.0	10.3	13.8	16.8	19.6	22.4	25.1	27.6
14	1.8	3.5	6.3	10.8	14.3	17.4	20.4	23.4	26.3	28.7
16	2.0	3.7	6.8	11.3	14.8	17.8	20.9	24.1	27.1	29.4
24 x 16	3.1	5.7	9.9	15.2	18.4	21.5	25.2	29.5	33.6	35.6

Note: Casing leakage determined with the air valve fully open and unit discharge sealed. A precision low flow orifice upstream of the unit is used to measure the leakage rate as a function of the inlet positive static pressure. Leakage testing conducted in accordance with ASHRAE 130-2008.

Table 17. Single duct (VCEF) with integral attenuator standard air leakage unit casing (cfm)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
4,5,6	1.4	2.8	5.3	9.5	12.9	15.7	18.3	20.7	23.3	26.1
8	1.5	3.0	5.5	9.8	13.2	16.1	18.7	21.3	23.8	26.4
10	1.7	3.2	5.9	10.2	13.5	16.4	19.2	22.0	24.7	27.3
12	1.7	3.2	6.0	10.3	13.8	16.8	19.6	22.4	25.1	27.6
14	1.8	3.5	6.3	10.8	14.3	17.4	20.4	23.4	26.3	28.7
16	2.0	3.7	6.8	11.3	14.8	17.8	20.9	24.1	27.1	29.4
24 x 16	3.1	5.7	9.9	15.2	18.4	21.5	25.2	29.5	33.6	35.6

Note: Casing leakage determined with the air valve fully open and unit discharge sealed. A precision low flow orifice upstream of the unit is used to measure the leakage rate as a function of the inlet positive static pressure. Leakage testing conducted in accordance with ASHRAE 130-2008.

Table 18. Single duct (VCEF) with integral attenuator and bottom access ultra-low air leakage unit casing (cfm)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
4,5,6	1.48	2.89	5.47	9.86	13.43	16.42	19.05	21.54	24.10	26.93
8	1.60	3.09	5.78	10.20	13.71	16.70	19.43	22.10	24.80	27.56
10	1.77	3.38	6.21	10.63	14.02	16.96	19.80	22.70	25.63	28.33
12	1.77	3.40	6.25	10.77	14.29	17.35	20.30	23.30	26.30	29.09
14	1.89	3.60	6.59	11.26	14.87	18.06	21.19	24.41	27.59	30.36
16	2.04	3.87	7.01	11.75	15.33	18.52	21.76	25.15	28.46	31.11
24 x 16	3.16	5.86	10.13	15.53	18.92	22.09	25.96	30.52	34.89	37.27

Note: Casing leakage determined with the air valve fully open and unit discharge sealed. A precision low flow orifice upstream of the unit is used to measure the leakage rate as a function of the inlet positive static pressure. Leakage testing conducted in accordance with ASHRAE 130-2008.

Table 19. Single duct (VCEF) with integral attenuator and bottom access standard air leakage unit casing (cfm)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
4,5,6	1.48	2.89	5.47	9.86	13.43	16.42	19.05	21.54	24.10	26.93
8	1.60	3.09	5.78	10.20	13.71	16.70	19.43	22.10	24.80	27.56
10	1.77	3.38	6.21	10.63	14.02	16.96	19.80	22.70	25.63	28.33
12	1.77	3.40	6.25	10.77	14.29	17.35	20.30	23.30	26.30	29.09
14	1.89	3.60	6.59	11.26	14.87	18.06	21.19	24.41	27.59	30.36
16	2.04	3.87	7.01	11.75	15.33	18.52	21.76	25.15	28.46	31.11
24 x 16	3.16	5.86	10.13	15.53	18.92	22.09	25.96	30.52	34.89	37.27

Note: Casing leakage determined with the air valve fully open and unit discharge sealed. A precision low flow orifice upstream of the unit is used to measure the leakage rate as a function of the inlet positive static pressure. Leakage testing conducted in accordance with ASHRAE 130-2008.

Table 20. Air valve leakage (cfm)

Inlet Size	Pressure (in. wg)									
	0.25	0.5	1	2	3	4	5	6	7	8
4,5,6	0.67	1.24	2.16	3.30	3.95	4.47	5.05	5.74	6.43	6.83
8	0.69	1.29	2.23	3.42	4.08	4.59	5.15	5.82	6.48	6.86
10	0.71	1.33	2.31	3.54	4.22	4.72	5.26	5.91	6.55	6.94
12	0.76	1.42	2.45	3.73	4.42	4.94	5.55	6.28	7.00	7.42
14	0.79	1.46	2.52	3.82	4.52	5.06	5.70	6.48	7.27	7.72
16	0.81	1.51	2.60	3.91	4.61	5.15	5.78	6.53	7.25	7.54
24 x 16	33.43	60.25	98.65	140.61	170.17	204.13	231.83	0.00	0.00	0.00

Note: Air valve leakage determined with the air valve fully closed and unit discharge open. A precision low flow orifice upstream of the unit is used to measure the leakage rate as a function of the inlet positive static pressure. Leakage testing conducted in accordance with ASHRAE 130-2008.

Table 21. Air pressure drop (in. wg) — I-P

Inlet Size	Airflow Cfm	Cooling Only	Hot Water				Electric Heat
			1-row coil	2-row coil	3-row coil	4-row coil	
4	50	0.01	0.01	0.02	0.02	0.03	0.01
	100	0.01	0.03	0.04	0.06	0.08	0.01
	150	0.01	0.04	0.07	0.1	0.13	0.01
	225	0.01	0.06	0.12	0.18	0.24	0.02
5	100	0.01	0.02	0.04	0.06	0.07	0.01
	200	0.01	0.06	0.11	0.16	0.21	0.01
	300	0.01	0.1	0.2	0.29	0.39	0.02
	350	0.02	0.13	0.25	0.37	0.49	0.02
6	100	0.01	0.02	0.04	0.06	0.07	0.01
	250	0.05	0.12	0.19	0.26	0.33	0.05
	350	0.1	0.22	0.34	0.46	0.59	0.11
	500	0.22	0.41	0.63	0.85	1.07	0.23
8	200	0.01	0.04	0.07	0.1	0.13	0.01
	400	0.02	0.11	0.2	0.29	0.38	0.02
	600	0.04	0.21	0.38	0.56	0.73	0.05
	900	0.08	0.39	0.72	1.06	1.41	0.11

Table 21. Air pressure drop (in. wg) — I-P (continued)

Inlet Size	Airflow Cfm	Cooling Only	Hot Water				Electric Heat
			1-row coil	2-row coil	3-row coil	4-row coil	
10	500	0.01	0.07	0.14	0.2	0.27	0.01
	800	0.01	0.15	0.28	0.43	0.57	0.02
	1100	0.01	0.24	0.47	0.7	0.94	0.03
	1400	0.01	0.34	0.68	1.03	1.38	0.05
12	800	0.01	0.08	0.16	0.24	0.33	0.01
	1200	0.01	0.16	0.31	0.47	0.62	0.03
	1600	0.01	0.25	0.49	0.73	0.98	0.05
	2000	0.01	0.35	0.69	1.05	1.4	0.08
14	1500	0.01	0.13	0.25	0.37	0.49	0.01
	2000	0.01	0.2	0.39	0.59	0.78	0.01
	2500	0.01	0.28	0.56	0.84	1.12	0.01
	3000	0.01	0.37	0.74	1.12	1.49	0.01
16	2000	0.01	0.15	0.29	0.43	0.57	0.01
	2500	0.01	0.21	0.41	0.62	0.82	0.02
	3000	0.01	0.28	0.55	0.82	1.1	0.02
	4000	0.01	0.43	0.87	1.3	1.74	0.03
24 x 16	4000	0.08	0.41	0.74	1.08	1.41	0.15
	5500	0.16	0.71	1.28	1.84	2.4	0.3
	6500	0.23	0.96	1.69	2.43	3.17	0.44
	8000	0.36	1.38	2.41	3.45	4.48	0.69

Table 22. Heating capacity (MBh), inlet size 04, 05, 06 — I-P

Coil Rows	Fluid Flow (GPM)	Water Pressure Drop (ft H_2O)	Airflow (cfm)									
			50	100	150	200	250	300	350	400	450	500
1	0.50	0.51	4.44	6.15	7.31	8.22	9.01	9.70	10.31	10.85	11.33	11.77
	1.00	1.68	4.75	6.81	8.28	9.49	10.55	11.51	12.38	13.17	13.91	14.61
	1.50	3.40	4.87	7.06	8.66	10.01	11.20	12.29	13.29	14.22	15.09	15.91
	2.00	5.63	4.93	7.19	8.87	10.29	11.56	12.72	13.80	14.81	15.76	16.66
	2.50	8.35	4.96	7.28	9.00	10.47	11.78	13.00	14.13	15.19	16.20	17.15
2	1.00	0.59	5.61	9.57	12.47	14.69	16.45	17.87	19.06	20.06	20.92	21.67
	2.00	2.03	5.76	10.13	13.56	16.34	18.65	20.60	22.28	23.74	25.03	26.18
	3.00	4.20	5.81	10.33	13.96	16.96	19.49	21.67	23.57	25.24	26.73	28.07
	4.00	7.06	5.83	10.43	14.17	17.28	19.94	22.24	24.26	26.06	27.66	29.11
	5.00	10.58	5.85	10.49	14.29	17.49	20.22	22.60	24.70	26.57	28.26	29.78
3	1.00	0.87	6.30	11.28	15.15	18.19	20.60	22.57	24.20	25.57	26.74	27.75
	2.00	2.93	6.44	11.78	16.30	20.08	23.28	26.03	28.42	30.50	32.35	33.99
	3.00	6.02	6.46	11.95	16.68	20.74	24.25	27.32	30.03	32.44	34.60	36.55
	4.00	10.08	6.46	12.04	16.88	21.08	24.75	28.00	30.89	33.48	35.81	37.94
	5.00	15.06	6.47	12.09	16.99	21.28	25.06	28.42	31.42	34.12	36.57	38.81
4	1.00	1.15	6.57	12.24	16.86	20.56	23.54	25.97	27.97	29.65	31.08	32.30
	2.00	3.83	6.62	12.63	17.90	22.46	26.41	29.84	32.84	35.48	37.82	39.91
	3.00	7.85	6.64	12.76	18.23	23.08	27.38	31.20	34.61	37.67	40.43	42.93
	4.00	13.10	6.64	12.81	18.41	23.38	27.86	31.89	35.52	38.81	41.80	44.53
	5.00	19.54	6.65	12.93	18.56	23.57	28.15	32.30	36.07	39.50	42.64	45.53

Notes:

1. Fouling factor = 0.00025
2. Use the following equations to calculate leaving air temperature (LAT) and water temperature difference (WTD).
3. LAT = EAT+(MBh x 921.7/Cfm)
4. WTD = EWT - LWT = (2 x MBh/Gpm)
5. Capacity based on 55°F entering air temperature and 180°F entering water temperature. Refer to correction factors for different entering conditions.
6. For premium coils (0.020 inch wall), side pressure drop increases x 17 percent and water velocity increases 7 percent for fixed GPM.

Table 23. Heating capacity (MBh), inlet size 08 — I-P

Coil Rows	Fluid Flow (GPM)	Water Pressure Drop (ft H_2O)	Airflow (cfm)								
			105	200	300	400	500	600	700	800	900
1	0.50	0.68	7.23	9.44	11.10	12.39	13.42	14.27	15.00	15.63	16.18
	1.00	2.25	8.03	10.92	13.16	15.01	16.62	18.06	19.34	20.48	21.52
	1.50	4.55	8.33	11.51	14.05	16.20	18.08	19.77	21.30	22.74	24.05
	2.00	7.53	8.50	11.83	14.54	16.86	18.92	20.79	22.49	24.07	25.54
	2.50	11.15	8.60	12.03	14.86	17.29	19.46	21.45	23.28	24.98	26.56
2	2.50	0.47	10.99	17.42	22.21	25.79	28.57	30.82	32.68	34.24	35.59
	4.00	1.11	11.27	18.26	23.72	27.94	31.33	34.12	36.48	38.51	40.27
	6.00	2.35	11.43	18.77	24.64	29.29	33.10	36.28	39.00	41.36	43.43
	8.00	4.00	11.52	19.03	25.14	30.03	34.06	37.47	40.40	42.96	45.22
	10.00	6.06	11.57	19.20	25.45	30.49	34.68	38.23	41.30	43.99	46.37
	12.00	8.52	11.60	19.31	25.66	30.81	35.10	38.76	41.93	44.71	47.19
3	2.50	0.54	12.65	21.12	27.79	32.88	36.90	40.16	42.85	45.13	47.07
	4.00	1.28	12.88	21.94	29.45	35.45	40.35	44.45	47.92	50.91	53.52
	6.00	2.68	12.99	22.41	30.43	37.01	42.50	47.17	51.20	54.72	57.82
	8.00	4.55	13.14	22.65	30.94	37.83	43.65	48.64	52.99	56.81	60.21
	10.00	6.87	13.13	22.79	31.25	38.34	44.36	49.57	54.12	58.15	61.75
	12.00	9.63	13.14	22.89	31.47	38.68	44.86	50.21	54.91	59.08	62.81
4	2.50	0.69	13.57	23.37	31.56	37.98	43.10	47.28	50.74	53.65	56.15
	4.00	1.59	13.65	24.07	33.18	40.68	46.93	52.20	56.70	60.60	64.01
	6.00	3.32	13.70	24.48	34.09	42.25	49.21	55.22	60.45	65.06	69.14
	8.00	5.61	13.73	24.77	34.55	43.05	50.40	56.81	62.46	67.47	71.95
	10.00	8.44	13.75	24.75	34.82	43.54	51.13	57.80	63.71	68.99	73.73
	12.00	11.81	13.76	24.83	35.01	43.87	51.63	58.48	64.57	70.03	74.96

Notes:

1. Fouling factor = 0.00025
2. Use the following equations to calculate leaving air temperature (LAT) and water temperature difference (WTD).
3. LAT = EAT+(MBh x 921.7/Cfm)
4. WTD = EWT - LWT = (2 x MBh/Gpm)
5. Capacity based on 55°F entering air temperature and 180°F entering water temperature. Refer to correction factors for different entering conditions.
6. For premium coils (0.020 inch wall), side pressure drop increases x 17 percent and water velocity increases 7 percent for fixed GPM.

Table 24. Heating capacity (MBh), inlet size 10 — I-P

Coil Rows	Fluid Flow (GPM)	Water Pressure Drop (ft H_2O)	Airflow (cfm)										
			200	300	400	500	600	700	800	900	1000	1200	1400
1	0.7	1.70	12.25	14.47	16.31	17.84	19.12	20.24	21.22	22.10	22.88	24.24	25.37
	1.0	3.13	13.10	15.71	17.81	19.65	21.30	22.75	24.06	25.25	26.33	28.24	29.88
	1.5	6.31	13.84	16.82	19.27	21.41	23.32	25.07	26.72	28.25	29.66	32.21	34.45
	2.0	10.42	14.24	17.42	20.08	22.43	24.55	26.49	28.29	29.98	31.59	34.56	37.20
	2.5	15.41	14.49	17.81	20.60	23.08	25.34	27.43	29.37	31.19	32.91	36.10	39.04
2	2.5	0.98	19.78	26.13	31.12	35.14	38.48	41.28	43.68	45.77	47.60	50.66	53.14
	4.0	2.36	20.45	27.47	33.17	37.91	41.94	45.40	48.43	51.10	53.48	57.54	60.90
	6.0	5.05	20.84	28.25	34.40	39.61	44.09	48.01	51.47	54.55	57.33	62.13	66.16
	8.0	8.70	21.04	28.66	35.05	40.50	45.24	49.41	53.12	56.44	59.45	64.69	69.11
	10.0	13.29	21.17	28.91	35.45	41.07	45.97	50.30	54.17	57.64	60.80	66.32	71.02
3	2.5	1.35	23.13	31.53	38.31	43.87	48.50	52.40	55.74	58.62	61.14	65.34	68.71
	4.0	3.19	23.72	32.89	40.61	47.17	52.82	57.73	62.03	65.84	69.24	75.04	79.83
	6.0	6.72	24.04	33.64	41.92	49.11	55.41	60.98	65.94	70.40	74.42	81.42	87.30
	8.0	11.46	24.20	34.02	42.59	50.10	56.76	62.69	68.02	72.84	77.23	84.92	91.46
	10.0	17.37	24.29	34.25	42.99	50.71	57.59	63.75	69.32	74.37	78.99	87.14	94.12
4	2.5	1.83	24.92	34.83	43.06	49.91	55.65	60.50	64.64	68.21	71.32	76.45	80.53
	4.0	4.26	25.37	36.04	45.31	53.37	60.39	66.55	71.98	76.80	81.10	88.46	94.52
	6.0	8.89	25.61	36.69	46.52	55.28	63.10	70.09	76.37	82.05	87.20	96.20	103.79
	8.0	15.04	25.71	36.97	47.12	56.24	64.46	71.89	78.64	84.79	90.42	100.37	108.88
	10.0	22.68	25.78	37.18	47.47	56.81	65.28	72.99	80.03	86.48	92.41	102.97	112.80

Notes:

1. Fouling factor = 0.00025
2. Use the following equations to calculate leaving air temperature (LAT) and water temperature difference (WTD).
3. LAT = EAT+(MBh x 921.7/Cfm)
4. WTD = EWT - LWT = (2 x MBh/Gpm)
5. Capacity based on 55°F entering air temperature and 180°F entering water temperature. Refer to correction factors for different entering conditions.
6. For premium coils (0.020 inch wall), side pressure drop increases x 17 percent and water velocity increases 7 percent for fixed GPM.

Table 25. Heating capacity (MBh), inlet size 12 — I-P

Coil Rows	Fluid Flow (GPM)	Water Pressure Drop (ft H_2O)	Airflow (cfm)									
			300	500	700	900	1100	1300	1500	1700	1900	2000
1	1.0	0.65	17.36	21.29	24.29	26.63	28.54	30.15	31.53	32.73	33.77	34.25
	2.0	2.24	19.71	24.99	29.13	32.62	35.76	38.54	41.02	43.26	45.28	46.23
	3.0	4.65	20.63	26.52	31.28	35.38	39.02	42.31	45.36	48.18	50.79	52.02
	4.0	7.85	21.12	27.37	32.47	36.93	40.94	44.59	47.95	51.07	54.00	55.41
	5.0	11.82	21.43	27.90	33.23	37.93	42.18	46.08	49.69	53.06	56.22	57.72
2	3.5	0.67	28.82	40.13	48.24	54.36	59.17	63.07	66.30	69.03	71.37	72.43
	5.0	1.31	29.75	42.23	51.53	58.77	64.60	69.42	73.48	76.96	79.99	81.36
	8.0	3.18	30.61	44.22	54.73	63.16	70.11	75.98	81.01	85.39	89.25	91.02
	11.0	5.82	31.02	45.17	56.30	65.36	72.92	79.36	84.94	89.83	94.17	96.16
	14.0	9.21	31.25	45.74	57.25	66.69	74.63	81.43	87.36	92.58	97.22	99.36
	17.0	13.35	31.41	46.12	57.88	67.58	75.78	82.84	89.00	94.45	99.32	101.57
3	3.5	0.85	33.17	47.68	58.32	66.42	72.78	77.92	82.17	85.74	88.78	90.15
	5.0	1.64	34.05	49.95	62.16	71.81	79.63	86.10	91.57	96.24	100.30	102.13
	8.0	3.92	34.82	52.01	65.77	77.03	86.44	94.42	101.30	107.31	112.60	115.03
	11.0	7.12	35.17	52.98	67.50	79.58	89.82	98.63	106.30	113.06	119.07	121.83
	14.0	11.20	35.37	53.54	68.52	81.10	91.86	101.17	109.34	116.59	123.06	126.05
	17.0	16.15	35.50	53.91	69.19	82.11	93.22	102.88	111.40	118.98	125.78	128.92
4	3.5	1.03	36.85	55.08	68.93	79.60	87.99	94.75	100.28	104.90	108.81	110.55
	5.0	1.97	37.52	57.24	73.06	85.83	96.29	104.99	112.33	118.60	124.02	126.46
	8.0	4.67	38.06	59.08	76.72	91.58	104.21	115.07	124.49	132.74	140.03	143.37
	11.0	8.42	38.31	59.89	78.38	94.26	108.00	119.99	130.54	139.90	148.26	152.12
	14.0	13.19	38.44	60.35	79.34	95.82	110.22	122.90	134.15	144.21	153.26	157.46
	17.0	18.95	38.52	60.68	79.95	96.83	111.67	124.82	136.56	147.10	156.62	161.05

Notes:

1. Fouling factor = 0.00025
2. Use the following equations to calculate leaving air temperature (LAT) and water temperature difference (WTD).
3. LAT = EAT+(MBh x 921.7/Cfm)
4. WTD = EWT - LWT = (2 x MBh/Gpm)
5. Capacity based on 55°F entering air temperature and 180°F entering water temperature. Refer to correction factors for different entering conditions.
6. For premium coils (0.020 inch wall), side pressure drop increases x 17 percent and water velocity increases 7 percent for fixed GPM.

Table 26. Heating capacity (MBh), inlet size 14 — I-P

Coil Rows	Fluid Flow (GPM)	Water Pressure Drop (ft H_2O)	Airflow (cfm)						
			600	1000	1400	1800	2200	2600	3000
1	2.0	1.17	30.78	38.17	43.92	48.49	52.26	55.44	58.17
	3.0	2.42	33.18	41.96	48.88	54.83	59.90	64.30	68.17
	4.0	4.07	34.51	44.18	51.96	58.57	64.49	69.72	74.40
	5.0	6.11	35.37	45.62	54.00	61.21	67.58	73.38	78.64
	6.0	8.52	35.96	46.64	55.45	63.10	69.91	76.06	81.72
	7.0	11.29	36.40	47.39	56.53	64.53	71.68	78.17	84.11
2	5.0	1.03	52.06	69.85	81.90	90.68	97.42	102.77	107.14
	9.0	3.16	55.39	76.76	92.20	104.01	113.40	121.10	127.55
	13.0	6.39	56.76	79.73	96.78	110.09	120.87	129.82	137.42
	17.0	10.69	57.52	81.39	99.38	113.60	125.21	134.94	143.25
	21.0	16.07	58.00	82.46	101.07	115.88	128.06	138.32	147.12
	23.0	19.15	58.18	82.86	101.71	116.75	129.16	139.62	148.61
3	5.0	1.27	62.87	87.29	104.08	116.29	125.58	132.90	138.82
	9.0	3.79	66.23	95.46	117.27	134.17	147.69	158.77	168.06
	13.0	7.58	67.53	98.79	122.91	142.11	157.81	170.93	182.09
	17.0	12.61	68.22	100.61	126.04	146.59	163.60	177.98	190.31
	21.0	18.85	68.66	101.76	128.04	149.47	167.37	182.58	195.72
	23.0	22.41	68.82	102.19	128.79	150.56	168.80	184.34	197.79
4	5.0	1.50	69.50	99.39	120.27	135.43	146.87	155.80	162.96
	9.0	4.43	72.46	107.86	135.13	156.55	173.79	187.94	199.78
	13.0	8.79	73.53	111.13	141.19	165.59	185.77	202.73	217.20
	17.0	14.53	74.09	112.86	144.46	170.58	192.50	211.17	227.28
	21.0	21.64	74.42	113.92	146.51	173.73	196.80	216.62	233.85
	23.0	25.69	74.55	114.32	147.28	174.92	198.42	218.68	236.34

Notes:

1. Fouling factor = 0.00025
2. Use the following equations to calculate leaving air temperature (LAT) and water temperature difference (WTD).
3. LAT = EAT+(MBh x 921.7/Cfm)
4. WTD = EWT - LWT = (2 x MBh/Gpm)
5. Capacity based on 55°F entering air temperature and 180°F entering water temperature. Refer to correction factors for different entering conditions.
6. For premium coils (0.020 inch wall), side pressure drop increases x 17 percent and water velocity increases 7 percent for fixed GPM.

Table 27. Heating capacity (MBh), inlet size 16 — I-P

Coil Rows	Fluid Flow (GPM)	Water Pressure Drop (ft H_2O)	Airflow (cfm)									
			600	1000	1400	1800	2200	2600	3000	3400	3800	4000
1	2.0	1.30	33.39	41.27	47.39	52.22	56.21	59.58	62.48	65.00	67.22	68.24
	3.0	2.68	36.04	45.42	52.74	59.08	64.48	69.18	73.32	77.01	80.33	81.86
	4.0	4.50	37.51	47.85	56.09	63.10	69.41	75.02	80.04	84.57	88.69	90.62
	5.0	6.73	38.45	49.43	58.31	65.96	72.73	78.93	84.59	89.74	94.47	96.70
	6.0	9.37	39.11	50.54	59.89	68.01	75.25	81.80	87.87	93.51	98.70	101.16
2	5.0	1.10	54.92	74.90	88.69	98.84	106.66	112.90	118.01	122.29	125.94	127.57
	9.0	3.32	54.92	74.90	88.69	98.84	106.66	112.90	118.01	122.29	125.94	127.57
	13.0	6.70	58.16	81.95	99.52	113.14	124.07	133.09	140.69	147.20	152.86	155.42
	17.0	11.19	59.47	84.92	104.25	119.58	132.11	142.60	151.56	159.32	166.12	169.23
	21.0	16.78	60.18	86.58	106.92	123.25	136.75	148.15	157.95	166.50	174.04	177.49
	23.0	19.99	60.64	87.63	108.64	125.64	139.78	151.79	162.17	171.26	179.30	183.00
3	5.0	1.36	60.81	88.03	109.30	126.55	140.93	153.18	163.79	173.08	181.33	185.12
	9.0	4.04	65.41	92.36	111.26	125.14	135.74	144.10	150.87	156.47	161.20	163.30
	13.0	8.06	68.53	100.46	124.85	144.04	159.54	172.33	183.09	192.29	200.24	203.84
	17.0	13.36	69.72	103.68	130.53	152.26	170.24	185.40	198.37	209.62	219.49	223.98
	21.0	19.93	70.34	105.42	133.64	156.85	176.31	192.90	207.24	219.79	230.89	235.97
	23.0	23.69	70.73	106.51	135.61	159.78	180.21	197.77	213.04	226.48	238.43	243.92
4	5.0	1.63	70.87	106.91	136.35	160.88	181.69	199.61	215.25	229.04	241.32	246.97
	9.0	4.77	71.57	104.12	127.34	144.37	157.25	167.30	175.35	181.93	187.42	189.84
	13.0	9.43	74.20	112.26	142.33	166.35	185.87	202.01	215.56	227.10	237.06	241.54
	17.0	15.54	75.13	115.30	148.25	175.50	198.31	217.66	234.28	248.72	261.38	267.15
	21.0	23.09	75.59	116.88	151.40	180.46	205.18	226.46	244.98	261.23	275.64	282.24
	23.0	27.39	75.88	117.84	153.35	183.56	209.54	232.10	251.88	269.38	284.98	292.17

Notes:

1. Fouling factor = 0.00025
2. Use the following equations to calculate leaving air temperature (LAT) and water temperature difference (WTD).
3. LAT = EAT+(MBh x 921.7/Cfm)
4. WTD = EWT - LWT = (2 x MBh/Gpm)
5. Capacity based on 55°F entering air temperature and 180°F entering water temperature. Refer to correction factors for different entering conditions.
6. For premium coils (0.020 inch wall), side pressure drop increases x 17 percent and water velocity increases 7 percent for fixed GPM.

Table 28. Heating capacity (MBh), inlet size 16x24 — I-P

Coil Rows	Fluid Flow (GPM)	Water Pressure Drop (ft H_2O)	Airflow (cfm)								
			800	1200	1800	2400	3000	3600	4200	4800	5000
1	2.0	1.44	40.19	47.47	55.50	61.47	66.17	69.99	73.16	75.85	76.66
	4.0	4.92	46.10	55.70	67.15	76.82	84.98	91.99	98.11	103.52	105.19
	5.0	7.35	47.47	57.75	70.23	80.65	89.82	97.83	104.92	111.25	113.21
	6.0	10.22	48.43	59.21	72.43	83.55	93.31	102.08	109.91	116.97	119.17
	7.0	13.52	49.13	60.29	74.09	85.79	96.03	105.31	113.73	121.37	123.76
2	5.0	1.36	69.16	87.30	105.71	118.21	127.32	134.29	139.82	144.34	145.67
	9.0	4.05	74.23	96.49	120.80	138.46	152.00	162.77	171.59	178.98	181.19
	13.0	8.07	76.30	100.39	127.51	147.81	163.73	176.63	187.36	196.46	199.20
	17.0	13.38	77.42	102.55	131.32	153.20	170.59	184.83	196.78	206.99	210.08
	21.0	19.96	78.14	103.93	133.78	156.72	175.10	190.26	203.06	214.05	217.39
	23.0	23.72	78.41	104.45	134.71	158.06	176.82	192.34	205.47	216.77	220.21
3	5.0	1.45	83.14	107.57	132.43	149.06	160.94	169.87	176.83	182.43	184.06
	9.0	4.30	88.40	118.43	152.10	176.81	195.73	210.72	222.91	233.04	236.06
	13.0	8.53	90.40	122.78	160.50	189.29	212.03	230.51	245.86	245.86	262.75
	17.0	14.12	91.46	125.11	165.14	196.34	221.42	242.10	259.49	274.37	278.86
	21.0	21.02	92.11	126.57	168.08	200.87	227.53	249.71	268.52	284.71	289.63
	23.0	24.97	92.35	127.11	169.18	202.58	229.84	252.61	271.97	288.69	293.77
4	5.0	1.75	91.81	121.36	151.59	171.54	185.51	195.78	203.65	209.86	211.66
	9.0	5.11	96.56	132.62	174.16	204.99	228.59	247.19	262.20	274.58	278.24
	13.0	10.07	98.23	136.82	183.31	219.50	248.33	271.80	291.29	307.75	312.68
	17.0	16.56	99.08	139.00	188.19	227.48	259.47	286.00	308.38	327.54	333.32
	21.0	24.56	99.60	140.32	191.22	232.52	266.60	295.21	319.58	340.63	347.02
	23.0	29.11	99.79	140.81	192.34	234.39	269.28	298.69	323.85	345.64	352.28

Notes:

1. Fouling factor = 0.00025
2. Use the following equations to calculate leaving air temperature (LAT) and water temperature difference (WTD).
3. LAT = EAT+(MBh x 921.7/Cfm)
4. WTD = EWT - LWT = (2 x MBh/Gpm)
5. Capacity based on 55°F entering air temperature and 180°F entering water temperature. Refer to correction factors for different entering conditions.
6. For premium coils (0.020 inch wall), side pressure drop increases x 17 percent and water velocity increases 7 percent for fixed GPM.

Table 29. Coil only-water weights

Inlet Size	1-Row Coil			2-Row Coil			3-Row Coil			4-Row Coil		
	Internal Volume		Oper. Weights	Internal Volume		Oper. Weights	Internal Volume		Oper. Weights	Internal Volume		Oper. Weights
	in^3	gal	lbs	in^3	gal	lbs	in^3	gal	lbs	in^3	gal	lbs
4	10.4	0.045	4.2	24.6	0.106	6.5	34.2	0.148	8.7	43.8	0.190	10.2
5	10.4	0.045	4.2	24.6	0.106	6.5	34.2	0.148	8.7	43.8	0.190	10.2
6	10.4	0.045	4.2	24.6	0.106	6.5	34.2	0.148	8.7	43.8	0.190	10.2
8	13.8	0.060	5.5	35.5	0.154	8.9	48.5	0.210	11.7	61.5	0.266	14.0
10	20.0	0.086	7.6	49.0	0.212	11.8	68.2	0.295	15.2	87.4	0.378	19.0
12	31.7	0.137	9.0	58.2	0.252	14.5	84.7	0.366	19.9	111.1	0.481	24.3
14	51.3	0.222	12.4	88.8	0.384	20.3	126.3	0.547	27.8	163.8	0.709	34.4
16	62.6	0.271	13.8	107.2	0.464	22.5	151.9	0.657	30.9	196.5	0.851	38.4
24x16	69.6	0.301	15.1	121.3	0.525	25.1	172.9	0.749	34.6	224.6	0.972	42.8

Table 30. 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 31. Temperature correction factors for coil capacity (MBh)

Entering Water Minus Entering Air (°F)	40	50	60	70	80	100	125	140	150	160	180	200
Correction Factor	0.32	0.40	0.48	0.56	0.64	0.80	1.00	1.12	1.20	1.28	1.44	1.60

Performance Data — SI

Table 32. Air pressure drop (Pa) — SI

Inlet Size	Airflow (L/s)	Cooling Only	Hot Water				
			1-row coil	2-row coil	3-row coil	4-row coil	Electric Heat
4	24	2	3	5	6	7	2
	47	2	7	11	15	19	2
	71	2	10	18	26	33	2
	106	2	15	29	44	59	5
5	47	2	6	10	14	18	2
	94	2	15	27	39	52	2
	141	2	26	49	73	97	5
	165	5	31	61	92	123	5
6	47	2	6	10	14	18	2
	118	12	30	47	65	83	12
	165	25	55	85	115	146	27
	235	55	102	156	211	266	57
8	94	2	9	16	24	31	2
	188	5	27	49	72	95	5
	282	10	51	94	138	182	12
	423	20	98	180	265	350	27
10	235	2	18	34	50	67	2
	376	2	36	71	106	142	5
	517	2	59	116	175	235	7
	658	2	84	170	256	344	12
12	376	2	21	41	61	81	2
	564	2	39	77	116	155	7
	752	2	61	121	183	244	12
	940	2	86	172	260	348	20
14	705	2	32	62	92	123	2
	940	2	49	97	146	194	2
	1175	2	70	139	208	277	2
	1410	2	92	185	278	371	2
16	940	2	37	72	107	143	2
	1175	2	52	102	153	204	5
	1410	2	69	137	205	273	5
	1880	2	108	216	324	433	7
24 x 16	1880	20	101	185	268	351	37
	2585	40	177	317	457	597	75
	3055	57	238	422	605	788	109
	3760	90	343	600	858	1115	172

Note: Hot water pressure drops are for the entire unit, not just the coil. To calculate the hot water coil only pressure drop, subtract the cooling only pressure drop from the other pressure drop.

Table 33. Heating capacity (kW), inlet size 04, 05, 06 — SI

Coil Rows	Fluid Flow (L/s)	Water Pressure Drop (kPa)	Airflow (L/s)									
			24	47	71	94	118	141	165	188	212	235
1	0.03	1.52	1.30	1.80	2.14	2.41	2.64	2.84	3.02	3.18	3.32	3.45
	0.06	5.02	1.39	2.00	2.43	2.78	3.09	3.37	3.63	3.86	4.08	4.28
	0.09	10.17	1.43	2.07	2.54	2.93	3.28	3.60	3.89	4.17	4.42	4.66
	0.13	16.83	1.44	2.11	2.60	3.01	3.39	3.73	4.04	4.34	4.62	4.88
	0.16	24.97	1.45	2.13	2.64	3.07	3.45	3.81	4.14	4.45	4.75	5.02
2	0.06	1.76	1.64	2.80	3.65	4.30	4.82	5.24	5.58	5.88	6.13	6.35
	0.13	6.07	1.69	2.97	3.97	4.79	5.46	6.04	6.53	6.96	7.33	7.67
	0.19	12.56	1.70	3.03	4.09	4.97	5.71	6.35	6.91	7.40	7.83	8.22
	0.25	21.11	1.71	3.06	4.15	5.06	5.84	6.52	7.11	7.64	8.10	8.53
	0.32	31.63	1.71	3.07	4.19	5.12	5.92	6.62	7.24	7.79	8.28	8.73
3	0.06	2.60	1.85	3.31	4.44	5.33	6.04	6.61	7.09	7.49	7.83	8.13
	0.13	8.76	1.89	3.45	4.78	5.88	6.82	7.63	8.33	8.94	9.48	9.96
	0.19	18.00	1.89	3.50	4.89	6.08	7.11	8.00	8.80	9.50	10.14	10.71
	0.25	30.14	1.89	3.53	4.95	6.18	7.25	8.20	9.05	9.81	10.49	11.12
	0.32	45.03	1.90	3.54	4.98	6.24	7.34	8.33	9.21	10.00	10.72	11.37
4	0.06	3.44	1.93	3.59	4.94	6.02	6.90	7.61	8.20	8.69	9.11	9.46
	0.13	11.45	1.94	3.70	5.24	6.58	7.74	8.74	9.62	10.40	11.08	11.69
	0.19	23.47	1.95	3.74	5.34	6.76	8.02	9.14	10.14	11.04	11.85	12.58
	0.25	39.17	1.95	3.75	5.39	6.85	8.16	9.34	10.41	11.37	12.25	13.05
	0.32	58.42	1.95	3.79	5.44	6.91	8.25	9.46	10.57	11.57	12.49	13.34

Notes:

1. Fouling factor = 0.00025
2. Use the following equations to calculate leaving air temperature (LAT) and water temperature difference (WTD).
3. LAT = EAT+(kW x 0.83/L/s)
4. WTD = EWT - LWT = (kW/(4.19)/L/s)
5. Capacity based on 12°C entering air temperature and 82°C entering water temperature. Refer to correction factors for different entering conditions.
6. For premium coils (.020” wall), side pressure drop increases x 17 percent and water velocity increases 7 percent for fixed GPM.

Table 34. Heating capacity (kW), inlet size 08 — SI

Coil Rows	Fluid Flow (L/s)	Water Pressure Drop (kPa)	Airflow (L/s)								
			49	94	141	188	235	282	329	376	423
1	0.03	2.03	2.12	2.77	3.25	3.63	3.93	4.18	4.40	4.58	4.74
	0.06	6.73	2.35	3.20	3.86	4.40	4.87	5.29	5.67	6.00	6.31
	0.09	13.60	2.44	3.37	4.12	4.75	5.30	5.79	6.24	6.66	7.05
	0.13	22.51	2.49	3.47	4.26	4.94	5.54	6.09	6.59	7.05	7.48
	0.16	33.34	2.52	3.52	4.35	5.07	5.70	6.28	6.82	7.32	7.78
2	0.16	1.41	3.22	5.10	6.51	7.56	8.37	9.03	9.58	10.03	10.43
	0.25	3.32	3.30	5.35	6.95	8.19	9.18	10.00	10.69	11.28	11.80
	0.38	7.03	3.35	5.50	7.22	8.58	9.70	10.63	11.43	12.12	12.72
	0.5	11.96	3.38	5.58	7.37	8.80	9.98	10.98	11.84	12.59	13.25
	0.63	18.12	3.39	5.63	7.46	8.93	10.16	11.20	12.10	12.89	13.59
	0.76	25.47	3.40	5.66	7.52	9.03	10.28	11.36	12.29	13.10	13.83

Table 34. Heating capacity (kW), inlet size 08 — SI (continued)

Coil Rows	Fluid Flow (L/s)	Water Pressure Drop (kPa)	Airflow (L/s)								
			49	94	141	188	235	282	329	376	423
3	0.16	1.61	3.71	6.19	8.14	9.63	10.81	11.77	12.56	13.22	13.79
	0.25	3.83	3.77	6.43	8.63	10.39	11.82	13.02	14.04	14.92	15.68
	0.38	8.01	3.81	6.57	8.92	10.84	12.45	13.82	15.00	16.03	16.94
	0.5	13.60	3.85	6.64	9.07	11.08	12.79	14.25	15.53	16.65	17.64
	0.63	20.54	3.85	6.68	9.16	11.23	13.00	14.52	15.86	17.04	18.09
	0.76	28.79	3.85	6.71	9.22	11.33	13.14	14.71	16.09	17.31	18.40
4	0.16	2.06	3.98	6.85	9.25	11.13	12.63	13.85	14.87	15.72	16.45
	0.25	4.75	4.00	7.05	9.72	11.92	13.75	15.29	16.61	17.76	18.75
	0.38	9.93	4.01	7.17	9.99	12.38	14.42	16.18	17.71	19.06	20.26
	0.5	16.77	4.02	7.26	10.12	12.61	14.77	16.65	18.30	19.77	21.08
	0.63	25.24	4.03	7.25	10.20	12.76	14.98	16.94	18.67	20.21	21.60
	0.76	35.31	4.03	7.28	10.26	12.85	15.13	17.13	18.92	20.52	21.96

Notes:

1. Fouling factor = 0.00025
2. Use the following equations to calculate leaving air temperature (LAT) and water temperature difference (WTD).
3. LAT = EAT+(kW x 0.83/L/s)
4. WTD = EWT - LWT = (kW/(4.19)/L/s)
5. Capacity based on 12°C entering air temperature and 82°C entering water temperature. Refer to correction factors for different entering conditions.
6. For premium coils (.020” wall), side pressure drop increases x 17 percent and water velocity increases 7 percent for fixed GPM.

Table 35. Heating capacity (kW), inlet size 10 — SI

Coil Rows	Fluid Flow (L/s)	Water Pressure Drop (kPa)	Airflow (L/s)										
			94	141	188	235	282	329	376	423	470	564	658
1	0.04	5.08	3.59	4.24	4.78	5.23	5.60	5.93	6.22	6.48	6.70	7.10	7.43
	0.06	9.36	3.84	4.60	5.22	5.76	6.24	6.67	7.05	7.40	7.71	8.27	8.75
	0.09	18.87	4.06	4.93	5.65	6.27	6.83	7.35	7.83	8.28	8.69	9.44	10.09
	0.13	31.16	4.17	5.10	5.88	6.57	7.19	7.76	8.29	8.78	9.26	10.13	10.90
	0.16	46.08	4.25	5.22	6.04	6.76	7.42	8.04	8.61	9.14	9.64	10.58	11.44
2	0.16	2.93	5.80	7.66	9.12	10.30	11.27	12.10	12.80	13.41	13.95	14.84	15.57
	0.25	7.06	5.99	8.05	9.72	11.11	12.29	13.30	14.19	14.97	15.67	16.86	17.84
	0.38	15.10	6.11	8.28	10.08	11.61	12.92	14.07	15.08	15.98	16.80	18.20	19.38
	0.50	26.01	6.16	8.40	10.27	11.87	13.26	14.48	15.56	16.54	17.42	18.95	20.25
	0.63	39.74	6.20	8.47	10.39	12.03	13.47	14.74	15.87	16.89	17.81	19.43	20.81
3	0.16	4.04	6.78	9.24	11.22	12.85	14.21	15.35	16.33	17.18	17.91	19.14	20.13
	0.25	9.54	6.95	9.64	11.90	13.82	15.48	16.91	18.17	19.29	20.29	21.99	23.39
	0.38	20.09	7.04	9.86	12.28	14.39	16.24	17.87	19.32	20.63	21.81	23.86	25.58
	0.50	34.27	7.09	9.97	12.48	14.68	16.63	18.37	19.93	21.34	22.63	24.88	26.80
	0.63	51.94	7.12	10.04	12.60	14.86	16.87	18.68	20.31	21.79	23.14	25.53	27.58
4	0.16	5.47	7.30	10.21	12.62	14.62	16.31	17.73	18.94	19.99	20.90	22.40	23.60
	0.25	12.74	7.43	10.56	13.28	15.64	17.69	19.50	21.09	22.50	23.76	25.92	27.69
	0.38	26.58	7.50	10.75	13.63	16.20	18.49	20.54	22.38	24.04	25.55	28.19	30.41
	0.50	44.97	7.53	10.83	13.81	16.48	18.89	21.06	23.04	24.84	26.49	29.41	31.90
	0.63	67.81	7.55	10.89	13.91	16.65	19.13	21.39	23.45	25.34	27.08	30.17	32.84

Table 35. Heating capacity (kW), inlet size 10 — SI (continued)

Coil Rows	Fluid Flow (L/s)	Water Pressure Drop (kPa)	Airflow (L/s)										
			94	141	188	235	282	329	376	423	470	564	658

Notes:
1. Fouling factor = 0.00025
2. Use the following equations to calculate leaving air temperature (LAT) and water temperature difference (WTD).
3. LAT = EAT+(kW x 0.83/L/s)
4. WTD = EWT - LWT = (kW/(4.19)/L/s)
5. Capacity based on 12°C entering air temperature and 82°C entering water temperature. Refer to correction factors for different entering conditions.
6. For premium coils (.020" wall), side pressure drop increases x 17 percent and water velocity increases 7 percent for fixed GPM.

Table 36. Heating capacity (kW), inlet size 12 — SI

Coil Rows	Fluid Flow (L/s)	Water Pressure Drop (kPa)	Airflow (L/s)									
			141	235	329	423	517	611	705	799	893	940
1	0.06	1.94	5.09	6.24	7.12	7.80	8.36	8.83	9.24	9.59	9.89	10.04
	0.13	6.70	5.78	7.32	8.54	9.56	10.48	11.29	12.02	12.68	13.27	13.55
	0.19	13.90	6.04	7.77	9.17	10.37	11.43	12.40	13.29	14.12	14.88	15.24
	0.25	23.47	6.19	8.02	9.51	10.82	12.00	13.06	14.05	14.96	15.82	16.24
	0.32	35.34	6.28	8.17	9.74	11.11	12.36	13.50	14.56	15.55	16.47	16.91
2	0.22	2.00	8.44	11.76	14.13	15.93	17.34	18.48	19.43	20.23	20.91	21.22
	0.32	3.92	8.72	12.37	15.10	17.22	18.93	20.34	21.53	22.55	23.44	23.84
	0.50	9.51	8.97	12.96	16.04	18.51	20.54	22.26	23.74	25.02	26.15	26.67
	0.69	17.40	9.09	13.23	16.50	19.15	21.37	23.25	24.89	26.32	27.59	28.17
	0.88	27.54	9.16	13.40	16.77	19.54	21.87	23.86	25.60	27.13	28.49	29.11
	1.07	39.92	9.20	13.51	16.96	19.80	22.20	24.27	26.08	27.67	29.10	29.76
3	0.22	2.54	9.72	13.97	17.09	19.46	21.32	22.83	24.08	25.12	26.01	26.41
	0.32	4.90	9.98	14.64	18.21	21.04	23.33	25.23	26.83	28.20	29.39	29.92
	0.50	11.72	10.20	15.24	19.27	22.57	25.33	27.67	29.68	31.44	32.99	33.70
	0.69	21.29	10.30	15.52	19.78	23.32	26.32	28.90	31.15	33.13	34.89	35.70
	0.88	33.49	10.36	15.69	20.08	23.76	26.91	29.64	32.04	34.16	36.06	36.93
	1.07	48.29	10.40	15.80	20.27	24.06	27.31	30.14	32.64	34.86	36.85	37.77
4	0.22	3.08	10.80	16.14	20.20	23.32	25.78	27.76	29.38	30.74	31.88	32.39
	0.32	5.89	10.99	16.77	21.41	25.15	28.21	30.76	32.91	34.75	36.34	37.05
	0.50	13.96	11.15	17.31	22.48	26.83	30.53	33.72	36.48	38.89	41.03	42.01
	0.69	25.18	11.22	17.55	22.97	27.62	31.64	35.16	38.25	40.99	43.44	44.57
	0.88	39.44	11.26	17.68	23.25	28.08	32.29	36.01	39.31	42.25	44.91	46.14
	1.07	56.66	11.29	17.78	23.43	28.37	32.72	36.57	40.01	43.10	45.89	47.19

Notes:
1. Fouling factor = 0.00025
2. Use the following equations to calculate leaving air temperature (LAT) and water temperature difference (WTD).
3. LAT = EAT+(kW x 0.83/L/s)
4. WTD = EWT - LWT = (kW/(4.19)/L/s)
5. Capacity based on 12°C entering air temperature and 82°C entering water temperature. Refer to correction factors for different entering conditions.
6. For premium coils (.020" wall), side pressure drop increases x 17 percent and water velocity increases 7 percent for fixed GPM.

Table 37. Heating capacity (kW), inlet size 14 — SI

Coil Rows	Fluid Flow (L/s)	Water Pressure Drop (kPa)	Airflow (L/s)						
			282	470	658	846	1034	1222	1410
1	0.13	3.50	9.02	11.18	12.87	14.21	15.31	16.24	17.04
	0.19	7.24	9.72	12.29	14.32	16.07	17.55	18.84	19.97
	0.25	12.17	10.11	12.94	15.22	17.16	18.90	20.43	21.80
	0.32	18.27	10.36	13.37	15.82	17.93	19.80	21.50	23.04
	0.38	25.47	10.54	13.67	16.25	18.49	20.48	22.29	23.94
	0.44	33.76	10.67	13.89	16.56	18.91	21.00	22.90	24.64
2	0.32	3.08	15.25	20.47	24.00	26.57	28.54	30.11	31.39
	0.57	9.45	16.23	22.49	27.01	30.47	33.23	35.48	37.37
	0.82	19.11	16.63	23.36	28.36	32.26	35.41	38.04	40.26
	1.07	31.96	16.85	23.85	29.12	33.28	36.69	39.54	41.97
	1.32	48.05	16.99	24.16	29.61	33.95	37.52	40.53	43.11
	1.45	57.26	17.05	24.28	29.80	34.21	37.84	40.91	43.54
3	0.32	3.80	18.42	25.58	30.50	34.07	36.79	38.94	40.67
	0.57	11.33	19.41	27.97	34.36	39.31	43.27	46.52	49.24
	0.82	22.66	19.79	28.95	36.01	41.64	46.24	50.08	53.35
	1.07	37.70	19.99	29.48	36.93	42.95	47.93	52.15	55.76
	1.32	56.36	20.12	29.82	37.52	43.79	49.04	53.50	57.35
	1.45	67.01	20.16	29.94	37.74	44.11	49.46	54.01	57.95
4	0.32	4.49	20.36	29.12	35.24	39.68	43.03	45.65	47.75
	0.57	13.25	21.23	31.60	39.59	45.87	50.92	55.07	58.54
	0.82	26.28	21.54	32.56	41.37	48.52	54.43	59.40	63.64
	1.07	43.44	21.71	33.07	42.33	49.98	56.40	61.87	66.59
	1.32	64.70	21.81	33.38	42.93	50.90	57.66	63.47	68.52
	1.45	76.81	21.84	33.50	43.15	51.25	58.14	64.07	69.25

Notes:

1. Fouling factor = 0.00025
2. Use the following equations to calculate leaving air temperature (LAT) and water temperature difference (WTD).
3. LAT = EAT+(kW x 0.83/L/s)
4. WTD = EWT - LWT = (kW/(4.19)/L/s)
5. Capacity based on 12°C entering air temperature and 82°C entering water temperature. Refer to correction factors for different entering conditions.
6. For premium coils (.020” wall), side pressure drop increases x 17 percent and water velocity increases 7 percent for fixed GPM.

Table 38. Heating capacity (kW), inlet size 16 — SI

Coil Rows	Fluid Flow (L/s)	Water Pressure Drop (kPa)	Airflow (L/s)									
			282	470	658	846	1034	1222	1410	1598	1786	1880
1	0.13	3.89	9.78	12.09	13.89	15.30	16.47	17.46	18.31	19.05	19.70	19.99
	0.19	8.01	10.56	13.31	15.45	17.31	18.89	20.27	21.48	22.56	23.54	23.98
	0.25	13.46	10.99	14.02	16.43	18.49	20.34	21.98	23.45	24.78	25.99	26.55
	0.32	20.12	11.27	14.48	17.08	19.33	21.31	23.13	24.78	26.29	27.68	28.33
	0.38	28.02	11.46	14.81	17.55	19.93	22.05	23.97	25.75	27.40	28.92	29.64
2	0.32	3.29	16.09	21.95	25.99	28.96	31.25	33.08	34.58	35.83	36.90	37.38
	0.57	9.93	16.09	21.95	25.99	28.96	31.25	33.08	34.58	35.83	36.90	37.38
	0.82	20.03	17.04	24.01	29.16	33.15	36.35	39.00	41.22	43.13	44.79	45.54
	1.07	33.46	17.42	24.88	30.55	35.04	38.71	41.78	44.41	46.68	48.67	49.58
	1.32	50.17	17.63	25.37	31.33	36.11	40.07	43.41	46.28	48.78	50.99	52.00
	1.45	59.77	17.77	25.68	31.83	36.81	40.96	44.47	47.52	50.18	52.53	53.62
3	0.32	4.07	17.82	25.79	32.02	37.08	41.29	44.88	47.99	50.71	53.13	54.24
	0.57	12.08	19.17	27.06	32.60	36.67	39.77	42.22	44.20	45.85	47.23	47.85
	0.82	24.10	20.08	29.43	36.58	42.20	46.75	50.49	53.65	56.34	58.67	59.73
	1.07	39.95	20.43	30.38	38.25	44.61	49.88	54.32	58.12	61.42	64.31	65.63
	1.32	59.59	20.61	30.89	39.16	45.96	51.66	56.52	60.72	64.40	67.65	69.14
	1.45	70.83	20.72	31.21	39.73	46.82	52.80	57.95	62.42	66.36	69.86	71.47
4	0.32	4.87	20.76	31.32	39.95	47.14	53.24	58.49	63.07	67.11	70.71	72.36
	0.57	14.26	20.97	30.51	37.31	42.30	46.07	49.02	51.38	53.31	54.91	55.62
	0.82	28.20	21.74	32.89	41.70	48.74	54.46	59.19	63.16	66.54	69.46	70.77
	1.07	46.46	22.01	33.78	43.44	51.42	58.10	63.77	68.64	72.87	76.58	78.27
	1.32	69.04	22.15	34.25	44.36	52.87	60.12	66.35	71.78	76.54	80.76	82.70
	1.45	81.90	22.23	34.53	44.93	53.78	61.40	68.01	73.80	78.93	83.50	85.61

Notes:

1. Fouling factor = 0.00025
2. Use the following equations to calculate leaving air temperature (LAT) and water temperature difference (WTD).
3. LAT = EAT+(kW x 0.83/L/s)
4. WTD = EWT - LWT = (kW/(4.19)/L/s)
5. Capacity based on 12°C entering air temperature and 82°C entering water temperature. Refer to correction factors for different entering conditions.
6. For premium coils (.020” wall), side pressure drop increases x 17 percent and water velocity increases 7 percent for fixed GPM.

Table 39. Heating capacity (kW), inlet size 16x24 — SI

Coil Rows	Fluid Flow (L/s)	Water Pressure Drop (kPa)	Airflow (L/s)								
			376	564	846	1128	1410	1692	1974	2256	2350
1	0.13	4.31	11.78	13.91	16.26	18.01	19.39	20.51	21.44	22.22	22.46
	0.25	14.71	13.51	16.32	19.67	22.51	24.9	26.95	28.75	30.33	30.82
	0.32	21.98	13.91	16.92	20.58	23.63	26.32	28.66	30.74	32.6	33.17
	0.38	30.56	14.19	17.35	21.22	24.48	27.34	29.91	32.2	34.27	34.92
	0.44	40.42	14.4	17.66	21.71	25.14	28.14	30.86	33.32	35.56	36.26
2	0.32	4.07	20.26	25.58	30.97	34.64	37.3	39.35	40.97	42.29	42.68
	0.57	12.11	21.75	28.27	35.39	40.57	44.54	47.69	50.28	52.44	53.09
	0.82	24.13	22.36	29.41	37.36	43.31	47.97	51.75	54.9	57.56	58.37
	1.07	40.01	22.68	30.05	38.48	44.89	49.98	54.16	57.66	60.65	61.55
	1.32	59.68	22.9	30.45	39.2	45.92	51.3	55.75	59.5	62.72	63.7
	1.45	70.92	22.97	30.6	39.47	46.31	51.81	56.36	60.2	63.51	64.52
3	0.32	4.34	24.36	31.52	38.8	43.67	47.16	49.77	51.81	53.45	53.93
	0.57	12.86	25.9	34.7	44.57	51.81	57.35	61.74	65.31	68.28	69.17
	0.82	25.5	26.49	35.97	47.03	55.46	62.12	67.54	72.04	75.84	76.99
	1.07	42.22	26.8	36.66	48.39	57.53	64.88	70.94	76.03	80.39	81.71
	1.32	62.85	26.99	37.09	49.25	58.85	66.67	73.17	78.68	83.42	84.86
	1.45	74.66	27.06	37.24	49.57	59.36	67.34	74.01	79.69	84.59	86.07
4	0.32	5.23	26.9	35.56	44.42	50.26	54.35	57.36	59.67	61.49	62.02
	0.57	15.28	28.29	38.86	51.03	60.06	66.98	72.43	76.82	80.45	81.52
	0.82	30.11	28.78	40.09	53.71	64.31	72.76	79.64	85.35	90.17	91.62
	1.07	49.51	29.03	40.73	55.14	66.65	76.02	83.8	90.36	95.97	97.66
	1.32	73.43	29.18	41.11	56.03	68.13	78.11	86.5	93.64	99.8	101.68
	1.45	87.04	29.24	41.26	56.36	68.68	78.9	87.52	94.89	101.27	103.22

Notes:

1. Fouling factor = 0.00025
2. Use the following equations to calculate leaving air temperature (LAT) and water temperature difference (WTD).
3. LAT = EAT+(kW x 0.83/L/s)
4. WTD = EWT - LWT = (kW/(4.19)/L/s)
5. Capacity based on 12°C entering air temperature and 82°C entering water temperature. Refer to correction factors for different entering conditions.
6. For premium coils (.020” wall), side pressure drop increases x 17 percent and water velocity increases 7 percent for fixed GPM.

Table 40. Coil only-water weights — SI

Inlet Size	1-Row Coil			2-Row Coil			3-Row Coil			4-Row Coil		
	Internal Volume		Oper. Weight	Internal Volume		Oper. Weight	Internal Volume		Oper. Weight	Internal Volume		Oper. Weight
	cm^3	liter	kg	cm^3	liter	kg	cm^3	liter	kg	cm^3	liter	kg
4	170.4	0.170	1.9	403.1	0.401	2.9	560.4	0.560	3.9	717.8	0.719	4.6
5	170.4	0.170	1.9	403.1	0.401	2.9	560.4	0.560	3.9	717.8	0.719	4.6
6	170.4	0.170	1.9	403.1	0.401	2.9	560.4	0.560	3.9	717.8	0.719	4.6
8	226.1	0.227	2.5	581.7	0.583	4.0	794.8	0.795	5.3	1007.8	1.007	6.4
10	327.7	0.326	3.4	803.0	0.803	5.4	1117.6	1.117	6.9	1432.2	1.431	8.6
12	519.5	0.519	4.1	953.7	0.954	6.6	1388.0	1.385	9.0	1820.6	1.821	11.0
14	840.7	0.840	5.6	1455.2	1.454	9.2	2069.7	2.071	12.6	2684.2	2.684	15.6
16	1025.8	1.026	6.3	1756.7	1.756	10.2	2489.2	2.487	14.0	3220.1	3.221	17.4
24x16	1140.5	1.139	6.8	1987.8	1.987	11.4	2833.3	2.835	15.7	3680.5	3.679	19.4

Table 41. 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 42. Temperature correction factors for coil capacity (kW)

Entering Water Minus Entering Air (°C)	22	28	33	39	44	56	69	78	83	89	100	111
Correction Factor	0.32	0.40	0.48	0.56	0.64	0.80	1.00	1.12	1.20	1.29	1.45	1.61

Electrical Data

Table 43. VCEF electric coil kW guidelines - minimum to maximum

Inlet Size	Stages	Single-Phase Voltage					Three-Phase Voltage			
		120V	208V/ 240V	277V	347V	480V	208V	480V	575V[a]	380V/ 50 Hz
4	1	1	1	1	1	1	1	1	-	1
	2	1	1	1	1	-	1	1	-	1
	3	1	1	1	-	-	1	-	-	-
5	1	1.0-2.5	1.0-2.5	1.0-2.5	1.0-2.5	1.0-2.5	1.0-2.5	1.0-2.5	1.5-2.5	1.0-2.5
	2	1.0-2.5	1.0-2.5	1.0-2.5	1.0-2.5	2.0-2.5	1.0-2.5	1.0-2.5	1.5-2.5	1.0-2.5
	3	1.0-2.5	1.0-2.5	1.0-2.5	1.5-2.5	2.5	1.0-2.5	2.5	-	2.0-2.5
6	1	1.0-4.0	1.0-4.0	1.0-4.0	1.0-4.0	1.0-4.0	1.0-4.0	1.0-4.0	1.5-4.0	1.0-4.0
	2	1.0-4.0	1.0-4.0	1.0-4.0	1.0-4.0	2.0-4.0	1.0-4.0	1.0.4.0	1.5-4.0	1.0-4.0
	3	1.0-4.0	1.0-4.0	1.0-4.0	1.5-4.0	2.5-4.0	1.0-4.0	2.5-4.0	4	2.0-4.0
8	1	1.0-5.0	1.0-7.0	1.0-7.0	1.0-7.0	1.0-7.0	1.0-7.0	1.0-7.0	1.5-7.0	1.0-7.0
	2	1.0-5.0	1.0-7.0	1.0-7.0	1.0-7.0[b]	1.5-7.0	1.0-7.0	1.0-7.0	1.5-7.0	1.0-7.0
	3	1.0-5.0	1.0-7.0	1.0-7.0	1.5-7.0	2.5-7.0	1.0-7.0	2.5-7.0	3.5-7.0	1.5-7.0
10	1	1.0-5.0	1.0-9.0	1.0-11.0	1.0-11.0	1.0-11.0	1.0-11.0	1.0-11.0	1.5-11.0	1.0-11.0
	2	1.0-5.0	1.0-9.0	1.0-11.0	1.0-11.0	1.0-11.0	1.0-11.0	1.0-11.0	1.5-11.0	1.0-11.0
	3	1.0-5.0	1.0-9.0	1.0-11.0	1.5-11.0	1.5-11.0	1.0-11.0	1.5-11.0	2.5-11.0	1.5-11.0
12	1	1.0-5.0	1.0-9.0	1.0-13.0	1.0-16.0	1.0-16.0	1.0-15.0	1.0-16.0	1.5-15.0	1.0-16.0
	2	1.0-5.0	1.0-9.0	1.0-13.0	1.0-16.0	1.0-16.0	1.0-15.0	1.0-16.0	1.5-15.0	1.0-16.0
	3	1.0-5.0	1.0-9.0	1.0-13.0	1.5-16.0	1.5-16.0	1.0-15.0	1.5-16.0	2.0-15.0	1.5-16.0
14	1	1.0-5.0	1.0-9.0	1.0-13.0	1.0-16.0	1.0-22.0	1.0-15.0	1.0-22.0	1.5-22.0	1.0-22.0
	2	1.0-5.0	1.0-9.0	1.0-13.0	1.0-16.0	1.0-22.0	1.0-15.0	1.0-22.0	1.5-22.0	1.0-22.0
	3	1.0-5.0	1.0-9.0	1.0-13.0	1.5-16.0	1.5-22.0	1.0-15.0	1.5-22.0	2.0-22.0	1.5-22.0
16	1	1.0-5.0	1.0-9.0	1.0-13.0	1.0-16.0	1.0-22.0	1.0-15.0	1.0-30.0	1.5-30.0	1.0-26.0
	2	1.0-5.0	1.0-9.0	1.0-13.0	1.0-16.0	1.0-22.0	1.0-15.0	1.0-30.0	1.5-30.0	1.0-26.0
	3	1.0-5.0	1.0-9.0	1.0-13.0	1.5-16.0	1.5-22.0	1.0-15.0	1.5-30.0	2.0-30.0	1.5-26.0
24 x 16	1	1.5-5.0	1.0-9.0	1.0-13.0	1.0-16.0	1.0-22.0	1.5-15.0	1.0-34.0	1.5-42.0	1.0-26.0
	2	1.5-5.0	1.0-9.0	1.0-13.0	1.0-16.0	1.0-22.0	1.5-15.0	1.0-34.0	1.5-42.0	1.0-26.0
	3	1.5-5.0	1.0-9.0	1.0-13.0	1.5-16.0	1.5-22.0	1.5-15.0	1.5-34.0	2.0-42.0	1.5-26.0

Notes:

1. Coils available with 24-volt magnetic or solid state relays contactors, load carrying P.E switches, and P.E. switch with magnetic or solid state relays contactors.
2. Available kW increments are by 0.5 kW from 1.0 to 8.0 kW, by 1.0 kW from 9.0 to 18.0 kW, and by 2.0 kW from 18.0 to 46.0 kW.
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 at the end of this section.
6. The maximum allowable kW is based on the largest kW possible per a voltage and the minimum airflow per an inlet size and kW.
7. SCR not available with 575V.

(a) No 5.5 kW available.
(b) No 6.5 kW available.

Table 44. Minimum and maximum airflow per inlet size and kW

Inlet size	kW	I-P		SI	
		Min Heat cfm	Max cfm	Min L/s	Max L/s
4	1.0	83	225	39	106
5	1.0	83	350	39	165
	1.5	124	350	59	165
	2.0	166	350	78	165
	2.5	175	350	82	165
6	1.0	83	500	39	236
	1.5	124	500	59	236
	2.0	166	500	78	236
6	2.5	175	500	82	236
	3.0	210	500	99	236
	3.5	245	500	115	236
	4.0	280	500	132	236
8	1.0	121	900	57	425
	1.5	157	900	74	425
	2.0	175	900	82	425
8	2.5	187	900	88	425
	3.0	210	900	99	425
	3.5	245	900	115	425
8	4.0	280	900	132	425
	4.5	315	900	148	425
	5.0	349	900	165	425
8	5.5	384	900	181	425
	6.0	419	900	198	425
	6.5	454	900	214	425
	7.0	489	900	231	425
10	1.0	165	1400	78	661
	1.5	165	1400	78	661
	2.0	190	1400	90	661
10	2.5	215	1400	101	661
	3.0	240	1400	113	661
	3.5	265	1400	125	661
10	4.0	290	1400	137	661
	4.5	315	1400	149	661
	5.0	349	1400	165	661
10	5.5	384	1400	181	661
	6.0	419	1400	198	661
	6.5	454	1400	214	661
10	7.0	489	1400	231	661
	7.5	524	1400	247	661
	8.0	559	1400	264	661

Table 44. Minimum and maximum airflow per inlet size and kW (continued)

Inlet size	kW	I-P		SI	
		Min Heat cfm	Max cfm	Min L/s	Max L/s
10	9.0	629	1400	297	661
	10.0	699	1400	330	661
	11.0	769	1400	363	661
12	1.0 - 7.5	524	2000	247	944
	8.0	559	2000	264	944
	9.0	629	2000	297	944
12	10.0	699	2000	330	944
	11.0	769	2000	363	944
	12.0	839	2000	396	944
12	13.0	909	2000	429	944
	14.0	978	2000	462	944
	15.0	1048	2000	495	944
	16.0	1118	2000	528	944
14	1.0 - 9.0	685	3000	323	1416
	10.0	731	3000	345	1416
	11.0	769	3000	363	1416
14	12.0	839	3000	396	1416
	13.0	909	3000	429	1416
	14.0	978	3000	462	1416
14	15.0	1048	3000	495	1416
	16.0	1118	3000	528	1416
	17.0	1188	3000	561	1416
14	18.0	1258	3000	594	1416
	20.0	1398	3000	660	1416
	22.0	1538	3000	726	1416
16	1.0 - 12.0	920	4000	434	1888
	13.0	951	4000	449	1888
	14.0	978	4000	462	1888
16	15.0	1048	4000	495	1888
	16.0	1118	4000	528	1888
	17.0	1188	4000	561	1888
16	18.0	1258	4000	594	1888
	20.0	1398	4000	660	1888
	22.0	1538	4000	726	1888
16	24.0	1677	4000	792	1888
	26.0	1817	4000	858	1888
	28.0	1957	4000	924	1888
	30.0	2097	4000	990	1888

Table 44. Minimum and maximum airflow per inlet size and kW (continued)

Inlet size	kW	I-P		SI	
		Min Heat cfm	Max cfm	Min L/s	Max L/s
16 x 24	1.0 - 22.0	1688	8000	797	3776
	24.0	1755	8000	828	3776
	26.0	1817	8000	858	3776
16 x 24	28.0	1957	8000	924	3776
	30.0	2097	8000	990	3776
	32.0	2236	8000	1055	3776
	34.0	2376	8000	1121	3776
16 x 24	36.0	2516	8000	1187	3776
	38.0	2656	8000	1253	3776
	40.0	2796	8000	1319	3776
	42.0	2935	8000	1385	3776

Table 45. Discharge air reset parameter setup

Inlet Size	kW	I-P				SI			
		Reset Min/ Max Local Heat Range	Nom Reset Min Local Heat Setting (cfm)	Nom Reset Max Local Heat Setting (cfm)	Max Discharge Air Temp Reset (Setpoint and Max) ΔT	Reset Min/ Max Local Heat Range	Nom Reset Min Local Heat Setting (L/s)	Nom Reset Max Local Heat Setting (L/s)	Max Discharge Air Temp Reset (Setpoint and Max) ΔT
4	1.0	25 - 112	25	83	38	12 - 53	12	39	21
5	1.0	40 - 175	40	83	38	19 - 83	19	39	21
	1.5	40 - 175	40	124	38	19 - 83	19	59	21
	2.0	40 - 175	40	166	38	19 - 83	19	78	21
	2.5	40 - 175	40	140	45	19 - 83	19	66	25
6	1.0	60 - 250	60	83	38	28 - 118	28	39	21
	1.5	60 - 250	60	124	38	28 - 118	28	59	21
	2.0	60 - 250	60	166	38	28 - 118	28	78	21
6	2.5	60 - 250	60	175	45	28 - 118	28	82	25
	3.0	60 - 250	60	210	45	28 - 118	28	99	25
	3.5	60 - 250	60	245	45	28 - 118	28	115	25
	4.0	60 - 250	60	250	45	28 - 118	28	118	25
8	1.0	105 - 450	105	121	26	50 - 213	50	57	14
	1.5	105 - 450	105	157	30	50 - 213	50	74	17
	2.0	105 - 450	105	175	36	50 - 213	50	82	20
8	2.5	105 - 450	105	187	42	50 - 213	50	88	23
	3.0	105 - 450	105	210	45	50 - 213	50	99	25
	3.5	105 - 450	105	245	45	50 - 213	50	115	25
8	4.0	105 - 450	105	280	45	50 - 213	50	132	25
	4.5	105 - 450	105	315	45	50 - 213	50	148	25
	5.0	105 - 450	105	349	45	50 - 213	50	165	25

Table 45. Discharge air reset parameter setup (continued)

Inlet Size	kW	I-P				SI			
		Reset Min/ Max Local Heat Range	Nom Reset Min Local Heat Setting (cfm)	Nom Reset Max Local Heat Setting (cfm)	Max Discharge Air Temp Reset (Setpoint and Max) ΔT	Reset Min/ Max Local Heat Range	Nom Reset Min Local Heat Setting (L/s)	Nom Reset Max Local Heat Setting (L/s)	Max Discharge Air Temp Reset (Setpoint and Max) ΔT
8	5.5	105 - 450	105	384	45	50 - 213	50	181	25
	6.0	105 - 450	105	419	45	50 - 213	50	198	25
	6.5	105 - 450	105	454	45	50 - 213	50	214	25
	7.0	105 - 450	105	489	45	50 - 213	50	231	25
10	1.0	165 - 700	165	165	19	78 - 331	78	78	11
	1.5	165 - 700	165	165	29	78 - 331	78	78	16
	2.0	165 - 700	165	190	33	78 - 331	78	90	18
10	2.5	165 - 700	165	215	37	78 - 331	78	101	20
	3.0	165 - 700	165	240	39	78 - 331	78	113	22
	3.5	165 - 700	165	265	42	78 - 331	78	125	23
10	4.0	165 - 700	165	290	43	78 - 331	78	137	24
	4.5	165 - 700	165	315	45	78 - 331	78	149	25
	5.0	165 - 700	165	349	45	78 - 331	78	165	25
10	5.5	165 - 700	165	384	45	78 - 331	78	181	25
	6.0	165 - 700	165	419	45	78 - 331	78	198	25
	6.5	165 - 700	165	454	45	78 - 331	78	214	25
10	7.0	165 - 700	165	489	45	78 - 331	78	231	25
	7.5	165 - 700	165	524	45	78 - 331	78	247	25
	8.0	165 - 700	165	559	45	78 - 331	78	264	25
10	9.0	165 - 700	165	629	45	78 - 331	78	297	25
	10.0	165 - 700	165	699	45	78 - 331	78	330	25
	11.0	165 - 700	165	700	45	78 - 331	78	330	25
12	1.0	240 - 1000	240	524	6	113 - 472	113	247	3
	1.5	240 - 1000	240	524	9	113 - 472	113	247	5
	2.0	240 - 1000	240	524	12	113 - 472	113	247	7
12	2.5	240 - 1000	240	524	15	113 - 472	113	247	8
	3.0	240 - 1000	240	524	18	113 - 472	113	247	10
	3.5	240 - 1000	240	524	21	113 - 472	113	247	12
12	4.0	240 - 1000	240	524	24	113 - 472	113	247	13
	4.5	240 - 1000	240	524	27	113 - 472	113	247	15
	5.0	240 - 1000	240	524	30	113 - 472	113	247	17
12	5.5	240 - 1000	240	524	33	113 - 472	113	247	18
	6.0	240 - 1000	240	524	36	113 - 472	113	247	20
	6.5	240 - 1000	240	524	39	113 - 472	113	247	22
12	7.0	240 - 1000	240	524	42	113 - 472	113	247	23
	7.5	240 - 1000	240	524	45	113 - 472	113	247	25
	8.0	240 - 1000	240	559	45	113 - 472	113	264	25

Table 45. Discharge air reset parameter setup (continued)

Inlet Size	kW	I-P				SI			
		Reset Min/ Max Local Heat Range	Nom Reset Min Local Heat Setting (cfm)	Nom Reset Max Local Heat Setting (cfm)	Max Discharge Air Temp Reset (Setpoint and Max) ΔT	Reset Min/ Max Local Heat Range	Nom Reset Min Local Heat Setting (L/s)	Nom Reset Max Local Heat Setting (L/s)	Max Discharge Air Temp Reset (Setpoint and Max) ΔT
12	9.0	240 - 1000	240	629	45	113 - 472	113	297	25
	10.0	240 - 1000	240	699	45	113 - 472	113	330	25
	11.0	240 - 1000	240	769	45	113 - 472	113	363	25
12	12.0	240 - 1000	240	839	45	113 - 472	113	396	25
	13.0	240 - 1000	240	909	45	113 - 472	113	429	25
	14.0	240 - 1000	240	978	45	113 - 472	113	462	25
12	15.0	240 - 1000	240	1000	45	113 - 472	113	472	25
	16.0	240 - 1000	240	1000	45	113 - 472	113	472	25
14	1.0	320 - 1500	320	685	5	151 - 708	151	323	3
	1.5	320 - 1500	320	685	7	151 - 708	151	323	4
	2.0	320 - 1500	320	685	9	151 - 708	151	323	5
14	2.5	320 - 1500	320	685	11	151 - 708	151	323	6
	3.0	320 - 1500	320	685	14	151 - 708	151	323	8
	3.5	320 - 1500	320	685	16	151 - 708	151	323	9
14	4.0	320 - 1500	320	685	18	151 - 708	151	323	10
	4.5	320 - 1500	320	685	21	151 - 708	151	323	11
	5.0	320 - 1500	320	685	23	151 - 708	151	323	13
14	5.5	320 - 1500	320	685	25	151 - 708	151	323	14
	6.0	320 - 1500	320	685	28	151 - 708	151	323	15
	6.5	320 - 1500	320	685	30	151 - 708	151	323	17
14	7.0	320 - 1500	320	685	32	151 - 708	151	323	18
	7.5	320 - 1500	320	685	34	151 - 708	151	323	19
	8.0	320 - 1500	320	685	37	151 - 708	151	323	20
14	9.0	320 - 1500	320	685	41	151 - 708	151	323	23
	10.0	320 - 1500	320	731	43	151 - 708	151	345	24
	11.0	320 - 1500	320	769	45	151 - 708	151	363	25
14	12.0	320 - 1500	320	839	45	151 - 708	151	396	25
	13.0	320 - 1500	320	909	45	151 - 708	151	429	25
	14.0	320 - 1500	320	978	45	151 - 708	151	462	25
14	15.0	320 - 1500	320	1048	45	151 - 708	151	495	25
	16.0	320 - 1500	320	1118	45	151 - 708	151	528	25
	17.0	320 - 1500	320	1188	45	151 - 708	151	561	25
14	18.0	320 - 1500	320	1258	45	151 - 708	151	594	25
	20.0	320 - 1500	320	1398	45	151 - 708	151	660	25
	22.0	320 - 1500	320	1500	45	151 - 708	151	708	25

Table 45. Discharge air reset parameter setup (continued)

Inlet Size	kW	I-P				SI			
		Reset Min/ Max Local Heat Range	Nom Reset Min Local Heat Setting (cfm)	Nom Reset Max Local Heat Setting (cfm)	Max Discharge Air Temp Reset (Setpoint and Max) ΔT	Reset Min/ Max Local Heat Range	Nom Reset Min Local Heat Setting (L/s)	Nom Reset Max Local Heat Setting (L/s)	Max Discharge Air Temp Reset (Setpoint and Max) ΔT
16	1.0	420 - 2000	420	920	3	198 - 891	198	434	2
	1.5	420 - 2000	420	920	5	198 - 891	198	434	3
	2.0	420 - 2000	420	920	7	198 - 891	198	434	4
16	2.5	420 - 2000	420	920	9	198 - 891	198	434	5
	3.0	420 - 2000	420	920	10	198 - 891	198	434	6
	3.5	420 - 2000	420	920	12	198 - 891	198	434	7
16	4.0	420 - 2000	420	920	14	198 - 891	198	434	8
	4.5	420 - 2000	420	920	15	198 - 891	198	434	9
	5.0	420 - 2000	420	920	17	198 - 891	198	434	9
16	5.5	420 - 2000	420	920	19	198 - 891	198	434	10
	6.0	420 - 2000	420	920	21	198 - 891	198	434	11
	6.5	420 - 2000	420	920	22	198 - 891	198	434	12
16	7.0	420 - 2000	420	920	24	198 - 891	198	434	13
	7.5	420 - 2000	420	920	26	198 - 891	198	434	14
	8.0	420 - 2000	420	920	27	198 - 891	198	434	15
16	9.0	420 - 2000	420	920	31	198 - 891	198	434	17
	10.0	420 - 2000	420	920	34	198 - 891	198	434	19
	11.0	420 - 2000	420	920	38	198 - 891	198	434	21
16	12.0	420 - 2000	420	920	41	198 - 891	198	434	23
	13.0	420 - 2000	420	951	43	198 - 891	198	449	24
	14.0	420 - 2000	420	978	45	198 - 891	198	462	25
16	15.0	420 - 2000	420	1048	45	198 - 891	198	495	25
	16.0	420 - 2000	420	1118	45	198 - 891	198	528	25
	17.0	420 - 2000	420	1188	45	198 - 891	198	561	25
16	18.0	420 - 2000	420	1258	45	198 - 891	198	594	25
	20.0	420 - 2000	420	1398	45	198 - 891	198	660	25
	22.0	420 - 2000	420	1538	45	198 - 891	198	726	25
16	24.0	420 - 2000	420	1677	45	198 - 891	198	792	25
	26.0	420 - 2000	420	1817	45	198 - 891	198	858	25
	28.0	420 - 2000	420	1957	45	198 - 891	198	924	25
	30.0	420 - 2000	420	2000	45	198 - 891	198	944	25
16x24	1.0	800 - 4000	800	1688	2	378 - 1782	378	797	1
	1.5	800 - 4000	800	1688	3	378 - 1782	378	797	2
	2.0	800 - 4000	800	1688	4	378 - 1782	378	797	2
16x24	2.5	800 - 4000	800	1688	5	378 - 1782	378	797	3
	3.0	800 - 4000	800	1688	6	378 - 1782	378	797	3
	3.5	800 - 4000	800	1688	7	378 - 1782	378	797	4

Table 45. Discharge air reset parameter setup (continued)

Inlet Size	kW	I-P				SI			
		Reset Min/ Max Local Heat Range	Nom Reset Min Local Heat Setting (cfm)	Nom Reset Max Local Heat Setting (cfm)	Max Discharge Air Temp Reset (Setpoint and Max) ΔT	Reset Min/ Max Local Heat Range	Nom Reset Min Local Heat Setting (L/s)	Nom Reset Max Local Heat Setting (L/s)	Max Discharge Air Temp Reset (Setpoint and Max) ΔT
16x24	4.0	800 - 4000	800	1688	7	378 - 1782	378	797	4
	4.5	800 - 4000	800	1688	8	378 - 1782	378	797	5
	5.0	800 - 4000	800	1688	9	378 - 1782	378	797	5
16x24	5.5	800 - 4000	800	1688	10	378 - 1782	378	797	6
	6.0	800 - 4000	800	1688	11	378 - 1782	378	797	6
	6.5	800 - 4000	800	1688	12	378 - 1782	378	797	7
16x24	7.0	800 - 4000	800	1688	13	378 - 1782	378	797	7
	7.5	800 - 4000	800	1688	14	378 - 1782	378	797	8
	8.0	800 - 4000	800	1688	15	378 - 1782	378	797	8
16x24	9.0	800 - 4000	800	1688	17	378 - 1782	378	797	9
	10.0	800 - 4000	800	1688	19	378 - 1782	378	797	10
	11.0	800 - 4000	800	1688	20	378 - 1782	378	797	11
16x24	12.0	800 - 4000	800	1688	22	378 - 1782	378	797	12
	13.0	800 - 4000	800	1688	24	378 - 1782	378	797	13
	14.0	800 - 4000	800	1688	26	378 - 1782	378	797	14
16x24	15.0	800 - 4000	800	1688	28	378 - 1782	378	797	16
	16.0	800 - 4000	800	1688	30	378 - 1782	378	797	17
	17.0	800 - 4000	800	1688	32	378 - 1782	378	797	18
16x24	18.0	800 - 4000	800	1688	34	378 - 1782	378	797	19
	20.0	800 - 4000	800	1688	37	378 - 1782	378	797	21
	22.0	800 - 4000	800	1688	41	378 - 1782	378	797	23
16x24	24.0	800 - 4000	800	1755	43	378 - 1782	378	828	24
	26.0	800 - 4000	800	1817	45	378 - 1782	378	858	25
	28.0	800 - 4000	800	1957	45	378 - 1782	378	924	25
16x24	30.0	800 - 4000	800	2097	45	378 - 1782	378	990	25
	32.0	800 - 4000	800	2236	45	378 - 1782	378	1055	25
	34.0	800 - 4000	800	2376	45	378 - 1782	378	1121	25
16x24	36.0	800 - 4000	800	2516	45	378 - 1782	378	1187	25
	38.0	800 - 4000	800	2656	45	378 - 1782	378	1253	25
	40.0	800 - 4000	800	2796	45	378 - 1782	378	1319	25
	42.0	800 - 4000	800	2935	45	378 - 1782	378	1385	25

Note: For VCEF units, Discharge Air Reset Enable is not compatible with legacy design LH and RH units. This feature can only be enabled with the (F) flippable orientation units with centrally located electric heat rack. Additionally, SCR heat, BACnet controls and averaging temp sensing matrix must be selected to enable this energy efficiency feature.

Minimum Circuit Ampacity (MCA) Equation

MCA = heater amps x 1.25

Maximum Over Current Protection (MOP) Equation

- MOP = heater amps
- Since MOP is less than or equal to MCA, choose next fuse greater than MCA.
- Standard Fuse Sizes: 15, 20, 25, 30, 35, 40, 45, 50, and 60.
- Units without electric reheat would use smallest fuse sizing.

Useful Formulas:

$$\text{kW} = \frac{\text{cfm x ATD}}{3145} \qquad \text{ATD} = \frac{\text{kW x 3145}}{\text{cfm}}$$

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

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

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

Example for MOP of Single-Duct Unit

A model VCEF, electric reheat unit size 14 has 480/3 phase 15 kW electric reheat with 2 stages.

- 15 kW – 480/3 heater
- 15 x 1000 / 480 x 1.73 = 18.06
- MCA = 18.06 x 1.25 = 22.58 amps.
- Since MOP is less than or equal to MCA, then MOP = 25.

Table 46. Discharge sound power (dB)

Inlet Size (in)	Air-flow (cfm)	Air-flow (L/s)	0.5-in. w.g. (125Pa) ΔPs[a]						1.0-in. w.g. (250Pa) ΔPs[a]						1.5-in. w.g. (375Pa) ΔPs[b]						2.0-in. w.g. (500Pa) ΔPs[a]						3.0-in. w.g. (750Pa) ΔPs					
			2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7
4	80	38	58	55	43	40	39	35	60	59	48	45	46	43	61	60	51	47	50	47	62	62	52	49	53	51	63	64	55	52	56	55
	120	57	63	60	48	44	43	39	65	63	52	49	50	46	67	65	55	52	54	51	67	66	57	53	56	54	69	68	59	56	60	58
	150	71	66	63	50	47	45	41	69	66	54	51	52	49	70	68	57	54	56	53	71	69	59	56	58	56	72	71	61	58	62	61
	225	106	73	68	53	50	49	47	75	71	58	55	55	55	76	73	61	58	59	59	77	74	62	60	62	62	78	76	65	62	66	66
5	130	61	58	55	44	41	42	37	61	59	49	46	49	44	63	61	52	49	53	49	64	63	54	51	56	52	66	65	57	53	60	56
	200	94	64	59	47	45	45	40	67	63	53	49	52	48	68	66	56	52	56	52	70	67	58	54	59	55	71	70	61	57	62	59
	250	118	67	61	49	47	46	42	70	66	54	51	53	50	72	68	57	54	57	54	73	70	60	56	60	57	74	72	62	59	64	61
	350	165	72	66	52	50	48	46	75	70	57	54	55	54	77	72	60	57	60	58	78	74	62	59	62	61	79	76	65	62	66	65
6	200	94	60	55	46	42	38	37	63	60	51	47	44	44	65	62	54	50	48	48	66	64	56	53	50	51	68	66	59	55	54	54
	300	142	64	60	49	45	41	40	67	64	54	50	47	47	69	67	57	54	51	51	71	68	59	56	53	54	72	71	62	59	57	57
	400	189	68	63	51	48	43	43	71	68	57	53	49	50	73	70	60	56	53	54	74	72	62	58	56	56	76	74	65	61	59	60
	500	236	70	66	54	50	45	45	74	71	59	55	52	52	75	73	62	58	55	56	77	75	64	60	58	59	78	77	67	63	61	62
8	350	165	63	55	46	41	43	38	66	60	52	47	50	46	68	63	56	51	54	51	69	65	58	53	57	54	71	68	62	56	61	58
	500	245	67	58	49	45	45	41	70	63	55	51	52	49	72	66	59	54	57	54	73	68	61	56	60	57	75	71	65	60	64	61
	700	330	72	62	52	49	48	45	75	67	59	54	56	53	76	70	62	58	60	58	78	72	65	60	63	61	79	75	68	63	67	65
	900	425	76	66	55	52	51	49	79	70	61	58	59	57	80	73	65	61	63	61	82	75	68	64	66	65	83	78	71	67	70	69
10	550	260	60	53	49	46	42	37	63	59	55	51	49	44	65	62	58	54	52	49	66	64	60	56	55	51	68	67	63	59	59	55
	800	387	65	57	53	49	45	41	68	62	58	54	52	48	70	65	61	57	56	52	71	68	64	60	59	55	72	71	67	62	62	59
	1100	519	69	61	57	53	49	45	72	66	62	58	55	52	74	69	65	61	59	56	75	72	67	63	62	59	77	74	70	66	66	63
	1400	661	73	65	60	57	52	49	76	70	65	62	58	56	78	73	68	65	62	60	79	75	70	67	65	63	81	78	73	69	69	67
12	800	378	58	54	51	44	41	37	62	59	56	50	48	44	65	62	59	53	52	48	67	64	61	55	54	51	69	67	63	59	58	55
	1200	566	63	58	55	47	45	42	68	63	60	53	52	49	70	66	63	57	55	53	72	68	65	59	58	55	74	71	67	62	62	59
	1600	755	68	62	59	51	48	45	72	67	64	56	55	52	74	70	66	60	59	56	76	72	68	62	61	59	78	74	71	66	65	63
	2000	944	72	65	62	54	51	49	76	70	67	59	58	56	78	72	70	63	62	60	80	74	72	65	64	62	82	77	74	69	68	66
14	1100	519	57	56	53	47	42	39	61	61	58	53	48	47	63	65	61	56	53	51	65	67	63	59	56	55	67	70	66	62	59	59
	1600	755	60	59	57	50	45	43	64	65	62	56	52	51	66	68	65	59	56	55	68	70	67	62	59	59	71	73	70	65	63	63
	2100	991	62	62	60	53	48	46	66	67	65	59	55	54	69	70	68	62	59	59	71	72	70	64	62	62	73	75	73	68	66	66
	3000	1416	66	64	65	57	53	51	70	70	70	62	60	59	72	73	73	66	64	64	74	75	75	68	67	67	76	78	78	71	70	71

Table 46. Discharge sound power (dB) (continued)

Inlet Size (in)	Air-flow (cfm)	Air-flow (L/s)	0.5-in. w.g. (125Pa) ΔPs[a]						1.0-in. w.g. (250Pa) ΔPs[a]						1.5-in. w.g. (375Pa) ΔPs[b]						2.0-in. w.g. (500Pa) ΔPs[a]						3.0-in. w.g. (750Pa) ΔPs					
			2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7
16	1400	661	59	57	52	47	42	39	63	63	58	53	49	46	66	66	61	57	54	50	68	69	63	59	57	54	70	72	66	63	61	58
	2100	991	62	61	56	50	46	43	67	66	62	57	53	50	69	70	65	60	57	55	71	72	67	63	60	58	74	75	70	66	64	62
	2800	1321	65	63	60	54	49	46	70	69	65	60	56	54	72	72	69	63	60	58	74	75	71	66	63	61	76	78	74	69	67	65
	4000	1888	69	67	65	58	53	52	74	73	70	64	61	60	76	76	74	68	65	64	78	78	76	71	68	67	80	81	79	74	72	71
24 x 16	2700	1274	68	63	60	56	54	52	72	68	65	62	61	58	74	71	69	65	64	61	76	74	71	67	67	64	79	77	74	71	70	67
	4000	1888	71	65	63	59	58	56	76	71	69	65	64	62	78	74	72	68	68	65	80	76	74	71	70	68	82	79	77	74	74	71
	5300	2501	74	67	66	61	61	59	78	73	72	67	67	65	81	76	75	71	71	69	82	78	77	73	73	71	85	81	80	76	77	74
	6000	2832	75	68	67	63	62	60	79	74	73	69	68	67	82	77	76	72	72	70	84	79	79	75	75	73	86	82	82	78	78	76
	7500	3540	77	70	70	65	65	63	82	75	76	71	71	69	84	79	79	75	75	73	86	81	81	77	77	75	88	84	85	80	81	79
	8000	3776	78	70	71	66	66	64	82	76	77	72	72	70	85	79	80	75	75	74	86	81	82	78	78	76	89	84	85	81	81	80

Notes:

1. All data are measured in accordance with Industry Standard ARI 880-2011.
2. All sound power levels, dB re: 10^{-12} Watts.
3. ΔPs is inlet static pressure minus discharge static pressure.

(a) Application ratings are outside the scope of the certification program.
(b) Shaded data constitute AHRI 880–2011 Standard Rating Conditions.

Table 47. Radiated sound power (dB)

Inlet Size (in)	Airflow (cfm)	Airflow (l/s)	0.5-in. w.g. (125Pa) ΔPs[a]						1.0-in. w.g. (250Pa) ΔPs[a]						1.5-in. w.g. (375Pa) ΔPs[b]						2.0-in. w.g. (500Pa) ΔPs[a]						3.0-in. w.g. (750Pa) ΔPs					
			2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7
4	80	38	42	40	33	24	24	25	45	45	38	28	29	28	46	48	40	30	31	30	47	50	42	32	33	32	49	52	44	34	36	34
	120	57	47	44	37	28	27	26	50	49	41	32	31	30	51	52	44	34	34	32	53	54	46	35	36	34	54	56	48	38	38	36
	150	71	51	47	39	30	28	27	53	51	44	34	33	31	55	54	46	36	36	33	56	56	48	38	37	35	57	59	50	40	40	37
	225	106	57	51	43	34	32	30	60	56	48	38	36	33	61	58	50	41	39	36	62	60	52	42	41	37	64	63	55	44	43	39
5	130	61	45	41	33	24	24	24	48	47	39	29	30	28	49	50	42	32	33	31	50	53	45	34	36	33	52	56	48	37	39	36
	200	94	51	44	36	27	26	26	53	50	42	32	32	30	55	53	45	35	35	33	56	55	47	37	38	35	57	59	51	40	41	38
	250	118	54	46	37	29	28	27	56	51	43	34	33	31	58	54	46	36	37	34	59	57	49	38	39	36	60	60	52	41	42	39
	350	165	59	48	39	31	29	28	61	53	45	36	35	33	63	56	48	39	38	35	64	59	51	41	41	37	65	62	54	44	44	40
6	200	94	47	42	34	26	25	22	50	47	40	30	30	26	51	51	43	32	33	29	52	53	45	34	35	31	54	56	48	36	38	33
	300	142	51	45	38	29	28	24	54	50	43	33	33	28	56	54	46	36	36	30	57	56	48	37	38	32	58	59	51	40	41	35
	400	189	54	47	40	33	30	25	57	53	45	37	35	29	59	56	48	39	38	32	60	58	50	41	40	33	62	61	53	43	43	36
	500	236	57	49	42	35	32	26	60	55	47	39	37	30	61	58	50	42	40	32	63	60	52	43	42	34	64	63	55	45	44	37
8	350	165	48	46	40	31	31	29	51	51	46	36	36	34	53	54	50	39	40	37	54	57	52	42	42	39	55	60	55	45	45	42
	520	245	52	48	42	33	32	30	55	53	48	38	38	35	57	56	52	42	42	38	58	59	54	44	44	41	60	62	58	47	47	44
	700	330	57	51	45	36	35	32	60	56	51	41	41	37	61	59	55	45	44	40	63	62	57	47	46	42	64	65	61	50	50	45
	900	425	61	54	48	39	37	33	64	59	54	44	43	38	66	62	58	47	46	41	67	64	60	50	49	44	68	67	63	53	52	47
10	550	260	46	44	36	27	24	23	49	49	41	32	28	26	51	52	44	34	31	29	53	54	46	36	33	30	54	57	49	39	35	32
	820	387	51	48	40	31	27	24	54	53	45	35	31	28	56	56	48	38	34	30	57	58	50	40	36	32	59	60	53	42	38	34
	1100	519	55	52	43	35	30	26	59	57	49	39	34	30	61	60	52	42	37	32	62	62	54	44	39	34	64	64	57	46	41	36
	1400	661	60	55	47	38	33	28	63	60	52	43	37	32	65	63	55	45	40	34	66	65	57	47	42	35	68	68	60	50	44	37
12	800	378	46	44	34	26	25	23	50	48	39	31	29	26	53	51	42	33	32	27	54	53	44	35	33	29	56	56	47	38	36	30
	1200	566	51	48	38	30	28	24	55	53	43	35	33	27	58	56	46	37	35	29	59	58	48	39	37	31	61	60	51	42	39	32
	1600	755	56	52	42	34	31	26	60	57	47	39	36	29	62	60	50	41	38	31	64	62	52	43	40	32	66	64	54	46	42	34
	2000	944	60	56	45	38	34	28	64	60	50	42	38	31	66	63	53	45	41	33	68	65	55	47	43	34	70	68	57	49	45	36
14	1100	519	46	47	36	28	21	22	50	52	41	33	25	25	52	55	44	35	27	27	54	57	47	37	29	28	56	60	50	39	31	30
	1600	755	49	50	39	32	24	24	53	55	45	36	28	27	56	58	48	39	30	29	57	60	50	40	32	30	60	63	53	43	34	32
	2100	991	52	53	42	35	27	25	56	58	47	39	30	28	58	61	50	41	33	30	60	63	52	43	34	31	62	66	55	45	36	33
	3000	1416	56	57	46	39	31	27	60	62	51	43	35	30	62	65	54	46	37	32	64	67	56	47	38	33	66	70	59	50	40	35

Table 47. Radiated sound power (dB) (continued)

Inlet Size (in)	Airflow (cfm)	Airflow (l/s)	0.5-in. w.g. (125Pa) ΔPs[a]						1.0-in. w.g. (250Pa) ΔPs[a]						1.5-in. w.g. (375Pa) ΔPs[b]						2.0-in. w.g. (500Pa) ΔPs[a]						3.0-in. w.g. (750Pa) ΔPs					
			2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7
16	1400	661	49	48	39	31	28	27	54	53	44	36	33	31	56	57	47	40	37	34	58	59	50	42	39	36	61	62	53	45	42	38
	2100	991	53	51	41	33	30	28	57	57	47	39	36	33	60	60	50	42	39	36	62	62	53	45	41	38	64	65	56	48	44	40
	2800	1321	55	54	44	36	33	30	60	60	50	42	38	35	63	63	53	45	41	37	65	65	56	47	43	39	67	68	59	50	46	42
	4000	1888	60	58	49	41	37	33	64	64	55	46	42	38	67	67	58	49	45	40	69	70	60	52	47	42	71	73	63	55	50	45
24 x 16	2700	1274	59	54	47	42	37	30	63	58	52	47	43	35	66	61	55	51	46	38	68	63	58	53	49	40	70	66	61	56	52	43
	4000	1888	63	57	50	44	40	32	67	62	55	50	46	37	70	65	58	54	49	40	72	67	61	56	52	42	74	69	64	59	55	45
	5300	2501	66	60	52	47	42	34	71	64	58	53	48	39	73	67	61	56	51	42	75	69	63	58	54	44	77	72	66	61	57	47
	6000	2832	68	61	53	48	43	35	72	66	59	54	49	40	75	69	62	57	52	43	77	71	64	59	55	45	79	73	67	63	58	48
	7500	3540	70	63	55	50	45	36	75	68	61	56	51	41	77	71	64	59	54	45	79	73	66	62	57	47	82	76	69	65	60	50
	8000	3776	71	64	56	51	46	37	76	69	61	57	52	42	78	72	65	60	55	45	80	74	67	62	57	47	82	76	70	65	61	50

Notes:

1. All data are measured in accordance with Industry Standard ARI 880-2011.
2. All sound power levels, dB re: 10^{-12} Watts.
3. ΔPs is inlet static pressure minus discharge static pressure.

(a) Application ratings are outside the scope of the certification program.
(b) Shaded data constitute AHRI 880–2011 Standard Rating Conditions.

Table 48. Noise criteria (NC)

Inlet Size (in)	Airflow (cfm)	Airflow (l/s)	Discharge @ ∆Ps					Radiated @ ∆Ps				
			0.5” w.g.	1.0” w.g.	1.5” w.g.	2.0” w.g.	3.0” w.g.	0.5” w.g.	1.0” w.g.	1.5” w.g.	2.0” w.g.	3.0” w.g.
4	80	38	-	17	18	20	23	-	-	-	15	18
	120	57	18	21	24	25	27	-	-	18	20	23
	150	71	21	25	27	28	31	-	17	20	23	26
	225	106	30	33	34	35	37	17	23	25	27	31
5	130	61	-	17	19	21	24	-	-	17	20	24
	200	94	19	22	25	26	30	-	17	20	23	27
	250	118	22	26	29	30	32	-	18	21	25	28
	350	165	25	29	31	33	36	19	21	24	27	31
6	200	94	15	19	21	24	26	-	-	19	21	25
	200	142	18	23	26	27	31	-	18	23	25	28
	400	189	21	27	30	32	34	15	21	25	27	31
	500	236	25	31	33	36	38	19	24	27	30	33
8	350	165	-	18	21	24	27	-	21	25	27	31
	520	245	19	22	25	27	31	16	23	27	30	34
	700	330	25	29	30	33	36	20	26	31	33	37
	900	425	28	31	33	35	38	23	30	34	36	39
10	550	260	-	17	20	23	26	-	18	21	24	27
	820	387	16	20	23	26	30	17	23	26	28	31
	1100	519	21	25	28	31	33	21	27	31	33	36
	1400	661	26	30	33	34	38	25	31	34	37	40
12	800	378	-	17	20	23	26	-	18	21	24	27
	1200	566	15	21	25	27	31	18	24	27	30	32
	1600	755	20	26	30	32	34	23	28	32	34	37
	2000	944	24	30	32	34	38	27	32	36	38	42
14	1100	519	-	20	25	27	31	17	23	26	28	32
	1600	755	18	25	28	31	34	20	26	30	32	36
	2100	991	21	27	31	33	37	24	30	33	36	39
	3000	1416	24	31	34	37	40	28	34	38	40	44
16	1400	661	15	23	26	30	33	17	23	27	30	33
	2100	991	20	26	31	33	37	20	27	31	33	37
	2800	1321	23	30	33	37	40	24	31	34	37	40
	4000	1888	27	34	38	40	44	28	36	39	43	46
24 x 16	2700	1274	21	27	31	34	38	25	30	33	36	39
	4000	1888	24	31	34	37	40	28	34	38	40	43
	5300	2501	26	33	37	39	43	32	37	40	43	46
	6000	2832	27	34	38	40	44	33	39	43	45	47
	7500	3540	30	36	40	43	46	36	42	45	47	51
	8000	3776	30	37	40	43	46	37	43	46	49	51

Notes:

1. “-” represents NC levels below NC15
2. NC values are calculated using sound power measured in accordance with Industry Standard ARI 880-2011 with modeling assumptions based on AHRI 885–2008–02 Addendum.
3. ΔPs is inlet static pressure minus discharge static pressure.

Table 49. AHRI 885-2008 discharge transfer function assumptions

Size	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. Add to 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. Where ΔPs inlet static pressure minus discharge static pressure.
4. Application ratings are outside the scope of the Certification Program.

Table 50. AHRI 885-2008 radiated transfer function assumptions

	Octave Band					
	2	3	4	5	6	7
Type - Mineral Fiber	-18	-19	-20	-26	-31	-36

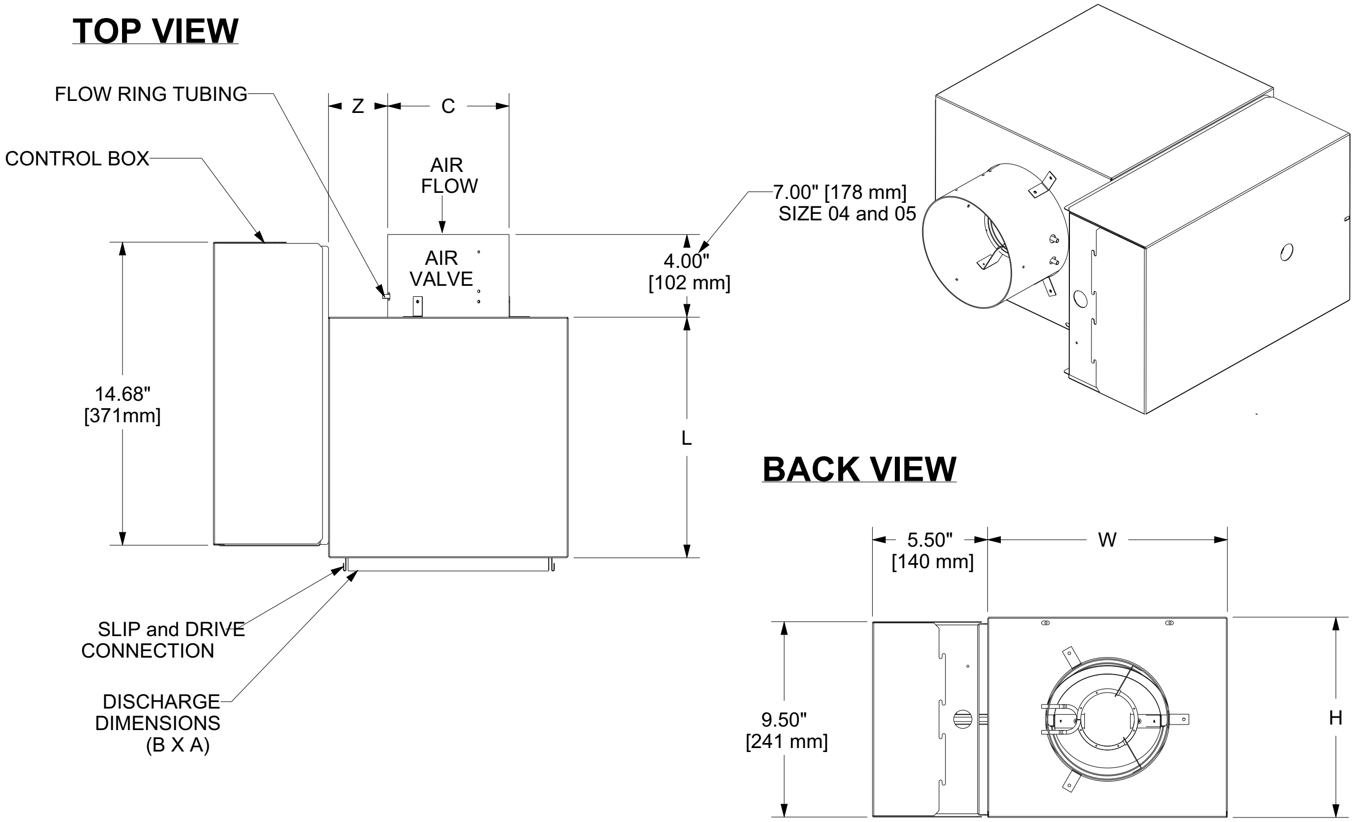
Notes:

1. Select the ceiling type which most closely represents the application. Next, add to the terminal unit sound power to determine radiated 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. Where ΔPs inlet static pressure minus discharge static pressure.
4. Application ratings are outside the scope of the Certification Program.

Dimensional Data — Single Duct Terminal Units

VCCF and VCWF Dimensions

Figure 1. Single duct, cooling only (VCCF)



Notes:

1. *See following tables for dimension values and weights.*
2. *Air inlet centered in unit front panel.*
3. *Minimum of 1.5 duct diameters of straight duct required at inlet for proper flow reading.*
4. *Allow 36–inch (914 mm) on control side for servicing.*
5. *Weights are an estimation and will vary based on selected options, insulation type, etc.*
6. *Coil furnished with stub sweat connections. Handedness of coil connection is determined by facing air stream.*
7. *Unit is field convertible from a left-hand connection (shown) to right-hand by rotating unit.*

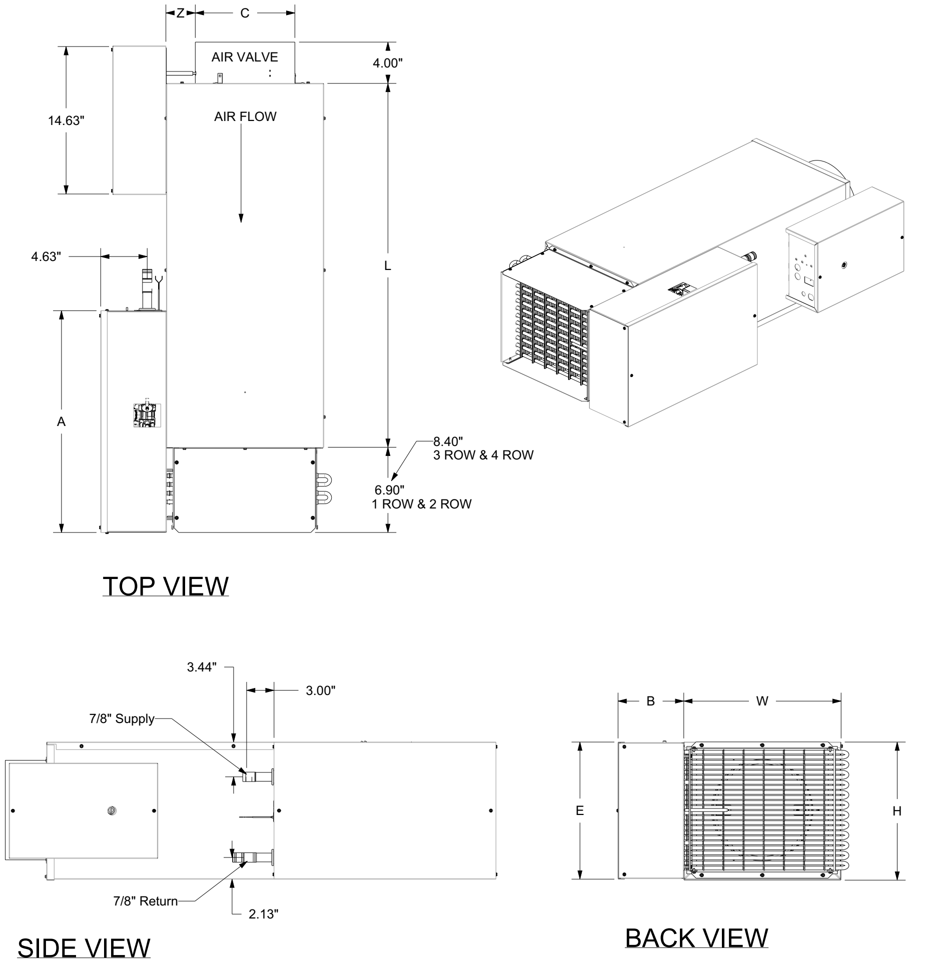
Table 51. Dimensions, single duct, cooling only (VCCF) — I-P

Valve	cfm	Inlet Dia (C) in.	L in.	H in.	W in.	Z in.	Discharge Dim		E in.	Weight lb
							Height (A) in.	Width (B) in.		
04	225	4	11.5	9.5	11.5	2.75	8	10	11.5	21
05	350	5	11.5	9.5	11.5	2.75	8	10	11.5	21
06	500	6	11.5	9.5	11.5	2.75	8	10	11.5	21
08	900	8	11.0	11.5	12.5	2.25	10	11	11.5	22
10	1400	10	12.0	13.5	15.5	2.75	12	14	14.0	30
12	2000	12	13.0	15.5	18.5	3.25	14	17	14.0	38
14	3000	14	14.0	19.5	20.5	3.25	18	19	n/a	46
16	4000	16	15.0	19.5	24.5	4.25	18	23	n/a	51
24RT	8000	16x24	18.0	19.5	28.5	2.25	18	27	n/a	70

Table 52. Dimensions, single duct, cooling only (VCCF) — SI

Valve	l/s	Inlet Dia (C) mm	L mm	H mm	W mm	Z mm	Discharge Dim		E mm	Weight kg
							Height (A) mm	Width (B) mm		
04	106	104	292	241	292	70	203	250	292	9.5
05	165	127	292	241	292	70	203	250	292	9.5
06	236	152	292	241	292	70	203	250	292	9.5
08	425	203	279	292	318	57	254	279	292	10
10	661	254	305	343	394	70	305	356	356	14
12	994	305	330	394	470	83	356	432	356	17
14	1416	356	356	495	521	83	457	483	n/a	21
16	1888	405	381	495	622	108	457	584	n/a	23
24RT	3776	406x610	457	495	724	57	457	686	n/a	32

Figure 2. Single duct terminal units with piping package



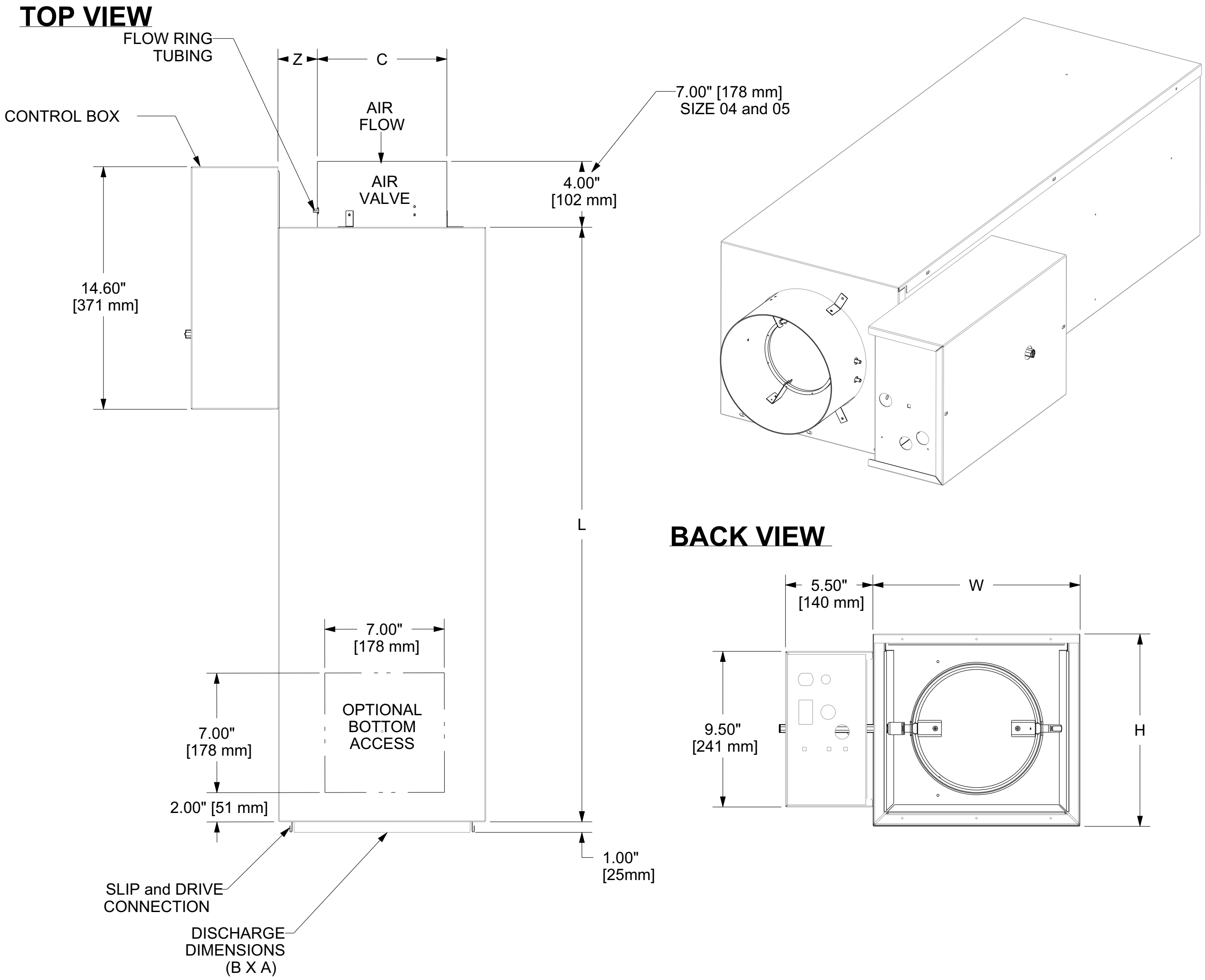
Notes:

1. *See following table for dimension values and weights.*
2. *Air inlet centered in unit front panel.*
3. *Minimum of 1.5 duct diameters of straight duct required at inlet for proper flow reading.*
4. *Allow 36–inch (914 mm) on control side for servicing.*
5. *Coil furnished with stub sweat connections. Handedness of coil connection is determined by facing air stream.*
6. *Coils and piping package are provided without internal insulation. If the unit is to be installed in a location with high humidity, external insulation around the heating coil should be installed as required.*
7. *Hot water coils come with standard bottom access panels. Optional unit bottom access is available as a selectable option.*

Table 53. Dimensions, single duct terminal units with piping package

Valve	CFM	Inlet Dia (C) in.	L in.	H in.	W in.	Z in.	Factory Installed Piping Package		
							L (A)	W (B)	H (E)
4	225	4	36	9.5	11.5	2.75	22	6.5	9.5
5	350	5	36	9.5	11.5	2.75	22	6.5	9.5
6	500	6	36	9.5	11.5	2.75	22	6.5	9.5
8	900	8	36	11.5	12.5	2.25	22	6.5	11.5
10	1400	10	36	13.5	15.5	2.75	22	6.5	13.5
12	2000	12	36	15.5	18.5	3.25	22	6.5	15.5
14	3000	14	36	19.5	20.5	3.25	22	6.5	19.5
16	4000	16	36	19.5	24.5	4.25	22	6.5	19.5
24RT	8000	16x24	36	19.5	28.5	2.25	22	6.5	19.5

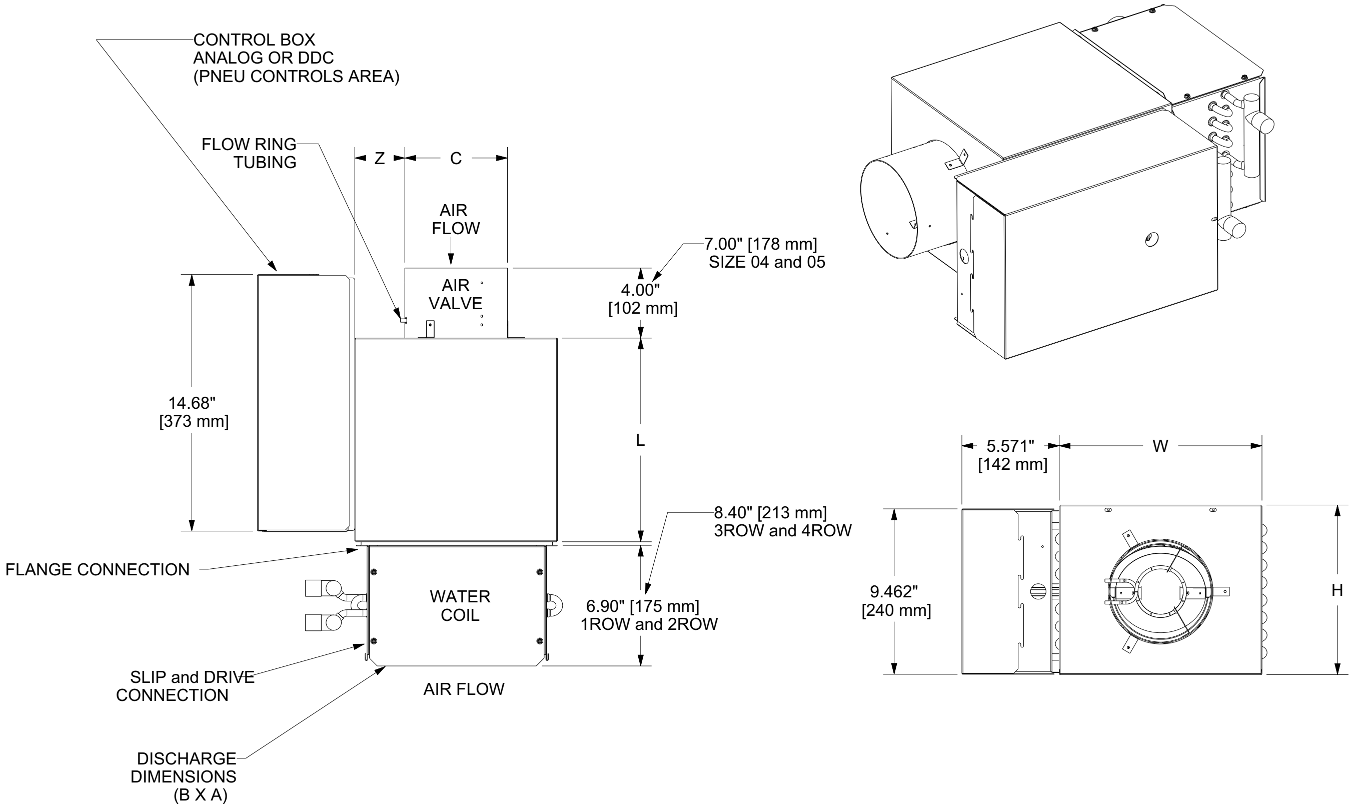
Figure 3. Single duct, cooling only, with integral attenuator and optional bottom access (VCCF)



Notes:

1. *All dimensions are the same as single duct, cooling only EXCEPT L = 36.00 in (914 mm). See tables on previous page for dimension values and weights.*
2. *Air inlet centered in unit front panel.*
3. *Minimum of 1.5 duct diameters of straight duct required at inlet for proper flow reading.*
4. *Allow 36–inch (914 mm) on control side for servicing.*
5. *Weights are an estimation and will vary based on selected options, insulation type, etc.*

Figure 4. Single duct, hot water (VCWF)



Notes:

1. *See following tables for dimension values and weights.*
2. *Air inlet centered in unit front panel.*
3. *Minimum of 1.5 duct diameters of straight duct required at inlet for proper flow reading.*
4. *Allow 36–inch (914 mm) on control side for servicing.*
5. *Weights are an estimation and will vary based on selected options, insulation type, etc.*
6. *Coil furnished with stub sweat connections. Handedness of coil connection is determined by facing air stream.*
7. *Coils are provided without internal insulation. If the unit is to be installed in a location with high humidity, external insulation around the heating coil should be installed as required.*
8. *Unit is field convertible from a left-hand connection (shown) to right-hand by rotating unit.*

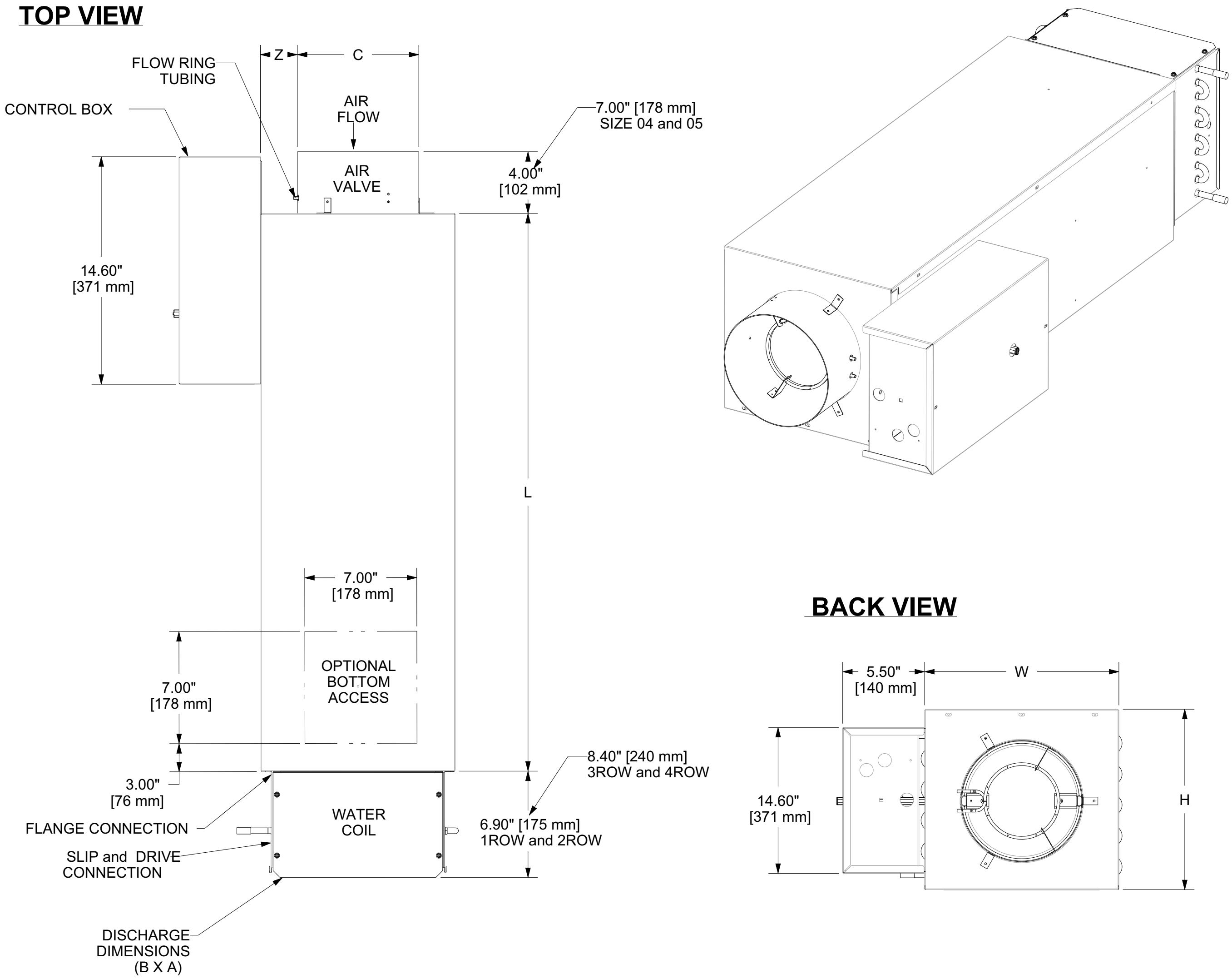
Table 54. Dimensions, single duct, hot water (VCWF) — I-P

Valve	cfm	Inlet Dia (C) in.	L in.	H in.	W in.	Z in.	Discharge Dim		E in.	Weight lb
							Height (A) in.	Width (B) in.		
04	225	4	11.5	9.5	11.5	2.75	8	10	11.5	27
05	350	5	11.5	9.5	11.5	2.75	8	10	11.5	27
06	500	6	11.5	9.5	11.5	2.75	8	10	11.5	27
08	900	8	11	11.5	12.5	2.25	10	11	11.5	30
10	1400	10	12	13.5	15.5	2.75	12	14	14	40
12	2000	12	13	15.5	18.5	3.25	14	17	14	51
14	3000	14	14	19.5	20.5	3.25	18	19	n/a	62
16	4000	16	15	19.5	24.5	4.25	18	23	n/a	71
24RT	8000	16x24	18	19.5	28.5	2.25	18	27	n/a	95

Table 55. Dimensions, single duct, hot water (VCWF) — SI

Valve	l/s	Inlet Dia (C) mm	L mm	H mm	W mm	Z mm	Discharge Dim		E mm	Weight kg
							Height (A) mm	Width (B) mm		
04	106	104	292	241	292	70	203	254	292	12
05	165	127	292	241	292	70	203	254	292	12
06	236	152	292	241	292	70	203	254	292	12
08	425	203	279	292	318	57	254	279	292	14
10	661	254	305	343	394	70	305	356	356	18
12	994	305	330	394	470	83	356	432	356	23
14	1416	356	356	495	521	83	457	483	n/a	28
16	1888	405	381	495	622	108	457	584	n/a	32
24RT	3776	406x610	457	495	724	57	457	686	n/a	43

Figure 5. Single duct, hot water, with integral attenuator and optional bottom access (VCWF)

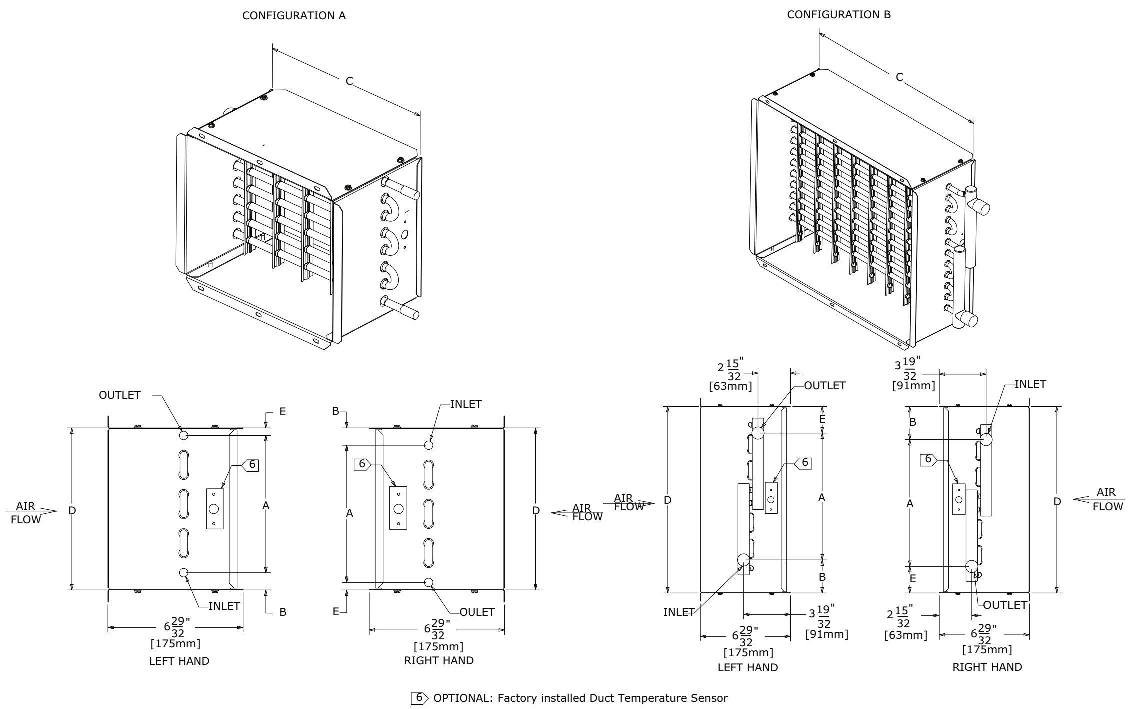


Notes:

1. *All dimensions are the same as single duct, hot water, EXCEPT L = 36.00 in (914 mm). See tables on previous page for dimension values, weights and outlet availability information.*
2. *Air inlet centered in unit front panel.*
3. *Minimum of 1.5 duct diameters of straight duct required at inlet for proper flow reading.*
4. *Allow 36–inch (914 mm) on control side for servicing.*
5. *Weights are an estimation and will vary based on selected options, insulation type, etc.*
6. *Coil furnished with stub sweat connections. Handedness of coil connection is determined by facing air stream.*
7. *Coils are provided without internal insulation. If the unit is to be installed in a location with high humidity, external insulation around the heating coil should be installed as required.*

Coil Dimensions

Figure 6. Coil information — 1–row coil assembly



Notes:

1. *Location of coil connections is determined by facing air stream. LH coil connection shown. RH opposite.*
2. *Coil furnished with stub sweat connections.*
3. *Use port at the bottom for inlet and top for outlet on single row coils. For multirow coils, always plumb in counter flow orientation. Water inlet always on the airflow downstream side of the hot water coil. Water outlet always on the upstream side of the hot water coil. See drawings for reference.*
4. *Coil height and width is dependent upon unit height and width.*
5. *Top/Bottom panels removable for access.*

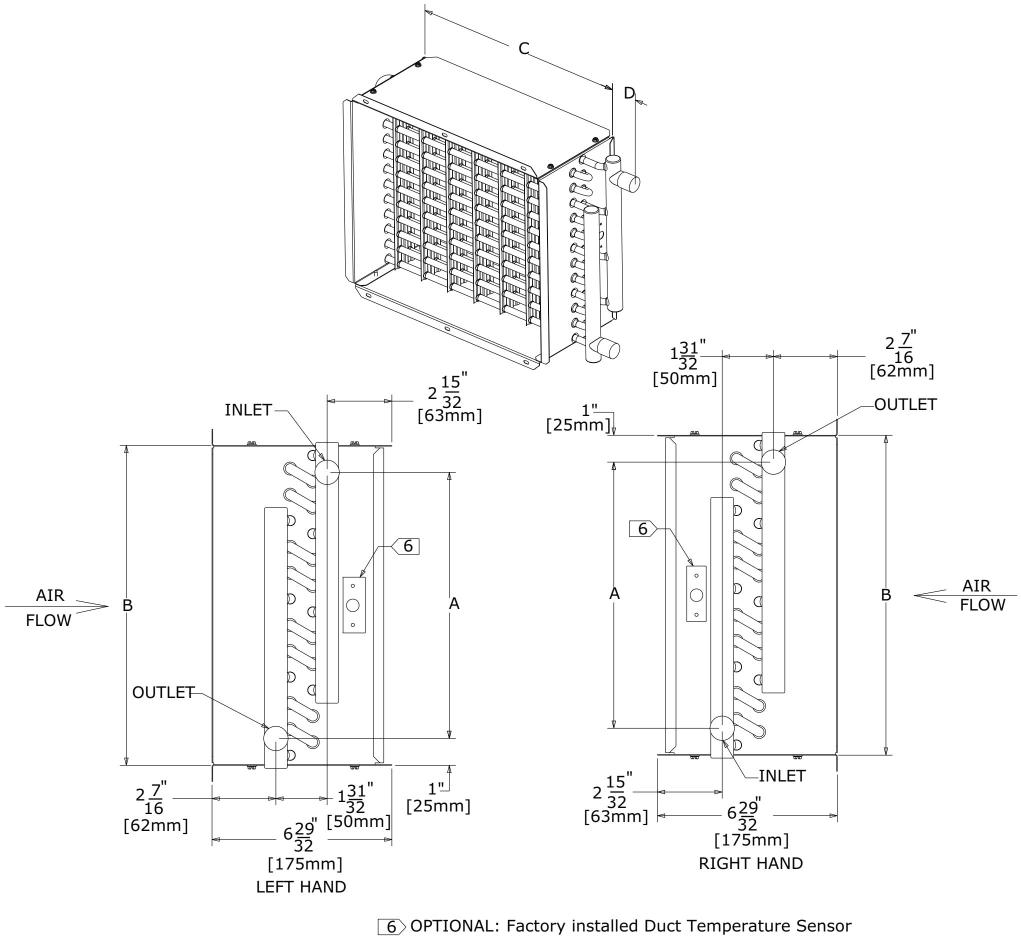
Table 56. Dimensions, 1–row coil assembly (in.)

Valve	cfm	Coil Connection O. D.	A	B	C	D	E
04	225	0.375	7.000	0.883	10.264	8.268	0.385
05	350	0.375	7.000	0.883	10.264	8.268	0.385
06	500	0.375	7.000	0.883	10.264	8.268	0.385
08	900	0.375	9.000	0.886	11.264	10.274	0.388
10	1400	0.375	11.000	0.886	14.264	12.274	0.388
12	2000	0.875	9.710	2.531	17.264	14.274	2.033
14	3000	0.875	15.710	1.531	19.264	18.274	1.033
16	4000	0.875	15.710	1.531	23.264	18.274	1.033
16x24	8000	0.875	16.743	1.531	27.264	18.274	1.033

Table 57. Dimensions, 1–row coil assembly (mm)

Valve	L/s	Coil Connection O. D.	A	B	C	D	E
04	106	10	178	22	261	210	10
05	165	10	178	22	261	210	10
06	236	10	178	22	261	210	10
08	425	10	229	23	286	261	10
10	661	10	279	23	362	312	10
12	994	22	247	64	439	363	52
14	1416	22	399	39	489	464	26
16	1888	22	399	39	591	464	26
16x24	3776	22	425	39	693	464	26

Figure 7. Coil information — 2–row coil assembly



Notes:

1. *Location of coil connections is determined by facing air stream. LH coil connection shown. RH opposite.*
2. *Coil furnished with stub sweat connections.*
3. *Use port at the bottom for inlet and top for outlet on single row coils. For multirow coils, always plumb in counter flow orientation. Water inlet always on the airflow downstream side of the hot water coil. Water outlet always on the upstream side of the hot water coil. See drawings for reference.*
4. *Coil height and width is dependent upon unit height and width.*
5. *Top/Bottom panels removable for access.*

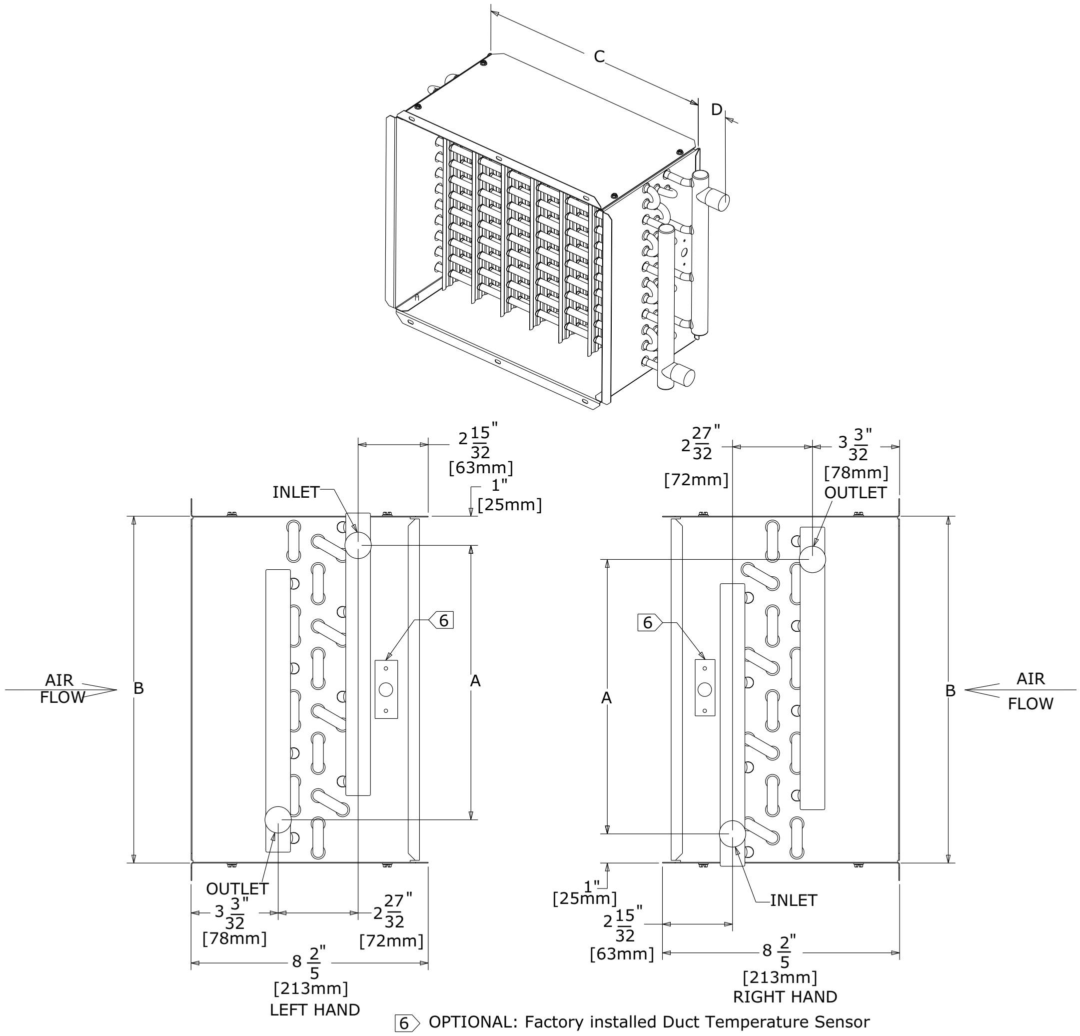
Table 58. Dimensions, 2–row coil assembly (in.)

Valve	cfm	Coil Connection O. D.	A	B	C	D	E
04	225	0.875	6.21	8.268	10.264	3.528	—
05	350	0.875	6.21	8.268	10.264	3.528	—
06	500	0.875	6.21	8.268	10.264	3.528	—
08	900	0.875	8.21	10.274	11.264	3.494	—
10	1400	0.875	10.21	12.274	14.264	3.494	—
12	2000	0.875	12.21	14.274	17.264	3.528	—
14	3000	0.875	16.21	18.274	19.264	3.528	—
16	4000	0.875	16.21	18.274	23.264	3.528	—
16x24	8000	0.875	16.21	18.274	27.264	3.528	—

Table 59. Dimensions, 2–row coil assembly (mm)

Valve	L/s	Coil Connection O. D.	A	B	C	D	E
04	106	22	158	210	261	90	—
05	165	22	158	210	261	90	—
06	236	22	158	210	261	90	—
08	425	22	209	261	286	89	—
10	661	22	259	312	362	89	—
12	994	22	310	363	439	90	—
14	1416	22	412	464	489	90	—
16	1888	22	412	464	591	90	—
16x24	3776	22	412	464	693	90	—

Figure 8. Coil information — 3–row coil assembly



Notes:

1. *Location of coil connections is determined by facing air stream. LH coil connection shown. RH opposite.*
2. *Coil furnished with stub sweat connections.*
3. *Use port at the bottom for inlet and top for outlet on single row coils. For multirow coils, always plumb in counter flow orientation. Water inlet always on the airflow downstream side of the hot water coil. Water outlet always on the upstream side of the hot water coil. See drawings for reference.*
4. *Coil height and width is dependent upon unit height and width.*
5. *Top/Bottom panels removable for access.*

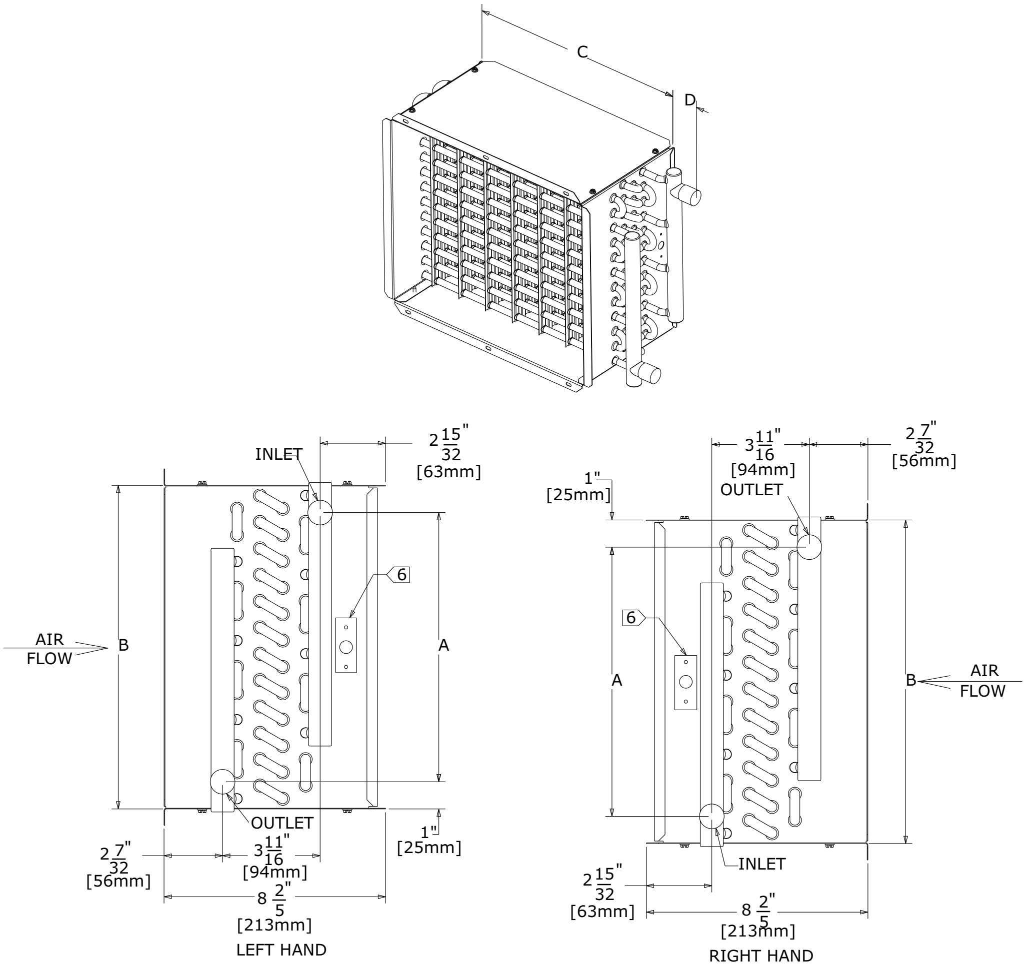
Table 60. Dimensions, 3–row coil assembly (in.)

Valve	cfm	Coil Connection O. D.	A	B	C	D	E
04	225	0.875	5.71	8.268	10.264	3.528	—
05	350	0.875	5.71	8.268	10.264	3.528	—
06	500	0.875	5.71	8.268	10.264	3.528	—
08	900	0.875	7.71	10.274	11.264	3.494	—
10	1400	0.875	9.71	12.274	14.264	3.494	—
12	2000	0.875	11.71	14.274	17.264	3.528	—
14	3000	0.875	15.71	18.274	19.264	3.528	—
16	4000	0.875	15.71	18.274	23.264	3.528	—
24	8000	0.875	15.71	18.274	27.264	3.528	—

Table 61. Dimensions, 3–row coil assembly (mm)

Valve	L/s	Coil Connection O. D.	A	B	C	D	E
04	106	22	145	210	261	90	—
05	165	22	145	210	261	90	—
06	236	22	145	210	261	90	—
08	425	22	196	261	286	89	—
10	661	22	247	312	362	89	—
12	994	22	297	363	439	90	—
14	1416	22	399	464	489	90	—
16	1888	22	399	464	591	90	—
16x24	3776	22	399	464	693	90	—

Figure 9. Coil information — 4–row coil assembly



6 OPTIONAL: Factory installed Duct Temperature Sensor

Notes:

1. *Location of coil connections is determined by facing air stream. LH coil connection shown. RH opposite.*
2. *Coil furnished with stub sweat connections.*
3. *Use port at the bottom for inlet and top for outlet on single row coils. For multirow coils, always plumb in counter flow orientation. Water inlet always on the airflow downstream side of the hot water coil. Water outlet always on the upstream side of the hot water coil. See drawings for reference.*
4. *Coil height and width is dependent upon unit height and width.*
5. *Top/Bottom panels removable for access.*

Table 62. Dimensions, 4–row coil assembly (in.)

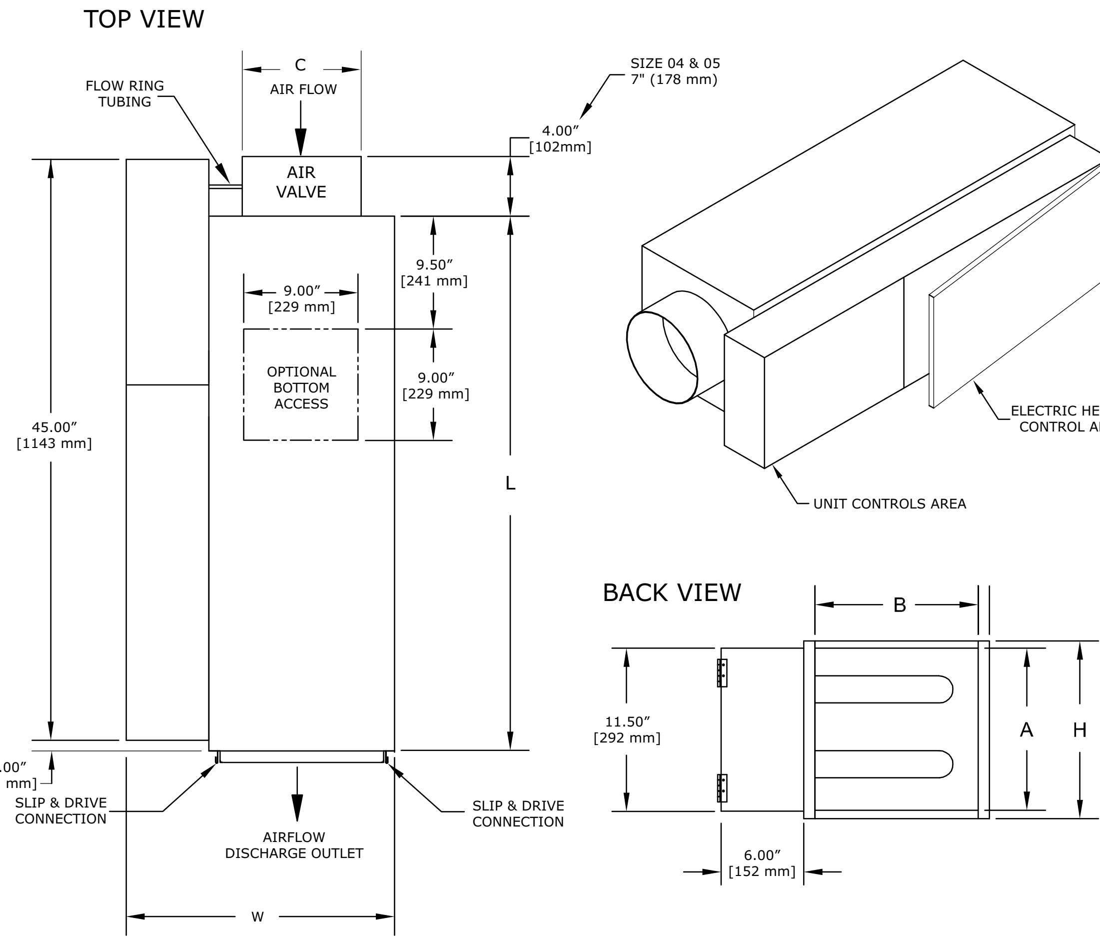
Valve	cfm	Coil Connection O. D.	A	B	C	D	E
04	225	0.875	6.21	8.268	10.264	3.528	—
05	350	0.875	6.21	8.268	10.264	3.528	—
06	500	0.875	6.21	8.268	10.264	3.528	—
08	900	0.875	8.21	10.274	11.264	3.494	—
10	1400	0.875	10.21	12.274	14.264	3.494	—
12	2000	0.875	12.21	14.274	17.264	3.528	—
14	3000	0.875	16.21	18.274	19.264	3.528	—
16	4000	0.875	16.21	18.274	23.264	3.528	—
16x24	8000	0.875	16.21	18.274	27.264	3.528	—

Table 63. Dimensions, 4–row coil assembly (mm)

Valve	L/s	Coil Connection O. D.	A	B	C	D	E
04	106	22	158	210	261	90	—
05	165	22	158	210	261	90	—
06	236	22	158	210	261	90	—
08	425	22	209	261	286	89	—
10	661	22	259	312	362	89	—
12	994	22	310	363	439	90	—
14	1416	22	412	464	489	90	—
16	1888	22	412	464	591	90	—
16x24	3776	22	412	464	693	90	—

VCEF Dimensions

Figure 10. Single duct, electric heat with integral attenuator, (VCEF — flippable to LH or RH orientation)



Notes:

1. *Air inlet is centered in unit front panel*
2. *Slip and drive discharge outlet standard.*
3. *Minimum of 1.5 times duct diameter of straight duct at inlet for proper flow reading.*
4. *For electric heater access, side hinged door must have minimum distance per NEC or local code.*
5. *Allow 48–inch (1219mm) of straight duct downstream of unit before first runout and inside of the duct should be equal discharge size (A and B).*
6. *Left-hand orientation shown (facing discharge). Unit can be flipped to right-hand orientation.*

Table 64. Dimensions, single duct, electric heat (VCEF) — I-P

Valve	cfm	Inlet Nom Dia (C) in.	L in.	H in.	W in.	Discharge Dim		Weight lb
						Height (A) in.	Width (B) in.	
04	225	4	42.5	11.5	18.5	10	11	67
05	350	5	42.5	11.5	18.5	10	11	67
06	500	6	42.5	11.5	18.5	10	11	67
08	900	8	42.5	11.5	18.5	10	11	67
10	1400	10	42.5	13.5	21.5	12	14	81
12	2000	12	42.5	15.5	24.5	14	17	93
14	3000	14	42.5	19.5	26.5	18	19	108
16	4000	16	42.5	19.5	30.5	18	23	121
24RT	8000	24x16	42.5	19.5	34.5	18	27	135

Table 65. Dimensions, single duct, electric heat (VCEF) — SI

Valve	L/s	Inlet Nom Dia (C) mm	L mm	H mm	W mm	Discharge Dim		Weight kg
						Height (A) mm	Width (B) mm	
04	106	104	1079	292	470	254	279	30
05	165	127	1079	292	470	254	279	30
06	236	152	1079	292	470	254	279	30
08	425	203	1079	292	470	254	279	30
10	661	254	1079	343	546	305	356	37
12	994	305	1079	394	622	356	432	42
14	1416	356	1079	495	673	457	483	49
16	1888	405	1079	495	775	457	584	55
24RT	3776	610x406	1079	495	876	457	686	61

Mechanical Specifications

Single-Duct Terminal Units

VCCF — Cooling Only **VCWF** — With Hot Water Coil **VCEF** — With Electric Coil

Casing

22–gauge galvanized steel.

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 1/2-inch, 1.8 lb/ft^3 (12.7 mm, 24.0 kg/m^3) composite density glass fiber with a high-density facing. Insulation R-Value is 4.2. 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, 1.8 lb/ft^3 (25.4 mm, 16.0 kg/m^3) composite density glass fiber with a high-density facing. Insulation R-Value is 4.2. 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, 1.8 lb/ft^3 (25.4 mm, 16.0 kg/m^3) density glass fiber with foil facing. Insulation R-Value is 4.2. 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, 1.8 lb./ft^3 (25.4 mm, 16.0 kg/m^3) composite density glass fiber with high-density facing. Insulation R-value is 4.2. 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).

Primary 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. See Table 20, p. 21 for air leakage performance data.

Air Valve Rectangular — Inlet collar is constructed of 18-gauge galvanized steel sized to fit standard rectangular duct. An integral multiple-point, averaging flow-sensing ring provides primary airflow measurement within +/-5% of unit cataloged airflow. Damper is 16-gauge galvanized steel. 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. See Table 20, p. 21 for air leakage performance data.

Outlet Connection

Slip and Drive Connection—Terminal units come standard with slip and drive connection.

Hot Water Coils

Factory installed on the discharge outlet. All hot water coils have 144 aluminum-plated fins per foot (0.305m). Full fin collars provided for accurate fin spacing and maximum fin-tube contact. The 3/8-inch (9.5mm) 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. Standard top and bottom gasketed access panels are attached with screws.

1-Row Hot Water Coils— The 1-row coil has 144 aluminum fins per foot. Full fin collars provided for accurate fin spacing and maximum fin-tube contact. Coil connections are left-hand. Right-hand connections are optional. Coils are assembled with either 3/8–inch or 7/8–inch (22.2 mm) OD braze connections.

2-Row Hot Water Coils— The 2-row coil has 144 aluminum fins per foot. Coils are assembled with headers that provide 7/8–inch (22.2 mm) OD braze connections. Full fin collars provided for accurate fin spacing and maximum fin-tube contact. Coil connections are left-hand. Right-hand connections are optional.

3-Row Hot Water Coils—The 3-row coil has 144 aluminum fins per foot. Coils are assembled with headers that provide 7/8–inch (22.2 mm) OD braze connections. Full fin collars provided for accurate fin spacing and maximum fin-tube contact. Coil connections are left-hand. Right-hand connections are optional.

4-Row Hot Water Coils—The 4-row coil has 144 aluminum fins per foot. Coils are assembled with headers that provide 7/8–inch (22.2 mm) OD braze connections. Full fin collars provided for accurate fin spacing and maximum fin-tube contact. Coil connections are left-hand. Right-hand connections are optional.

Electric Heat Coils

The electric heater is factory-provided and installed, open-coil, resistance-wire type heater with airflow proving switch. It also contains a disc-type automatically resetting pilot duty thermal primary cutout, and manually resettable thermal secondary cutout that is either load carrying or pilot duty with a backup contactor. Heater element material is type C nickel-chromium-iron. The line voltage end of the unit’s control box is provided with triple-sized knockouts for customer power connection. Terminal connections to resistance-wire heating elements are plated steel with ceramic insulators.

Electric Heat Options

Silicon-Controlled Rectifier (SCR) — Optional 0 to 10 Vdc electric heat control that provides modulation. Allows use of energy efficient dual max algorithm with selection of Tracer® BACnet Controllers UC210, Symbio™ 210/210e, or Symbio™ 500 controls. See Single-Duct: SCR Modulation of Electric Heat section in Controls chapter for detailed description of dual max algorithm function.

Electric Heat Transformer — Transformer is an integral component of heater control panel (dependent on unit load requirements) to provide class 2 24 Vac for controls. There is 19 VA available for controls.

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 — An air pressure device designed to disable the heater. This is standard on single-duct with electrical reheat units.

Line Fuse — An optional over-current protection fuse located in the line of power of the electric heater.

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

Unit Controls Sequence of Options

Unit controller continuously monitors zone temperature against its setpoint and varies primary airflow as required to meet zone temperature and ventilation setpoints. Airflow is limited by minimum and maximum airflow setpoints. Upon further call for heat after the air valve reaches the heating minimum airflow setting, any hot water or electric heat associated with the unit is enabled.

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.

Controllers monitor zone temperature setpoints, zone temperature, zone temperature rate of change, and valve airflow. They can also monitor supply duct air temperature, CO_2 concentration and discharge air temperature via appropriate sensors. Controller is provided in an enclosure with 7/8-inch (22mm) knockouts for remote control wiring. Trane zone sensor or Air-Fi® Receiver Interface Module paired with a Wireless Communications Sensor (WCS) is required.

Single duct units can use any of the following optional Trane unit controllers: Symbio™ 500, Symbio™ 210, Symbio™ 210e, Tracer® UC210.
Dual duct units use the following controller:
Symbio™ 500.
Additionally, VAV units may ship less controls or with factory mounted 3rd party unit controllers.

DDC Zone Sensor — The 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 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 controller is unnecessary.

Digital Display Zone Sensor with Liquid Crystal Display (LCD) — Digital display zone sensor contains a sensing element, which signals the controller. 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 from unoccupied to occupied. Override button cancel feature returns system to unoccupied mode.

System Communications — The Controller is designed to send and receive data from a Tracer® SC or other Trane controllers. Current unit status conditions and setpoints may be monitored and/or edited via this data communication feature. The network type is a twisted wire pair shielded serial communication.

Control Options

Transformer (VCCF, VCWF) — A 50-VA transformer is factory-installed in an enclosure with 7/8–inch (22 mm) knockouts to provide 24 VAC for controls.

Disconnect Switch (VCCF, VCWF) — A toggle disconnect disengages primary power to terminal.

Fuse (VCCF, VCWF) — Optional fuse is factory-installed in the primary voltage hot leg.

Trane Hot Water Valves

Modulating Water Valve — The valve is a field-adaptable, 2-way or 3-way configuration and ships with a cap over the bottom port. This configures the valve for 2-way operation. For 3-way operation, remove the cap. The valve is designed with an equal percentage plug. The intended fluid is water or water and glycol (50 percent maximum glycol). The actuator is a synchronous motor drive. The valve is driven to a predetermined position by the 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 94-5V 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 – 0.7 Cv, 1.7 Cv, 2.7 Cv, 5.0 Cv
Overall Diameter – ½-inch NPT
Maximum Allowable Pressure – 300 psi (2068 kPa)
Maximum Operating Fluid Temperature – 200°F (93°C)
Maximum Close-off Pressure – 60 psi (379 kPa)
Electrical Rating – 3VA at 24 Vac
8-inch plenum rated cable with AMP Mate-N-Lok connector. This connector is designed to mate with the optional factory mounted valve harness to make electrical connection quick and simple (120-inch plenum rated cable with quick connect tabs for control board interface).

Belimo Hot Water Valve

Modulating Water Valve — The valves are offered as a 2-way or 3-way configuration. 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 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–inch 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-inch plenum rated cable with AMP Mate-N-Lok connector. This connector is designed to mate with the optional factory mounted valve harness to make electrical connection quick and simple (120–inch plenum rated cable with quick connect tabs for control board interface).

Model Number Descriptions

Dual-Duct VAV Units

Digit 1, 2, 3, 4 — Unit Model

VDDF = VariTrane™ Dual—Duct

Digit 5, 6 — Primary Air Valve

05 = 5–inch inlet (350 cfm)
06 = 6–inch inlet (500 cfm)
08 = 8–inch inlet (900 cfm)
10 = 10–inch inlet (1400 cfm)
12 = 12–inch inlet (2000 cfm
14 = 14–inch inlet (3000 cfm)
16 = 16–inch inlet (4000 cfm)

Digit 7, 8 — Secondary Air Valve

05 = 5–inch inlet (350 cfm)
06 = 6–inch inlet (500 cfm)
08 = 8–inch inlet (900 cfm)
10 = 10–inch inlet (1400 cfm)
12 = 12–inch inlet (2000 cfm
14 = 14–inch inlet (3000 cfm)
16 = 16–inch inlet (4000 cfm)

Digit 9 — Not Used

0 = Not applicable

Digit 10, 11 — Design Sequence

****** = Factory Assigned

Digit 12, 13, 14, 15 — Controls

DD00 = Trane Actuator Only
FM00 = Other Actuator and Control
FM01 = Trane Supplied Actuator, Other Ctrl
SE41 = Symbio™ 500 - DDC Basic Variable Air Volume
SE48 = Symbio™ 500 - DDC Basic Constant Volume

Digit 16 — Insulation

A = 1/2–inch Matte-faced
B = 1–inch Matte-faced
D = 1–inch Foil-faced
F = 1–inch Double Wall
G = 3/8–inch Closed-cell

Digit 17 — Not Used

0 = Not Applicable

Digit 18 — Not Used

0 = Not Applicable

Digit 19 — Not Used

0 = Not Applicable

Digit 20 — Not Used

0 = Not Applicable

Digit 21 — Not Used

0 = Not Applicable

Digit 22 — Not Used

0 = Not Applicable

Digit 23 — Transformer

0 = None
1 = 120/24V, 50 VA
2 = 208/24V, 50 VA
3 = 240/24V, 50 VA
4 = 277/24V, 50 VA
5 = 480/24V, 50 VA
6 = 347/24V, 50 VA
7 = 575/24V, 50 VA

Digit 24 — Disconnect Switch

0 = None
W = With Toggle

Digit 25 — Power Fuse

0 = None
W = With

Digit 26 — Not Used

0 = Not Applicable

Digit 27 — Not Used

0 = Not Applicable

Digit 28 — Not Used

0 = Not Applicable

Digit 29 — Not Used

0 = Not Applicable

Digit 30— Not Used

0 = Not Applicable

Digit 31 — Not Used

0 = Not Applicable

Digit 32 — Not Used

0 = Not Applicable

Digit 33 — Special Options

0 = None
X = Varies, Factory Assigned

Digit 34 — Actuator

0 = Standard
A = Belimo™ Actuator
B = Trane Analog Actuator (Trane Controls Only)

Digit 35 — Wireless Sensor

0 = Sensor/Receiver Standard
3 = Trane Air-Fi® Wireless Communication Interface

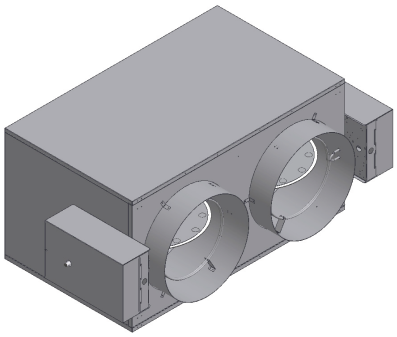
Note: *All sensors selected in accessories.*

Digit 36 — Duct Temperature Sensor

0 = None
1 = With Duct Temperature Sensor

Dual-Duct VAV Terminal Units

Dual-duct units have two air valves. One heating valve and one cooling air valve modulate to provide occupant comfort. These systems were popular prior to the energy crisis of the early 1970s. Popularity is increasing with alternative system concepts.



Selection Procedure

This section describes the catalog selection of dual-duct VAV terminal units with specific examples. A computer selection program is also available to aid in selection of VAV terminal units.

Selection of dual-duct VAV terminal units can involve two elements:

- Air valve selection
- Acoustics

Air Valve Selection

The wide-open static pressure and airflows are found in the performance data section of the catalog. To select the air valves, locate the required design cooling and heating airflows for your terminal unit type and find their vertical intersection, with the smallest air valve size that has a pressure drop equal to or lower than the maximum wide-open static pressure requirement.

Example: VDDF terminal unit design

- Cooling airflow: 1000 cfm
- Maximum wide-open air pressure drop: 0.25 in. wg
- Minimum cooling airflow: 500 cfm
- Design heating airflow: 1000 cfm
- Maximum wide-open air pressure drop: 0.25 in. wg
- Minimum heating airflow: 400 cfm

From the performance data charts, select a valve size 10 for cooling, which has a wide-open static pressure drop of 0.09 in. wg. Select a size 10 for heating, which has a wide-open static pressure drop of 0.09 in. wg.

Check the minimum and maximum cfm desired with the minimum and maximum cfm allowed in the table in the general data section. The maximum setting of 1000 cfm is within the acceptable range. The desired minimum setting of 500 cfm is acceptable for the unit desired.

Acoustics

The acoustical data found in the VAV catalog is used to determine sound the terminal unit will generate. Locate the table for the VAV terminal unit of interest. Sound power data and an equivalent NC level for an AHRI 885-2008 transfer function is listed.

Example: VDDF, Cooling-Only Terminal Unit, Size 10 cooling, Size 10 heating (See air valve selection)

- Cooling Airflow: 1000 cfm
- Max. inlet static pressure: 1.5 in. wg
- Heating Airflow: 1000 cfm
- Max. inlet static pressure: 1.5 in. wg

Interpolation gives sound power data of:

Octave Band	2	3	4	5	6	7	NC
Disch. Sound Power	83	72	69	67	66	60	39
Rad. Sound Power	69	63	57	54	47	40	34

The NC level above is determined by using either the catalog's AHRI 885-2008 (mineral fiber for radiated sound) transfer function for the conditions shown in the acoustics table. A different transfer function could be applied as conditions dictate.

The maximum NC level is NC-40. If the maximum NC level was exceeded, it would have been necessary to reselect the next larger unit size.

Trane Select Assist™

Trane Select Assist™ is an online tool used to determine properly sized VariTrane™ VAV terminal unit and resulting performance data for specific input specifications. In addition to selection of VAV terminal unit configuration selections, Trane Select Assist also includes most other Trane products, allowing user to select all required equipment within the one program.

Within the tool, required fields are denoted by red shading, and for VAV terminal units include maximum and minimum airflows, control type, and unit model. (Models with reheat have additional required fields.) The user has the option of viewing information for an individual selection on one screen, or as a schedule with all VAV units required for the specific application.

Trane Select Assist also calculates sound power data for the selected terminal unit. Input is either maximum individual sound level for each octave band, or maximum NC value. Trane Select Assist will calculate acoustical data subject to default or user-supplied sound attenuation data.

Schedule View: The program has many time saving features such as:

- Copy/paste from spreadsheets like Microsoft® Excel
- Easily arrange fields to match your schedule
- Time-saving templates to store default settings

The use can also export the schedule view to Excel for modification or inclusion in engineering drawings as a schedule. Details regarding the program, its operation, and instructions on obtaining a copy are available from your local Trane sales office.

General Data

Table 66. Primary airflow control factory settings (per valve) — I-P

Control Type	Air Valve Size in	Maximum Valve Cfm	Maximum Controller Cfm	Minimum Controller Cfm	Constant Volume Unit Cfm
Direct Digital Control/ Symbio™ 500	5	350	40-350	0,40-350	40-700
	6	500	60-500	0,60-500	60-1000
	8	900	105-900	0,105-900	105-1800
	10	1400	165-1400	0,165-1400	165-2800
	12	2000	240-2000	0,240-2000	240-4000
	14	3000	320-3000	0,320-3000	320-6000
	16	4000	420-4000	0,420-4000	420-8000

Table 67. Primary airflow control factory settings (per valve) — SI

Control Type	Air Valve Size in	Maximum Valve L/s	Maximum Controller L/s	Minimum Controller L/s	Constant Volume Unit L/s
Direct Digital Control/ Symbio™ 500	5	165	19-165	0,19-165	19-330
	6	236	28-236	0,28-236	28-472
	8	425	50-425	0,50-425	50-850
	10	661	77-661	0,77-661	77-1321
	12	944	111-944	0,111-944	111-1888
	14	1416	151-1416	0,151-1416	151-2832
	16	1888	198-1888	0,198-1888	198-3776

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

Performance Data

Table 68. Air pressure drop — VDDF

Inlet Size	I-P		SI	
	Airflow (Cfm)	Pressure Drop (in. wg)	Airflow (L/s)	Pressure Drop (Pa)
5	100	0.01	45	3
	200	0.02	95	5
	300	0.04	140	11
	350	0.06	165	15
6	100	0.01	45	3
	250	0.08	120	21
	350	0.17	165	42
	500	0.38	235	93
8	200	0.01	95	3
	400	0.04	190	11
	600	0.1	280	25
	900	0.24	420	59
10	500	0.02	235	5
	800	0.05	375	13
	1100	0.1	520	26
	1400	0.17	660	42
12	800	0.01	375	3
	1200	0.03	565	8
	1600	0.06	755	15
	2000	0.1	940	24
14	1500	0.04	700	9
	2000	0.07	945	18
	2500	0.12	1180	30
	3000	0.19	1415	46
16	2000	0.03	940	6
	2500	0.04	1180	10
	3000	0.06	1415	14
	4000	0.1	1885	25

Note: Pressure drops are per air valve.

Table 69. Discharge sound power (dB) — 0.5 to 1.5–in. Inlet Pressure ∆Ps

Inlet Size (in)	Cfm		0.5" Inlet Pressure ∆Ps[a]						1.0" Inlet Pressure ∆Ps						1.5" Inlet Pressure ∆Ps[b]					
		L/s	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7
5	130	61	54	46	42	41	36	33	59	52	49	48	46	43						
	200	94	60	50	46	45	42	36	64	56	52	51	47	44						
	250	118	63	52	49	47	45	39	67	57	54	53	50	45	70	62	58	57	53	50
	350	165	70	58	53	51	49	43	73	62	59	56	55	49						
6	200	94	59	49	46	45	42	35	64	55	52	50	47	43						
	300	142	66	54	50	48	46	39	69	60	58	54	52	46						
	400	189	69	57	53	50	46	40	75	64	61	57	55	49	77	66	63	61	58	53
	500	236	67	56	54	50	44	41	77	67	63	58	55	50						
8	350	165	64	54	51	50	48	39	70	61	58	57	55	45						
	520	245	67	56	54	54	52	44	75	64	61	61	58	51						
	700	330	69	58	56	55	53	46	77	66	63	62	61	54	81	71	69	67	64	58
	900	425	71	61	59	56	52	46	78	68	65	64	62	56						
12	800	378	70	59	55	53	51	46	78	67	64	62	61	57						
	1200	566	74	61	56	53	51	46	83	71	64	62	60	56						
	1550	732																		
	1600	755	74	64	58	55	53	48	84	72	65	62	60	56	90	77	69	68	65	61
	2000	944	76	66	61	57	55	50	84	74	67	63	61	56						
14	1100	519	70	60	57	57	57	50	79	69	65	65	65	61						
	1600	755	72	62	57	57	56	50	80	70	65	65	66	60						
	2100	991	74	65	60	59	58	51	82	72	66	66	66	60	86	76	70	70	70	65
	3000	1416	78	68	63	64	63	55	85	75	69	70	69	61						
16	1400	661	69	60	57	56	59	54	78	69	67	64	66	63						
	2100	991	70	61	57	58	60	53	79	70	66	65	66	63						
	2800	1321	72	64	59	60	62	54	79	71	66	67	67	63	84	76	70	70	71	68
	3000	1416																		
	4000	1888	75	67	63	67	67	59	82	74	69	71	71	64						

Notes:

1. All data are measured in accordance with Industry Standard AHRI 880–2011.
2. All sound power levels, dB re: 10 to 12 Watts.
3. Where ∆Ps is the inlet static pressure minus discharge static.

(a) Application ratings are outside the scope of the certification program.
(b) Data in this column constitute AHRI 880–2011 Standard Rating Conditions.

Table 70. Discharge sound power (dB) — 2.0 and to 3.0–in. Inlet Pressure ∆Ps

Inlet Size (in)	Cfm	L/s	2.0" Inlet Pressure ∆Ps						3.0" Inlet Pressure ∆Ps					
			2	3	4	5	6	7	2	3	4	5	6	7
5	130	61	61	55	54	55	55	52	61	57	59	61	61	58
	200	94	68	61	59	58	56	52	68	62	62	63	62	57
	250	118	72	64	61	60	57	53	72	66	65	64	63	57
	350	165	78	69	65	63	60	55	80	71	69	68	65	59
6	200	94	68	60	58	58	56	51	67	61	62	62	62	56
	300	142	75	66	63	61	58	53	75	68	66	65	63	57
	400	189	79	69	66	63	60	55	81	72	70	68	65	59
	500	236	85	73	69	66	63	57	86	75	74	71	67	61
8	350	165	73	66	64	64	62	53	73	68	68	68	66	58
	520	245	81	72	69	68	65	56	81	73	72	72	69	60
	700	330	85	74	72	70	68	60	87	79	76	74	71	62
	900	425	86	76	73	72	69	62	91	81	79	76	73	66
12	800	378	83	75	71	69	67	64	83	77	73	71	69	68
	1200	566	89	79	73	70	68	65	89	82	77	73	72	69
	1550	732												
	1600	755	92	81	73	71	69	65	94	84	77	75	72	70
	2000	944	95	82	74	72	69	65	97	87	78	76	72	69
14	1100	519	84	76	73	71	71	69	84	78	76	73	73	75
	1600	755	88	78	74	72	72	70	89	82	77	76	74	74
	2100	991	89	79	73	73	72	70	90	83	78	76	75	74
	3000	1416	91	82	76	75	74	70	94	86	80	77	76	75
16	1400	661	84	77	73	70	70	72	85	80	77	73	71	76
	2100	991	87	78	74	72	72	71	89	82	78	76	73	76
	2800	1321	87	78	74	72	72	71	91	83	79	76	75	75
	3000	1416												
	4000	1888	90	81	76	75	75	71	93	85	80	77	76	75

Notes:

1. All data are measured in accordance with Industry Standard AHRI 880–2011.
2. All sound power levels, dB re: 10 to 12 Watts.
3. Where ∆Ps is the inlet static pressure minus discharge static.

Table 71. Radiated sound power (dB) — 0.5 to 1.5–in. Inlet Pressure ∆Ps

Inlet Size (in)	Cfm	L/s	0.5" Inlet Pressure ∆Ps[a]						1.0" Inlet Pressure ∆Ps						1.5" Inlet Pressure ∆Ps[b]					
			2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7
5	130	61	51	44	33	28	24	24	52	46	38	34	29	30						
	200	94	53	46	36	31	25	23	56	50	42	37	31	29						
	250	118	55	49	39	33	27	24	58	52	44	39	33	29	59	55	48	42	37	35
	350	165	60	53	45	37	31	26	62	57	48	42	36	31						
6	200	94	52	45	35	29	24	23	55	48	41	34	28	27						
	300	142	57	50	40	34	26	23	59	53	45	38	31	27						
	400	189	58	51	42	34	28	24	63	58	49	42	35	29	64	60	52	45	37	31
	500	236	58	52	45	36	31	27	66	60	51	42	37	30						
8	350	165	56	49	40	34	28	25	60	55	47	41	33	28						
	520	245	57	52	44	37	31	26	64	58	51	44	37	30						
	700	330	60	55	47	40	34	28	66	61	52	46	39	32	69	64	57	51	43	36
	900	425	60	56	48	41	37	31	67	64	55	48	43	36						
12	800	378	61	51	45	39	32	22	66	59	50	45	38	31						
	1200	566	64	54	48	41	36	25	71	62	52	47	42	34						
	1550	732	65	57	47	42	40	28	73	64	53	47	46	36						
	1600	755													78	68	58	50	47	41
	2000	944	66	59	48	44	45	35	75	66	54	48	48	40						
14	1100	519	58	50	43	39	33	23	67	58	52	45	40	34						
	1600	755	61	53	44	40	36	24	69	60	53	47	42	32						
	2100	991	63	55	46	42	40	27	71	62	53	47	44	35	76	66	57	50	47	39
	3000	1416	66	60	50	46	49	36	75	66	55	50	50	40						
16	1400	661	57	50	46	43	37	25	65	58	52	48	42	34						
	2100	991	59	53	48	46	42	28	67	60	54	50	47	36						
	2800	1321													74	66	58	53	52	44
	3000	1416	61	56	50	50	48	33	69	62	54	52	52	40						
	4000	1888	65	61	54	54	59	43	71	65	58	55	60	49						

Notes:

1. All data are measured in accordance with Industry Standard AHRI 880–2011.
2. All sound power levels, dB re: 10 to 12 Watts.
3. Where ∆Ps is the inlet static pressure minus discharge static.

(a) Application ratings are outside the scope of the certification program.
(b) Data in this column constitute AHRI 880–2011 Standard Rating Conditions.

Table 72. Radiated sound power (dB) — 2.0 and to 3.0–in. Inlet Pressure ∆Ps

Inlet Size (in)	Cfm	L/s	2.0" Inlet Pressure ∆Ps						3.0" Inlet Pressure ∆Ps					
			2	3	4	5	6	7	2	3	4	5	6	7
5	130	61	52	48	43	43	39	39	48	49	46	48	47	47
	200	94	57	52	48	44	39	39	56	54	51	49	46	46
	250	118	59	56	50	45	41	39	59	58	54	51	47	46
	350	165	64	60	53	48	42	40	65	63	58	52	47	45
6	200	94	58	51	47	41	36	34	56	53	49	45	42	40
	300	142	62	57	50	44	37	34	61	59	55	49	43	39
	400	189	65	60	54	47	40	35	66	63	58	51	44	39
	500	236	69	65	57	50	43	37	71	67	60	55	46	41
8	350	165	63	59	53	46	39	35	62	61	55	49	44	40
	520	245	68	64	57	50	43	36	67	66	60	54	46	41
	700	330	71	67	59	53	45	39	73	72	64	58	49	44
	900	425	73	70	61	55	48	43	76	74	66	60	52	46
12	800	378	70	64	57	50	44	39	71	67	60	52	47	44
	1200	566	75	69	59	52	47	42	77	72	64	55	50	47
	1550	732	81	72	61	53	49	45	83	75	65	56	52	48
	1600	755												
	2000	944	85	74	62	53	51	47	88	79	67	57	53	50
14	1100	519	72	66	60	51	45	40	72	68	64	53	48	46
	1600	755	76	68	61	53	47	41	79	73	66	55	49	46
	2100	991	78	69	61	52	48	43	82	73	66	56	51	46
	3000	1416	85	73	61	54	52	47	88	77	66	57	53	48
16	1400	661	73	66	60	50	45	42	72	70	64	53	46	47
	2100	991	75	68	62	53	49	45	78	73	66	56	49	48
	2800	1321												
	3000	1416	78	69	61	55	53	47	83	74	66	58	53	51
	4000	1888	83	72	63	58	59	54	89	76	66	61	58	55

Notes:

1. All data are measured in accordance with Industry Standard AHRI 880–2011.
2. All sound power levels, dB re: 10 to 12 Watts.
3. Where ∆Ps is the inlet static pressure minus discharge static.

Table 73. Noise criteria (NC)

Inlet Size (in)	CFM	L/s	Discharge Inlet Pressure (∆Ps)					Radiated Inlet Pressure (∆Ps)				
			0.5”	1.0”	1.5”	2.0”	3.0”	0.5”	1.0”	1.5”	2.0”	3.0”
5	130	61	–	– 20	28	16	21	–	– 18	24	16	20
	200	94	–	24		25	25	– 17	20		22	25
	250	118	19	32		30	30	22	26		25	28
	350	165	28			38	41				30	33
6	200	94	-	16	33	21	20	– 19	16	30	21	23
	300	142	19	23		30	30	20	21		26	30
	400	189	23	30		35	38	20	27		30	33
	500	236	20	33		43	44		30		36	38
8	350	165	16	24	38	28	28	17	24	34	28	31
	520	245	20	30		38	38	20	27		34	37
	700	330	23	33		43	46	24	31		38	44
	900	425	25	34		44	51	25	34		42	46
10	550	260	16	26	39	32	32	20	25	36	30	34
	820	387	20	30		39	39	22	29		36	39
	1100	519	24	33		43	46	22	31		39	43
	1400	661	28	35		46	50	24	35		43	47
12	800	378	21	32	47	38	38	24	30	45	35	38
	1200	566	27	38		46	46	27	36		42	44
	1550	732						29	39		49	52
	1600	755	27	39		50	52					
	2000	944	29	39		54	56	30	42		54	58
14	1100	519	21	33	42	39	39	20	31	43	38	39
	1600	755	24	34		45	46	24	34		43	47
	2100	991	27	37		46	47	26	36		45	51
	3000	1416	32	41		48	52	30	42		54	58
16	1400	661	20	32	39	39	41	20	29	40	39	42
	2100	991	21	33		43	46	22	31		42	45
	2800	1321	24	33		43	48					
	3000	1416						25	34		45	52
	4000	1888	28	37		47	51	31	36		52	60

Notes:

1. – represents NC levels below NC 15.
2. NC Values are calculated using modeling assumptions based on AHRI 885-2008-02 Addendum.
3. Where ∆Ps is the inlet static pressure minus discharge static.
4. Data at 1.5–inch inlet pressure constitute AHRI 880-2011 Standard Rating Conditions.
5. Data at 0.5–inch, 1.0–inch, 2.0–inch and 3.0–inch are application ratings. These ratings are outside the scope of the certification program.

Table 74. AHRI 885-2008 discharge transfer function assumptions

Size	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 radiated sound pressure in the space.
2. NC Values are calculated using modeling assumptions based on AHRI 885-2008.
3. Where ∆Ps is inlet static pressure minus discharge static pressure.
4. Application ratings are outside the scope of the Certification Program.

Table 75. AHRI 885-2008 radiated transfer function assumptions

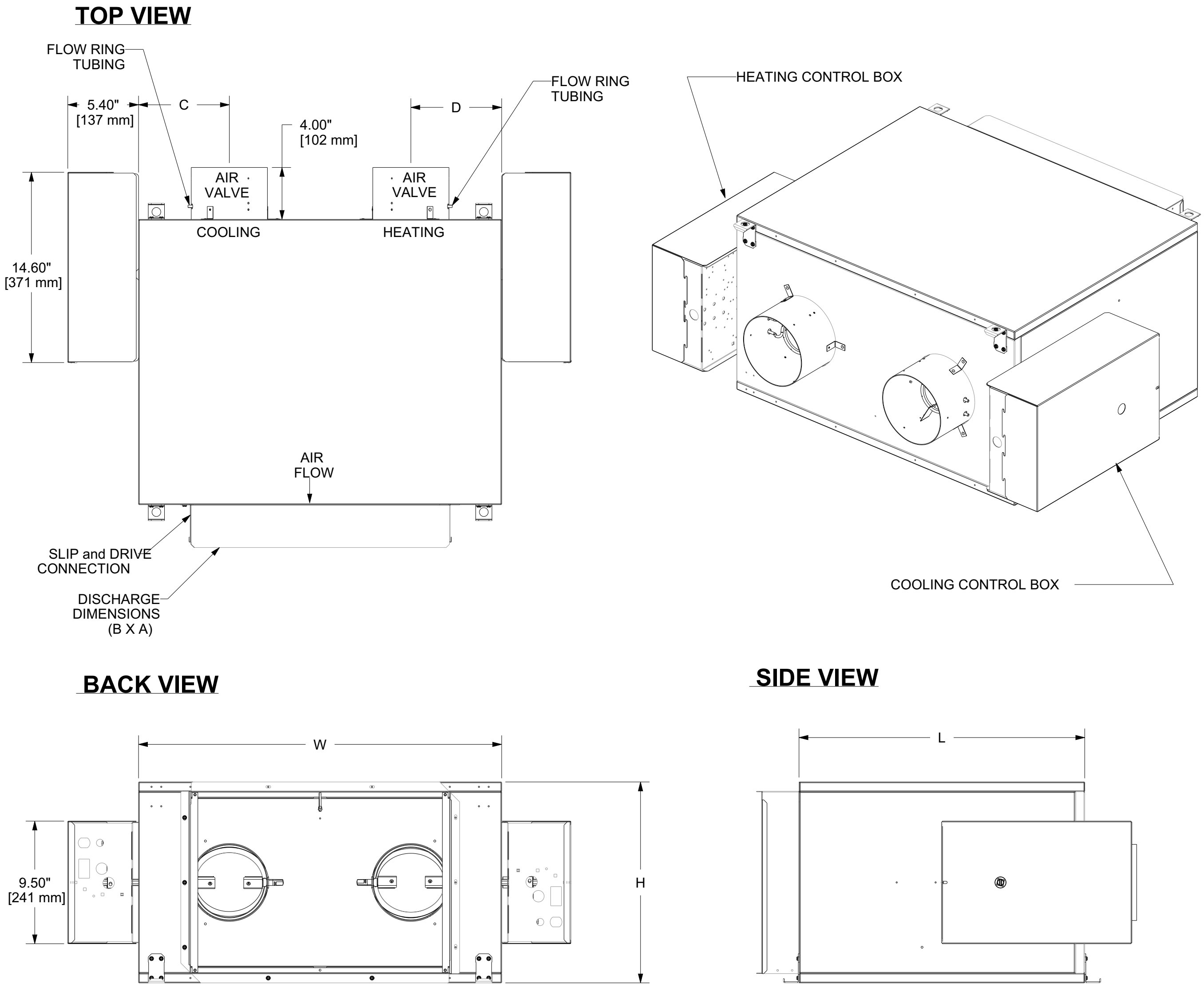
	Octave Band					
	2	3	4	5	6	7
Type 2- Mineral Fiber Insulation	-18	-19	-20	-26	-31	-36
Total dB reduction	-18	-19	-20	-26	-31	-36

Notes:

1. Subtract from terminal unit sound power to determine radiated sound pressure in the space.
2. NC Values are calculated using modeling assumptions based on AHRI 885-2008.
3. Where ∆Ps is inlet static pressure minus discharge static pressure.
4. Application ratings are outside the scope of the Certification Program.

Dimensional Data — Dual Duct Terminal Units

Figure 11. Dual duct (VDDF)



Notes:

1. *See following tables for dimension values and weights.*
2. *Minimum of 1.5 duct diameters of upstream straight duct required for proper flow reading.*
3. *Allow 36–inch (914mm) on control side for servicing.*
4. *Weights are an estimation and will vary based on selected options, insulation type, etc.*
5. *Allow 48–inch (1219mm) of straight duct downstream of unit before first runout. Inside of the duct should be equal to discharge size (A x B).*

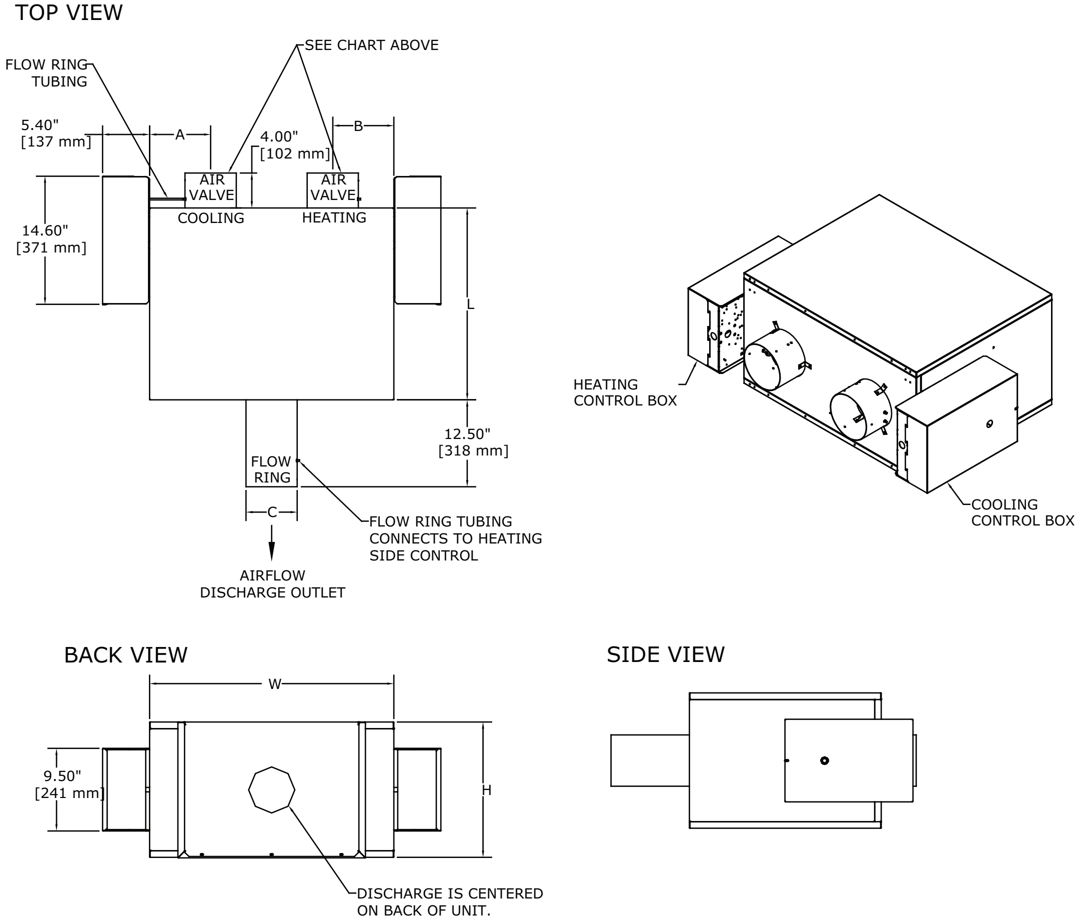
Table 76. Dimensions, dual duct (VDDF) — I-P

Cooling			Heating			Discharge Dim		C in	D in	L in	W in	H in	Weight lb
Valve	cfm	Inlet Dia C in	Valve	cfm	Inlet Dia C in	Height A in	Width B in						
05	350	5	5	350	5	14	20	7	7	22	28	15.5	54
06	500	6	5	350	5	14	20	7	7	22	28	15.5	54
06	500	6	6	500	6	14	20	7	7	22	28	15.5	54
08	900	8	6	500	6	14	20	8	7	22	28	15.5	55
08	900	8	8	900	8	14	20	8	8	22	28	15.5	56
10	1400	10	8	900	8	14	20	7	8	22	28	15.5	57
10	1400	10	10	1400	10	14	20	7	7	22	28	15.5	61
12	2000	12	8	900	8	20	20	10	8	24	40	21.5	58
12	2000	12	10	1400	10	20	20	10	9	24	40	21.5	59
12	2000	12	12	2000	12	20	20	10	10	24	40	21.5	60
14	3000	14	14	3000	14	20	20	10	10	24	40	21.5	81
16	4000	16	16	4000	16	20	20	10	10	24	40	21.5	83

Table 77. Dimensions, dual duct (VDDF) — SI

Cooling			Heating			Discharge Dim		C mm	D mm	L mm	W mm	H mm	Weight kg
Valve	L/s	Inlet Dia C mm	Valve	L/s	Inlet Dia C mm	Height A mm	Width B mm						
05	165	127	5	165	127	356	508	178	178	559	711	394	24
06	236	152	5	165	127	356	508	178	178	559	711	394	24
06	236	152	6	236	152	356	508	178	178	559	711	394	24
08	425	203	6	236	152	356	508	203	178	559	711	394	25
08	425	203	8	425	203	356	508	203	203	559	711	394	25
10	661	254	8	425	203	356	508	178	203	559	711	394	26
10	661	254	10	661	254	356	508	178	178	559	711	394	28
12	994	305	8	425	203	508	508	254	203	610	1016	546	26
12	994	305	10	661	254	508	508	254	229	610	1016	546	27
12	994	305	12	994	305	508	508	254	254	610	1016	546	27
14	1416	356	14	1416	356	508	508	254	254	610	1016	546	37
16	1888	406	16	1888	406	508	508	254	254	610	1016	546	38

Figure 12. Dual duct, constant volume control DD08 and DD18



Notes:

1. *Constant volume applications with non-Trane unit controllers require the constant volume outlet adapter. It is NOT needed when Symbio™ 500 control is used, or when dual-duct variable air volume operation is needed.*
2. *See mechanical specifications for general unit clearances.*
3. *No control box provided for the following option: DD00.*

Table 78. Dimensions, dual duct, constant volume control SE48 (VDDF) — I-P

Cooling			Heating			A in	B in	C in	L in	W in	H in	Weight lb
Valve	cfm	Inlet Dia C in	Valve	cfm	Inlet Dia C in							
05	350	5	5	350	5	7	7	5	22	28	15.5	54
06	500	6	5	350	5	7	7	6	22	28	15.5	54
06	500	6	6	500	6	7	7	6	22	28	15.5	54
08	900	8	6	500	6	8	7	8	22	28	15.5	55
08	900	8	8	900	8	8	8	8	22	28	15.5	56
10	1400	10	8	900	8	7	8	10	22	28	15.5	57
10	1400	10	10	1400	10	7	7	10	22	28	15.5	61
12	2000	12	8	900	8	10	8	12	24	40	21.5	58
12	2000	12	10	1400	10	10	9	12	24	40	21.5	59
12	2000	12	12	2000	12	10	10	12	24	40	21.5	60
14	3000	14	14	3000	14	10	10	14	24	40	21.5	81
16	4000	16	16	4000	16	10	10	16	24	40	21.5	83

Table 79. Dimensions, dual duct, constant volume control SE48 (VDDF) — SI

Cooling			Heating			A mm	B mm	C mm	L mm	W mm	H mm	Weight kg
Valve	L/s	Inlet Dia C mm	Valve	L/s	Inlet Dia C mm							
05	165	127	5	165	127	178	178	127	559	711	394	24
06	236	152	5	165	127	178	178	152	559	711	394	24
06	236	152	6	236	152	178	178	125	559	711	394	24
08	425	203	6	236	152	203	178	203	559	711	394	25
08	425	203	8	425	203	203	203	203	559	711	394	25
10	661	254	8	425	203	178	203	254	559	711	394	26
10	661	254	10	661	254	178	178	254	559	711	394	28
12	994	305	8	425	203	254	203	305	610	1016	546	26
12	994	305	10	661	254	254	229	305	610	1016	546	27
12	994	305	12	994	305	254	254	305	610	1016	546	27
14	1416	356	14	1416	356	254	254	356	610	1016	546	37
16	1888	406	16	1888	406	254	254	406	610	1016	546	38

Mechanical Specifications

Dual-Duct Terminal Unit

Model VDDF

Casing

22–gauge galvanized steel.
Hanger brackets provided.

Agency Listing

The 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 —The interior surface of the unit casing is acoustically and thermally lined with 1/2-inch, 1.8 lb/ft^3 (12.7 mm, 24.0 kg /m^3) composite density glass fiber with a high-density facing. The insulation R-Value is 4.2. The 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 —The interior surface of the unit casing is acoustically and thermally lined with 1-inch, 1.8 lb/ft^3 (25.4 mm, 16.0 kg /m^3) composite density glass fiber with a high-density facing. The insulation R-Value is 4.2. The 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 —The interior surface of the unit casing is acoustically and thermally lined with 1-inch, 1.8 lb/ft^3 (25.4 mm, 16.0 kg /m^3) density glass fiber with foil facing. The insulation R-Value is 4.2. The insulation is UL listed and meets NFPA-90A and UL 181 standards as well as bacteriological standard ASTM C 665. There are no exposed edges of insulation (complete metal encapsulation).

1–inch (25.4 mm) Double-wall Insulation —The interior surface of the unit casing is acoustically and thermally lined with a 1-inch, 1.8 lb./ft^3 (25.4 mm, 16.0 kg/m^3) composite density glass fiber with high-density facing. The insulation R-value is 4.2. The insulation is UL listed and meets NFPA-90A and UL 181 standards. An interior liner made of 26-gauge galvanized steel covers the insulation. 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 —The 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. The insulation is UL listed and meets NFPA-90A and UL 181 standards. The insulation has an R-Value of 1.4. There is complete metal encapsulation.

Primary Air Valves

Table 80. Air valve combinations available

Air Valve Size Cooling		Cataloged Airflow Cooling		Air Valve Size Heating		Catalog Airflow Heating	
in	mm	cfm	L/s	in	mm	cfm	L/s
05	127	350	165	05	127	350	165
06	152	500	236	06	152	350	165
06	152	500	236	06	152	500	236
08	203	900	425	08	203	500	236
08	203	900	425	08	203	900	425
10	254	1400	661	10	254	900	425
10	254	1400	661	10	254	1400	661
12	305	1400	944	12	305	900	425
12	305	2000	944	12	305	1400	661
12	305	2000	944	12	305	2000	944

Table 80. Air valve combinations available (continued)

Air Valve Size Cooling		Cataloged Airflow Cooling		Air Valve Size Heating		Catalog Airflow Heating	
in	mm	cfm	L/s	in	mm	cfm	L/s
14	356	3000	1416	14	356	3000	1416
16	406	4000	1888	16	406	4000	1888

Air Valve Round — The primary 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. See Table 20, p. 21 for air leakage performance data.

Outlet Connection

Slip and Drive Connection —Terminal units come standard with slip and drive connection.

Unit Controls Sequence of Operation

Unit controller continuously monitors zone temperature against its setpoint and varies primary airflow as required to meet zone temperature and pressure setpoints. Airflow is limited by minimum and maximum position setpoints.

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. Dual-duct units have one DDC actuator for each of the two dampers.

DDC Actuator - Belimo — LMB24-3-T TN 3-wire, 24 Vac/Vdc, floating-point, quarter turn actuator with linkage release button. Actuator has a constant drive rate independent of load, a rated torque of 45 in-lb, a 95 second drive time, and is 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. Dual-duct units have one DDC Actuator for each of the two dampers.

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 option available for dual-duct units is the Symbio™ 500.

Note: *Symbio™ 210, Symbio™ 210e, and Tracer® UC210 controller is not available on dual-duct units.*

Controllers monitor zone temperature setpoints, zone temperature, zone temperature rate of change, and valve airflow. They can also monitor supply duct air temperature, space CO_2 concentration and discharge air temperature via appropriate sensors. Controllers are provided in an enclosure with 7/8–inch (22mm) knockouts for remote control wiring. Trane zone sensor is required.

DDC Zone Sensor —The 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 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 controller is unnecessary.

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

System Communications —The Controller is designed to send and receive data from a Tracer® SC or other Trane controllers. Current unit status conditions and setpoints may be monitored and/or edited via this data communication feature. The network type is a twisted wire pair shielded serial communication.

Note: *When Symbio™ 500 controls are selected, Air-Fi® wireless communication is available as an alternate to wired communication.*

Control Options

Transformer — The 50-VA transformer is factory-installed in an enclosure with 7/8–inch (2 mm) knockouts to provide 24 Vac for controls.

Disconnect Switch — A toggle disconnect disengages primary power to the terminal.

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

DDC Controls

Symbio™ 210, Symbio™ 210e, Symbio™ 500, and Tracer® UC210 Programmable BACnet Controllers

The Symbio™ 210, Symbio™ 210e, Symbio™ 500 and Tracer® UC210 controllers are programmable general purpose BACnet®, microprocessor-based, Direct Digital Controllers (DDC). When factory installed on Trane (Variable Air Volume) VAV terminal units, they are factory downloaded with appropriate VAV programs and configuration settings. A single Symbio ™ 500 can control a dual-duct unit. Symbio™ 210, Symbio™ 210e, Symbio™ 500, or Tracer® UC210 are not an option on dual duct units.

The Symbio™ 210, Symbio™ 210e, Symbio™ 500 and Tracer® UC210 controller can be configured from the factory with three different application programs: Space Temperature Control (STC), Ventilation Flow Control (VFC), and Flow Tracking Control (FTC).

The Symbio™ 210, Symbio™ 210e, Symbio™ 500 and Tracer® UC210 controller programmed for STC modulates a VAV's damper blade based on a zone temperature, measured airflow, and setpoints to continuously control conditioned air delivery to the space. The volume of incoming air is monitored and the damper adjusts to provide accurate control independent of the duct pressure. The damper modulates between operator setpoints depending on space conditions. Additionally, fan and heat outputs may be energized depending on the application can be provided on dual-duct units and downloaded either for VAV operation or constant volume operation. Symbio™ 210, Symbio™ 210e, Symbio™ 500 and Tracer® UC210 is not available on dual-duct units.

The Symbio™ 210, Symbio™ 210e, Symbio™ 500 and Tracer® UC210 controller configured for VFC can be applied to a VAV terminal and used to temper cold outdoor air (OA) that is brought into a building for ventilation purposes. The tempered air is intended to supply an air-handling unit (AHU), which provides comfort control to the zones it is serving. The VAV terminal supplies the correct amount of ventilation air, and when reheat is added, tempers the ventilation air to reduce the load on the air handler by sensing the discharge air temperature of the VAV unit and controlling its long-term average to the discharge air temperature setpoint. VFC mode is not available on dual-duct.

The Symbio™ 210, Symbio™ 210e, Symbio™ 500 and Tracer® UC210 controller can be configured for FTC and has two VAV units with Tracer® UC210 controllers working together to provide flow tracking control. One Tracer® UC210 controller is configured from the factory with the Space temperature program and the other is downloaded with the FTC program. The STC airflow output is bound to the flow tracking controller airflow setpoint input. The flow tracking controller adds the configured airflow tracking offset (positive or negative) to the airflow setpoint (communicated airflow setpoint) and controls the airflow to this setpoint. FTC is not available on dual-duct units.

The Symbio™ 210, Symbio™ 210e, Symbio™ 500 and Tracer® UC210 controllers are BTL compliant with BACnet®, an open standard building automation protocol. It meets the Application Specific Controller (ASC) profile per ASHRAE 135-2004. This allows the controller to integrate with other BACnet® systems.

General Features and Benefits

Assured Accuracy

- Proportional-plus-integral control loop algorithm for determining required airflow needed to control zone temperature. Airflow is limited by active minimum and maximum airflow setpoints.
- Pressure-independent (PI) operation that automatically adjusts air valve position to maintain required 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.
- Fully factory tested – Fully screened and configured at the factory. All features are tested including fan and reheat stage energization, air valve modulation, and controller inputs and outputs.

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 UL 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.
- Hot-water coil units in ventilation flow control (VFC) have a freeze protection algorithm to protect the water coil and the internal space from water damage. This is accomplished by driving the water valve to maximum position on alarm conditions.

System-level Optimization

Trane controllers are designed to integrate into Trane Tracer® Building Automation Systems and leverage clear and clean unit-controller related data for system level control decisions. Integrating a Trane 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 duct static pressure optimization, ventilation reset, and CO_2 demand-controlled ventilation, 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 VAV 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 VAV 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 primary valve drives open using the heat of the main AHU to keep plumbing lines from freezing. Operation of the VAV unit fan (series or parallel) remains unaffected.

Controller Flexibility

- 24VAC binary input

  UC210: Hardcoded as an occupancy sensor.
- Auxiliary temperature analog input
  - Symbio™ 500: Two inputs, configured as discharge air temperature and supply air temperature.
  - Symbio™ 210, Symbio™ 210e, Symbio™ 500 and Tracer® UC210: Preconfigured for discharge air temperature.
- Dual-duct support with a single Symbio™ 500. The Symbio™ 500 controller controls both the cooling and heating air valves. With constant-volume sequences, the controller constantly monitors the airflow through both air valves to be sure the designated airflow is discharged from the unit.
- Symbio™ 210, Symbio™ 210e, Symbio™ 500 or Tracer® UC210 Programmable BACnet® Controller certified performance ensures that a Trane VAV 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 unit controller to adjust ventilation air flow setpoint based on the measured CO_2 concentration 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 VAV Controller Logic with Symbio™ 210, Symbio™ 210e, Symbio™ 500, and Tracer® UC210 Controllers

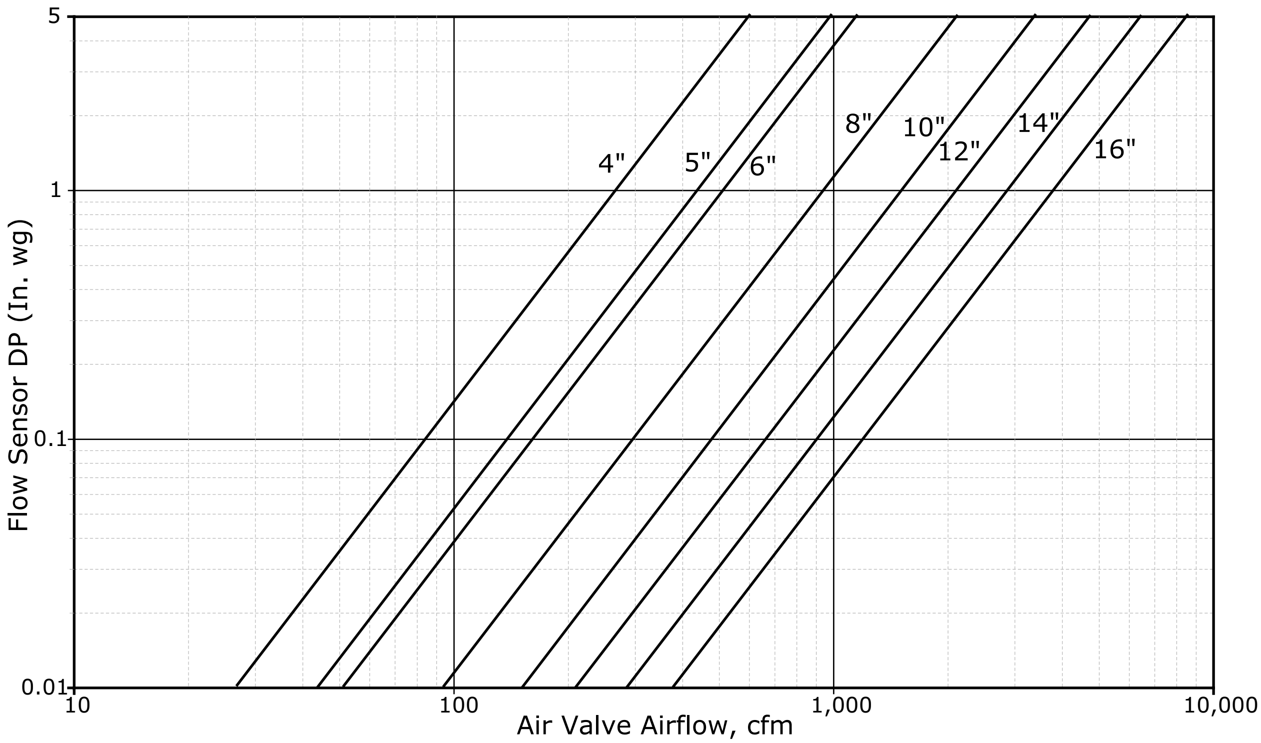
Control Logic

Direct Digital Control (DDC) controllers are today’s industry standard. DDC controllers share system-level data to optimize system performance (including changing ventilation requirements, system static pressures, supply air temperatures, etc.). Variables available via a simple twisted-shielded wire pair include occupied/unoccupied status, minimum and maximum airflow setpoints, zone temperature and temperature setpoints, air valve position, airflow cfm, fan status (on or off), fan operation mode (parallel or series), reheat status (on or off), VAV unit type, air valve size, temperature correction offsets, flow correction values, ventilation fraction, etc.

With the advent of Symbio™ 210, Symbio™ 210e, Symbio™ 500 and Tracer® UC210 open protocol, the most reliable VAV controller is now available for ANY system. Gone are the days of being locked into a single supplier. Trane DDC controllers provide Trane-designed solid-state electronics intended specifically for VAV applications including:

- Space Temperature Control
- Ventilation Flow Control (100 percent outside air applications)
- Flow Tracking Space Pressurization Control

Figure 13. Flow sensor single vs. airflow delivery



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

Space Temperature Control

Space temperature control applications, available on single-duct units, are where Trane emerged as an industry leader in quality and reliability. This did not occur overnight and has continued to improve as our controller and control logic has improved over time. STC employs controller logic designed to modulate the supply airstream and associated reheat (either local or remote) to exactly match the load requirements of the space.

Additionally, minimum and maximum airflow and specific controller sequence requirements are pre-programmed to verify that appropriate ventilation standards are consistently maintained. When connected to a Trane Tracer® SC control system, trend logging, remote alarming, etc. are available to fully utilize the power and capabilities of your systems.

General Operation — Cooling

In cooling control action, the DDC controller matches primary airflow to cooling load. The DDC controller will automatically change over to heating control action if the supply air temperature is above a configured/editable setpoint. When the supply air temperature is less than 10 degrees below this setpoint, the controller will automatically switch to cooling control action. The DDC controller first chooses the Tracer® SC -provided supply air temperature value to use for auto changeover. If this is not available, it uses the temperature provided by the optional auxiliary temperature sensor (must be installed for inlet temperature monitoring). If this is also not available, it uses the heating/cooling mode assigned by Tracer® SC or the DDC controller service tool.

General Operation — Heating and Reheat

In heating control action, the DDC controller matches primary airflow to heating load. The DDC controller will automatically change over to heating control action if the supply air temperature is above a configured/editable setpoint. When the supply air temperature is less than 10 degrees below this setpoint, the controller will automatically switch to cooling control action. The DDC controller first chooses the Tracer® SC-provided supply air temperature value to use for auto changeover. If this is not available, it uses the temperature provided by the optional auxiliary temperature sensor (must be installed for inlet temperature monitoring). If this is also not available, it uses the heating/cooling mode assigned by Tracer® SC or the DDC controller's service tool.

When heat is added to the primary air, the air is considered reheated. Reheat can be either **local** (integral to the VAV unit in the form of an electric coil or hot water coil) or **remote** (typically existing wall fin radiation, convector, etc.) or any combination of local and remote. The operating characteristics of the four basic types of VariTrane™ DDC terminal reheat are discussed.

Single-duct: On/Off Hot Water Reheat

Three stages of on/off hot water reheat are available. Two-position water valves complete the HW reheat system and are either fully opened or fully closed. The heating minimum airflow setpoint is enforced during reheat.

Stage 1 energizes when the space temperature is at or below the heating setpoint. When the zone temperature rises above the active heating setpoint by 0.5°F (0.28°C), stage 1 is de-energized. Stage 2 energizes when the space temperature is 1°F (0.56° C) or more below the active heating setpoint, and is de-energized when the space temperature is 0.5°F (0.28°C) below the active heating setpoint. Stage 3 energizes when the zone temperature is 2°F (1.11°C) or more below the active heating setpoint, and de-energizes when the space temperature is 1.5°F (0.83°C) below the active heating setpoint. When reheat is de-energized, the cooling minimum airflow setpoint is enforced.

Single-duct: Modulating Hot Water Reheat

Modulating hot water reheat uses 3-wire, floating-point-actuator technology and analog actuator technology.

When the space temperature drops below the active heating setpoint, the air valve open to the Airflow Setpoint Reset Minimum Local Heat and the reheat valve modulates to maintain space temperature at the active heating setpoint. Control of the water valve uses a separate proportional plus integral control loop, and its position is dependent on the degree that the space temperature is below the active heating setpoint and the amount of time that the space temperature has been below the active heating setpoint.

If the discharge air temperature reaches the Discharge Air Temperature Design Setpoint, the air valve opens further and modulates between Airflow Setpoint Reset Minimum Local Heat and Airflow Setpoint Reset Maximum Local Heat to maintain space temperature at the active heating setpoint, while the water valve modulates to maintain discharge air temperature at the Discharge Air Temperature Design Setpoint. If the air valve reaches Airflow Setpoint Reset Maximum Local Heat, the water valve opens further and modulates to maintain space temperature at the active heating setpoint, while the air valve remains at Airflow Setpoint Reset Maximum Local Heat.

An additional on/off remote heat output is available and energized when the water valve is driven 100% open and de-energized when the water valve reaches 50% open.

In the event that the DAT sensor fails, or is not connected, when the space temperature drops below the active heating setpoint, the air valve open to the Airflow Setpoint Minimum Local Heat and the water valve modulates to maintain space temperature at the active heating setpoint.

When reheat is de-energized, the cooling Airflow Minimum Setpoint is enforced.

Single-duct: On/Off Electric Reheat

One, two, or three stages of staged electric reheat are available. The heating minimum airflow setpoint is enforced during reheat.

Stage 1 is energized when the space temperature falls below the active heating setpoint and minimum airflow requirements are met. When the zone temperature rises above the active heating setpoint by 0.5°F (0.28°C), stage 1 is de-energized. Stage 2 energizes when the space temperature is 1°F (0.56°C) or more below the active heating setpoint, and is de-energized when the space temperature is 0.5°F (0.28°C) below the active heating setpoint. Stage 3 energizes when the zone temperature is 2°F (1.11°C) or more below the active heating setpoint, and de-energizes when the space temperature is 1.5°F (0.83°C) below the active heating setpoint. When reheat is de-energized, the cooling minimum airflow setpoint is enforced.

Single-duct: Pulse-width Modulation of Electric Heat

One to three stages of pulse-width modulation of electric heat are available. Energizing for a portion of a three-minute time period modulates the electric heater. This allows for closer matching of heating capacity to the heating load, resulting in more stable temperature control. The heating minimum airflow setpoint is enforced during reheat.

The amount of reheat supplied is dependent on both the degree that the space temperature is below the active heating setpoint and the time that the space temperature has been below the active heating setpoint. If not already off, reheat de-energizes when the zone temperature rises more than 0.5°F (0.28°C) above the heating setpoint.

The Stage 1 **on** time is proportional to the amount of reheat required. For example, when 50 percent of stage 1 capacity is required, reheat is on for 90 seconds and off for 90 seconds. When 75 percent of stage 1 capacity is required, reheat is on for 135 seconds and off for 45 seconds. When 100 percent of stage 1 capacity is required, reheat is on continuously.

Stage 2 uses the same **on** time logic as stage 1 listed above, except stage 1 is always energized. For example, when 75 percent of unit capacity is required, stage 1 is energized continuously, and stage 2 is on for 90 seconds and off for 90 seconds. When reheat is de-energized, the cooling minimum airflow setpoint is activated. Caution: Care should be taken when sizing electric heaters. Discharge air temperatures should not exceed between 100°F and 110°F, with a temperature between 85°F and 95°F being optimal for space temperature control. If too hot of air is delivered to the space through ceiling-mounted diffusers, and then leaves the space through ceiling-mounted return-air grilles, the buoyancy of this hot air will tend to cause some of the air to bypass from the supply-air diffusers to the return-air grilles, resulting in uneven air distribution and possible comfort complaints. To prevent stratification, the warm air temperature should not be more than 20°F (6.7°C) above zone air temperature.

Single-duct: SCR Modulation of Electric Heat

SCR is a heat controller that controls a single stage electric heater proportional to an analog signal. The analog output signal is proportional to the amount of reheat required. Typically with SCR heat, the heater is turned on and off on a very short cycle time to provide proportional control of heat output. This allows for closer matching of heating capacity to the heating load, resulting in more stable temperature control.

When the space temperature drops below the active heating setpoint, the air valve open to the Airflow Setpoint Reset Minimum Local Heat and the SCR controls the electric heater to maintain space temperature at the active heating setpoint. SCR control is dependent on the degree that the space temperature is below the active heating setpoint and the amount of time that the space temperature has been below the active heating setpoint.

If the discharge air temperature reaches the Discharge Air Temperature Design Setpoint, the air valve opens further and modulates between Airflow Setpoint Reset Minimum Local Heat and Airflow Setpoint Reset Maximum Local Heat to maintain space temperature at the active heating setpoint, while the SCR controls the electric heater to maintain discharge air temperature at the Discharge Air Temperature Design Setpoint. If the air valve reaches Airflow Setpoint Reset Maximum Local Heat, the SCR controls the electric heater to maintain space temperature at the active heating setpoint, while the air valve remains at Airflow Setpoint Reset Maximum Local Heat.

Reheat de-energizes when the space temperature rises more than 0.5°F (0.28°C) above the heating setpoint. When reheat is de-energized, the cooling Airflow Minimum Setpoint is enforced.

Dual Duct: Variable Volume Operation

When a Dual Duct unit is equipped with a Symbio™ 500 and is configured for variable volume operation, the air valves operate independently. If the cooling load in the space is high, the cooling air valve is controlled to its maximum airflow setting while the heating air valve is maintained at its minimum airflow setting. As the cooling load decreases towards the satisfied state, the cooling air valve modulates towards its minimum airflow setting while the heating air valve is maintained at its minimum airflow setting. When the space is satisfied, both the heating and cooling air valves maintain their respective minimum airflow settings. If the space temperature continues to fall such that there is a heating load, the heating air valve is modulated between its minimum and maximum airflow settings to satisfy to zone. During the heating mode, the cooling air valve is maintained at its minimum airflow setting.

Dual Duct: Constant Volume Operation

When a Dual Duct unit is equipped with a Symbio™ 500 is configured for constant volume operation, the operation of the air valves is synchronized. If the cooling load in the space is high, the cooling valve is controlled to its maximum airflow setting while the heating air valve is controlled to its minimum airflow or sufficient airflow to maintain the desired total unit airflow. The controller constantly monitors the total unit airflow to maintain the desired total airflow to the space. As the cooling load decreases, the cooling air valve modulates towards its minimum airflow setting. Meanwhile, the heating air valve is modulated open to allow additional airflow to maintain the total unit airflow as the cooling air valve modulates towards its minimum airflow setting.

Ventilation Control

Ventilation control enhances the usability of Trane DDC controllers in more select applications that require measurement of outside air (ventilation). Ventilation control is designed for use with constant volume single-duct VAV units which modulate the primary damper and associated reheat to maintain an average constant discharge air temperature. The reheat is modulated to provide discharge air temperature consistent with AHU supply air temperature (typically 50 to 60°F). This is critical to ensure that ASHRAE Standard 62.1 ventilation standards are attained, consistently maintained, and monitored. When connected to a Tracer® building automation control system, trend logging, remote alarming, etc. is available. In fact, the Trane Tracer® Control System can provide unmatched “peace of mind” by calling/paging the appropriate person(s) when specific alarms occur.

Flow Tracking Control

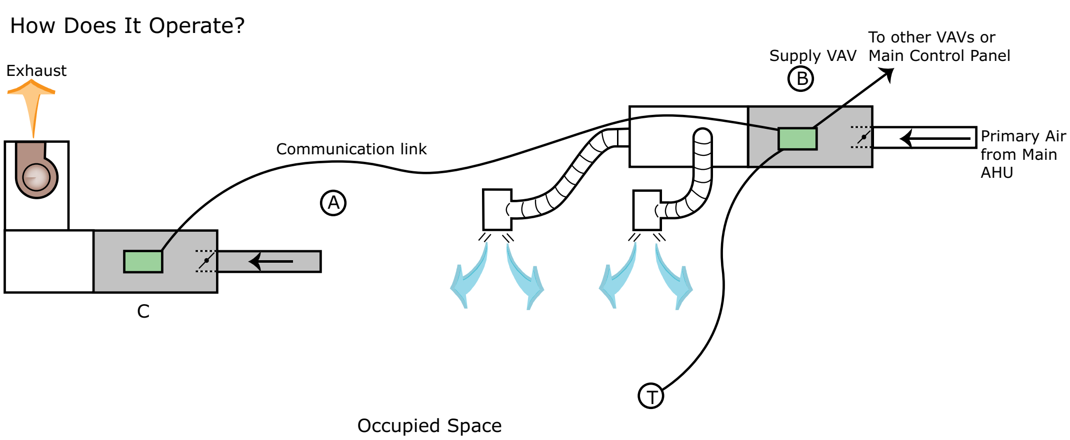
This enhanced VAV DDC controller feature allows two Trane controllers (Symbio™ 210, Symbio™ 210e, Symbio™ 500, or Tracer® UC210) to coordinate modulation simultaneously. This allows a specific CFM offset to be maintained. The CFM offset provides pressurization control of an occupied space, while maintaining the comfort and energy savings of a VAV system.

A flow tracking system in a given zone consists of a standard Space Comfort Control VAV (see B in the following figure) unit plus a single-duct, cooling-only, exhaust VAV unit (see C in the following figure). As the supply VAV unit modulates the supply airflow through the air valve to maintain space comfort, the exhaust box modulates a similar amount to maintain the required CFM differential. This is a simple, reliable means of pressurization control, which meets the requirements of the majority of zone pressurization control applications. Typical applications include:

- School and University laboratories
- Industrial laboratories
- Hospital operating rooms
- Hospital patient rooms
- Research and Development facilities
- And many more…

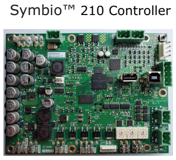
The CFM offset is assured and can be monitored and documented when connected to a Trane Tracer® Building Automation System. Flow Tracking Control is designed to meet most pressurization control projects. If an application calls for pressure control other than flow tracking, contact your local Trane Sales Office for technical support.

Figure 14. Flow tracking example



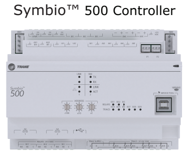
Tracer Symbio™ 210, Symbio™ 500, and Tracer® UC210 Programmable BACnet Controllers

Symbio™ 210 Controller



Symbio™ 210e Controller

Symbio™ 500 Controller



Tracer® UC210

The Symbio™ 210, Symbio™ 210e, Symbio™ 500, and Tracer® UC210 are programmable controllers available on VariTrane™ VAV boxes which provide accurate airflow and room temperature control. The controller can operate in pressure-independent or pressure-dependent.

These controllers monitor zone temperature, temperature setpoint, and flow rate. The controller also accepts a discharge air temperature sensor and accepts a supply air temperature from the building controller. When used with a Tracer® SC or other BACnet® building controller zone grouping, system set points and unit diagnostics can be obtained. Also factory commissioning of parameters is specified by the engineer. For additional details, see the appropriate Installation, Operation, and Maintenance (IOM):
Symbio™ 210/210e/500: *Symbio™ 210 Programmable Variable-Air-Volume (VAV) Box Controller - Installation, Operation, and Maintenance* (BAS-SVX084* EN)
Tracer® UC210: *Programmable Vari able-Air-Volume(VAV) Box Controller - Installation, Operation, and Programming* (BAS-SVX62* EN)

Specifications

Supply Voltage

Class 2, 24 Vac, 50/60 Hz

Maximum VA Load

No Heat or Fan

- 13VA (14.5VA for Symbio™ 210e) for cooling box only (includes temperature sensors, flow sensor, occupancy input and air valve).
- Fan: 6VA
- Modulating water valve: 4VA
- 2 position water valve: 6.5VA
- Staged electric: 10VA (magnetic contactor) each stage

Binary Inputs

Occupancy. Symbio™ 500 also has two additional generic binary inputs.

Binary Outputs

Fan Start, Air valve Open, Air Valve Closed, Heat (Water valve open/closed or staged heat)

The Symbio™ 500 also has two generic relays outputs.

Universal Analog Inputs

CO2 and one SCR Electric Heat control generic analog input.

Temperature Inputs

Discharge, Zone Temperature, and Zone Set Point.

Symbio™ 500 also has two generic temperature inputs.

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–inch (139.7 mm)
Length: 4.5–inch (69.85 mm)
Height: 2.0–inch (44.45 mm)

Connections

- Tracer® UC210: 1/4 tabs and removable screw terminals

Communications

BACnet® MS/TP

Heat Staging

Staged electric, SCR electric, modulating or two-position hot water or pulse-width modulation.

General Features and Benefits

Assured Accuracy

- Proportional-plus-integral control loop algorithm for determining required airflow needed to control room temperature. Airflow is limited by active minimum and maximum airflow setpoints.
- Pressure-independent (PI) operation that automatically adjusts valve position to maintain required 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.
- Fully factory tested – fully screened and configured at the factory. All features are tested including fan and reheat stage energization, air valve modulation, and controller inputs and outputs.

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 UL standards. The result is a rugged and safe VAV, controller, and thus, overall unit.
- When in PI-mode, EH is disabled when the sensed flow is below the minimum required.
- HW coil VAV units in ventilation flow control (VFC) have a Freeze protection algorithm to protect the water coil and the internal space from water damage. This is accomplished by driving the water valve to maximum position on alarm conditions.

System-level Operation

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 controller into a Tracer® SC Control System provides the next step in building system control.

Specifically, system-level decisions on how to operate all components can be made. Energy efficient optimization strategies like Static Pressure Optimization, Ventilation Reset, and CO_2 Demand-controlled Ventilation can be employed with the simple press of a button. The end-result is the most efficient and reliable building control system available.

Simplified Installation

Factory Commissioned Quality – All Trane DDC VAV 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 VariTrane VAV unit ships they must pass a rigorous quality control procedure. You can be assured that a Trane VAV unit with Trane DDC VAV controls will work right out of the crate.

Zone sensor air balance – When applied to a Trane zone sensor with thumb-wheel and on/cancel buttons, a balancing contractor can drive the primary air valve to maximum or minimum airflow from the sensor to determine the point of calibration to be used (maximum will result in optimum performance). The flow reading can then be calibrated from the sensor, without the use of additional service tools. (Non-LCD versions)

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 system is used for heat and because the internal furnishings are not complete, the sensors have not been installed. In this case, the primary valve drives open using the heat of the main AHU to keep plumbing lines from freezing. When available, the operation of the VAV unit fan (series or parallel) remains unaffected.

Controller Flexibility

- Auxiliary temperature analog input
  - Symbio™ 500: Two inputs, configured as discharge air temperature and supply air temperature.
  - UC210/Symbio™ 210: Preconfigured for discharge air temperature.
- CO_2 demand controlled ventilation enables a HVAC system to adjust ventilation flow based on the current CO_2 concentration 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.

Space Temperature Control

Space temperature control applications, available on single-duct units, are where Trane emerged as an industry leader in quality and reliability. This did not occur overnight and has continued to improve as our controller and control logic has improved over time. STC employs controller logic designed to modulate the supply airstream and associated reheat (either local or remote) to exactly match the load requirements of the space.

Additionally, minimum and maximum airflow and specific controller sequence requirements are pre-programmed to verify that appropriate ventilation standards are consistently maintained. When connected to a Trane Tracer® SC control system, trend logging, remote alarming, etc. are available to fully utilize the power and capabilities of your systems.

General Operation — Cooling

In cooling control action, the DDC controller matches primary airflow to cooling load. The DDC controller will automatically change over to heating control action if the supply air temperature is above a configured/editable setpoint. When the supply air temperature is less than 10 degrees below this setpoint, the controller will automatically switch to cooling control action. The DDC controller first chooses the Tracer® SC -provided supply air temperature value to use for auto changeover. If this is not available, it uses the temperature provided by the optional auxiliary temperature sensor (must be installed for inlet temperature monitoring). If this is also not available, it uses the heating/cooling mode assigned by Tracer® SC or the DDC controller service tool.

General Operation — Heating and Reheat

In heating control action, the DDC controller matches primary airflow to heating load. The DDC controller will automatically change over to heating control action if the supply air temperature is above a configured/editable setpoint. When the supply air temperature is less than 10 degrees below this setpoint, the controller will automatically switch to cooling control action. The DDC controller first chooses the Tracer® SC-provided supply air temperature value to use for auto changeover. If this is not available, it uses the temperature provided by the optional auxiliary temperature sensor (must be installed for inlet temperature monitoring). If this is also not available, it uses the heating/cooling mode assigned by Tracer® SC or the DDC controller’s service tool.

When heat is added to the primary air, the air is considered reheated. Reheat can be either **local** (integral to the VAV unit in the form of an electric coil or hot water coil) or **remote** (typically existing wall fin radiation, convector, etc.) or any combination of local and remote. The operating characteristics of the four basic types of VariTrane™ DDC terminal reheat are discussed.

Single-duct: On/Off Hot Water Reheat

Three stages of on/off hot water reheat are available. Two-position water valves complete the HW reheat system and are either fully opened or fully closed. The heating minimum airflow setpoint is enforced during reheat.

Stage 1 energizes when the space temperature is at or below the heating setpoint. When the zone temperature rises above the active heating setpoint by 0.5°F (0.28°C), stage 1 is de-energized. Stage 2 energizes when the space temperature is 1°F (0.56°C) or more below the active heating setpoint, and is de-energized when the space temperature is 0.5°F (0.28°C) below the active heating setpoint. Stage 3 energizes when the zone temperature is 2°F (1.11°C) or more below the active heating setpoint, and de-energizes when the space temperature is 1.5°F (0.83°C) below the active heating setpoint. When reheat is de-energized, the cooling minimum airflow setpoint is enforced.

Single-duct: Modulating Hot Water Reheat

Modulating hot water reheat uses 3-wire, floating-point-actuator technology and analog actuator technology.

The heating minimum airflow setpoint is enforced during reheat. The water valve opens as space temperature drops below the heating setpoint. A separate reheat proportional-plus-integral control loop from that controlling airflow into the room is enforced.

Water valve position is dependent on the degree that the space temperature is below the active heating setpoint and the time that the space temperature has been below the active heating setpoint. If not already closed, the water valve fully closes when the zone temperature rises above the active heating setpoint by 0.5°F (0.28°C).

An additional on/off remote heat output is available and energized when the proportional value is driven 10 percent open and de-energized when the modulating valve reaches 50 percent open.

When reheat is de-energized, the cooling minimum airflow setpoint is enforced. Again, these reheat devices can be either local or remote.

Single-duct: On/Off Electric Reheat

One, two, or three stages of staged electric reheat are available. The heating minimum airflow setpoint is enforced during reheat.

Stage 1 is energized when the space temperature falls below the active heating setpoint and minimum airflow requirements are met. When the zone temperature rises above the active heating setpoint by 0.5°F (0.28°C), stage 1 is de-energized. Stage 2 energizes when the space temperature is 1°F (0.56°C) or more below the active heating setpoint, and is de-energized when the space temperature is 0.5°F (0.28°C) below the active heating setpoint. Stage 3 energizes when the zone temperature is 2°F (1.11°C) or more below the active heating setpoint, and de-energizes when the space temperature is 1.5°F (0.83°C) below the active heating setpoint. When reheat is de-energized, the cooling minimum airflow setpoint is enforced.

Single-duct: Pulse-width Modulation of Electric Heat

One to three stages of pulse-width modulation of electric heat are available. Energizing for a portion of a three-minute time period modulates the electric heater. This allows for closer matching of heating capacity to the heating load, resulting in more stable temperature control. The heating minimum airflow setpoint is enforced during reheat.

The amount of reheat supplied is dependent on both the degree that the space temperature is below the active heating setpoint and the time that the space temperature has been below the active heating setpoint. If not already off, reheat de-energizes when the zone temperature rises more than 0.5°F (0.28°C) above the heating setpoint.

The Stage 1 **on** time is proportional to the amount of reheat required. For example, when 50 percent of stage 1 capacity is required, reheat is on for 90 seconds and off for 90 seconds. When 75 percent of stage 1 capacity is required, reheat is on for 135 seconds and off for 45 seconds. When 100 percent of stage 1 capacity is required, reheat is on continuously.

Stage 2 uses the same **on** time logic as stage 1 listed above, except stage 1 is always energized. For example, when 75 percent of unit capacity is required, stage 1 is energized continuously, and stage 2 is on for 90 seconds and off for 90 seconds. When reheat is de-energized, the cooling minimum airflow setpoint is activated. Caution: Care should be taken when sizing electric heaters. Discharge air temperatures should not exceed between 100°F and 110°F, with a temperature between 85°F and 95°F being optimal for space temperature control. If too hot of air is delivered to the space through ceiling-mounted diffusers, and then leaves the space through ceiling-mounted return-air grilles, the buoyancy of this hot air will tend to cause some of the air to bypass from the supply-air diffusers to the return-air grilles, resulting in uneven air distribution and possible comfort complaints. To prevent stratification, the warm air temperature should not be more than 20°F (6.7°C) above zone air temperature.

Ventilation Control

Ventilation control enhances the usability of Trane DDC controllers in more select applications that require measurement of outside air (ventilation). Ventilation control is designed for use with constant volume single-duct VAV units which modulate the primary damper and associated reheat to maintain an average constant discharge air temperature. The reheat is modulated to provide discharge air temperature consistent with AHU supply air temperature (typically 50 to 60°F). This is critical to verify that ASHRAE Standard 62.1 Ventilation standards are attained, consistently maintained, and monitored. When connected to a Trane Building Automation System control system, trend logging, remote alarming, etc. is available. In fact, the Trane Tracer® Control System can provide unmatched **peace of mind** by calling/paging the appropriate person(s) when specific alarms occur.

Flow Tracking Control

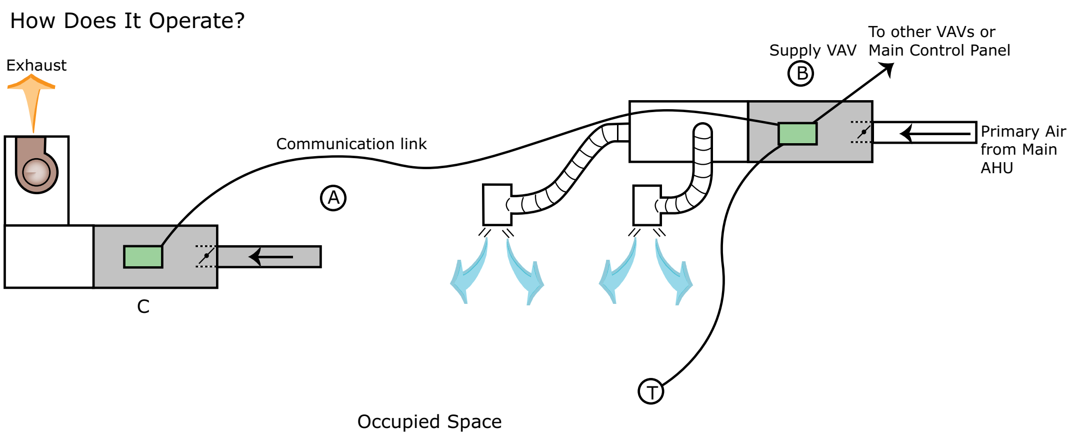
This enhanced VAV DDC controller feature allows two Trane controllers (Symbio™ 210, Symbio™ 210e, Symbio™ 500, or Tracer® UC210) to coordinate modulation simultaneously. This allows a specific CFM offset to be maintained. The CFM offset provides pressurization control of an occupied space, while maintaining the comfort and energy savings of a VAV system.

A flow tracking system in a given zone consists of a standard Space Comfort Control VAV (see B in the following figure) unit plus a single-duct, cooling-only, exhaust VAV unit (see C in the following figure). As the supply VAV unit modulates the supply airflow through the air valve to maintain space comfort, the exhaust box modulates a similar amount to maintain the required CFM differential. This is a simple, reliable means of pressurization control, which meets the requirements of the majority of zone pressurization control applications. Typical applications include:

- School and University laboratories
- Industrial laboratories
- Hospital operating rooms
- Hospital patient rooms
- Research and Development facilities
- And many more…

The CFM offset is assured and can be monitored and documented when connected to a Trane Tracer® Building Automation System. Flow Tracking Control is designed to meet most pressurization control projects. If an application calls for pressure control other than flow tracking, contact your local Trane Sales Office for technical support.

Figure 15. Flow tracking example



DDC Remote Heat Control Options

When heat is added to the primary air at the VAV unit before it enters the zone, the air is said to be reheated. The following subsections describe the operating characteristics of the four basic types of VariTrane™ DDC terminal reheat for fan-powered terminal units.

On/Off Hot Water Reheat

Two stages of on/off hot water reheat are available. The water valves used are two-position and are either fully opened or fully closed. The heating minimum airflow setpoint is enabled during reheat.

On parallel-configured fan-powered units, the fan is energized when the space temperature falls below the active fan on/off point (active heating setpoint plus fan offset). The parallel fan is turned off when the space temperature rises above the active fan on/off point (active heating setpoint plus fan offset) plus 0.5°F (0.28°C).

Series configured fan-powered terminal units use continuous fan operation during all occupied settings and while unoccupied when minimum airflows are being enforced.

When the zone temperature falls below the active heating setpoint, the controller modulates the primary airflow to the minimum heating airflow setpoint.

Stage 1 heat is energized when the zone temperature drops below the active heating setpoint; Stage 2 is energized when the zone temperature drops to 1°F (0.56°C) or more below the active heating setpoint. Stage 2 is de-energized when the zone temperature rises to warmer than 0.5°F (0.28°C) below the active heating setpoint; Stage 1 is de-energized when the zone temperature rises to warmer than 0.5°F (0.28°C) above the active heating setpoint.

Modulating Hot Water Reheat

Modulating hot water reheat uses 3-wire floating-point-actuator technology and analog actuator technology. The heating minimum airflow setpoint is enabled during reheat.

On parallel-configured. fan-powered units, the fan is energized when the space temperature falls below the active fan on/off point (active heating setpoint plus fan offset). The parallel fan is turned off when the space temperature rises above the active fan on/off point (active heating setpoint plus fan offset) plus 0.5°F (0.28°C).

Series-configured fan-powered terminal units use continuous fan operation during all occupied settings and while unoccupied when minimum airflows are being enforced.

When the zone temperature falls below the active heating setpoint, the controller modulates the primary airflow to the minimum heating airflow setpoint.

The water valve opens as space temperature drops below the heating setpoint. The degree to which the hot water valve opens is dependent on both the degree that zone temperature is below the active heating setpoint and the time that the zone temperature has been below the active heating setpoint. If not already closed, the water valve fully closes when the zone temperature rises above the active heating setpoint by 0.5 °F (0.28 °C). When reheat is de-energized, the cooling minimum airflow setpoint is activated.

On/Off Electric Reheat

Two stages of staged electric reheat are available. The heating minimum airflow setpoint is enabled during reheat.

On parallel-configured fan-powered units, the fan is energized when the space temperature falls below the active fan on/off point (active heating setpoint plus fan offset). The parallel fan is turned off when the space temperature rises above the active fan on/off point (active heating setpoint plus fan offset).

Series-configured fan-powered terminal units use the continuous fan operation during all occupied settings and while unoccupied when minimum airflows are being enforced.

When the zone temperature falls below the active heating setpoint, the controller modulates the primary airflow to the minimum heating airflow setpoint.

Stage 1 heat is energized when the zone temperature drops below the active heating setpoint; Stage 2 is energized when the zone temperature drops to 1°F (0.56°C) or more below the active heating setpoint. Stage 2 is de-energized when the zone temperature rises to warmer than 0.5°F (0.28°C) below the active heating setpoint; Stage 1 is de-energized when the zone temperature rises to warmer than 0.5°F (0.28°C) above the active heating setpoint.

Pulse-Width Modulation of Electric Heat

Electric heat is modulated by energizing for a portion of a three-minute time period. The heating minimum airflow setpoint is enabled during reheat. This allows exact load matching for energy efficient operation, and optimum zone temperature control. One or two stages can be used.

On parallel-configured fan-powered units, the fan is energized when the space temperature falls below the active fan on/off point (active heating setpoint plus fan offset). The parallel fan is turned off when the space temperature rises above the active fan on/off point (active heating setpoint plus fan offset) plus 0.5°F (0.28°C).

Series-configured fan-powered terminal units use the continuous fan operation during all occupied settings and while unoccupied when minimum airflows are being enforced. When the zone temperature falls below the active heating setpoint, the controller modulates the primary airflow to the minimum heating airflow setpoint.

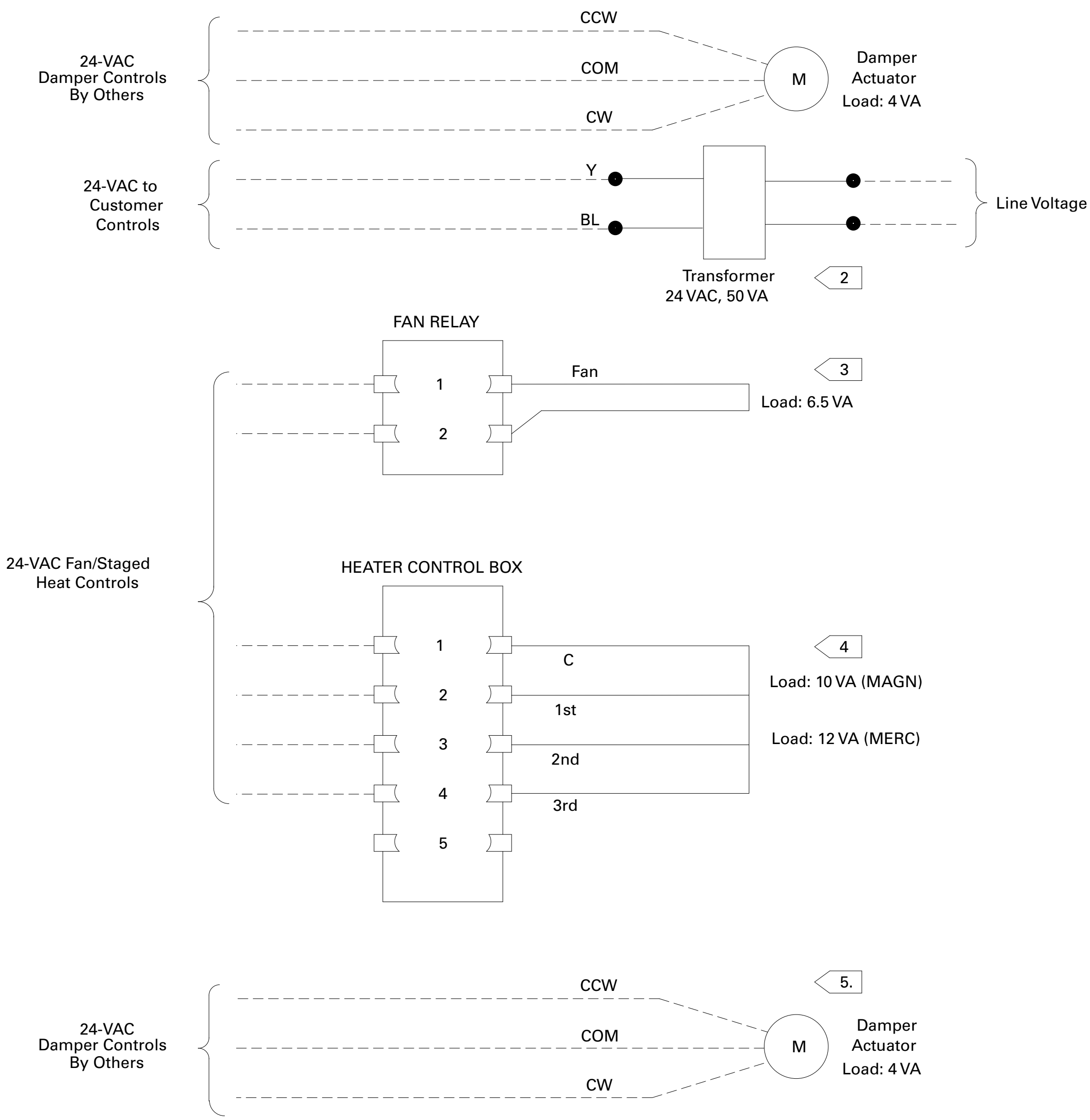
The amount of reheat supplied is dependent on both the degrees that zone temperature is below the active heating setpoint and the time that the zone temperature has been below the active heating setpoint. If not already off, reheat de-energizes when the zone temperature rises 0.5°F (0.28°C) above the active heating setpoint. The Stage 1 “on” time is proportional to the amount of reheat required. For example, when 50% of stage 1 capacity is required, reheat is on for 90 seconds and off for 90 seconds. When 75% of stage 1 capacity is required, reheat is on for 135 seconds and off for 45 seconds. When 100% of stage 1 capacity is required, reheat is on continuously.

Stage 2 uses the same “on” time logic as stage 1 listed above, except stage 1 is always energized. For example, when 75% of unit capacity is required, stage 1 is energized continuously, and stage 2 is on for 90 seconds and off for 90 seconds. When reheat is de-energized, the cooling minimum airflow setpoint is activated. When reheat is de-energized, the cooling minimum airflow setpoint is activated.

DD00—Available for all VariTrane 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 (fan-powered units), 24-VAC control power transformer (optional for single- and dual-duct units), and factory-installed electric heater contactor wires are attached to the outside of the unit for field connection of controls. A second actuator is provided with an integral screw terminal for dual-duct units.



NOTES:

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

2. Located in Heater Terminal Box for electric heat on single-duct units.
Located in Control Box for cooling only and hot water heat on single-duct units.
Located in Control Box on all fan-powered units.

3. Only available with fan-powered units.

4. Located in Heater Terminal box.

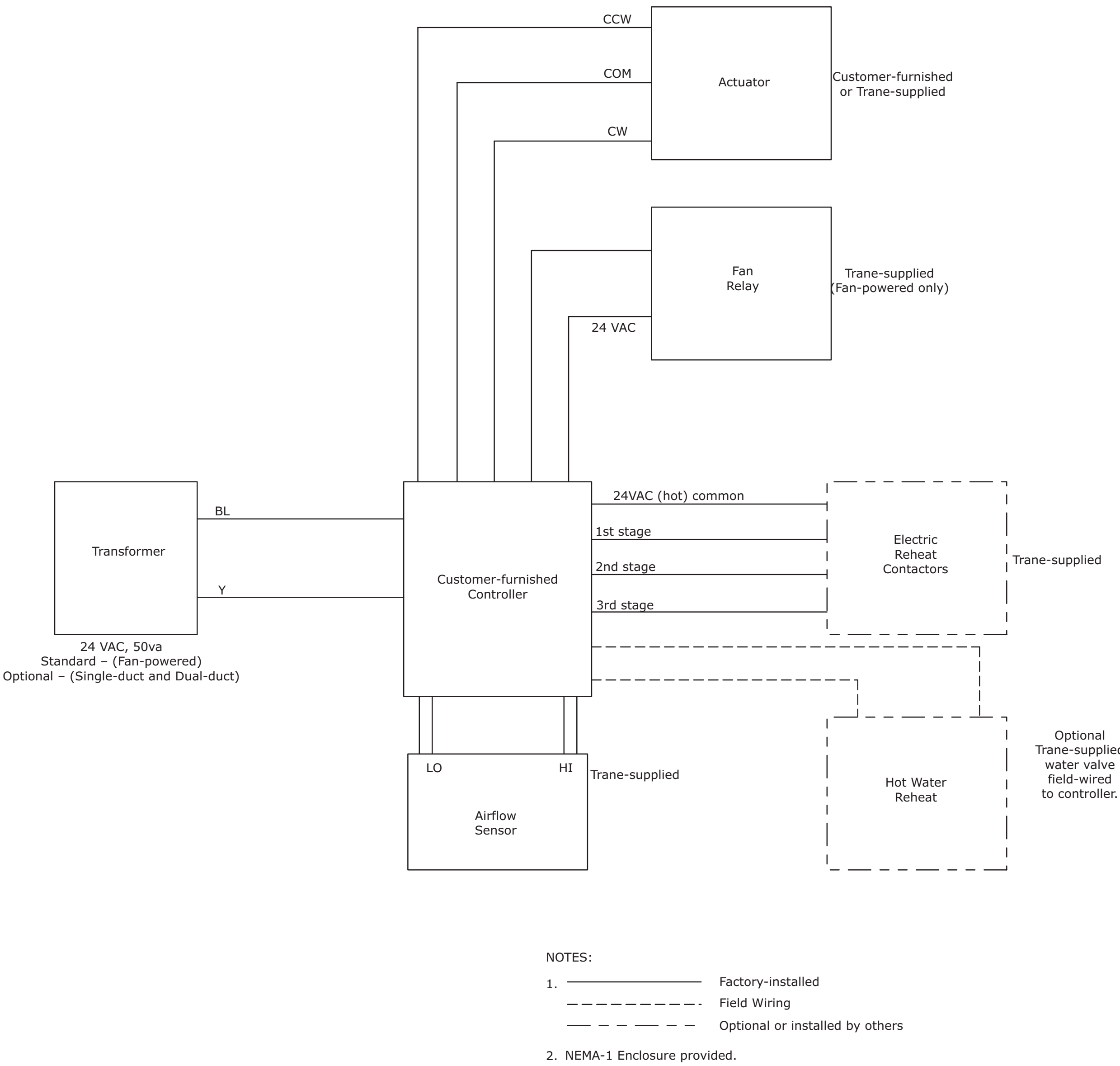
5. Only available with dual-duct units.

Available on all VariTrane 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.



Single-duct: On/Off Hot Water Reheat

Three stages of on/off hot water reheat are available. Two-position water valves complete the HW reheat system and are either fully opened or fully closed. The heating minimum airflow setpoint is enforced during reheat.

Stage 1 energizes when the space temperature is at or below the heating setpoint. When the zone temperature rises above the active heating setpoint by 0.5°F (0.28°C), stage 1 is de-energized. Stage 2 energizes when the space temperature is 1°F (0.56°C) or more below the active heating setpoint, and is de-energized when the space temperature is 0.5°F (0.28°C) below the active heating setpoint. Stage 3 energizes when the zone temperature is 2°F (1.11°C) or more below the active heating setpoint, and de-energizes when the space temperature is 1.5°F (0.83°C) below the active heating setpoint. When reheat is de-energized, the cooling minimum airflow setpoint is enforced.

Single-duct: Modulating Hot Water Reheat

Modulating hot water reheat uses 3-wire, floating-point-actuator technology and analog actuator technology.

The heating minimum airflow setpoint is enforced during reheat. The water valve opens as space temperature drops below the heating setpoint. A separate reheat proportional-plus-integral control loop from that controlling airflow into the room is enforced.

Water valve position is dependent on the degree that the space temperature is below the active heating setpoint and the time that the space temperature has been below the active heating setpoint. If not already closed, the water valve fully closes when the zone temperature rises above the active heating setpoint by 0.5°F (0.28°C).

An additional on/off remote heat output is available and energized when the proportional value is driven 10 percent open and de-energized when the modulating valve reaches 50 percent open.

When reheat is de-energized, the cooling minimum airflow setpoint is enforced. Again, these reheat devices can be either local or remote.

Single-duct: On/Off Electric Reheat

One, two, or three stages of staged electric reheat are available. The heating minimum airflow setpoint is enforced during reheat.

Stage 1 is energized when the space temperature falls below the active heating setpoint and minimum airflow requirements are met. When the zone temperature rises above the active heating setpoint by 0.5°F (0.28°C), stage 1 is de-energized. Stage 2 energizes when the space temperature is 1°F (0.56°C) or more below the active heating setpoint, and is de-energized when the space temperature is 0.5°F (0.28°C) below the active heating setpoint. Stage 3 energizes when the zone temperature is 2°F (1.11°C) or more below the active heating setpoint, and de-energizes when the space temperature is 1.5°F (0.83°C) below the active heating setpoint. When reheat is de-energized, the cooling minimum airflow setpoint is enforced.

Single-duct: Pulse-width Modulation of Electric Heat

One to three stages of pulse-width modulation of electric heat are available. Energizing for a portion of a three-minute time period modulates the electric heater. This allows for closer matching of heating capacity to the heating load, resulting in more stable temperature control. The heating minimum airflow setpoint is enforced during reheat.

The amount of reheat supplied is dependent on both the degree that the space temperature is below the active heating setpoint and the time that the space temperature has been below the active heating setpoint. If not already off, reheat de-energizes when the zone temperature rises more than 0.5°F (0.28°C) above the heating setpoint.

The Stage 1 **on** time is proportional to the amount of reheat required. For example, when 50 percent of stage 1 capacity is required, reheat is on for 90 seconds and off for 90 seconds. When 75 percent of stage 1 capacity is required, reheat is on for 135 seconds and off for 45 seconds. When 100 percent of stage 1 capacity is required, reheat is on continuously.

Stage 2 uses the same **on** time logic as stage 1 listed above, except stage 1 is always energized. For example, when 75 percent of unit capacity is required, stage 1 is energized continuously, and stage 2 is on for 90 seconds and off for 90 seconds. When reheat is de-energized, the cooling minimum airflow setpoint is activated. Caution: Care should be taken when sizing electric heaters. Discharge air temperatures should not exceed between 100°F and 110°F, with a temperature between 85°F and 95°F being optimal for space temperature control. If too hot of air is delivered to the space through ceiling-mounted diffusers, and then leaves the space through ceiling-mounted return-air grilles, the buoyancy of this hot air will tend to cause some of the air to bypass from the supply-air diffusers to the return-air grilles, resulting in uneven air distribution and possible comfort complaints. To prevent stratification, the warm air temperature should not be more than 20°F (6.7°C) above zone air temperature.

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-SCO$_2$
- Digital display (WCS-SD) model
- Base (WCS-SB) model has no exposed display or user interface
- 2 percent 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 81. WCI and WCS specifications

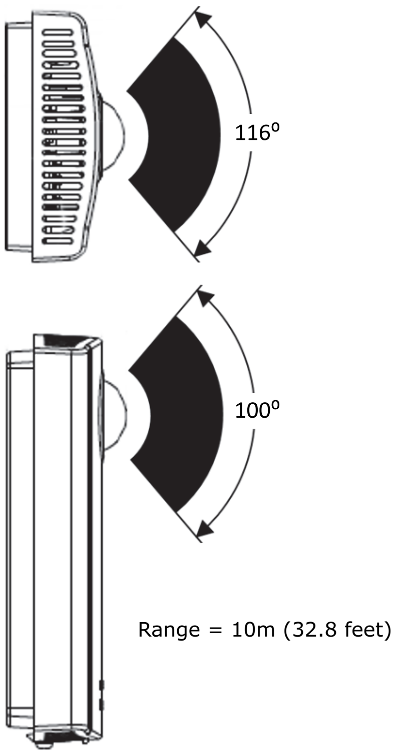
General Specifications	
Operating temperature	-40 to 158°F (–40 to 70°C)
Storage temperature	-40 to 185°F (-40 to 85°C)
Storage and operating humidity range	5% to 95% relative humidity (RH), non-condensing
Housing material	Polycarbonate/ABS (suitable for plenum mounting), UV protected, UL 94: 5 VA flammability rating
Range[(a)]	Open range: 2,500 ft (762 m) with packet error rate of 2 percent 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. 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 center line. Includes mounting screws for junction box and wall anchors for sheet-rock walls. Overall dimensions: 2.9 in (74 mm) by 4.7 in. (119 mm)

Table 81. WCI and WCS specifications (continued)

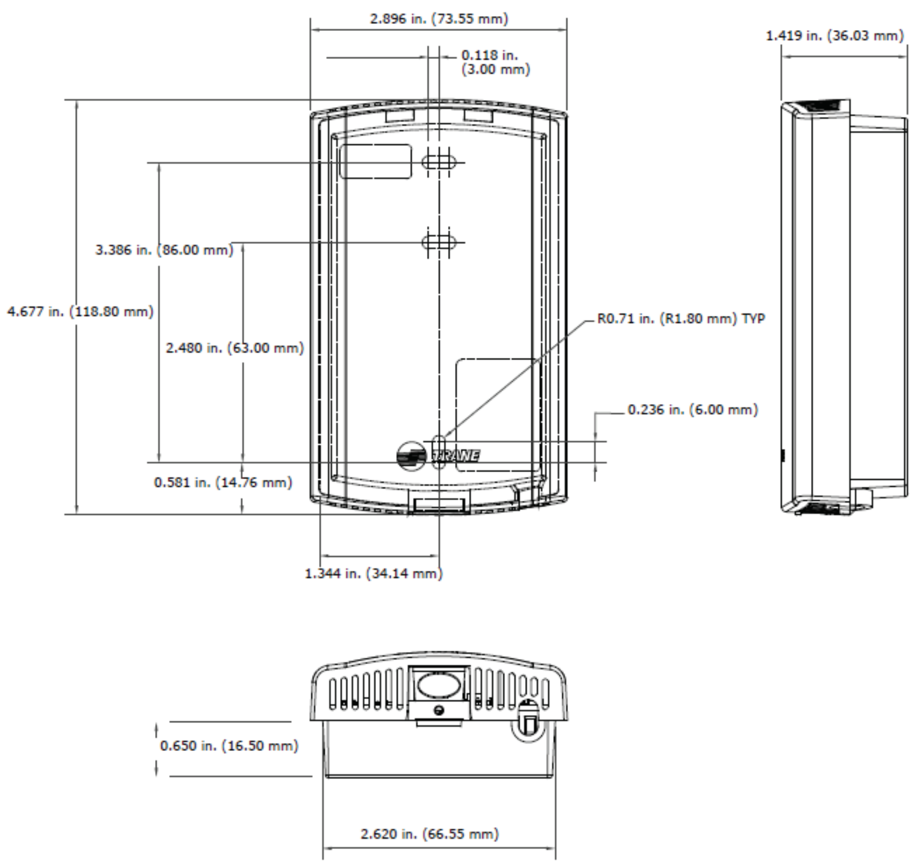
(a) Range values are estimated transmission distances for satisfactory operation. Actual distance is job specific and must be determined during site evaluation. Placement of the WCI is critical to proper system operation. In most general office space installations, distance is not the limiting factor 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 **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_2range	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 16. 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 17. **DDC zone sensor with LCD**

Figure 18. **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–inch (71.12 mm)

Length: 4.5–inch (114.3 mm)
Height: 1.1–inch (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–inch (69.8 mm)
Length: 4.5–inch (114.3 mm)
Height: 1.0–inch (25.4 mm)

CO_2 Sensors

Figure 19. Duct-mounted CO_2 sensor (L) and wall-mounted CO_2 sensor (R)

Wall- and duct-mounted carbon dioxide (CO_2) 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 increases beyond design ventilation rates if the CO_2 exceeds specified levels.

CO_2 Zone Sensor Summary

- Use with the 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 to 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 to 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 to 85% relative humidity (RH)

Output Signal (jumper selectable)

4 to 20 mA, 0 t 20 mA,
0 to 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–inch x 3 1/8–inch x 1 7/16–inch (Wall only)
(108 mm x 80 mm x 36 mm) (Wall only)

3 1/8–inch x 3 1/8–inch x 7 ¾-inch
(80 mm x 80 mm x 200 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 VAV controller upon detection of movement in the coverage area. The VAV system then changes the zone from occupied standby mode to occupied mode.

Figure 20. Zone occupancy sensor

Occupancy Zone Sensor Summary

- Compatible with VariTrane™ VAV and VariTrac™ controllers
- Used with zone damper 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 controller 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 percent non-condensing

Effective Coverage Area

1200 sq ft

Effective Coverage Radius

22 feet

Housing Material

ABS Plastic

Dimensions

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

Factory or Field Mounted Auxiliary Temperature Sensor

The auxiliary 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, the sensor determines the control action of the unit 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% to 95 % RH
Non-Condensing

Wiring Connection

8 ft 18 awg

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

Probe Dimensions

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

Mounting

In any position on duct.

Mount the sensor to the duct using
Part number 10 x ¾-inch (19.05 mm) sheet metal screws.

Factory Mounted Discharge Air Temperature Sensing Matrix

The sensing matrix consists of (2) probes factory installed in the unit reading an average of 4 points within the unit discharge. Traditional single point temperature sensors are more of a heat on/off indicator than an accurate temperature due to stratification in the duct work. The new sensing matrix provides a factory installed accurate discharge temp. Additionally, when coupled with SCR heat and UC210, the energy efficient dual max algorithm can be used to reduce energy costs.

Factory Installed Piping Packages

- Offered in both 2-way and 3-way configurations.
- The Automatic Balancing Flow Control sized for the specified VAV coil and gpm.
- Field supply and return connections are 3/4–inch NPT Sweat.
- 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.
  - Drain and manual air vent on supply and return to allow unit to be installed in Left Hand or Right Hand piping connection orientation
  - Each piping package includes a 24v floating point control modulating control ball valve or a 2 to 10V analog control ball valve.
  - The Cv is sized to match the specified gpm/coil performance of the VAV terminal unit. Piping package is connected to coil with unions for serviceability.

Piping package is installed in a sheet metal enclosure to protect the piping package from damage during shipping and installation. Supply and Return connections are externally labeled on the enclosure for proper installation. Piping package ships un-insulated for field insulation, if required.

Trane 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 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 1/2–inch (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 to 10V, 50/60 Hz

Power Consumption

1.0 VA at 24 Vac

Valve Offerings

All valves are modulating control with 1/2–inch (12.7 mm) O.D. NPT connections Cv offered:

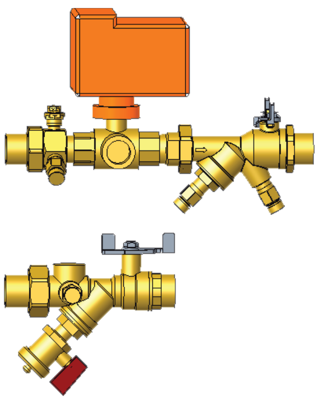
0.3, 0.46, 0.8, 1.2, 1.9, 3.0, 4.7

VAV Piping Package

Figure 21. Standard 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.

Figure 22. Belimo valve piping package



- 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 to 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)
- 2524 (3-80 psid 10.0 –13.0 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–inch (66.7 mm)

Length: 2.50–inch (63.5 mm)

Height: 2.30–inch (58.4 mm)

Trane Non-Spring Return Actuator

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–inches), 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 - 24VAC (20 to 30 Vac) at 50/60 Hz

Power Consumption - 1.8 VA maximum, Class 2

Electrical Connection

No. 6-32 screw terminals (For DD00 and FM01 control options and retrofit kits.)

6-pin connector harness for Trane DDC controls except retrofit kits.

Manual Override

External clutch release lever

Shaft Requirement

1/2–inch round

2.1–inch 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)

Trane Spring Return Actuator

This actuator is used with DDC controls and is a floating-point control device. It is direct-coupled over the shaft (minimum shaft length of 2.1–inches), enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The actuator is Underwriters Laboratories Standard 60730 and Canadian Standards Association C22.2 No. 24-93 certified as meeting correct safety requirements and recognized industry standards.

Specifications

Actuator Design

24-VAC, floating-point control. Spring return

Actuator Housing

Housing Type-NEMA IP54

Rotation Range

Adjustable from 0 to 90°F at 5° intervals, clockwise or counterclockwise

Electrical Rating

Power Supply – 24 Vac (19.2 to 28.8 Vac) at 50/60 Hz

Power Consumption – 4VA holding, 5VA running maximum, Class 2

Electrical Connection

6-pin connector for Trane DDC controls

Manual Override

Manual override key provided

Shaft requirement:
¼–inch to ¾–inch round

2.1–inch length

Humidity

95% RH, Non-Condensing

Temperature Rating

Ambient operating: 32 to 130°F
(0 to 54°C)

Shipping and storage: -40 to 158°F
(-40 to 70°C)

Torque

62 in.-lbs (7 Nm)

Actuator — Retrofit Kit and Unit Option

This actuator is available as an option on single-duct or dual-duct units, as well as with the DDC Retrofit Kit. It is a 3-terminal, floating-point control device. It is direct-coupled over the damper shaft so there is no 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. A three-foot plenum-rated cable with bare ends will be sent separately. The actuator is listed under Underwriters Laboratories Standard 873, CSA 22.2 No. 24 certified, and CE manufactured per Quality Standard SO9001.

Specifications

Actuator Design

on-off/floating-point

Actuator housing

Housing Type-NEMA type 1

Housing Material Rating- UL 94-5A

Direction of Rotation

Reverse wires terminals 2 and 3

Angle of Rotation

Max 95°F, adjustable with mechanical stops

Electrical Rating

Power Supply – 24 VAC ± 20% 50/60 Hz 24 VDC ± 10%

Power Consumption – 2 W

Transformer Sizing – 3 VA (Class 2 power source)

Manual Override

External push button

Humidity

5% to 95% RH, Non-Condensing

Ambient Temperature

-22 to 122°F (-30C to 50°C)

Storage Environment

-40 to 176°F (-40 to 80°C)

Torque

45 in.-lb [5 Nm]

Running Time

95 sec. for 0 to 35 in-lb

Noise Rating

35 dB (A)

Weight

1.2 lbs (0.55 kg)

Actuator — Proportional, Non-Spring Return

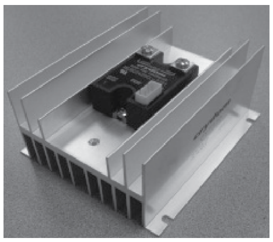
Proportional control damper actuators shall be electronic direct-coupled type, which require no crank arm and linkage and be capable of direct mounting to a shaft from 1/4-inch to 5/8-inch. Actuators must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500 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. • Switch position 0: counterclockwise • 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 to 100% Control Range
- Synchronized triggering output (P3)
- 20 AC Cycles Base Period
- Coupled with the averaging temperature sensing matrix and UC210 allows use of energy efficient dual max algorithm.
- Zero crossing — turns on with zero cross of voltage, turns off with zero cross of current

Specifications

Input Specifications	DC Control
Supply Voltage Range (VDC) (P1)	8-28[a]
Input Current Range [mA]	20-30
Nominal Input Impedance [Ohms]	30K
Control Voltage [b] [VDC][P4]	0-10
Nominal Input Impedance [ohms][P4]	20K

[a] UC210 modules provided this voltage to the SCR. If UC210 are not present, a 24VAC-to-24VDC module will be included.
[b] Control voltage< 0.2 Vdc guarantees heat is turned off.

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

General Specifications	Parameters
Output Max Wire Size	Output:2 x AWG 8 in. (3.8mm)
Output Screws Maximum Torque	20 in lbs (2.2 Nm)

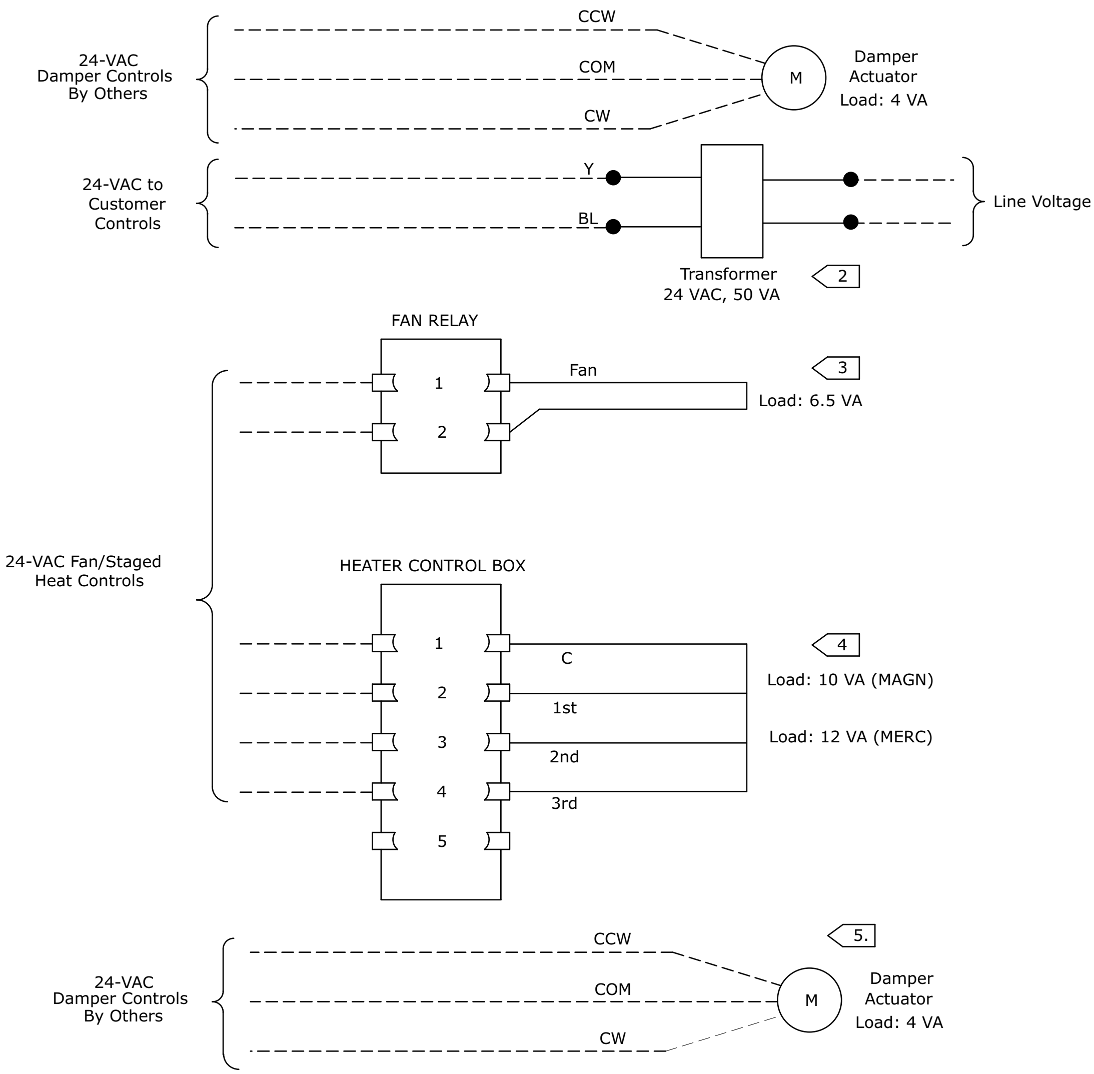
Assembly Specifications	
Weight (typical)	1.38 Lb (0.628 Kg.)
Heat Transfer Material Used	Thermal Pad
Material	Steel
Finish	Nickel Plate
Torque Applied	20 in/lbs ± 10%.

Figure 23. Actuator — field installed DDC controls (DD00)

DD00—Available for all VariTrane 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 (fan-powered units), 24-VAC control power transformer (optional for single- and dual-duct units), and factory-installed electric heater contactor wires are attached to the outside of the unit for field connection of controls. A second actuator is provided with an integral screw terminal for dual-duct units.



NOTES:

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

2. Located in Heater Terminal Box for electric heat on single-duct units.
Located in Control Box for cooling only and hot water heat on single-duct units.
Located in Control Box on all fan-powered units.

3. Only available with fan-powered units.

4. Located in Heater Terminal box.

5. Only available with dual-duct units.

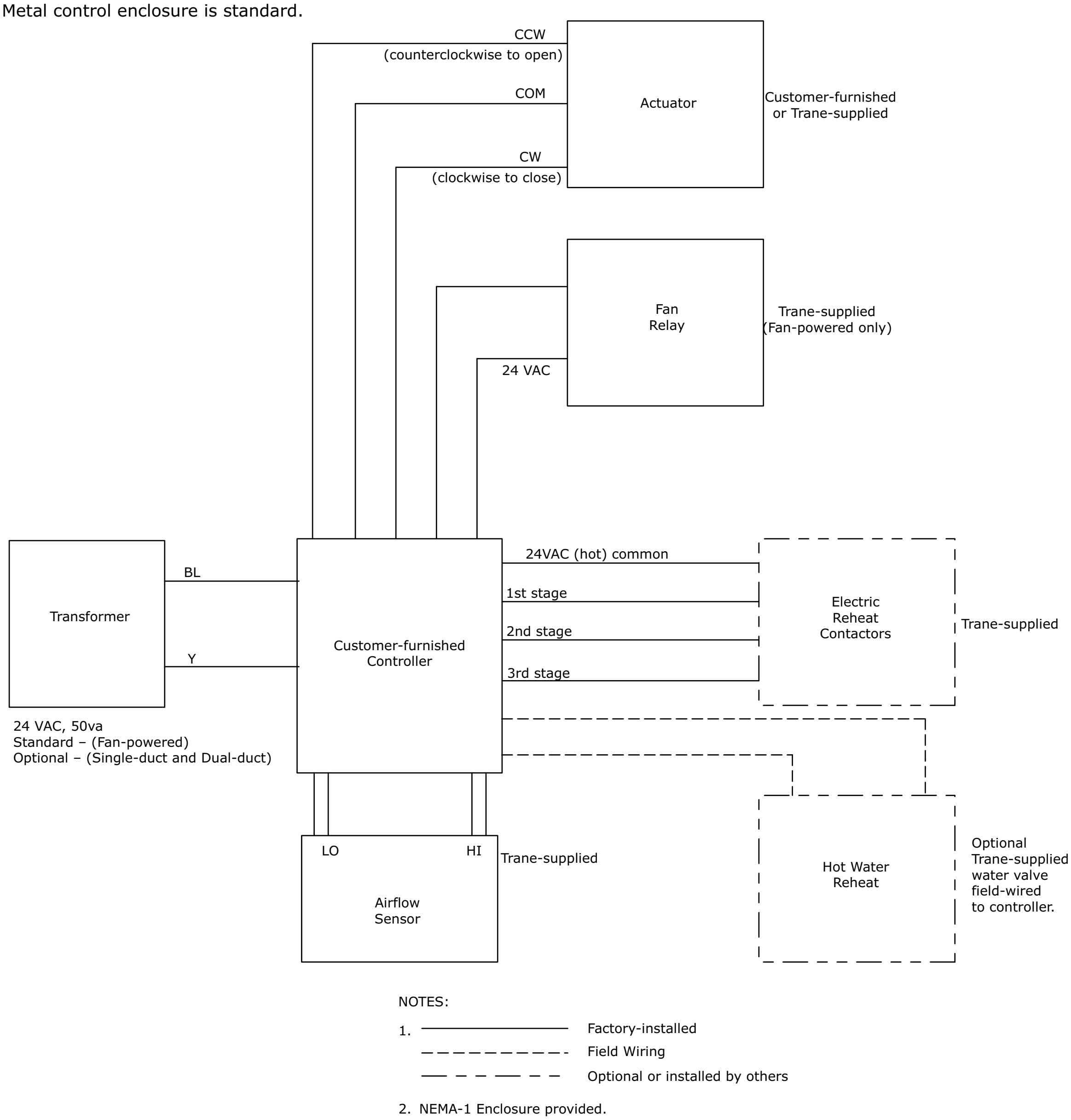
Figure 24. Customer-supplied actuator or controller (FM00, FM01)

Available on all VariTrane 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.



Controls Specifications

For all VariTrane™ units, the unit controller continuously monitors the zone temperature and varies the primary airflow as required to meet zone temperature and ventilation setpoints. Airflow is limited by adjustable minimum and maximum airflow setpoints.

Direct Digital Controls (DDC)

BACnet Direct Digital Controllers (Symbio™ 210, Symbio™ 500, and Tracer® UC210)

Trane-designed BACnet® Symbio™ 210, Symbio™ 500, and Tracer® UC210 controllers provide an open protocol technology and also can use the Trane Air-Fi® wireless mesh network system.

Direct Digital Controller(s) with VDD Dual-Duct Units

Dual-duct units with single Symbio 500 unit control operate either in Variable Air Volume mode or Constant Volume mode. In both cases, the Symbio 500 is directly measuring primary/cooling and secondary/heating airflow to maintain space temperature and ventilation control.

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 — 2 to 10 Vdc Analog Actuator

The Trane 3-wire 24 Vac/Vdc 2 to 10 Vdc analog quarter turn control actuator with linkage release button. Actuator has a constant drive rate independent of load, a rated torque of 45 in-lb, a 95 second drive time, and is non-spring return. Travel is terminated by end stops and fully opened (CCW) and closed (CW) positions. Internal electronic control prevents motor stall when motor reaches end stops.

DDC Actuator - Belimo

LMB24-3-T TN 3-wire, 24 Vac/Vdc, floating-point, quarter turn actuator with linkage release button. Actuator has a constant drive rate independent of load, a rated torque of 45 in-lb, a 95 second drive time, and is 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.

DDC Zone Sensor

The controller measures zone temperature through a sensing element located in the zone sensor. Other zone sensor options may include an externally-adjustable setpoint, communications jack for use with a portable service tool, 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 controller must be 18 to 22 awg. twisted pair wiring. The setpoint adjustment range is 50 to 88ºF (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 7-wire connection. Wireless zone sensors report the same zone information as wired zone sensors, but do so using radio transmitter technology. No wiring from the zone sensor to the controller is necessary.

Digital Display Zone Sensor with Liquid Crystal Display (LCD)

The direct digital zone sensor contains a sensing element which sends a signal to the controller. A Liquid Crystal Display (LCD) indicates setpoint, or space temperature. Sensor buttons allow setpoint adjust, and allow space temperature readings to be turned on or off. The digital display zone sensor also includes a communication jack, for use with a portable edit device, and an override button to change from unoccupied to occupied. The override button has a cancel feature, which returns the system to unoccupied mode. The digital display zone sensor requires seven wires, one for 24 Vac power.

Options

Power Fuse (cooling only and hot water units, and VDDF)

An optional fuse is factory-installed in the primary voltage hot leg.

Transformer (Standard on fan-powered, optional on VCCF, VCWF, VDDF)

The 50-VA transformer is factory-wired and installed in an enclosure with 7/8–inch (22 mm) knockouts to provide 24 VAC for controls.

Disconnect Switch (Optional on VCCF, VCWF, VDDF)

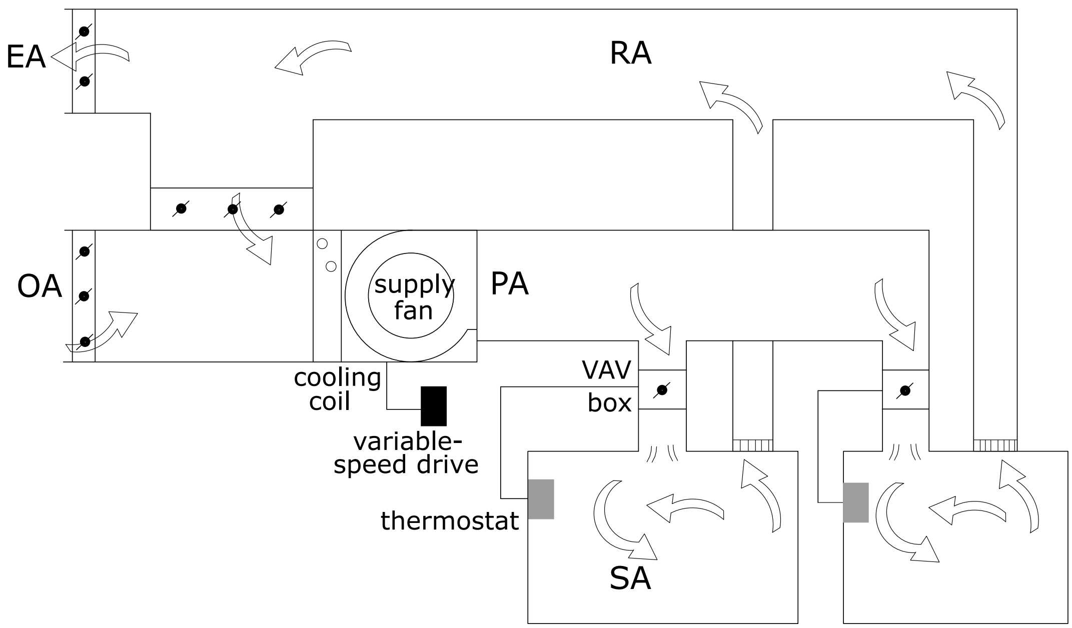
Disengages power.

Other Options Available

- DDC zone sensors - wired or wireless
- Modulating water valves
- Control transformer (ships loose with mounting plate for 4x4 junction box)
- Auxiliary temperature sensor
- Zone occupancy sensors
- CO_2 sensors (room or duct mounted)

Application Considerations

Variable-Air-Volume (VAV) System



VAV System

There are two primary types of VAV systems—single-duct and dual-duct.

Single-duct Systems

Single-duct systems include one supply fan and a single supply duct, which is attached to each zone. The supply fan delivers cooled air to the VAV zones in variable volumes, depending upon the cooling requirements. The supply fan is usually designed to modulate airflow delivered to the VAV zones.

Many VAV zones require heating as well as cooling. The supply air-handling unit provides either no heat (cooling only), morning warm-up heat or occupied (changeover) heat. In addition, heat may be provided at any individual VAV zone (within the zone or within the VAV terminal) by reheating cool air provided by the central air handler.

No Heat

Central Cooling Only—In some systems, the central air handler provides only cooling and ventilation during zone occupied periods. The supply air is maintained at a constant temperature and the supply airflow is modulated to match the VAV airflow rate with the zone cooling requirements.

Central Heat

Central Heat for Morning Warm-up—Many buildings cool down during the night. To be at a comfortable temperature in the morning when the building is again occupied, heat must be added to the spaces. Heat provided by the central air handler for morning warm-up is supplied at constant air volume to the zones, prior to the time of occupancy. During the morning warm-up period, the VAV terminal units must open to allow heated air to flow into the zones. In most instances very little additional heat is needed once the building is occupied.

Central Occupied Heating-Changeover—Some buildings use the same air handler to provide both occupied cooling and occupied heating. This is commonly referred to as a changeover system. The system changes between heating and cooling depending on the need of the zones on the system. In a changeover system, the operation of the VAV terminal units must also change over, opening to provide heat in the heating mode and opening to provide cooling in the cooling mode.

Terminal Heat

Remote Heat—In some zones of a single-duct VAV system, perimeter heating equipment, remote from the terminal unit, is used to add heat to the zone when the cooling load is lower than the minimum cooling capacity of the VAV terminal unit. Heat is added directly to the zone while cool supply air continues to enter the zone at a minimum rate for zone ventilation.

Terminal Reheat—In some zones of a single-duct VAV system, a minimum flow of cool supply air is reheated at the terminal unit before entering the zone. Terminal reheat can be provided by electrical resistance heaters or by hot water coils.

Parallel Fan-Powered Heat—In some zones of a single-duct VAV system, cool supply air at minimum flow is mixed with warm plenum air before entering the zone. A fan in the terminal unit, in parallel with the central fan, draws air from the plenum whenever the zone requires heat.

Series Fan-Powered Heat—In some zones of a single-duct VAV system, the airflow to the zone is held constant, during both heating and cooling, by a terminal unit fan that is in series with the central fan. The terminal unit fan runs continuously. When the zone requires heat, cool supply air at minimum flow is mixed with warm, return plenum air before entering the zone.

Dual-duct Systems

Dual-duct systems have either one or two supply fans and two duct systems. One duct system carries heated air and the other duct system carries cooled air. Heated air and cooled air are modulated and/or mixed at each zone in the proper proportions to control zone temperature. Terminal reheat is not required in a dual-duct system. See *Chilled-Water VAV Systems - Applications Engineering* (SYS-APM008*-EN) for more information.

Figure 25. Single-fan, dual-duct VAV system

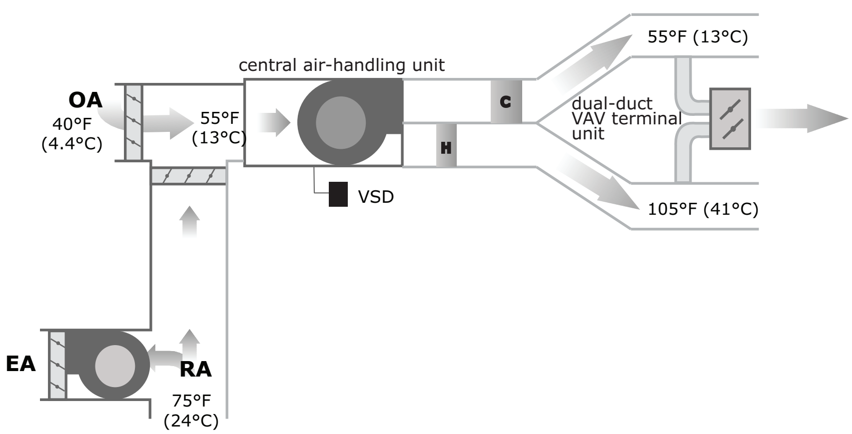
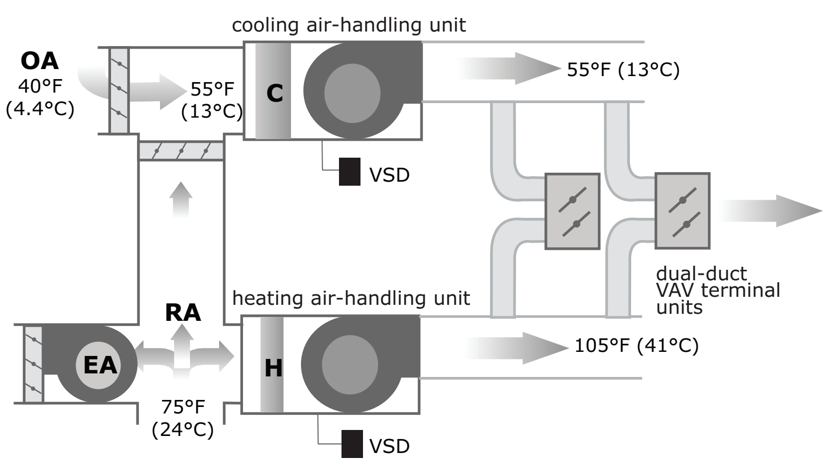


Figure 26. Dual-fan, dual duct VAV system



VariTrane VAV Terminal Units

VariTrane™ units are available with microprocessor-based DDC controls. Factory-installed controls are available with all types of terminal units.

Figure 27. Single-duct cooling only unit

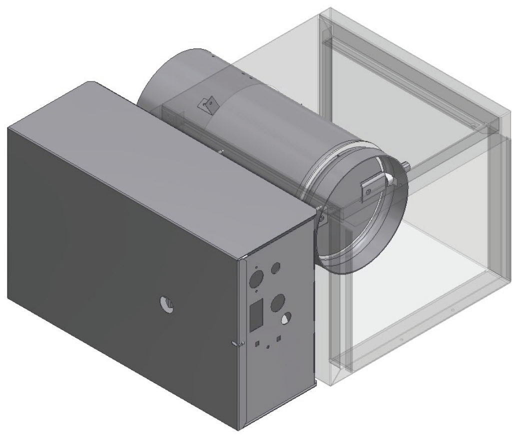


Figure 28. Single-duct unit with hot water coil

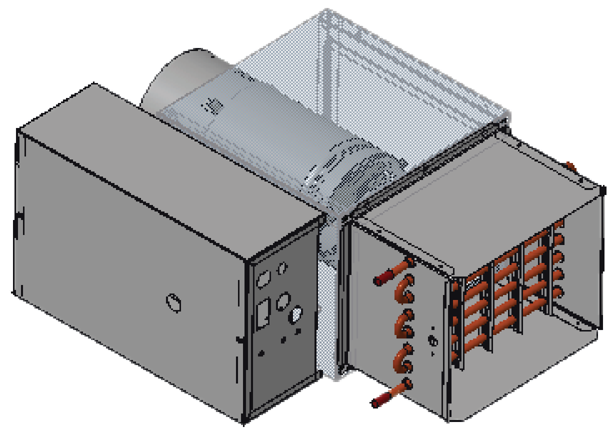
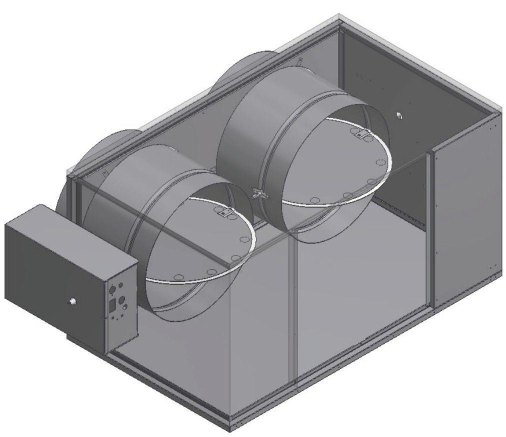


Figure 29. Dual-duct terminal unit



Single-duct

Single-duct terminal units control the volumetric flow of supply air to the space to maintain the zone temperature at setpoint. These units are generally applied in cooling-only VAV zones that require no heat during occupied hours. If local zone heat is necessary it can be provided either remotely (for example, perimeter heat) or by terminal reheat (either electric or hot water coils).

Dual-duct

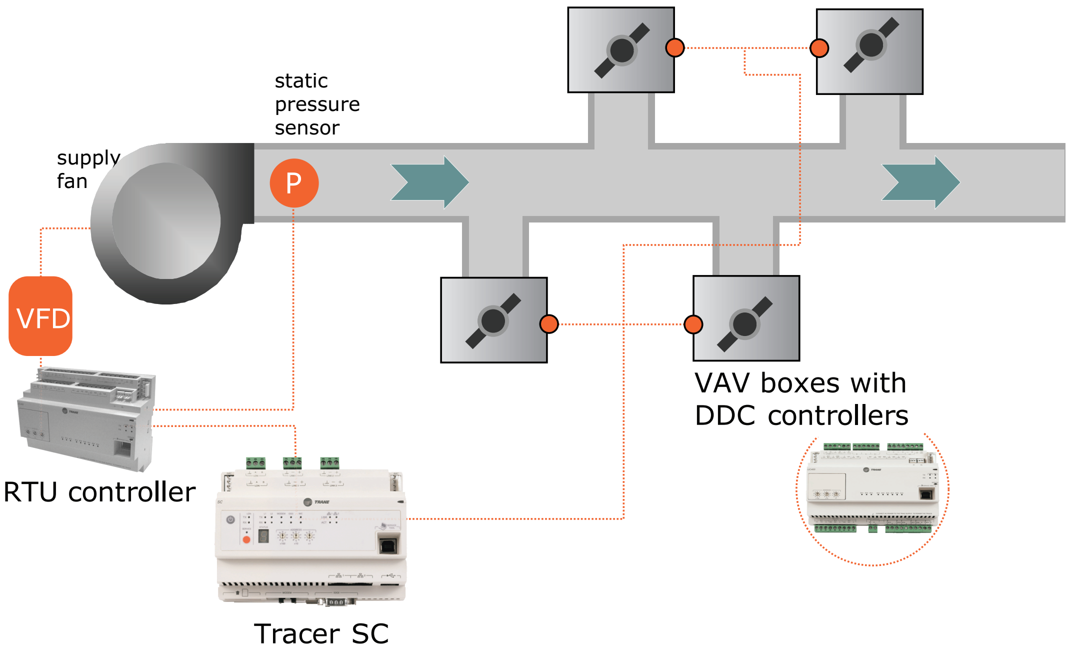
Dual-duct terminal units are used in a special type of air distribution system where the main system has both warm air and cold air separately ducted to each terminal unit. The flow of both warm air and cool air is modulated, delivering air to the zone at either a variable or constant volume. Since full capacity occupied heating is always available, control of additional local heat is not provided.

Fan-Pressure Optimization

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

The control system polls the VAV units for the air valve damper position on each unit. The duct static pressure setpoint for the 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 of the VAV units are pressure-independent, but the supply fan uses less energy since it is able to generate less pressure, which results in fan energy savings.

Figure 30. Optimized static-pressure control

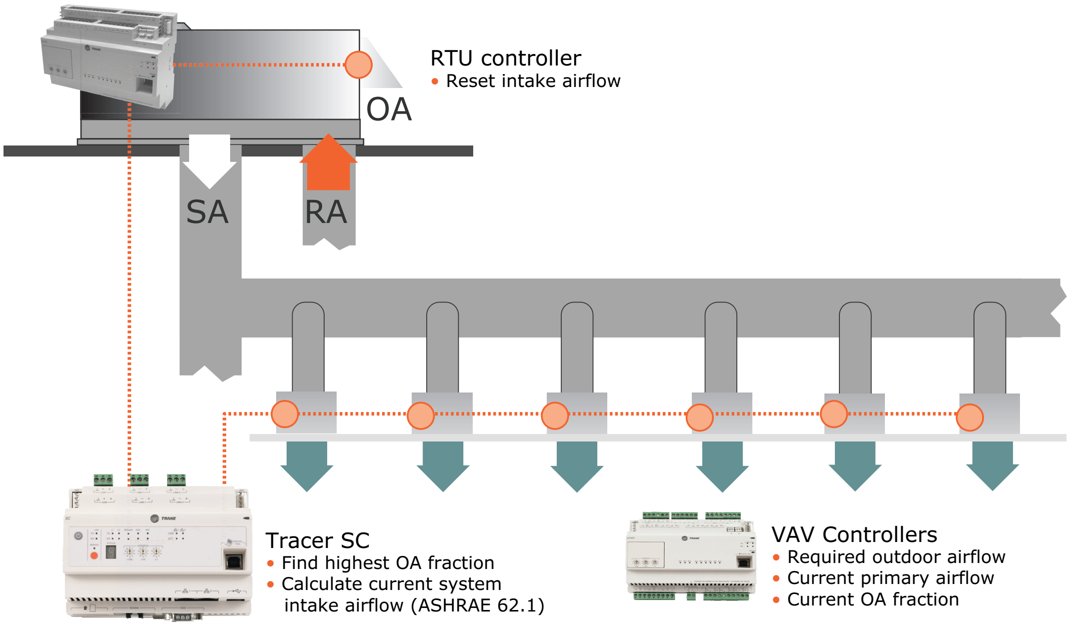


Ventilation Reset

The Ventilation Reset control strategy enables a building ventilation system to bring in an appropriate amount of outdoor air per **ASHRAE Standard 62.1**. The basis for the strategy is measuring airflow at each zone, calculating current system ventilation efficiency using the multiple-zone system equations of the standard, and communicating a new outdoor airflow setpoint to the air handler.

This strategy continually monitors the zone ventilation needs and system outdoor air intake flow, minimizing the amount of ventilation air and increasing the energy efficiency of the system. This ensures that the right amount of air is brought in at all times and that proper ventilation can be documented. Trane has integrated this control ability into the VAV controls, air-handler controls, and building controls.

Figure 31. Ventilation reset



Control Types

VAV terminal units are available with many different options. These options fall into three main categories of controls: direct digital (DDC), pneumatic, and analog electronic. All of these control types can be used to perform the same basic unit control functions, yet differences exist in accuracy of performance, versatility, installed cost, operating cost, and maintenance cost.

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. Controllers available on VAV units include:

- Symbio™ 210
- Symbio™ 500
- Tracer® UC210

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 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 via wired or wireless networks 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 VAV 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. The VariTrane™ system uses a primary air valve and flow transducer for both DDC systems and analog electronic systems. However, the DDC zone sensor is different from the analog electronic thermostat.

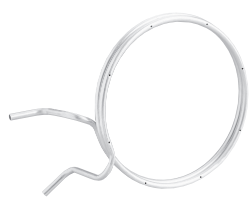
DDC controls provide flexibility and considerable diagnostic capability. DDC controllers can be connected together to form a network of controllers which can be can be monitored from a remote location to verify proper operation. Commands and overrides can be sent for groups of controllers at one time 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 VAV terminal units can be coordinated with other components of the overall system to verify comfortable, efficient operation and even reduce energy use.

DDC control of VAV 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 VAV 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 VAV terminal unit is its ability to accurately sense and control airflow. The VariTrane™ terminal unit was developed with exactly that goal in mind. The patented, multiple-point, averaging flow ring measures the velocity of the air at the unit primary air inlet.
The differential pressure signal output of the flow ring provides the terminal unit controller a measurement of the primary 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 primary 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 primary air entering the inlet.

The total pressure and the static pressure are measurable quantities. The flow measurement device in a VAV terminal unit is designed to measure velocity pressure. Most flow sensors consist of a hollow piece of tubing with orifices in it. The VariTrane™ 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 VariTrane™ 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 VAV 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 yield the following commonly used equation:

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

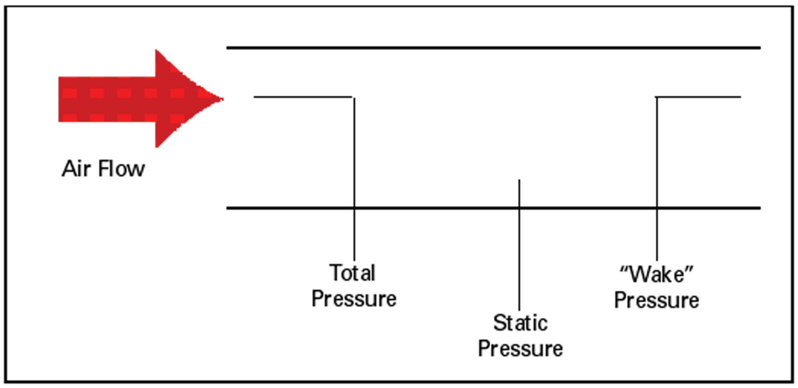
The amount of air traveling through the inlet is related to the area of the inlet and the velocity of the air:

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 VariTrane™ 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 primary airflow within ±5% of unit nominal airflow.

Figure 32. 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 setup 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 primary 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 verify proper control of the unit.

Heat Options

Hot Water Heating Coil

Figure 33. Hot water coil

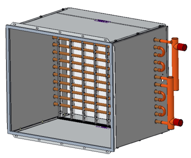


Figure 34. Trane hot water valve

Figure 35. Belimo hot water valve

Hot water heating coils are generally applied on VAV terminal units as reheat devices. 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
- ΔP = 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

Electric heating coils are applied on VAV terminal units as terminal reheat devices. Electric heat coil capacity is rated in kilowatts (kW). Coils are available with the total capacity divided into one, two, or three stages

Electric heat coils are available in single-phase or three-phase models. This refers to the type of power source connected to the coil. 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 coil will depend upon whether it is a single-phase or three-phase coil. The current draw is necessary for determining what size wire should be used to power the electric coil and how big the primary power fusing should be. The equations for current draw for these coils are:

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

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

VariTrane™ 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 coils have certain minimum airflow rates for each amount of kW heat the coil can supply to operate safely. See Airflow tables in for minimum air flow rates by unit inlet size and electric heat kW.

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

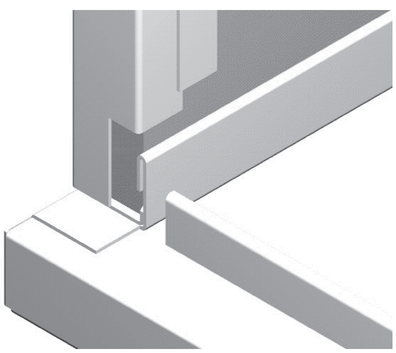
$$CFM = \frac{kW \times 3145}{\Delta T}$$

Where

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

Electric heat coils are available with magnetic or solid state relays. Magnetic contactors are less expensive than solid state relay contactors. However, solid state relay contactors can be cycled at a more rapid rate without failing.

Insulation



Insulation in a VariTrane™ terminal unit is used to avoid condensation on the outside of the unit, to reduce the heat transfer from the cold primary air entering the unit, and to reduce the unit noise. The VariTrane™ 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, if the VAV terminal unit has a fan, 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 us 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 VAV terminal units, which set the sound pressure levels and ultimately the NC within the space, is from radiated sound. This is readily known for fan-powered units, but less commonly known for single- and dual-duct units. 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 temperature in the space.** 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 VAV systems. With oversized units, the unit will act as a constant volume system eliminating the energy savings and individual zone control advantages of VAV systems. A good rule of thumb is to size cooling airflow for around 2000 FPM. VAV systems only operate at full flow when there is a maximum call for cooling in the zone. The greatest portion of the time, an air valve will be operating at partial flows.

When sizing fan-powered units, the fan airflow range can be determined by looking at the fan-curve. For parallel and series fan-powered units that operate at a constant fan speed, selections can be made all the way to the lowest flow ranges of the fan curve. A good balance of performance and cost is to select fans at 70 to 80 percent of maximum fan flow.

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.

Unit Attenuation

Terminal unit-installed attenuators are an option available to provide path sound attenuation. Manufacturer-provided attenuators on the discharge of a terminal unit are targeted at reducing discharge path noise and are typically a simple lined piece of ductwork. It would often be easier and less expensive to design the downstream ductwork to be slightly longer and require the installing contractor to include lining in it. Attenuators on the plenum inlet of fan-powered terminals are targeted at reducing radiated path noise since the plenum opening on a fan-powered terminal unit is typically the critical path sound source. Significant reduction in radiated path noise can result from a well-designed inlet attenuator. The attenuation from these attenuators is due to simple absorption from the attenuator lining and occupant line of sight sound path obstruction. Therefore, longer attenuators and attenuators that require the sound to turn multiple corners before reaching the occupied space provide superior results, particularly in the lower frequency bands.

Table 82. Octave band frequencies

Octave Band	Center Frequency	Band Edge Frequencies
1	63	44.6-88.5
2	125	88.5-177
3	250	177-354
4	500	354-707
5	1000	707-1414
6	2000	1414-2830
7	4000	2830-5650
8	8000	5650-11300

Certification and Testing

Terminal units should be submitted based on the same criteria. There are several ways to confirm 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 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).

Other Resources

Refer to Additional Resources at the end of this chapter to see a list of publications to help with the basics of acoustical theory and modeling. You can also contact your local Trane salesperson to discuss the issue.

Duct Design

Designing cost-effective VAV 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 VAV terminal units. The inputs and outputs for the program enable VariTrane™ 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 VAV systems. If the equal friction method is used for the VAV supply duct design, the terminal units usually require pressure-independent (PI) control capability to avoid excessive flow rates when duct pressures are high.

In VAV systems, 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 VAV 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.

Best Practices

Common Mistakes

Some of the most common system or installation errors are discussed below.

Reducers at Unit Inlet

This problem is a very common issue that is seen in applications of VAV products. It is often mistaken by those in the field as an unacceptably large static pressure drop through the unit. It is also sometimes mistaken as a malfunctioning flow ring or pressure transducer.

This problem is sometimes unknowingly encountered because of the capability of the VAV unit to allow greater airflow for a specific size duct than other terminal units. For example, a project engineer specifies an 8-inch (203 mm) round take off from the main duct trunk to the VAV terminal unit. The person supplying the VAV terminal unit checks the required airflow and finds that a VAV unit with a 6-inch (152 mm) inlet will provide the specified terminal unit performance. The terminal unit supplier submits, receives approval, and orders the 6-inch (152 mm) inlet unit. While this is happening, the installing contractor has run the connecting duct from the main trunk to the terminal unit in the specified 8-inch (152 mm) round. The unit arrives at the job site, and the installer notices that the 8-inch (203 mm) duct and the 6–inch (152 mm) terminal unit inlet do not match. To get the unit installed, an 8- to 6-inch reducer is placed at the inlet to the terminal unit air valve.

The reducer will cause a phenomenon called flow separation at the unit inlet. Fluid dynamics analysis can present a detailed technical explanation of flow separation, but the characteristics important to this discussion are the production of pressure loss and turbulence. The reducer will have a significant static pressure drop associated with it since the air velocity is increased (i.e., static pressure is given up for increased velocity pressure). The pressure loss is sometimes mistaken as a loss due to the function of the terminal unit. The turbulence is at its greatest just downstream of the reducer. Unfortunately, this is the location of the flow ring at the air-valve inlet. The reducer will cause the flow ring to give an inaccurate and inconsistent reading because of the turbulent air.

The solutions to this situation are:

- Locate the reducer upstream of the terminal unit at least three duct diameters to eliminate flow separation and turbulence at the unit inlet and to improve the airflow measurement accuracy.
- Consider proper sizing of the terminal unit in the duct design and account for the pressure loss of the reducer in the central fan selection if a reducer is required. Be cautious of oversizing a VAV terminal. It is good practice to make sure that the inlet duct velocity at the minimum airflow setting is no lower than 500 feet per minute.

Improper Use of Flexible Ductwork

While flexible ductwork has many benefits, improper use can cause numerous problems in a VAV system. Flexible ductwork causes turbulent airflow and relatively large static pressure drops. Flexible ductwork at a primary damper inlet (i.e., the flow sensor location) may cause flow accuracy and repeatability problems due to turbulence. The use of flexible ductwork should be primarily limited to the downstream side of the terminal units in a VAV system. Use of flexible ductwork upstream of terminal units should be kept to an absolute minimum. All runs of flexible ductwork should be kept as short as possible. While most know these guidelines, the ease of installation which flexible ductwork provides is always an enticement to push the limits of what are acceptable practices.

Static Pressure Measurement Errors

Improper measurement techniques for static pressure can lead many to mistakenly believe that the terminal unit is causing a large pressure drop in the system. The chief error made here is taking a static pressure measurement in turbulent locations such as flexible ductwork or near transitions. This produces invalid static pressure readings. Another error commonly made is trying to read the static pressure at the same point as the flow sensing device. The inlets to VAV terminal units produce turbulence and will give poor readings. Flow sensors with their multiple-point averaging capability are best equipped to deal with this type of flow, while a single-point static probe is not. Another common error is the incorrect orientation of the static pressure probe. The static pressure is correctly measured when the probe is oriented perpendicular to the direction of airflow. The probe, or a part of it, should never be facing the direction of airflow, because the total pressure will influence the reading of the probe.

Additional VAV System and Product References

VAV Systems Air Conditioning Clinic

This clinic is designed to explain the system components, the system configurations, many of the VAV system options and applications. A great resource for VAV system understanding.

Literature Order Number: TRG-TRC014-EN

Intelligent Variable Air —
An EarthWise System from Trane for chilled-water applications

This catalog describes Trane's EarthWise™ approach to chilled-water VAV systems, which includes pre-packaged, optimized system controls to consistently deliver energy savings, interactive operator dashboards that demonstrate real time savings, and intelligent analytics that identify efficiency improvement opportunities, helping sustain a high level of performance for life.

Literature Order Number: APP-PRC002-EN

Intelligent Variable Air —
An EarthWise System from Trane for packaged DX applications

This catalog describes Trane's EarthWise™ approach to packaged DX rooftop VAV systems, which includes pre-packaged, optimized system controls to consistently deliver energy savings, interactive operator dashboards that demonstrate real time savings, and intelligent analytics that identify efficiency improvement opportunities, helping sustain a high level of performance for life.

Literature Order Number: APP-PRC003-EN

Rooftop VAV Systems Applications Engineering Manual

Discusses proper design and application of packaged rooftop, VAV systems. Topics include: basic system operation, benefits and drawbacks of a rooftop VAV system, in-depth coverage of system components (packaged rooftop unit, VAV terminal units, air distribution system, hot water heating system), solutions to address common design challenges (thermal zoning, ventilation, humidity control, energy efficiency, acoustics), several system variations (cold air distribution, single-zone VAV, air-to-air energy recovery), and common unit-level and system-level control functions (including system optimization strategies).

Literature order Number: SYS-APM007-EN

Chilled-water VAV Systems Applications Engineering Manual

Discusses proper design and application of chilled-water, VAV systems. Topics include: basic system operation, benefits and drawbacks of a chilled-water VAV system, in-depth coverage of the components that make up the system (VAV air-handling units, VAV terminal units, air distribution system, chilled-water system, hot water heating system), solutions to address common design challenges (thermal zoning, ventilation, humidity control, energy efficiency, acoustics), several system variations (cold air distribution, single-zone VAV, air-to-air energy recovery, dual-duct VAV systems), and common unit-level and system-level control functions (including system optimization strategies)

Literature order Number: SYS-APM008-EN

Acoustics in Air Conditioning Applications Engineering Manual

This manual describes the basic fundamentals, behavior, measurement, and control of sound, all directed at the design of quiet systems.

Literature Order Number: ISS-APM001-EN

ASRAE Handbooks

- ASHRAE Handbook of Fundamentals
- ASHRAE Handbook of HVAC Systems and Equipment
- ASHRAE Handbook of HVAC Applications
- ASHRAE Handbook of Refrigeration

Websites

- www.ashrae.org
- www.ahrinet.org
- www.trane.com

Appendix A. Unit Conversions

Table 83. 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 84. 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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