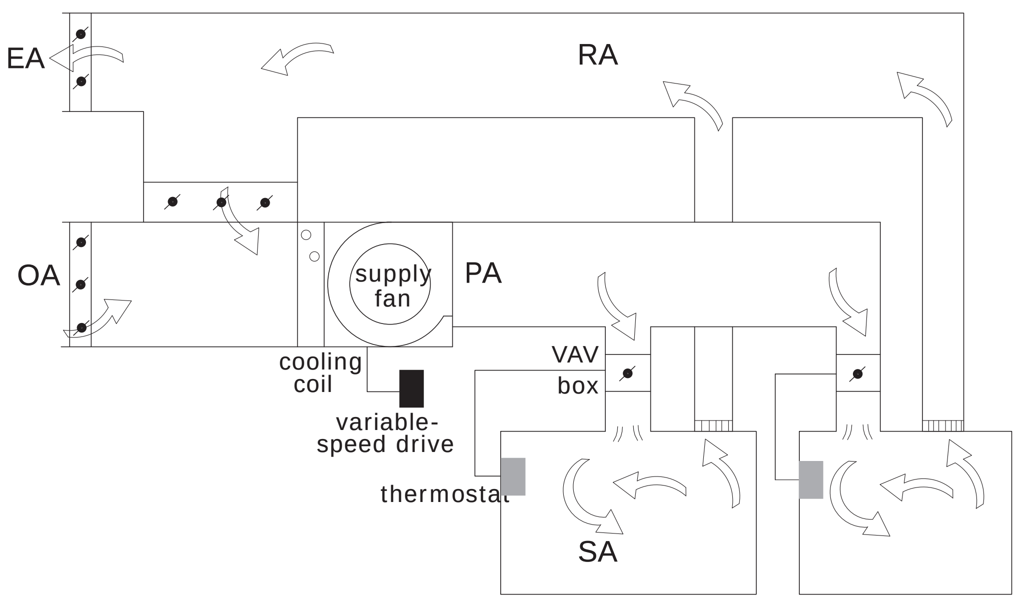
TRANE

Product Catalog

VariTrane™ Products
Single Duct/Dual Duct Units
VDD, VCC, VCW, VCE

Variable-Air-Volume (VAV) System



March 2015

VAV-PRC011M-EN

Ingersoll Rand

Introduction

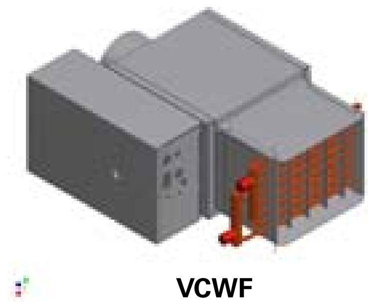
VariTrane™ variable-air-volume (VAV) units lead the industry in quality and reliability and are designed to meet the specific needs of today's applications. This generation of VariTrane units builds upon the history of quality and reliability and expands the products into the most complete VAV offering 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 simultaneously to provide occupant comfort. This option is also used with system concepts which use one valve for maintaining and monitoring 100% ventilation air.

VCCF

VCEF



VCWF

Copyright

Trademarks

Revision History

VAV-PRC011M-EN (033 Mar 2015)

Updated for Air-Fi™ wireless project.

Table of Contents

Features and Benefits

Construction

UL-listed products

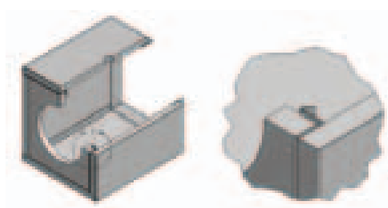
Safety and reliability are vital in commercial construction. All VariTrane™ units are listed in accordance with UL -1995 as terminal units. This listing includes the VAV terminal with electric heaters. Additionally, all insulation materials pass UL 25/50 smoke and flame safety standards.

AHRI Certified Performance

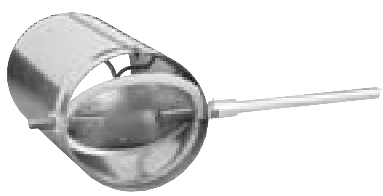
All VariTrane units are AHRI certified. AHRI 880 guarantees the pressure drop, flow performance, and acoustical performance provided is reliable and has been tested in accordance with industry accepted standards. AHRI 885 uses AHRI 880 performance and applies accepted industry methods to estimate expected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

Casing Design

Interlocking Panels—VariTrane products are manufactured in Trane’s state-of-the-art facility in the U. S. The interlocking panels are designed using integral I-beam construction technology. This minimizes deformation and creates tremendous product rigidity. An additional benefit is a smooth unit exterior with few exposed screws—ideal for exposed ceiling applications. VariTrane units are designed for use in systems that operate up to 5" w.c. of inlet pressure.



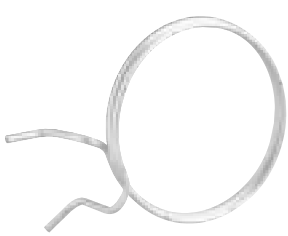
Metal Encapsulated Edges—All VariTrane units are complete with encapsulated edges to arrest cut fibers and prevent insulation erosion into the airstream. This is the standard of care in applications concerned with fiberglass erosion or projects with either double-wall or externally wrapped duct work.



The Trane Air Valve—is at the heart of VariTrane terminal units. This is where airflow is measured and controlled. Repeatability and ruggedness is vital. VariTrane products are the most rugged and reliable available.

18-gage 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.

Continuously Welded Seam — an automated weld process creates the highest quality continuous seam, which is “right” every time. The welded seam improves air valve rigidity and creates consistent and repeatable airflow across the flow measurement device. The result is a truly round cylinder, with no flat spots caused by lower quality crimping and riveting technologies.



Flow Ring—The Trane flow ring is time tested to perform under the most demanding conditions. Additionally, 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

The oil embargo of the early 1970s created an energy crisis, which resulted in tighter buildings, and reduced ventilation rates. A fallout issue of tighter building construction was poor indoor air quality. This heightened IAQ awareness. IAQ issues have been featured in publications from the smallest towns to the largest cities. System design should consider applicable ventilation and IAQ standards.(See your local Trane Sales Engineer or visit www.trane.com 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.

Tracer Building Automation System

Tracer™ Building Automation System assures comfort within your building

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

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

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

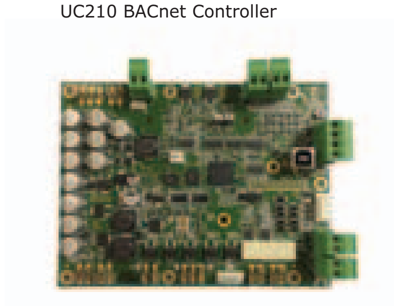
Whether factory-mounted or field-installed, Trane offers a wide range of controllers to suit virtually any application. These units are compatible with a variety of building types and can be used for new construction or renovation. Through extensive usability testing internally and with building operators,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

(Additional control options and sequence-of-operations are located in the "Controls" section.)

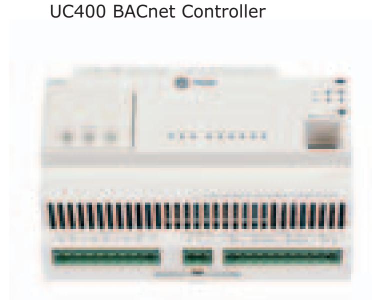
Tracer BACnet Controllers

Trane now 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-commissioned and shipped ready to be installed.

UC210 BACnet Controller

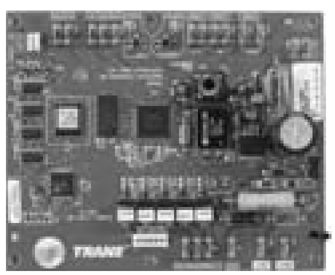


UC400 BACnet Controller



Tracer VV550 LonTalk Controllers

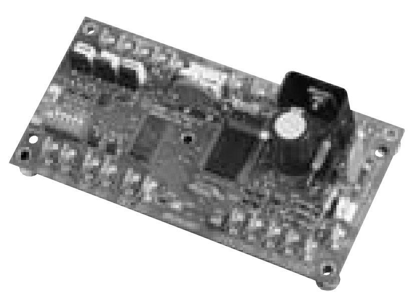
LonTalk controller



Trane offers a full line of LonTalk® controllers designed for simple integration into ANY system which can communicate via the LonMark® Space Comfort Control (SCC) protocol. These controllers are also completely factory-commissioned (see Table , p. 10).

Trane VAV UCM Controller

Trane VAV UCM DDC Controller



DDC (communicating electronic)—DDC controllers provide system-level data used to optimize overall SYSTEM performance. Variables such as occupied/unoccupied, minimum and maximum cfm and temperature, valve position, ventilation fraction, etc. are available on a simple twisted-shielded wire pair. For additional information, see "Industry Issues: Energy Efficiency".

Note: *One of many Trane DDC Control Options which are factory-installed, wired, calibrated, and fully tested before shipment.*

Trane DDC controllers provide Trane-designed solid-state electronics intended specifically for VAV temperature control in space comfort applications. DDC control capabilities include:

- Pressure-independent (PI) operation—Provides airflow required by the room thermostat to maintain occupant comfort. The controller automatically adjusts valve position to maintain required airflow. Minimum and maximum airflow is factory-set and field-adjustable.
- Factory-set airflow and temperature setpoints

Air-Fi Wireless System

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

- BAS-SVX40*: *Air-Fi™ Wireless Installation, Operation, and Maintenance*
- BAS-PRD021*-: A*ir-Fi™ Wireless Product Data Sheet*
- BAS-SVX55*: *Air-Fi™ Wireless Network Design Best Practices*

Air-Fi Wireless Communications Interface (WCI)

A factory-installed Air-Fi Wireless Communications Interface (WCI) provides wireless communication between the Tracer™ SC, Tracer unit controllers and optionally, Air-Fi Wireless Communication sensors. The Air-Fi WCI is the perfect alternative to a Trane BACnet® wired communication link. Eliminating the communication wire between terminal products, space sensors, and system controllers has substantial benefits:

- 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

The WCS communicates wirelessly to a Tracer 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.

Wireless Zone Sensor Set

The Trane wireless zone sensor set (sensor and receiver) communicates wirelessly to a Tracer unit controller. The Trane wireless zone sensor set is an alternative to a wired sensor when access and routing of communication cable are issues. It also allows flexible mounting and relocation.

Note: *The Trane wireless zone sensor set is not compatible with an Air-Fi™ wireless system.*

Pneumatic Controller

Pneumatic—Pneumatic controllers provide proven reliability and performance. A full line of options provide:

- Highest quality PVR available, which maximizes space temperature control.

Pressure-independent operation

- All VariTrane™ pneumatic controllers use the patented flow sensor input to provide the most accurate performance available.

Binary Input Controller

Binary Input Controller

Binary Input Controllers are system level controllers design to communicate with the VAV boxes via external binary inputs using the Trane Comm4 standard with VAV units that have VAV UCM DDC controllers installed. This non-programmable controller satisfies critical requirements for systems that do not need the full functionality of a true Building Automation System (BAS).

Integration Options (Interfacing with other control systems) - Trane offers the following ways to interface with other control systems.

1. Use Trane LonMark®, factory-commissioned VAV controllers
2. Use Trane BACnet® factory-commissioned VAV controllers.

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. Table , p. 10 differentiates these concepts.

Factory-commissioned controllers provide the highest quality and most reliable units for your VAV system. Additional testing verifies proper unit operation including occupied/unoccupied airflow, 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 VAV units is now available on ANY manufacturer's control system that can communicate using the LonMark® Space Comfort Control (SCC) protocol or using BACnet® communication 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

Table 1. Factory-installed vs. factory-commissioned (continued)

	Factory-installed	Factory-commissioned
Minimum & Maximum airflows settings (occupied/unoccupied)		X
Minimum & Maximum temperature setpoints (occupied/unoccupied)		X
Minimum ventilation requirements		X
Thumbwheel enable/disable		X
Heating offset		X
Trane Air-Fi™ wireless communications modules (WCI)	X	X
Pre-wired duct temperature sensor	X	X
Pre-wired water valve harness	X	X
Wireless zone sensor receiver	X	
Wireless zone sensor		
Trane Air-Fi™ Wireless Communications Sensor (WCS)		

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). Since then, it has blossomed 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. Data is easily accessed via a computer workstation.

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. For more information on these and other control strategies, contact your local Trane Sales Office, or visit www.trane.com.

- 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.

Agency Certifications

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

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

ASHRAE - 41.1

ASHRAE - 41.2

ASHRAE - 41.3

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

ASHRAE - 62

This standard specifies the minimum ventilation rates and indoor air quality that are acceptable for occupied spaces.

ASHRAE - 111

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

Air Conditioning and Refrigeration Institute (AHRI)

AHRI 880 - 2011

This standard sets forth classifications, performance testing requirements, and test results reporting requirements for air terminal units. The standard contains very detailed procedures that are to be followed for the testing and certification program associated with this standard. This is one of the most commonly referenced standards in the VAV terminal unit industry. The AHRI-880 certification program is designed to police the accuracy of documented performance for terminal units. The certification program requires a sampling of at least four units be tested annually. The tested units are chosen at random by AHRI and sent to an independent laboratory for the testing. The performance is tested at one specific operating condition. The operating characteristics tested include discharge and radiated sound power (for the damper and, in the case of fan-powered boxes, the fan), wide-open damper pressure drop, and fan motor amp draw. **VariTrane terminal units are certified according to AHRI-880.**

AHRI 885-2008

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

Underwriter's Laboratory (UL) 1995

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

National Fire Protection Association (NFPA)

NFPA 70

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

NFPA 90A

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

Model Number Descriptions

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

Digit 7, 8, 9—Not Used

000= N/A

Digit 10, 11—Design Sequence

** = Factory Assigned

Digit 12, 13, 14, 15—Controls

DD00 Trane Actuator Only and Enclosure
DD01= UCM4 Cooling Only Control
DD02= UCM4 N.C. On/Off Hot Water
DD03= UCM4 Prop. Hot Water
DD04= UCM4 Staged On/Off E-Heat
DD05= UCM4 Pulse Width MOD E-Heat
DD07= UCM4 N.O. On/Off Hot Water
DD11= VV550 DDC Controller - Cooling Only
DD12= VV550 DDC Ctrl to operate N.C. On/Off water valve
DD13= VV550 DDC Ctrl to operate Prop water valve
DD14= VV550 DDC Ctrl - On/Off Electric Heat
DD15= VV550 DDC Ctrl w/Pulse Width Modulation
DD16= VV550 DDC Controller - Ventilation Flow
DD17= VV550 DDC Ctrl to operate N.O. On/Off Water Valve
DD19= VV550 DDC Controller with Flow Tracking
DD20= VV550 DDC Vent Flow cntrl to operate N.C. water valve
DD21= VV550 DDC - Vent Flow w/ On/Off Elec Heat
DD22= VV550 DDC Vent Flow cntrl to operate prop water valve
DD23= VV550 DDC- Basic plus- Local (Electric heat- PWM) Remote (Staged EH)
DD24= VV550 DDC-Basic plus- Local (Water heat- Modulating) Remote (Water- N.C. 2 position)
DD25= VV550 DDC-Basic plus- Local (Water heat- Modulating) Remote (Water- N.O. 2 position)
DD26= VV550 DDC-Basic plus- Local (Water heat- N.O. 2-position) Remote (Water- Modulating)
DD27= VV550 DDC-Basic plus- Local (Water heat- N.C. 2-position) Remote (Water- Modulating)
DD28= VV550 DDC-Basic plus- Local (Water heat- N.O. 2-position) Remote (Water- N.O. 2-position)
DD29= VV550 DDC-Basic plus- Local (Water heat- N.C. 2-position) Remote (Water- NC 2-position)
DD30= VV550 DDC-Basic plus- Local (Water heat- N.O. 2-position) Remote (Water- N.C. 2-position)
DD31= VV550 DDC-Basic plus- Local (Water heat- N.C. 2-position) Remote (Water- N.O. 2-position)
DD32= VV550 DDC-Basic plus- Local (Electric heat- Staged) Remote (Staged EH)
DD33= VV550 DDC Vent Flow cntrl to operate N.O. On/Off water valve
DD41= UC400 DDC-Basic (No water or electric heat)
DD42= UC400 DDC-Basic (Water heat- N.C.- 2 position)
DD43= UC400 DDC-Basic (Water heat- Modulating)
DD44= UC400 DDC-Basic (Electric heat- staged)
DD45= UC400 DDC-Basic (Electric heat- PWM)
DD46= UC400 DDC Ventilation flow- cooling only
DD47= UC400 DDC-Basic (Water heat- N.O.- 2 position)
DD49= UC400 DDC-Flow Tracking (Cooling only)
DD50= UC400 DDC-Ventilation Flow (Water heat- N. C.- 2 position)
DD51= UC400 DDC-Ventilation Flow (Electric heat- staged)
DD52= UC400 DDC-Ventilation Flow (Water heat- Modulating)
DD53= UC400 DDC-Basic plus- Local (Electric heat- PWM) Remote (Staged EH)
DD54= UC400 DDC-Basic plus- Local (Water heat- Modulating) Remote (Water- N.C. 2 position)
DD55= UC400 DDC-Basic plus- Local (Water heat- Modulating) Remote (Water- N.O. 2 position)
DD56= UC400 DDC-Basic plus- Local (Water heat- N.O. 2-position) Remote (Water- Modulating)
DD57= UC400 DDC-Basic plus- Local (Water heat- N.C. 2-position) Remote (Water- Modulating)
DD58= UC400 DDC-Basic plus- Local (Water heat- N.O. 2-position) Remote (Water- N.O. 2-position)
DD59= UC400 DDC-Basic plus- Local (Water heat- N.C. 2-position) Remote (Water- N.C. 2-position)
DD60= UC400 DDC-Basic plus- Local (Water heat- N.O. 2-position) Remote (Water- N.C. 2-position)
DD61= UC400 DDC-Basic plus- Local (Water heat- N.C. 2-position) Remote (Water- N.O. 2-position)
DD62= UC400 DDC-Basic plus- Local (Electric heat- Staged) Remote (Staged EH)
DD63= UC400 DDC-Ventilation Flow (Water heat- N.O. 2-position)
DD65= UC400 Basic (Electric Heat Modulating SCR)
DD66= UC400 Basic plus-Local (Electric heat-Modulating SCR) Remote (Staged EH)
DD67= UC400 Ventilation Flow (Electric heat-Modulating SCR)
DD71= UC210 DDC-Basic (No water or electric heat)
DD72= UC210 DDC-Basic (Water heat- N.C.- 2 position)
DD73= UC400 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)
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 HeatModulating 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
ENON= Shaft Out Side for Electric Units
FM00= Other Actuator and Control
FM01= Trane Supplied Actuator, Other Ctrl
PC00= N.C. Actuator and Linkage Only
PC04= N.C. with DA Stat, 3000 Series
PC05= N.C. with RA STAT, 3000 Series
PCSS= Normally Closed Special
PN00= N.O. Actuator and Linkage Only
PN04= N.O. 3000 Series, DA STAT
PN05= N.O. 3000 Series, RA STAT
PN11= Auto Dual Min.
PN32= N.O. PNEU Constant Vol.
PN34= N.O. 3000 Series Constant Vol.,RA STAT
PNON= Shaft Out Side for Pneumatic Units
PNSS= Normally Open Special
N.C .= Normally-closed
N.O. = Normally-opened
DA Stat = Direct-acting pneumatic t-stat (by others)
RA Stat = Reverse-acting pneumatic t-stat (by others)
PN = Pneumatic
FM = Factory installation of customer-supplied controller
PVR = Pneumatic Volume Regulator

Digit 16—Insulation

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

Digit 17 & 18—Not Used

00 = N/A

Digit 19—Outlet Plenum (Connection is Slip & Drive)

0 = None
A = 1 Outlet RH
B = 1 Outlet END
C = 1 Outlet LH
D = 2 Outlets, 1 RH, 1 END
E = 2 Outlets, 1 LH, 1 END
F = 2 Outlets, 1 RH, 1 LH
H = 3 Outlets, 1 LH, 1 RH, 1 END
J = 4 Outlets, 1 LH, 1 RH, 2 END

Note: *See unit drawings for outlet sizes/ damper information.*

Digit 20—Not Used

0 = N/A

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 = Flippable (can be flipped in the field for LH or RH connections - VCEF only)
L = Left (Airflow hitting you in the face)
R = Right (Airflow hitting you in the face)
0 = Opposite side connection – coil and control (VCWF only)

Note: *VCCF, VCWF can be flipped in field for opposite-hand connection*

Digit 23—Transformer

0 = None
1 = 120/24 volt (50 VA)
2 = 208/24 volt (50 VA)
3 = 240/24 volt (50 VA)
4 = 277/24 volt (50 VA)
5 = 480/24 volt (50 VA)
6 = 347/24 Volt (50 VA)
7 = 380/24 Volt (50 VA)
8 = 575/24 Volt (50 VA)

Note: *For VCEF units with transformers the VA depends on the staging, control, and contactor type (ranges are 50 VA to 75 VA, for 1 and 3 phase)*

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 - 29—Electric Heat kW

000= None
010 = 1.0 kW
015 = 1.5 kW
460 = 46.0 kW

Note: *0.5 to 8.0 kW – ½ kW increments*
8.0 to 18.0 kW – 1 kW increments
18.0 to 46.0 kW – 2 kW increments

Digit 30—Electric Heat Stages

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

Digit 31—Electrical Heat Contactors

0 = None
1 = 24-volt magnetic
2 = 24-volt mercury
3 = PE with magnetic
4 = PE with mercury
5 = SCR heat UC400/UC210
6 = SCR heat FMTD/ENCL/DD00
A = 24-volt mercury (left hand)
B = 24-volt mercury (right hand)
C = PE with mercury (left hand)
D = PE with mercury (right hand)

Digit 32 & 33—Not Used

00 = N/A

Digit 34—Actuator

0 = Standard
A = Spring Return (Normally Open)
B = Spring Return (Normally Closed)
C = Belimo Actuator

Digit 35—Sensor Options

0 = Standard (Wired)
1 = Factory Mounted Wireless Receiver (Sensor Accessory)
2 = Wireless Communications Interface
3 = Trane Air-Fi Wireless Communications Interface

Digit 36—Pre-Wired Factory Solutions

0 = None
1 = Factory Mounted DTS
2 = HW Valve Harness
3 = Both DTS & HW Valve Harness
4 = Averaging DTS factory installed in unit (Required for UC210/UC400 with SCR heat)

Digit 37—Bottom Access with Cam Locks

0 = None
1 = Access Left Side Terminal Unit
2 = Access Right Side Terminal Unit
3 = Access Left Side Terminal Unit with Water Connection on Right
4 = Access Right Side Terminal Unit with Water Coil Connection on Left

Digit 38—Piping Package

0 = None
A = 2-way Automatic Balancing
B = 3-way Automatic Balancing

Digit 39—Water Valve

0 = None
1 = Proportional, HW Valve, 0.7 Cv
2 = Proportional, HW Valve, 2.7 Cv
3 = Proportional, HW Valve, 6.6 Cv
4 = Proportional, HW Valve, 8.0Cv

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 (0.19 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)
W = 13.0 gpm (0.82 l/s)
X = 14.0 gpm (0.88 l/s)
Y = 15.0 gpm (0.95 l/s)
Z = 16.0 gpm (1.01 l/s)
1 = 17.0 gpm (1.07 l/s)
2 = 18.0 gpm (1.14 l/s)
3 = 19.0 gpm (1.20 l/s)
4 = 20.0 gpm (1.26 l/s)
5 = 21.0 gpm (1.32 l/s)
6 = 22.0 gpm (1.39 l/s)
7 = 23.0 gpm (1.45 l/s)

Single-Duct VAV Terminal Units

The features of the single-duct VAV terminal units are described by the product categories shown in bold. Within each category the available options are listed.

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.

Selection Example: Cooling Only VCCF Terminal Unit

Design cooling airflow: 1700 cfm

Maximum wide open Air pressure drop: 0.25 in. 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 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 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)

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)

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 entering 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 "Performance Data" section of the VAV catalog is used to make a determination of the amount of noise 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)

Cooling Airflow: 1100 cfm

Maximum 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	68	68	65	65	60	57	28
Rad 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.

Computer Selection

The advent of personal computers has served to automate many processes that were previously repetitive and time-consuming. One of those tasks is the proper scheduling, sizing, and selection of VAV terminal units. Trane has developed a computer program to perform these tasks. The software is called the Trane Official Product Selection System (TOPSS™).

The TOPSS program will take the input specifications and output the properly sized VariTrane™ VAV terminal unit along with the specific performance for that size unit.

The program has several required fields, denoted by red shading in the TOPSS screen, and many other optional fields to meet the criteria you have. Required values include maximum and minimum airflows, control type, and model. If selecting models with reheat, you will be required to enter information to make that selection also. The user is given the option to look at all the information for one selection on one screen or as a schedule with the other VAV units on the job.

The user can select single-duct, dual-duct, and fan-powered VAV boxes with the program, as well as most other Trane products, allowing you to select all your Trane equipment with one software program.

The program will also calculate sound power data for the selected terminal unit. The user can enter a maximum individual sound level for each octave band or a maximum NC value. The program will calculate acoustical data subject to default or user supplied sound attenuation data.

Schedule View

The program has many time-saving features such as: 1) Copy/Paste from spreadsheets like Microsoft® Excel; 2) Easily arranged fields to match your schedule; and 3) Time-saving templates to store default settings.

The user can also export the Schedule View to Excel to modify and put into a CAD drawing as a schedule. Specific details regarding the program, its operation, and how to obtain a copy of it 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/ UCM	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
	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
	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
Pneumatic with Volume Regulator	4	225	38-225	0,38-225	38-225
	5	350	63-350	0,63-350	63-350
	6	500	73-500	0,73-500	73-500
	8	900	134-900	0,134-900	134-900
	10	1400	215-1400	0,215-1400	215-1400
	12	2000	300-2000	0,300-2000	300-2000
	14	2887	408-2887	0,408-2887	408-2887
	16	3789	536-3789	0,536-3789	536-3789
	24 x 16	7745	1096-7745	0,1096-7745	1096-7745

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/ UCM	4	106	12-106	0,12-106	12-106
	5	165	19-165	0,19-165	19-165
	6	236	28-236	0,28-236	28-236
	8	425	50-425	0,50-425	50-425
	10	661	77-661	0,77-661	77-661
	12	944	111-944	0,111-944	111-944
	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
Pneumatic with Volume Regulator	4	106	18-106	0,18-106	18-106
	5	165	30-165	0,30-165	30-165
	6	236	35-236	0,35-236	35-236
	8	425	63-425	0,63-425	63-425
	10	661	102-661	0,102-661	102-661
	12	944	141-944	0,141-944	141-944
	14	1363	193-1363	0,193-1363	193-1363
	16	1788	253-1788	0,253-1788	253-1788
	24 x 16	3656	517-3656	0,517-3656	517-3656

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

Performance Data

Table 4. Air pressure drop - in. wg (I-P)

Inlet Size	Airflow Cfm	Cooling Only	Hot Water 1-row coil	Hot Water 2-row coil	Hot Water 3-row coil	Hot Water 4-row coil	Electric Heat
04	50	0.01	0.01	0.01	0.01	0.01	0.01
	100	0.01	0.02	0.02	0.03	0.04	0.01
	150	0.01	0.03	0.03	0.08	0.10	0.01
	225	0.01	0.06	0.06	0.16	0.22	0.02
05	100	0.01	0.01	0.03	0.03	0.04	0.01
	200	0.01	0.05	0.08	0.13	0.18	0.01
	300	0.01	0.09	0.17	0.27	0.36	0.02
	350	0.02	0.12	0.22	0.35	0.47	0.02
06	100	0.01	0.02	0.03	0.03	0.04	0.01
	250	0.05	0.11	0.17	0.20	0.26	0.05
	350	0.10	0.22	0.32	0.35	0.47	0.11
	500	0.22	0.45	0.63	0.64	0.85	0.23
08	200	0.01	0.03	0.05	0.07	0.09	0.01
	400	0.02	0.10	0.17	0.24	0.32	0.02
	600	0.04	0.20	0.34	0.49	0.64	0.05
	900	0.08	0.40	0.69	0.97	1.28	0.11
10	500	0.01	0.07	0.12	0.17	0.22	0.01
	800	0.01	0.15	0.26	0.38	0.51	0.02
	1100	0.01	0.27	0.44	0.66	0.88	0.03
	1400	0.01	0.42	0.66	0.99	1.32	0.05
12	800	0.01	0.10	0.19	0.22	0.28	0.01
	1200	0.01	0.19	0.35	0.42	0.56	0.03
	1600	0.01	0.31	0.55	0.69	0.91	0.05
	2000	0.01	0.45	0.79	1.01	1.34	0.08
14	1500	0.01	0.10	0.23	0.34	0.44	0.01
	2000	0.01	0.16	0.36	0.54	0.72	0.01
	2500	0.01	0.22	0.51	0.79	1.05	0.01
	3000	0.01	0.30	0.69	1.09	1.45	0.01
16	2000	0.01	0.11	0.30	0.39	0.52	0.01
	2500	0.01	0.16	0.46	0.57	0.76	0.02
	3000	0.01	0.22	0.65	0.78	1.04	0.02
	4000	0.01	0.35	1.14	1.29	1.72	0.03
24 x 16	4000	0.08	0.40	0.66	0.97	1.29	0.15
	5500	0.16	0.70	*	1.73	2.30	0.30
	6500	0.23	0.95	*	2.38	3.17	0.44
	8000	0.36	*	*	3.62	4.83	0.69

Notes:

1. Hot water coil 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.
2. * indicated "not recommended"

Table 5. Air pressure drop - Pa (SI)

Inlet Size	Airflow (L/s)	Cooling Only	Hot Water 1-row coil	Hot Water 2-row coil	Hot Water 3-row coil	Hot Water 4-row coil	Electric Heat
04	25	3	3	3	2.5	2.5	3
	50	3	4	4	7.5	10	3
	70	3	7	7	20	25	3
	105	3	15	15	40	55	3
05	45	3	3	6	7.5	10	3
	95	3	12	21	32	45	3
	140	3	22	41	67	90	5
	165	4	29	54	87	117	6
06	45	3	4	7	7.5	10	3
	120	13	29	43	50	65	14
	165	26	55	79	87	117	27
	235	55	112	155	159	212	57
08	95	3	8	13	17	22	3
	190	4	25	43	60	80	6
	280	9	49	83	122	159	12
	420	21	99	169	242	319	28
10	235	3	16	29	42	55	3
	375	3	37	63	95	127	5
	520	3	67	110	164	219	9
	660	3	104	165	247	329	13
12	375	3	24	47	55	70	3
	565	3	47	88	105	139	7
	755	3	76	138	172	227	13
	940	3	111	195	252	334	19
14	700	3	26	55	85	110	3
	945	3	40	89	135	179	3
	1180	3	56	127	197	262	3
	1415	3	74	171	272	361	3
16	940	3	28	73	97	130	3
	1180	3	40	114	142	189	4
	1415	3	54	162	194	259	5
	1885	3	87	284	321	428	8
24 x 16	1885	20	100	165	242	321	38
	2600	40	176	279	431	573	76
	3070	57	236	366	593	790	110
	3775	90	341	513	902	1203	172

Notes:

1. 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.

OUTL CONVERSION CHART	
SYMBOL	NOMINALØ
I	5" (127 mm)
II	6" (152 mm)
III	8" (203 mm)
IV	10" (254 mm)

OUTLET AVAILABILITY CHART - SEE OUTL CONVERSION FOR NOMINALØ							
VALV		4	5	6	8	10	12
OUTL	A,B,C	I, II	I, II	I, II	III	III, IV	IV
	D,E,F	I, II	I, II	I, II	I, II, III	II, III, IV	III, IV
	H	I, II	I, II	I, II	I, II, III	II, III, IV	III, IV
	J	N/A	N/A	N/A	N/A	I	I, II

OUTLET PLENUM ARRANGEMENTS (TOP VIEW)

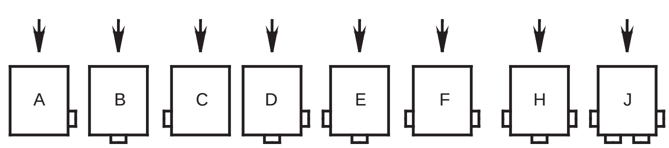


Table 6. Integral outlet plenum air pressure drop - in. wg (I-P)

Inlet Size	Outlet Configuration	Outlet (in.) Diameter	Airflow (Cfm)															
			50	100	150	200	250	350	400	500	600	800	900	1100	1200	1400	1600	2000
4,5,6	A,C	5	0.02	0.07	0.15	0.26	0.41	0.80	1.04	1.63								
4,5,6		6	0.01	0.03	0.07	0.13	0.20	0.37	0.48	0.74								
8,10		8				0.04	0.06	0.11	0.14	0.23	0.33	0.58	0.74	1.11	1.33	1.81		
10	AC	10				0.01	0.02	0.04	0.05	0.08	0.12	0.21	0.27	0.41	0.48	0.66		
12		10					0.03	0.06	0.08	0.12	0.17	0.29	0.37	0.54	0.64	0.86	1.11	1.71
4,5,6		5	0.01	0.03	0.08	0.15	0.23	0.48	0.64	1.02								
4,5,6	B	6	0.01	0.01	0.01	0.03	0.04	0.07	0.10	0.15								
8		8				0.01	0.01	0.02	0.02	0.03	0.05	0.07	0.09					
10		8				0.02	0.04	0.07	0.09	0.14	0.20	0.35	0.44	0.65	0.76	1.03		
10	B	10				0.01	0.01	0.01	0.01	0.02	0.02	0.04	0.06	0.08	0.10	0.13		
12		10					0.02	0.04	0.05	0.08	0.11	0.19	0.24	0.36	0.43	0.58	0.76	1.17
4,5,6	D,E	5	0.01	0.01	0.02	0.04	0.05	0.09	0.12	0.17								
4,5,6		6	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03								
8		5				0.06	0.09	0.18	0.23	0.35	0.49	0.85	1.06					
8	D, E	6				0.02	0.03	0.05	0.07	0.11	0.15	0.26	0.32					
8		8				0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01					
10		6				0.02	0.04	0.07	0.10	0.15	0.22	0.38	0.48	0.72	0.85	1.16		
10	D, E	8				0.01	0.01	0.01	0.02	0.02	0.04	0.06	0.08	0.12	0.14	0.19		
10		10				0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.05		
12	D, E	8					0.01	0.02	0.03	0.05	0.07	0.12	0.15	0.23	0.28	0.38	0.49	0.77
12		10						0.01	0.01	0.02	0.02	0.04	0.05	0.07	0.08	0.11	0.14	0.21
4,5,6	F	6	0.01	0.01	0.03	0.05	0.08	0.16	0.21	0.32								
4,5,6,8		5	0.01	0.03	0.06	0.10	0.16	0.30	0.38	0.58	0.83	1.43	1.78					
8,10	F	6				0.05	0.08	0.14	0.18	0.27	0.37	0.61	0.76	1.08	1.26	1.66		
8,10		8				0.01	0.02	0.04	0.06	0.09	0.13	0.23	0.29	0.43	0.52	0.71		
10		10				0.01	0.01	0.02	0.02	0.03	0.04	0.07	0.08	0.12	0.14	0.18		
12	F	8					0.02	0.04	0.05	0.07	0.10	0.17	0.21	0.31	0.37	0.50	0.64	0.98
12		10					0.01	0.02	0.02	0.03	0.04	0.06	0.08	0.11	0.13	0.16	0.21	0.30
4,5,6		5	0.01	0.01	0.01	0.01	0.01	0.03	0.04	0.06								
4	H	6	0.01	0.01	0.01	0.01												
5		6	0.01	0.01	0.01	0.01	0.01	0.01										
6		6		0.01	0.01	0.01	0.01	0.01	0.01	0.01								
8		5				0.03	0.05	0.09	0.11	0.18	0.25	0.43	0.54					
8	H	6				0.01	0.01	0.02	0.03	0.04	0.06	0.10	0.13					
8		8				0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03					
10		6				0.01	0.02	0.04	0.05	0.08	0.11	0.18	0.22	0.32	0.38	0.50		
10	H	8				0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.03	0.05	0.05	0.07		
10		10				0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		
12	H	8					0.01	0.01	0.02	0.03	0.04	0.06	0.08	0.11	0.13	0.17	0.21	0.32
12		10					0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.05	0.06	0.09
10		5				0.02	0.02	0.05	0.06	0.09	0.13	0.23	0.29	0.43	0.51	0.70		
12	J	5					0.03	0.06	0.08	0.12	0.17	0.30	0.38	0.57	0.68	0.92	1.20	1.87
12		6					0.01	0.02	0.03	0.04	0.06	0.11	0.14	0.21	0.25	0.35	0.45	0.71

Table 7. Integral outlet plenum air pressure drop - Pa (SI)

Inlet Size	Outlet Configuration	Outlet (mm) Diameter	Airflow (L/s)															
			25	50	70	95	120	165	190	235	280	375	420	520	565	660	755	940
4,5,6	A,C	127	4	17	37	66	102	199	260	405								
4,5,6		152	3	8	18	32	49	93	120	185								
8,10	AC	203			9	14	27	36	56	81	145	185	277	330	451			
10		254				3	5	10	13	21	30	53	67	101	120	164		
12		254					8	15	19	29	42	73	91	134	159	214	277	427
4,5,6	B	127	3	8	20	36	58	119	158	254								
4,5,6		152	3	3	4	6	10	19	24	37								
8		203				3	3	5	6	8	11	19	23					
10	B	203				6	9	17	22	35	49	86	109	161	190	257		
10		254				3	3	3	3	4	6	11	14	20	24	33		
12		254					5	10	12	19	28	48	61	90	107	145	188	292
4,5,6	D,E	127	3	3	6	9	13	23	29	42								
4,5,6		152	3	3	3	3	3	3	4	6								
8	D, E	127				15	23	44	57	87	123	211	264					
8		152				5	7	13	17	26	37	64	81					
8		203				3	3	3	3	3	3	3	3					
10	D, E	152				6	9	18	24	37	54	95	120	179	213	289		
10		203				3	3	3	4	6	9	16	20	30	35	48		
10		254				3	3	3	3	3	3	4	5	8	9	12		
12	D, E	203					3	6	7	12	17	30	38	57	69	94	123	193
12		254					3	3	3	4	6	10	12	17	20	27	34	52
4,5,6	F	152	3	4	8	14	21	40	52	81								
4,5,6,8		127	3	7	15	25	39	74	95	145	206	355	444					
8,10	F	152				13	19	35	45	66	92	153	189	269	315	414		
8,10		203				3	5	10	14	22	31	56	72	108	129	177		
10	F	254				3	3	4	5	7	10	17	21	29	34	45		
12		203					5	9	11	18	25	43	53	78	92	124	159	244
12		254					3	4	5	7	9	16	19	27	31	41	51	75
4,5,6	H	127	3	3	3	3	3	7	9	15								
4		152	3	3	3	3												
5		152	3	3	3	3	3	3										
6		152		3	3	3	3	3	3	3								
8	H	127				8	12	22	29	44	62	108	136					
8		152				3	3	6	7	11	15	26	33					
8		203				3	3	3	3	3	3	5	6					
10	H	152				4	5	10	13	19	27	45	56	81	95	126		
10		203				3	3	3	3	3	4	6	8	12	14	18		
10		254				3	3	3	3	3	3	3	3	3	3	3		
12	H	203					3	3	4	6	9	15	19	27	32	42	53	80
12		254					3	3	3	3	3	4	5	7	9	11	15	22
10	J	127				4	6	11	15	23	33	58	73	108	128	173		
12		127					7	14	19	29	42	75	95	142	168	229	299	467
12		152					3	5	7	11	15	28	35	53	63	86	113	178

Table 8. Heating capacity (MBh) - inlet size 04, 05, 06 (I-P)

Rows	gpm	Water Pressure Drop (ft)	Airflow (cfm)									
			50	100	150	200	250	300	350	400	450	500
1-Row Capacity MBH	0.5	0.48	4.33	5.97	7.09	7.97	8.73	9.39	9.98	10.50	10.97	11.39
	1.0	1.61	4.64	6.61	8.02	9.19	10.21	11.13	11.96	12.72	13.43	14.10
	1.5	3.27	4.75	6.85	8.39	9.68	10.83	11.87	12.83	13.72	14.55	15.34
	2.0	5.44	4.81	6.98	8.59	9.95	11.17	12.29	13.32	14.28	15.19	16.05
	2.5	8.07	4.85	7.06	8.71	10.12	11.39	12.55	13.63	14.65	15.61	16.51
2-Row Capacity MBH	1.0	0.57	5.54	9.39	12.19	14.31	15.98	17.33	18.46	19.40	20.22	20.92
	2.0	1.96	5.70	9.96	13.27	15.93	18.12	19.97	21.56	22.93	24.15	25.22
	3.0	4.08	5.75	10.16	13.66	16.54	18.95	21.01	22.80	24.37	25.77	27.03
	4.0	6.87	5.78	10.26	13.87	16.86	19.39	21.57	23.47	25.16	26.67	28.02
	5.0	10.31	5.80	10.33	14.00	17.06	19.66	21.92	23.90	25.66	27.24	28.66
3-Row Capacity MBH	1.0	0.82	6.00	10.53	13.96	16.62	18.75	20.48	21.93	23.15	24.20	25.11
	2.0	2.82	6.12	11.04	15.02	18.31	21.07	23.42	25.46	27.24	28.82	30.22
	3.0	5.83	6.19	11.21	15.39	18.91	21.93	24.54	26.83	28.86	30.67	32.30
	4.0	9.78	6.29	11.30	15.58	19.23	22.37	25.12	27.55	29.72	31.67	33.44
	5.0	14.64	6.35	11.35	15.70	19.42	22.65	25.49	28.00	30.26	32.30	34.15
4-Row Capacity MBH	1.0	1.08	6.46	11.64	15.80	19.08	21.72	23.88	25.67	27.18	28.47	29.58
	2.0	3.68	6.50	12.09	16.85	20.88	24.33	27.31	29.90	32.17	34.19	35.99
	3.0	7.58	6.51	12.24	17.19	21.50	25.25	28.55	31.47	34.08	36.42	38.54
	4.0	12.70	6.52	12.34	17.37	21.81	25.72	29.19	32.29	35.08	37.61	39.91
	5.0	18.97	6.53	12.47	17.47	21.99	26.00	29.58	32.80	35.70	38.34	40.76

Notes:
1. Fouling Factor = 0.00025 °F·ft²·h/Btu
2. Capacity based on 55°F entering air temperature and 180°F entering water temperature.

Table 9. Heating capacity (MBh) - inlet size 08 (I-P)

Rows	gpm	Water Pressure Drop (ft)	Airflow (cfm)								
			105	200	300	400	500	600	700	800	900
1-Row Capacity MBH	0.5	0.64	7.05	9.19	10.80	12.04	13.04	13.87	14.58	15.19	15.72
	1.0	2.14	7.82	10.61	12.78	14.56	16.11	17.50	18.72	19.82	20.81
	1.5	4.37	8.12	11.18	13.63	15.70	17.51	19.13	20.60	21.97	23.22
	2.0	7.25	8.28	11.49	14.10	16.33	18.31	20.09	21.73	23.24	24.63
	2.5	10.76	8.37	11.68	14.40	16.74	18.83	20.73	22.47	24.09	25.60
2-Row Capacity MBH	2.5	0.39	10.83	17.05	21.63	25.03	27.66	29.78	31.53	33.00	34.26
	4.0	0.94	11.12	17.89	23.11	27.13	30.33	32.97	35.18	37.08	38.72
	6.0	2.00	11.29	18.39	24.03	28.45	32.05	35.05	37.60	39.81	41.74
	8.0	3.42	11.37	18.66	24.52	29.17	32.99	36.20	38.95	41.34	43.45
	10.0	5.21	11.43	18.83	24.83	29.62	33.58	36.93	39.81	42.33	44.55
	12.0	7.35	11.46	18.94	25.04	29.94	34.00	37.44	40.42	43.02	45.33

Table 9. Heating capacity (MBh) - inlet size 08 (I-P) (continued)

Rows	gpm	Water Pressure Drop (ft)	Airflow (cfm)								
			105	200	300	400	500	600	700	800	900
3-Row Capacity MBH	2.5	0.53	11.95	19.51	25.34	29.76	33.26	36.09	38.44	40.43	42.15
	4.0	1.24	12.18	20.28	26.82	31.97	36.16	39.65	42.61	45.15	47.38
	6.0	2.62	12.31	20.74	27.71	33.32	37.98	41.91	45.29	48.23	50.83
	8.0	4.45	12.37	20.97	28.17	34.04	38.95	43.13	46.75	49.93	52.75
	10.0	6.73	12.41	21.11	28.46	34.49	39.56	43.91	47.68	51.01	53.97
	12.0	9.45	12.44	21.21	28.66	34.80	39.98	44.44	48.33	51.76	54.83
4-Row Capacity MBH	2.5	0.66	13.02	22.00	29.26	34.89	39.37	43.03	46.06	48.63	50.84
	4.0	1.55	13.18	22.72	30.80	37.33	42.73	47.25	51.12	54.45	57.37
	6.0	3.23	13.25	23.13	31.69	38.78	44.76	49.87	54.31	58.19	61.63
	8.0	5.48	13.29	23.33	32.14	39.53	45.83	51.27	56.02	60.22	63.97
	10.0	8.26	13.32	23.46	32.42	40.00	46.50	52.14	57.10	61.51	65.45
	12.0	11.56	13.34	23.54	32.61	40.31	46.95	52.74	57.85	62.39	66.47

Notes:
1. Fouling Factor = 0.00025 °F·ft²·h/Btu
2. Capacity based on 55°F entering air temperature and 180°F entering water temperature.

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

Rows	gpm	Water Pressure Drop (ft)	Airflow (cfm)										
			200	300	400	500	600	700	800	900	1000	1200	1400
1-Row Capacity MBH	0.7	1.60	11.99	14.16	15.95	17.43	18.69	19.77	20.73	21.58	22.35	23.68	24.79
	1.0	2.97	12.82	15.36	17.40	19.18	20.78	22.19	23.46	24.61	25.66	27.52	29.11
	1.5	6.04	13.53	16.42	18.80	20.87	22.72	24.41	26.01	27.48	28.85	31.30	33.47
	2.0	10.03	13.92	17.00	19.58	21.85	23.90	25.78	27.52	29.14	30.69	33.54	36.08
	2.5	14.87	14.16	17.37	20.08	22.48	24.66	26.67	28.54	30.30	31.95	35.02	37.83
2-Row Capacity MBH	2.5	1.09	19.51	25.67	30.49	34.36	37.55	40.24	42.54	44.53	46.27	49.20	51.56
	4.0	2.60	20.19	27.00	32.50	37.06	40.92	44.24	47.12	49.66	51.92	55.78	58.97
	6.0	5.55	20.58	27.78	33.72	38.72	43.02	46.76	50.06	52.99	55.62	60.17	63.98
	8.0	9.54	20.78	28.19	34.36	39.61	44.15	48.13	51.66	54.82	57.67	62.62	66.80
	10.0	14.53	20.90	28.44	34.76	40.16	44.86	48.99	52.67	55.98	58.97	64.19	68.61
3-Row Capacity MBH	2.5	1.31	21.72	29.21	35.21	40.10	44.18	47.62	50.58	53.15	55.40	59.18	62.24
	4.0	3.11	22.32	30.49	37.27	42.99	47.89	52.13	55.85	59.15	62.08	67.12	71.29
	6.0	6.59	22.65	31.22	38.48	44.71	50.13	54.90	59.14	62.93	66.35	72.30	77.31
	8.0	11.26	22.82	31.60	39.10	45.61	51.31	56.37	60.89	64.97	68.67	75.14	80.64
	10.0	17.10	22.92	31.82	39.48	46.16	52.04	57.28	61.99	66.25	70.12	76.94	82.76
4-Row Capacity MBH	2.5	1.76	23.85	32.84	40.21	46.29	51.39	55.70	59.39	62.59	65.39	70.06	73.79
	4.0	4.13	24.36	34.08	42.37	49.48	55.64	61.02	65.75	69.95	73.70	80.13	85.45
	6.0	8.67	24.71	34.75	43.58	51.31	58.13	64.19	69.61	74.49	78.91	86.62	93.13
	8.0	14.72	24.81	35.09	44.18	52.23	59.40	65.83	71.63	76.89	81.69	90.13	97.34
	10.0	22.23	24.85	35.29	44.55	52.79	60.18	66.84	72.88	78.38	83.42	92.34	100.00

Notes:
1. Fouling Factor = 0.00025 °F·ft²·h/Btu
2. Capacity based on 55°F entering air temperature and 180°F entering water temperature.

Table 11. Heating capacity (MBh) - inlet size 12 (I-P)

Rows	gpm	Water Pressure Drop (ft)	Airflow (cfm)									
			300	500	700	900	1100	1300	1500	1700	1900	2000
1-Row Capacity MBH	1.0	0.62	17.04	20.87	23.79	26.07	27.94	29.51	30.85	32.03	33.06	33.52
	2.0	2.17	19.32	24.45	28.47	31.86	34.91	37.59	39.99	42.15	44.11	45.02
	3.0	4.53	20.21	25.94	30.55	34.52	38.04	41.21	44.15	46.87	49.37	50.55
	4.0	7.68	20.69	26.75	31.70	36.01	39.88	43.40	46.64	49.63	52.44	53.80
	5.0	11.57	20.99	27.26	32.43	36.97	41.07	44.82	48.29	51.53	54.55	56.00
2-Row Capacity MBH	3.5	0.66	28.44	39.44	47.27	53.16	57.79	61.53	64.63	67.25	69.49	70.50
	5.0	1.29	29.38	41.51	50.49	57.46	63.05	67.66	71.55	74.88	77.77	79.08
	8.0	3.14	30.24	43.48	53.63	61.74	68.40	74.01	78.81	82.98	86.65	88.32
	11.0	5.76	30.65	44.43	55.18	63.88	71.13	77.28	82.59	87.24	91.36	93.25
	14.0	9.12	30.89	44.99	56.11	65.18	72.79	79.28	84.92	89.88	94.29	96.32
	17.0	13.23	31.05	45.37	56.73	66.06	73.91	80.65	86.51	91.69	96.30	98.43
3-Row Capacity MBH	3.5	0.83	31.05	44.01	53.46	60.67	66.37	71.00	74.84	78.09	80.88	82.14
	5.0	1.60	31.90	46.06	56.81	65.27	72.13	77.82	82.64	86.78	90.39	92.02
	8.0	3.86	32.66	47.95	59.97	69.73	77.85	84.73	90.66	95.84	100.40	102.50
	11.0	7.02	33.02	48.84	61.51	71.93	80.70	88.22	94.76	100.51	105.63	107.98
	14.0	11.05	33.22	49.37	62.41	73.24	82.42	90.33	97.25	103.37	108.84	111.36
	17.0	15.95	33.36	49.72	63.02	74.11	83.57	91.76	98.94	105.32	111.02	113.66
4-Row Capacity MBH	3.5	1.00	35.26	51.81	64.24	73.81	81.37	87.49	92.55	96.80	100.42	102.03
	5.0	1.92	35.98	53.92	68.04	79.36	88.62	96.32	102.84	108.43	113.28	115.48
	8.0	4.58	36.60	55.77	71.49	84.57	95.61	105.05	113.23	120.40	126.73	129.63
	11.0	8.28	36.88	56.61	73.10	87.04	98.99	109.35	118.43	126.47	133.64	136.95
	14.0	12.98	37.04	57.09	74.03	88.49	100.99	111.91	121.55	130.14	137.85	141.41
	17.0	18.68	37.16	57.41	74.64	89.45	102.31	113.62	123.64	132.60	140.68	144.43

Notes:
1. Fouling Factor = 0.00025 °F·ft²·h/Btu
2. Capacity based on 55°F entering air temperature and 180°F entering water temperature.

Table 12. Heating capacity (MBh) - inlet size 14 (I-P)

Rows	gpm	Water Pressure Drop (ft)	Airflow (cfm)									
			600	1000	1400	1800	2200	2600	3000	3400	3800	4000
1-Row Capacity MBH	2.0	1.13	25.34	32.22	37.40	41.72	45.32	48.41	51.10	53.46	55.57	56.85
	3.0	2.35	26.92	34.91	41.07	46.22	50.79	54.84	58.45	61.69	64.63	66.45
	4.0	3.96	27.78	36.42	43.21	48.99	54.07	58.64	62.86	66.70	70.22	72.41
	5.0	5.96	28.33	37.39	44.60	50.81	56.32	61.29	65.82	70.06	74.00	76.46
	6.0	8.33	28.71	38.06	45.58	52.10	57.92	63.21	68.06	72.55	76.73	79.40
	7.0	11.06	28.98	38.56	46.31	53.06	59.12	64.65	69.75	74.48	78.90	81.68
2-Row Capacity MBH	5.0	1.02	39.00	56.35	68.54	77.63	84.71	90.41	95.11	99.07	102.45	104.46
	9.0	3.13	40.70	60.53	75.32	86.87	96.21	103.96	110.52	116.17	121.09	124.04
	13.0	6.33	41.38	62.27	78.23	90.95	101.40	110.19	117.72	124.26	130.01	133.49
	17.0	10.61	41.75	63.23	79.87	93.27	104.38	113.79	121.91	129.00	135.28	139.08
	21.0	15.96	41.99	63.85	80.92	94.76	106.31	116.14	124.66	132.13	138.76	142.78
	23.0	19.02	42.07	64.08	81.32	95.33	107.05	117.04	125.71	133.33	140.09	144.21
3-Row Capacity MBH	5.0	1.24	43.53	64.87	80.32	92.01	101.18	108.59	114.70	119.86	124.26	126.87
	7.0	2.33	44.48	67.50	84.86	98.44	109.38	118.41	126.02	132.52	138.16	141.52
	9.0	3.74	45.01	69.01	87.53	102.29	114.38	124.48	133.09	140.53	147.04	150.94
	11.0	5.46	45.35	69.98	89.27	104.85	117.73	128.61	137.94	146.05	153.19	157.50
	13.0	7.50	45.59	70.67	90.51	106.67	120.14	131.59	141.46	150.09	157.71	162.33
	15.0	9.84	45.76	71.18	91.44	108.04	121.96	133.84	144.14	153.17	161.18	166.03
	15.0	9.84	45.76	71.18	91.44	108.04	121.96	133.84	144.14	153.17	161.18	166.03
	19.0	15.42	46.00	71.88	92.73	109.97	124.53	137.04	147.95	157.57	166.14	171.35
	21.0	18.67	46.09	72.14	93.20	110.67	125.47	138.22	149.36	159.20	167.98	173.33
	23.0	22.21	46.16	72.35	93.59	111.26	126.26	139.21	150.54	160.57	169.53	174.99
4-Row Capacity MBH	5.0	1.46	47.78	73.53	92.70	107.32	118.79	128.02	135.61	141.95	147.33	150.50
	7.0	2.72	48.59	76.19	97.71	114.80	128.67	140.13	149.78	158.02	165.13	169.37
	9.0	4.35	49.02	77.66	100.56	119.18	134.57	147.51	158.56	168.11	176.46	181.47
	11.0	6.33	49.29	78.59	102.40	122.04	138.48	152.47	164.52	175.02	184.27	189.85
	13.0	8.66	49.48	79.23	103.69	124.05	141.26	156.01	168.81	180.04	189.97	195.99
	15.0	11.33	49.64	79.71	104.64	125.55	143.34	158.68	172.05	183.84	194.32	200.69
	17.0	14.35	49.71	80.07	105.37	126.71	144.96	160.76	174.59	186.83	197.74	204.39
	19.0	17.70	49.80	80.35	105.95	127.63	146.25	162.42	176.63	189.24	200.51	207.39
	21.0	21.38	49.86	80.58	106.42	128.38	147.30	163.79	178.31	191.22	202.79	209.87
	23.0	25.40	49.92	80.78	106.81	129.01	148.18	164.93	179.72	192.89	204.71	211.95

Notes:
1. Fouling Factor = 0.00025 °F·ft²·h/Btu
2. Capacity based on 55°F entering air temperature and 180°F entering water temperature.

Table 13. Heating capacity (MBh) - inlet size 16 (I-P)

Rows	gpm	Water Pressure Drop (ft)	Airflow (cfm)									
			600	1000	1400	1800	2200	2600	3000	3400	3800	4000
1-Row Capacity MBH	2.0	1.25	32.86	40.56	46.53	51.24	55.14	58.43	61.26	63.73	65.91	66.90
	3.0	2.59	35.44	44.58	51.72	57.88	63.13	67.69	71.71	75.30	78.52	80.01
	4.0	4.37	36.88	46.94	54.96	61.77	67.89	73.31	78.17	82.55	86.54	88.40
	5.0	6.56	37.79	48.47	57.10	64.53	71.08	77.08	82.54	87.51	92.07	94.22
	6.0	9.15	38.43	49.55	58.62	66.50	73.50	79.83	85.69	91.11	96.12	98.48
	7.0	12.13	38.90	50.34	59.76	67.98	75.33	82.01	88.14	93.85	99.20	101.74
	8.0	15.50	39.26	50.96	60.64	69.13	76.76	83.73	90.13	96.07	101.63	104.31
2-Row Capacity MBH	5.0	1.08	54.27	73.74	87.13	96.97	104.54	110.57	115.52	119.66	123.18	124.76
	7.0	2.04	56.31	78.10	93.71	105.54	114.88	122.47	128.80	134.16	138.78	140.87
	9.0	3.29	57.49	80.68	97.71	110.87	121.41	130.09	137.39	143.64	149.07	151.53
	11.0	4.82	58.26	82.39	100.40	114.50	125.90	135.38	143.41	150.32	156.36	159.10
	13.0	6.64	58.80	83.61	102.34	117.13	129.19	139.27	147.86	155.28	161.80	164.76
	15.0	8.73	59.20	84.53	103.81	119.14	131.70	142.26	151.29	159.12	166.01	169.16
	17.0	11.10	59.51	85.24	104.96	120.71	133.69	144.62	154.01	162.18	169.38	172.67
	19.0	13.75	59.76	85.82	105.88	121.99	135.30	146.55	156.23	164.67	172.13	175.55
	21.0	16.67	59.96	86.29	106.65	123.04	136.63	148.14	158.07	166.75	174.43	177.95
	23.0	19.86	60.13	86.68	107.28	123.92	137.75	149.49	159.63	168.51	176.37	179.98
3-Row Capacity MBH	5.0	1.33	61.29	85.48	102.45	115.01	124.69	132.40	138.70	143.95	148.40	150.39
	7.0	2.48	63.23	90.09	109.84	125.00	137.04	146.85	155.04	161.98	167.96	170.65
	9.0	3.98	64.32	92.75	114.23	131.08	144.70	155.97	165.49	173.65	180.74	183.95
	11.0	5.80	65.01	94.49	117.14	135.17	149.91	162.24	172.73	181.80	189.73	193.33
	13.0	7.95	65.50	95.71	119.21	138.10	153.68	166.80	178.04	187.80	196.38	200.30
	15.0	10.42	65.85	96.62	120.76	140.31	156.53	170.28	182.10	192.42	201.51	205.68
	15.0	10.42	65.85	96.62	120.76	140.31	156.53	170.28	182.10	192.42	201.51	205.68
	19.0	16.32	66.35	97.88	122.93	143.42	160.58	175.22	187.91	199.04	208.91	213.44
	21.0	19.73	66.52	98.33	123.71	144.55	162.06	177.05	190.06	201.50	211.66	216.33
	23.0	23.46	66.67	98.71	124.37	145.51	163.31	178.58	191.87	203.57	213.98	218.78
4-Row Capacity MBH	5.0	1.58	68.18	97.68	118.67	134.16	146.01	155.34	162.90	169.14	174.39	176.72
	7.0	2.93	69.98	102.65	127.23	146.24	161.34	173.61	183.79	192.38	199.73	203.02
	9.0	4.67	70.95	105.42	132.20	153.46	170.73	185.04	197.09	207.41	216.34	220.38
	11.0	6.79	71.56	107.19	135.42	158.23	177.03	192.81	206.25	217.86	228.00	232.60
	13.0	9.27	71.98	108.41	137.68	161.62	181.55	198.43	212.93	225.53	236.60	241.66
	15.0	12.12	72.28	109.31	139.35	164.14	184.95	202.68	218.00	231.39	243.21	248.62
	17.0	15.33	72.53	110.00	140.64	166.09	187.59	206.01	221.99	236.02	248.45	254.15
	19.0	18.89	72.69	110.54	141.66	167.65	189.70	208.68	225.21	239.76	252.70	258.64
	21.0	22.80	72.84	110.98	142.50	168.93	191.44	210.88	227.86	242.86	256.21	262.36
	23.0	27.07	73.01	111.35	143.19	169.99	192.89	212.71	230.08	245.45	259.17	265.50

Notes:
1. Fouling Factor = 0.00025 °F·ft²·h/Btu
2. Capacity based on 55°F entering air temperature and 180°F entering water temperature.

Table 14. Heating capacity (MBh) - inlet size 16x24 (I-P)

Rows	gpm	Water Pressure Drop (ft)	Airflow (cfm)												
			800	1200	1800	2400	3000	3600	4200	4800	5400	6000	6600	7200	8000
1-Row Capacity MBH	2.0	1.38	39.61	46.73	54.59	60.43	65.04	68.79	71.91	74.56	76.83	78.80	80.54	82.07	83.86
	3.0	2.84	43.29	51.67	61.73	69.73	76.28	81.81	86.54	90.65	94.26	97.47	100.33	102.90	105.96
	4.0	4.78	45.36	54.73	65.89	75.29	83.20	90.01	95.95	101.20	105.88	110.09	113.89	117.34	121.49
	5.0	7.16	46.70	56.73	68.87	78.98	87.87	95.62	102.48	108.60	114.12	119.12	123.68	127.87	132.94
	6.0	9.97	47.63	58.14	71.00	81.78	91.23	99.70	107.26	114.07	120.25	125.89	131.07	135.85	141.68
	7.0	13.21	48.32	59.18	72.59	83.93	93.85	102.80	110.92	118.28	124.99	131.15	136.84	142.11	148.57
	8.0	16.87	48.85	59.99	73.84	85.62	95.98	105.26	113.80	121.61	128.76	135.35	141.46	147.14	154.13
2-Row Capacity MBH	5.0	1.14	68.34	86.06	103.98	116.13	124.98	131.76	137.14	141.53	145.20	148.31	151.00	153.35	156.05
	7.0	2.14	71.52	91.72	113.08	128.18	139.51	148.38	155.56	161.50	166.53	170.85	174.61	177.91	181.76
	9.0	3.45	73.37	95.09	118.70	135.79	148.87	159.26	167.77	174.89	180.97	186.22	190.82	194.88	199.64
	11.0	5.05	74.57	97.33	122.50	141.04	155.40	166.93	176.45	184.48	191.36	197.35	202.61	207.29	212.78
	13.0	6.94	75.42	98.93	125.26	144.87	160.21	172.62	182.94	191.68	199.20	205.78	211.58	216.75	222.83
	15.0	9.13	76.05	100.13	127.34	147.80	163.91	177.03	187.97	197.28	205.33	212.38	218.62	224.20	230.78
	17.0	11.59	76.54	101.06	128.97	150.11	166.84	180.53	191.99	201.77	210.26	217.70	224.31	230.22	237.21
	19.0	14.34	76.94	101.81	130.29	151.98	169.23	183.38	195.28	205.46	214.30	222.08	228.99	235.19	242.54
	21.0	17.38	77.26	102.42	131.38	153.53	171.21	185.76	198.02	208.54	217.69	225.75	232.93	239.37	247.01
	23.0	20.69	77.52	102.94	132.29	154.83	172.87	187.77	200.34	211.14	220.56	228.88	236.28	242.93	250.84
3-Row Capacity MBH	5.0	1.41	77.68	99.68	122.22	137.52	148.61	157.05	163.71	169.12	173.61	177.40	180.66	183.49	186.73
	7.0	2.64	80.85	105.82	132.77	151.99	166.44	177.75	186.88	194.42	200.77	206.21	210.92	215.06	219.86
	9.0	4.22	82.64	109.38	139.13	160.98	177.78	191.18	202.14	211.32	219.13	225.87	231.77	236.97	243.05
	11.0	6.15	83.78	111.70	143.37	167.09	185.61	200.55	212.91	223.34	232.29	240.06	246.90	252.96	260.08
	13.0	8.41	84.58	113.33	146.40	171.50	191.33	207.46	220.90	232.33	242.17	250.77	258.37	265.13	273.10
	15.0	11.02	85.17	114.54	148.68	174.85	195.68	212.76	227.07	239.29	249.87	259.14	267.35	274.69	283.36
	15.0	11.02	85.17	114.54	148.68	174.85	195.68	212.76	227.07	239.29	249.87	259.14	267.35	274.69	283.36
	19.0	17.21	85.98	116.23	151.86	179.57	201.89	220.36	235.97	249.38	261.06	271.36	280.52	288.75	298.50
	21.0	20.80	86.27	116.83	153.02	181.30	204.18	223.18	239.28	253.15	265.27	275.96	285.50	294.07	304.25
	23.0	24.71	86.51	117.34	153.99	182.76	206.11	225.55	242.07	256.34	268.82	279.86	289.72	298.59	309.15
4-Row Capacity MBH	5.0	1.69	87.07	113.91	141.48	159.95	173.12	182.96	190.61	196.72	201.76	205.92	209.47	212.53	216.01
	7.0	3.14	90.21	120.68	154.09	177.94	195.75	209.55	220.57	229.58	237.11	243.50	249.00	253.78	259.29
	9.0	4.99	91.90	124.47	161.53	188.97	210.07	226.81	240.43	251.75	261.32	269.52	276.66	282.92	290.19
	11.0	7.25	92.96	126.89	166.40	196.37	219.87	238.81	254.42	267.55	278.76	288.45	296.93	304.43	313.17
	13.0	9.89	93.68	128.56	169.83	201.67	226.97	247.60	264.78	279.34	291.86	302.76	312.34	320.86	330.84
	15.0	12.91	94.21	129.79	172.37	205.63	232.35	254.32	272.74	288.46	302.05	313.94	324.44	333.79	344.81
	17.0	16.31	94.61	130.73	174.34	208.72	236.56	259.61	279.06	295.72	310.19	322.90	334.17	344.24	356.14
	19.0	20.08	94.92	131.46	175.89	211.19	239.94	263.88	284.18	301.64	316.85	330.25	342.17	352.85	365.49
	21.0	24.23	95.18	132.06	177.16	213.21	242.72	267.41	288.41	306.55	322.39	336.39	348.86	360.06	373.35
	23.0	28.74	95.39	132.56	178.22	214.89	245.05	270.37	291.98	310.69	327.08	341.59	354.54	366.19	380.04

Notes:
1. Fouling Factor = 0.00025 °F·ft²·h/Btu
2. Capacity based on 55°F entering air temperature and 180°F entering water temperature.

Table 15. Temperature correction factors for water pressure drop (ft)

Average Water Temperature	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 16. Temperature correction factors for coil capacity (MBH)

Entering Water Minus Entering Air	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

Table 17. Coil only-water weights

	1-Row Coil			2-Row Coil			3-Row Coil			4-Row Coil		
	Internal Volume		Operating Weight	Internal Volume		Operating Weight	Internal Volume		Operating Weight	Internal Volume		Operating Weight
Inlet Size	(in^3)	(gal)	(lbs)	(in^3)	(gal)	(lbs)	(in^3)	(gal)	(lbs)	(in^3)	(gal)	(lbs)
04	9.37	0.041	5.3	23.68	0.102	6.9	33.52	0.145	23	43.08	0.186	24
05	9.37	0.041	5.3	23.68	0.102	6.9	33.52	0.145	23	43.08	0.186	24
06	9.37	0.041	5.3	23.68	0.102	6.9	33.52	0.145	23	43.08	0.186	24
08	12.78	0.055	5.5	35.47	0.154	9.0	48.89	0.212	24	61.92	0.268	26
10	19.06	0.083	7.7	48.83	0.211	11.7	68.84	0.298	32	88.28	0.382	36
12	30.05	0.130	10.7	67.34	0.292	15.5	98.89	0.428	41	129.54	0.561	45
14	51.21	0.222	13.9	94.27	0.408	19.8	148.04	0.641	51	200.27	0.867	55
16	58.62	0.254	16.2	109.09	0.472	23.3	170.64	0.739	56	230.43	0.998	61
24x16	66.03	0.286	20.4	123.91	0.536	29.8	193.24	0.837	76	260.59	1.128	82

Hot Water Reheat Coil Notes (I-P)

1. Fouling Factor = 0.00025
2. Capacity based on 55°F entering air temperature and 180°F entering water temperature. Refer to correction factors found in Table 15, p. 31 and Table 16, p. 31 for different entering conditions.
3. The following equations may be used in calculating Leaving Air Temperature (LAT) and Water Temperature Difference (WTD).

$$LAT = EAT + \left(\frac{MBH \times 921.7}{Cfm}\right)$$

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

4. For premium coils (.020” wall), side pressure drop increasesx 17% and water velocity increases 7% for fixed GPM.

Table 18. Heating capacity (kW) - inlet size 04, 05, 06 (SI)

Rows	L/s	Water Pressure Drop (kPa)	Airflow (L/s)									
			24	47	71	94	118	142	165	189	212	236
1-Row Capacity MBH	0.03	1.44	1.27	1.75	2.08	2.34	2.56	2.75	2.92	3.08	3.21	3.34
	0.06	4.80	1.36	1.94	2.35	2.69	2.99	3.26	3.50	3.73	3.94	4.13
	0.09	9.78	1.39	2.01	2.46	2.84	3.17	3.48	3.76	4.02	4.27	4.49
	0.13	16.25	1.41	2.05	2.52	2.92	3.27	3.60	3.90	4.19	4.45	4.70
	0.16	24.13	1.42	2.07	2.55	2.97	3.34	3.68	4.00	4.29	4.57	4.84
2-Row Capacity MBH	0.06	1.70	1.62	2.75	3.57	4.19	4.68	5.08	5.41	5.69	5.93	6.13
	0.13	5.86	1.67	2.92	3.89	4.67	5.31	5.85	6.32	6.72	7.08	7.39
	0.19	12.18	1.69	2.98	4.00	4.85	5.55	6.16	6.68	7.14	7.55	7.92
	0.25	20.53	1.69	3.01	4.06	4.94	5.68	6.32	6.88	7.37	7.82	8.21
	0.32	30.83	1.70	3.03	4.10	5.00	5.76	6.42	7.00	7.52	7.98	8.40
3-Row Capacity MBH	0.06	2.46	1.76	3.09	4.09	4.87	5.49	6.00	6.43	6.78	7.09	7.36
	0.13	8.43	1.79	3.23	4.40	5.37	6.17	6.87	7.46	7.98	8.45	8.86
	0.19	17.42	1.81	3.28	4.51	5.54	6.43	7.19	7.86	8.46	8.99	9.47
	0.25	29.24	1.84	3.31	4.57	5.64	6.56	7.36	8.07	8.71	9.28	9.80
	0.32	43.76	1.86	3.33	4.60	5.69	6.64	7.47	8.21	8.87	9.47	10.01
4-Row Capacity MBH	0.06	3.23	1.89	3.41	4.63	5.59	6.37	7.00	7.52	7.97	8.34	8.67
	0.13	10.99	1.90	3.54	4.94	6.12	7.13	8.00	8.76	9.43	10.02	10.55
	0.19	22.66	1.91	3.59	5.04	6.30	7.40	8.37	9.22	9.99	10.67	11.29
	0.25	37.95	1.91	3.62	5.09	6.39	7.54	8.55	9.46	10.28	11.02	11.70
	0.32	56.70	1.91	3.65	5.12	6.45	7.62	8.67	9.61	10.46	11.24	11.95

Note: Refer to the Hot Water Reheat & Coil Notes (SI) at the end of the Performance Data section for fouling factors and LAT/WTD calculating equations.

Table 19. Heating capacity (kW) - inlet size 08 (SI)

Rows	L/s	Water Pressure Drop (kPa)	Airflow (L/s)								
			50	94	142	189	236	283	330	378	425
1-Row Capacity kW	0.03	1.92	2.07	9.19	10.80	12.04	13.04	13.87	14.58	15.19	15.72
	0.06	6.41	2.29	10.61	12.78	14.56	16.11	17.50	18.72	19.82	20.81
	0.09	13.05	2.38	11.18	13.63	15.70	17.51	19.13	20.60	21.97	23.22
	0.13	21.67	2.43	11.49	14.10	16.33	18.31	20.09	21.73	23.24	24.63
	0.16	32.16	2.45	11.68	14.40	16.74	18.83	20.73	22.47	24.09	25.60
2-Row Capacity kW	0.16	1.17	3.17	17.05	21.63	25.03	27.66	29.78	31.53	33.00	34.26
	0.25	2.80	3.26	17.89	23.11	27.13	30.33	32.97	35.18	37.08	38.72
	0.38	5.97	3.31	18.39	24.03	28.45	32.05	35.05	37.60	39.81	41.74
	0.50	10.24	3.33	18.66	24.52	29.17	32.99	36.20	38.95	41.34	43.45
	0.63	15.57	3.35	18.83	24.83	29.62	33.58	36.93	39.81	42.33	44.55
	0.76	21.96	3.36	18.94	25.04	29.94	34.00	37.44	40.42	43.02	45.33

Table 19. Heating capacity (kW) - inlet size 08 (SI) (continued)

Rows	L/s	Water Pressure Drop (kPa)	Airflow (L/s) 50	94	142	189	236	283	330	378	425
3-Row Capacity kW	0.16	1.57	3.50	19.51	25.34	29.76	33.26	36.09	38.44	40.43	42.15
	0.25	3.71	3.57	20.28	26.82	31.97	36.16	39.65	42.61	45.15	47.38
	0.38	7.82	3.61	20.74	27.71	33.32	37.98	41.91	45.29	48.23	50.83
	0.50	13.31	3.63	20.97	28.17	34.04	38.95	43.13	46.75	49.93	52.75
	0.63	20.13	3.64	21.11	28.46	34.49	39.56	43.91	47.68	51.01	53.97
	0.76	28.25	3.65	21.21	28.66	34.80	39.98	44.44	48.33	51.76	54.83
4-Row Capacity kW	0.16	1.98	3.82	22.00	29.26	34.89	39.37	43.03	46.06	48.63	50.84
	0.25	4.62	3.86	22.72	30.80	37.33	42.73	47.25	51.12	54.45	57.37
	0.38	9.67	3.88	23.13	31.69	38.78	44.76	49.87	54.31	58.19	61.63
	0.50	16.38	3.90	23.33	32.14	39.53	45.83	51.27	56.02	60.22	63.97
	0.63	24.68	3.90	23.46	32.42	40.00	46.50	52.14	57.10	61.51	65.45
	0.76	34.55	3.91	23.54	32.61	40.31	46.95	52.74	57.85	62.39	66.47

Note: Refer to the Hot Water Reheat & Coil Notes (SI) at the end of the Performance Data section for fouling factors and LAT/WTD calculating equations.

Table 20. Heating capacity (kW) - inlet size 10 (SI)

Rows	L/s	Water Pressure Drop (kPa)	Airflow (L/s) 94	142	189	236	283	330	378	425	472	566	661
1-Row Capacity kW	0.04	4.79	3.51	4.15	4.67	5.11	5.48	5.80	6.08	6.33	6.55	6.94	7.26
	0.06	8.89	3.76	4.50	5.10	5.62	6.09	6.50	6.88	7.21	7.52	8.06	8.53
	0.09	18.06	3.97	4.81	5.51	6.12	6.66	7.15	7.62	8.05	8.45	9.17	9.81
	0.13	29.97	4.08	4.98	5.74	6.40	7.00	7.55	8.06	8.54	9.00	9.83	10.58
	0.16	44.45	4.15	5.09	5.88	6.59	7.23	7.82	8.37	8.88	9.36	10.26	11.09
2-Row Capacity kW	0.16	3.24	5.72	7.52	8.93	10.07	11.01	11.79	12.47	13.05	13.56	14.42	15.11
	0.25	7.77	5.92	7.91	9.53	10.86	11.99	12.96	13.81	14.55	15.22	16.35	17.28
	0.38	16.59	6.03	8.14	9.88	11.35	12.61	13.70	14.67	15.53	16.30	17.63	18.75
	0.50	28.51	6.09	8.26	10.07	11.61	12.94	14.11	15.14	16.07	16.90	18.35	19.58
	0.63	43.44	6.13	8.34	10.19	11.77	13.15	14.36	15.44	16.40	17.28	18.81	20.11
3-Row Capacity kW	0.16	3.92	6.36	8.56	10.32	11.75	12.95	13.96	14.82	15.58	16.24	17.34	18.24
	0.25	9.29	6.54	8.94	10.92	12.60	14.03	15.28	16.37	17.33	18.20	19.67	20.89
	0.38	19.70	6.64	9.15	11.28	13.10	14.69	16.09	17.33	18.44	19.45	21.19	22.66
	0.50	33.67	6.69	9.26	11.46	13.37	15.04	16.52	17.85	19.04	20.12	22.02	23.63
	0.63	51.10	6.72	9.33	11.57	13.53	15.25	16.79	18.17	19.42	20.55	22.55	24.26
4-Row kW MBH	0.16	5.26	6.99	9.63	11.78	13.57	15.06	16.32	17.41	18.34	19.17	20.53	21.63
	0.25	12.35	7.14	9.99	12.42	14.50	16.31	17.88	19.27	20.50	21.60	23.48	25.04
	0.38	25.92	7.24	10.18	12.77	15.04	17.04	18.81	20.40	21.83	23.13	25.39	27.29
	0.50	44.01	7.27	10.28	12.95	15.31	17.41	19.29	20.99	22.54	23.94	26.42	28.53
	0.63	66.45	7.28	10.34	13.06	15.47	17.64	19.59	21.36	22.97	24.45	27.06	29.31

Refer to the Hot Water Reheat & Coil Notes (SI) at the end of the Performance Data section for fouling factors and LAT/WTD calculating equations.

Table 21. Heating capacity (kW) - inlet size 12 (SI)

Rows	L/s	Water Pressure Drop (kPa)	Airflow (L/s)									
			142	236	330	425	519	613	708	802	897	944
1-Row Capacity kW	0.06	1.86	4.99	6.12	6.97	7.64	8.19	8.65	9.04	9.39	9.69	9.82
	0.13	6.48	5.66	7.17	8.34	9.34	10.23	11.02	11.72	12.35	12.93	13.20
	0.19	13.55	5.92	7.60	8.95	10.12	11.15	12.08	12.94	13.74	14.47	14.82
	0.25	22.94	6.06	7.84	9.29	10.55	11.69	12.72	13.67	14.55	15.37	15.77
	0.32	34.58	6.15	7.99	9.50	10.83	12.04	13.14	14.15	15.10	15.99	16.41
2-Row Capacity kW	0.22	1.97	8.34	11.56	13.85	15.58	16.94	18.03	18.94	19.71	20.37	20.66
	0.32	3.85	8.61	12.17	14.80	16.84	18.48	19.83	20.97	21.94	22.79	23.17
	0.50	9.38	8.86	12.74	15.72	18.09	20.05	21.69	23.10	24.32	25.39	25.89
	0.69	17.20	8.98	13.02	16.17	18.72	20.85	22.65	24.21	25.57	26.77	27.33
	0.88	27.27	9.05	13.19	16.44	19.10	21.33	23.24	24.89	26.34	27.63	28.23
	1.07	39.55	9.10	13.30	16.63	19.36	21.66	23.63	25.35	26.87	28.22	28.85
3-Row Capacity kW	0.22	2.48	9.10	12.90	15.67	17.78	19.45	20.81	21.93	22.89	23.70	24.07
	0.32	4.80	9.35	13.50	16.65	19.13	21.14	22.81	24.22	25.43	26.49	26.97
	0.50	11.53	9.57	14.05	17.58	20.44	22.82	24.83	26.57	28.09	29.43	30.04
	0.69	20.97	9.68	14.31	18.03	21.08	23.65	25.85	27.77	29.46	30.96	31.65
	0.88	33.04	9.74	14.47	18.29	21.46	24.15	26.47	28.50	30.30	31.90	32.64
	1.07	47.68	9.78	14.57	18.47	21.72	24.49	26.89	29.00	30.86	32.54	33.31
4-Row Capacity kW	0.22	2.99	10.33	15.18	18.83	21.63	23.85	25.64	27.12	28.37	29.43	29.90
	0.32	5.74	10.55	15.80	19.94	23.26	25.97	28.23	30.14	31.78	33.20	33.84
	0.50	13.68	10.73	16.34	20.95	24.78	28.02	30.79	33.18	35.28	37.14	37.99
	0.69	24.74	10.81	16.59	21.42	25.51	29.01	32.05	34.71	37.06	39.17	40.14
	0.88	38.81	10.86	16.73	21.70	25.93	29.60	32.80	35.62	38.14	40.40	41.44
	1.07	55.82	10.89	16.82	21.88	26.21	29.99	33.30	36.24	38.86	41.23	42.33

Note: Refer to the Hot Water Reheat & Coil Notes (SI) at the end of the Performance Data section for fouling factors and LAT/WTD calculating equations.

Table 22. Heating capacity (kW) - inlet size 14 (SI)

Rows	L/s	Water Pressure Drop (kPa)	Airflow (L/s)									
			283	472	661	849	1038	1227	1416	1604	1793	1888
1-Row Capacity kW	0.13	3.37	7.43	9.44	10.96	12.23	13.28	14.19	14.97	15.67	16.29	16.66
	0.19	7.02	7.89	10.23	12.04	13.54	14.88	16.07	17.13	18.08	18.94	19.47
	0.25	11.85	8.14	10.67	12.66	14.36	15.85	17.18	18.42	19.55	20.58	21.22
	0.32	17.81	8.30	10.96	13.07	14.89	16.50	17.96	19.29	20.53	21.69	22.41
	0.38	24.89	8.41	11.16	13.36	15.27	16.97	18.52	19.95	21.26	22.49	23.27
	0.44	33.04	8.49	11.30	13.57	15.55	17.33	18.95	20.44	21.83	23.12	23.94
2-Row Capacity kW	0.32	3.05	11.43	16.52	20.09	22.75	24.83	26.50	27.87	29.03	30.03	30.61
	0.57	9.35	11.93	17.74	22.07	25.46	28.20	30.47	32.39	34.04	35.49	36.35
	0.82	18.93	12.13	18.25	22.93	26.66	29.72	32.29	34.50	36.42	38.10	39.12
	1.07	31.73	12.24	18.53	23.41	27.33	30.59	33.35	35.73	37.81	39.65	40.76
	1.33	47.69	12.30	18.71	23.71	27.77	31.16	34.04	36.53	38.72	40.67	41.85
	1.45	56.86	12.33	18.78	23.83	27.94	31.37	34.30	36.84	39.07	41.06	42.26
3-Row Capacity kW	0.32	3.70	12.76	19.01	23.54	26.97	29.65	31.82	33.62	35.13	36.42	37.18
	0.44	6.96	13.04	19.78	24.87	28.85	32.06	34.70	36.93	38.84	40.49	41.48
	0.57	11.17	13.19	20.22	25.65	29.98	33.52	36.48	39.01	41.19	43.09	44.24
	0.69	16.33	13.29	20.51	26.16	30.73	34.50	37.69	40.43	42.80	44.90	46.16
	0.82	22.40	13.36	20.71	26.53	31.26	35.21	38.56	41.46	43.99	46.22	47.57
	0.95	29.40	13.41	20.86	26.80	31.66	35.74	39.23	42.24	44.89	47.24	48.66
	0.95	29.40	13.41	20.86	26.80	31.66	35.74	39.23	42.24	44.89	47.24	48.66
	1.20	46.10	13.48	21.07	27.18	32.23	36.50	40.16	43.36	46.18	48.69	50.22
	1.33	55.80	13.51	21.14	27.31	32.43	36.77	40.51	43.77	46.66	49.23	50.80
	1.45	66.38	13.53	21.20	27.43	32.61	37.00	40.80	44.12	47.06	49.68	51.29
4-Row Capacity kW	0.32	4.36	14.00	21.55	27.17	31.45	34.82	37.52	39.74	41.60	43.18	44.11
	0.44	8.13	14.24	22.33	28.64	33.65	37.71	41.07	43.90	46.31	48.40	49.64
	0.57	12.99	14.37	22.76	29.47	34.93	39.44	43.23	46.47	49.27	51.72	53.18
	0.69	18.92	14.45	23.03	30.01	35.77	40.59	44.68	48.21	51.29	54.00	55.64
	0.82	25.88	14.50	23.22	30.39	36.36	41.40	45.72	49.47	52.76	55.68	57.44
	0.95	33.87	14.55	23.36	30.67	36.80	42.01	46.50	50.42	53.88	56.95	58.82
	1.07	42.88	14.57	23.47	30.88	37.13	42.48	47.11	51.17	54.75	57.95	59.90
	1.20	52.89	14.60	23.55	31.05	37.40	42.86	47.60	51.77	55.46	58.76	60.78
	1.33	63.91	14.61	23.62	31.19	37.63	43.17	48.00	52.26	56.04	59.43	61.51
	1.45	75.91	14.63	23.67	31.30	37.81	43.43	48.34	52.67	56.53	59.99	62.12

Note: Refer to the Hot Water Reheat & Coil Notes (SI) at the end of the Performance Data section for fouling factors and LAT/WTD calculating equations.

Table 23. Heating capacity (kW) - inlet size 16 (SI)

Rows	L/s	Water Pressure Drop (kPa)	Airflow (L/s)									
			283	472	661	849	1038	1227	1416	1604	1793	1888
1-Row Capacity kW	0.13	3.74	9.63	11.89	13.64	15.02	16.16	17.12	17.95	18.68	19.32	19.61
	0.19	7.76	10.39	13.07	15.16	16.96	18.50	19.84	21.02	22.07	23.01	23.45
	0.25	13.06	10.81	13.76	16.11	18.10	19.90	21.49	22.91	24.19	25.36	25.91
	0.32	19.60	11.08	14.21	16.74	18.91	20.83	22.59	24.19	25.65	26.98	27.61
	0.38	27.34	11.26	14.52	17.18	19.49	21.54	23.40	25.11	26.70	28.17	28.86
	0.44	36.27	11.40	14.75	17.51	19.92	22.08	24.04	25.83	27.50	29.07	29.82
	0.50	46.33	11.51	14.94	17.77	20.26	22.50	24.54	26.42	28.16	29.79	30.57
2-Row Capacity kW	0.32	3.22	15.90	21.61	25.54	28.42	30.64	32.41	33.86	35.07	36.10	36.56
	0.44	6.10	16.50	22.89	27.46	30.93	33.67	35.89	37.75	39.32	40.67	41.28
	0.57	9.83	16.85	23.64	28.64	32.49	35.58	38.12	40.27	42.10	43.69	44.41
	0.69	14.42	17.07	24.15	29.43	33.56	36.90	39.67	42.03	44.06	45.82	46.63
	0.82	19.84	17.23	24.50	29.99	34.33	37.86	40.82	43.33	45.51	47.42	48.29
	0.95	26.10	17.35	24.77	30.42	34.92	38.60	41.69	44.34	46.63	48.65	49.58
	1.07	33.19	17.44	24.98	30.76	35.38	39.18	42.39	45.14	47.53	49.64	50.61
	1.20	41.09	17.51	25.15	31.03	35.75	39.65	42.95	45.79	48.26	50.45	51.45
	1.33	49.81	17.57	25.29	31.25	36.06	40.04	43.42	46.33	48.87	51.12	52.15
	1.45	59.35	17.62	25.40	31.44	36.32	40.37	43.81	46.78	49.38	51.69	52.75
3-Row Capacity kW	0.32	3.96	17.96	25.05	30.03	33.71	36.54	38.80	40.65	42.19	43.49	44.08
	0.44	7.42	18.53	26.40	32.19	36.63	40.16	43.04	45.44	47.47	49.22	50.01
	0.57	11.89	18.85	27.18	33.48	38.42	42.41	45.71	48.50	50.89	52.97	53.91
	0.69	17.35	19.05	27.69	34.33	39.61	43.93	47.55	50.62	53.28	55.60	56.66
	0.82	23.77	19.20	28.05	34.94	40.47	45.04	48.88	52.18	55.04	57.55	58.70
	0.95	31.16	19.30	28.32	35.39	41.12	45.88	49.90	53.37	56.39	59.06	60.28
	0.95	31.16	19.30	28.32	35.39	41.12	45.88	49.90	53.37	56.39	59.06	60.28
	1.20	48.77	19.44	28.69	36.03	42.03	47.06	51.35	55.07	58.33	61.22	62.55
	1.33	58.98	19.50	28.82	36.26	42.36	47.50	51.89	55.70	59.05	62.03	63.40
	1.45	70.12	19.54	28.93	36.45	42.64	47.86	52.34	56.23	59.66	62.71	64.12
4-Row Capacity kW	0.32	4.71	19.98	28.63	34.78	39.32	42.79	45.53	47.74	49.57	51.11	51.79
	0.44	8.76	20.51	30.08	37.29	42.86	47.28	50.88	53.86	56.38	58.53	59.50
	0.57	13.96	20.79	30.90	38.74	44.97	50.04	54.23	57.76	60.79	63.40	64.59
	0.69	20.28	20.97	31.41	39.69	46.37	51.88	56.51	60.45	63.85	66.82	68.17
	0.82	27.71	21.09	31.77	40.35	47.36	53.21	58.15	62.40	66.10	69.34	70.82
	0.95	36.23	21.18	32.04	40.84	48.10	54.20	59.40	63.89	67.81	71.28	72.86
	1.07	45.81	21.26	32.24	41.22	48.68	54.98	60.37	65.06	69.17	72.81	74.48
	1.20	56.46	21.30	32.40	41.52	49.13	55.60	61.16	66.00	70.27	74.06	75.80
	1.33	68.16	21.35	32.53	41.76	49.51	56.11	61.80	66.78	71.17	75.09	76.89
	1.45	80.90	21.40	32.63	41.96	49.82	56.53	62.34	67.43	71.94	75.96	77.81

Note: Refer to the Hot Water Reheat & Coil Notes (SI) at the end of the Performance Data section for fouling factors and LAT/WTD calculating equations.

Table 24. Heating capacity (kW) - inlet size 16x24 (SI)

Rows	L/s	Water Pressure Drop (kPa)	Airflow (L/s) 378	566	849	1133	1416	1699	1982	2265	2548	2831	3115	3398	3775
1-Row Capacity kW	0.13	4.11	11.61	13.70	16.00	17.71	19.06	20.16	21.08	21.85	22.52	23.09	23.60	24.05	24.58
	0.19	8.50	12.69	15.14	18.09	20.44	22.36	23.98	25.36	26.57	27.63	28.57	29.40	30.16	31.05
	0.25	14.27	13.29	16.04	19.31	22.07	24.38	26.38	28.12	29.66	31.03	32.26	33.38	34.39	35.61
	0.32	21.39	13.69	16.63	20.18	23.15	25.75	28.02	30.03	31.83	33.44	34.91	36.25	37.47	38.96
	0.38	29.81	13.96	17.04	20.81	23.97	26.74	29.22	31.44	33.43	35.24	36.89	38.41	39.81	41.52
	0.44	39.50	14.16	17.34	21.27	24.60	27.50	30.13	32.51	34.66	36.63	38.44	40.10	41.65	43.54
	0.50	50.42	14.32	17.58	21.64	25.09	28.13	30.85	33.35	35.64	37.74	39.67	41.46	43.12	45.17
2-Row Capacity kW	0.32	3.40	20.03	25.22	30.47	34.03	36.63	38.61	40.19	41.48	42.55	43.47	44.25	44.94	45.73
	0.44	6.41	20.96	26.88	33.14	37.57	40.89	43.49	45.59	47.33	48.81	50.07	51.17	52.14	53.27
	0.57	10.31	21.50	27.87	34.79	39.80	43.63	46.68	49.17	51.26	53.04	54.57	55.92	57.11	58.51
	0.69	15.10	21.85	28.52	35.90	41.33	45.54	48.92	51.71	54.07	56.08	57.84	59.38	60.75	62.36
	0.82	20.76	22.10	28.99	36.71	42.46	46.95	50.59	53.61	56.17	58.38	60.31	62.01	63.52	65.31
	0.95	27.28	22.29	29.34	37.32	43.32	48.04	51.88	55.09	57.82	60.18	62.24	64.07	65.71	67.63
	1.07	34.65	22.43	29.62	37.80	43.99	48.90	52.91	56.27	59.13	61.62	63.80	65.74	67.47	69.52
	1.20	42.87	22.55	29.84	38.18	44.54	49.60	53.74	57.23	60.21	62.81	65.09	67.11	68.93	71.08
	1.33	51.94	22.64	30.02	38.50	44.99	50.18	54.44	58.03	61.12	63.80	66.16	68.26	70.15	72.39
	1.45	61.84	22.72	30.17	38.77	45.38	50.66	55.03	58.71	61.88	64.64	67.08	69.25	71.20	73.51
3-Row Capacity kW	0.32	4.23	22.77	29.21	35.82	40.30	43.55	46.03	47.98	49.56	50.88	51.99	52.95	53.78	54.73
	0.44	7.89	23.70	31.01	38.91	44.54	48.78	52.09	54.77	56.98	58.84	60.43	61.82	63.03	64.43
	0.57	12.62	24.22	32.06	40.78	47.18	52.10	56.03	59.24	61.93	64.22	66.20	67.92	69.45	71.23
	0.69	18.37	24.55	32.74	42.02	48.97	54.40	58.78	62.40	65.46	68.08	70.36	72.36	74.14	76.22
	0.82	25.15	24.79	33.21	42.91	50.26	56.07	60.80	64.74	68.09	70.97	73.49	75.72	77.70	80.04
	0.95	32.92	24.96	33.57	43.57	51.24	57.35	62.35	66.55	70.13	73.23	75.95	78.35	80.50	83.04
	0.95	32.92	24.96	33.57	43.57	51.24	57.35	62.35	66.55	70.13	73.23	75.95	78.35	80.50	83.04
	1.20	51.44	25.20	34.06	44.51	52.63	59.17	64.58	69.15	73.09	76.51	79.53	82.21	84.62	87.48
	1.33	62.17	25.28	34.24	44.85	53.14	59.84	65.41	70.13	74.19	77.74	80.88	83.67	86.18	89.17
	1.45	73.87	25.35	34.39	45.13	53.56	60.40	66.10	70.94	75.13	78.78	82.02	84.91	87.51	90.60
4-Row Capacity kW	0.32	5.06	25.52	33.38	41.46	46.88	50.74	53.62	55.86	57.65	59.13	60.35	61.39	62.29	63.31
	0.44	9.39	26.44	35.37	45.16	52.15	57.37	61.41	64.64	67.28	69.49	71.36	72.97	74.38	75.99
	0.57	14.93	26.93	36.48	47.34	55.38	61.57	66.47	70.46	73.78	76.58	78.99	81.08	82.92	85.04
	0.69	21.66	27.24	37.19	48.77	57.55	64.44	69.99	74.56	78.41	81.70	84.54	87.02	89.22	91.78
	0.82	29.55	27.46	37.68	49.77	59.10	66.52	72.56	77.60	81.87	85.54	88.73	91.54	94.03	96.96
	0.95	38.58	27.61	38.04	50.52	60.27	68.09	74.53	79.93	84.54	88.52	92.01	95.08	97.83	101.05
	1.07	48.75	27.73	38.31	51.09	61.17	69.33	76.08	81.78	86.67	90.91	94.63	97.94	100.89	104.37
	1.20	60.03	27.82	38.53	51.55	61.89	70.32	77.34	83.28	88.40	92.86	96.79	100.28	103.41	107.11
	1.33	72.42	27.89	38.70	51.92	62.48	71.14	78.37	84.53	89.84	94.48	98.59	102.24	105.52	109.42
	1.45	85.91	27.96	38.85	52.23	62.98	71.82	79.24	85.57	91.05	95.86	100.11	103.90	107.32	111.38

Note: Refer to the Hot Water Reheat & Coil Notes (SI) at the end of the Performance Data section for fouling factors and LAT/WTD calculating equations.

Table 25. Temperature correction factors for water pressure drop (kPa)

Average Water Temperature	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 26. Temperature correction factors for coil capacity (kW)

Entering Water Minus Entering Air	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

Table 27. Coil only-water weights (SI)

	1-Row Coil			2-Row Coil			3-Row Coil			4-Row Coil		
Inlet Size	Internal Volume (cm^3)	Internal Volume (liter)	Operating Weight (kg)	Internal Volume (cm^3)	Internal Volume (liter)	Operating Weight (kg)	Internal Volume (cm^3)	Internal Volume (liter)	Operating Weight (kg)	Internal Volume (cm^3)	Internal Volume (liter)	Operating Weight (kg)
04	153.6	0.154	2.421	388.0	0.388	3.12	549.3	0.549	10.44	705.9	0.706	10.90
05	153.6	0.154	2.421	388.0	0.388	3.12	549.3	0.549	10.44	705.9	0.706	10.90
06	153.6	0.154	2.421	388.0	0.388	3.12	549.3	0.549	10.44	705.9	0.706	10.90
08	209.4	0.209	2.477	581.3	0.580	4.099	801.1	0.801	10.90	1014.8	1.015	11.80
10	312.4	0.312	3.487	800.1	0.799	5.294	1128.1	1.128	14.53	1446.7	1.447	16.34
12	492.5	0.493	4.853	1103.0	1.101	7.026	1620.6	1.621	18.61	2122.8	2.123	20.43
14	839.1	0.839	6.309	1545.0	1.542	8.965	2425.9	2.426	23.15	3281.9	3.282	24.97
16	960.6	0.961	7.337	1788.0	1.784	10.57	2796.3	2.796	25.42	3776.1	3.776	27.69
24x16	1082.0	1.082	9.273	2030.0	2.027	13.53	3166.6	3.167	34.50	4270.3	4.270	37.23

Hot Water Reheat Coil Notes (SI)

1. Fouling Factor = 0.00025
2. Capacity based on 12°C entering air temperature and 82°C entering water temperature. Refer to correction factors found in Table 15, p. 31 and Table 16, p. 31 for different entering conditions.
3. The following equations may be used in calculating Leaving Air Temperature (LAT) and Water Temperature Difference (WTD).

LAT = EAT + (kW x 0.83 / L/s)

WTD = EWT - LWT = (kW / (4.19) L/s)

4. For premium coils (.020” wall), side pressure drop increases x 17% and water velocity increases 7% for fixed GPM.

Electrical Data

Table 28. VCEF electric coil kW guidelines - minimum to maximum

		Single-Phase Voltage					Three-Phase Voltage			
Inlet Size	Stages	120V	208V/240V	277V	347V	480V	208V	480V	575V[(a)]	380V/50 Hz
04	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-	1.0
	2	1.0	1.0	1.0	1.0	-	1.0	1.0	-	1.0
	3	1.0	1.0	1.0	-	-	1.0	-	-	-
05	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
06	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	4.0	2.0-4.0
08	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[(a)]	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 mercury contactors, load carrying P.E switches, and P.E. switch with magnetic or mercury 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 29. Minimum and maximum airflow per inlet size and kW

		I-P		SI	
Inlet size	kW	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
	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
	2.5	187	900	88	425
	3.0	210	900	99	425
	3.5	245	900	115	425
	4.0	280	900	132	425
	4.5	315	900	148	425
	5.0	349	900	165	425
	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
	2.5	215	1400	101	661
	3.0	240	1400	113	661
	3.5	265	1400	125	661
	4.0	290	1400	137	661
	4.5	315	1400	149	661
	5.0	349	1400	165	661
	5.5	384	1400	181	661
	6.0	419	1400	198	661
	6.5	454	1400	214	661
	7.0	489	1400	231	661
	7.5	524	1400	247	661
	8.0	559	1400	264	661
	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
	10.0	699	2000	330	944
	11.0	769	2000	363	944
	12.0	839	2000	396	944
	13.0	909	2000	429	944
	14.0	978	2000	462	944
	15.0	1048	2000	495	944
	16.0	1118	2000	528	944

Table 29. Minimum and maximum airflow per inlet size and kW (continued)

		I-P		SI	
Inlet size	kW	Min Heat cfm	Max cfm	Min L/s	Max L/s
14	1.0 - 9.0	685	3000	323	1416
	10.0	731	3000	345	1416
	11.0	769	3000	363	1416
	12.0	839	3000	396	1416
	13.0	909	3000	429	1416
	14.0	978	3000	462	1416
	15.0	1048	3000	495	1416
	16.0	1118	3000	528	1416
	17.0	1188	3000	561	1416
	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
	15.0	1048	4000	495	1888
	16.0	1118	4000	528	1888
	17.0	1188	4000	561	1888
	18.0	1258	4000	594	1888
	20.0	1398	4000	660	1888
	22.0	1538	4000	726	1888
	24.0	1677	4000	792	1888
	26.0	1817	4000	858	1888
	28.0	1957	4000	924	1888
	30.0	2097	4000	990	1888
16 x 24	1.0 - 22.0	1688	8000	797	3776
	24.0	1755	8000	828	3776
	26.0	1817	8000	858	3776
	28.0	1957	8000	924	3776
	30.0	2097	8000	990	3776
	32.0	2236	8000	1055	3776
	34.0	2376	8000	1121	3776
	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 30. Discharge air reset parameter setup

		I-P				SI			
Inlet Size	kW	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 & Max) ΔT	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 & 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
	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

Table 30. Discharge air reset parameter setup (continued)

		I-P				SI			
Inlet Size	kW	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 & Max) ΔT	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 & Max) ΔT
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
	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
	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
	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
	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
	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
	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
	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
	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
	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
	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
	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
	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
	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
	12.0	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
	15.0	240 - 1000	240	1000	45	113 - 472	113	472	25
	16.0	240 - 1000	240	1000	45	113 - 472	113	472	25

Table 30. Discharge air reset parameter setup (continued)

		I-P				SI			
Inlet Size	kW	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 & Max) ΔT	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 & Max) ΔT
	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
	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
	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
	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
	7.0	320 - 1500	320	685	32	151 - 708	151	323	18
14	7.5	320 - 1500	320	685	34	151 - 708	151	323	19
	8.0	320 - 1500	320	685	37	151 - 708	151	323	20
	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
	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
	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
	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 30. Discharge air reset parameter setup (continued)

		I-P				SI			
Inlet Size	kW	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 & Max) ΔT	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 & 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
	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
	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
	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
	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
	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
	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
	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
	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
	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

Table 30. Discharge air reset parameter setup (continued)

		I-P				SI			
Inlet Size	kW	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 & Max) ΔT	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 & Max) ΔT
	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
	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
	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
	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
	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
	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
16 x 24	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
	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
	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
	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
	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
	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
- However since MOP is less than or equal to MCA, then choose next fuse greater than MCA.
- Units without electric reheat would use smallest fuse sizing.

Standard Fuse Sizes: 15, 20, 25, 30, 35, 40, 45, 50, and 60.
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
15x1000/480x1.73=18.06
MCA = 18.06 x 1.25 = 22.58 amps. Since MOP is less than or equal to MCA, then MOP = 25.

Useful Formulas

$$kW = \frac{Cfm \times ATD}{3145}$$

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

$$ATD = \frac{kW \times 3145}{Cfm}$$

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

kW = 1214 X L/s X ATD
ATD = kW / 1214 X L/s

Table 31. Discharge sound power (dB)[1, 2, 4]Perf

Inlet Size			0.5" Inlet Pressure ΔPs[5]						1.0" Inlet Pressure ΔPs[5]						1.5" Inlet Pressure ΔPs[3]						2.0" Inlet Pressure ΔPs[5]						3.0" Inlet Pressure ΔPs[5]					
(in)	Cfm	l/s	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	65	61	46	44	40	37	66	65	53	51	47	46							68	70	61	60	60	56	69	73	67	66	64	61
	120	57	68	64	49	48	43	41	72	69	55	53	49	47							72	73	64	60	57	55	73	76	71	68	63	60
	150	71	68	64	49	49	45	42	73	70	56	54	51	49	75	74	61	58	55	53	75	76	65	61	58	56	76	76	72	68	64	61
	225	106	73	68	54	54	50	49	78	75	61	59	55	54							81	81	68	64	61	59	80	82	73	69	65	63
5	130	61	60	56	45	43	41	38	63	62	52	50	48	47							65	68	61	59	58	55	67	72	69	66	63	60
	200	94	63	59	48	47	43	40	67	65	56	53	50	49							70	71	64	61	58	56	69	73	70	67	63	61
	250	118	65	61	49	49	44	42	70	67	57	55	52	50	71	70	61	57	55	54	73	73	64	60	58	57	73	75	72	69	63	61
	350	165	67	63	54	53	48	47	74	69	59	57	53	53							78	76	67	62	59	58	78	78	73	69	64	63
6	200	94	60	57	46	44	41	38	64	63	55	52	49	47							66	70	64	60	58	55	68	74	72	67	63	60
	300	142	64	60	48	48	44	41	67	65	56	53	50	48							71	71	65	61	58	56	72	75	72	69	64	62
	400	189	65	60	51	49	44	42	71	67	58	55	51	50	73	71	63	59	56	55	74	73	66	61	58	57	76	76	73	68	63	62
	500	236	69	64	55	53	49	47	73	69	61	58	53	53							77	75	69	63	60	59	79	78	73	69	64	63
8	350	165	61	57	48	45	44	40	64	64	54	51	50	53							68	71	62	58	58	60	71	76	71	66	63	61
	520	245	63	59	51	48	45	42	66	66	57	53	52	56							71	74	65	61	60	66	73	76	72	66	65	66
	700	330	65	60	54	51	48	44	69	67	60	56	53	57	71	71	63	59	58	60	73	74	67	62	61	64	75	77	74	68	66	69
	900	425	68	63	57	56	52	49	72	68	62	59	56	57							77	75	69	64	62	65	79	78	74	68	67	68
10	550	260	59	54	53	51	45	40	64	62	58	57	53	48							70	68	65	66	62	58	72	71	70	71	66	62
	820	387	62	57	55	51	46	42	67	64	61	60	55	52							72	70	66	66	62	60	75	74	70	70	66	63
	1100	519	66	60	58	54	49	46	71	67	64	61	56	53	75	70	67	66	61	57	76	72	68	68	63	60	78	75	73	71	67	64
	1400	661	70	63	62	58	53	51	75	68	65	62	57	54							79	74	70	66	63	60	80	77	73	70	67	64
12	800	378	59	54	52	49	47	41	64	61	57	55	55	52							71	69	65	63	63	61	72	71	68	67	67	64
	1200	566	61	56	54	50	49	43	67	64	60	57	57	55							73	71	67	63	64	62	77	75	71	68	68	66
	1600	755	64	59	58	53	52	46	69	66	62	58	57	56	73	71	66	61	62	60	75	73	69	64	65	63	78	77	73	69	69	66
	2000	944	68	62	61	56	56	51	73	69	65	61	60	59							78	75	70	65	65	64	81	77	74	69	69	67
14	1100	519	58	53	51	46	44	39	64	61	57	54	53	51							69	72	66	62	61	59	72	73	71	67	66	63
	1600	755	61	56	55	49	46	41	67	62	60	56	54	51							71	71	67	63	62	61	74	76	72	67	67	64
	2100	991	64	60	59	52	49	44	69	66	63	57	54	52	72	69	66	61	59	58	73	72	69	64	62	61	76	74	73	68	67	64
	3000	1416	70	66	67	57	55	52	75	71	68	61	58	58							80	77	72	66	64	61	81	78	75	70	69	66
16	1400	661	57	53	51	47	46	40	63	61	58	55	55	51							69	72	67	63	63	62	72	76	73	69	67	66
	2100	991	60	56	55	51	49	43	66	63	60	57	55	52							71	71	68	64	64	61	73	76	73	70	68	66
	2800	1321	64	61	61	54	51	48	69	66	64	58	57	54	72	69	67	62	61	60	72	72	70	65	64	63	75	74	73	70	69	65
	4000	1888	71	68	68	63	57	54	74	71	70	63	61	59							78	76	73	68	65	64	80	77	76	72	70	67
24 x 16	2700	1274	71	68	61	58	54	50	75	72	67	65	62	58							77	76	73	71	68	65	78	78	76	75	72	69
	4000	1888	73	71	65	62	58	54	77	76	71	68	65	61							81	80	77	75	72	68	82	82	80	78	76	72
	5300	2501	72	71	67	64	61	58	78	77	75	71	67	63	80	80	78	75	71	68	81	83	81	78	74	70	84	85	84	81	78	74
	6000	2832	71	71	68	65	62	60	78	77	76	72	68	65							82	83	83	79	75	71	84	86	86	82	79	75
	7500	3540	70	71	70	67	63	63	79	77	77	73	70	68							83	84	88	81	76	73	85	87	90	84	80	76
	8000	3776	70	71	71	68	64	64	79	77	78	74	71	69							83	84	89	82	77	74	85	87	91	85	81	77

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. Data in this column constitute AHRI 880-2011 Standard Rating Conditions
4. Where ΔPs is the inlet static pressure minus discharge static.
5. Application ratings are outside the scope of the certification program.

Table 32. Radiated sound power (dB)[1, 2, 4]

Inlet Size (in)	Cfm	l/s	0.5" Inlet Pressure ΔPs[5]						1.0" Inlet Pressure ΔPs[5]						1.5" Inlet Pressure ΔPs[3]						2.0" Inlet Pressure ΔPs[5]						3.0" Inlet Pressure ΔPs[5]					
			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	48	45	40	33	31	23	48	47	43	37	34	25							48	51	53	47	43	35	46	52	60	54	48	42
	120	57	47	45	40	33	30	23	49	48	45	38	34	27							50	51	54	46	42	36	51	54	60	52	47	42
	150	71	47	45	41	35	30	24	51	49	46	39	35	28	52	52	50	43	39	33	52	53	55	47	43	37	51	56	61	53	48	42
	225	106	52	49	44	40	35	30	57	54	49	43	39	33							60	59	57	48	45	39	59	61	63	54	49	44
5	130	61	47	44	35	29	24	21	48	45	41	35	30	25							48	48	50	45	39	33	48	51	58	51	45	40
	200	94	48	45	38	32	25	22	49	47	43	37	32	26							50	52	52	45	39	35	50	55	58	51	45	40
	250	118	48	44	40	34	27	23	50	48	45	38	33	27	52	50	49	42	37	31	52	53	53	44	40	35	53	56	60	52	44	40
	350	165	51	47	44	38	31	26	55	51	47	41	35	31							59	56	55	47	41	37	56	58	60	51	44	40
6	200	94	52	46	38	31	25	22	50	47	43	36	31	26							52	51	52	43	38	33	51	55	59	50	44	40
	300	142	52	48	41	33	25	22	55	50	46	38	32	27							56	53	53	44	38	35	57	57	60	50	44	39
	400	189	55	49	44	36	28	24	56	53	48	40	33	28	58	54	51	43	37	32	59	56	55	46	40	35	59	58	60	50	43	40
	500	236	55	49	47	40	32	27	59	54	51	43	36	31							62	59	57	47	41	36	63	60	61	52	44	40
8	350	165	46	42	38	31	27	22	48	45	43	36	35	27							54	52	53	42	41	36	56	58	64	52	46	42
	520	245	49	43	41	35	31	24	51	48	47	39	37	29							55	54	54	45	43	38	56	57	63	51	47	44
	700	330	50	46	44	38	34	26	54	51	50	42	38	34	57	54	53	45	42	36	58	57	57	48	45	39	60	59	62	52	48	44
	900	425	56	49	50	44	37	29	59	53	53	46	41	35							62	59	57	49	46	39	63	61	62	53	49	44
10	550	260	48	44	42	32	25	24	52	49	48	40	31	26							55	55	53	47	39	32	58	58	59	50	44	38
	820	387	53	47	43	36	28	25	57	52	49	41	33	27							60	58	55	48	40	33	62	61	60	52	44	38
	1100	519	58	50	46	39	30	27	61	55	51	43	35	29	63	59	54	47	39	32	64	61	57	50	42	35	67	63	61	53	45	39
	1400	661	62	53	49	42	34	30	66	58	54	46	38	33							69	63	58	51	43	37	71	65	63	55	46	41
12	800	378	49	46	40	33	27	27	54	51	46	39	34	29							58	58	53	46	42	35	59	62	59	51	47	40
	1200	566	54	48	43	35	29	27	59	54	48	41	35	30							64	61	55	48	43	37	66	64	60	52	47	42
	1600	755	60	53	47	38	32	30	63	58	50	42	37	32	66	62	54	46	40	36	68	64	57	49	43	39	71	66	61	53	48	43
	2000	944	63	58	52	42	37	34	67	62	54	45	40	38							72	68	58	50	45	42	75	68	61	54	50	45
14	1100	519	47	46	36	30	24	23	53	53	42	36	32	27							57	61	52	43	40	35	60	64	60	48	43	38
	1600	755	52	49	39	32	24	23	56	54	45	38	32	26							60	63	52	44	39	35	63	67	60	49	43	40
	2100	991	55	52	43	35	27	25	59	57	48	40	33	28	61	61	51	43	37	32	63	64	55	46	40	36	65	67	61	50	44	40
	3000	1416	63	59	51	42	34	31	65	64	54	44	36	34							68	68	57	48	41	37	69	69	60	52	45	41
16	1400	661	50	47	38	32	26	23	54	54	45	40	35	29							60	62	53	47	43	38	63	66	61	52	47	43
	2100	991	51	49	41	35	28	24	56	54	47	41	36	30							61	61	55	49	44	39	64	66	60	53	48	43
	2800	1321	56	54	45	38	31	27	59	56	49	43	37	32	60	60	53	46	41	36	62	62	56	49	44	39	65	65	61	54	49	44
	4000	1888	61	60	55	45	38	32	63	63	56	47	41	36							67	66	59	51	46	41	69	66	62	55	50	45
24 x 16	2700	1274	65	63	53	45	38	30	70	65	60	52	45	37							71	69	66	59	51	45	72	71	69	62	54	50
	4000	1888	67	67	57	48	40	32	71	71	64	55	48	41							74	75	69	61	54	48	76	77	72	65	58	52
	5300	2501	67	66	58	49	42	35	74	75	69	57	49	42	75	76	72	61	53	46	76	77	74	64	56	50	78	79	76	67	60	53
	6000	2832	68	66	59	51	44	37	74	75	69	58	50	43							77	78	75	65	57	51	79	80	77	68	61	54
	7500	3540	69	67	61	54	48	42	75	74	70	59	51	45							78	80	78	66	58	52	80	81	79	69	62	55
	8000	3776	69	67	62	55	49	44	75	74	70	59	52	46							79	81	79	67	59	52	80	82	80	70	63	56

Notes:

1. All data are measured in accordance with Industry Standard AHRI 880-2011.
2. All sound power levels, dB re: 10^{-12} Watts.
3. Data in this column constitute AHRI 880-2011 Standard Rating Conditions
4. Where ΔPs is the inlet static pressure minus discharge static.
5. Application ratings are outside the scope of the certification program.

Table 33. Sound noise criteria (NC)

Inlet Size (in)	CFM	l/s	Discharge[1,2,4] Inlet Pressure (ΔPs)[3,5] 0.5"	1.0"	1.5"	2.0"	3.0"	Radiated[1,2,4] Inlet Pressure (ΔPs)[3,5] 0.5"	1.0"	1.5"	2.0"	3.0"
4	80	38	21	25	35	31	34	--	16	24	27	35
	120	57	25	30		34	38	--	19		28	35
	150	71	25	32		38	38	--	20		30	36
	225	106	32	38		44	45	18	23		32	38
5	130	61	--	21	31	28	33	--	--	23	24	33
	200	94	19	25		32	34	--	16		26	33
	250	118	21	28		34	37	--	19		27	35
	350	165	24	33		38	40	18	21		30	35
6	200	94	--	21	31	29	34	--	16	25	26	34
	200	142	18	23		31	35	15	20		27	35
	400	189	18	26		33	37	18	22		30	35
	500	236	23	28		35	39	21	25		32	36
8	350	165	--	23	31	31	37	--	16	27	27	39
	520	245	17	25		34	37	--	21		28	38
	700	330	18	26		34	38	18	24		32	37
	900	425	21	27		36	39	24	27		32	37
10	550	260	--	19	29	26	30	15	22	28	27	34
	820	387	--	22		29	33	16	23		30	35
	1100	519	17	25		31	35	20	25		32	36
	1400	661	21	27		33	37	25	30		34	38
12	800	378	--	17	29	27	29	--	20	32	27	34
	1200	566	--	21		29	34	16	23		31	35
	1600	755	15	23		32	36	22	27		34	37
	2000	944	19	27		34	36	27	32		39	42
14	1100	519	--	18	28	31	32	--	21	31	31	35
	1600	755	--	19		30	36	17	23		33	38
	2100	991	17	24		31	33	20	26		34	38
	3000	1416	24	30		37	38	28	34		39	40
16	1400	661	--	18	27	31	36	--	23	30	32	37
	2100	991	--	20		30	36	17	23		31	37
	2800	1321	18	24		31	33	23	25		32	36
	4000	1888	26	30		36	37	30	33		37	37
24 x 16	2700	1274	26	31	40	35	38	33	36	49	41	45
	4000	1888	30	35		40	43	38	43		47	50
	5300	2501	30	37		44	46	37	47		50	52
	6000	2832	30	37		44	47	37	47		51	53
	7500	3540	30	37		45	49	38	46		55	56
	8000	3776	30	37		45	49	38	46		56	57

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

Table 34. AHRI 885-2008 discharge transfer function assumptions

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

Notes: Add to terminal unit sound power to determine discharge sound pressure in the space.

1. "—" represents NC levels below NC 15.
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 is inlet static pressure minus discharge static pressure.
4. Application ratings are outside the scope of the Certification Program.

Table 35. 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: Select the ceiling type which most closely represents the application. Next, add to terminal unit sound power to determine radiated sound pressure in the space.

1. "—" represents NC levels below NC 15.
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 is inlet static pressure minus discharge static pressure.
4. Application ratings are outside the scope of the Certification Program.

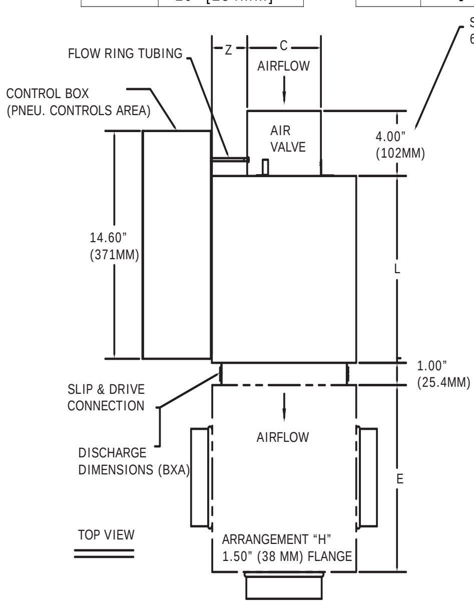
Dimensional Data

SINGLE-DUCT COOLING ONLY WITH OPTIONAL OUTLET PLENUM (VCCF)

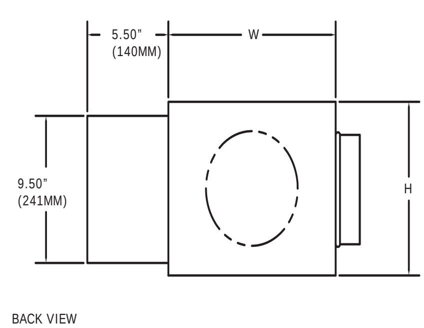
VALV	CFM	L/s	INLET SIZE (NOMINAL Ø) C	L	H	W	Z	DISCHARGE DIM W/O OUTLET PLENUM A (h)	DISCHARGE DIM W/O OUTLET PLENUM B (w)	E	WT LBS [KGS]
04	225	106	4" [104mm]	11.50" [292mm]	9.50" [241mm]	11.50" [292mm]	2.75" [70mm]	8.00" [203mm]	10.00" [250mm]	11.50" [292mm]	21 [9.5]
05	350	165	5" [127mm]								
06	500	236	6" [152mm]								
08	900	425	8" [203mm]	11.00" [279mm]	11.50" [292mm]	12.50" [318mm]	2.25" [57mm]	10.00" [254mm]	11.00" [279mm]		22 [10]
10	1400	661	10" [254mm]	12.00" [305mm]	13.50" [343mm]	15.50" [394mm]	2.75" [70mm]	12.00" [305mm]	14.00" [356mm]	14.00" [356mm]	30 [14]
12	2000	994	12" [305mm]	13.00" [330mm]	15.50" [394mm]	18.50" [470mm]	3.25" [83mm]	14.00" [356mm]	17.00" [432mm]	14.00" [356mm]	38 [17]
14	3000	1416	14" [356mm]	14.00" [356mm]	19.50" [495mm]	20.50" [521mm]		18.00" [457mm]	19.00" [483mm]	NA	46 [21]
16	4000	1888	16" [406mm]	15.00" [381mm]		24.50" [622mm]	4.25" [108mm]		23.00" [584mm]	NA	51 [23]
24RT	8000	3776	16X24" [406mm x 610MM]	18.00" [457mm]		28.50" [724mm]	2.25" [57mm]		27.00" [686mm]	NA	70 [32]

OUTL CONVERSION CHART	
SYMBOL	NOMINALØ
I	5" [127mm]
II	6" [152mm]
III	8" [203mm]
IV	10" [254mm]

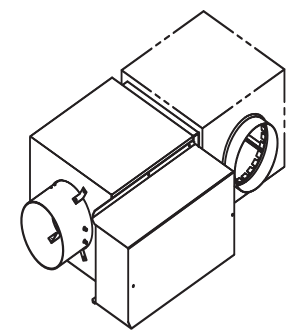
OUTLET AVAILABILITY CHART - SEE OUTL CONVERSION FOR NOMINALØ							
VALV		4	5	6	8	10	12
OUTL	A,B,C	I, II	I, II	I, II	III	III, IV	IV
	D,E,F	I, II	I, II	I, II	I, II, III	II, III, IV	III, IV
	H	I, II	I, II	I, II	I, II, III	II, III, IV	III, IV
	J	N/A	N/A	N/A	N/A	I	I, II

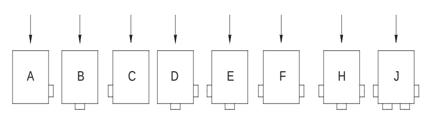


TOP VIEW



BACK VIEW





OUTLET PLENUM
ARRANGEMENTS
(TOP VIEW)

NOTES:

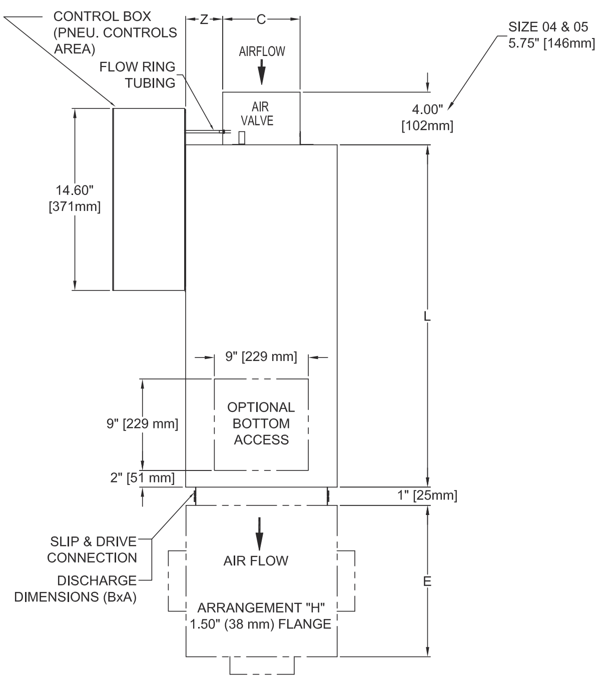
1. Air inlet centered in unit front panel.
2. Outlet combinations to remote diffusers have optional integral balancing dampers. (See specification sheet.)
3. Outlet connections are centered in plenum panel.
4. Plenum not available with size 14 & 16 units.
5. Minimum of 1.5 duct diamenters of straight duct required at inlet for proper flow reading.
6. Allow 36" (914 mm) on control side for servicing.
7. Weights are an estimation and will vary based on selected options, insulation type, etc.
8. Unit is field convertible from a left-hand connection (shown) to right-hand by rotating unit.

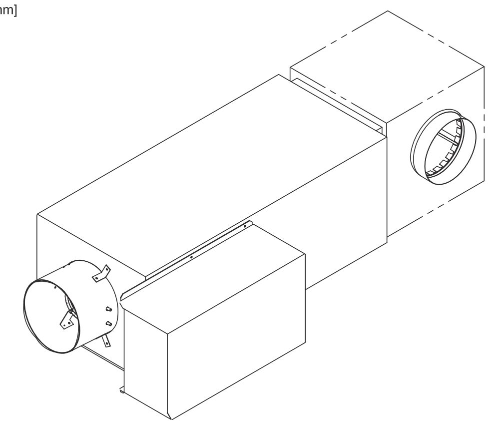
SINGLE-DUCT COOLING ONLY WITH OPTIONAL OUTLET PLENUM & BOTTOM ACCESS (VCCF)

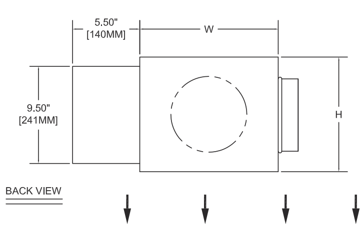
VALV	CFM	L/s	INLET SIZE (NOMINAL Ø) C	L	H	W	Z	DISCHARGE DIM W/O OUTLET PLENUM A (h)	DISCHARGE DIM W/O OUTLET PLENUM B (w)	E	WT LBS [KGS]
04	225	106	4" [104mm]	36.00" [914mm]	9.50" [241mm]	11.50" [292mm]	2.75" [70mm]	8.00" [203mm]	10.00" [250mm]	11.50" [292mm]	21 [9.5]
05	350	165	5" [127mm]	↓	↓	↓	↓	↓	↓	↓	↓
06	500	236	6" [152mm]	↓	↓	↓	↓	↓	↓	↓	↓
08	900	425	8" [203mm]	↓	11.50" [292mm]	12.50" [318mm]	2.25" [57mm]	10.00" [254mm]	11.00" [279mm]	↓	22 [10]
10	1400	661	10" [254mm]	↓	13.50" [343mm]	15.50" [394mm]	2.75" [70mm]	12.00" [305mm]	14.00" [356mm]	14.00" [356mm]	30 [14]
12	2000	994	12" [305mm]	↓	15.50" [394mm]	18.50" [470mm]	3.25" [83mm]	14.00" [356mm]	17.00" [432mm]	14.00" [356mm]	38 [17]
14	3000	1416	14" [356mm]	↓	19.50" [495mm]	20.50" [521mm]	↓	18.00" [457mm]	19.00" [483mm]	NA	46 [21]
16	4000	1888	16" [406mm]	↓	↓	24.50" [622mm]	4.25" [108mm]	↓	23.00" [584mm]	NA	51 [23]
24RT	8000	3776	16X24" [406mm x 610MM]	↓	↓	28.50" [724mm]	2.25" [57mm]	↓	27.00" [686mm]	NA	70 [32]

OUTL CONVERSION CHART	
SYMBOL	NOMINALØ
I	5" [127mm]
II	6" [152mm]
III	8" [203mm]
IV	10" [254mm]

OUTLET AVAILABILITY CHART - SEE OUTL CONVERSION FOR NOMINALØ							
VALV		4	5	6	8	10	12
OUTL	A,B,C	I, II	I, II	I, II	III	III, IV	IV
	D,E,F	I, II	I, II	I, II	I, II, III	II, III, IV	III, IV
	H	I, II	I, II	I, II	I, II, III	II, III, IV	III, IV
	J	N/A	N/A	N/A	N/A	I	I, II

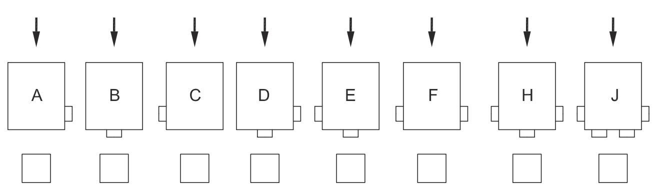






NOTES:

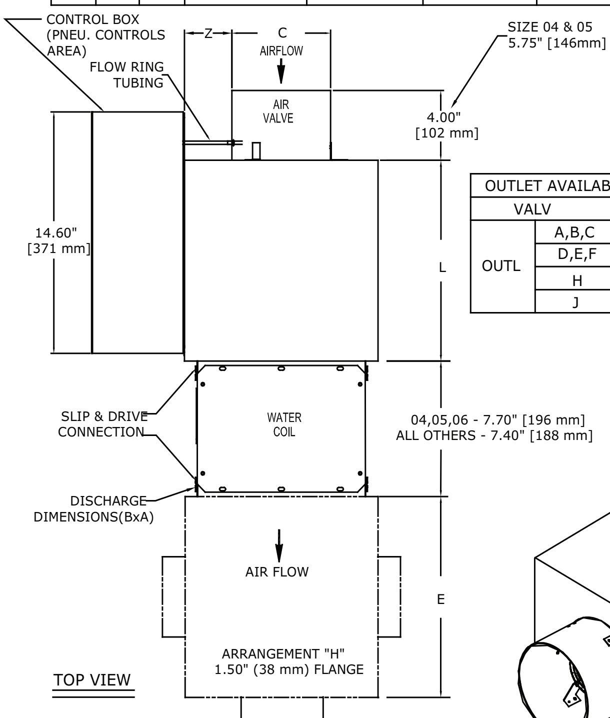
1. Air inlet is centered in unit front panel.
2. Outlet combinations to remote diffusers have optional integral balancing dampers (See specification sheet.)
3. Outlet connections are centered in plenum panel.
4. Plenum not available w/sizes 14 & 16 units.
5. Minimum of 1.5 duct diameters of straight duct required for proper flow reading.
6. Allow 36" [914mm] on control side for servicing.
7. Weights are an estimation and will vary based on selected options, insulation type, etc.
8. Optional bottom access requires an extended casing.



OUTLET PLENUM ARRANGEMENTS (TOP VIEW)

SINGLE DUCT HOT WATER W/PLENUM (VCWF)

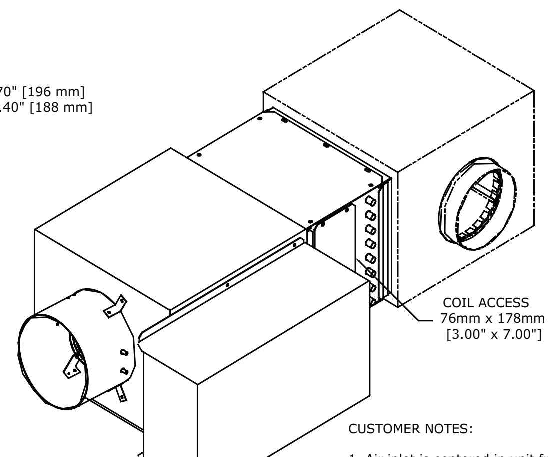
VALV	CFM	L/s	INLET SIZE (NOMINAL Ø) C	L	H	W	Z	DISCHARGE DIM W/O OUTLET PLENUM A (h)	DISCHARGE DIM W/O OUTLET PLENUM B (w)	E	WT LBS [KGS]
04	225	106	4" [104mm]	11.50" [292mm]	9.50" [241mm]	11.50" [292mm]	2.75" [70mm]	8.00" [203mm]	10.00" [254mm]	11.50" [292mm]	27 [12]
05	350	165	5" [127mm]								
06	500	236	6" [152mm]								
08	900	425	8" [203mm]	11.00" [279mm]	11.50" [292mm]	12.50" [318mm]	2.25" [57mm]	10.00" [254mm]	11.00" [279mm]		30 [14]
10	1400	661	10" [254mm]	12.00" [305mm]	13.50" [343mm]	15.50" [394mm]	2.75" [70mm]	12.00" [305mm]	14.00" [356mm]	14.00" [356mm]	40 [18]
12	2000	994	12" [305mm]	13.00" [330mm]	15.50" [394mm]	18.50" [470mm]	3.25" [83mm]	14.00" [356mm]	17.00" [432mm]	14.00" [356mm]	51 [23]
14	3000	1416	14" [356mm]	14.00" [356mm]	19.50" [495mm]	20.50" [521mm]		18.00" [457mm]	19.00" [483mm]	NA	62 [28]
16	4000	1888	16" [406mm]	15.00" [381mm]		24.50" [622mm]	4.25" [108mm]		23.00" [584mm]	NA	71 [32]
24RT	8000	3776	16X24"	18.00" [457mm]		28.50" [724mm]	2.25" [57mm]		27.00" [686mm]	NA	95 [43]

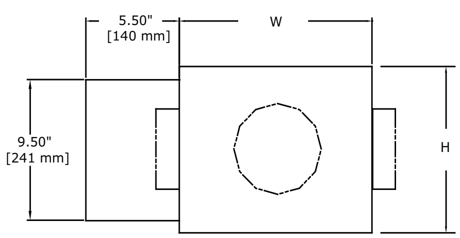


TOP VIEW

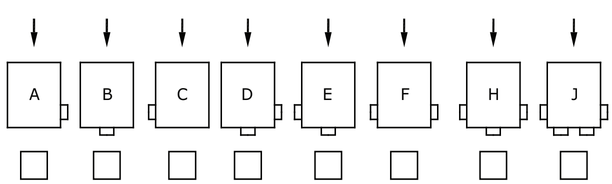
OUTL CONVERSION CHART	
SYMBOL	NOMINALØ
I	5" [127mm]
II	6" [152mm]
III	8" [203mm]
IV	10" [254mm]

OUTLET AVAILABILITY CHART - SEE OUTL CONVERSION FOR NOMINALØ							
VALV		4	5	6	8	10	12
OUTL	A,B,C	I, II	I, II	I, II	III	III, IV	IV
	D,E,F	I, II	I, II	I, II	I, II, III	II, III, IV	III, IV
	H	I, II	I, II	I, II	I, II, III	II, III, IV	III, IV
	J	N/A	N/A	N/A	N/A	I	I, II





BACK VIEW



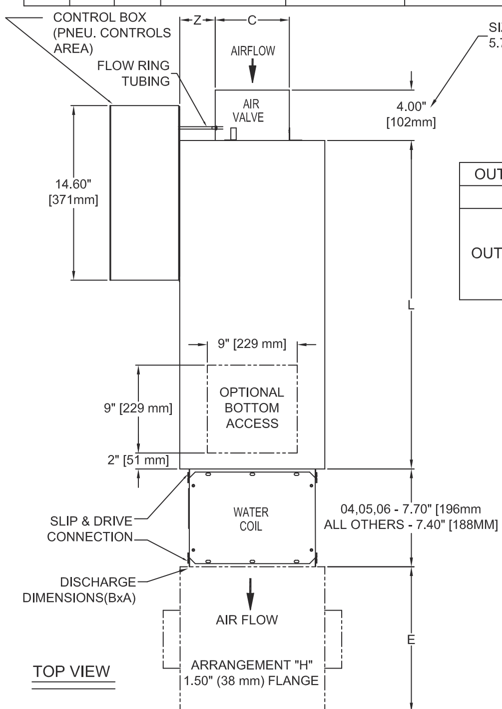
OUTLET PLENUM
ARRANGEMENTS
(TOP VIEW)

CUSTOMER NOTES:

1. Air inlet is centered in unit front panel.
2. Outlet combinations to remote diffusers have optional integral balancing dampers (See specification sheet.)
3. Outlet connections are centered in plenum panel.
4. Plenum not available w/sizes 14 & 16 units.
5. Minimum of 1.5 duct diameters of straight duct required for proper flow reading.
6. Allow 36" [914mm] on control side for servicing.
7. Weights are an estimation and will vary based on selected options, insulation type, etc.
8. Coil furnished with stub sweat connections. handedness of coil connection is determined by facing air stream.
9. 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.
10. Unit is field convertible from a left-hand connection (shown) to right-hand by rotating unit.
11. Add 1.75" for 3 or 4 row coils. 1 or 2 row shown.

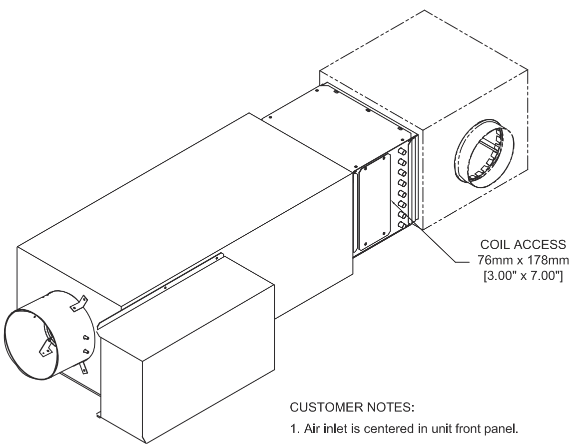
SINGLE DUCT HOT WATER W/ OPTIONAL PLENUM & BOTTOM ACCESS (VCWF)

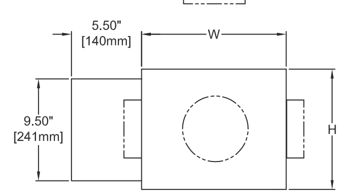
VALV	CFM	L/s	INLET SIZE (NOMINAL Ø) C	L	H	W	Z	DISCHARGE DIM W/O OUTLET PLENUM A (h)	DISCHARGE DIM W/O OUTLET PLENUM B (w)	E	WT LBS [KGS]
04	225	106	4" [104mm]	36.00" [914mm]	9.50" [241mm]	11.50" [292mm]	2.75" [70mm]	8.00" [203mm]	10.00" [254mm]	11.50" [292mm]	27 [12]
05	350	165	5" [127mm]								
06	500	236	6" [152mm]								
08	900	425	8" [203mm]		11.50" [292mm]	12.50" [318mm]	2.25" [57mm]	10.00" [254mm]	11.00" [279mm]		30 [14]
10	1400	661	10" [254mm]		13.50" [343mm]	15.50" [394mm]	2.75" [70mm]	12.00" [305mm]	14.00" [356mm]	14.00" [356mm]	40 [18]
12	2000	994	12" [305mm]		15.50" [394mm]	18.50" [470mm]	3.25" [83mm]	14.00" [356mm]	17.00" [432mm]	14.00" [356mm]	51 [23]
14	3000	1416	14" [356mm]		19.50" [495mm]	20.50" [521mm]		18.00" [457mm]	19.00" [483mm]	NA	62 [28]
16	4000	1888	16" [406mm]			24.50" [622mm]	4.25" [108mm]		23.00" [584mm]	NA	71 [32]
24RT	8000	3776	16X24"			28.50" [724mm]	2.25" [57mm]		27.00" [686mm]	NA	95 [43]

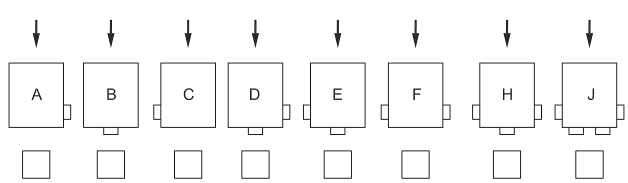


OUTL CONVERSION CHART	
SYMBOL	NOMINALØ
I	5" [127mm]
II	6" [152mm]
III	8" [203mm]
IV	10" [254mm]

OUTLET AVAILABILITY CHART - SEE OUTL CONVERSION FOR NOMINALØ							
	VALV	4	5	6	8	10	12
OUTL	A,B,C	I, II	I, II	I, II	III	III, IV	IV
	D,E,F	I, II	I, II	I, II	I, II, III	II, III, IV	III, IV
	H	I, II	I, II	I, II	I, II, III	II, III, IV	III, IV
	J	N/A	N/A	N/A	N/A	I	I, II





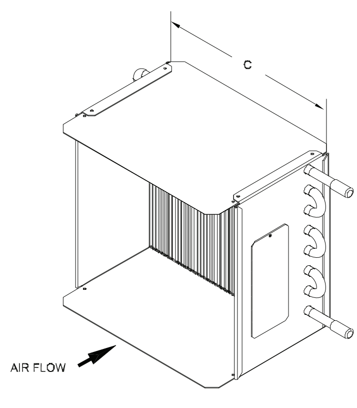


OUTLET PLENUM
ARRANGEMENTS
(TOP VIEW)

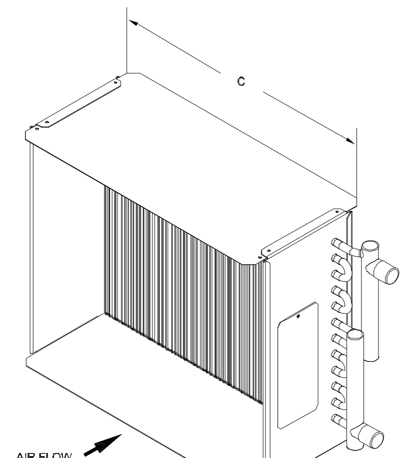
CUSTOMER NOTES:

1. Air inlet is centered in unit front panel.
2. Outlet combinations to remote diffusers have optional integral balancing dampers (See specification sheet.)
3. Outlet connections are centered in plenum panel.
4. Plenum not available w/sizes 14 & 16 units.
5. Minimum of 1.5 duct diameters of straight duct required for proper flow reading.
6. Allow 36" [914mm] on control side for servicing.
7. Weights are an estimation and will vary based on selected options, insulation type, etc.
8. Coil furnished with stub sweat connections. handedness of coil connection is determined by facing air stream.
9. 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.
10. Add 1.75" for 3 or 4 row coils. 1 or 2 row shown.
11. Optional bottom access requires an extended casing.

COIL INFORMATION FOR 1 ROW COIL ASSY										
VALV	CFM	LITERS per SECOND	COIL CONNECTION		A	B	C	D	E	W
04	225	106	3/8" [10mm] O.D.	SEE (FIG 1)	7" [178mm]	21/32" [17mm]	10" [254mm]	8 1/8" [206mm]	1/2" [13mm]	8 1/4" [210mm]
05	350	165	3/8" [10mm] O.D.		7" [178mm]	21/32" [17mm]	10" [254mm]	8 1/8" [206mm]	1/2" [13mm]	8 1/4" [210mm]
06	500	236	3/8" [10mm] O.D.		7" [178mm]	21/32" [17mm]	10" [254mm]	8 1/8" [206mm]	1/2" [13mm]	8 1/4" [210mm]
08	900	425	3/8" [10mm] O.D.		9" [229mm]	7/8" [22mm]	11" [279mm]	10 1/8" [257mm]	7/16" [11mm]	8 1/4" [210mm]
10	1400	661	3/8" [10mm] O.D.		11" [279mm]	7/8" [22mm]	14" [356mm]	12 1/8" [308mm]	7/16" [11mm]	8 1/4" [210mm]
12	2000	994	7/8" [22mm] O.D.	SEE (FIG 2)	9 3/4" [248mm]	2 1/2" [64mm]	17" [432mm]	14 1/8" [359mm]	2 1/16" [53mm]	8 1/4" [210mm]
14	3000	1416	7/8" [22mm] O.D.		15 3/4" [400mm]	1 1/2" [38mm]	19" [483mm]	18 1/8" [460mm]	1 1/16" [27mm]	8 1/4" [210mm]
16	4000	1888	7/8" [22mm] O.D.		15 3/4" [400mm]	1 1/2" [38mm]	23" [584mm]	18 1/8" [460mm]	1 1/16" [27mm]	8 1/4" [210mm]
16 x 24	8000	3776	7/8" [22mm] O.D.		15 3/4" [400mm]	1 1/2" [38mm]	27" [686mm]	18 1/8" [460mm]	1 1/16" [27mm]	8 1/4" [210mm]



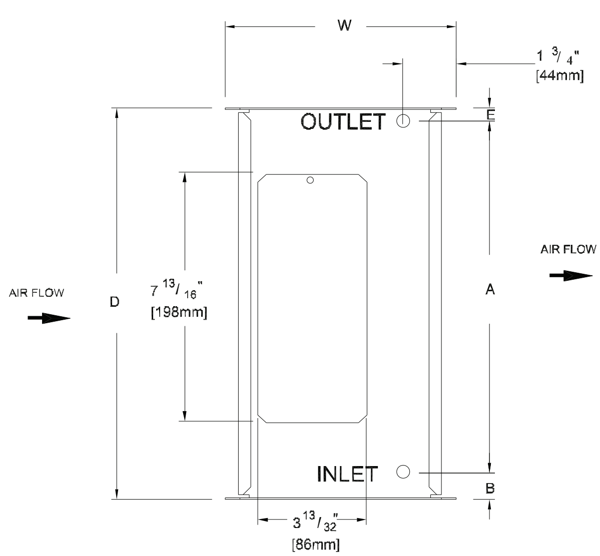
(FIG 1)



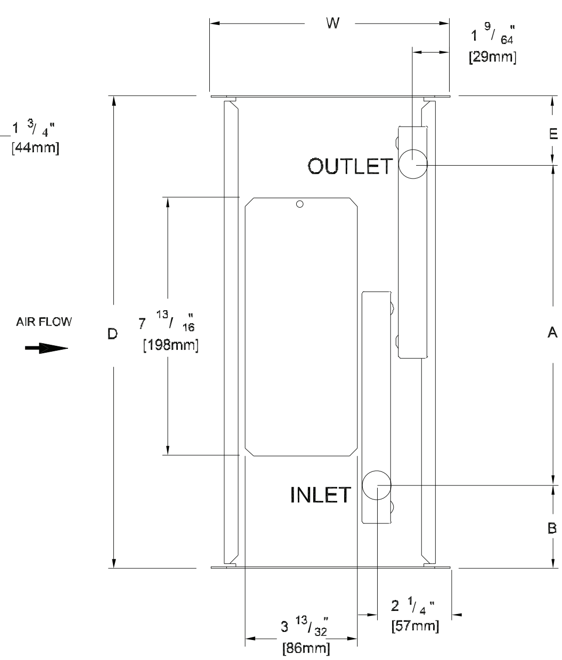
(FIG 2)

CUSTOMER NOTES:

1. Location of coil connections is determined by facing air stream. L.H. Coil connections shown, R.H. 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 below for reference.
4. Coil height and width is dependent upon unit height and width.
5. Access Panel is standard.



(FIG 1)

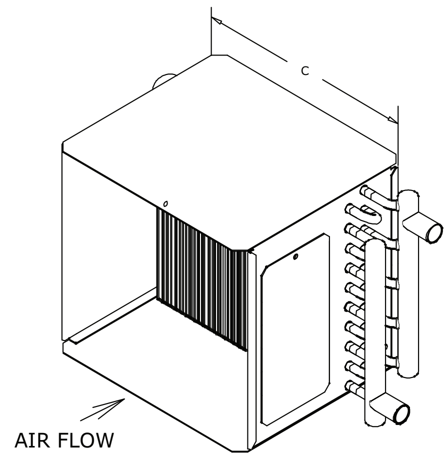


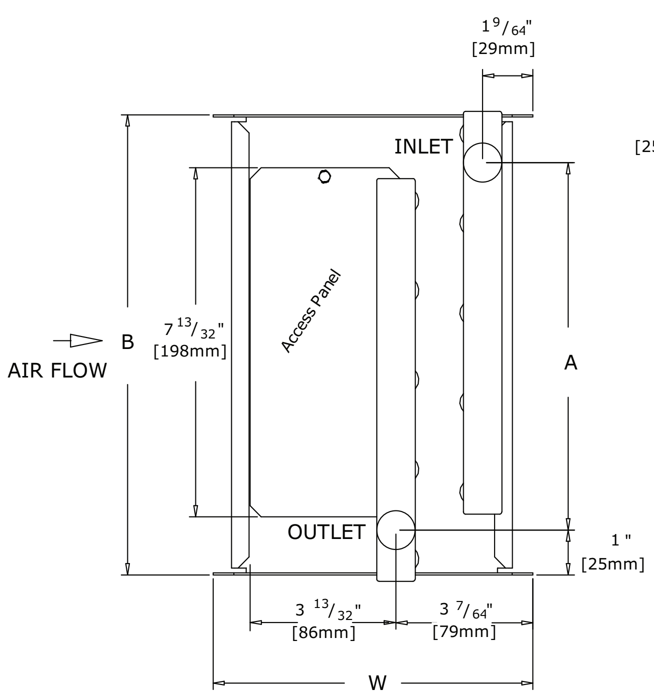
(FIG 2)

COIL INFORMATION FOR 2 ROW COIL ASSY							
INLT	CFM	LITERS per SECOND	COIL CONNECTION	A	B	C	W
04	225	106	7/8" [22mm] O.D.	6 1/4" [191mm]	8 1/8" [206mm]	10" [254mm]	8 1/4" [210mm]
05	350	165	7/8" [22mm] O.D.	6 1/4" [191mm]	8 1/8" [206mm]	10" [254mm]	8 1/4" [210mm]
06	500	236	7/8" [22mm] O.D.	6 1/4" [191mm]	8 1/8" [206mm]	10" [254mm]	8 1/4" [210mm]
08	900	425	7/8" [22mm] O.D.	8 1/4" [210mm]	10 1/8" [257mm]	11" [279mm]	8 1/4" [210mm]
10	1400	661	7/8" [22mm] O.D.	10 1/4" [260mm]	12 1/8" [308mm]	14" [356mm]	8 1/4" [210mm]
12	2000	994	7/8" [22mm] O.D.	12 1/4" [311mm]	14 1/8" [359mm]	17" [432mm]	8 1/4" [210mm]
14	3000	1416	7/8" [22mm] O.D.	16 1/4" [413mm]	18 1/8" [460mm]	19" [483mm]	8 1/4" [210mm]
16	4000	1888	7/8" [22mm] O.D.	16 1/4" [413mm]	18 1/8" [460mm]	23" [584mm]	8 1/4" [210mm]
16 x 24	8000	3776	7/8" [22mm] O.D.	16 1/4" [413mm]	18 1/8" [460mm]	27" [686mm]	8 1/4" [210mm]

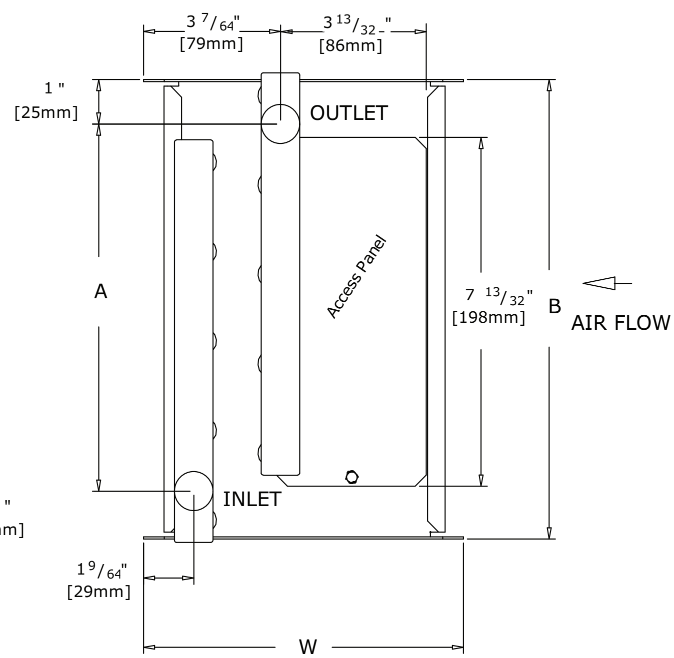
CUSTOMER NOTES:

1. Location of coil connections is determined bygfairin stream. L.H. Coil connections shown, R.H. 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 below for reference.
4. Coil height and width is dependent upon unit height and width.
5. Access Panel is standard.





LEFT HAND

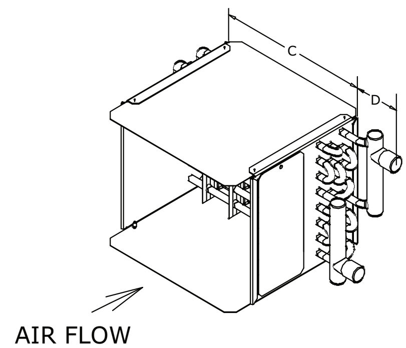


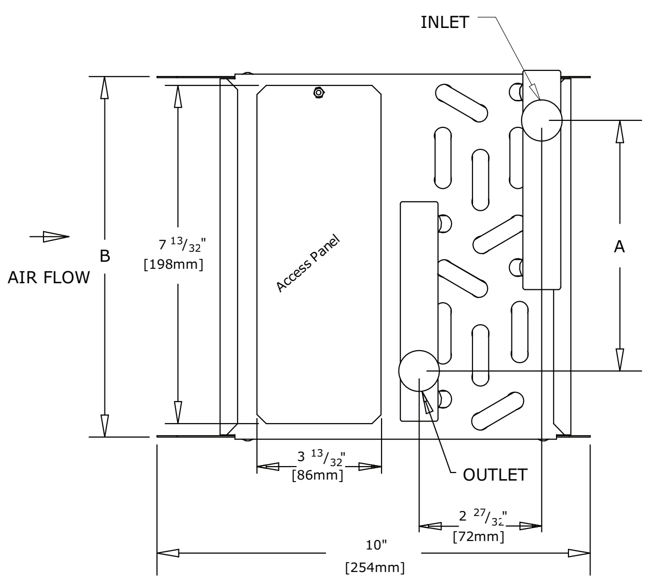
RIGHT HAND

COIL INFORMATION FOR 3 ROW COIL ASSY							
INLT	CFM	LITERS per SECOND	COIL CONNECTION	A	B	C	D
04	225	106	7/8" [22mm] O.D.	5 3/4" [146mm]	8 1/8" [206mm]	10" [254mm]	3 5/8" [92mm]
05	350	165	7/8" [22mm] O.D.	5 3/4" [146mm]	8 1/8" [206mm]	10" [254mm]	3 5/8" [92mm]
06	500	236	7/8" [22mm] O.D.	5 3/4" [146mm]	8 1/8" [206mm]	10" [254mm]	3 5/8" [92mm]
08	900	425	7/8" [22mm] O.D.	7 3/4" [196mm]	10 1/8" [257mm]	11" [279mm]	3 5/8" [92mm]
10	1400	661	7/8" [22mm] O.D.	9 3/4" [248mm]	12 1/8" [308mm]	14" [356mm]	3 5/8" [92mm]
12	2000	994	7/8" [22mm] O.D.	11 3/4" [298mm]	14 1/8" [359mm]	17" [432mm]	3 5/8" [92mm]
14	3000	1416	7/8" [22mm] O.D.	15 3/4" [400mm]	18 1/8" [460mm]	19" [483mm]	3 5/8" [92mm]
16	4000	1888	7/8" [22mm] O.D.	15 3/4" [400mm]	18 1/8" [460mm]	23" [584mm]	3 5/8" [92mm]
16 x 24	8000	3776	7/8" [22mm] O.D.	15 3/4" [400mm]	18 1/8" [460mm]	27" [686mm]	3 5/8" [92mm]

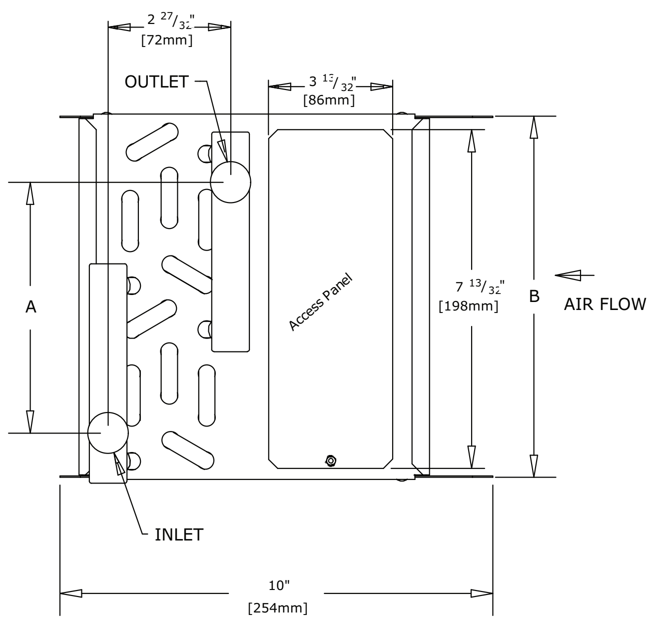
CUSTOMER NOTES:

1. Location of coil connections is determined by air in stream. L.H. Coil connections shown, R.H. 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 below for reference.
4. Coil height and width is dependent upon unit height and width.
5. Access Panel is standard.





LEFT HAND



RIGHT HAND

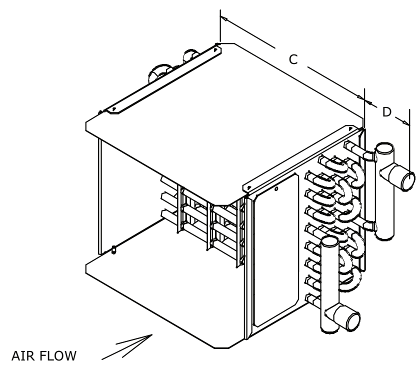
Single-Duct VAV Terminal Units

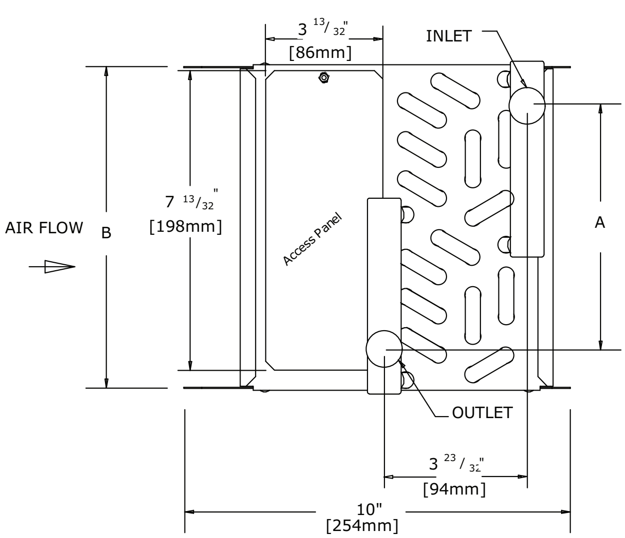
COIL INFORMATION FOR 4 ROW COIL ASSY

INLT	CFM	LITERS per SECOND	COIL CONNECTION	A	B	C	D
04	225	106	7/8" [22mm] O.D.	6 1/4" [158mm]	8 1/8" [206mm]	10" [254mm]	3 5/8" [92mm]
05	350	165	7/8" [22mm] O.D.	6 1/4" [158mm]	8 1/8" [206mm]	10" [254mm]	3 5/8" [92mm]
06	500	236	7/8" [22mm] O.D.	6 1/4" [158mm]	8 1/8" [206mm]	10" [254mm]	3 5/8" [92mm]
08	900	425	7/8" [22mm] O.D.	8 1/4" [210mm]	10 1/8" [257mm]	11" [279mm]	3 5/8" [92mm]
10	1400	661	7/8" [22mm] O.D.	10 1/4" [260mm]	12 1/8" [308mm]	14" [356mm]	3 5/8" [92mm]
12	2000	994	7/8" [22mm] O.D.	12 1/4" [311mm]	14 1/8" [359mm]	17" [432mm]	3 5/8" [92mm]
14	3000	1416	7/8" [22mm] O.D.	16 1/4" [413mm]	18 1/8" [460mm]	19" [483mm]	3 5/8" [92mm]
16	4000	1888	7/8" [22mm] O.D.	16 1/4" [413mm]	18 1/8" [460mm]	23" [584mm]	3 5/8" [92mm]
16 x 24	8000	3776	7/8" [22mm] O.D.	16 1/4" [413mm]	18 1/8" [460mm]	27" [686mm]	3 5/8" [92mm]

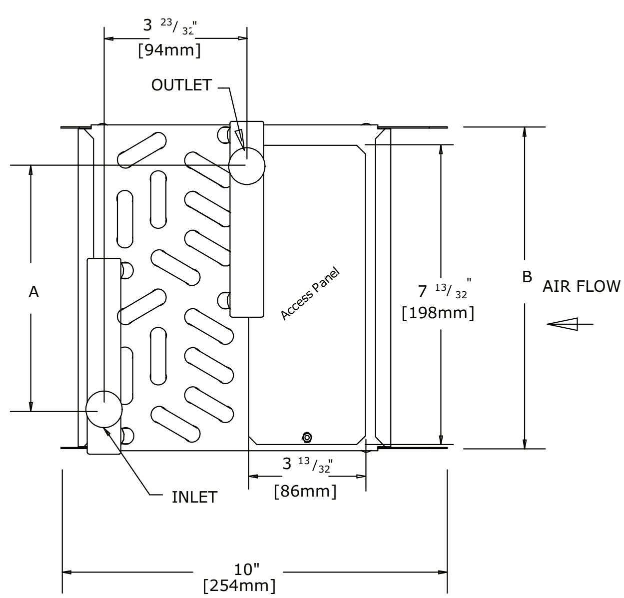
CUSTOMER NOTES:

1. Location of coil connections is determined by facing air stream. L.H. Coil connections shown, R.H. 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 below for reference.
4. Coil height and width is dependent upon unit height and width.
5. Access Panel is standard.





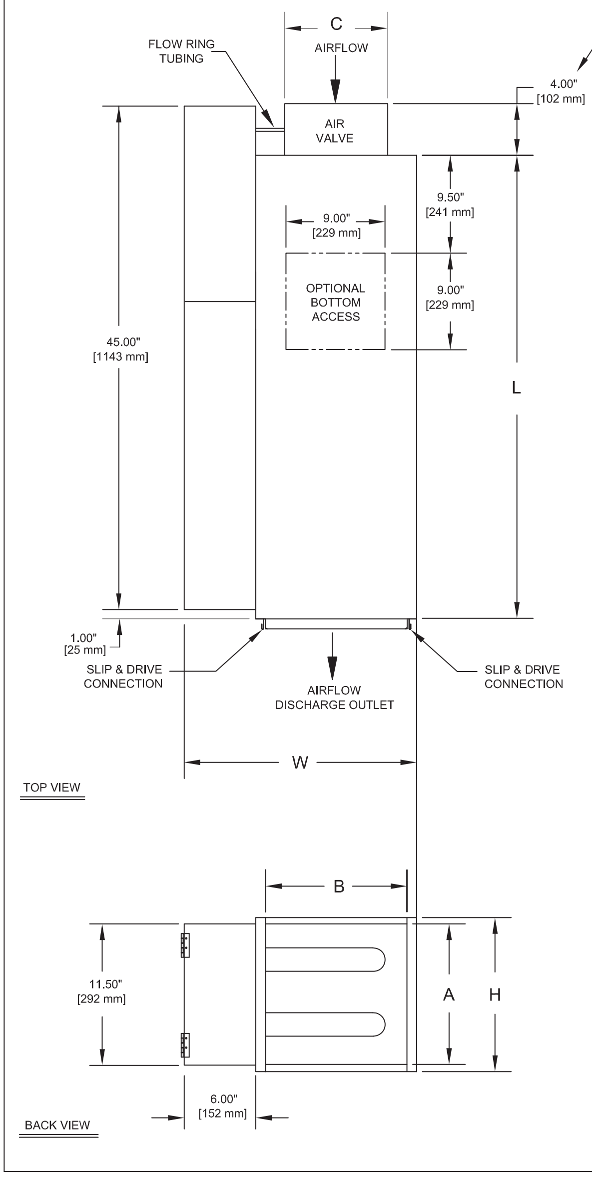
LEFT HAND

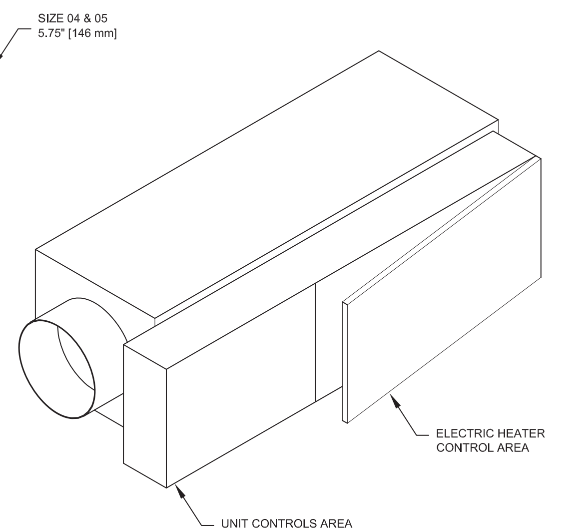


RIGHT HAND

SINGLE-DUCT ELECTRIC HEAT (VCEF - FLIPPABLE TO LH or RH ORIENTATION)

VALV	CFM	LITERS per SECOND	INLET SIZE (NOMINAL Ø) C	L	H	W	DISCHARGE DIMENSIONS A	DISCHARGE DIMENSIONS B	WT LBS/KGS
04	225	106	4" (104 mm)	42.50" (1079 mm)	11.50" (292 mm)	18.50" (470 mm)	10.00" (254 mm)	11.00" (279 mm)	67 (30)
05	350	165	5" (127 mm)						
06	500	236	6" (152 mm)						
08	900	425	8" (203 mm)						
10	1400	661	10" (254 mm)		13.50" (343 mm)	21.50" (546 mm)	12.00" (305 mm)	14.00" (356 mm)	81 (37)
12	2000	994	12" (305 mm)		15.50" (394 mm)	24.50" (622 mm)	14.00" (356 mm)	17.00" (432 mm)	93 (42)
14	3000	1416	14" (356 mm)		19.50" (495 mm)	26.50" (673 mm)	18.00" (457 mm)	19.00" (483 mm)	108 (49)
16	4000	1888	16" (406 mm)			30.50" (775 mm)		23.00" (584 mm)	121 (55)
24RT	8000	3776	24" x 16" (610 x 406 mm)			34.50" (876 mm)		27.00" (686 mm)	135 (61)





CUSTOMER NOTES:

1. Air inlet is centered in unit front panel.
2. Slip & 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" [1219 mm] of straight duct downstream of unit before first runout & inside of the duct should be equal discharge size (A & B)
6. Left-hand orientation shown. (Facing discharge) Unit can be flipped to right-hand orientation.

Mechanical Specifications

Single-Duct Terminal Units

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

Casing

22-gage 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" (12.7 mm) Matte-faced Insulation—Interior surface of unit casing is acoustically and thermally lined with ½-inch, 1.5 lb/ft3 (12.7 mm, 24.0 kg/m3) composite density glass fiber with a high-density facing. Insulation R-Value is 1.9. Insulation is UL listed and meets NFPA-90A and UL 181 standards. There are no exposed edges of insulation (complete metal encapsulation).

1" (25.4 mm) Matte-faced Insulation—Interior surface of unit casing is acoustically and thermally lined with 1-inch, 1.0 lb/ft3 (25.4 mm, 16.0 kg/m3) composite density glass fiber with a high-density facing. Insulation R-Value is 3.85. Insulation is UL listed and meets NFPA-90A and UL 181 standards. There are no exposed edges of insulation (complete metal encapsulation).

1" (25.4 mm) Foil-faced Insulation— Interior surface of unit casing is acoustically and thermally lined with 1-inch, 1.0 lb/ft3 (25.4 mm, 16.0 kg/m3) density glass fiber with foil facing. Insulation R-Value is 3.85. Insulation is UL listed and meets NFPA-90A and UL 181 standards and bacteriological standard ASTM C 665. There are no exposed edges of insulation (complete metal encapsulation).

1" (25.4 mm) Double-wall Insulation—Interior surface of unit casing is acoustically and thermally lined with a 1-inch, 1.0 lb./ft3 (25.4 mm, 16.0 kg/m3) composite density glass fiber with high-density facing. Insulation R-value is 3.85. Insulation is UL listed and meets NFPA-90A and UL 181 standards. Insulation is covered by interior liner made of 26-gage galvanized steel. All wire penetrations are covered by grommets. There are no exposed edges of insulation (complete metal encapsulation).

3/8" (9.5 mm) Closed-cell Insulation—Interior surface of the unit casing is acoustically and thermally lined with 3/8-inch, 4.4 lb/ft3 (9.5 mm, 70.0 kg/m3) 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 air inlet connection is an 18-gage 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-gage 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. At 4.0 in. wg, air valve leakage does not exceed 1% of cataloged airflow.

Air Valve Rectangular—Inlet collar is constructed of 22-gage 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 22-gage 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. At 3.0 in. wg air valve leakage does not exceed 6% of maximum airflow.

Outlet Conection

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

Outlet Plenum—A sheet metal, insulated box with circular opening(s) is attached to main unit discharge at the factory. Circular opening(s) are centered on unit plenum to accept round ductwork connections.

Outlet Plenum with Balancing Dampers—A sheet metal, insulated box with circular opening(s) is factory- connected to the main unit. The circular opening(s) with balancing damper(s) are centered on the unit plenum to accept round ductwork connections.

Hot Water Coils

All hot water coils are factory-installed on the discharge outlet. Full fin collars provided for accurate fin spacing and maximum fin-tube contact. The 3/8" (9.5 mm) OD seamless copper tubes are mechanically expanded into the fin collars. Coils shall be subjected to a pressure decay test at 450 psig for a minimum of 45 seconds. Coils shall then be evacuated and charged with a helium gas mixture and pressurized to 150 psig. While pressurized with the helium gas mixture, the coil shall be checked with a gas analyzer to detect helium leaks. Alternatively, the coil shall be subjected to a final air-under-water leak test at 300 psig.

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" or 7/8" (22.2 mm) OD braze connections.

2-Row Hot Water Coils— The 2-row coil has 144 aluminum per foot. Coils are assembled with headers that provide 7/8" (22.2 mm) OD braze connections. Right-hand connections are optional.

3-Row Hot Water Coils—The 3-row coil has 120 aluminum fins per foot. Coils are assembled with headers that provide 7/8" (22.2 mm) OD braze connections. Right-hand connections are optional.

4-Row Hot Water Coils—The 4-row coil has 120 aluminum fins per foot. Coils are assembled with headers that provide 7/8" (22.2 mm) OD braze connections. Right-hand connections are optional.

Electric Heat Coils

The electric heater is a factory-provided and -installed, UL recognized resistance open-type heater with airflow switch. It also contains a disc-type automatic pilot duty thermal primary cutout, and manual reset load carrying thermal secondary device. Heater element material is nickel-chromium. The heater terminal box is provided with 7/8" (22 mm) knockouts for customer power supply. Terminal connections are plated steel with ceramic insulators.

Electric Heat Options

Silicon-Controlled Rectifier (SCR)—Optional electric heat control that provides modulation. Allows use of energy efficient dual max algorithm with selection of UC210 or UC400 controls. See “Single-Duct: SCR Modulation of Electric Heat,” p. 84 for detailed description of dual max algorithm function.

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

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

Mercury Contactor—Optional electric heater 24V contactor for use with direct digital controls.

P.E. Switch with Magnetic Contactor—This optional switch and magnetic contactor is for use with pneumatic controls.

P.E. Switch with Mercury Contactor—This optional switch and mercury contactor is for use with pneumatic 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 safety fuse located in the line of power of the electric heater to prevent power surge damage to the electric heater.

Disconnect Switch—A optional 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 setpoints. Airflow is limited by minimum and maximum position setpoints. Upon further call for heat after the air valve reaches the minimum airflow setting, any hot water or electric heat associated with the unit is enabled.

Direct Digitals 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/DC, 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 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 controller provides accurate, pressure-independent control through the use of a proportional integral control algorithm and direct digital control technology. The controller, named Unit Control Module (UCM), monitors zone temperature setpoints, zone temperature and its rate of change, and valve airflow using a differential pressure signal from the pressure transducer. Additionally, the controller can monitor either supply duct air temperature or CO2 concentration via appropriate sensors. Controller enclosure has 7/8"(22 mm) knockouts for remote control wiring. Trane DDC zone sensor is required.

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

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

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.

Pneumatic Controls

Normally Open Actuator—Pneumatic 3-8 psig (20-55 kPa) spring-range pneumatic actuator.

Normally-Closed Actuator—Pneumatic 8 -13 psig (55-90 kPa) spring-range pneumatic actuator.

3011 Pneumatic Volume Regulator (PVR)—The regulator is a thermostat reset velocity controller, which provides consistent air delivery within 5% of cataloged flow down to 18% or less of unit cataloged cfm, independent of changes in system static pressure. Factory-calibrated, field-adjustable setpoints for minimum and maximum flows. Average total unit bleed rate, excluding thermostat, is 28.8 scim at 20 psig (7.87 ml/min at 138 kPa) supply.

Control Options

Transformer (VCCF, VCWF)—A 50-VA transformer is factory-installed in an enclosure with 7/8” (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.

Hot Water Valves

Two-Position Valve—The valve is a field-adaptable, 2-way or 3-way configuration and ships with a cap to be field-installed when configured as a 2-way valve. All connections are National Pipe Thread (NPT). valve body is forged brass with stainless steel stem and spring. Upon demand, the motor strokes the valve. When actuator drive stops, a spring returns valve to its fail-safe position.

Flow Capacity – 4.00 Cv
Overall Diameter – ½" NPT
Close-off Pressure – 25 psi (172 kPa)

Flow Capacity – 5.0 Cv
Overall Diameter – 3/4" NPT
Close-off Pressure – 20 psi (138 kPa)

Flow Capacity – 8.0 Cv
Overall Diameter – 1" NPT
Close-off Pressure – 17 psi (117 kPa)

Maximum Operating Fluid Temperature – 200ºF (93ºC)
Maximum system pressure – 300 psi (2067 kPa)
Electrical Rating – 7 VA at 24 VAC, 6.5 Watts, 50/60 Hz

Proportional 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% maximum glycol). The actuator is a synchronous motor drive. The valve is driven to a predetermined position by the UCM controller using a proportional plus integral control algorithm. If power is removed, the valve stays in its last position. The actuator is rated for plenum applications under UL 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, 2.7 Cv, 6.6 Cv, 8.0 Cv
Overall Diameter – ½" NPT
Maximum Allowable Pressure – 300 psi (2068 kPa)
Maximum Operating Fluid Temperature – 200ºF (93°C)
Maximum Close-off Pressure – 60 psi (379 kPa)
Electrical Rating – 3VA at 24 VAC
8” 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” plenum rated cable with quick connect tabs for control board interface).

Model Number Descriptions

Digit 1, 2, 3—Unit Type

VDD= VariTrane™ dual-duct

Digit 4—Development Sequence

F = Sixth

Digit 5, 6—Primary Air Valve

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

Digit 7, 8—Secondary Air Valve

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

Digit 9—Not Used

0 = N/A

Digit 10, 11—Design Sequence

** = Factory Assigned

Digit 12, 13, 14, 15—Controls

DD00= Trane Actuator Only
DD01= UCM4 Cooling Only Control
DD08= UCM4 Dual Duct Constant Volume
DD11= VV550 DDC Controller - Cooling Only
DD18= VV550 DDC Controller w Constant Volume
DD41= UC400 DDC-Basic (No water or electric heat)
DD48= UC400 DDC-Basic (Constant Volume)
DDSS= Digital Special
ENON= Shaft Out Side for Electric Units
FM00= Other Actuator and Control
FM01= Trane Supplied Actuator, Other Ctrl
PC03= NC Heating Valve, N.O. Cooling Valve
PCSS= Normally Closed Special
PN08= N.O. Heat/Cool Actuators & Linkage Only
PN09= N.O. Heating, N.O. Cooling, w/PVR’s
PN10= N.O. Heating, N.O. Cooling, w/PVR’s (CV DISCH)
PNON= Shaft Out Side for Pneumatic Units
PNSS= Normally Open Special

Notes:

N.C. = Normally-closed
N.O. = Normally-opened
DA Stat = Direct-acting pneumatic t-stat (by others)
RA Stat = Reverse-acting pneumatic t-stat (by others)
PN = Pneumatic
FM = Factory installation of customer-supplied controller
PVR = Pneumatic Volume Regulator

Digit 16—Insulation

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

Digit 17—Not Used

0 = N/A

Digit 18—Not Used

0 = N/A

Digit 19—Outlet Plenum (Connection is slip & drive)

0 = none
A = 1 outlet–RH
B = 1 outlet–END
C = 1 outlet–LH
D = 2 outlets–1 RH, 1 END
E = 2 outlets–1 LH, 1 END
F = 2 outlets–1 RH, 1 LH
G = 2 outlets - END
H = 3 outlets–1 LH, 1 RH, 1 END
J = 4 outlets–1 LH, 1 RH, 2 END

Note: *See unit drawings for outlet sizes/damper information.*

Digit 20—Not Used

0 = N/A

Digit 21—Not Used

0 = N/A

Digit 22—Not Used

0 = N/A

Digit 23—Transformer

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

Digit 24—Disconnect Switch

0 = None
W = With Toggle

Digit 25—Power Fuse

0 = None
W = With

Digit 26—Not Used

0 = N/A

Digit 27—Not Used

0 = N/A

Digit 28—Not Used

0 = N/A

Digit 29—Not Used

0 = N/A

Digit 30—Not Used

0 = N/A

Digit 31—Not Used

0 = N/A

Digit 32—Not Used

0 = N/A

Digit 33—Special Options

0 = None
X = Varies - Factory Assigned

Digit 34—Not Used

Blank

Digit 35—Wireless Sensor

0 = Sensor/Receiver Standard
1 = Wireless Sensor/Receiver Mounted

Note: *All sensors selected in accessories*

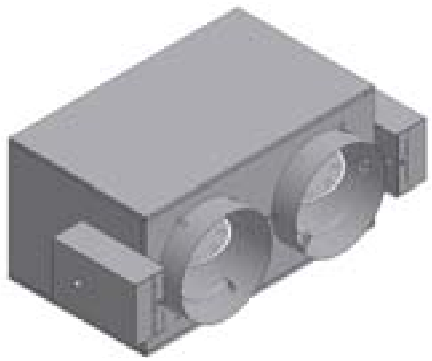
Digit 36—Duct Temp Sensor

0 = None
1 = With Duct Temp Sensor

Dual-Duct VAV Terminal Units

Dual-duct units have two air valves. One heating valve and one cooling air valve modulate simultaneously to provide occupant comfort. These systems were popular prior to the energy crisis of the early 1970s. Popularity is increasing with system concepts which use one valve for maintaining and monitoring 100% ventilation air.

Figure 1. Dual duct terminal unit



The features of the dual-duct VAV terminal units are described by the product categories shown in bold. Within each category the options available are listed

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 "Performance Data" section of the VAV catalog is used to make a determination of the amount of noise 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.

Computer Selection

The advent of personal computers has served to automate many processes that were previously repetitive and time-consuming. One of those tasks is the proper scheduling, sizing, and selection of VAV terminal units. Trane has developed a computer program to perform these tasks. The software is called the Trane Official Product Selection System (TOPSS™).

The TOPSS program will take the user's input specifications and output the properly sized VariTrane™ VAV terminal unit along with the specific performance for that size unit.

The program has several required fields, denoted by red shading in the TOPSS program, and many other optional fields to meet the criteria you have. Required values include maximum and minimum airflows, control type, and model. If selecting models with reheat, you will be required to enter information to make that selection also. The user is given the option to look at all the information for one selection on one screen or as a schedule with the other VAV units on the job.

The user can select single-duct, dual-duct, and fan-powered VAV boxes with the program, as well as most other Trane products, allowing you to select all your Trane equipment with one software program.

The program will also calculate sound power data for the selected terminal unit. The user can enter a maximum individual sound level for each octave band or a maximum NC value. The program will calculate acoustical data subject to default or user supplied sound attenuation data.

Schedule View: The program has many time-saving features such as: 1) Copy/Paste from spreadsheets like Microsoft® Excel; 2) Easily arranged fields to match your schedule; and 3) Time-saving templates to store default settings The user can also export the Schedule View to Excel to modify and put into a CAD drawing as a schedule. Details regarding the program, its operation, and how to obtain a copy of it are available from your local Trane sales office.

General Data

Table 36. 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/ UCM	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
Pneumatic with Volume Regulator	5	350	63-350	0,63-350	63-700
	6	500	73-500	0,73-500	73-1000
	8	900	134-900	0,134-900	134-1800
	10	1400	215-1400	0,215-1400	215-2800
	12	2000	300-2000	0,300-2000	300-4000
	14	2885	408-2885	0,408-2885	408-5770
	16	3785	536-3785	0,536-3785	536-7570

Table 37. 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/ UCM	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
Pneumatic with Volume Regulator	5	165	30-165	0,30-165	30-330
	6	236	35-236	0,35-236	35-472
	8	425	63-425	0,63-425	63-850
	10	661	102-661	0,102-661	102-1321
	12	944	141-944	0,141-944	141-1888
	14	1362	193-1362	0,193-1362	193-2723
	16	1787	253-1787	0,253-1787	253-3573

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

Performance Data

Table 38. Air pressure drop-in. wg (I-P)

Inlet Size	Airflow Cfm	VDDF
05	100 200 300 350	0.01 0.02 0.04 0.06
06	100 250 350 500	0.01 0.08 0.17 0.38
08	200 400 600 900	0.01 0.04 0.10 0.24
10	500 800 1100 1400	0.02 0.05 0.10 0.17
12	800 1200 1600 2000	0.01 0.03 0.06 0.10
14	1500 2000 2500 3000	0.04 0.07 0.12 0.19
16	2000 2500 3000 4000	0.03 0.04 0.06 0.10

Note: Pressure drops are per air valve

Table 39. Air pressure drop-Pa (SI)

Inlet Size	Airflow L/s	VDDF
05	45 95 140 165	3 5 11 15
06	45 120 165 235	3 21 42 93
08	95 190 280 420	3 11 25 59
10	235 375 520 660	5 13 26 42

Note: Pressure drops are per air valve

Table 39. Air pressure drop-Pa (SI) (continued)

12	375 565 755 940	3 8 15 24
14	700 945 1180 1415	9 18 30 46
16	940 1180 1415 1885	6 10 14 25

Note: Pressure drops are per air valve

Table 40. Integral outlet plenum air pressure drop-in. wg (I-P)

Outlet Diameter (in.)	Airflow (Cfm)	Integral Outlet Configurations						
		A,C	B	D,E	F	G	H	J
5	100	0.06	0.05	0.02	0.03	-	0.01	-
	200	0.23	0.19	0.09	0.09	-	0.03	-
	300	0.50	0.44	0.19	0.18	-	0.08	-
	350	0.67	0.60	0.26	0.24	-	0.12	-
6	100	0.04	0.03	0.01	0.01	-	0.01	-
	250	0.20	0.17	0.07	0.06	-	0.04	-
	350	0.38	0.32	0.13	0.11	-	0.08	-
	500	0.74	0.63	0.25	0.21	-	0.15	-
8	200	0.11	0.02	0.01	0.01	0.01	0.01	0.01
	400	0.28	0.10	0.03	0.04	0.02	0.02	0.01
	600	0.50	0.25	0.07	0.09	0.05	0.04	0.02
	900	0.88	0.59	0.15	0.22	0.11	0.09	0.03
10	500	0.07	0.08	0.02	0.03	-	0.01	-
	800	0.19	0.19	0.04	0.08	-	0.02	-
	1100	0.35	0.34	0.07	0.15	-	0.04	-
	1400	0.56	0.52	0.11	0.24	-	0.07	-

Table 41. Integral outlet plenum air pressure drop-Pa (SI)

Outlet Diameter (mm)	Airflow (L/s)	Integral Outlet Configurations						
		A,C	B	D,E	F	G	H	J
127	50	16	12	6	7	-	3	-
	100	58	48	23	22	-	8	-
	140	124	109	49	46	-	21	-
	165	166	148	65	60	-	30	-
152	50	9	8	3	3	-	3	-
	120	51	43	17	15	-	10	-
	165	95	80	32	27	-	19	-
	235	185	158	62	51	-	36	-
203	95	27	6	2	3	3	3	3
	190	71	26	8	10	6	5	2
	280	125	62	18	24	13	10	4
	420	219	147	39	54	27	22	8
254	235	18	20	5	7	-	3	-
	375	46	47	11	19	-	6	-
	520	87	84	18	36	-	11	-
	660	140	131	27	59	-	17	-

OUTL CONVERSION CHART	
SYMBOL	NOMINALØ
I	127 mm (5")
II	152 mm (6")
III	203 mm (8")
IV	254 mm (10")

OUTLET AVAILABILITY CHART-SEE OUTL CONVERSION FOR NOMINALØ					
VALV		0505	0606	0808	1010
OUTL	A,B,C	I, II, III	II, III	III, IV	N/A
	D,E,F	I, II	I, II, III	II, III, IV	III, IV
	G	N/A	N/A	N/A	III
	H	I, II	I, II, III	I, II, III	III, IV
	J	N/A	N/A	N/A	III

OUTLET PLENUM ARRANGEMENTS (TOP VIEW)

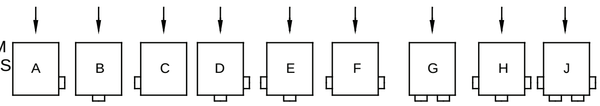


Table 42. Discharge sound power (dB)[1, 2, 4]

Inlet Size (in)	Cfm	l/s	0.5" Inlet Pressure ΔPs[5]						1.0" Inlet Pressure ΔPs[5]						1.5" Inlet Pressure ΔPs[3]						2.0" Inlet Pressure ΔPs[5]						3.0" Inlet Pressure ΔPs[5]					
			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
5	130	61	54	46	42	41	36	33	59	52	49	48	46	43							61	55	54	55	55	52	61	57	59	61	61	58
	200	94	60	50	46	45	42	36	64	56	52	51	47	44							68	61	59	58	56	52	68	62	62	63	62	57
	250	118	63	52	49	47	45	39	67	57	54	53	50	45	70	62	58	57	53	50	72	64	61	60	57	53	72	66	65	64	63	57
	350	165	70	58	53	51	49	43	73	62	59	56	55	49							78	69	65	63	60	55	80	71	69	68	65	59
6	200	94	59	49	46	45	42	35	64	55	52	50	47	43							68	60	58	58	56	51	67	61	62	62	62	56
	300	142	66	54	50	48	46	39	69	60	58	54	52	46							75	66	63	61	58	53	75	68	66	65	63	57
	400	189	69	57	53	50	46	40	75	64	61	57	55	49	77	66	63	61	58	53	79	69	66	63	60	55	81	72	70	68	65	59
	500	236	67	56	54	50	44	41	77	67	63	58	55	50							85	73	69	66	63	57	86	75	74	71	67	61
8	350	165	64	54	51	50	48	39	70	61	58	57	55	45							73	66	64	64	62	53	73	68	68	68	66	58
	520	245	67	56	54	54	52	44	75	64	61	61	58	51							81	72	69	68	65	56	81	73	72	72	69	60
	700	330	69	58	56	55	53	46	77	66	63	62	61	54	81	71	69	67	64	58	85	74	72	70	68	60	87	79	76	74	71	62
	900	425	71	61	59	56	52	46	78	68	65	64	62	56							86	76	73	72	69	62	91	81	79	76	73	66
12	800	378	70	59	55	53	51	46	78	67	64	62	61	57							83	75	71	69	67	64	83	77	73	71	69	68
	1200	566	74	61	56	53	51	46	83	71	64	62	60	56							89	79	73	70	68	65	89	82	77	73	72	69
	1550	732																														
	1600	755	74	64	58	55	53	48	84	72	65	62	60	56	90	77	69	68	65	61	92	81	73	71	69	65	94	84	77	75	72	70
	2000	944	76	66	61	57	55	50	84	74	67	63	61	56							95	82	74	72	69	65	97	87	78	76	72	69
14	1100	519	70	60	57	57	57	50	79	69	65	65	65	61							84	76	73	71	71	69	84	78	76	73	73	75
	1600	755	72	62	57	57	56	50	80	70	65	65	66	60							88	78	74	72	72	70	89	82	77	76	74	74
	2100	991	74	65	60	59	58	51	82	72	66	66	66	60	86	76	70	70	70	65	89	79	73	73	72	70	90	83	78	76	75	74
	3000	1416	78	68	63	64	63	55	85	75	69	70	69	61							91	82	76	75	74	70	94	86	80	77	76	75
16	1400	661	69	60	57	56	59	54	78	69	67	64	66	63							84	77	73	70	70	72	85	80	77	73	71	76
	2100	991	70	61	57	58	60	53	79	70	66	65	66	63							87	78	74	72	72	71	89	82	78	76	73	76
	2800	1321	72	64	59	60	62	54	79	71	66	67	67	63	84	76	70	70	71	68	87	78	74	72	72	71	91	83	79	76	75	75
	3000	1416																														
	4000	1888	75	67	63	67	67	59	82	74	69	71	71	64							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^{-12} Watts.
3. Data in this column constitute AHRI 880-2011 Standard Rating Conditions
4. Where ΔPs is the inlet static pressure minus discharge static.
5. Application ratings are outside the scope of the certification program.

Table 43. Radiated sound power (dB)[1, 2, 4]

Inlet Size (in)	Cfm	l/s	0.5" Inlet Pressure ΔPs[5]						1.0" Inlet Pressure ΔPs[5]						1.5" Inlet Pressure ΔPs[3]						2.0" Inlet Pressure ΔPs[5]						3.0" Inlet Pressure ΔPs[5]					
			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
5	130	61	51	44	33	28	24	24	52	46	38	34	29	30							52	48	43	43	39	39	48	49	46	48	47	47
	200	94	53	46	36	31	25	23	56	50	42	37	31	29							57	52	48	44	39	39	56	54	51	49	46	46
	250	118	55	49	39	33	27	24	58	52	44	39	33	29	59	55	48	42	37	35	59	56	50	45	41	39	59	58	54	51	47	46
	350	165	60	53	45	37	31	26	62	57	48	42	36	31							64	60	53	48	42	40	65	63	58	52	47	45
6	200	94	52	45	35	29	24	23	55	48	41	34	28	27							58	51	47	41	36	34	56	53	49	45	42	40
	300	142	57	50	40	34	26	23	59	53	45	38	31	27							62	57	50	44	37	34	61	59	55	49	43	39
	400	189	58	51	42	34	28	24	63	58	49	42	35	29	64	60	52	45	37	31	65	60	54	47	40	35	66	63	58	51	44	39
	500	236	58	52	45	36	31	27	66	60	51	42	37	30							69	65	57	50	43	37	71	67	60	55	46	41
8	350	165	56	49	40	34	28	25	60	55	47	41	33	28							63	59	53	46	39	35	62	61	55	49	44	40
	520	245	57	52	44	37	31	26	64	58	51	44	37	30							68	64	57	50	43	36	67	66	60	54	46	41
	700	330	60	55	47	40	34	28	66	61	52	46	39	32	69	64	57	51	43	36	71	67	59	53	45	39	73	72	64	58	49	44
	900	425	60	56	48	41	37	31	67	64	55	48	43	36							73	70	61	55	48	43	76	74	66	60	52	46
12	800	378	61	51	45	39	32	22	66	59	50	45	38	31							70	64	57	50	44	39	71	67	60	52	47	44
	1200	566	64	54	48	41	36	25	71	62	52	47	42	34							75	69	59	52	47	42	77	72	64	55	50	47
	1550	732	65	57	47	42	40	28	73	64	53	47	46	36							81	72	61	53	49	45	83	75	65	56	52	48
	1600	755													78	68	58	50	47	41												
	2000	944	66	59	48	44	45	35	75	66	54	48	48	40							85	74	62	53	51	47	88	79	67	57	53	50
14	1100	519	58	50	43	39	33	23	67	58	52	45	40	34							72	66	60	51	45	40	72	68	64	53	48	46
	1600	755	61	53	44	40	36	24	69	60	53	47	42	32							76	68	61	53	47	41	79	73	66	55	49	46
	2100	991	63	55	46	42	40	27	71	62	53	47	44	35	76	66	57	50	47	39	78	69	61	52	48	43	82	73	66	56	51	46
	3000	1416	66	60	50	46	49	36	75	66	55	50	50	40							85	73	61	54	52	47	88	77	66	57	53	48
16	1400	661	57	50	46	43	37	25	65	58	52	48	42	34							73	66	60	50	45	42	72	70	64	53	46	47
	2100	991	59	53	48	46	42	28	67	60	54	50	47	36							75	68	62	53	49	45	78	73	66	56	49	48
	2800	1321													74	66	58	53	52	44												
	3000	1416	61	56	50	50	48	33	69	62	54	52	52	40							78	69	61	55	53	47	83	74	66	58	53	51
	4000	1888	65	61	54	54	59	43	71	65	58	55	60	49							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^{-12} Watts.
3. Data in this column constitute AHRI 880-2011 Standard Rating Conditions
4. Where ΔPs is the inlet static pressure minus discharge static.
5. Application ratings are outside the scope of the certification program.

Table 44. Sound noise criteria (NC)

			Discharge[1,2,4]								Radiated[1,2,4]					
			Inlet Pressure (ΔPs)[3,5]								Inlet Pressure (ΔPs)[3,5]					
Inlet Size (in)	CFM	l/s	0.5"	1.0"	1.5"	2.0"	3.0"	Inlet Size (in)	CFM	l/s	0.5"	1.0"	1.5"	2.0"	3.0"
	130	61	--	--		16	21		130	61	--	--		16	20
5	200	94	--	20		25	25	5	"200	94	--	18		22	25
	250	118	19	24	28	30	30		250	118	17	20	24	25	28
	350	165	28	32		38	41		350	165	22	26		30	33
	200	94	--	16		21	20		200	94	--	16		21	23
6	300	142	19	23		30	30	6	"300	142	19	21		26	30
	400	189	23	30	33	35	38		400	189	20	27	30	30	33
	500	236	20	33		43	44		500	236	20	30		36	38
	350	165	16	24		28	28		300	142	17	24		28	31
8	520	245	20	30		38	38	8	500	236	20	27		34	37
	700	330	23	33	38	43	46		700	330	24	31	34	38	44
	900	425	25	34		44	51		900	425	25	34		42	46
	550	260	16	26		32	32		500	236	20	25		30	34
10	820	387	20	30		39	39	10	800	378	22	29		36	39
	1100	519	24	33	39	43	46		1100	519	22	31	36	39	43
	1400	661	28	35		46	50		1400	661	24	35		43	47
	800	378	21	32		38	38		650	307	24	30		35	38
	1200	566	27	38		46	46		1100	519	27	36		42	44
12	1550	732						12	1550	732	29	39		49	52
	1600	755	27	39	47	50	52		1600	755			45		
	2000	944	29	39		54	56		2000	944	30	42		54	58
	1100	519	21	33		39	39		900	425	20	31		38	39
14	1600	755	24	34		45	46	14	1500	708	24	34		43	47
	2100	991	27	37	42	46	47		2100	991	26	36	43	45	51
	3000	1416	32	41		48	52		3000	1416	30	42		54	58
	1400	661	20	32		39	41		1200	566	20	29		39	42
	2100	991	21	33		43	46		2000	944	22	31		42	45
16	2800	1321	24	33	39	43	48	16	2800	1321			40		
	3000	1416							3000	1416	25	34		45	52
	4000	1888	28	37		47	51		4000	1888	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. Data at 1.5" inlet pressure constitute AHRI 880-2011 Standard Rating Conditions
4. Where ΔPs is the inlet static pressure minus discharge static.
5. Data at 0.5", 1.0", 2.0"& 3.0" are application ratings. These ratings are outside the scope of the certification program.

Table 45. 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: Subtract from terminal unit sound power to determine radiated sound pressure in the space.
1. NC Values are calculated using modeling assumptions based on AHRI 885-2008.
2. Where DPs is inlet static pressure minus discharge static pressure.
3. Application ratings are outside the scope of the Certification Program.

Table 46. AHRI 885-2008 discharge transfer function assumptions

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

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

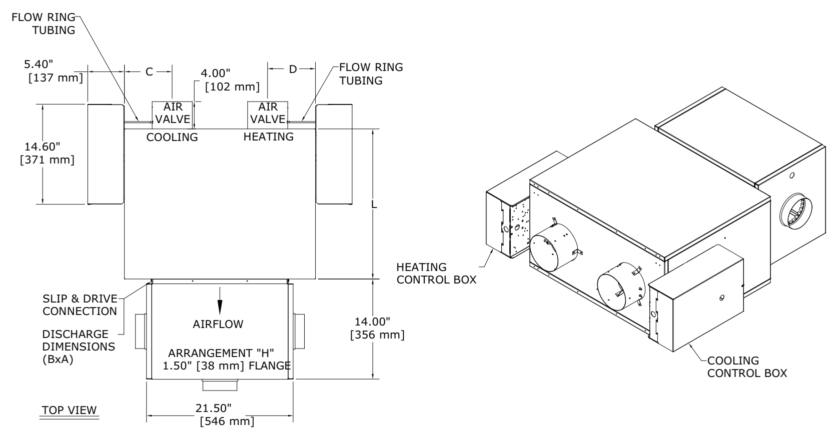
Dimensional Data

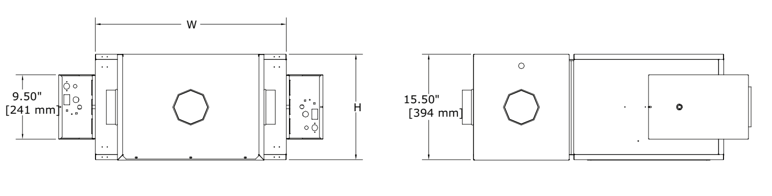
DUAL-DUCT WITH OUTLET PLENUM (VDDF)

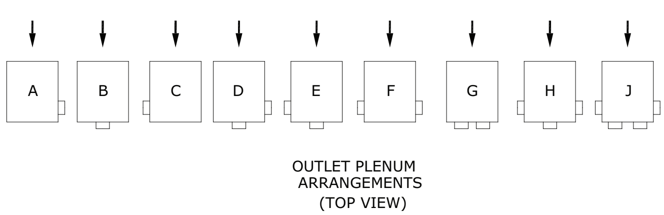
INLET		CFM		L/s		INLET SIZE (NOMINAL Ø)		DISCHARGE DIMENSIONS		C	D	L	W	H	WT LBS [kg]
COOL	HEAT	COOL	HEAT	COOL	HEAT	COOL	HEAT	A	B						
05	05	350	350	165	165	5" [127mm]	5" [127mm]	14.00" [356mm]	20.00" [508mm]	7.00" [178mm]	7.00" [178mm]	22.00" [559mm]	28.00" [711mm]	15.50" [394mm]	54 [24]
06	05	500	350	236	165	6" [152mm]									54 [24]
06	06	500	500	236	236		6" [152mm]								54 [24]
08	06	900	500	425	236	8" [203mm]				8.00" [203mm]					55 [25]
08	08	900	900	425	425		8" [203mm]				8.00" [203mm]				56 [25]
10	08	1400	900	661	425	10" [254mm]				7.00" [178mm]					57 [26]
10	10	1400	1400	661	661		10" [254mm]				7.00" [178mm]				61 [28]
12	08	2000	900	994	425	12" [305mm]	8" [203mm]	20.00" [508mm]		10.00" [254mm]	8.00" [203mm]	24.00" [610mm]	40.00" [1016mm]	21.50" [546mm]	58 [26]
12	10	2000	1400	994	661		10" [254mm]				9.00" [229mm]				59 [27]
12	12	2000	2000	994	994		12" [305mm]				10.00" [254mm]				60 [27]
14	14	3000	3000	1416	1416	14" [356mm]	14" [356mm]								81 [37]
16	16	4000	4000	1888	1888	16" [406mm]	16" [406mm]								83 [38]

OUTL CONVERSION CHART	
SYMBOL	NOMINALØ
I	5" [127mm]
II	6" [152mm]
III	8" [203mm]
IV	10" [254mm]

OUTLET AVAILABILITY CHART - SEE OUTL CONVERSION FOR NOMINALØ					
VALV		0505	0606	0808	1010
OUTL	A,B,C	I, II, III	II, III	III, IV	N/A
	D,E,F	I, II	I, II, III	II, III, IV	III, IV
	G	N/A	N/A	N/A	III
	H	I, II	I, II, III	I, II, III	III,IV
	J	N/A	N/A	N/A	III





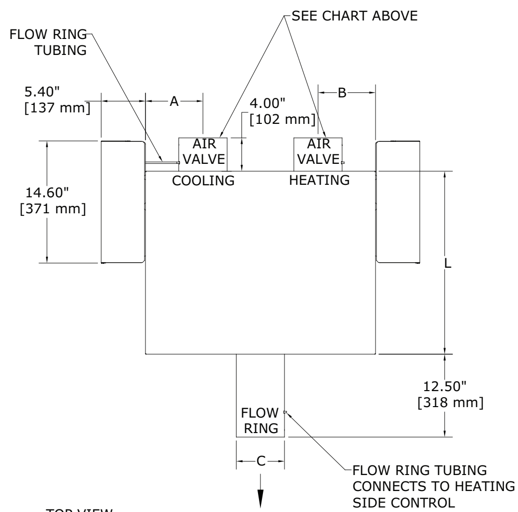


OUTLET PLENUM ARRANGEMENTS (TOP VIEW)

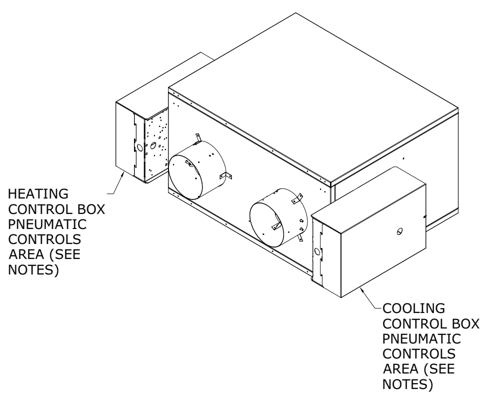
1. Outlet combinations to remote diffusers have optional integral balancing dampers (see specification sheet).
2. Outlet connections are centered in plenum panel.
3. Minimum of 1.5 duct diameters of straight duct required for proper flow reading.
4. Allow 36" [914mm] on control side for servicing
5. Weights are an estimation and will vary based on selected options, insulation type, etc.
6. Allow 48" [1219] of straight duct downstream of unit before first runout & inside of the duct should be equal discharge size (A x B).

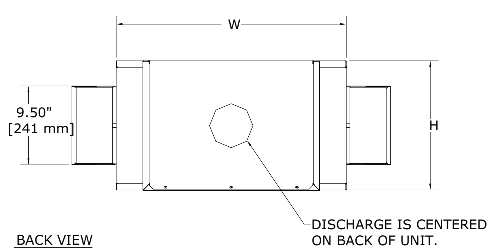
DUAL-DUCT WITH OUTLET PLENUM (VDDF)

INLET		CFM		L/s		INLET SIZE (NOMINAL Ø)		A	B	C	L	W	H	WT LBS [kg]
COOL	HEAT	COOL	HEAT	COOL	HEAT	COOL	HEAT							
05	05	350	350	165	165	5" [127mm]	5" [127mm]	7.00" [178mm]	7.00" [178mm]	5" [127mm]	22.00" [559mm]	28.00" [711mm]	15.50" [394mm]	54 [24]
06	05	500	350	236	165	6" [152mm]	↓			6" [152mm]				54 [24]
06	06	500	500	236	236	↓	6" [152mm]	↓		↓				54 [24]
08	06	900	500	425	236	8" [203mm]	↓	8.00" [203mm]	↓	8" [203mm]				55 [25]
08	08	900	900	425	425	↓	8" [203mm]	↓	8.00" [203mm]	↓				56 [25]
10	08	1400	900	661	425	10" [254mm]	↓	7.00" [178mm]	↓	10" [254mm]				57 [26]
10	10	1400	1400	661	661	↓	10" [254mm]	↓	7.00" [178mm]	↓	↓	↓	↓	61 [28]
12	08	2000	900	994	425	12" [305mm]	8" [203mm]	10.00" [254mm]	8.00" [203mm]	12" [305mm]	24.00" [610mm]	40.00" [1016mm]	21.50" [546mm]	58 [26]
12	10	2000	1400	994	661		10" [254mm]		9.00" [229mm]					59 [27]
12	12	2000	2000	994	994	↓	12" [305mm]		10.00" [254mm]	↓				60 [27]
14	14	3000	3000	1416	1416	14" [356mm]	14" [356mm]			14" [356mm]				81 [37]
16	16	4000	4000	1888	1888	16" [406mm]	16" [406mm]	↓	↓	16" [406mm]	↓	↓	↓	83 [38]

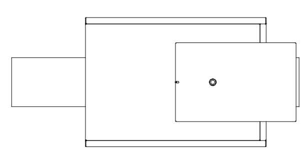


TOP VIEW





BACK VIEW



SIDE VIEW

1. See mechanical specifications for general unit clearances.
2. No control box provided for the following options: ENON, PNON, DD00 and Pneumatic controls.

Mechanical Specifications

Dual-Duct Terminal Unit

Model VDDF

Casing

22-gage 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" (12.7 mm) Matte-faced Insulation—The interior surface of the unit casing is acoustically and thermally lined with ½-inch, 1.5 lb/ft3 (12.7 mm, 24.0 kg /m3) composite density glass fiber with a high-density facing. The insulation R-Value is 1.9. The insulation is UL listed and meets NFPA-90A and UL 181 standards. There are no exposed edges of insulation (complete metal encapsulation).

1" (25.4 mm) Matte-faced Insulation—The interior surface of the unit casing is acoustically and thermally lined with 1-inch, 1.0 lb/ft3 (25.4 mm, 16.0 kg /m3) composite density glass fiber with a high-density facing. The insulation R-Value is 3.85. The insulation is UL listed and meets NFPA-90A and UL 181 standards. There are no exposed edges of insulation (complete metal encapsulation).

1" (25.4 mm) Foil-faced Insulation—The interior surface of the unit casing is acoustically and thermally lined with 1-inch, 1.0 lb/ft3 (25.4 mm, 16.0 kg /m3) density glass fiber with foil facing. The insulation R-Value is 3.85. 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" (25.4 mm) Double-wall Insulation—The interior surface of the unit casing is acoustically and thermally lined with a 1-inch, 1.0 lb./ft3 (25.4 mm, 16.0 kg/m3) composite density glass fiber with high-density facing. The insulation R-value is 3.85. The insulation is UL listed and meets NFPA-90A and UL 181 standards. An interior liner made of 26-gage galvanized steel covers the insulation. All wire penetrations are covered by grommets. There are no exposed edges of insulation (complete metal encapsulation).

3/8" (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/ft3 (9.5 mm, 70.0 kg/m3) 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 47. Air valve combinations available

Air Valve Size in. (mm) Cooling	Cataloged Airflow cfm (L/s) Cooling	Air Valve Size in. (mm) Heating	Catalog Airflow cfm (L/s) Heating
05 (127)	350 (165)	05 (127)	350 (165)
06 (152)	500 (236)	05 (127)	350 (165)
06 (152)	500 (236)	06 (152)	500 (236)
08 (203)	900 (425)	06 (152)	500 (236)
08 (203)	900 (425)	08 (203)	900 (425)

Table 47. Air valve combinations available (continued)

Air Valve Size in. (mm) Cooling	Cataloged Airflow cfm (L/s) Cooling	Air Valve Size in. (mm) Heating	Catalog Airflow cfm (L/s) Heating
05 (127)	350 (165)	05 (127)	350 (165)
10 (254)	1400 (661)	08 (203)	900 (425)
10 (254)	1400 (661)	10 (254)	1400 (661)
12 (305)	1400 (944)	08 (203)	900 (425)
12 (305)	2000 (944)	10 (254)	1400 (661)
12 (305)	2000 (944)	12 (305)	2000 (944)
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-gage 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-gage 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. At 4.0 in. wg, air valve leakage does not exceed 1% of cataloged airflow.

Outlet Connection

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

Outlet Plenum/Attenuator—A sheet metal, insulated plenum/attenuator with circular opening(s) is attached to the discharge of the main unit at the factory. The circular opening(s) are centered on the unit plenum to accept round ductwork connections.

Outlet Plenum/Attenuator with Balancing Dampers—A sheet metal, insulated plenum/attenuator with circular opening(s) is factory-connected to the main unit. The circular opening(s) with balancing damper(s) are centered on the unit plenum to accept round ductwork connections.

Unit Controls Sequence of Operation

Unit controller continuously monitors zone temperature against its setpoint and varies primary airflow as required to meet zone 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.

DDC Actuator - Belimo — LMB24-3-T TN 3-wire, 24 VAC/DC, 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.

Direct Digital Controller—The microprocessor based terminal unit controller provides accurate, pressure-independent control through the use of a proportional integral control algorithm and direct digital control technology. The controller, named the Unit Control Module (UCM), monitors zone temperature setpoints, zone temperature and its rate of change, and valve airflow using a differential pressure signal from the pressure transducer. Additionally, the controller can monitor either supply duct air temperature or CO2 concentration via appropriate sensors. The controller is provided in an enclosure with 7/8" (22 mm) knockouts for remote control wiring. A Trane UCM zone sensor is required.

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

Digital Display Zone Sensor with Liquid Crystal Display (LCD)—The digital display zone sensor contains a sensing element, which sends a signal to the UCM. 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 the UCM 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.

Pneumatic Controls

Normally-Open Actuator—Pneumatic 3 to 8 psig (20 to 55 kPa) spring-range pneumatic actuator.

Normally-Closed Actuator—Pneumatic 8 to 13 psig (55 to 90 kPa) spring-range pneumatic actuator.

3011 Pneumatic Volume Regulator (PVR)—The regulator is a thermostat reset velocity controller, which provides consistent air delivery within 5% of cataloged flow down to 18% or less of unit cataloged cfm, independent of changes in system static pressure. Factory-calibrated, field-adjustable setpoints for minimum and maximum flows. Average total unit bleed rate, excluding thermostat, is 28.8 scim at 20 psig (7.87 mL/min at 138 kPa) supply.

3501 Pneumatic Volume Regulator (PVR)—The 3501 regulator is a linear reset volume controller. This PVR is used to maintain a constant volume of airflow from the dual-duct unit when constant volume control is used. Average total unit bleed rate, excluding thermostat, is 43.2 scim at 20 psig (11.8 mL/min at 138 kPa) supply.

Control Options

Transformer—The 50-VA transformer is factory-installed in an enclosure with 7/8" (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

Tracer UC400 and UC210 Programmable BACnet Controllers

The Tracer™ UC400 and 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. Trane VAV units have been made with either pneumatic, analog electronic, or microprocessor controls (DDC VAV). UC400 is not an option on Dual Duct.

The Tracer UC400 or 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 Tracer UC400 or 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.

The Tracer UC400 or 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.

The Tracer UC400 or UC210 controller can be configured for FTC and has two VAV units with Tracer UC400 or UC210 controllers working together to provide flow tracking control. One Tracer UC400 or 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.

The Tracer UC400 or UC210 controller is 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 Tracer UC400 controller to integrate with other BACnet systems.

Available Inputs

Inputs include a twisted/shielded communication link, zone sensor, duct temperature sensors (optional), Occupancy Sensor (optional), Discharge Air Temperature (DAT) and/or Supply Air Temperature (SAT), CO2 sensor, and 24 VAC power. In addition to the points used for the VAV application, the spare inputs and outputs on the Tracer UC400 controller may be used for ancillary control, which can be programmed using Tracer TU Tracer Graphical Programming 2 (TGP2).

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

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 UL1995 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 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 VV550 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

- 24 VAC binary input that can be configured as a generic input or as occupancy input. When the DDC controller is operating with a Tracer ™ SC, the status of the input is provided to Tracer for its action. In stand-alone operation and when configured for an occupancy input, the input will control occupancy status of the DDC controller.
- Auxiliary temperature analog input configured for an auxiliary temperature sensor. When sensor is mounted in the supply air duct, the value of the input is used as status-only by Tracer SC if Tracer SC is providing a supply air temperature to the DDC controller. Otherwise, the input will be used for determining heating/cooling control action of the VAV unit. When the auxiliary temperature sensor is located in the discharge of the unit, and attached to a Trane Tracer SC BAS, additional test sequencing and reporting is available to maximize VAV system capabilities and simplify system commissioning.
- Dual-duct support with two DDC controllers. One DDC controller controls the cooling air valve and the other controller controls the heating air valve. With constant-volume sequences, the discharge air volume is held constant by controlling discharge air volume with the heating Controller.
- Tracer™ UC400 or UC210 Programmable BACnet® Controller certified performance ensures that a Trane VAV 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 a HVAC system to adjust ventilation flow based on the measured CO2 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.

Trane DDC VAV Controller Logic with UC210 or UC400 Controls

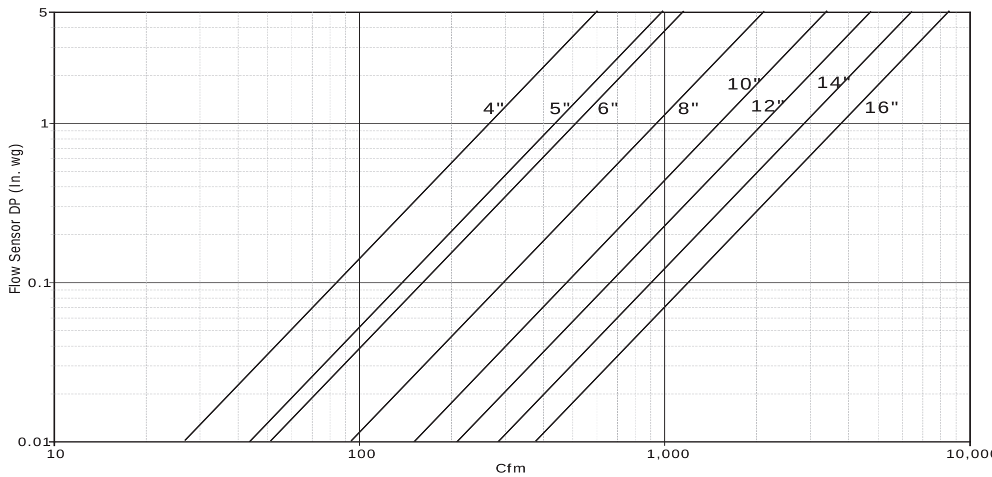
Control Logic

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 Tracer UC400 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:

1. Space Temperature Control
2. Ventilation Flow Control (100% outside air applications)
3. Flow Tracking Space Pressurization Control (New feature)

Figure 2. 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 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 ensure 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's 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: Proportional Hot Water Reheat

Proportional hot water reheat uses 3-wire, floating-point-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% 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. 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. (See Diffuser, "D", section for additional application details).

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.

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°–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.

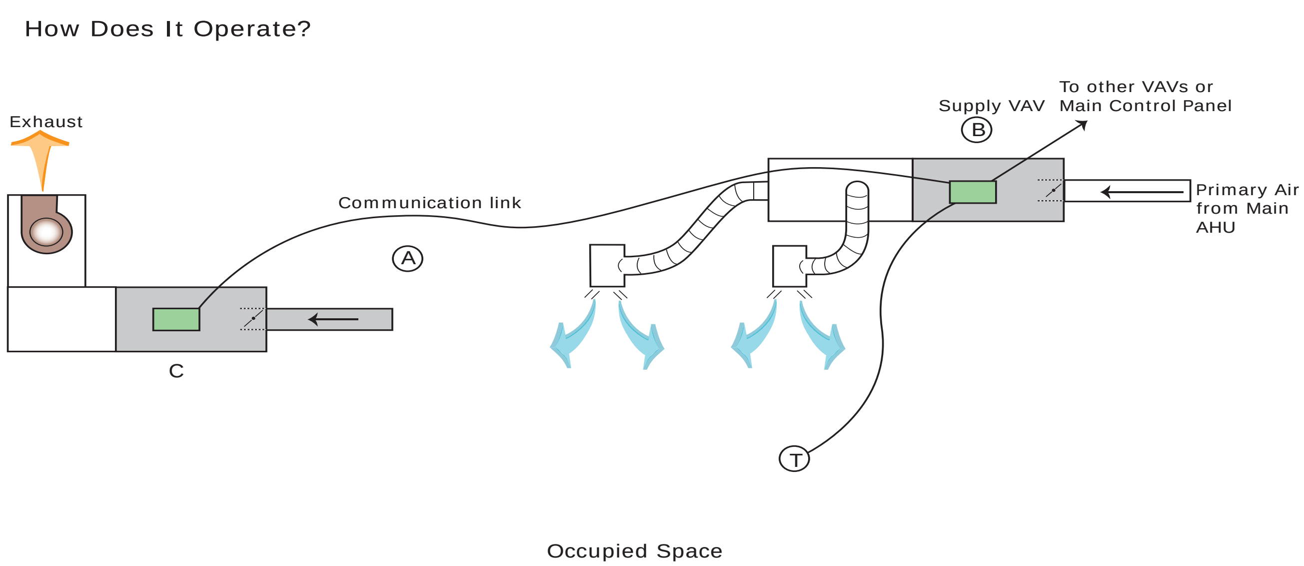
Flow Tracking Control

This enhanced VAV DDC controller feature allows two Trane VV550 controllers 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) unit plus a single-duct, cooling-only, exhaust VAV unit (see C). 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...

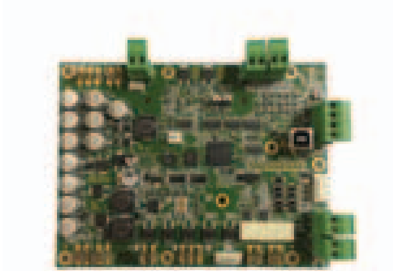
The CFM offset is assured and can be monitored and documented when connected to a Trane Tracer Building Automation System. Flow Tracking Control is designed to meet most pressurization control projects. If an application calls for pressure control other than flow tracking, contact your local Trane Sales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

Figure 3. How does it operate?

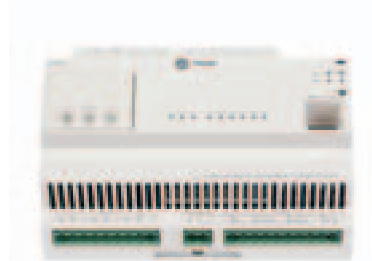


Tracer UC210 and Tracer UC400 Programmable BACnet Controllers

UC210 BACnet Controller



UC400 BACnet Controller



The Tracer™ UC210 and Tracer UC400 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.

The UC210 and UC400 monitor zone temperature, temperature set point, and flow rate. The controller also accepts a discharge air temperature sensor and accepts a supply air temperature from the building controller. hen 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. (See “Factory-installed vs. Factory-commissioned,” p. 10 for more details).

Specifications

Supply Voltage

24 VAC, 50/60 Hz

Maximum VA Load

No Heat or Fan

- 13VA for cooling box only (includes temperature sensors, flow sensor, occupancy input and air valve).
- Additional power needed for other devices and power sensors. See IOM VAV-SVX008*-EN for details.
  - Fan: 6VA
  - Proportional water valve: 4VA
  - 2 position water valve: 6.5VA
  - Staged electric: 10VA (magnetic contactor) each stage

Binary Inputs

Occupancy. Tracer UC400 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 Tracer UC400 also has two generic relays outputs.

Universal Analog Inputs

CO2 and one generic analog input.

Temperature Inputs

Discharge, Zone Temperature, and Zone Set Point.

Tracer UC400 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" (139.7 mm)
Length: 4.5" (69.85 mm)
Height: 2.0" (44.45 mm)

Connections

- UC210: 1/4 tabs and removable screw terminals
- UC400: Removable screw terminals

Communications

BACnet® MS/TP

Heat Staging

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

Trane LonMark™ DDC VAV Controller (VV550)

This LonMark™ certified controller uses the Space Comfort Controller (SCC) profile to exchange information over a LonTalk™ network. Networks with LonMark certified controllers provide the latest open protocol technology. Being LonMark certified guarantees that owners and end-users have the capability of adding Trane products to other "open" systems and relieves owners of the pressure and expense of being locked into a single DDC supplier. The Trane VV550 VAV controller with VariTrane VAV units can be applied to more than just Trane systems. When a customer buys a Trane VAV unit with Trane DDC controller, they take advantage of:

- Factory-commissioned quality
- Knowing they have selected the most reliable VAV controllers in the industry
- Trane as a single source to solve any VAV equipment, or system-related issues
- The most educated and thorough factory service technicians in the controls industry
- Over 150 local parts centers throughout North America that can provide what you need, when you need it.

Don't let your existing controls supplier lock you out of the most recognized name in VAV system control in the industry. Specify Trane open-protocol systems.

The features of this controller are explained below.

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 UL1995 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 Optimization

Trane controllers are designed to integrate into Trane Tracer SC and leverage clear and clean unit-controller related data for system level control decisions. Integrating a Trane VV550 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

- 24 VAC binary input that can be configured as a generic input or as occupancy input. When the DDC controller is operating with Tracer SC, the status of the input is provided to Tracer for its action. In stand-alone operation and when configured for an occupancy input, the input will control occupancy status of the DDC controller.
- Auxiliary temperature analog input configured for an auxiliary temperature sensor. When sensor is mounted in the supply air duct, the value of the input is used as status-only by Tracer SC if Tracer SC is providing a supply air temperature to the DDC controller. Otherwise, the input will be used for determining heating/cooling control action of the VAV unit. When the auxiliary temperature sensor is located in the discharge of the unit, and attached to a Trane SC BAS, additional test sequencing and reporting is available to maximize VAV system capabilities and simplify system commissioning.
- Dual-duct support with two DDC controllers. One DDC controller controls the cooling air valve and the other controller controls the heating air valve. With constant-volume sequences, the discharge air volume is held constant by controlling discharge air volume with the heating Controller.
- LonMark certified performance ensures that a Trane VAV 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 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.

Trane DDC VAV Controller Logic with VV550 Controls

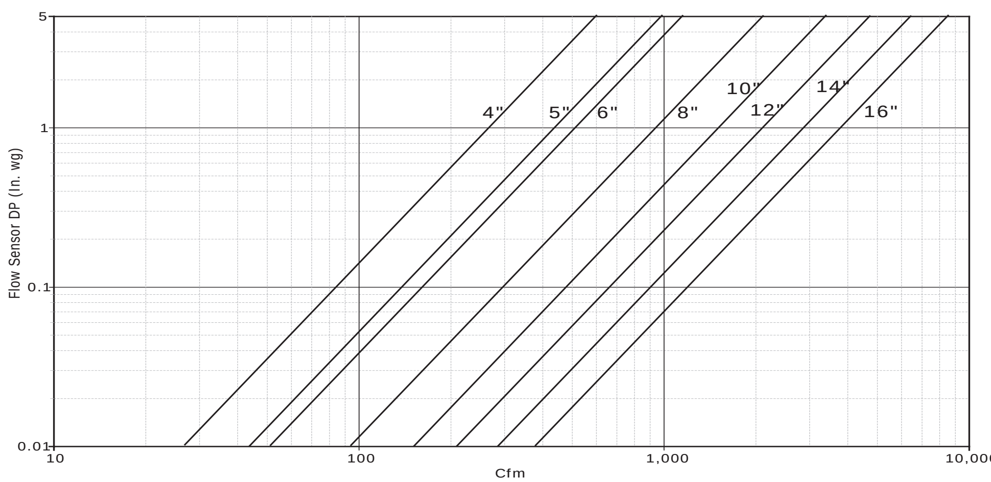
Control Logic

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 LonMark 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:

4. Space Temperature Control
5. Ventilation Flow Control (100% outside air applications)
6. Flow Tracking Space Pressurization Control (New feature)

Figure 4. 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 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 ensure 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's 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: Proportional Hot Water Reheat

Proportional hot water reheat uses 3-wire, floating-point-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% open and de-energized when the proportional valve reaches 50% 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% 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. 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. (See Diffuser, "D", section for additional application details).

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 50º–60ºF). This is critical to ensure 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.

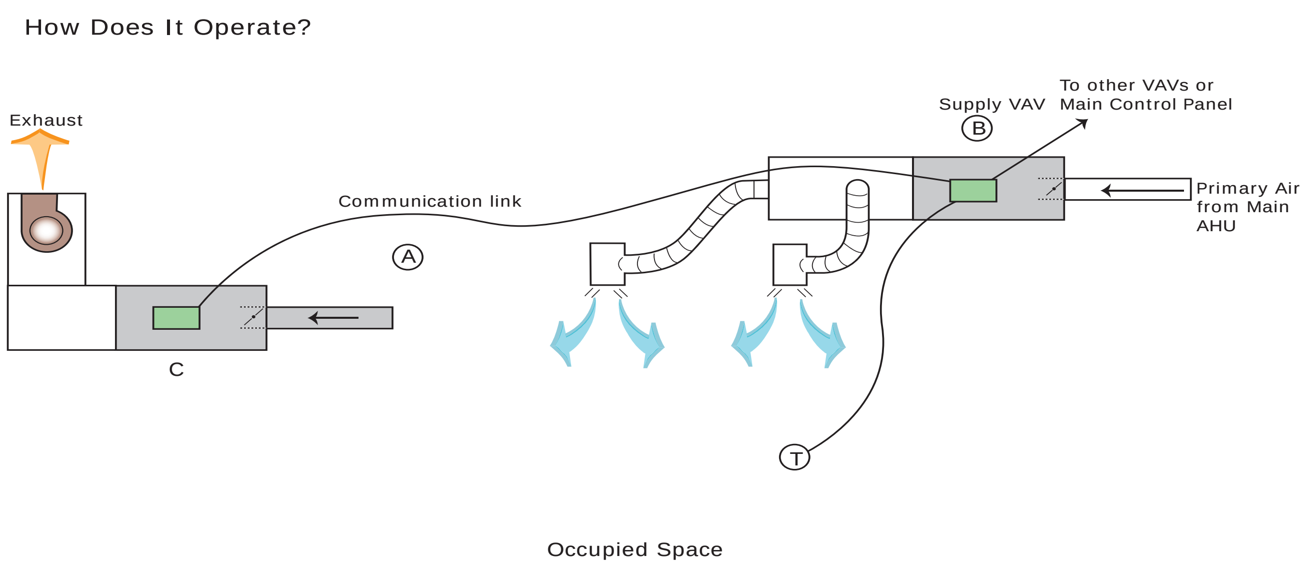
Flow Tracking Control

This enhanced VAV DDC controller feature allows two Trane VV550 controllers 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) unit plus a single-duct, cooling-only, exhaust VAV unit (see C). 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:

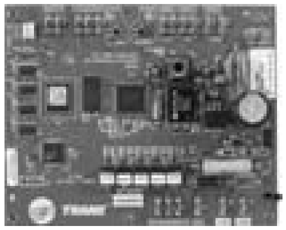
- School and University laboratories
- Industrial laboratories
- Hospital operating rooms
- Hospital patient rooms
- Research and Development facilities
- And many more...

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 5. How does it operate?



LonMark Direct Digital Controller—Unit Control Module (VV550)



The Trane LonMark® direct digital controller Unit Control Module (DDC-UCM) is a microprocessor-based terminal unit with non-volatile memory which provides accurate airflow and room temperature control of Trane and non-Trane VAV air terminal units. provides a simple open protocol to allow integration of Trane VAV units and controls into other existing control systems. The UCM can operate in pressure-independent or pressure-dependent mode and uses a proportional plus integral control algorithm.

The controller monitors zone temperature setpoints, zone temperature and its rate of change and valve airflow (via flow ring differential pressure). The controller also accepts an auxiliary duct temperature sensor input or a supply air temperature value from Tracer™ SC. Staged electric heat, pulse width modulated electric heat, proportional hot water heat or on/off hot water heat control are provided when required. The control board operates using 24-VAC power. The Trane LONMARK DDC-UCM is also a member of the Trane Integrated Comfort™ systems (ICS) family of products. When used with a Trane Tracer SC or other Trane controllers, zone grouping and unit diagnostic information can be obtained. Also part of ICS is the factory-commissioning of parameters specified by the engineer (see “Factory-installed vs. Factory-commissioned,” p. 10 for more details).

Note: *Trane LONMARK® DDC-UCM controllers can also take advantage of factory-commissioned quality on non-Trane systems through LONMARK open protocol.*

Specifications

Supply Voltage

24 VAC, 50/60 Hz

Maximum VA Load

No Heat or Fan

8 VA (Board, Transducer, Zone Sensor, and Actuator)

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

Output Ratings

Actuator Output:24 VAC at 12 VA
1st Stage Reheat:24 VAC at 12 VA
2nd Stage Reheat:24 VAC at 12 VA
3rd Stage Reheat:24 VAC at 12 VA

Binary Input

24 VAC, occupancy or generic.

Auxiliary Input

Can be configured for discharge or primary air temperature sensor.

Operating Environment

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

Storage Environment

-40 to 180°F (-40 to 82.2°C),
5% to 95%RH, Non-Condensing

Physical Dimensions

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

Connections

1/4" (6.35 mm) Stab Connections

Communications

LONMARK – Space Comfort Control (SCC) profile with FTT-10 transceiver.

22 awg. unshielded level 4 communication wire.

Heat Staging

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

Table 48. Input listing

Input description	Input	SNVT type
Space temperature	nviSpaceTemp	SNVT_temp_p
Setpoint	nviSetpoint	SNVT_temp_p
Occupancy, schedule	nviOccSchedule	SNVT_tod_event
Occupancy, manual command	nviOccManCmd	SNVT_occupancy
Occupancy sensor	nviOccSensor	SNVT_occupancy
Application mode	nviApplicMode	SNVT_hvac_mode
Heat/cool mode input	nviHeatCool	SNVT_hvac_mode
Fan speed command	nviFanSpeedCmd	SNVT_switch
Auxiliary heat enable	nviAuxHeatEnable	SNVT_switch
Valve override	nviValveOverride	SNVT_hvac_overid
Flow override	nviFlowOverride	SNVT_hvac_overid
Emergency override	nviEmergOverride	SNVT_hvac_emerg
Source temperature	nviSourceTemp	SNVT_temp_p
Space CO2	nviSpaceCO2	SNVT_ppm
Clear alarms/diagnostics	nviRequest[a]	SNVT_obj_request
Air flow setpoint input	nviAirFlowSetpt	SNVT_flow

(a) Part of the node object

Table 49. Output listing

Output description	Output	SNVT type
Space temperature	nvoSpaceTemp	SNVT_temp_p
Unit status, mode	nvoUnitStatus	SNVT_hvac_status
Effective setpoint	nvoEffectSetpt	SNVT_temp_p
Effective occupancy	nvoEffectOccup	SNVT_occupancy
Heat cool mode	nvoHeatCool	SNVT_hvac_mode
Setpoint	nvoSetpoint	SNVT_temp_p
Discharge air temperature	nvoDischAirTemp	SNVT_temp_p
Space CO2	nvoSpaceCO2	SNVT_ppm
Effective air flow setpoint	nvoEffectFlowSP	SNVT_flow
Air flow	nvoAirFlow	SNVT_flow
File table address	nvoFileDirectory[a]	SNVT_address
Object status	nvoStatus[a]	SNVT_obj_status
Alarm message	nvoAlarmMessage	SNVT_str_asc

(a) Part of the node object.

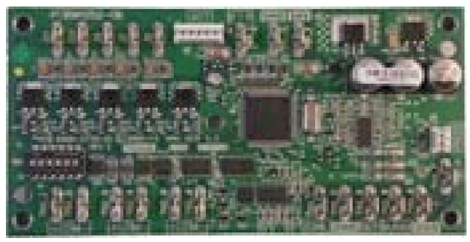
Table 48, p. 95 provides an input listing for Tracer VV550/551 VAV controllers, and Table 49, p. 95 provides an output listing for Tracer VV550/551 VAV controllers. Table 50, p. 96 provides the configuration properties for the controller. The content of the lists conforms to both the LonMark SCC functional profile 8500 and the LonMark node object.

Table 50. Configuration properties

Configuration property description	Configuration property	SNVT type	SCPT reference
Send heartbeat	nciSndHrtBt	SNVT_time_sec	SCPTmaxSendTime (49)
Occ temperature setpoints	nciSetpoints	SNVT_temp_setpt	SCPTsetPnts (60)
Minimum send time	nciMinOutTm	SNVT_time_sec	SCPTminSendTime (52)
Receive heartbeat	nciRecHrtBt	SNVT_time_sec	SCPTmaxRcvTime (48)
Location label	nciLocation	SNVT_str_asc	SCPTlocation (17)
Local bypass time	nciBypassTime	SNVT_time_min	SCPTbypassTime (34)
Manual override time	nciManualTime	SNVT_time_min	SCPTmanOverTime (35)
Space CO2 limit	nciSpaceCO2Lim	SNVT_ppm	SCPTlimitCO2 (42)
Nominal air flow	nciNomFlow	SNVT_flow	SCPTnomAirFlow (57)
Air flow measurement gain	nciFlowGain	SNVT_multiplier	SCPTsensConstVAV (67)
Minimum air flow	nciMinFlow	SNVT_flow	SCPTminFlow (54)
Maximum air flow	nciMaxFlow	SNVT_flow	SCPTmaxFlow (51)
Minimum air flow for heat	nciMinFlowHeat	SNVT_flow	SCPTminFlowHeat (55)
Maximum air flow for heat	nciMaxFlowHeat	SNVT_flow	SCPTmaxFlowHeat (37)
Minimum flow for standby	nciMinFlowStdby	SNVT_flow	SCPTminFlowStby (56)
Firmware major version	nciDevMajVer[a]	n/a	SCPTdevMajVer (165)
Firmware minor version	nciDevMinVer[a]	n/a	SCPTdevMinVer (166)
Flow offset for tracking applications	nciFlowOffset	SNVT_flow_f	SCPToffsetFlow (265)
Local heating minimum air flow	nciMinFlowUnitHt	SNVT_flow	SCPTminFlowUnitHeat (270)
Minimum flow for standby heat	nciMnFlowStbyHt	SVNT_flow	SCPTminFlowStbyHeat(263)

(a) Part of the node object.

Direct Digital Controller—Unit Control Module (UCM4)



The Trane direct digital controller Unit Control Module (DDC-UCM) is a microprocessor-based terminal unit with non-volatile memory which provides accurate airflow and room temperature control of Trane VAV air terminal units. The UCM can operate in a pressure-independent or a pressure-dependent mode and uses a proportional plus integral control algorithm. The controller monitors zone temperature setpoints, zone temperature and its rate of change and valve airflow (via flow ring differential pressure).

The controller also accepts an auxiliary duct temperature sensor input or a supply air temperature value from Tracer™ SC. Staged electric heat, pulse width modulated electric heat, proportional hot water heat or on/off hot water heat control are provided when required. The control board operates using 24-VAC power. The Trane DDC-UCM is a member of the Trane Integrated Comfort™ systems (ICS) family of products. When used with a Trane Tracer SC building management controller or other Trane controllers, zone grouping and unit diagnostic information can be obtained. Also part of ICS is the factory-commissioning of parameters specified by the engineer (see “Factory-installed vs. Factory-commissioned,” p. 10 for more details).

Specifications

Supply Voltage

24 VAC, 50/60 Hz

Maximum VA Load
No Heat or Fan

12 VA (Board, Transducer, Zone Sensor, and Actuator)

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

Output Ratings

Actuator Output: 24 VAC at 12 VA
1st Stage Reheat: 24 VAC at 12 VA
2nd Stage Reheat: 24 VAC at 12 VA
3rd Stage Reheat: 24 VAC at 12 VA

Binary Input

24 VAC

Auxiliary Input

Can be configured for an optional 2–10 VDC CO_2 sensor, or auxiliary temperature sensor.

Operating Environment:

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

Storage Environment

-40 to 180°F (-40 to 82.2°C),
5% to 95%RH, Non-Condensing

Physical Dimensions

Width: 5.5" (139.7 mm)
Length: 2.8" (69.85 mm)
Height: 1.8" (44.45 mm)

Connections

1/4" (6.35 mm) Stab Connections

Communications

RS-485; Stranded wire, twisted pair, shielded, copper conductor only, 18–20 awg

Fan Control

- Series fan: On unless unoccupied and min. flow has been released.
- Parallel fan: On when zone temperature is less than heating setpoint plus fan offset. Off when zone temperature is more than heating setpoint plus fan offset plus 0.5°F (0.28°C).

Heat Staging

Staged electric or hot water proportional or pulse-width modulation

Trane DDCVAV Controller Logic - UCM 4

DDC controllers are today's industry standard. DDC controllers provide system-level data used to optimize system performance. Variables such as occupied/unoccupied status, minimum and maximum airflow setpoints, temperature and temperature setpoints, valve position, fan status (on or off, and mode of operation: series or parallel), reheat status (on or off), box type and air valve size, temperature correction offsets, flow correction values, ventilation fraction, etc. are available on a simple twisted-shielded wire pair.

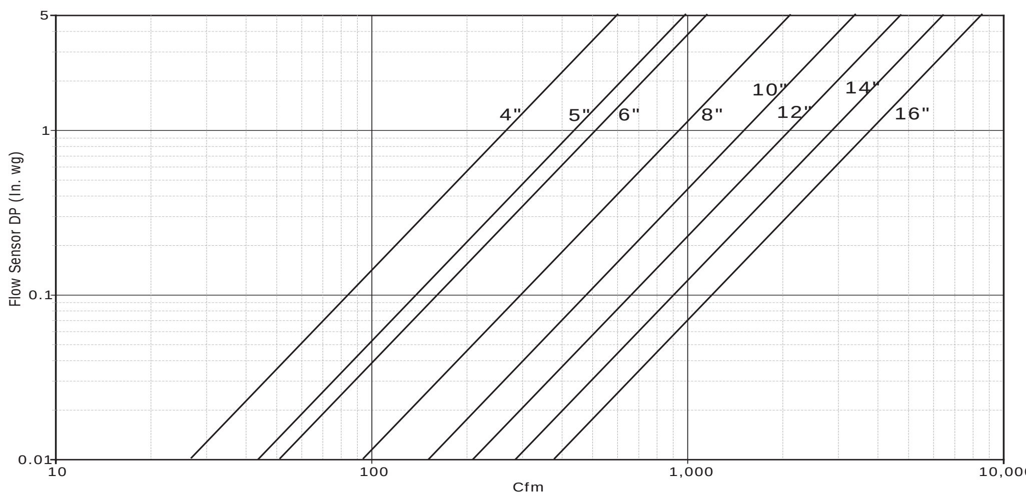
Trane DDC controllers provide Trane-designed, solid-state electronics intended specifically for VAV temperature control in space comfort applications. DDC control capabilities include:

- 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, which 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.
- Cooling and heating control action of air valve. In cooling control action, the DDC controller matches cooling airflow to cooling load. In heating control action, the DDC controller matches the heating airflow to control heating load. The DDC controller will automatically change over to cooling control action if the supply air temperature is below the room temperature and will automatically change over to heating control action if the supply air temperature is 10°F or more above the room temperature. If the supply air temperature is between the room temperature and the room temperature plus 10°F, then the DDC controller will provide the active minimum airflow. The DDC controller first chooses the Tracer™ SC -supplied 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. If this is also not available, it uses the heating/cooling mode assigned by Tracer SC or the DDC controller's service tool (Everyware™ or Rover™ V4).
- Multiple reheat control options including staged electric, staged hot-water (normally on or normally off), proportional hot-water, slow pulsed width modulation, electric, and SCR electric. Modulating reheat options utilize a separate reheat proportional-plus-integral control loop from that controlling airflow into the room. Staged reheat options utilize a control algorithm based on heating setpoint and room temperature.
- 24 VAC binary input that can be configured as a generic input or as occupancy input. When the DDC controller is operation with Tracer SC, the status of the input is provided to Tracer SC for its action. In stand-alone operation and when configured for an occupancy input, the input will control occupancy status of the DDC controller.
- Auxiliary temperature analog input that can be configured for an auxiliary temperature sensor or a 2-to-10 VDC CO_2 sensor. When sensor is mounted in the supply air duct and configured for temperature, the value of the input is used as status-only by Tracer SC if Tracer SC is providing a supply air temperature to the DDC controller. Otherwise, the input will be used for

determining control action of the DDC controller. When configured for a CO_2 sensor, the value of the input is used as a status-only input by Tracer SC.

- Dual-duct support with two DDC controllers. One DDC controller controls the cooling air valve and the other controller controls the heating air valve. With constant-volume sequences, the discharge air volume is held constant by controlling discharge air volume with the heating UCM.

Figure 6. Flow sensor signal 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.

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 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. The water valves used are 2-position 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: Proportional Hot Water Reheat

Proportional hot water reheat uses 3-wire, floating-point-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.

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

Single-Duct: On/Off Electric Reheat

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

Electric heat is modulated by energizing for a portion of a three-minute time period. One of two stages can be used. 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 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% 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 enforced.

Air-Fi™ Wireless System

Wireless Communications Interface (WCI)

The Trane® Wireless Communication Interface (WCI) enables wireless communication between system controls, unit controls, and wireless sensors for the new generation of Trane control products. The WCI works with BACnet DDC VAV unit controllers and replaces the need for communication wire in all system applications.

Note: *See BAS-SVX40*-EN, Installation, Operation and Maintenance, Air-Fi Wireless Comm for more information.*

Quantity of WCIs per Network

Each Trane wireless network can have a total of 31 WCIs (30 member WCIs plus 1 coordinator WCI). Each network requires one WCI to function as network coordinator.

Quantity of Networks per Tracer SC

A Tracer SC can support up to 8 wireless networks.

Automatic Network Formation

When a WCI is connected to a Tracer SC, it is auto-assigned as the coordinator. To enable the coordinator, Tracer SC must be configured for wireless communication. The coordinator WCI opens the network to allow all WCIs having matching addresses to automatically join the network.

If no Tracer SC is present, a centrally located WCI must be designated to act as the coordinator. You can manually set the coordinator WCI so all WCIs having matching addresses automatically join the network.

Air-Fi™ Wireless Communication Sensors (WCS)

Two wireless communication sensors are available:

- Digital display model (WCS-SD)
- Base model with no exposed display or user interface (WCS-SB)

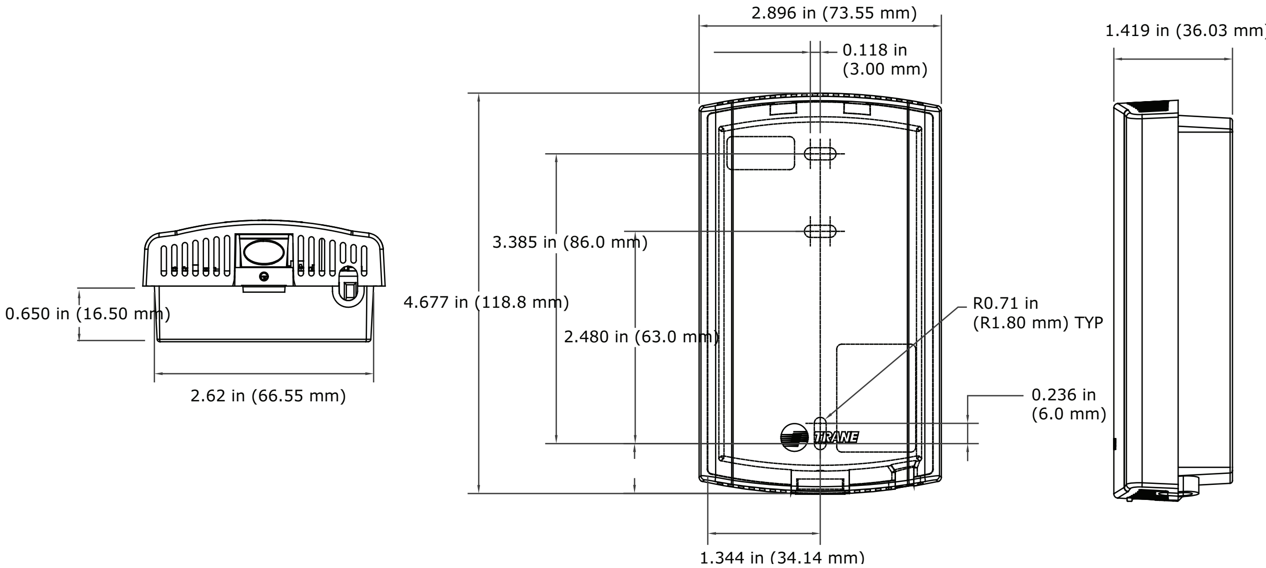
Optional: in most applications, one WCS will be used per WCI acting as a router. However, up to 6 WCS's can be associated to a single BACnet DDC VAV unit.

Wireless Zone Sensors and Wired Zone Sensors

Systems using Air-Fi™ can be wed with WCS or wired sensors. Our previous line of wireless zone sensors are not compatible with Air-Fi™ WCIs.

Systems using Wireless Comm can also use wired zone sensors.

Dimensions



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

Voltage

24 Vac/Vdc nominal ± 10%. If using 24 Vac, polarity must be maintained.

Receiver power consumption

<2.5 VA

Housing material

Polycarbonate/ABS (suitable for plenum mounting), UV protected, UL 94: 5 VA flammability rating

Mounting

3.2 in (83 mm) with 2 supplied mounting screws

Range

Open range: 2,500 ft (762 m) with packet error rate of 2%

Indoor: Typical range is 200 ft (61 mm); actual range is dependent on the environment. See BAS-SVX55 for more detail.

Note: *Range values are estimated transmission distances for satisfactory operation. Actual distance is job specific and must be determined during site evaluation. Placement of 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 effected by walls, barriers, and general clutter. For more information is available at http://www.trane.com.*

Output power

North America: 100 mW

Radio frequency

2.4 GHz (IEEE Std 802.15.4-2003 compliant) (2405–2480 MHz, 5 MHz spacing)

Radio channels

16

Address range

Group 0–8, Network 1–9

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)

Wireless protocol

ZigBee PRO—ZigBee Building Automation Profile, ANSI/ASHRAE Standard 135-2008 Addendum q (BACnet™/ZigBee)

Wireless Receiver/Wireless Zone Sensor

The wireless zone sensor system eliminates the wiring problems associated with VAV temperature sensors. It provides the flexibility to move zone sensors after the occupants have revised the space floor plan layout. The zone sensor houses the space temperature sensor, local setpoint adjustment thumb wheel, OCCUPIED/UNOCCUPIED button, battery life, signal strength indicators, and spread spectrum transmitter. Works with all Trane VAV DDC unit controllers.

Specifications

Power Requirements

Receiver: 24 V nominal AC/DC ± 10% < 1VA

Zone Sensor: (2) AA lithium batteries

Sensor Operating Environments

32 to 122°F, (0 to 50°C)
5 to 95%RH, Non-condensing

Receiver Operating Environments

-40 to 158°F, (-40 to 70°C)
5 to 95%RH, Non-condensing

Storage Environment—Sensor/Receiver

-40 to 185°F, (-40 to 85°C)
5 to 95%RH, Non-condensing

Mounting

Receiver: Suitable for mounting above or below ceiling grid. Requires 24 V power. Factory installed receiver comes mounted to the VAV unit with power provided by associated unit controller transformer. Field installed option provided with associated wire harness for similar power and communication connection.

Sensor: Mounts to a 2x4 handi-box or directly to the wall by attaching the backplate and then snapping the sensor body into place.

Dimensions

	Receiver/Translator
Enclosure:	Plastic
Height:	4.75" (120.6 mm)
Width:	2.90" (73.5 mm)
Depth:	1.08" (27.5 mm)
	Sensor/Transmitter
Enclosure:	Plastic
Height:	4.78" (121.4 mm)
Width:	2.90" (73.5 mm)
Depth:	1.08" (27.5 mm)

DDC Zone Sensor

The DDC zone sensor is used in conjunction with the Trane direct digital controller to sense the space temperature and to allow for user adjustment of the zone setpoint. Models with external zone setpoint adjustments and occupied mode override pushbuttons are available.

Specifications

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
Communications Jack – WE-616 (available for field installation)

Physical Dimensions

Width: 2.75" (69.85 mm)
Height: 4.5" (114.3 mm)
Depth: 1.0" (25.4 mm)

CO_2 Wall Sensor and Duct CO_2 Sensor

Figure 7. CO_2 wall sensor (L) and duct CO_2 sensor (R)

The wall- and duct-mounted carbon dioxide (CO_2) sensors are designed for use with Trane DDC/ UCM control systems. Installation is made simple by attachment directly to the DDC/ UCM controller. This allows the existing communication link to be used to send CO_2 data to the higher-level Trane control system.

Wall-mounted sensors can monitor individual zones, and the duct-mounted sensor is ideal for monitoring return air of a given unit. Long-term stability and reliability are assured with advanced based Non-Dispersive Infrared (NDIR) technology.

When connected to a building automation system with the appropriate ventilation equipment, the Trane CO_2 sensors measure and record carbon dioxide in parts-per-million (ppm) in occupied building spaces. These carbon dioxide measurements are typically used to identify under-ventilated building zones or to reduce ventilation airflow during periods of reduced occupancy to save energy (i.e. demand-controlled ventilation).

Specifications

Measuring Range
0–2000 parts per million (ppm)

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

< ± (30 ppm CO_2 + 3% of reading)

Recommended calibration interval

5 years

Response Time

1 minute (0–63%)

Operating Temperature

59 to 95°F (15 to 35°C) **(Wall only)**

23 to 113°F (-5 to 45°C)

Storage Temperature

-4 to 158°F (-20 to 70°C)

Humidity Range

0–85% relative humidity (RH)

Output Signal (jumper selectable)

4-20 mA, 0–20 mA,
0–10 VDC

Resolution of Analog Outputs

10 ppm CO_2

Power Supply

Nominal 24 VAC

Power Consumption

<5 VA

Housing Material

ABS plastic

Dimensions

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

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

DDC Zone Sensor with LCD

The DDC zone sensor with LCD has the look and functionality of the standard Trane DDC zone sensor but has a LCD display. The sensor includes setpoint adjustment, the display of the ambient temperature, a communication jack, and occupied mode override pushbuttons. Also, it can be configured in the field for either a Fahrenheit or Celsius display, a continuous display of the setpoint and the offset of displayed temperatures.

Specifications

Thermistor Resistance Rating

10,000 Ohms at 77°F (25°C)

Setpoint Resistance Rating

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

Temperature Range

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

Electrical Connections

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

Physical Dimensions

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

Zone Occupancy Sensor

The zone occupancy sensor is ideal for spaces with intermittent occupancy. It is connected to the Trane DDC UCM and allows the zone to shift to unoccupied setpoints for energy savings when movement is not detected in the space.

The zone occupancy sensor has a multi-cell, multi-tier lens with a maximum field of view of 360°. The maximum coverage area of the sensor is 1200 square feet with a maximum radius of 22 feet from the sensor when mounted at 8 feet above the floor.

Sensor ships with 30-minute time delay pre-set from the factory. Time delay and sensitivity can be field-adjusted.

Specifications

Power Supply

24 VAC or 24 VDC, ± 10%

Maximum VA Load

0.88 VA @ 24 VAC,
0.72 VA @ 24 VDC

Isolated Relay Rating

1 A @ 24 VAC or 24 VDC

Operating Temperature

32 to 131°F (0 to 55°C)

Storage Temperature

-22 to 176°F (-30 to 80°C)

Humidity Range

0 to 95% non-condensing

Effective Coverage Area

1200 sq ft

Effective Coverage Radius

22 feet

Housing Material

ABS Plastic

Dimensions

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

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 UCM in a heat/cool changeover system.

When factory mounted, the sensor is terminated. If sensor is field mounted, it is shipped loose and is terminated in the field.

Factory or Field Mounted Auxiliary Temperature Sensor

Sensing Element

Thermistor 10,000 Ohms @ 77°F (25°C)

Operating Environment

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

Wiring Connection

8 ft 18 awg

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

Probe Dimensions

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

Mounting

In any position on duct.

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

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 or UC400 controls, the energy efficient dual max algorithm can be used to reduce energy costs.

Two-Position Water Valve

Two-position hot water valves are used with Trane DDC/UCM controls and analog electronic controls. Valve actuation is by a hysteresis synchronous motor.

All valves are field-installed and convertible from three-way to two-way by means of an included cap.

Specifications

Valve Design

Body: Brass
Cover: Aluminum
Case: Stainless Steel

Stem: Brass, Hard Chrome Plate
“O” Ring Seals: Viton
Operating Paddle: Buna N

Valve Body Ratings

UL 873 Listed File E27743

Plenum Rated CSA C22.2 No. 139
Certified, File LR85083, Class 3221 01

Temperature Limits

200°F (93.33°C) Fluid
104°F (40°C) Ambient

Maximum Operating Pressure

300 psi (2069 kPa)

Electrical Rating

Motor Voltage – 24 VAC, 50/60 Hz

Power Consumption – 7.0 VA of 24 VAC

Valve Offerings

All valves are spring returned.
4.0 Cv – ½" (12.7 mm) O.D. NPT
5.0 Cv – ¾" (19.1 mm) O.D. NPT
8.0 Cv – 1" (25.4 mm) O.D. NPT

Cv offered (Close-off Pressure):
Cv 3.0 (25) psi (172 kPa)
Cv 4.0 (20) psi (138 kPa)
Cv 8.00 (17) psi (117 kPa)

Proportional Water Valve

The proportional water valve is used to provide accurate control of a hot water heating coil to help maintain a zone temperature setpoint. The valve is a ball design and comes in 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 plug that is installed loose in the bypass 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

Valve Design:

Ball valve construction 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 proportional control with ½" (12.7 mm) O.D. NPT connections

Cv offered:

0.7

2.7

6.6

8.0

VAV Piping Package

- Offered in both 2-way and 3-way configurations
- The Automatic Balancing Flow Control sized for the specified VAV coil and gpm.
- Field connections are NPT with Coil connections Sweat to match the Trane VAV water coil copper
- For 3-way configuration the connections between the ATC valve and the supply shut off assembly are sweat to allow for field installation of hose or piping connection between the supply and return lines.
- Included in the package are:
  - P/T Ports for pressure and temperature measurement on both the supply and return sections.
  - Blow down drainable filter on the supply.
  - Y-Ball Combination Mesurflo Automatic Balance Valve on the Return side to isolate the coil
  - Y-Ball Combination Strainer on the supply to isolate the coil.
- Each piping package is tagged to match the VAV terminal tag it is specified for.
- Each piping package includes a 24v floating point control proportional 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 Operation Pressure:

- 2519 (2-80 psid 0.5-3.0 gpm) / (3-80 psid 3.50 – 5.00 gpm)
- 2515 (3-80 psid 5.50 – 9.00 gpm)
- 2524 (3-80 psid 10.0 –17.0 gpm) / (5-80 psid 18.0 –23.0 gpm)
- ± 10% accuracy of published flow

Operating Temperature:

32° - 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 180° F, (-40 to 82.2°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}

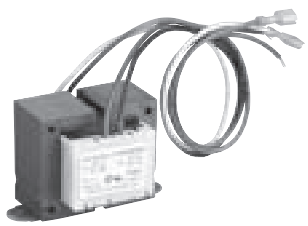
Physical Dimensions

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

Pressure Connections

1/8" (3.175 mm) barbed tubing connections

Transformers



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

Specifications

Primary Voltage

120 VAC
208 VAC
240 VAC
277 VAC
347 VAC
480 VAC
575 VAC

Secondary Voltage

24 VAC

Power Rating

50 VA

Physical Dimensions

For all voltages:

The transformers will be no larger than the following dimensions:
Width: 2.63" (66.7 mm)
Length: 2.50" (63.5 mm)
Height: 2.30" (58.4 mm)

Trane 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”), 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. The actuator is Underwriters Laboratories Standard 873 and Canadian Standards associate Class 3221 02 certified as meeting correct safety requirements and recognized industry standards.

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 female connector harness for Trane UCM (for Trane DDC controls except retrufit kits)

Manual Override

External clutch release lever

Shaft Requirement

1/2” round

2.1” length

Humidity

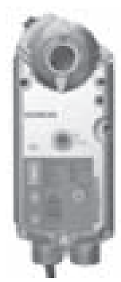
5% to 95% RH, Non-Condensing

Temperature Rating

Ambient operating: 32 to 125°F (0 to 52°C)

shipping and storage: -20 to 130°F (-29 to 66°C)

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"), 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° 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 female connector for Trane UCM (for Trane DDC controls)

Manual Override

Manual override key provided

Shaft requirement:
¼" to ¾" round

2.1" 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 (7N-m)

VariTrane™ DDC Retrofit Kit

The retrofit kit provides the system advantages of VariTrane DDC controls to building owners for existing systems. The kit can be applied when converting from pneumatic or analog controlled systems to a DDC controlled system. The kit may be used on existing single-duct units with hot water and electric reheat (three stages), dual-duct units, and all fan-powered units (both series and parallel) with hot water and electric reheat (two stages).

A VariTrane DDC-UCM, an electronic differential pressure transducer, and a six-pin connector with wiring for an actuator, make up the assembly of the retrofit kit. All are housed inside a metal enclosure. For maximum flexibility, the kit is available with one of two actuators or without an actuator. If a kit is ordered without an actuator, ensure the actuator used has 24VAC three-wire floating control. Other accessories are available with the retrofit kit which include zone sensors, flow bars (used with units without a flow sensor), power transformers, control relays, and E/P solenoid valves.

Retrofit Kit Actuator

This actuator is available with the DDC Retrofit Kit and 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 94-5V

Direction of Rotation

Reverse wires terminals 2 and 3

Angle of Rotation

Max 95°, 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

Min 35 in.-lb (4Nm), Independent of load

Running Time

95 sec. for 0 to 35 in-lb

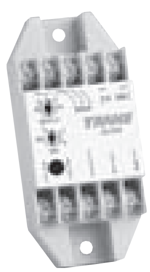
Noise Rating

Less than 35 dB (A)

Weight

1.2 lbs (0.55 kg)

Static Pressure Controller



The Trane static pressure controller will sense duct static pressure and modulate a relief device in an effort to limit maximum duct static pressure. An analog signal from the air probe is used to compare the difference in the duct static pressure and the duct static pressure setpoint. The relief device can be a VariTrane terminal or any blade damper device with the specifications stated below. See VAV-EB-64 for installation and calibration.

Specifications

Supply Voltage

24 VAC, 60 HZ

Maximum VA Load

No more than 12 VA

Recommended Wire Size

14 – 22 AWG Stranded

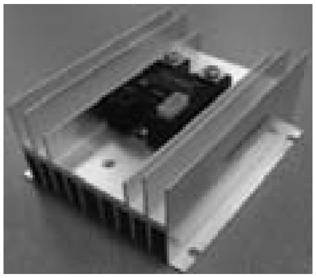
Housing Material

ABS

Components

Control box
Pressure sensor
Interconnecting wire
Static pressure tap
Fits standard 2" deep x 4" x 2 1/8" utility box.

Electric Heater Silicon-Controlled Rectifier (SCR)



- Microprocessor based burst-fire controller / SSR
- Low-voltage control
- Output status indicator
- 0-100% Control Range
- Synchronized triggering output (P3)
- 20 AC Cycles Base Period
- Coupled with the averaging temperature sensing matrix and UC210 or UC400 controls, allows use of energy efficient dual max algorithm.

Specifications

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

(a) 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

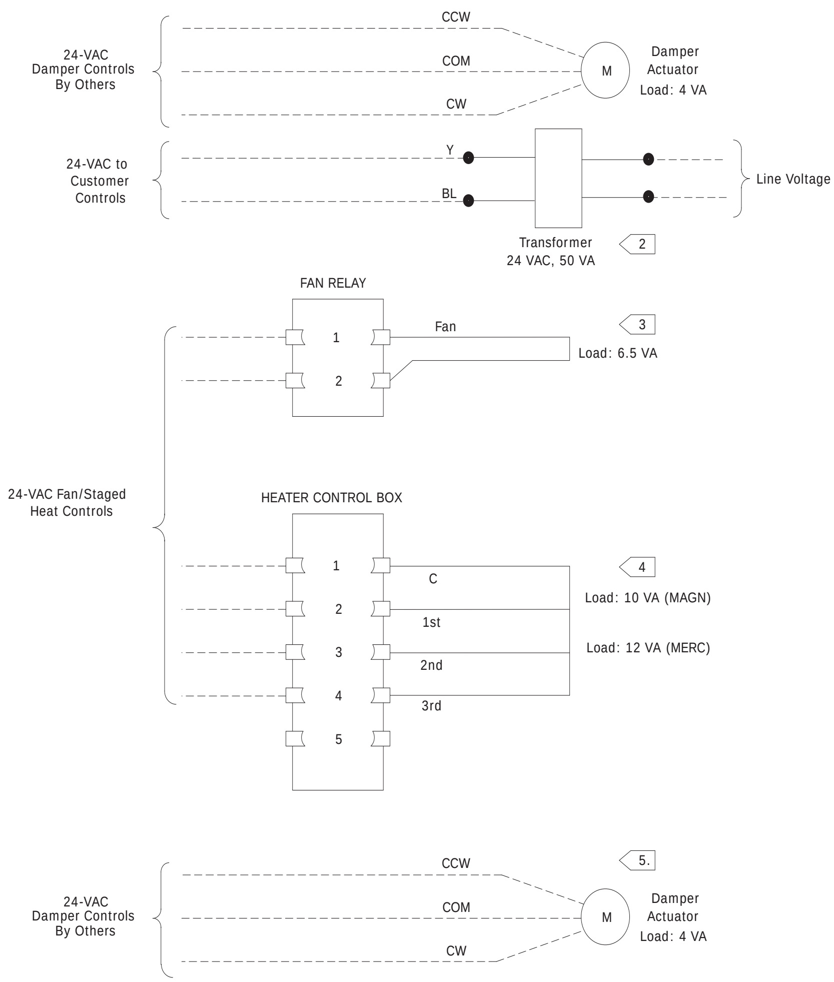
General Specifications	Parameters
Dielectric Strength, Input/Output/Base (50/60Hz)	4000 Vrms
Minimum Insulation Resistance (@ 500 V DC)	10^9 Ohm
Maximum Capacitance, Input/Output	10 pF
Ambient Operating Temperature Range	-20 to 80°C
Ambient Storage Temperature Range	-40 to 125 °C
Encapsulation	Thermally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

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

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.

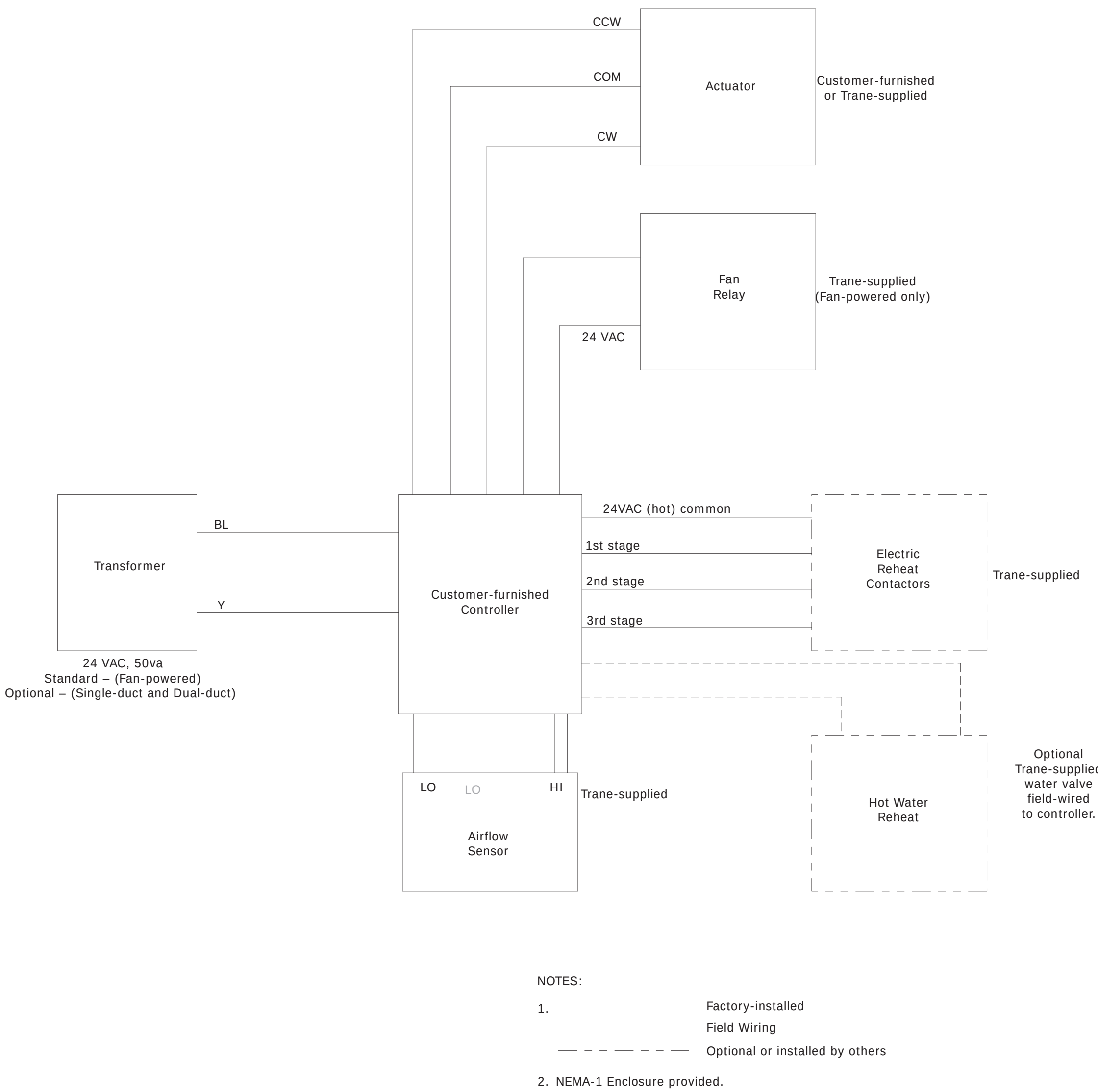
5. Only available with dual-duct units.

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.



Pneumatic Controls

3011 Pneumatic Volume Regulator

The pneumatic volume regulator (PVR) is a controller that provides a consistent airflow to the space, regardless of varying inlet duct pressure conditions, in response to a pneumatic thermostat signal. The controller maintains minimum and maximum airflow setpoints. The 3011 PVR can be set to control either normally open or normally-closed air valve actuators and can be calibrated to accept either direct-acting or reverse-acting thermostat signals. Fixed reset control of maximum and minimum airflow setpoints is provided.

Specifications

Differential Pressure Range

0-1 in. wg (0–249 Pa)

Minimum Setpoint Range

0-1 in. wg (0–249 Pa)

Maximum Setpoint Range

0.05 in. wg (12.5 Pa) above minimum to 1 in. wg (249 Pa) above minimum

Operating Static Pressure Range

0.25 in. wg—6.0 in. wg (62.3–1494 Pa)

Reset Pressure Span

Factory-set at 5 psig (34.5 kPa)
Field-adjustable from 0 to 10 psig
(0 to 68.9 kPa)

Reset Start Point

Field-adjustable from 0 to 10 psig
(0 to 68.9 kPa)

Main Air Pressure

15 to 30 psig (103 to 207 kPa)

Air Consumption

28.8 scim (0.472 L/m) at 20 psig (138 kPa) main air pressure

Operating Environment

40 to 120ºF (4 to 49°C)

Storage Environment

-40 to 140ºF (-40 to 60°C)

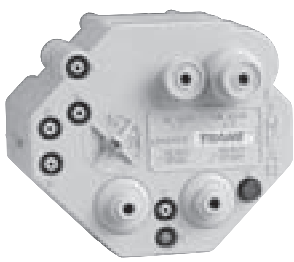
Output Sensitivity

5 psig/0.02 in. wg (34.5 kPa/5.0 Pa)

Physical Dimensions

Width: 4.5" (114.3 mm)
Length: 2.3" (58.4 mm)
Height: 3.87" (98.3 mm)
Weight: 11 oz (312 g)

3501 Pneumatic Volume Regulator



Tubing Connections:
1/4" O.D. tubing connections
The 3501 PVR can be set to control either normally open or normally-closed air valve actuators and can be calibrated to accept either direct-acting or reverse-acting thermostat signals. Fixed reset control of maximum and minimum airflow setpoints is provided. The controller is used primarily in dual-duct constant-volume applications because of its linear output response characteristics. The controller resets the primary air velocity linearly with a change in thermostat pressure.

This is in contrast to the 3011 PVR, which resets velocity pressure with a change in thermostat pressure. This allows the 3501 PVR to have improved stability at low flows.

Specifications

Differential Pressure Range

0–1.0 in. wg (0–249 Pa)

Minimum Setpoint Range

0–1.0 in. wg (0–249 Pa)

Maximum Setpoint Range

Minimum to 1.0 in. wg (249 Pa)

Operating Static Pressure Range

0.25–6.0 in. wg (62.3–1494 Pa)

Reset Pressure Span

Factory-set at 5 psig (34.5 kPa)
Field-adjustable from 0 to 7 psig
(0 to 48.3 kPa)

Reset Start Point

Factory-set at 8 psig (55.2 kPa)
Field-adjustable from 0 to 10 psig
(0 to 68.9 kPa)

Main Air Pressure

15–30 psig (103 to 207 kPa)

Air Consumption

43.2 scim (0.708 L/m) at 20 psig (138 kPa) main air pressure

Operating Environment

40 to 120°F (4 to 49°C)

Storage Environment

-40 to 140°F (-40 to 60°C)

Output Sensitivity

5 psig/ 0.02 in. wg (34.5 kPa/ 5.0 Pa)

Physical Dimensions

Width: 4.5" (114.3 mm)
Length: 3.87" (98.3 mm)

Height: 4.1" (104.1 mm)
Weight: 12 oz (340 g)

Pneumatic Damper Actuator

The pneumatic actuator is designed for use on VAV terminal units in HVAC systems. The damper actuator mounts to a standard ½" diameter shaft by a pin and cross hold arrangement, retaining clip, and non-rotation bracket. Two model actuators are offered with spring ranges of 3–8 psi or 8–13 psi.

Specifications

Effective Area

8 sq inches (51.6 sq cm)

Normal Rotation

100 degrees

Spring Ranges

Model 3631–5000: 8-13 psi (55.2–89.6 kPa)

Model 3631–8000: 3-8 psi (20.7–55.2 kPa)

Supply Connection

3/16" (4.8 mm) nipple for ¼" (6.4 mm) O.D. tubing

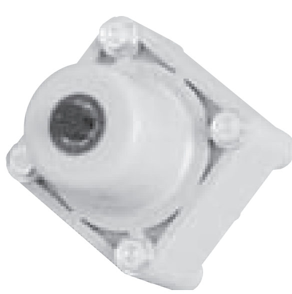
Weight

1.5 lbs (680 g)

Ambient Limits:

Operating:-20 to 120°F
(-28.889 to 48.889°C)
Shipping:-40 to 140°F (-40 to 60°C)

Reversing Relay



Tubing Connections:
1/4" O.D. tubing connections
The pneumatic reversing relay is a proportional device that reverses the action of the input signal. It is used to change a direct-acting signal into a reverse-acting signal or to change a reverse-acting signal into a direct-acting signal. This relay is used to match the operating pressure range of controlled devices (valves, pressure switches, etc.) to the output pressure range of a controller (such as a thermostat). The output response will always remain in 1:1 proportion to the input signal, but the relay includes the capability to bias the output signal.

Specifications

Factory Setting

Contingent upon the selected control option

Generally set for 8 psig in. = 8 psig out or 9 psig in=9 psig out (55.2 kPa in. = 55.2 kPa out or 62.1 kPa in. = 62.1 kPa out)

Bias Adjustment

+/- 15 psig (103 kPa)

Main Air Pressure

15-30 psig (103–207 kPa)

Air Consumption

18 scim (0.295 L/m) at 20 psig (138 kPa) main air pressure

Operating Environment

40 to 120ºF (4°C to 49°C)

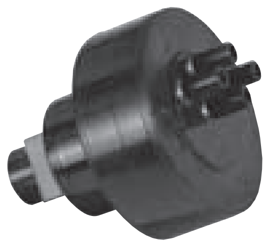
Storage Environment

-40 to 140ºF (-40 to 60°C)

Physical Dimensions

Width: 1.5" (38.1 mm)
Length: 1.5" (38.1 mm)
Height: 2.5" (63.5 mm)

Signal Limiter



Tubing Connections:
3/16" (4.8 mm) nipples for 1/4" (6.4 mm) polyethylene tubing
The pneumatic signal limiter is a pressure limiting type device. The output pressure from the signal limiter is not allowed to rise above the signal limiter's setting. Adjustments to the output pressure setting are made via a screw on the back side of the valve.

Specifications

Factory Setting

Maximum output = 8 psig (55.2 kPa) Adjustable from 2–12 psig (13.8–82.7 kPa)

Main Air Pressure

Nominal 20 psig (138 kPa) 22 psig
(152 kPa) maximum acceptable pressure

Air Consumption

10 scim (0.164 L/m) at 20 psig (138 kPa) main air pressure

Operating Environment

50 to 120°F (10 to 48.89°C)

Physical Dimensions

Width:. 1.1" (27.94 mm)|
Length: 0.9" (22.86 mm)
Height: 0.9" (22.86 mm)

Tubing Connections

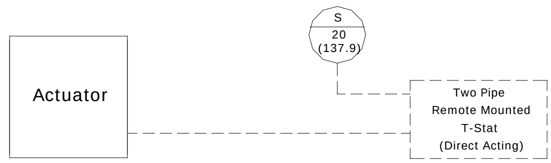
9/100" (2.3 mm) nipples

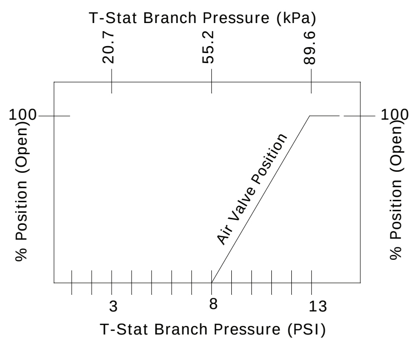
PC00 – VCCF - Single-Duct Terminal Units

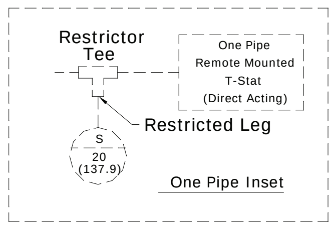
(Normal Operation: Cooling Only)

Normally-Closed Damper and Actuator (Direct-Acting Thermostat)

With an increase in room temperature, the thermostat output pressure is increased and the actuator opens to increase primary cooling airflow to the space. With a decrease in room temperature, the opposite action occurs.







Customer Notes:

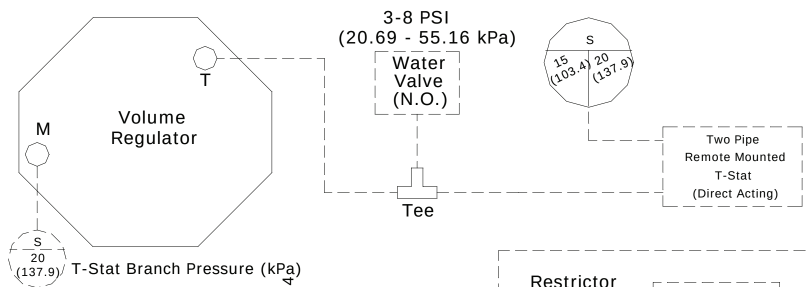
1. ———— Factory installed.
   – – – – – Optional or installed by others.

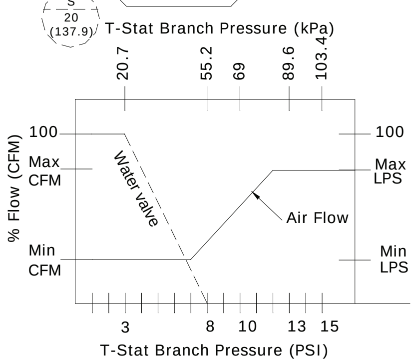
PC04 – VCCF and VCWF - Single-Duct Terminal Units

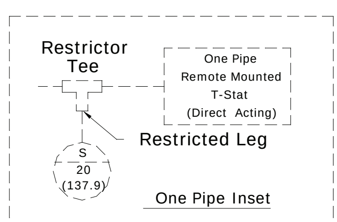
(Normal Operation: Cooling with Hot Water Reheat)

Normally-Closed Damper, Actuator, and 3011 Pneumatic Volume Regulator (Direct-Acting Thermostat)

With an increase in room temperature, the thermostat output pressure is increased. This signal is input for the volume regulator, which also receives inputs from the high- and low-pressure sides of the flow ring. The volume regulator outputs a signal compensated for changing duct pressure to the valve actuator which opens the damper and increases primary cooling flow to the space. With a decrease in room temperature, the opposite action occurs. Minimum and maximum primary airflow settings are maintained by the volume regulator. When the system is designed with reheat, heating stages are energized at the appropriate pressure settings.







Customer Notes:

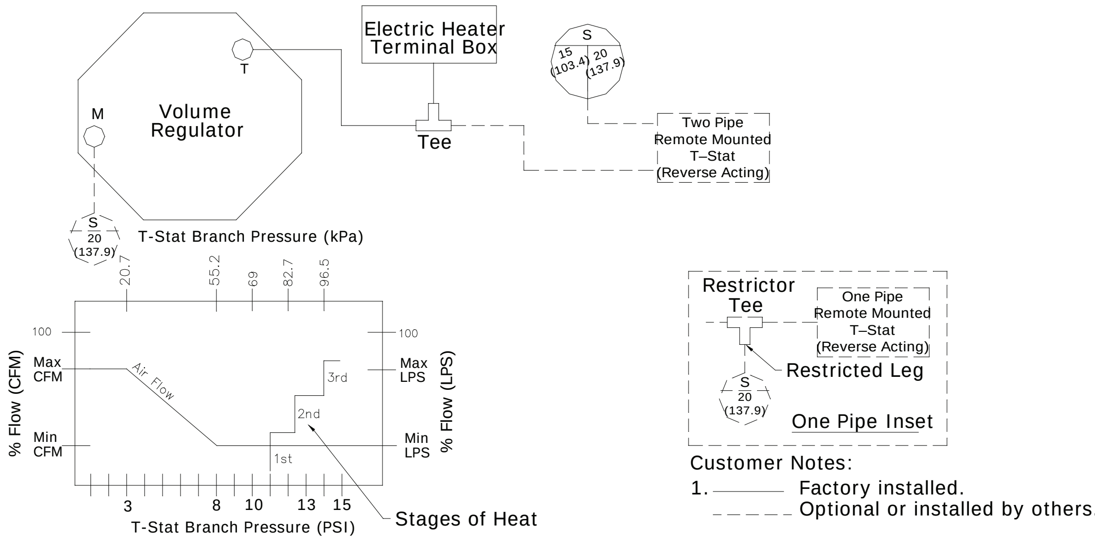
1. ———— Factory installed.
   – – – – – Optional or installed by others.

PN05 – VCCF and VCEF - Single-Duct Terminal Units

(Normal Operation: Cooling with Electric Reheat)

Normally-Open Damper, Actuator, and 3011 Pneumatic Volume Regulator (Direct-Acting Thermostat)

With an increase in room temperature, the thermostat output pressure is decreased. This signal is input for the volume regulator, which also receives the inputs from the high- and low-pressure sides of the flow ring. The volume regulator outputs a signal compensated for changing duct pressure to the valve actuator which opens the damper and increases primary cooling flow to the space. With a decrease in room temperature, the opposite action occurs. Minimum and maximum primary airflow settings are maintained by the volume regulator. When the system is designed with reheat, heating stages are energized at the appropriate pressure settings.

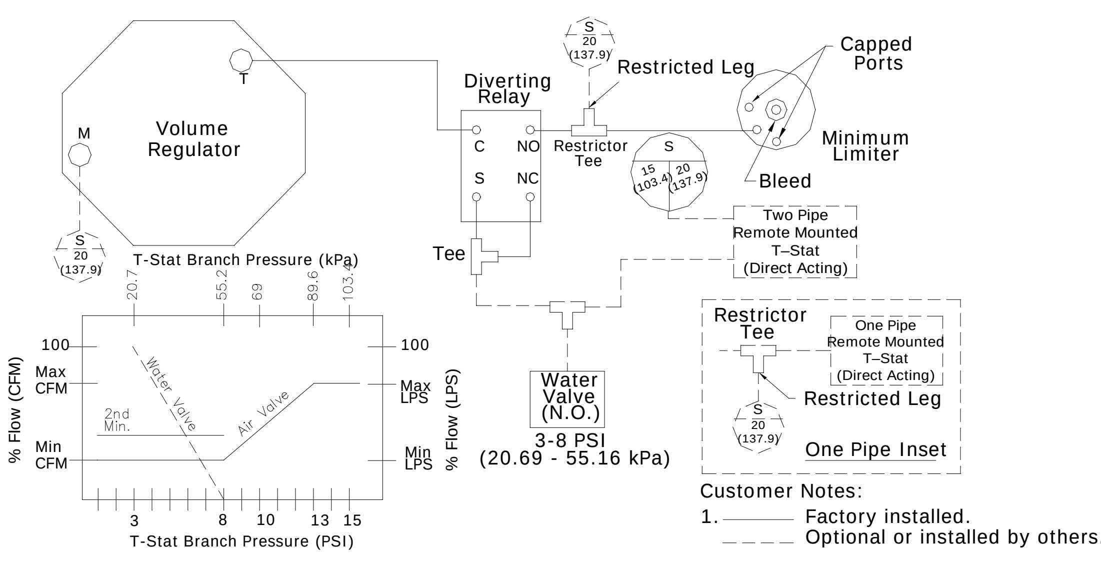


PN11 – VCWF - Single-Duct Terminal Units

(Normal Operation: Cooling with Hot Water Reheat - Auto Dual Minimum)

Normally-Open Damper, Actuator, and 3011 Pneumatic Volume Regulator (Direct-Acting Thermostat)

With a decrease in room temperature, the thermostat output pressure is decreased. This signal is input to the volume regulator, which also receives inputs from the high- and low-pressure sides of the flow ring. The volume regulator outputs a signal compensated for changing duct pressure to the valve actuator, which closes the damper and decreases primary cooling flow to the space. With a further decrease in room temperature, the auxiliary limit will override the thermostat signal, which is followed by the reheat being energized. Once the reheat has been energized, the volume regulator will send a signal to the actuator to open to its secondary minimum. With an increase in temperature, the opposite action occurs. Minimum and maximum airflow settings are maintained by the volume regulator. Heating stages are energized at the appropriate pressure settings.

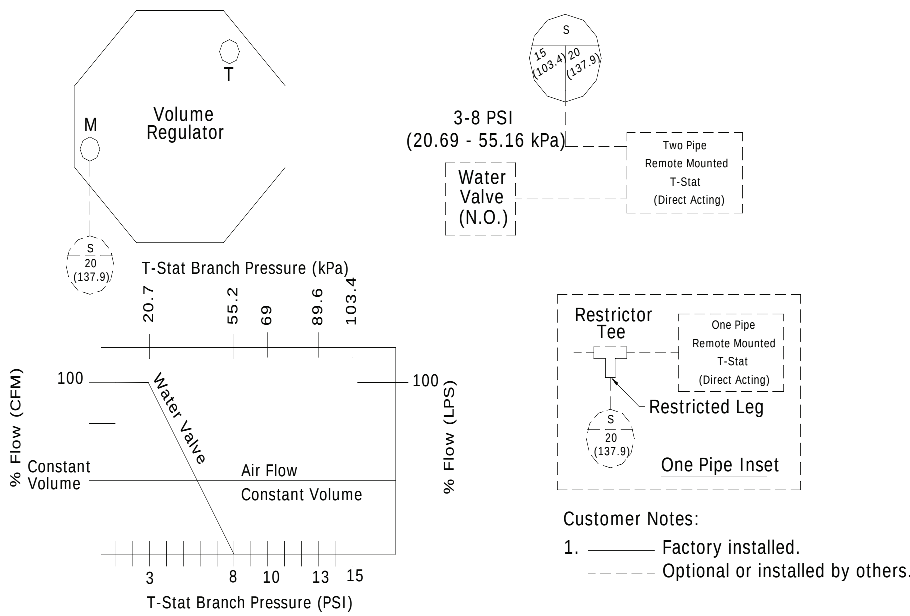


PN32 – VCWF - Single-Duct Terminal Units

(Normal Operation: Cooling with Hot Water Reheat - Constant Volume)

Normally-Open Damper, Actuator, and 3011 Pneumatic Volume Regulator (Direct-Acting Thermostat)

The unit shall operate to a constant volume flow regardless of changes in space temperature. The volume regulator receives the inputs from high- and low-pressure sides of the flow ring. The volume regulator outputs a signal compensated for changing duct pressure to maintain constant volume flow. When reheat is applied, heating stages are energized at the appropriate settings.

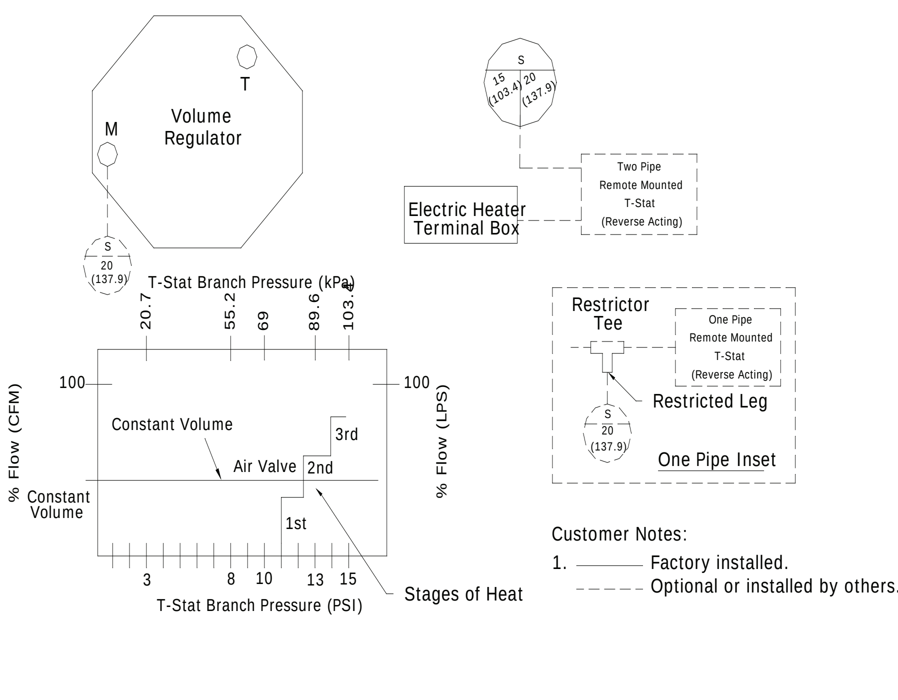


PN34 – VCEF - Single-Duct Terminal Units

(Normal Operation: Cooling with Electric Reheat - Constant Volume)

Normally-Open Damper, Actuator, and 3011 Pneumatic Volume Regulator (Reverse-Acting Thermostat)

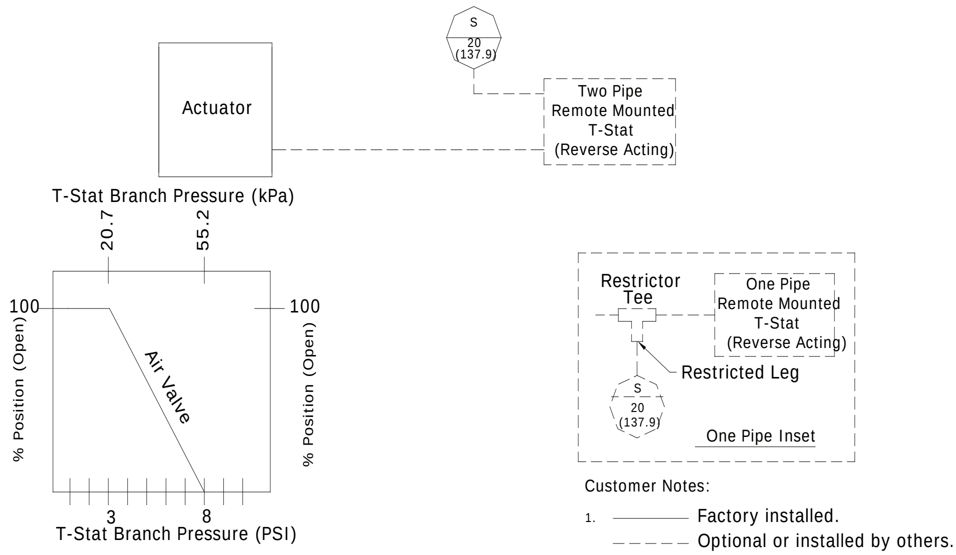
The unit shall operate to a constant volume flow regardless of changes in space temperature. The volume regulator receives the inputs from high- and low-pressure sides of the flow ring. The volume regulator outputs a signal compensated for changing duct pressure to maintain constant volume flow. When reheat is applied, heating stages are energized at the appropriate settings.



PN00 – VCCF - Single-Duct Terminal Units

(Normal Operation: Cooling Only)
Normally-Open Damper and Actuator (Reverse-Acting Thermostat)

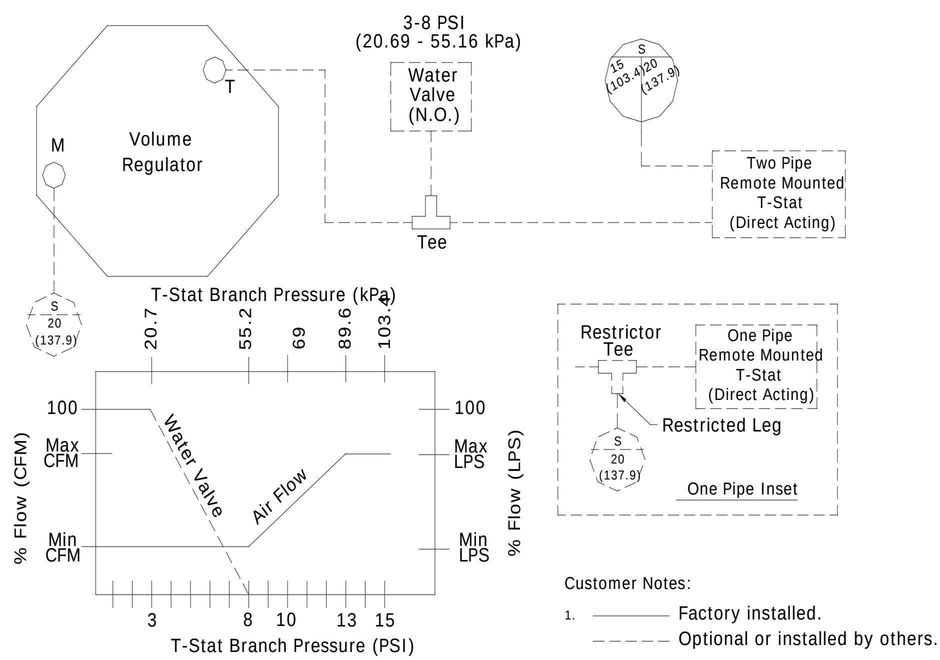
With an increase in room temperature, the thermostat output pressure is decreased and the actuator opens to increase primary cooling airflow to the space. With a decrease in room temperature, the opposite action occurs.



PN04 – VCCF and VCWF - Single-Duct Terminal Units

(Normal Operation: Cooling with Hot Water Reheat)
Normally-Open Damper, Actuator, and 3011 Pneumatic Volume Regulator (Direct-Acting Thermostat)

With an increase in room temperature, the thermostat output pressure is increased. This signal is input for the volume regulator, which also receives inputs from the high- and low-pressure sides of the flow ring. The volume regulator outputs a signal compensated for changing duct pressure to the valve actuator, which opens the damper and increases primary cooling flow to the space. With a decrease in room temperature, the opposite action occurs. Minimum and maximum primary airflow settings are maintained by the volume regulator. When the system is designed with reheat, heating stages are energized at the appropriate pressure settings.

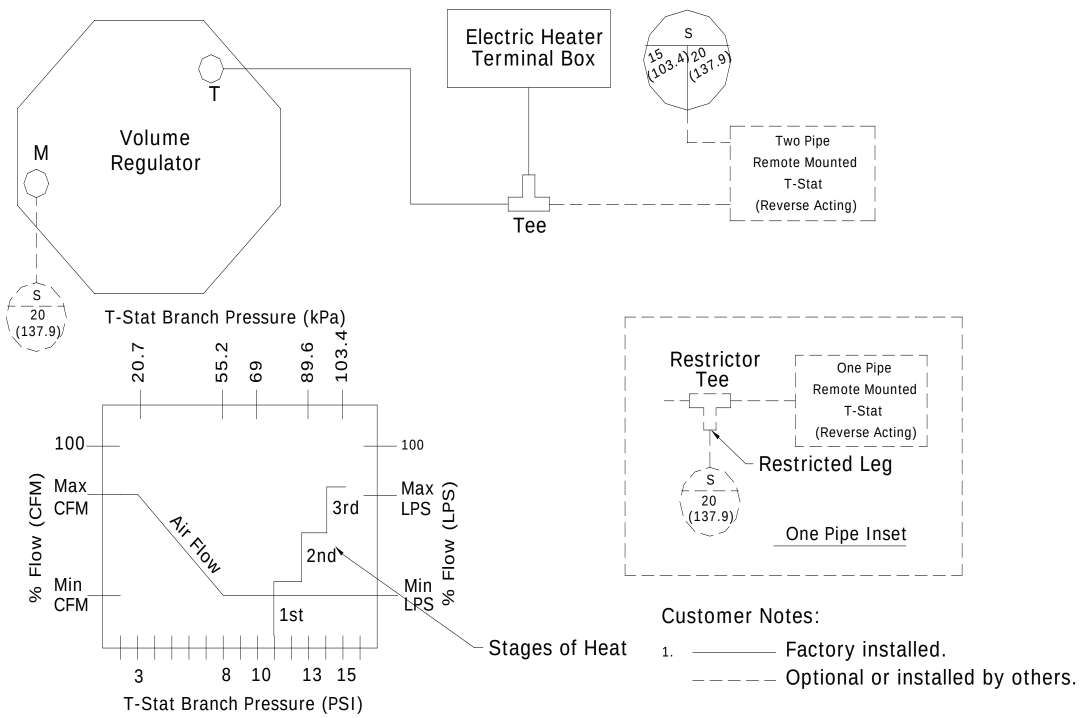


PC05 – VCCF and VCEF - Single-Duct Terminal Units

(Normal Operation: Cooling with Electric Reheat)

Normally-Closed Damper, Actuator, and 3011 Pneumatic Volume Regulator (Reverse-Acting Thermostat)

With an increase in room temperature, the thermostat output pressure is decreased. This signal is input for the volume regulator, which also receives the inputs from the high- and low-pressure sides of the flow ring. The volume regulator outputs a signal compensated for changing duct pressure to the valve actuator which opens the damper and increases primary cooling flow to the space. With a decrease in room temperature, the opposite action occurs. Minimum and maximum primary airflow settings are maintained by the volume regulator. When the system is designed with reheat, heating stages are energized at the appropriate pressure settings.

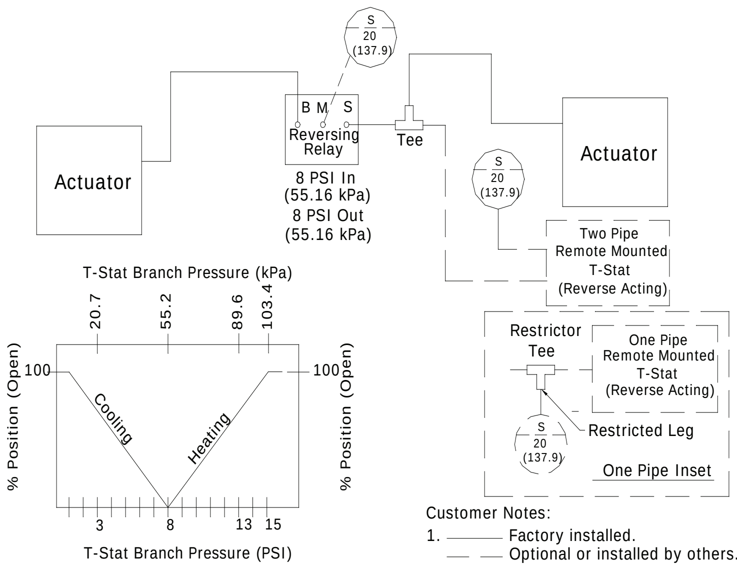


PN08 – VDDF - Dual-Duct Terminal Units

(Normal Operation: Cooling and Heating)

Normally-Open Heating Damper with Actuator and Normally-Open Cooling Damper with Actuator (Reverse-Acting Thermostat)

With an increase in room temperature, the thermostat pressure is decreased. The cooling valve actuator opens the damper to increase primary cooling flow to the space, the heating valve is closed. With a decrease in room temperature, the heating valve modulates and the cooling valve is closed.

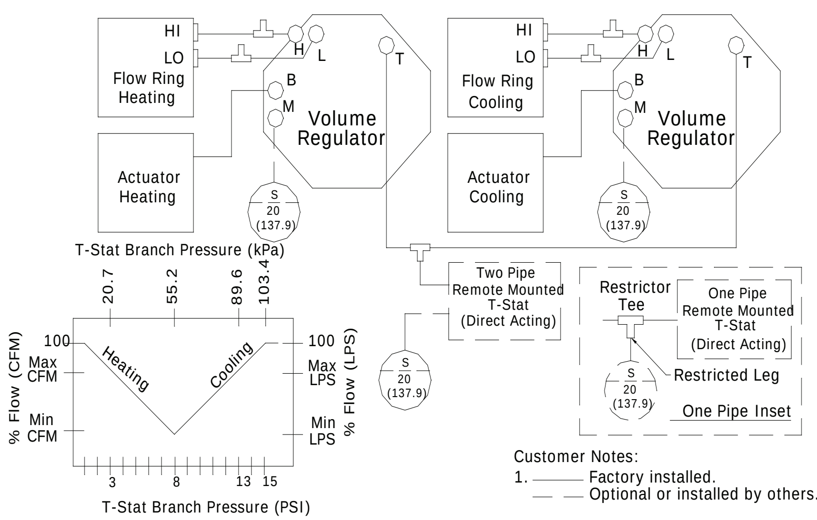


PN09 – VDDF - Dual-Duct Terminal Units

(Normal Operation: Cooling and Heating)

Normally-Open Heating Damper with Actuator, Normally-Open Cooling Damper with Actuator, and 3001 Pneumatic Volume Regulator (Qty of 2) (Direct-Acting Thermostat)

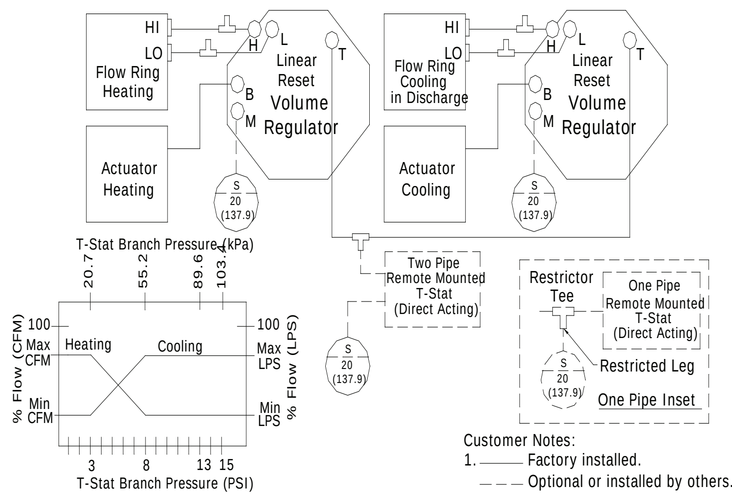
With an increase in room temperature, the thermostat output pressure is decreased. This signal is input to the volume regulator, which also receives the inputs from the high- and low-pressure from the flow ring. The volume regulator outputs a signal compensated for changing duct pressures to the valve actuator, which opens the damper and increases primary cooling flow to the space. With a decrease in room temperature, the opposite action occurs. Minimum and maximum primary airflow settings are maintained by the volume regulator. If the zone temperature continues to decrease after the fan has been energized, heating stages are energized at the appropriate pressure settings.



PN10 – VDDF - Dual-Duct Terminal Units

(Normal Operation: Cooling and Heating - Constant Volume)
Normally-Open Heating Damper with Actuator, Normally-Open Cooling Damper with Actuator, and 3501 Pneumatic Volume Regulator (Qty of 2) (Direct-Acting Thermostat)

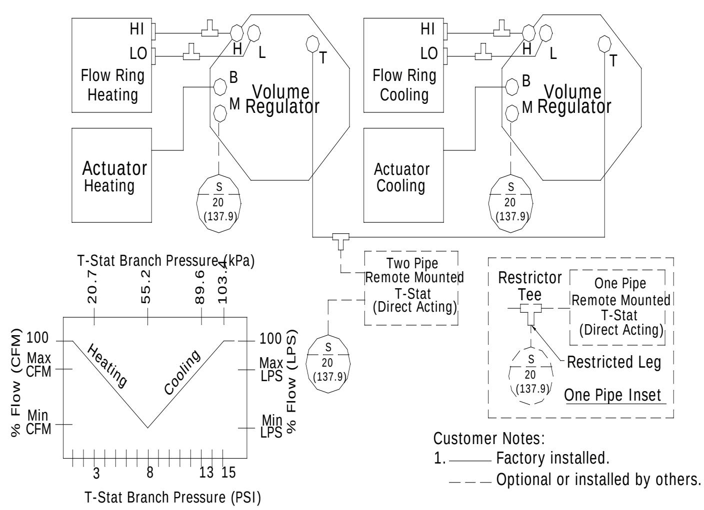
With an increase in room temperature, the thermostat output pressure is increased. This signal is input to the volume regulators, which also receives the inputs from the high- and low-pressure from the flow ring. The cooling volume regulator outputs a signal compensated for changing duct pressure to the valve actuator, which opens the damper and increases primary cooling airflow to the space. The heating valve is at a minimum flow. With a decrease in room temperature, the heating valve modulates in response to signals from the heating pneumatic volume regulator, while maintaining constant volume at the discharge. The heating minimum and maximum settings and the constant volume settings are maintained by the volume regulators.



PC03 – VDDF - Dual-Duct Terminal Units

(Normal Operation: Cooling and Heating)
Normally-Closed Heating Damper with Actuator, Normally-pen Cooling Damper with Actuator, and 3011 Pneumatic Volume Regulator (Qty of 2) (Direct-Acting Thermostat)

With an increase in room temperature, the thermostat output pressure is increased. This signal is input to the volume regulators, which also receives the inputs from the high- and low-pressure from the flow ring. The cooling volume regulator outputs a signal compensated for changing duct pressure to the valve actuator, which opens the damper and increases primary cooling airflow to the space. The heating valve is at a minimum flow. With a decrease in room temperature, the heating valve modulates in response to signals from the heating pneumatic volume regulator. The heating valve is at a minimum flow. Both heating and cooling minimum and maximum settings are maintained by the volume regulators.

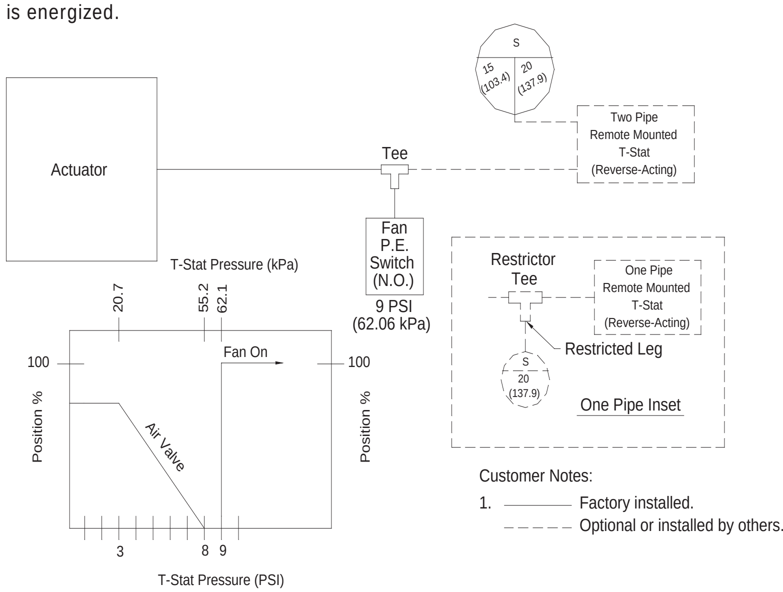


PN00 – VPCF, LPCF Parallel Fan-Powered Without Reheat

(Normal Operation: Cooling Only)

Normally-Open Damper and Actuator (Reverse-Acting Thermostat)

With an increase in room temperature, the thermostat output pressure is decreased and the actuator opens to increase primary cooling airflow to the space. With a decrease in room temperature, the opposite action occurs until the damper is fully closed. Upon a continued decrease in zone temperature below setpoint, the parallel fan is energized.

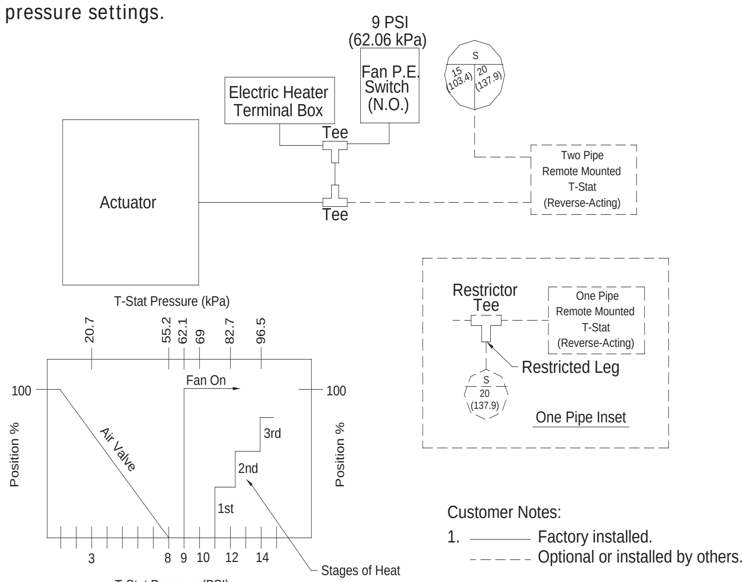


PN00 – VPEF, LPEF Parallel Fan-Powered with Electric Heat

(Normal Operation: Cooling Only)

Normally-Open Damper and Actuator (Reverse-Acting Thermostat)

With an increase in room temperature, the thermostat output pressure is decreased and the actuator opens to increase primary cooling airflow to the space. With a decrease in room temperature, the opposite action occurs until the damper is fully closed. Upon a continued decrease in zone temperature below setpoint, the parallel fan is energized. If zone temperature continues to decrease after the fan has been energized, heating stages are energized at the appropriate pressure settings.



Controls Specifications

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

Additionally, for series fan-powered units, the controller will start and run the fan continuously during the occupied mode and intermittently during the unoccupied mode. Upon a further call for heat, any hot water or electric heat associated with the unit is enabled.

For parallel fan-powered units, the controller energizes the fan upon a call for heat. Upon a further call for heat, reheat is enabled.

Direct Digital Controls (DDC)

LonMark Direct Digital Controller

Trane-designed LonMark® certified controller uses the space comfort control (SCC) profile to exchange information over a LonTalk™ Network. LonMark networks provide the latest open protocol technology.

Direct Digital Controller

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

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/DC, 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 UCM 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 UCM controller must be 18 to 22 awg. twisted pair wiring. The setpoint adjustment range is 50–88ºF (10–31°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 UCM 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 UCM. 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 the UCM 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.

Pneumatic Controls

Normally-Open Actuator

Pneumatic 3 to 8 psig (20 to 55 kPa) spring-range pneumatic actuator.

Normally-Closed Actuator

Pneumatic 8 to 13 psig (55 to 90 kPa) spring-range pneumatic actuator.

3011 Pneumatic Volume Regulator (PVR)

The regulator is a thermostat reset velocity controller, which provides consistent air delivery within 5% of cataloged flow down to 15% of unit cataloged cfm, independent of changes in system static pressure. Factory-calibrated, field-adjustable setpoints for minimum and maximum flows. Average total unit bleed rate, excluding thermostat, is 28.8 scim at 20 psig (7.87 mL/min at 138 kPa) supply.

3501 Pneumatic Volume Regulator (PVR)

The 3501 regulator is a linear-reset volume controller. This PVR is used to maintain a constant volume of airflow from the dual-duct unit when constant volume control is used. Average total unit bleed rate, excluding thermostat, is 43.2 scim at 20 psig (11.8 mL/min at 138 kPa) supply.

Considerations for Pneumatic Thermostat

Field-supplied and -installed based on chosen control options, a direct-acting or a reverse- acting, one-pipe or two-pipe pneumatic room thermostat will control the available air valve, reheat and fan switch to maintain room temperature setpoint. The following pneumatic control features are available with VariTrane terminal units:

- Controls Option – PN00: Cooling with Normally-Open damper and actuator only (Reverse-Acting Thermostat)
- Controls Option – PN04: Cooling with hot water reheat, Normally-Open damper, 3011 PVR (Direct-Acting Thermostat)
- Controls Option – PN05: Cooling with electric reheat, Normally-Open damper, 3011 PVR (Reverse-Acting Thermostat)
- Controls Option – PN08: Cooling and Heating, Normally-Open dampers, actuators only (Reverse-Acting Thermostat)
- Controls Option – PN09: Cooling and Heating, Normally-Open dampers, 3011 PVR's (Direct-Acting Thermostat)
- Controls Option – PN10: Cooling and Heating, Normally-Open dampers, 3501 PVR's, Dual-Duct Constant Volume (Direct-Acting Thermostat)
- Controls Option – PN11: Cooling with hot water reheat, Normally-Open damper, 3011 PVR - Auto Dual Minimum (Direct-Acting Thermostat) (N.O. Water Valve)
- Controls Option – PN32: Cooling with hot water reheat, Normally-Open damper, 3011 PVR - Constant Volume (Direct-Acting Thermostat)
- Controls Option – PN34: Cooling with electric reheat, Normally-Open damper, 3011 PVR - Constant Volume (Reverse-Acting Thermostat)
- Controls Option – PN51: Cooling with reheat, Normally-Open damper, 3011 PVR Duct Pressure Switch (Reverse-Acting Thermostat)
- Controls Option – PN52: Cooling with reheat, Normally-Open damper, 3011 PVR - Dual Pressure Minimum (Reverse-Acting Thermostat)
- Controls Option – PC00: Cooling Only with Normally-Closed damper - Direct-Acting Thermostat

- Controls Option – PC03: Cooling and Heating, Normally-Closed heating damper, Normally-Open cooling damper, actuators only - Direct-Acting Thermostat
- Controls Option – PC04: Cooling with hot water reheat, Normally-Closed damper, 3011 PVR - Direct-Acting Thermostat
- Controls Option – PC05: Cooling with electric reheat, Normally-Closed damper, 3011 PVR - Reverse-Acting Thermostat

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" (22 mm) knockouts to provide 24 VAC for controls.

Wireless Zone Sensor/Receiver

Factory mounted Receiver with field mounted sensor accessory eliminates the need for the wiring between the zone sensor and unit level controller.

Disconnect Switch (Optional on VCCF, VCWF, VDDF)

Disengages power.

DDC Retrofit Kit (VRTO)

The kit consists of a Trane DDC Unit Control Module (UCM) VAV terminal unit controller and a pressure transducer installed in a metal enclosure. The mechanical specifications of accessories such as DDC zone sensors, hot water valves, and transformers are found elsewhere in this section.

Retrofit Kit Options

Flow Bar Sensor

The flow bar sensor is a multiple-point, averaging, pitot tube type flow sensor. It is intended for field installation on terminal units that have no flow measurement device. The total and static pressure outputs of the sensor are field-piped to the high and low inputs of the pressure transducer in the retrofit kit.

Retrofit Kit Actuator

The electric actuator is a direct-coupled type actuator that utilizes three-wire, floating-point control. The actuator is field-installed to the damper shaft and field-wired to the controller.

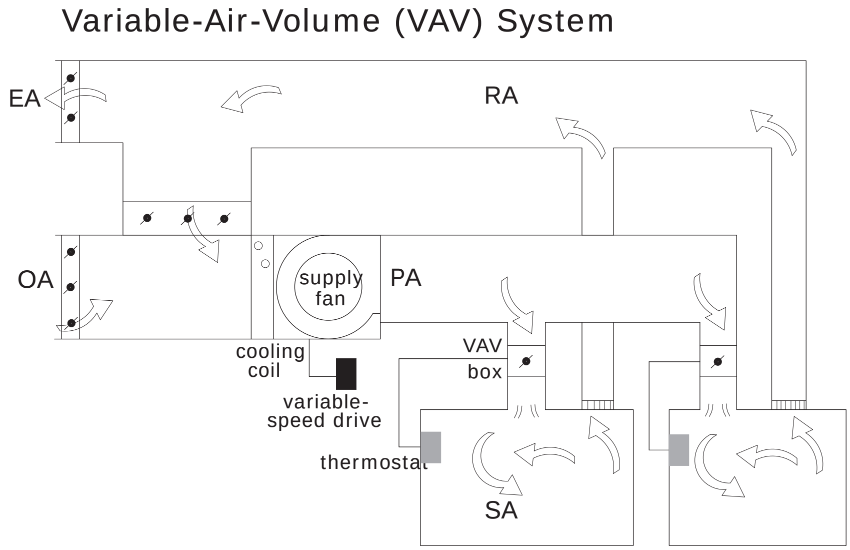
Trane Actuator – Actuator is rated at 4 VA at 24 VAC. Drive time is 90 seconds with 35 in.-lb (4 N-m).

Retrofit Actuator – Actuator is rated at 3 VA at 24 VAC. Drive time is 80 to 110 seconds for 0 to 35 in.-lb (0 to 4 N-m).

Other Options Available

- DDC Zone Sensors - wired or wireless
- 2-Position & 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



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.

Trane's main product in this type of application is called VariTrac™ . VariTrane products can also be used in these systems. (These types of systems are beyond the scope of this manual and are discussed in detail in the VariTrac II Manual.

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.

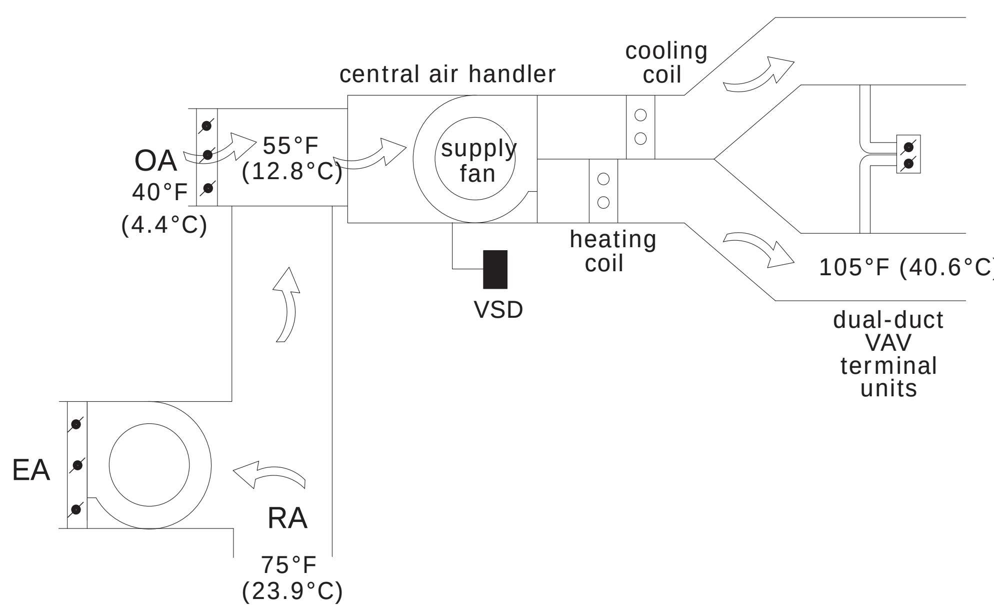
Parallel Fan-Powered Heat—In some zones of a single-duct VAV system, cool supply air at minimum flow is mixed with warm plenum air before entering the zone at a constant flow rate. A fan in the terminal unit, in parallel with the central fan, draws air from the plenum whenever the zone requires heat.

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.

Figure 8. Single-fan, dual-duct VAV system



VariTrane VAV Terminal Units

The function of the VariTrane™ terminal unit in a VAV control zone is to vary the volumetric airflow rate to the zone. VariTrane units are available with either microprocessor-based DDC controls or pneumatic or analog electronic controls. Factory-installed controls are available with all types of terminal units.

Figure 9. Single-Duct cooling only unit (L) and single-duct unit with hot water coil (R)

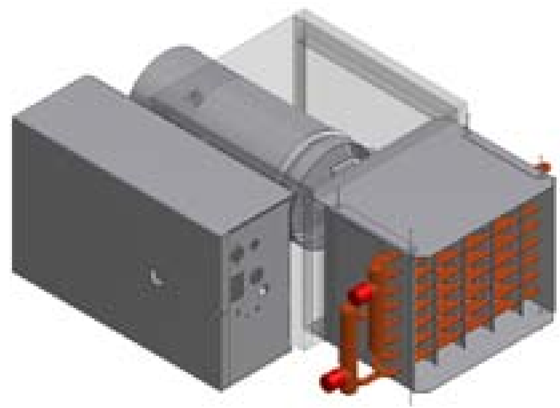
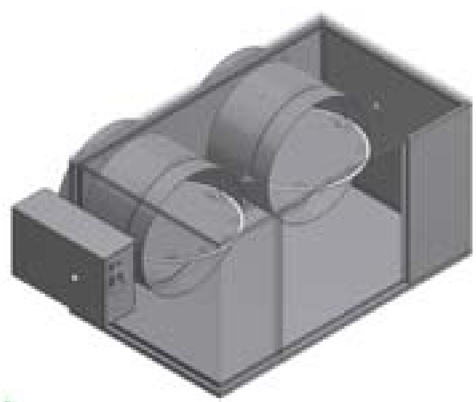


Figure 10. Dual-Duct terminal unit



VAV Terminal Unit Types

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

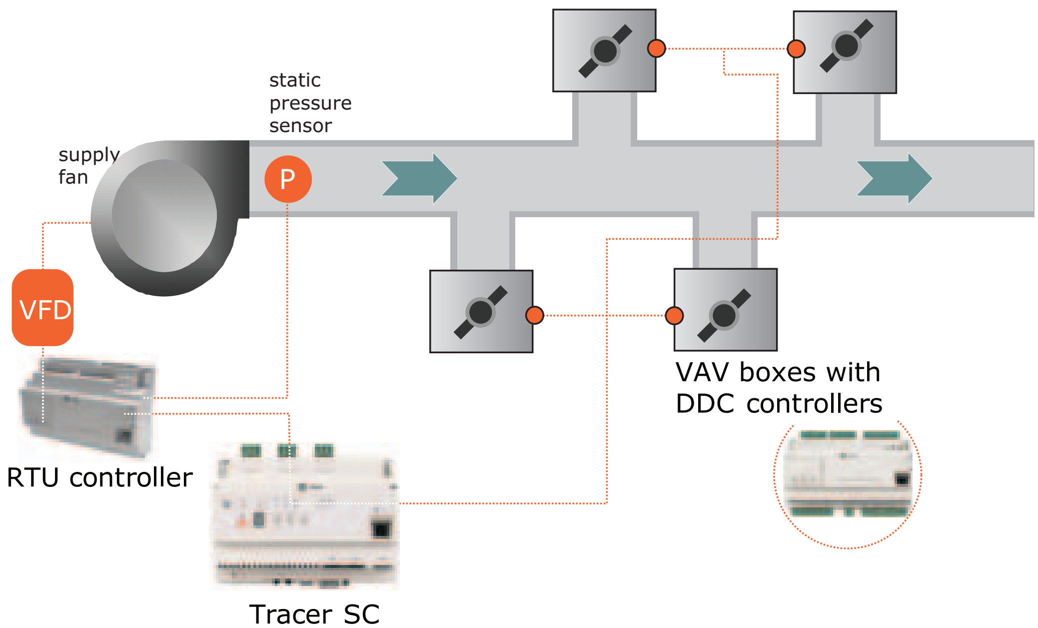
Dual-duct terminal units are used in a special type of air distribution system where the main system has both warm air and cold air separately ducted to each terminal unit. The flow of both warm air and cool air is modulated, delivering air to the VAV zone at variable air volumes as well as variable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

Fan-Pressure Optimization

With Trane's Integrated Comfort 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 allows this scenario. The system polls the VAV units for the damper position on each unit. The supply fan is modulated until the most wide-open damper is between 85% and 95% open. The correct airflow is still being sent to the zones since the controls of the VAV units are pressure-independent, and the fan modulates to an optimal speed and duct static pressure which results in fan energy savings.

Figure 11. Optimized static-pressure control



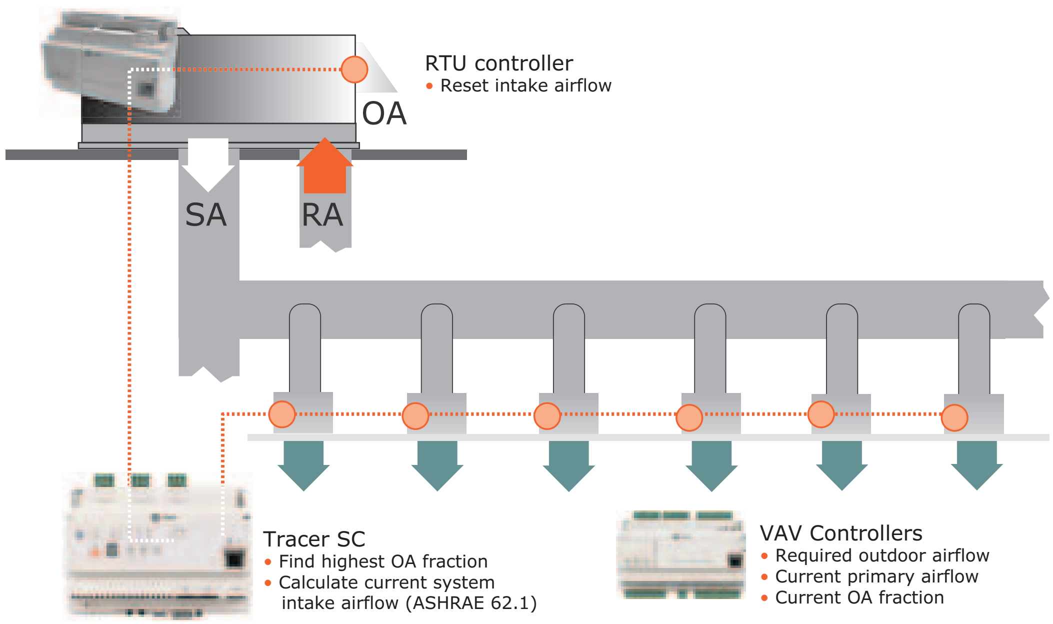
Ventilation Reset

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.

For more detailed information on these energy-saving strategies, please refer to “Additional VAV System and Product References,” p. 156 for appropriate material.

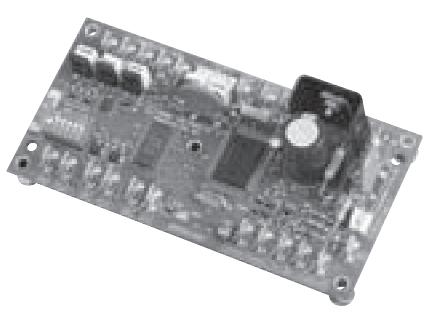
Figure 12. Ventilation reset



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.

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 accepts 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.

Pneumatic Control Systems

Pneumatic control systems use compressed air through simple mechanical control devices, such as diaphragms, springs, and levers to change an output in response to a change in a monitored variable. With VAV terminal units, the output is typically a primary airflow and the monitored variable is zone temperature.

Benefits

Performance—Pneumatic controls are a proven technology that is effective and has a long life cycle.

Installed Cost—When a source of compressed air exists at the facility, pneumatics generally have a lower installed cost than other types of controls when only a basic functionality is required.

Operating and Maintenance Costs—Pneumatics are still the most familiar control technology to many building designers and maintenance people.

Large Installed Base—Pneumatic systems are very common in existing buildings. This eliminates the need to purchase the most expensive piece of equipment in a pneumatic control system—the control air compressor. Extensions to existing pneumatic systems are generally very simple and extremely cost-effective.

Disadvantages

Performance—Pneumatic controls provide proportional-only control for VAV terminal unit systems. This control scheme is less accurate than the more advanced control schemes. Improper calibration of pneumatic controls leads to poor energy utilization.

Versatility—A central pneumatic control system, where each of the control zones can be monitored and adjusted from a remote location, is extremely costly to configure and to modify.

Operating and Maintenance Costs—Pneumatics easily drift and require constant upkeep and scheduled maintenance. Diagnostic capability for pneumatics is not available. A main compressor which is not maintained and becomes contaminated with oil or water can pump those contaminants into the compressed-air-distribution system. This may require costly cleaning of the system and a possible replacement of system components.

DDC Controls Basic Information

DDC controls have become 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 thermostat. 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 much flexibility and considerable diagnostic capability. DDC controllers can be connected together to form a network of controllers. Once the controllers are networked, they can be monitored for proper operation from a remote location. 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 units to allow problem diagnosis, temporary shutdown, startup schedules or other specialized changes. When integrated into a building management system, the operation of the VAV terminal unit system can be modified to do such things, as coincide with occupancy schedules and reduce energy charges.

DDC control of VAV terminal units is a key element in providing intelligent and responsive building management. Precision control, flexible comfort, and after hours access are all available with the VariTrane™ DDC control system for VAV terminal units.

Key features of the system include:

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

Pneumatic Controls Basic Information

Pneumatic controls modulate air pressure of a controller to maintain setpoint. For VAV systems, there are two primary types of pneumatic controllers—the room thermostat and the pneumatic volume regulator (PVR).

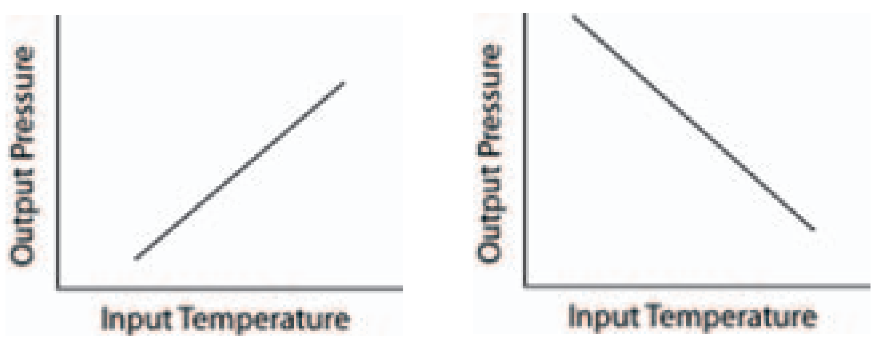
Room Thermostats

The most visible controller to the customer is the room thermostat. Pneumatic room thermostats can be classified by two characteristics: the tubing connection(s) to the thermostat and the action of the thermostat output in response to a change in the input.

Room thermostats are available in models that require a one-pipe or a two-pipe configuration. The name is derived from the number of tubes that must run to the thermostat location. The difference is really in the construction of the thermostats. The two-pipe thermostats have a constant pressure supply connected via an air tube to the thermostat supply air port. The supply air travels through the thermostat's relays, levers, diaphragm, and bleed port to produce an output. The output line is connected to the output port of the thermostat and extends to the controlled device. The one-pipe thermostat has, as its name suggests, only one air line connection. The thermostat works by opening and closing an air bleed valve. This will either decrease or increase the pressure on the controlled device, which is connected to the same line that runs to the thermostat.

Room thermostats also can be classified by their reaction to a change in temperature. Room thermostats classified this way are denoted as either direct-acting or reverse-acting. Direct-acting thermostats will increase their output pressure as the temperature the thermostat measures increases.

Figure 13. Direct-acting thermostat response (L) and direct-acting thermostat response (R)



On the contrary, reverse-acting thermostats will decrease their output pressure as the temperature the thermostat measures increases.

Pneumatic Volume Regulators

These controllers accept the room thermostat signal and modulate the VAV terminal unit primary air damper. The primary air damper is controlled for an airflow setpoint that is determined by the room thermostat. The thermostat increases the PVR's airflow setting when the temperature in the space is warm. On the other hand, the thermostat decreases the PVR's airflow setting when the temperature in the space is cold.

Currently, VariTrane offers two models of pneumatic volume regulators in its controls offering—the 3011 regulator (used in most applications) and the 3501 model (used in dual-duct constant-volume applications). The primary difference is the 3501 PVR's ability to change the velocity pressure linearly with a change in thermostat pressure, which results in improved stability at low flows. In contrast, the 3011 PVR resets the velocity pressure with a change in thermostat pressure.

Reset Control of Minimum and Maximum Flow—The 3011 PVR and 3501 use fixed reset control of minimum and maximum flow settings. The primary benefit of fixed reset in a pneumatic volume regulator is stable flow control without excessive damper movement.

Fixed Reset—A fixed reset controller operates over a thermostat signal change of 5 psi between minimum and maximum flow, regardless of the differential pressure flow sensor signal. The thermostat is usually set for a gain of 2.5; i.e. it produces a 2.5 psi output change per degree of space temperature change. This control strategy provides stable flow control with the primary air valve throttling between minimum and maximum flow over a 2°F space temperature change.

Example 1: Air valve with a 6" inlet, Pneumatic thermostat gain = 2.5 psi/degree:

Minimum Flow=0 cfm, 0.0 in. wg flow signal

Maximum Flow=680 cfm, 2.0 in. wg flow signal

2.0 in. wg signal range

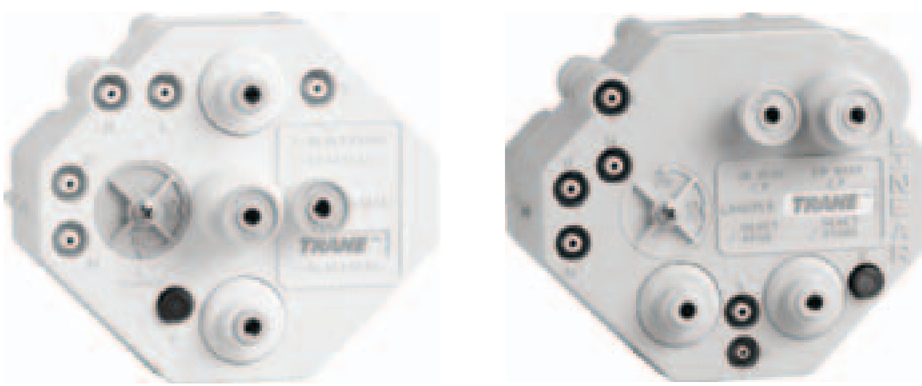
The damper will modulate from zero to maximum position over a 2°F temperature change.

Bleed Port to Atmosphere—Bleeding air to the atmosphere is a normal operation for a volume regulator. The 3011 volume regulator addresses this function with a dedicated bleed port. When air is bled through the flow sensor, the differential pressure signal from the sensor is affected. As a result, the flow sensor signal can be radically altered if the volume regulator is bleeding air, and may cause excessive damper movement.

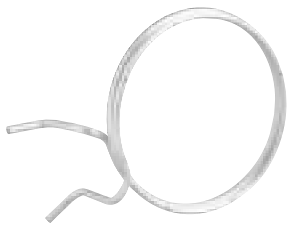
Calibration—The minimum and maximum settings are independent of each other and need to be set only once during calibration.

Signal Configuration Flexibility—Both can be configured to work with both normally-open and normally-closed pneumatic air valves, and both direct-acting and reverse-acting thermostats.

Pneumatic Volume Regulators



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 VAV 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 box 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 velocity pressure is defined as the difference between the total pressure in the duct and the static pressure in the duct:

VP = TP - SP (All units are expressed in inches of water)

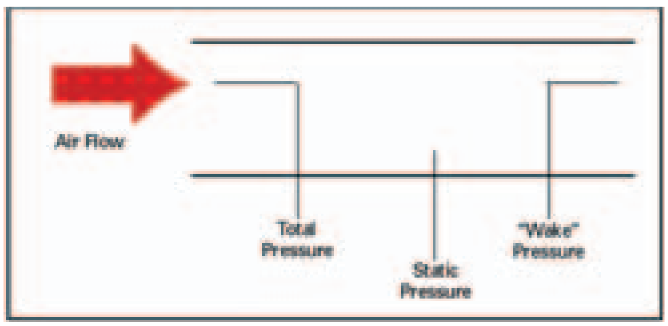
The amount of air traveling through the inlet is related to the area of the inlet and the velocity of the air:

AIRFLOW = 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 14. Air pressure measurement orientations



Air Density Effects

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

Elevation

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

$$\frac{\Delta P\ S\tau\alpha\nu dard\ Conditions}{DENS\ S\tau\alpha\nu dard\ Conditions} = \frac{\Delta P\ New\ Conditions}{DENS\ New\ Conditions}$$

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

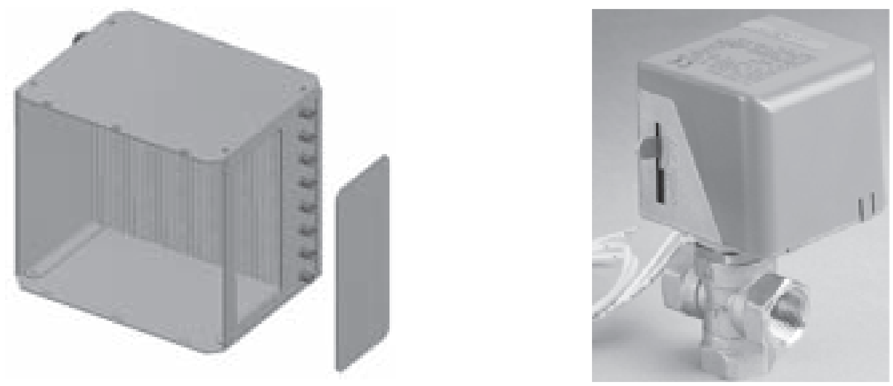
While changes in these factors certainly affect the density of air, most operating parameters which VAV systems need keep these effects very small. The impact on accuracy due to these changes is less than one half of one percent except in very extreme conditions (extreme conditions are defined as those systems with 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 increase in DDC controls over 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 insure proper control of the unit.

Reheat Options

Figure 15. Hot water coil (L) & hot water valves (R)



Hot water heating coils are generally applied on VAV terminal units as reheat devices. When applying these coils it is important to make sure that they are operating in the proper air flow and water flow range. 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. The C_V is defined as the flow rate, in gallons of 60°F (15.56°C) water, that will pass through the valve in one minute with a one pound pressure drop. The 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 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

DP=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 Reheat

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 coil or a three-phase coil. The current draw is necessary for determining what size wire should be used to power the electric coils and how big the primary power fusing should be.

The equations for current draw for these coils are:

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

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

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 Figure 29, p. 40 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

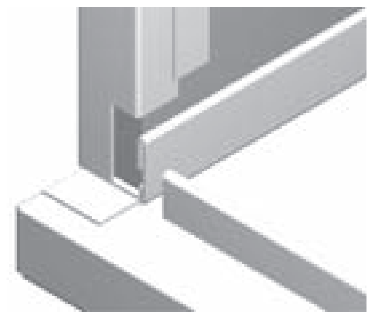
3145=A constant

DP=The maximum rise in air temperature across the coil (usually 50 degrees F (28 degrees C))

Electric heat coils are available with magnetic or mercury contactors. Magnetic contactors are less expensive than mercury contactors. However, mercury contactors can be cycled at a more rapid rate without failing. Mercury contactors are rated for heavier duty use and should be used in as many applications as possible. For pneumatic applications the electric coils are available with factory-installed pressure-electric switches.

Insulation

Encapsulated edges



Insulation in a VAV 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-gage 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, a lower RPM provides better Acoustical performance. It is as simple as that—there are some catches, however.

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

Sizing of Units

Before blindly increasing the size of units, we must first understand what is setting the acoustics within the space. In general, over 95% of acoustics in 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 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, regardless of the max cooling velocity the 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. Because parallel and series fan-powered units operate at a constant fan flow, 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 70-80% 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 51. 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

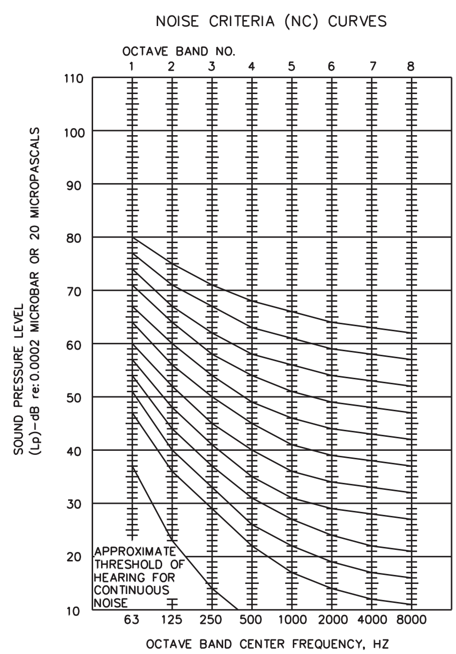
Attenuators that are simple “cups” at the plenum inlet(s) have been shown in Trane’s acoustical mock-up to provide no measurable reduction in sound pressure in the critical octave bands which set the occupied space noise criteria.

Certification and Testing

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

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

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



By using NC sound levels, it is possible to express acceptable sound levels for various types of buildings or environments. A few examples are:

Concert Hall	NC-22
Hospital Room	NC-30
School Room	NC-35
General Office	NC-40
Cafeteria	NC-45
Factory	NC-65

Path Attenuation

Sound is 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™).

TAP 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 (TOPSS™) 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 VAV System and Product References," p. 156 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 for VAV systems, 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 VariTrane 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, pressure transducer (if DDC or analog electronic controls are present) or PVR (if pneumatic controls are present).

This problem is sometimes unknowingly encountered because of the capability of the VariTrane unit to allow greater airflow for a specific size duct than other terminal units. For example, a project engineer specifies an 8" (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 VariTrane unit with a 6" (152 mm) inlet will provide the specified terminal unit performance. The terminal unit supplier submits, receives approval, and orders the 6" (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" (152 mm) round. The unit arrives at the job site, and the installer notices that the 8" (203 mm) duct and the 6" (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.

Unit Conversions

Table 52. Conversions of length and area

To convert	From	To	Multiply by
Length	In.	m	0.0254
Length	Ft	m	0.3048
Length	m	In.	39.3701
Length	m	Ft	3.28084
Area	In.^{2}	m^2	0.00064516
Area	Ft^2	m^2	0.092903
Area	m^2	In.^{2}	1550
Area	m^2	Ft2	10.7639

Table 53. Conversions of velocity, pressure, and flow rate

To convert	From	To	Multiply by
Velocity	Ft/min	M/s	0.00508
Velocity	M/s	Ft/min	196.850
Pressure	Psi	Pa	6894.76
Pressure	Ft of water	Pa	2988.98
Pressure	In. of water	Pa	249.082
Pressure	Pa	Psi	0.000145038
Pressure	Pa	Ft of water	0.000334562
Pressure	Pa	In. of water	0.00401474
Flow Rate	Cfm	L/s	0.4719
Flow Rate	Cfm	m^3/s	0.000471947
Flow Rate	Gpm	L/s	0.0630902
Flow Rate	m^3/s	Cfm	2118.88
Flow Rate	L/s	Cfm	2.1191
Flow Rate	L/s	Gpm	15.8503

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

VariTrac™ catalog

The catalog will help explain features and benefits of VariTrac, how the VariTrac product works, applications for the product, and selection procedures.

Literature Order Number: VAV-PRC003-EN

ASHRAE Handbook of Fundamentals

ASHRAE Handbook of HVAC Systems and Equipment

ASHRAE Handbook of HVAC Applications

ASHRAE Handbook of Refrigeration

Web sites:

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

AHRI CERTIFIED™
www.ahridirectory.org
VAV Terminals
AHRI Standard 880

c UL US LISTED

Trane optimizes the performance of homes and buildings around the world. A business of Ingersoll Rand, the leader in creating and sustaining safe, comfortable and energy efficient environments, Trane offers a broad portfolio of advanced controls and HVAC systems, comprehensive building services, and parts. For more information, visit www.Trane.com.

Trane has a policy of continuous product and product data improvement and reserves the right to change design and specifications without notice.

VAV-PRC011M-EN 03 Mar 2015
Supersedes VAV-PRC011L-EN (16 Sep 2014)

We are committed to using environmentally conscious print practices that reduce waste.

Ingersoll Rand