Titus
Redefine your comfort zone.™

chilled beams

k-12 education | woodgrains | dual-function | energy solutions

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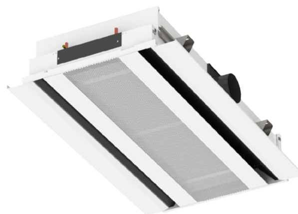
active chilled beams

CBAL

LINEAR ACTIVE CHILLED BEAM

- Active linear chilled beam with 1-way or 2-way air distribution patterns
- Optimized nozzle design provides high capacity and low noise levels
- Linear design matching commercial architectural styling
- Designed to fit in standard 12-inch and 24-inch ceiling systems
- Optimized diffuser geometry maximizes occupant comfort



CBLE

LINEAR EXPOSED ACTIVE CHILLED BEAM

- Exposed linear chilled beam with 1-way or 2-way air distribution patterns
- Optimized nozzle design provides high capacity and low noise levels
- Linear design matching commercial architectural styling
- Integral coanda plates for ceiling independent operation
- Optimized diffuser geometry maximizes occupant comfort

CBLV

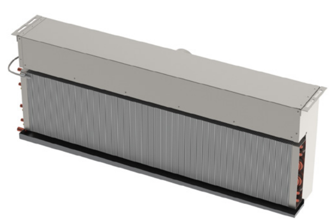
LINEAR BEAM WITH VERTICAL COILS

- Active linear chilled beam with 2-way air distribution patterns
- Optimized nozzle design provides high capacity and low noise levels
- Linear design matching commercial architectural styling
- Designed to fit in standard 24-inch ceiling systems
- Vertical coil configuration
- Optimized diffuser geometry maximizes occupant comfort

CBAM

MODULAR ACTIVE CHILLED BEAM

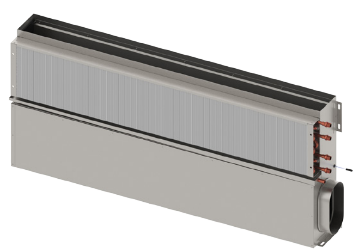
- Active modular chilled beam with 4-way air distribution pattern
- Optimized nozzle design provides high capacity and low noise levels
- Modular design matching commercial architectural styling
- Designed to fit in standard 24-inch ceiling systems
- Optimized diffuser geometry maximizes occupant comfort



CBAV

VERTICAL RECESSED ACTIVE CHILLED BEAM

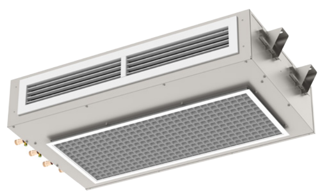
- Active chilled beam for use in recessed applications
- Optimized nozzle design provides high capacity and low noise levels
- Vertical coil with condensate pan
- Designed to integrate with Titus slot diffusers
- Optimized diffuser geometry maximizes occupant comfort

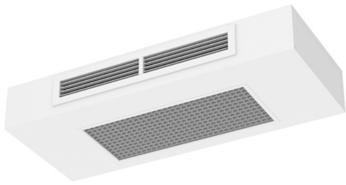


CBAS

SILL MOUNTED CHILLED BEAM

- Provides comfortable, effective sensible cooling to the space
- Optimized nozzle design provides high capacity and low noise levels
- Ideal for induction unit and unit ventilator retrofit projects
- Quick and simple installation
- Available in nominal lengths up to 6 feet
- ½" Sweat or ½" MNPT coil connections





CBAB

CONCEALED BULKHEAD ACTIVE CHILLED BEAM

- Provides comfortable, effective sensible cooling to the space
- Optimized nozzle design provides high capacity and low noise levels
- Ideal for single room hospitality spaces
- Quick and simple installation
- Available in nominal lengths up to 6 feet
- ½″ Sweat or ½″ MNPT coil connections

CBAC

EXPOSED BULKHEAD ACTIVE CHILLED BEAM

- Provides comfortable, effective sensible cooling to the space
- Optimized nozzle design provides high capacity and low noise levels
- Durable powder coated steel cabinet with tool-less access panels
- Quick and simple installation
- Available in nominal lengths up to 6 feet
- ½″ Sweat or ½″ MNPT coil connections

CBAW

SIDEWALL ACTIVE CHILLED BEAM

- Provides comfortable, effective sensible cooling to the space
- Optimized nozzle design provides high capacity and low noise levels
- Ideal for multi-story residential and hospitality spaces
- Quick and simple installation
- Available in nominal lengths up to 6 feet
- ½″ Sweat or ½″ MNPT coil connections

passive chilled beams

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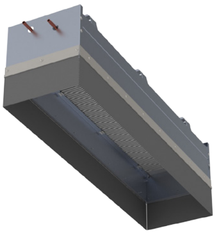

CBPE

EXPOSED PASSIVE CHILLED BEAM

- Provides comfortable, effective sensible cooling to the space
- Ultra quiet, natural convection driven operation
- Perforated or Linear Bar Grille options for exposed models
- Exposed or concealed installation

CBPR

RECESSED PASSIVE CHILLED BEAM

- Provides comfortable, effective sensible cooling to the space
- Ultra quiet, natural convection driven operation
- Perforated or Linear Bar Grille options for exposed models
- Exposed or concealed installation

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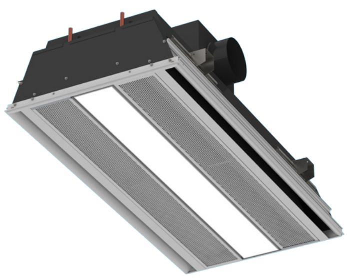
integrated service chilled beam



VLR (12 / 24)

LIGHTED CHILLED BEAMS

- 1-way and 2-way air pattern
- Multiple nozzles providing low sound levels
- Normal and High output LED lighting fixture with dimming capabilities
- Beam width: 24" Nominal Lengths: 4ft / 8ft
- Light fixture width: 6" or 12"
- 2-pipe or 4-pipe for heating and cooling

VLP

LIGHTED CHILLED BEAMS

- 1-way and 2-way air pattern
- Multiple nozzles providing low sound levels
- Normal and High output LED lighting fixture with dimming capabilities
- Beam width: 24" Nominal Lengths: 4ft / 8ft
- Light fixture width: 6" or 12"
- 2-pipe or 4-pipe for heating and cooling

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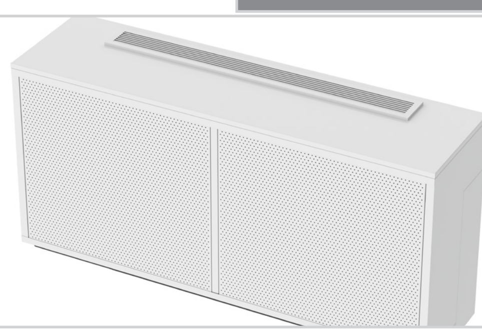
floor mounted displacement chilled beam



TAO

FLOOR MOUNTED DISPLACEMENT CHILLED BEAM

- Heavy gauge casing construction
- Separate heating and cooling
- Removable condensate pan
- Low sound levels
- Perfect for school applications

Overview

The Titus chilled ceiling product line is comprised of chilled beams, both active and passive beams, and floor mounted displacement chilled beams. These products offer optimized performance and provide high levels of thermal comfort for the occupant. In addition to increased occupancy comfort, use of the chilled ceiling products reduce the amount of energy required to heat and cool a building.

The chilled ceiling products provide sensible cooling and heating to the space by utilizing the more efficient heat transfer capacity of water, as opposed to air. This decouples the latent and sensible loads, reducing the energy cost of sensible cooling. With passive beams and radiant products, an additional system is necessary to meet the ventilation and latent cooling needs of the space. The Titus active chilled beams integrate the supply of ventilation air creating an active diffuser. Using the ventilation air to pressurize a plenum with aerodynamically designed nozzles, high velocity jets of air are created forcing induction of room air over the water coils integral to the units. Forced induction dramatically improves the heating and cooling capacity over passive beams and radiant products. Titus active chilled beams harness the energy of the supply air to further reduce total energy consumption.

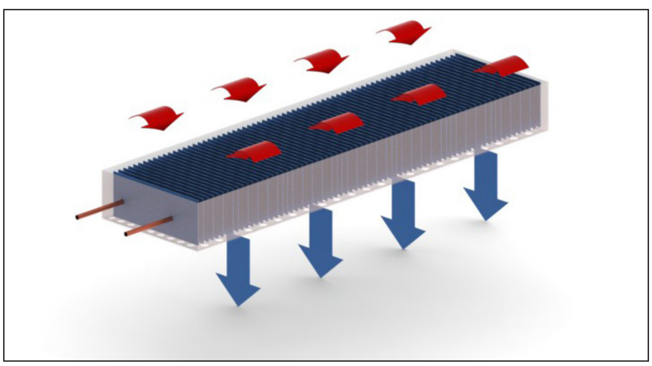
Titus offers a chilled ceiling product to meet the requirements of any design or installation. CBPE and CBPR models of passive beam accommodate both exposed and recessed mounting applications. Active chilled beams are available in 1, 2, and 4-way throw patterns. There is even a model for high sidewall applications. In addition to the variety of product solutions available, the appearance of the units can be customized through standard options, which enables seamless integration into any architectural style, traditional or contemporary.

Introduction

Chilled ceiling systems consist of three main product types: active chilled beams, passive chilled beams, and radiant ceiling panels/sails. Even though these units are commonly referred to as "chilled" products they are also effectively used for both cooling and heating.

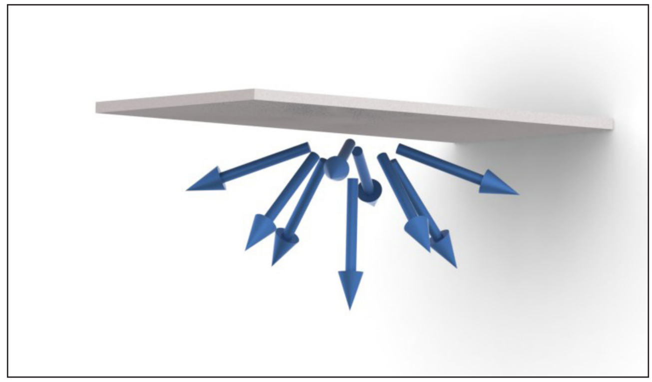
Both active and passive beams utilize water coils to provide sensible cooling, reducing the total load that must be addressed through the building's air handlers. Since chilled beams provide sensible only cooling they are best suited for spaces with low to moderate latent loads. This offers considerable potential for energy savings due to the volumetric heat transfer capacity of water and trade-off between fan energy and pumping power.

Passive beams consist of a water coil and an enclosure. The enclosure is primarily cosmetic, but helps to maintain even heat transfer across the coil. Passive beams provide cooling primarily through convective heat transfer. A convection current is created where higher density cool air sinks into the space, inducing warm low density air at the ceiling level through the coil. When using passive beams ventilation air must be introduced to the space either through natural or mechanical means.



Incorporating supply air into a beam creates an active diffuser. Ventilation air pressurizes a plenum and the aerodynamically designed jets induce room air over water coils. Forced induction dramatically increases the heating and cooling capacity per square foot, compared to passive beams and radiant products. Active chilled beams harness the energy of the supply air to further reduce total energy consumption.

Radiant ceilings systems emit heating and cooling by both convection and radiation. During cooling, ambient air near the ceiling cools and falls to the occupied area, due to its higher density. The ceiling panels emit cooling and heating to the surrounding surfaces in the area by radiation. Radiant heat transfer typically results in high thermal comfort since the ambient temperature will feel 2.5°F to 5°F cooler/warmer than actual

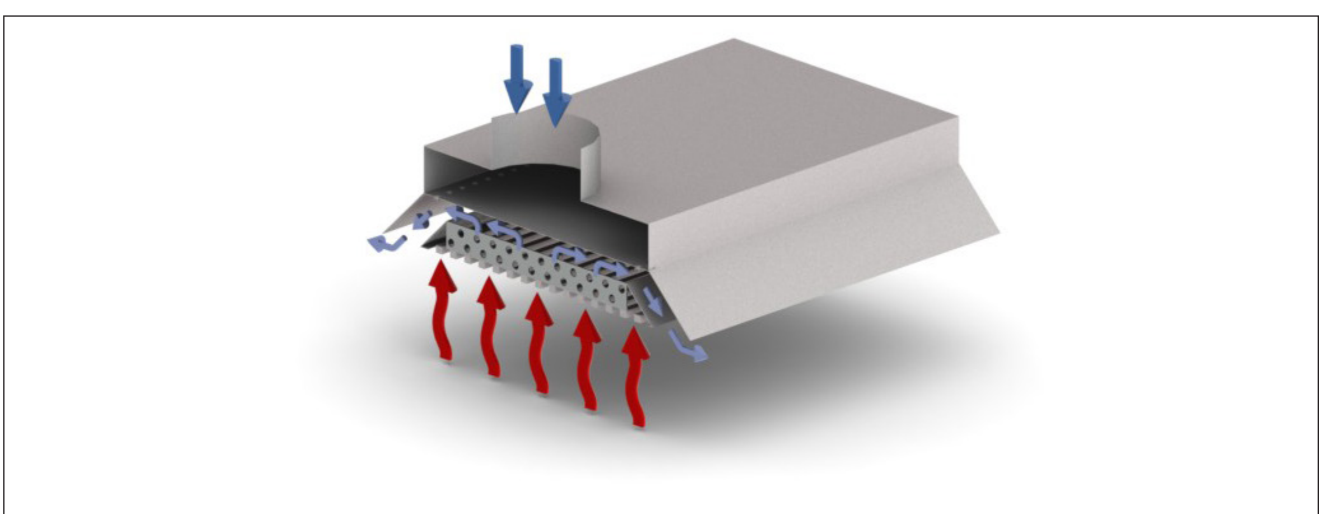


room temperature. This effect has the advantage that the room requires less conditioning than a traditional system, introducing an additional opportunity for energy savings.

History

Modern chilled ceiling systems, more specifically active chilled beams, got their start in the 1920s when Willis Carrier began to develop the concepts for under-sill induction units. Patents were applied for and first installations of these units were completed in 1940. The use of an air-water terminal located in the space was an important advance in and of itself; however, these systems solidified the advantages of an air-water system over an all-air system.

- Water is much more efficient heat transfer medium than air.
- Reduced duct size required to only supply ventilation air increased usable space, and reduced the material cost and installation time.



Scandinavian engineers, during the mid-1970's, adapted this technology along with radiant heating/cooling panels for overhead applications to work with new buildings designed to utilize natural ventilation. The result of their efforts was the passive chilled beam.

In regions where using natural ventilation was not effective, engineers integrated the mechanical ventilation into chilled beam. Utilizing the same principles used in the under-sill induction boxes, the active chilled beam was developed.

Theoretical Background

HEAT TRANSFER

ASHRAE defines heat transfer as "the flow of heat energy induced by a temperature difference."
Thermal energy can be transferred or be affected by:

- Conduction
- Convection
- Radiation
- Humidity

Thermal conduction is the mechanism of heat transfer by the transfer of kinetic energy between particles or groups of particles at the atomic level.

With solid bodies, such as with an air jet near a window, thermal conduction dominates only very close to the solid surface.

Thermal convection is the transfer by eddy mixing and diffusion in addition to conduction.

The transfer of fluid currents produced by external sources, such as by a blower, is called forced convection.

When the fluid air movement is caused by the difference in density and the action of gravity, it is called natural convection. Natural convection is very active near windows and near heat sources in the occupied spaces. The colder air falls and the warmer air rises.

Radiant heat transfer takes place through matter. It is a change in energy form, from internal energy at the source to electromagnetic energy for transmission, then back to internal energy at the receiver. Examples of radiation are sunshine through the air and window to the inside floor or ceiling light to occupants and to the floor.

All of these methods of heat transfer effect a person's comfort reaction. In addition, humidity has some effect caused by a change in evaporation rate from the body.

Heat transfer is also affected by the following factors:

- A greater temperature difference will result in a greater amount of heat transfer.
- The amount of surface area is directly proportional to the amount of heat transfer.
- The amount of time is also directly proportional to the amount of heat transfer.
- The thermal resistance of the material use affects the rate of heat transfer.

Heat loss is measured in "BTU" which is the amount of heat required to raise 1 lb. of water 1°F. Coefficients used to estimate the value of the heat loss include:

- 'K' Factor: amount of heat transferred in 1 hour through 1 sq. ft. of material, 1" thick at 1°F of temperature difference.
- 'C' Factor: amount of heat transferred in 1 hour through 1 sq. ft. of material through the specified thickness of the material used.
- 'R' Value: resistance to heat transfer, measured as the reciprocal of conductance (1/K or 1/C).
- 'U' Value: designates the overall transmission of heat in 1 hour per sq. ft. of area for the difference of 1°F across specified material.
- Conductance of individual materials is not directly applicable to the heat loss calculation. First, it must be converted to the 'R' value, which is (1/K or 1/C).

Equation 1: For a structure with multiple skin materials, the total heat transmission can be calculated as:

$$U = 1/(R1 + R2 + \ldots\ldots Rn)$$

For hydronic heating and cooling systems heat is removed from the occupied space (cooling) or added to the occupied space (heating) via a closed loop water system. Return air from the space passes across a fin tube coil.

PSYCHROMETRICS

One of the four major elements of thermal energy and comfort is humidity. Psychrometrics uses thermodynamics properties to analyze conditions and processes involving moist air. A detailed study of psychrometrics can be found in Chapter 1 of ASHRAE 2009 Fundamentals Handbook. This section is a summary of how knowledge of psychrometrics can be used to maximize space comfort and system performance.

Atmospheric Air (the air that you breathe), contains many gaseous components including water vapor and containments. Dry Air is atmospheric air with all moisture removed and is used only as a point of reference. Moist Air is a combination of dry air and water vapor and can be considered equal to atmospheric air for this discussion.

A psychrometric chart (FIGURE 4) is a graphical representation of the thermodynamic properties of moist air. There are several charts available to cover all common conditions. The one shown here is taken from ASHRAE Fundamentals Handbook, Chapter 1 and illustrates conditions of 32 to 100°F at sea level.

The Dry-bulb Temperature (DBT), is the temperature measured using a standard thermometer. Dry-bulb is also known as the sensible temperature.

The Wet-bulb Temperature (WBT), is the temperature measured using a 'wetted' thermometer. Wet-bulb is used to determine the moisture content of air.

The Absolute Humidity (AH), is the vapor content of air. It is described in terms of moisture per lb of dry air or grains of moisture per lb. of dry air. AH is also referred to as 'moisture content' or 'humidity ratio.' There are 7000 grains in a lb. of water.

The Relative Humidity (RH), is the vapor content of air. It is described as the percentage of saturation humidity at the same temperature (%). The goal for optimum space comfort is 30-35% for heating conditions, and 45-60% for cooling conditions. Saturation humidity is the maximum vapor content (lb./lb.) per lb. dry air that air can hold at a fixed temperature.

The Dew Point Temperature (DPT), is the temperature at which vapor begins to fall out of air to form condensation. DPT is the temperature at which a state of saturation humidity occurs, or 100% RH. It is also known as the saturation temperature.

The Specific Volume (Spv), is the reciprocal of air density which is described in terms of cubic feet per lb of dry air (cu ft/lb.). An increase in air temperature will result in a decrease in density and an increase in volume. A decrease in atmospheric pressure also decreased air density while increasing volume. At 5000 feet above sea level, density is decreased by 17%. Higher altitudes require larger motors and blowers to move the same effective mass, due to the increase in specific volume.

The Enthalpy (H) is the heat content of air. Enthalpy is also known as the total heat of air. Enthalpy is defendant on the wet-bulb temperature of air. It is described in terms of Btu's per lb. dry air (Btu/lb.).

A Status Point is a location on the psychrometric chart defined by any two psychrometric properties. A hydrometer or psychrometer is commonly used to define a status point.

At 100% RH the wet-bulb will equal the dry-bulb temperature. As the temperature difference between temperatures increases, the RH will decrease.

To locate a status-point, find the dry-bulb temperature on the bottom of the psychrometric chart. Follow this line upward until it intersects with the wet-bulb temperature from the left side of the chart.

From the 'status point' you can locate:

- Absolute Humidity (AH)
- Relative Humidity (RH)
- Dew Point Temperature (DPT)
- Specific Volume (Spv)

When will condensation occur? To determine if a supply air duct or air outlet device will form condensation on the surface:

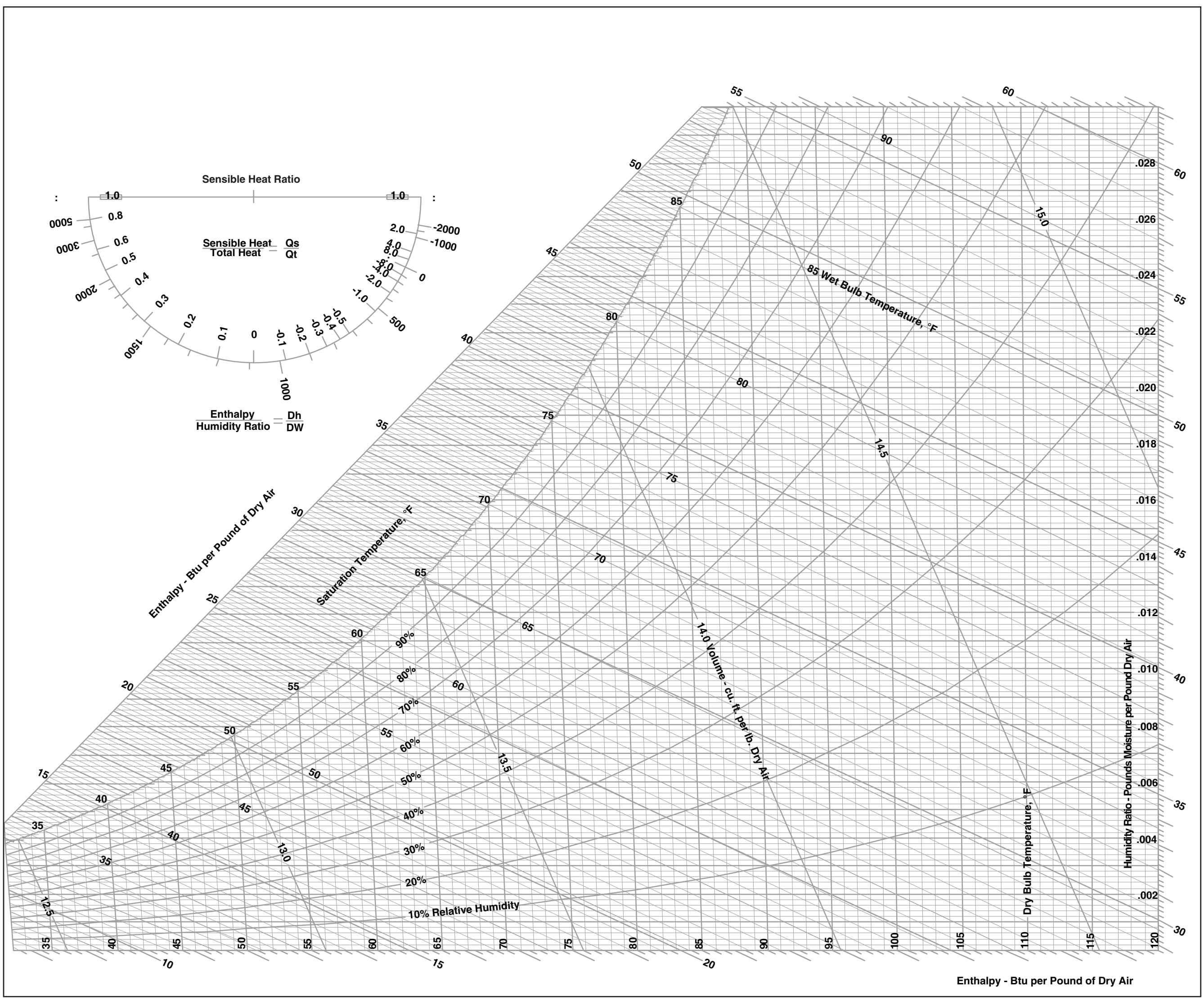


Figure 4. Psychrometric Chart

First, using the R-value of any thermal barrier, determine the minimum surface temperature.

Next, determine the DPT of the atmospheric air in contact with the surface.

If the surface temperature is equal or lower than the DPT, the surface will form condensation. If yes, an additional thermal barrier or other condensation prevention strategies may be required to solve the problem.

Sensible heating (Qsen), is the heat that raises the dry-bulb temperature of air without increasing the moisture content. Because we can easily sense this change in temperature, it is called 'sensible.' Sensible cooling is the removal of heat without removing moisture content of the air.

Latent Heat (Qlat), is the heat content of air due to the presence of water vapor. Latent heat is the heat required to evaporate this same amount of water (970 Btu/lb), also known as the latent heat of vaporization. As latent heat increases, moisture content increases.

Water can be heated to 212°F. If more heat is added, the water will vaporize but the temperature will not change.

Latent Cooling (Qlat), is the removal of latent eat from air without lowering the dry-bulb temperature. To retrieve 1 lb. of condensate, 970 Btu's would need to be removed. As latent heat decreased, moisture content decreases.

Latent Heat of Fusion is the heat required to change a liquid into a solid (144 Btu/lb. Water can be cooled to 32°F. If more heat is removed, it will cause ice to form. To retrieve 1 lb of water from ice, 144 Btu's must be added.

Sensible processes can be shown as horizontal paths on a psychrometric chart. Latent processes can be shown as vertical paths on a psychrometric chart. Most processes include both, resulting in an angled or diagonal path.

Sensible heat factor (SHF) is the measure of sensible heat to latent heat. Sensible heating only is 1.0. Equal proportions result in 0.5. SHF is generally higher than 0.5 because of the cooling processes that remove more sensible heat than latent heat.

INDUCTION

Induction is a flow that occurs as a result of the change in velocity pressure as a jet of air expands. The principals of induced air flow are based on the Venturi effect. The Venturi effect is a derivation of Bernoulli's principle and the continuity laws. In order to satisfy the fluid dynamic principles of continuity, a fluid's velocity must decrease as the flow expands; at the same time the static pressure of the flow must increase. The increase in static pressure balances the decreased velocity, thus maintaining the principles of conservation.

Benefits of Chilled Ceiling Systems

Chilled Ceiling Systems are designed to provide superior occupancy comfort. These systems require less energy to operate, operate more efficiently, and use less materials than conventional all air systems. Tempered and dehumidified air is supplied to the space to meet ventilation requirements and to handle the latent load. The majority of the sensible load is addressed with the chilled ceiling products. Decoupling the latent and sensible loads takes advantage of the superior volumetric heat capacity of water. The reduced volume of air that must be delivered to the space results in reduced air handler capacity and size, smaller duct sizes, and overall energy savings. A higher supply temperature contributes to increased occupancy comfort.

FIRST COST BENEFITS:

- Shallow unit profiles allow for reduced ceiling space requirements; typically require 60% less vertical space than conventional all air systems.
  - Reduced slab to slab spacing; reducing material costs per floor
  - Easily integrated into retrofit applications where space is limited
- Low volume of supply air required for active beams enables reduction of the total amount of air processed at the air-handler by an all air system up to 50%.
  - Reduced air-handler size/capacity, and duct work size

COMFORT AND IAQ BENEFITS:

- Active beams typically supply a constant volume of primary air, decreasing occurrences of dumping and changes to the air motion in the space; issues common to typical VAV systems
- When supplied with primary air from a dedicated outside air system (DOAS) 100% fresh air is supplied to the space
- Dry-coil sensible cooling, eliminates bacterial, fungal, or mold growth associated with fan coils and other unitary products with condensing coils
- Constant primary air volume ensures ventilation requirements are met and helps to maintain relative humidity levels in the space

ENERGY EFFICIENCY AND OPERATIONAL BENEFITS:

- Utilizing the heat transfer capacity of water also takes advantage of the superior operational efficiency of pumps as compared to fans.
  - A 1" diameter pipe can deliver the same cooling/heating capacity as an 18" x 18" duct
  - Reduction of fan energy by a factor of 7 to deliver the same cooling to the space
- Higher supply water temperatures compared to conventional systems allow for use of water side economizers.
  - Increased opportunities for free-cooling
- Significant reduction in maintenance costs and labor as compared to conventional all air systems
  - No moving parts - no blowers, motors, damper actuators to replace
  - Dry-coil operation - does not require regular cleaning and disinfecting of condensate pans
  - Recommend cleaning of coils once every 4 to 5 years, more frequently in hospitality rooms where linens are frequently changed (i.e. hospital patient rooms and hotel rooms)

Chilled Ceiling System Design

CHILLED CEILING APPLICATIONS

Chilled beam and radiant ceiling products are designed to handle high thermal loads in the space. They are also an effective solution in spaces where individual temperature control is desired. Ideal applications are spaces where the sensible heat ratio is greater than 0.75, meaning that 75% or more of the total heat gains in the space are sensible gains. These locations include computer/server rooms, condos/apartments/hotel guest rooms, libraries, and museums.

Use of chilled ceiling systems should be limited to applications where cooling loads are less than 40 BTUH/ft^2, and heating loads are lower than 15 BTUH/ft^2. More specifically, passive beam and radiant panel usage should be limited to applications where cooling loads are no more than 25 BTUH/ft^2, and active chilled beams are not recommended for use when cooling loads are more than 40 BTUH/ft^2. Chilled ceiling systems are not recommended in these applications since addressing the loads will likely create thermal comfort issues. In transitional spaces where thermal comfort is not critical, chilled ceiling products can be used to address higher loads.

Chilled beams and radiant ceiling systems should not be applied in buildings where relative humidity of the space is not easily maintained. This would include retrofit applications, lobbies, and entrances where there is excessive infiltration.

Chilled beams are best applied when installed no higher than 14 feet above the floor, but can remain effective with installation heights up to 20 feet. When installed above these heights it is difficult to effectively get heating and cooling into the occupied space.

PRACTICAL DESIGN GUIDELINES

There are guidelines that should be followed when considering a chilled ceiling system to ensure the design will create a comfortable environment for occupants and result in optimum energy efficiency.

The system should be designed to meet only the heating and cooling requirements of the actual space. Overdesigning the system will increase the cost of the project, and potentially result in decreased comfort.

Primary air must be adequately dehumidified, and supplied at a flow rate large enough to offset the latent loads of the space. This flow rate must also be high enough to meet the ventilation requirements outlined in ASHRAE standard 62.1.

When heating with chilled beams and radiant panels, care must be taken that the system is not oversized for heating. Entering water temperatures should be as low as possible to meet the heating requirements, and should never be over 140°F.

Condensation control strategies must be implemented to maintain optimum operating conditions, prevent bacterial, mold, and fungus growth, ensure damage to building does not occur.

When designing a chilled beam system it is best to limit the types and configurations of products used. This will help to make logistics during installation and building maintenance easier.

Room air temperature is maintained through regulation of 2-way control valves. Use of 2-way valves is preferred as they will minimize pumping costs.

Systems should be designed to take full advantage of free cooling and heating opportunities through economizers and heat recovery devices. Chilled beams and radiant panels are highly efficient products and offer energy savings over traditional systems. However, one of the biggest advantages these products offer is the additional energy savings that can be achieved in the rest of the system due to the unit operating conditions.

DESIGN METHODOLOGY

The design of chilled ceiling systems is an iterative process between selection of the equipment to be used and the inlet conditions for the system. This also includes placement/orientation. The iterative process enables the inlet conditions to be optimized so that the design results in a comfortable space for the occupant, and that the equipment is operating with the highest efficiency possible. This is true for all chilled ceiling systems, but is especially true for active chilled beams.

Equipment selection is based on the following items and must be balanced for creating an effective, efficient, and comfortable system:

- Total unit capacity
  - Size of units
  - Quantity of units
  - Unit Configuration
- Supply Air
  - Flow rate
  - Temperature
  - Relative humidity
  - Operating pressure
- Entering Water Conditions (cooling & heating)
  - Entering water temperature
  - Flow rate
  - Coil pressure drop
- Unit Placement
  - Throw patterns
  - Throw length
- Noise

Once the inlet conditions and equipment has been selected, the controls for the system are selected. The room control system must be designed to deliver the selected inlet parameters and maintain the energy efficiency of the design. The critical points to be maintained are the entering water conditions as well as the supply air conditions. After control of the critical points has been established, additional controls to compensate for changes in space dew point temperature and occupancy should be considered through a building management system.

This methodology is depicted in Figure 5, Chilled Ceiling Design Methodology.

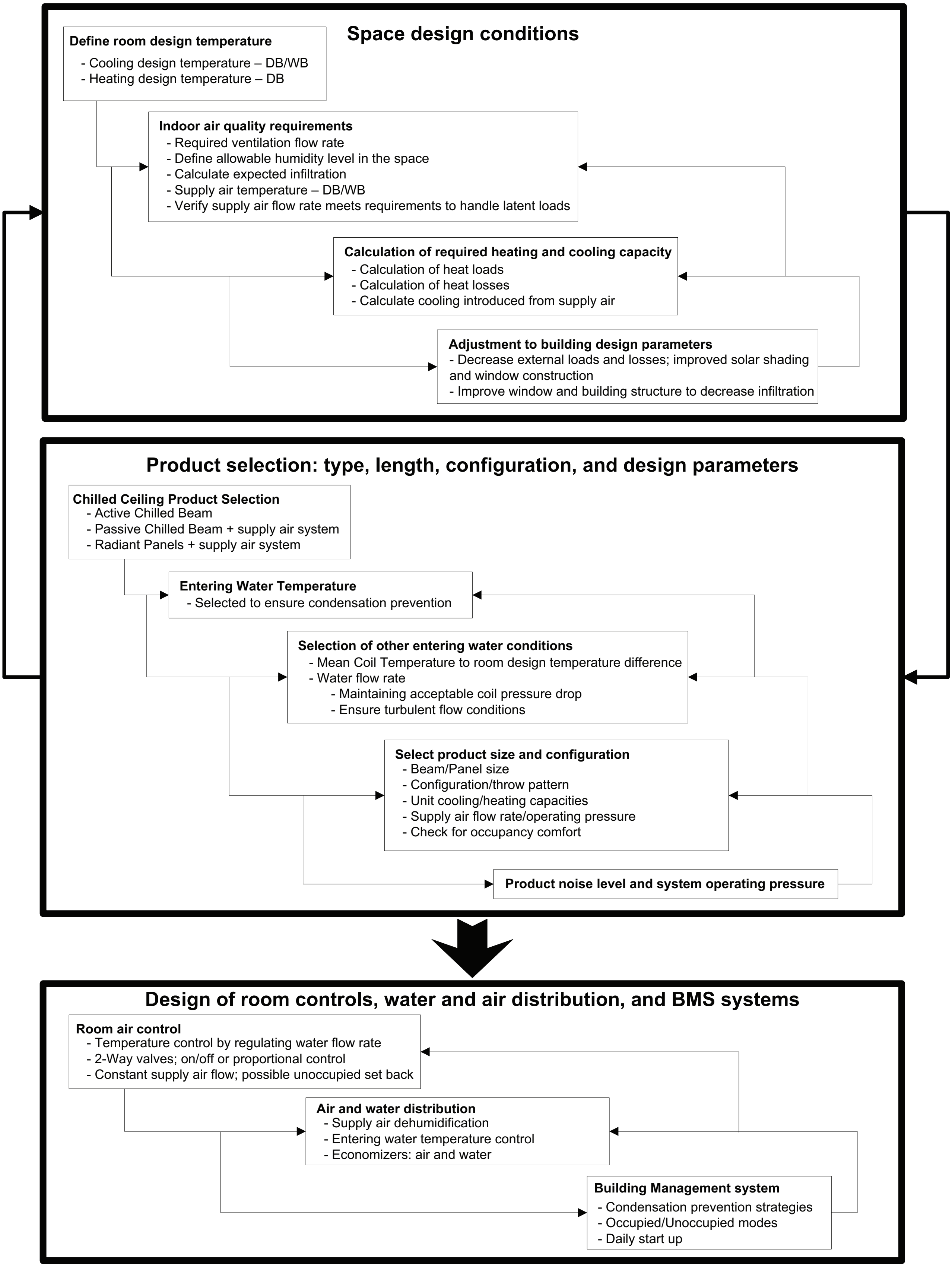
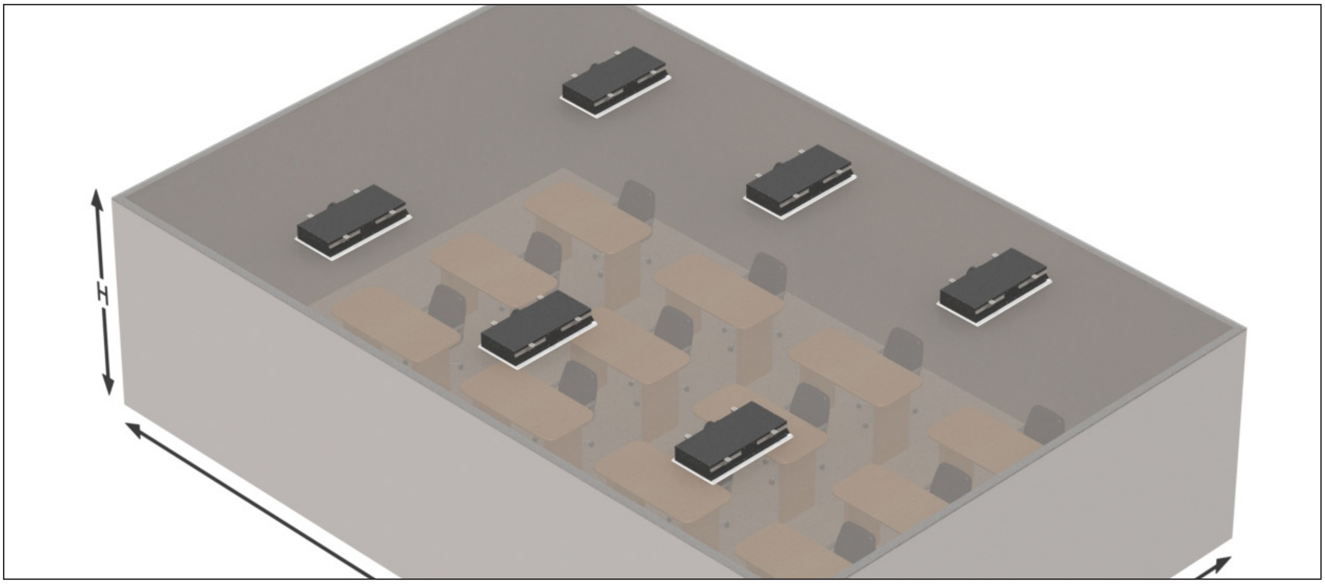


Figure 5. Chilled Ceiling Design Methdology



System Design Process

SPACE DESIGN CONDITIONS

The first step in determining the space design conditions is to define the design temperatures for both heating and cooling. This should be done by following the guidelines set in ASHRAE Standard 55 and the chapters on heating and cooling loads in the ASHRAE Fundamentals Handbook.

Once the design temperatures have been defined, an iterative process should be used to determine the indoor air quality requirements, calculating the required capacities to address the heating/cooling loads, and adjusting the building design/construction (if applicable).

The indoor air quality (IAQ) requirements include supply air flow rate, to meet both ventilation requirements and address the latent loads in the space, determining infiltration, and defining the maximum allowable humidity level.

Based on the building design and construction, anticipated infiltration should be calculated. Information on how to calculate infiltration and how to use infiltration when calculating heat loads and losses can be found in the ASHRAE Fundamentals Handbook. The heat loads and losses calculated associated with infiltration are used in determining the latent cooling requirements. This will affect the volume of supply air necessary to maintain the design humidity levels in the room.

Guidelines for determining the minimum ventilation requirements are given in ASHRAE Standard 62.1. Criteria for maximum relative humidity in the space, based on a humidity ratio of 0.012, is set in ASHRAE Standard 55; for a room design temperature of 75°F, the maximum relative humidity is 63.5%. Once the design conditions for room relative humidity have been determined the supply air flow rate necessary to maintain this level can be calculated. The required flow rate to meet the latent load can be determined by the following equation:

$$\dot{V} = \dot{q} / [4840 \text{ x } (H_{Rr} - H_{Rp})]$$

$\dot{V}$ = the volumetric flow rate, CFM
q = latent heat gain in the space, BTU/H
H_{Rr} = room air humidity ratio, lbs $_{water}$/lbs $_{dry\ air}$
H_{Rp} = primary air humidity ratio, lbs $_{water}$/lbs $_{dry\ air}$

It follows that the required flow rate to maintain control of the humidity will rapidly increase as the difference between the room air and primary air humidity ratios decrease. As a result, designs seeking to maintain relatively low humidity ratios will need a high primary flow rate if the dew point temperature of the supply air is close to the design dew point in the room.

Comparing the required supply airflow rates for ventilation and to maintain the relative humidity of the space, the higher of the two flow rates will determine the minimum flow rate allowable for the space. If necessary the supply air flow rate can be increased to supplement the sensible cooling of the products selected.

After the IAQ requirements have been tentatively set, the required equipment capacities to meet the heat loads and losses can are determined. Care should be taken to design around actual loads/losses that will be experienced in the space. Overdesigning the system will increase installation and equipment costs, and could potentially cause thermal comfort issues. Once the capacity requirements have been calculated, either supply air conditions or building design/construction (if possible) can be adjusted to be more suited to chilled ceiling application.

PRODUCT SELECTION

The type of product to be used to is at the designer's discretion. However the recommended limitations of maximum capacity per square foot should not be exceeded where high levels of thermal comfort are required.

Once product type has been decided the entering water temperature should be selected such that condensation is prevented. The majority of chilled ceiling products do not include a means to collect or manage condensation. This means the temperature of the heat transfer surface, either water coil or panel/sail surface, must be higher than the dew-point temperature of the space to prevent the formation of condensation. However, to achieve the maximum cooling capacity the entering water temperature should be as low as possible. This can be difficult when trying to get the most capacity out of chilled ceiling products.

There are several ways to operate these products to prevent condensation. The primary step to preventing condensation is for the chilled water design supply temperature to be at least 1°F above the dew-point temperature of the space. Also, the supply air to the space must also be sufficiently dehumidified to maintain the design relative humidity conditions. The secondary measures are noted below:

- Properly insulated valves and piping
- Measures used to shut off chilled water flow
  - Condensation sensors installed on the supply water piping
  - Relative humidity/dew-point temperature sensor installed in the return air path
- Raising the chilled water supply temperature
  - Using a relative humidity sensor in conjunction with a room temperature system to determine moisture content and dew-point temperature of the space. Using this information the chilled water temperature can be adjusted upward to prevent condensation. This measure should only be used in the event that an entire building is at risk for condensation.

At this time the supply air temperature should be tentatively selected. Supply air temperature can be varied between cooling and heating, but most designs keep a fixed temperature as long as heating requirements can be met.

The size and configuration of products selected should be completed while adjusting the following parameters:

- Water flow rate: this should be selected to minimize pressure drop, should be no higher 10 ft w.g., while maintaining turbulent flow through the product
- Supply airflow rate: flow rate must be maintained above the minimum determined for IAQ requirements, but can be increased to offset the sensible cooling requirements of the product selected
  - Increasing the flow rate in active beams while maintaining the same nozzle geometry will result in an increase of operating pressure. The recommended operating range is typically between 0.2 in w.g. and 0.8 in w.g. Operating pressure in active beams will also directly impact the noise generated by the product during operation.
- Unit placement/Configurations:
  - Radiant panels and sails: These products should be installed so that no more than 75% of the available ceiling space is made up of active panels/sails. Panels models with perforated faces and backed with acoustic fleece insulation can be used to improve noise attenuation within the space.

  - Passive Beams: Passive beams should not be installed directly above occupants since the highest velocities occurring from the convection process will occur directly underneath the beam

  - It is critical to the operation of passive beams that adequate space is provided for air flow through the beam. When installed in a flush mount application, shadow gaps, perforated ceiling tiles, dummy beams, or return air grilles must be installed so that warm room air enter the air path for the passive beams. It is recommended that the total free area for the return air path be at least 50% of the passive beam surface area. In exposed applications, the beams should be installed with a minimum distance between the top surface of the beam and the ceiling that is equivalent to half of the beam width, see Figure 7.

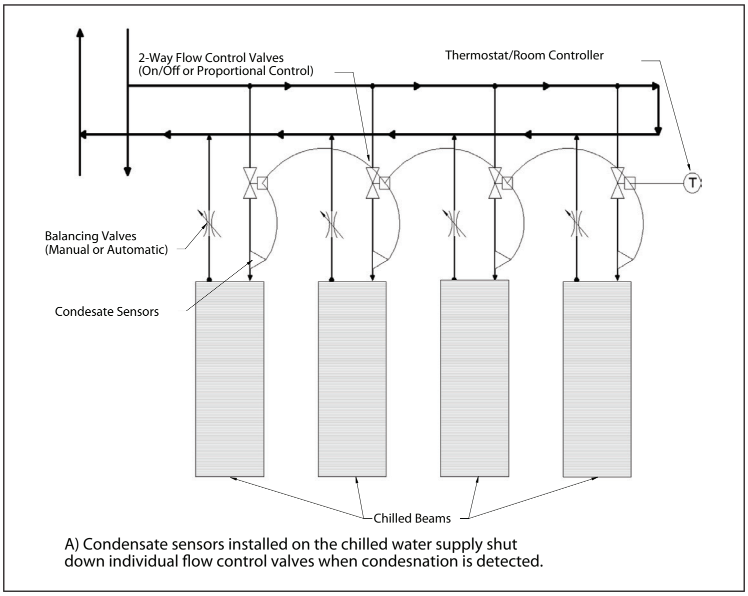


Figure 6a. Condensation Prevention Strategies

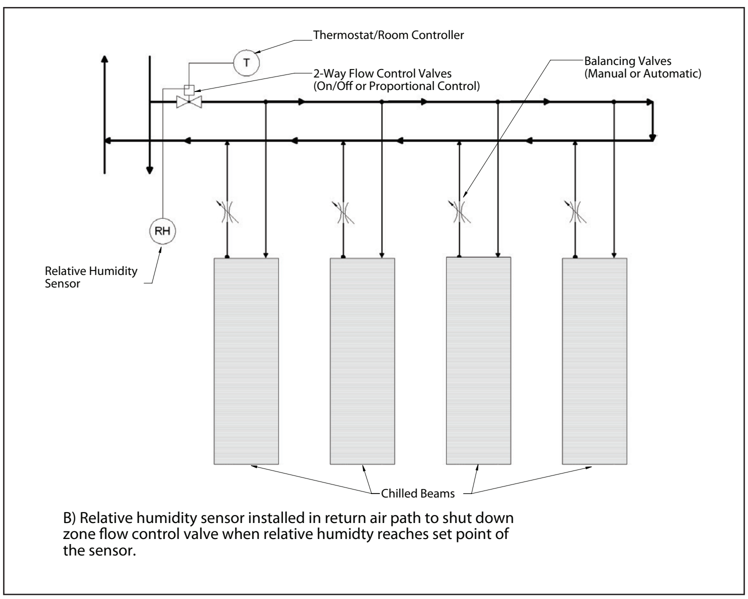


Figure 6b. Condensation Prevention Strategies

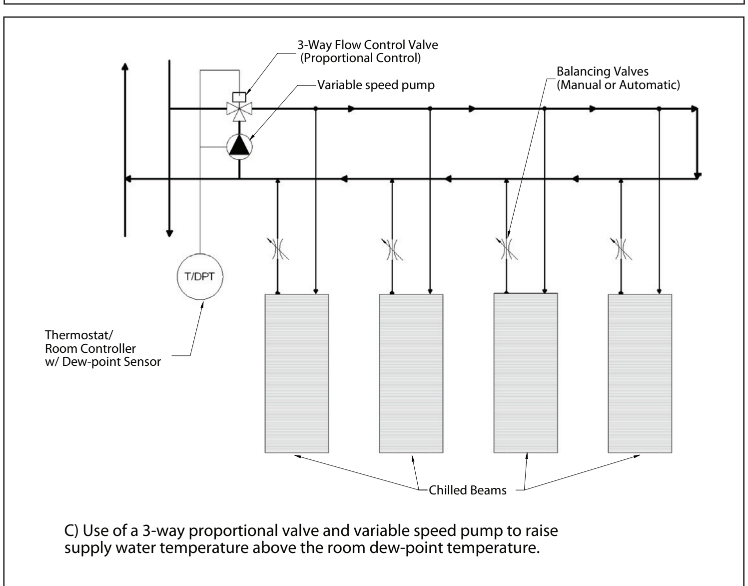
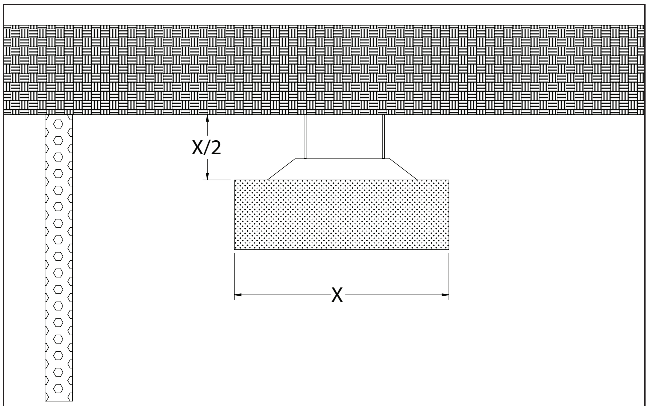


Figure 6c. Condensation Prevention Strategies



Passive beams should be mounted such that the return air path is not restricted.

Figure 7. Passive beam mounting height

- Active Beams: With the different configurations available in active beams, 1, 2, and 4-way beams a design can be implemented to effectively create a comfortable space. In open office spaces as well as internal offices 2-way or 4-way beams are typically used. The flexibility provided by 2-way and 4-way beams, due to multiple sizes and nozzle configurations, allow them to be appropriately applied in most applications. 1-way beams are typically used in perimeter zones and small spaces such as individual offices and hotel rooms.

- After the throw pattern has been decided, placement of the beam within the space can be determined. Active chilled beams, because of their design, share throw characteristics with conventional slot diffusers. Placement and orientation of active beams is critical for thermal comfort due long throw values associated with active beams. In open office plans it is typically more cost effective to use several longer beams that are installed parallel to the long direction of conventional ceiling systems, instead of numerous smaller beams the length of the module division. (Figure 8, Open-office Active Beam Layout) However in an open office the number and size of beams used will be determined by balancing the cost per beam, cost of air side operating pressure, and water side pumping power to achieve optimum energy efficiency.

- When applying 2-way and 4-way beams in small offices and individual offices the recommended location is directly above the occupants. This will result in the lowest velocities within the occupied space. It is also recommended that 2-way beams are installed lengthwise in the space. This will allow for the use of longer beams, reducing the cooling requirements per linear foot which will in-turn lower total air flow per foot and the resulting velocities in the space ensuring occupancy comfort. If placement is required near a wall use of 1-way throw beams are recommended. 1-way beams can also be effectively used in perimeter zones for cooling applications; however they should be supplemented with baseboard heating to address window loads during the heating season. 2-way beams can be effectively applied in perimeter zones for both heating and cooling. Care must be taken if 2-way beams are installed parallel to windows. In intermediate seasons when internal cooling is required and window surfaces are cool an acceleration of the air can occur in the space creating drafts and potential discomfort.

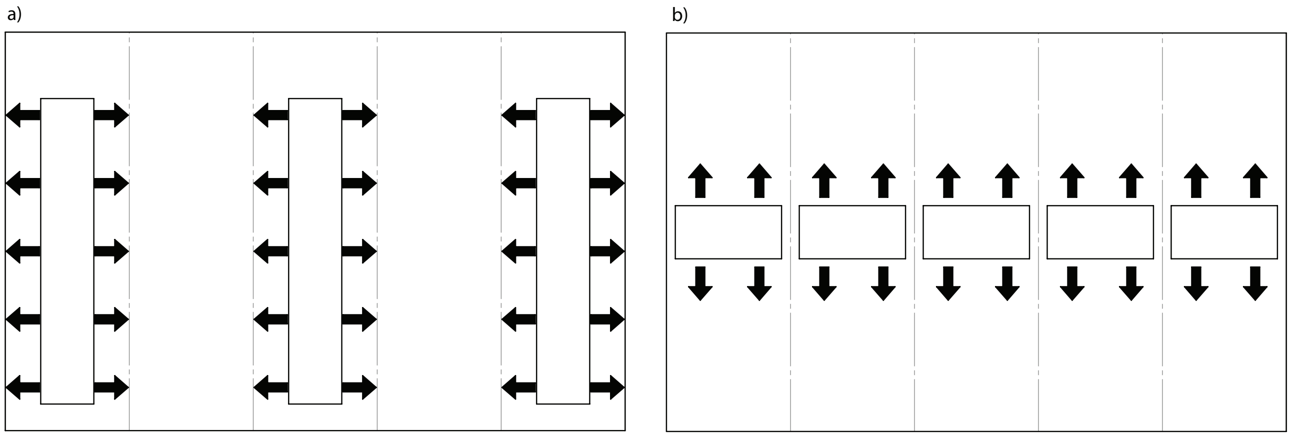
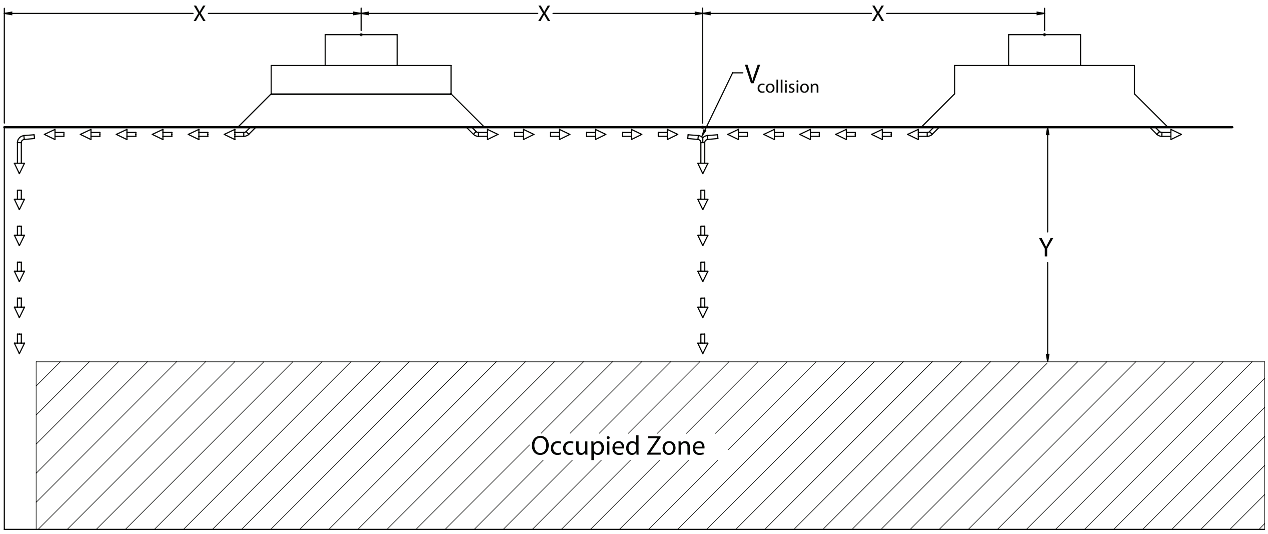


Figure 8 - Open-office Active Beam Layout: In lengthwise installations(a) there are less piping and duct connections than in crosswise installations(b). In crosswise installations, there is typically one beam per module. Even if the total cost for the beams in both layouts are the same, installation costs, additional valves, piping, and ductwork will prove to be more costly.



The minimum distance between units (2X) or minimum distance from a sidewall (X), can be determined by taking the difference between the diffuser's characteristic throw to 50 fpm (T_{50}) and the distance between the ceiling and the occupied zone (Y).

Figure 9. Local Velocity Diagram

- The ideal location for most active beams is directly above the occupant. This is because the lowest velocities in the space will occur in the induced air path. If it is desired to position an active beam close to a wall, a unit with an asymmetrical or 1-way throw pattern is recommended. As active chilled beams have throw characteristics similar to linear slot diffusers the same principles for determining thermal comfort conditions should be used. Location for final placement should take into consideration the allowable average air speed in the occupied space in accordance with ASHRAE Standard 55. Accounting for the air side sensible capacity will allow for reduced capacity requirements of the water coils in the beams. Designing with this in mind will reduce airflow requirements per linear foot, which will help to meet the requirements for thermal comfort. When placing two beams in the same space as shown in Figure 9, Local velocity diagram, care must be taken to ensure that the colliding air streams do not result in velocities over 50 fpm causing discomfort. A general guideline to achieve air velocities of 50 fpm or less in the occupied space is to ensure the velocities of colliding airstreams are below 100 fpm. If velocities at the point of collision are greater than 100 fpm, the distance from the ceiling for the air flow to slow to 50 fpm is noted in the equation below:

$$Y=T_{50} - X$$

Where:
Y = distance from the ceiling
X = half the distance to the adjacent diffuser
T_{50} = diffuser characteristic throw to 50 fpm

CONTROL OF CHILLED CEILING SYSTEMS

Very basic room controls can be used with chilled ceiling systems. This is due to the fact that most systems are designed to operate with a constant volume of supply air. Also, the large coil size, combined with relatively low velocities across the coils result in a fairly long response time.

With chilled beams or radiant systems, the most common method for controlling room temperature is regulating the water flow rate through the selected equipment. The alternative is to vary the supply water temperature.

The control of water flow rate is achieved through on-off, time proportional on-off, or modulating control valve actuators. The maximum flow rate should be limited by a balancing valve installed on each beam circuit. It is generally recommended for 2-way valves to be used to reduce pumping costs, but 3-way valves can be used when pump speeds are not variable. While on-off and modulating actuator control is straight forward, time proportional on-off systems are a bit more complex. These systems use a feedback control loop to open and close an on-off actuator such that the total time open is proportional to the percentage of flow that is requested by a modulated room controller. While control of this system is more complex, actuator first costs are greatly reduced.

Chilled beams should be connected in parallel so that each beam sees the same entering water temperature. For the greatest flexibility of control each beam should be fitted with an actuated control valve. With this setup, the flow rate can be modulated in each beam. And, in the event the entering water temperature reaches a point where condensation is a concern the flow rate to individual units affected can be shut down, so that the entire zone do not suffer a loss in sensible capacity. The alternative is one actuated control valve per zone. In either situation, each beam should be fitted with isolation valves on the both the supply and return.

Alternatively to varying water flow rate through the beam, the entering water temperature can be varied according to the load in the space. This requires more sophisticated control sequences. Varying the water temperature also requires a bypass loop, that can inject higher temperature water from the return loop of the chilled beams or main air handler into the supply water loop for the beams.

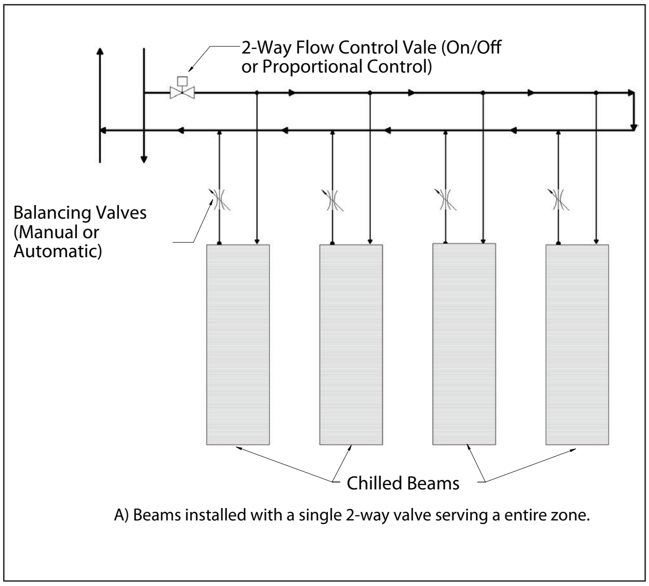


Figure 10a. Chilled beam zone control - Single flow control

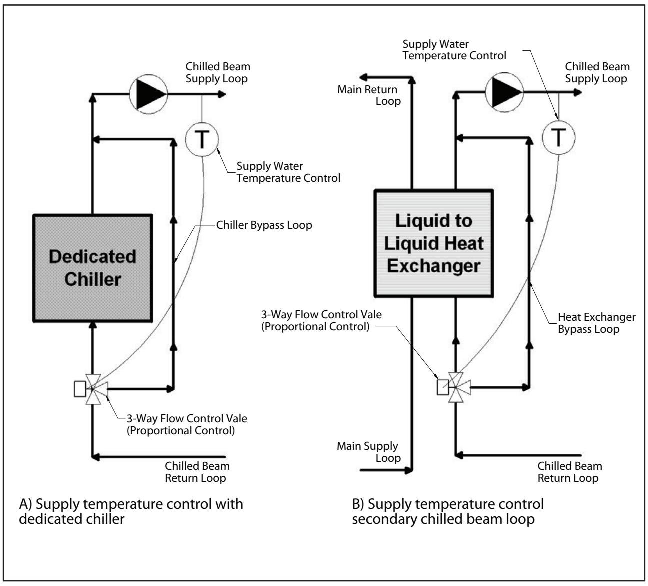


Figure 11a. Supply water temperature control with dedicated chiller; Figure 11b. Supply water temperature control chilled beam loop

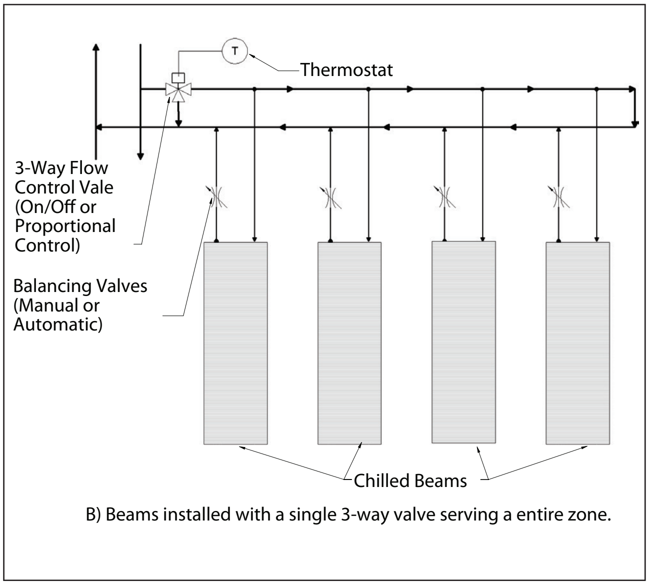


Figure 10b. Chilled beam zone control

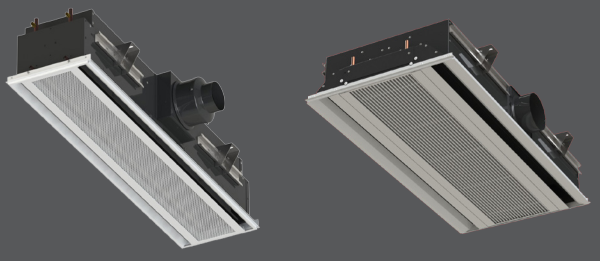
In order to control the supply water temperature a dedicated chiller and supply/return circuits can be used (see Figure 11a), or heat exchanger between the main air handler loop and chilled beam loop are acceptable (see Figure 11b).

When designing systems with occupied/unoccupied modes or with night set back set ups. It is critical to ensure the design relative humidity conditions are met prior any water based sensible cooling. In most cases, 30 minutes of dry-air ventilation will be enough to prevent any condensation during morning start-up and when returning to occupied modes. This can easily be achieved for night set back/morning start up by offsetting the time schedules for the air handlers and chilled beam system pumps.

Linear Active Chilled Beams

CBAL

- Active linear chilled beam with 1-way or 2-way air distribution patterns
- Optimized nozzle design provides high capacity and low noise levels
- Linear design matching commercial architectural styling
- Designed to fit in standard 12-inch and 24-inch ceiling systems
- Optimized diffuser geometry maximizes occupant comfort



CBAL-12 CBAL-24

See website for Specifications

AVAILABLE MODELS:

CBAL: 12-inch / 24-inch

FINISHES:

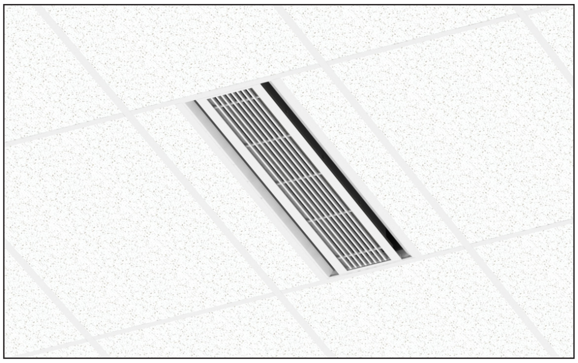
Standard Finish - #26 White
Optional Finish - #84 Black

OVERVIEW

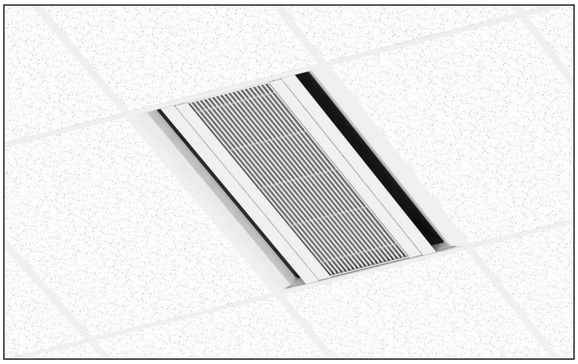
Titus active chilled beams features the aerodynamic properties of Titus ceiling diffusers and benefit from the use of using hydronic coils and induced air to reduce energy consumption associated with removal of sensible thermal loads. The primary air is supplied to the chilled beam subsequent to it being discharged through a series of nozzles located along the length of the beam. The nozzles inject the primary air into the mixing chamber at velocities capable of inducing room air through one or two coils and where it mixes with the primary supply air. This mixture of air is then discharged into the space through the ceiling slot diffusers. This provides high cooling outputs with low amounts of primary air. The reduced volume of air results in the reduction of the air handler capacity and size, smaller duct sizes, and the overall energy consumption.

Primary air from the air handling unit is tempered and dehumidified to handle the latent load. The remaining loads in the space are addressed with the heat exchanger which is incorporated into the chilled beam. Applications with low latent cooling loads could use 100 percent outdoor air allowing for use of a dedicated outdoor air system with energy recovery further reducing total system energy consumption.

The CBAL's are offered for both, cooling and heating, in 12" and 24" widths and lengths from 2 to 10 ft. They can be easily integrated into different grids styles within a suspended ceiling or even in drywall ceilings. The low overall height of the CBAL product line is ideal for reducing the space required for false ceiling in any application.



Rendering of CBAL-12 installed in a ceiling

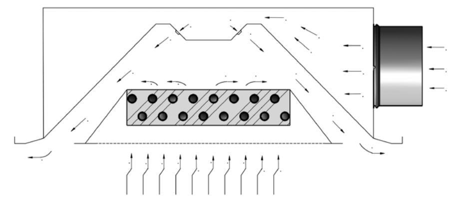


Rendering of CBAL-24 installed in a ceiling

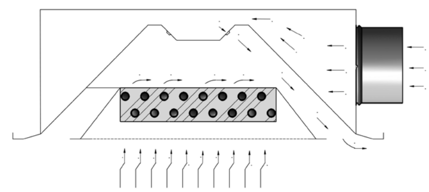
ADVANTAGES

- Removal of high thermal loads is possible in this air/water system
- The size of the air duct system is reduced to a minimum, due to the low supply of primary air
- Substantial reduction in the operating costs, due to low primary air volume
- Improvement of the thermal comfort inside the room
- Suitable for several standard ceiling grids
- Contributing sound levels below NC-30

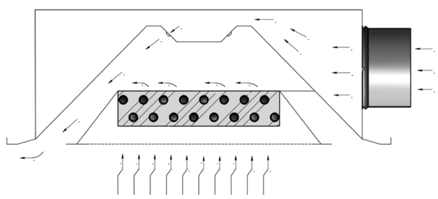
CBAL-24 2-Way



CBAL-24 1-Way (front)



CBAL-24 1-Way (back)



CBAL-24 STANDARD FEATURES

- 1-way or 2-way air distribution patterns
- 24-inch width
- 2 foot to 10 foot lengths, 1 foot increments
- Perforated or linear bar induced air grille
- Left hand or right hand coil connections
- Side or top air inlet locations
- 2-pipe and 4-pipe coil configurations
- Configured nozzle geometry for capacity optimization
- Hinged induced air grille for roomside coil access
- Commissioning port with roomside access for balancing
- Mounting brackets with adjustments in two directions
- Durable powder coat finish
- ½" Sweat water coil connections
- Coil air vent

OPTIONS AND ACCESSORIES

- ½" thick foil-faced EcoShield, anti-microbial external insulation
- Coil drain valve
- ½" MNPT water coil connections
- 12-inch, 18-inch or 24-inch stainless steel braided hoses
- Lay-in, narrow tee and drop face border types

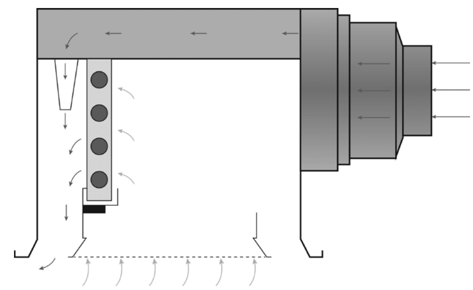
CBAL-12 STANDARD FEATURES

- 1-way or 2-way air distribution patterns
- 12-inch width
- 2 foot to 10 foot lengths, 1 foot increments
- Perforated or linear bar induced air grille
- Left hand or right hand coil connections
- Side or top air inlet locations
- 2-pipe and 4-pipe coil configurations
- Configured nozzle geometry for capacity optimization
- Hinged induced air grille for roomside coil access
- Commissioning port with roomside access for balancing
- Mounting brackets with adjustments in two directions
- Durable powder coat finish
- ½" Sweat water coil connections
- Coil air vent
- Condensate tray with drain connection for field plumbing (12-inch version only)

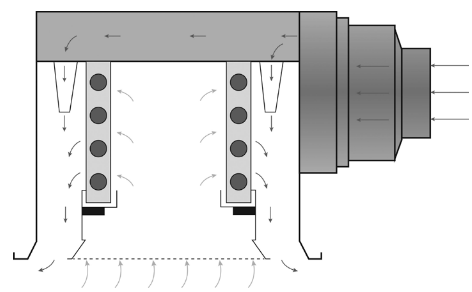
OPTIONS AND ACCESSORIES

- ½" thick foil-faced EcoShield, anti-microbial external insulation
- Coil drain valve
- ½" MNPT water coil connections
- 12-inch, 18-inch or 24-inch stainless steel braided hoses
- Lay-in, narrow tee and drop face border types

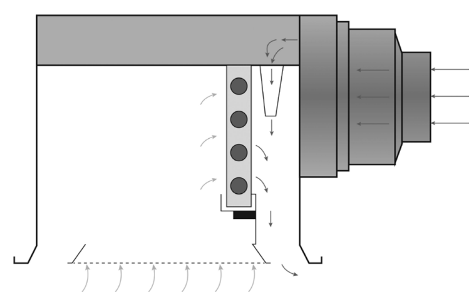
CBAL-12 1-Way (back)



CBAL-12 2-Way



CBAL-12 1-Way (front)



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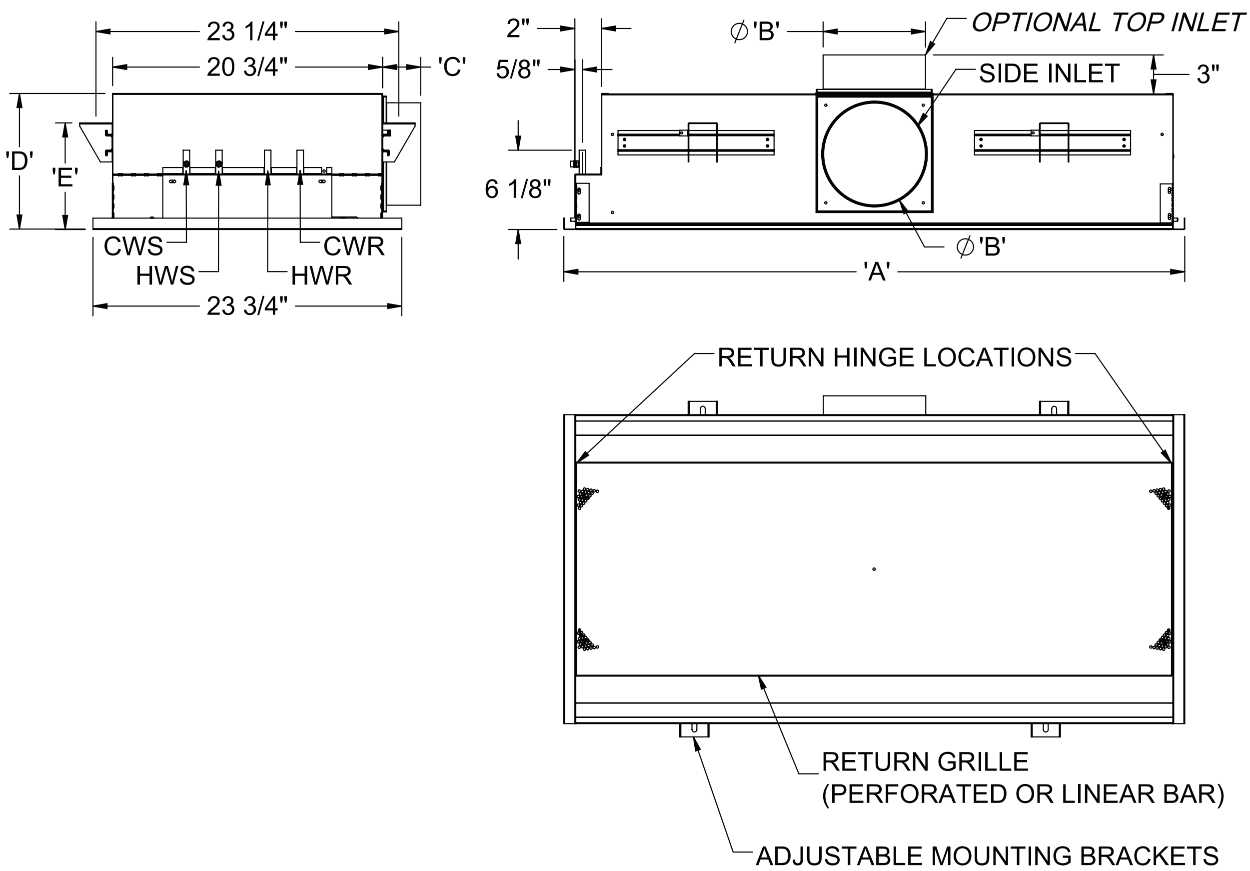
CBAL-24" UNIT DIMENSIONS



Nominal Unit Length (ft)	'A' (IN)
2	23¾
3	35¾
4	47¾
5	59¾
6	71¾
7	83¾
8	95¾
9	107¾
10	119¾

Nominal Inlet Dia. (ft)	'B' (IN)	'C' (IN)	'D' (IN)	'E' (IN)
5	4⅞	3	8⅜	6¼
6	5⅞	3	8⅜	6¼
8	7⅞	3	10⅜	8¼
8**	7⅞	--	8⅜	6¼

*Side Inlet Only

**Top Inlet Only

Integrated ¼" pressure port for balancing/commissioning accessable from roomside opposite coil connection

All dimensions are in inches

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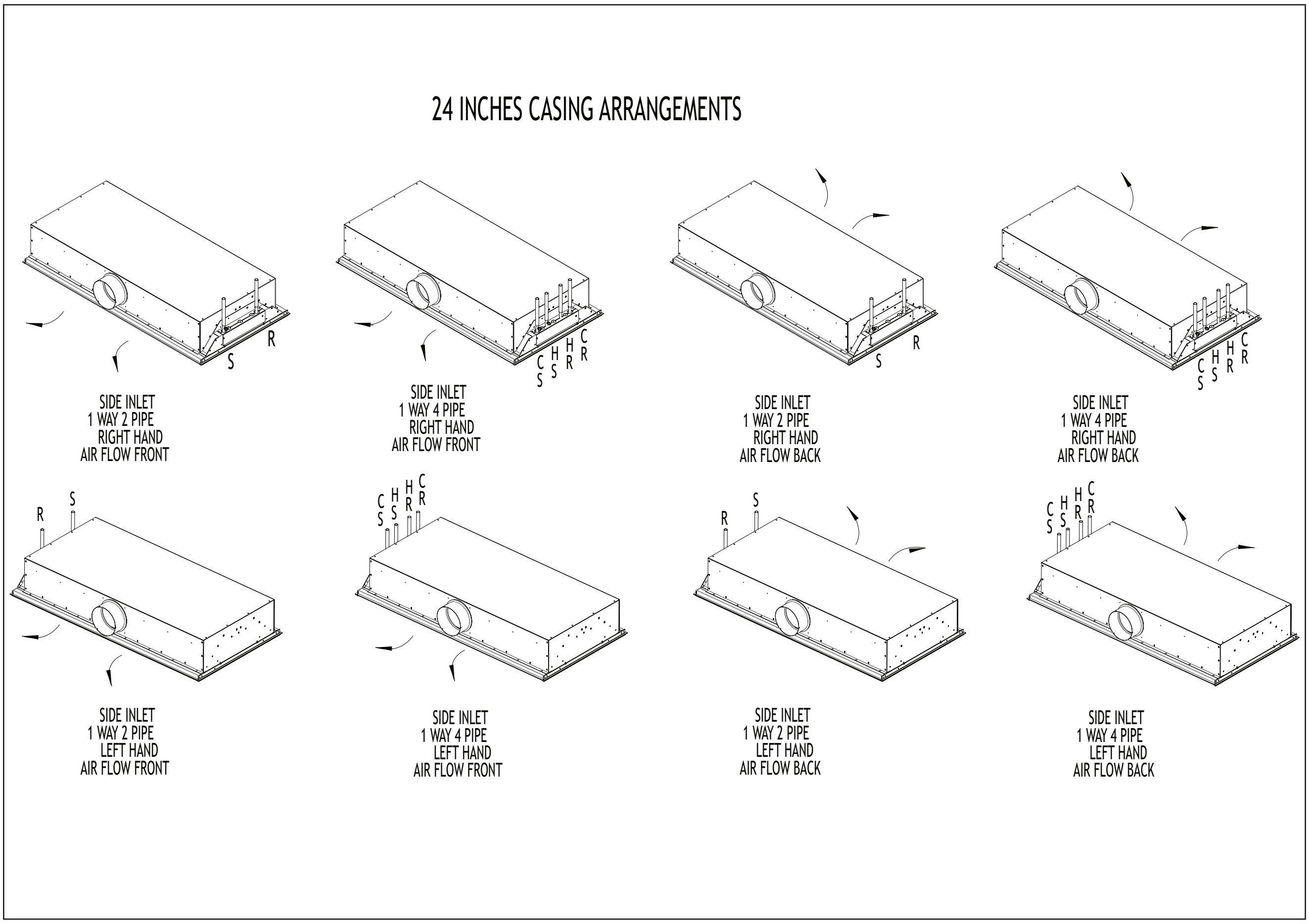
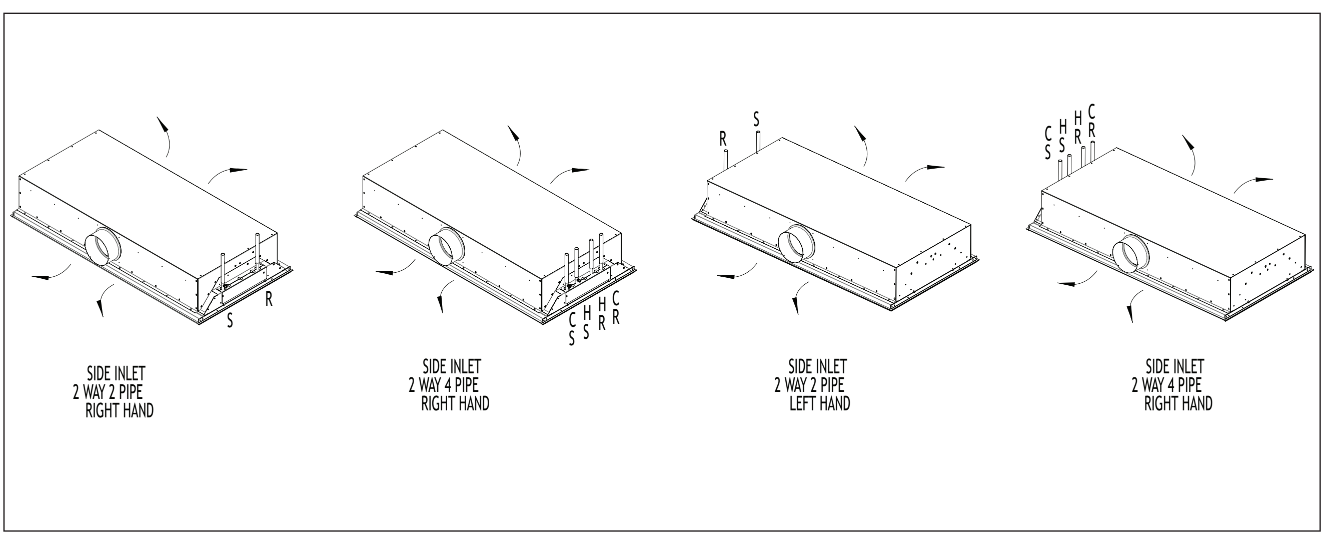
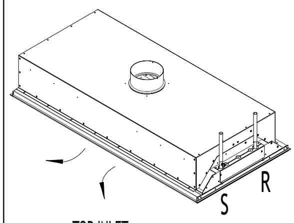
CBAL-24" CASING ARRANGEMENTS / SIDE INLET 1-WAY



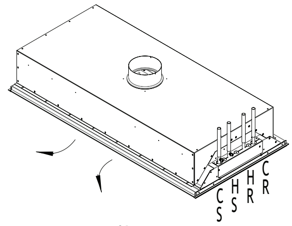
CBAL-24" CASING ARRANGEMENTS / SIDE INLET 2-WAY



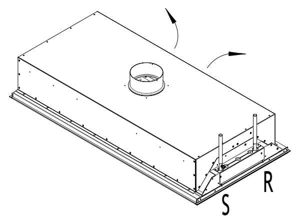
CBAL-24" CASING ARRANGEMENTS / TOP INLET 1-WAY



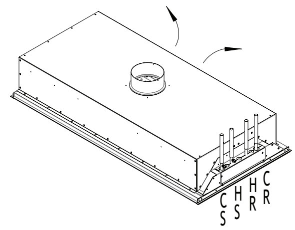
TOP INLET
1 WAY 2 PIPE
RIGHT HAND
AIR FLOW FRONT



TOP INLET
1 WAY 4 PIPE
RIGHT HAND
AIR FLOW FRONT

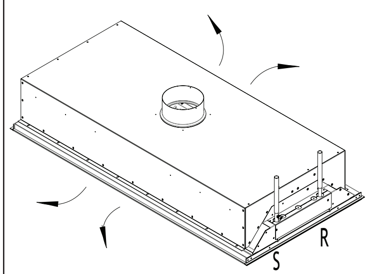


TOP INLET
1 WAY 2 PIPE
RIGHT HAND
AIR FLOW BACK

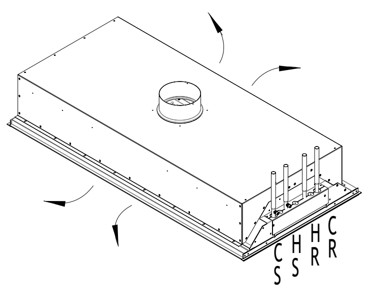


TOP INLET
1 WAY 4 PIPE
RIGHT HAND
AIR FLOW BACK

CBAL-24" CASING ARRANGEMENTS / TOP INLET 2-WAY



TOP INLET
2 WAY 2 PIPE
RIGHT HAND



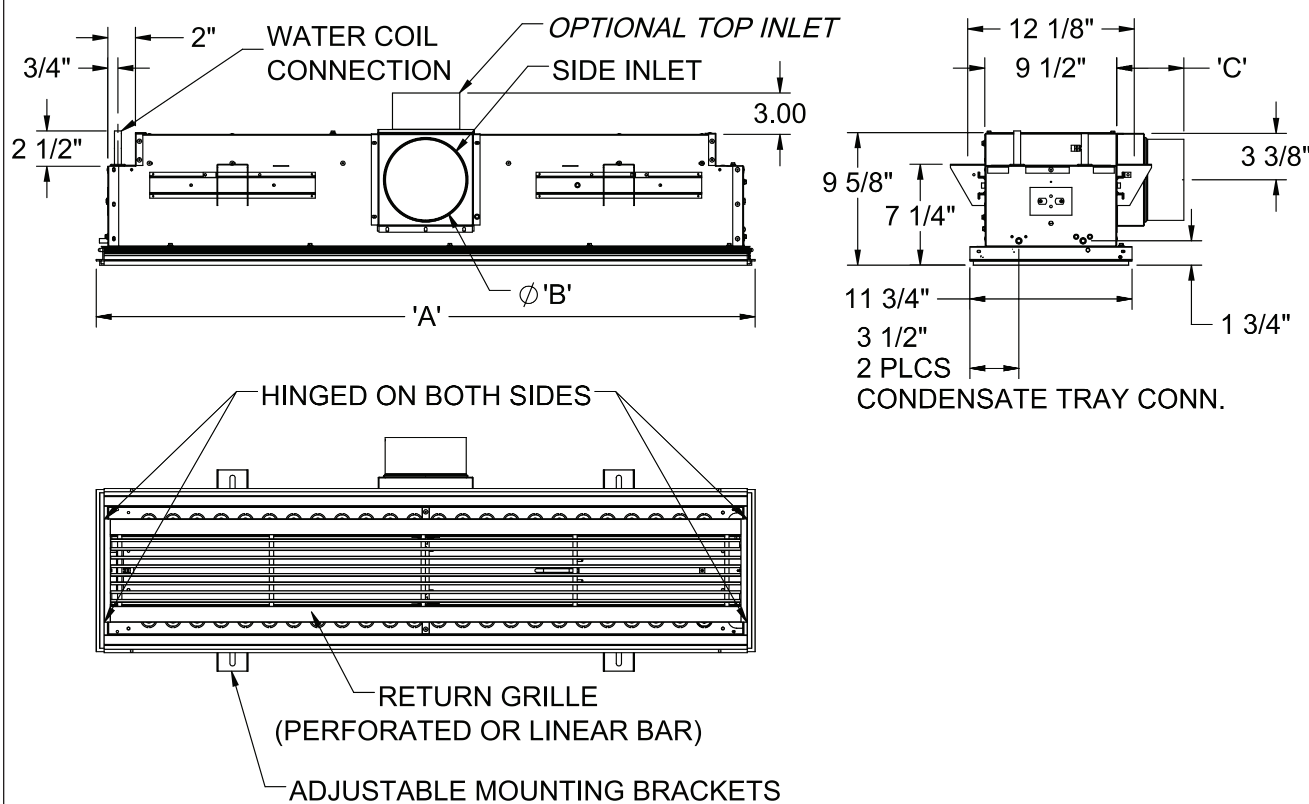
TOP INLET
2 WAY 4 PIPE
RIGHT HAND

R - Return S - Supply;

HR - Heating Return HS - Heating Supply;

CR - Cooling Return CS - Cooling Supply

CBAL-12" UNIT DIMENSIONS



Nominal Unit Length (ft)	'A' (IN)
2	23¾
3	35¾
4	47¾
5	59¾
6	71¾
7	83¾
8	95¾
9	107¾
10	119¾

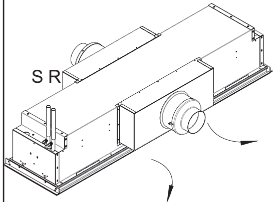
Nominal Inlet Dia. (ft)	'B' (IN)	'C' (IN)
4	3 7/8	7
5	4 7/8	4 7/8
6	5 7/8	4 7/8

*Side Inlet Only

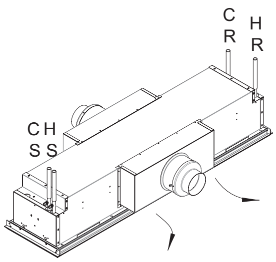
Integrated ¼" pressure port for balancing/commissioning accessable from roomside

All dimensions are in inches

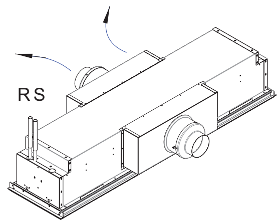
CBAL-12" CASING ARRANGEMENTS / SIDE INLET 1-WAY



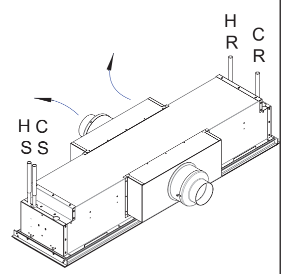
SIDE INLET
1 WAY, 2-PIPE
LEFT HAND
AIR FLOW FRONT
(RIGHT HAND
AIR FLOW BACK)



SIDE INLET
1 WAY, 4-PIPE
LEFT HAND
AIR FLOW FRONT
(RIGHT HAND
AIR FLOW BACK)

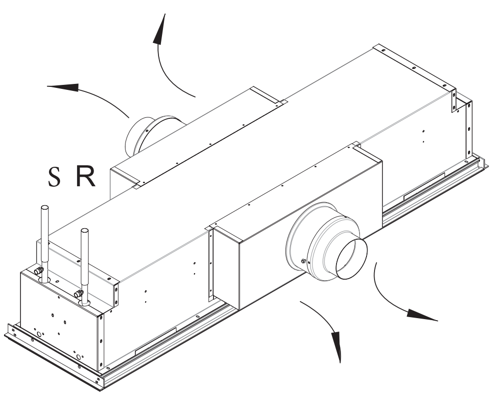


SIDE INLET
1 WAY, 2-PIPE
LEFT HAND
AIR FLOW BACK
(RIGHT HAND
AIR FLOW FRONT)

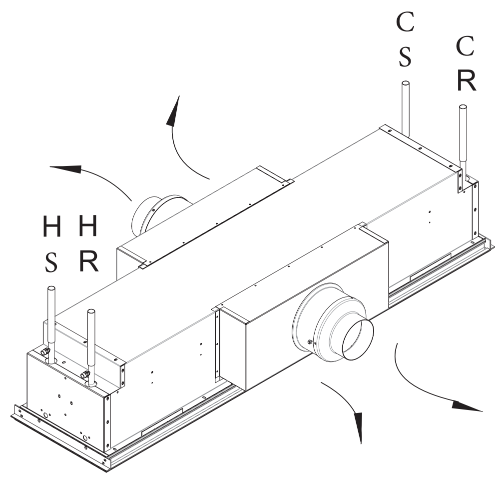


SIDE INLET
1 WAY, 4-PIPE
LEFT HAND
AIR FLOW BACK
(RIGHT HAND
AIR FLOW FRONT)

CBAL-12" CASING ARRANGEMENTS / SIDE INLET 2-WAY

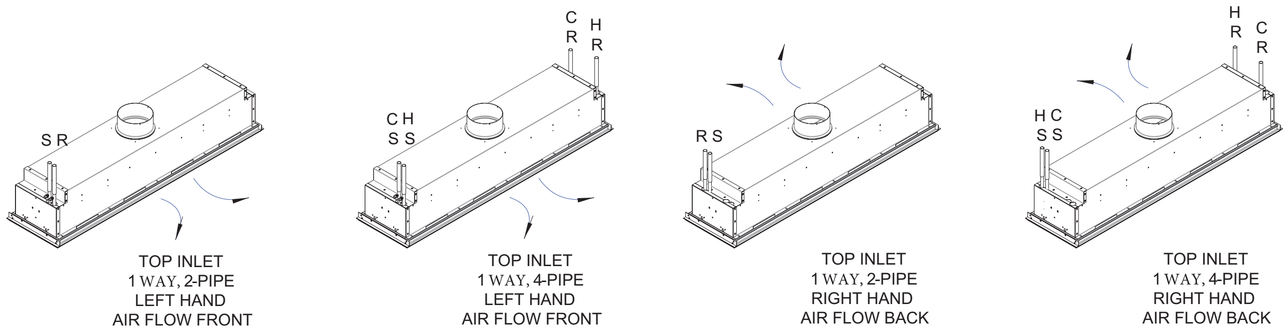


SIDE INLET
2 WAY, 2-PIPE
LEFT HAND
(RIGHT HAND)



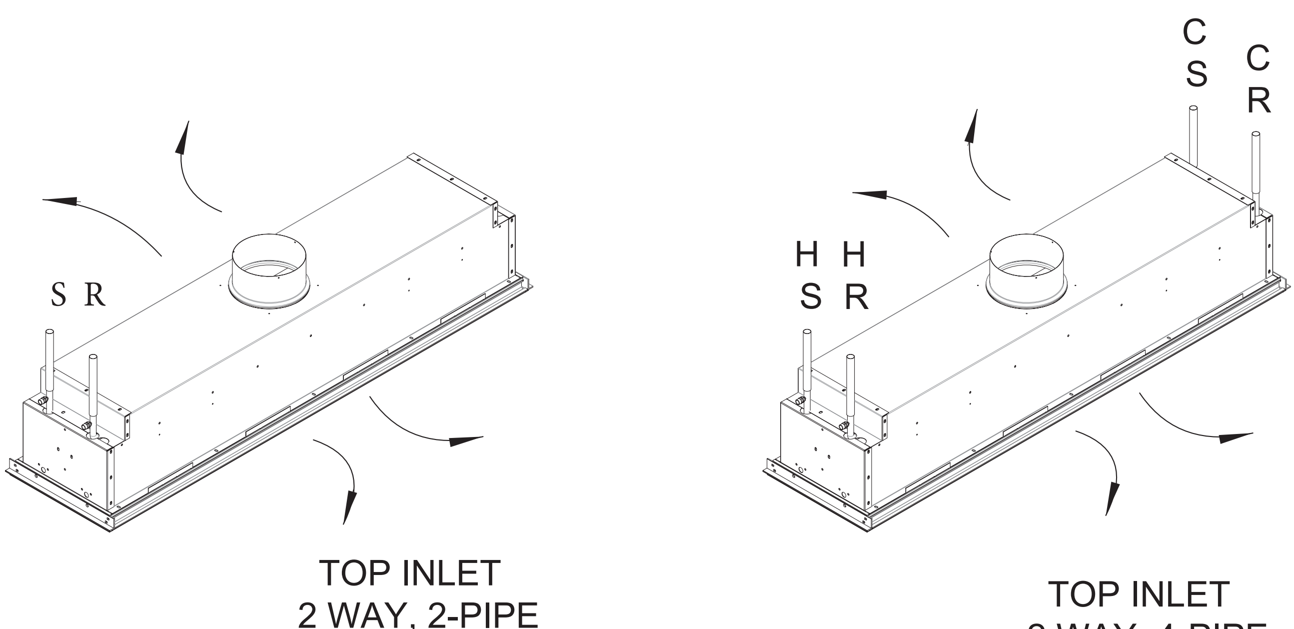
SIDE INLET
2 WAY, 4-PIPE
LEFT HAND
(RIGHT HAND)

CBAL-12" CASING ARRANGEMENTS / TOP INLET 1-WAY



R - RETURN   S - SUPPLY
HR - HEATING RETURN   HS - HEATING SUPPLY
CR - COOLING RETURN   CS - COOLING SUPPLY

CBAL-12" CASING ARRANGEMENTS / TOP INLET 2-WAY



CBAL-24 / 4-PIPE COOLING

Nominal Length ft	Nozzle Size	Primary Air: Inlet Dia.	Primary Air: Flow Rate	Primary Air: Inlet ΔPS	Sound	Coil Sensible Cooling (Btu/h): 0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM		Induction ratio	Throw
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
4	B1	4	15	0.20	-	1,483	0.72	1,842	2.88	1,992	6.49	2,078	1.10	5.9	0 - 1 - 4
			20	0.35	-	1,782		2,214		2,395		2,498			1 - 2 - 7
			25	0.54	-	2,072		2,573		2,784		2,904			1 - 3 - 10
	B2	4	20	0.15	-	1,307		1,623		1,756		1,831		4.8	1 - 1 - 5
			30	0.35	-	1,877		2,332		2,522		2,631			1 - 3 - 10
			40	0.62	22	2,237		2,778		3,005		3,135			2 - 5 - 14
	B3	5	40	0.18	-	1,515		1,882		2,036		2,124		4.0	2 - 4 - 12
			60	0.40	23	2,249		2,794		3,022		3,153			4 - 8 - 18
			80	0.71	30	2,657		3,301		3,571		3,725			7 - 12 - 21
	B4	6	70	0.21	19	1,705		2,118		2,291		2,390		2.5	2 - 6 - 14
			105	0.48	29	2,449		3,043		3,291		3,433			6 - 11 - 20
			140	0.86	37	2,918		3,625		3,921		4,091			10 - 14 - 23
6	B1	4	20	0.16	-	1,774	1.01	2,203	4.03	2,383	9.06	2,486	2.26	5.9	0 - 1 - 4
			30	0.35	-	2,549		3,166		3,424		3,572			1 - 2 - 9
			40	0.62	22	3,037		3,772		4,080		4,257			2 - 4 - 13
	B2	5	30	0.15	-	1,868		2,321		2,510		2,619		4.8	1 - 2 - 6
			45	0.33	16	2,684		3,334		3,607		3,763			2 - 3 - 12
			60	0.60	24	3,199		3,973		4,298		4,483			3 - 6 - 17
	B3	6	60	0.16	16	2,167		2,691		2,911		3,037		4.0	2 - 5 - 14
			90	0.36	26	3,113		3,867		4,183		4,363			5 - 10 - 21
			120	0.64	34	3,709		4,607		4,984		5,199			8 - 14 - 26
	B4	10*	105	0.19	-	2,438		3,028		3,276		3,417		2.5	3 - 7 - 18
			160	0.45	21	3,503		4,351		4,706		4,910			7 - 13 - 25
			215	0.81	29	4,173		5,184		5,608		5,850			12 - 18 - 29
8	B1	4	25	0.17	-	2,030	1.32	2,522	5.28	2,728	1.54	2,846	2.74	5.9	0 - 1 - 4
			40	0.43	20	3,233		4,016		4,344		4,532			1 - 2 - 10
			55	0.81	28	3,852		4,785		5,176		5,400			2 - 5 - 16
	B2	5	40	0.19	-	2,370		2,944		3,185		3,322		4.8	1 - 2 - 7
			60	0.43	22	3,405		4,230		4,575		4,773			2 - 4 - 14
			80	0.76	30	3,958		4,917		5,318		5,548			3 - 7 - 19
	B3	8	80	0.21	-	2,748		3,414		3,693		3,852		4.0	2 - 5 - 16
			120	0.47	18	3,949		4,905		5,306		5,535			5 - 12 - 25
			160	0.83	25	4,705		5,844		6,322		6,595			9 - 16 - 30
	B4	10*	145	0.22	17	3,092		3,841		4,155		4,335		2.5	4 - 8 - 21
			215	0.49	27	4,443		5,519		5,970		6,228			8 - 16 - 29
			285	0.86	34	5,294		6,576		7,113		7,421			14 - 21 - 33
10	B1	5	35	0.16	-	2,743	1.63	3,407	6.53	3,685	1.91	3,845	3.40	5.9	1 - 1 - 5
			52	0.36	20	3,796		4,715		5,101		5,321			1 - 3 - 12
			69	0.63	27	4,523		5,618		6,077		6,340			2 - 5 - 18
	B2	6	55	0.18	-	2,889		3,589		3,882		4,050		4.8	1 - 2 - 9
			80	0.38	24	3,998		4,967		5,373		5,605			2 - 5 - 17
			105	0.66	31	4,764		5,918		6,401		6,678			4 - 9 - 22
	B3	8	100	0.16	-	3,350		4,161		4,501		4,696		4.0	3 - 6 - 18
			150	0.35	22	4,637		5,760		6,230		6,499			6 - 13 - 28
			200	0.62	30	5,525		6,862		7,423		7,744			10 - 18 - 33
	B4	10*	180	0.15	21	3,486		4,331		4,685		4,887		2.5	4 - 9 - 23
			240	0.27	29	4,400		5,465		5,912		6,167			7 - 15 - 30
			300	0.43	35	5,146		6,392		6,915		7,213			11 - 19 - 34

Note: Reference page U37 for operational conditions used for performance notes

CBAL-24 / 4-PIPE HEATING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil Heating (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
4	B1	4	15	0.20	-	2,243	0.18	2,787	0.71	3,014	1.59	3,145	2.83	5.9	0 - 1 - 4
			20	0.35	-	2,696		3,349		3,623		3,780			1 - 2 - 7
			25	0.54	-	3,134		3,893		4,211		4,393			1 - 3 - 10
	B2	4	20	0.15	-	1,977		2,455		2,656		2,771		4.8	1 - 1 - 5
			30	0.35	-	2,840		3,528		3,816		3,981			1 - 3 - 10
			40	0.62	22	3,384		4,204		4,547		4,743			2 - 5 - 14
	B3	5	40	0.18	-	2,292		2,847		3,080		3,213		4	2 - 4 - 12
			60	0.40	23	3,403		4,227		4,572		4,770			4 - 8 - 18
			80	0.71	30	4,020		4,994		5,402		5,636			7 - 12 - 21
	B4	6	70	0.21	19	2,579		3,204		3,466		3,615		2.5	2 - 6 - 14
			105	0.48	29	3,706		4,603		4,979		5,194			6 - 11 - 20
			140	0.86	37	4,415		5,485		5,933		6,189			10 - 14 - 23
6	B1	4	20	0.16	-	2,684	0.28	3,334	1.11	3,606	2.50	3,762	4.44	5.9	0 - 1 - 4
			30	0.35	-	3,856		4,790		5,181		5,405			1 - 2 - 9
			40	0.62	22	4,594		5,707		6,173		6,440			2 - 4 - 13
	B2	5	30	0.15	-	2,827		3,511		3,798		3,962		4.8	1 - 2 - 6
			45	0.33	16	4,061		5,045		5,457		5,693			2 - 3 - 12
			60	0.60	24	4,839		6,011		6,502		6,783			3 - 6 - 17
	B3	6	60	0.16	16	3,278		4,072		4,404		4,595		4	2 - 5 - 14
			90	0.36	26	4,710		5,850		6,328		6,602			5 - 10 - 21
			120	0.64	34	5,612		6,970		7,540		7,866			8 - 14 - 26
	B4	10*	105	0.19	19	3,688		4,581		4,956		5,170		2.5	3 - 7 - 18
			160	0.45	30	5,299		6,583		7,120		7,428			7 - 13 - 25
			215	0.81	38	6,314		7,843		8,484		8,851			12 - 18 - 29
8	B1	4	25	0.17	-	3,072	0.34	3,816	1.35	4,127	3.04	4,306	5.40	5.9	0 - 1 - 4
			40	0.43	20	4,891		6,076		6,572		6,856			1 - 2 - 10
			55	0.81	28	5,828		7,239		7,831		8,169			2 - 5 - 16
	B2	5	40	0.19	-	3,586		4,454		4,818		5,026		4.8	1 - 2 - 7
			60	0.43	22	5,152		6,400		6,922		7,222			2 - 4 - 14
			80	0.76	30	5,989		7,439		8,046		8,394			3 - 7 - 19
	B3	8	80	0.21	-	4,158		5,165		5,587		5,828		4	2 - 5 - 16
			120	0.47	18	5,974		7,421		8,027		8,374			5 - 12 - 25
			160	0.83	25	7,118		8,842		9,565		9,978			9 - 16 - 30
	B4	10*	145	0.22	17	4,679		5,812		6,287		6,558		2.5	4 - 8 - 21
			215	0.49	27	6,722		8,350		9,032		9,423			8 - 16 - 29
			285	0.86	34	8,010		9,949		10,762		11,227			14 - 21 - 33
10	B1	5	35	0.16	-	4,150	0.42	5,155	1.68	5,576	3.77	5,817	6.70	5.9	1 - 1 - 5
			52	0.36	20	5,743		7,134		7,717		8,051			1 - 3 - 12
			69	0.63	27	6,843		8,500		9,195		9,592			2 - 5 - 18
	B2	6	55	0.18	-	4,371		5,429		5,873		6,127		4.8	1 - 2 - 9
			80	0.38	24	6,050		7,514		8,128		8,480			2 - 5 - 17
			105	0.66	31	7,208		8,953		9,685		10,103			4 - 9 - 22
	B3	8	100	0.16	-	5,069		6,296		6,810		7,105		4	3 - 6 - 18
			150	0.35	22	7,015		8,714		9,426		9,833			6 - 13 - 28
			200	0.62	30	8,358		10,383		11,231		11,716			10 - 18 - 33
	B4	10*	180	0.15	21	5,275		6,552		7,087		7,394		2.5	4 - 9 - 23
			240	0.27	29	6,657		8,269		8,944		9,331			7 - 15 - 30
			300	0.43	35	7,786		9,671		10,461		10,914			11 - 19 - 34

Note: Reference page U37 for operational conditions used for performance notes

CBAL-24 / 2-PIPE COOLING

Nominal Length ft	Nozzle Size	Primary Air Inlet Dia. Inches	Primary Air Flow Rate CFM	Primary Air Inlet ΔPS (in. H2O)	Sound NC	Coil Sensible Cooling (Btu/h) 0.5 GPM qCOIL	0.5 GPM ΔCOIL	1.0 GPM qCOIL	1.0 GPM ΔCOIL	1.5 GPM qCOIL	1.5 GPM ΔCOIL	2.0 GPM qCOIL	2.0 GPM ΔCOIL	Induction ratio	Throw ft.
4	B1	4	15	0.20	-	1,587	0.93	1,972	3.72	2,133	8.38	2,225	1.92	5.9	0 - 1 - 4
			20	0.35	-	1,970		2,447		2,647		2,761			1 - 2 - 7
			25	0.54	-	2,272		2,822		3,052		3,184			1 - 3 - 10
	B2	4	20	0.15	-	1,431		1,778		1,923		2,006		4.8	1 - 1 - 5
			30	0.35	-	2,062		2,561		2,770		2,890			1 - 3 - 10
			40	0.62	22	2,453		3,047		3,296		3,438			2 - 5 - 14
	B3	5	40	0.18	-	1,802		2,238		2,421		2,525		4.0	2 - 4 - 12
			60	0.40	23	2,459		3,054		3,304		3,446			4 - 8 - 18
			80	0.71	30	3,007		3,736		4,041		4,215			7 - 12 - 21
	B4	6	70	0.21	19	1,904		2,365		2,558		2,669		2.5	2 - 6 - 14
			105	0.48	29	2,708		3,363		3,638		3,795			6 - 11 - 20
			140	0.86	37	3,243		4,028		4,357		4,545			10 - 14 - 23
6	B1	4	20	0.16	-	1,904	1.35	2,366	5.40	2,559	1.58	2,670	2.81	5.9	0 - 1 - 4
			30	0.35	-	2,780		3,453		3,735		3,897			1 - 2 - 9
			40	0.62	22	3,286		4,082		4,416		4,606			2 - 4 - 13
	B2	5	30	0.15	-	1,968		2,445		2,644		2,759		4.8	1 - 2 - 6
			45	0.33	16	2,910		3,614		3,909		4,078			2 - 3 - 12
			60	0.60	24	3,418		4,245		4,592		4,791			3 - 6 - 17
	B3	6	60	0.16	16	2,478		3,078		3,329		3,473		4.0	2 - 5 - 14
			90	0.36	26	3,469		4,309		4,661		4,863			5 - 10 - 21
			120	0.64	34	4,188		5,202		5,627		5,870			8 - 14 - 26
	B4	10*	105	0.19	19	2,643		3,283		3,552		3,705		2.5	3 - 7 - 18
			160	0.45	30	3,858		4,792		5,183		5,407			7 - 13 - 25
			215	0.81	38	4,624		5,744		6,213		6,482			12 - 18 - 29
8	B1	4	25	0.17	-	2,196	1.77	2,727	7.08	2,950	2.07	3,078	3.68	5.9	0 - 1 - 4
			40	0.43	20	3,504		4,353		4,708		4,912			1 - 2 - 10
			55	0.81	28	4,191		5,206		5,631		5,874			2 - 5 - 16
	B2	5	40	0.19	-	2,449		3,042		3,291		3,433		4.8	1 - 2 - 7
			60	0.43	22	3,667		4,555		4,928		5,140			2 - 4 - 14
			80	0.76	30	4,281		5,317		5,752		6,000			3 - 7 - 19
	B3	8	80	0.21	-	3,083		3,830		4,143		4,322		4.0	2 - 5 - 16
			120	0.47	18	4,372		5,431		5,875		6,128			5 - 12 - 25
			160	0.83	25	5,244		6,514		7,046		7,351			9 - 16 - 30
	B4	10*	145	0.22	17	3,444		4,277		4,627		4,827		2.5	4 - 8 - 21
			215	0.49	27	4,885		6,067		6,563		6,847			8 - 16 - 29
			285	0.86	34	5,798		7,202		7,790		8,127			14 - 21 - 33
10	B1	5	35	0.16	-	2,983	2.19	3,705	8.76	4,008	2.56	4,181	4.55	5.9	1 - 1 - 5
			52	0.36	20	4,196		5,212		5,638		5,882			1 - 3 - 12
			69	0.63	27	5,010		6,224		6,732		7,023			2 - 5 - 18
	B2	6	55	0.18	-	3,304		4,105		4,440		4,632		4.8	1 - 2 - 9
			80	0.38	24	4,459		5,538		5,991		6,250			2 - 5 - 17
			105	0.66	31	5,335		6,627		7,169		7,479			4 - 9 - 22
	B3	8	100	0.16	-	3,579		4,446		4,809		5,017		4.0	3 - 6 - 18
			150	0.35	22	5,114		6,352		6,871		7,168			6 - 13 - 28
			200	0.62	30	6,111		7,590		8,210		8,565			10 - 18 - 33
	B4	10*	180	0.15	21	3,432		4,264		4,612		4,811		2.5	4 - 9 - 23
			240	0.27	29	4,945		6,143		6,645		6,932			7 - 15 - 30
			300	0.43	35	5,307		6,592		7,131		7,439			11 - 19 - 34

Note: Reference page U37 for operational conditions used for performance notes

CBAL-24 / 2-PIPE HEATING

Nominal Length ft	Nozzle Size	Primary Air: Inlet Dia. (Inches)	Primary Air: Flow Rate (CFM)	Primary Air: Inlet ΔPS (in. H2O)	Sound (NC)	Coil Heating (Btu/h) 0.5 GPM qCOIL	0.5 GPM ΔCOIL	1.0 GPM qCOIL	1.0 GPM ΔCOIL	1.5 GPM qCOIL	1.5 GPM ΔCOIL	2.0 GPM qCOIL	2.0 GPM ΔCOIL	Induction ratio	Throw ft.
4	B1	4	15	0.20	-	2,105	0.93	2,615	3.72	2,829	8.38	2,951	1.92	5.9	0 - 1 - 4
			20	0.35	-	2,613		3,245		3,511		3,662			1 - 2 - 7
			25	0.54	-	3,013		3,743		4,048		4,223			1 - 3 - 10
	B2	4	20	0.15	-	1,898		2,357		2,550		2,660		4.8	1 - 1 - 5
			30	0.35	-	2,734		3,396		3,674		3,833			1 - 3 - 10
			40	0.62	22	3,253		4,041		4,371		4,560			2 - 5 - 14
	B3	5	40	0.18	-	2,389		2,968		3,211		3,349		4.0	2 - 4 - 12
			60	0.40	23	3,261		4,051		4,382		4,571			4 - 8 - 18
			80	0.71	30	3,989		4,954		5,359		5,591			7 - 12 - 21
	B4	6	70	0.21	19	2,525		3,136		3,393		3,539		2.5	2 - 6 - 14
			105	0.48	29	3,591		4,461		4,825		5,034			6 - 11 - 20
			140	0.86	37	4,301		5,342		5,779		6,029			10 - 14 - 23
6	B1	4	20	0.16	-	2,526	1.35	3,138	5.40	3,394	1.58	3,541	2.81	5.9	0 - 1 - 4
			30	0.35	-	3,687		4,580		4,954		5,168			1 - 2 - 9
			40	0.62	22	4,359		5,414		5,856		6,109			2 - 4 - 13
	B2	5	30	0.15	-	2,610		3,242		3,507		3,659		4.8	1 - 2 - 6
			45	0.33	16	3,859		4,793		5,185		5,409			2 - 3 - 12
			60	0.60	24	4,533		5,631		6,091		6,354			3 - 6 - 17
	B3	6	60	0.16	16	3,286		4,082		4,415		4,606		4.0	2 - 5 - 14
			90	0.36	26	4,601		5,715		6,182		6,449			5 - 10 - 21
			120	0.64	34	5,554		6,899		7,463		7,786			8 - 14 - 26
	B4	10*	105	0.19	19	3,506		4,355		4,710		4,914		2.5	3 - 7 - 18
			160	0.45	30	5,116		6,355		6,874		7,171			7 - 13 - 25
			215	0.81	38	6,133		7,618		8,240		8,596			12 - 18 - 29
8	B1	4	25	0.17	-	2,912	1.77	3,617	7.08	3,913	2.07	4,082	3.68	5.9	0 - 1 - 4
			40	0.43	20	4,647		5,773		6,244		6,514			1 - 2 - 10
			55	0.81	28	5,558		6,904		7,468		7,791			2 - 5 - 16
	B2	5	40	0.19	-	3,248		4,035		4,365		4,553		4.8	1 - 2 - 7
			60	0.43	22	4,864		6,042		6,535		6,818			2 - 4 - 14
			80	0.76	30	5,678		7,052		7,629		7,958			3 - 7 - 19
	B3	8	80	0.21	-	-		5,080		5,495		5,732		4.0	2 - 5 - 16
			120	0.47	24	18		7,203		7,791		8,128			5 - 12 - 25
			160	0.83	32	25		8,639		9,345		9,749			9 - 16 - 30
	B4	10*	145	0.22	26	17		5,673		6,137		6,402		2.5	4 - 8 - 21
			215	0.49	36	27		8,047		8,704		9,081			8 - 16 - 29
			285	0.86	44	34		9,552		10,332		10,779			14 - 21 - 33
10	B1	5	35	0.16	-	-	2.19	4,914	8.76	5,315	2.56	5,545	4.55	5.9	1 - 1 - 5
			52	0.36	20	20		6,913		7,478		7,801			1 - 3 - 12
			69	0.63	27	27		8,254		8,929		9,314			2 - 5 - 18
	B2	6	55	0.18	-	-		5,444		5,888		6,143		4.8	1 - 2 - 9
			80	0.38	24	24		7,346		7,946		8,289			2 - 5 - 17
			105	0.66	31	31		8,790		9,508		9,919			4 - 9 - 22
	B3	8	100	0.16	18	-		5,897		6,379		6,654		4.0	3 - 6 - 18
			150	0.35	29	22		8,425		9,113		9,507			6 - 13 - 28
			200	0.62	36	30		10,067		10,889		11,360			10 - 18 - 33
	B4	10*	180	0.15	28	21		5,655		6,117		6,381		2.5	4 - 9 - 23
			240	0.27	36	29		8,147		8,813		9,194			7 - 15 - 30
			300	0.43	41	35		8,743		9,457		9,866			11 - 19 - 34

Note: Reference page U37 for operational conditions used for performance notes

CBAL-12 / 4-PIPE COOLING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil Sensible Cooling (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		1.0 GPM		2.0 GPM		3.0 GPM		4.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
4	A1	5	26	0.22	17	992	1.48	1,271	5.92	1,363	1.71	1,423	3.04	4.6	3-4-6
			32	0.33	23	1,185		1,466		1,573		1,641			3-5-7
			38	0.47	28	1,268		1,569		1,683		1,757			4-5-8
			44	0.63	32	1,370		1,695		1,819		1,898			4-6-8
	A2	6	36	0.14	-	1,096		1,357		1,455		1,518		3.7	3-4-7
			48	0.24	20	1,318		1,631		1,750		1,826			4-6-8
			60	0.38	26	1,497		1,853		1,988		2,074			5-7-9
			72	0.55	31	1,641		2,030		2,178		2,272			6-7-10
	A3	8	55	0.15	-	1,135		1,404		1,506		1,572		2.9	3-5-8
			75	0.28	21	1,383		1,711		1,836		1,916			5-7-10
			95	0.44	28	1,581		1,957		2,099		2,190			6-8-11
			115	0.65	33	1,845		2,284		2,450		2,556			7-8-12
6	A1	6	30	0.17	-	1,167	2.12	1,445	8.48	1,550	1.80	1,617	3.20	4.6	2-4-7
			40	0.30	18	1,403		1,736		1,862		1,943			3-5-8
			50	0.46	24	1,597		1,976		2,120		2,212			4-6-9
			60	0.67	30	1,749		2,164		2,321		2,422			5-7-10
	A2	6	55	0.19	16	1,489		1,842		1,976		2,062		3.7	4-5-9
			70	0.30	23	1,737		2,150		2,306		2,406			5-7-10
			85	0.45	28	1,957		2,422		2,598		2,711			6-8-11
			100	0.62	33	2,118		2,621		2,811		2,934			7-9-12
	A3	8	85	0.21	20	1,552		1,920		2,060		2,149		2.9	4-6-10
			110	0.35	27	1,829		2,264		2,428		2,534			6-8-12
			135	0.53	33	2,070		2,562		2,747		2,867			7-9-13
			160	0.74	38	2,323		2,875		3,084		3,218			8-10-14
8	A1	8	40	0.16	-	1,525	2.76	1,887	1.40	2,024	3.15	2,112	5.60	4.6	3-4-8
			53	0.27	19	1,825		2,258		2,422		2,527			4-6-9
			66	0.42	25	2,076		2,569		2,755		2,875			5-7-10
			79	0.61	30	2,269		2,808		3,012		3,143			6-8-11
	A2	8	70	0.17	15	1,890		2,339		2,509		2,618		3.7	4-6-10
			95	0.32	23	2,296		2,841		3,048		3,180			5-8-12
			120	0.51	30	2,626		3,250		3,486		3,638			7-9-13
			145	0.74	35	2,888		3,574		3,834		4,000			8-10-14
	A3	8	110	0.21	18	1,990		2,463		2,642		2,757		2.9	5-7-12
			145	0.37	26	2,371		2,934		3,148		3,285			6-9-13
			180	0.56	32	2,703		3,345		3,588		3,745			8-10-15
			215	0.80	37	3,046		3,770		4,043		4,219			9-11-16
10	A1	8	55	0.18	15	1,942	3.40	2,403	1.76	2,577	3.96	2,690	7.04	4.6	4-5-9
			70	0.30	22	2,272		2,811		3,016		3,147			4-7-10
			85	0.44	27	2,535		3,137		3,365		3,511			5-8-11
			100	0.61	31	2,748		3,400		3,647		3,806			6-9-12
	A2	8	90	0.19	16	2,310		2,858		3,066		3,199		3.7	5-7-11
			120	0.35	24	4,226		5,230		5,609		5,854			6-9-13
			150	0.54	30	3,162		3,913		4,197		4,380			8-10-15
			180	0.78	36	3,462		4,284		4,595		4,795			9-11-16
	A3	8	130	0.22	17	2,313		2,862		3,070		3,204		2.9	5-8-13
			170	0.37	25	5,885		7,283		7,812		8,152			7-10-14
			210	0.56	31	3,155		3,904		4,188		4,370			8-11-16
			250	0.80	35	3,398		4,205		4,510		4,706			10-12-17

Note: Reference page U37 for operational conditions used for performance notes

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CBAL-12 / 4-PIPE HEATING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil Heating (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		1.0 GPM		2.0 GPM		3.0 GPM		4.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
4	A1	5	26	0.22	17	2,634	0.06	3,373	0.24	3,618	0.54	3,775	0.96	4.6	3-4-6
			32	0.33	23	3,144		3,891		4,174		4,355			3-5-7
			38	0.47	28	3,365		4,165		4,467		4,661			4-5-8
			44	0.63	32	3,635		4,499		4,826		5,036			4-6-8
	A2	6	36	0.14	-	2,909		3,600		3,861		4,029		3.7	3-4-7
			48	0.24	20	3,498		4,329		4,643		4,845			4-6-8
			60	0.38	26	3,973		4,917		5,274		5,504			5-7-9
			72	0.55	31	4,354		5,388		5,779		6,030			6-7-10
	A3	8	55	0.15	-	3,011		3,726		3,996		4,170		2.9	3-5-8
			75	0.28	21	3,670		4,541		4,871		5,083			5-7-10
			95	0.44	28	4,196		5,193		5,570		5,812			6-8-11
			115	0.65	33	4,897		6,060		6,500		6,783			7-8-12
6	A1	6	30	0.17	-	3,098	0.09	3,834	0.36	4,113	0.81	4,292	1.44	4.6	2-4-7
			40	0.30	18	3,723		4,608		4,942		5,157			3-5-8
			50	0.46	24	4,238		5,244		5,625		5,870			4-6-9
			60	0.67	30	4,641		5,743		6,160		6,429			5-7-10
	A2	6	55	0.19	16	3,951		4,889		5,244		5,473		3.7	4-5-9
			70	0.30	23	4,610		5,705		6,120		6,386			5-7-10
			85	0.45	28	5,195		6,429		6,895		7,196			6-8-11
			100	0.62	33	5,620		6,955		7,460		7,785			7-9-12
	A3	8	85	0.21	20	4,117		5,095		5,465		5,703		2.9	4-6-10
			110	0.35	27	4,855		6,008		6,444		6,725			6-8-12
			135	0.53	33	5,493		6,797		7,291		7,608			7-9-13
			160	0.74	38	6,165		7,629		8,183		8,539			8-10-14
8	A1	8	40	0.16	-	4,046	0.12	5,007	0.48	5,371	1.08	5,605	1.92	4.6	3-4-8
			53	0.27	19	4,842		5,992		6,427		6,707			4-6-9
			66	0.42	25	5,508		6,816		7,311		7,629			5-7-10
			79	0.61	30	6,021		7,451		7,992		8,340			6-8-11
	A2	8	70	0.17	15	5,016		6,208		6,659		6,948		3.7	4-6-10
			95	0.32	23	6,093		7,540		8,087		8,439			5-8-12
			120	0.51	30	6,970		8,625		9,251		9,654			7-9-13
			145	0.74	35	7,664		9,485		10,173		10,616			8-10-14
	A3	8	110	0.21	18	5,281		6,535		7,010		7,315		2.9	5-7-12
			145	0.37	26	6,292		7,787		8,352		8,716			6-9-13
			180	0.56	32	7,173		8,878		9,522		9,937			8-10-15
			215	0.80	37	8,083		10,003		10,730		11,197			9-11-16
10	A1	8	55	0.18	15	5,152	0.14	6,376	0.56	6,839	1.26	7,137	2.24	4.6	4-5-9
			70	0.30	22	6,028		7,460		8,002		8,350			4-7-10
			85	0.44	27	6,726		8,324		8,928		9,317			5-8-11
			100	0.61	31	7,291		9,023		9,678		10,099			6-9-12
	A2	8	90	0.19	16	6,128		7,584		8,135		8,489		3.7	5-7-11
			120	0.35	24	11,213		13,877		14,885		15,533			6-9-13
			150	0.54	30	8,391		10,384		11,138		11,623			8-10-15
			180	0.78	36	9,186		11,368		12,193		12,724			9-11-16
	A3	8	130	0.22	17	6,137		7,595		8,146		8,501		2.9	5-8-13
			170	0.37	25	15,616		19,326		20,729		21,631			7-10-14
			210	0.56	31	8,371		10,360		11,112		11,596			8-11-16
			250	0.80	35	9,016		11,157		11,967		12,488			10-12-17

Note: Reference page U37 for operational conditions used for performance notes

PERFORMANCE DATA

CBAL-12 / 2-PIPE COOLING

Nominal Length ft	Nozzle Size	Primary Air Inlet Dia.	Primary Air Flow Rate	Primary Air Inlet ΔPS	Sound	Coil Sensible Cooling (Btu/h) 1.0 GPM		2.0 GPM		3.0 GPM		4.0 GPM		Induction ratio	Throw
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
4	A1	5	26	0.22	17	1,092	1.96	1,398	7.84	1,500	2.25	1,565	4.00	4.6	3-4-6
			32	0.33	23	1,303		1,613		1,730		1,805			3-5-7
			38	0.47	28	1,395		1,726		1,852		1,932			4-5-8
			44	0.63	32	1,507		1,865		2,000		2,087			4-6-8
	A2	6	36	0.14	-	1,206		1,492		1,601		1,670		3.7	3-4-7
			48	0.24	20	1,450		1,794		1,925		2,009			4-6-8
			60	0.38	26	1,647		2,038		2,186		2,281			5-7-9
			72	0.55	31	1,805		2,233		2,395		2,500			6-7-10
	A3	8	55	0.15	-	1,248		1,545		1,657		1,729		2.9	3-5-8
			75	0.28	21	1,521		1,883		2,019		2,107			5-7-10
			95	0.44	28	1,739		2,153		2,309		2,409			6-8-11
			115	0.65	33	2,030		2,512		2,695		2,812			7-8-12
6	A1	6	30	0.17	-	1,284	2.82	1,589	1.44	1,705	3.24	1,779	5.76	4.6	2-4-7
			40	0.30	18	1,543		1,910		2,049		2,138			3-5-8
			50	0.46	24	1,757		2,174		2,332		2,433			4-6-9
			60	0.67	30	1,924		2,381		2,553		2,665			5-7-10
	A2	6	55	0.19	16	1,638		2,027		2,174		2,268		3.7	4-5-9
			70	0.30	23	1,911		2,365		2,537		2,647			5-7-10
			85	0.45	28	2,153		2,665		2,858		2,983			6-8-11
			100	0.62	33	2,330		2,883		3,092		3,227			7-9-12
	A3	8	85	0.21	20	1,707		2,112		2,265		2,364		2.9	4-6-10
			110	0.35	27	2,012		2,490		2,671		2,788			6-8-12
			135	0.53	33	2,277		2,818		3,022		3,154			7-9-13
			160	0.74	38	2,555		3,162		3,392		3,540			8-10-14
8	A1	8	40	0.16	-	1,677	3.67	2,076	1.88	2,226	4.23	2,323	7.52	4.6	3-4-8
			53	0.27	19	2,007		2,484		2,664		2,780			4-6-9
			66	0.42	25	2,283		2,826		3,031		3,163			5-7-10
			79	0.61	30	2,496		3,089		3,313		3,457			6-8-11
	A2	8	70	0.17	15	2,079		2,573		2,760		2,880		3.7	4-6-10
			95	0.32	23	2,525		3,125		3,352		3,498			5-8-12
			120	0.51	30	2,889		3,575		3,835		4,002			7-9-13
			145	0.74	35	3,177		3,931		4,217		4,400			8-10-14
	A3	8	110	0.21	18	2,189		2,709		2,906		3,032		2.9	5-7-12
			145	0.37	26	2,608		3,228		3,462		3,613			6-9-13
			180	0.56	32	2,974		3,680		3,947		4,119			8-10-15
			215	0.80	37	3,351		4,147		4,448		4,641			9-11-16
10	A1	8	55	0.18	15	2,136	4.53	2,643	2.36	2,835	5.31	2,959	9.44	4.6	4-5-9
			70	0.30	22	2,499		3,093		3,317		3,462			4-7-10
			85	0.44	27	2,788		3,451		3,701		3,862			5-8-11
			100	0.61	31	3,023		3,740		4,012		4,187			6-9-12
	A2	8	90	0.19	16	2,540		3,144		3,372		3,519		3.7	5-7-11
			120	0.35	24	4,648		5,753		6,170		6,439			6-9-13
			150	0.54	30	3,478		4,305		4,617		4,818			8-10-15
			180	0.78	36	3,808		4,712		5,055		5,275			9-11-16
	A3	8	130	0.22	17	2,544		3,148		3,377		3,524		2.9	5-8-13
			170	0.37	25	6,474		8,011		8,593		8,967			7-10-14
			210	0.56	31	3,470		4,295		4,606		4,807			8-11-16
			250	0.80	35	3,737		4,625		4,961		5,177			10-12-17

Note: Reference page U37 for operational conditions used for performance notes

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CBAL-12 / 2-PIPE HEATING

Nominal Length	Nozzle Size	Primary Air			Sound	Coil Heating (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		1.0 GPM		2.0 GPM		3.0 GPM		4.0 GPM			
ft		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
4	A1	5	26	0.22	17	4,214	1.96	5,397	7.84	5,788	2.25	6,040	4.00	4.6	3-4-6
			32	0.33	23	5,031		6,226		6,678		6,969			3-5-7
			38	0.47	28	5,384		6,663		7,147		7,458			4-5-8
			44	0.63	32	5,817		7,198		7,721		8,057			4-6-8
	A2	6	36	0.14	-	4,654		5,760		6,178		6,447		3.7	3-4-7
			48	0.24	20	5,597		6,926		7,429		7,753			4-6-8
			60	0.38	26	6,358		7,868		8,439		8,806			5-7-9
			72	0.55	31	6,966		8,620		9,246		9,649			6-7-10
	A3	8	55	0.15	-	4,817		5,961		6,394		6,672		2.9	3-5-8
			75	0.28	21	5,871		7,266		7,794		8,133			5-7-10
			95	0.44	28	6,713		8,308		8,911		9,299			6-8-11
			115	0.65	33	7,835		9,696		10,400		10,853			7-8-12
6	A1	6	30	0.17	-	4,957	2.82	6,135	1.44	6,580	3.24	6,867	5.76	4.6	2-4-7
			40	0.30	18	5,957		7,372		7,908		8,252			3-5-8
			50	0.46	24	6,780		8,391		9,000		9,392			4-6-9
			60	0.67	30	7,426		9,190		9,857		10,286			5-7-10
	A2	6	55	0.19	16	6,321		7,823		8,391		8,756		3.7	4-5-9
			70	0.30	23	7,376		9,128		9,791		10,218			5-7-10
			85	0.45	28	8,312		10,286		11,033		11,513			6-8-11
			100	0.62	33	8,992		11,128		11,936		12,456			7-9-12
	A3	8	85	0.21	20	6,588		8,152		8,744		9,125		2.9	4-6-10
			110	0.35	27	7,768		9,613		10,311		10,760			6-8-12
			135	0.53	33	8,788		10,876		11,665		12,173			7-9-13
			160	0.74	38	9,863		12,206		13,092		13,662			8-10-14
8	A1	8	40	0.16	-	6,474	3.67	8,011	1.88	8,593	4.23	8,967	7.52	4.6	3-4-8
			53	0.27	19	7,747		9,587		10,283		10,731			4-6-9
			66	0.42	25	8,812		10,906		11,697		12,207			5-7-10
			79	0.61	30	9,634		11,922		12,788		13,344			6-8-11
	A2	8	70	0.17	15	8,026		9,933		10,654		11,117		3.7	4-6-10
			95	0.32	23	9,748		12,064		12,940		13,503			5-8-12
			120	0.51	30	11,151		13,800		14,802		15,447			7-9-13
			145	0.74	35	12,262		15,175		16,277		16,986			8-10-14
	A3	8	110	0.21	18	8,449		10,457		11,216		11,704		2.9	5-7-12
			145	0.37	26	10,068		12,459		13,364		13,946			6-9-13
			180	0.56	32	11,478		14,204		15,235		15,899			8-10-15
			215	0.80	37	12,933		16,005		17,167		17,915			9-11-16
10	A1	8	55	0.18	15	8,243	4.53	10,202	2.36	10,942	5.31	11,419	9.44	4.6	4-5-9
			70	0.30	22	9,645		11,936		12,803		13,360			4-7-10
			85	0.44	27	10,761		13,318		14,285		14,906			5-8-11
			100	0.61	31	11,666		14,437		15,485		16,159			6-9-12
	A2	8	90	0.19	16	9,805		12,135		13,016		13,582		3.7	5-7-11
			120	0.35	24	17,941		22,203		23,815		24,852			6-9-13
			150	0.54	30	13,425		16,614		17,820		18,596			8-10-15
			180	0.78	36	14,697		18,188		19,509		20,358			9-11-16
	A3	8	130	0.22	17	9,819		12,152		13,034		13,601		2.9	5-8-13
			170	0.37	25	24,986		30,921		33,166		34,610			7-10-14
			210	0.56	31	13,394		16,576		17,779		18,553			8-11-16
			250	0.80	35	14,425		17,851		19,148		19,981			10-12-17

Note: Reference page U37 for operational conditions used for performance notes

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NOTES:

1. All performance data based on test performed in accordance with ASHRAE Standard 200-2015
2. ΔP_s values are measured in inches of water
3. NC values are based on room absorption of 10 dB. A dash (-) indicates an NC value less than 15.
4. Throw values are based on isothermal supply air and represent throw distances to terminal velocities of 150, 100 and 50 fpm respectively
5. ΔP_{Coil} values are measured in feet of water. ΔP_{Coil} values in shaded cells indicate use of a two circuit coil. All other values represent a single circuit coil.
6. Induction ratio is multiplied by the volume flow rate of primary air to estimate the volume flow rate of room air entrained through the coil

Cooling performance:

- Cooling capacity listed (qCOIL) is the sensible heat removal by the beam's integral coil. It does not include any contribution or offset by the primary air
- Capacity is based on 18°F ΔT between the induced air and the chilled water supply.
- Primary air sensible cooling contribution can be calculated by the following equation:

qSENSPA = 1.085 x CFMPA x (TPA - TROOM)

- Primary air latent cooling can be calculated by the following equation:

qLATENT = 0.69 x CFMPA x (WROOM - WPA)

where WROOM and WPA are the humidity ratio of the room and primary air respectively expressed in Grains of moisture per pound dry air

TABLE 4: CORRECTION FOR (ΔT) BETWEEN ENTERING AIR AND ENTERING CHILLED WATER

Actual ΔT	10	12	14	16	18	20	22	24
Multiply Table Value by:	0.56	0.67	0.78	0.89	1.00	1.11	1.22	1.33

Heating performance:

- Heating capacity listed (qCOIL) is the sensible heat removal by the beam's integral coil. It does not include any contribution or offset by the primary air
- Capacity is based on 50°F ΔT between the induced air and the chilled water supply.
- Primary air sensible heating offset (or contribution) can be calculated by the following equation:

qSENSPA = 1.085 x CFMPA x (TPA - TROOM)

if the primary air temperature is lower than that of the room, it will offset the coil's heating

if the primary air temperature is higher than that of the room, it will contribute to the coil's heating

Legend:

ΔP_S = Unit Inlet Pressure [in wg]

qCoil = Sensible Capacity, Coil [Btu/h]

ΔCoil = Water coil pressure drop [ft wg]

qSENSPA = Sensible Capacity, Primary Air [Btu/h]

CFMPA = Air Flowrate, Primary Air [CFM]

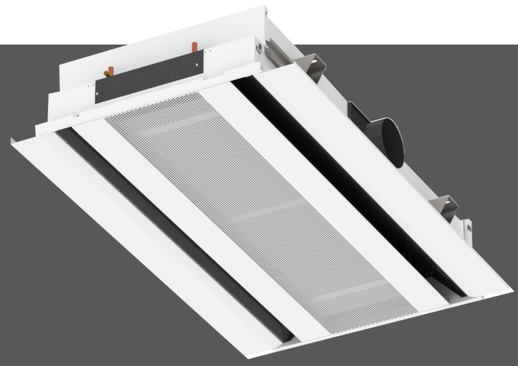
TPA = Temperature Primary Air [°F]

TROOM = Temperature Room Air [°F]

qSENSPA = Latent Capacity, Primary Air [Btu/h]

CBLE

- Exposed linear chilled beam with 1-way or 2-way air distribution patterns
- Optimized nozzle design provides high capacity and low noise levels
- Linear design matching commercial architectural styling
- Integral coanda plates for ceiling independent operation
- Optimized diffuser geometry maximizes occupant comfort



CBLE

dual-function | open ceiling | k-12 education | universities | energy solutions

See website for Specifications

AVAILABLE MODEL:

CBLE

FINISHES:

Standard Finish - #26 White
Optional Finish - #84 Black

OVERVIEW

Titus active chilled beams features the aerodynamic properties of Titus ceiling diffusers and benefit from the use of using hydronic coils and induced air to reduce energy consumption associated with removal of sensible thermal loads. The primary air is supplied to the chilled beam subsequent to it being discharged through a series of nozzles located along the length of the beam. The nozzles inject the primary air into the mixing chamber at velocities capable of inducing room air through its water coil where it mixes with the primary supply air. This mixture of air is then discharged into the space through the ceiling slot diffusers. This provides high cooling outputs with low amounts of primary air. The reduced volume of air results in the reduction of the air handler capacity and size, smaller duct sizes, and the overall energy consumption.

The supplied air from the air handling unit is tempered and dehumidified to handle the latent load. The remaining loads in the space are addressed with the heat exchanger which is incorporated into the chilled beam. Applications with low latent cooling loads could use 100 percent outdoor air allowing for use of a dedicated outdoor air system with energy recovery further reducing total system energy consumption.

The CBLE's are offered for both, cooling and heating and lengths from 2 to 10 ft. The low overall height of the CBLE is ideal for open ceiling or retrofit applications with limited floor height.

ADVANTAGES

- Removal of high thermal loads is possible in this air/water system
- The size of the air duct system is reduced to a minimum, due to the low supply of primary air
- Substantial reduction in the operating costs, due to low primary air volume
- Improvement of the thermal comfort inside the room
- Suitable for several standard ceiling grids
- Contributing sound levels below NC-30

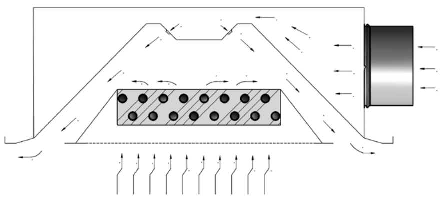
CBLE STANDARD FEATURES

- 1-way or 2-way air distribution patterns
- 2 foot to 10 foot lengths, 1 foot increments
- Perforated or linear bar induced air grille
- Left hand or Right hand coil connections
- Side or top air inlet locations
- 2-pipe and 4-pipe coil configurations
- Configured nozzle geometry for capacity optimization
- Hinged induced air grille for roomside coil access
- Commissioning port with roomside access for balancing
- Mounting brackets with adjustments in two directions
- Durable powder coat finish
- ½" Sweat water coil connections
- Coil air vent

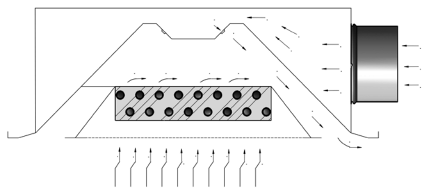
OPTIONS AND ACCESSORIES

- ½" thick foil-faced EcoShield, anti-microbial external insulation
- Coil drain valve
- ½" MNPT water coil connections
- 12-inch, 18-inch or 24-inch stainless steel braided hoses

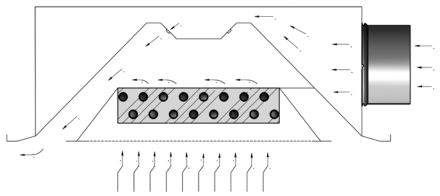
CBLE 2-Way



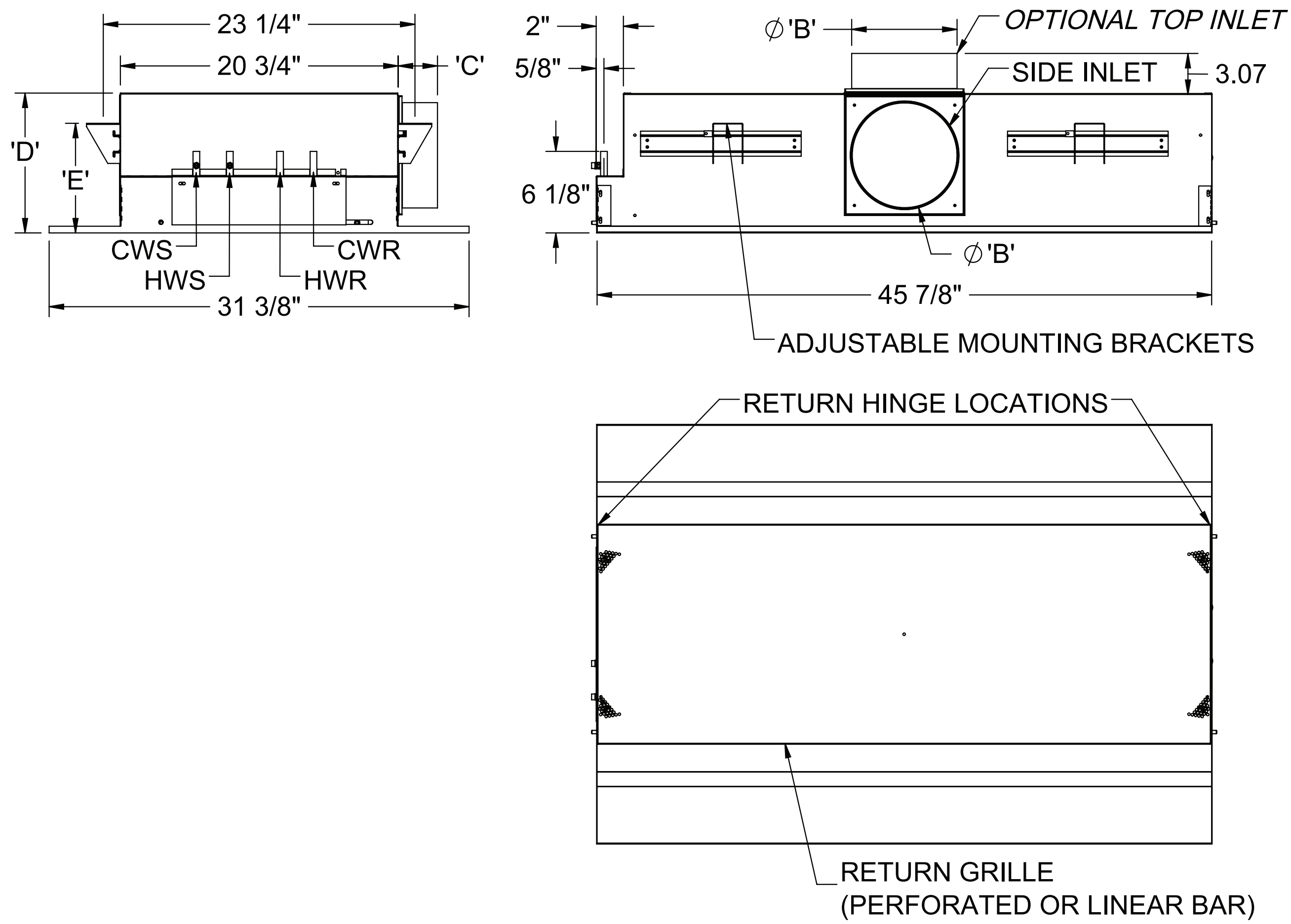
CBLE 1-Way (front)



CBLE 1-Way (back)



CBLE UNIT DIMENSIONS



Nominal Unit Length (ft)	'A' (IN)
2	21 7/8
3	33 7/8
4	45 7/8
5	57 7/8
6	69 7/8
7	81 7/8
8	93 7/8
9	105 7/8
10	117 7/8

Nominal Inlet Dia. (IN)	'B' (IN)	'C' (IN)*	'D' (IN)	'E' (IN)
5	4 7/8	3	8 3/8	6¼
6	5 7/8	3	8 3/8	6¼
8	7 7/8	3	10 3/8	8¼
8**	7 7/8	--	8 3/8	6¼

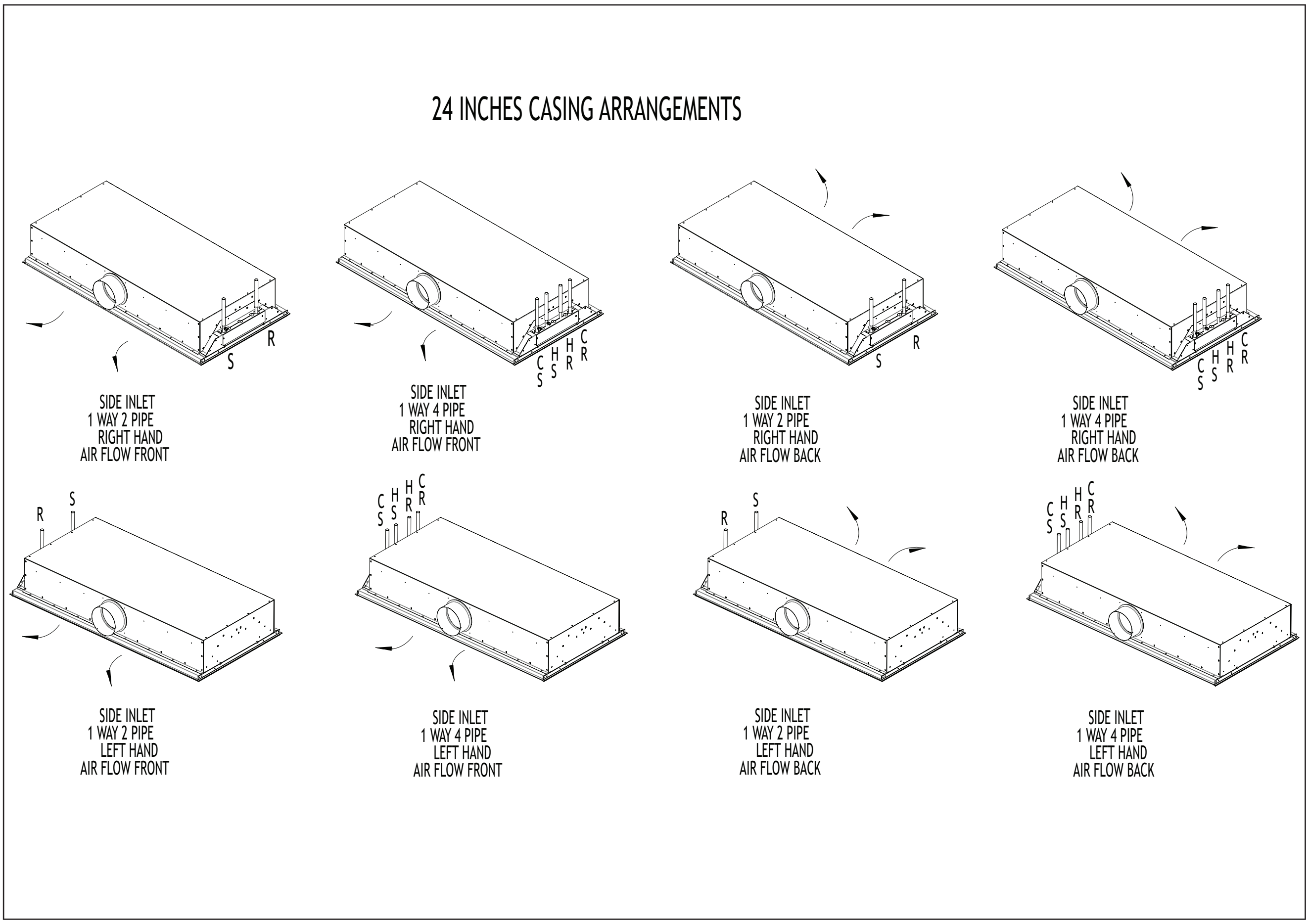
*Side Inlet Only

**Top Inlet Only

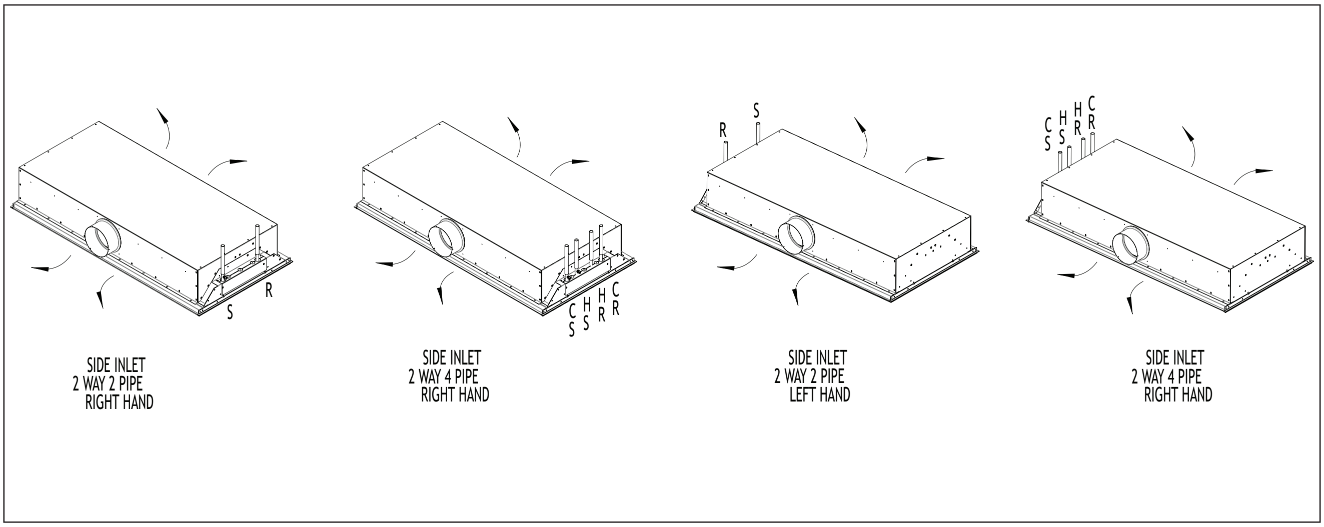
Integrated ¼" pressure port for balancing/commissioning accessable from roomside opposite coil connection

All dimensions are in inches

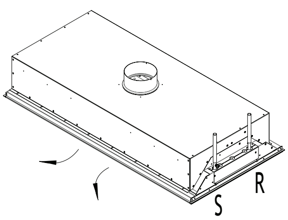
CBLE CASING ARRANGEMENTS / SIDE INLET 1-WAY



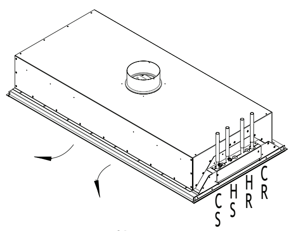
CBLE CASING ARRANGEMENTS / SIDE INLET 2-WAY



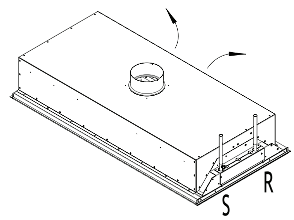
CBLE CASING ARRANGEMENTS / TOP INLET 1-WAY



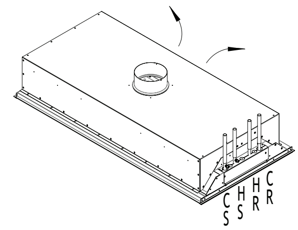
TOP INLET
1 WAY 2 PIPE
RIGHT HAND
AIR FLOW FRONT



TOP INLET
1 WAY 4 PIPE
RIGHT HAND
AIR FLOW FRONT

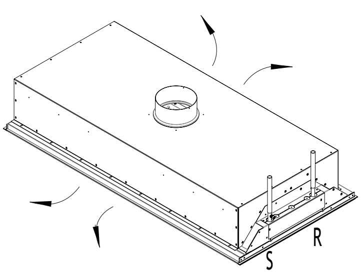


TOP INLET
1 WAY 2 PIPE
RIGHT HAND
AIR FLOW BACK

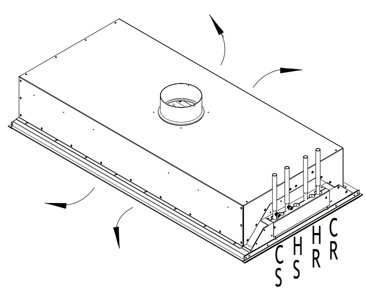


TOP INLET
1 WAY 4 PIPE
RIGHT HAND
AIR FLOW BACK

CBLE CASING ARRANGEMENTS / TOP INLET 2-WAY



TOP INLET
2 WAY 2 PIPE
RIGHT HAND



TOP INLET
2 WAY 4 PIPE
RIGHT HAND

R - Return S - Supply;

HR - Heating Return HS - Heating Supply;

CR - Cooling Return CS - Cooling Supply

CBLE-24 / 4-PIPE COOLING

Nominal Length ft	Nozzle Size	Primary Air: Inlet Dia.	Primary Air: Flow Rate	Primary Air: Inlet ΔPS	Sound	Coil Sensible Cooling (Btu/h): 0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM		Induction ratio	Throw
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
4	B1	4	15	0.20	-	1,483	0.72	1,842	2.88	1,992	6.49	2,078	1.10	5.9	0 - 1 - 3
			20	0.35	-	1,782		2,214		2,395		2,498			1 - 2 - 5
			25	0.54	-	2,072		2,573		2,784		2,904			1 - 3 - 7
	B2	4	20	0.15	-	1,307		1,623		1,756		1,831		4.8	1 - 1 - 4
			30	0.35	-	1,877		2,332		2,522		2,631			1 - 3 - 7
			40	0.62	22	2,237		2,778		3,005		3,135			2 - 4 - 10
	B3	5	40	0.18	-	1,515		1,882		2,036		2,124		4.0	2 - 3 - 9
			60	0.40	23	2,249		2,794		3,022		3,153			4 - 6 - 13
			80	0.71	30	2,657		3,301		3,571		3,725			7 - 9 - 15
	B4	6	70	0.21	19	1,705		2,118		2,291		2,390		2.5	2 - 5 - 10
			105	0.48	29	2,449		3,043		3,291		3,433			6 - 8 - 14
			140	0.86	37	2,918		3,625		3,921		4,091			10 - 10 - 17
6	B1	4	20	0.16	-	1,774	1.01	2,203	4.03	2,383	9.06	2,486	2.26	5.9	0 - 1 - 3
			30	0.35	-	2,549		3,166		3,424		3,572			1 - 2 - 7
			40	0.62	22	3,037		3,772		4,080		4,257			2 - 3 - 10
	B2	5	30	0.15	-	1,868		2,321		2,510		2,619		4.8	1 - 2 - 5
			45	0.33	16	2,684		3,334		3,607		3,763			2 - 3 - 9
			60	0.60	24	3,199		3,973		4,298		4,483			3 - 5 - 12
	B3	6	60	0.16	16	2,167		2,691		2,911		3,037		4.0	2 - 4 - 10
			90	0.36	26	3,113		3,867		4,183		4,363			5 - 7 - 15
			120	0.64	34	3,709		4,607		4,984		5,199			8 - 10 - 19
	B4	10*	105	0.19	-	2,438		3,028		3,276		3,417		2.5	3 - 5 - 13
			160	0.45	21	3,503		4,351		4,706		4,910			7 - 10 - 18
			215	0.81	29	4,173		5,184		5,608		5,850			12 - 13 - 21
8	B1	4	25	0.17	-	2,030	1.32	2,522	5.28	2,728	1.54	2,846	2.74	5.9	0 - 1 - 3
			40	0.43	20	3,233		4,016		4,344		4,532			1 - 2 - 7
			55	0.81	28	3,852		4,785		5,176		5,400			2 - 4 - 12
	B2	5	40	0.19	-	2,370		2,944		3,185		3,322		4.8	1 - 2 - 5
			60	0.43	22	3,405		4,230		4,575		4,773			2 - 3 - 10
			80	0.76	30	3,958		4,917		5,318		5,548			3 - 5 - 14
	B3	8	80	0.21	-	2,748		3,414		3,693		3,852		4.0	2 - 4 - 12
			120	0.47	18	3,949		4,905		5,306		5,535			5 - 9 - 18
			160	0.83	25	4,705		5,844		6,322		6,595			9 - 12 - 21
	B4	10*	145	0.22	17	3,092		3,841		4,155		4,335		2.5	4 - 6 - 15
			215	0.49	27	4,443		5,519		5,970		6,228			8 - 12 - 21
			285	0.86	34	5,294		6,576		7,113		7,421			14 - 15 - 24
10	B1	5	35	0.16	-	2,743	1.63	3,407	6.53	3,685	1.91	3,845	3.40	5.9	1 - 1 - 4
			52	0.36	20	3,796		4,715		5,101		5,321			1 - 3 - 9
			69	0.63	27	4,523		5,618		6,077		6,340			2 - 4 - 13
	B2	6	55	0.18	-	2,889		3,589		3,882		4,050		4.8	1 - 2 - 7
			80	0.38	24	3,998		4,967		5,373		5,605			2 - 4 - 12
			105	0.66	31	4,764		5,918		6,401		6,678			4 - 7 - 16
	B3	8	100	0.16	-	3,350		4,161		4,501		4,696		4.0	3 - 5 - 13
			150	0.35	22	4,637		5,760		6,230		6,499			6 - 10 - 20
			200	0.62	30	5,525		6,862		7,423		7,744			10 - 13 - 24
	B4	10*	180	0.15	21	3,486		4,331		4,685		4,887		2.5	4 - 7 - 17
			240	0.27	29	4,400		5,465		5,912		6,167			9 - 12 - 23
			300	0.43	35	5,146		6,392		6,915		7,213			15 - 17 - 26

Note: Reference page U47 for operational conditions used for performance notes

CBLE-24 / 4-PIPE HEATING

Nominal Length ft	Nozzle Size	Primary Air: Inlet Dia. Inches	Primary Air: Flow Rate CFM	Primary Air: Inlet ΔPS (in. H2O)	Sound NC	Coil Heating (Btu/h) 0.5 GPM qCOIL	0.5 GPM ΔCOIL	1.0 GPM qCOIL	1.0 GPM ΔCOIL	1.5 GPM qCOIL	1.5 GPM ΔCOIL	2.0 GPM qCOIL	2.0 GPM ΔCOIL	Induction ratio	Throw ft.
4	B1	4	15	0.20	-	2,243	0.18	2,787	0.71	3,014	1.59	3,145	2.83	5.9	0 - 1 - 3
			20	0.35	-	2,696		3,349		3,623		3,780			1 - 2 - 5
			25	0.54	-	3,134		3,893		4,211		4,393			1 - 3 - 7
	B2	4	20	0.15	-	1,977		2,455		2,656		2,771		4.8	1 - 1 - 4
			30	0.35	-	2,840		3,528		3,816		3,981			1 - 3 - 7
			40	0.62	22	3,384		4,204		4,547		4,743			2 - 4 - 10
	B3	5	40	0.18	-	2,292		2,847		3,080		3,213		4	2 - 3 - 9
			60	0.40	23	3,403		4,227		4,572		4,770			4 - 6 - 13
			80	0.71	30	4,020		4,994		5,402		5,636			7 - 9 - 15
	B4	6	70	0.21	19	2,579		3,204		3,466		3,615		2.5	2 - 5 - 10
			105	0.48	29	3,706		4,603		4,979		5,194			6 - 8 - 14
			140	0.86	37	4,415		5,485		5,933		6,189			10 - 10 - 17
6	B1	4	20	0.16	-	2,684	0.28	3,334	1.11	3,606	2.50	3,762	4.44	5.9	0 - 1 - 3
			30	0.35	-	3,856		4,790		5,181		5,405			1 - 2 - 7
			40	0.62	22	4,594		5,707		6,173		6,440			2 - 3 - 10
	B2	5	30	0.15	-	2,827		3,511		3,798		3,962		4.8	1 - 2 - 5
			45	0.33	16	4,061		5,045		5,457		5,693			2 - 3 - 9
			60	0.60	24	4,839		6,011		6,502		6,783			3 - 5 - 12
	B3	6	60	0.16	16	3,278		4,072		4,404		4,595		4	2 - 4 - 10
			90	0.36	26	4,710		5,850		6,328		6,602			5 - 7 - 15
			120	0.64	34	5,612		6,970		7,540		7,866			8 - 10 - 19
	B4	10*	105	0.19	19	3,688		4,581		4,956		5,170		2.5	3 - 5 - 13
			160	0.45	30	5,299		6,583		7,120		7,428			7 - 10 - 18
			215	0.81	38	6,314		7,843		8,484		8,851			12 - 13 - 21
8	B1	4	25	0.17	-	3,072	0.34	3,816	1.35	4,127	3.04	4,306	5.40	5.9	0 - 1 - 3
			40	0.43	20	4,891		6,076		6,572		6,856			1 - 2 - 7
			55	0.81	28	5,828		7,239		7,831		8,169			2 - 4 - 12
	B2	5	40	0.19	-	3,586		4,454		4,818		5,026		4.8	1 - 2 - 5
			60	0.43	22	5,152		6,400		6,922		7,222			2 - 3 - 10
			80	0.76	30	5,989		7,439		8,046		8,394			3 - 5 - 14
	B3	8	80	0.21	-	4,158		5,165		5,587		5,828		4	2 - 4 - 12
			120	0.47	18	5,974		7,421		8,027		8,374			5 - 9 - 18
			160	0.83	25	7,118		8,842		9,565		9,978			9 - 12 - 21
	B4	10*	145	0.22	17	4,679		5,812		6,287		6,558		2.5	4 - 6 - 15
			215	0.49	27	6,722		8,350		9,032		9,423			8 - 12 - 21
			285	0.86	34	8,010		9,949		10,762		11,227			14 - 15 - 24
10	B1	5	35	0.16	-	4,150	0.42	5,155	1.68	5,576	3.77	5,817	6.70	5.9	1 - 1 - 4
			52	0.36	20	5,743		7,134		7,717		8,051			1 - 3 - 9
			69	0.63	27	6,843		8,500		9,195		9,592			2 - 4 - 13
	B2	6	55	0.18	-	4,371		5,429		5,873		6,127		4.8	1 - 2 - 7
			80	0.38	24	6,050		7,514		8,128		8,480			2 - 4 - 12
			105	0.66	31	7,208		8,953		9,685		10,103			4 - 7 - 16
	B3	8	100	0.16	-	5,069		6,296		6,810		7,105		4	3 - 5 - 13
			150	0.35	22	7,015		8,714		9,426		9,833			6 - 10 - 20
			200	0.62	30	8,358		10,383		11,231		11,716			10 - 13 - 24
	B4	10*	180	0.15	21	5,275		6,552		7,087		7,394		2.5	4 - 7 - 17
			240	0.27	29	6,657		8,269		8,944		9,331			9 - 12 - 23
			300	0.43	35	7,786		9,671		10,461		10,914			15 - 17 - 26

Note: Reference page U47 for operational conditions used for performance notes

CBLE-24 / 2-PIPE COOLING

Nominal Length ft	Nozzle Size	Primary Air: Inlet Dia. (Inches)	Primary Air: Flow Rate (CFM)	Primary Air: Inlet ΔPS (in. H2O)	Sound NC	Coil Sensible Cooling (Btu/h) 0.5 GPM qCOIL	0.5 GPM ΔCOIL	1.0 GPM qCOIL	1.0 GPM ΔCOIL	1.5 GPM qCOIL	1.5 GPM ΔCOIL	2.0 GPM qCOIL	2.0 GPM ΔCOIL	Induction ratio	Throw ft.
4	B1	4	15	0.20	-	1,587	0.93	1,972	3.72	2,133	8.38	2,225	1.92	5.9	0 - 1 - 3
			20	0.35	-	1,970		2,447		2,647		2,761			1 - 2 - 5
			25	0.54	-	2,272		2,822		3,052		3,184			1 - 3 - 7
	B2	4	20	0.15	-	1,431		1,778		1,923		2,006		4.8	1 - 1 - 4
			30	0.35	-	2,062		2,561		2,770		2,890			1 - 3 - 7
			40	0.62	22	2,453		3,047		3,296		3,438			2 - 4 - 10
	B3	5	40	0.18	-	1,802		2,238		2,421		2,525		4.0	2 - 3 - 9
			60	0.40	23	2,459		3,054		3,304		3,446			4 - 6 - 13
			80	0.71	30	3,007		3,736		4,041		4,215			7 - 9 - 15
	B4	6	70	0.21	19	1,904		2,365		2,558		2,669		2.5	2 - 5 - 10
			105	0.48	29	2,708		3,363		3,638		3,795			6 - 8 - 14
			140	0.86	37	3,243		4,028		4,357		4,545			10 - 10 - 17
6	B1	4	20	0.16	-	1,904	1.35	2,366	5.40	2,559	1.58	2,670	2.81	5.9	0 - 1 - 3
			30	0.35	-	2,780		3,453		3,735		3,897			1 - 2 - 7
			40	0.62	22	3,286		4,082		4,416		4,606			2 - 3 - 10
	B2	5	30	0.15	-	1,968		2,445		2,644		2,759		4.8	1 - 2 - 5
			45	0.33	16	2,910		3,614		3,909		4,078			2 - 3 - 9
			60	0.60	24	3,418		4,245		4,592		4,791			3 - 5 - 12
	B3	6	60	0.16	16	2,478		3,078		3,329		3,473		4.0	2 - 4 - 10
			90	0.36	26	3,469		4,309		4,661		4,863			5 - 7 - 15
			120	0.64	34	4,188		5,202		5,627		5,870			8 - 10 - 19
	B4	10*	105	0.19	19	2,643		3,283		3,552		3,705		2.5	3 - 5 - 13
			160	0.45	30	3,858		4,792		5,183		5,407			7 - 10 - 18
			215	0.81	38	4,624		5,744		6,213		6,482			12 - 13 - 21
8	B1	4	25	0.17	-	2,196	1.77	2,727	7.08	2,950	2.07	3,078	3.68	5.9	0 - 1 - 3
			40	0.43	20	3,504		4,353		4,708		4,912			1 - 2 - 7
			55	0.81	28	4,191		5,206		5,631		5,874			2 - 4 - 12
	B2	5	40	0.19	-	2,449		3,042		3,291		3,433		4.8	1 - 2 - 5
			60	0.43	22	3,667		4,555		4,928		5,140			2 - 3 - 10
			80	0.76	30	4,281		5,317		5,752		6,000			3 - 5 - 14
	B3	8	80	0.21	-	3,083		3,830		4,143		4,322		4.0	2 - 4 - 12
			120	0.47	18	4,372		5,431		5,875		6,128			5 - 9 - 18
			160	0.83	25	5,244		6,514		7,046		7,351			9 - 12 - 21
	B4	10*	145	0.22	17	3,444		4,277		4,627		4,827		2.5	4 - 6 - 15
			215	0.49	27	4,885		6,067		6,563		6,847			8 - 12 - 21
			285	0.86	34	5,798		7,202		7,790		8,127			14 - 15 - 24
10	B1	5	35	0.16	-	2,983	2.19	3,705	8.76	4,008	2.56	4,181	4.55	5.9	1 - 1 - 4
			52	0.36	20	4,196		5,212		5,638		5,882			1 - 3 - 9
			69	0.63	27	5,010		6,224		6,732		7,023			2 - 4 - 13
	B2	6	55	0.18	-	3,304		4,105		4,440		4,632		4.8	1 - 2 - 7
			80	0.38	24	4,459		5,538		5,991		6,250			2 - 4 - 12
			105	0.66	31	5,335		6,627		7,169		7,479			4 - 7 - 16
	B3	8	100	0.16	-	3,579		4,446		4,809		5,017		4.0	3 - 5 - 13
			150	0.35	22	5,114		6,352		6,871		7,168			6 - 10 - 20
			200	0.62	30	6,111		7,590		8,210		8,565			10 - 13 - 24
	B4	10*	180	0.15	21	3,432		4,264		4,612		4,811		2.5	4 - 7 - 17
			240	0.27	29	4,945		6,143		6,645		6,932			9 - 12 - 23
			300	0.43	35	5,307		6,592		7,131		7,439			15 - 17 - 26

Note: Reference page U47 for operational conditions used for performance notes

CBLE-24 / 2-PIPE HEATING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil Heating (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
4	B1	4	15	0.20	-	2,105	0.93	2,615	3.72	2,829	8.38	2,951	1.92	5.9	0 - 1 - 3
			20	0.35	-	2,613		3,245		3,511		3,662			1 - 2 - 5
			25	0.54	-	3,013		3,743		4,048		4,223			1 - 3 - 7
	B2	4	20	0.15	-	1,898		2,357		2,550		2,660		4.8	1 - 1 - 4
			30	0.35	-	2,734		3,396		3,674		3,833			1 - 3 - 7
			40	0.62	22	3,253		4,041		4,371		4,560			2 - 4 - 10
	B3	5	40	0.18	-	2,389		2,968		3,211		3,349		4.0	2 - 3 - 9
			60	0.40	23	3,261		4,051		4,382		4,571			4 - 6 - 13
			80	0.71	30	3,989		4,954		5,359		5,591			7 - 9 - 15
	B4	6	70	0.21	19	2,525		3,136		3,393		3,539		2.5	2 - 5 - 10
			105	0.48	29	3,591		4,461		4,825		5,034			6 - 8 - 14
			140	0.86	37	4,301		5,342		5,779		6,029			10 - 10 - 17
6	B1	4	20	0.16	-	2,526	1.35	3,138	5.40	3,394	1.58	3,541	2.81	5.9	0 - 1 - 3
			30	0.35	-	3,687		4,580		4,954		5,168			1 - 2 - 7
			40	0.62	22	4,359		5,414		5,856		6,109			2 - 3 - 10
	B2	5	30	0.15	-	2,610		3,242		3,507		3,659		4.8	1 - 2 - 5
			45	0.33	16	3,859		4,793		5,185		5,409			2 - 3 - 9
			60	0.60	24	4,533		5,631		6,091		6,354			3 - 5 - 12
	B3	6	60	0.16	16	3,286		4,082		4,415		4,606		4.0	2 - 4 - 10
			90	0.36	26	4,601		5,715		6,182		6,449			5 - 7 - 15
			120	0.64	34	5,554		6,899		7,463		7,786			8 - 10 - 19
	B4	10*	105	0.19	19	3,506		4,355		4,710		4,914		2.5	3 - 5 - 13
			160	0.45	30	5,116		6,355		6,874		7,171			7 - 10 - 18
			215	0.81	38	6,133		7,618		8,240		8,596			12 - 13 - 21
8	B1	4	25	0.17	-	2,912	1.77	3,617	7.08	3,913	2.07	4,082	3.68	5.9	0 - 1 - 3
			40	0.43	20	4,647		5,773		6,244		6,514			1 - 2 - 7
			55	0.81	28	5,558		6,904		7,468		7,791			2 - 4 - 12
	B2	5	40	0.19	-	3,248		4,035		4,365		4,553		4.8	1 - 2 - 5
			60	0.43	22	4,864		6,042		6,535		6,818			2 - 3 - 10
			80	0.76	30	5,678		7,052		7,629		7,958			3 - 5 - 14
	B3	8	80	0.21	-	-		5,080		5,495		5,732		4.0	2 - 4 - 12
			120	0.47	24	18		7,203		7,791		8,128			5 - 9 - 18
			160	0.83	32	25		8,639		9,345		9,749			9 - 12 - 21
	B4	10*	145	0.22	26	17		5,673		6,137		6,402		2.5	4 - 6 - 15
			215	0.49	36	27		8,047		8,704		9,081			8 - 12 - 21
			285	0.86	44	34		9,552		10,332		10,779			14 - 15 - 24
10	B1	5	35	0.16	-	-	2.19	4,914	8.76	5,315	2.56	5,545	4.55	5.9	1 - 1 - 4
			52	0.36	20	20		6,913		7,478		7,801			1 - 3 - 9
			69	0.63	27	27		8,254		8,929		9,314			2 - 4 - 13
	B2	6	55	0.18	-	-		5,444		5,888		6,143		4.8	1 - 2 - 7
			80	0.38	24	24		7,346		7,946		8,289			2 - 4 - 12
			105	0.66	31	31		8,790		9,508		9,919			4 - 7 - 16
	B3	8	100	0.16	18	-		5,897		6,379		6,654		4.0	3 - 5 - 13
			150	0.35	29	22		8,425		9,113		9,507			6 - 10 - 20
			200	0.62	36	30		10,067		10,889		11,360			10 - 13 - 24
	B4	10*	180	0.15	28	21		5,655		6,117		6,381		2.5	4 - 7 - 17
			240	0.27	36	29		8,147		8,813		9,194			9 - 12 - 23
			300	0.43	41	35		8,743		9,457		9,866			15 - 17 - 26

Note: Reference page U47 for operational conditions used for performance notes

NOTES:

1. All performance data based on test performed in accordance with ASHRAE Standard 200-2015
2. ΔP_s values are measured in inches of water
3. NC values are based on room absorption of 10 dB. A dash (-) indicates an NC value less than 15.
4. Throw values are based on isothermal supply air and represent throw distances to terminal velocities of 150, 100 and 50 fpm respectively
5. ΔP_{Coil} values are measured in feet of water. ΔP_{Coil} values in shaded cells indicate use of a two circuit coil. All other values represent a single circuit coil.
6. Induction ratio is multiplied by the volume flow rate of primary air to estimate the volume flow rate of room air entrained through the coil

Cooling performance:

- Cooling capacity listed (qCOIL) is the sensible heat removal by the beam's integral coil. It does not include any contribution or offset by the primary air
- Capacity is based on 18°F ΔT between the induced air and the chilled water supply.
- Primary air sensible cooling contribution can be calculated by the following equation:

qSENSPA = 1.085 x CFMPA x (TPA - TROOM)

- Primary air latent cooling can be calculated by the following equation:

qLATENT = 0.69 x CFMPA x (WROOM - WPA)

where WROOM and WPA are the humidity ratio of the room and primary air respectively expressed in Grains of moisture per pound dry air

TABLE 4: CORRECTION FOR (ΔT) BETWEEN ENTERING AIR AND ENTERING CHILLED WATER

Actual ΔT	10	12	14	16	18	20	22	24
Multiply Table Value by:	0.56	0.67	0.78	0.89	1.00	1.11	1.22	1.33

Heating performance:

- Heating capacity listed (qCOIL) is the sensible heat removal by the beam's integral coil. It does not include any contribution or offset by the primary air
- Capacity is based on 50°F ΔT between the induced air and the chilled water supply.
- Primary air sensible heating offset (or contribution) can be calculated by the following equation:

qSENSPA = 1.085 x CFMPA x (TPA - TROOM)

if the primary air temperature is lower than that of the room, it will offset the coil's heating

if the primary air temperature is higher than that of the room, it will contribute to the coil's heating

Legend:

ΔP_S = Unit Inlet Pressure [in wg]

qCoil = Sensible Capacity, Coil [Btu/h]

ΔCoil = Water coil pressure drop [ft wg]

qSENSPA = Sensible Capacity, Primary Air [Btu/h]

CFMPA = Air Flowrate, Primary Air [CFM]

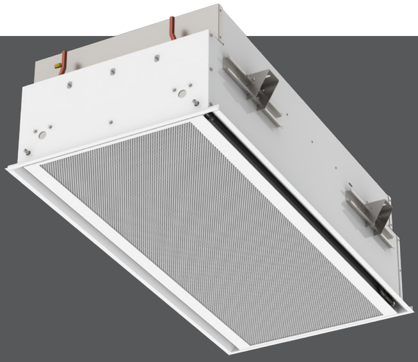
TPA = Temperature Primary Air [°F]

TROOM = Temperature Room Air [°F]

qSENSPA = Latent Capacity, Primary Air [Btu/h]

CBLV

- Active linear chilled beam with 2-way air distribution patterns
- Optimized nozzle design provides high capacity and low noise levels
- Linear design matching commercial architectural styling
- Designed to fit in standard 24-inch ceiling systems
- Vertical Coil configuration
- Optimized diffuser geometry maximizes occupant comfort



CBLV

dual-function | k-12 education | universities | energy solutions

AVAILABLE MODEL:

CBLV

FINISHES:

Standard Finish - #26 White
Optional Finish - #84 Black

OVERVIEW

Titus active chilled beams features the aerodynamic properties of Titus ceiling diffusers and benefit from the use of using hydronic coils and induced air to reduce energy consumption associated with removal of sensible thermal loads. The primary air is supplied to the chilled beam subsequent to it being discharged through a series of nozzles located along the length of the beam. The nozzles inject the primary air into the mixing chamber at velocities capable of inducing room air through two coils and where it mixes with the primary supply air. This mixture of air is then discharged into the space through the ceiling slot diffusers. This provides high cooling outputs with low amounts of primary air. The reduced volume of air results in the reduction of the air handler capacity and size, smaller duct sizes, and the overall energy consumption.

The supplied air from the air handling unit is tempered and dehumidified to handle the latent load. The remaining loads in the space are addressed with the heat exchanger which is incorporated into the chilled beam. Applications with low latent cooling loads could use 100 percent outdoor air allowing for use of a dedicated outdoor air system with energy recovery further reducing total system energy consumption.

See website for Specifications

The CBLV's are offered for both, cooling and heating, and lengths from 2 to 10 ft. They can be easily integrated into different grids styles within a suspended ceiling or even in drywall ceilings.

ADVANTAGES

- Removal of high thermal loads is possible in this air/water system
- The size of the air duct system is reduced to a minimum, due to the low supply of primary air
- Substantial reduction in the operating costs, due to low primary air volume
- Improvement of the thermal comfort inside the room
- Suitable for several standard ceiling grids
- Contributing sound levels below NC-30

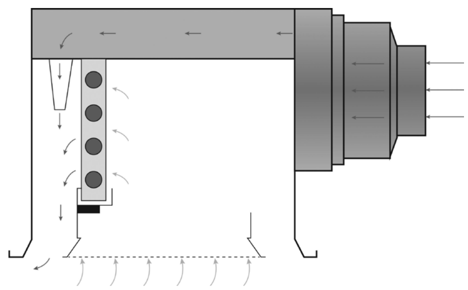
CBLV STANDARD FEATURES

- 2-way air distribution patterns
- 2 foot to 10 foot lengths, 1 foot increments
- Perforated or linear bar induced air grille
- Left hand or right hand coil connections
- Side or top air inlet locations
- 2-pipe and 4-pipe coil configurations
- Configured nozzle geometry for capacity optimization
- Hinged induced air grille for roomside coil access
- Commissioning port with roomside access for balancing
- Mounting brackets with adjustments in two directions
- Durable powder coat finish
- ½" Sweat water coil connections
- Coil air vent
- Condensate tray with drain connection for field plumbing

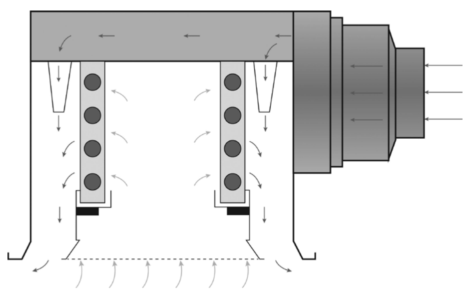
OPTIONS AND ACCESSORIES

- ½" thick foil-faced EcoShield, anti-microbial external insulation
- Coil drain valve
- ½" MNPT water coil connections
- 12-inch, 18-inch or 24-inch stainless steel braided hoses
- Lay-in, narrow tee and drop face border types

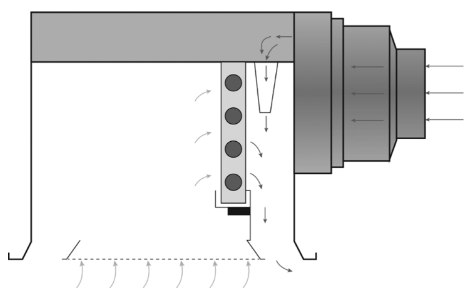
CBLV 1-Way (back)



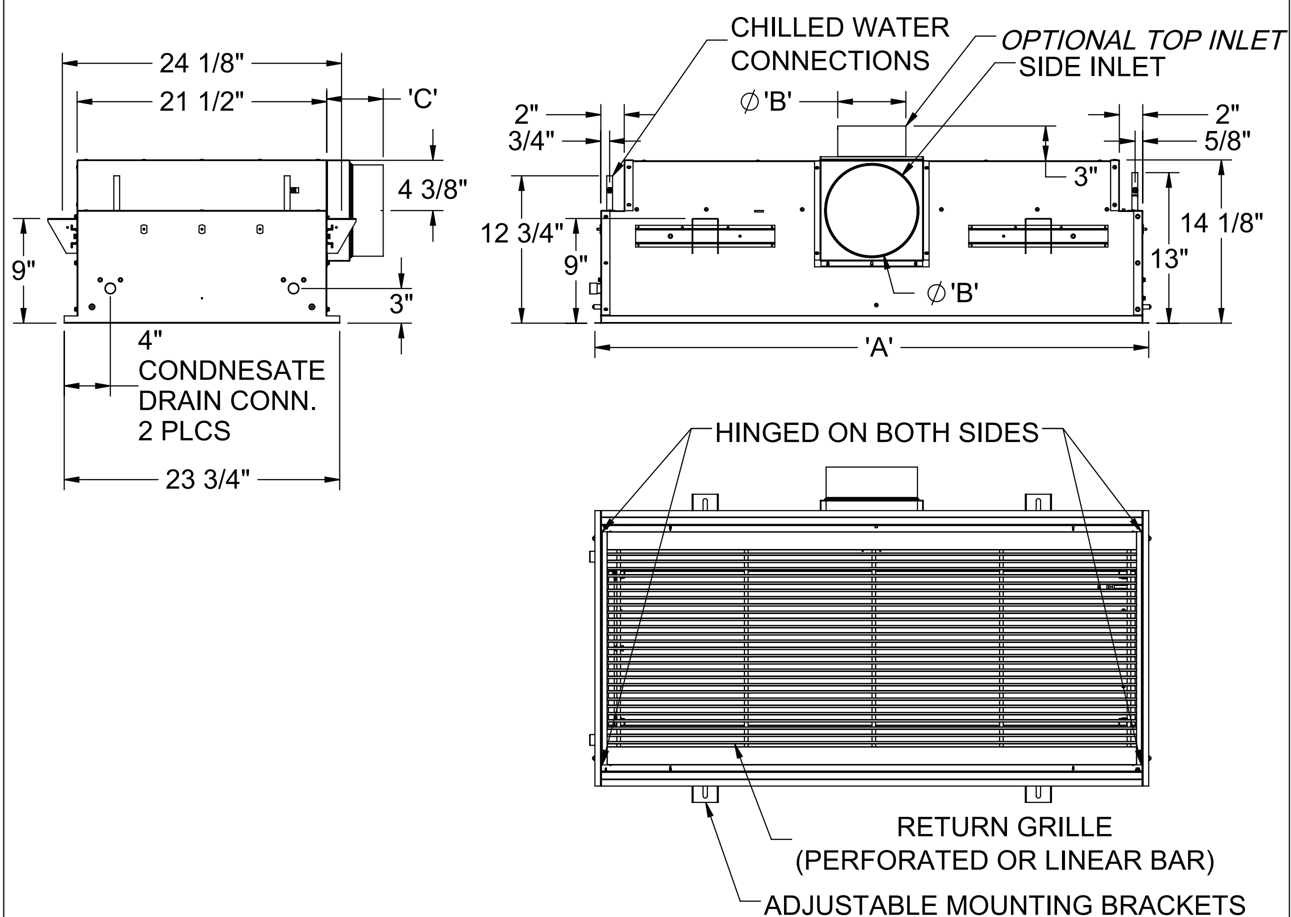
CBLV 2-Way



CBLV 1-Way (front)



CBLV UNIT DIMENSIONS



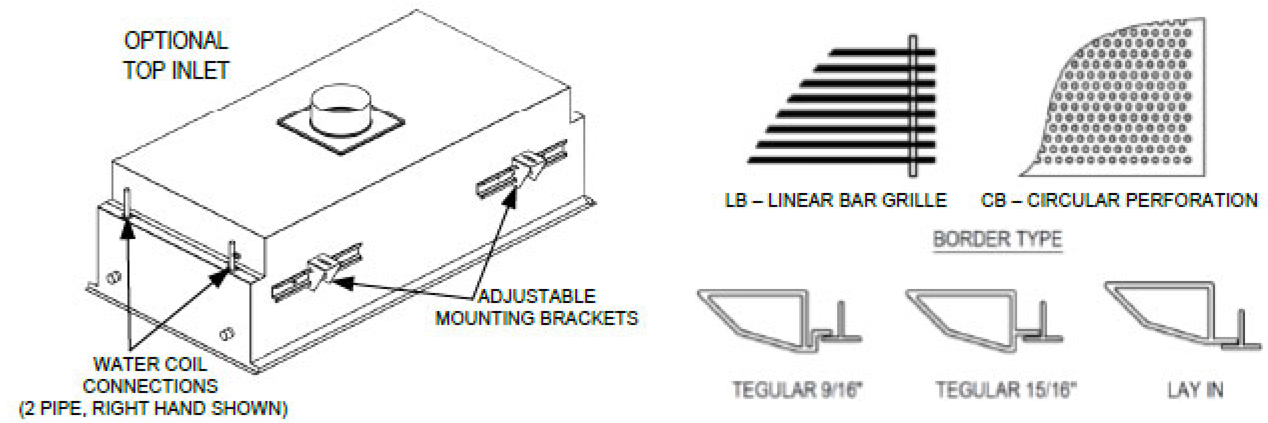
Nominal Unit Length (ft)	'A' (IN)
2	23¾
3	35¾
4	47¾
5	59¾
6	71¾
7	83¾
8	95¾
9	107¾
10	119¾

Nominal Unit Length (ft)	'B' (IN)	'C' (IN)*
4	3⁷/₈	7
5	4⁷/₈	5
6	5⁷/₈	5
8	7⁷/₈	5

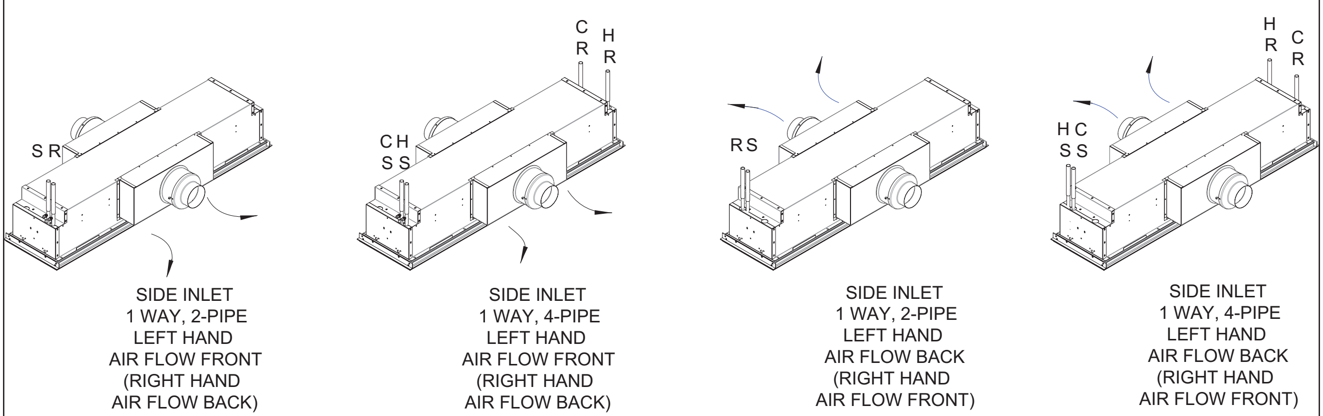
*Side Inlet Only

Integrated ¼" pressure port for balancing/commissioning accessable from roomside opposite coil connection

CBLV UNIT OPTION DETAILS



CBLV INLET, DISCHARGE AND PIPING CONFIGURATION



CBLV / 4-PIPE COOLING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil Sensible Cooling (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
4	B1	5	12	0.12	14	887	1.48	1,102	5.92	1,192	1.71	1,244	3.04	4.2	0 - 0 - 2
			18	0.28	24	1,280		1,590		1,720		1,795			0 - 1 - 4
			24	0.50	30	1,522		1,891		2,045		2,134			1 - 2 - 7
	B2	6	18	0.12	12	917		1,139		1,232		1,285		3.7	0 - 1 - 3
			27	0.27	22	1,340		1,664		1,800		1,878			1 - 2 - 7
			36	0.48	28	1,583		1,966		2,127		2,219			1 - 3 - 12
	B3	8	40	0.17	-	1,327		1,648		1,783		1,860		2.7	1 - 2 - 10
			60	0.39	15	1,626		2,020		2,185		2,280			2 - 6 - 15
			80	0.69	21	2,106		2,615		2,829		2,951			4 - 10 - 17
	B4	8	65	0.18	-	1,269		1,577		1,705		1,779		1.9	2 - 4 - 13
			95	0.38	17	1,766		2,193		2,372		2,475			4 - 8 - 17
			125	0.65	23	2,089		2,595		2,807		2,929			7 - 13 - 19
6	B1	6	20	0.16	14	1,386	2.12	1,722	8.48	1,863	1.80	1,943	3.20	4.2	0 - 1 - 3
			30	0.35	23	1,887		2,344		2,536		2,645			1 - 1 - 6
			40	0.62	30	2,311		2,871		3,106		3,240			1 - 3 - 10
	B2	6	30	0.15	18	1,433		1,780		1,925		2,008		3.7	1 - 1 - 5
			45	0.33	27	1,975		2,453		2,654		2,768			1 - 3 - 11
			60	0.60	34	2,403		2,985		3,229		3,368			2 - 5 - 16
	B3	8	60	0.19	-	1,804		2,241		2,424		2,528		2.7	1 - 3 - 12
			90	0.42	17	2,356		2,927		3,166		3,303			3 - 7 - 18
			120	0.75	24	2,948		3,662		3,962		4,133			5 - 12 - 21
	B4	8	105	0.18	-	1,925		2,391		2,586		2,698		1.9	2 - 6 - 17
			160	0.43	22	2,619		3,254		3,519		3,672			6 - 13 - 22
			215	0.77	29	3,254		4,042		4,372		4,561			10 - 18 - 25
8	B1	8	25	0.13	-	1,555	2.76	1,932	1.40	2,090	3.15	2,180	5.60	4.2	0 - 1 - 3
			40	0.34	-	2,356		2,926		3,165		3,302			1 - 2 - 7
			55	0.64	16	2,892		3,593		3,886		4,054			1 - 3 - 13
	B2	8	40	0.14	-	1,734		2,154		2,329		2,430		3.7	1 - 1 - 6
			60	0.32	-	2,465		3,062		3,312		3,455			1 - 3 - 12
			80	0.57	19	2,953		3,668		3,967		4,139			2 - 6 - 18
	B3	8	80	0.16	-	2,183		2,711		2,933		3,060		2.7	2 - 3 - 14
			120	0.36	20	2,940		3,652		3,951		4,122			3 - 8 - 21
			160	0.63	26	3,621		4,497		4,865		5,075			6 - 14 - 24
	B4	8	145	0.17	16	2,437		3,028		3,275		3,417		1.9	3 - 7 - 21
			215	0.37	25	3,285		4,080		4,413		4,604			7 - 15 - 25
			285	0.65	31	4,002		4,971		5,377		5,609			12 - 20 - 29
10	B1	8	35	0.16	-	2,077	3.40	2,580	1.76	2,791	3.96	2,912	7.04	4.2	0 - 1 - 4
			52	0.36	-	2,806		3,486		3,770		3,933			1 - 2 - 8
			69	0.63	18	3,421		4,249		4,596		4,795			2 - 4 - 14
	B2	8	55	0.18	-	2,301		2,858		3,092		3,225		3.7	1 - 2 - 7
			80	0.38	16	2,982		3,704		4,007		4,180			2 - 4 - 16
			105	0.66	22	3,643		4,525		4,895		5,107			3 - 7 - 22
	B3	8	100	0.16	-	2,493		3,097		3,350		3,494		2.7	2 - 4 - 15
			150	0.35	22	3,420		4,248		4,595		4,794			4 - 9 - 24
			200	0.62	28	4,172		5,182		5,605		5,847			7 - 15 - 27
	B4	10*	180	0.15	15	2,769		3,440		3,721		3,882		1.9	3 - 8 - 23
			270	0.35	24	3,831		4,759		5,148		5,370			8 - 17 - 28
			360	0.62	31	4,653		5,780		6,252		6,523			13 - 23 - 32

Note: Reference page U56 for operational conditions used for performance notes

CBLV / 4-PIPE HEATING

Nominal Length ft	Nozzle Size	Primary Air: Inlet Dia. Inches	Primary Air: Flow Rate CFM	Primary Air: Inlet ΔPS (in. H2O)	Sound NC	0.5 GPM qCOIL	0.5 GPM ΔCOIL	1.0 GPM qCOIL	1.0 GPM ΔCOIL	1.5 GPM qCOIL	1.5 GPM ΔCOIL	2.0 GPM qCOIL	2.0 GPM ΔCOIL	Induction ratio	Throw ft.
4	B1	5	12	0.12	14	2,057	0.06	2,556	0.24	2,764	0.54	2,884	0.96	4.2	0 - 0 - 2
			18	0.28	24	2,969		3,688		3,990		4,162			0 - 1 - 4
			24	0.50	30	3,530		4,385		4,743		4,948			1 - 2 - 7
	B2	6	20	0.15	12	2,563		3,184		3,444		3,593		3.7	0 - 1 - 3
			30	0.33	22	3,314		4,116		4,453		4,645			1 - 2 - 7
			40	0.59	28	4,169		5,179		5,602		5,844			1 - 3 - 12
	B3	8	40	0.17	-	3,077		3,823		4,135		4,314		2.7	1 - 2 - 10
			60	0.39	15	3,772		4,685		5,068		5,287			2 - 6 - 15
			80	0.69	21	4,883		6,065		6,561		6,844			4 - 10 - 17
	B4	8	70	0.20	-	3,410		4,236		4,582		4,780		1.9	2 - 4 - 13
			105	9.57	17	4,353		5,408		5,849		6,102			4 - 8 - 17
			140	17.01	23	5,514		6,850		7,409		7,730			7 - 13 - 19
6	B1	6	20	0.16	14	3,215	0.09	3,994	0.36	4,320	0.81	4,507	1.44	4.2	0 - 1 - 3
			30	0.35	23	4,377		5,437		5,881		6,135			1 - 1 - 6
			40	0.62	30	5,360		6,658		7,202		7,513			1 - 3 - 10
	B2	6	30	0.15	18	3,322		4,127		4,464		4,657		3.7	1 - 1 - 5
			45	0.33	27	4,580		5,689		6,154		6,420			1 - 3 - 11
			60	0.60	34	5,573		6,922		7,488		7,812			2 - 5 - 16
	B3	8	60	0.19	-	4,183		5,196		5,621		5,864		2.7	1 - 3 - 12
			90	0.42	17	5,464		6,788		7,342		7,659			3 - 7 - 18
			120	0.75	24	6,838		8,494		9,187		9,584			5 - 12 - 21
	B4	8	105	0.18	-	4,463		5,544		5,997		6,256		1.9	2 - 6 - 17
			160	0.43	22	6,074		7,545		8,162		8,514			6 - 13 - 22
			215	0.77	29	7,546		9,374		10,140		10,578			10 - 18 - 25
8	B1	8	25	0.17	-	3,606	0.12	4,480	0.48	4,846	1.08	5,055	1.92	4.2	0 - 1 - 3
			40	0.43	-	5,463		6,786		7,340		7,658			1 - 2 - 7
			55	0.81	16	6,707		8,332		9,012		9,402			1 - 3 - 13
	B2	8	40	0.19	-	4,021		4,994		5,402		5,636		3.7	1 - 1 - 6
			60	0.43	-	5,717		7,101		7,681		8,013			1 - 3 - 12
			80	0.76	19	6,847		8,506		9,201		9,598			2 - 6 - 18
	B3	8	80	0.21	-	5,062		6,288		6,801		7,095		2.7	2 - 3 - 14
			120	0.47	20	6,819		8,470		9,162		9,558			3 - 8 - 21
			160	0.83	26	8,397		10,430		11,282		11,770			6 - 14 - 24
	B4	8	145	0.22	16	5,653		7,021		7,595		7,923		1.9	3 - 7 - 21
			215	0.49	25	7,617		9,462		10,235		10,677			7 - 15 - 25
			285	0.86	31	9,280		11,528		12,470		13,008			12 - 20 - 29
10	B1	8	35	0.16	-	4,817	0.14	5,984	0.56	6,472	1.26	6,752	2.24	4.2	0 - 1 - 4
			52	0.36	-	6,508		8,083		8,744		9,122			1 - 2 - 8
			69	0.63	18	7,933		9,854		10,659		11,119			2 - 4 - 14
	B2	8	55	0.18	-	5,336		6,628		7,170		7,480		3.7	1 - 2 - 7
			80	0.38	16	6,916		8,591		9,292		9,694			2 - 4 - 16
			105	0.66	22	8,449		10,495		11,352		11,843			3 - 7 - 22
	B3	8	100	0.16	-	5,781		7,181		7,768		8,104		2.7	2 - 4 - 15
			150	0.35	22	7,931		9,851		10,656		11,117			4 - 9 - 24
			200	0.62	28	9,674		12,017		12,999		13,561			7 - 15 - 27
	B4	10*	180	0.15	15	6,422		7,978		8,629		9,002		1.9	3 - 8 - 23
			270	0.35	24	8,885		11,036		11,938		12,454			8 - 17 - 28
			360	0.62	31	10,791		13,405		14,500		15,126			13 - 23 - 32

Note: Reference page U56 for operational conditions used for performance notes

CBLV / 2-PIPE COOLING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil Sensible Cooling (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
4	B1	5	12	0.12	14	976	1.96	1,212	7.84	1,311	2.25	1,368	4.00	4.2	0 - 0 - 2
			18	0.28	24	1,408		1,750		1,892		1,974			0 - 1 - 4
			24	0.50	30	1,674		2,080		2,250		2,347			1 - 2 - 7
	B2	6	20	0.15	12	1,216		1,510		1,634		1,704		3.7	0 - 1 - 3
			30	0.33	22	1,572		1,952		2,112		2,203			1 - 2 - 7
			40	0.59	28	1,978		2,457		2,657		2,772			1 - 3 - 12
	B3	8	40	0.17	-	1,460		1,813		1,961		2,046		2.7	1 - 2 - 10
			60	0.39	15	1,789		2,222		2,404		2,508			2 - 6 - 15
			80	0.69	21	2,316		2,877		3,112		3,247			4 - 10 - 17
	B4	8	70	0.20	-	1,618		2,009		2,174		2,268		1.9	2 - 4 - 13
			105	9.57	17	2,065		2,565		2,775		2,894			4 - 8 - 17
			140	17.01	23	2,616		3,249		3,515		3,666			7 - 13 - 19
6	B1	6	20	0.16	14	1,525	2.82	1,894	1.44	2,049	3.24	2,138	5.76	4.2	0 - 1 - 3
			30	0.35	23	2,076		2,579		2,789		2,910			1 - 1 - 6
			40	0.62	30	2,542		3,158		3,416		3,564			1 - 3 - 10
	B2	6	30	0.15	18	1,576		1,958		2,117		2,209		3.7	1 - 1 - 5
			45	0.33	27	2,172		2,698		2,919		3,045			1 - 3 - 11
			60	0.60	34	2,643		3,284		3,552		3,705			2 - 5 - 16
	B3	8	60	0.19	-	1,984		2,465		2,666		2,781		2.7	1 - 3 - 12
			90	0.42	17	2,592		3,220		3,483		3,633			3 - 7 - 18
			120	0.75	24	3,243		4,029		4,358		4,546			5 - 12 - 21
	B4	8	105	0.18	-	2,117		2,630		2,844		2,967		1.9	2 - 6 - 17
			160	0.43	22	2,881		3,579		3,871		4,039			6 - 13 - 22
			215	0.77	29	3,580		4,446		4,810		5,017			10 - 18 - 25
8	B1	8	25	0.17	-	1,711	3.67	2,125	1.88	2,298	4.23	2,398	7.52	4.2	0 - 1 - 3
			40	0.43	-	2,591		3,219		3,482		3,632			1 - 2 - 7
			55	0.81	16	3,182		3,952		4,275		4,460			1 - 3 - 13
	B2	8	40	0.19	-	1,907		2,369		2,562		2,673		3.7	1 - 1 - 6
			60	0.43	-	2,712		3,368		3,644		3,801			1 - 3 - 12
			80	0.76	19	3,248		4,034		4,364		4,553			2 - 6 - 18
	B3	8	80	0.21	-	2,401		2,982		3,226		3,366		2.7	2 - 3 - 14
			120	0.47	20	3,234		4,018		4,346		4,534			3 - 8 - 21
			160	0.83	26	3,983		4,947		5,351		5,583			6 - 14 - 24
	B4	8	145	0.22	16	2,681		3,330		3,602		3,758		1.9	3 - 7 - 21
			215	0.49	25	3,613		4,488		4,855		5,064			7 - 15 - 25
			285	0.86	31	4,402		5,468		5,915		6,170			12 - 20 - 29
10	B1	8	35	0.16	-	2,285	4.53	2,838	2.36	3,070	5.31	3,203	9.44	4.2	0 - 1 - 4
			52	0.36	-	3,087		3,834		4,147		4,327			1 - 2 - 8
			69	0.63	18	3,763		4,674		5,056		5,274			2 - 4 - 14
	B2	8	55	0.18	-	2,531		3,144		3,401		3,548		3.7	1 - 2 - 7
			80	0.38	16	3,280		4,075		4,408		4,598			2 - 4 - 16
			105	0.66	22	4,007		4,978		5,385		5,617			3 - 7 - 22
	B3	8	100	0.16	-	2,742		3,406		3,685		3,844		2.7	2 - 4 - 15
			150	0.35	22	3,762		4,673		5,054		5,273			4 - 9 - 24
			200	0.62	28	4,589		5,700		6,166		6,432			7 - 15 - 27
	B4	10*	180	0.15	15	3,046		3,784		4,093		4,270		1.9	3 - 8 - 23
			270	0.35	24	4,214		5,235		5,662		5,907			8 - 17 - 28
			360	0.62	31	5,119		6,358		6,878		7,175			13 - 23 - 32

Note: Reference page U56 for operational conditions used for performance notes

CBLV / 2-PIPE HEATING

Nominal Length ft	Nozzle Size	Primary Air Inlet Dia.	Primary Air Flow Rate	Primary Air Inlet ΔPS	Sound	Coil Heating (Btu/h) 0.5 GPM qCOIL	0.5 GPM ΔCOIL	1.0 GPM qCOIL	1.0 GPM ΔCOIL	1.5 GPM qCOIL	1.5 GPM ΔCOIL	2.0 GPM qCOIL	2.0 GPM ΔCOIL	Induction ratio	Throw
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
4	B1	5	15	0.20	14	3,832	1.96	4,759	7.84	5,148	2.25	5,371	4.00	4.2	0 - 0 - 2
			20	0.35	24	4,276		5,311		5,745		5,993			0 - 1 - 4
			25	0.54	30	5,208		6,469		6,997		7,300			1 - 2 - 7
	B2	6	20	0.15	12	3,461		4,299		4,650		4,851		3.7	0 - 1 - 3
			30	0.33	22	4,474		5,557		6,011		6,271			1 - 2 - 7
			40	0.59	28	5,629		6,992		7,563		7,890			1 - 3 - 12
	B3	8	40	0.17	-	4,154		5,160		5,582		5,823		2.7	1 - 2 - 10
			60	0.39	15	5,092		6,325		6,841		7,137			2 - 6 - 15
			80	0.69	21	6,592		8,188		8,857		9,240			4 - 10 - 17
	B4	8	70	0.20	-	4,604		5,719		6,186		6,454		1.9	2 - 4 - 13
			105	9.57	17	5,877		7,300		7,897		8,238			4 - 8 - 17
			140	17.01	23	7,445		9,247		10,003		10,435			7 - 13 - 19
6	B1	6	20	0.16	14	4,340	2.82	5,391	1.44	5,832	3.24	6,084	5.76	4.2	0 - 1 - 3
			30	0.35	23	5,909		7,340		7,939		8,282			1 - 1 - 6
			40	0.62	30	7,236		8,989		9,723		10,143			1 - 3 - 10
	B2	6	30	0.15	18	4,485		5,571		6,027		6,287		3.7	1 - 1 - 5
			45	0.33	27	6,183		7,680		8,308		8,667			1 - 3 - 11
			60	0.60	34	7,523		9,345		10,109		10,546			2 - 5 - 16
	B3	8	60	0.19	-	5,647		7,015		7,588		7,916		2.7	1 - 3 - 12
			90	0.42	17	7,377		9,163		9,912		10,340			3 - 7 - 18
			120	0.75	24	9,231		11,466		12,403		12,939			5 - 12 - 21
	B4	8	105	0.18	-	6,025		7,484		8,096		8,446		1.9	2 - 6 - 17
			160	0.43	22	8,200		10,186		11,018		11,495			6 - 13 - 22
			215	0.77	29	10,188		12,655		13,689		14,280			10 - 18 - 25
8	B1	8	25	0.17	-	4,869	3.67	6,048	1.88	6,542	4.23	6,824	7.52	4.2	0 - 1 - 3
			40	0.43	-	7,375		9,161		9,909		10,338			1 - 2 - 7
			55	0.81	16	9,055		11,248		12,167		12,692			1 - 3 - 13
	B2	8	40	0.19	-	5,428		6,742		7,293		7,608		3.7	1 - 1 - 6
			60	0.43	-	7,718		9,587		10,370		10,818			1 - 3 - 12
			80	0.76	19	9,244		11,483		12,421		12,957			2 - 6 - 18
	B3	8	80	0.21	-	6,834		8,488		9,182		9,579		2.7	2 - 3 - 14
			120	0.47	20	9,206		11,435		12,369		12,904			3 - 8 - 21
			160	0.83	26	11,335		14,080		15,231		15,889			6 - 14 - 24
	B4	8	145	0.22	16	7,631		9,479		10,253		10,696		1.9	3 - 7 - 21
			215	0.49	25	10,283		12,774		13,817		14,414			7 - 15 - 25
			285	0.86	31	12,529		15,563		16,834		17,561			12 - 20 - 29
10	B1	8	35	0.16	-	6,503	4.53	8,078	2.36	8,738	5.31	9,115	9.44	4.2	0 - 1 - 4
			52	0.36	-	8,785		10,913		11,804		12,314			1 - 2 - 8
			69	0.63	18	10,709		13,302		14,389		15,011			2 - 4 - 14
	B2	8	55	0.18	-	7,204		8,948		9,679		10,097		3.7	1 - 2 - 7
			80	0.38	16	9,336		11,597		12,545		13,087			2 - 4 - 16
			105	0.66	22	11,406		14,168		15,325		15,987			3 - 7 - 22
	B3	8	100	0.16	-	7,805		9,695		10,487		10,940		2.7	2 - 4 - 15
			150	0.35	22	10,707		13,299		14,386		15,007			4 - 9 - 24
			200	0.62	28	13,061		16,223		17,549		18,307			7 - 15 - 27
	B4	10*	180	0.15	15	8,670		10,770		11,650		12,153		1.9	3 - 8 - 23
			270	0.35	24	11,994		14,899		16,116		16,812			8 - 17 - 28
			360	0.62	31	14,568		18,096		19,574		20,420			13 - 23 - 32

Note: Reference page U56 for operational conditions used for performance notes

NOTES:

1. All performance data based on test performed in accordance with ASHRAE Standard 200-2015
2. ΔP_s values are measured in inches of water
3. NC values are based on room absorption of 10 dB. A dash (-) indicates an NC value less than 15.
4. Throw values are based on isothermal supply air and represent throw distances to terminal velocities of 150, 100 and 50 fpm respectively
5. ΔP_{Coil} values are measured in feet of water. ΔP_{Coil} values in shaded cells indicate use of a two circuit coil. All other values represent a single circuit coil.
6. Induction ratio is multiplied by the volume flow rate of primary air to estimate the volume flow rate of room air entrained through the coil

Cooling performance:

- Cooling capacity listed (qCOIL) is the sensible heat removal by the beam's integral coil. It does not include any contribution or offset by the primary air
- Capacity is based on 18°F ΔT between the induced air and the chilled water supply.
- Primary air sensible cooling contribution can be calculated by the following equation:

qSENSPA = 1.085 x CFMPA x (TPA - TROOM)

- Primary air latent cooling can be calculated by the following equation:

qLATENT = 0.69 x CFMPA x (WROOM - WPA)

where WROOM and WPA are the humidity ratio of the room and primary air respectively expressed in Grains of moisture per pound dry air

TABLE 4: CORRECTION FOR (ΔT) BETWEEN ENTERING AIR AND ENTERING CHILLED WATER

Actual ΔT	10	12	14	16	18	20	22	24
Multiply Table Value by:	0.56	0.67	0.78	0.89	1.00	1.11	1.22	1.33

Heating performance:

- Heating capacity listed (qCOIL) is the sensible heat removal by the beam's integral coil. It does not include any contribution or offset by the primary air
- Capacity is based on 50°F ΔT between the induced air and the chilled water supply.
- Primary air sensible heating offset (or contribution) can be calculated by the following equation:

qSENSPA = 1.085 x CFMPA x (TPA - TROOM)

if the primary air temperature is lower than that of the room, it will offset the coil's heating

if the primary air temperature is higher than that of the room, it will contribute to the coil's heating

Legend:

ΔP_S = Unit Inlet Pressure [in wg]

qCoil = Sensible Capacity, Coil [Btu/h]

ΔCoil = Water coil pressure drop [ft wg]

qSENSPA = Sensible Capacity, Primary Air [Btu/h]

CFMPA = Air Flowrate, Primary Air [CFM]

TPA = Temperature Primary Air [°F]

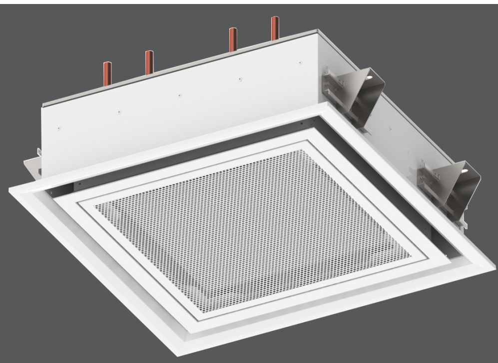
TROOM = Temperature Room Air [°F]

qSENSPA = Latent Capacity, Primary Air [Btu/h]

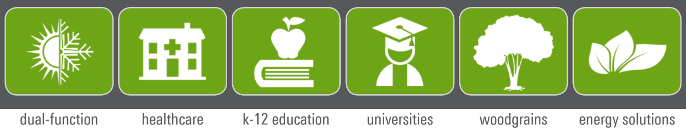
Modular Active Chilled Beams

CBAM

- Active modular chilled beam with 4-way air distribution pattern
- Optimized nozzle design provides high capacity and low noise levels
- Modular design matching commercial architectural styling
- Designed to fit in standard 24 inch ceiling systems
- Optimized diffuser geometry maximizes occupant comfort



CBAM



AVAILABLE MODEL:

CBAM: 24″ x 24″ and 48″ x 24″ module sizes

FINISHES:

Standard Finish - #26 White
Optional Finish - #84 Black

OVERVIEW

Titus active chilled beams features the aerodynamic properties of Titus ceiling diffusers and benefit from the use of using hydronic coils and induced air to reduce energy consumption associated with removal of sensible thermal loads. The primary air is supplied to the chilled beam subsequent to it being discharged through a series of nozzles located along the perimeter of the beam. The nozzles inject the primary air into the mixing chamber at velocities capable of inducing room air through the water coil and where it mixes with the primary supply air. This mixture of air is then discharged into the space through the ceiling slot diffusers. This provides high cooling outputs with low amounts of primary air. The reduced volume of air results in the reduction of the air handler capacity and size, smaller duct sizes, and the overall energy consumption.

The supplied air from the air handling unit is tempered and dehumidified to handle the latent load. The remaining loads in the space are addressed with the heat exchanger which is incorporated into the chilled beam. Applications with low latent cooling loads could use 100 percent outdoor air allowing for use of a dedicated outdoor air system with energy recovery further reducing total system energy consumption.

See website for Specifications

The CBAM's are offered for both, cooling and heating, and in 24″ x 24″ and 48″ x 24″ module sizes. They can be easily integrated into different grids styles within a suspended ceiling or even in drywall ceilings. The low overall height of the CBAM product line is ideal for reducing the space required for false ceiling in any application.

ADVANTAGES

- Removal of high thermal loads is possible in this air/water system
- The size of the air duct system is reduced to a minimum, due to the low supply of primary air
- Substantial reduction in the operating costs, due to low primary air volume
- Improvement of the thermal comfort inside the room
- Suitable for several standard ceiling grids
- Contributing sound levels below NC-30

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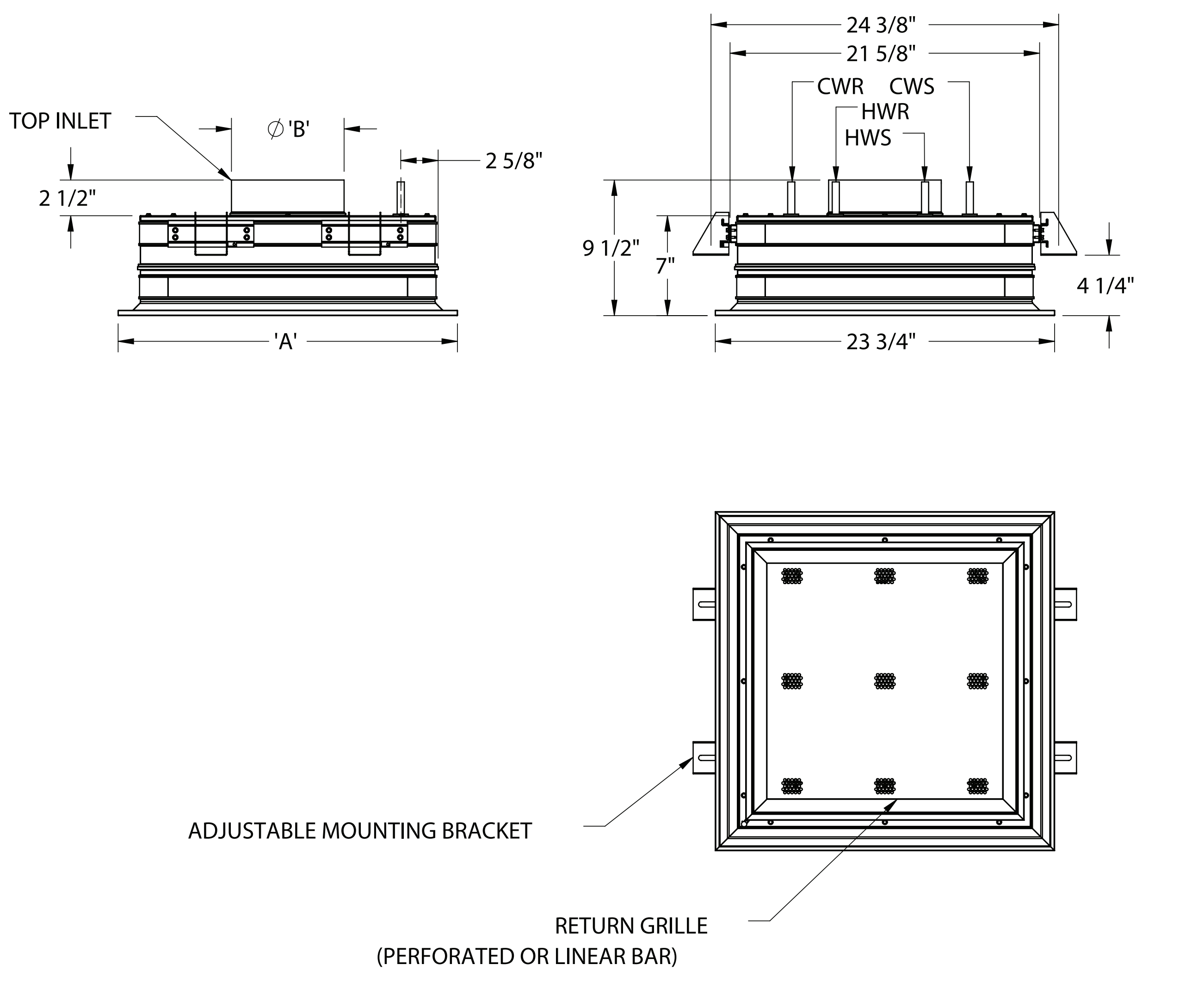
CBAM STANDARD FEATURES

- 4-way way air distribution pattern
- 24-inch and 48 inch lengths
- 24-inch width
- Perforated or linear bar induced air grille
- Top coil connections
- Top or side air inlet locations
- 2-pipe and 4-pipe coil configurations
- Configured nozzle geometry for capacity optimization
- Removable induced air grille for roomside coil access
- Commissioning port with roomside access for balancing
- Mounting brackets with adjustments in two directions
- Durable powder coat finish
- ½" Sweat water coil connections
- Coil air vent

OPTIONS AND ACCESSORIES

- ½" thick foil-faced EcoShield, anti-microbial external insulation
- Coil drain valve
- ½" MNPT water coil connections
- 12-inch, 18-inch or 24-inch stainless steel braided hoses
- Lay-in, narrow tee and drop face border types

CBAM UNIT DIMENSIONS / TOP INLET



Module Size (IN)	'A' Dimension
24 x 24	23¾
24 x 48	47¾

Nominal Inlet Diameter (IN)	'B' Dimension
5	4⅞
6	5⅞
8	7⅞

All dimensions are in inches

CBAM / 4-PIPE COOLING

Nominal Size, L x W (ft)	Nozzle Size	Primary Air			Sound	Coil Sensible Cooling (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL		
2 x 2	B1	4	11	0.17	-	607	0.48	754	1.92	815	4.33	851	7.69	5.9	0 - 0 - 2
			16	0.36	16	872		1,083		1,172		1,222			0 - 1 - 3
			21	0.62	24	1,039		1,291		1,396		1,456			1 - 1 - 6
	B2	4	18	0.20	-	764		949		1,027		1,071		3.5	0 - 1 - 3
			24	0.35	21	918		1,141		1,234		1,287			1 - 1 - 5
			30	0.55	28	1,041		1,293		1,399		1,459			1 - 2 - 8
	B3	5	30	0.16	-	752		934		1,010		1,054		2.2	1 - 1 - 5
			45	0.35	24	1,065		1,323		1,431		1,493			1 - 3 - 9
			60	0.62	32	1,266		1,573		1,701		1,775			2 - 5 - 12
	B4	6	55	0.16	15	834		1,036		1,121		1,169		1.5	1 - 3 - 9
			85	0.37	28	1,198		1,489		1,610		1,680			3 - 6 - 13
			115	0.68	37	1,428		1,774		1,919		2,002			5 - 9 - 16
2 x 4	B1	4	18	0.17	-	963	0.95	1,197	3.81	1,294	8.57	1,350	1.96	6.9	0 - 1 - 3
			27	0.37	23	1,384		1,719		1,860		1,940			1 - 2 - 6
			36	0.66	32	1,649		2,049		2,216		2,312			1 - 3 - 11
	B2	5	25	0.14	-	1,016		1,262		1,365		1,424		3.9	0 - 1 - 4
			40	0.36	23	1,458		1,811		1,959		2,044			1 - 2 - 10
			55	0.69	32	1,738		2,159		2,335		2,436			2 - 5 - 14
	B3	6	50	0.16	-	1,177		1,462		1,581		1,649		2.6	1 - 2 - 9
			75	0.35	26	1,691		2,100		2,272		2,370			2 - 5 - 15
			100	0.62	34	2,014		2,502		2,707		2,824			4 - 9 - 19
	B4	8	90	0.15	-	1,324		1,645		1,779		1,856		1.8	2 - 5 - 14
			135	0.34	20	1,902		2,363		2,556		2,666			5 - 11 - 20
			180	0.61	28	2,267		2,815		3,045		3,177			9 - 14 - 23

CBAM / 4-PIPE HEATING

Nominal Size, L x W (ft)	Nozzle Size	Primary Air			Sound	Coil Heating (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL		
2 x 2	B1	4	11	0.17	-	1,426	0.01	1,659	0.04	1,758	0.09	1,819	0.16	5.9	0 - 0 - 2
			16	0.36	16	2,049		2,383		2,526		2,613			0 - 1 - 3
			21	0.62	24	2,442		2,839		3,010		3,114			1 - 1 - 6
	B2	4	18	0.20	-	1,796		2,088		2,214		2,290		3.3	0 - 1 - 3
			24	0.35	21	2,159		2,510		2,661		2,753			1 - 1 - 5
			30	0.55	28	1,887		2,194		2,326		2,406			1 - 2 - 8
	B3	5	30	0.16	-	1,767		2,055		2,178		2,254		2.2	1 - 1 - 5
			45	0.35	24	2,503		2,911		3,085		3,192			1 - 3 - 9
			60	0.62	32	2,346		2,728		2,891		2,991			2 - 5 - 12
	B4	6	55	0.16	15	1,960		2,279		2,416		2,500		1.5	1 - 3 - 9
			85	0.37	28	2,817		3,275		3,472		3,592			3 - 6 - 13
			115	0.68	37	4,450		5,174		5,485		5,675			5 - 9 - 16
2 x 4	B1	4	18	0.17	-	2,264	0.02	2,633	0.08	2,791	0.19	2,887	0.22	6.9	0 - 1 - 3
			27	0.37	23	3,253		3,783		4,009		4,148			1 - 2 - 6
			36	0.66	32	3,115		3,622		3,839		3,972			1 - 3 - 11
	B2	5	25	0.14	-	2,387		2,776		2,942		3,044		3.9	0 - 1 - 4
			40	0.36	23	3,426		3,984		4,223		4,369			1 - 2 - 10
			55	0.69	32	3,649		4,243		4,498		4,653			2 - 5 - 14
	B3	6	50	0.16	-	2,765		3,216		3,408		3,526		2.6	1 - 2 - 9
			75	0.35	26	3,973		4,620		4,897		5,067			2 - 5 - 15
			100	0.62	34	4,450		5,174		5,485		5,675			4 - 9 - 19
	B4	8	90	0.15	-	3,112		3,618		3,835		3,968		1.8	2 - 5 - 14
			135	0.34	20	4,471		5,198		5,510		5,701			5 - 11 - 20
			180	0.61	28	4,450		5,174		5,485		5,675			9 - 14 - 23

Note: Reference page U62 for operational conditions used for performance notes

CBAM / 2-PIPE COOLING

Nominal Size, L x W (ft)	Nozzle Size	Primary Air			Sound	Coil Sensible Cooling (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL		
			11	0.17	-	715		888		961		1,002			0 - 0 - 2
	B1	4	16	0.36	16	981		1,219		1,319		1,376		5.9	0 - 1 - 3
			21	0.62	24	1,164		1,446		1,564		1,632			1 - 1 - 6
			18	0.20	-	817		1,015		1,098		1,146			0 - 1 - 3
	B2	4	24	0.35	21	1,027		1,276		1,380		1,440		3.3	1 - 1 - 5
2 x 2			30	0.55	28	1,177	0.59	1,462	2.35	1,582	5.29	1,650	9.40		1 - 2 - 8
			30	0.16	-	800		994		1,075		1,122			1 - 1 - 5
	B3	5	45	0.35	24	1,178		1,463		1,583		1,651		2.2	1 - 3 - 9
			60	0.62	32	1,387		1,723		1,863		1,944			2 - 5 - 12
			55	0.16	15	935		1,162		1,257		1,311			1 - 3 - 9
	B4	6	85	0.37	28	1,359		1,688		1,825		1,904		1.5	3 - 6 - 13
			115	0.68	37	1,653		2,053		2,221		2,317			5 - 9 - 16
			18	0.17	-	1,119		1,390		1,504		1,569			0 - 1 - 3
	B1	4	27	0.37	23	1,569		1,950		2,109		2,200		6.9	1 - 2 - 6
			36	0.66	32	1,893		2,352		2,544		2,654			1 - 3 - 11
			25	0.14	-	1,049		1,303		1,409		1,470			0 - 1 - 4
	B2	5	40	0.36	23	1,630		2,025		2,190		2,285		3.9	1 - 2 - 10
2 x 4			55	0.69	32	1,975	1.16	2,454	4.65	2,654	1.36	2,769	1.46		2 - 5 - 14
			50	0.16	-	1,271		1,578		1,707		1,781			1 - 2 - 9
	B3	6	75	0.35	26	1,870		2,323		2,513		2,621		2.6	2 - 5 - 15
			100	0.62	34	2,201		2,734		2,958		3,086			4 - 9 - 19
			90	0.15	-	1,411		1,753		1,896		1,978			2 - 5 - 14
	B4	8	135	0.34	20	2,095		2,602		2,815		2,937		1.8	5 - 11 - 20
			180	0.61	28	2,456		3,051		3,300		3,443			9 - 14 - 23

CBAM / 2-PIPE HEATING

Nominal Size, L x W (ft)	Nozzle Size	Primary Air			Sound	Coil Heating (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL		
			11	0.17	-	1,376		1,600		1,696		1,755			0 - 0 - 2
	B1	4	16	0.36	16	1,889		2,196		2,328		2,409		5.9	0 - 1 - 3
			21	0.62	24	2,241		2,606		2,762		2,857			1 - 1 - 6
			18	0.20	-	1,756		2,042		2,165		2,240			0 - 1 - 3
	B2	4	24	0.35	21	2,207		2,566		2,720		2,814		3.3	1 - 1 - 5
2 x 2			30	0.55	28	2,529	0.59	2,941	2.35	3,118	5.29	3,225	9.40		1 - 2 - 8
			30	0.16	-	1,745		2,029		2,151		2,225			1 - 1 - 5
	B3	5	45	0.35	24	2,568		2,986		3,166		3,275		2.2	1 - 3 - 9
			60	0.62	32	3,024		3,516		3,727		3,856			2 - 5 - 12
			55	0.16	15	2,204		2,562		2,716		2,810			1 - 3 - 9
	B4	6	85	0.37	28	3,201		3,722		3,946		4,082		1.5	3 - 6 - 13
			115	0.68	37	3,894		4,528		4,800		4,966			5 - 9 - 16
			18	0.17	-	2,687		3,124		3,312		3,426			0 - 1 - 3
	B1	4	27	0.37	23	3,767		4,380		4,643		4,804		6.9	1 - 2 - 6
			36	0.66	32	4,544		5,284		5,601		5,795			1 - 3 - 11
			25	0.14	-	2,799		3,255		3,450		3,569			0 - 1 - 4
	B2	5	40	0.36	23	4,351		5,060		5,363		5,549		3.9	1 - 2 - 10
2 x 4			55	0.69	32	5,273	1.16	6,131	4.65	6,499	1.36	6,724	1.46		2 - 5 - 14
			50	0.16	-	3,566		4,147		4,396		4,548			1 - 2 - 9
	B3	6	75	0.35	26	5,249		6,103		6,470		6,693		2.6	2 - 5 - 15
			100	0.62	34	6,179		7,185		7,616		7,880			4 - 9 - 19
			90	0.15	-	3,998		4,649		4,928		5,098			2 - 5 - 14
	B4	8	135	0.34	20	5,934		6,900		7,314		7,567		1.8	5 - 11 - 20
			180	0.61	28	6,957		8,089		8,575		8,871			9 - 14 - 23

Note: Reference page U62 for operational conditions used for performance notes

NOTES:

1. All performance data based on test performed in accordance with ASHRAE Standard 200-2015
2. ΔP_s values are measured in inches of water
3. NC values are based on room absorption of 10 dB. A dash (-) indicates an NC value less than 15.
4. Throw values are based on isothermal supply air and represent throw distances to terminal velocities of 150, 100 and 50 fpm respectively
5. ΔP_{Coil} values are measured in feet of water. ΔP_{Coil} values in shaded cells indicate use of a two circuit coil. All other values represent a single circuit coil.
6. Induction ratio is multiplied by the volume flow rate of primary air to estimate the volume flow rate of room air entrained through the coil

Cooling performance:

- Cooling capacity listed (qCOIL) is the sensible heat removal by the beam's integral coil. It does not include any contribution or offset by the primary air
- Capacity is based on 18°F ΔT between the induced air and the chilled water supply.
- Primary air sensible cooling contribution can be calculated by the following equation:

qSENSPA = 1.085 x CFMPA x (TPA - TROOM)

- Primary air latent cooling can be calculated by the following equation:

qLATENT = 0.69 x CFMPA x (WROOM - WPA)

where WROOM and WPA are the humidity ratio of the room and primary air respectively expressed in Grains of moisture per pound dry air

TABLE 4: CORRECTION FOR (ΔT) BETWEEN ENTERING AIR AND ENTERING CHILLED WATER

Actual ΔT	10	12	14	16	18	20	22	24
Multiply Table Value by:	0.56	0.67	0.78	0.89	1.00	1.11	1.22	1.33

Heating performance:

- Heating capacity listed (qCOIL) is the sensible heat removal by the beam's integral coil. It does not include any contribution or offset by the primary air
- Capacity is based on 50°F ΔT between the induced air and the chilled water supply.
- Primary air sensible heating offset (or contribution) can be calculated by the following equation:

qSENSPA = 1.085 x CFMPA x (TPA - TROOM)

if the primary air temperature is lower than that of the room, it will offset the coil's heating

if the primary air temperature is higher than that of the room, it will contribute to the coil's heating

Legend:

ΔP_S = Unit Inlet Pressure [in wg]

qCoil = Sensible Capacity, Coil [Btu/h]

ΔCoil = Water coil pressure drop [ft wg]

qSENSPA = Sensible Capacity, Primary Air [Btu/h]

CFMPA = Air Flowrate, Primary Air [CFM]

TPA = Temperature Primary Air [°F]

TROOM = Temperature Room Air [°F]

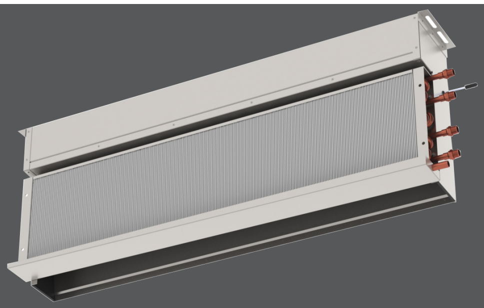
qSENSPA = Latent Capacity, Primary Air [Btu/h]

Redefine your comfort zone.™

Vertical Recessed Active Chilled Beams

CBAV

- Active chilled beam for use in recessed applications
- Optimized nozzle design provides high capacity and low noise levels
- Vertical coil with condensate pan
- Designed to integrate with Titus slot diffusers
- Optimized diffuser geometry maximizes occupant comfort



CBAV

dual-function | k-12 education | universities | energy solutions

See website for Specifications

AVAILABLE MODEL:

CBAV: Vertical Recessed Chilled Beam

OVERVIEW

Titus active chilled beams benefit from the use of using hydronic coils and induced air to reduce energy consumption associated with removal of sensible thermal loads. The primary air is supplied to the chilled beam subsequent to it being discharged through a series of nozzles located along the length of the beam. The nozzles inject the primary air into the mixing chamber at velocities capable of inducing plenum or soffit air through the water coil and where it mixes with the primary supply air. This mixture of air is then discharged into the space through ceiling slot diffusers. This provides high cooling outputs with low amounts of primary air. The reduced volume of air results in the reduction of the air handler capacity and size, smaller duct sizes, and the overall energy consumption.

The supplied air from the air handling unit is tempered and dehumidified to handle the latent load. The remaining loads in the space are addressed with the heat exchanger which is incorporated into the chilled beam. Applications with low latent cooling loads could use 100 percent outdoor air allowing for use of a dedicated outdoor air system with energy recovery further reducing total system energy consumption.

The CBAV's are offered for both, cooling and heating, lengths from 2 to 8 ft. They can be easily integrated with many of Titus' slot diffusers. Units can have single slot diffusers installed directly to the discharge of the chilled beam, or CBAV beams can be located in specific locations above a long run of slot differs creating active and inactive sections.

ADVANTAGES

- Removal of high thermal loads is possible in this air/water system
- The size of the air duct system is reduced to a minimum, due to the low supply of primary air
- Substantial reduction in the operating costs, due to low primary air volume
- Improvement of the thermal comfort inside the room
- Contributing sound levels below NC-30

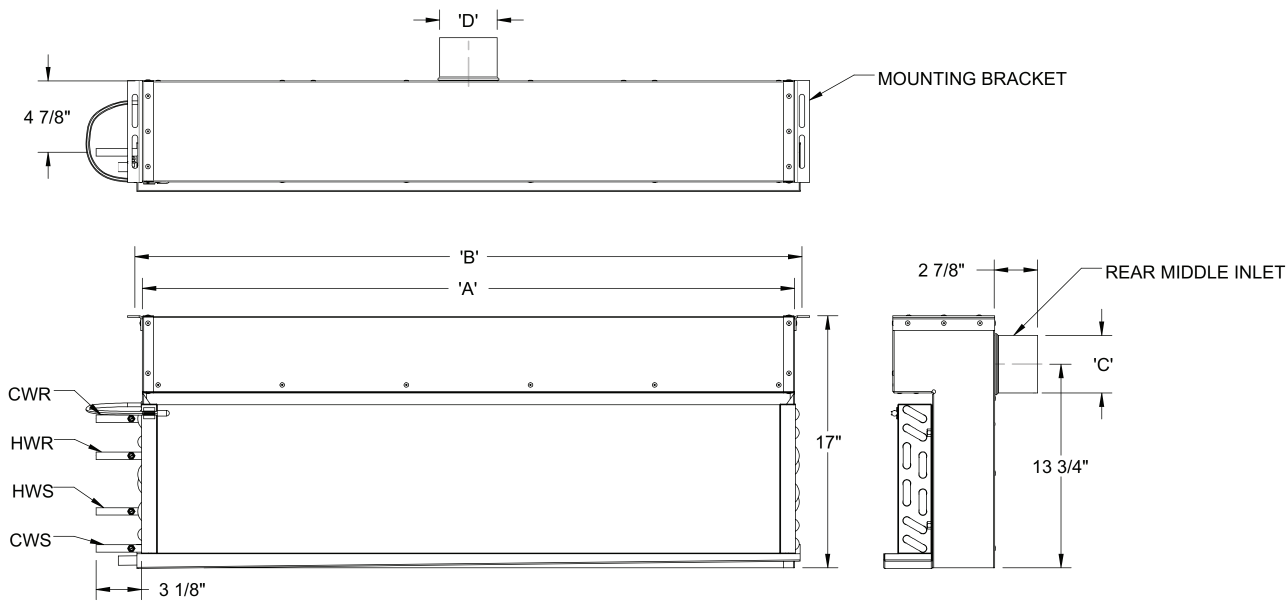
CBAV STANDARD FEATURES

- 2 foot to 8 foot lengths
- Left hand or right hand coil connections
- Rear air inlet locations
- 2-pipe and 4-pipe coil configurations
- Configured nozzle geometry for capacity optimization
- Commissioning port with roomside access for balancing
- Mounting brackets with adjustments in two directions
- ½" Sweat water coil connections
- Coil air vent
- Condensate tray with drain connection for field plumbing

OPTIONS AND ACCESSORIES

- ½" thick foil-faced EcoShield, anti-microbial external insulation
- Coil drain valve
- ½" MNPT water coil connections
- 12-inch, 18-inch or 24-inch stainless steel braided hoses

CBAV UNIT DIMENSIONS



CBAV VERTICAL RECESSED BEAM

Nominal Unit Length (ft)	'A' (IN)	'B' (IN)
2	20	21
3	32	33
4	44	45
6	68	69
8	92	93

Nominal Inlet (IN)	'C' (IN)	'D' (IN)
4 IN Round	3 7/8	-
5 IN Round	4 7/8	-
6 IN Oval	5 1/4	6 1/4
8 IN Oval	5 1/4	9 3/8

All dimensions are in inches

Titus

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CBAV / 4-PIPE COOLING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil Sensible Cooling (Btu/h)								Induction ratio	Throw ft
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL		
2	B1	4	3	0.21	20	539	0.39	670	1.56	724	3.51	756	6.24	7.2	0 - 0 - 1
			4	0.38	29	682		847		916		956			0 - 0 - 1
			5	0.59	37	800		993		1,075		1,121			0 - 0 - 2
	B2	4	4	0.16	15	517		643		695		725		5.7	0 - 0 - 1
			6	0.37	28	718		892		965		1,007			0 - 1 - 2
			8	0.65	38	842		1,046		1,132		1,181			0 - 1 - 4
	B3	4	9	0.23	19	717		891		964		1,005		4.8	0 - 1 - 3
			12	0.41	29	862		1,071		1,158		1,208			1 - 1 - 5
			15	0.64	36	977		1,213		1,313		1,369			1 - 2 - 7
	B4	4	15	0.19	16	675		839		907		946		3.4	0 - 1 - 4
			21	0.38	27	970		1,205		1,303		1,360			1 - 2 - 7
			27	0.62	35	1,099		1,365		1,477		1,541			2 - 4 - 9
3	B1	4	5	0.22	20	751	0.54	933	2.15	1,009	4.83	1,053	8.59	7.2	0 - 0 - 1
			7	0.44	31	983		1,221		1,321		1,378			0 - 0 - 2
			9	0.72	39	1,171		1,455		1,574		1,642			0 - 1 - 3
	B2	4	7	0.19	16	721		895		968		1,010		5.7	0 - 0 - 2
			10	0.39	28	1,035		1,286		1,391		1,451			0 - 1 - 3
			13	0.65	37	1,173		1,457		1,577		1,645			1 - 1 - 5
	B3	4	13	0.18	-	836		1,038		1,123		1,171		4.8	0 - 1 - 3
			19	0.38	27	1,201		1,491		1,613		1,683			1 - 2 - 7
			25	0.66	36	1,396		1,734		1,875		1,956			1 - 3 - 9
	B4	4	25	0.20	15	940		1,168		1,263		1,318		3.4	1 - 2 - 7
			35	0.39	27	1,351		1,678		1,815		1,894			1 - 3 - 10
			45	0.65	35	1,570		1,951		2,110		2,201			2 - 5 - 13
4	B1	4	6	0.17	-	877	0.72	1,090	2.88	1,179	6.49	1,229	1.10	7.2	0 - 0 - 1
			9	0.37	28	1,218		1,513		1,637		1,707			0 - 0 - 2
			12	0.67	37	1,465		1,820		1,968		2,053			0 - 1 - 3
	B2	4	10	0.18	17	924		1,148		1,241		1,295		5.7	0 - 1 - 2
			14	0.35	28	1,327		1,649		1,784		1,861			0 - 1 - 4
			18	0.58	36	1,504		1,869		2,021		2,109			1 - 2 - 7
	B3	4	18	0.18	-	1,071		1,331		1,439		1,502		4.8	0 - 1 - 4
			27	0.40	27	1,539		1,912		2,068		2,158			1 - 2 - 9
			36	0.71	37	1,834		2,278		2,464		2,571			2 - 4 - 12
	B4	6	30	0.14	-	1,088		1,351		1,461		1,525		3.4	1 - 2 - 6
			50	0.40	17	1,732		2,151		2,327		2,428			2 - 4 - 12
			70	0.79	28	2,165		2,689		2,909		3,035			4 - 9 - 16
6	B1	4	10	0.19	16	1,254	1.01	1,558	4.03	1,685	1.27	1,758	2.26	7.2	0 - 0 - 1
			14	0.37	27	1,742		2,164		2,340		2,441			0 - 1 - 3
			18	0.61	35	2,042		2,537		2,744		2,863			0 - 1 - 4
	B2	4	16	0.21	17	1,450		1,801		1,949		2,033		5.7	0 - 1 - 3
			22	0.40	28	1,898		2,358		2,550		2,661			1 - 1 - 5
			28	0.65	36	2,151		2,672		2,890		3,015			1 - 2 - 9
	B3	6	30	0.20	-	1,682		2,089		2,260		2,357		4.8	1 - 2 - 6
			45	0.44	19	2,274		2,825		3,056		3,188			2 - 3 - 12
			60	0.79	29	2,687		3,338		3,610		3,766			3 - 6 - 16
	B4	6	55	0.20	-	1,892		2,350		2,542		2,652		3.4	1 - 3 - 11
			80	0.43	18	2,559		3,179		3,438		3,587			3 - 6 - 16
			105	0.74	26	2,951		3,666		3,965		4,136			5 - 10 - 20

Note: Reference page U69 for operational conditions used for performance notes

CBAV / 4-PIPE HEATING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil Heating (Btu/h)								Induction ratio	Throw ft
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL		
2	B1	4	3	0.21	20	1,526	0.10	1,775	0.38	1,881	0.86	1,946	1.53	7.2	0 - 0 - 1
			4	0.38	29	1,931		2,245		2,380		2,462			0 - 0 - 1
			5	0.59	37	2,264		2,633		2,791		2,887			0 - 0 - 2
	B2	4	4	0.16	15	1,526		1,775		1,881		1,946		5.7	0 - 0 - 1
			6	0.37	28	1,995		2,320		2,459		2,544			0 - 1 - 2
			8	0.65	38	2,385		2,773		2,939		3,041			0 - 1 - 4
	B3	4	9	0.23	19	1,978		2,300		2,438		2,522		4.8	0 - 1 - 3
			12	0.41	29	2,440		2,838		3,008		3,112			1 - 1 - 5
			15	0.64	36	2,765		3,216		3,409		3,526			1 - 2 - 7
	B4	4	15	0.19	16	1,991		2,315		2,454		2,539		3.4	0 - 1 - 4
			21	0.38	27	2,746		3,193		3,384		3,501			1 - 2 - 7
			27	0.62	35	3,112		3,618		3,835		3,968			2 - 4 - 9
3	B1	4	5	0.22	20	2,137	0.14	2,485	0.55	2,634	1.23	2,725	2.55	7.2	0 - 0 - 1
			7	0.44	31	921		1,071		1,135		1,174			0 - 0 - 2
			9	0.72	39	3,316		3,855		4,087		4,228			0 - 1 - 3
	B2	4	7	0.19	16	2,126		2,472		2,620		2,711		5.7	0 - 0 - 2
			10	0.39	28	2,931		3,408		3,613		3,738			0 - 1 - 3
			13	0.65	37	3,322		3,862		4,094		4,236			1 - 1 - 5
	B3	4	13	0.18	-	2,465		2,866		3,038		3,143		4.8	0 - 1 - 3
			19	0.38	27	3,399		3,952		4,189		4,334			1 - 2 - 7
			25	0.66	36	3,951		4,594		4,870		5,038			1 - 3 - 9
	B4	4	25	0.20	15	2,774		3,225		3,419		3,537		3.4	1 - 2 - 7
			35	0.39	27	3,825		4,447		4,714		4,877			1 - 3 - 10
			45	0.65	35	4,446		5,169		5,479		5,669			2 - 5 - 13
4	B1	4	6	0.17	-	2,587	0.18	3,009	0.71	3,189	1.59	3,299	2.83	7.2	0 - 0 - 1
			9	0.37	28	3,382		3,932		4,168		4,313			0 - 0 - 2
			12	0.67	37	4,147		4,822		5,111		5,288			0 - 1 - 3
	B2	4	10	0.18	17	2,725		3,169		3,359		3,475		5.7	0 - 1 - 2
			14	0.35	28	3,758		4,370		4,632		4,792			0 - 1 - 4
			18	0.58	36	4,259		4,952		5,249		5,430			1 - 2 - 7
	B3	4	18	0.18	-	3,160		3,675		3,895		4,030		4.8	0 - 1 - 4
			27	0.40	27	4,358		5,067		5,371		5,557			1 - 2 - 9
			36	0.71	37	5,192		6,037		6,400		6,621			2 - 4 - 12
	B4	6	30	0.14	-	3,347		3,892		4,125		4,268		3.4	1 - 2 - 6
			50	0.40	17	4,903		5,701		6,043		6,253			2 - 4 - 12
			70	0.79	28	6,129		7,127		7,554		7,816			4 - 9 - 16
6	B1	4	10	0.19	16	3,700	0.28	4,302	1.11	4,560	2.50	4,718	4.44	7.2	0 - 0 - 1
			14	0.37	27	4,836		5,623		5,961		6,167			0 - 1 - 3
			18	0.61	35	5,782		6,723		7,126		7,373			0 - 1 - 4
	B2	4	16	0.21	17	4,126		4,798		5,086		5,262		5.7	0 - 1 - 3
			22	0.40	28	5,374		6,248		6,623		6,852			1 - 1 - 5
			28	0.65	36	6,090		7,081		7,506		7,766			1 - 2 - 9
	B3	6	30	0.20	-	4,785		5,564		5,898		6,102		4.8	1 - 2 - 6
			45	0.44	19	6,439		7,487		7,936		8,210			2 - 3 - 12
			60	0.79	29	7,607		8,845		9,376		9,700			3 - 6 - 16
	B4	6	55	0.20	-	5,384		6,261		6,636		6,866		3.4	1 - 3 - 11
			80	0.43	18	7,245		8,424		8,930		9,238			3 - 6 - 16
			105	0.74	26	8,354		9,714		10,297		10,653			5 - 10 - 20

Note: Reference page U69 for operational conditions used for performance notes

CBAV / 2-PIPE COOLING

Nominal Length ft	Nozzle Size	Primary Air Inlet Dia.	Primary Air Flow Rate	Primary Air Inlet ΔPS	Sound	Coil Sensible Cooling (Btu/h) 0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM		Induction ratio	Throw ft
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL		
2	B1	4	3	0.21	20	604	0.51	750	2.07	811	4.61	846	8.10	7.2	0 - 0 - 1
			4	0.38	29	764		949		1,026		1,071			0 - 0 - 1
			5	0.59	37	896		1,113		1,204		1,256			0 - 0 - 2
	B2	4	4	0.16	15	579		720		779		812		5.7	0 - 0 - 1
			6	0.37	28	805		1,000		1,081		1,128			0 - 1 - 2
			8	0.65	38	943		1,172		1,268		1,322			0 - 1 - 4
	B3	4	9	0.23	19	803		998		1,079		1,126		4.8	0 - 1 - 3
			12	0.41	29	965		1,199		1,297		1,353			1 - 1 - 5
			15	0.64	36	1,094		1,359		1,470		1,534			1 - 2 - 7
	B4	4	15	0.19	16	756		939		1,016		1,060		3.4	0 - 1 - 4
			21	0.38	27	1,086		1,349		1,460		1,523			1 - 2 - 7
			27	0.62	35	1,231		1,529		1,654		1,726			2 - 4 - 9
3	B1	4	5	0.22	20	841	0.72	1,045	2.88	1,130	6.49	1,179	1.25	7.2	0 - 0 - 1
			7	0.44	31	1,101		1,368		1,479		1,543			0 - 0 - 2
			9	0.72	39	1,312		1,629		1,763		1,839			0 - 1 - 3
	B2	4	7	0.19	16	807		1,003		1,084		1,131		5.7	0 - 0 - 2
			10	0.39	28	1,160		1,440		1,558		1,625			0 - 1 - 3
			13	0.65	37	1,314		1,632		1,766		1,842			1 - 1 - 5
	B3	4	13	0.18	-	936		1,163		1,258		1,312		4.8	0 - 1 - 3
			19	0.38	27	1,345		1,670		1,807		1,885			1 - 2 - 7
			25	0.66	36	1,563		1,942		2,100		2,191			1 - 3 - 9
	B4	4	25	0.20	15	1,053		1,308		1,415		1,476		3.4	1 - 2 - 7
			35	0.39	27	1,513		1,879		2,033		2,121			1 - 3 - 10
			45	0.65	35	1,759		2,185		2,363		2,465			2 - 5 - 13
4	B1	4	6	0.17	-	982	0.93	1,220	3.72	1,320	8.38	1,377	1.92	7.2	0 - 0 - 1
			9	0.37	28	1,364		1,695		1,833		1,912			0 - 0 - 2
			12	0.67	37	1,641		2,038		2,204		2,300			0 - 1 - 3
	B2	4	10	0.18	17	1,035		1,285		1,390		1,450		5.7	0 - 1 - 2
			14	0.35	28	1,487		1,847		1,998		2,084			0 - 1 - 4
			18	0.58	36	1,685		2,093		2,264		2,362			1 - 2 - 7
	B3	4	18	0.18	-	1,200		1,490		1,612		1,682		4.8	0 - 1 - 4
			27	0.40	27	1,724		2,141		2,316		2,416			1 - 2 - 9
			36	0.71	37	2,054		2,552		2,760		2,879			2 - 4 - 12
	B4	6	30	0.14	-	1,218		1,513		1,637		1,708		3.4	1 - 2 - 6
			50	0.40	17	1,940		2,410		2,606		2,719			2 - 4 - 12
			70	0.79	28	2,425		3,012		3,258		3,399			4 - 9 - 16
6	B1	4	10	0.19	16	1,405	1.35	1,745	5.40	1,888	1.58	1,969	2.81	7.2	0 - 0 - 1
			14	0.37	27	1,951		2,423		2,621		2,734			0 - 1 - 3
			18	0.61	35	2,287		2,841		3,073		3,206			0 - 1 - 4
	B2	4	16	0.21	17	1,624		2,018		2,182		2,277		5.7	0 - 1 - 3
			22	0.40	28	2,126		2,641		2,857		2,980			1 - 1 - 5
			28	0.65	36	2,409		2,993		3,237		3,377			1 - 2 - 9
	B3	6	30	0.20	-	1,883		2,340		2,531		2,640		4.8	1 - 2 - 6
			45	0.44	19	2,547		3,164		3,423		3,570			2 - 3 - 12
			60	0.79	29	3,009		3,738		4,044		4,218			3 - 6 - 16
	B4	6	55	0.20	-	2,119		2,632		2,848		2,971		3.4	1 - 3 - 11
			80	0.43	18	2,866		3,560		3,851		4,018			3 - 6 - 16
			105	0.74	26	3,305		4,106		4,441		4,633			5 - 10 - 20

Note: Reference page U69 for operational conditions used for performance notes

CBAV / 2-PIPE HEATING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil Heating (Btu/h)								Induction ratio	Throw ft
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL		
2	B1	4	3	0.21	20	1,600	0.51	1,988	2.07	2,150	4.61	2,243	8.10	7.2	0 - 0 - 1
			4	0.38	29	2,025		2,515		2,720		2,838			0 - 0 - 1
			5	0.59	37	2,374		2,949		3,190		3,327			0 - 0 - 2
	B2	4	4	0.16	15	1,600		1,988		2,150		2,243		5.7	0 - 0 - 1
			6	0.37	28	2,091		2,598		2,810		2,932			0 - 1 - 2
			8	0.65	38	2,500		3,106		3,360		3,505			0 - 1 - 4
	B3	4	9	0.23	19	2,074		2,576		2,786		2,907		4.8	0 - 1 - 3
			12	0.41	29	2,558		3,178		3,438		3,586			1 - 1 - 5
			15	0.64	36	2,899		3,601		3,896		4,064			1 - 2 - 7
	B4	4	15	0.19	16	2,088		2,593		2,805		2,926		3.4	0 - 1 - 4
			21	0.38	27	2,879		3,576		3,868		4,035			1 - 2 - 7
			27	0.62	35	3,262		4,052		4,383		4,573			2 - 4 - 9
3	B1	4	5	0.22	20	2,240	0.72	2,783	2.88	3,010	6.49	3,140	1.25	7.2	0 - 0 - 1
			7	0.44	31	965		1,199		1,297		1,353			0 - 0 - 2
			9	0.72	39	3,476		4,318		4,671		4,873			0 - 1 - 3
	B2	4	7	0.19	16	2,229		2,768		2,995		3,124		5.7	0 - 0 - 2
			10	0.39	28	3,073		3,817		4,129		4,308			0 - 1 - 3
			13	0.65	37	3,483		4,326		4,679		4,882			1 - 1 - 5
	B3	4	13	0.18	-	2,584		3,210		3,472		3,623		4.8	0 - 1 - 3
			19	0.38	27	3,564		4,427		4,788		4,995			1 - 2 - 7
			25	0.66	36	4,142		5,145		5,566		5,806			1 - 3 - 9
	B4	4	25	0.20	15	2,908		3,612		3,907		4,076		3.4	1 - 2 - 7
			35	0.39	27	4,010		4,981		5,388		5,620			1 - 3 - 10
			45	0.65	35	4,661		5,789		6,262		6,533			2 - 5 - 13
4	B1	4	6	0.17	-	2,713	0.93	3,370	3.72	3,645	8.38	3,802	1.92	7.2	0 - 0 - 1
			9	0.37	28	3,546		4,404		4,764		4,970			0 - 0 - 2
			12	0.67	37	4,348		5,401		5,842		6,094			0 - 1 - 3
	B2	4	10	0.18	17	2,857		3,549		3,839		4,005		5.7	0 - 1 - 2
			14	0.35	28	3,940		4,894		5,294		5,522			0 - 1 - 4
			18	0.58	36	4,465		5,546		5,999		6,258			1 - 2 - 7
	B3	4	18	0.18	-	3,313		4,116		4,452		4,644		4.8	0 - 1 - 4
			27	0.40	27	4,569		5,675		6,139		6,404			1 - 2 - 9
			36	0.71	37	5,444		6,762		7,314		7,630			2 - 4 - 12
	B4	6	30	0.14	-	3,509		4,359		4,715		4,918		3.4	1 - 2 - 6
			50	0.40	17	5,141		6,386		6,907		7,206			2 - 4 - 12
			70	0.79	28	6,426		7,982		8,634		9,007			4 - 9 - 16
6	B1	4	10	0.19	16	3,879	1.35	4,819	5.40	5,212	1.58	5,437	2.81	7.2	0 - 0 - 1
			14	0.37	27	5,070		6,298		6,813		7,107			0 - 1 - 3
			18	0.61	35	6,062		7,530		8,145		8,497			0 - 1 - 4
	B2	4	16	0.21	17	4,326		5,374		5,813		6,064		5.7	0 - 1 - 3
			22	0.40	28	5,634		6,998		7,570		7,897			1 - 1 - 5
			28	0.65	36	6,385		7,931		8,579		8,949			1 - 2 - 9
	B3	6	30	0.20	-	5,017		6,232		6,741		7,032		4.8	1 - 2 - 6
			45	0.44	19	6,750		8,385		9,070		9,462			2 - 3 - 12
			60	0.79	29	7,975		9,907		10,716		11,179			3 - 6 - 16
	B4	6	55	0.20	-	5,645		7,012		7,585		7,912		3.4	1 - 3 - 11
			80	0.43	18	7,596		9,435		10,206		10,647			3 - 6 - 16
			105	0.74	26	8,759		10,880		11,769		12,277			5 - 10 - 20

Note: Reference page U69 for operational conditions used for performance notes

NOTES:

1. All performance data based on test performed in accordance with ASHRAE Standard 200-2015
2. ΔP_s values are measured in inches of water
3. NC values are based on room absorption of 10 dB. A dash (-) indicates an NC value less than 15.
4. Throw values are based on isothermal supply air and represent throw distances to terminal velocities of 150, 100 and 50 fpm respectively
5. ΔP_{Coil} values are measured in feet of water. ΔP_{Coil} values in shaded cells indicate use of a two circuit coil. All other values represent a single circuit coil.
6. Induction ratio is multiplied by the volume flow rate of primary air to estimate the volume flow rate of room air entrained through the coil

Cooling performance:

- Cooling capacity listed (qCOIL) is the sensible heat removal by the beam's integral coil. It does not include any contribution or offset by the primary air
- Capacity is based on 18°F ΔT between the induced air and the chilled water supply.
- Primary air sensible cooling contribution can be calculated by the following equation:

qSENSPA = 1.085 x CFMPA x (TPA - TROOM)

- Primary air latent cooling can be calculated by the following equation:

qLATENT = 0.69 x CFMPA x (WROOM - WPA)

where WROOM and WPA are the humidity ratio of the room and primary air respectively expressed in Grains of moisture per pound dry air

TABLE 4: CORRECTION FOR (ΔT) BETWEEN ENTERING AIR AND ENTERING CHILLED WATER

Actual ΔT	10	12	14	16	18	20	22	24
Multiply Table Value by:	0.56	0.67	0.78	0.89	1.00	1.11	1.22	1.33

Heating performance:

- Heating capacity listed (qCOIL) is the sensible heat removal by the beam's integral coil. It does not include any contribution or offset by the primary air
- Capacity is based on 50°F ΔT between the induced air and the chilled water supply.
- Primary air sensible heating offset (or contribution) can be calculated by the following equation:

qSENSPA = 1.085 x CFMPA x (TPA - TROOM)

if the primary air temperature is lower than that of the room, it will offset the coil's heating

if the primary air temperature is higher than that of the room, it will contribute to the coil's heating

Legend:

ΔP_S = Unit Inlet Pressure [in wg]

qCoil = Sensible Capacity, Coil [Btu/h]

ΔCoil = Water coil pressure drop [ft wg]

qSENSPA = Sensible Capacity, Primary Air [Btu/h]

CFMPA = Air Flowrate, Primary Air [CFM]

TPA = Temperature Primary Air [°F]

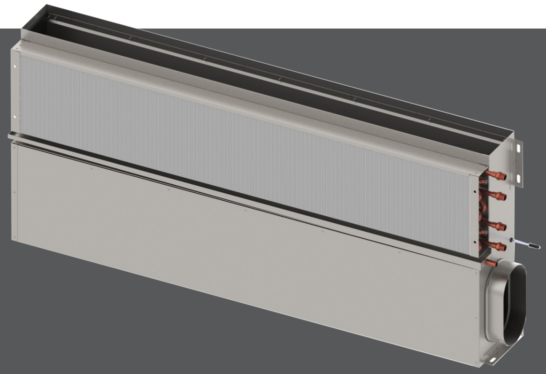
TROOM = Temperature Room Air [°F]

qSENSPA = Latent Capacity, Primary Air [Btu/h]

Under Sill Active Chilled Beams

CBAS

- Provides comfortable, effective sensible cooling to the space
- Optimized nozzle design provides high capacity and low noise levels
- Ideal for induction unit and unit ventilator retrofit projects
- Quick and simple installation
- Available in nominal lengths up to 6 feet
- ½" Sweat or ½" MNPT coil connections



CBAS

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See website for Specifications

AVAILABLE MODEL:

CBAS / Under sill active chilled beam

OVERVIEW

Titus active chilled beams benefit from the use of using hydronic coils and induced air to reduce energy consumption associated with removal of sensible thermal loads. The primary air is supplied to the chilled beam subsequent to it being discharged through a series of nozzles located along the length of the beam. The nozzles inject the primary air into the mixing chamber at velocities capable of inducing plenum or soffit air through the water coil and where it mixes with the primary supply air. This mixture of air is then discharged into the space through ceiling slot diffusers. This provides high cooling outputs with low amounts of primary air. The reduced volume of air results in the reduction of the air handler capacity and size, smaller duct sizes, and the overall energy consumption.

The supplied air from the air handling unit is tempered and dehumidified to handle the latent load. The remaining loads in the space are addressed with the heat exchanger which is incorporated into the chilled beam. Applications with low latent cooling loads could use 100 percent outdoor air allowing for use of a dedicated outdoor air system with energy recovery further reducing total system energy consumption.

The CBAS's are offered for both, cooling and heating, lengths from 2 to 6 ft. They can be easily integrated in retrofit projects where induction units, unit ventilator, or other under sill units are being replaced. Under sill active beams save significant energy and reduce sounds levels compared to other under sill mounted products. Additionally, the utilization of most or all of the existing piping and duct work minimizes project costs.

ADVANTAGES

- Removal of high thermal loads is possible in this air/water system
- The height of the air duct system is reduced to a minimum, due to the low supply of primary air
- Substantial reduction in the operating costs, due to low primary air volume
- Improvement of the thermal comfort inside the room
- Contributing sound levels below NC-30

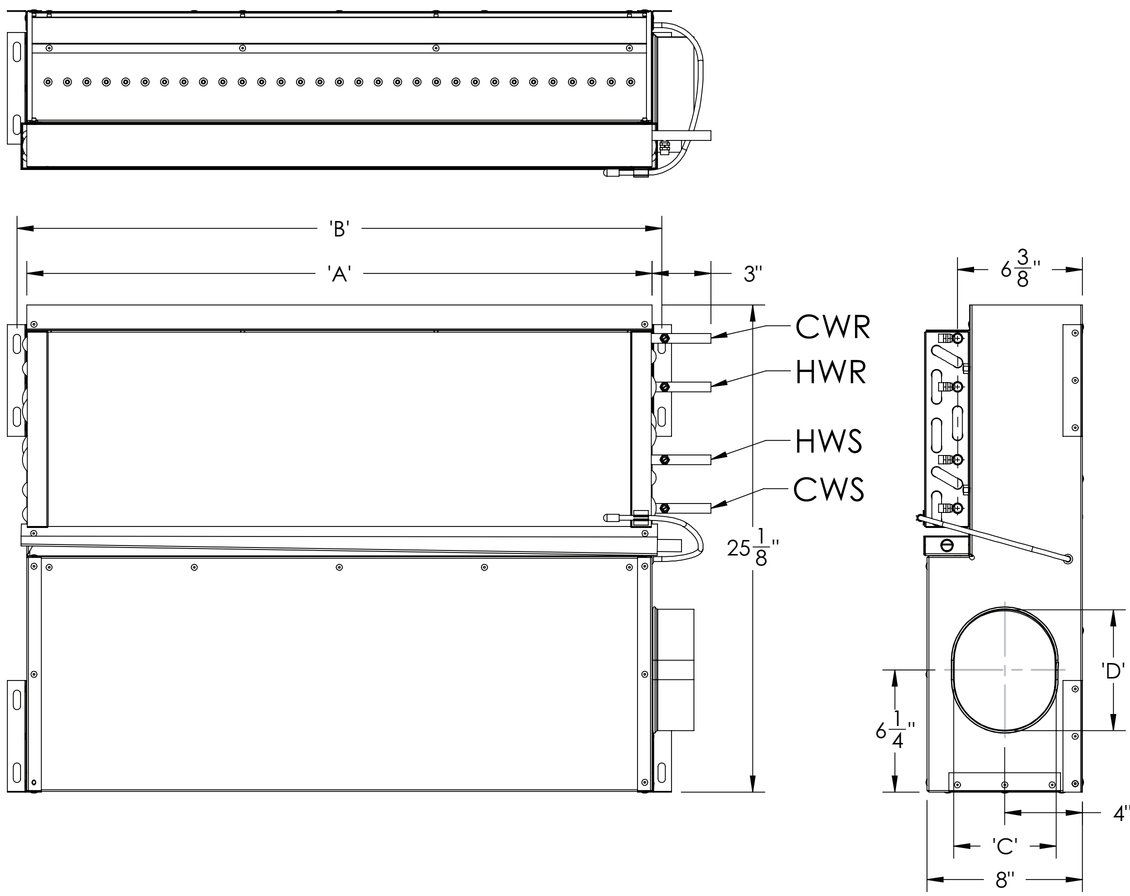
CBAS STANDARD FEATURES

- 2 foot to 6 foot lengths
- Left hand or right hand coil connections
- Left hand, right hand, or rear air inlet locations
- 2-pipe and 4-pipe coil configurations
- Configured nozzle geometry for capacity optimization
- Commissioning port with roomside access for balancing
- Mounting brackets with adjustments in two directions
- ½" Sweat water coil connections
- Coil air vent
- Condensate tray with drain connection for field plumbing

OPTIONS AND ACCESSORIES

- ½" thick foil-faced EcoShield, anti-microbial external insulation
- Coil drain valve
- ½" MNPT water coil connections
- 12-inch, 18-inch or 24-inch stainless steel braided hoses

CBAS UNIT DIMENSIONS



All dimensions are in inches

CBAS / 4-PIPE COOLING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil Sensible Cooling (Btu/h)								Induction ratio
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM		
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	
3	B1	6" oval	6	0.32	-	1,001	0.39	1,244	1.56	1,345	3.51	1,403	6.24	7.2
			8	0.57	-	1,156		1,436		1,553		1,620		
			10	0.89	-	1,321		1,641		1,775		1,852		
	B2	6" oval	10	0.32	-	1,172		1,456		1,575		1,643		5.7
			13	0.54	-	1,273		1,582		1,711		1,785		
			17	0.92	20	1,495		1,857		2,008		2,095		
	B3	6" oval	17	0.30	-	1,194		1,483		1,604		1,673		4.2
			23	0.56	-	1,406		1,746		1,889		1,970		
			30	0.95	20	1,649		2,049		2,216		2,312		
	B4	6" oval	30	0.28	-	1,303		1,618		1,750		1,826		3.4
			40	0.50	-	1,540		1,914		2,070		2,159		
			55	0.95	24	1,869		2,321		2,511		2,620		
4	B1	6" oval	8	0.30	-	1,228	0.54	1,525	2.15	1,650	4.83	1,721	8.59	7.2
			10	0.46	-	1,388		1,725		1,866		1,946		
			14	0.91	16	1,703		2,116		2,289		2,388		
	B2	6" oval	12	0.29	-	1,277		1,587		1,716		1,791		5.7
			16	0.51	-	1,512		1,878		2,032		2,119		
			22	0.97	19	1,834		2,279		2,465		2,571		
	B3	6" oval	22	0.27	-	1,414		1,757		1,901		1,983		4.8
			30	0.49	-	1,734		2,153		2,329		2,430		
			42	0.97	22	2,127		2,642		2,858		2,981		
	B4	6" oval	42	0.29	-	1,688		2,096		2,268		2,366		3.4
			55	0.50	15	1,964		2,440		2,639		2,753		
			75	0.94	25	2,371		2,945		3,185		3,323		
5	B1	6" oval	10	0.28	-	1,452	0.72	1,804	2.88	1,951	6.49	2,035	1.10	7.2
			13	0.47	-	1,702		2,115		2,288		2,386		
			18	0.91	17	2,075		2,577		2,788		2,908		
	B2	6" oval	16	0.31	-	1,625		2,019		2,184		2,278		5.7
			20	0.49	-	1,809		2,248		2,431		2,536		
			28	0.96	20	2,220		2,758		2,983		3,112		
	B3	6" oval	28	0.23	-	1,707		2,121		2,294		2,393		4.8
			40	0.46	-	2,160		2,683		2,902		3,028		
			58	0.97	26	2,710		3,366		3,641		3,799		
	B4	6" oval	58	0.34	-	2,233		2,774		3,001		3,131		3.4
			70	0.50	16	2,377		2,953		3,194		3,332		
			97	0.96	26	2,898		3,600		3,894		4,062		
6	B1	6" oval	13	0.32	-	1,841	1.01	2,287	4.03	2,473	1.27	2,580	2.26	7.2
			16	0.48	-	2,018		2,507		2,712		2,829		
			23	1.00	20	2,517		3,127		3,382		3,528		
	B2	6" oval	18	0.27	-	1,750		2,173		2,351		2,452		5.7
			25	0.52	-	2,166		2,690		2,910		3,036		
			34	0.95	21	2,610		3,242		3,507		3,658		
	B3	6" oval	30	0.20	-	1,735		2,155		2,331		2,432		4.8
			45	0.46	-	2,421		3,008		3,254		3,394		
			66	0.99	25	3,058		3,798		4,108		4,286		
	B4	6" oval	66	0.30	-	2,437		3,027		3,274		3,415		3.4
			85	0.50	17	2,794		3,471		3,755		3,917		
			120	0.99	28	3,447		4,281		4,631		4,831		

Note: Reference page U77 for operational conditions used for performance notes

CBAS / 4-PIPE HEATING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil Heating (Btu/h)								Induction ratio
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM		
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	qCOIL	ΔPCOIL	
3	B1	6" oval	6	0.32	-	2,835	0.10	3,296	0.38	3,494	0.86	3,615	1.53	7.2
			8	0.57	-	3,272		3,805		4,033		4,173		
			10	0.89	-	3,740		4,349		4,610		4,770		
	B2	6" oval	10	0.32	-	3,319		3,860		4,091		4,233		5.7
			13	0.54	-	3,604		4,191		4,443		4,596		
			17	0.92	20	4,232		4,921		5,216		5,396		
	B3	6" oval	17	0.30	-	3,379		3,929		4,165		4,309		4.8
			23	0.56	-	3,979		4,627		4,904		5,074		
			30	0.95	20	4,670		5,430		5,756		5,955		
	B4	6" oval	30	0.28	-	3,688		4,288		4,545		4,703		3.4
			40	0.50	-	4,361		5,071		5,375		5,561		
			55	0.95	24	5,291		6,152		6,521		6,747		
4	B1	6" oval	8	0.30	-	3,476	0.14	4,041	0.55	4,284	1.23	4,432	2.55	7.2
			10	0.46	-	3,931		4,570		4,845		5,012		
			14	0.91	16	4,822		5,608		5,944		6,150		
	B2	6" oval	12	0.29	-	3,617		4,205		4,458		4,612		5.7
			16	0.51	-	4,281		4,977		5,276		5,458		
			22	0.97	19	5,193		6,038		6,401		6,622		
	B3	6" oval	22	0.27	-	4,004		4,656		4,936		5,106		4.8
			30	0.49	-	4,908		5,707		6,049		6,258		
			42	0.97	22	6,021		7,001		7,422		7,678		
	B4	6" oval	42	0.29	-	4,778		5,556		5,889		6,093		3.4
			55	0.50	15	5,561		6,466		6,854		7,091		
			75	0.94	25	6,712		7,804		8,272		8,559		
5	B1	6" oval	10	0.28	-	4,111	0.18	4,780	0.71	5,067	1.59	5,242	2.83	7.2
			13	0.47	-	4,820		5,604		5,941		6,146		
			18	0.91	17	5,873		6,829		7,239		7,489		
	B2	6" oval	16	0.31	-	4,601		5,351		5,672		5,868		5.7
			20	0.49	-	5,123		5,956		6,314		6,532		
			28	0.96	20	6,285		7,308		7,746		8,014		
	B3	6" oval	28	0.23	-	4,834		5,621		5,958		6,164		4.8
			40	0.46	-	6,115		7,111		7,537		7,798		
			58	0.97	26	7,672		8,921		9,456		9,783		
	B4	6" oval	58	0.34	-	6,323		7,352		7,793		8,063		3.4
			70	0.50	16	6,730		7,825		8,295		8,582		
			97	0.96	26	8,204		9,540		10,112		10,462		
6	B1	6" oval	13	0.32	-	5,211	0.28	6,060	1.11	6,423	2.50	6,645	4.44	7.2
			16	0.48	-	5,713		6,644		7,042		7,286		
			23	1.00	20	7,126		8,286		8,784		9,087		
	B2	6" oval	18	0.27	-	4,953		5,759		6,105		6,316		5.7
			25	0.52	-	6,132		7,130		7,558		7,819		
			34	0.95	21	7,388		8,591		9,107		9,422		
	B3	6" oval	30	0.20	-	4,912		5,712		6,054		6,264		4.8
			45	0.46	-	6,855		7,971		8,449		8,741		
			66	0.99	25	8,656		10,065		10,669		11,038		
	B4	6" oval	66	0.30	-	6,898		8,021		8,502		8,796		3.4
			85	0.50	17	7,911		9,199		9,751		10,088		
			120	0.99	28	9,757		11,345		12,026		12,442		

Note: Reference page U77 for operational conditions used for performance notes

CBAS / 2-PIPE COOLING

Nominal Length ft	Nozzle Size	Primary Air Inlet Dia. Inches	Primary Air Flow Rate CFM	Primary Air Inlet ΔPS (in. H2O)	Sound NC	0.5 GPM qCOIL	0.5 GPM ΔPCOIL	1.0 GPM qCOIL	1.0 GPM ΔPCOIL	1.5 GPM qCOIL	1.5 GPM ΔPCOIL	2.0 GPM qCOIL	2.0 GPM ΔPCOIL	Induction ratio
3	B1	6" oval	6	0.32	-	1,121	0.51	1,393	2.07	1,507	4.61	1,572	8.10	7.2
			8	0.57	-	1,295		1,608		1,739		1,815		
			10	0.89	-	1,480		1,838		1,988		2,074		
	B2	6" oval	10	0.32	-	1,313		1,631		1,764		1,841		5.7
			13	0.54	-	1,426		1,771		1,916		1,999		
			17	0.92	20	1,674		2,080		2,249		2,347		
	B3	6" oval	17	0.30	-	1,337		1,661		1,796		1,874		4.8
			23	0.56	-	1,574		1,955		2,115		2,207		
			30	0.95	20	1,847		2,295		2,482		2,590		
	B4	6" oval	30	0.28	-	1,459		1,812		1,960		2,045		3.4
			40	0.50	-	1,725		2,143		2,318		2,418		
			55	0.95	24	2,093		2,600		2,812		2,934		
4	B1	6" oval	8	0.30	-	1,375	0.72	1,708	2.88	1,848	6.49	1,927	1.25	7.2
			10	0.46	-	1,555		1,932		2,089		2,180		
			14	0.91	16	1,908		2,370		2,563		2,674		
	B2	6" oval	12	0.29	-	1,431		1,777		1,922		2,006		5.7
			16	0.51	-	1,693		2,104		2,275		2,374		
			22	0.97	19	2,054		2,552		2,760		2,880		
	B3	6" oval	22	0.27	-	1,584		1,968		2,129		2,221		4.8
			30	0.49	-	1,942		2,412		2,609		2,722		
			42	0.97	22	2,382		2,959		3,201		3,339		
	B4	6" oval	42	0.29	-	1,890		2,348		2,540		2,649		3.4
			55	0.50	15	2,200		2,733		2,956		3,084		
			75	0.94	25	2,655		3,298		3,568		3,722		
5	B1	6" oval	10	0.28	-	1,626	0.93	2,020	3.72	2,185	8.38	2,280	1.92	7.2
			13	0.47	-	1,907		2,369		2,562		2,673		
			18	0.91	17	2,324		2,886		3,122		3,257		
	B2	6" oval	16	0.31	-	1,820		2,261		2,446		2,552		5.7
			20	0.49	-	2,027		2,517		2,723		2,841		
			28	0.96	20	2,486		3,089		3,341		3,485		
	B3	6" oval	28	0.23	-	1,912		2,375		2,570		2,681		4.8
			40	0.46	-	2,419		3,005		3,251		3,391		
			58	0.97	26	3,035		3,770		4,078		4,254		
	B4	6" oval	58	0.34	-	2,501		3,107		3,361		3,506		3.4
			70	0.50	16	2,662		3,307		3,577		3,732		
			97	0.96	26	3,246		4,032		4,361		4,550		
6	B1	6" oval	13	0.32	-	2,062	1.35	2,561	5.40	2,770	1.58	2,890	2.81	7.2
			16	0.48	-	2,260		2,808		3,037		3,168		
			23	1.00	20	2,819		3,502		3,788		3,952		
	B2	6" oval	18	0.27	-	1,960		2,434		2,633		2,747		5.7
			25	0.52	-	2,426		3,013		3,260		3,400		
			34	0.95	21	2,923		3,631		3,927		4,097		
	B3	6" oval	30	0.20	-	1,943		2,414		2,611		2,724		4.8
			45	0.46	-	2,712		3,369		3,644		3,801		
			66	0.99	25	3,425		4,254		4,601		4,800		
	B4	6" oval	66	0.30	-	2,729		3,390		3,667		3,825		3.4
			85	0.50	17	3,130		3,888		4,205		4,387		
			120	0.99	28	3,860		4,795		5,187		5,411		

Note: Reference page U77 for operational conditions used for performance notes

CBAS / 2-PIPE HEATING

Nominal Length ft	Nozzle Size	Primary Air: Inlet Dia. (Inches)	Primary Air: Flow Rate (CFM)	Primary Air: Inlet ΔPS (in. H2O)	Sound NC	Coil Heating (Btu/h) 0.5 GPM qCOIL	0.5 GPM ΔPCOIL	1.0 GPM qCOIL	1.0 GPM ΔPCOIL	1.5 GPM qCOIL	1.5 GPM ΔPCOIL	2.0 GPM qCOIL	2.0 GPM ΔPCOIL	Induction ratio
3	B1	6" oval	6	0.32	-	3,827	0.51	4,450	2.07	4,717	4.61	4,880	8.10	7.2
			8	0.57	-	4,418		5,137		5,445		5,633		
			10	0.89	-	5,049		5,871		6,224		6,439		
	B2	6" oval	10	0.32	-	4,481		5,210		5,523		5,714		5.7
			13	0.54	-	4,866		5,658		5,998		6,205		
			17	0.92	20	5,713		6,643		7,041		7,285		
	B3	6" oval	17	0.30	-	4,562		5,304		5,623		5,817		4.8
			23	0.56	-	5,372		6,246		6,621		6,850		
			30	0.95	20	6,304		7,330		7,770		8,039		
	B4	6" oval	30	0.28	-	4,979		5,789		6,136		6,349		3.4
			40	0.50	-	5,887		6,846		7,257		7,508		
			55	0.95	24	7,143		8,305		8,804		9,108		
4	B1	6" oval	8	0.30	-	4,692	0.72	5,456	2.88	5,783	6.49	5,983	1.25	7.2
			10	0.46	-	5,306		6,170		6,540		6,767		
			14	0.91	16	6,510		7,570		8,024		8,302		
	B2	6" oval	12	0.29	-	4,882		5,677		6,018		6,226		5.7
			16	0.51	-	5,779		6,719		7,123		7,369		
			22	0.97	19	7,011		8,152		8,641		8,940		
	B3	6" oval	22	0.27	-	5,406		6,286		6,663		6,894		4.8
			30	0.49	-	6,625		7,704		8,166		8,449		
			42	0.97	22	8,129		9,452		10,019		10,366		
	B4	6" oval	42	0.29	-	6,450		7,500		7,950		8,225		3.4
			55	0.50	15	7,507		8,729		9,252		9,573		
			75	0.94	25	9,061		10,536		11,168		11,554		
5	B1	6" oval	10	0.28	-	5,550	0.93	6,453	3.72	6,840	8.38	7,077	1.92	7.2
			13	0.47	-	6,507		7,566		8,020		8,297		
			18	0.91	17	7,929		9,220		9,773		10,111		
	B2	6" oval	16	0.31	-	6,212		7,223		7,657		7,921		5.7
			20	0.49	-	6,915		8,041		8,524		8,818		
			28	0.96	20	8,485		9,866		10,458		10,819		
	B3	6" oval	28	0.23	-	6,526		7,588		8,043		8,322		4.8
			40	0.46	-	8,255		9,599		10,175		10,527		
			58	0.97	26	10,357		12,043		12,766		13,207		
	B4	6" oval	58	0.34	-	8,536		9,925		10,521		10,885		3.4
			70	0.50	16	9,085		10,564		11,198		11,585		
			97	0.96	26	11,076		12,879		13,651		14,123		
6	B1	6" oval	13	0.32	-	7,035	1.35	8,181	5.40	8,671	1.58	8,971	2.81	7.2
			16	0.48	-	7,713		8,969		9,507		9,836		
			23	1.00	20	9,621		11,187		11,858		12,268		
	B2	6" oval	18	0.27	-	6,687		7,775		8,242		8,527		5.7
			25	0.52	-	8,278		9,626		10,203		10,556		
			34	0.95	21	9,974		11,598		12,294		12,719		
	B3	6" oval	30	0.20	-	6,631		7,711		8,173		8,456		4.8
			45	0.46	-	9,254		10,761		11,406		11,801		
			66	0.99	25	11,686		13,588		14,403		14,901		
	B4	6" oval	66	0.30	-	9,312		10,828		11,478		11,875		3.4
			85	0.50	17	10,680		12,419		13,164		13,619		
			120	0.99	28	13,172		15,316		16,235		16,797		

Note: Reference page U77 for operational conditions used for performance notes

NOTES:

1. All performance data based on test performed in accordance with ASHRAE Standard 200-2015
2. ΔP_s values are measured in inches of water
3. NC values are based on room absorption of 10 dB. A dash (-) indicates an NC value less than 15.
4. Throw values are based on isothermal supply air and represent throw distances to terminal velocities of 150, 100 and 50 fpm respectively
5. ΔP_{Coil} values are measured in feet of water. ΔP_{Coil} values in shaded cells indicate use of a two circuit coil. All other values represent a single circuit coil.
6. Induction ratio is multiplied by the volume flow rate of primary air to estimate the volume flow rate of room air entrained through the coil

Cooling performance:

- Cooling capacity listed (qCOIL) is the sensible heat removal by the beam's integral coil. It does not include any contribution or offset by the primary air
- Capacity is based on 18°F ΔT between the induced air and the chilled water supply.
- Primary air sensible cooling contribution can be calculated by the following equation:

qSENSPA = 1.085 x CFMPA x (TPA - TROOM)

- Primary air latent cooling can be calculated by the following equation:

qLATENT = 0.69 x CFMPA x (WROOM - WPA)

where WROOM and WPA are the humidity ratio of the room and primary air respectively expressed in Grains of moisture per pound dry air

TABLE 4: CORRECTION FOR (ΔT) BETWEEN ENTERING AIR AND ENTERING CHILLED WATER

Actual ΔT	10	12	14	16	18	20	22	24
Multiply Table Value by:	0.56	0.67	0.78	0.89	1.00	1.11	1.22	1.33

Heating performance:

- Heating capacity listed (qCOIL) is the sensible heat removal by the beam's integral coil. It does not include any contribution or offset by the primary air
- Capacity is based on 50°F ΔT between the induced air and the chilled water supply.
- Primary air sensible heating offset (or contribution) can be calculated by the following equation:

qSENSPA = 1.085 x CFMPA x (TPA - TROOM)

if the primary air temperature is lower than that of the room, it will offset the coil's heating

if the primary air temperature is higher than that of the room, it will contribute to the coil's heating

Legend:

ΔP_S = Unit Inlet Pressure [in wg]

qCoil = Sensible Capacity, Coil [Btu/h]

ΔCoil = Water coil pressure drop [ft wg]

qSENSPA = Sensible Capacity, Primary Air [Btu/h]

CFMPA = Air Flowrate, Primary Air [CFM]

TPA = Temperature Primary Air [°F]

TROOM = Temperature Room Air [°F]

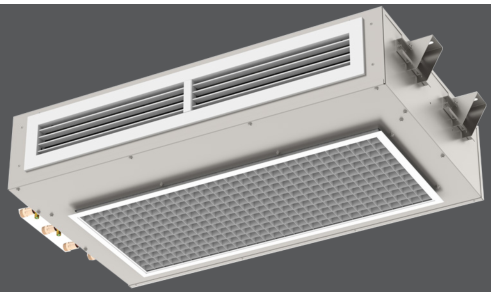
qSENSPA = Latent Capacity, Primary Air [Btu/h]

Redefine your comfort zone.™

Bulkhead Mounted Recessed Active Chilled Beams

CBAB

- Provides comfortable, effective sensible cooling to the space
- Optimized nozzle design provides high capacity and low noise levels
- Ideal for single room hospitality spaces
- Quick and simple installation
- Available in nominal lengths up to 6 feet
- ½" Sweat or ½" MNPT coil connections



CBAB

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See website for Specifications

AVAILABLE MODEL:

CBAB / Bulkhead Mounted Recessed Active Chilled Beam

OVERVIEW

Titus active chilled beams benefit from the use of using hydronic coils and induced air to reduce energy consumption associated with removal of sensible thermal loads. The primary air is supplied to the chilled beam subsequent to it being discharged through a series of nozzles located along the length of the beam. The nozzles inject the primary air into the mixing chamber at velocities capable of inducing plenum or soffit air through the water coil and where it mixes with the primary supply air. This mixture of air is then discharged into the space through ceiling slot diffusers. This provides high cooling outputs with low amounts of primary air. The reduced volume of air results in the reduction of the air handler capacity and size, smaller duct sizes, and the overall energy consumption.

The supplied air from the air handling unit is tempered and dehumidified to handle the latent load. The remaining loads in the space are addressed with the heat exchanger which is incorporated into the chilled beam. Applications with low latent cooling loads could use 100 percent outdoor air allowing for use of a dedicated outdoor air system with energy recovery further reducing total system energy consumption.

The CBAB bulkhead beams are the ideal solution for single room hospitality spaces, such as hotel, dorm, and hospital rooms. With their shallow height, ceiling heights can be maximized creating an open and inviting space. Bulkhead chilled beams are great for use in retrofit of buildings which were not originally built with HVAC systems originally installed.

ADVANTAGES

- Removal of high thermal loads is possible in this air/water system
- The height of the air duct system is reduced to a minimum, due to the low supply of primary air
- Substantial reduction in the operating costs, due to low primary air volume
- Improvement of the thermal comfort inside the room
- Contributing sound levels below NC-30

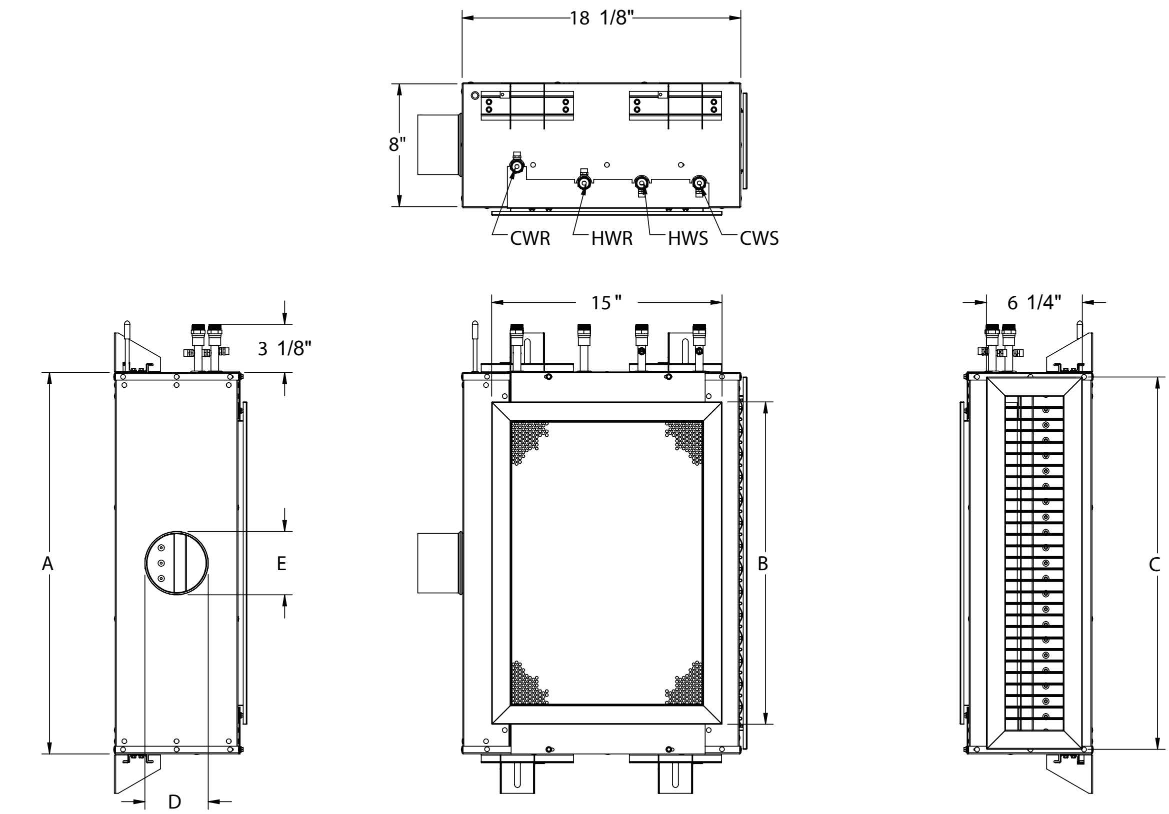
CBAB STANDARD FEATURES

- 2 foot to 6 foot lengths
- Left hand or right hand coil connections
- Rear air inlet location
- Louvered supply grille
- Perforated return grille
- 2-pipe and 4-pipe coil configurations
- Configured nozzle geometry for capacity optimization
- Commissioning port with roomside access for balancing
- Mounting brackets with adjustments in two directions
- ½" Sweat water coil connections
- Coil air vent

OPTIONS AND ACCESSORIES

- Linear Bar supply grille
- Linear Bar return grille
- Louvered Bar return grille
- Eggcrate Bar return grille
- ½" thick foil-faced EcoShield, anti-microbial external insulation
- Coil drain valve
- ½" MNPT water coil connections
- 12-inch, 18-inch or 24-inch stainless steel braided hoses

CBAB UNIT DIMENSIONS



NOTE:
- SCREW HOLES ON GRILLES NOT SHOWN.
- 271RS SUPPLY AND 8R RETURN SHOWN, OTHER OPTIONS AVAILABLE.

Nominal	A	B	C
2ft	24.85	21.00	24.25
3ft	36.85	33.00	36.25
4ft	48.85	45.00	48.25
5ft	60.85	57.00	60.25
6ft	72.85	69.00	72.25

Inlet	D	E
4 IN Round	3.88	3.88
5 IN Round	4.88	4.88
6 IN Oval	5.25	6.25
8 IN Oval	5.25	9.38

CBAB / 4-PIPE COOLING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil Sensible Cooling (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
3	B2	4	8	0.21	-	392	0.74	493	2.95	530	6.47	557	1.50	6.0	1 - 2 - 8
			11	0.39	-	562		708		761		800			2 - 4 - 12
			14	0.63	20	638		803		863		907			3 - 6 - 16
			17	0.93	26	703		885		952		1,000			4 - 9 - 18
	B3	4	15	0.20	-	803	0.74	1,011	2.95	1,087	6.47	1,143	1.50	4.5	2 - 4 - 13
			20	0.36	-	1,117		1,406		1,512		1,589			4 - 8 - 17
			25	0.56	19	1,231		1,550		1,666		1,751			6 - 11 - 19
			30	0.80	25	1,375		1,731		1,861		1,956			8 - 13 - 21
	B4	4	30	0.22	-	1,086	0.74	1,367	2.95	1,470	6.47	1,545	1.50	2.7	4 - 8 - 17
			40	0.39	17	1,305		1,642		1,766		1,856			6 - 12 - 20
			50	0.61	24	1,479		1,862		2,001		2,104			10 - 15 - 22
			60	0.88	29	1,631		2,053		2,208		2,320			12 - 17 - 24
4	B2	4	11	0.20	-	886	0.95	1,115	3.80	1,199	8.55	1,260	1.94	6.0	1 - 2 - 10
			15	0.38	-	1,273		1,602		1,723		1,811			2 - 5 - 15
			19	0.61	21	1,443		1,816		1,952		2,052			3 - 7 - 19
			23	0.89	27	1,591		2,003		2,154		2,264			5 - 11 - 21
	B3	4	21	0.21	-	1,130	0.95	1,423	3.80	1,530	8.55	1,608	1.94	4.5	2 - 6 - 16
			28	0.36	-	1,456		1,833		1,971		2,071			4 - 10 - 20
			35	0.57	21	1,627		2,049		2,203		2,315			7 - 13 - 23
			42	0.82	27	1,850		2,328		2,503		2,631			10 - 16 - 25
	B4	4	35	0.17	-	1,164	0.95	1,465	3.80	1,575	8.55	1,656	1.94	2.7	3 - 7 - 18
			50	0.34	15	1,646		2,072		2,227		2,341			6 - 13 - 22
			65	0.58	23	1,895		2,386		2,565		2,696			11 - 17 - 25
			80	0.88	30	2,091		2,632		2,829		2,974			14 - 20 - 28
5	B2	4	15	0.23	-	1,197	1.16	1,506	4.65	1,619	1.33	1,702	2.37	6.0	1 - 3 - 13
			20	0.41	16	1,438		1,811		1,947		2,046			3 - 6 - 17
			25	0.64	23	1,672		2,105		2,263		2,378			4 - 9 - 22
			30	0.93	28	1,798		2,263		2,433		2,557			6 - 13 - 24
	B3	4	25	0.18	-	1,250	1.16	1,573	4.65	1,692	1.33	1,778	2.37	4.5	2 - 6 - 17
			35	0.35	15	1,768		2,225		2,392		2,514			5 - 11 - 23
			45	0.58	23	2,036		2,563		2,755		2,896			8 - 15 - 26
			55	0.86	29	2,245		2,827		3,039		3,194			12 - 19 - 28
	B4	6" oval	40	0.14	-	1,180	1.16	1,486	4.65	1,597	1.33	1,679	2.37	2.7	3 - 6 - 18
			60	0.32	-	1,819		2,290		2,462		2,588			6 - 14 - 24
			80	0.56	15	2,130		2,681		2,883		3,030			11 - 18 - 28
			100	0.88	22	2,349		2,958		3,180		3,342			15 - 22 - 31
6	B2	4	20	0.28	-	1,916	1.38	2,412	5.51	2,593	1.58	2,725	2.81	6.0	2 - 4 - 16
			25	0.43	18	1,882		2,369		2,547		2,677			3 - 7 - 20
			30	0.62	23	2,118		2,666		2,866		3,013			4 - 10 - 24
			35	0.85	28	2,278		2,867		3,082		3,240			6 - 13 - 26
	B3	4	35	0.24	-	1,760	1.38	2,215	5.51	2,382	1.58	2,503	2.81	4.5	4 - 8 - 22
			45	0.39	17	2,117		2,664		2,864		3,011			6 - 14 - 26
			55	0.58	23	2,398		3,018		3,245		3,411			9 - 17 - 28
			65	0.81	29	2,645		3,329		3,579		3,762			13 - 20 - 31
	B4	6" oval	60	0.22	-	1,989	1.38	2,504	5.51	2,692	1.58	2,829	2.81	2.7	5 - 11 - 24
			80	0.39	-	2,392		3,011		3,237		3,402			9 - 17 - 28
			100	0.61	17	2,710		3,411		3,667		3,855			13 - 21 - 31
			120	0.87	22	2,989		3,763		4,045		4,252			17 - 24 - 34

Note: Reference page U87 for operational conditions used for performance notes

CBAB / 4-PIPE HEATING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil heating (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
3	B2	4	8	0.21	-	1,156	0.12	1,455	0.49	1,564	1.10	1,644	1.95	6.0	1 - 2 - 8
			11	0.39	-	1,633		2,056		2,211		2,324			2 - 4 - 12
			14	0.63	20	1,881		2,368		2,546		2,676			3 - 6 - 16
			17	0.93	26	2,075		2,612		2,808		2,952			4 - 9 - 18
	B3	4	15	0.20	-	1,833	0.12	2,308	0.49	2,481	1.10	2,608	1.95	4.5	2 - 4 - 13
			20	0.36	-	2,550		3,210		3,451		3,627			4 - 8 - 17
			25	0.56	19	2,810		3,537		3,802		3,997			6 - 11 - 19
			30	0.80	25	3,139		3,952		4,248		4,465			8 - 13 - 21
	B4	4	30	0.22	-	2,479	0.12	3,120	0.49	3,355	1.10	3,526	1.95	2.7	4 - 8 - 17
			40	0.39	17	2,978		3,748		4,030		4,236			6 - 12 - 20
			50	0.61	24	3,375		4,249		4,568		4,802			10 - 15 - 22
			60	0.88	29	3,773		4,750		5,106		5,367			12 - 17 - 24
4	B2	4	11	0.20	-	2,022	0.16	2,546	0.63	2,737	1.41	2,877	2.51	6.0	1 - 2 - 10
			15	0.38	-	2,905		3,657		3,932		4,133			2 - 5 - 15
			19	0.61	21	3,293		4,145		4,456		4,684			3 - 7 - 19
			23	0.89	27	3,632		4,572		4,915		5,166			5 - 11 - 21
	B3	4	21	0.21	-	2,580	0.16	3,247	0.63	3,491	1.41	3,670	2.51	4.5	2 - 6 - 16
			28	0.36	-	3,324		4,184		4,498		4,728			4 - 10 - 20
			35	0.57	21	4,245		5,344		5,745		6,038			7 - 13 - 23
			42	0.82	27	4,222		5,315		5,714		6,005			10 - 16 - 25
	B4	4	35	0.17	-	2,657	0.16	3,345	0.63	3,596	1.41	3,779	2.51	2.7	3 - 7 - 18
			50	0.34	15	3,756		4,729		5,084		5,343			6 - 13 - 22
			65	0.58	23	4,326		5,446		5,855		6,154			11 - 17 - 25
			80	0.88	30	4,836		6,087		6,544		6,879			14 - 20 - 28
5	B2	4	15	0.23	-	2,731	0.19	3,438	0.78	3,696	1.75	3,885	3.11	6.0	1 - 3 - 13
			20	0.41	16	3,283		4,133		4,443		4,670			3 - 6 - 17
			25	0.64	23	3,816		4,804		5,164		5,428			4 - 9 - 22
			30	0.93	28	4,104		5,166		5,554		5,837			6 - 13 - 24
	B3	4	25	0.18	-	2,853	0.19	3,591	0.78	3,861	1.75	4,058	3.11	4.5	2 - 6 - 17
			35	0.35	15	4,035		5,079		5,460		5,739			5 - 11 - 23
			45	0.58	23	4,646		5,849		6,288		6,609			8 - 15 - 26
			55	0.86	29	5,125		6,452		6,936		7,291			12 - 19 - 28
	B4	4	40	0.14	-	2,694	0.19	3,391	0.78	3,646	1.75	3,832	3.11	2.7	3 - 6 - 18
			60	0.32	-	4,152		5,227		5,619		5,906			6 - 14 - 24
			80	0.56	15	4,862		6,120		6,580		6,916			11 - 18 - 28
			100	0.88	22	5,363		6,751		7,257		7,628			15 - 22 - 31
6	B2	4	20	0.28	-	3,746	0.23	4,716	0.92	5,070	2.06	5,329	3.67	6.0	2 - 4 - 16
			25	0.43	18	3,816		4,804		5,164		5,428			3 - 7 - 20
			30	0.62	23	4,834		6,085		6,542		6,877			4 - 10 - 24
			35	0.85	28	5,199		6,544		7,035		7,395			6 - 13 - 26
	B3	4	35	0.24	-	4,017	0.23	5,057	0.92	5,436	2.50	5,714	3.67	4.5	4 - 8 - 22
			45	0.39	17	4,831		6,081		6,538		6,872			6 - 14 - 26
			55	0.58	23	5,473		6,889		7,407		7,785			9 - 17 - 28
			65	0.81	29	6,118		7,701		8,279		8,702			13 - 20 - 31
	B4	4	60	0.22	-	4,540	0.23	5,715	0.92	6,144	2.50	6,458	3.67	2.7	5 - 11 - 24
			80	0.39	-	5,459		6,872		7,388		7,766			9 - 17 - 28
			100	0.61	17	6,185		7,786		8,370		8,798			13 - 21 - 31
			120	0.87	22	6,822		8,588		9,233		9,705			17 - 24 - 34

Note: Reference page U87 for operational conditions used for performance notes

CBAB / 2-PIPE COOLING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil Sensible Cooling (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
3	B2	4	8	0.21	-	439	0.92	552	2.69	594	8.30	624	1.88	6.0	1 - 2 - 8
			11	0.39	-	630		793		852		896			2 - 4 - 12
			14	0.63	20	714		899		966		1,016			3 - 6 - 16
			17	0.93	26	788		992		1,066		1,120			4 - 9 - 18
	B3	4	15	0.20	-	900	0.92	1,132	2.69	1,217	8.30	1,280	1.88	4.5	2 - 4 - 13
			20	0.36	-	1,251		1,575		1,693		1,780			4 - 8 - 17
			25	0.56	19	1,379		1,736		1,866		1,961			6 - 11 - 19
			30	0.80	25	1,540		1,939		2,085		2,191			8 - 13 - 21
	B4	4	30	0.22	-	1,216	0.92	1,531	2.69	1,646	8.30	1,730	1.88	2.7	4 - 8 - 17
			40	0.39	17	1,461		1,839		1,977		2,078			6 - 12 - 20
			50	0.61	24	1,656		2,085		2,242		2,356			10 - 15 - 22
			60	0.88	29	1,827		2,300		2,472		2,599			12 - 17 - 24
4	B2	4	11	0.20	-	992	1.19	1,249	4.76	1,343	1.37	1,412	2.43	6.0	1 - 2 - 10
			15	0.38	-	1,426		1,795		1,929		2,028			2 - 5 - 15
			19	0.61	21	1,616		2,034		2,187		2,298			3 - 7 - 19
			23	0.89	27	1,782		2,243		2,412		2,535			5 - 11 - 21
	B3	4	21	0.21	-	1,266	1.19	1,593	4.76	1,713	1.37	1,801	2.43	4.5	2 - 6 - 16
			28	0.36	-	1,631		2,053		2,207		2,320			4 - 10 - 20
			35	0.57	21	1,823		2,295		2,467		2,593			7 - 13 - 23
			42	0.82	27	2,072		2,608		2,804		2,947			10 - 16 - 25
	B4	4	35	0.17	-	1,304	1.19	1,641	4.76	1,764	1.37	1,855	2.43	2.7	3 - 7 - 18
			50	0.34	15	1,843		2,320		2,495		2,622			6 - 13 - 22
			65	0.58	23	2,123		2,672		2,873		3,020			11 - 17 - 25
			80	0.88	30	2,342		2,948		3,169		3,331			14 - 20 - 28
5	B2	4	15	0.23	-	1,340	1.46	1,687	5.83	1,814	1.33	1,906	2.97	6.0	1 - 3 - 13
			20	0.41	16	1,611		2,028		2,180		2,292			3 - 6 - 17
			25	0.64	23	1,872		2,357		2,534		2,664			4 - 9 - 22
			30	0.93	28	2,014		2,535		2,725		2,864			6 - 13 - 24
	B3	4	25	0.18	-	1,400	1.46	1,762	5.83	1,895	1.67	1,991	2.97	4.5	2 - 6 - 17
			35	0.35	15	1,980		2,492		2,679		2,816			5 - 11 - 23
			45	0.58	23	2,280		2,870		3,086		3,243			8 - 15 - 26
			55	0.86	29	2,515		3,166		3,404		3,577			12 - 19 - 28
	B4	6" oval	40	0.14	-	1,322	1.46	1,664	5.83	1,789	1.33	1,880	2.97	2.7	3 - 6 - 18
			60	0.32	-	2,037		2,565		2,757		2,898			6 - 14 - 24
			80	0.56	15	2,386		3,003		3,229		3,393			11 - 18 - 28
			100	0.88	22	2,631		3,313		3,561		3,743			15 - 22 - 31
6	B2	4	20	0.28	-	2,146	1.72	2,701	6.89	2,904	1.98	3,052	3.52	6.0	2 - 4 - 16
			25	0.43	18	2,108		2,653		2,852		2,998			3 - 7 - 20
			30	0.62	23	2,372		2,986		3,210		3,374			4 - 10 - 24
			35	0.85	28	2,551		3,211		3,452		3,629			6 - 13 - 26
	B3	4	35	0.24	-	1,971	1.72	2,481	6.89	2,668	1.98	2,804	3.52	4.5	4 - 8 - 22
			45	0.39	17	2,371		2,984		3,208		3,372			6 - 14 - 26
			55	0.58	23	2,686		3,381		3,634		3,820			9 - 17 - 28
			65	0.81	29	2,962		3,729		4,009		4,214			13 - 20 - 31
	B4	6" oval	60	0.22	-	2,228	1.72	2,804	6.89	3,015	1.98	3,169	3.52	2.7	5 - 11 - 24
			80	0.39	-	2,679		3,372		3,625		3,811			9 - 17 - 28
			100	0.61	17	3,035		3,820		4,107		4,317			13 - 21 - 31
			120	0.87	22	3,348		4,214		4,530		4,762			17 - 24 - 34

Note: Reference page U87 for operational conditions used for performance notes

CBAB / 2-PIPE HEATING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil heating (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
3	B2	4	8	0.21	-	1,560	0.92	1,964	2.69	2,112	8.30	2,219	1.88	6.0	1 - 2 - 8
			11	0.39	-	2,205		2,776		2,984		3,137			2 - 4 - 12
			14	0.63	20	2,540		3,197		3,437		3,613			3 - 6 - 16
			17	0.93	26	2,801		3,526		3,791		3,985			4 - 9 - 18
	B3	4	15	0.20	-	2,475	0.92	3,115	2.69	3,349	8.30	3,521	1.88	4.5	2 - 4 - 13
			20	0.36	-	3,442		4,333		4,658		4,896			4 - 8 - 17
			25	0.56	19	3,793		4,775		5,133		5,396			6 - 11 - 19
			30	0.80	25	4,238		5,335		5,735		6,028			8 - 13 - 21
	B4	4	30	0.22	-	3,346	0.92	4,212	2.69	4,529	8.30	4,760	1.88	2.7	4 - 8 - 17
			40	0.39	17	4,020		5,060		5,440		5,718			6 - 12 - 20
			50	0.61	24	4,557		5,736		6,167		6,482			10 - 15 - 22
			60	0.88	29	5,094		6,412		6,894		7,246			12 - 17 - 24
4	B2	4	11	0.20	-	2,730	1.19	3,437	4.76	3,695	1.37	3,884	2.43	6.0	1 - 2 - 10
			15	0.38	-	3,922		4,937		5,308		5,579			2 - 5 - 15
			19	0.61	21	4,445		5,596		6,016		6,323			3 - 7 - 19
			23	0.89	27	4,903		6,172		6,636		6,975			5 - 11 - 21
	B3	4	21	0.21	-	3,483	1.19	4,384	4.76	4,713	1.37	4,954	2.43	4.5	2 - 6 - 16
			28	0.36	-	4,487		5,648		6,072		6,382			4 - 10 - 20
			35	0.57	21	5,731		7,214		7,755		8,152			7 - 13 - 23
			42	0.82	27	5,699		7,175		7,713		8,107			10 - 16 - 25
	B4	4	35	0.17	-	3,587	1.19	4,515	4.76	4,854	1.37	5,102	2.43	2.7	3 - 7 - 18
			50	0.34	15	5,071		6,384		6,863		7,214			6 - 13 - 22
			65	0.58	23	5,840		7,352		7,904		8,308			11 - 17 - 25
			80	0.88	30	6,528		8,218		8,835		9,286			14 - 20 - 28
5	B2	4	15	0.23	-	3,687	1.46	4,641	5.83	4,990	1.33	5,245	2.97	6.0	1 - 3 - 13
			20	0.41	16	4,432		5,579		5,998		6,305			3 - 6 - 17
			25	0.64	23	5,152		6,485		6,972		7,328			4 - 9 - 22
			30	0.93	28	5,540		6,974		7,497		7,880			6 - 13 - 24
	B3	4	25	0.18	-	3,852	1.46	4,848	5.83	5,212	1.67	5,479	2.97	4.5	2 - 6 - 17
			35	0.35	15	5,447		6,857		7,371		7,748			5 - 11 - 23
			45	0.58	23	6,273		7,896		8,489		8,923			8 - 15 - 26
			55	0.86	29	6,919		8,710		9,364		9,842			12 - 19 - 28
	B4	4	40	0.14	-	3,637	1.46	4,578	5.83	4,921	1.33	5,173	2.97	2.7	3 - 6 - 18
			60	0.32	-	5,606		7,056		7,586		7,974			6 - 14 - 24
			80	0.56	15	6,563		8,262		8,882		9,336			11 - 18 - 28
			100	0.88	22	7,240		9,113		9,798		10,298			15 - 22 - 31
6	B2	4	20	0.28	-	5,057	1.72	6,366	6.89	6,844	1.98	7,194	3.52	6.0	2 - 4 - 16
			25	0.43	18	5,152		6,485		6,972		7,328			3 - 7 - 20
			30	0.62	23	6,526		8,215		8,832		9,283			4 - 10 - 24
			35	0.85	28	7,018		8,834		9,498		9,983			6 - 13 - 26
	B3	4	35	0.24	-	5,423	1.72	6,827	6.89	7,339	1.98	7,714	3.52	4.5	4 - 8 - 22
			45	0.39	17	6,522		8,210		8,826		9,277			6 - 14 - 26
			55	0.58	23	7,388		9,301		9,999		10,510			9 - 17 - 28
			65	0.81	29	8,259		10,396		11,177		11,748			13 - 20 - 31
	B4	4	60	0.22	-	6,129	1.72	7,715	6.89	8,294	1.98	8,718	3.52	2.7	5 - 11 - 24
			80	0.39	-	7,370		9,278		9,974		10,484			9 - 17 - 28
			100	0.61	17	8,350		10,511		11,300		11,877			13 - 21 - 31
			120	0.87	22	9,210		11,594		12,464		13,101			17 - 24 - 34

Note: Reference page U87 for operational conditions used for performance notes

NOTES:

1. All performance data based on test performed in accordance with ASHRAE Standard 200-2015
2. ΔP_s values are measured in inches of water
3. NC values are based on room absorption of 10 dB. A dash (-) indicates an NC value less than 15.
4. Throw values are based on isothermal supply air and represent throw distances to terminal velocities of 150, 100 and 50 fpm respectively
5. ΔP_{Coil} values are measured in feet of water. ΔP_{Coil} values in shaded cells indicate use of a two circuit coil. All other values represent a single circuit coil.
6. Induction ratio is multiplied by the volume flow rate of primary air to estimate the volume flow rate of room air entrained through the coil

Cooling performance:

- Cooling capacity listed (qCOIL) is the sensible heat removal by the beam's integral coil. It does not include any contribution or offset by the primary air
- Capacity is based on 18°F ΔT between the induced air and the chilled water supply.
- Primary air sensible cooling contribution can be calculated by the following equation:

$$qSENSPA = 1.085 \times CFMPA \times (TPA - TROOM)$$

- Primary air latent cooling can be calculated by the following equation:

$$qLATENT = 0.69 \times CFMPA \times (WROOM - WPA)$$

where WROOM and WPA are the humidity ratio of the room and primary air respectively expressed in Grains of moisture per pound dry air

TABLE 4: CORRECTION FOR (ΔT) BETWEEN ENTERING AIR AND ENTERING CHILLED WATER

Actual ΔT	10	12	14	16	18	20	22	24
Multiply Table Value by:	0.56	0.67	0.78	0.89	1	1.11	1.22	1.33

Heating performance:

- Heating capacity listed (qCOIL) is the sensible heat removal by the beam's integral coil. It does not include any contribution or offset by the primary air
- Capacity is based on 50°F ΔT between the induced air and the chilled water supply.
- Primary air sensible heating offset (or contribution) can be calculated by the following equation:

$$qSENSPA = 1.085 \times CFMPA \times (TPA - TROOM)$$

if the primary air temperature is lower than that of the room, it will offset the coil's heating

if the primary air temperature is higher than that of the room, it will contribute to the coil's heating

Legend:

ΔP_S = Unit Inlet Pressure [in wg]

qCoil = Sensible Capacity, Coil [Btu/h]

ΔCoil = Water coil pressure drop [ft wg]

qSENSPA = Sensible Capacity, Primary Air [Btu/h]

CFMPA = Air Flowrate, Primary Air [CFM]

TPA = Temperature Primary Air [°F]

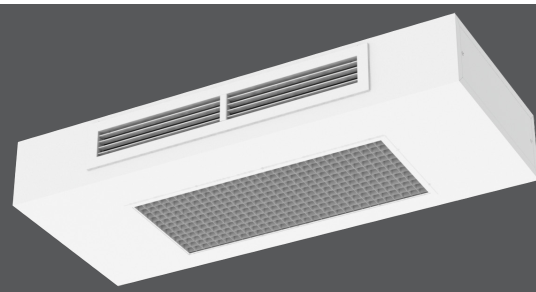
TROOM = Temperature Room Air [°F]

qSENSPA = Latent Capacity, Primary Air [Btu/h]

Bulkhead Mounted Exposed Active Chilled Beams

CBAC

- Provides comfortable, effective sensible cooling to the space
- Optimized nozzle design provides high capacity and low noise levels
- Durable powder coated steel cabinet with tool-less access panels
- Quick and simple installation
- Available in nominal lengths up to 6 feet
- ½" Sweat or ½" MNPT coil connections



CBAC

hotels / motels | retrofit | dual-function | universities | energy solutions

See website for Specifications

AVAILABLE MODEL:

CBAC / Bulkhead Mounted Exposed Active Chilled Beam

FINISHES:

Standard Finish - #26 White
Optional Finish - #84 Black

OVERVIEW

Titus active chilled beams benefit from the use of using hydronic coils and induced air to reduce energy consumption associated with removal of sensible thermal loads. The primary air is supplied to the chilled beam subsequent to it being discharged through a series of nozzles located along the length of the beam. The nozzles inject the primary air into the mixing chamber at velocities capable of inducing plenum or soffit air through the water coil and where it mixes with the primary supply air. This mixture of air is then discharged into the space through ceiling slot diffusers. This provides high cooling outputs with low amounts of primary air. The reduced volume of air results in the reduction of the air handler capacity and size, smaller duct sizes, and the overall energy consumption.

The supplied air from the air handling unit is tempered and dehumidified to handle the latent load. The remaining loads in the space are addressed with the heat exchanger which is incorporated into the chilled beam. Applications with low latent cooling loads could use 100 percent outdoor air allowing for use of a dedicated outdoor air system with energy recovery further reducing total system energy consumption.

The CBAC bulkhead beams are the ideal solution for single room hospitality spaces, such as hotel, dorm, and hospital rooms. With their shallow height, ceiling heights can be maximized creating an open and inviting space. Exposed bulkhead chilled beams are great for use in retrofit of buildings which were not originally built with HVAC systems originally installed.

ADVANTAGES

- Removal of high thermal loads is possible in this air/water system
- The height of the air duct system is reduced to a minimum, due to the low supply of primary air
- Substantial reduction in the operating costs, due to low primary air volume
- Improvement of the thermal comfort inside the room
- Contributing sound levels below NC-30

CBAC STANDARD FEATURES

- 2 foot to 6 foot nominal lengths
- Left hand or right hand coil connections
- Rear air inlet location
- Durable powder coated steel cabinet
- Louvered supply grille
- Perforated return grille
- 2-pipe and 4-pipe coil configurations
- Configured nozzle geometry for capacity optimization
- Commissioning port with roomside access for balancing
- Mounting brackets with adjustments in two directions
- ½" Sweat water coil connections
- Coil air vent

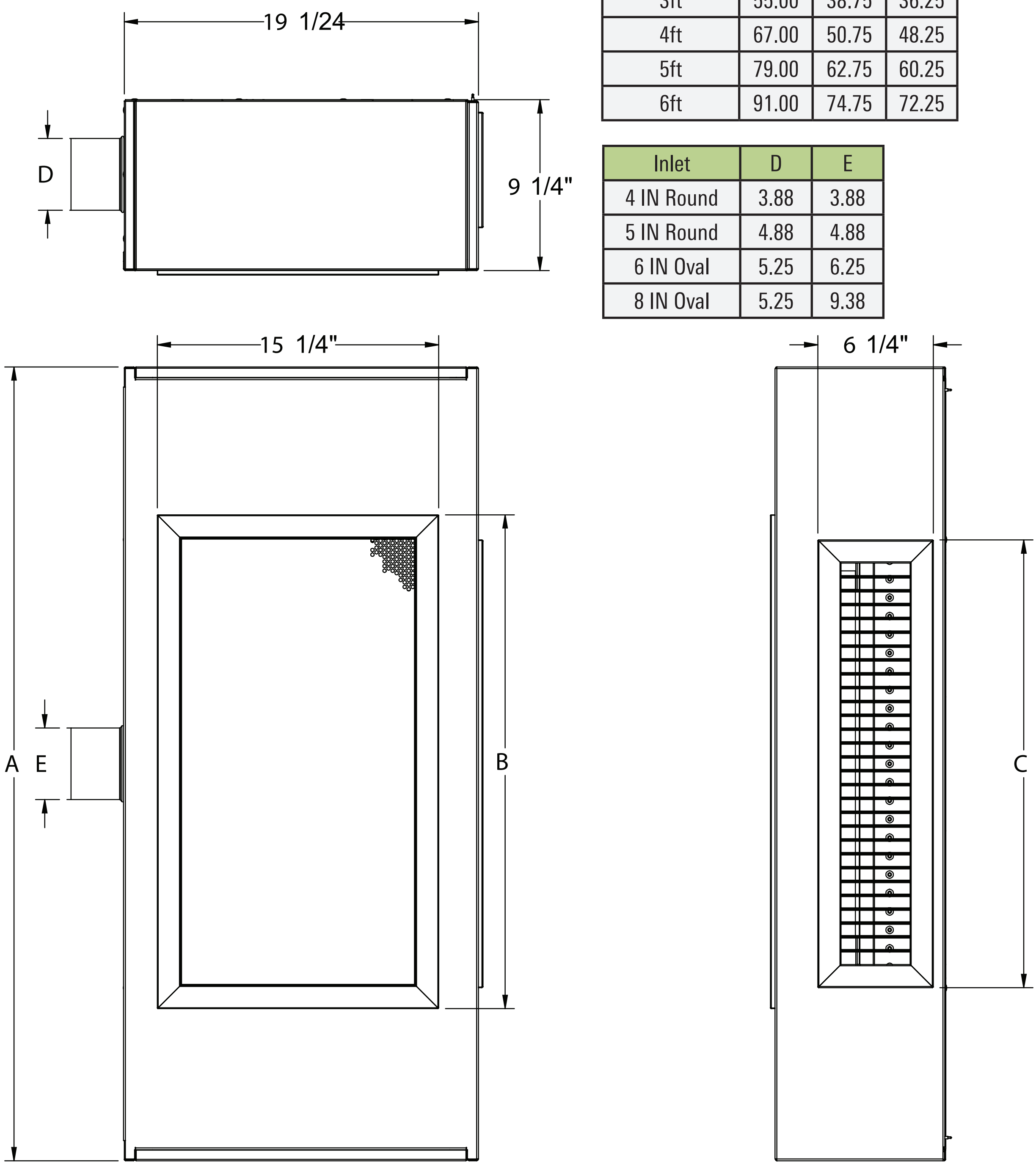
OPTIONS AND ACCESSORIES

- Linear Bar supply grille
- Linear Bar return grille
- Louvered return grille
- Eggcrate return grille
- ½" thick foil-faced EcoShield, anti-microbial external insulation
- Coil drain valve
- ½" MNPT water coil connections
- 12-inch, 18-inch or 24-inch stainless steel braided hoses

CBAC UNIT DIMENSIONS

Nominal	A	B	C
2ft	43.00	26.75	24.25
3ft	55.00	38.75	36.25
4ft	67.00	50.75	48.25
5ft	79.00	62.75	60.25
6ft	91.00	74.75	72.25

Inlet	D	E
4 IN Round	3.88	3.88
5 IN Round	4.88	4.88
6 IN Oval	5.25	6.25
8 IN Oval	5.25	9.38



All dimensions are in inches

CBAC / 4-PIPE COOLING

Nominal Length ft	Nozzle Size	Primary Air: Inlet Dia. Inches	Primary Air: Flow Rate CFM	Primary Air: Inlet ΔPS (in. H2O)	Sound NC	0.5 GPM qCOIL	0.5 GPM ΔCOIL	1.0 GPM qCOIL	1.0 GPM ΔCOIL	1.5 GPM qCOIL	1.5 GPM ΔCOIL	2.0 GPM qCOIL	2.0 GPM ΔCOIL	Induction ratio	Throw ft.
3	B2	4	8	0.21	-	392	0.74	493	2.95	530	6.47	557	1.50	6.0	1 - 2 - 8
			11	0.39	-	562		708		761		800			2 - 4 - 12
			14	0.63	20	638		803		863		907			3 - 6 - 16
			17	0.93	26	703		885		952		1,000			4 - 9 - 18
	B3	4	15	0.20	-	803	0.74	1,011	2.95	1,087	6.47	1,143	1.50	4.5	2 - 4 - 13
			20	0.36	-	1,117		1,406		1,512		1,589			4 - 8 - 17
			25	0.56	19	1,231		1,550		1,666		1,751			6 - 11 - 19
			30	0.80	25	1,375		1,731		1,861		1,956			8 - 13 - 21
	B4	4	30	0.22	-	1,086	0.74	1,367	2.95	1,470	6.47	1,545	1.50	2.7	4 - 8 - 17
			40	0.39	17	1,305		1,642		1,766		1,856			6 - 12 - 20
			50	0.61	24	1,479		1,862		2,001		2,104			10 - 15 - 22
			60	0.88	29	1,631		2,053		2,208		2,320			12 - 17 - 24
4	B2	4	11	0.20	-	886	0.95	1,115	3.80	1,199	8.55	1,260	1.94	6.0	1 - 2 - 10
			15	0.38	-	1,273		1,602		1,723		1,811			2 - 5 - 15
			19	0.61	21	1,443		1,816		1,952		2,052			3 - 7 - 19
			23	0.89	27	1,591		2,003		2,154		2,264			5 - 11 - 21
	B3	4	21	0.21	-	1,130	0.95	1,423	3.80	1,530	8.55	1,608	1.94	4.5	2 - 6 - 16
			28	0.36	-	1,456		1,833		1,971		2,071			4 - 10 - 20
			35	0.57	21	1,627		2,049		2,203		2,315			7 - 13 - 23
			42	0.82	27	1,850		2,328		2,503		2,631			10 - 16 - 25
	B4	4	35	0.17	-	1,164	0.95	1,465	3.80	1,575	8.55	1,656	1.94	2.7	3 - 7 - 18
			50	0.34	15	1,646		2,072		2,227		2,341			6 - 13 - 22
			65	0.58	23	1,895		2,386		2,565		2,696			11 - 17 - 25
			80	0.88	30	2,091		2,632		2,829		2,974			14 - 20 - 28
5	B2	4	15	0.23	-	1,197	1.16	1,506	4.65	1,619	1.33	1,702	2.37	6.0	1 - 3 - 13
			20	0.41	16	1,438		1,811		1,947		2,046			3 - 6 - 17
			25	0.64	23	1,672		2,105		2,263		2,378			4 - 9 - 22
			30	0.93	28	1,798		2,263		2,433		2,557			6 - 13 - 24
	B3	4	25	0.18	-	1,250	1.16	1,573	4.65	1,692	1.33	1,778	2.37	4.5	2 - 6 - 17
			35	0.35	15	1,768		2,225		2,392		2,514			5 - 11 - 23
			45	0.58	23	2,036		2,563		2,755		2,896			8 - 15 - 26
			55	0.86	29	2,245		2,827		3,039		3,194			12 - 19 - 28
	B4	6" oval	40	0.14	-	1,180	1.16	1,486	4.65	1,597	1.33	1,679	2.37	2.7	3 - 6 - 18
			60	0.32	-	1,819		2,290		2,462		2,588			6 - 14 - 24
			80	0.56	15	2,130		2,681		2,883		3,030			11 - 18 - 28
			100	0.88	22	2,349		2,958		3,180		3,342			15 - 22 - 31
6	B2	4	20	0.28	-	1,916	1.38	2,412	5.51	2,593	1.58	2,725	2.81	6.0	2 - 4 - 16
			25	0.43	18	1,882		2,369		2,547		2,677			3 - 7 - 20
			30	0.62	23	2,118		2,666		2,866		3,013			4 - 10 - 24
			35	0.85	28	2,278		2,867		3,082		3,240			6 - 13 - 26
	B3	4	35	0.24	-	1,760	1.38	2,215	5.51	2,382	1.58	2,503	2.81	4.5	4 - 8 - 22
			45	0.39	17	2,117		2,664		2,864		3,011			6 - 14 - 26
			55	0.58	23	2,398		3,018		3,245		3,411			9 - 17 - 28
			65	0.81	29	2,645		3,329		3,579		3,762			13 - 20 - 31
	B4	6" oval	60	0.22	-	1,989	1.38	2,504	5.51	2,692	1.58	2,829	2.81	2.7	5 - 11 - 24
			80	0.39	-	2,392		3,011		3,237		3,402			9 - 17 - 28
			100	0.61	17	2,710		3,411		3,667		3,855			13 - 21 - 31
			120	0.87	22	2,989		3,763		4,045		4,252			17 - 24 - 34

Note: Reference page U95 for operational conditions used for performance notes

CBAC / 4-PIPE HEATING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil Heating (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
3	B2	4	8	0.21	-	1,156	0.12	1,455	0.49	1,564	1.10	1,644	1.95	6.0	1 - 2 - 8
			11	0.39	-	1,633		2,056		2,211		2,324			2 - 4 - 12
			14	0.63	20	1,881		2,368		2,546		2,676			3 - 6 - 16
			17	0.93	26	2,075		2,612		2,808		2,952			4 - 9 - 18
	B3	4	15	0.20	-	1,833	0.12	2,308	0.49	2,481	1.10	2,608	1.95	4.5	2 - 4 - 13
			20	0.36	-	2,550		3,210		3,451		3,627			4 - 8 - 17
			25	0.56	19	2,810		3,537		3,802		3,997			6 - 11 - 19
			30	0.80	25	3,139		3,952		4,248		4,465			8 - 13 - 21
	B4	4	30	0.22	-	2,479	0.12	3,120	0.49	3,355	1.10	3,526	1.95	2.7	4 - 8 - 17
			40	0.39	17	2,978		3,748		4,030		4,236			6 - 12 - 20
			50	0.61	24	3,375		4,249		4,568		4,802			10 - 15 - 22
			60	0.88	29	3,773		4,750		5,106		5,367			12 - 17 - 24
4	B2	4	11	0.20	-	2,022	0.16	2,546	0.63	2,737	1.41	2,877	2.51	6.0	1 - 2 - 10
			15	0.38	-	2,905		3,657		3,932		4,133			2 - 5 - 15
			19	0.61	21	3,293		4,145		4,456		4,684			3 - 7 - 19
			23	0.89	27	3,632		4,572		4,915		5,166			5 - 11 - 21
	B3	4	21	0.21	-	2,580	0.16	3,247	0.63	3,491	1.41	3,670	2.51	4.5	2 - 6 - 16
			28	0.36	-	3,324		4,184		4,498		4,728			4 - 10 - 20
			35	0.57	21	4,245		5,344		5,745		6,038			7 - 13 - 23
			42	0.82	27	4,222		5,315		5,714		6,005			10 - 16 - 25
	B4	4	35	0.17	-	2,657	0.16	3,345	0.63	3,596	1.41	3,779	2.51	2.7	3 - 7 - 18
			50	0.34	15	3,756		4,729		5,084		5,343			6 - 13 - 22
			65	0.58	23	4,326		5,446		5,855		6,154			11 - 17 - 25
			80	0.88	30	4,836		6,087		6,544		6,879			14 - 20 - 28
5	B2	4	15	0.23	-	2,731	0.19	3,438	0.78	3,696	1.75	3,885	3.11	6.0	1 - 3 - 13
			20	0.41	16	3,283		4,133		4,443		4,670			3 - 6 - 17
			25	0.64	23	3,816		4,804		5,164		5,428			4 - 9 - 22
			30	0.93	28	4,104		5,166		5,554		5,837			6 - 13 - 24
	B3	4	25	0.18	-	2,853	0.19	3,591	0.78	3,861	1.75	4,058	3.11	4.5	2 - 6 - 17
			35	0.35	15	4,035		5,079		5,460		5,739			5 - 11 - 23
			45	0.58	23	4,646		5,849		6,288		6,609			8 - 15 - 26
			55	0.86	29	5,125		6,452		6,936		7,291			12 - 19 - 28
	B4	4	40	0.14	-	2,694	0.19	3,391	0.78	3,646	1.75	3,832	3.11	2.7	3 - 6 - 18
			60	0.32	-	4,152		5,227		5,619		5,906			6 - 14 - 24
			80	0.56	15	4,862		6,120		6,580		6,916			11 - 18 - 28
			100	0.88	22	5,363		6,751		7,257		7,628			15 - 22 - 31
6	B2	4	20	0.28	-	3,746	0.23	4,716	0.92	5,070	2.06	5,329	3.67	6.0	2 - 4 - 16
			25	0.43	18	3,816		4,804		5,164		5,428			3 - 7 - 20
			30	0.62	23	4,834		6,085		6,542		6,877			4 - 10 - 24
			35	0.85	28	5,199		6,544		7,035		7,395			6 - 13 - 26
	B3	4	35	0.24	-	4,017	0.23	5,057	0.92	5,436	2.50	5,714	3.67	4.5	4 - 8 - 22
			45	0.39	17	4,831		6,081		6,538		6,872			6 - 14 - 26
			55	0.58	23	5,473		6,889		7,407		7,785			9 - 17 - 28
			65	0.81	29	6,118		7,701		8,279		8,702			13 - 20 - 31
	B4	4	60	0.22	-	4,540	0.23	5,715	0.92	6,144	2.50	6,458	3.67	2.7	5 - 11 - 24
			80	0.39	-	5,459		6,872		7,388		7,766			9 - 17 - 28
			100	0.61	17	6,185		7,786		8,370		8,798			13 - 21 - 31
			120	0.87	22	6,822		8,588		9,233		9,705			17 - 24 - 34

Note: Reference page U95 for operational conditions used for performance notes

CBAC / 2-PIPE COOLING

Nominal Length	Nozzle Size	Primary Air			Sound	Coil Sensible Cooling (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
ft		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
3	B2	4	8	0.21	-	439	0.92	552	2.69	594	8.30	624	1.88	6.0	1 - 2 - 8
			11	0.39	-	630		793		852		896			2 - 4 - 12
			14	0.63	20	714		899		966		1,016			3 - 6 - 16
			17	0.93	26	788		992		1,066		1,120			4 - 9 - 18
	B3	4	15	0.20	-	900	0.92	1,132	2.69	1,217	8.30	1,280	1.88	4.5	2 - 4 - 13
			20	0.36	-	1,251		1,575		1,693		1,780			4 - 8 - 17
			25	0.56	19	1,379		1,736		1,866		1,961			6 - 11 - 19
			30	0.80	25	1,540		1,939		2,085		2,191			8 - 13 - 21
	B4	4	30	0.22	-	1,216	0.92	1,531	2.69	1,646	8.30	1,730	1.88	2.7	4 - 8 - 17
			40	0.39	17	1,461		1,839		1,977		2,078			6 - 12 - 20
			50	0.61	24	1,656		2,085		2,242		2,356			10 - 15 - 22
			60	0.88	29	1,827		2,300		2,472		2,599			12 - 17 - 24
4	B2	4	11	0.20	-	992	1.19	1,249	4.76	1,343	1.37	1,412	2.43	6.0	1 - 2 - 10
			15	0.38	-	1,426		1,795		1,929		2,028			2 - 5 - 15
			19	0.61	21	1,616		2,034		2,187		2,298			3 - 7 - 19
			23	0.89	27	1,782		2,243		2,412		2,535			5 - 11 - 21
	B3	4	21	0.21	-	1,266	1.19	1,593	4.76	1,713	1.37	1,801	2.43	4.5	2 - 6 - 16
			28	0.36	-	1,631		2,053		2,207		2,320			4 - 10 - 20
			35	0.57	21	1,823		2,295		2,467		2,593			7 - 13 - 23
			42	0.82	27	2,072		2,608		2,804		2,947			10 - 16 - 25
	B4	4	35	0.17	-	1,304	1.19	1,641	4.76	1,764	1.37	1,855	2.43	2.7	3 - 7 - 18
			50	0.34	15	1,843		2,320		2,495		2,622			6 - 13 - 22
			65	0.58	23	2,123		2,672		2,873		3,020			11 - 17 - 25
			80	0.88	30	2,342		2,948		3,169		3,331			14 - 20 - 28
5	B2	4	15	0.23	-	1,340	1.46	1,687	5.83	1,814	1.33	1,906	2.97	6.0	1 - 3 - 13
			20	0.41	16	1,611		2,028		2,180		2,292			3 - 6 - 17
			25	0.64	23	1,872		2,357		2,534		2,664			4 - 9 - 22
			30	0.93	28	2,014		2,535		2,725		2,864			6 - 13 - 24
	B3	4	25	0.18	-	1,400	1.46	1,762	5.83	1,895	1.67	1,991	2.97	4.5	2 - 6 - 17
			35	0.35	15	1,980		2,492		2,679		2,816			5 - 11 - 23
			45	0.58	23	2,280		2,870		3,086		3,243			8 - 15 - 26
			55	0.86	29	2,515		3,166		3,404		3,577			12 - 19 - 28
	B4	6" oval	40	0.14	-	1,322	1.46	1,664	5.83	1,789	1.33	1,880	2.97	2.7	3 - 6 - 18
			60	0.32	-	2,037		2,565		2,757		2,898			6 - 14 - 24
			80	0.56	15	2,386		3,003		3,229		3,393			11 - 18 - 28
			100	0.88	22	2,631		3,313		3,561		3,743			15 - 22 - 31
6	B2	4	20	0.28	-	2,146	1.72	2,701	6.89	2,904	1.98	3,052	3.52	6.0	2 - 4 - 16
			25	0.43	18	2,108		2,653		2,852		2,998			3 - 7 - 20
			30	0.62	23	2,372		2,986		3,210		3,374			4 - 10 - 24
			35	0.85	28	2,551		3,211		3,452		3,629			6 - 13 - 26
	B3	4	35	0.24	-	1,971	1.72	2,481	6.89	2,668	1.98	2,804	3.52	4.5	4 - 8 - 22
			45	0.39	17	2,371		2,984		3,208		3,372			6 - 14 - 26
			55	0.58	23	2,686		3,381		3,634		3,820			9 - 17 - 28
			65	0.81	29	2,962		3,729		4,009		4,214			13 - 20 - 31
	B4	6" oval	60	0.22	-	2,228	1.72	2,804	6.89	3,015	1.98	3,169	3.52	2.7	5 - 11 - 24
			80	0.39	-	2,679		3,372		3,625		3,811			9 - 17 - 28
			100	0.61	17	3,035		3,820		4,107		4,317			13 - 21 - 31
			120	0.87	22	3,348		4,214		4,530		4,762			17 - 24 - 34

Note: Reference page U95 for operational conditions used for performance notes

CBAC / 2-PIPE HEATING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil Heating (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
3	B2	4	8	0.21	-	1,560	0.92	1,964	2.69	2,112	8.30	2,219	1.88	6.0	1 - 2 - 8
			11	0.39	-	2,205		2,776		2,984		3,137			2 - 4 - 12
			14	0.63	20	2,540		3,197		3,437		3,613			3 - 6 - 16
			17	0.93	26	2,801		3,526		3,791		3,985			4 - 9 - 18
	B3	4	15	0.20	-	2,475	0.92	3,115	2.69	3,349	8.30	3,521	1.88	4.5	2 - 4 - 13
			20	0.36	-	3,442		4,333		4,658		4,896			4 - 8 - 17
			25	0.56	19	3,793		4,775		5,133		5,396			6 - 11 - 19
			30	0.80	25	4,238		5,335		5,735		6,028			8 - 13 - 21
	B4	4	30	0.22	-	3,346	0.92	4,212	2.69	4,529	8.30	4,760	1.88	2.7	4 - 8 - 17
			40	0.39	17	4,020		5,060		5,440		5,718			6 - 12 - 20
			50	0.61	24	4,557		5,736		6,167		6,482			10 - 15 - 22
			60	0.88	29	5,094		6,412		6,894		7,246			12 - 17 - 24
4	B2	4	11	0.20	-	2,730	1.19	3,437	4.76	3,695	1.37	3,884	2.43	6.0	1 - 2 - 10
			15	0.38	-	3,922		4,937		5,308		5,579			2 - 5 - 15
			19	0.61	21	4,445		5,596		6,016		6,323			3 - 7 - 19
			23	0.89	27	4,903		6,172		6,636		6,975			5 - 11 - 21
	B3	4	21	0.21	-	3,483	1.19	4,384	4.76	4,713	1.37	4,954	2.43	4.5	2 - 6 - 16
			28	0.36	-	4,487		5,648		6,072		6,382			4 - 10 - 20
			35	0.57	21	5,731		7,214		7,755		8,152			7 - 13 - 23
			42	0.82	27	5,699		7,175		7,713		8,107			10 - 16 - 25
	B4	4	35	0.17	-	3,587	1.19	4,515	4.76	4,854	1.37	5,102	2.43	2.7	3 - 7 - 18
			50	0.34	15	5,071		6,384		6,863		7,214			6 - 13 - 22
			65	0.58	23	5,840		7,352		7,904		8,308			11 - 17 - 25
			80	0.88	30	6,528		8,218		8,835		9,286			14 - 20 - 28
5	B2	4	15	0.23	-	3,687	1.46	4,641	5.83	4,990	1.33	5,245	2.97	6.0	1 - 3 - 13
			20	0.41	16	4,432		5,579		5,998		6,305			3 - 6 - 17
			25	0.64	23	5,152		6,485		6,972		7,328			4 - 9 - 22
			30	0.93	28	5,540		6,974		7,497		7,880			6 - 13 - 24
	B3	4	25	0.18	-	3,852	1.46	4,848	5.83	5,212	1.67	5,479	2.97	4.5	2 - 6 - 17
			35	0.35	15	5,447		6,857		7,371		7,748			5 - 11 - 23
			45	0.58	23	6,273		7,896		8,489		8,923			8 - 15 - 26
			55	0.86	29	6,919		8,710		9,364		9,842			12 - 19 - 28
	B4	4	40	0.14	-	3,637	1.46	4,578	5.83	4,921	1.33	5,173	2.97	2.7	3 - 6 - 18
			60	0.32	-	5,606		7,056		7,586		7,974			6 - 14 - 24
			80	0.56	15	6,563		8,262		8,882		9,336			11 - 18 - 28
			100	0.88	22	7,240		9,113		9,798		10,298			15 - 22 - 31
6	B2	4	20	0.28	-	5,057	1.72	6,366	6.89	6,844	1.98	7,194	3.52	6.0	2 - 4 - 16
			25	0.43	18	5,152		6,485		6,972		7,328			3 - 7 - 20
			30	0.62	23	6,526		8,215		8,832		9,283			4 - 10 - 24
			35	0.85	28	7,018		8,834		9,498		9,983			6 - 13 - 26
	B3	4	35	0.24	-	5,423	1.72	6,827	6.89	7,339	1.98	7,714	3.52	4.5	4 - 8 - 22
			45	0.39	17	6,522		8,210		8,826		9,277			6 - 14 - 26
			55	0.58	23	7,388		9,301		9,999		10,510			9 - 17 - 28
			65	0.81	29	8,259		10,396		11,177		11,748			13 - 20 - 31
	B4	4	60	0.22	-	6,129	1.72	7,715	6.89	8,294	1.98	8,718	3.52	2.7	5 - 11 - 24
			80	0.39	-	7,370		9,278		9,974		10,484			9 - 17 - 28
			100	0.61	17	8,350		10,511		11,300		11,877			13 - 21 - 31
			120	0.87	22	9,210		11,594		12,464		13,101			17 - 24 - 34

Note: Reference page U95 for operational conditions used for performance notes

NOTES:

1. All performance data based on test performed in accordance with ASHRAE Standard 200-2015
2. ΔP_s values are measured in inches of water
3. NC values are based on room absorption of 10 dB. A dash (-) indicates an NC value less than 15.
4. Throw values are based on isothermal supply air and represent throw distances to terminal velocities of 150, 100 and 50 fpm respectively
5. ΔP_{Coil} values are measured in feet of water. ΔP_{Coil} values in shaded cells indicate use of a two circuit coil. All other values represent a single circuit coil.
6. Induction ratio is multiplied by the volume flow rate of primary air to estimate the volume flow rate of room air entrained through the coil

Cooling performance:

- Cooling capacity listed (qCOIL) is the sensible heat removal by the beam's integral coil. It does not include any contribution or offset by the primary air
- Capacity is based on 18°F ΔT between the induced air and the chilled water supply.
- Primary air sensible cooling contribution can be calculated by the following equation:

qSENSPA = 1.085 x CFMPA x (TPA - TROOM)

- Primary air latent cooling can be calculated by the following equation:

qLATENT = 0.69 x CFMPA x (WROOM - WPA)

where WROOM and WPA are the humidity ratio of the room and primary air respectively expressed in Grains of moisture per pound dry air

TABLE 4: CORRECTION FOR (ΔT) BETWEEN ENTERING AIR AND ENTERING CHILLED WATER

Actual ΔT	10	12	14	16	18	20	22	24
Multiply Table Value by:	0.56	0.67	0.78	0.89	1.00	1.11	1.22	1.33

Heating performance:

- Heating capacity listed (qCOIL) is the sensible heat removal by the beam's integral coil. It does not include any contribution or offset by the primary air
- Capacity is based on 50°F ΔT between the induced air and the chilled water supply.
- Primary air sensible heating offset (or contribution) can be calculated by the following equation:

qSENSPA = 1.085 x CFMPA x (TPA - TROOM)

if the primary air temperature is lower than that of the room, it will offset the coil's heating

if the primary air temperature is higher than that of the room, it will contribute to the coil's heating

Legend:

ΔP_S = Unit Inlet Pressure [in wg]

qCoil = Sensible Capacity, Coil [Btu/h]

ΔCoil = Water coil pressure drop [ft wg]

qSENSPA = Sensible Capacity, Primary Air [Btu/h]

CFMPA = Air Flowrate, Primary Air [CFM]

TPA = Temperature Primary Air [°F]

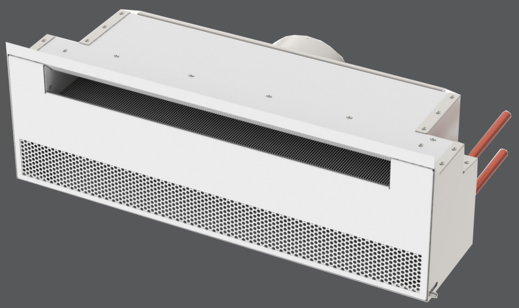
TROOM = Temperature Room Air [°F]

qSENSPA = Latent Capacity, Primary Air [Btu/h]

Sidewall Active Chilled Beams

CBAW

- Provides comfortable, effective sensible cooling to the space
- Optimized nozzle design provides high capacity and low noise levels
- Ideal for multi-story residential and hospitality spaces
- Quick and simple installation
- Available in nominal lengths up to 10 feet
- ½" Sweat or ½" MNPT coil connections



CBAW

hotels / motels | dual-function | universities | energy solutions

See website for Specifications

AVAILABLE MODEL:

CBAW / Sidewall Active Chilled Beam

OVERVIEW

Titus active chilled beams benefit from the use of using hydronic coils and induced air to reduce energy consumption associated with removal of sensible thermal loads. The primary air is supplied to the chilled beam subsequent to it being discharged through a series of nozzles located along the length of the beam. The nozzles inject the primary air into the mixing chamber at velocities capable of inducing plenum or soffit air through the water coil and where it mixes with the primary supply air. This mixture of air is then discharged into the space through ceiling slot diffusers. This provides high cooling outputs with low amounts of primary air. The reduced volume of air results in the reduction of the air handler capacity and size, smaller duct sizes, and the overall energy consumption.

The supplied air from the air handling unit is tempered and dehumidified to handle the latent load. The remaining loads in the space are addressed with the heat exchanger which is incorporated into the chilled beam. Applications with low latent cooling loads could use 100 percent outdoor air allowing for use of a dedicated outdoor air system with energy recovery further reducing total system energy consumption.

In multi-story residential and hospitality spaces, the CBAW sidewall beams complement modern architectural styling and minimize installed space, as well as minimizing energy consumption. Superior comfort and near maintenance free operation of the CBAW product family, combined with energy efficiency are an ideal solution in such demanding applications.

ADVANTAGES

- Removal of high thermal loads is possible in this air/water system
- The height of the air duct system is reduced to a minimum, due to the low supply of primary air
- Substantial reduction in the operating costs, due to low primary air volume
- Improvement of the thermal comfort inside the room
- Contributing sound levels below NC-30

CBAW STANDARD FEATURES

- 2 foot to 10 foot lengths, 1 foot increments
- 2-pipe and 4-pipe coil configurations
- Configured nozzle geometry for capacity optimization
- Commissioning port with roomside access for balancing
- ½" Sweat water coil connections
- Coil air vent
- Perforated grille

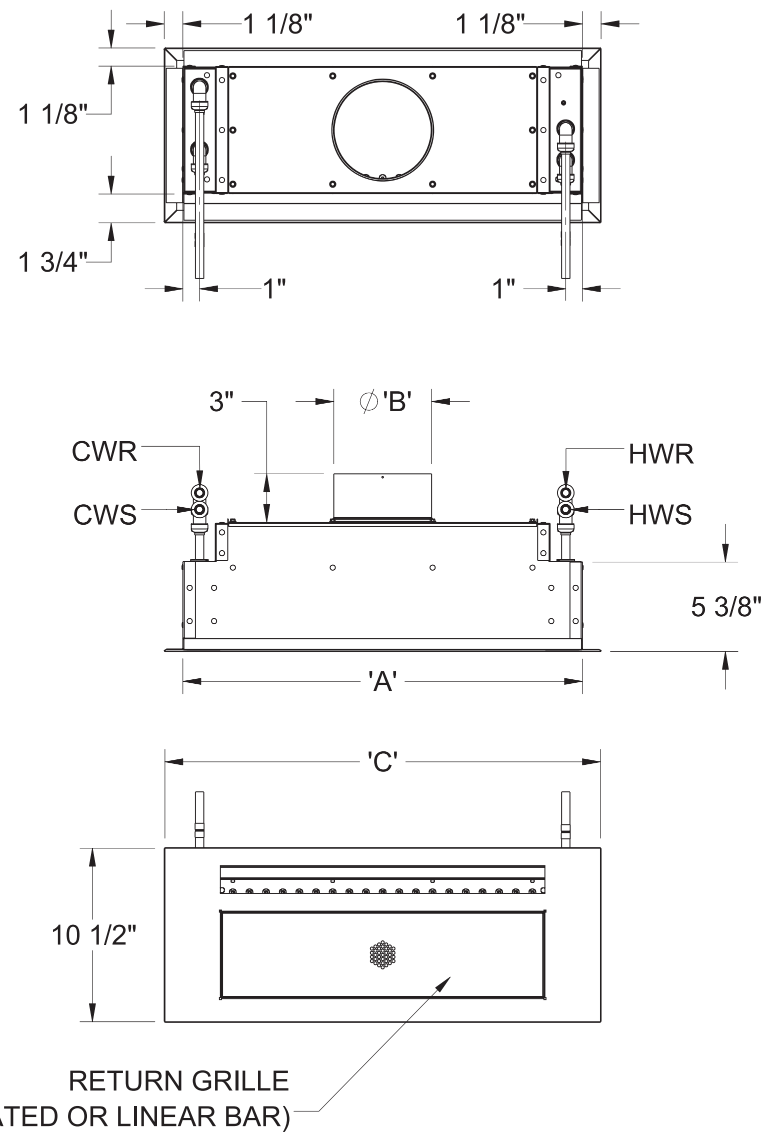
OPTIONS AND ACCESSORIES

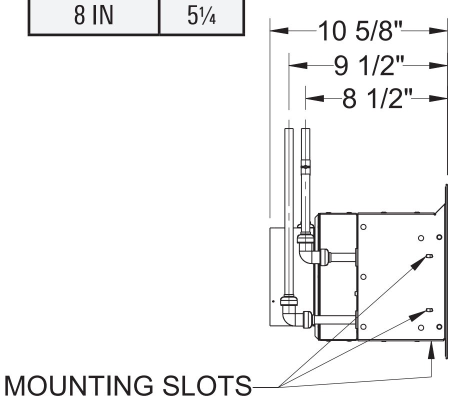
- Linear bar grille
- ½" thick foil-faced EcoShield, anti-microbial external insulation
- Coil drain valve
- ½" MNPT water coil connections
- 12-inch, 18-inch or 24-inch stainless steel braided hoses

CBAW UNIT DIMENSIONS

Nominal Length	A	C
2ft	24	26⅛
3ft	36	38⅛
4ft	48	50⅛
5ft	60	62⅛
6ft	72	74⅛
7ft	84	86⅛
8ft	96	98⅛
9ft	108	110⅛
10ft	120	122⅛

Nominal Inlet	B
4 IN	3⅞
5 IN	4⅞
6 IN	5¼
8 IN	5¼





All dimensions are in inches

CBAW / 4-PIPE COOLING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil Sensible Cooling (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
3	B2	4	8	0.24	-	513	0.28	645	1.11	694	2.50	729	4.44	4.4	1 - 2 - 6
			10	0.38	19	616		776		834		877			1 - 2 - 8
			12	0.54	23	678		853		917		964			2 - 4 - 9
			14	0.74	27	734		924		994		1,044			2 - 5 - 11
	B3	4	14	0.21	16	546		687		739		777		3.6	2 - 5 - 11
			18	0.34	22	667		839		902		948			4 - 7 - 12
			22	0.51	27	762		959		1,031		1,084			5 - 8 - 13
			26	0.71	31	851		1,072		1,152		1,211			7 - 10 - 15
	B4	4	24	0.18	19	560		704		757		796		3.0	6 - 9 - 14
			32	0.31	26	750		944		1,015		1,067			8 - 12 - 16
			40	0.49	31	857		1,079		1,160		1,220			10 - 13 - 18
			48	0.70	36	958		1,206		1,296		1,363			12 - 14 - 20
4	B2	4	10	0.20	-	550	0.36	692	1.43	744	3.22	782	5.72	4.4	1 - 2 - 6
			13	0.34	20	737		928		998		1,048			1 - 3 - 9
			16	0.51	24	843		1,061		1,140		1,198			2 - 4 - 11
			19	0.73	28	941		1,185		1,274		1,339			3 - 6 - 13
	B3	4	18	0.18	17	638		803		863		907		3.6	2 - 5 - 12
			24	0.32	24	855		1,076		1,157		1,216			4 - 8 - 14
			30	0.49	29	977		1,230		1,322		1,390			6 - 10 - 16
			36	0.71	33	1,092		1,374		1,477		1,553			8 - 12 - 17
	B4	4	35	0.20	-	788		991		1,066		1,120		3.0	8 - 12 - 17
			45	0.34	20	962		1,211		1,302		1,368			10 - 14 - 19
			55	0.50	24	1,099		1,384		1,488		1,564			12 - 15 - 21
			65	0.71	28	1,228		1,546		1,662		1,747			13 - 16 - 23
5	B2	4	12	0.18	-	668	0.44	840	1.75	903	3.94	950	7.00	4.4	1 - 2 - 7
			16	0.31	20	895		1,126		1,211		1,273			1 - 3 - 10
			20	0.49	26	1,023		1,288		1,384		1,455			2 - 5 - 12
			24	0.70	30	1,143		1,439		1,546		1,626			3 - 7 - 14
	B3	4	24	0.18	20	774		974		1,048		1,101		3.6	3 - 7 - 14
			30	0.29	25	1,038		1,306		1,404		1,476			5 - 9 - 16
			36	0.41	29	1,149		1,447		1,555		1,635			7 - 11 - 17
			42	0.56	33	1,260		1,586		1,705		1,792			8 - 13 - 19
	B4	6" oval	40	0.19	-	871		1,096		1,179		1,239		3.0	8 - 12 - 18
			55	0.35	20	1,168		1,470		1,580		1,661			11 - 15 - 21
			70	0.57	26	1,335		1,680		1,806		1,898			14 - 17 - 24
			85	0.84	31	1,491		1,877		2,018		2,121			15 - 19 - 27
6	B2	4	15	0.19	16	786	0.52	990	2.07	1,064	4.66	1,118	8.28	4.4	1 - 2 - 8
			20	0.33	23	1,054		1,327		1,426		1,499			2 - 4 - 11
			25	0.52	28	1,205		1,517		1,631		1,714			2 - 5 - 14
			30	0.74	32	1,346		1,694		1,822		1,915			4 - 8 - 16
	B3	4	28	0.18	20	912		1,148		1,234		1,297		3.6	3 - 7 - 15
			36	0.29	26	1,354		1,704		1,832		1,925			5 - 10 - 17
			44	0.44	31	1,266		1,594		1,714		1,801			8 - 12 - 19
			52	0.61	35	1,484		1,868		2,009		2,111			9 - 14 - 21
	B4	6" oval	50	0.17	15	1,026		1,291		1,388		1,459		3.0	9 - 14 - 20
			70	0.34	23	1,375		1,731		1,861		1,956			13 - 17 - 24
			90	0.56	29	1,621		2,041		2,194		2,306			16 - 19 - 27
			110	0.83	34	1,843		2,319		2,494		2,621			17 - 21 - 30

Note: Reference page U102 for operational conditions used for performance notes

CBAW / 4-PIPE HEATING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil Heating (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
3	B2	4	8	0.24	-	1,359	0.09	1,710	0.37	1,839	0.82	1,933	1.46	4.4	1 - 2 - 6
			10	0.38	19	1,633		2,056		2,210		2,323			1 - 2 - 8
			12	0.54	23	1,796		2,261		2,430		2,555			2 - 4 - 9
			14	0.74	27	1,946		2,449		2,633		2,768			2 - 5 - 11
	B3	4	14	0.21	16	1,447		1,821		1,958		2,058		3.6	2 - 5 - 11
			18	0.34	22	1,767		2,224		2,391		2,513			4 - 7 - 12
			22	0.51	27	2,020		2,542		2,733		2,873			5 - 8 - 13
			26	0.71	31	2,256		2,840		3,053		3,209			7 - 10 - 15
	B4	4	24	0.18	19	1,483		1,867		2,007		2,109		3.0	6 - 9 - 14
			32	0.31	26	1,988		2,502		2,690		2,828			8 - 12 - 16
			40	0.49	31	2,272		2,860		3,075		3,232			10 - 13 - 18
			48	0.70	36	2,539		3,196		3,436		3,611			12 - 14 - 20
4	B2	4	10	0.20	-	1,457	0.12	1,834	0.47	1,972	1.06	2,073	1.88	4.4	1 - 2 - 6
			13	0.34	20	1,953		2,459		2,643		2,778			1 - 3 - 9
			16	0.51	24	2,233		2,811		3,022		3,176			2 - 4 - 11
			19	0.73	28	2,494		3,140		3,376		3,548			3 - 6 - 13
	B3	4	18	0.18	17	1,690		2,127		2,287		2,403		3.6	2 - 5 - 12
			24	0.32	24	2,265		2,851		3,065		3,222			4 - 8 - 14
			30	0.49	29	2,589		3,259		3,504		3,683			6 - 10 - 16
			36	0.71	33	2,893		3,641		3,915		4,115			8 - 12 - 17
	B4	4	35	0.20	-	1,901		2,393		2,573		2,704		3.0	8 - 12 - 17
			45	0.34	20	2,549		3,208		3,449		3,625			10 - 14 - 19
			55	0.50	24	2,913		3,667		3,943		4,144			12 - 15 - 21
			65	0.71	28	3,255		4,097		4,405		4,630			13 - 16 - 23
5	B2	4	12	0.18	-	1,769	0.14	2,227	0.58	2,394	1.29	2,516	2.30	4.4	1 - 2 - 7
			16	0.31	20	2,371		2,985		3,209		3,373			1 - 3 - 10
			20	0.49	26	2,711		3,412		3,668		3,856			2 - 5 - 12
			24	0.70	30	3,028		3,812		4,098		4,308			3 - 7 - 14
	B3	4	24	0.18	20	2,051		2,582		2,776		2,918		3.6	3 - 7 - 14
			30	0.29	25	2,750		3,461		3,721		3,911			5 - 9 - 16
			36	0.41	29	3,045		3,833		4,121		4,332			7 - 11 - 17
			42	0.56	33	3,339		4,203		4,519		4,750			8 - 13 - 19
	B4	6" oval	40	0.19	-	2,308		2,905		3,124		3,283		3.0	8 - 12 - 18
			55	0.35	20	3,094		3,895		4,187		4,401			11 - 15 - 21
			70	0.57	26	3,537		4,452		4,786		5,031			14 - 17 - 24
			85	0.84	31	3,951		4,974		5,347		5,621			15 - 19 - 27
6	B2	4	15	0.19	16	2,084	0.17	2,623	0.69	2,820	1.54	2,964	2.74	4.4	1 - 2 - 8
			20	0.33	23	2,793		3,516		3,780		3,973			2 - 4 - 11
			25	0.52	28	3,193		4,019		4,321		4,542			2 - 5 - 14
			30	0.74	32	3,567		4,490		4,827		5,074			4 - 8 - 16
	B3	4	28	0.18	20	2,416		3,042		3,270		3,437		3.6	3 - 7 - 15
			36	0.29	26	3,587		4,515		4,854		5,102			5 - 10 - 17
			44	0.44	31	3,355		4,224		4,541		4,773			8 - 12 - 19
			52	0.61	35	3,933		4,951		5,323		5,595			9 - 14 - 21
	B4	6" oval	50	0.17	15	2,719		3,422		3,679		3,867		3.0	9 - 14 - 20
			70	0.34	23	3,645		4,588		4,932		5,184			13 - 17 - 24
			90	0.56	29	4,296		5,408		5,814		6,111			16 - 19 - 27
			110	0.83	34	4,883		6,147		6,608		6,946			17 - 21 - 30

Note: Reference page U102 for operational conditions used for performance notes

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CBAW / 2-PIPE COOLING

Nominal Length ft	Nozzle Size	Primary Air: Inlet Dia. (Inches)	Primary Air: Flow Rate (CFM)	Primary Air: Inlet ΔPS (in. H2O)	Sound NC	Coil Sensible Cooling (Btu/h) 0.5 GPM qCOIL	0.5 GPM ΔCOIL	1.0 GPM qCOIL	1.0 GPM ΔCOIL	1.5 GPM qCOIL	1.5 GPM ΔCOIL	2.0 GPM qCOIL	2.0 GPM ΔCOIL	Induction ratio	Throw ft.
3	B2	4	8	0.24	-	574	0.38	723	1.50	777	3.38	817	6.00	4.4	1 - 2 - 6
			8	0.38	19	690		869		934		982			1 - 2 - 8
			8	0.54	23	759		955		1,027		1,080			2 - 4 - 9
			8	0.74	27	822		1,035		1,113		1,170			2 - 5 - 11
	B3	4	8	0.21	16	611		770		827		870		3.6	2 - 5 - 11
			8	0.34	22	747		940		1,011		1,062			4 - 7 - 12
			8	0.51	27	854		1,074		1,155		1,214			5 - 8 - 13
			8	0.71	31	954		1,200		1,290		1,356			7 - 10 - 15
	B4	4	8	0.18	19	627		789		848		892		3.0	6 - 9 - 14
			8	0.31	26	840		1,058		1,137		1,195			8 - 12 - 16
			8	0.49	31	960		1,209		1,300		1,366			10 - 13 - 18
			8	0.70	36	1,073		1,351		1,452		1,526			12 - 14 - 20
4	B2	4	8	0.20	-	616	0.48	775	1.93	833	4.34	876	7.72	4.4	1 - 2 - 6
			8	0.34	20	826		1,039		1,117		1,174			1 - 3 - 9
			8	0.51	24	944		1,188		1,277		1,342			2 - 4 - 11
			8	0.73	28	1,054		1,327		1,427		1,500			3 - 6 - 13
	B3	4	8	0.18	17	714		899		966		1,016		3.6	2 - 5 - 12
			8	0.32	24	957		1,205		1,296		1,362			4 - 8 - 14
			8	0.49	29	1,094		1,377		1,481		1,557			6 - 10 - 16
			8	0.71	33	1,223		1,539		1,654		1,739			8 - 12 - 17
	B4	4	8	0.20	-	882		1,110		1,194		1,255		3.0	8 - 12 - 17
			8	0.34	20	1,077		1,356		1,458		1,532			10 - 14 - 19
			8	0.50	24	1,231		1,550		1,666		1,751			12 - 15 - 21
			8	0.71	28	1,376		1,732		1,862		1,957			13 - 16 - 23
5	B2	4	8	0.18	-	748	0.59	941	2.36	1,012	5.31	1,063	1.20	4.4	1 - 2 - 7
			8	0.31	20	1,002		1,262		1,356		1,426			1 - 3 - 10
			8	0.49	26	1,146		1,442		1,550		1,630			2 - 5 - 12
			8	0.70	30	1,280		1,611		1,732		1,821			3 - 7 - 14
	B3	4	8	0.18	20	867		1,091		1,173		1,233		3.6	3 - 7 - 14
			8	0.29	25	1,162		1,463		1,573		1,653			5 - 9 - 16
			8	0.41	29	1,287		1,620		1,742		1,831			7 - 11 - 17
			8	0.56	33	1,411		1,777		1,910		2,007			8 - 13 - 19
	B4	6" oval	8	0.19	-	975		1,228		1,320		1,388		3.0	8 - 12 - 18
			8	0.35	20	1,308		1,646		1,770		1,860			11 - 15 - 21
			8	0.57	26	1,495		1,882		2,023		2,126			14 - 17 - 24
			8	0.84	31	1,670		2,102		2,260		2,375			15 - 19 - 27
6	B2	4	8	0.19	16	881	0.70	1,109	2.78	1,192	6.26	1,253	1.44	4.4	1 - 2 - 8
			8	0.33	23	1,181		1,486		1,598		1,679			2 - 4 - 11
			8	0.52	28	1,349		1,699		1,826		1,920			2 - 5 - 14
			8	0.74	32	1,508		1,898		2,040		2,144			4 - 8 - 16
	B3	4	8	0.18	20	1,021		1,286		1,382		1,453		3.6	3 - 7 - 15
			8	0.29	26	1,516		1,908		2,052		2,156			5 - 10 - 17
			8	0.44	31	1,418		1,785		1,919		2,017			8 - 12 - 19
			8	0.61	35	1,662		2,093		2,250		2,365			9 - 14 - 21
	B4	6" oval	8	0.17	15	1,149		1,446		1,555		1,634		3.0	9 - 14 - 20
			8	0.34	23	1,540		1,939		2,085		2,191			13 - 17 - 24
			8	0.56	29	1,816		2,286		2,457		2,583			16 - 19 - 27
			8	0.83	34	2,064		2,598		2,793		2,936			17 - 21 - 30

Note: Reference page U102 for operational conditions used for performance notes

CBAW / 2-PIPE HEATING

Nominal Length ft	Nozzle Size	Primary Air			Sound	Coil Heating (Btu/h)								Induction ratio	Throw
		Inlet Dia.	Flow Rate	Inlet ΔPS		0.5 GPM		1.0 GPM		1.5 GPM		2.0 GPM			
		Inches	CFM	(in. H2O)	NC	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL	qCOIL	ΔCOIL		ft.
3	B2	4	8	0.24	-	1,834	0.38	2,309	1.50	2,482	3.38	2,609	6.00	4.4	1 - 2 - 6
			10	0.38	19	2,204		2,775		2,983		3,136			1 - 2 - 8
			12	0.54	23	2,424		3,052		3,281		3,449			2 - 4 - 9
			14	0.74	27	2,627		3,306		3,555		3,736			2 - 5 - 11
	B3	4	14	0.21	16	1,953		2,459		2,643		2,778		3.6	2 - 5 - 11
			18	0.34	22	2,385		3,002		3,228		3,393			4 - 7 - 12
			22	0.51	27	2,726		3,432		3,690		3,878			5 - 8 - 13
			26	0.71	31	3,046		3,834		4,122		4,333			7 - 10 - 15
	B4	4	24	0.18	19	2,002		2,520		2,709		2,848		3.0	6 - 9 - 14
			32	0.31	26	2,684		3,378		3,632		3,817			8 - 12 - 16
			40	0.49	31	3,068		3,862		4,152		4,364			10 - 13 - 18
			48	0.70	36	3,427		4,314		4,638		4,875			12 - 14 - 20
4	B2	4	10	0.20	-	1,967	0.48	2,476	1.93	2,662	4.34	2,798	7.72	4.4	1 - 2 - 6
			13	0.34	20	2,637		3,319		3,569		3,751			1 - 3 - 9
			16	0.51	24	3,014		3,794		4,079		4,288			2 - 4 - 11
			19	0.73	28	3,367		4,239		4,557		4,790			3 - 6 - 13
	B3	4	18	0.18	17	2,281		2,871		3,087		3,245		3.6	2 - 5 - 12
			24	0.32	24	3,058		3,849		4,138		4,350			4 - 8 - 14
			30	0.49	29	3,495		4,400		4,730		4,972			6 - 10 - 16
			36	0.71	33	3,905		4,916		5,285		5,555			8 - 12 - 17
	B4	4	35	0.20	-	2,567		3,231		3,474		3,651		3.0	8 - 12 - 17
			45	0.34	20	3,441		4,331		4,656		4,894			10 - 14 - 19
			55	0.50	24	3,933		4,951		5,323		5,594			12 - 15 - 21
			65	0.71	28	4,394		5,531		5,946		6,250			13 - 16 - 23
5	B2	4	12	0.18	-	2,388	0.59	3,006	2.36	3,232	5.31	3,397	1.20	4.4	1 - 2 - 7
			16	0.31	20	3,201		4,030		4,332		4,554			1 - 3 - 10
			20	0.49	26	3,659		4,606		4,952		5,205			2 - 5 - 12
			24	0.70	30	4,088		5,146		5,533		5,815			3 - 7 - 14
	B3	4	24	0.18	20	2,769		3,486		3,748		3,939		3.6	3 - 7 - 14
			30	0.29	25	3,712		4,673		5,024		5,280			5 - 9 - 16
			36	0.41	29	4,111		5,175		5,564		5,848			7 - 11 - 17
			42	0.56	33	4,508		5,675		6,101		6,412			8 - 13 - 19
	B4	6" oval	40	0.19	-	3,116		3,922		4,217		4,432		3.0	8 - 12 - 18
			55	0.35	20	4,177		5,258		5,653		5,942			11 - 15 - 21
			70	0.57	26	4,775		6,010		6,462		6,792			14 - 17 - 24
			85	0.84	31	5,334		6,715		7,219		7,588			15 - 19 - 27
6	B2	4	15	0.19	16	2,813	0.70	3,541	2.78	3,807	6.26	4,001	1.44	4.4	1 - 2 - 8
			20	0.33	23	3,771		4,747		5,103		5,364			2 - 4 - 11
			25	0.52	28	4,310		5,426		5,833		6,131			2 - 5 - 14
			30	0.74	32	4,816		6,062		6,517		6,850			4 - 8 - 16
	B3	4	28	0.18	20	3,262		4,106		4,414		4,640		3.6	3 - 7 - 15
			36	0.29	26	4,842		6,096		6,553		6,888			5 - 10 - 17
			44	0.44	31	4,530		5,702		6,130		6,443			8 - 12 - 19
			52	0.61	35	5,310		6,684		7,186		7,553			9 - 14 - 21
	B4	6" oval	50	0.17	15	3,670		4,620		4,967		5,221		3.0	9 - 14 - 20
			70	0.34	23	4,920		6,194		6,659		6,999			13 - 17 - 24
			90	0.56	29	5,799		7,300		7,849		8,250			16 - 19 - 27
			110	0.83	34	6,592		8,298		8,921		9,377			17 - 21 - 30

Note: Reference page U102 for operational conditions used for performance notes

NOTES:

1. All performance data based on test performed in accordance with ASHRAE Standard 200-2015
2. ΔP_s values are measured in inches of water
3. NC values are based on room absorption of 10 dB. A dash (-) indicates an NC value less than 15.
4. Throw values are based on isothermal supply air and represent throw distances to terminal velocities of 150, 100 and 50 fpm respectively
5. ΔP_{Coil} values are measured in feet of water. ΔP_{Coil} values in shaded cells indicate use of a two circuit coil. All other values represent a single circuit coil.
6. Induction ratio is multiplied by the volume flow rate of primary air to estimate the volume flow rate of room air entrained through the coil

Cooling performance:

- Cooling capacity listed (qCOIL) is the sensible heat removal by the beam's integral coil. It does not include any contribution or offset by the primary air
- Capacity is based on 18°F ΔT between the induced air and the chilled water supply.
- Primary air sensible cooling contribution can be calculated by the following equation:

qSENSPA = 1.085 x CFMPA x (TPA - TROOM)

- Primary air latent cooling can be calculated by the following equation:

qLATENT = 0.69 x CFMPA x (WROOM - WPA)

where WROOM and WPA are the humidity ratio of the room and primary air respectively expressed in Grains of moisture per pound dry air

TABLE 4: CORRECTION FOR (ΔT) BETWEEN ENTERING AIR AND ENTERING CHILLED WATER

Actual ΔT	10	12	14	16	18	20	22	24
Multiply Table Value by:	0.56	0.67	0.78	0.89	1	1.11	1.22	1.33

Heating performance:

- Heating capacity listed (qCOIL) is the sensible heat removal by the beam's integral coil. It does not include any contribution or offset by the primary air
- Capacity is based on 50°F ΔT between the induced air and the chilled water supply.
- Primary air sensible heating offset (or contribution) can be calculated by the following equation:

qSENSPA = 1.085 x CFMPA x (TPA - TROOM)

if the primary air temperature is lower than that of the room, it will offset the coil's heating

if the primary air temperature is higher than that of the room, it will contribute to the coil's heating

Legend:

ΔP_s = Unit Inlet Pressure [in wg]

qCoil = Sensible Capacity, Coil [Btu/h]

ΔCoil = Water coil pressure drop [ft wg]

qSENSPA = Sensible Capacity, Primary Air [Btu/h]

CFMPA = Air Flowrate, Primary Air [CFM]

TPA = Temperature Primary Air [°F]

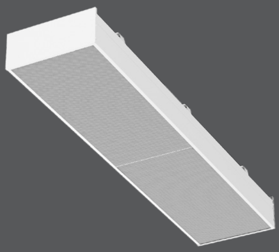
TROOM = Temperature Room Air [°F]

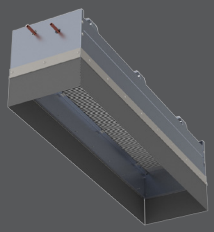
qSENSPA = Latent Capacity, Primary Air [Btu/h]

Linear Passive Chilled Beams

CBPE / CBPR

- Provides comfortable, effective sensible cooling to the space
- Ultra quiet, natural convection driven operation
- Perforated or Linear Bar Grille options for exposed models
- Exposed, recessed or concealed installation
- Quick and simple installation
- Available in nominal lengths up to 10 feet
- ½" Sweat or ½" MNPT coil connections


CBPE


CBPR

k-12 education | universities | energy solutions

See website for Specifications

AVAILABLE MODELS:

CBPE / Exposed linear passive chilled beam
CBPR / Recessed linear passive chilled beam

FINISHES:

Standard Finish - #26 White
Optional Finish - #84 Black

OVERVIEW

Comfortable, effective, ultra-quiet sensible cooling technology

Passive chilled beams are primarily used to provide sensible cooling in perimeter zones and comfortable sensible cooling within interior zones. The primary mode of heat transfer is by natural convection, with a percentage of heat transfer transmitted through radiation. During cooling, warm room air rises to the ceiling area; cool air around the coil sinks down to the occupied area as a result of the higher density. As the cool air descends in to the space, more warm air is drawn over the coil creating a convective current that drives the system.

The airflow pattern generated from a passive beam is unidirectional with direct downward projection from the bottom of the beam. As the thermal buoyancy of the cool air drives the airflow down into space it will begin to mix with ambient room air and diffuse throughout the space. To maximize occupant comfort with passive beam systems, stationary or seated occupants should not be positioned directly under a beam. Passive beams should be installed in aisles, walkways or corridors, or at least 15 feet above the occupied space to prevent instances of occupant discomfort.

When using passive chilled beams, ventilation and latent cooling loads are addressed by a separate primary air system. Primary air systems could be traditional mixed air distribution, underfloor air distribution or displacement ventilation systems. As the primary air system is not used to address the entire cooling load the total system fan energy is reduced improving overall energy efficiency of the building. Applications with low latent cooling loads could use 100 percent outdoor air allowing for use of a dedicated outdoor air system with energy recovery further reducing total system energy consumption.

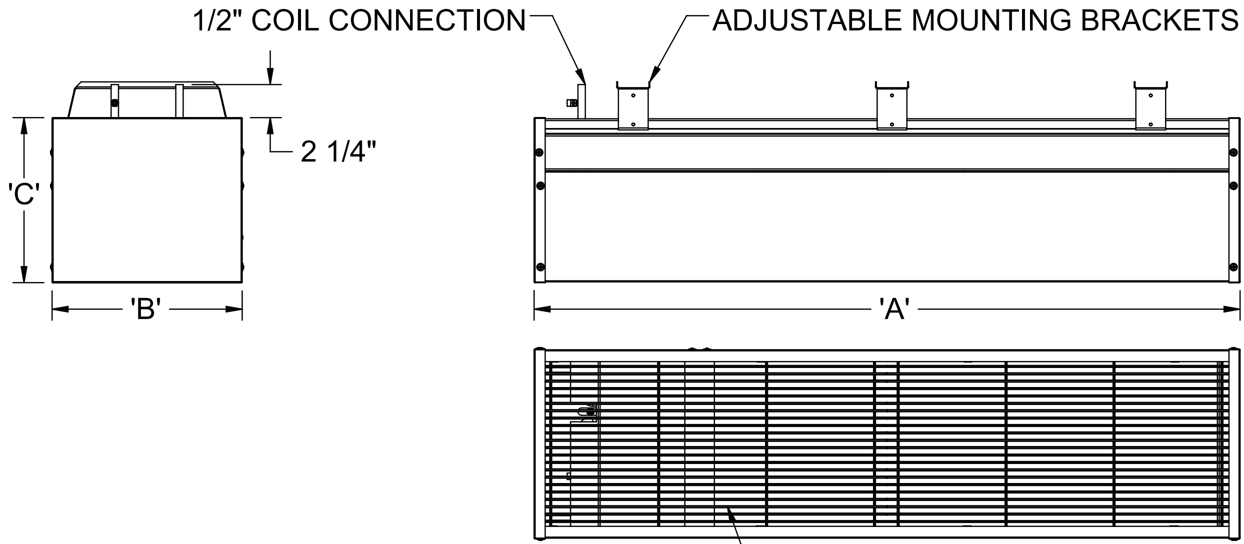
CBPE

The CBPE is ideal for exposed installations or can be integrated into lay-in ceiling systems for concealed installations. For applications with low ceilings or limited ceiling plenum height the low profile design excels at satisfying sensible cooling.

CBPR

CBPR passive beams are designed for recessed installation above a false ceiling. The false ceiling could be an architectural cloud type or even a perforated panel in a conventional lay-in ceiling grid. The CBPR beams are supplied with an additional skirt below the unit's coil that is designed to further enhance the convective current through beam augmenting performance. Beams should be installed with the skirt in contact with the top side of the false ceiling.

CBPE UNIT DIMENSIONS



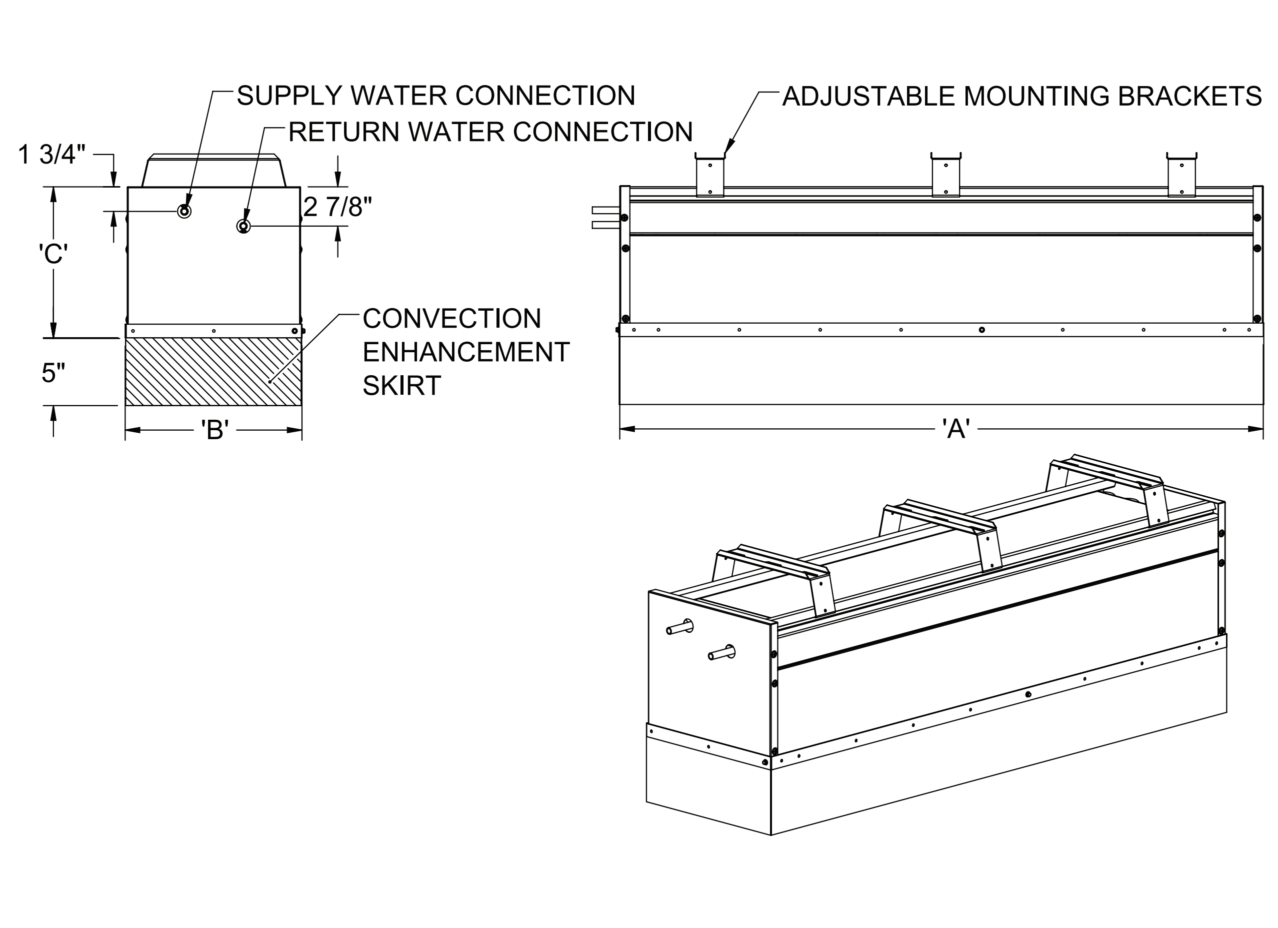
Nominal Unit Length (ft)	'A' (IN)
2	1¾
3	2¾
4	3¾
5	4¾
6	5¾
7	6¾
8	7¾
9	8¾
10	9¾

Nominal Unit Width (ft)	'B' (IN)
13	7¾
17	7¾
18	7¾
22	7¾
24	7¾

Nominal Unit Height (IN)	'C' (IN)
8	8⅞
10	10⅞
12	12⅞

All dimensions are in inches

CBPR UNIT DIMENSIONS



Nominal Unit Length (ft)	'A' (IN)
2	1¾
3	2¾
4	3¾
5	4¾
6	5¾
7	6¾
8	7¾
9	8¾
10	9¾

Nominal Unit Width (ft)	'B' (IN)
13	12¾
17	16¾
18	17¾
22	21¾
24	23¾

Nominal Unit Height (IN)	'C' (IN)
8	8⅞
10	10⅞
12	12⅞

All dimensions are in inches

CBPE / CBPR COOLING CAPACITY

Nominal Length	Coil Width	Chilled Water Flow Rate, GPM											
		0.75 GPM		1.0 GPM		1.25 GPM		1.5 GPM		2.0 GPM		2.5 GPM	
		Q_{SENS}	ΔP_W	Q_{SENS}	ΔP_W	Q_{SENS}	ΔP_W	Q_{SENS}	ΔP_W	Q_{SENS}	ΔP_W	Q_{SENS}	ΔP_W
ft	in	Btu/h	ft wg	Btu/h	ft wg	Btu/h	ft wg	Btu/h	ft wg	Btu/h	ft wg	Btu/h	ft wg
4	**12.5**	963	0.33	1,000	0.75	1,029	1.17	1,054	1.62	1,094	2.69	1,127	4.01
	15.0	1,045	0.40	1,085	0.90	1,117	1.41	1,144	1.94	1,188	3.23	1,223	4.81
	17.5	1,121	0.46	1,164	1.06	1,198	1.64	1,227	2.26	1,274	3.77	1,312	5.61
	20.0	1,190	0.53	1,236	1.21	1,272	1.88	1,303	2.59	1,353	4.31	1,393	6.41
	22.5	1,255	0.60	1,303	1.36	1,342	2.11	1,374	2.91	1,427	4.84	1,469	7.21
6	**12.5**	1,444	0.45	1,499	1.05	1,544	1.63	1,581	2.24	1,642	3.70	1,690	5.48
	15.0	1,568	0.54	1,628	1.26	1,676	1.95	1,717	2.68	1,782	4.44	1,835	6.58
	17.5	1,681	0.63	1,745	1.46	1,797	2.28	1,840	3.13	1,911	5.18	1,967	7.67
	20.0	1,785	0.72	1,854	1.67	1,909	2.60	1,955	3.58	2,029	5.92	2,089	8.77
	22.5	1,883	0.81	1,955	1.88	2,013	2.93	2,061	4.02	2,140	6.66	2,204	9.86
8	**12.5**	1,925	0.57	1,999	1.34	2,058	2.08	2,108	2.85	2,189	4.71	2,254	6.95
	15.0	2,091	0.68	2,171	1.61	2,235	2.50	2,289	3.42	2,376	5.65	2,447	8.35
	17.5	2,241	0.79	2,327	1.87	2,396	2.91	2,454	4.00	2,548	6.59	2,623	9.74
	20.0	2,380	0.91	2,472	2.14	2,545	3.33	2,606	4.57	2,706	7.53	2,786	11.13
	22.5	2,510	1.02	2,606	2.41	2,684	3.75	2,748	5.14	2,854	8.47	2,938	12.52
10	**12.5**	2,407	0.68	2,499	1.63	2,573	2.54	2,635	3.47	2,736	5.71	2,817	8.43
	15.0	2,613	0.82	2,713	1.96	2,794	3.04	2,861	4.17	2,971	6.86	3,059	10.11
	17.5	2,801	0.96	2,909	2.28	2,995	3.55	3,067	4.86	3,185	8.00	3,279	11.80
	20.0	2,975	1.09	3,089	2.61	3,181	4.06	3,258	5.56	3,382	9.14	3,482	13.49
	22.5	3,138	1.23	3,258	2.94	3,354	4.56	3,435	6.25	3,567	10.28	3,673	15.17

Performance based on:

1. Unit height of 10 inches. Correction factors for other unit heights are shown in table 1 below.
2. Distance (Y) between top of beam and horizontal surface equal to 30% of coil width (W). For other values of Y/W see table 2 below.
3. Discharge through a minimum 50% free area face. Correction factors for other free areas are shown in table 3 below.
4. Free area for room air to enter ceiling cavity equal to free area of beam discharge into space.
5. Based on an 18°F ΔT between entering air and entering chilled water. Correction factors for other ΔT values are shown in table 4 below.

Legend:

Q_{SENS} - Sensible Capacity, Coil [Btu/h]

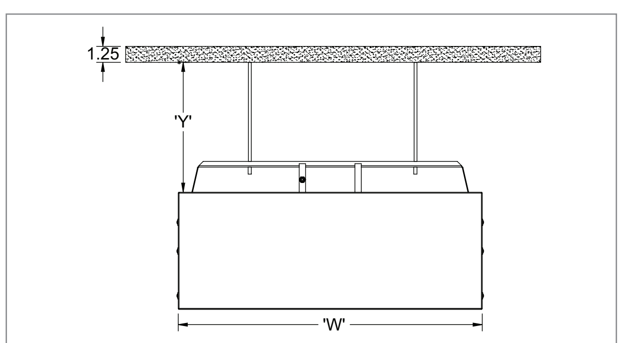
ΔP_w - Water coil pressure drop [ft wg]

TABLE 2: CORRECTION FOR DISTANCE BELOW STRUCTURE VERSUS UNIT WIDTH (Y/W)

Y/W	Multiply Table Value by:
0.10	0.66
0.20	0.92
0.30	1.00
0.40	1.03
0.50	1.04

TABLE 3: CORRECTION FOR FALSE CEILING FREE AREA

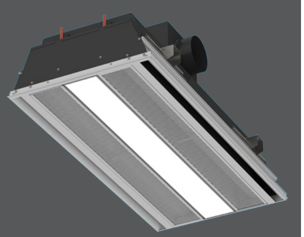
Face free area	Multiply Table Value by:
30%	0.94
40%	0.98
50% or more	1.00



Integrated Service Chilled Beams

VENTUS LUX

- 1-way and 2-way air patterns
- Multiple nozzles providing low sound levels
- Normal and High output LED lighting fixture with dimming capabilities
- Beam width: 24" Nominal Lengths: 4ft / 8ft
- Light fixture width: 6" or 12"
- 2-pipe or 4-pipe for heating and cooling



VLR

VLP

open ceilings | healthcare | integrated lighting | k-12 education | universities | woodgrains | energy solutions

See website for Specifications

AVAILABLE MODELS:

VLR-24 & 12 / Recessed
VLP-12 / Pendant

FINISHES:

Standard Finish - #26 White
Optional Finish - #84 Black

OVERVIEW

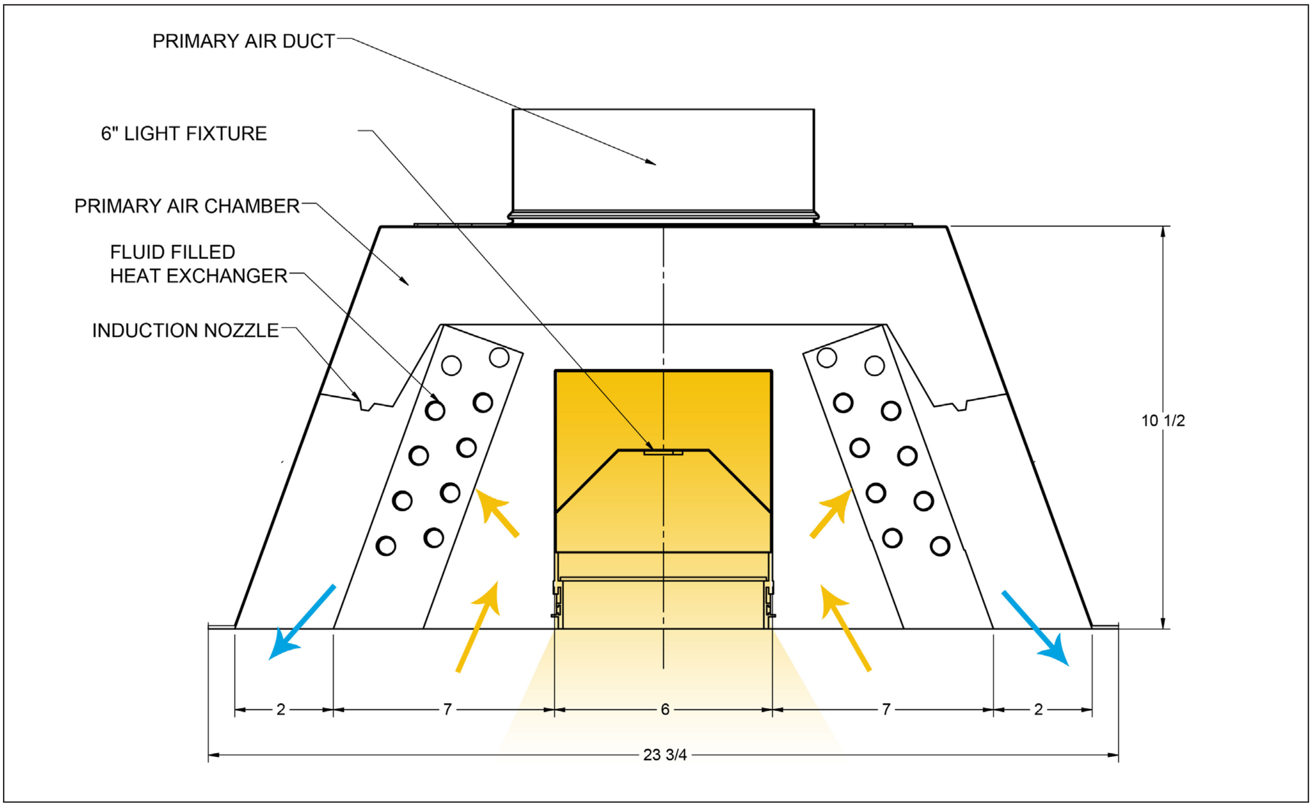
VENTUS LUX artfully combines air, water and light. This high performance integrated air and light-distribution system fills a void in the U.S. manufacturing and interior tenant market.

Units are available in a variety of sizes and styles to accommodate various projects. They are equipped with hydronic cooled air technology and linear lighting fixtures.

Operation requires only a primary air and cooling source; no mechanical fan components are needed and the use of primary air ducts is 20% of that utilized by conventional systems. While a unit is integrated, the air-cooling and distribution carriage may be installed separately from the lighting fixture. This addresses regional labor concerns and duties.

Rendering of the VENTUS LUX - VLP (Pendant version) installed in a open ceiling office environment

VENTUS LUX - VLR UNIT DIMENSIONS



A recessed, integrated assembly combining high-efficiency cooling with state-of-the-art lighting fixtures

Sizes: 1 x 4, 1 x 8, 2 x 4, and 2 x 8

Mechanical: High-efficiency cooling with a variety of performance metrics and distributions

Ceiling Types: Flanges for a variety of ceiling grid systems

Lighting (Integral): Available with factory installed high performance lighting options

Installation: Contractor coordinated installation by mechanical, electrical and plumbing

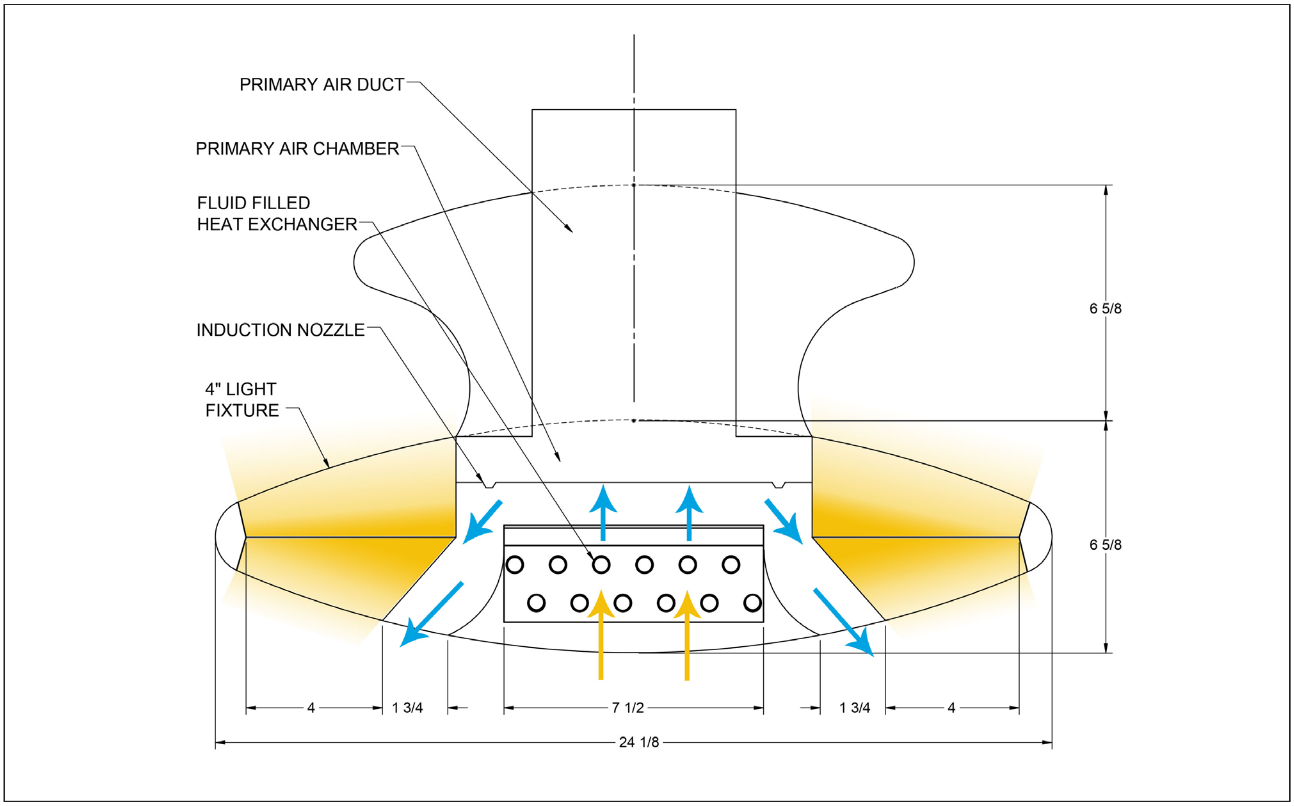
Electrical: Areaways provided for ease of light fixture installation by the electrical contractor with separate support to structure

Devices: Blank panels can be provided to receive sprinklers, speakers and other approved devices

VENTUS LUX bridges the gap between lighting, cooling and any ceiling system within one thoughtfully designed fixture

All dimensions are in inches

VENTUS LUX - VLP UNIT DIMENSIONS



Fully exposed system integrating high-efficiency cooling and state-of-the-art lighting into an aesthetically expressive assembly

Sizes: 4ft and 8ft / Hard metric sizes available / End-to-end mounting to create continuous runs

Mechanical: High-efficiency cooling with a variety of performance metrics and distributions

Ceilings: Exposed mounting hardware for a variety of ceilings types, including grid, drywall and exposed concrete or steel deck construction

Lighting (Integral): Available with factory installed high performance lighting options producing direct or direct/indirect light distribution

Installation: Contractor coordinated installation by mechanical, electrical and plumbing

Devices: Blank panels can be provided to receive sprinklers, speakers and other approved devices

VENTUS LUX can be suspended directly below feeder ducts and chilled water pipes, allowing the direct/indirect light to cleanly illuminate the exposed ceiling above and wash the spaces below with cool air and light

All dimensions are in inches

Redefine your comfort zone™ | www.titus-hvac.com

VENTUS LUX - LIGHTING EXCELLENCE

LED Components
Nichia® - 757A-V1 chips (>80CRI)

Driver
EZ1 driver option allows for 0-10V dimming, flicker free from 2 to 100%. Universal input voltage 120-277VAC, 50/60Hz. EZB driver option provides superior 0-10V dimming from 100% to off, universal voltage 120/277V, 50/60Hz.

Color Consistency
The Acuity Brands circuit boards with color a variation of no greater than a 2.5 Step MacAdam (2.55DCM) along the black body locus from board to board.

Integrated Controls
Optional nLight® embedded controls make luminaire addressable, allowing it to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Simply connect all the nLight enabled control devices using standard CAT5 Cabling.

Lumen Management
An optional lumen management system provides onboard intelligence that actively manages the LED light source so that constant lumen output is maintained over the system's life, creating a consistently illuminated environment while preventing energy waste. (Option: n80)

Mounting
Recessed, lay-in extruded aluminum trim. Accommodates 9⁄16" slot grid or 15⁄16" inverted tee, or 9⁄16" inverted tee.

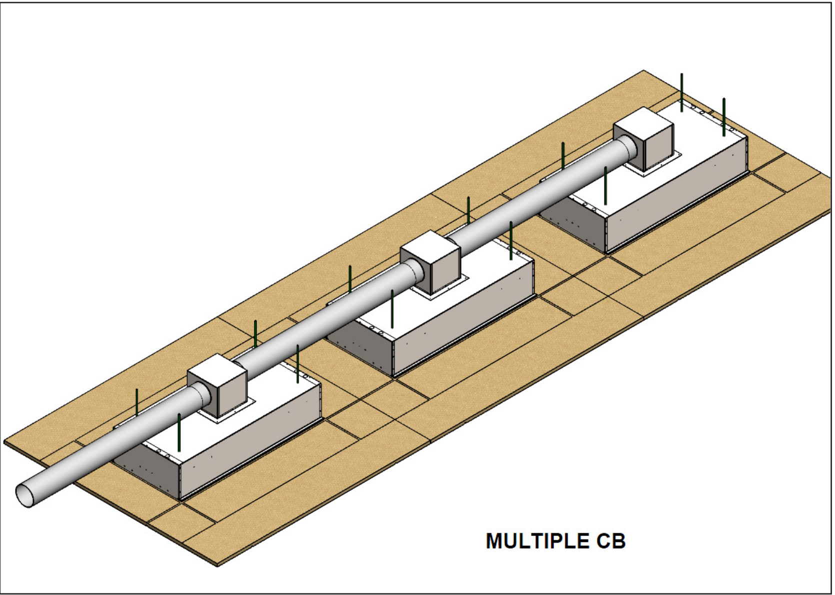
Certification
CSA Certified to meet U.S. and Canadian standards, rated for Chicago Plenum, and IBEW (Local 3) Union-made in the USA.

LUMEN - WATTAGE						
SIZE	LED OUTPUT	COLOR TEMP	SHIELDING	SYSTEM WATTS	DELIVERED LUMENS	LM/W DELIVERED
1 x 4	Normal (N)	3500K	SWSW	31	2642	84
1 x 4	Hi (H)	3500K	SWSW	54	4782	88

VENTUS LUX - VLR / VLP TYPICAL CEILING LAYOUT

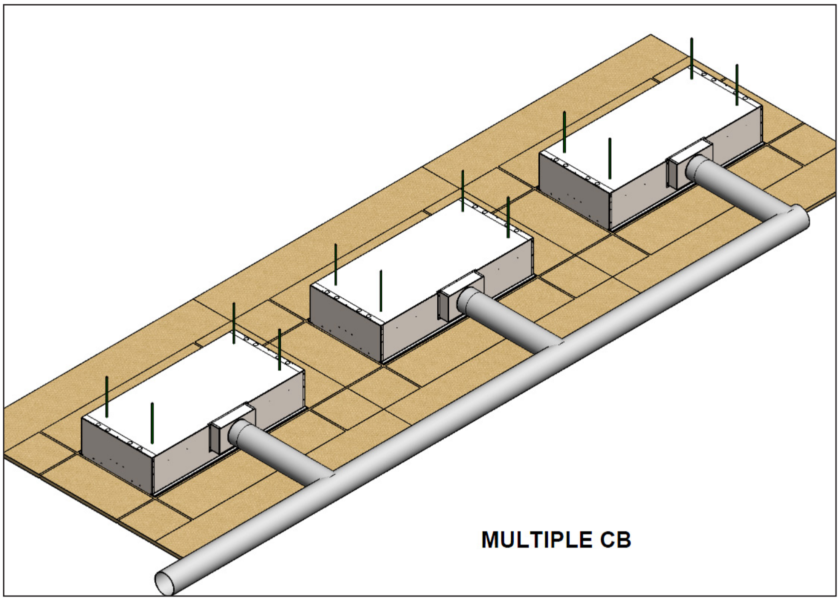
SERIES VLR | 24" RECESSED – Primary air ducting with universal duct connection on top of the chilled beam

- Series primary air connection with the universal duct connection to save ducting and assure same pressure drop across each VLR for up to 3 chilled beams
- Approximately 19" Heights



SERIES VLR | 24" RECESSED – Primary air ducting with side duct connectionof the chilled beam

- Conventional attachment parallel to assure same pressure drop across each VLR
- Approximately 11" Heights



VENTUS LUX - VLR / VLP

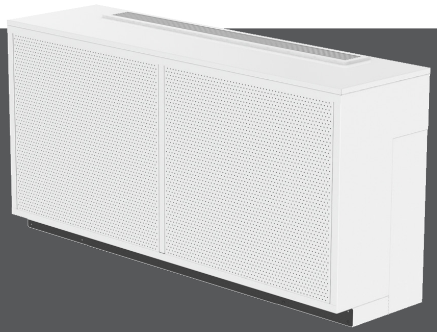
Beam Type	Light Fixture Width (in.)	Beam Length	Nozzle Diameter	Primary Air	Static Pressure	Water Side Performance			Total Performance		
						Btuh	Head Loss (ft.)	COPA	Btuh	Btu/h-lf	COPA
VLR-12	12"	48	B3	38	0.6	860	2.2	22.6	1,696	424	44.6
					0.6	890	2.1	23.4	1,726	432	45.4
					0.6	910	2.6	23.9	1,746	437	45.9
VLR-24	6"	48	B3	72	0.6	2,610	2.4	36.2	4,195	1,049	58.2
					0.6	2,814	5.3	39.1	4,399	1,100	61.1
					0.6	2,891	9.2	40.1	4,476	1,119	62.1
VLR-24	12"	48	B3	72	0.6	2,486	1.9	34.5	4,071	1,018	56.5
					0.6	2,678	4.2	37.2	4,263	1,066	59.2
					0.6	2,796	7.4	38.8	4,381	1,095	60.8
VLP	2" x 4"	48	B3	72	0.6	2,146	2.9	29.8	3,731	933	51.8
					0.6	2,271	6.4	31.5	3,856	964	53.5
					0.6	2,347	8.6	32.6	3,932	983	54.6

All data based on:

- A 18°F temperature differential between room and entering chilled water temperature
- A 20°F temperature differential between room and entering chilled water temperature
- Primary airflow rate is limited to that which requires 0.6" inlet SP
- Chilled water flow rate is limited to that which requires 10 feet of hed
- Coil performance is taken directly from GAC coil selection program at induced air and water flow rates listed
- Different nozzle size available for higher performance

Floor Mounted Displacement Chilled Beams

TAO



- Floor mounted, under the sill or fully exposed active chilled beam perfectly suited for educational and healthcare facilities
- Suited for climate zones with heat loads greater than 250 Btuh per foot
- Designed to meet the highest ventilation effectiveness required in schools and healthcare facilities while maximizing the hydronic system to handle the sensible load
- Circular perforated front face for return air
- Pencil proof grille
- Ultra quiet operation
- Available in 5 and 6 ft length to match different classrooms spaces and loads
- Heavy gauge painted cabinet
- Pressure port for air-side balancing and flow verification

TAO

* The Titus AR mobile app is available for download in Google Play and iOS

dual-function | k-12 education | woodgrains | energy solutions

See website for Specifications

AVAILABLE MODEL:

TAO

FINISHES

Standard Finish - #26 White
Optional Finish - Woodgrains (See Woodgrains Brochure for Finishes)

OVERVIEW

Installed along building perimeters to best handle extreme temperatures where they start – from the outside in - the TAO (Temperature Ambient Optimizer) provides superior thermal comfort in areas where high ventilation loads are needed, such as educational facilities and theaters. It combines the benefits of both chilled beam and displacement units, rolled into one system perfect for extreme climates.

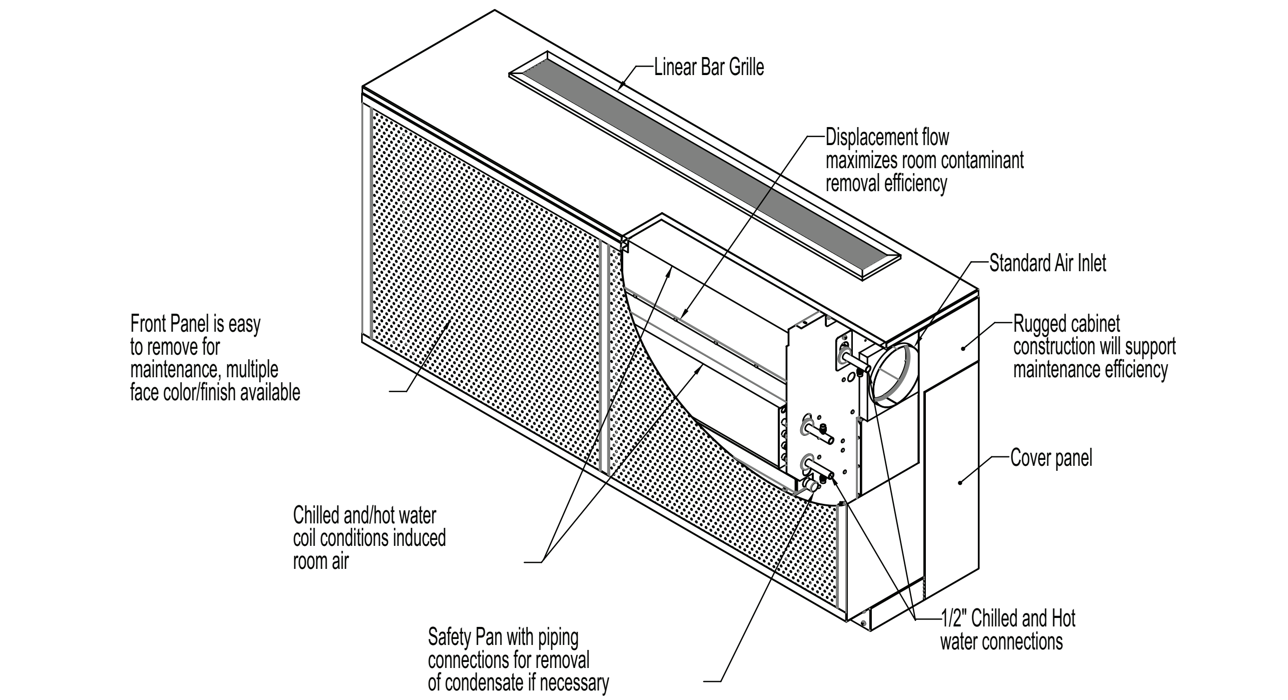
Ideal for use in classrooms and theaters where air quality and sound are critical, the TAO supplies 100% outside air while meeting ANSI Standard S12.60 for acoustics in educational facilities.

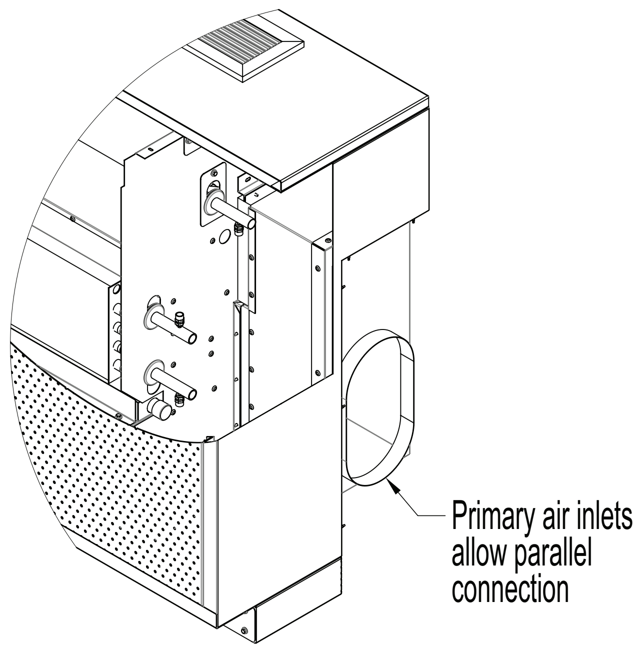
Multiple TAO units installed in an elementary school

ADVANTAGES

- Maximizes the displacement ventilation benefits and enhances the removal of space respiratory contaminants
- Dedicated heating coil to neutralize the thermal load of the window or perimeter wall
- 2 x 2 pipe vertical mounted coil with removable condensate tray for cooling during the Summer and to provide supplemental heating for the Winter
- Optional integral primary air parallel duct connection to minimize air pressure drop, noise and ease of installation

TAO UNIT DIMENSIONS

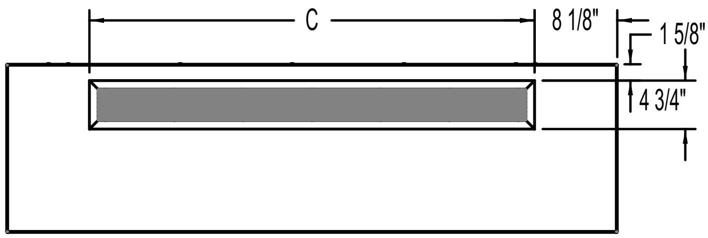




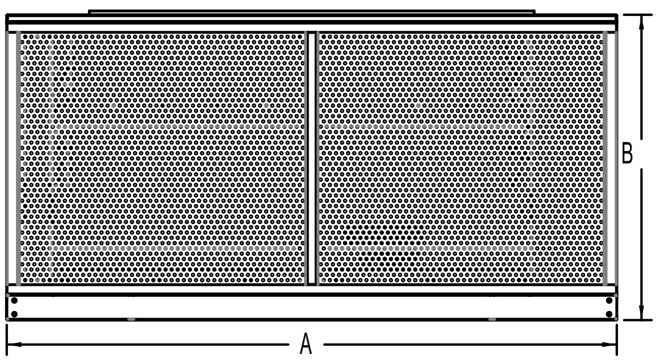
All units are shipped as right air inlet connecting. To modify the unit to allow a left side air connection, simply remove the cover panel and cap from the left side and replace them on the right. For center units in series, remove the cover panel and cap from the left side and discard.

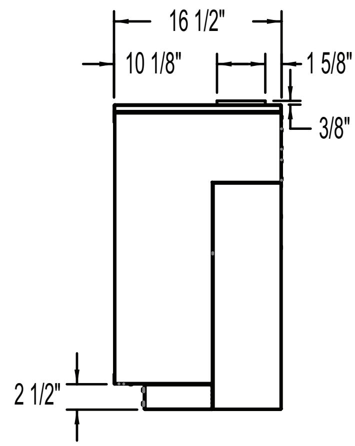
All dimensions are in inches

TAO UNIT DIMENSIONS

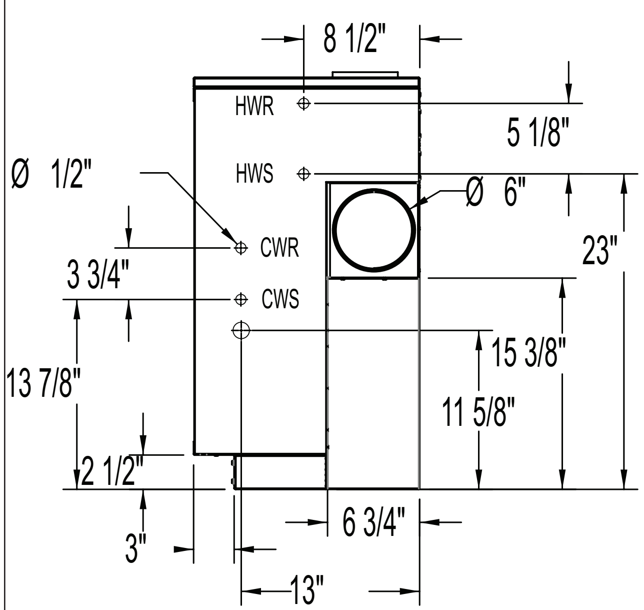


Inlet Size	Unit	Dimensions		
		A	B	C
6″ Round	5 ft	60	30	43 3/4
8″ Oval	6 ft	72	30	55 3/4

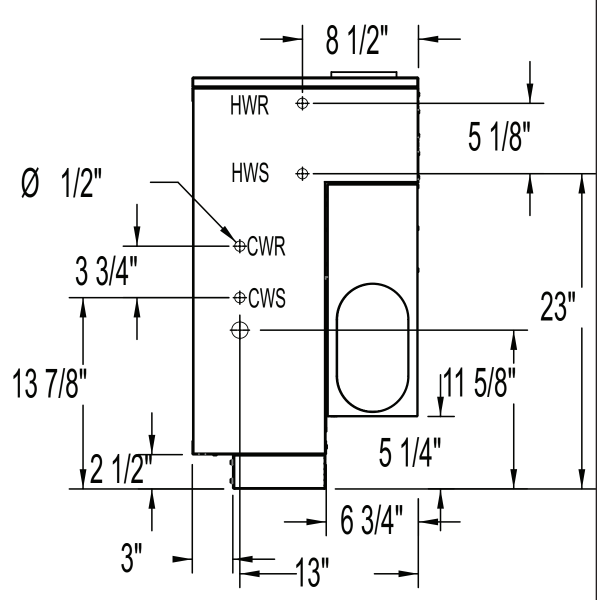




6″ ROUND INLET FOR STAND-ALONE APPLICATIONS



8″ OVAL INLET FOR MULTI-UNIT APPLICATIONS



All dimensions are in inches

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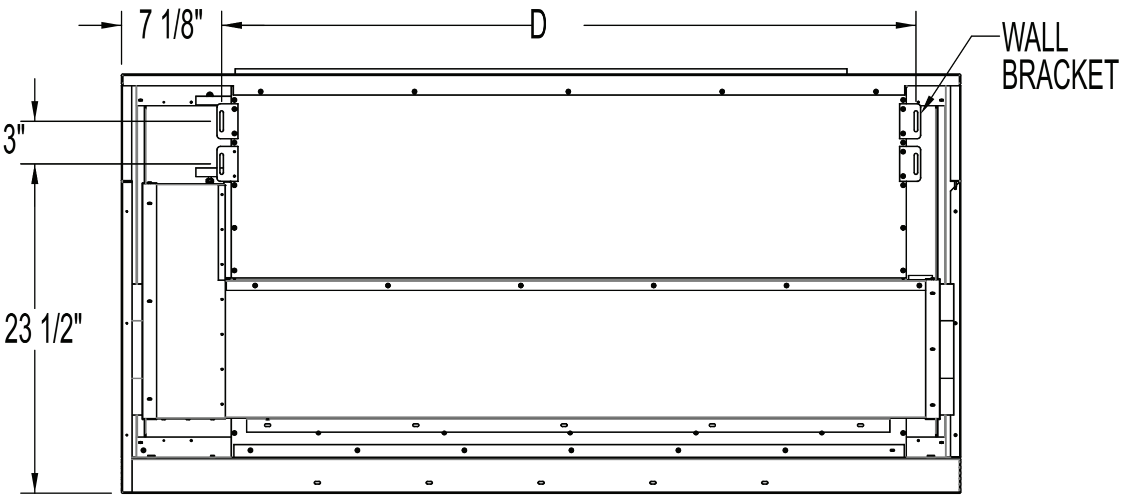
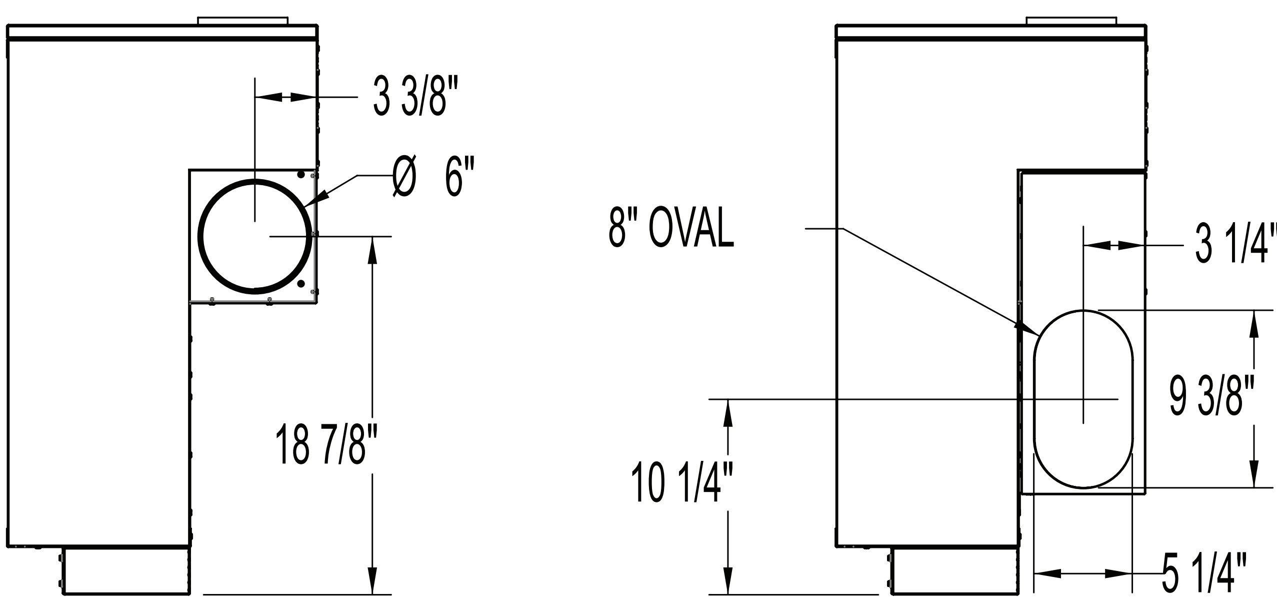
TAO UNIT DIMENSIONS

Wall Mounting



Inlet Size	Unit	D
6" Round	5 ft	49 1/8
8" Oval	6 ft	61 1/8

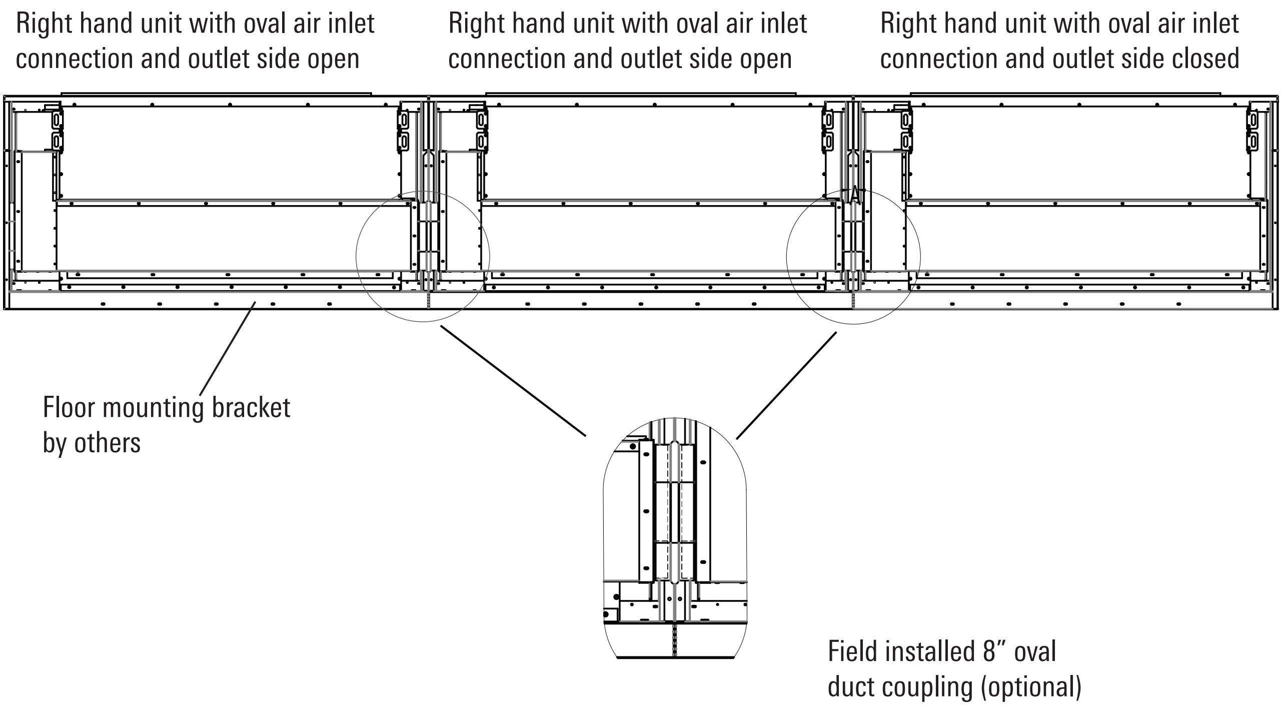
Duct Connections (Stand-alone configuration shown)



All dimensions are in inches

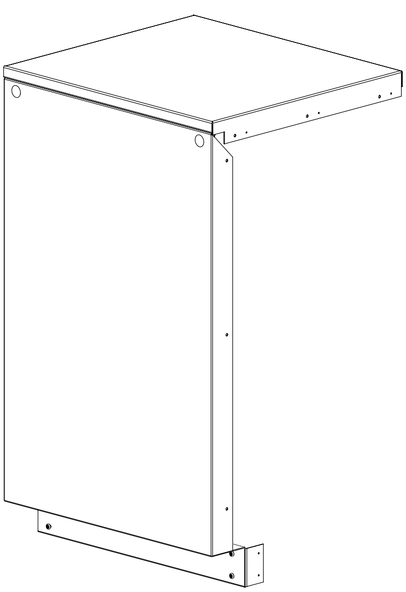
TAO

Multiple Units Connected in Parallel

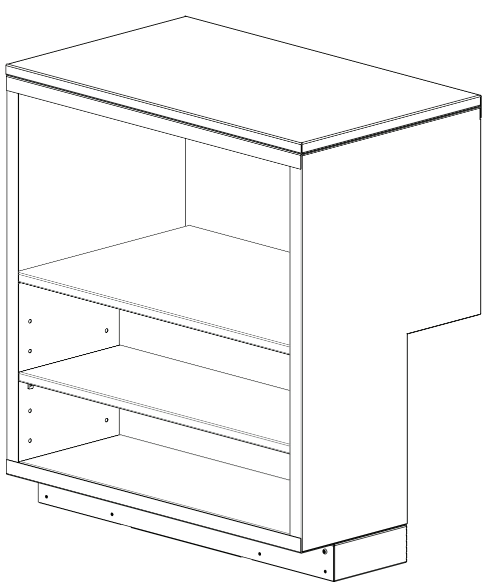


Units viewed from the back showing interconnection between units

Filler Panel & Bookshelf Details



Filler panel (optional)



Bookshelf (optional)

TAO WATER

COIL ROWS	WATER FLOW (GPM)	ΔPW (FT WG)	TAO - 5 FT										
			SECONDARY COOLING [BTU/H] AT PRIME AIRFLOWS [CFM]										
			80	90	100	110	120	130	140	150	160	170	180
AIR INLET P [W.G.″]			0.25″	0.33″	0.40″	0.48″	0.56″	0.64″	0.75″	0.82″	0.92″	1.00″	1.12″
SUPPLY AIRFLOW			210	247	278	309	339	370	403	432	459	480	518
2	0.5	0.08	1278	1414	1535	1644	1738	1823	1907	1966	2025	2056	2129
	0.75	0.18	1380	1542	1689	1825	1943	2053	2163	2240	2319	2360	2461
	1	0.32	1437	1615	1779	1932	2066	2192	2318	2408	2501	2549	2668
	1.25	0.49	1474	1662	1838	2002	2147	2284	2422	2521	2624	2677	2810
	1.5	0.7	1500	1695	1879	2052	2205	2350	2498	2603	2714	2771	2914
ROOM AIR TEMPERATURE: 75°F, WATER ENTERING TEMPERATURE: 57°F													
			SECONDARY HEATING [BTU/H] AT PRIME AIRFLOWS [CFM]										
2	0.5	0.08	2639	3018	3277	3525	3763	4038	4343	4552	4793	4948	5318
	0.75	0.17	2725	3133	3413	3685	3949	4255	4599	4836	5112	5291	5722
	1	0.3	2769	3193	3486	3771	4048	4372	4737	4991	5286	5479	5945
	1.25	0.47	2796	3230	3531	3824	4110	4445	4824	5087	5396	5597	6086
	1.5	0.66	2815	3255	3561	3860	4152	4495	4883	5154	5472	5679	6184
ROOM AIR TEMPERATURE: 70°F, WATER ENTERING TEMPERATURE: 140°F													

Correction factors for other entering conditions:							
ΔT (°F)		8	13	18	23	28	33
Cooling Factor		0.71	0.82	1.00	1.23	1.51	1.85
ΔT (°F)	60	65	70	75	80	85	90
Heating Factor	0.85	0.93	1.00	1.07	1.14	1.22	1.30

COIL ROWS	WATER FLOW (GPM)	ΔPW (FT WG)	TAO - 6 FT										
			SECONDARY COOLING [BTU/H] AT PRIME AIRFLOWS [CFM]										
			120	130	140	150	160	170	180	190	200	210	220
AIR INLET P [W.G.″]			0.23″	0.33″	0.43″	0.50″	0.61″	0.70″	0.75″	0.88″	0.96″	1.00″	1.12″
SUPPLY AIRFLOW			291	331	369	405	442	477	513	547	579	612	644
2	0.5	0.1	1564	1682	1809	1918	2018	2109	2192	2265	2329	2392	2448
	0.75	0.22	1711	1854	2014	2153	2282	2402	2514	2614	2701	2790	2869
	1	0.39	1794	1954	2133	2292	2440	2580	2711	2828	2933	3039	3134
	1.25	0.6	1848	2019	2212	2383	2545	2699	2844	2974	3091	3210	3317
	1.5	0.85	1885	2064	2268	2449	2621	2785	2940	3080	3206	3335	3452
ROOM AIR TEMPERATURE: 75°F, WATER ENTERING TEMPERATURE: 57°F													
			SECONDARY HEATING [BTU/H] AT PRIME AIRFLOWS [CFM]										
2	0.5	0.1	3503	4050	4513	4903	5311	5619	5947	6224	6455	6678	6891
	0.75	0.21	3653	4257	4775	5219	5689	6048	6435	6766	7045	7316	7578
	1	0.37	3731	4366	4916	5390	5895	6283	6705	7068	7375	7675	7966
	1.25	0.57	3780	4434	5004	5497	6024	6432	6877	7260	7586	7904	8215
	1.5	0.81	3813	4481	5064	5570	6114	6535	6996	7393	7733	8065	8389
ROOM AIR TEMPERATURE: 70°F, WATER ENTERING TEMPERATURE: 140°F													

Correction factors for other entering conditions:							
ΔT (°F)		8	13	18	23	28	33
Cooling Factor		0.71	0.82	1.00	1.23	1.51	1.85
ΔT (°F)	60	65	70	75	80	85	90
Heating Factor	0.85	0.93	1.00	1.07	1.14	1.22	1.30

TAO (ETHYLENE/GLYCOL)

COIL ROWS	ETHYLENE GLYCOL/ WATER FLOW (GPM)	ΔPW (FT WG)	TAO - 5 FT										
			SECONDARY COOLING [BTU/H] AT PRIME AIRFLOWS [CFM]										
			80	90	100	110	120	130	140	150	160	170	180
AIR INLET P [W.G."]			0.25"	0.33"	0.40"	0.48"	0.56"	0.64"	0.75"	0.82"	0.92"	1.00"	1.12"
SUPPLY AIRFLOW			210	247	278	309	339	370	403	432	459	480	518
2	0.5	0.33	1173	1239	1329	1408	1473	1533	1590	1635	1669	1689	1737
	0.75	0.54	1250	1377	1491	1592	1679	1757	1835	1897	1943	1971	2039
	1	0.76	1319	1462	1592	1709	1810	1904	1996	2070	2126	2160	2242
	1.25	0.99	1365	1520	1662	1791	1903	2007	2111	2195	2258	2297	2391
	1.5	1.23	1398	1563	1741	1852	1973	2086	2198	2290	2359	2401	2505
ROOM AIR TEMPERATURE: 75°F, FLUID ENTERING TEMPERATURE: 57°F, ETHYLENE GLYCOL 35%													
			SECONDARY HEATING [BTU/H] AT PRIME AIRFLOWS [CFM]										
2	0.5	0.1	3273	3714	4010	4291	4559	4863	5197	5423	5681	5845	6233
	0.75	0.23	3391	3870	4195	4507	4805	5148	5527	5786	6083	6275	6729
	1	0.39	3455	3956	4297	4626	4942	5307	5714	5992	6314	6521	7017
	1.25	0.6	3550	4088	4459	4820	5170	5577	6034	6351	6720	6904	7538
	1.5	0.86	3582	4133	4513	4884	5245	5666	6141	6470	6856	7106	7713
ROOM AIR TEMPERATURE: 70°F, FLUID ENTERING TEMPERATURE: 160°F, ETHYLENE GLYCOL 50%													

Correction factors for other entering conditions:							
ΔT (°F)		8	13	18	23	28	33
Cooling Factor		0.64	0.72	1.00	1.28	1.55	1.83
ΔT (°F)			70	75	80	85	90
Heating Factor			0.77	0.83	0.88	0.94	1.00

COIL ROWS	ETHYLENE GLYCOL/ WATER FLOW (GPM)	ΔPW (FT WG)	TAO - 6 FT										
			SECONDARY COOLING [BTU/H] AT PRIME AIRFLOWS [CFM]										
			120	130	140	150	160	170	180	190	200	210	220
AIR INLET P [W.G."]			0.23"	0.33"	0.43"	0.50"	0.61"	0.70"	0.75"	0.88"	0.96"	1.00"	1.12"
SUPPLY AIRFLOW			291	331	369	405	442	477	513	547	579	612	644
2	0.5	0.4	1394	1483	1578	1657	1729	1793	1852	1902	1946	1989	2027
	0.75	0.66	1550	1664	1787	1892	1988	2077	2158	2229	2291	2352	2406
	1	0.93	1646	1776	1918	2042	2155	2260	2358	2444	2519	2595	2663
	1.25	1.21	1710	1852	2009	2146	2273	2391	2501	2599	2685	2772	2805
	1.5	1.51	1757	1908	2076	2223	2361	2489	2610	2717	2812	2908	2994
ROOM AIR TEMPERATURE: 75°F, FLUID ENTERING TEMPERATURE: 57°F, ETHYLENE GLYCOL 35%													
			SECONDARY HEATING [BTU/H] AT PRIME AIRFLOWS [CFM]										
2	0.5	0.13	4302	4923	5437	5862	6299	6624	6966	7251	7487	7712	7926
	0.75	0.28	4508	5201	5784	6274	6784	7167	7576	7920	8207	8483	8747
	1	0.48	4621	5355	5979	6507	7060	7479	7928	8309	8628	8936	9232
	1.25	0.74	4787	5594	6291	6889	7525	8013	8541	8993	9376	9748	10110
	1.5	1.05	4843	5673	6393	7015	7678	8189	8745	9222	9628	10023	10403
ROOM AIR TEMPERATURE: 70°F, FLUID ENTERING TEMPERATURE: 160°F, ETHYLENE GLYCOL 50%													

Correction factors for other entering conditions:							
ΔT (°F)		8	13	18	23	28	33
Cooling Factor		0.64	0.72	1.00	1.28	1.55	1.83
ΔT (°F)			70	75	80	85	90
Heating Factor			0.77	0.83	0.88	0.94	1.00

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energy solutions — contributes toward energy savings by reducing operating costs of air distribution devices

woodgrains — finish options that resemble woodgrains, perfect for high-profile architectural applications

universities — ideally suited for occupant spaces on university and college campuses

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integrated lighting — lighting fixture incorporated into air device for an all-in-one solution

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hotels / motels — excellent air distribution device for hotels, motels or any similar commercial building application

open ceiling — can be used in open ceiling environments

dual-function — supplies both heating and cooling from one air device

healthcare — can be used in healthcare facility common areas such as: nurse's stations, patient rooms and waiting rooms