



Solar Plexicon

ADVANCING THE SCIENCE OF AIR DISTRIBUTION



light powered

k-12 education

woodgrains

dual-function

energy solutions

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Redefine your comfort zone.™



Sales representatives learn about the ambient light-powered Solar Plexicon during a tour of the Titus Comfort Zone.

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Overview – Displacement Ventilation Systems

TAKING AIR DISTRIBUTION TO THE NEXT LEVEL

Displacement Ventilation systems use low velocity cold air to displace warm room air. They are defined by ASHRAE as fully stratified systems. Supply air is introduced low in the occupied space and travels along the floor until it reaches a heat source, such as a person or computer. Natural convection flows cause the supply air to rise around the heat source.

The Displacement Ventilation system is similar to an UnderFloor Air Distribution (UFAD) system in that it uses warmer supply air and lower pressures than a conventional overhead system. As a result, displacement ventilation systems have many of the same benefits of UFAD systems, such as longer economizer periods, potential energy savings from the warmer supply air and lower horsepower fans, and quiet operation. Although many parts of North America need to cool the supply air below 65°F for humidity reasons, all areas should benefit from the increased economizer time.

An additional benefit to Displacement Ventilation systems is that ASHRAE Standard 62.1-2007 Ventilation for Acceptable Indoor Air Quality gives Displacement Ventilation Systems a Ventilation Effectiveness Factor of 1.2. Ventilation Effectiveness is a measure of how effectively the zone air distribution uses its supply air to maintain acceptable air quality in the breathing zone. A Ventilation Effectiveness Factor of 1.2 means that a lower volume of fresh air can be used to meet ASHRAE 62.1 requirements. This makes displacement ventilation systems an effective way to achieve the LEED Increased Ventilation credit.

One of the challenges to displacement ventilation is that the diffusers are placed in the occupied zone, typically along the wall. Because

displacement diffusers supply air directly into the room, placement of the diffusers is critical to achieving a comfortable space. The ASHRAE Guideline recommends that the air velocity in the occupied zone not exceed 50 fpm. For a displacement diffuser, the zone where the velocity exceeds 50 fpm is called the adjacent zone or near zone. Occupants need to be placed outside of the adjacent zone for comfort. A typical displacement diffuser can maintain comfort in a space that is approximately 5-6 times the length of the adjacent zone.

Titus has a full line of displacement ventilation diffusers to accommodate any application. One unique feature of Titus displacement diffusers is the variable air pattern controllers located behind the perforated face. The pattern controllers can be adjusted to change the size and direction of the supply airflow pattern and adjacent zone area. Engineers may not always know the final room layout or furniture location during the design phase. Titus displacement diffusers provide the perfect solution by offering adjustability without the need to move or change the location of the diffuser. This ability to shape and customize the airflow pattern and adjacent zone to match requirements in the occupied space ensures the highest level of thermal comfort for building occupants.



Introducing the Titus Solar Plexicon

THE MOST ENERGY EFFICIENT, SOLAR-POWERED SOLUTION FOR AIR DISTRIBUTION

Displacement ventilation is growing in popularity as engineers and design professionals seek to use air distribution systems that are ultra efficient and occupant friendly. The benefits of displacement ventilation include energy savings, and the highest level of indoor air quality (IAQ) of any HVAC system in the market. An additional factor, the cost of the system, is also driving the decision process toward displacement. One reason cost has become so important is the fact that more and more designs with displacement ventilation are also calling for a supplementary heating system as well. Since heating from a traditional displacement system is not possible, providing a second HVAC system to heat the occupied space presents challenges on the cost, design, and installation sides.

To provide a solution, Titus developed the DVIR-HCS Solar Plexicon dual function diffuser. The Solar Plexicon addresses the heating problem by incorporating two air distribution delivery methods - stratified and mixed ventilation, into one diffuser assembly with a single supply duct connection. The Solar Plexicon uses displacement principles to cool and mixed airflow principles to heat the occupied space. The design features two separate internal plenums that provide separate air passage ways for cooling and heating. The front plenum is ducted to a DVRI face to provide displacement cooling. The rear plenum in the unit is ducted to a CT diffuser located at the bottom of the diffuser to provide heating from the floor level. Pattern controllers were added to the CT to provide additional spread in heating mode. The result is a unique dual function

diffuser that provides an optimum level of cooling and heating per ASHRAE without the need for a secondary heating system.

To power the auto-changeover action when changing to the cooling or heating mode, the solar Plexicon utilizes the same wireless, energy-harvesting platform that is found in the EOS solar diffuser. The energy-harvesting process that drives the auto-changeover function is achieved by using solar light energy to power the unit. Two miniature motor/actuator assemblies are mounted internally and connected to dampers. Each assembly is powered by solar panels mounted on the unit that gather sun and ambient room light and stores the energy on a capacitor. An internal circuit board houses the energy storing capacitor, temperature sensing device, and specially programmed algorithmic logic to regulate actuation changeover time and sequence. The unit "wakes up" every 10 minutes to check the room and supply air temperature and logs both. When an air temperature is recorded out of the pre-set dead band, the smart logic instructs the diffuser to change the blade position for either heating or cooling. If the temperature that is recorded calls for heating, the logic instructs the actuator to direct the airflow to the CT diffuser for mixed airflow heating. If the temperature that is recorded calls for cooling, the logic instructs the actuator to direct the airflow to the DVRI face for low velocity displacement cooling.

The Solar Plexicon is designed to operate with all types of HVAC systems in the market (Single Duct, Dual Duct, Fan-Powered, DX, etc.). To

Displacement Diffuser Adjustment

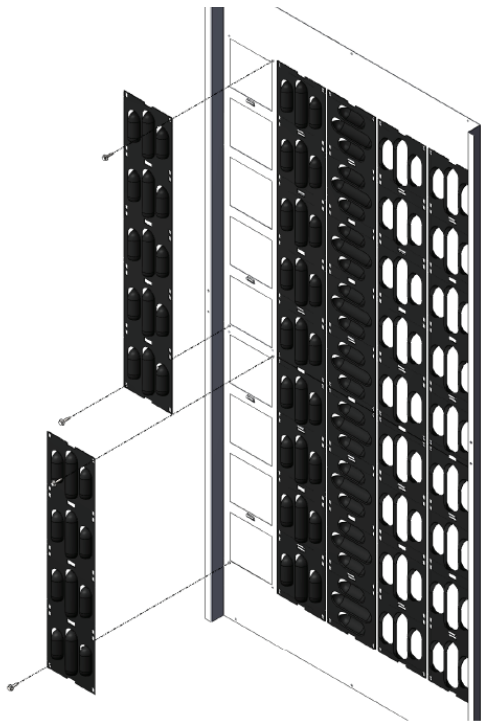


Illustration 1. Adjusting the pattern

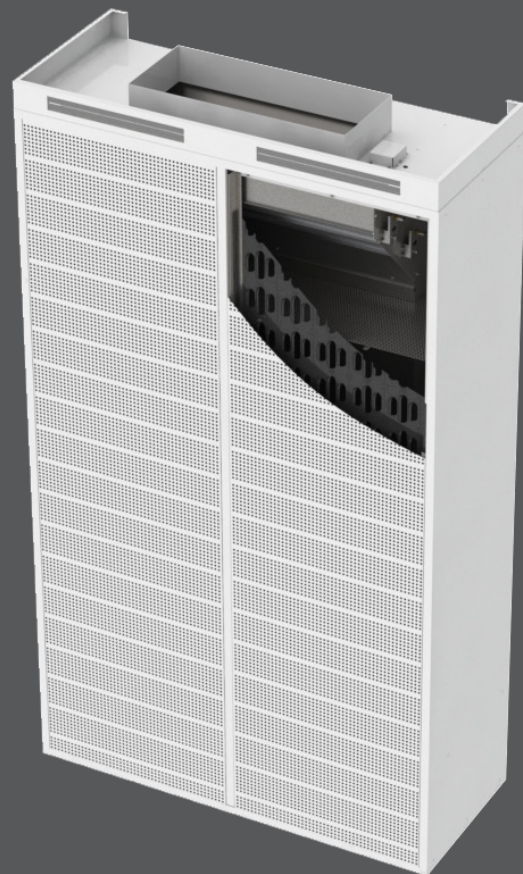
accomplish this, the unit was created with a narrow temperature band for the cooling and heating changeover actuation. The default values for the band are 78 degree F. for heating and 71 degree F. for cooling. In addition, the changeover set-points are adjustable. Each default set-point can be adjusted in one 2-degree increment up or down. This provides maximum flexibility by allowing the installing contractor to customize the band to fit any type of HVAC system they may be using. At the narrowest point, the band can be adjusted to 73 degrees F. for cooling and 76 degrees F. for heating. The band can also be expanded to 11 degrees or shifted up or down in 7 degree increments depending on system requirements.

The benefits of the Plexicon unit can be seen throughout the building process. Design engineers don't have to worry about designing and integrating a secondary system for the heating requirements. This saves valuable time and energy during the planning and design phase. Contractors can save time and money since they don't have to install a secondary air delivery system that includes additional ductwork, diffusers and controls. The building owner doesn't have to pay for the second system which saves money on the overall project. Finally, the building occupants can enjoy the highest level of thermal comfort and indoor air quality delivered by low velocity displacement cooling, or mixed airflow heating from the floor level. With the solar Plexicon, Titus continues to provide "Clever, Creative, Comfort" in a new and innovative way.

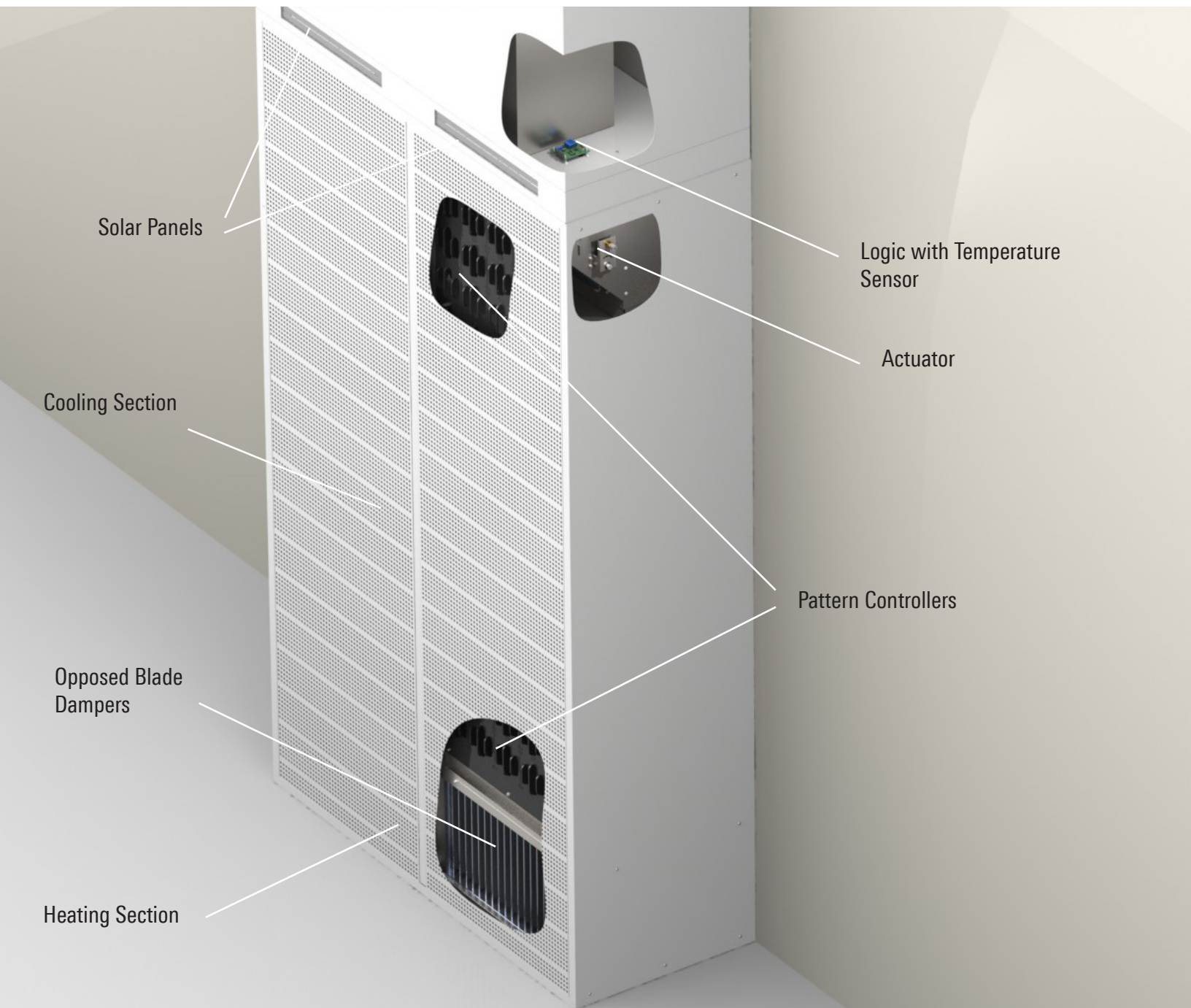
All Titus Displacement diffusers feature integral variable air pattern controllers located in the unit behind the perforated face (see illustration 1). These pattern controllers can be removed and repositioned to change the adjacent zone pattern from the diffuser face. To adjust the pattern: (see illustration 2).

- Remove diffuser face
- Remove louvers
- Reposition louvers
- Replace face

This unique feature provides a high level of flexibility for the end user. They can react to changes in the space by adjusting the adjacent zone rather than disconnecting and moving the diffuser. Illustration 3 shows a conference room with displacement diffusers and the standard adjacent zone from the factory. Illustration 4 shows how these adjacent zones can be changed to accommodate the needs in the space.



Cutaway view of the DVIR-HCS Solar Plexicon showing the adjustable pattern controllers and blade actuators



The innovative design of the Solar Plexicon created an energy-efficient HVAC unit that will revolutionize the industry. Cooling and heating that comes from a device that requires no external power source will save building owners hundreds of thousands of dollars over the life cycle of their new or renovated building.

LEED CREDITS available via DISPLACEMENT VENTILATION SYSTEMS

ENERGY AND ATMOSPHERE

Credit 1: Optimize Energy Performance

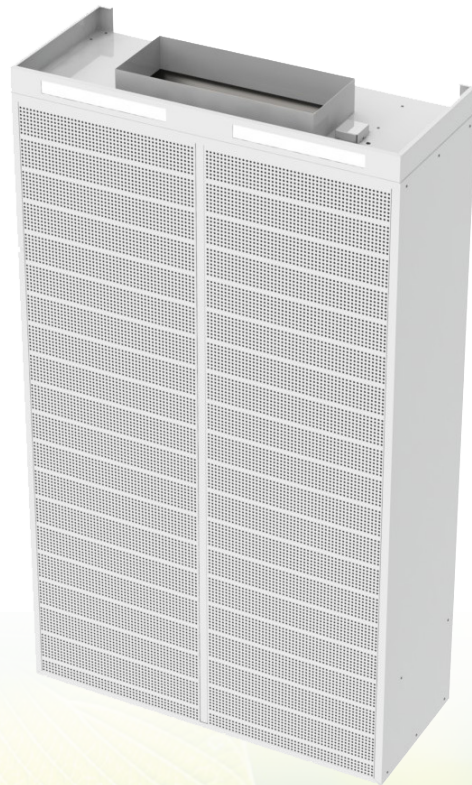
INDOOR ENVIRONMENTAL QUALITY

Credit 2: Increased Ventilation

Credit 7.1: Thermal Comfort - Design



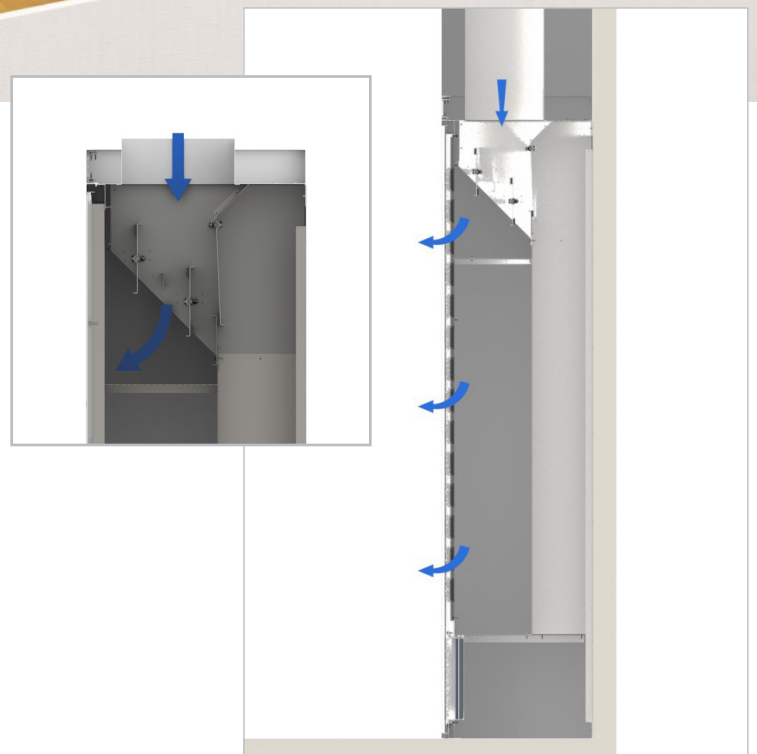
"'USGBC' and related logo is a trademark owned by the U.S. Green Building Council and is used by permission."





How Cooling works in the Solar Plexicon

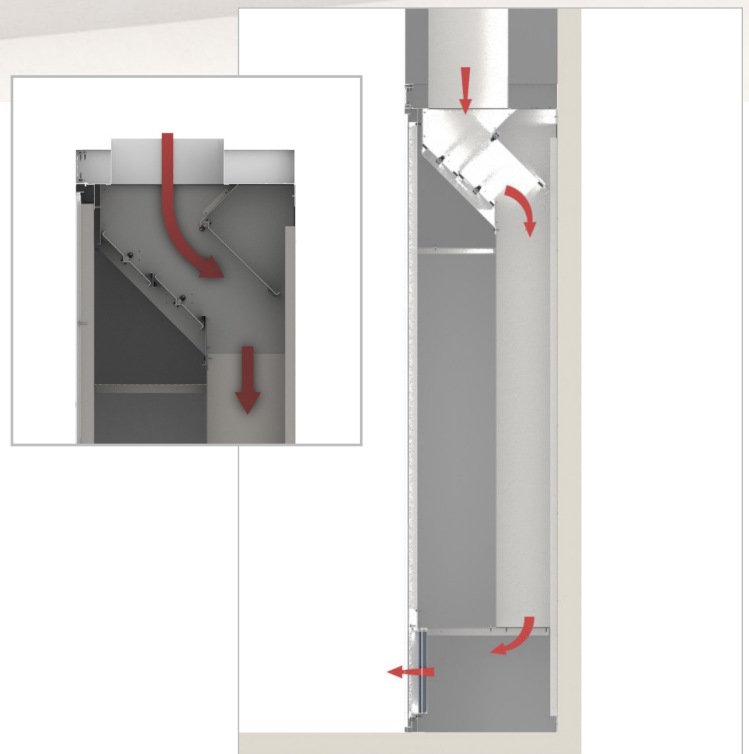
In cooling mode, cool air is directed to travel straight down and come out of the top portion of the face of the diffuser via the adjustable air pattern controllers. Cool fresh air then enters the occupied zone and provides comfort.





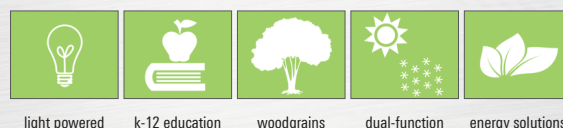
How Heating works in the Solar Plexicon

In heating mode, warm air is directed to travel down pass the adjustable air pattern controllers toward the bottom portion of the face of the diffuser and leave via the opposed blade dampers. Warm air then enters the occupied zone to provide comfort.



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