APC

APPLICATION NOTE #69

Air Distribution Unit Application

Abstract

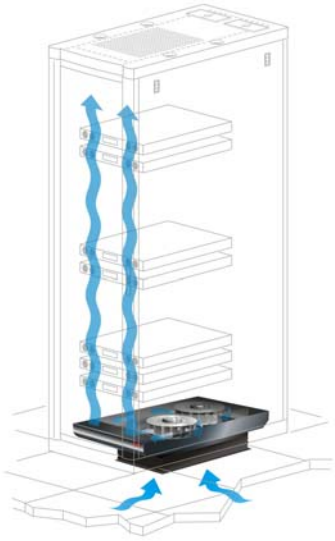
This application note serves as a detailed reference of the functionality of the Air Distribution Unit (ADU). It also discusses the use and implementation of the product in raised floor environments.

Introduction

The Air Distribution Unit (ADU) aids in thermal issues that occur in raised floor IT spaces. These issues include thermal gradient or mixing of air from floor to ceiling and low static pressures under the raised floor. The ADU fans ensure the distribution of conditioned air to the IT inlet by pulling airflow into the enclosure and positioning this flow to the equipment inlet.

Product Applications and Features

- Increase Airflow -- When used in an environment with typical static pressure (typically .01" to .03" external static pressure), the ADU will increase the amount of conditioned air distributed directly to the inlet of IT equipment.
- Improve Distribution --The ADU will overcome poor static pressure conditions under a raised floor, pulling a minimum of 460CFM (@ 0" e.s.p.).
- Additional Filtration --An ASHRAE 30% filter provides additional filtration of inlet air to prevent dust that collects under the raised floor from reaching the inside of IT enclosure.
- Adjustable Rails --Designed to fit any EIA-310-D 19" enclosure that provides an open gland plate.



Legendary Reliability®

How and When to Implement (Raised Floor Only)

Static Pressure Problems

Obstructions such as cabling, piping, or boxes are frequently placed under the raised floor during the life of a facility. These obstructions were most likely not accounted for in the initial room design and therefore the under-floor distribution of air may not react as intended. The addition of these obstructions may create a higher pressure drop (ΔP) than the ΔP of the perforated floor tile. The end result will be a non-uniform distribution of air to the room.

The IT equipment fans will draw the airflow they require from the room even if there is no conditioned air being supplied through the floor tile. When this occurs, hot aisle air can be pulled over the top of the IT enclosure and used at the IT equipment inlet. This re-circulation of exhaust air is a major cause of hot spots. The ADU can overcome most under-floor obstructions by pulling air to the required location under the floor. This changes the flow paths under the raised floor and distributes the conditioned air from the CRAC (Computer Room Air Conditioner) to the IT enclosure inlet minimizing the potential for occurrence of hot spots.

Note: Special care must be taken to remove perforated tiles from the front of IT enclosures in this application and replace it with a standard floor tile. If the perforated tile is left in place, the perforation becomes a point of least resistance and the ADU could pull room air through the tile. The resulting effect could be a short circuit of air from the adjacent hot aisle.

Medium Density Installations

What is considered a medium density IT enclosure? A medium density raised floor data center is defined as one having capacity for 2-3 kW/rack loads (For more information on air cooling densities, see APC White Paper #55) A standard perforated tile will provide approximately 250 – 400 CFM (depending on the static pressure of the data center) to the front an IT enclosure. It is important to note that CFM through a tile is dependent on the installation and room design. Field measurements are the only accurate way to determine the airflow of a perforated tile. This should be done at each tile as static pressures will vary in short distances as little as twelve inches apart. Assuming a 20°F rise in temperature through the IT equipment (ΔT), approximately 160 CFM per kW of properly conditioned (68-77°F) room air would be required in order to maintain proper cooling. See the chart below for detailed calculations.

Q (btu/hr.) = 1.085 × cfm × ΔT (°F) or **Q (watts) = .318 × cfm × ΔT (°F)** or **Q (watts) = .337 × $m^{3/}$h × ΔT (°C)**	Example: **Q (watts) = .318 × cfm × ΔT** **1000 (watts) = .318 × cfm × 20°F** **cfm = 157.23**

In properly designed IT space, 2-3 kW load can be cooled without supplemental cooling or air distribution at the enclosure. One of the reasons this can be achieved is that the kW load is concentrated near the bottom ½ of the enclosure. The air remains cool at the lower portion of the room unaffected by thermal gradient. When higher loads are spread across the enclosure, two issues combine to create a hot spot.

The first issue is thermal gradient. Rising air from the hot aisle spreads across the ceiling. When this heated air is not removed quickly enough from the IT space it mixes with the cold aisle air stream causing mixing. This mixed air is often pulled into the upper 1/2 to 1/3 of the enclosure and used as inlet air for the IT equipment.

The second issue is the need for additional airflow in higher density applications. As the kW load of equipment increases so does the need for air to cool that load. IT equipment fans will naturally pull air from the point of least resistance. If the perforated tile does not supply a curtain of cool air to the entire face of the IT enclosure this demand for airflow will be supplied by whatever is available at that height in the room. This is when re-circulation from the hot aisle to cold aisle occurs.

Medium densities can be obtained by the use of the ADU with perforated tiles in a properly designed data center. If this application is to be used then effort must be taken to ensure that the CFM entering the raised floor plenum from the CRACs exceeds the combined airflow capabilities of the ADU and perforated tiles by 30% due to leakages in the raised floor. Only when this is the case will the additional airflow required for medium densities at the IT enclosure become attainable.

Non-Raised Floor Installations

APC only recommends that the ADU be used in raised floor applications. If it is to be used in a non-raised floor installation then effort must be taken to block side and rear air paths between the enclosure's frame and floor. When these paths are not blocked, hot exhaust air can be pulled into the ADU and delivered to the inlet of the IT equipment. APC does not supply tools to block these paths of air, so it is not a recommended application for the ADU.

Conclusions

The ADU should be used if you have a low static pressure issue under the raised floor up to 3kW.

The ADU can be used to allow for medium density installations in an environment with proper static pressure and airflow supply from the CRAC. Efforts must be taken to ensure that the flow rates of the CRACs exceed that of the perforated tiles and ADUs.

The ADU is not recommended for use on non-raised floor.