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PanZone® TrueEdge™ Wall Mount Enclosure Thermal Solutions

INTRODUCTION

Dissipated heat that comes with power consumption by electronic endpoint devices such as switches, servers, UPS, etc., plays a significant role in the performance of the equipment. Airflow and internal enclosure temperature are major concerns and should be addressed in the deployment plan to avoid equipment overheating and prevent network failures.

Some current cooling solutions in the market include louvers, minimal perforation, and fan kits. All these solutions provide airflow but not enough airflow to dissipate the heat generated by the high-density power that the equipment generates. For example, A 6 RU enclosure allows for 6 RU of active equipment, but it is the thermal capability of the enclosure that defines the type of equipment that can be mounted in the enclosure. The PanZone TrueEdge Wall Mount Enclosure's engineered design is thermally tested to withstand the maximum heat output with minimal limitations on the equipment used.

Most datacenter cabinets separate the hot and cold air zones and exploit the pressure rise and the momentum generated by the equipment's internal fans to evacuate heat from the cabinet, eliminating the need for additional fans. Conversely, most small network equipment enclosures are sealed and must utilize enclosure fans to remove heat. In this case, the enclosure fan's flow rate must typically exceed the equipment's internal fan's flow rate at all times to prevent hot air recirculation to the equipment inlet, leading to a costly and noisy solution.

Panduit PanZone TrueEdge Wall Mount Enclosures combine both approaches by positioning the equipment's hot air outlet near a fully perforated bottom floor. This method allows the momentum of air generated by the equipment's fans to do some of the work in ventilation, while enclosure fans can supplement ventilation where needed. The perforated top and bottom draw cool air in from the top, and the equipment and added fans push the hot air out through the bottom of the enclosure, guaranteeing top network performance. Our approach reduces the cost and noise when deploying high-heat-generating equipment.

This application guide overviews key design considerations for thermal management solutions to mitigate thermal factors for Panduit TrueEdge enclosures. The solutions presented in this guide are based on maintaining the internal temperature of the enclosure below the maximum operating temperature requirements of typical enterprise equipment with margin (35°C for servers, 40°C for UPS, and 45°C for switches). The charts in the following sections illustrate the allowable ambient temperature outside an enclosure vs. a heat load for various applications.

SOLUTIONS

Panduit combined practical testing with actual equipment under workloads, practical testing with simulated equipment, and computational fluid dynamics simulation (CFD) to validate a broad scope of potential use cases. PanZone TrueEdge Wall Mount Enclosures utilize a user-configurable design to optimize ventilation and cable management for any application. The floor of the enclosure is perforated to permit the warm air exhaust from the vertically oriented equipment to exit directly through the bottom of the enclosure. The perforation includes multiple mounting locations for fans. The equipment rail height is adjustable to support the equipment at the ideal height for proper ventilation. Additional rails can be purchased to mount equipment of various heights. The total expected heat load of the equipment can determine the minimum quantity of enclosures fans needed for your application.

INFORMATION GATHERING

To properly select any thermal solution, some basic information must be collected about the system (enclosure and the equipment it will house). Most of this information is available from the equipment vendor in the form of data sheets, specifications, instruction manuals, deployment guides, etc. Below is a list of the information required to apply any cooling solutions.

1. ***Maximum Ambient Air Temperature*** - This is the maximum expected air temperature that will surround the exterior of the enclosure.
2. ***Enclosed Space Ventilation*** - If the enclosure is mounted in an enclosed space such as a closet or telecommunications room, ensure the closet ventilation is sufficient to remove the heat from the room. Ensure the building air conditioning system has sufficient cooling capacity to handle the additional heat loads from the active equipment.
3. ***Maximum Desired Internal Enclosure Temperature*** - The equipment with the lowest maximum operating temperature limit will dictate the maximum allowable internal temperature for the enclosure. Check this temperature limit for every device and include high altitude adjustments where necessary. The graphs below assume 35°C for servers, 40°C for uninterruptible power supplies (UPS), and 45°C for switches. Adjust your ambient temperatures accordingly if your equipment’s operating limits differ from the assumptions.
4. ***The Internal Heat Load*** - This is the sum of the power consumed by all equipment mounted inside the enclosure. Use the worst-case scenario – when all devices are at their maximum output.

Switches

For network switches, 100% of the switching power is dissipated as heat inside the enclosure. Use the switching power consumption rating for 100% of traffic listed in most datasheets. Some network switch manufacturers may report the total heat dissipation in BTU/h. This must be converted to watts (1 BTU/h = 0.293W). Note that listed heat dissipation in the equipment datasheet may exclude heat from secondary POE power supplies.

When calculating heat created by POE devices outside the enclosure, include 15% of the total POE power provided by the switches. For typical enterprise applications, POE devices (security cameras, LED lighting, etc.) dissipate at least 85% of their heat at the device location (away from the enclosure). Power supply inefficiencies, cabling, and connectors are a significant portion of the internal heat load of the enclosure. If any POE devices are inside the enclosure, assume 100% of the POE power for that device is dissipated as heat inside the enclosure. You may choose either the total available POE power of the switch (worst case) or the total expected installed power consumption of all connected POE devices (expected case) based on your preference.

Servers

To calculate the heat dissipation of a server, assume all of the power consumed by the server is dissipated as heat inside the enclosure. When the power consumption of the server is unknown, assume 75% of the power supply rating will be consumed and converted to heat. Be sure to account for the redundancy configuration (I.E., 2+0 or 1+1) when the server contains multiple power supplies.

UPS

It is also necessary to account for the heat generated by an uninterruptable power supply (UPS). A UPS typically operates at a reduced efficiency when operating in “battery mode” (versus “normal mode” or “line mode”). Battery mode efficiencies are typically the worst case and may not be reported in the manufacturer’s datasheet. For a typical UPS running in battery mode, assume the UPS heat output is equivalent to 15% of the total power *consumed* by all devices connected to the UPS.

EXAMPLE 1

Two switches, each having a power consumption rating of 127.7W at 100% traffic, and 48 POE+ (30W) ports. All ports are expected to draw full POE power.

The POE power consumption per switch is 30W multiplied by 48 ports.

$$30W \text{ x } 48 \text{ ports} = 1440W \textit{ POE Power Consumed per Switch}$$

The POE heat output per switch is 15% of the POE Power (216W).

$$1440W \text{ x } 0.15 = 216W \textit{ POE Heat Dissipation per switch}$$

The combined heat output per switch is the switching power added to the POE heat output (343.7W).

$$216W + 127.7W = 343.7W \textit{ Heat Dissipation per Switch}$$

The total system heat output is 343.7W multiplied by the number of switches.

$$343.7W \text{ x } 2.0 = 687.4W \textit{ Total System Heat Dissipation}$$

EXAMPLE 2

One switch with a listed total heat output of 395.5 BTU/h and with a secondary 840W POE Power supply. All POE power to be utilized. One server with a known power consumption of 1052.4W at maximum workload. A UPS is connected with enough capacity to power the switch, server, and all POE devices.

The heat output of the switch must be converted to watts by multiplying by 0.293.

$$395.5\ BTU/h \times 0.293W = 115.9W\ \textit{Switching Heat dissipation}$$

The POE heat output of the switch is 15% of the available POE power.

$$840W \times 0.15 = 126W\ \textit{POE Heat Dissipation}$$

The total heat output of the switch is the POE heat output added to the switching power.

$$115.9W + 126W = 241.9W\ \textit{Total Switch Heat Dissipation}$$

The total heat output of the equipment is the switch heat output added to the server power.

$$241.9W + 1052.4W = 1294.3W\ \textit{Equipment Heat Dissipation}$$

The total power ***consumed*** by the equipment is switching power plus the total available POE power plus the server power.

$$115.9W + 840W + 1052.4W = 2008.3W\ \textit{Total Equipment Power Consumption}$$

The heat load of the UPS is 15% of the total equipment power consumption.

$$2008.3W \times 0.15 = 301.2W\ \textit{UPS Heat Dissipation}$$

Total heat dissipated inside the enclosure is the equipment heat dissipation plus the UPS heat dissipation.

$$1294.3W + 301.2W = 1595.5W\ \textit{Total System Heat Dissipation with UPS in battery mode}$$

EXAMPLE 3

One server with two 1600W power supplies in 1+1 full redundant mode, unknown consumption at full load.

The total available power for this redundancy configuration is the power rating for only one power supply (1600W) since it is fully redundant. The maximum expected heat load is 75% of this available power.

$$1600W \times 0.75 = 1200W\ \textit{Total Internal Heat Load}$$

EXAMPLE 4

Two servers, each with two 1100W power supplies in 2+0 non-redundant mode, unknown consumption at full load.

The total available power for each server is the combined power of two power supplies since they are in non-redundant mode.

$$1100W \text{ x } 2 = 2200W \textit{ Available Power per Server}$$

The maximum expected heat load is 75% of the available power multiplied by two servers.

$$2200W \text{ x } 0.75 \text{ x } 2 = 3300W \textit{ Total System Heat Dissipation}$$

EQUIPMENT CONFIGURATION

The positions of equipment, cabling, and accessories within the enclosure have a major impact on the airflow within the enclosure. Improper setup may elevate equipment temperatures above acceptable levels. Follow the guidelines below to ensure sufficient cooling is achieved.

1. Mount all heat-generating equipment in the lowest possible position to prevent hot air recirculation inside the enclosure.
2. Use additional E-rail kits (i.e., WME*ERAIL) when various size equipment is installed to ensure all heat-generating equipment is mounted in the lowest possible position or a maximum height of 6 inches from the bottom of the hot air outlet to the bottom of the enclosure. Place taller equipment, such as servers, behind the shorter equipment to prevent blockage of fresh air.
3. Avoid mounting heat-generating equipment in the rearmost rack unit (RU). This rack space is not above the perforated floor plate.
4. Avoid mounting servers with over 1000W heat output in the front rack unit or the rear two rack units. The ideal location for high heat-generating equipment is centered above the lower perforation. Reserve the outer rack units for PDUs or cable pathways.
5. Install enclosure fans with **downward flow.** Align front-to-back position to match equipment position.
6. Install enclosure fans on both left and right sides when two or more are required.
7. Connect enclosure fans to UPS battery power whenever equipment is connected to any battery backup power. Power drawn from fans is negligible.
8. Carefully arrange and secure power cabling to avoid obstructing the lower perforation and equipment outlets.
9. Carefully arrange and secure data cabling to avoid obstructing the upper perforation and equipment inlets.
10. Inspect and replace filter media every three to six months when TrueEdge Filter Kits (WME^**-FKIT) are installed.
11. Avoid any obstructions below the bottom perforation. Maintain a minimum clearance of 24 inches below the enclosure to achieve maximum thermal performance.

EXAMPLE CONFIGURATIONS

Rack Space	Installed Equipment
RU 1 (rear):	Empty
RU 2:	Empty
RU 3:	Empty
RU 4:	1 RU switch
RU 5:	1 RU switch
RU 6 (front):	1 RU switch
WME61RU:	PDU (upside down)

Rack Space	Installed Equipment
Fans installed:	2x PZAEFAN
RU 1 (rear):	Empty
RU 2 and RU 3:	2 RU server
RU 4 and RU 5:	2 RU UPS
RU 6 (front):	Switch
WME0UB (vertical):	Patch Panel

SELECTING ENCLOSURE FAN QUANTITY

Use the following charts to determine the minimum required enclosure fan flow rate in cubic feet per minute (CFM) for your application. The recommendations are for standard 120mm axial fans such as Panduit PZAEFAN (60CFM).

- If your application falls on the border between two colored zones, choose the higher CFM
- These recommendations are for typical front-to-back breathing equipment. Any side-to-side breathing equipment or equipment with atypical hot air outlets will require additional enclosure fans to maintain acceptable temperatures

- When operating at a high elevation or your equipment's maximum operating temperature is lower than the standard assumptions, increase your expected ambient temperature to accommodate

When TrueEdge Filter Kits (WME^**-FKIT) are installed, add 10% to your heat load to accommodate the airflow restriction.