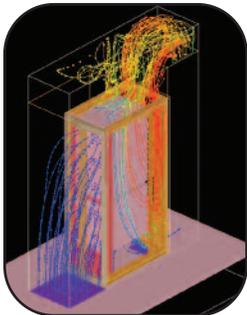


Frequently Asked Questions

CPI Passive Cooling® Solutions



CFD Model of High Heat Density F-Series TeraFrame® Cabinet deploying CPI Passive Cooling® Solution



Q. What are CPI Passive Cooling® Solutions?

A. CPI Passive Cooling® Solutions are thermal management accessories that help control airflow through equipment cabinets to improve cooling effectiveness in your data center. CPI Passive Cooling Solutions include the KoldLok® Raised Floor Grommet, Snap-In Filler Panels, Air Dam Kit, Internal Air Duct, Bottom Panel and Vertical Exhaust Duct. CPI Passive Cooling Solutions transform equipment cabinets into an extension of your facility's cooling system. Achieve 2-20+ kW of cooling without the use of supplemental liquid or active cooling systems by carefully controlling airflow through equipment cabinets. CPI Passive Cooling Solutions control airflow, are easy to install, have no active components, require no maintenance and can be used in any Tier facility.

Q. How do you control airflow through the equipment cabinet?

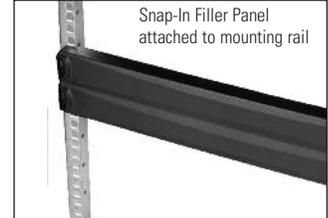
A. There are three basic steps that control airflow through the equipment cabinet. First, you must eliminate hot air recycling through the cabinet. Next, you must increase the amount of cold air entering the cabinet. Then, you must isolate hot air from the room. The next three questions address these steps in detail.

Q. How do you eliminate hot air recycling through the cabinet?

A. Eliminate hot air recycling through the cabinet with the Air Dam Kit and Snap-In Filler Panels. Include a Bottom Panel if the cabinet is elevated above the floor on leveling feet or cabinets. The Air Dam Kit seals the space between the equipment mounting rails and the top, bottom and sides of the cabinet enclosure. Snap-In Filler Panels seal rack-mount spaces between equipment. Air temperature can increase 20° F (11° C) or more in one cycle through equipment. The Air Dam Kit and Snap-In Filler Panels block airflow around equipment to guide cold air through equipment and to prevent hot exhaust air from re-circulating through the cabinet. In the 600 mm cabinet, an effective air dam can be created by sliding the equipment rails to the full forward position. In the GlobalFrame™ Cabinet System, use the Rail Seal Kit instead of the Air Dam Kit to seals airflow around the equipment.



Air Dam Kit installed on TeraFrame Cabinet



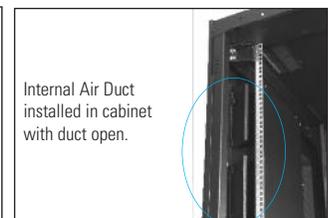
Snap-In Filler Panel attached to mounting rail

Q. How do you increase the amount of cold air entering the cabinet?

A. Increase the amount of cold air entering the cabinet with the KoldLok® Raised Floor Grommet and the Internal Air Duct. Seal cable holes in access floor tiles with the KoldLok Raised Floor Grommet and use the Internal Air Duct to deliver additional cold air to the top half of the cabinet. Up to 50 percent of the cold air under the access floor can be lost through unsealed cable holes. Seal cable holes in the access floor to deliver more cold air to equipment through the vented access floor tiles in the cold aisles. In high heat density environments, hot air also travels over the cabinet and is re-circulated through equipment at the top half of the cabinet. Re-circulated air is too high in temperature to effectively cool equipment. The Internal Air Duct delivers additional cold air from under the access floor to the space between the front door and equipment. The cold air mixes with the air entering the cabinet lowering the temperature of the air used to cool equipment at the top half of the cabinet.



KoldLok Raised Floor Grommet



Internal Air Duct installed in cabinet with duct open.

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Q. How do you isolate hot air from the room?

A. Guide hot air out of the cabinet and the room with the Vertical Exhaust Duct. For best results use the Vertical Exhaust Duct with a Bottom Panel, Airflow Director and Rear Door Sealing Kit. The cabinet is fitted with a solid rear door to guide hot exhaust air to the Vertical Exhaust Duct. The duct is attached to a drop ceiling or is extended to a point high above the cabinet. Hot air returns to the primary cooling units through the plenum space above the drop ceiling or through the room. Since hot air is directed up, there is no hot aisle. Vented access floor tiles can be placed anywhere in the room to increase cold air delivery into the room. The air that re-circulates over and around cabinets is lower in temperature and can be used to cool equipment because it has not been mixed with hot exhaust air.



Q. Can I add a fan to increase the amount of cold air entering my cabinets?

A. Yes, but it may not be the best solution. Fans move air, but do not reduce the temperature of the air. Rack-mount equipment has internal fans that draw the correct amount of air through equipment. The challenge is to deliver air at the right temperature. Less than 78° F (26° C) is optimal. If fans are used, they should be used to direct low temperature air to the front of equipment when there are hot spots in equipment cabinets. Bottom-mount fans that direct cold air up the front of the cabinet like the Delphi ECS Enclosure Blower are a good option where the Internal Air Duct cannot be used. The disadvantage of using fans (or other active cooling solutions) in a medium or large data center is the additional planning and maintenance required to supply redundant power to the fans.

Q. Can I use fans that attach to the rear door or the top of the cabinet to remove hot air from the rear of the cabinet?

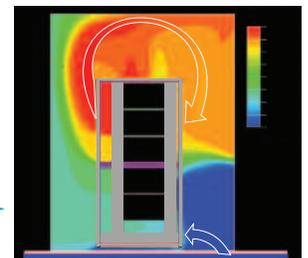
A. Yes, but it may not be the best solution. Fans move air, but do not reduce the temperature of the air. The reason for adding fans to the rear door or to the top of the cabinet is to move hot exhaust air away from the cabinet. This method will work in many low to medium heat density environments or in a mixed environment where average heat loads are lower. However, when every cabinet in the row has a medium to high heat load, adding exhaust fans can increase the amount of hot air that re-circulates over the cabinets. Use the Vertical Exhaust Duct System instead to isolate and remove hot air from the room.

Q. Is 6-7 kW per cabinet the heat load limit for conventional hot aisle/cold aisle cooling solutions?

A. Yes, 6-7 kW per cabinet is the heat load limit for conventional hot aisle/cold aisle cooling solutions; however, heat loads above 7 kW can be easily managed with CPI Passive Cooling® Solutions by using the Vertical Exhaust Duct System for the TeraFrame® Cabinet System. The conventional hot aisle/cold aisle configuration delivers cold air to each cabinet through a single vented access floor tile placed directly in front of the cabinet. When heat loads reach 6-7 kW per cabinet, the volume of cold air required to remove heat from the cabinet typically exceeds the amount of cold air that can be practically delivered to the cabinet. As a result, air is borrowed from the room, and the air near the top of the cabinet is much higher in temperature because it mixes with hot air that re-circulates over and around the cabinet from the hot aisle. The solution is to isolate and remove the heat (the hot exhaust air) from the room with the Vertical Exhaust Duct. Once the heat is isolated and removed from the room, vented access floor tiles can be placed anywhere in the room to flood the room with the additional cold air required to cool equipment. The low temperature cold air re-circulates over and around the cabinet to keep equipment cool.

Q. Are supplemental liquid or active cooling systems the only way to handle heat loads over 20 kW in the data center?

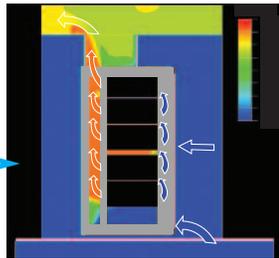
A. No, heat loads over 20 kW do not necessarily require supplemental liquid or active cooling at or in the server cabinet. This assertion typically arises because above 6 to 7 kW per cabinet, the cabinet heat load will have an air consumption demand that exceeds the delivery capacity of the vented access floor tile situated in front of the cabinet. As a result, air is borrowed from the room and the high temperature air in the hot aisle re-circulates over the cabinet. The re-circulated high temperature air mixes with air in front of the cabinet creating hot spots near the top of the cabinet.



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CPI Passive Cooling Solutions solve the problem of hot air re-circulation by isolating and removing hot air from the room. First, block bypass airflow through cable access holes in the raised floor with the KoldLok® Raised Floor Grommet to deliver more conditioned air to equipment through vented access floor tiles. Next, block re-circulation through the inside of cabinets with Air Dam Kit and Snap-In Filler Panels. Then, use the Vertical Exhaust Duct System to guide hot air from the cabinet to a location high above the cabinet. The Vertical Exhaust Duct can be attached to a drop ceiling or a return air duct to create a closed hot air return to the primary air conditioning system or to vent hot air from the room. Once heat is removed from the room, ambient air temperatures are more easily controlled. Since the heat is removed through the Vertical Exhaust Duct, there is no need for a conventional hot aisle to collect exhaust air and vented access floor tiles can be placed anywhere to fill the room with low temperature air. With sufficient cooling capacity in your primary cooling system, CPI Passive Cooling Solutions will help you control airflow to eliminate hot spots and improve cooling effectiveness without supplemental liquid or active cooling systems.



Q. How is Passive Cooling with a Vertical Exhaust Duct different than supplemental liquid or active cooling systems?

A. The Vertical Exhaust Duct moves hot air from the cabinet to a location high above the cabinet. Hot air is returned to the primary air conditioners through the room, ductwork, or plenum above a drop ceiling. Active cooling systems are mini-air conditioners co-located next to or over equipment cabinets. They cool air from the hot aisle as it re-circulates over or around the cabinets. Active cooling systems require additional power, and the liquid systems require additional plumbing to and from the cabinets.

Q. What are the advantages of using a Vertical Exhaust Duct instead of supplemental liquid or active cooling systems in high heat density environments?

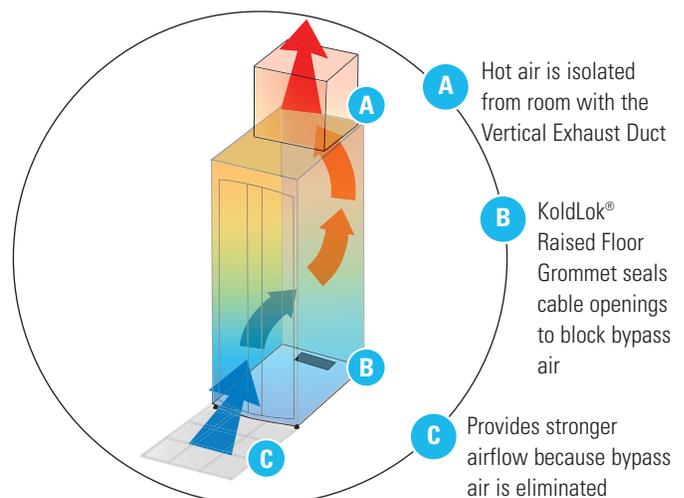
A. The Vertical Exhaust Duct has no additional power or plumbing requirements at or near equipment cabinets. The Vertical Exhaust Duct extends the room cooling system to the cabinet so maintenance and redundancy concerns are concentrated at the primary cooling units. The thermal management accessories in the Vertical Exhaust Duct System have no moving parts, do not add potential points of failure and can be used in any Tier facility. Your facility staff does not have to learn, manage and maintain an additional cooling sub-system.

Q. How do you use a Vertical Exhaust Duct to return hot exhaust air to your primary cooling system?

A. The Vertical Exhaust Duct helps control airflow through your equipment cabinets and facility. Configure cabinets with a vented front door, a solid rear door, solid side panels and the Vertical Exhaust Duct. The Vertical Exhaust Duct extends high above the cabinets (if you have a high ceiling) or connects to a drop ceiling to isolate hot air. A duct is added to the air conditioner so that return air is drawn from the drop ceiling or from the air high above the cabinets. Open rack-mount spaces and the space around the front pair of equipment mounting rails are sealed with Snap-In Filler Panels and the Air Dam Kit. Cold air enters the front of the cabinet, travels through equipment and absorbs heat, exits the Vertical Exhaust Duct and is returned to the primary cooling system.

Q. It sounds too easy. The conventional hot aisle/cold aisle layout does not seem to handle high kilowatt loads. Why does the Vertical Exhaust Duct work?

A. In the conventional hot aisle/cold aisle layout, heated exhaust air exits the rear of the cabinet into the hot aisle. In high heat density environments, the volume of air required to cool equipment is much larger. The powerful fans in equipment pull hot air over the cabinet and back through equipment. By the time the air is cycled a second time, it is already too high in temperature for most equipment. The Vertical Exhaust Duct installed on a cabinet isolates and removes hot air from the room instead of spilling it into the hot aisle. You can deliver more cold air into the room because you can place vented access floor tiles anywhere. There is no hot aisle. Instead of hot exhaust air re-circulating over the cabinet, the whole room is flooded with low temperature conditioned air.



CPI Passive Cooling® Solution



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Q. Are there special design requirements when using the Vertical Exhaust Duct?

A. Yes. The Vertical Exhaust Duct is part of an engineered room cooling solution. In high heat density environments, equipment produces more heat and consumes a larger volume of conditioned air. Your cooling system must have sufficient cooling capacity and provide enough air volume to cool equipment. Positioning of equipment cabinets is important. For best results, equipment cabinets should be parallel to airflow from the cooling units. Aisle spacing should be maintained to allow sufficient airflow into cabinets. Align the drop ceiling support grid with the access floor tiles to minimize modifications where ducts interface with the drop ceiling. Use overhead cable pathways to minimize cable holes in the access floor. Seal all holes in the access floor.

Q. How do you estimate the heat load in a cabinet?

A. The heat load in a cabinet is the sum of the heat produced by the equipment in the cabinet. The heat load can be stated in Watts or British thermal units (Btu). (1 Watt = 3.413 Btu/hr.) The corresponding amount of air conditioning may be stated in Watts, Btu or Tons. (1 Ton of air conditioning = 12,000 Btu or 3516 Watts.) Refer to the technical specifications of the equipment to find the heat produced by each piece of equipment when it is operated at full capacity. Note that the power supply rating is not the heat load. Also, you cannot calculate the heat load by multiplying the power supply rating by the nominal operating voltage. Technical specifications drafted in the manner recommended in the American Society of Heating, Refrigeration and Air Conditioning Engineers' (ASHRAE) TC9.9 Thermal Guidelines for Data Processing Environments will provide a reliable reference point. Also, many manufacturers have configuration tools that give heat loads for specific equipment configurations.

Q. What CPI Products are used to create a low heat density (2-4 kW) CPI Passive Cooling Solution?

A. Configure a 600 mm wide or 700 mm wide by 1000 mm deep or deeper F-Series TeraFrame Cabinet with a vented front and rear door, solid side panels and a solid top panel. Use the Air Dam Kit at the front of the cabinet to seal the space between the rack-mount rails and the top, bottom and sides of the cabinet enclosure. Use Snap-In Filler Panels to seal open rack-mount spaces between equipment. The Air Dam Kit and Snap-In Filler Panels are also available for CPI MegaFrame®, and SlimFrame® and Cabinet Systems. Use Rail Seal Kit, Bottom Panel and Snap-In Filler Panels in GlobalFrame™ Cabinet Systems. Access our online Product Configurator at www.chatsworth.com/configurator to configure a solution that meets your exact requirements.

Q. What CPI Products are used to create a medium heat density (4-7 kW) CPI Passive Cooling Solution?

A. Configure a 600 mm wide or 700 mm wide by 1000 mm deep or deeper F-Series TeraFrame Cabinet with a vented front and rear door, solid side panels and a solid top panel. Use the Internal Air Duct to deliver additional cold air from under the access floor to the top half of the cabinet. Use Snap-In Filler Panels to seal open rack-mount spaces between equipment. The Vertical Exhaust Duct is also available for the GlobalFrame™ Cabinet System. Use the online Product Configurator at www.chatsworth.com/configurator to configure a solution that meets your exact requirements.

Q. What CPI Products are used to create a high heat density (7-20+ kW) CPI Passive Cooling Solution?

A. Configure a 600 mm wide or 700 mm wide by 1200 mm deep TeraFrame Cabinet with a vented front and solid rear door, solid side panels and the Vertical Exhaust Duct System. Use the Air Dam Kit at the front of the cabinet to seal the space between the rack-mount rails and the top, bottom and sides of the cabinet enclosure. Use Snap-In Filler Panels to seal open rack-mount spaces between equipment. A top-mount Airflow Duct is also available for Enhanced SteelFrame Cabinet. Use the online Product Configurator at www.chatsworth.com/configurator to configure a solution that meets your exact requirements.

Q. How do I find out more about CPI Passive Cooling Solutions?

A. Visit www.chatsworth.com/passivecooling or contact CPI Technical Support (1-800-834-4969 or techsupport@chatsworth.com).

