3.14.2 System Cooling Facts

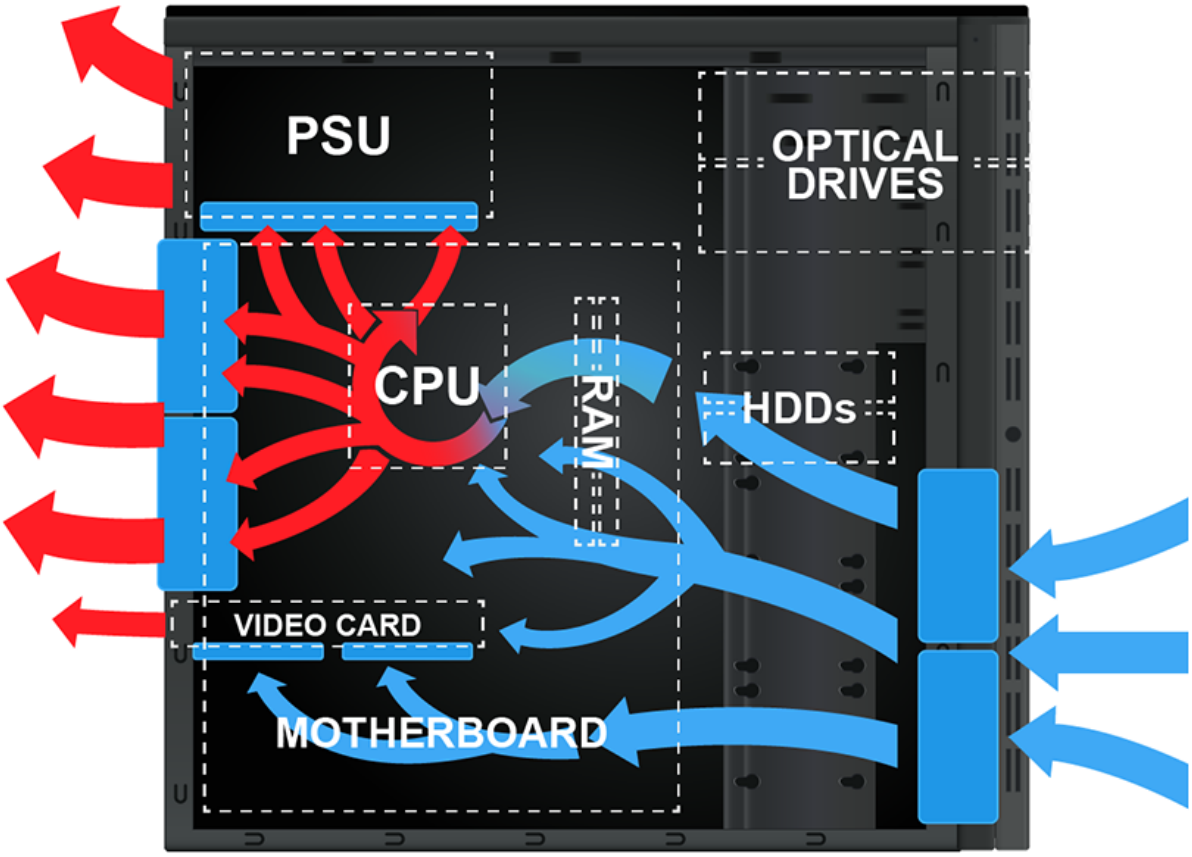
The normal operation of computer components produces heat. Overheated components can cause intermittent errors and reduce component life. If components are overheated for an extended period of time, they will fail. To keep component temperatures optimal, computer cases maintain a consistent, one-way flow of air through the case.

This lesson covers the following topics:

- Airflow in a computer case
- Cooling system components
- Cooling system recommendations

Airflow in a Computer Case

The following diagram shows how air should flow through a computer case:



Cooling System Components

The following table identifies several components that are used to help regulate a computer system's internal temperature:

Component	Description
Case fans	Case fans create a pressurized system that allows air to flow through the case in a specific way. ▪ Intake fans (at the front) pull air inside the case to cool components. ▪ Outtake fans (at the back and top) exhaust warm air from inside the case. ▪ Some cases have intake fans on the side case cover. ▪ Fan filters can be installed to keep dust and debris inside the case to a minimum.

Power supply	ATX power supplies aid in cooling by exhausting hot air out the back of the case.

Heat sink	Heat sinks are made of a heat conductive material (usually aluminum or copper) and are attached to components using a thermal paste or pad. Heat sinks are designed with fins to increase the surface area exposed to air, allowing heat to dissipate from the component much faster. Heat sinks can be either active or passive.
	▪ Active heat sinks have an attached fan that helps cool off the component at a faster rate. Active heat sinks are used with the following components:
	  ▪ CPUs
	  ▪ High-end video cards
	  ▪ Some motherboard chipsets with integrated graphics
	▪ Passive heat sinks do not have a fan and instead rely on increased surface area and passive air movement to cool the component. Passive heat sinks are used with the following components:
	  ▪ Most motherboard chipsets
	  ▪ Low-end video cards
	  ▪ Memory modules (heat sinks on memory modules are also called heat spreaders)
	Because passive heat sinks do not use a fan, they are 100% reliable. However, active heat sinks can dissipate heat much faster than passive ones.

Heat sensors	Most motherboards include the following heat sensors: ▪ CPU sensor (located on the circuit board underneath the processor) ▪ System case sensor (located either on the motherboard or on a cable attached to the motherboard) ▪ Room temperature sensor (usually connected to the motherboard by a cable and mounted on a case slot) Special software can monitor the temperature levels and be configured to send warnings when high temperature conditions exist. The BIOS in most motherboards can also be configured to automatically shut the system down when a specified thermal threshold is exceeded.
Liquid cooling	Liquid cooling systems are used when air cooling is not sufficient. Liquid-based cooling systems are composed of tubes, cooling plates, a reservoir, and a radiator. Cooling plates have tubes connected to them and are attached to components. Liquid coolant is then circulated through the system, cooling it. Because liquid cooling can dissipate heat much faster than air cooling, it is primarily used for high-end gaming computers and high-performance systems.

Issues related to insufficient cooling are sometimes difficult to identify. They usually manifest as random errors or system lockups. One tool that can be used to troubleshoot cooling problems is freeze spray. If a system is starting to fail due to overheating, spraying it with freeze spray reduces the temperature and could restore it to normal functionality. If the problem goes away after spraying a suspected component, implement additional cooling solutions for that component.

Cooling System Recommendations

Because proper airflow is necessary to keep components cool, consider the following recommendations to ensure optimal system cooling:

- Keep the case free of dust and debris. Excess dust can restrict airflow and prevent proper heat transfer.
- Reduce the number of airflow obstructions.
  - Employ proper cable management (e.g., bundle cables together and secure unused cables to the case).
  - Space out multiple hard disk drives instead of stacking them next to each other.
  - Do not use an excess number of expansion cards.
- Maintain appropriate ambient temperatures. Optimal ambient temperatures are between 60 and 80 degrees Fahrenheit. For server rooms, the ambient temperature might be as low as 45 degrees.
- Ensure proper ventilation.
  - Keep air intakes and exhausts free from obstructions.
  - Leave space between the computer and any walls or desks.
- Preserve negative pressure inside the case by keeping all covers and shields installed (e.g., unused expansion cards, I/O shield, front drive bays).