Kidde Fire Systems

Data Center HDD and SSD Storage - Fire Protection Systems

Addressing the impact of noise and vibration

KiddeFenwal

Data Center HDD and SSD Storage - Fire Protection Systems

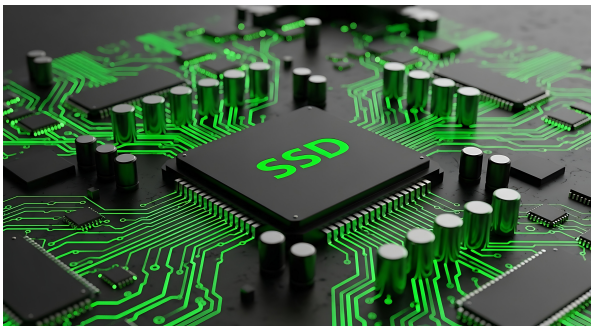
Addressing the impact of noise and vibration

The rapid adoption of AI and digital transformation has fueled massive data growth, placing unprecedented pressure on data centers to maintain uptime. As data volumes from machine learning and IoT skyrocket, it's critical to re-evaluate fire protection strategies for storage, addressing the unique risks posed by both SSDs and HDDs.

Solid-state drives (SSDs)

Growth:

The data center SSD market is experiencing significant growth, with projections to reach ~USD 167 billion by 2031, growing at a CAGR of 24%+ according to Mordor Intelligence. This growth is fueled by their advantages in performance and reliability



Performance:

SSDs boast superior performance compared to HDDs, including faster data access, lower latency, and higher throughput, making them ideal for performance-critical applications like databases, virtualization hosts, and AI workloads.

Power Efficiency:

SSDs are significantly more energy-efficient than HDDs, consuming less power, particularly in idle states. This translates to reduced cooling costs and a smaller overall data center footprint.

Total Cost of Ownership (TCO):

Although SSDs have a higher initial cost per terabyte compared to HDDs, their lower power consumption and improved reliability can lead to a lower TCO in the long run.

Hard disk drives (HDDs)

Market Share:

Mordor Intelligence reported the global hard disk drive (HDD) market size at approximately $19.9 billion as of January 2024. While the hard disc drive market is expected to decline by ~4.9% by 2030, HDDs still represent the vast majority of storage in hyper-scale and cloud data centers, and will account for almost 80% through 2028, according to Western Digital. As the technology landscape evolves hybrid cloud infrastructure will be adopted leveraging the benefits of both SDDs and HDDs.

Cost-Effectiveness:

HDDs still offer a lower cost per terabyte than SSDs, making them attractive for storing massive amounts of data, especially for cold storage, backups, and archiving.


HDD

Capacity:

HDDs continue to offer higher storage capacities than SSDs. Manufacturers are also developing advanced technologies to further increase HDD capacities.

Vulnerability to Vibration:

Digital infrastructures have become more resilient and reliable due to industry advancements, yet they are not immune to the damaging effects of sound and vibration. For storage drives in a data center, vibration is a notable threat to both performance and longevity. The causes are both internal and external. Internal sources include HVAC systems, generators, uninterruptible power supplies (UPS), cooling fans, and the operation of other drives in the same enclosure. External sources like traffic and construction can also introduce harmful vibrations.

SSDs have no moving parts, making them inherently more resistant to shock, vibration, and extreme temperatures. This translates to a longer lifespan, fewer mechanical failures, and reduced downtime.

HDDs are particularly susceptible to vibration, which can cause read/write head misalignment, leading to performance degradation, data errors, and even drive failure. Studies have shown that continuous exposure to vibration can reduce HDD lifespan by 30-50%.

Vibration Mitigation Strategies:

When data center systems utilizing HDDs are designed, vibration isolation and damping solutions are incorporated and may include the use of specialized mounting hardware and chassis designs to minimize the impact of vibration on HDDs. To protect sensitive equipment from vibration, data centers employ various mitigation techniques, such as:

- Strategic placement of equipment
- Vibration-absorbing materials and flooring
- Acoustic panels and foam to reduce noise and vibration transmission

Overall, the data center storage landscape is dynamic, with both SSDs and HDDs playing important roles. Many data centers utilize a mix of SSDs and HDDs, with SSDs managing frequently accessed data (hot data) and HDDs storing less frequently accessed data (cold data).

Reports suggest that data centers will likely continue to utilize a hybrid approach, leveraging the strengths of both SSDs and HDDs to optimize performance, capacity, and cost for various workloads.

Fire Risk SSD vs. HDD:

Heat Generation:

Due to their moving parts HDDs generate more heat compared to SSDs. This increased heat output in HDD-intensive data centers necessitates greater cooling efforts, potentially impacting energy consumption and contributing to higher ambient temperatures, which could increase fire risk.

Durability in Harsh Conditions:

SSDs, lacking moving parts, are more resilient to physical shocks, vibrations, and accidental drops, making them suitable for harsh environments. However, extreme temperatures, such as those encountered in a fire, can still damage SSD memory modules. HDDs are more susceptible to damage from drops and vibration.

Fire Risks for Data Centers and Storage Technology

Data centers present unique fire risks and require specialized fire protection systems due to the high density of electronic equipment, electrical infrastructure, cooling systems, and potentially combustible materials. Fires can originate from overloaded circuits, faulty wiring, UPS failures, HVAC system malfunctions, human error, or equipment malfunctions.

Choosing the right storage technology should involves fire safety concerns in addition to typical considerations including balancing performance, capacity, cost and energy consumption. Implementing a comprehensive fire protection strategy that includes early detection, appropriate suppression systems, and adherence to best practices is essential for data center safety and operational continuity.

Fire-related considerations

Extreme temperatures:

While the absence of moving parts makes SSDs more robust against physical shocks, they are still vulnerable to fire and high temperatures. Some industrial-grade SSDs are equipped with features like super capacitors to protect data during power outages, and their internal design can offer some protection against direct impacts.

Water exposure:

Though SSDs are more resistant than HDDs, large volumes of water can damage the electronic components of an SSD if they penetrate the casing. HDDs, with their sensitive mechanical parts, are more prone to physical damage in the event of a fire, including potential corrosion if exposed to water.

Battery energy storage systems (BESS):

Data centers often use lithium-ion batteries in UPS systems, which can pose a fire risk and require specialized fire suppression approaches.

Data Center Fire Suppression Types:

Clean agent fire suppression systems are designed to discharge and suppress fires before heat or flame levels trigger the building sprinkler system to activate. After the clean agent suppresses the fire, the building ventilation system easily removes the agent. Clean agents do not leave messy residue or cause equipment damage and are typically deployed in the main hall housing the key business assets viz. the data racks and servers.

Traditional sprinklers are primarily for building protection and are not ideal for areas with sensitive electronics.

Fires are caused by a combination of fuel, oxygen, and heat – often referred to as the “fire triangle”. Clean Agents absorb heat from the surface of the burning material and effectively lower its temperature below the ignition point – thereby disrupting the fire triangle and suppressing the fire without harming equipment or personnel in the protected room. Clean Agents offer fast extinguishment, suppressing fires within seconds of the agent being discharged into the protected area. Clean Agents are non-toxic when used in compliance with NFPA Standard 2001. They do not impair breathing or obscure vision in an emergency, providing an added measure of safety for personnel.

The Kidde Fire Systems clean agent fire suppression line is available in a range of options. Kidde Fire Systems offers Fluoro-K™ (FK-5-1-12) and HFC-227ea ‘chemical’ fire suppression clean agents in versatile total flood type delivery system platforms including ECS™, ECS-500™ and ADS™. The ECS platform is standard and delivers either a small amount of agent at a moderate distance or a large amount of agent at a short distance. ECS-500™ offers design flexibility for small to medium volume hazards by enabling smaller diameter pipes for longer distances. ADS™ offers significant enhancement in distance traveled for systems with large agent volumes. All systems discharge clean agent within 10 seconds.

The Kidde Fire Systems NATURA™ Inert Gas System is an alternative to 'chemical' clean agents. Inert gases suppress fire by lowering the oxygen content in the room to a level where the process of combustion is no longer supported – which means that the fire won't continue to burn. These gases are environmentally responsible, having an ozone depletion potential (ODP) of zero and a global warming potential (GWP) of zero. At room temperature, inert gases are odorless and colorless. Inert Gases are stored at high pressure and are also typically discharged at higher pressure relative to chemical clean agent systems. Although NATURA™ features pressure-and-flow control valve technology, in order to mitigate any perceived risk of SSD or HHD susceptibility to noise and vibration, Kidde Fire Systems offers new acoustic nozzles designed to reduce sound levels during the discharge of NATURA™ Inert Clean Agent. The nozzles have a special design which allows for spacing exactly as per a standard NATURA™ Inert Gas nozzle and also limits the sound output below 110dB between 500 Hz and 10 kHz in the one-third-octave frequency bands when measured at 1m (3 ft) from the nozzle. They can replace installed discharge nozzles without requiring major pipe modifications, making them an affordable retrofit solution.

As opposed to other bulky and unsightly nozzle-silencer combos for inert gas (IG) fire suppression systems, Kidde Fire Solutions acoustic nozzles deliver a more aesthetically pleasing, compact solution. This is particularly important for environments where appearance and noise reduction are critical, such as data centers and high-end commercial spaces.

Fire industry consensus is for acoustic testing to be conducted within the framework of ISO standards 3740 through 3747 and requires the measurement of sound output at a distance of 1 m (3 ft) from the sound source and at a range between 500 Hz and 10 kHz in the one-third-octave frequency band.

Inert gases are safe for human exposure under limited conditions and criteria. According to NFPA 2001 in occupied areas, people can breathe Inert gas blends at extinguishing concentrations below 52% for very brief periods of time thereby aiding egress. There are no toxicological factors associated with the use of Inert gases as they will not decompose or produce any by-products when exposed to a flame.

Delivery System Comparison Chart

Delivery System	ECS™	ECS™-500	ADS™	NATURA™	NATURA™
Storage Pressure[1] psi (Bar)	360 PSI (25 Bar)	500 PSI (35 Bar)	1,800 psi[2] (124 Bar)	2900 psi (200 Bar)	4350 psi (300 Bar)
Distance[3] feet (meters)	120' (36.5 m)	140' (42.7 m)	245' (74.7 m)	500' (152.4 m)	500' (152.4 m)
Storage Footprint[4] ft x ft (m x m)	13.5' x 2.5' (4.1m x 0.77m)	13.5' x 2.5' (4.1m x 0.77m)	26' x 3.5' (8m x 1.1m)	80 Liter: 34' x 3.5' (10.4m x 1.1m) 140 Liter: 27' x 4' (8.2m x 1.21m)	80 Liter: 25' x 3.5' (7.6m x 1.1m) 140 Liter: 18.5' x 4' (5.6m x 1.21m)
Nozzle Height[5]	16'	16'	16' – 18.5'[6]	16'	16'

[1] Nominal system storage pressure at 70° F (21° C)
[2] Pressure indicated is that of the separate Nitrogen driver. Agent cylinder pressure depends on the agent 44 psi for HFC-227ea and 360 psi for Fluoro-K™
[3] Distance is defined as the distance measured from the agent storage location to the asset room being protected.
[4] Storage footprint is the space required to house the armed agent cylinders. In this example of a 10,000 square foot Data Center with 12-foot height, the storage footprint is calculated assuming Fluoro-K™ in 6 x 900 lb. cylinders each with 819 lb. (4,914 lb. total) for the ECS and ADS™ platforms and IG-100 in an 80 Liter cylinder at 300 Bar for the Natura™ platform.
[5] Maximum nozzle mounting height from the floor or the vertical interval between levels of nozzles for rooms with high ceilings.
[6] The maximum mounting height of the ADS™ nozzle depends on the agent used – it is 16 ft for HFC-227ea and 18.5 ft for Fluoro-K™

About Kidde Fire Systems:

For decades, Kidde Fire Systems has been an industry leader in fire prevention, detection & control, and suppression. Our name is backed by a strong commitment to product quality, innovation, and expertise in system design, installation, and service. We operate globally through a network of trained and authorized Engineered Systems Integrators/Distributors that excel in initial hazard analysis, system design, installation, testing and commissioning as well as aftermarket service including parts, refills and code-mandated periodic testing and maintenance.

System Design: Crafting fire protection plans that account for a facility's specific layout and requirements.

Installation: Expert implementation of fire suppression systems with minimal disruption to operations.

Ongoing Maintenance: Regular inspections and servicing to ensure systems remain in peak condition.

Upgrades and Retrofits: Adapting existing systems to meet evolving needs or comply with new regulations.

Closing Thoughts:

Whether you are building a new data center or upgrading an existing facility, investing in a fire suppression system is an essential step in safeguarding your organization's future. Kidde Fire Systems offers tailored solutions that help data centers operate with confidence knowing that their critical assets are protected by the most advanced and effective fire systems available.

Kidde Fire Systems suppression solutions are not just an insurance policy; they're a fundamental component of business continuity and risk management.

Contact us at www.kiddefenwal.com to learn more about Kidde Fire Systems tailored solutions.

Kidde-Fenwal, LLC
400 Main St
Ashland, MA 01721, USA

KFI U.K. Limited
Station Road,
Bentham,
Lancaster, LA2 7NA
Company No 15335712

Kiddel Technologies PVT. LTD.
Survey No. 28/2,44/2 and 45
Rasyani,Dandapta Road
Raigad Maharashtra-410207 India
CIN: U28192HR2024PTC118812

www.kiddefenwal.com | 508.881-2000

Kidde Fire Systems, Kidde Fire Protection and Fenwal Controls branded products are created exclusively by Kidde-Fenwal, LLC.
All other trademarks are the property of their respective owners.
©2026 Kidde-Fenwal, LLC | All Rights Reserved.