

Clean Extinguishing Agent System Noise and Hard Disk Drive (HDD) Failure FAQs

What we know

From 2008 through 2013 there have been multiple documented events per year where actuation of an inert gas clean agent fire suppression system caused subsequent failure of hard disk drives (HDDs).¹ There are no reported instances of a halocarbon clean agent system discharge, including systems with 3M™ Novec™ 1230 Fire Protection Fluid, that have resulted in HDD damage.

What causes HDD failure during a discharge?

The cause of HDD failure is acoustic noise at a specific frequency and decibel (dB) level impinging on the flexible stainless steel cover of an HDD case. Such impingement transmits vibration into the spindle and actuator axis, causing the read/write element to misalign and fail. Current generation HDD cannot tolerate more than 12 nanometers (0.00000045 in.) of misalignment.² Room pressure and temperature changes resulting from a CEA discharge do not affect HDD performance or failure rates.

Is it volume, tone or duration of the acoustic noise that contributes to HDD failure?

All three are contributing factors. Multiple research studies have demonstrated that HDD failure occurs at only very specific frequencies (tones, Hz) above a certain sound pressure threshold (volume, dB). The frequencies and minimum volume threshold for HDD vulnerability are different across various manufacturers and models. Exposure to noise at the right frequency above a certain volume will cause nearly instantaneous decreases in data input output (I/O) performance that may be recoverable.³ However, longer duration exposure to the same noise can cause permanent HDD damage.

What sources of noise and other factors contribute to HDD failures?

- Pre-discharge alarm notification has been shown to negatively impact the I/O performance of HDDs. Pneumatic sirens typically emit sound at a higher volume level than electric alarm sounders and therefore can impact HDD performance more severely.

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- The distance between the source of the noise and the HDD affects the sound level, with HDDs closer to the source being exposed to a higher sound level.
- Design of newer generation higher capacity HDDs with more densely packed data tend to be more sensitive to noise induced failures.

Considerations to minimize risk of HDD damage

- Relative to traditional inert gas systems, halocarbon clean agent systems have significantly shorter duration discharge times and lower nozzle pressures (less noise)
- Inert gas systems are now being designed to minimize noise at the nozzle but still require longer discharge times than halocarbon systems. The duration of discharge for inert gas systems is 12 times longer than halocarbon systems.
- Noise insulated data center HDD cabinets will lower the sound pressure level at the HDD, reducing the likelihood of failure.

¹Green, K., Nickerson, M. (2013) Clean Agent Fire Suppression and Hard Disk Drives (p. 6). IBM Corporation.

²Green, K., Nickerson, M. (2013) Clean Agent Fire Suppression and Hard Disk Drives (p. 9). IBM Corporation.

³Green, K., Nickerson, M. (2013) Clean Agent Fire Suppression and Hard Disk Drives (p. 10-13). IBM Corporation.

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