SHREE GANESH ENTERPRISES
NEW DELHI · AMC MEP 24x7 · sge.org.in

DOC: SGE-EB-2026-07

E-BOOK 07 ADVANCED EDITION

Special Hazard Suppression Guide

Data Centres, CO2, Clean Agent and Water Curtain Systems



FIG 07.1 — CLEAN AGENT CYLINDER BANK, MANIFOLD & NOZZLE DISCHARGE

SYLLABUS	CALCULATIONS	SITE READY
10 Structured Chapters	Worked SI Examples & Tables	Forms & Hinglish Glossary

Shree Ganesh Enterprises (SGE) — AMC MEP 24x7
Fire Fighting · Fire Alarm · Electrical · Plumbing · HVAC · IBMS · AMC

1st Edition, 2026
sge.org.in/ebooks/special-hazard-suppression-guide

Special Hazard Suppression Guide

Data Centres, CO2, Clean Agent and Water Curtain Systems

An advanced engineering and safety guide for special fire hazards where standard sprinklers fall short: Data Centres and UPS rooms using Clean Agent total flooding (FK-5-1-12, HFC-227ea, Inert Gas) and aspirating smoke detection, CO2 lethal asphyxiation lock-out protocols, Enclosure Room Integrity testing, Pressure Relief Venting (PRD), and Water Curtain deluge glazing systems.

Intended Audience: Mission-critical data-centre facility heads, hospital/industrial MEP engineers, clean-agent system designers, and advanced fire contractors.

Engineering Notice & Standards Policy

This publication is an educational and field-reference guide prepared by **Shree Ganesh Enterprises (SGE)**. It is **not** a substitute for a stamped project design, statutory approval, or the governing text of the National Building Code of India (NBC), Bureau of Indian Standards (BIS) codes, Indian Electricity Rules / CEA Regulations, or your State/Municipal Fire Service Bye-Laws. Standards are cited at document level; always verify the **current applicable edition**, manufacturer datasheets, and local amendments before design, procurement, testing, or certification.

Worked numerical examples across this book are illustrative engineering demonstrations. All design inputs, pipe friction factors, battery deratings, and protective clearances must be re-checked for project conditions by a competent licensed professional. High-voltage electrical testing, pump-room servicing, and gaseous fire suppression operations can be fatal if undertaken without qualified personnel, written Permits-to-Work, and Lockout-Tagout (LOTO) controls.

Roman-script Hindi/Hinglish site terms are included cleanly to assist execution teams; formal English engineering terminology governs contractual and code interpretations.

Copyright & Licensing

© 2026 Shree Ganesh Enterprises (SGE). All rights reserved. No part of this manual may be reproduced, redistributed, or resold publicly without written authorization. Licensed strictly for purchaser and internal engineering team reference.

Publisher: Shree Ganesh Enterprises (SGE) — AMC MEP 24x7 | **Web:** sge.org.in | **Support:** support@amcmep.in

Contents

01 Chapter 1: Why Special Hazards Require Tailored Protection

02 Chapter 2: Data Centres and Server Rooms — Early Detection and Cross-Zoning

03 Chapter 3: Clean Agent Systems (FK-5-1-12, HFC-227ea & Inert Gases)

04 Chapter 4: Agent Quantity Calculation and Pressure-Relief Dampers (PRD)

05 Chapter 5: Enclosure Sealing and Door-Fan Room Integrity Testing

06 Chapter 6: Pre-Discharge Alarms, Abort Switches and Manual Controls

07 Chapter 7: Carbon Dioxide (CO2) Fire Suppression and Mandatory Life-Safety Controls

08 Chapter 8: Water Curtain (Drencher) Systems for Glazing and Openings

09 Chapter 9: Handover Tests, Cylinder Weighing, Refilling and Templates

10 Chapter 10: Cost Matrix, Decision Guide, FAQ and Hinglish Glossary

What You Will Learn

- Select Clean Agent (FK-5-1-12 / HFC-227ea / Inert Gas), CO2, or Water Curtain drencher technologies accurately
- Design Data Centre early-warning detection pairing ASD aspirating sampling with cross-zoned point heads
- Calculate clean agent flooding mass (W = V/S * C/(100-C)) and understand Pressure Relief Damper (PRD) needs
- Supervise Door-Fan Enclosure Integrity testing to achieve 10-minute clean-agent hold times cleanly
- Enforce life-critical CO2 lethality barriers: lock-out valves, pre-discharge alarms, and odorisers
- Size atrium and facade Water Curtain deluge systems with linear drencher demand arithmetic

Chapter 1: Why Special Hazards Require Tailored Protection

Where Standard Water Sprinklers Need Backup or Replacement

Water excels at absorbing heat across ordinary offices, apartments, and factories—yet fails or worsens damage in three mission-critical environments:

1. **Live High-Value Electronics (Data Centres, Core Server Racks, MRI/CT Suites, Switchgear Rooms):** Water extinguishes fire well, *yet soaked busbars and flooded disk racks shut down business continuity for months*. Gaseous **Clean Agents** leave zero conductive water or powder residue!
2. **Deep-Seated Electrical Vaults & Industrial Oil Tanks:** Where dry clean-gas total flooding or local-application **CO2** smothers three-dimensional liquid/cabinet voids.
3. **Open Glazed Atriums & Curtain Facade Separations:** Where no masonry compartment wall exists to stop radiant fire jumping upward from floor to floor—requiring continuous falling **Water Curtain (Drencher)** shields!

System Solution	Extinguishing Physics	Electrical Safety	Residual Clean-Up	Human Occupancy Safety
FK-5-1-12 / HFC-227ea Clean Agent	Heat absorption + chemical radical interruption	Completely non-conductive	Zero residue (evaporates cleanly)	**Safe at normal Class A design concentrations** (check NOAEL/LOAEL!)
Inert Gas (IG-541 / IG-55 / Nitrogen)	Oxygen reduction (~21% down to ~12–14%)	Non-conductive	Zero residue; zero global warming	Safe when properly designed within oxygen/CO2 thresholds
Carbon Dioxide (CO2)	Severe oxygen starvation (< 15% O2 at 34%+ CO2)	Non-conductive	Zero residue (super-chills)	**LETHAL IN OCCUPIED ROOMS!** Strict evacuation & lock-out mandatory
Water Curtain / Drencher	Cooling water barrier film over glazing/openings	Conductive water	Wet drainage below	Safe for occupants; drains to storm/basement sump

NOTE

Clean agent concentrations, hold times, specific vapour volumes (`S`), and safety margins depend strictly on NFPA 2001, ISO 14520, and NFPA 12 (CO2). Never copy agent mass constants across brands—always verify final calculations through OEM UL/FM listed hydraulic software!

HINGLISH

Clean agent = aisa gas jo bina paani ya powder ke aag bujha de aur server kharab na kare. Total flooding = poore band kamre ko ek saath gas se bhar dena.

Chapter 2: Data Centres and Server Rooms — Early Detection and Cross-Zoning

Stopping Smouldering Cables Before Flame Breaks Out

Modern server racks circulate fierce cooling air at high velocity via CRAC/CRAH downflow plenums. High airflow *dilutes* slow point smoke detectors mounted high on ceiling tiles, hiding hot overheated power connectors until arc flash erupts!

Multi-Layer Data Centre Protection Architecture

1. **Aspirating Smoke Detection (ASD / VESDA style):** Draws room and return-grille air continuously through laser-calibrated capillary pipes—alerting staff at microscopic off-gassing stages (**Alert / Action**) long before fire suppression even thinks of releasing!
2. **Zone Separation Across Sub-Zones:** Monitor **Under Raised Floor Void**, **Room Ambient Space**, and **False Ceiling Void** independently!
3. **Double-Knock (Cross-Zoned) Interlock:** Never trigger expensive clean agent banks on one single dusty sensor! Split room ceiling sensors into odd/even Zones **A** and **B**:
   - **Stage 1 (Single Sensor Trip):** Rings pre-alarm alert at Fire Command Centre and room sounder only; closes nothing destructive yet.
   - **Stage 2 (Both Zone A AND Zone B Trip — Confirmed Fire):** Starts **30-second Pre-Discharge Countdown**, shuts off CRAC/HVAC blowers immediately, closes motorized room isolation dampers cleanly, drops BMS alerts, and prepares solenoid cylinder actuator firing!

FIELD TIP

If your CRAC air conditioners keep spinning while clean agent discharges, fans dilute agent concentration rapidly or blow clean gas right out through leakage gaps—**interlock HVAC & exhaust damper shutdown strictly prior to T=0 discharge!**

HINGLISH

Double knock / Cross-zoning = jab kamre ke do alag-alag sensor aag pakde tabhi gas cylinder khulega, taaki galti se gas barbad na ho.

Chapter 3: Clean Agent Systems (FK-5-1-12, HFC-227ea & Inert Gases)

Comparing Modern Clean Agents

All clean agents must discharge rapidly (typically **within <= 10 seconds** for chemical halocarbon agents; up to **60 seconds** for high-pressure inert gas banks) to achieve uniform extinguishing concentration before fire grows.

Agent Comparison Feature	FK-5-1-12 (Novec 1230 style)	HFC-227ea (FM-200 style)	Inert Gases (IG-541 / IG-55)
Storage State & Pressure	Liquid at ~25–42 bar (N2 padded)	Liquefied compressed gas at ~25–42 bar	Compressed gas (~200–300 bar!)
Cylinder Footprint	**Very compact** (often inside/adjacent to room)	**Very compact**	**Large multi-cylinder bank** needed
Environmental Profile (GWP)	Ultra-low atmospheric lifetime (~days; GWP < 1)	High GWP (subject to global HFC phasedowns)	Zero ODP / Zero GWP natural gases
Over-Pressure Risk During Dump	Both positive & slight brief negative pulse	Pressure wave on dump	High sustained gas inflow -> **Large PRD vent needed**

Note on Safety Margin: Always verify **Design Concentration (C)** stays below agent **NOAEL** (No Observed Adverse Effect Level) in normally occupied control rooms. Confirm environmental HFC restrictions applicable in your jurisdiction before specifying HFC-227ea on new builds.

> **HINGLISH**
> Hold time = gas chhootne ke baad kam से kam 10 minute tak kamre mein ruka rehna taaki aag dobara na bhadke. Cylinder bank = deewar ke paas line mein lage hue bhaari gas cylinders ka group.

Chapter 4: Agent Quantity Calculation and Pressure-Relief Dampers (PRD)

Total Flooding Gas Mass Formula (Illustrative Engineering Relationship)

Under clean agent total-flooding standards (NFPA 2001 / ISO 14520), minimum mass `W` of chemical agent needed to reach volume concentration `C` (%) inside sealed enclosure net volume `V` (m3) at design minimum room temperature is given by:

> **FORMULA**
> `W (kg) = (V / S) x (C / (100 – C)) Where: V = Net protected enclosure volume (L x W x H , including raised floor + ceiling void!) S = Specific vapour volume of agent in m3/kg at minimum expected room temperature (TAKE EXACT CONSTANT FROM AGENT STANDARD / VENDOR SHEET!) C = Required design volumetric concentration in % (typically derived per fuel class from listed agent table, plus altitude correction if above sea level).`