
AMERICAN FIRE TECHNOLOGIES
FIRE AND LIFE SAFETY SPECIALIST
Fire Suppression On Turbines

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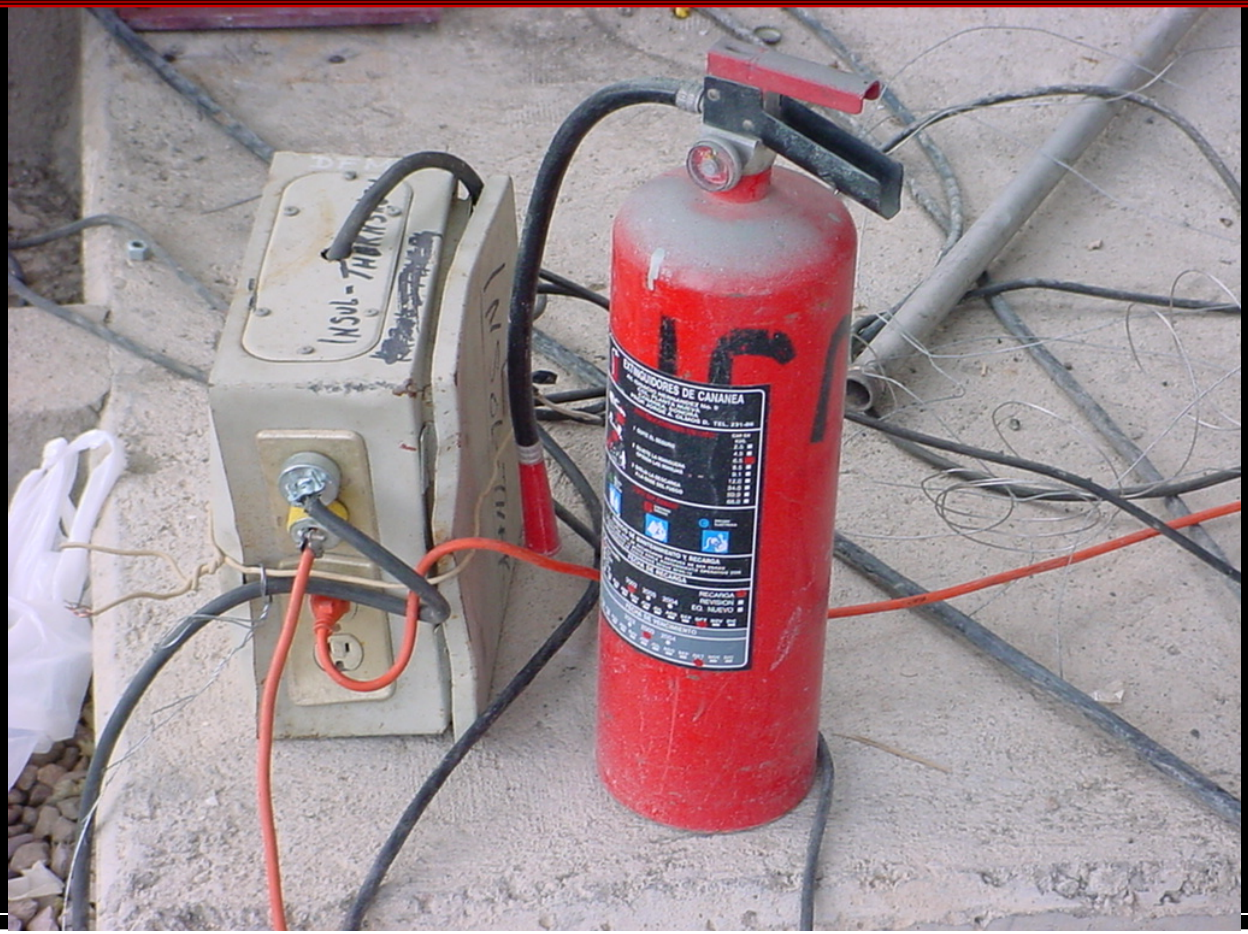


American Fire Technologies

Alarm and Detection/Suppression

American Fire Technologies

- To provide special hazard services world wide to the industrial market through the integration of components and services

Turbine Fire Suppression

- What are our goals today?
  - Types of Suppression systems.
  - How does an system extinguish a fire?
  - Comparison of system types.
  - Design Considerations of a Suppression System.
  - System Components.
  - Sequence of Operation.

Turbine Fire Suppression

- A System design is based on reasonably anticipated events to control the fire until an informed party can determine the next course of action.

Turbine Fire Suppression

- Main Types of Suppression Systems today?
  - Clean Agent systems
  - CO2 Systems
  - Mist Systems
  - Dry Chemical
  - Foam System

How Does a Suppression System Work?

- Most Clean agent's work by chemically extinguishing a fire at the molecular level.
  - The agent decomposes to extinguish a fire.
  - When a Clean Agent decomposes, toxic gases are released. (Does not apply to inert gasses: Inergen)
  - To avoid high levels of decomposed gasses, Clean agent systems are designed for quick discharges (UL requires <10 seconds).

How Does a Suppression System Work?

- CO2 System work by removing/reducing the Oxygen level in the hazard.
  - In order to extinguish a fire, the oxygen level is displaced in the enclosure where it wont support a fire.
  - CO2 system are design to total flooding with an extended discharge.
  - Most common suppression agent used.

How Does a Suppression System Work?

- Mist system remove the heating capacity.
  - In order to extinguish a fire, the mist is entrained into the fire and cools the heat.
  - Mist system have an “un-extinguishable” fire.
  - Vortex uses additional nitrogen/inerting to over come the fire as well by reducing the O2 levels.
  - Mist system are design for Total flooding and extended discharge.
  - So Far limited use in Turbines.

How Does a Suppression System Work?

- Dry Chemical smothers the fire and chemically breaks the chain.
  - Pre-engineer systems with set volume pressurized cylinders.
  - Has been used on bearing tunnels.
  - One shoot only.
  - Limited use in Turbines.

How Does a Suppression System Work?

- Foam System Smoothers the fire by creating a blanket between the fuel and the oxygen source.
  - System have low and high expansion foam.
  - Usually tied to a sprinkler system.
  - High volume of water.
  - Very limited use in Turbines.

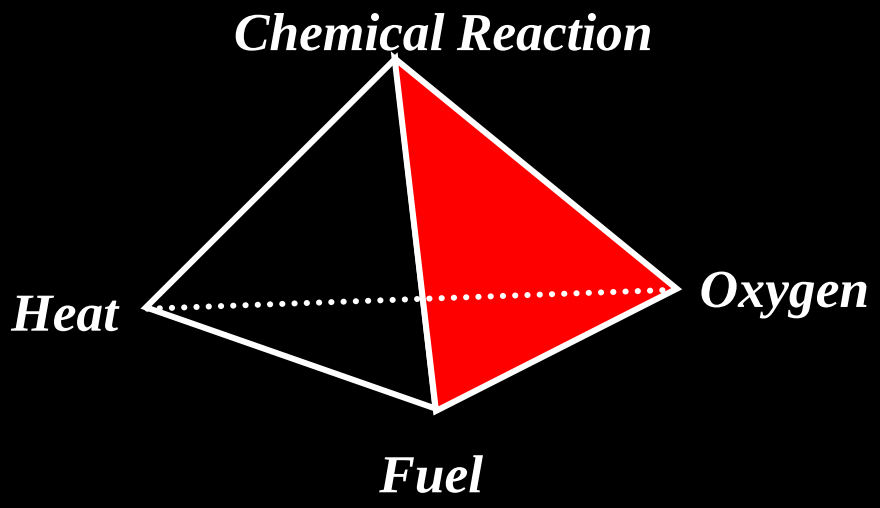
How Does a Suppression System Work? (cont)

	Halon	*HFC's*	*Inert Gas*	*CO2*	*Mist*	*Dry Chem*	*Foam*
Oxygen Depletion			P*	P		S	S
Heat Absorption	S	P			P		
Reaction Interruption		P	S			P	S

P- Primary

S-Secondary

* Depletes O2 to where it wont support fire but will support life.



How Does a Clean Agent System Work? (cont)

- Physical
  - Heat absorption - remove heat faster than generated.
  - Reduces flame temperature below that necessary to maintain combustion.
  - Remove oxygen below level to support combustion.
- Chemical
  - Interruption of chemical chain reactions of combustion process by halogenated atoms (Fl, Cl, Br).

Different Types of Fire Suppression Systems

- CO2 (Carbon Dioxide)
  - Not classified as a Clean Agent.
  - Can be lethal to humans.
  - Required at 34% for surface fires.
  - Operates by removing the oxygen from the air.
  - Good for non-occupied hazards.
  - Additional safety equipment and operation issues. – Pneumatic Delays and sirens.

Different Types of Fire Suppression Systems

- CO2 (Carbon Dioxide)
  - Designed for 20 Min hold times.
  - Higher Front in cost – Lower recharge cost.
  - Possible pressure and Venting issues.
  - LPCO2 – refill tank.
  - HPCO2 - refill bottles.
  - Extracted as a by product – No added environmental impact.

Different Types of Fire Suppression Systems

- CO2 (Carbon Dioxide) - allowed with
  - Operation Client access procedures cost.
  - Limited access and safety procedures.
  - Lock out valves and solenoid disconnects.
  - Pneumatic delays.
  - Safety equipment – odorizers and alarms.
  - Warning Signs.
  - Flow performance analysis.

Different Types of Fire Suppression Systems

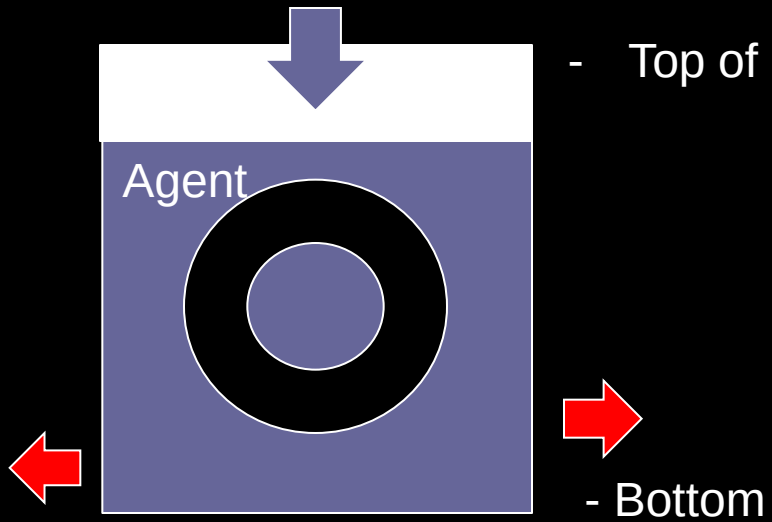
- CO2 (Carbon Dioxide) - allowed with Exceptions apply
  - Time delays may damage equipment.
  - Provision made for lock out during entry.

Different Types of Clean Agents Suppression Systems

- FM-200 (HFC-227ea) **CF3CHFCF3**
  - Most common agent used.
  - Works by chemically inhibiting fire propagation.
  - Poor flow characteristics.
  - Supports 12 nozzles max.
  - Lower up front cost – Higher Recharge cost.
  - Hold time of 10 minutes – May be an issues with FM.

Different Types of Clean Agents Suppression Systems

- FM-200 (HFC-227ea) **CF3CHFCF3**
  - Works like a cup of water.



Different Types of Clean Agents Suppression Systems

- FM-200 – Implications of hold time
  - Fan test for certification no dump test usually performed.
  - Height of hazard changes over time.
  - Type of hazard changes over time.
  - Location of leaks matter.
  - Changes to the enclosures impact certification.

Different Types of Fire Suppression Systems (cont)

- Novec 1230 (Sapphire) **$CF_3CF_2C(o)CF(CF_3)_2$**
  - Fairly new agent.
  - Works the same as FM-200.
  - Short after life in the atmosphere (days).
  - Poor flow characteristics.
  - Pressurized with Nitrogen.
  - Not typically used on turbines.

Different Types of Fire Suppression Systems (cont)

- Ecaro 25 (Dupont FE-25) **CHF_2CF_3**
  - Closest to replacing Halon 1301.
  - Works by removing O_2 at the molecular level.
  - Superior flow characteristics.
  - Required 25% less agent than FM-200.
  - Most economical of Clean Agents.
  - No pressurization concerns.
  - No venting required.
  - Support 30 to 40 Nozzles.

Different Types of Fire Suppression Systems (cont)

- Inergen (Argonite. Same as Inergen without any CO2)
  - Inert gas (52% nitrogen, 40% argon, and 8% carbon dioxide).
  - Lowers the oxygen in the room to a level that won't support a fire, but still enough oxygen to breath.
  - Design is critical.
  - Must vent room due to pressure build up.
  - Doesn't leak from the room because of low density.
  - Economical to recharge (Hard to find recharge locations).

Physical Properties

Property	Halon 1301	FE-25™	HFC-227ea	Novec	Inergin
Chemical Formula	CF3Br	CHF2CF3	CF3CHFCF3		
Molecular Weight	148.9	120.02	170.0	316.4	34
Boiling Point	-72º F	-55º F	3º F	120º F	
Vapor Pressure	200 psi	195 psi	66 psi	5.87 psi	2175
ODP	12	0	0	0	0
GWP	6900	2800	2900	1	0

- Zero Ozone Depletion Potential (ODP)
- Very low Global Warming Potential (GWP)
- GWP is calculated of a 100 year time horizon and represents mass of CO2 equivalent to emission of one unit of this compound

How Does a Suppression Agent System Work? (cont)

- Agent Storage
  - Agent is a liquid, stored in cylinders or tanks pressurized as needed.
  - Agent is super pressurized with N2 to a pressure of 360 psi.
  - Agent is distributed to discharge nozzles, drilled to allow a specific flow rate.
  - Discharge nozzles are located in the room area and below under floors.
  - Cylinders are furnished with low-pressure switches to monitor agent pressure.

Different Types of Fire Suppression Systems (cont)

- Water Mist
  - Non-Chemical.
  - Micron size water droplets.
  - Best used for generator rooms or areas with high leakage.
  - Very economical to recharge.
  - Has not gained a lot of acceptance in US, widely used in Europe.

Different Types of Fire Suppression Systems (cont)

- Dry Chem
  - Powered Chemical.
  - Used on Bearings tunnels.
  - One shot only.
  - Requires clean up.
  - Very economical to refill.

Different Types of Fire Suppression Systems (cont)

- Foam System
  - Non-Chemical.
  - Requires water supply.
  - Water damage to Turbines?
  - Very limited application in turbines.

System Design

- Define Hazard
  - Determine volume of area(s) (L x W x H).
  - Areas may include room, under-floor, and above ceiling.

Agent/Quantity

- Determine which agent to use.
  - Try to use the same agent/mfg that is currently used in the facility.
  - Determine quantity of agent to use.

Design Concentrations Comparison

ECARO-25	8.0%	685 lb.	1
Halon 1301	6.0%	623 lb.	1
HFC-227ea	6.25%	765 lb.	1
Inergen	37%	357 m^3	21
Novec	4%	948 lb.	2

Systems Design

- Automatic and Manual Operation
  - Smoke Detectors are used for automatic operation.
  - Manual release stations are used for manual operation.
- System Alarms
  - Alarm bells
  - Horn strobes
  - Strobes

Systems Design

- Releasing Panels
  - System controls
    - Main Control Panel (**UL9th Must be listed to release specific**)
      - Operates on 24 volts DC from a 120-volt AC input power source.
      - Contains batteries for DC back up.
      - Monitors and controls all input and output circuits.
      - Includes replays for connections to building alarm panels and remote monitoring.

System Components

- Main Control Panel
  - Is “Conventional” or “Intelligent”.
  - Used to monitor and control input and output devices.
  - Supplies power to the field devices.
  - Supervises field wiring
    - INPUTS – Opens, Grounds
    - OUTPUTS – Opens, Grounds, shorts
  - Displays alarms and troubles.
  - Contains timers for time delays for agent release.

System Components (cont)

- Ionization Smoke Detector
  - Detects 1-2 micron particle size.
  - Should be used in room areas only (airflow issues)

System Components (cont)

- Photoelectric Smoke Detector
  - Detects visible particles (4+ microns) (Visible)
  - Good for under floor areas.
  - Normally not as sensitive as an ionization detector.

System Components (cont)

- Heat (Thermal Detector)
  - Operates when temperature reaches set point.
  - Not good for early warning detection
  - Best suited for harsh areas (Smokey/Dirty).

System Components (cont)

- Air Sampling System
  - Detects “Sub-micron” size particles.
  - Good for ultra early warning of a fire condition.
  - Detects “Thermal degradation” of the item.
  - Allows you to be “Pro-Active” to alarms. You can find the source of the problem before needing the suppression system.
  - Fairly expensive, but could save the cost of a systems recharge.

System Components (cont)

- Manual Release Station
  - Used to manually discharge the system.
  - Instant release, bypassing any time delays.
  - Normally located near exit doors.
  - Code requires every system to have a manual release.

System Components (cont)

- Abort Station
  - Used with Clean agent systems.
  - Used to bypass a pending discharge.
  - Located next to the manual release station.
  - Must be depressed (operated) in order to bypass a discharge.
  - Must be operated prior to a system release.

System Components (cont)

- Agent Storage Cylinders
  - Used to store Agent.
  - Is supplied with pressure gauges and low-pressure switches.
  - Are supplied with valves or bursting disc.
    - Solenoids used to actuate valves.
    - Actuators used for bursting disc type.

System Components (cont)

- Actuators
  - Impulse valve
    - Activated by applying voltage to a releasing module .
  - Solenoid
    - Activated by applying voltage to coil.
    - Used on cylinders with valves.
    - Can also be used on N2 (Nitrogen Actuators)

System Components (cont)

- Special Detection Systems
  - Early Warning Fire Alarms (VESDA/SAFE)
    - Used for very early warning of a fire.
    - Monitors particle size of .01 micron (Invisible).
    - Works by taking air samples in the room and counting the particulate.
    - Allow personnel to be pro-active in finding a potential fire hazard and eliminating the need to use the suppression system.

Sequence of Operation

- Single Smoke Detector In Alarm
  - Control Panel Indicates “Alarm” Condition.
  - Control Panel Alarm Contacts Operate.
  - Control Panel Displays Device and Location of Alarm.
  - L.E.D. On Smoke Detector Illuminates Steady “On”.
  - Alarm Horn in Hazard Area Starts a Slow Pulse Signal.
  - Alarm Strobe in Hazard Area is Activated.

Sequence of Operation (cont)

- Two Smoke Detectors in Alarm (Same Hazard Area)
  - Control Panel Displays Device and Location of Alarm.
  - L.E.D. on Smoke Detector Illuminates Steady “On”.
  - Alarm Horn in Hazard Area Changes to a Fast Pulse Signal.
  - Control Panel Pre-Discharge Delay Timer is Activated.
  - Equipment Shutdown Contacts Are Activated.

Sequence of Operation (cont)

- Note:
  - At the end of 30 seconds, the system is discharged into the hazard area.
  - If the abort station is operated prior to the 30-time delay, the system will not discharge. The abort is a “Dead Man” type, and must be continually depressed in order to bypass a discharge. Releasing the abort station will cause the time delay to restart.

Sequence of Operation (cont)

- System Discharge
  - Control Panel Displays System Has Released.
  - Discharge Strobe Outside Exit Door is Activated.
  - Alarm Horn in Hazard Area Changes to a Steady Tone.
  - Discharge Strobe Outside of Exit Door is Activated.
  - Shutdown Relays are Energized.

Sequence of Operation (cont)

- System Alarms and Troubles
  - Control Panel will Display Either “Alarm” or “Trouble”.
  - Control Panel will Display Cause of the Alarm or Trouble.
  - Control Panel Sonalert Will Sound.

Sequence of Operation (cont)

- FIRE ALARM
  - Operation of Any Smoke Detector or Fire Alarm Pull Station
    - Control Panel Indicates “Alarm” Condition.
    - Control Panel Alarm Contacts Operate.
    - Control Panel Displays Device and Location of Alarm.
    - L.E.D. on Smoke Detector Illuminates Steady “On”.
    - Alarm Horns in Hazard Area Starts a Pulse Signal.
    - Shutdown Contacts Operate.

Turbine Suppression system

The End

“Thanks” For Taking The Time To See This!!
We Hope This Will Help.

Remember Knowledge and proper planning


DANGER
EAR
PROTECTION
REQUIRED

Questions

- ?
- Leave me your card/email or email me if you would like additional information or detail
- If you have an questions please come by our booth
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