Associazione Italiana di Ingegneria Antincendio
Sezione Italiana della
Society of Fire Protection Engineers

Seminario tecnico di aggiornamento in materia di prevenzione incendi
(art. 7 D.M. 05/08/2011)
Seminario tecnico di aggiornamento professionale continuo
(Art. 7 DPR 7/08/2012 n. 137)

SEMINARIO DI AGGIORNAMENTO ANTINCENDIO

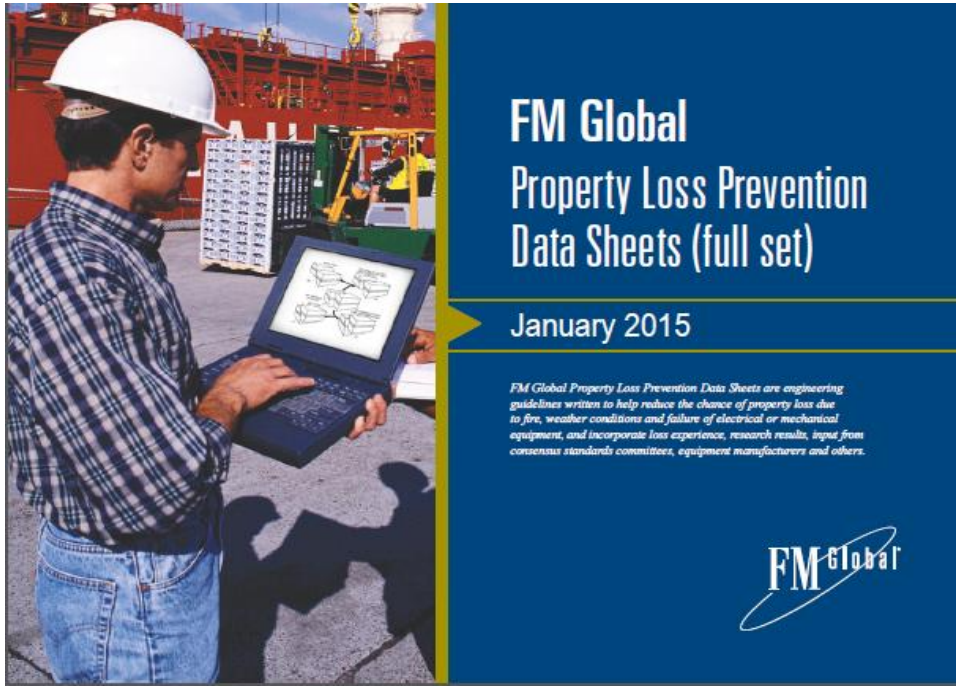
I SISTEMI DI CONTROLLO DELL'INCENDIO NON AD ACQUA

Milano 31 marzo 2014

Dispositivi di protezione indiretta

Relatore: Ermanno Spina

Dispositivi di protezione indiretta



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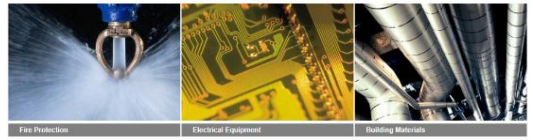


- Gruppo assicurativo con sede in Rhode Island - US, partecipazione societaria degli assicurati (mutualita')
- Non quotata in Borsa
- Piu' di 5,300 dipendenti di cui 1,800 Loss Prevention Engineers (13 in Italia), in 66 uffici nel mondo (Milano)
- Serve clienti in 150 nazioni diverse

- **Posizionamento e Riconoscimenti:**
  - Ranked #557 on the FORTUNE 1000 list of America's largest companies
  - Rated "A+" (Superior) by A.M. Best and "AA" (Very Strong) by Fitch Ratings year after year
  - Rated "A+" for financial strength and counterparty credit with a "Stable" outlook by Standard & Poor's Rating Services (2015)
  - Voted "Best Commercial Property Insurer" in *Business Insurance* Magazine's Annual Readers Choice Awards (2013)
  - Rated the top choice for "commercial property coverage," "business interruption (BI)/contingent BI," "boiler and machinery," "excess flood" as well as "terrorism" insurance in *National Underwriter*'s Risk Manager Choice Awards (2013)
  - Ranked #1 two years in a row by risk managers for "underwriting expertise," "customer service" and "claims processing" by Greenwich Associates (2012)
  - Named "World's Best Supply Chain Risk-Consulting Services Provider" by *Global Finance* magazine (2014)

Premesse

- www.fmglobaldatasheets.com e www.approvalguide.com sono gli unici riferimenti di questa presentazione

- Sistemi di protezione indiretta dell'incendio sono qui "metodi non convenzionali" che agiscono su 1 dei 3 lati triangolo del fuoco.

- L'esperienza sinistri FM Global li pone **alla pari** di sistemi di protezione attivi o protezioni dirette (estinzione in caso di incendio)

- FM Global ormai da tempo non fa' piu' distinzione tra infiammabili e combustibili, se un materiale brucia e' "combustibile"

FM Global Data Sheets www.fmglobaldatasheets.com

- Incendio
- Sicurezza Intrinseca
- Allagamento/alluvione
- Terremoto
- Conclusioni

- Heated Plastic Tanks (Galvaniche) DS 7-16
- Chemical Plants, DS 7-14
- Ignitable Liquids, DS 7-32
- Aluminum Industry, DS 7-64
- Dust Collectors & Explosions, DS 7-73, 7-76
- Printing Plants, DS 7-96
- Heat Transfer Fluids, DS 7-99
- Steam Turbines, 7-101
- Cutting & Hydraulic Fluids, DS 7-37, 7-98

IN GENERALE IN QUESTI CASI SI AGISCE SUL COMBUSTIBILE E SULL'INNESCO

Heated Plastic Tanks (Galvaniche) DS 7-6

- Section 2.2.3 Process Operations
  - Plastic or Plastic Lined Tanks
    - Immersion Heaters Low Level Switch
    - High Temperature Switch
    - De-energizing (idle hours, electrical failure)
    - Operators' training
  - Quarterly testing !

2.2.3 Where heaters are used on processes involving plastic or plastic-lined tanks, arrange for the following features:

a) Mount and secure immersion heaters in a fixed position in accordance with the manufacturers' mounting recommendations. This will ensure that proper distance from the walls and bottom of the plastic tank or liner is provided.

b) Provide FM Approved (see Appendix A for definition) low liquid level sensors or limit switches interlocked to de-energize the heaters and sound an alarm if the liquid level falls below any section of the element where heat is produced. The tank heater should not be able to re-start until the *process level sensor* is satisfied.

c) Equip tanks that are filled from facility's bulk supply system with a high level interlock. This interlock should stop the flow of chemical if the tank is filled above the normal process level.

d) Provide each heated tank with a high liquid temperature limit sensor or limit switch arranged to de-energize the heater and sound an alarm when the liquid temperature rises 25°F (14°C) above normal operating temperatures. The interlock should have a manual reset.

e) Provide each heater with a heating element over-temperature sensor, limit switch or snap switch. The sensor should be located as close as possible to the heater or be an integral part of the heater, and should be interlocked to shut down the heating system if the pre-set value is exceeded. The pre-set value should be factory set and not be field adjustable. If not an integral part of the heater, the location of the sensor should be determined by the heater manufacturer.

f) Provide interlocks for the high temperature limit and the liquid level limit switches outlined above, that operate independently of normal process controls. Some installations are microprocessor controlled with integrated liquid level and high temperature cutout. These systems should be evaluated for the proper application of the limit switches.

g) Turn off power to the heating system serving the tank in question upon actuation of a vessel's drain sequence. Power to the heater should be permitted only when the proper process liquid level in the tank is restored.

h) Provide interlocks that shut down the power to the heating system if the associated process pump is deactivated and/or liquid flow is interrupted in systems where liquid flow is required for safe operation. In systems where a mechanical pump is not directly associated with the heater, provide a flow sensing system using an independent sensor and associated circuitry interlocked to shut off power to the heater on loss of fluid flow.

i) For bonded or embedded heating systems, any outer enclosure around the heater should be made of noncombustible material such as stainless steel, quartz, or materials that are Listed to the Class 4910 Standard.

j) Shut off heaters during idle periods when practical.

k) Protect heaters from mechanical damage.

Chemical Reactions, DS 7-46

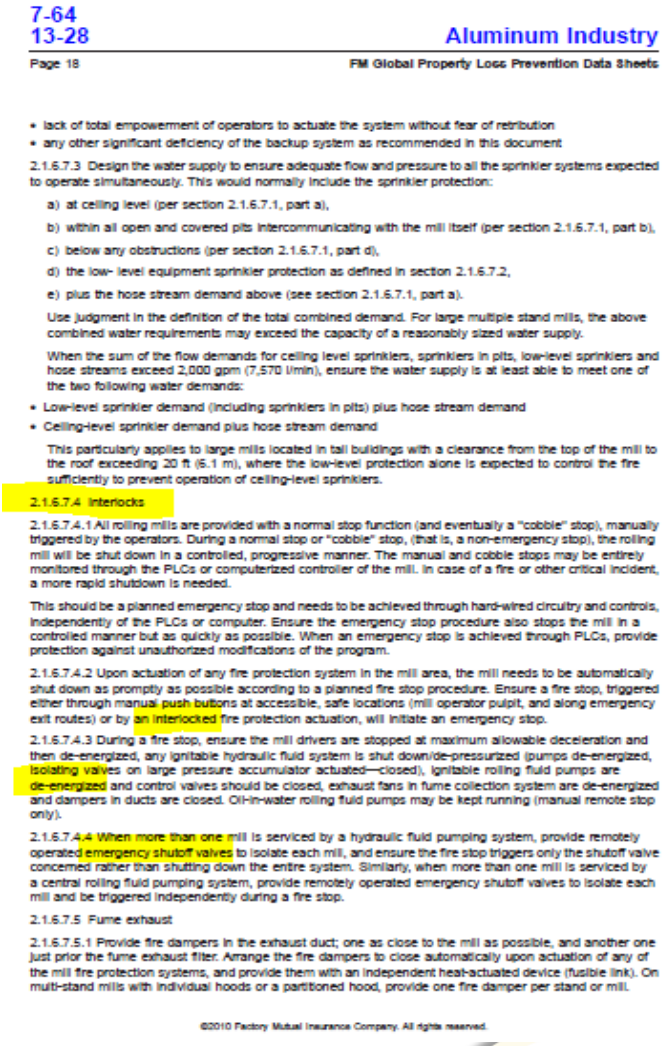
- SIL: Safety Interlock Levels
- Section 2.3.12: Interlock with Heat Transfer Systems
- Section 2.3.14: Process Safety Interlocks should be independent from Process Controls !
- Full Annual Testing !

Ignitable Liquids, DS 7-32

- Section 2.3.2: Ventilation (power supplies, high temperature)
- Section 2.5.2.4: Equipment, Process and Piping Systems. Emergency Shut Off Valves interlocks with:
  - NC SSOV valves,
  - Inert gas systems,
  - Sprinkler operation,
  - Pumping/filling systems,
  - Overflow or leak detectors,
  - Exhaust ventilation systems,
  - Heating equipment.
- Segregation, Containment/Drainage, Ventilation, Ignition and Fire Protection
- Full Annual Testing !

Aluminum Industry, DS 7-64

- Section 2.1.6.7.4: Interlocks
  - Manual AND Automatic,
  - Hard wired emergency stops,
  - Dependent from ANY fire actuation present,
  - Any hydraulic systems to be interlocked,
  - Any Carbon Dioxide system triggers interlocks
- Full Annual Testing !



7-64
13-28 Aluminum Industry

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- lack of total empowerment of operators to actuate the system without fear of retribution
- any other significant deficiency of the backup system as recommended in this document

2.1.6.7.3 Design the water supply to ensure adequate flow and pressure to all the sprinkler systems expected to operate simultaneously. This would normally include the sprinkler protection:

a) at ceiling level (per section 2.1.6.7.1, part a),

b) within all open and covered pits intercommunicating with the mill itself (per section 2.1.6.7.1, part b),

c) below any obstructions (per section 2.1.6.7.1, part d),

d) the low- level equipment sprinkler protection as defined in section 2.1.6.7.2,

e) plus the hose stream demand above (see section 2.1.6.7.1, part a).

Use judgment in the definition of the total combined demand. For large multiple stand mills, the above combined water requirements may exceed the capacity of a reasonably sized water supply.

When the sum of the flow demands for ceiling level sprinklers, sprinklers in pits, low-level sprinklers and hose streams exceed 2,000 gpm (7,570 l/min), ensure the water supply is at least able to meet one of the two following water demands:

- Low-level sprinkler demand (including sprinklers in pits) plus hose stream demand
- Ceiling-level sprinkler demand plus hose stream demand

This particularly applies to large mills located in tall buildings with a clearance from the top of the mill to the roof exceeding 20 ft (6.1 m), where the low-level protection alone is expected to control the fire sufficiently to prevent operation of ceiling-level sprinklers.

2.1.6.7.4 Interlocks

2.1.6.7.4.1 All rolling mills are provided with a normal stop function (and eventually a "cobble" stop), manually triggered by the operators. During a normal stop or "cobble" stop, (that is, a non-emergency stop), the rolling mill will be shut down in a controlled, progressive manner. The manual and cobble stops may be entirely monitored through the PLCs or computerized controller of the mill. In case of a fire or other critical incident, a more rapid shutdown is needed.

This should be a planned emergency stop and needs to be achieved through hard-wired circuitry and controls, independently of the PLCs or computer. Ensure the emergency stop procedure also stops the mill in a controlled manner but as quickly as possible. When an emergency stop is achieved through PLCs, provide protection against unauthorized modifications of the program.

2.1.6.7.4.2 Upon actuation of any fire protection system in the mill area, the mill needs to be automatically shut down as promptly as possible according to a planned fire stop procedure. Ensure a fire stop, triggered either through manual push buttons at accessible, safe locations (mill operator pulpit, and along emergency exit routes) or by an interlocked fire protection actuation, will initiate an emergency stop.

2.1.6.7.4.3 During a fire stop, ensure the mill drivers are stopped at maximum allowable deceleration and then de-energized, any ignitable hydraulic fluid system is shut down/de-pressurized (pumps de-energized, isolating valves on large pressure accumulator actuated—closed), ignitable rolling fluid pumps are de-energized and control valves should be closed, exhaust fans in fume collection system are de-energized and dampers in ducts are closed. Oil-in-water rolling fluid pumps may be kept running (manual remote stop only).

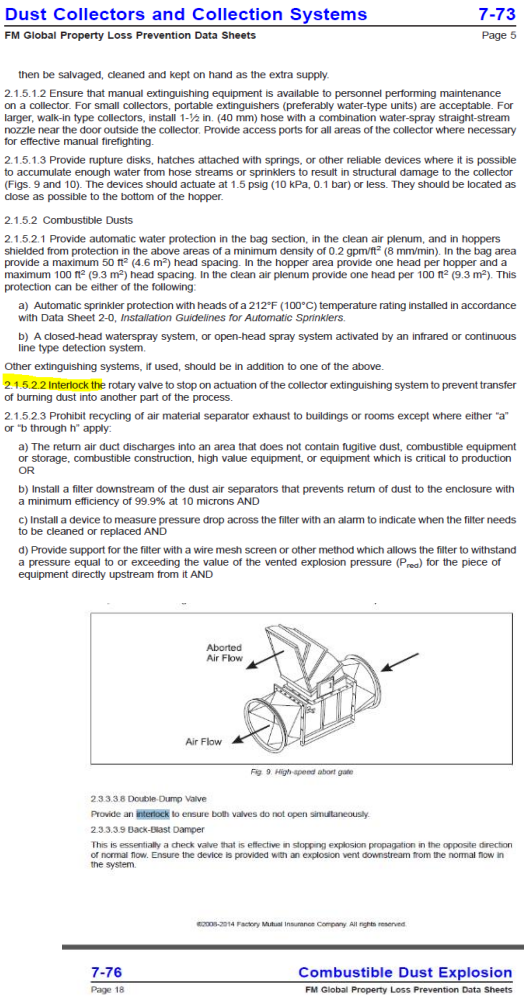
2.1.6.7.4.4 When more than one mill is serviced by a hydraulic fluid pumping system, provide remotely operated emergency shutoff valves to isolate each mill, and ensure the fire stop triggers only the shutoff valve concerned rather than shutting down the entire system. Similarly, when more than one mill is serviced by a central rolling fluid pumping system, provide remotely operated emergency shutoff valves to isolate each mill and be triggered independently during a fire stop.

2.1.6.7.5 Fume exhaust

2.1.6.7.5.1 Provide fire dampers in the exhaust duct; one as close to the mill as possible, and another one just prior the fume exhaust filter. Arrange the fire dampers to close automatically upon actuation of any of the mill fire protection systems, and provide them with an independent heat-actuated device (fusible link). On multi-stand mills with individual hoods or a partitioned hood, provide one fire damper per stand or mill.

Dust Collectors & Explosions, DS 7-73, 7-76

- Sect. 2.1.4 DS 7-73 Equipment and Process
- Typical interlocks with:
  - Air streams temperatures;
  - Explosion protection systems;
  - Rotary valves with extinguishing systems,
  - Electrostatic precipitators with associated sprinkler system,
    - Alarm at 1% oxygen concentration in precipitator, shutdown at 2%;
    - Purging systems.
- Sect. 2.3 DS 7-76 Equipment Explosion Hazard
- Typical interlocks with:
  - Suppression systems with dust solid streams;
  - Rotary valves with extinguishing systems,
- Full Annual Testing !



Dust Collectors and Collection Systems **7-73**
FM Global Property Loss Prevention Data Sheets Page 5

then be salvaged, cleaned and kept on hand as the extra supply.

2.1.5.1.2 Ensure that manual extinguishing equipment is available to personnel performing maintenance on a collector. For small collectors, portable extinguishers (preferably water-type units) are acceptable. For larger, walk-in type collectors, install 1-½ in. (40 mm) hose with a combination water-spray straight-stream nozzle near the door outside the collector. Provide access ports for all areas of the collector where necessary for effective manual firefighting.

2.1.5.1.3 Provide rupture disks, hatches attached with springs, or other reliable devices where it is possible to accumulate enough water from hose streams or sprinklers to result in structural damage to the collector (Figs. 9 and 10). The devices should actuate at 1.5 psig (10 kPa, 0.1 bar) or less. They should be located as close as possible to the bottom of the hopper.

2.1.5.2 Combustible Dusts

2.1.5.2.1 Provide automatic water protection in the bag section, in the clean air plenum, and in hoppers shielded from protection in the above areas of a minimum density of 0.2 gpm/ft² (8 mm/min). In the bag area provide a maximum 50 ft² (4.6 m²) head spacing. In the hopper area provide one head per hopper and a maximum 100 ft² (9.3 m²) head spacing. In the clean air plenum provide one head per 100 ft² (9.3 m²). This protection can be either of the following:

a) Automatic sprinkler protection with heads of a 212°F (100°C) temperature rating installed in accordance with Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*.

b) A closed-head waterspray system, or open-head spray system activated by an infrared or continuous line type detection system.

Other extinguishing systems, if used, should be in addition to one of the above.

2.1.5.2.2 Interlock the rotary valve to stop on actuation of the collector extinguishing system to prevent transfer of burning dust into another part of the process.

2.1.5.2.3 Prohibit recycling of air material separator exhaust to buildings or rooms except where either "a" or "b through h" apply:

a) The return air duct discharges into an area that does not contain fugitive dust, combustible equipment or storage, combustible construction, high value equipment, or equipment which is critical to production OR

b) Install a filter downstream of the dust air separators that prevents return of dust to the enclosure with a minimum efficiency of 99.9% at 10 microns AND

c) Install a device to measure pressure drop across the filter with an alarm to indicate when the filter needs to be cleaned or replaced AND

d) Provide support for the filter with a wire mesh screen or other method which allows the filter to withstand a pressure equal to or exceeding the value of the vented explosion pressure (P_{red}) for the piece of equipment directly upstream from it AND

Fig. 9. High-speed abort gate

2.3.3.3.8 Double-Dump Valve

Provide an interlock to ensure both valves do not open simultaneously.

2.3.3.3.9 Back-Blast Damper

This is essentially a check valve that is effective in stopping explosion propagation in the opposite direction of normal flow. Ensure the device is provided with an explosion vent downstream from the normal flow in the system.

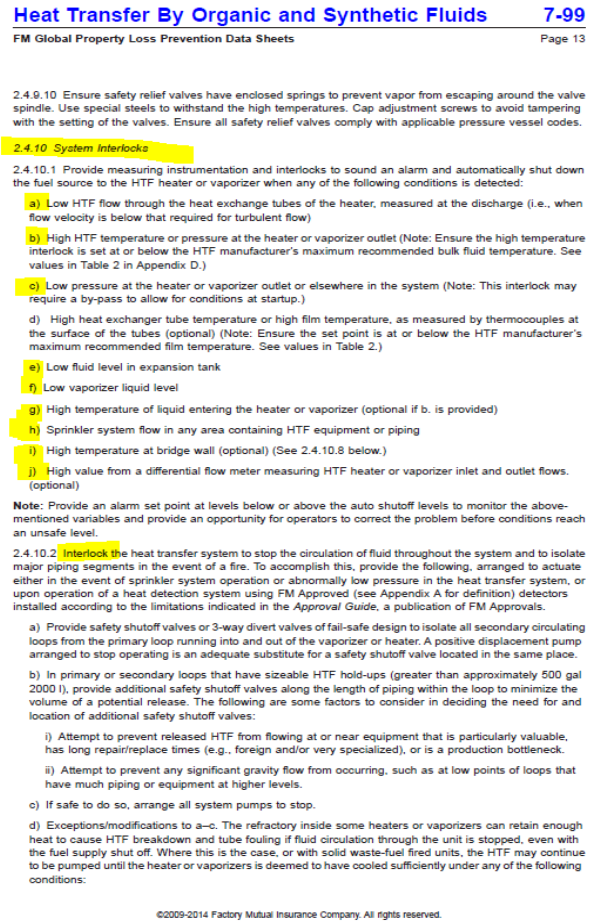
7-76 **Combustible Dust Explosion**
Page 18 **FM Global Property Loss Prevention Data Sheets**

Printing Plants, DS 7-96

- Section 2.2.1: Ink and Solvent Handling
- Interlocks with:
  - NC SSOV valves,
  - Pumping/filling systems,
- Section 2.2.4 Heat Transfer Fluid Systems or 2.2.5 Hydraulic Oil Systems or 2.4 Dryers & Solvent Recovery Systems
- Interlocks with:
  - NC SSOV valves,
  - Pumping/filling systems,
  - Fluid/Hydraulic/Lube oil distribution systems,
  - All solvent/ink, fluid & pneumatic supply systems with fire detection/protection
  - Low Flammability Level detector with rollers, ventilation and RTO
- Full Annual Testing !

Heat Transfer Fluids, DS 7-99

- Section 2.4.10: Interlocks
  - Low HTF flow;
  - High HTF temperature or pressure;
  - Low pressure;
  - Low fluid level in expansion tank,
  - Low vaporizer liquid level,
  - Sprinkler system actuation;
  - High value from differential flow meter in heater or vaporizer
  - SSOV divisional valves on loops
  - NOT with inert gas system inside heater/vaporizer
  - If T>56°of max HTF working temperature through thermocouples prevents tubes overheating
- Full Annual Testing !



Heat Transfer By Organic and Synthetic Fluids **7-99**

FM Global Property Loss Prevention Data Sheets Page 13

2.4.9.10 Ensure safety relief valves have enclosed springs to prevent vapor from escaping around the valve spindle. Use special steels to withstand the high temperatures. Cap adjustment screws to avoid tampering with the setting of the valves. Ensure all safety relief valves comply with applicable pressure vessel codes.

2.4.10 System Interlocks

2.4.10.1 Provide measuring instrumentation and interlocks to sound an alarm and automatically shut down the fuel source to the HTF heater or vaporizer when any of the following conditions is detected:

a) Low HTF flow through the heat exchange tubes of the heater, measured at the discharge (i.e., when flow velocity is below that required for turbulent flow)

b) High HTF temperature or pressure at the heater or vaporizer outlet (Note: Ensure the high temperature interlock is set at or below the HTF manufacturer's maximum recommended bulk fluid temperature. See values in Table 2 in Appendix D.)

c) Low pressure at the heater or vaporizer outlet or elsewhere in the system (Note: This interlock may require a by-pass to allow for conditions at startup.)

d) High heat exchanger tube temperature or high film temperature, as measured by thermocouples at the surface of the tubes (optional) (Note: Ensure the set point is at or below the HTF manufacturer's maximum recommended film temperature. See values in Table 2.)

e) Low fluid level in expansion tank

f) Low vaporizer liquid level

g) High temperature of liquid entering the heater or vaporizer (optional if b. is provided)

h) Sprinkler system flow in any area containing HTF equipment or piping

i) High temperature at bridge wall (optional) (See 2.4.10.8 below.)

j) High value from a differential flow meter measuring HTF heater or vaporizer inlet and outlet flows. (optional)

Note: Provide an alarm set point at levels below or above the auto shutoff levels to monitor the above-mentioned variables and provide an opportunity for operators to correct the problem before conditions reach an unsafe level.

2.4.10.2 Interlock the heat transfer system to stop the circulation of fluid throughout the system and to isolate major piping segments in the event of a fire. To accomplish this, provide the following, arranged to actuate either in the event of sprinkler system operation or abnormally low pressure in the heat transfer system, or upon operation of a heat detection system using FM Approved (see Appendix A for definition) detectors installed according to the limitations indicated in the *Approval Guide*, a publication of FM Approvals.

a) Provide safety shutoff valves or 3-way divert valves of fail-safe design to isolate all secondary circulating loops from the primary loop running into and out of the vaporizer or heater. A positive displacement pump arranged to stop operating is an adequate substitute for a safety shutoff valve located in the same place.

b) In primary or secondary loops that have sizeable HTF hold-ups (greater than approximately 500 gal 2000 l), provide additional safety shutoff valves along the length of piping within the loop to minimize the volume of a potential release. The following are some factors to consider in deciding the need for and location of additional safety shutoff valves:

i) Attempt to prevent released HTF from flowing at or near equipment that is particularly valuable, has long repair/replace times (e.g., foreign and/or very specialized), or is a production bottleneck.

ii) Attempt to prevent any significant gravity flow from occurring, such as at low points of loops that have much piping or equipment at higher levels.

c) If safe to do so, arrange all system pumps to stop.

d) Exceptions/modifications to a–c. The refractory inside some heaters or vaporizers can retain enough heat to cause HTF breakdown and tube fouling if fluid circulation through the unit is stopped, even with the fuel supply shut off. Where this is the case, or with solid waste-fuel fired units, the HTF may continue to be pumped until the heater or vaporizers is deemed to have cooled sufficiently under any of the following conditions:

Steam Turbines, 7-101

- Section 2.5.2: Emergency Shutdown
  - OFHA (Oil Fire Hazard Assessment) scenarios and safeguards
  - Typical interlocks with:
    - Emergency, any !
    - Critical shutdown equipment remoted (Control Room)
    - Control oil (steam flow) and Lube oil systems;
  - Shutdown sequence along manufacturer recommendations
- Full Annual Testing !

Cutting & Hydraulic Fluids, DS 7-37, 7-98

- DS 7-37 Cutting Fluids
- Typical interlocks with:
  - Any fire protection system – single interlock !
  - Liquid level switch for EDM to prevent oil ignition
  - Heat detectors, flame detectors, <FM> fusible-link valve
- DS 7-98 Hydraulic Fluids
- Typical interlocks with:
  - Any fire protection system – single interlock !
  - Oil pumping system
  - Heat detectors, flame detectors, <FM> fusible-link valve
  - Manual stop buttons !!!
- Quarterly Testing !
- Video

2.5 Equipment and Processes

2.5.1 Design and install equipment to confine the fluid within the system, keep escaping material to a minimum, and prevent its spread. Design and construct equipment using cutting fluids, heating equipment, measurement and observation instruments, piping systems, and transfer systems in accordance with the recommendations in Data Sheet 7-32, *Ignitable Liquid Operations.*

2.5.2 Tightly enclose cutting fluid return troughs from machines to fluid-cleaning systems. Alternatively, use standard piping designed in accordance with the recommendations in Data Sheet 7-32, *Ignitable Liquid Operations.* Ensure return lines are trapped.

2.5.3 Provide return tanks with provisions for overflow if flooded by excessive cutting fluid or by water from sprinklers or other sources.

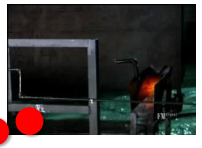
2.5.4 Where ignitable industrial fluids are used, provide safety/emergency shutoff valves and/or an automatically actuated means for shutting down the pumping system and shutting off flow from equipment. Automatic shutdown may be accomplished using one of the following methods:

A. Actuation by use of heat detectors located at ceiling level. Locate additional heat detectors within any shielded equipment areas.

B. Operation of the automatic sprinkler system. Arrange the system to permit protection system alarm testing without unwanted production shutdown by providing a push button switch that requires constant attendance to bypass the interlock.

C. Actuation by use of flame detection.

D. Operation of an FM Approved fire-safe fusible link-operated valve. Install the safety shutoff valves in accordance with the recommendations in Data Sheet 7-32, *Ignitable Liquid Operations,* including valve installation at all potential points of liquid release, and proper placement of the fusible link(s) to ensure prompt operation when exposed to a cutting fluid fire.



FM Global Data Sheets www.fmglobaldatasheets.com

- Incendio
- Sicurezza Intrinseca
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FM Approval Guide www.approvalguide.com

- Transformers, DS 5-4
  - FM Approved Transformers
  - FM Approved Fluids
- Heated Plastic Tanks (Galvaniche) DS 7-6
  - Indirect Water Heating devices (non-electrical)
- Hydraulic Fluids, DS 7-98
  - FM Approved Less Ignitable Industrial Fluids

IN GENERALE IN QUESTI CASI SI AGISCE SUL COMBUSTIBILE E SULL'INNESCO

FM Global Data Sheets www.fmglobaldatasheets.com

- Incendio
- Sicurezza Intrinseca
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FM Approval Guide www.approvalguide.com

- Barriere di difesa (Flood Abatement)
- Dispositivi di difesa temporanei

SEMPLICI SISTEMI AUTOMATICI PER RIDUZIONE DEI DANNI DA ALLAGAMENTO

FM Global Data Sheets www.fmglobaldatasheets.com

- Incendio
- Sicurezza Intrinseca
- Allagamento/alluvione
- Terremoto
- Conclusioni

Sensori/Valvole Sismiche ASCE 25

(DS 1-11 “Fire Following Earthquake”)

- Valvole Meccaniche o Sensori Sismici
- Interblocchi sistemi centralizzati di:
  - Gas Combustibili (valvole o sensori)
  - Liquidi Combustibili (sensori)
- Sensori sismici multipli con logiche “and”

ANCHE IN QUESTI CASI SI AGISCE SUL COMBUSTIBILE E SULL’INNESCO

Conclusioni

- Interblocchi sono primari dispositivi di protezione - seppure “indiretta”

- Parole chiave per la ricerca tematica nei Data Sheets FM Global:

  Interlock, shut off, shutdown

- In alcuni casi una scelta verso fluidi non combustibili o omologati FM puo’ garantire la sicurezza intrinseca di processi industriali altrimenti pericolosi

- Non e’ mai troppo tardi per rianalizzare il rischio ed adattare interblocchi alle parti di processo critiche e pericolose.