

Designing protection systems for use in hazmat buildings

Proactively reducing health/safety and environmental risks

Fred W. Romig

The prefabricated hazardous material, or "hazmat," building was created in EPA's CFR 26.175, and has been further defined in the National Fire Protection Association's NFPA 30 flammable and combustible liquids code, as meeting local, state or federal requirements.

Many of these buildings are preapproved by Factory Mutual (FM).

Originally, these buildings were used just for storage, but today they are being used for testing, mixing, dispensing, chemical processing and manufacturing applications, which has greatly affected their design and outfitting.

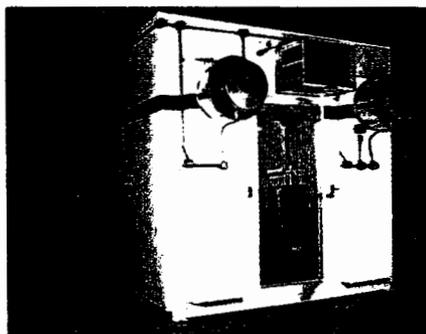
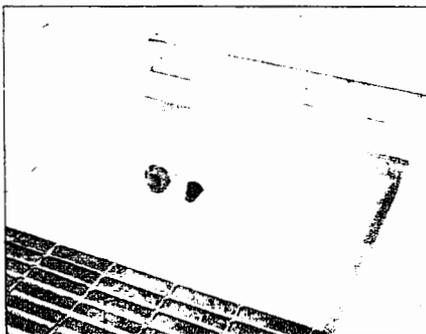
Similarly, the configurations of these buildings have depended on the hazards of the liquid chemicals involved, which can be determined by referring to the relevant Material Safety Data Sheets (MSDS).

These added considerations call for more proactive safety measures, which can be referred to as "prevent systems."

Chemical hazards

Some chemicals can cause damage to the building and its surroundings, as well as chronic detrimental health effects on an exposed worker and/or environmental pollution. Chemical dangers may include fire and explosive potential, the acute health effects of corrosives (acids or bases) that cause burns, and reactives that may release deadly toxic gases.

The codes define fire- and blast-resistant construction, ventilation and fire-suppression requirements. However, most of these codes emphasize reacting to a catastrophe (either a fire or blast using a fire-suppression system) that is underway, as



Top: Fig. 1. A grating section is removed to show the corner of a sloped floor, an alarm pit with a drain connection and the red bulb of a float detector.

Bottom: Fig. 2. The continuous running fan (right) removes vapor/air through the wall and up the outside duct. If air pressure drops below set-point, an alarm sounds and a backup fan (left) starts.

opposed to preventing one.

Consequently, because the burden of proof as to whether a company has maintained a safe facility is on the company itself, it would be wise to consider what protection systems and devices are available and whether they are in the code or

not to ensure that a little accident will not become a major legal liability case.

Prevent systems are designed to draw attention to a problem in its beginning stages so the response can be localized and the problem can be controlled through quick action. The potential problem could be from an after-hours chemical leak, or a spill or accident during working hours that has gone unnoticed.

In a hazmat building, a prevent system can be automatically triggered by a spill detector, an exhaust fan malfunction, gas detection, high or low temperature, an open explosion-relief panel, and door security alarm and electrical grounding systems.

Spill-detection systems

Because most hazmat buildings are used to contain hazardous liquids, the code requires a sump or tank to be a part of the floor to catch a spill and protect the environment.

The minimum FM requirement is 25% of what is to be stored in the building. In conventional construction, this is usually a continuously poured concrete pad with a berm or curb around the perimeter. The concrete floor is usually sloped to a drain. Fire-rated concrete or steel walls are then set on the berm to complete the structure. It is difficult to install a float detector into a concrete floor to provide a spill alarm.

In an all-steel building, the standard sump floor is usually flat but features a convenient elevated floor several inches above it. If grating is used, spills can be checked visually, and leaking liquids fall through and do not get onto workers' shoes and under non-leaking containers.

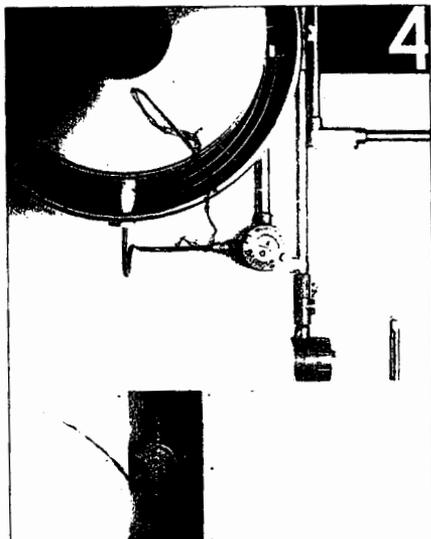


Fig. 3. A gas detector in the air stream of an outside exhaust duct.

A sloped floor, which is usually optional on steel buildings, is very important when considering a spill alarm system. If a float detector is installed into a

flat floor, it might take three to five (depending on the size of the floor area) 55-gal drums releasing all their chemicals at the same time to raise the float detector bulb enough to trigger an alarm.

When a spill occurs in a building with a sloped floor, as little as 1 pt of liquid accumulating in the drain box or alarm pit (Fig. 1) at the low end of the floor will cause an alarm to be initiated.

A sloped floor with a spill alarm is the earliest warning against fire and explosions available today. If the chemical is a fast-evaporating type and the leak is slow, a gas alarm might go off sooner but, overall, a sloped floor/spill alarm provides the quickest reaction and is inexpensive compared to a gas-alarm system.

A spill alarm has another advantage over a gas alarm. Liquids flow downhill in a predictable and calculable pattern. A vapor or fume flow spreads unpredictably, and it is a guess as to where to mount the gas alarms and how many are needed.

After a spill alarm, a sloped floor is conducive to both rapid cleanup and fire fighting. Whoever responds to the spill alarm in a building with a flat floor would have to move containers or equipment out of the way or even out of the building to get most of the elevated flooring out of the way. With a sloped floor, less elevated flooring would have to be removed because the chemical would flow to one or the other of the sump walls. If the building has a double-sloped floor with the slope coming together under an aisle, a liquid fire would not be under any storage containers or shelving, and the flames would come up through the open grating and be accessible for fire suppression.

Plant personnel should keep in mind that storing full or empty containers, pallets or trash in aisles will enable a fire in one aisle to cross over to the next, inhibiting fire suppression.

It might also pay to preplan the use of the floor surface for storage and aisle

Automatic Sample Collection

Isolok® Sampling Systems

Effective process control requires accurate input based on representative samples. Isolok sampling systems provide you, and your customers, with highly reliable samples of liquids, slurries or powders. Using simple pneumatic operation, they directly tap process lines for small, precise sample portions on an adjustable time base, or in proportion to product flow. Available in 316 stainless steel or other job-suited materials, they handle everything from wastewater to hot or hazardous substances.

Write, phone or Fax today for more information.



BRISTOL EQUIPMENT COMPANY

210 Beaver Street, Box 696 Yorkville, Illinois 60560
Phone: (630) 553-7161 FAX: (630) 553-5981

Typical ISOLOK installation. One of over 10,000 now in field service.

locations and require the building manufacturer to cut and locate the floor material so containers under shelving do not necessarily have to be removed, allowing the aisle flooring to be removed separately and first.

Fan malfunction alarm

For a hazmat building, NFPA 30 states, "mechanical ventilation where dispensing operations are required." FM mentions natural or mechanical ventilation at a minimum rate of six air changes per hour. Natural ventilation cannot be set up or calculated to provide a definite number of air changes; only mechanical ventilation can accomplish that.

The code says the air must enter and leave at floor level at opposite ends of the building, usually requiring a duct up the wall so that the fumes are exhausted at roof level.

Mechanical ventilation with a malfunction alarm, usually an air flow or pressure sensor, is second to a spill alarm in early warning systems. Mechanical ventilation can prevent a vapor/air mixture from reaching a flammable state, thus ensuring that an explosion will not occur. This is good news if the fan is continuously running during work hours and at night, when a container may spring an undetected leak. The only way to know the fan is moving air is by means of a flow detector.

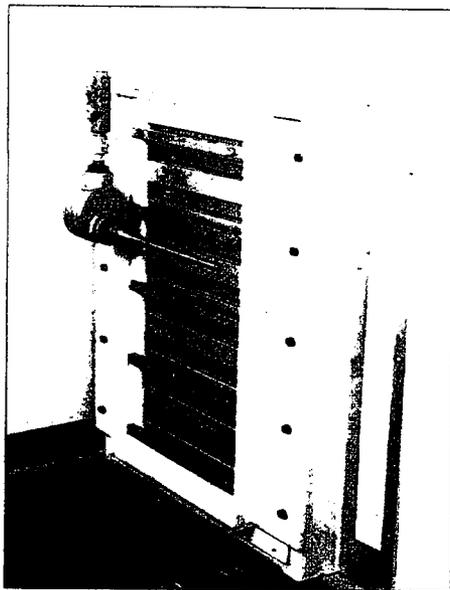
This is important to another area of the code, which requires explosion-relief venting. The problem is that explosion-relief vents or panels are not fire-rated. Sometimes the local authority has approved not using explosion-relief panels as long as the exhaust fan malfunction alarm sensor automatically turns on a second redundant exhaust fan (Fig. 2). This way, fresh air is always being brought into the building, and there cannot be an explosion.

Wastewater treatment and collection facilities face flammable and combustible threats from both natural and manufactured gases, yet NFPA 820, which covers fire protection standards for such facilities, calls for both supply and exhaust fans to achieve dual

ventilation with air changes of six and 12 per hour, with no mention of relief panels.

Explosion-relief panel openings can be fire-rated with drop-down shutters that are FM-approved as sold by overhead roll-up

Fig. 4. A high/low temperature alarm from a thermocouple installed in front of exhaust air vent.



The Smart Way to Reduce Waste Volumes and Disposal Costs

Trying to get a grip on the increasing cost of hazardous waste disposal? Haz-Stor's microprocessor controlled *CTI In-Drum*

Compaction Systems fit more waste into every drum.

The result: fewer drums and reduced costs. Depending on your company's waste stream, you may expect compaction ratios as high as 20:1.

System options can include:

- Explosion proof design
- HEPA/carbon filtration system
- Drum crushing capabilities
- Liquid waste removal pumps
- Fire extinguisher system



The Haz-Stor® *CTI Compactor System* is the better way for hazardous and bio-hazardous waste disposal. It's the system that pays for itself. For a **FREE Payback Analysis** of the savings to your company, call 1-800-727-2067 today.

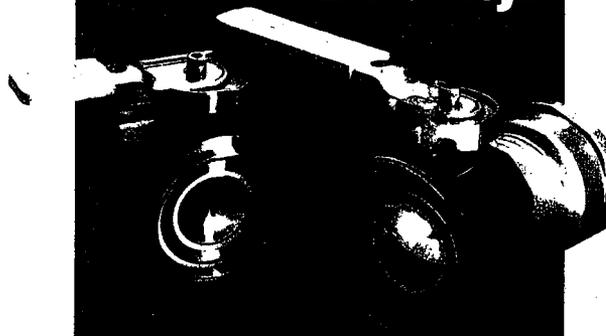
HAZ-STOR®
HAZARDOUS MATERIALS STORAGE

Justrite Manufacturing Co. LLC Subsidiary of Federal Signal Corp.

© 1996 Justrite

CIRCLE 231

Reduce Spillage. Reduce Costs. Reduce Liability.



EPSILON™

Premier coupling and containment system virtually eliminates chemical spills

For more information, call 1-800-722-2688 or visit our web site at <http://www.aeroquip.com>



CIRCLE 232

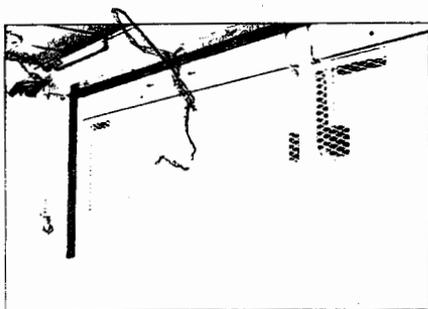


Fig. 5. An explosion-relief panel protected with an anti-intrusion steel screen. The panel is equipped with magnetic security alarm contacts and a drop-down shutter (grey box), which is released by a heat-activated fire sensor. The ultraviolet (UV)/infrared (IR) flame detector (red device) provides early warning of fire.

door manufacturers. In a building with a dual-fan system, the second fan can be turned on manually to double the air flow during hazardous operations and spill cleanups. The second fan could also auto-

matically turn on in the event of a liquid-spill alarm or during a gas-detection alarm.

Gas detectors

A very dangerous chemical liquid that rapidly evaporates into a vapor may require gas detection.

Fumes and vapors are usually heavier than air, but their flow and dispersion are not predictable. Should the building have a continuously running exhaust fan mounted at the top of an outside duct, the gas detector could be placed inside the duct (Fig. 3). This is where all vapors will be drawn and will pass the sensor.

Sensors are available that can detect almost any flammable or toxic gas with contacts to turn on equipment. In some cases, fire suppression systems that use CO₂ or Inergen, which is an alternative to Halon and CO₂ that workers can see through and breathe for limited periods,

can be discharged.

High/low temperature alarms

Some chemical liquids are classified by their flash points, which are directly related to volatility or their ability to generate vapor.

Liquids having low flash points are highly hazardous and, if the ambient storage temperature begins to rise, danger increases and sometimes self-ignition can occur. If ventilation, air conditioning or refrigeration systems fail to maintain proper operating temperatures, an alarm should be sounded.

A good practice is to install a thermocouple in front of the exhaust vent opening of a continuously running fan. Then, if the air temperature exceeds a predetermined setting, an alarm will be initiated.

It is not good practice to put the thermocouple inside an uninsulated outside exhaust duct (Fig. 4). Extra contacts could turn on the second fan or redundant refrig-

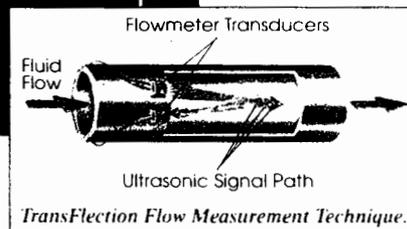
Panametrics TransPort® Flowmeter With TransFlection® Technology Obsoletes Doppler And Ordinary Transit-Time Flowmeters.

Using exclusive advanced transit-time and TransFlection technologies, the TransPort flowmeter measures all fluids, from ultrapure liquids to gas-liquid-solid mixtures. With clamp-on transducers, its nonintrusive flow rate measurement has a turndown ratio of 400 to 1, in pipe sizes from less than 1/2 inch to over 16 feet, at temperatures from cryogenic up to 500°F.



The TransPort Flowmeter.

For a demonstration of the world's most technically advanced flowmeters, contact Panametrics, Inc., 221 Crescent Street, Waltham, MA 02154, USA. Call toll-free: 1-800-833-9438 or Fax: 617-894-8582.



PANAMETRICS



LEADING INNOVATION. ADVANCED TECHNOLOGY. WORLDWIDE SERVICE.

eration if available.

Explosion-relief panel alarms

If some disgruntled ex-employee or even a terrorist wants to make an embarrassing situation into an attention-getting headline, the spill of a hazardous material or an explosion would do it. An intruder with a small screwdriver could easily pry open an explosion-relief panel, which is made of lightweight (less than 2.5 lb per sq ft per NFPA 68) aluminum.

In addition to being pried open, an explosion-relief panel is susceptible to being sucked open in a strong windstorm.

Installing magnetic security contacts on all explosion-relief panels (Fig. 5) would generate an alarm. If an explosion occurred, the magnet contacts would also provide a blast alarm. Installing magnetic contacts on all doors would make the building very secure.

Alarm wiring strategies

Most hazmat buildings hard-wire these alarm systems using unsupervised line voltage wiring and relay contacts, but a true industrial equipment monitoring system requires all initiating circuits to be supervised.

If something is wrong with the sensor wiring, a trouble alarm in the control panel will go off. When this happens, it is time to send out a service crew instead of the spill-response team or fire department.

With a few alarm zones (2-3), there

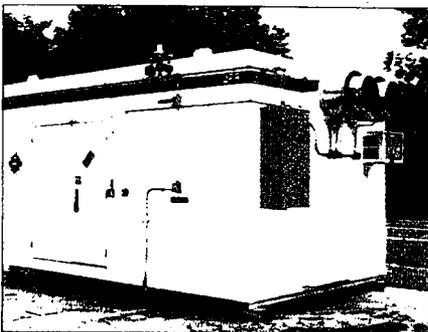


Fig. 6. The blue strobe on the roof provides early warning of a chemical spill in a sloped sump floor. A yellow strobe indicates malfunction in a fan (left) and turns on the other fan (right). The red strobe sounds a fire alarm as dry chemical tanks in the grey box discharge into building.

could be a local alarm strobe on the roof (Fig. 6) for each zone (it is easy to specify many zones by having each sensor be a zone). With four or more zones, it is better to have a single fire-alarm strobe and a single equipment-monitoring strobe. When responding, the team would look at an LED display that would identify the

zone and mode of alarm.

These zones can also be transmitted to a central alarm station.

Electrical grounding

Finally, whenever liquids are handled, processed or moved, an electrostatic charge can accumulate on containers and



DO NOT HANDLE CHEMICALS WITHOUT DICKOW PROTECTION

ISO 9001 - approved Dickow magnet drive centrifugal pumps have long been known for their ruggedness and dependability.

Now Dickow pumps are available with Mag-Safe™, a totally reliable device which monitors the temperature directly in the center of the magnets - the only monitor available which can "read" this vital area. If necessary, Mag-Safe™ will send a signal to your switching device for activating an

alarm or shutting down the pump. No other monitor can respond as fast.

If you're handling potentially dangerous chemicals, doesn't it make sense to insist on the double protection of Dickow: the toughest pump and the most reliable monitor?

Ask for our new bulletin. Or call us when your liquid demands caution.



PERFORMANCE IS EVERYTHING.

Dickow Pump Company, 2140 Newmarket Parkway, Bldg. 120, Marietta, GA 30067

THE LOWEST IN THE INDUSTRY



Nothing can measure lower liquid flow rates than a **Rheotherm® Flow Meter**... from Intek, Inc., "The Leader in Precision Thermal Flow Metering."

- As low as one gallon/year
- No moving parts
- Straight-through design
- Maintenance free
- Liquids or gases

1-800-6-LOW-FLOW
(1-800-656-9356)



INTEK, INC.
751 Intek Way
Westerville, OH 43082-9057

PH (614) 895-0301 • FAX (614) 895-0319

RHEOTHERM® Flow Instruments

CIRCLE 235

SPOTLIGHT: HAZARDOUS WASTE MANAGEMENT

equipment, setting up conditions for an electrostatic spark that can ignite vapors. Proper bonding and grounding of process vessels, containers and equipment are critical and limit the rate of dissipation.

By connecting conductive containers to the same electrical potential, such as a bus bar 42-in off the floor, static sparking can be prevented. Of course, the building's continuously welded tubular steel frame and thick plate skin is then connected to an earthing electrode (10 ft of copper clad rod) as required by NFPA 30 and

the National Electrical Code (NEC).

NFPA 780, the Standard for the Installation of Lightning Protection Systems, Chapter 6, Protection for Structures Containing Flammable Vapors, Gases or Liquids, states, "Metallic structures that are electrically continuous, tightly sealed to prevent escape of liquids, vapors ... and adequate thickness to withstand direct strokes ($\frac{3}{16}$ -in or 18.75-gauge or thicker) are inherently self-protecting."

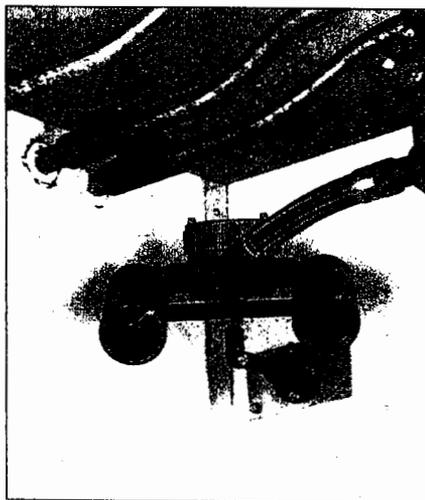
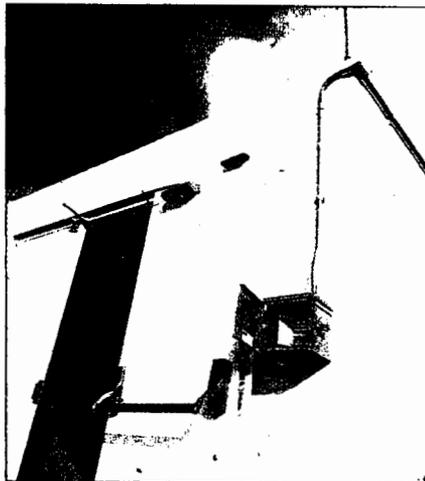
This rules out prefabricated hazmat buildings because (1) any time natural or mechanical ventilation is required, vapors are not sealed in the building away from lightning strikes and (2) many manufacturers' buildings' steel skin is thinner than $\frac{3}{16}$ in.

Lightning protection systems should be considered on all hazmat buildings according to the National Severe Storm Laboratory, which states that lightning strikes are responsible for more deaths and damages than the combined reports for hurricanes, tornadoes and floods.

Warehouses and industrial and chemical storage sites and loading zones receive lightning strikes each year and should typically be equipped with air terminals at roof corners (Fig. 7) and be properly grounded as a prevent system.

Prevent systems, especially sloped floor/spill and fan malfunction alarms, are the best defense against a catastrophic fire or explosion in a hazmat building.

But without a fast and efficient response, a chemical plant may still need what most codes require—a fire suppression system. These systems are usually heat-sensor activated, but can be supplemented with advanced warning smoke or flame detection systems (Fig. 8).



Top: Fig. 7. A lightning protection system copper air terminal on a roof corner. A security system magnetic switch is on the door with a key pad, and an alphanumeric display in a weatherproof box is next to the door.

Bottom: Fig. 8. A combination ultraviolet (UV)/infrared (IR) flame detector mounted in a ceiling corner.

■ To receive information on hazmat buildings—CID Associates, Leechburg, PA. **CIRCLE 405**

■ To receive information on Inergen suppression gas—Ansul Fire Protection, Marinette, WI. **CIRCLE 406**

Fred W. Romig is vice president of Haz-Safe Buildings at CID Associates, Leechburg, PA.