Safety Considerations for High Hazard Occupancies

Presented by: Jeff Nichols
Scott Beverly
Outline

• Separation Distances
• Explosion Control
• Spill Control and Secondary Containment
• Ventilation
• Standby and Emergency Power
• Separation of Incompatible Material
• Seismic Protection
• Static Accumulation
• Protection From Light
• Shock Padding
• Handling
§415.3 [F] Fire separation distance. Group H occupancies shall be located on property in accordance with the other provisions of this chapter. In Groups H-2 and H-3, not less than 25 percent of the perimeter wall of the occupancy shall be an exterior wall.

Exceptions:
1. Liquid use, dispensing and mixing rooms having a floor area of not more than 500 square feet (46.5 m²) need not be located on the outer perimeter of the building where they are in accordance with the Fire Code of New York State and NFPA 30.
2. Liquid storage rooms having a floor area of not more than 1,000 square feet (93 m²) need not be located on the outer perimeter where they are in accordance with the Fire Code of New York State and NFPA 30.
3. Spray paint booths that comply with the Fire Code of New York State need not be located on the outer perimeter."
Separation Distance

Purpose:

- Firefighting operations
- Ventilation
- Transmission to other properties
§415.3.1 [F] Group H occupancy minimum fire separation distance. Regardless of any other provisions, buildings containing Group H occupancies shall be set back to the minimum fire separation distance as set forth in Items 1 through 4 below. Distances shall be measured from the walls enclosing the occupancy to lot lines, including those on a public way. Distances to assumed lot lines established for the purpose of determining exterior wall and opening protection are not to be used to establish the minimum fire separation distance for buildings on sites where explosives are manufactured or used when separation is provided in accordance with the quantity distance tables specified for explosive materials in the Fire Code of New York State.
Separation Distance

1. Group H-1. Not less than 75 feet (22 860 mm) and not less than required by the *Fire Code of New York State*.

**Exceptions:**

1. Fireworks manufacturing buildings separated in accordance with NFPA 1124.
2. Buildings containing the following materials when separated in accordance with Table 415.3.1:
   2.1. Organic peroxides, unclassified detonable.
   2.2. Unstable reactive materials, Class 4.
   2.3. Unstable reactive materials, Class 3 detonable.
   2.4. Detonable pyrophoric materials.
Separation Distance

2. **Group H-2.** Not less than 30 feet (9144 mm) where the area of the occupancy exceeds 1,000 square feet (93 m²) and it is not required to be located in a detached building.

3. **Groups H-2 and H-3.** Not less than 50 feet (15 240 mm) where a detached building is required (see Table 415.3.2).

4. **Groups H-2 and H-3.** Occupancies containing materials with explosive characteristics shall be separated as required by the *Fire Code of New York State*. Where separations are not specified, the distances required shall not be less than the distances required by Table 415.3.1.
Separation Distance

Fireworks Factory Fire
Separation Distance
§F911.1 General. Explosion control shall be provided in the following locations:

1. Where a structure, room or space is occupied for purposes involving explosion hazards as identified in Table F911.1.

2. Where quantities of hazardous materials specified in Table F911.1 exceed the maximum allowable quantities in Table F2703.1.1(1).

Explosion Testing
# Explosion Control

## Table 911.1

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>CLASS</th>
<th>Hazard Category</th>
<th>Explosion Control Requirements</th>
<th>Explosion (deflagration) venting or explosion (deflagration) prevention systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combustible dusts&lt;sup&gt;a&lt;/sup&gt;</td>
<td>—</td>
<td>—</td>
<td>Not required</td>
<td>Required</td>
</tr>
<tr>
<td>Cryogenic fluids</td>
<td>Flammable</td>
<td>—</td>
<td>Not required</td>
<td>Required</td>
</tr>
<tr>
<td>Explosives</td>
<td>Division 1.1</td>
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<td>Required</td>
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</tr>
<tr>
<td></td>
<td>Division 1.2</td>
<td>—</td>
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<td>Not required</td>
</tr>
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<td></td>
<td>Division 1.3</td>
<td>—</td>
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<td>Required</td>
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<td></td>
<td>Division 1.4</td>
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<tr>
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<td>Division 1.5</td>
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<td>Division 1.6</td>
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<td>Liquid</td>
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<td>Required</td>
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<td></td>
<td>IB&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>Required</td>
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<tr>
<td></td>
<td>I</td>
<td>—</td>
<td>Required</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Oxidizer liquids and solids</td>
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<td>—</td>
<td>Required</td>
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<tr>
<td>Prepolymer</td>
<td>Gas</td>
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<td>Not permitted</td>
</tr>
<tr>
<td></td>
<td>3 detonable</td>
<td>—</td>
<td>Required</td>
<td>Not permitted</td>
</tr>
<tr>
<td></td>
<td>3 non-detonable</td>
<td>—</td>
<td>Not required</td>
<td>Required</td>
</tr>
<tr>
<td>Water-reactive liquids and solids</td>
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<td>—</td>
<td>Not required</td>
<td>Required</td>
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<td></td>
<td>2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>—</td>
<td>Not required</td>
<td>Required</td>
</tr>
</tbody>
</table>

### Special Uses

- **Acetylene generator rooms**: — Not required Required
- **Grain processing**: — Not required Required
- **Liquefied petroleum gas distribution facilities**: — Not required Required
- **Where explosion hazards exist**: <sup>d</sup> Detonating Not required Required
  <sup>a</sup> Combustible dusts that are generated during manufacturing or processing. See definition of Combustible Dust in Chapter 2.
  <sup>b</sup> Storage or use.
  <sup>c</sup> In open use or dispensing.
  <sup>d</sup> Risk of containing dispensing and use of hazardous materials when an explosive environment can occur because of the characteristics or nature of the hazardous materials or as a result of the dispensing or use process.
  <sup>e</sup> A method of explosion control shall be provided on Class 2 water-reactive materials that can form potentially explosive mixtures.
Explosion Control
Explosion Control

§F911.2 Required deflagration venting. Areas that are required to be provided with deflagration venting shall comply with the following:

1. Walls, ceilings and roofs exposing surrounding areas shall be designed to resist a minimum internal pressure of 100 pounds per square foot (psf) (4788 Pa). The minimum internal design pressure shall not be less than five times the maximum internal relief pressure specified in §F911.2, Item 5.
2. Deflagration venting shall be provided only in exterior walls and roofs.

**Exception:** Where sufficient exterior wall and roof venting cannot be provided because of inadequate exterior wall or roof area, deflagration venting shall be allowed by specially designed shafts vented to the exterior of the building.

3. Deflagration venting shall be designed to prevent unacceptable structural damage. Where relieving a deflagration, vent closures shall not produce projectiles of sufficient velocity and mass to cause life threatening injuries to the occupants or other persons on the property or adjacent public ways.
4. The aggregate clear area of vents and venting devices shall be governed by the pressure resistance of the construction assemblies specified in Item 1 of this section and the maximum internal pressure allowed by Item 5 of this section.
5. Vents shall be designed to withstand loads in accordance with the *Building Code of New York State*. Vents shall consist of any one or any combination of the following to relieve at a maximum internal pressure of 20 pounds per square foot (958 Pa), but not less than the loads required by the *Building Code of New York State*:

5.1. Exterior walls designed to release outward.
5.2. Hatch covers.
5.3. Outward swinging doors.
5.4. Roofs designed to uplift.
5.5. Venting devices listed for the purpose.
6. Vents designed to release from the exterior walls or roofs of the building when venting a deflagration shall discharge directly to the exterior of the building where an unoccupied space not less than 50 feet (15 240 mm) in width is provided between the exterior walls of the building and the property line.

Exception: Vents complying with Item 7 of this section.
Explosion Control

7. Vents designed to remain attached to the building when venting a deflagration shall be so located that the discharge opening shall not be less than 10 feet (3048 mm) vertically from window openings and exits in the building and 20 feet (6096 mm) horizontally from exits in the building, from window openings and exits in adjacent buildings on the same property, and from the property line.

8. Discharge from vents shall not be into the interior of the building.
Explosion Control

Other considerations:

• FM Data Sheet 1-44
• Environment
• Obstructions
§F2704.2.1 Spill control for hazardous material liquids. Rooms, buildings or areas used for the storage of hazardous material liquids in individual vessels having a capacity of more than 55 gallons (208 L), or in which the aggregate capacity of multiple vessels exceeds 1,000 gallons (3785 L), shall be provided with spill control to prevent the flow of liquids to adjoining areas. Floors in indoor locations and similar surfaces in outdoor locations shall be constructed to contain a spill from the largest single vessel by one of the following methods:

1. Liquid-tight sloped or recessed floors in indoor locations or similar areas in outdoor locations.
2. Liquid-tight floors in indoor locations or similar areas in outdoor locations provided with liquid-tight raised or recessed sills or dikes.
3. Sumps and collection systems.
4. Other approved engineered systems.
Spill Control and Secondary Containment

Texas Chemical Fire
## Spill Control and Secondary Containment

### Table 2704.2.2

**Required Secondary Containment—Hazardous Material Solids and Liquids Storage**

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>INDOOR STORAGE</th>
<th>OUTDOOR STORAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Solids</td>
<td>Liquids</td>
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<td><strong>1. Physical-hazard materials</strong></td>
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<td>Combustible liquids</td>
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<td>Class II</td>
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<td>See Chapter 34</td>
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<tr>
<td>Class IIIA</td>
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<td>See Chapter 34</td>
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<td>Class IIIB</td>
<td>See Chapter 32</td>
<td>See Chapter 32</td>
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<td>Cryogenic fluids</td>
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<td>Explosives</td>
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<td></td>
</tr>
<tr>
<td>Class IA</td>
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<td>See Chapter 34</td>
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<tr>
<td>Class IB</td>
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<td>See Chapter 34</td>
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<tr>
<td>Class IC</td>
<td>See Chapter 34</td>
<td>See Chapter 34</td>
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<td>Flammable solids</td>
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<td>Unclassified Detonable</td>
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<td>Class I</td>
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<tr>
<td>Class II</td>
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<td>Class V</td>
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<tr>
<td>Class 2</td>
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<tr>
<td>Unstable (reactives)</td>
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<tr>
<td>Toxics</td>
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</tbody>
</table>
Spill Control and Secondary Containment
§F2704.3 **Ventilation.** Indoor storage areas and storage buildings shall be provided with mechanical exhaust ventilation or natural ventilation where natural ventilation can be shown to be acceptable for the materials as stored.

**Exception:** Storage areas for flammable solids complying with Chapter F36.
§F2704.3.1 System requirements. Exhaust ventilation systems shall comply with all of the following:

1. Installation shall be in accordance with the *Mechanical Code of New York State*.

2. Mechanical ventilation shall be at a rate of not less than 1 cubic foot per minute per square foot \([0.00508 \text{ m}^3/(\text{s} \cdot \text{m}^2)]\) of floor area over the storage area.

3. Systems shall operate continuously unless alternative designs are approved.

4. A manual shutoff control shall be provided outside of the room in a position adjacent to the access door to the room or in an approved location. The switch shall be a break-glass or other approved type and shall be labeled: VENTILATION SYSTEM EMERGENCY SHUTOFF.
5. Exhaust ventilation shall be designed to consider the density of the potential fumes or vapors released. For fumes or vapors that are heavier than air, exhaust shall be taken from a point within 12 inches (305 mm) of the floor. For fumes or vapors that are lighter than air, exhaust shall be taken from a point within 12 inches (305 mm) of the highest point of the room.

6. The location of both the exhaust and inlet air openings shall be designed to provide air movement across all portions of the floor or room to prevent the accumulation of vapors.

7. Exhaust air shall not be recirculated to occupied areas if the materials stored are capable of emitting hazardous vapors and contaminants have not been removed. Air-contaminated with explosive or flammable vapors, fumes or dusts; flammable, highly toxic or toxic gases; or radioactive materials shall not be recirculated.
§F2705.1.9 Ventilation. Indoor dispensing and use areas shall be provided with exhaust ventilation in accordance with §F2704.3.

Exception: Ventilation is not required for dispensing and use of flammable solids other than finely divided particles.
§F2704.7 Standby or emergency power. Where mechanical ventilation, treatment systems, temperature control, alarm, detection or other electrically operated systems are required, such systems shall be provided with an emergency or standby power system in accordance with Chapter 27 of the Building Code of New York State and §F604.

Exceptions:
1. Storage areas for Class 1 and 2 oxidizers.

2. Storage areas for Class III, IV and V organic peroxides.

3. For storage areas for highly toxic or toxic materials, see §F3704.2.2.8 and §F3704.3.2.6.

4. Standby power for mechanical ventilation, treatment systems and temperature control systems shall not be required where an approved fail-safe engineered system is installed.
§F2705.1.5 Standby or emergency power. Where mechanical ventilation, treatment systems, temperature control, manual alarm, detection or other electrically operated systems are required, such systems shall be provided with an emergency or standby power system in accordance with Chapter 27 of the Building Code of New York State and §F604.

Exceptions:

1. Standby power for mechanical ventilation, treatment systems and temperature control systems shall not be required where an approved fail-safe engineered system is installed.

2. Systems for highly toxic or toxic gases shall be provided with emergency power in accordance with §F3704.2.2.8 and F3704.3.2.6.
Separation of Incompatible Material

§F2703.9.8 Separation of incompatible materials. Incompatible materials in storage and storage of materials that are incompatible with materials in use shall be separated when the stored materials are in containers having a capacity of more than 5 pounds (2 kg) or 0.5 gallon (2 L). Separation shall be accomplished by:

1. Segregating incompatible materials in storage by a distance of not less than 20 feet (6096 mm).

2. Isolating incompatible materials in storage by a noncombustible partition extending not less than 18 inches (457 mm) above and to the sides of the stored material.

3. Storing liquid and solid materials in hazardous material storage cabinets.

4. Storing compressed gases in gas cabinets or exhausted enclosures in accordance with §F2703.8.5 and §F2703.8.6. Materials that are incompatible shall not be stored within the same cabinet or exhausted enclosure.
§F2703.2.8 Seismic protection. Machinery and equipment utilizing hazardous materials shall be braced and anchored in accordance with the seismic design requirements of the Building Code of New York State for the seismic design category in which the machinery or equipment is classified.
§F2703.9.5 Static accumulation. When processes or conditions exist where a flammable mixture could be ignited by static electricity, means shall be provided to prevent the accumulation of a static charge.

References:

- NFPA 70
- NFPA 77
§F2703.9.6 Protection from light. Materials that are sensitive to light shall be stored in containers designed to protect them from such exposure.

Examples:
- Chloroform
- Tetrahydrofuran
- Ketones
- Anhydrides
§F2703.9.7 Shock padding. Materials that are shock sensitive shall be padded, suspended or otherwise protected against accidental dislodgement and dislodgement during seismic activity.

- Mostly explosive materials
- Shock is not just seismic
Handling

• to engage in the buying, selling, or distributing of (a commodity)

• OSHA Standards
  – Where mechanical handling equipment is used, sufficient safe clearances shall be allowed for aisles – OSHA 1910.176
  – Housekeeping. Storage areas shall be kept free from accumulation of materials that constitute hazards from tripping, fire, explosion, or pest harborage – OSHA 1910.176
  – Storage of material shall not create a hazard. Bags, containers, bundles, etc., stored in tiers shall be stacked, blocked, interlocked and limited in height so that they are stable and secure against sliding or collapse – OSHA 1910.176
  – All flammable and combustible materials are labeled with their proper name and warnings - OSHA 29 CFR 1910.1200(f)(1); OSHA 29 CFR 1910.106(a)(13)
Handling

• OSHA Standards cont...
  – All gas cylinders are being stored in the up-right position using with the wall supported storage technique (supported or strapped to the wall) or the nested storage technique (a rack or cage where the cylinder is stored). - OSHA 29 CFR 1910.101(b); CGA 3.4.4; CGA Pamphlet P-1-1965; OSHA 29 CFR 1926.360(a)(9); CGA Pamphlet P-1-2006;
  – A 36 inch clearance is maintained around electrical panels. OSHA 29 CFR 1910.303 (g)(1)(vi)(B)
  – When a powered industrial truck is left unattended the forks are fully lowered, controls are be neutralized, power is shut off, and brakes set. OSHA 29 CFR 1910.178(m)(5)(i)
  – Flammable and oxidizing gases must be stored at least 20 ft apart from each other. CGA 3.5.3; OSHA 29 CFR 1926.350(a)(10); NFPA 55 – 2-1.6.3(e)(1)
Examples

- **E. I. DuPont De Nemours Co. Fatal Hotwork Explosion**
  - hot sparks ignited flammable vapors inside the tank

- **Hoeganaes Corporation Fatal Flash Fires**
  - Combustible Dust Explosion and Fire

- **Veolia Environmental Services Flammable Vapor Explosion and Fire**
  - uncontrolled venting allowed vapors to accumulate to explosive concentrations outside process equipment. Inadequate Class I Div I electrical equipment radius near source.

- **Kleen Energy Natural Gas Explosion**
  - To remove the debris, workers used natural gas at a high pressure of approximately 650 pounds per square inch. The high velocity of the natural gas flow was intended to remove any debris in the new piping. During this process, the natural gas found an ignition source and exploded.

- **Catalyst Systems Inc. Reactive Chemical Explosion**
  - Organic peroxides may be thermally unstable and sensitive to shock, impact, and friction. Benzoyl Peroxide likely ignited when temperature probe failed, and material was overheated and reached thermal decomposition temperature.
Questions

• What provides superior means for power: standby or emergency power?
• Minimum separation of incompatible materials in feet?
• Where mechanical handling equipment is used, sufficient safe clearances shall be allowed for ______?