FLAMMABLE AND COMBUSTIBLE LIQUIDS

- CODE AND PRACTICE -

For the Illinois Fire Inspectors Association

March 28, 2014

Presented by:

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LEARNING OBJECTIVES

1. Gain basic knowledge about flammable and combustible materials in use and storage from the IBC, IFC, and NFPA 30.

2. Understand the four step technique for assessing flammable and combustible liquids.

3. Review containers, storage, ignition control, bonding, grounding, and fire protection methods.

4. Learn from example situations.

PRESENTATION OUTLINE

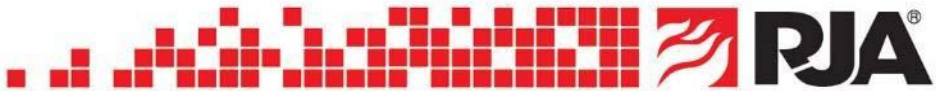
- PART 1 – CODE
  - Steps to Assessing Materials
  - Containers and Storage Arrangements
  - Determining MAQ's and Control Areas
  - Occupancy Classifications
  - Hazard Communication
  - Bonding and Grounding
  - Spill Control and Containment
  - Fire Protection
  - Explosion Prevention and Venting

PRESENTATION OUTLINE

- PART 2 – PRACTICE
  - What to Ask
  - Examples

PART 1

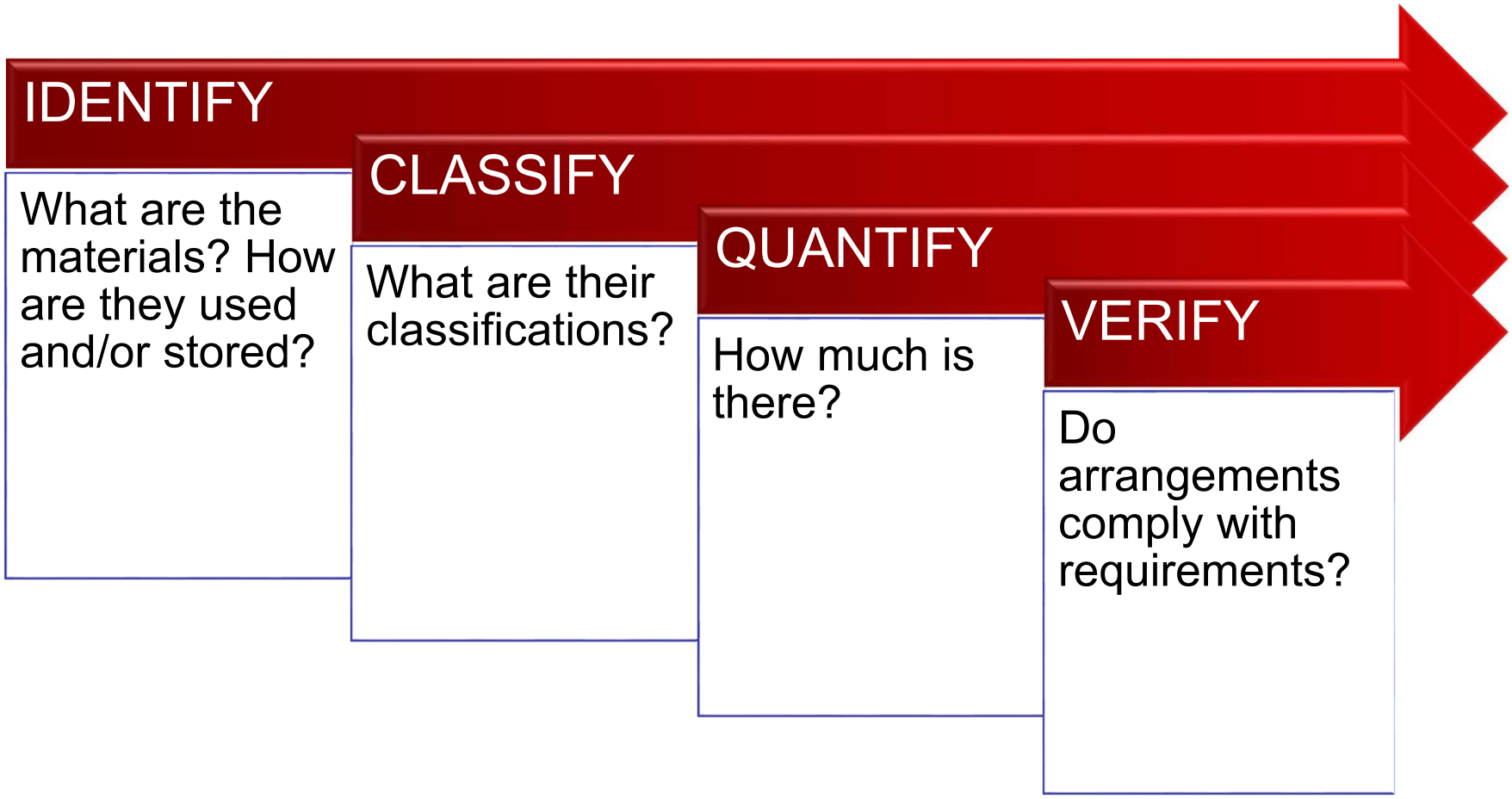
CODE



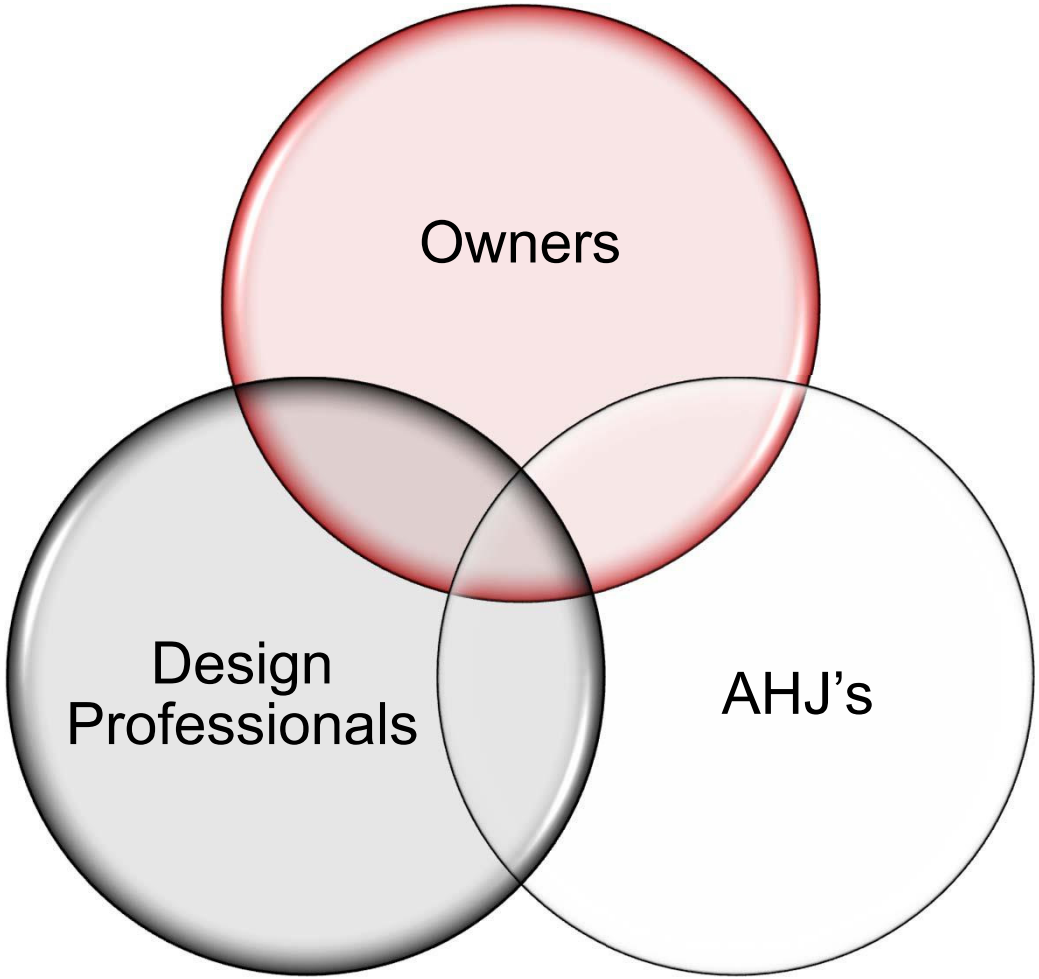
FLAMMABLE AND COMBUSTIBLE MATERIALS…WHERE ARE THEY?

- Elementary and high schools
- Universities
- Sporting goods stores
- Warehouses
- Factories and industrial
- Laboratories
- Hospitals and clinics
- Mercantile
- Office buildings
- Dry cleaning
- Garden centers
- Semiconductor fabrication
- Storage facilities
- Tank farms
- Waste collection facilities
- Welding shops
- Repair garages
- Service stations
- Home improvement stores
- Pools
- Agriculture

STEPS TO ASSESSING FLAMMABLE AND COMBUSTIBLE LIQUIDS



WHO USES THESE STEPS?



STEP 1

IDENTIFY

WHERE DO YOU FIND FLAMMABLE AND COMBUSTIBLE LIQUIDS?

- Small and large containers
- Loading docks
- Shipping and receiving
- Storage rooms
- Shelving
- Tanks
- Drums
- Process areas
- And more…

FLASH POINT

- **Definition of Flash Point**

  Temperature a liquid will give off sufficient vapors to form an ignitable mixture with air near the surface or in the container, but will not sustain combustion.

- **Flammable Liquid**

  Flash Point <100°F

- **Combustible Liquid**

  Flash Point >100°F

CONTAINERS

- **Non-bulk container:** less than or equal to 119 gallons

- **Intermediate bulk container:** 119 up to 793 gallons

- **Bulk container:** greater than 793 gallons

STORAGE ARRANGEMENT

STORAGE ARRANGEMENT

STORAGE ARRANGEMENT

STORAGE ARRANGEMENT

STEP 2

CLASSIFY

FLAMMABLE OR COMBUSTIBLE?

FLAMMABLE CLASSIFICATION	FLASH POINT	BOILING POINT
Class IA	< 73° F	< 100° F
Class IB	< 73° F	≥ 100° F
Class IC	≥ 73° F	< 100° F

COMBUSTIBLE CLASSIFICATION	FLASH POINT	BOILING POINT
Class II	≥ 100° F and < 140° F	N/A
Class IIIA	≥ 140° F and < 200° F	N/A
Class IIIB	≥ 200° F	N/A

(IFC 3402.1 & NFPA 30, 1.7)

EXAMPLES

- **Flammable Liquids:**
  - **Class IA:** Acetaldehyde, diethyl ether, pentane, petroleum ether, propylene oxide, vinyl chloride
  - **Class IB:** Acetone, ethyl alcohol, gasoline, isopropyl alcohol, lacquer thinner, methanol
  - **Class IC:** Amyl acetate, isobutyl alcohol, mineral spirits, turpentine, xylene

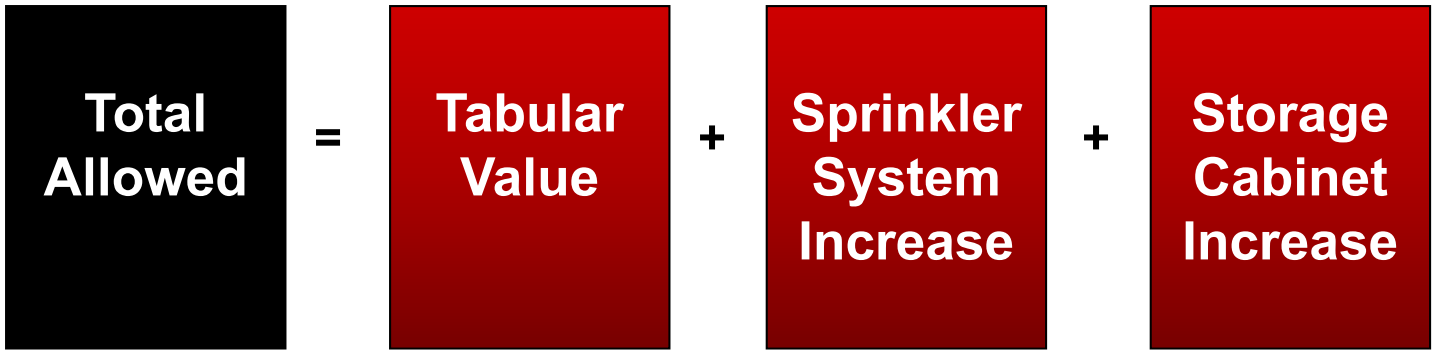
EXAMPLES

- **Combustible Liquids:**
  - **Class II:** Diesel fuel, Jet Fuel A, kerosene, mineral spirits, No.2 fuel oil (home heating oil)
  - **Class IIIA:** No.4 and No.6 fuel oils
  - **Class IIIB:** Cooking oils, lubricants, motor oils

STEP 3

QUANTIFY

DETERMINING MAQ



Example: Determine the Total Allowed per Control Area for Flammable Liquid Class IA.

- **Tabular Value:** IFC Table 2703.1.1(1)
- **Sprinkler Increase:** 100% of Tabular Value (Note d)
- **Storage Cabinet Increase:** additional 100% (Note e)

MAQ EXAMPLE

TABLE 2703.1.1(1)
MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD[a, j, m, n, p]

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED	STORAGE[b]			USE-CLOSED SYSTEMS[b]			USE-OPEN SYSTEMS[b]	
			Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas cubic feet at NTP	Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas cubic feet at NTP	Solid pounds (cubic feet)	Liquid gallons (pounds)
Combustible liquid[q, i]	II IIIA IIIB	H-2 or H-3 H-2 or H-3 Not Applicable	Not Applicable	120[d, e] 330[d, e] 13,200[e, f]	Not Applicable	Not Applicable	120[d] 330[d] 13,200[f]	Not Applicable	Not Applicable	30[d] 80[d] 3,300[f]
Combustible fiber	Loose Baled[o]	H-3	(100) (1,000)	Not Applicable	Not Applicable	(100) (1,000)	Not Applicable	Not Applicable	(20) (200)	Not Applicable
Cryogenic Flammable	Not Applicable	H-2	Not Applicable	45[d]	Not Applicable	Not Applicable	45[d]	Not Applicable	Not Applicable	10[d]
Consumer fireworks (Class C Common)	1.4G	H-3	125[d, e, l]	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Cryogenic Oxidizing	Not Applicable	H-3	Not Applicable	45[d]	Not Applicable	Not Applicable	45[d]	Not Applicable	Not Applicable	10[d]
Explosives	Division 1.1 Division 1.2 Division 1.3 Division 1.4 Division 1.4G Division 1.5 Division 1.6	H-1 H-1 H-1 or H-2 H-3 H-3 H-1 H-1	1[e, g] 1[e, g] 5[e, g] 50[e, g] 125[d, e, l] 1[e, g] 1[d, e, g]	(1)[e, g] (1)[e, g] (5)[e, g] (50)[e, g] Not Applicable (1)[e, g] Not Applicable	Not Applicable	0.25[g] 0.25[g] 1[g] 50[g] Not Applicable 0.25[g] Not Applicable	(0.25)[g] (0.25)[g] (1)[g] (50)[g] Not Applicable (0.25)[g] Not Applicable	Not Applicable	0.25[g] 0.25[g] 1[g] Not Applicable Not Applicable 0.25[g] Not Applicable	(0.25)[g] (0.25)[g] (1)[g] Not Applicable Not Applicable (0.25)[g] Not Applicable
Flammable gas	Gaseous Liquefied	H-2	Not Applicable	Not Applicable	1,000[d, e] Not Applicable	Not Applicable	Not Applicable	1,000[d, e] Not Applicable	Not Applicable	Not Applicable
Flammable liquids[c]	IA IB and IC	H-2 or H-3	Not Applicable	30[d, e] 120[d, e]	Not Applicable	Not Applicable	30[d] 120[d]	Not Applicable	Not Applicable	10[d] 30[d]
Combination Flammable liquid (IA, IB, IC)	Not Applicable	H-2 or H-3	Not Applicable	120[d, e, h]	Not Applicable	Not Applicable	120[d, h]	Not Applicable	Not Applicable	30[d, h]
Flammable solid	Not Applicable	H-3	125[d, e]	Not Applicable	Not Applicable	125[d]	Not Applicable	Not Applicable	25[d]	Not Applicable
Organic peroxide	UD I II III IV V	H-1 H-2 H-3 H-3 Not Applicable Not Applicable	1[e, g] 5[d, e] 50[d, e] 125[d, e] Not Limited Not Limited	(1)[e, g] (5)[d, e] (50)[d, e] (125)[d, e] Not Limited Not Limited	Not Applicable	0.25[g] 1[d] 50[d] 125[d] Not Limited Not Limited	(0.25)[g] (1)[d] (50)[d] (125)[d] Not Limited Not Limited	Not Applicable	0.25[g] 1[d] 10[d] 25[d] Not Limited Not Limited	(0.25)[g] (1)[d] (10)[d] (25)[d] Not Limited Not Limited

(continued)

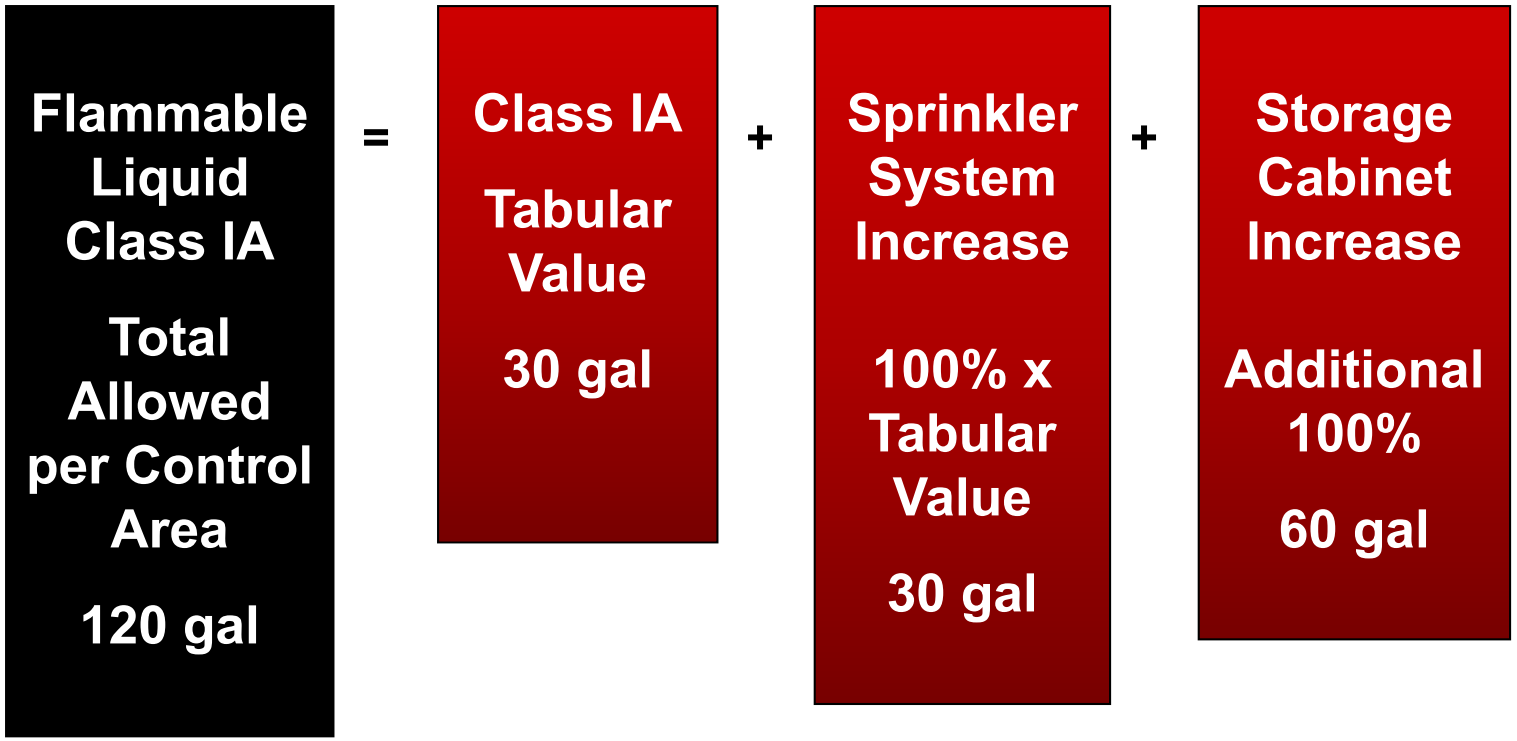
IFC Table 2703.1.1(1)

Slide 23

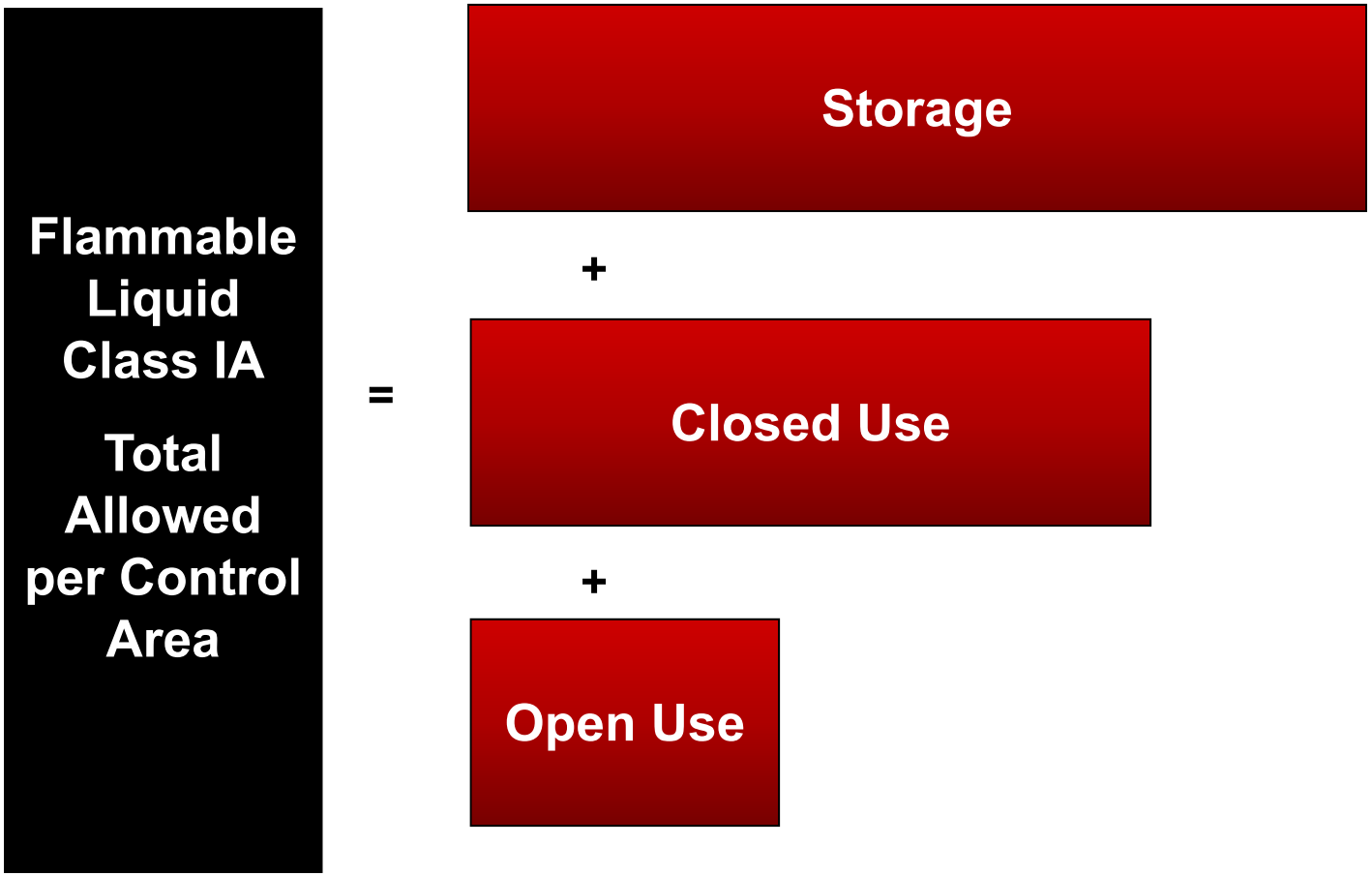
MJ3 References unverified...

Mammoser, John, 3/18/2014

MAQ EXAMPLE


Flammable Liquid Class IA
Total Allowed per Control Area
120 gal
=
Class IA
Tabular Value
30 gal
+
Sprinkler System Increase
100% x Tabular Value
30 gal
+
Storage Cabinet Increase
Additional 100%
60 gal

MAQ EXAMPLE (CONT.)



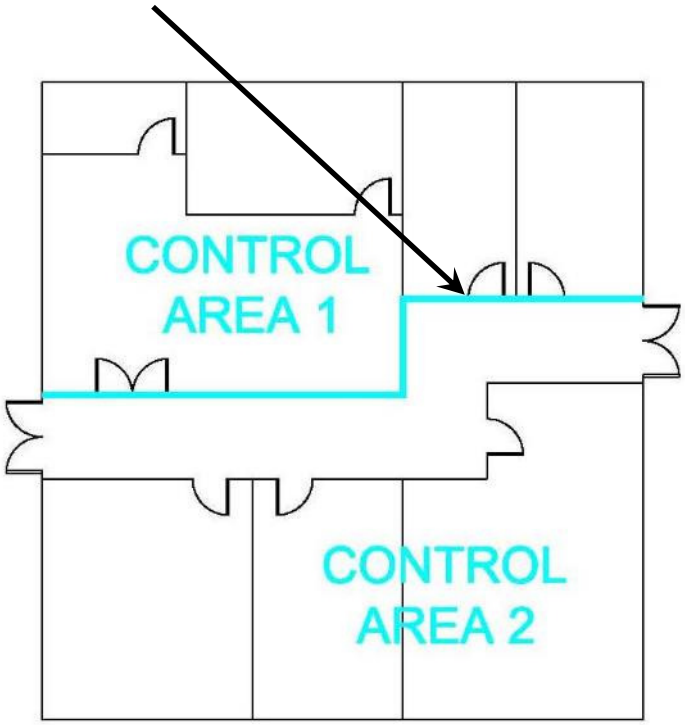
CONTROL AREAS

- **Control Area:** Spaces where quantities of hazardous materials less than the maximum allowable quantities per control area are stored, dispensed, used or handled.
  - Permitted to include offices, restrooms, corridors or other contiguous rooms
  - Permitted to be the entire floor of a building
  - Permitted to be an entire building
  - Vertical control areas

(IFC 2702.1)

MULTIPLE CONTROL AREAS

Fire-resistance rated separation required.



- Only a certain **number of control areas** are permitted per floor based on the level above ground.
- Each of the control areas required to comply with the requirements for **maximum allowed quantity** of hazardous materials allowed.

NUMBER OF CONTROL AREAS

Automatic Fire Sprinkler System Provided	Number Permitted	% of MAQ Permitted	Size Allowed (IFC)
Greater than Level 9	1	5% of Total Allowed	Unlimited except for > 2 levels below grade
Level 7 – 9	2	12.5% of Total Allowed	
Level 4 – 6	2	12.5% of Total Allowed	
Level 3	2	50% of Total Allowed	
Level 2	3	75% of Total Allowed	
Level 1	4	100% of Total Allowed	
1 Level Below Grade	3	75% of Total Allowed	
2 Levels Below Grade	2	50% of Total Allowed	
Lower than 2 Levels Below Grade	Not Permitted	Not Permitted	

CONTROL AREA SEPARATION

Automatic Fire Sprinkler System Provided	Floor Construction	Wall Separation
Greater than Level 9	2-hr fire rated	2-hr fire rated
Level 7 – 9		2-hr fire rated
Level 4 – 6		2-hr fire rated
Level 3	2-HR fire-resistance rated or 1-HR fire-resistance rated in Type IIA, IIIA and VA buildings 3 stories or less with automatic sprinkler system	1-hr fire rated
Level 2		1-hr fire rated
Level 1		1-hr fire rated
1 Level Below Grade		1-hr fire rated
2 Levels Below Grade		1-hr fire rated
Lower than 2 Levels Below Grade	Not Permitted	Not Permitted

MAQ EXAMPLE

Quantity of Hazardous Materials Permitted	
Automatic Fire Sprinkler System Provided	Control Areas (IBC & IFC)
Greater than Level 9	5% of Total Allowed
Level 7 – 9	12.5% of Total Allowed
Level 4 – 6	12.5% of Total Allowed
Level 3	50% of Total Allowed
Level 2	75% of Total Allowed
Level 1	100% of Total Allowed
1 Level Below Grade	75% of Total Allowed
2 Levels Below Grade	50% of Total Allowed
Lower than 2 Levels Below Grade	Not Permitted

Flammable Liquid Class IA

Total Allowed per Control Area

120 gal

If Control Area is located on Level 2:

Total Quantity Permitted = 120 gal x 75% = 90 gal

If Control Area is located on Level 4 – 9:

Total Quantity Permitted = 120 gal x 12.5% = 15 gal

TOO MUCH?

- What happens if quantity stored and/or in use is greater than MAQ?

Hazardous Occupancy (Group H)

CHANGE IN OCCUPANCY

Hazardous Occupancy (Group H)

Change in occupancy to include Group H effects:

- Height and area
- Mixed occupancy buildings
- Egress requirements
- Fire-resistant rated separations
- Fire protection systems
- Explosion venting
- Explosion prevention
- And more…

NOT HAZARDOUS OCCUPANCY

- Not classified as Group H, but classified in the occupancy that they most nearly resemble (IBC 307.1):
  - Buildings that contain less than the MAQ's per control area
  - Buildings that use control areas and limit the quantities below MAQ's per control area
  - Buildings occupied for the application of flammable finishes
  - Wholesale and retail sales and storage of flammable and combustible liquids

NOT HAZARDOUS OCCUPANCY (CONT.)

- Not classified as Group H, but classified in the occupancy that they most nearly resemble (IBC 307.1):
  - Closed piping systems for the operation of machinery or equipment
  - Cleaning establishments using closed systems and separated by 1-hour fire-resistance rated construction
  - Liquor stores or distributors without bulk storage
  - Refrigeration systems
  - Use of materials for agricultural purposes on the premises

10 MINUTE

BREAK

STEP 4

VERIFY

HAZARDOUS OCCUPANCY DEFINITIONS

- Group H-1: detonation hazard
- Group H-2: deflagration hazard
- Group H-3: support combustion or physical hazard
- Group H-4: health hazard
- Group H-5: semiconductor fabrication

GROUP H-2

- Class I, II or IIIA flammable or combustible liquids:
  - Used/stored open, or stored closed **>15 psig**

- Other:
  - Combustible dusts, flammable cryogenic fluids, flammable gases, Class I organic peroxides, non-detonable Class 3 unstable (reactive), Class 3 water reactive
  - Class 3 oxidizers used/stored open or stored closed >15psig
  - Non-detonable pyrophoric liquids solids and gases

GROUP H-3

- Class I, II or IIIA flammable or combustible liquids and flammable solids:
  - Used/stored closed **<15 psig**

- Other
  - Combustible fibers, consumer fireworks, oxidizing cryogenic fluids, Class II and III organic peroxides, Class 2 and Class 3 oxidizers, oxidizing gases, Class 2 unstable (reactive), Class 2 water-reactive

HAZARDOUS OCCUPANCIES

- Location on property:
  - Located on perimeter of building
    - Minimum 25% exterior walls
    - Some exceptions based on size of room
  - Rating of exterior walls based on property line distance
  - Challenge with mixed occupancy buildings.

(IBC 415.3)

LIQUID STORAGE ROOMS

- Liquids Storage Room
  - Quantity limits
    (IFC Table 3404.3.6.3(2), (3))
  - Spill control, secondary containment
  - Ventilation
  - Fire suppression
- Prefab Storage Rooms

LIQUID STORAGE ROOMS (CONT.)

LIQUID STORAGE ROOMS (CONT.)

IFC TABLE 3404.3.6.3(2)

TABLE 3404.3.6.3(2)
STORAGE ARRANGEMENTS FOR PALLETIZED OR SOLID-PILE STORAGE IN LIQUID STORAGE ROOMS AND WAREHOUSES

CLASS	STORAGE LEVEL	MAXIMUM STORAGE HEIGHT			MAXIMUM QUANTITY PER PILE (gallons)		MAXIMUM QUANTITY PER ROOM[a] (gallons)	
		Drums	Containers[b] (feet)	Portable tanks[b] (feet)	Containers	Portable tanks	Containers	Portable tanks
IA	Ground floor	1	5	Not Allowed	3,000	Not Allowed	12,000	Not Allowed
	Upper floors	1	5	Not Allowed	2,000	Not Allowed	8,000	Not Allowed
	Basements	0	Not Allowed	Not Allowed	Not Allowed	Not Allowed	Not Allowed	Not Allowed
IB	Ground floor	1	6.5	7	5,000	20,000	15,000	40,000
	Upper floors	1	6.5	7	3,000	10,000	12,000	20,000
	Basements	0	Not Allowed	Not Allowed	Not Allowed	Not Allowed	Not Allowed	Not Allowed
IC	Ground floor[d]	1	6.5[c]	7	5,000	20,000	15,000	40,000
	Upper floors	1	6.5[c]	7	3,000	10,000	12,000	20,000
	Basements	0	Not Allowed	Not Allowed	Not Allowed	Not Allowed	Not Allowed	Not Allowed
II	Ground floor[d]	3	10	14	10,000	40,000	25,000	80,000
	Upper floors	3	10	14	10,000	40,000	25,000	80,000
	Basements	1	5	7	7,500	20,000	7,500	20,000
III	Ground floor	5	20	14	15,000	60,000	50,000	100,000
	Upper floors	5	20	14	15,000	60,000	50,000	100,000
	Basements	3	10	7	10,000	20,000	25,000	40,000

For SI: 1 foot = 304.8 mm, 1 gallon = 3.785 L.

a. See Section 3404.3.8.1 for unlimited quantities in liquid storage warehouses.

b. In buildings protected by an automatic sprinkler system, the storage height for containers and portable tanks shall not exceed the maximum storage height permitted for the fire protection scheme set forth in NFPA 30 or the maximum storage height demonstrated in a full-scale fire test, whichever is greater. NFPA 30 criteria and fire test results for metallic containers and portable tanks shall not be applied to nonmetallic containers and portable tanks.

c. These height limitations are allowed to be increased to 10 feet for containers having a capacity of 5 gallons or less.

d. For palletized storage of unsaturated polyester resins (UPR) in relieving-style metal containers with 50 percent or less by weight Class IC or II liquid and no Class IA or IB liquid, height and pile quantity limits shall be permitted to be 10 feet and 15,000 gallons, respectively, provided that such storage is protected by sprinklers in accordance with NFPA 30 and that the UPR storage area is not located in the same containment area or drainage path for other Class I or II liquids.

IFC TABLE 3404.3.6.3(3)

TABLE 3404.3.6.3(3)
STORAGE ARRANGEMENTS FOR RACK STORAGE IN LIQUID STORAGE ROOMS AND WAREHOUSES

CLASS	TYPE RACK	STORAGE LEVEL	MAXIMUM STORAGE HEIGHT (feet)[b]	MAXIMUM QUANTITY PER ROOM[a] (gallons)
			Containers	Containers
IA	Double row or Single row	Ground floor Upper floors Basements	25 15 Not Allowed	7,500 4,500 Not Allowed
IB IC	Double row or Single row	Ground floor Upper floors Basements	25 15 Not Allowed	15,000 9,000 Not Allowed
II	Double row or Single row	Ground floor Upper floors Basements	25 25 15	24,000 24,000 9,000
III	Multirow Double row Single row	Ground floor Upper floors Basements	40 20 20	48,000 48,000 24,000

For SI: 1 foot = 304.8 mm, 1 gallon = 3.785 L.

a. See Section 3404.3.8.1 for unlimited quantities in liquid storage warehouses.

b. In buildings protected by an automatic sprinkler system, the storage height for containers and portable tanks shall not exceed the maximum storage height permitted for the fire protection scheme set forth in NFPA 30 or the maximum storage height demonstrated in a full-scale fire test, whichever is greater. NFPA 30 criteria and fire test results for metallic containers and portable tanks shall not be applied to nonmetallic containers and portable tanks.

LIQUID STORAGE WAREHOUSE

- Liquids Storage Warehouse
  - Unlimited size
  - Unlimited quantity
  - Spill control, secondary containment
  - Ventilation
  - Fire suppression

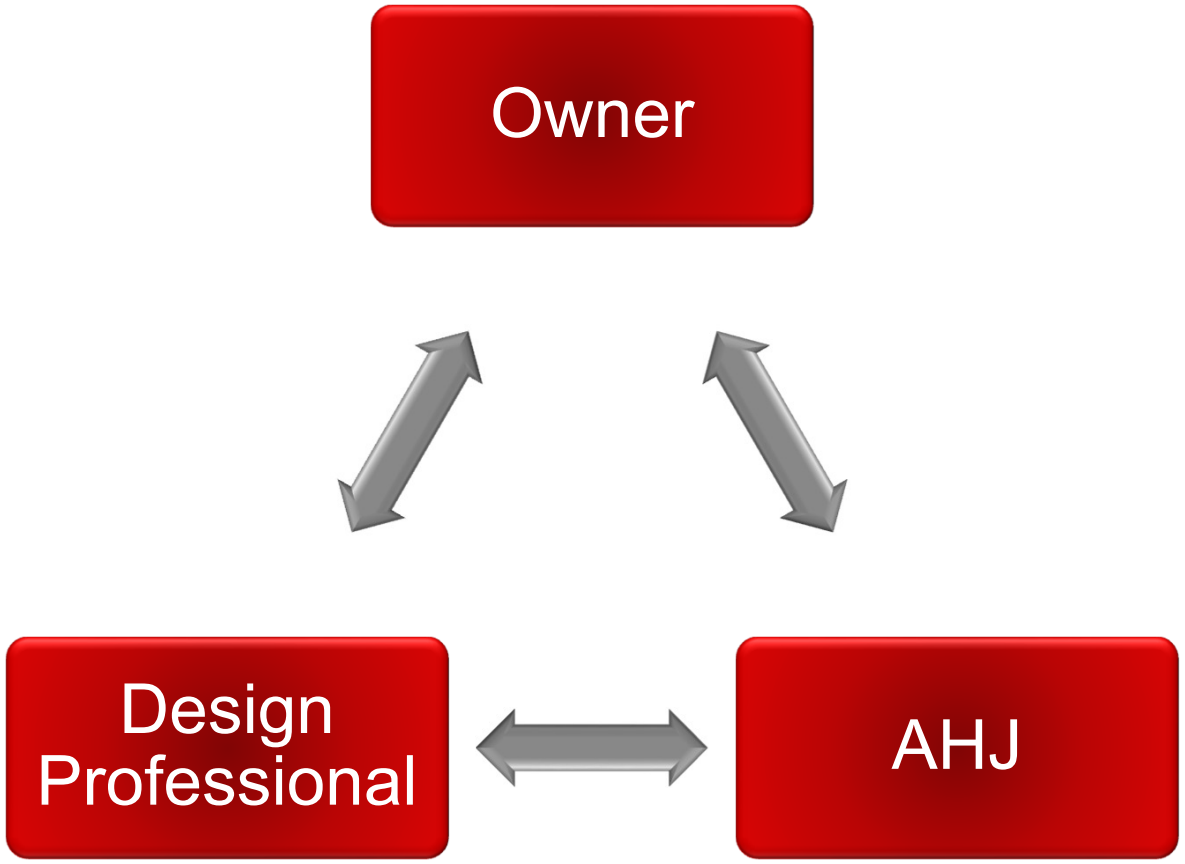
USE WITHIN A BUILDING

- Dispensing, Use, Mixing, Handling inside of a building:
  - Open or Closed use in excess of MAQ's
    - H-2 or H-3 (IFC 3405.3.7.1)
    - Not permitted in basements
    - Requires Ventilation
    - Explosion Control
    - Spill and Secondary Containment

HAZARD COMMUNICATION

- Communication guidelines from IFC Section 407:
  - Safety Data Sheets (SDS)
  - Identification
  - Hazardous Materials Inventory Statement
  - Hazardous Materials Management Plan

WHO'S RESPONSIBLE FOR HAZARD COMMUNICATION?



SAFETY DATA SHEETS

- Safety Data Sheets (SDS)
  - Formerly MSDS
  - New terminology starting in June 2016
  - Must be readably available
  - SDS for each hazardous material
  - Also required by OSHA
  - Submit SDS during permitting process

IDENTIFICATION

- Display of NFPA 704 Diamond
  - Flammable
  - Health
  - Instability
  - Specific Hazard

- Labeling of containers

- Identification signs for rooms and buildings

HAZARDOUS MATERIALS INVENTORY STATEMENT

- Hazardous Materials Inventory Statement (HMIS)
  - Communicates relevant information regarding the materials in the facility (IFC 2701.5.2).

- Smaller facilities:
  - Owner's description or narrative
  - More typical for small facilities with limited use

HAZARDOUS MATERIALS INVENTORY STATEMENT (CONT.)

- Larger facilities:
  - Superfund Amendments and Reauthorization Act (SARA)
    - Required to comply with federal regulations
    - Applicable to larger facilities and high environmental impact

WHAT DOES HMIS INCLUDE?

- HMIS required to include the following for each material:
  - Manufacturer's name
  - Chemical name, trade name, hazardous ingredients
  - Hazard classification (IFC category and class)
  - SDS or equivalent
  - United Nations (UN), North America (NA) or the Chemical Abstract Service (CAS) identification number
  - Maximum quantity used or stored at one time
  - Storage conditions

HAZARDOUS MATERIALS MANAGEMENT PLAN

- Hazardous Materials Management Plan (HMMP)
  - Communicates the operation and fire fighting procedures for the facility. (IFC 2701.5.1)

- Important to have discussions with local fire departments about their equipment and training to fight a fire at these locations.

WHAT DOES HMMP INCLUDE?

- HMMP is required to include the following:
  - Storage and use areas with arrangement
  - Maximum amount of storage or use
  - Container sizes
  - Location of emergency isolation and mitigation valves and devices
  - Piping conveying hazardous materials
  - Normal conditions for valves (on/off)
  - Location and type of emergency equipment

IGNITION CONTROL

- Open flames
- Lighting
- Hot Surfaces
- Radiant heat
- Smoking
- Cutting and welding
- Spontaneous ignition
- Static electricity
- Friction heat or sparks
- Electrical sparks
- Stray currents
- Ovens, furnaces, and heating equipment.

HAZARDOUS LOCATIONS PER NEC

- NFPA 70, National Electrical Code (NEC)
- NEC definition of hazardous area:
  - where fire or explosion hazards may exist due to flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings.
- Articles 500 – 504, and 510 – 517 provide classification and installation standards for the use of electrical equipment in these locations.

HAZARDOUS LOCATIONS – CLASS I

- **Class I Hazardous Location:**
  - Flammable gases or vapors may be present in the air in sufficient quantities to be explosive or ignitable.

- Some typical Class I locations are:
  - Petroleum refineries, and gasoline storage and dispensing areas;
  - Dry cleaning plants where vapors from cleaning fluids can be present;
  - Spray finishing areas;
  - Aircraft hangars and fuel servicing areas; and
  - Utility gas plants, and operations involving storage and handling of liquified petroleum gas or natural gas.

HAZARDOUS LOCATIONS – CLASS II

- **Class II Hazardous Location:**
  - Presence of combustible dusts.

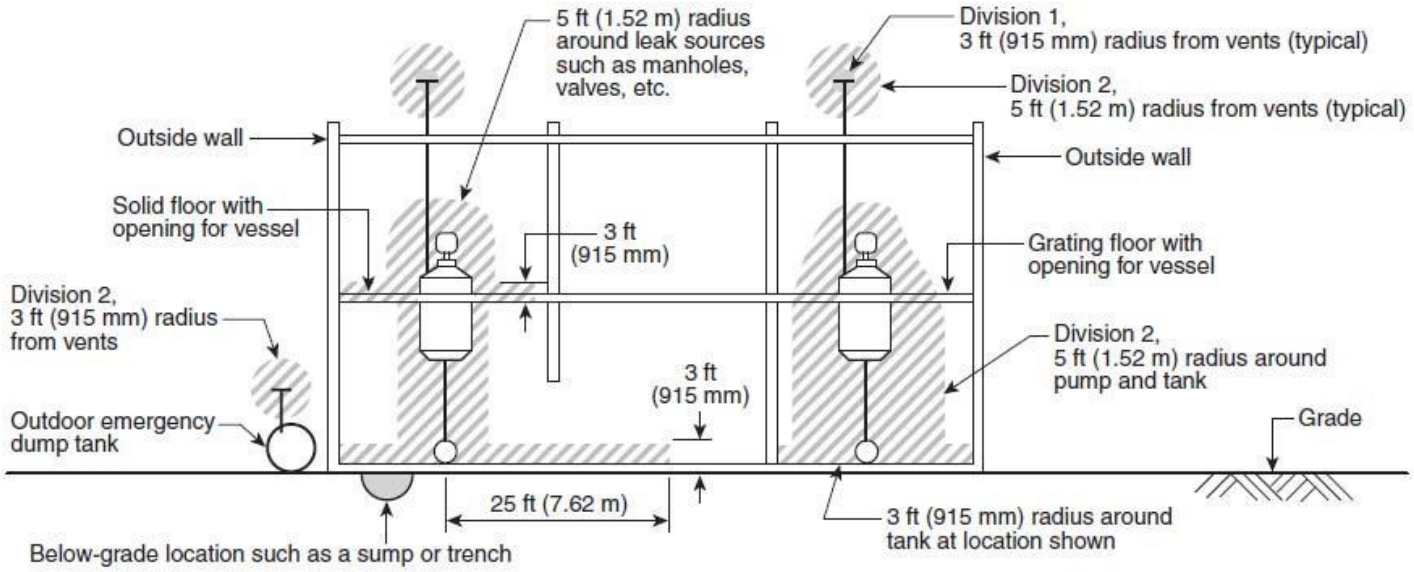
- Some typical Class II locations are:
  - Grain elevators;
  - Flour and feed mills;
  - Plants that manufacture, use or store magnesium or aluminum powders;
  - Producers of plastics, medicines and fireworks;
  - Producers of starch or candies;
  - Spice-grinding plants, sugar plants and cocoa plants; and
  - Coal preparation plants and other carbon handling or processing areas

HAZARDOUS LOCATIONS – CLASS III

- **Class III Hazardous Location:**
  - Areas where there are easily-ignitable fibers or flyings present, due to the types of materials being handled, stored, or processed.
  - Fibers and flyings are not likely to be suspended in the air, but can collect around machinery.

- Some typical Class III locations are:
  - Textile mills, cotton gins;
  - Cotton seed mills, flax processing plants; and
  - Plants that shape, pulverize or cut wood and create sawdust or flyings.

EXAMPLE FROM NFPA 497



Material: Flammable liquid

	Small/low	Moderate	Large/high
Process equipment size	X	X	
Pressure	X	X	
Flow rate	X	X	

Division 1

Division 2

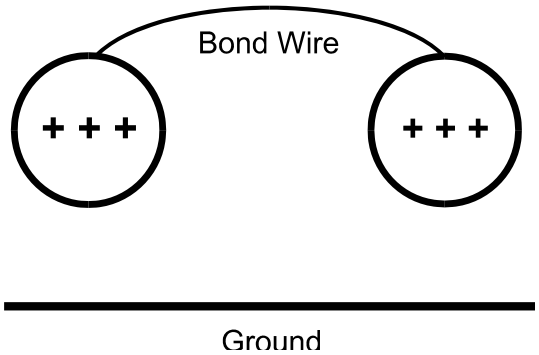
FIGURE 5.9.1(n) Multiple Sources of Leakage, Located Both at and above Floor Level, in an Adequately Ventilated Building. The material being handled is a flammable liquid.

WHEN TO USE BONDING AND GROUNDING

- Bonding and Grounding:
  - Where potential exists for an ignitable mixture and liquids are handled at or above flash point bonding and grounding procedures shall be used.

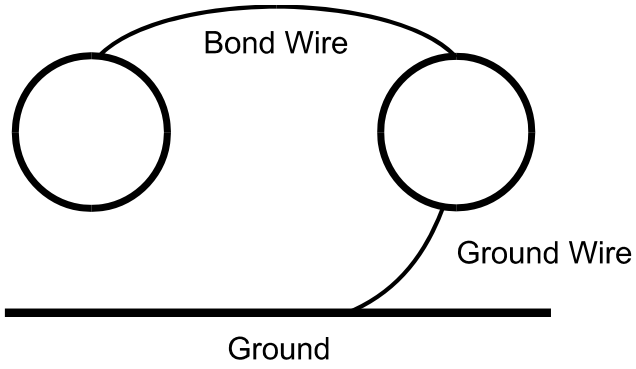
  - Examples:
    - Transfer of liquids can create difference in electrical potential.
    - Mixing and dispensing.
    - Transfer from tanks to containers or trucks.
    - And more…

BONDING



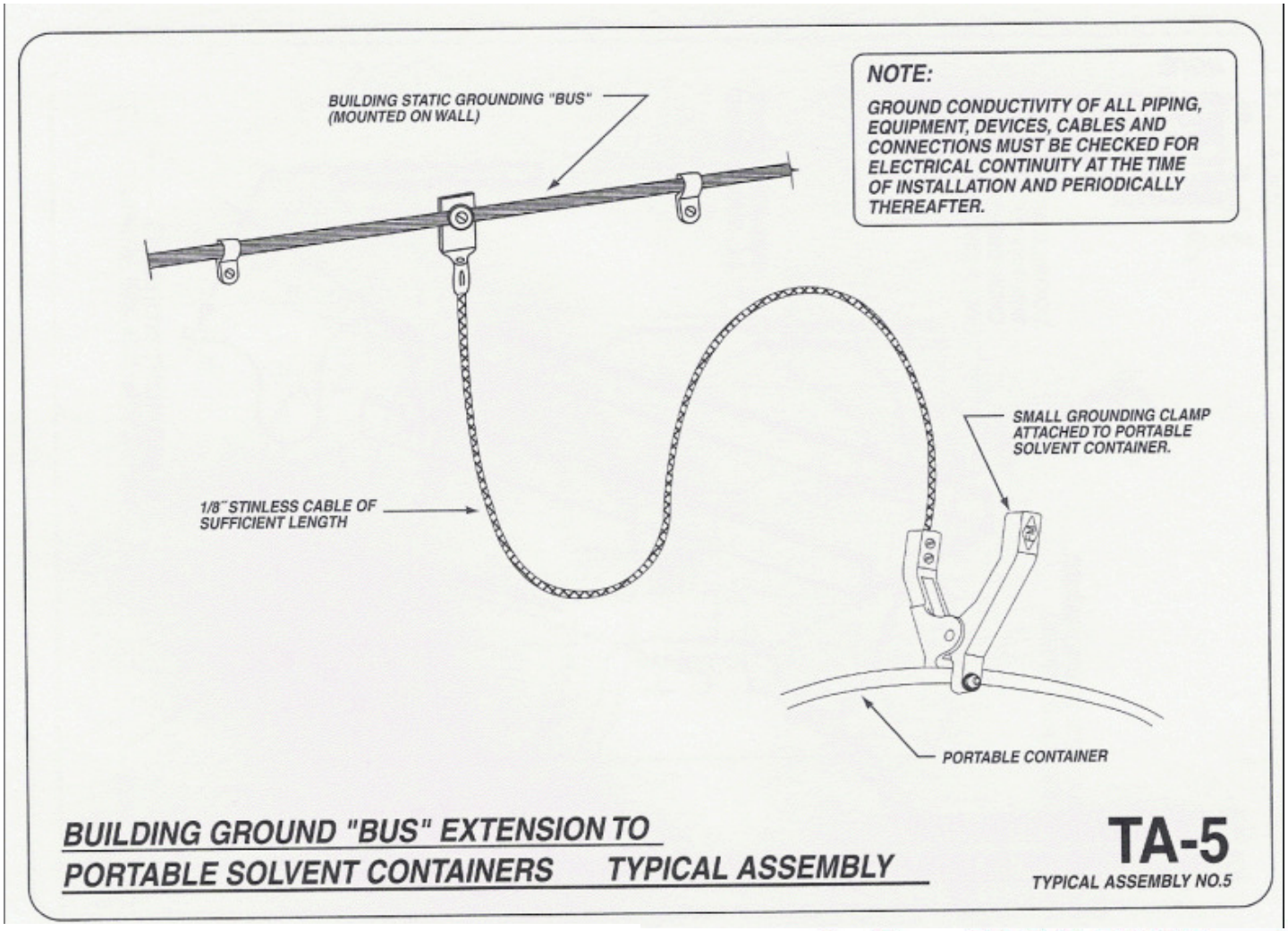
- Bonding:
  - Two or more conductive objects connected by wire so that they are at the same electrical potential (no difference in voltage).
  - Used when liquid filling operations.

GROUNDING



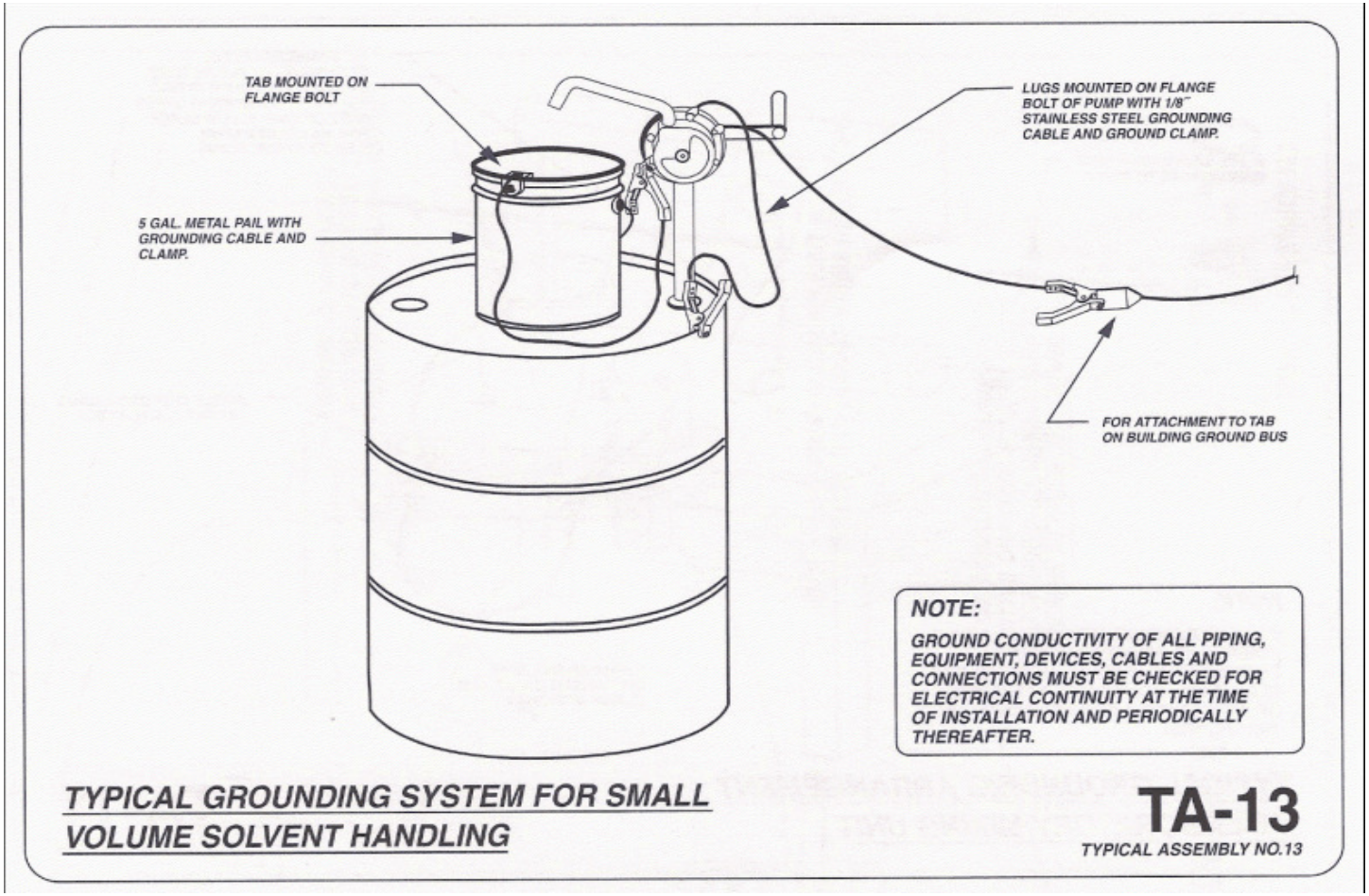
- Grounding:
  - Bonding one or more conductive objects to the earth so that they are all at zero electrical potential.

A 1/8th inch stainless cable is connected from ground bus bar to container. A ground clamp is used to connect to container.

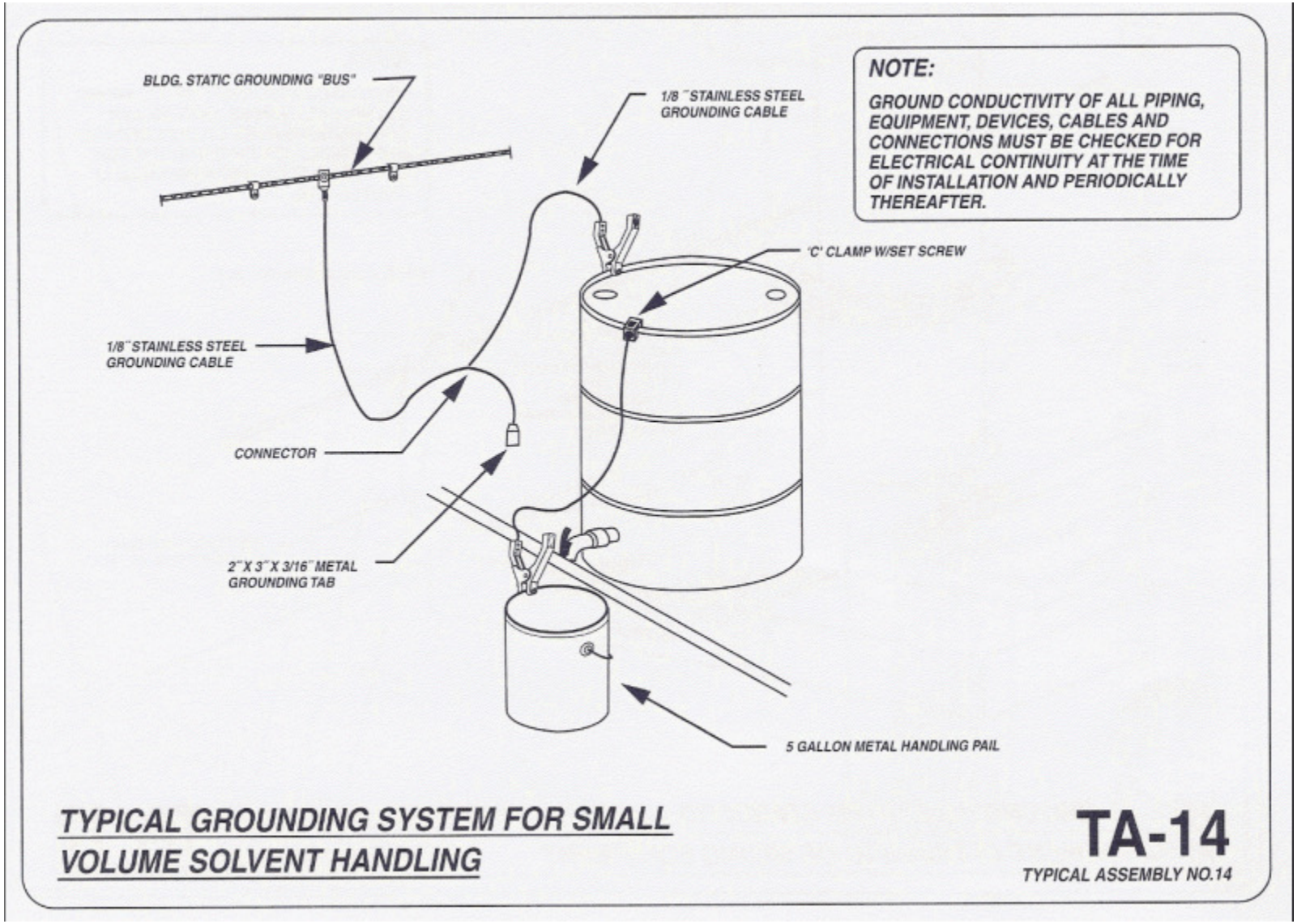


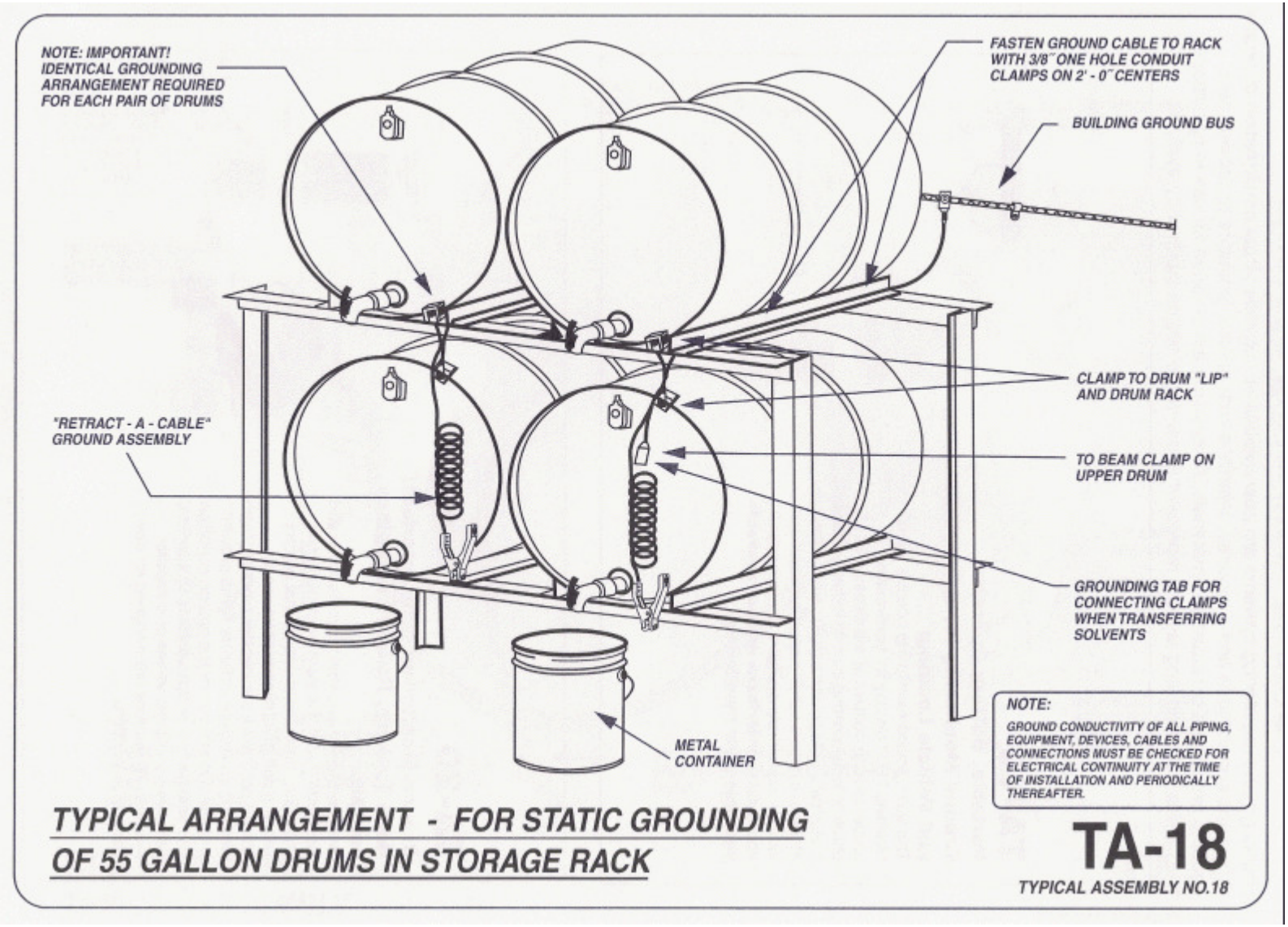
From the Industrial Accident Prevention Association

The steel points assure continuity of connection by penetrating any painted surfaces. This clamp is allowed to attach to listed pump as long as riser is secured on top of container.



From the Industrial Accident Prevention Association


BLDG. STATIC GROUNDING "BUS"
1/8 "STAINLESS STEEL GROUNDING CABLE
NOTE:
GROUND CONDUCTIVITY OF ALL PIPING, EQUIPMENT, DEVICES, CABLES AND CONNECTIONS MUST BE CHECKED FOR ELECTRICAL CONTINUITY AT THE TIME OF INSTALLATION AND PERIODICALLY THEREAFTER.
'C' CLAMP W/SET SCREW
1/8"STAINLESS STEEL GROUNDING CABLE
CONNECTOR
2"X 3"X 3/16" METAL GROUNDING TAB
5 GALLON METAL HANDLING PAIL
TYPICAL GROUNDING SYSTEM FOR SMALL VOLUME SOLVENT HANDLING
TA-14
TYPICAL ASSEMBLY NO.14


NOTE: IMPORTANT!
IDENTICAL GROUNDING
ARRANGEMENT REQUIRED
FOR EACH PAIR OF DRUMS
FASTEN GROUND CABLE TO RACK
WITH 3/8" ONE HOLE CONDUIT
CLAMPS ON 2' - 0" CENTERS
BUILDING GROUND BUS
CLAMP TO DRUM "LIP"
AND DRUM RACK
"RETRACT - A - CABLE"
GROUND ASSEMBLY
TO BEAM CLAMP ON
UPPER DRUM
GROUNDING TAB FOR
CONNECTING CLAMPS
WHEN TRANSFERRING
SOLVENTS
METAL
CONTAINER
NOTE:
GROUND CONDUCTIVITY OF ALL PIPING, EQUIPMENT, DEVICES, CABLES AND CONNECTIONS MUST BE CHECKED FOR ELECTRICAL CONTINUITY AT THE TIME OF INSTALLATION AND PERIODICALLY THEREAFTER.
TYPICAL ARRANGEMENT - FOR STATIC GROUNDING
OF 55 GALLON DRUMS IN STORAGE RACK
TA-18
TYPICAL ASSEMBLY NO.18

SPILL CONTROL & CONTAINMENT

- Required for Group H Occupancies, areas above MAQs, and tanks.

- Spill Control:
  - Volume of largest container

- Secondary Containment:
  - Volume of largest container plus fire suppression water

SPILL CONTROL & CONTAINMENT (CONT.)

- Examples:
  - Non-combustible, liquid tight raised sills, curbs, dikes, or ramps.
  - Sloped floors.
  - Open-grate trenches or floor drains connected to a properly designed drainage system.
  - Wall scuppers that discharge to a safe location or to a properly designed drainage system.
  - Spill pallets.
  - Other means per AHJ.

FIRE PROTECTION

Fire protection associated with hazardous materials includes:

- Operational
- Physical
- Suppression
- Detection and Notification

FIRE PROTECTION – OPERATIONAL

- Administrative controls
- Limiting amount of hazardous materials used or stored
- Tracking systems
- Substitution to use a less hazardous material
- Choose to protect as a Group H hazardous occupancy
- Building layout and material location (control areas)

FIRE PROTECTION – PHYSICAL

- Fire-resistance rated separation (walls, floors, barriers, etc.)
- Physical barriers
- Ventilation
- Containment
- Storage cabinets and containers
- Explosion control or venting
- Control of ignition sources

FIRE PROTECTION – SUPPRESSION

- Automatic fire sprinkler system
- Early Suppression Fast Response (ESFR) sprinkler protection
- Foam agents
- Chemical agents
- Clean agent systems
- Water mist

Note: Choose suppression appropriately for water reactive materials.

FIRE PROTECTION – DETECTION & NOTIFICATION

- Fire alarm system
- Gas monitoring
- UVIR
- Flame detectors
- CO monitors
- Explosion control monitoring (gas)
- Occupant notification (audible/visible)

EXPLOSION PREVENTION

- Options for prevention in IFC
  - NFPA 68 “Standard on Explosion Protection by Deflagration Venting”
  - NFPA 69 “Standard on Explosion Prevention Systems”

- NFPA 68 is reactive approach:
  - An event may happen; limit structural damage
- NFPA 69 is proactive approach:
  - Limit chances of an event happening

EXPLOSION PREVENTION (CONT.)

- Sometimes venting only option:
  - When detection / dilution methods too slow
  - Fast reactions
  - High pressure / high temperature fluids

- Examples of prevention methods (NPFA 69):
  - Combustible concentration reduction
  - Limit oxygen
  - Explosion suppression
  - Flame arrestors

10 MINUTE

BREAK

PART 2

PRACTICE

WHAT TO ASK

- Are you storing hazardous materials in any quantity?
- What identification procedures are you using for your facility?
- Are there any special hazards or health hazards?

WHAT TO ASK (CONT.)

- Have you prepared a description of hazardous materials communications (HMIS)?
- Are all safety data sheets (SDS) included? Where is your binder?
- Are quantities and hazard classification included?
- What is the storage arrangement?
- What are your housekeeping procedures?

WHAT TO ASK (CONT.)

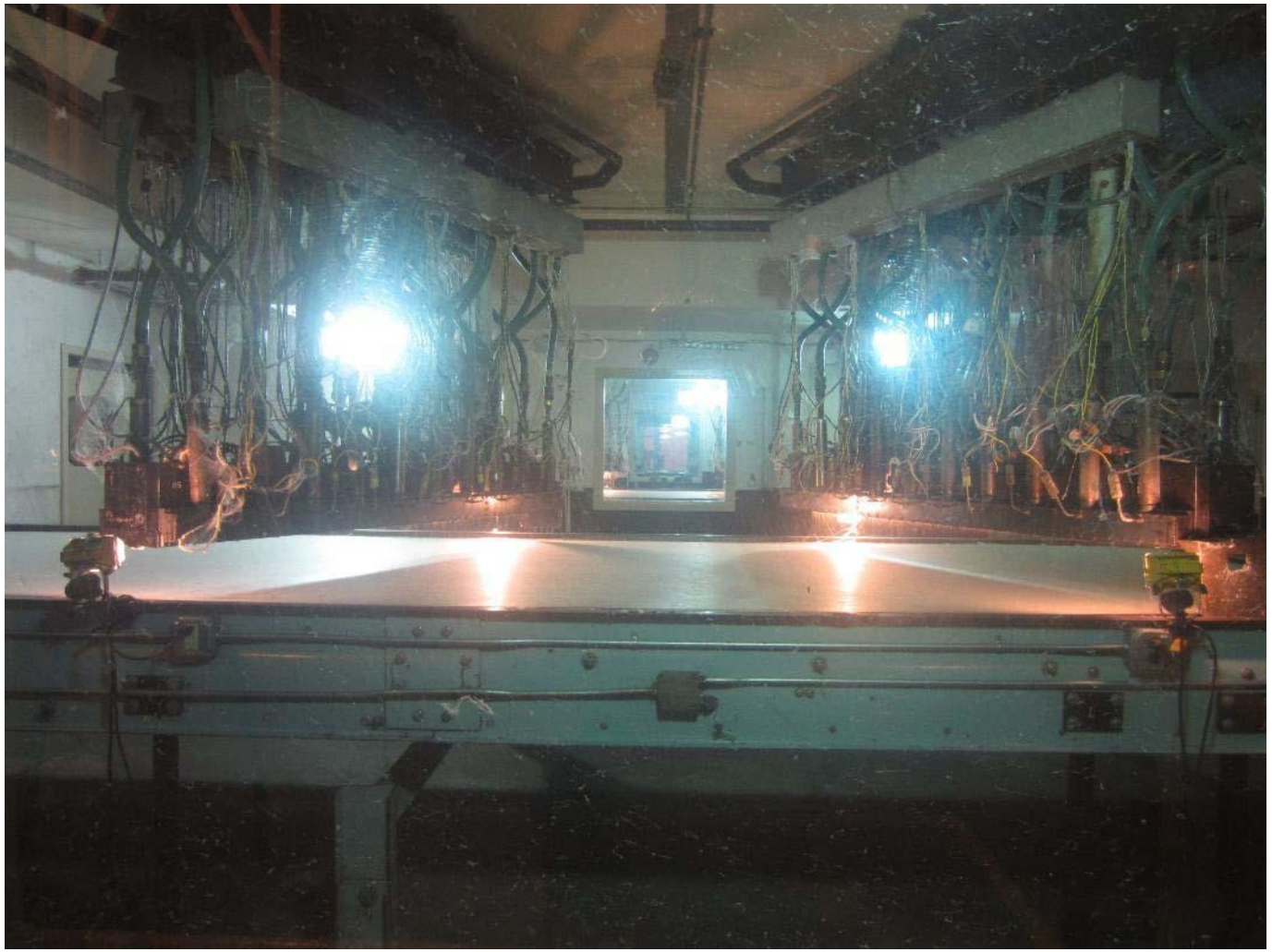
- Have you prepared your process hazard analysis (PHA) and process safety management plan (PSM)?
- Is there any special fire fighting procedures or equipment?
- What is your emergency and operational plan (HMMP)?

EXAMPLES

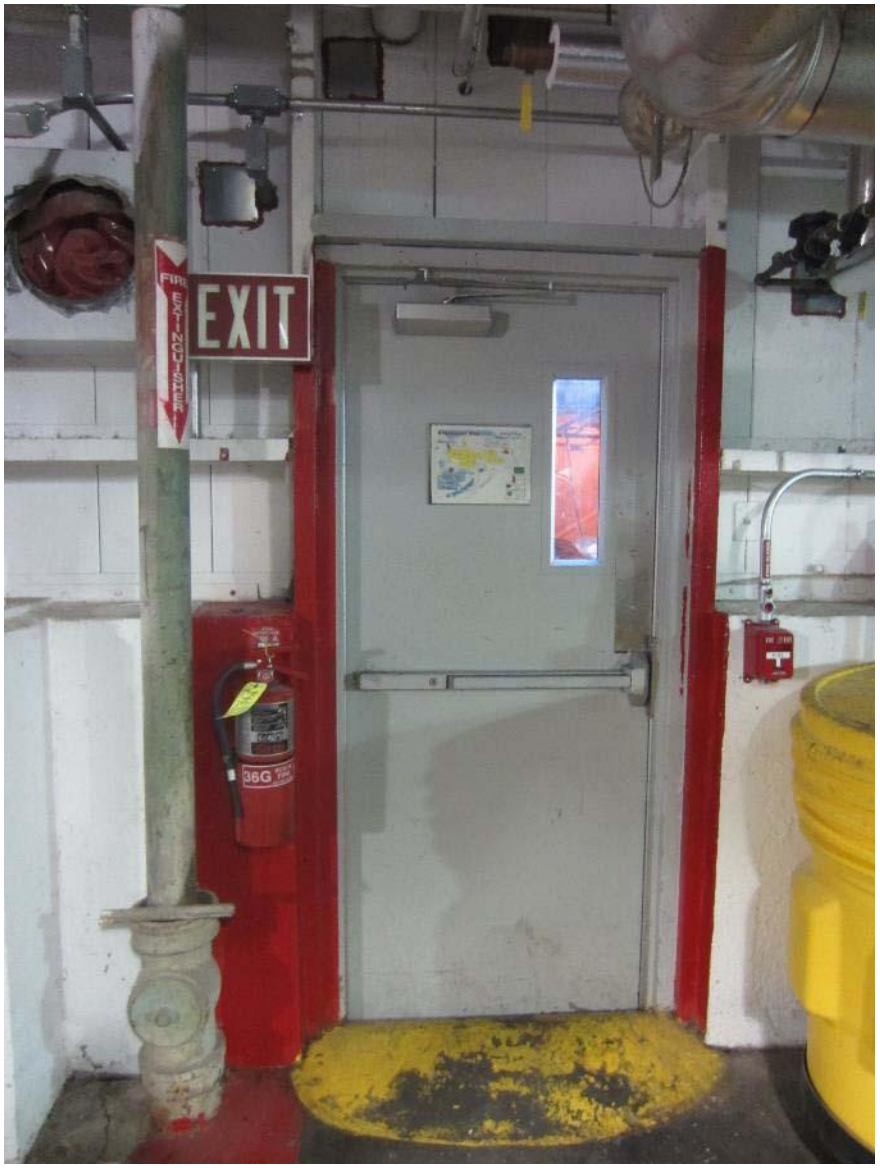

25 26 27 28 29 30 31


FLEET
CHARGE

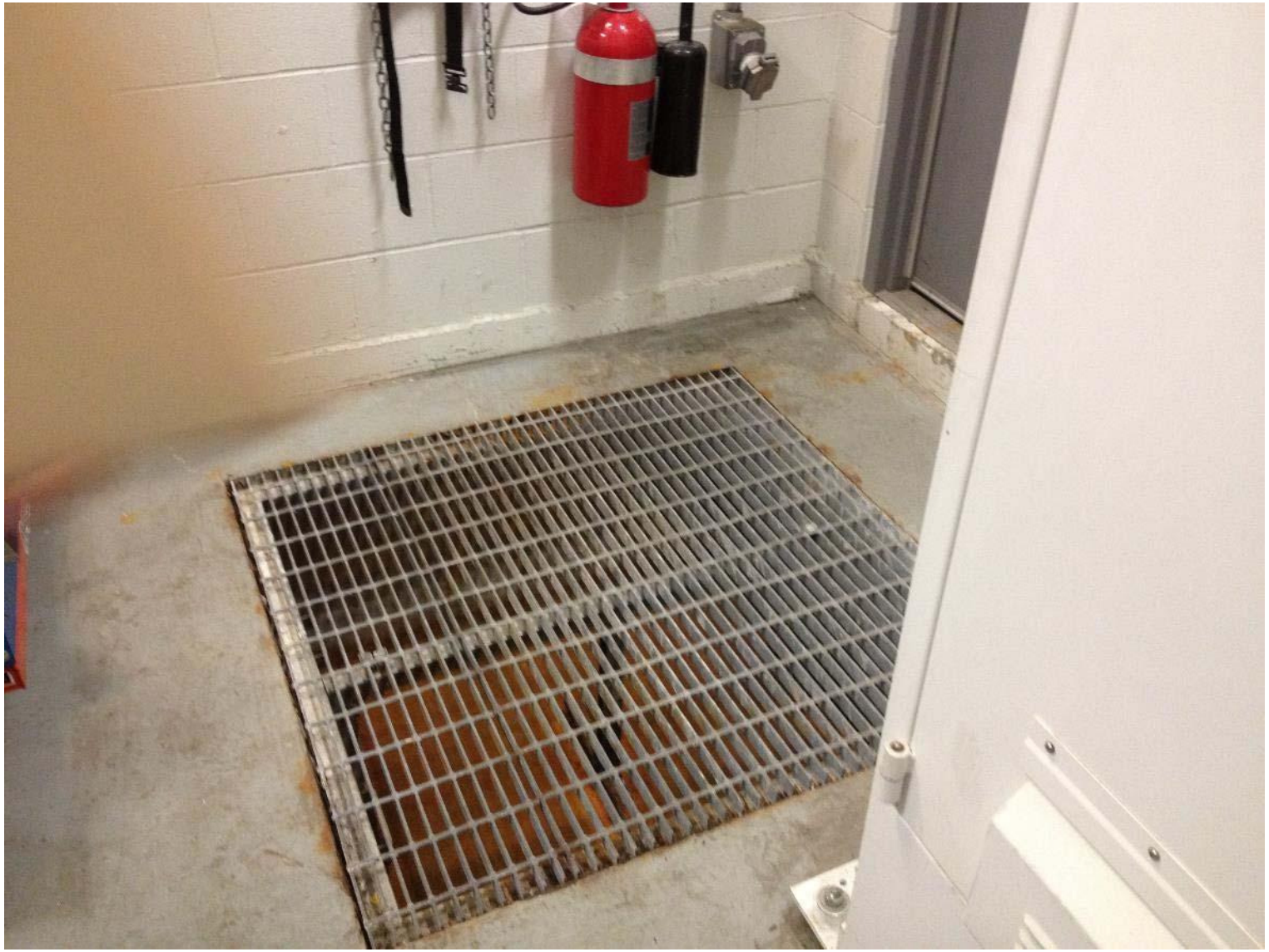

Fike




18
17
16
15
14
13
12

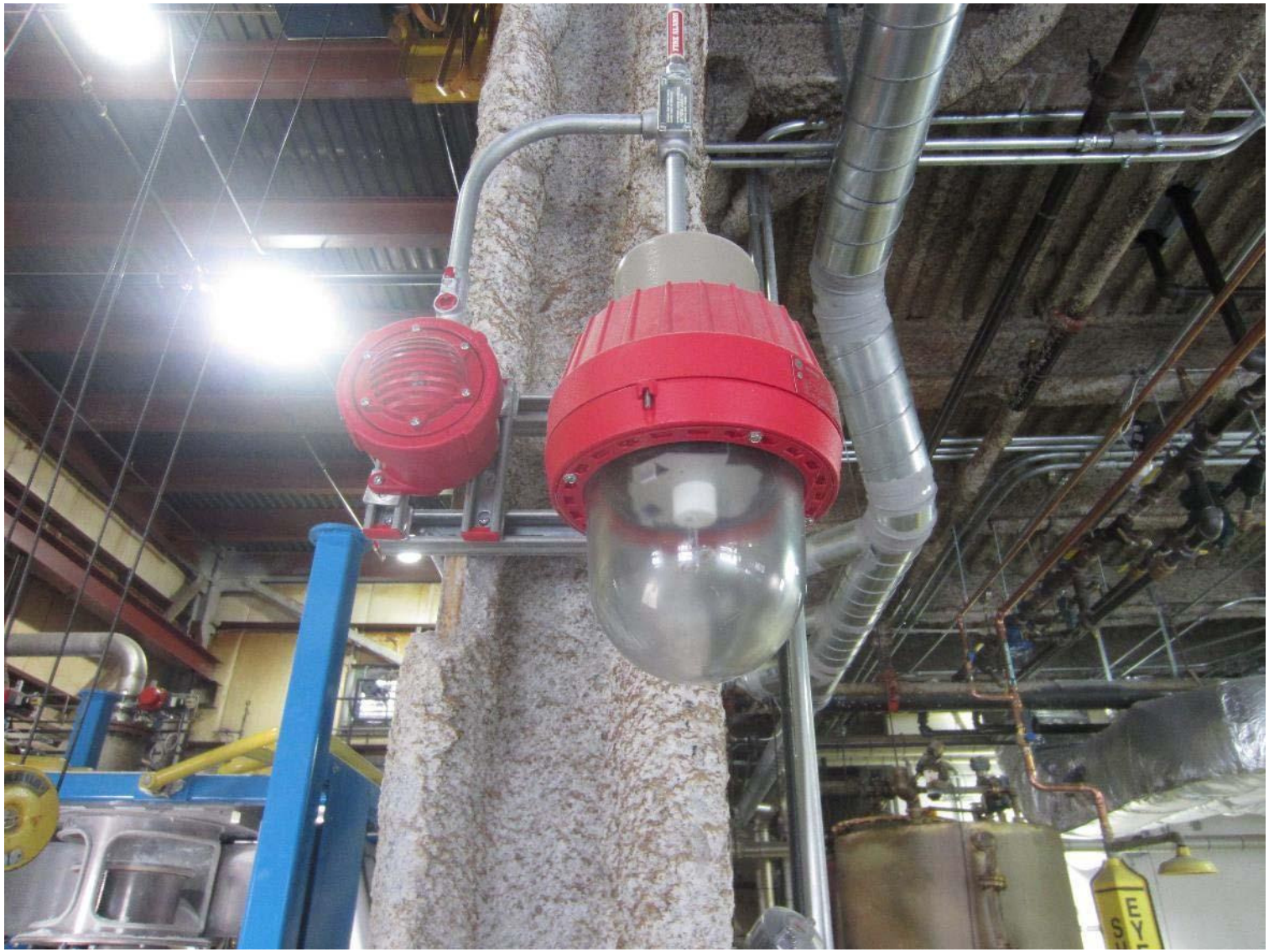

EXIT


NOTICE




Electromode
AUBURN, N.Y.
60
70
15
20
50
25
80
30
40
90
947H
thermostat for
hazardous locations
CLASS I GROUP D;
CLASS II GROUP E, F AND G
THIS APPARATUS MUST BE DISCONNECTED
FROM THE SUPPLYING CIRCUIT BEFORE
OPENING AND MUST BE TIGHTLY CLOSED
AGAIN BEFORE IT IS PUT INTO OPERATION
Garder Le Couvercle Bien Ferme Lorsque
Les Circuits Sont Sous Tension.
CAT. NO.
8117
RANGE
40°F to 90°F & 5°C to 32°C
DIFFERENTIAL
3°F & 1.6°C
OPENS ON RISE
MOTOR RATING
120 V.A.C.
240V.A.C.
FULL LOAD CURRENT
14A.
7A.
LOCKED ROTOR CURRENT
84A.
42A.
AMPERE RATING
25
30
PILOT DUTY:
125 VOLT-AMPS 600 V.A.C.

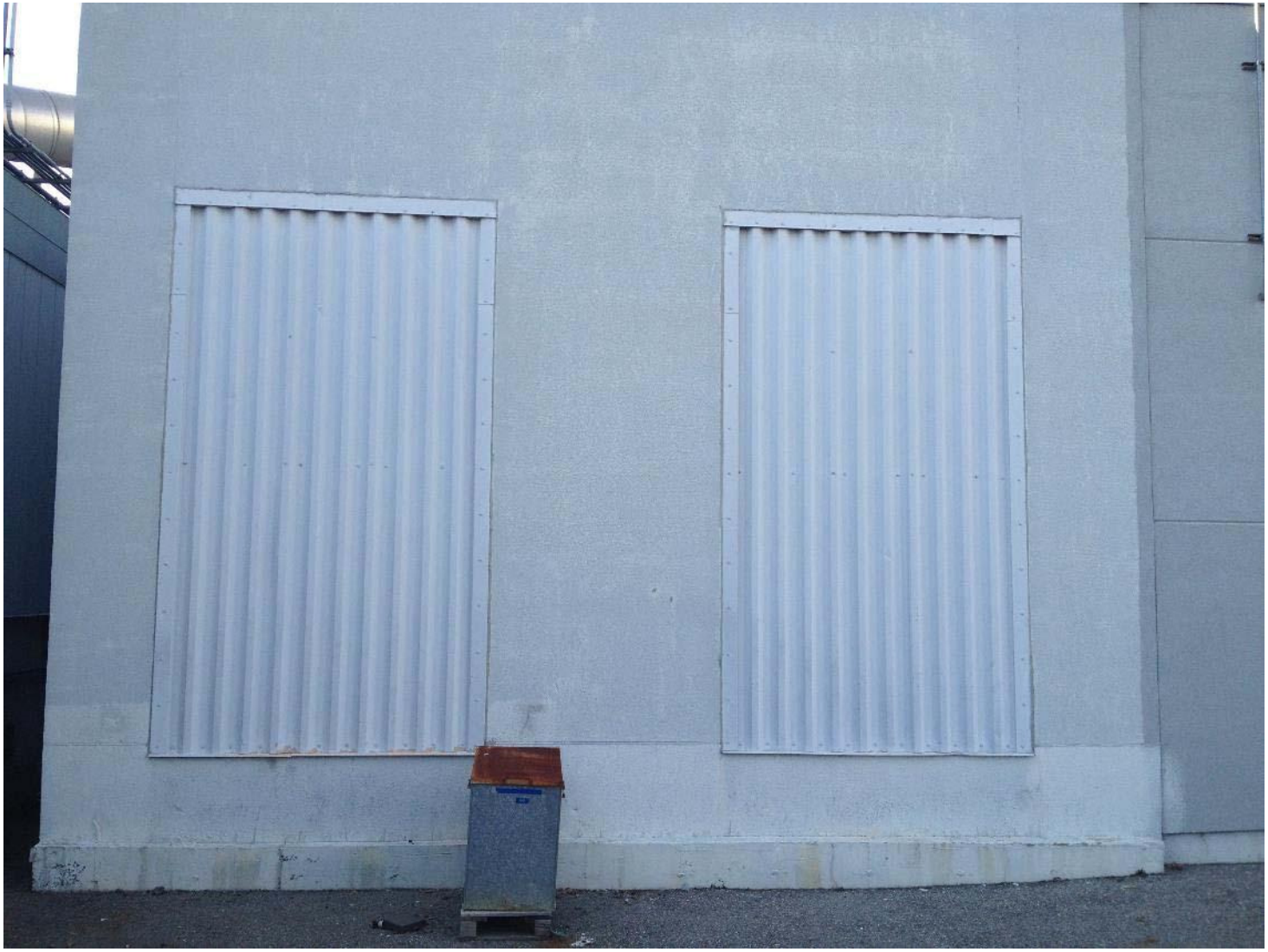

FOR HAZ. LOC.
CL I
CL II
CL III
GR C,D
GR E,F,&G
ON
CAUTION:
SPST

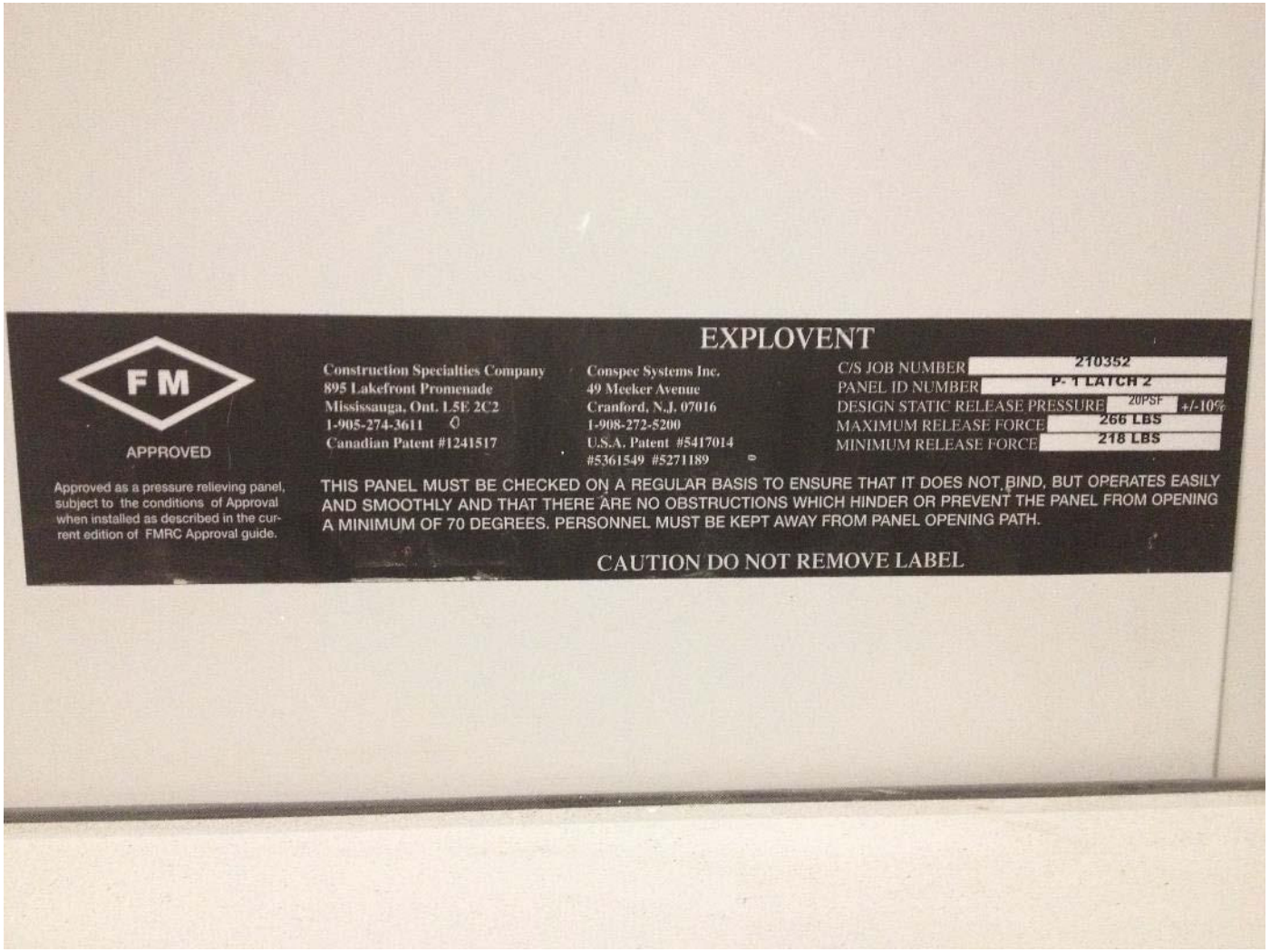



LISTED
790 A
OUTLET BOX
FOR HAZARDOUS LOCATIONS
BALDOR


SOLVENT ADHESIVE WASTE
WASTE OIL & ABSORBENT SOLIDS
SATELLITE ACCUMULATION AREA


ATTENTION
FUME HOOD MUST
REMAIN ON WHILE
MIXING IS IN PROCESS




EXPLOVENT
FM
APPROVED
Approved as a pressure relieving panel, subject to the conditions of Approval when installed as described in the current edition of FMRC Approval guide.
Construction Specialties Company
895 Lakefront Promenade
Mississauga, Ont. L5E 2C2
1-905-274-3611
Canadian Patent #1241517
Conspec Systems Inc.
49 Meeker Avenue
Cranford, N.J. 07016
1-908-272-5200
U.S.A. Patent #5417014
#5361549 #5271189
C/S JOB NUMBER 210352
PANEL ID NUMBER P-1 LATCH 2
DESIGN STATIC RELEASE PRESSURE 20PSF +/-10%
MAXIMUM RELEASE FORCE 266 LBS
MINIMUM RELEASE FORCE 218 LBS
THIS PANEL MUST BE CHECKED ON A REGULAR BASIS TO ENSURE THAT IT DOES NOT BIND, BUT OPERATES EASILY AND SMOOTHLY AND THAT THERE ARE NO OBSTRUCTIONS WHICH HINDER OR PREVENT THE PANEL FROM OPENING A MINIMUM OF 70 DEGREES. PERSONNEL MUST BE KEPT AWAY FROM PANEL OPENING PATH.
CAUTION DO NOT REMOVE LABEL


CHILLED WATER RET.
POLYURETHANE
REACTOR

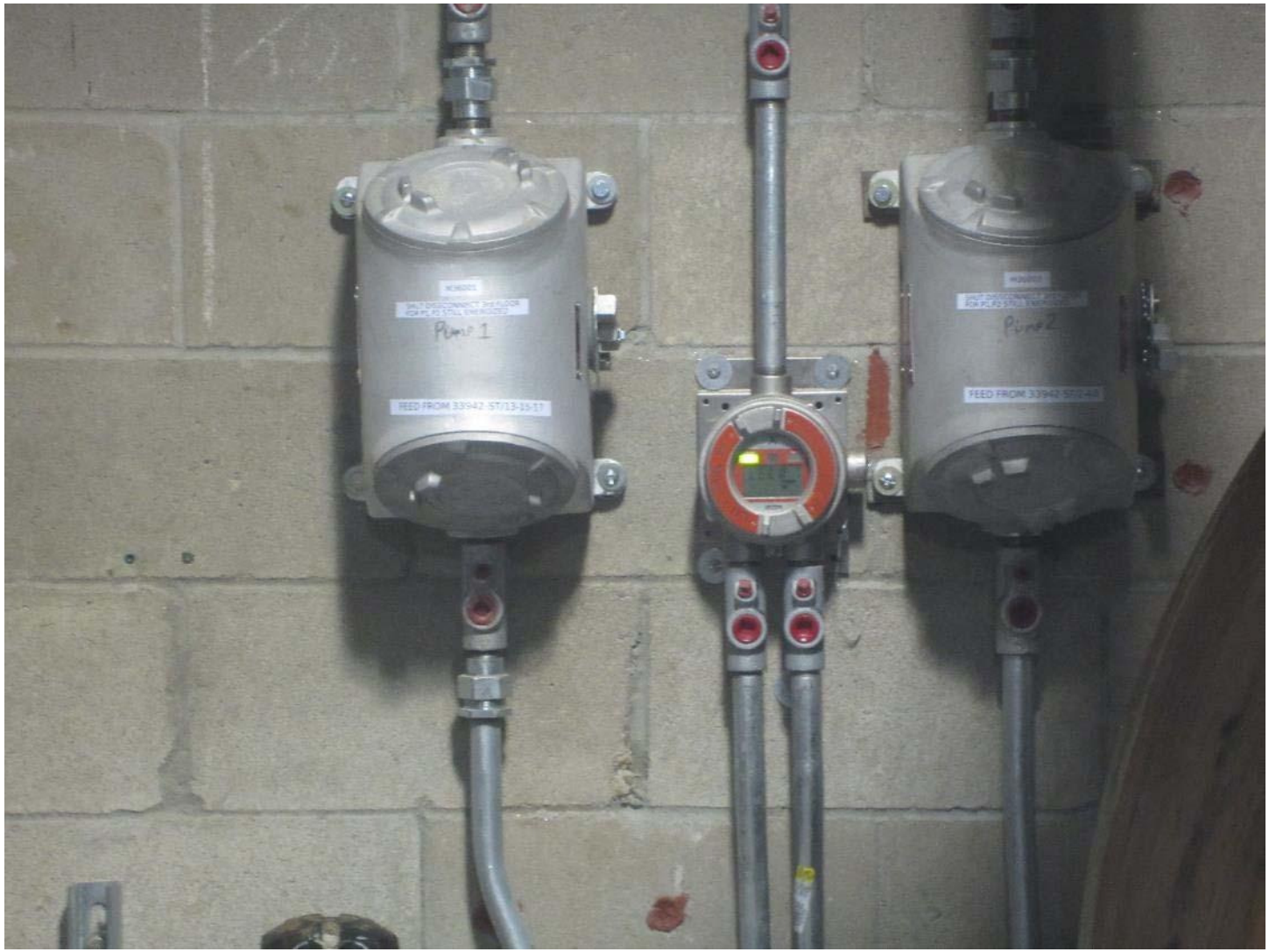

HAZARDOUS
WASTE


TH55-3R


ETHYLENE GLYCOL
88915
0087C00065


Empty Drum
Storage Area
A2


FOR
TESTS


Pump 1
Pump 2


LEL ETHANOL EXPLOSION MONITOR
ID: 515
% LEL
TEST
RESET
LOW
HIGH
LOW CHECK
HIGH CHECK
HYDROCARBON DETECTOR


MSA


NOTICE
MEK & M-PYROL
Wash Tanks
Containment
Area Capacity
2,860 Gallons
MEK-WASH
TANK BOTTOM
PULL TO OPEN

THANK YOU

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