SOLID WOOD FURNITURE MANUFACTURING

INTRODUCTION

The wood furniture industry is one of the oldest in the World. Many of the plants making wood furniture today have been in existence for decades. These older plants have characteristics that make fire control difficult; the buildings may be of combustible construction and have probably become congested over the years. Many are multistory and have conveyors carrying combustible materials throughout the premises.

Woodworking operations generate large amounts of dust and other waste, which must be controlled. Spraying operations use flammable finishes, some of which contain nitrocellulose resins. These two operations are the most common source of furniture plant losses.

Rapid fire spread is more likely in this type of occupancy than in many others, requiring a high level of fixed protection and very strict implementation of management programs for loss prevention and control. *OVERVIEW*, AXA XL Risk Consulting's guide for developing comprehensive management programs, should be used to establish new programs or evaluate existing ones.

This PRC Guideline covers manufacturing of furniture made primarily from solid wood. For information on manufacturing furniture made from pressboard, see PRC.17.8.2.

PROCESSES AND HAZARDS

There are several steps in making furniture. First, the lumber must be dried. The wood is then roughed out to form blanks for various furniture parts. The rough blanks are machined to the proper shape and sanded. The furniture is then assembled, finished, and packed for storage or shipping.

Lumber Handling

Most plants receive green lumber from a saw mill and store the lumber outside in the yard. Some store the green lumber in Pre-Dryer buildings. This storage can be in solid piles of uniform shape, solid bundles with boards of random length, or "stuck" lumber, where boards are laid out horizontally and separated by small sticks to allow for uniform drying. The lumber is eventually dried in kilns to reduce the moisture content to approximately 7%, and is stored inside until needed. These kilns are most often heated by steam produced in boilers that burn wood waste from machining operations.

The fire hazards of lumber yards are well known and can approach those of idle wood pallet storage when the wood is stored as "stuck" lumber.

Machining

In the machining rooms, the rough wood is shaped into its finished form. Operations include sawing, planing, turning on lathes, carving and sanding. These operations all produce large amounts of sawdust, chips and other wood waste.

When a piece is completed, up to 50% of the original wood may have been removed as waste. About 35% of the waste is in the form of solid pieces such as small blocks and chips. The remainder is sawdust. Many furniture facilities burn this waste in boilers to generate steam, while others sell wood by-products, such as chips, to plants that make particle board.

The fire hazards of machining operations include flash fires and dust explosions. Housekeeping is a never-ending challenge. Dust collection systems are necessary to remove the dust and other waste from the immediate area, and involve the use of metal ducts and collectors.

Explosions originating in collectors can communicate through the ducts back into the machine rooms. Conversely, a spark from a machining operation can pass through ductwork and into the collector and cause an explosion or fire.

Assembly

Assembly and joining are done with nails, screws, staples, tacks and glue, and are primarily manual operations. Most of the assembly is usually done before finishing operations.

The fire hazards in an assembly area are moderate compared to other areas. Where upholstering is done, the hazards of foam polyurethane cushions and fiber fill materials can be found. Storage of synthetic cloth is often in racks on solid shelves.

Finishing

Finishing operations involve many of the same techniques used in other industries, i.e., spray application of a finish followed by oven drying. However, finishing wood is usually more complicated than finishing metals or plastics. Woods may need to be bleached, filled, stained, glazed and sealed. Many coats may be needed on the finished product to provide the appearance and durability needed.

The primary hazards of finishing operations are those of flammable liquids handling. Flammable liquids typically used as solvents in these operations include acetone, naphtha, MEK (methyl ethyl ketone), xylene and toluene, all of which are Class I flammable liquids. The lacquers are frequently nitrocellulose based. Other lacquers, such as acrylics or urethanes, are sometimes used.

Flammable liquids for spraying operations may be pumped from drums, received from pressurized tanks or pots, or fed from a bulk distribution system. Most finishing operations use a combination of all three methods.

Since furniture varies in size from small tables to large cabinets and bedroom furniture, the spray booths and conveyor network must be able to handle these items. However, the spray booths may not always fully contain them, increasing the chance for accumulation of overspray. In addition, due to the number of coats applied, finishing rooms are often congested. The items will probably pass through several spray booths before entering an oven. Ovens can provide a source of ignition if not properly arranged.

Some facilities air-dry the product without ovens. Unless this is done in an enclosure, the vapors escape into the room, making it an electrically classified area. This requires that electrical equipment and its installation be in accordance with the requirements for Class I, Group D, Division 1 or 2 of the NFPA 70.

Packaging and Storage

Finished furniture is usually packaged in cartons and stored in warehouses prior to shipping. Upholstered furniture is often encapsulated in plastic. Rack storage is common because it eliminates exposure of finished furniture to excessive weight.

The hazards of furniture warehousing are not unique. Foamed plastic cushions and other fill materials can increase the commodity class above that for other wood products. Unusual rack storage configurations may be encountered, and the irregular shapes and large solid surfaces of some products can prevent sprinkler discharge from reaching the lower levels of storage. Furniture is especially subject to smoke and water damage.

LOSS PREVENTION AND CONTROL

General

Furniture factories contain many hazardous operations and are subject to potentially serious fires and explosions. Adequate fire protection features must be provided for all areas if catastrophic losses are to be avoided. Flash fire and explosion potentials exist in the machining and finishing areas due to the combustible loading (sawdust and lumber in machining areas; flammable vapors and combustible overspray in the finishing areas), making division into distinct fire areas vital. Control of dust and good housekeeping in these facilities may be the single, most important feature that will prevent a small fire loss from escalating into a major one.

There is no single NFPA standard covering furniture manufacturing facilities. Guidance can be found in various NFPA standards. Use these standards to supplement the recommendations in this section.

Management Programs

Develop and implement management programs for loss prevention and control in accordance with *OVERVIEW*. In furniture manufacturing facilities, programs for housekeeping and control of ignition sources are particularly important. Incorporate the following features in management programs:

Housekeeping

Maintain excellent housekeeping, particularly in machining and finishing rooms. The frequency of cleaning will depend on the operation. Some areas may require cleaning each shift.

Store dirty rags in listed waste receptacles. Empty the receptacles as soon as they are filled and at the end of the day. Where stain is manually applied with rags, dispense it from listed safety containers.

Clean dust buildup with a well designed vacuum system. Prohibit using compressed air or other gas to “blow down” the dust. Correct unacceptable dust accumulations by improving the dust collection system pickup points. See PRC.9.3.2.0.

Maintain strict duct inspection and cleaning schedules. This applies to ducts for both wood waste handling and spray finishing exhaust. For additional information, refer to PRC.1.14.0 or *OVERVIEW*, Section 14, *Proper Housekeeping*.

Smoking

Prohibit smoking in all storage, woodworking and finishing areas. Provide safe, remote designated smoking areas. For additional information, refer to PRC.1.2.0 or *OVERVIEW*, Section 2, *Smoking Regulations*.

Cutting and Welding

Use a formal, written cutting and welding program with written permits. Before performing hot work on any equipment, completely empty and clean that equipment, its associated ductwork and the surrounding areas. Empty and clean adjacent equipment or shield it from sparks with substantial noncombustible barriers. Refer to PRC.1.9.0 or *OVERVIEW*, Section 9, *Cutting, Welding, and Other Hot Work*.

Operator Training

Train machine operators in the hazards of handling sawdust and other wood waste products and in proper operation of the dust collection and vacuuming systems. Prohibit machining with any

protective systems out of service or when the dust collection system is not operating properly. Have operators take immediate action on dust buildup that presents an unacceptable hazard.

Train spray booth operators in the hazards of the liquids being sprayed and in the correct way to operate the spray booth. Prohibit spraying with any protective systems or safety interlocks out of service. Have operators take immediate action on overspray accumulations sufficient to make spray booth operation dangerous. For more information, refer to PRC.1.4.0 or *OVERVIEW*, Section 4, *Employee Training*.

Maintenance

Maintain boilers in accordance with PRC.7.1.0.4 and PRC.7.1.0.5. Inspect, test and maintain boiler pressure relief devices in accordance with PRC.7.0.5.2.

Maintain dust collection and ventilation system fans. Maintain transformers in accordance with PRC.5.9.1.

Pre-emergency Planning

Organize and train a fire brigade. Due to the potential for rapidly developing fires in the finishing and machining areas, all but small facilities should have an Interior Structural Fire Brigade. Additional information can be found in PRC.1.7.0 or *OVERVIEW*, Section 7, *Pre-Emergency Planning*.

Construction

Incorporate the following construction features in buildings used for furniture manufacturing:

- Use only noncombustible construction for new buildings. While noncombustible construction is preferred, plank on timber roof construction is acceptable for existing buildings. Buildings of wood joist roof construction are generally considered unacceptable.
- Design new buildings to be single story. The flammable materials handling associated with finishing rooms is often located on the upper floors of existing multistory facilities. This is an undesirable arrangement because fire experience has shown that large numbers of sprinklers often operate in finishing room fires with extensive water damage resulting on the lower floors. In addition, when machine rooms are located on intermediate or lower floors of multistory structures, difficulties are encountered in designing efficient and well arranged dust collection systems so vital to these areas.
- Separate the major sections of the facility with parapeted fire walls of at least 4 h fire resistance. Major sections include the dry lumber storage, machining areas, assembly areas, finishing rooms and finished product storage.
- Protect all openings in fire walls with double Class A fire doors. When it is necessary for conveyors to pass through fire walls, the preferred arrangement is for the conveyor to pass around the outside of the wall and back into the building. When this is not possible, arrange the conveyor openings to pass through a 3 h rated masonry enclosure on each side of the fire wall with single Class A automatic fire doors on each opening, and breaks in the conveyor designed to permit the doors to close. See PRC.2.2.2 and NFPA 80 for additional information. **Water curtains are not acceptable protection for fire wall openings**.

  Provide sprinklered noncombustible enclosures where conveyors must pass through floor openings. The fire resistance of such an enclosure should be equivalent to the rating of the floor assembly being penetrated.
- Provide automatic heat and smoke venting in accordance with PRC.2.1.4, with 50% arranged as mechanical exhaust for all machining, finishing and warehouse areas.
- Design building structural members in machining areas and other areas where dust is handled to limit dust accumulation. This can be accomplished by avoiding flat horizontal surfaces and keeping other surfaces as smooth and vertical as possible. Surfaces should be inclined at an angle of not less than 45 degrees from the horizontal.

- Install noncombustible draft curtains at least 4 ft (1.2 m) deep in finishing rooms. The curtains should subdivide the room into areas of 5000 ft^2 to 10,000 ft^2 (465 m^2 to 930 m^2) maximum.

Water Supplies

Design the water supplies to be capable of meeting the largest sprinkler demand plus 1000 gpm (3780 L/min) for hose stream use. Where there is lumber storage in the yard, and the width of pile groups exceeds 75 ft (23 m), design water supplies to be capable of providing 3000 gpm (11,350 L/min) at 75 psi – 100 psi (5.0 bar – 7 bar) or the above sprinkler and hose stream demand, whichever is greater. When values dictate, provide a second water supply. When fire pumps are necessary, select diesel drives for reliability.

Provide a minimum three-way, 6 in. (150 mm) fire department connection within 50 ft (15 m) of a public hydrant. When multiple fire department connections are provided, two-way 4 in. (100 mm) connections are acceptable.

Hydrant Protection and Underground Mains

Provide looped underground mains to distribute water to the sprinkler systems, yard hydrants and monitors.

- Size the loop to meet the demand with one leg of the loop out of service. Minimum 10 in. (250 mm) mains are recommended, or larger as the hydraulics requires.
- Provide two-way yard hydrants with individual curb box control, spaced at approximately 250 ft (75 m) intervals around the loop. Provide gate valves on each 2½ in. (65 mm) outlet. Where an Interior Structural Fire Brigade exists, equip each hydrant with a hose house containing 300 ft (90 m) of 2½ in. (65 mm) fire hose, adjustable nozzles and a full complement of associated equipment. Centrally located hose carts are acceptable where paved roadways are available.
- Install sectional control valves in accordance with NFPA 24 and PRC.14.5.0.1.
- When the width of lumber pile groups exceeds 75 ft (23 m), provide fixed monitors equipped with 500 gpm (1890 L/min) nozzles arranged to reach all areas with at least one stream.
- Provide hydrant coverage for drying kilns.

Automatic Sprinklers

Provide automatic sprinkler protection throughout the facility. Use wet pipe systems in all areas with dry pipe systems limited to outbuildings or minor areas where sufficient heat is not available. Design sprinkler systems as follows:

- Woodworking Areas - Design for the most remote 4000 ft^2 (372 m^2).
  - Machining Areas - Extra Hazard Group 1
  - Assembly Areas with no machining - Ordinary Hazard Group 2
  - Assembly Areas with machining - Extra Hazard Group 1
- Finishing Rooms - Use 0.30 gpm/ft^2 (12.2 L/min/m^2) over the most remote 5000 ft^2 (465 m^2) area if draft curtains subdivide the area into 5000 ft^2 (465 m^2) sections. Use 0.20 gpm/ft^2 (8.15 L/min m^2) over the most remote 10,000 ft^2 (930 m^2) area if draft curtains subdivide the area into 10,000 ft^2 (930 m^2) sections. For draft curtained sections between these areas, interpolate between the densities and use the draft curtained area for the design area.
- Dust Collection System - Protect the inside of dust collectors, bins, hoppers and silos. Use 0.30 gpm/ft^2 (12.2 L/min/m^2) over the horizontal projected area of the piece of equipment. Manual or Shut in Winter systems are not acceptable.
- Finished Goods Storage - Design in accordance with NFPA 13 and modified by PRC.12.1.1.0.
- Lumber Storage - Design sprinkler protection over lumber storage as specified in Table 1.

TABLE 1
Protection For Lumber Storage

Type of Lumber Storage	Height ft	Density gpm/ft^2	Area of Operation 286°F (141°C) ft^2	Area of Operation 165°F (74°C) ft^2
Solid piles of lumber, plywood, or particle board with or without banding. Smooth edges and ends.	0 - 12	0.15	2000	3000
	12$^+$- 20	0.20	2500	3000
	20$^+$- 30	0.30	3000	4000
Solid piles of lumber, with irregular ends (i.e. random lengths.)	0 - 12	0.15	3000	4000
	12$^+$- 20	0.30	3000	4000
	20$^+$- 30	0.30	4000	Not Recommended
Stuck Lumber (Basically a solid shelf of boards with 1 in. runners between levels.)	0 - 10	0.30	2500	4000
	10$^+$- 15	0.45	2500	4000
	15$^+$- 20	0.60	2500	4000
Stuck Lumber with spaces between boards (equated to storage of wood pallets).	0 - 8	0.30	2500	4000
	8$^+$- 20	0.60	4500	Not Recommended

SI Units: in. = 25.4 mm; ft = 0.3048 m; gpm/ft^2 = 40.7 L/min/m^2; ft^2 = 0.093 m^2
NOTE: Densities are based on wet pipe systems. For dry systems, increase the area of application by 30%.

- Kilns - Base sprinkler design on the lumber storage arrangement within the kiln. See Table 1. Extend protection to associated cooling sheds and fan houses.
- Flammable Liquid Mix Rooms - Design for Extra Hazard Group 2. Use the total room area for the area of application.
- Flammable Liquid Storage - Design protection for bulk and container storage in accordance with NFPA 30 and PRC.8.1.0.
- Finishing Ovens - Use 0.35 gpm/ft^2 (14.3 L/min/m^2) over the entire area.
- Spray Booths - Design sprinkler protection in accordance with NFPA 33 and PRC.9.2.3.1. Extend protection to all exhaust ducts and plenums. Equip sprinkler systems with a separate OS&Y control valve. Automatic non-freeze systems are acceptable for the stack sprinklers. Manual or “Shut in Winter” systems are not acceptable.
- Dipping Processes - Design sprinkler protection in accordance with NFPA 34 and PRC.9.2.3.3.

Lumber Yard

Arrange solid piled or bundled lumber storage in the plant yard areas as follows:

- Locate lumber piles at least 200 ft (60 m) from all buildings and structures. Where space does not permit a 200 ft (60 m) separation, lumber piles may be 100 ft (30 m) from buildings that have parapeted 3 h fire resistant masonry walls and exposure protection for openings. Other combinations of exposure protection and separation distance may be accepted subject to review by the Principal Consultant.
- Limit lumber piles to a width of 25 ft (7.5 m), length of 50 ft (15 m) and a height of 20 ft (6 m).
- Leave a clear space of at least 20 ft (6.0 m) between lumber piles. Where the separation from plant buildings is less than 200 ft (60 m), leave 50 ft (15 m) clear space between piles.
- Limit pile groups to a width of 150 ft (45 m), and a length of 250 ft (75 m).
- Separate pile groups by a minimum of 100 ft (30 m).
- Keep access roads usable under all weather conditions. Well drained gravel roads are acceptable; dirt roads are not.

Drying Kilns

Use fire resistive or noncombustible construction for kilns and provide the following features:

- Steam or indirect fired heating systems for the kilns.
- Combustion controls meeting NFPA 86 and PRC.4.0.1.
- Monitoring of ventilation, humidity and temperature.

Machining Rooms

Provide the following features for machining rooms:

- Install a vacuum cleaning system to remove dust throughout the woodworking areas and establish cleaning schedules to prevent dust accumulation from exceeding 1⁄16 in. (1.6 cm) in depth.
- Provide all cutting, shaping, planing, sanding or other machines which produce finely divided wood dust or shavings with a dust pickup, conveying and collection system. See recommendations for Waste Handling.
- In addition to the pickups at the machines, provide intakes at the floor level where fine materials accumulate. Screens may be needed to prevent the entry of over-sized waste materials that could lead to clogging.
- In areas subject to dust accumulation, use electrical equipment suitable for Class II, Division 1 areas.

Finishing Rooms

Provide the following features for finishing rooms:

- Build spray booths of substantial noncombustible construction (minimum 18 gage [1.02 mm] steel). Water wash type booths are preferred for limiting accumulation of overspray. Dry filter booths are acceptable if adequate cleaning schedules are maintained. Open type booths without filters are not acceptable. Interlock spraying equipment with the ventilation systems (both booth and room ventilation) so that it cannot operate without air flow. Also refer to NFPA 33.
- Within 5 ft (1.5 m) of spray booths, use electrical equipment suitable for Class I, Group D, Division 1. In the rest of the finishing room, use electrical equipment suitable for Class I, Group D, Division 2. Furniture may pass through several spray booths prior to being dried in an oven. Flammable vapors are emitted after the product has left the spray booth, so classification of the entire finishing room is necessary. When conveyorized air drying is used in lieu of ovens, treat the entire finishing room as a Division 1 location.
- Keep the quantity of flammable materials in the finishing room to a minimum. The preferred arrangement is to supply the spray booths from a central mix room with a pumping system:
    - Cut off the mix room from the finishing room by a blank 3 h rated fire wall with outside access. Fill spaces at pipe penetrations through the wall with listed penetration firestops. Do not pass ducts through the wall. Where this is unavoidable, provide listed automatic dampers with a fire resistance equivalent to the wall.
    - Interlock an excess flow or line pressure switch and sprinkler water flow signal to shut down all pumps. Also provide manual shutdown stations.
    - Use only metallic piping, and pitch it to drain back to the mix room. For additional guidance on piping joints and design, refer to NFPA 30 and NFPA 33.
    - Pressure pots of up to 60 gal (230 L) capacity are an acceptable means of supplying spray equipment. Refill these pots in a flammable liquids dispensing area cut off from the finishing room.
    - Provide no more than two 55 gal (210 L) drums at any single spray station within a booth; one is preferred. In addition, space the spray stations at least 30 ft (9.2 m) apart. Pump

materials from the drums to the spray equipment using listed air-operated pumps. Install listed bung vents on drums, and properly bond and ground all dispensing equipment. **Do not pressurize 55 gal (210 L) drums**.

- Provide steam or indirect fired heating systems in the finishing room. When an indirect fired system is provided, locate the burners outside the finishing room. When the units are on the roof, locate air intakes away from spray booth and oven exhaust stacks.
- Waterproof floors above grade level, and provide adequate drainage to remove spills and sprinkler discharge to a safe location. Curb drums or pressure pots located in the finishing room.
- Provide ventilation specifically for the finishing room. Design the ventilation system to sweep air across the floor and to provide at least 1 cfm/ft^2 (0.3 m^3/min/m^2) of ventilation per ft^2 unit of floor area. The spray booth ventilation systems are not usually sufficient to remove vapors from the floor areas of the finishing area. Fresh air makeup equivalent in volume to the air exhausted is needed to ensure proper air movement.

Waste Handling

Provide the following features for wood dust/waste removal and handling systems:

- Use only steel construction for enclosures, hoods, ducts, separators, hoppers, bins and silos. Make all joints in the dust handling system air- and dust-tight. Use welded construction when finely divided wood dust capable of exploding is handled.
- Design the collection system to carry the material to the dust collector without depositing materials on the duct interior. Provide access ports at frequent intervals for verifying system effectiveness, for regular housekeeping activities, for cleanout in the event of an abnormal buildup, and for firefighting access.
- Size the collection system assuming that all parts of the system are in use at the same time.
- Use collection equipment made only of noncombustible materials, except for filter bags, if provided, and locate it outside.
- Arrange equipment that discharges wood dust from collection equipment into hoppers, storage silos or other equipment to minimize the formation of dust clouds.
- Install a choke, rotary valve or explosion suppression system in each hopper, storage silo and other piece of equipment to prevent the propagation of an explosion to other parts of the dust handling system.
- Provide either explosion relief or explosion suppression systems for the ductwork and collectors.
    - Design explosion relief in accordance with NFPA 68. Install explosion proof dampers to prevent flashback from the separator into the duct system.
    - Design explosion suppression systems in accordance with NFPA 69.
- Install spark extinguishing systems in the exhaust ductwork from grinding and sanding equipment.
- Provide the following features for dust collectors, bins, hoppers and silos:
    - Interlock sprinkler system water flow to shut down the conveying system air flow.
    - Provide explosion relief designed in accordance with NFPA 68 for storage bins and silos.
    - Equip the bins and silos with manual dump facilities to permit the rapid removal of the contents in the event of a smoldering fire.
- It is not desirable to recirculate collection system air. However, if the air is to be returned to the building, provide the following features:
    - Additional filters to keep “fines” from entering the building.

  - A photoelectric detection system downstream of the additional filters, arranged to automatically divert collection system air to the outside atmosphere through an abort damper and exhaust stack in the return air duct. The abort damper should be provided with a manual reset and alarm.
  - A spark extinguishing system in the return air duct interlocked with the abort damper.
  - If an explosion suppression system is provided in the collector, also interlock it with the abort damper.
- Arrange and protect belt conveyors used to transport wood waste in accordance with PRC.9.3.1.
- Cut off wood "hogs" or chippers from the adjacent woodworking areas, and locate them outside or along an exterior wall. Provide magnetic collectors for the removal of tramp metal. Arrange metal detectors to divert the feed to a waste bin if the collectors fail to remove any metallic object.
- Arrange boilers firing sawdust or other wood waste products as follows:
  - Detach boilers 50 ft (15 m) from the main building or separate them by a 4 h rated fire wall with double Class A automatic fire doors at openings.
  - Provide combustion controls for nonfuel-related features, such as water level and steam pressure, in accordance with NFPA 85 and PRC.4.0.1.
  - Provide overpressure and low water protection in accordance with PRC.7.0.5.0 and PRC.7.1.0.6.
  - Install automatic sprinkler protection designed for Extra Hazard Group 1 with a 3000 ft^2 (279 m^2) minimum area of application. Extend protection to storage bins and silos.
  - Provide a choke or rotary valve to prevent flashback from the combustion chamber to the wood waste feed system.
  - Locate pulverizing operations in a detached noncombustible building.

Furniture Storage

Protect furniture storage as follows:

- Verify the plastic type and amount in all furniture and packaging materials when determining the commodity classification for designing the sprinkler systems. Choose a commodity classification reflecting the worst plausible storage makeup.
- Choose the worst plausible storage configuration in determining the extent of blockage of sprinkler discharge when deciding on the placement of in-rack sprinklers.
- Install heat and smoke venting in accordance with PRC.2.1.4.
- Locate 1 in. (25 mm) hose connections equipped with 50 ft (15.3 m) of woven-jacket, lined fire hose so that two hose streams can reach any point in the storage area.

Miscellaneous

- Skid all stock 4 in. (100 mm) off the floor.
- Provide inside hose connections throughout the facility, spaced at approximately 100 ft (30 m) intervals and equipped with 50 ft – 75 ft (15 m – 22.5 m) of fire hose and an adjustable nozzle. Supply hose connections in the finishing rooms independently from the ceiling sprinklers. Hard rubber hose on reels would be advantageous in the finishing areas.
- Provide roof-mounted hose cabinets on the roof of the machine rooms, finishing rooms and adjacent roof areas. When hose stations are supplied by dry systems, equip them with instantaneous electrical releases to trip the dry valve. When yard storage of lumber is located within 150 ft (46 m) of buildings, provide roof hydrants or monitors.
- Locate bulk and drum storage of flammable liquids in a protected, cut-off storage vault or detached tank farm.