NONWOVEN MATERIAL STORAGE

INTRODUCTION

A nonwoven material consists of randomly arranged fibers bonded together by either adhesives, hydroentanglement, thermobonding, or needle punch. The fibers may be natural, such as cotton or wood pulp; or synthetic, such as polyester, polypropylene, or polyethylene. Nonwoven materials are used to manufacture products such as diapers, hospital gowns, feminine hygiene products, floppy disk liners, vehicle paddings, pavement underlayments, garments, and fill for sleeping bags, winter jackets, and quilts. Fiberglass insulation, paper, and felt are also well known examples of nonwoven materials.

There are two basic categories of nonwoven materials, highloft material and nonwoven fabric. Highloft material is a low density, thick material. Fill for quilts is an example of a highloft material. Nonwoven fabric is a low to moderately dense, thin material. Felt and disposable garment fabric are examples of nonwoven fabric.

Although fiberglass insulation products and paper are actually nonwoven material products, tests have been conducted to determine their severity. As a result of these tests, protection requirements were derived for these products. Recently rolls of polypropylene batting and polyester fabric have been tested and determined to be a more severe fire protection problem.

POSITION

Rolled Material

General

Cut off the warehouse area from adjacent occupancies with a minimum 3 hr fire wall. Protect steel building columns located within the storage arrangement, or within 3 ft (0.9 m) of the piles, with listed 1 hr fireproofing material.

Sprinkler System Design

Provide automatic sprinkler protection in accordance with NFPA 13 and PRC.12.1.1.0 as modified by this guideline.

Protect rolls of nonwoven material in accordance with Figure 1 and Tables 1, 2 or 3 as applicable, using a wet pipe sprinkler system. When racks are utilized, use 286°F (141°C) ceiling sprinklers, 3000 ft^2 (279 m^2) area of application and quick response, in-rack sprinklers.

Arrange hose connections in accordance with NFPA 13 for the appropriate storage configuration. Use a minimum 750 gpm (2840 L/min) for hose stream allowance. Provide a 2 hr duration water supply.

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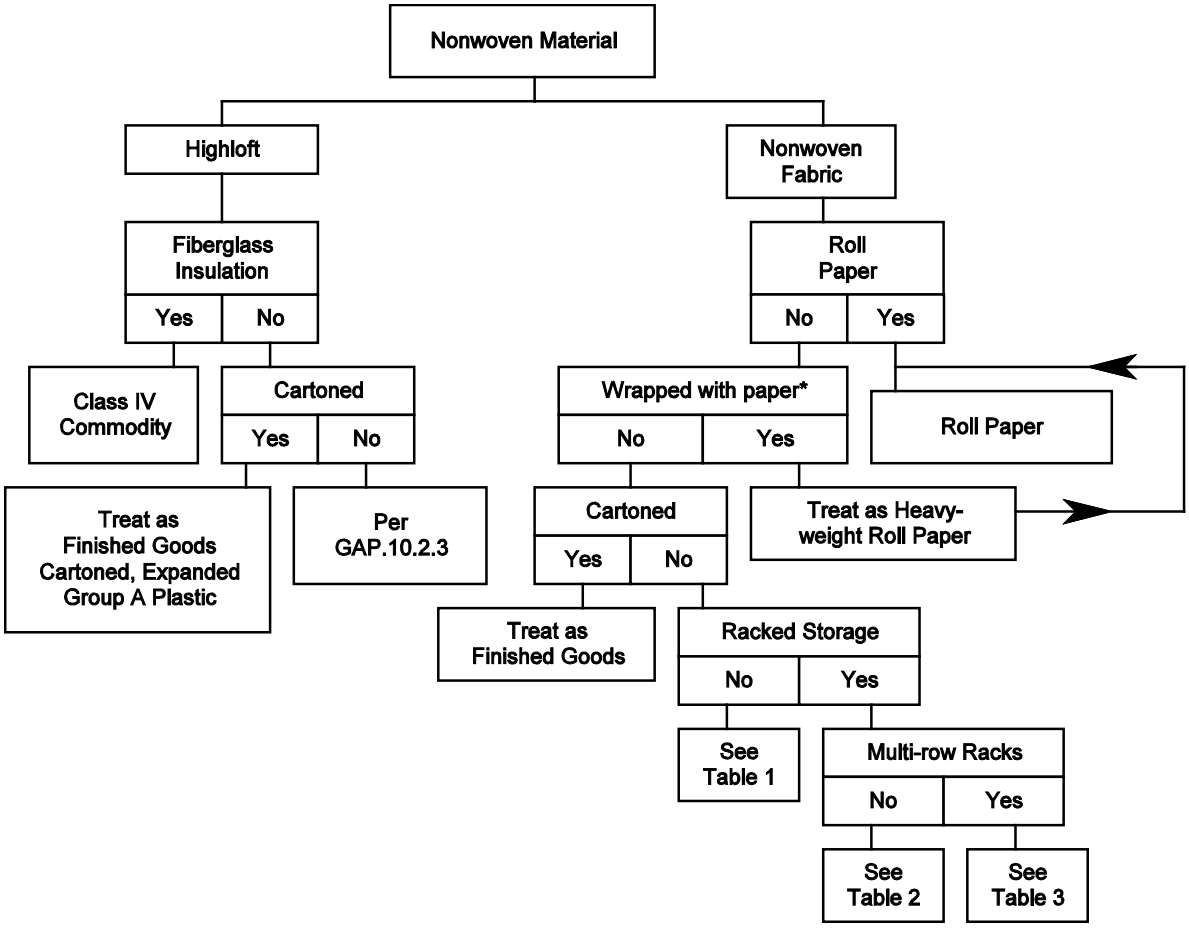


*Wrapped including the ends, with four layers of heavyweight paper.

Figure 1. Decision Tree for Protection of Rolled Nonwoven Material.

TABLE 1

Sprinkler Protection Of Palletized Or Solid Pile Storage Of Nonwoven Fabrics

Building Height	Sprinkler Design	Storage Height	Sprinkler Demand
Maximum 30 ft	large drop sprinklers operating at 75 psi	16 ft or less	20 sprinklers
		between 16 and 20 ft	25 sprinklers

SI Units: m = 0.305 ft; bar = 0.069 psi

TABLE 2
Sprinkler Protection Of Double Row Rack Storage Of Nonwoven Fabrics

Storage Height ft	Ceiling Density gpm/ft^2	In-Rack Design
≤ 10[1]	0.30	Install face and flue sprinklers a maximum 5 ft above the top of storage, staggered 8 ft on centers, and 8 sprinklers operating at 30 psi. (See Figure 2) OR Install a barrier a maximum 5 ft above the of top of storage, with face sprinklers beneath the barrier, staggered 8 ft on centers, 8 sprinklers operating at 30 psi. (See Figure 3)
	0.15	Install a barrier a maximum 5 ft above the of top of storage, with face and flue sprinklers beneath the barrier, staggered 8 ft on centers, 8 sprinklers operating at 30 psi. (See Figure 4)
10 ≤ 15[1]	0.45	Install face and flue sprinklers at mid-level, staggered 8 ft on centers, 8 sprinklers operating at 30 psi. (See Figure 5) OR Install a barrier at mid-level with face sprinklers beneath the barrier, staggered 8 ft on centers, and 8 sprinklers operating at 30 psi. (See Figure 6)
	0.15	Install a barrier at mid-level with face sprinklers beneath the barrier, staggered 8 ft on centers. AND Install a second barrier a maximum 5 ft above the of top of storage, with face and flue sprinklers beneath the barrier, staggered 8 ft on centers, 8 sprinklers operating at 30 psi. (See Figure 7)
15 ≤ 20[1]	0.60	Install face and flue sprinklers at mid-level, staggered 8 ft on centers, 8 sprinklers operating at 30 psi. (See Figure 8) OR Install a barrier at mid-level, with face sprinklers beneath the barrier, staggered 8 ft on centers, and 8 sprinklers operating at 30 psi. (See Figure 9)
	0.15	Install a barrier at mid-level, with face sprinklers beneath the barrier, staggered 8 ft on centers. AND Install a second barrier a maximum 5 ft above the of top of storage, with face and flue sprinklers beneath the barrier, staggered 8 ft on centers, 8 sprinklers operating at 30 psi. (See Figure 10)
> 20[2]	0.60[3]	Install face and flue sprinklers at maximum every 10 ft except for the top 10 ft, staggered 8 ft on centers, 14 sprinklers (seven on each level) operating at 30 psi. (See Figure 11)
	0.45[3]	Install face and flue sprinklers at maximum every 10 ft except for the top 5 ft, staggered 8 ft on centers, 14 sprinklers (seven on each level) operating at 30 psi. (See Figure 12)
	0.15	Install face and flue sprinklers at maximum every 10 ft, staggered 8 ft on centers, and a barrier a maximum 5 ft above the top of storage with face and flue sprinklers beneath the barrier, staggered 8 ft on centers, 14 sprinklers (seven on each level) operating at 30 psi. (See Figure 13) OR Install barriers maximum every 10 ft with face sprinklers beneath the barrier, staggered 8 ft on centers. AND Install a barrier a maximum 5 ft above the of top of storage with face and flue sprinklers beneath the barrier, staggered 8 ft on centers, 14 sprinklers (seven on each level) operating at 30 psi. (See Figure 14)

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2; bar = 0.069 psi

NOTE 1: Maximum building height is 30 ft (9.3 m).

NOTE 2: For storage 25 ft (7.6 m) or greater, provide maximum reliability in accordance with PRC.10.1.2.1 using Figures 10 or 13 in PRC.10.1.2.1.

NOTE 3: Maximum 10 ft (3.1 m) clearance from top of storage to sprinkler.

TABLE 3

Sprinkler Protection Of Multi-Row Rack Storage Of Nonwoven Fabrics

Storage Height ft	Ceiling Density gpm/ft^2	In-Rack Design
≤ 20	0.60[1]	Install face and flue sprinklers at mid-level staggered 8 ft on centers, 8 sprinklers operating at 30 psi. (See Figure 15)
> 20[2]	0.60[1]	Install face and flue sprinklers at maximum every 10 ft except for the top 10 ft, staggered 8 ft on centers, 14 sprinklers (seven on each level) operating at 30 psi. (See Figure 16)
	0.45[1]	Install face and flue sprinklers at maximum every 10 ft except for the top 5 ft, staggered 8 ft on centers, 14 sprinklers (seven on each level) operating at 30 psi. (See Figure 17)
	0.15	Install barriers at maximum every 10 ft level and a maximum 5 ft above the of top of storage, with face and flue sprinklers beneath the barriers, staggered 8 ft on centers, 14 sprinklers (seven on each level) operating at 30 psi. (See Figure 18)

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2; bar = 0.069 psi

NOTE 1: Maximum 10 ft (3.1 m) clearance from top of storage to sprinkler.

NOTE 2: For storage 25 ft (7.6 m) or greater, provide maximum reliability in accordance with PRC.10.1.2.1 using Figures 10 or 13 in PRC.10.1.2.1.

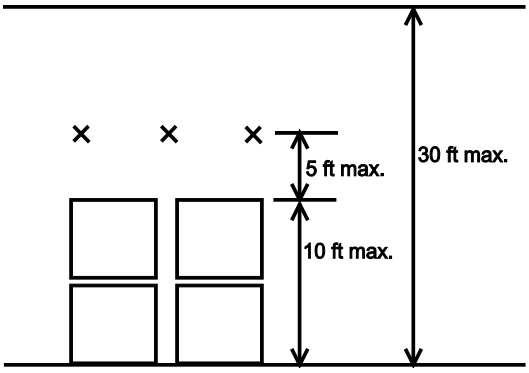


Figure 2. Double Row Rack Without Barriers, 10 ft (3 m) or Less With a Ceiling Density of 0.30 gpm/ft.^{2}

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2

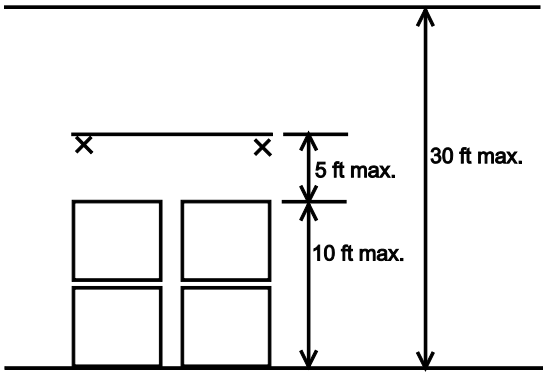


Figure 3. Double Row Rack With Barriers, 10 ft (3 m) or Less With a Ceiling Density of 0.30 gpm/ft.^{2}

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2

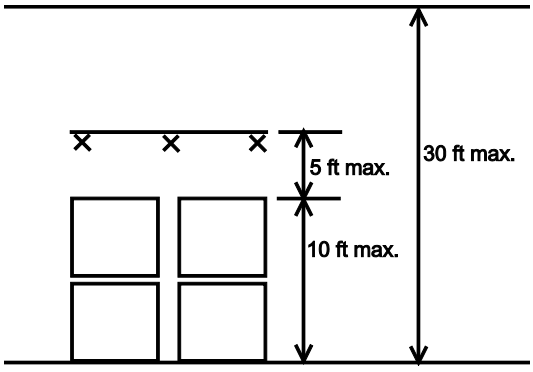


Figure 4. Double Row Rack With Barriers, 10 ft (3 m) or Less With a Ceiling Density of 0.15 gpm/ft.^{2}

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2

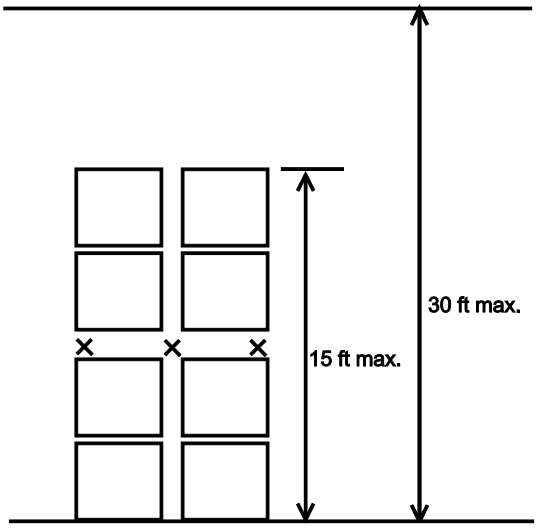


Figure 5. Double Row Rack With Barriers, Between 10 and 15 ft (3 and 4.5 m) With a Ceiling Density of 0.45 gpm/ft.^{2}

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2

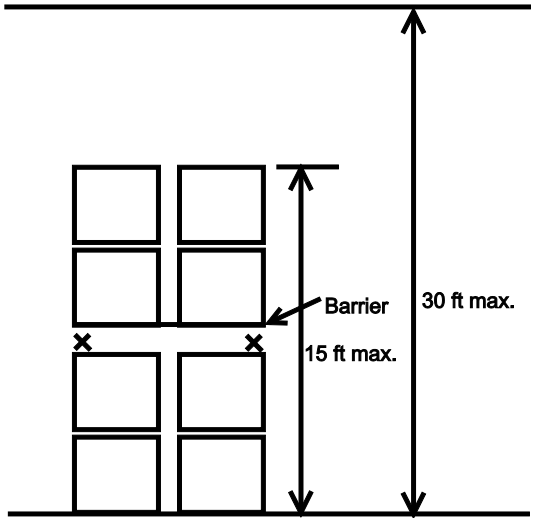


Figure 6. Double Row Rack With Barriers, Between 10 and 15 ft (3 and 4.5 m) With a Ceiling Density of 0.45 gpm/ft.^{2}

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2

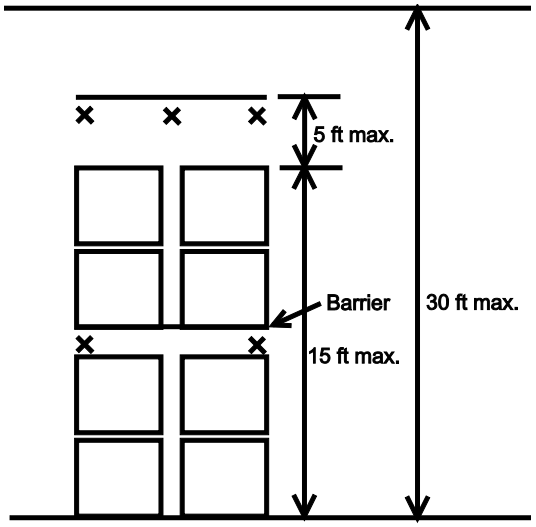


Figure 7. Double Row Rack With Barriers, Between 10 and 15 ft (3 and 4.5 m) With a Ceiling Density of 0.15 gpm/ft.^{2}

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2

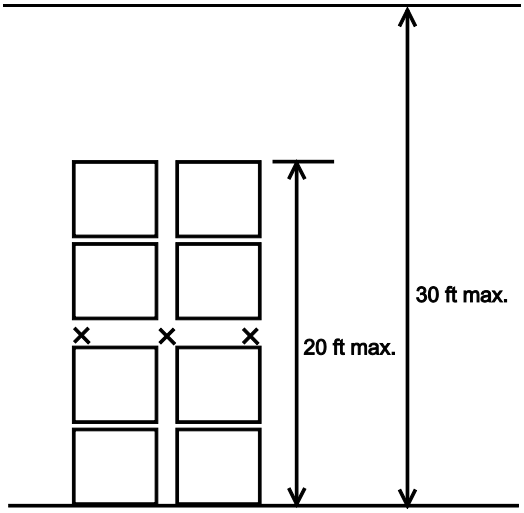


Figure 8. Double Row Rack Without Barriers, Between 15 and 20 ft (4.5 and 6.1 m) With a Ceiling Density of 0.60 gpm/ft.^{2}

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2

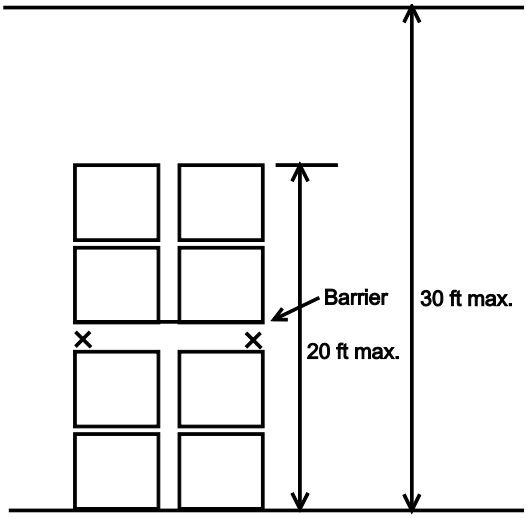


Figure 9. Double Row Rack With Barriers, Between 15 and 20 ft (4.5 and 6.1 m) With a Ceiling Density of 0.60 gpm/ft.^{2}

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2

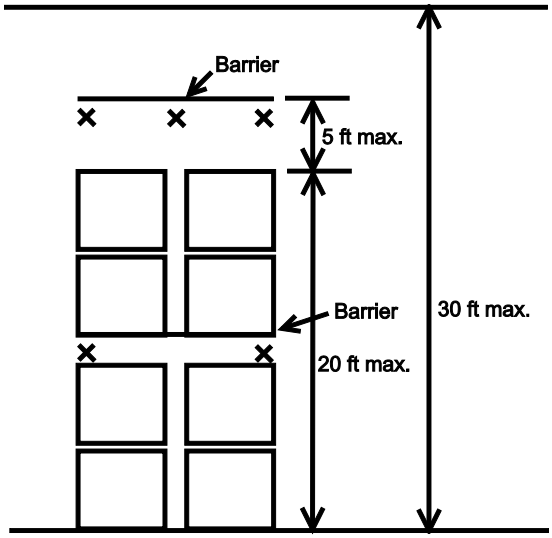


Figure 10. Double Row Rack With Barriers, Between 15 and 20 ft (4.5 and 6.1 m) With a Ceiling Density of 0.15 gpm/ft.^{2}

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2

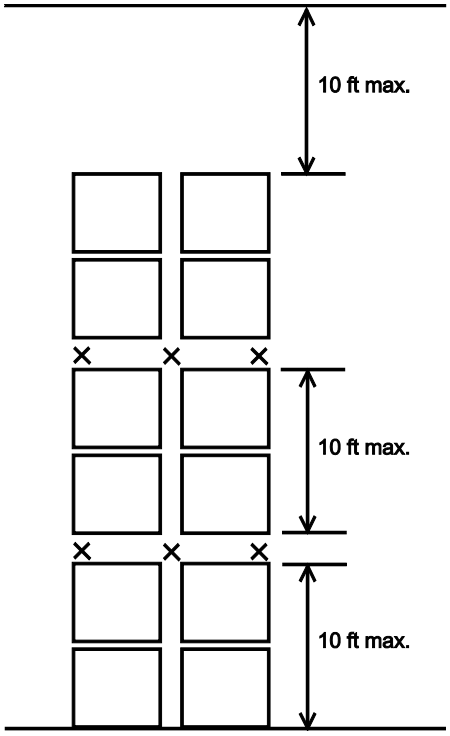


Figure 11. Double Row Rack Without Barriers, Greater than 20 ft (6.1 m) With a Ceiling Density of 0.60 gpm/ft.^{2}

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2

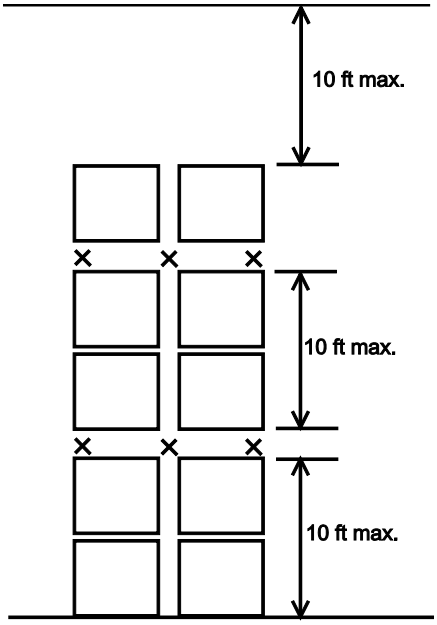


Figure 12. Double Row Rack Without Barriers, Greater than 20 ft (6.1 m) With a Ceiling Density of 0.45 gpm/ft.^{2}

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2

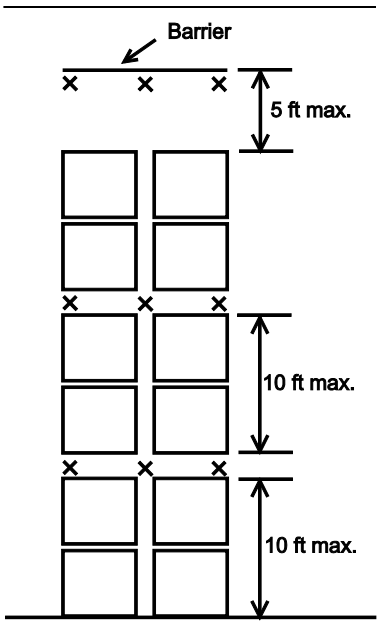


Figure 13. Double Row Rack With Barrier, Greater than 20 ft (6.1 m) With a Ceiling Density of 0.15 gpm/ft.^{2}

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2

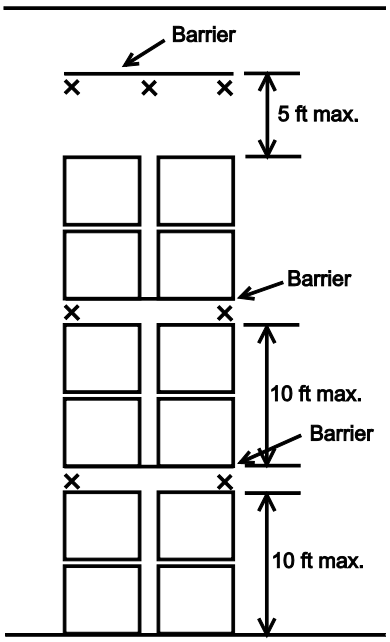


Figure 14. Double Row Rack With Barriers, Greater than 20 ft (6.1 m) With a Ceiling Density of 0.15 gpm/ft.^{2}

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2

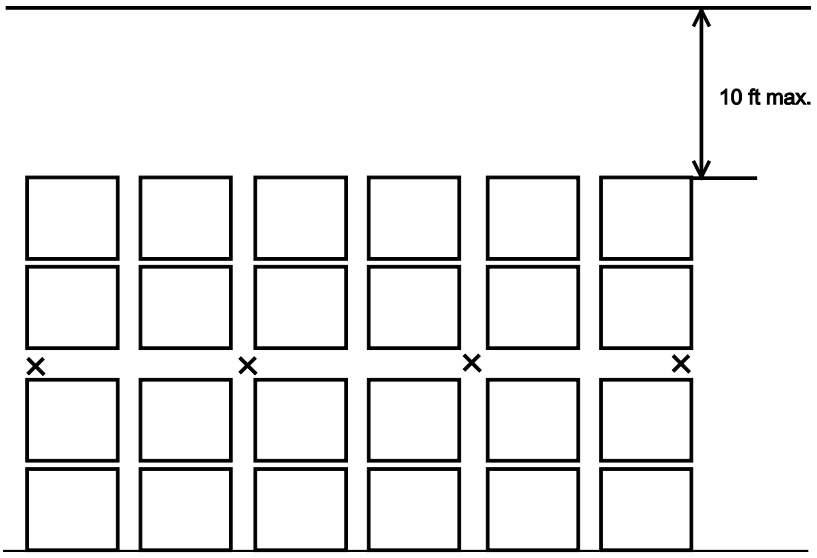


Figure 15. Multi-row Rack Without Barriers, 20 ft (6.1 m) or Less With a Ceiling Density of 0.60 gpm/ft.^{2}

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2

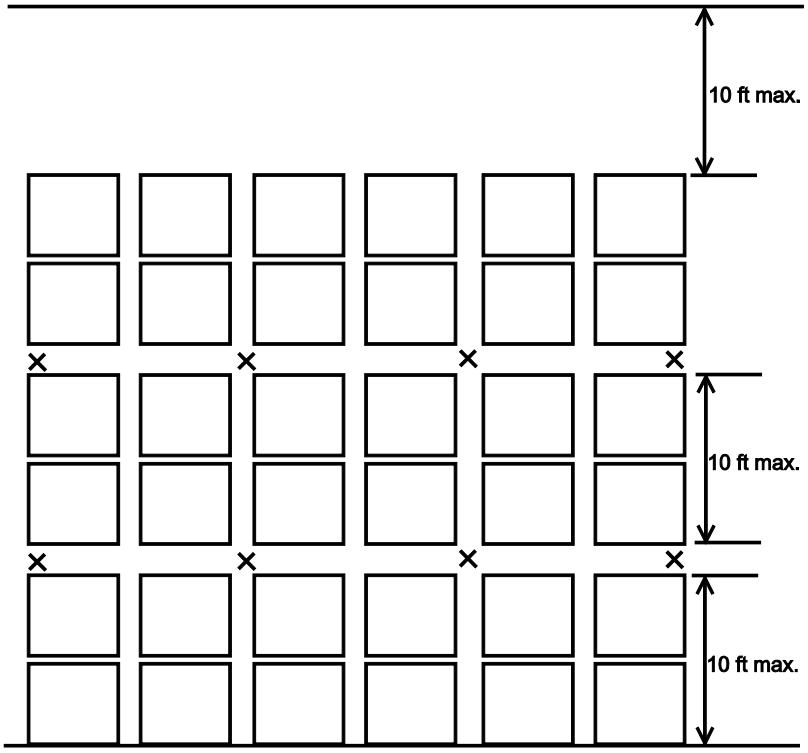


Figure 16. Multi-row Rack Without Barriers, Greater Than 20 ft (6.1 m) With a Ceiling Density of 0.60 gpm/ft.^{2}

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2

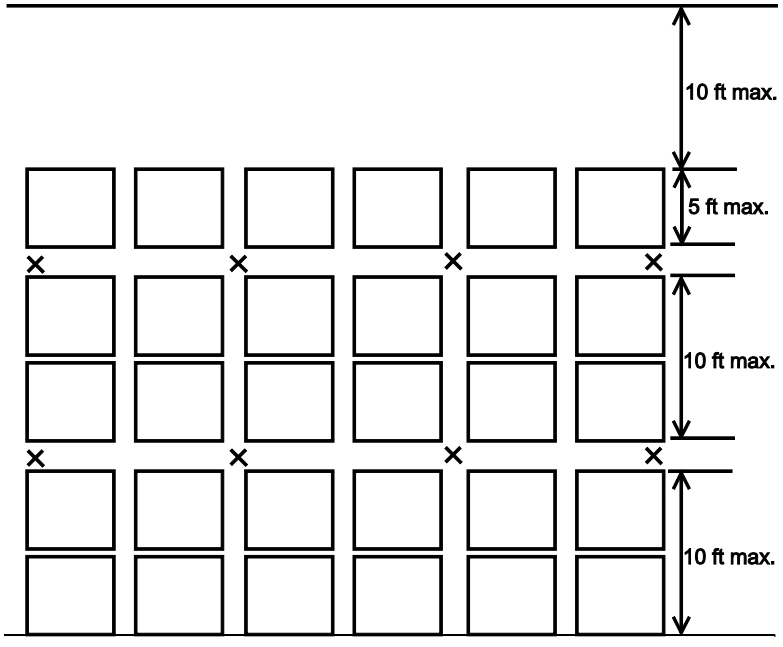


Figure 17. Multi-row Rack Without Barriers, Greater Than 20 ft (6.1 m) With a Ceiling Density of 0.45 gpm/ft.^{2}

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2

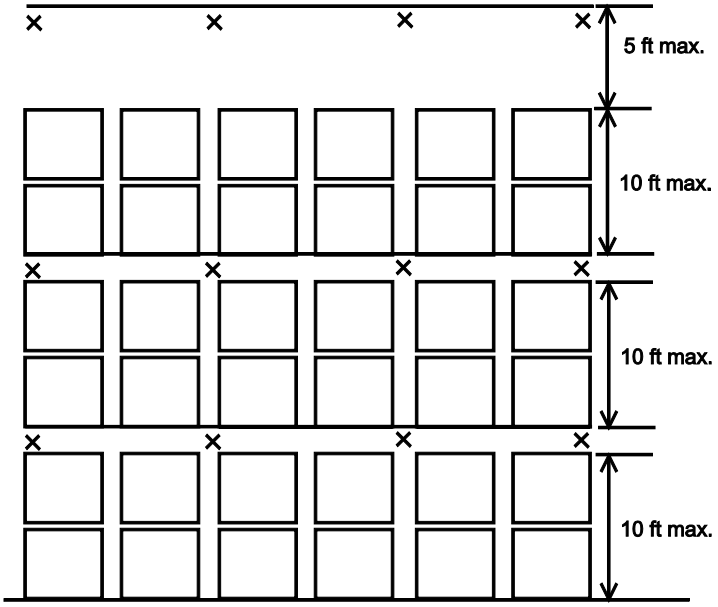
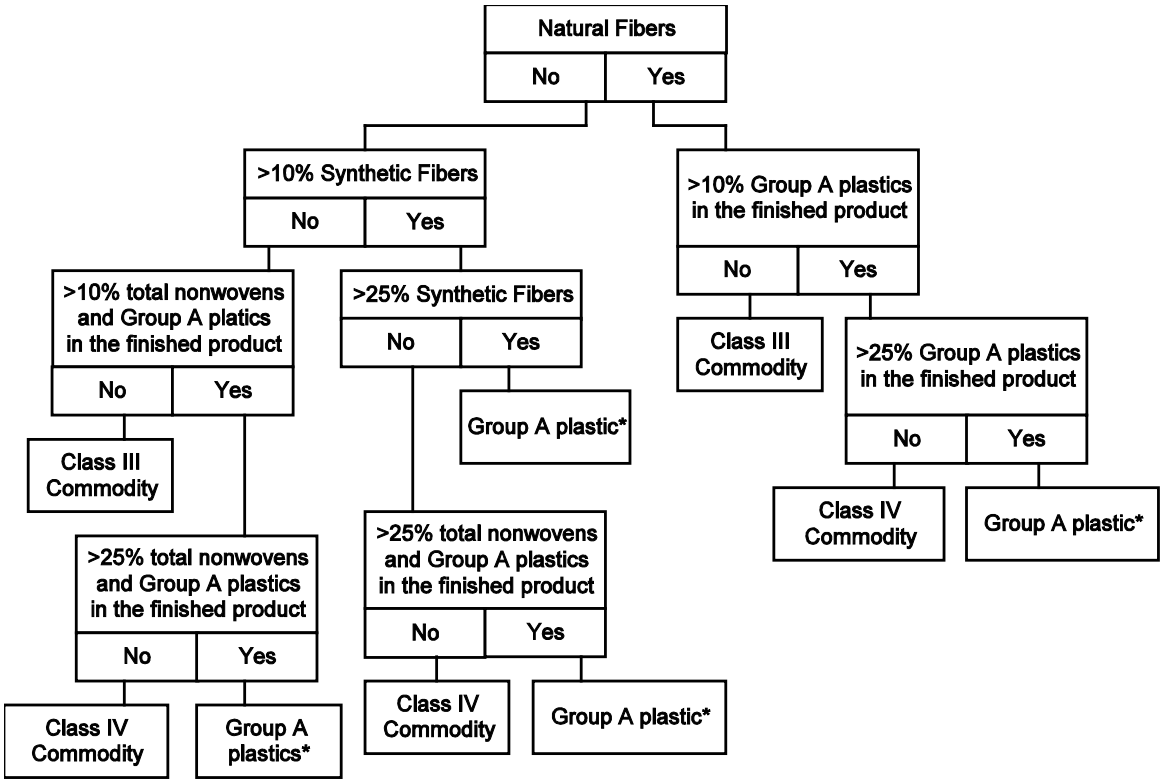


Figure 18. Multi-row Rack With Barriers, Greater Than 20 ft (6.1 m) With a Ceiling Density of 0.15 gpm/ft.^{2}

SI Units: m = 0.305 ft; L/min/m^2 = 40.7 gpm/ft^2



*The type of plastic, expanded or nonexpanded, would dictate the type of protection needed.

Figure 19. Decision Tree for Protection of Finished Products Containing Nonwoven Material

Finished Products

Protect finished products containing nonwoven material in accordance with NFPA 13 for the appropriate arrange arrangement. Use Figure 19 to determine the appropriate commodity classification.

DISCUSSION

Fire tests have show that nonwoven materials have a wide range of heat release rates. Some of these rates are higher than those for Group A plastics. The amount of exposed surfaces and the air entrained in the nonwoven material causes these materials to have a higher heat release rate than either a solid or woven sheet using the same material. Since these products have a high heat release rate and dry pipe systems take longer to deliver water to the fire, dry pipe systems should not be used to protect nonwoven material.

Fires in rolls of synthetic nonwovens are characterized by rapid heat release, pile collapse, deep seated fires, pool fires from molten plastic, and extensive product damage. There has been numerous fire tests conducted on rolled nonwoven materials and finished products containing nonwoven material. From these tests the protection criteria in this section was derived.

In one test, flames reached the top of an 18 ft (5.5 m) stack of rolled rayon within 25 seconds. Four sprinklers operated 40 seconds after ignition, at a density of 0.60 gpm/ft^2 (24.4 L/min). A total of 12 sprinklers operated, but they failed to control the temperature at the ceiling. Most of the stack collapsed, and fire penetrated the rolls up to 1 ft (0.3 m) deep. In another test using polypropylene, it took almost 5 minutes for the flames to reach the top of the 20 ft (6.1 m) high stack. In this test a total of nine sprinklers operated at a density of 0.60 gpm/ft^2 (24.4 L/min). The piles collapsed, and fire jumped the aisle and penetrated the rolls up to 1 ft (0.3 m) deep.