Second in a Series

General Requirements for Storage

By John D. Campbell, P.E., CFPS

There are many factors involved in determining the proper level of protection for storage. A number of questions must be asked, though three primary ones should always be asked: what is the commodity classification is of the material being stored?; what is the storage arrangement involved?; and, how high is the material being stored? The requirements for rack storage differ greatly from those for solid pile, and the protection schemes for wood and paper products differ significantly from those required for rubber tires. However, all storage arrangements and protection have a number of requirements in common. This article will briefly address those requirements.

"The understanding of how to locate and apply the requirements found in Chapter 12 is critical for protecting storage."

In all storage occupancies, certain requirements and conditions must be met. These are typically addressed in the building and fire codes. Fire sprinkler general requirements for storage are addressed in Chapter 12 of NFPA 13. The requirements found in Chapter 12 apply to all storage unless modified in one of the other storage chapters. For example, where automatic roof vents and draft curtains are required by the building and fire codes, NFPA 13 indicates that ESFR protection is not permitted, except that automatic vents can be used provided that the vents use a high temperature rated, standard response activation. Draft curtains that separate ESFR systems from other systems, or separate hazards, are also permitted. The primary concern is to prevent delayed activation of the ESFR system (after a vent has opened) and to eliminate blockage issues (draft curtains).

Chapter 12 also addresses ceiling slope and building and storage heights. All the design criteria found in Chapter 12 and Chapters 14 through 20 are based on a slope not exceeding 2 in 12. Steeper slopes present different challenges and must be addressed differently, and are outside the scope of the standard. Building and storage heights affect sprinklers and the corresponding protection schemes differently and must be considered in the selection of the appropriate design. Clearances between storage and ceilings, as well as between storage and sprinkler deflectors, are factors that must also be taken into consideration when selecting design criteria. Clearances can delay sprinkler operation, as well as affect spray pattern development, and may require a reduction in spacing or an increase in in-rack protection. Some sprinklers have building height restrictions that must also be considered in the design.

High-Volume-Low-Speed (HVLS) Fans are also addressed in Chapter 12. These fans present a significant challenge in that they provide a significant blockage to the spray pattern and affect heat flow. These fans are permitted in sprinklered buildings provided they are limited to a maximum diameter of 24', are centered approximately between four adjacent sprinklers (to allow heat flow to the sprinklers), have a minimum of 3' (.9 m) clearance to the sprinklers, and all fans are interlocked to shutdown on sprinkler activation. Other design consideration issues outlined in Chapter 12 include hose connection requirements, how adjacent hazards should be protected, the use of wet pipe systems, and the need for modifications to the area considered in hydraulic calculations for dry systems.

When designing on a density/area (or CMDA) basis, certain

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orifice size sprinklers, such as K-8.0, are only permitted for certain densities. These are outlined in Chapter 12. In many storage occupancies, design densities exceed .34 gpm/ft², so only K-11.2 or larger orifice sprinklers are permitted. Regardless, the minimum design density permitted by NFPA is .15 gpm/ft². The areas of operation must meet the requirements found in chapters 12–20 with adjustments for special conditions such as unsprinklered combustible concealed spaces and dry and preaction systems.

When dealing with sprinklers that are CMSA or ESFR, design densities are not used, but rather a specific number of sprinklers at defined pressures determine the design requirement. The limiting factor on CMSA and ESFR sprinkler designs is the building height. The design requirements for these designs are based on actual test data that were performed to a maximum building height, and are addressed in Chapters 14 through 17. Water supply requirements are determined based on the design method used (either CMDA or CMSA/ESFR) plus a hose stream allowance. In structures with multiple storage hazards, the water supply is required to be based on the highest hazard requirement(s). Further information on the required hose stream allowances and supply durations are provided in Table 12.8.6.1.

If high expansion foam is utilized in the protection of storage applications, it must be an automatic operating system and must be designed to operate prior to sprinkler operation within the area. Detectors used for activation are required to be spaced at one-half of their listed distances. Idle pallet storage protected by high expansion foam requires that the foam fill time be achieved in a maximum of four minutes. However, using high expansion foam can result in a 50% decrease in the ceiling density provided the minimum density provided is at least .15 gpm/sq. ft.

Idle pallet storage presents unique firefighting issues and the requirements for protection, including high expansion foam, are outlined in Chapter 12. Wood pallets are allowed to be stored outside, within a detached structure, or inside the building. When inside the building, the protection must be either CMDA as outlined in Table 12.12.1.2(a), CMSA as outlined in Table 12.12.1.2(b), or ESFR as outlined in Table 12.12.1.2(c). When using CMDA, however, pallet height is limited to a maximum of 6' with a maximum clearance of 20' to the ceiling. In each of these situations, specifically indoors, wood pallets cannot be stored in racks.

Plastic pallets present an even greater challenge to the design professional. While plastic pallets can be stored in the same locations as wood pallets, the preferred protection criteria utilize ESFR sprinklers in accordance with Table 12.12.2.2.3. Standard spray sprinklers may be used for the protection of plastic pallets indoors, provided one of the following situations exists:

- Pallets are stored in a cut-off room.
- Pallet storage is separated from the rest of the building by a three-hour wall.
- A density of .60 gpm/sq. ft. is provided over the entire room. (high expansion foam and sprinklers delivering .30 gpm/sq. ft. is an approved alternative)
- Storage is no higher than 12'.
- Steel columns are protected by spray-on fireproofing, or a sidewall sprinkler at 15' above the floor.

Cut-off rooms have specific limitations in storage height, room height, density, and K-factor, which must be followed in order to allow for plastic pallet storage. Merely putting these items in a cut-off room is not enough to provide adequate protection. Where the storage of plastic pallets is not higher than 4', the pallets have no more than two stacks per pile that are separated by at least 8', or are located 25' from stored commodities, the overhead system can be designed for an Ordinary Group 2 occupancy, but must utilize high-temperature rated sprinklers.

Finally, idle pallet storage in racks is acceptable provided that the storage is limited to the lowest level of the racks, where no storage or shelving is located above the pallets and the applicable protection outlined previously for idle pallet storage is provided.

The understanding of how to locate and apply the requirements found in Chapter 12 is critical for protecting storage. Remember that Chapter 12 applies to all storage and its requirements must be followed unless modified by one of the other storage chapters.

About the Author:

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Next Month: Part 3

Chapter 13 Miscellaneous Storage

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