Shelving and Fire Codes

Today’s shelving systems integrate fire code requirements as a major part of design. Most municipalities require fire protection for shelving in some form or another. The building classification and the commodities being stored dictate the level of protection required. Any system considered High Piled Storage (12 ft. and higher) requires fire protection in the form of an automatic sprinkler system.

The codes can be complicated and confusing, as they tend to use different terminology than we use for shelving. Pallet rack and shelving are lumped together as the code makes little distinction between the two.

This is where we need to be careful in how we define the shelving system. For most High Rise and Catwalk systems it is recommended that a fire protection consultant familiar with shelving be contacted and hired to prepare the plans and specifications for fire permit submittal. I have found that consultants are better than sprinkler contractors as the consultant is more specialized and can put together a package that can be bid on by contractors if additional fire protection is required. Borroughs has used Warde Comeaux, Fire Protection International Consortium. Warde does all of the Iron Mountain record archive catwalk systems and has done several Borroughs catwalk systems. Greg Cox, Premier Fire Consulting, did the HC Pacific project using the Press-Lock shelf featured in the April newsletter. Typical cost is $3,000-$5,000 which generally pays for itself in streamlining the permit process. Both consultants will work on a national basis.

The main governing fire code for shelving is either the International Fire Code Chapter 23 High-Piled Combustible Storage, or NFPA 13 Standard for the Installation of Sprinkler Systems. This report references the NFPA 13 2010 Edition. Also be aware that states may have their own fire codes that override the NFPA. For instance California has the California Fire Code, CFC. The definitions in each code are similar if not identical.

The NFPA (National Fire Protection Association) has its own definitions for shelving. It is important to note the type of shelving as it affects the design. Most of the special design requirements come into effect with High-Piled Storage.

Below are some NFPA 13 definitions that relate to shelving systems. Many of the definitions appear to overlap. Choosing a way to describe a system can affect the way shelving is designed: open, closed, open grate shelves, or a combination of these.

3.9 Storage Definitions

3.9.1.4 Catwalk. For the purposes of carton records storage, a storage aid consisting of either open metal grating or solid horizontal barriers supported from a rack storage system that is utilized as a walkway for access to storage at elevated levels. Catwalks are accessed using stairs and are not separate floors of a building.
Note that the last part of this “not separate floors of a building” is important as it relates to general building codes which have much more stringent requirements if the system is considered a building floor. This is why we define our systems as “High-Rise Shelving with Catwalks” and not mezzanines as they are often classified as building floors.

3.9.17 High-Piled Storage. Solid-piled, palletized, rack storage, bin box, and shelf storage in excess of 12 ft. in height.

3.9.2 Palletized, Solid Pile, Bin Box, and Shelf Storage
3.9.2.2 Bin Box Storage. Storage in five-sided wood, metal or cardboard boxes with open face on the aisles. Boxes are self-supporting or supported by a structure so designed that little or no horizontal or vertical space exists around boxes.

This type of shelving is typically closed shelving, often with full height dividers.

3.9.3.7.5 Single Row Rack. Racks that have no longitudinal flue space and that have a depth up to 6 ft. with aisles having a width of at least 3.5 ft. between loads on racks.

For shelving units 32 in. or 36 in. deep back-to-back it may be better to describe the system this way as opposed to Back-to-Back Shelf Storage. Deep B-Span or Rivet Span should be defined this way. Be sure the aisles are at least 42 in. wide.

3.9.2.6 Shelf Storage. Storage on structures up to and including 30 in. deep and separated by aisles a least 30 in.

Note that B-Span and Rivet Span often have depths over 30 in. When the shelving is 12 ft. or higher this typically necessitates 50% open grate shelves such as wire decks or Press-Lock. DACS inc. makes Punch Deck® perforated corrugated deck with a 50% open area as well.

3.9.2.6.1 Back-to-Back Shelf Storage. Two solid or perforated shelves up to 30 in. in depth each, not exceeding a total depth of 60 in., separated by a longitudinal vertical barrier such as plywood, particle-board, sheet metal, or equivalent, with a maximum 0.25 in. diameter penetrations and no longitudinal flue space and a maximum storage height of 15 ft.

This definition is potentially the most problematic for steel shelving. Technically it eliminates open style shelving with solid shelves in double deck or triple level systems. We have been successful using closed-type shelving classified as Bin Box Storage.

3.9.3.8 Solid Shelving. Solid shelving is fixed in place, slatted, wire mesh or other type of shelves located within racks. The area of a solid shelf is defined by perimeter aisle or flue space on all four sides. Solid shelves having an area equal to or less than 20 ft² shall be defined as open racks. Shelves of wire mesh, slats, or other materials more than 50 percent open and where the flue spaces are maintained shall be defined as open racks.

This NFPA definition of Solid Shelving with regards to the area of 20 ft² is more restrictive than the International Fire Code (IFC) Section 2308

Rack Storage 2308.2.2 Racks with solid shelving. Racks with solid shelving having an area greater than 32 square feet measured between approved flue spaces at all four edges of the shelf, shall be in accordance with this section.

Exceptions:

1. Racks with mesh, grated, slatted or similar shelves having uniform openings, not more than 6 inches apart, comprised of at least 50 percent of the overall shelf area, and with approved flue spaces are allowed to be treated as racks without solid shelves.
2. Racks used for the storage of combustible paper records, with solid shelving, shall be in accordance with NFPA 13
With respect to the April Newsletter HC Pacific case study, Greg Cox, Premier Fire Consulting, used the IFC code with the 32 sq. ft. area. The open grate Press-Lock shelf provided a Longitudinal Flue Space by restricting a 6 in. space at the edge of the shelf. The system uses 48x18 shelves back-to-back, making a cluster of four Solid Shelving sections 32 sq. ft. every third unit having the open grate shelf. The aisle acted as a Transverse Flue Space.

Here are the flue space definitions:

3.9.3.6 Longitudinal Flue Space. The space between rows of storage perpendicular to the direction of loading with a width not exceeding 24 in. between storage. Typically this is obtained by a periodic 6 in. space between units of storage. In the HC Pacific example a 6 in. space along the edge of the Press-Lock shelf created this space eliminating the need to separate the shelving structure. In lieu of an open space, we have successfully used a solid side panel, called a Bulkhead 3.9.3.3 A vertical barrier across the rack. But not all fire officials are accepting this.

3.9.3.9 Transverse Flue Space. The space between rows of storage parallel to the direction of loading.

This is not practical with steel shelving. Limiting the units to 60 in. deep back-to-back eliminate the need for these flue spaces. Alternative is to use solid backs as a Barrier, effectively cut the size of the rows in half. Also adding closed sides turns the shelving into Bin Box Storage eliminating all flue spaces. The aisle is considered a Transverse Flue Space.

3.9.3.4 Face Sprinklers. Standard sprinklers that are located in transverse flue spaces along the aisle or in the rack, are within 18 in. of the aisle face of storage, and are used to oppose vertical development of fire on the external face of storage.

These sprinklers are located underneath the catwalks and hang from the catwalk beams. Sprinklers over the top of the system must have an 18 in. horizontal plane clearance from the shelving or stored product.

Greg Cox, Premier Fire Consulting, recently worked with a Southern CA fire department in developing a fire plan for a large Borroughs 3-level catwalk system. By doing an engineering analysis of the fire sprinkler placement, volume and spray patterns, he was able to get solid shelves with closed backs and sides approved without any longitudinal or transverse flue spaces within the shelving units. The aisles acted as transverse flue spaces. Sprinklers were placed under each catwalk thereby reducing the High-Piled storage height of each level to under 12 ft. The building has ceiling sprinklers as well. The value of this type of consulting resulted in an over-the-counter fire permit and preserved the design of the shelving, more than paying for the consulting fees.

There is no single way to define a shelving system and the code is interpreted many different ways by fire departments. Many departments are not intimately familiar with shelving systems and consequently interpret a worse-case scenario. Having a fire consultant prepare the plans guides the fire department and gives them confidence that it is done properly, thereby making them more comfortable approving the plan.

Mike Mahaffey
Industrial Systems Project Manager
800-748-0227 | mmahaffey@borroughs.com