

**Carlsbad Fire Department
Fire Prevention Bureau**

**Guideline for
High-Piled Combustible Storage**



Approved and Authorized By:

Randall Metz, Fire Marshal

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Guideline for High-Piled Combustible Storage

PURPOSE

This guideline provides the requirements for the protection of high-piled storage (HPS) for a variety of commodities. HPS increases the potential fire hazard within a structure by increasing the vertical height of storage. The following requirements will ensure that the minimum measures required by code have been taken to provide for the public safety and that the required protection of these commodities has been designed in accordance with Chapter 32 of the 2019 California Fire Code (CFC), the 2019 California Building Code (CBC) and locally adopted ordinances enforced the City of Carlsbad.

SCOPE

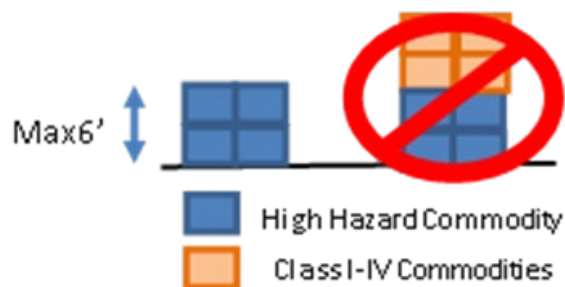
This guideline provides the requirements for all HPS within the City of Carlsbad.

Definitions

High-Piled Combustible Storage

The storage of combustible materials in closely packed piles, on pallets, in racks, or on shelves where the top of storage is greater than 12 feet in height. High-piled combustible storage also includes certain high-hazard commodities, such as rubber tires, Group A plastics, flammable and combustible liquids, idle pallets, and similar commodities where the top of storage is greater than 6 feet in height.

Note: To be considered non-high pile combustible storage for high hazard commodities < 6 feet there cannot be any storage above it.



High-Piled Storage Area

An area within a building that is designated, intended, proposed, or actually used for high-piled combustible storage. For purposes of selecting the applicable fire protection requirement row in Table 3206.2:

- A. This area shall include the “footprint” of the actual storage array (racks, shelves, fixtures, or pallets), inclusive of aisles within the storage area(s). When individual storage arrays are separated by less than 15-foot spaces, the spaces shall be considered aisles and shall be included in a single storage area footprint. When individual storage arrays are separated by more than 15-foot spaces, the individual arrays shall be considered separate storage areas with their own footprint calculation.
- B. Each storage area shall also include a 48-inch perimeter aisle calculated in the footprint. This additional perimeter aisle is not required for areas that abut to a wall. The aisle is the space between the racks not at the end of the rack.
- C. For multiple storage areas within a building, the aggregate of all high-piled storage areas shall be used for selecting the applicable row in Table 3206.2, unless such areas are separated from each other by a one-hour rated fire barrier wall constructed in accordance with Section 707 of the California Building Code (CBC). Openings in such walls shall be protected by fire assemblies having a one-hour fire-protection rating. CFC 3206.3.2.1.

Rack Storage

A combination of vertical, horizontal, and diagonal members that support stored materials. Racks can be fixed or portable. NFPA13 Section 3.9.3.7.

Open Rack

Racks without shelving or with shelving in racks that are fixed in place with shelves having a solid surface and shelf area equal or less than 20 ft² or with shelves having a wire mesh, slatted surface, or other material with openings representing at least 50 percent of the shelf area including the horizontal area of the rack members and where the flue spaces are maintained.

Shelf Storage

Storage on shelves less than 30 inches deep with the distance between shelves not exceeding three feet vertically. For larger shelves and other storage arrangements see Rack Storage. 2016 NFPA 13 Section 3.9.2.6.

Solid Shelving

Shelving that is solid, slatted, mesh, or grated, or of other construction and less than 50% open located within racks that obstruct sprinkler water penetration through the racks. Within the codes that regulate HPS there are two different thresholds when the size of shelf is considered solid; the Fire Code specifies 32 ft² while NFPA 13 specifies 20 ft². Carlsbad’s interpretation is

that in a non-sprinklered building 32 ft² applies; in a sprinklered building 20 ft² applies. In sprinklered buildings two factors are used to determine if the shelf is considered solid; the construction type of the shelf and the size of the product that will be stored on the shelf. If the item stored has a horizontal area that exceeds 20 ft² in size the shelf is considered solid regardless of the construction of the shelf. As an example the HPS uses wire mesh shelves with an opening greater than 50%. The commodity being stored is on a non-standard pallet of 4' deep by 6' wide, total horizontal size = 24 ft². The shelving would be considered solid since the commodity exceeds 20 ft² irrespective that the shelf is wire mesh.

SUMBITTAL REQUIREMENTS

1. General

- A. At the time of permit application, plans and specifications, including but not limited to the information listed below, shall be submitted for review and approval. For certain HPS reviews, the services of a design professional familiar with the requirements contained in CFC Chapter 32 may be of great assistance. All new plan submittals and revisions will consist of 3 plan hard copies. Plans shall be submitted with the following information per CFC 3201.3 Items #1-14:
- B. A letter of intent containing a detailed description of the products to be stored and the description of all containers, pallets, and packaging materials. This letter must also include a detailed description of the storage methods (racks, shelves, pallets), the total storage area in square feet, maximum storage height, and aisle widths. An authorized officer of the company or business must sign this letter. The letter shall be copied onto the plans.
- C. A scaled site plan that shows the entire building, including all fire access lanes, fire hydrants, fire department connection, and fire sprinkler risers. CFC 3206.6.
- D. A scaled floor plan of the building showing locations and dimensions of the HPS area, location of the racks, and access doors to the storage area.
- E. The maximum desired/proposed storage height for each designated storage area per array. This height is measured from the finished floor to the highest point of the commodity stored (not shelf level).
- F. The number of tiers within each rack.
- G. The commodity clearance between the top of storage and the sprinkler deflector for each storage arrangement.
- H. Aisle dimensions between each storage array. Aisles are measured from the actual edge of the commodity to commodity, not rack to rack.
- I. Maximum pile volume for each storage array for solid pile and shelf-storage.
- J. The location and classification of different commodity classes. In sprinklered buildings with multi-tenant spaces, where the HPS area is less than 12,001 ft² and the building

does not have access doors spaced per CFC 3206.6 and smoke & heat vents are not provided, the plan shall show one of the following:

1. Once verification is made, identify the full height wall between the adjacent tenant space is a minimum of a one-hour fire barrier per CBC Section 707, or
2. Identify all HPS areas in all adjacent tenant spaces. The aggregate of all areas of HPS within the building shall be used to determine fire protection and life safety features per Table 3206.2. The protection required by Table 3206.2 will be based on the individual HPS areas commodity classification and extends the lesser of 15 feet in all direction or to a full height partition.

In sprinklered buildings with multi-tenant spaces, where the HPS area is > 12,000 ft² the plan only needs to show the protection and life safety requirements per Table 3206.2 for the new HPS area.

- K. The location of commodities that is banded or encapsulated.
- L. The dimension and location of the transverse and longitudinal flue spaces.
- M. Identify the sprinkler design. The sprinkler design requirements are based on commodity type, aisle width, and sprinkler temperature rating as outlined in 2016 NFPA 13, Chapter 12-18 (e.g., .45/3000 with 286-degree heads). A complete sprinkler design shall be submitted under a separate Service Request number by a C16 licensed contractor.

If the sprinkler design is only provided for the HPS area while the surrounding sprinklers are of a different design, identify the sprinkler protection area for the HPS; insure it extends the lesser of 15 feet in all direction or to a full height partition. NOTE: The 15 feet begins at the outer most portion of the required aisle as set forth in CFC 3206.10.1.1.

- N. The location of all steel columns in relationship to the racks. All steel columns located within a rack flue space or immediately adjacent to a rack in an aisle may require protection. See 2016 NFPA 13, Section 16.1.4, 17.1.4, or 18.2.1
- O. The location, make, model, type, and automatic link temperature of the automatic/manual release smoke vents. In sprinklered buildings, the fusible links for smoke and heat vents shall operate at a temperature no less than 100 degrees and no more than 200 degrees above the sprinkler rating. In non-sprinklered buildings, the fusible links shall operate between 100 and 220 degrees above the ambient temperature. Gravity-operated drop-out vents shall operate at 500 degrees.

Note: New construction shall only use approved/labeled smoke vents as specified by CFC 3206.87. Required smoke vents in existing structures (constructed under the 1998 or previous codes) shall be inspected for proper operation (manual & automatic) and

proper link temperature by an independent qualified contractor. Non-required existing vents shall be either treated as a required vent or shall have the automatic and manual mechanism deactivated including the removal of the release handles.

An inspection report by the inspecting contractor shall be provided to CFD prior to plan approval. The report, at a minimum, shall identify the year the building was constructed, a roof plan showing the location of each vent inspected, the fusible link temperature rating, the presence of a manual release mechanism, and the operational status of each vent. Prior to submitting the report to CFD, all identified deficiencies must be corrected and included within the report.

If the smoke vents do not contain manual release devices, and CFD determines that the manual release devices were not specifically required at the time of construction or during any previously approved high piled storage use, then manual release devices will not be required. CFD staff will evaluate all other conditions on a case by case basis during the review process. If this requirement is placed, CFD staff will indicate the requirement adjacent to the CFD approval stamp on the final approved plans from the proposed operation. The vent inspection report shall be copied onto the plans prior to OFM plan approval.

Establishing HPS in an existing building where the building owner can demonstrate that the smoke & heat vents have been maintained and inspected per NFPA 204 a new inspection report will not be required.

- P. If required, the design (construction), location, and depth of the curtain board assembly, if applicable.
- Q. The occupancy group as defined by CBC Chapter 3.
- R. Pallet/commodity stop details for maintaining the required flue space (see attachment 2-4).
- S. CFD requires High Pile Storage Minimum Information Form (Attachment 8) completed and copied onto the first sheet of the HPS plan.

2. California Fire Code Permits—CFC 3201.2

- A. Plans and specifications shall be submitted to the CFD as indicated elsewhere in this document. All permits will be issued following plan approval and completion of corresponding inspections of the HPS installation. A CFC permit is required when a building or portion thereof is used for high-piled storage exceeding 500 square feet in area (see the definition of high-piled storage area under “Scope”).

3. Commodity Classification—CFC 3203

- A. Commodities shall be classified as Class I, II, III, IV, or High Hazard, in accordance with CFC Chapter 32 and referenced standards.
- B. Plastics shall be classified as Group A, B, or C in accordance with CFC Chapter 32. To determine the proper commodity classification of products with limited quantities of Group A plastics in mixed commodities, use CFC Figure 3203.9(2). This figure identifies the quantity of Group A plastics allowed to be stored in a package, carton, or on a pallet without increasing the hazard and commodity classification to “high hazard”.
- C. The designation and protection features of a high-piled combustible storage area intended for storage of different commodity classes shall be based on the highest hazard commodity stored, except as otherwise provided for by engineering analysis in CFC 3204.2.

Note: Flammable liquids, flammable solids, flammable gasses, aerosols, explosives, oxidizers, and reactive materials, etc. fall under the category of hazardous materials and have additional codes that apply. Storage of hazardous materials often shall require submittal and approval of additional plans prior to further review of the high-piled storage plan.

4. General Fire-Protection Provisions—CFC 3206

- A. Fire-protection features for high-piled storage areas shall be in accordance with CFC Chapter 32 and other nationally recognized standards approved by the OFM. Fire-detection systems, smoke and heat removal, curtain boards, and fire sprinkler design densities shall extend to 15 feet beyond the high-piled storage area or to a permanent partition, whichever is least. CFC 3206.2 The aggregate of all high-piled storage areas within a building shall be used to design the fire protection features found in CFC Table 3206.2 (attached), unless such areas are separated from each other by a one-hour fire barrier wall constructed in accordance with CBC 706. Distinct occupancy groups shall be separated according to CBC 508.

5. Fire Sprinkler Systems-CFC 3206.4

- A. Fire-protection features for high-piled storage areas shall be in accordance with CFC Chapter 32 and other nationally recognized standards approved by the OFM. Fire-detection systems, smoke and heat removal, curtain boards, and fire sprinkler design densities shall extend to 15 feet beyond the high-piled storage area or to a permanent partition, whichever is least. CFC 3206.2 The aggregate of all high-piled storage areas within a building shall be used to design the fire protection features found in CFC Table 3206.2 (attached), unless such areas are separated from each other by a one-hour fire barrier wall constructed in accordance with CBC 706. Distinct occupancy groups shall be separated according to CBC 508.

6. Fire Detection Systems—CFC 3206.5

- A. When fire detection is required by CFC Table 3206.2, an approved automatic fire detection system shall be installed in accordance with 2016 NFPA 72 standard throughout the high-piled storage area. This system shall be installed and monitored as required by CFC 907.

7. Fire Department Access—CFC 3206.6

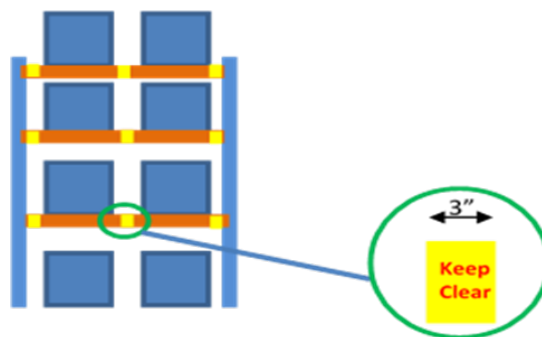
- A. When building access is required by CFC Table 3206.2, access roadways shall be provided to within 150 feet of all portions of the exterior walls of the building used for high-piled storage. When access doors are required by CFC Table 3206.2, they shall be provided in each 100 lineal feet or fraction thereof, of the exterior wall that faces the required access roadway. The required access doors shall be distributed such that the lineal distance between adjacent doors does not exceed 100 feet.

8. Smoke and Heat Removal—CFC 3206.8

- A. When smoke and heat removal are required by CFC Table 3206.2, smoke and heat vents shall be of an approved type and shall operate automatically by a heat response device and contain a manual release roof handle. Vent size shall be in accordance with CFC Section 910. The fusible link temperature shall be rated as specified in Section 1-0 above. Smoke and heat vents are not required when storage areas with an exit access travel distance of 250 feet or less and protected by early suppression fast response (ESFR) sprinkler systems installed in accordance with 2016 NFPA 13. Smoke vents shall be inspected and maintained in accordance with NFPA 204.

9. Rack Flue Spaces-CFC 3208.3

- A. Requirements for flue spaces within the rack storage are provided in CFC Table 3208.3 (attached). Single and double row racks shall be equipped with a transverse flue space. Either a mechanical means shall be provided to maintain the transverse flue space, or the load beam shall be painted with a 3-inch yellow strip with the words in red that read, “Keep Clear,” as indicated below. Durable vinyl tape or other appropriate material may be used in lieu of paint, or other methods as approved by CFD.



- B. Double-row racks shall be equipped with a pallet/commodity stop along the longitudinal flue space at each level. The stop along the longitudinal flue space shall be steel or other ferrous material ¼" thick and, in the mounted position, shall extend a minimum of 4 inches above the shelf or cross member, or other method (i.e., 9 gauge chain link) approved by the fire code official (CFC 3208.3; see Attachment 4). In double row racks, where products are hand-stacked, chain link shall be securely attached to the rear of both racks. The chain link shall be a minimum of 12 gauge. Attachment method shall be in compliance with Figure 3208.3 (Attachment 5) or other methods as approved by the fire code official.
- C. Alternative acceptable designs are outlined in Attachment 1 through 7. If an alternate design outlined in the attachments is used, the appropriate detail or details shall be copied onto the plan.

NOTE: Regardless of the design of the pallet stop, the flue space shall be measured from the back of the pallet stop to the back of the pallet stop (see Attachment 8).

- D. Transverse flue space is measured as the distance between the loads, not the distance between the racks. A flue space's net width is a measure of its gross width minus any horizontal obstructions, such as rack uprights, located within the flue space. In other words, a rack upright (typically 3 in. wide) is not considered a flue space, due to the cross bracing used.

10. Solid Piled and Shelf Storage

- A. Shelf storage, storage in solid piles, solid piles on pallets, and storage in bin boxes not exceeding five feet in any dimension shall be in accordance with CFC 3206 and 3207.

11. Rack Storage

- A. Rack storage in a non-sprinklered building shall be in accordance with CFC 3206 and 3208. Rack storage in a sprinklered building shall be in accordance with CFC 3206 and 3208; however, the sprinkled protection for solid shelves shall be based on NFPA 13 definition for solid shelves.

12. Automated Storage

- A. Automated storage similar to carousel storage shall be in accordance with CFC 3209.

13. Specialty Storage-CFC 3210

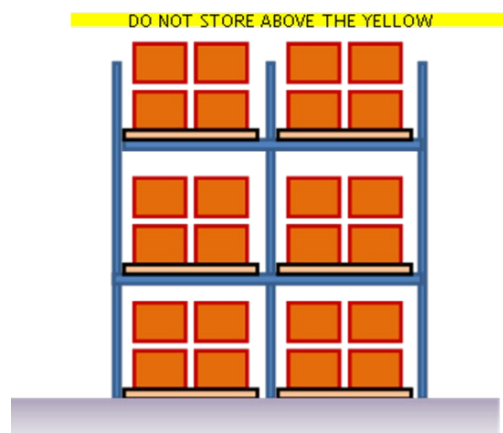
- A. Record storage facilities used for rack or shelf storage of combustible paper records greater than 12 feet in height shall be in accordance with CFC 3206, 3208, and NFPA 13. Palletized storage of records shall be in accordance with CFC 3207.

14. Approved storage layout

- A. A floor plan, of legible size, shall be provided, mounted on a wall and protected from damage. The floor plan shall be mounted in an approved location and show the following:
1. Locations, dimensions and rack layout of high-piled storage areas.
 2. Design storage height for each storage area.
 3. Types of commodities.
 4. Commodity clearance between top of storage and the sprinkler deflector for each storage arrangement.
 5. Aisle dimensions between each storage array.
 6. For palletized and solid-piled storage, the maximum pile volume for each storage array.
 7. Location and classification of commodities in accordance with Section 3203.
 8. Location of required fire department access doors.
 9. Location of valves controlling the water supply of ceiling and in-rack sprinklers.

15. Maintenance

- A. All fire and life safety equipment and systems required by the CFC shall be maintained operable at all times. Equipment, devices, and systems shall be regularly tested in accordance with nationally recognized standards, manufacturers' recommendations, and adopted regulations.
- B. The responsibility for inspections, maintenance of the HPS areas as approved, and all fire and life safety equipment and systems required by the CFC shall be the ultimate responsibility of the building owner provided that this responsibility has not been transferred in written form to a management company or other party via a lease agreement or other legal document.



Note: Where required by the fire code official, a visual method of indicating the maximum allowable storage height shall be provided. CFC 3205.6

16. Approved Plans

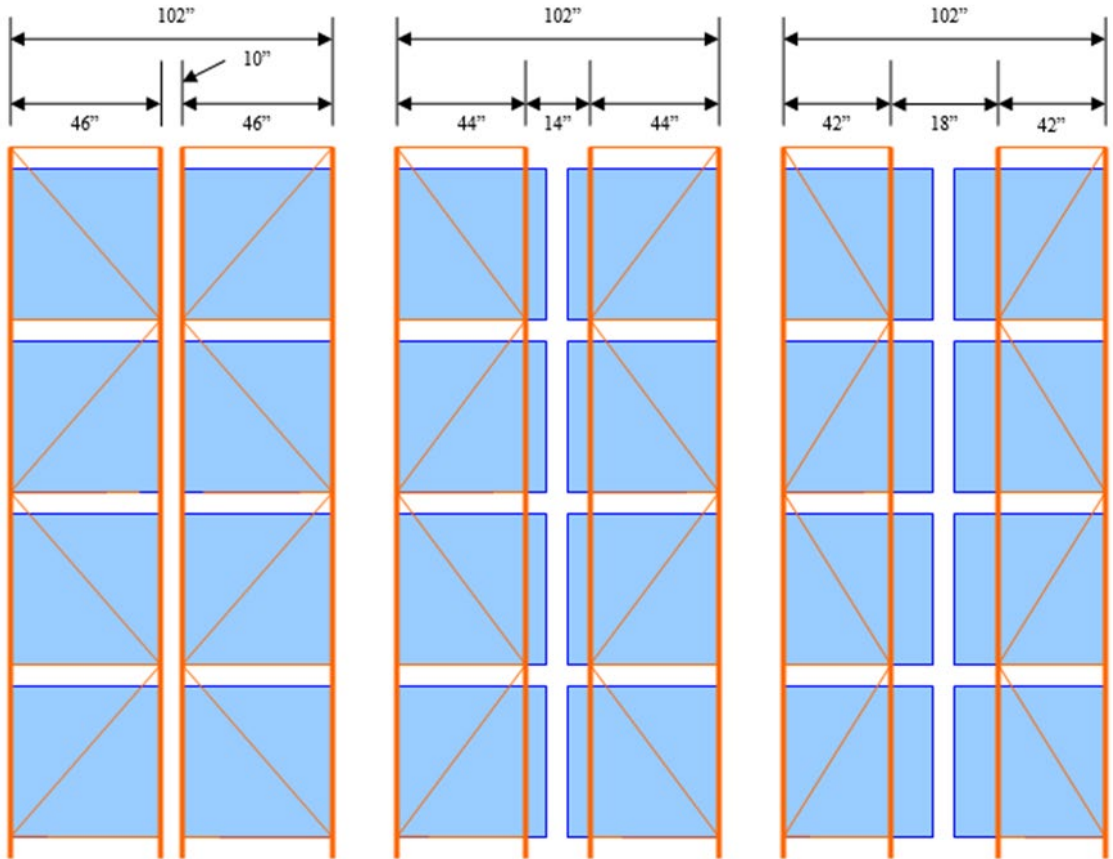
- A. A copy of the approved HPS plans shall be signed by the CFD Inspector upon completion of final inspection. HPS permits will also be completed by CFD. Signed documentation and plans shall be maintained on site for the life of the HPS system. CFD shall be consulted prior to any changes in the approved/existing/permitted HPS system(s). CFC Chapter 3201.3

17. Technical Assistance

- A. Due to the complexity of the designs specified within the CFC and adopted standards, it may be necessary to obtain the service of a fire protection design professional to assist with developing a protection scheme that meets the requirements of the CFC and other applicable regulations.

ATTACHMENT 1

LOAD BEAM CONFIGURATION NOT REQUIRING PALLET STOPS



NOTES:

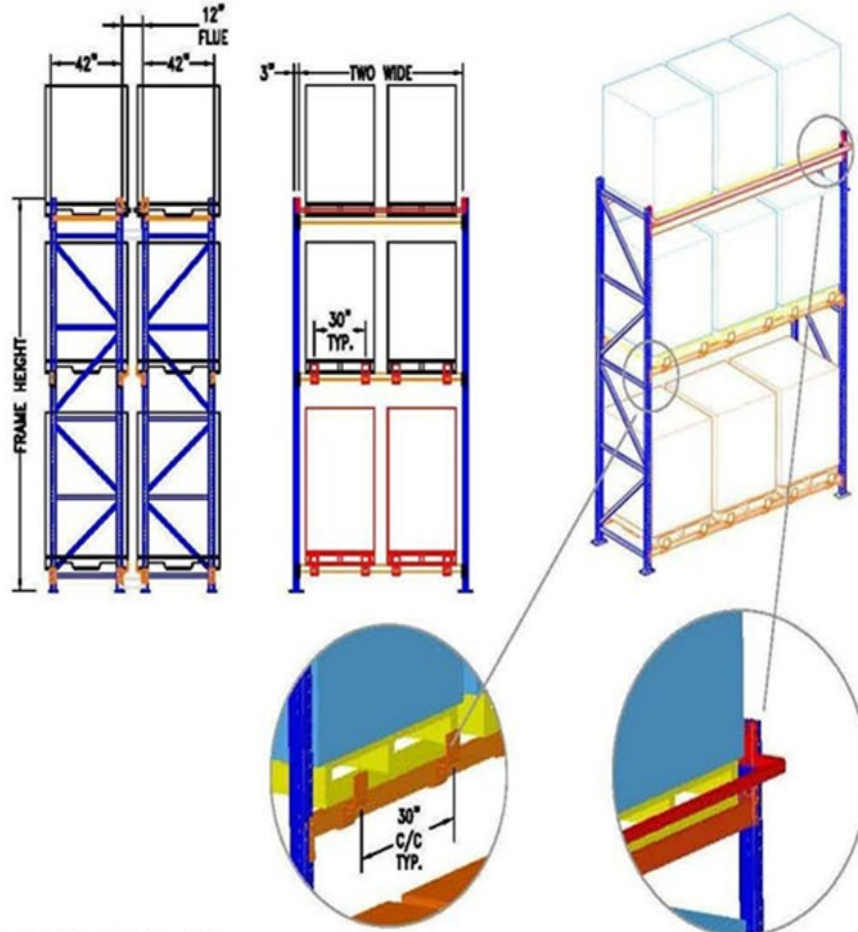
1. MAXIMUM PALLET DEPTH 48"
2. STORAGE ON LOAD BEAM ONLY, NO SHELVING, WIRE MESH GRATING, OR PALLET SUPPORTS.
3. 6" FLUE SPACE SHALL BE MAINTAINED AT ALL TIMES.

NOTES:

1. WHEN 42" UPRIGHTS ARE UTILIZED WITH AN 18" ROW SPACER AND A TYPICAL 48"x40" PALLET IS USED, NO PALLET STOPS ARE REQUIRED.
2. WHEN 44" UPRIGHTS ARE UTILIZED WITH A 14" ROW SPACER AND A TYPICAL 48"x40" PALLET IS USED, NO PALLET STOPS ARE REQUIRED.
3. WHEN 46" UPRIGHTS ARE UTILIZED WITH A 10" ROW SPACER AND A TYPICAL 48"x40" PALLET IS USED, NO PALLET STOPS ARE REQUIRED.

ATTACHMENT 2

STORAGE CONFIGURATION REQUIRING PALLET STOPS



NOTES:

RACKS WITH OPEN SHELVES SUPPORTING PALLETS SHALL BE PROVIDED WITH A PALLET / COMMODITY STOP.

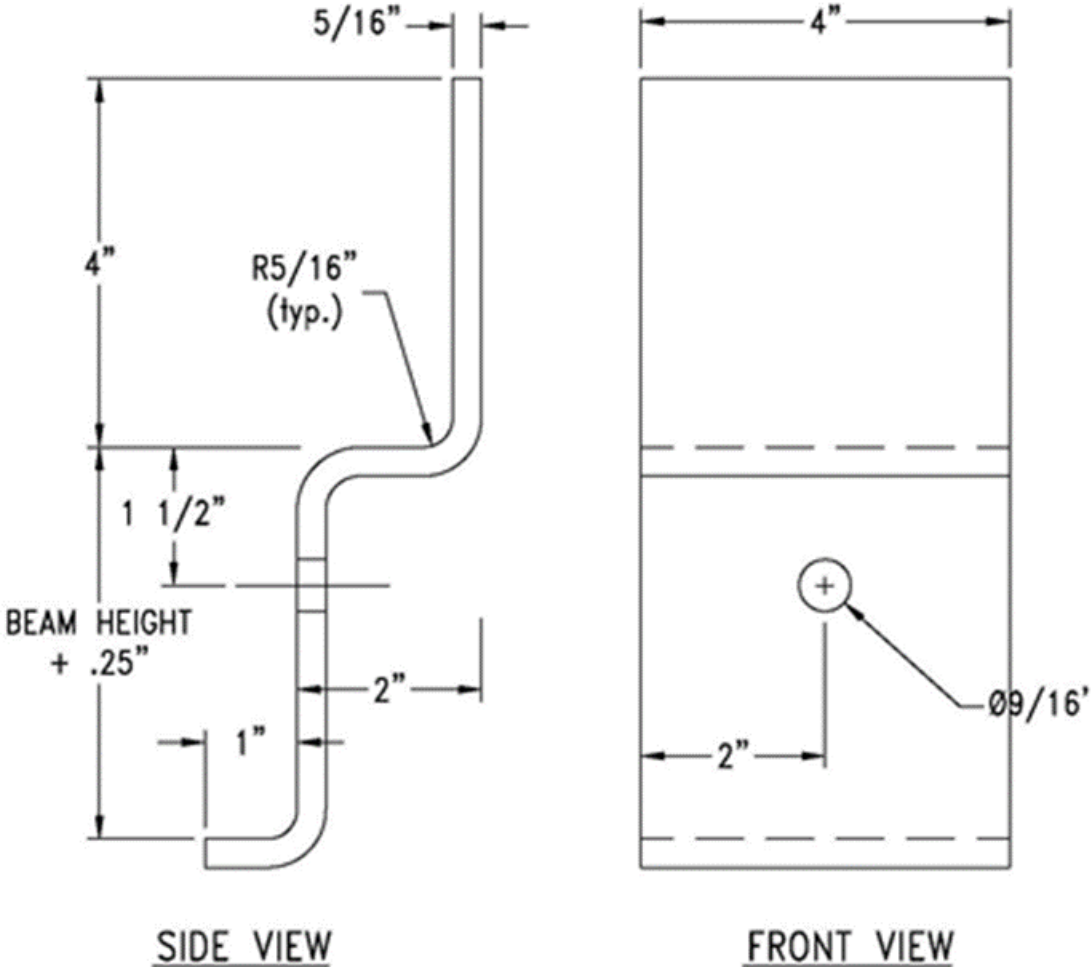
FOR ROLL FORM RACKING A FULL LENGTH FRAME MOUNTED SUPPORT IS TO BE USED PER THE ATTACHED DETAIL.

FOR STRUCTURAL (C-CHANNEL TYPE) RACKING, USE A BOLT IN Z TYPE SUPPORT ON 30" CENTERS PER THE ATTACHED DETAIL.

PS-X (PALLET STOPS - LENGTH") - USED FOR STRUCTURAL C CHANNEL BEAMS
SEE ATTACHMENT 3

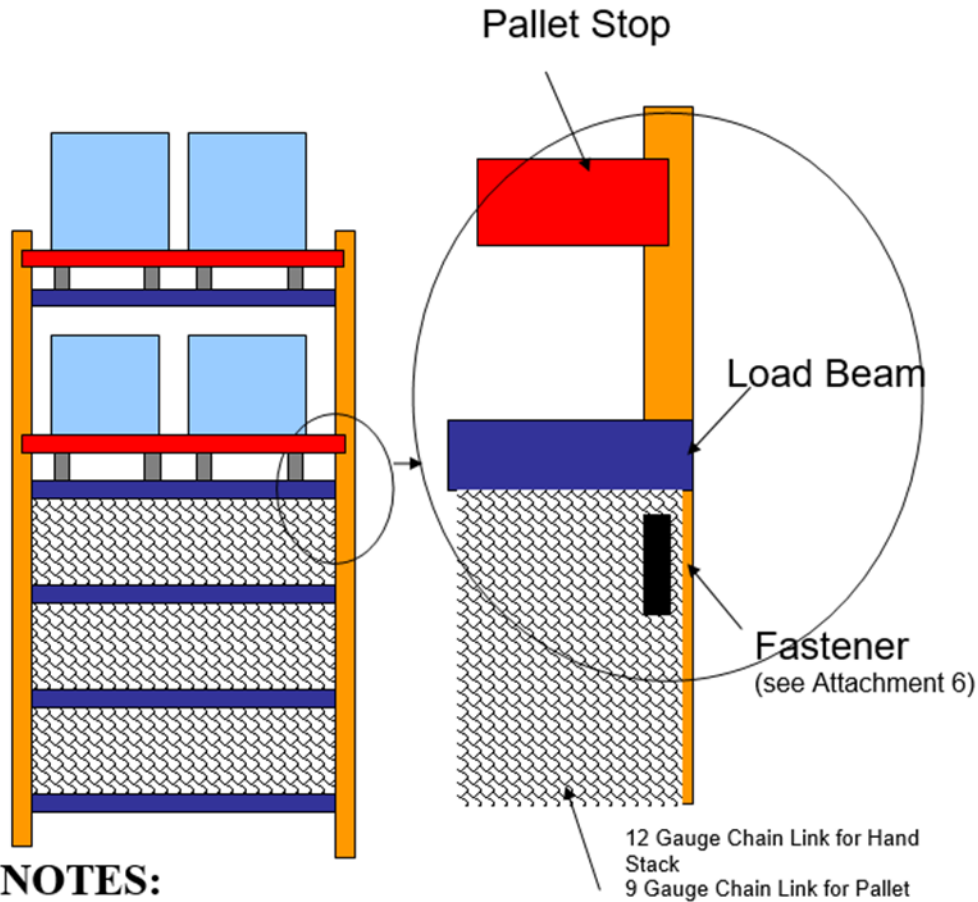
PBS-XX (PALLET BACK STOP - LENGTH") ATTACHED 4" FROM TOP OF LOAD BEAM USED FOR ROLL FORM RACKING BEAMS STOP CAN BE USED FOR DECKED RACK IF ON 12" VERTICAL CENTERS - SEE ATTACHMENT 4

ATTACHMENT 3
STRUCTURAL "C" CHANNEL BEAM DETAIL



ATTACHMENT 4

STORAGE CONFIGURATION FOR HAND STACK RACK



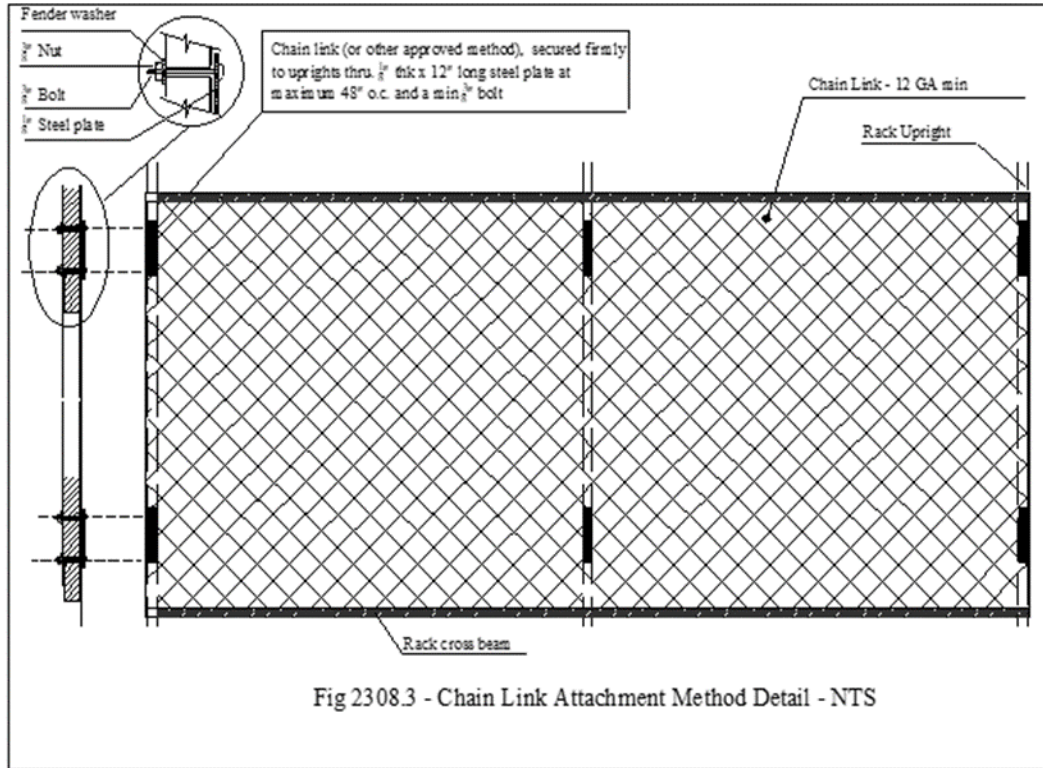
NOTES:

HAND STACKING/PICKING RACKS: HAND STACKING NON-PALLETIZED AREAS SHALL BE PROVIDED WITH A MEANS TO ENSURE THAT THE FLUE SPACES ARE MAINTAINED. HAND STACK LOCATION WILL BE SECURED FLUSH TO THE REAR COLUMN OF EACH FRAME AS SHOWN IN ATTACHED DETAIL (SEE ATTACHMENT 6 FOR CHAIN LINK).

9 Gauge Chain Link Fence for Pallet Loads.
12 Gauge Chain Link for Hand Stack Loads.

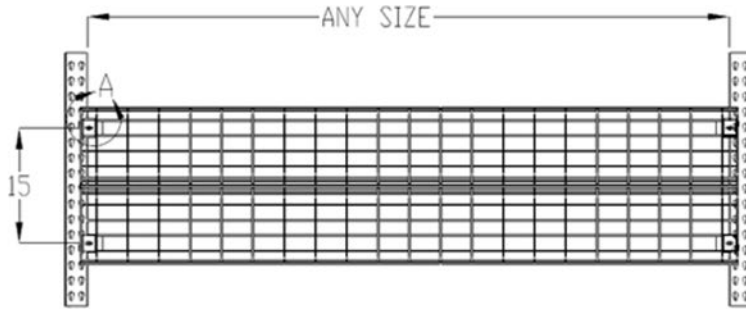
ATTACHMENT 5

CHAIN LINK ATTACHMENT METHOD DETAIL

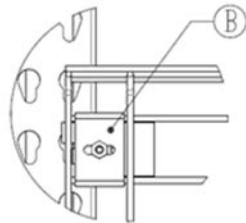


ATTACHMENT 6

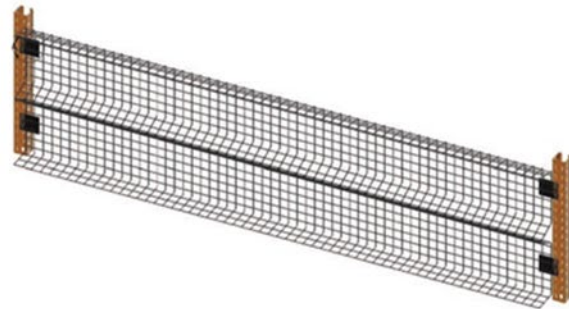
AISLE SHIELD METHODS



**AISLE
SHIELD**

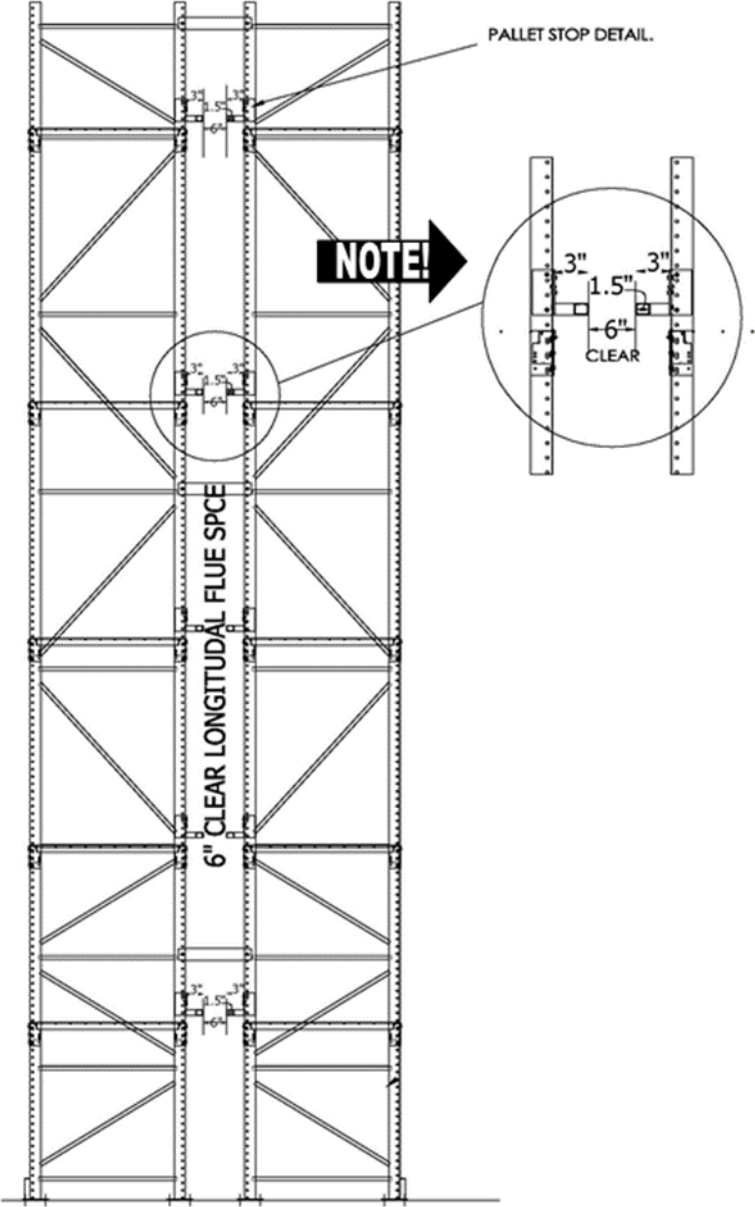


Method 1



Method 2

ATTACHMENT 7
PALLET STOP CLEAR SPACE



ATTACHMENT 9

High Pile Storage (HPS) Required Information

The following information shall be completed and copied onto the HPS plans for all projects within the city of Carlsbad:

Commodity Classification:

I II III IV High Hazard Group A plastic

Commodity detailed

description: _____

For Group A Plastics where the commodity classification is not High Hazard complete the following:

Expanded plastic: Percent by volume: _____%. Percent by weight: _____%

Non-expanded plastic: Percent by weight: _____%

Packaging consist of: _____

Cartoned Free flowing Non-expanding Encapsulated Non-encapsulated
 Other _____

The maximum storage height (solid pile _____ rack _____)

The following storage methods are employed at this facility (mark all that apply):

Solid pile storage Palletized Single row rack Double row rack Multi-row rack
 Other _____

Rack storage shelf: N/A Load beam only Wire mesh Wood slates Plywood
 Other (Describe) : _____

The area designated in the building and used for high piled storage is _____ square feet.

CLASS _____ commodity, _____ sq ft.

CLASS _____ commodity, _____ sq ft.

CLASS _____ commodity, _____ sq ft.

Smoke vents required No Yes Fusible link _____ degree F.

Draft Curtains Required? Yes NO

The overhead fire sprinkler system utilizes the following heads:

ESFR: K _____ at _____ PSI with _____ F° heads

Standard Coverage Heads: K _____ Pendant Upright _____ degree with a density of _____ gpm over _____ square feet spaced at a maximum of _____ square feet per fire sprinkler.

NFPA 13 Design Table: _____ Curve: _____

Minimum distance between top of storage and sprinkler deflector: _____ Feet

In-rack sprinklers required Yes No

There is/are _____ level(s) of in-rack fire sprinkler protection.

Aisle width: _____ feet.

Fire access doors required? Yes (Maximum distance of 100 lineal feet) No

Flue spaces required? Yes No

Flue space between racks shall be maintained a minimum of:

Transverse _____" clear. Must be vertically aligned (for storage >25')

Longitudinal _____" clear

Column protection required? Yes No

Pallet Stops Required? Yes No

Longitudinal pallet stop configuration:

Chain Link Roll Form "C" Channel Other: _____

Transverse Flue Pallet Stop configuration:

Mechanical means (flue keepers, etc.) Load beam markings "Keep Clear"

Hand Stack? No Yes # of tiers: _____ Chain link required No Yes