

ORANGE COUNTY FIRE AUTHORITY

Planning & Development Services Section

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High-Piled Combustible Storage



Approved and Authorized by

Guideline G-09

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High-Piled Combustible Storage

PURPOSE

The intent of this guideline is to provide the requirements for the protection of high-piled storage (HPS) for a variety of commodities. 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 23 of the 2007 California Fire Code (CFC) and referenced standards.

SCOPE

This guideline provides the requirements for all HPS within the jurisdiction of the Orange County Fire Authority (OCFA).

For the purposes of this guideline, certain terms are defined as follows:

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 six feet in height.

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 2306.2:

- 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.
- 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.
- 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 2306.2, unless such areas are separated from each other by a one-hour rated fire barrier wall constructed in accordance with Section

706 of the California Building Code (CBC). Openings in such walls shall be protected by fire assemblies having a one-hour fire-protection rating. CFC 2306.3.2.1.

Rack Storage

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

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*.

Solid Shelving

Shelving that is solid, slatted, mesh, or grated located within racks that obstructs sprinkler water penetration through the racks.

SUBMITTAL REQUIREMENTS

1. General

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 23 may be of great assistance. All new plan submittals and revisions will consist of 2 plan hard copies and 1 electronic copy. All electronic formats will be accepted and may be submitted on CD, DVD, and Memory Stick. Plans shall be submitted with the following information per CFC 2301.3:

- A. 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, and 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.
- B. A scaled site plan that shows the entire building, including all fire access lanes, fire hydrants, fire department connection, and fire sprinkler risers.
- C. 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.
- D. 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).
- E. The number of tiers within each rack.

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- F. The commodity clearance between the top of storage and the sprinkler deflector for each storage arrangement.
 - G. Aisle dimensions between each storage array. Aisles are measured from the actual edge of the commodity to commodity, not rack to rack.
 - H. Maximum pile volume for each storage array.
 - I. The location and classification of different commodity classes.
 - J. The location of commodities that are banded or encapsulated.
 - K. The dimension and location of the transverse and longitudinal flue spaces.
 - L. The sprinkler design requirements based on commodity type, aisle width, and sprinkler temperature rating as outlined in 2002 NFPA 13, Chapter 12 (e.g., .45/3000 with 286-degree heads). A complete sprinkler design shall be submitted under a separate Service Request number.
 - M. 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 will require protection. See 2002 NFPA 13, Section 12.3.1.7.
 - N. 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 per CFC 910.3.2.1.

Note: New construction shall only use approved/labeled smoke vents as specified by CFC 2306.7. 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 OCFA prior to plan approval. The report at a minimum shall identify the year the building was constructed, a listing of all vents 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 OCFA, all identified deficiencies must be corrected and included within the report.

If the smoke vents do not contain manual release devices, and OCFA 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. OCFA staff will evaluate all other conditions on a case by case basis during the review process. If this requirement is placed, OCFA staff will indicate the

requirement adjacent to the OCFA approval stamp on the final approved plans from the proposed operation. The vent inspection report shall be copied onto the plans prior to OCFA plan approval.

- O. If required, the design (construction), location, and depth of the curtain board assembly, if applicable.
- P. The occupancy group as defined by CBC Chapter 3.

2. California Fire Code Permits—CFC 2301.2

Plans and specifications shall be submitted to the OCFA Planning and Development Services Section 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”). CFC permit fees are invoiced annually.

3. Commodity Classification—CFC 2303

Commodities shall be classified as Class I, II, III, IV, or High Hazard, in accordance with CFC Chapter 23.

Plastics shall be classified as Group A, B, or C in accordance with CFC Chapter 23. To determine the proper commodity classification of products with limited quantities of Group A plastics in mixed commodities, use CFC Figure 2303.7.4. 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.”

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 2304.2.

4. General Fire-Protection Provisions—CFC 2306

Fire-protection features for high-piled storage areas shall be in accordance with CFC Chapter 23 and other nationally recognized standards approved by the OCFA. 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. The aggregate of all high-piled storage areas within a building shall be used to design the fire protection features found in CFC Table 2306.2 (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 2306.4

When fire sprinklers are required by CFC Table 2306.2 or the CBC (or if otherwise provided), the sprinkler system shall be installed in accordance with 2002 NFPA 13. A full

description of the tables, figures, and curves in NFPA 13, Section 12,(Storage) shall be used to determine the design criteria is required.

6. Fire Detection Systems—CFC 2306.5

When fire detection is required by CFC Table 2306.2, an approved automatic fire detection system shall be installed in accordance with 2002 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 2306.6

When building access is required by CFC Table 2306.2, 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 2306.2, they shall be provided in each 100 lineal feet of exterior wall and shall face the required access roadway.

8. Smoke and Heat Removal—CFC 2306.7

When smoke and heat removal are required by CFC Table 2306.2, 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 Table Section 910 (attached.) The fusible link temperature shall be rated as specified in Section 1-N.

Smoke and heat vents are *not* required when storage areas are protected by early suppression fast response (ESFR) sprinkler systems installed in accordance with 2002 NFPA 13.

For existing conditions refer to Section 1 N of this document.

9. Curtain Boards

When required by CFC Table 2306.2, curtain boards shall be installed in accordance with CFC 910.3.5.

10. Rack Flue Spaces—CFC 2308.3

Requirements for flue spaces within the rack storage are provided in CFC Table 2308.3 (attached). Double-row racks shall be equipped with a pallet/commodity stop along the longitudinal flue space at each level. The stop 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 approved by the fire code official (CFC 2308.3 amended).

Alternative acceptable designs are outlined in Attachment 1 through 5. If an alternate design outlined in the attachments is used, the appropriate detail or details shall be copied onto the plan.

When a 6” transverse flue space is required, mechanical means shall be provided to maintain the transverse flue, which shall be identified on the plan.

11. Solid Piled and Shelf Storage

Shelf storage, storage in solid piles, solid piles on pallets, and storage in binboxes not exceeding five feet in any dimension shall be in accordance with CFC 2306 and 2307.

12. Rack Storage

Rack storage shall be in accordance with CFC 2306 and 2308. 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 CFC 2308.2.2.

13. Automated Storage

Automated storage similar to carousel storage shall be in accordance with CFC 2309.

14. Specialty Storage—CFC 2310

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 2306 2308, and NFPA 13 and NFPA 230. Palletized storage of records shall be in accordance with CFC 2307.

15. Maintenance—CFC Chapter 9

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.

16. Technical Assistance

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.

TABLE 2306.2: GENERAL FIRE-PROTECTION AND LIFE-SAFETY REQUIREMENTS

Commodity Class	Size of High-Piled Storage Area ^a (square feet) (See Sections 2306.2 and 2306.4)	ALL STORAGE AREAS (See Sections 2306, 2307 and 2308) ^b					SOLID-PILED STORAGE, SHELF STORAGE AND PALLETIZED STORAGE (See Section 2307.3)		
		Automatic Fire-extinguishing System (See Section 2306.4)	Fire-detection System (See Section 2306.5)	Building Access (See Section 2306.6)	Smoke and Heat Removal (See Section 2306.7)	Draft curtains (See Section 2306.7)	Maximum Pile Dimension ^c	Maximum Permissible Storage Height ^d (feet)	Maximum Pile Volume (cubic feet)
I-IV	0-500	NR ^a	NR	NR ^e	NR	NR	NR	NR	NR
	501-2,500	NR ^a	Yes ⁱ	NR ^e	NR	NR	100	40	100,000
	2,501-12,000 Public Accessible	Yes	NR	NR ^e	NR	NR	100	40	400,000
	2,501-12,000 Nonpublic Accessible (Option 1)	Yes	NR	NR ^e	NR	NR	100	40	400,000
	2,501-12,000 Nonpublic Accessible (Option 2)	NR ^a	Yes	Yes	Yes ^j	Yes ^j	100	30 ^f	200,000
	12,001-20,000	Yes	NR	Yes	Yes ^j	NR	100	40	400,000
	20,001-500,000	Yes	NR	Yes	Yes ^j	NR	100	40	400,000
	500,000+ ^g	Yes	NR	Yes	Yes ^j	NR	100	40	400,000
High-hazard	0-500	NR ^a	NR	NR ^e	NR	NR	50	NR	NR
	501-2,500 Public Accessible	Yes	NR	NR ^e	NR	NR	50	30	75,000
	501-2,500 Nonpublic accessible (Option 1)	Yes	NR	NR ^e	NR	NR	50	30	75,000
	501-2,500 Nonpublic accessible (Option 2)	NR ^a	Yes	Yes	Yes ^j	Yes ^j	50	20	50,000
	2,501-300,000	Yes	NR	Yes	Yes ^j	NR	50	30	75,000
	300,001-500,000 ^{g-h}	Yes	NR	Yes	Yes ^j	NR	50	30	75,000

NR = Not Required

^a When fire sprinklers are required for reasons other than those in Chapter 23, the portion of the sprinkler system protecting the high-piled storage area shall be designed and installed in accordance with Sections 2307 and 2308.

^b For aisles, see Section 2306.9.

^c Piles shall be separated by aisles complying with Section 2306.9.

^d For storage in excess of the height indicated, special fire protection shall be provided in accordance with Footnote g when required by the chief. See also Chapters 28 and 34 for special limitations for aerosols and flammable and combustible liquids.

^e Section 503 shall apply for fire apparatus access.

^f For storage exceeding 30 feet in height, Option 1 shall be used.

^g Special fire-protection provisions including, but not limited to, fire protection of exposed steel columns; increased sprinkler density; additional in-rack sprinklers, without associated reductions in ceiling sprinkler density; or additional fire department hose connections shall be provided when required by the chief.

^h High-piled storage areas shall not exceed 500,000 square feet. A two-hour fire wall constructed in accordance with the California Building Code shall be used to divide high-piled storage exceeding 500,000 square feet in area.

ⁱ Not required when an automatic fire-extinguishing system is designed and installed to protect the high-piled storage area in accordance with Sections 2307 and 2308.

^j Not required when storage areas are protected by early suppression fast response (ESFR) sprinkler systems installed in accordance with NFPA 13.

TABLE 910.3: REQUIREMENTS FOR DRAFT CURTAINS AND SMOKE AND HEAT VENTS^a (See Section 2306.7)

OCCUPANCY GROUP AND COMMODITY CLASSIFICATION	DESIGNATED STORAGE HEIGHT (feet)	MINIMUM DRAFT CURTAIN DEPTH (feet)	MAXIMUM AREA FORMED BY DRAFT CURTAINS (square feet)	VENT- AREA-TO FLOOR-AREA RATIO ^c	MAXIMUM SPACING OF VENT CENTERS (feet)	MAXIMUM DISTANCE TO VENTS FROM WALL OR DRAFT CURTAIN ^b (feet)
Group F-1 and S-1	-	0.2 x H ^d but ≥ 4	50,000	1:100	120	60
Commodity Classification I-IV (Option 1)	≤ 20	6	10,000	1:100	100	60
	> 20 ≤ 40	6	8,000	1:75	100	55
Commodity Classification I-IV (Option 2)	≤ 20	4	3,000	1:75	100	55
	> 20 ≤ 40	4	3,000	1:50	100	50
High-hazard (Option 1)	≤ 20	6	6,000	1:50	100	50
	> 20 ≤ 30	6	6,000	1:40	90	45
High-hazard (Option 2)	≤ 20	4	4,000	1:50	100	50
	> 20 ≤ 30	4	2,000	1:30	75	40

^a Requirements for rack storage heights in excess of those indicated shall be in accordance with Chapter 23. For solid-piled storage heights in excess of those indicated, an approved engineered design shall be used.

^b The distance specified is the maximum distance from any vent in a particular draft curtained area to walls or draft curtains which form the perimeter of the draft curtained area.

^c Where draft curtains are not required, the vent area to floor area ratio shall be calculated based on a minimum draft curtain depth of 6 feet (Option 1.)

^d "H" is the height of the vent, in feet above the floor.

TABLE 2308.3: REQUIRED FLUE SPACES FOR RACK STORAGE

RACK CONFIGURATION	FIRE SPRINKLER PROTECTION Storage Height		SPRINKLER AT THE CEILING WITH OR WITHOUT MINIMUM IN-RACK SPRINKLERS			IN-RACK SPRINKLERS AT EVERY TIER	NON-SPRINKLERED
			≤ 25 feet		> 25 feet		
			Option 1	Option 2		Any Height	Any Height
Single-row Rack	Transverse Flue Space	Size ^b	3 inch	NA	3 inch	NR	NR
		Vertically Aligned	NR	NA	Yes	NA	
	Longitudinal Flue Space		NR	NA	NR	NR	
Double-row Rack	Transverse Flue Space	Size ^b	6 inch ^a	3 inch	3 inch	NR	
		Vertically Aligned	NR	NR	Yes	NA	
	Longitudinal Flue Space		NR	6 inch	6 inch	NR	
Multi-row Rack	Transverse Flue Space	Size ^b	6 inch	NA	6 inch	NR	
		Vertically Aligned	NR	NA	Yes	NA	
	Longitudinal Flue Space		NR	NA	NR	NR	

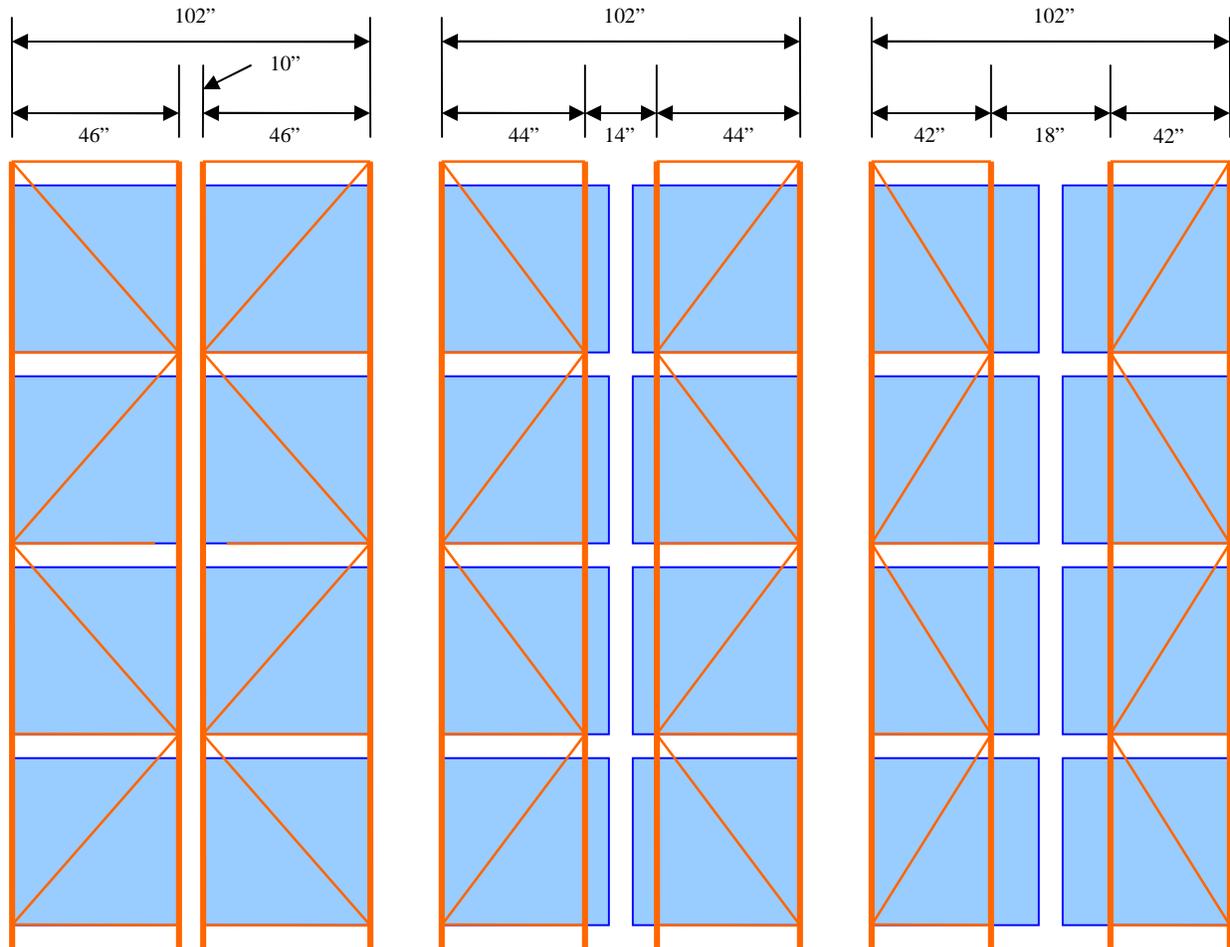
NR = "not required." NA means "not applicable."

^a Three-inch transverse flue spaces shall be provided at least every 10 feet where ESFR sprinkler protection is provided.

^b Random variations are allowed, provided that the configuration does not obstruct water penetration.

ATTACHMENT 1

LOAD BEAM CONFIGURATION NOT REQUIRING PALLET STOPS



NOTES:

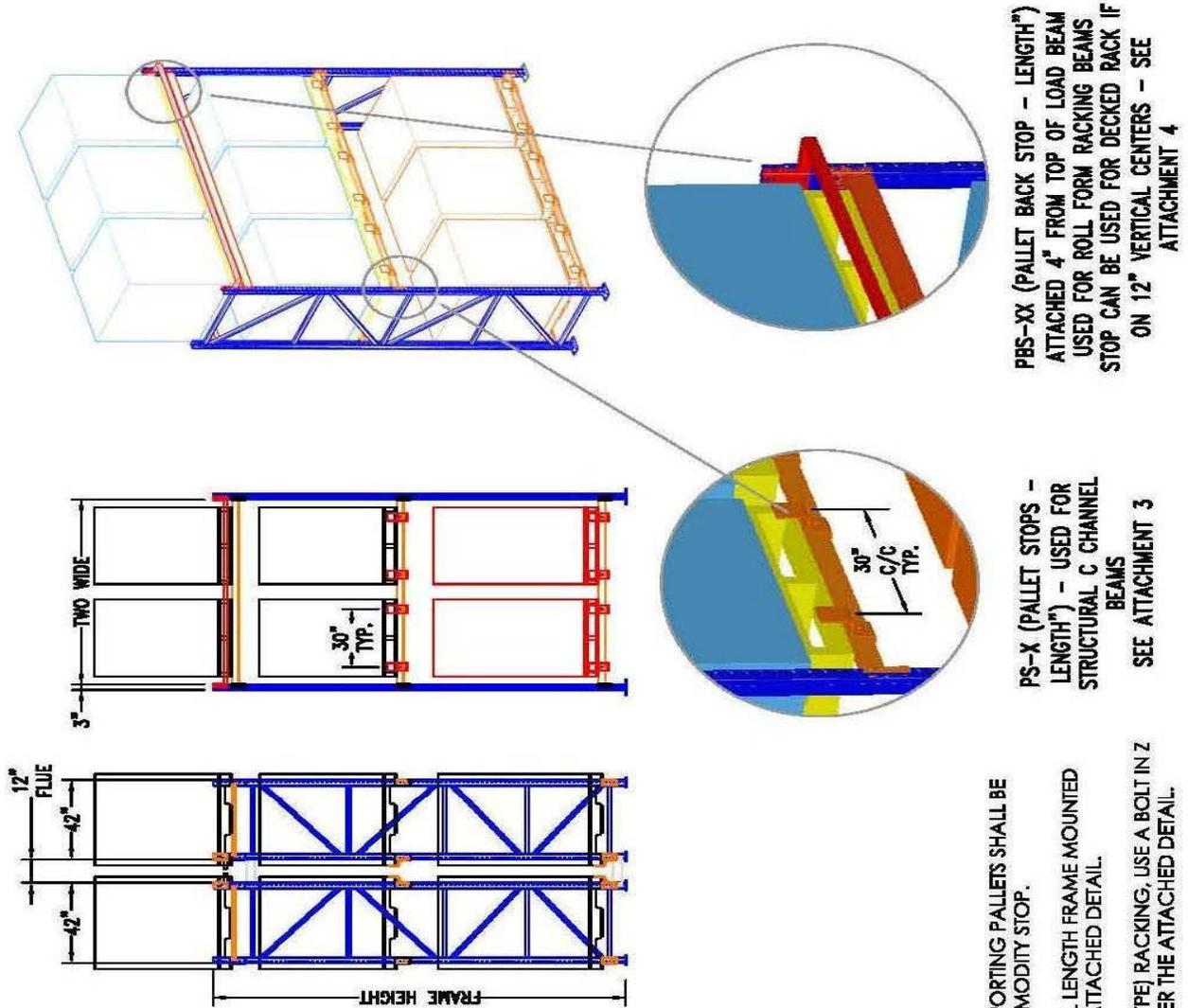
1. MAXIMUM PALLET DEPTH 48"
2. STORAGE ON LOAD BEAM ONLY, NO SHELVING, WIRE MESH GRATING, OR PALLET SUPPORTS.
3. 6" FLUE SPACE SHALL BE MAINTAINED AT ALL TIMES.
4. CHANGE TO THE STORAGE CONFIGURATION REQUIRES PRIOR OCFA APPROVAL.

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

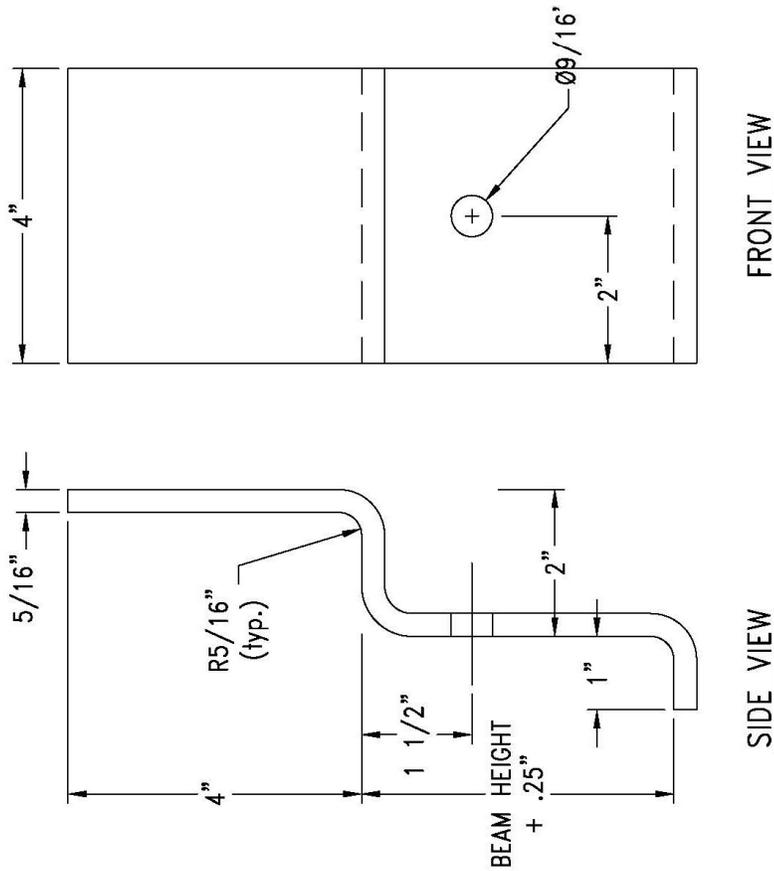
FOR STRUCTURAL [C-CHANNEL TYPE] RACKING, USE A BOLT IN Z TYPE SUPPORT ON 30" CENTERS PER THE ATTACHED DETAIL.

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

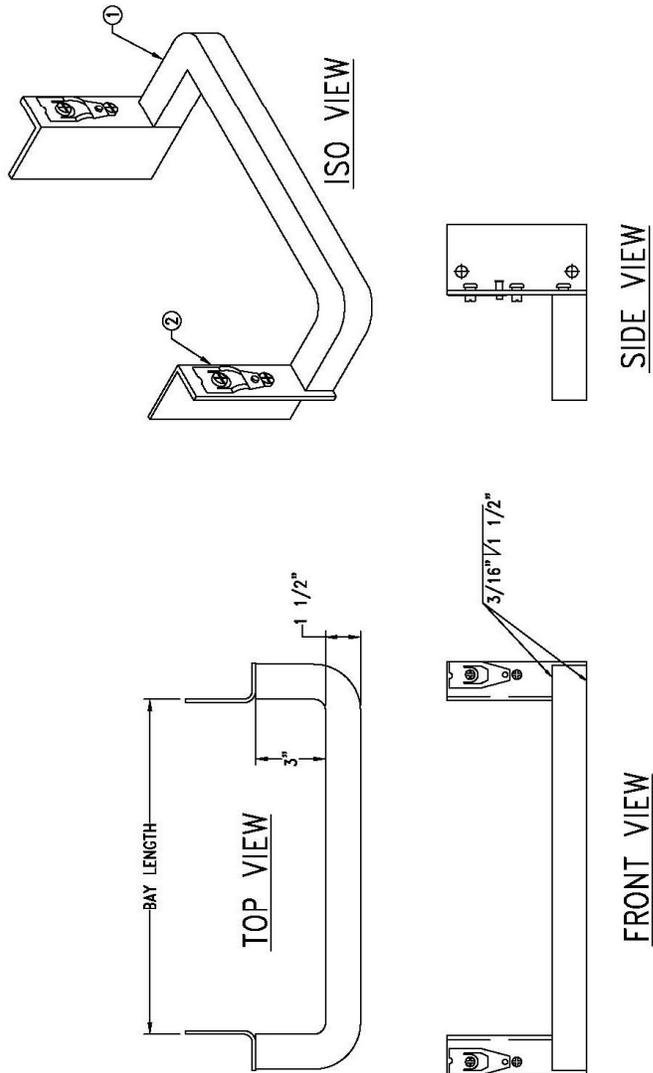
ATTACHMENT 3

STRUCTURAL "C" CHANNEL BEAM DETAIL



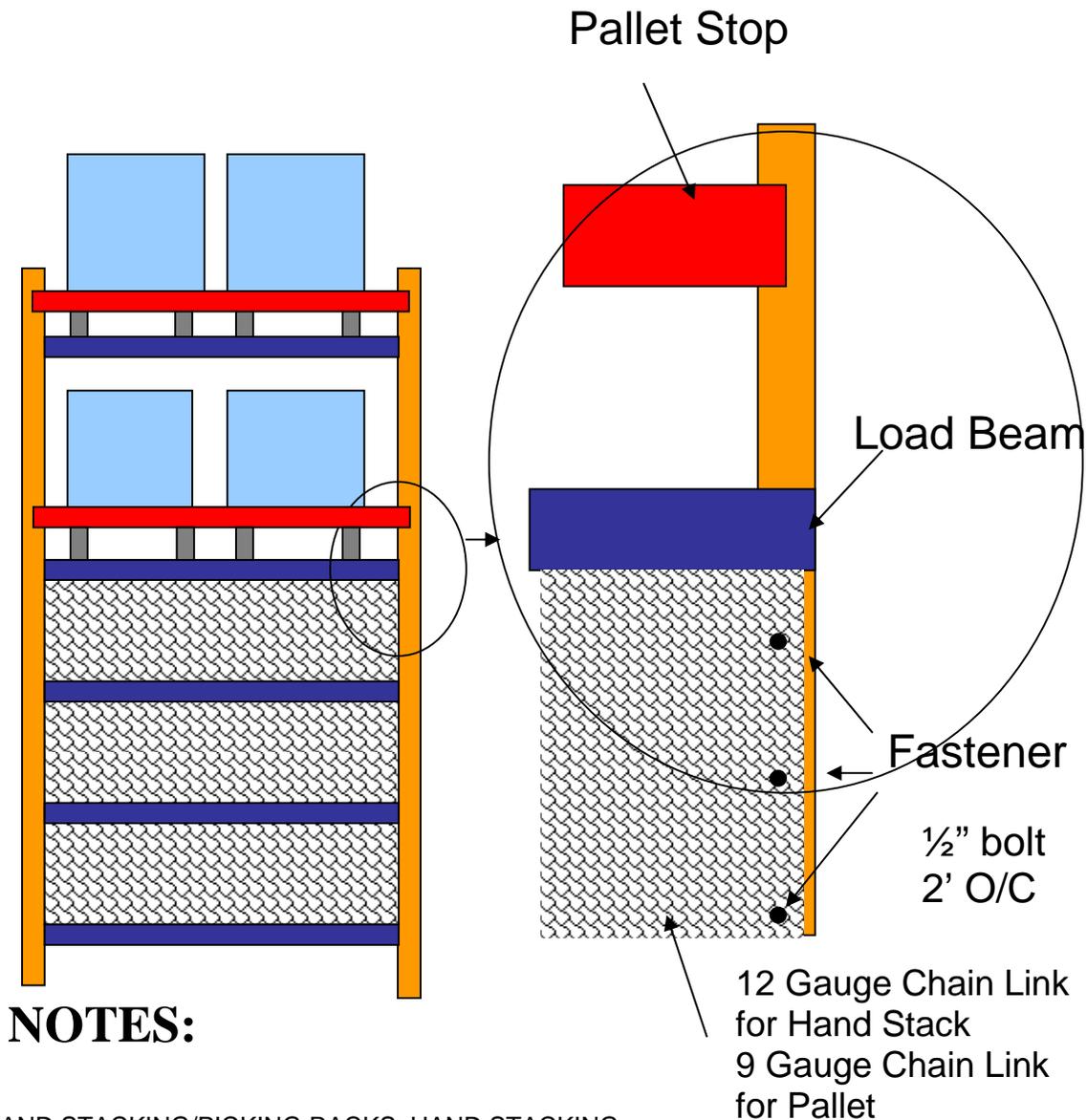
ATTACHMENT 4

ROLL FORM RACKING DETAIL



ATTACHMENT 5

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.

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