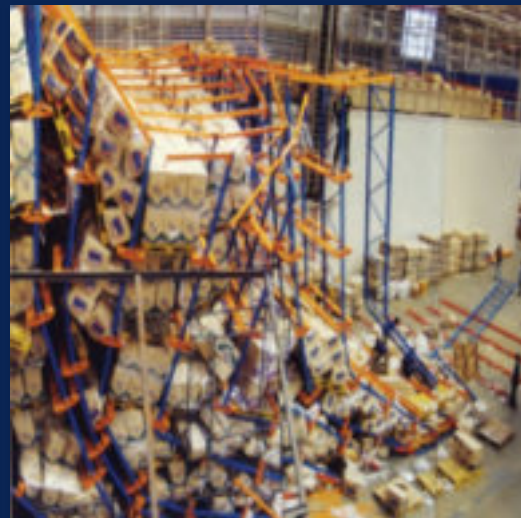




# USER'S GUIDE FOR INSPECTION OF DAMAGED STORAGE RACK SYSTEMS



**DON'T WAIT UNTIL IT'S TOO LATE!**



CONTACT US  
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815-723-7400

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INTRODUCTION

Warehouse Pallet Rack Systems are engineered, high performance structures that are designed to support product loads many times their weight. Each pallet rack component is designed, manufactured, and tested against rigorous quality controls. These standards ensure that the rack system will safely perform with designed load applications corresponding to specific configurations.

Although the Rack Manufacturers Institute (RMI) design specifications include safety factors, these calculations do not consider additional requirements that are imposed as a result of post-manufacture damage. Therefore, it is critical that pallet racks be routinely inspected and maintained correctly so they can continue to perform as originally designed.

Component damage reduces the pallet rack’s carrying capacity and may ultimately lead to a catastrophic pallet rack collapse. The total cost of a rack collapse is staggering and typically far exceeds the value of the entire rack structure and stored product. Even worse, a collapse often times leads to:

- ▶ Serious injury or fatality
- ▶ Higher insurance premiums, fines and legal expenses
- ▶ Product, equipment and business loss
- ▶ Expensive cleanup and replacement costs
- ▶ Loss of time and money

**This document is by no means intended to replace regular pallet rack system evaluations performed by qualified, trained professionals. This document specifically does not provide any engineering or legal opinion on this subject matter.**

**Modifications to any pallet rack systems, including those located in geographical areas that are in danger of seismic activity, need to be reviewed by a qualified professional engineer.**

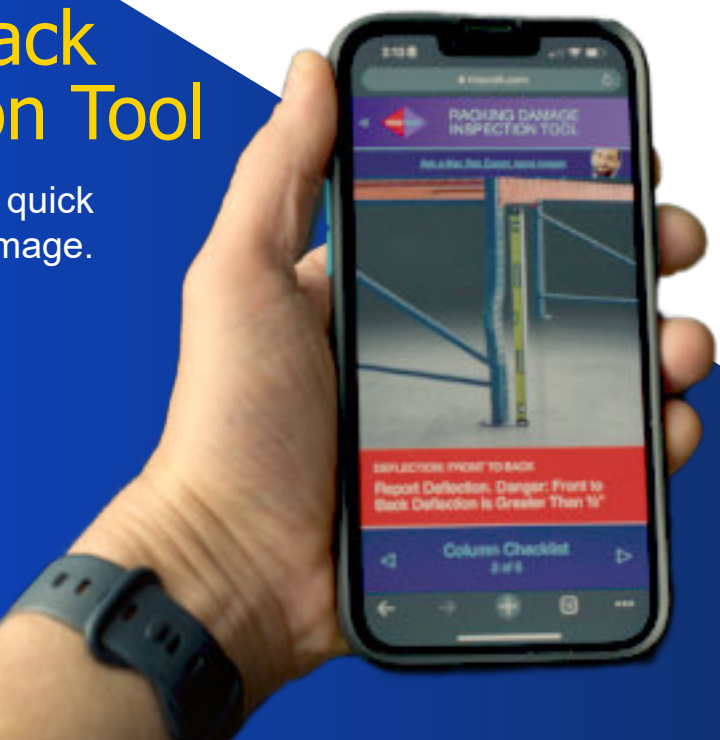
**The purpose of this document is to provide owners/operators with a simple, educational pictorial resource to aid in their timely identification of the most common types of pallet rack damage.**

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Online Rack Inspection Tool

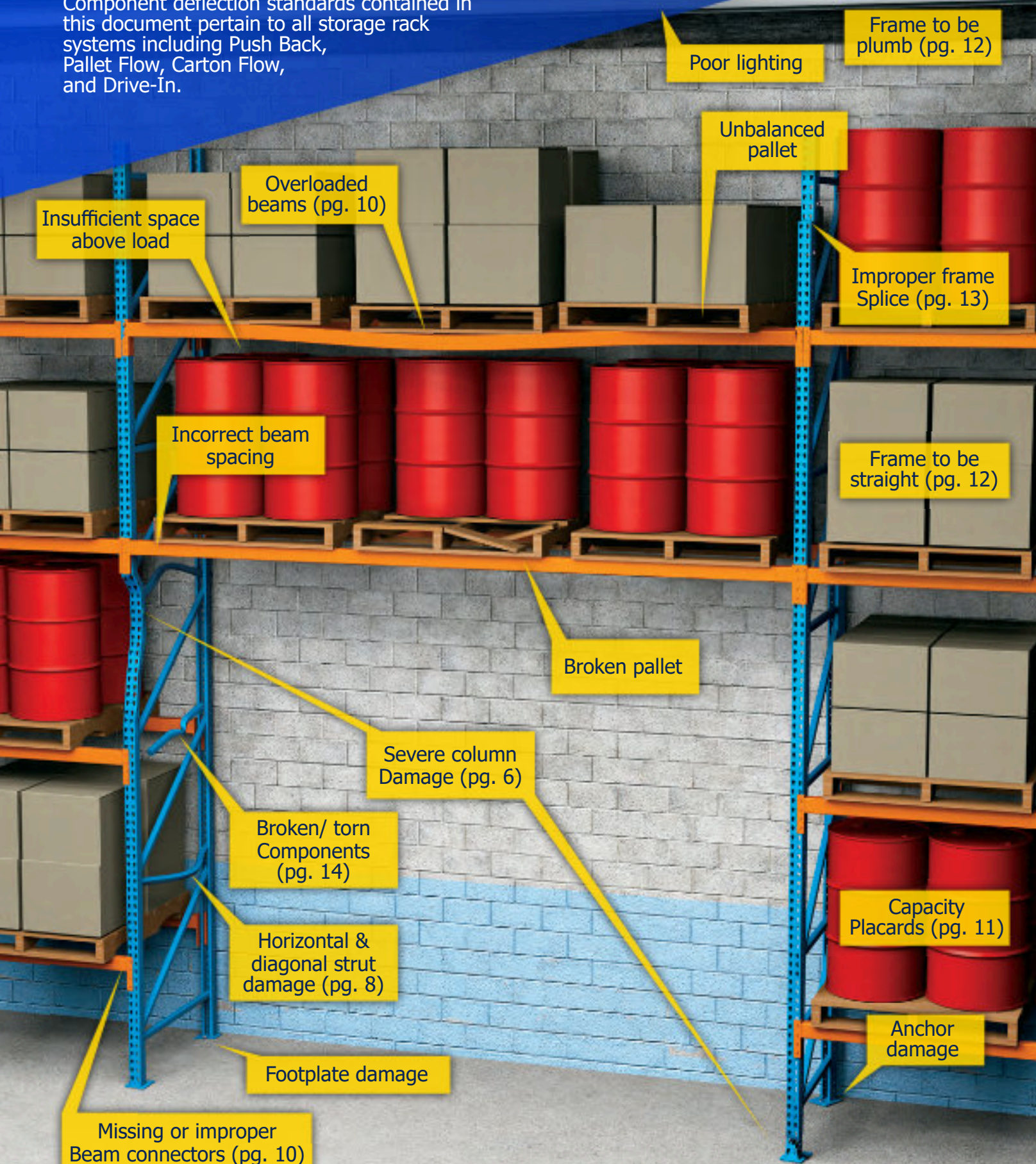
Use this tool for a quick check for rack damage.





## MAJOR SAFETY ISSUES FOR PALLET RACKING

Component deflection standards contained in this document pertain to all storage rack systems including Push Back, Pallet Flow, Carton Flow, and Drive-In.



## INDUSTRY STANDARDS

Pallet Rack safety is becoming increasingly scrutinized by OSHA, Federal and State agencies and insurance companies, and comes with substantial legal and moral responsibilities. ANSI MH 16.1 – 2012 the industry standard for industrial pallet rack has recently been incorporated into the more general International Building Code. The I.B.C. includes the requirements and governs the construction of all warehouses in the United States. I.B.C. standards must be met in order to obtain local municipal building permit approval prior to construction and upon final completion. Therefore ANSI MH 16.1 – 2012 requirements are now subject to the same enforcement requirements as the I.B.C.

### EXCERPTS FROM ANSI MH 16.1 – 2012

1. The storage rack system operator is responsible for maintenance and repair of storage systems.
2. Upon visible damage, the pertinent portions of the rack shall be unloaded immediately and removed from service by the user until the damaged portion is repaired or replaced.
3. Adjusting beam elevations or operating beyond approved work load limits on pallet rack frames and or support beams without regard to published manufacturers load tables is not allowed and will lead to rack failure.
4. Altering / modifying components without the direction of a proper supervisory engineer is not allowed and may lead to rack failure.
5. Proper aisle and bay width must be maintained based on storage requirements.

### OSHA General Duty Clause - Section 5 (a) (1)

- Employers are required to provide their employees with a place of employment that is "free from recognizable hazards that are causing or likely to cause death or serious harm to employees".

Far too often, damaged rack remains in operation because it is ignored or mistakenly assumed to be safe. The reality is that many damaged systems are at the critical "TIPPING POINT" where just one more damaged component, or just one more seemingly non-significant impact will push the system into collapse. While no official standards have been adopted in the United States regarding rack damage, we are referencing the SEMA standards that are enforced throughout Canada and Europe.

### **RACK IS UNSAFE, DANGEROUS AND UNACCEPTABLE**

It is imperative that management create an environment with operators that ensures timely reports and immediate remedial action.

**Owners/Operators should inspect their pallet rack systems on a regular basis. Particular attention should focus on damaged or missing rack system components listed on the following pages.**



SEVERE COLUMN DAMAGE



Damage under beam level



Damage above beam level



Damage behind beam connector



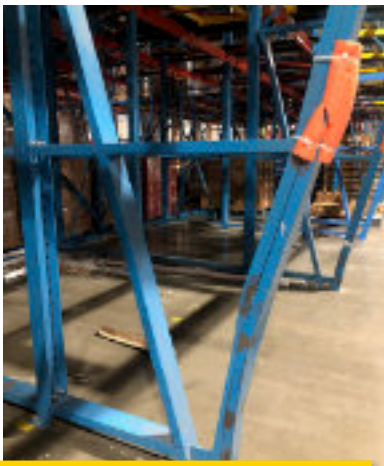
Ripped column



Outrigger damage



Closed tube damage



Structural column damage



Structural column damage



Structural column damage

COLUMN DAMAGE INSPECTION CRITERIA



**REPAIR** if front to back deflection is greater than 1/2"

- ▶ **Reference Standard:**  
Columns with rips, tears or deflection greater than 1/2" in either the down aisle or front to back direction must be repaired.
- ▶ **Helpful Hint:**  
Inspect both front and back leg columns. Inspect for possible deformation BEHIND beam connectors as pictured on page 6, upper right hand corner.



**REPAIR** if down aisle deflection is greater than 1/2"

Rack damage to free standing single rows is more dangerous than the same damage on back to back rows with row spacers.



**REPAIR** if corner deflection is greater than 1/2"

Corner column damage is more critical than damage to the front and sides of columns.



HORIZONTAL AND DIAGONAL STRUT DAMAGE



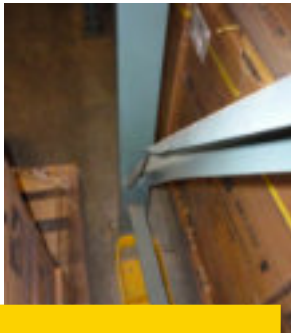
Roll formed horizontal strut damage



Roll formed closed tube horizontal strut damage



Ripped / torn horizontal and diagonal strut



Damaged roll form diagonal strut



Broken diagonal weld



Missing horizontal struts

- ▶ **Reference Standard:**  
Missing horizontal or diagonal braces, or braces with any rips, tears or deflection in either plane beyond 1/2" must be repaired.
- ▶ **Helpful Hint:**  
The strut must be repaired if the weld is torn, broken or missing.



**REPAIR**  
if horizontal plane of strut is deflected greater than 1/2"



**REPAIR**  
if vertical plane of strut is deflected greater than 1/2"

FOOTPLATE DAMAGE



Sheared weld



Sheared weld



Sheared weld



**REPAIR**  
if footplate is twisted greater than 1/2"

- ▶ **Reference Standard:**  
Front and back footplates which are torn, ripped or twisted past 1/2" require repair.

ANCHOR DAMAGE



Missing anchor



Loose anchor

- ▶ **Reference Standard:**  
Each footplate of the upright frame (front and back) must be anchored to the floor with a minimum of one anchor per footplate or per manufacturer's requirements for your application. Check for missing, loose or sheared anchors.

BEAM DAMAGE, MISSING OR IMPROPER BEAM CONNECTORS



Disengaged beam end plate



Missing / damaged safety-locks



Damaged beam

Reference Standard: Missing horizontal or diagonal braces, or braces with any rips, tears or deflection in either plane beyond 1/2" must be repaired.

OVERLOAD BEAMS



Reference Standard: 
$$\frac{\text{LENGTH OF BEAM}}{180} = \text{ALLOWABLE DEFLECTION}$$
  
$$\frac{96" \text{ BEAM}}{180} = .53" \text{ ALLOWABLE DEFLECTION}$$

When the beam is loaded with product and bends down more than the allowable deflection, the beam must be replaced.

Helpful Hint: Any beam with visible deformation or cracking of the beam end connectors must be unloaded and replaced. Be sure beams are fully engaged and installed with proper safety locks.

CAPACITY PLACARDS

Reference Standard: Each manufacturer publishes frame capacity charts. Applicable information to your system must be prominently displayed on a placard at the end of an aisle.

Helpful Hint: Be sure capacity plaques include beam elevations and design loads.

**WARNING**

**DO NOT CLIMB ON RACKS**

Report all damage to management

Do not alter the structure without

- Evaluation by a Design Professional, and/or,
- Seeking approval from the Supplier

**CAUTION**

Conduct regular inspections to check for:

- Proper application and use
- Loads within allowable limits
- Damaged/disengaged structure or components

For questions contact:

**ABC Rack Systems**

123 Main Street  
Anywhere, ST 01234

**987-555-1234**

**WARNING**

**LOADING DETAILS**

All loads to be uniformly distributed.  
For more info see load application and configuration drawings on file.

**25,000 LBS**

**Maximum Bay Load**

Client: XYZ Warehouse  
Project Reference: Mac Rak  
Sample Date Supplied: 01/10/2014

DO NOT CHANGE ORIGINAL CONFIGURATION OR WEIGHT LOAD WITHOUT ENGINEERING APPROVAL. CHANGES TO THE ORIGINAL CONFIGURATION CAN CAUSE DANGEROUSLY OVERLOADED FRAMES.

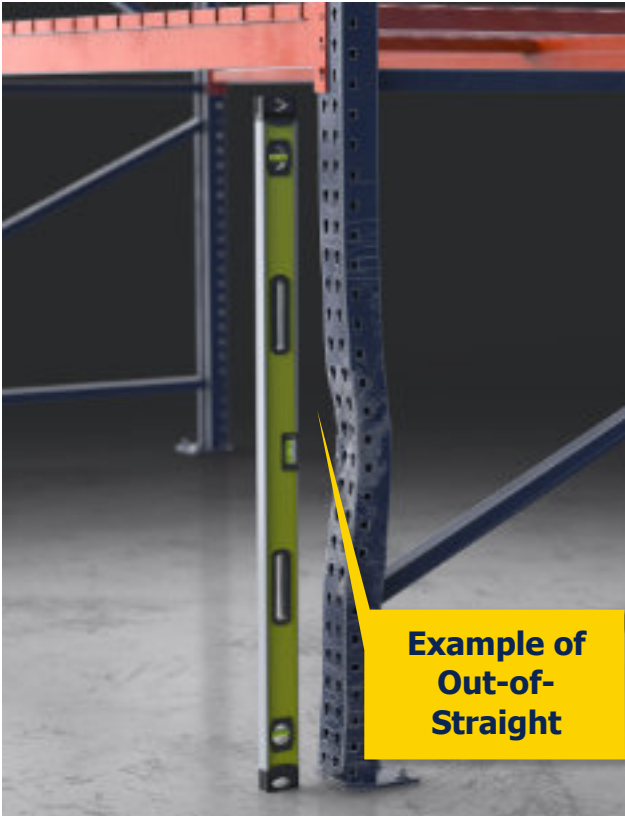
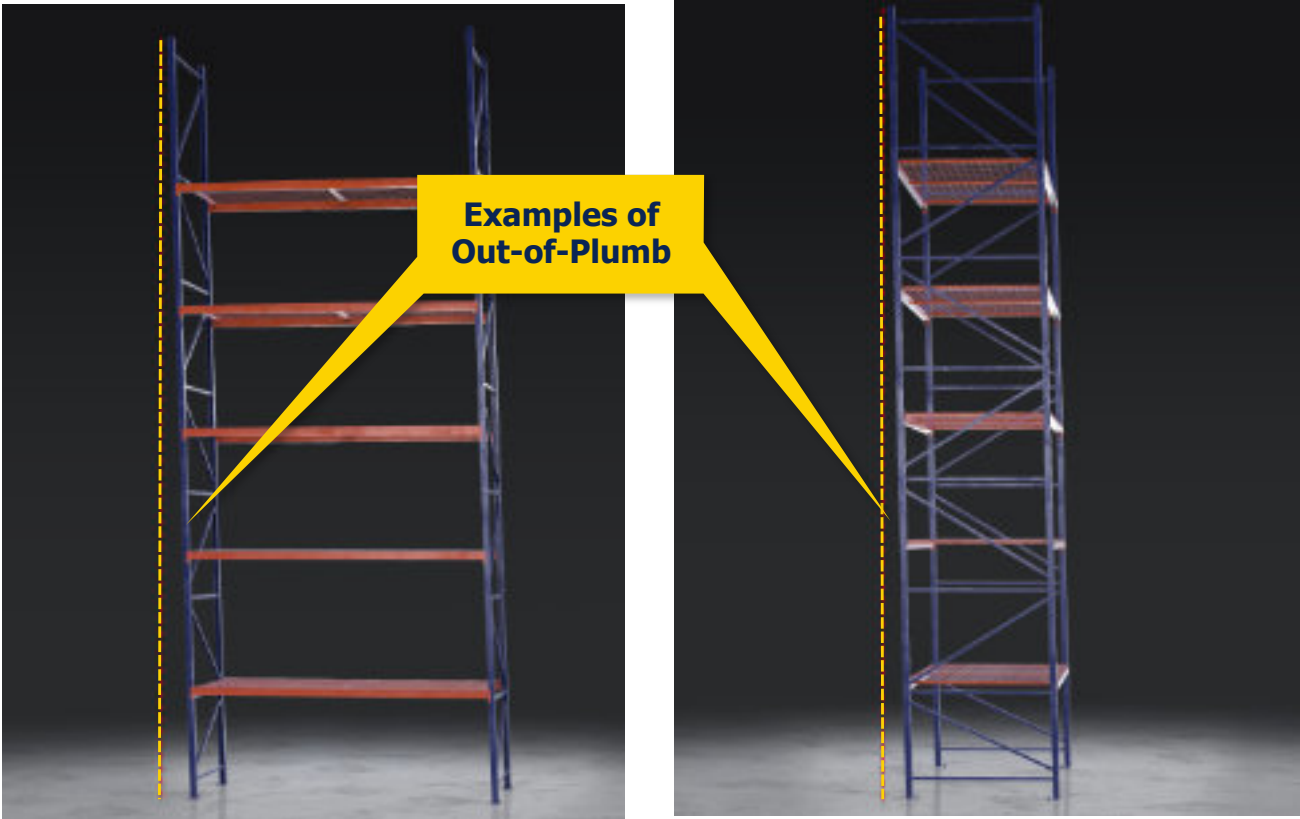
Plaques need to be changed whenever there are modifications to the rack configuration or load.

Placard examples of acceptable format / content. Actual appearance may vary.

All engineered rack capacity and designed configuration can be found in your LARC drawings (Load Application Rack Capacity). LARC drawings, as built, are required by regulation.



FRAME TO BE PLUMB/FRAME TO BE STRAIGHT



▶ **Reference Standard:** Out-of-Plumb/ Out-of-Straight Ratio – 1/2" in 10'-0" as measured by the maximum horizontal distance from the edge of the column at the top of the frame to a plumb line that extends downward to the floor (as illustrated).

Columns exceeding this limit are required to be offloaded and re-plumbed, repaired or replaced.

When frames are out of plumb, the designed load capacity of the system is reduced. Any damage to a column that changes the original design shape would cause a reduction in the designed load capacity of the frame. This could also be considered out of straight based on the amount of deflection.

**DAMAGED PARTS MUST BE REPAIRED.**

IMPROPER FRAME SPLICE



Improper splice installation

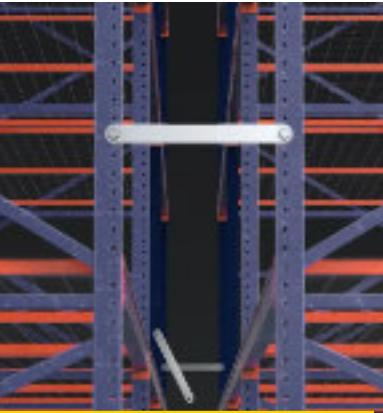


Dangerous connections

▶ **Reference Standard:**  
Although engineered approved splices are an accepted practice, extreme care must be exercised to ensure they are approved by the various frame manufacturers, and are within their installation and performance limits.

**CRITICAL:**  
All modifications to frames, including frame splices, must have engineering approval per application.

MISSING / INSUFFICIENT ROW SPACERS



Example of insufficient row spacers



Example of roll formed row spacer



Example of structural row spacer

▶ **Reference Standard:**  
Back-to-back frames need row spacers positioned a maximum of 10'-0" apart from each other. Consult a qualified engineer.

BROKEN / TORN COMPONENTS



Torn column



Torn footplate weld



Broken strut connection

► **Reference Standard:**  
Any component with broken or torn welds must be repaired or replaced.

DANGEROUS REPAIRS



Non-engineered repairs



Non-engineered repairs



Improper installation



Multiple issues

► **Reference Standard:**  
Rack repairs must be approved by a supervisory rack engineer who is familiar with the design and construction of your racking system.

PROPERLY ENGINEERED RACK REPAIR SOLUTIONS



ADVANTAGE Non-Protruding Deflector Kit



ADVANTAGE Protruding Deflector Kit



ELITE Vertical Single Leg Kit



ELITE Vertical Double Leg Kit

PROPERLY ENGINEERED RACK PROTECTION PRODUCTS



MAX Guard V-Nose Protector



MAX Guard V-Nose Plus Protector



MAX Guard Force V-Nose Protector



Formed End of Row Protector

**IMPORTANT FINAL WORD:**  
When choosing a pallet rack repair vendor be sure that their products and installation procedures have been reviewed and approved by a qualified supervisory engineer. Repair solutions and installation procedures that do not conform to accepted industry standards may often be as dangerous as the damaged rack component. Insist on an RMI member company.



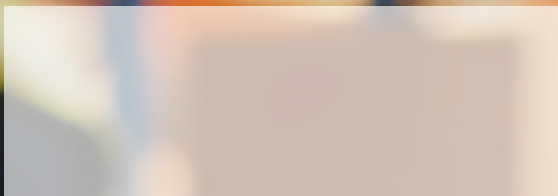
# ENGINEERED RACK REPAIR UNCOMPROMISING RACK GUARDS

When lives, time and reputations are on the line, Mac Rak is the number one choice for engineered pallet rack repair and protective guarding solutions.



- ▶ No outsourcing
- ▶ Leading manufacturer in USA
- ▶ Engineered to exceed RMI specs
- ▶ Lifetime warranty
- ▶ Maximizes value in your budget
- ▶ Turnkey service

**Mac Rak, helping families reunite safely after every shift.**



All specifications are subject to change.  
See [macrak.com](http://macrak.com) for additional technical specifications on every product.

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