User's Manual For Unarco Racks

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I. Purpose and Scope of the Rack User's Manual

II. The Rack Manufacturer's Specification

- A. What is the RMI?
- B. Importance of RMI compliance.
- C. Manufacturer's responsibility
- D. Installer's responsibility
- E. User's responsibility
- F. Obtaining a copy of the RMI Specifications

III. Design Information

- A. Why the design information is needed
- B. Required information
- C. What Specifications should be met?
- D. Use of Unarco Capacity Tables
- E. Engineer's Review
- F. Seismic Considerations and Special Conditions
- G. Permits

IV. Installation of Storage Racks

- A. Installation Instructions
- B. Load Plaques

V. Rack Maintenance

- A. Inspection
- B. Repair
- C. Modifications
- D. Changes to Configuration
- E. Driver Training

VI. Technical Support

- A. Answers to Frequently asked questions
- B. Answers to other technical questions
- C. Unarco Web Site

I. Purpose and Scope

This rack manual is to provide basic information for users of racks manufactured by Unarco Material Handling, Inc. (Unarco). All users should read this entire manual. Failure to properly install, use and maintain the rack system can result in product damage, business interruption, serious injury and, possibly, loss of life. Proper installation, use and maintenance of the rack system will result in a safer environment for the workers and business.

This manual is written mainly for pallet racks, but much of the manual also applies to modules, pallet flow rack, pushback racks or any frame-beam style rack. Some portions may also apply to drive-in racks. This manual is intended for the users, so detailed engineering concepts are beyond the scope of this manual. If technical or other issues arise that are beyond the scope of this manual, refer to section VI for technical assistance.

II. The Rack Manufacturer's Institute (RMI) Specification

A. What is the RMI Specification?

The title of the RMI Specification is, "Specification for the Design, Testing, and Utilization of Industrial Steel Storage Racks – 2002 Edition". There is a newer version of this document that will be either a 2006 or 2007 version.

The Rack Manufacturer's Institute is an independent trade association, which is made up of the companies that produce the vast majority of the storage racks that are made in the United States. The (2006 or 2007) RMI Specification is the latest edition of the rack specifications that have been written by the Rack Manufacturer's Institute.

The 1997 RMI Specification was the first RMI specification to receive universal acceptance in the rack industry. Earlier editions of the RMI Specifications (1964 – 1990) were seldom followed because they contained some requirements that were costly to users, unnecessary, and difficult to meet with standard product. In recognition of this situation, the 1997 RMI Specification was developed and, with its universal acceptance, has already resulted in safer storage rack systems. The 1997 version has been superseded by a 2002 version and soon the 2006 (or 2007) version will be available for use. This new version of the RMI Specification is undergoing ANSI review.

B. The importance of RMI compliance.

It is essential that the owner or operator of a facility only buy and install racks that comply with the latest RMI Specification. Rack systems designed to this specification have been designed using state-of-the-art methods. Purchasing a rack system that does not meet this specification could result in a structure that is less safe or less functional. The cost of even a small incident with a storage rack likely will outweigh the perceived savings of an inferior rack system. The first question that will be asked if there is ever a problem is, "Was this rack designed to the current RMI Specifications?" A responsible owner would want to answer, "Yes" to this question.

C. Manufacturer's Responsibility

As a leading manufacturer of storage racks, Unarco only sells racks that comply with the RMI Specification. Unarco has been a member of the RMI since its inception and is an active participant in the RMI. Unarco was one of the first manufacturer's to receive the RMI "R" mark for certification of compliance for its frame and beam capacity charts. Unarco has registered professional engineers on its staff whose responsibility is the design of Unarco racks to meet this specification.

D. Installer's Responsibility

It is the installer's responsibility to properly install Unarco rack products. This includes making sure the racks are plumb, the bolts are properly tightened, the racks are properly anchored to the floor and the location and configuration are correct. Refer to the Unarco installation instructions in Section IV of this manual.

E. User's Responsibility

It is the user's responsibility to purchase a rack that complies to the latest RMI Specification. "Utilization" appears in the title of the RMI Specification because the RMI recognizes that the user's role is extremely important in procuring and maintaining a rack structure in compliance with the specification.

It is the user's responsibility to see that the design loads for the structure are not exceeded. The user should provide the necessary signage so the load limits are clearly visible (refer to section IV). The user must also make sure the configuration is not altered in a way that will compromise the integrity of the rack design (refer to Section IV). The user is also responsible for properly maintaining the condition of the rack structure (refer to Section V) and maintaining a safe working environment around the racks. The user should make sure that the racks remain plumb. The RMI Specification limit for out-of-plumb for a loaded rack is ½" per 10 feet of height. This plumb requirement is for both the down-aisle and the cross-aisle directions. Adequate lighting is necessary to ensure that the operators have the visibility they need to safely load and unload the racks.

F. Obtaining a copy of the RMI Specification

The RMI Specification may be obtained by contacting the RMI at:

Rack Manufacturer's Institute
8720 Red Oak Blvd., Suite 201
Charlotte, NC 28217

Phone No. 704-676-1190

The RMI Specification also can be purchased on the web from the RMI bookstore. The RMI website is:

http://www.mhia.org/psc/PSC_Products_Racks.cfm

G. Frequently Asked Questions about Storage Racks

The RMI website also has a link to frequently asked questions about storage racks. This link provides answers and discussion to some of the most frequently asked questions about storage racks. The answers to these questions were prepared and reviewed by the Specification Advisory Committee of the RMI.

III. Design Information

A RACK SYSTEM MUST ONLY BE DESIGNED BY A COMPETENT PROFESSIONAL. THE PURPOSE OF THIS SECTION IS NOT TO GIVE INSTRUCTION ON THE DESIGN OF STORAGE RACKS, BUT RATHER TO PROVIDE THE RACK USER OR BUYER WITH BASIC INFORMATION ON THOSE TOPICS WHICH WILL FACILITATE THE DESIGN PROCESS.

A. Why the design information is needed.

Complete design information is needed to ensure that the storage rack system is compatible with the facility, the stored product and the fork truck or other loading and unloading device. The rack must be strong enough to properly support the loads with the required factor of safety and the load openings, aisle widths, etc. must be the correct dimensions to allow for the safe and efficient use of the storage rack structure.

B. Required Information.

The exact design information required for a storage rack system will vary depending on the type of rack required and the particular site conditions. Failure to provide clear and specific information for the design of a rack system can result in multiple design iterations or, ultimately, a rack design that does not meet the expectations of the end user. The following checklist, while not necessarily complete, contains some basic information that should be provided to your design professional for a pallet rack.

Project location and seismic design requirement, if known
Site seismic ground accelerations can be found on the internet at the USGS website:
http://earthquake.usgs.gov/research/hazmaps/design
Layout of desired rack structure, including the building column size, aisle size and grid if known
Pallet size and type
Load size (depth, width and height including pallet).
Maximum and average load weights.
Clear available ceiling height.
Lift height of the fork-lift truck
Fork truck aisle width requirements
Fork truck outrigger dimensions (when applicable)
Desired shelf elevations and storage bay width.
Number of pallets per shelf
Accessories that are needed (crossbars, wire decks, column protectors etc.)
Paint color of all components.

C. What Specifications should be met?

Whenever applicable, the design of the rack system should meet the latest edition of the RMI Specification. If the rack is made from hot rolled structural shapes, the design should also meet the requirements of the AISC (American Institute of Steel Construction) Specifications. If the rack is made from cold-formed shapes the design also should meet the "North American Specification For The Design Of Cold-Formed Structural Members", (formerly known as the AISI Specification written by the American Iron and Steel Institute). The requirement to meet these specifications is stated in the RMI Specification. The rack should also meet any applicable city, state or local building codes. The appropriate sections of the AWS (American Welding Society) Specification also should be adhered to concerning the welding of the components and the welding should be done by certified welders.

D. Use of Unarco Capacity Tables.

The published Unarco frame and beam tables have been certified by the RMI and have received the RMI's R-mark. The tables list frame and shelf capacities for typical pallet rack applications. These tables can be used to configure pallet rack systems in low seismic risk areas. Only those individuals who have adequate experience and understanding of pallet rack systems and the capacity tables should use the tables to configure a system, and they should have a thorough understanding of the limitations of the tables. When using the Unarco tables, if there is anything that creates uncertainty as to the proper use of the tables, contact Unarco technical support. The user should remember that the capacity values in the tables are for racks that are plumb, properly

installed and anchored, and undamaged. The tables only apply to pallet rack frame-beam applications. These tables should not be used for the construction of structures other than pallet rack.

E. Engineer's Review

Engineers are on staff at Unarco to assist in project proposals, offer project review and offer technical support. Calculations are sometimes required for a rack structure. While an engineering fee is usually required for this service, a Unarco licensed engineer can supply the calculations in most states where rack calculations are required. Unarco offers CADD drafting and project management site support for projects where required.

F. Seismic Considerations and Special Conditions.

Many areas of the country now require seismic design. Structures in those areas must be designed for code prescribed seismic lateral forces in addition to the gravity forces imposed by the loads stored in the rack. These lateral forces are caused by ground accelerations that would be expected in the event of an earthquake. It is necessary to know the building code that is used where the rack is to be installed and to supply this information to Unarco. The Rack Manufacturer's Specification states, "Where customer specifications require or local building codes dictate that provisions be made for earthquake effects and associated lateral forces, customers or their representatives shall bring such requirements to the attention of the rack manufacturer."

Generally, one can find out the building code and seismic design requirements by contacting the appropriate building department. Design ground acceleration values for areas that use the IBC (International Building Code) can also be found on the internet at the address given in Section III B, above. Unarco engineering can provide assistance in getting this information or may already have this information based on previous projects. Most areas in the U.S. now use the IBC code but not all areas. To find out if your jobsite uses the IBC code you can contact the building authority or look at the following website: http://www.iccsafe.org/government/adoption.html

For racks that are in areas of the country that still use the BOCA or the Southern Building Codes Code, it is necessary to know the design ground accelerations (Av and Aa). There are very few areas that still use these codes.

If the rack is in an area that uses the UBC Code (California), it is necessary to know the seismic zone (1, 2A, 2B, 3 or 4). If the site is in seismic zone #4, it is also necessary to know the Near Source Factor for the project site. The Near Source Factors are based on the site's proximity to a known seismic source. These values can usually be supplied by the jurisdiction if they have the site address. California is planning to switch to the IBC code soon.

Note: It is important that seismic design requirements be known at the beginning of the design phase to avoid costly delays and field retrofits.

In general, attaching racks to the building is not recommended. If the rack must be tied to the building, the user must first get approval of this detail from the building engineer. Racks should not be tied to the building in moderate or high seismic risk areas.

If there are other special conditions, contact Unarco technical support.

G. Permits.

Prior to the start of the design of the project, the user should determine whether the rack structure or its installation requires a permit. When this is known from the beginning of the project, the

permit process can run rather smoothly. When the owner does not check beforehand and finds out that a permit is required during the installation phase, the permit process can become difficult and lead to project delays and unexpected fees. Unarco can provide the drawings and calculations required to be submitted for the permit. Unarco charges an engineering fee for this service, but can provide an estimate of this cost with the project quotation. It is the owner's responsibility to obtain the permit.

IV. Installation of Storage Racks

A. Installation Instructions.

For proper installation, the Unarco installation instructions must be followed (refer to Pallet Rack Installation Instructions available on the Unarco website www.unarcorack.com). It is extremely important that the storage racks are properly installed before they are put into use. All bolts must be properly tightened. **Failure to properly tighten the T-bolts can result in a loss of lateral stiffness of the rack assembly and possible collapse of the rack.**

B. Load Plaques.

The RMI Specification states that load plaques should be displayed that show the permissible unit load weights that can be placed on the rack structure. In addition, the plaques should show the average load and the maximum load per bay. Refer to the RMI Specification section 1.4.2 for more details. The user is encouraged to display these plaques. The user can purchase these plaques from Unarco. See the Unarco website for some typical plaques.

V. Rack Maintenance, Inspection and Training

FOR A RACK STRUCTURE TO MAINTAIN ITS LOAD CARRYING CAPACITY, IT MUST BE PROPERLY INSTALLED AND ANCHORED, REMAIN PLUMB, AND ITS COMPONENTS MUST BE KEPT FREE FROM DAMAGE. RACKS THAT HAVE BEEN DAMAGED, LEANING RACKS OR RACKS THAT HAVE BEEN ALTERED CAN RESULT IN SIGNIFICANTLY REDUCED LOAD CARRYING CAPACITY. THIS CAN RESULT IN PROPERTY DAMAGE AND PERSONAL INJURY IF A COLLAPSE SHOULD OCCUR.

A. Inspection.

It is the responsibility of the rack user to make sure the rack remains in good condition. Refer to "User's Responsibility" in Section II of this manual. The user should periodically inspect the racks for damage, lean, or any other significant alteration from its original condition. The user should periodically check to make sure the fasteners are tight. The required inspection intervals will depend how the racks are used. For example, a warehouse with fast throughput and a high amount of fork truck activity will require much shorter inspection intervals than a storage rack in a lower use environment. Any damage that is noticed during inspection or at any time between inspections should be repaired. If a repeated pattern of damage is observed or anticipated, protective devices should be considered. Some of these are shown on the Unarco website, and protective devices may be obtained from Unarco. The rack should also be periodically checked for plumb. The out-of plumb limits for a loaded pallet rack are given in Section II E above and are also given in the RMI Specification.

B. Repair.

The RMI states the following in section 1.4.1:

> 1.4.1 Owner Maintenance
>
> The owner shall maintain the structural integrity of the installed rack system by assuring proper operational, housekeeping, and maintenance procedures including, but not limited to, the following:
>
> (1) Prohibit any overloading of any pallet positions and of the overall rack system.
> (2) Regularly inspect for damage. If damage is found, immediately unload the affected area and repair or replace any damaged columns, beams or other structural components.
> (3) Require all pallets to be maintained in good, safe, operating condition.
> (4) Ensure that pallets are properly placed onto the pallet load support members in a properly stacked and stable position.
> (5) Require that all goods stored on each pallet be properly stacked and stable.
> (6) Prohibit double stacking of any pallet position, including the top-most position, unless the rack system is specifically designed for such loading.

The user is reminded that the rack capacity ratings are for straight, undamaged rack members and that any damage to the cross-section, any lean, any bow or any twist will reduce the load carrying capacity of that member and possibly the entire rack system.

Effective structural repairs can be made to damaged rack members if the repairs are properly engineered by a competent design professional, and carried out by certified welders (see Modifications, section C). In many cases it will more cost effective to replace the rack component. Contact Unarco technical support for questions regarding repairs.

C. Modifications

Modifications that involve cutting or welding Unarco parts will void the Unarco warranty and should not be done without consulting a structural engineer. The user should not use parts in the Unarco rack structure that have not been manufactured or supplied by Unarco. This will void the Unarco warranty and could cause structural problems with the rack system.

Racks components should not be used to construct other structures for which they were not intended.

D. Changes to the Rack Configuration.

Even though storage rack columns are punched for the full height to allow for beam elevation adjustability, pallet racks are normally designed for a specific configuration (or configurations) agreed upon by the seller and the buyer at the time the rack is purchased. If it becomes necessary to deviate from the design configurations, the user must obtain the prior approval of a competent design professional and Unarco. One common mistake that is made is that the user will remove lower shelf beams to store higher pallet at the floor or to double stack at the floor level. The removal of the lower beams will increase the columns spans and may significantly lower the capacity of the upright frame to a point where the rack is no longer safe.

E. Training.

NOTE: FORK- TRUCK DAMAGE IS THE LEADING CAUSE OF RACK ACCIDENTS AND COLLAPSE.

The rack user must make sure that all forklift drivers have been properly trained in the operation of their forklift trucks. All safety devices required for the forklift trucks must be kept in proper working order. The drivers should be aware of the load weight limits and size limits for the loads that are to be placed into the rack structure. The forklift supervisor must make sure that the drivers are capable of properly loading and unloading the rack without hitting the rack frames or otherwise damaging the rack. The forklift drivers should be required to report any accidents that they witness and any damage or any out-of plumb conditions that they may observe in the rack structure.

Forklift vehicles should never be operated by anyone who is under the influence of alcoholic beverages, or other intoxicating substance, or has taken any type of medication that may impair his ability to operate the vehicle.

Forklift operators, order pickers or any other personnel should not climb the racks or walk on any areas of the structure that have not been specifically designed as a walkway.

Order picking personnel and all other individuals who work in or around the racks should be trained in the safe operation of their duties. If the rack structure has elevated platforms or order picking platforms, these individuals must be trained to not climb or walk out onto the areas of the structure that are not designed to be pick aisles or work areas. Components of the fall protection system (handrails, guardrails, kick-plates, safety grating, etc.) should be periodically inspected so workers are not at a risk of falling when they are properly performing their duties

The order picking personnel and other individuals who work around the racks should never be permitted to work in or around the structure if they are under the influence of alcoholic beverages, or other intoxicating substance, or have taken any type of medication that may impair his ability to safely work in or around the rack structure.

VI. Technical Support

A. Answers to Frequently Asked Questions.

Check the Unarco web site for answers to frequently asked questions.

B. Answers to Other Technical Questions

If you need to contact Unarco technical support, you can do so by e-mail:
racksafety@unarcorack.com

You can write to us :
Unarco Material Handling, Inc.
701 16th Ave. East
Springfield, TN 37172
Or phone us from 8:00 am. to 5:00 pm. central time, Monday - Friday:
615-384-3531.

C. Unarco Web Site:

The Unarco web site is: www.unarcorack.com.